INSTRUCTION MANUAL

335B

3300 WATT VHF LOW BAND TRANSMITTER

AXCERA, LLC
103 FREEDOM DRIVE P.O. BOX 525 LAWRENCE, PA 15055-0525 USA
(724) 873-8100 • FAX (724) 873-8105
www.axcera.com • info@axcera.com

TABLE OF CONTENTS

CHAPTER 1 INTRODUCTION

SECTION **PAGE**

TABLE OF CONTENTS (continued)

SECTION **PAGE**

LIST OF FIGURES

FIGURE **PAGE**

LIST OF TABLES

TABLE **PAGE**

Chapter 1
Introduction

This manual explains the installation, setup, alignment, and maintenance procedures for the 335B 3300-watt solid state VHF Low Band 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 five chapters and supporting appendices. **Chapter 1**, Introduction, contains information on the assembly numbering system used by Axcera, safety, contact information, return procedures, and warranties. **Chapter 2**, System Description, Maintenance and Remote Control Connections, describes the transmitter and includes discussions on system control and status indicators, maintenance and remote control connections. **Chapter 3** Installation and Set Up Procedure, explains how to unpack, install, setup, and operate the transmitter. **Chapter 4**, Circuit Descriptions, contains a detailed discussion of the circuits and boards that make up the 335B. **Chapter 5**, Detailed Alignment Procedures, provides information on adjusting the system and trays to achieve peak operation of the transmitter and assemblies. The **appendices** contain system specifications, a sample log sheet, typical operational readings, interconnects, schematics, assembly and subassembly drawings and parts lists.

1.2 Assembly Designation Procedure

Axcera has assigned assembly numbers, such as Ax (x=1,2,3...), to all assemblies, trays, subassemblies, and boards that make up the 335B. The assembly numbers are referenced to in the text of this manual and shown on the block diagrams and interconnect drawings provided in the appendices. These supporting documents are arranged in increasing numerical order in the appendices. Section titles in the text for assembly, tray descriptions and alignment procedures also indicate the associated drawing(s) and the relevant appendix that contains the drawing. Sections describing vendor-supplied items, such as meters and power supplies, do not contain this information.

1.3 Safety

The transmitters manufactured by Axcera are designed for ease of operation 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 attempting to maintain or repair the transmitter.

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

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

Heed all Notes, Warnings, and Cautions – The avoid injury or damage to the equipment, 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 all power from the equipment before cleaning. Do not use liquid or aerosol cleaners as damage to silk screens may occur. Use a damp cloth for cleaning.

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

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

Replacement Parts – When replacement parts are needed, use the replacement part numbers as given on the parts lists included in this manual, in Appendix C or Appendix D. If other 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 field service department if you have any questions regarding service or replacement parts.

1.4 Contact Information

The Axcera Field Service Department can be contacted by phone at **(724) 873-8100** or by fax at **(724) 873-8105**.

Before calling Axcera, please be prepared to supply the Axcera technician with answers to the following questions. This will save time and help ensure the most direct resolution to the problem.

1. What are the Customers' Name and call letters?
2. What are the model number and type of transmitter?
3. Is the transmitter digital or analog?
4. How long has the transmitter been on the air? (Approximately when was the transmitter installed.)
5. What are the symptoms being exhibited by the transmitter? Include the status as read on the LCD display, if present. Also record the status of any LEDs located on the front panels of the Trays. Include all meter readings from the trays.

1.5 Material Return Procedure

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

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

NOTE: To prevent damage to the product during shipping, Axcera will supply a shipping container to the customer upon request.

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

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

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

Please forward all MRA items to:

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

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

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

1.6 Limited One-Year Warranty for Axcera Products

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

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

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

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

Chapter 2
System Description, Maintenance & Remote Control Connections

The 335B is a complete 3300-watt VHF Low Band solid state internally diplexed television transmitter that operates at a nominal visual output power of 3300 watts peak sync and an average aural output power of 330 watts, at an A/V ratio of 10 dB, 10% sound, or 165 watts at 13 dB, 5% sound.

2.1 System Overview

The 335B is made up of the trays and assemblies listed in Table 2-1.

Table 2-1. 335B Trays and Assemblies

MAJOR ASSEMBLY DESIGNATOR	TRAY/ASSEMBLY NAME	DRAWING NUMBER
A2	AC distribution block	
A4	VHF L.B. exciter	1070820 or 1304463 w/Precise Frequency
A5, A6, A7, A9, A11	Five VHF amplifier trays	1304363
A8	VHF combiner assembly	1065241
A13	Harmonic filter	1304390
A14	Bandpass filter assembly	1304388
A12	Remote interface assembly	1083510
(Optional) A25	Precise Frequency Control Tray	1294-1153(+), 1294-1154(0) or 1294-1155(-)

VHF L.B. Exciter Tray

The (A4) VHF L.B. exciter tray (1070820) operates using baseband audio and video inputs to produce a diplexed, modulated, and on-channel frequency visual + aural RF output.

NOTE: If your transmitter contains a precise frequency kit, a precise frequency control tray provides the PLL circuits that connect to the VHF exciter tray w/precise frequency (1304463) for precise channel oscillator frequency control. Refer to the 335B precise frequency control system instruction manual for information on the precise frequency control tray and system.

Aural IF Synthesizer Board

The baseband audio, either balanced at TB1 or composite at J6, and the subcarrier audio at J4, if present, connect from the rear of the VHF exciter to (A4) the aural IF synthesizer board (1265-1303). The board amplifies and controls the levels of the three possible audio inputs and provides a single audio output. A 4.5-MHz CW signal is generated using a voltage controlled oscillator (VCO), onto which the audio is modulated. This produces the modulated 4.5 MHz output of the board that connects to the sync tip modulator board. The board also contains a phase lock loop (PLL) circuit that maintains the precise 4.5-MHz separation between the aural (41.25 MHz) and the visual (45.75 MHz) IF frequencies

Sync Tip Clamp/Modulator Board

The baseband video connects from J1 on the rear of the VHF exciter to (A5) the sync tip clamp/modulator board (1265-1302). The sync tip clamp/modulator board takes the video, amplifies it, provides a sync tip clamp circuit and modulates the video with a 45.75 MHz IF generated by the IF carrier oven oscillator or IF VCXO board. The audio modulated 4.5 MHz IF, from the aural IF synthesizer board, is mixed with the 45.75 MHz CW to produce a modulated 41.25 MHz aural IF output. The video modulated 45.75 MHz is then diplexed with the audio modulated 41.25 MHz to produce the combined Visual IF + Aural IF output of the board that connects to the ALC board.

4.5 MHz Composite Input Kit

NOTE: If your transmitter does not contain the 4.5 MHz composite input kit, the following paragraph description does not pertain. If the (optional) 4.5-MHz composite input kit is purchased, the 4.5-MHz composite input or the baseband video and audio inputs are used. The switching between the inputs is accomplished by a relay mounted on the sync tip clamp modulator board that is controlled by a baseband select. The baseband select controls a relay that selects either the 4.5 MHz generated from the baseband inputs or from the 4.5-MHz composite input. To operate the transmitter with the (optional) 4.5-MHz composite input kit using baseband inputs, the baseband video must be connected to J1 or J2, the baseband audio must be connected to the proper input jack, and a baseband select must be connected from J7-6 and J7-7. To operate the transmitter with the (optional) 4.5-MHz composite input kit using the 4.5-MHz composite input, the 4.5-MHz composite input must be connected to J1 or J2 and the baseband select must be removed from J7-6 and J7-7.

IF Carrier Oven Oscillator Board

NOTE: If the precise frequency kit is present in your transmitter, the IF VCXO Board (1248-1131) will be used.

The IF carrier oven oscillator (1191-1404) or the IF VCXO board generates the 45.75 MHz visual IF CW signal that connects to the sync tip clamp/modulator board.

ALC Board

The (A8) automatic level control (ALC) board (1265-1305) provides the ALC and amplitude linearity correction of the 45.75 MHz + 41.25 MHz IF signal. The ALC circuit adjusts the level of the combined IF signal through the board that controls the output power of the transmitter. The level controlled combined IF output of the ALC board connects to the filter/mixer board.

VHF L.B. Filter/Mixer Board

The (A11-A2) VHF filter/mixer board (1153-1101) is made up of three separate circuits. The on channel frequency RF output of the x2 multiplier board connects to a filter and amplifier circuit before it is connected to the mixer stage. The combined 41.25 MHz + 45.75 MHz IF from the ALC board also connects to the mixer stage. The RF output of the mixer is filtered and amplified in the final circuit before it is connected to the VHF filter amplifier board.

X2 Multiplier Board

The (A11-A1) x2 multiplier board (1172-1111) multiplies the frequency of the RF from the channel oscillator by a factor of two using a broadband frequency doubler circuit. The RF on channel frequency output of the board connects to the filter/mixer board.

VHF Low Band Filter Amplifier Board

The VHF low band filter/amplifier board (1064251) is made up of two separate circuits. The RF output of the filter/mixer board is connected to a filter circuit tuned for best response on the channel frequency. The filtered RF is then connected to an amplifier circuit with a manual gain control. The output of the board connects to J15, the RF output jack located on the rear of the VHF exciter tray

Channel Oscillator Board

NOTE: If the precise frequency kit is present in your transmitter, the VCXO Channel Oscillator Board (1145-1204) will be used.

The channel oscillator board (1145-1201) or VCXO board generates a stable frequency reference signal of approximately 100 MHz. The output connects to the x2 multiplier board.

Transmitter Control Board

The (A17) transmitter control board (1265-1311) provides system control functions and the operational LED indications, which can be viewed on the front panel of the transmitter. The main control functions are the Operate/Standby and Auto/Manual selections. When the transmitter is switched to Operate, the board supplies the enables to the three external VHF amplifier trays. The board also performs the automatic switching of the transmitter to Standby upon the loss of the video input when the transmitter is in Automatic.

Visual/Aural Metering Board

The (A19) visual/aural metering board (1265-1309) provides detected outputs of the visual, aural, and reflected output samples that are used for monitoring on the front panel meter. These readings are attained from the forward power and the reflected power samples from the output coupler assembly of the transmitter.

4 Way Power Splitter

The RF output of the VHF exciter is split four ways in (A5) the 4-way power splitter assembly (ZFSC-4-3BNC). Only three of the outputs are used in this configuration, the fourth is terminated.

VHF Low Band Amplifier Tray

The outputs of the splitter feed the three (A6, A7 and A11) VHF amplifier trays (1304363). Each tray amplifies the RF signals to approximately 750 watts peak of sync visual + aural.

In the VHF amplifier tray, a forward power sample and a reflected power sample from the combiner board are connected to the AGC control board that provides peak-detected samples that are monitored on the front panel meter of the tray.

3 Way VHF Combiner Assembly

The outputs of the three VHF amplifier trays are combined in (A8) the 3 way VHF combiner that provides approximately 2100 watts peak of sync output.

Harmonic and Bandpass Filters

The output of the combiner assembly is connected to (A13) a harmonic filter and (A14) a bandpass filter assembly. The harmonic and bandpass filters are tuned to provide a high out-of-band rejection of unwanted products.

Output Coupler Assembly

The filtered signal is connected to the (A16) coupler assembly, which provides a forward and a reflected power sample to the visual/aural metering board mounted in the VHF exciter. The forward sample is processed to provide peak detected visual and aural power output samples to the transmitter control board in the VHF exciter. The reflected power sample is also peak detected and wired to the transmitter control board. The transmitter control board connects the visual, aural, and reflected power output samples to the front panel meter for visual monitoring of the system operation.

2.2 Control and Status of Transmitter

Control and status information for the transmitter is provided by the meter and LED indicators on the front panel of the VHF exciter. The switches and LED indicators are part of the (A17) transmitter control board that is mounted so that the switches and LEDs are operated or viewed from the front panel of the VHF exciter.

Switch S1 is an Operate/Standby switch that controls the output of the transmitter by providing the Enables that, when the transmitter is in Operate, are needed to turn on the switching power supplies in the three VHF amplifier trays. When the transmitter is in Operate, the green LED DS2, located on the front panel of the VHF exciter. When it is in Standby, the amber LED DS1 is on. If the transmitter does not switch to Operate when S1 is switched to Operate, check that a dummy jumper plug is connected to (A12-J9 at pins 21 and 22) on the remote interface panel. It must be present for the transmitter to operate. If the interlock is present, the green LED DS5, mounted on the transmitter control board, will be lit.

NOTE: If the remote interface panel is not present in your transmitter the dummy jumper plug must be present on J11, with a jumper between pins 23 and 24, located on the back of the VHF exciter tray. The jumper provides the interlock needed for the transmitter to operate. If the interlock is present, the green LED DS5, mounted on the transmitter control board, will be lit.

Switch S2 is an Automatic/Manual switch that controls the operation of the transmitter by the presence of the video input signal. When the switch is in Automatic, the green LED DS3 is lit and, if the video input signal to the transmitter is lost, the transmitter will automatically switch to Standby. When the video input signal returns, the transmitter will automatically switch back to Operate. In Manual, the amber LED DS4 is lit and the operation of the transmitter is controlled by the front panel switches. During normal operation of the transmitter, switch S2 should be in the Auto position. The front panel of the VHF exciter also has LEDs that indicate a Video Fault (red LED DS9) and VSWR Cutback (amber LED DS7).

2.2.1 VHF Exciter Tray (A4)

Table 2-2. VHF Exciter Tray Meters

METER	FUNCTION	
Meter (A4-A18)	This meter reads power in terms of a percentage of the calibrated output power level on the upper scale. The voltage level or frequency level is read on one of the bottom two scales. A full-scale reading on the top scale is 120%. 100% is equivalent to the full-rated 3300 watts peak of sync visual. The meter also reads % Aural Power, % Exciter Power, % Reflected Power, audio levels, video levels, and the ALC reading.	
	With Switch S3 in Position	***Display***
	Switch S3, Meter	Selects the desired ALC voltage reading, % Exciter Power, % Reflected Power, % Visual Power, % Aural Power, video level, or audio level.
	Audio (0 to 100 kHz)	Reads the audio level, ±25 kHz balanced or ±75 kH composite, on the 0 to 10 scale. Will indicate baseband audio, if it is connected to the transmitter, even with the (optional) video + 4.5-MHz SCA input selected.
	ALC (0 to 10 volts)	Reads the ALC voltage level, .8 VDC, on the 0 to 10 scale.
	% Exciter (0 to 120)	Reads the % Exciter Output Power Level needed to attain 100% output of the transmitter on the top scale.
	% Aural Power (0 to 120)	Reads the % Aural Output Power of the transmitter, 100% = 330 watts at 10 dB A/V ratio, on the top scale.
	% Visual Power (0 to 120)	Reads the % Visual Output Power of the transmitter, 100% = 3300 watts peak of sync, on the top scale.
	% Reflected (0 to 120)	Reads the % Reflected Output Power, <5%, on the top scale.
	Video (0 to 1 volt)	Reads the video level, at white, on the bottom 0 to 10 scale.

Table 2-3. VHF Exciter Tray Switches

SWITCH	FUNCTION
S1 Transmitter Operate/Standby	The momentary 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, the low, Enable commands are applied to the VHF amplifier trays. These Enables will turn on the VHF amplifier trays. The opposite occurs when the switch is turned to Standby.
S2 Mode Select Auto/Manual	The momentary 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 video 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 video is lost and will switch back to Operate, quickly, when the video is restored. In Manual, the transmitter is controlled by the operator using the front panel Operate/Standby switch or by remote control.
R1 Power Adjust	The 5 kΩ pot (A20) sets the ALC level on the ALC board that controls the output power of the transmitter.

Table 2-4. VHF Exciter Tray Fault Indicators

INDICATOR	DESCRIPTION
DS9 Video Loss (Red)	Indicates that the input video to the transmitter has been lost. The fault is generated on the ALC board in the VHF exciter tray.
DS7 VSWR Cutback (Amber)	Indicates that the reflected power level of the transmitter has increased above 20%. This automatically cuts back the output power level to 20%. The fault is generated on the transmitter control board in the VHF exciter tray.

Table 2-5. VHF Exciter Tray Samples

SAMPLE	DESCRIPTION
f(IF)	A sample of the visual IF that is taken from the sample jack on the IF carrier oven oscillator board.
f(IC)	A sample of the intercarrier signal that is taken from the sample jack on the aural IF synthesizer board.
f(s)	A sample of the channel oscillator output that is taken from the sample jack of the channel oscillator assembly.
Exciter O/P	An output power sample of the exciter that is taken from the VHF filter/amplifier board.
Transmitter O/P	A forward power sample of the transmitter that is taken from the output coupler assembly through the visual/aural metering board.

2.2.2 VHF Amplifier Tray (A6, A7 & A11)

Table 2-6. VHF Amplifier Tray Switches

SWITCH	FUNCTION	
CB1 On/Off Circuit Breaker	Switches 220 VAC through a 15-amp circuit breaker-type protection device. The switch lights if AC is present. The AC is applied to the switching power supply in the tray.	
S1 **Switch, Meter**	Selects the desired % Visual Forward Output Power, % Visual Reflected Power reading, AGC Voltage, Power Supply Voltage, or Current	
	With Switch S1 in Position	***Display***
	% Forward	Reads the % Forward Output Power of the tray (100%= 750 watts peak of sync + aural)
	% Refl (Reflected)	Reads the % Reflected Output Power (<5%)
	AGC Voltage	Reads the AGC level of the tray (1 to 3 VDC)
	Power Supply	Reads the voltage from the switching power supply (+30 VDC)
	Current	Uses Switch S2 to indicate the current of transistor devices
S2 **Switch, Meter**	Selects the current of the transistor devices on the high band amplifier boards. S1 must be in the Current position.	
	With Switch S2 in Position	***Display***
	I_1	Reads the current of (A3-A1) the low band amplifier board (idling current=1.8 amps and operating current=12-13 amps, black picture)
	I_2	Reads the current of (A3-A2) the low band amplifier board (idling current=1.8 amps and operating current=12-13 amps, black picture)
	I_3	Reads the current of (A3-A3) the low band amplifier board (idling current=1.8 amps and operating current=12-13 amps, black picture)
	I_D	Reads the current of (A2-A1) the low band amplifier board (idling current=3 amps and operating current=3 amps, black picture)

Table 2-7. VHF Amplifier Tray Fault Indicators

INDICATOR	DESCRIPTION
DS1 Overdrive	Indicates that the level of drive is too high. The protection circuit will limit the drive level to the set threshold. The fault is generated on the overdrive protection board.
DS2 Enable	Indicates that the Enable supplied by the exciter tray is present
DS3 Module Status	Indicates that the forward power sample level is lower than the set reference level
DS4 VSWR Cutback	Indicates that the reflected level of the tray has increased above 20%; this will automatically cut back the output power of the tray. The fault is generated on the AGC control board.
DS5 Overtemperature	Indicates that the temperature of (A4-A5, A4-A6 or A5-A2) one of the thermal switches is above 175° F. When this fault occurs, the Enable to the switching power supply is immediately removed.

Table 2-8. VHF Amplifier Tray Control Adjustments

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

Table 2-9. VHF Amplifier Tray Sample

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

2.3 Maintenance

The 335B is designed with components that require little or no periodic maintenance except for the routine cleaning of the fans and the openings in 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 should be 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 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 B. Photocopies of the log sheet should be made to allow you to make continued data entries.

2.4 Input Connections

The baseband audio input connects to (A12) the A/V input and remote interface assembly. The baseband audio connects to TB1 for balanced audio or to jack J6 for composite, stereo, audio. The baseband video input connects to jack J2. **NOTE:** If another transmitter is using the same composite audio and video inputs, the loop through connections on the rear of the VHF exciter can be used. The video can be connected to J2 and the composite audio to J13.

NOTE: If your transmitter contains a precise frequency kit, a 5/10 MHz reference input must be connected to the BNC jack J19 on the remote interface assembly.

NOTE: If your transmitter contains a receiver tray the RF input connects to the “N” connector J1 or the “F” connector J18 on the remote interface assembly.

If the (A12) A/V input and remote interface panel is not present in your system, the baseband video and audio inputs connect directly to the rear of the VHF exciter.

NOTE: If your transmitter does not contain the 4.5 MHz composite input kit, the following description does not pertain to your transmitter. The baseband video input or the 4.5-MHz composite input connects to jacks J1 or J2, which are loop-through connected. The baseband audio input connects to TB1 for balanced audio or to jacks J3 or J13, which are loop-thru connected, for composite, stereo, audio. To use the (Optional) 4.5-MHz composite input kit, the baseband audio can remain connected to the VHF exciter even if the 4.5-MHz composite input kit is used, but the baseband video must be removed from J1 or J2 and the 4.5-MHz composite input must be connected to J1 or J2. The baseband select command must be removed from J7-6 and J7-7.

2.5 Remote Connections

The remote connections listed in Table 2-10 are made to the (A12) A/V input and remote interface assembly. The remote connections are made to the 37 pos “D” connector J9 or the 25 pos “D” connector J10 on the assembly. Refer to the interconnect drawing (1304391) to confirm the remote pin connections.

Table 2-10. 335B Remote Interface Connections to (A12) the A/V Input and Remote Interface Assembly

FUNCTION	REMOTE JACK/PIN NUMBER	INTERFACE TYPE
Transmitter Enable Interlock	J9-21	J9-21 and J9-22 must be connected together for normal operation. The (1176-1038) jumper jack or an external interlock can be used.
Transmitter Enable Interlock Rtn.	J9-22	
Remote Control Commands		
Transmitter Standby (Disable)	J9-9	Contact closure
Transmitter Standby/Operate Rtn.	J9-10	
Transmitter Operate (Enable)	J9-11	Contact closure
Transmitter Manual	J9-15	Contact closure
Transmitter Auto/Manual Rtn.	J9-16	
Transmitter Auto	J9-17	Contact closure
Power Level Raise (Optional)	J9-27	Contact closure
Pwr Lvl Raise/Lower Rtn (Optional)	J9-28	
Power Level Lower (Optional)	J9-29	Contact closure
Modulator Select (Optional)	J9-31	Contact closure
Modulator Select Rtn (Optional)	J9-32	
Remote Status Indications		
Transmitter Operate (Enable) Ind.	J9-12	50 mA max current sink
Operate/Standby Ind. Return	J9-13	
Transmitter Standby (Disable) Ind.	J9-14	50 mA max current sink
Transmitter Auto Indicator	J9-18	50 mA max current sink
Auto/Manual Indicator Return	J9-19	
Transmitter Manual Indicator	J9-20	50 mA max current sink
VSWR Cutback Indicator	J9-23	50 mA max current sink
VSWR Cutback Indicator Return	J9-24	
Video Loss (Fault) Indicator	J9-25	50 mA max current sink
Video Loss (Fault) Ind. Rtn.	J9-26	
Receiver Fault (Optional)	J9-30	

FUNCTION	REMOTE JACK/PIN NUMBER	INTERFACE TYPE
Remote Metering		
Visual Output Power	J9-1	1V full scale at 1kΩ source resistance
Visual Output Power Rtn	J9-2	
Aural Output Power	J9-3	1V full scale at 1kΩ source resistance
Aural Output Power Rtn	J9-4	
Reflected Power	J9-5	1V full scale at 1kΩ source resistance
Reflected Power Rtn	J9-6	
Exciter Output Power	J9-7	1V full scale at 1kΩ source resistance
Exciter Output Power Rtn	J9-8	
Forward Output Power (A6) VHF Amp #1	J10-1	1V full scale at 1kΩ source resistance
Forward Output Power (A6) Rtn	J10-2	
Reflected O/P Power (A6) VHF Amp #1	J10-3	1V full scale at 1kΩ source resistance
Reflected O/P Power (A6) Rtn	J10-4	
Forward Output Power (A7) VHF Amp #2	J10-6	1V full scale at 1kΩ source resistance
Forward Output Power (A7) Rtn	J10-7	
Reflected O/P Power (A7) VHF Amp #2	J10-8	1V full scale at 1kΩ source resistance
Reflected O/P Power (A7) Rtn	J10-9	
Forward Output Power (A11) VHF Amp #3	J10-10	1V full scale at 1kΩ source resistance
Forward Output Power (A11 Rtn	J10-11	
Reflected O/P Power (A11 VHF Amp #3	J10-12	1V full scale at 1kΩ source resistance
Reflected O/P Power (A11) Rtn	J10-13	

NOTE: If your transmitter does not contain the (A12) A/V input and remote interface assembly, the remote connections are made directly to the rear of the VHF exciter at J10 a 25 pos “D” connector or J11 a 37 pos “D” connector and to each of the VHF amplifier trays at J3 a 25 pos “D” connector. Refer to the interconnect drawing (1304391) to confirm the remote pin connections.

This concludes this chapter on the System Description, Maintenance and Remote Control Connections.

Chapter 3
Installation and Setup Procedures

There are special considerations that need to be taken into account before the 335B 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 50 amps that connects to the transmitter cabinet. Make sure that the proposed site for the transmitter has the necessary voltage requirements.

The 335B 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, 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.

The second source of heat is other equipment in the same room. This number is calculated in the same way as the equation for BTUs. The third source of heat is equally obvious but not as simple to calculate. This is the heat coming through the walls, roof, and windows on a hot summer day. Unless the underside is exposed, the floor is usually not a problem. Determining this number is usually best left up to a qualified HVAC technician. There are far too many variables to even estimate this number without reviewing the detailed drawings of the site that show all of the construction details. The sum of these three sources is the bulk of the heat that must be removed. There may be other sources of heat, such as personnel, and all should be taken into account.

Now that the amount of heat that must be removed is known, the next step is to determine how to accomplish this. The options are air conditioning, ventilation, or a combination of the two. Air conditioning is always the preferred method and is the only way to create anything close to an ideal environment.

Ventilation will work quite well if the ambient air temperature is below 100° F, or about 38° C, and the humidity is kept at a reasonable level. In addition, the air stream must be adequately filtered to ensure that no airborne particulates of any kind will be carried into the transmitter. The combination of air conditioning for summer and ventilation during the cooler months is acceptable, when the proper cooling cannot be obtained through the use of ventilation alone and using air conditioning throughout the year is not feasible.

Caution: The use of air conditioning and ventilation simultaneously is not recommended. This can cause condensation in transmitters.

The following precautions should be observed regarding air conditioning systems:

1. Air conditioners have an ARI nominal cooling capacity rating. In selecting an air conditioner, do not assume that this number can be equated to the requirements of the site. Make certain that the contractor uses the actual conditions that are to be maintained at the site in determining the size of the air conditioning unit. With the desired conditioned room temperature under 80° F, the unit must be derated, possibly by a substantial amount.

2. Do not have the air conditioner blowing directly onto the transmitter. 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 flow of cooling air.

4. Interlocking the transmitter with the air conditioner is recommended to keep the transmitter from operating without the necessary cooling.

5. The periodic cleaning of all filters is a must.

When using ventilation alone, the following general statements apply:

1. The blower, with attendant filters, should be on the inlet, thereby pressurizing the room and preventing dirt from entering the transmitter.

2. The inlet and outlet vents should be on the same side of the building, preferably the leeward side. As a result, the pressure differential created by wind will be minimized. Only the outlet vent may be released through the roof.

3. The inlet and outlet vents should be screened with 1/8-inch hardware cloth (preferred) or galvanized hardware cloth (acceptable).

4. Cooling air should enter the room as low as practical but in no case higher than four feet above the floor. The inlet must be located where dirt, leaves, snow, etc., will not be carried in with the cooling air.

5. The exhaust should be located as high as possible. Some ducting is usually required to insure the complete flushing of heated air with no stagnant areas.

6. The area of the filter, located in the ducting, must be large enough 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 should be used even in the summer.

9. A controlled-air bypass system must be installed to prevent the temperature in the room from falling below 40° F during transmitter operation.

10. The blower should have two speeds, which are thermostatically controlled, and also be 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 the filters, if used, can not be overemphasized.

13. It is recommended that a site plan be submitted to Axcera for comments before installation begins.

In calculating the blower requirements, filter size, and exhaust size, if the total load is known in watts, 2000 CFM into ½ inch of water will be required for each 5000 watts. If the load is known in BTUs, 2000 CFM into ½ inch of water will be required for each 17,000 BTUs. The inlet filter must be a minimum of seven square feet, larger for dusty and remote locations, for each 5000 watts or 17,000 BTUs. The exhaust must be at least four square feet at the exhaust screen for each 5000 watts or 17,000 BTUs.

The information presented in this section is intended to serve only as a general guide and may need to be modified for unusually severe conditions. A combination of air conditioning and ventilation should not be difficult to design (see Figure 3-1). System interlocking and thermostat settings should be reviewed with Axcera.

As with any equipment installation, it is always good practice to consult the manufacturer when questions arise. The field support department at Axcera can be contacted at (724) 873-8100.

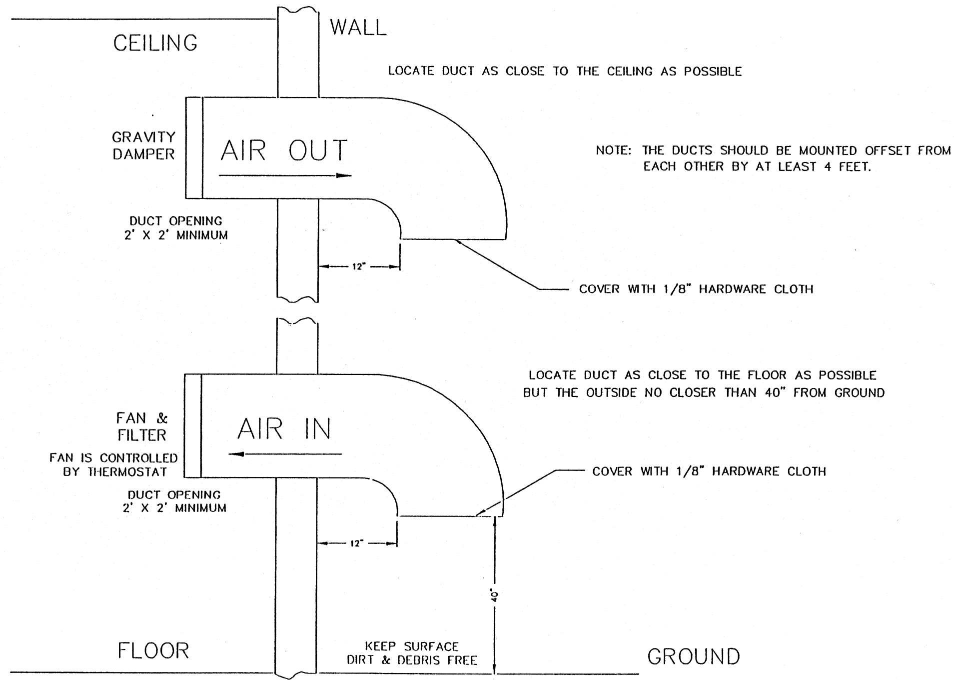

Figure 3-1. 1 kW Minimum Ventilation Configuration

3.2 Unpacking the Cabinet 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 cabinet 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 cabinet and the trays from the crates and boxes. Remove the straps that hold the cabinet to the shipping skid and slide the cabinet from the skid. Remove the plastic wrap and foam protection from around the cabinet. Do not remove any labeling or tags from any cables or connectors; these are identification markers that make assembly of the transmitter much easier.

Remove the two L-brackets, mounted on the front panel rails, which held the trays in place during shipment. The trays are mounted in the cabinet using Chassis Trak cabinet slides as shown in Figure 3-2. The tray slides are on the sides of the three VHF amplifier trays and the VHF exciter tray. Inspect the trays for any loose hardware or connectors, tightening as needed.

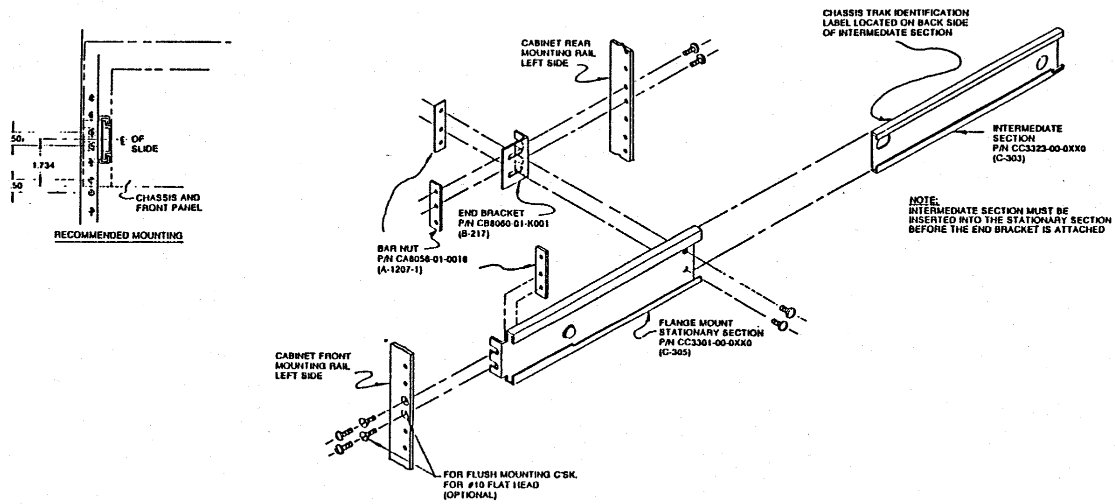

Figure 3-2. Chassis Trak Cabinet Slides

Open the rear door and inspect the interior of the cabinet for packing materials and carefully remove any that are 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. It may be necessary to adjust the position of the trays to keep them from rubbing. This is 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, as needed, to correct for the rubbing.

3.3 Installing the Cabinet and Trays

The air intake to the 3300-watt transmitter is only intended for room air. The cabinet should be positioned for adequate air intake and exhaust, the opening of the rear door, if present; access to the trays, including sliding them out for testing, the main AC hookup, and the installation of the output transmission line. The cabinet should be grounded using copper strapping material and should be permanently mounted to the floor of the site using the holes in the bottom of the cabinet.

Once the cabinet is in place, and the trays are checked for damage, the main AC hookup can be made.

Caution: Before connecting the 220 VAC, make certain that the circuit breaker associated with the transmitter has been switched off.

The main AC input circuit to the 3300-watt transmitter should be a 50-amp, 220-VAC line, inside of a 1-1/4-inch conduit. The three wire 220 VAC input is connected to the AC distribution block, white to white, black to black and green to green by stripping the ends of the wires, approximately ½", and placing them into the proper hole and tightening the retaining screws that holds them in place. **NOTE**: The 220VAC should be connected by a qualified electrician.

The AC is distributed to the trays through AC plugs that connect from the power distribution block to the rear of each tray.

The output of the (A16) coupler assembly at (A16-J2), which is a 1-5/8" connector and the RF output for the transmitter, should connect to the transmission line for the antenna system.

This completes the unpacking and installation of the 335B 3300-watt VHF television transmitter. Refer to the setup and operation procedures that follow before applying power to the transmitter.

3.4 Setup and Operation Procedures

Initially, the transmitter should be turned on with the RF output at (A16-J2) of the coupler assembly terminated into a dummy load of at least 3300 watts. If a load is not available, check that the output of the coupler assembly is connected to the antenna.

The baseband audio and video inputs and any remote control connections must be made to the (A12) A/V input and remote interface assembly. The baseband balanced audio input connects to the terminal block TB1 or the composite audio input connects to the BNC jack J6. Connect the baseband video input to the BNC jack J2.

NOTE: If your transmitter does not contain the 4.5 MHz composite input kit, the following description does not pertain to your transmitter. The baseband audio input can remain connected when the 4.5-MHz composite input is in use without affecting the operation of the tray. Connect the baseband video input to BNC jack J2 on the A/V input and the remote interface assembly. If the (optional) 4.5-MHz composite input kit is purchased, connect the 4.5-MHz composite input to the BNC jack J2. To use the 4.5-MHz composite input, the 4.5-MHz composite input must be connected to J2 and the baseband select must be removed from J7-6 and J7-7 on the rear of the VHF exciter tray. To use the baseband video and audio inputs, the baseband video input must be connected to J2, the baseband audio must be connected to the proper jack, and the baseband select must be connected from J7-6 and J7-7 on the rear of the VHF exciter tray.

If the (A12) A/V input and remote interface assembly is not present in the system, connections are made directly to the rear of the VHF exciter tray. Connect the baseband balanced audio input to the terminal block TB1 or the composite audio input to the BNC jack J3 or J13 on the rear of the VHF exciter. The baseband audio input can remain connected when using the (Optional) 4.5-MHz composite input, if present, without affecting the operation of the tray. Connect the baseband video input to the BNC jack J2 or J1 also on the rear of the VHF exciter or, if the (optional) 4.5-MHz composite input kit is purchased, connect the 4.5-MHz composite input to the BNC jack J2 or J1. To use the 4.5-MHz composite input, the 4.5-MHz composite input must be connected to J2 or J1 and the baseband select must be removed from J7-6 and J7-7 on the rear of the tray. To use the baseband video and audio inputs, the baseband video input must be connected to J2 or J1, the baseband audio must be connected to the proper jack, and a baseband select must be connected from J7-6 and J7-7.

Switch on the main AC for the transmitter and the circuit breakers located on the rear of the VHF exciter, and on the front of the three VHF amplifier trays. On the VHF exciter tray, switch the Operate/Standby switch to Standby and the Auto/Manual switch to Manual. Normal operation of the transmitter is in Automatic, which uses the video input to the VHF exciter as an Operate/Standby switch. In Auto, if the input video is lost for approximately 7 seconds, the transmitter will automatically revert to Standby and, when the video signal is restored, the transmitter will quickly return to Operate.

Move the Operate/Standby switch on the VHF exciter tray to Operate. This will apply enables to the switching power supplies in each of the VHF amplifier trays. Observe that a power supply voltage reading of +28 V is on the front panels of the VHF amplifier trays, in the power supply position.

NOTE: If the transmitter does not switch to Operate when the Operate/Standby switch is placed in Operate, check that on the (A12) A/V input and remote interface assembly an external interlock plug is connected to J9, with a jumper wired from pins 21 to 22. If the (A12) A/V input and remote interface assembly is not present in your transmitter, check that an external interlock plug is connected to J11, with a jumper wired from pins 23 to 24, on the rear of the VHF exciter.

With the transmitter in Operate, monitor the front panel meter of the VHF exciter tray. In the % Visual Power position, it should read 100%. If necessary, adjust the screwdriver adjust power pot on the front panel of the VHF exciter for 100%. Check the % Reflected Power position. If the % Reflected Power is very high, above 10%, a problem exists with the output coaxial lines and they will need to be checked. A center bullet missing from the coax lines or loose bolts on the connections can cause this problem.

The gain and phase controls on the front panels of the individual VHF amplifier trays were adjusted at the factory to obtain an output of 100% for the transmitter and should not need to be readjusted. The front panel readings on the individual VHF amplifier trays may not be the same. Refer to the Test Data Sheet for the transmitter to compare the final readings from the factory with the readings on each of the trays after the setup. If a reading is off by a significant amount, refer to the phasing and power adjustment procedures for the VHF 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 unit to Standby and switch off the main AC circuit breaker. Remove the dummy load and make all of the connections that are needed to connect the transmitter to the antenna. Switch the main AC circuit breaker on and the Operate/Standby switch to Operate. Adjust the output power screwdriver pot to achieve an output of 100%.

If the transmitter is already connected to the antenna, check that the output is 100%. If necessary, adjust the power screwdriver pot.

This completes the transmitter setup and operation procedures for the 335B VHF low band transmitter. The transmitter can now be operated normally.

If a problem occurred during the setup and operation procedures, refer to Chapter 5, Detailed Alignment Procedures, of this manual for more information.

Chapter 4
Circuit Descriptions

4.1 (A4) Low Band VHF Exciter (1070820 or 1304463 w/P.F.; Appendix C)

NOTE: The 1304463 VHF Exciter is used with the precise frequency system and will contain the VCXO Assembly (1145-1206), in place of the Channel Oscillator Assembly (1145-1202), and the IF VCXO Board (1248-1131), in place of the IF Oven Oscillator Assembly (1191-1404).

4.1.1 (A4) Aural IF Synthesizer Board, 4.5 MHz (1265-1303; Appendix D)

The aural IF synthesizer board amplifies and controls the levels of the three possible audio inputs and provides a single audio output. The balanced audio or the composite audio input is connected to the board while the subcarrier audio (SCA) input can be connected at the same time as either of the other two inputs. The board has the 4.5-MHz voltage-controlled oscillator (VCO) and the aural modulation circuitry that produces the modulated 4.5-MHz output. The board also contains a phase lock loop (PLL) circuit that maintains the precise 4.5-MHz separation between the aural (41.25 MHz) and the visual (45.75 MHz) IF frequencies.

4.1.1.1 Balanced Audio Input

The first of the three possible baseband audio inputs to the board is a 600Ω-balanced audio input (+10 dBm low gain or 0 dBm high gain) that enters through jack J2, pins 1 (+), 2 (GND), and 3 (-). The input is then buffered by U1B and U1C. The diodes CR18 and CR19 are transient voltage suppressors that protect the board from any surges or transients that may occur on the balanced audio input lines. The Diodes, CR1 to CR4, protect the input stages of U1B and U1C if an excessive signal level is applied to the board. The outputs of U1B and U1C are applied to the differential amplifier U1A that eliminates any common mode signals (hum) on its input leads. A pre-emphasis of 75 µs is provided by R11, C11, and R10 and can be eliminated, if not needed, by removing the jumper W5 on J5. The signal is then applied to the amplifier U1D whose gain is controlled by the jumper W3 on J11. The Jumper is positioned according to the input level of the audio signal (0 or +10 dBm). If the input level is approximately 0 dBm, the mini-jumper should be in the high gain position between pins 1 and 2 of J11. If the input level is approximately +10 dBm, the mini-jumper should be in low gain position which is between pins 2 and 3 of J11. The balanced audio is then connected to the buffer amplifier U2A whose input level is determined by the setting of balanced audio gain pot R13. The output of the amplifier stage is wired to the summing point at U2D pin 13.

4.1.1.2 Composite Audio Input

The second possible audio input to the board is the composite audio (stereo) input at BNC jacks J3 and J13. The two jacks are loop-through connected. Therefore, the audio can be used in another application by connecting to the unused jack and moving the jumper W4 to J12 between pins 2 & 3. The jumper W4 on jack J12 provides a 75Ω-input impedance when the jumper is on J12 pins 1 and 2 and a high impedance when it is on pins 2 and 3. The diodes CR20 and CR21 are transient voltage suppressors that protect the board from surges and transients on the composite audio input lines. Diodes CR9 to CR12 protect the input stages of U6A and U6B if an excessive signal level is applied to the board. The outputs of U6A and U6B are connected to the differential amplifier U2C, which eliminates any common mode signals (hum) that may occur on its input leads. The composite audio input signal is applied to the amplifier U2B whose gain is controlled by the composite audio gain pot R17. The composite audio signal is then connected to the summing point at U2D pin 13.

4.1.1.3 Subcarrier Audio Input

The third possible input to the board is the subcarrier audio (SCA) input at the BNC jack J4. The SCA input has an input impedance of 75Ω that can be eliminated by removing the jumper W2 from J14. The SCA input is bandpass filtered by C66, C14, R22, C15, C67, and R23 and fed to the buffer amplifier U3A pin 3. The amplified signal is then applied though the SCA gain pot R24 to the summing point at pin 13 of U2D.

4.1.1.4 Audio Modulation of the VCO

The balanced audio or the composite audio and/or the SCA audio signals, are fed to the common junction of resistors R14, R20, and R27 that connect to the summing point at pin 13 of the amplifier U2D. The output audio signal at pin 14 of U2D is typically .8 Vpk-pk at a ±25-kHz deviation with a balanced audio input or .8 Vpk-pk at ±75-kHz deviation with a composite audio input, as measured at TP1. This audio signal is applied to the VCO U10. A sample of the deviation level is amplified, detected by U7A and U7B, and connected to J10 on the board, which is cabled to the front panel meter through the transmitter control board.

The audio is applied through C64, a frequency response adjustment, to CR13 to CR16, which are varactor diodes that frequency modulate the audio signal onto the generated 4.5-MHz signal in U10. U10 is the 4.5-MHz VCO that generates the 4.5-MHz continuous wave (CW) signal. The output frequency of this signal is maintained and controlled by the correction voltage output of the PLL IC U5. The audio-modulated, 4.5-MHz signal is fed to amplifiers U11A and U11B. The output of U11B is connected to the 4.5-MHz output jacks at J7 and J8.

4.1.1.5 Phase Lock Loop (PLL) Circuit

A sample of the signal from the 4.5-MHz aural VCO at the output of U11A is applied to the PLL IC U5 pin 1, the F_{in} connection. In U5, the signal is divided down to 50 kHz and is compared to a 50-kHz reference signal. The 50-kHz reference signal is a divided-down sample of the visual IF, 45.75-MHz signal generated on the IF carrier oven oscillator board, that is applied to pin 27, the oscillator in connection, on the PLL chip through jack J6 on the board. These two 50-kHz signals are compared in the IC and the f_V output at pin 8 and the f_R output at pin 7 are applied to the differential amplifier U3B. The output of U3B is fed back through CR17 to the 4.5-MHz VCO IC U10, which sets up a PLL circuit, therefore any change in frequency will be corrected by the AFC error voltage. The 4.5-MHz VCO, using the PLL circuit, will maintain the extremely accurate 4.5-MHz separation between the visual 45.75 MHz and aural 41.25 MHz IF signals.

The PLL chip U5 also contains an internal lock detector that indicates the status of the PLL circuit. When U5 is in a "locked" state, pin 28 goes high and causes the green LED DS1 to illuminate. If the 4.5-MHz VCO and the 45.75-MHz oscillator become "unlocked," out of the capture range of the PLL circuit, pin 28 of U5 will go to a logic low and cause the red LED DS2 to light. A mute output signal from Q3 (unlock mute) will be applied to jack J9. This mute is connected to the transmitter control board.

4.1.1.6 Voltage Requirements

The ±12 VDC needed for the operation of the board enters through jack J1. The +12 VDC is connected to J1-3 and filtered by L2, C3, and C4 before it is connected to the rest of the board. The

-12 VDC is connected to J1-5 and filtered by L1, C1, and C2 before it is connected to the rest of the board. Two connections of the +12 VDC are to U8 and U9, which are 5-volt regulator ICs that provide the voltage to the U10 and U5 ICs.

4.1.2 (A5) Sync Tip Clamp/ Modulator Board (1265-1302; Appendix D)

The sync tip clamp/modulator board is divided into five circuits: the main video circuit, the sync tip clamp circuit, the visual modulator circuit, the aural IF mixer circuit, and the diplexer circuit.

The sync tip clamp/modulator board takes the baseband video or the 4.5-MHz composite input that is connected to the video input jack, either J1 or J2, which are loop-through connected, and produces a modulated visual IF + aural IF output at output jack J20 on the board. The clamp portion of the board maintains a constant peak of sync level over varying average picture levels (APL). The modulator portion of the board contains the circuitry that generates an amplitude modulated vestigial sideband visual IF signal output that is made up of the baseband video input signal (1 Vpk-pk) modulated onto an externally generated 45.75-MHz IF carrier frequency. The visual IF signal and the aural IF signal are combined in the diplexer circuit to produce the visual IF + aural IF output that is connected to J20, the IF output jack of the board.

4.1.2.1 Main Video Signal Path (Part 1 of 2)

The baseband video or the 4.5-MHz composite input connects to the board at J2. J2 is loop-through connected to J1 and terminated into 75O, if the jumper W4 is on jack J3. With jumper W4 removed, the input can be connected to another transmitter through J1.

Test point TP1 is provided to monitor the level of the input. The input is fed to the non-inverting and inverting inputs of U1A, a differential amplifier that minimizes any common-mode hum that may be present on the incoming signal. Diodes CR1 to CR4 form a voltage-limiter network in which, if the input voltages exceed the supply voltages for U1A, the diodes conduct, preventing damage to U1A. CR1 and CR3 conduct if the input voltage exceeds the negative supply and CR2 and CR4 conduct if the input voltage exceeds the positive supply voltage.

The video output of U1A is connected to J22 on the board. Normally, the video at J22 is jumpered to J27 on the board. If the optional 4.5-MHz composite input kit is purchased, the 4.5-MHz composite signal at J22 connects to the external composite 4.5-MHz filter board and the 4.5-MHz bandpass filter board. These two boards provide the video-only signal to J27 and the 4.5-MHz intercarrier signal to J28 from the 4.5-MHz composite input. The video through the video gain pot R12 is typically adjusted for 1 Vpk-pk at TP2 and connects to amplifier U1B.

The output of U1B, if the delay equalizer board is present in the tray, connects the video from J6 pin 2, to the external delay equalizer board and back to the sync tip clamp/modulator board at J6 pin 4. If the delay equalizer is not present, the video connects through jumper W1 on J5, pins 1 and 2. The delay equalizer board plugs directly into J6 on the sync tip clamp/modulator board. The video from J6 pin 4 is connected through the jumper W1 on J5 pins 2 and 3, to the amplifier Q1. The output of Q1 connects to Q2. The base voltage of Q2 is set by the DC offset voltage output of U3B, which is the sync tip clamp circuit output.

4.1.2.2 Sync Tip Clamp Circuit

The automatic sync tip clamp circuit is made up of U4A, Q7, U3B, and associated components. The circuit begins with a sample of the clamped video that is split off from the main video path at the emitter of Q3. The video sample is buffered by U3A and connected to U4A. The level at which the tip of sync is clamped, approximately -1.04 VDC, as measured at TP2, is set by the voltage-divider network connected to U4A. If the video level changes, the sample applied to U4A changes. If the jumper W7 on J4 is in the Clamp-On position, the voltage from the clamp circuit that is applied to the summing circuit at the base of Q2 will change and bring the sync tip level back to approximately -1.04 VDC. Q7 will be turned off and on by the peak of sync voltage level that is applied to U4A. The capacitors C14, C51, C77, and C41 will charge or discharge to the new voltage level, which biases U3B more or less, through the jumper W7 on J4 when in the Auto Clamp-On position. U3 will increase or decrease its output, as needed, to bring the peak of sync back to the correct level that is set by R152 and R12. This voltage level is applied through U3B to Q2. In the Manual position, jumper W7 on J4 is in the Clamp-Off position, between pins 1 and 2, and the adjustable resistor R41 provides the manual clamp bias adjustment for the video that connects to Q2.

The Jumper W6 on jack J35 must be in the Normal position, between pins 2 and 3, for the clamp circuit to operate with a normal non-scrambled signal. If a scrambled signal is used, the tray is operated with jumper W6 in the Encoded position, connected between pins 1 and 2.

The clamp circuit is set by adjusting the depth of modulation pot R152 for the correct depth of modulation as measured at TP2. Depending on the input video level, the waveform as measured at TP2 may not be 1 Vpk-pk. If W7 on J4 is moved to the Clamp-Off (Manual) position, between pins 1 and 2, the clamp level is adjusted by R41 and will not automatically be clamped to the set level.

The output of buffer amplifier U3A drives the sync tip clamp circuit consisting of the differential amplifier U4A, FET Q7, and buffer amplifier U3B. U4A is biased by R124, R125, R184, R152, and R126 so that the clamped voltage level at the peak of sync is approximately -1.04 VDC as measured at TP2.

4.1.2.3 Main Video Signal Path (Part 2 of 2)

The clamped video from Q2 is connected to the white clipper circuit Q3. Q3 is adjusted by R20 and set to prevent video transients from overmodulating the video carrier. The clamped video is connected to the sync clipper circuit Q4, which is adjusted by R24. Q4 limits the sync to -40 IRE units. The corrected video output of the emitter follower Q4 is wired to the unity gain amplifier U2A that provides a low impedance, clamped video output at pin 1, which can be measured at TP2.

4.1.2.4 Visual Modulator Circuit

The clamped video signal from U2A is split. One part connects to a metering circuit, consisting of U20 and associated components, which produces a video output sample, white level, at J8-6 that connects through the transmitter control board to the front panel meter for monitoring. The other clamped video path from U2A is through a sync stretch circuit that consists of Q5 and Q6. The sync stretch circuit contains R48 that adjusts the sync stretch magnitude (amount) and R45 that adjusts the cut-in point. This sync stretch adjustment should not be used to correct for output sync problems, but it can be used for input video sync problems. The output of the sync stretch circuit connects to pin 5, the I input of mixer Z1.

The video signal is heterodyned, in mixer Z1, with the 45.75 MHz visual IF CW signal. The visual IF CW signal enters the board at jack J15 and is connected to U9, where it is amplified and wired to pin

1, the L input of mixer Z1. The adjustable capacitor C78 and resistor R53 are set up to add a small amount of incidental carrier phase modulation (ICPM) correction to the output of the mixer stage to compensate for any non-linearities generated by the mixer.

The modulated 45.75-MHz RF output of mixer Z1, at pin 4, the R output, is amplified by U5 and is fed to J18 the double sideband visual IF output jack. The level at this output jack is adjusted by R70, typically –4 to –10 dBm. J18 is the visual IF loop-through output jack that is normally jumpered by W10 to J19 on the board. If the (Optional) visual IF loop-through kit is purchased, the visual is connected out of the board to any external IF processor trays and then back to the board.

After any external processing, the modulated visual IF, double-sideband signal re-enters the board through J19. The visual IF from J19 is amplified by U10 and U11 and routed through the vestigial sideband filter network, consisting of T1, FL1, and T2, that produces a vestigial sideband visual IF signal output. The filtered vestigial sideband visual IF is amplified by U7 and connected to a T-type attenuator. R62 is adjustable to set the visual IF gain, which is the amount of visual IF signal that is coupled to the amplifier IC U8. R63 and C30 are adjusted for the best VSBF frequency response. The amplified IF signal output of U8 is fed to the input of the diplexer circuit that consists of R76, L13, and L12. A detected voltage sample of the visual IF is available at the test point TP5.

4.1.2.5 41.25-MHz Aural IF Circuit

The modulated 41.25-MHz aural IF is created on this board by mixing the modulated 4.5-MHz aural intercarrier signal, produced by the aural IF synthesizer board or by the optional composite 4.5-MHz filter board, with the 45.75-MHz CW signal produced by the 45.75-MHz IF carrier oven oscillator board or the IF VCXO board, in a precise frequency system. The modulated baseband 4.5-MHz aural intercarrier signal enters the board at J14, baseband 4.5-MHz Input, and for normal operation connects through the jumper W8 on J32 pins 1 and 2, IF Relay Disabled, through the jumper W3 on J7 pins 2 and 3, Internal 4.5-MHz, to Z2 pin 5, the I input of the Mixer.

If both composite 4.5-MHz and baseband 4.5-MHz is to be used in your system, then the relay K1 must be enabled. This is accomplished by moving the jumper W8 on J32 to between pins 2 and 3. Both inputs, the modulated baseband 4.5-MHz aural intercarrier input from J14 and the Composite 4.5-MHz Input from J28 connect to the IF relay K1. The jumper W2 on J30 must be between pins 1 and 2, baseband select off, for external operation of the relay. Now the relay is controlled by a baseband select, Low, that connects to J31 Pin 3. With the baseband select, Low, present at J31 pin 3, the relay is energized and applies the baseband 4.5 MHz to the mixer Z2 and DS1 the baseband indicator will be lit. With the baseband select removed, not present at J31 pin 3, the relay is de-energized and applies the composite 4.5 MHz to the mixer Z2 and DS1 the baseband indicator will not be lit.

The Jumper W3 on J7 determines whether the 4.5-MHz used by the board is internally generated, either the baseband or composite inputs, or from an external source. With the jumper W3 connected between pins 2 and 3, the 4.5 MHz from the aural IF synthesizer board or from the 4.5-MHz composite input is connected to the mixer Z2. With the jumper W3 connected between pins 1 and 2, the external 4.5 MHz input is connected to the mixer Z2. The external 4.5-MHz signal enters the board at J12 and is fed through the gain pot R88 to the amplifier IC U13A. The amplified 4.5-MHz is then connected to J7 through the jumper W3 to the mixer.

The Mixer Z2 heterodynes the aural-modulated, 4.5-MHz signal with the 45.75-MHz CW signal to produce the modulated 41.25-MHz aural IF signal output.

The output of the mixer at pin 4, the R output, is fed to a bandpass filter that is tuned to pass only the modulated 41.25-MHz aural IF signal. The bandpass filtered signal is fed to jack J16, the 41.25-MHz aural IF loop-through output jack of the board. For normal operation, the 41.25-MHz signal is jumpered by a coaxial cable W11 from J16 to J17 on the board. If the (Optional) aural IF loop-through kit is purchased, the Aural IF 41.25-MHz signal is connected to the rear of the tray, to which any Aural IF processing trays can be connected, and then back to jack J17 on the board.

The modulated 41.25-MHz aural IF signal from J17 is connected through an impedance matching transformer T3, 75O to 50O, to the amplifier ICs U15 and U16. The amplified output is connected to the attenuator matching circuit that is adjusted by R85. R85 increases or decreases the level of the Aural IF 41.25 MHz that sets the A/V ratio in the diplexer circuit.

4.1.2.6 Diplexer Circuit

The diplexer circuit takes the modulated 45.75-MHz visual IF, that connects to the junction of R76 and L12, and the modulated 41.25-MHz aural IF, that connects to the junction of R76 and L13, and combines them to produce the 45.75-MHz + 41.25-MHz IF output. The combined 45.75-MHz + 41.25-MHz IF signal is amplified by U12 and connected to J20 the combined IF output jack of the board. A sample of the combined IF output is provided at J21.

If an (Optional) NICAM input is used, it connects to J36 on the board. The level of the NICAM signal is set by R109 before it is fed to the diplexer circuit consisting of L28, L29, and R115. This circuit combines the NICAM signal with the 45.75-MHz visual IF + 41.25-MHz aural IF signal.

4.1.2.7 Operational Voltages

The +12 VDC needed to operate the sync tip clamp modulator board enters the board at J23 pin 3, and is filtered by L26, L33, and C73 before it is connected to the rest of the board.

The -12 VDC needed to operate the board enters the board at J23 pin 5, and is filtered by L27 and C74 before being fed to the rest of the board.

4.1.3(Optional) (A6) Delay Equalizer Board (1227-1204; Appendix D)

The (Optional) delay equalizer board provides a delay to the video signal, correction to the frequency response, and amplification of the video signal.

The video signal enters the board at J1-2 and is connected to a pi-type, low-pass filter consisting of C16, L7, and C17. This filter eliminates any unwanted higher frequencies from entering the board. The output of the filter is connected to the amplifier stage U1, whose gain is controlled by R29. The video output of the amplifier stage is wired to the first of four delay-equalizing circuits that shape the video signal to the FCC specification for delay equalization or to the desired shape needed for the system. The board has been factory-adjusted to the FCC specification and should not be readjusted without the proper equipment.

Resistors R7, R12, R17, and R22 adjust the sharpness of the response curve, while inductors L1, L2, L3, and L4 adjust the position of the curve. With a delay equalizer test generator signal or a sine x/x video test pattern input, the resistors and inductors can be adjusted, while monitoring a Tektronix VM700 test measurement set, until the desired FCC delay equalization curve or system curve is attained. The delay-equalized video signal output of the board is at J1-4. A sample of the delayed video signal is provided at J2 on the board and can be used for testing purposes.

The ±12 VDC needed to operate the board enters the board at J1. The +12 VDC connects to J1-9, which is filtered by L5 and C11 before it is directed to the rest of the board. The -12 VDC connects to J1-6, which is filtered by L6 and C12 before it is directed to the rest of the board.

4.1.4 (A7) IF Carrier Oven Oscillator Board (1191-1404; Appendix D)

NOTE: If the precise frequency kit is present in your transmitter, the IF VCXO Board (1248-1131) will be used.

The IF carrier oven oscillator board generates the visual IF CW signal at 45.75 MHz for NTSC system "M" usage.

The 45.75 MHz crystal Y1 is the principal device that determines the operating frequency and is the most sensitive in terms of temperature stability, therefore it is enclosed in an oven. +12 VDC is applied through jack J10 to the crystal oven HR1, which is preset to operate at 60° C. The oven encloses the crystal Y1 and stabilizes the crystal temperature. The crystal operates in an oscillator circuit consisting of the transistor Q1 and its associated components. Feedback is provided through a capacitor voltage divider, consisting of C5 and C6, that operates the crystal in a common-base amplifier configuration using Q1. The operating frequency of the oscillator can be adjusted by the variable capacitor C17. The oscillator circuit around Q1 has a separate regulated voltage, 6.8 VDC, which is produced from the +12 VDC by a combination of the dropping resistor R4 and the zener diode VR1. The output of the oscillator at the collector of Q1 is capacitively coupled through C8 to the base of Q2. The small value of C8, 10 pF, prevents the oscillator from being loaded down by Q2.

Q2 is operated as a common-emitter amplifier stage whose bias is provided through R8 from the +12 VDC line. The output of Q2, at its collector, is split between two emitter-follower transistor stages, Q3 and Q4. The output of Q3 is taken from its emitter through R11, to establish an approximate 50-ohm source impedance, through C11 to J3, the main output jack of the board. This 45.75-MHz signal is approximately +5 dBm in level. The output is directed to a visual modulator circuit located on the clamp/modulator board. The second output from the collector of Q2 is fed to the base of Q4, an emitter follower transistor. Q4 drives two different output circuits. One output is directed through the voltage dividers R14 and R15 to jack J2 and is normally fed to a frequency counter. While monitoring J2 the oscillator can be set exactly on the operating frequency (45.75 MHz) by adjusting C17. The output at J2 is approximately -2 dBm in level, which is sufficient to drive most frequency counters. The other output of Q4 connects to the prescaler chip U1, which divides the signal by 15. The output of U1 is applied to U2, a programmable divider IC. U2 is programmed through pins 11 to 20 to divide by 61, which results in a 50-kHz signal at pin 9 that is available as an output at J1. This 50 kHz reference output is generally used in systems where the visual IF carrier oven oscillator is used as the reference for a PLL circuit. An example of this is when the PLL circuit locks the aural VCO on the aural IF synthesizer board. The 50-kHz CMOS output at jack J1 is not capable of achieving enough drive level for a long coaxial cable length. As a result, when a long coaxial cable is needed, the output at jack J5 is utilized. The push-pull transistor stage Q5 and Q6, along with emitter resistor R18, provide a large load output capability at J5.

The stages U1, U2, U3, Q5, and Q6 are powered by +5.1 VDC, which is obtained from the +12 VDC line voltage using the voltage-dropping resistor R16 and the zener diode VR2.

The +12 VDC input to the board is applied through the jack J4 at pin 3. The voltage is isolated from any RF, which may occur in the +12 VDC line, through the use of the RF choke L2 and the filter capacitor C10.

4.1.4.1 (Optional) (A7) IF VCXO Board (1248-1131; Appendix D)

NOTE: If a precise frequency kit is not present in your transmitter, the IF Carrier Oven Oscillator Board (1191-1404) will be used.

The IF Carrier VCXO Board generates the Visual IF CW signal at 45.75 MHz for NTSC System "M" usage.

The 45.75 MHz crystal Y1 is the principal device that determines the operating frequency and is the most sensitive in terms of temperature stability, therefore it is enclosed in an oven. +12 VDC is applied through jack J10 to the crystal oven HR1, which is preset to operate at 60° C. The oven encloses the crystal Y1 and stabilizes the crystal temperature. The crystal operates in an oscillator circuit consisting of the transistor Q1 and its associated components. Feedback is provided through a capacitor voltage divider, consisting of C5 and C6, which operates the crystal in a Common Base Amplifier configuration using Q1. The operating frequency of the Oscillator is adjustable by the variable capacitor C22 and maintained for accuracy by the AFC voltage, from the external Precise Frequency Tray, that connects to J13. The AFC voltage input connects through J13 and then the combination of the dropping resistor R23 and the Zener Diode VR1 to the oscillator circuit. The output of the oscillator at the collector of Q1 is capacitively coupled through C8 to the base of Q2. The small value of C8, 10 pF, prevents the oscillator from being loaded down by Q2.

Q2 is operated as a Common Emitter Amplifier stage whose bias is provided through R8 from the +12 VDC line. The output of Q2, at its collector, is split between two Emitter Follower Transistor Stages, Q3 and Q4. The output of Q3 is taken from its Emitter through R11 to establish an approximate 50O source impedance thru C11 to J3 the Main Output Jack of the board. The 45.75 MHz signal is approximately +5 dBm in level. A Sample of the Main O/P is provided at J11. The second output from the collector of Q2 is fed to the Base of the Emitter Follower Transistor, Q4.

Q4 drives two different output circuits. One output is directed through a voltage divider R14 and R15 to Jack J2 that is typically fed to a Frequency Counter. The output level at J2 is approximately -2 dBm, which is sufficient to drive most Frequency Counters. The other output of Q4 connects to (U1) a Prescaler Chip that divides the signal by 15. The output of U1 is applied to (U2) a Programmable Divider IC. U2 is programmed through Pins 11-20 to divide by 61, which results in a 50 kHz signal at Pin 9 that is available as an output at J1. The output of 50 kHz is generally used in systems where the Visual IF Carrier Oven Oscillator is used as the reference for a PLL Circuit. An example is the PLL Circuit using the Aural IF Synthesizer Board and the Aural VCO. The 50 kHz CMOS Output at Jack J1 is not capable of enough drive level for a long coaxial cable length, therefore, when a long coaxial cable is needed, the output at Jack J5 is utilized. The Push-Pull transistor stage Q5 and Q6, along with the Emitter resistor R18, provide a large load output capability at J5.

The stages U1, U2, U3, Q5 and Q6 are powered by +5.1 VDC, which is obtained from the +12 VDC line voltage and the voltage dropping resistor R16 and Zener Diode VR2.

The +12 VDC input to the board is applied through Jack J4 Pin 3 and is isolated from any RF, which may occur on the +12 VDC Line, through the use of the RF choke L2 and the filter capacitor C10.

4.1.5 (A8) ALC Board, NTSC (1265-1305; Appendix D)

The automatic level control (ALC) board provides the ALC and amplitude linearity correction of the IF signal. The ALC adjusts the level of the IF signal through the board to control the output power of the transmitter.

The visual + aural IF input (0 dBm) signal, from the clamp/modulator board, enters the board at the modulator IF input jack J32. If the (Optional) receiver tray is present, the visual + aural IF input (0 dBm) from the receiver tray connects to receiver IF input jack J1.

4.1.5.1 Local Modulator Select Enabled (Normal Operation with the Modulator IF as the Input)

The modulator IF input connects to the relay K3 and the receiver IF input connects to the relay K4. The two relays are controlled by the position of the local Modulator Select enable/disable jumper W11 on J29. The normal operation of the transmitter uses the Modulator IF input at J32. The jumper W11 connected between pins 2 and 3 is the normal operating position for the board. This sets the board to the local Modulator enable position, which is both relays de-energized and the Modulator IF Input connected to the rest of the board. DS5 the Modulator Enable LED will be lit.

4.1.5.2 Local Modulator Select Disabled (Operation with the ability to select either the Modulator IF or the Receiver IF as the Input)

If a receiver tray is part of your system, then the relays need to be controlled by the Modulator Select command that is connected to J30 on the board, so that either the receiver IF or the modulator IF can be used by the board. The position of the Modulator select enable/disable jumper W11 on J29 provides for the Modulator Select command at J30 to control the operation of the relays. With the jumper W11 on J29, between pins 1 and 2, the Modulator Select command at J30 controls the operation of the relays and with the jumper W11 on J29, between pins 2 and 3, the modulator is selected all of the time and DS5, the modulator enable LED, will be lit.

4.1.5.3 Modulator IF Selected (With the Local Modulator Select Disabled)

The modulator is normally selected by J11-10 and J11-28 on the rear of the VHF exciter tray, wired to J30 on the board, connected together. This makes J30 go low and causes relays K3 and K4 to de-energize. When K4 is de-energized, it connects the receiver IF input at J1 to 50O. When K3 is de-energized, it connects the modulator IF input at J32 to the rest of the board and the Modulator Enable LED DS5 will be illuminated.

4.1.5.4 Receiver IF Selected (With the Local Modulator Select Disabled)

The receiver is normally selected when J11-10 and J11-28 on the rear of the VHF exciter tray, connected to J30 on the board, are not connected together. This makes J30 high and causes the relays K3 and K4 to energize. When K4 is energized, it connects the receiver IF input at J1 to the rest of the board. When K3 is energized, it connects the modulator IF input at J32 to 50O and the Modulator Enable LED DS5 will not be illuminated.

4.1.5.5 Main IF Signal Path (Part 1 of 3)

The selected visual + aural IF input (0 dBm) signal is split at L1 and L2, with one half of the signal flowing through L1 and entering a bandpass filter that consists of L3, L4, C4, L5, and L6. This bandpass filter can be tuned with C4 and is substantially broader than the IF signal bandwidth. It is used to slightly steer the frequency response of the IF to make up for any small discrepancies in the frequency response in the stages that precede this point. The filter also serves the additional function of rejecting unwanted frequencies that may occur if the tray cover is off and the tray is in a high RF environment. If this is the case, the transmitter will have to be serviced with the tray cover off in spite of the presence of other RF signals. The filtered IF signal is fed through a pi-type matching pad consisting of R2, R3, and R4 to the pin-diode attenuator circuit consisting of CR1, CR2, and CR3.

4.1.5.6 Input Level Detector Circuit

The other part of the split IF input is connected through L2 and C44 to U7, an IC amplifier that is the first stage of the input level detector circuit. The amplified IF is fed to T4 that is a step-up transformer, which feeds a 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 the emitter follower Q1. The signal is then connected to the detector CR15 that produces a peak of sync voltage, which is applied to the 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 also serves as an input threshold detector. The input threshold detector prevents the automatic level control from reducing the attenuation of the pin-diode attenuator to minimum (the maximum signal) if the IF input to the board is removed. Without the threshold detector, and with the pin-diode attenuator at minimum, when the signal is restored it will overdrive the stages following this board. 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.

As part of the threshold detector operation, the minimum IF input level, as measured at TP3, is fed through the detector diode CR15 to the op-amp IC U9A pin 2. The reference voltage for the op-amp is determined by the voltage divider that consists of R50 and R51, off the +12 VDC line. When the detected input signal level at U9A pin 2, falls below this reference threshold, approximately 10 dB below the normal input level, the output of U9A at pin 1 goes to the +12 VDC rail. This high is connected to the base of Q2. At this point, Q2 is forward biased and creates a current path from the -12 VDC line through the red LED DS1, the input level fault indicator, which lights, the resistor R54, and the transistor Q2 to the +12 VDC line.

The high from U9A also connects through the diode CR16 to U9B pin 5, whose output at pin 7 goes high. The high connects through the range adjust pot R74 to J20, which connects to the front panel mounted power adjust pot. This high also connects to U10A pin 2, and causes it to go low at U10A pin 1. The low is applied through the jumper W3 on J6, when in auto, to the pin-diode attenuator circuit, CR1 – CR3, that cuts back the IF level and, therefore also the output power level, to 0. When the input signal level increases above the threshold level, the output power will increase, as the input level increases, until normal output power is reached.

The video input level as measured at TP3 is also fed to a sync-separator circuit, consisting of U8, CR17, Q3, and associated components, and then to a comparator circuit made up of U9C and U9D. The reference voltage for the comparators is determined by a voltage divider network consisting of R129, R64, R65, R66, and R130, off the -12 VDC line. When the input signal level falls below this reference threshold, which acts as a loss of sync detector circuit, the outputs of U9C and U9D move towards the -12 VDC rail. The low output is split with one part connecting to and biasing on the transistor Q5. A current path is then established from the +12 VDC line through Q5, the resistors R69, R137, and the red LED DS3, the video loss indicator, which lights. When Q5 is biased on, it applies a high to the gates of Q6 and Q7. This causes them to conduct and apply 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, which controls the cutback enable/disable operation. The jumper W2 on J5, in the Cutback Enable position, which is between pins 2 and 3, connects the low to the base of Q4 that is forward-biased. If the jumper W2 is in the Disable position, between pins 1 and 2, the auto cutback will not operate. With Q4 biased on, a level determined by the setting of the 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 at 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, CR1-CR3, to cut back the level of the output to the cut back value of approximately 25%.

4.1.5.7 Pin-Diode Attenuator Circuit

The input IF signal to the board is fed to a pin-diode attenuator circuit that consists of CR1, CR2 & CR3. Each of the pin diodes contains 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 applied to the diodes. 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 the variable resistor R87 when the jumper is in the Manual Gain position, between pins 2 and 3. 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, decreases their resistances which increases 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, as measured at TP1, approaches the +12 VDC line. There is a current path created through R6, through series diode CR3, and finally through R9 to ground. This path forward biases CR3 and causes it to act as a relatively low-value resistor. In addition, the larger current flow increases the voltage drop across R9 that tends to turn off the diodes CR1 and CR2 and causes them to act as high-value resistors. In this case, the shunt elements act as a high resistance and the series element acts as a low resistance to represent the minimum loss condition of the attenuator (maximum signal output). The other extreme case occurs as the voltage at TP1 is reduced and goes towards ground or even slightly negative. This tends to turn off (reverse bias) diode CR3, the series element, causing it to act as a high-value resistor. An existing fixed current path from the +12 VDC line 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.

4.1.5.8 Main IF Signal Path (Part 2 of 3)

When the IF signal passes out of the pin-diode attenuator through C11, it is applied to the modular amplifier U1. This device includes within it the biasing and impedance matching circuits that makes it operate as a wide-band IF amplifier. The output of U1, at jack J2, is available, as a sample of the pre-correction IF for troubleshooting purposes and system setup. The IF signal is then connected to the linearity corrector portion of the board.

4.1.5.9 Linearity Corrector Circuits

The linearity corrector circuits use three stages of correction to correct for any amplitude non-linearities in the IF signal. 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 stages. The Zener diode VR1 using R33 and R135 provides a +6.8 VDC reference from +12 VDC. The diodes CR11 and CR12 provide a .9 VDC reference that temperature compensates for the two diodes in each corrector stage.

The linearity corrector stages begin operation when an 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 that the level is lowered is adjusted by adding more or less resistance, using R13, in parallel with the L-pad resistors. R13 is only in parallel when the signal reaches a level large enough to turn on the 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 stretch is determined by the adjustment of R13. The signal is next applied to the amplifier U2 that compensates for any loss through the L-pad. The breakpoint, or cut-in point, for the first corrector stage is set by controlling where CR4 and CR5 turn on. This is accomplished by adjusting the 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 the unity-gain amplifier U5D. This reference voltage output of U5D 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 the unity-gain amplifier U5B. The reference voltage is then connected to the diode CR5 through the choke L11. The two chokes L11 and L12 form a high impedance for IF 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. The second and the third corrector stages operate in the same fashion as the first. All three corrector stages are independent and do not interact with each other.

The corrector stages are disabled by moving the jumper W1 on J4 to the Disable position, which is between pins 2 and 3. This moves all of the breakpoints of the stages past the tip of sync so that if adjusted they will have no affect on the IF signal.

The IF signal exits the board at the IF output jack J3 (0 dBm) after passing through the three corrector stages. A sample of the corrected IF is provided at TP2. The IF output is normally connected to an external IF phase corrector board.

4.1.5.10 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 (0 dBm). The IF then passes through a bandpass filter consisting of L20, C97, C62, L21, L22, L23, C64, C99, and C63, which is adjustable for best response. This bandpass filter is intended to make up for small errors in frequency response that are incurred by the signal while 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 main IF signal is split off and connected to J10, the IF sample jack. The main IF, whose level is controlled by R99, connects to jacks J27 and J28. These jacks control if a 6-dB pad is included in the circuit by the positioning of the jumpers W9 and W10. The 6-dB pad is in when the 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 jumpered out. The IF signal is then applied to a two-stage, frequency-response corrector circuit that is adjusted as needed. The variable resistors R103 and R106 adjust the depth and gain of the notches and the variable capacitors C71 and C72 adjust the frequency position of the notches. The corrected IF signal is amplified by U13 and U14 before it is connected to J12, the IF output jack of the board. The output level is set for 0 dBm by R99. The combined IF output of the ALC board connects to (A11-A2) the filter/mixer board. A sample of the IF is fed to J11 to provide 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 the frequency-response correction takes place.

4.1.5.11 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 and connects to op-amp U12. The output of U12 is wired to jacks J8 and J9 on which jumpers W4 and W8 control the normal or encoded operation of the ALC circuitry. For normal operation, jumper W4 on J8 and jumper W8 on J9 are between pins 1 and 2. The IF signal is applied to the transformer T5 that doubles the voltage swing by means of a 1:4 impedance transformation. The IF is then connected to the ALC detector circuit on the board, amplified by U10B and applied to jacks J26 and J21.
For normal operation, jumper W7 on J26 and jumper W5 on J21 are 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 controlled by the screwdriver adjust pot R1, located on the front panel of the VHF exciter tray. If the (Optional) remote power raise/lower kit is purchased, the power is set by adjusting R75, a motor-driven pot controlled by the switch S1 on the board. 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 VHF exciter tray. S1, or the remote switch, controls relays K1 and K2, which control the 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 VHF exciter tray. The ALC voltage is set for .8 VDC at TP4 with a 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 used on the front panel meter and in the AGC circuits.

This 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, CR1-CR3. If there is a loss of gain somewhere in an IF circuit, the output power of the transmitter will drop and the ALC circuit will sense this drop at U10A that will automatically lower the loss of the pin-diode attenuator circuit that increases the IF level through the attenuator circuit.

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 the resistor R77 to a summing point at the op-amp U10A pin 2. The current available from the ALC detector is offset, or complemented, by the current taken away from the summing junction. In normal operation, U10A pin 2, is at 0 VDC when the loop is satisfied. If the recovered or peak-detected IF signal at the IF input jack J7 of this board should drop in level, which normally means that the output power is decreasing, the null condition, 0 VDC, would no longer occur at U10A pin 2. When the level drops, the output of U10A at pin 1, will go more positive. If jumper W3 on J6 is in the Automatic position, it will cause the ALC pin-diode attenuators CR1, CR2, and CR3 to have less attenuation therefore increasing the IF level through them that will act to compensate for the original decrease in level. If the ALC cannot increase the input level enough to satisfy the ALC loop, due to 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 causes the red ALC Fault LED DS2 to light.

4.1.5.12 (Optional) Scrambled Operation with Encoding

For optional encoded, scrambled operation, the jumper W4 on J8, the jumper W8 on J9, the jumper W7 on J26 and the jumper W5 on J21 must all be between pins 2 and 3. The IF is connected through W4 on J8 to the sync regeneration circuits beginning with L37.

If this board is operated with scrambling, using suppressed sync, the ALC circuit operates differently than described above because there is no peak of sync present on the IF input. A timing pulse from the scrambling encoder must connect to the board at J24. This timing pulse is converted to sync pulses by U17A and U17B, which control the operation of Q8. The sync amplitude is controlled by R149 and is then applied to U15A, where it is added to the detected IF signal to produce a peak of sync level. The output of U15A is peak detected by CR26 and fed to U15B. If necessary, the intercarrier notch L39 can be placed in the circuit by placing the jumper W6 on J22. The intercarrier notch is adjusted to filter any aural and 4.5-MHz intercarrier frequencies. The peak of sync signal is fed through R162, the ALC calibration control, to amplifier U15C. The amplified peak of sync output is connected through J21 pins 2 and 3, to U10A, where it is used as the reference for the ALC circuit and the AGC reference to the transmitter control board. Voltage TP4 should be the same in either the normal or the encoded video mode. Monitor J9 pins 3 and 4, with a spectrum analyzer, check that the board is in the AGC mode, and tune C103 to notch-out the aural IF carrier.

4.1.5.13 Mute Fault Command

NOTE: This fault command circuit is not used in the 335B VHF transmitter.

The ALC board has circuitry for an external mute fault input that can connect to J19 pin 6. This is a Mute command, in most systems, it is involved in the protection of the circuits of high gain output amplifier devices. The Mute command is intended to protect the amplifier devices against VSWR faults. In this case, the action should occur faster than just pulling the ALC reference down. Two different mechanisms are employed. One is a very fast-acting circuit to increase the attenuation of the pin-diode attenuator, CR3, CR1, and CR2, and the second is the reference voltage being pulled away from the ALC amplifier device. An external Mute is a pull-down applied to J19 pin 6, to provide a current path from the +12 VDC line through R78 and R139, the LED DS4 (Mute indicator), and the LED section of opto-isolator U11. These actions turn on the transistor section of U11 that applies -12 VDC through CR21 to U10A, pin 3, and pulls down the reference voltage. This is a fairly slow action that is kept at this pace 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.

4.1.5.14 ±12 VDC Needed to Operate the ALC Board

The ±12 VDC connects to the board at J14. The +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.

One of the boards +12 VDC connects to U16, a 5-VDC regulator IC that produces the +5 VDC needed to operate the timing IC U17.

4.1.6 (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 may occur in the solid state amplifier devices located in the external VHF amplifier trays. Two separate, adjustable IF paths are found 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 they are combined in Z2, it provides the required adjustable phase correction to the IF signal.

The IF input signal (0 dBm) enters at J1 and is AC coupled to U1. U1 amplifies the IF before it is connected to Z1, a splitter that creates two equal IF outputs. IF output 1 is connected to J2 and IF output 2 is connected to J3. The IF output 1, at J2, is jumpered through the coaxial cable W4 to jack J6, the quadrature input. The IF output 2, at J3, is jumpered through the coaxial cable W5 to jack J7, the in-phase input.

4.1.6.1 Phase Corrector Circuit, Quadrature Correction

The phase corrector circuit corrects 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 at which 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 correction, so that the gain can increased either above or below the threshold, therefore either black or white stretch can be achieved.

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. Diodes CR11 and CR12 provide a .9 VDC reference, V_{ref}, to temperature compensate the corrector circuits from the effects of the two diodes in each corrector stage.

In the phase corrector circuit, the Quadrature IF signal from J6 is applied to the 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 that allows 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.

The threshold for the first corrector stage is set by controlling where CR1 and CR2 turn on. This is accomplished by adjusting R3 that forms 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 through the choke L2. The .9 VDC reference is connected to U9D, a unity-gain amplifier, whose output is wired to CR2 through the choke L3. The L2 and L3 chokes form a high impedance for RF to isolate the op-amps from any RF. The adjusted signal is next applied to the amplifier U2 that 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 a matching, isolation transformer T2 and then to a third corrector stage through the matching, isolation transformer T3. The other two corrector stages operate in the same manner as the first. Each stage is independent and do not interact with each other. The Quadrature corrected IF output of the third corrector stage, at unity gain through the three corrector stages, is applied to pin 6 of the combiner Z2.

When jumper W1 on J8 is connected from pin 2 to pin 1, 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 pin 2 to pin 3, center 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.

The phase correctors can be bypassed by moving the jumper W2 on J9 to the Disable position, between pins 2 and 3. This action will move all of the threshold points past sync tip so that they will have no effect. R68 is adjusted and set for the correction range that is needed. 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.

4.1.6.2 Amplitude Corrector Circuit, In Phase Correction

The amplitude corrector circuit, in phase, uses one stage of correction to correct for any amplitude nonlinearities of the IF signal. The stage has a variable threshold control, R31, and a variable magnitude control, R35. The threshold control determines the point at which 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 the +6.8 VDC reference. The diodes CR11 and CR12 provide the other reference of .9 VDC, $V_{ref,}$ which temperature compensates for the two diodes, CR8 and CR9, in the corrector stage. In the amplitude corrector circuit, the IF signal from J7 is applied to transformer T4 to double 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 is 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 and puts 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.

The amount of stretch is determined by the adjustment of R35.

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

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 delays the signal to match the Quadrature input path. The signal is then applied to amplifier U6 that compensates for the loss in level through the L-pad and provides unity gain. 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 delays the signal to match the Quadrature input path. The signal is then applied to amplifier U7 to compensate for the loss in level through the L-pad. The in-phase corrected IF signal is connected to pin 5 on the combiner stage Z2. TP1 is a test point that gives the operator a place to measure the level of the in-phase IF signal. The amplitude corrector can be disabled by moving the jumper W3 on J10 to the Disable position, between pins 2 and 3, which will move the breakpoint past sync tip and the circuit will then have no effect on the signal.

4.1.6.3 Output Combiner Circuit, Z2

The Quadrature, phase, corrected input on pin 6 and the In phase, amplitude, corrected input on pin 5 are combined in Z2. The phase-corrected signal from pin 1 on combiner Z2 exits the board at the IF output jack J4 after passing through a pad network consisting of six resistors, R62-R67, that provides a unity gain, through the board, output level.

4.1.7 (A11) VHF Mixer/Amplifier Enclosure Assembly, Low Band (1070902; Appendix C)

The VHF mixer/amplifier enclosure assembly is an aluminum enclosure that provides RFI protection for the x2 multiplier board, the VHF filter/mixer board, and the low-band VHF filter/amplifier board, which are mounted inside the enclosure.

4.1.7.1 (A1) x2 Multiplier Board (1172-1111; Appendix D)

The x2 multiplier board multiplies the frequency of the RF from the channel oscillator by a factor of two. The board is made up of a x2 broadband frequency doubler.

The input signal, typically +5 dBm, at the fundamental frequency enters through the SMA jack J1 and is fed through a 3-dB matching pad, consisting of R1, R2, and R3, to the amplifier IC U1. The output of the amplifier stage is directed through a bandpass filter, consisting of L1 and C4, that is tuned to the fundamental frequency. The voltage measured at TP1 is typically +0.6 VDC. The RF is next connected to the doubler stage that consists of Z1 and the bandpass filter, L2 and C6, which is tuned to the second harmonic. The second harmonic is amplified by U2 and fed to the SMA output jack of the board at J2. The typical LO signal output level is +5 dBm. The voltage measured at TP2 is typically +0.6 VDC.

The +12 VDC for the board enters through jack J3-3 and is filtered by L3, C2 and C7 before being distributed to the rest of the board.

4.1.7.2 (A2) VHF Filter/Mixer Board (1153-1101; Appendix D)

The VHF filter/mixer board is made up of three separate circuits: a filter and amplifier circuit for the LO input, a mixer stage, and a filter and amplifier for the RF output of the mixer.

The LO input, +5 dBm, from the x2 multiplier connects to the board at J3 and is fed to a filter circuit. The input to the filter consists of C11, C12, L5, and C12 that is adjusted for the best input loading. C13 and C17 are adjusted for the best frequency response and C18 is adjusted for the best output loading of the LO signal. The filtered LO is amplified by U2 and connected to the LO output jack J4, typically+14 dBm. Normally, the output at jack J4 is jumpered by a coaxial cable to jack J5 on the board. The LO Input, +14 dBm, at J5 connects to the mixer Z1 at pin 1.

The combined IF input, typically, -3 to 0 dBm, from the ALC board, connects to the board at J7 and is fed to mixer Z1 at pin 3.

Mixer Z1 takes the LO input at pin 1 and the IF input at pin 3 and produces an RF output at pin 8. The RF output at pin 8 connects through a pi-type attenuator, made up of R3, R4, and R5, before it is connected to RF output jack J6, typically -14 dBm in level. Normally, jack J6 is connected by a coaxial cable to J1 on the board. The RF from J1 is wired to the input of a filter circuit, consisting of C25, C1, C23, C2, and L1, with C2 adjusted for the best input loading. C3 and C6 are adjusted for the best frequency response, C4 is adjusted for the best coupling, and C7 is adjusted for the best output loading of the RF signal. The filtered RF is amplified by U1 and connected to the RF output jack for the board at J2 (-2 dBm to 0 dBm).

The +12 VDC needed for the operation of the board is supplied by an external power supply in the tray. The +12 VDC enters the board at J8 pin 3, and is filtered and isolated from the rest of the tray by L7 and C22 before being applied to the board.

4.1.7.3 (A3) Low Band VHF Filter/ Amplifier Board (1064251; Appendix D)

The VHF low band filter/amplifier board is made up of two separate circuits: a filter circuit and an amplifier with a gain control circuit.

The RF input connects to the board at J7, typically 0 dBm, and is fed through a channel filter circuit. The input filter consists of C31, C27, C28, and C29, with C29 adjusted for the best input loading. C23 and C26 are adjusted for center frequency, with C24 adjusted for the best coupling, and C20 is adjusted for the best output loading of the RF signal. The filtered RF is connected to RF output jack J6, which is usually jumpered to jack J1 on the board.

The filtered RF at J1 connects through a 7-dB pi-type attenuator, consisting of R1, R2, and R3, before it is wired to a pin-diode attenuator circuit. The pin-diode attenuator circuit is made up of CR1, CR2, and CR3 and is controlled by the bias current applied to them through R5. The diodes CR1, CR2, and CR3 are pin-type diodes with a broad intrinsic region sandwiched inside the diode. This broad intrinsic region causes the pin diodes to act as variable resistors instead of as detecting devices at RF frequencies. The resistance values of the pin diodes are determined by the relative amount of forward bias that is applied to the diodes. Jumper W1 on J5 is set for manual gain or auto gain by its position on the jack. Between 1 and 2 is manual gain, which uses pot R9 to set the output level. Between pins 2 and 3 is auto gain, which uses an external control voltage input at jack J4 as the level control. **NOTE:** The 335B transmitter operates in Manual only.

The level set RF is pre-amplified by U1 and connected to Q1, the output amplifier for the board. The RF output is amplified by Q1 and connected to a matching network with C17 adjusted to maximize the RF signal level that is fed to the direction coupler Z1. The RF exits pin 4 of Z1 and connects to J2, the RF output jack of the board (+10 dBm to +20 dBm). Z1 provides a RF sample at pin 3 that is split. The first split sample connects to J8 through a voltage divider consisting of R19 and R18 that is fed to the front panel of the VHF exciter tray for monitoring purposes. The second split sample provided by Z1, pin 3, is fed through a pad consisting of R20, R21, and R22. The voltage is stepped up by a 1 to 4 transformer T1. The signal is then peak detected by C32 and CR4 before being buffered and amplified by U2A and U2B. The peak-detected voltage at J9-1 and J9-2, which is used for metering purposes, through the transmitter control board, is level controlled by the pot R29 on the board.

The ±12 VDC needed for the operation of the board is supplied by an external power supply in the tray. The +12 VDC enters the board at J3 pin 3, and is filtered and isolated by L5 and C19 before being applied to the rest of the board. The –12 VDC enters the board at J3 pin 5, and is filtered and isolated by L6 and C35 before being applied to the rest of the board.

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

The transmitter control board provides system control functions and the operational LED indications, which can be viewed on the front panel of the transmitter. The main control functions are the Operate/Standby and Auto/Manual selections. When the transmitter is switched to Operate, the board supplies the enables to the three external VHF amplifier trays. The board also performs the automatic switching of the transmitter to Standby upon the loss of the video input when the transmitter is in Automatic.

The transmitter control board contains a VSWR cutback circuit. If the VSWR of the transmitter increases above 20%, the VSWR cutback circuit will become active 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. When the interlock is present, the green Interlock LED DS5 will be lit.

4.1.8.1 Operate/Standby Switch S1

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 moved to Operate, the coil connected to pins 3 & 4 of relay K1 energizes and causes the contacts to close and apply a low to U4B-9. If the transmitter interlock is present, and there is no overtemperature fault, lows will also be applied to U4B-10, 11, and 12. With all the inputs low to U4B, the output at U4B-13 will also be low. This low biases off Q1 that turns off the amber Standby LED DS1 on the front panel. Q1 off applies a high to Q2 that 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 that biases it off; which allows the ALC, from J6 through U2C, to be applied to J1 and connect to the three external VHF amplifier trays. The low from U4B-13 is also applied to Q4 and Q24, which are biased off that removes the disables from J1-4, which connects to the remote standby indicator, if present, and J18-1. The low from U4B-13 also connects to Q10, which is biased on, and connects a high to Q6, Q7, Q8, and Q9, which are biased on and apply -12 VDC enables to J8-2, J8-3, J8-4, and J8-5 that connect to the VHF amplifier trays. The high applied to Q2 is also connected to Q5, which is biased on, and applies a low enable to J1-3, which connects to the remote operate indicator, if present, turning it on. The transmitter is now in the Operate mode.

When the Operate/Standby switch S1 is moved to Standby, the coil connected to pins 1 and 6, of relay K1 energizes, causing the contacts to open and a high, +12 VDC, to be 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, that turns on. The low is also applied to Q2, which causes Q2 to turn off and extinguishes the green Operate LED DS2. The low from Q2 connects to Q12 that is biased on, which causes the output from U2C to go low that pulls the ALC voltages at J1 low. This lowers the gain of the external VHF amplifier trays. The high from U4B-13 is applied to Q4 and Q24, which are biased on, and applies a disable at J1-4, which connects to the remote standby indicator, if present, and to J18-1, power supply disable, which is not used in the 335B. The high from U4B-13 connects to the base of Q10, which is biased off. Q10 biased off removes the high from Q6, Q7, Q8, and Q9, which are biased off, and removes the -12 VDC enables at J8-2, J8-3, J8-4, and J8-5, which connect to the external VHF amplifier trays, turning off the power supplies in the trays. The low applied to Q2 is also connected to Q5, which is biased off, and removes the remote enable at J1-3, which connects to the remote operate indicator, if present, turning it off. The transmitter is now in the Standby mode.

4.1.8.2 Automatic/Manual Switch S2

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

When S2 is set to the Auto position, the operation of the transmitter is controlled by the fault circuits and will stay in Operate even if the Operate/Standby switch S1 is moved to Standby, as long as no fault occurs. With S2 in Auto, a low is applied to the coil connected to pins 3 and 4, in the relay and this energizes and closes the contacts. The closed contacts apply a low to the green Automatic LED DS3, which will light. The low from the relay connects to U5A pin 2, U5D pin 13, Q21, and Q23. The low to Q21 and Q23 causes them to be 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 also to Q22, biasing it on. The drain of Q22 goes low and is applied to J8-7 that enables any remote auto indicator. The low to Q23 biases it off and removes the enable to J8-6 and any remote manual indicator.

When 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 S2 in Manual, a low is applied to the coil connected to pins 1 and 6 in the relay that energizes and opens the contacts. The open contacts remove the low from the green Automatic LED DS3 on the front panel that causes it to not light. The high connects to U5A pin 2, U5D pin 13, Q21, and Q23. Q21 and 23 are biased on that causes 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 and is applied to J8-7, which will disable any remote auto indicators. Q23 is biased on and applies a low to J8-6, which will enable any remote manual indicators.

4.1.8.3 The Automatic Turning On and Off of the Transmitter Using the Presence of Video.

The transmitter control board also allows the transmitter to be turned on and off by the presence of video at the transmitter when the transmitter is in Auto. When a video fault occurs due to the loss of video, J7-5 goes low. The low is applied through the jumper W1, on J10, to Q16, which is biased off, and to the red Video Loss Fault LED DS9, on the front panel, which will 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, and causes 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, causing its output at pin 10 to go low. The high also connects 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 is low and U5D pin 13 is low, it causes its 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 that places the transmitter in the Standby mode.

When the video signal is returned, J7-5 goes high. The high is applied to Q16, which is biased on, and to the red Video Fault LED DS9, which is extinguished. 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, this causes the output at pin 4 to go high. The 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 its output at pin 10 to go high. The low also connects to U5A pin 1. With the Auto/Manual switch S2 in Auto, a low is applied to U5A pin 2, and to U5D pin 13. When U5A pins 1 and 2, are low, its output at pin 3 goes high. When pin 12 of U5D is high, the output of U5D at pin 11 goes low. When U5A pin 3, is high, it biases on Q20 and applies a pull-down enable to the Operate switch. A low at U5D pin 11, biases off Q19 and removes any pull down to the Standby switch. As a result of these actions, the transmitter is switched to Operate.

4.1.8.4 Faults

There are four possible faults that may occur in the transmitter and are applied to the transmitter control board. They are video loss fault, VSWR cutback fault, overtemperature fault, and ALC fault. During normal operation, no faults are sent 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 heatsink of the system 3 way combiner assembly.

4.1.8.5 Video Loss Fault

If a video loss occurs while the transmitter is in Auto, the system will switch to the Standby mode until the video is returned. When this happens the transmitter will immediately revert to Operate. A video loss fault applies a low from the ALC board to the video fault input at J7-5 on the transmitter control board. With jumper W1 in place on J10, the video fault is connected to the LED DS9 and to Q16. The red Video Loss Fault LED DS9 on the front panel will light. Q16 is biased off and causes 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 its output at U3D pin 14 to go high. The high connects to U5A pin 1. If the transmitter is in Auto, pin 2 of U5A is low. When pin 1 is high and pin 2 is 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. If the transmitter is in Auto, pin 13 of U5D is also low. The lows on pins 12 and 13 cause the output of U5D to go high and forward bias Q19. The drain of Q19 goes low and energizes the coil connected to pins 1 and 6 in relay K1, causing it to switch to Standby.

When the video returns, the video 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 Video Loss Fault LED DS9 on the front panel will be extinguished. Q16 is biased on, which causes its drain to go low. The low is wired to U5B pin 5. 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, causing 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 and causes its drain to go low. The low energizes to the operate coil connected to pins 3 and 4 on relay K1 that switches the transmitter to Operate. The low at U5C pins 8 and 9, causes its 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 this removes the low from the standby coil in relay K1. Transmitter is in Operate

4.1.8.6 Overtemperature Fault

In the 2-kW transmitter, the thermal switch on (A8) the 3 way combiner assembly connects to J8-1 on the board. If the temperature of the heatsink on which the thermal switch is mounted rises above 175° F, the switch closes and applies a low to J8-1. The low from J8-1 connects to the Overtemperature LED DS6, which is biased on. The low also connects to Q3, which is biased off, causing the drain of Q3 to go high that 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, which removes the Operate Enable commands to the three external VHF amplifier trays. After the thermal switch cools below 175° F, the transmitter will switch back to operate.

4.1.8.7 VSWR Cutback Fault

The reflected power sample of the RF output of the transmitter, through the visual/aural metering board, is connected to J2 pin 9 of the transmitter control board. The sample connects to op-amp U1B pin 5, which buffers the signal before it is split. One of the split reflected samples connects to J1-5 on the board that is wired to J10-5 on the rear of the tray for remote monitoring. Another split reflected sample connects to position 3 on the front panel meter for the tray. The final split remote reflected sample connects to U2B pin 5. If this 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 AGC outputs to the VHF 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 power adjust, bias-adjust, pot that sets the level of the pin attenuator bias available as an output at J16. **NOTE:** This bias output is not used in the 335B. The high at U2B pin 7, is also fed to the base of Q14 and Q13, which are forward biased. This produces a low at the drains that connect to the front panel amber VSWR Cutback LED DS7, causing it to light and indicate that the tray is in cutback, and to output jack

J8-37 for the connection to a remote VSWR cutback indicator.

4.1.8.8 Receiver ALC Fault

If a receiver tray is part of the system, a sample of the ALC voltage from this tray is connected to J8-11 on the transmitter control board. If the receiver is operating normally, the ALC level that is applied to U3C pin 9, remains below the trip level set by R35; as a result, 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. In addition, U5B normally has a low that is connected to U5B, pin 5, and produces a high at 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, the output at U3D pin 14 goes low. A low at this point indicates a no-fault condition. The high that is connected to U3A pin 2, causes 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 malfunctions, the ALC level applied to U3C pin 9 goes high. This is above the level set by R35 and causes the output at pin 13 to 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 that produces a low at output pin 4. The low is wired to Q18, which is biased off and makes its drain go high. The high connects to U3D pin 12 and, 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 and causes the drain to go low. The low is connected to J8-12, which can light any remote receiver fault indicator that is connected to it.

4.1.8.9 Metering

The front panel meter connects to J3-1 (-) and J3-2 (+), the output of switch S3, on the transmitter control board. The front panel meter has seven metering positions, which are controlled by S3. They are the Audio level, Video level, % Aural Power, % Visual Power, % Reflected Power, % Exciter Power, and ALC level. A sample of the video connects to the board at J5-4 and is connected through the video calibration pot R20 to position 6 on front panel meter switch S3. An audio sample enters the board at J5-6 and is connected through audio calibration pot R19 to position 7 on front panel meter switch S3. A reflected sample connects to the board at J2-9 and is connected through buffer amplifier U1B and 100Ω resistor R84 to position 3 on front panel meter switch. A visual sample connects to the board at J2-5 and is connected through buffer amplifier U1D and 100Ω resistor R86 to position 4 on the meter switch. The aural sample connects to the board at J2-7 and is connected through buffer amplifier U1C and 100-watt resistor R85 to position 5 on the front panel meter switch. An exciter sample connects to the board at J2-3 and is connected through the buffer amplifier U1A and the 100Ω resistor R87 to position 2 on the front panel meter switch. An ALC sample connects to the board at J6-1 and is connected through the buffer amplifier U2C and the ALC calibration pot R15, which adjusts the output of U2A pin 1, and through the 100Ω resistor R18 to position 1 on front panel meter switch.

Typical readings on the meter are:

- Video = 1 Vpk-pk at white
- % Reflected = < 5%
- % Visual power = 100%

- % Aural power = 100%
- % Exciter = The level on the meter needed to attain 100% output power from the transmitter
- ALC = .8 VDC
- Audio = ±25 kHz with a balanced audio input or ±75 kHz with a composite audio input

Refer to the test data sheet for the transmitter for the actual reading:

Remote metering samples are provided at J1-10 for the exciter, J8-26 for the visual, J8-27 for the aural, and J1-5 for the reflected. 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).

4.1.8.10 Operational Voltages

The +12 VDC needed for the operation of the transmitter control 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 the board 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.

Four +12 VDC outputs are fed out of the board at J8-16, J8-17, J8-18, and J8-19 through diodes CR7, CR8, CR9, or CR10 and resistors R50, R51, R52, or R53 to the three VHF amplifier trays for use in their logic circuits. The resistors are for current limiting and the diodes are to prevent voltage feedback from the VHF amplifier trays.

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

The visual/aural metering board provides detected outputs of the visual, aural, and reflected output samples that are used for monitoring on the front panel meter. These readings are attained from samples of the forward power and reflected power outputs from (A16) the output coupler assembly for the transmitter. The board also provides adjustments for the calibration of the readings on the meter.

A forward power sample, visual + aural, is applied to the SMA jack J1 on the board. The input signal is split, with one path connected to the front panel 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 visual + aural signal is amplified by U6B and its output is split. One amplified output of U6B connects to the aural level circuit and the other output connects to the visual level circuit.

4.1.9.1 Aural Level Circuit

One of the detected visual + aural level outputs of U6B connects through C6 to the intercarrier filter circuit that consists of R13, R14, L1, C7, and C8. C8 and L1 are typically adjusted for a maximum aural reading. The filter notches out the video + aural and only leaves the 4.5-MHz difference frequency between the visual and aural, which is a good representation of the aural level. The 4.5-MHz signal is fed to the buffer amplifier U6A. The output of U6A is detected by the diode detector CR3 and U1A and then fed through the aural calibration control R20 to amplifier U2D. The amplified output of U2D is split, with the main output connected through R21 to J6 pin 1, which supplies the aural level output to the front panel meter for monitoring. The other output of U2D is connected to the aural null adjust R51 and offset null adjust R48, which are adjusted to set up the visual power calibration output.

4.1.9.2 Visual Level Circuit

The other detected visual + aural level output from U6B is connected to U1C and, if there is no scrambling, connects directly to intercarrier notch L3, which is adjusted to filter out the aural and the 4.5-MHz intercarrier frequencies, leaving only a visual + sync output. The visual + sync output is fed to a peak detector circuit consisting of CR5 and U2A. The signal is then fed through the visual calibration control R28, which is adjusted for a 100% visual reading with no aural, to amplifier U2B. The amplified visual peak of sync output is connected to comparator U2C. The other input to U2C is the level set by the aural null adjust R51, which is adjusted for 100% visual power after the aural is added and the peak power is adjusted back to the reference level and also from the offset null adjust R48, which is adjusted for 0% visual power with the transmitter in Standby. The adjusted output is amplified by U3D and connected to the other input of U2C pin 9. The output of U2C connects to J6 pins 2 and 3, which supply the peak of sync visual level output to the front panel meter for monitoring.

If this board is operated with scrambling, using suppressed sync, the visual level circuit operates differently than described above because there is no peak of sync present on the forward sample input. For the board to operate properly, a timing pulse from the scrambling encoder must connect to the board at J4. This timing pulse is converted to sync pulses by U4A and U4B, which control the operation of Q2. Intercarrier notch L2 is tuned to remove any visual + aural signal that may remain. The sync amplitude is controlled by the gate amplitude adjust R25 and then applied to the minus input of U1C. At this point, the sync is inserted into the visual + aural signal that is connected to the plus input of U1C, producing a peak of sync in the signal. The output of U1C is connected to intercarrier notch L3, which is adjusted to filter out the aural and the 4.5-MHz intercarrier frequencies. The visual + sync output is fed to a peak detector circuit, consisting of CR5 and U2A, and then fed through the visual calibration control R28 to amplifier U2B. The amplified visual peak of sync output is connected to J6 pins 2 and 3, which supply the peak of sync visual level output to the front panel meter for monitoring. R32 moves the pulse to where the sync should be and R25 sets the visual metering calibration with no sync present.

4.1.9.3 Reflected Level Circuit

A reflected-power sample is applied to J3 of the visual/aural metering board and is detected by the diode detector circuit CR7 and U3B. The detected output is fed through the reflected calibration pot R39, 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 transmitter control board for VSWR cutback and also to the front panel meter.

4.1.9.4 Voltages for Circuit Operation

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

4.1.10 (A14) Channel Oscillator Assembly, Dual Oven (1145-1202; Appendix D)

NOTE: If the precise frequency kit is present in your transmitter, the VCXO Assembly (1145-1206) will be used.

The channel oscillator assembly contains (A14-A1) the channel oscillator board

(1145-1201) that generates a stable frequency reference signal of approximately 100 MHz. The channel oscillator assembly is an enclosure that provides temperature stability for the crystal oscillator. An SMA output at jack J1 and an RF sample at BNC connector jack J2 are also part of the assembly.

Adjustments can be made through access holes in the top cover of the assembly. These adjustments are set at the factory and should not be tampered with unless it is absolutely necessary and the proper, calibrated equipment is available. R1 is the temperature adjustment; C11 is the course-frequency adjustment; C9 is the fine-frequency adjustment; and C6, C18, L2, and L4 are adjusted for the maximum output level at the frequency as measured at jack J1.

The +12 VDC for the assembly enters through FL1 and the circuit ground connection is made at E1.

4.1.10.1 (A14) (Optional) VCXO Assembly, Dual Oven (1145-1206; Appendix D)

NOTE: If the precise frequency kit is not present in your transmitter, the Channel Oscillator Assembly (1145-1202) will be used.

The VCXO assembly contains the VCXO channel oscillator board (1145-1204), which generates a stable frequency reference signal of approximately 100 MHz. The VCXO channel oscillator assembly is an enclosure that provides temperature stability for the crystal oscillator. An SMA output at jack J1 feeds the x2 multiplier board and an RF sample at BNC connector jack J2 provides an oscillator sample to the front panel of the VHF exciter tray.

Adjustments are provided through access holes in the top cover of the assembly. These adjustments are set at the factory and should not be adjusted unless it is absolutely necessary and the properly calibrated equipment is available. R1 is the temperature adjustment; C11 is the course frequency adjustment; and C6, C18, L2, and L4 are adjusted for maximum output level at frequency as measured at jacks J1 or J2. The AFC voltage, which is fed to FL2 from the precise frequency control tray, is the fine frequency adjustment.

The +12 VDC for the assembly enters through FL1 and the circuit ground connection is made at E1.

4.1.11 (Optional) (A13) EEPROM FSK Identifier Board (1265-1308; Appendix D)

The (Optional) FSK identifier board, with EEPROM, generates a morse code identification call sign by sending a bias voltage to the IF attenuator board to amplitude modulate the aural carrier. This gives the station a means of automatically repeating its identification call sign, at a given time interval, to meet FCC requirements.

The starting circuit is made up of U1B and U1D, which are connected as a flip-flop, with gate U1A used as the set flip-flop. U1A automatically starts the flip-flop each time U3 completes its timing cycle. At the start of a cycle, U1B enables clock U2. U2 applies the clock pulses that set the speed, which is adjusted by R2, for when the identification code is sent to 12-bit binary counter U4. R2, fully clockwise (CW), is the fastest pulse train and R2, fully counter-clockwise (CCW), is the slowest pulse train. U4 provides binary outputs that address EEPROM U5.

The scans in U4 will continue until the field effect transistor (FET) Q1 is gated on. The gate of Q1 is connected to pin 13 on U4, which is the maximum count used in the EEPROM, and will provide a reset pulse each time the binary counter goes high on pin 13. The reset pulse, when the drain of Q1 goes low, is applied to the flip-flop and the timer U3, which determines the length of time between the sending of the identification code. R14 is adjusted to set this time interval. R14, fully CW, is the longest interval between identification calls, approximately eight minutes. R14, fully CCW, is the shortest interval between the sending of the code (approximately 10 seconds).

U6B is an amplifier connected to the output of U5, which turns the LED DS1 on and off at the rate set by R2. This gives the operator a visual indication that the FSK identifier board is operating and at the rate at which it is operating.

The data output of U5, which is serial, is connected to U6A, whose output shifts low and high, and is applied to the VCXO board, which shifts the frequency according to the programming of U5. The deviation of the shift is adjusted by R4 and is typically set at 1 kHz. Once R4 is set, R9 is re-adjusted to -1.5 VDC at J3-2.

The +12 VDC from an external power supply enters the board at J1, pin 3. The voltage is fed through RF choke L1 and is filtered by C1 before being applied to the rest of the tray. The +12 VDC is also applied to U7, which is a voltage regulator that regulates its output at +5 VDC. The +5 VDC is fed to the ICs on the board. The -12 VDC from an external power supply enters the board at J1, pin 5. The voltage is fed through RF choke L2 and filtered by C2 before being applied to the rest of the tray.

4.1.12 (Optional) (A12) IF Attenuator Board (1150-1201; Appendix D)

The IF attenuator board is operated with the FSK identifier board to produce an amplitude modulated aural IF signal for broadcasting the required FCC station identification call sign at the proper time intervals. The board contains a pin-diode attenuation circuit that consists of CR1 and the two resistors R2 and R3. The bias output of the FSK identifier board is applied to J3 of the IF attenuator board. As the bias applied to J3 increases and decreases, the amplitude of the aural IF signal, which enters the board at J1 and exits the board at J2, will increase and decrease. This produces an amplitude-modulated IF signal at J2, the aural IF output jack of the board.

4.2 (A6, A7 and A11) Low Band VHF Amplifier Trays (1304363; Appendix C)

The low band VHF amplifier tray is adjusted at the factory for use as a visual + aural RF amplifier tray. The tray has approximately 55 dB of gain at the frequency of the VHF low band channel and will take the typical +7 dBm Visual – 3dBm Aural input and amplify it to an output level of approximately +58.8 dBm. As a visual + aural amplifier, the tray is calibrated for 750 watts peak of sync visual plus 10 dB aural power (75 watts) that is equal to a 100% meter reading.

The tray is made up of the boards and assemblies listed in Table 4-1.

Table 4-1. VHF Amplifier Tray Boards and Assemblies

MAJOR ASSEMBLY DESIGNATOR	BOARD / ASSEMBLY NAME	DRAWING NUMBER
A2-A1	Phase shifter board (mounted in [A2] an RF enclosure assembly)	1198-1602
A2-A2	Filter/amplifier board (mounted in [A2] an RF enclosure assembly)	1198-1606
A3-A1	Low band VHF amplifier board (mounted in [A3] an RF enclosure	1198-1605

	assembly)	
MAJOR ASSEMBLY DESIGNATOR	**BOARD / ASSEMBLY NAME**	**DRAWING NUMBER**
A3-A2	Overdrive protection board (mounted in [A3] an RF enclosure assembly)	1198-1601
A3-A3	3-way splitter board (mounted in [A3] an RF enclosure assembly)	1198-1608
A4-A1, A4-A2 and A4-A3	Three low band VHF amplifier pallets (mounted in [A4] an RF enclosure assembly)	P400-VHF-L-18 1304348
A5-A1	3-way combiner board (mounted on [A5] the combiner heatsink assembly)	1198-1626
A13	AGC control board	1142-1601
A8	Current metering board	1304362
A10	+30 VDC switching power supply assembly	PM3329B-5-1-R-2-E 1301504

The on-channel RF input signal (+7 dBm Visual –3 dBm Aural) enters the rear of the tray at the BNC jack J1 and is fed through J1 of the (A2) enclosure assembly to J1 of (A2-A1) the phase shifter board (1198-1602). The board provides a phase shifter adjustment of the RF signal that is needed to provide maximum output during the combining of the three VHF amplifier trays in the 3 way combiner. The front panel mounted phase shift potentiometer R2 (A7) connects to J3 on the board and controls the phase of the RF signal.

If the input signal level to the phase shifter board falls below a preset level, a high, which is an input fault, connects from J5 of the board to J14 on the AGC control board. When an input fault occurs, the AGC control board generates a fault output at J1, which is connected to J4 on the filter/amplifier board. The fault cuts back the RF signal level using the pin-diode attenuator circuit on the filter/amplifier board.

The phase-controlled output at J2 of the phase shifter board (+7 dBm) is directed to J7, the input jack of the (A2—A2) filter amplifier board (1198-1606) that is made up of two circuits. The first circuit is a channel filter that is adjusted for the desired channel frequency and bandwidth. The filtered output (+5 dBm) is connected to the second circuit that contains two amplifiers. The RF connects through a pin-diode circuit to the amplifier IC U1. The voltage applied to J4, which is the external control jack of the board, controls the amplitude of the RF signal through the pin-diode attenuator circuit. Jumper W1 on J5 should be between pins 2 and 3, which provide external control, through J4, of the gain of the board, as well as the output level of the tray. R9 is the manual gain pot that is in the circuit when the jumper W1 is between pins 1 & 2.

The front panel mounted gain pot R3 (A6) connects to the AGC control board and is used to adjust the AGC pin-attenuator bias voltage that connects to J4 on the filter/amplifier board. The RF signal, after the pin-attenuator circuit, is amplified by the second amplifier stage Q1 to about +19.5 dBm; this signal is connected to the output of the board at J2.

The RF output of the filter/amplifier board connects to J2 of (A3) a RF enclosure that contains the low band VHF amplifier board, the overdrive protection board and the 3-way splitter board. The RF from J2 on the enclosure connects to

J1 on the low band VHF amplifier board (1198-1605) that amplifies the signal approximately 22 dB.

The RF output of the low band VHF amplifier board at J2 (+41.5 dBm) connects to J4 of (A3-A2) the overdrive protection board (1198-1601). The RF signal is through connected directly to J5, the RF output jack of the board. A sample of the RF on the board is applied to a diode-detector circuit that consists of CR1 and U1A. The gain of amplifier U1D is controlled by detector gain pot R11, which is set to +.4 VDC as measured at TP1. The set output of U1D is connected to the comparator IC U1B. The trip point for the comparator is adjusted by R12, typically set to 110% output power, sync only. When the signal reaches that level, the overdrive protection board will cut back the output power of the tray and the red Overdrive LED DS1 located on the board and the red Overdrive LED DS1 mounted on the front panel will be illuminated. Typically, the output power level will bounce down and then up and continue bouncing until the output level is lowered to the normal operating level (100%). The red Overdrive LED DS1, the green Module LED DS3, and the Enable LED DS2 may blink on and off during the bouncing of the output level; this is a normal occurrence. The greater the output level is above 110%, the larger the bounce will be.

The RF output of the overdrive protection board at J5 connects to J1 on (A3-A3) the 3-way splitter board (1198-1608). The splitter board takes the +41.3 dBm input and provides three +36.3 dBm outputs at J1, J2 and J3 of the (A3) amplifier enclosure.

The three RF outputs connect to (A4) the final amplifier enclosure. This enclosure contains three (A4-A1, A4-A2 and A4-A3) low-band amplifier pallets 1304348 (P400-VHF-L). The RF signals connect to J1 on each of the low-band amplifier pallets. Each amplifier pallet provides approximately 18 dB of gain.

The RF signal inputs to the amplifier pallets (+36.3 dBm) are amplified to +54.3 dBm outputs at J2. These outputs are connected to J1, J2 and J3 on (A5-A1) a 3-way combiner board (1198-1626). The 3-way combiner takes the three +54.3 dBm inputs and combines them to form the 750-watt RF output at J5 of the combiner that connects to J2, the RF output jack of the tray.

The (A5-A1) 3-way combiner board provides a forward power sample at J6 and a reflected output power sample at J7. The forward output power sample connects to J4 on (A13) the AGC control board (1142-1601). The reflected output power sample connects to J5 on (A13) the AGC control board (1142-1601). The AGC control board contains two peak-detector networks that provide detected outputs that are used for front panel and remote meter indications of forward and reflected output power levels, the AGC detector voltage level, and the VSWR cutback protection if the reflected power level increases above the preset level.

+30VDC and +12 VDC Voltages

Two voltages, +30 VDC from the internal switching power supply and +12 VDC from the VHF exciter tray, are needed for the operation of the tray. The +12 VDC connects to J3-7 and J3-8 on the rear of the tray and are wired to J8 pins 4 and 1, on (A13) the AGC control board. The +12 VDC is connected to U8, a +5 VDC regulator IC that supplies the +5 VDC needed for the operation of the front panel mounted LEDs.

The (A10) +30 VDC switching power supply provides the +30 VDC to (A8) the current metering board (1304362). The current metering board distributes the +30 VDC through fuses to the amplifier devices on (A2-A2) the filter/amplifier board, (A3-A1) the low-band amplifier board, and A4-A1, A2 & A3) the three final low-band amplifier pallets. +12 VDC from the AGC control board is through connected to the (A2-A1) phase shifter board, the (A2-A2) filter/amplifier board and the (A3-A2) overdrive protection board.

The fuses F1, F2 and F3 are 20-amp fuses. F4 is a 5-amp fuse, F6 is a 2-amp fuse, and F7 is a 1-amp fuse. F5 is not used in this configuration. The 20 amp fuse F1 protects +30 VDC to (A4-A1) one of the low-band final amplifier pallet, the 20 amp fuse F2 protects (A4-A2) another low-band final amplifier pallet and the 20 amp fuse F3 protects (A4-A3) the last low-band final amplifier pallet. The 5 amp fuse F4 protects +30 VDC to (A3-A1) the low-band VHF amplifier board. The fuse F5 is not used in this configuration. The 2 amp fuse F6 protects +30 VDC to (A2-A2) the filter/amplifier board. The 1 amp Fuse F7 protects the +30 VDC connected to J8 pin 2, on (A13) the AGC control board. On the AGC control board, the +30 VDC is connected to the regulator IC U7 that takes the +30 VDC and regulates it to a +12 VDC output. The +12 VDC is used for the operation of the AGC control board. The +12 VDC from A13-J11-3 is connected to the current metering board at A8-TB1-5. The +12 VDC is jumpered on TB1 from TB1-5 to TB1-6, which is wired to the (A2-A1) phase shifter board, the (A2-A2) filter/amplifier board, and the (A3-A2) overdrive protection board.

The current metering board also supplies sample outputs of the operating currents of the amplifier devices in the tray to the front panel current meter. The meter in the (I_1) position reads the current for the (A4-A1) low-band final amplifier pallet, the meter in the (I_2) position reads the current for (A4-A2) the low-band final amplifier pallet and the meter in the (I_3) position reads the current for the (A4-A3) low-band final amplifier pallet. The meter in the (I_D) position reads the current for the (A3-A1) low-band VHF amplifier board. To read the desired current, place switch S1 to the Current position, then place switch S2 to the desired current measuring position. These current readings can be used when setting up the idling currents, no RF drive applied, for the devices. The (I_1, I_2, and I_3) currents are each set for 1.8 amps, while the ($I_{D)}$ current is set for 3 amps.

220 VAC Input

In the tray, the 220 VAC is applied through jack J4 to terminal block TB1. When CB1, the 15-amp, front panel-mounted circuit breaker, is switched on, the 220 VAC is distributed from TB1 to (A11 and A12) two cooling fans, which will begin to operate, and to (A10) the switching power supply. There are four surge suppressors on the AC input lines for protection from transients or surges. VR1 and VR2 are mounted on TB1, between the AC lines and VR3 and VR4 are mounted at the input to the switching power supply from each AC line to ground.

Power Supply Enable

The (A10) switching power supply only operates when the power supply enable control line, jack J3 pins 9 and 10, on the rear of the tray, is shorted and there is no overtemperature fault. The enable is supplied by the VHF exciter tray when the transmitter is switched to Operate. The enable is applied to J10 pins 10 and 9 on (A13) the AGC control board (1142-1601), which, if there is no overtemperature fault, connects the enable from J10 pins 6 and 7 to J1-18 and J1-14 located on the switching power supply assembly. The green Enable LED DS2 on the front panel will light, indicating that an enable is present. If the transmitter is in Standby, or if an overtemperature fault occurs, the AGC control board will not enable the switching power supply. As a result, the +30 VDC will be removed from the amplifier modules and the front panel Enable and Module Status LEDs will not be lit.

Front Panel Metering

The front panel meter (A9) uses the front panel Selector switch S1 to monitor the AGC Voltage, % Forward Power, % Reflected Power, the power supply voltage, and the current. The meter in the AGC position will read between 1 and 2 volts. The power supply voltage reading is calibrated using R86 on the AGC control board. The % Output Power is calibrated using R44 and the % Reflected Power is calibrated using R53 on the AGC control board. With S1 in the Current position, S2 can be switched to read the idling currents, no RF drive applied, of the low-band amplifier pallets. Typical readings are an idling current of 1.8 amps in the I_1, I_2, and I_3, positions and 3 amps in the I_D position.

Reflected Power Sample

The reflected power sample from the 3-way combiner board is fed back to the AGC control board at J5. On the board, the reflected sample is connected through a detector circuit, CR13 and associated components, to the VSWR cutback circuit, consisting of U5B and associated components. If the reflected power increases above 20%, the output power of the tray, as set by R59, the VSWR cutback adjust, will be cut back to maintain a 20% reflected output level. The red VSWR Cutback LED DS4 on the front panel will remain lit until the reflected level drops below 20%.

Thermal Protection Devices

There are three thermal switches in the tray for overtemperature protection. Two of the thermal switches (A4-A6 and A4-A5) are mounted to the (A4) heatsink for the three low-band amplifier pallets and the third thermal switch (A5-A2) is mounted on the (A5) heatsink for (A5-A1) 3-way combiner board. The thermal switches close when the heatsink on which they are mounted reaches a temperature of 175° F. The closed thermal switch causes the AGC control board to remove the enable to the switching power supply. This eliminates the +30 VDC and lights the red Overtemperature LED DS5 on the front panel and the AGC control board will extinguish the green Module Status LED DS3.

4.3 (A8) 3 Way Combiner Assembly (1065241; Appendix D)

The outputs of the three VHF amplifier trays (750 Watts each) connect to the 3 way combiner assembly. They are combined to give approximately 2200 Watts at J5 of the assembly. A thermal switch is mounted to the heatsink of the combiner for overtemperature protection in case of amplifier failure or a problem in the output filtering network. The thermal switch closes when the heatsink on which it is mounted reaches a temperature of 175° F. The closed switch connects an overtemperature command through FL1 & FL2 on the combiner to J11-1 & J11-35 on the VHF Exciter. The overtemperature command will cause an overtemperature fault, that will remove the enables to the VHF amplifier trays and place the transmitter in Standby.

4.4 (A13) Harmonic Filter, (A14) Bandpass Filter and (A16) Coupler Assembly

The RF output of the 3 way combiner at (A8-J5) is fed through 1/2" superflex to a 7/8” to 1-5/8” adapter that connects to J1 on the (A13) harmonic filter. The harmonic and bandpass filters screen out the -3.58-MHz, -4.5-MHz, +8.08-MHz, +9.00-MHz intermodulation products, as well as all of the visual and aural harmonic frequencies. The output of the (A14) bandpass filter is fed through 1-5/8” hardline to (A16) the output coupler. The coupler provides a reflected and a forward power sample to the VHF exciter for VSWR and metering purposes. The forward sample connects to J8 and the reflected sample connects to J9 on the VHF exciter tray. The output of the coupler, 3300 watts, at the 1-5/8” connector J2 is then fed to the antenna for your system.

This completes the description of the 335B VHF Low Band Transmitter.

Chapter 5
Detailed Alignment Procedures

The 335B transmitter was aligned at the factory and should not require additional alignments to achieve normal operation.

This transmitter operates using the baseband audio and video inputs or, if the (optional) 4.5-MHz composite input kit is purchased, either a single composite video + 4.5-MHz input or separate baseband video and audio inputs.

Check that the RF output at J2 of (A16) the coupler is terminated into a dummy load of at least 3300 watts. 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. They should be very similar. If a reading is off by a significant amount, the problem is likely to be in that tray.

Switch on the main AC circuit breaker for the transmitter and the VHF exciter circuit breaker located on the rear of the tray.

5.1 (A4) VHF Low-Band Exciter Tray (1070820 or 1304463 w/P.F; Appendix C) with Baseband Video and Audio Inputs

NOTE: The 1304463 VHF Exciter is used with the precise frequency system and will contain the VCXO Assembly (1145-1206), in place of the Channel Oscillator Assembly (1145-1202), and the IF VCXO Board (1248-1131), in place of the IF Oven Oscillator Assembly (1191-1404).

The (A4) low-band VHF exciter tray has adjustments for video levels, audio modulation levels, and other related parameters.

Connect an NTSC baseband video test signal input (1 Vpk-pk) to the transmitter video input jack J2 on the (A12) remote interface panel. Jacks J1 and J2 on the VHF exciter tray are loop-through connected and the unused jack J2 can be used as a video source for another transmitter by removing jumper W4 on jack J3 on (A5) the sync tip clamp modulator board (1265-1302). Connect a baseband audio input (+10 dBm) to the balanced audio input terminal block TB1-1 (+), TB1-2 (-), and TB1-3 (ground). If stereo/composite audio is provided, connect it to BNC jack J6, the composite audio input jack on the remote interface panel. Jacks J3 and J13 on the rear of the VHF exciter tray are loop-through connected and the unused jack J13 can be used as an audio source for another transmitter by removing jumper W1 on jack J15 on the aural IF synthesizer.

Look at the front panel meter on the VHF exciter tray. In the Video position, the meter indicates active video from 0 to 1 Vpk-pk. The normal video input level is 1 Vpk-pk on the meter. If this reading is not at the proper level, the overall video level can be changed by adjusting the video level control R12 on the sync tip clamp/ modulator board.

Switch the meter to the Audio position, which shows the audio deviation, modulation level, of the signal from 0 to 100 kHz. The aural IF synthesizer board was factory set for a ±25 kHz deviation with a balanced audio input of +10 dBm. If the reading is at not the correct level, adjust the balanced audio gain pot R13 on the aural IF synthesizer board, as needed, to attain the ±25 kHz deviation. The aural IF synthesizer board was factory set for a ±75 kHz deviation with a composite audio input of 1 Vpk-pk. If this reading is not correct, adjust composite audio gain pot R17 on the aural IF synthesizer board, as needed, for the ±75 kHz deviation.

5.2 (A4) VHF low-Band Exciter Tray with the 4.5-MHz Composite Input Kit (**NOTE:** If your transmitter does not contain the 4.5MHz composite input kit, skip this section.)

With the 4.5-MHz composite input kit, the (A4) VHF exciter tray is able to operate using either the separate video and audio baseband inputs or the single 4.5-MHz composite input. The 4.5-MHz composite input kit includes a composite 4.5-MHz filter board (1227-1244) and a 4.5-MHz bandpass filter board (1265-1307).

To align the VHF exciter using baseband video and audio, refer to the alignment instructions described in Section 5.1 of this chapter. Select the baseband input operation by a applying a baseband select, using a jumper or closed contacts, connected between J7-6 and J7-7 on the rear of the tray.

To operate the transmitter using the 4.5-MHz composite input, remove the baseband select command from J7-6 and J7-7 on the rear of the tray.

Connect a multiburst test signal from an envelope delay measurement set to the input of the rear interface panel at J2. On (A24) the composite 4.5-MHz filter board (1227-1244), connect an oscilloscope between J7, the center pin, and pin 1 or 3, which are ground. Adjust C21, if necessary, for the best frequency response. Adjust R32 for a signal level of 1 Vpk-pk on the oscilloscope. The output, as measured at J6 and J7 of the board, should be video only with a minimum 4.5-MHz aural subcarrier.

On the (A25) 4.5-MHz bandpass filter board (1265-1307), adjust the filter with L2, C3, L4, and C7 for a frequency response of no greater than ±.3 dB from 4.4 to 4.6 MHz. Adjust C19 for an overall peak-to-peak variation of less than ±.3 dB from 4.4 MHz to 4.6 MHz. Recheck the frequency response; it may have changed with the adjustment of the envelope delay.

5.3 (A4) VHF Exciter Tray with either Baseband or the 4.5-MHz Composite Input

The IF section of the (A4) VHF exciter tray includes adjustments for automatic level control (ALC), linearity (amplitude predistortion), and phase (phase change vs. level) predistortion for correction of the nonlinearities 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 on the VHF exciter tray to Standby. The setup of the RF output includes an adjustment to the drive level of the three VHF amplifier trays, the adjustment of the linearity and phase predistortion (which compensate for any nonlinear responses of the amplifier trays), and the gain and phasing adjustments of the three VHF amplifier trays.

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

- DS1 (Input Fault) – Indicates that an 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 because jumper W3 on J6 is in the Manual ALC Gain position.
- DS3 (Video Loss) – Indicates a loss of video at the input of the board

- DS4 (Mute) – Indicates that a visual Mute command is present. (**NOTE:** not used in this configuration)

- DS5 (Modulator Enable) – Indicates that the modulator IF output has been selected (**NOTE:** this is only used if a receiver tray is present in the system. DS5 is always on with no receiver present.)

The ALC is muted when the transmitter is in Standby. To monitor the ALC, turn off the three VHF amplifier trays on/off circuit breakers on the front panel of the trays switch the transmitter to Operate. Adjust the power adjust gain pot on the front panel of the VHF 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 jumper W3 back to Auto (between pins 1 and 2); this is the normal operating position. The detected IF signal level at J19-2 of the ALC board is connected to the transmitter control board that distributes the level to the three VHF amplifier trays where it is used as a reference for the automatic gain control (AGC) in each amplifier tray.

5.4 IF Phase Corrector Adjustment

As shipped, the exciter was preset to include linearity (gain vs. level) and phase (phase vs. level) predistortion. The predistortion was adjusted to approximately compensate the corresponding non-linear distortions of the VHF amplifier trays and should not require additional adjustments.

Locate (A9) the IF phase corrector board (1227-1250) mounted in the VHF exciter. The amplitude correction portion of the board is not utilized in this configuration. As a result, jumper W3 on J10 should be in the Disable position, to +6.8 VDC, and R35 and R31 should be fully counter-clockwise (CCW). R68 is the range adjustment and should be set in the middle of the range. The phase correction Enable/Disable jumper W2 on J9 should be in the Enable position, to ground.

Switch the input video test source to select an NTSC 3.58-MHz modulated staircase or ramp test waveform. Set up the station demodulator and monitoring equipment to monitor the differential phase or intermodulation products of the RF output signal. There are three corrector stages on the IF phase corrector board, each with a magnitude and a threshold adjustment that are adjusted, as needed, to correct for any differential phase or intermodulation 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. Jumper W1 on J8 is set to give the desired polarity of the correction shaped by the threshold R11 and the 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.

NOTE: Adjusting these pots changes all visual parameters and should be done cautiously and only if necessary.

5.5 Linearity Corrector Adjustment

The IF linearity correction function consists of three non-linear cascaded stages, each having adjustable magnitude and threshold, or cut-in points, located on the ALC board. The threshold adjustment determines at what IF signal level the corresponding corrector stage begins to increase gain. The magnitude adjustment determines the amount of gain change for the part of the signal that exceeds the corresponding threshold point. Refer to the assembly drawing for the ALC board (1265-5305), to find the adjustments for the first through third linearity corrector stages. Because the stages are cascaded, the order of correction is important. The first stage should cut in near white level, with the cut-in point of the next stage toward black, and with the last stage primarily stretching sync.

To adjust the linearity correctors from scratch, ensure that the transmitter is operating at full power with the desired A/V ratio. Check that jumper W1 on J4 on the ALC board is in the linearity enabled position, between pins 1 and 2. Make sure that the ALC voltage is set to +0.8 VDC as monitored on the front panel meter in the ALC position.

Insert a modulated ramp video test signal into the transmitter. Demodulate the output signal of the transmitter and observe the waveform on a waveform monitor while also looking at the signal on a spectrum analyzer. On the ALC board (1265-1305), preset pots R34, R37, and R40 (threshold, cut in) fully CCW and the magnitude adjustments R13, R18, and R23 fully clockwise (CW). On the IF phase corrector board (1227-1250), preset pots R7, R15, R23, and R35 fully CW and R3, R11, R19, and R31 fully CCW.

Set the waveform monitor to differential step filter and the volts/division scale to .1 volts. Center the display to approximately the blanking level.

Gradually adjust pots R3, R11, and R19 clockwise on the IF phase corrector board, as needed, to minimize the observed thickness of the intermodulation as seen on the display.

Adjust pots R34, R37, and R40 clockwise on the ALC board, as needed, to give correction at sync or at low luminance levels as viewed at the left-most edge of the waveform monitor.

The intermodulation beat products between the colorburst and the aural carrier at 920 kHz above visual carrier should also be observed on the spectrum analyzer while performing the preceding adjustments. The frequency will vary for different video systems. When the adjustments are performed properly, the intermodulation products on the spectrum analyzer should be at least -52 dB down, with a red field input, from peak visual carrier. The intermodulation distortion as displayed on the waveform monitor should be no more than 1 IRE. Pot R31 on the IF phase corrector board is used for any extra intermodulation correction that may be needed.

NOTE: Any adjustments to the above pots affects other visual parameters and some slight adjustments of all of the pots may be needed to meet all specifications simultaneously.

If the transmitter is being driven very hard, it may not be possible to get enough sync stretch while maintaining a flat differential gain. In this case, some video sync stretch may be used from the sync tip clamp/modulator board; the sync stretch adjustment is R48.

Switch the transmitter to Standby.

5.6 (A6, A7 and A11) Low-Band VHF Amplifier Tray (1304363; Appendix C)

NOTE: The following procedure should be followed only if complete alignment of a VHF amplifier tray is needed.

The (A6, A7, and A11) low-band VHF amplifier trays 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. If necessary, any adjustments to the boards in this tray should be performed in the Manual Gain position, with S1 on (A13) the AGC control board

(1142-1601) in Manual. The idling currents for the amplifier boards are adjusted with no RF drive applied. Remember to put S1 back to the Auto AGC position after any adjustments. Auto AGC is the normal position during operation of the transmitter.
Connect a dummy load with a rating of at least 750 watts to J2, the RF output jack of the tray being aligned, before beginning the alignment procedure.

Switch the VHF amplifier tray on and the transmitter to operate.

5.6.1 (A13) AGC Control Board (1142-1601; Appendix D)

Using a calibrated wattmeter, check that the tray is operating at the rated power. Remove the sample forward power connection J4 from the (A13) AGC control board (1142-1601). The output power level should drop to 20% because of the VSWR cutback and DS4, the VSWR Cutback LED, should be illuminated. The front panel Module Status LED should not be lit.

Reconnect J4 and adjust R59 so that it begins to cut back on the output power level when the reflected level increases above 20%.

In the Power Supply Voltage position, the front panel meter is calibrated to +30 VDC using R86 on the AGC control board.

5.6.2 (A2-A1) Phase Shifter Board (1198-1602; Appendix D)

There are no adjustments to (A2-A1) the phase shifter board (1198-1602). The front panel has adjustments for phase that are made during the amplifier array setup procedure. Typically +7 dBm input and +7 dBm output.

5.6.3 (A2-A2) VHF Filter/Amplifier Board (1198-1606; Appendix D)

The (A2-A2) VHF filter/amplifier board (1198-1606) has approximately 14 dB of gain. Tune the channel filter capacitors C29 and C20 (loading), C26 and C23 (center frequency), and C24 (coupling) at J6 on the board for the best response. Set voltage adjust pot R19 for +24 VDC at the anode of CR5.

The idling current, no RF drive applied, of the device Q1 is set for 250 mA. To set the current, remove the RF drive, measure the voltage across R16 (a 1Ω resistor on the filter/amplifier board) and adjust R13 for .25 volts (using Ohms' Law: [E=I x R] : [E=250 mA x 1 Ω] : E=250 mV). Typically the board has a +7 dBm input and a +19.5 dBm output level.

5.6.4 (A3-A1) VHF Low-Band Amplifier Board (1198-1605; Appendix D)

The (A3-A1) VHF low-band amplifier board (1198-1605) has 22 dB of gain and is biased for 3 amps of idling current, no RF drive applied. Adjust voltage adjust pot R10 for +24 VDC at pin 0 of the regulator IC U1. To set the bias, remove the RF drive from the board, measure the voltage across R6 and R7 (two 1Ω resistors in parallel on the high-band driver board), and adjust R4 for 1.5 volts (using Ohms' Law: [E=I x R] [E=3 amps x .5 Ω] : E=1.5 volts).

Connect a spectrum analyzer to output jack J2 on the board and adjust C15 for peak output. Typically +19.5 dBm input and +41.5 dBm output.

5.6.5 (A3-A2) Overdrive Protection Board (1198-1601; Appendix D)

The typical input level to the (A3-A2) overdrive protection board (1198-1601) is +41.5 dBm during normal operation with a typical output of +41.3 dBm.

To set up the overdrive circuit, check that the output power level of the transmitter is at 100% and adjust R11 on the board for a reading of .4 VDC at TP1. Increase the output power level of the transmitter to 110%, sync only, and adjust R12 until the output power begins to drop off. Return the output power level of the transmitter to 100%.

5.6.6 (A3-A3) 3-Way Splitter Board (1198-1608; Appendix D)

There are no tuning adjustments for (A3-A3) the 3-way splitter board. The board takes the +41.3 dBm input and splits it into three equal +36.3 dBm outputs.

5.6.7 (A4-A1, A4-A2, and A4-A3) VHF Low-Band Amplifier Pallet (1304348; Appendix D)

These pallets, P400-VHF-L, are supplied by Delta RF Technology, Inc. Refer to the data sheets in the subassembly section of this manual for more information. Each board has approximately 18 dB of gain and with an input of +36.3 dBm the output is typically +54.3 dBm.

5.6.8 (A5-A1) 3-Way Combiner Board (1198-1626; Appendix D)

There are no adjustments to the (A5-A1) 3-way combiner board. The three +54.3 dBm inputs are combined to produce the 750 watts, +58.8 dBm, peak of sync output at J2 of the combiner assembly.

5.6.9 Calibration of the Visual Plus Aural Output Power and VSWR Cutback of the Tray

Check that a dummy load of at least 750 watts is connected to the output of the tray that is to be calibrated. Place switch S1 on the AGC control board in the Manual position before beginning the setup.

To adjust the visual output power levels:

1. Remove the J16 cable from (A5) the sync tip clamp/modulator board (1265-1302) in the VHF exciter tray. Set the Manual AGC switch S1, on the (A13) AGC control board (1142-1601) in the VHF L.B. amplifier tray, to the Manual position. Turn the transmitter to the Operate position.

2. Connect a sync and black test signal to the video input jack of the remote interface panel.

3. Adjust the manual gain pot R5 on the AGC control board for:

- Sync + black 0 IRE setup; wattmeter=450 watts
- Sync + black 7.5 IRE setup; wattmeter=405 watts

NOTE: The transmitter must have 40 IRE units of sync.

4. Obtain a zero span reference of the visual-only carrier on a spectrum analyzer. Replace the J16 connector on the sync tip clamp/modulator board in the VHF exciter tray. Adjust R5 on the AGC control board until the same visual reference is obtained. Adjust R44 on the AGC control board for 100% Forward Power.

Lower the forward power reading to 80% on the front panel meter using R5, the manual gain adjust on the AGC control board. Adjust R65, the AGC fault adjust on the AGC control board, until the green Module LED DS3 on the front panel just begins to light. Use R5 to readjust the forward power to 100%.

Switch off the tray and reverse the J6 and J7 cables on the 3-way combiner enclosure.

Switch on the tray and adjust the front panel meter, in the Reflected Output Power position, to a 100% reading using R53, the reflected power meter adjust on the AGC control board. Adjust the reflected output power to a 20% reading using R5 on the AGC control board. Adjust R59, the VSWR cutback adjust on the AGC control board, until the red VSWR Cutback LED DS4 on the front

panel lights. This sets up the VSWR cutback circuitry.
Readjust R5 for 100% on the meter to achieve a 750 watts peak of sync output + 75 watts aural power. However, if the system requires less output power per amplifier tray, adjust each tray by the same amount to give the desired total output power.

Switch off the tray and return the J6 and J7 cables on the 3-way combiner assembly, back to their original positions. If the tray was originally operating below 100% output power, the AGC fault adjust was set for 20% below the operational % Output Power of the tray. See the Test Data Sheet for the transmitter for the actual readings for the tray. Place S1 on the AGC control board in the AGC position. This is the normal operating position after the setup is completed.

The VHF amplifier tray is aligned, calibrated, and ready for normal operation. Repeat as needed for the other VHF amplifier trays.

5.7 Phase and Gain Adjustment of multiple VHF Amplifier Trays

The following procedure was completed at the factory and should only be followed if one of the VHF amplifier trays is replaced.

Adjust the gain controls located on the VHF Amplifier Trays full CCW. Switch On the front panel AC Circuit Breaker on the bottom VHF amplifier tray. 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. Monitor the output power of the Transmitter by connecting a Spectrum Analyzer to a sample of the output. 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.

Turn On the AC to the middle amplifier tray and adjust its' output power to 50%. While monitoring the output power of the Transmitter, adjust the Phase Control until the power reaches a peak. If the Phase adjust reaches its end of travel, add a 4 inch cable to the RF Input (J1) of the amplifier. 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, add a 3 inch cable to J1 of the amplifier 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.

Turn On the AC to the top amplifier tray and adjust its' output power to 50%. While monitoring the output power of the Transmitter, adjust the Phase Control until the power reaches a peak. If the Phase adjust reaches its end of travel, add a 4 inch cable to the RF Input (J1) of the amplifier. Readjust 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, add a 3 inch cable to J1 of the amplifier 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.

Increase the output power on the bottom and middle amplifier trays to 90%.

Adjust the Phase Control on the middle amplifier tray to peak the System output power.

Increase the output power on the top amplifier to 90% and adjust the Phase control for maximum System output power.

Monitor the Reflected Power on all of the VHF Amplifier Trays. The Reflected Power should read <5%. If an amplifier is showing high reflected power, adjust the Phase control as needed 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 tray will affect the Reflected on the other amplifier trays.

Raise or lower the output power of each tray as needed to achieve 100% Output Power. The output power of each tray should be 90% to 100%.

5.8 Calibration of the Forward Output Power Level of the Transmitter

NOTE: Only perform the following procedure if the forward power calibration is suspect.

Switch the transmitter to Standby and preset R51, the aural null pot on the visual/aural metering board (1265-1309), fully CCW. Adjust R48, the null offset pot on the visual/aural metering board, for 0% Visual Output. Perform the following adjustments with no aural present. This is accomplished by removing jumper cable W1, the aural IF loop-through, that is connected to J16 on (A5) the sync tip clamp/modulator board (1265-1302). Connect a sync and black test signal to the video input jack of the VHF exciter tray. Switch the transmitter to Operate.

Next, set up the transmitter for the appropriate average output power level:

- Sync + black 0 IRE setup/wattmeter=1190 watts
- Sync + black 7.5 IRE setup/wattmeter=1090 watts

NOTE: The transmitter must have 40 IRE units of sync.

Adjust R28, visual calibration, on (A19) the visual/aural metering board (1265-1309) for 100% on the front panel meter in the % Visual Output position.

With the spectrum analyzer set to the zero span mode, obtain a peak reference on the screen. Reconnect jumper cable W1 to J16 on (A5) the sync tip clamp/modulator board. While in the Visual Output Power position, adjust L3 for a minimum visual power reading. Turn the power adjust pot on the front panel until the original peak reference level is attained. Peak L1 and C8 for a maximum aural power reading and then also adjust R20 for a 100% Aural Power reading. Switch the transmitter to the Visual Output Power position and adjust R51, the aural null pot, for 100% Visual Power.

5.9 Calibration of the Reflected Output Level of the Transmitter

NOTE: Only perform the following procedure if the reflected power calibration is suspect.

Check that the transmitter is at 100% forward power. Switch the transmitter to Standby and move the reflected cable to the other Incidental port on the A16 Coupler. Switch the transmitter to Operate and adjust R39 on the visual/aural metering board (1265-1309) for a 10% reading in the Reflected Power position. At this 10% reference power reading, the VSWR LED mounted on the front panel of the exciter should be illuminated. If this LED is not lit, adjust R22 on the transmitter control board in the VHF exciter tray 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 A16 Coupler back to the Reflected port.

Switch the transmitter to Operate and adjust the front panel power pot for a 100% Visual Power reading.

5.10 (A8) 3-Way Combiner Assembly (1065241; Appendix C)

There are no adjustments to (A8) the 3 way combiner assembly.

5.11 (A14) Bandpass Filter Assembly (1304388; Appendix C)

The harmonic and bandpass filters are factory swept by the filter manufacturer and should not be tuned without the proper equipment. Do not attempt to tune the filters without a sweep generator or, preferably, a network analyzer. If tuning is required, consult the Axcera Field Support Department before attempting to make any adjustments.

5.12 Complete Board Level Alignment Procedures for the VHF Low Band Exciter

NOTE: The following procedure should be fallowed only if complete alignment of the VHF exciter tray is needed.

5.12.1 (Optional) 4.5-MHz Composite Input Kit

If the (optional) 4.5-MHz composite input kit is purchased, the tray is capable of operating by using either the 4.5-MHz composite input or the baseband audio and video inputs. The kit adds the (A24) composite 4.5-MHz filter board (1227-1244; Appendix D) and the (A25) 4.5-MHz bandpass filter board (1265-1307; Appendix D) to the transmitter. When the 4.5-MHz intercarrier signal generated by the 4.5-MHz composite input has been selected by the 4.5-MHz composite input kit, the 4.5-MHz generated by the aural IF synthesizer board is not used. When the 4.5-MHz intercarrier signal generated by the baseband video and audio inputs with baseband has been selected by the 4.5-MHz composite input kit, the composite 4.5-MHz filter board and the 4.5-MHz bandpass filter board are not used.

The tray has been factory tuned and should not need any alignments to achieve normal operation. To align the tray for the 4.5-MHz composite input, apply the 4.5-MHz composite input, with the test signals used as needed, to the video input jack (J1 or J2 [loop-through connections]) on the rear of the tray. Select the 4.5-MHz composite input by removing the baseband select from J18-6 and J18-7 on the rear of the tray.

To align the exciter using baseband video and audio inputs, apply the baseband video, with the test signals used as needed, to the video input jack (J1 or J2 [loop-through connections]) and the baseband audio to the proper baseband audio input on the rear of the tray. For balanced audio input, connect TB1-1(+), TB1-2(-), and TB1-3 (GND). For composite/stereo audio, connect the composite audio input jack (J3 or J13 [loop-through connections]) and connect a baseband select from J18-6 and J18-7 on the rear of the tray.

5.12.2 (A6) Delay Equalizer Board (1227-1204; Appendix D)

The jumper W1 on J5 of the sync tip clamp/modulator board, if present, must be in the Enable position between pins 2 and 3.

NOTE: This board has been factory tuned and should not be retuned without the proper equipment.

To tune this board:

1. Connect a sinX/X test signal into jack J1-2 on the delay equalizer board.

2. Monitor the video output of the board, at the video sample jack J2, with a video measuring set, such as the VM700, adjusted to measure group delay.

3. Tune the four stages of the board using the variable inductors (L1-L4)

and potentiometers (R7, R12, R17, and R22) until the signal attains the FCC group delay curve. The stages are arranged in order of increasing frequency. Adjust R29, as needed, to attain the same level out of the board as into the board.

5.12.3 (Optional) (A24) Composite 4.5-MHz Filter Board (1227-1244; Appendix D)

This board is part of the 4.5-MHz input kit and will only function properly with a 4.5-MHz composite input signal and the 4.5-MHz composite input selected. To align this board:

1. Connect the test signal from an envelope delay measurement set to the video input of the tray at J1 or J2.

2. Connect an oscilloscope to jack J7, video out, between the J7 center pin and pin 1 or 3 (ground). Adjust C21, frequency response, if needed, for the best frequency response. Adjust R32, video gain, for a signal level of 1 Vpk-pk on the oscilloscope.

The output at J6 and J7 on the board should be video only, without the 4.5-MHz aural subcarrier.

5.12.4(Optional) (A25) 4.5-MHz Bandpass Filter Board (1265-1307; Appendix D)

This board is part of the 4.5-MHz input kit and will only function properly with a 4.5-MHz composite input signal and the 4.5-MHz composite input selected. To align this board:

1. Adjust the filter with L2, C3, L4, and C7 for a frequency response of no greater than ±0.3 dB from 4.4 to 4.6 MHz.

2. Adjust C19 for an overall peak-to-peak variation of less than ±0.3 dB from 4.4 MHz to 4.6 MHz.

3. Recheck the frequency response; it may have changed with the adjustment of the envelope delay. If necessary, retune the board.

5.12.5 (A7) IF Carrier Oven Oscillator Board (1191-1404; Appendix D)

NOTE: If your transmitter contains a precise frequency control system, an IF VCXO Board (1248-1131) will replace the IF Carrier VCXO Board. . Refer to the precise frequency control instruction manual for set up details.

To align this board:

1. While monitoring J3 with a spectrum analyzer, observe the 45.75-MHz visual IF (typical +5 dBm).

2. Connect a frequency counter to J3 and adjust C17 for 45.750000 MHz.

3. Connect a frequency counter to J1 and check for 50 kHz, which is the aural phase lock loop reference.

5.12.6 (A5) Sync Tip Clamp/Modulator Board (1265-1302; Appendix D)

To align this board:

1. Determine if jumper W4 on jack J3 is present. Jumper W4 terminates the video input into 75Ω. Remove jumper W4 if a video loop-through is required on the rear chassis at jacks J1 and J2.

2. Set the controls R20, the white clip, R24, the sync clip, and R45, the sync stretch cut-in, to their full CCW position. Set R48, the sync magnitude, fully CW and place the

jumper W7 on jack J4 to the Clamp-Off, Disable, position.

3. Connect a 5-step staircase video test signal to the input of the transmitter.

4. Monitor TP2 with an oscilloscope. Adjust R12, the video gain pot, for 1 Vpk-pk.

5. Change the video input test signal to a multiburst test pattern. While monitoring TP2, adjust C8 and R32 for a flat-frequency response. Change the input video test signal back to the 5-step staircase.

6. Monitor TP2 with an oscilloscope. Adjust pot R41, manual offset, for a blanking level of -0.8 VDC. The waveform shown in Figure 5-1 should be observed. Move the jumper W2 on J4 to the Clamp Enable position. Adjust pot R152, depth of modulation, for a blanking level of -0.8 VDC.

NOTE: This waveform represents the theoretical level for proper modulation depth. Step 9 below describes how to set the modulation depth through the use of a television demodulator or a zero-spanned spectrum analyzer tuned to the visual IF frequency.

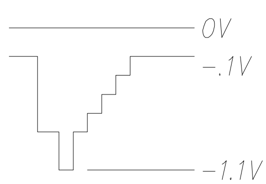

Figure 5-1. Waveform

7. The following test setup is for the adjustment of the depth of modulation and ICPM at IF:

   A. Remove the cable that is on J18 and connect the double-sideband, 45.75-MHz visual IF signal from J18 to a 10-dB splitter/coupler. Connect the coupled port of the splitter/coupler to the RF input of a television demodulator. Connect the direct port to a spectrum analyzer.

   B. Connect the 75Ω video output of the demodulator to the video input of a waveform monitor. For ICPM measurements, also connect the quadrature output of the demodulator to the horizontal input of the waveform monitor using a 250 -kHz, low-pass filter. (An oscilloscope can be used in place of a waveform monitor).

   C. Set the controls of the demodulator to the following:

Detector mode – Cont
Sound trap – In
Zero carrier – On
Auto – Sync
Audio source – Split
De-emphasis – In

8. Move jumper W7 on J4 to the Clamp Disable position. Readjust pot R41, manual offset, for the correct depth of modulation by observing the demodulated waveform on the waveform monitor or on the spectrum analyzer set to zero span.

9. Check the demodulated video for a proper sync-to-video ratio (sync is 28.6% of the total white video signal). If sync stretch is needed, adjust R45, sync stretch cut-in, until sync stretch occurs. Adjust R48, sync stretch magnitude, for the proper amount of stretch. Readjust R41, manual offset, if needed, for the correct depth of modulation.

10. Move jumper W7 on J4 to the Clamp Enable position. Readjust pot R152, depth of modulation, for the correct depth of modulation.

11. Set the waveform monitor to display ICPM. Preset R53 fully CCW, adjust C78 for the greatest effect at white on the ICPM display, and then adjust R53 for minimum ICPM.

12. Recheck the depth of modulation and, if necessary, adjust R152, depth of modulation.

13. On a spectrum analyzer, adjust pot R70 for a level of approximately -10 dBm at J18.

14. Remove the input video test signal. Place the front panel meter in the video position and, while monitoring the meter, adjust pot R144, zero adjust, for a reading of zero.

15. Replace the input video test signal (the 5-step staircase). Turn the front panel meter to the video position and adjust R20 on the transmitter control board for a reading of 1 volt (10 on the 0 to 10 scale). This board does not have sync metering.

16. Reconnect the plug to J18 and move the spectrum analyzer test cable to the 41.25 IF output jack J16. Tune C59 and L17 to L20 to maximize the 41.25-MHz aural IF signal and minimize the out-of-band products. Adjust pot R97 for -20 dBm at J16.

17. Reconnect the plug to J16 and move the spectrum analyzer test cable to IF output jack J20. Preset R62, the visual IF gain pot, to the middle of the range. Insert a multiburst test signal into the transmitter and observe the visual frequency response with the spectrum analyzer set at 1 dB/division. Tune R63 and C30, the IF frequency response adjustments, for a flat-frequency response (±0.5 dB).

18. While still monitoring J20 with a spectrum analyzer, readjust R62, visual IF gain, for a 0 dBm visual output level. Adjust R85, A/V ratio, for a minus 10 dB aural-to-visual ratio or to the desired A/V ratio. Reconnect the plug to J20.

19. Using an input video test signal (the 5-step staircase) with 100 IRE white level, monitor TP2 with an oscilloscope. Set control R24, the sync clip, just below the point where sync clipping begins to occur. Similarly, set R20, the white clip, to just below the point at which the white video begins to clip.

5.12.7 (A4) Aural IF Synthesizer Board, 4.5 MHz (1265-1303; Appendix D)

1. To set up the test equipment for this board:

   A. Connect the 600Ω balanced audio output from an audio oscillator to the balanced audio input terminals of the tray at TB1-1 (+), TB1-2 (-), and TB1-3 (ground) on the rear chassis.

   B. Connect the combined IF output at J21 (IF sample) on the clamp modulator board to the input of an IF splitter. Connect one output of the splitter to the video demodulator and the other output to the spectrum analyzer.

   C. At the front of the demodulator, connect a short cable from the RF-out jack to the IF-in jack.

D. Connect a cable from the 600Ω audio output jack of the demodulator to the input of an audio distortion analyzer.

2. Set the output frequency of the audio oscillator to 400 Hz and the output level to +10 dBm.

3. Center the aural carrier on the spectrum analyzer with the spectrum analyzer set to the following:

Frequency/Division – 10 kHz
Resolution bandwidth – 3 kHz
Time/Division – 50 msec
Trigger – Free run

A. Adjust L5 for approximately +3.5 VDC at TP2.

B. The green LED DS1 should be illuminated, indicating a locked condition. If not, retune L5 for a locked condition.

4. Adjust R13, balanced audio gain, on the aural IF synthesizer board for ±25-kHz deviation.

5. Check the distortion on the aural distortion analyzer (THD=< 0.5%).

6. Disconnect the 600Ω balanced audio input to the tray. Connect a 75Ω stereo audio input (400 Hz at 1 Vpk-pk) to composite audio input jack J3 on the rear of the tray. Follow the procedure in the stereo generator instruction manual for matching the level of the generator to the exciter. Use R17 to adjust the composite audio gain.

7. Check the distortion level on the distortion analyzer (THD)=< 0.5%)

5.12.8 (A8) ALC Board (1265-1305; Appendix D) (Part 1 of 2)

Table 5-1 describes the functions of each LED on the ALC board (A8).

Table 5-1. ALC Board LEDs

LED	FUNCTION
DS1 (Red LED)	Indicates that an abnormally low IF signal level is present at IF input connector J1
DS2 (Red LED)	Indicates that the ALC circuit is unable to maintain the level requested by the ALC reference due to excessive attenuation in the linearity or the IF phase corrector signal path or because jumper W3 on J6 is in manual gain
DS3 (Red LED)	Indicates a video loss fault
DS4 (Red LED)	Indicates that a Mute command is present
DS5 (Green LED)	Indicates that the output from the modulator is selected as the input to the board

1. To align the ALC board, preset the following controls on the tray:

A. ALC Board (1265-1305)

Connect jumper W1 on J4 to disable, between pins 2 and 3 (to disable linearity correctors). Connect jumper W3 on J6 to manual, between pins 2 and 3 (for manual gain control).

Adjust R87, manual gain pot, to mid-range.

B. IF Phase Corrector Board (1227-1250)

Move W2 on J9 to phase correction: enable. Move W3 on J10 to amplitude correction: disable.

2. The combined IF output of the sync tip clamp modulator board is cabled to jack J32 of the ALC board. Remove J32 from the board, and look to see if DS1, Input Fault, is illuminated. Reconnect J32 and make sure that DS1 is extinguished.

3. Jumper W3 on J6 should be in the Manual position. Monitor jack J3 with a spectrum analyzer.

4. With a multiburst video signal present, tune C4 for a flat-frequency response of ±0.5 dB.

5. Before proceeding with the second part of the ALC board alignment, check to see that the IF phase corrector board (1227-1250) is functioning properly.

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

This board is set up during system alignment. The signal level into the board should be approximately the same as the output of the board.

The IF input jack (0 dBm) of the IF phase corrector board is fed from the J3 IF O/P jack of (A8) the ALC board.

The IF output jack of the IF phase corrector board at J4 is fed to J7 IF I/P jack (0 dBm) of the ALC board (A8).

5.12.10 (A8) ALC Board (1265-1305; Appendix D) (Part 2 of 2)

To align this board:

1. Input a multiburst video test signal. Connect a spectrum analyzer to J11. Tune C63 for a flat-frequency response of ±0.5 dB.

2. Move the Operate/Standby switch on the front panel to the Operate position.

3. Place jumper W3 on jack J6 in the Manual mode and adjust R87 for 0.5 volts at TP4.

4. Place jumper W3 on J6 in the Auto mode and adjust the front panel power adjust control A20 fully CW. If the (optional) remote power raise/lower kit is present, then adjust switch S1 on the board to maximum voltage at TP4. Adjust R74, the range adjust, for 1 volt at TP4.

5. Adjust the front panel power adjust control A20 for 0.5 VDC at TP4. If the (optional) remote power raise/lower kit is present, move switch S1 on the board to mid-range and then adjust (A20) the front panel power adjust control for 0.8 VDC at TP4.

6. Disconnect the plug that is on J12 (IF output) and monitor J12 with a spectrum analyzer. Verify an output of approximately 0 dBm. If necessary, adjust R99 to increase the output level. If less of an output level is needed, move jumpers J27 and J28 to pins 2 and 3 and then adjust R99. Reconnect J12.

7. Move W2 on J5 to the Cutback Enable position. Remove the input video signal and verify that the output of the transmitter drops to 25%. Adjust R71, the cutback level, if necessary. Restore the input video.

NOTE: The following step affects the response of the entire transmitter.

8. Connect a video sweep signal to the input of the tray. Monitor the output of the system with a spectrum analyzer. Adjust C71 with R103 and C72 with R106, as needed, to flatten the response. C71 and C72 adjust for the frequency of the correction notch being applied to the visual response

of the transmitter. R103 and R106 are used to adjust the depth and width of the correction notch.

9. The linearity correctors are set up during the system alignment procedure. Controls R13, R18, and R23, the magnitude controls, should be set fully CW. Controls R34, R37, and R40 are the linearity cut-in adjustments.

5.12.11 (A14-A1) Channel Oscillator Board, Dual Oven (1145-1201; Appendix D)

NOTE: If your transmitter contains a precise frequency control system, a VCXO Channel Oscillator Board (1145-1204) will replace the Channel Oscillator Board. Refer to the precise frequency control instruction manual for set up details.

This board is mounted in (A14) the channel oscillator assembly (1145-1202). To align the board:

1. Connect the main output of the channel oscillator (J1) to a spectrum analyzer, tuned to the crystal frequency, and peak tuning capacitors C6 and C18 for maximum output. 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 x4 multiplier board. Tune capacitors C6 and C18 for maximum voltage, then also tune L2 and L4 for a maximum voltage output at TP1.

2. Connect the sample output of the channel oscillator (J2) to a suitable counter and tune C11, coarse adjust, and C9, fine adjust, to the crystal frequency.

3. Reconnect the main output (J1) of the channel oscillator (+5 dBm) to the input (J1) of the x2 multiplier.

NOTE: Do not repeak C6, C18, L2, or L4. This may change the output level.

NOTE: While adjusting C9 and C11 to the crystal frequency, the peak voltage monitored at TP1 of the x2 multiplier board should not decrease. If a decrease does occur, there may be a problem with the crystal. Contact Axcera Field Support for further instructions.

NOTE: If the VCXO board (1145-1204) in the VCXO assembly (1145-1206) is used, the fine-frequency adjust C9 is not located on the VCXO board. It is located in the precise frequency tray. Refer to the precise frequency control instruction manual for set up details.

5.12.12 (A11-A1) x2 Multiplier Board (1172-1111; Appendix D)

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

1. Monitor TP1 with a DVM and tune C4 for maximum voltage. Monitor TP2 with a DVM and tune C6 for maximum voltage. Repeak C4 and C6 for maximum voltage.

2. Connect a spectrum analyzer, tuned to two times the crystal frequency, to the x2 multiplier output jack J2. While trying to keep the out-of-band products to a minimum, monitor the output and peak the tuning capacitors for maximum output.

The output of the x2 multiplier (+15dBm) connects to (A11-A1) the filter/mixer board.

5.12.13 (A11-A2) VHF Filter/Mixer Board (1153-1101; Appendix D)

Typically a +15dBm RF input at J3, a 0dBm combined IF input at J7, and a RF output of 0dBm at J2.

To align the board:

1. Monitor J4, the LO output of the board, with a spectrum analyzer and adjust C12 and C18 for maximum output (+14 dBm) at the LO frequency and minimum out-of-band products. Adjust C13 and C17 for the best frequency response for the LO frequency.

2. Adjust C3 and C6 to determine the center frequency. Use C2 and C7 to locate the upper and lower channel-edge shaping. C4 is used to determine the channel bandwidth.

5.12.14 (A11-A3) VHF Low-Band Filter/Amplifier Board (1064251; Appendix D)

The filter/amplifier board has been factory swept and adjusted for a 6-MHz bandwidth.

NOTE: This board should not be tuned without the proper equipment.

The output of the filter/mixer board connects to the board at J7 (0dBm). It is filtered on the board with the filtered output connecting to J1 on the board that is amplified by U1 to a nominal +12 dBm visual and +2 dBm aural level set by adjusting R9. The output at J2 is fed to J4 on the A11 enclosure and from there to J15 the RF output jack on the rear of the tray.

To align the board, use a multiburst or sweep video signal inserted into the exciter tray.

Check that there is a cable connected from J6 to J1 on the filter/amplifier board. Monitor J2, the RF output of the board, and peak C17 for the maximum signal level. Tune the manual gain adjust R9 for a +12 dBm peak visual output.

This completes the detailed alignment procedure for the VHF Exciter Tray, the VHF L.B. Amplifier Tray, and also the detailed alignment procedures for the entire 335B transmitter. If a problem occurred during the alignment procedure, please call Axcera field support at 724-873-8100 for assistance.

APPENDIX A

SYSTEM SPECIFICATIONS

Low Power VHF Transmitters/Translators 700W - 4kW

334B/434B Pictured

These low power VHF transmitters and translators deliver high quality and performance in a compact and economical package. The time-proven Axcera exciter provides a pre-corrected output directly to the high-gain final power amplifier modules.

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

Low Power VHF Transmitters/Translators 700W - 4kW

Visual Performance

Frequency Range[1]	
300B	54 to 88 MHz
400B	174 to 216 MHz
Carrier Stability *(Transmitters or Translators w/FCR)*	
Standard	±250 Hz
w/PFC	±1 Hz
Frequency Translation Stability *(Translators)*	
Standard	±500 Hz
w/PFC	±1 Hz
Regulation of RF Output Power	3%
Output Variation *(Over 1 Frame)*	2%
Sideband Response	
-1.25 MHz and below	-20 dB
-0.75 to -0.5 MHz	+0.5 db, -2 dB
-0.5 to +3.58 MHz	±0.5 dB
+3.58 MHz to +4.18 MHz	+0.5, -1.0 dB
Freq Response vs. Brightness	±0.5 dB
Visual Modulation Capability	1%
Differential Gain	5%
Incidental Phase Modulation	±3°
Linearity *(Low Frequency)*	5%

Visual Performance *(continued)*

Differential Phase	±3°
Signal-to-Noise Ratio	55 dB
2t K-Factor	2%
Noise Factor *(Translators)*	5 dB *(Max)*
w/Input Preamp	3 dB *(Max)*
Input Dynamic Range *(Translators)*	-60 dB to -25 dBm
w/Input Preamp	-75 dBm to -30 dBm
Env. Delay *(Transmitters)*	Per FCC Standard
Video Input *(Transmitters)*	75 ohms (Loop through)
Harmonics	-60 dB or better
Intermodulation Products	-52 dB or better
Spurious *(>3 MHz from channel edge)*	-60dB or better

Aural Performance

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

General

Model Number	325B/327B 425B/427B	330B/332B 430B/432B	334B/336B 434B/436B	335B-2.6 435B-2.6	335B-3.3 435B-3.3	335B-4 435B-4
Power Output *(Watts)*						
Visual *(Peak)*	700	1350	2000	2650	3300	4000
Aural *(Avg.)*	50	100	200	300	400	500
Output Connector	N	1 5/8" EIA	1 5/8" EIA	3 1/8" EIA	3 1/8" EIA	3 1/8" EIA
No. of PAS	1	2	3	4	5	6
Power Consumption *(Watts)*						
Grey	1800	3350	4900	6450	8000	9550
Sync & Black	2250	4250	6250	8250	10,250	12,250
Input Power						
Line Voltage *(Volts)*[1]	208 or 240 ± 10%					
Power Requirements	Single Phase, 50 or 60 Hz					
Size *(H x W x D)*	69"x22"x34"				69"x44"x34"	
Operational Temperature Range	0 to +50°, derate 2°C/1000 ft.					
Maximum Altitude[1]	8500 feet (2600m) AMSL					
Operational Humidity Range	0% to 95% non-condensing					
RF Load Impedance	50 Ω					

[1] Consult factory for other frequencies, altitudes and line voltages

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

APPENDIX B

SAMPLE LOG REPORT SHEET
AND TYPICAL READINGS

VHF Exciter (A4)

ALC (0 to 1 V) = ____________V

% Exciter (0 to 120) = ______________%

% Reflected (0 to 120) = ____________%

% Visual Power (0 to 120) = _________%

% Aural Power (0 to 120) = __________%

Video (0 to 1 V) = ________________IRE

Audio (0 to 100 kHz) = ____________kHz

VHF Amplifier Trays

#1 (A5)

AGC Voltage (0 to 10 V) = ___________V

% Reflected Power (0 to 120) = _______%

% Output Power (0 to 120) = ________%

Power Supply Voltage (0 to 100 V) = ___V

Current (0 to 10A scale, readings are then multiplied by 2)

Current I_1 = ___________A

Current I_2 = ___________A

Current I_3 = ___________A

Current I_D = ___________A

#2 (A6)

AGC Voltage (0 to 10 V) = ___________V

% Reflected Power (0 to 120) = _______%

% Output Power (0 to 120) = ________%

Power Supply Voltage (0 to 100 V) = ___V

Current (0 to 10A scale, readings are then multiplied by 2)

Current I_1 = ___________A

Current I_2 = ___________A

Current I_3 = ___________A

Current I_D = ___________A

VHF Amplifier Trays

#1 (A7)

AGC Voltage (0 to 10 V) = ___________V

% Reflected Power (0 to 120) = _______%

% Output Power (0 to 120) = ________%

Power Supply Voltage (0 to 100 V) = ___V

Current (0 to 10A scale, readings are then multiplied by 2)

Current I_1 = ___________A

Current I_2 = ___________A

Current I_3 = ___________A

Current I_D = ___________A

#2 (A10)

AGC Voltage (0 to 10 V) = ___________V

% Reflected Power (0 to 120) = _______%

% Output Power (0 to 120) = ________%

Power Supply Voltage (0 to 100 V) = ___V

Current (0 to 10A scale, readings are then multiplied by 2)

Current I_1 = ___________A

Current I_2 = ___________A

Current I_3 = ___________A

Current I_D = ___________A

VHF Amplifier Trays

#3 (A11)

AGC Voltage (0 to 10 V) = ___________V

% Reflected Power (0 to 120) = _______%

% Output Power (0 to 120) = ________%

Power Supply Voltage (0 to 100 V) = ___V

Current (0 to 10A scale, readings are then multiplied by 2)

Current I_1 = ___________A

Current I_2 = ___________A

Current I_3 = ___________A

Current I_D = ___________A

Date __________________

Customer Name ______________________________ Call Letters ________________

Technician ____

VHF Low Band Exciter Tray (A4)

ALC = .8V

% Exciter = The level needed to attain 100% output power from the transmitter (Typically between 80 & 100%).

% Reflected = < 10%

% Visual Power = 100 % (3300 Watts Peak of Sync)

% Aural Power = 100 % (330 Watts @ 10 dB A/V Ratio)

Video = 1 V at White w/.3V Sync Only, -40 IRE

Audio = ±25 kHz with Balanced Audio Input or ±75 kHz with Stereo Composite Audio Input

VHF Amplifier Trays (A5, A6, A7, A10 & A11)

AGC Voltage = 1 to 3V

% Reflected Power = < 5%

% Output Power = ˜ 100%

Power Supply Voltage = 30V

	Operating Currents	Idling Currents
Current I_1 =	12A-13A (Black Picture)	1.8A (No RF Applied)
Current I_2 =	12A-13A (Black Picture)	1.8A (No RF Applied)
Current I_3 =	12A-13A (Black Picture)	1.8A (No RF Applied)
Current I_D =	3A (Black Picture)	3A (No RF Applied)

(The readings are from the 0 to 10A scale with the value then multiplied by 2)

APPENDIX C

ASSEMBLY DRAWING LISTS

335B System:

VHF Low Band Exciter Tray, M/N, Sync Tip Clamp

VHF Low Band Amplifier Tray

APPENDIX D

SUBASSEMBLY DRAWING LISTS