R2001A/B/C Service Monitor Alignment Sections

R2001A Depot Alignment Notes

5.1.1 Select the Monitor Function and the Gen/Mon Mtr Display on the R2001A. Set the Intensity Control for a medium intense display.

5.1.2 While using the Focus Control to maintain a focused display at the center of the CRT, adjust the Astigmatism and Geometry potentiometers (See Figure 5.1) for the best focus at the outer edges of the CRT while minimizing the pincushion and barrel distortion of the display. The two adjustments are interactive so that repeated small adjustments alternated between the two potentiometers will be required to obtain the best display. NOTE: USE A SINE WAVE ON CRT - MUCH EASIER TO SEE (LOW ASTIG, GEO USE GEN, MON, SET FOR clear letters)

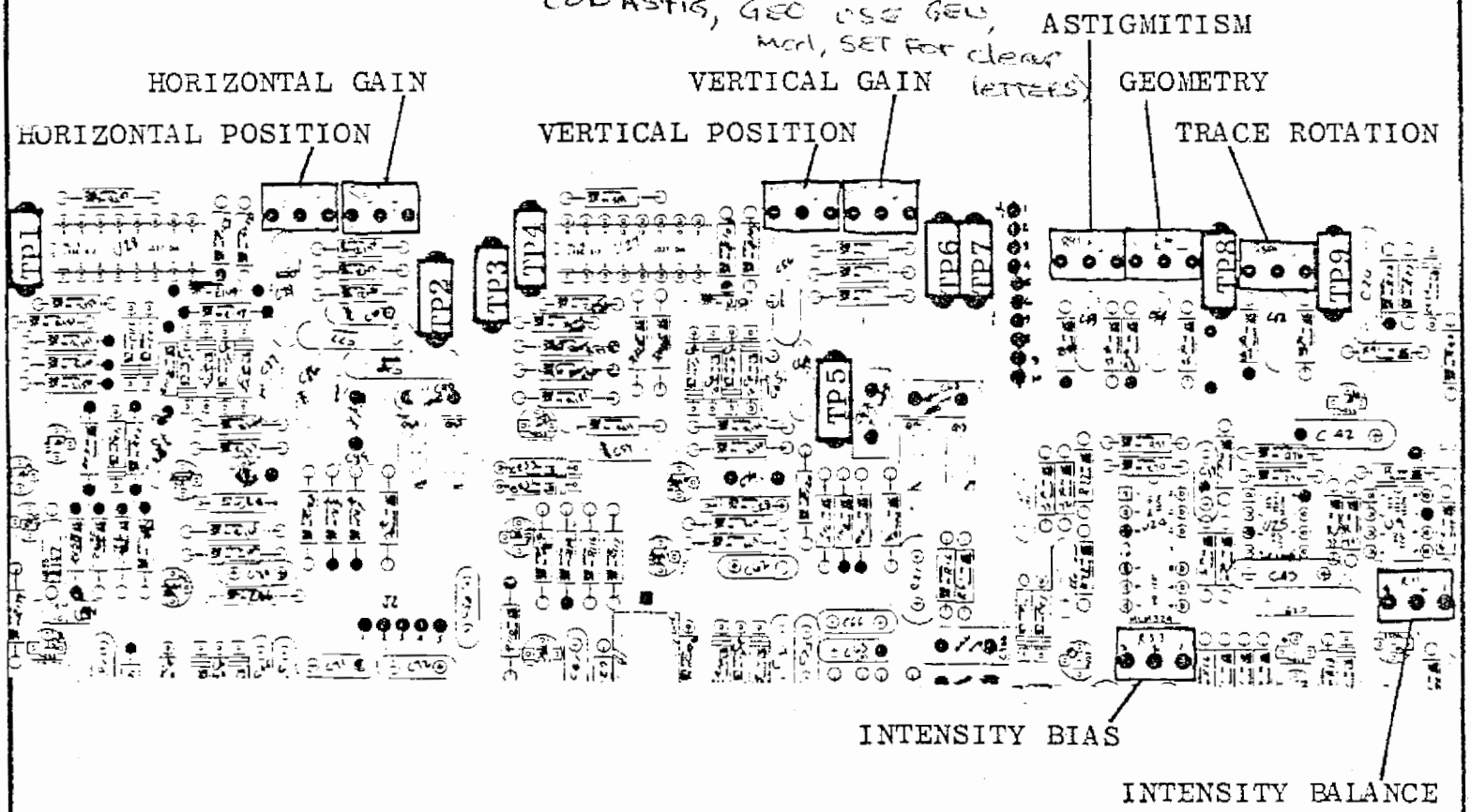

FIGURE 5.1 SCOPE AMPLIFIER ALIGNMENT POINTS

5.2 CRT Intensity Bias

5.2.1 Select the Scope DC Display and the Ext Horiz. Input mode. Set the Intensity Control fully counter clockwise. Caution: Do not let a dot set in one place on the CRT screen for more than 30 seconds as a permanent burn in the phosphor will occur.

5.2.2 Adjust the Intensity Bias potentiometer (See Figure 5.1) until a dot appears on the screen. (The Vertical and Horizontal Position Control on the front panel may have to be used to bring the dot on to the screen.) Then back off the Intensity Bias potentiometer until the dot just disappears.

5.3 CRT Intensity Balance

5.3.1 Select the Scope DC Display and the 10 mSec/Div Horizontal Sweep rate on the R2001A. Set the Horizontal Timebase Veriner to the Cal position and adjust the Intensity Control for a barely visible horizontal line on the CRT.

5.3.2 Adjust the Intensity Balance potentiometer (See Figure 5.1) for uniform intensity of the horizontal trace from left to right. The Balance potentiometer affects the intensity on the left side of the trace.

5.4 CRT Horizontal Centering

5.4.1 Select the Gen/Mon Mtr Display on the R2001A. Adjust the Intensity Control for a comfortable viewing brightness.

5.4.2 With the Test Point Shorting Jumper connect TP1 of the Scope Amplifier Board (See Figure 5.1) to chassis ground.

5.4.3 Adjust the Horizontal Position Potentiometer (See Figure 5.1) so that the vertical trace on the CRT screen passes through the graticule center point.

5.4.4 Remove the jumper from TP1.

5.5 CRT Vertical Centering

5.5.1 Select the Gen/Mon Mtr Display on the R2001A. Adjust the Intensity Control for comfortable viewing brightness.

5.5.2 With the Test Point Shorting Jumper connect TP4 of the Scope Amplifier Board (See Figure 5.1) to chassis ground.

5.5.3 Adjust the Vertical Position Potentiometer (See Figure 5.1) so that the horizontal trace on the CRT screen passes through the graticule center point.

5.6 CRT Trace Rotation

5.6.1 Select the Gen/Mon Mtr Display on the R2001A. Adjust the Intensity Control for a comfortable viewing brightness.

5.6.2 Adjust the Trace Rotation Potentiometer for a properly rotated CRT display.

5.7 CRT Horizontal Gain

5.7.1 Connect the Mod Out Jack to the Ext Horiz Jack on the R2001A front panel.

5.7.2 Set the R2001A for the Generate FM Function and the Scope DC Display. Set the Horiz Control for Ext Horiz input. Turn the Code Synthesizer off, the Ext Level off, and the 1 KHz Level up about half way.

5.7.3 Connect an oscilliscope with a calibrated vertical input to TP1 on the Scope Amplifier Board. (See Figure 5.1)

5.7.4 Using the front panel Horizontal Vernier Control adjust for a 3 V p-p amplitude on the sinewave at TP1.

5.7.5 With 3V p-p at TP1 adjust the Horizontal Gain Potentiometer (See Figure 5.1) for a horizontal trace 6 cm long on the CRT. (Use the front panel controls to position the trace at a convenient place near the center of the CRT).

5.8 CRT Vertical Gain

5.8.1 Connect the Mod Out Jack to the Vert Input Jack on the R2001A front panel.

5.8.2 Set the R2001A for the Generate FM Function and the Scope DC Display. Set the Horiz Control for 1 m Sec/Div sweep rate and the Horizontal Vernier to the Cal position. Set the Vert Control for 1 V/Div input sensitivity and the Vertical Vernier to the Cal position.

5.8.3 Turn the Code Synthesizer off, the Ext Level off and the 1 KHz Level up about half way.

5.8.4 Connect an oscilliscope with a calibrated vertical input to TP4 on the Scope Amplifier Board. (See Figure 5.1)

5.8.5 Using the front panel 1 KHz Level Control adjust for a 3V p-p amplitude on the sinewave at TP4.

5.8.6 With 3V p-p at TP4 adjust the Vertical Gain Potentiometer (See Figure 5.1) for a 6 cm p-p sinewave on the CRT. (use the front panel Position Controls to center the waveform on the CRT).

5.9 Vertical Input Gain

5.9.1 Set the R2001A for the Generate FM Function and the Scope DC Display. Set the Horiz Control for 1 m Sec/Div sweep rate and the Horizontal Vernier to the Cal position. Set the Vert Control for 1 V/Div input sensitivity and the Vertical Vernier to the Cal position.

5.9.2 Connect an oscilliscope with a calibrated vertical input to the Mod Out Jack on the front panel.

5.9.3 Turn the Code Synthesizer off, the Ext Level off and adjust the 1 KHz Level Control for a 6 V p-p sinewave on the attached oscilliscope.

5.9.4 Disconnect the oscilliscope from the Mod Out Jack and connect the Mod Out Jack to the Vert Input Jack on the R2001A.

5.9.5 Adjust the Input Vertical Gain Potentiometer on the Front Panel Interface Board (See Figure 5.2) for a 6 cm p-p sine-wave on the CRT. (Use the front panel Position Controls to center the waveform on the CRT.)

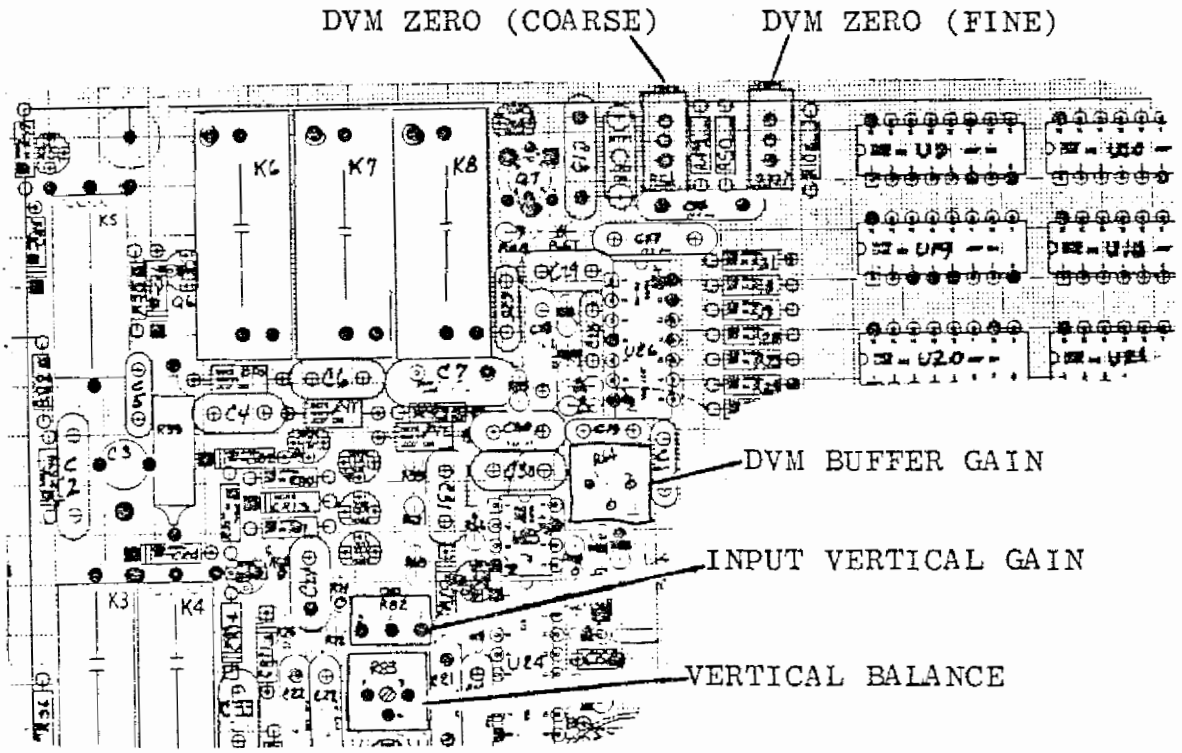

FIGURE 5.2 FRONT PANEL INTERFACE ALIGNMENT POINTS

5.10 DVM Zero

5.10.1 Select the DVM Display and the DC Mode on the R2001A.

5.10.2 Short the center conductor of the DVM Input Jack to ground.

5.10.3 Adjust the DVM Zero (Coarse) and the DVM Zero (Fine) Potentiometers on the Front Panel Interface Board (See Figure 5.2) for a zero reading on the DVM Display.

5.11 Spectrum Analyzer Centering

5.11.1 Select the Spect Analyzer Display on the R2001A. Set the Dispersion Control on the front panel to the 1 MHz position. (full counter clockwise) Set the center frequency of the analyzer to 10.0 MHz. SET TO 550 MHZ - GLITCH IS AT CENTER

5.11.2 Connect the 10 MHz Output on the rear panel to the RF Input on the front panel. Set the RF Step Attenuator to obtain a convenient spectral display.

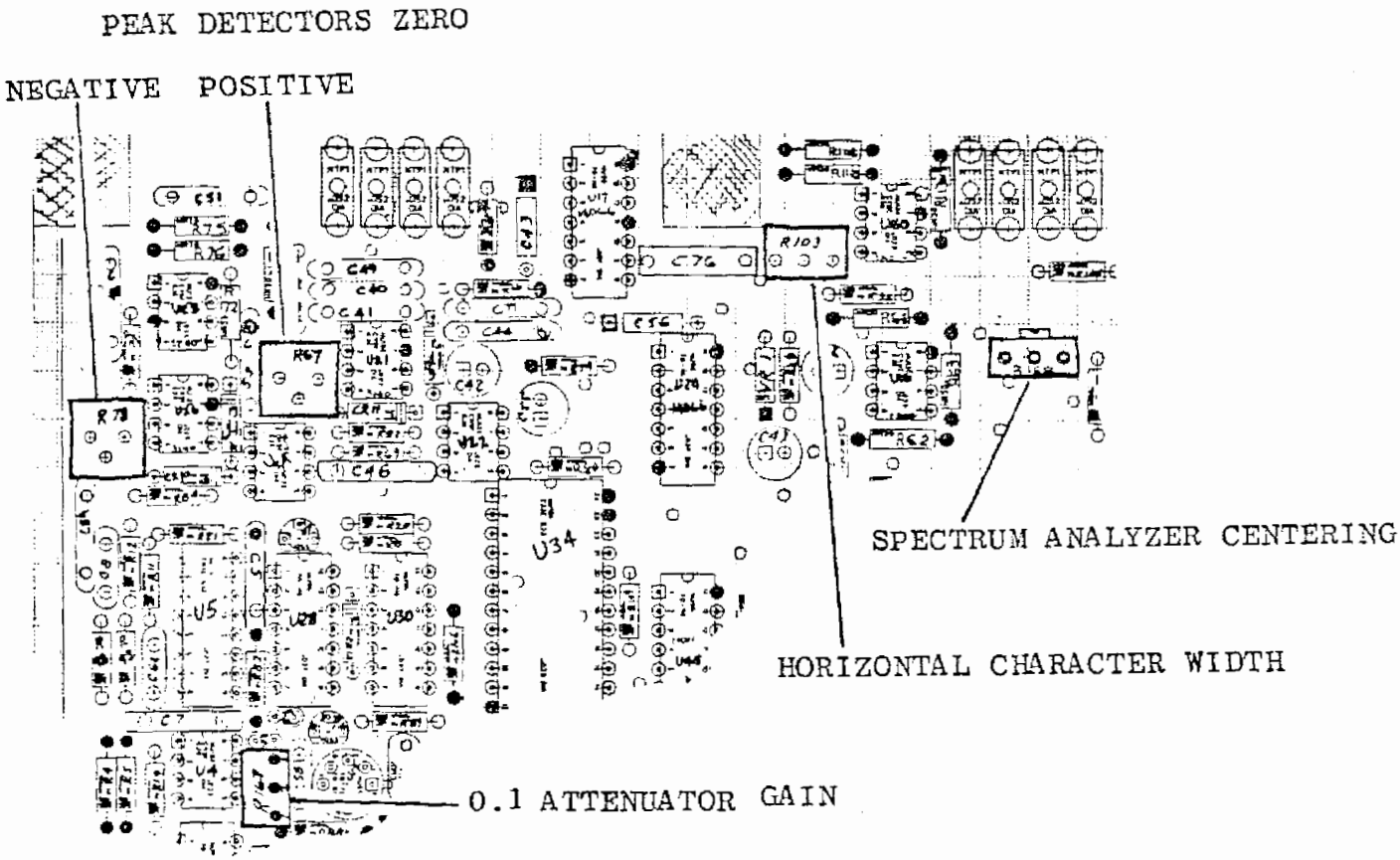

FIGURE 5.3 SCOPE/DVM CONTROL ALIGNMENT POINTS

5.11.3 Adjust the Spectrum Analyzer Centering Potentiometer on the Scope/DVM Control Board (See Figure 5.3) so that the spectral line on the CRT is centered about the center graticule line.

5.12 Horizontal Time Base

5.12.1 Select the Tone Memory Display and the Generate FM Function on the R2001A. Program tone A for 20.0 Hz and Tone B for 2000.0 Hz.

5.12.2 Select the Modulation Display. Set the Oscilliscope Controls for 2.5 KHz/Div vertical range, Auto Trigger, and 10 m Sec/Div horizontal sweep rage. Set the Horizontal and Vertical Vernier Controls to their Cal positions.

5.12.3 Set the Code Synthesizer for Continuous, Tone A, and turn up the Code Synth Level to obtain a nearly full scale sinusoidal waveform on the CRT. Turn the Ext Level and the 1 KHz Level Controls to the off position.

5.12.4 Adjust the Coarse Time Base Calibration Potentiometer on the Scope Amplifier Board (See Figure 5.4) so that one cycle of the displayed waveform occurs in 5 cm along the horizontal axis. Use the Vertical and Horizontal Position controls to center and to move the waveform so that the 5 cm are measured in the middle of the screen to avoid nonlinearities near the edge of the CRT.

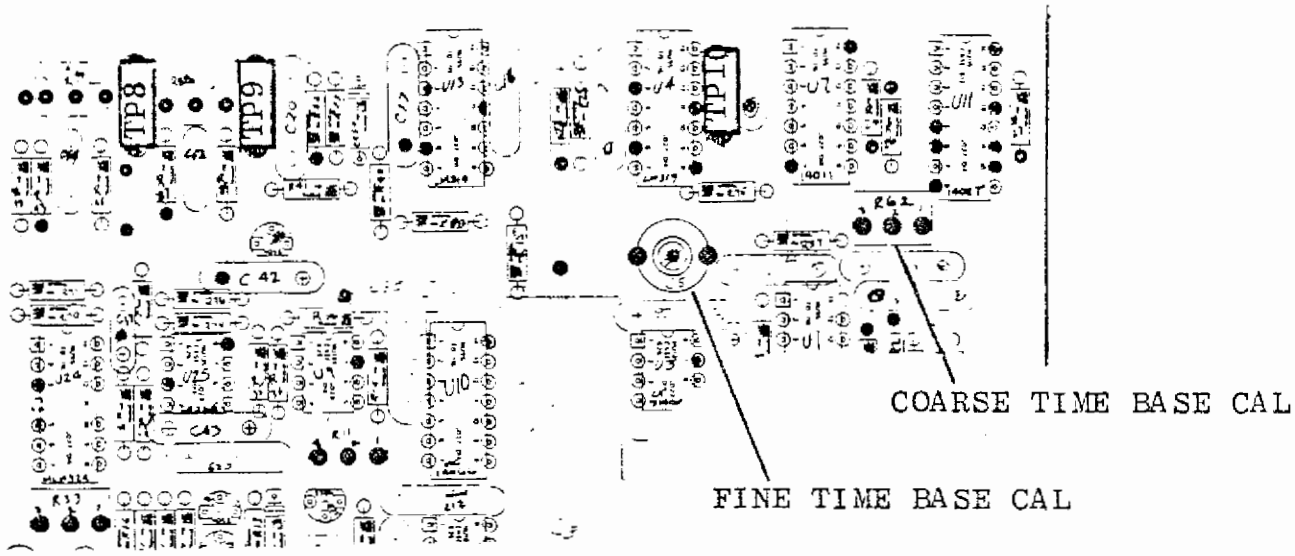

FIGURE 5.4 HORIZONTAL TIME BASE ALIGNMENT POINTS

5.12.5 Set the Oscilliscope Horizontal Control for a 100 μ Sec/Div sweep rate and select the Tone B output on the Code Synthesizer.

5.12.6 Adjust the Fine Time Base Calibration Capacitor on the Scope Amplifier Board (See Figure 5.4) so that one cycle of the displayed waveform occurs in 5 cm along the horizontal axis. Use the Vertical and Horizontal Position controls to center and to move the waveform so that the 5 cm are measured in the middle of the screen to avoid nonlinearities near the edge of the CRT.

6.0 EXTENDED ALIGNMENT PROCEEDURE

6.1 DVM

6.1.1 Remove the top and bottom covers of the R2001A.

6.1.2 Connect the R2001A to a primary power source and turn it on. Allow approximately 15 minutes warm up before proceeding with the alignment proceedure.

6.1.3 Short the center conductor of the DVM Input Jack on the front panel to ground. Connect an external DVM with a floating input between pin 1 and pin 6 of J3 on the bottom side of the motherboard.

6.1.4 Adjust the Coarse and Fine DVM Zero potentiometers on the Front Panel Interface board (See Figure 6.1) for a reading of 0 ± 0.5 mV on the external DVM.

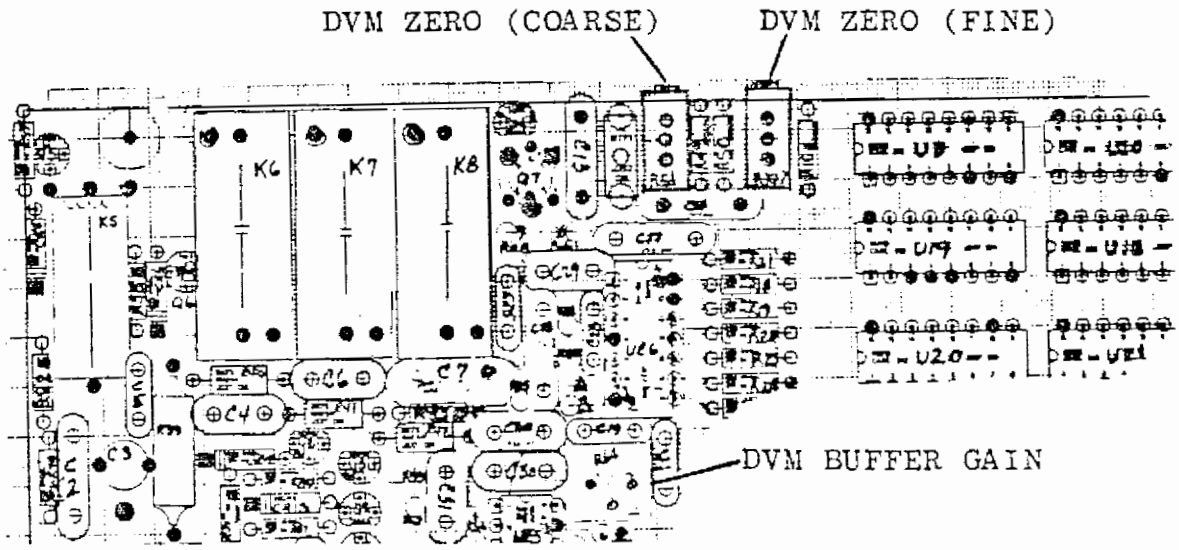

FIGURE 6.1 DVM INPUT BUFFER ALIGNMENT POINTS

6.1.5 Remove the ground from the DVM Input and connect the DVM Input to TP 12 of the Scope/DVM Control Board. (See Figure 6.2)

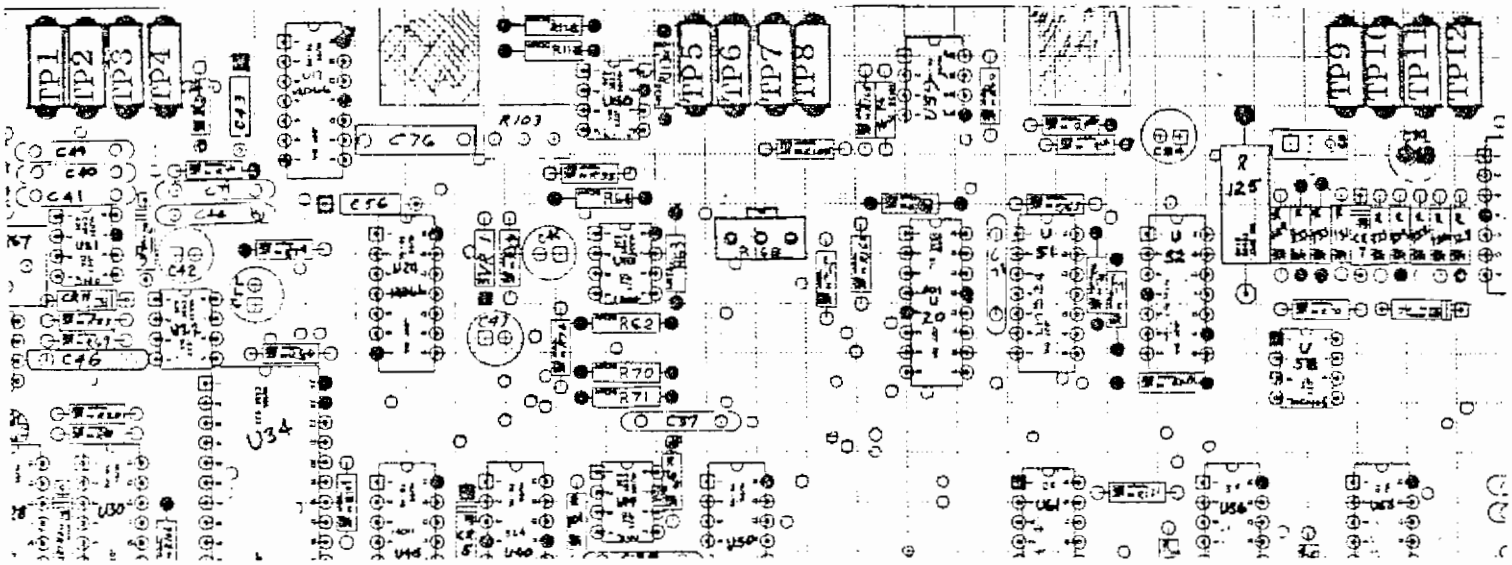

FIGURE 6.2 SCOPE/DVM CONTROL TEST POINT NUMBERING

6.1.6 Disconnect the external DVM from pins 1 and 6 of J3 and connect it to TP 12 of the Scope/DVM Control Board and chassis ground. Note the DVM reading for TP 12.

6.1.7 Reconnect the external DVM between pin 1 and pin 6 of J3. The external DVM should show a reading equal to one-tenth the voltage at TP 12 noted in paragraph 6.1.6 plus or minus 10 mV.

6.1.7 Cont. If the reading falls outside this range it will be necessary to physically disconnect the front panel from the chassis in order to adjust the DVM Input Gain Potentiometer on the Front Panel Interface Card. (See Figure 6.3) . Adjust the DVM Input gain for a reading on the external DVM equal to one-tenth the voltage noted for paragraph 6.1.6. Reconnect the front panel to the chassis.

6.1.8 Repeat paragraphs 6.1.3 and 6.1.4.

6.1.9 Disconnect the external DVM. With the DVM input jack still shorted adjust the A/D Zero Potentiometer on the I/O Board (See Figure 6.3) for a 0.0 VDC reading on the R2001A CRT display. Caution: Do not use the card extender while aligning the Processor I/O board.

6.1.10 Remove the short from the DVM Input and connect the DVM Input to TP 12 of the Scope/DVM Control Board.

6.1.11 Adjust the A/D Gain Potentiometer on the Processor I/O Board (See Figure 6.3) for a DVM reading on the CRT equal to the voltage measured at TP 12 with the external DVM for paragraph 6.1.6.

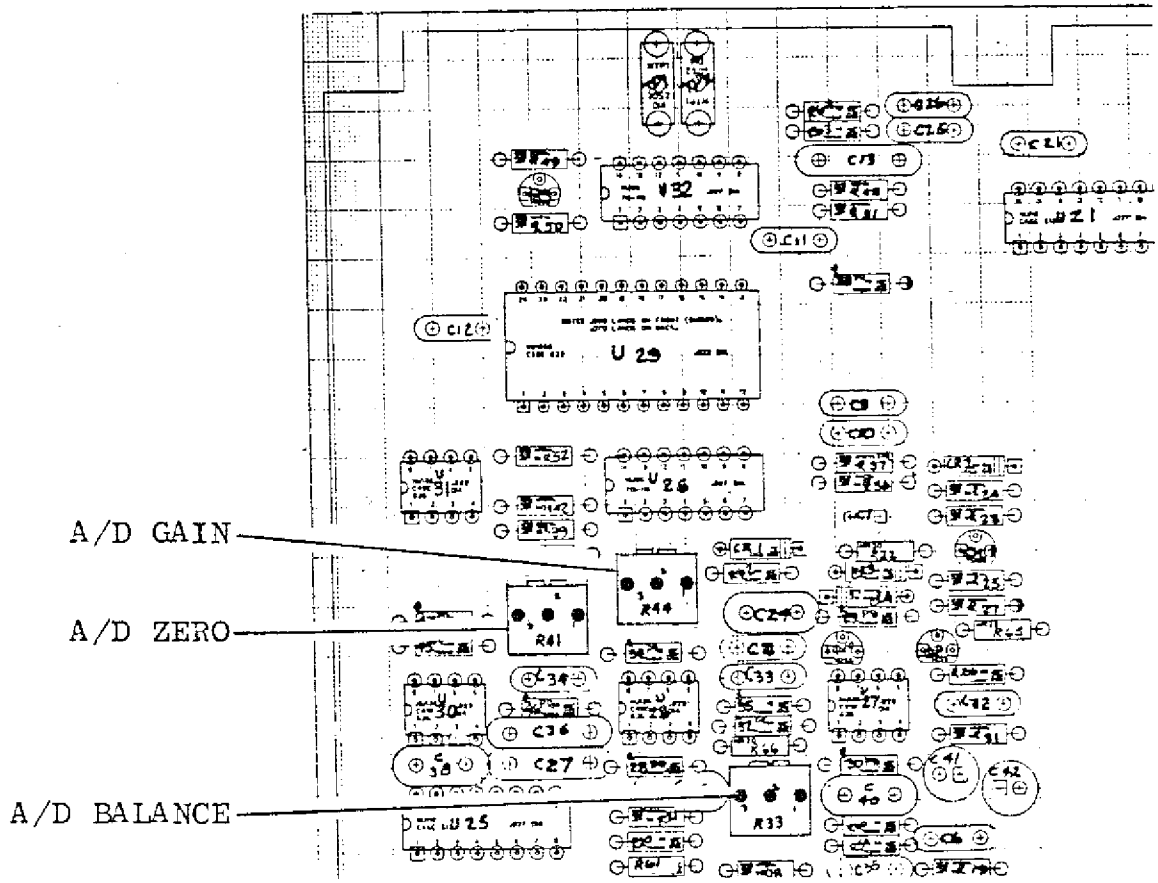

FIGURE 6.3 PROCESSOR I/O A/D ALIGNMENT POINTS

6.1.12 Connect the external DVM to TP11 of the Scope/DVM Control Board and chassis ground. Note the DVM reading for TP11.

6.1.13 Disconnect the external DVM from TP11 and connect the DVM Input Jack on the front panel to TP11 of the Scope/DVM Control Board.

6.1.14 Adjust the A/D Balance Potentiometer on the Processor I/O Board (See Figure 6.3) for a DVM reading on the CRT equal to the voltage measured at TP11 with the external DVM for paragraph 6.1.13.

6.2 Character Generator

6.2.1 Perform the Basic Alignment Procedure of section 5.0

6.2.2 Turn the R2001A off and extend the Scope/DVM Control Board using the 100 pin extender card.

6.2.3 Turn the R2001A on and select the Monitor FM Function and the Gen/Mon Mtr Display.

6.2.4 Adjust the Horizontal Character Sweep Width Potentiometer on the Scope/DVM Control Board (See Figure 6.4) so that the right-hand edge of the CRT character display is approximately 4.2 graticule divisions to the right of the graticule center line.

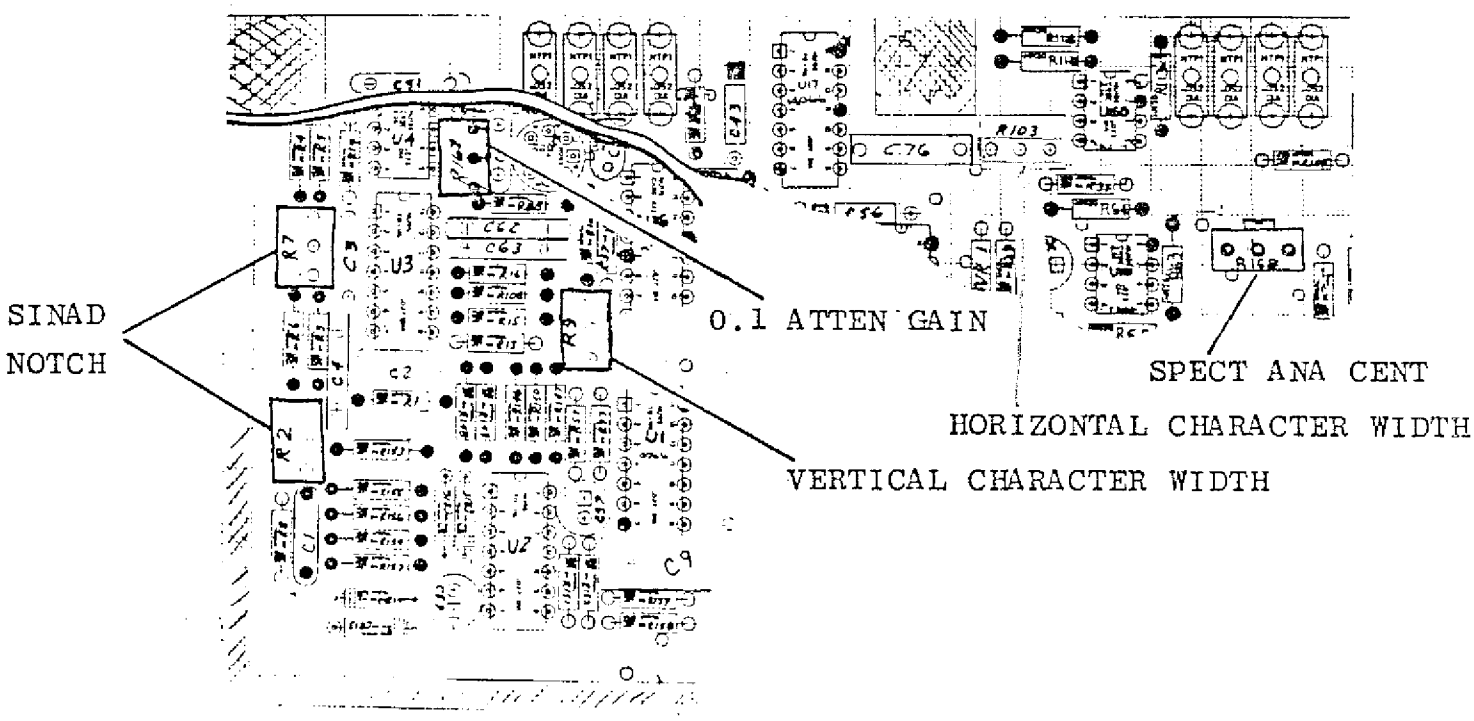

FIGURE 6.4 SCOPE/DVM CONTROL CHAR SWEEP AND AND SINAD ALIGNMENT POINTS

6.2.5 Adjust the Vertical Character Sweep Width Potentiometer on the Scope/DVM Control Board (See Figure 6.4) so that the bottom edge of the CRT display is approximately 3.3 graticule divisions below the graticule center line.

6.2.6 Turn the system power off and reinstall the Scope/DVM Control Board into the R2001A.

6.3 Sinad Notch Filter

6.3.1 Turn the R2001A off and extend the Scope/DVM Control Board using the 100 pin extender card.

6.3.2 Turn the R2001A on and select the Generate FM Function and the Gen/Mon Mtr Display.

6.3.3 Set the Modulation Switch and the Ext. Level Control to their off positions. Set the BW Switch to the Narrow position and adjust the 1 KHz Level Control for a 20 KHz deviation reading on the CRT display.

6.3.4 Connect the Mod Out Jack on the front panel to the Vert/Sinad/DVM/Counter Input Jack on the front panel.

6.3.5 Alternately adjust the two SINAD Notch potentiometers on the Scope/DVM Control Board (See Figure 6.4) for a maximum SINAD reading on the CRT display. A reading greater than 30 db should be obtained.

6.3.6 Turn the system power off and reinstall the Scope/DVM Control Board into the R2001A.

6.4 Receiver

6.4.1 AM Detector

6.4.1.1 Perform the basic alignment procedure of Section 5.0.

6.4.1.2 Turn the R2001A off and remove the Receiver Module. Remove the Receiver Module cover and install the Receiver Test Cover on the module housing. Extend the Receiver module on the Receiver Extender Card.

6.4.1.3 Turn the R2001A on and select the Monitor AM Function and the Gen/Mon Mtr Display. Set the monitor frequency to 250 MHz, the RF Step Attenuator to the 0 db position, and the BW Switch to the Narrow position.

6.4.1.4 Connect the external signal generator to the RF In/Out Jack on the front panel. Adjust the external generator for an output level of approximately -60 dbm and a calibrated 30% AM.

6.4.1.5 Adjust R60 (Marked on the Receiver Test Cover) for a reading of 30% ±5% on the CRT AM display.

6.4.2 FM Detector

6.4.2.1 Select the Monitor FM Function and the Gen/Mon Mtr Display. Set the monitor frequency to 250 MHz, the RF Step Attenuator to the 0 db position, and the BW Switch to the Wide position.

6.4.2.2 Connect the external signal generator to the RF In/Out Jack 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 20 KHz FM.

6.4.2.3 Adjust R70 (Marked on the Receiver Test Cover) for a reading 20 KHz ± 1 KHz on the CRT FM display.

6.4.2.4 Set the BW switch to the Narrow position and reset the FM on the external generator to 3 KHz deviation.

6.4.2.5 Adjust R125 (Marked on the Receiver Test Cover) for a reading of 3 KHz ± 150 Hz on the CRT FM display.

6.4.2.6 Turn off the FM on the external generator so that a CW signal of a level of approximately -30 dbm is applied to the R2001A.

6.4.2.7 Connect the Demod Out Jack to the Vert/Sinad/DVM/Counter Input Jack on the front panel. Select the DVM Display and the DC DVM Mode on the R2001A.

6.4.2.8 Adjust R68 (Marked on the Receiver Test Cover) for a 0.0 VDC ±100 mVDC reading on the DVM Display.

6.4.3 Spectrum Analyzer

6.4.3.1 Select the Monitor Function and the Spectrum Analyzer Display on the R2001A. Set the monitor frequency to 250 MHz, and the RF Step Attenuator to the 40db position.

6.4.3.2 Connect the external signal generator to the RF In/Out Jack 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.

6.4.3.3 Adjust in succession C2, C83, C88, and C96 (Marked on the Receiver Test Cover) to maximize the amplitude of the spectral line in the center of the CRT display.

6.4.3.4 Adjust R124, R91, and R100 (Marked on the Receiver Test Cover) to obtain a uniform change in the spectral amplitude per 10 db change of the RF Step Attenuator. R124 affects the level of the spectral component when in the top quarter of the screen, R91 affects levels in the third quarter from the top, and R100 affects levels in the bottom quarter.

6.4.3.5 Adjust R119 for offset and R121 for gain so that with the step attenuator in the 0db Position the peak of the spectral line lies on the 30db line of the CRT and that successive step increases of the input attenuator move the spectral amplitude downward in 10db increments on the CRT. The accuracy required for any one step attenuator position is ±3db.

6.4.3.6 It will generally be necessary to repeat paragraphs 6.4.3.4 and 6.4.3.5 until the best possible accuracy is obtained.

6.4.3.7 Turn the power off and remove the Receiver Module and the Receiver Extender for the chassis. Remove the Test Cover from the Receiver Module and replace the module cover. Reinstall the Receiver Module into the system chassis.

R2001A Alignment Section

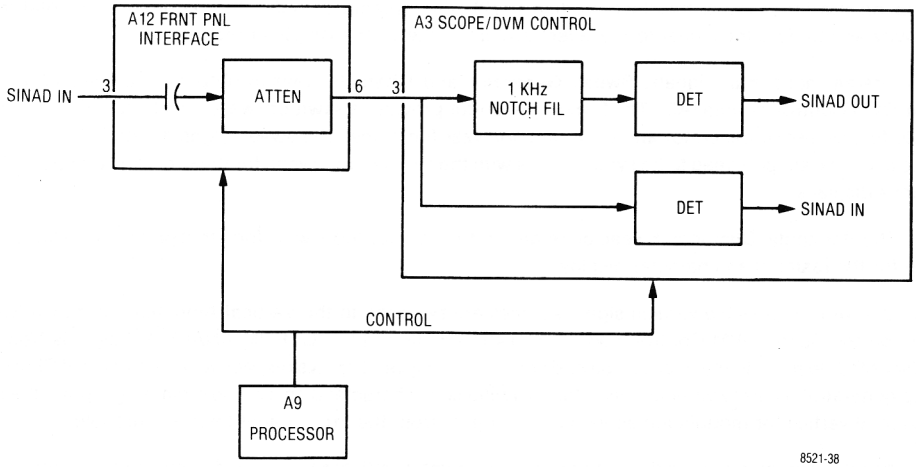

Figure 5-12. Sinad Meter Block Diagram

5-99. ALIGNMENT PROCEDURE

5-100. Introduction

5-101. This section provides a basic (para 5-105) and an extended (para 5-118) alignment procedure. The basic procedure requires only the use of a calibrated oscilloscope. It is expected that the basic alignment be performed whenever service work is performed. The extended alignment procedure requires module extenders and a calibrated digital voltmeter in addition to the oscilloscope. The extended procedure should be performed as required after servicing the system. All adjustments not covered in this procedure are to be performed on suitable module test fixtures only.

5-102. Test Equipment Required

5-103. The test equipment or its equivalent listed in table 5-3 is required for the basic procedure. The additional equipment required for the extended procedure is listed in table 5-4.

Table 5-3. Basic Test Equipment Required

Description	Model
'Oscilloscope Test Point Shorting Jumper Nonmetallic Alignment Tool	Motorola R1004A

*A R2001A is a suitable substitute

Table 5-4. Extended Test Equipment Required

Description	Model
'Oscilloscope	Motorola R1004A
'Digital Voltmeter	Motorola R1001A
*RF Signal Generator	Motorola R1201A
•Modulation Meter	Boonton 82AD
Receiver Test Cover	Motorola 15-P01324V001
Extender Card Set	Motorola67-P01322V001

"A R2001A is suitable for use in place of these separate equipments.

5-104. Preparation for Alignment

1. All alignments to be performed at normal ambient temperature.
2. Remove the top cover of the unit to be aligned.
3. Apply power to the unit to be aligned and allow a warmup time of 15 minutes prior to alignment.

5-105. Basic Alignment Procedure

5-106. CRT Astigmatism and Geometry

1. Select the Monitor Function and the Gen/Mon Mtr Display on the R2001 A. 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 5-13) for the best focus at the outer edges of the CRT while minimizing the pincushion and barrel distortion of the display. The two adjustments are interactive so that repeated small adjustments alternated between the two potentiometers will be required to obtain the best display.

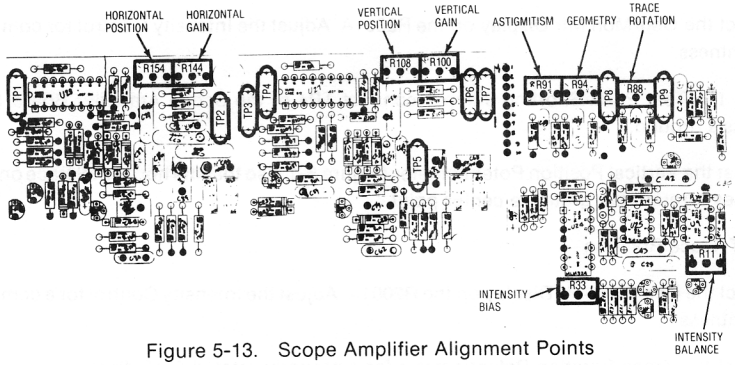

Figure 5-13. Scope Amplifier Alignment Points

5-107. CRT intensity Bias

1. Select the Scope DC Display and the Ext Horiz. Input mod» 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 as a permanent burn in the phosphor will occur.

2. Adjust the Intensity Bias potentiometer (Figure 5-13) until a dot appears on the screen. (The Vertical and Horizontal Position Control on the front panel may have to be used to bring the dot on to the screen.) Then back off the Intensity Bias potentiometer until the dot just disappears.

5-108. CRT Intensity Balance

1. Select the Scope DC Display and the 1 mSec/Div Horizontal Sweep rate on the R2001A. Set the Horizontal Timebase Veriner to the Cal position and adjust the Intensity Control for a barely visible horizontal line on the CRT.

2. Adjust the Intensity Balance potentiometer (Figure 5-13) for uniform intensity of the horizontal trace from left to right. The Balance potentiometer affects the intensity on the left side of the trace.

5-109. CRT Horizontal Centering

1. Select the Gen/Mon Mtr Display on the R2001A. Adjust the Intensity Control for a comfortable viewing brightness.

2. With the Test Point Shorting Jumper connect TP1 of the Scope Amplifier Board (Figure 5-13) to chassis ground.

3. Adj ust the Horizontal Position Potentiometer (Figure 5-13) so that the vertical trace on the CRT screen passes through the graticule center point.

4. Remove the jumper from TP1.

5-110. CRT Vertical Centering

1. Select the Gen/Mon Mtr Display on the R2001A. Adjust the Intensity Control for comfortable viewing brightness.

2. With the Test Point Shorting Jumper connect TP4 of the Scope Amplifier Board (Figure 5-13) to chassis ground.

3. Adjust the Vertical Position Potentiometer (Figure 5-13) so that the horizontal trace on the CRT screen passes through the graticule center point.

5-111. CRT Trace Rotation

1. Select the Gen/Mon Mtr Display on the R2001A. Adjust the Intensity Control for a comfortable viewing brightness.

2. Adjust the Trace Rotation Potentiometer for a properly rotated CRT display.

5-112. CRT Horizontal Gain

1. Connect the Mod Out Jack to the Ext Horiz Jack on the R2001A front panel.

2. Set the R2001 A for the Generate FM Function and the Scope DC Display. Set the Horiz Control for Ext Horiz input. Turn the Code Synthesizer off/the Ext Level offhand the 1 kHz Level up about half way.

3. Connect an oscilloscope with a calibrated vertical input-to TP1 on the Scope Amplifier Board. (Figure 5-13).

4. Using the front panel Horizontal Vernier Control adjust for a 3 V p-p amplitude on the sinewave at TP1.

5. With 3V p-p at TP1 adjust the Horizontal Gain Potentiometer (Figure 5-13) for a horizontal trace 6 cm long on the CRT. (Use the front panel controls to position the trace at a convenient place near the center of the CRT).

5-113. CRT Vertical Gain

1. Connect the Mod Out Jack to the Vert Input Jack on the R2001A front panel.

2. Set the R2001A for the Generate FM Function and the Scope DC Display. Set the Horiz Control for 1 mSec/Div sweep rate and the Horizontal Vernier to the Cal position. Set the Vert Control for 1 V/Div input sensitivity and the Vertical Vernier to the Cal position.

3. Turn the Code Synthesizer off, the Ext Level off and the 1 kHz Level up about half way.

4. Connect an oscilloscope with a calibrated vertical input to TP4 on the Scope Amplifier Board. (Figure 5-13).

5. Using the front panel 1 kHz Level Control adjust for a 3V p-p amplitude on the sinewave at TP4.

6. With 3V p-p at TP4 adjust the Vertical Gain Potentiometer (Figure 5-13) for a 6 cm p-p sinewave on the CRT. (use the front panel Position Controls to center the waveform on the CRT).

5-114. Vertical Input Gain

1. Set the R2001 A for the Generate FM Function and the Scope DC Display. Set the Horiz Control for 1 m Sec/Div sweep rate and the Horizontal Vernier to the Cal position. Set the Vert Control for 1 V/Div input sensitivity and the Vertical Vernier to the Cal position.

2. Connect an oscilloscope with a calibrated vertical input to the Mod Out Jack on the front panel.

3. Turn the Code Synthesizer off, the Ext Level off and adjust the 1 kHz Level Control for a 6 V p-p sinewave on the attached oscilloscope.

4. Disconnect the oscilloscope from the Mod Out Jack and connect the Mod Out Jack to the Vert Input Jack on the R2001A.

5. Adjust the Input Vertical Gain Potentiometer on the Front Panel Interface Board (Figure 5-14) for a 6 cm p-p sinewave on the CRT. (Use the front panel Position Controls to center the waveform on the CRT.)

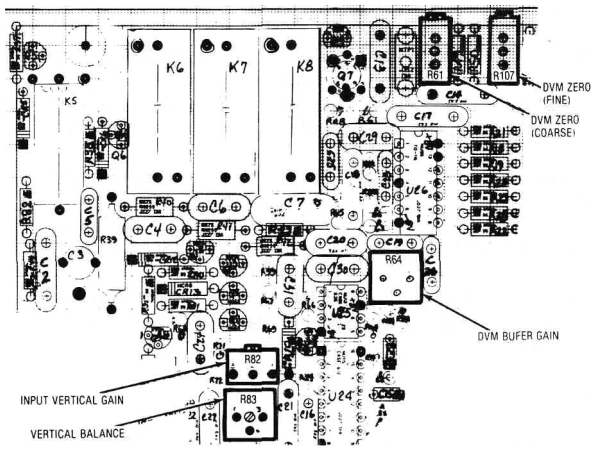

Figure 5-14. Front Panel Interface Alignment Points

5-115. DVM Zero

1. Select the DVM Display and the DC Mode on the R2001A.

2. Short the center conductor of the DVM Input Jack to ground.

3. Adjust the DVM Zero (Coarse) and the DVM Zero (Fine) Potentiometers on the Front Panel Interface Board (Figure 5-14) for a zero reading on the DVM Display.

5-116. Spectrum Analyzer Centering

1. Select the Spect Analyzer Display on the R2001 A. Set the Dispersion Control on the front panel to the 1 MHz position, (full counter clockwise) Set the center frequency of the analyzer to 10.0 MHz.

2. Connect the 10 MHz Output on the rear panel to the RF Input on the front panel. Set the RF Step Attenuator to obtain a convenient spectral display.

3. Adjust the Spectrum Analyzer Centering Potentiometer on the Scope/DVM Control Board (Figure 5-15) so that the spectral line on the CRT is centered about the center graticule line.

5-117. Horizontal Time Base

1. Select the Tone Memory Display and the Generate FM Function on the R2001 A. Program tone A for 20.0 Hz and Tone B for 2000.0 Hz.

2. Select the Modulation Display. Set the Oscilloscope Controls for 2.5 kHz/Div vertical range, Auto Trigger, and 10 mSec/Div horizontal sweep range. Set the Horizontal and Vertical Vernier Controls to their Cal positions. •

3. Set the Code Synthesizer for Continuous, Tone A, and turn up the Code Synth Level to obtain a nearly full scale sinusoidal waveform on the CRT. Turn the Ext Level and the 1 kHz Level Controls to the off position.

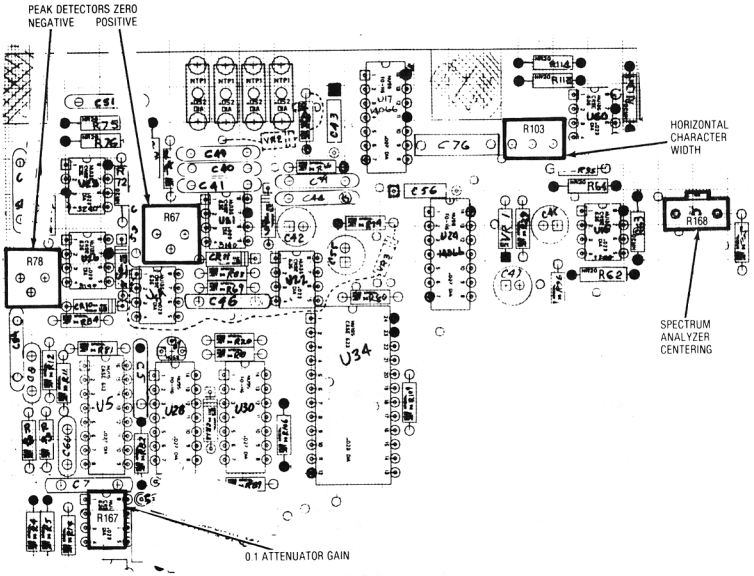

Figure 5-15. Scope/DVM Control Alignment Points

Adjust the Coarse Time Base Calibration Potentiometer on the Scope Amplifier Board (Figure 5-16) so that one cycle of the displayed waveform occurs in 5 cm along the horizontal axis. Use the Vertical and Horizontal Position controls to center and to move the waveform so that the 5 cm are measured in the middle of **the screen to avoid nonlinearities near the edge of the CRT.**

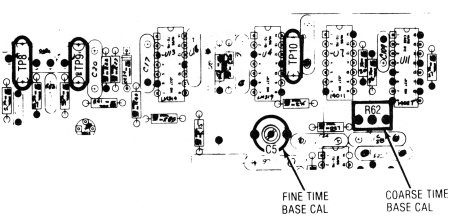

Figure 5-16. Horizontal Time Base Alignment Points

Set the Oscilloscope Horizontal Control for a *100ft* Sec/Div sweep rate and select the Tone B output on'-the Code Synthesizer.

Adjust the Fine Time Base Calibration Capacitor on the Scope Amplifier Board (Figure 5-16) so that one cycle of the displayed waveform occurs in 5 cm along the horizontal axis, Use the Vertical and Horizontal Position controls to center and to move the waveform so that the 5 cm are measured in the middle of the screen to avoid nonlinearities near the edge of the CRT.

5-118. Extended Alignment Procedure

5-119. DVM

1. Remove the top and bottom covers **of the-R2001A.**

2. Connect the R2001Atoa primary power source and turn it on. Allow approximatly 15 minutes warm up before proceeding with the alignment procedure.

3. Short the center conductor of the DVM Input Jack on the front panel to ground. Connect an external DVM with a floating input between pin 1 and pin 6 of J3 on the bottom side of the motherboard.

4. Adjust the Coarse and Fine DVM Zero potentiometers on the Front Panel Interface board (Figure 5-17) for a reading of 0 ±0.5 mV on the external DVM.

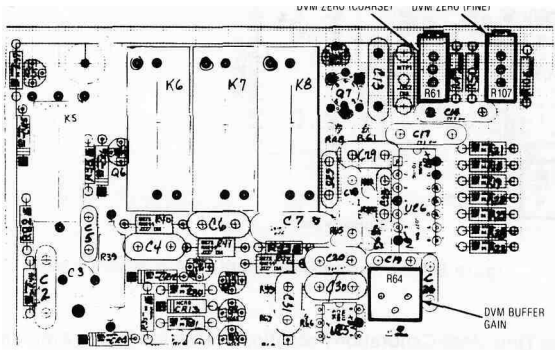

Figure 5-17. DVM Input Buffer Alignment Points

5. Remove the ground from the DVM Input and connect the DVM Input to TP 12 of the Scope/DVM Control Board. (Figure 5-18)

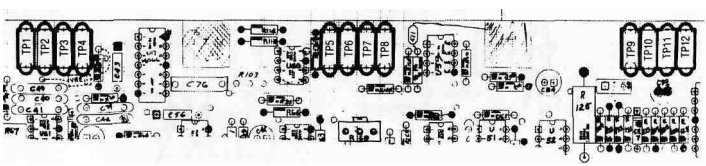

Figure 5-18. Scope/DVM Control Test Point Numbering

6. Disconnect the external DVM from pins 1 and 6 of J3 and connect it to TP 12 of the Scope/DVM Control Board and chassis ground. Note the DVM reading for TP 12.

7. Reconnect the external DVM between pin 1 and pin 6 of J3. The external DVM should show a reading equal to one-tenth the voltage at TP 12 noted in paragraph 5-119.6 plus or minus 10 mV. If the reading falls outside this range it will be necessary to physically disconnect the front panel from the chassis in order to adjust the DVM Input Gain Potentiometer on the Front Panel Interface Card (Figure 5-17). Adjust the DVM Input gain for a reading on the external DVM equal to one-tenth the voltage noted for paragraph 5-119.6. Reconnect the front panel to the chassis.

8. Repeat paragraphs 5-119.3 and 5-119.4.

9. Disconnect the external DVM. With the DVM input jack still shorted adjust the A/D Zero Potentiometer on the I/O Board (Figure 5-19) **for a** O.tfVDC'reading on the R2001ACRT display.

CAUTION

Do not use the card extender while aligning the Processor I/O board.

10. Remove the short from the DVM Input and connect the DVM Input to TP 12 of the Scope/DVM Control Board.

11. Adjust the A/D Gain Potentiometer on the Processor I/O Board (Figure 5-19) for a DVM reading on the CRT equal to the voltage measured at TP 12 with the external DVM for paragraph 5-119.6.

12. Connect the external DVM to TP11 of the Scope/DVM Control Board and chassis ground. Note the DVM reading for TP11.

13. Disconnect he external DVM from TP11 and connect the DVM Input Jack on the front panel to TP11 of the Scope/DVM Control Board.

14. Adjust the A/D Balance Potentiometer on the Processor I/O Board (Figure 5-19) for a DVM reading on the CRT equal to the voltage measured at TP11 with. the external DVM in step 13.

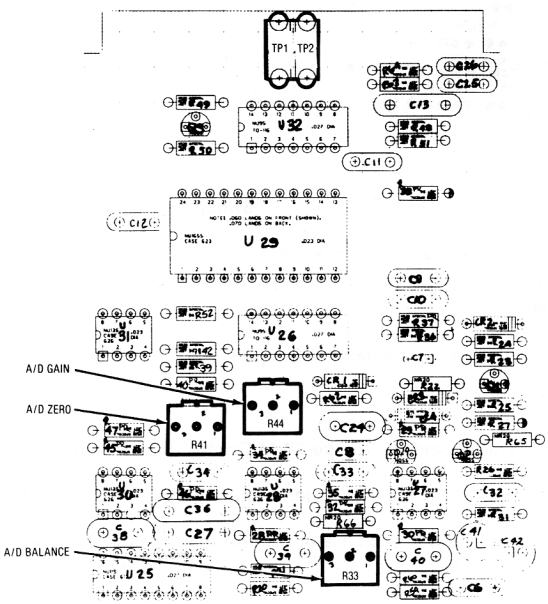

Figure 5-19. Processor I/O A/D Alignment Points

5-120. Character Generator

1. Perform the Basic Alignment Procedure of para 5-105.

2. Turn the R2001A off and extend the Scope/DVM Control Board using the 100 pin extender card.

3. Turn the R2001A on and select the Monitor FM Function and the Gen/Mon Mtr Display.

4. Adjust the Horizontal Character Sweep Width Potentiometer on the Scope/DVM Control Board (Figure 5-20) so that the right-hand edge of the CRT character display is approximately 4.2 graticule divisions to the right of the graticule center line.

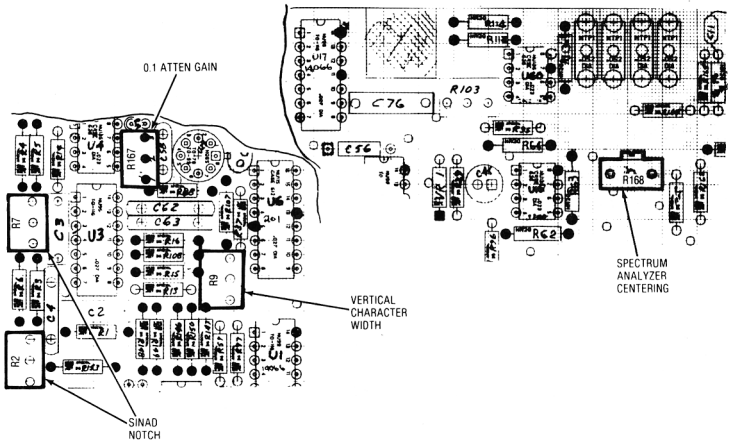

Figure 5-20. Scope/DVM Control Char Sweep and Sinad Alignment Points

5. Adjust the Vertical Character Sweep Width Potentiometer on the Scope/DVM Control Board (FigureS-20) so that the bottom edge of the CRT display is approximately 3.3 graticule divisions below the graticule center line.

6. Turn the system power off and reinstall the Scope/DVM Control Board into the R2001A,

5-121. Sinad Notch Filter

1. Turn the R2001A off and extend the Scope/DVM Control Board using the 100 pin extender card.

2. Turn the R2001A on and select the Generate FM Function and the Gen/Mon Mtr Display.

3. Set the Modulation Switch and the Ext. Level Control to their off positions. Set the BW Switch to the Narrow position and adjust the 1 kHz Level Control for a 20 kHz deviation reading on the CRT display.

4. Connect the Mod Out Jack on the fron panel to the Vert/Sinad/DVM/Counter Input Jack on the front panel.

5. *AHernatety ad/usl She Iwo SWAD Noich polenf/ome'ters on 8ie Scope/DVW Coniro) Board iF/gare* 5-20) for a maximum SINAD reading on the CRT display. A reading greater than 30 dB should be obtained.

6: Turn the system power off and reinstall the Scope/DVM Control Board into the R2001A.

5-122. Receiver

5-123. AM Detector

1. Perform the basic alignment procedure of para 5-105.

2. Turn the R2001 A off and remove the Receiver Module. Remove the Receiver Module cover and install the Receiver Test Cover on the module housing. Extend the Receiver module on the Receiver Extender Card.

3. Turn the R2001 A on and select the Monitor AM Function and the Gen/Mon Mtr Display. Set the monitor frequency to 250 MHz, the RF Step Attenuator to the 0 dB position, and the BW Switch to the Narrow position.

4. Connect the external signal generator to the RF In/Out Jack on the front panel. Adjust the external generator for an output level of approximately -60 dBm and a calibrated 30% AM.

5. Adjust R60 (Marked on the Receiver Test Cover) for a reading of 30% ±5% on the CRT AM display.

5-124. FM Detector

1. Select the Monitor FM Function and the Gen/Mon Mtr Display. Set the monitor frequency to 250 MHz, the RF Step Attenuator to the 0 dB position, and the BW Switch to the Wide position.

2. Connect the external signal generator to the RF In/Out Jack 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 20 kHz** FM.

3. Adjust R70 (Marked on the Receiver Test Cover) for a reading of 20 kHz ± 1 kHz on the CRT FM display.

4. Set the BW switch to the Narrow position and reset the FM on the external generator to 3 kHz deviation.

5. Adjust R125 (Marked on the Receiver Test Cover) for a reading of 3 kHz ± 150 Hz on the CRT FM display.

6. Turn off the FM on the external generator so that a CW signal of a level of approximately -30 dBm is applied to the R2001A.

7. Connect the Demod Out Jack to the Vert/Sinad/DVM/Counter I nputdaek on the front panel. Select the DVM Display and the DC DVM Mode on the R2001A. • ..

8. Adjust R68 (Marked on the Receiver Test Qover) for a 0.0 VDC ±100 mVDC reading on the DVM Display. I

5-125. Spectrum Analyzer

1. Select the Monitor Function and the Spectrum Analyzer Display on the R2001A. Set the monitor frequency to 250 MHz, and the RF Step Attenuator to the 40 dB position.

2. Connect the external signal generator to the RF In/Out Jack 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.

3. Adjust in succession C2, C83, C88, and C96 (Marked on the Receiver Test Cover) to maximize the amplitude of the spectral line in the center of the CRT display.

4. Adjust R124, R91, and R100 (Marked on the Receiver Test Cover) to obtain a uniform change in the spectral amplitude per 10 dB change of the RF Step Attenuator. R124 affects the level of the spectral component when in the top quarter of the screen, R91 affects levels in the third quarter from the top, and R100 affects levels in the bottom quarter.

5. Adjust R119 for offset and R121 for gain so that with the step attenuator in the 0 dB Position the peak of the spectral line lies on the 30 dB line of the CRT and that successive step increases of the input attenuator move the spectral amplitude downward in 10 dB increments on the CRT. The accuracy required for any one step attenuator position is ±3 dB.

6. It will generally be necessary to repeat paragraphs 5-125.4 and 5-125.5 until the best possible accuracy is obtained.

7. Turn the power off and remove the Receiver Module and the Receiver Extender for the chassis. Remove the Test Cover from the Receiver Module and replace the module cover. Reinstall the Receiver Module into the system chassis.

5-126. CHECKOUT PROCEDURE

5-127. Introduction

5-128. This section provides a system checkout procedure. This procedure will help isolate system failures when used with the troubleshooting information in para 5-146.

5-129. Test Equipment Required

5-130. The test equipment listed in table 5-5 or its equivalent will be required to perform the checkout procedure.

Table 5-5. Test Equipment

*RF Signal Generator	Motorola R-1201A
"RF Power Meter	Motorola S-1339A
*SINAD Meter	Motorola R-1013A
"Modulation Meter	Boonton 82AD
RF Power Source	1 watt to 100 watts

*An R2001 A is suitable for use in place of these separate equipments.

R2001B Alignment Section

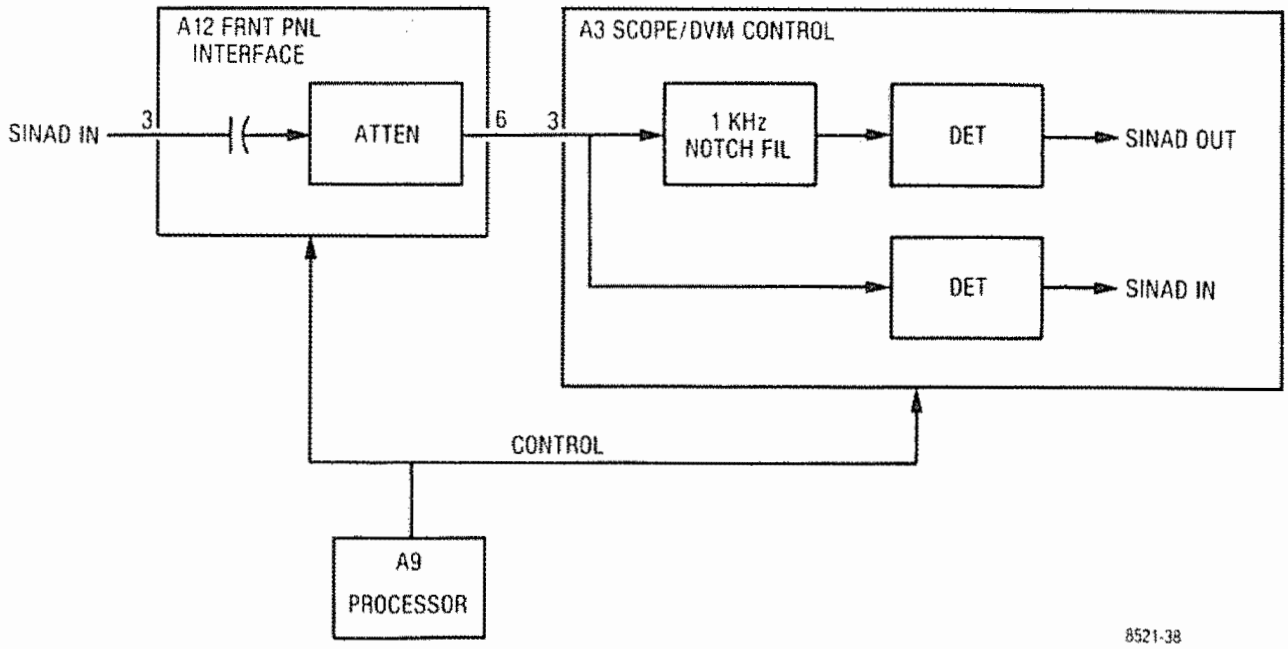

Figure 5-12. Sinad Meter Block Diagram

5-99. ALIGNMENT PROCEDURE

5-100. Introduction

5-101. This section provides a basic (para 5-105) and an extended (para 5-118) alignment procedure. The basic procedure requires only the use of a calibrated oscilloscope. It is expected that the basic alignment be performed whenever service work is performed. The extended alignment procedure requires module extenders and a calibrated digital voltmeter in addition to the oscilloscope. The extended procedure should be performed as required after servicing the system. All adjustments not covered in this procedure are to be performed on suitable module test fixtures only.

5-102. Test Equipment Required

5-103. The test equipment or its equivalent listed in table 5-3 is required for the basic procedure. The additional equipment required for the extended procedure is listed in table 5-4.

Table 5-3. Basic Test Equipment Required

Description	Model
*Oscilloscope Test Point Shorting Jumper Nonmetallic Alignment Tool	Motorola R1004A

*An R2001 is a suitable subsitute

Table 5-4. Extended Test Equipment Required

Description	Model
*Oscilloscope	Motorola R1004A
*Digital Voltmeter	Motorola R1001A
*RF Signal Generator	Motorola R1201A
*Modulation Meter	Boonton 82AD
Receiver Test Cover	Motorola 15-P01324V001
Extender Card Set	Motorola 67-P01322V001

*An R2001 is a suitable for use in place of these separate equipments.

5-104. Preparation for Alignment

1. All alignments to be performed at normal ambient temperature.
2. Remove the top cover of the unit to be aligned.
3. Apply power to the unit to be aligned and allow a warmup time of 15 minutes prior to alignment.

5-105. Basic Alignment Procedure

5-106. CRT Astigmatism and Geometry

1. Select the Monitor Function and the Gen/Mon Mtr Display on the R2001B. 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 5-13) for the best focus at the outer edges of the CRT while minimizing the pincushion and barrel distortion of the display. The two adjustments are interactive so that repeated small adjustments alternated between the two potentiometers will be required to obtain the best display.

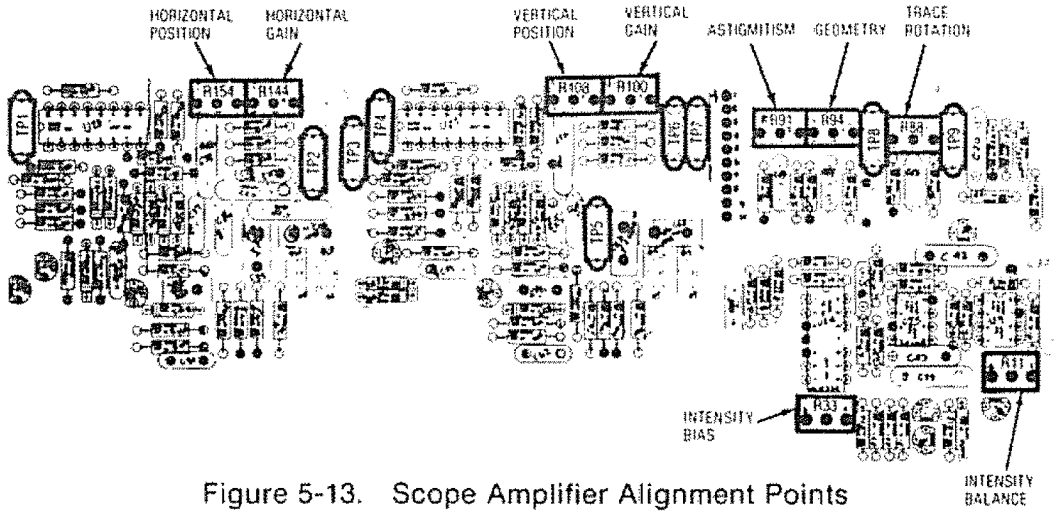

Figure 5-13. Scope Amplifier Alignment Points

5-107. CRT Intensity Bias

1. Select the Scope DC Display and the Ext Horiz. Input mode. 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 as a permanent burn in the phosphor will occur.

2. Adjust the Intensity Bias potentiometer (Figure 5-13) until a dot appears on the screen. (The Vertical and Horizontal Position Control on the front panel may have to be used to bring the dot on to the screen.) Then back off the Intensity Bias potentiometer until the dot just disappears.

5-108. CRT Intensity Balance

1. Select the Scope DC Display and the 1 mSec/Div Horizontal Sweep rate on the R2001B. Set the Horizontal Timebase Veriner to the Cal position and adjust the Intensity Control for a barely visible horizontal line on the CRT.

2. Adjust the Intensity Balance potentiometer (Figure 5-13) for uniform intensity of the horizontal trace from left to right. The Balance potentiometer affects the intensity on the left side of the trace.

5-109. CRT Horizontal Centering

1. Select the Gen/Mon Mtr Display on the R2001B. Adjust the Intensity Control for a comfortable viewing brightness.

2. With the Test Point Shorting Jumper connect TP1 of the Scope Amplifier Board (Figure 5-13) to chassis ground.

3. Adjust the Horizontal Position Potentiometer (Figure 5-13) so that the vertical trace on the CRT screen passes through the graticule center point.

4. Remove the jumper from TP1.

5-110. CRT Vertical Centering

1. Select the Gen/Mon Mtr Display on the R2001B. Adjust the Intensity Control for comfortable viewing brightness.

2. With the Test Point Shorting Jumper connect TP4 of the Scope Amplifier Board (Figure 5-13) to chassis ground.

3. Adjust the Vertical Position Potentiometer (Figure 5-13) so that the horizontal trace on the CRT screen passes through the graticule center point.

4. Remove jumper from TP4.

5-111. CRT Trace Rotation

1. Select the Gen/Mon Mtr Display on the R2001B. Adjust the Intensity Control for a comfortable viewing brightness.

2. Adjust the Trace Rotation Potentiometer for a properly rotated CRT display.

5-112. CRT Horizontal Gain

1. Connect the Mod Out Jack to the Ext Horiz Jack on the R2001B front panel.

2. Set the R2001B for the Generate FM Function and the Scope DC Display. Set the Horiz Control for Ext Horiz input. Turn the Code Synthesizer off, the Ext Level off, and the 1 kHz Level up about half way.

3. Connect an oscilloscope with a calibrated vertical input to TP1 on the Scope Amplifier Board. (Figure 5-13).

4. Using the front panel Horizontal Vernier Control adjust for a 3 V p-p amplitude on the sinewave at TP1.

5. With 3V p-p at TP1 adjust the Horizontal Gain Potentiometer (Figure 5-13) for a horizontal trace 6 cm long on the CRT. (Use the front panel controls to position the trace at a convenient place near the center of the CRT).

5-113. CRT Vertical Gain

1. Connect the Mod Out Jack to the Vert Input Jack on the R2001B front panel.

2. Set the R2001B for the Generate FM Function and the Scope DC Display. Set the Horiz Control for 1 mSec/Div sweep rate and the Horizontal Vernier to the Cal position. Set the Vert Control for 1 V/Div input sensitivity and the Vertical Vernier to the Cal position.

3. Turn the Code Synthesizer off, the Ext Level off and the 1 kHz Level up about half way.

4. Connect an oscilloscope with a calibrated vertical input to TP4 on the Scope Amplifier Board. (Figure 5-13).

5. Using the front panel 1 kHz Level Control adjust for a 3V p-p amplitude on the sinewave at TP4.

6. With 3V p-p at TP4 adjust the Vertical Gain Potentiometer (Figure 5-13) for a 6 cm p-p sinewave on the CRT. (use the front panel Position Controls to center the waveform on the CRT).

5-114. Vertical Input Gain

1. Set the R2001B for the Generate FM Function and the Scope DC Display. Set the Horiz Control for 1 m Sec/Div sweep rate and the Horizontal Vernier to the Cal position. Set the Vert Control for 1 V/Div input sensitivity and the Vertical Vernier to the Cal position.

2. Connect an oscilloscope with a calibrated vertical input to the Mod Out Jack on the front panel.

3. Turn the Code Synthesizer off, the Ext Level off and adjust the 1 kHz Level Control for a 6 V p-p sinewave on the attached oscilloscope.

4. Disconnect the oscilloscope from the Mod Out Jack and connect the Mod Out Jack to the Vert Input Jack on the R2001B.

5. Adjust the Input Vertical Gain Potentiometer on the Front Panel Interface Board (Figure 5-14) for a 6 cm p-p sinewave on the CRT. (Use the front panel Position Controls to center the waveform on the CRT.)

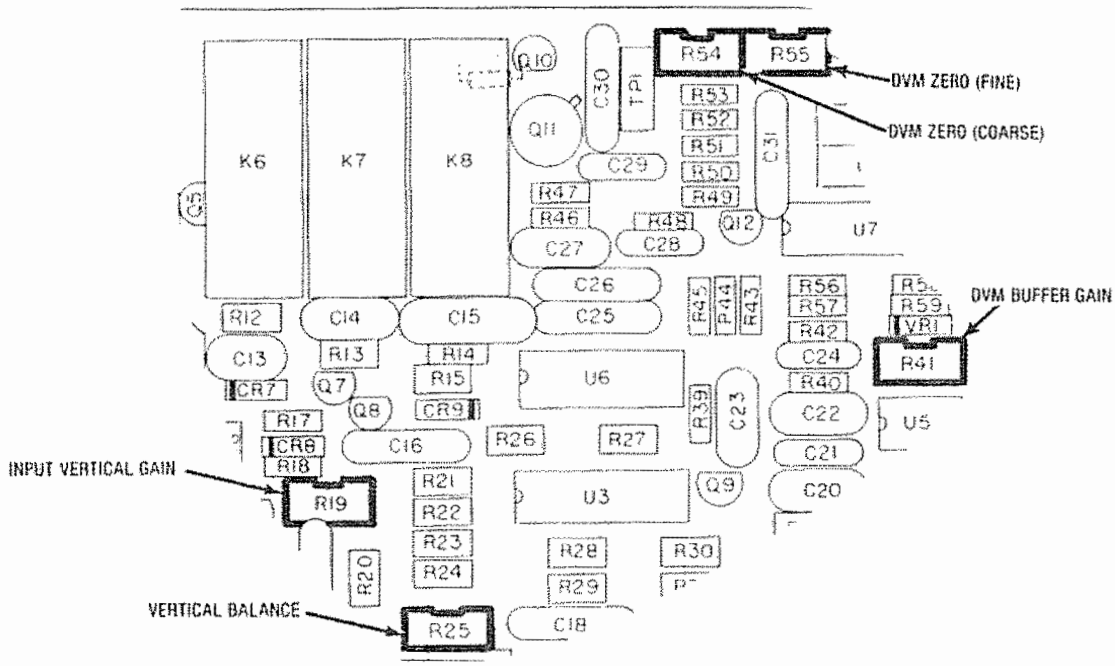

Figure 5-14. Front Panel Interface Alignment Points

5-115. DVM Zero

1. Select the DVM Display and the DC Mode on the R2001B.

2. Short the center conductor of the DVM Input Jack to ground.

3. Adjust the DVM Zero (Coarse) and the DVM Zero (Fine) Potentiometers on the Front Panel Interface Board (Figure 5-14) for a zero reading on the DVM Display.

5-116. Spectrum Analyzer Centering

1. Select the Spect Analyzer Display on the R2001B.Set the Dispersion Control on the front panel to the 1 MHz position. (full counter clockwise) Set the center frequency of the analyzer to 10.0 MHz.

2. Connect the 10 MHz Output on the rear panel to the RF Input on the front panel. Set the RF Step Attenuator to obtain a convenient spectral display.

3. Adjust the Spectrum Analyzer Centering Potentiometer on the Scope/DVM Control Board (Figure 5-15) so that the spectral line on the CRT is centered about the center graticule line.

5-117. Horizontal Time Base

1. Select the Tone Memory Display and the Generate FM Function on the R2001B. Program tone A for 20.0 Hz and Tone B for 2000.0 Hz.

2. Select the Modulation Display. Set the Oscilloscope Controls for 2.5 kHz/Div vertical range, Auto Trigger, and 10 mSec/Div horizontal sweep range. Set the Horizontal and Vertical Vernier Controls to their Cal positions.

3. Set the Code Synthesizer for Continuous, Tone A, and turn up the Code Synth Level to obtain a nearly full scale sinusoidal waveform on the CRT. Turn the Ext Level and the 1 kHz Level Controls to the off position.

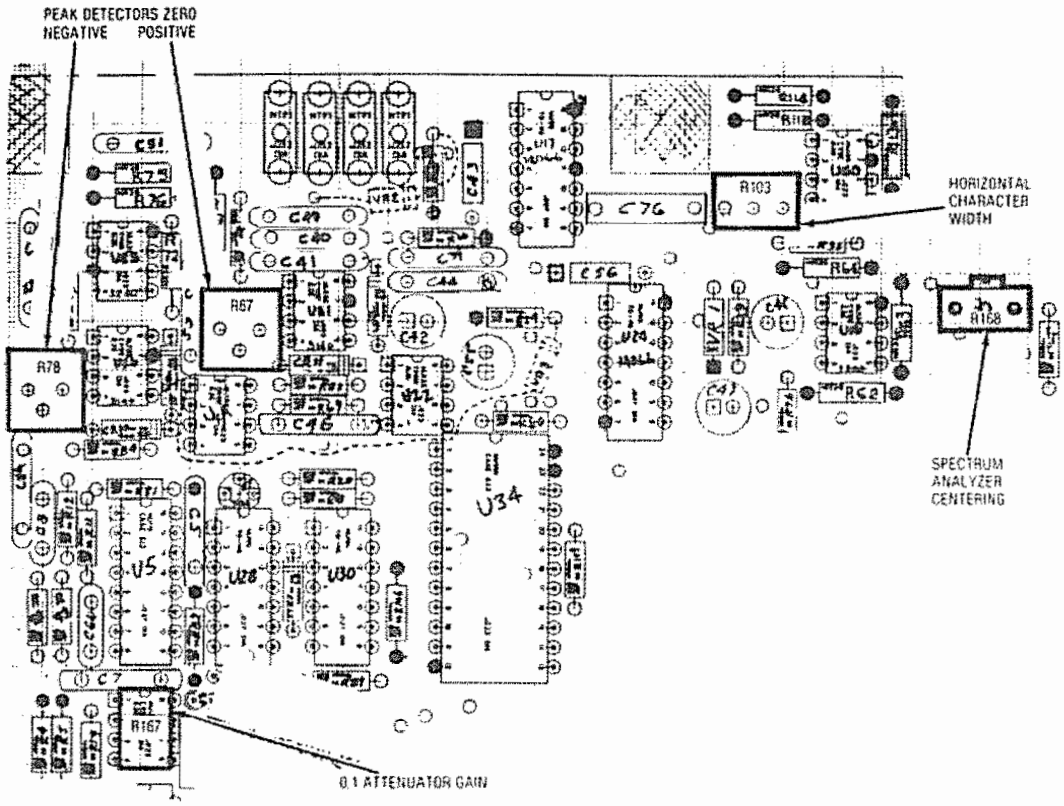

Figure 5-15. Scope/DVM Control Alignment Points

4. Adjust the Coarse Time Base Calibration Potentiometer on the Scope Amplifier Board (Figure 5-16) so that one cycle of the displayed waveform occurs in 5 cm along the horizontal axis. Use the Vertical and Horizontal Position controls to center and to move the waveform so that the 5 cm are measured in the middle of the screen to avoid nonlinearities near the edge of the CRT.

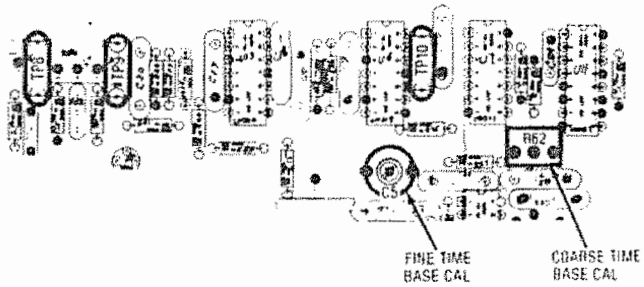

Figure 5-16. Horizontal Time Base Alignment Points

5. Set the Oscilloscope Horizontal Control for a 100 μ Sec/Div sweep rate and select the Tone B output on the Code Synthesizer.

6. Adjust the Fine Time Base Calibration Capacitor on the Scope Amplifier Board (Figure 5-16) so that one cycle of the displayed waveform occurs in 5 cm along the horizontal axis. Use the Vertical and Horizontal Position controls to center and to move the waveform so that the 5 cm are measured in the middle of the screen to avoid nonlinearities near the edge of the CRT.

5-118. Extended Alignment Procedure

5-119. DVM

1. Remove the top and bottom covers of the R2001B.

2. Connect the R2001B to a primary power source and turn it on. Allow approximatly 15 minutes warm up before proceeding with the alignment procedure.

3. Short the center conductor of the DVM Input Jack on the front panel to ground. Connect an external DVM with a floating input between pin 1 and pin 6 of J3 on the bottom side of the motherboard.

4. Adjust the Coarse and Fine DVM Zero potentiometers on the Front Panel Interface board (Figure 5-17) for a reading of 0 ±0.5 mV on the external DVM.

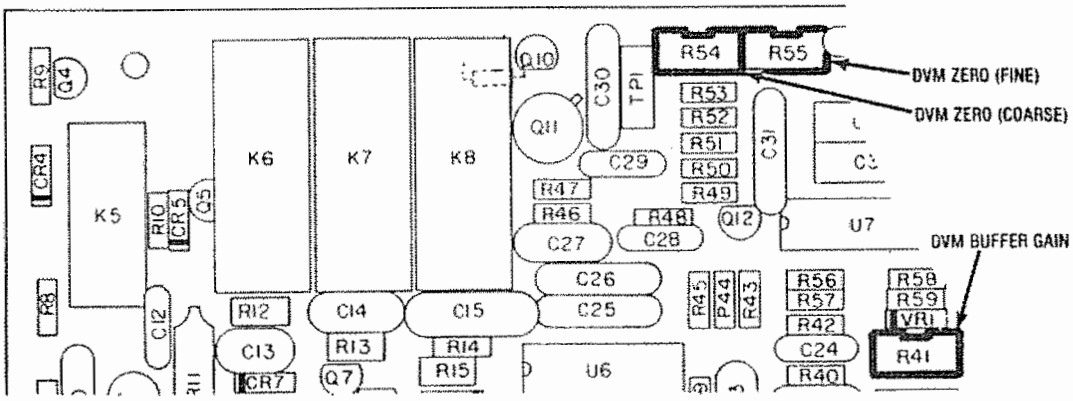

Figure 5-17. DVM Input Buffer Alignment Points

5. Remove the ground from the DVM Input and connect the DVM Input to TP 12 of the Scope/DVM Control Board. (Figure 5-18)

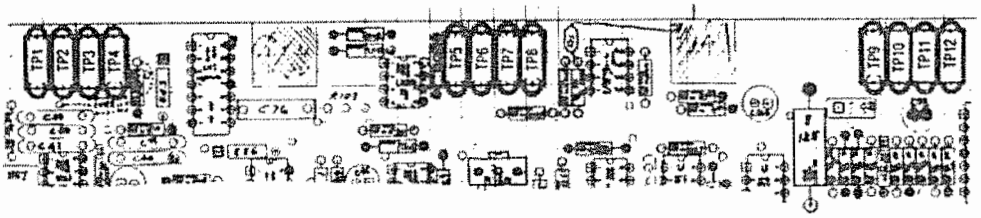

Figure 5-18. Scope/DVM Control Test Point Numbering

6. Disconnect the external DVM from pins 1 and 6 of J3 and connect it to TP 12 of the Scope/DVM Control Board and chassis ground. Note the DVM reading for TP 12.

7. Reconnect the external DVM between pin 1 and pin 6 of J3. The external DVM should show a reading equal to one-tenth the voltage at TP 12 noted in paragraph 5-119.6 plus or minus 10 mV. If the reading falls outside this range it will be necessary to physically disconnect the front panel from the chassis in order to adjust the DVM Input Gain Potentiometer on the Front Panel Interface Card (Figure 5-17). Adjust the DVM Input gain for a reading on the external DVM equal to one-tenth the voltage noted for paragraph 5-119.6. Reconnect the front panel to the chassis.

8. Repeat paragraphs 5-119.3 and 5-119.4.

9. Disconnect the external DVM. With the DVM input jack still shorted adjust the A/D Zero Potentiometer on the I/O Board (figure 5-19) for a 0.0 VDC reading on the R2001B CRT display.

CAUTION

Do not use the card extender while aligning the Processor I/O board.

10. Remove the short from the DVM Input and connect the DVM Input to TP 12 of the Scope/DVM Control Board.

11. Adjust the A/D Gain Potentiometer on the Processor I/O Board (Figure 5-19) for a DVM reading on the CRT equal to the voltage measured at TP 12 with the external DVM for paragraph 5-119.6.

12. Connect the external DVM to TP11 of the Scope/DVM Control Board and chassis ground. Note the DVM reading for TP11.

13. Disconnect he external DVM from TP11 and connect the DVM Input Jack on the front panel to TP11 of the Scope/DVM Control Board.

14. Adjust the A/D Balance Potentiometer on the Processor I/O Board (Figure 5-19) for a DVM reading on the CRT equal to the voltage measured at TP11 with the external DVM in step 13.

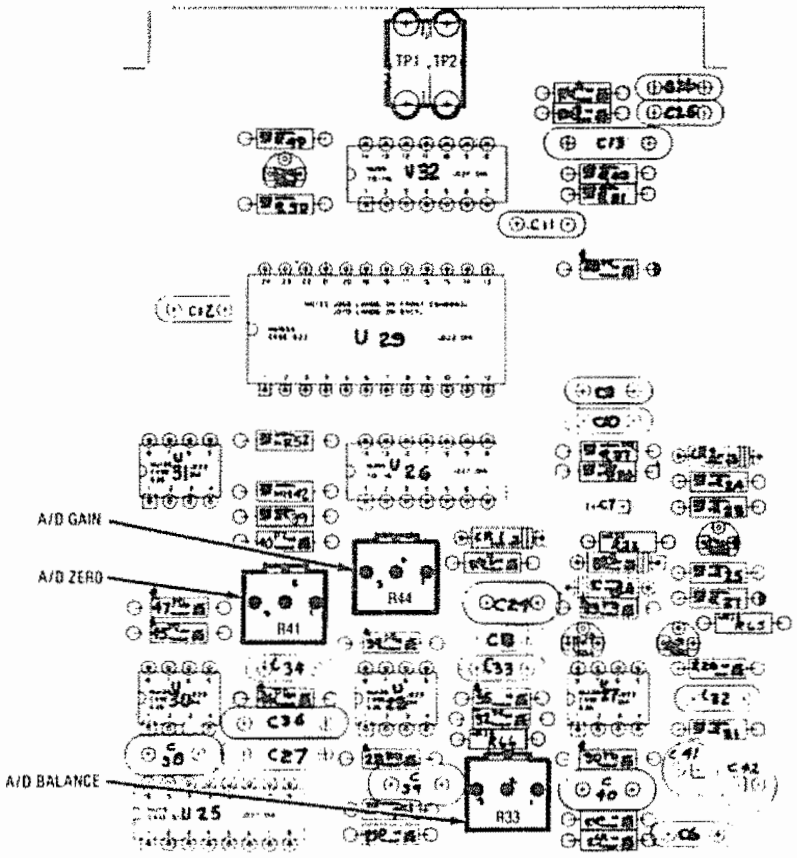

Figure 5-19. Processor I/O A/D Alignment Points

5-120. Character Generator

1. Perform the Basic Alignment Procedure of para 5-105.

2. Turn the R2001B off and extend the Scope/DVM Control Board using the 100 pin extender card.

3. Turn the R2001B on and select the Monitor FM Function and the Gen/Mon Mtr Display.

4. Adjust the Horizontal Character Sweep Width Potentiometer on the Scope/DVM Control Board (Figure 5-20) so that the right-hand edge of the CRT character display is approximately 4.2 graticule divisions to the right of the graticule center line.

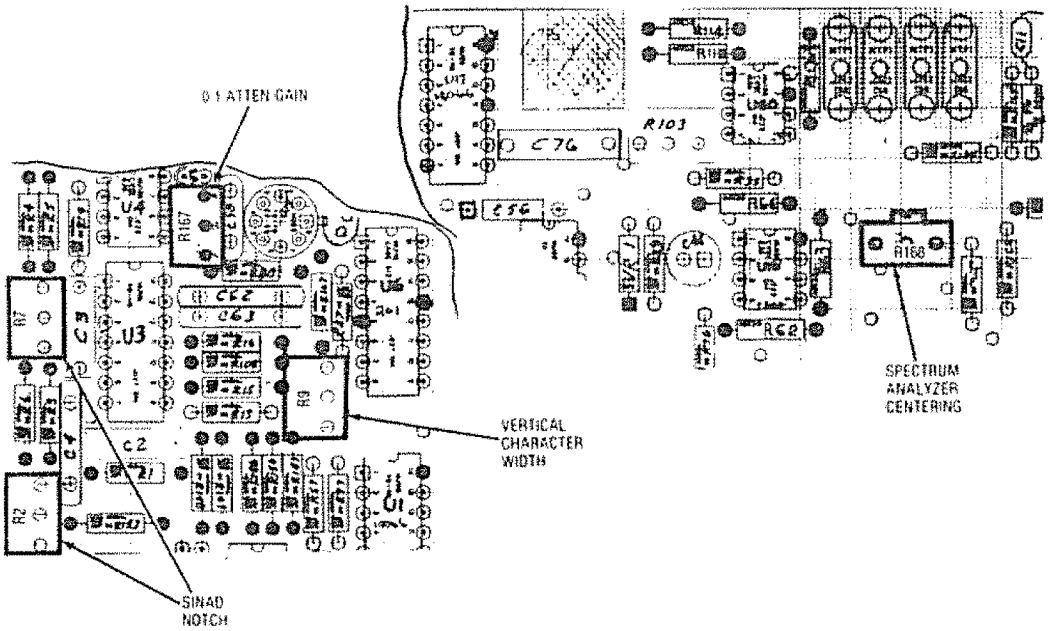

Figure 5-20. Scope/DVM Control Char Sweep and Sinad Alignment Points

5. Adjust the Vertical Character Sweep Width Potentiometer on the Scope/DVM Control Board (Figure 5-20) so that the bottom edge of the CRT display is approximately 3.3 graticule divisions below the graticule center line.

6. Turn the system power off and reinstall the Scope/DVM Control Board into the R2001B.

5-121. Sinad Notch Filter

1. Turn the R2001B off and extend the Scope/DVM Control Board using the 100 pin extender card.

2. Turn the R2001B on and select the Generate FM Function and the Gen/Mon Mtr Display.

3. Set the Modulation Switch and the Ext. Level Control to their off positions. Set the BW Switch to the Narrow position and adjust the 1 kHz Level Control for a 20 kHz deviation reading on the CRT display.

4. Connect the Mod Out Jack on the fron panel to the Vert/Sinad/DVM/Counter Input Jack on the front panel.

5. Alternately adjust the two SINAD Notch potentiometers on the Scope/DVM Control Board (Figure 5-20) for a maximum SINAD reading on the CRT display. A reading greater than 30 dB should be obtained.

6. Turn the system power off and reinstall the Scope/DVM Control Board into the R2001B.

5-122. Receiver

5-123. AM Detector

1. Perform the basic alignment procedure of para 5-105.

2. Turn the R2001B off and remove the Receiver Module. Remove the Receiver Module cover and install the Receiver Test Cover on the module housing. Extend the Receiver module on the Receiver Extender Card.

3. Turn the R2001B on and select the Monitor AM Function and the Gen/Mon Mtr Display. Set the monitor frequency to 250 MHz, the RF Step Attenuator to the 0 dB position, and the BW Switch to the Narrow position.

4. Connect the external signal generator to the RF In/Out Jack on the front panel. Adjust the external generator for an output level of approximately -60 dBm and a calibrated 30% AM.

5. Adjust R60 (Marked on the Receiver Test Cover) for a reading of 30% ±5% on the CRT AM display.

5-124. FM Detector

1. Select the Monitor FM Function and the Gen/Mon Mtr Display. Set the monitor frequency to 250 MHz, the RF Step Attenuator to the 0 dB position, and the BW Switch to the Wide position.

2. Connect the external signal generator to the RF In/Out Jack 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 20 kHz FM.

3. Adjust R70 (Marked on the Receiver Test Cover) for a reading of 20 kHz ± 1 kHz on the CRT FM display.

4. Set the BW switch to the Narrow position and reset the FM on the external generator to 3 kHz deviation.

5. Adjust R125 (Marked on the Receiver Test Cover) for a reading of 3 kHz ± 150 Hz on the CRT FM display.

6. Turn off the FM on the external generator so that a CW signal of a level of approximately -30 dBm is applied to the R2001B.

7. Connect the Demod Out Jack to the Vert/Sinad/DVM/Counter Input Jack on the front panel. Select the DVM Display and the DC DVM Mode on the R2001B.

8. Adjust R68 (Marked on the Receiver Test Cover) for a 0.0 VDC ±100 mVDC reading on the DVM Display.

5-125. Spectrum Analyzer

1. Select the Monitor Function and the Spectrum Analyzer Display on the R2001B. Set the monitor frequency to 250 MHz, and the RF Step Attenuator to the 40 dB position.

2. Connect the external signal generator to the RF In/Out Jack 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.

3. Adjust in succession C2, C83, C88, and C96 (Marked on the Receiver Test Cover) to maximize the amplitude of the spectral line in the center of the CRT display.

4. Adjust R124, R91, and R100 (Marked on the Receiver Test Cover) to obtain a uniform change in the spectral amplitude per 10 dB change of the RF Step Attenuator. R124 affects the level of the spectral component when in the top quarter of the screen R91 affects levels in the third quarter from the top, and R100 affects levels in the bottom quarter.

5. Adjust R119 for offset and R121 for gain so that with the step attenuator in the 0 dB Position the peak of the spectral line lies on the 30 dB line of the CRT and that successive step increases of the input attenuator move the spectral amplitude downward in 10 dB increments on the CRT. The accuracy required for any one step attenuator position is ±3 dB.

6. It will generally be necessary to repeat paragraphs 5-125.4 and 5-125.5 until the best possible accuracy is obtained.

7. Turn the power off and remove the Receiver Module and the Receiver Extender for the chassis. Remove the Test Cover from the Receiver Module and replace the module cover. Reinstall the Receiver Module into the system chassis.

5-126. CHECKOUT PROCEDURE

5-127. Introduction

5-128. This section provides a system checkout procedure. This procedure will help isolate system failures when used with the troubleshooting information in para 5-146.

5-129. Test Equipment Required

5-130. The test equipment listed in table 5-5 or its equivalent will be required to perform the checkout procedure.

Table 5-5. Test Equipment

*RF Signal Generator	Motorola R-1201A
*RF Power Meter	Motorola S-1339A
*SINAD Meter	Motorola R-1013A
*Modulation Meter	Boonton 82AD
RF Power Source	1 watt to 100 watts

*An R2001 is suitable for use in place of these separate equipments.

R2001C Alignment Section

which is controlled from the front panel vertical switch through the processor. The attenuator provides external vertical input sensitivities from 0.01 to 1.0 volt per division and modulation scope sensitivities from 0.25 to 25 kHz per division.

5-94. A Select Switch ahead of the Attenuator selects between the external vertical input or the modulation scope inputs. The External Vertical input path is further selected between AC and DC coupling before becoming the vertical input jack on the front panel. The modulation scope signal path is switched to one of three possible sources on the Scope/DVM Control module. Demodulation signals from the Receiver are selected via the DEMOD CAL AUDIO path, and frequency and amplitude modulation signals via the MOD CAL AUDIO and CARRIER + MOD LVL signal paths respectively. The Audio Synthesizer module provides the MOD CAL AUDIO signal while the RF Input module gives the CARRIER + MOD LVL signal.

5-95. A Z-Axis Select circuit on the Scope/DVM Control module gates either the CHARACTER GEN signal for character displays or the retrace blanking signal from the Time Base Generator for scope displays to the Z-Axis Modulator on the Scope Amplifier module.

5-96. ALIGNMENT PROCEDURE

5-97. Introduction

5-98. This section provides a basic (para 5-102) and an extended (para 5-115) alignment procedure. The basic procedure requires only the use of a calibrated oscilloscope. It is expected that the basic alignment be performed whenever service work is performed. The extended alignment procedure requires module extenders and a calibrated digital voltmeter in addition to the oscilloscope. The extended procedure should be performed as required after servicing the system. All adjustments not covered in this procedure are to be performed on suitable module test fixtures only.

5-99. Test Equipment Required

5-100. The test equipment or its equivalent listed in table 5-3 is required for the basic procedure. The additional equipment required for the extended procedure is listed in table 5-4.

Table 5-3. Basic Test Equipment Required

Description	Model
*Oscilloscope Test Point Shorting Jumper Nonmetallic Alignment Tool	Motorola R1029A

*An R2001 is a suitable substitute

Table 5-4. Extended Test Equipment Required

Description	Model
*Oscilloscope	Motorola R1029A
*Digital Voltmeter	Motorola R1024A
*RF Signal Generator	Motorola R1201A
*Modulation Meter	Boonton 82AD
Audio Generator	Motorola S1067
Receiver Test Cover	Motorola 15-80346A49
Extender Card Set	Motorola RPX-4150A

*An R2001 is suitable for use in place of these separate equipments.

5-101. Preparation for Alignment

1. All alignments to be performed at normal ambient temperature.

2. Remove the top cover of the unit to be aligned.

3. Apply power to the unit to be aligned and allow a warmup time of 15 minutes prior to alignment.

5-102. Basic Alignment Procedure

5-103. CRT Astigmatism and Geometry

1. Select the Monitor Function and the Gen/Mon Mtr Display on the R2001C. 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 5-12) for the best focus at the outer edges of the CRT while minimizing the pincushion and barrel distortion of the display. The two adjustments are interactive so that repeated small adjustments alternated between the two potentiometers will be required to obtain the best display.

5-104. CRT Intensity Bias

1. Select the Scope DC Display and the Ext Horiz. Input mode. 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 as a permanent burn in the phosphor will occur.

2. Adjust the Intensity Bias potentiometer (Figure 5-12) until a dot appears on the screen. (The Vertical and Horizontal Position Control on the front panel may have to be used to bring the dot on to the screen.) Then back off the Intensity Bias potentiometer until the dot just disappears.

5-105. CRT Intensity Balance

1. Select the Scope DC Display and the 1 mSec/Div Horizontal Sweep rate on the R2001C. Set the Horizontal Timebase Vernier to the Cal position and adjust the Intensity Control for a barely visible horizontal line on the CRT.

2. Adjust the Intensity Balance potentiometer (Figure 5-12) for uniform intensity of the horizontal trace from left to right. The Balance potentiometer affects the intensity on the left side of the trace.

5-106. CRT Horizontal Centering

1. Select the Gen/Mon Mtr Display on the R2001C. Adjust the Intensity Control for a comfortable viewing brightness.

2. With the Test Point Shorting Jumper connect TP1 of the Scope Amplifier Board (Figure 5-12) to chassis ground.

3. Adjust the Horizontal Position Potentiometer (Figure 5-12) so that the vertical trace on the CRT screen passes through the graticule center point.

4. Remove the jumper from TP1.

5-107. CRT Vertical Centering

1. Select the Gen/Mon Mtr Display on the R2001C. Adjust the Intensity Control for comfortable viewing brightness.

2. With the Test Point Shorting Jumper connect TP4 of the Scope Amplifier Board (Figure 5-12) to chassis ground.

3. Adjust the Vertical Position Potentiometer (Figure 5-12) so that the horizontal trace on the CRT screen passes through the graticule center point.

4. Remove jumper from TP4.

5-108. CRT Trace Rotation

1. Select the Gen/Mon Mtr Display on the R2001C. Adjust the Intensity Control for a comfortable viewing brightness.

2. Adjust the Trace Rotation Potentiometer (Figure 5-12) for a properly rotated CRT display.

5-109. CRT Horizontal Gain

1. Connect the Mod Out Jack to the Ext Horiz Jack on the R2001C front panel.

2. Set the R2001C for the Generate FM Function and the Scope DC Display. Set the Horiz Control for Ext Horiz input. Turn the Code Synthesizer off, the Ext Level off, and the 1 kHz Level up about half way.

3. Connect an oscilloscope with a calibrated vertical input to TP1 on the Scope Amplifier Board. (Figure 5-12).

4. Using the front panel Horizontal Vernier Control adjust for a 3V p-p amplitude on the sinewave at TP1.

5. With 3V p-p at TP1 adjust the Horizontal Gain Potentiometer (Figure 5-12) for a horizontal trace 6 cm long on the CRT. (Use the front panel controls to position the trace at a convenient place near the center of the CRT).

5-110. CRT Vertical Gain

1. Connect the Mod Out Jack to the Vert Input Jack on the R2001C front panel.

2. Set the R2001C for the Generate FM Function and the Scope DC Display. Set the Horiz Control for 1 mSec/Div sweep rate and the Horizontal Vernier to the Cal position. Set the Vert Control for 1 V/Div input sensitivity and the Vertical Vernier to the Cal position.

3. Turn the Code Synthesizer off, the Ext Level off and the 1 kHz Level up about half way.

4. Connect an oscilloscope with a calibrated vertical input to TP4 on the Scope Amplifier Board. (Figure 5-12).

5. Using the front panel 1 kHz Level Control adjust for a 3V p-p amplitude on the sinewave at TP4.

6. With 3V p-p at TP4 adjust the Vertical Gain Potentiometer (Figure 5-12) for a 6 cm p-p sinewave on the CRT. (use the front panel Position Controls to center the waveform on the CRT).

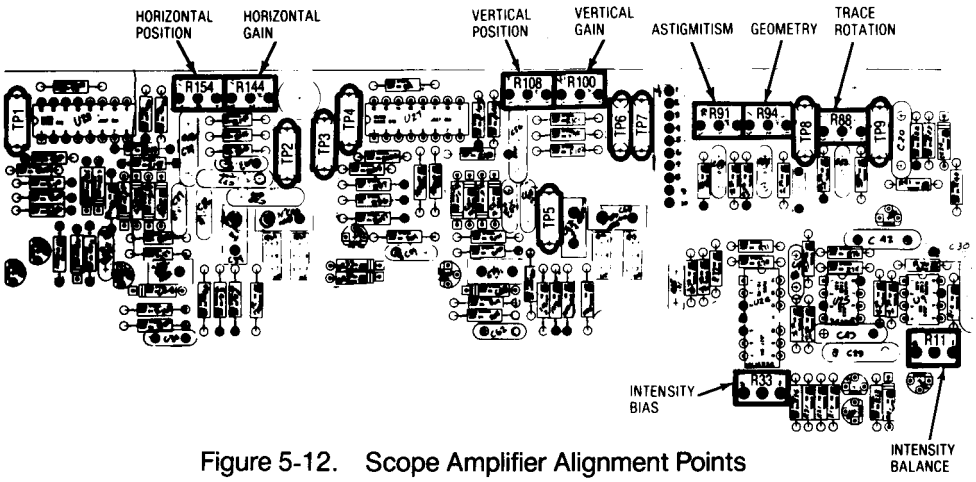

Figure 5-12. Scope Amplifier Alignment Points

5-111. Vertical Input Gain

1. Set the R2001C for the Generate FM Function and the Scope DC Display. Set the Horiz Control for 1m Sec/Div sweep rate and the Horizontal Vernier to the Cal position. Set the Vert Control for 1V/Div input sensitivity and the Vertical Vernier to the Cal position.

2. Connect an oscilloscope with a calibrated vertical input to the Mod Out Jack on the front panel.

3. Turn the Code Synthesizer off, the Ext Level off and adjust the 1 kHz Level Control for a 6V p-p sinewave on the attached oscilloscope.

4. Disconnect the oscilloscope from the Mod Out Jack and connect the Mod Out Jack to the Vert Input Jack on the R2001C.

5. Adjust the Input Vertical Gain Potentiometer on the Front Panel Interface Board (Figure 5-13) for a 6 cm p-p sinewave on the CRT. (Use the front panel Position Controls to center the waveform on the CRT.)

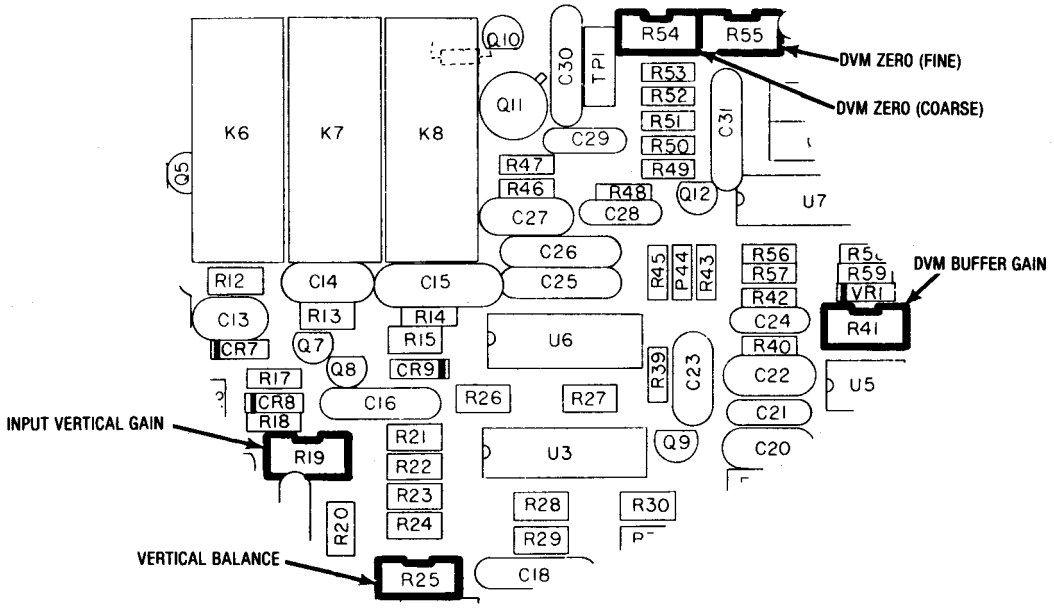

Figure 5-13. Front Panel Interface Alignment Points

5-112. DVM Zero

1. Select the DVM Display and the DC Mode on the R2001C.

2. Short the center conductor of the DVM Input Jack to ground.

3. Adjust the DVM Zero (Coarse) and the DVM Zero (Fine) Potentiometers on the Front Panel Interface Board (Figure 5-13) for a zero reading on the DVM Display.

5-113. Spectrum Analyzer Centering

1. Select the Spect Analyzer Display on the R2001C. Set the Dispersion Control on the front panel to the 1 MHz position. (full counter clockwise) Set the center frequency of the analyzer to 10.0 MHz.

2. Connect the 10 MHz Output on the rear panel to the RF Input on the front panel. Set the RF Step Attenuator to obtain a convenient spectral display.

3. Adjust the Spectrum Analyzer Centering Potentiometer on the Scope/DVM Control Board (Figure 5-14) so that the spectral line on the CRT is centered about the center graticule line.

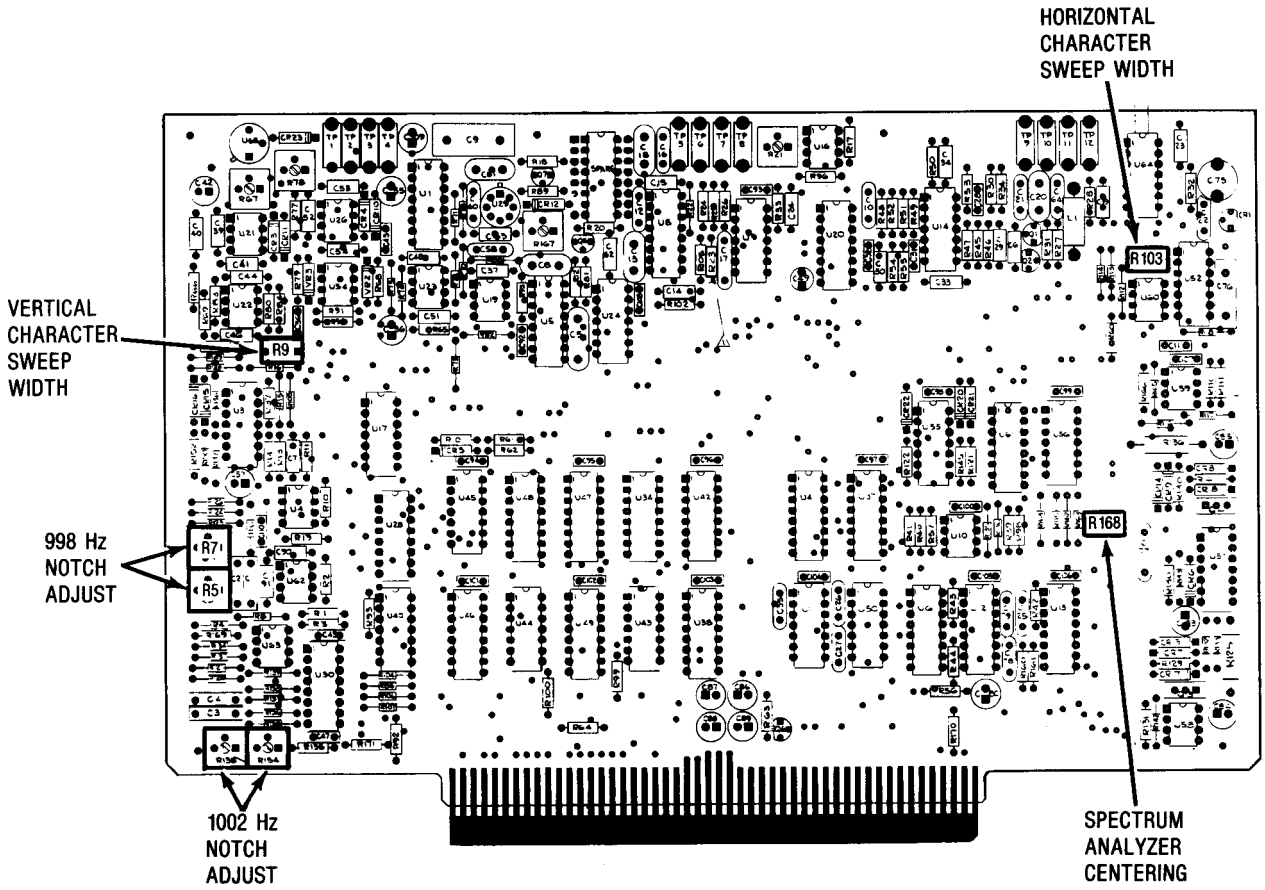

Figure 5-14. Scope/DVM Control Alignment Points

5-114. Horizontal Time Base

1. Select the Tone Memory Display and the Generate FM Function on the R2001C. Program tone A for 20.0 Hz and Tone B for 2000.0 Hz.

2. Select the Modulation Display. Set the Oscilloscope Controls for 2.5 kHz/Div vertical range, Auto Trigger, and 10 mSec/Div horizontal sweep range. Set the Horizontal and Vertical Vernier Controls to their Cal positions.

3. Set the Code Synthesizer for Continuous, Tone A, and turn up the Code Synth Level to obtain a nearly full scale sinusoidal waveform on the CRT. Turn the Ext Level and the 1 kHz Level Controls to the off position.

4. Adjust the Coarse Time Base Calibration Potentiometer on the Scope Amplifier Board (Figure 5-15) so that one cycle of the displayed waveform occurs in 5 cm along the horizontal axis. Use the Vertical and Horizontal Position controls to center and to move the waveform so that the 5 cm are measured in the middle of the screen to avoid nonlinearities near the edge of the CRT.

5. Set the Oscilloscope Horizontal Control for a 100 μSec/Div sweep rate and select the Tone B output on the Code Synthesizer.

6. Adjust the Fine Time Base Calibration Capacitor on the Scope Amplifier Board (Figure 5-15) so that one cycle of the displayed waveform occurs in 5 cm along the horizontal axis. Use the Vertical and Horizontal Position controls to center and to move the waveform so that the 5 cm are measured in the middle of the screen to avoid nonlinearities near the edge of the CRT.

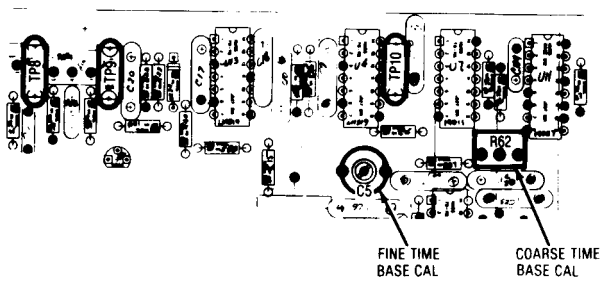

Figure 5-15. Horizontal Time Base Alignment Points

5-115. EXTENDED ALIGNMENT PROCEDURE

5-116. DVM

1. Remove the R2001C top cover.

2. Connect the R2001C to a primary power source, turn it on, and select the EXT DVM mode. Allow approximately 15 minutes warmup before proceeding with the alignment procedure.

3. Short the center conductor of the DVM input jack on the front panel to ground. Connect an external DVM between TP2 and TP9 of the Scope DVM Control Board (Figure 5-14).

4. Adjust the Coarse DVM Zero and the Fine DVM Zero on the Front Panel Interface Board (Figure 5-13) until the external DVM reads 0 $\pm$ 0.5 millivolts DC.

5. Remove the short circuit on the DVM input jack and apply approximately 0.900 volts DC from an external power supply. The voltage between TP2 and TP9 of the Scope/DVM Control Board should be within $\pm$1 mv of the voltage at the front panal DVM input jack. If the unit fails this test, adjust the DVM Buffer Gain on the Front Panel Interface Board (Figure 5-13) until the above two voltages are equal.

6. Select the generate FM narrowband mode and the Gen/Mon Metering display.

7. Short TP4 to TP9 on the Scope/DVM Control Board.

8. Adjust the A/D Offset on the Processor Interface Board (Figure 5-16) until the plus peak deviation reading on the CRT is just toggling between 0.00 and 0.01 kHz. Then slightly turn the adjustment just enough to make the reading 0.00 all the time. 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.

9. 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 module. Place the negative lead on the ground plane or TP9 of the Scope/DVM Control Board.

10. Turn on the 1 kHz internal modulation and adjust the level until the voltage TP4 reads 0.900 volts.

11. Adjust the A/D Gain (Figure 5-16) until the reading on the positive deviation peak is 4.50 kHz.

12. Select the DC DVM mode.

13. With the center conductor of the front panel DVM input jack again shorted to ground, adjust the RMS Converter offset on the Processor Interface Board (Figure 5-16) for a reading of 0.000 volts on the CRT DVM display.

14. Adjust the sign detector offset (Figure 5-16) until the sign of the 0.000 volt reading is just flashing between plus and minus.

15. Remove the short and apply approximately 0.900 volts to the front panel. DVM input jack.

16. While monitoring the input voltage on an external DVM, adjust the RMS Converter Gain on the Processor Interface Board (Figure 5-16) until the CRT DVM reading is equal to the external voltage applied.

5-117. Character Generator

1. Perform the Basic Alignment Procedure of para 5-102.

2. Select the Monitor FM Function and the Gen/Mon Mtr Display.

3. Adjust the Horizontal Character Sweep Width Potentiometer on the Scope/DVM Control Board (Figure 5-14) so that the right-hand edge of the CRT character display is approximately 4.2 graticule divisions to the right of the graticule center line.

4. Adjust the Vertical Character Sweep Width Potentiometer on the Scope/DVM Control Board (Figure 5-14) so that the bottom edge of the CRT display is approximately 3.3 graticule divisions below the graticule center line.

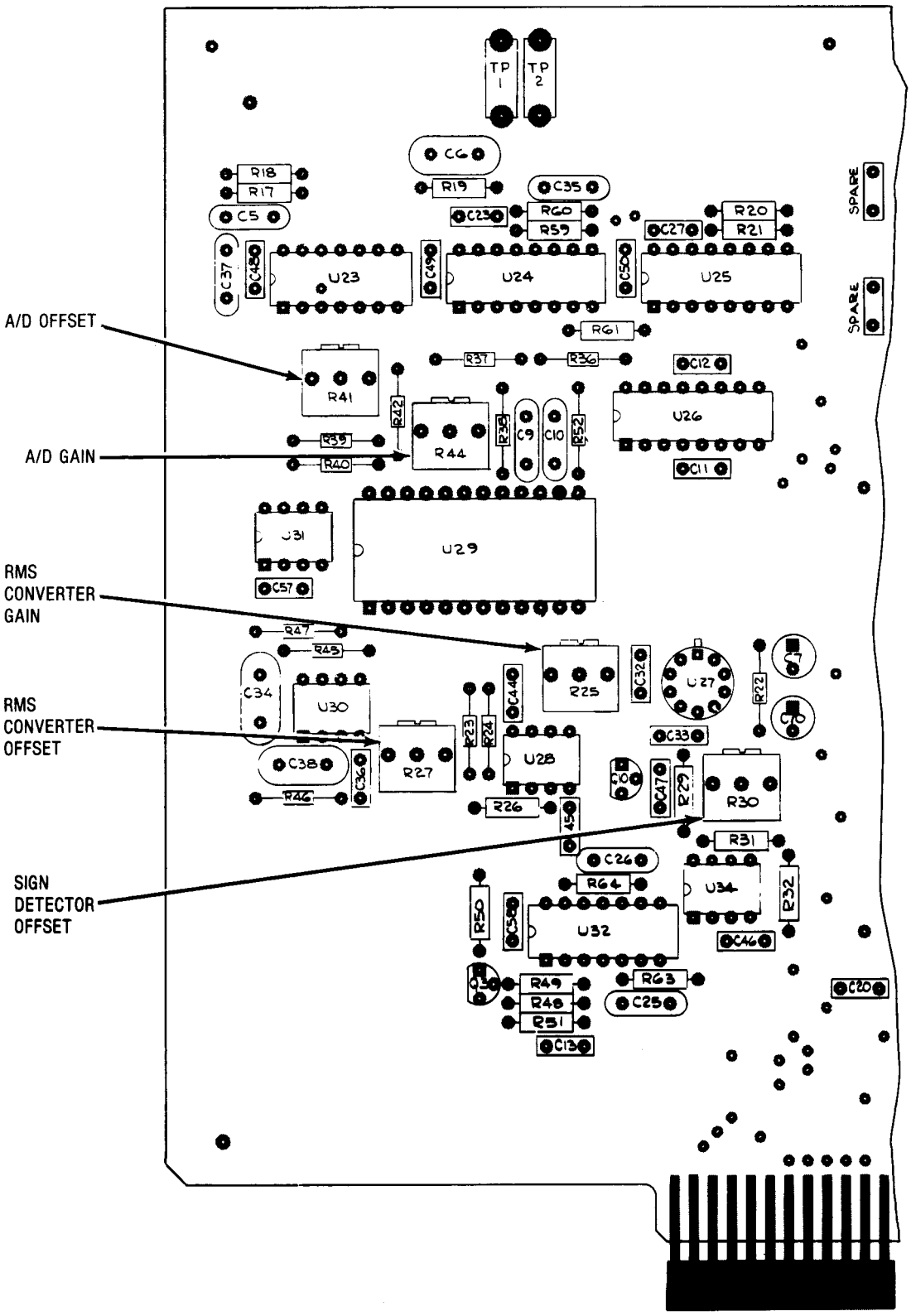

Figure 5-16. Processor I/O A/D Alignment Points

5-118. DISTORTION/SINAD ALIGNMENT

1. Enter the generate mode and the Gen/Mon Metering 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 In input on the front panel.
2. Verify that the distortion reading on the CRT is ≤0.5%. If this test fails the notch filter should be aligned.
3. Turn the R2001C off and extend the Scope/DVM Control Board using the 100 pin extender card.
4. Turn the R2001C on and select the generate FM mode and the Gen/Mon Metering display.
5. Using the same low distortion generator as in article 1, apply a 998 ± 0.2 Hz sine wave to the Distortion input.
6. Alternately adjust the 998 Hz notch potentiometers on the Scope/DVM Control Board (Figure 5-14) to null the distortion reading on the CRT. A reading less than 0.5% should be obtained.
7. Change the audio generator input frequency to 1002 ± 0.2 Hz.
8. Alternately adjust the 1002 Hz notch potentiometers on the Scope/DVM Control Board (Figure 5-14) to again null the CRT distortion reading. A reading less than 0.5% should be obtained.
9. Turn the system power off and reinstall the Scope/DVM Control Board into the R2001C.

5-119. Receiver

5-120. AM Detector

1. Perform the basic alignment procedure of para 5-102.
2. Turn the R2001C off and remove the Receiver Module. Remove the Receiver Module cover and install the Receiver Test Cover on the module housing. Extend the Receiver module on the Receiver Extender Card.
3. Turn the R2001C on and select the Monitor AM Function and the Gen/Mon Mtr Display. Set the monitor frequency to 250 MHz, the RF Step Attenuator to the 0 dB position, and the BW Switch to the Narrow position.
4. Connect the external signal generator to the RF In/Out Jack on the front panel. Adjust the external generator for an output level of approxiamtely −60 dBm and a calibrated 30% AM.
5. Adjust R60 (Marked on the Receiver Test Cover) for a reading of 30% ±5% on the CRT AM display.

5-121. FM Detector

1. Select the Monitor FM Function and the Gen/Mon Mtr Display. Set the monitor frequency to 250 MHz, the RF Step Attenuator to the 0 dB position, and the BW Switch to the Wide position.
2. Connect the external signal generator to the RF In/Out Jack 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 20 kHz FM.
3. Adjust R70 (Marked on the Receiver Test Cover) for a reading of 20 kHz ± 1 kHz on the CRT FM display.
4. Set the BW switch to the Narrow position and reset the FM on the external generator to 3 kHz deviation
5. Adjust R125 (Marked on the Receiver Test Cover) for a reading of 3 kHz ± 150 Hz on the CRT FM display.

6. Turn off the FM on the external generator so that a CW signal of a level of approximately −30 dBm is applied to the R2001C.

7. Connect the Demod Out Jack to the Vert/Sinad Dist/DVM/Counter Input Jack on the front panel. Select the DVM Display and the DC DVM Mode on the R2001C.

8. Adjust R68 (Marked on the Receiver Test Cover) for a 0.0 VDC ± 100 mVDC reading on the DVM Display.

5-122. Spectrum Analyzer

1. Select the Monitor Function and the Spectrum Analyzer Display on the R2001C. Set the monitor frequency to 250 MHz, and the RF Step Attenuator to the 40 dB position.

2. Connect the external signal generator to the RF In/Out Jack 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.

3. Adjust in succession C2, C83, C88, and C96 (Marked on the Receiver Test Cover) to maximize the amplitude of the spectral line in the center of the CRT display.

4. Adjust R124, R91, and R100 (Marked on the Receiver Test Cover) to obtain a uniform change in the spectral amplitude per 10 dB change of the RF Step Attenuator. R124 affects the level of the spectral component when in the top quarter of the screen, R91 affects levels in the third quarter from the top, and R100 affects levels in the bottom quarter.

5. Adjust R119 for offset and R121 for gain so that with the step attenuator in the 0 dB Position the peak of the spectral line lies on the 30 dB line of the CRT and that successive step increases of the input attenuator move the spectral amplitude downward in 10 dB increments on the CRT. The accuracy required for any one step attenuator position is ±3 dB.

6. It will generally be necessary to repeat paragraphs 5-122.4 and 5-122.5 until the best possible accuracy is obtained.

7. Turn the power off and remove the Receiver Module and the Receiver Extender for the chassis. Remove the Test Cover from the Receiver Module and replace the module cover. Reinstall the Receiver Module into the system chassis.

5-123. CHECKOUT PROCEDURE

5-124. Introduction

5-125. This section provides a system checkout procedure. This procedure will help isolate system failures when used with the troubleshooting information in para 5-143.