7. PARTS LIST / TUNE UP INFOR

7.1 Parts List

7.1.1 Tray and Assembly Components

The exciter/amplifier tray and output filter assembly can be subdivided as follows:

Exciter / amplifier tray:
-Video input
-Audio input
-Video AGC circuit
-Sync-tip clamp
-Modulator
-Vestigal sideband SAW filter
-Visual/aural buffers
-IF crystal oscillator
-Phase frequency comparator
-Aural frequency modulated oscillator
-Automatic level control
-Linearity correctors
-Channel crystal oscillator
-Frequency multiplier
-Filter/mixer
-Filter/amplifier
-Class AB dual stage amplifier
-Directional coupler
-Metering circuits
-Control and protection circuits
-Power supplies

Output filter assembly:
-Bandpass filter with traps
-VHF coupler

7.1.2 System Overview

The 420A (1066428) consists of (A1) a 100-watt, high-band VHF exciter/amplifier tray (1066308) and (A2) a bandpass filter assembly.

The exciter/modulator section of the 100-watt, high-band VHF exciter/amplifier tray operates using baseband audio and video inputs. However, if the (optional) 4.5-MHz composite input kit (1273-1128) is purchased, the 4.5-MHz composite input or the baseband video and audio inputs are used to produce a diplexed, modulated, on-channel frequency visual + aural RF output. The switching between the 4.5 MHz generated by the baseband inputs, or by the 4.5-MHz composite input, is accomplished by a relay, on the sync tip clamp modulator board. The relay is controlled by a baseband select that connects to J18-6 and 7 on the rear of the tray. To operate the transmitter with the (optional) 4.5-MHz composite input kit using baseband inputs, the baseband video must be connected to J1 or J2, the baseband audio must be connected to the proper input jack, and a baseband select must be connected to J18-6 and 7. To operate the transmitter with the (optional) 4.5-MHz composite input kit using the 4.5-MHz composite input, the 4.5-MHz composite input must be connected to J1 or J2 and the baseband select must be removed from J18-6 and 7.

The exciter/modulator section of the tray takes the baseband audio and video inputs, or the (optional) 4.5-MHz composite input, and produces a combined 45.75 MHz + 41.25 MHz IF output that connects to J32 on the ALC board. The combined IF output of the ALC board connects to the mixer/amplifier assembly where it is upconverted and filtered to the on-channel frequency visual + aural RF output. The RF is filtered and amplified in the amplifier section to achieve the 100-watt output power level. The RF output is filtered in the bandpass filter assembly and fed to the antenna through the transmission line.

The exciter and upconverter section of the tray operate when the circuit breaker CB1 is on; the amplifier section only operates when the transmitter is in Operate. This occurs because the switching power supply that provides the operating voltages to the amplifier section has an inhibit command applied to it, shutting it off as long as the transmitter is in Standby.

7.1.2.1 Exciter Section

The baseband video and audio inputs to the transmitter connect to the rear panel of the tray. The baseband video or the (optional) 4.5-MHz composite input connects to jack (J2), which is loop-through connected to jack J1. By removing the termination jumper on the sync tip clamp/modulator board, jack J1 can be used as a connection for the baseband video or the 4.5-MHz composite input to another transmitter. The baseband audio input connects to the terminal block TB1 for balanced audio or to the BNC jack J3 for composite audio that is loop-through connected to jack J13. There are also connections for the remote monitoring and operation of the transmitter at the "D"-connector jacks J10 and J11.

The baseband audio connects to (A4) the aural IF synthesizer board (1265-1303), in the exciter section, that provides the amplification for each of the three possible audio inputs and the amplifier circuit that supplies the single audio output. The board has the 4.5-MHz VCO and the aural modulation circuitry that produces the modulated 4.5-MHz output. The board also contains a PLL circuit to maintain the precise 4.5-MHz separation between the aural (41.25 MHz) and visual (45.75 MHz) IF frequencies. The video input or 4.5-MHz composite input to the exciter section connects to (A5) the sync tip clamp/modulator board (1265-1302) that takes the video input and produces a sync tip clamped and modulated visual IF + aural IF output at the output jack J20. If the optional 4.5-MHz composite input is purchased, the input is directed out of the sync tip camp/modulator board to the (A24) composite 4.5-MHz filter board (1227-1244) and the (A25) 4.5-MHz bandpass filter board (1265-1307). These two boards process the 4.5-MHz composite input and produce the video that connects back to the sync tip clamp/modulator board at J27. The clamp portion of the board maintains a constant peak of sync level for the video signal over varying average picture levels (APL). The modulator portion of the board contains the circuitry that generates an amplitude-modulated, vestigial-sideband IF signal output at 45.75 MHz.

The 45.75 MHz is generated by (A7) the IF oven oscillator board (1191-1404) and connected (+5 dBm) to the sync tip clamp/modulator board. The combined visual IF + aural IF output (0 dBm) connects to J32 on (A8) the ALC board and then through relays to the rest of the ALC board. The ALC board gives the operator control over the output power level of the transmitter by adjusting the level of the combined IF signal. The IF connects out of the board at J3 and is directed to (A9) an IF phase corrector board (1227-1250). The IF signal is phase corrected as needed and fed back to the ALC board.

7.1.2.2 Upconverter Section

The output of the ALC board (0 dBm) connects to (A11-A1) the filter/mixer board (1150-1102), in the (A11) mixer/amplifier enclosure (1065007), that takes the LO and heterodynes it with the combined IF. This signal is then fed to the high-band VHF filter/amplifier board, high output (1064150) that amplifies the RF signal and feeds it to the (A23) high-band amplifier heatsink assembly (1065008). The crystal frequency needed to generate the LO is produced by (A14-A1) the channel oscillator board (1145-1201) in (A14) the channel oscillator assembly (1145-1202). The crystal frequency (+5 dBm) from the oscillator is multiplied four times by (A15-A1) the x4 multiplier board (1174-1112), in (A15) the multiplier enclosure (1235-1101), to produce the LO signal.

7.1.2.3 Amplifier Section

The RF output of the upconverter section (+11 dBm) is fed to the amplifier section of the transmitter. The amplifier section consists of an (A23) amplifier heatsink assembly (1065008) and associated components. The first stage of the amplifier section amplifies the RF to +31 dBm in (A23-A1) a high-band VHF amplifier board assembly (1065812). This assembly consists of a high-band VHF amplifier board (1218-1201) and associated components. The RF is divided by the (A23-A2) 2-way combiner assembly (1064485) and fed to two parallel (A23-A3 and A23-A4) high-band VHF amplifier board assemblies (1065812). The amplified signals are fed to another (A23-A5) 2-way combiner board. The RF output from this 2-way combiner board (+51 dBm) is fed through (A31) an output coupler board (1088-1104) that provides a forward power sample to (A19) the visual/aural metering board (1265-1309). A forward sample connects to the transmitter control board that supplies the voltage sample to the front panel meter of the tray. The reject port of the output coupler board provides the reject sample to the visual/aural metering board. The metering board connects the reflected sample to the transmitter control board for VSWR cutback and front panel-reflected metering for the tray.

7.1.2.4 Bandpass Filter Assembly

The output from the (A1) 100-watt, high-band VHF exciter/amplifier tray is fed to the input of the (A2) bandpass filter assembly. The signal is fed to the (A2-A1) 5-section bandpass filter with traps and then through (A2-A2) a high-band VHF coupler assembly that provides a filtered RF sample for test purposes.

7.1.2.5 Operational Voltages

The transmitter needs an AC input of 115 or 230 VAC at 10 amps connected to it, through the AC power plug, in order to operate. The tray is set at the factory to operate at the proper input voltage. This is accomplished by setting the (A1) power entry module to the correct line voltage.

7.1.2.6 Configuration of the Power Entry Module AC Input

For 115 volts, verify that 115V is indicated on the rear panel cover on the power entry module. If it is not, gently open the cover, remove the fuse assembly, and reinsert it so that 115V is visible with the cover closed.

For 230 volts, verify that 230V is indicated on the rear panel cover on the power entry module. If it is not, gently open the cover, remove the fuse assembly, and reinsert it so that 230V is visible with the cover closed.

The input AC voltage connects from jack J14, which is part of (A1) the power entry module on the rear of the tray, to CB1, a 10-amp circuit breaker that is also on the rear of the tray. The switched AC is wired through (A1) the power entry module. This module contains two fuses, one on each line, to the terminal block TB2. TB2 has four MOVs mounted to the terminal block, one connected from each leg of the input AC to ground and one across each of the two legs, for surge and transient voltage protection of the tray.

The input AC is wired from TB2 to (A28) the switching power supply and to (A2) a toroid transformer. The (A28) switching power supply (1063547) provides the +48 VDC to operate the amplifier assembles and also to (A10) the +48 VDC fan in the tray. The step-down toroid (A2) supplies two 16-VAC outputs, through the terminal block TB2, to (A3) the +12V(4A)/-12V(1A) power supply board (1265-1312). The AC connects on the board to two full wave bridge networks for +12 VDC and one full wave bridge network for -12 VDC. The rectified DC from the +12 VDC full wave bridge networks is connected to the (U1-U4) current-limiting voltage regulator ICs. The rectified DC from the -12 VDC full wave bridge network is connected to the (U5) current-limiting voltage regulator ICs. The ±12 VDC outputs connect to the rest of the boards in the tray through jacks J3 to J8.

7.2 Tune Up Info

If this transmitter contains the (optional) 4.5-MHz composite input kit, the baseband video input is used when the baseband video is connected to J2 and a baseband select is connected to J18 pins 6 and 7 on the rear of the tray.

Check that the RF output at J15 of the transmitter is terminated into a dummy load of at least 100 watts. While performing the alignment, refer to the Test Data Sheet for the transmitter and compare the final readings from the factory with the meter readings on the tray. They should be very similar. If a reading is more than 10% different, a problem with the tray may exist. Switch on the on/off AC circuit breaker on the rear of the tray.

7.2.1 Baseband Section

This tray has adjustments for video and audio modulation levels and other related parameters.

Connect an NTSC composite video test signal input (1 Vpk-pk) or an (optional) 4.5-MHz composite input to the transmitter video input jack J2 on the rear of the tray.

Note: J2 is loop-through connected to J1. It can be used as a baseband video source if the jumper W1 on J3 of the sync tip clamp/modulator board is removed.

Connect the baseband audio, if it is balanced audio (+10 dBm), to the terminal block TB1 or connect the composite audio (stereo) (1 Vpk-pk) to the BNC jack J13.

Note: J13 is loop-through connected to J3. It can be used as a composite audio source if the jumper W4 on J12 of the aural IF synthesizer board is removed.

The baseband audio is not used with the (optional) 4.5-MHz composite input.

Observe the front panel meter on the tray. In the Video position, the meter indicates active video from ≅ 0.3 volts to 1.0 volts. With an input video of 1 Vpk-pk, the display should indicate 100 IRE units at white. If the reading is at not the proper level, the overall video level can be changed by adjusting the video level control R15 on (A5) the sync tip clamp/modulator board (1265-1302).

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

7.2.2 IF/Upconverter Section

The upconverter section of the tray includes adjustments for automatic level control (ALC), linearity (amplitude pre-distortion), and incidental phase (phase change vs. level) pre-distortion for correction of the non-linearities of the RF amplifier section of the tray. The upconverter section also includes adjustments to the local oscillator chain tuning and the local oscillator center frequency tuning. Both of these alignments were completed at the factory and should not need to be adjusted at this time. Move the Operate/Standby switch on the front panel of the tray to Standby.

The set-up of the RF output includes an adjustment to the drive level of the amplifier section of the tray, the adjustment of the linearity, and the (optional) incidental phase predistortion which compensates for any nonlinear response from the amplifier section.

Verify that all red LEDs on the ALC board are extinguished. The following list details the meaning of each LED when it is 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 due to excessive attenuation in the linearity or ICPM corrector signal path or that 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 (Visual mute) - Indicates that a Visual Mute command is present (The visual mute is not used in this system.)
- DS5 (Modulator Enable) - Indicates that the modulator output has been selected

Check that jumper W3 on J6 of (A8) the ALC board (1265-1305) is in the Auto position. Adjust the power gain pot R1 on the front panel of the tray to obtain +0.85 VDC on the front panel meter in the ALC position. Move jumper W3 on J6 to the Manual position and adjust R87 on the ALC board for +0.85 VDC on the front panel meter in the ALC position. Move the jumper back to Auto; 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. This signal supplies the voltage to the high-band mixer/amplifier board where it is used as an automatic gain control (AGC) for the RF output signal of the upconverter section in the amplifier section of the tray.

7.2.3 Amplifier Section of the Tray

Note: Power is applied to the amplifier boards when the transmitter is switched to Operate.

Switch the transmitter to Operate and verify that the visual power reading on the front panel meter is 100%. If not, adjust the front panel power adjust pot to achieve a reading of 100%.

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 observe the differential gain and phase of the RF output signal.

If a synchronous demodulator with a quadrature video output is available, it can be used with an X-Y oscilloscope to display incidental carrier phase modulation (ICPM). As shipped, the exciter was preset to include linearity (gain vs. level) and incidental phase (carrier phase vs. level) predistortion. The predistortion was adjusted to approximately compensate the corresponding non-linear distortions of the amplifier when it is driven to place the sync level near saturation.

7.2.4 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. 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.

Find the ALC board on the tray level control locations drawing (1265-5305) to locate the adjustments for the three 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 the last stage primarily stretching sync.

To adjust the linearity correctors, check that the IF phase corrector jumper W2 on J9 of the IF phase corrector board is disabled. Also check that jumper W1 on J4 of the ALC board is enabled. Select a 3.58-MHz modulated staircase or ramp input test video signal and monitor the differential gain at the output of the transmitter.

Check that the ALC is set to +0.85 VDC on the front panel meter in the ALC position. The ALC will maintain the corresponding peak power level following the correctors. A positive aspect of linearity adjustment with the ALC enabled is that the control movements will not affect peak power.

Note: The adjustment procedure must be repeated to achieve the correct differential gain predistortion.

Start with the first linearity stage and adjust R34 CW on the IF ALC board to stretch the signal above the white region. Back off on the corresponding magnitude control R13 as required. Next, advance the second threshold control R37 to stretch the signal above the black range and then back off on the magnitude control R18 as required. Adjust the third threshold pot R40 to stretch sync. Back off on the corresponding magnitude control R23 as required. Go back through the white through black and sync correctors to touch up the effects of ALC level changes resulting from the adjustment.

Note: If additional sync stretch is required, adjust R43 on the (A5) sync tip clamp/modulator board.

7.2.5 IF Phase Corrector Board Adjustment

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

Locate (A9) the IF phase corrector board (1227-1250). The amplitude correction portion of the board is not utilized in this configuration; as a result, the jumper W3 on J10 should be in the Disable position and R35 and R31 should be fully CCW. R68 is the range adjustment and should be set to the mid-point of the range. The phase correction enable/disable jumper W2 on J9 should be in the Enable position.

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 observe the differential phase or intermod 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. They are adjusted, as necessary, 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. The 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.

7.2.6 Calibration of the Output Power Level

Note: Do not perform this procedure unless the power calibration is suspect.

Switch the transmitter to Standby. Move jumper W1 on J5 of the filter/amplifier board, high output (1064150), to the Manual position (J5-1, 2). Preset R51, the aural null pot on the visual/aural metering board (1265-1309), full CCW. Adjust R48, the offset null pot on the visual/aural metering board (1265-1309), for 0% visual output.

Perform the following adjustments, with no aural present, by removing the jumper cable W1, the aural IF loop-through connected to J16 on (A5) the sync tip clamp/modulator board. Switch the transmitter to Operate. Connect a sync and black test signal to the video input jack of the tray. Set up the transmitter for the appropriate average output power level on a wattmeter (sync + black and 0 IRE setup, wattmeter=59.5 watts; sync + black and 7.5 IRE setup, wattmeter=54.5 watts).

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

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

With the spectrum analyzer set to zero span mode, obtain a peak reference level on the screen. Reconnect the 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 gain adjust pot on the front panel until the original peak reference level is attained. Peak L1 and C8 for a maximum aural power reading, then adjust R20 for a 100% Aural Power reading. Switch to the Visual Output Power position and adjust R51 for 100% Visual Power.

To adjust the VSWR cutback of the transmitter, after the visual and aural outputs are calibrated for 100%, adjust the power to 20% by using the front panel power adjust pot and with the jumper in Manual on the VHF filter/mixer board (1064150). Reverse the forward and reflected cables on the (A31) output coupler board and adjust R39 on the visual/aural metering board for a 20% reading. Adjust R22 on the transmitter control board (1068933) until the front panel VSWR LED is illuminated. Put the cables back in the original configuration and place the transmitter in Standby.

Return jumper W1 on the filter/amplifier board, high output (1064150), to the AGC position (J5-2, 3). Use the front panel gain adjust pot to set all of the voltages to .85 volts. If necessary, use R73 on the transmitter control board to bring the tray to 100% power.

This completes the detailed alignment procedures for the transmitter. If a problem occurred during the alignment, refer to the board-level alignment procedures that follow for more detailed information.

7.2.7 Board Level Alignment Procedures

7.2.7.1 (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) and the (A25) 4.5-MHz bandpass filter board (1265-1307). 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 need no 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.

7.2.7.2 Delay Equalizer Board (1227-1204)

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 coming out of the board as is going into the board.

7.2.7.3 (A24) Composite 4.5-MHz Filter Board (1227-1244)

This board is part of the 4.5-MHz input kit and will only function properly when the 4.5-MHz composite input signal and the 4.5-MHz composite input are 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.

7.2.8 (Optional) (A25) 4.5-MHz Bandpass Filter Board (1265-1307)

This board is part of the 4.5-MHz input kit and will only function properly when the 4.5-MHz composite input signal and the 4.5-MHz composite input are 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.

7.2.9 (A7) IF Carrier Oven Oscillator Board (1191-1404)

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; this is the aural phase lock loop reference.

7.2.10 (A5) Sync Tip Clamp/Modulator Board (1265-1302)

To align this board:

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

2. Set the controls R20, the white clip, R24, the sync clip, and R45, the sync stretch cut-in, to their full counter clockwise (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 8-1 should be observed on the oscilloscope. 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: The waveform shown in Figure 7-1 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.

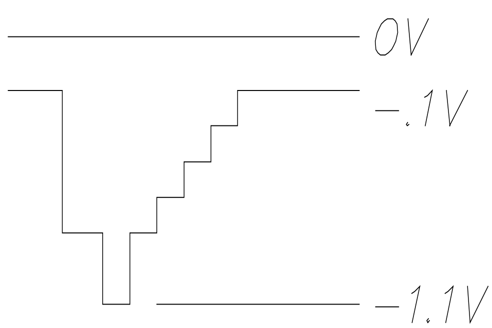

Figure 7-1. Waveform

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. Connect the double sideband 45.75-MHz visual IF signal from J18 to a 10-dB splitter/coupler. Connect the coupled port of the splitter/coupler to the RF input of a television demodulator. Connect the direct port to a spectrum analyzer.

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

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

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

8. Move the 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 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 needed, for the correct depth of modulation.

10. Move the 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 full 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 the IF output jack J20. Preset R62, the visual IF gain pot, to the middle of the setting. 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, the visual IF gain, for a 0 dBm visual output level. Adjust R85, the 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 a 100 IRE white level, monitor TP2 with an oscilloscope. Set the control R24, the sync clip, just below the point at which sync clipping begins to occur. Similarly, set R20, the white clip, to just below the point at which the white video begins to clip.

7.2.11 (A4) Aural IF Synthesizer Board, 4.5-MHz (1265-1303)

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

   A. Connect the 600Ω balanced audio output from an audio oscillator to the balanced audio input terminals of the tray at TB1-1 (+), TB1-2 (-), and TB1-3 (ground) on the rear chassis.
   B. Connect the combined IF output at J21 (IF sample) on the clamp modulator board to the input of an IF splitter. Connect one output of the splitter to the video demodulator and the other output to the spectrum analyzer.

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

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

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

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

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

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

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

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

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

6. Disconnect the 600Ω balanced audio input to the tray. Connect a 75Ω stereo audio input (400 Hz at 1 Vpk-pk) to the 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%)

7.2.12 (A8) ALC Board (1265-1305) (Part 1 of 2)

Table 7-1 describes the functions of each LED on the (A8) ALC board.

Table 7-1. ALC Board LEDs

LED	FUNCTION
DS1 (Red LED)	Indicates that an abnormally low IF signal level is present at IF input connector J1
DS2 (Red LED)	Indicates that the ALC circuit is unable to maintain the level requested by the ALC reference due to excessive attenuation in the linearity or the IF phase corrector signal path, or the jumper W3 on J6 is in the Manual Gain position
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 in the tray:

   A. ALC Board (1265-1305)

   Connect jumper W1 on J4 to disable, between pins 2 and 3 (to disable the linearity correctors). Connect jumper W3 on J6 to Manual, between pins 2 and 3 (for Manual Gain Control).

   Adjust R87, the 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, the Input Fault LED, 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 the second part of the ALC board alignment, make sure that the IF phase corrector board (1227-1250) is functioning properly.

7.2.13 (A9) IF Phase Corrector Board (1227-1250)

Refer to section 7.2.5 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 output jack of the ALC board (A8).

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

7.2.14 (A8) ALC Board, NTSC (1265-1305) (Part 2 of 2)

To align this board:

1. Input a multiburst video test signal into the transmitter. 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 full clockwise (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, adjust switch S1 on the board to mid-range and then adjust the front panel Power Adjust control (A20) 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 output level is needed, move the 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 video input 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: The following step affects the response of the entire transmitter.

8. Connect a video sweep signal to the input of the tray. Monitor the output of the system with a spectrum analyzer. Adjust C71 with R103 and C72 with R106, as needed, to flatten the response. C71 and C72 are 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.

9. Refer to section 7.2.4 of this chapter for the system alignment procedures for the linearity correctors. R13, R18, and R23, the magnitude controls, should be set full CW. Controls R34, R37, and R40 are the linearity cut-in adjustments.

7.2.15 (A14-A1) Channel Oscillator Board (1145-1201)

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

1. Connect J1, the main output of the channel oscillator, to a spectrum analyzer that is 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 x4 multiplier board. Tune capacitors C6 and C18 for maximum voltage, then also tune L2 and L4 for the maximum voltage output at TP1.

2. Connect J2, the sample output of the channel oscillator, to a suitable counter. 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 the ADC Field Service Department for further instructions.

Note: If the VCXO board (1145-1204) in the VCXO assembly (1145-1206) is used, the C9 fine frequency adjust is not located on the VCXO board. Use R9 on the FSK w/EEPROM board.

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

7.2.16 (A15-A1) x4 Multiplier Board (1174-1112)

While monitoring this 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.

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

7.2.17 (A11-A1) Filter/Mixer Board (1150-1102)

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.

3. Adjust C13 and C17 for the best frequency response for the LO frequency.

7.2.18 (A11-A2) Filter/Amplifier Board, High Output (1064150)

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 +11 dBm visual and +1 dBm aural level by adjusting R9. The output is fed to the (A23-A1) high-band amplifier board (1218-1201) that is mounted on the VHF amplifier heatsink assembly (A23).

7.2.19 (A23-A1, A23-A3, A23-A4) High-Band Amplifier Boards (1218-1201)

Each of the high-band amplifier boards has 20 dB of gain. A23-A1 is biased at 2 amps of idling current with no RF drive applied. A23-A3, A4 are biased at 1.5 amps each, with no RF drive applied. To set the bias for the final amplifier board (A23-A1), the RF drive will need to be removed. To monitor the current adjustment, read the voltage drop across the 3-watt resistor, R5, mounted on the overcurrent protection board (1273-1130). Using Ohm's Law, determine the voltage drop across the resistor (2 amps x 0.01Ω=0.020 volts). Preset the bias adjust pots R5 and R9 CCW. Slowly adjust the bias adjust pot R5 for 1 amp on the meter and then adjust R9 for 2 amps total current on the meter.

To set the bias for the final amplifier board (A23-A3), the RF drive will need to be removed. To monitor the current adjustment, read the voltage drop across the 3-watt resistor R6 that is mounted on the overcurrent protection board (1273-1130). Using Ohm's Law, determine the voltage drop across the resistor (1.5 amps x 0.01Ω=0.015 volts). Preset the bias adjust pots R5 and R9 CCW. Slowly adjust the bias adjust pot R5 for .75 amps on the meter and then adjust R9 for 1.5 amps total current on the meter. To set the bias for the final amplifier board (A23-A4), the RF drive will need to be removed. To monitor the current adjustment, read the voltage drop across the 3-watt resistor R7 that is mounted on the overcurrent protection board (1273-1130). Using Ohm's Law, determine the voltage drop across the resistor (1.5 amps x 0.01Ω=0.015 volts). Preset the bias adjust pots R5 and R9 CCW. Slowly adjust the bias adjust pot R5 for .75 amps on the meter and then adjust R9 for 1.5 amps total current on the meter.

7.2.20 Frequency Adjustment of the High-Band Amplifier Boards

The following procedures describe how to adjust the high-band amplifier boards.

Move the ALC/manual jumper on the (A11-A2) filter/amplifier board to the Manual position, disabling the ALC circuit. Remove two fuses F2 and F3 on the overcurrent protection board to disable the (A23-A3 and A4) high-band amplifier boards. Connect a spectrum analyzer to output connector J2 on the (A23-A1) high-band amplifier board. Adjust C9 and C19 for peak power and frequency response.

Move the spectrum analyzer to the output connector J2 on the (A23-A3) high-band amplifier board. Install fuse F2 and adjust C9 and C19 (on the [A23-A3] high-band amplifier board) for peak power and frequency response.

Move the spectrum analyzer to the output connector J2 on the (A23-A4) high-band amplifier board. Remove fuse F2, install fuse F3, and adjust C9 and C19 (on the [A23-A4] high-band amplifier board) for peak power and frequency response.

Move the spectrum analyzer to J2, the output of the (A23) amplifier heatsink assembly. Install all of the fuses and readjust C9 and C19, if necessary, on all three amplifier boards for peak power and frequency response.

7.2.21 (A29) Overcurrent Protection Board (1273-1130)

There are no adjustments to this board.

7.2.22 (A19) Visual/Aural Metering Board (1265-1309)

This board is calibrated to give a peak detected output indication to the front panel meter for % Visual Output, % Aural Output, and % Reflected Output and should not be adjusted.

7.2.23 (A3) +12 VDC (4A)/-12 VDC (1A) Power Supply Board (1265-1312)

There are no adjustments to this 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.

7.2.24 (A31) Output Coupler Board (1211-1004)

There are no adjustments to this board.

This completes the tune up procedures for the boards in the 420A transmitter.