3.1 INTRODUCTION

This section provides a basic (paragraph 3.2) and an extended (paragraph 3.3) alignment procedure. The basic procedure, which should accompany any service work, requires only a calibrated oscilloscope. The extended procedure, which should be performed at nominal six-month intervals, requires the oscilloscope, module extenders, a calibrated digital voltmeter and other equipment as listed in Table 3-2. All adjustments not covered in this procedure should be performed on suitable module test fixtures only.

3.1.1 TEST EQUIPMENT REQUIRED

The basic procedure requires the test equipment listed in Table 3-1. The additional equipment required for the extended procedure is listed in Table 3-2.

Table 3-1. Basic Test Equipment Req

Description	Model
*Oscilloscope Test-Point Shorting Jumper Nonmetallic Alignment Tool	Tektronix 2215

*An R2001 is a suitable substitute.

Table 3-2. Extended Test Equipment Required

Description	Model
*Oscilloscope	Tek 2215
*Digital Voltmeter	Fluke 8840A
 RF Signal Generator 	Fluke 6060B
 Modulation Meter 	HP8901
Audio Generator	HP8903
Receiver Test Cover	Motorola
Extender Card Set	Motorola RPX- 4379A

*An R2001 is a suitable substitute for these separate equipments.

3.1.2 PREPARATION FOR ALIGNMENT

- Perform all alignments at normal ambient temperature.
- 2. Remove the top cover of the unit to be aligned.
- 3. Turn on the unit to be aligned, allowing a warmup time of 15 minutes before starting alignment.

3.2 BASIC ALIGNMENT PROCEDURE

3.2.1 LOW VOLTAGE SUPPLY

- Remove low voltage power supply cover and turn on System Analyzer.
- 2. Connect a DVM to test point TP5 on the Output board A5.
- Adjust R6 on the Control board, A4, (Figure 3-1) for a DVM reading a TP5 (A5) of +5.2 Vdc ±0.1 Vdc.
- 3.2.2 CRT INTENSITY BIAS
- Select Scope DC display and Ext Horiz input mode on the System Analyzer. Set the Intensity control fully counter clockwise.

CAUTION

Do not let a dot stay in one place on the CRT screen for more than 30 seconds because it will leave a permanent burn in the phosphor.

2. Adjust the Intensity Bias potentiometer on the Scope Amplifier board (Figure 3-2) until a dot appears on the screen. You may have to use the Vertical and Horizontal position control (Vert, Horiz) on the front panel to bring the dot onto the screen. Then back off the Intensity Bias potentiometer until the dot just disappears.

3.2.3 CRT INTENSITY BALANCE

- Select Scope DC display and a horizontal sweep rate of 1 mSec/Div on the System Analyzer. Set the horizontal timebase vernier to calibrate (Cal) and adjust the Intensity control for a barely visible horizontal line on the CRT.
- 2. Adjust the Intensity Balance potentiometer (Figure 3-2) for uniform intensity of the horizontal trace from left to right. The Balance potentiometer affects the intensity on the left side of the trace.



Figure 3-1. Control Board (A4) - Alignment Points



Figure 3-2. Scope Amplifier Board (A2) - Alignment Points

3.2.4 CRT ASTIGMATISM AND GEOMETRY

- Select Monitor function and Gen/Mon Mtr display on the System Analyzer. Set the Intensity control for a medium-intense display.
- 2. While using the Focus control to maintain a focused display at the center of the CRT, adjust the Astigmatism and Geometry potentiometers (Figure 3-2) for the best focus at the outer edges of the CRT with minimum pincushion and barrel distortion of the display. The two adjustments are interactive; to get the best display, alternate repeated small adjustments between the two potentiometers.

3.2.5 CRT VERTICAL CENTERING AND TRACE ROTATION

- Select Gen/Mon Mtr display. Adjust the Intensity control for a comfortable viewing brightness.
- 2. With the Test-Point Shorting Jumper, connect TP1 of the Scope Amplifier board (Figure 3-2) to chassis ground.
- Adjust the Trace Rotation potentiometer (Figure 3-2) to make the horizontal trace on the CRT perpendicular to the graticule center line.

- 4. Adjust the Vertical Position potentiometer (Figure 3-2) so that the horizontal trace on the CRT passes through the graticule center point.
- 5. Adjust the Trace Rotation potentiometer (Figure 3-2) to align the horizontal trace on the CRT behind the horizontal graticule line.
- 6. Remove the jumper from TP1.

3.2.6 CRT HORIZONTAL CENTERING

- 1. Select Gen/Mon Mtr display. Adjust the Intensity control for a comfortable viewing brightness.
- 2. With the Test-Point Shorting Jumper, connect TP6 of the Scope Amplifier board (Figure 3-2) to chassis ground.
- 3. Adjust the Horizontal Position potentiometer (Figure 3-2) so that the vertical trace on the CRT passes through the graticule center point.
- 4. Remove the jumper from TP6.

3.2.7 CRT HORIZONTAL GAIN

- Connect the Mod Out port to the Ext Horiz port on the System Analyzer's front panel.
- Select Generate FM function and Scope DC display. Set the Horiz control for external horizontal

input (Ext). Turn the Code Synthesizer and the Ext Level control OFF, and the 1 KHz Level control up about half way.

- Connect an oscilloscope with a calibrated vertical input to TP6 on the Scope Amplifier board (Figure 3-2).
- Using the front panel's horizontal vernier control, adjust for a 3 Vp-p amplitude on the sinewave at TP6.
- 5. With 3 Vp-p at TP6, adjust the Horizontal Gain potentiometer (Figure 3-2) for a CRT horizontal trace of 6 cm. (Use the front panel controls to position the trace at a convenient place near the center of the CRT.)

3.2.8 CRT VERTICAL GAIN

- Connect the Mod Out port to the vertical input port (Vert In) on the System Analyzer's front panel.
- Select Generate FM function and Scope DC display. Set the Horiz control for a sweep rate of 1 mSec/Div and the horizontal vernier to Cal. Set the Vert control for an input sensitivity of 1V/Div and the vertical vernier to Cal.
- 3. Turn the Code Synthesizer and the Ext Level control OFF, and the 1 KHz Level control up about half way.
- Connect an oscilloscope with a calibrated vertical input to TP1 on the Scope Amplifier board (Figure 3-2).

- 5. Using the 1 KHz Level control on the front panel, adjust for a 3 Vp-p amplitude on the sinewave at TP1.
- 6. With 3 Vp-p at TP1, adjust the Vertical Gain potentiometer (Figure 3-2) for a 6-cm p-p sinewave on the CRT. (Use the front panel's Horiz and Vert position controls to center the waveform on the CRT.)

3.2.9 VERTICAL INPUT GAIN

- Select Generate FM function and Scope DC display. Set the Horiz control for a sweep rate of 1 mSec/Div and the horizontal vernier to Cal. Set the Vert control for an input sensitivity of 1V/Div, and the vertical vernier to Cal.
- 2. Connect an oscilloscope with a calibrated vertical input to the Mod Out port on the front panel.
- 3. Turn the Code Synthesizer and the Ext Level control OFF and adjust the 1 KHz Level control for a 6 Vp-p sinewave on the attached oscilloscope.
- 4. Disconnect the oscilloscope from the Mod Out port and connect the Mod Out port to the Vert input port.
- 5. Adjust the Input Vertical Gain potentiometer on the Front-Panel Interface board (Figure 3-3) for a 6-cm p-p sinewave on the CRT. (Use the front panel's Horiz and Vert position controls to center the waveform on the CRT.)



Figure 3-3. Front Panel Interface Board (A15) - Alignment Points

3.2.10 DVM ZERO

- 1. Select DVM display and DC mode.
- 2. Short the center conductor of the DVM input port (DVM In) to ground.
- Adjust the Coarse DVM Zero and the Fine DVM Zero potentiometers on the Front-Panel Interface board (Figure 3-3) for a zero reading on the DVM display.

3.2.11 CHARACTER GENERATOR

- Select Monitor FM function and Gen/Mon Mtr display.
- Adjust the Horizontal Character-Sweep-Width potentiometer on the Scope/DVM Control board (Figure 3-4) so that the right-hand edge of the CRT character display is approximately 4.2 gra-

ticule divisions to the right of the graticule center line.

 Adjust the Vertical Character-Sweep-Width potentiometer on the Scope/DVM Control board (Figure 3-4) so that the bottom edge of the CRT display is approximately 3.3 graticule divisions below the graticule center line.

3.2.12 SPECTRUM ANALYZER CENTERING

- Select Spect Analyzer display. Set the dispersion control (Dispr) on the front panel to 1 MHz (fully counter clockwise). Set the center frequency of the Analyzer to 10.0 MHz.
- 2. Connect the 10 MHz STD port on the rear panel to the RF In/Out port on the front panel. Set the RF step attenuator (Step) to obtain a convenient spectral display.



Figure 3-4. Scope/DVM Control Board (A7) - Alignment Points

 Adjust the Spectrum Analyzer Centering potentiometer on the Scope/DVM Control board (Figure 3-4) so that the spectral line on the CRT is centered about the center graticule line.

3.2.13 HORIZONTAL TIMEBASE

- 1. Select Generate FM function and Signaling Sequence (Seq) display. Select A/B encode, and program Tone A for 20.0 Hz, and Tone B for 19,999.9 Hz.
- Select Modulation display. Set the Oscilloscope controls for a vertical range of 2.5 kHz/Div, Auto Trigger, and a horizontal sweep rate of 10 mSec/ Div. Set the horizontal and vertical vernier controls to Cal.
- 3. Set the Code Synthesizer for continuous (Cont) Tone A, and turn up the Code Synthesizer level control (Code Synth Lvl) to obtain a nearly fullscale sinusoidal waveform on the CRT. Turn the Ext Level and the 1 KHz Level controls OFF.
- 4. Adjust the Coarse Timebase Calibration potentiometer on the Scope Amplifier board (Figure 3-2) so that one cycle of the displayed waveform occurs in 5 cm along the horizontal axis. Use the Vert and Horiz position controls to center and move the waveform; this will measure the 5 cm in the middle of the screen and avoid nonlinearities near the edge of the CRT.
- 5. Set the Oscilloscope Horiz control for a sweep rate of 10 μ Sec/Div and select Tone B output on the Code Synthesizer.
- 6. Adjust the Fine Timebase Calibration capacitor on the Scope Amplifier board (Figure 3-2) so that one cycle of the displayed waveform occurs in 5 cm along the horizontal axis. As with coarse timebase calibration, use the Vert and Horiz position controls to center and move the waveform.

3.3 EXTENDED ALIGNMENT PROCEDURE

3.3.1 DVM

Perform 3.1.2 preparation for alignment and 3.2 basic alignment procedure before proceeding to any of the extended alignment procedure.

3.3.1.1 Peak Detector Zero

NOTE

Do not attempt to make a peak detector alignment with any boards on extender cards. The Receiver Board (A8) may be removed to make access to adjustments.

- 1. Select generate FM Narrowband function and turn the code synthesizer, External level control, and 1 KHz level control OFF.
- Connect an external DVM to TP4 on the Scope/ DVM Control board (see Figure 3-4).
- 3. Adjust the positive detector zero (R67) for a DVM reading of 0.000 ± 0.0009 Vdc at TP4.
- Connect the external DVM to TP6 on the Scope/ DVM Control board.
- Adjust the negative detector zero (R78) for a DVM reading of 0.000 ± 0.0009 Vdc at TP6.

3.3.1.2 DVM X0.1 Gain

- Select generate FM Narrowband function and Gen/Mon Mtr display.
- Connect an external DVM to test point TP6 on the Scope/DVM Control board (see(Figure 3-4).
- Turn on the 1 kHz internal modulation and adjust the level until the voltage at TP6 reads 2.000 Vdc.

NOTE

Because the internal DVM is continuously multiplexed through nine internal voltage points, the microprocessor must be halted to make the DVM X0.1 Gain adjustment. The microprocessor must be halted on the negative detector cycle. A number of halt attempts may have to be made.

- Connect a DVM to test point TP5 on the Scope/ DVM control board.
- 5. To halt the microprocessor short test point TP6 on the Processor board to ground. Once the microprocessor has been halted measure the voltage at TP5. The voltage should be 0.2V, approximately X0.1 the voltage at TP6. If the voltage at TP5 is not approximately X0.1 the voltage of TP6 restart and halt the microprocessor until it is.
- 6. Now that the microprocessor is halted in the negative detector position, adjust R167 (See Figure 3-4) so that the voltage reading at TP5 is equal to X0.1 the voltage at TP6 to four significant figures. (Example TP6 = 2.000 Vdc, TP5 = 0.2000 Vdc.)

3.3.1.3 DVM

NOTE

Do not attempt to make the DVM alignment with any boards on extender cards.

- Select DVM/DIST display and DC Volts mode. Short the center conductor of the front panel's DVM input port (DVM In) to ground. Connect an external DVM between TP2 and TP90 on the Scope/DVM Control board (Figure 3-4).
- 2. Adjust the Coarse DVM Zero and the Fine DVM Zero potentiometers on the Front-Panel Interface board (Figure 3-3) until the external DVM reads 0 ± 0.5 mVdc.
- 3. Remove the short-circuit on the DVM input port and apply approximately 0.900 Vdc from an external power supply. The voltage between TP2 and TP9 of the Scope/DVM Control board should be within ± 1 mV of the voltage at the front panel's DVM input port. If the unit fails this test, adjust the DVM Buffer Gain on the Front Panel Interface board (Figure 3-3) until the two voltages are equal.
- Select Generate FM Narrowband mode and Gen/ Mon Mtr display, and turn the MODULATION switch to OFF.
- 5. Short TP4 to TP9 on the Scope/DVM Control board (Figure 3-4).
- Adjust the A/D Offset on the Processor Interface board (Figure 3-5) until the plus-peak-deviation reading on the CRT is just toggling between 0.00 and 0.01 kHz. The slightly turn the adjustment to maintain a constant 0.00 reading. Note that if the

offset adjustment is turned past this point, the deviation reading is still 0.00, but the A/D converter is not aligned properly.

- Remove the short-circuit between TP4 and TP9, and connect the positive lead of the external DVM to TP4 of the Scope/DVM Control board (Figure 3-4). Place the negative lead on the ground plane or TP9 of the Scope/DVM Control board.
- Turn on the 1-kHz internal modulation and adjust the level until the voltage at TP4 reads 0.900 Vdc.
- Adjust the A/D Gain (Figure 3-5) until the reading on the positive deviation peak is 4.50 kHz.
- 10. Select DVM DC mode.
- 11. With the center conductor of the front panel's DVM input port again shorted to ground, adjust the RMS-Converter Offset on the Processor Interface board (Figure 3-5) for a reading of 0.000V on the CRT DVM display.
- Adjust the Sign Detector Offset (Figure 3-5) until the sign of the 0.000V reading is just flashing between plus and minus.
- Remove the short and apply approximately 0.900 Vdc to the front panel's DVM input port.
- 14. While monitoring the input voltage on an external DVM, adjust the RMS-Converter Gain on the Processor Interface Board (Figure 3-5) until the CRT DVM reading equals the external voltage applied.



Figure 3-5. Processor Interface Board (A11) - Alignment Points

3.3.2 DISTORTION/SINAD ALIGNMENT

- Select Generate function and Gen/Mon Mtr display. Using an audio generator with less than 0.1% distortion, apply a 900 mVrms, 1-kHz ± 2 Hz signal to the Vert/SINAD/DVM/Dist/Counter input port on the front panel.
- Verify that the distortion reading on the CRT is ≤0.5%. If this test fails, align the notch filter.
- Turn the System Analyzer OFF and extend the Scope/DVM Control board using the 100-pin extender card.
- 4. Turn the System Analyzer ON and select Generate FM function and Gen/Mon Mtr display.
- 5. Using the same low-distortion generator as in step 1, apply a 998 \pm 0.2-Hz sinewave to the distortion input port (Dist In).
- 6. Alternately adjust the 998-Hz notch potentiometers on the Scope/DVM Control board (Figure 3-4) to null the distortion reading on the CRT. You should get a reading of less than 0.5%.
- 7. Change the audio generator's input frequency to 1002 ± 0.2 Hz.
- 8. Alternately adjust the 1002-Hz notch potentiometers on the Scope/DVM Control board (Figure 3-4) to again null the CRT distortion reading. You should again get a reading of less than 0.5%.
- Turn the system's power OFF and put the Scope/ DVM Control board back into the system chassis.

3.3.3 RECEIVER

3.3.3.1 Linear IF

- Perform the basic alignment procedure of paragraph 3.2.
- 2. Turn the System Analyzer OFF and remove the Receiver board. Remove the Receiver board cover, install the Receiver Test Cover on the board, and insert the Receiver board into the appropriate extender card. Place the Receiver and extender assembly in the Receiver board's edge connector.
- Turn the Analyzer ON and select Monitor AM function and Distortion display. Set the monitor frequency to 250 MHz, the RF step attenuator (Step) to 0 dB, the IF bandwidth switch (BW) to Wide, and the Receiver audio filter to 300-Hz HPFL and 3-kHz LPFL.
- Connect the external signal generator to the Antenna port on the front panel. Adjust the external generator for an output level of approximately -80 dBm and a calibrated, 30 percent AM, 1-kHz tone at 250 MHz.
- 5. Connect the Demod Out port to the distortion input port (Dist In) on the front panel.
- Adjust C307 and C320 (marked on the Receiver Test Cover) for lowest distortion; adjust the signal strength of the generator as needed.
- 7. Select Narrowband FM mode.

- Adjust the external generator for an output level of approximately -40 dBm and a calibrated, 3-kHz FM, 1-kHz tone.
- 9. Adjust C327, C328 and C320 (marked on the Receiver Test Cover) for lowest distortion.

3.3.3.2 AM/AGC Calibration

- Select Monitor AM function and Gen/Mon Mtr display. Set the monitor frequency to 250 MHz, the RF step attenuator to 0 dB, and the BW switch to Narrow.
- 2. Connect the external generator to the Antenna port on the front panel. Adjust the external generator for an output level of -50 dBm and a calibrated 40 percent AM at 250 MHz.
- Adjust R359 (marked on the Receiver Test Cover) for a reading of 40% ± 5% on the CRT AM display.
- Adjust R398 for the increase RF attenuator setting warning to just flash on the CRT.
- 5. Repeat steps 3 and 4 once.

3.3.3.3 FM Calibration

- Select Monitor FM function and Gen/Mon Mtr display. Set the monitor frequency to 250 MHz, the RF step attenuator to 0 dB, and the BW switch to Wide.
- Connect the external signal generator to the Antenna port on the front panel. Adjust the external generator for a center frequency of 250 MHz at an output level of approximately -30 dBm and a calibrated 40-kHz FM.
- Adjust R421 (marked on the Receiver Test Cover) for a reading of 40 kHz ± 2 kHz on the CRT FM display.
- 3.3.3.4 Spectrum Analyzer

NOTE

Unless the factory alignment has been disturbed through repair, do not re-align the Spectrum Analyzer except for offset adjustment (R241B). Because all the adjustments interact, re-aligning the Spectrum Analyzer is difficult.

- 1. Remove cover from receiver board.
- Connect a high input impedance frequency counter to pin 8 of U201 on the receiver board (see Figure 3-6).
- Adjust C236 on the receiver board (see Figure 3-6) for a frequency reading of 10.24 MHz ± 100 Hz.
- 4. Replace receiver test cover.
- Select Monitor function and the Spect Analyzer display on the System Analyzer. Set the monitor

frequency to 250 MHz, and the RF step attenuator to 40 dB.

- 6. Connect the external signal generator to the Antenna port on the front panel. Adjust the external generator for a center frequency of 250 MHz and a calibrated output level of -30 dBm with no modulation.
- Adjust, in succession, C207, C208, C213 and C218 (marked on the Receiver Test Cover) to maximize the amplitude of the spectral line in the center of the CRT display.
- 8. Adjust R219, R226 and R229 (marked on the Receiver Test Cover) to obtain a uniform change in the spectral amplitude per 10-dB change of the RF step attenuator. R229 affects the level of the spectral component in the top quarter of the screen, R219 affects levels in the third quarter from the top, and R226 affects levels in the bottom quarter.
- 9. Adjust R241B for offset and R241A for gain, so that with the step attenuator at 0 dB, the peak of the spectral line lies on the 30-dB line of the CRT, and successive step increases of the input attenuator move the spectral amplitude downward on the CRT in 10-dB increments. The accuracy required for any one step-attenuator position is ± 2 dB.
- To obtain the best possible accuracy, you will generally need to repeat steps 4 and 5 multiple times.
- 11. For the Cellular Option, connect a calibrated signal of -40 dB at 850 MHz into the Antenna port on the front panel. Adjust R241B for a reading of $-40 \text{ dBm} \pm 1 \text{ dB}$ on the CRT signal-strength display.
- 12. Turn the power OFF and remove the Receiver board and extender card from the chassis. Remove the Test Cover from the Receiver board and replace the board cover. Put the board back into the system chassis.

3.3.3.5 BFO Centering

- 1. Select Monitor SSB/BSBSC function, Gen/Mon Mtr display, and turn squelch control off.
- Adjust C394 (see Figure 3-6) on the Receiver board so that the BFO error frequency control is centered such that both positive and negative BFO error frequencies are equal.

3.3.4 RF SYNTHESIZER

3.3.4.1 24 MHz VCO

- 1. Remove the 60.5 MHz Loop Board cover (A9A4).
- Connect a DVM to the junction of CR11 and R37 on the 60.5 MHz Loop Board (see Figure 3-7).
- 3. Adjust C46 for a DVM reading of $+7.0 \pm 1$ Vdc.

3.3.4.2 Phase Shift

NOTE

Unless the factory alignment has been disturbed through repair no adjustment should be made.

- 1. Remove the GHz Loop cover (A9A5).
- 2. Connect an audio generator through an external resistor ($R \ge 50$ K ohm) to the junction of R12 and C10 on the GHz Loop board (see Figure 3-8).
- Connect an oscilloscope to the lock detector output, junction of R51 and C35 (see Figure 3-8).
- Place the RF synthesizer on the appropriate extender card and turn the System Analyzer ON.
- Select Generate FM function and Gen/Mon Mtr display. Set the Generate FM frequency to 500.0000 MHz.
- 6. Adjust the audio generator for a 50 Hz sinewave with zero volts dc offset and adjust the variable output control for zero volts ac.
- 7. With the GHz loop locked increase the output level of generator until a 0.1 Vp-p ac waveform is observed on the oscilloscope.

NOTE

If the current summed into the loop filter is too large (i.e. the output level of the audio signal generator is too large) the GHz loop will break lock. If this happens adjust the level of the audio generator back to zero volts ac, until the GHz loop locks. Then gradually increase the level until a 0.1 Vp-p waveform is observed at the lock detector output.

8. If the lock detector is properly phased, the waveform at the lock detector output will be doubled in frequency (100 Hz) and every peak will be equal in amplitude as shown below:



9. If the lock detector is not properly phased, every peak will not be of equal amplitude (see example below). Adjust C24 until the correct waveform above is obtained. If the correct waveform cannot be obtained, select in test a value for C12 that in conjunction with the adjustment of C24 will produce the correct waveform.



3.3.4.3 FM Deviation

- Select Generate FM function and Gen/Mon Mtr display. Set the generate frequency to 100 MHz.
- 2. Connect the calibrated external modulation meter to the Antenna port on the front panel. Tune the external modulation meter to 100-MHz FM.
- Turn on the Modulation 1 KHz Level switch and adjust for a reading of 20 kHz on the CRT generate-deviation display.
- 4. Adjust R12 through the hole in the RF Synthesizer cover. (First locate R12 by removing the RF Synthesizer cover.) The reading should be 20 kHz ± 1 kHz, as measured by the external modulation meter.

3.3.5 FREQUENCY STANDARD

3.3.5.1 Oven Ready Light

1. Remove System Analyzer bottom cover.

NOTE

If the System Analyzer has a temperature compensated crystal oscillator (TCXO) perform alignment 3.3.5.1.1 TCXO. If the system analyzer has an oven controlled crystal oscillator (OCXO) perform alignment 3.3.5.1.2 OCXO.

3.3.5.1.1 TCXO.

- 1. Turn System Analyzer ON.
- 2. Turn R8 (see Figure 3-9) on the frequency Standard Interface board fully clockwise which will turn the oven ready light on the front panel ON.

3.3.5.1.2 OCXO.

- Turn System Analyzer on and wait approximately 10-20 minutes until heater input current and frequency stabilize. To monitor the heater input current put a DVM across R11 and R12 (see Figure 3-9) which are in parallel. The warm-up current will be 700 to 900 mA (voltage across R11 and R12 will be 0.35 to 0.45 Vdc). The stabilized current will be 200 to 250 mA (0.1 to 0.13 Vdc).
- Once the heater input has stabilized, adjust R8 on the frequency Standard Interface board until the oven ready light on the front panel just turns on.
- 3. Connect an external resistor load from the collector to Q1 to ground to increase the heater input current to 350 mA (0.18 Vdc across R11 and R12). The typical resistor value is 100 ohms, 2 watts. The resistor value required to bring the heater input current to 350 mA may change from unit to unit.
- With the external load resistor connect, adjust R8 on frequency Standard Interface board until the oven ready light just fully turns ON.
- Remove load resistor and make sure oven ready light is turned ON.

3.3.5.2 Oscillator Level

- 1. Connect a high input impedance scope probe to the junction of C15 and C17 on the frequency Standard Interface Board (see Figure 3-9).
- 2. Adjust R18 on the frequency Standard Interface Board for a peak-to-peak voltage between 1 and 2 volts at junction of C15 and C17.

3.3.5.3 Oscillator Frequency

- Connect an external frequency counter, with at least a 1 part in 10⁹ stability reference oscillator, to the 10 MHz STD output on the system analyzer's back panel.
- 2. Remove the timebase calibration cover screw on the lower left side of the System Analyzer.
- 3. Turn on System Analyzer and allow to warm up. Ten minutes for a TCXO or 20 minutes for a OCXO until oven ready light comes on.
- Using an appropriate non-metallic tuning tool, adjust the timebase oscillator for a counter reading of 10 MHz ± 1 Hz.

NOTE

If a National Bureau of Standards radio station is receivable, the following procedure can be performed.

- 1. Remove the timebase-calibration cover screw on the lower left side of the System Analyzer.
- 2. Allow the Analyzer to warm up for at least 20 minutes.
- Select Monitor AM function and Gen/Mon Mtr display. Set the monitor frequency to one of the National Bureau of Standards radio stations (5, 10, 15, or 20 MHz), and use a suitable antenna for these frequencies.
- 4. Adjust the timebase for a reading of 0 Hz \pm 1 Hz on the CRT monitor frequency-error display.

3.3.6 DUPLEX GENERATORS

3.3.6.1 Duplex Generator

- Remove the bottom cover of the System Analyzer and the Duplex Generator cover.
- Select Generate FM function and Duplex Gen display. Set the DUPLEX GEN switch to ON, the Duplex monitor frequency to 145 MHz, the offset frequency to 45 MHz, and the Image/Dplx switch to Low.
- 3. Adjust C68 on the Duplex Generator board (Figure 3-5) for 8 to 10V, as measured at TP 1.
- 4. Connect the calibrated external modulation meter to the DUPLEX GEN Output port on the front panel. Tune the external modulation meter to 100-MHz FM.
- 5. Turn on the Modulation 1 kHz Level switch and adjust for a reading of 20 kHz on the CRT generate-deviation display.
- 6. Adjust R69 on the Duplex Generator board (Figure 3-5) for a reading of 20 kHz \pm 1 kHz, as measured by the external modulation meter.
- 7. Set the Duplex offset frequency to 0 Hz Select Monitor FM function and Gen/Mon Mtr display.
- Connect the DUPLEX GEN Output port to the Antenna port on the front panel.
- Adjust C40 on the Duplex Generator board (Figure 3-5) for a reading of 0 Hz ± 50 Hz on the CRT monitor frequency-error display.

3.3.6.2 Enhanced Duplex Generator

- Remove the bottom cover of the System analyzer and the Duplex Generator cover.
- 2. Select Generate FM function and Duplex Gen display. Set the DUPLEX GEN switch to ON, the Duplex monitor frequency to 145 MHz, the offset frequency to 45 MHz, and the Image/Dplx switch to High.

- 3. Adjust C68 on the Enhanced Duplex Generator board (Figure 3-10) for 8 to 10V, as measured at CR14.
- 4. Connect the calibrated external modulation meter (HP8901) to the DUPLEX GEN Output port on the front panel. Tune the external modulation meter to 145 MHz FM.
- 5. Turn on the Modulation 1 kHz Level switch and adjust for a reading of 20 kHz on the CRT generate-deviation display.
- Adjust R69 on the Enhanced Duplex Generator board (Figure 3-10) for a reading of 20 kHz ±50 Hz, as measured by the external modulation meter.
- Select Monitor FM function and Gen/Mon Mtr display.
- 8. Connect the DUPLEX GEN Output port to the Antenna port on the front panel.
- 9. Adjust Y1 on the Enhanced Duplex Generator board (Figure 3-10) for an error reading on the CRT monitor frequency-error display equal to the offset stamped on Y1 \pm 10 Hz.

3.3.7 WIDEBAND AMPLIFIER

NOTE

Perform extended alignment procedures 3.3.1A Peak Detector Zero and 3.3.1C DVM before making the following alignment.

- 1. Remove the RF input module (A17) from the system analyzer and remove the wideband amplifier cover from the RF input module. Reconnect the ribbon cable connector and the coax cable coming from the RF synthesizer module (A9) to the A17 module.
- 2. Select the Generate FM function, Gen/Mon Mtr display, and turn all modulation OFF. Set the Generate Frequency to 500.0000 MHz.
- 3. Select the Antenna Port and set the step attenuator to the 0 dB position.
- Connect a calibrated wattmeter (HP4364) to the Antenna Port.
- 5. Adjust the RF variable level control on the front panel for a reading of 10.00 dBm on the external wattmeter.
- Adjust R34 (OFFSET) on the wideband Amplifier board (see Figure 3-11) for a reading of 10.0 dBm ± 0.2 dBm on the CRT RF level display.
- 7. Adjust the RF variable level control on the front panel for a reading of 1.00 dBm on the external wattmeter.
- 8. Adjust R38 (GAIN) on the wideband Amplifier board for a reading of 1.0 dBm \pm 0.2 dBm on the CRT RF level display.



Figure 3-6. Receiver Board (A8) - Alignment Points

71642-11

3-12



Figure 3-7. 60.5 MHz Loop Board (A9A4) Alignment Points



Figure 3-8. GHz Loop Board - Alignment Points



Figure 3-9. Frequency Standard Interface Board - Alignment Points

3-15



Figure 3-10. Duplex Generator Board (A17A3) - Alignment Points



BACKSIDE VIEW OF UIS

Figure 3-10a. Enhanced Duplex Generator Board (A17A3) - Alignment Points

3-16a/(3-16b Blank)



Figure 3-11. Wideband Amplifier Board - Alignment Points



Figure 3-12. Wattmeter Board - Alignment Points

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NOTE

Due to the interaction between the two adjustments the procedure must be repeated a number of times.

9. Repeat steps 5-8 until no adjustment of R34 and R38 is required to obtain the 10.0 dBm and 1.0 dBm readings on the CRT RF level display.

3.3.8 WATTMETER

- Remove System Analyzer bottom cover and wattmeter (A17A1) cover.
- Select monitor function and Gen/Mon Mtr display.
- 3. Set the step attenuator on the front panel to the 10 dB position and select the RF IN/OUT port.
- Set the Offset (R20) and Gain (R7) pots in the halfway position.
- 5. Connect a calibrated 1 watt 500 MHz generator, using a 600 MHz low-pass filter to filter out second harmonic, to the RF IN/OUT port.
- Adjust the OFFSET (R20) pot on the wattmeter board (see Figure 3-12) for an input level reading of 1 watt on the CRT display.
- 7. Connect a calibrated 50 watt 500 MHz (again use a 600 MHz L-PF to the RF IN/OUT port).
- Adjust the gain (R7) pot for an input level ready of 50 watts on the CRT display of 50 watts.

NOTE

Due to the interaction between the two adjustments the procedure must be repeated a number of times.

9. Repeat steps 5 through 9 until no adjustment of R20 and R7 is required to obtain the 1 watt and 50 watt readings on the CRT wattmeter display.

3.3.9 SCOPE COMPENSATION

- 1. Remove Front Panel Interface Board (A15) and place it on the appropriate extender card.
- Turn System Analyzer ON and select DC scope display.
- Apply a 1Vp-p square wave to the vertical scope input.
- 4. Adjust C11 on the Front Panel Interface board (see Figure 3-3) so that the waveform on the scope display has not overshoot or undershoot (see Figure 3-13).



Figure 3-13. Scope Compensation

3.3.10 CATHODE VOLTAGE

CAUTION

Unless the factory alignment has been disturbed through repair or if the CRT adjustments CRT intensity bias, CRT horizontal gain, CRT vertical gain, and character generator, will not align, do not make the adjustment. Because of the presence of high voltages, +4 KV and -2KV, on the module requiring adjustment. This adjustment will require a high voltage probe capable of measuring 2KV. Handle this monitor with extreme care when making this adjustment to avoid electrical shock.

- 1. Disconnect the System Analyzer from power source. Remove the High Voltage Power Supply module and place it on the appropriate extender card.
- 2. Connect power to the System Analyzer and turn the unit ON.
- 3. While monitoring the cathode voltage wire P2-2 (point 2 on High Voltage Power Supply printed wiring board). Adjust R37 (see Figure 3-14) for a cathode voltage of $-2000 \text{ Vdc} \pm 10 \text{ Vdc}$.
- 4. When adjustment is completed disconnect power from System Analyzer and reinstall High Voltage Power Supply.



Figure 3-14. High Voltage Power Supply Board - Alignment Points