Preliminary Instruction Manual

CU250ATD

Innovator

250-Watt Transmitter

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CU250ATD INNOVATOR 250-WATT TRANSMITTER

Manual Overview

This manual describes the transmitter, along with the setup and alignment procedures for the transmitter.

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 diagram and interconnect drawings provided in the appendix.

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 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.

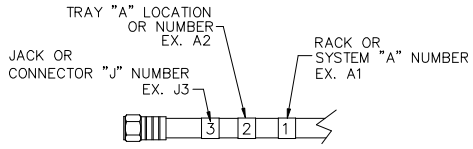


Figure 1: Brady Marker Identification Drawing

Safety

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

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

Retain Manuals – The manuals for the transmitter should be retained at the transmitter site for future reference. Axcera provides two manuals for this purpose; one manual can be left at the office while the other can be kept at the site.

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

Follow Operating Instructions – All of the operating and use instructions for the transmitter should be followed.

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

Ventilation – Openings in the cabinet and module front panels are provided for ventilation. To ensure the reliable operation of the driver/transmitter, and to protect the unit from overheating, these openings must not be blocked.

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

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

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.

Return Material Procedure

To insure the efficient handling of equipment or components that have been returned for repair, Axcera requests that each returned item be accompanied by a Return Material Authorization Number (RMA#). The RMA# can be obtained from any Axcera Field Service Engineer by contacting the Axcera Field Service Department at (724) 873-8100 or by fax at (724) 873-8105. This procedure applies to all items sent to the Field Service Department regardless of whether the item was originally manufactured by Axcera.

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

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

When shipping an item to Axcera, please include the RMA# on the packing list and on the shipping container. The packing slip should also include contact information and a brief description of why the unit is being returned.
Please forward all RMA items to:

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

For more information concerning this procedure, call the Axcera Field Service Department at (724) 873-8100.

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

Limited One Year Warranty for Axcera Products

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

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

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

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

☞ WARNING!!!

⋖ HIGH VOLTAGE ⋗

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

★ RADIO FREQUENCY RADIATION HAZARD ★

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

EMERGENCY FIRST AID INSTRUCTIONS

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

RESCUE BREATHING

1. Find out if the person is breathing.

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

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

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

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

-Keep his head tilted backward. Pinch nose shut.
-Put your mouth tightly over his mouth.
-Blow into his mouth once every five seconds
-DO NOT STOP rescue breathing until help arrives.

LOOSEN CLOTHING - KEEP WARM

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

BURNS

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

SKIN BLISTERED OR FLESH CHARRED: Apply ice cold water to burned area to prevent burn from going deeper into skin tissue. Cover area with clean sheet or cloth to keep away air. Treat victim for shock and take to hospital.

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

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

50 Ohm System

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

TEMPERATURE CONVERSION

°F = 32 + [(9/5) °C]

°C = [(5/9) (°F - 32)]

USEFUL CONVERSION FACTORS

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

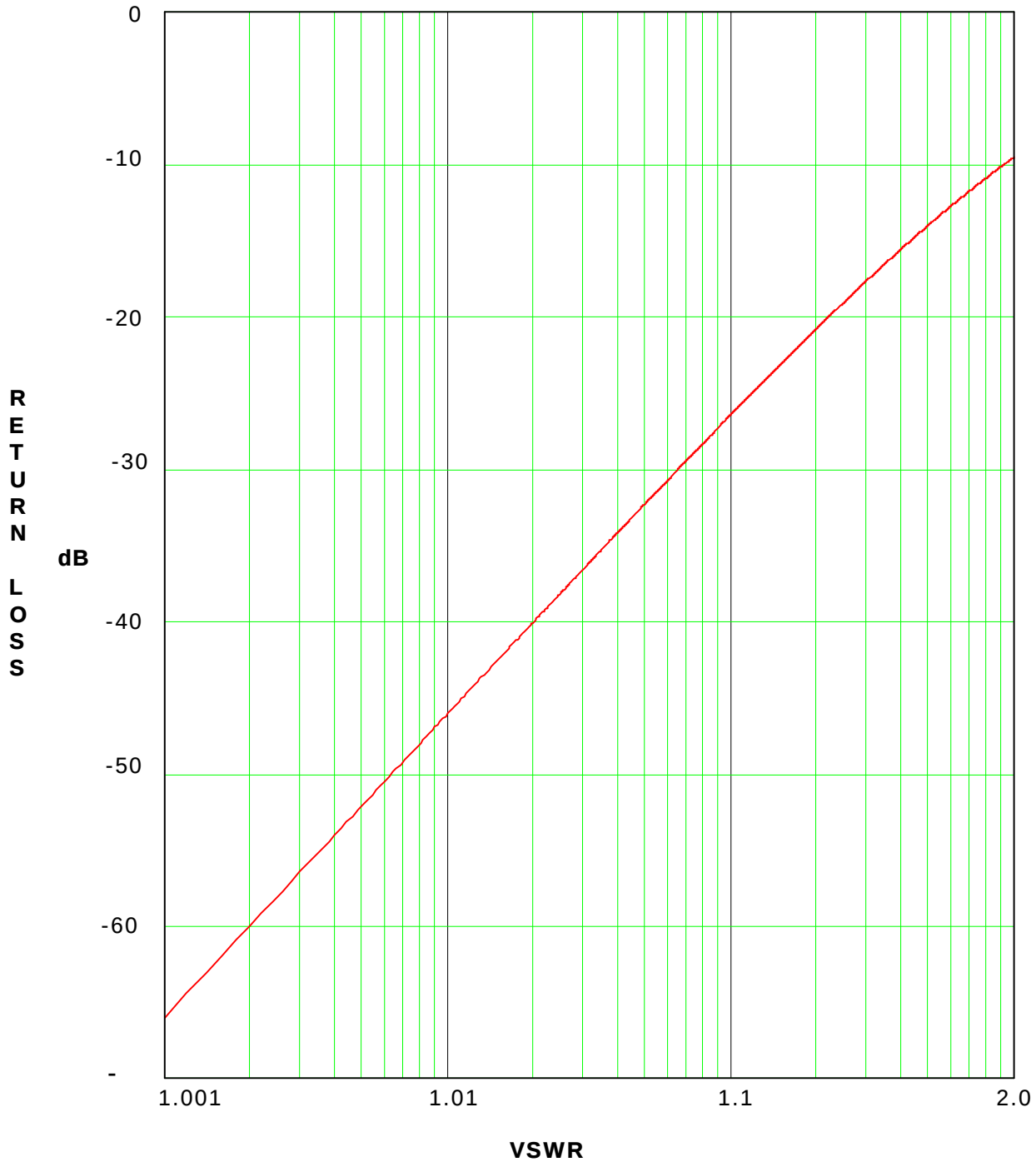
NOMENCLATURE OF FREQUENCY BANDS

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
DSP	Digital Signal Processing
DTV	Digital Television
dB	Decibel
dBm	Decibel referenced to 1 milliwatt
dBmV	Decibel referenced to 1 millivolt
dBw	Decibel referenced to 1 watt
FEC	Forward Error Correction
FM	Frequency modulation
FPGA	Field Programmable Gate Array
Hz	Hertz
ICPM	Incidental Carrier Phase Modulation
I / P	Input
IF	Intermediate Frequency
LED	Light emitting diode
LSB	Lower Sideband
MPEG	Motion Pictures Expert Group
O / P	Output
PLL	Phase Locked Loop
PCB	Printed circuit board
QAM	Quadrature Amplitude Modulation
SMPTE	Society of Motion Picture and Television Engineers
VSB	Vestigial Side Band

CU250ATD Innovator 250-Watt Transmitter

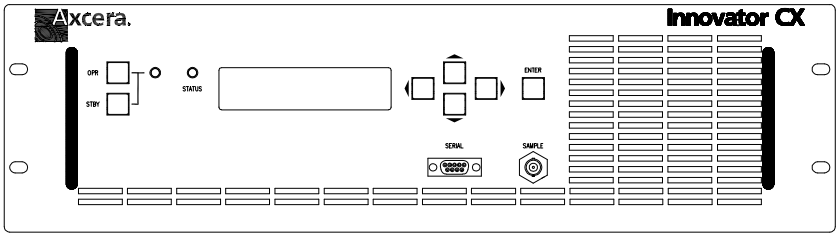


Figure 1: Front View of 30W Driver Tray.

30W Driver Tray Description

The Driver Tray accepts an RF On Channel signal (-79 to –8 dBm) and converts it to a DTV RF On Channel output signal at 30 Watts. The transmitter provides linear and nonlinear correction capability for the transmission path as well as internal test sources that are used during initial transmitter installation.

(A1) 8 VSB Demodulator Board (1308275)

The RF input to the Transmitter is connected to the J1 BNC connector located on the rear panel of the tray. This RF signal is wired to (A1) the 8 VSB demodulator board (1308275), which generates a SMPTE-310 output at J13. The (A1) 8 VSB demodulator assembly receives an off air 8 VSB signal on any VHF or UHF channel and demodulates this to an MPEG-2 transport stream that is per the SMPTE-310M standard. The input to the assembly is at an "F" style connector on the shielded tuner and can be at a level of –78 dBm to –8 dBm. The tuner (TU1) down converts the RF channel to a 44 MHz IF signal. This IF signal is the input to the digital receiver chip U1. The digital receiver chip subsequently decodes the IF and delivers an MPEG-2 transport stream, on a parallel data bus, to a programmable logic array, U8. U8 clocks the asynchronous MPEG data from the receiver chip and outputs a synchronous data stream at a 19.39 MHz rate to buffer/driver U11. U11 subsequently drives the output at J13 to a lower level that is AC coupled out of the board and is cabled to J42 on the 8 VSB Modulator Board.

(A2) 8 VSB Modulator Board (1304883)

The (A2) 8 VSB Modulator Board (1304883) accepts the SMPTE-310 MPEG data stream input at the SMA connector J42 and produces a 6 MHz wide IF output, at the IF Output Jack J38. The IF output is centered at 44 MHz using a pilot carrier of 46.69 MHz generated on the board.

This SMPTE-310 MPEG data stream input is applied to a high-speed window comparator U21 that adjusts the level to a low voltage TTL signal to be used by the Altera FPGA, U3. The SMPTE-310 signal is input to the FPGA to recover the clock and the data. A portion of the clock and recovery circuit is performed by a high-speed comparator, U17, which functions as an external delay circuit.

The FPGA subsequently uses the SMPTE-310 clock and data as the input to the channel coder contained inside the FPGA. The channel coder is a series of DSP blocks defined by the ATSC standard for 8 VSB data transmission. These blocks include the data randomizer, Reed Solomon Encoder, data interleaver, trellis coder, and sync inserter.

The channel coder portion, inside the FPGA, generates the 8 distinct levels in an 8 VSB transmitter. These levels are subsequently input to a linear equalizer that provides for frequency response correction in the transmission path. The linear equalizer is a 67-tap FIR filter that is loaded with tap values from the microcontroller, U1, located on this board. The output of the linear equalizer is then input to two pulse shaping filters, an in phase (I) and a quadrature (Q) filter that are also located inside the FPGA. The pulse shaping filters are FIR filters that have fixed tap values that are preset inside the FPGA. The output of the pulse shaping filters is then applied to a Pre-Distortion Linearizer chip, U4, which can be used to correct for nonlinearities in the data transmission path. The output of the Pre-Distortion chip is gain scaled and output to a dual D/A converter, which output a baseband I and Q analog signal.

The baseband I and Q signals from the D/A converter are applied to differential analog filters that remove some of digital artifacts from the D/A conversion process. The output of the I channel filter is then mixed with the pilot frequency, 46.69 MHz, using mixer U30. The output of the Q filter is mixed with the pilot frequency that is phase shifted 90 degrees using mixer U34. The mixers are current driven devices so that when the outputs of U30 and U34 are connected together, they provide a combined output. This combined output is subsequently input to a final differential output filter which provides the final IF output at the SMA connector, J38. To maintain signal integrity, this IF output is connected to the SMA connector J39 with a small semi-rigid cable assembly. The final IF output then appears at J1-2B.

The 46.69 MHz pilot, that is used in the mixing process is generated from a 46.69 MHz VCXO, U37, that is phase locked to a 10 MHz reference. The VCXO and the 10 MHz are divided down to a common frequency, which is then compared internal to the FPGA. The FPGA subsequently provides error signals to an analog phase locked implemented with op amp stages U45-A, B and C. The output of these compensation stages is used as the control voltage to the VCXO, U37. The phase locked output of U37 is applied to an analog filter to remove harmonics of the pilot and then input to the quadrature splitter Z1. The outputs of Z1 are used as the inputs to the mixers in the analog output section.

(A3) IF Pre-Corrector Board (1308796)

This IF output (0 dBm) of the 8 VSB Modulator connects to J2 on the (A3) IF Pre-Corrector Board (1308796), which provides response, in phase and quadrature pre-correction to the IF signal. The Pre-Corrected IF output at J1 is cabled to the IF In Jack on (A4) the Digital Agile Upconverter Board, which up converts the IF to the On Channel RF signal that is cabled to the RF Out Jack of the board. The RF out is connected to J1 the RF input jack on the ALC board. The (A5) ALC Board, (1308570), is used to control the RF drive power to the RF amplifier chain in the transmitter. The board accepts an 8-VSB RF input signal at J1, the RF input jack, at a nominal input level of -3 dBm average power and amplifies it to whatever drive level is necessary to drive the final RF amplifier in the tray to full power. The RF output of the ALC board at J2, typically 0 to +10 dBm, is cabled to J1 on the Amplifier Assembly.

(A6) Amplifier Assembly (1308867)

The (A6) Amplifier Assembly (1308867) is made up of (A6-A1) the 2 Stage UHF Amplifier Board, (1308784) and (A6-A2) the RF Module Pallet w/Philips transistors (1300116). The assembly has approximately 36 dB of gain.

(A6-A1) 2 Stage UHF Amplifier Board, (1308784)

The 2 Stage UHF Amplifier Board, (1308784) consists of a driver stage and a parallel connected final amplifier stage, which have a total gain of approximately 23 dB. The working point settings for the 2 Stage Amplifier Board are factory set using the potentiometers R32 for Q2, R15 for Q1, and R24 for Q3 and should not be altered. The input RF connects to the first amplifier stage U2, which has a gain of approximately 14 dB. The output is split by U2 and connected to the final amps. The final amplification circuit consists of parallel-connected push-pull LDMOS amplifier circuits Q1 and Q3 operating in class AB each with approximately 14 dB of gain. The board uses a power supply voltage of 28-32V. The RF transistors are operated at a voltage of 24V generated by the voltage regulators U1 for Q1, U5 for Q3 and U6 for Q2, which provide a separate regulated voltage to each transistor. In order to match the LDMOS impedance to the characteristic impedance of the input and output sides, matching networks are located before and after the amplifier circuits. The hybrid coupler U2 splits the input to the parallel amplifiers and the hybrid coupler U4 combines the amplified outputs. The combined output connects through a directional coupler to J1, the RF output jack of the board. The directional coupler provides an RF sample at J3 that is used by an external overdrive protection circuit. The RF output of the board, when used as a driver, has an output power level of 3 Watts maximum 8-VSB with approximately 1.8 Amps total current draw from the power supply. The board can also be used as the final output stage in a transmitter with the amplifier generating 6 Watts maximum 8-VSB. In the transmitter, the output of the 2 Stage UHF Amplifier Board at J1 connects to the RF input of the RF Module Pallet.

(A6-A2) RF Module Pallet w/Philips Transistors (1300116)

The RF Module Pallet w/Philips Transistors (1300116) is made from a RF Module Pallet w/o Transistors (1152336). The amplifier is capable of delivering a maximum output power of 100-Watts peak, with an amplification factor of approximately 13 dB. The amplification circuit consists of push-pull amplifier blocks V1 and V2, connected in parallel and operating class AB. In order to match the impedance of the transistors to the characteristic impedance of the input and output sides, matching networks are placed ahead and behind the amplifier blocks. Transformers Z3 and Z4 at the input to V1 and V2 and Z5 and Z6 at the output of V1 and V2 serve to balance the input and output signals. The paralleling circuit is achieved using the 3-dB input coupler Z1 and the second part of Z1, which is the 3-dB output coupler. The working point settings of the amplifier circuits are factory implemented by means of the potentiometers R9, R11, and R12 and should not be altered. The combined output of Z1 connects to the RF output jack of the board, which is cabled to J2 the output jack of the assembly. The output of the amplifier assembly at J2 connects to the input jack J1 of the output detector board.

(A7) Output Detector Board (1308685)

The (A7) Output Detector Board (1308685) provides forward (2V=100%) and reflected (2V=100%) power samples to the transmitter's Control Board for metering and monitoring purposes. R7 is the reflected power calibration pot and R23 is the forward power calibration pot. A Forward power sample, -10 dBm, connects to J4 on the board, which is cabled to the front panel sample jack of the tray. The RF output of the board, typically +46 dBm, is at J2, which is cabled to J2 the RF Output Jack of the tray.

30W Driver Tray Power Supplies

The 110VAC or 220VAC, needed to operate the tray, connects through the AC power cord at J6, the power entry module located on the rear panel of the tray. An On/Off 10A/250VAC circuit breaker is part of the power entry module. With the circuit breaker switched On, the (L) line input is wired to F1 a 20 Amp fuse for over current protection. The AC lines are connected to terminal block TB1, which distributes the AC to (A9 and A10) the two DC power supplies. Voltages for the operation of the boards in the tray are generated by (A9) a +5VDC and ±12VDC power supply and (A10) a +32VDC power supply. There are two varistors, mounted on TB1, connected from the line input to neutral and to ground for surge protection. The AC also connects to the (A11) fan mounted on the rear panel of the tray. The fan will run when AC is applied to the tray. The +5VDC and ±12VDC outputs of the (A9) power supply connects to the terminal block (TB2) that distributes the DC to the boards in the tray. Some of the +5VDC and ±12VDC outputs connect directly to the 8 VSB Demodulator and 8 VSB Modulator boards while the other outputs connect through the transmitter's Control Board to the IF Pre-corrector, the Digital Upconverter, the ALC, the Amplifier Assembly and the Output Detector Boards. The +32VDC power supply outputs connect to the (A8) Control Board, which then supplies the switched +32VDC to the (A6) Amplifier Assembly.

30W Driver Tray LCD Display and Front Panel LED Indicators

Table 1: 30W Driver Tray LCD Display

DISPLAY	FUNCTION
LCD	Provides a two-line readout of the input received channel, internal functions, status, and fault conditions.

The front panel has seven pushbuttons for the two for the control of the transmitter and five for control of the displayed menus.

Table 2: 30W Driver Tray Control Pushbuttons

PUSHBUTTON	FUNCTION
OPR	When pushed switches the transmitter to Operate.
STBY	When pushed switches the transmitter to Standby.
ENTER	Selects the changes made in the menus and submenus.
Left & Right Arrow	Scrolls through the main menus
Up & Down Arrow	Scrolls through submenus of the main menu when they are present.

Table 3: 30W Driver Tray Operate/Standby Indicators

LED	FUNCTION
OPERATE/STANDBY (Green/Amber)	A **Green** LED indicates that the system is in Operate. An **Amber** LED indicates that the system is in Standby.
STATUS (Green/Red/ Amber)	A **Green** LED indicates that the system is functioning normally. A flashing **Red** LED indicates a fault is occurring at this time. An **Amber** LED indicates a fault occurred in the past but the system is now operating normally.

30W Driver Tray Input and Output Connections

The input connections to the 30W Driver Tray are made to the jacks mounted on the rear of the tray. The tray accepts an On Channel RF signal at J1, the RF input jack, and outputs a digital RF ON Channel signal at J2, the RF Output Jack. A 10 MHz reference input connects to J3 on the tray. Refer to Figure 2 and to Table 4 that follow for detailed information.

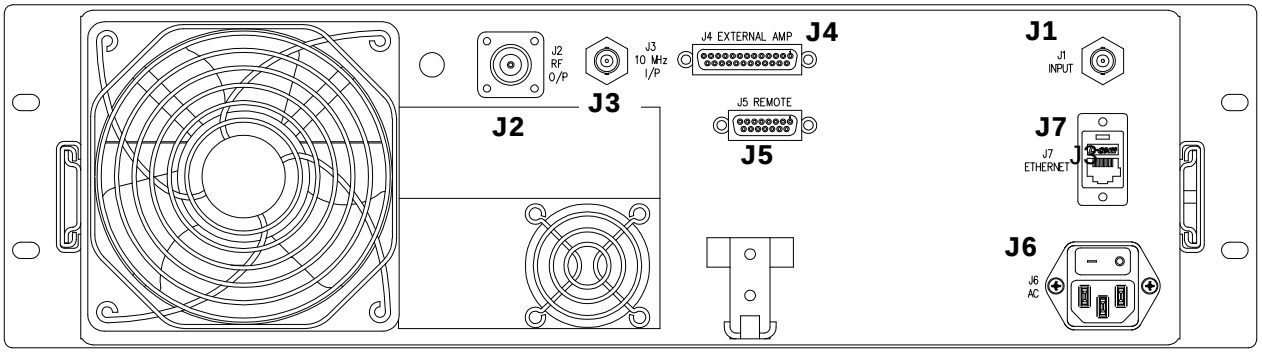


Figure 2: Rear View of the 30W Driver Tray.

Table 4: Rear Chassis Connections for the Driver Tray.

Port	Type	Function	Impedance
J1	BNC	RF Input: On Channel RF Input	75O
J2	N	RF Output: On Channel RF Output	50O
J3	BNC	10 MHz Input: External 10 MHz Reference Input	50O
J4	25 Pos D	External Amplifier: Interface to external amplifier tray	N/A
J5	16 Pos D	Remote: Remote control and status indications	N/A
J6	IEC	AC Input: AC input connection and On/Off circuit breaker	N/A
J7		Ethernet: (Optional Ethernet connection)	N/A

Remote Connections

The remote connections for the Driver Tray are made to the Remote 15 Pos “D” connector Jack J5 located on the rear panel of the tray.

Table 5: Remote Connections to J5 for the Driver Tray.

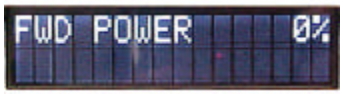
Signal Name	**J5 Pin Designations**	**Signal Type / Description**
RMT Transmitter Operate	1	Discrete Open Collector Input - A pull down to ground on this line indicates that the transmitter is to be placed into the operate mode.
RMT Forward Power	2	Analog Output - 0 to 4.0 V- This is a buffered loop through of the calibrated “System Forward Power ”. Indicates the transmitter's Forward power. Scale factor is 100 % / 3.2V.
RMT Transmitter Standby	3	Discrete Open Collector Input - A pull down to ground on this line indicates that the transmitter is to be placed into the standby mode.
Ground	4,8,9,10 & 14	Ground pins available for remote

Signal Name	J5 Pin Designations	Signal Type / Description
RMT RF System Interlock	5	When this signal's circuit is completed to ground, the transmitter is allowed to operate. If this circuit is opened, the transmitter switches to Standby.
RMT Reflected Power	6	Analog Output - 0 to 4.0 V- This is a buffered loop through of the calibrated “System Reflected Power ”. Indicates the transmitter's Reflected power. Scale factor is 100 % / 3.2V.
RMT Fault Reset	7	Discrete Open Collector Input - A pull down to ground on this line indicates that any transmitter Faults are to be reset.
RMT Operate Status	11	Discrete Open Collector Output - A low indicates that the Transmitter is in Operate.
RMT Fault	13	Discrete Open Collector Output - A low indicates that the Transmitter has a Fault.
RMT Input Fault	15	Discrete Open Collector Output - A low indicates that the Transmitter has an Input Fault.
Not Used	16	N/A

Front Panel Screens for the Transmitter

A LCD display located on the front of the Driver Tray displays the current operating status of the transmitter. The screens are scrolled through using the buttons to the right of the display. The Left & Right Arrows scroll through the Main Menus, which are shown below aligned on the left side. The Up & Down Arrows scroll through the Submenus of the Main Menus, when they are present, which are shown below indented under the Main Menu in which they are contained. The ENTER button selects the changes made. The following screens are typical of an operating transmitter.

Table 6: Transmitter Forward Power Screen



This screen provides an indication of the Output Power of the transmitter in terms of Percent. There are no adjustments on this menu.

Table 7: Transmitter Reflected Power Screen

This screen provides an indication of the Reflected Power of the transmitter in terms of Percent. There are no adjustments on this menu

Table 8: Heatsink Temperature Screen

This screen shows the temperature of the amplifier heatsink assembly, mounted in the transmitter, in degrees F. If the temperature is below the trip point, it will indicate OK.

Table 9: Demodulator Status Screen

This menu indicates whether there is a signal present at the demodulator. This menu only provides status information and no adjustments are available.

This menu indicates whether the Phase Lock Loop is locked in the demodulator. This menu only provides status information and no adjustments are available.

This screen provides the user information on the signal to noise ratio and the signal level of the receive signal. The signal strength allows the user to optimize the position of the receive antenna. The signal strength ranges from 0 to 100 % and typically should be above 40 % for reliable operation. Signal to noise ratio is also provided on this menu to indicate to the user the quality of the receive signal. This reading may also assist the user in the positioning of the antenna.

Table 10: Modulator Status Screen

This menu indicates if the modulator has an SMPTE-310 signal input coming from the demodulator. This menu only provides status information and no adjustments are available.

This menu indicates if the Phase Lock Loop A in the modulator is locked. This menu only provides status information and no adjustments are available.

This menu indicates if the Phase Lock Loop B in the modulator is locked. This menu only provides status information and no adjustments are available.

Table 11: IF Processor Screen

This menu indicates whether there is a signal present to the IF processor from the modulator. This menu only provides status information and no adjustments are available.

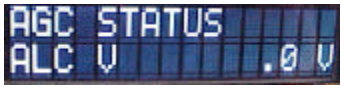
This menu indicates if the IF Signal to the IF Processor has modulation. This menu only provides status information and no adjustments are available.

Table 12: AGC Status Screen

This menu indicates if the AGC circuit has an input. This menu only provides status information and no adjustments are available.

This menu indicates if the AGC circuit is operating within its range. This menu only provides status information and no adjustments are available.

This menu indicates if the AGC circuit is operating in Auto or Manual. This menu only provides status information and no adjustments are available.



This menu indicates the Auto ALC voltage setting. This menu only provides status information and no adjustments are available.

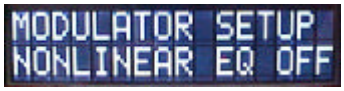
Table 13: Demodulator Channel Set Up Screen

The channel setup screen can be accessed by holding the left and right arrow keys down until the setup screen is displayed. Once the user is in this menu, the channel plan can be changed to either broadcast or cable by hitting the ENTER button. In addition, the receive channel can be changed by hitting the up or down arrow to select the channel. After the selections have been made, the user needs to depress the right or left arrow again and then the display will ask "PUSH ENTER TO ACCEPT CHANGES". If the ENTER button is depressed, the changes will be accepted. If any other key is chosen, the changes will not be made.

Table 14: Modulator Set Up Screen

This screen allows the user to select between an internal or external source in the modulator. During the installation of the system, an off air signal may not be available to the modulator, therefore the user can set the source to INTERNAL to generate an 8 VSB signal from the unit that can be used for set up. Once a receive signal is available, the source should be set to EXTERNAL

This screen controls the operation of the linear equalizer. When set to ON, the modulator applies linear correction to the IF output. When set to OFF, no correction is applied to the IF.



This screen controls the operation of the nonlinear correction. When set to ON, the modulator applies nonlinear correction to the IF output. When set to OFF, no correction is applied to the IF.

Table 15: Fault Reset Menu

This screen allows the user to reset any previous faults that may have occurred in the tray. When a fault is present in the tray, the status LED on the front panel will flash RED as long as the fault is present. In addition, the menu will jump to the present fault on the display and blink this fault continuously. When the fault goes away, the tray will turn the status LED to AMBER to indicate that there was a fault and the menu will still display the fault but it will not flash. This allows the user to know that there was a fault and what type of fault occurred. To reset the indication of a previous fault, the user can hit the ENTER button when this screen is visible and all of the faults will be cleared.

This completes the description of the menu screens for the transmitter.

CU250ATD Innovator 250-Watt Transmitter

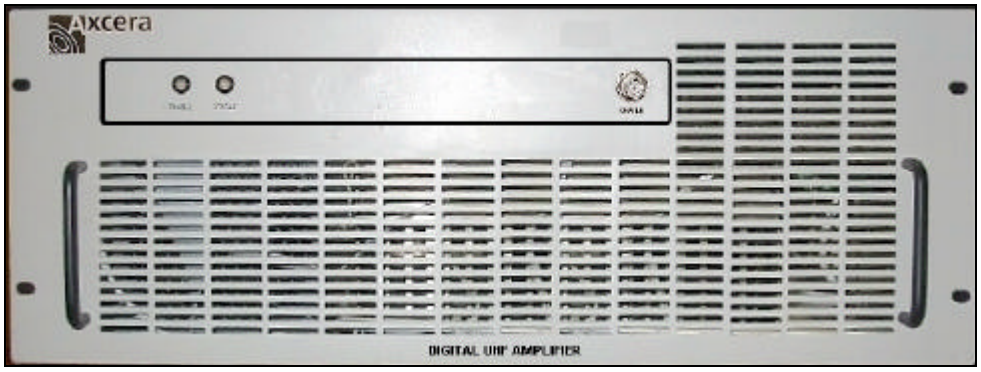


Figure 3: Front View of the 250W Power Amplifier Tray.

250W Power Amplifier Tray Description

The 250-Watt Power Amplifier Tray accepts an RF On Channel signal from the 30-Watt driver tray and amplifies the signal to a power level of 250 Watts.

2-Way Splitter Board (1308933)

The 2-Way Splitter Board splits the incoming RF signal from the 30W Driver Tray and applies the two RF signal paths to (2) 600W PEP UHF Amplifier Pallets.

600W PEP RF Pallet (LDU601-C) x2

The 600W PEP RF Pallet amplifies an incoming UHF RF signal and provides +18 dB gain. The pallet is powered by a +30VDC source. Two pallets are required.

2-Way Combiner Board (1308930)

The 2-Way Combiner Board combines the two RF output signals from each 600W PEP RF Pallet.

Amplifier Control Board (1308936)

The Amplifier Control Board receives commands from the 30W Driver Tray to control the 250W Amplifier Tray. The board also monitors the status, faults and power levels of the amplifier tray and sends these signals back to the 30W Driver tray to be monitored on the Driver's LCD display.

+12VDC Switching Power Supply (1308896)

The +12VDC Switching Power Supply Board supplies +12VDC to power the Amplifier Control Board.

+30VDC Switching Power Supply (1308906)

The +30VDC Switching Power Supply supplies +30VDC to power both 600W PEP RF Pallets.

Table 6: 250W UHF Amplifier Tray Operate/Standby Indicators

LED	FUNCTION
ENABLE (Green)	When lit, indicates that the system is in Operate. When extinguished, indicates that the system is in Standby.
STATUS (Green/Red/ Amber)	A **Green** LED indicates that the system is functioning normally. A flashing **Red** LED indicates a fault is occurring at this time. An **Amber** LED indicates a fault occurred in the past but the system is now operating normally.

250W Power Amplifier Tray Input and Output Connections

The input connections to the amplifier tray are made to the jacks mounted on the rear of the amplifier tray. The tray accepts an On Channel RF signal at J1, the RF input jack, and outputs a digital RF ON Channel signal at J2, the RF Output Jack. Refer to Figure 3 and to Table 7 that follow for detailed information.

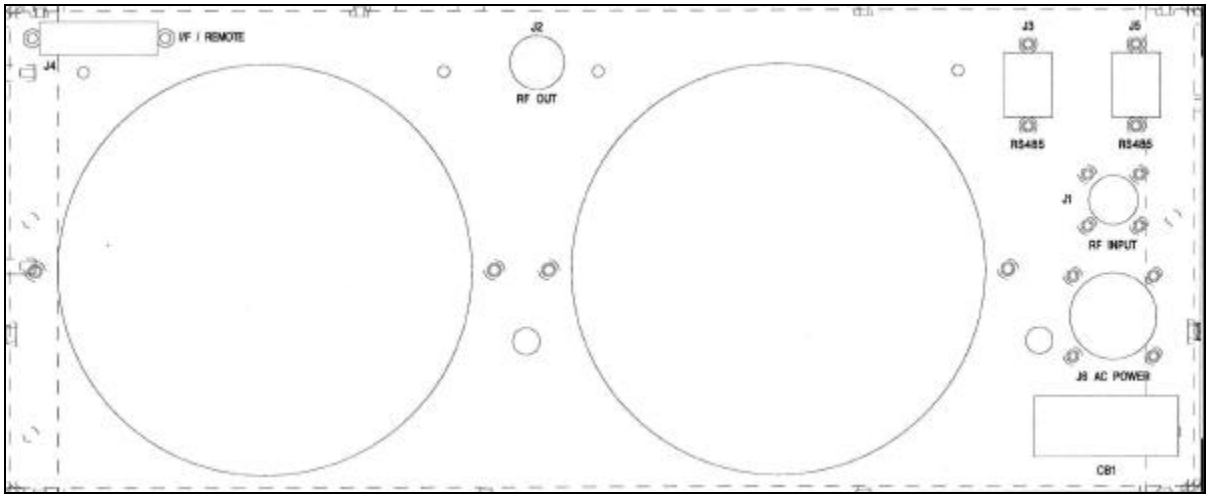


Figure 3: Rear View of the 250W Power Amplifier Tray.

Table 7: Rear Chassis Connections for the Power Amplifier Tray.

Port	Type	Function	Impedance
J1	N	RF Input: On Channel RF Input	50O
J2	N	RF Output: On Channel RF Output	50O
J3		Ethernet: (Optional Ethernet connection)	N/A
J4	25 Pos D	Remote: Interface to Driver tray	N/A
J5		Ethernet: (Optional Ethernet connection)	N/A
J6	Circular	AC Input: AC input connection and On/Off circuit breaker	N/A

System Alignment

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

This transmitter is of a tray design with multiple boards inside the tray. If a board fails, that board needs to be changed out with a replacement board. The failed board 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 board or module.

Set Up of the Output Power of the Transmitter

Check that the Auto/Man switch S1 on the IF Pre-Corrector Board is in the Automatic ALC position. This is the normal operating position for the switch. The voltage at TP1 on the IF Pre-Corrector Board should be .8 VDC with 100% output power.

Check that the Auto/Man switch S1 on the ALC Board is in the Automatic ALC position. Adjust R75 the ALC pot on the ALC Board as needed to attain 100% output power. Switch to Manual Gain (Manual ALC) and adjust the Manual Gain pot R62 for 100 % output power. Switch the ALC Board back to Automatic ALC.

ALC Board Set-Up In the Tray

On (A5) the ALC Board (1308570), preset the Overdrive Threshold pot R38 full CW and set R62, Manual Adjust, and R75, ALC Adjust, full CCW.

Apply an 8-VSB signal at -3 dBm average level to the J1 input jack to the tray. Switch S1 to Manual Gain, and increase the output power to 100%. Calibrate the transmitter output power using R23, Forward Calibration pot, on the Output Detector Board.

Turn the output power down to 10% power. Remove the output RF connector from J2 on tray and calibrate the reflected power to 10%, using R7, the Reflected Calibration pot, on the Output Detector Board. Re-connect the RF output connector to the tray and increase the power, in Manual gain, to 110%. Adjust the Overdrive pot R38, CCW until the overdrive threshold just trips and the Overdrive Fault LED DS4 lights. Turn the pot slightly CW so that power comes back up and DS4 goes out.

Switch S1 to ALC. Turn the ALC Adjust pot R75 until the power is 100%. Switch S1 between ALC and Manual to verify smooth switching, with minimal change in power.

Switch the tray Off and insert a 10 dB attenuator at the input. Switch the tray On and verify the input fault LED comes on and the RF power Mutes. Output power should drop by at least 20-30 dB.

Switch the tray Off and remove the 10 dB attenuator. Replace the input connector and turn the tray back on. With the tray in ALC, use the ALC Adjust pot, R75, to decrease the power to 10%. Remove the RF output connector from the tray. Verify that the VSWR Cutback LED, DS6, comes on and the Reflected Power drops to approximately 6%. Reconnect the RF output connector and increase the power back up to 100%.

This completes the set up of the ALC board.

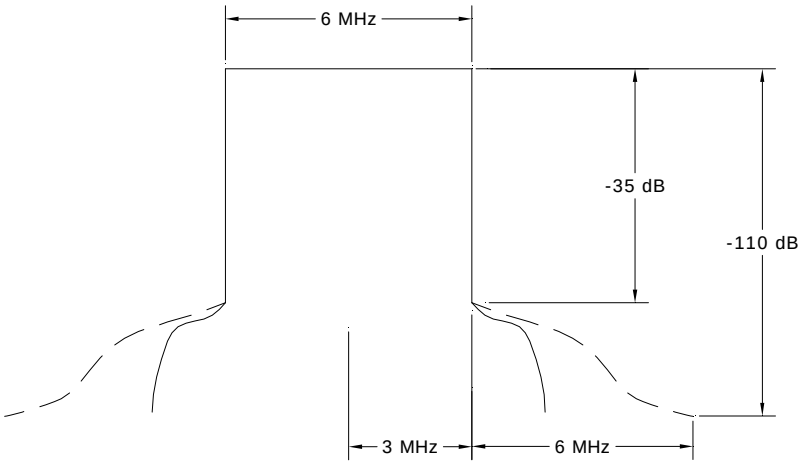


Figure 3: Typical Digital Spectrum

Linearity Correction Adjustment (Non-Linear Distortions)

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

NOTE: On (A3) the IF pre-corrector board (1308796), check that the correction enable/disable jumper W4 on J8 is in the Enable position, between pins 2 & 3.

Set up a spectrum analyzer with 30 kHz resolution bandwidth and 30 kHz video bandwidth to monitor the intermodulation products of the RF output signal of the Tray at J2. A typical digital spectrum is shown in Figure 3.

There are three Corrector stages, two in phase and one quadrature, adjustments located on the IF Pre-Corrector Board. The adjustments are threshold settings that are adjusted as needed to correct for any amplitude or phase intermod problems. Adjust in phase linearity correction adjustment R67 threshold 1 cut in for the in phase amplitude distortion pre-correction that is needed. Next adjust the linearity correction adjustment R69 threshold 2 cut in also for the in phase amplitude distortion pre-correction that is needed. Finally, adjust the quadrature linearity correction adjustment R89, threshold cut in, for the quadrature phase distortion pre-correction that is needed. The above pots are adjusted for the greatest separation between the digital signal and the intermod at the channel edges.

Frequency Response Delay Equalization Adjustment at 44 MHz

The procedure for performing a frequency response delay equalization adjustment for the transmitter is described in the following steps. Check that the jumpers on J4, J5 & J6 are set for 44 MHz between Pins 2 & 3.

The center frequency for the first stage is 46.5 MHz. Adjust R24, located on the IF Pre-Corrector Board, for the best depth of frequency response correction at 46.5 MHz. C14 may need to be adjusted to attain best depth at 46.5 MHz.

The center frequency for the second stage is 41.5 MHz. Adjust R25 for the best depth of frequency response correction at 41.5 MHz. C15 may need to be adjusted to attain best depth at 41.5 MHz.

The center frequency for the third stage is 44 MHz. Adjust R26 for the best depth of frequency response correction at 44 MHz. C16 may need to be adjusted to attain best depth at 44 MHz.

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

The transmitter is now set up and ready for normal operation.

If a problem occurred during the set up, help can be found by calling Axcera field support at 724-873-8100.

APPENDIX A

DRAWINGS LIST

CU250ATD Innovator Transmitter

30-Watt Driver Tray

250-Watt Power Amplifier Tray

APPENDIX B

TRANSMITTER SPECIFICATIONS

Low Power UHF DTV Transmitter/Translator 5W - 250W

Designed to provide broadcasters a cost effective product that will meet their needs like no other solution on the market, this new low power transmitter line uses the latest LDMOS devices for broadband operation across the entire UHF band, and can be configured as a DTV transmitter or regenerative translator. This allows users to minimize spare parts stock, which is especially important to multi-transmitter operators, and also enables simple and inexpensive channel changes

Each very compact unit is completely contained within a single 3RU rackmount tray up to 50 watts, including the digital receiver and modulator. Monitoring is simple with the optional secure Web browser/SNMP interface, allowing users to access all transmitter operating and control parameters through any computer with Internet access.

Low Power UHF DTV Transmitter/Translator 5W - 250W

Specifications

General Output Parameters	
Standard	ATSC
Connector Type	N
Impedance	50 Ohms
Bandwidth	6 MHz
Test Signal	Internal PRBS-23
Frequency Range[1]	470 to 806 MHz
Frequency Stability w/precise frequency control	±1 ppm (max. 30 day variation) ±2Hz
Regulation of Output Power	3%
Out of Band[2]	Compliant with FCC Simple or Stringent DTV Mask
SNR	32 dB (typical), 30dB (min.)
Input Parameters (Transmitter)	
Connector Type	BNC
Data Interface	
Input Rate	19.39Mbps, 6MHz Channel
Input Interface	SMPTE 310M (ASI optional)
Input Parameters (Translator)	
Frequency Range	54 to 806 MHz
Connector Type	BNC
Impedance	50 Ohms
Level	-78 to -8 dBm
White Noise Threshold of Errors	Better than 15.5 dB
Equalization Range	Better than ±45 µsec

Options

AC Surge Protector
GPS Receiver
Stringent Mask Filter
Spare Parts Kit
Climate Controlled Outdoor Enclosure
Equipment Rack

[1] Consult factory for other frequencies, voltages or altitudes
[2] Measured in 30KHz RBW, relative to total average power

Model Information

Model Numbers	CU5ATD CU5ARD	CU30ATD CU30ARD	CU50ATD CU50ARD	CU125ATD CU125ARD	CU250ATD CU250ARD
Power Output	5W	30W	50W	125W	250W
Power Consumption	180W	400W	500W	1100W	1700W
Input Power[1] Line Voltage (VAC)	100-240			208-240±10%	
Power Requirements	Single Phase, 50 or 60 Hz				
Size (19" rackmount)	3RU			7RU	
Weight (lbs)	40	45	50	150	150
Maximum Altitude[1]	8500ft (2600m) AMSL				
Operational Temperature Range	0 to +50°, derate 2°C/1000 ft				
Operational Humidity Range	0% to 95% non-condensing				

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