HEWLETT PACKARD

SIGNAL ANALYZER SYSTEM VOL. I
SYSTEM SERVICE MANUAL
PART NO. 05480-90012 (MANUAL)
APRIL 1971

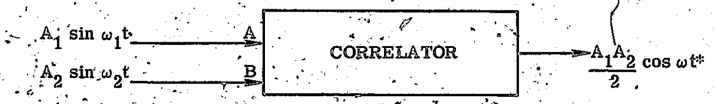
5480A/B
SERIAL PFX ALL SERIALS
05480-90015 (FICHE)
3 of 7

Table 2-23. Correlation

GENERAL

Correlation is a measure of the similarity between two waveforms.

Each Correlator input waveform can be considered as consisting of one or more sine wave components whose amplitudes and phases are such that, when added together, they produce the input waveshape (no matter how complex that shape is). The correlator compares the two waveforms and provides outputs only for those components that are present in both input signals; no output is provided for a component occurring in only one signal. In the correlation process, we give up information about the relative phases of the sine wave components in each input signal; therefore, it is not possible to reconstruct the input signal from a given correlation function. Example: a sine wave, correlated with any other waveform, will provide an output only when the other signal has a component of the same frequency, and the output will only be a cosine wave.



A_1 = amplitude of input A at time of sampling

A_2 = amplitude of input B at time of sampling

$\omega_1 t$ = frequency of one input A component

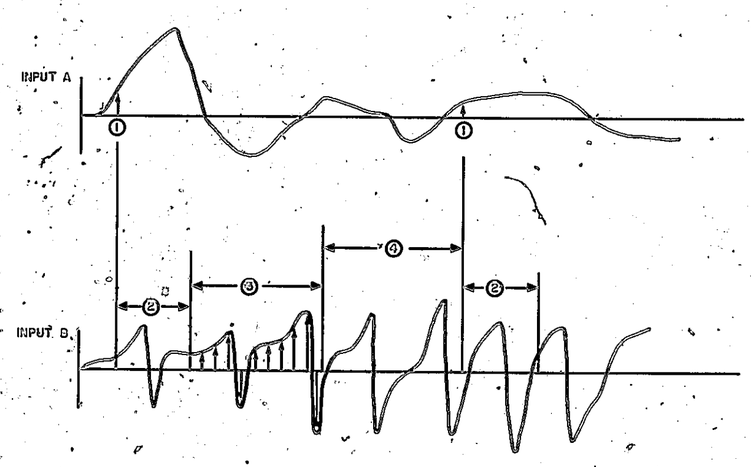
$\omega_2 t$ = frequency of one input B component.

*Output occurs only when $\omega_1 t = \omega_2 t$

In a general sense, what the 5488A does is slide the Input B signal past the Input A signal and indicate any points of similarity between them. The SWEEP TIME switch calibrates the time interval in delay/cm between the occurrence of some signal component at the Channel A input and the occurrence of the same signal component at the Channel B input. A periodic cross- or auto-correlation function indicates that some component of both input signals is repeated after a time interval corresponding to the period of that component.

A positive peak in the correlation function indicates that the similar components of the two input signals are in phase (at the indicated time delay); a negative peak indicates that the components are 180 degrees out-of-phase (at the indicated delay). Amplitude of any point in the correlation function is the average of the product of the correlation coefficients for that delay. A point on the correlation baseline indicates either: 1) there are no common signal components having a period less than ten times the SWEEP TIME (delay time/cm) setting; or 2) at the given delay time between the two signals, the similar components are ±90 degrees out-of-phase.

Table 2-23. Correlation (Cont'd)



NOTES:

1. Input A is sampled once, at the beginning of each process sweep
2. After a time determined by the PRE-ANALYSIS DELAY setting, the Correlator begins processing Input B.
3. The Correlator processes 1000 (500, or 250) samples of Input B during each sweep. The digital value of each sample of B is multiplied by the digital value of A sampled at the beginning of that sweep. Sampling is not synchronized to either input signal. The product of each multiplication of A and B is converted to an analog level, compared with the analog value of the signal stored in memory, and the difference used to establish new memory contents for that point.
4. If desired, POST-ANALYSIS DELAY can be used to increase the time between the end of one process sweep and the next sampling of Input A.

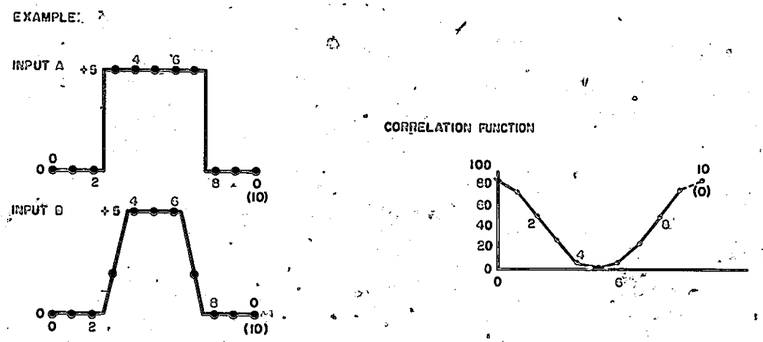
The SWEEP NUMBER switch determines how many process sweeps (how many Input A samples are used in determining the correlation function. MEMORY SELECTOR switches determine how many samples of Input B are used in determining the correlation function (FULL = 1000 points/sweep, HALF = 500 points/sweep, QUARTER = 250 points/sweep). The SWEEP TIME switch determines how often samples of Input B are taken (and, therefore, how often samples of Input A are taken).

METHOD

The 5480A/B system averages the correlation coefficient for 1000 (or 500 or 250) sampled points. The correlation coefficient for each point is the product of a sample of input signal A multiplied by each sample of input signal B. For example, consider the autocorrelation function of the signal below.

Table 2-23. Correlation (Cont'd)

EXAMPLE:



This example is not an exact duplication of the correlation process performed in the 5488A. The example does not provide weighting of the input signal correction factor as performed by the average program, nor does it perform random sampling as is done in actual practice.

INPUT A and INPUT B have the same frequency, and are repeated (point 10 and point 0 are the same point).

During Sweep Number	The value of INPUT A point	is multiplied by the values of INPUT B points (in order) in this example only)	giving the values below for the correlation function points 0 through 9
1	0	0-9	0 0 0 0 0 0 0 0 0 0
2	1	1-0	0 0 0 0 0 0 0 0 0 0
3	2	2-1	0 0 0 0 0 0 0 0 0 0
4	3	3-2	10 15 15 15 10 0 0 0 0 0
5	4	4-3	25 25 25 10 0 0 0 0 0 10
6	5	5-4	25 25 10 0 0 0 0 0 10 25
7	6	6-5	25 10 0 0 0 0 0 10 25 25
8	7	7-6	10 0 0 0 0 0 10 15 15 15
9	8	8-7	0 0 0 0 0 0 0 0 0 0
10	9	9-8	0 0 0 0 0 0 0 0 0 0
The sum of the values in each column represents the correlation coefficient of the above two input signals.			95 75 50 25 10 0 10 25 50 75

CORRELATION COEFFICIENT GENERATOR ASSEMBLY. This assembly has two buffer-storage registers, a gray code to weighted binary code converter, a digital multiplier, and digital-to-analog converter. The gray code representation of the channel A input is gated in to Buffer Register A; the representation of the B input is gated in to Buffer Register B. The output of each register is converted to a 4-line binary representation that includes sign and magnitude information. The two four-line signals are multiplied together to produce an 8-line output that is converted to an analog voltage.

In the Sample and Hold Assembly, the analog output from the correlation coefficient generator is averaged with the previous value stored in memory for that point in the correlation, and the difference between these signals used to form the new average value for that point. From this point in the circuit, there is no difference between correlation and averaging.

Table 2-23. Correlation (Cont'd)

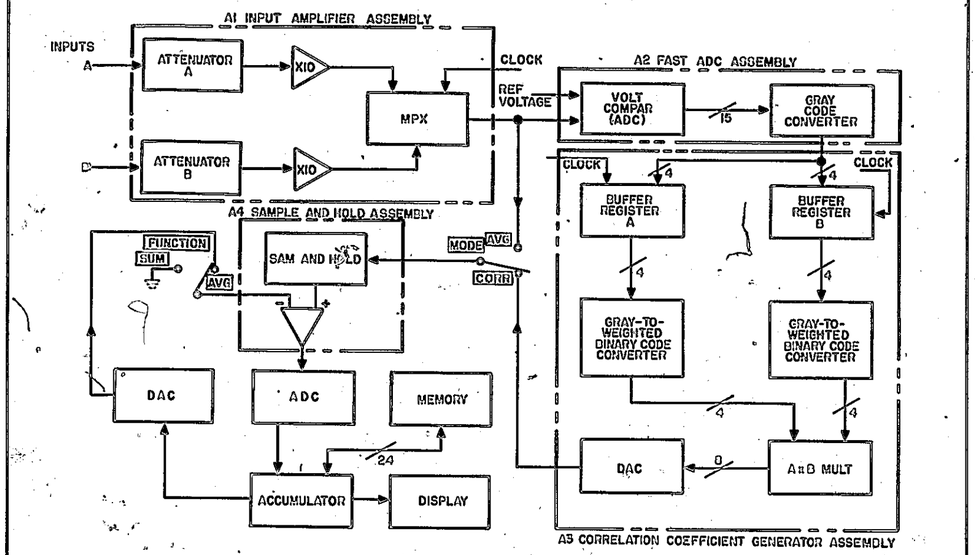
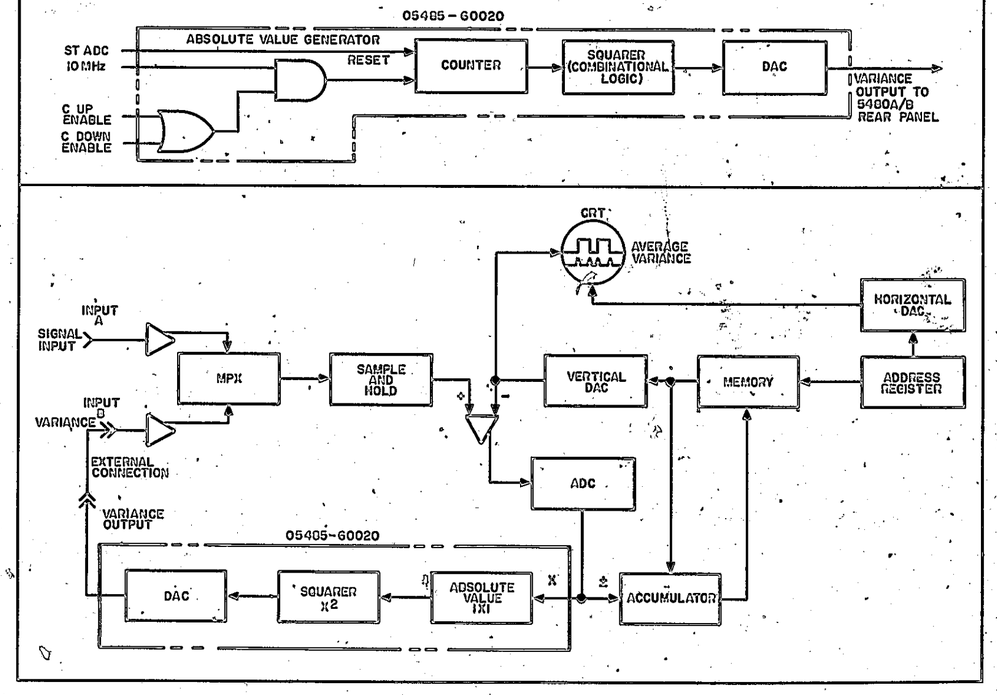


Table 2-24. Variance

The variance is defined as the average of the square of the deviation from the mean. The variance signal is formed in much the same way as the average signal is. The average signal is formed by splitting the incoming signal into equal time increments and forming the average over successive sweeps of each one of these time increments; each time increment is represented by a dot in the Signal Analyzer display. The variance is formed by comparing each successive input for each of the time increments against the stored average value for the same point, and squaring the difference between them. By time-locking the variance signal to the average signal, points in the variance signal are easily used to identify points in the average waveform where there is additional activity at the input, other than random noise.

The variance is formed by gating a 10 MHz clock signal into the counter in the Absolute Value Generator, using the Count Up Enable or Count Down Enable signal from the ADC as the gate control. When the Signal Analyzer is averaging, as it must be doing, to use the Variance Option, the ADC digitizes the difference between the analog input signal and the analog value of the average, which is stored in memory. Thus, the counter in the Absolute Value Generator contains a count which is proportional to the magnitude of the difference signal, but which is without any sign (polarity) information. The output of the Absolute Value Generator is squared, digitally, then converted into an analog signal, using an 8-bit Digital-to-Analog Converter (DAC). The DAC output is the signal that appears at the 5480A/B rear-panel VARIANCE OUTPUT connector. The Variance Output signal contains noise, and must be averaged to yield meaningful results.

If the Signal Analyzer is operating in the SUMMATION FUNCTION, the Variance Output signal is <u>not</u> the variance of the input signal, it is, instead, the square of the input signal. This property is useful in verifying that the variance is operating properly. If a triangular wave is put into one input while the 5480A/B is summing (instead of averaging), the Variance Output signal, averaged on another channel, should be a repetitive paraboloid of twice the input signal frequency. Peaks of the paraboloid will be of uniform amplitude only if BASELINE ADJUST has been adjusted to be at the center of the triangular input waveform.



PERFORMANCE CHECK

SECTION III

OPERATIONAL CHECKS AND ADJUSTMENTS

3-1. GENERAL

3-2. This section contains Operational Check and Adjustment information for all standard 5480A/B Signal Analyzer Systems. The procedure for each of these operations is in a separate table.

3-3. CALIBRATION AND ADJUSTMENTS

3-4. The Calibration and Adjustments table (Table 3-1) lists equipment required, calibration procedures, and adjustment locations for all standard 5480A/B Signal Analyzer Systems. Adjustment locations are shown in photographs at the end of the table.

3-5. OPERATIONAL CHECKS

3-6. The Operational Checks table (Table 3-2) lists equipment required, and procedures to be used to check 5480A/B operational characteristics.

Table 3-1. Calibration and Adjustments

This table lists equipment and methods required to perform the Calibration and Adjustments for the 5480A/B Signal Analyzer System, including plug-in units. Before beginning the procedure, refer to Section I of this manual for a discussion of operating controls for the 5480A/B Signal Analyzer System.

This table is organized in two sections:

A. Test equipment required

B. Procedure: describing adjustments, including adjustment and test point locations, and pertinent waveforms. Calibration and adjustment procedures for the 5485A, 5487A, or 5488A Analog plug-in units are covered in Section B (6), (7), (8), respectively. A variance test (for Option 001) is covered in Section 9. There are no adjustments for the 5486A/B. Adjustment location photographs are provided at the end of this table.

A. TEST EQUIPMENT REQUIRED

Type/Minimum Characteristics	Recommended Instrument
	NOTES: 1. Hewlett-Packard instrument, unless other manufacturer listed. 2. Other equipment may be used, if it has required minimum characteristics for test being performed.
Digital Voltmeter Range: ±200 Vdc; Resolution = 10 mV.	Model 3440A with Model 3441A Range Selector Plug-in
Oscilloscope Bandwidth = 20 MHz; Sensitivity: .005V/cm (10:1 Probe) Sweep Time: 0.1 μs/cm	Model 180A with Model 1801A Dual Channel Vertical Amplifier and Model 1820A Time Base Plug-ins
Voltmeter Calibrator Range: .05V, min, 20V, max; Accuracy: .2%; AC and DC preferred with calibrated peak-to-peak AC output. Frequency: 400 Hz (Nominal) Substitution of DC levels for gain adjustments and a Test Oscillator (after its output is calibrated) for Dynamic Range and Overload is permissible. The 1.0V CALIBRATOR output from the 5480A is also usable, after adjustment, for gain tests if appropriate SENSITIVITY settings are used.	Model 738BR
Extender Cable Set	05480-60050
Voltmeter Range: -3000 Vdc	Model 412A with High Voltage Probe.

Table 3-1. Calibration and Adjustments (Cont'd)

B. PROCEDURE

This procedure includes all adjustments in the 5480A/B, 5485A, 5487A, and 5488A; the 5486A/B has no adjustments. For best results, the sequence of adjustments should be performed exactly as listed.

1. Preliminary

   a. Before connecting ac power, remove top cover and left-hand side cover.

   b. Set controls as follows:

   5486A/B:

   FUNCTION to AVERAGE

   TRIGGER SOURCE to INTERNAL

   PRE-ANALYSIS DELAY to "0"

   POST-ANALYSIS DELAY to OFF

   SWEEP NUMBER to "0"

   PRESET/NORMAL to NORMAL

   SWEEP TIME to 2 msec/cm

   SENSITIVITY MULTIPLIER to AUTO

   PRESET TOTALIZER to OFF

   5480A/B Front:

   MAGNIFIER to X1

   5480A/B Rear:

   SCALE CAL to OFF

   DISPLAY INTERLACE to IN

   5485A, 5487A, or 5488A:

   DISPLAY to DATA (all channels)

   AC/GND/DC to GND (all inputs)

   HISTOGRAM to OFF

   All SENSITIVITY switches to .2V/cm

   All SENSITIVITY VERNIERS to CAL

   5485A only:

   A MEMORY SELECTOR to HALF 3, 4

   B MEMORY SELECTOR to HALF 1, 2

   ALT/A+B to ALT

Table 3-1. Calibration and Adjustments (Cont'd)

B. PROCEDURE (Cont'd)

1. Preliminary (Cont'd)

b. Set controls as follows: (Cont'd)

5487A only:

ON/OFF to ON (all channels)

MEMORY to QUARTER

5488A only:

A MEMORY SELECTOR to HALF 3, 4

B MEMORY SELECTOR to HALF 1, 2.

MODE (AVG/CORR) to AVG

c. Check for correct line fuse and line voltage switch setting, see Item 16, Figure 1-2, then connect Signal Analyzer System to ac line.

d. For access to power supply test points and adjustments, loosen two captive screws holding memory deck at right-hand front of instrument. Swing memory deck all the way open, so it rests on rear panel.

2. Power Supplies

a. Turn ac POWER on. (Line voltage must be 102–128 VAC.) Observe that:

POWER lamp is lighted.

RESET lamp is off.

PROCESS STOP pushbutton is lighted.

b. Press both CLEAR DISPLAY pushbuttons. Observe that OUTPUT DISPLAY pushbutton lights.

c. Adjust A POSITION and B POSITION (5487A also adjust C and D POSITION) so there is a trace on-screen for each control. Position traces so they are separated vertically for easy viewing.

d. Make power supply adjustments in order listed in chart on the following page.

e. Adjust Intensity Limit (A1A4R14) so traces go off when INTENSITY control arrow is between 9:30 and 10 o'clock positions.

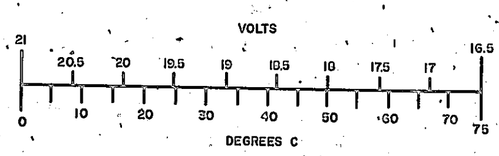
f. Adjust astigmatism (A1A4R17A) and FOCUS controls for best overall focus and clarity of CRT traces.

Table 3-1. Calibration and Adjustments (Cont's)

B. PROCEDURE (Cont'd)

SUPPLY VOLTAGE (TOLERANCE)	TEST POINTS	ADJUSTMENT
+12V (±50 mV)	Terminal Board in Power Supply Section	A5A1R15
+5V (±50 mV)		A5A1R33
-7.5V (±50 mV)		A5A1R42
-12V (±50 mV)		A5A1R10
+19.5V (±20 mV) NOTE		A2A11R35
-19.5V (±20 mV) NOTE		A2A11R38
48.5V (50V Nominal)		A5A2R15*
-48.5V (50V Nominal)		A5A2R18*
+200V (must be at least +175V)		None
-2950V (Do not use 3440A)	CRT Cathode	A1A4R17B
-3000V (approx.) Do not use 3440A.	CRT Grid	None

NOTE: 19.5V supplies may be adjusted in either order. These supplies are temperature-compensated, and will drift as temperature changes. The graph below shows voltage-versus-temperature characteristics of these supplies.



*Series 928 and above only. No adjustment on lower numbered instruments.

Table 3-1. Calibration and Adjustments (Cont'd)

B. PROCEDURE (Cont'd)

3. Calibrator

The Calibrator output can be used in several adjustments in the Analog plug-in; make this adjustment carefully.

a. Set SWEEP TIME to 5 sec/cm.

b. Monitor CALIBRATOR output with Digital Voltmeter. Observe both low and high portions of signal. CALIBRATOR signal is referenced to ground through a saturated transistor, so the low portion will be up to 20 mV away from ground. Note the low voltage and adjust A1A2R4 so the high output is 1 ±0.005V more positive than the low level.

4. Digital-to-Analog Converters (DACs)

a. Adjust A2A10R96 (Gain) and A2A10R104 (Balance) to give a swing between +2V and -2V (±20 mV) at A2A10A(B) when Scale Cal Switch is moved between Full and Zero positions.

b. Adjust A2A9R95 (Gain) and A2A9R103 (Balance) for a swing between 0V and +10V (±20 mV) at A2A9A(B) when Scale Cal is switched between Zero and Full.

c. Set Scale Cal of Off.

5. Time Base, 20 MHz Clock

(Not required for 5480A/B Serial Nos. 928-00176 and higher)

a. Install extender board for A2A12.

b. Connect Oscilloscope to A2A12(2).

c. Adjust A2A12R12 for best symmetry of 20 MHz signal.

d. Replace Oscilloscope at A2A12(2) with Electronic Counter.

e. Adjust A2A12C8 for 20 MHz ±0.001 MHz (0.005%) or better.

6. 5485A Analog Plug-In Circuits

(See Section 7 for 5487A procedure or Section 8 for 5488A procedure.)

a. Prepare for testing as follows:

Turn POWER off.

Remove 5485A from its compartment in 5480A/B.

Remove 5485A top and bottom covers.

Connect 5485A to 5480A/B using 05480-60050 Extender Cable Set. Be sure plugs and connectors are matched so J25 goes to P25, etc.

Turn POWER on.

Table 3-1. Calibration and Adjustments (Cont'd)

B. PROCEDURE (Cont'd)

6. 5485A Analog Plug-In Circuits (Cont'd)

b. Set Controls as in Step 1b, then set trigger source to EXTERNAL +.

SWEEP TIME to 5 msec/cm

A POLARITY to UP+

B POLARITY to -UP

A SENSITIVITY to .1V/cm

B SENSITIVITY to .1V/cm

A AC/GND/DC to DC

B AC/GND/DC to DC

Channel A MEMORY SELECTOR to FULL

Channel B MEMORY SELECTOR to FULL

c. Input Amplifier: Gain, Balance.

1) Set 738 Voltmeter Calibration to .5V peak-to-peak output.

2) Connect 180A Oscilloscope to Voltmeter Calibrator and adjust for full-screen display of signal.

3) Connect Voltmeter Calibrator to 5485A Channel A and Channel B INPUTS, and to TRIGGER INPUT, and connect Oscilloscope to A1(1).

4) Adjust A1R24 ("A" Gain) for the same deflection as in 2) within ±2%.

5) Set ALT/A+B to A+B.

6) Adjust A1R75 ("B" Gain) for minimum signal at A1(1).

7) Switch both AC/GND/DC to GND.

8) Change SWEEP TIME to 2 SEC/CM and remove Voltmeter Calibrator inputs.

9) Set B POLARITY to UP+.

10) Set ALT/A+B to ALT.

11) Press both CLEAR DISPLAY buttons, then PROCESS START.

12) As process sweep moves across screen, switch A POLARITY between UP+ and -UP. Adjust A1R19 for minimum offset in trace.

13) Turn Channel A DISPLAY to OFF.

14) Press both CLEAR DISPLAY buttons, then PROCESS START.

15) As process sweep moves across screen, switch B POLARITY between UP+ and -UP. Adjust A1R70 for minimum offset in trace.

16) Set Channel A DISPLAY to DATA.

Table 3-1. Calibration and Adjustments (Cont'd)

B. PROCEDURE (Cont'd)

6. 5485A Analog Plug-In Circuits (Cont'd)

d. Input Attenuators: Check Accuracy

1) Set Voltmeter Calibrator for .0.5V peak-to-peak output at 400 Hz. Connect Oscilloscope to 738BR Voltmeter Calibrator output and adjust sensitivity controls for a one-half screendsplay. Reduce Calibrator to .05V output.

2) Disconnect Oscilloscope from Voltmeter Calibrator.

3) Connect Oscilloscope to 5485A A1(1).

4) Connect Voltmeter Calibrator to 5485A Channel A INPUT (or other channel under test) and TRIGGER SOURCE input.

5) Switch Channel A SENSITIVITY through all positions as necessary, starting from .005V/cm, while increasing Voltmeter Calibrator output to correspond with the Sensitivity. Observe amplitude of Oscilloscope for full screen display.* Do not change Oscilloscope sensitivity settings. Each SENSITIVITY range should be within ±2% of its nominal value.

6) Return Voltmeter Calibrator to 0.05V output.

7) Set Channel A DISPLAY to OFF.

8) Repeat steps 5 and 6 for Channel B.

9) Remove Voltmeter Calibrator inputs.

e. Balance and Scale Calibration

1) Set controls as follows: ALT/A+B to A+B
TRIGGER SOURCE to INTERNAL
AC/GND/DC to GND
Channel A DISPLAY to ON

2) Press both CLEAR DISPLAY buttons, then PROCESS START. Adjust front-panel DC BAL A+B for minimum offset in trace. (Use first sweep only. If more than one sweep is required, press CLEAR DISPLAY and PROCESS START buttons each time adjustment is made.)

3) Set ALT/A+B to ALT. Press both CLEAR DISPLAY buttons, then PROCESS START.

4) Adjust DC BAL A for minimum offset in trace. (Use first sweep only. If more than one sweep is required, press CLEAR DISPLAY and PROCESS START buttons each time adjustment is made.)

5) Turn Channel A DISPLAY to OFF. Press both CLEAR DISPLAY buttons, then PROCESS START.

6) Adjust DC BAL B for minimum offset in trace. (Use first sweep only. If more than one sweep is required, press CLEAR DISPLAY and PROCESS START buttons each time adjustment is made.)

7) Press both CLEAR DISPLAY pushbuttons.

8) Connect Digital Voltmeter to A2(11). This is signal from Vertical Digital-to-Analog Converter (DAC) output. Signal level should be 0V ±10 mV and change from +2V ±10 mV to -2V ±10 mV as SCALE CAL (rear panel) is switched from FULL to ZERO. Repeat Vertical DAC Gain and Balance adjustments (step 4. a.), if necessary.

*Note: Gain of amplifier being tested is 20.

Table 3-1. Calibration and Adjustments (Cont'd)

B. PROCEDURE (Cont'd)

6. 5485A Analog Plug-In Circuits (Cont'd)

e. Balance and Scale Calibration (Cont'd)

9) Set SCALE CAL (rear panel) to OFF.

10) Adjust DAC buffer amplifier DC Balance (A2R67) to give 0V at A2(14), measured with Digital Voltmeter.

11) Set SCALE CAL to FULL. Adjust DAC buffer amplifier Gain A2R54 for +2V ±10 mV at A2(14).

12) Repeat steps 10 and 11 several times until correct values are obtained.

13) Observe that voltage at A2(14) swings from +2V ±10 mV, to 0V ±10 mV, to -2V ±10 mV as SCALE CAL is switched from FULL, to OFF, to ZERO.

14) Switch SCALE CAL to OFF.

15) Connect Digital Voltmeter to A5(18).

16) Adjust Channel B POSITION for 0V ±20 mV at A5(18).

17) Observe that voltage at A5(18) (or OUTPUT Y, rear panel) changes 8V ±40 mV (+4V to -4V) as SCALE CAL is switched between FULL and ZERO. Adjust A5R73, if necessary, for proper output swings.

18) Set SCALE CAL to ZERO.

19) Using HORIZONTAL POSITION and Channel B POSITION controls, position dot at lower left-hand corner of 5480A CRT graticule.

20) Switch SCALE CAL to FULL.

21) Note position of dot. Adjust Vertical and Horizontal Gain controls on 5480A/B A1A1 (A1A1R33 and A1A1R48, respectively) to move dot halfway from this position to upper right-hand corner of CRT graticule.

22) Repeat steps 18 through 21 until dot moves between lower left-hand and upper right-hand CRT graticule corners when SCALE CAL is switched from ZERO to FULL, and without adjustment of Gain or Position controls.

23) Set controls as follows:

SCALE CAL to OFF
Channel A DISPLAY to INPUT
Channel A SENSITIVITY to .1V/cm
Channel A AC/GND/DC to DC
SWEEP TIME to 5 msec/cm
TRIGGER SOURCE to EXTERNAL +

24) Adjust the 738BR Voltmeter Calibrator to .8V peak-to-peak output and connect to Channel "A" INPUT.

25) Press PROCESS START and observe 5480 CRT. Adjust Sample and Hold Gain (A2R49) for Vertical deflection of 8 cm ±2% (0.16 cm).

Table 3-1. Calibration and Adjustments (Cont'd)

B. PROCEDURE (Cont'd)

6. 5485A Analog Plug-In Circuits (Cont'd)

e. Balance and Scale Calibration (Cont'd)

26) Set controls as follows:

PRESET/NORMAL to PRESET
SWEEP NUMBER to "0"
SWEEP TIME to 5 msec/cm
Channel A DISPLAY to DATA
MAGNIFIER to X5

27) Press both CLEAR DISPLAY buttons, then press PROCESS START. Initially adjust ADC gain (A3R9) for 8 cm vertical deflection.

28) Adjust ADC Gain for minimum change in signal amplitude on second sweep.

29) CLEAR DISPLAY and repeat 28) until there is no discernible change between first and second sweeps.

f. Overload

1) Set controls as follows:

MAGNIFIER to X1
PRESET/NORMAL to NORMAL
Channel A SENSITIVITY to .1V/CM
SWEEP TIME to 5 msec/cm
SWEEP NUMBER to 3
FUNCTION to AVERAGE
A and B SENSITIVITY VERNIERS full CCW

2) Apply a 5V peak-to-peak Voltmeter Calibrator signal to Channel A INPUT.

3) Check CRT display for a stable square wave with no random dots moving on screen. Waveform amplitude should be < 5 cm. Check Waveform at 2 msec/cm and 1 msec/cm SWEEP TIMEs. Period of 400 Hz Voltmeter Calibrator signal is 2.5 msec; thus, display will appear as a clipped sine wave with this period.

g. Dynamic Range

1) Set Channel A controls as follows:

SENSITIVITY VERNIER to CAL
SENSITIVITY to .1V/CM
POLARITY to UP+

Push both CLEAR/DISPLAY buttons. Use A POSITION to place baseline on bottom line of CRT graticule.

2) Set Voltmeter Calibrator to 1V peak-to-peak output.

Table 3-1. Calibration and Adjustments (Cont'd)

B. PROCEDURE (Cont'd)

6. 5485A Analog Plug-In Circuits (Cont'd)

g. Dynamic Range (Cont'd)

3) Push PROCESS START. Maximum of CRT display of signal should be greater than 5.5 cm from baseline. You may place the baseline in 1, 2 memory and Signal in 3, 4 Memory then switch Display to Full Memory.

4) Push CLEAR DISPLAY buttons and set baseline at top graticule line with A POSITION control. Change A POLARITY to -UP. Push PROCESS START, Maximum of CRT display of signal should be greater than 5.5 cm below baseline position.

h. Baseline

1) Set controls as follows:

DC/GND/AC to GND
FUNCTION to SUMMATION
SWEEP TIME to 1 sec/cm

2) Press both CLEAR DISPLAY pushbuttons, then PROCESS START.

3) Adjust BASELINE for no offset in trace. Use 1 sweep only, if more than one sweep is required, repeat step 2) each time adjustment is made. (Note: If bipolar signals are going to be summed, it may be desirable to purposely offset the baseline so cumulative zero crossing errors are not present in the summed waveform.)

i. Separation

1) Set Channel A MEMORY SELECTOR to OVERLAP.

2) Press OUTPUT DISPLAY.

3) CRT display should show four traces, each less than 1 mm wide. Each pair of traces is controlled by one of the vertical POSITION controls. Adjust the Separation control (A5R81) for 1 cm separation between the pair of traces controlled by each POSITION control (both pairs of traces should be affected equally). Wider separation may be set, if desired.

j. X5 MAGNIFIER (Display Section Adjustments)

1) Set Channel A MEMORY SELECTOR for any one QUARTER.

2) Press both CLEAR DISPLAY pushbuttons.

3) CRT display for Channel A will be a trace with 25 points per cm.

4) Switch MAGNIFIER to X5. Adjust A1A1R47, Magnifier gain, for 5 points per cm; compromise adjustment as necessary to give an optimum trace of 50 points for 10 cm.

NOTE: This completes adjustment of the Signal Analyzer system using the 5485A plug-in; there are no adjustments in the 5486A Plug-in or other logic circuits. For units containing Variance Option 001, perform test described in Section 9. There are no Variance adjustments.

Table 3-1. Calibration and Adjustments (Cont'd)

B. PROCEDURE (Cont'd)

7. 5487A Four-Channel Analog Plug-In Circuits

a. Turn POWER off.

b. Remove 5487A from its compartment in 5480A/B.

c. Remove top and bottom covers.

d. Connect 5487A to 5480A/B using 05480-60050 Extender Cable Set. Be sure P25, P26, and P27 are properly matched to their mating connectors to the 5480A/B.

e. Turn POWER on.

f. Set controls as in Section 1b, then set:

5486A/B:

SWEEP TIME to 1 sec/cm

5487A:

All SENSITIVITY VERNIER controls to CAL
All SENSITIVITY switches to .1V/cm
All AC/GND/DC switches to DC

g. Press CLEAR DISPLAY then PROCESS START.

h. Adjust Channels A through D, in turn, for minimum offset during first sweep. Press CLEAR DISPLAY then PROCESS START for each. Controls on board A1 for each channel are: A(A1R5), B(A1R6), C(A1R7), D(A1R8), from left to right (front view).

i. Input Attenuators: Accuracy

1) Set 5487A MEMORY to FULL.

2) Set 5486A SWEEP TIME to 5 msec/cm.

3) Set 738BR Voltmeter Calibrator for 0.5 peak-to-peak at 400 Hz. Connect Oscilloscope to Voltmeter Calibrator output and adjust sensitivity controls for one-half screen display of the 0.5V signal.

4) Disconnect Oscilloscope from Calibrator and connect to 5487A A1(1).

5) Connect Voltmeter Calibrator to Channel A INPUT (or other channel under test).

6) Switch Channel A SENSITIVITY through all positions, starting from 0.05V/cm, while increasing Voltmeter Calibrator output to correspond with the Sensitivity. Input amplifier gain of the 5487A is 2. Observe amplitude for full screen display on the Oscilloscope. (Do not change Oscilloscope sensitivity setting.) Each SENSITIVITY range should be within 2% of its nominal value.

7) Return Voltmeter Calibrator to 0.5V output.

8) Switch Channel A ON/OFF to OFF and repeat steps 6 and 7 for Channel B.

9) Switch Channel B ON/OFF to OFF and repeat Steps 6 and 7 for Channel C.

10) Switch Channel C ON/OFF to OFF and repeat Steps 6 and 7 for Channel D.

Table 3-1. Calibration and Adjustments (Cont'd)

B. PROCEDURE (Cont'd)

7. 5487A Four-Channel Analog Plug-In Circuits (Cont'd)

j. Scale Calibration

1) Set AC/GND/DC to GND. Push CLEAR DISPLAY.

2) Connect Digital Voltmeter to A2(11). This signal is the Vertical Digital-to-Analog Converter (DAC) output. Signal level should be 0V ±10 mV at SCALE CAL OFF. As SCALE CAL (rear panel) is switched from FULL to ZERO, this voltage changes from +2V ±10 mV to -2V ±10 mV. If not, repeat Vertical DAC Gain and Balance adjustments (Step 4. a.).

3) Set SCALE CAL (rear panel) to OFF.

4) Adjust DAC buffer amplifier DC Balance (A2R67) to give 0V at A2(14), measured with Digital Voltmeter.

5) Set SCALE CAL to FULL. Adjust DAC buffer gain (A2R54) for +2V ±10 mV at A2(14).

6) Repeat steps 3, 4, and 5 several times until correct values are obtained.

7) Observe that voltage at A2(14) swings from +2V ±10 mV to -2V ±10 mV as SCALE CAL is switched from FULL, to OFF, to ZERO.

8) Switch SCALE CAL to OFF.

9) Connect Digital Voltmeter to A5(21).

10) Adjust Channel D POSITION for 0V ±20 mV at A5(21).

11) Observe that voltage at A5(21) changes 8V ±40 mV (+4V to -4V) as SCALE CAL is switched from FULL to ZERO. Adjust A5R102, if necessary, for proper output swings.

12) Set SCALE CAL to ZERO.

13) Using HORIZONTAL POSITION and Channel D POSITION controls, position dot at lower left hand corner of 5480A CRT graticule.

14) Switch SCALE CAL to FULL.

15) Note position of dot. Adjust Vertical and Horizontal Gain Controls on 5480A/B A1A1 (A1A1R33 and A1A1R48, respectively) to move dot halfway from this position to upper right hand corner of graticule.

16) Repeat steps 13, 14, and 15 as often as necessary until dot moves from lower left-hand to upper right-hand corners of the graticule as SCALE CAL is moved from ZERO to FULL, without adjustment to Vertical and Horizontal position controls.

17) Set controls as follows:

SCALE CAL to OFF
DISPLAY to INPUT
Channel A SENSITIVITY to .1V/cm
Channel A AC/GND/DC to DC
TRIGGER SOURCE to EXTERNAL +
SWEEP TIME to 5 msec/cm
Set all Channel ON/OFF switches to ON

Table 3-1. Calibration and Adjustments (Cont'd)

B. PROCEDURE (Cont'd)

7. 5487A Four-Channel Analog Plug-In Circuits (Cont'd)

j. Scale Calibration (Cont'd)

18) Adjust the 738BR Voltmeter Calibrator to .8V output and connect to Channel A INPUT and TRIGGER SOURCE input.

19) Press PROCESS START, adjust TRIGGER and observe 5480A/B CRT. Adjust Sample and Hold Gain (A2R49) for Vertical Deflection of 8 cm ±2% (0.1 cm).

20) Set controls as follows:

PRESET/NORMAL to PRESET
SWEEP NUMBER to 0
MAGNIFIER to X5
DISPLAY to DATA

21) Press both CLEAR DISPLAY buttons, then press PROCESS START. Initially adjust ADC gain (A3R9) for 8 cm vertical deflection.

22) Press CLEAR DISPLAY buttons then PROCESS START.

23) Adjust ADC gain (A3R9) for minimum change in signal amplitude on second sweep.

24) Check that amplitude change between first and second sweep is negligible. If not, repeat steps 22 and 23.

k. Overload

1) Set controls as follows:

MAGNIFIER to X1
PRESET/NORMAL to NORMAL
Channel A SENSITIVITY to .1V/cm
SWEEP TIME to 2 msec/cm
SWEEP NUMBER to 3
A SENSITIVITY VERNIER full CCW

2) Set Voltmeter Calibrator to 5V peak-to-peak.

3) Check CRT display for a stable square wave with no random dots moving on screen. Waveform amplitude should be < 5 cm. Check also at 2 msec/cm and 1 msec/cm SWEEP TIMES. (Period of 400 Hz Voltmeter Calibrator signal is 2.5 msec; thus display will appear as a clipped sine wave of this period.)

l. Dynamic Range

1) Set Channel A controls as follows:

SENSITIVITY VERNIER to CAL
DC/GND/AC to DC
TRIGGER SOURCE to INTERNAL

Table 3-1. Calibration and Adjustments (Cont'd)

B. PROCEDURE (Cont'd)

7. 5487A Four-Channel Analog Plug-In Circuits (Cont'd)

l. Dynamic Range (Cont'd)

2) Apply to Channel A input 1V peak-to-peak from Voltmeter Calibrator.

3) Press both CLEAR DISPLAY buttons and position baseline on lowest horizontal graticule line.

4) Push PROCESS START.

5) Top of display should be 5.5 cm or more above previously set baseline level.

6) Again push both CLEAR DISPLAY buttons.

7) Position baseline along top horizontal graticule line.

8) Push PROCESS START. Observe if maximum of waveform is over 5.5 cm below the baseline position.

m. Baseline

1) Set controls as follows:

DC/AC/GND to GND
FUNCTION to SUMMATION
SWEEP TIME to 1 sec/cm

2) Press CLEAR DISPLAY pushbutton then PROCESS START.

3) Adjust BASELINE (front panel) for no offset in trace. Use one sweep only, if more than one sweep is required, repeat step 2 each time adjustment is made. (NOTE: If bipolar signals are to be summed it may be desirable to purposely offset the baseline to avoid cummulative zero crossing errors.)

n. X5 Magnifier (Display Section Adjustments)

1) Set Channel A MEMORY SELECTOR for any one QUARTER.

2) Press both CLEAR DISPLAY PUSHBUTTONS.

3) CRT display for CHANNEL A will be a trace with 25 points per cm.

4) Switch MAGNIFIER to X5. Adjust A1A1R47, Magnifier gain, for 5 points per cm; compromise adjustment as necessary to give an optimum trace of 50 points for 10 cm.

NOTE: This completes adjustment of the Signal Analyzer System using the 5487A plug-in. There are no adjustments to the 5486A/B Plug-in or other logic circuits. For units containing Variance Option 001, perform test described in Section 9. There are no Variance adjustments.

Table 3-1. Calibration and Adjustments (Cont'd)

B. PROCEDURE (Cont'd)

8. 5488A Correlation Analog Plug-In Circuits

a. Prepare for testing as follows:

Turn POWER off.

Remove 5488A from Plug-in Compartment

Remove 5488A top cover.

Connect 5488A to 5480A/B using 05480-60050 Extender Cable Set. Be sure the plugs and jacks are matched so J25 connects to P25, etc.

Turn POWER on.

b. Set controls as in Step 1b, then set:

SWEEP TIME to 5 msec/cm
A SENSITIVITY to .05V/cm
B SENSITIVITY to .05V/cm
A AC/GND/DC to DC
B AC/GND/DC to DC
Channel A MEMORY SELECTOR to FULL
Channel B MEMORY SELECTOR to FULL
MODE to AVG.

c. Input Amplifier: Gain, Balance

1) Set 738 Voltmeter Calibrator to .5V peak-to-peak 400 Hz output.

2) Connect 180A Oscilloscope to Calibrator and adjust for full-screen display of 400 Hz signal. Use DC Oscilloscope input.

3) Reduce Voltmeter Calibrator output to .05V.

4) Connect Voltmeter Calibrator to Channel A, Channel B, and to TRIGGER SOURCE.

5) Connect Oscilloscope to 5488A A1(22).

6) Press both CLEAR DISPLAY buttons then PROCESS START.

7) Adjust Channel A gain pot (A1R7) for the same full scale deflection on the Oscilloscope as in (2) above. Amplifier gain is 10.

8) Switch Channel A DISPLAY to OFF.

9) Press both CLEAR DISPLAY buttons then PROCESS START.

10) Adjust Channel B gain pot (A1R9) for the same full scale deflection on the Oscilloscope as in (2) above.

11) Set Channel A AC/GND/DC to GND.

12) Set Channel B AC/GND/DC to GND.

Table 3-1. Calibration and Adjustments (Cont'd)

B. PROCEDURE (Cont'd)

8. 5488A Correlation Analog Plug-In Circuits (Cont'd).

c. Input Amplifier: Gain, Balance (Cont'd)

13) Set 180A Sensitivity to .005V/cm, and center its trace with 0V input.

14) Reconnect Oscilloscope to A1(22). Adjust Channel B balance pot (A1R6) for minimum offset.

15) Set Channel A DISPLAY to DATA.

16) Adjust Channel A balance pot (A1R4) for minimum offset.

d. Balance, Scale Calibration

1) Set SWEEP SPEED to 1 sec/cm.

2) Press both CLEAR DISPLAY buttons, then PROCESS START.

3) Adjust DC BALANCE (front panel) for minimum discontinuity. (Use first sweep only.)

4) Set 5486A FUNCTION to SUMMATION.

5) Push both CLEAR DISPLAY buttons then PROCESS START.

6) Adjust BASELINE ADJ (Front panel 5488A) for minimum discontinuity on first sweep.

7) Set 5486A FUNCTION to AVERAGE, and set SWEEP TIME to 5 msec/cm.

8) Check that rear panel SCALE CAL is OFF.

9) Push both CLEAR DISPLAY buttons.

10) Connect Digital Voltmeter to 5488A A4(11, M) or VERTICAL DAC OUTPUT (rear panel). This is the Vertical DAC signal.

11) Signal level should be 0V ±10 mV and change from +2V ±10 mV to -2V ±10 mV as SCALE CAL is switched from FULL to ZERO. If not satisfactory, repeat Vertical DAC Gain and Balance adjustment (step 4a.)

12) Adjust A POSITION and HORIZONTAL POSITION to enter trace on middle graticule line. Trace width should be 10 cm ± .1 cm; if not, go back to step 4b.

13) Connect Digital Voltmeter to 5488A A7(18) or the VERTICAL SCOPE OUTPUT (rear panel).

14) Adjust A POSITION for 0V ±20 mV.

15) Check for voltage change from 0 to ±4V as SCALE CAL is switched from FULL to ZERO, respectively.

16) Adjust 5488A A7R73 (left pot.) to achieve the 8V swing, if necessary.

17) Set SCALE CAL to ZERO.

18) Using position controls, position dot at lower-left-hand corner of 5480A/B CRT graticule.

Table 3-1. Calibration and Adjustments (Cont'd)

B. PROCEDURE (Cont'd)

8. 5488A Correlation Analog Plug-In Circuits (Cont'd)

d. Balance, Scale Calibration (Cont'd)

19) Switch SCALE CAL to FULL

20) Note position of dot. Adjust Vertical and Horizontal Gain controls on 5480A/B A1A1 (A1A1R33 and A1A1R48, respectively) to move dot halfway from this position to upper right-hand corner of CRT graticule.

21) Repeat steps 17 through 20 until dot moves between lower left-hand and upper right-hand corners of the graticule when SCALE CAL is switched from ZERO to FULL, without adjustment of Gain and Position controls.

22) Set controls as follows:

PRESET/NORMAL to PRESET
TRIGGER SOURCE to EXTERNAL +
SWEEP NUMBER TO "0"
SWEEP TIME to 5 msec/cm
MAGNIFIER to X5
Channel A DISPLAY to DATA
Channel A SENSITIVITY to .2V/cm
Channel A AC/GND/DC to DC

23) Adjust 738BR Voltmeter Calibrator to .8V peak-to-peak.

24) Press both CLEAR DISPLAY buttons and PROCESS START.

25) Initially adjust ADC gain 5488A A5R9 for 8 cm vertical deflection.

26) Press both CLEAR DISPLAY buttons then PROCESS START.

27) Adjust ADC gain A5R9 for minimum change in amplitude between first and second sweep.

28) Repeat 26 and 27 as necessary until there is no observable difference in amplitude between first and second sweeps.

e. Overload

1) Set controls as follows:

MAGNIFIER to X1
PRESET/NORMAL to NORMAL
Channel A SENSITIVITY to .1V/cm
SWEEP TIME to 2 msec/cm
SWEEP NUMBER to 3
FUNCTION to AVERAGE
A and B SENSITIVITY VERNIERS full CCW

Table 3-1. Calibration and Adjustment (Cont'd)

B. PROCEDURE (Cont'd)

8. 5488A Correlation Analog Plug-In Circuits (Cont'd)

e. Overload (Cont'd)

2) Apply a 5V Voltmeter Calibrator signal to Channel A input.

3) Check CRT display for stable square wave with no random dots moving on screen.

4) Repeat 2 and 3 for Channel B (Period of 400 Hz Voltmeter Calibrator signal is 2.5 msec; thus display will appear as a clipped sinewave with this period.)

f. Dynamic Range

1) Set Channel A controls as follows:

POLARITY to UP+
SENSITIVITY VERNIER to CAL
SENSITIVITY to .1V/cm

2) Adjust Voltmeter Calibrator for 1V peak-to-peak output.

3) Push both CLEAR DISPLAY buttons.

4) Adjust baseline position at bottom graticule line.

5) Push PROCESS START.

6) Maximum amplitude of CRT display should be > 5.5 cm above bottom graticule line.

7) Push CLEAR DISPLAY buttons.

8) Adjust baseline position at top graticule line.

9) Push PROCESS START.

10) Maximum amplitude of CRT display should be > 5.5 cm below top graticule line.

g. Overlap Separation

1) Set Channel A MEMORY SELECTOR to OVERLAP

2) Push CLEAR DISPLAY buttons.

3) CRT display should show four traces, each less than 1 mm wide. There are two pairs of traces, each controlled by one vertical position control.

4) Adjust separation control 5488A A7R81 for 1 cm separation between the pairs. Wider separation may be set if desired.

h. Correlation

1) Set controls and switches as follows:

5480A/B (Front Panel): MAGNIFIER X1
5480A/B (Back Panel): INTERLACE DISPLAY to IN,
SCALE CAL to OFF.

Table 3-1. Calibration and Adjustment (Cont'd)

B. PROCEDURE (Cont'd)

8. 5488A Correlation Analog Plug-In Circuits (Cont'd)

h. Correlation (Cont'd)

1) Set controls and switches as follows: (Cont'd)

5486A same as in Section 1. b., except for the following:

SWEEP NUMBER to 10
SWEEP TIME to 2 ms/cm

5488A as follows:

A DISPLAY to INPUT
B DISPLAY to OFF
MEMORY SELECTOR to FULL (both channels)
HISTOGRAM to OFF
SENSITIVITY to .05V/cm (both channels)
SENSITIVITY VERNIER to CAL (both channels)
MODE to AVG
AC/GND/DC to GND (both channels)

2) Connect Voltmeter Calibrator to both Channel A and Channel B INPUTS.

3) Set Voltmeter Calibrator for .5V peak-to-peak output at 400 Hz.

4) Push both CLEAR DISPLAY buttons and adjust A POSITION for trace at center graticule line.

5) Set MODE to CORR.

6) Adjust 5488A A3R2 for minimum offset from center graticule line when MODE is switched back and forth.

7) Set A DISPLAY to DATA.

Set AC/GND/DC to DC (both channels).

8) Push both CLEAR DISPLAY buttons and PROCESS START.

9) Observe amplitude of display. It should be 2.5 cm ± .2 cm.

10) Set PRE-ANALYSIS DELAY to 1 msec.

11) Push both CLEAR DISPLAY buttons and PROCESS START.

12) Observe display. The amplitude again should be 2.5 cm with the first maximum at .75 cm ± .05 cm from left end of sweep.

i. X5 Magnifier

1) Set Channel A MEMORY SELECTOR for any one QUARTER.

2) Press both CLEAR DISPLAY pushbuttons.

Table 3-1. Calibration and Adjustment (Cont'd)

B. PROCEDURE (Cont'd)

8. 5488A Correlation Analog Plug-In Circuits (Cont'd)

i. X5 Magnifier

3) CRT display for Channel A will be a trace with 25 points per cm.

4) Switch MAGNIFIER to X5. Adjust A1A1R47, Magnifier gain, for 5 points per cm; compromise adjustment as necessary to give an optimum trace of 50 points for 10 cm.

NOTE: This completes adjustments of the 5480A/B Signal Analyzer System using the 5488A plug-in. There are no adjustments to the Process Plug-in or other logic circuits. For units containing the Variance Option 001, perform test described in Section 9. There are no variance adjustments.

9. Variance Test

(Test is valid only if Variance Option 001 is installed in the 5485A, 5487A, or 5488A Analog Plug-in.)

a. Set controls as follows:

1) 5486A: Same as in Section 1. b. except set TRIGGER SOURCE to EXTERNAL + and SWEEP NUMBER to 0.

2) 5480A/B: Same as in Section 1. b.

3) 5485A, 5487A, or 5488A

DISPLAY to DATA (Channels A and B)
AC/GND/DC to DC (Channels A and B)
HISTOGRAM to OFF
MEMORY SELECTOR to HALF (For 5485A and 5488A, select HALF 1, 2 for Channel A and HALF 3, 4 for Channel B.)
ALT/A+B to ALT (5485A only)
Channel A SENSITIVITY to .5V/cm
Channel B SENSITIVITY to .05V/cm
SENSITIVITY VERNIERS to CAL (Channels A and B)

5487A only:

All Channels ON/OFF switches to ON

4) Set Voltmeter Calibrator to 1 Vrms (≈3V peak-to-peak) and connect OUTPUT to Channel A INPUT and TRIGGER SOURCE INPUT.

5) With BNC-BNC cable, connect VARIANCE output on 5480A/B back panel to Channel B INPUT, on front panel.

Table 3-1. Calibration and Adjustment (Cont'd)

B. PROCEDURE (Cont'd)

9. Variance Test (Cont'd)

b, Test Procedure

1) Push CLEAR DISPLAY buttons and PROCESS START.

2) Observe Channel A signal trace and Channel B variance trace, which is virtually a straight line. Position traces for easy viewing.

3) Switch Voltmeter Calibrator to .1 Vrms output.

4) Watch B trace grow from baseline to a waveform of about .75 cm in amplitude.

5) Each variance peak should correspond with a plus and minus maximum of the Channel A signal.

Table 3-1. Calibration and Adjustment (Cont'd)

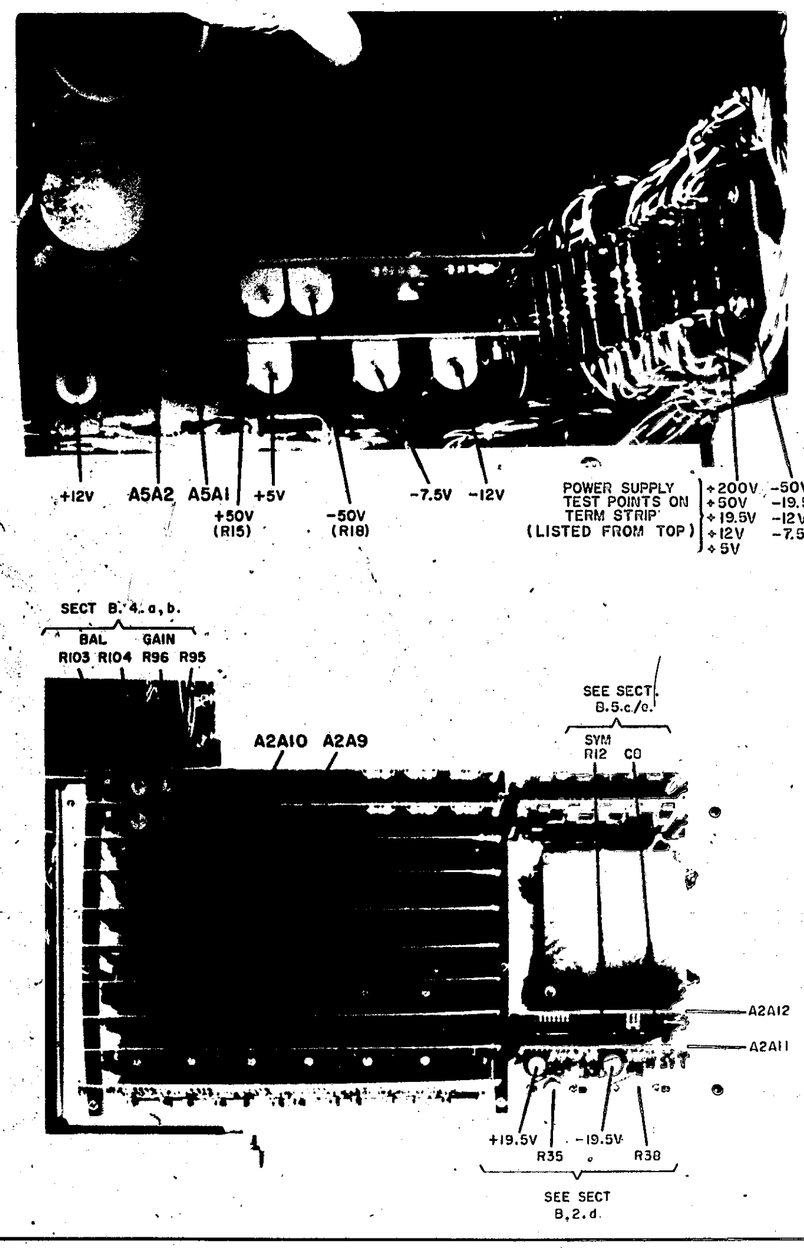


Table 3-1. Calibration and Adjustment (Cont'd)

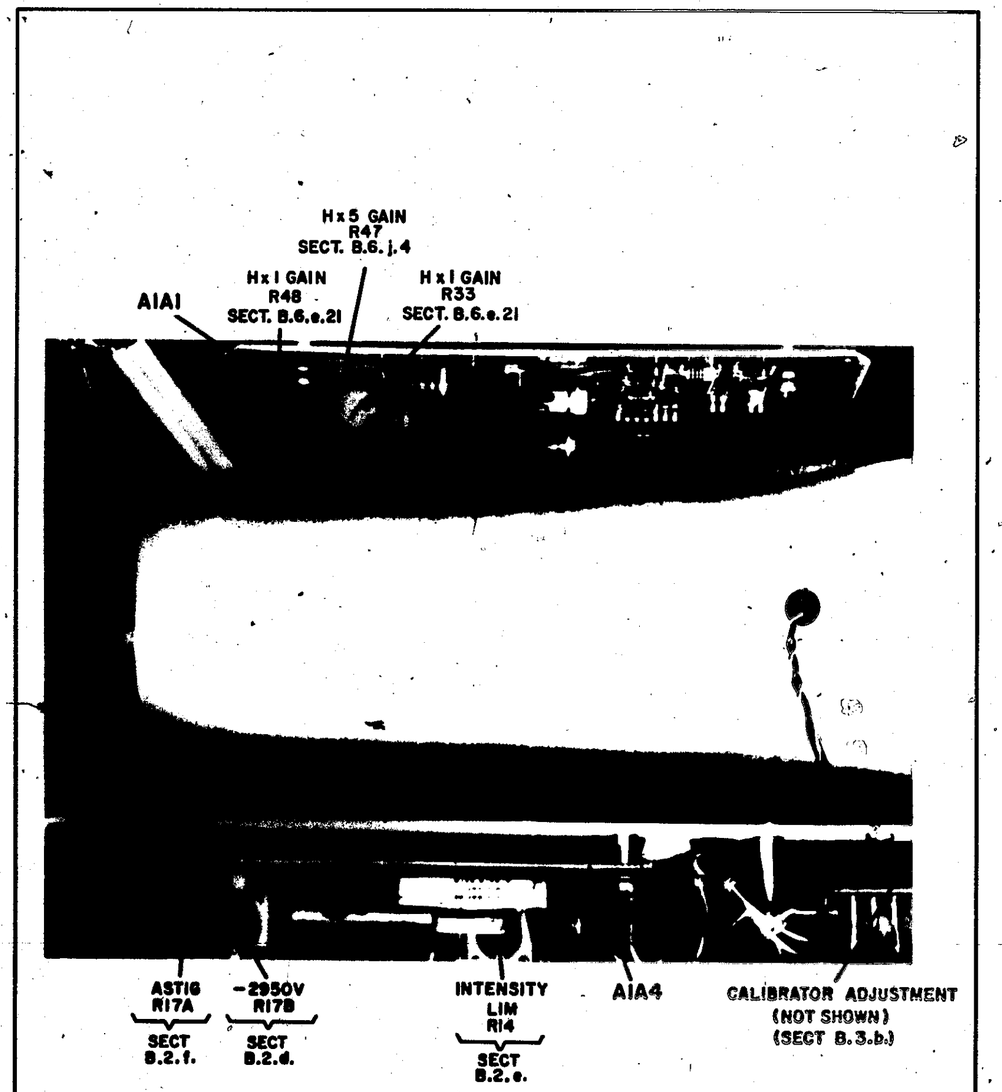
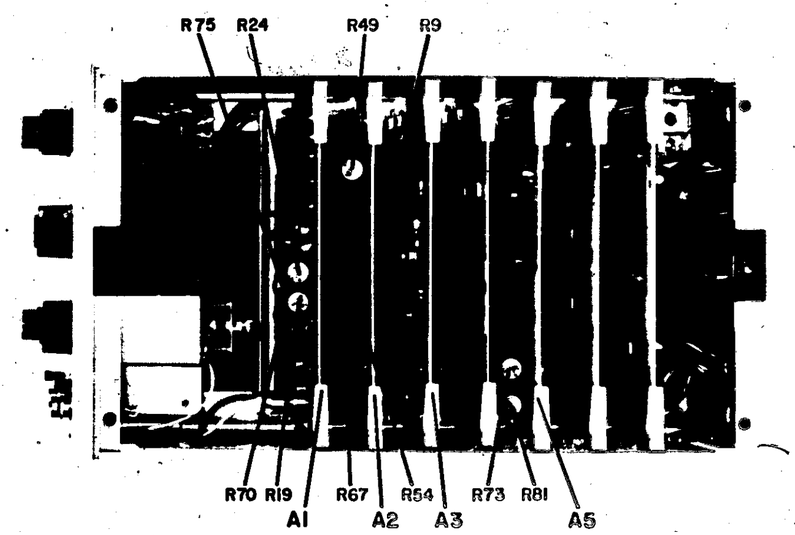


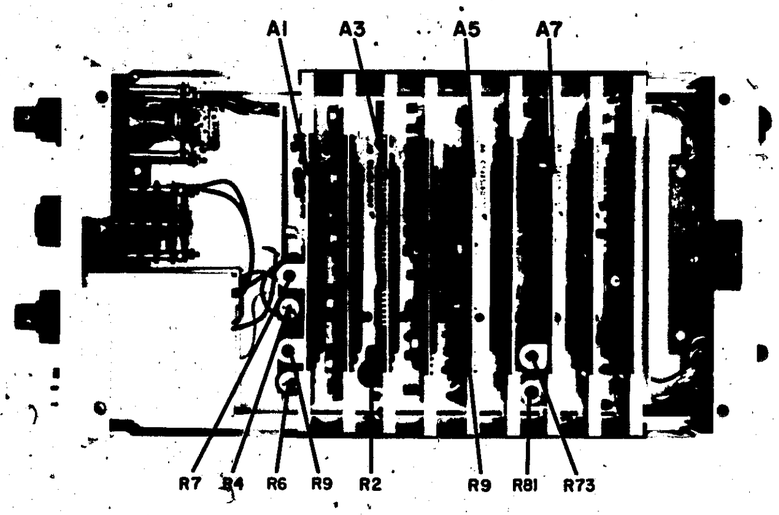
Table 3-1. Calibration and Adjustment (Cont'd)



5485A

REF. DESIG.	ADJUSTMENT	PROCEDURE STEP WHERE ADJUSTED (PERFORM ALL PRECEDING STEPS)
A1R19	"A" BAL	B. 6. c. 13)
A1R24	"A" GAIN	B. 6. c. 4)
A1R70	"B" BAL	B. 6. c. 15)
A1R75	"B" GAIN	B. 6. c. 6)
A2R49	SAMPLE AND HOLD GAIN	B. 6. e. 25)
A2R54	DAC BUFF AMPL. GAIN	B. 6. e. 11)
A2R67	DAC BUFF AMPL. BAL	B. 6. e. 10)
A3R9	ADC GAIN	B. 6. e. 27)
A5R73	OUTPUT AMPL. GAIN	B. 6. e. 17)
A5R81	OVERLAP SEPARATION	B. 6. i. 3)

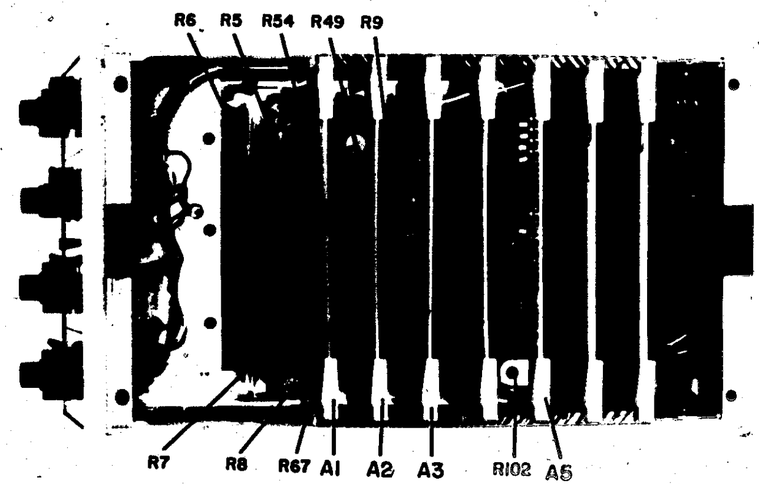
Table 3-1. Calibration and Adjustment (Cont'd)



5488A

REF. DESIG.	ADJUSTMENT	PROCEDURE STEP WHERE ADJUSTED (PERFORM ALL PRECEDING STEPS)
A1R5	"A" AMPL. BAL	B. 7. h.
A1R6	"B" AMPL. BAL	B. 7. h.
A1R7	"C" AMPL. BAL	B. 7. h.
A1R8	"D" AMPL. BAL	B. 7. h.
A2R49	SAMPLE AND HOLD GAIN	B. 7. j. 18)
A2R54	DAC BUFF AMPL. GAIN	B. 7. j. 4)
A2R67	DAC BUFF AMPL. BAL	B. 7. j. 3)
A3R9	ADC GAIN	B. 7. j. 22)
A5R102	OUTPUT AMPL. GAIN	B. 7. j. 10)

Table 3-1. Calibration and Adjustment (Cont'd)



5487A

REF. DESIG.	ADJUSTMENT	PROCEDURE STEP WHERE ADJUSTED (PERFORM ALL PRECEDING STEPS)
A1R4	"A" BAL	B. 8. c. 16)
A1R6	"B" BAL	B. 8. c. 14)
A1R7	"A" GAIN	B. 8. c. 7)
A1R9	"B" GAIN	B. 8. c. 10)
A3R2	DAC BAL	B. 8. h. 6)
A5R9	ADC GAIN	B. 8. h. 6)
A7R73	OUTPUT AMPL. GAIN	B. 8. d. 16)
A7R81	OVERLAP SEPARATION	B. 8. g. 4)

Table 3-2. Operational Check

This table lists equipment and methods required to perform an Operational check of the Model 5480A/B Signal Analyzer. Before beginning the check, refer to Section I of this manual for a discussion of operating controls for the 5480A/B Memory/Display unit and its plug-ins.

This table is organized in the following sections:

A. Test equipment required, with recommended Hewlett-Packard instruments listed.

B. Procedure, describing tests.

A. TEST EQUIPMENT REQUIRED

Type/Characteristics	Recommended HP Instrument (Other equipment may be used, if it has required characteristics)
Electronic Counter	Model 5221B
Voltage Standard	
DC: Output voltage range ±20 mV to ±20V	Model 740B or 741B
AC: Output voltage range 0.5V to 20V peak-to-peak	Model 745A (NOTE: Model 738AR Voltmeter Calibrator may be used. Model 738BR Voltmeter Calibrator may be used, except change test voltages that are multiples of "2" to multiples of "1.5".)
Oscilloscope Vertical Sensitivity: 5 mV/cm Sweep Speeds: 0.1 μsec/cm to 100 msec/cm Intensity modulation capability	Model 180A with Model 1801A Dual Channel Vertical Amplifier and Model 1820 Time Base Plug-ins
Pulse Generator Repetition rate 1K to 1M Pulse width 0.5 μsec Positive polarity Amplitude 2V	Model 222A
Strip Chart Recorder	Model 680

Table 3-2. Operational Check (Cont'd)

B. PROCEDURE

NOTE: Observe exceptions noted for various analog plug-in units (5485A, 5487A, and 5488A) that may be with system.

1. Before turn-on, set Signal Analyzer System controls as follows:

FUNCTION to AVERAGE
TRIGGER SOURCE to INTERNAL
PRE-ANALYSIS DELAY to "0"
POST-ANALYSIS DELAY to OFF
SWEEP NUMBER to "0"
PRESET/NORMAL to NORMAL
SWEEP TIME to 1 sec/cm
SENSITIVITY MULTIPLIER to AUTO
PRESET TOTALIZER to OFF
MAGNIFIER to X1
SCALE CAL to OFF
DISPLAY INTERLACE to IN

5485A, 5488A:

A DISPLAY to DATA
B DISPLAY to DATA
A MEMORY SELECTOR to HALF 3, 4
B MEMORY SELECTOR to HALF 1, 2

5487A:

MEMORY SELECTOR to QUARTER
DISPLAY to DATA
All ON/OFF switches to ON

5485A:

ALT/A+B to ALT
SENSITIVITY (both channels) to .005V/cm
A POLARITY to UP+
B POLARITY to UP+
AC/GND/DC to GND (both channels)

5487A, 5488A:

SENSITIVITY to .05V/cm (all channels)
AC/GND/DC to GND (all channels)

2. Check for correct line fuse and line voltage switch setting (see item 16, Figure 3-3), check for correct 5-volt fuse, then connect Signal Analyzer System to ac line and turn on POWER. Observe that:

POWER lamp is lighted
RESET lamp is off
PROCESS STOP pushbutton is lighted.

Table 3-2. Operational Check (Cont'd)

B. **PROCEDURE** (Cont'd)

3. Press both CLEAR DISPLAY pushbuttons. Observe that OUTPUT DISPLAY pushbutton lights, and two traces appear on CRT (four traces on 5487A).

4. Adjust A POSITION. Observe that one trace moves across entire vertical range of CRT graticule.

5. Adjust B POSITION. Observe that B trace moves across entire range of CRT graticule.

6. On 5487A only, adjust C and D POSITIONS. Observe that their respective traces move across entire range of CRT graticule.

7. 5487A only, set MEMORY to HALF.

8. Set Channel A trace on top graticule line. Set Channel B trace on bottom graticule line. Observe trace widths. Adjust FOCUS for best traces. Traces should be less than 0.2 cm wide.

9. Switch MAGNIFIER to X5. Observe that each trace has approximately 10 dots per cm.

10. Adjust HORIZONTAL POSITION. Observe both ends of traces as position control is moved from one extreme to the other.

11. 5485A, 5488A only: Switch Channel A MEMORY SELECTOR to QUARTERS 1, 2, 3, and 4. Observe that Channel A trace has approximately 5 dots per cm for each quarter.

12. 5485A, 5488A only: Switch Channel A DISPLAY to OFF. Switch Channel B MEMORY SELECTOR to QUARTERS 1, 2, 3, and 4. Observe that Channel B trace has approximately 5 dots per cm for each quarter. Channel A trace should not be present.

13. 5487A only:

a. Switch MEMORY SELECTOR to QUARTERS

b. Observe 5 dots/cm for each of four traces

c. Observe traces on CRT according to the switch conditions in the table below.

MEMORY	CHANNEL(S) SWITCHED ON	OFF	TRACE(S)
FULL	ABCD	-	A
FULL	BCD	A	B
FULL	CD	AB	C
FULL	D	ABC	D
HALF	ABCD	-	AB
HALF	BCD	A	BC
HALF	CD	AB	CD
HALF	ACD	B	AC
HALF	AD	BC	AD
HALF	BD	AC	BD

d. Return MEMORY SELECTOR to FULL.

e. All ON/OFF switches to ON.

Table 3-2. Operational Check (Cont'd)

B. **PROCEDURE** (Cont'd)

14. 5485A, 5488A only: Set controls as follows:

A DISPLAY to DATA
A MEMORY SELECTOR to FULL
B MEMORY SELECTOR to FULL
ALT/A+B to A+B (5485A only)

15. Set 5480A controls:

MAGNIFIER to X1
Press both CLEAR DISPLAY buttons
Press PROCESS START pushbutton

16. Observe trace. If trace contains a moving offset, adjust DC Bal, or DC BAL A+B for 5485A, to minimize offset. To check adjustment, press both CLEAR DISPLAY pushbuttons, then PROCESS START pushbutton; observe moving offset, and repeat adjustment if necessary.

17. 5485A only:

a. Press both CLEAR DISPLAY pushbuttons, then PROCESS START. Switch Channel A POLARITY alternately between UP+ and -UP. Observe trace. Offsets associated with polarity switching should be less than 0.2 cm.

b. Press both CLEAR DISPLAY pushbuttons, then PROCESS START. Switch Channel B POLARITY alternately between UP+ and -UP. Observe trace. Offsets associated with polarity switching should be less than 0.2 cm.

c. Switch ALT/A+B to ALT. Press both CLEAR DISPLAY pushbuttons, then PROCESS START. Observe trace. If trace contains a moving offset, adjust Channel A DC BAL for minimum offset. To check adjustment, press both CLEAR DISPLAY pushbuttons, then PROCESS START pushbutton; observe moving offset, and repeat adjustment if necessary.

d. Switch Channel A DISPLAY to OFF. Press both CLEAR DISPLAY pushbuttons, then PROCESS START. Observe trace. If trace contains a moving offset, adjust Channel B DC BAL for minimum offset. To check adjustment, press both CLEAR DISPLAY pushbuttons, then PROCESS START pushbutton; observe moving offset, and repeat adjustment if necessary.

e. Switch Channel A DISPLAY to ON.

18. Press OUTPUT DISPLAY. Switch SENSITIVITY MULTIPLIER to "0"; then in sequence through 1, 2, 3, 4, 5, 6, 7, etc. Observe trace. There should be no change switching between AUTO and "0". As SENSITIVITY MULTIPLIER is stepped to each higher-numbered position, vertical spacing, due to signal or noise, between dots of trace doubles.

19. Set controls as follows:

SENSITIVITY MULTIPLIER to AUTO
SWEEP TIME to 10 msec/cm
INTERLACE DISPLAY to OUT
Press PROCESS START

Observe trace. Trace should flicker.

Table 3-2. Operational Check (Cont'd)

B. **PROCEDURE** (Cont'd)

20. Switch SWEEP TIME through each position from 10 msec/cm to 50 sec/cm. Observe trace. With each successive switch position, trace should flicker at a slower rate until display is a dot slowly moving across CRT.

21. Switch SWEEP TIME to 1 msec/cm. Set PRE-ANALYSIS DELAY to 0.5 sec. Observe trace. Flicker rate should be about two times per second.

22. Switch PRE-ANALYSIS DELAY to 0.2 sec, 0.1 sec, 50 msec, and 20 msec. Observe trace. Flicker rate should increase as PRE-ANALYSIS DELAY decreases.

23. Switch PRE-ANALYSIS DELAY to 10 msec and 5 msec. Observe trace. Trace should brighten at each of these PRE-ANALYSIS times.

24. Set PRE-ANALYSIS DELAY to "0". Set POST-ANALYSIS DELAY to any position out of "OFF". Observe trace. Flicker rate depends on setting of POST-ANALYSIS DELAY.

25. Switch TRIGGER SOURCE to LINE. Observe trace. Flicker rate depends on POST-ANALYSIS DELAY setting.

26. Set controls as follows:

POST-ANALYSIS DELAY to OFF
SWEEP NUMBER TO "0"
PRESET/NORMAL to NORMAL
Press PROCESS START pushbutton

Connect a BNC-to-BNC cable between Electronic Counter INPUT and 5480A/B rear-panel NEG SYNC OUTPUT.

Set Electronic Counter as follows:

GATE to OPEN
SAMPLE RATE to mid-range
TRIGGER LEVEL for uniform counting rate.

Set 5480A as follows:

Switch SWEEP NUMBER to PRESET
Press both CLEAR DISPLAY pushbuttons

Proceed as follows:

Reset Electronic Counter
Press PROCESS START button
Observe 5480A/B and Electronic Counter. Signal Analyzer should provide one sweep, and OUTPUT DISPLAY button should light. Electronic Counter should indicate "1" sweep.

27. Perform the following procedure for SWEEP NUMBER settings indicated:

Set SWEEP NUMBER switch as indicated.
Reset Electronic Counter.
Press PROCESS START button.
Allow Signal Analyzer to sweep until OUTPUT DISPLAY lamp lights.
Observe Electronic Counter display. Number of sweeps should correspond to selected SWEEP NUMBER as shown in the table on the following page.

Table 3-2. Operational Check (Cont'd)

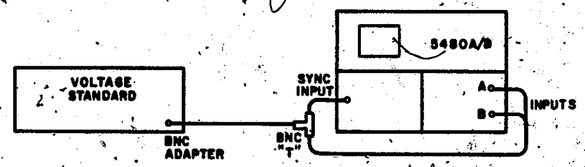
B. **PROCEDURE** (Cont'd)

27. Procedure for SWEEP NUMBER settings (Cont'd)

SWEEP NUMBER	NUMBER OF SWEEPS
1	2
2	4
3	8
4	16
5	32
6	64
7	128
8	256
9	512
10	1024

Disconnect Electronic Counter from 5480A/B. Leave 5480A in PRESET and SWEEP No. 10.

28. Connect equipment as shown in setup diagram below.



Center Channel A and B traces (also C and D traces for Model 5487A). Observe traces by switching off Channels in succession starting with A.

Switch AC/GND/DC to DC for all Channels.

29. 5485 only:

a. Switch A POLARITY to UP-.

b. Apply +20 mV at .005V/cm SENSITIVITY. For Voltmeter Calibrators not having a 20 mV output, use 200 mV output fed through a 10:1 probe. Probe tip goes to Voltmeter Calibrator.

c. Observe trace. Trace should move to within 0.2 cm of bottom graticule line.

d. Switch Channel A POLARITY to +UP. Observe trace. Trace should move to within 0.2 cm of top graticule line.

e. Switch Channel A DISPLAY to OFF and repeat a. through d. for Channel B.

30. 5487A and 5488A only:

a. Apply +200 mV at .05V/cm SENSITIVITY.

b. Observe trace. Trace should move to within .2 cm of top graticule line.

Table 3-2. Operational Check (Cont'd)

B. **PROCEDURE** (Cont'd)

30. 5487A and 5488A only: (Cont'd)

    c. Apply -200 mV at .05 V/cm SENSITIVITY.

    d. Observe trace. Trace should move to within 0.2 cm of bottom graticule line.

    e. Switch Channel A DISPLAY to OFF and repeat a. through d. for Channel B.

    f. For the Four Channel 5487A, also perform a. through d. to check Channels C and D. It will be necessary to move input connections to C and D and switch Channel B ON/OFF to OFF, and then Channel C ON/OFF to OFF.

31. Set all Channel DISPLAY switches to DATA or ON for the 5487A.

32. 5485A only:

    a. Apply +50 mV at .01V/cm SENSITIVITY. Observe 5 cm ±.2 cm displacement of trace.

    b. Switch to .02V/cm SENSITIVITY. Observe 2.5 cm ±.2 cm displacement of trace.

    c. Switch to .05V/cm SENSITIVITY. Observe 1 cm ±.2 cm displacement of trace.

    d. Switch Channel A DISPLAY to OFF.

    e. Repeat a. to c. for Channel B.

    f. Switch Channel A DISPLAY to ON.

33. Change control settings as follows:

    Set Voltmeter Calibrator to provide 400 Hz at 0.5V peak-to-peak SENSITIVITY to 0.1 V/cm for all Channels TRIGGER SOURCE to EXTERNAL +. Adjust TRIGGER SOURCE/LEVEL for stable triggering.

34. Observe trace. Display should be a stable sine wave, 5 ±.2 cm in height.

35. Turn Channel A SENSITIVITY VERNIER fully counterclockwise (CCW). Height of displayed signal should be less then 2 cm.

36. Return SENSITIVITY VERNIER to CAL position.

37. Switch Voltmeter Calibrator output and Channel A SENSITIVITY according to the table below. Display size should be within 0.2 cm of given size.

Voltmeter Calibrator Output Voltage	SENSITIVITY (V/cm)	Display Size (cm)
0.5V	0.2	2.5
0.5V	0.5	1
1V	1	1
2V	2	1
5V	5	1
10V	10	1
20V	20	1

Table 3-2. Operational Check (Cont'd)

B. **PROCEDURE** (Cont'd)

38. Switch Channel A DISPLAY to OFF. Repeat steps 33 through 37 for Channel B. Switch Channel A DISPLAY to DATA.

39. 5487A only: Switch off Channel B and repeat steps 33 through 37 for Channel C. Switch off Channel C and repeat steps 33 through 37 for Channel D. When completed set all ON/OFF switches to ON.

40. Switch PRE-ANALYSIS DELAY to 20 μs, 50 μs, .1 ms, .2 ms, .5 ms, 1 ms, and 2 ms. Observe trace. Initial phase of displayed sine wave should change as switch settings are changed.

41. Switch TRIGGER SOURCE to EXTERNAL - . Observe trace. Phase of displayed sine wave should reverse.

42. Voltmeter Calibrator to 1V peak-to-peak output.

43. Set controls as follows:

    PRE-ANALYSIS DELAY to "0"
    SWEEP TIME to 200 msec/cm
    FUNCTION to SUMMATION
    SWEEP NUMBER to "4"
    PRESET/NORMAL to PRESET
    Press both CLEAR DISPLAY pushbuttons
    Press PROCESS START button
    SENSITIVITY to .2 V/cm

    Observe trace. Pattern should grow, divide by 2, for a total of three divisions by 2. Amplitude should be 5 cm.

44. Reduce SENSITIVITY to 1V/cm. Push CLEAR DISPLAY button and START. Display amplitude should be 1 cm. Switch SENSITIVITY MULTIPLIER to 10. Observe trace. Sine wave displayed should be 0.5 ±0.2 cm in amplitude.

45. Switch SENSITIVITY MULTIPLIER to 11, 12, 13, 14, 15. Observe trace. Amplitude of displayed sine wave should double with each successive switch position.

    Note: There may be a small amount of overflow on position 15. Overflow causes displayed pattern to appear folded-over at top or bottom.

46. Set controls as follows:

    SENSITIVITY MULTIPLIER to AUTO
    SWEEP NUMBER to 19
    SWEEP TIME to 5 msec/cm
    Channel A DISPLAY to INPUT (Lever switch to INPUT for 5487A)
    Press both CLEAR DISPLAY pushbuttons.
    Press PROCESS START button.

    Observe trace. Should be flickering sine wave.

47. Switch Channel A DISPLAY to NOISE. (Lever switch to NOISE for 5487A). Observe trace. Should be flickering sine wave, same as in step 46.

Table 3-2. Operational Check (Cont'd)

B. PROCEDURE (Cont'd)

48. Switch SWEEP TIME to 10 msec/cm. Observe trace. Flicker is half rate of step 46.

49. Set controls as follows:

FUNCTION to AVERAGE
Channel A SENSITIVITY to 0.5V/cm
Channel A DISPLAY to DATA
SWEEP TIME to 2 msec/cm
Channel A SENSITIVITY VERNIER to fully CCW
Press both CLEAR DISPLAY pushbuttons.
Press PROCESS START button.

50. For the remaining checks of this procedure, an external oscilloscope is used to observe Signal Analyzer output waveforms. Initially, the oscilloscope controls should be set as follows:

51. Connect oscilloscope to 5480A rear-panel POS SYNC OUTPUT.

Set 5486A TRIGGER SOURCE to INT.
Press both CLEAR DISPLAY pushbuttons.
Press PROCESS START button.

Observe oscilloscope. Display should be positive-going pulse as shown in waveform A.

52. Disconnect oscilloscope from POS SYNC OUTPUT and connect to NEG SYNC OUTPUT. Observe oscilloscope. Display should be negative-going pulse as shown in waveform B.

53. Disconnect oscilloscope from NEG SYNC OUTPUT and connect to SAMPLE OUTPUT. Observe oscilloscope. Display should be negative-going pulse as shown in waveform C.

54. Disconnect oscilloscope from SAMPLE OUTPUT and connect to Z AXIS OUTPUT. Observe oscilloscope. Display should be negative-going pulse as shown in waveform D.

55. Connect ohmmeter from PEN LIFT terminal, J36, pin 4 to ground. Press both CLEAR DISPLAY buttons. Press OUTPUT RECORD button, repeat as many times as desired. Observe ohmmeter for 0 resistance each time OUTPUT RECORD button is pressed. (Note 5480A instruments have 4V level change on PEN LIFT terminal, unless modified.)

56. Disconnect oscilloscope from Z AXIS and connect to POINT PLOTTER SEEK on J39 pin 13, using probe tip.

Change oscilloscope time/cm to 20 μsec/cm.
Change 5480A SWEEP TIME to 100 msec/cm.
Press OUTPUT RECORD button. Repeat as necessary.

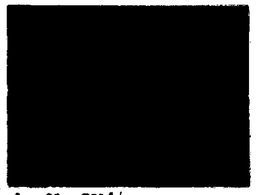
Observe oscilloscope. Positive pulse occurs during time OUTPUT RECORD button is lighted. OUTPUT RECORD stays lighted for about 1 second (10 times SWEEP TIME setting). Pulse should resemble one shown in waveform E. Disconnect oscilloscope from POINT PLOTTER SEEK output.

Table 3-2. Operational Check (Cont'd)

B. PROCEDURE (Cont'd)

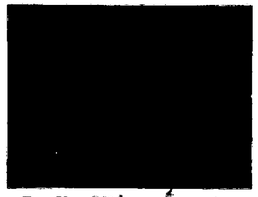
OSCILLOGRAMS

Pos Sync Output



A. V = 5V/cm
H = 0.5 μsec/cm
0V = vertical centerline

Neg Sync Output



B. V = 5V/cm
H = 0.5 μsec/cm
0V = vertical centerline

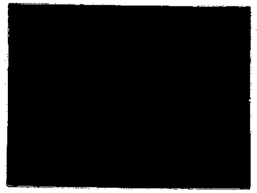
Sample Output

C. V = 2V/cm
H = 0.1 μsec/cm
0V = vertical centerline

Z-Axis Output

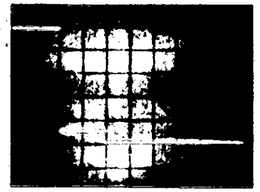
D. V = 2V/cm
H = 1 μsec/cm
0V = vertical centerline

Point Plotter Seek



E. V = 5V/cm
H = 20 μsec/cm
0V = vertical centerline

MCS Display



F. V = 20 kHz/cm
H = 10 sec/cm
0 counts = baseline
SENSITIVITY MULT. set to 9

57. Connect Pulse Generator OUTPUT to POINT PLOTTER PLOT input. Set Pulse Generator controls as follows:

REP RATE to 1K-10K
REP RATE VERNIER fully CCW
PULSE DELAY to less than 0.1 μs
PULSE WIDTH to 0.5 – 5 μs
PULSE WIDTH VERNIER fully CCW
PULSE POLARITY to "+"
PULSE AMPLITUDE to 2V
PULSE AMPLITUDE VERNIER fully CCW

Set 5400A controls as follows:

SWEEP TIME to EXT

Push OUTPUT RECORD button.

Observe 5480A CRT. Dot moves across CRT. PROCESS STOP button lights about 1 to 2 seconds after OUTPUT RECORD button is pressed. Disconnect Pulse Generator from POINT PLOTTER PLOT input.

Table 3-2. Operational Check (Cont'd)

B. **PROCEDURE** (Cont'd)

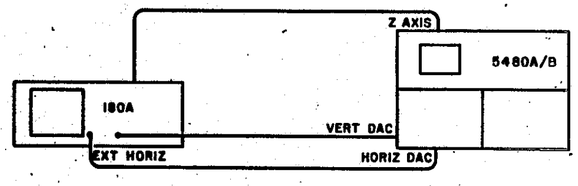
58. Connect Pulse Generator to SAMPLE INPUT. Press both CLEAR DISPLAY pushbuttons. Press PROCESS START button. Observe CRT. Dot sweeps across CRT in about 1 to 2 seconds. Disconnect Pulse Generator from SAMPLE INPUT.

59. Connect Pulse Generator to MCS INPUT. Change Pulse Generator REP RATE to 100k–1M. Set 5480A controls as follows:

TRIGGER SOURCE TO INTERVAL
SWEEP TIME to 10 sec/cm
FUNCTION to MCS
SENSITIVITY MULTIPLIER to 9
Press both CLEAR DISPLAY pushbuttons.
Press PROCESS START button.

After about 20 seconds, change Pulse Generator REP RATE to 10K–100K. After about 20 more seconds, push PROCESS STOP. Press DISPLAY. Observe CRT. Disregard scattered points. If two-step picture, similar to one shown in waveform G, appears, MCS works. Disconnect all signal leads from 5480A rear-panel. Return SENSITIVITY MULTIPLIER to AUTO.

60. Connect oscilloscope as shown in picture below.



Set oscilloscope controls as follows:

HORIZ to EXT CAL
Vertical Sensitivity to 0.2V/cm
Adjust Horizontal and Vertical position controls as necessary for on-screen display.

Observe waveforms on Signal Analyzer and oscilloscope. They should be similar.
NOTE: Be sure oscilloscope intensity control is not turned up so high that it overrides Z axis input voltage.

61. Disconnect oscilloscope from VERTICAL DAC OUTPUT and connect to VERTICAL SCOPE OUTPUT. Leave SENSITIVITIES of oscilloscope and Signal Analyzer the same. Adjust Signal Analyzer Vertical POSITION control. Observe oscilloscope trace. Trace should move up and down as Signal Analyzer trace moves up and down. Vertical height on oscilloscope should be twice as high as in step 60.

Table 3-2. Operational Check (Cont'd)

B. **PROCEDURE** (Cont'd)

62. Set controls as follows:

FUNCTION to HISTOGRAM
HISTOGRAM to TIME
SWEEP TIME to 1 msec/cm
SENSITIVITY MULTIPLIER to 10
Press both CLEAR DISPLAY pushbuttons.
Press PROCESS START button.

Observe 5480A CRT. (Note: 400 Hz Voltmeter Calibration signal should still be connected to the 5480A/B system TRIGGER SOURCE input.) One to three dots should rise out of baseline approximately 2.5 cm from left-hand side.

63. Switch HISTOGRAM to FREQ, and SWEEP TIME to 5 sec/cm. Press both CLEAR DISPLAY pushbuttons. Press PROCESS START button. Observe 5480A CRT. One to three dots will slowly rise about 0.2 cm from left-hand end of baseline.

64. Connect Strip Chart Recorder to 5480A SWEEP VOLTAGE OUTPUT. Set recorder as follows:

RANGE to 1V
PEN to DOWN
Division to "8"
Min/Hr to Min
Zero pen while holding 5480A OUTPUT RECORD button in.

Set Signal Analyzer controls as follows:

INTERLACE DISPLAY to OUT
PRESET/NORMAL to NORMAL
Press PROCESS START

Observe strip chart recording. Should show a linear ramp across 10 vertical divisions and approximately 6.7 horizontal divisions.

NOTE: 5480 sweep is 5 sec/cm, 50 sec/sweep chart speed is 8 div/min

$$\frac{50\ \text{sec}}{60\ \text{sec}} = \frac{X\ \text{div}}{8\ \text{div}}, \quad X = 6.7\ \text{div}$$

TROUBLE-SHOOTING

02850-1

SECTION IV

TROUBLESHOOTING

4-1. INTRODUCTION

4-2. General

4-3. Knowledge of computer circuit servicing techniques is helpful, but not essential, in troubleshooting the 5480A/B. The 5480A/B is a computer, except there is no programming flexibility; program selection depends on FUNCTION switch setting, as described in Section II of this manual.

4-4. TROUBLESHOOTING AIDS

4-5. Recommended equipment for troubleshooting 5480A/B Systems is listed in Table 4-1, Section A.

4-6. TIMING DIAGRAMS

4-7. Figures 4-1 through 4-6 provide timing information for 5480A and 5480B programs. Where there are differences between the A and B models, the correct signal for each Model is indicated by placing a small "A" or "B" where appropriate.

4-8. WIRING INFORMATION

4-9. Table 4-2 and Figures 4-7 through 4-14 provide wiring information for all standard 5480A/B Signal Analyzer Systems. Table 4-2 is divided into several sections; signals are identified in PART A, the "Signal Dictionary". Going from the "dictionary," line numbers for each signal lead you to corresponding lines in the wiring lists for the areas in the system where the signal appears. The wiring list for each section tells you the signal source for that section and where in that section the signal is connected. The wiring lists are sectioned for 5480A/B sections and 5480A/B input/output connectors, Logic (Control) plug-in, and each Analog Plug-in. Wiring of the 5480A and 5480B is nearly identical, so these are covered in the same list. Wiring of the 5486A and 5486B is different enough that these are covered in two separate parts of the same section of the list. Connections for rear-panel switches are shown in Figure 4-16.

4-10. REPLACEMENT PARTS, SERVICE KITS

4-11. All 5480A/B System printed circuit boards and certain other often-replaced parts are listed in Table 4-4, "Replacement Parts". Service kits containing replacement boards and other parts are available. These kits are described in Table 4-5.

Table 4-1. Troubleshooting

DESCRIPTION

This table provides a logical way to troubleshoot most problems in a standard HP 5480A/B Signal Analyzer System. The information is provided to enable servicing to the assembly-replacement level. No attempt is made to provide troubleshooting information to the component-replacement level. Using this procedure, the time required to find any one trouble should be about two hours or less.

When a faulty board is found, it can be checked for a bad component and repaired, or (in some cases) returned to Hewlett-Packard on the board exchange program described in Figure 4-15. Replacement Parts and Service kits including replacement boards, spare components for isolated operation, and extender cables are described in Tables 4-4 and 4-5.

This table is divided into four sections:

A. Equipment Required

B. Initial Control Settings

C. Summary of Checks – Summarizes all the checks in Section D. Used for troubleshooting by leading you to a failed system "check" which identifies the part of Section D having detailed troubleshooting "tests".

D. Troubleshooting Procedure – Complete procedure, divided into two major classes, "checks" and "tests", which are broadly defined below:

A "CHECK" is simply a check of instrument operation, generally involving use of visual indications provided by the 5480A/B System itself (including knob settings, correct lighting of indicator lamps, correct CRT display; etc.). If the instrument passes a CHECK, you are directed to the next CHECK. If the instrument fails a CHECK, you are directed to perform certain TESTS to determine the cause of failure.

A "TEST" is a detailed examination of operating characteristics of a portion of the 5480A/B System, generally using an oscilloscope as the monitoring instrument. TESTS are performed only when the System fails a CHECK, and (in most cases) will lead you to a faulty assembly within the System. When the trouble is cured, you are directed back to the CHECKS to examine the system for other faults.

If the System passes all troubleshooting TESTS for a given CHECK failure, repeat as many CHECKS as you think necessary to determine that the problem still exists, then use your own judgement as to whether to continue with the series of CHECKS or to do additional troubleshooting in the areas indicated by the TESTS.

Most pages in Section D are divided into two sections. The upper portion lists one or more CHECKS, and the lower portion lists the TESTS to be performed if the System fails a particular CHECK. Each CHECK and the corresponding TEST GROUP are numbered for easy reference.

NOTE

When you are directed in a TEST to "check" a board assembly, the checks should include connections to and from that assembly; the trouble is associated with the assembly, not necessarily on it.

Additional troubleshooting information is contained in text, figures, and tables following this table.

Table 4-1. Troubleshooting

A. EQUIPMENT REQUIRED

DESCRIPTION	RECOMMENDED INSTRUMENT*
Oscilloscope:	
Frequency Response: DC to 50 MHz Sensitivity: 1V/cm Sweep Speeds: 1 μsec/cm to 100 msec/cm	Model 180A with Model 1801A Dual Channel Vertical Amplifier
Electronic Counter:	Model 5325B
Signal Source:	
Frequency Range: 10 Hz to 1 MHz Output Level: ≥ 2V P-P	Model 651B

*Use Hewlett-Packard instruments unless noted. Other instruments may be used if they have the required characteristics.

B. INITIAL CONTROL SETTINGS

Begin troubleshooting procedure by setting System controls as follows:

Mainframe (MF) (5480A/B) Front Panel:

POWER to OFF
MAGNIFIER to X1

Mainframe (MF) (5480A/B) Rear Panel:

SCALE CAL to OFF
INTERLACE to OUT
115/230 to your line voltage

Control "Logic" Plug-In (LPI) (5486A/B) Front Panel:

FUNCTION to SUMMATION
SENSITIVITY MULTIPLIER to AUTO
SWEEP TIME to 2 msec/cm
TRIGGER SOURCE to INTERNAL
PRE-ANALYSIS DELAY to "0"
POST-ANALYSIS DELAY to OFF
SWEEP NUMBER to "19"
PRESET/NORMAL to NORMAL
PRESET TOTALIZER to OFF

Analog Plug-In (API) Front Panel: (5485A, 5487A, 5488A)

5485A, 5488A:

"A" DISPLAY to DATA
"B" DISPLAY to OFF

5485A, 5488A (Continued):

"A" MEMORY SELECTOR to FULL
"B" MEMORY SELECTOR to FULL
"A" SENSITIVITY to .2V/CM
"B" SENSITIVITY to .2V/CM
"A" VERNIER to CAL
"B" VERNIER to CAL
"A" AC/GND/DC to AC
"B" AC/GND/DC to AC
HISTOGRAM to OFF

5485A only:

"A" POLARITY to UP+
"B" POLARITY to UP+
ALT/A+B to ALT

5487A only:

DISPLAY to DATA
MEMORY to FULL
SENSITIVITY (all channels) to .2V/CM
VERNIER (all channels) to CAL
AC/GND/DC (all channels) to AC
"A" Channel ON/OFF to ON
"B", "C", "D" Channels ON/OFF to OFF
HISTOGRAM to OFF

All normally accessible pots not listed above should be centered.

Connect AC power cable between rear panel and line.

Connect Mainframe (MF) front panel CALIBRATOR output through a BNC "T" to "A" and "B" INPUTS.

Table 4-1. Troubleshooting

C. SUMMARY OF CHECKS (A GUIDE TO TROUBLESHOOTING TREE, SECTION D)

This and the following pages provide all the same information as that in the CHECKS portions of the diagrams on pages through . You can check 5480A/B operation using the information provided in this summary. If the instrument fails any check listed here, turn to the beginning same check in the main part of the table, and you will be led to the troubleshooting tests to make to find the cause of trouble.

CHECK NUMBER	SET CONTROLS AS FOLLOWS:	QUESTIONS
Corresponds to circled "C" number in Section D	Abbreviations for unit: MF: Mainframe 5480A or 5480B LPI: Logic (Control) Plug-In 5486A/B API: Analog Plug-in 5485A, 5487A, or 5488A	Unless otherwise indicated, System passes check only if answers to all questions for that check can be answered "YES". If System fails any check, turn to the beginning of that check in Section D, and you will be led toward the faulty part of the circuit.
BEGIN	As described in Section B of this procedure.	
1	POWER to ON	Is POWER light lighted? Is RESET light lighted? ("No" = "pass") Is PROCESS STOP button (only) lighted? Is there a spot or trace on CRT? ("No" = "pass")
2	Press and release both CLEAR DISPLAY buttons.	Is (only) OUTPUT DISPLAY button lighted? Is there a trace (line) on CRT?
3	Rotate API Channel A POSITION Rotate HORIZONTAL POSITION	Does trace move vertically? Does trave move horizontally?
4	Switch MAGNIFIER to X5.	Is the trace continuous? Is there an average of 20 dots per cm?
5	Switch API MEMORY SELECTOR from FULL to HALF 3, 4; HALF 1, 2; QUARTER 4; QUARTER 3; QUARTER 2; and QUARTER 1	Is there an average of 10 dots per cm on each HALF setting; and 5 dots per cm on each QUARTER setting? Monitor Mainframe (MF) A2A9B(21), Sync from A2A9B(10) Do waveforms show pulses spaced 20 μs in FULL, 40 μs in HALF, and 80 μs in QUARTER.
6	Switch MAGNIFIER to X1. Switch API Channel A MEMORY SELECTOR to FULL. Switch CPI SENSITIVITY MULTIPLIER from AUTO to "15" and back to AUTO.	Does trace move vertically? ("No" = "pass") NOTE: You may get a "No" if SENSITIVITY MULTIPLIER is not working. This check assumes it is working.

Table 4-1. Troubleshooting

CHECK NUMBER	SET CONTROLS AS FOLLOWS:	QUESTIONS
7	Switch DISPLAY to INPUT. Press PROCESS START button.	Is CRT display a square wave?
8	Switch DISPLAY to NOISE.	Does signal have same amplitude as INPUT?
9	Switch DISPLAY to INPUT.	Is display a 1V p-p square wave?
10	Switch AC/GND/DC to GND.	Is display a square wave? ("No" = "pass")
11	Switch AC/GND/DC to DC.	Is display a square wave, going positive from 0V baseline of previous step?
12	For 5485A only. Switch 5485A Channel A POLARITY to -UP. (For 5487A and 5488A go to Check 13.)	Is display same as preceding step, except inverted?
13	Vary API Channel A SENSITIVITY VERNIER. Return Channel A VERNIER to CAL after check.	Does 5480 display reduce from 5 cm in CAL to less than 2 cm?
14	For 5487A and 5488A go to Check 15. Switch 5485A ALT/A+B to A+B. Switch 5485A Channel B DISPLAY to INPUT. Switch 5485A Channel A POLARITY to UP+. Switch 5485A Channel B POLARITY to -UP. Check Display Switch simultaneously A and B SENSITIVITY controls through all positions from .05V/cm to 20V/cm. Check Display for each pair of positions. Go to Check 16.	So square wave inputs cancel, so display is a straight line?
15	For 5487A and 5488A only: Switch DISPLAY to INPUT. Switch SENSITIVITY control thru the 0.05V/cm to 20V/cm positions for each channel. (Use 10:1 probe to reduce 1V CAL signal for high sensitivities, higher voltage signal needed to check 10V and 20V positions.)	Is the CRT Display the correct height for each?
16	Switch DISPLAY to DATA. Switch 5485A ALT/A+B to ALT. Switch LPI SWEEP TIME to 1 msec/cm. DC/GND/AC to AC Press both CLEAR DISPLAY buttons. Press PROCESS START button.	Is display a square wave that grows symmetrically, then divides by 2, grows, divides by 2, etc.?
17	Press both CLEAR DISPLAY buttons. Switch LPI SWEEP TIME to 2 msec/cm. Press PROCESS START button.	Is (only) PROCESS START button lighted? Is display a square wave? Does square wave grow symmetrically, divide by 2, grow, divide by 2, etc.?

Table 4-1. Troubleshooting

CHECK NUMBER	SET CONTROLS AS FOLLOWS:	QUESTIONS
18	Switch LPI SWEEP TIME to 5 msec/cm. Press both CLEAR DISPLAY buttons. Press PROCESS START button.	Is (only) PROCESS START button lighted? Is display a square wave? Does square wave grow, divide by 2, grow, divide by 2, etc. ?
19	Switch LPI SWEEP TIME to 10 msec/cm. Press both CLEAR DISPLAY buttons. Press PROCESS START button. Rotate LPI SWEEP TIME from 10 msec/cm thru 50 msec/cm.	Does sweep speed decrease? Does square wave become more differentiated (more a series of spikes) as sweep speed is decreased?
20	Switch LPI SWEEP TIME to 100 msec/cm. Switch LPI SWEEP NUMBER to "0". Switch LPI PRESET/NORMAL to PRESET. Press both CLEAR DISPLAY buttons. Press PROCESS START button.	Does (only) PROCESS START button light? Does dot move (only) once across CRT? Does (only) OUTPUT DISPLAY button light?
21	Switch LPI SENSITIVITY MULTIPLIER one step at a time from AUTO to "15". Return SENSITIVITY MULTIPLIER to AUTO.	Does square wave disappear at "0", then eventually double in size with each step?
22	Set LPI SWEEP NUMBER to next "N" number. Press both CLEAR DISPLAY buttons. Press PROCESS START button. Repeat this check for sweep numbers thru "10". A counter can be connected at 5480A/B MF rear-panel Synch Out Pos connector to keep track of number of sweeps performed.	Does spot move across screen 2^N times, and then does OUTPUT DISPLAY button (only) light? N / 2^N / N / 2^N 0 / 1 / 5 / 32 1 / 2 / 6 / 64 2 / 4 / 7 / 128 3 / 8 / 8 / 256 4 / 16 / 9 / 512 10 / 1024
23	Connect counter to MF rear-panel Synch Out Pos connector. Set counter to make period measurements with 1 μs resolution. Switch SWEEP TIME to 1 msec/cm. Switch SWEEP NUMBER to "19". Switch PRE-ANALYSIS DELAY to "0". Press both CLEAR DISPLAY buttons. Press PROCESS START button. Repeat the above procedure with LPI PRE-ANALYSIS DELAY set to each position.	Is measured period 10040 μsec? Is delay time added to basic 10040 μsec period? PRE-ANALYSIS DELAY / Period (μsec) 0 μsec / 10040 20 μsec / 10060 50 μsec / 10090 .1 msec / 10140 .2 msec / 10240 .5 msec / 10540 1 msec / 11040 2 msec / 12040 5 msec / 15040 10 msec / 20040 20 msec / 30040 50 msec / 60040 .1 sec / 110040 .2 sec / 210040 .5 sec / 510040

Table 4-1. Troubleshooting

CHECK NUMBER	SET CONTROLS AS FOLLOWS:	QUESTIONS
24	Switch LPI PRE-ANALYSIS DELAY to "0". Press both CLEAR DISPLAY buttons. Press PROCESS START button. Rotate POST-ANALYSIS DELAY.	Does rotating POST-ANALYSIS DELAY change time between sweeps? (Center of rotation should cause about 1 second of delay.
25	Switch LPI POST-ANALYSIS DELAY to OFF. Switch LPI SWEEP TIME to 100 msec/cm. Switch rear-panel Interlace to In. Press both CLEAR DISPLAY buttons. Press PROCESS START button.	Does signal appear on first sweep, and is display continuous after first sweep?
26	Perform checks listed for C26 in Section D of this procedure.	Does the 5480 pass all checks?
27	Switch: LPI FUNCTION to AVERAGE, SWEEP TIME to 1 msec/cm, SWEEP NUMBER TO "4", PRESET/NORMAL to NORMAL. Switch: API SENSITIVITY to .2V/cm, MEMORY SELECTOR to FULL, AC/GND/DC to AC. Press both CLEAR DISPLAY buttons. Press PROCESS START button.	Is display a square wave? Does square wave appear ragged (misplaced point). ("No" = "pass") Is (only) PROCESS START button lighted? Is square wave amplitude 5 ± 0.2 cm high?
28	Switch LPI SWEEP TIME to 2msec/cm. Press both CLEAR DISPLAY buttons. Press PROCESS START button. Switch LPI SWEEP TIME to 5 msec/cm. Press both CLEAR DISPLAY buttons. Press PROCESS START button.	Is display a square wave? Is display a square wave? Does square wave appear ragged (missing points) ("No" = "pass")
29	Switch LPI SWEEP TIME to 100 msec/cm. Switch API Input AC/GND/DC to DC. Switch 5480 Interlace to IN. Press both CLEAR DISPLAY buttons. Press PROCESS START button.	Does amplitude change between first and second sweeps? ("No" = "pass")
30	Switch LPI: FUNCTION to HISTOGRAM, SWEEP TIME to 2 msec/cm, SENSITIVITY MULTIPLIER to "15", TRIGGER SOURCE to LINE, PRESET TOTALIZER to OFF. Switch API HISTOGRAM to TIME. Press both CLEAR DISPLAY buttons. Press PROCESS START button. Adjust LPI TRIGGER LEVEL for best counting.	Are any dots rising from baseline? Are dots rising only 8.3 cm from left end of baseline?

Table 4-1. Troubleshooting

CHECK NUMBER	SET CONTROLS AS FOLLOWS:	QUESTIONS
31	Switch LPI TRIGGER SOURCE to EXT+, and SWEEP TIME to 2 msec/cm. Switch API HISTOGRAM to FREQ. Connect external 1 MHz signal source, greater than 100 mV RMS to LPI SYNC input. Press both CLEAR DISPLAY buttons. Press PROCESS START.	Are there 1 to 3 dots rising from baseline, about 0.2 cm from left end of line?
32	Switch LPI: SWEEP TIME to 10 sec/cm, PRESET TOTALIZER to 10^2, TRIGGER SOURCE to INT. Disconnect external signal from SYNC input connector. Press both CLEAR DISPLAY buttons. Press PROCESS START button. OPTIONAL CHECK: Check other PRESET TOTALIZER positions, see Section D, Check 32.	Is the operation sequence: PROCESS START button lighted for 20 sec, followed by OUTPUT DISPLAY button lighted?
33	Switch LPI: FUNCTION to MCS, SWEEP TIME to 1 sec/cm, SENSITIVITY MULTIPLIER to ".9". Connect 1 MHz, 2V p-p signal to rear-panel MCS Input connector. Press both CLEAR DISPLAY buttons. Press PROCESS START button. Wait 1 second. Change input signal frequency to 100 kHz. Wait 1 second. Press PROCESS STOP. Press OUTPUT DISPLAY.	Is display as shown above?

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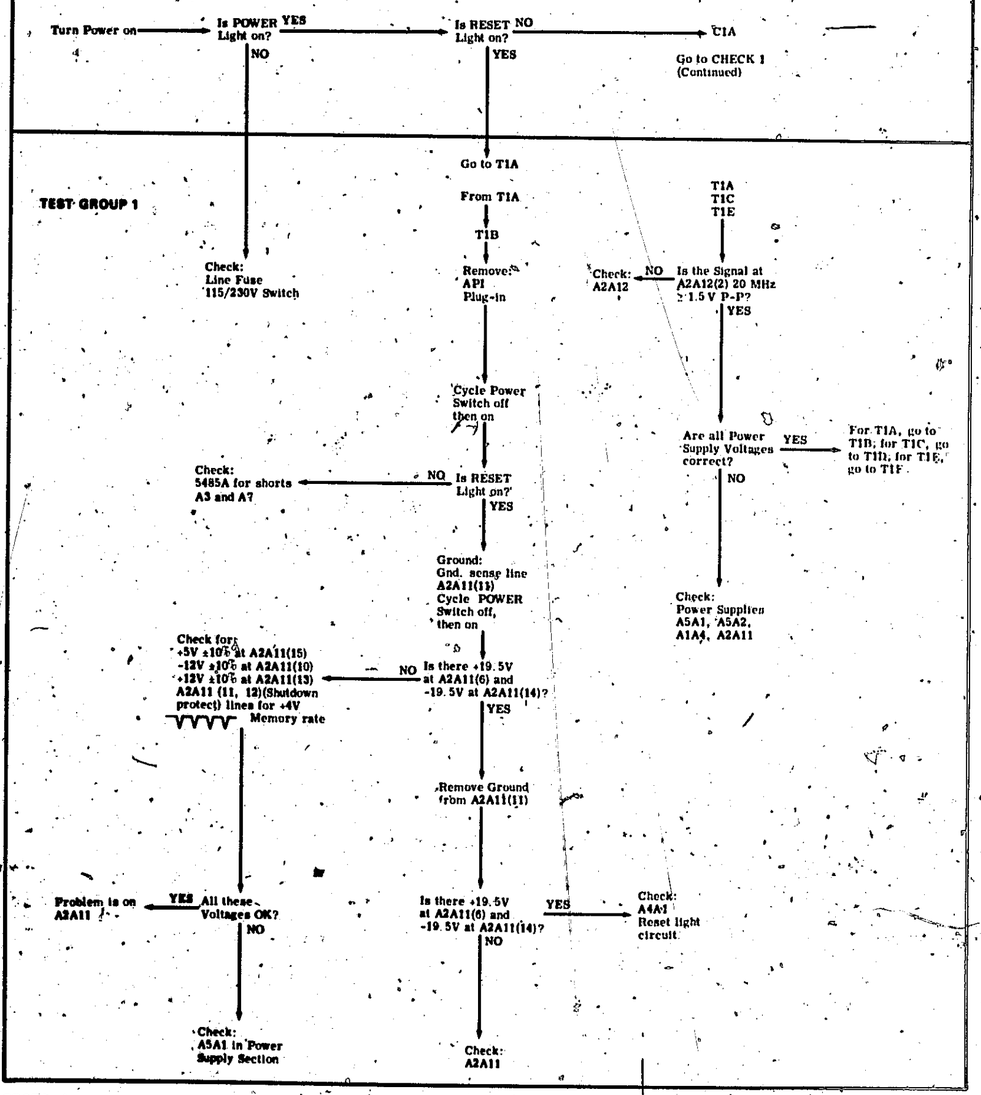
Table 4-1. Troubleshooting

D. TROUBLESHOOTING PROCEDURE



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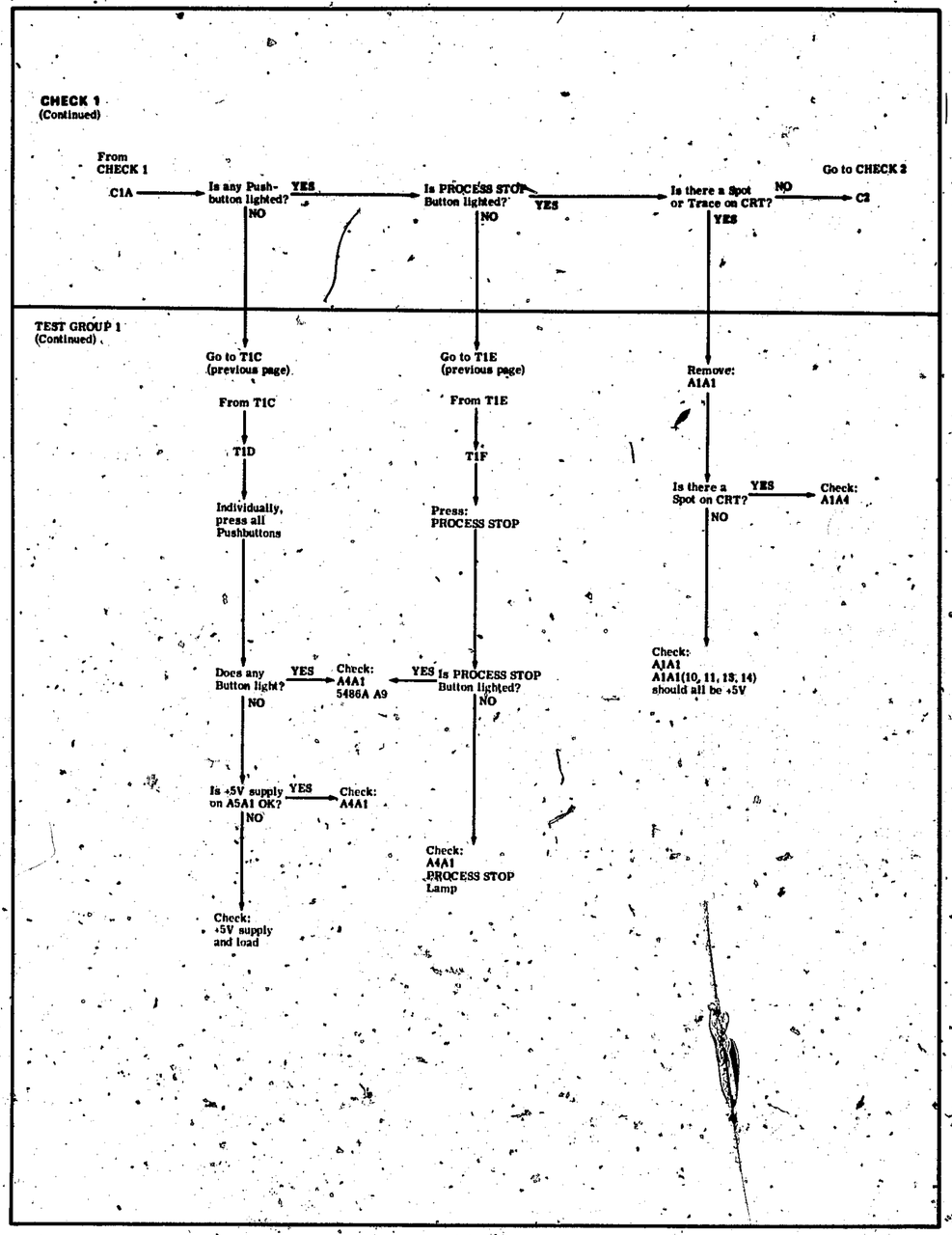

Table 4-1. Troubleshooting

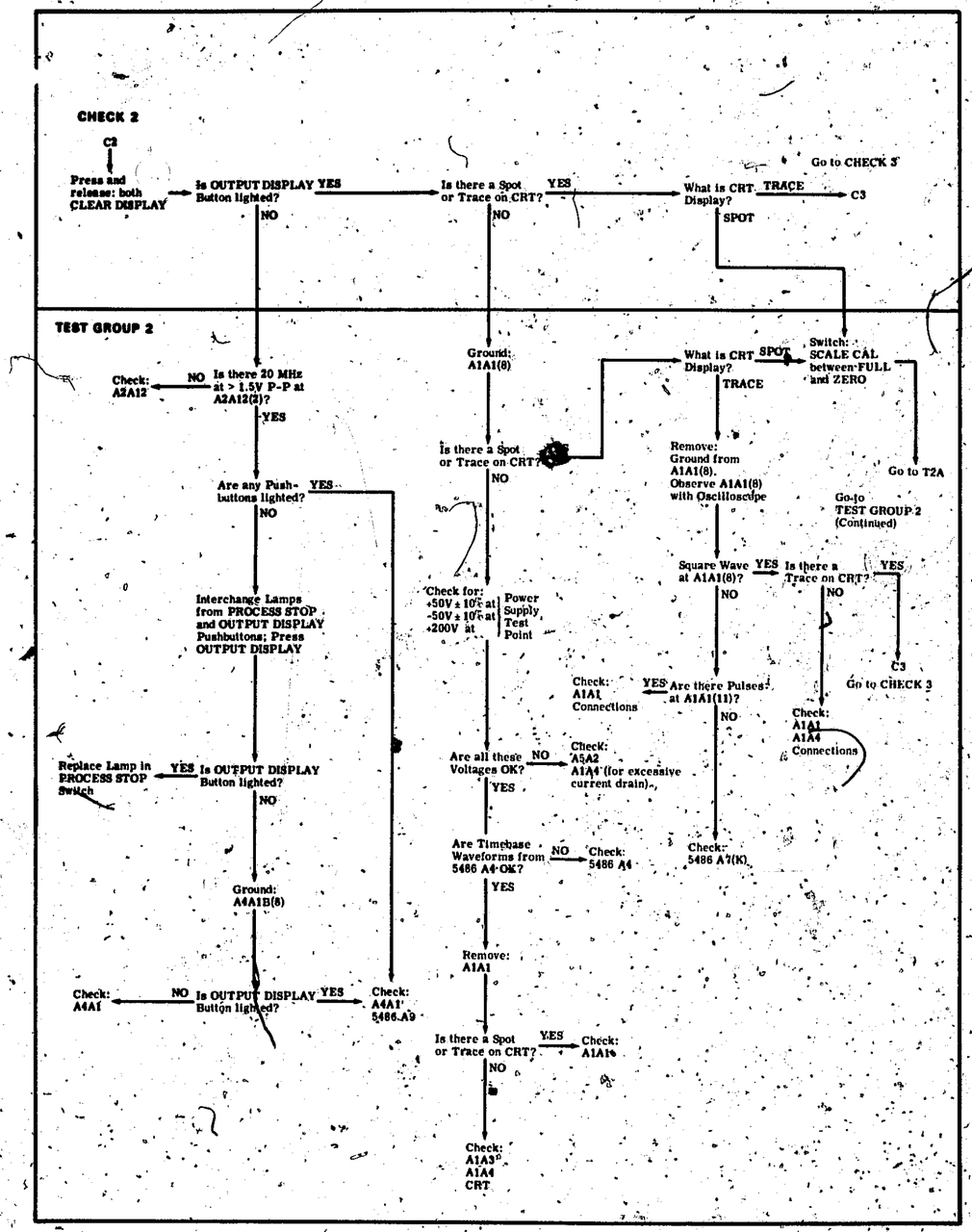

Table 4-1. Troubleshooting

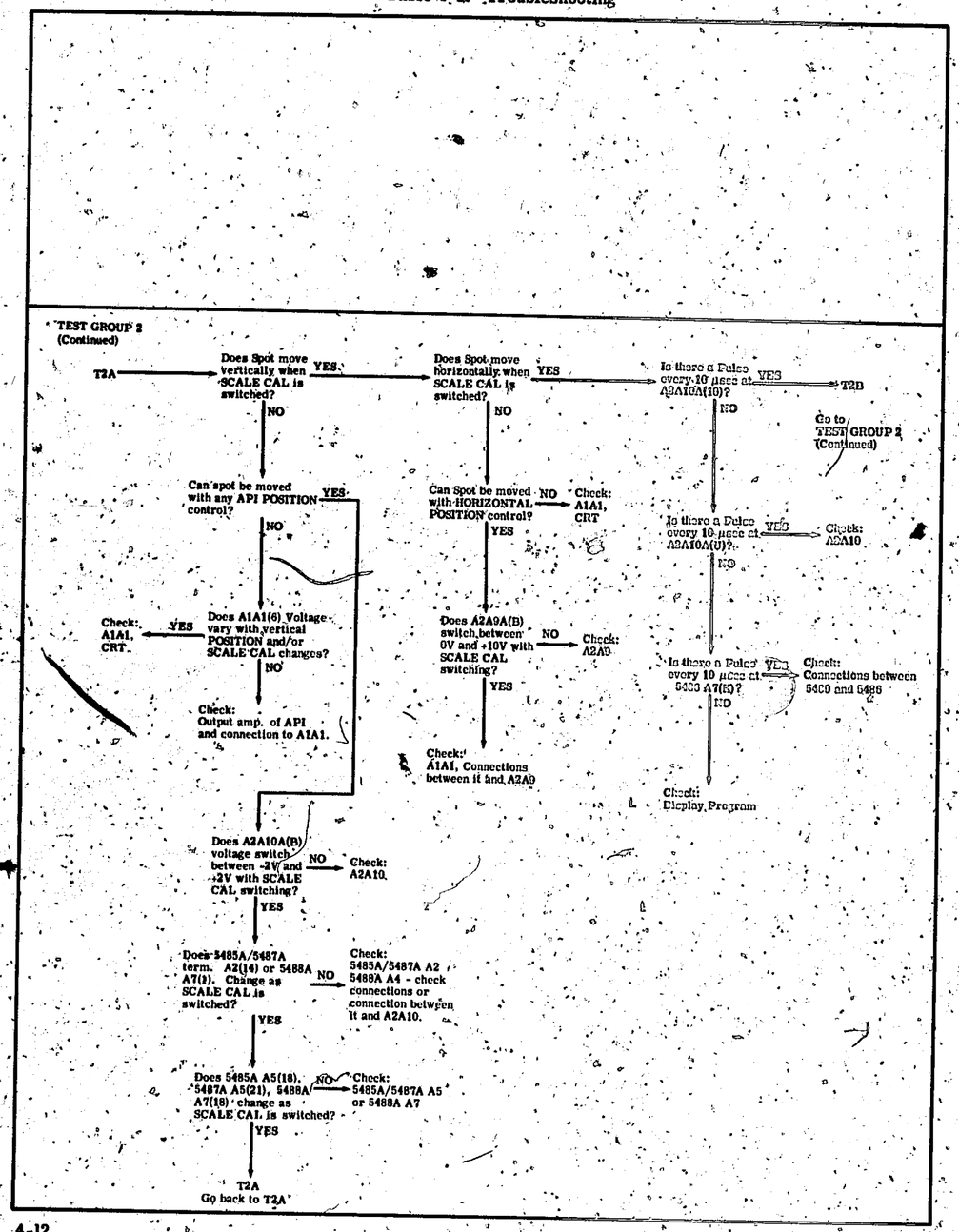

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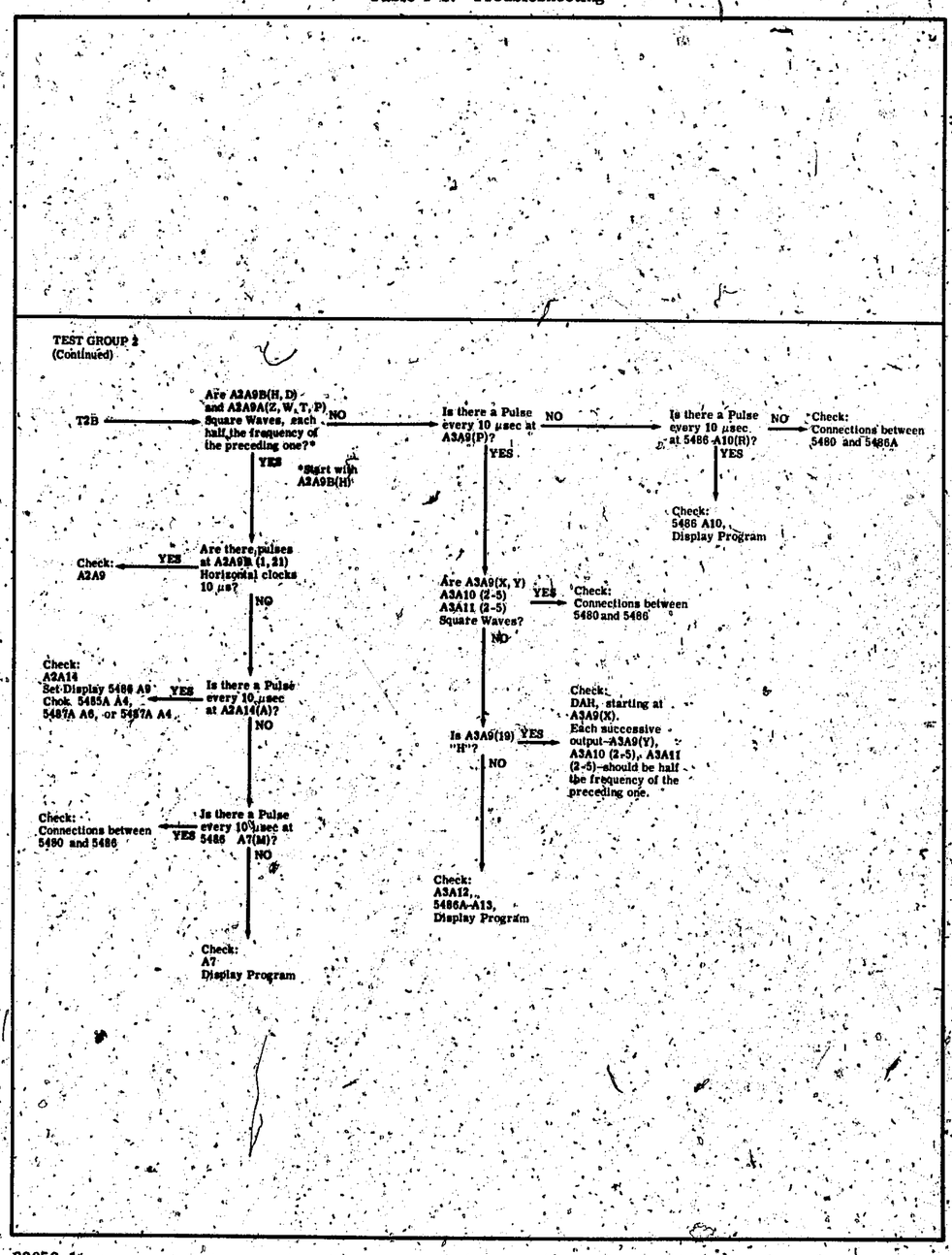
Table 4-1. Troubleshooting



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