8. OPERATIONAL DESCRIPTION - MODEL Axcera-LHV60ATD

8.1 General Description

The LHV60ATD is a complete 60-watt High-band VHF solid-state, digital transmitter. It operates at a nominal output power of 60 watts average.

8.2 Technical Specifications

Type of Emission 6M00K1D

Frequency Range..... 174 MHz to 216 MHz (any 6-MHz channel)

Output Power ..... 60 watts average

8.3 Performance Specifications

Operating Frequency Range ..... 174 MHz to 216 MHz

RF output - Nominal:
- Power ..... 60 watts average
- Impedance ..... 50 ohms
- Connector ..... "N"

Regulation of Output 3%
Signal-to-Noise Ratio (SNR) ..... 33 dB typical
Carrier Frequency Stability..... ±1000 Hz

Out of Band:
Compliant with FCC Mask
(Measured in 30 KHz RBW, relative to total average power
Channel Edge ± 500 KHz..... -47 dB or better
6 MHz Channel Edge .....-110 dB or better

Data Interface:
Input Rate..... 19.39 Mbps, 6 MHz Channel
Input Interface..... SMPTE 310M, Serial Differential ECL & TTL

<u>Electrical Requirements</u>

Power Line Voltage ..... 110-260 volts, 50/60 Hz
Power Consumption ..... 725 watts

<u>Environmental</u>

Maximum Altitude ..... 8,500 feet
Operational Temperature Range ..... 0°C to +50°C

Mechanical

Dimensions:

Width .....22 inches
Depth .....34 inches
Height.....55 inches
Weight.....250 lbs

8.4. System Overview

The LHV60ATD is made up of the trays listed in Table 8-1.

Table 8-1. LHV60ATD Major Trays and Assemblies

MAJOR ASSEMBLY DESIGNATOR	TRAY / ASSEMBLY NAME
A1	Axciter Modulator Tray
A2	VHF HB Exciter Assembly

8.4.1 Exciter Tray

8.4.1.1 Axciter – Enternal Digital Modulator

The Axciter modulator is an ATSC compliant 8 VSB modulator that is used externally with the Innovator LX Driver chassis assembly. The Axciter modulator also accepts a SMPTE-310 MPEG data stream input and outputs a 6 MHz wide IF output centered at 44 MHz. All of the functions of the Axciter modulator are controlled from the front panel pushbuttons.

8.4.1.2 Axciter Upconverter Module

The 44 MHz IF input, -6 dBm in level, to the upconverter module assembly is applied through the backplane board from the modulated IF input jack located on the rear of the HX or LX exciter/driver chassis assembly. The 44 MHz IF input to the upconverter/downconverter tray connects through J5, the IF input jack located on the rear panel. The signal connects to the First Conversion board and is converted to a second IF of 1044 MHz by an image rejection mixer located on the First Conversion board. A filter selects the appropriate conversion product, which is then amplified to a level of approximately –8 dBm. The 1 GHz LO frequency is generated externally by the Axciter modulator and is applied to a high pass and low pass filter designed to eliminate any other interfering signals that might be coupled into the 1 GHz LO. The LO is applied to an ALC circuit that maintains the LO level to each mixer of +13 dBm over a wide range of 1 GHz LO input levels. The LO sample is also sent to the Downconverter board inside the tray or to the external Downconverter module for its use.

This second IF signal is then applied to a second mixer mounted on the Final Conversion board that converts it back to a broadcast channel (2-69) by an LO that operates in 1.0 MHz steps between 1.1-1.9 GHz depending on the channel selected. The LO frequency equals the Channel center frequency plus 1044 MHz. (As an example CH: 14: Center Frequency is 473.00 MHz therefore LO2 is 473 + 1044, which equals 1517.00 MHz.)

The output of the mixer is applied to a 900 MHz Low pass filter to remove unwanted conversion products. The resulting signal is amplified and wired to a Pin diode attenuator and then connected to the output of the Upconverter/Downconverter Tray or the output of the Upconverter Module. This pin diode attenuator adjusts the gain of the tray or 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. Processor board detects an Input Signal fault it automatically Mutes the transmitter. The system controller does not Mute on an IF Processor Input fault.

The Axciter upconverter module has no need for periodic alignment.

8.4.1.3 Axciter Downconverter Module

A sample of the transmitter's RF output is applied to the downconverter board, mounted on the downconverter module, at a nominal input level of –6 dBm. The signal is attenuated by a 10 dB pad, and then converted to an IF of 1044 MHz by mixer U1. A sample of the upconversion LO from the L-Band PLL Board mounted in the upconverter module assembly is sent through the exciter's backplane board, or directly to the board in the stand alone tray. On the downconverter board, the LO is amplified and then filtered to remove any spurious energy before being applied to U1.

A filter selects the appropriate conversion product, with the resulting signal being applied to the mixer U9, which converts the signal to a second IF of 44 MHz. A 1 GHz LO frequency that is generated externally, and either sent through the exciter's backplane board to the downconverter module or connected from the 1st conversion board in the stand alone tray. The 1 GHz LO is applied to a high pass and low pass filter designed to eliminate any other interfering signals that might be coupled into the 1 GHz LO. This 44 MHz second IF signal is then applied to a low pass filter to remove any out of band energy, amplified and connected to a frequency response correction circuit intended to compensate for any linear distortions in the downconversion path. Adjustments R50-R52 and C78-C80 are used to control the frequency response of the downconverter. The resulting signal is sent to a pin diode attenuator, which allows the operator to adjust the gain of the downconversion path. The signal is then amplified again to a level of +4 dBm average and applied to a cascaded high pass low pass filter, which removes any out of band energy that would be aliased in the demodulation process.

8.4.1.4 Control & Monitoring / Power Supply Module

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 allows monitoring of system parameters, including forward and reflected power, transistor currents, module temperatures and power supply voltages.

8.4.1.5 Power Amplifier Module

The (A6) Power Amplifier Module Assembly is made up of a VHF HB Coupler Board Assembly (1308258), an Amplifier Control Board (1309216), 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 1.6 VDC on the Axciter's Upconverter Screen. When an over-drive condition is detected, the Upconverter module reduces its RF output level. For values less than 1.6 VDC, the Upconverter uses this voltage for automatic gain.

8.5 Control and Status

8.5.1 External Axciter Digital Modulator Tray

Please refer to the Axciter Operating Manual for status indicators and controls.

8.5.2 Exciter Tray

Table 8-14. 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 8-15. Controller/Power Supply Status Indicators

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 8-16. Controller/Power Supply Control Adjustments

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

Table 8-17. Power Amplifier Status Indicators

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. 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

MOD OK (Amber)	A blinking Amber Mod OK LED indicates the power output of the amplifier module is below 65%. (**NOTE**: Only in Amplifier Code Versions 3.7A or later & System Controller Code Versions 3.9C or later.)

Table 8-18. Power Amplifier Control Adjustments

POTENTIOMETERS	DESCRIPTION
RFL CAL	Adjusts the gain of the Reflected Power monitoring circuit
FORWARD CAL	Adjusts the gain of the Forward Power monitoring circuit
AURAL CAL	(NOT USED) Adjusts the gain of the Aural Power monitoring circuit
AURAL NULL	(NOT USED) Adjusts the offset of the Forward Power monitoring circuit based on the Aural signal level..

Table 8-19. Power Amplifier Sample

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

The driver/power amplifier RF output jack is at an “N” connector J25, PA RF Output. The RF output of the driver/amplifier chassis assembly is connected to the input of the (A6) circulator and then to the (A7) pre-filter coupler assembly.

The pre-filter coupler supplies a forward, pre-filter power sample at J3, Non-Linear Distortion, which is cabled to J1 on (K2) the Axciter relay mounted on the left side toward the rear of the cabinet. The output of the pre-filter coupler connects to the (A10) low pass filter and then to J1, the RF input jack, on (A8) the DTV bandpass filter. The low pass and bandpass filtered output connects to the (A9) coupler and then to (A11) the post-filter coupler assembly.

The post-filter coupler supplies a forward sample, Linear Distortion, which is cabled to J2 on the (K2) Axciter relay.

The RF output of the post-filter coupler assembly at the J2 “N” connector, connects to the antenna for your system

8.6 Remote Interface Connections

8.6.1 Remote Interface Connections

Port	Type	Function	Ohm
J1	IEC	AC Input	N/A
TB02	Term	Base Band Audio Input	600
J3	BNC	Composite Audio Input	75
J4	BNC	SAP / PRO Audio Input	50
J5	BNC	CW IF Input	50
J6	BNC	Modulated IF Input	50
J7	BNC	Video Input (Isolated)	75
J8	BNC	Visual IF Loop-Thru Output	50
J9	BNC	Aural IF Loop-Thru Output	50
J10	BNC	10 MHz Reference Input	50
J11	BNC	10 MHz Reference Output	50
J17	BNC	Video Loop-Thru (Isolated)	75
J18	BNC	Visual IF Loop-Thru Input	50
J19	BNC	Aural IF Loop-Thru Input	50
J23	BNC	Upconverter RF Output	50
J24	BNC	Power Amplifier RF Input	50
J25	N	Power Amplifier RF Output	50
TB30	Term	Remote Control & Monitoring	
TB31	Term	Remote Control & Monitoring	
J32	RJ-45	SCADA (Input / Loop-Thru)	CAT5
J33	RJ-45	SCADA (Input / Loop-Thru)	CAT5
J34	RJ-45	System RS-485 Serial	CAT5

8.7 AC Input

8.7.1 Exciter Tray

The AC input to the Exciter Tray is 117 VAC or 230 VAC. The AC input is applied to the tray through Jack J1. MOV's are provided to protect the Tray from transients or surges, which may occur on the AC Input Lines.

8.8 System Operation

When the transmitter is in operate, as set by the menu screen located on the Control & Monitoring Module. 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 is green. The enable and DC OK indicators on the PA Module will also be turned to green.

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

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

8.8.1 Principles of Operation

Operating Modes

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

Operate Mode

Operate mode is the normal mode for the transmitter when it is providing RF power output.

Entering Operate Mode

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

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

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

- Power Amplifier heat sink temperature greater than 78˚C.
- 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.

RF System Interlock

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

Operating Frequency

The transmitter controller is designed to operate on VHF frequencies. 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. 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.