INSTRUCTION MANUAL

Innovator
LX Series
Analog
VHF Translator

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Chapter 1
Introduction

1.1 Manual Overview

This manual explains the installation, setup, alignment, and maintenance procedures for the Innovator LX Series VHF 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.

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. **Chapter 2**, System Description, Maintenance & Remote Control Connections, describes the transmitter and includes discussions on system control and status indicators, maintenance, and remote control connections. **Chapter 3**, Site Considerations, Installation and Setup Procedures, explains how to unpack, install, setup, and operate the transmitter. **Chapter 4**, Circuit Descriptions, contains circuit level descriptions for boards and board level components in the transmitter. **Chapter 5,** Detailed Alignment Procedures, provides information on adjusting the system assemblies for optimal operation. **Appendix A** contains the System, Remodulator & Exciter/Amplifier drawings and parts lists.

1.2 Assembly Designators

Axcera has assigned assembly numbers, Ax designations such as A1, where x=1,2,3…etc, to all assemblies, modules, and boards in the system. These designations are referenced in the text of this manual and shown on the block diagrams and interconnect drawings provided in the appendices. The Block Diagrams, Interconnects, Schematics, Assembly Drawings and Parts Lists are arranged in increasing numerical order in the appendices. Section titles in the text for assembly or module descriptions or alignment procedures contain the associated part number(s) and the relevant appendix that contains the drawings for that item.

The cables that connect between the boards within a tray or assembly and that connect between the trays, racks and cabinets are labeled using Brady markers.

Figure 1-1 is an example of a Brady marked cable. There may be as few as two or as many as four Markers on any one cable. These Brady markers are read starting furthest from the connector. If there are four Brady Markers, this marker is the transmitter number such as transmitter 1 or transmitter 2. The next or the furthest Brady Marker is the rack or cabinet number on an interconnect cable or the board number within a tray. The next number on an interconnect cable is the Tray location or number. The Brady marker closest to the connector is the jack or connector number on an interconnect cable or the jack or connector number on the board within a tray.

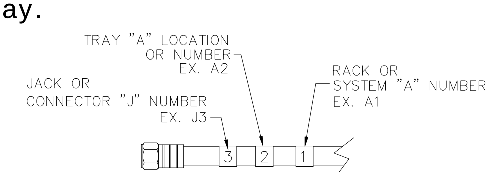


Figure 1-1 Brady Marker Identification Drawing

1.3 Safety

The VHF translator systems manufactured by Axcera are designed to be easy to use and repair while providing protection from electrical and mechanical hazards. Please review the following warnings and familiarize yourself with the operation and servicing procedures before working on the transmitter system.

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

Retain Manuals – The manuals for the transmitter should be retained at the transmitter site for future reference. Axcera provides 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 Operating Instructions – All of the operating and use instructions for the transmitter 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 cabinet and module front panels are provided for ventilation. To ensure the reliable operation of the driver/transmitter, 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 Contact Information

The Axcera Field Service Department can be contacted by phone at **(724) 873-8100** or by fax at **(724) 873-8105**.

Before calling Axcera, please be prepared to supply the Axcera technician with answers to the following questions. This will save time and help ensure the most direct resolution to the problem.

1. What are the Customers' Name and call letters?
2. What are the model number and type of transmitter?
3. Is the transmitter digital or analog?
4. How long has the transmitter been on the air? (Approximately when was the transmitter installed.)
5. What are the symptoms being exhibited by the transmitter? Include the current control/power supply LCD readings and the status of LEDs on the front panels of the modules. If possible, include the control/power supply LCD readings before the problem occurred.

1.5 Return Material 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 Return Material Authorization Number (RMA#).

The RMA# 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 RMA# is included with the unit. The RMA# 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 RMA# to allow for the proper routing of the exchanged hardware. Failure to close out this type of RMA# will normally result in the customer being invoiced for the value of the loaner item or the exchanged assembly.

When shipping an item to Axcera, please include the RMA# 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 RMA 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 @ (724) 873-8100.
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, bulbs or LEDs.

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 ≻

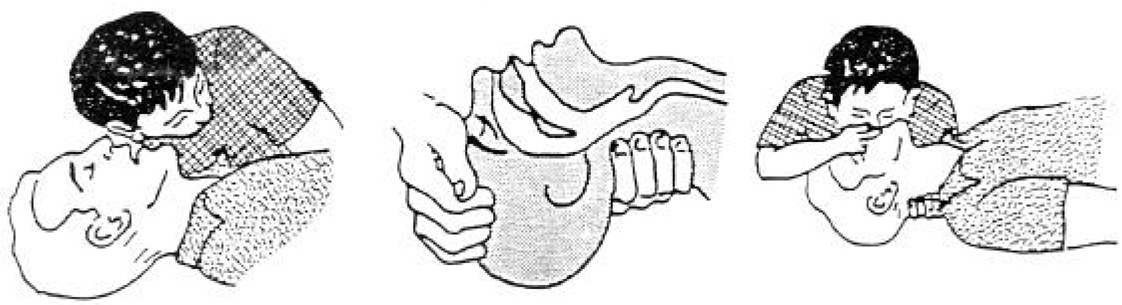
DO NOT ATTEMPT TO REPAIR OR TROUBLESHOOT THIS EQUIPMENT UNLESS YOU ARE FAMILIAR WITH ITS OPERATION AND EXPERIENCED IN SERVICING HIGH VOLTAGE EQUIPMENT. LETHAL VOLTAGES ARE PRESENT WHEN POWER IS APPLIED TO THIS SYSTEM. IF POSSIBLE, TURN OFF POWER BEFORE MAKING ADJUSTMENTS TO THE SYSTEM.

⋆ 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 TRANSMITTER 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 a 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.

dBm, dBw, dBmV, dBmV, & VOLTAGE EXPRESSED IN WATTS

50 Ohm System

WATTS	PREFIX	dBm	dBw	dBmV	dBμV	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

°F = 32 + [(9/5) °C]

°C = [(5/9) (°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) U.S. liquid (One U.S. gallon equals 0.8327 Canadian gallon)	liter	3.7854118
fluid ounce (fl oz)	milliliters (ml)	29.57353
British Thermal Unit per hour (Btu/hr)	watt (W)	0.2930711
horsepower (hp)	watt (W)	746

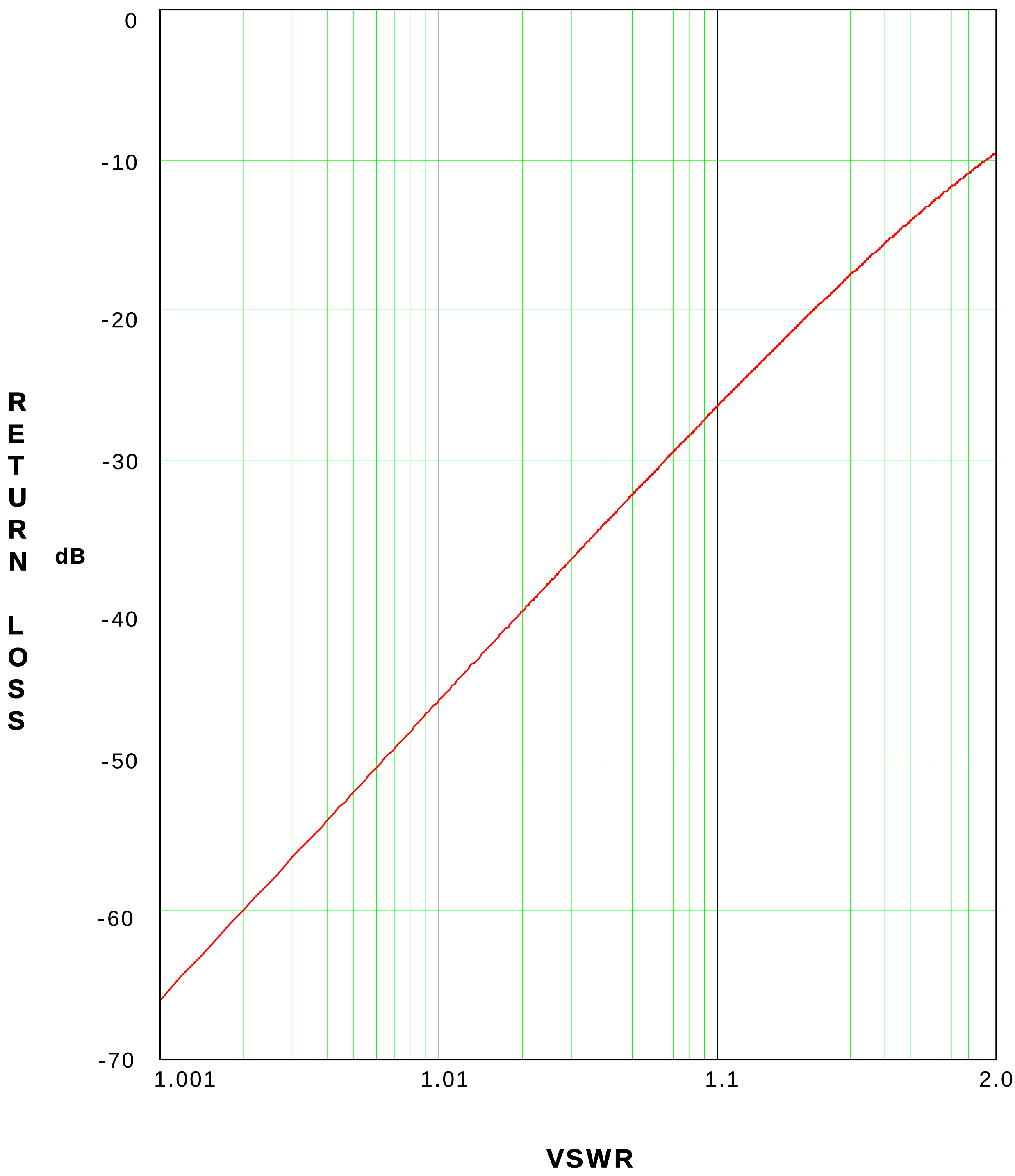
NOMENCLATURE OF FREQUENCY BANDS

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

RETURN LOSS VS. VSWR



ABBREVIATIONS/ACRONYMS

AC Alternating Current

AFC Automatic Frequency Control

ALC Automatic Level Control

AM Amplitude modulation

AGC Automatic Gain Control

ATSC Advanced Television Systems Committee

AWG American wire gauge

BER Bit Error Rate

BW Bandwidth

DC Direct Current

D/A Digital to analog

DTV Digital Television

dB Decibel

dBm Decibel referenced to 1 milliwatt

dBmV Decibel referenced to 1 millivolt

dBw Decibel referenced to 1 watt

FEC Forward Error Correction

FM Frequency modulation

Hz Hertz

ICPM Incidental Carrier Phase Modulation

I/P Input

IF Intermediate Frequency

LED Light emitting diode

LSB Lower Sideband

MPEG Motion Pictures Expert Group

O/P Output

PLL Phase Locked Loop

PCB Printed circuit board

QAM Quadrature Amplitude Modulation

SMPTE Society of Motion Picture and Television Engineers

VSB Vestigial Side Band

Chapter 2
System Description, Maintenance & Remote Control Connections

2.0 System Overview

This analog translator is a complete VHF internally diplexed modular television translator. There are three systems, one that operates at CH:6 at a nominal visual output power of 20W or a DTV output of 10W, one that operates at CH:10 at a nominal visual output power of 20W or a DTV output of 10W, and one that operates at CH:8 at a nominal visual output power of 100W or a DTV output of 50W..

The Analog LX Series translator is made up of the modules and assemblies as listed in Table 2-1.

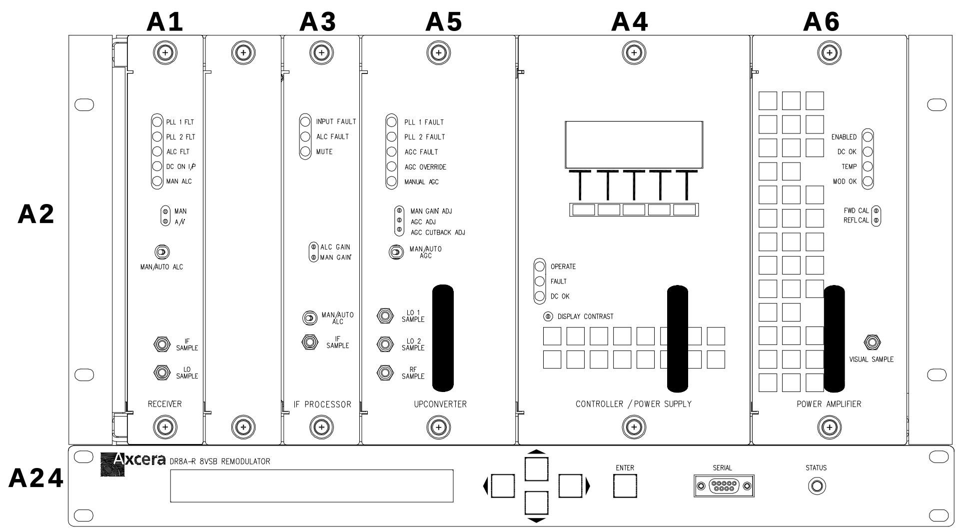


Figure 2-1:Exciter/Amplifier w/Remodulator Front View

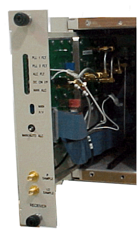
Table 2-1: Exciter/Amplifier w/Remodulator Translator Assemblies

ASSEMBLY DESIGNATOR	TRAY / ASSEMBLY NAME	PART NUMBER
A2	**Exciter Amplifier Chassis Assembly, V2, LX Series**	**1304052 (110 VAC)**
A2-A11	Backplane Board, V2, LX Series	1304047
A1	Receiver Module (used in the analog translator system)	1304001 (VHF High Band)
A3	IF Processor Module	1301938
A4	Control/Power Supply Module	1301936 (110 VAC)
A5	VHF/UHF Upconverter Module	1303829
A6	Power Amplifier Module, 20 W Analog	1305833 (VHF High Band

2.2 (A2) Exciter Amplifier Chassis Assembly, 110 VAC (1304052; Appendix A)

This chassis assembly is factory set for operation using 110 VAC. All of the modules except the power amplifier module and the power supply section of the Control & Monitoring/Power Supply Module, plug directly into a backplane board. The backplane board provides module to module interconnection as well as interconnection to remote command and control connectors.

2.2.1 (A1) Receiver Module Assembly, VHF High Band (1304001; Appendix A)



NOTE: The Receiver module is not used in the digital system.

NOTE: For analog translator operation the Receiver IF output at A2-J13 is connected to the Modulated IF input Jack A2-J6 and the On Channel RF input is connected to A2-J12.

The VHF Receiver converts a low level RF input signal (-65 to –15 dBm) to an IF frequency of 44 MHz, filters off any unwanted out of band energy, and normalizes the level so that it can be applied to the IF processor assembly. The receiver consists of three boards, the VHF High Band Preamplifier Board (1306445), the Mixer/PLL Board (1306472), and the IF ALC Board (1304003). The RF input is applied first to the VHF preamplifier board, which filters off out of channel energy and amplifies the input signal. The RF output is connected to the Mixer/PLL board, which converts the signal down to an IF frequency of 44 MHz. The IF output is cabled to the IF ALC board, which amplifies the signal, filters off any unwanted out of band energy and controls its own IF gain to make sure that the IF output level is constant.

There is also a provision to apply +12V to the RF input center conductor to power an external preamplifier.

CAUTION: Do not hook up the RF input to any test equipment with the DC bias applied. Always move the jumper W1 on J2, on the UHF Preamplifier Board, to the Bias off position, between pins 2 & 3, to prevent possible damage to the test equipment.

Table 2-5: Receiver Front Panel Switch

SWITCH	FUNCTION
MAN/AUTO ALC SW1	When Manual ALC is selected, the level is set by the Manual ALC Pot R57 located on the mixer/PLL board. (**NOTE**: The pot is factory set and needs no adjustment by the customer). When Auto ALC is selected, the level control circuit will automatically increase or decrease the ALC to maintain the desired output level.

Table 2-6: Receiver Front Panel Status Indicators

LED	FUNCTION
PLL1 Fault DS6	Displays the status of the Local oscillator PLL
PLL 2 Fault DS8	Displays status of optional input frequency correcting PLL
DC on center conductor DS4	Displays whether or not DC is applied to the RF input center conductor
Man ALC Gain DS7	Displays when ALC is switched to Manual bypass
ALC Fault DS5	Displays ALC status

Table 2-7: Receiver Front Panel Control Adjustments

POTENTIOMETERS	DESCRIPTION
Manual Gain R57	Adjusts the gain of the receiver when the ALC is bypassed.
A/V Ratio R50	Adjusts the ratio between the visual and aural carriers.

Table 2-8: Receiver Front Panel Samples

SMA CONNECTORS	DESCRIPTION
Receiver IF J13	Sample of the IF output of the IF ALC Board.
Receiver LO J2	Sample of the LO generated on the UHF Mixer PLL Board.

2.2.2 (A3) IF Processor Module Assembly (1301938; Appendix A)

The (A3) IF Processor Assembly contains the IF Processor Board (1301977). The IF Processor provides pre-correction to ensure broadcast quality output signal. The pre-correction consists of amplitude linearity correction, Incidental Carrier Phase Modulation (ICPM) correction and frequency response correction.

The IF Processor module is configured either for an analog or digital system. Pin 13C of the IF Processor module is grounded in analog systems and left not connected in digital systems. An IF Processor Interlock signal is used to report the presence of the IF Processor module to the Control Monitoring board. If the IF Processor interlock signal is not present, the LX Series translator RF output is Muted (turned off). If an analog IF Processor module is installed and the Modulation Present signal is not true, the LX Series Translator output is Muted (turned off).

The Control & Monitoring/Power Supply module uses the IF Processor module for System output power control. Through the front panel display or a remote interface, an operator can set the RF output power level of the translator. The range of RF power adjustment is between 0% (full off) and 105% (full power plus). A front panel IF Processor module potentiometer sets the upper limit of RF power at 120%. The system's Control Monitoring board compares the RF Power Monitoring module RF power level with the desired level and uses the IF Power Control PWM line to correct for errors.

In digital systems, a digital level control (DLC) voltage is generated on the IF Processor module and sent to an external digital modulator (DT1B/C). RF power control is implemented by changing the DLC voltage provided to the external digital modulator. The 'RF High' potentiometer sets the upper adjusted range of RF control circuit output to 120%.

The IF Processor module provides a reference ALC voltage to the system's Upconverter. When the ALC voltage decreases, the Upconverter automatically lowers the system output power through the AGC circuits.

The IF Processor module has a front panel switch to select Auto or Manual ALC. When Manual ALC is selected, the reference ALC voltage is set by a front panel potentiometer. In this condition, the RF power level control circuit is removed from use. When the ALC select switch is changed to Auto, the RF power level control circuit will start at low power and increase the RF output until the desired output power is attained.

The IF Processor module Modulation Present signal is monitored. If the modulation level is too low or non-existent, a Modulation Present Fault is reported to the Control Monitoring board. When the controller detects this fault, it can be set to Automatically Mute the translator or in Manual mode the translator will continue to operate at 25% output.

The IF Processor module Input Signal level is monitored. If the signal level is too low or non-existent, an Input Fault is reported on the Control Monitoring board. When the IF Processor board detects an Input Signal Fault it automatically Mutes the translator. The system controller does not Mute on an IF Processor Input Fault.

Table 2-9: IF Processor Front Panel Switch

SWITCH	FUNCTION
MAN/AUTO ALC	When Manual ALC is selected, the reference ALC voltage is set by the ALC Gain front panel potentiometer. When Auto ALC is selected, the IF level control circuit will automatically increase the IF output until the desired output power is attained.

Table 2-10: IF Processor Front Panel Status Indicators

LED	FUNCTION
INPUT FAULT (Red)	When lit it indicates that there is a loss of the IF Input signal to the IF Processor. Translator can be set to Mute on an IF Input Fault.
ALC Fault (Red)	When lit it indicates that the required gain to produce the desired output power level has exceeded the operational range of the ALC circuit. The LED will also be lit when ALC is in Manual.
MUTE (Red)	When lit it indicates that the IF input signal is cut back but the enable to the Power Supply is present and the +32 VDC remains on.

Table 2-11: IF Processor Front Panel Control Adjustments

POTENTIOMETERS	DESCRIPTION
FREQUENCY RESPONSE EQUALIZER	These three variable resistors, R103, R106 & R274, adjust the depth of gain for the three stages of frequency response correction.
ALC GAIN	Adjusts the gain of the translator when the translator is in the Auto ALC position.
MAN GAIN	Adjusts the gain of the translator when the translator is in the Manual ALC position.
LINEARITY CORRECTION	These three variable resistors adjust the threshold cut in for the three stages of linearity pre-correction. R211 and R216, the top two pots, are adjusted to correct for in phase amplitude distortions. R 231, the bottom pot, is adjusted to correct for quadrature phase distortions.

Table 2-12: IF Processor Front Panel Sample

SMA CONNECTOR	DESCRIPTION
IF SAMPLE	Sample of the pre-corrected IF output of the IF Processor

2.2.3 (A5) VHF/UHF Upconverter Module Assembly (1303829; Appendix A)

The VHF/UHF Upconverter Module Assembly contains (A1) a Downconverter Board Assembly (1303834), (A3) a First Conversion Board, LX Series (1303838), (A2) a L-Band PLL Board, LX Series (1303846) and (A4) an Upconverter Control Board (1304760).

A 0 dBm 44 MHz IF input to the upconverter through the backplane board is applied to a mixer mounted on the first conversion board. Also applied to the mixer is a nominal 1 GHz LO1. The mixer converts it to a nominal frequency centered at 1044 MHz. A filter selects the appropriate conversion product, which is then amplified to a level of approximately –4 dBm. The frequency of the first conversion LO1 can be shifted by ± 10 kHz to generate channel offsets of 10kHz. For +offsets the frequency is 999.99 MHz and for – offsets the frequency is 1000.01 MHz.

This signal is applied to a second mixer mounted on the downconverter board that converts it back to a broadcast channel (2-69) by an LO2 that operates in 100kHz steps between 1.1-1.9 GHz depending on the channel selected. The LO2 frequency equals the Channel center frequency plus the LO1 frequency plus 44 MHz. (As an example CH14+: Center Frequency is 473.01 MHz and LO1 is 999.99 MHz therefore LO2 is 473.01 + 999.99 + 44, which equals 1517.00 MHz.)

The output of the mixer is applied to a 900 MHz Low pass filter to remove unwanted conversion products. The resulting signal is amplified and applied to a Pin diode attenuator before it is connected to the output of the upconverter. This pin diode attenuator adjusts the gain of the module and is controlled by an Automatic Gain Control circuit, which maintains a constant power out of the upconverter, and also the translator, that connects to the power amplifier module.

Table 2-13: VHF/UHF Upconverter Front Panel Switch

SWITCH	FUNCTION
MAN/AUTO AGC (Left Manual, Right AGC)	When Manual AGC is selected, the reference AGC voltage is set by the AGC Manual Gain front panel potentiometer. When Auto AGC is selected, the RF power level control circuit will automatically increase the RF output until the desired output power is attained.

Table 2-14: VHF/UHF Upconverter Front Panel Status Indicators

LED	FUNCTION
PLL 1 Fault (Red)	When lit it indicates that the 1 GHz PLL is unlocked
PLL 2 Fault (Red)	When lit it indicates that the 1.1 –1.9 GHz PLL is unlocked
AGC Fault (Red)	When lit it indicates that the AGC is out of range.
AGC Override (Red)	When lit it indicates that the AGC is cutting back due to too much drive to the driver module.
Man Gain (Amber)	When lit it indicates that the AGC is bypassed in Manual.

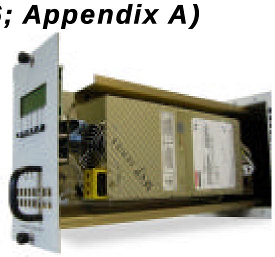
Table 2-15: VHF/UHF Upconverter Front Panel Control Adjustments

POTENTIOMETERS	DESCRIPTION
MAN GAIN ADJ	Adjusts the gain of the upconverter and translator when in the Manual AGC position.
AGC ADJ	Adjusts the gain of the upconverter and translator when in the Auto AGC position.
AGC CUTBACK ADJ (AGC OVERRIDE)	Adjusts the point at which the translator will cut back in power, due to too much drive, when the Translator is in Auto AGC.

Table 2-16: VHF/UHF Upconverter Front Panel Samples

SMA CONNECTOR	DESCRIPTION
LO1 SAMPLE	Sample of the 1 GHz nominal LO1 signal in the Upconverter as generated on the L-Band PLL Board.
LO2 SAMPLE	Sample of the 1.1-1.9 GHz LO2 signal in the Upconverter as generated on the First Conversion Board.
RF SAMPLE	Sample of the On Channel RF Output of the Upconverter

2.2.4 (A4) Control/Power Supply Module Assembly, 110VAC (1301936; Appendix A)



This (A4) Control & Monitoring/Power Supply Assembly was configured at the factory for operation at 110 VAC. The assembly is made up of a Control Board (1302021), a Power Protection Board (1302837) and a Switch Board (1527-1406).

The Assembly also contains a switching power supply that provides ±12 VDC to the rest of the modules in the chassis and +32 VDC to the Power Amplifier module.

The Assembly provides all translator control and monitoring functions. The Front panel LCD allows monitoring of system parameters, including forward and reflected power, transistor currents, module temperatures and power supply voltages. The LCD screens are detailed in Chapter 3.

Table 2-17: Controller/Power Supply Display

DISPLAY	FUNCTION
LCD	A 4 x 20 display providing a four-line readout of the internal functions, external inputs, and status. See Chapter 3, Controller/Power Supply Display Screens, for a listing of displays.

Table 2-18: Controller/Power Supply Status Indicator

LED	FUNCTION
OPERATE (green)	When lit it indicates that the translator is in the Operate Mode. If translator is Muted the Operate LED will stay lit, the translator will remain in Operate, until the input signal is returned.
FAULT (red or green)	Red indicates that a problem has occurred in the translator. The translator will be Muted or placed in Standby until the problem is corrected.
DC OK (red or green)	Green indicates that the switchable fuse protected DC outputs that connect to the modules in the translator are OK.

Table 2-19: Controller/Power Supply Control Adjustments

POTENTIOMETERS	DESCRIPTION
DISPLAY CONTRAST	Adjusts the contrast of the display for desired viewing of screen.

2.2.6 (A6) Power Amplifier Module Assembly, VHF High Band, (1305833; Appendix A)

NOTE: This 20W Analog power amplifier module is used in the VHF High Band Translator.

The (A6) Power Amplifier Module Assembly is made up of a VHF High Band Coupler Board (1211-1004), a VHF Amplifier Control Board (1308260), and a High Band VHF Amplifier Pallet Assembly (1305820).

The Power Amplifier Module contains Broadband LDMOS amplifiers that cover the VHF High Band with no tuning required. The module amplifies the RF output of the Upconverter to approximately 22 watts Peak of Sync Visual. A cable, located on the rear chassis, connects the RF output from the Upconverter at J23 to J24 the RF input to the PA Assembly. The High Band VHF Amplifier Pallet Assembly (1305820) is made from a Delta RF Technology pallet PA25-VHF-HB.

The PA module contains RF monitoring circuitry for both an analog and a digital system. Control and monitoring lines to the Power Amplifier module are routed through the floating blind-mate connector of the Control & Monitoring/Power Supply module. The Driver Power Amplifier module contains a control and monitoring board. This board monitors RF output power, RF reflected power, the current draw of amplifier sections, the supply voltage, and the temperature of the PA heat sink.

The RF power detector circuit outputs vary with operating frequency. These circuits must be calibrated at their intended operating frequency. Front panel adjustment potentiometers are used to calibrate the following:

Power Amplifier Calibration Adjustments in Analog Systems

R201 Reflected Power Cal
R202 Visual/Forward Power Cal
R203 Aural Power Cal
R204 Visual Offset Zero
R205 Aural Null

In analog systems, the Aural power of an Exciter Driver Power Amplifier and the Aural power of any external PA amplifiers will not be reported by the system Control Monitoring module. Additionally the Visual power of these amplifiers is reported as Forward Power just like in digital systems. In analog systems, aural and visual power will only be reported for the final system RF output.

In this translator, system power is measured in the Power Amplifier module. The wired connections are transferred through the power supply connector to the backplane board on a five position header. All four positions of control board switch SW1 must be set ON to route these lines as the system's RF power signals.

The Forward Power of the Exciter Driver Power Amplifier module is routed to the Upconverter module as AGC #1. A system over-drive condition is detected when this value rises above 0.9 VDC. When an over-drive condition is detected, the Upconverter module reduces its RF output level. For values less than 0.9 VDC, the Upconverter uses this voltage for automatic gain.

Table 2-23: Power Amplifier Status Indicator

LED	FUNCTION
ENABLED (Green)	When lit Green, it indicates that the PA is in the Operate Mode. If a Mute occurs, the PA will remain Enabled, until the input signal is returned.
DC OK (Green)	When lit Green, it indicates that the fuse protected DC inputs to the PA module are OK.
TEMP (Green)	When lit Green, it indicates that the temperature of the heatsink assembly in the module is below 78°C.
MOD OK (Green)	When lit Green, it indicates that the PA Module is operating and has no faults.
MOD OK (Red)	If the Module OK LED is Red and blinking a fault is present. **1 Blink** indicates Amplifier Current Fault. If the Module OK LED is Red and blinking a fault is present, as indicated below by the number of blinks and a pause then a repeat of the number of blinks and a pause. **2 Blinks** indicate Temperature Fault. **3 Blinks** indicate +32V Power Supply Over Voltage Fault. **4 Blinks** indicate +32V Power Supply Under Voltage Fault. **5 Blinks** indicate Reflected Power Fault. **6 Blinks** indicate +12V or –12V Power Supply Fault.
MOD OK (Amber)	A blinking Amber Mod OK LED indicates the power output of the amplifier module is below 65%. (**NOTE**: Only in Amplifier Code Versions 3.7A or later & System Controller Code Versions 3.9C or later.)

Table 2-24: Power Amplifier Control Adjustments

POTENTIOMETERS	DESCRIPTION
RFL CAL	Adjusts the gain of the Reflected Power monitoring circuit
VISUAL CAL	Adjusts the gain of the Visual / Forward Power monitoring circuit
AURAL CAL	Adjusts the gain of the Aural Power monitoring circuit
VISUAL ZERO	Adjusts the offset of the Forward Power monitoring circuit
AURAL NULL	Adjusts the offset of the Forward Power monitoring circuit based on the Aural signal level.

Table 2-25: Power Amplifier Sample

DISPLAY	FUNCTION
FWD SAMPLE	RF sample of the amplified signal being sent out the module on J25.

2.3 RF Output Assemblies

The RF output from the exciter power amplifier is at the RF output jack, an “N” connector J25, PA RF Output, of the chassis assembly.

2.4 Control and Status

A 4 x 20 display located on the front of the Control & Monitoring/Power Supply Module is used in the LX Series translator for control of the operation and display of the operating parameters of the translator. Refer to Chapter 3 for descriptions of the screens.

2.5 System Operation

When the translator is in operate, as set by the menu screen located on the Control & Monitoring Module, the following occurs. The IF Processor will be enabled and the mute indicator on the front panel will be extinguished. The +32 VDC stage of the Power Supply in the Control & Monitoring Module is enabled, the operate indicator on the front panel is lit and the DC OK on the front panel should also be green. The enable and DC OK indicators on the PA Module will also be green.

When the translator is in standby. The IF Processor will be disabled, the mute indicator on the front panel will be red. The +32 VDC stage of the Power Supply in the Control & Monitoring Module is disabled, the operate indicator on the front panel will be extinguished and the DC OK on the front panel should remain green. The enable indicator on the PA Module is also extinguished.

If the translator does not switch to Operate when the operate menu is switched to Operate, check that all faults are cleared and that the remote control terminal block stand-by signal is not active.

The translator can be controlled by the presence of a modulated input signal. If the input signal to the translator is lost, the translator will automatically cutback and the input fault indicator on the IF Processor module will light. When the video input signal returns, the translator will automatically return to full power and the input fault indicator will be extinguished.

2.5.1 Principles of Operation

Operating Modes

This translator is either operating or in standby mode. The sections below discuss the characteristics of each of these modes.

Operate Mode

Operate mode is the normal mode for the translator when it is providing RF power output. To provide RF power to the output, the translator will not be in mute. Mute is a special case of the operate mode where the +32 VDC section of the power supply is enabled but there is no RF output power from the translator. This condition is the result of a fault that causes the firmware to hold the IF Processor module in a mute state.

Operate Mode with Mute Condition

The translator will remain in the operate mode but will be placed in mute when the following fault conditions exists in the translator.

- Upconverter is unlocked
- Upconverter module is not present
- IF Processor module is not present

Entering Operate Mode

Entering the operate mode can be initiated a few different ways by the transmitter control board. A list of the actions that cause the operate mode to be entered is given below:

- A low on the Remote Transmitter Operate line.
- User selects "OPR" using switches and menus of the front panel.
- Receipt of an “Operate CMD” over the serial interface.

There are several fault or interlock conditions that may exist in the translator that will prevent the translator from entering the operate mode. These conditions are:

- Power Amplifier heat sink temperature greater than 78°C.
- Translator is Muted due to conditions listed above.
- Power Amplifier Interlock is high indicating that the amplifier is not installed.

Standby Mode

The standby mode in the translator indicates that the output amplifier of the translator is disabled.

Entering Standby Mode

Similar to the operate mode, the standby mode is entered using various means. These are:

- A low on the Remote Translator Stand-By line.
- Depressing the “STB” key on selected front panel menus.
- Receipt of a “Standby CMD” over the serial interface.

Auto Standby Mode

The FCC requires that certain translators automatically switch to standby operation on loss of video input. The LX Series translator incorporates this feature as a user configurable setting. When Auto Stand-By on modulation loss is selected in the set-up menus, the translator temporarily switches to standby after ten seconds of modulation loss. When the modulated signal as reported by the IF Processor module is again present, the translator automatically returns to Operate mode. This feature is implemented in transmitter software versions 1.4 and above.

RF System Interlock

A RF System Interlock signal is provided through TB30-5. When this signal's circuit is completed to ground such as through a wire between TB30-5 and TB30-15, the translator is allowed to operate. If this circuit is opened, the translator switches to a Mute condition. This circuit may be completed through coax relay contacts and reject load contact closures to assure the RF output system is available to receive the translator's output RF signal. This feature is implemented in translator software versions 1.4 and above.

Operating Frequency

The LX Series translator controller is designed to operate on the VHF frequencies. The exact output frequency of the translator can be set to one of the standard VHF frequencies, or to a custom frequency using the software channel set-up menu on the Controller Module.. The Power detectors in the translator are frequency dependent, therefore detectors of power amplifiers are calibrated at their frequency of use. The detectors for System RF monitoring are also calibrated at the desired frequency of use. Refer to Chapter 5 for the Channel Change Procedure.

2.6 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 modules and the periodic check of general tightness of hardware.

It is recommended that periodically, the time interval depends on the amount of movement the cabinet receives, all mounting hardware, holding tray slides, shelving and mounting plates inside the cabinet are checked for tightness. All screws and bolts that are accessible should be tightened initially when the translator is received and periodically thereafter if the translator is moved by vehicle. All coaxial connectors, hard-line connections and hardware holding combiners, splitters, or any other mounted items should be checked and tightened. Check the front panel thumbscrews that hold the Exciter/Driver Sleds, Amplifier Module and Power Supply Sleds in place are tight. This is especially important after the translator has been transported.

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 module.

When the front panels of the modules become dust covered, the module should be pulled out and any accumulated foreign material should be removed.

NOTE: To remove the driver/power amplifier module, mounted in the exciter/amplifier assembly, the input and output cables must be removed from the rear of the module and also a 6/32" x ½" Philips screw, mounted between the two connectors, needs to be removed before the module will pull out. After removal of the screw, which is used to hold the module in place during shipping, it does not need to be replaced.

NOTE: To remove the Combiner Module, found in the external power amplifier assembly, the output cable must be removed from the rear of the module and also two 8/32" x ½" Philips screws, mounted above the connector, need to be removed before the module will pull out. After removal of the screws, which are used to hold the module in place during shipping, they do not need to be replaced.

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 modules 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 driver/translator be recorded from the LEDs on the modules and the LCD system metering on the control/monitoring module at least once a month. It is suggested that this data be retained in a rugged folder or envelope.

2.7 Customer Remote Connections

The remote monitoring and operation of the translator is provided through jacks TB30 and TB31 located on the rear of the chassis assembly. If remote connections are made to the translator, they must be made through plugs TB30 and TB31 at positions noted on the translator interconnect drawing and Table 2-26. TB30 and TB31 are 18 position terminal blocks that are removable from their sockets to make connections easier. Just grasp and pull connector straight out. After connections are made, replace the connector and push firmly to seat the connector in the socket.

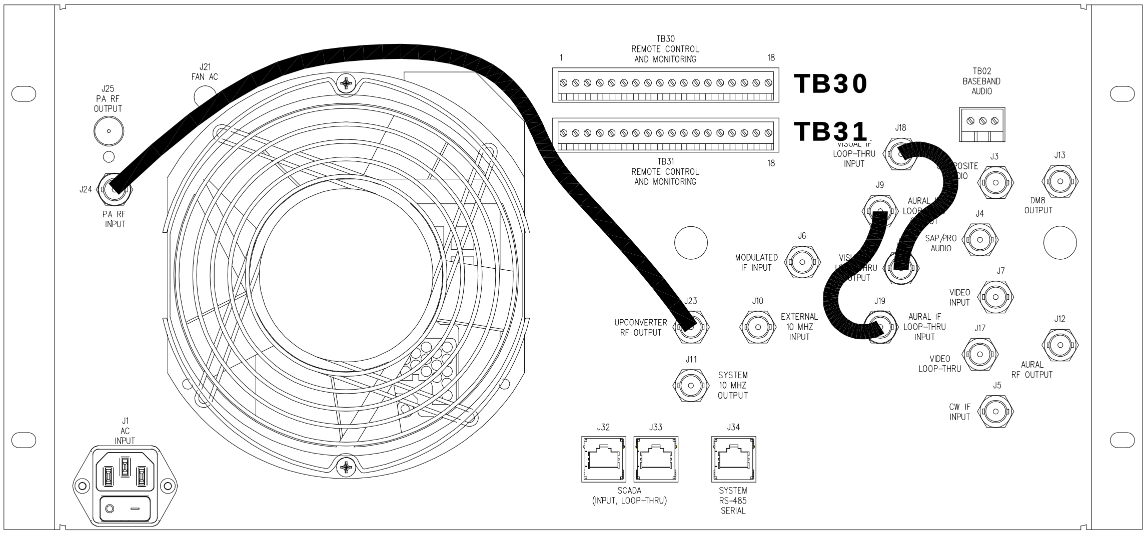


Figure 2-2: Exciter/Amplifier Chassis Assembly Rear View

Table 2-26: LX Series Chassis Assembly Hard Wired Remote Interface Connections to TB30 or TB31, 18 pos. Terminal Blocks Located on the Rear of the Assembly

Signal Name	**Pin Designations**	**Signal Type / Description**
RMT Transmitter State	TB30-1	Discrete Open Collector Output - A low indicates that the translator is in the operate mode.
RMT Transmitter Interlock	TB30-2	Discrete Open Collector Output - A low indicated the translator is OK or completes a interlock daisy chain. When the translator is not faulted, the interlock circuit is completed.
RMT Transmitter Interlock Isolated Return	TB30-3	Ground - Configurable ground return which can be either jumpered directly to ground or it can be the "source" pin of an FET so that the transmitter interlock can be daisy chained with other transmitters. This signal does not directly interface to the microcontroller.
RMT AUX IO 1	TB30-4	Discrete Open Collector Inputs, Discrete Open Drain Outputs, or 0 - 5 VDC Analog Input - When used as an output, this line is pulled to +5 VDC with a 1.0 kO resistor for logic high and pulled to ground for a low. A diode allows this line to be pulled up to 12 VDC. When used as a digital input, this line considers all values over 2 Volts as high and those under 1 volt as low. As an analog input, this line is protected by a 5.1 zener diode.
RMT RF System Interlock	TB30-5	When this signal's circuit is completed to ground such as through a jumper between TB30-5 and TB30-15, the translator is allowed to operate. If this circuit is opened, the translator switches to a Mute condition. Implemented in transmitter software versions 1.4 and above.

Signal Name	Pin Designations	Signal Type / Description
RMT Transmitter Operate	TB30-6	Discrete Open Collector Input - A pull down to ground on this line indicates that the translator is to be placed into the operate mode.
RMT Transmitter Stand-By	TB30-7	Discrete Open Collector Input - A pull down to ground on this line indicates that the translator is to be placed into the standby mode.
RMT Power Raise	TB30-8	Discrete Open Collector Input - A pull down to ground on this line indicates that the translator power is to be raised.
RMT Power Lower	TB30-9	Discrete Open Collector Input - A pull down to ground on this line indicates that the translator power is to be lowered.
RMT System Reflect Power	TB30-10	Analog Output (0 to 4.0 V). This is a buffered loop through of the calibrated "System Reflected Power " and indicates the translator's reflected output power. The scale factor is 25% = 3.2V.
RMT System Visual/Forward Power	TB30-11	Analog Output (0 to 4.0 V). This is a buffered loop through of the calibrated "System Visual/Avg. Power ". Indicates the translator's Visual / Average power. Scale factor is 100% = 3.2V.
RMT System Aural Power (Not used in DTV system)	TB30-12	Analog Output (0 to 4.0 V). This is a buffered loop through of the calibrated "System Aural Power ". Indicates the translator's forward Aural output power. The scale factor is 100% = 3.2V.
RMT Spare 1	TB30-13	Remote connection to spare module - Use is TBD.
RMT Spare 2	TB30-14	Remote connection to spare module - Use is TBD.
RMT +12 VDC	TB30-16	+12 VDC available through Remote w/ 2 Amp re-settable fuse.
RMT -12 VDC	TB30-18	-12 VDC available through Remote w/ 2 Amp re-settable fuse.
IF Processor IF Signal Select	TB31-3	Discrete Open Collector Input – By connecting a low to this pin, the Modulator IF source is used by the IF Processor module. When floating the IF from the internal or external Receiver is used. (**NOTE:** The IF Processor board must be configured for external switching by placing jumper W11 on J29 between pins 1 & 2 for the modulated IF input at J6 to be used).
IF Processor DLC Voltage	TB31-4	Analog Output (0 to 5.00 V). This is the input of IF Processor module for digital system RF output power control.
UC AGC #2 Voltage	TB31-5	Auxiliary Analog Input (0 to 1V). This voltage is used by the Upconverter for gain control. Linear signal with display resolution of 0.01 %. Primary signal source is J34-1.
Ground Return	TB31-12	Ground Return pin.
System Reflected Power	TB31-13	Analog Input (0 to 1.00 V). This is the input of the "System Reflected Power " indicating the translator's reflected output power. The scale factor is 25% = 0.80V.
System Visual /	TB31-14	Analog Input (0 to 1.00 V). This is the input of the

Signal Name	Pin Designations	Signal Type / Description
Forward Power		"System Visual / Forward Power " indicating the translator's forward Visual / Forward output power. The scale factor is 100% = 0.80V.
System Aural Power (Not used in DTV system)	TB31-15	Analog Input (0 to 1.00 V). This is the input of the "System Aural Power " indicating the translator's forward Aural output power. The scale factor is 100% = 0.80V.
+12 VDC	TB31-16	+12 VDC available through Remote w/ 2 Amp re-settable fuse.
Ground Return	TB31-17	Ground Return pin.
-12 VDC	TB31-18	-12 VDC available through Remote w/ 2 Amp re-settable fuse.
RMT Ground	TB30-15, and 17	Ground pins available through Remote
RMT Ground	TB31-1, 2, 6 to 12	Ground pins available through Remote

Chapter 3
Site Considerations, Installation and Setup Procedures

3.1 Site Considerations

There are special considerations that need to be taken into account before the Innovator LX Series translator can be installed. For example, if the installation is completed during cool weather, a heat-related problem may not surface for many months, suddenly appearing during the heat of summer. This section provides planning information for the installation and set up of the translator.

The AC input and current requirements for analog/digital LX Series translator is 110 VAC @ 15 Amps. Check that your site has the needed power requirements.

The LX Series Translators are designed and built to provide long life with a minimum of maintenance. The environment in which they are placed is important and certain precautions must be taken. The three greatest dangers to the translator are heat, dirt, and moisture. Heat is usually the greatest problem, followed by dirt, and then moisture. Over-temperature can cause heat-related problems such as thermal runaway and component failure. Each amplifier module in the translator contains a thermal interlock protection circuit that will shut down that module until the temperature drops to an acceptable level.

A suitable environment for the translator can enhance the overall performance and reliability of the translator and maximize revenues by minimizing downtime. A properly designed facility will have an adequate supply of cool, clean air, free of airborne particulates of any kind, and no excessive humidity. An ideal environment will require temperature in the range of 40° F to 70° F throughout the year, reasonably low humidity, and a dust-free room. It should be noted that this is rarely if ever attainable in the real world. However, the closer the environment is to this design, the greater the operating capacity of the translator.

The fans are designed and built into the translator will remove the heat from within the modules, but additional means are required for removing this heat from the building. To achieve this, a few issues need to be resolved. The first step is to determine the amount of heat to be removed from the transmitter room. There are generally three sources of heat that must be considered. The first and most obvious is the heat from the translator itself. This amount can be determined for a 100 Watt translator by subtracting the average power to the antenna (69.5 watts) from the AC input power (675 watts) and taking this number in watts (605.5) and then multiplying it by 3.41. This gives a result of 2065, the BTUs to be removed every hour. 12,000 BTUs per hour equals one ton. Therefore, a 1/4 ton air conditioner will cool a 100W translator.

The second source of heat is other equipment in the same room. This number is calculated in the same way as the equation for BTUs. The third source of heat is equally obvious but not as simple to calculate. This is the heat coming through the walls, roof, and windows on a hot summer day. Unless the underside is exposed, the floor is usually not a problem. Determining this number is usually best left up to a qualified HVAC technician. There are far too many variables to even estimate this number without reviewing the detailed drawings of the site that show all of the construction details. The sum of these three sources is the bulk of the heat that must be removed. There may be other sources of heat, such as personnel, and all should be taken into account. Now that the amount of heat that must be removed is known, the next step is to determine how to accomplish this. The options are air conditioning, ventilation, or a combination of the two. Air conditioning is always the preferred method and is the only way to create anything close to an ideal environment.

Ventilation will work quite well if the ambient air temperature is below 100° F, or about 38° C, and the humidity is kept at a reasonable level. In addition, the air stream must be adequately filtered to ensure that no airborne particulates of any kind will be carried into the translator. The combination of air conditioning for summer and ventilation during the cooler months is acceptable when the proper cooling cannot be obtained through the use of ventilation alone and using air conditioning throughout the year is not feasible.

Caution: The use of air conditioning and ventilation simultaneously is not recommended. This can cause condensation in the translators.

The following precautions should be observed regarding air conditioning systems:

1. Air conditioners have an ARI nominal cooling capacity rating. In selecting an air conditioner, do not assume that this number can be equated to the requirements of the site. Make certain that the contractor uses the actual conditions that are to be maintained at the site in determining the size of the air conditioning unit.

2. Do not have the air conditioner blowing directly onto the translator. Under certain conditions, condensation may occur on, or worse in, the translator.

3. Do not separate the front of the translator from the back with the thought of air conditioning only the front of the unit. Cooling air is drawn in at the front of all translators and in the front and back of others. Any attempt to separate the front of the translator from the rear of the unit will adversely affect the flow of cooling air.

4. Interlocking the translator with the air conditioner is recommended to keep the translator from operating without the necessary cooling.

5. The periodic cleaning of all filters is a must.

When using ventilation alone, the following general statements apply:

1. The blower, with attendant filters, should be on the inlet, thereby pressurizing the room and preventing dirt from entering the translator.

2. The inlet and outlet vents should be on the same side of the building, preferably the leeward side. As a result, the pressure differential created by wind will be minimized. Only the outlet vent may be released through the roof.

3. The inlet and outlet vents should be screened with 1/8-inch hardware cloth (preferred) or galvanized hardware cloth (acceptable).

4. Cooling air should enter the room as low as practical but in no case higher than four feet above the floor. The inlet must be located where dirt, leaves, snow, etc., will not be carried in with the cooling air.

5. The exhaust should be located as high as possible. Some ducting is usually required to insure the complete flushing of heated air with no stagnant areas.

6. The filter area must be large enough to insure a maximum air velocity of 300 cubic feet per minute through the filter. This is not a conservative number but a never-exceed number. In a dusty or remote location, this number should be reduced to 150 CFM.

7. The inlet and outlet(s) must have automatic dampers that close any time the ventilation blower is off.

8. In those cases in which a translator is regularly off for a portion of each day, a temperature-differential sensor that controls a small heater must be installed. This sensor will monitor inside and outside temperatures simultaneously. If the inside temperature falls to within 5° F of the outside temperature, the heater will come on. This will prevent condensation when the ventilation blower comes on and should be used even in the summer.

9. A controlled air bypass system must be installed to prevent the temperature in the room from falling below 40° F during translator operation.

10. The blower should have two speeds, which are thermostatically controlled, and are interlocked with the translator. The blower on high speed must be capable of moving the required volume of air into a half inch of water pressure at the required elevation. The free air delivery method must not be used.

11. Regular maintenance of any filters can not be overemphasized.

12. Above 4000 feet, for external venting, the air vent on the cabinet top must be increased to an 8-inch diameter for a 1 kW transmitter and to a 10 inch diameter for 5 kW and 6 kW transmitters. An equivalent rectangular duct may be used but, in all cases, the outlet must be increased by 50% through the outlet screen.

13. It is recommended that a site plan be submitted to Axcera for comments before installation begins.

In calculating the blower requirements, filter size, and exhaust size, if the total load is known in watts, 2000 CFM into ½ inch of water will be required for each 5000 watts. If the load is known in BTUs, 2000 CFM into ½ inch of water will be required for each 17,000 BTUs. The inlet filter must be a minimum of seven square feet, larger for dusty and remote locations, for each 5000 watts or 17,000 BTUs. The exhaust must be at least four square feet at the exhaust screen for each 5000 watts or 17,000 BTUs.

The information presented in this section is intended to serve only as a general guide and may need to be modified for unusually severe conditions.

A combination of air conditioning and ventilation should not be difficult to design (see Figure 3-1).

System interlocking and thermostat settings should be reviewed with Axcera. As with any equipment installation, it is always good practice to consult the manufacturer when questions arise. Axcera can be contacted at (724) 873-8100.

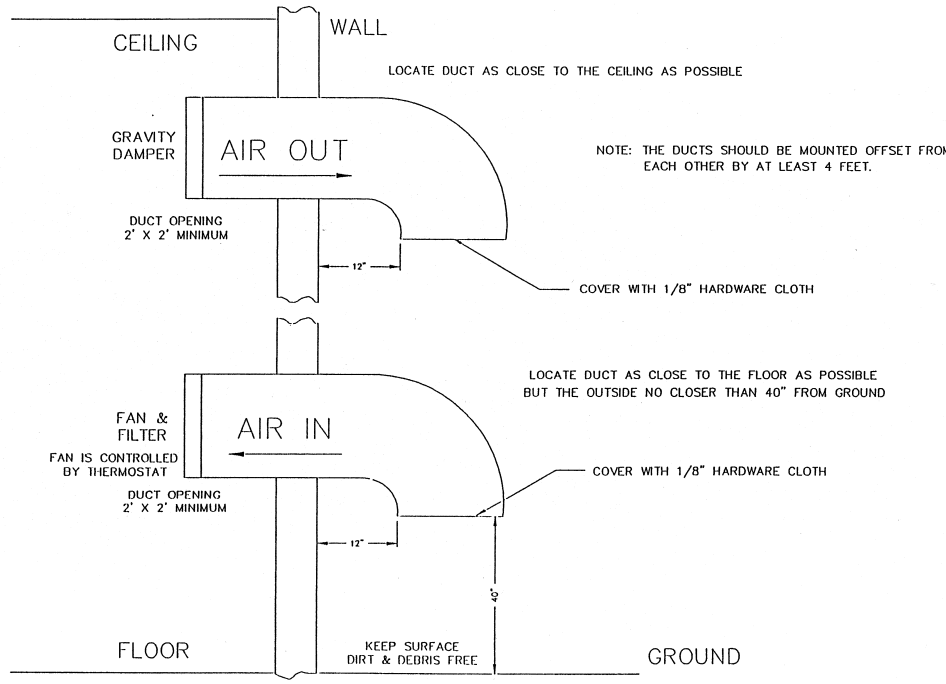


Figure 3-1. 1 kW Minimum Ventilation Configuration

3.2 Unpacking the Cabinet, Chassis w/modules and mask filter

Thoroughly inspect the cabinet, chassis with modules and all other materials upon their arrival. Axcera certifies that upon leaving our facility the equipment was undamaged and in proper working order. The shipping containers should be inspected for obvious damage that indicates rough handling. Remove the cabinet, if purchased, chassis and modules, along with mask filter, from the crates and boxes. Check for dents and scratches or broken connectors, switches, display, or connectors. Any claims against in-transit damage should be directed to the carrier. Inform Axcera as to the extent of any damage as soon as possible.

The modules are mounted to the chassis assembly with slides that are on the top and the bottom of the modules. There are two thumb screws on the front panel that hold each of the modules in place.

After placement of cabinet, all mounting hardware, holding tray slides, shelving and mounting plates inside the cabinet should be checked for tightness. All screws and bolts that are accessible should be tightened initially when the translator is received and periodically thereafter if the translator is moved by vehicle. All coaxial connectors, hard-line connections and hardware holding combiners, splitters, or any other mounted items should be checked and tightened. Check the front panel thumbscrews that hold the Exciter/Driver Sleds, Amplifier Module and Power Supply Sleds in place are tight. This is especially important after the translator has been transported.

NOTE: Typically the translator is shipped pre-installed into a cabinet and therefore the following sections may be skipped.

3.3 Installing the Chassis w/modules and filters

The chassis assembly is made to mount in a standard 19” rack. The chassis assembly mounts using the four #10 clearance mounting holes on the ends. The chassis should be positioned; to provide adequate air intake into the front and the air exhaust of the fan(s) in the rear; the ability to slide the modules out for replacement purposes; the installation of the bandpass filter, and output transmission line. The chassis or cabinet in which it is mounted should be grounded using copper strapping material.

NOTE: To remove the power amplifier module, mounted in the exciter/amplifier assembly, the input and output cables must be removed from the rear of the module and also a 6/32” x ½” Philips screw, mounted between the two connectors, needs to be removed before the module will pull out. After removal of the screw, which is used to hold the module in place during shipping, it does not need to be replaced. (See Figure 3-2)

Connect the output of the chassis assembly at the “N” connector J25 to the input of the mask filter. Connect the transmission line for the antenna system to the output of the mask filter.

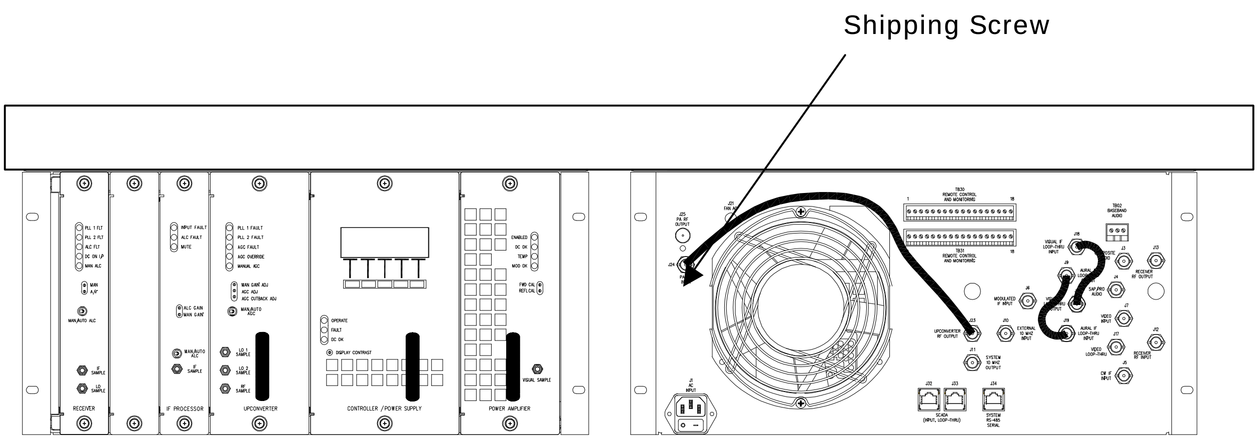


Figure 3-2: Exciter/Amplifier Front and Rear View Reconnection Drawing

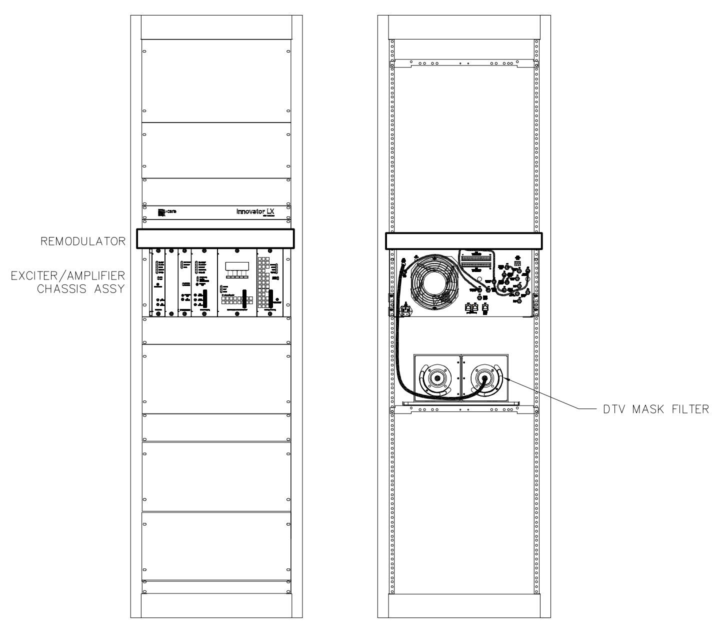


Figure 3-3: Translator Front and Rear View Reconnection Drawing

3.4 AC Input

Once the chassis and output connections are in place, connect the AC power cords from the exciter/amplifier chassis assembly to 110 VAC outlets.

The AC input and current requirements for analog/ digital LX Series translator is 110 VAC @ 15 Amps.

This completes the unpacking and installation of the LX Series VHF television translator. Refer to the setup and operation procedures that follow before applying power to the translator.

3.5 Setup and Operation

Initially, the translator should be turned on with the RF output at the coupler terminated into a dummy load of at least 25W. If a load is not available, check that the output of the coupler is connected to the antenna for your system.

3.5.1 Input Connections

The input connections to the translator are to the rear of the exciter/amplifier chassis assembly.

Refer to the tables and description that follows for detailed information on the input connections to the Exciter/Amplifier.

Figure 3-4: Rear View of the Analog Translator

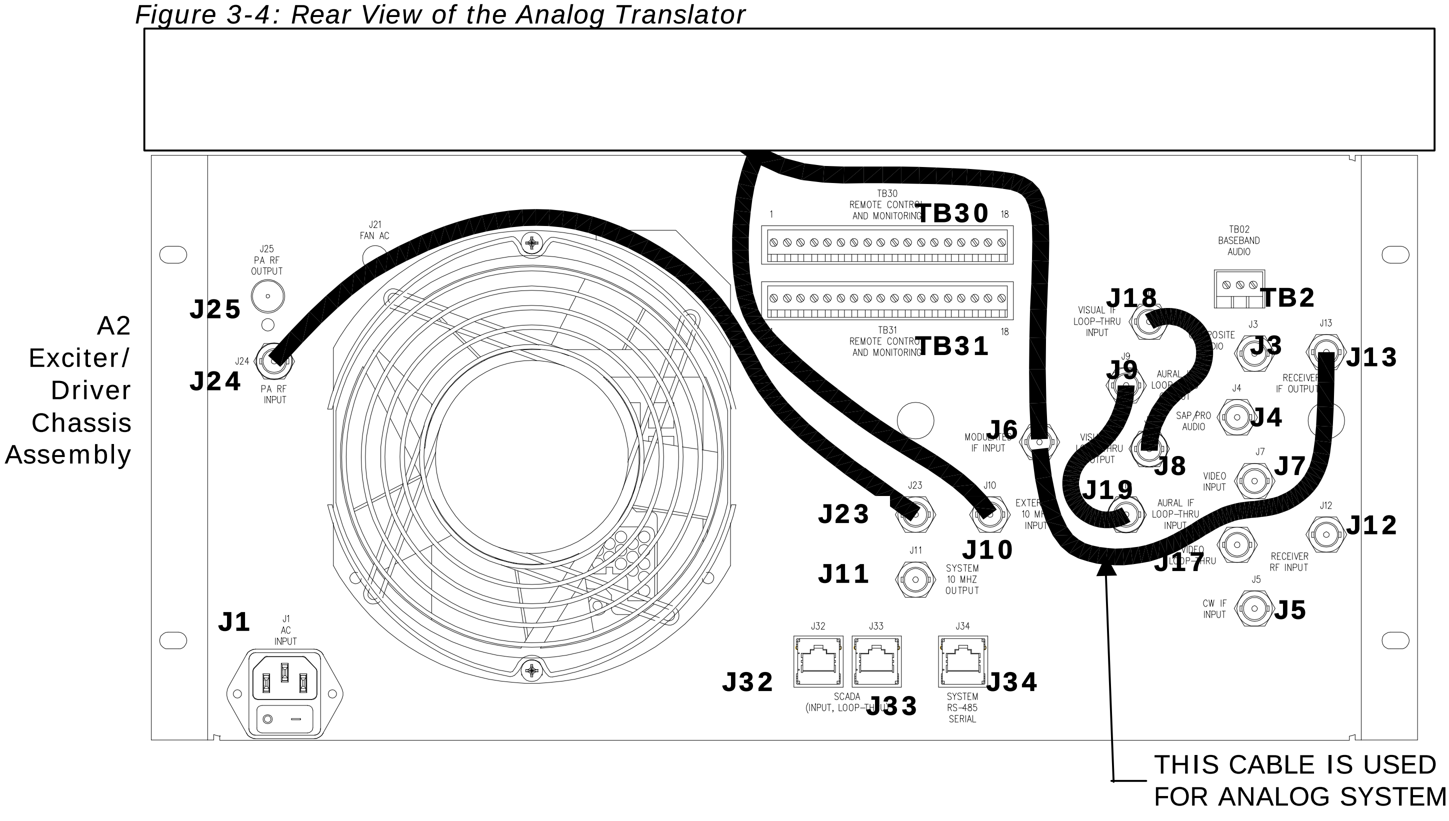


Table 3-1: Rear Chassis Connections for the LX Series Exciter/Driver.

Port	Type	Function	Impedance
J1	**IEC**	**AC Input**	**N/A**
TB02	Term	(NOT USED) Base Band Audio Input	600O
J3	BNC	(NOT USED) Composite Audio Input	75O
J4	BNC	(NOT USED) SAP / PRO Audio Input	50O
J5	BNC	(NOT USED) CW IF Input	50O
J6	**BNC**	**Modulated IF Input (In Analog System connects to J13**	**50O**
J7	BNC	(NOT USED) Video Input (Isolated)	75O
J8	BNC	(NOT USED) Visual IF Loop-Thru Output	50O
J9	BNC	(NOT USED) Aural IF Loop-Thru Output	50O
J10	**BNC**	**External 10 MHz Reference Input**	**50O**
J11	**BNC**	**System 10 MHz Reference Output**	**50O**
J12	**BNC**	**Receiver RF Input (Used in Analog System)**	**50O**
J13	**BNC**	**Receiver IF Output (In Analog System connects to J6)**	**50O**
J17	BNC	(NOT USED) Video Loop-Thru (Isolated)	75O
J18	BNC	(NOT USED) Visual IF Loop-Thru Input	50O
J19	BNC	(NOT USED) Aural IF Loop-Thru Input	50O
J23	**BNC**	**Upconverter RF Output (Jumpered to J24)**	**50O**
J24	**BNC**	**Power Amplifier RF Input (Jumpered to J23)**	**50O**
J25	**N**	**Power Amplifier RF Output**	**50O**
J32	**RJ-45**	**SCADA (Input / Loop-Thru)**	**CAT5**
J33	**RJ-45**	**SCADA (Input / Loop-Thru)**	**CAT5**
J34	**RJ-45**	**System RS-485 Serial**	**CAT5**
TB30	**Termination**	**Remote Control & Monitoring**	**N/A**
TB31	**Termination**	**Remote Control & Monitoring**	**N/A**

3.5.2 Initial Turn On

Once the translator has been installed and all connections have been made, the process of turning on the equipment can begin. Verify that AC power is present and connected to the translator. Verify all cables are properly connected and are the correct type. Once these checks are completed, the unit is ready to be turned on using the following procedures.

Turn on the main AC power source that supplies the AC to the translator. Check that the AC power plug is connected to J1 on the rear of the exciter/amplifier chassis assembly. Check that the On/Off circuit breaker, located on the rear of the Exciter/Amplifier is On.

Monitor the LCD display located on the front of the control/monitoring power supply module in the exciter/amplifier chassis assembly as you proceed through this section. When the translator is in the operate mode, the STB menu appears on the screen. When in the standby mode, the OPR menu appears on the screen. Press the NXT key after each menu to continue through the sequence to the next screen.

3.5.2.2 Receiver Module LEDs on Front Panel

Fault Indicators:

PLL 1 FLT: This illuminates Red when the Local Oscillator PLL is unlocked.

PLL 2 FLT: This illuminates Red when the optional input frequency correcting PLL is unlocked.

ALC FLT: This illuminates Red when the ALC can not maintain output level.

Status Indicators:

DC ON I/P: This indicator will illuminate Red when DC is applied to the RF input center conductor.

MAN ALC: This illuminates Red when the ALC can not maintain output level.

3.5.2.3 IF Processor Module LEDs on Front Panel

Fault Indicators:

INPUT FAULT: This illuminates Red if the input to the module is missing or low.

ALC FAULT: This illuminates RED when the needed ALC value to maintain the output level is beyond the range of the circuitry.

MUTE: This indicator will illuminate Red when the translator is muted.

3.5.2.4 VHF/UHF Upconverter Module LEDs on Front Panel

Fault Indicator:

AGC FAULT: This illuminates Red if the required gain to produce the desired output level is beyond the value set by the AGC circuit. AGC out of range.

AGC OVERRIDE: This illuminates Red if the drive to the driver module is too high.

MAN GAIN: This illuminates Red if the AGC is bypassed in Manual.

PLL 1: This illuminates Red if the 1 GHz PLL is unlocked.

PLL 2: This illuminates Red if the 1.1-1.9 GHz PLL is unlocked.

3.5.2.5 Controller Module LEDs on Front Panel

Status Indicators:

OPERATE: This illuminates Green when translator is in operate.

FAULT: This illuminates Red when a fault has occurred in the translator.

DC OK: This illuminates Green when the DC outputs that connect to the modules in the translator are present.

3.5.2.6 Power Amplifier Module LEDs on Front Panel

NOTE: Both the VHF High Band and Low Band PA Modules have the same front panel LEDs.

Status Indicators:

ENABLED: This illuminates Green when the PA is in operate.

DC OK: This illuminates Green when the DC inputs to the PA module are present.
TEMP: This illuminates Green when the temperature of the heatsink in the PA is below 78°C.

MOD OK: This illuminates Green when the PA module is operating and has no faults.

If the Module OK LED is Red and blinking a fault is present. The meaning of the blinking LED is as follows.

1 Blink: Indicates Amplifier Current Fault.
2 Blinks: Indicate Temperature Fault.
3 Blinks: Indicate +32V Power Supply

Over Voltage Fault.
4 Blinks: Indicate +32V Power Supply Under Voltage Fault.
5 Blinks: Indicate Reflected Power Fault.
6 Blinks: Indicate +12V or –12V Power Supply Fault

If the Module OK LED is Amber and blinking, it indicates the power output of the amplifier has dropped below 65%. (**NOTE:** Only in Amplifier Code Versions 3.7A or later and System Controller Code Versions 3.9C or later.).

3.5.3 Front Panel Screens for the Exciter/Amplifier Chassis Assembly

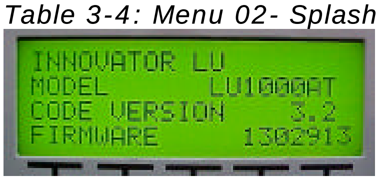
A 4 x 20 display located on the front of the Control & Monitoring/Power Supply Module is used in the LX Series translator for control of the operation and display of the operating parameters of the translator. Below are the typical display screens for the system and may vary depending on your system. The ↑ and ↓ characters are special characters used to navigate up or down through the menu screens. Display text flashes on discrete fault conditions for all screens that display a fault condition. When the translator is in operate mode, the STB menu appears. When the translator is in standby mode, the OPR menu appears.

Display Menu Screens for the LX Series Translator

Table 3-3: Menu 01 - Splash Screen #1

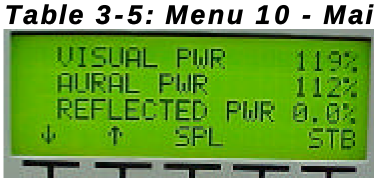
This is the first of the two transmitter splash screens that is shown for the first few seconds after reset or after pushing the SPL button on the Main Screen. Will automatically switch to the second splash screen.

Table 3-4: Menu 02- Splash Screen #2



This is the second of the two transmitter splash screens. Will automatically switch to the Main Screen. The Model Number, Code Version Number and Firmware Number for your system are displayed on this screen. Make note of these two numbers when conferring with Axcera on software problems.

Table 3-5: Menu 10 - Main Screen:



This is the default main screen of the translator. When the translator is in operate, the 'STB' characters appear, allowing an operator to place the translator in STANDBY, by pushing the right most button located under to display. When the translator is in standby the 'STB' characters are replaced with 'OPR' and the forward power values are displayed as OFF. An operator can change the translator from STANDBY to OPERATE by pressing the right most button on the front panel display. If the translator is in operate mode but off due to a modulation fault, the display reports the system power as Auto Off. Pushing the SPL button will display the two splash screens.

If the ↓ key is activated the display changes to Menu 11, the System Error List Access Screen. If the ↑ key is activated the display changes to Menu 13, the Transmitter Configurations Access Screen.

Table 3-6: Menu 11 - Error List Access Screen

This screen of the translator shows the current number of system errors, displayed in upper, right of screen, shown above is System Errors 0. and provides operator access to view Menu 20, the error list screens, by pushing the ENT button if errors are indicated. . If the ↓ key is pushed the display changes to Menu 12, Table 3-7, the Transmitter Device Data Access Screen. If the ↑ key is activated the display returns to Menu 10, the Main Screen. When ENT is pushed, if errors are present, Menu 20, Table 3-9, the System Error List Display Screen is displayed with the error indicated.

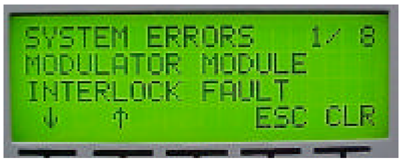
Table 3-7: Menu 12 - Transmitter Device Data Access Screen

This screen of the translator allows access to various parameters of the translator system. This is the entry point to Menu 30, the System Details Screens, by pausing the ENT button. When the ENT button is pushed, Menu 30 is accessed. Go to Menu 30, Table 3-12 for set up details. Before pushing the ENT button: if the ↓ key is activated the display changes to Menu 13, Transmitter Configurations Access Screen. If the ↑ key is activated the display returns to Menu 11, the Error List Access Screen.

Table 3-8: Menu 13 - Transmitter Configuration Access Screen

This screen of the translator allows access to various software settings of the translator system. If ENT is pushed, go to Menu 40, Table 3-13, the access to transmitter configuration and set up. Before pushing the ENT button: if the ↓ key is activated the display returns to Menu 10, Main Screen. If the ↑ key is activated the display returns to Menu 12, the Transmitter Device Data Access Screen.

Table 3-9: Menu 20 - Error List Display Screen



When ENT is pushed on the Error List Access Screen, Menu 11, if errors are present, Menu 20, the System Error List Display Screen is displayed with the System Error indicated as shown above. This screen of the translator allows access to the system faults screens. Fault logging is stored in non-volatile memory. The translator's operating state can not be changed in this screen. The 'CLR' switch is used to clear previously detected faults that are no longer active. The ↑ key and ↓ key allow an operator to scroll through the list of errors that have occurred. The ESC button is used to leave this screen and return to Menu 11, Table 3-16, the Error List Access Screen.

The screen shown indicates a Modulator Module Interlock Fault, typically because the Modulator is not present. It also indicates that there are a total of eight faults. The other faults can be displayed by pushing the ↓ key button. To clear the displayed System Error, fault, that is no longer active, push the button under CLR. Repeat to clear each additional displayed System Error. If an error is active it will not clear.

NOTES: In Dual Exciter Systems with an Exciter Switcher, for the automatic switching to the back up exciter to occur, the System Error, Fault, Log located in the Back Up Exciter must be cleared of all Previous Faults, as described above.

With all Errors, faults, cleared the screen below should be displayed. Push the button under ESC to return to Menu 11, Table 3-6, the Error List Access Screen.

Menu 30 is entered by selecting ENT at Menu 12, Table 3-7.

Table 3-10: Menu 30 - Transmitter Device Details Screen

This screen allows access to the translator parameters of installed devices. The system is configured to know which devices are present. Current values for all installed devices are shown. If a module is not installed, only a "MODULE NOT PRESENT" message will be displayed. The first screen displayed is Menu 30-1, Table 3-11, the System Details Screen.

Table 3-11: Menu 30-1 – System Details Screen

The ↓ and ↑ arrows allow you to scroll through the different parameters of each device as shown in **Table 3-12** that follows. Each System Component is a different screen. The proper IF Processor and the Driver or the Power Amplifier will be programmed for your system. The External Amplifier Modules will only be used in high power translators. Examples of External Amplifier Modules displays are: (AMP SET 1 MODULE 1) and (AMP SET 2 MODULE 4).

Table 3-12: Transmitter Device Parameters Detail Screens

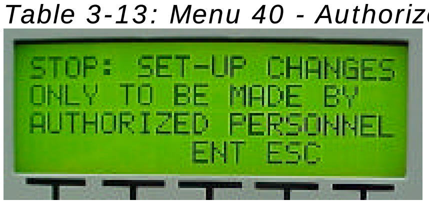
System Component	Parameter	Normal	Faulted (Blinking)
Receiver Details (Not used with Digital.)	AFC 1 LEVEL	0 - 10.00 V	N/A
	PLL 1 CIRCUIT	LOCKED	UNLOCKED
	ALC INPUT	OK	FAULT
	FAULT AT	0 - 10.00 V	FAULT
IF Processor Details	INPUT SIGNAL STATE	OK	FAULT
	MODULATION	OK	FAULT
	INPUT IF	MODULATOR or J6	N/A
	DLC CONTROL LOCK	0 - 5.00 V	N/A
	ALC LEVEL	0 - 5.00 V	N/A
	ALC MODE	AUTO or MANUAL	N/A
Upconverter Details	AFC 1 LEVEL	0 – 5.00 V	N/A
	AFC 2 LEVEL	0 - 5.00 V	N/A
	CODE VERSION	x.x	N/A
	PLL 1 CIRCUIT	LOCKED	FAULT
	PLL 2 CIRCUIT	LOCKED	FAULT
	AGC 1 LEVEL	0 - 5.00 V	N/A
	AGC 2 LEVEL	0 - 5.00 V	N/A
	INT. 10 MHz	IS USED	N/A
System Control Details	SUPPLY ENABLED FOR	xxx HOURS	N/A

System Component	Parameter	Normal	Faulted (Blinking)
Exciter/Amplifier Power Amplifier Details	POWER SUPPLY STATE, 32V	32 VDC	N/A
	±12V SUPPLY	OK or OFF	FAULT
	FORWARD POWER	xxx%	xxx%
	REFLECTED POWER	xxx%	xxx%
	AMP 1 CURRENT	xx.xA	xx.xA
	AMP 2 CURRENT	xx.xA	xx.xA
	TEMPERATURE	xxC	xxC
	CODE VERSION	x.x	N/A
	PA HAS OPERATED FOR	xxx HOURS	N/A

Pushing the ↓ Down Arrow, after scrolling through all the detail screens, will put you back to Menu 30, Table 3-10. Push the ESC button to exit the Transmitter Device Parameter Screens to Menu 12, Table 3-7 to the Transmitter Device Parameter Access Screen.

Menu 40 (Table 3-13) is entered by selecting ENT at Menu 13.

Table 3-13: Menu 40 - Authorized Personnel Screen



This screen of the translator notifies an operator that they are only to proceed if they are authorized to make changes to the translator's operation. Changes made within the following set-up screens can affect the translators output power level, output frequency, and the general behavior of the translator. Please do not make changes within the translator's set-up screens unless you are familiar with the operation of the translator. This screen is implemented in transmitter software version 1.4 and above.

Pressing ENT will put you into the Transmitter Set Up Screens for Menu 40.

A safeguard is added to the Set Up Menus in software version 2.5 and above. If a change is made to a screen within the Set Up Menus, when you go to the next menu, a new screen asks if you accept the change or want to return to the previous menu to reconsider the changes made.
To accept the changes, the two buttons located under ACCEPT must be pushed simultaneously.

To return to the previous Menu to make corrections, the two buttons located under the RETURN must be pushed simultaneously.

Upon returning to the previous Menu the correct input must be entered and the above procedure repeated, this time accepting the changes.

Accept or Return to previous Menu Screen

Pushing these two buttons Simultaneously will accept the change.

Pushing these two buttons Simultaneously will return you to the previous Menu.

The Set Up Screens are shown in Table 3-14 Menu 40-1 through Table 3-32 Menu 40-19 that follow.

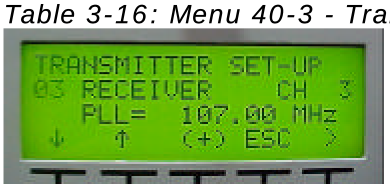
Table 14: Menu 40-1 - Transmitter Set-up: Power Control Screen

This screen of the translator is the first of several that allows access to translator set-up parameters. This is the output Power Control Screen. When + is selected, the Power will increase. When - is selected, the Power will decrease.

Table 3-15: Menu 40-2 - Transmitter Set-up: Model Select Screen

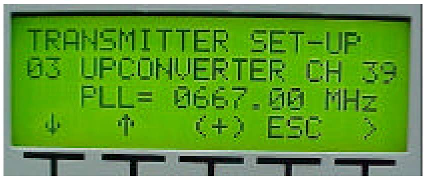
This screen is used to specify which components are expected to be part of the system. By specifying the model number, the transmitter control firmware knows which components should be installed and it will be able to display faults for components that are not properly responding to system commands.

Table 3-16: Menu 40-3 - Transmitter Set-up: Receiver Channel Configuration



This screen of the translator allows access to translator frequency set-up parameters. The choices of this screen are as follow. **NOTE:** The above screen will only be present if a Receiver is part of the system. Used to set the Receiver Channel designation and for custom Channel Offsets the setting of the PLL operating frequency.

Table 3-17: Menu 40-4 - Transmitter Set-up: Upconverter Channel Select Screen



The choices of this screen are to the standard UHF / VHF channels. The + and – buttons change the desired channel of the translator. The PLL frequency is set for custom Offsets within the upconverter frequency. Any change to the channel is immediately set to the LO / Upconverter Frequency Synthesizer PLL circuit.

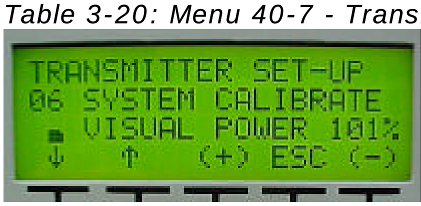
Table 3-18: Menu 40-5 - Transmitter Set-up: Serial Address Screen

This screen allows the user to set the serial address of the translator. The default address is 5. This value and all other set-up parameters, are stored in non-volatile memory.

Table 3-19: Menu 40-6 - Transmitter Set-up: Station ID Screen

This screen allows the user to set the Station ID, Call Sign, in analog translators. If blank characters are used for all five positions, then the Station ID feature is disabled. Otherwise the Station ID code is transmitted every 15 minutes. This value and all other set-up parameters, are stored in non-volatile memory. (**NOTE:** If an external Receiver Tray is used in your system, the LX Series Station ID is disabled. Therefore, the Station ID must be set up in the external Receiver Tray.)

Table 3-20: Menu 40-7 - Transmitter Set-up: System Visual Power Calibration



This screen is used to adjust the calibration of the system's visual power. A symbol placed under the '6' character is used to show major changes in the calibration value. When the calibration value is at full value, the character will be full black. As the value decreases, the character pixels are gradually turned off. The calibration value is a value between 0 and 255 but the calibration value symbol only has 40 pixels. Therefore small changes in actual calibration value may not affect the symbol's appearance.

Table 3-21: Menu 40-8 - Transmitter Set-up: System Aural Power Calibration

This screen is used to adjust the calibration of the system's aural forward power. A calibration value symbol is used for this screen as on the previous screen.

Table 3-22: Menu 40-9 - Transmitter Set-up: System Reflected Power Calibration

This screen is used to adjust the calibration of the system's reflected power. Again a calibration value symbol is used for this screen as on the previous screens.

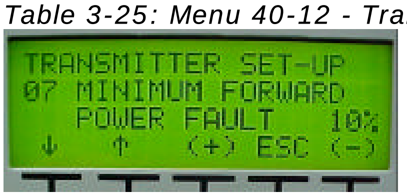
Table 3-23: Menu 40-10 - Transmitter Set-up: Modulated Output Calibration

In analog systems, this screen is used to adjust the calibration of the system's modulated output signal detector. The calibration value symbol is again used to graphically represent the modulated output signal detector's calibration value.

Table 3-24: Menu 40-11 - Transmitter Set-up: Aural Deviation Calibration

In analog systems this screen is used to adjust the calibration of the system's aural deviation detector. The calibration value symbol is again used to graphically represent the aural deviation detector's calibration value.

Table 3-25: Menu 40-12 - Transmitter Set-up: Forward Power Fault Threshold Screen



This screen is used to set the minimum forward power fault threshold. When the translator is operating, it must operate above this value otherwise the system will shut down with fault for 5 minutes. If after five minutes the fault is not fixed, the translator will enable, measure power less than this value and again shut down for five minutes.

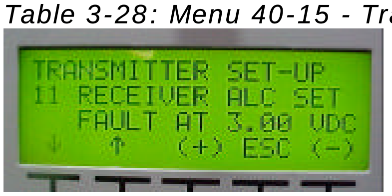
Table 3-26: Menu 40-13 - Transmitter Set-up: Reflected Power Fault Threshold

This screen is used to set the maximum reflected power fault threshold. When the translator is operating, it must not operate above this value otherwise the system will slowly begin to reduce the forward output power. If the system's reflected output power exceeds the maximum reflected power threshold by five percent or more, the translator will shut down with fault for 5 minutes. If after five minutes the fault is not fixed, the translator will enable, measure power above this value plus five percent and again shut down for five minutes. If the system's reflected output power exceeds the maximum reflected power threshold due to some condition like the formation of ice on an antenna, the translator reduces forward power to a level where the reflected power is less than this threshold. The translator will automatically increase its output power to normal operation when the cause of higher than normal reflected power is corrected.

Table 3-27: Menu 40-14 - Transmitter Set-up: Auto Stand-By Control

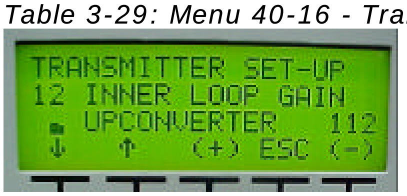
Certain LX translator locations are required to reduce to no output power on the loss of video input. When a LX translator is configured for Auto Stand-By On Modulation Loss, the translator will switch to stand-by, if a modulated input signal fault is detected by the IF Processor module that lasts for more than ten seconds. Once the modulated input signal fault is cleared, a translator in operate mode will return to normal operation. This feature is implemented in transmitter software version 1.4 and above.

Table 3-28: Menu 40-15 - Transmitter Set-up: Receiver ALC Fault Set Up



This screen is used to set up the level of the ALC at which the Receiver will fault. This feature is implemented in transmitter software version 2.0 and above. **NOTE:** The above screen will only be present if a Receiver is part of the system.

Table 3-29: Menu 40-16 - Transmitter Set-up: Inner Loop Gain Control



This screen is used to set up the Inner Loop Gain of the exciter/amplifier assembly. This feature is implemented in transmitter software version 2.0 and above.

Table 3-30: Menu 40-17 - Transmitter Set-up: Optional System Control

This screen is used to set up any optional system, including the addition of the optional Modulator in a translator system. This feature is implemented in transmitter software version 2.0 and above.

Table 3-31: Menu 40-18 - Transmitter Set-up: Amplifier Output Power Warning

This screen is used to set up the Amplifier Output Power level at which a warning will be sent out if the power output of the amplifier drops below this setting. The warning indication is the blinking of the Module OK LED colored Amber, located on the front of the amplifier module. (**NOTE:** Only in Amplifier Code Versions 3.7A or later and System Controller Code Versions 3.9C or later.)

Table 3-32: Menu 40-19 - Transmitter Set-up: Remote Commands Control

This screen is used to allow or deny the use of remote control commands. When disabled, remote commands are not used. Remote commands are commands received either through the rear terminal blocks or through serial messages. Push the ESC button to exit the Transmitter Set Up Screens to Menu 13, Table 3-8, the Transmitter Configuration Access Screen.

This completes the description of the menu screens for the LX Series exciter/driver chassis assembly.

3.5.5 Operation Procedure

If necessary, place the translator in standby and connect the translator to the antenna. Switch the translator to operate and check that the output is 100% and if needed adjust the ALC Gain adjust pot on the front panel of the IF Processor to attain 100%. The power raise / lower settings, in the menus, are only to be used for temporary reductions in power.

The power set-back values do not directly correspond to the output power of the translator.

This completes the Installation, Set Up and Turn On of the Translator. If a problem occurred during the setup and operation procedures, refer to Chapter 5, Detailed Alignment Procedures, of this manual for more information.

Chapter 4
Circuit Descriptions

4.2 (A1) Receiver Module, VHF High Band (1304001; Appendix A)

NOTE: Used in analog translator system.

4.2.1 IF ALC Board (1304003; Appendix A)

The board provides the interface between the receiver and the backplane and also contains the control and ALC circuits for the sled.

The control portion of the board consists of a microcontroller (U8) and its associated components that communicate to the outside world via an RS-485 serial data link. The microcontroller receives various metering and alarm functions such as AFC and ALC voltages, PLL and ALC faults and communicates them back to the system controller for display on the transmitter's LCD display. It also receives the channel information from the system controller, and converts it to the programming data for the PLL chip on the Mixer/PLL Board in the receiver.

The IF portion of the board consists of an input pin attenuator, which is used to normalize the gain of the board to account for variations in the input level to the board. The pin attenuator is made up of DS1, DS2 and associated components. The signal is then amplified by U2-U4 and associated components and applied to a SAW filter that rejects any out of channel signal that made it through the receivers RF front end. Amplifiers U5, U6 and their associated components are used to amplify the signal to make up for the loss through the filter. The final output of U6 is split by a lumped element Wilkinson splitter consisting of C21, C26, C27, L12, and L14. The output from one of the output ports is sent to the output of the receiver, and the other output is connected to a peak detector and used by the ALC. The ALC circuit, consisting of U1, CR4 and its associated components, varies the gain of the pin attenuator on the front end of the board to maintain a constant output level. The pin attenuator has an overall adjustment range of approximately 50 dB.

There is a comparator that looks at the pin attenuator voltage and generates an alarm if the pin attenuator is close to running out of range. This alarm is likely to occur if the RF input signal to the receiver is weak or missing. This alarm is received by the microcontroller that passes it along to the transmitter's system controller, which mutes the signal in the IF processor until the fault goes away.

4.2.2 VHF Mixer/PLL Board (1306472; Appendix A)

The VHF Mixer/PLL Board converts the RF input to the receiver to a 44 MHz IF. It consists of a Mixer, a local oscillator and some IF amplifiers used to make up for the loss of the mixer.

The Local oscillator signal is generated by the VCO (U3), which operates directly at the LO frequency of the VHF channel center frequency (104-176 MHz) + 44 MHz. The oscillator is phase locked to a 10 MHz standard by U2, U8, and their associated components. TP1 shows the AFC voltage, which is also sent back to the IF ALC board to be displayed on the system level controller. The variable resistor R30 sets the LO output level to +10 dBm into the mixer U4. This is done by looking at the LO sample at J2 with a spectrum analyzer, adjusting R30 until the level is -10 dBm. This ensures that the mixer gets the correct level, as the sample is 20 dB down from the level into the mixer.

Mixer U4 converts the RF input at J1 to an IF frequency of 44 MHz. L13, L14 and C56 form a low pass filter, which rejects any unwanted higher frequency conversion products. U5 and U9 amplify the signal, which exits the board at J5. There are two jumpers on J3 and J4 that allow the user to switch in a 10 dB attenuator if the input level to the receiver is too high. Normally the jumpers are connected between pins 1 and 2 of each connector, but if the user has a high input level, they can be switched to connect pins 2 and 3 of each connector, which switches in the 10 dB pad.

The A/V ratio of the incoming signal can be adjusted via an external front panel pot, which controls the bias on pin attenuator DS3. The pin attenuator controls the Q of a notch set at the aural IF carrier frequency, set by C41 and L7. The A/V ratio control is used if the incoming signal has an aural carrier that is too high relative to the visual carrier.

4.2.3 VHF High Band Preamplifier Board (1306445; Appendix A)

The VHF High Band Preamplifier Board filters and amplifies the low level RF input signal to the receiver. It consists of two two-pole bandpass filters and a dual stage preamplifier. The filters are tuned at the RF channel frequency and are about 8 MHz wide. They are intended to filter off the unwanted image product 88 MHz below the Channel center frequency. Each filter is a combination micro-strip lumped element filter.

The input filter also has provisions to insert a +12V DC signal onto the center conductor of the receiver's RF input to power an external preamp. The jumper W1 on J2 controls whether or not the DC bias is applied to the center conductor. When it is connected between pins 1 and 2, the +12V bias is applied. When it is between pins 2 and 3, there is no bias applied. The presence of the DC bias is displayed on a front panel LED on the sled.

CAUTION: Do not hook up the RF input to any test equipment with the DC bias applied. Always move the jumper W1 on J2 to the Bias off position, between pins 2 & 3, to prevent possible damage to the test equipment.

The amplifier consists of two cascaded stages, which provide approximately 27 dB of gain across the VHF High Band channels.

4.3 (A3) IF Processor Module Assembly (1301938; Appendix A)

The IF from the modulator enters the module and the signal is pre-corrected as needed for amplitude linearity correction, Incidental Carrier Phase Modulation

(ICPM) correction and frequency response correction.

The Module contains the IF Processor board 1301977.

4.3.1 IF Processor Board (1301977; Appendix A)

The automatic level control (ALC) portion of the board provides the ALC and amplitude linearity correction of the IF signal. The ALC adjusts the level of the IF signal that controls the output power of the transmitter.

The IF from the modulator enters the board at J42 pin 32B. If the (optional) receiver is present, the IF input (-6 dBm) from the receiver connects to the modulated IF input jack J42 Pin 21C. The modulator IF input connects to relay K3 and the receiver IF input connects to relay K4.

The Modulator select enable/disable jumper W11 on J29 controls whether the Modulator Select command at J42 Pin 14C controls the operation of the relays. With the jumper W11 on J29 between pins 1 and 2, the external Modulator Select command at J42 Pin 14C controls the operation of the relays. With the jumper W11 on J29 between pins 2 and 3, the Modulator input is selected all of the time.

4.3.1.1 Modulator Selected

With the modulator selected, J42-14C low or the jumper W11 on J29 between pins 2 and 3, the low shuts off Q12 and causes Pin 8 on the relays to go high that causes relays K3 and K4 to de-energize. When K4 is de-energized, it connects the receiver IF input at J42-21C, if present, to a 50O load. When K3 is de-energized, it connects the modulator IF input at J42-32B to the rest of the board and the Modulator Enable LED DS5 will be illuminated.

4.3.1.2 External Modulated IF Selected

With the External Modulated IF selected, J42-14C high and jumper W11 on J29 between pins 1 and 2, this high turns on Q12 and makes pin 8 on the relays Low that causes the relays K3 and K4 to energize. When K4 is energized, it connects the receiver IF input at J42-21C, if present, to the rest of the board. When K3 is energized, it connects the modulator IF input at J42-32B to a 50O load and the Modulator Enable LED DS5 will not be illuminated.

4.3.1.3 Main IF Signal Path (Part 1 of 3)

The selected IF input (-6 dBm average) signal is split, with one half entering a bandpass filter that consists of L3, L4, C4, L5, and L6. This bandpass filter can be tuned with C4 and is substantially broader than the IF signal bandwidth. It is used to slightly steer the frequency response of the IF to make up for any small discrepancies in the frequency response in the stages that precede this point. The filter also serves the additional function of rejecting unwanted frequencies that may occur if the tray cover is off and the tray is in a high RF environment. (If this is the case, the transmitter will have to be serviced with the tray cover off in spite of the presence of other RF signals). The filtered IF signal is fed through a pi-type matching pad consisting of R2, R3, and R4 to the pin-diode attenuator circuit consisting of CR1, CR2, and CR3.

4.3.1.4 Input Level Detector Circuit

The other part of the split IF input is connected through L2 and C44 to U7. U7 is an IC amplifier that is the input to the input level detector circuit. The amplified IF is fed to T4, which is a step-up transformer that feeds diode detector CR14. The positive-going detected signal is then low-pass filtered by C49, L18, and C50. This allows only the positive digital peaks to be applied through emitter follower Q1. The signal is then connected to detector CR15 to produce a peak digital voltage that is applied to op-amp U9A. There is a test point at TP3 that provides a voltage-reference check of the input level. The detector serves the dual function of providing a reference that determines the input IF signal level to the board and also serves as an input threshold detector.

The input threshold detector prevents the automatic level control from reducing the attenuation of the pin-diode attenuator to minimum, the maximum signal output, if the IF input to the board is removed. The ALC, input loss cutback, and the threshold detector circuits will only operate when jumper W2 on jack J5 is in the Enabled position, between pins 2 and 3. Without the threshold detector, and with the pin-diode attenuator at minimum, the signal will overdrive the stages following this board when the input is restored.

As part of the threshold detector operation, the minimum IF input level at TP3 is fed through detector CR15 to op-amp IC U9A, pin 2. The reference voltage for the op-amp is determined by the voltage divider that consists of R50 and R51, off the +12 VDC line. When the detected input signal level at U9A, pin 2, falls below this reference threshold, approximately 10 dB below the normal input level, the output of U9A at pin 1 goes high, toward the +12 VDC rail. This high is connected to the base of Q2 that is forward biased and creates a current path. This path runs from the -12 VDC line, through red LED DS1, the input level fault indicator, which lights, resistor R54, and transistor Q2 to +12 VDC. The high from U9A also connects through diode CR16 and R52, to U24D pin 12, whose output at pin 14 goes high. The high connects through the front panel accessible ALC Gain pot R284 and the full power set pot R252 to U24C Pin 9. This high causes U24C pin 8 to go low. A power raise/lower input from the Control/Monitoring Module connects to J42C pin 24C and is wired to Q14. This input will increase or decrease the value of the low applied to U24B and therefore increase or decrease the power output of the transmitter.

The low connects to U24B pin 5 whose output goes low. The low is wired to U24A pin 2 whose output goes high. The high is applied to U10A, pin 2, whose output goes low. The low connects through the switch SW1, if it is in the auto gain position, to the pin-diode attenuator circuit, CR1, CR2 & CR3. The low reverse biases them and cuts back the IF level, therefore the output level, to 0. When the input signal level increases above the threshold level, the output power will increase, as the input level increases, until normal output power is reached.

The input level at TP3 is also fed to a pulse detector circuit, consisting of IC U8, CR17, Q3, and associated components, and then to a comparator circuit made up of U9C and U9D. The reference voltage for the comparators is determined by a voltage divider consisting of R243, R65, R66, and R130, off the -12 VDC line. When the input signal level to the detector at TP3 falls below this reference threshold, which acts as a loss-of-signal peak detector circuit, the output of U9C and U9D goes towards the -12 VDC rail and is split, with one part biasing on transistor Q5. A current path is then established from the +12 VDC line through Q5, the resistors R69 and R137, and the red LED DS3, input loss indicator, which is illuminated. When Q5 is on, it applies a high to the gate of Q6. This causes it to conduct and apply a modulation loss pull-down output to J42C, pin 7C, which is applied to the front panel display on the Control/Monitor module.

The other low output of U9C and U9D is connected through CR18, CR19 & CR20 to jack J5. Jumper W2 on J5, in the Cutback Enable position, which is between pins 2 and 3, connects the low to the base of Q4 that is now forward-biased. **NOTE:** If jumper W2 is in the Disable position, between pins 1 and 2, the auto cutback will not operate. With Q4 biased on, a negative level determined by the setting of cutback level pot R71 is applied to U24D, pin 12. The level is set at the factory to cut back the output to approximately 25%. The output of U24D at pin 14 goes low and is applied through the power adjust pot to U24C, pin 9, whose output goes low. The low connects to U24B, pin 5, whose output goes low. The low then connects to U24A, pin 2, whose output goes high. The high is applied to U10A, pin 2, whose output goes low. The low connects through the switch SW1, if it is in the auto gain position, to the pin-diode attenuator circuit, CR1, CR2 & CR3. The low reverse biases them and cuts back the level of the output to approximately 25%.

4.3.1.5 Pin-Diode Attenuator Circuit

The input IF signal is fed to a pin-diode attenuator circuit that consists of CR1, CR2 & CR3. Each of the pin diodes contains a wide intrinsic region; this makes the diodes function as voltage-variable resistors at this intermediate frequency. The value of the resistance is controlled by the DC bias supplied to the diode. The pin diodes are configured in a pi-type attenuator configuration where CR1 is the first shunt element, CR3 is the series element, and CR2 is the second shunt element. The control voltage, which can be measured at TP1, originates either from the ALC circuit when the switch SW1 is in the ALC Auto position, between pins 2 and 3, or from pot R87 when SW1 is in the Manual Gain position, between pins 1 and 2.

In the pin diode attenuator circuit, changing the amount of current through the diodes by forward biasing them changes the IF output level of the board. There are two extremes of attenuation ranges for the pin-diode attenuators. In the minimum attenuation case, the voltage, measured at TP1, approaches the +12 VDC line. There is a current path created through R6, through series diode CR3, and finally through R9 to ground. This path forward biases CR3 and causes it to act as a relatively low-value resistor. In addition, the larger current flow increases the voltage drop across R9 that tends to turn off diodes CR1 and CR2 and causes them to act as high-value resistors. In this case, the shunt elements act as a high resistance and the series element acts as a low resistance to represent the minimum loss condition of the attenuator (maximum signal output). The other extreme case occurs as the voltage at TP1 is reduced and goes towards ground or even slightly negative. This tends to turn off (reverse bias) diode CR3, the series element, causing it to act as a high-value resistor. An existing fixed current path from the +12 VDC line, and through R5, CR1, CR2, and R9, biases series element CR3 off and shunt elements, diodes CR1 and CR2, on, causing them to act as relatively low-value resistors. This represents the maximum attenuation case of the pin attenuator (minimum signal output). By controlling the value of the voltage applied to the pin diodes, the IF signal level is maintained at the set level.

4.3.1.6 Main IF Signal Path (Part 2 of 3)

When the IF signal passes out of the pin-diode attenuator through C11, it is applied to the modular amplifier U1. This device contains the biasing and impedance-matching circuits that makes it operate as a wide-band IF amplifier. The output of U1 connects to J40 that is jumpered to J41. The J40 jack is available, as a sample of the pre-correction IF for troubleshooting purposes and system setup. The IF signal is connected to a splitter Z1 that has an In Phase output and a 90° Quadrature output, which are then connected to the linearity corrector portion of the board.

4.3.1.7 Amplitude and Phase Pre-Correction Circuits

The linearity corrector circuits use three stages of correction, two adjust for any amplitude non-linearities and one for phase non-linearities of the output signal. Two of the stages are in the In Phase Amplitude pre-correction path and one stage is in the Quadrature Phase pre-correction path. Each stage has a variable threshold control

adjustment, R211 and R216, in the In Phase path, and R231, in the Quadrature path, that determines the point at which the gain is changed for that stage.
Two reference voltages are needed for the operation of the corrector circuits. The Zener diode VR3, through R261, provides the +6.8 VDC reference. The VREF is produced using the path through R265 and the diodes CR30 and CR31. They provide a .9 VDC reference, which temperature compensates for the two diodes in each corrector stage.

The first corrector stage in the In Phase path operates as follows. The In Phase IF signal is applied to transformer T6, which doubles the voltage swing by means of a 1:4 impedance transformation. Resistors R222 and R225 form an L-pad that lowers the level of the signal. The input signal level, when it reaches a set level, causes the diodes CR24 and CR25 to turn on, generating current flow that puts them in parallel with the L-pad. When the diodes are put in parallel with the resistors, the attenuation through the L-pad is lowered, causing signal stretch.

The signal is next applied to amplifier U17 to compensate for the loss through the L-pad. The breakpoint, or cut-in point, for the first corrector is set by controlling where CR24 and CR25 turn on. This is accomplished by adjusting the threshold cut-in resistor R211. R211 forms a voltage-divider network from +6.8 VDC to ground. The voltage at the wiper arm of R211 is buffered by the unity-gain amplifier U16B. This reference voltage is then applied to R215, R216, and C134 through L44 to the CR24 diode. C134 keeps the reference from sagging during the vertical interval. The .9 VDC reference voltage is applied to the unity-gain amplifier U16D. The reference voltage is then connected to diode CR25 through choke L45. The two chokes L44 and L45 form a high impedance for RF that serves to isolate the op-amp ICs from the IF.

After the signal is amplified by U17, it is applied to the second corrector stage in the In Phase path through T7. These two correctors and the third corrector stage in the Quadrature path operate in the same fashion as the first. All three corrector stages are independent and do not interact with each other.

The correctors can be disabled by moving the jumper W12 on J30 to the Disable position, between pins 1 and 2, this moves all of the breakpoints past the signal peaks so that they will have no affect.

The pre-distorted IF signal in the In Phase path, connects to an op amp U18 whose output level is controlled by R238. R238 provides a means of balancing the level of the amplitude pre-distorted IF signal that then connects to the combiner Z2.

The pre-distorted IF signal in the Quadrature path connects to op amp U20 and then step up transformer T9, next op amp U21 and step up transformer T10 and finally op amp U22 whose output level is controlled by R258. R258 provides a means of balancing the level of the Phase pre-distorted IF signal that then connects to the combiner Z2.

The Amplitude and Phase pre-distorted IF signals are combined by Z2 and connected to J37 that is jumpered to J36 on the board. J37 can be used for testing or monitoring purposes of the IF signal after Amplitude and Phase pre-distortion. The pre-distorted IF signal connects through a resistor buffer network that prevents loading of the combiner before it is wired to the frequency response circuitry.

4.3.1.8 Main IF Signal Path (Part 3 of 3)

The IF signal, at the input to the frequency-response corrector circuit, is split using L24, L25 and R89. One path is through L24, which is the main IF path through the board. The main IF is fed through a resistor network that controls the level of the IF by adjusting the resistance of R99, the output level adjust.

The IF signal is then applied to a three-stage, frequency-response corrector circuit that is adjusted as needed.

The frequency-response corrector circuit operates as follows. Variable resistors R103, R106 and R274 are used to adjust the depth and gain of the notches and variable caps C71, C72 and C171 are used to adjust the frequency position of the notches. These are adjusted as needed to compensate for frequency response problems.

The frequency-response corrected IF is connected to J38 that is jumpered to J39 on the board. J38 can be used for testing or monitoring purposes of the IF signal after frequency response pre-correction.

The IF is next amplified by U13 and U14. After amplification, the IF is split with one path connected to J42C pin 1C the IF output to the LO/Upconverter Module. The other path is fed through a divider network to J35 a SMA IF Sample Jack, located on the front panel, which provides a sample of the corrected IF for test purposes.

4.3.1.9 ALC Circuit

The other path of the corrected IF signal at the input to the frequency response corrector circuit is used in the ALC circuit. The IF flows through L25, of the L24 L25 splitter, and connects to the op-amp U12. The IF signal is applied through a resistor divider network to transformer T5. T5 doubles the voltage swing by means of a 1:4 impedance transformation before it is connected to the ALC detector circuit, consisting of C70, CR23 and R91. The detected ALC level output is amplified by U10B and wired to U10A, pin 2, where it is summed with the power control setting, which is the output power setting that is maintained by the ALC. The output of U10A connects through SW1, if it is in the auto gain position, to the pin-diode attenuator circuit, CR1, CR2 & CR3. The high forward biases them more or less, that increases or decreases the IF level, therefore the output level, opposite the input level. When the input signal level increases, the forward bias on the pin attenuator decreases, therefore the output power will decrease, which keeps the output power the same as set by the customer.

An external power raise/lower switch can be used by connecting it to TB30, at TB30-8 power raise and TB30-9 power lower, on the rear of the exciter/amplifier chassis. The ALC voltage is set for .8 VDC at TP4 with a 0-dBm output at J42C pin 1C of the module. A sample of the ALC at J42C pin 11C, is wired to the Control Monitoring/Power Supply module where it is used on the LCD display and in the AGC circuits.

The ALC voltage, and the DC level corresponding to the IF level after signal correction, are fed to U10A, pin 2, whose output at pin 1 connects to the ALC pin-diode attenuator circuit. If there is a loss of gain somewhere in an IF circuit, the output power of the transmitter will drop. The ALC circuit senses this drop at U10A and automatically decreases the loss through the pin-diode attenuator circuit therefore increasing its gain maintaining the same output power level.

The ALC action starts with the ALC detector level monitored at TP4. The detector output at TP4 is nominally +.8 VDC and is applied through resistor R77 to a summing point at op-amp U10A, pin 2. The current available from the ALC detector is offset, or complemented, by current taken away from the summing junction. In normal operation, U10A, pin 2, is at 0 VDC when the loop is satisfied. If the recovered or peak-detected IF signal level at IF input to this board should drop, which normally means that the output power will decrease, the null condition would no longer occur at U10A, pin 2. When the level drops, the output of U10A, pin 1, will go more positive. If SW1 is in the Automatic position, it will cause the ALC pin-diode attenuators CR1, CR2, and CR3 to have less attenuation and increase the IF level; this will compensate for the decrease in the level. If the ALC cannot increase the input level enough to satisfy the ALC loop, due to the lack of range, an ALC fault will occur. The fault is generated because U10D, pin 12, increases above the trip point set by R84 and R83 until it conducts. This makes U10D, pin 14, high and causes the red ALC Fault LED DS2 to light.

4.3.1.10 Fault Command

The board also has circuitry for an external mute fault input at J42 pin 10C. This is a Mute command that protects the circuits of high-gain output amplifier devices against VSWR faults. This action needs to occur faster than just pulling the ALC reference down. Two different mechanisms are employed: one is a very fast-acting circuit to increase the attenuation of the pin-diode attenuator, CR1, CR2, and CR3, and the second is the reference voltage being pulled away from the ALC amplifier device. An external Mute is a pull-down applied to J42 pin 10C, which completes a current path from the +12 VDC line through R78 and R139, the LED DS4 (Mute indicator), and the LED section of opto-isolator U11. These actions turn on the transistor section of U11 that applies -12 VDC through CR21 to U10A pin 3, and pulls down the reference voltage. This is a fairly slow action controlled by the low-pass filter function of R81 and C61. When the transistor section of U11 is on, -12 VDC is also connected through CR22 directly to the pin-diode attenuator circuit. This establishes a very fast muting action, by reverse biasing CR3. This action occurs in the event of an external VSWR fault.

4.3.1.11 ±12 VDC Needed to Operate the Board

The ±12 VDC connects to the board at J42C. The +12 VDC connects to J42C pin 16C and is filtered by L30, L41, and C80 before it is applied to the rest of the board. The -12 VDC connects to J42C pin 18C and is filtered by L31 and C81 before it is applied to the rest of the board.

The +12 VDC connects through R261 to the zener diode VR3 that connects to ground, which generates the +6.8 VDC output to the rest of the board. The +12 VDC also connects through R265 to the diodes CR30 and CR31 provide a .9 VDC reference output voltage VREF that temperature compensates for the two diodes in each corrector stage.

4.4 (A5) VHF/UHF Upconverter Module (1303829; Appendix A)

This module contains the Downconverter Board Assembly 1303834, the First Conversion Board 1303838, L-Band PLL Board 1303846 and the Upconverter Control Board 1304760. This module takes an external IF and converts it to the final RF output frequency using two internally generated local oscillator frequencies.

4.4.1 (A1) Downconverter Board Assembly (1303834; Appendix A)

This board converts a signal at an input frequency of 1044 MHz to a broadcast VHF or UHF TV channel.

The IF at 1044MHz is applied to the board at J7, and is converted down to VHF or UHF by the mixer IC U6. The LO frequency is applied to the board at a level of +20 dBm at J8. The output of the mixer is applied to a 6 dB attenuator and then to a 900 MHz Low Pass filter. The filter is intended to remove any unwanted conversion products. The signal is next connected to the amplifier U2, and then a pin diode attenuator consisting of DS4, DS5 and their associated components. The attenuator sets the output level of the board and is controlled either by a manual gain pot R7, or an external AGC circuit. This automatic or manual mode of operation is controlled by the switch SW1.

When in manual mode, the LED DS6 is illuminated.

The output of the pin attenuator is applied to another amplifier U3 and another low pass filter, before reaching the final amplifier U1. The output of the board is at J5 with a sample of the output available at J6, which is 20 dB in level below the signal at J5.

4.4.2 (A2) L-Band PLL Board (1303846; Appendix A)

This board generates an LO at a frequency of 1.1-1.9 GHz. The board contains a PLL IC U6, which controls the output frequency of a VCO. The PLL IC divides the output of the VCO down to 100kHz, and compares it to a 100kHz reference created by dividing down an external 10 MHz reference that is applied to the board at J1 pin 4. The IC generates an error current that is applied to U3 and its associated components to generate a bias voltage for the VCO's AFC input.

There are two VCOs on the board, U4, which operates at 1.1-1.3 GHz for VHF channels, and U5, which operates at 1.5-1.9 GHz for UHF channels. The VCO in use is selected by a signal applied to J1 pin 20. This input enables the power supply either U1 or U2 for the appropriate VCO for the desired channel. U7 is a power supply IC that generates +5V for the PLL IC U6.

The output of each VCO is filtered by a low pass filter to remove any harmonic content and applied to a pin diode switch consisting of CR1, CR2, and their associated components. The selected signal is amplified by U9 and U10, then applied to a high pass filter and finally amplified to a level of approximately +21 dBm by U11. The output is connected to a low pass filter to remove any unwanted harmonic content and leaves the board at J3 at a level of +20 dBm.

4.4.3 (A3) First Conversion Board (1303838; Appendix A)

This board generates a 1 GHz LO signal using the VCO U9, the PLL IC U12, and the loop filter, C30-C33 and R49. The PLL IC compares a divided down sample of the VCO to a divided down sample of the transmitter's system 10 MHz reference.

The output of the VCO is amplified by U10 and U11 and applied to a low pass filter before being connected to an image rejection mixer consisting of U1, U2, U3 and U6. The 44 MHz IF input is connected to the board at J2, and then to the image rejection mixer. This mixer converts the 44 MHz input to an output frequency of 1044 MHz. The output of the mixer is amplified by U4 and applied to a band pass filter consisting of C2-C4 and some microstrip line sections. This filter rejects any LO leakage at 1 GHz and also any unwanted out of band products. The output of the filter is amplified by U5 and then filtered before exiting the board at J1.

4.4.4 (A4) Upconverter Control Board (1304760; Appendix A)

This board performs a variety of functions, which include an interface between the other boards in the upconverter and the rest of the transmitter. It also has a microcontroller U8, which controls and monitors the functions of the other boards in the assembly.

The microcontroller communicates via an RS-485 interface with the transmitter's system control module. It reports any faults and metering information and receives channel information, which it passes along to the PLLs on the L-Band PLL Board and the First Conversion Board.

The board also generates various voltages used by the rest of the boards in the upconverter. U9 converts the +12V input to the board to +20V. U15 converts +12V to +5V for the on board 10 MHz crystal oscillator. U12 converts +12V to +9V for the L-Band PLL board and the First Conversion board. U13 and U14 generate +5V for the microcontroller.

The board also selects whether the internal or external 10 MHz reference source will be used. There is an onboard 10 MHz oscillator, U3, which is used when no external 10 MHz source is present. The Relay K1 is automatically switched to the external 10 MHz reference whenever it is present. The LED DS1 illuminates whenever the internal 10 MHz reference is used. The diode detector CR1 detects the presence of the 10 MHz external reference that connects to U2, which compares the detected level to a reference level and switches the relay whenever the reference is present. It also disables the internal oscillator whenever the external 10 MHz reference is being used.

The output of the relay is split to drive multiple outputs, some internal and some external. The external outputs leave the board at J1-22C and J1-31B and are used by the external receiver and modulator modules.

The board also contains AGC circuitry, which controls a pin diode attenuator on the Downconverter Board. There are three references used by the AGC circuit. The first is the AGC reference #1, which comes from the transmitter's driver module. The second is the AGC reference #2, which is a diode ORed sample of the output stages of the transmitter. The IC U5 normalizes the level of the AGC reference # 1 and sets it at a level that is 0.2V less than the level of AGC reference #2. The AGC reference #1 and #2 are diode ORed with only the highest reference used by the AGC circuit.

The highest reference is compared to the ALC reference, which originated on the IF processor module, and the error voltage generated by U4D and applied to the external pin attenuator. The AGC will try to maintain a constant ratio between the ALC voltages and the higher of the two AGC voltages. If something in the output amplifier of the transmitter fails, the AGC reference #1 voltage will take over and the power will be regulated at the output of the driver.

The RF from the Upconverter Module Assembly connects from the Upconverter RF Output BNC Jack J23, through a cable, to the PA RF Input BNC Jack J24, located on the rear of the exciter/amplifier chassis assembly.

4.5 (A4) Control Monitoring/Power Supply Module, 110 VAC (1301936; Appendix A)

The Control Monitoring/Power Supply Module Assembly contains (A1) a Power Protection Board (1302837), (A2) a 600 Watt Switching Power Supply, (A3) a Control Board (1302021), (A4) a Switch Board (1527-1406) and (A5) a LCD Display.

AC Input to Innovator LX Exciter/Amplifier Chassis Assembly

The AC input to the Exciter/Amplifier Chassis Assembly is connected from J1, part of a fused entry module, located on the rear of the chassis assembly to J50 on the Control Monitoring/Power Supply Module. J50-10 is line #1 input, J50-8 is earth ground and J50-9 is line #2 input. The input AC connects to J1 on the Power Protection Board where it is fuse protected and connected back to J50, at J50-11 AC Line #1 and J50-12 AC Line #2, for distribution to the cooling Fan.

4.5.1 (A1) Power Protection Board (1302837; Appendix A)

The input AC connects through J1 to two 10 Amp AC fuses F1 and F2. The AC line #1 input connects from J1-1 to the F1 fuse. The AC line #1 input after the F1 fuse is split with one line connected back to Jack J1 Pin 4, which becomes the AC Line #1 to the Fan. The other line of the split connects to J4. The AC line #2 input connects from J1-3 to the F2 fuse. The AC line #2 input after the F2 fuse is split with one line connected back to Jack J1 at Pin 5, which becomes the AC Line #2 to the Fan. The other line of the split connects to J2. J1-2 is the earth ground input for the AC and connects to J3.

Three 150 VAC MOVs are connected to the input AC for protection. One connects from each AC line to ground and one connects across the two lines. VR1 connects from J4 to J2, VR2 connects from J4 to J3 and VR3 connects from J2 to J3.

4.5.1.1 +12 VDC Circuits

+12 VDC from the Switching Power Supply Assembly connects to J6 on the board. The +12 VDC is divided into four separate circuits each with a 3 amp self resetting fuse, PS3, PS4, PS5 and PS6.

The polyswitch resettable fuses may open on a current as low as 2.43 Amps at 50°C, 3 Amps at 25°C or 3.3 Amps at 0°C. They definitely will open when the current is 4.86 Amps at 50°C, 6 Amps at 25°C or 6.6 Amps at 0°C.

PS3 protects the +12 VDC 2 Amp circuits for the System Controller, the Amplifier Controller and the Spare Slot through J62 pins 7, 8, 9 and 10. If this circuit is operational, the Green LED DS3, mounted on the board, will be lit.

PS4 protects the +12 VDC 2 Amp circuits for the Modulator and the IF Processor through J62 pins 13, 14, 15 and 16. If this circuit is operational, the Green LED DS4, mounted on the board, will be lit

PS5 protects the +12 VDC 2 Amp circuits for the Upconverter through J62 pins 17, 18, 19 and 20. If this circuit is operational, the Green LED DS5, mounted on the board, will be lit

PS6 protects the +12 VDC 2 Amp circuits for the Remote through J63 pins 17, 18, 19 and 20. If this circuit is operational, the Green LED DS6, mounted on the board, will be lit

4.5.1.2 -12 VDC Circuits

-12 VDC from the Switching Power Supply Assembly connects to J5 on the board. The -12 VDC is divided into two separate circuits each with a 3 amp self resetting fuse, PS1 and PS2.

PS1 protects the -12 VDC 2 Amp circuits for the System through J63 pins 1, 2, 3 and 4. If this circuit is operational, the Green LED DS1, mounted on the board, will be lit

PS2 protects the -12 VDC 2 Amp circuits for the Remote through J62 pins 1, 2, 3 and 4. If this circuit is operational, the Green LED DS2, mounted on the board, will be lit

The connections from J62 and J63 of the Power Protection Board are wired to J62 and J63 on the Control Board.

4.5.2 (A3) Control Board (1302021; Appendix A)

In this translator, the control and monitoring functions and the front panel operator interfaces are found on the Control Board. Front panel operator interfaces are brought to the control board using a 26 position conductor ribbon cable that plugs into J60. The control board controls and monitors the Power Supply and Power Amplifier module through a 16 position connector J61 and two 20 position connectors J62 & J63.

4.5.2.1 Schematic Page 1

U1 is an 8 bit RISC microcontroller that is in circuit programmed or programmed using the serial programming port J4 on the board. When the microcontroller, U1, is held in reset, low on pin 20, by either the programming port or the external watchdog IC (U2), a FET Q1 inverts the reset signal to a high that connects to the control lines of U5, an analog switch. The closed contacts of U5 connects the serial programming lines from J4 to U1. LED DS10 will be lit when programming port J4 is used.

U2 is a watchdog IC used to hold the microcontroller in reset, if the supply voltage is less the 4.21 VDC; (1.25 VDC < Pin 4 (IN) < Pin 2 (Vcc). The watchdog momentarily resets the microcontroller, if Pin 6 (ST) is not clocked every second. A manual reset switch S1 is provided but should not be needed.

Diodes DS1 through DS8 are used for display of auto test results. A test board is used to execute self test routines. When the test board is installed, Auto_Test_1 is held low and Auto_Test_2 is allowed to float at 5 VDC. This is the signal to start the auto test routines.

U3 and U4 are used to selectively enable various input and output ICs found on pages 2 & 3 of the schematic.

U1 has two serial ports available. In this application, one port is used to communicate with transmitter system components where U1 is the master of a RS-485 serial bus. The other serial port is used to provide serial data I/O where U1 is not the master of the data port. A dual RS-232 port driver IC and a RS-485 Port driver are also in the second serial data I/O system. The serial ports are wired such that serial data input can come through one of the three serial port channels. Data output is sent out through each of the three serial port channels.

Switch SW1, transmitter operation select, is used to select either transmitter operation or exciter/driver operation. When the contacts of SW1 are closed, transmitter operation is selected and the power monitoring lines of the transmitter's power amplifier are routed to the system power monitoring lines.

4.5.2.2 Schematic Page 2

U9 is a non-inverting transceiver IC that provides 2 way asynchronous communication between data busses. The IC is used as an input buffer to allow the microcontroller to monitor various digital input values.

Digital output latch circuits are used to control system devices. Remote output circuits are implemented using open drain FETs, Q13, Q14, Q16, and Q17, with greater than 60 Volt drain to source voltage ratings.

Remote digital inputs are diode protected, using CR6, CR7, CR8 and CR9 with a 1 kO pull-up resistor, to +5 VDC. If the remote input voltage is greater than about 2 Volts or floating, the FET is turned on and a logic low is applied to the digital input buffer, U9. If the remote input voltage is less than the turn on threshold of the FET (about 2 VDC), a logic high is applied to the digital input buffer, U9.

Four of the circuits on page two of the schematic, which include Q2, Q9, Q19 and Q21, are auxiliary I/O connections wired for future use. They are wired similar to the remote digital inputs but include a FET, Q5, Q12, Q20 and Q22, for digital output operations. To operate these signals as inputs, the associated output FET must be turned off. The FETs are controlled by U10 and U12, analog input multiplexer ICs.

4.5.2.3 Schematic Page 3

U13, U14, U15, U16, U17 and U18 are 3 state non-inverting transceiver ICs that provide 2 way asynchronous communication between data busses. The ICs are used as input buffers to allow the microcontroller to monitor various digital input values. The digital inputs to the ICs utilize a 10 kO pull-up resistor. The buffer

IC, U18, used for data transfer to the display is wired for read and write control.

4.5.2.4 Schematic Page 4

U19 and U20 are digitally controlled analog switches that provide samples back to the microprocessor. Each analog input is expected to be between 0 and 5 VDC. If a signal exceeds 5.1 VDC, a 5.1 Volt zener diode clamps the signals voltage, to prevent damage to the IC. Most signals are calibrated at their source, however two dual serial potentiometers ICs are used to calibrate four signals, System Visual/Average Power, System Aural Power, System Reflected Power and the Spare AIN 1. For these four circuits, the input value is divided in half before it is applied to an op-amp. The serial potentiometer is used to adjust the output signal level to between 80 and 120% of the input signal level. Serial data, serial clock and serial pot enables are supplied by the microprocessor to the dual serial potentiometer ICs. J62 and J63 are two 20 position connectors that provide the +12 VDC and –12 VDC power through the Power Protection Board. The ±12 VDC generated by the switching power supply connects to J62 and J63 after being fuse protected on the Power Protection Board.

4.5.2.5 Schematic Page 5

There are three dual element, red/green, common cathode LED indicators mounted on the front panel of the sled assembly; DC OK, Operate and Fault.

There are three, the fourth is a spare, identical circuits that drive the front panel mounted LED indicators. The levels on the 1, 2, 3 and 4 LED Control Lines, for both the red and green LEDs, are generated by the IC U11 as controlled by the DATABUS from the microprocessor U1.

Each LED controller circuit consists of an N-Channel MOSFET w/internal diode that controls the base of an N-P-N transistor in an emitter follower configuration. The emitter of the transistor connects the LED.

With the LED control line LOW, the MOSFET is Off, which causes the base of the transistor to increase towards +12 VDC, forward biasing the transistor. With the transistor forward biased, current will flow from ground through the LED, the transistor and the current limiting resistors in the collector to the +12 VDC source. The effected LED will light.

With the LED control line HIGH, the MOSFET is On, which causes the base of the transistor go toward ground potential, reverse biasing the transistor. With the transistor reverse biased, no current through the transistor and LED, therefore the effected LED will not light.

A third color, amber, can also be generated by having both transistors conducting, both control lines LOW. The amber color is produced because the current applied to the green element is slightly greater than the red element. This occurs because the current limiting resistors have a smaller ohmage value in the green circuit.

There are four voltage regulators, three for +5 VDC and one for +7 VDC, which are used to power the Control Board. +12 VDC is applied to U25 the +7 VDC regulator that produces the +7 VDC, which is applied to the LEDs mounted on the board. The +7V is also connected to the input of U26 a precision +5.0 Volt regulator. The +5.0 VDC regulator output is used to power the analog circuits and as the microcontroller analog reference voltage. Another two +5 Volt regulator circuits U27, +5V, and U8, +5 Vserial, are used for most other board circuits.

4.5.3 (A4) Switch Board (1527-1406; Appendix A)

The switch board provides five front-panel momentary contact switches for user control and interface with the front-panel LCD menu selections. The switches, SW1 to SW5, complete the circuit through connector J1 to connector J2 that connects to J1 on (A5) the 20 Character by 4 line LCD Display. J1 on the switch board is also cabled to the Control Board. When a switch is closed, it connects a logic low to the control board that supplies the information from the selected source to the display. By pushing the button again, a different source is selected. This occurs for each push button. Refer to Chapter 3, for more information on the Display Menu Screens.

4.5.4 (A2) Switching Power Supply Assembly

The power supply module contains a switching power supply, an eight position terminal block for distributing the DC voltages, a three position terminal block to which the AC Input connects. Jack J1 connects to the Control Board and supplies DC OK, at J1-4 & 3, and AC OK, at J1-2 & 1, status to the control board. A Power Supply enable connects from the control board to the power supply at V1-6 & 7. The power supply is configured for three output voltages +12V, -12V, at the 8 position terminal block, and a main output power of +32 VDC at J50 pin A (+) and J50 pin B (Rtn). The power supply is power factor corrected to .98 for optimum efficiency and a decrease in energy consumption. For safety purposes all outputs are over voltage and over current protected. This supply accepts input voltages from 85 to 264 volts AC, but the power entry module, for the exciter/amplifier chassis, must be switched to the proper input voltage setting, for the transmitter to operate.

4.7 (A6) Power Amplifier Assembly, VHF High Band, (1305833; Appendix A)

The Power Amplifier Module Assembly 1305833 contains (A2) a 25 Watt VHF Driver Pallet 1305820, (A4) a VHF HB Coupler Board 1211-1004, and (A5) an Amplifier Control Board 1308260.

4.7.1 (A2) 25 Watt VHF Driver Pallet (1305820; Appendix A)

The RF input at a level of approximately +4 dBm connects to the RF input jack on the (A2) Driver Assembly Pallet. The pallet is an assembly manufactured by Delta RF and has a gain of approximately +30dB. The Refer to the Delta RF data sheet (PA25-VHF-H) located in Appendix A for more information on the assembly. The RF output, approximately+34 dBm, connects to the RF input jack on (A4) the coupler board assembly.

The +30 VDC bias voltage connects from the amplifier control board at TB18 to the feed thru capacitor FL2 on the module assembly that is wired to the $+V_{dd}$ input on the 25 Watt VHF Amplifier Assembly.

4.7.2 (A4) Coupler Board Assembly (1211-1004; Appendix A)

The coupler board assembly provides forward and reflected power samples of the output to (A5) the amplifier control board where they connect to the metering and overdrive protection circuits in the system.

The RF input to the coupler assembly, from the 25 Watt VHF Amplifier module, connects to the SMA jack J1. In the assembly, the RF is connected by a stripline track to the SMA type connector RF Output jack J2. A hybrid-coupler circuit picks off a power sample that is connected to a SMA type connector jack J3 as the forward power sample. Another power sample is taken from the coupler circuit that is connected to the SMA type connector jack J4 as the reflected power sample.

4.7.3 (A5) Amplifier Control Board (1308260; Appendix A)

The amplifier control board provides LED fault and enable indications on the front panel of the module and also performs the following functions: overdrive cutback, when the drive level reaches the amount needed to attain 110% output power; and overtemperature, VSWR, and overdrive faults. The board provides connections to the LCD Display for monitoring the % Reflected Power, % Output Power, and the power supply voltage.

If the Module OK LED, located on the front panel, is Red and blinking, a fault is present. The meaning of the blinking LED is as follows.

1 Blink: Indicates Amplifier Current Fault.
2 Blinks: Indicate Temperature Fault.
3 Blinks: Indicate +32V Power Supply Over Voltage Fault.
4 Blinks: Indicate +32V Power Supply Under Voltage Fault.
5 Blinks: Indicate Reflected Power Fault.
6 Blinks: Indicate +12V or –12V Power Supply Fault

If the Module OK LED, located on the front panel, is Amber and blinking, it indicates the power output of the amplifier has dropped below 65%. (**NOTE:** Only in Amplifier Code Versions 3.7A or later and System Controller Code Versions 3.9C or later.).

4.7.3.1 Schematic Page 1

U4, located upper center of page, is an in circuit microcontroller. The controller is operated at the frequency of 3.6864 MHz using crystal Y1. Programming of this device is performed through the serial programming port J2. U4 selects the desired analog channel of U3 through the settings of PA0-PA2. PA3 of U4 is a processor operating LED that can be flashed to show continued operation. PF1 is used to monitor the +12VDC supply to the board. PF4 is the selected channel of analog switch U3. PF3 is connected to a via, V10, for future access.

U2 is a serial to RS-485 driver IC. U5 is a watchdog IC used to hold the microprocessor in reset, if the supply voltage is less than 4.21 VDC. U5 momentarily resets the microcontroller if Pin 6 (!ST) is not clocked every second. A manual reset switch is provided but should not be needed.

In the Upper left corner, U1 is used to determine where the amplifier control board is located. The eight inputs come from the main amp connector J8 and are used to set the SCADA address of the controller. Pull-up resistors set a default condition of logic high.

U6 below U1 is used to control two of the four board mounted status LEDs and three other circuits that are not allowed to change state during a microcontroller reset. A FET is turned On to shunt current away from the LED to turn it Off. U8 below U6 is used to enable different features within the software. Actual use is to be determined.

4.7.3.2 Schematic Page 2

In the lower right corner are voltage regulator circuits. U17 should allow for 0.14 amps of power using its 92 C/W rating if Ta = 60°C max and Tj = 125°C max. 0.26 amps can be obtained from U17 if the mounting pad is 0.5 square inches. The controller will not need this much current. U18 and U19 are low drop out +5 VDC, voltage regulators with a tolerance greater than or equal to 1%. 100mA of current is available from each device but again the controller will not need this much current.

In the upper left section are circuits with U9 and U11. U11 is used to generate a regulated voltage that is about 10 volts less than the +32 VDC supply, approximately +20.75 VDC. When the +32 VDC supply is enabled, the circuitry around U9A is used to provide gate voltage to Q14 that is 5 volts greater than the source pin of this FET. The gate of Q14 can be turned Off by any one of a few different circuits.

U10A is used to turn Off the gate of Q14 in the event of high current in amplifier #1. At 1.10 VDC the current to amplifier #1 should be greater than 6.2 Amps. U10B is used to turn off the Q14 FET, if high current is detected in amplifier #2. U12A is used to turn off the Q14 FET, if high current is detected in amplifier #3. With 2.743 VDC at Pin 5 of U10B or Pin 3 of U12A, the voltage output of current sense amplifier U15 or U16, at high current shut down, should be greater than 15 Amps. These circuits are wired through Q12 and Q13. At this time, these transistors are not installed but they may be installed to increase the shut-down time on a detected fault. Without Q12 and Q13 installed, Q14 is only turned off by the microcontroller through Q16.

U10A is used to detect high current in amplifier #1. At 1.10 VDC, the current to amplifier #1 should be 6.2 Amps. U10B and U12A are used to detect high current conditions in amplifier stages #2 and #3. With 2.74 VDC reference, high current shut down should be approximately 15 Amps.

U12B is used to turn Off the gate of Q14 in the event of high power supply voltage, approximately +35.4 VDC. U13A is used to keep the FET disabled in the event of low power supply voltage, approximately +26 VDC.

4.7.3.3 Current monitoring sections of the board.

The ICs U14, U15 and U16 along with associated components set up the current monitoring sections of the board. R67, R68 and R69 are 0.01O/5W 1% through hole resistors used for monitoring the current through several sections of the amplifier. The voltage developed across these resistors are amplified for current monitoring by U14, U15 or U16. The LT1787HVCS8 precision high side current sense IC amplifier accepts a maximum voltage of 60 VDC. The 43.2 kO resistor from pin 5 to ground sets the gain of the amplifier to about 17.28. This value is not set with much accuracy since the manufacturer internally matches the resistors of this part but their actual resistance value is not closely defined. A trimming resistor is suggested to give a temperature stability of –200 ppm/C, but instead the microcontroller will determine the exact gain of the circuit and use a correction factor for measurements.

A6 is a temperature sensor thermistor that is used to monitor the temperature of the module's heat sink. It connects to J6 pins 1 & 2 on the board and is wired to the comparator IC U13B. If the temperature increases above 75°C the output will go Low that is used as a temperature fault output, which generates a Fault alert and disables Amplifier #1.

4.7.3.4 Schematic Page 3, RF power detector circuits.

Q16 is used by the microcontroller to disable the aural circuit of a digital transmitter or in external amplifiers where the amplifier is not to monitor visual power. A Forward Power Sample enters the board at SMA Jack J3 and is connected to pin 1 of U23. The output at Pin 6 of U23 is split with one input connected to J4 on the board that is cabled to J1, the SMA Forward Power Sample Jack, located on the front panel of the assembly. The other part of the split forward power sample is detected by CR24 and the DC level amplified by U21B. The output of U21B at pin 7 is split with one part connected to test point TP2, forward power sample. The other split output connects to U21C that is part of the Forward Average Power circuit. The detected level is connected through the average/visual calibration pot R202 to U24A, a comparator IC that has Aural Null and Offset Null, if present in the system, connected to the other input. The output

Average Forward power level connects to J9 pin 1 of the board.

A Reflected Power Sample enters the board at SMA Jack J5 and is detected by CR31 and the DC level amplified by U21D. The output of U21D at pin 14 is connected through the reflected calibration pot R201 to U25A. The output is split with one part connected to J9 pin 5, the Reflected Power Output level of the board. The other part of the split from U25A connects to the comparator IC U25B that has a reference level connected to the other input. If the reflected level increases above the reference level a low output is produced and connected to the Reflected Power Shutdown circuit at CR14 and CR5 on Page 2 of the schematic. This produces a Reflected Power Fault that is connected to an output of the board, the Fault Alert circuit and shuts down Amplifier #1.

Gain of the power measurements is completed through software. Only the Aural Null and Offset Null, if used, need to be done through front panel pots.

NOTE: In this configuration the output of U23 at pin 6 is not used. This circuit is for analog 4.5 MHz and Aural power samples.

This completes the description of the 1305833 20W Analog Power Amplifier Module Assembly.

Chapter 5
Detailed Alignment Procedures

This translator was aligned at the factory and should not require additional adjustments to achieve normal operation.

The analog translator takes the VHF on channel input, which connects to the receiver module, that converts it to an IF output which is then upconverted to the desired UHF On Channel RF Output at 20W peak of sync visual power level.

The exciter/amplifier chassis assembly of the LX Series translator is of a Modular design and if a Module fails that module can be easily changed out with a replacement module. The failed module can then be sent back to Axcera for repair. Contact Axcera Customer Service Department at 724-873-8100 or fax to 724-873-8105, before sending in any module.

5.1 Module Replacement

Module replacement on the LX series products is a relatively simple process. All modules plug directly into the backplane board except for the power amplifier module that plugs into a blind mating connector. To replace a module, refer to the following procedure.

Loosen the two grip lock connectors, located on the front panel, at the top and bottom of the module, counterclockwise until the module releases. The Receiver, IF Processor, Upconverter and Controller/Power Supply can then be gently pulled from the unit. To remove the Driver/Power Amplifier Module in the exciter/amplifier chassis assembly, the two cables, Input and Output, connected to the rear of the chassis must be removed. A 6/32” x ½” shipping screw, located between the two connectors, also must be removed before the module will slide out. After removal of the failed module, slide the replacement module in place and make certain it connects to the backplane board. If the replacement module is a driver/PA module replace the two cables onto J24 and J25 on the rear of the exciter/amplifier chassis assembly. The 6/32” x ½” shipping screw does not need to be replaced. It is only used during shipping. If the replacement module does not slide in easily, verify it is properly aligned in the nylon tracks, located on both the top and bottom of the module.

Note: Each Module has an assigned slot and will not fit properly or operate in the incorrect slot. Do not try to place a Module in the wrong slot as this may damage the slot or the connectors on the backplane board. Each module has the name of the module on the front, bottom for identification and correct placement. The Modules are placed in the chassis assembly from left to right; (1) Receiver, (2) Blank panel, (3) IF Processor, (4) Upconverter, (5) Controller/Power Supply and (6) Driver Power Amplifier.

5.1.1 Initial Test Set Up

Check that the RF output of the translator is terminated into a dummy load of at least 20 Watts. While performing the alignment, refer to the Test Data Sheet for the system and compare the final readings from the factory with the readings on each of the modules. The readings should be very similar. If a reading is way off, the problem is likely to be in that module.

Switch On the main AC for the system.

5.2 LX Series Exciter/Amplifier Chassis Assembly

On the LCD Display, located on the Controller/Power Supply Module, in the Transmitter Set-Up menu, push the right button to switch the translator to Operate, STB will be displayed. The level of the RF output includes adjustments of the drive level to the Power Amplifier and the adjustment of the linearity and phase predistortion to compensate for any nonlinear response of the Power Amplifier. The adjustments are located on the front panel of the IF Processor module.

5.2.1 Receiver Module Assembly

(Used in Analog Translator Only.)

Connect the on channel RF input to J12 the receiver RF input jack on the rear of exciter/amplifier assembly. Verify that all LEDs located on the front panel of the Receiver are Green. The following details the meaning of each LED:

PLL 1 Fault (DS6) - Displays the status of the Local oscillator PLL

PLL 2 Fault (DS8) - Displays status of optional input frequency correcting PLL

DC on center conductor (DS4) - Displays whether or not DC is applied to the RF input center conductor*

***Caution: Do not hook up the RF input to any test equipment with the DC bias applied. Always move the jumper W1 on J2 on the VHF Preamplifier board to the Bias off position, between pins 2 & 3, before beginning tests, to prevent possible damage to the test equipment.**

5.2.2 IF Processor Module Assembly

Verify that all red LEDs located on the IF Processor front panel are extinguished. The following details the meaning of each LED when illuminated:

Input Fault (DS1) – Indicates that either abnormally low or no IF is present at the input of the IF Processor module.

- **ALC Fault (DS2)** – Indicates that the ALC circuit is unable to maintain the signal level requested by the ALC reference. This is normally due to excessive attenuation in the linearity signal path or the IF phase corrector signal path, or that switch SW1 is in the Manual ALC Gain position.

- **Mute (DS4)** – Indicates that a Mute command is present to the system.

Switch the translator to Standby. The ALC is muted when the translator is in Standby.

5.2.3 VHF/UHF Upconverter Module Assembly

Switch the translator to Operate. Verify that all LEDs located on the front panel of the Upconverter are Green. The following details the meaning of each LED:

PLL 1 Fault (DS1) - Displays the status of the 1 GHz PLL, Green locked or Red unlocked

PLL 2 Fault (DS2) - Displays status of the 1.1-1.9 GHz PLL, Green locked or Red unlocked

AGC Fault (DS7) - Displays status of AGC, Green normal or Red out of range

AGC Override (DS3) - Displays status of AGC cutback, either Green normal drive level, no cutback, or too much drive level to driver module, Red cutback.

Manual Gain (DS6) - Displays status of the control of the AGC level, either Green normal, AGC Adj. using R6 or Amber manual, Man Gain Adj. using R7.

The translator is now ready for normal operation.

5.3 Changing the Analog Translator Output Channel Procedure

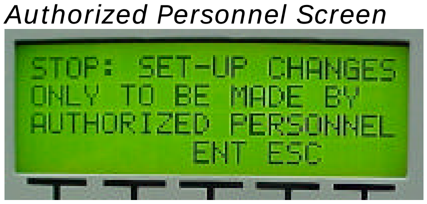
NOTE: Depending on the new channel frequency, the bandpass filter may need to be retuned or replaced to achieve maximum output power.

Place the translator in Standby and go to the Set Up Menu, Transmitter Configuration Access Screen, on the LCD Display by pushing the down arrow on the default main screen and each succeeding screen until the Transmitter Set-Up Main Screen appears.

Transmitter Set-Up, Configuration Access Screen

Enter the Set-Up screens by pushing the ENT button. The following screen will appear.

Authorized Personnel Screen



This screen of the translator notifies an operator that they are only to proceed if they are authorized to make changes to the translator's operation. This screen is implemented in transmitter software version 1.4 and above. Push the ENT button and step through the Set Up screens by pushing the Down Arrow button until the screen labeled "Upconverter CH xx" is reached, as shown in the following example. This example shows the Transmitter set to Channel 39.

Transmitter Set-up: Upconverter Channel Select Screen

The choices of this screen are to the standard UHF/VHF channels. The channel number should be blinking. To change the channel, hit the **+** button to step through the channels until the desired channel is reached.

To select a 10kHz offset to the channel frequency, use the **>** button to move the curser to the LO frequency listed below the Channel number, and keep pressing the **>** button until the desired digit is blinking, and then use the **+** button to change the frequency.

Example:

Nominal LO frequency for Channel 39 = 0667.00 MHz. To generate a + offset, change the LO frequency to 0667.01 MHz. To generate a – offset, change the LO frequency to 0666.99 MHz.

A safeguard is added to the Set Up Menus in software version 2.5 and above. If a change is made to a screen within the Set Up Menu, as was just completed with the channel change, when you go to the next menu, by pushing the Down or Up Arrow, a screen appears that asks if you accept the change or want to return to the previous menu to reconsider the changes made. See the Accept or Return to previous Menu Screen. To accept the changes, the two buttons located under ACCEPT must be pushed simultaneously. To return to the previous Menu to make corrections, the two buttons located under the RETURN must be pushed simultaneously. Upon returning to the previous Menu, the correct input must be entered and the above procedure repeated, this time accepting the changes.

Accept or Return to previous Menu Screen

Pushing these two buttons together will accept the change.

Pushing these two buttons together will return you to the previous Menu.

Accepting the changes will put you back to the Main Set-Up Screen.

5.4 Adjusting the Manual AGC, Auto AGC, and the Overdrive Cutback Protection (AGC Cutback) in the Analog Translator

NOTE: For alignment and calibration of the digital translator proceed to the Section 5.8.

NOTE: The translator was setup and calibrated at the factory and should require no adjustment to attain normal operation.

5.4.1 Setting the Manual AGC

Switch the Translator to Standby. Preset the front panel "Man Gain" pot on the Upconverter full **Counterclockwise**, and the Man/Auto Gain Switch to the **Left, Man.**

Turn the translator to **Operate**, and slowly adjust the "Man Gain" pot until the desired % output power, as read on the LCD display, has been reached.

The Manual AGC is now set. Normal operation of the Translator is in the Auto AGC position.

5.4.2 Setting the Auto AGC

With the translator in **Standby**, preset the AGC pot on the Upconverter full **Counterclockwise**. Preset the AGC Cutback pot on the Upconverter full **Clockwise**. Move the Man/Auto Gain Switch on the Upconverter to the **Right, Auto**. Switch the translator to **Operate** and slowly adjust the AGC pot until the desired output power has been reached.

Monitor the output of the translator with a Spectrum Analyzer and turn the power up 1 dB higher than desired using the AGC pot. Enter the Translator Set-Up menu on the LCD Control Panel and step through the screens until the screen labeled "Inner Loop Gain" is reached. The inner loop is adjustable from 0-255. Push the **+** button to increase the Inner Loop Gain until the power on the spectrum analyzer just begins to decrease. Now push the **–** button to decrease the inner loop gain by 10%. (Example: If it begins to affect power at setting 160, drop it back down to 160-16=144 or if it affects power at 100, drop it down by 10 to 90, etc.…).

5.4.3 Setting the AGC Cutback

Slowly turn the AGC Cutback Pot **Counterclockwise** until the AGC Override light begins to flicker, and the output power begins to drop. Turn the pot **Clockwise** slightly, so the light just goes out and the power stabilizes. Adjust the AGC pot until the power level returns to the desired % output power level. The Auto AGC is now set. Normal operation of the Translator is in the Auto AGC position.

The translator is now ready for normal operation.

5.5 Calibration of the Forward and Reflected Output Power for the Analog Translator

NOTE: Only perform the following procedures if the output power calibration is suspect.

5.5.1 Calibration of Forward Output Power

Switch the translator to Standby and place the Upconverter into Manual Gain. Preset R205, the aural null pot on the Amp Control board, fully CCW. Adjust R204, the null offset pot on the Amp Control board, for 0% visual output. Perform the following adjustments with no aural present by removing the aural IF carrier jumper on the back of the chassis assembly. Connect an RF On Channel frequency with a sync and black test signal modulated onto it to the Receiver RF input jack J12 on the rear of the exciter/amplifier chassis. Switch the translator to Operate.

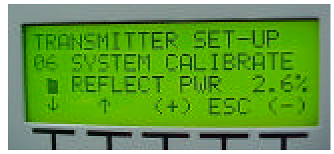
Next, set up the translator for the appropriate average output power level:

Example is for a 20 Watt Translator.

- Sync + black 0 IRE setup/wattmeter=11.9 watts
- Sync + black 7.5 IRE setup/wattmeter=10.9 watts

NOTE: The translator must have 40 IRE units of sync.

Adjust R202, visual calibration, on the Amp Control board for 100% on the front panel LCD display in the % Visual Output position. (Examples of the screens are shown below).



With the spectrum analyzer set to zero span mode, obtain a peak reference on the screen. Reconnect the aural carrier jumper on the rear of the chassis assembly. Turn the power adjust pot on the front panel until the original peak reference level is attained. Adjust R203 for a 100% aural power reading. Switch to the Visual Output Power position and adjust R205 (aural null pot) for 100% visual power.

5.5.2 Calibration of Reflected Power

To calibrate the reflected output power reading of the translator. Reduce the manual gain pot R3 to a 10% reading on the LCD front panel display in the % Output Power position. Place the translator in Standby. Remove the PA Module Sled. Remove the load from J4 on the (A4) Directional Coupler Board and switch the LCD Display screen to the Reflected Output Power position. Reinstall the PA Module. Switch the translator to operate. Adjust the reflected power calibration adjust pot R163 on the power amplifier module to a 10% reading. A reflected power fault should be present on the LCD Display. Reconnect the load to J4 in the module.

After this calibration is completed, move switch SW1 on the upconverter module to the Automatic AGC position. This is the normal operating position for the switch. Adjust the ALC pot on the IF Processor as needed to attain 100% output power. Switch to Manual Gain (Manual AGC) and adjust the Manual Gain pot for 100 % output power. Switch the upconverter back to Automatic AGC.

The translator is now ready for normal operation.

5.6 Linearity Correction Adjustment for the Analog Translator

As shipped, the exciter was preset to include amplitude and phase pre-distortion. The pre-distortion was adjusted to approximately compensate the corresponding non-linear distortions of the Power Amplifier.

NOTE: On the IF processor board inside the IF Processor module, the correction enable/disable jumper W12 on J30 must be in the Enable position, on pins 2 & 3. This is the normal operating position.

Set up a spectrum analyzer with 100 kHz resolution bandwidth and 100 kHz video bandwidth to monitor the intermodulation products of the RF output signal of the Power Amplifier.

A typical red field spectrum is shown in Figure 5-1.

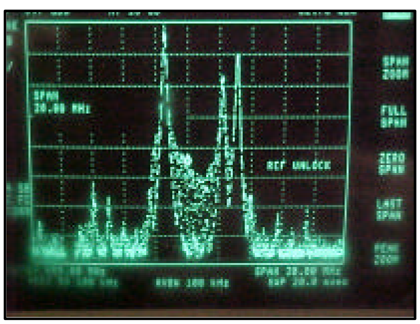


Figure 5-1: Typical Red Field Spectrum in Analog Translator

There are three Linearity Corrector stage adjustments located on the front panel of the IF Processor Module. The adjustments are threshold settings that are set up as needed to correct for any amplitude or phase intermod problems. Adjust the top linearity correction adjustment R211 threshold cut in for the in phase amplitude distortion pre-correction that is needed. Next, adjust the middle linearity correction adjustment R216 threshold cut in also for the in phase amplitude distortion pre-correction that is needed. Finally, adjust the bottom linearity correction adjustment R231 threshold cut in for the quadrature phase distortion pre-correction that is needed. The above pots are adjusted for the greatest separation between the peak visual carrier and the intermod products. **NOTE:** These pots affect many other video parameters, so care should be taken when adjusting the linearity correction.

5.7 Frequency Response Delay Equalization Adjustment for the Analog Translator

NOTE: Perform the following procedure only if a frequency response delay equalization problem is suspect.

The procedure for performing a frequency response delay equalization adjustment for the translator is done at IF and is described in the following steps:

The center frequency for the first stage is 42 MHz. Adjust R103, the top frequency response equalizer pot, located on the front panel of the IF Processor Module, for the best depth of frequency response correction at 42 MHz.

The center frequency for the second stage is 43.5 MHz. Adjust R106, the middle frequency response equalizer pot, located on the front panel of the IF Processor Module, for the best depth of frequency response correction at 43.5 MHz.

The center frequency for the third stage is 45 MHz. Adjust R274, the bottom frequency response equalizer pot, located on the front panel of the IF Processor Module, for the best depth of frequency response correction at 45 MHz.

After the three delay attenuation equalizers have been adjusted, fine tune, as needed, for the best frequency response across the channel.

The Analog Translator is now aligned, calibrated, and ready for normal operation.

If a problem occurred during the alignment, help is available by calling Axcera field support at (724) 873-8100.

APPENDIX A

SYSTEM AND EXCITER/AMPLIFIER DRAWINGS