

## Chapter 1 Introduction

This manual explains the installation, setup, alignment, and maintenance procedures for the Innovator LX Series modular UHF translator. It is important that you read all of the instructions, especially the safety information in this chapter, before you begin to install or operate the unit.

### 1.1 Manual Overview

This instruction manual is divided into five chapters and supporting appendices. Chapter 1, Introduction, contains information on the assembly numbering system used in the manual, safety, maintenance, return procedures, and warranties. The second chapter describes the translator and includes discussions on system control and status indicators and remote control connections. Chapter 3 explains how to unpack, install, setup, and operate the translator. Chapter 4 contains circuit-level descriptions for boards and board-level components in the translator. Chapter 5, Detailed Alignment Procedures, provides information on adjusting the system assemblies for optimal operation. The appendices contain a sample log sheet, test data sheet, assembly and subassembly drawings and parts lists, and system specifications.

### 1.2 Assembly Designators

Axcera has assigned assembly numbers, such as Ax (x=1,2,3...), to all assemblies, trays, and boards that are referenced in the text of this manual and shown on the block diagrams and interconnect drawings provided in the appendices. These supporting documents are arranged in increasing numerical order in the appendices. Section titles in the text for assembly or tray descriptions or alignment procedures contain the associated part number(s) and the

relevant appendix that contains the drawings for that item.

### 1.3 Safety

The UHF translators manufactured by Axcera are designed to be easy to use and repair while providing protection from electrical and mechanical hazards. Listed throughout the manual are notes, cautions, and warnings concerning possible safety hazards that may be encountered while operating or servicing the translator. Please review these warnings and familiarize yourself with the operation and servicing procedures before working on the translator.

**Read All Instructions** – All of the operating and safety instructions should be read and understood before operating this equipment.

**Retain Manuals** – The manuals for the translator should be retained at the translator site for future reference. We provide two sets of manuals for this purpose; one set can be left at the office while one set can be kept at the site.

**Heed all Notes, Warnings, and Cautions** – All of the notes, warnings, and cautions listed in this safety section and throughout the manual must be followed.

**Follow Instructions** – All of the operating and use instructions for the translator should be followed.

**Cleaning** – Unplug or otherwise disconnect all power from the equipment before cleaning. Do not use liquid or aerosol cleaners. Use a damp cloth for cleaning.

**Ventilation** – Openings in the cabinets and tray front panels are provided for ventilation. To ensure the reliable

operation of the translator, and to protect the unit from overheating, these openings must not be blocked.

**Servicing** – Do not attempt to service this product yourself until becoming familiar with the equipment. If in doubt, refer all servicing questions to qualified Axcera service personnel.

**Replacement Parts** – When replacement parts are used, be sure that the parts have the same functional and performance characteristics as the original part. Unauthorized substitutions may result in fire, electric shock, or other hazards. Please contact the Axcera Technical Service Department if you have any questions regarding service or replacement parts.

#### 1.4 Maintenance

The Innovator LX Series Translator is designed with components that require little or no periodic maintenance except for the routine cleaning of the fans and the front panels of the trays.

The amount of time between cleanings depends on the conditions within the transmitter room. While the electronics have been designed to function even if covered with dust, a heavy buildup of dust, dirt, or insects will affect the cooling of the components. This could lead to a thermal shutdown or the premature failure of the affected trays.

When the front panels of the trays become dust covered, the top covers should be taken off and any accumulated foreign material should be removed. A vacuum cleaner, utilizing a small, wand-type attachment, is an excellent way to suction out the dirt. Alcohol and other cleaning agents should not be used unless you are certain that the solvents will not damage components or the silk-screened markings on the trays and boards. Water-based cleaners can be used, but do not saturate the components. The fans and heatsinks

should be cleaned of all dust or dirt to permit the free flow of air for cooling purposes.

It is recommended that the operating parameters of the translator be recorded from the meters on the trays and the system metering control panel at least once a month. It is suggested that this data be retained in a rugged folder or envelope. A sample format for a log sheet is provided in Appendix A. Photocopies of the log sheet should be made to allow for continued data entries.

#### 1.5 Material Return Procedure

To insure the efficient handling of equipment or components that have been returned for repair, Axcera requests that each returned item be accompanied by a Material Return Authorization Number (MRA#).

An MRA# can be obtained from any Axcera Field Service Engineer by contacting the Axcera Field Service Department at (724) 873-8100 or by fax at (724) 873-8105. This procedure applies to all items sent to the Field Service Department regardless of whether the item was originally manufactured by Axcera.

When equipment is sent to the field on loan, an MRA# is included with the unit. The MRA# is intended to be used when the unit is returned to Axcera. In addition, all shipping material should be retained for the return of the unit to Axcera.

Replacement assemblies are also sent with an MRA# to allow for the proper routing of the exchanged hardware. Failure to close out this type of MRA# will normally result in the customer being invoiced for the value of the loaner item or the exchange assembly.

When shipping an item to Axcera, please include the MRA# on the packing list and on the shipping container.

The packing slip should also include contact information and a brief description of why the unit is being returned.

Please forward all MRA items to:

**AXCERA, LLC**  
**103 Freedom Drive**  
**P.O. Box 525**  
**Lawrence, PA 15055-0525 USA**

For more information concerning this procedure, call the Axcera Field Service Department.

Axcera can also be contacted through e-mail at **info@axcera.com** and on the Web at **www.axcera.com**.

### **1.6 Limited One-Year Warranty for Axcera Products**

Axcera warrants each new product that it has manufactured and sold against defects in material and workmanship under normal use and service for a period of one (1) year from the date of shipment from Axcera's plant, when operated in accordance with Axcera's operating instructions. This warranty shall not apply to tubes, fuses, batteries, or bulbs.

Warranties are valid only when and if (a) Axcera receives prompt written notice of breach within the period of warranty, (b) the defective product is

properly packed and returned by the buyer (transportation and insurance prepaid), and (c) Axcera determines, in its sole judgment, that the product is defective and not subject to any misuse, neglect, improper installation, negligence, accident, or (unless authorized in writing by Axcera) repair or alteration. Axcera's exclusive liability for any personal and/or property damage (including direct, consequential, or incidental) caused by the breach of any or all warranties, shall be limited to the following: (a) repairing or replacing (in Axcera's sole discretion) any defective parts free of charge (F.O.B. Axcera's plant) and/or (b) crediting (in Axcera's sole discretion) all or a portion of the purchase price to the buyer.

Equipment furnished by Axcera, but not bearing its trade name, shall bear no warranties other than the special hours-of-use or other warranties extended by or enforceable against the manufacturer at the time of delivery to the buyer. **NO WARRANTIES, WHETHER STATUTORY, EXPRESSED, OR IMPLIED, AND NO WARRANTIES OF MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE, OR FREEDOM FROM INFRINGEMENT, OR THE LIKE, OTHER THAN AS SPECIFIED IN PATENT LIABILITY ARTICLES, AND IN THIS ARTICLE, SHALL APPLY TO THE EQUIPMENT FURNISHED HEREUNDER.**

 **WARNING!!!****◀ HIGH VOLTAGE ▶**

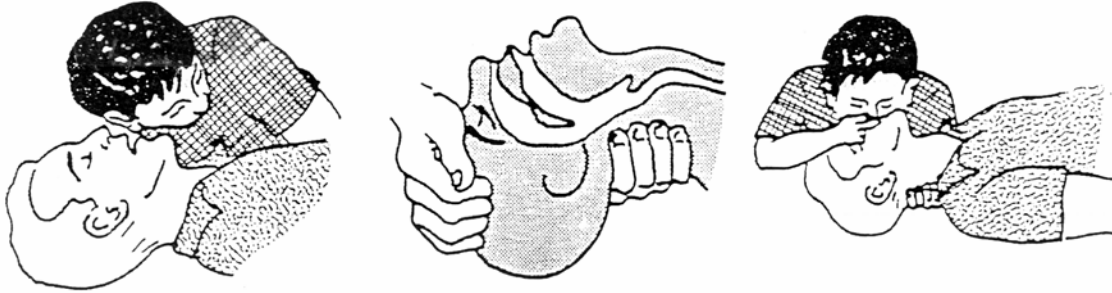
**DO NOT ATTEMPT TO REPAIR OR TROUBLESHOOT THIS EQUIPMENT UNLESS YOU ARE FAMILIAR WITH ITS OPERATION AND EXPERIENCED IN SERVICING HIGH VOLTAGE EQUIPMENT. LETHAL VOLTAGES ARE PRESENT WHEN POWER IS APPLIED TO THIS SYSTEM. IF POSSIBLE, TURN OFF POWER BEFORE MAKING ADJUSTMENTS TO THE SYSTEM.**

**★ RADIO FREQUENCY RADIATION HAZARD ★**

**MICROWAVE, RF AMPLIFIERS AND TUBES GENERATE HAZARDOUS RF RADIATION THAT CAN CAUSE SEVERE INJURY INCLUDING CATARACTS, WHICH CAN RESULT IN BLINDNESS. SOME CARDIAC PACEMAKERS MAY BE AFFECTED BY THE RF ENERGY EMITTED BY RF AND MICROWAVE AMPLIFIERS. NEVER OPERATE THE TRANSLATOR SYSTEM WITHOUT A PROPERLY MATCHED RF ENERGY ABSORBING LOAD ATTACHED. KEEP PERSONNEL AWAY FROM OPEN WAVEGUIDES AND ANTENNAS. NEVER LOOK INTO AN OPEN WAVEGUIDE OR ANTENNA. MONITOR ALL PARTS OF THE RF SYSTEM FOR RADIATION LEAKAGE AT REGULAR INTERVALS.**

## EMERGENCY FIRST AID INSTRUCTIONS

Personnel engaged in the installation, operation, or maintenance of this equipment are urged to become familiar with the following rules both in theory and practice. It is the duty of all operating personnel to be prepared to give adequate Emergency First Aid and thereby prevent avoidable loss of life.



### RESCUE BREATHING

1. Find out if the person is breathing.

You must find out if the person has stopped breathing. If you think he is not breathing, place him flat on his back. Put your ear close to his mouth and look at his chest. If he is breathing you can feel the air on your cheek. You can see his chest move up and down. If you do not feel the air or see the chest move, he is not breathing.

2. If he is not breathing, open the airway by tilting his head backwards.

Lift up his neck with one hand and push down on his forehead with the other. This opens the airway. Sometimes doing this will let the person breathe again by himself.

3. If he is still not breathing, begin rescue breathing.

-Keep his head tilted backward. Pinch nose shut.

-Put your mouth tightly over his mouth.

-Blow into his mouth once every five seconds

**-DO NOT STOP** rescue breathing until help arrives.

LOOSEN CLOTHING - KEEP WARM

Do this when the victim is breathing by himself or help is available. Keep him as quiet as possible and from becoming chilled. Otherwise treat him for shock.

### BURNS

**SKIN REDDENED:** Apply ice cold water to burned area to prevent burn from going deeper into skin tissue. Cover area with clean sheet or cloth to keep away air. Consult a physician.

**SKIN BLISTERED OR FLESH CHARRED:** Apply ice cold water to burned area to prevent burn from going deeper into skin tissue.

Cover area with clean sheet or cloth to keep away air. Treat victim for shock and take to hospital.

**EXTENSIVE BURN - SKIN BROKEN:** Cover area with clean sheet or cloth to keep away air. Treat victim for shock and take to hospital.

**Note: Because of possible FCC assigned offset, check for the assigned Carrier Frequency as written on License.**

| UHF Channels NTSC Standard IF, 45.75 MHz |         |        |        |               |                         |          |          |
|------------------------------------------|---------|--------|--------|---------------|-------------------------|----------|----------|
| Visual Carrier Frequency (MHz)           |         |        |        | L.O.<br>(MHz) | Crystal Frequency (MHz) |          |          |
| Channel                                  | Nominal | Minus  | Plus   | Nominal       | Nominal                 | Minus    | Plus     |
| 14                                       | 471.25  | 471.24 | 471.26 | 517.00        | 64.625                  | 64.62375 | 64.62625 |
| 15                                       | 477.25  | 477.24 | 477.26 | 523.00        | 65.375                  | 65.37375 | 65.37625 |
| 16                                       | 483.25  | 483.24 | 483.26 | 529.00        | 66.125                  | 66.12375 | 66.12625 |
| 17                                       | 489.25  | 489.24 | 489.26 | 535.00        | 66.875                  | 66.87375 | 66.87625 |
| 18                                       | 495.25  | 495.24 | 495.26 | 541.00        | 67.625                  | 67.62375 | 67.62625 |
| 19                                       | 501.25  | 501.24 | 501.26 | 547.00        | 68.375                  | 68.37375 | 68.37625 |
| 20                                       | 507.25  | 507.24 | 507.26 | 553.00        | 69.125                  | 69.12375 | 69.12625 |
| 21                                       | 513.25  | 513.24 | 513.26 | 559.00        | 69.875                  | 69.87375 | 69.87625 |
| 22                                       | 519.25  | 519.24 | 519.26 | 565.00        | 70.625                  | 70.62375 | 70.62625 |
| 23                                       | 525.25  | 525.24 | 525.26 | 571.00        | 71.375                  | 71.37375 | 71.37625 |
| 24                                       | 531.25  | 531.24 | 531.26 | 577.00        | 72.125                  | 72.12375 | 72.12625 |
| 25                                       | 537.25  | 537.24 | 537.26 | 583.00        | 72.875                  | 72.87375 | 72.87625 |
| 26                                       | 543.25  | 543.24 | 543.26 | 589.00        | 73.625                  | 73.62375 | 73.62625 |
| 27                                       | 549.25  | 549.24 | 549.26 | 595.00        | 74.375                  | 74.37375 | 74.37625 |
| 28                                       | 555.25  | 555.24 | 555.26 | 601.00        | 75.125                  | 75.12375 | 75.12625 |
| 29                                       | 561.25  | 561.24 | 561.26 | 607.00        | 75.875                  | 75.87375 | 75.87625 |
| 30                                       | 567.25  | 567.24 | 567.26 | 613.00        | 76.625                  | 76.62375 | 76.62625 |
| 31                                       | 573.25  | 573.24 | 573.26 | 619.00        | 77.375                  | 77.37375 | 77.37625 |
| 32                                       | 579.25  | 579.24 | 579.26 | 625.00        | 78.125                  | 78.12375 | 78.12625 |
| 33                                       | 585.25  | 585.24 | 585.26 | 631.00        | 78.875                  | 78.87375 | 78.87625 |
| 34                                       | 591.25  | 591.24 | 591.26 | 637.00        | 79.625                  | 79.62375 | 79.62625 |
| 35                                       | 597.25  | 597.24 | 597.26 | 643.00        | 80.375                  | 80.37375 | 80.37625 |
| 36                                       | 603.25  | 603.24 | 603.26 | 649.00        | 81.125                  | 81.12375 | 81.12625 |
| 37                                       | 609.25  | 609.24 | 609.26 | 655.00        | 81.875                  | 81.87375 | 81.87625 |
| 38                                       | 615.25  | 615.24 | 615.26 | 661.00        | 82.625                  | 82.62375 | 82.62625 |
| 39                                       | 621.25  | 621.24 | 621.26 | 667.00        | 83.375                  | 83.37375 | 83.37625 |
| 40                                       | 627.25  | 627.24 | 627.26 | 673.00        | 84.125                  | 84.12375 | 84.12625 |
| 41                                       | 633.25  | 633.24 | 633.26 | 679.00        | 84.875                  | 84.87375 | 84.87625 |
| 42                                       | 639.25  | 639.24 | 639.26 | 685.00        | 85.625                  | 85.62375 | 85.62625 |
| 43                                       | 645.25  | 645.24 | 645.26 | 691.00        | 86.375                  | 86.37375 | 86.37625 |

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| UHF Channels NTSC Standard IF, 45.75 MHz |         |        |        |               |                         |           |           |
|------------------------------------------|---------|--------|--------|---------------|-------------------------|-----------|-----------|
| Visual Carrier Frequency (MHz)           |         |        |        | L.O.<br>(MHz) | Crystal Frequency (MHz) |           |           |
| Channel                                  | Nominal | Minus  | Plus   | Nominal       | Nominal                 | Minus     | Plus      |
| 44                                       | 651.25  | 651.24 | 651.26 | 697.00        | 87.125                  | 87.12375  | 87.12625  |
| 45                                       | 657.25  | 657.24 | 657.26 | 703.00        | 87.875                  | 87.87375  | 87.87625  |
| 46                                       | 663.25  | 663.24 | 663.26 | 709.00        | 88.625                  | 88.62375  | 88.62625  |
| 47                                       | 669.25  | 669.24 | 669.26 | 715.00        | 89.375                  | 89.37375  | 89.37625  |
| 48                                       | 675.25  | 675.24 | 675.26 | 721.00        | 90.125                  | 90.12375  | 90.12625  |
| 49                                       | 681.25  | 681.24 | 681.26 | 727.00        | 90.875                  | 90.87375  | 90.87625  |
| 50                                       | 687.25  | 687.24 | 687.26 | 733.00        | 91.625                  | 91.62375  | 91.62625  |
| 51                                       | 693.25  | 693.24 | 693.26 | 739.00        | 92.375                  | 92.37375  | 92.37625  |
| 52                                       | 699.25  | 699.24 | 699.26 | 745.00        | 93.125                  | 93.12375  | 93.12625  |
| 53                                       | 705.25  | 705.24 | 705.26 | 751.00        | 93.875                  | 93.87375  | 93.87625  |
| 54                                       | 711.25  | 711.24 | 711.26 | 757.00        | 94.625                  | 94.62375  | 94.62625  |
| 55                                       | 717.25  | 717.24 | 717.26 | 763.00        | 95.375                  | 95.37375  | 95.37625  |
| 56                                       | 723.25  | 723.24 | 723.26 | 769.00        | 96.125                  | 96.12375  | 96.12625  |
| 57                                       | 729.25  | 729.24 | 729.26 | 775.00        | 96.875                  | 96.87375  | 96.87625  |
| 58                                       | 735.25  | 735.24 | 735.26 | 781.00        | 97.625                  | 97.62375  | 97.62625  |
| 59                                       | 741.25  | 741.24 | 741.26 | 787.00        | 98.375                  | 98.37375  | 98.37625  |
| 60                                       | 747.25  | 747.24 | 747.26 | 793.00        | 99.125                  | 99.12375  | 99.12625  |
| 61                                       | 753.25  | 753.24 | 753.26 | 799.00        | 99.875                  | 99.87375  | 99.87625  |
| 62                                       | 759.25  | 759.24 | 759.26 | 805.00        | 100.625                 | 100.62375 | 100.62625 |
| 63                                       | 765.25  | 765.24 | 765.26 | 811.00        | 101.375                 | 101.37375 | 101.37625 |
| 64                                       | 771.25  | 771.24 | 771.26 | 817.00        | 102.125                 | 102.12375 | 102.12625 |
| 65                                       | 777.25  | 777.24 | 777.26 | 823.00        | 102.875                 | 102.87375 | 102.87625 |
| 66                                       | 783.25  | 783.24 | 783.26 | 829.00        | 103.625                 | 103.62375 | 103.62625 |
| 67                                       | 789.25  | 789.24 | 789.26 | 835.00        | 104.375                 | 104.37375 | 104.37625 |
| 68                                       | 795.25  | 795.24 | 795.26 | 841.00        | 105.125                 | 105.12375 | 105.12625 |
| 69                                       | 801.25  | 801.24 | 801.26 | 847.00        | 105.875                 | 105.87375 | 105.87625 |
| 70                                       | 807.25  | 807.24 | 807.26 | 853.00        | 106.625                 | 106.62375 | 106.62625 |

**Note:** Because of possible FCC assigned offset, check for the assigned Carrier Frequency as written on License.

| UHF Frequency Assignments |                 |             |             |             |
|---------------------------|-----------------|-------------|-------------|-------------|
| Channel Number            | Bandwidth (MHz) | Video (MHz) | Color (MHz) | Audio (MHz) |
| 14                        | 470-476         | 471.25      | 474.83      | 475.75      |
| 15                        | 476-482         | 477.25      | 480.83      | 481.75      |
| 16                        | 482-488         | 483.25      | 486.83      | 487.75      |
| 17                        | 488-494         | 489.25      | 492.83      | 493.75      |
| 18                        | 494-500         | 495.25      | 498.83      | 499.75      |
| 19                        | 500-506         | 501.25      | 504.83      | 505.75      |
| 20                        | 506-512         | 507.25      | 510.83      | 511.75      |
| 21                        | 512-518         | 513.25      | 516.83      | 517.75      |
| 22                        | 518-524         | 519.25      | 522.83      | 523.75      |
| 23                        | 524-530         | 525.25      | 528.83      | 529.75      |
| 24                        | 530-536         | 531.25      | 534.83      | 535.75      |
| 25                        | 536-542         | 537.25      | 540.83      | 541.75      |
| 26                        | 542-548         | 543.25      | 546.83      | 547.75      |
| 27                        | 548-554         | 549.25      | 552.83      | 553.75      |
| 28                        | 554-560         | 555.25      | 558.83      | 559.75      |
| 29                        | 560-566         | 561.25      | 564.83      | 565.75      |
| 30                        | 566-572         | 567.25      | 570.83      | 571.75      |
| 31                        | 572-578         | 573.25      | 576.83      | 577.75      |
| 32                        | 578-584         | 579.25      | 582.83      | 583.75      |
| 33                        | 584-590         | 585.25      | 588.83      | 589.75      |
| 34                        | 590-596         | 591.25      | 594.83      | 595.75      |
| 35                        | 596-602         | 597.25      | 600.83      | 601.75      |
| 36                        | 602-608         | 603.25      | 606.83      | 607.75      |
| 37                        | 608-614         | 609.25      | 612.83      | 613.75      |
| 38                        | 614-620         | 615.25      | 618.83      | 619.75      |
| 39                        | 620-626         | 621.25      | 624.83      | 625.75      |
| 40                        | 626-632         | 627.25      | 630.83      | 631.75      |
| 41                        | 632-638         | 633.25      | 636.83      | 637.75      |
| 42                        | 638-644         | 639.25      | 642.83      | 643.75      |
| 43                        | 644-650         | 645.25      | 648.83      | 649.75      |



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| UHF Frequency Assignments |                 |             |             |             |
|---------------------------|-----------------|-------------|-------------|-------------|
| Channel Number            | Bandwidth (MHz) | Video (MHz) | Color (MHz) | Audio (MHz) |
| 44                        | 650-656         | 651.25      | 654.83      | 655.75      |
| 45                        | 656-662         | 657.25      | 660.83      | 661.75      |
| 46                        | 662-668         | 663.25      | 666.83      | 667.75      |
| 47                        | 668-674         | 669.25      | 672.83      | 673.75      |
| 48                        | 674-680         | 675.25      | 678.83      | 679.75      |
| 49                        | 680-686         | 681.25      | 684.83      | 685.75      |
| 50                        | 686-692         | 687.25      | 690.83      | 691.75      |
| 51                        | 692-698         | 693.25      | 696.83      | 697.75      |
| 52                        | 698-704         | 699.25      | 702.83      | 703.75      |
| 53                        | 704-710         | 705.25      | 708.83      | 709.75      |
| 54                        | 710-716         | 711.25      | 714.83      | 715.75      |
| 55                        | 716-722         | 717.25      | 720.83      | 721.75      |
| 56                        | 722-728         | 723.25      | 726.83      | 727.75      |
| 57                        | 728-734         | 729.25      | 732.83      | 733.75      |
| 58                        | 734-740         | 735.25      | 738.83      | 739.75      |
| 59                        | 740-746         | 741.25      | 744.83      | 745.75      |
| 60                        | 746-752         | 747.25      | 750.83      | 751.75      |
| 61                        | 752-758         | 753.25      | 756.83      | 757.75      |
| 62                        | 758-764         | 759.25      | 762.83      | 763.75      |
| 63                        | 764-770         | 765.25      | 768.83      | 769.75      |
| 64                        | 770-776         | 771.25      | 774.83      | 775.75      |
| 65                        | 776-782         | 777.25      | 780.83      | 781.75      |
| 66                        | 782-788         | 783.25      | 786.83      | 787.75      |
| 67                        | 788-794         | 789.25      | 792.83      | 793.75      |
| 68                        | 794-800         | 795.25      | 798.83      | 799.75      |
| 69                        | 800-806         | 801.25      | 804.83      | 805.75      |
| 70                        | 806-812         | 807.25      | 810.83      | 811.75      |

## dBm, dBw, dBmV, dB $\mu$ V, & VOLTAGE EXPRESSED IN WATTS

### 50 Ohm System

| WATTS             | PREFIX         | dBm  | dBw  | dBmV | dB $\mu$ V | VOLTAGE |
|-------------------|----------------|------|------|------|------------|---------|
| 1,000,000,000,000 | 1 TERAWATT     | +150 | +120 |      |            |         |
| 100,000,000,000   | 100 GIGAWATTS  | +140 | +110 |      |            |         |
| 10,000,000,000    | 10 GIGAWATTS   | +130 | +100 |      |            |         |
| 1,000,000,000     | 1 GIGAWATT     | +120 | + 99 |      |            |         |
| 100,000,000       | 100 MEGAWATTS  | +110 | + 80 |      |            |         |
| 10,000,000        | 10 MEGAWATTS   | +100 | + 70 |      |            |         |
| 1,000,000         | 1 MEGAWATT     | + 90 | + 60 |      |            |         |
| 100,000           | 100 KILOWATTS  | + 80 | + 50 |      |            |         |
| 10,000            | 10 KILOWATTS   | + 70 | + 40 |      |            |         |
| 1,000             | 1 KILOWATT     | + 60 | + 30 |      |            |         |
| 100               | 1 HECTROWATT   | + 50 | + 20 |      |            |         |
| 50                |                | + 47 | + 17 |      |            |         |
| 20                |                | + 43 | + 13 |      |            |         |
| 10                | 1 DECAWATT     | + 40 | + 10 |      |            |         |
| 1                 | 1 WATT         | + 30 | 0    | + 77 | +137       | 7.07V   |
| 0.1               | 1 DECIWATT     | + 20 | - 10 | + 67 | +127       | 2.24V   |
| 0.01              | 1 CENTIWATT    | + 10 | - 20 | + 57 | +117       | 0.707V  |
| 0.001             | 1 MILLIWATT    | 0    | - 30 | + 47 | +107       | 224mV   |
| 0.0001            | 100 MICROWATTS | - 10 | - 40 |      |            |         |
| 0.00001           | 10 MICROWATTS  | - 20 | - 50 |      |            |         |
| 0.000001          | 1 MICROWATT    | - 30 | - 60 |      |            |         |
| 0.0000001         | 100 NANOWATTS  | - 40 | - 70 |      |            |         |
| 0.00000001        | 10 NANOWATTS   | - 50 | - 80 |      |            |         |
| 0.000000001       | 1 NANOWATT     | - 60 | - 90 |      |            |         |
| 0.0000000001      | 100 PICOWATTS  | - 70 | -100 |      |            |         |
| 0.00000000001     | 10 PICOWATTS   | - 80 | -110 |      |            |         |
| 0.000000000001    | 1 PICOWATT     | - 90 | -120 |      |            |         |

## TEMPERATURE CONVERSION

$$^{\circ}\text{F} = 32 + [(9/5) ^{\circ}\text{C}]$$

$$^{\circ}\text{C} = [(5/9) (^{\circ}\text{F} - 32)]$$

## **USEFUL CONVERSION FACTORS**

| TO CONVERT FROM                                                | TO                        | MULTIPLY BY |
|----------------------------------------------------------------|---------------------------|-------------|
| mile (US statute)                                              | kilometer (km)            | 1.609347    |
| inch (in)                                                      | millimeter (mm)           | 25.4        |
| inch (in)                                                      | centimeter (cm)           | 2.54        |
| inch (in)                                                      | meter (m)                 | 0.0254      |
| foot (ft)                                                      | meter (m)                 | 0.3048      |
| yard (yd)                                                      | meter (m)                 | 0.9144      |
| mile per hour (mph)                                            | kilometer per hour(km/hr) | 1.60934     |
| mile per hour (mph)                                            | meter per second (m/s)    | 0.44704     |
| pound (lb)                                                     | kilogram (kg)             | 0.4535924   |
| gallon (gal)                                                   | liter                     | 3.7854118   |
| U.S. liquid<br>(One U.S. gallon equals 0.8327 Canadian gallon) |                           |             |
| fluid ounce (fl oz)                                            | milliliters (ml)          | 29.57353    |
| British Thermal Unit<br>per hour (Btu/hr)                      | watt (W)                  | 0.2930711   |
| horsepower (hp)                                                | watt (W)                  | 746         |

## **NOMENCLATURE OF FREQUENCY BANDS**

| FREQUENCY RANGE | DESIGNATION                    |
|-----------------|--------------------------------|
| 3 to 30 kHz     | VLF - Very Low Frequency       |
| 30 to 300 kHz   | LF - Low Frequency             |
| 300 to 3000 kHz | MF - Medium Frequency          |
| 3 to 30 MHz     | HF - High Frequency            |
| 30 to 300 MHz   | VHF - Very High Frequency      |
| 300 to 3000 MHz | UHF - Ultrahigh Frequency      |
| 3 to 30 GHz     | SHF - Superhigh Frequency      |
| 30 to 300 GHz   | EHF - Extremely High Frequency |

## **LETTER DESIGNATIONS FOR UPPER FREQUENCY BANDS**

| LETTER | FREQ. BAND       |
|--------|------------------|
| L      | 1000 - 2000 MHz  |
| S      | 2000 - 4000 MHz  |
| C      | 4000 - 8000 MHz  |
| X      | 8000 - 12000 MHz |
| Ku     | 12 - 18 GHz      |
| K      | 18 - 27 GHz      |
| Ka     | 27 - 40 GHz      |
| V      | 40 - 75 GHz      |
| W      | 75 - 110 GHz     |

**ABBREVIATIONS/ACRONYMS**

|             |                                     |            |                                 |
|-------------|-------------------------------------|------------|---------------------------------|
| <b>AC</b>   | Alternating Current                 | <b>PCB</b> | Printed circuit board           |
| <b>AFC</b>  | Automatic Frequency Control         | <b>QAM</b> | Quadrature Amplitude Modulation |
| <b>ALC</b>  | Automatic Level Control             |            |                                 |
| <b>AM</b>   | Amplitude modulation                |            |                                 |
| <b>AGC</b>  | Automatic Gain Control              |            |                                 |
| <b>AWG</b>  | American wire gauge                 |            |                                 |
| <b>BER</b>  | Bit Error Rate                      |            |                                 |
| <b>BW</b>   | Bandwidth                           |            |                                 |
| <b>DC</b>   | Direct Current                      |            |                                 |
| <b>D/A</b>  | Digital to analog                   |            |                                 |
| <b>dB</b>   | Decibel                             |            |                                 |
| <b>dBm</b>  | Decibel referenced to 1 milliwatt   |            |                                 |
| <b>dBmV</b> | Decibel referenced to 1 millivolt   |            |                                 |
| <b>dBw</b>  | Decibel referenced to 1 watt        |            |                                 |
| <b>FEC</b>  | Forward Error Correction            |            |                                 |
| <b>FM</b>   | Frequency modulation                |            |                                 |
| <b>Hz</b>   | Hertz                               |            |                                 |
| <b>ICPM</b> | Incidental Carrier Phase Modulation |            |                                 |
| <b>I/P</b>  | Input                               |            |                                 |
| <b>IF</b>   | Intermediate Frequency              |            |                                 |
| <b>LED</b>  | Light emitting diode                |            |                                 |
| <b>LSB</b>  | Lower Sideband                      |            |                                 |
| <b>MPEG</b> | Motion Pictures Expert Group        |            |                                 |
| <b>O/P</b>  | Output                              |            |                                 |
| <b>PLL</b>  | Phase Locked Loop                   |            |                                 |

## RETURN LOSS VS. VSWR

