8. OPERATIONAL DESCRIPTION - MODEL Axcera-DT325B

8.1 General Description

The DT325B is a complete 350-watt High-band VHF solid-state, digital transmitter. It operates at a nominal output power of 350 watts average.

8.2 Technical Specifications

Type of Emission 6M00K1D

Frequency Range..... 54 MHz to 88 MHz (any 6-MHz channel)

Output Power .....350 watts average

8.3 Performance Specifications

Operating Frequency Range.....54 MHz to 88 MHz

RF output - Nominal:
Power ..... 350 watts average
Impedance ..... 50 ohms
Connector ..... "N"

Regulation of Output.....3%
Signal-to-Noise Ratio (SNR) ..... 27 dB or better
Carrier Frequency Stability ..... ±250 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

Electrical Requirements

Power Line Voltage .....208/240 volts, 50/60 Hz
Power Consumption .....2250 watts

Environmental

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

Mechanical

Dimensions:

Width..... 22 inches
Depth ..... 34 inches
Height..... 69 inches
Weight ..... 350 lbs

8.4. System Overview

The DT325B is made up of the trays listed in Table 8-1.

Table 8-1. DT325B Major Trays and Assemblies

MAJOR ASSEMBLY DESIGNATOR	TRAY / ASSEMBLY NAME
A1	Axciter Modulator Tray
A2	VHF LB Exciter Assembly
A3	VHF LB Amplifier Tray

8.4.1 Axciter – External Digital Modulator Tray

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.

8.4.2 Exciter Tray

8.4.2.1 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.

8.4.2.2 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.

8.4.2.3 Control & Monitoring / Power Supply Module

The Control & Monitoring/Power Supply Assembly is made up of a Control Board, a Power Protection Board and a Switch Board. 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.

8.4.3 VHF Low Band Amplifier Tray

The tray provides approximately 54 dB of gain. The tray contains a phase shifter board and Filter/amplifier board, which are mounted in the (A1) RF enclosure assembly. The VHF low band amplifier board, the Overdrive protection board and 3-way splitter board are mounted in the (A2) RF enclosure assembly. The low-band VHF amplifier pallets, P400-VHF-L-18, 1304348 are mounted in the (A3) RF enclosure assembly. The 3-way combiner board and the Low pass filter boards are mounted in the 3-way combiner enclosure. The tray also contains the AGC control board, the Current metering board and the +30 VDC switching power supply assembly PM3329B-5-1-R-2-E.

The On Channel RF signal (0 to +10 dBm), enters the rear of the Tray at the "BNC" Jack J1. The RF connects to a phase shifter board that provides a phase shift adjustment of the RF Signal that is needed to produce the maximum output during the combining of multiple Amplifier Trays in an Amplifier Array. The output of the phase shifter is cabled to the filter/amplifier board. The gain of the tray is controlled by an external bias voltage that connects to the AGC Control Board and adjusts the AGC Pin Attenuator Bias Voltage, which is applied to the Filter/Amplifier Board. The RF output of the Filter/Amplifier Board is amplified by the LB Amplifier Board and connected to the Overdrive Protection Board. The overdrive protection board provides a trip point, 110%, for over power conditions, which will cut back the output power of the Tray.

The RF Output of the Overdrive Protection Board connects to the 3 Way Splitter Board. The three RF outputs connect to the three Low Band Output Amplifier Pallets. Each amplifier pallet provides approximately 18 dB gain. The RF signal inputs to the Output Amplifier Boards (+33.3 dBm) are amplified to +51.3 dBm outputs at J2, which are connected to the 3 Way Combiner Assembly. The 3 Way Combiner takes the three +51.3 dBm combined inputs and combines them to form the ~ 375 Watt RF Output at J4 of the Combiner which soldered to J2, the RF Output Jack of the Tray.

The 3 Way Combiner Board provides a Forward Power Sample and a Reflected Output Power Sample that connect thru low pass filters to the AGC Control Board. The AGC Control Board provides detected outputs that are used for front panel and remote meter Indications of the forward and reflected output power levels, AGC Detector Voltage Level and also the VSWR Cutback protection if the Reflected Power level increases above the preset level.

Two voltages, +28 VDC from the internal switching power supply and +12 VDC from the Driver/Amplifier Assembly are needed for operation of the Tray. The +12 VDC is connected to a +5 VDC Regulator IC which supplies the +5 VDC needed for operation of the front panel mounted LEDs. The (A10) +28 VDC Switching Power Supply provides the +28 VDC to the Current Metering Board. The Current Metering Board distributes the voltages through fuses to the Amplifier Devices on the Filter/Amplifier, Low Band Driver Board and the three Final Low Band Amplifier Boards.

The Current Metering Board also supplies sample outputs of the operating currents of the amplifier devices in the Tray to the front panel Current Meter. The Meter in the (I_1) position reads the current for the (A3-A1) Low Band Output Amplifier Board, (I_2) for the (A3-A2) Low Band Output Amplifier Board and (I_3) for the (A3-A3) Low Band Output Amplifier Board. To read the desired current; switch S2 to the proper position checking that S1 is in the Current position. These current readings can be

used when setting up the Idling Currents, no RF Drive applied, for the devices. (I_1, I_2 & I_3) are set for 3 Amps max.

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 8-2. 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 8-3. 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 8-4. Controller/Power Supply Control Adjustments

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

8.5.3 VHF LB Amplifier Tray

Table 8-5. VHF Amplifier Tray Indicators

INDICATOR	DESCRIPTION
DS1 Overdrive	Indicates that the level of drive is too high. The protection circuit will limit the drive level to the set threshold. The fault is generated on the overdrive protection board.
DS2 Enable	Indicates that the Enable supplied by the driver/amplifier chassis assembly is present
DS3 Module Status	Indicates that the forward power sample level is lower than the set reference level
DS4 VSWR Cutback	Indicates that the reflected level of the tray has increased above 20%; this will automatically cut back the output power of the tray. The fault is generated on the AGC control board.
DS5 Overtemperature	Indicates that the temperature of (A13, A14 or A15) one of the thermal switches is above 175° F. When this fault occurs, the Enable to the switching power supply is immediately removed.

Table 8-6. VHF Amplifier Tray Switches

SWITCH	FUNCTION	
CB1 On/Off Circuit Breaker	Switches 220 VAC through a 15-amp circuit breaker-type protection device. The switch lights if AC is present. The AC is applied to the switching power supply in the tray.	
S1 Switch, Meter	Selects the desired % Forward Output Power, % Reflected Power reading, AGC Voltage, Power Supply Voltage, or Current	
	With Switch S1 in Position	*Display*
	% Forward	Reads the % Forward Output Power of the tray (100%= 375 watts DTV)
	% Refl (Reflected)	Reads the % Reflected Output Power (<5%)
	AGC Voltage	Reads the AGC level of the tray (1 to 3 VDC)
	Power Supply	Reads the voltage from the switching power supply (+28 VDC)
	Current	Uses Switch S2 to indicate the current of transistor devices
S2 Switch, Meter	Selects the current of the transistor devices on the low band amplifier boards. S1 must be in the Current position.	
	With Switch S2 in Position	***Display***
	I_1	Reads the current of (A3-A1) the low band amplifier board (idling current=1.8 amps and operating current=12-13 amps, black picture)
	I_2	Reads the current of (A3-A2) the low band amplifier board (idling current=1.8 amps and operating current=12-13 amps, black picture)
	I_3	Reads the current of (A3-A3) the low band amplifier board (idling current=1.8 amps and operating current=12-13 amps, black picture)
	I_D	Reads the current of (A2-A1) the low band amplifier board (idling current=3 amps and operating current=3 amps, black picture)

Table 8-7: VHF Amplifier Tray Control Adjustments

ADJUSTMENT	DESCRIPTION
R2 – A7 Phase	Adjusts the phase of the RF output by approximately 70°.
R3 – A6 Gain	Adjusts the gain of the RF output when the amplifier control board is in the AGC mode.

Table 8-8: VHF Amplifier Tray Sample

SAMPLE	DESCRIPTION
J5 RF Front Panel Sample	Forward power sample of the tray from the AGC control board.

8.6 Remote Interface Connections

8.6.1 Remote Interface Connections

Port	Type	Function	Impedance
J1	**IEC**	**AC Input**	**N/A**
TB02	Term	(NOT USED) Base Band Audio Input	600O
J3	BNC	(NOT USED) Composite Audio Input	75O
J4	BNC	(NOT USED) SAP / PRO Audio Input	50O
J5	BNC	(NOT USED) CW IF Input	50O
J6	BNC	(NOT USED) Digital IF Input	50O
J7	BNC	(NOT USED) Video Input (Isolated)	75O
J8	BNC	(NOT USED) Visual IF Loop-Thru Output	50O
J9	BNC	(NOT USED) Aural IF Loop-Thru Output	50O
J10	**BNC**	**External 10 MHz Reference Input (From Axciter)**	50O
J12	BNC	(NOT USED) MPEG Input	50O
J13	**BNC**	**Downconverter IF Output (To Axciter)**	**50O**
J68 / J15	**BNC**	**Digital IF I/P (From Axciter)**	**50O**
J17	BNC	(NOT USED) Video Loop-Thru (Isolated)	75O
J18	BNC	(NOT USED) Visual IF Loop-Thru Input	50O
J19	BNC	(NOT USED) Aural IF Loop-Thru Input	50O
J23	**BNC**	**Upconverter RF Output (To Splitter)**	**50O**
J24	BNC	IPA RF Input (Jumpered from J23)	50O
J25	N	IPA RF Output	50O
J32	RJ-45	SCADA (Input / Loop-Thru)	CAT5
J33	RJ-45	SCADA (Input / Loop-Thru)	CAT5
J34	**RJ-45**	**System RS-485 Serial**	**CAT5**
J40	**SMA**	**1GHz Input (From Axciter)**	**50O**
J41	**SMA**	**Downconverter RF Input (From K2 Relay)**	**50O**
TB30	**Termination**	**Remote Control & Monitoring**	**N/A**
TB31	**Termination**	**Remote Control & Monitoring**	**N/A**

8.7 AC Input

8.7.1 External Axciter Modulator Tray

The AC input to the Axciter Modulator is 117 VAC or 230 VAC

8.7.2 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.

8.7.3 VHF LB Amplifier Tray

The AC input to the VHF LB Amplifier Tray is 220VAC. 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.

Auto Standby Mode

The FCC requires that certain transmitters automatically switch to standby operation on loss of input. The transmitter 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

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.