WESTERN Multiplex

INSTALLATION AND MAINTENANCE MANUAL

Tsunami™

WIRELESS
FAST ETHERNET BRIDGES
(5.3/5.8, 5.3 and 5.8 GHz, U-NII/LE-LAN)

MAN-27700-003

Installation and Maintenance Manual

The information contained in this manual is subject to change without notice. Western Multiplex shall not be liable for errors contained herein or for incidental or consequential damages in connection with the furnishing, performance, or use of this manual or equipment supplied with this manual. Western Multiplex makes no warranty of any kind with regard to this manual or any equipment supplied with this manual, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose.

Printed in the United States of America

Notice: Y2K (Year 2000 Issue)

All software supplied by and for Western Multiplex products adheres to the four-(4) digit year nomenclature as required for Year 2000 compliance.

Western Multiplex
1196 Borregas Avenue
Sunnyvale, California
USA
Tel: +1 408 542-5200
Fax:: +1 408 542-5300

Our facility has been Registered to the International Organization for Standardization ISO 9000 Series Standards for quality.

Issue: December 2001 Revision 003

Revision history:

July 2000: Updated Section 2.1
Fixed Table 3-B title
Added TelNet detail (Section 4.11.5)
Added 100Mbps Model information
Added information on Ethernet Switches
Fixed Alarm Diagram (Figures 3-10 & D-2)

November Added more 100Mb model detail
Clarified 802.1q (VPN) capabilities
Added single band 5.3GHz model
Added mounting details

January 2001 Added 100Mb (27720) HTTP NMS screens

April Added information on single band 5.3 GHz products
Added more detail on Tsunami interface criteria
Added using SNMP detail
Clarification on use of both fiber (F) and twisted pair (T) interfaces
Modified model 27710-52 details (2xE1s)
Added default Login for 100BaseT/F Model

June Added safety instructions (Section 1.3)
Added AUX port information

July Updated screen captures for new 45Mb w/E1s

December (v003)
Changed maximum receive level from –30 to –10 dBm
Added 100Mbps SB 2xE1 Model 28010

Regulatory Notice

This equipment has been tested and found to comply with the limits for a class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

* Reorient or relocate the receiving antenna.
* Increase the separation between the equipment and receiver.
* Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
* Consult the dealer or an experienced radio/TV technician for help.

Shielded cables and I/O cords must be used for this equipment to comply with the relevant FCC regulations.

Changes or modifications not expressly approved in writing by Western Multiplex may void the user's authority to operate this equipment.

This device complies with RSS-210 of Industry Canada. Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

This device must be professionally installed.

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WARRANTY

GENERAL TERMS

1.1 All Definitions contained in Western Multiplex's Conditions of Sale (Western Multiplex document number CS96-8), apply to the Warranty.

1.2 Subject to the provisions of the Warranty, Western Multiplex warrants that the equipment described in Paragraph 1.3 shall conform to their specifications described in Paragraph 1.4 in all material respects and that the equipment shall be free from material defects in materials and workmanship.

1.3 This Warranty applies to all original purchases of Western Multiplex manufactured equipment and accessories (collectively the "Equipment").

1.4 This Warranty applies to the specifications contained in the most recent version of the manual for the model of the Equipment purchased (the "Specifications").

1.5 This Warranty does not apply to the following items of Equipment which are covered by the Original Equipment Manufacturer's warranty:

(a) antenna systems, including coax cable, waveguide, connectors flex-sections, mounts, other parts of the antenna system and installation materials;

(b) non-Western Multiplex manufactured rack mounted equipment that is assembled wired and tested at Western Multiplex's factory or supplied as part of a system, including orderwire items, channel banks, multiplexers, fuse/alarm panels, remote alarm items; and

(c) equipment which is not listed in Western Multiplex's price book.

1.6 The effective period of this Warranty shall start on the date of shipment of the Equipment and shall end:

(a) for all spread spectrum unlicensed radio products and for all licensed digital microwave radio products, two (2) years later;

(b) for all analog microwave radio products, three (3) years later; or

(c) for all baseband products, five (5) years later (in each case the "Warranty Period").

1.7 The Customer acknowledges that Western Multiplex does not represent or warrant that the services provided by Western Multiplex under this Warranty will ensure uninterrupted or error-free operation of the Equipment.

RETURN OF EQUIPMENT UNDER WARRANTY

2.1 If an item of Equipment malfunctions or fails in normal intended usage and maintenance within the applicable Warranty Period:

(a) the Customer shall promptly notify Western Multiplex of the problem and the serial number of the defective item;

(b) Western Multiplex shall, at its sole option, either resolve the problem over the telephone or provide the Customer with a Returned Materials Authorization number (RMA #) and the address of the location to which the Customer may ship the defective item;

(c) if the problem is not resolved over the telephone, the Customer shall attach a label to each Returned item describing the fault and the Customer's Return address. The Customer shall, at its cost, properly pack the item to be Returned, prepay the insurance and shipping charges, and ship the item to the specified location;

(d) if the Western Multiplex product shall prove to be defective in material or workmanship upon examination by Western Multiplex, Western Multiplex shall either repair or replace the Returned item at its sole option. The replacement item may be new or refurbished; if refurbished, it shall be equivalent in operation to new Equipment. If a Returned item is replaced by Western Multiplex, the Customer agrees that the Returned item shall become the property of Western Multiplex.

(e) Western Multiplex shall at its cost, ship the repaired item or replacement to any destination within the United States of America by carrier and method of delivery chosen by Western Multiplex. If the Customer has requested some other form of conveyance, such as express shipping, or is located beyond the USA borders, then the Customer shall pay to the cost of return shipment.

2.2 Equipment which is repaired or replaced by *Western Multiplex* under this Warranty shall be covered under all of the provisions of this Warranty for the remainder of the applicable Warranty Period or ninety (90) days from the date of shipment of the repaired item or replacement, whichever period is longer.

DEFAULT AND TERMINATION

3.1 *Western Multiplex* may immediately terminate this Warranty and all of its performance under this Warranty, upon notification to the Customer, if the Customer:

(a) makes any unauthorized modifications to the Equipment;

(b) assigns or transfers the Customer's rights or obligations under this Warranty without the written consent of *Western Multiplex*;

(c) becomes bankrupt or insolvent, or is put into receivership; or

(d) has not paid *Western Multiplex* all amounts for the Equipment, services, or other additional charges within thirty (30) days of receipt of written notice from *Western Multiplex*.

3.2 If this Warranty is terminated by *Western Multiplex*, the Customer shall remain liable for all amounts due to *Western Multiplex*.

FORCE *MAJEURE*

4.1 "Force Majeure" has the same meaning as defined in *Western Multiplex*'s Conditions of Sale (*Western Multiplex* document number CS96-8).

4.2 *Western Multiplex* shall not be responsible for failure to discharge its obligations under this Warranty due to Force Majeure.

LIMITATIONS AND QUALIFICATIONS OF WARRANTY

5.1 This Warranty does not apply to any damage, defect or failure caused by:

(a) any part of the Equipment having been modified, adapted, repaired, or improperly installed, operated, maintained, transported or relocated by any person other than *Western Multiplex* personnel or a *Western Multiplex* authorized service agent, without *Western Multiplex*'s prior written consent;

(b) storage or environmental conditions which do not conform to the applicable sections of the appropriate *Western Multiplex* Equipment Manual;

(c) failure to conform with the Equipment Installation, Operating and Maintenance Instructions of the appropriate *Western Multiplex* Equipment Manual;

(d) external causes, including external electrical stress or lightning, or use in conjunction with incompatible equipment, unless such use was with *Western Multiplex*'s prior written consent;

(e) cosmetic damage;

(f) accidental damage, negligence, neglect, mishandling, abuse or misuse, other than by *Western Multiplex* personnel or a *Western Multiplex* authorized service agent; or

(g) Force *Majeure*.

Please see reverse side for additional limitations on damages.

LIMITATIONS ON DAMAGES (North America)

6.1 THE WARRANTY STATED IN THIS DOCUMENT IS THE CUSTOMER'S EXCLUSIVE WARRANTY FOR THE EQUIPMENT; WESTERN MULTIPLEX SPECIFICALLY DISCLAIMS ALL OTHER WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING ANY WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE AND OF MERCHANTABILITY.

6.2 WESTERN MULTIPLEX SHALL NOT BE LIABLE IN TORT, INCLUDING LIABILITY IN NEGLIGENCE OR STRICT LIABILITY, AND SHALL HAVE NO LIABILITY AT ALL FOR INJURY TO PERSONS OR PROPERTY. WESTERN MULTIPLEX'S LIABILITY FOR FAILURE TO FULFIL ITS OBLIGATIONS UNDER THIS WARRANTY OR ANY OTHER LIABILITY UNDER OR IN CONNECTION WITH THE EQUIPMENT SHALL BE LIMITED TO THE AMOUNT OF THE PURCHASE PRICE OF THE EQUIPMENT. THE REMEDIES STATED IN THIS WARRANTY ARE THE CUSTOMER'S EXCLUSIVE REMEDIES AGAINST WESTERN MULTIPLEX REGARDING THE EQUIPMENT.

6.3 EVEN IF WESTERN MULTIPLEX HAS BEEN ADVISED OF THE POSSIBILITY OF THEM, WESTERN MULTIPLEX SHALL NOT BE LIABLE FOR ANY INDIRECT, INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES, INCLUDING THE COST OF LABOR BY THE CUSTOMER'S OWN EMPLOYEES, AGENTS OR CONTRACTORS IN IDENTIFYING, REMOVING OR REPLACING THE DEFECTIVE ITEM; LOST PROFITS, AND REVENUES; FAILURE TO REALIZE EXPECTED SAVINGS; ANY CLAIM AGAINST A CUSTOMER BY A THIRD PARTY; OR ANY OTHER COMMERCIAL OR ECONOMIC LOSSES OF ANY KIND.

6.4 THESE LIMITATIONS AND DISCLAIMERS ARE NOT MADE BY WESTERN MULTIPLEX WHERE PROHIBITED BY LAW.

LIMITATIONS ON DAMAGES (International)

6.1 THE WARRANTY STATED IN THIS DOCUMENT IS THE CUSTOMER'S EXCLUSIVE WARRANTY FOR THE EQUIPMENT; ALL OTHER WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING ANY WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE AND OF MERCHANTABILITY ARE EXCLUDED TO THE FULLEST EXTENT PERMITTED BY LAW.

6.2 WESTERN MULTIPLEX'S LIABILITY FOR FAILURE TO FULFIL ITS OBLIGATIONS UNDER THIS WARRANTY OR IN TORT OR AS A RESULT OF STRICT LIABILITY OR ANY OTHER LIABILITY UNDER OR IN CONNECTION WITH THE EQUIPMENT OR ITS SUPPLY SHALL BE LIMITED, EXCEPT IN RESPECT OF DEATH AND PERSONAL INJURY CAUSED BY WESTERN MULTIPLEX'S NEGLIGENCE, TO THE AMOUNT OF THE PURCHASE PRICE OF THE EQUIPMENT. THE REMEDIES STATED IN THIS WARRANTY ARE THE CUSTOMER'S EXCLUSIVE REMEDIES AGAINST WESTERN MULTIPLEX REGARDING THE EQUIPMENT.

6.3 EVEN IF WESTERN MULTIPLEX HAS BEEN ADVISED OF THE POSSIBILITY OF THEM, WESTERN MULTIPLEX SHALL NOT BE LIABLE FOR ANY INDIRECT, INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES, INCLUDING THE COST OF LABOR BY THE CUSTOMER'S OWN EMPLOYEES, AGENTS OR CONTRACTORS IN IDENTIFYING, REMOVING OR REPLACING THE DEFECTIVE ITEM; LOST PROFITS, AND REVENUES; FAILURE TO REALIZE EXPECTED SAVINGS; ANY CLAIM AGAINST A CUSTOMER BY A THIRD PARTY; OR ANY OTHER COMMERCIAL OR ECONOMIC LOSSES OF ANY KIND.

CONDITIONS OF SALE

DEFINITIONS

1.1 In these Conditions, unless there is something in the subject matter or context necessarily inconsistent:

(a) "Western Multiplex" means Western Multiplex (d.b.a. Western Multiplex), Sunnyvale, CA;

(b) "Equipment" means the equipment itemized on the Quotation/Order Acknowledgment;

(c) "International" means any location other than United States of America and Canada, including their territories and possessions;

(d) "North America" means any location in the United States of America and Canada, including their territories and possessions;

(e) "Order Acknowledgment" means the sales order acknowledgment provided by Western Multiplex to the Customer;

(f) "Payment Instructions" means Western Multiplex's payment instructions, (Western Multiplex document P197-1);

(g) "Quotation" means the quotation signed by an authorized representative of Western Multiplex and provided to the Customer;

(h) "Shipping Date" means the actual date on which the Equipment left Western Multiplex's factory at Sunnyvale, CA, U.S.A.;

(i) "Warranty" means Western Multiplex's warranty, document W97-1;

(j) "Invoice" means the bill of goods prepared by Western Multiplex for the equipment with the shipping and any insurance costs.

1.2 Headings have been inserted in these Conditions for convenience of reference only and will not effect their construction.

ENTIRE AGREEMENT

2.1 The Quotation, these Conditions of Sale, the Order Acknowledgment, the Payment Instructions and the Warranty shall apply to all sales made by Western Multiplex and shall constitute the entire agreement by Western Multiplex and the Customer (the "Agreement ").

2.2 Any terms and/or conditions of sale, which may be included on the Customer's purchase order form or any communication from the Customer, that are not identical with the terms and conditions steed in this document shall NOT become a part of the agreement of sale unless expressly agreed to in writing in the Quotation.

2.3 Western Multiplex's failure to object to any terms and/or conditions of sale contained in any communication from the Customer shall not be considered as acceptance of such terms and/or conditions or as a waiver of the terms and conditions of sale contained herein.

2.4 Western Multiplex shall sell to the Customer, and the Customer shall purchase from Western Multiplex, the Equipment in accordance with the Agreement. Western Multiplex accepts the Customer's purchase orders for Equipment and agrees to deliver the Equipment to the Customer only on the terms of the Agreement.

2.5 No variation of the Agreement shall be binding unless agreed to in writing by authorized representatives of Western Multiplex and the Customer.

PRICING

3.1 All prices in the Quotation are exclusive of all shipping charges and all applicable taxes including but not limited to, federal, state, local, excise, sales and use taxes.

3.2 All prices in the Quotation unless otherwise stated:

(a) for North American customers are FOB Sunnyvale, CA, USA. (New York Uniform Commercial Code); or

(b) for international customers are Ex-Works, Sunnyvale, CA, U.S.A. (Incoterms 1990).

3.3 All prices in the Quotation include standard domestic packing, unless a separate line item is provided detailing export or special packing charges.

SHIPPING AND INSURANCE

4.1 Western Multiplex shall arrange shipping and insurance when requested by the Customer, and shall bill the Customer for the Equipment with the shipping and any insurance costs as separate items, on an invoice (the "Invoice").

4.2 Delivery dates quoted by Western Multiplex are to be considered estimates only. In no event will Western Multiplex be liable for any loss or damage resulting from its failure to deliver products within a specified time.

TERMS OF PAYMENT

5.1 The Customer shall pay for all Equipment, including shipping and insurance in accordance with the terms of the Invoice.

5.2 All Invoices for North American Customers are due and payable in thirty (30) days from the date of the Invoice.

5.3 International Customers shall make payments in accordance with Western Multiplex's Payment Instructions by either:

(a) providing a wire transfer (telegraphic transfer) for the full amount of the Equipment, shipping and insurance charges contained in the Quotation or the pro-forma Invoice sent to the Customer, prior to the Shipping Date; or

(b) establishing an acceptable Letter of Credit (LC) for the full amount of the Equipment, shipping and insurance charges contained in the Quotation prior to the order being booked and accepted by Western Multiplex.

5.4 If a Customer fails to pay an Invoice when due, Western Multiplex may, without prejudice to am other remedy, postpone shipments, alter payment terms, terminate the Agreement and charge interest on all overdue amounts the rate of 1.5% per month compounded monthly (or if less, the maximum allowed by law). Upon demand, the Customer shall pay all such interest charges and all reasonable collection fees, including reasonable legal expenses.

SECURITY FOR PAYMENT

6.1 If the Customer is located in North America, the Customer grants to Western Multiplex a purchase money security interest in the Equipment to secure the payment of the purchase price of the Equipment and all other amounts due from the Customer.

6.2 If the Customer is not located in North America:

(a) despite delivery and passing of risk in the Equipment and any other provision of these Conditions, the title in the Equipment shall not pass to the Customer until Western Multiplex has received payment in full of the purchase price of the Equipment and all other amounts then due from the Customer, and

(b) until the title in the Equipment passes to the Customer:

(i) the Customer shall hold the equipment as Western Multiplex 's fiduciary agent and bailee, and shall properly store, protect and insure the Equipment and shall identify the Equipment as Western Multiplex property;

(ii) if the Customer fails to pay Western Multiplex in accordance with the agreed payment terms, Western Multiplex may require the Customer to deliver up the Equipment to Western Multiplex, and, if the Customer does not, Western Multiplex may enter on the premises where the Equipment is stored and repossess the Equipment; and

(iii) the Customer shall not pledge the Equipment by way of security for any, indebtedness of the Customer, but if the Customer does so all moneys owed by the Customer to Western Multiplex shall, without prejudice to any other remedy of Western Multiplex, immediately become due.

CHANGES TO PRODUCT SPECIFICATIONS

7.1 Western Multiplex may, without notice to the Customer, make changes to the specifications of Equipment which do not materially affect the quality or performance of the Equipment.

EQUIPMENT CONFIGURATION AND EXPEDITING CHARGES

8.1 At the Customer's request, Western Multiplex may, for a fee agreed in advance:

(a) reconfigure the Equipment; or

(b) expedite the Customer's order.

SHORTAGES

9.1 The customer shall not make any claim for shortages (which are items that the Invoice does not show are on back-order) after twenty-one (21) days after the date of the Invoice.

RETURNS AND EXCHANGES

10.1 The return of defective Equipment is covered by the Warranty .

10.2 The Customer may only return Equipment that is not defective if:

(a) the Equipment does not correspond with the Customer's purchase order; or

(b) the Equipment has been ordered in error by the Customer and Western Multiplex has permitted the Customer to remedy the mistake by ordering the correct equipment and resuming the Equipment and the Customer obtains a Returned Materials Authorization number ("RMA #") from Western Multiplex prior to returning any Equipment.

10.3 Western Multiplex reserves the right to charge a fee for returned equipment under Subparagraph 10.2(b) with the amount of the fee being determined prior to an RMA # being given by Western Multiplex.

10.4 Authorized returns of equipment under Paragraph 10.2 must be in an undamaged condition, in the original configuration, in the original packing materials and within a time period agreed to when the RMA # was issued.

10.5 If the Customer does not comply with the provisions of Paragraphs 10.2, 10.3, and 10.4, the Customer shall pay the full amount of the Invoice.

10.6 The party liable for all shipping, insurance and any other expenses incurred by the Customer in returning the Equipment under Paragraph 10.2 and for all loss or damage to the Equipment until received by Western Multiplex, shall be: (a) for all items returned under Subparagraph 10.2(a), Western Multiplex and (b) for all items resumed under Subparagraph 10.2(b), the Customer.

CANCELLATION

11.1 If the Customer cancels an order before the Shipping Date, Western Multiplex reserves the right to charge the Customer a cancellation charge up to 100% of the amount of the order.

11.2 The Customer shall pay all cancellation charges within thirty (30) days from date of the Invoice.

FORCE MAJEURE

12.1 Western Multiplex shall not be liable if its performance of the Agreement becomes commercially impractical due to any contingency beyond Western Multiplex's reasonable control, including acts of God, fires, floods, wars, sabotage, civil unrest, accidents, labor disputes or shortages, government laws, rules and regulations, whether valid or invalid, inability to obtain material, equipment or transportation, incorrect, delayed or incomplete specifications, drawings or data supplied by the Customer or others (collectively "Force Majeure"). In no event of Force Majeure shall Western Multiplex be required to purchase goods from others to enable it to deliver the Equipment under the Agreement.

ENGINEERING AND SYSTEM DESIGN

13.1 The Customer is solely responsible for the engineering, design, integration and normal preventative and remedial maintenance of the Customer's system for which Western Multiplex supplies Equipment.

13.2 Western Multiplex is not responsible for the satisfactory operation of the Equipment in conjunction with other manufacturer's equipment, nor for any losses which may occur as a result of a failure of the Equipment to operate in conjunction with other manufacturer's equipment.

WARRANTY

14.1 All Equipment is covered by the Warranty.

14.2 THE WARRANTY CONTAINS LIMITATIONS ON THE CUSTOMER'S RIGHTS AND REMEDIES AGAINST WESTERN MULTIPLEX UNDER THE AGREEMENT.
THE CUSTOMER ACKNOWLEDGES HAVING READ, UNDERSTOOD AND AGREED TO THOSE LIMITATIONS.

DAMAGES FOR BREACH OF AGREEMENT

15.1 If either party is successful in any litigation between the parties based on the Agreement, the successful party shall recover from the other, in addition to direct damages, the successful party's reasonable attorney's fees and other costs of litigation.

INSOLVENCY OF CUSTOMER, ETC.

16.1 Western Multiplex may cancel the Agreement and suspend any further deliveries under the Agreement without any liability to the Customer, and, if Equipment has been delivered but not paid for, the price shall become immediately due and payable despite any other agreement to the contrary if:

(a) any proceedings in bankruptcy, insolvency, receivership or liquidation are taken against the Customer;

(b) the Customer makes an assignment for the benefit of creditors or commits an act of bankruptcy or insolvency;

(c) the Customer ceases, or threatens to cease, to carry on the ordinary course of its business, or transfers all or substantially all of its property;

(d) the Equipment is seized under any legal process or confiscated; or

(e) Western Multiplex in good faith believes that the ability of the Customer to pay or perform any provision of the Agreement is impaired, or that any of the events mentioned above is about to occur.

NOTICE

17.1 All requests, instructions and notices from one party to the other must be in writing and may be given via registered post or facsimile transmission to the address of the parties shown on the Quotation or Order Acknowledgment.

EXPORT PROVISIONS

18.1 The Customer shall not, whether directly or indirectly (including facilitating a third party) export or re-export the Equipment outside the country in which the Customer has stated these items are to be used without obtaining the licenses required under ail applicable rules. The Customer shall indemnify Western Multiplex against any liability incurred by Western Multiplex due to any violation by the Customer of any of the provisions of this Section, but this indemnity shall not apply if the Customer reasonably relies on information supplied to it by Western Multiplex with respect to export licenses. Upon receipt of a governmental consent to export the receiving party shall immediately notify the other in writing.

MISCELLANEOUS

19.1 No waiver by Western Multiplex of any breach of this Agreement shall be considered as a waiver of any subsequent breach of the same or any other provision.

19.2 Any provision of the Agreement which is, or is deemed to be, unenforceable in any jurisdiction shall be severable from the Agreement in that jurisdiction without in any way invalidating the remaining portions of the Agreement, and that unenforceability shall not make that provision unenforceable in any other jurisdiction.

19.3 The rights which accrue to Western Multiplex by virtue of the Agreement shall inure for the benefit of and be binding upon the successors and assigns of Western Multiplex.

19.4 The agreement shall be governed by the laws of the State of California including the California Uniform Commercial Code. However Western Multiplex may enforce the provisions of the Agreement in accordance with the laws of the jurisdiction in which the Equipment is situated. The United Nations Convention on the Sale of Goods (The Vienna Convention) shall not apply to the Agreement.

19.5 Les parties ont exigés que cette entente soit rédigée en anglais.

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1. How to Use This Manual

1.1 Manual Organization

The Installation and Maintenance Manual provides information required to install and maintain *Tsunami* and to use its many features to the fullest advantage. This manual is divided into the following sections:

Section 1 Provides instructions on how to most effectively utilize the information in this manual.

Section 2 Provides a brief description and specifications of the *Tsunami*.

Section 3 Explains the *Tsunami* installation and adjustments in detail.

Section 4 Provides maintenance, repair and troubleshooting information for the *Tsunami Fast Ethernet radios*.

Appendices Charts and diagrams are provided for radio connections and DIP switch settings along with other general information.

This device must be professionally installed. Instructions on setting the transmitter RF output power are contained in Section 3 of this Manual.

This device is to be used exclusively for fixed point-to-point operation that employs directional antennas.

1.2 Icons

Throughout this manual, the following icons are used to highlight areas of special interest and importance.

Note

Practical Tip

Caution

1.3 IMPORTANT SAFETY INSTRUCTIONS

This product is intended to be installed, used and maintained by experienced telecommunications personnel only.

This product has been evaluated to the U.S. and Canadian (Bi-National) Standard for Safety of Information Technology Equipment, Including Electrical Business Equipment, CAN/CSA C22.2, No. 950-95 * UL 1950, Third Edition, including revisions through revision date March 1, 1998, which are based on the Fourth Amendment to IEC 950, Second Edition. In addition, this product was also evaluated to the applicable requirements in UL 1950, Annex NAE.

WARNING - This unit is intended for installation in a Restricted Access location in accordance with Articles 110-18, 110- 26, and 110-27 of the United States National Electric Code ANSI/NFPA 70.

This equipment should be installed in accordance with Article 810 of the United States National Electrical Code.

When installed, this equipment is intended to be connected to a Lightning/Surge Protection Device that meets all applicable national Safety requirements. TO AVOID INJURY, RISK OF FIRE, AND DAMAGE, DO NOT CONNECT THIS PRODUCT DIRECTLY TO AN ANTENNA, AND ENSURE THAT PROPER LIGHTNING ISOLATION IS ALSO PROVIDED BETWEEN THIS UNIT AND OTHER EQUIPMENT.

Equipment is to be used and powered by the type of power source indicated on the marking label only.

This product is intended to be connected to a $\pm$ 24 VDC OR $\pm$ 48 VDC power source which must be electrically isolated from any ac sources and reliably earthed. Only a DC power source that complies with the Safety Extra Low Voltage (SELV) requirements in the Standard for the Safety of Information Technology Equipment, Including Electrical Business Equipment, CAN/CSA C22.2, No. 950-95 * UL 1950, Third Edition, can be used with this product. A 15-Amp circuit breaker is required at the power source. In addition, an easily accessible disconnect device should be incorporated into the facility wiring. Always use copper conductors only for all power connections.

WARNING - This equipment is intended to be earthed. If you are not using the power supply provided by Western Multiplex, you will need to connect the earthing conductor of your power source to the earthing terminal located on the back of the unit; or, connect an earthing conductor between the unit's earthing terminal and your earthing point. See Ill. for instructions. For safe operation, always ensure that the unit is earthed properly as described in this manual and per Figure 1-1.

Do not connect or disconnect the power cable to the equipment when the other end of the cable is connected to the dc power supply.

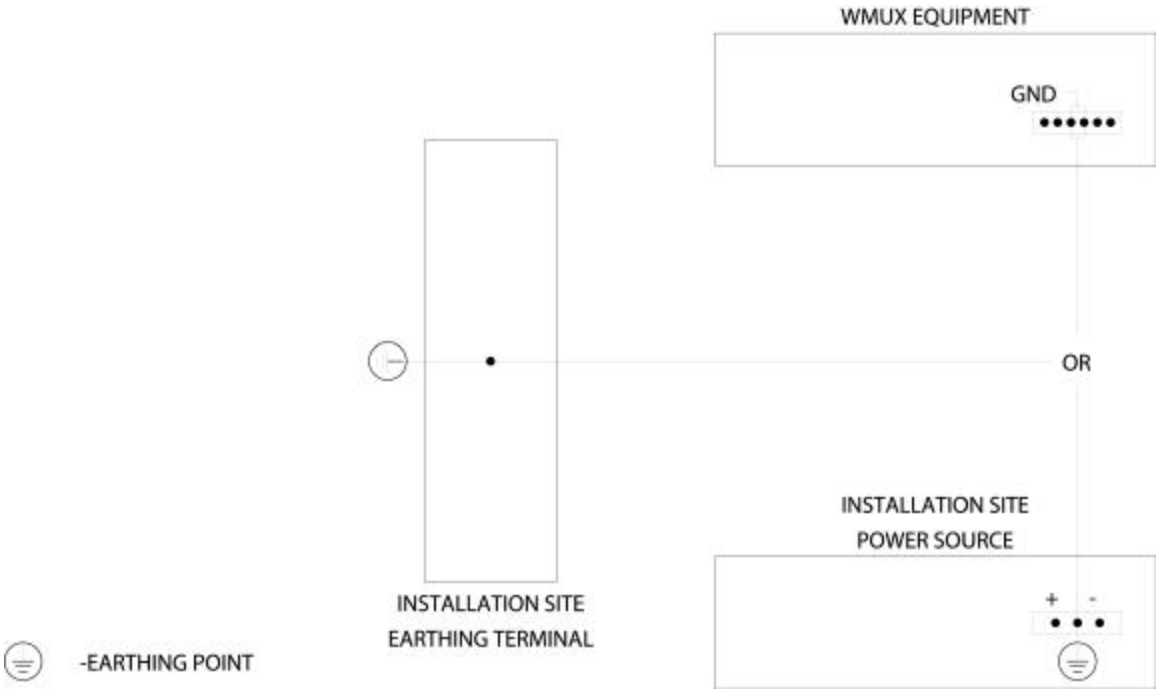


Figure 1-1: Proper Earthing/Grounding

Servicing of this product should be performed by trained personnel only. Do not disassemble this product. By opening or removing any covers you may expose yourself to hazardous energy parts. Incorrect re-assembly of this product can cause a malfunction, and/or electrical shock when the unit is subsequently used.

Do not insert any objects of any shape or size inside this product while powered. Objects may contact hazardous energy parts that could result in a risk of fire or personal injury.

Do not spill any liquids of any kind on or inside this product.

Side openings are provided for ventilation. To protect this product from overheating, do not cover or block any of the openings.

Always ensure that sufficient amount of space is provided above and below this product.

This product can be installed in a standard 19 inch rack. Check the size and clearance requirements for this product and ensure that enough clearance is provided for installation. Considerations should be given to the mechanical loading of the rack and the equipment to avoid potential hazards.

If this product is to be powered from the same source as other units, ensure that the power supply circuit does not get overloaded.

When installed in a rack, always ensure that proper air flow is provided for this product.

The maximum room ambient temperature (Tmra) for this product is 65°C. When installed in a closed or multi-unit rack, consideration should be given to installing this equipment in an environment compatible with the Tmra.

Equipment is suitable for mounting on concrete or other noncombustible surface only.

If you are using a handset not provided by Western Multiplex with this product, ensure that the handset is a UL-Listed (ITE) device, that has been evaluated to the Standard for the Safety of Information Technology Equipment, Including Electrical Business Equipment, CAN/CSA C22.2, No. 950-95 * UL 1950, Third Edition.

2. Product Description

2.1 General Description

The *Tsunami* license-free radios provide a new level of control and convenience in a digital communications network.

These *Tsunami* radios provide 100BaseT intelligent bridging between two locations without the delay and expense of installing cable or traditional microwave.

Because each owner controls the operation of the link, there is no reliance on any outside services. *Tsunami* radio operators are able to operate instant links whenever needed, and to be in control of their own network.

The *Tsunami* offers two primary benefits:

- **CONVENIENCE** — Easy to install and operate with **no user license requirements** or frequency coordination in the USA. (Other countries may require a user license and/or frequency coordination).
- **CAPABILITY** — Full transparent Fast Ethernet connections with no throughput reduction over any line-of-sight distance (within legal limits of government regulation)

Tsunami radios are ISO Layer 2 Data Link Layer (use MAC address for filtering) devices where they provide their full stated throughput. At level 2 (bridges) or 3/4 (routers) where hardware plays the major part, the most common tester is the SmartBits 200 product from NetCom Systems. At Application Layer 7, you will see less than 40% throughput from the maximum capacity measured with SmartBits due to the increased protocol/software overhead at that level. Layer 7 can be tested with software such as Ganymede's Chariot or Qcheck product (www.qcheck.net/index.html). Use Qcheck (or equivalent), do NOT use PING for throughput testing (www.qcheck.net/whyqcheck.html)!

As an example: testing copper CAT5 cable with SmartBits will test 100% throughput (let's say you can send/rcv a full 100Mbps). At Layer 7 you will be transferring bits at the 100Mbps rate, but approximately only 45Mbps of user data will transfer (Ethernet has a high overhead of bytes added to each data packet frame each time you go up a layer). The advantage is the more complex overhead makes the data virtually resilient to corruption and minor errors (i.e. collisions), it's easy to reroute and the network can use inexpensive plug/play devices like hubs/switches instead of multiplexers as used in the telco industry (i.e. LYNX T1/E1/DS3 radios).

Western Multiplex tests for stated throughput at Layer 2/3 where bridges are defined. At layer 7 (application layer), you may see less than 50% or more depending on the other traffic that may be on the LAN as this layer is more dependent on the type of data being sent (it does not matter if it's wire, fiber or any Ethernet bridge -wired or wireless). Another way to look at it: the model 31145 12Mbps (10Mbps 10BaseT+T1/E1 wayside) bridge will test the same as a piece of CAT5 Ethernet cable.

2.2 Specifications

All specifications are subject to change without notice.

2.2.1 Transmitter

		45 Mbps Models		100 Mbps Model
Frequency	Dual-Band	Single-Band	Single-band	Dual-Band
A1	5284 MHz	5750 MHz	5275	5300 MHz
A2	5759 MHz	5800 MHz	5325	5775 MHz
B1	5316 MHz	N/A	N/A	N/A
B2	5791 MHz	N/A	N/A	N/A
Model #	27700	27710	27750	27720
Output Power	+10/+17 dBm	+17 dBm	+10 dBm	+10/+17 dBm
(Note: output power is specified as guaranteed minimum before attenuation)				
Control Range	16 dB min.	16 dB min.	16 dB min.	16 dB min.

	100 Mbps Model
Frequency	Single-Band
A1	5747 MHz
A2	5803 MHz
Model #	28010
Output Power	+16 dBm
(Note: output power is specified as guaranteed minimum before attenuation)	
Control Range	20 dB min.

DO NOT exceed the transmit power setting as set at the factory! Exceeding the factory-set power level will degrade the specifications of the radio and may also violate regulatory compliance. Output power may be attenuated from factory setting to comply with regulatory EIRP limits.

2.2.2 Antenna / Antenna Coupling Unit

Mechanics	External antenna
Antenna Connection	N-type female
Impedance	50 ohms
Recommended Antenna (ordered separately)	2 foot flat panel or 2, 4 or 6 foot parabolic
Gain & Beamwidth (3 dB)	
2 ft Flat	28 dB / 4.6°
2 ft Parabolic	28.5 dB / 6°
4 ft Parabolic	35 dB / 3°
6 ft Parabolic	38 dB / 2.9°

2.2.3 Receiver

	All Models
Nominal Receive Level	-30 to -60 dBm
Maximum Receive Level	-10 dBm error free, 0 dBm no damage (all other models) -30 dBm error free, -20 dBm no damage (model 28010)
Frequency Selection	Craft port selection with installer-removable 7-cavity RF filter assembly (No selection on Model 28010)
Threshold Rx Level (typ.) (BER = 10^{-6})	-79 dBm (Models 27700, 27710 & 27750) -76 dBm (Model 27720) -73 dBm (Model 28010)
Bandwidths	~42 MHz (Models 27700, 27710 & 27750) ~97 MHz (Model 27720) ~27 MHz (Model 28010)
Frequency Range	
Dual-band low channel	5250-5350 MHz
Dual-band high channel	5725-5825 MHz
Single-band channel (high-band)	5725-5825 MHz (5.8 GHz – model 27710 & 28010)
Single-band channel (low-band)	5250-5350 MHz (5.3 GHz – model 27750)

2.2.4 System (Single Hop Performance)

Error Floor	10^{-11}
Transmission delay	
(radio only)	250 µsec, maximum
(10 mile path)	300 µsec, maximum

Transmit Frequencies

	45 Mbps Models			100 Mbps Models	
	Dual-band	Single-band	Single-band	Dual-band	Single-band
A1 channel	5284 MHz	5750MHz	5275MHz	5300 MHz	5747 MHz
A2 channel	5759 MHz	5800 MHz	5325MHz	5775 MHz	5803 MHz
B1 channel	5316 MHz	N/A	N/A	N/A	N/A
B2 channel	5791 MHz	N/A	N/A	N/A	N/A

Receive Frequencies

	Dual-band	Single-band	Single-band	Dual-band	Single-band
A1 channel	5759 MHz	5800 MHz	5325MHz	5775 MHz	5803 MHz
A2 channel	5284 MHz	5750 MHz	5275MHz	5300 MHz	5747 MHz
B1 channel	5791 MHz	N/A	N/A	N/A	N/A
B2 channel	5316 MHz	N/A	N/A	N/A	N/A

2.2.5 Line Interfaces

Fast Ethernet Port:

Data Interface	100BaseT (fully compatible with IEEE 802.3u)
VPN (IEEE 802.1q)	45 Mbps Models 27700-51 & 27710-51 transfer jumbo frames over 8500 bytes in size – for 27710-52, see below Other models force the sending device to break up jumbo frames into legal Ethernet frames that do not exceed the 1538 byte limit for Ethernet 802.3 (Models 27720, 27710-52 and 28010) In all cases, 802.1q frames are passed through the bridge (IEEE 802.1d)
Connectors	RJ-45/48c (wire) Pins:1=Tx+, 2=Tx-, 3=Rx+ & 6=Rx- SC (fiber) 1300nm multimode to 2000m, either 50/125 or 62.5/125 fiber
Configuration	Half duplex or full duplex on the WAN interface On the 100Mbps Models 27720 and 28010, both the T and F ports can be used at the same time if desired.
Filtering	15,000 packets per second theoretical, before forwarding
Buffer	4000 packets (200 kbytes)
LAN Table	1,024 MAC addresses
Self-learning	Automatic learning and aging
Digital Capacity (ISO Layer 2)	~45 Mbps full or half duplex (90 Mbps total + T1s or E1s) ~100 Mbps full or half duplex (200 Mbps total + T1s or E1s)

DS-1 (T1) Port: (on models with –51 suffix, some models may have more than one channel)

Data Rate	1.544 Mbps
Digital Interface *	DSX-1
Connector	8-pin modular jack female (RJ-48C) Pins:1=TT, 2=TR, 4=RT & 5=RR
Line Code	AMI / B8ZS (NMS selectable) – one choice for all T1s
Line Build Out	0-660 feet (NMS selectable)
Blue Code **	Alarm Indication Signal (AIS)
Loopback	Near or far end (NMS selectable)

* Meets AT&T Pub 62411, Bellcore TR-TSY-000499.
** Signal is selectable (on/off) and is generated only on data loss or link failure when enabled.

CEPT (E1) Port: (on models with –52 suffix, some models may have more than one channel)

Data Rate	2.048 Mbps
Digital Interface *	CEPT-1
Connector	RJ45/8 balanced, 120 ohm Pins:1=TT, 2=TR, 4=RT & 5=RR (optional external 75 ohm, unbalanced balun available – consult factory)
Line Code	HDB3
Blue Code **	Alarm Indication Signal (AIS)
Remote Loopback	Available through software control

* Meets ITU-T G.703.
** Signal is selectable (on/off) and is generated only on data loss or link failure when selected.

2.2.6 Auxiliary Connections

Orderwire Interface	2-wire, 4-pin modular jack, female (RJ-11)
REN (Ringer Equivalency Number)	1.0 B
DTMF tones	within ±1.5% of nominal freq. (+0-6 dB)
Ringing Voltage	48 VDC, typical
(use telephones with solid state ringers, NOT adequate for older style mechanical ringers)	
VF Orderwire Bridge	600 ohm balanced, 4-wire, 0 dBm, DB-9, male
Config(uration) Port	RS-232, DB-9, male
Aux Data (clear service channel)	RS-232, ≤9600 baud, DB-9, female
Alarm	2 x Form C, DB-9, female
Test Points	Output Power Near-end and far-end received signal level (RSL)

10 (or 10/100)BaseT NMS Ethernet Port:

In/out of band	45Mbps models: the NMS port is out of band from the data port 100Mbps model: user choice of in or out of band with the data port *Note: if jumper for in-band is used, multicasting will appear in NMS channel*
Data Interface	10BaseT (Model 28010 offers a 10/100BaseT port)
Connectors	RJ-45/48c (wire)
Configuration	Half duplex (10BaseT), Full Duplex (100BaseT)

2.2.7 Temperature and Environment

Operating Temperature Range	-10 to +50°C (IDU component) -30 to +60°C (ODU component on Model 28010)
Humidity	95% non-condensing (IDU) 100%, all-weather (ODU on Model 28010)
Altitude	4,500 meters, maximum

2.2.8 Power

DC Input Voltage	±24 or ±48 VDC (Models with IDU only) ±10% ±48 VDC (Models with ODU) ±10%
Power Consumption	< 55 watts (Models with IDU only) < 100 watts (Models with IDU and ODU)
AC Adapter (optional)	100-250 VAC, 50-60 Hz
Connector	Barrier strip, plug-in type

2.2.9 Regulatory Information

	Dual-band	Single-band (5.8)	Single-band (5.3)	Dual-band
FCC Identifier	HZB-U5358-45	HZB-U58-45	HZB-U53-45	HZB-U5358-100
FCC Rule Parts	15.407 (UNII)	15.407 (UNII)	15.407 (UNII)	15.407 (UNII)
Industry Canada ID	5221021766A	5221021581A	2028104200A	20281032175A
IC Rule Parts	RSS 210 (LE-LAN)	RSS-210 (LE-LAN)	RSS-210 (LE-LAN)	RS-210 (LE-LAN)

	Single-band
FCC Identifier	HZB-U58-100
FCC Rule Parts	15.407 (UNII)
Industry Canada ID	
IC Rule Parts	RSS 210 (LE-LAN)

2.2.10 Mechanical

Models 27700, 27710, 27720, 27750 and 28010's IDU)	
Width (for 19-inch EIA rack mounting)	437 mm (17.2") rack mounting brackets supplied
Height	89 mm (3.5") (2RU)
Depth	368 mm (14.5")
Weight	5 kg. (11 lbs.)
Model 28010's ODU	
Width	229 mm (9")
Height	330 mm (13")
Depth	127 mm (5")
Weight	6.8 kg. (15 lbs.)

2.3 Front Panel Description

2.3.1 General

The *Tsunami* radio front panel (no user access on rear panel), as shown in Figure 2-1, has LED indicators, test points, controls and connections that are used for installation, maintenance, operation and troubleshooting. Prior to installation, it is best to be familiar with the front panel of your particular model. Sections 2.3.2 through 2.3.5 briefly describe the front panel access and indicators.

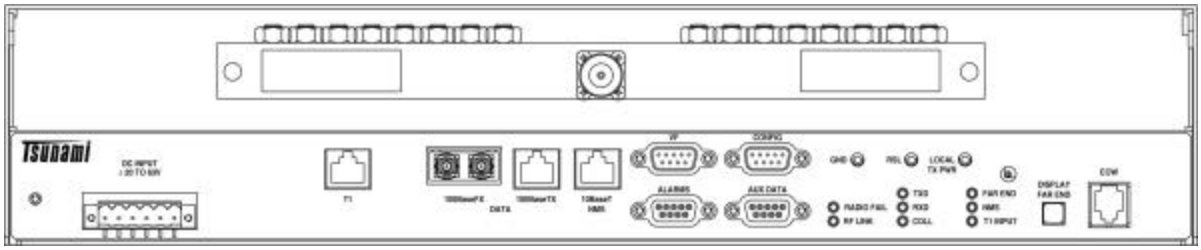


Figure 2-1: Front Panel (45Mbps T1 Models)

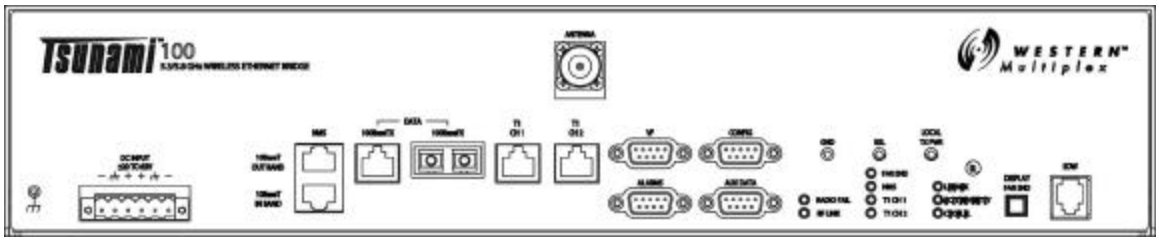


Figure 2-2: Front Panel (100Mbps Model 2xT1 & 45Mbps 1or2 E1)

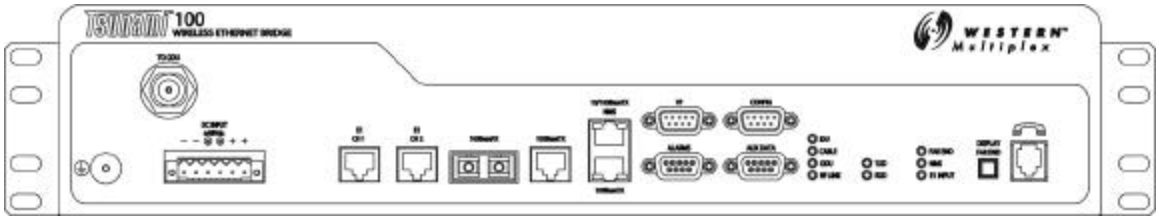


Figure 2-3: Front Panel (100 Mbps with 2xE1)

NMS Note: For out-of-band use, connect the NMS LAN to the OUT BAND 10BaseT connector.

For in-band use, connect a short crossed CAT5 cable between the OUT BAND

connector and IN BAND connector. The IP address for the NMS port will now be available through the radios DATA ports. This must be done on both ends of the bridge link. Note: Multicasting with in-band connection may cause collisions in the data stream.

2.3.2 Test Points / Power Indicator

ON This is an LED indication. When lit GREEN, *Tsunami* is powered.

The Tsunami radio products do not have an on/off switch.

GND This is a test point referenced to chassis ground. This is used in conjunction with the next two test points to measure voltages related to radio performance.

Note: The ground lug on the Model 28010 ODU must be properly connected to earth ground.

RSL This is a test point that relates to the Received Signal Level (RSL). The voltage is measured with a voltmeter (using the GND test point for reference) which corresponds to the actual power level of the incoming received signal. While the DISPLAY FAR END button is pressed, this RSL voltage corresponds to the RSL of the far-end radio. These measurements are used during installation, maintenance and troubleshooting. Refer to Figure 3-6 in Section 3-20.

RSL is located on the Model 28010 ODU with a weather protected BNC connector.

LOCAL TX PWR This is a test point which corresponds to the output transmit power of the radio. The voltage is measured with a voltmeter (using the GND test point for reference) which corresponds to the actual power level of the outgoing signal. This measurement is used during installation, maintenance and troubleshooting (software controlled on Model 28010 with ODU transceiver)

This voltage only applies to the near-end and does not allow measurement of the far-end output transmit power, even when the DISPLAY FAR END button is pressed.

There is a receptacle on the front panel to the right of the LOCAL TX PWR test point which is an installation adjustment allowing the output transmit power to be increased or decreased within the radio's specified limits. Using a small screwdriver, this adjustment is used to set the output power of the transmitter, in accordance to the path planning. Not available on models with ODU component.

The Tsunami system requires professional installation. Transmitted output power limits may apply when using this radio. Consult FCC, IC, Western Multiplex or other regulatory authorities for limits which may apply. See Section 3.13.1 for details on setting output power.

Do not adjust output power above factory settings.

2.3.3 Alarm and Status Indicators (models with IDU only)

Radio Fail	Green = Radio hardware O.K. Red = Hardware failure detected
RF Link	Green = Error-free operation Yellow = Bit errors occurring Red = Excessive bit errors or radio link failure ***Flashing Red = Link security ID mismatch***
TXD	Green = 100BaseT data transmit present Yellow = 100BaseT port connected (no data present) Off = No 100BaseT connection detected
RXD	Green = 100BaseT data receive present Yellow = 100BaseT port connected (no data present) Off = No 100BaseT connection detected Blinking = Security ID mismatch
COLL	Yellow = Collisions occurring on 100BaseT (half-duplex mode)
FAR END	Red = Alarm(s) present on the far-end radio**
NMS (10BaseT)	Green = Tx or Rx data present on the NMS interface Yellow = NMS interface connected (no data present) Off = No NMS interface connection detected
T1/E1 INPUT Note: there are two T1s on the 27720 Model Model 27710-52 has one full-time E1 as well as an additional E1 if selected for 2xE1	Green = Alarm enabled and T1/E1 connection detected Red = Alarm enabled and no T1/E1 connection detected Yellow = Alarm disabled and T1/E1 connection detected Off = Alarm disabled and no T1/E1 connection detected

*** Radio Fail, RF Link (yellow or red), T1/E1 Input (yellow or red)*

2.3.4 Alarm and Status Indicators (models with IDU and ODU)

IDU	Green = Indoor Unit OK Yellow = warning condition in IDU (over-temp and/or both fans failed) Red = All fans failed, over-temp (>55°C), or NMU/IDU communication failure
Cable	Green = ODU Cable OK Red = ODU Cable shorted
ODU	Green = Outdoor Unit OK Red = Over-temp (>60°C), IDU to ODU communication failure, DC power loss, or Outdoor Unit detected hardware failure Yellow = Over temperature alarm, exceeds 55 degrees C
RF Link	Green = Link established with BER <10E-6 Yellow = BER 10E-6 ; any bit errors due to FEC overload Red = BER >10E-3 or Loss of Sync **Blinkin** **Red = link ID does not match with far end radio**
TXD	Red = Links have loss of signal, both 100BaseT and 100BaseFX connectors Yellow = Main Ethernet port is okay, but collision detected within the last 5 seconds or set to half duplex Green = Main Ethernet port is okay and valid data is passing thru Off (Dark) = Main Ethernet port is okay, but no data passing thru
RXD	Red = Links have loss of signal, both 100BaseT and 100BaseFX connectors Green = Main Ethernet port is okay and valid data is passing thru Off (Dark) = Main Ethernet port is okay, but no data passing thru
Far End	Red = Alarm(s) present on the far-end radio** Green = No far end alarm(s) detected
NMS (10/100BaseT	Green = Tx or Rx data present on the NMS interface Off = No NMS data, interface connection detected
E1 (or T1) WAYSIDE INPUT	Green = Wayside connection detected on enabled channels (both waysides) or channel(s) disabled Red = Wayside(s) input channel(s) enabled (either of the waysides) but either chan has a LOS detected Yellow = One or both channels in Loopback mode

** Radio Fail, RF Link (yellow or red), T1/E1 Input (yellow or red)

2.3.5 Controls

DISPLAY FAR END This push-button provides the capability to determine alarms and status of the far-end radio. When pressed and held, the alarm and status LEDs and the RSL test point (except for the Model 28010 with ODU) correspond to the far-end radio's status and RSL value. This can be used for installation, maintenance and troubleshooting. When the LED on this switch is flashing, no far-end information is available. This typically indicates that there is no link between near-end and far-end radios.

2.3.6 Connections

RF CONNECTION

The RF port of the *Tsunami* radio is an N-type female connector that is an integral part of the filter assembly. The filter assembly occupies nearly the entire top half of the front panel. The N-Type connector is used to connect the antenna, typically using coaxial transmission line. In some cases, waveguide may be used as the primary transmission line, in which case a waveguide-to-N adapter is required.

For the Tsunami, 1/2" or 5/8" coaxial cable (LDF4-50 or LDF4.5-50) is recommended. Coaxial cable that is 7/8" or larger can exhibit moding at 5.8 GHz and is not recommended for 5.8 GHz radios. For waveguide transmission line at 5.8 GHz, EW-52 waveguide is recommended. EW-63 will also work, but may exhibit more loss.

DATA CONNECTION

The connection for the Fast Ethernet interface that carries the signals in and out of the radio is an RJ45 100BaseT wire connection or ST 100BaseT fiber connection.

DC POWER CONNECTION

The input accepts positive or negative DC power at any voltage between 20 and 63 Volts. Optionally, an AC power adapter can be used.

OPTIONAL CONNECTIONS

There are several connections that are not required for operation, but provide additional facilities to the user.

EOW This connection is used to access the electronic orderwire function. This is a facility for "telephone" style service from one radio to another. A standard electronic telephone [one with a handset and DTMF (push-button tone) dialing] plugs into this connector. The user can dial the orderwire address of the far-end radio (or any radio in the *Tsunami* network) to establish telephone communication between sites. This communication does not interrupt or interfere with the other radio communications. The radio link must be operational to use this facility. The orderwire feature can be very useful for installation, maintenance and troubleshooting.

VF This connector is used to link two *Tsunami* radios at a repeater site for Orderwire operation. This would allow orderwire "telephone" calls to and from any point in the *Tsunami* network. This circuit is 4-wire audio (2xTx and 2xRx)

The Tsunami orderwire circuit can also be connected to other existing orderwire networks. See Section 3.14.1 for details.

ALARM This connector is used for monitoring alarms electrically. The Form C relays can be connected to other transmission equipment for monitoring alarm status locally or remotely.

CONFIG This is a serial interface port (RS-232) to the *Tsunami* radio. This port provides configuration and maintenance information about the *Tsunami* radio(s) to a connected computer or terminal. Consult factory for operation.

AUX DATA This is a serial interface port (RS-232, ≤9600 baud) which allows the user to connect auxiliary serial data from one point in the radio network to another. It can be used for separate data connection for serial devices.

10BaseT NMS This is an Ethernet connection for access to the Tsunami NMS (SNMP or HTML). See section 4.11 for more detail for operation.

Note: Multicasting with in-band connection may cause collisions in the data stream.

T1 This is a wayside data channel for T1 (DS-1) interface of auxiliary traffic (2XXX0-51 Models).

E1 This is a wayside data channel for E1 (CEPT-1) interface of auxiliary traffic (2XXX0-52 Models).

2.4 Installation Accessories

The *Tsunami* radio is shipped with several accessories commonly required for the radio as described below:

Rack Mount Brackets — Two brackets (along with required mounting screws) are provided which allow 19-inch rack mounting of the *Tsunami* radio.

Terminal Connector — This is a 6-pin mating connector used for DC power supply.

D Connector 9-pin — Four of these mating connectors are provided. One is used for the VF port, one for the CONFIG port, one for the ALARMS port and one for the AUX DATA port.

RF Power Adjustment Cover — A small plastic cap is provided which is placed over the RF output power adjustment receptacle once output power has been set by professional installation personnel.

Do not adjust the power higher than the factory setting! Before setting the power level lower, note the factory setting or keep the radio's configuration sheet attached for future reference.

Other accessories are available, such as orderwire handsets, connector adapters and special cables. These can be ordered separately upon request.

3. Installation & Adjustments

3.1 Shipping Container

The equipment is shipped in boxes unless ordered as an integrated system and configured at the factory, in which case the equipment may be racked and shipped in a crate. The equipment is packaged so as to prevent damage in transit.

The boxes should be left intact and sheltered until arrival at the installation site.

If the shipping container shows signs of damage, the transportation company should be notified immediately. Extra care and inspection of the contents is advised immediately upon receipt.

It is recommended that all the packaging materials be retained**. In the unlikely event that the equipment must be returned to the factory, use the original packing materials for return shipment. **The original packaging materials are also recommended for transporting the equipment from location to location.

Inside the primary shipping containers, internal boxes may contain other items. These boxes should also be saved for future use.

Also, save the Tsunami radio test data sheet that is provided. The test data sheet can be placed where the Tsunami terminal will be installed for future quick reference. All Tsunami units are individually tested and the actual measured performance recorded on the Factory Test Data Sheet. You will find this information to be of use during installation, troubleshooting and maintenance.

A set of “quick installation instructions” is also provided which can be useful for easy reference during installation.

3.2 Packing Items Identification

The primary shipping container houses the radio along with other items including:

- This manual
- Installation accessory kit (see Section 2.5)

3.3 Before Installation Task List

There are several tasks that should be accomplished prior to installing the *Tsunami* radio system. This section briefly describes the following:

- Site selection
- Line-of-Sight and Path Clearance determination
- Anticipated RSL calculation
- Fade margin calculation
- Availability calculation
- Frequency plan determination
- Power supply planning
- Antenna (and accessories) purchase

Only directional antennas should be used with Tsunami radios. These are typically flat panel or solid parabolic antennas. Western Multiplex recommends a maximum beamwidth of 10 degrees for directional systems.

3.3.1 Site Selection Requirements

The radio site must have:

- access to the appropriate power
- close proximity to the telephone or computer system you wish to interconnect
- line-of-sight to the other radio location with adequate clearance
- location for mounting the antenna

3.3.2 Line-of-Sight and Path Clearance Guidelines

The *Tsunami* radios will not operate properly unless they have line-of-sight between their corresponding antennas. The *Tsunami* radio transmission will not pass through trees or other obstacles. Factors to consider include:

- Earth curvature
- Future growth of trees
- Height of buildings

In addition to the line-of-sight requirement, a well-engineered path will also have additional path clearance to allow for signal loss due to partial obstructions, atmospheric ducting and ground reflections. To maximize radio reception, 0.6 times the first Fresnel zone should be calculated and this distance added to the path clearance (in addition to trees or buildings).

3.3.3 RSL Calculation and Link Budget

The received signal level (RSL) can be estimated using the following formula:

$RSL\ (dBm) = P_{out} - FL_1 + G_1 + G_2 - FL_2 - L_p$

where: P_{out} is the transmitter output power (in dBm)

FL_1 is the feeder loss of the transmit side (in dB)

G_1 is the gain of the transmit antenna (in dB)

G_2 is the gain of the receive antenna (in dB)

FL_2 is the feeder loss of the receive side (in dB)

L_p is the Path loss, defined by:

$L_p\ (dB) = 96.6 + 20 \log_{10} F + 20 \log_{10} D$

where: F = Frequency in GHz (2.4 or 5.8)

D = Distance of path in miles

This link budget is very important for determining any potential problems during installation. If you have calculated the expected RSL, you can see if it has been achieved during installation, and troubleshoot if necessary.

In the USA and Canada, Tsunami radios may be installed with any gain directional antennas but with a total system limit of +30 dBm EIRP for the 5.3 GHz transmitter channel frequencies. 5.8 GHz transmitters have an EIRP limit of +53 dBm. For the equation above, replace the $P_{out} - FL_1 + G_1$ *by the EIRP limit.*

3.3.4 Fade Margin Calculation

The fade margin is the difference between the actual received signal and the radio's threshold. Using the formula provided in Section 3.3.3, the anticipated RSL can be calculated. Compare this RSL to the specified threshold of the *Tsunami* radio (shown in Section 2.2) and calculate the fade margin as the difference between the two signal levels.

3.3.5 Availability Calculation

Availability of the microwave path is a measure of the percent of the time that the link will operate without producing an excessive BER due to multipath fading. In the absence of direct interference, availability is affected by the following:

- Path length
- Fade margin
- Frequency (5.3 or 5.8 GHz in the case of these *Tsunami* radios)
- Terrain (smooth, average, mountainous)
- Climate (dry, temperate, hot/humid)

Depending on the type of traffic carried over the link, the system designer may wish to design for a specific availability. For example, if the data or voice traffic that is carried by the radio is critical then it may be designed for a very high availability (e.g. 99.999% or 5.3 minutes of outage per year). To improve availability, for example, the fade margin can be increased by making the path shorter, or by using higher gain antennas in conjunction with lower loss feeders (by using high quality transmission line or shortening feed length).

3.3.6 Frequency Plan Determination

When configuring radios in a hub or repeater configuration, careful engineering of the *Tsunami* radio frequency plans and antenna locations should be performed in order to minimize potential interference between the nearby radios. As a rule of thumb, do not place identical frequency plan radios (*e.g.* two "A" channel radios) at the same site. In most cases, it is desirable to use a different frequency plan (*e.g.* A versus B). However, with careful engineering, placing more than one radio of the same frequency channel plan at the same site is easily accomplished. In fact, the *Tsunami* frequency plan is designed to allow complex hub configurations that may require re-using the same frequency plan. When designing these types of configurations, antenna size and antenna location are critical. If identical channel plans must be used at the same site, the same radio channel (*e.g.* A1 and A1) should be used at a site to minimize interference. Using alternate channels (*e.g.* A1 and A2) is less likely to be successful (and therefore not recommended) due to the high level of transmitter to receiver isolation required from the antenna system.

Sometimes it is required to locate the *Tsunami* radio nearby a transmitter that is the same as, or close to the *Tsunami* receive or transmit frequencies. In this case, the *Tsunami* terminal that should be placed closest to this interfering transmitter should be the specific terminal with the receive frequency which is furthest from this unwanted transmitted frequency. This approach minimizes the potential of interference. While interference conditions are rare when using the *Tsunami* radios, cases of interference may be overcome by exchanging the radios from end to end or simply reinstalling a different filter unit (if applicable), as described in Section 4.2. In some cases, changing frequency plans (e.g. from A to B) can also help mitigate any interference.

Section 4.8 of this manual describes interference countermeasures in further detail.

3.3.7 Power Supply Planning

The *Tsunami* radio must have access to a supply of appropriate power, either DC or AC (if the AC adapter option has been ordered). The *Tsunami* can be powered from a DC battery system, or from a solar or generator power plant, usually with battery reserves. Typically either a positive or negative ground 24 or 48 volt supply is used. For DC, be sure the cable is of sufficient gauge to carry the necessary current and it is less than three (3) meters (9.75 feet) in length.

Before installing the radio, plan for the continuous power consumption needs in accordance with the specifications given in Section 2.2 of this manual. It is also wise to plan for backup power for critical communication circuits (including the *Tsunami* radio). Backup power allows the radios and associated equipment to continue operation when primary power is interrupted.

3.3.8 Antenna Planning

Using the path planning tools and equations presented in the Product Guide, proper antenna size can be determined which will yield the desired path performance. In general, the larger the antenna that is used with the radio, the better the link will perform. Larger antennas have narrower beamwidth and higher gain, which will yield better link performance (higher fade margin, better availability) and improve immunity to interference (due to the smaller beamwidths). However, larger antennas are more costly to purchase and install than smaller antennas, in some cases requiring special equipment for installation. All of these factors should be taken into consideration when selecting an antenna. Consult the Product Guide for more details on selecting antennas.

Recommended Antenna

Size	Gain / 3 dB Beam Width
2 ft	29 dB / 6°
4 ft	35 dB / 3°
6 ft	38 dB / 2°
8 ft	41 dB / 1.5°
10 ft	43 dB / 1.3°

In areas where transmitted output power restrictions apply, the use of larger antennas will maintain the benefit of narrow beamwidths and receive gain. However, output power may need to be reduced to meet regulations. (See Section 3.13.1)

Prior to installation, the specific antenna location and mounting should be determined. This advanced planning also yields the transmission line requirements.

Only directional antennas may be used with these radios.

Antenna Type	Manufacturer	Model Number	Mid-band Gain (dBi)
1 Foot Flat Panel	Gabriel	DFPD1-52	23.5
	Andrew	FPA5250D12-N	23.6
2 Foot Flat Panel	Gabriel	DFPD2-52	28.0
	Andrew	FPA5250D24-N	28.2
2 Foot Parabolic	Gabriel	SSP2-52B	28.5
	Gabriel	SSD2-52A	28.4
	Gabriel	HSSP2-52	28.1
	Radio Waves	SP2-5.2	28.3
	Radio Waves	SPD2-5.2	28.1
	Andrew	P2F-52	29.4
	Andrew	PX2F-52	29.4
3 Foot Parabolic	Radio Waves	SP3-5.2	31.4
	Radio Waves	SPD3-5.2	31.1
	Andrew	P3F-52	33.4
	Andrew	PX3F-52	33.4
4 Foot Parabolic	Gabriel	SSP4-52A	34.2
	Gabriel	SSD4-52	34.1
	Gabriel	HSSP4-52	33.9
	Radio Waves	SP4-5.2	34.6
	Radio Waves	SPD4-5.2	34.4
6 Foot Parabolic	Gabriel	SSP6-52A	37.5
	Gabriel	SSD6-52	37.4
	Gabriel	HSSP6-52	37.2
	Radio Waves	SP6-5.2	37.7
	Radio Waves	SPD6-5.2	37.5
8 Foot Parabolic	Gabriel	SSP8-52	39.8
	Gabriel	SSD8-52	39.7
	Gabriel	HSSP8-52	39.6

Feeder Loss Typ	Manufacturer	Model Numbe	Loss/100'	Notes
1/2" foam coax	Andrew	LDF 4-50	6.6 dB	add ~0.25 dB per connecto
5/8" foam coax	Andrew	LDF 4.5-50	4.7 dB	add ~0.25 dB per connecto
Waveguide	Andrew	EW-52	1.2 dB	does not include transition

Formula for determining maximum output power setting for 5.25-5.35 GHz U-NII (LE-LAN) Transmitters (@ EIRP=30dBm):

Max Tx (dBm) is the lesser of 23dBm and 30 - G + FL

where: G = Antenna Gain
FL = Feeder Loss including connectors

Notes:

All Western Multiplex radios require professional installation.

Antennas with gain less than 23.5 dBi are not allowed

Antennas of other make may be used with the HZB-U53-45 device, but must be of the same type, dimensions and gain as those listed.

3.4 Tools Required

The following tools may be required for the installation of the *Tsunami* radios:

- Phillips (cross tip) screwdrivers (for 19-inch rack mounting and attachment of brackets)
- Small blade standard screwdriver (for power supply connector and RF output power adjust)
- Soldering iron (if using any D-type connectors)
- Wire strippers (for removing insulation from power supply and other wiring)
- Wire crimpers (if using any RJ-style connectors that aren't pre-made)
- Digital Voltmeter (to measure RSL, Tx output power, Alarms)

The following tools are recommended for the installation of the *Tsunami* radios:

- RF power meter (to measure transmitter output power)
- Cellular phone or two-way radio (for talking with far-end crew and tower crew)
- Bit Error Rate test set (to test link after installation)
- Computer (for NMS access with 10BaseT interface and cable)
- Touch-tone Telephone* (to test orderwire circuits and for communication with far-end)

Additional tools will likely be needed for antenna and transmission line installation and antenna alignment. Consult Sections 3.8 through 3.10 of this manual for more details.

*Telephone connection specifications:

REN (Ringer Equivalency Number)	1.0 B
DTMF tones	within ±1.5% of nominal freq.
Ringing Voltage	48 VDC, typical

(Ringing voltage is adequate for modern solid state ringers, NOT for the older mechanical type ringers)

3.5 Frequency Channel Plans

The *Tsunami* system offers non-overlapping channel plans. This channel plan arrangement allows users to implement *Tsunami* systems in the proximity of other *Tsunami* radios (planned or unplanned), hub and repeater applications, and can be used to mitigate interference. The channel plans are illustrated below in Figures 3-1 through 3-2. Section 4.2 and 4.3 describe how to change frequency channel assignments of a *Tsunami* radio.

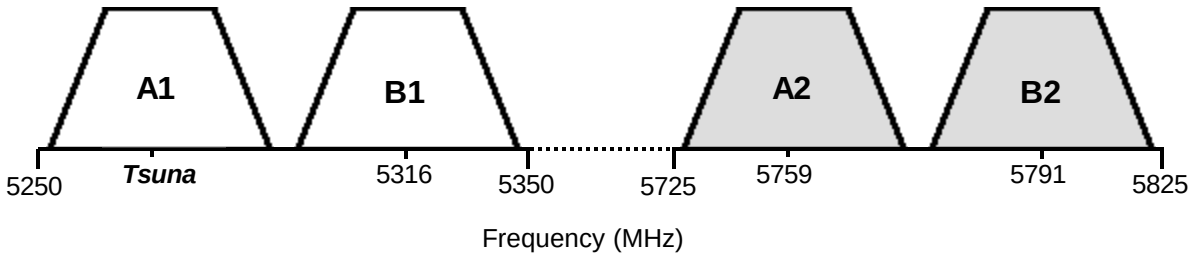


Figure 3-1: Channel Plans, Dual-Band (45 Mbps)

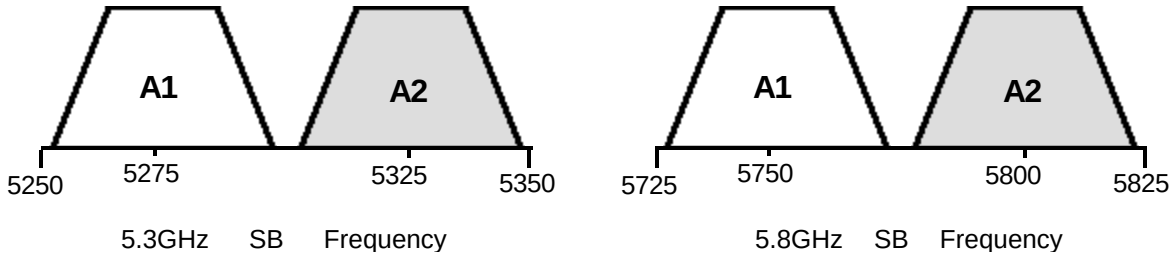


Figure 3-2: Channel Plans, Single-Band (45 Mbps)

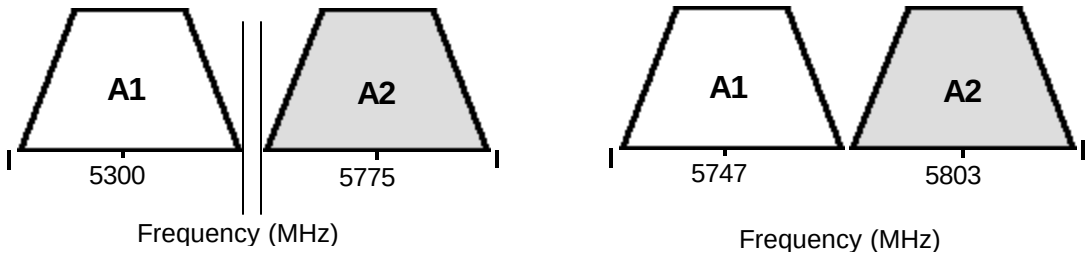


Figure 3-3: Channel Plans, Dual & Single-Band (100 Mbps)

3.6 Mounting the *Tsunami*

The *Tsunami* radio can be mounted at any height in a standard 19-inch rack. Blank rack-mounting spaces above and below the *Tsunami* are recommended, especially if the surrounding equipment dissipates a considerable amount of heat (over 40W).

The *Tsunami* radio may be set up for mounting with the front edge projecting from the front face of a standard 19-inch rack using the rack mounting brackets enclosed with the screws in the Accessory Kit (4 per bracket). The rack mounting brackets may be reversed, in order to install for flush or cabinet mounting if preferred. Depending on rack configuration, it may be necessary to remove the four adhesive backed rubber feet on the bottom of the unit.

The Tsunami radio has internal fans which intake and exhaust on the left and right sides of the chassis. When rack mounting, it is important to leave a small gap between the outer edges of the radio and the inside edge of the rack.

The Tsunami radio may alternatively be placed on a table or shelf attached to a wall. Because of the low weight of the Tsunami, any mounting option other than rack mounting will be less secure.

3.7 Power Connection and Wiring (Models w/o ODU)

There is no ON/OFF switch on the Tsunami. As soon as power is applied, the equipment will be operational. This means that there can be up to 1W of RF power present at the antenna port. The antenna port should be terminated before power is applied.

Power is connected using the DC power plug contained in the Accessory Kit. Use Table 3-A or 3-B along with the associated diagram of Figure 34 or 3-5 to connect the DC power cables. For example, for a negative DC power input, use Table 3-A and Figure 3-4.

NEGATIVE DC POWER INPUT (–20 TO –63 VDC)	
PIN	**FUNCTION**
1	**Power (–DC)**
2	**Ground (see figure 3-7)**
3	**Return (+DC)**
4	**Return (+DC)**
5	**Ground (see figure 3-7)**
6	**Power (–DC)**

Table 3-A: DC Power Connection for Negative Supply

POSITIVE DC POWER INPUT (+20 TO +63 VDC)	
PIN	**FUNCTION**
1	**Return (–DC)**
2	**Ground (see figure 3-8)**
3	**Power (+DC)**
4	**Power (+DC)**
5	**Ground (see figure 3-8)**
6	**Return (–DC)**

Table 3-B: DC Power Connection for Positive Supply

Pins 1 and 6 are connected together on the motherboard. Either pin may be used to apply (-DC) DC power input. Similarly, pins 3 and 4 are connected together on the motherboard and may be used to apply (+DC) DC power input.

For DC power return connection, connect to the opposite voltage (either the -DC or the +DC Pin) and connect the return to ground at the DC power plug on pins 2 and/or 5.

3.7.1 DC Power Wiring (Models w/o ODU)

Connect the power cable with adequate current rating (minimum of 20 AWG) to the terminals shown on the removed (not plugged into the radio) DC power plug using the screw connections. The recommended minimum current rating of external fuses and cables is 3 Amps. The *Tsunami* radios consume less than 1 Amp at ±48V and less than 2 Amps at ±24V. Be sure the DC power cable is less than 3 meters (9.75 feet) in length.

Each Tsunami terminal should be externally fused separately with a 5 Amp maximum fuse. The DC power cable must be less than three (3) meters in length.

If using **negative** power, connect the negative voltage to pins 1 or 6. Connect the ground return connection to pins 3 or 4. See Figure 3-4.

If using **positive** power, connect the positive voltage to pins 3 or 4. Connect the ground return connection to pins 1 or 6. See Figure 3-5.

The **ground** connection is available at pins 2 and 5. Either pin may be used to ground the return side of the power supply. Do not ground both sides of the power supply.

Proper grounding, either through the chassis and/or the power supply, can be very important for protection from lightning. A grounding screw hole is provided on the rear panel.

The ground connection may be left floating if the power supply is referenced to ground externally and to avoid ground loops in some configurations. However, this may not provide adequate grounding for lightning protection.

Use a DVM (digital voltmeter) to verify voltage and polarity on the DC power plug.

Do not connect the DC power plug to the rear of the Tsunami terminal until a load is connected to the antenna port (either an RF pad, or an RF cable and antenna).

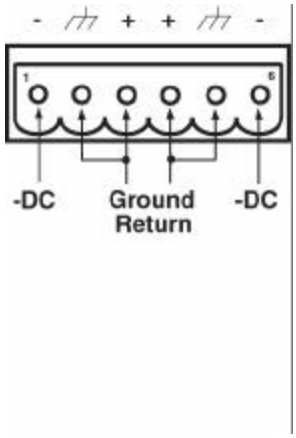


Figure 3-4: Negative Voltage DC Connection

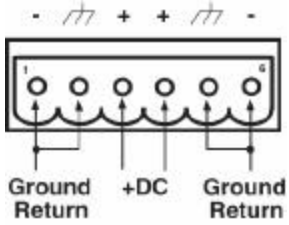


Figure 3-5: Positive Voltage DC Connection

Make sure that when connecting the mating plug that it is properly oriented (terminal screws pointing up) and securely fastened.

3.7.2 AC Power Connection

The optional AC power supply operates from any AC voltage 100V - 250V and 50 Hz or 60 Hz. The AC supply is equipped with a mating connector that plugs directly into the *Tsunami* radio and an AC cord with a 3-pin AC plug. The AC cord color code is shown in Figure 3-5 in case users wish to replace the AC plug supplied with a different type of plug.

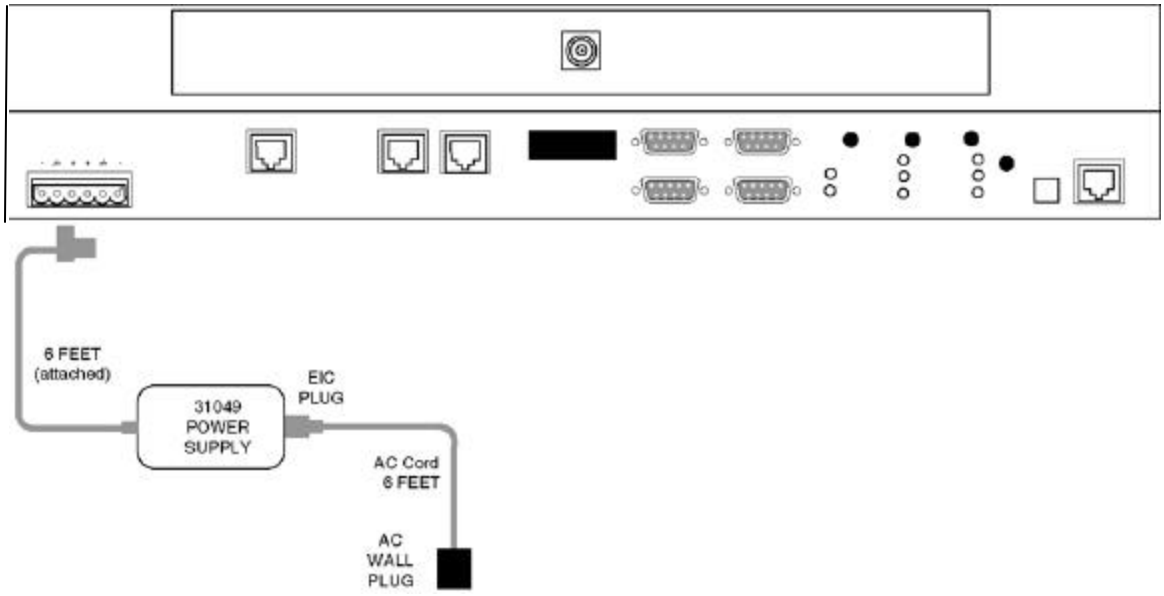


Figure 3-6: AC Connection (Generic radio – IDU)

3.8 Mounting the Radio w/ODU

The ODU is mounted on a substantial mounting pole (minimum 2.5 inches O.D.) to accommodate the supplied mounting bracket. In the figure below, the top connector is cabled to the antenna feed.

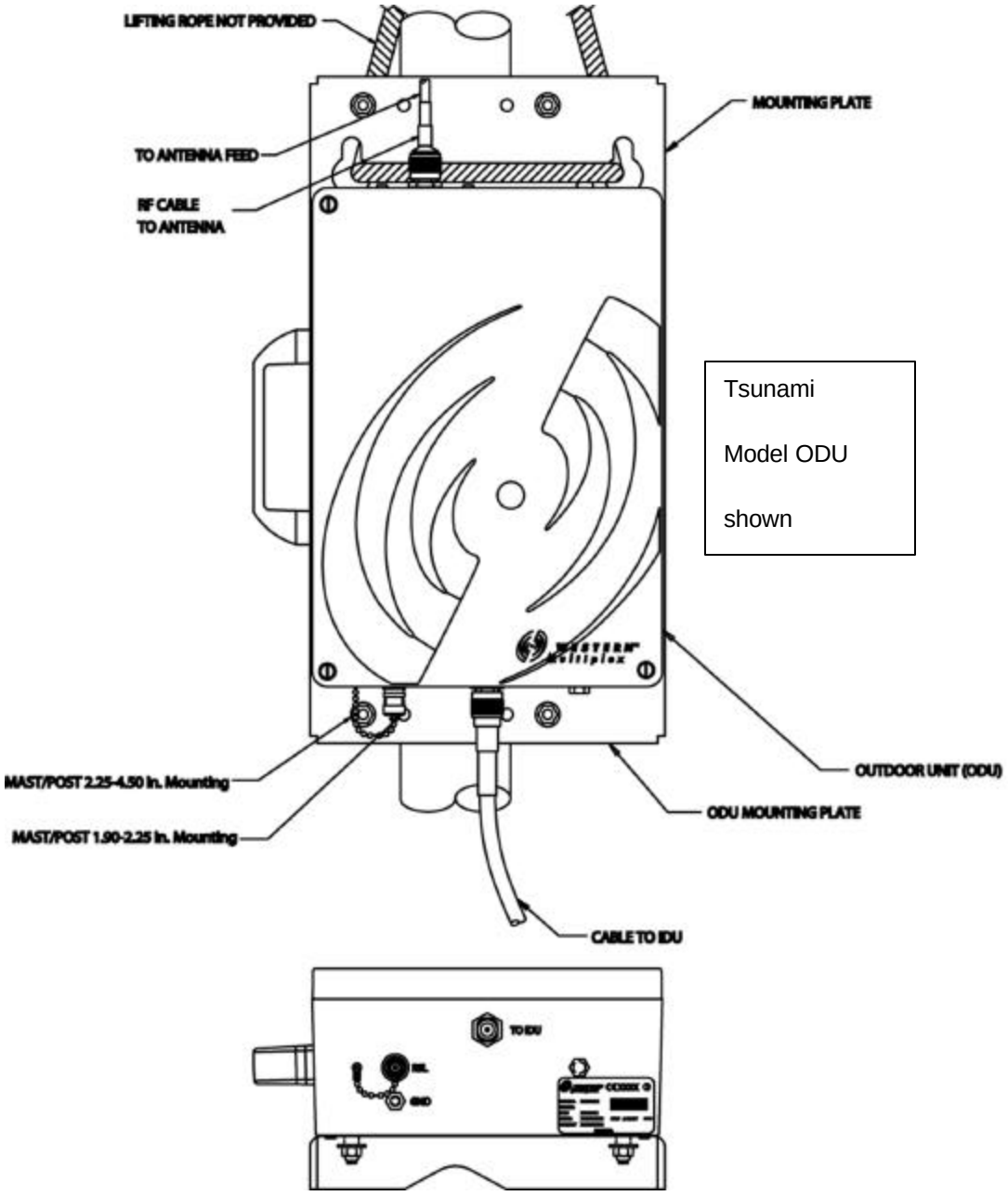


Figure 3-7: ODU Mounting Detail

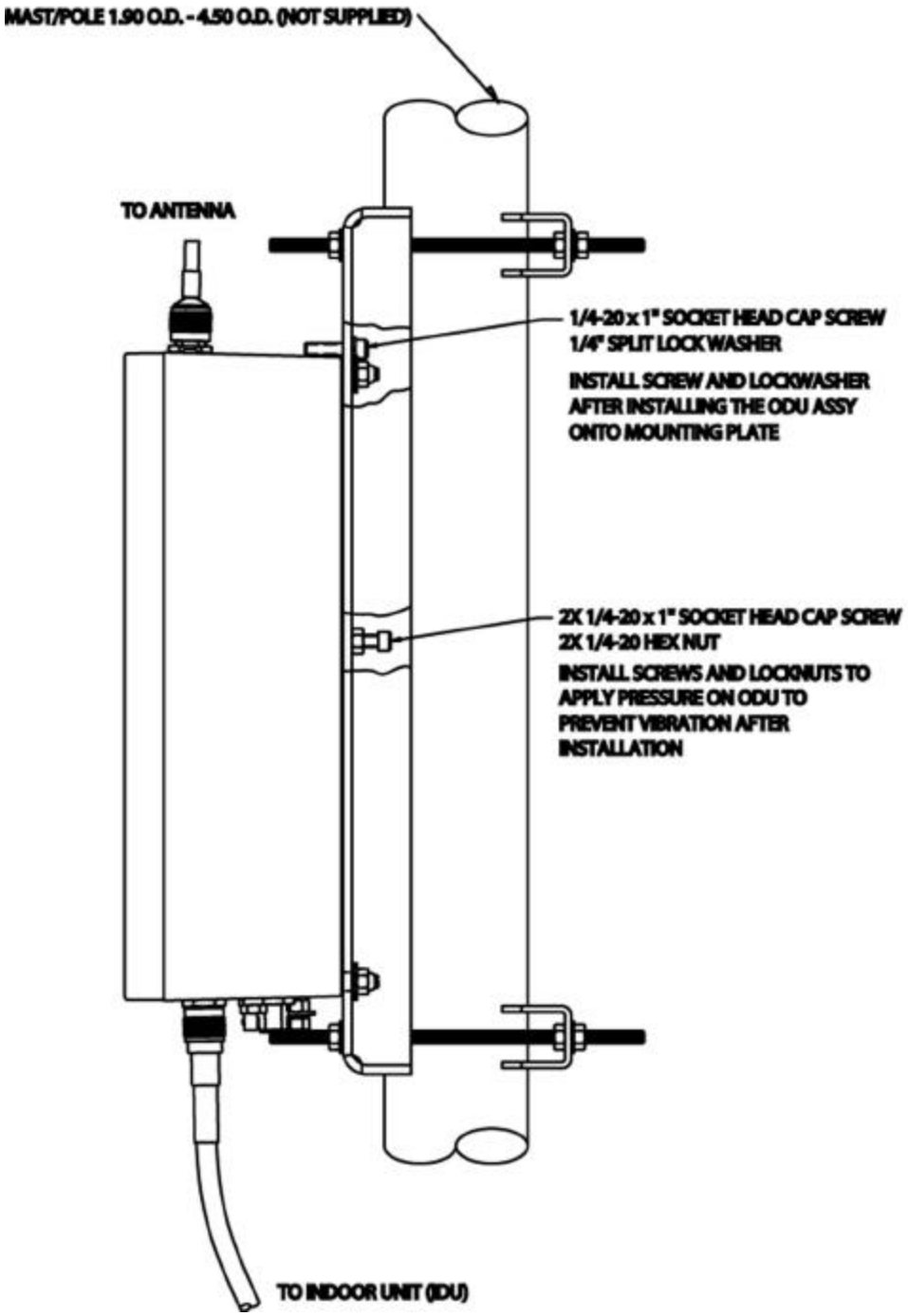


Figure 3-8: ODU Mount – Side Detail

3.9 Power Connection and Wiring IDU w/ODU Model(s)

There is no ON/OFF switch on the radio bridge. As soon as power is applied, the equipment will be operational. This means that there can be up to 1W of RF power present at the antenna port. The antenna port should be terminated before power is applied.

Power is connected using the DC power plug contained in the Accessory Kit. Use Table 3-C or 3-D along with the associated diagram of Figure 3-9 or 3-10 to connect the DC power cables. For example, for a negative DC power input, use Table 3-C and Figure 3-9. Use 14 gauge wire as the minimum size.

NEGATIVE DC POWER INPUT (–37 TO –63 VDC)	
PIN	**FUNCTION**
1	**Power (–DC)**
2	**Power (–DC)**
3	**Ground**
4	**Ground**
5	**Return (+DC)**
6	**Return (+DC)**

Table 3-C: DC Power Connection for Negative Supply

POSITIVE DC POWER INPUT (+37 TO +63 VDC)	
PIN	**FUNCTION**
1	**Return (–DC)**
2	**Return (–DC)**
3	**Ground**
4	**Ground**
5	**Power (+DC)**
6	**Power (+DC)**

Table 3-D: DC Power Connection for Positive Supply

Pins 1 and 2 are connected together on the motherboard. Either pin may be used to apply (+DC) DC power input. Similarly, pins 5 and 6 are connected together on the motherboard and may be used to apply (-DC) DC power input.

3.9.1 DC Power Wiring (Models w/ODU)

Connect the power cable with adequate current rating (minimum of 18 AWG, recommend 16 AWG) to the terminals shown on the removed (not plugged into the radio) DC power plug using the screw connections. The recommended minimum current rating of external fuses and cables is 5 Amps. The radios consume less than 3.1 Amps at ±48V. Be sure the DC power cable is less than 3 meters (9.75 feet) in length and not less than stranded 14 gauge in size.

Each terminal should be externally fused separately with a 8 Amp maximum fuse. The DC power cable must be less than three (3) meters in length. Use 14 gauge wire as the minimum size.

If using **negative** power, connect the negative voltage to pins 5 or 6. Connect the ground return connection to pin 1 and use an optional jumper - 2 to 3 for ground reference. See Figure 3-9.

If using **positive** power, connect the positive voltage to pins 1 or 2. Connect the ground return connection to pin 6 and use an optional jumper - 4 to 5 for ground reference. See Figure 3-10.

The **ground** connection is available at pins 3 and 4. Either pin may be used to ground the return side of the power supply. Do not ground both sides of the power supply.

Proper grounding, either through the chassis and/or the power supply, can be very important for protection from lightning. A grounding screw and nut (#4x40) is provided on the left front panel.

The ground connection may be left floating if the power supply is referenced to ground externally and to avoid ground loops in some configurations. However, this may not provide adequate grounding for lightning protection. Be sure to use the local electrical code to determine wire size and proper connection to the grounding screw.

Use a DVM (digital voltmeter) to verify voltage and polarity on the DC power plug.

Do not connect the DC power plug to the front of the IDU until the ODU is connected via coax).

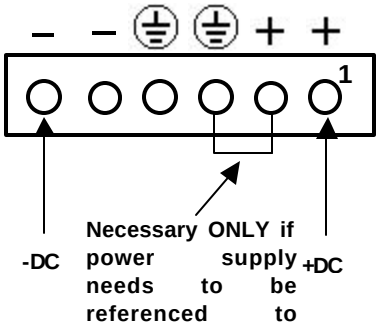


Figure 3-9: Negative Voltage DC Connection

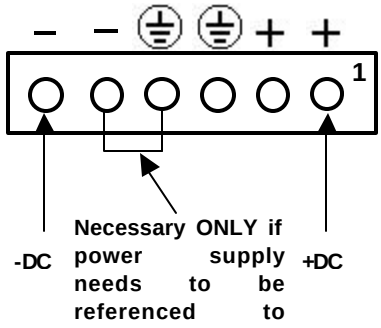


Figure 3-10: Positive Voltage DC Connection

Make sure that when connecting the mating plug that it is properly oriented (terminal screws pointing up) and securely fastened.

Use 14 gauge wire for jumper if used.

3.10 Antenna Installation & Alignment (Models w/ODU)

INSTALLER CAUTION: Antenna(s) used for this transmitter must be fixed-mounted on outdoor permanent structures with a separation distance of at least 1.5 meters from all persons during normal operation. Users and installers must be provided with antenna installation instructions and transmitter operating conditions, including antenna co-location requirements of 1.1307(b)(3), for satisfying RF exposure compliance.

The antenna installation consists of permanently mounting the antenna to the mast/pole/tower and then attaching the ODU mounting plate and then the ODU itself to the mount. The antenna and ODU assembly must be mounted outdoors on a tower, building roof, or other location that provides line-of-sight path clearance to the far-end location. In general, antennas smaller than 2.0 feet diameter are not recommended.

Antennas should be ordered with the suitable mounting kit specific to the site requirements. The antenna must be very rigidly mounted, with adequate room for azimuth and elevation adjustment from the rear. The antenna polarization must be the same at both ends of the link, either vertical or horizontal. The mounting kit includes the details on how to mount and adjust azimuth and tilt. Here, the details on how to mount the adapter plate and ODU are described. Be sure to have all the necessary tools available (see section 3.4) before mounting the antenna and ODU.

In general, antenna mountings require a support pipe to which upper and lower support brackets are attached with “U” bolts. The antenna and optional elevation and azimuth adjustment rods are then mounted onto the support brackets. The whole structure must be adequately grounded for lightning protection. The antenna system must always be installed according to the manufacturer’s instructions.

Unless special test equipment is available, two operating radios are required to align the antennas. The antenna is coarse aligned using visual sighting and then fine aligned using the receive signal level (RSL) voltage of the radio. See figure 3-11.

The RSL voltage reading can still be used to peak antennas even if the radios have not synchronized, however far-end RSL cannot be measured from the near-end terminal until radios are synchronized.

3.10.1 Mounting plate to pole mounting assembly:

Refer to the diagrams below and figures 3.7, 3.8, 3.11 and 3.12.
Note:
Be sure to mount the ODU with the antenna connector UP and the connection to the IDU DOWN.

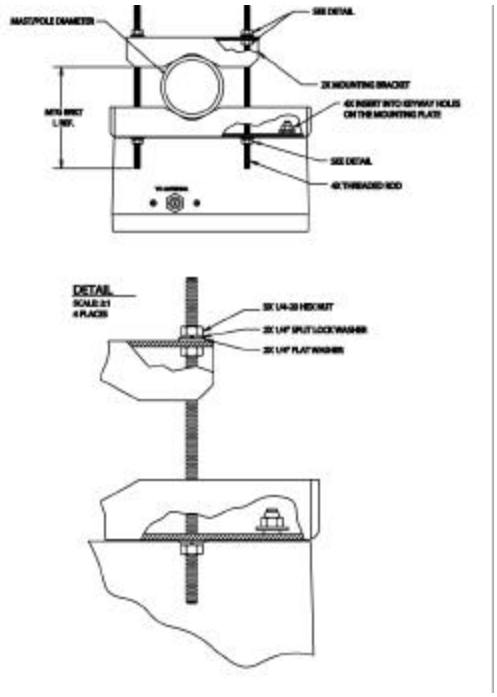
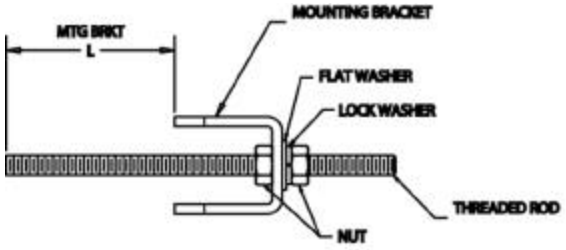


Figure 3-11: ODU Mounting Detail

After attaching the antenna assembly per their enclosed instructions, attach the ODU to the mounting plate as shown in Figure 3-8.

After mounting the antenna, attach the coax cable that connects the ODU with the IDU.

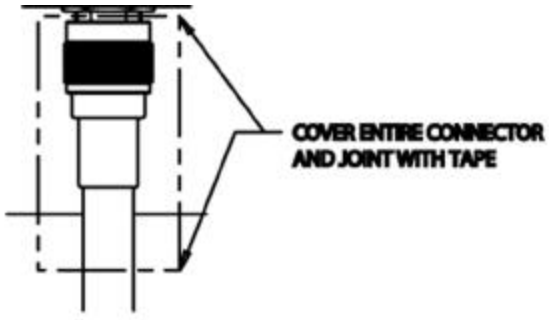


PRE ASSEMBLE CLAMP

2X ASSEMBLE MOUNTING BRACKET THREADED ROD AND HARDWARE PRIOR TO MOUNTING ODU TO MAST/POLE. REFER TO TABLE B FOR THREAD ROD ASSEMBLED LENGTHS.

TABLE

MAST/POLE DIA. In.	MTG BRKT L Inches
1.90	2.7
2.38	3.3
2.88	4.0
3.50	4.7
4.00	5.3
4.50	5.9



4 PLACES

REMOVE BACKING LINER FROM SEALING TAPE FOUND IN INSTALLATION KIT. STRETCH TAPE ABOUT 50%. WRAP TAPE AROUND CONNECTORS LABLED "TO IDU", AND "TO ANTENNA", AND BOTH CONNECTORS ATTACHED TO ANTENNA.

Figure 3-12: Bracket Assy. and Coaxial Connections

3.10.2 Course Antenna Alignment

To coarse-align the antenna, first set it for flat elevation (no up or down tilt) using a spirit level. Then point it at a heading marker obtained using a compass/GPS (magnetic corrected) back-bearing from an adjacent location, (ideally, 100 feet or more away from the antenna).

If a heading marker cannot be set sufficiently far away (for example when on a city building roof or looking through a window) then a rough azimuth setting can be obtained by sighting along the antenna feed.

It should be verified that both antennas are on the same polarization by using the manufacturer's instructions. Otherwise the RSL will be approximately 25 to 30 dB below the calculated level.

Most antennas will also need fine alignment obtained using an operating link because it is very important to maximize the receive RF signal level at each end of the radio link.

Read Section 3.9 before applying DC power to the radio.

Once the coarse alignment has been set-up at both ends, then the link can be powered and some level of reliable communication established. The voltage at the ODU RSL test point (BNC connector) should be measured with a DVM to determine the relative receive RF signal level.

For the fine alignment, adjusting first the azimuth and then the elevation of the local antenna will maximize the RSL voltage. Then, the far antenna is aligned in the same way, using the RSL voltage of its local radio ODU.

When aligning antennas it may be convenient to allow direct visibility to the technicians aligning the antenna.

An orderwire telephone will provide end-to-end voice communications once radios are synchronized. Synchronization usually can be accomplished by coarse alignment only. After synchronization, the orderwire phones can be used to communicate between radio sites for antenna fine alignment. The phone interconnect cable can be extended to the antenna when desired.

The larger the antenna size, the more critical alignment becomes: for example, with a 2 foot dish, the antenna can be moved ±3 degrees off the correct heading before the receive signal level drops by 3 dB. This compares with a 6-foot dish which may only be moved ±1 degree for the same degradation.

The graph shown in Figure 3-13 shows the typical variation of RSL voltage as the receive signal level is increased from threshold to a higher level. There is some variation between receivers, but an approximate estimate of the potential RSL value may be made using this figure.

Use the Factory Test Data Sheet shipped with your terminal to obtain the best estimate of your RSL.

Above 0 dBm RSL, the receiver may produce errors: however this level is rarely likely to be exceeded. A link budget calculation should be made to calculate the anticipated RSL as described in Section 3.3.3. During anomalous propagation conditions, the RSL may fade but will not increase up more than 10 dB (except in unusual very long paths which may fade up by 15 dB).

Antenna alignment should enable the RSL to be peaked to the level calculated in the link budget. If the RSL is peaked but is approximately 20 dB below the calculated level, then it is likely that the antennas are aligned on a sidelobe of the antenna's radiated signal. In this case, the antennas should be rotated in a wide arc until the main lobe is located. (Other possible causes of low RSL are path obstructions, loss in connectors, adapters and pigtail jumper cables or different antenna polarization at each end of the link.)

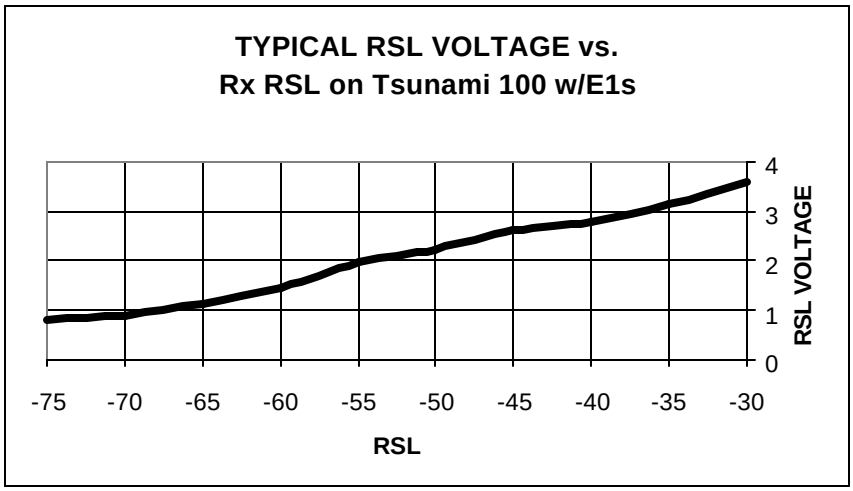


Figure 3-13: Typical RSL Voltage versus Received Signal Level (RSL) - Model 28010

3.11 Antenna Connection

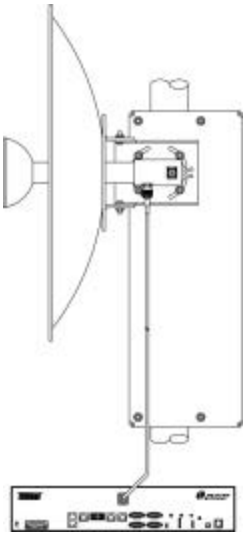
The *Tsunami* radio is equipped with an N-type female connector at the antenna port located on the rear panel. A short length (~6 feet) jumper cable such as RG-214 coax (or "pigtail") fitted with two N-type male connectors can be used to connect the antenna port to the antenna transmission line (see Section 3.9). The recommended cable type for a jumper is RG-214.

A low loss 50-ohm cable (for example LDF4-50 1/2 inch coax) or EW-52 waveguide is recommended for the antenna transmission line between the top of the rack and the antenna. The return loss presented by the transmission line at the top of the rack should be as high as possible (20 dB, minimum recommended). The length of the antenna transmission line should be kept as short as possible (to minimize losses).

To minimize feeder losses, the use of elliptical waveguide is recommended (typical loss is 1.25 dB/100 ft) for feeder lengths in excess of 200 feet. Depending on path length and feeder length, 1/2 inch or 5/8 inch coax cable can be used.

For the Tsunami radio, 1/2" or 5/8" coaxial cable (LDF4-50 or LDF4.5-50) is recommended. Coaxial cable 7/8" or larger can exhibit moding at 5.8 GHz and is not recommended for 5.8 GHz radios. For waveguide transmission line at 5.8 GHz, EW-52 waveguide is recommended. EW-63 will also work, but may exhibit more loss.

Do not use right angle N-type connectors with the 5.8 GHz Tsunami radios: they may present high loss at 5.8 GHz. Do not use a low quality N-type jumper cable with the Tsunami. Some cable types, such as RG-8, may have high loss at 5.8 GHz.



Radio w/o Outdoor Unit (ODU)

Radio mounting with ODU

3.12 Transmission Line Connection

The transmission line feeder (such as LDF4-50 1/2 inch coax cable or EW-52 elliptical waveguide) should be prepared first by cutting to the approximate length (allowing some excess) and installing the appropriate connector on the antenna end.

The prepared transmission line is then pulled through the cable ducts, trays or conduit (as required) to the antenna, while being careful not to kink or damage the transmission line in any way.

The transmission line should be supported in a tray on horizontal runs and by hangers on vertical runs. Hangers should be spaced according to the manufacturer's instructions (typically every 5 feet under conditions of no ice and not greater than 85 mph winds).

The transmission line should be grounded using the manufacture's recommended grounding kit. Grounding kits attach to the outer copper conductor. Grounds must be installed at the antenna, at the bottom of the tower (if applicable) and where the transmission line enters the building. Long transmission line runs should be grounded every 100 feet. In areas of high incidence of lightning, dissipaters should be attached to antennas. In addition, coaxial, in-line, spark-gap type, lightning suppressors should be added at the bottom of the coax cable before entering the building/enclosure.

Any in-line lightning protection device must be rated for the operating frequency of the Tsunami (5.3/5.8 GHz).

After installation, the transmission line is terminated with an N-type male connector/adapter attached at the equipment end. For waveguide, this typically requires a CPR-to-N adapter.
Prior to operation, the electrical integrity of the transmission line, including all connectors, can be checked with a simple DC check between the center conductor and outer conductor. (This is neither possible, nor required for waveguide).
The transmission line should ideally be connected directly to the antenna at one end and to the *Tsunami* antenna port at the other end. However, short RG-214 type pigtail jumper cables may be required to avoid sharp bends in the transmission line to limit stress on either connection.

7/8 inch coax cable or larger is not recommended for use at 5.3 GHz and higher frequencies.

Do not use right angle N-type connectors with the 5.3 or 5.8 GHz Tsunami radios: they may present high loss at 5.3 or 5.8 GHz.
Do not use a low quality N-type jumper cable with the Tsunami. Some cable types, such as RG-8, may have too high a loss at 5.3 and 5.8 GHz.

3.13 Antenna Installation & Alignment

INSTALLER CAUTION: Antennas used for this device must be fix-mounted on permanent outdoor structures to provide 5 meter or more separation from all persons during device operation to comply with FCC and other regulatory RF Exposure requirements. Installers should contact the manufacturer for applicable antenna gain and type restrictions to ensure compliance.

The antenna installation consists of permanently mounting the antenna outdoors on a tower, building roof, or other location that provides line-of-sight path clearance to the far-end location. In general, antennas smaller than 2 feet diameter are not recommended for urban areas due to their wider beamwidths, which results in higher interference susceptibility.

Antennas should be ordered with a suitable mounting kit specific to the site requirements. For example, specifying round or angle tower leg adapters, or a roof tripod as necessary.

The antenna must be very rigidly mounted, with adequate room for azimuth and elevation adjustment from the rear.

The antenna polarization must be the same at both ends of the link, either vertical or horizontal.

In general, antenna mountings require a support pipe to which upper and lower support brackets are attached with "U" bolts. The antenna and optional elevation and azimuth adjustment rods are then mounted onto the support brackets. The whole structure must be adequately grounded for lightning protection. The antenna system must always be installed according to the manufacturer's instructions.

Unless special test equipment is available, two operating *Tsunami* terminals are required to align the antennas. Alternatively, a CW generator may be used to transmit a signal toward the end under alignment.

The antenna is coarse aligned using visual sighting and then fine aligned using the receive signal level (RSL) voltage of the *Tsunami*.

The RSL voltage reading can still be used to peak antennas even if the radios have not synchronized, however far-end RSL cannot be measured from the near-end terminal until radios are synchronized.

To coarse align the antenna, first set it for flat elevation (no up or down tilt) using a spirit level. Then point it at a heading marker obtained using a compass back-bearing from an adjacent location, (ideally, 100 feet or more away from the antenna).

If a heading marker cannot be set sufficiently far away (for example when on a city building roof or looking through a window) then a rough azimuth setting can be obtained by sighting along the antenna feed.

It should be verified that both antennas are on the same polarization by using the manufacturer's instructions. Otherwise the RSL will be approximately 25 to 30 dB below the calculated level.

Most antennas will also need fine alignment obtained using an operating link because it is very important to maximize the receive RF signal level at each end of the radio link.

Read Section 3.9 before applying DC power to the Tsunami radio.

Once the coarse alignment has been set-up at both ends, then the link can be powered and some level of reliable communication established. The voltage at the *Tsunami* front panel RSL test point should be measured with a DVM to determine the relative receive RF signal level.

For the fine alignment, adjusting first the azimuth and then the elevation of the local antenna will maximize the RSL voltage. Then, the far antenna is aligned in the same way, using the RSL voltage of its local *Tsunami* radio.

When aligning antennas it may be convenient to run two wires from the RSL and ground test points to the antenna so that the voltmeter reading is directly visible to the technicians aligning the antenna. Also, a cellular telephone or two-way radio may be useful for coordinating alignment activities between both ends of the link. Once the radios are coarse aligned and synchronized, the built-in orderwire phone service can also be used to coordinate alignment between both ends of the link.

An orderwire telephone will provide end-to-end voice communications once radios are synchronized. Synchronization usually can be accomplished by coarse alignment only. After synchronization, the orderwire phones can be used to communicate between radio sites for antenna fine alignment. The phone interconnect cable can be extended to the antenna when desired.

The larger the antenna size, the more critical alignment becomes: for example, with a 2 foot dish, the antenna can be moved ±3 degrees off the correct heading before the receive signal level drops by 3 dB. This compares with a 6foot dish which may only be moved ±1 degree for the same degradation.

The graph shown in Figure 3-14 shows the typical variation of RSL voltage as the receive signal level is increased from threshold to a higher level. There is some variation between *Tsunami* receivers, but an approximate estimate of the potential RSL value may be made using this figure.

Use the Factory Test Data Sheet shipped with your Tsunami terminal to obtain the best estimate of your RSL.

Above 0 dBm RSL, the receiver may produce errors: however this level is rarely likely to be exceeded. A link budget calculation should be made to calculate the anticipated RSL as described

in Section 3.3.3. During anomalous propagation conditions, the RSL may fade but will not increase up more than 10 dB (except in unusual very long paths which may fade up by 15 dB).

Antenna alignment should enable the RSL to be peaked to the level calculated in the link budget. If the RSL is peaked but is approximately 20 dB below the calculated level, then it is likely that the antennas are aligned on a sidelobe of the antenna's radiated signal. In this case, the antennas should be rotated in a wide arc until the main lobe is located. (Other possible causes of low RSL are path obstructions, loss in connectors, adapters and pigtail jumper cables or different antenna polarization at each end of the link.)

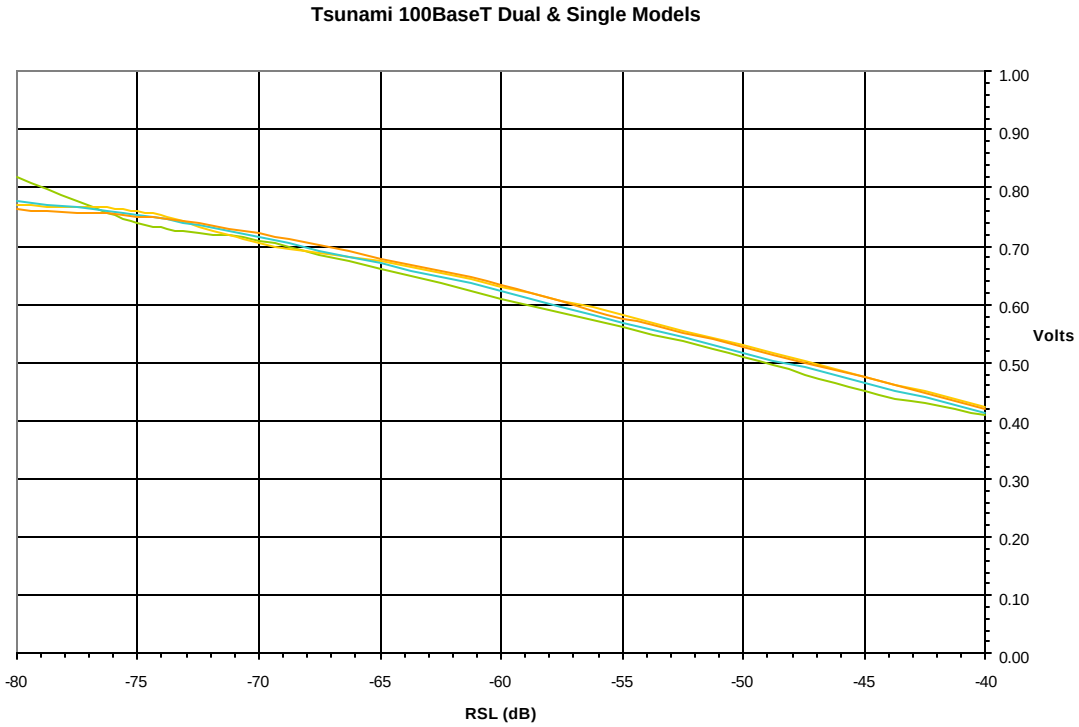


Figure 3-14: Typical ODU RSL Voltage versus Received Signal Level (all except 28010)

3.14 Ethernet Interface Connection

The radio link's 100BaseT interface connection to the *Tsunami* radio is on the front panel.

Additional external lightning protection devices are recommended for the connections if the radio is installed in an area prone to lightning.

The 100BaseT connection to the *Tsunami* is at the data interface on the front of the shelf. Either wire or fiber connections can be used.

3.15 System Turn-up to Service

1. Prior to installing the system, it may be desirable to perform a back-to-back test of the *Tsunami* radio pair. Consult Section 4.9 for further details. Back-to-back testing is a simple way to verify that the *Tsunami* radios are fully operational before they are installed. Installation adds several variables (such as antenna alignment) which can lead to system turn-up delays. Also, during back-to-back testing, the DIP switch settings and some connections can be tested. This step can eliminate a majority of troubleshooting once the radios are installed.

A cellular phone or two-way radio system (walkie talkie, CB, mobile radio) can be very useful during installation. These can be used for temporary near-end and far-end communications between the installation personnel at one site and installation personnel at the other site while installing the system. These can also be helpful for communication between a person at the top of a very tall tower and ground personnel.

The Tsunami radio incorporates an internal Orderwire feature that provides end-to-end "telephone" style communications. However, the link must be partially operational to use this feature. In lieu of, or in addition to the use of cellular phones or two-way radio, this Orderwire feature can also be very useful for installation, but typically cannot be put into service until step 8 or 9 of this procedure is completed.

2. Perform a general alignment of the antennas on both ends of the path using binoculars, compass or other related tools. It is important to have the antennas aligned as accurately as possible before putting radio traffic over the link. This will help in getting the system running more rapidly.

3. Connect the transmission line to the antenna, and feed it to the *Tsunami* radio location. Connect the opposite end of the transmission line to the N-type female connector located on the filter assembly which occupies the top half of the *Tsunami* rear panel. The connection must be terminated into an antenna or a load before DC power is applied to the radio.

4. Verify that the same channel plan (e.g. A, B) as the near-end radio, and the opposite Tx and Rx frequencies (e.g. A1 and A2 make up a matched pair of radios).

5. With the DC power source active, but not plugged into the *Tsunami* radio, using a voltmeter, confirm that the DC mating connector has the proper power connections in accordance with Section 3.7. Verify the polarity and the absolute voltage on all pins. Verify ground connection for power.

6. Connect power to the *Tsunami* radio. Verify that the IDU's Front Panel "ON" LED indication is illuminated. This confirms that power has been properly applied.

Ensure that the RF Antenna port connection is properly terminated before applying power to the Tsunami terminal, as in

step 3.

When the Tsunami radio is initially powered-on, some alarm conditions may be present. This is normal and alarms can be ignored at this time.

7. Place a voltmeter across the GND and PWR front panel test points. See Figure 3-15 for voltage setting information and Table 3E for typical output power levels for given cable lengths where EIRP limits apply. If necessary, use a small screwdriver at the front panel receptacle to adjust the output power of the local transmitter in accordance with the path analysis calculations. The recessed potentiometer is rotated clockwise to increase transmit output power and counter clockwise to decrease transmit output power. After verifying correct setting of the transmit output power, disconnect the voltmeter. Place the cover cap found in the installation accessory kit over the front panel receptacle.

The Tsunami radio requires professional installation. With some Tsunami models, in certain countries, there may be Effective Isotropic Radiated Power (EIRP) limits which dictate the maximum output power that the Tsunami radio can transmit given the transmission line loss and the gain of the antenna. Consult with appropriate government agencies or Western Multiplex if there is any question regarding maximum output power allowed. ***Do not adjust output power above factory settings.***

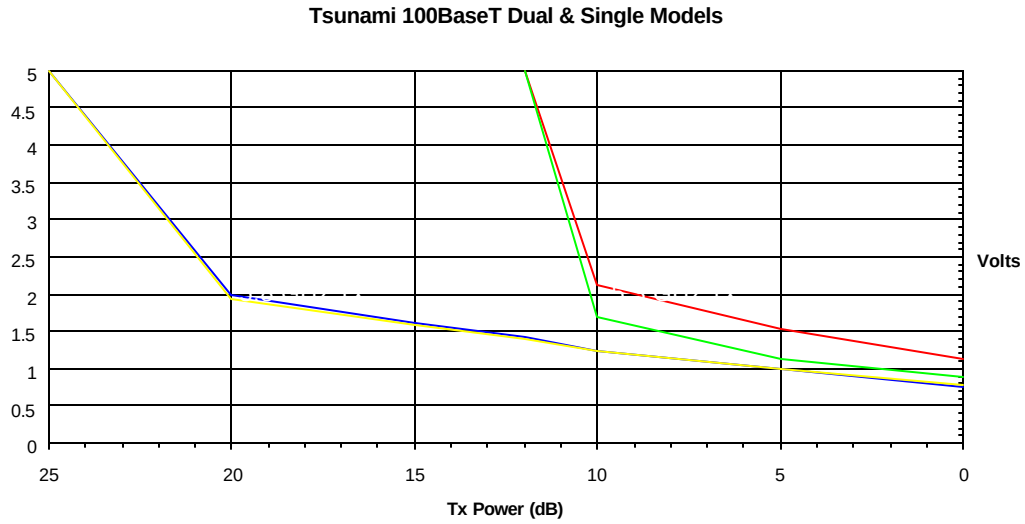


Figure 3-15: Typical RF Output Power versus PWR Voltage (all Models except 28010)

Use the Tsunami Factory Test Data sheet that came with your radio(s) to determine more precisely the voltage corresponding to the RF output power.

For precision measurement of transmit output power, it is best to connect an RF power meter to the antenna port. The PWR port voltage may not provide enough precision. This is especially important where EIRP limits apply to the installation.

In cases of no EIRP limits, the radio transmitter output power should be left at the factory setting, except for very short paths using very high gain antennas, where excessive power may not be advised.

Don't forget that the RF output port should be terminated at all times when power is applied to the Tsunami radio. Therefore, disconnect power to the radio before connecting a power meter and reapply power once connected. Often, an RF power meter may have a limit to the input power that it can measure without damage. It is advised to place a calibrated fixed value RF attenuator (typically 20 dB or more) between the Tsunami radio and the power meter to assure proper operation and safety for the RF power meter. The value of this fixed attenuation can then be added to the value of the RF power meter reading to obtain the actual Tsunami radio transmitter output power.

8. Connect a voltmeter across the GND and RSL front panel test points. This voltage reading corresponds to the Received Signal Level (RSL) of the near-end radio. In other words, RSL is the "amount" of signal the near-end radio is receiving from the far-end radio. Since the antennas have not been finely aligned, it is not expected at this time that the RSL will read very high. However, at this point it can be verified that some communication is taking place between the two *Tsunami* terminals. Use the RSL voltage reading to align the antennas. Align one antenna at a time in accordance with Section 3.13. Complete alignment of both ends of the radio link before going further.

The RSL voltage output on the radio's front panel will output a voltage over the usable range of the radio. Refer to Figure 3-14.

The *Tsunami* radio has a unique feature of allowing measurement of the far-end RSL from the near-end radio. This is only possible if the *Tsunami* radios are communicating (the RSL is above threshold). The far-end RSL can be used to verify that adjustments to local antenna alignment are corresponding to the far-end radio reception. Far-end RSL is measured by pressing and holding the DISPLAY FAR END front panel button. While this button is held, the RSL voltage indicates the RSL of the far-end radio. RSL of both ends should be verified to be within approximately 2 dB of predicted value (see Section 3.3.3). There are several factors that can contribute to low RSL:

- Incorrect antenna alignment (aligned on a lobe and not on the main signal)
- Improper polarization alignment of antennas (horizontal vs. vertical)
- Transmission line problems (loose connections, bent or damaged cables, lossy adapters)
- Path obstructions (trees, buildings, hills, etc.)

- Path clearance (line-of-sight, earth curvature, Fresnel zone, diffraction and partial obstruction)
- Weather (inversion layers, ducting and multipath)
- Antenna feed (coaxial/connector) problem

The Tsunami radio requires professional installation. Don't forget that the transmitter output power adjustment on the Tsunami radio effects the RSL. Depending on EIRP limits (if any), path distance, and antenna gain, you may need to adjust the output transmit power to the proper level before putting the radios in service.

If radio synchronization has been established, the radio link may be able to provide some limited communications over the link. It can be helpful to establish voice communications from one end of the radio link to the other using the Orderwire feature of the Tsunami radio.

If RSL is lower than anticipated, recheck the path clearance and transmission line as these are the typical causes of low RSL. Radio operations can be verified by connecting radios back-to-back with attenuators (40-60 dB), (see Section 4.9). If the problem remains, consult Section 4 of this manual for troubleshooting techniques which will help determine the source of the problem.

9. Once radio performance is verified and acceptable, the *Tsunami* radios can now be put into service with the intended Fast Ethernet traffic. Connect to the LAN or computer using the RJ45 (wire) or ST (fiber) 100BaseT connector. With Fast Ethernet traffic applied in both directions, all front panel LEDs, except for POWER and the data TXD/RXD lights should be off. If any other LEDs are on, consult the trouble shooting sections of this manual.

10. Now that the link is operational, other services can be connected including T1 (DSX-1), Orderwire, Diagnostics, Alarms and Aux Data (Service Channel). Consult Section 3.17 for details on these connections.

3.16 Output Power Adjustment

The *Tsunami* radio requires professional installation. In certain cases, it is necessary to adjust the output power ***lower*** (never higher) from the factory setting, for example:

- to meet EIRP (effective isotropic radiated power) limits.
- to avoid exceeding the maximum far-end RSL of -30 dBm.
- to coordinate a hub or repeater location.

*To ensure maximum protection of the radio circuits, always ensure the antenna connector is terminated when power is applied**. Never adjust output power above factory settings.***

For precise measurement of transmitter power, a calibrated RF power meter (such as the HP 435B with Power Sensor HP8481) is recommended. This power sensor can be connected directly to the output of the radio without exceeding the power rating. With some power meters, it may be necessary to place a calibrated in-line fixed attenuator between the radio antenna port and the power meter so as to not exceed the power meter's maximum input level. Thruline power meters do not operate at *Tsunami* RF frequencies.

If adjusting the output power to meet an EIRP limit, it will be first necessary to calculate the overall system gains and losses, including feeder losses for the type of transmission line installed and the antenna gain. Also refer to Table 3-E for transmitter output power settings where installed with various transmission line lengths and antenna sizes. You may determine the radio transmit power for EIRP limited installations by the following equation:

Tx Power (dBm) = EIRP Limit(dBm) + Feeder Loss(dB) - Antenna Gain(dB)

For the US and Canada, a +30 dBm EIRP limit applies for the dual band (5.3/5.8 GHz) Tsunami radios and a +53 dBm EIRP limit applies for the single band (5.8 GHz) Tsunami radios.

Output power may be adjusted using a small screwdriver and rotating the potentiometer which is recessed behind the front panel. Clockwise rotation increases output power while counter-clockwise rotation decreases output power.

In lieu of a calibrated RF power meter, the PWR test port voltage can be used to estimate the output power. Figure 3-15 illustrates the voltage reading for various output power levels. The factory test data sheet should be used to establish a more precise setting of this adjustment.

After setting the correct output power, place the cover cap found in the installation accessory kit over the front panel receptacle.

FCC EIRP limitations:

Models that have transmitters that use the 5.3 GHz band should not exceed a total of +30 dB E.I.R.P.
Models that have transmitters that use the 5.8 GHz band should not exceed a total of +53 dB

E.I.R.P.

3.17 Additional Connections

There are additional customer connections which are optional and are **not required** to make the *Tsunami* operational but may prove useful.

3.17.1 Orderwire Connection

Orderwire is a "telephone" type wayside service which allows users of the *Tsunami* radio to establish voice communications from one radio to another, either directly to the companion far-end, or through a repeater configuration, or several repeater configurations.

Telephone connection specifications:

REN (Ringer Equivalency Number)	1.0 B
DTMF tones	within ±1.5% of nominal freq.
Ringing Voltage	48 VDC, typical

(Ringing voltage is adequate for modern solid state ringers, NOT for the older mechanical type ringers)

This Orderwire service does not affect the normal radio transmission of traffic. Refer to Section 2.3.5 for the telephone specifications. For simple near-end to far-end communications, follow the steps below:

1. Using a standard RJ-11 telephone cable, connect a standard electronic telephone (a touch tone phone, complete with dialer; a handset by itself will not work) to the Orderwire connector on the *Tsunami* front panel. This connector is wired identically to a standard two-wire telephone jack, see Figure 3-16 for details.

2. With a telephone connected to each *Tsunami* terminal on opposite ends of the link, either telephone can be used to "dial-up" the far-end location. The far-end terminal's internal ringer and the connected telephone will ring, and if answered, two-way full-duplex voice communication is established.

If using the Orderwire or Network management functions, all Tsunami radios connected must have unique address settings (telephone numbers).

4. If the *Tsunami* radios are connected in a repeater configuration, Orderwire services can be established to all *Tsunami* terminals in the network by implementing a connection of their rear-panel connectors between repeater terminals. At the repeater site, a cable can be connected to the two *Tsunami* terminals between their rear panel VF 9-pin connectors as shown in Figure 3-16. With this cable in place, the Orderwire function will operate at terminals at each end of the repeater and at the repeater site. This function can be continued through several repeater sites if desired. For hub connections of 3 or more *Tsunami* radios at the same site, an external 4-wire bridge is required to connect all radios to the orderwire.

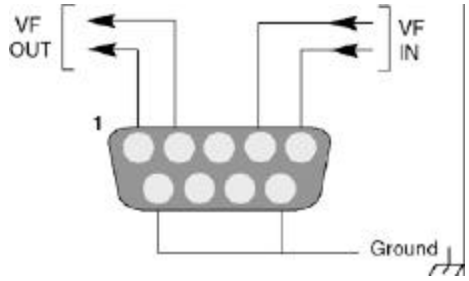
The orderwire system can be integrated with orderwire equipment supported by many other vendors. If your existing orderwire

network uses 2 digit addressing, and 0 dBm VF interface, it can be connected to a Tsunami as shown in Figure 3-16.

Dialing a ✶ (star key) on the orderwire telephone implements an "all call" feature which rings all connected radios. Also, if a phone anywhere in the connected network has accidentally been left off-hook, the # (pound key) key can be used to mute all off-hook handsets until they are placed on and off hook again.

The orderwire operates like a "party line". All telephones provide communication to all other telephones in the connected network. Even if a particular telephone does not ring, it can still be used to talk and listen to any ongoing orderwire activity if the orderwire is in use at other terminal locations.

Orderwire Connection



VF Port Connection

Figure 3-16: Orderwire & VF Port Connection

3.17.2 Alarm Connections

External alarm outputs are provided at the 9-pin, D-type subminiature ALARM connector. There are two Form C summary alarm relays capable of switching 30 VDC at 1 A. See Table 3-E and Figure 3-17 for Alarm Connections.

The "summary" alarm (Form C relay) is activated by any near-end front panel LED alarm condition, including if the internal test mode is enabled.

The "out-of-service summary" alarm (Form C relay) is activated by any of the following alarm conditions:

- RF LINK
- Radio Fail
- Internal Test

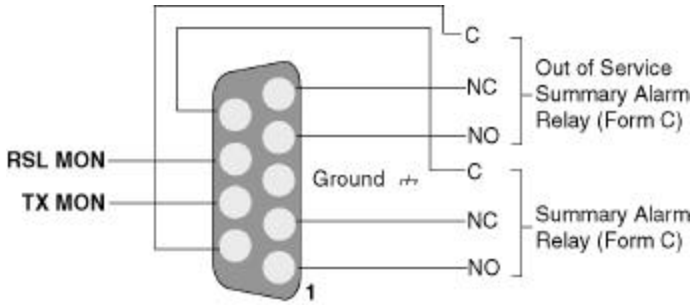


Figure 3-17: Pin Connections, ALARM Interface

PIN 1	**NO, SUMMARY ALARM, FORM C -** normally open connection on summary alarm relay. Closed when in alarm.	**PIN 4**	**NO, OUT OF SERVICE SUMMARY ALARM, FORM C -** normally open connection on out-of-service summary alarm relay. Closed when in alarm.
PIN 6	**C, SUMMARY ALARM, FORM C -** common connection on the summary alarm relay.	**PIN 9**	**C, OUT OF SERVICE SUMMARY ALARM, FORM C -** common connection for the out-of-service summary alarm relay.
PIN 2	**NC, SUMMARY ALARM, FORM C -** normally closed connection on summary alarm relay.	**PIN 5**	**NC, OUT OF SERVICE SUMMARY ALARM, FORM C -** normally closed connection on out-of-service summary alarm relay. Open when in alarm.
PIN 7	RSL output DC voltage referenced to pin 3	**PIN 8**	Tx Power output DC voltage referenced to pin 3

Table 3-E: Alarm Interface Connections

All alarms are active for a minimum of one second, or as long as the alarm condition persists, which ever is longer.

3.14.3 Configuration Port Operation

The "Config" Port is used to retrieve diagnostic information and to configure additional features within the *Tsunami* radios by means of a computer connection via SERIAL interface. Also can be used as an RS-232 port to download the latest revision radio operation software.

The config port allows connection of RS-232 devices to receive status of the *Tsunami* radio and provide configuration.

For RS-232 diagnostics connection (Section 4.11) to the *Tsunami* radio, connect the serial device (modem, computer, terminal) to the male 9-pin subminiature connector in accordance with Figure 3-18.

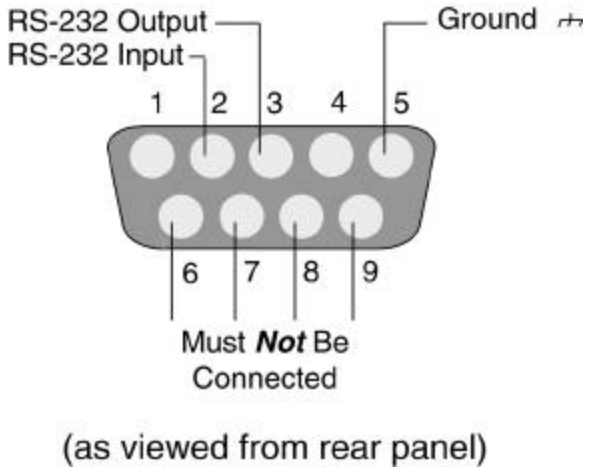
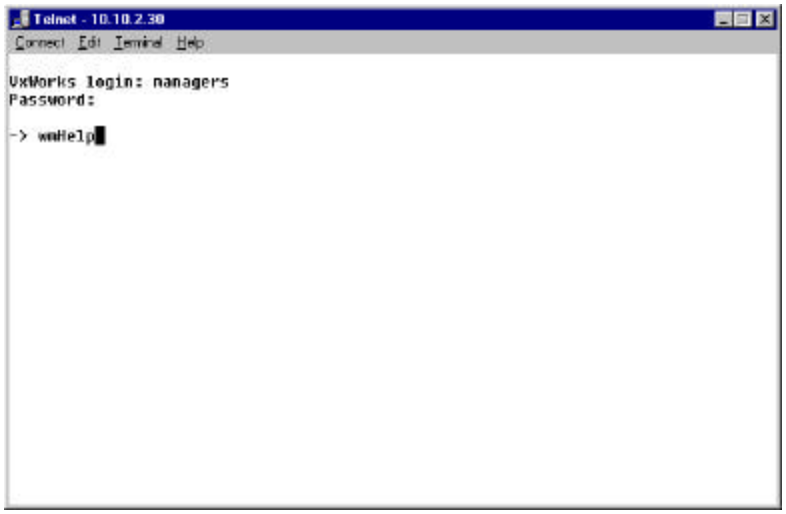


Figure 3-18: RS-232 Config Port Connections

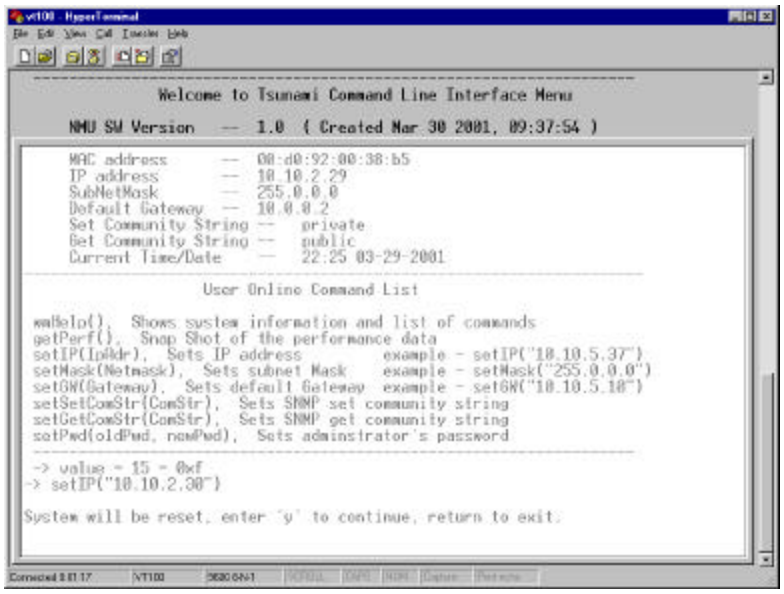
Pins 6 through 9 must not be connected for RS-232 communications to operate properly.

3.17.4 AUX DATA (Digital Service Channel) Connection

The AUX DATA port is a separate wayside serial port which can be configured to allow the connection of any user serial data (to 9600 baud, 1 start/stop bits) through the radio network. Connection to the AUX DATA port is an RS-232 serial interface, identical to the config port (see Section 3.17.3). This port does not affect the Ethernet traffic on the *Tsunami* radio.



The following HELP screen will be presented. Type one of the listed commands.



In this example, the setIP command was initiated.

3.17.5 T1 (DSX-1) Interface Connection

The Tsunami radio also provides a wayside T1 connection. This connection allows for standard DSX-1 connect of voice circuits without affecting the Ethernet traffic. A standard RJ-48c connector is provided for this connection.

3.17.6 CEPT-1 (E1) InterfaceConnection

The CEPT-1 interface connection provides a balanced (120 ohm) wayside E1 connection.

If an unbalanced 75 ohm connection (RJ45) is required, an optional balun will provide this interface. If you can not locate these baluns (balanced/unbalanced) devices, please consult the factory.

Additional external lightning protection devices are recommended for all user connections if the radio is installed in an area prone to lightning.

3.17.7 NMS Interface Connection

The NMS connection provides connection for the network management system. This allows an HTML interface to the Tsunami radio for purposes of monitoring, configuration and security settings. This connection is an RJ-45 style connection and complies to standard 10BaseT interface. Typically, the installer or manager will connect to the NMS with a stand-alone computer to initially configure the radio prior to installation. If IP addresses and security are set properly, the connection can also be used as an out-of-band connection for radio management. Alternatively, if the 10BaseT is connected to a network, or combined with the 100BaseT traffic on the link, via an external 10/100 switch, hub or router, full wireless NMS can be achieved for all radios in the network.

The factory default IP address is set to 10.0.0.1. To reset the radio back to the factory default, Hold down the far-end test button while powering up the radio. Release the switch after 6 seconds.

More details on the NMS connection can be found in Section 4 of this manual. In the future, this connection will also allow NMS via SNMP (Simple Network Management Protocol) in addition to the HTML interface that is presently supplied. Consult factory for details or assistance with NMS connections, if required.

Note: Multicasting with in-band connection may cause collisions in the data stream.

Your Notes on the *Tsunami* Radio