Instruction Manual

Innovator® HX Series

Analog VHF High Band Transmitter

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Chapter 1
Introduction

This manual provides information about and documentation on the Innovator® HX Series Analog VHF High Band Transmitter.

It is important that any user of this equipment read all of the instructions, especially the safety information in this chapter, before operating the transmitter.

1.1 Manual Overview

This instruction manual is divided into five chapters and the supporting appendix. **Chapter 1**, Introduction, contains information on safety, return procedures, and warranties. **Chapter 2** contains the system and assembly descriptions. **Chapter 3** describes the installation and set up procedures and the operation of the overall transmitter. **Chapter 4** contains the detailed circuit descriptions of the boards and subassemblies that are contained in the transmitter. **Chapter 5** describes the alignment of the overall transmitter. **Appendix A** contains the interconnects, schematics and assembly drawings of the system, trays, assemblies, subassemblies and boards that make up the transmitter.

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.

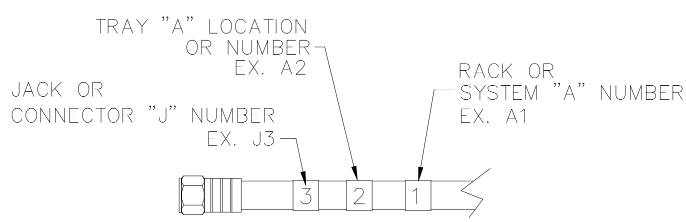


Figure 1-1 Brady Marker Identification Drawing

1.3 Safety

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

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

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

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

Follow Instructions – All of the operating and use instructions for the product 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.

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 needed, 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 Material Return Procedure

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

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

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

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

When shipping an item to Axcera, please include the MRA# on the packing list and on the Axcera-provided shipping container. The packing slip should also include contact information and a brief description of why the unit is being returned.

Please forward all MRA items to:

Axcera
Customer Service Department
103 Freedom Drive
P.O. Box 525
Lawrence, PA 15055-0525 USA

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

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

1.6 Limited One-Year Warranty for Axcera Products

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

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

Equipment furnished by Axcera, but not bearing its trade name, shall bear no warranties other than the special hours-of-use or other warranties extended by or enforceable against the manufacturer at the time of delivery to the buyer.

NO WARRANTIES, WHETHER STATUTORY, EXPRESSED, OR IMPLIED, AND NO WARRANTIES OF MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE, OR FREEDOM FROM INFRINGEMENT, OR THE LIKE, OTHER THAN AS SPECIFIED IN PATENT LIABILITY ARTICLES, AND IN THIS ARTICLE, SHALL APPLY TO THE EQUIPMENT FURNISHED HEREUNDER.

☞ WARNING!!!

≺ HIGH VOLTAGE ≻

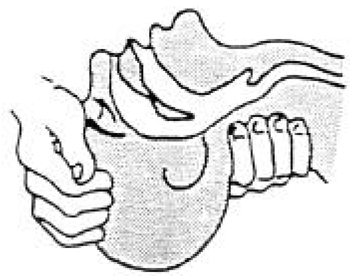
DO NOT ATTEMPT TO REPAIR OR TROUBLESHOOT THIS EQUIPMENT UNLESS YOU ARE FAMILIAR WITH ITS OPERATION AND EXPERIENCED IN SERVICING HIGH VOLTAGE EQUIPMENT. LETHAL VOLTAGES ARE PRESENT WHEN POWER IS APPLIED TO THIS SYSTEM. IF POSSIBLE, TURN OFF POWER BEFORE MAKING ADJUSTMENTS TO THE SYSTEM.

★ RADIO FREQUENCY RADIATION HAZARD ★

MICROWAVE, RF AMPLIFIERS AND TUBES GENERATE HAZARDOUS RF RADIATION THAT CAN CAUSE SEVERE INJURY INCLUDING CATARACTS, WHICH CAN RESULT IN BLINDNESS. SOME CARDIAC PACEMAKERS MAY BE AFFECTED BY THE RF ENERGY EMITTED BY RF AND MICROWAVE AMPLIFIERS. NEVER OPERATE THE 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.

VHF TELEVISION CHANNEL FREQUENCIES						
CHANNEL	FREQ LIMIT LOW (MHz)	FREQ LIMIT HIGH (MHz)	VISUAL CARRIER (Vc) (MHz)	COLOR CARRIER (MHz)	AURAL CARRIER (MHz)	L.O. FREQ 45.75 + Vc (MHz)
2	54.00	60.00	55.25	58.83	59.75	101
3	60.00	66.00	61.25	64.83	65.75	107
4	66.00	72.00	67.25	70.83	71.75	113
5	76.00	82.00	77.25	80.83	81.75	123
6	82.00	88.00	83.25	86.83	87.75	129
7	174.00	180.00	175.25	178.83	179.75	221
8	180.00	186.00	181.25	184.83	185.75	227
9	186.00	192.00	187.25	190.83	191.75	233
10	192.00	198.00	193.25	196.83	197.75	239
11	198.00	204.00	199.25	202.83	203.75	245
12	204.00	210.00	205.25	208.83	209.75	251
13	210.00	216.00	211.25	214.83	215.75	257

NOTE: Because of a possible FCC assigned offset, the carrier frequency may vary from those given in the above table. Please check for the assigned carrier frequency as written on the license.

dBm, dBw, dBmV, dBμV, & 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

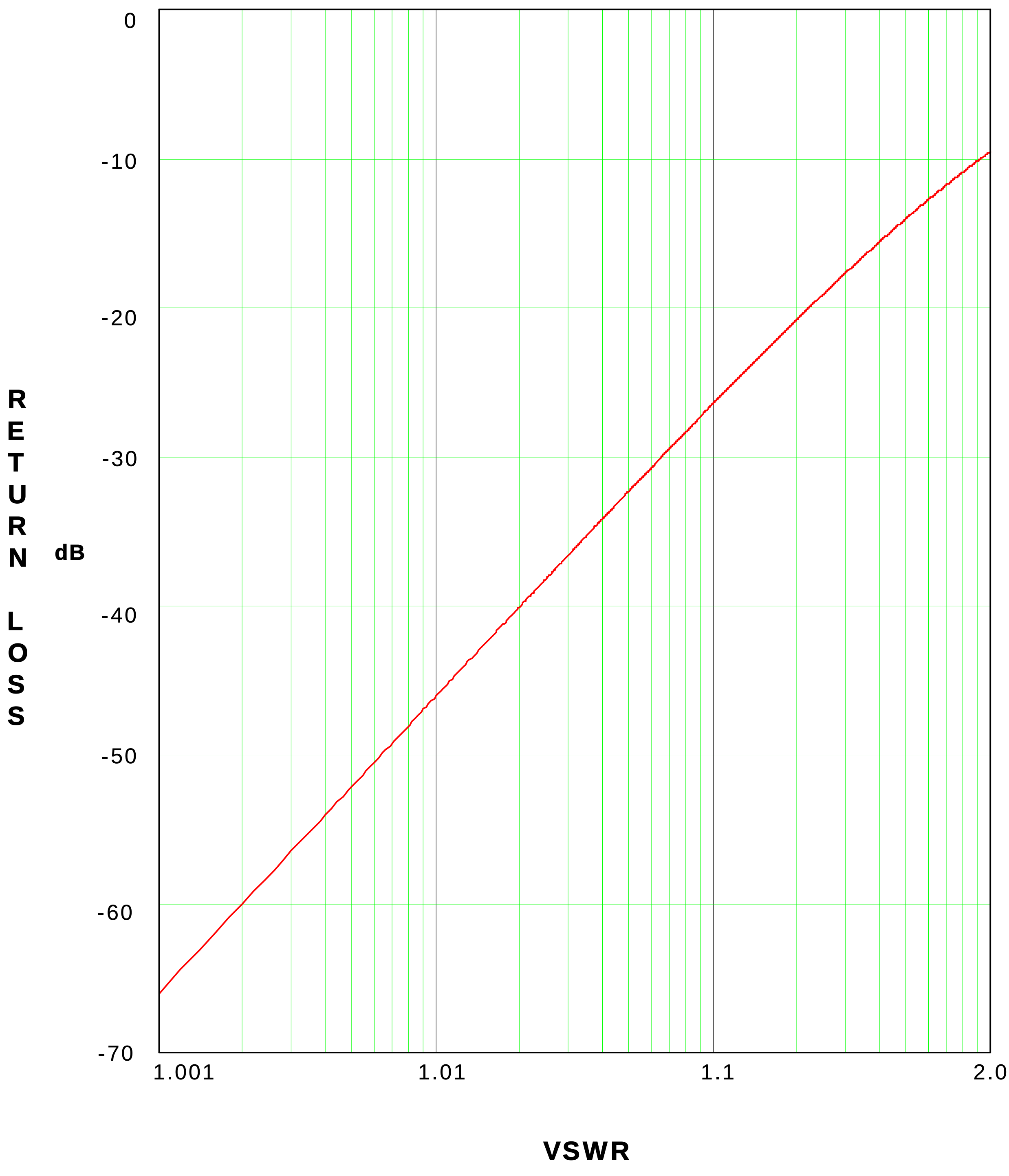
NOMENCLATURE OF FREQUENCY BANDS

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

AWG American wire gauge

BER Bit Error Rate

BW Bandwidth

DC Direct Current

D/A Digital to analog

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

Chapter 2
System Description and Remote Control Connections

2.0 System Overview

The Innovator® HX Series VHF Transmitter is a complete internally diplexed modular television transmitter. It operates at a nominal output power of 100 watts analog.

The HX Series transmitter is made up of the modules and assemblies as shown in Figure 2-1 and listed in Table 2-1.

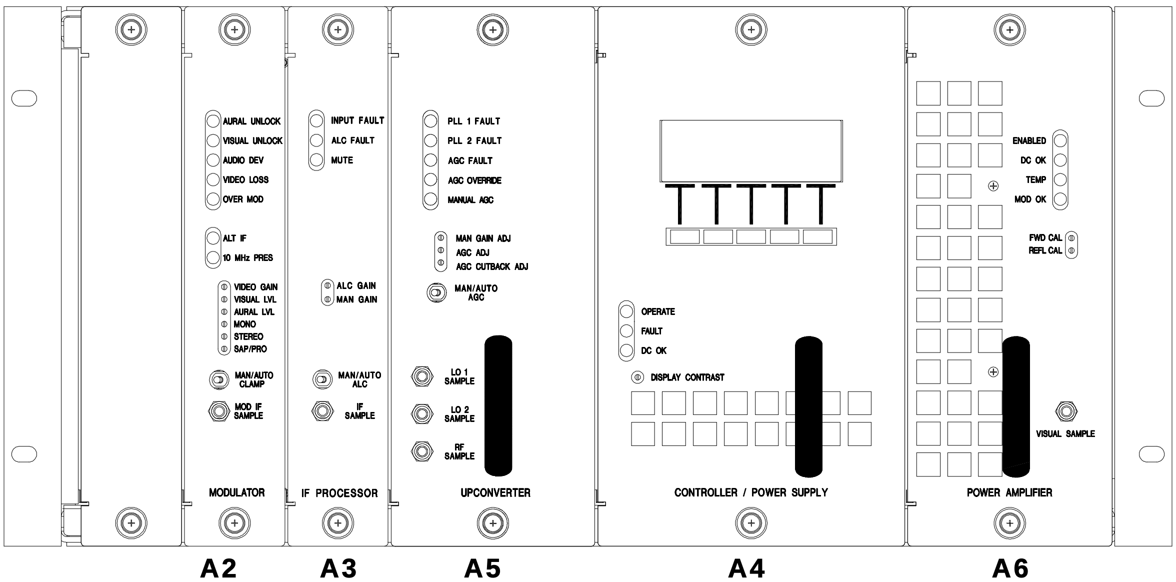


Figure 2-1: Transmitter Front View

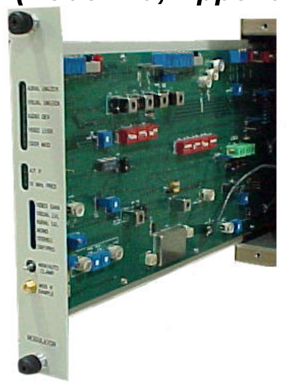
Table 2-1: HX Series Trays and Assemblies

ASSEMBLY DESIGNATOR	TRAY/ASSEMBLY NAME	PART NUMBER
	Exciter Driver Chassis Assembly, HX Series	1307715 (110 VAC)
A11	Backplane Board, Axciter	1307307
A2	Modulator Module	1305420
A3	IF Processor Module	1305421
A5	VHF/UHF Upconverter Module	1303829
A4	Control/Power Supply Module	1301936 (110 VAC)
A6	Power Amplifier Module	1305822

2.1 Exciter Amplifier Chassis Assembly, (1307715/110VAC; Appendix A)

All of the modules, except the power amplifier module and the power supply section of the Control & Monitoring/Power Supply Module plug directly into the Backplane Board, Axciter (1307307). The backplane board provides module to module interconnection as well as interconnection to remote command and control connectors. Refer to the backplane board schematic drawing (1307308), located in Appendix A, for the exciter driver chassis assembly connections.

2.1.1 (A2) Modulator Module Assembly (1305420; Appendix A)



The (A2) Modulator Assembly contains the Modulator Board (1304704). The modulator is broadcast quality and provides front panel access to control and monitoring points. The video level is controlled through a sync tip clamp and sync and white clipping circuitry. The IF oscillator is oven controlled and locked to a 10 MHz reference for stability. The IF signal is fed through a SAW filter for precise sideband shaping. The Modulator operates using the baseband audio and video inputs to produce a diplexed, modulated, and on-channel frequency visual + aural IF output that is cabled to the IF Processing Module.

Table 2-2. Modulator Front Panel Switch

SWITCH	FUNCTION
MAN/AUTO CLAMP SW1	When Manual Clamp is selected, the video level is set by the Manual Bias Pot R67 located on the board. (**NOTE**: The pot is factory set and needs no adjustment by the customer). When Auto Clamp is selected, the video level control circuit will automatically increase or decrease the video to maintain the desired video level.

Table 2-3. Modulator Front Panel Status Indicators

LED	FUNCTION
AUR UNLOCK DS5 (Red)	When lit it indicates that the 4.5 MHz VCO and the 10 MHz reference are not PLL locked.
VIS UNLOCK DS6 (Red)	When lit it indicates that the 45.75 MHz VCXO and the 10 MHz reference signal are not PLL locked.
AUDIO DEV DS4 (Red)	When lit it indicates the deviation level is more than ±80kHz
VIDEO LOSS DS1 (Red)	When lit it indicates the Video Input to the transmitter is lost.
OVER MOD DS3 (Red)	When lit it indicates the Video input level is too high.
ALT IF DS7 (Green)	When lit it indicates that external or alternate 4.5MHz is present.
10 MHz PRES DS2 (Green)	When lit it indicates that a 10MHz reference is present to the transmitter.

Table 2-4. Modulator Front Panel Control Adjustments

POTENTIOMETERS	DESCRIPTION
Video Gain (R42)	Adjusts the level of the output video.
Visual Level (R214)	Adjusts the Visual IF level that combines with the Aural IF.
Aural Level (R243)	Adjusts the Aural IF level that combines with the Visual IF.
MONO (R110)	Adjusts the deviation level of the balanced audio input.
STEREO (R132)	Adjusts the deviation level of the composite audio input.
SAP/PRO (R150)	Adjusts the deviation level of the subcarrier audio input.

Table 2-5. Modulator Front Panel Sample

SMA CONNECTOR	DESCRIPTION
MOD IF SAMPLE (J10)	Sample of the combined Aural IF and Visual IF signals.

2.1.2 (A3) IF Processor Module Assembly (1305421; Appendix A)

The (A3) IF Processor Assembly contains the IF Processor Board (1304687). 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 HX Series Exciter Driver RF 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 transmitter. 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.

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 by the Control Monitoring board. 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 transmitter or if it is set to Manual mode the transmitter will continue to operate at 25% output.

The IF Processor module Input Signal level is monitored by the Control Monitoring board. 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 transmitter. The system controller does not Mute on an IF Processor Input Fault.

Table 2-6. 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 2-7. 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. Transmitter 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 2-8. IF Processor Front Panel Control Adjustments

POTENTIOMETERS	DESCRIPTION
ALC GAIN	Adjusts the gain of the transmitter when the transmitter is in the Auto ALC position.
MAN GAIN	Adjusts the gain of the transmitter when the transmitter is in the Manual ALC position.

Table 2-9. IF Processor Front Panel Sample

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

2.1.3 (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 (1303838), (A2) a L-Band PLL Board (1303846) and (A4) an Upconverter Control Board (1304760).

A 44 MHz IF input @ 0 dBm level connects to the upconverter through the backplane board and 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 CH9: Center Frequency is 189.00 MHz and LO1 is 1000.00 MHz therefore, LO2 is 189 + 1000 + 44, which equals 1233.00 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 transmitter, that connects to the power amplifier module.

Table 2-10. 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 2-11. 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 2-12. VHF/UHF Upconverter Front Panel Control Adjustments

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

Table 2-13. 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

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

The (A4) Control & Monitoring/Power Supply 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 transmitter control and monitoring functions. The Front panel LCD screens allow 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 2-14. 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 2-15. Controller/Power Supply Status Indicator

LED	FUNCTION
OPERATE (green)	When lit it indicates that the transmitter is in the Operate Mode. If transmitter is Muted the Operate LED will stay lit, the transmitter will remain in Operate, until the input signal is returned.
FAULT (red or green)	Red indicates that a problem has occurred in the transmitter. The transmitter 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 transmitter are OK.

Table 2-16. Controller/Power Supply Control Adjustments

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

2.1.5 (A6) VHF Power Amplifier Module (1305822; Appendix A)

The (A6) Power Amplifier Module Assembly is made up of a Coupler Board Assembly (1211-1004), an Amplifier Control Board (1303682), a Delta RF 25 Watt VHF Driver Assembly (1305820) and a Delta RF 200 Watt VHF Amplifier Assembly (1300167).

The Power Amplifier Module contains Broadband LDMOS amplifiers that cover the VHF High Band with no tuning required. They amplify the RF to the output power of the transmitter.

The Power Amplifier is used to amplify the RF output of the Upconverter module. A jumper cable, located on the rear chassis, connects the RF output from the LO/Upconverter at J23 to J24 the RF input to the PA Assembly.

The Power Amplifier module contains an amplifier control and monitoring board. This board monitors the RF output power, RF reflected power, the current draw of amplifier sections, the supply voltage, and the temperature of the PA heat sink. The 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 RF power detector circuit outputs vary with operating frequency. These circuits must be calibrated at their intended operating frequency. Front panel adjustment potentiometers, R201 for Reflected Power and R202 for Forward Power, are used for calibration.

The Aural power of the Power Amplifier assembly is not reported by the system Control Monitoring module. Additionally the Visual power of the amplifier is reported as Forward Power.

The Forward Power of the 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 2-17. 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. 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.

Table 2-18. Power Amplifier Control Adjustments

POTENTIOMETERS	DESCRIPTION
FWD CAL	Adjusts the gain of the Forward Power monitoring circuit
RFL CAL	Adjusts the gain of the Reflected Power monitoring circuit

Table 2-19. Power Amplifier Sample

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

2.1.6 RF Output

The RF output from the power amplifier is at the RF output jack, an "N" connector J25, PA RF Output, of the chassis assembly. This is the 100 Watt VHF output of the transmitter that connects to the bandpass filter for your system..

2.2 Control and Status

The control and status readings of the chassis assembly are found by operating the front panel display screen located on the front of the control assembly. Detailed information on the use of the screens is found in chapter 3.

2.2.1 Front Panel Display Screens

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

2.3 System Operation

When the transmitter 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 will also be green. The enable and DC OK indicators on the PA Module will also be green.

When the transmitter is in standby, the following occurs. 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 will remain green. The enable indicator on the PA Module is extinguished.

If the transmitter does not switch to Operate when the operate menu is switched to Operate, check that all faults are cleared from the Fault Log and that the remote control terminal block stand-by signal is not active. Also check that TB30-5 and TB30-17, on the remote control terminal block are connected together providing the needed transmitter interlock.

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

2.3.1 Principles of Operation

Operating Modes

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

Operate Mode

Operate mode is the normal mode for the transmitter when it is providing RF power output. To provide RF power to the output, the transmitter must 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 transmitter. 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 transmitter will remain in the operate mode but will be placed in mute when the following fault conditions exists in the transmitter.

- Upconverter is unlocked
- Upconverter module is not present
- IF Processor module is not present
- Modulator is in Aural/Visual Mute

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 faults or interlock conditions that may exist in the transmitter that will prevent the transmitter from entering the operate mode. These conditions are:

- Power Amplifier heat sink temperature greater than 78°C.
- Transmitter 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 transmitter indicates that the output amplifier of the transmitter 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 Transmitter 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 transmitters automatically switch to standby operation on loss of video input. The HX Series exciter incorporates this feature as a user configurable setting. When Auto Stand-By on modulation loss is selected in the set-up menus, the transmitter 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 transmitter automatically returns to Operate mode.

RF System Interlock

The RF System Interlock must be provided through TB30-5. When this interlock circuit is completed to ground such as through a wire or an external switch connected between TB30-5 and TB30-17, the exciter/driver (transmitter) is allowed to operate. If this circuit is opened, the transmitter switches to a Mute condition. This circuit may be completed through coaxial relay contacts and/or reject load contact closures to assure the RF output system is available to receive the transmitter's RF output signal before it is allowed to switch to operate.

Operating Frequency

The HX Series exciter driver controller is designed to operate on VHF or UHF frequencies. This transmitter is set for the VHF channels. The VHF channel center and + & - offset frequencies are used to set the LO1 and LO2 frequencies in the Upconverter Module. The exact output frequency of the transmitter 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. **NOTE**: Refer to the Channel Change Procedure found in chapter 5 of this manual for additional information. Since RF performance of the transmitter requires different hardware for different frequency bands, not all frequency configurations are valid for a specific transmitter. The Power detectors in the transmitter 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.

2.4 Maintenance

The Innovator HX Series transmitter 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.

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 power amplifier module, mounted in the exciter/driver 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.

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

2.5 Customer Remote Connections

The remote monitoring and operation of the transmitter is provided through jacks TB30 and TB31 located on the rear of the chassis assembly. If remote connections are made to the transmitter, they must be made through plugs TB30 and TB31 at positions noted on the transmitter interconnect drawing and Table 2-20.

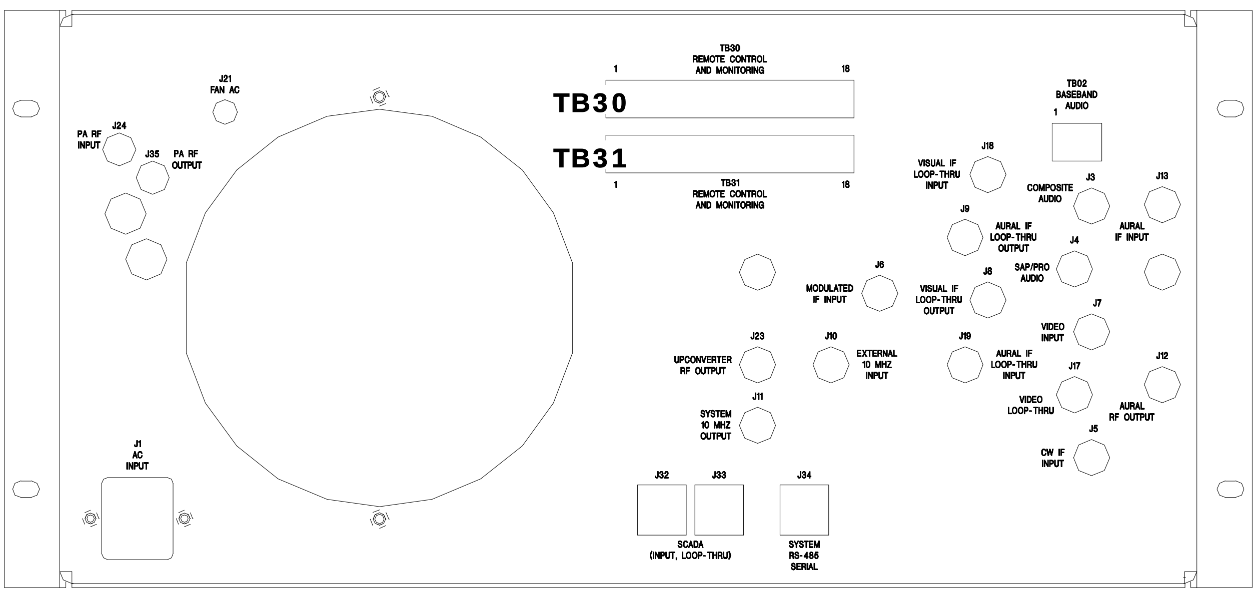


Figure 2-2. Exciter/Driver Chassis Assembly Rear View

Table 2-20: HX 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 transmitter is in the operate mode.
RMT Transmitter Interlock	TB30-2	Discrete Open Collector Output - A low indicated the transmitter is OK or completes an interlock daisy chain. When the transmitter 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 a FET so that the transmitter interlock can be daisy chained with other transmitters. This signal does not directly interface to the microcontroller.
RMT System Interlock	TB30-5	When this interlock circuit is completed to ground such as through a jumper between TB30-5 and TB30-17, the transmitter is allowed to operate. If this circuit is opened, the transmitter switches to a Mute condition.
RMT Set to Operate Transmitter	TB30-6	Discrete Open Collector Input - A pull down to ground on this line indicates that the transmitter is to be placed into the operate mode.
RMT Set to Stand-By Transmitter	TB30-7	Discrete Open Collector Input - A pull down to ground on this line indicates that the transmitter 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 transmitter 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 transmitter 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 transmitter's reflected output power. The scale factor is 25% = 3.2V.
RMT System Visual Power	TB30-11	Analog Output (0 to 4.0 V). This is a buffered loop through of the calibrated "System Visual Power ". Indicates the transmitter's Visual power. Scale factor is 100% = 3.2V.
RMT System Aural Power	TB30-12	Analog Output (0 to 4.0 V). This is a buffered loop through of the calibrated "System Aural Power ". Indicates the transmitter's Aural power. Scale factor is 100% = 3.2V.
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).

Signal Name	Pin Designations	Signal Type / Description
IF Processor DLC Voltage	TB31-4	Analog Output (0 to 5.00 V). This is the input of IF Processor module for system RF output power control.
System Reflect Power	TB31-13	Analog Input (0 to 1.00 V). This is the input of the “System Visual Reflected Power ” indicating the transmitter's reflected output power. The scale factor is 25% = 0.80V.
System Visual Power	TB31-14	Analog Input (0 to 1.00 V). This is the input of the “System Visual Power ” indicating the transmitter's forward Visual output power. The scale factor is 100% = 0.80V.
*+12 VDC	TB31-16	+12 VDC for external use w/ 2 Amp re-settable fuse
*-12 VDC	TB31-18	-12 VDC for external use w/ 2 Amp re-settable fuse
RMT Ground	TB31-1, 2, 6, 11, 12 & 17	Ground pins available through Remote
+12 VDC	TB30-16	+12 VDC for external use w/ 2 Amp re-settable fuse
-12 VDC	TB30-18	-12 VDC for external use w/ 2 Amp re-settable fuse
*RMT System Interlock Rtn	TB30-17	RMT System Interlock return.

* Indicates that these connections are used in the system and are not available for remote use.

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 HX Series analog VHF transmitter 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 transmitter.

The transmitter is factory set for operation using 110 VAC that connects to the AC input jack J1, through the AC power cord, located on the rear of the chassis assembly.

The HX Series Analog transmitter is 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 transmitter 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 transmitter 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 transmitter can enhance the overall performance and reliability of the transmitter 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 transmitter.

The fans are designed and built into the transmitter 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 transmitter itself.

This amount can be determined for a 100 Watt transmitter 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 2,065, 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 transmitter.

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 transmitter. 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 transmitters.

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. With the desired conditioned room temperature under 80° F, the unit must be derated, possibly by a substantial amount.

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

3. Do not separate the front of the transmitter 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 transmitters and in the front and back of others. Any attempt to separate the front of the transmitter from the rear of the unit will adversely affect the flow of cooling air.

4. Interlocking the transmitter with the air conditioner is recommended to keep the transmitter 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 transmitter.

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 transmitter 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 transmitter operation.

10. The blower should have two speeds, which are thermostatically controlled, and are interlocked with the transmitter. 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.

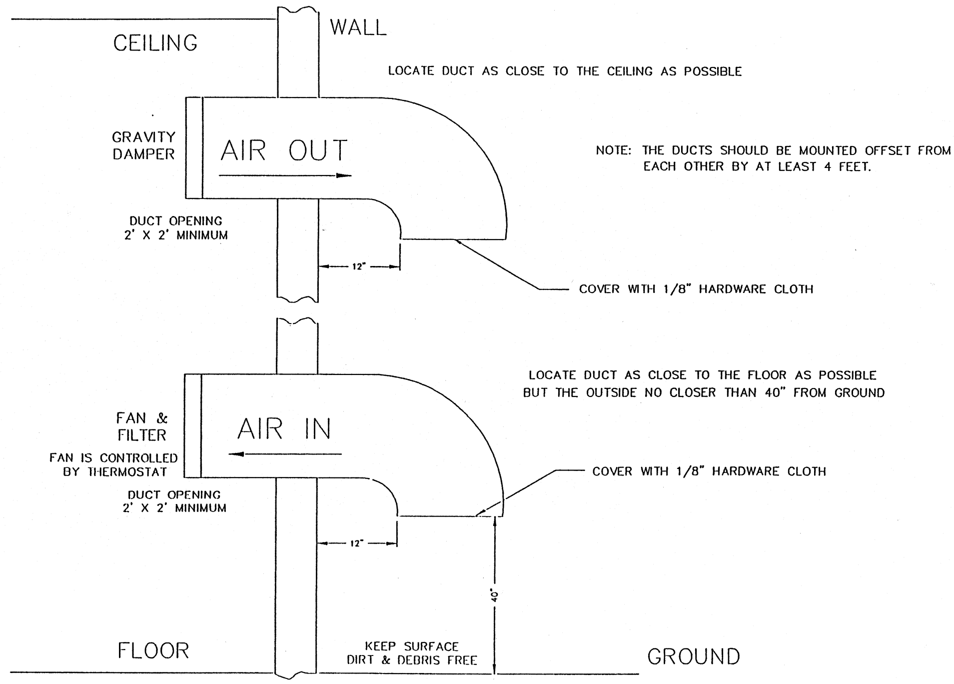


Figure 3-1. 1 kW Minimum Ventilation Configuration

3.2 Unpacking and Installing the Transmitter

Remove the transmitter and filter from the shipping container. Remove the plastic wrap and foam protection from around the transmitter and filter. Thoroughly inspect the 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. 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 chassis assembly and filter are made to mount in a standard 19” rack. Two tray slides are provided in the shipping material to mount the chassis assembly into a standard 19” rack. Follow the instructions provided with the slides to mount them into the cabinet. There are two tray slide rails mounted on the sides of the chassis assembly that fit the tray slides just mounted in the rack. The tray slides give the customer access to the adjustments made through the top of the chassis assembly. The front of the chassis assembly and the front of the filter have #10 mounting holes into which screws can be inserted to hold the chassis and filter in place.

The exciter/driver 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.

NOTE: To remove the power amplifier module, mounted in the chassis assembly, 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 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.

3.2.1 AC Input

Once the chassis is mounted in the equipment rack the AC can be connected to the chassis.

Connect the AC power jack, found with the shipping material, to J1 located on the rear of the chassis assembly. Connect the AC power plug to a 110 VAC/10 Amp source.

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

3.3 Setup and Operation

Initially, the transmitter should be turned on with the RF output at the "N" connector J25 terminated into a dummy load or check that the output is connected to the filter and the antenna for your system.

3.3.1 Input Connections

The input connections to the transmitter are to the rear of the Chassis Assembly.

Refer to the table and description that follows for detailed information on the input connections.

Figure 3-2: Rear View of HX Series Analog exciter/driver

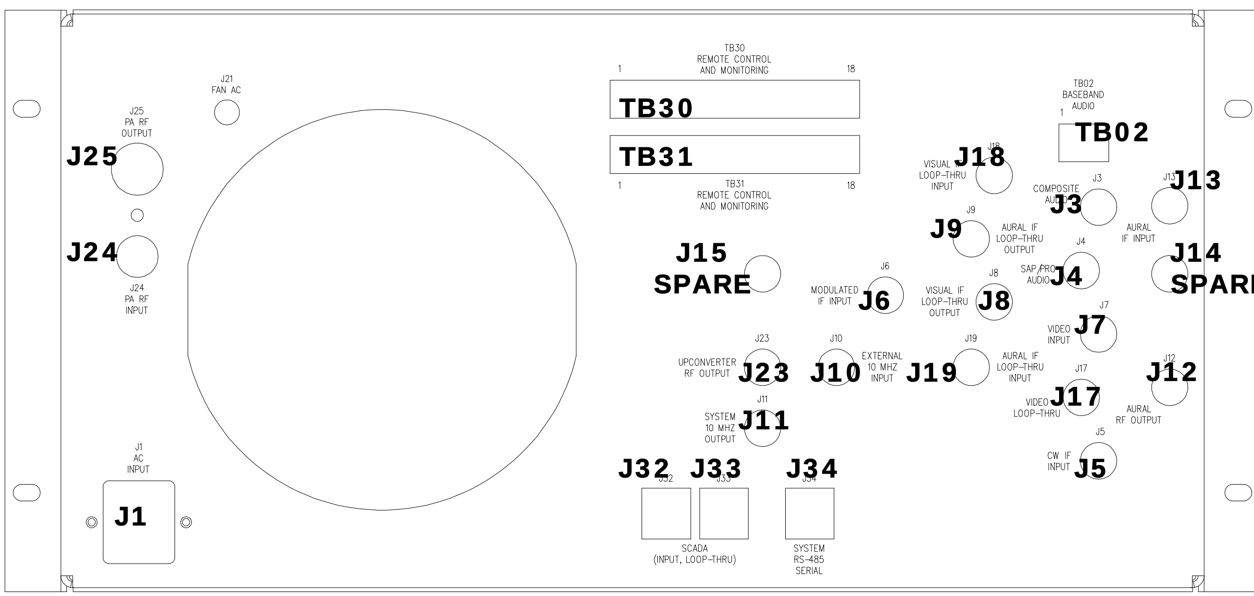


Table 3-1: Rear Chassis Connections for the HX Series Analog Transmitter.

Port	Type	Function	Impedance
J1	IEC	AC Input	N/A
TB02	Terminal	Base Band Audio Input	600O
J3	BNC	Composite Audio Input	75O
J4	BNC	SAP/PRO Audio Input	50O
J5	BNC	CW IF Input	50O
J6	BNC	Modulated IF Input	50O
J7	BNC	Video Input (Isolated)	75O
J8	BNC	Visual IF Loop-thru Output (Jumpered to J18)	50O
J9	BNC	Aural IF Loop-Thru Output (Jumpered to J19)	50O
J10	BNC	External 10 MHz Reference Input	50O
J11	BNC	System 10 MHz Reference Output	50O

Port	Type	Function	Impedance
J14	BNC	RF Spare 2	50O
J15	BNC	RF Spare 1	50O
J17	BNC	Video Loop-Thru (Isolated)	75O
J18	BNC	Visual IF Loop-Thru Input (Jumpered to J8)	50O
J19	BNC	Aural IF Loop-Thru Input (Jumpered to J9)	50O
J23	BNC	Upconverter RF Output (Jumpered to J24)	50O
J24	BNC	Power Amplifier RF Input	50O
J25	N	Power Amplifier RF Output	50O
TB30	Termination	Remote Control & Monitoring	N/A
TB31	Termination	Remote Control & Monitoring	N/A
J32	RJ-45	SCADA (Input/Loop-Thru)	CAT5
J33	RJ-45	SCADA (Input/Loop-Thru)	CAT5
J34	RJ-45	System RS-485 Serial	CAT5

3.4 Initial Turn On

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

Turn on the main AC power source that supplies the AC to the chassis. Power is now applied to the exciter/driver assembly. If power is not applied check that the on/off circuit breaker located near the AC input Jack is switched On.

3.4.1 Exciter/Driver Front Panel LED Indicators

Monitor the LCD display located on the front of the control/monitoring module as you proceed through this section. When the transmitter is in the operate mode, the STB menu appears. When in the standby mode, the OPR menu appears. Press the NXT key after each menu to continue through the sequence.

3.4.1.1 Modulator Module LEDs on Front Panel

Fault Indicators:

AURAL UNLOCK: This illuminates Red when the Aural IF PLL is unlocked.

VISUAL UNLOCK: This illuminates RED when the Visual IF PLL is unlocked.

AUDIO DEV: This indicator will illuminate Red when the audio over-deviates the aural carrier.

VIDEO LOSS: This indicates the loss of Video to the modulator, when Red.

OVER MOD: This illuminates Red when the video is over-modulated.

Status Indicators:

ALT IF CW: This indicates that there is an external IF CW signal applied to the Modulator

10MHz PRES: This indicates the presence of a 10 MHz reference input.

3.4.1.2 IF Processor Module LEDs on Front Panel

Fault Indicators:

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

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

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

3.4.1.3 Upconverter Module LEDs on Front Panel

Fault Indicator:

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

PLL 2: This illuminates Red if the 1.0 GHz + LO PLL is unlocked.

AGC FAULT: NOT USED IN THIS CONFIGURATION.

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

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

3.4.1.4 Controller Module LEDs on Front Panel

Status Indicators:

OPERATE: This illuminates Green when transmitter is in operate.

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

DC OK: This illuminates Green when the DC outputs that connect to the modules in the exciter/driver assembly are present.

3.4.1.5 Power Amplifier Module LEDs on Front Panel

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

3.4.2 Front Panel Screens on the Exciter/Driver Chassis Display

A 4 x 20 display located on the front of the Control & Monitoring/Power Supply Module is used in the HX Series exciter/driver for control of the operation and display of the operating parameters. Below are the display screens for the system. The ↑ and ↓ arrows 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 transmitter is in operate mode, the STB menu appears on the screen. When the transmitter is in standby mode, the OPR menu appears.

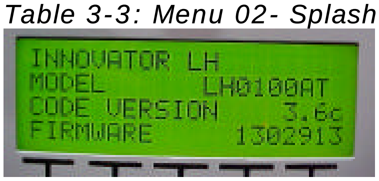
Display Menu Screens for the HX Series Exciter / Driver

NOTE: The following screens are typical and vary with the system.

Table 3-2: Menu 01 - Splash Screen #1

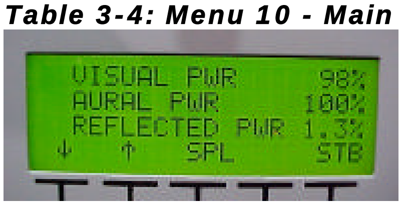
This is the first of the two transmitter splash screens that is shown for the first few seconds after reset or after pushing the SPL button on the Main Screen. Will automatically switch to the second splash screen.

Table 3-3: 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 3-4: Menu 10 - Main Screen:



This is the default main screen of the transmitter. When the transmitter is in operate, the 'STB' characters appear, allowing an operator to place the transmitter in STANDBY, by pushing the right most button located under to display. When the transmitter is in standby the 'STB' characters are replaced with 'OPR' and the forward power values are displayed as OFF. An operator can change the transmitter from STANDBY to OPERATE by pressing the right most button on the front panel display. 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 3-5: Menu 11 - Error List Access Screen

This screen of the transmitter shows the current number of errors, displayed in upper, right of screen (0), and provides operator access to view Menu 20, the error list screens, by pushing the ENT button. When ENT is pushed, Menu 20, the Error List Display Screen is displayed. If the ↓ key is pushed the display changes to Menu 12, Table 3-6, the Transmitter Device Data Access Screen. If the ↑ key is activated the display returns to Menu 10, the Main Screen.

Table 3-6: Menu 12 - Transmitter Device Data Access Screen

This screen of the transmitter allows access to various parameters of the transmitter 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 3-9 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 3-7: Menu 13 - Transmitter Configuration Access Screen

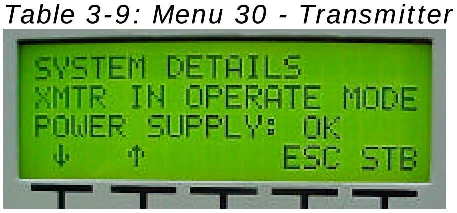
This screen of the transmitter allows access to various software settings of the transmitter system. If ENT is pushed, go to Menu 40, Table 3-13, the access to transmitter configuration and set up. Before pushing the ENT button: if the ↓ key is activated the display returns to Menu 10, Main Screen. If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

Table 3-8: Menu 20 - Error List Display Screen

This screen of the transmitter allows access to the system faults screens. Fault logging is stored in non-volatile memory. The transmitter's operating state can not be changed using 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 3-5, the Error List Access Screen. **NOTE:** Shown is example of a typical screen.

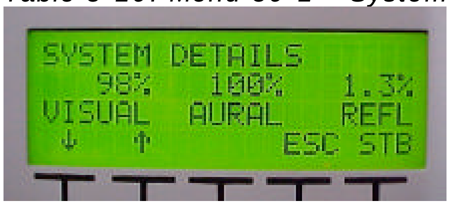
Menu 30 is entered by selecting ENT at Menu 12, Table 3-6.

Table 3-9: Menu 30 - Transmitter Device Details Screen



This screen allows access to the transmitter 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 3-10, the System Details Screen.

Table 3-10: Menu 30-1 – System Details Screen



The ↓ and ↑ arrows allow you to scroll through the different parameters of each device as shown in **Table 3-11**. Each System Component is a different screen. The proper IF Processor and the Power Amplifier will be programmed for your system.

Table 3-11: Transmitter Device Parameters Detail Screens

System Component	Parameter	Normal	Faulted (Blinking)
Modulator Details	PLL CIRCUIT	LOCKED	UNLOCKED
	MOD DEPTH	0 – 100 IRE	N/A
	AURAL DEVIATION	0 - 125 kHz	N/A
	CW INPUT	PRESENT	NOT USED
	CALL SIGN	NONE	N/A
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	1.8	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
PA 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	1.8	N/A
	PA HAS OPERATED FOR	xxx HOURS	N/A

Pushing the ↓ Down Arrow, after scrolling through all of the detail screens, will put you back to Menu 30, Table 3-9. Push the ESC button to exit the Transmitter Device Parameter Screens to Menu 12, Table 3-6, the Transmitter Device Parameter Access Screen.

Menu 40 (Table 3-12) is entered by selecting ENT at Menu 13.

Table 3-12: Menu 40 - Authorized Personnel Screen

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

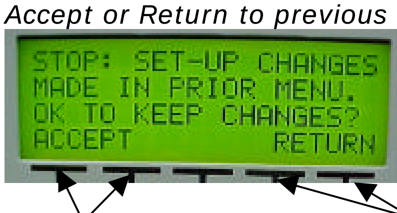
Pressing ENT will put you into the Transmitter Set Up Screens for Menu 40.

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 3-13 Menu 40-1 through Table 3-26 Menu 40-19 that follow.

Table 3-13: Menu 40-1 - Transmitter Set-up: Power Control Screen

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

Table 3-14: Menu 40-3 - 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.

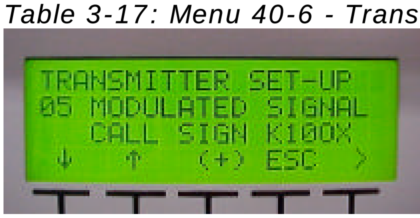
Table 3-15: Menu 40-4 - Transmitter Set-up: Upconverter Channel Select Screen

The choices of this screen are to the standard UHF / VHF channels. The + and – buttons change the desired channel of the transmitter. 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 3-16: Menu 40-5 - Transmitter Set-up: Serial Address Screen

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

Table 3-17: Menu 40-6 - Transmitter Set-up: Station ID Screen



This screen allows the user to set the Station ID, Call Sign, in analog transmitters. 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 HX Series Station ID is disabled. Therefore, the Station ID must be set up in the external Receiver Tray.)

Table 3-18: Menu 40-7 - Transmitter Set-up: System Forward Power Calibration

This screen is used to adjust the calibration of the system's forward 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 3-19: Menu 40-9 - Transmitter Set-up: System Reflected Power Calibration

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

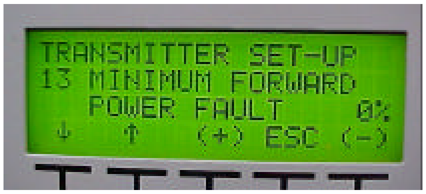
Table 3-20: Menu 40-11 - Transmitter Set-up: Modulated Output Calibration

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 3-21: Menu 40-12 - Transmitter Set-up: Aural Deviation Calibration

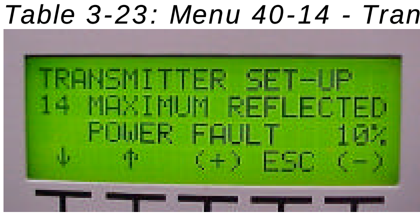
This screen adjusts the calibration of the system's aural deviation detector. The calibration value symbol is again used to graphically represent the aural deviation detector's calibration value.

Table 3-22: Menu 40-13 - Transmitter Set-up: Forward Power Fault Threshold Screen



This screen is used to set the minimum forward power fault threshold. When the transmitter 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 transmitter will enable, measure power less than this value and again shut down for five minutes.

Table 3-23: Menu 40-14 - Transmitter Set-up: Reflected Power Fault Threshold

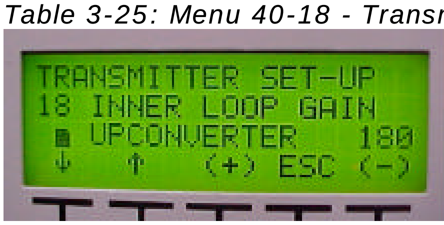


This screen sets the maximum reflected power fault threshold. When the transmitter is operating, it must not operate above this value otherwise the system will slowly begin to reduce the forward output power. If the system's reflected output power exceeds the maximum reflected power threshold by five percent or more, the transmitter will shut down with fault for 5 minutes. If after five minutes the fault is not fixed, the transmitter 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 transmitter reduces forward power to a level where the reflected power is less than this threshold. The transmitter will automatically increase its output power to normal operation when the cause of higher than normal reflected power is corrected.

Table 3-24: Menu 40-17 - Transmitter Set-up: Auto Stand-By Control

Certain HX transmitter locations are required to reduce to no output power on the loss of video input. When a HX transmitter is configured for Auto Stand-By on Modulation Loss, the transmitter 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 transmitter in operate mode will return to normal operation. This feature is implemented in transmitter software version 1.4 and above.

Table 3-25: Menu 40-18 - 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 3-26: 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 3-7, and the Transmitter Configuration Access Screen

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

3.4.3 Operation Procedure

If necessary, connect to the output of the transmitter at the "N" connector J25 to the external filter assembly. Check that the RF output is 100% and if needed adjust the ALC Gain adjust pot on the front panel of the IF Processor to attain 100% RF Output. 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 transmitter.

This completes the Installation, Set Up and Turn On of the Transmitter.

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

4.0 (A2) Exciter/Driver Chassis Assembly (1307715, 110 VAC; Appendix A)

The Exciter/Driver Chassis Assembly contains, as mounted in the assembly from left to right, (A2) the Modulator Module (1305420), (A3) the IF Processor Module (1305421), (A5) the Upconverter Module (1303829), (A4) the System Controller/Power Supply Module (1301936), and (A6) the Power Amplifier Module (1308252).

4.1 (A2) Modulator Module, HX Series (1305420; Appendix A)

Contains an Analog Modulator Board (1304704).

4.1.1 Analog Modulator Board, HX Series (1304704; Appendix A)

The board takes the audio and video inputs and produces a modulated visual IF and aural IF outputs. Refer to the Schematic # 1304705 while following this description.

Main Audio and Aural IF portion of the board

The analog modulator board takes each of the three possible audio inputs, Balanced, Composite and/or Subcarrier and provides a single audio output.

4.1.1.1 MONO, Balanced Audio Input

The first of the three possible baseband inputs to the board is a 600Ω, balanced-audio input (0 to +10 dBm) that enters through Jack J41A, Pins 10A (+)A, 11A (-)B and 12A (GND), on page 3 of the schematic, "A" & "B", and is buffered by U11A and U11B, on page2 of the schematic. Diodes CR9, CR10, CR12 and CR13 protect the input to U11A and U11B if an excessive signal level is present on the input. The outputs of U11A and U1B are applied to differential amplifier U11C. U11C eliminates any common mode signals (hum) on its input leads. A pre-emphasis of 75 µs is provided by R97, C44, and R98 and can be eliminated by removing jumper W6 on J22. The signal is then applied to amplifier U11D whose gain is controlled by jumper W12 on J23. Jumper W12 on jack J23 is positioned according to the input level of the audio signal (0 or +10 dBm). If the input level is approximately 0 dBm, the mini-jumper should be in the high gain position between pins 1 and 2 of Jack J23. If the input level is approximately +10 dBm, the mini-jumper should be in low gain position between pins 2 and 3 of Jack J23. The balanced audio is then connected to buffer amplifier U12A whose input level is determined by the setting of the MONO, balanced audio gain pot R110, accessed through the front panel. The output of the amplifier stage is wired to the summing point at U13C, pin 9.

4.1.1.2 STEREO, Composite Audio Input

The second possible audio input to the board is the composite audio (stereo) input that connects to the board at J41A Pins 13A (-) and 14A (+), on page 3 of the schematic, "R" & "S".

NOTE: Refer to page 2 of the schematic. For the transmitter to operate using the composite audio input the Jumper W1 on J4 must be between Pins 2 and 3, the Jumper W2 on J6 must be between Pins 2 and 3 and the Jumper W4 on J5 must be between Pins 1 and 2. These jumpers connect the composite audio to the rest of the board.

Jumper W14 on jack J26 provides a 75Ω input impedance when the jumper is between pins 1 and 2 and a high impedance when it is between pins 2 and 3. The Diodes CR17, CR18, CR20 and CR21 protect the input stages of U14A and U14B if an excessive signal level is applied to the board. The outputs of U14A and U14B are applied to the differential amplifier U13A, which eliminates common mode signals (hum) on its input leads. The composite input signal is then applied to the amplifier U13B, whose gain is controlled by the STEREO, composite audio gain pot R132, accessed through the front panel. The composite audio signal is then connected to the summing point at U13C, pin 9.

4.1.1.3 SAP/PRO, Subcarrier Audio Input

The third possible input to the board is the SAP/PRO, SCA audio input at J41A pin 16A(+) and 17A(-), on page 3 of the schematic, "D". On page 3 of the schematic, the SCA input has an input matching impedance of 75Ω that can be eliminated by removing the jumper W15 from pins 1 and 2 on J28. The SCA input is bandpass filtered by C73, C74, R145, C78, C79, and R146 and is fed to the buffer amplifier U13D. The amplified signal is then applied though the SAP/PRO, SCA gain pot R150, accessed through the front panel, to the summing point at pin 9 of U13C.

4.1.1.4 Audio Modulation of the 4.5 MHz VCO

On page 2 of the schematic, the Mono balanced audio, or the Stereo composite audio, or the SAP/PRO SCA buffered audio signal, is fed to the common junction of resistors R111, R130, and R152 that connect to pin 9 of amplifier U13C. The output audio signal at pin 8 of U13C is typically .8 Vpk-pk at a ±25 kHz deviation for Mono balanced audio or .8 Vpk-pk at ±75 kHz deviation for Stereo composite audio as measured at the Test Point TP1. This audio deviation signal is applied to the circuits containing the 4.5 MHz aural VCO U16. A sample of the aural deviation level is amplified, detected by U15A and U15B, and connected to J41A pin 5A on the board, on page 3 of the schematic. This audio-deviation level is connected to the front panel LCD display on the Control/Power Supply Assembly.

The audio from U13C is connected thru C71, a frequency response adjustment, to varactor diodes, CR24 to CR27, that frequency modulate the audio signal onto the generated 4.5 MHz signal. U16 is the 4.5 MHz VCO that generates the 4.5 MHz continuous wave (CW) signal. The output frequency of the 4.5 MHz signal is maintained and controlled by the correction voltage output of the U21 PLL integrated circuit (IC), on page 3 of the schematic, at "N", that connects to the varactor diodes. The audio modulated, 4.5 MHz signal is fed through the emitter follower Q13 to the amplifiers U17A and U17B. A sample of the audio modulated, 4.5 MHz is fed back to U21 the PLL integrated circuit (IC), on page 3 of the schematic, at "M". The amplified output of U17A is connected to a 4.5 MHz filter and then to U17B. The output of U17B is connected to the 4.5 MHz output sample jack at J29 and through the Jumper W4 on J5 pins 1 & 2, "J", to the I input of the mixer Z1, on page 3.

4.1.1.5 Phase Lock Loop (PLL) Circuit

A sample of the signal from the 4.5 MHz aural VCO at the output of Q13, "M", is applied to the PLL IC U21 at pin 1, the F_{in} connection. In U21, the signal is divided down to 50 kHz and is compared to a 50 kHz reference signal that is a divided-down sample of the 45.75 MHz visual IF signal. This 50 kHz sample is applied to the oscillator-in connection at Pin 27 on the PLL chip. These two 50 kHz signals are compared in the IC and the fV, and fR is applied to the differential amplifier U18A. The output of U18A, "N", is fed back through CR28 and C85 to the 4.5 MHz VCO IC U16, which sets up a PLL circuit. The 4.5 MHz VCO will maintain the extremely accurate 4.5 MHz separation between the visual and aural

IF signals. Any change in frequency will be corrected by the AFC error voltage.

The PLL chip U21 also contains an internal lock detector that indicates the status of the PLL circuit. When U21 is in a "locked" state, pin 28 is high. If the 4.5 MHz VCO and the 45.75 MHz oscillator become "unlocked," out of the capture range of the PLL circuit, pin 28 of U21 will go to a logic low and cause the Aural Unlock LED DS5 to light red. The Aural Unlock LED is viewed through the front panel of the Assembly. An Aural unlock, PLL Unlocked, output signal from Q16 is also applied to jack J41B pin 1B.

Sync Tip Clamp and the Visual and Aural Modulator portions of the board

The sync tip clamp and modulator portion of the board is made up of four circuits: the main video circuit, the sync tip clamp circuit, the visual modulator circuit and the aural modulator circuit.

The clamp portion of the board maintains a constant peak of sync level over varying average picture levels (APL). The modulator portion of the board contains the circuitry that generates an amplitude-modulated vestigial sideband visual IF signal output that is made up of the baseband video input signal (.5 to 1 Vpk-pk) modulated onto a 45.75 MHz IF carrier frequency. The modulated visual IF signal is amplified by U30 and connected thru J17 and an external cable assembly, W8, “WB” to J13 that connects to J41C Pin 17C, the Visual IF Output of the board. The modulated aural IF signal is amplified by U27 and connected thru J21 and an external cable assembly, W9, “WC” to J18 that connects to J41C Pin 6C, the Aural IF Output of the board.

4.1.1.6 Main Video Signal Path (Part 1 of 2)

The baseband video input connects to the board at J41A pins 19A (-), “W”, and 20A (+), “V”. The +, “V” and -, “W”, video inputs are fed to Diodes CR1 to CR4, on page 1 of the schematic, that form a voltage-limiter network in which, if the input voltages exceed the supply voltages for U2B, the diodes conduct, preventing damage to U2B. CR1 and CR3 conduct if the input voltage exceeds the negative supply and CR2 and CR4 conduct if the input voltage exceeds the positive supply voltage. The baseband video input connects to the non-inverting and inverting inputs of U2B, a differential amplifier that minimizes any common-mode problems that may be present on the incoming signal

The video output of U2B is connected through the Video Gain pot R42, accessed through the front panel, to the amplifier U2A. The output of U2A connects to the delay equalizer circuits

4.1.1.7 Delay Equalizer Circuits

The delay equalizer circuits provide a delay to the video signal, correction to the frequency response, and amplification of the video signal.

The video output of U2A is spit with a sample connected to J7 for Pre Video Delay signal testing. The other path is wired to the first of four delay-equalizing circuits that shape the video signal to the FCC specification for delay equalization or to the shape needed for the system. The board has been factory-adjusted to this FCC specification and should not be readjusted without the proper equipment.

Resistors R53, R63, R61, and R58, are adjustable and accessed through the top cover of the exciter/driver assembly. They adjust the sharpness of the response curve while inductors GD1, GD2, GD3, and GD4 adjust the position of the curve. The group delayed video signal at the output of U3A is split with a sample connected to J8 on the board that can be used for testing purposes of the Post Video Delay signal. The other portion of the video signal connects through the Jumper W5 on J9 pins 2 and 3. The delay-equalizing circuits can be bypassed by placing the jumper W5 on J9 between pins 1 and 2. The video at VIN connects through SW13 or R325 a 0? resistor, on page 4 of the schematic, to U35A and U35B. U35B is an inverting amplifier that provides the inverted video to the differential phase circuits. U35A is an amplifier that provides the main video to the differential phase circuits. The Zener Diodes VR3 and VR4 offset the in-phase main video signal by +3.9 VDC and -3.9 VDC. A signal with no offset is available at the junction of these Zener diodes, Main Video. The three in-phase video signals along with an inverted video signal are applied to a Differential Phase Corrector network. There are four stages of Phase Correction, which are combined at R355. The Color Subcarrier Phase Shift is accomplished by summing the inverted video signal with the main video signal thru capacitors C205-C208. Potentiometers R335-R337 & R333, are adjustable and accessed through the top cover of the exciter/driver assembly. They set up the threshold points in the video signal beyond which each Phase Corrector section becomes effective. Gating diodes CR43-CR46 can be inverted, turned in the sockets in which they are mounted, for an additional degree of freedom in setting the correct Differential Phase characteristic.

The output from the Differential Phase Corrector circuit is connected to a buffer amplifier IC U36A. The phase corrected video output can be measured at TP6 on the board. The phase corrected video, at VOUT on page 4 of the schematic, connects to a splitter, consisting of R44 and R62, on page 1 of the schematic. The video is split with one part connecting to a sync tip clamp circuit, another part connecting to a video loss detector circuit and the other part is the main video output path that connects through R44. The video input to the video loss detector circuit is detected by CR5 and connected to a comparator UC U5A. If video is present Q5 will be off and DS1 will be off. If video is lost Q5 will conduct and the Red Video Loss LED DS1, located on the front panel, will be on. A sample of the main video from R44, at "P", connects to U32 and U33, on page 2 of the schematic, that provides a zero adjust and a 1 Volt output level, which connects at "T" to J41A pin 3A, on page 3 of the schematic. This video level is wired to the Control/Power Supply assembly.

4.1.1.8 Sync Tip Clamp Circuit

The phase corrected video connects through R62 to the automatic sync tip clamp circuit that is made up of U6A, Q8, U5C, and associated components. The level at which the tip of sync is clamped is -1.04 VDC as set by the voltage-divider network, consisting of R77, R78, R75, R76 and R80 connected to U6A. If the video level changes, the sample applied to U6A changes. The voltage from the clamp circuit that is applied to the summing circuit at the base of Q8 will change; this will bring the sync tip level back to -1.04 VDC. Q8 will be turned off and on according to the peak of sync voltage level that is applied to U6A. The capacitors C35 and C24, in the output circuit of Q8, will charge or discharge to the new voltage level. This will bias U5C more or less, through the front panel MANUAL/AUTO CLAMP switch, SW1, when it is in the Auto Clamp-On position, between pins 2 and 3. In AUTO CLAMP, U5C will increase or decrease its output, as needed, to bring the peak of sync back to the correct level. The voltage level is applied through U5C to U2A. In the Manual CLAMP position, SW1 in manual position, between pins 1 and 2, the adjustable resistor R67 provides the manual clamp bias adjustment for the video that connects to U5C. This level is set at the factory and is not adjustable by the customer. In Manual clamp the peak of sync auto clamp circuit will not automatically be clamped to the pre set level.

4.1.1.9 Main Video Signal Path (Part 2 of 2)

A sample of the clamped video output from the group delay circuitry through R44 is connected through R322 to a white clipper circuit consisting of Q1 and associated circuitry. R322 adjusts the level of the video to the clipper circuit. The base voltage of Q1 is set by the voltage divider network consisting of R1, R9 and R5. R5 is adjustable and accessed through the top cover of the exciter/driver assembly and sets the level of the white clipper circuit to prevent video transients from over modulating the video carrier.

At R322 another clamped video path connects to a sync clip and sync-stretch circuits that consist of Q2, Q3 and Q4. The sync-stretch circuit contains R19, which adjusts the Sync Stretch Magnitude (amount), R11, which adjusts the Sync Stretch Cut-In and R6, which adjusts the Sync Clipping point. R11 and R6 are accessed through the top cover of the exciter/driver assembly. The sync-stretch adjustments should not be used to correct for output sync problems, but it can be used for input video sync problems. The output of the sync-stretch circuit is amplified by U31A and connected, “K”, to pin 5, the I input of Mixer Z2, the Visual IF Mixer, found on page 3 of the schematic.

4.1.1.10 45.75 MHz Oven Oscillator Circuit

Refer to page 3 of the schematic. The oven oscillator portion of the board generates the visual IF CW signal at 45.75 MHz for NTSC system "M" usage. The +12 VDC needed to operate the oven is applied through jack J30 pin 1 on the crystal oven HR1. The oven is preset to operate at 60° C. The oven encloses the 45.75 MHz crystal Y1 and stabilizes the crystal temperature. The crystal is the principal device that determines the operating frequency and is the most sensitive in terms of temperature stability.

Crystal Y1 operates in an oscillator circuit consisting of transistor Q24 and its associated components. Feedback that is provided by a voltage divider, consisting of C173, L38 and R295, is fed to the base of Q24 through C169. This circuitry operates the crystal in a common-base amplifier configuration using Q24. The operating frequency of the oscillator is maintained by a PLL circuit, which consists of ICs U20 and U22 and associated components, whose PLL output connects to R293 in the crystal circuit.

The oscillator circuit around Q24 has a regulated voltage, +6.8 VDC, which is produced from the +12 VDC by a combination of dropping resistor R261, diodes CR37 and CR38 and Zener diode VR2. The output of the oscillator at the collector of Q24 is capacitively coupled through C165 to the base of Q23. The small value of C165, 15 pF, prevents the oscillator from being loaded down by Q23. Q23 is operated as a common-emitter amplifier stage whose bias is provided through R259 from the +12 VDC line. The output of Q23, at its collector, is connected to an emitter-follower transistor stage, Q21. The output of Q21 at its emitter is split. One path connects to the input of the IC U20 in the PLL circuit. The other path is through R270 to establish an approximate 50O source impedance through C166 to the Pin 1 contact of the relay K2. The 45.75 MHz connects through the closed contacts of K2 to a splitter network consisting of L31 and L32.

NOTE: The relay contacts for the internally generated 45.75 MHz signal will be closed unless an external IF signal, such as the IF for offset and precise frequency 45.74 or 45.76 MHz, connects to the board.

If Present, the external IF CW Input connects at J41A pin 32A and is connected to J19 and through the external cable assembly W10 back to the board at J20. The external IF CW input is split on the board. One branch connects through C157 to a buffer amplifier Q20 to the K2 relay at pin 14. The other path is through C152 to the amplifier U23A. The output of U23A is split with one part connecting to Q26 that shuts down the 45.75 MHz Oscillator. Another path connects to Q25 that conducts and lights the Red LED DS7, Alternate IF, viewed on the front panel. The final path connects through R268 to Q22 that is biased on and energizes the relay, K2. The external IF CW Input at contact 14 now connects through the closed contact to the splitter network consisting of L31 and L32.

Either the internal or external CW IF from the K2 relay is split with one path through L31 to the amplifier U28 to the L input of Z1 the Aural IF Mixer. The other path is through L32 to the amplifier U29 to the L input of Z2 the Visual IF Mixer.

4.1.1.11 Visual Modulator Circuit

The video signal is heterodyned in mixer Z2 with the visual IF CW signal (45.75 MHz). The visual IF CW signal from L32 of the splitter connects to U29, where it is amplified and wired to pin 1, the L input of mixer Z2. Adjustable capacitor C168 and resistor R275 are set up to add a small amount of incidental carrier phase modulation (ICPM) correction to the output of the mixer stage to compensate for any non-linearities generated by the mixer.

The modulated 45.75 MHz RF output of the mixer Z2, at pin 4 the R output, is amplified by U30 and is fed to J17 through W8, the external cable assembly, “WB”, to J13 on the board. J17 is the visual IF loop-through output jack that is normally jumpered to J13 on the board. On page 1 of the schematic, the modulated visual IF through J13 connects to J41C pin 17C the Visual IF Output of the board.

4.1.1.12 Aural Modulator Circuit

On page 3 of the schematic, the mixer Z1 heterodynes the aural-modulated 4.5 MHz signal with the 45.75 MHz IF CW signal to produce the modulated 41.25-MHz aural IF signal. The audio modulated 4.5 MHz from the 4.5 MHz VCO IC U16 connects, “J”, to the I input at pin 5 of Z1. The visual IF CW signal from L31 of the splitter connects to U28, where it is amplified and wired to pin 1, the L input of mixer Z1. The R output of the mixer at pin 4 is fed to a bandpass filter, consisting of L18-L21, L25-L28 and C136, C137 and C142-144, that is tuned to pass only the modulated 41.25-MHz aural IF signal. The filtered 41.25 MHz is fed to the amplifier U27. The amplified 41.25 MHz signal is connected by a coaxial cable, W9, from J21, “WC”, to J18 on the board. On page 1 of the schematic, the modulated 41.25 MHz aural IF signal from J18 is connected to J41C pin 6C, the Aural IF Output of the board.

4.1.1.13 Visual IF loop thru path

The Visual IF connects back to the board at J41C pin 3C, through a Visual IF jumper cable connected to the rear chassis of the exciter/driver. IF processing equipment can be connected in place of the jumper if needed. The visual IF is connected to J12, through jumper W7, “WA”, to J14. The visual IF is amplified by U24 and filtered by FL1 with T1 and T2 providing isolation. The filtered visual IF is amplified by U25 and adjusted in level by R214 before it is connected through L16 to the frequency response correcting circuit. The frequency response of the 45.75 MHz Visual IF signal is set by R238 and R239 and associated components. The corrected visual IF signal is amplified by U26 and connected to a splitter matching network consisting of T3 and T4. One part of signal connects to J10, the visual

IF sample output jack, located on the front panel. The other part, "G", connects to J41C pin 28C the Visual IF Output of the board.

4.1.1.14 Voltage Requirements

The ±12 VDC needed for the operation of the board enters through jack J41A pins 25A (+12 VDC_C4) and 26A (-12 VDC_C1), page 3 on schematic. The +12 VDC is filtered by L6, L7, and C27, on page 1 of schematic, before it is connected to the rest of the board. The +12 VDC also connects to U7, a 5-volt regulator IC, that provides +5 VDC to the rest of the board.

The -12 VDC is filtered by L5, C16, and C17, on page 1 of schematic, before it is connected to the rest of the board.

4.2 (A3) IF Processor Module Assembly (1305421; Appendix A)

The visual 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 (1304687).

4.2.1 IF Processor Board (1304687; 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.
Refer to the schematic # 1304688 while readings this description. The Visual IF from the modulator enters the board at J42B pin 32B, located on page 2 of the schematic. If the (optional) receiver is present, the Modulated IF input (-6 dBm) from the receiver connects to the modulated IF input jack J42C Pin 21C. The modulator IF input, labeled J42-G, connects to relay K3 and the receiver IF input, labeled J42-D, connects to relay K4, located on page 1 of the schematic.

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 J42C 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. **NOTE:** Modulator input is normally selected all the time.

4.2.1.1 Modulator Selected

With the modulator selected, J42C-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 J42C-21C, if present, to a 50O load. When K3 is de-energized, it connects the modulator IF input at J42B-32B to the rest of the board and the Modulator Enable LED DS5 will be illuminated.

4.2.1.2 External Modulated IF Selected

With the External Modulated IF selected, J42C-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 J42B-32B to a 50O load and the Modulator Enable LED DS5 will not be illuminated.

4.2.1.3 Main IF Signal Path (Part 1 of 3)

The selected Visual IF input (-6 dBm average) signal, from the relays, 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 visual 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.

4.2.1.4 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 peaks to be applied through emitter follower Q1. The signal is then connected to detector CR15 to produce a peak voltage that is applied to op-amp Pin 2 of U9A. There is a test point at TP3, which is accessed through the top cover of the exciter/driver assembly, that provides a voltage-reference check of the IF input level. The detector serves the dual function of providing a reference that determines the input IF signal level to the board and also it 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 visual 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 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, labeled J42-F, 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, labeled A, is applied to U10A, pin 2, on sheet 2 of the schematic, whose output goes low. The low connects through the switch SW1, if it is in the auto gain position, labeled B, to the pin-diode attenuator circuit, CR1, CR2 & CR3, on sheet 1 of the schematic . 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 IF input level at TP3, on page 1 of the schematic, 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, Video 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, labeled J42-A, to J42C, pin 7C, on page 2 of the schematic, 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%.

4.2.1.5 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, MAN GAIN, 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.

4.2.1.6 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 through a cable to J41. The J40 jack is available, as a sample of the pre-corrected IF for troubleshooting purposes and system setup. The IF signal from J41 is connected to In-PHASE-OUT on page 3 of the schematic, to the transformer T9, which doubles the voltage swing by means of a 1:4 impedance transformation. This is the input to the amplitude and phase correction circuits.

4.2.1.7 Amplitude and Phase Pre-Correction Circuits

The linearity corrector circuits use six stages of correction; three adjust for any amplitude non-linearities and three for phase non-linearities of the output signal. Three of the stages are in the In Phase Amplitude pre-correction path and three stages are in the Quadrature Phase pre-correction path. Each stage has a variable threshold control adjustment, R300, R211 and R216, in the In Phase path, and R231, R308 and R 309 in the Quadrature path, which determine the point that the gain is changed in each of the stages.

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 T9, which doubles the voltage swing by means of a 1:4 impedance transformation. Resistors R304 and R306 form an L-pad that lowers the level of the signal. The input signal level, when it reaches a set level, causes the diodes CR35 and CR36 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 U28 to compensate for the loss through the L-pad. The breakpoint, or cut-in point, for the first corrector is set by controlling where CR35 and CR36 turn on. This is accomplished by adjusting the threshold cut-in resistor R300. R300 forms a voltage-divider network from +6.8 VDC to ground. The voltage at the wiper arm of R300 is buffered by the unity-gain amplifier U27A. This reference voltage is then applied to R301, R302, and C185 through L54 to the CR35 diode. C185 keeps the reference from sagging during the vertical interval. The .9 VDC reference voltage is applied to the unity-gain amplifier U27B. The reference voltage is then connected to diode CR36 through choke L55. The two chokes L54 and L55 form a high impedance for RF that serves to isolate the op-amp ICs from the IF.

After the signal is amplified by U28, it is applied to the second corrector stage in the In Phase path through T6. These three correctors and the three corrector stages in the Quadrature path operate in the same fashion as the first. All six corrector stages are independent and do not interact with each other. The in phase correctors can be disabled by switching SW2 to the Disable position, this moves all of the breakpoints past the signal peaks so that they will have no affect. The quadrature phase correctors can be disabled by switching SW3 to the Disable position, 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, IN-PHASE-IN, that connects to the splitter/combiner Z1, located on page 1 of the schematic. There are two outputs of Z1, at Port 1, that connects to J31, Quadrature Output and at Port 2, In Phase Output, which connects to J32.

The pre-distorted IF signal in the Quadrature path at J31 is cabled to J34 that connects to a step up transformer T8 to the amp U20. The amplified output of U20, QUAD-OUT, connects to a step up transformer T10, located on page 3 of the schematic. SW4 is switchable to change the correction polarity as needed in the quadrature path. The signal connects to two corrector stages through op-amp U31, QUAD-IN, to page 1 of the schematic. The QUAD-IN is controlled by the variable resistor R258 the provides a means of balancing the level of the Quad Phase pre-distorted IF signal that then connects to the combiner Z2 at Port 2.

The In Phase signal connects to Port 1 of 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, R239, R242 & R241, that prevents loading of the combiner. The output, labeled C, connects to L25 & L24 the input to the frequency response circuitry located on page 2 of the schematic.

4.2.1.8 Main IF Signal Path (Part 3 of 3)

On page 2 of the schematic, the IF signal, labeled C, 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 Visual 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.

4.2.1.9 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 through L25, of the L24 & L25 splitter connects to the op-amp U12. The IF signal is applied through a resistor divider network, R203-R205, 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 that connects as A from page 1 of the schematic, 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, located on page 1 of the schematic. 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 indicates that the output power has decreased, the null condition no longer occurs 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 that will compensate for the decrease in the output power 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, located on the front panel, to light.

4.2.1.10 Fault Command

The board also has circuitry for an external mute fault input at J42C 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 J42C 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.

4.2.1.11 ±12 VDC Needed to Operate the Board

The ±12 VDC connects to the board at jack J42C. The +12 VDC connects to J42C pin 16C (J42-E) and is filtered (on Page 1 of the schematic) by L30, L41, and C80 before it is applied to the rest of the board. The -12 VDC connects to J42C pin 18C (J42-H) and is filtered (on Page 1 of the schematic) by L31 and C81 before it is applied to the rest of the board.

The +12 VDC is split by R261 and R265. The +12 VDC output through R261 (on Page 1 of the schematic) connects to the Zener diode VR3, which generates the +6.8 VDC output to the rest of the board. The +12 VDC output through R265 (on Page 1 of the schematic) connects to the diodes CR30 and CR31, which provide a .9 VDC reference output voltage, VREF, which provides temperature compensation for the two diodes in each corrector stage.

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

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

4.3.1 (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.

4.3.2 (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.

4.3.3 (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.

4.3.4 (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.

4.4 (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 HX 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.

4.4.1 (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 power supply and 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 power supply and 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 115 VAC input 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.

4.4.1.1 +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 Aural Upconverter 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

4.4.1.2 -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.

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

In this exciter/driver, control monitoring functions and 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.

4.4.2.1 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 enabled.

U2 is a watchdog IC, which holds 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 LEDs that display the auto test results. A separate 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.

The ICs 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.

4.4.2.2 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.

The 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.

4.4.2.3 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.

4.4.2.4 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.

4.4.2.5 Schematic Page 5

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

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, U26, U27 & U28, and one for +7 VDC, U25, which are used to power the Control Board. +12 VDC is applied to U25 a +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.

4.4.3 (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.

4.4.4 (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.

4.5 (A4) VHF Power Amplifier Module Assembly (1305822; Appendix A)

The Power Amplifier Module Assembly contains (A5) an Amplifier Control Board (1303682), a Coupler Board (1211-1004), a 25 Watt VHF Driver Module (1305820), and a 200 Watt Power Amplifier Assembly (1300167).

The RF (-2 dBm) from the Upconverter Module Assembly connects from the Upconverter RF Output BNC Jack J23 to the PA RF Input BNC Jack J24, located on the rear of the exciter/amplifier chassis assembly.

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

The RF input at a level of -2 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 (+32 dBm), connects to the RF input jack on (A3) the 200 Watt power amplifier 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.

4.5.2 (A3) 200 Watt VHF Amplifier Assembly (1300167; Appendix A)

The RF input at a level of +32 dBm connects to the RF input jack on the (A3) 200 Watt Amplifier Assembly Pallet. The pallet is an assembly manufactured by Delta RF and has a gain of approximately +16dB. The Refer to the Delta RF data sheet (P200-VHF-H) located in Appendix A for more information on the assembly. The RF output (+48.2 dBm) connects to the coupler assembly at J1.

The +30 VDC bias voltage connects from the amplifier control board at TB19 to the feed thru capacitor FL1 on the module assembly that is wired to the $+V_{dd}$ input on the 200 Watt VHF Amplifier Assembly.

4.5.3 (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 200 Watt VHF Power Amplifier module, connects to the SMA jack J1. 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.

4.5.4 (A5) Amplifier Control Board (1303682; 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

4.5.4.1 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 U1 through the settings of PA0-PA3. The outputs of Port A must be set and not changed during an analog input read of channels PA5-PA7. PA4 of U4 is a processor operating LED that monitors the ±12 VDC. PA5 is used to monitor the +12VDC supply to the board. PA6 is the selected channel of analog switch U1. PA7 is connected to a via, V10, for future access.

U6 is a serial to RS-485 driver IC. U7 is a watchdog IC used to hold the microprocessor in reset, if the supply voltage is less than 4.21 VDC. U7 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, U3 is used to determine where the amplifier control board is located. The eight inputs come from the main amp connector and are used to set the SCADA address of the controller. Pull-up resistors set a default condition of logic high.

U5 below U3 is used for getting digital input information of the board. Page two has several monitoring circuits that provide information on the amplifier's status. Many of these circuits automatically shut down the amplifier if a specific fault occurs.

U8 below U5 is used to control four board mounted status LEDs. A FET is turned On to shunt current away from the LED to turn it Off. U9 below U8 is used to enable different features within the software. Actual use is to be determined.

4.5.4.2 Schematic Page 2

In the lower right corner are voltage regulator circuits. U22 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 U22 if the mounting pad is 0.5 square inches. The controller will not need this much current. U23 and U24 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 U12 and U13. U12 is used to generate a regulated voltage that is about 5 volts less than the +32 VDC supply, approximately +26.25 VDC. When the +32 VDC supply is enabled, the circuitry around U13B is used to provide gate voltage to Q10 that is 5 volts greater than the source pin of this FET. The gate of Q10 can be turned Off by any one of a few different circuits. U10A is used to turn Off the gate of Q10 in the event of high current in amplifier #1. At 0.886 VDC the current to amplifier #1 should be greater than 5 Amps. U11B is used to turn off the Q10 FET, if high current is detected in amplifier #2. U11A is used to turn off the Q10 FET, if high current is detected in amplifier #3. With 2.257 VDC at Pin 5 of U11B or Pin 3 of U11A, the voltage output of current sense amplifier U17 or U18 at high current shut down should be greater than 15 Amps.

U14B is used to turn Off the gate of Q10 in the event of high power supply voltage, approximately +35.4 VDC. U14A is used to keep the FET disabled in the event of low power supply voltage, approximately +25.4 VDC.

4.5.4.3 Current monitoring sections of the board.

The ICs U16, U17 and U18 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 U16, U17 or U18. 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. Circuit loading components are located in the lower portion of each current monitoring circuit. These components allow for short duration high current loading of the supply. By measuring the current through the sense resistor with and without the additional four 30.1 O 1% resistors. For very short duration pulses, a 1206 resistor can handle up to 60 watts. The processor requires 226 uSec per conversion. A supply voltage of +32 VDC will pass 1.06 amps + 1% through the load resistors.

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 U10B. 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 at U15A and disables Amplifier #1.

4.5.4.4 Schematic Page 3, Aural, Visual/Average and Reflected power detector sections of the board.

A Forward Power Sample enters the board at SMA Jack J3 and is split. One part connects 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 CR17 and the DC level amplified by U25A. The output of U25A at pin 1 is split with one part connected to the Aural Power sample, which is not used in a digital transmitter. The other split output connects to U265A that is part of the Forward Average Power circuit. The detected level is connected to L4 that is part of an intercarrier notch filter circuit that is tuned to eliminate the 4.5 MHz aural intercarrier, if present. The Average power sample is amplified by

U26D and connected through the average calibration pot R166 to U26C. The output of U26C is connected to the comparator IC U26B 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 2 of the board.

A Reflected Power Sample enters the board at SMA Jack J5 and is detected by CR20 and the DC level amplified by U28B. The output of U28B at pin 7 is connected through the reflected calibration pot R163 to U28C. 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 U28C connects to the comparator IC U28D 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 CR28. The low shuts off Q14 causing pin 3 to go high that is connected to the inverter U15C. The output of U15C goes low producing a Reflected Power Fault that is connected to an output of the board, the Fault Alert circuit and also shuts down Amplifier #1. Gain of the power measurements is completed through software. Only the Aural Null and Offset Null need to be done through front panel pots.

4.5.4.5 Schematic Page 3, Aural, Visual/Digital and Reflected power detector sections of the board.

A Visual/Digital Power Sample enters the board at the SMA Jack J3 and is split. One part connects to J4 on the board that is the SMA Visual/Digital Power Sample Jack, located on the front panel of the assembly. **NOTE:** In this configuration Jumper W3 on J12 is connected between pins 2 & 3 that is for a visual peak sample. The other part of the split visual/forward power sample is detected by CR35 and the DC level amplified by U21A. The output of U21A at pin 1 is connected to R202, the Visual Power Calibration Adjustment. R202 sets the level to the IC U27A, which amplifies the visual power sample before it is split. One visual power sample, Visual Power connects back to U4 on Page 1. Another visual power sample connects through the jumper on J12 to a split point. A sample of the visual power, Selected Frd Power, connects back to U3 on Page 1. The other visual power sample connects to amp U27B whose output is level detected by CR29, CR28 and CR30 and back to Page 1, Visual Power Remote, at J8-7 for remote use.

A Visual/Digital Reflected Power Sample enters the board at the SMA Jack J5 and is detected by CR31 and the DC level amplified by U21B. The output of U21B at pin 7 is connected through the visual reflected calibration pot R203 to U25A. The output is split with one part connected to the Reflected Pwr V connection on Page 1 of the schematic that connects to U3. The other part of the split from U25A connects to the comparator IC U25B that has a reference level connected to Pin 5. If the reflected level increases above the reference level a low Fault output is produced and connected to the Reflected Power Shutdown V circuit on Page 2 at CR14 & CR15, which produces a Reflected Power Fault V that is connected to an output of the board, the Fault Alert circuit and also shuts down the Amplifier.

An Aural Power Sample enters the board at the SMA Jack J13 and is split. One part connects to J14 on the board that is the Aural Power Sample Jack, located on the front panel of the assembly. The other part of the split aural power sample is detected by CR36 and the DC level amplified by U28A. The output of U28A at pin 1 is connected to R204, the Aural Power Calibration Adjustment. R204 sets the level to the IC U29A, which amplifies the aural power sample before it is split. One aural power sample, Aural Power connects back to U4 on Page 1. Another aural power sample connects to amp U29B whose output is level detected by

CR39, CR37 and CR40 and back to Page 1, Aural Power Remote, at J8-9 for remote use.

An Aural Reflected Power Sample enters the board at the SMA Jack J15 and is detected by CR41 and the DC level amplified by U28B. The output of U28B at pin 7 is connected through the aural reflected calibration pot R205 to U30A. The output is split with one part connected to the Reflected Pwr A connection on Page 1 of the schematic that connects to U3. The other part of the split from U30A connects to the comparator IC U30B that has a reference level connected to Pin 5. If the reflected level increases above the reference level a low Fault output is produced and connected to the Reflected Power Shutdown A circuit on Page 2 at CR43 & CR44, which produces a Reflected Power Fault A that is connected to an output of the board, the Fault Alert circuit and also shuts down the Amplifier.

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

This completes the description of the Power Amplifier Module Assembly.

4.6 Output Assemblies

The RF output from the transmitter power amplifier is at the RF output jack (J25), an “N” connector labeled PA RF Output, of the chassis assembly. The RF is cabled thru RG-214 coaxial cable to the RF input jack on the bandpass filter assembly. The output of the bandpass filter connects to the antenna for your system.

This completes the description for the entire HX transmitter.

Chapter 5
Detailed Alignment Procedures

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

This exciter/driver takes the baseband audio and video inputs and converts them to the desired VHF On Channel RF Output.

The Innovator HX Series Exciter/Driver assembly is of a Modular design and when a Module fails that module needs to be 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 HX Series products is a relatively simple process. In the Exciter/Driver assembly, the individual modules plug into a blind mating connector located on the chassis. 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.

NOTE: To remove the driver/power amplifier module, mounted in the exciter/driver 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.

After removal of the failed module, slide the replacement module in place and make certain it connects to the blind mate connector. Replace the two cables on the rear of the PA chassis assembly. 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 in the incorrect slot. Do not try to place a Module in the wrong slot as this may damage the slot or the blind mate connectors.

5.1.1 Initial Test Set Up

Check that the RF output at the visual combiner and the aural amplifier trays are terminated into dummy loads of at least the rated output of the each system. While performing the alignment, refer to the final Test Data Sheet for the system and compare the final readings from the factory with the readings on each of the modules and trays. 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 Innovator HX Series Exciter/Driver Chassis Assembly

This system operates using the baseband audio and video inputs.

On the LCD Display, located on the Controller/Power Supply Module, in Transmitter Set-Up, push the button to switch the transmitter to Operate.

The check of and the setup of the Audio and Video input levels are completed using the LCD Display and the front panel adjustments on the Modulator assembly. 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 Modulator Module Assembly

The Modulator Assembly has adjustments for video levels and audio modulation levels, and other related parameters.

Connect an NTSC baseband video test signal input (1 Vpk-pk) to the transmitter video input jack J7 on the rear of the tray. Jacks J7 and J17 are loop-through connected; the J17 jack can be used as a video source for another transmitter. Connect a baseband audio input (+10 dBm) to the balanced audio input terminal block TB02-1 [+], TB02-2 [-], and TB02-3 [ground] or, if stereo/composite audio is provided, connect it to BNC jack J3, the composite audio input jack.

Verify that all LEDs located on the front panel of the Modulator are Green. The following details the meaning of each LED:

AURAL UNLOCK (DS5) – Red Indicates that 4.5 MHz Aural IF is unlocked from the 45.75 MHz visual IF.

VISUAL UNLOCK (DS6) – Red Indicates that the 45.75 MHz visual IF is unlocked from the 10 MHz reference.

AUDIO OVER DEVIATION (DS4) – Red Indicates that the input Audio level is too high.

VIDEO LOSS (DS1) – Red Indicates that the input Video level is too low.

OVER MODULATION (DS3) – Red Indicates that the input Video level is too high.

ALTERNATE IF (DS7) – Red Indicates that an external 45.75 MHz IF is not present to the modulator.

10 MHz PRESENT (DS2) – Red Indicates that an external 10 MHz reference in not present to the modulator.
Look at the front panel LCD meter on the Control/Power Supply Module Assembly. Set the LCD screen to the Modulator Details video output level screen, the screen indicates active video from 0 to 1 Vpk-pk. The normal video input level is 1 Vpk-pk on the front panel screen. If this reading is not at the proper level, the overall video level can be changed by adjusting the VIDEO LEVEL control R42 on the front panel of the Modulator to the 1 Vpk-pk level on the front panel screen.

Switch the LCD display to the Modulator Details screen that indicates the AUDIO DEVIATION (modulation level) of the signal from 0 to 100 kHz.

MONO SET UP: The modulator was factory set for a ±25-kHz deviation with a mono, balanced, audio input of +10 dBm. If the reading is not at the correct level, adjust the MONO Audio Gain pot R110, located on the front panel of the modulator, as necessary, to attain the ±25-kHz deviation on the front panel screen.

STEREO SET UP: The modulator was factory set for a ±75-kHz deviation with a stereo, composite, audio input of 1 Vpk-pk. If this reading is not correct, adjust the STEREO Audio Gain pot R132, located on the front panel of the modulator, as necessary, for the ±75-kHz deviation.

SECONDARY AUDIO SET UP: NOTE: Remove any stereo or mono audio modulation input to the transmitter during the set up of the secondary audio. The modulator was factory set for a ±15-kHz deviation with a secondary audio input of 1 Vpk-pk. If this reading is not correct, adjust the SAP/PRO Audio Gain pot R150, located on the front panel of the modulator, as necessary, for the ±15-kHz deviation.

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:

- DS1 (input fault) – Indicates that either abnormally low or no visual IF is present at the input of the IF Processor module.
- DS2 (ALC fault) – 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.
- DS4 (Mute) – Indicates that a Mute command is present to the system.

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

5.2.3 Upconverter Module Assembly

Switch the transmitter to Operate. Verify that all LEDs located on the front panel of the visual 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) – NOT USED IN THIS CONFIGURATION.

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

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

5.2.4 Setting Up the Drive Level of the Transmitter Procedure

Setting the Manual AGC

Preset the front panel “MAN GAIN ADJ” pot on the Upconverter full **Counterclockwise**, and the MAN/AUTO AGC Switch to the **Left, Man.** Turn the transmitter 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 Transmitter is in the Auto AGC position.

Setting the Auto AGC

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

Monitor the output of the transmitter with a Spectrum Analyzer and turn the power up 1 dB higher than the normal desired output using the AGC Adj pot. Enter the Transmitter Set-Up menu on the LCD Control Panel and step through the screens until the screen labeled “Inner Loop Gain U/C” is reached. The inner loop is adjustable from 0-255. Use the **+** button to increase the Inner Loop Gain until the power on the spectrum analyzer just begins to decrease. Use the **–** button to decrease the inner loop gain by 10%. (If it begins to affect power at setting 160, drop it back down to 160-16=144, if it affects power at 100, drop it down by 10 to 90, etc….). 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. Turn the AGC pot down to get back to the desired % output power level. The Auto AGC is now set. Normal operation of the Transmitter is in the Auto AGC position.

5.3 Linearity Corrector Adjustment

Refer to Figure 5-1, which shows the top on the exciter chassis assembly and the pots, switches and test points located on the modulator and IF processor boards that are accessed through the top cover.

The IF linearity correction function consists of three non-linear cascaded stages, each having adjustable threshold or cut-in points. The threshold adjustment determines at what IF signal level the corresponding corrector stage begins to increase gain. Using Figure 5-1, locate the IN PHASE THRESHOLD adjustments for the first through third linearity corrector stages. Because the stages are cascaded, the order of correction is important. The first stage, R294, should cut-in near white level, with the cut-in point of the next stage, R295, toward black and with the last stage, R300, primarily stretching sync.

Check that ALC is set to +0.8 VDC on the LCD display in the set up menu. The ALC will operate to maintain the corresponding peak power level following the correctors. Therefore, the adjustment procedure must be repeated to achieve the correct differential gain predistortion. A positive aspect of linearity adjustment with the ALC Enabled is that the control movements will not affect peak power.

Start with the first linearity stage and adjust R294 CW to stretch the signal above the white region. Next, advance the second Threshold Control R295 to stretch the signal above the Black range. Adjust the third Threshold Pot R300 to stretch Sync. Go back through the white through black and sync correctors to touch up the effects of ALC level changes during the adjustment.

If the Transmitter is being driven very hard, it may not be possible to get enough Sync Stretch while maintaining a flat differential gain. In this case, some Video Sync Stretch may be used from the Modulator, R11, accessed through the top cover of the exciter/driver chassis assembly. The Video White Stretch Circuit, R393, can be used to stretch the Luminance portion of the Video Signal. To adjust it, apply a 5 Step Staircase Test Signal to the Transmitter and monitor the Low Frequency Linearity. Adjust R391 until the White portion of Video begins to Stretch. Adjust R393 as needed to control the amount of Stretch. Switch the Waveform Monitor to look at the full Video Signal. Adjust to the proper Depth of Modulation using the LCD screen set up depth of modulation screen, located on the control monitoring module. It may be necessary to repeat the White Stretch and Depth of Modulation adjustments a few times to get both parameters correct at the same time. If the Video Sync Stretch is used, it will need to be readjusted as the Sync Level has been slightly changed.

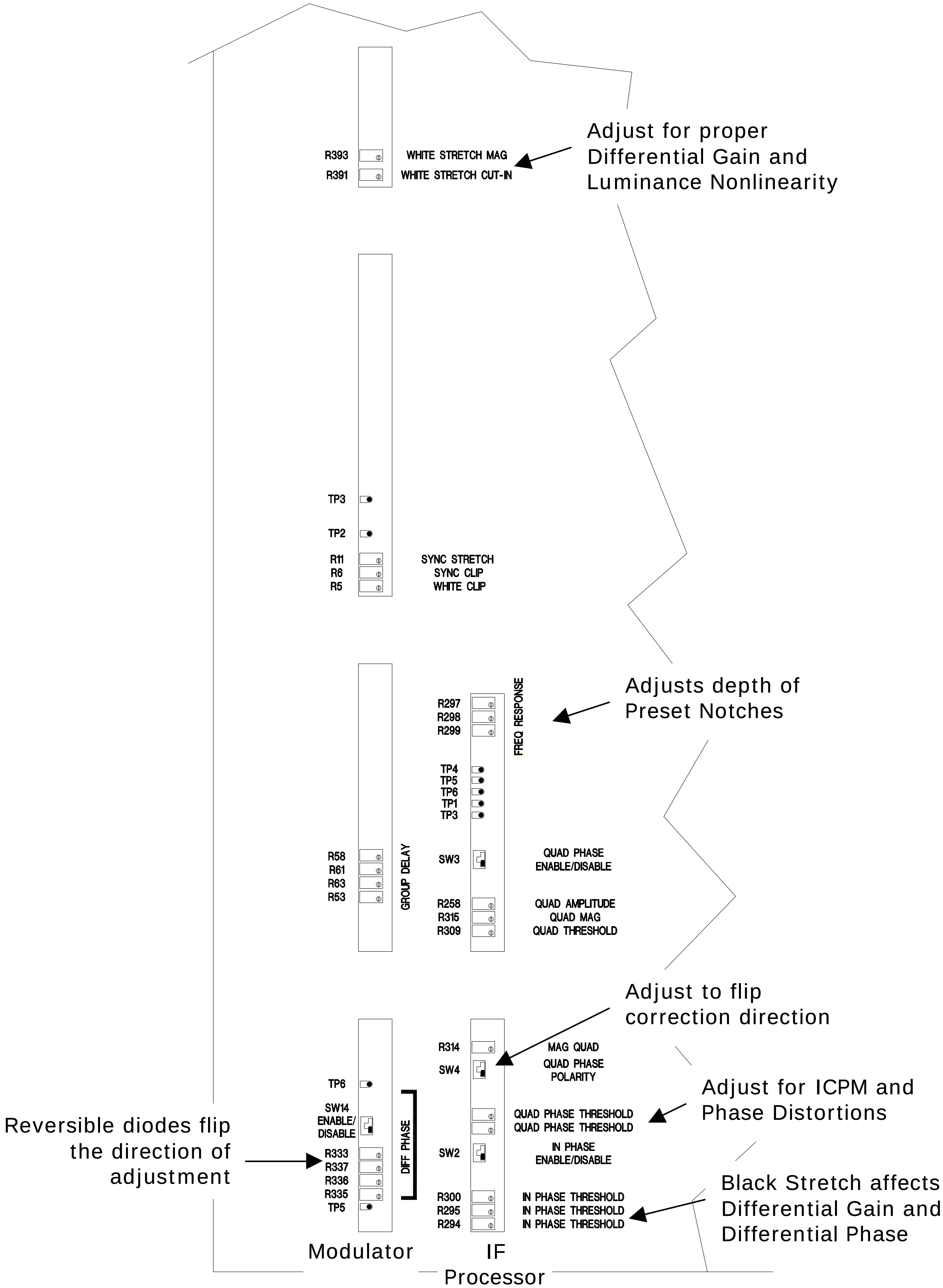


Figure 5-1. Adjustments accessed through the top of the HX Exciter Chassis

5.4 Differential Phase and ICPM Corrector Adjustment

The ICPM and phase distortions of the Transmitter are adjusted with the quad phase threshold and magnitude pots accessed through the top cover of the exciter/driver chassis. These pots are adjusted to control the Video Signal towards Sync, the point where the ICPM is Inverted and the Video Signal towards White. Switch SW4 sets up the quad phase polarity of the adjustment that is needed. SW3 enables or disables the quad phase adjustment.

The last step in the set up procedure is to correct whatever differential phase remains after the ICPM correctors are properly adjusted. Monitor the differential phase of the Transmitter Output and switch on the Video Differential Phase Corrector Switch, SW14 accessed through the top of the exciter/driver chassis assembly. The shape of the correction may be changed by the adjustment of the differential phase corrector pots R333, R335, R336 and R337. By reversing the diode adjacent to each pot (each diode is mounted in a plug socket), the direction of adjustment can be changed. The process of adjusting the pot and/or reversing the diode will provide the necessary phase correction.

This completes the set up and adjustment of the transmitter. If a problem occurred during alignment, contact Axcera field service at (724) 873-8100.

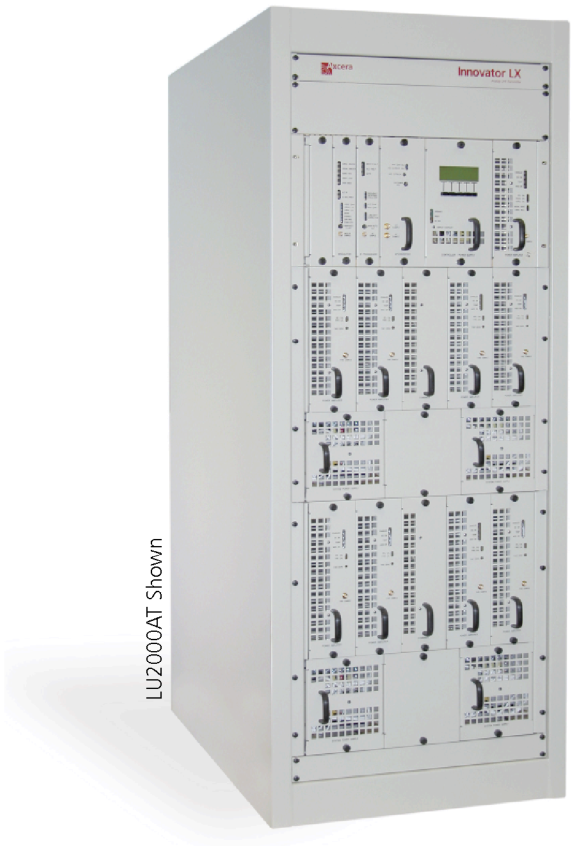
Appendix A

HX Series VHF High Band Transmitter Drawings and Parts Lists

Appendix A
Drawing List

Appendix B
SYSTEM SPECIFICATIONS

Low Power Transmitter 1 W - 6 kW



LU2000AT Shown

Designed to provide broadcasters with a product that will meet their needs like no other solution on the market, this advanced low to medium power transmitter line uses the latest LDMOS devices for broadband operation across the entire UHF band and MOSFET devices for broadband VHF operation. This allows users to minimize spare parts stock, which is especially important to group owners and networks, and also enables simple and inexpensive channel changes.

The very compact and completely modular design uses a chassis/backplane configuration with parallel amplifier and power supply modules that can be removed and replaced while the transmitter is on the air. Additionally, the Innovator LX series is field upgradable to digital operation.

Configurations are available in power levels from 1 watt to 6 kilowatts analog and up to 3 kilowatts DTV, and all are manufactured in the USA by Axcera - *The RF Experts*.

Low Power Transmitter 1 W - 6 kW

Visual Performance

Frequency Range[1]	
LLV	54 to 88 MHz
LHV	174 to 216 MHz
LU	470 to 806 MHz
Carrier Stability *(Transmitters)*	
Standard	±1 kHz
w/PFC	±1 Hz
Frequency Translation Stability *(Translators)*	
Standard	±1 kHz
w/PFC	±1 Hz
Regulation of RF Output Power	3%
Output Variation *(Over 1 Frame)*	2%
Sideband Response	
-1.25 MHz and below	-20 dB
-0.75 to -0.5 MHz	+0.5 dB, -2 dB
-0.5 to +3.58 MHz	±0.5 dB
+3.58 MHz to +4.18 MHz	+0.5, -1.0 dB
Freq Response vs. Brightness	±0.5 dB
Visual Modulation Capability	1%
Differential Gain	5%
Incidental Phase Modulation	±3°
Linearity *(Low Frequency)*	5%

Visual Performance *(continued)*

Differential Phase	±3°
Signal-to-Noise Ratio	55 dB
2t K-Factor	2%
Noise Factor *(Translators)*	5 dB *(Max)*
w/Input Preamp	3 dB *(Max)*
Input Dynamic Range *(Translators)*	-60 dB to -15 dBm
w/Input Preamp	-75 dBm to -30 dBm
Env. Delay *(Transmitters)*	Per FCC Standard
Video Input *(Transmitters)*	75 Ω *(Loop through)*
Harmonics	-60 dB or better
Intermodulation Products	-52 dB or better
Spurious *(>3 MHz from channel edge)*	
100W and lower	-50dB or better
Greater than 100W	-60dB or better

Aural Performance

Frequency Deviation Capability *(Transmitters)*	±75 kHz
Distortion	0.5%
FM Noise	-60 dB
AM Noise	-55 dB
Aural to Visual Separation	4.5 MHz ± 100 Hz
Composite Audio Input *(Multi-channel sound, Transmitters)*	
Input Level	1V peak, nominal
Input Impedance	75 Ω, unbalanced
Frequency Range	
±0.1 dB response	50 Hz to 50 kHz
±0.5 dB response	30 Hz to 120 kHz
Monaural Audio Input *(Transmitters)*	
Input Level	0 to +10 dBm
Input	600 Ω, balanced
Freq Range *(±0.5 dB resp.)*	30 Hz to 15 kHz
Pre-emphasis	75μs
Subcarrier Input *(Transmitters)*	
Input Level	1V peak, nominal
Input Impedance	75 Ω, unbalanced
Freq Range *(±0.5 dB resp.)*	20 kHz to 120 kHz

General

Model Number[2]	LLV1Ax LHV1Ax LU1Ax	LU10Ax	LLV20Ax LHV20Ax	LLV100AX LHV100AX LU100AX	LU250Ax	LU500Ax	LU1000Ax	LU2000Ax	LU3000Ax	LU4000Ax	LU5000Ax	LU6000Ax
Power Output												
Visual *(Peak)*	1 W	10 W	20 W	100 W	250 W	500 W	1000 W	2000 W	3000 W	4000 W	5000 W	6000 W
Aural *(Avg.)*	.1 W	1 W	2 W	10 W	25 W	50 W	100 W	200 W	300 W	400 W	500 W	600 W
Output Connector	N	N	N	N	7/8" EIA	7/8" EIA	7/8" EIA	7/8" EIA	1 5/8" EIA	1 5/8" EIA	1 5/8" EIA	1 5/8" EIA
Power Consumption												
Sync & Black	200 W	250 W	300 W	840 W	1400 W	2400 W	4400 W	8400 W	12,800 W	16,900 W	20,900 W	24,900 W
Grey	200 W	225 W	250 W	675 W	1100 W	1900 W	3500 W	6700 W	10,250 W	13,500 W	16,700 W	19,900 W
Input Power												
Line Voltage *(Volts)*[1]	117/230 ±10%				230 ± 10%							
Power Requirements	Single Phase, 50 or 60 Hz											
Size *(H x W x D)*	8.75"x19"x23" *(Chassis Only)*				55"x22"x34"				76"x22"x34"	76"x44"x34"		
Weight *(lbs.)*	45	45	45	45	340	360	400	550	700	1030	1180	1330
Operational Temperature Range	0 to +50°, derate 2°C/1000 ft.											
Maximum Altitude[1]	8500 feet (2600m) AMSL											
Operational Humidity Range	0% to 95% non-condensing											
RF Load Impedance	50 Ω											

1 Consult factory for other frequencies, altitudes and line voltages
2 For transmitters use "T" suffix, translators use "L" suffix (ex. LU100AT - 100W Transmitter)

103 Freedom Drive, PO Box 525, Lawrence, PA 15055 t: 724-873-8100 f: 724-873-8105