

Chapter 5

Detailed Alignment Procedures

The 425A 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 (A9-A5) the coupler is terminated into a dummy load of at least 500 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 and the VHF exciter circuit breakers on the AC distribution panel behind the rear cabinet door.

5.1 (A4) High-Band VHF Exciter Tray (1070901; Appendix C) with Baseband Video and Audio Inputs

The (A4) high-band VHF exciter tray (1070901) 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 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 exciter panel are loop-through connected and the unused jack 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 video level control R12 on the sync tip clamp/modulator board.

Switch the meter to the Audio position to show 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 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 Exciter Tray (1070901; Appendix C) with the 4.5-MHz Composite Input Kit

With the 4.5-MHz composite input kit, the (A4) VHF exciter tray (1070901) 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 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 ± 0.3 dB from 4.4 to 4.6 MHz. Adjust C19 for an overall peak-to-peak variation of less than ± 0.3 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 (1070901; Appendix C) with either Baseband or the 4.5-MHz Composite Input

The IF section of the (A4) VHF exciter tray (1070901) 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 two 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 two 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 (not used in this configuration)
- DS5 (Modulator Enable) – Indicates that the modulator IF output has been selected (this is only used if a receiver tray is present in the system). DS5 is always on with no receiver.

The ALC is muted when the transmitter is in Standby. To monitor the ALC, turn off

the two amplifier on/off circuit breakers on the AC input assembly in the rear of the cabinet and switch the transmitter to Operate. Adjust the power adjust gain pot on the front panel of the VHF exciter tray to obtain +0.8 VDC on the front panel meter in the ALC position. On the ALC board (1265-1305), move 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 two 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 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.

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 VHF exciter tray control locations drawing, ALC board (1265-1305), 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 of the ALC board is enabled 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 IF ALC board (1265-1306), preset pots R34, R37, and R40 (threshold) 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 IF 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 Phase and Gain Adjustment of the 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.

Preset the phase and gain potentiometer on each VHF amplifier tray fully CCW. Switch the transmitter to Operate and adjust the gain pot on each tray for 25% Output Power. Adjust the phase control CW on the left VHF amplifier tray. If the % Visual Output Power goes up, continue to adjust the phase control until either the peak is reached or the end-of-travel is reached. If the % Output Power goes down, reset the phase control on the VHF amplifier tray fully CCW and repeat the above procedure with the phase control of the other amplifier tray.

If the end-of-travel is reached on the phase adjust, reset the phase control CCW and add a 2-inch length of cable to the input of the affected VHF amplifier tray at J1. Readjust the phase of that tray until a peak is reached or until the end-of-travel is achieved. If the end-of-travel is reached, repeat the above

procedure and replace the 2-inch length of cable with a 4-inch length of cable. Once a peak has been reached, move the phase control that is fully CCW up two turns and repeak using the phase control on the other tray. This allows both trays to have some range of adjustment.

Adjust the gain of both VHF amplifier trays for 90% Tray Output Power. Readjust each phase control to peak the combined output; the phase should only have been slightly affected. Although it may take a few turns to notice a change, there should be a definite peak that is achieved while adjusting the phase of each tray. Raise or lower the output power of each tray to achieve 100% Output Power. The output power of each tray should be 90% to 100%.

5.7 Calibration of the Forward Output Power Level of the Transmitter

Note: Only perform the following procedure if the 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.

Set up the transmitter for the appropriate average output power level: sync + black 0 IRE setup/wattmeter=298 watts; sync + black 7.5 IRE setup/wattmeter=273 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.

5.8 Calibration of the Reflected Output Level of the Transmitter

On the meter, in the Visual Power position, turn the power adjust pot to 20%. Check that the jumper is in Manual on the VHF filter/amplifier board (1064252). Reverse the cables on A9-A5, J3 and J4, and adjust R39 on the visual/aural metering board (1265-1309) for a 20% reading in the Reflected Power position. At this 20% reference power reading, the VSWR LED mounted on the front panel of the exciter 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 cables on A9-A5, J3 and J4, to their original positions. Switch the transmitter to Operate and adjust the front panel power pot for a 100% Visual Power reading.

5.9 (A11) 2-Way Combiner Assembly (1219-1006; Appendix C)

There are no adjustments to (A11) the VHF combiner assembly (1219-1006).

Note: The bandpass filter is 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 the ADC Field Support Department before attempting to make any adjustments.

5.10 (A13) Bandpass Filter Assemblies (1076294 through 1076297; Appendix C)

The input to the (A13) bandpass filter assemblies (1076294 through 1076297) is the output of the VHF combiner

assembly, which is the combined output of the VHF amplifier trays. The filter is made of aluminum waveguide and has five resonant cavities. The filter has five bolts for tuning adjustments. The bandpass filter also utilizes two integral traps at -4.5 MHz and +9 MHz from F_V . Refer to the bandpass filter drawing for the location of the 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.

Table 5-1 contains typical values for the bandpass filter.

Table 5-1. Bandpass Filter Typical Values

FREQUENCY	INSERTION LOSS (DB)	RETURN LOSS (DB)
$F_V - 4.5$	≥ 35	
$F_V - 0.5$		≥ 20
F_V	≤ 0.8	≥ 20
F_a	≤ 0.8	≥ 20
$F_V + 8.08$	≥ 15	
$F_V - 9$	≥ 30	
$2F_V$	≥ 30	

5.11 (A6 and A7) 600-Watt High-Band VHF Amplifier Tray (1219-1100; Appendix C)

The (A6 and A7) 600-watt high-band VHF amplifier tray (1219-1100) has 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 tray should not need to be adjusted to attain normal operation. 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 current for the amplifier boards are adjusted with no RF drive applied. S1 should be in the Auto AGC position for the normal operation of the transmitter.

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

5.11.1 (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 should be illuminated. The front panel Module Status LED should not be lit.

Reconnect J4 and adjust R59 to begin cutting 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 +48 VDC using R86 on the AGC control board.

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

There are no adjustments to (A1-A1) the phase shifter board (1198-1602). The front panel has adjustments for phase that are made during the amplifier array setup procedure.

5.11.3 (A2-A1) VHF Filter/Amplifier Board (1218-1104; Appendix D)

The (A2-A1) VHF filter/amplifier board (1218-1104) has approximately 15 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: $[E=I \times R] : [E=250 \text{ mA} \times 1 \Omega] : E=250 \text{ mV}$).

5.11.4 (A2-A2) High-Band VHF Amplifier Board (1219-1103; Appendix D)

The (A2-A2) VHF high-band amplifier board (1219-1103) has 20 dB of gain and is biased for .6 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 .30 volts (using Ohms' Law: $[E=I \times R] : [E=.6 \text{ amps} \times .5 \Omega] : E=.30 \text{ volts}$).

Connect a spectrum analyzer to output jack J2 on the board and adjust C15 for peak output.

5.11.5 (A3-A1) Overdrive Protection Board (1198-1601; Appendix D)

The level of the RF input and output of the (A3-A1) overdrive protection board (1198-1601) should be +16 dBm during normal operation.

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%.

5.11.6 (A3-A2) VHF High-Band Amplifier Board (1219-1114; Appendix D)

The (A3-A2) VHF high-band amplifier board (1219-1114) has 20 dB of gain and is biased for 3 amps of idling current, no RF drive applied. To set the bias, remove the RF drive from the board and preset bias adjust pots R5 and R9 CCW. Measure the voltage drop across R5 (the .1Ω/10W resistor on the current metering board) and slowly adjust bias adjust pot R5 for .15 volts. Continue to measure the voltage drop across R5 and slowly adjust the other bias adjust pot R9 for .3 volts (using Ohms' Law: $[E=I \times R] : [E=3 \text{ amps} \times .1 \Omega] : E=.30 \text{ volts}$).

Connect a spectrum analyzer to output jack J2 on the board and adjust C9 and

C19 for peak output with the best linearity across the spectrum.

5.11.7 (A3-A3) 4-Way Splitter Board (1219-1101; Appendix D)

There are no tuning adjustments for (A3-A3) the 4-way splitter board (1219-1101). The board takes the +36 dBm input and splits it into four equal +30 dBm inputs.

5.11.8 (A4-A1, A4-A2, A4-A3, and A4-A4) High-Band Amplifier Board (1218-1201; Appendix D)

Each of the (A4-A1, A4-A2, A4-A3, and A4-A4) high-band amplifier boards (1218-1201) have 20 dB of gain and are biased at 2 amps of idling current when they are used as a visual, or visual + aural, amplifier or 1 amp of idling current when they are used as an aural amplifier, no RF drive applied. To set the bias for the final amplifier board (A4-A1), remove the RF drive and switch the front panel current meter to the I_1 position. Preset bias adjust pots R5 and R9 CCW. Slowly tune bias adjust pot R5 for 1 amp on the meter for a visual, or visual + aural, amplifier or .5 amps on the meter for an aural amplifier. Adjust R9 for 2 amps on the meter for a visual, or visual + aural, amplifier or 1 amp on the meter for an aural amplifier.

To set the bias for the final amplifier board (A4-A2), remove the RF drive and switch the front panel current meter to the I_2 position. Preset bias adjust pots R5 and R9 CCW. Slowly adjust bias adjust pot R5 for 1 amp on the meter for a visual, or visual + aural, amplifier or .5 amps on the meter for an aural amplifier. Adjust R9 for 2 amps on the meter for a visual, or visual + aural, amplifier or 1 amp on the meter for an aural amplifier.

To set the bias for the final amplifier board (A4-A3), remove the RF drive and switch the front panel current meter to the I_3 position. Preset bias adjust pots R5 and R9 CCW. Slowly adjust bias adjust

pot R5 for 1 amp on the meter for a visual, or visual + aural, amplifier or .5 amps on the meter for an aural amplifier. Adjust R9 for 2 amps on the meter for a visual, or visual + aural, amplifier or 1 amp for an aural amplifier.

To set the bias for the final amplifier board (A4-A4), remove the RF drive and switch the front panel current meter to the I_4 position. Preset bias adjust pots R5 and R9 CCW. Slowly adjust bias adjust pot R5 for 1 amp on the meter for a visual, or visual + aural, amplifier or .5 amps on the meter for an aural amplifier. Adjust R9 for 2 amps on the meter for a visual, or visual + aural, amplifier or 1 amp on the meter for an aural amplifier.

Connect a spectrum analyzer to output jack J2 of the board and adjust C1 for peak output.

5.11.9 (A5-A1) 4-Way Combiner Board (1219-1102; Appendix D)

There are no adjustments to the (A5-A1) 4-way combiner board (1219-1102). The four +49.5 dBm inputs are combined to produce the 600 watts peak of sync output at J5 for a visual amplifier, 300 watts peak of sync plus aural for common amplification, or the 400 watts for an aural amplifier.

5.11.10 Calibration of the Visual Plus Aural Output Power and VSWR Cutback

Check that a dummy load of at least 300 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 exciter tray. Set Manual AGC switch S1, on the (A13) AGC control board (1142-1601) in the

600-watt amplifier, 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 manual gain pot R5 on the AGC control board for:
 - Sync + black 0 IRE setup; wattmeter=180 watts
 - Sync + black 7.5 IRE setup; wattmeter=163 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 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 J9 and J11 cables on the 4-way combiner board. 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 300 watts peak of sync and sound output. 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 J9 and J11 cables on the 4-way combiner board 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.

There is a spare 1-amp and 10-amp fuse on the top, right-hand side of the tray. These are replacements for fuses on the current metering board.

The 600-watt amplifier tray is aligned, calibrated, and ready for normal operation.

5.12 Board Level Alignment Procedures

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 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 (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 (A25) (Optional) 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)

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 75 Ω . 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.

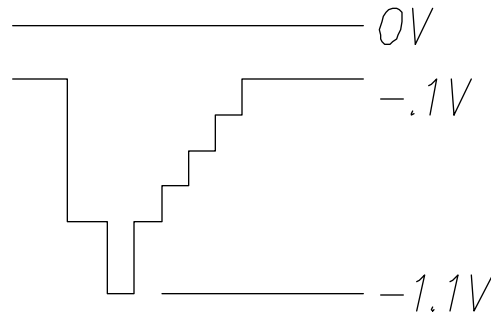


Figure 5-1. Waveform

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 75 Ω 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 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 (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 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 (THD = < 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. 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 5-2 describes the functions of each LED on the ALC board (A8).

Table 5-2. 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)

See Section 5.4 of this chapter for the system alignment procedures for the IF phase corrector board. 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 the J3 IF O/P jack of (A8) the ALC board. The IF output jack of the IF phase corrector board is fed to the J7 IF I/P jack of the ALC board (A8).

5.12.10 (A8) ALC Board, NTSC (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.
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. Refer to Section 5.5 of this chapter for the system alignment procedures for the linearity correctors. Controls R13, R18, and

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

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)

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.

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 x4 multiplier board should not decrease. If a decrease does occur, there may be a problem with the crystal. Contact ADC 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. Use R9 on the FSK with EEPROM board.

3. Reconnect the main output (J1) of the channel oscillator to the input (J1) of the x4 multiplier.

5.12.12 (A11-A1) x4 Multiplier Board (1174-1112; 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 and C10 for maximum voltage. Monitor TP3 with a DVM and tune C12; repeak C4, C6, and C10 for maximum voltage.
2. Connect a spectrum analyzer, tuned to four times the crystal frequency, to the x4 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.

Connect a spectrum analyzer to J6 on board. Adjust C23 and C26 to determine the center frequency. Use C2 and C7 to locate the upper and lower channel-edge shaping. C24 is used to determine the channel bandwidth.

The output of the x4 multiplier connects to (A11-A1) the filter/mixer board.

5.12.13 (A11-A2) VHF Filter/Mixer Board (1150-1102; Appendix D)

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) High-Band VHF Filter/Amplifier Board (1064252; 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 filtered output connects to J1 of the board and is amplified by U1 to a nominal +8 dBm visual and -2 dBm aural level by adjusting R9. The output at J2 is fed to J4 on the A11 enclosure and from there to J15 on the rear of the tray.

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

Reconnect the cable 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 manual gain adjust R9 for a +8 dBm peak visual output.

This completes the detailed alignment procedures for the 425A transmitter. If a problem occurred during the alignment, refer to the detailed alignment procedure for that tray for more information.