Chapter 5
Detailed Alignment Procedures

This transmitter was aligned at the factory and should not require additional alignments to achieve normal operation. Before beginning the alignment procedures, check that the RF output at J2 of (A18) the output coupler assembly of the transmitter is terminated into a dummy load or is connected to the antenna. While performing any alignments, 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 substantial amount, the problem is likely to be in that tray.

5.1 (A1-A4) UHF Exciter Tray (1063301; Appendix A)

If the (optional) 4.5-MHz composite input kit has been purchased, the UHF exciter tray is capable of operating using either the 4.5-MHz composite input or the baseband audio and video inputs. The kit adds (A24) the composite 4.5-MHz filter board and (A25) the 4.5-MHz bandpass filter board to the UHF exciter. The 4.5 MHz generated by the aural IF synthesizer board is not used when the 4.5-MHz composite input kit has selected the 4.5-MHz intercarrier signal generated by the 4.5-MHz composite input. The composite 4.5-MHz filter board and the 4.5-MHz bandpass filter board are not used when the 4.5-MHz composite input kit uses the 4.5-MHz intercarrier signal generated by the baseband video and audio inputs with baseband select.

The exciter tray has been factory tuned and should not need to be aligned to achieve normal operation. To align the UHF exciter for 4.5-MHz composite input, apply the 4.5-MHz composite input, with the test signals used as needed, to video input jack J1 on the rear of the tray. Select the 4.5-MHz composite input by removing the baseband select from J7-6 and J7-7 on the rear of the tray, if applied.

To align the UHF exciter using baseband video and audio inputs, connect the baseband video, with the test signals used as needed, to video input jack J2 on the remote interface panel. For balanced audio input, connect the baseband audio to TB1-1(+), TB1-2(-), and TB1-3 (GND) on the remote interface panel. For composite/stereo audio, connect the stereo source to J6 on the remote interface panel.

5.1.1 (A6) (Optional) Delay Equalizer Board (1227-1204; Appendix B)

This board has been factory tuned and should not be retuned without the proper equipment. If it is necessary to tune the board:

1. Select a sinX/X test signal as the video source to the delay equalizer board.

2. Monitor the video output of the board at video sample jack J2 with a video measuring set (VM700) that has been 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 coming out of the board as is going into the board.

5.1.2 (A24) (Optional) Composite 4.5-MHz Filter Board (1227-1244; Appendix B)

The (A24) (optional) composite 4.5-MHz filter board will only function properly with a 4.5-MHz composite input signal and with the 4.5-MHz composite input selected.

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

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 of the board should be video only with no 4.5-MHz aural subcarrier.

5.1.3 (A25) (Optional) 4.5-MHz Bandpass Filter Board (1265-1307; Appendix B)

The (A25) (optional) 4.5-MHz bandpass filter board will only function properly with a 4.5-MHz composite input signal and with the 4.5-MHz composite input selected.

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. If necessary, retune the board.

5.1.4 (A7) IF Carrier Oscillator Board (1191-1404; Appendix B)

To align (A7) the IF carrier oscillator 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; this is the aural phase lock loop (PLL) reference.

5.1.5 (A5) Sync Tip Clamp/ Modulator Board (1265-1302; Appendix B)

To align (A5) the sync tip clamp/ modulator board:

1. Determine if jumper W4 on jack J3 is present. Jumper W4 terminates the video input into 75Ω. Remove jumper W4 if the 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 fully counter-clockwise (CCW) position. Set R48, the sync magnitude, fully clockwise (CW).
3. Place the jumper W7 on jack J4 to the clamp off, disable, position.
4. Connect a 5-step staircase video test signal to the input of the transmitter.
5. Monitor TP2 with an oscilloscope. Adjust R12, the video gain pot, for 1 Vpk-pk.
6. 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.

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

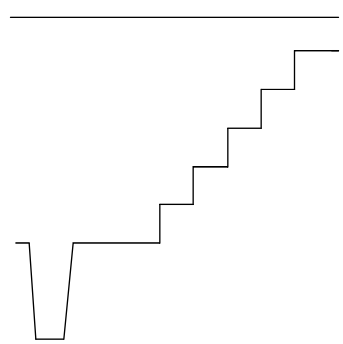

Figure 5-1. Waveform at TP2.

Note: The waveform in Figure 5-1 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.

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

   A. Remove the cable that is now on J18. 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 75-Ω video output of the demodulator to the video input of a waveform monitor. For incidental carrier phase modulation (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 as follows:

   - Detector Mode: Cont
   - Sound Trap: In
   - Zero Carrier: On
   - Auto: Sync
   - Audio Source: Split
   - De-Emphasis: In

9. 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.

10. Check the demodulated video for the 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 necessary, for the correct depth of modulation.

11. Move jumper W7 on J4 to the clamp enable position. Readjust pot R152, the depth of modulation, for the correct depth of modulation.

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

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

14. Adjust pot R70 for a level of approximately -10 dBm on the spectrum analyzer at J18.

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

16. Replace the video input 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 100 (10 on the 0-to-10 scale). This board does not have sync metering.

17. Reconnect the plug to J18 and move the spectrum analyzer test cable to 41.25 IF output jack J16. Tune C59 and L17-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.

18. 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. 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).

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

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

Note: This procedure should be performed after the system setup or if linearity problems occur.

5.1.6 (A26) Diacrode VSBF Bypass Board (1293-1230; Appendix B)

The (A26) diacrode VSBF bypass board is used to bypass the clamp board saw filter when S1 and S2 are in the enable position. This double sideband signal can be used to sweep the tube cavity with a double sideband and no aural present. C2 is used to flatten the double sideband response. S1 and S2 are normally in the bypass position.

5.1.7 (A4) Aural IF Synthesizer Board, 4.5 MHz (1265-1303, Appendix B)

1. The test equipment setup for (A4) the aural IF synthesizer board, 4.5 MHz, is as follows:

    A. Connect a 600-Ω 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, the 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. Connect a short cable at the front of the demodulator from the RF-out jack to the IF-in jack.

    D. Connect a cable from the 600-Ω 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 (< 0.5%).

6. Disconnect the 600-Ω balanced audio input to the tray. Connect a 75-Ω 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. R17 is used to adjust the composite audio gain.

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

5.1.8 (A8) ALC Board (1265-1305; Appendix B) (Part 1 of 2)

The following details the meaning of each LED of (A8) the ALC board when it is illuminated:

- 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 signal level requested by the ALC reference; this is usually due to excessive attenuation in the linearity or the IF phase corrector signal path, or because the 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 (not used in this configuration)

- DS5 - Green LED: Indicates that the output from the modulator is selected as the input to the ALC board

1. To align the ALC board, preset the following controls in the UHF exciter tray:

- ALC board – Move jumper W1 on J4 to disable, between pins 2 and 3 (to disable linearity correctors); move jumper W3 on J6 to manual, between pins 2 and 3 (for manual gain control); adjust R87, the manual gain pot, to mid-range
- IF phase corrector board – Move jumper W2 on J9 to the phase correction enable position; move the jumper W3 on J10 to the amplitude correction disable position.

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 check to see that DS1, Input Fault, is illuminated. Reconnect J32 and check to see 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 part 2 of the ALC board alignment (described in section 5.1.10), check the IF phase corrector board to make sure that it is functioning properly.

5.1.9 (A9) IF Phase Corrector Board (1227-1250; Appendix B)

Refer to the system alignment procedures at the end of this chapter for the set up of (A9) the IF phase corrector board in the exciter tray. The signal level into the board should be approximately the same as the output of the board.

The IF input jack of the IF phase corrector board is fed from J3, the IF output jack of (A8) the ALC board.

The IF output jack of the IF phase corrector board is fed to J7, the IF input jack of (A8) the ALC board.

5.1.10 (A8) ALC Board, NTSC (1265-1305; Appendix B) (Part 2 of 2)

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

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

Place jumper W3 on jack J6 in the Manual mode and adjust R87 for 0.8 volts at TP4.

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, adjust switch S1 on the board to maximum voltage at TP4. Adjust R74, the range adjust, for 1 volt at TP4.

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

Disconnect the plug that is now on J12 (IF output) and monitor the output with a spectrum analyzer. The output should be approximately 0 dBm. Adjust R99, if necessary, to increase the output level. If a smaller output level is needed, move the jumpers J27 and J28 to pins 2 and 3 and adjust R99 as needed. Reconnect J12.

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 video input signal.

Note: This step affects the response of the entire transmitter. 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 can be adjusted 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.

Controls R13, R18, and R23, the magnitude controls, should be set fully CW. Controls R34, R37, and R40 are the linearity cut-in adjustments.

5.1.11 (A11) UHF Upconverter Board (1265-1310; Appendix B)

To align (A11) the UHF upconverter board, place W1 on J10 in the Manual position. R10 is a gain control that is adjusted to give an output of approximately +17 dBm at J5 of the board with an input of 0 dBm of IF.

5.1.12 (A14-A1) Channel Oscillator Board (1145-1201; Appendix B)

The (A14-A1) channel oscillator board is mounted in (A14) the channel oscillator assembly. To align this board:

1. Connect J1, the main output of the channel oscillator, to a spectrum analyzer tuned to the crystal frequency. Peak the 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 x8 multiplier board. Tune capacitors C6 and C18 for maximum voltage and tune L2 and L4 for maximum voltage output at TP1.

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

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

Note: While adjusting C9 and C11 to the crystal frequency, the peak voltage monitored at TP1 of the x8 multiplier board should not decrease. If a decrease does occur, there may be a problem with the crystal. Contact the ADC Field Service Department for further instructions.

Note: If the channel oscillator in the channel oscillator assembly is used, the C9 fine-frequency adjust is not on the channel oscillator board. It can be found on the FSK w/EEPROM board by using R9.

3. Reconnect J1, the main output of the channel oscillator, to J1, the input of the x8 multiplier.

5.1.13 (A15-A1) x8 Multiplier Board (1227-1002; Appendix B)

The (A15-A1) x8 multiplier board is mounted in an x8 multiplier enclosure assembly. During normal operation, the green LED DS1, which can be seen through the access hole in the enclosure assembly, will be lit to indicate that the LO is present at the output of the x8 multiplier board.

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

Tune C4, C6, C10, C12, C18, and C20 for maximum output.

Readjust all of the capacitors to minimize the seventh and the ninth harmonics of the channel oscillator frequency. They should be at least -30 dB down without affecting the x8 multiplier output.

If a spectrum analyzer is not available, a DC voltmeter can be used. When a voltmeter is used, the harmonic frequencies must be minimized to prevent interference with other channels.

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

- Monitor TP1 with a DVM and tune C4 for maximum (typical 0.6 VDC).
- Monitor TP2 and tune C6 and C10 for maximum (typical 1.2 VDC).
- Monitor TP3 and tune C12 and C18 for maximum (typical 2.0 VDC).
- Monitor TP4 and tune C20 for maximum.
- Repeak C12 and C10 while monitoring TP4 (typical 3.5 VDC).
- The typical output level is +15 dBm.

5.1.14 (A19) Visual/Aural Metering Board (1265-1309; Appendix B)

The (A19) visual/aural metering board is adjusted to give a peak-detected output indication to the front panel meter for the visual output and aural output of the driver cabinet. The board should not need to be adjusted to achieve normal operation.

5.1.15 (A3) +12 VDC (4A)/-12 VDC (1A) Power Supply Board (1265-1312; Appendix B)

There are no adjustments that need to be made to (A3) the +12 VDC (4A)/-12 VDC (1A) power supply board. DS1 will be lit if a +12 VDC output is connected to J6. DS2 will be lit if a +12 VDC output is connected to J3. DS3 will be lit if a +12 VDC output is connected to J4. DS4 will be lit if a +12 VDC output is connected to J5. DS5 will be lit if a -12 VDC output is connected to J7 and J8.

5.1.16 Transmitter Control Board (1293-1221; Appendix B)

To align the VSWR cutback, adjust the 3-watt amplifier tray for a 12.5% Visual Power reading on the metering control panel. Reverse the J6 and J3 cables on (A2-A2) the coupler on the output of the diacrode cavity. Adjust R22 unto the VSWR light starts to illuminate on the exciter front panel. Place the J3 and J6 cables back in their original positions.

To align the video metering, insert a composite or some other 100-IRE test signal into the exciter tray. Adjust R20 for a full-scale reading (1 volt) on the bottom scale of the front panel meter of the exciter tray in the video metering position.

To align the audio metering, adjust the audio input level for a ±25 kHz deviation using a spectrum analyzer. Adjust R19 on the board for a 25-kHz reading on the bottom scale of the front panel meter of the exciter tray.

This completes the detailed alignment procedures for the UHF exciter tray.

5.2 (A9) 3-Watt Amplifier Tray (1068203; Appendix A)

The 3-watt amplifier tray has been aligned at the factory and should not require any further adjustments. If an alignment is necessary, terminate the 3-watt tray into a dummy load before performing any adjustments.

5.2.1 (A1) UHF Filter (1007-1101; Appendix B)

The (A1) UHF filter (1007-1101) has been factory swept and should not be tuned without the proper equipment. The filtered output is sent to (A2) the AGC board input jack J1.

5.2.2 (A2) AGC Board (1007-1201; Appendix B)

Perform the following steps to align (A2) the AGC board (1007-1201):

1. With S1 on the AGC board in the Manual position, adjust R32 for about a -2 dBm output at J2.
2. The RF output of the AGC board is fed to (A27) the UHF phase shifter board input jack J1.

5.2.3 (A27) UHF Phase Shifter Board (1142-1315; Appendix B)

The (A27) UHF phase shifter board (1142-1315) adjusts the phase of the signal to produce the maximum output of the transmitter when the two parallel amplifiers are added together.

Adjust R7 on the front panel of the tray for maximum output power. Monitor the combined % Output power on the front panel meter of the transmitter.

The phase-corrected RF output is fed to (A3) the UHF amplifier/regulator board input jack J1.

5.2.4 (A3) UHF Amplifier/Regulator Board (1007-1204; Appendix B)

The (A3) UHF amplifier/regulator board (1007-1204) has no tuning adjustments and has a gain of about +17 dB. The output is fed to (A5) the 3-watt amplifier board #1 input jack J1.

5.2.5 (A5) 3-Watt Amplifier # 1 (1007-1211; Appendix B)

The (A5) 3-watt amplifier #1 (1007-1211) has a gain of about 9 dB and is tuned with C2, C4, and C8 for maximum output.

The operating current, static current with no drive applied, of the amplifier is set to 800 milliamps with R7 on (A6) the opto-bias board. The current is determined by measuring the voltage drop across R3, the 3.3-ohm resistor in the collector circuit of Q1 on the amplifier board, and adjusting R7 for a voltage drop of 2.64 volts.

The RF output is fed to (A7) the 3-watt amplifier board #2.

5.2.6 (A7) 3-Watt Amplifier # 2 (1007-1211; Appendix B)

The (A7) 3-watt amplifier #2 (1007-1211) has a gain of about 9 dB and is tuned with C2, C4, and C8 for maximum output.

The operating current of the amplifier is set to 850 mA with R7 on (A8) the opto-bias board. The current is determined by measuring the voltage drop across R3, the 3.3-ohm resistor in the collector circuit of Q1 on the amplifier board, and adjusting R7 for a voltage drop of 2.8 volts.

The output of the amplifier is fed through (A9) the UHF dual coupler assembly to RF output jack J2 of the tray. A forward and reflected power sample is taken from the UHF dual coupler assembly and fed to (A10) the dual peak detector board.

5.2.7 (A10) Dual Peak Detector Board (1002-1208; Appendix B)

While monitoring the RF output of (A10) the dual peak detector board (1002-1208), adjust R32 on (A2) the AGC board for a reading of 3-watts peak envelope power (3 watts CW). While in the Output position of the Meter Selector switch, adjust R14 on the dual peak detector board for a reading of 100% on the front panel meter.

Move the cable from J1 of the dual peak detector board to J2. Move the Meter Selector switch to the Reflected Power position and adjust R16 on the dual peak detector board for a reading of 100%. Replace the cable onto J1.

5.2.8 (A2) AGC Board (1007-1201; Appendix B)

Remove RF input J1 to (A2) the AGC board (1007-1201) and adjust R10 for a reading of 0 volts on TP1. Replace the RF input. The nominal reading at TP1 should be +.35 volts.

If necessary, adjust R32 for an output power reading of 100%. Switch S1 to the AGC position and adjust R49 for a reading of 100% on the Output Power meter.

5.2.9 (A25) AGC Control Board (1137-1201; Appendix B)

To align (A25) the AGC control board (1137-1201), measure TP3 with a DVM and adjust R3, gain #1, for a 0.9 volt nominal reading. Then, if the outer loop AGC is used, adjust R12, gain #2, for 1 volt, with the output of the transmitter at the normal output level.

5.2.10 (A29) Overdrive Protection Board (1142-1626; Appendix B)

To set up the override circuit, check that the output power level of the transmitter is at 100% with a sync-only 0 IRE test signal. Adjust R11 for a reading of .4 VDC at TP1.

Increase the output power level of the transmitter to 110% and adjust R12 until the output power begins to drop off. Return the output power level of the transmitter to 100%. The trip circuit may need to be readjusted if the amplifier tray is terminated into a different load.

5.2.11 (A11) Power Supply Control Board (1007-1202; Appendix B)

There are no adjustments to (A11) the power supply control board (1007-1202).

5.2.12 (A22) ±12V Power Supply Board (1062-1013; Appendix B)

There are no adjustments to (A22) the ±12V power supply board (1062-1013).

5.2.13 (A16) +24V Power Supply Board (1007-1207; Appendix B)

To adjust the power supply for overvoltage protection, start by presetting R11 on (A16) the +24V power supply board (1007-1207) fully CW. Measure the voltage at J1-10 with a DVM and adjust R8 for 25 volts. Adjust R11 CCW until the power supply shuts off due to overvoltage. Adjust R8 fully CCW. Turn off the tray, wait a few seconds, and then turn the tray back on. This will reset the power supply board.

While monitoring J1-10, slowly adjust R8 CW toward 25 volts. If the power supply does not shut off at 25 volts, adjust R11 slightly more CCW until it does shut off.

Adjust R8 CCW. Reset the tray by turning the tray off, waiting a few seconds, and then turning the tray back on. Adjust R8 CW while monitoring J1-10 and check to see if the supply will now shut off at 25 volts. If necessary, repeat this procedure. Adjust the output voltage of the board at J1-10 to 24 volts using adjustable resistor R8.

This completes the detailed alignment procedures for the 3-watt UHF amplifier tray.

5.3 (A6, A7) 250-Watt Amplifier Tray (1044027/1044028/1044029; Appendix A)

This tray has been adjusted at the factory to meet all specifications, including feedforward correction, and should not require any adjustments to attain normal operation.

5.3.1 (A1-A1) Single Stage Amplifier Assembly, Class A (1286-1608/ 1286-1609/1286-1610; Appendix B)

The (A1-A1) single stage amplifier assembly, class A, is made from a generic single stage amplifier board, class A, with a frequency determining kit.

This board operates class A and has a gain of approximately 11 dB. The bias of the transistor is set by the on-board biasing circuit. Adjust R6 for 5 amps of idle current and no RF drive applied. Connect a voltage meter across E2 and E3 on (A15) the amplifier protection board and switch S1 to the #1 position. Adjust R6 for a reading of 50 mV. Connect a sweep test signal to J1, the RF input jack of the UHF amplifier tray, and monitor the output of the board at J2 with a padded-input spectrum analyzer. Tune capacitor C5 for peak output and tune C6 for peak output power with a flat-frequency response at J2.

5.3.2 (A1-A3) Stripline Coupler Board (1286-1604; Appendix B)

There are no adjustments to (A1-A3) the stripline coupler board.

5.3.3 (A1-A5) Single Stage Amplifier Assembly, Class AB (1286-1605/ 1286-1606/1286-1607; Appendix B)

The (A1-A5) single stage amplifier assembly, class AB, is made from a generic single stage amplifier board, class AB, with a frequency determining kit.

This board operates class AB and has a gain of approximately 9 dB. The bias of the transistor is set by the on-board biasing circuit. Adjust R106 for 500 milliamps and no RF drive applied. Connect a voltage meter across E2 and E3 on the amplifier protection board and switch S1 to the #2 position. Adjust R106 for a reading of 5.0 mV. Connect a sweep test signal to J1, the RF input jack of the UHF amplifier tray, and monitor the output of the board at J2 with a padded-input spectrum analyzer. Tune capacitor C105 for peak output and tune C119 for peak output with a flat-frequency response and minimum current at J2.

5.3.4 (A19-A6) 2-Way Splitter Assembly

There are no adjustments to (A19-A6) the 2-way splitter assembly (1044096).

5.3.5 (A19-A7, A19-A8) Dual Output Power Amplifier Assemblies, Class AB (1286-1316/1286-1317/1286-1318; Appendix B)

Each board in (A19-A7, A19-A8) the dual output power amplifier assemblies, class AB, is made from a generic dual stage amplifier board, class AB, with a frequency determining kit.

These boards operate class AB and have a gain of approximately 9 dB. The idling current for each of the transistors is set to 250 mA.

To adjust the idling currents, no RF applied to the tray, of the devices on (A1-A7), connect a voltage meter across E2 and E3 on the amplifier protection board. Switch S1 to the #3 position and adjust R106 for a reading of 2.5 mV. Switch S1 to the #4 position and adjust R206 for a reading of 2.5 mV.

To adjust the idling currents of the devices, no RF applied to the tray, on (A1-A8), connect a voltage meter across E2 and E3 on the amplifier protection board. Switch S1 to the #5 position and adjust R106 for a reading of 2.5 mV.

Switch S1 to the #6 position and adjust R206 for a reading of 2.5 mV.

Connect a sweep test signal to J1, the RF input jack of the UHF amplifier tray. On (A1-A7) the amplifier board, tune capacitors C105 and C205 for peak output power. Tune C119 and C219 for peak output power with a flat-frequency response and minimum current.

Connect a sweep test signal to J1, the RF input jack of the UHF amplifier tray. On (A1-A8) the amplifier board, tune capacitors C105 and C205 for peak output power. Tune C119 and C219 for peak output power with a flat-frequency response and minimum current.

5.3.6 (A1-A9) 2-Way Combiner Board (1292-1122/1292-1102/1292-1121; Appendix B)

There are no adjustments to (A1-A9) the 2-way combiner board.

5.3.7 (A3) Phase/Gain Adjust Module (1286-1616; Appendix B)

There is no basic setup for (A3) the phase/gain adjust module. All tuning or adjustments should be performed using the feedforward correction alignment procedure (see section 5.3.19).

5.3.8 (A5) Stripline Coupler Board (1286-1604; Appendix B)

There are no adjustments for (A5) the stripline coupler board.

5.3.9 (A20-A1) Error Amplifier Phase/Gain Module (1286-1703; Appendix B)

There is no basic setup for (A20-A1) the error amplifier phase/gain module. All tuning or adjustments should be performed using the feedforward correction alignment procedure (see section 5.3.19).

5.3.10 (A2-A2) 1-Watt UHF Amplifier Assembly (1286-1235; Appendix B)

The (A2-A2) 1-watt UHF amplifier board within the 1-watt amplifier assembly has approximately 10 dB of gain. There are no adjustments to this board.

5.3.11 (A2-A3) Single Stage Amplifier Assembly, Class A (1286-1608/1286-1609/1286-1610; Appendix B)

The (A2-A3) single stage amplifier assembly, class A, is made from the generic single stage amplifier board, class A, with a frequency determining kit.

This board operates class A and has a gain of approximately 11 dB. The bias of the transistor is set by the on-board biasing circuit. Adjust R6 for 5 amps of idle current and no RF drive applied. Connect a voltage meter across E2 and E3 on (A15) the amplifier protection board and switch S1 to the #8 position. Adjust R6 for a reading of 50 mV.

Connect a sweep test signal to J1, the RF input jack of the UHF amplifier tray, and monitor the output of the board at J2 with a padded-input spectrum analyzer. Tune capacitor C5 for peak output and tune C6 for peak output power with a flat-frequency response at J2.

5.3.12 (A7) 7-dB UHF Coupler (2011-1000/2011-1001; Appendix B)

There are no adjustments to (A7) the 7-dB UHF coupler.

5.3.13 (A8) UHF Coupler Assembly (1007-1208; Appendix B)

There are no adjustments to (A8) the UHF coupler assembly.

5.3.14 (A10) Circulator

There are no adjustments to (A10) the circulator.

5.3.15 (A17) Dual Peak Detector Board (1002-1208; Appendix B)

There are no adjustments to (A17) the dual peak detector board.

5.3.16 (A15) Amplifier Protection Board (1292-1125; Appendix B)

There are no adjustments to (A15) the amplifier protection board.

5.3.17 (A16) Amplifier Control Board (1292-1112; Appendix B)

Note: The phase and gain adjustments should only be performed during the feedforward correction setup procedure (see section 5.3.19).

To set up the forward and reflected metering, perform the procedure described in this section. The 250-watt tray must be terminated into a dummy load rated for at least 250 watts and the amplifier Test switch should be enabled on the amplifier assembly metering control panel.

Note: This procedure should only be performed after the feedforward cancellation setup in section 5.3.19, if required, has been completed.

To set the video signal to 0 IRE with no aural, the aural must first be removed by pulling connector J16 from (A5) the sync tip clamp board in the exciter tray. Adjust manual gain pot R32 on (A2) the AGC board in the 3-watt amplifier tray for 150 watts average power with 40 IRE units of sync. Use correction or sync stretch, if necessary, to correct for 40 IRE units of sync.

Use a spectrum analyzer to reference the visual carrier level.

Reconnect the aural carrier at J16 on the sync tip clamp board with the correct V/A ratio from the exciter tray.

Readjust R32, the manual gain pot, to match the visual carrier to the previous reference level. Use the correction or sync stretch again, if necessary, to correct for 40 IRE units of sync.

Adjust R3 on (A16) the amplifier control board on the 250-watt amplifier tray for a 100% forward power meter reading on the tray.

Decrease the R32 manual gain pot on the 3-watt tray for a 20% Forward Power reading on the 250-watt amplifier tray meter.

Disconnect the RF output from the 250-watt amplifier tray.

Adjust R10 on (A16) the amplifier control board on the 250-watt amplifier tray for a 20% reflected power meter reading.

Reconnect the RF output to the 250-watt amplifier tray.

Reset manual gain pot R32 on the 3-watt tray for a 100% forward power meter reading.

5.3.18 (A11) ASTEC America +26.5V/1500W Switching Power Supply (VS1-L6-01-CE; Appendix B)

The (A11) ASTEC America +26.5V/ 1500W switching power supply (VS1-L6-01-CE) contains no customer-repairable items. If the power supply should malfunction, do not attempt to repair the power supply without first consulting the ADC Field Service Department. The power supply is adjusted to provide an output of +27 VDC.

5.3.19 Calibration of the Feedforward Correction Circuits

Note: This procedure is factory set and should not need to be readjusted in the field.

Set up a network analyzer for the following settings:

- Frequency: Center of channel to be tuned
- Span: 20 MHz
- Power level: > +10 dBm
- Markers: > Center frequency, CF +6 MHz, CF - 6 MHz

Turn on the 250-watt amplifier tray and tune the main amplifier output power path for maximum gain. Verify that the main signal path is peaked.

Verify that the response is within +/- 0.25 dB across the center frequency +/- 6 MHz. Using this main path as a reference, calibrate Channel 1 of the network analyzer for transmission.

Turn off the 250-watt amplifier tray.

Terminate (A18) the delay line output with a high-power termination and terminate the RF input on (A7) the 7-dB UHF coupler assembly.

Terminate (A4) the delay line output and J1 on (A5) the UHF dual stripline coupler board.

Turn on the 250-watt amplifier tray.

Tune the correction amplifier path for maximum gain.

Verify that the response is within +/- 0.25 dB across the center frequency +/- 6 MHz.

Adjust R20, gain adjustment, on (A16) the amplifier control board until the gain is within 0.5 dB from the calibrated reference.

Adjust R29, phase adjustment, on (A16) the amplifier control board until the phase is 180° from the calibrated reference.

Make sure that the delay is within 5 nsec of the calibrated reference. Adjust A18) the delay line accordingly to achieve a delay of within 5 nsec.

Note: The main output power path will need to be recalibrated if it is necessary to adjust the delay line.

After setting up the gain and phase, turn off the 250-watt amplifier tray. Reconnect (A18) the delay line to (A7) the 7-dB UHF coupler assembly.

Turn on the 250-watt amplifier tray and readjust the R20 gain adjustment and the R29 phase adjustment for the best cancellation across the center frequency +/- 6 MHz.

Note: The cancellation should be >20 dB.

Turn off the 250-watt amplifier tray.

Disconnect (A18) the delay line and re-terminate it with a high-power termination.

Re-terminate the RF input on (A7) the 7-dB UHF coupler assembly with a 1-watt termination.

Turn on the 250-watt amplifier tray and, using this path as the reference, calibrate Channel 1 of the network analyzer for transmission.

Turn off the 250-watt amplifier tray.

Disconnect and terminate J4 from (A5) the UHF stripline coupler board.

Terminate the rigid line going to J4 of (A5) the UHF stripline coupler board.

Reconnect (A4) the delay line to J1 of (A5) the UHF stripline coupler board. Turn on the 250-watt amplifier tray and adjust capacitors C1 and C2 on (A3) the phase/gain adjust module until they are 180° from the 2nd calibrated reference.

Adjust R22, gain adjust, on (A16) the amplifier control board until the gain is within 0.5 dB.

Make sure that the delay is within 5 nsec from the 2nd calibrated reference. Adjust (A4) the delay line accordingly to achieve this delay.

After setting up the gain and phase, turn off the 250-watt amplifier tray.

Reconnect the rigid line to J3 of (A5) the dual UHF stripline coupler board.

Turn on the 250-watt amplifier tray. Adjust the phase adjustment caps on (A3) the phase/gain adjust module and R22, gain adjustment, on (A16) the amplifier control board for the best cancellation.

Note: Cancellation should be >20 dB.

Reconnect (A18) the delay line to (A7) the 7-dB UHF coupler assembly.

At this point, the UHF amplifier tray is aligned, calibrated, and ready for normal operation.

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 amplifier trays and should need no additional adjustments.

Locate (A9) the IF phase corrector board (1227-1250) mounted in the UHF exciter. Because the amplitude correction portion of the board is not utilized in this configuration, the jumper W3 on J10 should be in the disable position, to +6.8 VDC, and R35 and R31 should be fully 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 video input test source to select an NTSC 3.58-MHz modulated staircase or ramp test waveform and 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. If necessary, adjust the R3 threshold for the cut-in point of the correction and the R7 magnitude for the amount of the correction.

Jumper W1 on J8 is set to give the desired polarity of the correction that has been shaped by the threshold R11 and magnitude R15 adjustments. After setting the polarity, adjust the R11 threshold for the cut-in point of the correction and the R15 magnitude for the amount of the correction that is needed. Finally, adjust the R19 threshold for the cut-in point of the correction and the R23 magnitude for the amount of the correction that is needed.

Note: Adjusting these pots changes all visual parameters and should be done cautiously.

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 volt. Center the display around blanking.

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

While performing the preceding adjustments, the intermodulation beat products between the colorburst and the aural carrier at 920 kHz above visual carrier should be observed on the spectrum analyzer. 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 unit of IRE. The pot R31 on the IF phase corrector board is used for any extra intermodulation corrections that may be needed.

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

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, 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 UHF exciter tray assembly drawing (1064946) and the ALC board parts location drawing (1265-5305) for 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 initially adjust the linearity correctors, make sure that the transmitter is operating at full power with the desired A/V ratio. Check that the jumper W1 on J4 on the ALC board is enabled, between pins 1 and 2. Check 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 video input connector on the remote interface panel of 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 IF ALC board (1265-1305), preset pots R34, R37, and R40 (threshold) fully CCW, and the magnitude adjustments R13, R18, and R23 fully CW.

Adjust pots R34, R37, and R40 CW on the IF ALC board, as necessary, to give correction at sync or at low luminance levels; these are viewed at the right-hand edge of the waveform monitor.

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 on the modulator board. The sync stretch adjustment is R48 on the sync tip clamp on the modulator board.

Switch the transmitter to Standby.

5.6 (A11) UHF High-Power Tee

The inputs to the UHF tee (1227-1017, low band; 1227-1018, mid band; or 1227-1019, high band) are the outputs of the two UHF amplifier trays. The inputs are 50-Ω impedances to match the output impedance of the UHF amplifier trays. The two inputs are combined and then sent through a piece of transmission line, one quarter of a wavelength long, to transform the output impedance of the tee to 50Ω. The output of the UHF tee is then sent to (A9) a bandpass waveguide filter.

Note: The bandpass filter and the (optional) trap filter are factory swept 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 with the ADC Field Support Department before attempting to tune the filters.

5.7 (A13) Bandpass Filter

The input to the bandpass filter is the output of the hybrid combiner, which is the combined output of the UHF amplifier trays. The filter is made of aluminum waveguide and has five resonant cavities. The filter has five bolts for tuning adjustments, three located in the middle on the left and two on the right, and four or six rods on the front of the bandpass filter, depending upon the channel, for coupling adjustments between the sections. The bandpass filter also utilizes two integral traps at -4.5 MHz and +9 MHz from F_V at the top and bottom, respectively, of the left-hand side of the bandpass filter, looking from the rear of the cabinet. Figure 5-2 shows the location of the bolts used for making tuning adjustments.

To tune the filter, connect a sweep signal to the input of the filter and adjust the five tuning bolts for a 6-MHz bandwidth and a flat-frequency response across the desired band.

Note: The bandpass ripple should be ≤0.25 dB. The 6-MHz band should also have a minimum of 20 dB return loss across the pass band.

See Table 5-1 for typical bandpass values.

Table 5-1. Typical Bandpass Values

FREQUENCY	INSERTION LOSS (dB)	RETURN LOSS (dB)
F_V-4.5	≥ 35	
F_V-0.5		≥ 20
F_V	≤ 0.6	≥ 20
F_a	≤ 0.6	≥ 20
F_V+8.08	≥ 15	
F_V-9	≥ 30	
$2F_V$	≥ 30	

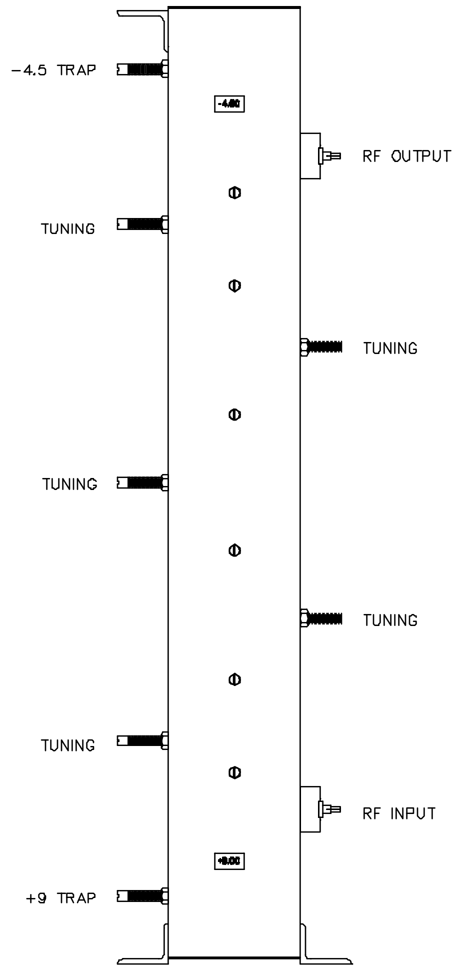

Figure 5-2. Bandpass Filter

5.8 (Optional) (A14) One- or Two-Section Trap Filter

The trap sections in the one- or two-section trap filter have been factory tuned and should not need major adjustments. The trap filter is optional and may not be part of this system.

The input to the one- or two-section trap filter is the output of the coupler assembly. The trap filter is comprised of 3-1/8" EIA standard transmission line sections connected to the main transmission line. The transmission line assembly consists of 7/8" EIA standard rigid coaxial components.

The traps on the output trap filter are labeled with their center frequency relative to the frequency of the carrier (for example, the traps labeled -4.5 MHz are tuned for a center frequency of 4.5 MHz lower than the frequency of the visual carrier).

The trap sections are reflective notches and can be adjusted across the entire UHF frequency band. The electrical length of the outer sleeve and the center rod of the notch can be adjusted to tune the notch frequency. The depth of the notch is set by the gap between the center conductor of the trap section and the center conductor of the main line. Tight coupling makes a deep notch, while loose coupling makes a shallow notch. A one-section trap filter is shown in Figure 5-3.

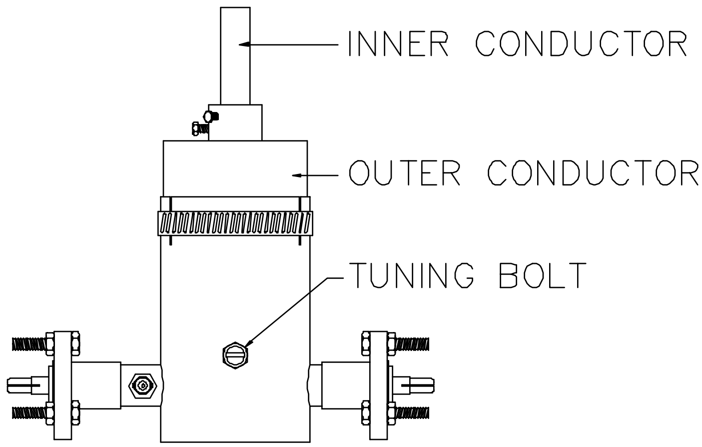

Figure 5-3. One-Section Trap Filter

5.8.1 Fine Tuning

Fine tuning of the center frequency of the notches can be accomplished with the tuning bolts on the side of the filter section. Loosen the nut that locks the bolt in place and adjust the bolt to change the frequency of the notch. Monitor the output of the transmitter with a spectrum analyzer and null the distortion product with the bolt. Red field is a good video test signal to use in order to see the +8.08-MHz product. Tighten the nut when the tuning is completed. Hold the bolt in place with a screwdriver as the nut is tightened to prevent the bolt from slipping.

5.8.2 Major Tuning

For major tuning, such as changing the notch depth or moving the notch frequency more than 1 MHz, the outer conductor and the center conductor of the trap section must both be moved. An RF sweep generator is required to perform major tuning. Apply the sweep signal to the input of the trap filter and monitor the output. Loosen the clamp holding the outer conductor in place and lengthen the conductor to lower the frequency of the notch or shorten it to raise the frequency of the notch. Loosen the center conductor with an Allen wrench and move it deeper for a lower-frequency notch or out for a higher-frequency notch. These adjustments must both be made to change the notch frequency. Moving only the center conductor or the outer conductor will effect the notch depth and the center frequency. The variable that is being adjusted with this procedure is the length of the center conductor inside the trap filter. The gap between the trap and the main line should not be changed. Moving only the inner or the outer conductors will effect the gap and the notch depth.

To only affect the notch depth, both sections have to be moved. The notch depth is controlled by the gap between the center conductor and the trap section. This gap also has an effect on the center frequency. To deepen the notch, shorten the outer conductor and pull out the center conductor until the notch is back in the same place. Move the sections in the opposite direction to make a shallow notch.

Note: The trap filter is typically adjusted for a notch depth of 10 dB.

The results of tuning the output trap filter are described in Table 5-2.

Table 5-2. Results of Tuning the Output Trap Filter

TUNING ADJUSTMENT	RESULT
Lengthening outer conductor only	Notch frequency up, shallower notch
Shortening outer conductor only	Notch frequency down, deeper notch
Inserting inner conductor deeper	Notch frequency down, deeper notch
Inserting less inner conductor	Notch frequency up, shallower notch
Tuning bolt in	Notch frequency down
Tuning bolt out	Notch frequency up
Moving both inner and outer conductors to keep the same gap inside	Center frequency moves, notch stays the same

After the tuning has been completed, tighten the clamp and the Allen screws that hold the conductors. Use the fine-tuning bolts to bring in the frequency. The final tuning adjustments should be completed with the transmitter driving the output trap filter for at least one hour to allow for warm-up drift.

5.9 Phase and Gain Adjustment of the UHF Amplifier Trays

The following procedure was completed at the factory and should only be performed if one of the 250-watt amplifier trays is replaced.

To begin this procedure, terminate the driver cabinet into a dummy load rated for at least 500 watts.

Preset (A8) the line stretcher rod in the rear of the driver cabinet to mid-range. Switch on the driver enable and adjust the gain pot on the 3-watt tray for 25% Driver Output Power. Adjust the phase control upward. If the % Driver Output Power goes up, continue to adjust the line stretcher until either the peak is reached or the end-of -travel is reached. If the % Output Power goes down, push (A8) the line stretcher downward.

If the end-of-travel is reached on the phase adjust as it is being moved upward, reset the phase control to mid-range and add a 2-inch length of cable to the input of (A6) the 250-watt amplifier tray at J1. Readjust (A8) the line stretcher rod until a peak is reached or until end-of-travel is achieved. If end-of-travel is reached, repeat the above procedure, but replace the 2-inch length cable with a 4-inch length of cable.

If the amount of downward range runs out, add a 2-inch phase cable to the input of (A7) the 250-watt tray and start mid-range with (A8) the line stretcher. If a visual power peak is reached, lockdown (A8) the line stretcher knob. If a peak is not reached, replace the 2-inch cable with a 4-inch cable and repeat this procedure.

5.10 Calibration of the Forward Output Power Level of the Amplifier Cabinet

Note: Perform the following procedure only if the power calibration is suspect. The amplifier cabinet output must be terminated into a minimum dummy load of 10 kW.

Switch the transmitter to Standby and perform the following adjustments, with no aural present, by removing jumper cable W1, aural IF loop-through, connected to J16 on the sync tip clamp on the sync tip clamp/modulator board

(1265-1302). Connect a sync and black test signal to the video input jack of the UHF 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 =5950 watts; sync + black 7.5 IRE setup/wattmeter=5400 watts).

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

Adjust R28, visual and audio calibration, on (A19-A2) the visual/aural metering board (1161-1103) for 2 volts on FL5 on the visual/aural metering assembly. Adjust R29 on the same board for 100% on the front panel meter in the % Visual Output position.

With the spectrum analyzer set to zero span mode, obtain a peak reference on the screen with the following readings:

- Resolution bandwidth – maximum
- Span – 0 MHz
- Scale – linear

Reconnect jumper cable W1 to J16 on (A5) the sync tip clamp on the modulator board. Turn the power adjust pot on the 3-watt amplifier tray front panel until the original peak reference level is attained. Peak C5 for a maximum aural power reading and then also adjust R11 for a 100% aural power reading. Switch to the Visual Output Power position and adjust R39 for 100% Visual Power. Turn the 3-watt amplifier tray front panel gain pot fully CCW and switch the exciter to standby. Re-terminate the drive output into the diacrode cavity.

5.11 Calibration of Reflected Metering

Adjust the 3-watt amplifier tray front panel gain pot for 15% Visual Power on the metering control panel. Switch S4, the power meter, to the Reflected position. Reverse the J6 cable and the J4 termination on (A18) the final output coupler. Adjust R6 on (A19-A1) the single peak detector board (1164-1403) in the visual/audio metering assembly for a 15% Reflected Power reading. Return J4 and J6 to their original positions.

5.12 Board Level Adjustments

5.12.1 (A1) Control Logic Board (1137-1402; Appendix B)

The rear of the metering control panel is shown in Figure 5-4. The control logic board is in the metering control panel and provides the circuitry needed for the control of the automatic on/off sequence of the transmitter and the monitoring of the operation of the transmitter for fault conditions. An Operate command and the interlocks for the transmitter are also connected to the board.

The control logic board monitors the air-on sense, the filament-on sense, the bias-on sense, the high voltage-on sense, and the screen-on sense commands during each step of the automatic turn-on procedure. The board also provides the on-command outputs in the proper sequence and enables to the Command Status and Operating Status LEDs on the front panel. The fault circuits monitor the operation of the power supplies and the tube, the air flow to the tube, and the temperature of the transmitter; the board will shut down the transmitter if any of these faults occur.

The board supplies the air-on, filament-on, bias-on, screen-on, high voltage-on, and RF-on commands to the transmitter. In addition, the board is connected to the High-Voltage Enable/Disable switch to provide commands to magnetic latching relay K1.

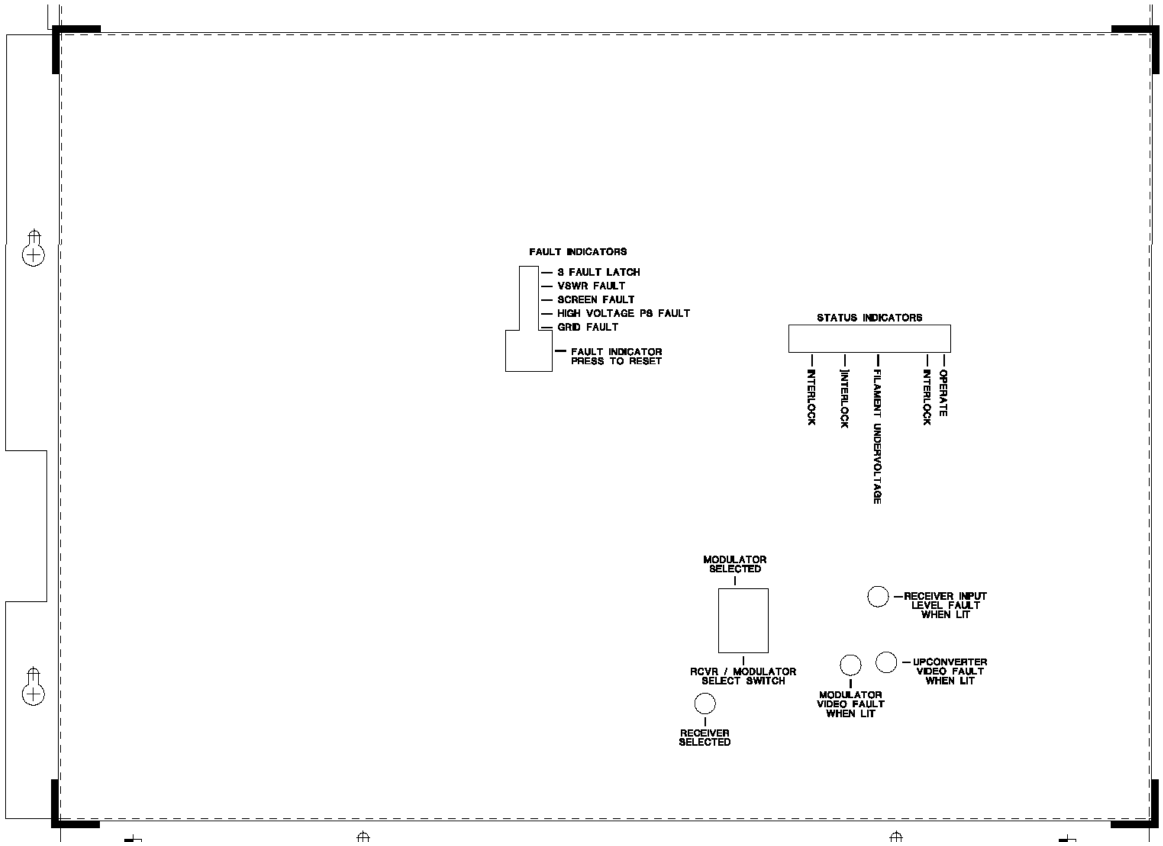

Figure 5-4. Metering Control Panel (Rear)

The status indicators on the board, and a description of what each of the indicators represent when they are lit, are listed in Table 5-3.

Table 5-3. Control Logic Board Status Indicators

LED	FUNCTION	DESCRIPTION
DS1	OPERATE	Indicates that transmitter is in the Operate mode
DS2*	INTLK. (INTERLOCK)	Whole system shutdown interlock used for external connections; normally jumpered across on the remote control and interface assembly
DS3	AIR	Indicates that air pressure switch is closed and there is sufficient air flow around the tube
DS4	FIL (FILAMENT)	Indicates that filament power supply is operating
DS5	FIL UV (FILAMENT UNDER VOLTAGE)	Indicates that filament voltage is above the preset of the lower threshold point
DS6	BIAS	Indicates that bias power supply is operating
DS7*	INTLK (INTERLOCK)	High-voltage shutdown interlock; normally jumpered across on the remote control and interface assembly
DS8	H.V. (HIGH VOLTAGE)	Indicates that high-voltage supply is on and above the preset level
DS9*	INTLK (INTERLOCK)	Interlock is not used in the 10-kW amplifier; jumpered across on the control logic board (J3, pins 9 and 10)
DS10	RF (DRIVE)	Indicates that Mute command has been removed from the upconverter tray **Note: If the exciter and the aural and visual driver sections are operating normally, the transmitter will have an output.**
DS11	FAULT 3	Indicates that three faults have occurred in succession or within a given time frame **Note: This action will remove the high voltage, screen, and RF drive.**

LED	FUNCTION	DESCRIPTION
DS13	VSWR	Indicates that a voltage standing wave ration that exceeds 12.5% of reflected power
DS14	SCREEN	Indicates that the screen current is greater than ±120 mA
DS15	HVPS	Indicates that the cathode current exceeds 5 amps or the high-voltage power supply current exceeds the preset limit
DS12	GRID	Indicates that the bias current exceeds the preset limit of ±50 mA
S1	IND. RESET	When pushed, will only reset the fault indicator LEDs (DS12 through DS13); will not reset the transmitter or the DS11 LED if lit. To reset the DS11 LED, the fault reset switch on the front panel of the metering control panel must be used.

* The three Interlock indicators should be lit at all times unless they are connected to an external sensor and a fault occurs.

5.12.2 Filament Power Supply Board (1293-1304; Appendix B)

The following steps will allow a thorough test of the software programmed into the microcontroller and used on the filament power supply board (1293-1304):

1. Install a pre-programmed U4, using the latest 1293-6316 software version, into its socket on the filament power supply board (1293-1304).

2. On the filament power assembly (1299-1107), connect +12 volts to TB1-2, -12 volts to TB1-1, and ground to TB1-3.

3. Disconnect J3 from the filament power supply board (1293-1304) and turn on the external DC voltages. Verify that DS1 is blinking at a 1-Hz rate.

4. Turn off the external DC voltages. Reconnect J3 to the controller board; 220 VAC to TB2-1 and TB2- 2; and ground to TB2-3. Connect the power supply output to a .1-ohm, 300-watt resistor, TB2-5 to the (+) side of the resistor, and TB2-6 to the (–) side. Turn on the resistor-cooling fan.

5. Turn on the external voltages; momentarily close SW1-8 and then reopen it. Verify that J3-1 is 0.0 volts and DS1 is blinking at a 1-Hz rate. The power supply output should be 1.5 volt at this point and TB1-8 should have a low voltage. Take note of the time; a 10-minute timeout must be measured from power application to the board.

6. At this point, DS1 should be blinking at a 1-Hz rate. Measure the voltage on TB1-7; it should be +12 volts. Measure the output voltage of the

filament power supply; it should be 1.5 volts.

7. Verify that J3-1 remains at 0 volts and DS1 blinks at a 1-Hz rate while the following actions are performed:

   - Switch on SW1-3 and turn on SW1-5, SW1-6, and SW1-7 individually (no time limit).
   - Connect +12 volts to TB1-5 for less than 5 seconds.
   - Turn off the external +/-12-volt power supply for less than 5 seconds.
   - Remove J6 from the controller board for less than 5 seconds.
   - Ground TB1-6 several times and then leave it unconnected.
   - Turn off the 220 VAC at TB2-1 and TB2-2 for less than 5 seconds.

8. After 10 minutes, DS1 should begin blinking at a 2-Hz rate. This signals that the 10-minute time-out period has successfully been completed. At this point, with SW1-3 on, switch SW1-5 on. J3-1 should be 0 volts. Switch SW1-5 off and SW1-6 on; J3-1 should be 4.625 volts. Switch SW1-6 off and SW1-7 on; J3-1 should be 5.0 volts. If necessary, adjust R6 on the controller board until a reading of 5.0 volts is obtained.

9. Ground TB1-6 to simulate a filament-on command and note the time. The voltage at TB1-7 should be 0 volts; 220 VAC should now be present at TB2-7 and TB2-8; and DS1 should be blinking at a 4-Hz rate. The voltage at J3-1 should increase to 4.625 volts over a three-minute time frame. During this ramp-up phase, the following conditions should not cause DS1 to stop blinking at its 4-Hz rate or the ramp-up to discontinue:

   - Connecting TB1-5 to +12 volts for less than 5 seconds
   - Turning off the external +/-12-volt power supply for less than 5 seconds
   - Removing J6 from the controller board for less than 5 seconds
   - Turning off the 220 VAC at TB2-1 and TB2-2 for less than 5 seconds
   - Switching SW1-5, SW1-6, and SW1-7 on and off individually (no time limit)

Note: Leaving any of the above conditions on for longer than 5 seconds should cause the filament power supply to revert back to the 10-minute warm up cycle (J3-1 at 0 volts).

10. Remove the ground from TB1-6. The voltage at J3-1 should begin to decrease. Re-ground TB1-6. This should cause J3-1 to start ramping back up. Once J3-1 is at 4.625 volts (5.2 volts across the load resistor), DS1 should not be blinking. Perform all of the tasks in step 10 and verify that J3-1 remains at 4.625 volts. It should be noted once again that performing these tasks for longer than 5 seconds should cause the voltage at J3-1 to again return to 0 volts for 10 minutes.

11. Remove the ground from TB1-6. The 5 volts at J3-1 should start to ramp down. Re-ground TB1-6. The voltage at J3-1 should start to ramp back up. Remove the ground again. J3-1 should return to 0 volts over a 3-minute time frame; TB1-7 should remain at 0 volts; TB2-7 and TB2-8 should not have 220 VAC present; and DS1 should be blinking at a 4-Hz rate. Perform the same tasks as in step 10 and verify that they have no effect on the ramp-down cycle. Taking any more than 5 seconds for

any of them should cause J3-1 to return to 0 volts for the 10-minute warm-up cycle.

12. Remove all of the connections to the filament power supply assembly. The test is complete.

5.12.3 10-kW Bias Power Supply Board, 230 VAC (1181-1001; Appendix B)

With the high voltage disabled, disconnect the bias cable from the TH18610 cavity assembly. Measure the DC voltage on the cable output. Adjust R14 on the bias supply board to calibrate the bias voltage on the meter on the metering control panel on the amplifier assembly.

To calibrate the bias current, attach a variable power supply and current metering device with the (+) lead connected to the R5/R4 junction and the (-) lead to ground. Adjust the current to 10 mA and adjust R6 for a 10-mA reading on the current meter on the metering control panel.

5.12.4 Screen Power Supply Board (1293-1319; Appendix B)

With the high voltage enabled, and the screen power supply breaker turned off, disconnect the screen supply cable from the TH18610 cavity. Turn on the screen power supply breaker and measure the voltage with a meter capable of at least 600 VDC. Adjust R14 on the screen power supply board (1293-1319) for 500 volts. Adjust R20 on the same board for 500 volts of screen power supply voltage on the metering control panel.

To calibrate the screen current, turn off the screen power supply breaker. Attach a variable power supply and current measuring device with the (-) lead connected to the R7/R8 junction and the (+) lead connected to ground. Adjust the power supply current until a reading of 10 mA is obtained on the current measuring device. Adjust R9 on the screen power supply board for a 10-mA reading on the current meter on the metering control panel. The screen current is now calibrated.

5.12.5 Dual Polarity Fault Sensing Board (1016-1402; Appendix B)

To align the screen current fault, switch off the screen breaker and disable the high voltage. Attach a variable power supply and a current meter as described in the alignment procedures for the screen power supply board (1293-1319) in Section 5.12.4. Adjust the current for 90 mA and turn R6 until the Screen Fault LED DS14 lights. Reduce the current and DS14 should go out after fault reset S9 on (A1) the control logic board (1137-1402) has been pushed.

To align the screen overcurrent fault (reverse polarity), reverse the variable power supply connections and repeat the alignment procedures for the screen current fault while using R12 to adjust the trip point.

To align the bias overcurrent fault, switch off the bias supply breaker; the transmitter will be in the Standby mode. Attach a variable power supply and a current meter as described in the alignment procedures for the 10-kW bias power supply board, 230 VAC (1181-1001), in Section 5.12.3. Adjust the power supply for a 30-mA current and adjust R25 until the Bias Current Fault LED DS12 lights. Slightly reduce the current and push fault reset switch S9 on (A1) the control logic board (1137-1402).

To align the bias overcurrent fault (opposite polarity), reverse the variable power supply connections and repeat the procedure described above while using R18 to adjust the trip point.

5.12.6 Inverting Fault Sensing Board (1016-1401; Appendix B)

To align the plate overcurrent function, attach a variable power supply and a current meter as described in the alignment procedure for (A9) the current metering board (1084-1205) in Section 5.12.9. Adjust the current for 5 amps and turn R6 until the Plate Current Fault LED DS15 on (A1) the logic control board (1137-1402) lights. Slightly reduce the current and push fault reset switch S9 on (A1) the control logic board (1137-1402). DS15 should go out.

To align the reflected power fault, set the transmitter for 12.5% output power. Reverse the cable at J6 and the attenuator on J5 of (A2-A2) the diacrode output coupler. Adjust R12 until the VSWR Fault LED DS7 illuminates.

Note: This is a 3-fault adjustment. The transmitter logic looks for the same fault three times before latching in a permanent fault state.

Reverse the J5 and J6 connections and clear the fault by pushing the 3-fault reset switch on the metering control front panel.

To align the bias-on sense, the high voltage should be enabled and there should be no RF drive. Adjust the bias voltage for 2 amps static plate current. Adjust R18 until the Bias Status LED DS18 goes out on the metering control panel. Return the bias voltage to the original reading of 1.5 amps of static phase current.

5.12.7 Fault Sensing Board (1293-1307; Appendix B)

To align the screen sense, place the exciter tray in the Standby mode. Adjust R14 on the screen power supply board fully CCW (approximately 430 volts). Adjust R6 until the Screen Status LED DS20 just goes out. Return R14 to 500 volts screen voltage.

To align the high-voltage sense, turn off CB1 and discharge all high voltage.

Caution: Make sure that the high-voltage power supply cabinet is safely turned off.

Remove fuse F1 from one of the high-voltage rectifier boards (A5, A6, or A7). Turn the screen breaker off and bring the transmitter power up normally (with the high voltage enabled). Adjust R12 until the High-Voltage Status LED DS19 on the metering control panel goes out. Shut down the transmitter and rectifier F1 on the rectifier board while making sure that the high-voltage power supply cabinet is safely discharged.

To align the filament ready function, set the filament voltage to 5.2 volts. Adjust R18 until the Filament Status LED DS17 just goes out and then turn the pot until DS17 just comes back on.

To align the filament undervoltage, set the filament voltage to 5.2 volts. Place the transmitter in the Standby mode by using S5 on the metering control panel. At ≈5.0 volts, adjust R25 until the Filament Undervoltage LED DS5 on (A1) the control logic board (1137-1402) just goes out. Return the transmitter to Operate. DS5 should be lit when the filament voltage is normal (5.2 volts).

5.12.8 Transmitter Control Board (1137-1003; Appendix B)

To align the VSWR fault adjust on the transmitter control board, turn the transmitter power down to 10%. Using the 3-watt amplifier tray front panel gain pot, reverse the cable on J6 and the attenuator on J5 on (A2-A2) the output coupler. Adjust R44 until the VSWR Cutback LED DS23 just begins to light on the front panel of the metering control panel. Place J5 and J6 in their original positions.

To align the output fault adjust, turn the transmitter output power down to 10%.

Adjust R38 until the RF Request LED DS21, on the metering control front panel in the Operating Status section, just goes out. When the transmitter output power is above 10%, the LED should be illuminated.

5.12.9 (A9) Current Metering Board (1084-1205; Appendix B)

Caution: Extreme care must be taken when aligning the current metering board.

First, disable the high-voltage section of the high-voltage power supply by turning circuit breaker CB2 (HV) to the Off position. Connect a variable power supply capable of 5 amps and a current measuring device across E1 (-) and E2 (+) on (A9) the current metering board (1084-1205). Set the current for 4 amps on the measuring device. Adjust R3 on the board for a 4-amp reading on the current meter on the metering control board.

This completes the detailed alignment procedures for the transmitter. If a problem occurred during the alignment, refer to the detailed alignment procedure for that tray.