
INSTRUCTION MANUAL

DT835A
DIGITAL
UHF TRANSMITTER

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Chapter 1 Introduction

This manual explains the installation, setup, alignment, and maintenance procedures for the DT835A Digital UHF Transmitter. It is important that you read all of the instructions, especially the safety information in this chapter, before you begin to install or operate the unit.

1.1 Manual Overview

This instruction manual is divided into four chapters and supporting appendices. Chapter 1, Introduction, contains information on safety, maintenance, return procedures, and warranties. The Chapter 2, System Description and Customer Remote Interface Connections, describes the transmitter and includes discussions of system control and status indicators and remote control connections. Chapter 3, Installation and Set up Procedures, explains how to unpack, install, setup, and operate the transmitter. Chapter 4, Circuit Descriptions, provides information on the boards and subassemblies that make up the DT835A. Chapter 5, Detailed Alignment Procedures, provides information on adjusting the system assemblies for optimal operation. The appendices contain sample log sheets, typical operational readings, assembly and subassembly drawings and parts list, and system specifications.

1.2 Safety

The digital UHF transmitters manufactured by Axcera are designed for ease of 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 transmitter. Please review these warnings and familiarize yourself with the operation and servicing

procedures before working on the transmitter.

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 transmitter should be retained at the transmitter site 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 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 transmitter should be followed.

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

Ventilation – Openings in the cabinets and tray front panels are provided for ventilation. To ensure reliable operation, and to protect the unit from overheating, these openings must not be blocked.

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

Replacement Parts – When replacement parts are used, be sure that the parts have the same functional and performance characteristics as the original part. Unauthorized substitutions may result in fire, electric shock, or other

hazards. Please contact the Axcera Technical Service Department if you have any questions regarding service or replacement parts.

1.3 Maintenance

The DT835A 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 trays.

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 premature failure of the affected trays.

When the front panels of the trays become dust covered, the top covers should be removed and any accumulated foreign material removed. 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 trays 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 transmitter be recorded from the meters on the trays and the system metering control panel at least once a month. It is suggested that this data be retained in a rugged folder or envelope. A sample format for a log sheet is provided in Appendix A. Photocopies of the log sheet should be made for continued data entries.

1.4 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 Field Service Engineer by calling the Axcera Field Service Department, at (724) 873-8100. 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 MRA# is included with the unit. The MRA# is intended to be used for the return of the unit 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 invoicing 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 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
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** or by fax at **(724) 873-8105**.

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

1.5 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.

Chapter 2

System Description and Customer Remote Connections

MAJOR ASSEMBLY NUMBER	TRAY/ASSEMBLY NAME
A1	Single UHF exciter assembly
A2 and A3	two 2-3kW amplifier array assemblies
A4	Hybrid combiner assembly
A7	Directional coupler assembly
	Output coupler assembly
	DM8-R digital modulator tray

Table 2-1: DT835A Major Assemblies

2.1 System Overview

The DT835A is a complete UHF solid-state television transmitter that operates at an output power of 2000 watts to 3000 watts digital, depending on the digital application. The DT835A is made up of three cabinets: a UHF exciter cabinet and two amplifier array cabinets.

The DT835A is made up of the trays and assemblies shown in Table 2-1.

2.1.1 (A1) Single UHF Exciter Assembly

The single UHF exciter assembly contains (A1) a UHF exciter tray, a DM8-R digital modulator tray, (A10) an (Optional) 10 MHz reference generator tray, (A3) a splitter, (A4 and A5) two variable phase/gain trays, (A6) a metering panel, (A8) an AC distribution assembly, and (A9) a remote interface assembly.

The DM8-R modulator tray can have an external 10 MHz reference connected to J3 on the rear panel or it will generate and internal 10 MHz reference if no external reference is supplied. The Digital input connects to J2 on the remote interface assembly that is cabled to J2 on the DM8-R modulator. The Output from the DM8-R modulator at J4 connects to J6 on the rear of the UHF exciter tray. The Digital IF is wired to J18 on the 5 section delay equalizer board, 44 MHz (1072090). The

processed digital IF signal is then cabled to the J32 on the ALC board (1265-1305). The digital IF input must be selected as the input. This is accomplished by connecting the jumper W11 on J29 between pins 2 and 3 on the ALC board. The digital IF is wired through the K3 and K4 relays to the rest of the ALC board. The LED DS5, digital IF modulator enable, should be lit. The ALC board has the capability of switching between two different IF inputs, but in this case only the digital IF input is used.

The output of the ALC board (-10 dBm) connects to (A11) the UHF upconverter board (1265-1310) in the upconverter section of the UHF digital exciter. The upconverter takes the LO and heterodynes it with the IF; the signal is then filtered to produce the RF on-channel output.

The (A15-A1) UHF generator board (1565-1109) is mounted in the UHF Generator Enclosure (1519-1144) for EMI and RFI protection. The board contains a VCXO circuit and additional circuitry to multiply the VCXO frequency by eight. The output is split and provides an input to the x8 multiplier circuitry as well as a sample for the PLL board. The amplified eighth harmonic is then fed to the SMA output jack of the board at J3. Typical output level of the signal is +16 dBm nominal.

The (Optional) (A14-A1) 10-MHz reference generator board (1519-1126)

is located in the (Optional) (A10) 10-MHz reference kit (1286-1108). The board contains a high-stability crystal oscillator that provides a 10-MHz output that is used as reference frequency for the transmitter. The board is mounted within an enclosed assembly that helps to maintain the operating temperature of the oscillator board.

The (A13) PLL board (1286-1104) is part of the phase lock loop (PLL) circuit, which provides the automatic frequency control (AFC) voltage, that connects to the VCXO assembly, on the UHF Generator board, and maintains the accurate output frequency of the VCXO. The AFC is generated by comparing a sample of the 10-MHz reference to a sample of the VCXO frequency. The PLL board uses an external 10-MHz signal as the reference unless it is missing, then an internally generated 10-MHz signal is used. A sample of the signal from the UHF generator board connects to SMA jack J9, the sample input on the board. The signal is amplified by U8 and coupled to U9, a divide by 20/21 IC. A sample of the signal at the output of U8 is connected to J10, the sample output jack on the board, which is typically connected to the front panel of the tray.

The selected 10-MHz reference connects to amplifier IC U1 whose output is split. A sample of the 10-MHz reference is cabled to jack J3, the 10-MHz output jack, which is connected to J5 on the rear of the tray.

If the 50 kHz from the 10-MHz reference and the 50-kHz from the UHF generator board become unlocked, the red Unlock LED, lights and the Lock LED, located on the LED display board, is extinguished.

The RF output of the UHF exciter at J15 is split two ways by the (A3) splitter. The RF output #1 connects to the input of (A4) one of the variable phase/gain trays and the RF output #2 connects to the input of (A5) the other variable phase/gain tray. The output of the (A4)

variable phase/gain tray connects to (A2) the side A amplifier array assembly. The output of the (A5) variable phase/gain tray connects to (A3) the side B amplifier array assembly.

2.1.2 (Optional) 10 MHz Reference Distribution Amplifier Tray

The (Optional) 10 MHz reference distribution amplifier tray provides a 10 MHz reference at a suitable output level for distribution.

The system is made up of an internal 10 MHz reference source, a reference distribution amplifier, and splitter kit(s) without precise offset IF to distribute the reference signal to each transmitter. The reference distribution amplifier tray utilizes an internal 10 MHz reference generator assembly to generate a 10 MHz reference signal. This signal is then divided into five equivalent signals and then amplified and delivered to the output of the tray.

2.1.3 DM8-R Digital Modulator Tray

The DM8-R modulator Tray is an ATSC compliant 8 VSB modulator that mounts in a standard 19" rack. The DM8-R modulator accepts a SMPTE-310 MPEG data stream and outputs a 6 MHz wide IF output centered at 44 MHz with a pilot carrier at 46.69 MHz. The DM8-R modulator provides linear and nonlinear correction capability for the transmission path as well as internal test sources that are used during initial transmitter installation. All of the functions of the DM8-R modulator are controlled from the LX Controller LCD display and pushbuttons.

2.1.4 Amplifier Array Assemblies

The amplifier array assemblies each contain (A9-A1) an 8-way splitter (ZFSC-8-43) with four to six connections used depending on the power level of the transmitter, four to six (A1, A2, A3,

A4, A5 & A6) UHF amplifier trays, (A7) a 4 to 6-way combiner, (A8) an output coupler, (A10) an AC distribution assembly, and (A11) an interface panel.

The RF input from the variable phase/gain tray connects to J1 on (A11) the interface panel in the amplifier array assembly. The RF is connected to the COM input of the 8-way splitter, which splits it eight ways, with six of the outputs connected to J1, the RF input on each of the UHF amplifier trays and the other two outputs terminated with 50Ω. The UHF amplifier trays amplify the RF signals to the power needed to produce a maximum of 300 watts 64 QAM or 8-VSB digital per tray.

The outputs of the four, five or six UHF amplifier trays are combined in the 4, 5 or 6-way combiner. This provides approximately half of the power needed to generate the full 8-VSB digital output of the transmitter. The RF output is connected to the output coupler assembly. The output coupler assembly supplies a forward and a reflected power sample of the output from the amplifier assembly to the metering panel in the single exciter assembly.

In each UHF amplifier tray, the forward power and reflected power samples from the 4-way combiner board are connected to the dual peak detector board, single supply, that provides peak detected samples to the amplifier control board. The amplifier control board then supplies DC voltages to the front panel meter of the UHF amplifier tray. Before exiting each UHF amplifier tray, the RF is fed through a circulator for the protection of the tray from high VSWR conditions.

2.1.5 Transmitter Output Assemblies

The outputs of the amplifier array assemblies connect through (A5 and A6) 1-5/8" to 3-1/8" adapters to (A4) a hybrid combiner (55223A) that

combines the output from the amplifier assemblies into a single output. The reject output of the hybrid combiner is connected to (A7) an output coupler that provides a reject sample from J3 to the metering panel in the single UHF exciter assembly for monitoring purposes. The output of the (A7) directional coupler connects to (A8) a 2500-watt reject load that dissipates any reject power produced during the combining process. A (A8-A1) thermal switch is mounted on the 2500-watt reject load that connects to the overtemperature fault circuit on the transmitter control board in the UHF exciter tray. This fault circuit shuts down the transmitter if an overtemperature fault occurs. The overtemperature is normally caused by a large reject power being dissipated by the reject load due to the malfunctioning of one of the amplifier arrays.

The output of the (A4) hybrid combiner at J3 is fed to (A11) the output coupler assembly. The filtered signal is connected to (A11) an output coupler assembly that provides combined forward and reflected power samples to the metering panel in the single UHF exciter assembly. The forward sample is processed to provide peak detected visual and aural power output samples to the front panel meter on the metering panel. The reflected power sample is also peak detected and wired to the front panel meter.

2.1.6 Control and Status

Information on the control and status of the transmitter is provided by the indicators on the metering panel and the variable phase/gain trays. There are also control, status, and LED indicators on the front panel of the UHF exciter tray. The functions of these control and status indicators are shown in the following tables. The switches and LED indicators, which are mounted so that the switches and LEDs can be operated or viewed from the front panel of the UHF exciter, are part of the transmitter control board.

On the UHF exciter tray, switch (S1) is an Operate/Standby switch that provides the Operate command (Enable), when in Operate, to the each of the amplifier arrays. The Enable to each amplifier array is split four, five or six ways and then applied to the UHF amplifier trays. The Enable is needed to turn on the switching power supplies located in the UHF amplifier trays.

When the UHF exciter is in Operate, the green LED (DS2) is on and when the exciter is in Standby, the amber LED (DS1) is on.

NOTE: If the transmitter does not switch to Operate when S1 is switched to Operate, check that a dummy jumper

plug, with a jumper between pins 1 and 2, is connected to jack J7 on (A9) the remote interface assembly in the single UHF exciter assembly. This jumper provides the interlock needed for the operation of the transmitter. If the interlock is present, the green LED (DS5) on the transmitter control board should be lit.

The operation of the transmitter is controlled by the front panel switches on the UHF exciter tray. During normal operation of the transmitter, switch S2 should be in the Auto position. The front panel of the UHF exciter also has LEDs that indicate a Modulation Fault (Loss), red LED (DS9), and a VSWR Cutback, amber LED (DS7).

2.1.7 Metering Panel

Table 2-2: Metering Panel Meters

METER	FUNCTION
Combination meter (A13)	Displays power in terms of a percentage of the calibrated transmitter output level on the scale; a full-scale reading is 120%
Switch (S1), meter	Selects the desired % Forward, % Reject, or % Reflected reading.
% Forward (0 - 120 %)	Displays the output power level ($\approx 100\%$)
% Reject (0 - 120 %)	Displays the % Reject Output Power (<5%)
% Reflected (0 - 120 %)	Displays the % Reflected Output Power (<5%)
Power meter side A (A15)	Displays power in terms of a percentage of the calibrated amplifier array output level on the scale; a full-scale reading is 120%
Switch (S2), meter	Selects the desired % Forward or % Reflected reading
Forward (0 - 120 %)	Displays the output level of the array ($\approx 95\%$)
% Reflected (0 - 120 %)	Displays the % Reflected Output Power of the array (<5%)
Power meter side B (A16)	Displays power in terms of a percentage of the calibrated amplifier array output level on the scale; a full-scale reading is 120%
Switch (S3), meter	Selects the desired % Forward or % Reflected reading
Forward (0 - 120 %)	Displays the output level of the array ($\approx 95\%$)
% Reflected (0 - 120 %)	Displays the % Reflected Output Power of the array (< 5%)

2.1.8 UHF Exciter Tray

Table 2-3: UHF Exciter Tray Meters

METER	FUNCTION
Meter (A18)	Displays power in terms of a percentage of the calibrated exciter output level on the upper scale. The voltage level is read on one of the two bottom scales. A full-scale reading on the top scale is 120%. 100% equals +10 dBm 8-VSB digital. Also reads the ALC voltage level.
Switch (S3), meter	Selects the desired % Exciter or the ALC voltage reading
ALC (0 - 1 V)	Displays the ALC voltage level (≈ 0.85 VDC)
% Exciter	Displays the % Exciter Output Power. This is the level needed to attain (0 -100) which is the desired output power of the transmitter (≈ 30 %).

Table 2-4: UHF Exciter Tray Switches

SWITCH	FUNCTION
Transmitter (S1) Operate/Standby	The momentary contact switch (S1) applies a ground to K1, a latching relay, on the transmitter control board. K1 will switch either to Operate or to Standby depending on which direction S1 is pushed. When switched to Operate, a low, Enable command, is applied to the UHF amplifier trays mounted in the amplifier arrays. These Enables will turn on the UHF amplifier trays. The opposite occurs when the transmitter is switched to Standby.
Mode Select (S2) Auto/Manual	The momentary contact switch (S2) applies a ground to K2, a latching relay, on the transmitter control board. K2 will switch the transmitter to Automatic or Manual depending on which direction S2 is pushed. In Automatic, the Modulation Fault command from the ALC board will control the operation of the transmitter. The transmitter will switch to Standby, after a slight delay, if the input modulation is lost and will quickly switch back to Operate when the modulation is restored. In Manual, the transmitter is controlled by the operator using the front panel Operate/Standby switch or by remote control.

Table 2-5: UHF Exciter Tray Fault Indicators

FAULT INDICATOR	FUNCTION
Modulation loss (DS9 red)	Indicates that the input has been lost to the transmitter. The fault is generated on the ALC board in the UHF exciter tray.
VSWR cutback (DS7 amber)	Indicates that the reflected power level of the transmitter has increased above 20%. This will automatically cut back the output power level to 20%. The fault is generated on the transmitter control board in the UHF exciter tray.

Table 2-6: UHF Exciter Tray Samples

SAMPLE	DESCRIPTION
f(s)	A sample of the channel oscillator output taken from the sample jack of the PLL board
Exciter O/P	An output power sample of the exciter taken from the UHF upconverter board

2.1.9 Variable Phase/Gain Trays

Table 2-7: Variable Phase/Gain Tray Meters

METER	FUNCTION
Switch (S1), meter	Selects the desired % Power or the ALC voltage reading
% Output Power	Displays the % Output Power of the amplifier array (100%=+15 dBm 8- VSB digital ≈45%)
ALC	Displays the ALC voltage from the UHF exciter that connects to the amplifier trays in the amplifier array (.6 - 1 VDC typical)

Table 2-8: Variable Phase/Gain Tray Sample

SAMPLE	DESCRIPTION
Output (J4), (0 dBm)	A front panel sample of the RF output of the phase/gain tray, which connects to the amplifier array, taken from the variable gain/phase board

2.1.10 UHF Amplifier Trays

Table 2-9: UHF Amplifier Tray Meters

METER	FUNCTION
Meter (A9)	Displays power in terms of a percent of the calibrated power output value. A full-scale reading is 100%, which is equivalent to 300 watts 8-VSB digital. Also reads % Reflected Power, power supply voltage levels, and AGC voltage levels.
Switch (S2), meter	Selects the desired % Power or the voltage reading
% Output pwr	Displays the % Output Power of the tray (100%=300 watts 8-VSB digital)
% Refl (Reflected)	Displays the % Reflected Output Power of the tray (<5% with all amplifier trays operating as measured on the top scale)
Power supply	Displays the power supply voltage, +26.5 VDC, on the middle scale
AGC voltage	Displays the AGC voltage level, +1 - +2 VDC, on the bottom scale

Table 2-10: UHF Amplifier Tray Status Indicators

INDICATOR	FUNCTION
Enable (DS4 green)	Indicates that an Enable, Operate command, is applied to the UHF amplifier tray from the selected UHF exciter tray
Overdrive (DS2 red)	Indicates that the level of the drive is too high. The protection circuit will limit the drive to the set threshold. The fault is generated on the amplifier control board.
VSWR cutback (DS1 red)	Indicates that the reflected power level of the tray has increased above 50%. This will automatically cut back the output power level to 50%. The fault is generated on the amplifier control board.
Overtemp (DS3 red)	Indicates that the temperature of (A5-A6- A3 and A5-A6-A4), one or both of two thermal switches mounted on the heatsink assembly for the output amplifiers, is above 175° F. When this fault occurs, the Enable to the switching power supply in the affected amplifier tray is immediately removed and it will shut down.
Input fault (DS5 red)	Indicates that the input RF level to the amplifier trays dropped below the 0 dBm range

Table 2-11: UHF Amplifier Tray Control Adjustments

ADJUSTMENT	FUNCTION
Phase (A10-R5)	Adjusts the phase of the RF output by approximately 70°
Gain (A11-R6)	Adjusts the gain of the RF output when the amplifier control board is in the AGC mode

Table 2-12: UHF Amplifier Tray Sample

SAMPLE	DESCRIPTION
Module O/P (0 dBm)	A sample of the combined output of the four dual-stage amplifier boards taken from the dual-peak detector board

2.1.11 DM8-R Modulator Front Panel LED Indicators

The front panel LEDs are described in Table 2-13.

Table 2-13: Modulator Front Panel LEDs

LED Indicator	Function
PWR	Indicates that the DC power supply is operating
MPEG LED	Indicates the presence of a valid MPEG stream at the J1-2B input
PLL A LED	Indicates that the DM8 symbol clock is locked to the frequency of the 10 MHz reference.
PLL B LED	Indicates that the pilot frequency is locked to the incoming 10 MHz reference.

2.1.12 Main AC Input

The transmitter needs an AC input of 208/240 VAC at 100 amps for each amplifier array assembly and at 20 amps for the exciter assembly.

The 208/240 VAC input to each amplifier assembly connects to (A10) the AC distribution assembly, amplifier array (1278-1200), on the right, center of each cabinet. The assembly contains the terminal block (TB1) that connects to the 208/240 VAC. Line 1 is connected to TB1-1A, line 2 to TB1-3A, and safety ground to TB1-4A.

The distribution assembly contains nine circuit breakers that supply the AC to the rest of the amplifier assembly. The input AC from TB1 is connected to (CB1) the main AC circuit breaker (100 amps) that distributes the 208/240 VAC to the other eight circuit breakers. The output of CB1 has three MOVs, VR3, VR4, and VR6, mounted to it: VR4 is connected from line 1 to ground, VR6 is connected from line 2 to ground and VR3 is mounted across the two lines. The switched input AC is wired through the six circuit breakers, CB2-CB7, to the six UHF amplifier trays in the amplifier cabinets. CB2 is a 20-amp circuit breaker that supplies the AC voltage to the (A1) UHF amplifier tray. CB3 is a 20-amp circuit breaker that supplies the AC voltage to the (A2) UHF amplifier tray. CB4 is a 20-amp circuit breaker that supplies the AC voltage to the (A3) UHF amplifier tray. CB5 is a 20-amp circuit breaker that supplies the AC voltage to the (A4) UHF amplifier tray. CB6 is a 20-amp circuit breaker that supplies the AC voltage to the (A5) UHF amplifier tray. CB7 is a 20-amp circuit breaker that supplies the AC voltage to the (A6) UHF amplifier tray. The circuit breakers CB8 and CB9 control the AC to the A12-A3 and A12-A5 fans mounted on the (optional) (A12) reject load assembly

that only used as part of the 2.5 and 3 kW amplifier array assemblies.

The 208/240 VAC input to the single UHF exciter assembly connects to (A8) the AC distribution assembly, single UHF exciter assembly (1245-1500), in the right, center rear of the cabinet. The assembly contains the terminal block (TB1) that connects to the 208/240 VAC. Line 1 is connected to TB1-1A, line 2 to TB1-3A, and ground to TB1-2A. The AC distribution panel contains (CB1) the main circuit breaker (20 amps) that supplies the AC to the rest of the single exciter assembly. The output of CB1 has three MOVs, VR1, VR2, and VR3, connected to it: VR1 from line 1 to ground, VR3 from Line 2 to ground and VR2 across the two lines. The AC output of CB1 connects to A1 and A2, the IEC outlet strips, into which the external trays connect. The (A1) UHF exciter tray and the (A4) variable phase/gain tray plug into the (A1) IEC outlet strip. The (A5) variable phase/gain tray, the (A6) metering panel, the (optional) (A7) receiver tray, the 8 VSB modulator tray or other optional trays plug into the (A2) IEC outlet strip. When the circuit breaker CB1 on the single UHF exciter assembly is switched on, +12 VDC from the UHF exciter tray is supplied to each of the amplifier array cabinets. The +12 VDC is split six ways in the amplifier array and connected to each of the UHF amplifier trays to operate the LED status indicators in the tray. Also +12V is connected to the (Optional) external exhaust kit, if present.

2.1.13 Customer Remote Interface Connections

The remote monitoring and operation of the transmitter is provided through the jacks (J8, J9, and J10) on (A9) the remote interface assembly mounted on the rear of the single UHF exciter assembly (see Figure 2-1).

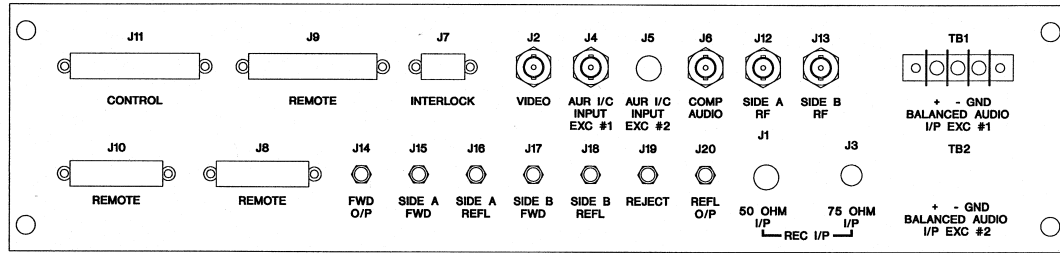


Figure 2-1: Exciter Remote Interface Assembly

Jack (J7) should have a dummy plug connected to it, with a jumper connected between pins 1 and 2, to provide the interlock to the exciter needed to operate the transmitter. If the jumper is missing, the transmitter will not switch to Operate. If remote connections are made to the transmitter, they should be made

through the plugs provided in the installation material for the transmitter and wired as indicated on the interconnect drawing for the single UHF exciter assembly (11056919). The remote control interface connections for this transmitter are shown in Table 2-14.

Table 2-14: Remote Control Interface Connections

FUNCTION	REMOTE JACK/PIN NUMBER	INTERFACE TYPE
Exciter Enable Interlock	J7-1	J7-1 and 2 must be jumpered together for normal operation.
Exciter Enable Interlock Rtn	J7-2	
Transmitter Remote Metering		
Combined Output Power	J10-7	1V full scale at 1k Ω source resistance
Combined Output Power Rtn	J10-8	
Combined Reflected Power	J10-9	1V full scale at 1k Ω source resistance
Combined Reflected Power Rtn	J10-10	
Exciter Output	J9-26	1V full scale at 1k Ω source resistance
Exciter Output Rtn	J9-27	
Exciter Remote Control Commands		
Exciter Operate (Enable)	J8-3	Contact closure
Exciter Standby/Operate Rtn	J8-2	
Exciter Standby (Disable)	J8-1	Contact closure
Exciter Auto	J8-6	Contact closure
Exciter Auto/Manual Rtn	J8-5	
Exciter Manual	J8-4	Contact closure
Power Raise (optional)	J9-6	Contact closure
Raise/Lower Rtn (optional)	J9-5	
Power Lower (optional)	J9-4	Contact closure
Exc Modulator Select (optional)	J8-10	Contact closure
Exc Modulator Select Rtn (optional)	J8-11	
Exciter Remote Status Indications		
Exciter Auto Mode Indicator	J9-30	50 mA max current sink
Auto/Manual Mode Ind Rtn	J9-31	
Exciter Manual Mode Indicator	J9-32	50 mA max current sink
Operate Indicator	J9-1	50 mA max current sink
Operate/Standby Ind Rtn	J9-2	
Standby Indicator	J9-3	50 mA max current sink

FUNCTION	REMOTE JACK/PIN NUMBER	INTERFACE TYPE
Exciter VSWR Cutback Indicator	J8-7	50 mA max current sink
Video Loss Indicator	J9-7	50 mA max current sink
Video Loss Indicator Rtn	J9-8	
Exc Receiver Fault Ind (optional)	J8-9	50 mA max current sink
Side A Driver Remote Metering		
Side A Driver Output Power	J10-1	1V full scale at 1k Ω source resistance
Side A Driver Output Power Rtn	J10-2	
Side B Driver Remote Metering		
Side B Driver Output Power	J10-3	1V full scale at 1k Ω source resistance
Side B Driver Output Power Rtn	J10-4	
Side A Remote Metering		
Side A Forward Power	J10-14	1V full scale at 1k Ω source resistance
Side A Forward Power Rtn	J10-15	
Side A Reflected Power	J10-16	1V full scale at 1k Ω source resistance
Side A Reflected Power Rtn	J10-17	
Side B Remote Metering		
Side B Forward Power	J10-20	1V full scale at 1k Ω source resistance
Side B Forward Power Rtn	J10-21	
Side B Reflected Power	J10-18	1V full scale at 1k Ω source resistance
Side B Reflected Power Rtn	J10-19	
Side A + B Remote Metering		
Reject Power	J10-11	1V full scale at 1k Ω source resistance
Reject Power Rtn	J10-12	
The above connections are made to jack (J9), the 37-position "D" connector; to jack (J10), the 25-position "D" connector; to jack (J8), the 25-position "D" connector; or to jack (J7), the 9-position "D" connector on (A9) the remote interface assembly mounted at the top, rear of the single UHF exciter cabinet.		

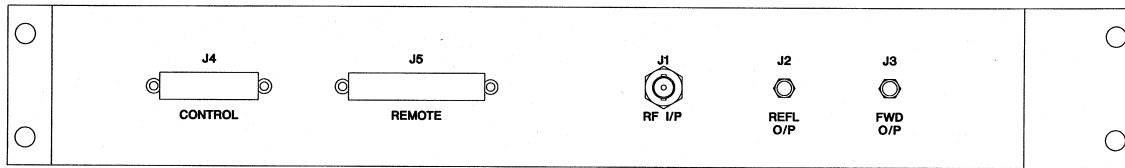


Figure 2-2: Amplifier Array Remote Interface Panel

Amplifier Array Assembly Remote Metering		
(A1) UHF Amp Tray Refl Pwr	J5-2	1V full scale at 1kΩ source resistance
(A1) Reflected Power Rtn	J5-1	
(A1) UHF Amp Tray Fwrd Pwr	J5-4	1V full scale at 1kΩ source resistance
(A1) Forward Power Rtn	J5-3	
(A2) UHF Amp Tray Refl Pwr	J5-6	1V full scale at 1kΩ source resistance
(A2) Reflected Power Rtn	J5-5	
(A2) UHF Amp Tray Fwrd Pwr	J5-8	1V full scale at 1kΩ source resistance
(A2) Forward Power Rtn	J5-7	
(A3) UHF Amp Tray Refl Pwr	J5-9	1V full scale at 1kΩ source resistance
(A3) Reflected Power Rtn	J5-10	
(A3) UHF Amp Tray Fwrd Pwr	J5-11	1V full scale at 1kΩ source resistance
(A3) Forward Power Rtn	J5-12	
(A4) UHF Amp Tray Fwrd Pwr	J5-13	1V full scale at 1kΩ source resistance
(A4) Forward Power Rtn	J5-14	
(A4) UHF Amp Tray Refl Pwr	J5-15	1V full scale at 1kΩ source resistance
(A4) Reflected Power Rtn	J5-16	
(A5) UHF Amp Tray Fwrd Pwr	J5-18	1V full scale at 1kΩ source resistance
(A5) Forward Power Rtn	J5-17	
(A5) UHF Amp Tray Refl Pwr	J5-21	1V full scale at 1kΩ source resistance
(A5) Reflected Power Rtn	J5-20	
The above connections are made to jack (J5), the 37-position "D" connector on (A11) the remote interface panel (Figure 2-2) mounted at the top, rear of each of the amplifier array cabinets.		

Chapter 3

Installation and Setup Procedures

There are special considerations that need to be taken into account before the DT835A 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.

3.1 Site Considerations

The transmitter requires an AC input line of 220 VAC with a rating of 20 amps for the exciter cabinet and 100 amps for each amplifier cabinet. Make sure that the proposed site for the transmitter has the voltage requirements that are needed.

The DT835A is designed and built to provide long life with a minimum of maintenance. The environment in which it is 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 tray in the transmitter contains a thermal interlock protection circuit that will shut down that tray 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 down time. 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 and blowers designed and built into the transmitter will remove the heat from within the trays, but additional means are required for removing this heat from the building. To achieve this, a few considerations should be taken into account. The first step is to determine the amount of heat to be removed. There are generally three sources of heat that must be considered. The first and most obvious is the heat from the transmitter itself. This can be determined by subtracting the average power to the antenna (1500 watts) from the AC input power (15,000 watts). This number in watts (13,500) is then multiplied by 3.41, which gives 46,035, the BTUs to be removed every hour. 12,000 BTUs per hour equals one ton, so a 4-ton air conditioner will cool a 1.5 kW digital 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 detailed drawings of the site showing all construction details. The sum of these three sources is the total amount of 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 particulate 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 operation of air conditioning and ventilation simultaneously is not recommended. This can cause condensation in transmitters. For tube type transmitters, this can be especially serious if the condensation forms in the tube cavity and creates damaging arcs.

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. Condensation may occur on, or worse in, the transmitter under certain conditions.
3. Do not isolate 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 isolate the front from the rear will adversely affect the cooling air flow.
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" 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 or snow 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 adequate to insure a maximum air velocity of 300 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 transmitters are 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 applies 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 interlocked with the transmitter.
 11. 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.
 12. Regular maintenance of any filters can not be overemphasized.
 13. Tube transmitters should not rely on the internal blower to exhaust cooling air at elevations above 4000 feet. For external venting, the air vent on the cabinet top must be increased to an 8" diameter for a 1 kW transmitter and to 10" for 5 kW and 10 kW transmitters. An equivalent rectangular duct may be used but, in all cases, the outlet must be increased in area by 50% through the outlet screen.
 14. It is recommended that a site plan be submitted to Axcera for comments before installation commences.
- In calculating the blower requirements, filter size, and exhaust size, if the total load is known in watts, 2000 CFM into 1/2" of water will be required for each 5000 watts. If the load is known in BTUs, 2000 CFM into 1/2" of water will be required for each 17,000 BTUs. The inlet filter must be a minimum of seven square feet, larger for dusty and remote locations, for each 5000 watts or 17,000 BTUs. The exhaust must be at least four square feet at the exhaust screen for each 5000 watts or 17,000 BTUs.
- The information presented in this section is intended to serve only as a general guide and may need to be modified for unusually severe conditions. A combination of air conditioning and ventilation should not be difficult to design (see Figure 3-1). System interlocking and thermostat settings should be reviewed with Axcera. As with any equipment installation, it is always good practice to consult the manufacturer when questions arise. Axcera can be contacted at (724) 873-8100.

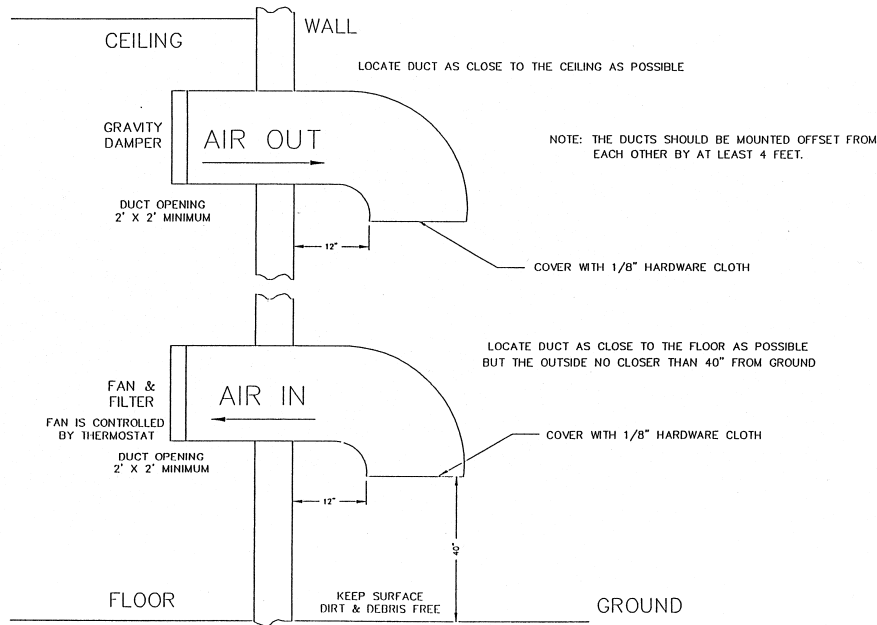


Figure 3-1. 1 kW Minimum Ventilation Configuration

3.2 Unpacking the Cabinets and Trays

Note: Air conditioning and any related heat exhaust ducts should be in place before continuing with the installation of the transmitter.

Thoroughly inspect the cabinets 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 switches, meters, 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.

Remove the cabinets, trays, hybrid combiner, bandpass filter, trap filter, and output couplers, along with any installation material, from the crates and boxes. Remove the straps that hold the cabinets to the shipping skids and slide the cabinets from the skids. Remove the plastic wrap and foam protection from

around the cabinets. Do not remove any labeling or tags from any cables or connectors. These are identification markers that make reassembly of the transmitter much easier.

3.3 Installing the Cabinets and Trays

There are three cabinets: (A1) the single UHF exciter assembly, (A2) the side A amplifier array assembly, and (A3) the side B amplifier array assembly. With the operator facing the cabinets, they should be arranged from left to right with the single UHF exciter cabinet on the left, the side A amplifier cabinet in the center, and the side B amplifier cabinet on the right.

The cabinets should be positioned with consideration given to adequate air intake and exhaust, the opening of the rear door, access to the trays (including sliding them out for testing), the AC hookup, and the installation of the output transmission line. The cabinets should be grounded using copper strapping material and should also be permanently mounted to the floor of the site using the holes in the bottom of the cabinets.

If trays are pre-mounted in the exciter cabinet, remove the two L-brackets, mounted on the front panel rails of the single exciter cabinet, which hold the trays in place during shipment. The UHF amplifier trays are shipped separately from the amplifier array cabinets because of the weight of each tray. The trays are mounted in the cabinet using Chassis Trak cabinet slides. The tray slides are on the top and bottom of the UHF amplifier trays and on the sides of the UHF exciter tray and the variable phase/gain trays. Inspect the trays for any loose hardware or connectors, tightening where needed. Open the rear door; the key to unlock the door, if the door has the optional lock, is found in a tan envelope taped to the door. Inspect the interior for packing material and carefully remove any packing material that is found. Slowly slide each tray in and out to verify that they do not rub against each other and have no restrictions to free movement.

Note: The UHF amplifier trays must be placed into the cabinets in the proper location, and according to the labeling on each tray, or the gain and the phasing will not be maximized.

The UHF amplifier trays are labeled to indicate where they are positioned in the side A or the side B amplifier cabinets. They are mounted in each cabinet from bottom left to top right, with A1 the bottom, left tray and A6 (if used) the top, right tray. Locate the tray labeled A1 and slide it into the side A cabinet in the bottom, left position. Locate the tray labeled A2 and slide it into the side A cabinet in the bottom, right position. Locate the tray labeled A3 and slide it into the side A cabinet in the middle, left position. Locate the tray labeled A4 and slide it into the side A cabinet in the middle, right position. Locate the tray labeled A5 and slide it into the side A cabinet in the top, left position.

Locate the UHF amplifier tray labeled B1 and slide it into the side B cabinet in the bottom, left position. Locate the tray

labeled B2 and slide it into the side B cabinet in the bottom, right position. Locate the tray labeled B3 and slide it into the side B cabinet in the middle, left position. Locate the tray labeled B4 and slide it into the side B cabinet in the middle, right position. Locate the tray labeled B5 and slide it into the side B cabinet in the top, left position. All of the amplifier trays should now be installed. Slowly slide each tray in and out to verify that they do not rub against each other and have no restrictions to free movement.

Caution: Each UHF amplifier tray has a hard-line coaxial cable connected to the rear panel. The tray will not slide out without first removing this connection.

In order to pull out the tray for test purposes or other reasons, use the test cable included in the installation material kit for connections from the tray to the output cable.

It may be necessary to make adjustments to the positions of the trays. This can be accomplished by loosening the cabinet slide mounting bolts that hold the front of the slide to the mounting frame of the cabinet and moving the tray up or down or left or right, as needed, to correct for any misalignment.

3.3.1 DM8-R Modulator Installation

1. If not pre-mounted, remove the modulator tray from the shipping box and inspect it for any damage that may have occurred during shipment. Remove all packing material used to protect the unit during shipment.
2. The tray mounts using four clearance holes into a standard 19" rack or cabinet. Mount the tray into the cabinet and adjust or align the tray so that it does not interfere with cabling or other trays.

3. Verify that the circuit breaker (CB1), located on the rear of the tray, and the main circuit breaker for the system are off.
4. Connect the AC power cord, provided in the installation kit, to J1, the AC input jack on the rear of the tray.
5. Connect the MPEG input to J2, the IF output from J4, and the 10 MHz reference input, if supplied, to J3 on the rear of the tray.
6. Connect the IF output at J4 to the digital IF input to the upconverter of the system.

This completes the installation procedure for the DM8-R modulator.

3.4 Main AC Inputs

Once the cabinets are in place, and the trays have been checked for damage and alignment, the main AC hookup is ready to be made.

Caution: Before connecting the 208/240 VAC, make certain that all of the circuit breakers associated with the transmitter are switched off.

There are three AC input circuits to the DT835A transmitter: one is 20 amps and the two others are 100 amps single phase. The input AC to the exciter cabinet should be a 20 amp, 208/240 VAC line. The input AC to each amplifier cabinet should be a single-phase, 100 amp, 208/240 VAC line.

The 20-amp, 208/240 VAC input connections are made to the terminal block A1-TB1, part of the AC distribution

assembly, exciter cabinet (1245-1500), near the center, right-hand side, rear portion of cabinet #1. Connect terminal 1 to line 1, terminal 3 to line 2 (208/240 VAC), and terminal 2 to the chassis ground.

For single phase - Connect one of the 100-amp, 208/240 VAC inputs to the terminal block A3-TB1, part of the AC distribution assembly, amplifier assembly (1278-1100), near the center, right-hand side, rear portion of cabinet #2. Connect line 1 to TB1-1A, line 2 to TB1-3A and the safety ground to TB1-4A. Follow the same procedure for cabinet #3.

3.5 Output Connections

The RF output of the (A2) amplifier assembly connects through (A5) a 1-5/8" to 3-1/8" adapter to J1 on (A4) the hybrid combiner. The RF output of the (A3) amplifier assembly connects through (A6) a 1-5/8" to 3-1/8" adapter to J2 on (A4) the hybrid combiner. The reject output of the combiner at J4 connects through (A12) a 1-5/8" to 3-1/8" adapter to (A7) a directional coupler (1016-1043) and then to (A8) the 2500-watt reject load. The combined RF output of the combiner at J3 connects through (A9) the bandpass filter to (A10) the output trap filter assembly. The filtered output connects through (A11) the output coupler assembly (1020-1002) to the transmission line that is connected to the antenna.

This completes the unpacking and installation procedures for the DT835A transmitter. Refer to the setup and operation procedures that follow before applying power to the transmitter.

Table 3-2: Jumper Positions in the Gain 1 and Gain 2 Circuits for an Input Level of Between -6 and -26 dBm

IF Input Range	W3 on J4 and W4 on J5	W5 on J6 and W6 on J7
-11 to -6 dBm	Low	Low
-16 to -11 dBm	Low	High
-21 to -16 dBm	High	Low
-26 to -21 dBm	High	High

3.6 Setup and Operation Procedures

The transmitter should initially be turned on with the RF output at J2 of the (A11) output coupler assembly terminated into a dummy load. If a load is not available, check that the output of the coupler assembly at J2 is connected to the antenna. Connect the digital IF input to J6 on the rear of the UHF exciter tray. On (A5) the 5 Section delay equalizer board, 44 MHz, set the input matching jumpers J2 and J3 to positions 1 and 2 for a 50 Ω input, or to positions 2 and 3 for a 75 Ω input, as needed. Depending on the input level, two gain circuits on the delay equalizer board, 44 MHz, are adjusted using jumpers, W3-W6, to set the gain through the board. Table 3-2 shows the jumper positions in the gain 1 and gain 2 circuits for an input level of between -6 to -26 dBm.

Switch on the main AC circuit breaker on the AC distribution assembly mounted toward the rear of the single UHF exciter assembly. Switch on the main AC circuit breakers on the AC distribution assemblies mounted toward the rear of the amplifier cabinets. Switch on the CB2-CB6 circuit breakers for the individual UHF amplifier trays on the AC distribution assemblies mounted in each amplifier array cabinet.

Switch the Operate/Standby switch on the UHF exciter to standby and the Auto/Manual switch, also on the UHF exciter, to Auto. Normal operation of the transmitter is with the switch in Automatic. Automatic operation of the exciter uses the digital input to the exciter as an Operate/Standby switch. In Auto, if the input is lost, the exciter will

automatically cause the transmitter to revert to Standby. When the input signal is restored, the exciter will automatically return the transmitter to Operate.

Move the Operate/Standby switch on the exciter to Operate. Observe the power supply readings on the front panel meters of the UHF amplifier trays in each amplifier cabinet assembly; the reading should be +26.5 VDC.

Note: If the transmitter does not switch to Operate when the Operate/Standby switch is switched to Operate, check that there is an external interlock plug connected to jack (J7) on the remote interface assembly mounted in the top, rear of the single UHF exciter cabinet. Make sure that the plug has a jumper from pins 1 to 2 to provide the interlock for the exciter. The interlock must be present for the transmitter to operate.

Observe the front panel meter on the metering panel with the switch in the Combined Visual Output Power position; it should read 100%. If needed, adjust the power adjust screwdriver pot on the front panel of the UHF exciter to attain a 100% reading on the front panel meter.

At the same time that the output power is being observed, check the meter readings on the metering panel and the combined meter, in the % Reflected Power position, for the side A and side B amplifier assemblies. If the % Reflected Power for any of the readings is very high, above 50%, a problem is present with the output coaxial lines in the side A amplifier assembly or in the output lines

for the system and needs to be checked and corrected. A center bullet missing from the 1-5/8" or 3-1/8" rigid coax lines or loose bolts on the connections can cause this problem. Return the Operate/Standby switch to Standby.

Observe the % Exciter Power reading of the meter on the exciter; it should be the same as on the Test Data Sheet for the transmitter, typically 70%. Move the Operate/Standby switch on the exciter to Standby.

The gain and phase controls on the front panels of the individual UHF amplifier trays were adjusted at the factory to attain 100% output of the transmitter and should not need to be readjusted. The forward meter readings for side A and side B may not be the same, but should be the same as the values written on the Test Data Sheet. Side A and side B are combined to give the total output, which is 100% in the combined output power position.

The readings on each of the individual UHF amplifier trays may not be the same. Refer to the Test Data Sheet and compare the final readings from the factory with the readings on each of the trays after the setup. They should be

very similar. If a reading is way off, refer to the phasing and power adjustment procedures for the UHF amplifier trays in Chapter 5, Detailed Alignment Procedures, of this manual before trying to make any adjustments.

If a dummy load is connected to the transmitter, switch the transmitter to Standby and switch off the main AC circuit breakers found on the AC distribution panels in each cabinet. Remove the dummy load and make all of the connections needed to connect the transmitter to the antenna. Switch the main AC circuit breakers on and the Operate/Standby switch to Operate. Adjust the exciter power adjust pot to attain 100% combined visual output.

If the transmitter is already connected to the antenna, check that the combined power output is 100%. If necessary, adjust the power adjust pot located on the UHF exciter for 100%.

3.6.1 DM8-R Modulator Setup Procedures

NOTE: The modulator was setup at the factory to meet specifications for digital mask and corrections and should not need adjusted.

Chapter 4 Circuit Descriptions

4.1 (A1) UHF Exciter Assembly

The (A1) UHF Exciter Assembly contains (A1) a UHF Exciter Tray (1142445), (A4 & A5) two Variable Gain/Phase Trays (1245-1200), (A6) a Metering Panel (1061456), (A8) an AC Distribution Assembly, Exciter (1245-1500) and (A9) a Remote Interface Assembly (1061198).

The (A1) UHF Exciter Tray (1142445), takes the Digital IF Input that is upconverted to the On Channel RF by mixing it with a L.O. signal generated by the Channel Oscillator Assembly. The RF Output of the UHF Exciter at J15 connects to (A3) a Splitter which splits the RF two ways with the RF Output #1 connected to the input of the (A5) Variable Gain/Phase Tray (1245-1200) and the RF Output #2 connected to the input of the (A4) Variable Gain/Phase Tray (1245-1200). The output of the (A4) Variable Gain/Phase Tray connects to (A2) the Side A Amplifier Assembly (1278-1300). The output of the (A5) Variable Gain/Phase Tray connects to (A3) the Side B Amplifier Assembly (1278-1300).

4.1.1 Control and Status

The Control and Status of the Transmitter are provided by the Meter indications on the Metering Panel and the Variable Gain Phase Trays. There are also Control, Status and LED Indications located on the front panel of the UHF Exciter Tray. The switches and LED indicators, which are mounted so that the switches and LEDs are operated or viewed from the front Panel of the UHF Exciter, are part of the Transmitter Control Board (1245-1101). On the UHF Exciter Tray, switch (S1) is an Operate/Standby Switch that provides the Operate Commands (Enables), when in Operate, to each of

the Amplifier Arrays. The Enable is needed to turn on the Switching Power Supplies located in each of the UHF Amplifier Trays. When the UHF Exciter is in Operate, the Green LED (DS2) is On and when in Standby the Amber LED (DS1) is On. **NOTE:** If the Transmitter does not switch to Operate, when S1 is switched to Operate, check that a Dummy Jumper Plug is connected to Jack J7, with a Jumper between Pins 1 & 2, located on (A9) the Remote Interface Assembly in the Single UHF Exciter Assembly. The Jumper provides the Interlock to the UHF Exciter needed for the operation of the Transmitter. If the Interlock is present, the Green LED (DS5), located on the Transmitter Control Board, should be lit.

Operation of the Transmitter is controlled by the front panel switches located on the UHF Exciter Tray. During Normal operation of the Transmitter, Switch S2 should be in the Auto position. The front panel of the UHF Exciter also has LEDs that indicate a Input Fault (Loss), Red LED (DS9) and a VSWR Cutback, Amber LED (DS7).

4.1.2 Digital Input and Remote Connections

The Digital Input to the Transmitter, connects to the (A9) Remote Interface Panel located on the rear of the Single UHF Exciter Assembly. The Digital Input connects to Jack J2 that is cabled to J2 on the DM8-R Modulator.

Remote Monitoring and Operation of the Transmitter is provided through the Jacks (J8, J9 & J10) located on (A9) the Remote Interface Assembly mounted toward the rear of the Single UHF Exciter Assembly. Jack (J7) should have a dummy plug connected to it,

which has a jumper connected between Pins 1 & 2, that provides the Interlock to the Exciter needed to operate the Transmitter. If the Jumper is missing, the Transmitter will not switch to Operate. If remote connections are made to the Transmitter, they should be made through the plugs provided in the Installation Material as noted on the Interconnect Drawing (1056919 or 1278-8400) for the Single UHF Exciter.

4.1.3 AC Input

The Single UHF Exciter Assembly needs an AC input of 208/240 VAC at 20 Amps. The AC Input to the Single UHF Exciter Assembly connects to (A8) the AC Distribution Assembly, UHF Exciter Assembly (1245-1500) located in the right, center rear of the Cabinet. The Assembly contains the 4 Terminal Block (TB1) to which the 208/240 VAC connects. Line 1 to TB1-1, Line 2 to TB1-3 and Safety Ground to TB1-2. The AC Distribution Panel contains one Circuit Breaker that supplies the AC to the rest of the Single Exciter Assembly.

The Input AC is connected to (CB1) the Main AC Circuit Breaker (20 Amps). The output of CB1 has three MOVs, VR1, VR2 and VR3, connected to it, one connected from each leg of the Input AC to ground and one across the two legs. The AC output of CB1 connects to A1 and A2 which are IEC Outlet Strips. The (A1) Exciter 1 and the (A4) Variable Gain/Phase Tray plug into the (A1) IEC Outlet Strip. The (A5) Variable Gain/Phase Tray, the (A8) Metering Panel and the 8 VSB Modulator Tray plug into the (A2) IEC Outlet Strip.

When the Circuit Breaker CB1, mounted on the AC Distribution Assembly, is switched On, +12 VDC from the Exciter, is supplied to each of the Amplifier Array Cabinets for the operation of the LED Status Indicators in each of the UHF Amplifier Trays.

4.2 (A19) DM8-R Digital Modulator (1306978; Appendix C)

4.2.1 (A1) DM8 Modulator Board (1304883; Appendix D)

4.2.1.1 SMPTE-310 Input

The DM8-R modulator accepts a SMPTE-310 input the BNC Jack J2 located on the rear panel of the tray. This input is connected to J42 on the Digital Modulator Board via a RG-179 cable. This input is applied to a high speed window comparator 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, that functions as an external delay circuit.

4.2.1.2 Channel Coder

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 insertion. 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 that output a baseband I and Q analog signal.

4.2.1.3 Analog Output Section

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. This output is connected through a RG-174 cable to the BNC connector J4, the IF output jack, located on the rear panel of the tray.

4.2.1.4 Pilot Frequency Generation

The 46.69 MHz pilot signal, which is used in the mixing process, is generated from a 46.69 MHz VCXO 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 a 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 a analog

filter to remove harmonics of the pilot and then input to quadrature splitter Z1. The outputs of Z1 are used as the inputs to the mixers in the analog output section.

4.2.2 (A2) DM8-R Front Panel Board (1307113; Appendix D)

The front panel board contains four LEDs, Power, MPEG, PLL A and PLL B, which are viewable on the front panel. J2 connects to the Modulator Board, which controls the operation of the LEDs. When the system is operation normally, all LEDs will be Green. If a problem occurs, that LED will not be lit.

4.3 (A4) UHF Exciter Tray (1142445 or 1294-1111; Appendix C)

4.3.1 (A12 and A18) UHF Filter (1007-1101; Appendix D)

The UHF filter is a tunable two-section cavity filter that is typically tuned for a bandwidth of 5 MHz and has a loss of -1 dB through the filter.

4.3.2 (A15-A1) UHF Generator Board (1565-1109; Appendix D)

The UHF generator board is mounted in the UHF Generator Enclosure (1519-1144) for EMI and RFI protection. The board contains a VCXO circuit and additional circuitry to multiply the VCXO frequency by eight. The VCXO produces an output of ≈ 67 MHz to 132 MHz, depending on the desired channel frequency. Course adjustment to the frequency is made by C11, while fine adjustments are accomplished by the AFC voltage from (A11) the PLL board (1286-1104). The VCXO frequency level is adjusted by C6, L2, and L4. The output is split and provides an input to the x8 multiplier circuitry as well as a sample for the PLL board.

The x8 circuitry consists of three identical x2 broadband frequency doublers. The input signal at the fundamental frequency is fed through a 6-dB pad consisting of R21, R24, and R25 to amplifier U3. The output of the amplifier stage is directed through a bandpass filter consisting of L8 and C32, which is tuned to the fundamental frequency (67 MHz to 132 MHz). The voltage measured at TP1 is typically +.6 VDC. The first doubler stage consists of Z1 with bandpass filter L9 and C34 tuned to the second harmonic (134 MHz to 264 MHz). The harmonic is amplified by U4 and again bandpass filtered at the second harmonic by C38 and L11 (134 MHz to 264 MHz). The voltage measured at TP2 is typically +1.2 VDC. The next doubler stage consists of Z2 with bandpass filter C40 and L12 tuned to the fourth harmonic of the fundamental frequency (268 MHz to 528 MHz). The fourth harmonic is then amplified by U5 and fed through another bandpass filter tuned to the fourth harmonic consisting of L14 and C44 (268 MHz to 528 MHz). The voltage measured at TP3 is typically +2.0 VDC. The final doubler stage consists of Z3 with bandpass filter C46 and L15 tuned to the eighth harmonic of the fundamental frequency (536 MHz to 1056 MHz). The signal is amplified by U6 and U7 to a typical value of from +2 to +4 VDC as measured at TP4. The amplified eighth harmonic is then fed to the SMA output jack of the board at J3.

Typical output level of the signal is +16 dBm nominal.

The +12 VDC for the board enters through jack J4-3 and is filtered by L22 and C54-C58 before being distributed to the circuits on the board.

4.3.3 (Optional) (A14-A1) 10-MHz Reference Generator Board (1519-1126; Appendix D)

The 10-MHz reference generator board is located in (A10) the (Optional) 10-

MHz reference kit (1286-1108). The board contains a high-stability crystal oscillator that provides a 10-MHz output that is used as reference frequency for the transmitter. The board is mounted within an enclosed assembly that helps to maintain the operating temperature of the oscillator board.

The oscillator operates at 10 MHz. Transistor Q1 is the oscillating transistor with the frequency of oscillation set by the crystal Y1. L2, C2, and C3 have second-order effects on the frequency, with C2 and C3 used to pull the oscillator exactly on frequency. Capacitors C4 and C5 provide the positive feedback necessary for oscillation.

The output of the oscillator is buffered by Q2 and Q3. L4 and C12 form a 40-MHz bandpass filter. The 40-MHz signal passes through a digital divider IC U4, which divides the signal down to 10 MHz. Transistor Q5 provides a buffered, 10-MHz output at jack J1.

The crystal is heated in an enclosed crystal oven (HR-1) that is internally set at 60° C. The oscillator board is heated by a separate oven that is set at 50° C. U1 is a temperature sensor/controller IC that monitors the temperature of the oscillator assembly and controls the operation of Q4 and U2. The operating temperature of the assembly is set by adjusting R15. If the temperature of the assembly falls below 50° C, U1 will bias Q4 on, which in turn increases the amount of current flow through U2.

The flange of U2 is thermally connected to the heatsink of the assembly. The temperature of the heatsink will increase as the current through U2 increases. As a result, U2 will dissipate more power in the form of heat, and the temperature of the assembly will increase. If the assembly temperature rises above 50° C, the opposite action

will occur, thus lowering the temperature of the assembly.

The +12 VDC enters the board at J2 and is filtered by L1 and C1 before it is applied to the remaining circuits on the board.

4.3.4 (A13) PLL Board (1286-1104; Appendix D)

The PLL board is part of the phase lock loop (PLL) circuit, which provides the automatic frequency control (AFC) voltage, that connects to the VCXO assembly, and maintains the accurate output frequency of the VCXO. The AFC is generated by comparing a sample of the 10-MHz reference to a sample of the VCXO frequency. The PLL board uses an external 10-MHz signal as the reference unless it is missing, then an internally generated 10-MHz signal is used. The two 10-MHz reference signals are connected to the K1 relay and the selected reference to U1. The switching between the two references is accomplished by the K1 relay which, when energized, applies the external 10-MHz reference to U1, as long as an externally generated 10-MHz reference signal is present and an interlock is connected to J8, pin 1.

If the interlock is removed or the external 10-MHz reference is missing, the relay is de-energized and the internal 10-MHz reference is applied through the relay to U1. The internally generated 10-MHz reference connects from J7 to pins 3 and 6 of relay K1. The externally generated 10-MHz reference connects from J2 to pins 2 and 5 of relay K1. The unused 10-MHz reference is connected through the relay to R10, a 51- Ω load.

With the relay energized, the internally generated 10-MHz reference from J7 connects through the closed contact of the relay from pin 6 to pin 7 to R10, the 51- Ω load. The externally generated 10-MHz from jack J2

connects through the closed contact of the relay from pin 2 to pin 1 to amplifier U1. With the relay not energized, the internally generated 10-MHz reference from J7 connects through the closed contact of the relay from pin 3 to pin 1 to amplifier U1. The externally generated 10-MHz from jack J2 connects through the closed contact of the relay from pin 5 to pin 7 to R10, the 51- Ω load.

External 10-MHz Reference Present Circuitry

The external 10-MHz reference signal enters the board at J2 and is filtered by C4, L2, and C5 before it is connected to the K1 relay. A sample of the 10 MHz is rectified by CR3 and connected to U3A. If the sample level of the external 10 MHz is above the reference set by R13 and R14, which is connected to pin 2 of U3A, the output of U3A stays high. The high connects to gates of Q4 and Q9, which are biased on and cause their drains to go low. The low from the drain of Q9 is wired to J8, pin 6, for connection to a remote external 10-MHz present indicator. The low from the drain of Q4 connects to the green LED DS2 which lights to indicate that an external 10-MHz reference is present. The low from the drain of Q4 also connects to the gate of Q5, biasing it off and causing its drain to go high.

This high reverse biases CR4 and allows a high to be applied to the gates of Q6, Q8, and Q3, if an interlock, low, is present at J8, pin 1. The high to the gate of Q6 biases it on and causing its drain to go low; the low is connected to the green LED DS3, which lights, indicating that an external 10-MHz reference is selected. The high to the gate of Q8 biases it on and applies a low to J8, pin 7, for connection to a remote reference select indicator. The high that is applied to the gate of Q3 biases it on and causes its drain to go low, which energizes the K1 relay and

applies the external 10-MHz reference signal to U1 for use in the PLL circuits.

Internal 10-MHz Reference Circuitry

The internally generated 10-MHz reference signal connects from jack J7 on the board to pins 3 and 6 of relay K1. If the external 10-MHz reference is missing, or the interlock is not present at J8, pin 1, the relay is de-energized. The internally generated 10-MHz reference connects through the closed contact of the relay from pin 3 to pin 1 to amplifier U1. The externally generated 10-MHz signal from jack J2 connects through the closed contact of the relay from pin 5 to pin 7 to R10, the 51- Ω load.

Sample Input Circuitry

A sample of the signal from the UHF generator board connects to SMA jack J9, the sample input on the board. The signal is amplified by U8 and coupled to U9, a divide by 20/21 IC. A sample of the output of U8 is connected to J10, the sample output jack on the board, which is typically connected to the front panel of the tray.

Comparator Phase Lock Loop Circuit

The selected 10-MHz reference connects to amplifier IC U1 whose output is split by the circuit consisting of L3, L4, and R8. A sample of the 10-MHz reference is cabled to jack J3, the 10-MHz output jack, which is connected to J5 on the rear of the tray. The 10-MHz reference connects to IC U4, a divider PLL chip. The divided-down sample of the 10-MHz reference, which is measurable at TP2, connects from pin 10 of U4 to pin 27 of U5.

The divided-down sample from U9 is connected to U5, a divider comparator IC, which divides this signal to a 50-kHz reference. The 50-kHz references are compared in the U5 IC to a 50-kHz sample of the 10-MHz signal that is

generated from an external 10-MHz reference input or internally from a 10-MHz reference kit. The three DIP switches, SW1, SW2, and SW3, are set up to divide down the reference sample input generated by the VCXO to 50 kHz. The reference is then compared to the 50-kHz sample from the 10-MHz input in the U5 IC.

The output of U5 at pins 7 and 8 connect to U6A, a differential comparator, whose output is the difference between the two 50-kHz references which is the AFC voltage. The AFC voltage is amplified by U6B and connected to jack J4. W1 on J4 must be in the AFC auto position, between pins 1 and 2, for the PLL circuit to operate. With jumper W1 between pins 2 and 3 on J6, fixed bias, the AFC bias is set by R12. The AFC output at J6 on the board connects to the VCXO on the UHF generator board. The PLL circuit will maintain the very accurate VCXO output because any change in frequency will be corrected by the AFC error voltage.

Lock Detector Circuit

IC chip U2 contains an internal lock detector that indicates the status of the PLL circuit. When U2 is in a locked state, pin 3 and pin 7 go low; the low is applied to Q1, which is biased off. With Q1 off, pin 1 of J1 goes high and is connected to the Lock LED on the LED display board that lights. The low applied to DS1, the Red Unlock LED, causes it not to light.

If the 50 kHz from the 10-MHz reference and the 50-kHz from the UHF generator board become unlocked, out of the capture range of the PLL, pins 2 and 6 of U2 go to a logic low; this causes U2, pins 3 and 7, to go high. The high connects to DS1, the red Unlock LED, which lights, and to Q1 and Q2, which are biased on. When Q2 is biased on, it connects a low remote unlock to jack J1, pin 4. With Q1 biased

On, the drain goes low and removes the high to pin 1 of J1, which is connected to the Lock LED, on the LED display board, which is extinguished.

Voltage Requirements

The ± 12 VDC needed for the operation of the board enters through jack J11. The +12 VDC is connected to J11-3, which is filtered and isolated by L6 and C38 before it is connected to the rest of the board. The -12 VDC is connected to J11-5, which is filtered and isolated by L7 and C39 before it is connected to the rest of the board.

The +12 VDC is connected to U7, a 5-volt regulator IC, that provides the +5 VDC operating voltage to the U2, U4, U5, and U9 ICs.

4.3.5 (A1) Power Entry Module Assembly (1227-1206; Appendix D)

The power entry module assembly provides overvoltage and surge protection for the input AC lines that connect to the exciter tray. The AC input plug connects to J14; J14 is part of the power entry module on the rear panel of the exciter tray.

The module assembly contains two 130-VAC varistors and one 250-VAC varistor that connect across the AC lines and to ground. The module also contains two 4-amp fuses, one in each input line for overcurrent protection.

4.3.6 (A9) IF Phase Corrector Board (1227-1250; Appendix D)

The IF phase corrector board has adjustments that pre-correct for any IF phase modulation distortion that might occur in output amplifier devices such as Klystron power tubes and solid-state amplifiers. Two separate, adjustable IF paths are on the board: a quadrature IF path and an in-phase IF path. The quadrature IF is 90° out of phase and

much larger in amplitude than the in-phase IF. When these paths are combined in Z1, they provide the required adjustable phase correction to the IF signal.

The IF input signal enters at J1 and is capacitively coupled to U1. U1 amplifies the IF before it is connected to Z1, a splitter, to create two, equal IF outputs. IF output #1 is connected to J2 and IF output #2 is connected to J3. IF output #1 at J2 is jumpered through coaxial cable W4 to jack J6, the quadrature input, on the board. IF output #2 at J3 is jumpered through coaxial cable W5 to jack J7, the in-phase input, on the board.

4.3.6.1 Phase Corrector Circuit

The phase corrector circuit adjusts for any amplitude nonlinearities of the IF signal. It is designed to work at IF and has three stages of correction. Each stage has a variable threshold and magnitude control. The threshold control determines the point where the gain is changed and the magnitude control determines the gain change once the breakpoint is reached. The second stage has a jumper that determines the direction of the correction so that the gain can be made to increase either above or below the threshold and either black or white stretch can be accomplished in stage two.

When the phase corrector circuit is operating, the IF signal from J6 is applied to transformer T1, which doubles the voltage swing using a 1:4 impedance transformation. Resistors R8, R61, R9, and R48 form an L-pad that attenuates the signal. This attenuation is adjusted by adding R7, a variable resistor, in parallel with the L-pad. R7 is only in parallel when the signal reaches a level large enough to bias on CR1 and CR2 and allow current to flow through R7. When R7 is put in parallel with the L-pad, the attenuation

through the L-pad is lowered, causing black stretch.

Two reference voltages are utilized in the corrector stages and both are derived from the +12 VDC line. Zener diode VR1, with R46 as a dropping resistor, provides +6.8 VDC from the +12 VDC line. Diodes CR11 and CR12 provide a .9-VDC reference that temperature compensates the corrector circuits from the affects of the two diodes in each corrector stage. The threshold for the first corrector stage is set by controlling where CR1 and CR2 turn on. This is accomplished by adjusting R3 and forming a voltage divider from +6.8 VDC to ground. The voltage at the wiper of R3 is buffered by U9C, a unity-gain amplifier, and applied to CR1. The .9-VDC reference is connected to U9D, a unity-gain amplifier, whose output is wired to CR2. These two references are connected to diodes CR1 and CR2 through chokes L2 and L3. The two chokes form a high impedance for RF that isolates the op-amps from the RF. The adjusted signal is next applied to amplifier U2, which compensates for the loss through the L-pad. U2 is powered through L4 and R10 from the +12 VDC line. After the signal is amplified by U2, it is applied to the second corrector stage through T2 and then to a third corrector stage through T3. The two other corrector stages operate the same as the first; they are independent and do not interact with each other.

When jumper W1 on J8 is connected from center to ground, R15 is put in series with ground. In this configuration, black stretch (white compression) is applied to the IF signal by controlling the attenuation through the path. When W1 is connected from the center pin to the end that connects to T2, R15 is put in parallel with the L-pad. In this configuration, black compression (white stretch) is applied

to the IF signal by controlling the attenuation through the path.

The phase correctors can be bypassed by moving jumper W2 on J9 to the Disable position. This will move all of the threshold points past sync tip so that they will have no affect. R68 can be adjusted and set for the required correction range. TP2 is a test point that gives the operator a place to measure the level of the quadrature IF signal that is connected to pin 6 on combiner Z2.

4.3.6.2 Amplitude Corrector Circuit

The amplitude corrector circuit adjusts for any amplitude nonlinearities of the IF signal using one stage of correction. The stage has a variable threshold control, R31, and a variable magnitude control, R35. The threshold control determines the point where the gain is changed and the magnitude control determines the amount of gain change once the breakpoint is reached.

Two reference voltages are needed for the operation of the corrector circuit. Zener diode VR1 with R46 provides +6.8 VDC and diodes CR11 and CR12 provide a .9-VDC reference voltage that is used to temperature compensate for the two diodes in the corrector stage.

When the amplitude corrector circuit is operating, the IF signal from J7 is applied to transformer T4, which doubles the voltage swing by means of a 1:4 impedance transformation. Resistors R36, R55, R56, and R37 form an L-pad that lowers the level of the signal. The amount that the level is lowered can be adjusted by adding more or less resistance, using R35, in parallel with the L-pad resistors. R35 is only in parallel when the signal reaches a level large enough to turn on diodes CR8 and CR9. When the diodes turn on, current flows through R35, putting it in parallel with the L-pad. When R35 is in parallel with the resistors, the

attenuation through the L-pad is lowered, causing signal stretch, which is the amount of stretch determined by the adjustment of R35.

The signal is next applied to amplifier U5 to compensate for the loss in level through the L-pad. The breakpoint, cut-in, for the corrector stage is set by controlling where CR8 and CR9 turn on. This is accomplished by adjusting cut-in resistor R31, which forms a voltage divider from +6.8 VDC to ground. The voltage at the wiper arm of R31 is buffered by unity-gain amplifier U8B. This voltage is then applied to R34, through L11, and to diode CR9. The .9-VDC reference created by CR11 and CR12 is applied to unity-gain amplifier U8A. C36 keeps the reference from sagging during the vertical interval. The reference voltage is then connected to diode CR8 through choke L12. Chokes L11 and L12 form a high impedance for RF that isolates the op-amp ICs from the IF.

After the signal is amplified by U5, it is applied to a second stage through T5. The transformer doubles the voltage swing by means of a 1:4 impedance transformation. Resistors R39, R57, R58, and R40 form an L-pad that lowers the level of the signal. The signal is applied to amplifier U6 to compensate for the loss in level through the L-pad. After the signal is amplified by U6, it is applied to a third stage through T6. The transformer doubles the voltage swing by means of a 1:4 impedance transformation. Resistors R42, R59, R60, and R43 form an L-pad that lowers the level of the signal. The signal is applied to amplifier U7 to compensate for the loss in level through the L-pad.

TP1 is a test point that gives the operator a place to measure the level of the in-phase IF signal that is connected to mixer stage Z2. The amplitude corrector can be disabled by moving jumper W3 on J10 to the

Disable position; this will move the breakpoint past sync tip so that it will have no effect on the signal.

4.3.6.3 Output Circuit

The phase-corrected signal from pin 1 on combiner Z2 exits the board at IF output jack J4 after passing through a matching network consisting of six resistors.

4.3.7 (A8) ALC Board (1265-1305; Appendix D)

The ALC board provides for automatic level control (ALC) and amplitude linearity correction of the IF signal. The ALC adjusts the level of the IF signal through the ALC board which, in turn, controls the output power of the transmitter.

The visual + aural IF input (0 dBm) signal from the modulator enters the board at modulator IF input jack J32 and, if the (optional) receiver tray is present, the visual + aural IF input (0 dBm) from the receiver tray connects to J1, the receiver IF input jack. The modulator IF input connects to relay K3 and the receiver IF input connects to relay K4. The two relays are controlled by the Modulator Select command that is connected to J30 on the board. Modulator select enable/disable jumper W11 on J29 controls whether the Modulator Select command at J30 controls the operation of the relays. With jumper W11 on J29, pins 1 and 2, the Modulator Select command at J30 controls the operation of the relays but, with jumper W11 on J29, pins 2 and 3, the modulator is selected all of the time.

4.3.7.1 Modulator Selected

With the modulator selected, J11-10 and J11-28 on the rear of the UHF exciter tray are connected together; this makes J30 low and causes relays K3 and K4 to de-energize. When K4 is

de-energized, it connects the receiver IF input at J1, if present, to 50 watts. When K3 is de-energized, it connects to the modulator IF input at J32 and from there to the rest of the board. At this point, the Modulator Enable LED DS5 will be lit.

4.3.7.2 Receiver Selected

With the receiver selected, J11-10 and J11-28, which are on the rear of the UHF exciter tray and connect to J30 on the board, are not connected together; relays K3 and K4 are energized. When K4 is energized, it connects the receiver IF input at J1, if present, to the rest of the board. When K3 is energized, it connects to the modulator IF input at J32 to 50 watts. At this point, the Modulator Enable LED DS5 will not be lit.

4.3.7.3 Main IF Signal Path (Part 1 of 3)

The selected visual + aural IF input (0 dBm) signal is split, with one half entering a bandpass filter consisting of L3, L4, C4, L5, and L6. This bandpass filter, which can be tuned with C4, is substantially broader than the IF signal bandwidth. It is used to slightly steer the frequency response of the IF and 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. This allows for the servicing of this transmitter with the tray cover off in spite of being in the presence of other RF signals. The filtered IF signal is fed through a pi-type matching pad, consisting of R2, R3, and R4, to the pin-diode attenuator circuit consisting of CR1, CR2, and CR3.

4.3.7.4 Input Level Detector Circuit

The other part of the split IF input is connected through L2 and C44 to U7, an IC amplifier, which is the input to the input level detector circuit. The amplified IF is fed to T4, 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 video with positive sync to be applied through emitter follower Q1. The signal is then connected to detector CR15, which produces a peak-sync voltage that is applied to op-amp U9A. There is a test point at TP3 that provides a voltage reference check of the input level. The detector serves the dual function of providing a reference that determines the input IF signal level to the board and acting 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 (maximum signal) if the IF input to the board is removed. The ALC, video loss cutback, and the threshold detector circuits will only operate when jumper W3 on jack J6 is in the Auto position, between pins 1 and 2. Without the threshold detector, with the pin-diode attenuator at minimum when the signal is restored, the stages following this board will be overdriven.

On the threshold detector, 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 consisting of R50 and R51 off of 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, pin 1, goes to the +12 VDC rail. This high is connected to the base of Q2, which is forward biased, and creates a current

path from the -12 VDC line, through the red Input Level Fault Indicator LED DS1 (which lights), resistor R54, and transistor Q2 to +12 VDC. The high from U9A also connects through diode CR16 to U9B, pin 5, whose output at pin 7 goes high. The high connects through range adjust pot R74 to J20, which connects to the front panel-mounted power adjust pot. This high connects to U10A, pin 2, which causes it to go low at output U10A, pin 1. The low is applied through jumper W3 on J6 to the pin-diode attenuator circuit that cuts back the IF level and also cuts back the output power level to 0. When the input signal level increases above the threshold level, the output power will rise as the input level increases until normal output power is reached.

The video input level at TP3 is also fed to a sync-separator 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 are determined by the voltage divider, consisting of R129, R64, R65, R66, and R130, off of 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 sync detector circuit, the output of U9C and U9D goes towards the -12 VDC rail, which is split, with one part biasing on the transistor Q5. A current path is then established from the +12 VDC line through Q5, resistors R69 and R137, and the red Video Loss Indicator LED DS3, which lights. When Q5 is on, it applies a high to the gates of Q6 and Q7, causing them to conduct; this applies video loss fault pull-down outputs to J18, pins 5 and 2.

The other low output of U9C and U9D is connected through CR20 to jack J5. Jumper W2 on J5, in the cutback enable position between pins 2 and 3, connects the low to the base of Q4, which is forward biased. If jumper W2 is in the Disable position, between pins

1 and 2, the automatic cutback will not operate. With Q4 biased on, a level determined by the setting of cutback level pot R71, which is set at the factory to cut back the output to approximately 25%, is applied to U9B, pin 5. The output of U9B, pin 7, goes low and is applied through the power adjust pot to U10A, pin 2, whose output goes low. This low is applied to the pin-diode attenuator, which will cut back the level of the output to approximately 25%.

4.3.7.5 Pin-Diode Attenuator Circuit

The input IF signal is fed to the pin-diode attenuator circuit, consisting of CR1 to CR3. Each of the pin diodes contain a wide, intrinsic region, which 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 jumper W3 on J6 is in the ALC Auto position between pins 1 and 2, or from pot R87 when the jumper is in the Manual Gain position.

In the pin-diode attenuator circuit, a current path exists from J6 through R6 and then through the diodes of the pin attenuator. 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 is measured as 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. The larger current flow increases the voltage drop across R9 and tends to turn off the diodes CR1 and CR2, causing them to act as high-value resistors. In this case, the shunt elements act as high resistance and the series element acts as low resistance, which represents the minimum loss condition of the attenuator, maximum signal output.

The other extreme case occurs as the voltage at TP1 is reduced, going towards ground or even slightly negative. This tends to turn off and reverse bias diode CR3, the series element, which causes it to act as a high-value resistor. An existing fixed-current path from the +12 VDC line through R5, CR1, CR2, and R9 biases the series element CR3 off and the shunt elements, diodes CR1 and CR2, on, causing them to act as relatively low-value resistors. This represents the maximum attenuation case of the pin attenuator, minimum signal output. By controlling the value of the voltage applied to the pin diodes, the IF signal level is maintained at the set level.

4.3.7.6 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 modular amplifier U1. This device includes the biasing and impedance-matching circuits that allows it operate as a wideband IF amplifier. The output of U1 is available at jack J2, as a sample of the pre-correction IF, for troubleshooting purposes and system set-up. The IF signal is then connected to the linearity corrector portion of the board.

4.3.7.7 Linearity Corrector Circuits

The linearity corrector circuits adjust for any amplitude non-linearities of the IF signal using three stages of correction. Each stage has a variable threshold control adjustment, R34, R37, or R40, and a variable magnitude

control adjustment, R13, R18, or R23. The threshold control determines the point at which the gain is changed and the magnitude control determines the amount of gain change that occurs once the breakpoint is reached. Two reference voltages are needed for the operation of the corrector circuits. Zener diode VR1, with R33 and R135, provides a +6.8-VDC reference and diodes CR11 and CR12 provide a .9-VDC reference that temperature compensates for the two diodes in each corrector stage.

When the linearity correctors are operating, the IF signal is applied to transformer T1, which doubles the voltage swing by means of a 1:4 impedance transformation. Resistors R14, R15, and R16 form an L-pad that lowers the level of the signal. The amount the level is lowered can be adjusted with R13, in parallel with the L-pad resistors. R13 is only in parallel when the signal reaches a level large enough to turn on diodes CR4 and CR5. When the diodes turn on, current flows through R13, putting it in parallel with the L-pad. When R13 is put in parallel with the resistors, the attenuation through the L-pad is lowered, causing signal stretch, the amount of which is determined by the adjustment of R13. The signal is next applied to amplifier U2, which compensates for the loss through the L-pad.

The breakpoint, cut-in, for the first corrector is set by controlling where CR4 and CR5 turn on. This is accomplished by adjusting cut-in resistor R34, which forms a voltage-divider network from +6.8 VDC to ground. The voltage at the wiper arm of R34 is buffered by unity-gain amplifier U5D. This reference voltage is then applied to R35, R36, and C39, through L12, to the CR4 diode. C39 keeps the reference from sagging during the vertical interval. The .9-VDC reference created by CR11 and CR12 is applied to unity-gain amplifier U5B. The

reference voltage is then connected to diode CR5 through choke L11. Chokes L11 and L12 form a high impedance for the RF that serves to isolate the op-amp ICs from the IF.

After the signal is amplified by U2, it is applied to the second corrector stage through T2. This corrector and the third corrector operate in the same fashion as the first. All three corrector stages are independent and do not interact with each other.

The correctors can be disabled by moving jumper W1 on J4 to the Disable position, between pins 2 and 3; this moves all of the breakpoints past the tip of sync so that they will have no affect. The IF signal exits the board at IF output jack J3 after passing through the three corrector stages and is normally connected to an external IF phase corrector board.

4.3.7.8 Main IF Signal Path (Part 3 of 3)

After the IF signal passes through the external IF phase corrector board, it returns to the ALC board at IF input jack J7. The IF then passes through a bandpass filter consisting of L20, C97, C62, L21, C63, L22, L23, C64, and C99. This bandpass filter is identical in both form and function to the one described at IF input jack J1. In this case, the filter is intended to make up for the small errors in frequency response that are incurred by the signal while it is being processed through the linearity and incidental phase correction circuits. Following the bandpass filter, the signal is split using L24, L25, and R89. The signal passing through L24 is the main IF path through the board.

A sample of the corrected IF signal is split off and connected to J10, the IF sample jack. The IF connects to jacks J27 and J28, which control whether a 6-dB pad is included in the circuit by the positioning of jumpers W9 and W10. The 6-dB pad is in when jumpers

W9 and W10 are connected between pins 2 and 3 on J27 and J28. The 6-dB pad is out when jumpers W9 and W10 are connected between pins 1 and 2 on J27 and J28. Normally, the pad is out. The IF signal is then applied to a two-stage frequency response corrector circuit that is adjusted as necessary.

Variable resistors R103 and R106 adjust the depth, or gain, of the notches and variable caps C71 and C72 adjust the frequency, or position, of the notches. The IF signal is amplified by U13 and U14 before it is connected to J12, the IF output jack of the board. R99 is an output level adjustment that is set to provide approximately 0 dBm of IF output at J12. A sample of the IF is fed to J11, which provides an IF sample point that can be monitored without breaking the signal path and gives an indication of the IF signal after the linearity and frequency response correction takes place.

4.3.7.9 ALC Circuit

The other path of the corrected IF signal is used in the ALC circuit. The IF is wired out of the splitter through L25, which is connected to op-amp U12. The output of U12 is wired to jacks J8 and J9; jumpers W4 and W8 control the normal, or encoded, operation of the ALC circuitry. For normal operation, jumper W4 on J8 is between pins 1 and 2 and jumper W8 on J9 is between pins 1 and 2.

The IF signal is applied to transformer T5, which doubles the voltage swing by means of a 1:4 impedance transformation before it is connected to the ALC detector circuit on the board and amplified by U10B. For normal operation, jumper W7 on J26 is between pins 1 and 2 and jumper W5 on J21 is between pins 1 and 2. The detected ALC voltage is wired to U10A, pin 2, where it is summed with the front panel power control setting. The output power adjustment for the

transmitter is accomplished, if the (optional) remote power raise/lower kit (1227-1039) is purchased, by R75, a motor-driven pot controlled by switch S1 on the board or screwdriver adjust pot R1 on the front panel of the UHF exciter tray. An external power raise/lower switch can be used by connecting it to jack J10, at J10-11 power raise, J10-13 power raise/lower return, and J10-12 power lower on the rear of the UHF exciter tray.

S1, or the remote switch, controls relays K1 and K2 which, in turn, the control motor M1 that moves variable resistor R75. If the (optional) remote power raise/lower kit is not purchased, the ALC voltage is controlled only by screwdriver adjust pot R1 on the front panel of the UHF exciter tray. The ALC voltage is set for .8 VDC at TP4 with 0 dBm output at J12 of the board. A sample of the ALC at J19, pin 2, is wired to the transmitter control board where it is passed on to the front panel meter and 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, which the ALC circuit senses at U10A, automatically lowering the loss of the pin-diode attenuator circuit and increasing the gain to compensate.

The ALC action starts with the ALC detector level that is 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 complimented, by current that is 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 at IF input jack J7 of this board should

drop in level, which would normally mean that the output power is decreasing, the null condition would no longer occur at U10A, pin 2. When the level drops, the output of U10A at pin 1 will go more positive and, if jumper W3 on J6 is in the Automatic position, it will cause ALC pin-diode attenuators CR1, CR2, and CR3 to have less attenuation. This will increase the IF level and compensate for the decrease in level. If the ALC cannot sufficiently increase the input level to satisfy the ALC loop, because of not enough 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 lights the red ALC Fault LED DS2 on the board.

4.3.7.10 Fault Command

The ALC board also has circuitry for an external mute fault input at J19, pin 6. This is a Mute command and, in most systems, it is part of the interface for the protection circuits of high-gain output amplifier devices. The Mute command is intended to protect the amplifier devices against VSWR faults. In this case, it is required that the actions occur faster than just pulling the ALC reference down. Two different mechanisms are employed: one is a fast-acting circuit to increase the attenuation of pin-diode attenuator CR3, CR1, and CR2, and the second, as just described, is the reference voltage being pulled away from the ALC amplifier device. An external mute is a pull-down applied to J19, pin 6, that provides a current path from the +12 VDC line through R78 and R139, the Mute Indicator LED DS4, 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, which pulls down the reference voltage. This is a fairly slow action that is slowed down 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 to the pin-diode attenuator circuit. This establishes a very fast muting action, by reverse biasing CR3, in the event of an external VSWR fault.

4.3.7.11 ± 12 VDC to Operate the Board

The ± 12 VDC connects to the board at J14. +12 VDC connects to J14-3 and is filtered by L30, L41, and C80 before it is applied to the rest of the board. The -12 VDC connects to J14-5 and is filtered by L31 and C81 before it is applied to the rest of the board.

The +12 VDC also connects to U16, a 5-VDC regulator IC, which produces the +5 VDC needed to operate timing IC U17.

4.3.8 (A19) Visual/Aural Metering Board (1265-1309; Appendix D)

Note: This board was originally designed for analog television signal operation. For digital applications, forward digital can be substituted for forward visual and the aural circuits along with the scrambling circuits are not used.

The visual/aural metering board provides detected outputs of the forward digital and reflected output samples that are used for monitoring on the front panel meter. The board also provides adjustments for the calibration of the readings on the meter. These readings are obtained from the samples of the forward power and reflected power outputs of the tray.

A forward power sample is applied to SMA jack J1 of the board. The input signal is split, with one path connected to forward power sample SMA jack J2 for monitoring purposes. The other path is connected through C1 to CR2, R4, R5, R6, C4, and CR1, which make

up a detector circuit. The detected signal is amplified by U6B and its output is split. One amplified output of U6B connects to the digital level circuit, the other output is not used in digital operation.

4.3.8.1 Digital Level Circuit

The detected digital level output from U6B is connected to U1C. The intercarrier notch L3 is not used with digital. The digital output of U1C is fed to a peak-detector circuit consisting of CR5 and U2A and then fed through R28, the digital calibration control that is adjusted for a 100% digital reading, to amplifier U2B. The amplified digital output is connected to comparator U2C. The other input to U2C is the level set by aural null adjust R51, which is not used with digital. Pots R51 and R20 should be set full CCW. The offset null adjust R48 is adjusted for 0% digital power with the transmitter in Standby. The adjusted output is amplified by U3D and connected to the other input of U2C. The output of U2C connects to J6, pins 2 and 3, which supplies the forward digital level output to the front panel meter for monitoring.

The scrambling circuits are not used with digital operation.

4.3.8.2 Reflected Level Circuit

A reflected power sample is applied to J3 of the board and is detected by diode detector CR7 and U3B. The detected output is fed through R39, the reflected calibration pot, which can be adjusted to control the gain of U3C. The output of U3C connects to J6, pin 7, which supplies a reflected power level output to the front panel meter.

4.1.8.3 Voltages for Circuit Operation

The ± 12 VDC is applied to the board at J5. +12 VDC is connected to J5, pin 3, and is isolated and filtered by L4 and C34 before it is connected to the rest of

the board. The +12 VDC also connects to U5, a 5-VDC regulator that provides the voltage needed to operate U4. The -12 VDC is applied to J5, pin 1, and is isolated and filtered by L5 and C35 before it is connected to the rest of the board.

4.3.9 (A11) UHF Upconverter Board (1265-1310; Appendix D)

The UHF upconverter board provides upconversion processing by mixing the IF and LO signals in mixer Z1 to produce the desired RF frequency output. The RF output is connected through J3 to an external filter and applied back to the board at J4 where the gain is set by R10. The RF is amplified and connected to the RF output jack of the board at J5.

The IF signal (0 dBm) enters the board at J1, an SMA connector, and is applied through a filter circuit consisting of L10 and C25 to C28 to a matching pad. This pad consists of R1, R2, and R3, which presents a relatively good source impedance, and feeds the signal to pins 3 and 4, the I input of mixer Z1. The local oscillator signal (+13 dBm) from the x8 multiplier connects to the board at jack J2, an SMA connector, through a UHF channel filter and is connected directly to pin 8, the L input of the mixer.

The frequency of the LO is the sum of the IF frequency above the required visual carrier. For instance, in system M, the IF visual frequency is at 45.75 MHz and the relative location of the aural would be 4.5 MHz lower, or 41.25 MHz. For digital applications, the LO is the center frequency of the digital channel added to the 44-MHz IF frequency. By picking the local oscillator to be 45.75 MHz above the visual carrier, a conversion in frequency occurs by selecting the difference product. The difference product, the local oscillator minus the IF, will be at the required visual carrier frequency

output. There will also be other signals present at the RF output connector J3 at a lower level. These are the sum conversion product: the LO and the IF frequencies. Usually, the output product that is selected by the tuning of the external filter is the difference product: the LO minus the 45.75-MHz IF. The difference product has its sidebands flipped so that the visual carrier is lower in frequency than the aural carrier.

If a bad reactive load is connected to the mixer, the LO signal that is fed through it can be increased because the mixer no longer serves as a double-balanced mixer. The mixer has the inherent property of suppressing signals that may leak from one input port to any of the other ports. This property is enhanced by having inputs and outputs of the mixer at 50 Ω impedance. The reactive filter that is externally connected to J3 of the board does not appear as a good 50- Ω load at all frequencies. The pad, in the output line of the board, consists of R5, R4, R6, and R7. The pad buffers the bad effects of the reactive filter load and makes it appear as a 50- Ω impedance. The RF signal is amplified by U1, a modular amplifier, and includes within it biasing and impedance matching networks that makes U1 act as a wideband-RF amplifier device. This amplifier, in a 50- Ω system, has approximately 12 dB of gain. U1 is powered from the +12 VDC line through RF decoupling components R27, R28, C30, R8, and L1. Inductor L1 is a broadband-RF choke and is resonance free through the UHF band. The amplified RF connects to SMA RF output jack J3 which is cabled to the external filter.

The RF input signal from the external filter re-enters the board at J4 (-11 to -14 dBm) and is capacitively coupled to the pin-diode attenuator circuit consisting of CR1, CR2, and CR5. The pin-diode attenuator acts as a voltage-

variable attenuator in which each pin diode functions as a voltage-variable resistor that depends on the DC bias supplied to the diode for the resistance value. The pin diodes, because of a large, intrinsic region, cannot rectify signals at this RF frequency; therefore, they act as a linear voltage-variable resistor.

The pin diodes are configured in shunt configuration: CR1 is the first shunt element, CR2 is the second shunt element, and CR5 is the series element. The manual gain AGC, W1 on J10 between pins 1 and 2, is used in most cases. The control voltage from manual gain pot R10 sets up a current path through R11 and the diodes in the pin attenuator. The level-controlled RF signal from the pin-diode attenuator circuit is amplified by wideband-hybrid amplifier IC U2 which is configured in the same way as U1. The RF signal is buffered by Q1 and applied to the push-pull class A amplifier circuit consisting of Q2 and Q3. At the input to the transistors, the RF is converted to a balanced, dual feed by balun L4, which is made from a short length of UT-141 coaxial cable.

Capacitors C12 and C13 provide DC blocking for the input signal to the amplifier devices. The RF outputs at the collectors of the transistors are applied through C19 and C20, which provide DC blocking for the output signals. The RF signals connect to L7, which consists of UT-141 coaxial cable. L7 combines the RF back to a single-RF output at a 50- Ω impedance to L8, which provides a sample of the RF. The main path through L10 is to J5, the RF output jack of the board (+10 to +20 dBm). The sample of the RF connects to a splitter that provides a sample output (0 dBm) at J6 of the board. The other output of the splitter connects to a peak-detector circuit consisting of CR3 and U3, which provides a DC level at J7 that represents the RF output of the UHF exciter to the front panel meter. R29

sets up the calibration of the front panel meter for 100% in the UHF exciter position when the output power of the exciter is at +17 dBm peak visual or +10 dBm average for digital applications.

The board is powered by ± 12 VDC that is produced by an external power supply. +12 VDC enters the board through J8, pin 3, and is filtered and isolated by RF choke L9 and shunt capacitors C24 and C33. This circuit isolates the RF signals from the board away from those of other devices connected to the same +12 VDC line external to the UHF upconverter board. The +12 VDC is then applied to the rest of the board.

The -12 VDC enters the board through J8, pin 5, and is filtered and isolated by RF choke L11 and shunt capacitors C34 and C35. This circuit isolates the RF signals from this board away from those of other devices connected to the same

-12 VDC line that is external to the UHF upconverter board; the -12 VDC is then applied to the rest of the board.

4.3.10 (A17) Transmitter Control Board (1265-1311; Appendix D)

The transmitter control board provides the system control functions and the operational LED indications that can be viewed on the front panel of the transmitter. The main control functions are for Operate/Standby and Auto/Manual selection. When the transmitter is switched to Operate, the board supplies the enables to any external amplifier trays. When the transmitter is in Auto, the board also performs the automatic switching of the transmitter to Standby upon the loss of the video input. The board contains a VSWR cutback circuit. If the VSWR of the transmitter increases above 20%, the VSWR cutback circuit will operate and cut back the output level of the

transmitter, as needed, to maintain a maximum of 20% VSWR. An interlock (low) must be present at J8-24 for the transmitter to be switched to Operate and, when the interlock is present, the green Interlock LED DS5 will be lit.

4.3.10.1 Operate/Standby Switch

K1 is a magnetic latching relay that controls the switching of the transmitter from Operate and Standby. When the Operate/Standby switch S1 on the front panel of the tray is switched to Operate, one coil of relay K1 energizes; this causes the contacts to close and apply a low to U4B-9. If the transmitter interlock is present, and there are no overtemperature faults, lows will also be applied to U4B-10, U4B-11, and U4B-12. With all the inputs to U4B low, the output at U4B-13 will be low. This low biases off Q1, which turns off the amber Standby LED DS1 on the front panel, and applies a high to Q2. The high turns on and lights the green Operate LED DS2 also on the front panel. When Q2 is biased on, it connects a low to Q12, which biases it off, and allows the ALC to be applied to J1, which is connected to any external amplifier trays. The low from U4B-13 is also applied to Q4 and Q24, which are biased off, and removes the disables from J1-4 and J18-1. The low from U4B-13 also connects to Q10, which is biased on, connects a high to Q6, Q7, Q8, and Q9, which are also biased on, and applies -12 VDC enables at J8-2, 3, 4, and 5, which connect to any external amplifier trays. The high applied to Q2 is also connected to Q5 and Q26, which are biased on, and applies a low enable to J1-3, which can connect to a remote operate indicator. The transmitter is now in Operate.

When the Operate/Standby switch S1 is switched to Standby, the other coil of relay K1 energizes, which causes the contacts to open. A high, +12 VDC, is applied to U4B-9. The high at the input causes the output at U4B-13 to go

high. The high biases on Q1, which applies a low to the amber Standby LED DS1 on the front panel and turns it on. Q1 also applies a low to Q2, which turns off and extinguishes the green Operate LED DS2. In addition, Q12 is biased on and connects to U2C, whose output goes low and pulls the ALC voltages at J1 low, lowering the gain of the external amplifier trays. The high from U4B-13 is applied to Q4 and Q24, which are biased on, and applies disables at J1-4 and J18-1. The high from U4B-13 also connects to Q10, which is biased off. When Q10 is off, it removes the high from Q6, Q7, Q8, and Q9, which are biased off, and removes the -12 VDC enables at J8-2, 3, 4, and 5 that connect to the external amplifier trays. The low applied to Q2 is also connected to Q5 and Q26, which are biased off, and removes the remote enable at J1-3. The transmitter is now in Standby.

4.3.10.2 Automatic/Manual Switch

K2 is a magnetic latching relay that switches the operation of the transmitter to Automatic or Manual using Auto/Manual switch S2 on the front panel of the tray.

When the S2 switch is set to the Auto position, the operation of the transmitter is controlled by the fault circuits and will stay in Operate even if Operate/Standby switch S1 is switched to Standby.

With switch S2 in Auto, a low is applied to one coil in the relay that energizes and closes the contacts. The closed contacts apply a low to the green Automatic LED DS3, causing it to light. The low from the relay connects to U5A, pin 2; U5D, pin 13; Q21; and Q23. Q21 and Q23 are biased off, which causes their outputs to go high. The high from Q21 connects to the amber Manual LED DS4 on the front panel, biasing it off, and to Q22, biasing it on. The drain of Q22 goes

low. The low is applied to J8-7 and this will enable any remote auto indicator that is connected to it. The low to Q23 biases it off and removes the enable to any remote manual indicator connected to J8-6.

When switch S2 is set to the Manual position, the operation of the transmitter is no longer controlled by the fault circuits; it is controlled by Operate/ Standby switch S1. With switch S2 in Manual, a low is applied to the other coil in the relay, which energizes and opens the contacts. The open contacts remove the low from the green Automatic LED DS3 on the front panel, causing it to not light. The high connects to U5A, pin 2; U5D, pin 13; Q21; and Q23. Q21 and Q23 are biased on, causing their outputs to go low. The low from Q21 connects to the amber Manual LED DS4 on the front panel, biasing it on, and to Q22, biasing it off. The drain of Q22 goes high. This high is applied to J8-7 and will disable any remote auto indicator that is connected to it. Q23 is biased on and applies a low enable to any remote manual indicator connected to J8-6.

4.3.10.3 Automatic Control of the Transmitter

The transmitter control board also allows the transmitter to be turned on and off by the presence of modulation to the transmitter when the transmitter is in Auto. When a modulation fault occurs due to the loss of the modulation input, J7-5 goes low. The low is applied through W1 on J10 to Q16, which is biased off, and to the red Modulation Loss Fault LED DS9 on the front panel, causing it to light. The drain of Q16 goes high and connects to U5B, pin 5, causing the output at pin 4 to go low. The low connects to Q18, which is biased off, causing the drain of Q18 to go high. The high connects to U3D, pin 12, whose output at pin 14 goes high. The high connects to U5C, pins 8 and 9, which causes its output at

pin 10 to go low, and to U5A, pin 1, causing its output at pin 3 to go low. With S2 set to Automatic, a low is applied to U5A, pin 2, and to U5D, pin 13. When U5A, pin 1, is high and U5A, pin 2, is low, it causes the output at pin 3 to go low. When U5D, pin 12, and U5D, pin 13, are both low, it causes the output to go high. When U5A, pin 3, is low, it biases off Q20 and removes any pull-down to the Operate switch. A high at U5D, pin 11, biases on Q19 and applies a low enable to the Standby switch; this places the transmitter in the Standby mode.

When the modulation input is returned, J7-5 goes high. The high is applied to Q16, which is biased on, and to the red Modulation Fault LED DS9, which goes out. The output of Q16 goes low and connects to U5B, pin 5. If there is no receiver ALC fault, U5B, pin 6, is also low, which causes the output at pin 4 to go high. This high connects to Q18, which is biased on, and causes the drain of Q18 to go low. The low connects to U3D, pin 12, whose output at pin 14 goes low. The low connects to U5C, pins 8 and 9, which causes the output at pin 10 to go high, and to U5A, pin 1. With Auto/Manual switch S2 in Auto, a low is applied to U5A, pin 2, and to U5D, pin 13. With U5A, pins 1 and 2, low, the output at pin 3 goes high. With pin 12 of U5D high, the output of U5D at pin 11 goes low. When U5A, pin 3, is high, it biases on Q20, which applies a pull-down enable to the Operate switch. A low at U5D, pin 11, biases off Q19, which removes any pull-down to the Standby switch. The transmitter is switched to Operate.

4.3.10.4 Faults

There are four possible faults that may occur in the transmitter and are applied to the board: modulation loss fault, VSWR cutback fault, overtemperature fault, and ALC fault. During normal operations there are no faults to the board. The receiver ALC fault circuit will

only function if a receiver tray is part of the system. The overtemperature fault is controlled by the temperature of the reject load.

Modulation Loss Fault

If a modulation loss occurs while the transmitter is in Auto, the system will go to Standby after a few seconds until the modulation is returned. The transmitter will immediately revert to Operate. An input loss fault applies a low from the ALC board to the fault input at J7-5 on the board.

With jumper W1 in place on J10, the input fault is connected to the red Input Loss Fault LED DS9, causing it to light, and to Q16. Q16 is biased off, causing its drain to go high. The high is wired to U5B, pin 5, whose output at U5B, pin 4, goes low. The low is wired to Q18, which is biased off, and causes the drain to go high. The high is connected to U3D, pin 12, which causes the output at U3D, pin 14, to go high. The high connects to U5A, pin 1, and, if the transmitter is in Auto, pin 2 of U5A is low. With pin 1 high and pin 2 low, the output of U5A goes low and reverse biases Q20, shutting it off. The high at U5C, pins 8 and 9, causes its output at pin 10 to go low. This low is connected to U5D, pin 12, and, if the transmitter is in Auto, pin 13 of U5D is also low. The lows on pins 12 and 13 cause the output to go high and forward bias Q19. The drain of Q19 goes low and connects the coil in relay K1, causing it to switch to Standby.

When the input returns, the input loss fault is removed from the video fault input at J7-5. With jumper W1 in place on J10, the base of Q16 goes high. The red Input Loss Fault LED DS9 on the front panel will go out. Q16 is biased on, causing the drain to go low. This low is wired to U5B, pin 5, and U5B, pin 6, will be low if no ALC fault occurs. The two lows at the inputs make the output at U5B, pin 4, go high. The high is

wired to Q18, which is biased on, and causes the drain to go low. The low is connected to U3D, pin 12, which causes its output at U3D, pin 14, to go low. The low connects to U5A, pin 1, and, if the transmitter is in Auto, pin 2 of U5A is also low. With both inputs low, the output of U5A at pin 3 goes high. The high forward biases Q20, causing its drain to go low. The low connects to the Operate coil on the K1 relay that switches the transmitter to Operate. The low at U5C, pins 8 and 9, causes the output at pin 10 to go high. This high is connected to U5D, pin 12, and, if the transmitter is in Auto, pin 13 of U5D is low. The high on pin 12 causes the output of U5D to go low and reverse bias Q19. The drain of Q19 goes high and removes the low from the Standby coil in relay K1.

Overtemperature Fault

The thermal switch A8-A1 on the output dummy load A8 connects to J8-1 on the board. If the temperature of the thermal switch rises above 170° F, it closes and applies a low to J8-1. The low connects to Q3, which is biased off, and to the red Overtemperature LED DS6, which is biased on. The drain of Q3 goes high and connects to pins 11 and 12 of U4B. The high at the input to U4B causes it to go high and switches the system to standby. This removes the Operate enable commands to any external amplifier trays.

VSWR Cutback Fault

The reflected power sample of the RF output of the transmitter is connected to J2, pin 9, of the board. The sample connects to op-amp U1B, pin 5, which buffers the signal before it is split. One of the reflected samples that is split is connected to J1-5, which is wired to J10-5 on the rear of the tray, for remote monitoring. The other reflected sample that is split is connected to position 3 on the front panel meter of the tray. The final remote reflected

sample that is split is connected to U2B, pin 5.

If the reflected sample level increases above the level set by R22, the VSWR cutback pot, the output of U2B at pin 7 goes high. The high is connected to Q11 through CR11, which is biased on, making U2C, pin 10, low and causing U2C, pin 8, to go low. This low is split and fed out of the tray at J1-6, J1-7, J1-8, and J1-9; these are ALC outputs to the amplifier trays that cut back the output power of the amplifier trays. The low from U2C, pin 8, is also fed through coaxial jumper W2 on J13 and J14 to R73. R73 is a bias adjust pot that sets the level of the pin-attenuator bias that is available as an output at J16.

The high at U2B, pin 7, is fed to the base of Q14 and Q13, which are forward biased, and produces a low at the drains. The low connects to the front panel amber VSWR Cutback LED DS7 and causes it to light, indicating that the tray is in cutback, and to output jack J8-37 for a connection to a remote VSWR cutback indicator.

(Optional) Receiver ALC Fault

If a receiver tray is part of the system, a sample of the ALC voltage from the receiver tray is connected to J8-11 on the board. If the receiver is operating normally, the ALC level applied to U3C, pin 9, remains below the trip level set by R35; the output at pin 13 stays high. The high is applied to the red ALC Fault LED DS8, which is off. The high also connects to U3A, pin 2, and to Q15. Q15 is biased on and the drain goes low. The low connects to U5B, pin 6. U5B normally has a low that is connected to U5B, pin 5, and produces a high at the output pin 4. The high is wired to Q18, which is biased on, and makes its drain low. The low connects to U3D, pin 12, which, because the level is below the preset, its output at U3D, pin 14, goes low. A low at this point indicates a no-fault condition. The

high connected to U3A, pin 2, causing its output to go low. The low is connected to Q25, which is biased off. The low is removed from J8-12, which will not light any remote receiver fault indicator that is connected to it.

If the receiver should malfunction, the ALC level applied to U3C, pin 9, goes high; because this is above the level set by R35, the output at pin 13 will go low. The low is applied to the red ALC Fault LED DS8, which lights. The low also connects to U3A, pin 2, and to Q15. Q15 is biased off and the drain goes high. The high connects to U5B, pin 6, which produces a low at its output at pin 4. The low is wired to Q18, which is biased off, and makes its drain high. The high connects to U3D, pin 12; because the level is above the preset, the output at U3D, pin 14, goes high. A high at this point indicates a fault condition that switches the transmitter to Standby. The low connected to U3A, pin 2, causes its output to go high. The high is connected to Q25, which is biased on, causing its drain to go low. The low is connected to J8-12, which can light any remote receiver fault indicator that is connected to it.

4.3.10.5 Metering

The front panel meter connects to J3-1(-) and J3-2(+) on the board; this is the output of switch S3. The front panel meter has four metering positions that are controlled by switch S3: % Forward Power, % Reflected Power, % Exciter, and ALC.

The reflected sample connects to the board at J2-9 and is connected through buffer amplifier U1B and 100- Ω resistor R84 to position 3 of switch S3. The forward sample connects to the board at J2-5 and is connected through buffer amplifier U1D and 100- Ω resistor R86 to position 4 of switch S3. The exciter sample connects to the board at J2-3 and is connected through buffer

amplifier U1A and 100- Ω resistor R87 to position 2 of switch S3. The ALC sample connects to the board at J6-1 and is connected through buffer amplifier U2C; R15, the ALC calibration pot that adjusts the output of U2A, pin 1; through 100- Ω resistor R18; and to position 1 on switch S3.

Typical readings on the meter are:

- % Reflected = <5%
- % Forward Power = 100%
- % Exciter = The level on the meter needed to attain 100% output power from the transmitter

Refer to the test specifications sheet for the transmitter for the actual readings for the items shown below:

- ALC = .8 VDC

U6 is a temperature sensor IC that gives the operator the ability to measure the temperature inside the tray by measuring the voltage at TP1. The sensor is set up for +10 mV equals 1° F (for example, 750 mV equals 75° F).

4.3.10.6 Operational Voltages

The +12 VDC needed for the operation of the board enters the board at jack J4, pin 3. C28, L1, and L3 are for the filtering and isolation of the +12 VDC before it is split and applied to the rest of the board. The -12 VDC needed for the operation of the board enters at jack J4, pin 5. C29 and L2 are for the filtering and isolation of the -12 VDC before it is split and applied to the rest of the board.

When the +12 VDC is connected to the board, it is split. Four of the +12 VDC outputs are fed out of the board at J8-16, J8-17, J8-18, and J8-19 through diode CR7, CR8, CR9, or CR10 and resistor R50, R51, R52, or R53 to any

external amplifier trays for use in their logic circuits. The resistors are for current limiting and the diodes are to prevent voltage feedback from the external amplifier trays.

4.3.11 (A3)+12V(4A)/-12V(1A) Power Supply Board (1265-1312; Appendix D)

The ± 12 -volt power supply board consists of three separate power supplies, two of which produce the +12 VDC and one for the -12 VDC needed to power the circuit boards in the exciter tray.

4.3.11.1 +12 VDC Power Supply

The 18 VAC from the external step-down toroid in the tray connects to J1, pins 7 and 8. The 18 VAC connects through 7-amp fuse F2, for over-current protection, to two full-wave bridge rectifier circuits.

CR1, CR2, CR3, and CR4 rectify the AC that is then filtered by C2 and connected to U3 and U4; U3 and U4 are voltage-regulator ICs for the +12 VDC. The voltage-regulated and current-limited +12-VDC output of U3 connects to J4, pins 1, 2, 3, and 4, which is one of the +12-VDC outputs of the board. The green LED DS3 will be lit if +12 VDC is present to J4; C7 and C8 are bypass capacitors. The +12 VDC output of U4 connects to J5, pins 1, 2, 3, and 4, which is another one of the +12-VDC outputs of the board. The green LED DS4 will be lit if +12 VDC is present to J5; C9 and C10 are bypass capacitors.

CR5, CR6, CR7, and CR8 rectify the AC that is then filtered by C1 and connected to U1 and U2; U1 and U2 are voltage-regulator ICs for the +12 VDC. The voltage-regulated and current-limited +12-VDC output of U1 connects to J6, pins 1, 2, 3, and 4, which is one of the +12-VDC outputs of the board. The green LED DS1 will be

lit if +12 VDC is present to J6; C3 and C4 are bypass capacitors. The +12-VDC output of U2 connects to J3, pins 1, 2, 3, and 4, which is another one of the +12-VDC outputs of the board. The green LED DS2 will be lit if +12 VDC is present to J3; C5 and C6 are bypass capacitors.

4.3.11.2 -12 VDC Power Supply

The 18 VAC from an external step-down toroid connects to J1, pins 1 and 4, of the board and is wired to CR9, CR10, CR11, and CR12 which form a full-wave bridge rectifier network for the -12-VDC power supply. F1 is a 3-amp fuse that provides over-current protection. The rectified output is filtered by C11 and fed to U5, the voltage-regulator IC for the -12 VDC. The voltage-regulated and current-limited -12 VDC is connected to the -12-VDC output jacks J7, pins 5 through 10, and J8, pins 5 through 10. The green LED DS5 will be lit if -12 VDC is present to J7 and J8; C12 and C13 are bypass capacitors.

4.3.12 (A21) 5-Section Delay Equalizer Board, 44 MHz (1072090; Appendix D)

The 5-section delay equalizer board, 44 MHz, is designed to correct for any group delay errors that have been created by the digital mask filter. The board consists of five separate delay/attenuation equalizer sections. Each section is tuned across the 41 to 47 MHz band depending on where the correction is needed. J9 on W3 determines the input impedance for the IF source:

- J19-1, J19-2=50 Ω
- J19-2, J19-3=75 Ω

J23, J27 determines 6 dB attenuation; J23-1, J23-2 and J27-1, J27-2 means that there is no attenuation; and J23-2, J23-3 and J27-2, J27-3 means that there is 6-dB attenuation.

Delay equalizers 1 through 5 are each tuned to a different frequency to equalize the delay characteristics of that frequency. Attenuation equalizers 1 through 5 are tuned to the same frequency as their matched delay equalizer section and are isolated from them by a 3-dB pad. Each equalizer/attenuation pair is followed by a 12-dB gain stage with 6 dB of attenuation between the sections. Depending on where the jumpers are positioned, each equalizer section can be jumpered into the circuit or bypassed by using a 2-dB pad.

4.4 (A4 and A5) Variable Phase/Gain Trays (1245-1200; Appendix C)

The Variable Phase/Gain Tray sets the phase and gain adjustments of the RF to provide maximum output when the outputs of the two Amplifier Arrays are combined. There are two Variable Phase/Gain Trays in the 835A UHF Transmitter, each controlling the phase and gain of one of the two Amplifier Arrays.

The Tray is made up of (A4) a Variable Phase/Gain Assembly (1245-1204), which contains (A4-A1) a Variable Phase/Gain Board (1245-1201), (A5) a Metering Board (1245-1202) and (A3) a +15V/-12V Power Supply Board (1245-1203).

4.4.1 (A4-A1) Variable Gain/Phase Board (1245-1201; Appendix D)

The RF Input signal connects to the rear panel of the Tray at J1 and is cabled to J1 on (A4-A1) the Variable Phase/Gain Board (1245-1201) that is mounted inside (A4) the Variable Phase/Gain Assembly (1245-1204) for RFI and EMI protection. The Variable Phase/Gain Board contains two main circuits, one for ALC and one for Phase adjustment of the RF signal. A front

panel mounted ALC adjust Pot (A8) connects through (A5) the Metering Board (1245-1202) to J5 on the Board which controls the output level to the tray. A front panel mounted Phase adjust Pot (A7) connects through the Metering Board to J4 on the Variable Phase/Gain Board which controls the phasing of the RF output. The Phasing adjust is needed to phase the two RF outputs of the Amplifier Arrays, when they are combined, to achieve maximum output. The phase and level controlled RF signal connects to J2 of the Variable Phase/Gain Board which connects to the RF Output Jack J3 located on the rear panel of the Tray. A sample of the RF from the Variable Phase/Gain Board connects to J4 the output Sample Jack located on the front panel of the Tray.

4.4.2 (A5) Metering Board (1245-1202; Appendix D)

A detected output sample level connects to the Metering Board at J7 Pins 3 & 4 which is connected to the % Power Level position on (A6) the front panel meter of the Tray. S1 is a two position front panel mounted switch that allows the operator to view the ALC Level, typically reads .6V - 1V, or the % Power, which is calibrated for 100 % is +23 dBm output.

4.4.3 (A1) Power Entry Module Assembly (1227-1206; Appendix D)

120/240 VAC connects to the Tray at J2 on (A1) the Power Entry Module Assembly. Jumpers on the Power Entry Module are set for the desired AC Voltage Input. The assembly contains an On/Off Switch, two 4 Amp Fuses and three Varistors for AC line protection. The AC is connected to (A2) a step down Toroid that supplies an 18 VAC output to the +15VDC/-12VDC Power Supply Board.

4.4.4 (A3) +15V/-12V Power Supply Board (1245-1203; Appendix D)

The +15 VDC and -12 VDC needed to operate the boards in the Tray are generated on (A3) the +15 VDC/-12 VDC Power Supply Board (1245-1203). The +15VDC/-12VDC Power Supply Board supplies voltage regulated +15 VDC and -12 VDC Outputs to the rest of the Tray. The Green LED DS1 is lit if +15 VDC is present and the Green LED DS2 is lit if -12 VDC is present at the output of the +15V/-12V Power Supply Board.

4.5 (A6) Metering Panel (1061456; Appendix C)

The Metering Panel provides three meters, one for Combined, one for Side A Amplifier Array and one for Side B Amplifier Array Outputs. The Side A Meter (A15) displays the % Forward and the % Reflected Power samples for the Side A Amplifier Array. The Side B Meter (A17) displays the % Forward and the % Reflected Power samples for the Side B Amplifier Array. The Combined Meter (A13) displays the % Reject, % Forward and the % Reflected Power samples for the Combined Output of the Transmitter. The Metering Panel also takes the ALC Reference Inputs from the (A4 & A5) Variable Phase/Gain Trays and splits them six ways which are then connected to the UHF Amplifier Trays in the two amplifier arrays.

The Metering Panel (A6) contains (A4, A5, A6 & A11) four Splitter Boards (1181-1002), (A7, A8 & A9) three Dual Peak Detector Modules (1159965 or 1555-1271), (A10) a Visual/Aural Metering Board (1265-1309), (A18) a Detector Threshold Board (1245-1402) and (A3) a ± 12 V Power Supply Board (1062-1013).

The (A13) Front Panel Meter is for Combined Output Power that is controlled by (S1) the Meter Control Switch, the (A15) Front Panel Meter is for Side A Output Power with (S2) the Meter Control Switch and the (A17) Front Panel Meter is for Side B Output Power with (S3) the Meter Control Switch.

4.5.1 (A4, A5, A6 & A11) Splitter Board (1181-1002; Appendix D)

The (A4) Splitter Board (1181-1002) takes the ALC reference from the (A4) Variable Phase/Gain Tray at J1-1 and splits it six ways that connect to the UHF Amplifier Trays mounted in the Side A Amplifier Array.

The (A5) Splitter Board (1181-1002) takes the ALC reference from the (A5) Variable Phase/Gain Tray at J1-1 and splits it six ways that connect to the UHF Amplifier Trays mounted in the Side B Amplifier Array.

The (A6) Splitter Board takes the Combined Reflected Sample Input at J1-1 and splits it. One of the split Combined Samples connects to the front panel Meter, one is used for Remote Monitoring and the other two connect back to the UHF Exciters for use in the VSWR Cutback circuitry.

The (A11) Splitter Board (1181-1002) takes the Combined Aural Sample Input at J1-1 from the (A10) Visual/Aural Metering Board and splits it. One of the split Aural Samples connects to the front panel Meter and the other is used for Remote Monitoring.

4.5.2 (A10) Visual/Aural Metering Board (1265-1309; Appendix D)

This board was originally designed for Analog operation only. When used in a digital transmitter the visual references and circuits become combined and the

aural references and circuits are not used.

The (A10) Visual/Aural Metering Board has a Combined Forward Sample from the Output Coupler Assembly of the Transmitter connected to J1 on the Board where it is split. One Forward Sample connects to J2 on the board that is cabled to J9, the Transmitter Output Sample Jack, located on the front panel of the Metering Panel. The Combined Forward Sample on the Visual/Aural Metering Board is split again with one Sample used to produce a Combined Forward Sample, that connects to the front panel Meter (A13) and also to the rear panel for Remote monitoring. The other Combined Forward Sample produces a combined Aural Sample that connects to the (A11) Splitter Board.

4.5.3 (A7, A8 & A9) Dual Peak Detectors (1159965; Appendix D)

The (A7) Dual Peak Detector takes the Combined Reflected Sample Input from the Output Coupler Module and splits it. A peak detected output of the reflected sample connects to the (A6) Splitter Board. The (A7) Dual Peak Detector also has a Reject Sample Input from the Reject Output Coupler Module and splits it. One of the peak detected split Reject Samples connects to the front panel Meter and the other is used for Remote Monitoring.

The (A8) Dual Peak Detector Module takes a Reflected Sample from the Side B Amplifier Array that is peak detected and connected to the (A17) front panel meter. Another input to the (A8) Dual Peak Detector Module is a Forward Sample from the Side B Amplifier Array that is peak detected and connected to the (A17) front panel meter.

The (A9) Dual Peak Detector Module receives the Reflected Sample from the Side A Amplifier Array which is peak detected and connected to the (A15)

front panel meter. Another input to the (A9) Dual Peak Detector Module is the Forward Sample from the Side A Amplifier Array which is peak detected and connected to the (A15) front panel meter.

4.5.4 (A18) Detector Threshold Board (1245-1402; Appendix D)

The Detector Threshold Board consists of three identical signal paths. One path uses a detected Reflected sample from Side A, another the detected Reflected sample from Side B and the final path uses a detected Combined Reflected sample. These samples are compared to the threshold settings, 20% Reflected level, and provide an output to cut back the transmitter if the reflected level of any of the input samples increase above 20%.

A Sample of the Side A Reflected level enters the board at J1-1. The level is split and one path connects to J1-2 to be used as a Side A Remote Reflected output. The other path connects to the Operational Amplifier U1A whose turn on level is controlled by the setting of R5. R5 is set to cause U1A to conduct if the reflected sample input increases above the 20% level. The output, at J2-1 and also J2-5 through the jumper W1 on J4, connects to the Transmitter Control Board, located in the UHF Exciter, where it cuts back the transmitter using the VSWR cut back circuits.

A Sample of the Side B Reflected level enters the board at J8-1. The level is split and one path connects to J8-2 to be used as a Side B Remote Reflected output. The other path connects to the Operational Amplifier U1B whose turn on level is controlled by the setting of R12. R12 is set to cause U1B to conduct if the reflected sample input increases above the 20% level. The output, at J2-5 and also J2-1 through the jumper W1 on J4 connects to the Transmitter Control Board, located in

the UHF Exciter, where it cuts back the transmitter using the VSWR cut back circuits.

A Sample of the Combined Reflected level enters the board at J7-1. The level is split and one path connects to J7-2 to be used as a Remote Combined Reflected output. The other path connects to the Operational Amplifier U1C whose turn on level is controlled by the setting of R19. R19 is set to cause U1C to conduct if the combined reflected input sample increases above the 20% level. The output, at J6-1 and also J2-5 through the jumper W2 on J5 connects to the Transmitter Control Board, located in the UHF Exciter, where it cuts back the transmitter using the VSWR cut back circuits

4.5.5 (A1) Power Entry Module Assembly (1227-1206; Appendix D)

120/240 VAC connects to the Tray at J8 on (A1) the Power Entry Module Assembly. Jumpers on the Power Entry Module are set for the desired AC Voltage Input. The assembly contains an On/Off Switch, two 4 Amp Fuses and three Varistors for AC line protection. The AC is connected to (A2) a step down Toroid that supplies an 18 VAC output thru TB1 to the $\pm 12V$ Power Supply Board.

4.5.6 (A3) $\pm 12V$ Power Supply Board (1062-1013; Appendix D)

The ± 12 VDC needed to operate the Boards in the Metering Panel are provided by the ± 12 VDC Power Supply Board (1062-1013).

The 18 VAC, from an external step-down Transformer, is directed to the Board thru J5 Pins 1 & 4, with Pin 2 connected to the center tap of the secondary of the Transformer.

The +12 VDC is produced by using a Full-Wave rectifier circuit consisting of CR1 and CR2 whose output is filtered

by capacitor C1 and bypassed by C2 to prevent oscillations. The filtered +12 VDC is applied to U1 a 7812 IC voltage regulator and current limiter. C3 is a bypass capacitor to prevent oscillations in the output DC lines. DS1 is a Green LED which when lit indicates that the +12VDC is present at the output of the board. The +12 VDC is distributed thru Pins 2 & 7 of each of the Output Jacks, J1, J2, J3 & J4, to the rest of the boards in the Tray.

The -12 VDC is produced by using a Full-Wave rectifier circuit that consists of CR3 and CR4 whose output is filtered by capacitor C4 and bypassed by C5 to prevent oscillations. The filtered -12 VDC is applied to U2 a 7912 IC voltage regulator and current limiter. C6 is a bypass capacitor to prevent oscillations in the output DC lines. C7 is a holding capacitor to maintain -12VDC for an instance even if the supply is lost. This is to allow the positive voltages to be removed from GaAs FET Amplifier devices to prevent damage to the devices. DS2 is a Green LED which when lit indicates that the -12 VDC is present at the output of the board. The -12VDC is distributed to the rest of the Boards in the Tray thru Pins 4 & 5 of each of the Output Jacks, J1, J2, J3 & J4.

The ± 12 VDC outputs of the board are connected to the rest of the boards in the Metering Panel.

4.6 (A8) AC Distribution Assembly (1245-1500; Appendix C)

The AC Distribution Assembly distributes the Main AC Input, 208/240 VAC @ 20 Amps, that connects to the UHF Exciter Assembly Cabinet to the Trays and Assemblies which make up the Exciter.

The 208/240 VAC Main AC Input to the Exciter Cabinet connects to the Terminal Block TB1, Line 1 to TB1-1A,

Line 2 to TB1-3A and Ground to TB1-2A.

The 208/240 VAC Main AC Input connects from the Terminal Block TB1-1B (Line 1) to the 20 Amp Circuit Breaker CB1-1, TB1-2B (Ground) to Chassis Ground & TB1-3B (Line 2) to the Circuit Breaker CB1-3. Three MOVs, for surge and transient protection, are connected to the AC Lines from the Circuit Breaker, VR1 and VR3 from the AC Lines to Ground and VR2 across the AC Lines.

The switched 208/240 VAC Main AC Input is wired from the Circuit Breaker Terminal 2 to the L inputs and Terminal 4 to the N Inputs of the (A1 & A2) IEC Outlet Strips. The E Inputs to both IEC Outlet Strips connect to Chassis Ground.

There are four outputs for both the (A1) and the (A2) IEC Outlet Strips. On the A1 Outlet Strip, J1 connects to J14 on the (A1) Exciter #1, J2 connects to J14 on the (Optional) (A2) Exciter #1, J3 connects to J8 on the (Optional) (A3) Exciter Switcher Tray and J4 connects to J2 on the (A4) Variable Phase/Gain Tray. On the A2 Outlet Strip, J5 connects to J2 on the (A5) Variable Phase/Gain Tray, J6 connects to J8 on the (A6) Metering Panel, J7 connects to J2 on the (Optional) (A7) Receiver Tray or to the AC Input Jack on the (Optional) Digital Modulator and J8 is not used in this System.

4.7 (A2 & A3) 2-3 kW Amplifier Array (1278-1300; Appendix C)

There are two Amplifier Array Assemblies in the DT835A 2-3 kW UHF Solid State Internally Diplexed Digital Television Transmitter. The (A2 & A3) Amplifier Array Assemblies (1278-1300) are identical and configured according to the output power needed. Each Amplifier Array contains (A9-A1) an 8 Way Splitter (ZFSC-8-43), four to

six outputs of the splitter are used, depending on output power, (A1 thru A6) UHF Amplifier Trays (1281-1100), the number used depending on the output power needed, (A7) a 4, 5 or 6 Way Combiner, depending on the output power needed, (A8) an Output Coupler (1016-1043), (A10) an AC Distribution Assembly (1278-1200) for Single Phase AC Input or (1278-1100) for Three Phase AC Input and (A11) an Interface Panel. If the Amplifier Array contains the 2.5 kW or 3 kW Output Power Kit, the Array also has (A12) a Reject Load Assembly (1278-1312). In the 2 kW configuration no Reject Load Assembly is needed.

The output of the (A4) Variable Phase/Gain Tray, located in the Exciter Assembly, connects to (A2) the Side A Amplifier Assembly (1278-1300). The output of the (A5) Variable Phase/Gain Tray connects to (A3) the Side B Amplifier Assembly (1278-1300). The RF Input from the Variable Phase/Gain Tray connects to the RF Input Jack J1 on (A11) the Interface Panel located in the Amplifier Array Assembly. The RF is cabled to the COM Input of (A9-A1) the 8 Way Splitter which splits it eight ways maximum. Four to Six of the RF outputs of the Splitter, depending on the output power needed, are connected to J1, the RF Input Jack on each of the up to six UHF Amplifier Trays (1281-1100). The outputs of the Splitter that are not used are terminated with 50Ω. Each of the UHF Amplifier Trays amplify the RF signals to the power needed to produce a total of 4000 - 6000 Watts Peak of Sync after combining of the two Amplifier Assemblies, with a maximum of 600 Watts Peak of Sync output per Tray. The outputs of the UHF Amplifier Trays are combined in (A7) the 4, 5 or 6 Way Combiner that provides half of the power needed to generate the output power of the Transmitter. In Amplifier Arrays which contain a 2.5 kW or 3.0 kW Amplifier Array Power Level Kit, the Reject Outputs of the Combiner are

connected to (A12-A2) the Combiner Reject Load Board (1278-1311) in (A12) the Reject Load Assembly (1278-1312). In the 2 kW Amplifier Array Power Level, the Combiner has a different Reject Load Assembly. The RF Output of the Combiner is cabled to (A8) the Output Coupler Assembly (1016-1043). The Output Coupler Assembly supplies a Forward and a Reflected Power Sample of the output from the Amplifier Assembly which connects through the SMA Connectors J2 and J3 located on the Interface Panel to the Metering Panel located in the UHF Exciter Assembly.

In each UHF Amplifier Tray, a Forward Power Sample and a Reflected Power Sample, from the 4 Way Combiner Board, are connected to the Dual Peak Detector Board, Single Supply which provides peak detected forward samples to the Amplifier Control Board that supplies the samples to the front panel meter of the UHF Amplifier Tray and also to the Interface Panel for remote monitoring. Before exiting each UHF Amplifier Tray the RF is fed through a Circulator which protects the Tray from high VSWR conditions. The Reject Port of the Circulator provides a Reject Sample to the 4 Way Combiner Board which supplies the Reflected Sample to the Dual Peak Detector Board, Single Supply located in the UHF Amplifier Tray that connects to the front panel meter. The outputs of the (A2 & A3) Amplifier Array Assemblies connect to (A4) a Hybrid Combiner (55223A) which combines the outputs into a single output.

The two Enable (Operate) Commands from the UHF Exciter Tray, located in the UHF Exciter Assembly, connect to the Terminal Block (A9-TB2) mounted in each Amplifier Array. The terminal block splits the Enables in each array and supplies them to all of the UHF Amplifier Trays. The Enable is needed to turn on the Switching Power Supply located in each UHF Amplifier Tray. If

the Amplifier Array contains an External Exhaust Kit, then a Fan Enable is supplied at J4-19 with +12V at J4-20 that connect to the fan mounted on the roof which turns it on..

Main AC Input

Each Amplifier Assembly needs an AC Input of 208/240 VAC at 100 Amps Single Phase or 208/240 VAC at 55 Amps Three Phase wired to it. The 208/240 VAC Input to each Amplifier Assembly connects to (A10) the AC Distribution Assembly, Amplifier Array (1278-1200 Single Phase or 1278-1100 Three Phase) located on the right side, center rear of each Cabinet. Each AC Distribution Assembly contains the Terminal Block (TB1) to which the 208/240 VAC connects. For Single Phase operation connect Line 1 to TB1-1A, Line 2 to TB1-3A and Ground to TB1-4A and for Three Phase operation, connect Line 1 to TB1-1A, Line 2 to TB1-2A, Line 3 to TB1-3A and Ground to TB1-4A. The AC Distribution Panel contains from five to seven Circuit Breakers that supply the AC to the rest of the Amplifier Assembly. The Input AC from TB1 is connected to (CB1) the Main AC Circuit Breaker (100 Amps for Single Phase or 80 Amps for Three Phase) which distributes the 220 VAC to the other circuit breakers (CB2-CB7). The CB6 and CB7 Circuit Breakers are used if the extra Amplifier Trays are needed. The output of CB1 has three MOVs, VR1, VR2 and VR3 for Single Phase or six MOVs VR1-VR6 for Three Phase, mounted to it, one connected from each leg of the Input AC to ground and one across the each of the legs.

The switched Input AC is wired through a maximum of six Circuit Breakers, CB2-CB7, to the UHF Amplifier Trays in the Amplifier Array Cabinets. CB2 is a 20 Amp Circuit Breaker that supplies the AC voltage to the (A1) UHF Amplifier Tray. CB3 is a 20 Amp Circuit Breaker which supplies the AC voltage

to the (A2) UHF Amplifier Tray. CB4 is a 20 Amp Circuit Breaker which supplies the AC voltage to the (A3) UHF Amplifier Tray. CB5 is a 20 Amp Circuit Breaker which supplies the AC voltage to the (A4) UHF Amplifier Tray. The CB6 and CB7 circuit breakers are part of the (Optional) 2.5 kW or 3 kW High Power Kit and may not be present. CB6 is a 20 Amp Circuit Breaker which supplies the AC voltage to the (A5) UHF Amplifier Tray. CB7 is a 20 Amp Circuit Breaker which supplies the AC voltage to the (A6) UHF Amplifier Tray. In the (Optional) 2.5 kW and 3 kW Amplifier Array Assemblies circuit breakers CB8 and CB9 apply AC to the (A12-A3 & A12-A5) Fans located on (A12) the Reject Load Assembly.

When the Circuit Breaker CB1 on the AC Distribution Assembly in the UHF Exciter Assembly is switched On, +12 VDC from the Exciter is supplied to each of the Amplifier Array Cabinets. In the Amplifier Array, the +12 VDC is split and connected to each of the UHF Amplifier Trays in the Amplifier Assemblies for operation of the LED Status Indicators in the Tray.

4.8 (A1, A2, A3 & A4 with A5 & A6 used in 2.5 & 3 kW Arrays) UHF Amplifier Trays (1294-1112 low band/1294-1113 mid band/1294-1114 high band; Appendix C)

4.8.1 (A1) UHF Filter (1007-1101; Appendix D)

The UHF filter is a tunable two-section cavity filter that is typically tuned for a bandwidth of 6 MHz and has a loss of -1 dB through the filter.

4.8.2 (A3) 1-Watt Amplifier Board Assembly (1227-1319; Appendix D)

The 1-watt UHF amplifier board assembly provides radio frequency interference (RFI) and electromagnetic interference (EMI) protection, as well

as the heatsink, for the 1-watt UHF amplifier board (1227-1303) that is mounted inside the assembly. Depending on the frequency of the channel of operation, the assembly has approximately 9 dB of gain.

The RF input to the assembly connects to SMA jack J1. The amplified RF output of the assembly is at SMA jack J2. Typically, with an input signal of +21 dBm at J1 of the assembly, an output of +30 dBm can be expected at J2.

The +28-VDC bias voltage connects through FL1, an RF-bypass, feed-through capacitor, that is mounted to E1 on the amplifier board.

4.8.3 (A3-A1) 1-Watt Amplifier Board (1227-1303; Appendix D)

The 1-watt UHF amplifier board is part of the 1-watt UHF amplifier assembly (1227-1319) and provides approximately +10 dB of gain.

The UHF signal enters the board at J1, an SMA connector, and is applied through coupling capacitor C1 and a stripline circuit to Q1, a UTV040F UHF wideband-amplifier device. The base and collector voltages needed to operate the transistor are obtained from the +26.5 VDC line that connects to the board at E1. The collector voltages are fed through VR1, VR2, R3, and R4 and the base voltages are fed through R2 and R1. The amplified UHF output of Q1 is coupled through a stripline circuit and C14 to J2, the output SMA jack of the board.

The board is powered by the +26.5 VDC that is produced by an external power supply in the tray. The +26.5 VDC enters through E1 and is fed across R4 and R5, which drops approximately 6 volts, to the collector (+20 VDC). The voltage is filtered by RF decoupling components L4, C11, C12, and C15 before it is connected to the collector. The bias voltage is

connected across R3, VR1, VR2, R1, and R2, which sets the base bias voltage at +.8 VDC and forward biases Q1. C6, L1, and L2 provide RF decoupling of the bias voltage before it is connected to the base.

The board has a self-bias protection circuit that uses zener diodes VR1 and VR2. If the current draw of the device increases, the voltage drop across R4 and R5 increases; this decreases the voltage that is applied to VR1 and VR2. These two diodes drop a fixed voltage of 20 VDC across them. As a result, if the voltage drop across R4 and R5 increases, the voltage available to the base of Q1 decreases and the device will eventually be shut off.

4.8.4 (A4-A1) Single Stage Amplifier Assembly (1265-1418, low band /1265-1416, mid band/1265-1417, high band; Appendix D)

4.8.4.1 Low Band

The single stage UHF amplifier assembly, Class A, low band, is made from the generic single stage amplifier board, Class A (1265-1415). The assembly uses a single PTB20101 Ericsson device that is made up of two transistors in parallel and operating Class A, which amplify the signal by approximately +11 dB. Bias adjust pot R6 sets the operating current for Q1.

Q1 and Associated Circuitry

The RF input signal connects to SMA jack J1 on the board. The RF input is applied through AC coupling and DC blocking capacitor C1 to L1 and associated circuitry. This forms a balun that converts the input signal from a 50- Ω unbalanced impedance to a 12.5- Ω balanced impedance configuration. The two outputs, applied to the bases of Q1, are 180° out of phase with each other. C3, C4, C6, and C5, which are adjusted for peak output, are for impedance matching to the input of the

parallel transistors that make up Q1. The base circuit is RF bypassed by C2, C7, C17, C28, and C29.

The collectors are impedance matched to 12.5Ω by C22, C23, and C19, which can be adjusted for peak output with the best linearity. C25 provides AC coupling and DC blocking for the output signal to SMA RF output connector J2. L2 and its associated circuitry form a balun that transforms the two balanced signals back to a single, unbalanced $50\text{-}\Omega$ impedance output. The collector circuit is RF bypassed by C9, C12 to C15, C18, C21, C24, C26, C30, and C31.

The +26 VDC needed for biasing Q1 is applied to E1. E1 is the high side of A4-A4, a $.5\text{-}\Omega/25\text{-watt}$ external metering resistor that is mounted on the heatsink next to the single stage amplifier assembly. The metering resistor is in the collector circuit of the RF transistor, Q1, and provides the main current path for Q1. The base bias applied to Q1 is supplied through R11, R4, R2, and R3.

The collector bias voltage drop across the A4-A4 metering resistor is in parallel with the branch consisting of R10 and the green Current LED DS1; as a result, it has the same voltage across it. The collector bias voltage drop biases on the green LED DS1. The current flow through R10 and DS1 gives a visual indication of the current draw of Q1 by the relative brightness of DS1. The higher the collector current of the transistor, the larger the voltage drop across the metering resistor; this action increases the voltage across DS1 and R10. This greater voltage level increases the current flow through DS1 and R10, which increases the brightness of DS1. The opposite occurs when the collector current decreases.

The use of opto-isolator U1 allows no direct connection between the base and collector biasing circuits other than

R11, the $200\text{-}\Omega/5\text{-watt}$ control resistor that determines the actual base current flowing in Q1. R11 provides the primary current path from the collector circuit to the base of Q1. If there is no current flowing initially through Q1, R11 provides a substantial amount of base drive. When the collector current of Q1 increases to the desired operating level, the opto-isolator LED, which is across U1, is turned on. This turn-on point, or threshold, is set by the voltage-divider network consisting of R7, R9 and adjustable resistor R6. R6 is adjusted to set up the operating current at 5 amps. When the opto-isolator LED turns on, it causes the transistor portion to also turn on. When the transistor portion turns on, it biases on Q2, which acts as a shunt regulator for the base current of Q1.

Negative feedback for the circuit is preset so that if Q1 draws more than the desired amount of collector current, the voltage drop across A4-A4, the metering resistor, becomes greater than normal. This increase causes the voltage across the opto-isolator to increase; as a result, the opto-isolator LED is brighter than normal and forward biases Q2 even more. This action tends to make the available current that was fed through R11 and Q1 to flowing more through Q2, from collector to the emitter ground, setting up the negative feedback path. The negative feedback tends to stabilize the current flow through Q1. Capacitor C8 provides an active filtering action for this current source, which provides an improved response in Q1 during the vertical interval average current changes that take place.

4.8.4.2 Mid Band

The single stage UHF amplifier assembly, Class A, mid band is made from the generic single stage amplifier board, Class A (1265-1415). The assembly uses a single PTB20101 Ericsson device that is made up of two

transistors in parallel and operating Class A, which amplify the signal by approximately +11 dB. Bias adjust pot R6 sets the operating current for Q1.

Q1 and Associated Circuitry

The RF input signal connects to SMA jack J1 on the board. The RF input is applied through AC coupling and DC blocking capacitor C1 to L1 and associated circuitry. This forms a balun that converts the input signal from a 50- Ω unbalanced impedance to a 12.5- Ω balanced impedance configuration with the two outputs. These outputs are applied to the bases of Q1 and are 180° out of phase with each other. C3, C4, C6, and C5, which are adjusted for peak output, are for impedance matching to the input of the parallel transistors that make up Q1. The base circuit is RF bypassed by C2, C7, C17, and C29.

The collectors are impedance matched to 12.5 Ω by C22, C23, and C19, which are adjusted for peak output with the best linearity. C25 provides AC coupling and DC blocking for the output signal to SMA RF output connector J2. L2 and its associated circuitry form a balun that transforms the two balanced signals back to a single, unbalanced 50- Ω impedance output. The collector circuit is RF bypassed by C9, C12 to C15, C18, C21, C24, C26, C30, and C31.

The +26 VDC needed for biasing Q1 is applied to E1. E1 is the high side of A4-A4, a .5- Ω /25-watt external metering resistor that is mounted on the heatsink next to the single stage amplifier assembly. The metering resistor is in the collector circuit of RF transistor Q1 and provides the main current path for Q1. The base bias applied to Q1 is supplied through R11, R4, R2, and R3.

The collector bias voltage drop across the A4-A4 metering resistor is in parallel with the branch consisting of

R10 and the green Current LED DS1; as a result, it has the same voltage across it. The collector bias voltage drop biases on the green LED DS1. The current flow through R10 and DS1 gives a visual indication of the current draw of Q1 by the relative brightness of DS1. The higher the collector current of the transistor, the larger the voltage drop across the metering resistor; this, in turn, increases the voltage across DS1 and R10. This greater voltage level increases the current flow through DS1 and R10 and increases the brightness of DS1. The opposite occurs when the collector current decreases.

The use of opto-isolator U1 allows no direct connection between the base and collector biasing circuits other than R11, the 200- Ω /5-watt control resistor that determines the actual base current flowing in Q1. R11 provides the primary current path from the collector circuit to the base of Q1. If there is no current flowing initially through Q1, R11 provides a substantial amount of base drive. When the collector current of Q1 increases to the needed operating level, the opto-isolator LED, which is across U1, is turned on. This turn-on point, or threshold, is set by the voltage-divider network consisting of R7, R9, and adjustable resistor R6. R6 is adjusted to set up the operating current, at 5 amps. When the opto-isolator LED turns on, it causes the transistor portion to also turn on. When the transistor portion turns on, it biases on Q2, which acts as a shunt regulator for the base current of Q1.

Negative feedback for the circuit is preset so that if Q1 draws more than the desired amount of collector current, the voltage drop across A4-A4, the metering resistor, becomes greater than normal. This increase causes the voltage across the opto-isolator to increase; as a result, the opto-isolator LED is brighter than normal and forward biases Q2 even more. This action tends to make the available

current that was fed through R11 and Q1 to flow more through Q2, from collector to the emitter ground, and setting up the negative feedback path. The negative feedback tends to stabilize the current flow through Q1. Capacitor C8 provides an active filtering action for this current source, which provides an improved response in Q1 during the vertical interval average current changes that take place.

4.8.4.3 High Band

The single stage UHF amplifier assembly, Class A, high band is made from the generic single stage amplifier board, Class A (1265-1415). The assembly uses a single PTB20101 Ericsson device that is made up of two transistors in parallel and operating Class A, which amplify the signal by approximately +11 dB. Bias adjust pot R6 sets the operating current for Q1.

Q1 and Associated Circuitry

The RF input signal connects to SMA jack J1 on the board. The RF input is applied through AC coupling and DC blocking capacitor C1 to L1 and associated circuitry. This forms a balun that converts the input signal from a 50- Ω unbalanced impedance to a 12.5- Ω balanced impedance configuration with the two outputs. The two outputs are applied to the bases of Q1 and are 180° out of phase with each other. C6 and C5, which are adjusted for peak output, are for impedance matching to the input of the parallel transistors that make up Q1. The base circuit is RF bypassed by C2, C7, C17, C28, and C29.

The collectors are impedance matched to 12.5 Ω by C16, C22, C23, and C19, which are adjusted for peak output with the best linearity. C25 provides AC coupling and DC blocking for the output signal to SMA RF output connector J2. L2 and its associated circuitry form a balun that transforms the two balanced

signals back to a single, unbalanced 50- Ω impedance output. The collector circuit is RF bypassed by C9, C12 to C15, C18, C21, C24, C26, C30, and C31.

The +26 VDC needed for biasing Q1 is applied to E1. E1 is the high side of A4-A4, a .5- Ω /25-watt external metering resistor that is mounted on the heatsink next to the single stage amplifier assembly. The metering resistor is in the collector circuit of RF transistor Q1 and provides the main current path for Q1. The base bias applied to Q1 is supplied through R11, R4, R2, and R3.

The collector bias voltage drop across the A4-A4 metering resistor is in parallel with the branch consisting of R10 and the green Current LED DS1; as a result, it has the same voltage across it. The collector bias voltage drop biases on the green LED DS1. The current flow through R10 and DS1 gives a visual indication of the current draw of Q1 by the relative brightness of DS1. The higher the collector current of the transistor, the larger the voltage drop across the metering resistor, which, in turn, increases the voltage across DS1 and R10. This greater voltage level increases the current flow through DS1 and R10 and increases the brightness of DS1. The opposite occurs when the collector current decreases.

The use of opto-isolator U1 allows no direct connection between the base and collector biasing circuits other than R11, the 200- Ω /5-watt control resistor that determines the actual base current flowing in Q1. R11 provides the primary current path from the collector circuit to the base of Q1. If there is no current flowing initially through Q1, R11 provides a substantial amount of base drive. When the collector current of Q1 increases to the desired operating level, the opto-isolator LED, which is across U1, is turned on. This turn-on point, or threshold, is set by the voltage-divider

network consisting of R7, R9, and adjustable resistor R6. R6 is adjusted to set up the operating current at 5 amps. When the opto-isolator LED turns on, it causes the transistor portion to also turn on. When the transistor portion turns on, it biases on Q2, which acts as a shunt regulator for the base current of Q1.

Negative feedback for the circuit is preset so that if Q1 draws more than the desired amount of collector current, the voltage drop across A4-A4, the metering resistor, becomes greater than normal. This increase causes the voltage across the opto-isolator to increase; as a result, the opto-isolator LED is brighter than normal and forward biases Q2 even more. This action tends to make the available current that was fed through R11 and Q1 to flow more through Q2, from collector to the emitter ground, setting up the negative feedback path. The negative feedback tends to stabilize the current flow through Q1. Capacitor C8 provides an active filtering action for this current source, which provides an improved response in Q1 during the vertical interval average current changes that takes place.

4.8.5 (A4-A2) Coupler Board Assembly (1227-1316; Appendix D)

The UHF coupler assembly is mounted in the UHF amplifier tray and provides a forward power sample of the input drive level to the dual stage amplifier assembly, class AB. The drive-level sample from J3 is cabled to the amplifier control board where it connects to the input of the overdrive-protection circuit.

The RF input to the UHF coupler assembly from the dual stage amplifier assembly, class A, connects to SMA jack J1. The RF is connected by a stripline track to SMA output jack J2. A hybrid-coupler circuit picks off a forward sample that is connected to

SMA-type connector jack J3. R1 is a dissipation load for the reject port of the coupler.

4.8.6 (A6) Dual Peak Detector Enclosure (1227-1317; Appendix D)

The dual peak detector enclosure provides EMI and RFI protection for the dual peak detector board, single supply (1227-1333), which is mounted inside the enclosure.

The module has two inputs: a forward power sample at SMA jack J1 and a reflected power sample at SMA jack J2. The module has two peak-detected sample outputs: a forward power sample at FL3 from J4-4 on the board and a reflected power sample at FL2 from J4-2 on the board. The module also has a forward power sample output at SMA jack J3.

The voltage, +28 VDC, needed to operate the board connects to FL1 on the assembly, which is wired to J4-7 on the board.

4.8.7 (A6-A1) Dual Peak Detector Board, Single Supply (1227-1333; Appendix D)

The function of the dual peak detector board is to detect forward and reflected samples of visual or aural RF signals and generate an output voltage proportional to the power levels of the sampled signals for metering purposes.

There are two identical signal paths on the board: one for forward power and one for reflected power. A sample of forward output power enters the board at SMA jack J1. Resistors R1, R2, and R3 form an input impedance-matching network of 50Ω. The forward power signal is detected by CR1, R4, R5, R7, R10, C1, and C2. The output is buffered by operational amplifiers U3B and U1C before it is connected to forward power output jack J4-4. U3 has a very high input impedance that makes the IC less

sensitive to changes in the video level. A sample of the forward power is tapped off by R6 and R8 and fed to J3, the forward sample output jack. Diode CR2 provides temperature compensation for diode CR1. An input signal level of approximately +17 dBm is enough to give a 1-VDC level at the output of U1C.

A reflected output power sample enters the board at SMA jack J2. Resistors R18, R19, and R20 form an input impedance-matching network of 50Ω. The reflected power signal is then detected by CR3, R21, R22, R24, C5, and C6 and the output is buffered by operational amplifiers U3A and U1B before it is connected to reflected power output jack J4-2. U3 has a very high input impedance that makes the IC less sensitive to changes in the video level. Diode CR4 provides temperature compensation for diode CR3. An input signal level of approximately +17 dBm is enough to give a 1-VDC level at the output of U1B.

The +12 VDC needed for the operation of U1 on the board is generated from the +28 VDC which enters at J4, pin 7. The +28 VDC is fed to U2, a voltage regulator IC, that produces +12 VDC at its output, which is connected to U1.

4.8.8 (A5-A1) 4-Way Splitter Assembly (1265-1432; Appendix D)

The 4-way splitter assembly contains (A5-A1-A1) a 4-way splitter board (1227-1312) that is made up of three 2-way Wilkinson stripline splitters. One RF input to the board provides four, equal RF outputs.

The RF input to the board is connected to the input of the first 2-way splitter that contains R1. R1 is a balancing resistor in which any RF due to mismatching in the first splitter will be dissipated. One of the two outputs from the splitter connects to another 2-way

splitter that contains R2. R2 is a balancing resistor in which any RF due to mismatching in the splitter will be dissipated. The other output of the first splitter connects to the third 2-way splitter that contains R3. R3 is a balancing resistor in which any RF due to mismatching in the splitter will be dissipated. The two output splitters provide four, equal RF outputs, two each, which are connected to the inputs of the external amplifier boards.

4.8.9 (A5-A1-A1) 4-Way Splitter Board (1227-1312; Appendix D)

The 4-way splitter board is made up of three 2-way Wilkinson stripline splitters. One RF input to the board provides four, equal RF outputs.

The RF input to the board is connected to the input of the first 2-way splitter that contains R1. R1 is a balancing resistor in which any RF due to mismatching in the first splitter will be dissipated. One of the two outputs from the splitter connects to another 2-way splitter that contains R2. R2 is a balancing resistor in which any RF due to mismatching in the splitter will be dissipated. The other output of the first splitter connects to the third 2-way splitter that contains R3. R3 is a balancing resistor in which any RF due to mismatching in the splitter will be dissipated. The two output splitters provide four, equal RF outputs, two each, that are connected to the inputs of the external amplifier boards.

4.8.10 (A4-A3, A5-A2, A5-A3, A5-A4, A5-A5) Dual Stage Amplifier Assemblies (1265-1413 and 1265-1439, low band/1265-1411 and 1265-1440, mid band/1265-1420 and 1265-1441, high band; Appendix D)

4.8.10.1 Low Band

The dual stage UHF amplifier assembly, Class AB, low band is made using a

generic dual stage amplifier board, Class AB (1265-1404). The board uses two PTB20101 Ericsson transistors in parallel-biased Class AB to amplify the signal by approximately +9 dB. Bias adjust R106 sets the idling current for Q101 at 300 mA and bias adjust R206 sets the idling current for Q201 at 300 mA. Each dual amplifier device is mounted in identical, parallel circuits. These devices may be biased up to 600 mA depending on the linearity of the tray.

Input Description

The input signal from J1 on the dual stage amplifier assembly connects to E1 on the board. The signal is split in a 2-way Wilkinson splitter, using R1, which provides two equal inputs, one to each identical amplifier side.

Q101 and Associated Circuitry

One of the outputs of the splitter is applied through AC coupling and DC blocking capacitor C101 to L101 and associated circuitry. This forms a balun that converts the input signal from a 50- Ω unbalanced impedance to a 12.5- Ω balanced impedance configuration. C103, C104, C106, and C105, which are adjusted for peak output, are for impedance matching to the input of the parallel transistors that make up Q101.

The bias voltage to the bases of the paralleled transistors in Q101 is applied at E101. The transistors are protected from overvoltage by Q102, Q103, R104, R105, and R106, which can be adjusted to set the bias, operating currents of the transistors. The base voltage is RF bypassed by C129, C102, C107, C108, C109, and C110 and applied to the bases through R102 and R103.

The collectors are impedance matched to 12.5 Ω by C122, C123, and C119, which are adjusted for peak output with the best linearity and lowest current.

C125 provides AC coupling and DC blocking for the output signal to the combiner. L102 and associated circuitry form a balun that transforms the signal back to an unbalanced 50- Ω impedance signal.

The collector voltage is applied at E101. The collector voltage is connected through R108 to the collectors on the two devices that make up Q101. R106 can be adjusted to set up the operating currents. The collector circuit is RF bypassed by C112 to C115, C117, C118, C121, C124, C130, and C131.

Q201 and Associated Circuitry

The other output of the splitter is applied through AC coupling and DC blocking capacitor C201 to L201 and associated circuitry. This forms a balun that converts the input signal from a 50- Ω unbalanced impedance to a 12.5- Ω balanced impedance configuration. C203, C204, C206, and C205, which are adjusted for peak output, are for impedance matching to the input of the parallel transistors (Q201).

The bias voltage to the bases of the paralleled transistors, Q201, is applied at E201. The transistors are protected from overvoltage by Q202, Q203, R204, R205, and R206, which can be adjusted to set the bias, operating currents of the transistors. The base voltage is RF bypassed by C229, C202, C207, C208, C209, and C210 and applied to the bases through R202 and R203.

The collectors are impedance matched to 12.5 Ω by C222, C223, and C219, which are adjusted for peak output with the best linearity and lowest current. C225 provides AC coupling and DC blocking for the output signal to the combiner. L202 and associated circuitry form a balun that transforms the signal back to an unbalanced 50- Ω impedance signal.

The collector voltage is applied at E201. The collector voltage is connected through R208 to the collectors on the two devices that make up Q201. R206 can be adjusted to set up the operating currents. The collector circuit is RF bypassed by C212 to C215, C217, C218, C221, C224, C230, and C231.

Output Description

The outputs of the two sides are combined by a 2-way Wilkinson combiner, using R2, and applied to the RF output of the board at E2, which is connected to J2, the SMA output jack on the dual stage amplifier assembly.

4.8.10.2 Mid Band

The dual stage UHF amplifier assembly, Class AB, mid band is made using a generic dual stage amplifier board, Class AB (1265-1404). The board uses two PTB20101 Ericsson transistors in parallel-biased Class AB to amplify the signal by approximately +9 dB. Bias adjust R106 sets the idling current for Q101 at 300 mA and bias adjust R206 sets the idling current for Q201 at 300 mA. Each dual amplifier device is mounted in identical parallel circuits. These devices may be biased up to 600 mA, depending on the linearity of the tray.

Input Description

The input signal from J1 on the dual stage amplifier assembly connects to E1 on the board. The signal is split in a 2-way Wilkinson splitter, using R1, which provides two equal inputs, one to each identical amplifier side.

Q101 and Associated Circuitry

One of the outputs of the splitter is applied through an AC coupling and DC blocking capacitor C101 to L101 and associated circuitry. This forms a balun that converts the input signal from a 50- Ω unbalanced impedance to a 12.5-

Ω balanced impedance configuration. C106 and C105, which are adjusted for peak output, are for impedance matching to the input of the parallel transistors that make up Q101.

The bias voltage to the bases of the paralleled transistors in Q101, which is applied at E101. The transistors are protected from overvoltage by Q102, Q103, R104, R105, and R106, which can be adjusted to set the bias, operating currents of the transistors. The base voltage is RF bypassed by C129, C102, C107, C108, C109, and C110 and applied to the bases through R102 and R103.

The collectors are impedance matched to 12.5 Ω by C116, C120, C122, C123, and C119, which are adjusted for peak output with the best linearity and lowest current. C125 provides AC coupling and DC blocking for the output signal to the combiner. L102 and associated circuitry form a balun that transforms the signal back to an unbalanced 50- Ω impedance signal.

The collector voltage is applied at E101. The collector voltage is connected through R108 to the collectors on the two devices that make up Q101. R106 can be adjusted to set up the operating currents. The collector circuit is RF bypassed by C112 to C115, C117, C118, C121, C124, C130, and C131.

Q201 and Associated Circuitry

The other output of the splitter is applied through AC coupling and DC blocking capacitor C201 to L201 and associated circuitry. This forms a balun that converts the input signal from a 50- Ω unbalanced impedance to a 12.5- Ω balanced impedance configuration. C206 and C205, which can be adjusted for peak output, are for impedance matching to the input of the parallel transistors (Q201).

The bias voltage to the bases of the paralleled transistors, Q201, is applied at E201. The transistors are protected from overvoltage by Q202, Q203, R204, R205, and R206, which can be adjusted to set the bias, operating currents of the transistors. The base voltage is RF bypassed by C229, C202, C207, C208, C209, and C210 and applied to the bases through R202 and R203.

The collectors are impedance matched to 12.5Ω by C216, C220, C222, C223, and C219, which are adjusted for peak output with the best linearity and lowest current. C225 provides AC coupling and DC blocking for the output signal to the combiner. L202 and associated circuitry form a balun that transforms the signal back to an unbalanced $50\text{-}\Omega$ impedance signal.

The collector voltage is applied at E201. The collector voltage is connected through R208 to the collectors on the two devices that make up Q201. R206 can be adjusted to set up the operating currents. The collector circuit is RF bypassed by C212 to C215, C217, C218, C221, C224, C230, and C231.

Output Description

The outputs of the two sides are combined by a 2-way Wilkinson combiner, using R2, and applied to the RF output of the board at E2, which is connected to J2, the SMA output jack on the dual stage amplifier assembly.

4.8.10.3 High Band

The dual stage UHF amplifier assembly, Class AB, high band is made using a generic dual stage amplifier board, Class AB (1265-1404). The board uses two PTB20101 Ericsson transistors in parallel-biased Class AB to amplify the signal by approximately +9 dB. Bias adjust R106 sets the idling current for Q101 at 300 mA and bias adjust R206 sets the idling current for Q201 at 300

mA. Each dual amplifier device is mounted in identical, parallel circuits. These devices may be biased up to 600 mA depending on the linearity of the tray.

Input Description

The input signal from J1 on the dual stage amplifier assembly connects to E1 on the board, which is split in a 2-way Wilkinson splitter, using R1, and provides two equal inputs, one to each identical amplifier side.

Q101 and Associated Circuitry

One of the outputs of the splitter is applied through AC coupling and DC blocking capacitor C101 to L101 and associated circuitry. This forms a balun that converts the input signal from a $50\text{-}\Omega$ unbalanced impedance to a $12.5\text{-}\Omega$ balanced impedance configuration. C106 and C105, which are adjusted for peak output, are for impedance matching to the input of the parallel transistors that make up Q101.

The bias voltage to the bases of the paralleled transistors in Q101 is applied at E101. The transistors are protected from overvoltage by Q102, Q103, R104, R105, and R106, which can be adjusted to set the bias, static currents with no RF drive applied, of the transistors. The base voltage is RF bypassed by C129, C102, C107, C108, C109, and C110 and applied to the bases through R102 and R103.

The collectors are impedance matched to 12.5Ω by C116, C120, C123, and C119, which are adjusted for peak output with the best linearity and lowest current. C125 provides AC coupling and DC blocking for the output signal to the combiner. L102 and associated circuitry form a balun that transforms the signal back to an unbalanced $50\text{-}\Omega$ impedance signal.

The collector voltage is applied at E101. The collector voltage is connected through R108 to the collectors on the two devices that make up Q101. R106 can be adjusted to set up the operating currents. The collector circuit is RF bypassed by C112 to C115, C117, C118, C121, C124, C130, and C131.

Q201 and Associated Circuitry

The other output of the splitter is applied through AC coupling and DC blocking capacitor C201 to L201 and associated circuitry. This forms a balun that converts the input signal from a 50- Ω unbalanced impedance to a 12.5- Ω balanced impedance configuration. C206 and C205, which are adjusted for peak output, are for impedance matching to the input of the parallel transistors (Q201).

The bias voltage to the bases of the paralleled transistors, Q201, is applied at E201. The transistors are protected from overvoltage by Q202, Q203, R204, R205, and R206, which can be adjusted to set the bias, operating currents of the transistors. The base voltage is RF bypassed by C229, C202, C207, C208, C209, and C210 and applied to the bases through R202 and R203.

The collectors are impedance matched to 12.5 Ω by C216, C220, C223, and C219, which are adjusted for peak output with the best linearity and lowest current. C225 provides AC coupling and DC blocking for the output signal to the combiner. L202 and associated circuitry form a balun that transforms the signal back to an unbalanced 50- Ω impedance signal.

The collector voltage is applied at E201. The collector voltage is connected through R208 to the collectors on the two devices that make up Q201. R206 can be adjusted to set up the static

currents, with no RF applied. The collector circuit is RF bypassed by C212 to C215, C217, C218, C221, C224, C230, and C231.

Output Description

The outputs of the two sides are combined by a 2-way Wilkinson combiner, using R2, and applied to the RF output of the board at E2, which is connected to J2, the SMA output jack on the dual stage amplifier assembly.

4.8.11 (A7) Amplifier Protection Board (1265-1412; Appendix D)

The amplifier protection board distributes the biasing voltages to the transistor amplifier devices that are mounted on the amplifier boards in the UHF amplifier tray. It also protects the transistor devices from overcurrent conditions using the board-mounted 7-amp fuses F1 to F12. F13 is a board-mounted 3-amp fuse that protects the +26.5 VDC that is applied to the amplifier control board and is needed for the operation of the board. F14 and F15 are 7-amp spare fuses.

The +26.5 VDC from the switching power supply enters the board at TB1, with the plus (+) connections sent to pins 1 to 4 and the minus (-) connections sent to pins 5 and 6. The +26.5 VDC is connected across the .01-W/3- Ω voltage-dropping resistors R14 to R26 that are used to set up the idling currents for the transistor devices; the fuses F1 to F13 that protect the transistor devices during an overcurrent condition through the outputs of the board at TB2, TB3; and also to output jack J1. Table 4-1 indicates the fuse, the amplifier device it protects, and the idling current settings for the class AB amplifier devices.

Table 4-1: Fuses, Idling Currents, and Voltage Settings for the Class AB Amplifier Devices

SWITCH POSITION	AMPLIFIER MODULE	TRANSISTOR DEVICE	BIAS ADJUST POT	IDLING CURRENT	VOLTAGE SETTING	FUSE
I1	A4-A1	Q1	R6	*5 Amps	50 mV	F1
I2	A4-A3	Q201	R206	600 mA	6.0 mV	F2
I3	A4-A3	Q101	R106	600 mA	6.0 mV	F3
I4	A5-A2	Q201	R206	300 mA	3.0 mV	F4
I5	A5-A2	Q101	R106	300 mA	3.0 mV	F5
I6	A5-A3	Q201	R206	300 mA	3.0 mV	F6
I7	A5-A3	Q101	R106	300 mA	3.0 mV	F7
I8	A5-A4	Q201	R206	300 mA	3.0 mV	F8
I9	A5-A4	Q101	R106	300 mA	3.0 mV	F9
I10	A5-A5	Q201	R206	300 mA	3.0 mV	F10
I11	A5-A5	Q101	R106	300 mA	3.0 mV	F11

*The A4-A1 transistor Q1 operates class A and is adjusted for 5 amps of operating current.

The voltage drop across the selected resistor that uses switch S1 is read with a digital voltmeter (DVM) that is connected from E1 to E2 on the board. This voltage reading converts to the idling current, with no RF drive applied, or the operating current, with RF drive applied, of the transistor.

4.8.12 (A8) Amplifier Control Board (1265-1414; Appendix D)

The amplifier control board provides LED fault and enable indications on the front panel of the tray and also performs the following functions: automatic gain control (AGC); overdrive cutback, when the drive level reaches the amount needed to attain 110% output power; and overtemperature, VSWR, and overdrive faults. The board also provides connections to the front panel meter for monitoring the AGC, % Reflected

Power, % Output Power, and the power supply voltage.

A -12-VDC enable is applied to the board at J4-1 from the transmitter control board in the UHF exciter tray. The enable causes the J-FET Q5 to be biased off, making the drain go high; the high is applied to Q4, which is biased on. The drain of Q4 goes low and lights the green Enable LED DS4 on the front panel. The high at the drain of Q5 is also applied through CR5 to J4, pin 7, which is a high enable, to the +26-VDC switching power supply, switching it on.

If there is an overtemperature fault, which is a low applied to J4, pin 3, the low connects through CR4 and overrides the high enable, switching off the switching power supply. As long as the fault is present, the switching power supply is off and the red

Overtemperature LED DS3 on the front panel is lit.

4.8.12.1 Phase Control

The phase control pot on the front of the tray connects to J8-1 (+26 VDC), J8-3 (phase I/P), and J8-4 (RTN) on the board. The phase-control output connects from J7 on the board to the input of the phase-control circuit on the variable gain/phase board (1265-1425).

4.8.12.2 Automatic and Manual Gain Control Circuits

The amplifier control board contains the AGC function for the UHF amplifier tray in which it is mounted. An AGC reference-level input from the UHF exciter tray is applied to J3, pin 1, and is amplified by U3B. The output of U3B is connected to J5, which is wired to the front panel gain pot that sets the output power level of the tray when the AGC is in the Auto position. The voltage at the arm of the front panel gain pot is amplified by U2D and is compared to a sample of the output power of the tray in U2A. The error voltage from U2A is sent through Auto/Manual switch S1 to J10, which connects to the pin-diode attenuator circuit on the variable gain/phase board. A sample of the AGC voltage level is connected to position 1 on the front panel meter switch. The tray can also be operated in manual gain by switching S1 to the Manual position and adjusting R16 for the desired output power level.

FETs Q1 and Q3 delay and slowly reapply the AGC voltage to the variable gain/phase board when the system is switched on or when the board is switched from Auto to Manual (or back) to prevent the overdriving of the tray.

4.8.12.3 Overdrive Circuit

A sample of the output of the single stage amplifier assembly, class A, from

the coupler board assembly connects to J11 on the amplifier control board. The sample is peak detected by CR7 and U3A and the output is connected to U3D. If the input drive level increases above the overdrive threshold reference set by R71, which is the drive level needed to produce 110% output power, the output of U3D goes high and is split three ways. One of the highs is connected through R38 and CR3 to U3C, causing its output to go high and lighting the red Overdrive LED DS2 on the front panel. Another of the highs is connected through R74 and R75 to Q6, which is biased on, causing its output to go low. The low is connected through J10 to the variable gain/phase board and its output power is cut back.

The final high from U3D is connected through CR2 and R37 to U1D, which is biased on, causing its output to go high. The high is connected to U2A, whose output decreases and its output power is cut back. If this path is not present, the AGC, because the forward power decreases, will try to drive the variable gain/phase board harder, creating a positive feedback loop that could damage the amplifier tray.

4.8.12.4 Metering Circuits

The +26 VDC that is connected to the board from the switching power supply is applied to jack J6, pin 1, of the board and connected through R63, R96, R66, R65, and R76 to the front panel meter for monitoring. R65 can be adjusted to calibrate the voltage reading to +26 VDC on the front panel meter, bottom scale. This calibration was completed at the factory and should not need to be adjusted at this time.

A forward power sample of the output of the tray is applied to jack J1-1 and J1-2 of the board from the dual peak detector board, single supply. The forward power sample is connected through R1 and R2 to U1A, a buffer

amplifier. The output of U1A is split, with one part going to the AGC circuits, another sample connected to J1-5 for remote metering, and the final sample applied to the meter at position 3 on S2, the front panel meter switch. R2 can be adjusted to calibrate the % Forward Power indication on the front panel meter.

A sample of the reflected power output of the tray is applied to jack J2-1 and J2-2 of the board from the dual peak detector board, single supply. The reflected power sample is connected through R21 and R22 to U1B, a buffer amplifier. The output of U1B is split, with one part going to the VSWR threshold circuit, another sample connected to J2-5 for remote metering, and the final sample applied to the meter at position 2 on S2, the front panel meter switch. R22 can be adjusted to calibrate the % Reflected Power indication on the front panel meter.

A sample of the AGC voltage level at R20 on the board is connected through a divider network consisting of R87, R88, R19, and R18 to the meter at position 1 of S2, the Front Panel Meter switch.

4.8.12.5 Operational Voltages

The voltage input to the board is +26.5 VDC from the switching power supply. The +26.5 VDC connects to the board at J6-1 and is wired to U4, which is a 3-terminal regulator IC that takes the +26 VDC input and produces the +12 VDC needed for the operation of the board.

The +12 VDC from U4 is connected through CR6 to U5, a +5-VDC regulator, that takes the +12 VDC input from U4, or the transmitter control board in the UHF exciter tray, through J6, pin 3, and produces a +5-VDC output that is applied to the rest of the board. This +12 VDC is connected

to U5, a regulator IC, which produces a +5 VDC output that is applied to the Enable and Overtemperature LEDs that operate even when the +26.5 VDC input to the board from the switching power supply is removed.

4.8.13 (A2) Variable Gain/Phase Board Enclosure (1265-1426; Appendix D)

The variable gain/phase enclosure assembly provides EMI and RFI protection for the variable gain/phase board (1265-1425) that is mounted inside of the assembly.

The RF input to the assembly is at SMA jack J1 and the RF output is at SMA jack J2. There are two control inputs that connect to the assembly: the attenuator bias input and the phase control input. The attenuator bias input from the amplifier control board connects to FL4 and FL5 on the assembly and is wired to J5 on the board. The phase control input from the amplifier control board connects to FL2 and E1 on the assembly and is wired to J4 on the board. The input fault to the amplifier control board connects to FL3 on the assembly and is wired to J6-1 on the board. E1 on the assembly connects to J3-4 on the board.

The +26 VDC needed to operate the board connects to FL1 on the assembly which is wired to J3-3 on the board.

4.8.14 (A2-A1) Variable Gain/Phase Board (1265-1425; Appendix D)

The variable gain/phase board provides the circuits that adjust the phase and the gain of the RF signal for the amplifier tray in which it is mounted.

The RF input signal at J1 is split, with one output connected to a detector circuit consisting of C8, CR4, and U3A. This detected level is then applied to comparator U3D, which provides a high

output when the input signal level drops below a threshold set by R16, R17, and CR5. This high is applied to the red Input Fault LED DS1, which lights to indicate an input fault. DS1 can be seen through the hole in the lid on the variable gain/phase assembly. The high is also connected to the gate of Q1, which biases it on and causes its drain to go low. The low is applied to the pin-diode attenuator circuit consisting of CR1, CR2, and CR3. The low to CR3 decreases the current through it and increases its resistance, decreasing or completely shutting off the RF that flows through it.

The other output of the RF input signal from J1 is connected through C1 to a voltage-controlled, pin-diode attenuator circuit consisting of diodes CR1, CR2, and CR3. The diodes are pin diodes in a pi-type configuration whose resistance varies inversely with the DC current flow through them.

As the AGC voltage, attenuator bias, applied to J5 increases, CR3 is forward biased even more. This increases the current flow through it by decreasing its resistance; the RF signal that flows through it increases in level. CR1 and CR2 have less current through them; this raises their resistance, causing the RF signal that is applied to them to decrease in level.

The three diodes form a pi-type attenuator whose attenuation decreases with the increasing AGC voltage. U4 provides amplification, approximately 8 dB, of the RF signal before it is connected to the phase-shifter circuit. The phase-shifter circuit consists of L1, C16, C17, CR7, and CR8. L1 is a 90°, 2-way splitter. The signal at pin 1 of L1 is split and applied to pins 2 and 4. The signal reflects off CR7 and CR8 and is passed to pin 3. The phase shift between pins 1 and 3 changes with the voltage applied across CR7 and CR8. This voltage is controlled by an external phase-adjust pot that

connects to J4. The +26 VDC from the external switching power supply is used as the reference that is applied to the phase-control pot. The IC U2 provides approximately 10 dB of gain at the output of the phase-shifter circuit that connects to two class A amplifier stages, Q2 and Q3, with a total gain of approximately 20 dB.

The first amplifier stage, Q2, is biased at a collector current of approximately 100 mA. This current is set by R29, R30, VR1, and Q2. VR1 forces the voltage at the collector to stay at 8.9 VDC. This biases on Q2 and draws enough current through R29 and R30 to keep the collector voltage at 8.9 VDC. The amplified output connects to the second amplifier Q3. The bias circuit for Q3 works in a manner similar to the bias circuit for Q2. VR2 and VR3 maintain a collector voltage of 21 VDC, while R36 and R37 limit the collector current to 650 mA.

The output connects to J2 on the board. A sample of the output is detected by CR10 and connected to TP4. A DVM can be connected to TP4 to give a voltage indication of the RF output level.

The +26 VDC connects to the board at J3-3 and is split, with one half connected to the two, class A amplifier circuits. The other half of the +26-VDC input is filtered, isolated by L4 and C13, and connected to U1. U1 is a +12-VDC regulator IC that produces the +12 VDC needed to operate the ICs on the board.

4.8.15 (A5-A6) 4-Way Combiner Assembly (1265-1428 [Channels 14 to 26], 1265-1429 [Channels 27 to 43], and 1265-1430 [Channels 44 to 69]; Appendix D)

The 4-way combiner assembly contains a 4-way combiner board, low band. The 4-way combiner board is made up of three, 2-way Wilkinson stripline

combiners. Two of the RF inputs to the board are soldered directly to the inputs for the 2-way combiner that contains R5. R5 is a balancing resistor in which any RF due to mismatching in the combiner will be dissipated. The other two RF inputs are soldered directly to the 2-way combiner that contains R6. R6 is a balancing resistor in which any RF due to mismatching in the combiner will be dissipated. The outputs of the two, input 2-way combiners connect to the third 2-way combiner that contains R7. R7 is a balancing resistor in which any RF due to mismatching in the combiner will be dissipated. The output of the third combiner is connected to the output of the 4-way combiner board that is cabled to an external circulator.

A directional coupler is built into the RF output circuit on the 4-way combiner board. The coupler provides a forward power sample at J1 that is -40 dB down from the level of the RF output signal.

A reject power sample from the circulator is fed to reject sample input jack J2 on the 4-way combiner board. A directional coupler is built into the reject sample circuit that provides J3 with a signal that is -40 dB down from the level of the reject power sample.

NOTE: Your Transmitter will contain either a 1278-1200 Single Phase or a 1278-1100 Three Phase AC Distribution Assembly.

4.9 (A10) AC Distribution Assembly, Single Phase (1278-1200; Appendix C)

The AC Distribution Assembly, Single Phase, Amplifier Assembly (1278-1200) distributes the Main AC Input, 208/240 VAC @ 100 Amps, to the individual Trays in the Amplifier Cabinet which make up the Amplifier Array.

The 208/240 VAC Single Phase Main AC Input to the Amplifier Cabinet connects to the Terminal Block TB1, Line 1 to TB1-1A, Line 2 to TB1-3A and Safety Ground to TB1-4A.

The 208/240 VAC Main AC Input is wired from the Terminal Block TB1-1B (Line 1) to the 100 Amp Circuit Breaker CB1-1 and TB1-3B (Line 2) to the Circuit Breaker CB1-5. The switched Main AC Input is wired from the main circuit breaker to the up to six 20 Amp Circuit Breakers, CB2-CB7, that distribute the AC to the up to six UHF Amplifier Trays in the Amplifier Array and two 3A circuit breakers CB8 and CB9 which connect the AC to the Fan (A12-A3) mounted on the Reject Load Assembly. The number of 20 Amp circuit breakers is determined by the number of Amplifier Trays which is determined by the output power of the Transmitter in which the Amplifier Assemblies are used. Four circuit breakers, CB2-CB5, are needed for a 4 kW Transmitter, five circuit breakers, CB2-CB6, are needed for a 5 kW Transmitter and six circuit breakers, CB2-CB7, are needed for a 6 kW Transmitter. Three MOVs, for surge and transient protection, are connected to the AC Lines from the Circuit Breaker. VR4 and VR6 connect from the AC Lines to Ground and VR3 connects across the AC Lines.

CB2 is a 20 Amp Circuit Breaker which protects the AC connected through J1 on the AC Distribution Assembly to J4 on the (A1) UHF Amplifier Tray. CB3 is a 20 Amp Circuit Breaker which protects the AC connected through J2 on the AC Distribution Assembly to J4 on the (A2) UHF Amplifier Tray. CB4 is a 20 Amp Circuit Breaker which protects the AC connected through J3 on the AC Distribution Assembly to J4 on the (A3) UHF Amplifier Tray. CB5 is a 20 Amp Circuit Breaker which protects the AC connected through J4 on the AC Distribution Assembly to J4 on the (A4) UHF Amplifier Tray. CB6

and CB7 are 20 Amp Circuit Breakers that are added to the AC Distribution Assembly when the two extra UHF Amplifier Trays are needed for the 5 kW and 6 kW Transmitters. CB6 is a 20 Amp Circuit Breaker which protects the AC connected through J5 on the AC Distribution Assembly to J4 on the (A5) UHF Amplifier Tray. CB7 is a 20 Amp Circuit Breaker which protects the AC connected through J6 on the AC Distribution Assembly to J4 on the (A6) UHF Amplifier Tray.

4.10 (A10) AC Distribution Assembly, Three Phase (1278-1100; Appendix C)

The AC Distribution Assembly, 3 Phase AC Input distributes the Main AC Input, 208/240 VAC 3 Phase @ 55 Amps, that connects to the individual Trays in the Amplifier Cabinet which make up the Amplifier Array.

The 208/240 VAC 3 Phase Main AC Input to the Amplifier Cabinet connects to the Terminal Block TB1, Line 1 to TB1-1A, Line 2 to TB1-2A, Line 3 to TB1-3A and Safety Ground to TB1-4A.

The 208/240 VAC Main AC Input is wired from the Terminal Block TB1-1B (Line 1) to the 55 Amp Circuit Breaker CB1-1, TB1-2B (Line 2) to the Circuit Breaker CB1-3, TB1-3B (Line 3) to the Circuit Breaker CB1-5 and TB1-4B (Safety Ground) to Chassis Ground #1. The switched Main AC Input is wired from the Circuit Breaker to the up to six 20 Amp Circuit Breakers, CB2-CB7, that distribute the AC to the up to six UHF Amplifier Trays in the Amplifier Array. The number of circuit breakers is determined by the number of Amplifier Trays which is determined by the output power of the Transmitter in which the Amplifier Assemblies are used. Six MOVs, for surge and transient protection, are connected to the AC Lines from the Circuit Breaker, VR4, VR5 and VR6 from the AC Lines to

Ground and VR1, VR2 and VR3 across the AC Lines.

CB2 is a 20 Amp Circuit Breaker which protects the AC connected through J1 on the AC Distribution Assembly to J4 on the (A1) UHF Amplifier Tray. CB3 is a 20 Amp Circuit Breaker which protects the AC connected through J2 on the AC Distribution Assembly to J4 on the (A2) UHF Amplifier Tray. CB4 is a 20 Amp Circuit Breaker which protects the AC connected through J3 on the AC Distribution Assembly to J4 on the (A3) UHF Amplifier Tray. CB5 is a 20 Amp Circuit Breaker which protects the AC connected through J4 on the AC Distribution Assembly to J4 on the (A4) UHF Amplifier Tray. CB6 and CB7 are 20 Amp Circuit Breakers that are added to the AC Distribution Assembly when the two extra UHF Amplifier Trays are needed. CB6 is a 20 Amp Circuit Breaker which protects the AC connected through J5 on the AC Distribution Assembly to J4 on the (A5) UHF Amplifier Tray. CB7 is a 20 Amp Circuit Breaker which protects the AC connected through J6 on the AC Distribution Assembly to J4 on the (A6) UHF Amplifier Tray.

4.11 (A12) Combiner Reject Load Assembly (1278-1312)

NOTE: The Combiner Reject Load Assembly is only used in the 2.5 and 3 kW Amplifier Arrays.

The Reject Load Assembly provides connections to 6 loads to which the reject outputs of the 6 Way Combiner Board are cabled. The Assembly consists of (A2) a Combiner Reject Load Board (1278-1311), mounted on a heatsink, two Thermal Switches (A1 & A4) and two Fans (A3 & A5).

If a miss-match due to a malfunction or other problem occurs in the combining process, the reject power is dissipated in the load to which it is connected.

The heatsink and the fans cool the Assembly while the thermal switches provide overtemperature protection for the Transmitter, if the temperature of the heatsink raises above 175°F.

4.11.1 (A12-A2) Combiner Reject Load Board, (1278-1311; Appendix D)

The Board is made up of 6 "N" connectors to which 50 ohm 400 Watt load resistors are connected.

This completes the description of the 2-3kW Amplifier Array and the DT835A Transmitter.

Chapter 5 Detailed Alignment Procedures

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

This transmitter operates using a MPEG digital input. Check that the RF output at J2 of (A11) the coupler is terminated into a dummy load of at least the rated output power of the transmitter. While performing the alignment, refer to the Test Data Sheet for the transmitter and compare the final readings from the factory with the readings on each of the trays. The readings should be very similar. If a reading is way off, the problem is likely to be in that tray.

Switch on the main AC and the UHF exciter circuit breakers on the AC distribution panel behind the rear door of the exciter cabinet.

5.1 (A11) DM8-R Digital Modulator (1306978; Appendix C)

The connections to the DM8-R modulator are made through the rear panel except for the IF sample output, which is made through the front panel. These connections are shown in Table 5-1.

Table 5-1: DM8-R Modulator Connections

Description	Reference Designator	Function
IF Output	J4	Provides a 44 MHz IF Output with a 50 ohm output impedance
10 MHz Input	J3	10 MHz input to the DM8-R modulator. Provides the reference frequency to the pilot VCXO.
SMPTE-310M Input	J2	SMPTE-310 input that provides the MPEG stream to the modulator.
110/220 VAC	J1	Input Power to the Modulator

5.1.1 DM8-R Modulator Board Configuration

The Digital Modulator Board in the DM8-R is setup through a configuration header located on the board. The configuration header contains 8 jumper positions between pins on J26 and J27. The functions of these positions are given in Table 5-2.

Table 5-2 J26/J27 Configuration Header Definition

Jumper Position	Function when	
	Jumper Is Present	Jumper Not Present
1	Header Enabled	RS485 Enabled
2	CW Zero	Normal Mode
3	Internal PRBS	External Source
4	Linear Equalizer On	Linear Equalizer Off
5	Nonlinear Off	Nonlinear On
6	Preset Table 1	Preset Table 2
7	AGC Tracking	AGC Fixed
8	Spare	

Table 5-3: Jumper Positions on the 6-dB Pad

IF Input Range	6-dB Pad	W1 on J23 & W2 on J27
-5 to 0 dBm	Enable	2-3 2-3
-10 to -5 dBm	Disable	1-2 1-2

5.2 (A4) UHF Exciter Tray (1294-1111; Appendix C)

The UHF exciter tray operates using the digital IF output from the DM8-R modulator or other digital IF source.

The digital IF connects to J6 on the rear of the UHF exciter, which is cabled to the delay equalizer board, and then to the IF relays on the ALC board. To operate using the digital input, the modulator select must be present. The jumper must be connected from J11-10 and J11-28 on the rear of the UHF exciter or jumper W11 on J29 must be on pins 2 and 3.

To align the UHF exciter tray using the digital IF input, apply the digital IF, with the test signals used as needed, to the IF input jack (J6) on the rear of the tray. In addition, check that the modulator select is enabled by having W11 on J29 on the ALC board between pins 2 and 3.

Set the input matching jumper J9 to positions 1 and 2 for a 50- Ω input, or to positions 2 and 3 for 75 Ω , on the delay equalizer board (1072090).

Table 5-3 shows the jumper positions for the 6-dB pad on the delay equalizer board for an input level of between 0 to -10 dBm.

The output level of the delay equalizer board should be -11 to -6 dBm with a response of 0.1 dB across the channel. The IF connects to the (A8) ALC board (1265-1305). The IF section of the UHF exciter tray includes adjustments for automatic level control (ALC), linearity (amplitude pre-distortion), and phase (phase change vs. level) pre-distortion for correction of the non-linearities of the RF amplifier trays. The upconverter section also includes adjustments to the

local oscillator chain tuning and the local oscillator center frequency tuning. Both of these were completed at the factory and should not require adjustments at this time.

Move the Operate/Standby switch located on the UHF exciter tray to Standby. The setup of the RF output includes adjustment to the drive level of the amplifier arrays, the adjustment of the linearity and phase pre-distortion to compensate for any nonlinear response of the amplifier trays, and also gain and phasing adjustments to the UHF amplifier trays.

Verify that all red LEDs on the ALC board are extinguished. The following details the meaning of each LED when illuminated:

- DS1 (input fault) – Indicates that either abnormally low or no IF is present at the input of the board
- 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 jumper W3 on J6 is in the Manual ALC Gain position.
- DS3 (modulation loss) – Indicates a loss of modulation at the input of the board
- DS4 (Mute) – Indicates that a Visual Mute command is present (DS4 is not used in this configuration.)
- DS5 (modulator enable) – Indicates that the modulator IF output is selected. This is only used if a

receiver tray is present in the system. DS5 is always on with no receiver.

The ALC is muted when the transmitter is in Standby. To monitor the ALC, turn off the four amplifier on/off circuit breakers on the AC input assembly in the rear of the cabinet and switch the transmitter to Operate. Adjust the power adjust gain pot on the front panel of the UHF exciter tray to obtain +0.8 VDC on the front panel meter in the ALC position. On the ALC board (1265-1305), move the jumper W3 on J6 to the Manual position, between pins 2 and 3, and adjust R87 on the ALC board for +0.8 VDC on the front panel meter in the ALC position. Move the jumper W3 back to Auto, between pins 1 and 2, which is the normal operating position. The detected IF signal level at J19-2 of the ALC board is connected to the transmitter control board. This board distributes the level to the amplifier arrays where it is used as a reference for the automatic gain control (AGC) in each amplifier tray.

5.2.1 Delay Equalization Adjustment

The procedure for performing a delay equalization adjustment for the UHF exciter tray is described in the following steps:

1. Set J19 to the proper position (for either a 50- Ω or 75- Ω input) and monitor the output of the board at J10 with a spectrum analyzer.
2. Bypass all attenuation and equalizer sections, except delay equalizer #1. With W12 removed, tune L30 for the proper center frequency as shown in Table 5-2. Install W12 on J22 and adjust L21 and C43 for the best frequency response across the band. Jumper in attenuator equalizer #1.
3. Pull W14 from J26 and adjust L29 for the proper center frequency. Install W14 and adjust L18 for the best frequency response.
4. Repeat Steps 2 and 3 for each delay/attenuation equalizer while tuning the proper inductor for each section.
5. After all five delay/attenuation equalizers have been adjusted according to Table 5-4, individually jumper in all of the sections and fine tune, as needed, for the best group delay and frequency response.

Table 5-4: Center Frequencies for the Delay Equalizer Sections

DELAY EQUALIZER SECTION	CENTER FREQUENCY
1	46.5 MHz
2	44 MHz
3	44 MHz
4	41.5 MHz
5	44 MHz

5.2.2 IF Phase Corrector Adjustment

As shipped, the exciter was preset to include linearity (gain vs. level) and phase pre-distortion. The pre-distortion was adjusted to approximately compensate the corresponding non-linear distortions of the amplifier trays.

Locate (A9) the IF phase corrector board (1227-1250) mounted in the UHF exciter tray. Because the amplitude correction portion of the board is not utilized in this configuration, the jumper W3 on J10 should be in the disable position and R35 and R31 should be fully counter-clockwise (CCW). R68 is the range adjustment and should be set in the middle. The phase correction enable/disable jumper W2 on J9 should be in the Enable position to ground.

Set up a spectrum analyzer with 30 kHz resolution bandwidth and 30 kHz modulation bandwidth to monitor the intermodulation products of the RF

output signal. A typical digital spectrum is shown in Figure 5-1. There are three corrector stages on the IF phase corrector board, each with a magnitude and a threshold adjustment which are adjusted as needed to correct for any intermod problems. Adjust the R3 threshold for the cut in point of the correction and the R7 magnitude for the amount of the correction that is needed. The jumper W1 on J8 is set to give the desired polarity of the correction shaped by the threshold R11 and magnitude R15 adjustments. After setting the polarity, adjust the R11 threshold for the cut in point of the correction and the R15 magnitude for the amount of the correction that is needed. Finally, adjust the R19 threshold for the cut in point of the correction and the R23 magnitude for the amount of the correction that is needed. The above pots are adjusted for the greatest separation between the digital signal and the intermod at the channel edges.

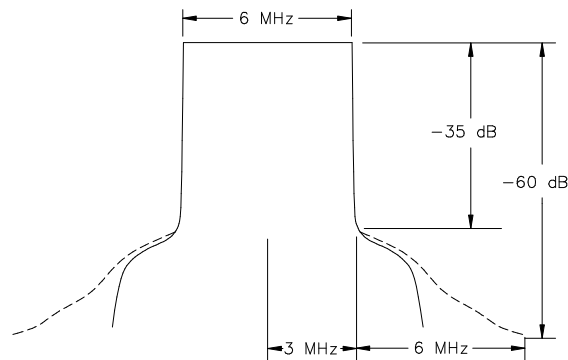


Figure 5-1: Typical Digital Spectrum

5.2.3 (A15-A1) UHF Generator Board (1565-1109)

The (A15-A1) UHF generator board is mounted in (A15) the UHF generator enclosure. This procedure should be performed to align this board.

In the Manual Adjust Set Up position, W1 on J4 between Pins 2 & 3, on (A13) the PLL board (1286-1104), adjust R12 for –2.5 volts at J6 pin 2.

Connect J1, the sample output of the section of the UHF generator board, to a spectrum analyzer, tuned to the crystal frequency, and peak tuning capacitors C6 and C18 for maximum output. Also tune L2 and L4 for maximum output. The output level should be about +5 dBm. The channel oscillator should maintain an oven temperature of 50° C.

If a spectrum analyzer is not available, connect a digital voltmeter (DVM) to TP1 on the UHF generator board. Tune capacitor C32 for maximum voltage at TP1.

Connect J2, the sample output of the channel oscillator, to a suitable counter and tune C11, the coarse adjust, to the crystal frequency. The fine frequency is controlled by the external PLL circuit when in the Auto mode.

Caution: Do not re-peak C32. This can change the output level.

Connect a spectrum analyzer to J2, the output jack of the board.

Tune C32, C34, C38, C40, C44, and C46 for maximum output. Re-adjust all of the capacitors to minimize the seventh and the ninth harmonics of the channel oscillator frequency. They should be down at least -30 dB without affecting the output of the UHF generator board.

If a spectrum analyzer is not available, a DC voltmeter can be used. When a voltmeter is used, the harmonic

frequencies must be minimized to prevent interference with other channels.

While monitoring each test point with a DC voltmeter, maximize each test point by tuning the broadband multipliers in the following sequence:

- Monitor TP1 with a DVM and tune C32 for maximum (typical 0.6 VDC).
- Monitor TP2 and tune C34 and C38 for maximum (typical 1.2 VDC).
- Monitor TP3 and tune C40 and C44 for maximum (typical 2.0 VDC).
- Monitor TP4 and tune C46 for maximum.
- Repeak C40 and C38 while monitoring TP4 (typical 3.5 VDC).
- The typical output level is +15 dBm.

5.2.4 (Optional) (A14-A1) 10-MHz Reference Generator Board (1519-1126)

Monitor J1 with a spectrum analyzer. Adjust C12 for a maximum 10-MHz signal.

Attach a frequency counter. Tune C3 for a coarse frequency adjustment close to 10 MHz and C2 for exactly 10 MHz. Re-adjust C12 for peak signal amplitude at J1 using the spectrum analyzer. Adjust R15 to maintain a constant crystal temperature of 50° C.

5.2.5 (A13) PLL Board (1286-1104)

Check that Jumper W1 on J4 is between Pins 2 and 3 and that R12 is adjusted for –2.5 volts at J6-2. Adjust C11 on the (A15-A1) UHF generator board (1565-1109) for the correct channel oscillator frequency. Monitor J10 on the board. Install jumper W1 between J4-1 and J4-2. With switches SW1, SW2, and SW3 in the positions shown in Table 5-5 (refer to the PLL board schematic [1286-3104]), the PLL Unlock LED should go out.

Table 5-5: Switch Positions

SWITCH	POSITION
SW1-8	N5
SW1-7	N4
SW1-6	N3
SW1-5	N2
SW2-8	N1
SW2-7	N0
SW2-6	A5
SW2-5	A4
SW3-8	A3
SW3-7	A2
SW3-6	A1
SW3-5	A0

Table 5-6 shows the proper switch positions according to channel frequencies.

Note: N7 and N6 are fixed values and can not be programmed.

Table 5-6: Switch Positions for Channel Frequencies

CHANNEL	FREQUENCY (MHz)	N	N7-N0	A	A5-A0
14	517	64	01000000	40	101000
15	523	65	01000001	24	011000
16	529	66	01000010	8	001000
17	535	66	01000010	56	111000
18	541	67	01000011	40	101000
19	547	68	01000100	24	011000
20	553	69	01000101	8	001000
21	559	69	01000101	56	111000
22	565	70	01000110	40	101000
23	571	71	01000111	24	011000
24	577	72	01001000	8	001000
25	583	72	01001000	56	111000
26	589	73	01001001	40	101000
27	595	74	01001010	24	011000
28	601	75	01001011	8	001000
29	607	75	01001011	56	111000
30	613	76	01001100	40	101000
31	619	77	01001101	24	011000
32	625	78	01001110	8	001000
33	631	78	01001110	56	111000
34	637	79	01001111	40	101000
35	643	80	01010000	24	011000
36	649	81	01010001	8	001000
37	655	81	01010001	56	111000
38	661	82	01010010	40	101000
39	667	83	01010011	24	011000

CHANNEL	FREQUENCY (MHz)	N	N7-NO	A	A5-A0
40	673	84	01010100	8	001000
41	679	84	01010100	56	111000
42	685	85	01010101	40	101000
43	691	86	01010110	24	011000
44	697	87	01010111	8	001000
45	703	87	01010111	56	111000
46	709	88	01011000	40	101000
47	715	89	01011001	24	011000
48	721	90	01011010	8	001000
49	727	90	01011010	56	111000
50	733	91	01011011	40	101000
51	739	92	01011100	24	011000
52	745	93	01011101	8	001000
53	751	93	01011101	56	111000
54	757	94	01011110	40	101000
55	763	95	01011111	24	011000
56	769	96	01100000	8	001000
57	775	96	01100000	56	111000
58	781	97	01100001	40	101000
59	787	98	01100010	24	011000
60	793	99	01100011	8	001000
61	799	99	01100011	56	111000
62	805	100	01100100	40	101000
63	811	101	01100101	24	011000
64	817	102	01100110	8	001000
65	823	102	01100110	56	111000
66	829	103	01100111	40	101000
67	835	104	01101000	24	011000
68	841	105	01101001	8	001000
69	847	105	01101001	56	111000

5.3 (A1-A6) UHF Amplifier Trays (1294-1112, low band/1294-1113, mid band/ 1294-1114, high band; Appendix C)

The UHF Amplifier Trays are located in the 2-3kW Amplifier Arrays.

The UHF amplifier trays (1294-1112, low band/1294-1113, mid band/ 1294-1114, high band) have been adjusted at the factory to meet all specifications, including phase adjustment, to match the multiple trays in an amplifier array when they are combined. The trays should not need to be adjusted to attain normal operation. Any adjustments to the boards

in the trays should be performed in the Manual Gain position, with S1 on (A8) the amplifier control board (1265-1414) in Manual. The idling current for the amplifier boards are adjusted with no RF drive applied. S1 should be in the Auto AGC position for the normal operation of the transmitter.

Connect a dummy load with a rating of a least 300 watts to J2, the RF output jack of the tray being aligned.

5.3.1 (A2-A1) Variable Gain/Phase Board (1265-1425; Appendix D)

The board is mounted in (A2) the variable gain/phase enclosure. The board has an AGC adjustable gain of 0 to 20 dB.

5.3.2 (A3-A1) 1-Watt UHF Amplifier Board (1227-1303; Appendix D)

The board is mounted in (A3) the 1-watt UHF amplifier enclosure. There are no adjustments to this board; it has approximately 10 dB of gain.

5.3.3 (A1) UHF Filter (1007-1101; Appendix D)

Apply a multiburst test signal to the transmitter. Monitor J2 with a spectrum analyzer and tune C1 and C3 for peak output with a flat-frequency response.

5.3.4 (A4-A1) Single Stage Amplifier Assembly, Class A (1265-1418, low band/1265-1416, mid band/1265-1417, high band; Appendix B)

This assembly is made from a generic single stage amplifier board, class A (1265-1415) with a frequency determining kit.

The generic single stage amplifier board operates class A and has a gain of approximately 11 dB. The bias of the transistor is set by the on-board biasing circuit. Adjust R6 for 5 amps of idle current, no RF drive applied. Connect a voltage meter across E1 and E2 on the amplifier protection board and move switch S1 to the I1 position; adjust R6 for a reading of 50 mV. Connect a sweep test signal to J1, the RF input jack of the UHF amplifier tray and monitor the output of the board at J2 with a padded-input spectrum analyzer. Tune capacitor C5 for peak output and then tune C6 for peak output power with a flat-frequency response at J2.

5.3.5 (A4-A2) Coupler Board Assembly (1227-1316; Appendix D)

There are no adjustments to this board.

5.3.6 (A4-A3) Dual Stage Amplifier Assembly, Class AB (1265-1413, low band/1265-1411, mid band/1265-1420, high band; Appendix D)

This assembly is made from a generic dual stage amplifier board, class AB (1265-1404) with a frequency determining kit.

The generic dual stage amplifier board operates class AB and has a gain of approximately 9 dB. The biases of the transistors are set by the on-board biasing circuits. Adjust R106 and R206 100 mA digital of idle current per side, no RF drive applied. Connect a voltage meter across E1 and E2 on the amplifier protection board and move switch S1 to the I3 position; adjust R106 for a reading of 1 mV digital. Move switch S1 to the I2 position and adjust R206 for a reading of 1 mV digital. Depending on the linearity of tray, these transistors may have 50 mA digital of bias. Connect a sweep test signal to J1, the RF input jack of the UHF amplifier tray, and monitor the output of the board at J2 with a padded input to a spectrum analyzer. Tune capacitors C105 and C205 for peak output and then tune C119 and C219 for peak output with a flat-frequency response and minimum current at J2.

5.3.7 (A5-A1) 4-Way Splitter Assembly (1265-1432; Appendix D)

There are no adjustments to this assembly.

5.3.8 (A5-A2, A5-A3, A5-A4, and A5-A5) Dual Stage Amplifier Assemblies, Class AB (1265-1439, low band/1265-1440, mid band/1265-1441, high band; Appendix D)

Each board is made from a generic dual stage amplifier board, class AB (1265-

1404) with a frequency determining kit. These boards operate class AB and have a gain of approximately 9 dB. The idling current for each of the transistors is set to 100 mA digital.

To adjust the idling currents, no RF applied to the tray, of the devices on (A5-A2) the amplifier board, connect a voltage meter across E1 and E2 on the amplifier protection board and move switch S1 to the I5 position; adjust R106 for a reading of 1 mV digital. Move switch S1 to the I4 position and adjust R206 for a reading of 1 mV digital.

Connect a sweep test signal to J1, the RF input jack of the UHF amplifier tray. On (A5-A2) the amplifier board, tune capacitors C105 and C205 for peak output power and then tune C119 and C219 for peak output power with a flat-frequency response and minimum current.

To adjust the idling currents, no RF applied to the tray, of the devices on (A5-A3) the amplifier board, connect a voltage meter across E1 and E2 on the amplifier protection board and move switch S1 to the I7 position; adjust R106 for a reading of 1 mV digital. Move switch S1 to the I6 position and adjust R206 for a reading of 1 mV digital.

Connect a sweep test signal to J1, the RF input jack of the UHF amplifier tray. On the (A5-A3) dual stage amplifier board, tune capacitors C105 and C205 for peak output power and then tune C119 and C219 for peak output power with a flat-frequency response and minimum current.

To adjust the idling currents, no RF applied to the tray, of the devices on the (A5-A4) amplifier board, connect a voltage meter across E1 and E2 on the amplifier protection board and move switch S1 to the I9 position; adjust R106 for a reading of 1 mV digital. Move switch S1 to the I8 position and adjust R206 for a reading of 1 mV digital.

Connect a sweep test signal to J1, the RF input jack of the UHF amplifier tray. On the (A5-A4) amplifier board, tune capacitors C105 and C205 for peak output power and then tune C119 and C219 for peak output power with a flat-frequency response and minimum current.

To adjust the idling currents, no RF applied to the tray, of the devices on the (A5-A5) amplifier board, connect a voltage meter across E1 and E2 on the amplifier protection board and move switch S1 to the I11 position; adjust R106 for a reading of 1 mV digital. Move switch S1 to the I10 position and adjust R206 for a reading of 1 mV digital.

Connect a sweep test signal to J1, the RF input jack of the UHF amplifier tray. On the (A5-A5) amplifier board, tune capacitors C105 and C205 for peak output power and then tune C119 and C219 for peak output power with a flat-frequency response and minimum current.

5.3.9 (A5-A6) 4-Way Combiner Assembly (1265-1428, low band/1265-1429, mid band/1265-1430, high band; Appendix D)

This assembly contains (A5-A6-A1) a 4-way combiner board. There are no adjustments to the board.

5.3.10 (A5-A6-A2) Circulator

There are no adjustments to the circulator.

5.3.11 (A6-A1) Dual Peak Detector Board, Single Supply (1227-1333; Appendix D)

The dual peak detector board is mounted in (A6) a dual peak detector enclosure. There are no adjustments to the board.

5.3.12 (A7) Amplifier Protection Board (1265-1412; Appendix D)

There are no adjustments to this board.

5.3.13 (A8) Amplifier Control Board (1265-1414; Appendix D)

To check the operation of the overdrive circuit, increase the gain pot of the UHF amplifier tray to approximately 110%. The Overdrive LED DS2 should light and the output power should not increase above the 110% level. If the LED does not light, adjust R71 the overdrive threshold as needed until the LED lights.

5.3.14 (A12) +26.5V/2000W Switching Power Supply

This switching power supply does not contain any customer-repairable items. If the power supply should malfunction, do not attempt to repair the power supply without first consulting the Xcera Field Support Department. The power supply is adjusted to provide an output of +26.5 VDC.

5.3.15 Calibration of Output Power, Reflected Power and VSWR Cutback of the tray

To calibrate the forward output power reading of the tray. Place a calibrated coupler, average power wattmeter and dummy load of at least 300 watts at the output of the tray that is to be calibrated. Switch the front panel meter to the % Output Power position. Preset R16, manual gain, on (A8) the amplifier control board fully CCW. Move switch S1 on the amplifier control board to the Manual position. Insert a digital test signal and adjust R16 for 300 watts 64 QAM or 8-VSB digital on the wattmeter. Calibrate the front panel output power meter to 100% by adjusting the pot, R2, forward calibration, located on the amplifier control board. The forward output power reading of the tray is now calibrated.

To calibrate the reflected output power reading and VSWR cutback of the tray. Reduce manual gain pot R16 to a 50% reading on the front panel meter in the % Output Power position. Turn off the tray. Remove the load from the output of the tray and switch the front panel meter to the Reflected Output Power position. Switch on the tray. Adjust reflected power adjust pot R22 on the amplifier control board to a 50% reading. Then adjust R29, the VSWR threshold cutback pot, on the amplifier control board until the VSWR Cutback LED DS1 on the front panel just lights. This sets up the VSWR cutback circuitry.

After this calibration is completed, reconnect the tray to the system and move switch S1 on the amplifier control board to the Automatic Gain Control position. This is the normal operating position for the switch.

The UHF amplifier tray is now aligned, calibrated, and ready for normal operation. Repeat as needed for the other Amplifier Trays in the System

5.4 Phase and Gain Adjustment of the UHF Amplifier Trays in each Amplifier Array

Switch the Transmitter to Standby and switch Off the Main AC Circuit Breaker located on each of the AC Distribution Assemblies in the Amplifier Array Assemblies. Switch Off all the AC Circuit Breakers, located on the AC Distribution Assembly, for the individual Amplifier Trays.

1. Adjust all gain controls located on the UHF Amplifier Trays full CCW.
2. Switch On the Main AC Circuit Breaker for the Side A Amplifier Array Assembly and switch On the AC Circuit Breaker for Amplifier #1.
3. Place the Transmitter in Operate and adjust the Gain control on the

- Amplifier Tray for 50% output power and adjust the Phase control to mid range.
4. Monitor the output power of the Transmitter by connecting a Spectrum Analyzer to the Sample Jack located on the Metering Panel. Adjust the Spectrum Analyzer for Zero Span operation. The power could be monitored by watching the meters on the panel but the power change is easier to see on the analyzer.
 5. Turn On the AC to Amplifier Tray #2 and adjust its' output power to 50%.
 6. While monitoring the output power of the Transmitter, adjust the Phase Control on amplifier tray #2 until the power reaches a peak. If the Phase adjust reaches its end of travel, add a 2 inch cable to the RF Input (J1) of amplifier tray #2. Re-adjust the Phase to peak the System output power. If the Phase Control again reaches its end of travel before a peak in power is reached, remove the 2 inch cable and add a 3 inch cable to J1 of amplifier tray #2 and readjust phase for peak output power. The adding of cables should be done during the adjustment anytime the range of the phase adjust needs extended.
 7. Repeat steps 5 and 6 for the remaining Amplifiers.
 8. Increase the output power on Amplifier #1 and Amplifier #2 to 90%.
 9. Adjust the Phase Control on Amplifier #2 to peak the System output power.
 10. Increase the output power on Amplifier #3 to 90% and adjust the Amplifier #3 Phase control for maximum System output power.
 11. Increase the output power on Amplifier #4 to 90% and adjust the Amplifier #4 Phase control for maximum System output power.
 12. Increase the output power on Amplifier #5, if present, to 90% and adjust the Amplifier #5 Phase control for maximum System output power.
 13. Increase the output power on Amplifier #6, if present, to 90% and adjust the Amplifier #6 Phase control for maximum System output power.
 14. Monitor the Reflected Power on all of the UHF Amplifier Trays. The Reflected Power should read <5%. If an amplifier is showing high reflected power adjust the Phase control to minimize Reflected Power. Be careful not to increase Reflected Power on the other Amplifier Trays. The Amplifier Trays should interact in such a way that the phasing of any one Amplifier will affect the Reflected on the other Amplifiers.

5.5 Calibration of the Side A and Side B Amplifier Arrays Forward Output Power Level

Note: Perform the following procedure only if the power calibration is suspect.

Set up the transmitter for the appropriate average output power level out of the Side A Cabinet. A calibrated coupler and average power wattmeter must be used to measure the digital power level.

Side A Forward Power Calibration.

In (A6) the Metering Control Panel, located in the UHF Exciter Cabinet, find the (A9) Dual Peak Detector Board

(1159965). Adjust R9 for 100% on the Side A Power Meter.

Side B Forward Power Calibration.

In (A6) the Metering Control Panel, located in the UHF Exciter Cabinet, find the (A8) Dual Peak Detector Board (1159965). Adjust R9 for 100% on the Side B Power Meter.

5.6 Calibration of the Side A and Side B Amplifier Arrays Reflected Output Level

Monitor the Side A Power Meter, in the Forward Power position, and turn the power adjust pot, located on the (A4) Phase/Gain Tray, to 20%. Move the cable connected to J3, located on the (A8) Output Coupler, inside the Side A Amplifier Cabinet, to Jack J6 and the cable on J6 to J3. Adjust R10 on (A9) the Dual Peak Detector Board, located in the Metering Control Panel, for a 20% reading in the Reflected Power position. At this 20% reference power reading, the VSWR LED mounted on the front panel of the Exciter Tray should be illuminated. If the VSWR LED is not illuminated, adjust R5 on (A18) the Detector Threshold Board, located in the Metering Control Panel, until the LED just begins to turn on. Turn the power adjust pot slightly CCW and the LED should go out. Turn the pot CW until the LED just begins to turn on. The reflected output power for the amplifier array is now calibrated. Move the cable connected to J6 back to J3 and the cable on J3 back to J6, on the (A8) Coupler.

Monitor the Side B Power Meter, in the Forward Power position, and turn the power adjust pot, located on the (A5) Phase/Gain Tray for Side B, to 20%. Move the cable connected to J3, located on the (A8) Output Coupler, inside the Side B Amplifier Cabinet, to Jack J6 and the cable on J6 to J3. Adjust R10 on the (A8) Dual Peak Detector Board, located in the Metering Control Panel, for a 20% reading in the Reflected Power position.

At this 20% reference power reading, the VSWR LED mounted on the front panel of the Exciter Tray should be illuminated. If the VSWR LED is not illuminated, adjust R12 on (A18) the Detector Threshold Board, located in the Metering Control Panel, until the LED just begins to turn on. Turn the power adjust pot slightly CCW and the LED should go out. Turn the pot CW until the LED just begins to turn on. The reflected output power for Side B is now calibrated. Move the cable connected to J6 back to J3 and the cable on J3 back to J6, on the (A8) Coupler.

5.7 Phase and Gain Adjustment Procedure for entire Amplifier Array Assembly

Begin the alignment with all Amplifier Trays up and running. Monitor the Reject Power by setting the Combined Metering switch to the Reject position and adjusting the Phase Control on either, or both, of the Phase/Gain Modules to minimize the Reject reading.

Adjust the Amplifier Gain controls so that all amplifiers have equal output power.

The Gain control on the Phase/Gain Tray can be used to balance the output power between Sides A and B. This adjustment has a 10% range. If the end of its' range is reached, you must adjust the gain of each amplifier in the Amplifier Side to balance the power of each Side.

5.8 Calibration of the Forward Output Power Level of the Transmitter

Note: - Perform the following only if the power calibration is suspect.

Set the Transmitter up for the appropriate Average Output Power Level.

Using a calibrated coupler on the combined RF output line and an HP power meter (or an equivalent

measurement instrument), adjust the output power for a reading of 2000, 2500 or 3000 watts on the true average power meter. Adjust R28 on (A10) the visual/aural metering board in the metering panel for 100% in the % Combined Output Power position. Set pot R20 on (A10) the visual/aural metering board full CCW.

5.9 Calibration of the Reflected Output Level of the Transmitter

Turn the Power Adjust Pot on the UHF Exciter to 20% on the Metering Panel Combined Meter in the Visual Power position. **NOTE:** Check that the Jumper is in Manual on the UHF Upconverter Board (1265-1310) in the UHF Exciter.

On (A11) the Output Coupler for the Transmitter, move the cable on J6 to J5 and the Termination on J5 to J6. Adjust R10 on the (A7) Dual Peak Detector Board (1159965), in the Metering Panel, for a 20% reading in the Combined Reflected Power position. At this 20% Reference Power reading, the VSWR LED mounted on the front panel of the UHF Exciter should be illuminated. If not adjust R19 on the Detector Threshold Board, in the Metering Control Panel, until the VSWR LED just turns On. Turn

the Power Adjust pot slightly CCW and the LED should go out, turn the pot CW until the LED just turns On. The Reflected Output Power is now calibrated. Switch the Transmitter to Standby. Move the cable on J5 to J6 and the Termination on J6 back to J5. Switch the Transmitter to Operate and adjust the front panel power pot for 100% Power reading on the Combined Meter.

5.10 Calibration of the Reject Power of the Transmitter

Check that the System is operating at 100% Output Power. Remove the AC power to the Side A Amplifier Array by switching Off CB1 the Main AC circuit breaker, located on the AC Distribution Panel for the Side A Amplifier Array.

Adjust R9 on the (A7) Dual Peak Detector Board, located in the Metering Control Panel, for a 25% Power reading in the reject power position. The Reject power is now calibrated.

Return CB1, the Main AC circuit breaker for the Side A Amplifier Array, to the On position.

The Transmitter is fully aligned and ready for normal operation

APPENDIX A

SAMPLE LOG REPORT SHEET

(A1) Single UHF Exciter Assembly

(A1-A6) DT835A Metering Panel

Combined

Forward (0 - 120%) = _____ %
Reject (0 - 120%) = _____ % Reflected (0 - 120%) = _____ %

(A2) Amplifier Array Side A

Forward (0 - 120%) = _____ % Reflected (0 - 120%) = _____ %

(A3) Amplifier Array Side B

Forward (0 - 120%) = _____ % Reflected (0 - 120%) = _____ %

(A1-A1) UHF Exciter Tray

% Exciter (0 - 120%) = _____ % ALC (0 - 1 V) = _____ V

(A1-A4) Phase/Gain Tray Side A

% Power (0 - 120%) = _____ % ALC (0 - 1 V) = _____ V

(A1-A5) Phase/Gain Tray Side B

ALC (0 - 1 V) = _____ V % Power (0 - 120%) = _____ %

(A2 and A3) Amplifier Array Assemblies

Two amplifier arrays with four, five or six UHF amplifier trays each

(A2) Side A

(A2-A1)

AGC Voltage = _____V
% Reflected = _____%
% Output Forward = _____%
Power Supply = _____V

(A2-A2)

AGC Voltage = _____V
% Reflected = _____%
% Output Forward = _____%
Power Supply = _____V

(A2-A3)

AGC Voltage = _____V
% Reflected = _____%
% Output Forward = _____%
Power Supply = _____V

(A2-A4)

AGC Voltage = _____V
% Reflected = _____%
% Output Forward = _____%
Power Supply = _____V

(A2-A5)

AGC Voltage = _____V
% Reflected = _____%
% Output Forward = _____%
Power Supply = _____V

(A2-A6)

AGC Voltage = _____V
% Reflected = _____%
% Output Forward = _____%
Power Supply = _____V

(A3) Side B

(A3-A1)

AGC Voltage = _____V
% Reflected = _____%
% Output Forward = _____%
Power Supply = _____V

(A3-A2)

AGC Voltage = _____V
% Reflected = _____%
% Output Forward = _____%
Power Supply = _____V

(A3-A3)

AGC Voltage = _____V
% Reflected = _____%
% Output Forward = _____%
Power Supply = _____V

(A3-A4)

AGC Voltage = _____V
% Reflected = _____%
% Output Forward = _____%
Power Supply = _____V

(A3-A5)

AGC Voltage = _____V
% Reflected = _____%
% Output Forward = _____%
Power Supply = _____V

(A3-A6)

AGC Voltage = _____V
% Reflected = _____%
% Output Forward = _____%
Power Supply = _____V

Date: _____

Technician: _____

Customer Name: _____ Call Letters: _____

APPENDIX B

TYPICAL OPERATIONAL READINGS

(A1) Single UHF Exciter Assembly

(A1-A6) DT835A Metering Panel

Combined

Forward (0 - 120%) = $\approx 100\%$
Reject (0 - 120%) = $< 5\%$

Reflected (0 - 120%) = $< 5\%$

(A2) Amplifier Array Side A

Forward (0 - 120%) = The level as needed to attain the desired output power of the transmitter

Reflected (0 - 120%) = $< 5\%$

(A3) Amplifier Array Side B

Forward (0 - 120%) = The level as needed to attain the desired output power of the transmitter

Reflected (0 - 120%) = $< 5\%$

(A1-A1) UHF Exciter Tray

% Exciter (0 - 120%) = $\approx 70\%$
(100% = +10 dBm 64 QAM or 8-VSB digital)

ALC (0 - 1 V) = ≈ 0.8 V

(A1-A4) Phase/Gain Tray Side A

% Power (0 - 120%) = $\approx 50\%$

ALC (0 - 1 V) = 0.6 - 1 V typical

(A1-A5) Phase/Gain Tray Side B

% Power (0 - 120%) = $\approx 50\%$

ALC (0 - 1 V) = 0.6-1 V typical

(A2 and A3) Amplifier Array Assemblies

Two amplifier arrays, each with four, five or six UHF amplifier trays

(A2) Side A

(A2-A1)

AGC Voltage = 1 V - 2 V

% Reflected = <5% with all trays operating

% Output Forward = The level is as needed to attain the desired output power from the transmitter

Power Supply = 26.5 V

(A2-A2)

AGC Voltage = 1 V - 2 V

% Reflected = <5% with all trays operating

% Output Forward = The level is as needed to attain the desired output power from the transmitter

Power Supply = 26.5 V

(A2-A3)

AGC Voltage = 1 V - 2 V

% Reflected = <5% with all trays operating

% Output Forward = The level is as needed to attain the desired output power from the transmitter

Power Supply = 26.5 V

(A2-A4)

AGC Voltage = 1 V - 2 V

% Reflected = <5% with all trays operating

% Output Forward = The level is as needed to attain the desired output power from the transmitter

Power Supply = 26.5 V

(A2-A5)

AGC Voltage = 1 V - 2 V

% Reflected = <5% with all trays operating

% Output Forward = The level is as needed to attain the desired output power from the transmitter

Power Supply = 26.5 V

(A2-A6)

AGC Voltage = 1 V - 2 V

% Reflected = <5% with all trays operating

% Output Forward = The level is as needed to attain the desired output power from the transmitter

Power Supply = 26.5 V

(A3) Side B

(A3-A1)

AGC Voltage = 1 V - 2 V

% Reflected = <5% with all trays operating

% Output Forward = The level is as needed to attain the desired output power from the transmitter

Power Supply = 26.5 V

(A3-A3)

AGC Voltage = 1 V - 2 V

% Reflected = <5% with all trays operating

% Output Forward = The level is as needed to attain the desired output power from the transmitter

Power Supply = 26.5 V

(A3-A5)

AGC Voltage = 1 V - 2 V

% Reflected = <5% with all trays operating

% Output Forward = The level is as needed to attain the desired output power from the transmitter

Power Supply = 26.5 V

(A3-A2)

AGC Voltage = 1 V - 2 V

% Reflected = <5% with all trays operating

% Output Forward = The level is as needed to attain the desired output power from the transmitter

Power Supply = 26.5 V

(A3-A4)

AGC Voltage = 1 V - 2 V

% Reflected = <5% with all trays operating

% Output Forward = The level is as needed to attain the desired output power from the transmitter

Power Supply = 26.5 V

(A3-A6)

AGC Voltage = 1 V - 2 V

% Reflected = <5% with all trays operating

% Output Forward = The level is as needed to attain the desired output power from the transmitter

Power Supply = 26.5 V

APPENDIX C
ASSEMBLY DRAWINGS

DT835A

Transmitter Racking Plan	1142231
Transmitter Interconnect	1056920

UHF Exciter Assembly

Interconnect.....	1056919
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AC Distribution Assembly, Exciter Assembly

Interconnect.....	1245-8500
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UHF Digital Exciter Tray

Block Diagram	1300494
Interconnect.....	1300491

Variable Phase/Gain Tray

Block Diagram	1245-3200
Interconnect.....	1245-8200

Metering Panel

Interconnect.....	1061458
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Amplifier Array Assembly, 2 required for Digital Transmitter

Block Diagram	1278-3300
Interconnect	1278-8300

AC Distribution Assembly, one in each Amplifier Array

Interconnect.....	1278-8200
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UHF Amplifier Tray, 4, 5 or 6 in each Amplifier Array Assembly

Block Diagram	1281-3100
Interconnect.....	1281-8100

APPENDIX C
SUBASSEMBLY DRAWINGS

UHF Filter	
Schematic.....	1007-3101
±12V Power Supply Board	
Schematic.....	1062-3013
General Purpose +12V Power Supply Board	
Schematic.....	1128-3504
Channel Oscillator Board, Dual Oven	
Schematic.....	1145-3201
Splitter Board	
Schematic.....	1181-3002
IF Delay Equalizer Board	
Schematic	1197-3112
x8 Multiplier Board	
Schematic.....	1227-3002
IF Phase Corrector Board	
Schematic.....	1227-3250
1 Watt Amplifier Board	
Schematic.....	1227-3303
Coupler Board Assembly	
Schematic.....	1227-3316
Dual Peak Detector Board, Single Supply	
Schematic.....	1227-3333
Transmitter Control Board	
Schematic.....	1245-3101
Variable Gain/Phase Board	
Schematic.....	1245-3201
Metering Board	
Schematic.....	1245-3202
+15V/-12V Power Supply Board	
Schematic.....	1245-3203
Detector Threshold Board	
Schematic.....	1245-3402
ALC Board, NTSC	
Schematic.....	1265-3305

Visual/Aural Metering Board	
Schematic.....	1265-3309
UHF Upconverter Board	
Schematic.....	1265-3310
Transmitter Control Board	
Schematic.....	1265-3311
+ 12V(4A)/-12V(1A) Power Supply Board	
Schematic.....	1265-3312
Dual Stage Amplifier Assembly, Class AB, Mid Band	
Made from a Generic Dual Stage Amplifier Board, Class AB (1265-1404).	
Schematic.....	1265-3411
Amplifier Protection Board	
Schematic.....	1265-3412
Dual Stage Amplifier Assembly, Class AB, Low Band	
Made from a Generic Dual Stage Amplifier Board, Class AB (1265-1404).	
Schematic.....	1265-3413
Amplifier Control Board	
Schematic.....	1265-3414
Single Stage Amplifier Assembly, Class A, Mid Band	
Made from a Generic Dual Stage Amplifier Board, Class A (1265-1415).	
Schematic.....	1265-3416
Single Stage Amplifier Assembly, Class A, High Band	
Made from a Generic Dual Stage Amplifier Board, Class A (1265-1415).	
Schematic.....	1265-3417
Single Stage Amplifier Assembly, Class A, Low Band	
Made from a Generic Dual Stage Amplifier Board, Class A (1265-1415).	
Schematic.....	1265-3418
Dual Stage Amplifier Assembly, Class AB, High Band	
Made from a Generic Dual Stage Amplifier Board, Class AB (1265-1404).	
Schematic.....	1265-3420
Variable Gain/Phase Board	
Schematic.....	1265-3425
Dual Stage Amplifier Assembly, Class AB, Low Band	
Made from a Generic Dual Stage Amplifier Board, Class AB (1265-1404).	
Schematic.....	1265-3439
Dual Stage Amplifier Assembly, Class AB, Mid Band	
Made from a Generic Dual Stage Amplifier Board, Class AB (1265-1404).	
Schematic.....	1265-3440

Dual Stage Amplifier Assembly, Class AB, High Band
Made from a Generic Dual Stage Amplifier Board, Class AB (1265-1404).
Schematic..... 1265-3441

Combiner Reject Load Board
Schematic..... 1278-3311

PLL Board
Schematic..... 1286-3104
Output Distribution Amplifier Board (2 per unit)
Schematic..... 1500-3602

Dual Average Detector Board
Schematic..... 1510-3105

10 MHz Reference Generator Board
Schematic..... 1519-3126

IF Input Equalizer Board, 44 MHz
Schematic..... 1555-3219

Dual Peak Detector Board, SMT
Schematic..... 1555-3270

Transmitter Control Board
Schematic..... 1061195

5 Section Delay Equalizer Board, 44 MHz
Schematic..... 1072141

Serial Port Interface Board
Schematic..... 1075976

Dual Peak Detector Board
Schematic..... 1159976

APPENDIX D

DT835A SYSTEM SPECIFICATIONS



Solid State DTV Transmitters DT835A-3, DT835A-4, DT835A-5, DT835A-6



The DT800A Series is a full line of low and medium power UHF DTV transmitters. This time proven design offers high performance and simplicity in a very compact unit. Solid state digital output power levels are available up to 3 kilowatts average while tube type versions offer up to 5 kilowatts average. To ensure optimum performance, these transmitters benefit from years of experience in DTV modulator, exciter, and solid-state amplifier design and manufacturing.

Designed for high reliability and unattended operation, these products utilize parallel amplifier designs with a high level of protection circuitry. Features such as VSWR cutback, overdrive protection, over-temperature protection, dedicated power supplies and cooling, and output circulators in each amplifier ensure on-air reliability. Convenient system monitoring is achieved through front panel samples, status indicators and metering, most of which are remote controllable.

DT835A-3, DT835A-4, DT835A-5, DT835A-6

Performance

Output Power (average)	1500 / 2000 / 2500 / 3000 Watts
Frequency Range ¹	470 to 806MHz
Output Impedance	50 ohms
Frequency Stability	±1KHz (max 30 day variation)
w/Precise Frequency Option	±2Hz
Regulation of RF Output Power	3%
Out of Band - Compliant with FCC Mask ²	
Channel Edge ±500KHz	-47dB or better
6MHz from Channel Edge	-110dB or better
Signal to Noise (SNR)	27dB or better
Data Interface	
Input Rate	19.39Mbps. 6Hz channel
Input Interface	SMPTE 310M, Serial Differential ECL and TTL
Test Signals	Staircase, VSB Pilot, Zero Pilot, Average Power Pilot, Nyquist
Waveform	

General

Operational Temperature Range	0 to +50°C, derate 2°C/1000ft
Maximum Altitude ³	8500 feet (2600 m) AMSL
Operational Humidity Range	0% to 95% non-condensing
Transmitter Dimensions (W x D x H)	
DT835A-3	44" x 34" x 80"
DT835A-4, 5, 6	66" x 34" x 80"
Weight	1050 / 1350 / 1500 / 1650 lbs
RF Load Impedance	50 ohms
Line Voltage ⁴	230V ±10%, 1 or 3 phase, 50/60Hz
Power Consumption	
System Power	10.5kW / 13.5kW / 17kW / 20.5kW
Power Factor	0.95

Options

Dual Exciter with Automatic Switcher
AC Surge Protector
Precise Frequency Kit
Spare Parts Kit

¹ Other Frequencies - Consult Factory

² Measured in 30KHz RBW, relative to total average power

³ Above 8,500 feet - Consult Factory

⁴ Other Voltages - Consult Factory



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