HEWLETT hp PACKARD

Signal Analyzer System
Operating and Service Manual
05480-90021 (Manual)
June 1975

Model 5480A/B
Serial Pfx – All
05480-90025 (Fiche)
3 of 5

CHECK

ADJUSTMENTS

CON'T

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.

C. Test record which provides a place to record the results of each test. This test record may be kept as a reference against which later performance checks can be compared.

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	Model 180A with
Vertical Sensitivity: 5 mV/cm Sweep Speeds: 0.1 μsec/cm to 100 msec/cm Intensity modulation capability	Model 1801A Dual Channel Vertical Amplifier and Model 1820 Time Base Plug-ins
Pulse Generator	Model 222A
Repetition rate 1K to 1M Pulse width 0.5 μsec Positive polarity Amplitude 2V	
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:

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 1 sec/cm
SENSITIVITY MULTIPLIER to AUTO
PRESET TOTALIZER to OFF

5490A/B:

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

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

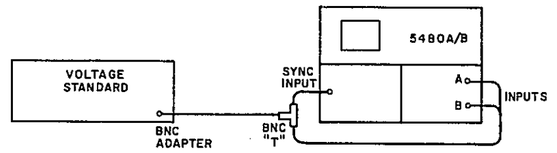
B. PROCEDURE (Cont'd)

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.

Observe trace. Should be clipped sinewave with no "rain." Rain is many dots moving randomly up or down in the CRT display.

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 J36 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.

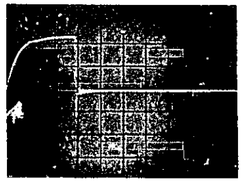
Observe oscilloscope. Positive pulse occurs during time OUTPUT RECORD button is lighted. OUTPUT RECORD stays lighted for about 1 second (10 times SWEEP TIME setting). Pulse should resemble one shown in waveform E. Disconnect oscilloscope from POINT PLOTTER SEEK output.

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

B. PROCEDURE (Cont'd)

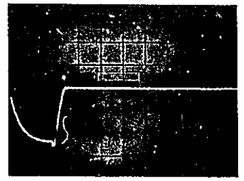
OSCILLOGRAMS

Pos Sync Output



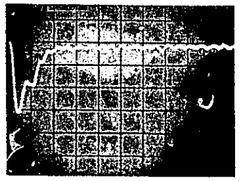
A. V = 5V/cm
H = 0.5 μsec/cm
0V = vertical centerline

Neg Sync Output



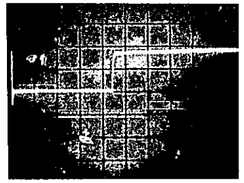
B. V = 5V/cm
H = 0.5 μsec/cm
0V = vertical centerline

Sample Output



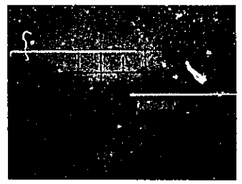
C. V = 2V/cm
H = 0.1 μsec/cm
0V = vertical centerline

Z-Axis Output



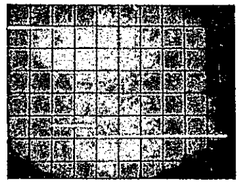
D. V = 2V/cm
H = 1 μsec/cm
0V = vertical centerline

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 5480A controls as follows:

SWEEP TIME to EXT

Push OUTPUT RECORD button.

Observe 5480A/B 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)

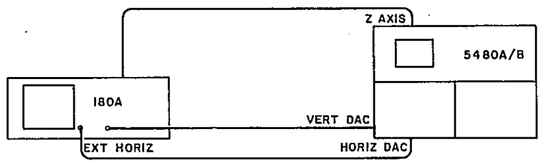
58. Connect Pulse Generator to SAMPLE INPUT. Press both CLEAR DISPLAY pushbuttons. Press PROCESS START button. Observe CRT. Dot sweeps across CRT in about 1 to 2 seconds. Disconnect Pulse Generator from SAMPLE INPUT.

59. Connect Pulse Generator to 5486B TREND ANALYSIS INPUT. Change Pulse Generator REP RATE to 100k–1M. Set 5480A/B controls as follows:

TRIGGER SOURCE TO INTERVAL
SWEEP TIME to 10 sec/cm
FUNCTION to TREND ANALYSIS
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 F, appears, TREND ANALYSIS works. Disconnect all signal leads from 5480A/B 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
TIME INTERVAL CONTROL to SINGLE
SWEEP TIME to 1 msec/cm
SENSITIVITY MULTIPLIER to 10
Press both CLEAR DISPLAY pushbuttons
Press PROCESS START button

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

Change TIME INTERVAL CONTROL to SEP

Dots should stop rising above baseline.

Connect Voltmeter Calibrator output to both 5486B connectors (START and START/STOP) through a "T" connector.

Display should now show one to three dots rising from baseline, approximately 1.25 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/B 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/B 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

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

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

C. TEST RECORD

HP Model 5480A/B Signal Analyzer System
(cross out letters or numbers that don't apply)

Tests performed by _____
Date _____

HP Model 5480A/B Memory/Display
Serial No. _____ -- _____ Other ID _____

Analog Plug-in unit (5485A, 5487A, 5488A)
Serial No. _____ -- _____ Other ID _____

HP Model 5486A/B Control
Serial No. _____ -- _____ Other ID _____

Step*	Description	Test Results
	*Step refers to number in part B. PROCEDURE	
1.	Initial Control Settings	1. _____
2.	Turn-on	2. POWER lamp lighted _____ RESET lamp off _____ PROCESS STOP lighted _____
3.	CLEAR DISPLAY	3. OUTPUT DISPLAY lighted _____ CRT Display _____
4.	A POSITION	4. One trace moves _____
5.	B POSITION	5. Second trace moves _____
6.	(5487A only) C and D POSITIONS	6. Remaining two traces move _____
7.	(5487A only) MEMORY to HALF	7. _____
8.	FOCUS	8. Traces < 0.2cm wide _____
9.	MAGNIFIER to X5	9. 10 dots/cm A _____ B _____
10.	HORIZONTAL POSITION	10. See both ends of trace _____
11.	(5485A, 5488A only) Channel A MEMORY SELECTOR	11. QUARTER 1 _____ 2 _____ 3 _____ 4 _____
12.	(5485A, 5488A only) Channel B MEMORY SELECTOR	12. QUARTER 1 _____ 2 _____ 3 _____ 4 _____
13.	(5487A only) QUARTERS, all channels ON	13. Each trace has 5 dots/cm _____

Channel priority check

MEMORY	CHANNEL(S) ON	SWITCHED OFF	Trace(s) displayed
FULL	ABCD	none	A only _____
FULL	BCD	A only	B only _____
FULL	CD	AB	C only _____
FULL	D only	ABC	D only _____

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

C. TEST RECORD (Cont'd)

Step*	Description	Test Result
13. (Cont'd)	MEMORY / CHANNEL(S) ON / SWITCHED OFF	Trace(s) displayed
	HALF / ABCD / none	A and B only _____
	HALF / BCD / A	B and C only _____
	HALF / CD / AB	C and D only _____
	HALF / ACD / B only	A and C only _____
	HALF / AD / BC	A and D only _____
	HALF / BD / AC	B and D only _____
	MEMORY SELECTOR to FULL	MEMORY _____
	All ON/OFF switches to ON	ON/OFF _____
14.	(5485A, 5488A only) Set controls	14. _____
15.	Set 5480A/B Controls	15. _____
16.	DC Bal or DC BAL A+B	16. Minimal offset _____
17.	(5485A only)	17. _____
	a. Channel A POLARITY reversal	a. Minimal offset (<0.2 cm) ____
	b. Channel B POLARITY reversal	b. Minimal offset (<0.2 cm) ____
	c. DC BAL A	c. Minimal offset _____
	d. DC BAL B	d. Minimal offset _____
	e. A DISPLAY ON	e. _____
18.	SENSITIVITY MULTIPLIER	18. No change in size switching between AUTO and "O" Vertical spacing between dots changes by factor of 2 when switching between following positions 0-1 _____ 10-11 _____ 1-2 _____ 11-12 _____ 2-3 _____ 12-13 _____ 3-4 _____ 13-14 _____ 4-5 _____ 14-15 _____ 5-6 _____ 15-16 _____ 6-7 _____ 16-17 _____ 7-8 _____ 17-18 _____ 8-9 _____ 18-19 _____ 9-10 _____
19.	INTERLACE DISPLAY OUT	19. Trace flickers _____
20.	Increase SWEEP TIME	20. Dot moves more slowly _____
21.	PRE-ANALYSIS DELAY to 0.5 sec	21. Trace flickers about twice/second _____
22.	PRE-ANALYSIS DELAY to 0.2 sec, 0.1 sec, 50 msec, 20 msec	22. Flicker rate increases _____
23.	PRE-ANALYSIS DELAY to 10 msec, 5 msec	23. Trace brightens _____
24.	POST-ANALYSIS DELAY	24. Flicker rate depends on POST-ANALYSIS DELAY setting _____

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

C. TEST RECORD (Cont'd)

Step*	Description	Test Result
25.	TRIGGER SOURCE to LINE	25. Flicker rate depends on POST-ANALYSIS DELAY setting_____
26.	SWEEP NUMBER counter	26. N=0, count = 1_____
27.	SWEEP NUMBER counter	27. N=1, count =_____ N=2, count =_____ N=3, count =_____ N=4, count =_____ N=5, count =_____ N=6, count =_____ N=7, count =_____ N=8, count =_____ N=9, count =_____ N=10, count =_____
28.	Perform test setup	28. _____
29.	(5485A only) Attenuator calibration CHANNEL A 0.005 V, UP- UP+ CHANNEL B, 0.005 V, UP- UP+	29. Trace moves to bottom of screen _____ Trace moves to top of screen_____ Trace moves to bottom of screen_____ Trace moves to top of screen_____
30.	(5487A and 5488A only) Attenuator calibration CHANNEL A, 0.05 V, +200 mV input -200 mV input CHANNEL B, 0.05 V, +200 mV input -200 mV input (5487A only) CHANNEL C, 0.05V, +200 mV input -200 mV input CHANNEL D, 0.05V, +200 mV input -200 mV input	30. _____ Trace moves to top of screen_____ Trace moves to bottom of screen_____ Trace moves to top of screen_____ Trace moves to bottom of screen_____ Trace moves to top of screen _____ Trace moves to bottom of screen_____ Trace moves to top of screen_____ Trace moves to bottom of screen_____
31.	All DISPLAY switches to DATA or ON	31. _____
32.	(5485A only) Attenuator calibration	32. CHANNEL A CHANNEL B .01V/CM_____ _____ .02V/CM_____ _____ .05V/CM_____ _____
33.	Change control settings	33. _____
34.	Observe trace	34. Stable sinewave 5 ±.2 cm high_____
35.	Channel A SENSITIVITY VERNIER CCW	35. Sinewave height <2 cm._____

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

C. TEST RECORD (Cont'd)

Step*	Description	Test Result
36.	Channel A SENSITIVITY VERNIER to CAL.	36. _____
37.	Attenuator calibration	37. 0.2V/CM 0.5V/CM 1 V/CM 2 V/CM 5 V/CM 10 V/CM 20 V/CM
38.	Repeat steps 34-37 for Channel B Observe trace SENSITIVITY VERNIER CCW SENSITIVITY VERNIER to CAL. Attenuator calibration	38. Stable sinewave 5±.2cm high_____ Sinewave height <2 cm_____ 0.2V/CM 0.5V/CM 1 V/CM 2 V/CM 5 V/CM 10 V/CM 20 V/CM
39.	(5487A only) Repeat steps 34-37 for Channels C and D. Observe trace SENSITIVITY VERNIER CCW SENSITIVITY VERNIER to CAL. Attenuator Calibration	39. CHANNEL: C D Stable sinewave 5±0.2 cm high_____ _____ Sinewave height <2 cm_____ _____ 0.1 V/CM . . . . ._____ _____ 0.2 V/CM . . . . ._____ _____ 0.5 V/CM . . . . ._____ _____ 1V/CM . . . . ._____ _____ 2 V/CM . . . . ._____ _____ 5 V/CM . . . . ._____ _____ 10V/CM . . . . ._____ _____ 20V/CM . . . . ._____ _____
40.	PRE-ANALYSIS DELAY Observe phase of sinewave change	40. 20 µs_____ 50 µs_____ .1 ms_____ .2 ms_____ .5 ms_____ 1 ms_____ 2 ms_____
41.	TRIGGER SOURCE to EXTERNAL -	41. Initial phase of displayed sinewave reverses_____
42.	Change control setting	42. _____
43.	Change control settings. Observe trace	43. Pattern grows, divides by two, etc._____
44.	Change SENSITIVITY MULTIPLIER to 10.	44. Trace is sinewave 0.5 ±0.2 cm high._____

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

C. TEST RECORD (Cont'd)

Step*	Description	Test Result
45.	SENSITIVITY MULTIPLIER to 11 through 15	45. Amplitude of sinewave changes by a factor of two when switching between the following positions: 10-11_____ 11-12_____ 12-13_____ 13-14_____ 14-15_____
46.	Channel A DISPLAY to INPUT	46. Trace flickers_____
47.	Channel A DISPLAY to NOISE	47. Trace flickers_____
48.	SWEEP TIME to 10 msec	48. Flicker rate is half that of steps 46 and 47_____
49.	Memory overload in AVERAGE	49. Display is clipped sine wave with no "rain"_____
50.	Connect oscilloscope (POS SYNC OUTPUT)	50. Positive pulse_____ Amplitude_____
51.		51. Width at base_____ Baseline level_____
52.	NEG SYNC OUTPUT	52. Negative pulse_____ Amplitude_____ Width at base_____ Baseline level_____
53.	SAMPLE OUTPUT	53. Negative pulse_____ Amplitude_____ Width at base_____ Baseline level_____
54.	Z AXIS OUTPUT	54. Negative pulse_____ Amplitude_____ Width at base_____ Baseline level_____
55.	PEN LIFT (J36, pin 4) continuity.	55. Resistance to ground is Oohm each time OUTPUT RECORD is pressed_____
56.	POINT PLOTTER SEEK (J36, pin 13)	56. Positive pulse while OUTPUT RECORD is lighted_____
57.	POINT PLOTTER PLOT	57. Dot on CRT_____ PROCESS STOP lights_____
58.	SAMPLE INPUT	58. Dot on CRT_____
59.	TREND ANALYSIS	59. Two-step waveform_____
60.	External Oscilloscope (DAC, Z OUTPUTS)	60. External Oscilloscope and 5480A/B display same picture_____
61.	External Oscilloscope (SCOPE OUTPUT)	61. 5480A/B VERTICAL POSITION controls control external oscilloscope vertical position_____

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

C. TEST RECORD (Cont'd)

Step*	Description	Test Result
62.	TIME HISTOGRAM	62. SINGLE input: dot(s) 2.5 cm from left side of trace_____ SEP inputs: dot(s) 1.25 cm from left side of trace_____
63.	FREQUENCY HISTOGRAM	63. Dot 0.2 cm from left side of trace_____
64.	SWEEP VOLTAGE OUTPUT	64. Ramp height_____ Ramp linearity_____

TROUBLE-SHOOTING

SECTION IV
TROUBLESHOOTING

4.1. GENERAL

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.

4.2. TROUBLESHOOTING AIDS

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

4.3. TIMING DIAGRAMS

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.

4.4. WIRING INFORMATION

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.

4.5. REPLACEMENT PARTS, SERVICE KITS

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.

NOTE: On 5480B's, beginning with serials prefixed 1108A, and on 5486B's, beginning with serials prefixed 1104A, the MCS INPUT via 5480B rear-panel connector is replaced by TREND ANALYSIS input via 5486B front-panel connector. In all other respects, TREND ANALYSIS and MCS operate identically; generally you may substitute TREND ANALYSIS wherever MCS appears in this section.

Model 5480A/B

Section IV

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
TIME INTERVAL CONTROL to SINGLE

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 4 pages provide all the same information as that in the CHECKS portions of the diagrams on pages 4-9 through 4-49. 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, TIME INTERVAL control to SINGLE 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 baseling? 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 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?

Table 4-1. Troubleshooting

D. TROUBLESHOOTING PROCEDURE

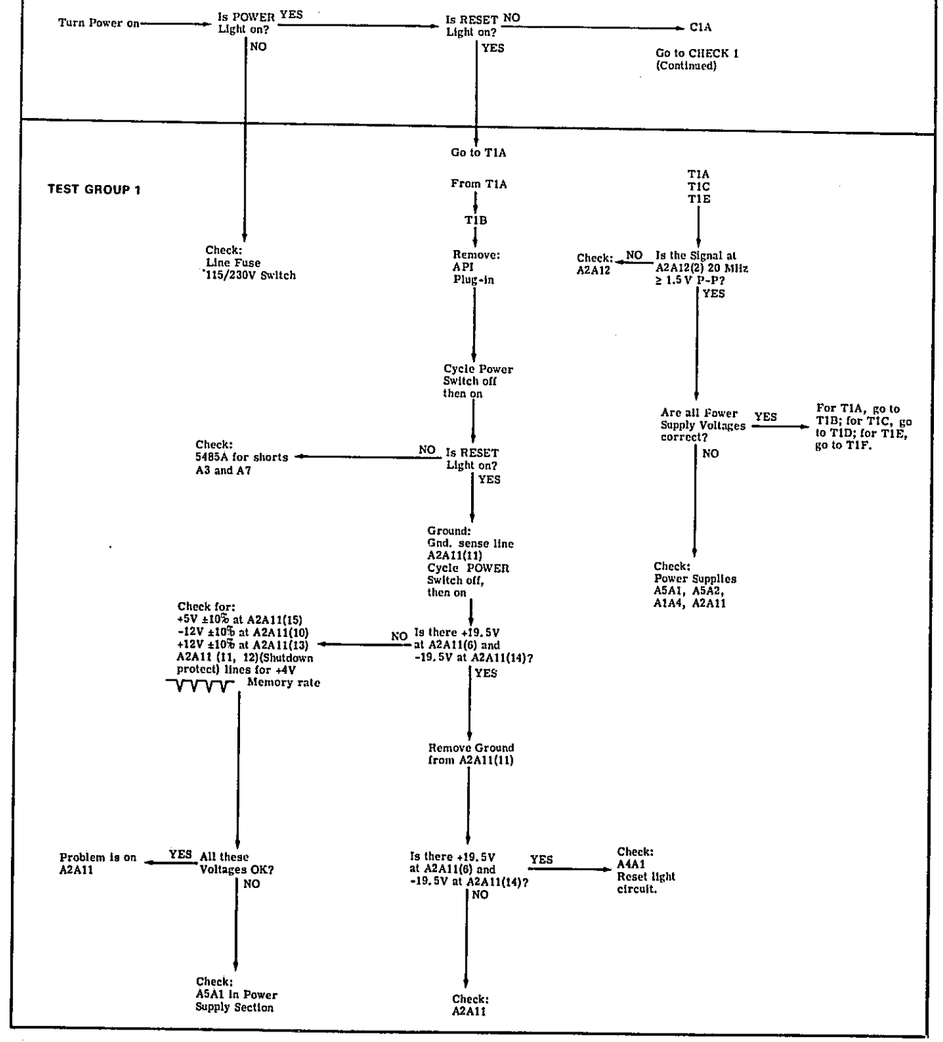


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Table 4-1. Troubleshooting

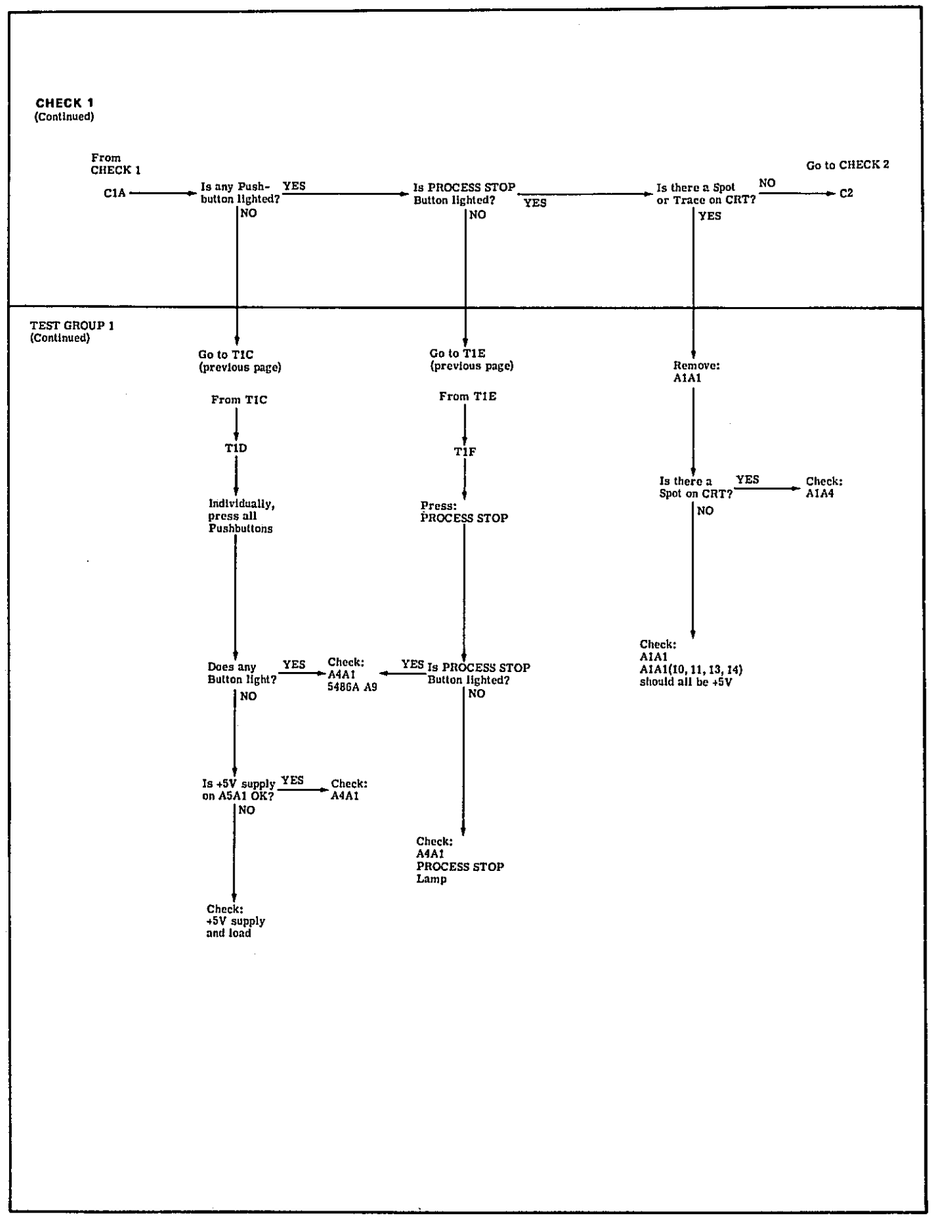

Table 4-1. Troubleshooting

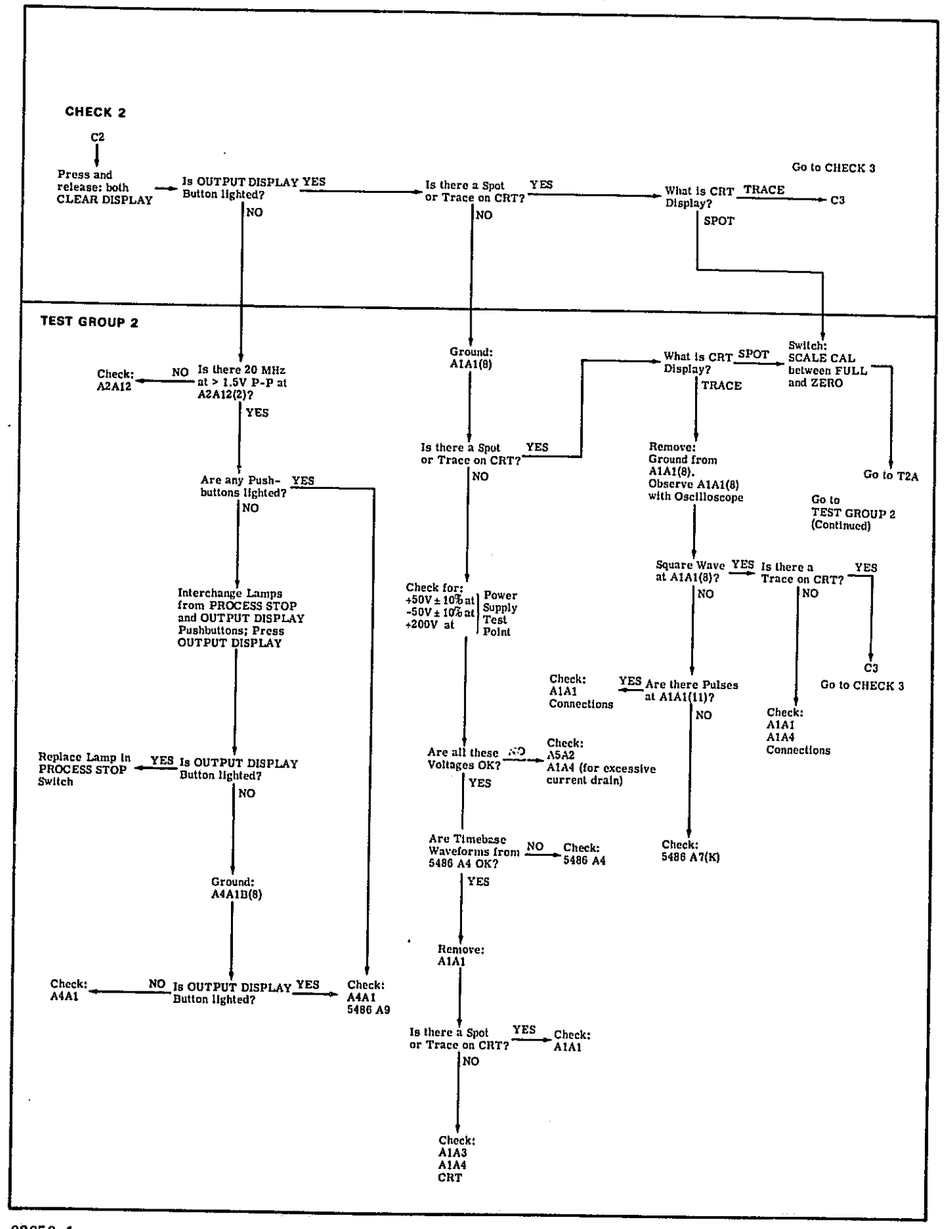

Table 4-1. Troubleshooting

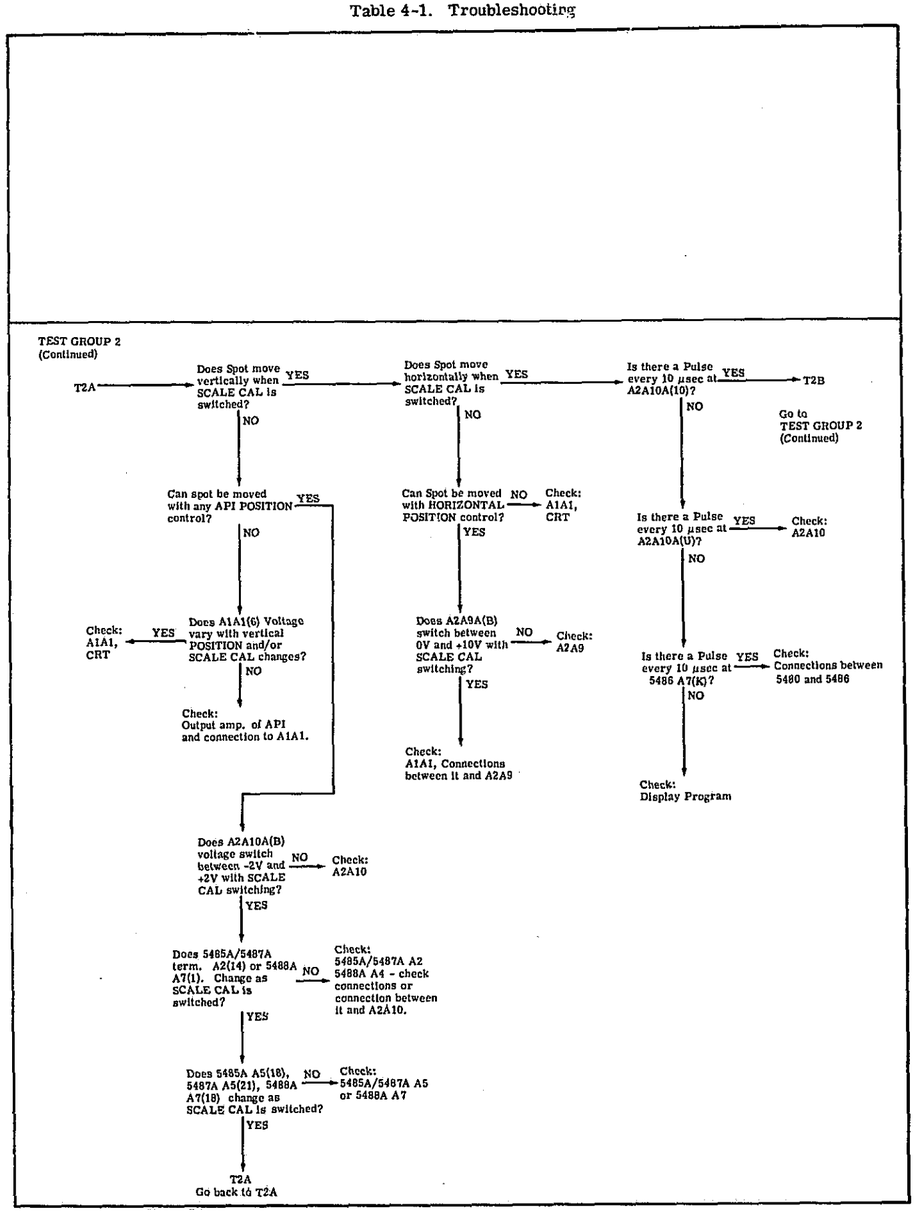

Table 4-1. Troubleshooting

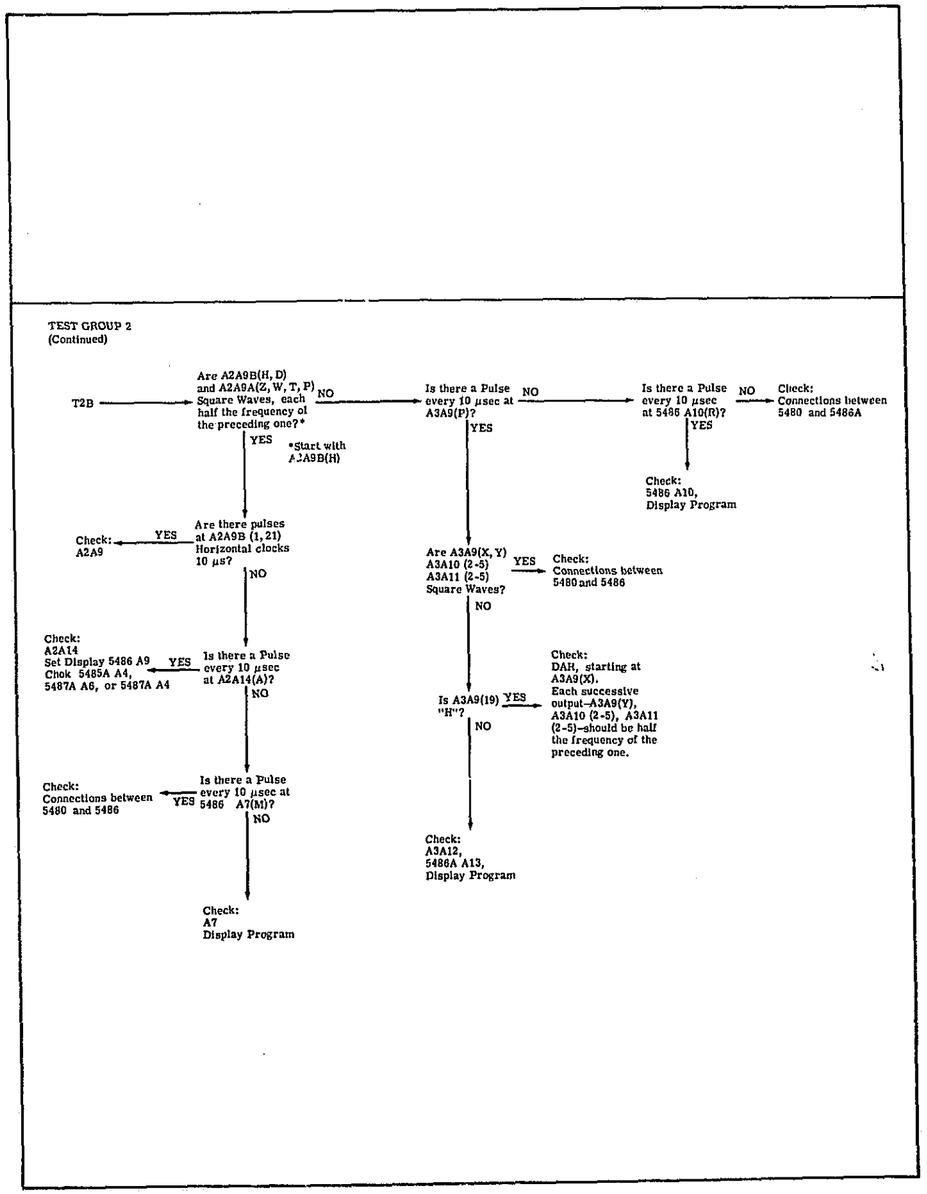

Table 4-1. Troubleshooting

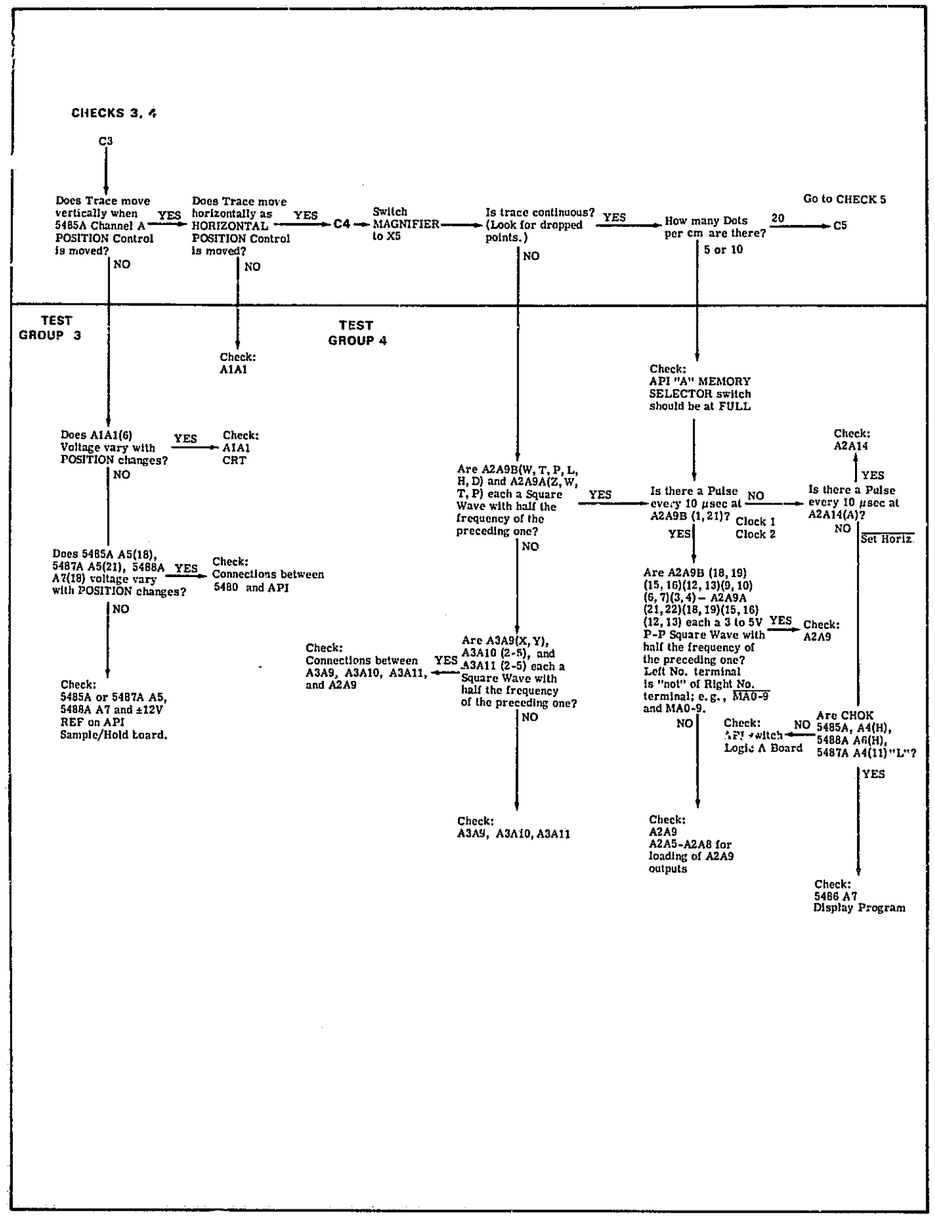

Table 4-1. Troubleshooting

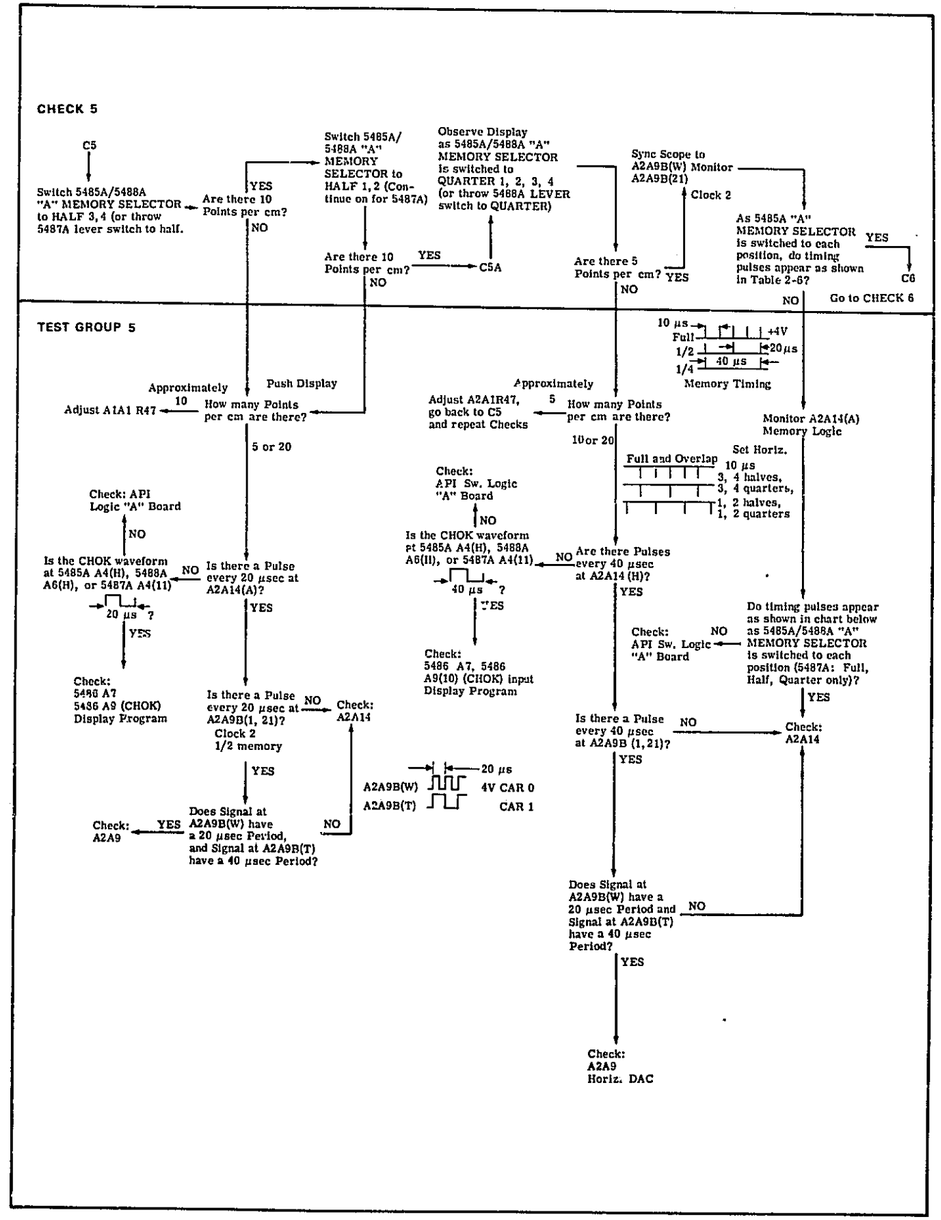

Table 4-1. Troubleshooting

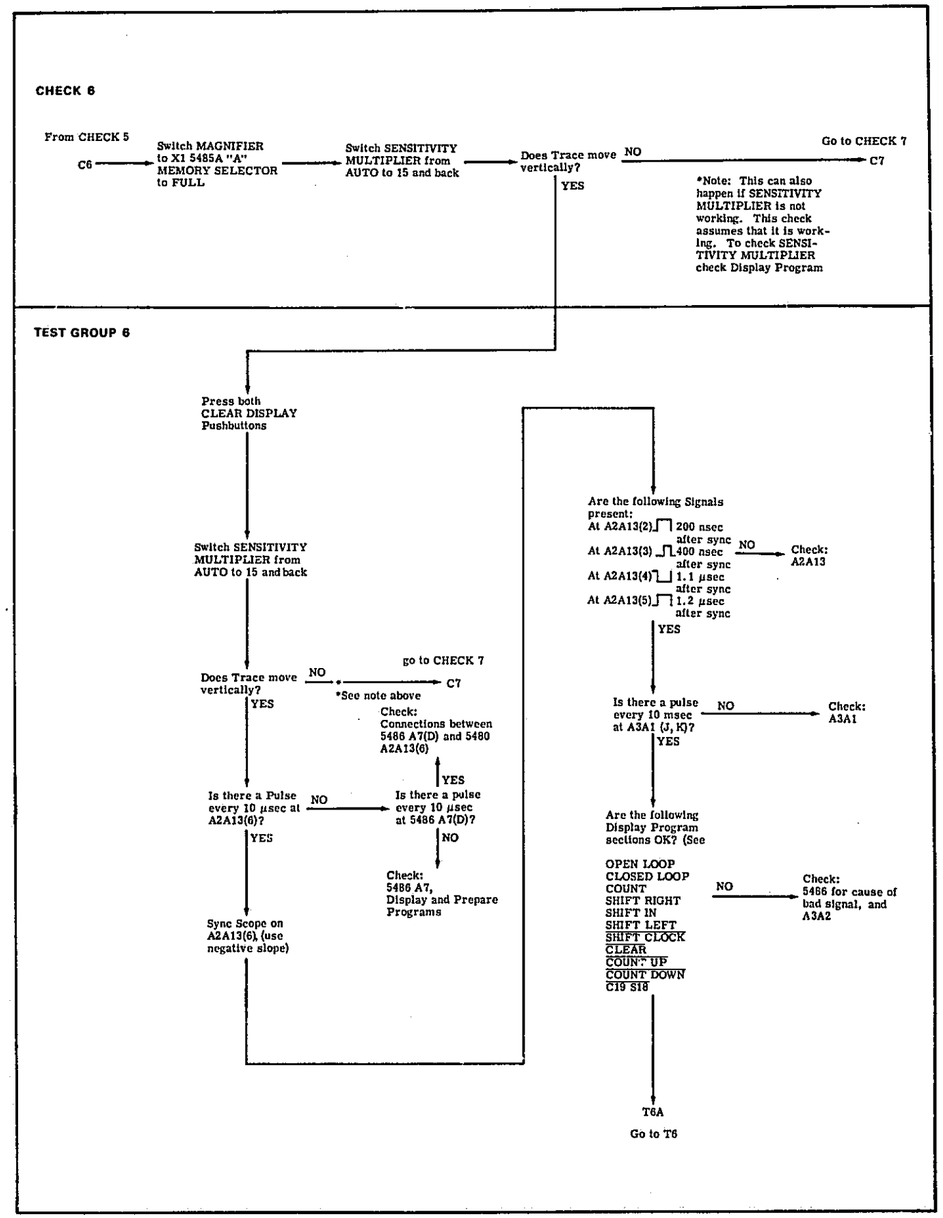

Table 4-1. Troubleshooting

T6A

All of the following tests should be performed to determine how correctly the 5480A/B System is operating. Even if any test is failed, you should proceed on to completion of all tests before going back to troubleshoot the suspected circuit area.

T6B **Memory Operation**

Set SENSITIVITY MULTIPLIER to '0'.
Press both CLEAR DISPLAY buttons.
Momentarily short A2A9A(21) to A2A1A(22).
5480A/B CRT should display a square wave.

T6C **Memory-Accumulator Loop**

Set SENSITIVITY MULTIPLIER to '0'.
Press both CLEAR DISPLAY buttons.
Sync oscilloscope to A2A13(6).
Monitor A2A2A(5).
Momentarily short A2A1A(5) to ground.
Pulses should appear on A2A2A(5).
Momentarily short A2A2A(5) to ground.
Pulse at A2A2A(5) should disappear, and level go "L".
Monitor and short the following points. In each case, there should be a pulse that disappears when the correct point is shorted, and the monitored signal level should go "L".

MONITOR	SHORT
A2A2A(6)	A2A1A(6)
(11)	(11)
(12)	(12)
(15) thru (22)	(15) thru (22)
A2A4A(5)	A2A3A(5)
(6)	(6)
(11)	(11)
(12)	(12)
(15) thru (22)	(15) thru (22)

Troubleshooting Hints for T6C

This test locates the bit(s) which are not cleared when the CLEAR DISPLAY buttons are pressed. It also locates bits which are otherwise not operating properly.

Boards can be swapped within the accumulator circuit and within the memory section, as a way to isolate a problem or provide an additional test.

Table 4-1. Troubleshooting

T6C (Continued)

Example: A problem is detected while monitoring A2A2A(17) and shorting A2A1A(17).
A2A2 and A2A4 are swapped, but the problem remains.
A2A1 and A2A3 are swapped, but the problem remains.

It must now be assumed that A2A2 and A2A4 were OK. Therefore, the problem is either in the Memory Core Stack (A2A15) or in the Accumulator circuit.

Each of the six Accumulator boards handles four data bits.

Each Sense Amplifier board and each Inhibit Generator board handles 12 data bits.

Any one data bit is associated with only one Accumulator board locations, only one Inhibit Generator location and only one Sense Amplifier location. Inhibit Generator boards, or Sense Amplifier boards can be swapped (making only one swap at a time), to ascertain whether the problem moves to a different bit, and thus isolate the problem to one of these boards. The table below shows which board assemblies handle which data bits. Identifying a faulty Accumulator board must be handled differently. This is because all of these boards are not identical. Boards A3A4, A3A5, A3A6, and A3A7 are identical and can be swapped if desired.

DATA BITS	ACCUMULATOR BOARD	SENSE AMPLIFIER BOARD	INHIBIT GENERATOR BOARD
0–3	A3A3	A2A3	A2A4
4–7	A3A4	A2A3	A2A4
8–11	A3A5	A2A3	A2A4
12–15	A3A6	A2A1	A2A2
16–19	A3A7	A2A1	A2A2
20–23	A3A8	A2A1	A2A2

Most bits at fault can be identified by using the SENSITIVITY MULTIPLIER switch, the CRT display and the chart below. The switch is rotated until the deflection of the CRT trace is 1 cm from its Clear Display position with input SENSITIVITY VERNIERS on CAL. Then find the corresponding bits/cm vs. switch position from the chart below. The faulty bit; e.g., AC1, AC2, or AC3, can then be found on the schematic diagram in 5480A/B Service Manual, Volume II.

SWITCH POSITION	1	2	3	4	5	6	7	8
BIT	AC19	AC18	AC17	AC16	AC15	AC14	AC13	AC12
SWITCH POSITION	9	10	11	12	13	14	15	
BIT	AC11	AC10	AC9	AC8	AC7	AC6	AC5	

Bits 0 – 4 and 19 – 23 cannot be identified in this manner. To check these use an HP logic probe or a dc coupled oscilloscope. Clear display, press PROCESS STOP, and check for logic "lows" on terminals:

20, 21, X, Y of boards A3A3, A3A8;
20 of board A3A4; and
Y of board A3A7

Table 4-1. Troubleshooting

T6D **Shift Left**

Set SENSITIVITY MULTIPLIER to '0'.
Press both CLEAR DISPLAY buttons.
Momentarily short A2A3A(5) to ground.
Monitor A2A4A(5) with scope, display should be a series of negative pulses.
Monitor A2A4A(6). Level should be "L".
Rotate SENSITIVITY MULTIPLIER one position (to "1").
Signal at A2A4A(6) should become a series of negative pulses.

Monitor the following additional points. As SENSITIVITY MULTIPLIER is switched to indicated number, monitored signal should change from "L" to a pulse train.

MONITOR	SENSITIVITY MULTIPLIER Setting (N)
A2A4A(11)	2
(12)	3
(15) thru (22)	4 thru 11
A2A2A(5)	12
(6)	13
(11)	14
(12)	15

Return SENSITIVITY MULTIPLIER to '0'.
Press both CLEAR DISPLAY buttons.
Momentarily short A2A1A(5).
Monitor A2A2A(5) with scope, display should be a series of negative pulses.
Monitor A2A2A(6). Level should be "L".
Rotate SENSITIVITY MULTIPLIER one position (to "1").

Signal at A2A2A(6) should be H

Monitor the following additional points. As SENSITIVITY MULTIPLIER is switched to indicated number, monitored signal should change from "L" to

MONITOR	SENSITIVITY MULTIPLIER Setting (N)
A2A2A(11)	2
(12)	3
(15) thru (22)	4 thru 11
A2A4A(5)	12
(6)	13
(11)	14
(12)	15

Table 4-1. Troubleshooting

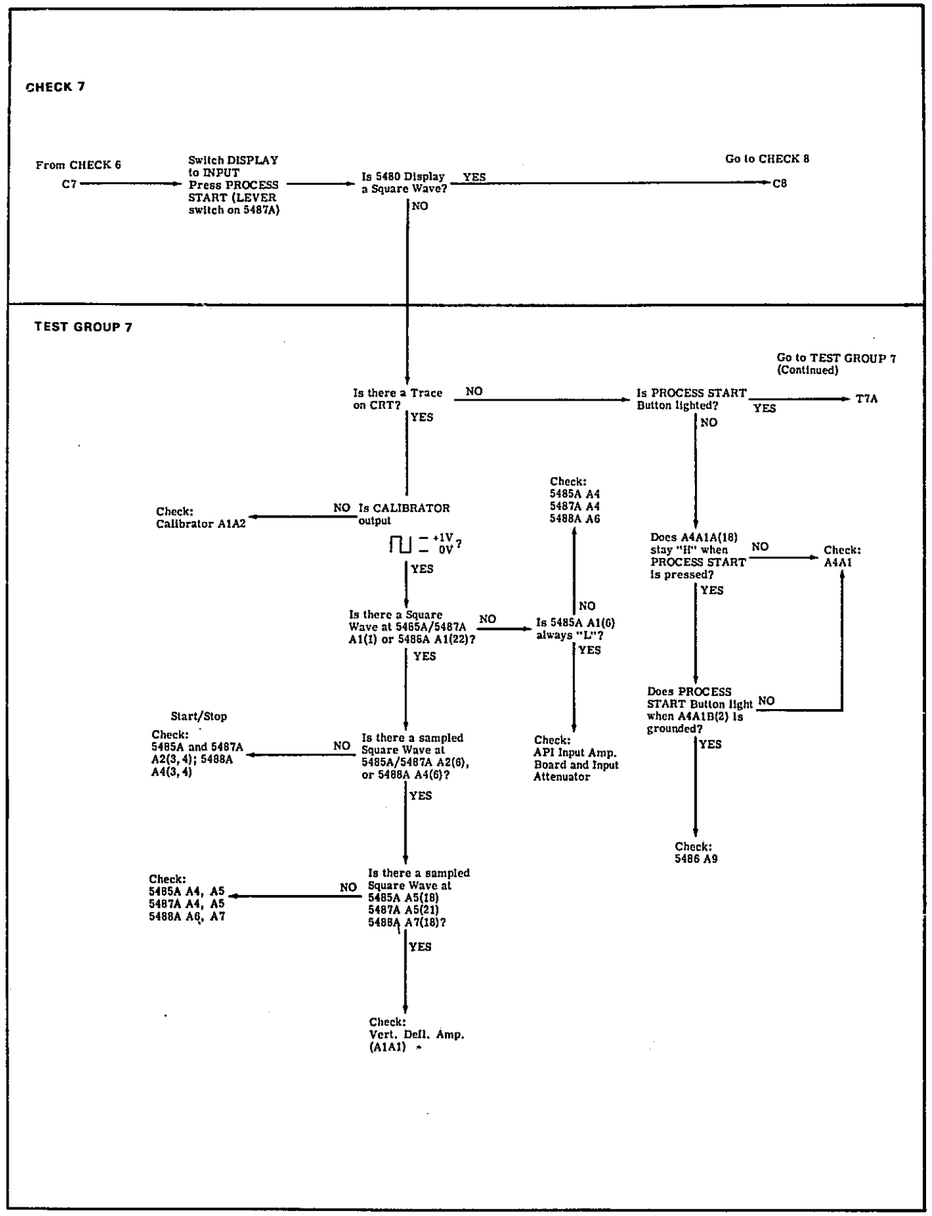

Table 4-1. Troubleshooting

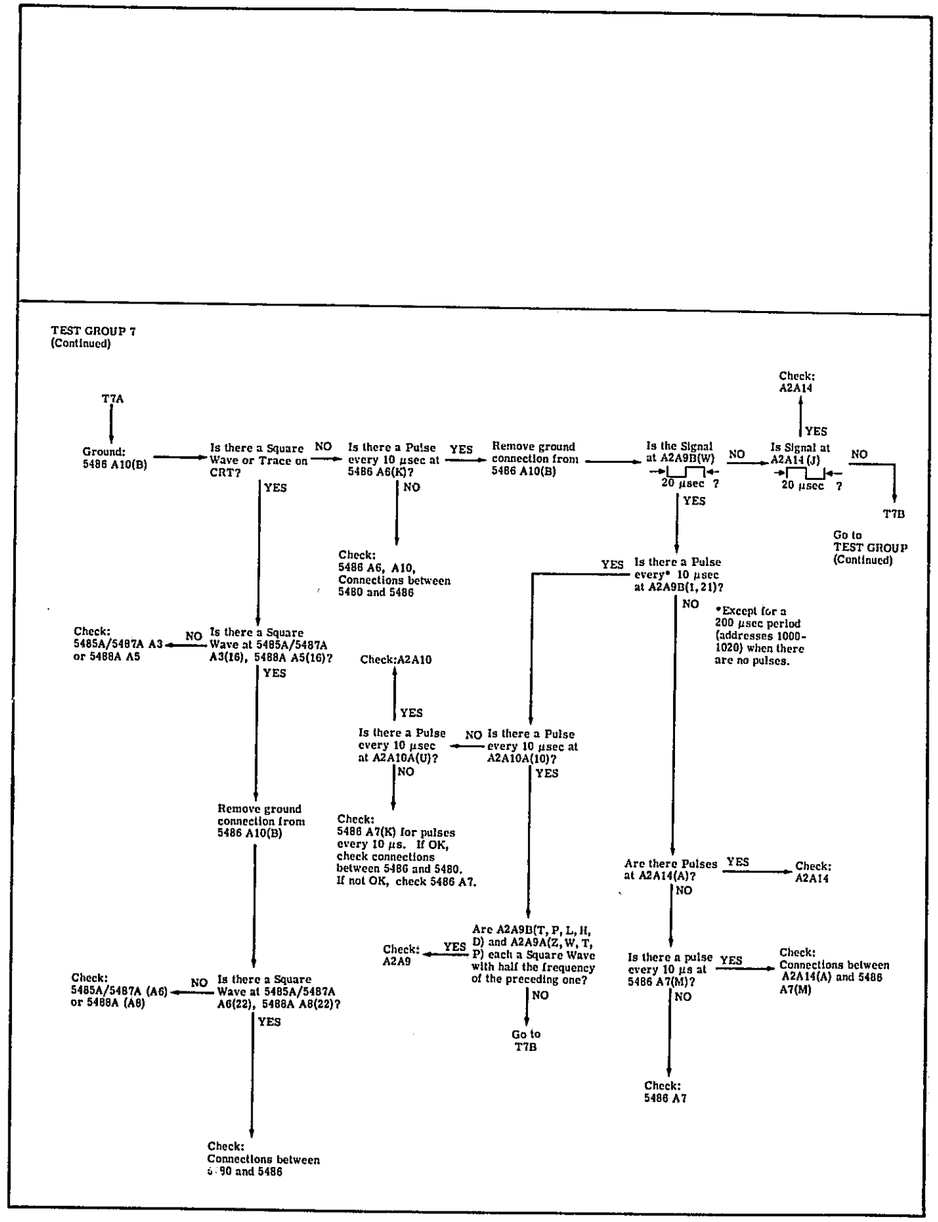

Table 4-1. Troubleshooting

TEST GROUP 7
(Continued)

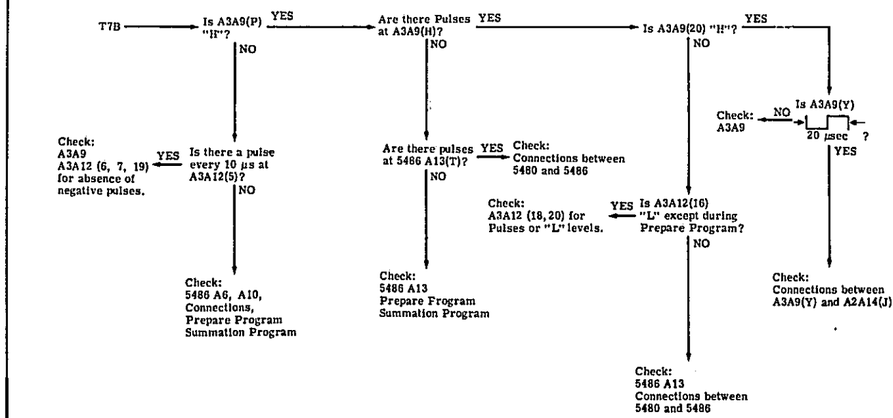

Table 4-1. Troubleshooting

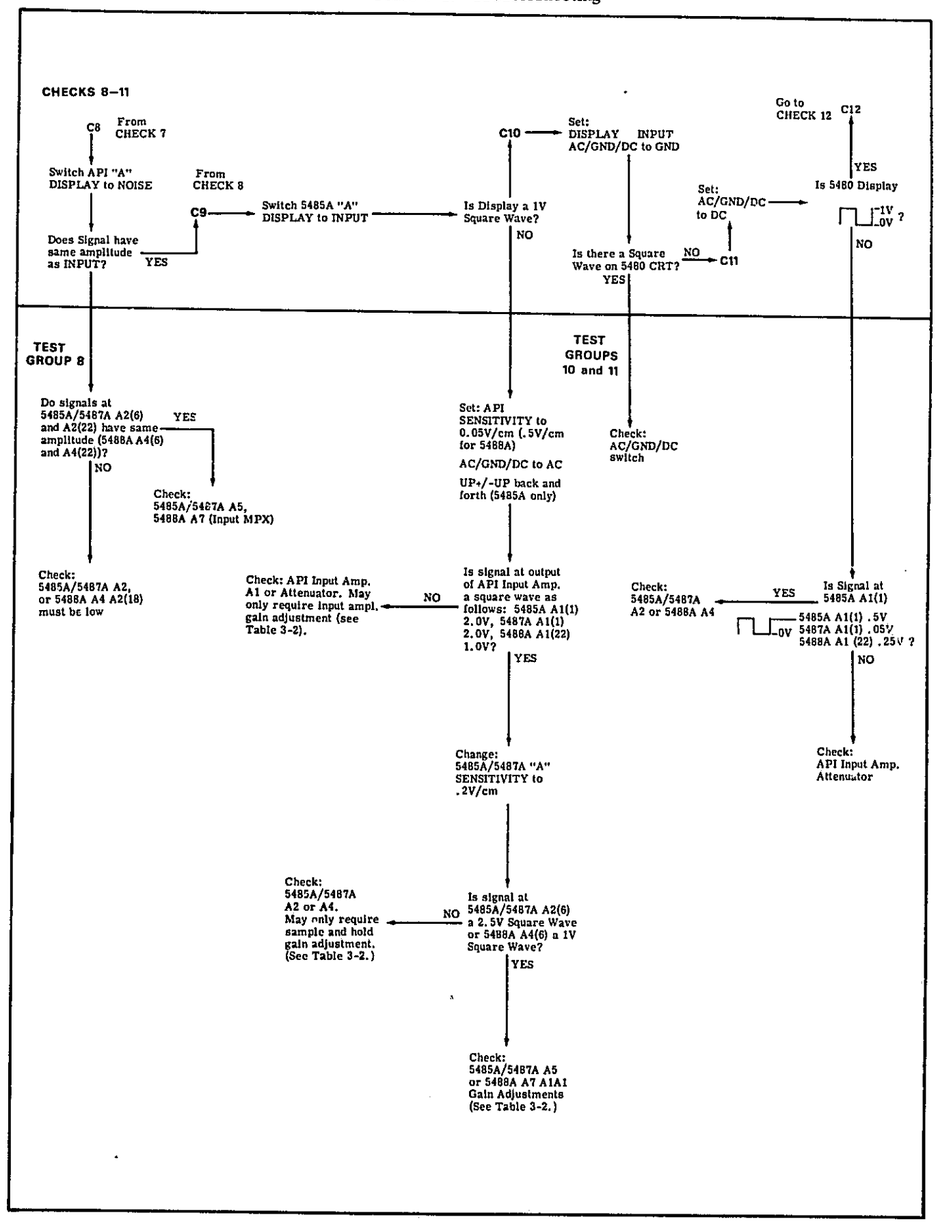

Table 4-1. Troubleshooting

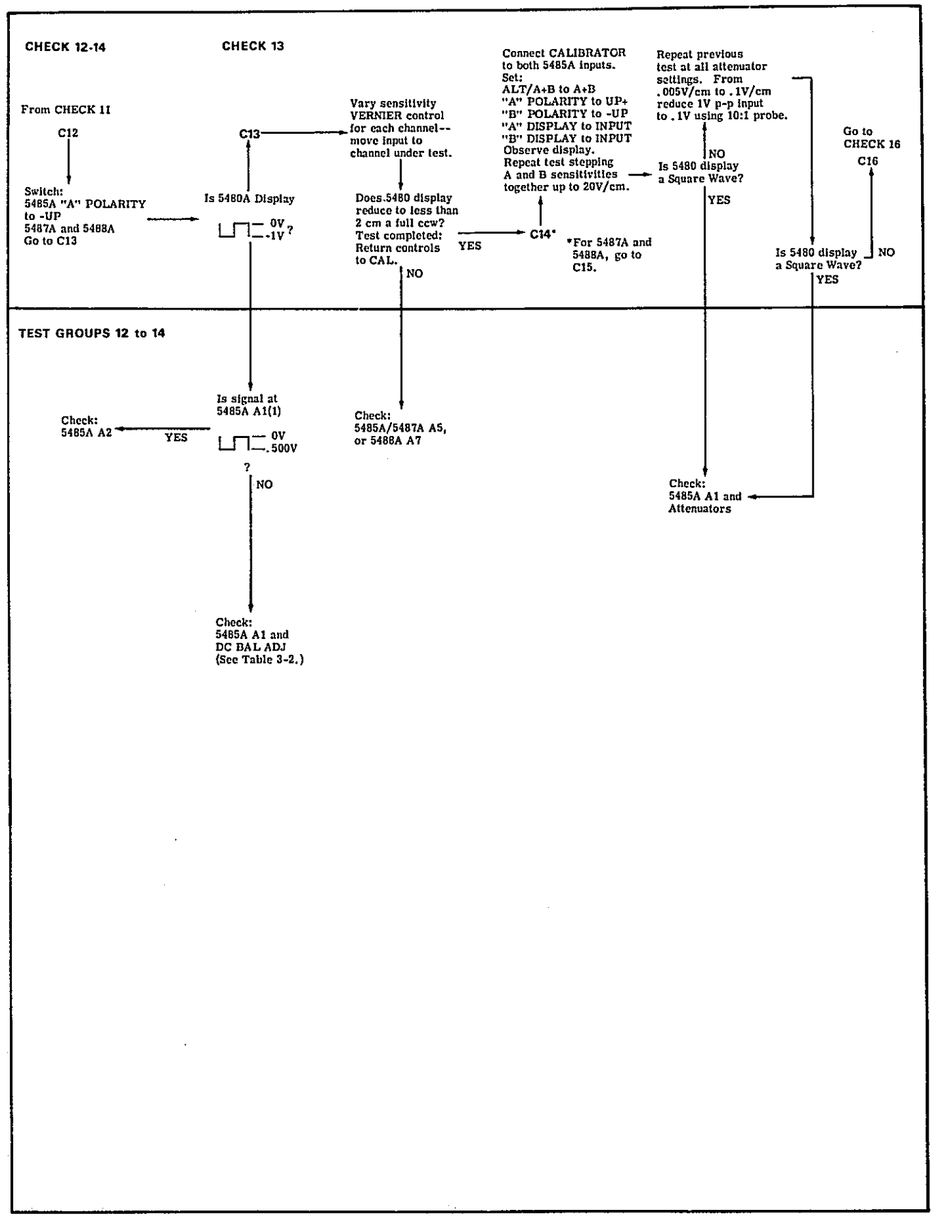

Table 4-1. Troubleshooting

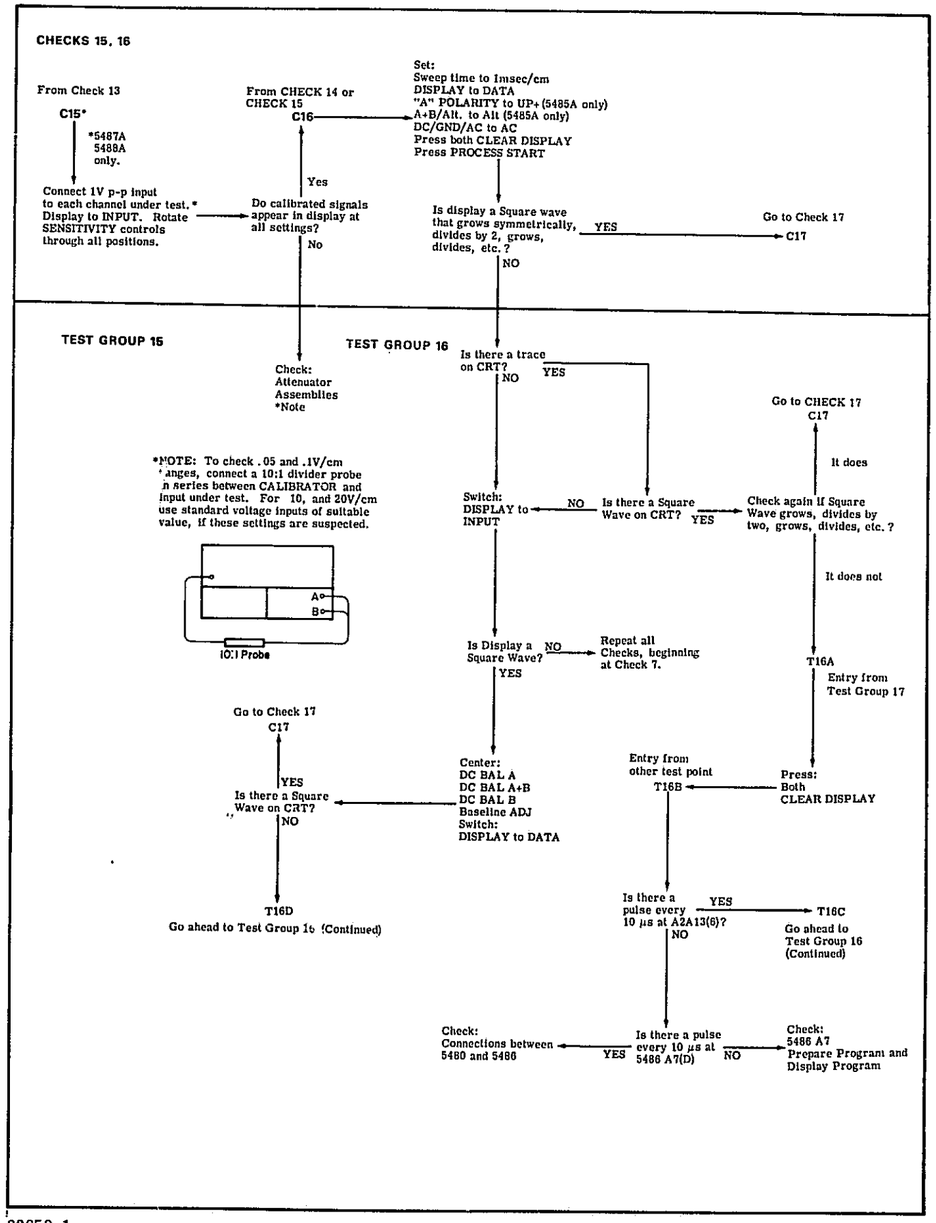

Table 4-1. Troubleshooting

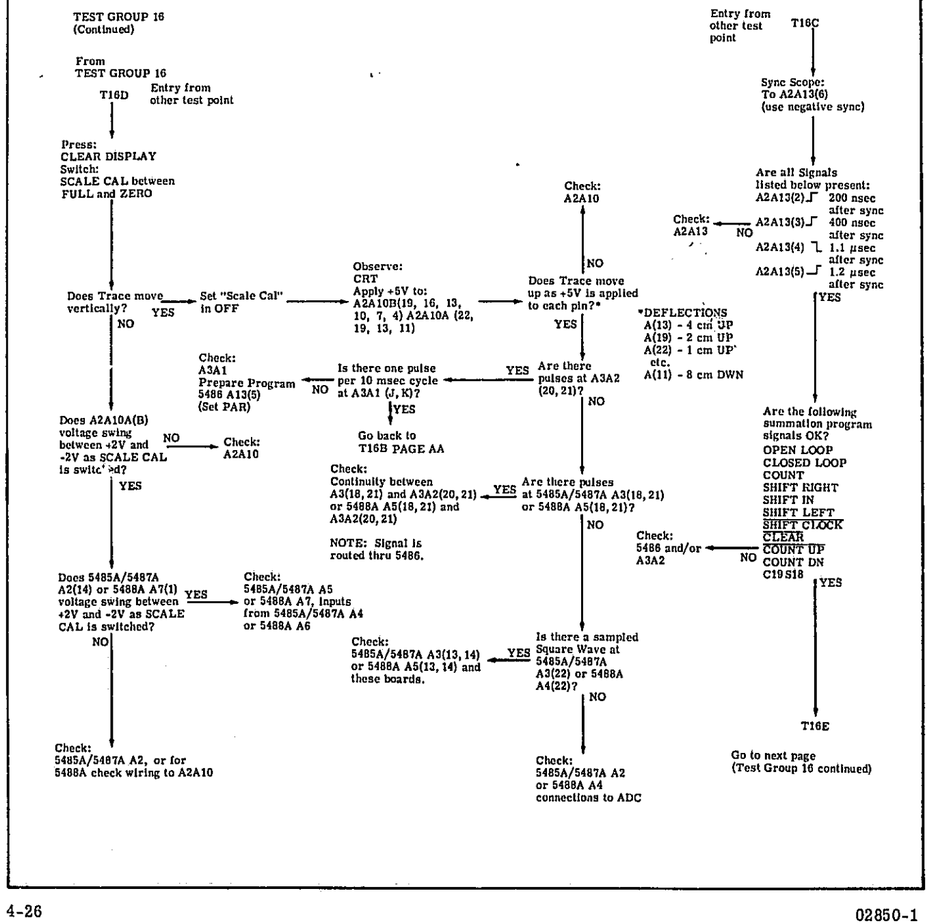

Table 4-1. Troubleshooting

T16E

All of the following tests should be performed to determine how correctly the 5480A/B System is operating. Even if any test is failed, you should proceed on to completion of all tests before going back to troubleshoot the suspected circuit area.

T16F Count Up

Press PROCESS STOP Button.

Ground A3A2 (2, 20, U).

Observe the points listed below. Signal at each should be a square wave which is half the frequency of the one at the preceding point.

Observe:

A3A2(16) – 20 MHz Square Wave
A2A4A(5) – 20 MHz Square Wave
(6)
(11)
(12)
(15)
thru
(22)

Remove ground from A3A2 (20).

T16G Count Down

Press PROCESS STOP Button.

Ground A3A2 (2, 21, U).

Observe the points listed below. Signal at each should be a square wave which is half the frequency of the one at the preceding point.

Observe:

A3A2(17) – 20 MHz Square Wave
A2A4A(5) – 20 MHz Square Wave
(6)
(11)
(12)
(15)
thru
(22)

Remove ground from A3A2 (2, 21, U).

Table 4-1. Troubleshooting

T16H Memory Operation

Set SENSITIVITY MULTIPLIER to '0'.

Press both CLEAR DISPLAY Buttons.

Momentarily short A2A9A(21) to A2A1A(22).

5480A CRT should display a square wave. This is 8 cm p-p – move vertical position to observe.

T16I Memory-Accumulator Loop

Set SENSITIVITY MULTIPLIER to '0'.

Press CLEAR DISPLAY Buttons.

Sync oscilloscope to A2A13(6).

Monitor A2A2A terminal according to table below. This is the accumulator output into the inhibit generator.

Momentarily ground A2A1A terminal opposite the A2A2A terminal. This simulates the Set Accumulator (SA) signal.

Accumulator output pulses should appear on the A2A2A terminal.

Simultaneously, a look at the corresponding A2A2B terminal which is the Inhibit Generator output will show -4V pulses before setting the accumulator and smaller spurious pulses after setting the accumulator.

Next, reset the accumulator by grounding the A2A2A terminal being monitored. This restores all terminals to their original state.

Set Bit (ground)	Check Accum. (monitor and reset)	Check Inhibit Generator (monitor)
A2A1A(5)	A2A2A(5)	A2A2B(Z)
(6)	(6)	(D)
(11)	(11)	(Y)
(12)	(12)	(E)
(15)	(15)	(X)
(16)	(16)	(N)
(17)	(17)	(W)
(18)	(18)	(P)
(19)	(19)	(V)
(20)	(20)	(R)
(21)	(21)	(U)
(22)	(22)	(S)

REPEAT ABOVE TESTS MOVING UP ONE PAIR OF BOARD NUMBERS.

A2A1 same as A2A3.

A2A2 same as A2A4.

For example:

Monitor A2A4A(5) for Accumulator, A2A4B(Z) for Inhibit Generator.
Set bit by grounding A2A3A(5).

Table 4-1. Troubleshooting

T16I Troubleshooting Hints for T16I

This test locates the bit(s) which are not cleared when the CLEAR DISPLAY buttons are pressed. It also locates bits which are otherwise not operating properly.

Boards can be swapped within the Accumulator Circuit and within the Memory Section, as a way to isolate a problem or provide an additional test.

EXAMPLE:

A problem is detected while monitoring A2A2A(17) and shorting A2A1A(17).

A2A2 and A2A4 are swapped, but the problem remains.

A2A1 and A2A3 are swapped, but the problem remains.

It must now be assumed that A2A2 and A2A4 were OK. Therefore, the problem is either in the Memory Core Stack (A2A15) or in the Accumulator Circuit.

Each of the six Accumulator boards handles four data bits.

Each Sense Amplifier board and each Inhibit Generator board handles 12 data bits.

Any one data bit is associated with only one Accumulator board location, only one Inhibit Generator location and only one Sense Amplifier location. Therefore, if Accumulator boards, Inhibit Generator boards, or Sense Amplifier boards are swapped (making only one swap at a time), the problem will not change until the faulty board is moved to a new location (and then the problem will also show up at a new location, and should be traceable to a few components on one board assembly). The table below shows which board assemblies handle which data bits. (Note: A3A3 and A3A8 boards cannot be swapped with any other.)

Data Bits	Accumulator Board	Sense Amplifier Board	Inhibit Generator Board
0 – 3	A3A3	A2A3	A2A4
4 – 7	A3A4	A2A3	A2A4
8 – 11	A3A5	A2A3	A2A4
12 – 15	A3A6	A2A1	A2A2
16 – 19	A3A7	A2A1	A2A2
20 – 23	A3A8	A2A1	A2A2

T16J Shift Left

Set SENSITIVITY MULTIPLIER to '0'.

Press both CLEAR DISPLAY buttons.

Momentarily short A2A3A(5) to ground.

Monitor A2A4A(5) with scope, display should be a series of negative pulses.

Monitor A2A4A(6). Level should be "L".

Rotate SENSITIVITY MULTIPLIER one position (to "1").

Signal at A2A4A(6) should be "H".

Table 4-1. Troubleshooting

T16J **Shift Left (Cont'd)**

Monitor the following additional points. As SENSITIVITY MULTIPLIER is switched to indicated number, monitored signal should change from "L" to "H".

Monitor	SENSITIVITY MULTIPLIER Setting (N)
A2A4A(11)	2
(12)	3
(15) thru (22)	4 thru 11
A2A2A(5)	12
(6)	13
(11)	14
(12)	15

Return SENSITIVITY MULTIPLIER to '0'.

Press both CLEAR DISPLAY buttons.

Momentarily short A2A1A(5)

Monitor A2A2A(5) with scope, display should be a series of negative pulses.

Monitor A2A2A(6). Level should be "L".

Rotate SENSITIVITY MULTIPLIER one position (to "1").

Signal at A2A2A(6) should be "H"

Monitor the following additional points. As SENSITIVITY MULTIPLIER is switched to indicated number, monitored signal should change from "L" to "H"

Monitor	SENSITIVITY MULTIPLIER Setting (N)
A2A2A(11)	2
(12)	3
(15) thru (22)	4 thru 11
A2A4A(5)	12
(6)	13
(11)	14
(12)	15

T16K **Shift Right**

Set SENSITIVITY MULTIPLIER to '0'.

Press both CLEAR DISPLAY buttons.

Ground A3A2(D).

Connect A3A2(C) to +5V.

Observe A2A2A(22). Level should be "L".

Momentarily ground A2A1A(22).

Signal at A2A2A(22) should be "H", with a series of negative pulses.

Table 4-1. Troubleshooting

T16K **Shift Right (Cont'd)**

Observe each of the points listed below. The signal should be "L", and a positive step should appear when the SENSITIVITY MULTIPLIER is set to the indicated number.

Observe	SENSITIVITY MULTIPLIER Setting (N)
A2A2A(21) thru (15)	1 thru 7
(12)	8
(11)	9
(6)	10
(5)	11
A2A4A(22) thru (19)	12 thru 15

Return SENSITIVITY MULTIPLIER to '0'.

Press both CLEAR DISPLAY buttons.

Observe A2A4A(22). Level should be "L".

Momentarily ground A2A3A(22).

Signal at A2A4A(22) should be "H", with a series of negative pulses.

Observe each of the points listed below. The signal should be "L", and a positive step should appear when the SENSITIVITY MULTIPLIER is set to the indicated number.

Observe	SENSITIVITY MULTIPLIER Setting (N)
A2A4A(21) thru (15)	1 thru 7
(12)	8
(11)	9
(6)	10
(5)	11
A2A2A(22) thru (19)	12 thru 15

If your 5480 passed all the above tests, and your problem no longer exists, go on to Check 17.

If your 5480 passed all the above tests, and your problem still exists, the problem is in the Accumulator. Check for such things as short circuits between signal or control lines that would cause the Accumulator to try to do two things at once or shift data to the wrong locations, etc. Perform the following check:

Set SENSITIVITY MULTIPLIER to '0'.

5485A AC/GND/DC to GND.

Press PROCESS START.

Wait approximately 30 seconds.

Press PROCESS STOP.

Press OUTPUT DISPLAY.

Table 4-1. Troubleshooting

T16K **Shift Right (Cont'd)**

Rotate SENSITIVITY MULTIPLIER to '15'. If display "grows" as SENSITIVITY MULTIPLIER is rotated, there may be some overflow or wrap around experienced and some interference between shift and count. If the display doubles with each SENSITIVITY MULTIPLIER step, then suddenly breaks up at some point as the SENSITIVITY MULTIPLIER is advanced, the problem is associated with a particular Accumulator board assembly, as indicated by the following chart:

Board	A3A8	A3A7	A3A6	A3A5	A3A4	A3A3
Bit	23 22 21 20	19 18 17 16	15 14 13 12	11 10 9 8	7 6 5 4	3 2 1 0
Sens. Mult. Setting at which display breaks up.	0 1 2 3	4 5 6 7	8 9 10 11	12 13 14 15		

To check A3A4, swap it with A3A7 and repeat test.

If your 5480 System failed any of the above checks, go back and determine and repair the cause of failure.

Table 4-1. Troubleshooting

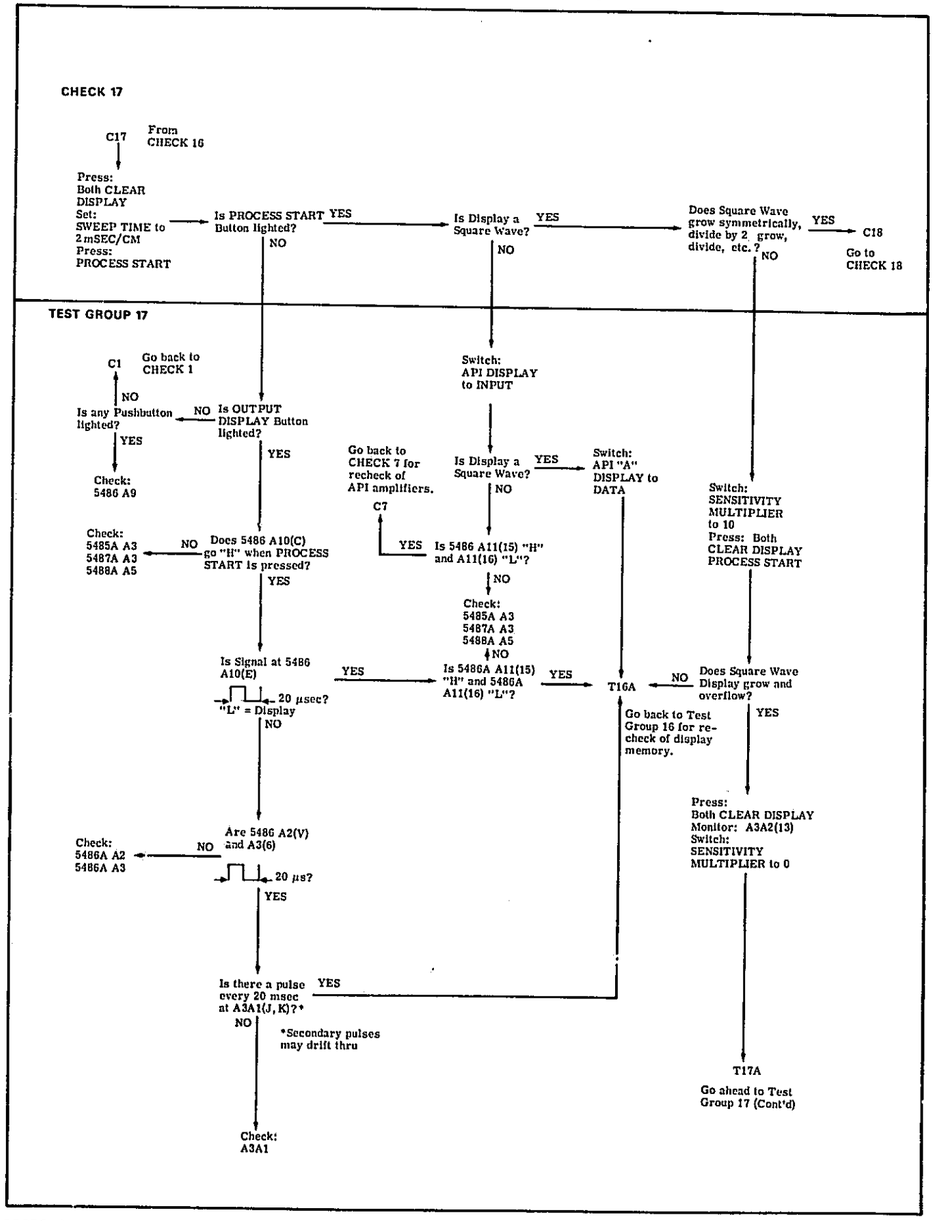

Table 4-1. Troubleshooting

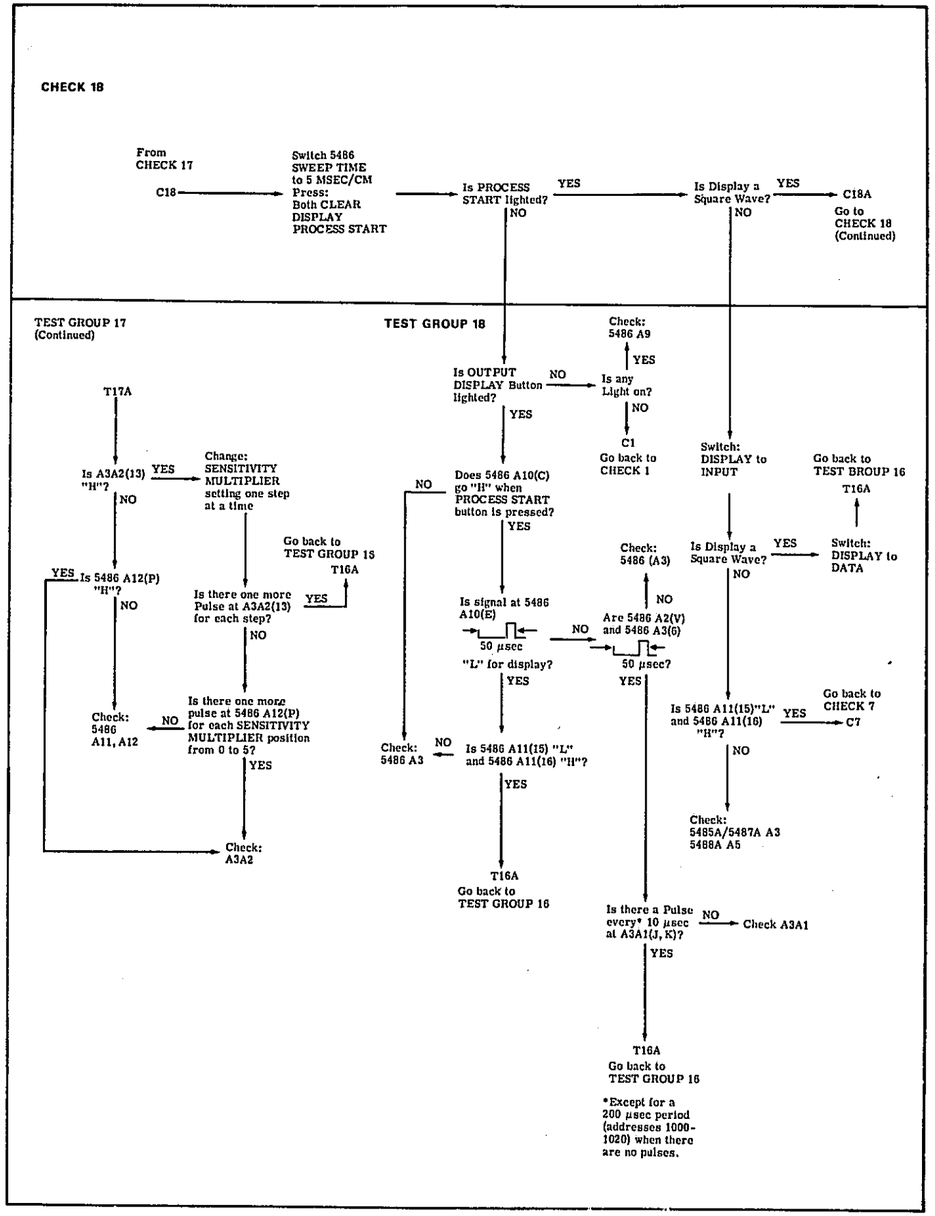

Table 4-1. Troubleshooting

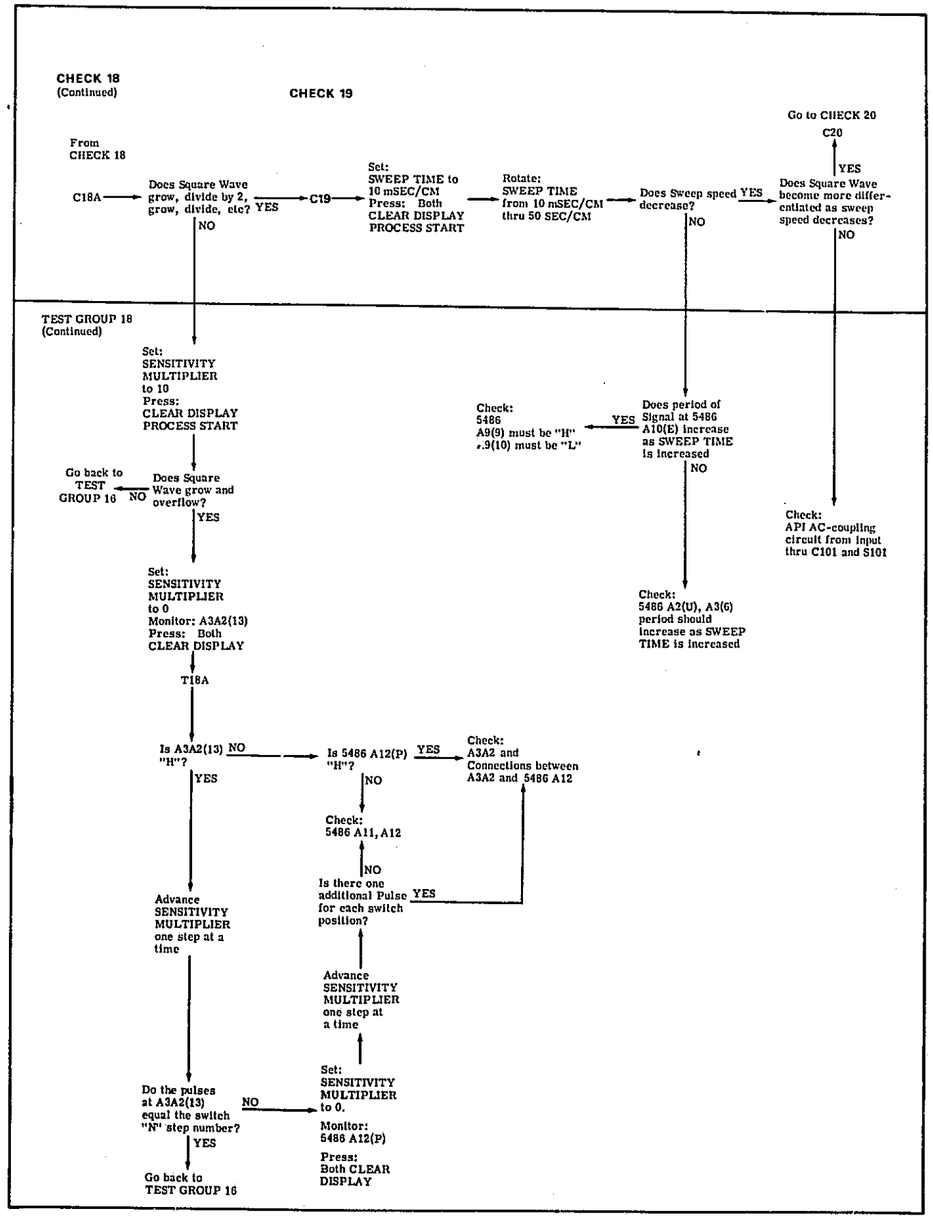

Table 4-1. Troubleshooting

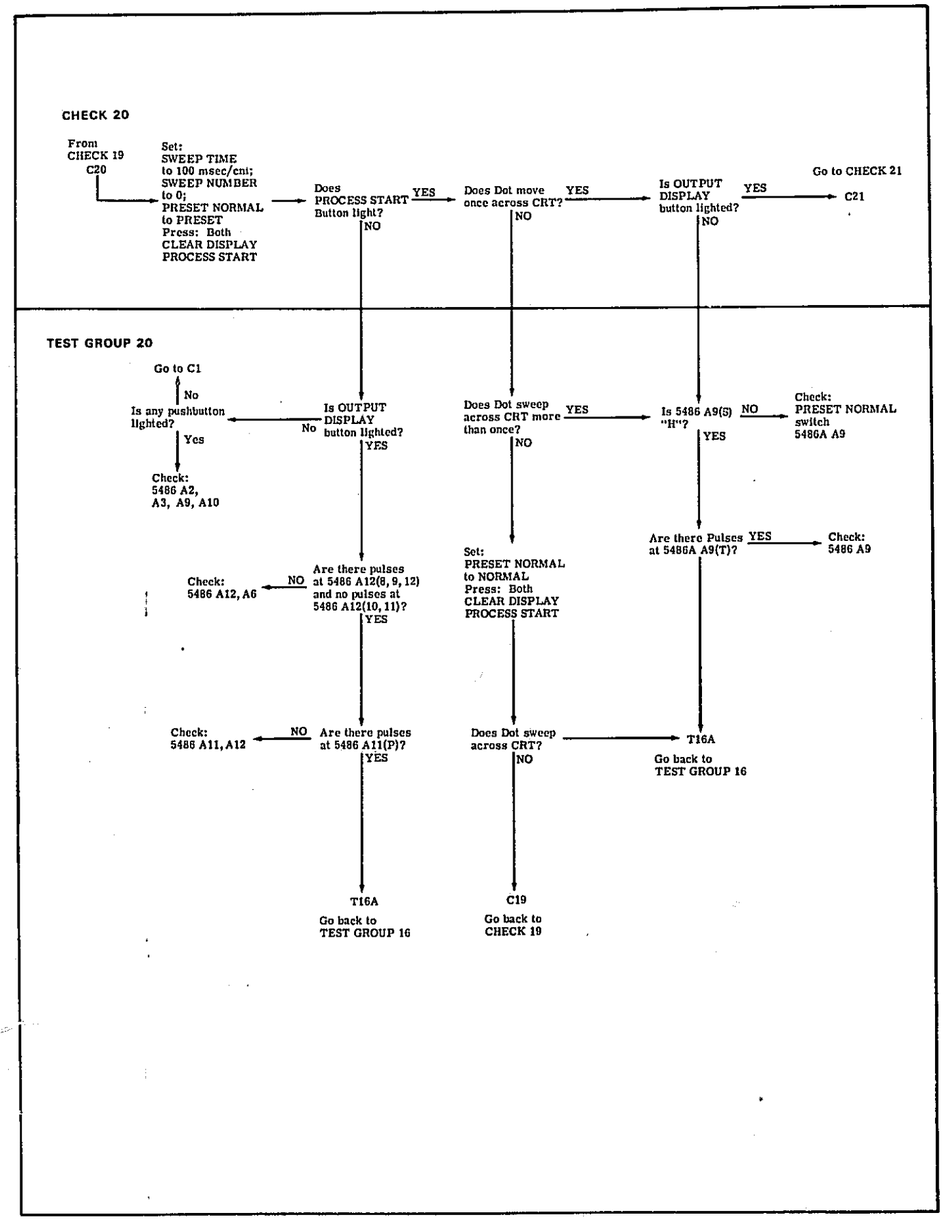

Table 4-1. Troubleshooting

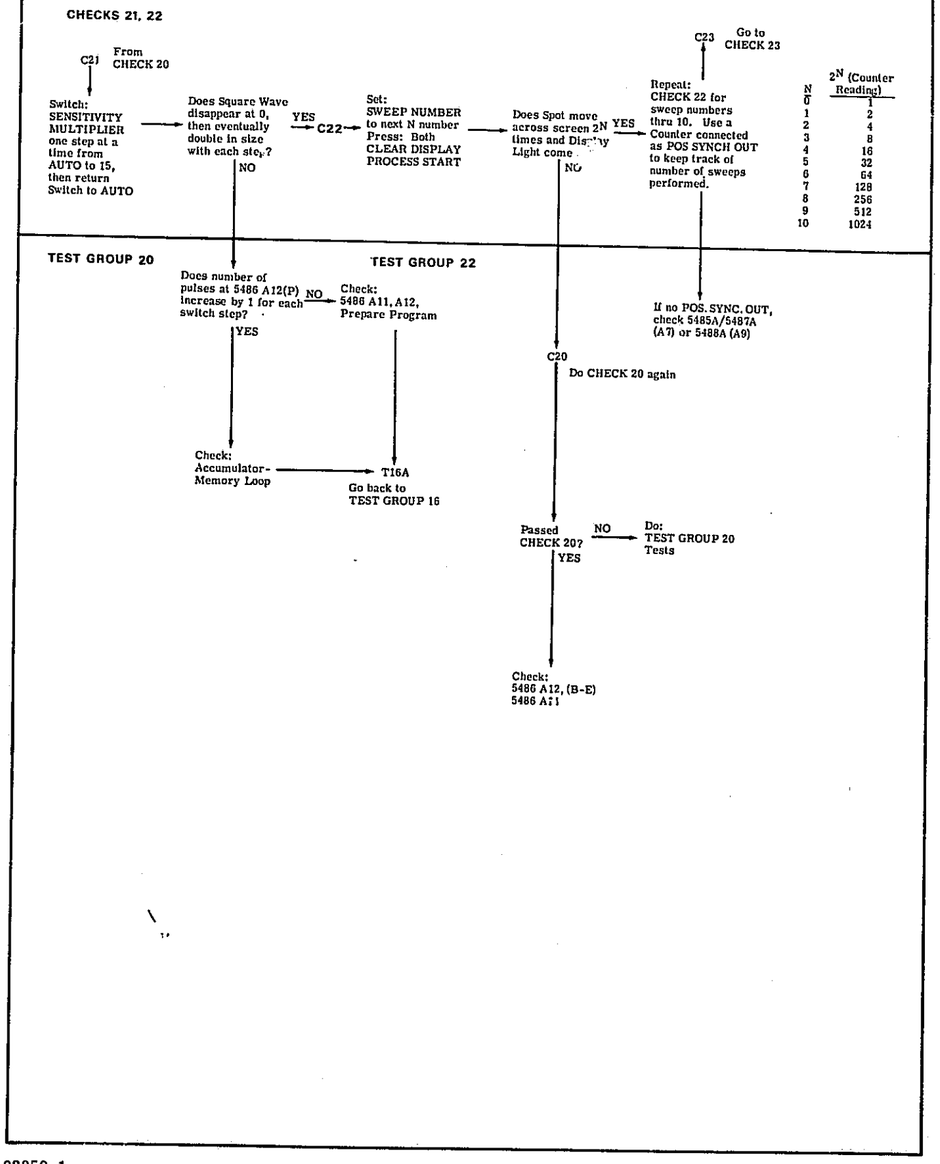

Table 4-1. Troubleshooting

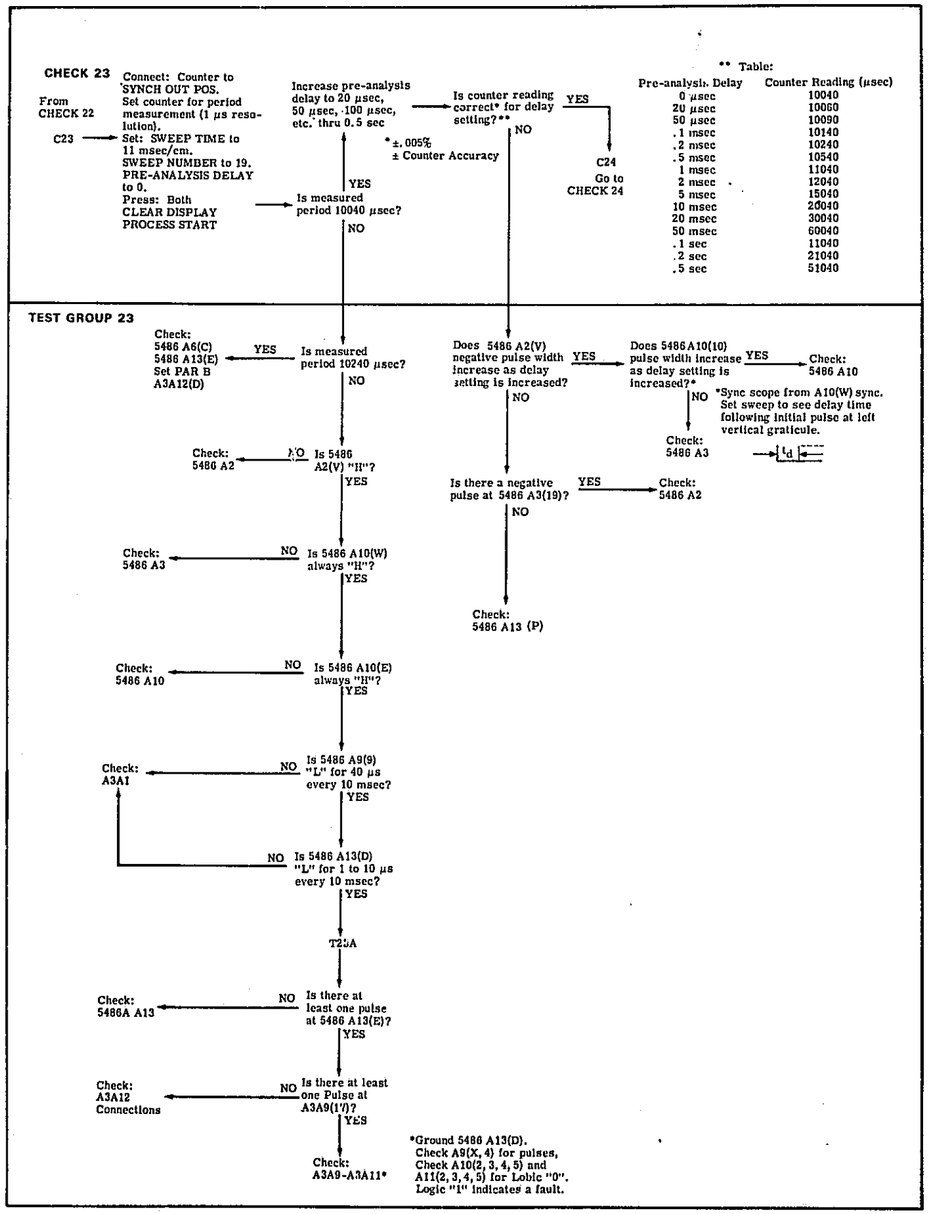

Table 4-1. Troubleshooting

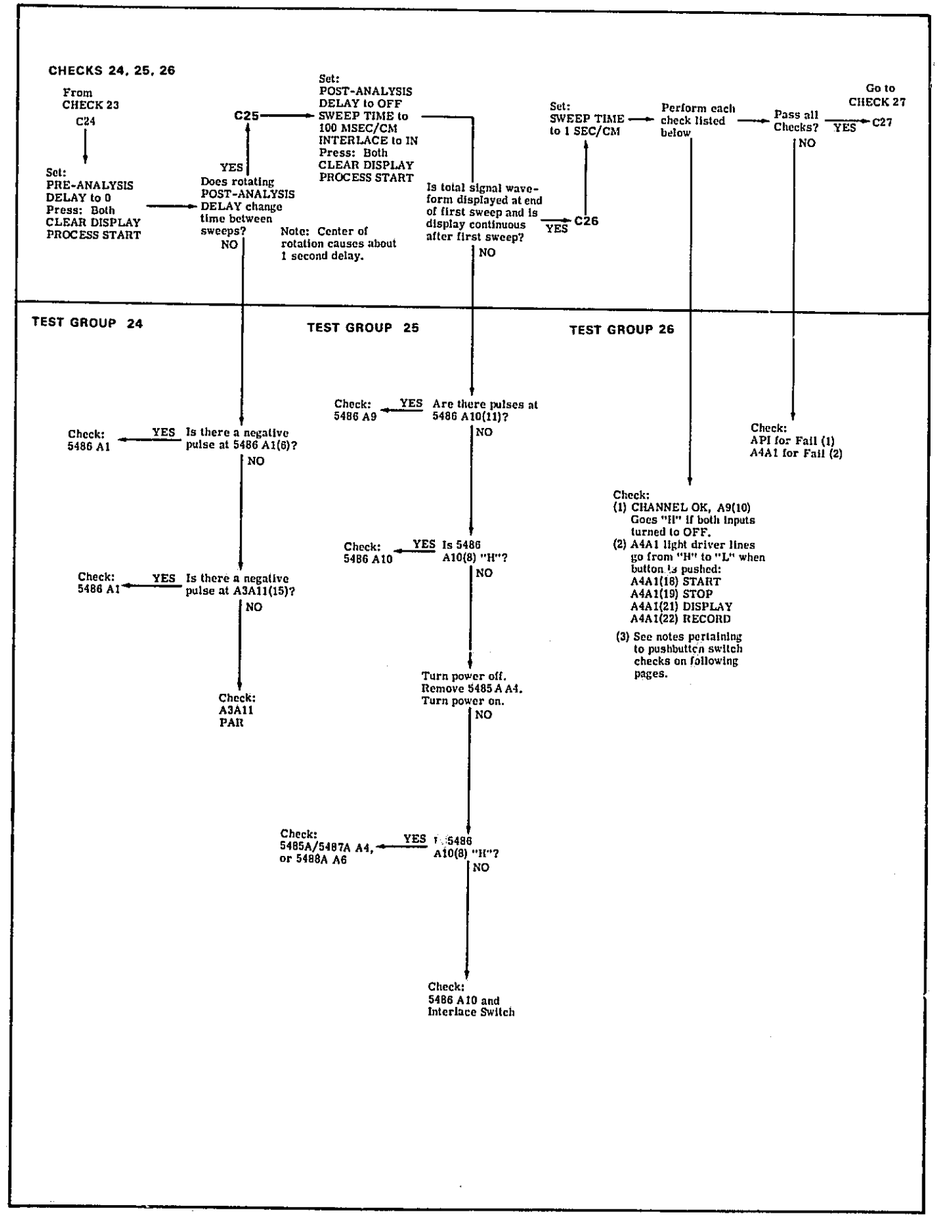

Table 4-1. Troubleshooting

NOTES PERTAINING TO PUSHBUTTON SWITCH CHECKS

1. Perform all checks before troubleshooting.
2. See Tests below for troubleshooting information.

CHECKS:

STOP-DISPLAY

Press PROCESS STOP button. PROCESS STOP button (only) should be lighted. There should be no display on CRT.

Press OUTPUT DISPLAY. OUTPUT DISPLAY button (only) should be lighted. There should be a trace on CRT.

DISPLAY-STOP

When OUTPUT DISPLAY button is lighted, press PROCESS STOP button. PROCESS STOP button (only) should be lighted. Display should disappear from CRT.

STOP-START

When PROCESS STOP button is lighted, press PROCESS START button. PROCESS START button (only) should be lighted. CRT display should be a single dot, moving at rate determined by SWEEP TIME control setting.

START-STOP

When PROCESS START button is lighted, press PROCESS STOP button. PROCESS STOP button (only) should be lighted. Display should disappear from CRT.

STOP-RECORD

When PROCESS STOP button is lighted, press OUTPUT RECORD button. OUTPUT RECORD button (only) should be lighted. CRT display should be a single dot, moving at rate determined by SWEEP TIME control setting.

At end of one sweep, PROCESS STOP button will light, and OUTPUT RECORD button will go out; display will disappear from CRT.

Table 4-1. Troubleshooting

CHECKS (Continued):

RECORD-DISPLAY

Press OUTPUT RECORD button (see STOP-RECORD). While OUTPUT RECORD button is lighted, press OUTPUT DISPLAY button.

Display should continue until end of single sweep, when PROCESS STOP button (only) will light, OUTPUT RECORD button will go out; display will disappear from CRT. (Pressing OUTPUT DISPLAY while OUTPUT RECORD button is lighted should have no effect.)

RECORD-STOP

Press OUTPUT RECORD button (see STOP-RECORD). While OUTPUT RECORD button is lighted, press PROCESS STOP button.

Moving dot should disappear from screen immediately, PROCESS STOP button should light, and OUTPUT RECORD button go out.

RECORD-START

Press OUTPUT RECORD button (see STOP-RECORD). While OUTPUT RECORD button is lighted, press PROCESS START button.

Moving dot should immediately return to left edge of screen and begin sweeping again at same rate as before; PROCESS START button should light, and OUTPUT RECORD button go out. When moving dot reaches right-hand edge of screen, next sweep should begin at left-hand edge.

START-RECORD

While PROCESS START button is lighted, press OUTPUT RECORD button.

Pressing OUTPUT RECORD button while PROCESS START button is lighted should have no effect.

START-DISPLAY

While PROCESS START button is lighted, press OUTPUT DISPLAY button.

Nothing will happen until sweeping dot reaches right-hand of screen, then: OUTPUT DISPLAY button will light and PROCESS START button will go out; display will change from a moving dot to a complete trace.

DISPLAY-RECORD

While OUTPUT DISPLAY button is lighted, press OUTPUT RECORD button.

Trace will be replaced by a dot at left-hand edge of screen as long as OUTPUT RECORD button is pressed. When OUTPUT RECORD button is released, dot will move across screen at rate determined by SWEEP TIME setting. When dot reaches right-hand edge of screen, PROCESS STOP button will light and OUTPUT RECORD button will go out; display will disappear from CRT.

All possible pushbutton combinations have now been tested. If your 5480A/B System failed any check, refer to Test Group 26 for troubleshooting information.
If your 5480A/B System passed all checks, go to Check 27.

Table 4-1. Troubleshooting

CHECKS (Continued):

The lamp in each pushbutton can be checked by grounding the appropriate A4A1B connection.

To check the lamp in the button below	Ground
PROCESS START	A4A1B(12)
PROCESS STOP	A4A1B(13)
OUTPUT DISPLAY	A4A1B(18)
OUTPUT RECORD	A4A1B(20)

The pushbutton switches can be bypassed by grounding the appropriate connection at A4A1A.

Pressing the button or grounding the point listed below	Should cause: Point listed below to go "H"	Point listed below to go "L"*
PROCESS START A4A1A(9)	A4A1A(18)	A4A1B(2)
PROCESS STOP A4A1A(10)	A4A1A(19)	A4A1B(4)
OUTPUT DISPLAY A4A1A(14)	A4A1A(21)	A4A1B(8)
OUTPUT RECORD A4A1A(16)	A4A1A(22)	A4A1B(10)

*Only one of these signals should be "L" at any one time, and it should correspond to the lamp that is lighted. Logic rules for these signals are the same as for the PUSHBUTTON SWITCH CHECKS. For example, if A4A1B(2) is "L" (corresponding to PROCESS START button lighted), grounding A4A1A(16) (corresponding to pressing OUTPUT RECORD) will cause A4A1A(22) to go "H", but there will be no change at A4A1B(10) (see START-RECORD check).

Table 4-1. Troubleshooting

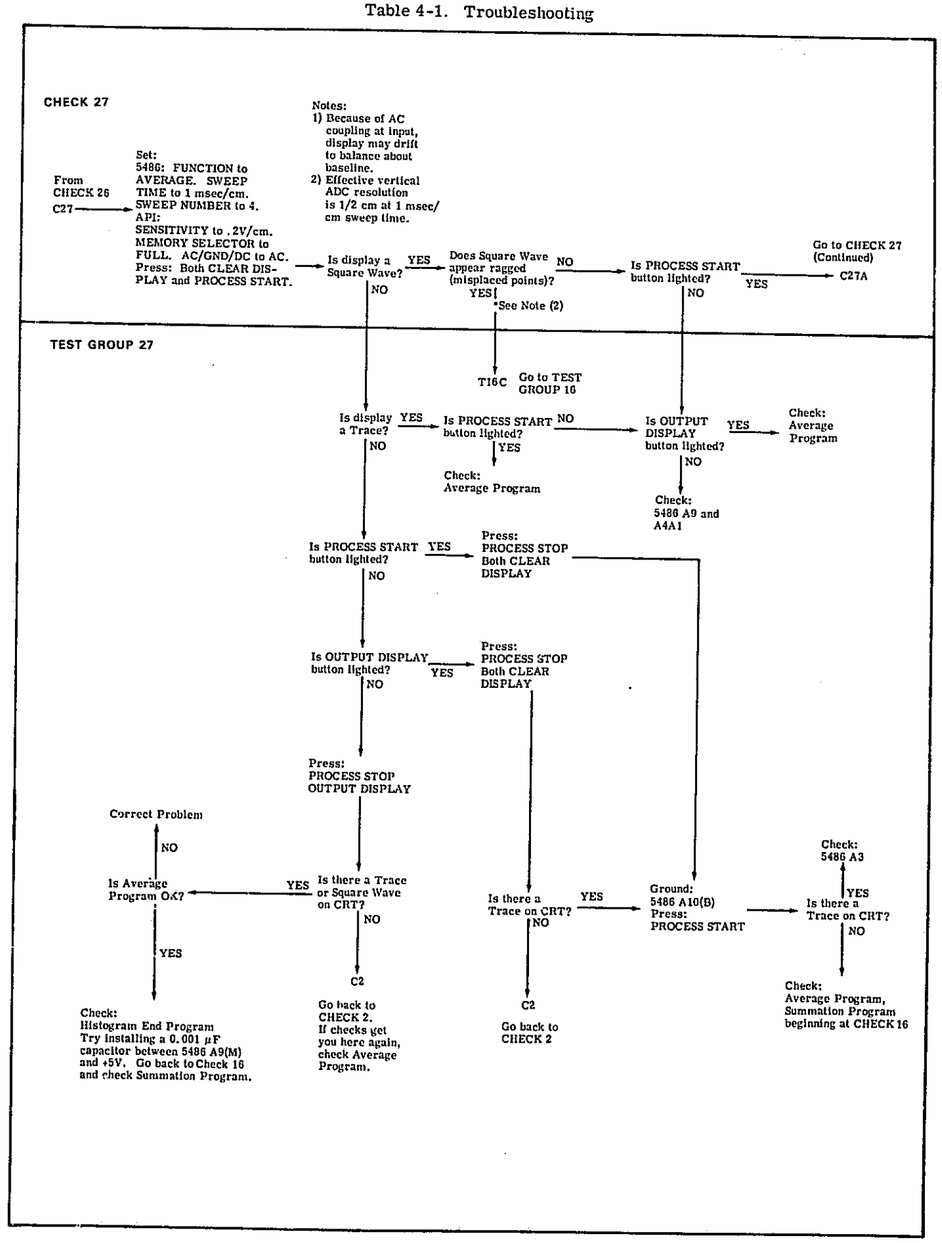

Table 4-1. Troubleshooting

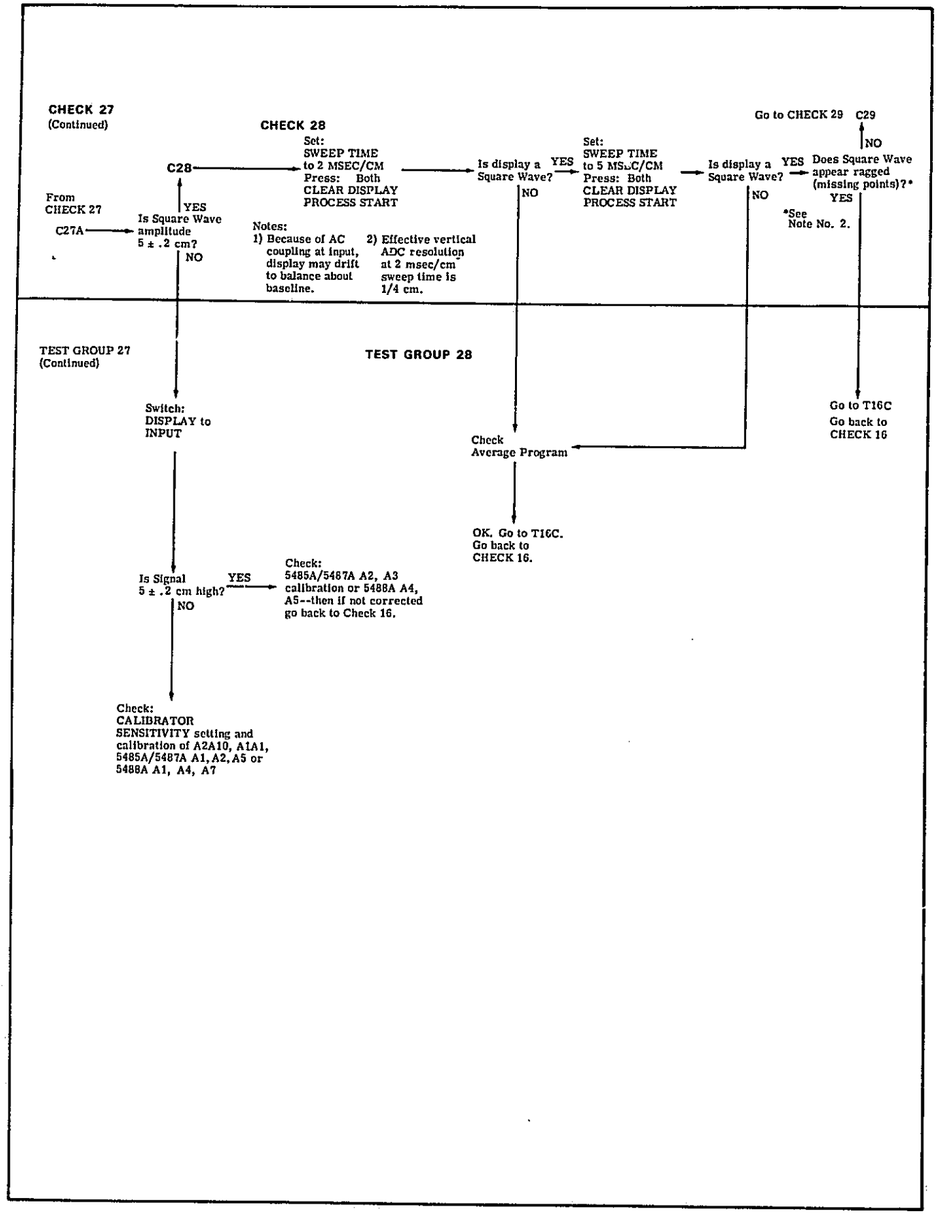

Table 4-1. Troubleshooting

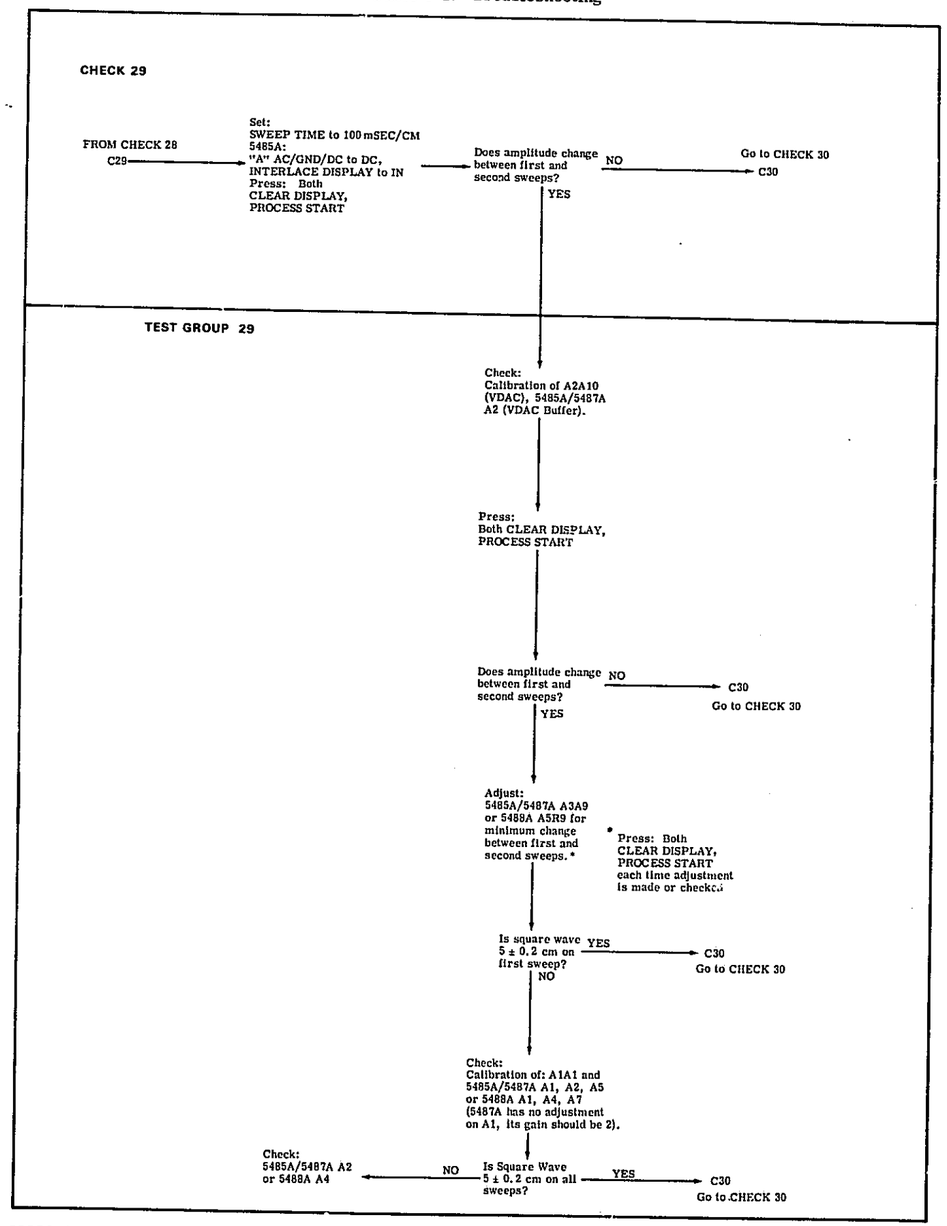

Table 4-1. Troubleshooting

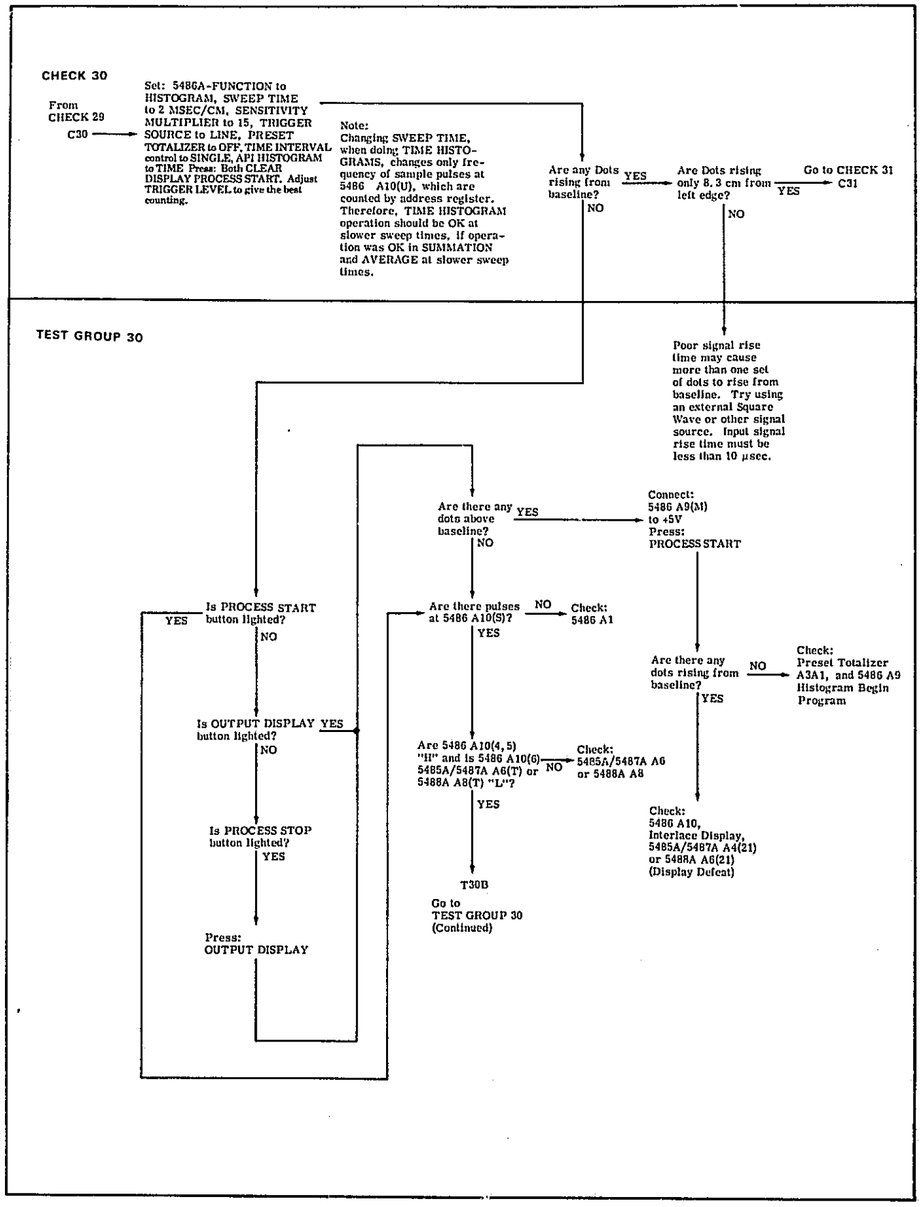

Table 4-1. Troubleshooting

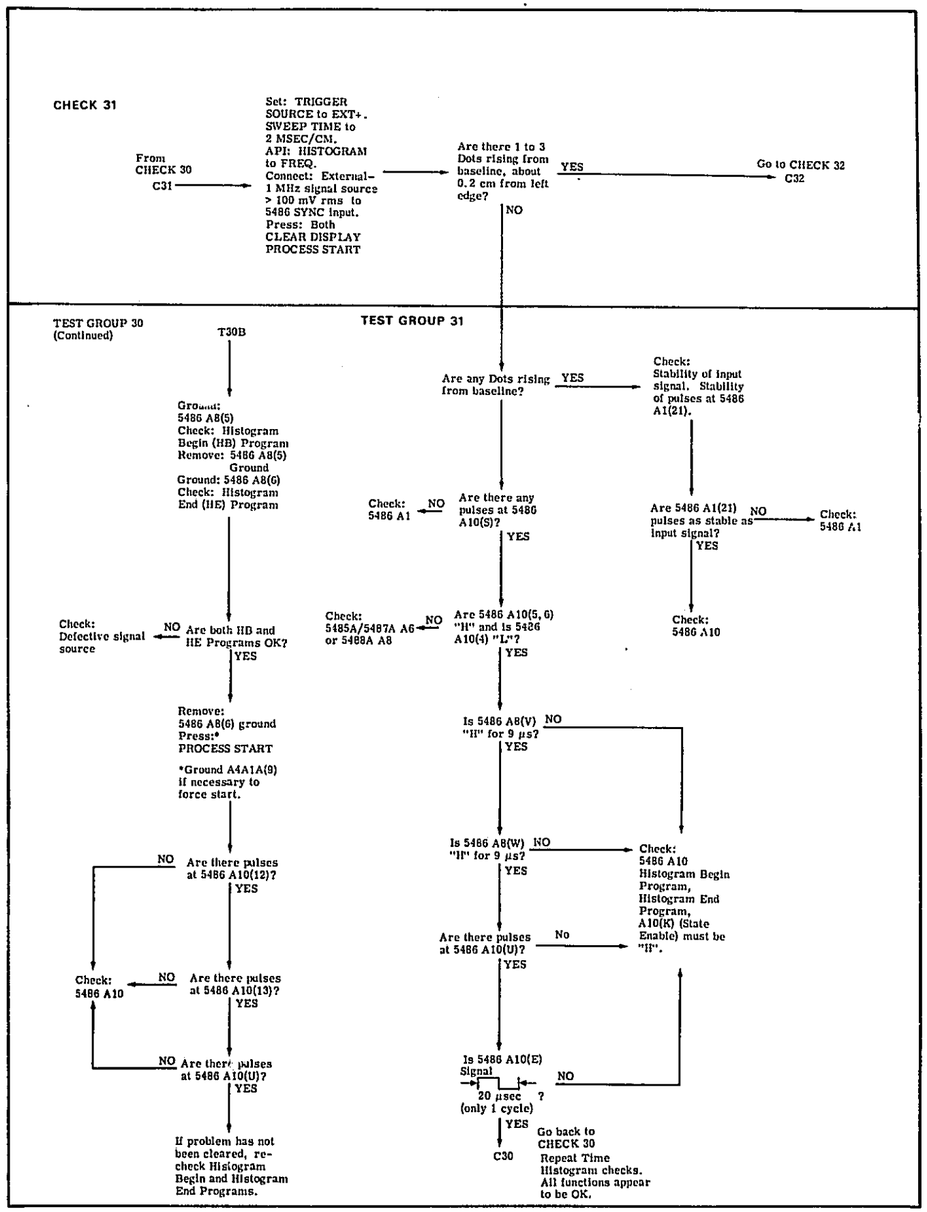

Table 4-1. Troubleshooting

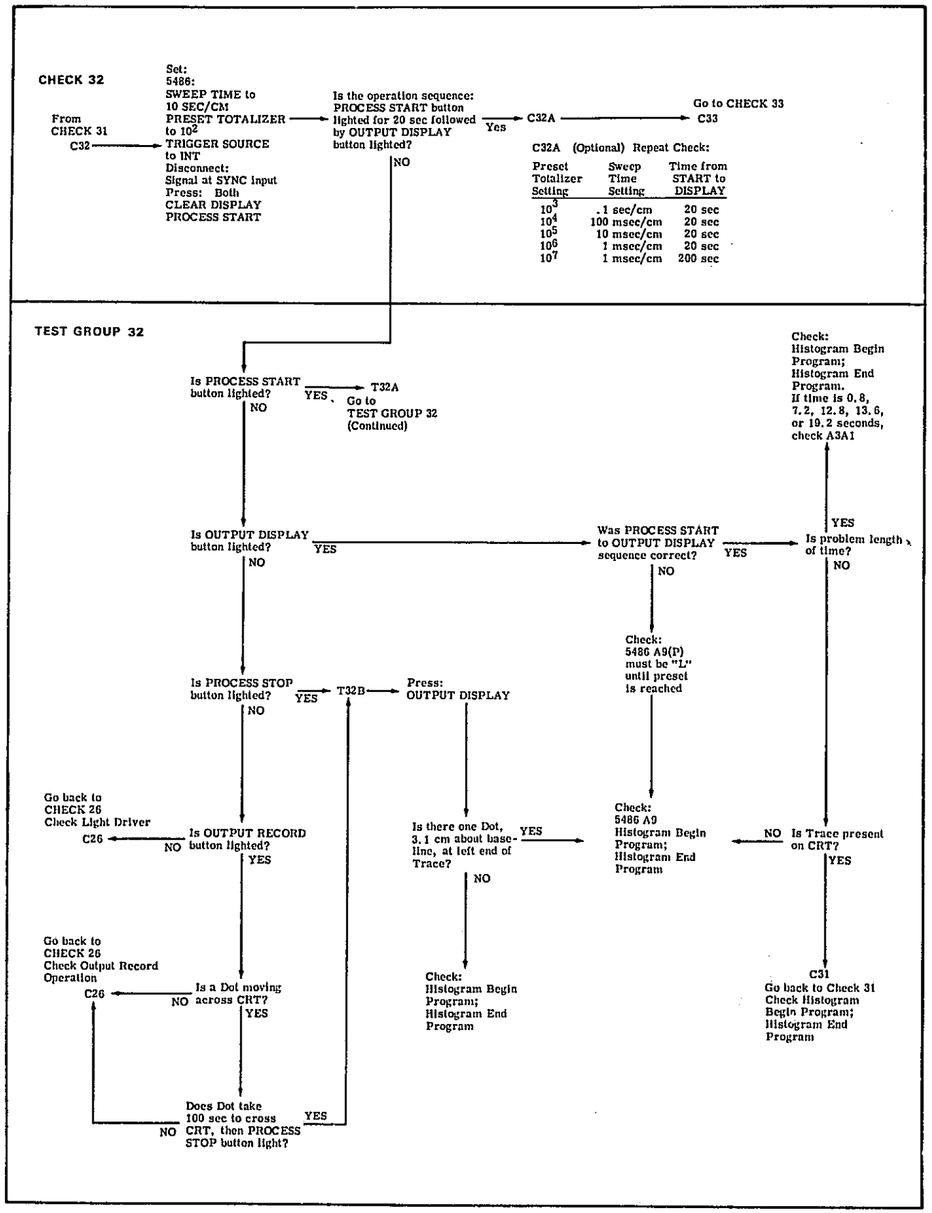

Table 4-1. Troubleshooting

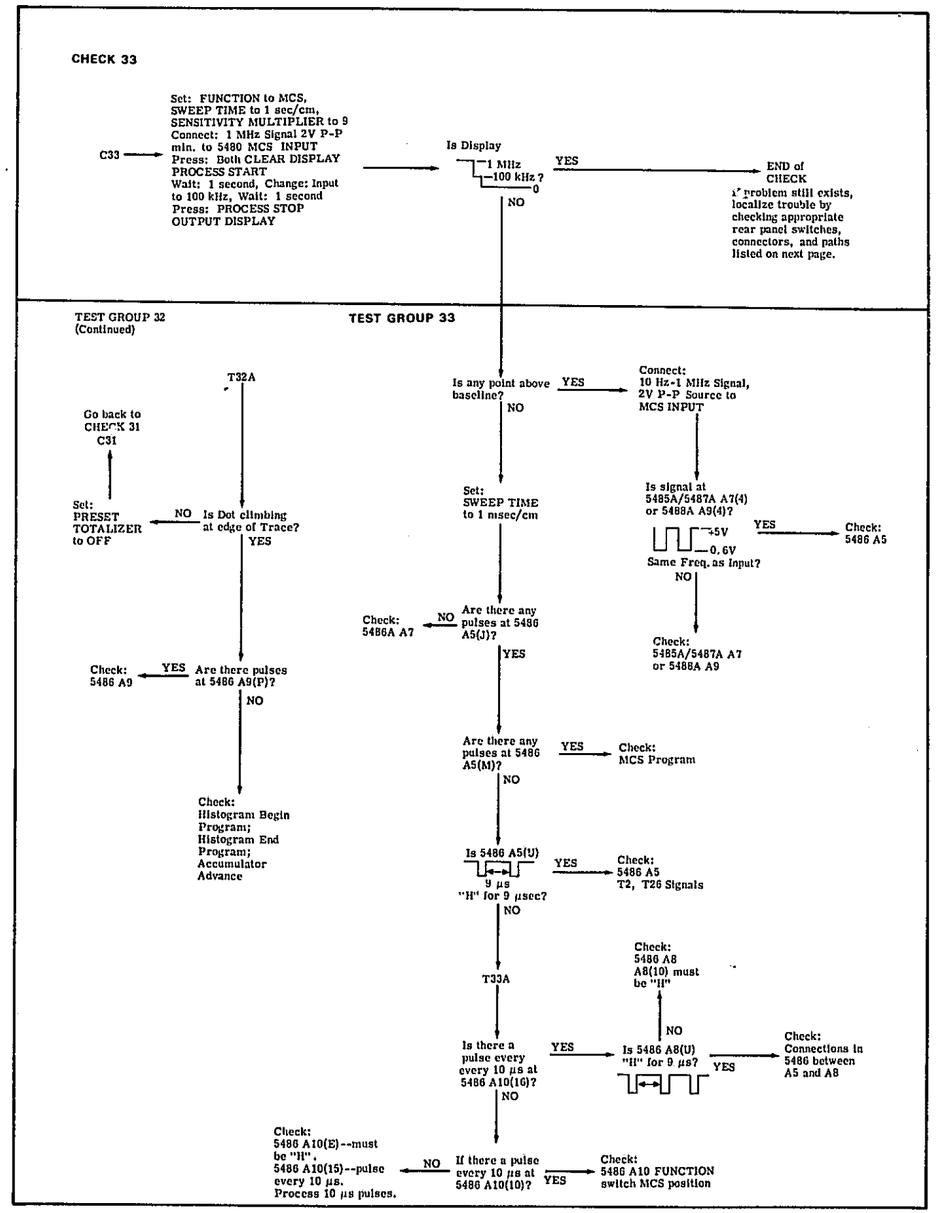

Figure 4-1. Test Points Prepare Program

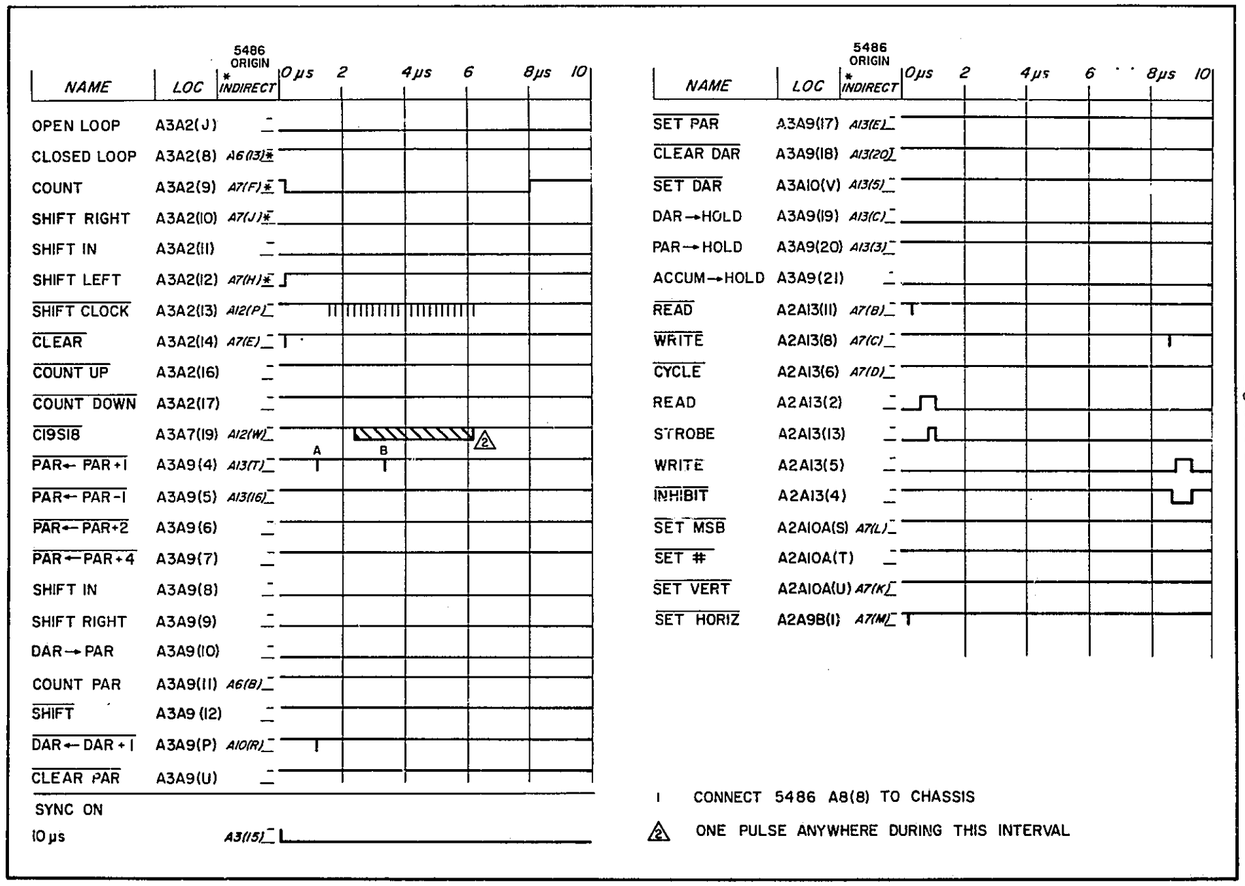

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Figure 4-1. Test Points Prepare Program (Cont'd)

5486A/B Signals, PREPARE Program:

LOCATION	SIGNAL
A5(2)	Low pulse at T14
A5(3)	Always low
A5(L)	Normally low; high pulse at T80, if: 1) SENSITIVITY MULTIPLIER is not set to AUTO or 2) FUNCTION is not set to AVERAGE and PROCESS START is not lighted.
A5(M)	Low pulse at T80, if PROCESS START is lighted.
A5(N)	Low pulse at T2, or Low pulse at T60, if: 1) SENSITIVITY MULTIPLIER is not set to AUTO or 2) FUNCTION is not set to AVERAGE and PROCESS START is not lighted
A5(P)	Always high
A5(R)	Pulse at T12, if PROCESS START is lighted
A6(B)	Pulse at TØ, if PROCESS START is lighted
A6(C)	Always high
A6(D)	Pulse at TØ
A6(E)	Pulse at T80
A6(F)	Always high
A6(H)	High pulse at T12
A6(J)	Always high
A6(K)	Always high
A7(B)	Low pulse at T4
A7(C)	Low pulse at T86
A7(D)	Always high
A7(E)	Low pulse at T2
A7(F)	Low pulse at T80
A7(H)	Low pulse at T2
A7(J)	Always high
A7(K)	Always high
A7(L)	Always high
A7(M)	Low pulse at T12
A7(N)	Always high
A9(B)	High pulse at T98 (.2 μsec before TØ)
A9(C)	Always high
A9(E)	Pulse at T12 is PROCESS START is lighted
A9(F)	Always high
A9(H)	Always high
A9(M)	5486B: Low pulse at T94 5486A: Low pulse at T90
A9(U)	Always high
A9(V)	Always high
A9(W)	Always high
A9(X)	Low pulse at T90
A9(Y)	Always high
A10(C)	Always low
A10(D)	Always high
A10(E)	If PROCESS START is lighted: 1) Goes high at T40 if Presample is high, 2) Goes low at T40 if Presample is low.
A10(9)	Low pulse at T98 if Presample is high
A10(10)	Pulse at T98 if PROCESS START lamp is lighted
A10(N)	High pulse at T98 if Presample is high
A10(11)	High pulse at T98 if PROCESS START is lighted, and 5480A has completed a display sweep, but not a process sweep.
A10(12)	Always high
A10(13)	Always high
A10(16)	Always high
A10(R)	Low pulse at T12
A10(U)	Always high

Figure 4-2. Test Points Display Program

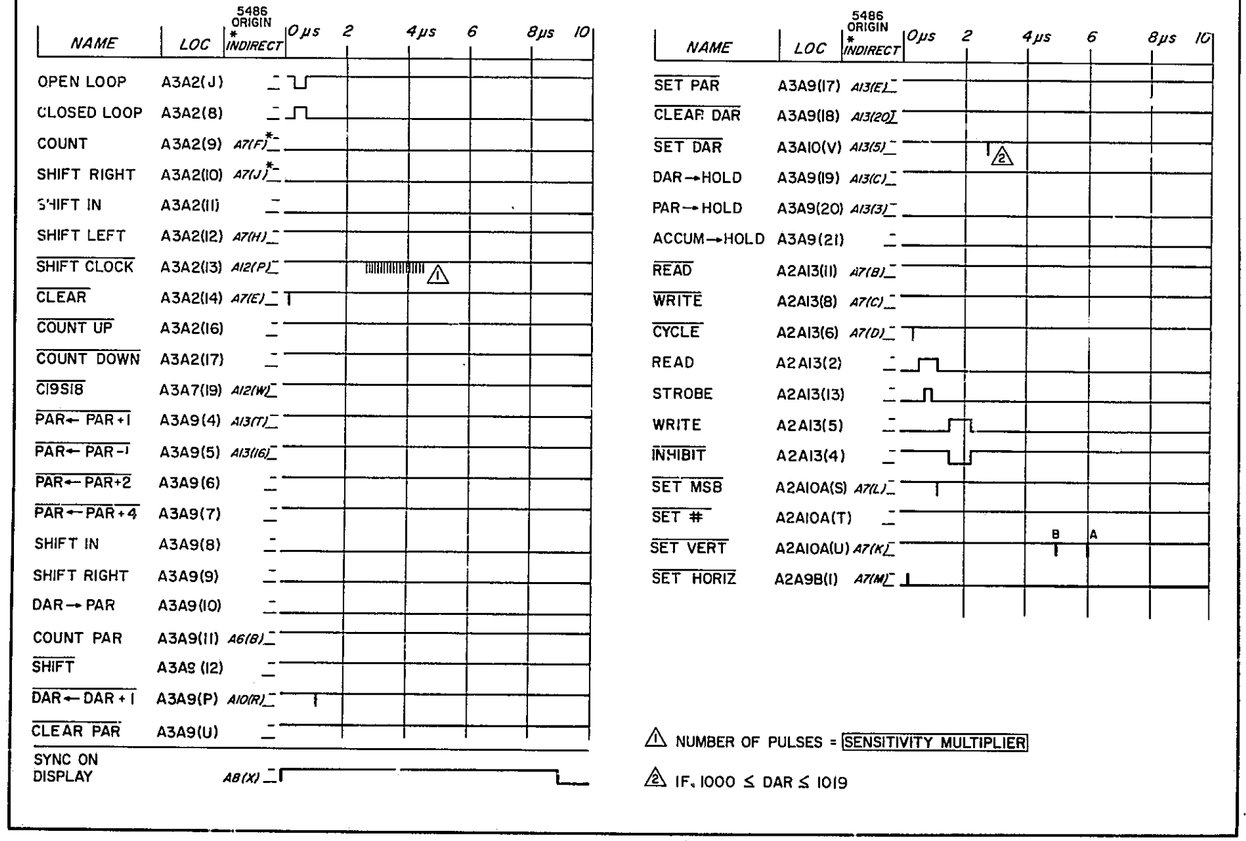


Figure 4-2

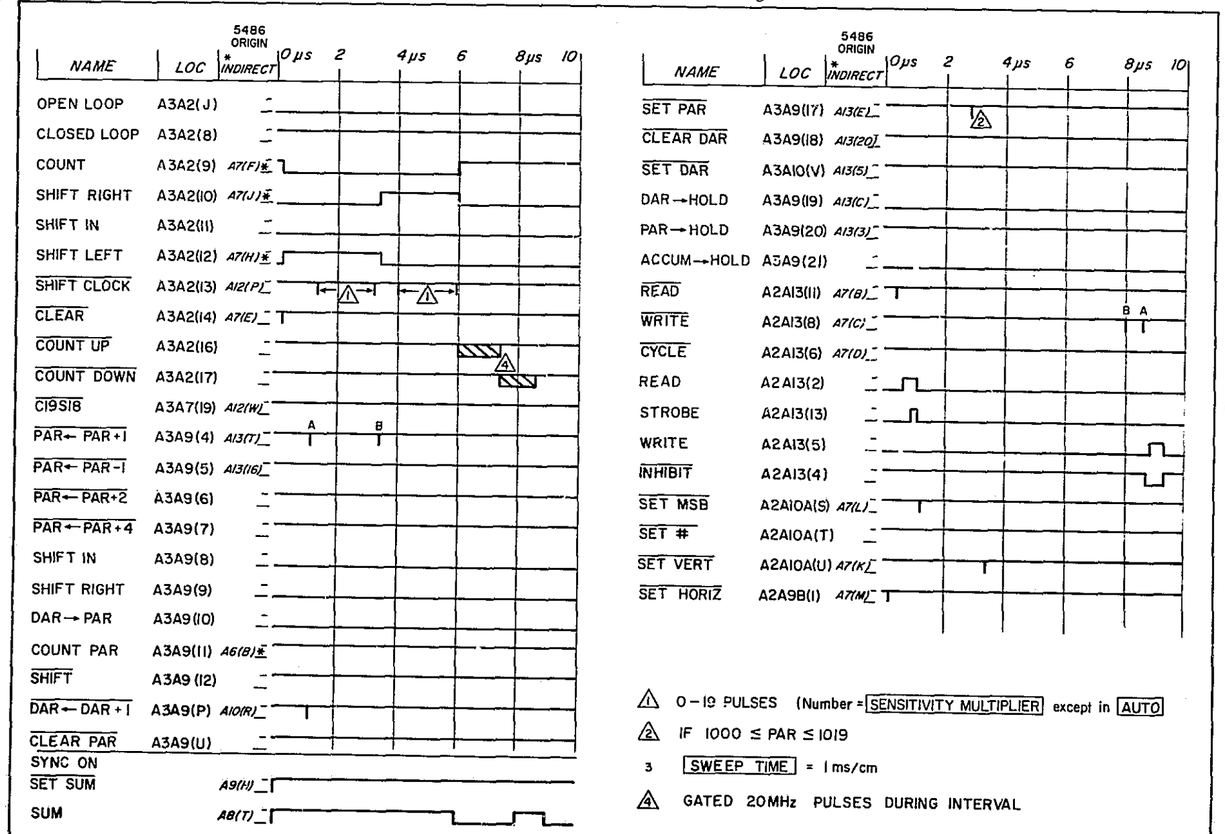
Figure 4-2. Test Points Display Program (Cont'd)

5486A/B Signals, DISPLAY Program:

LOCATION	SIGNAL
A5(2)	Low pulse at T26 if: 1) SENSITIVITY MULTIPLIER is not set to AUTO and 2) FUNCTION is not set to AVERAGE.
A5(3)	High pulse at T12 if: 1) SENSITIVITY MULTIPLIER is set to AUTO and 2) FUNCTION is not set to AVERAGE.
A5(L)	Always low.
A5(M)	Always high.
A5(N)	Always high.
A5(P)	Always high.
A5(R)	Always high.
A6(B)	Always high.
A6(C)	Always high.
A6(D)	Low pulse at TØ.
A6(E)	Low pulse at T80.
A6(F)	Always high.
A6(H)	Always low.
A6(J)	Always high.
A6(K)	Always high.
A6(20)	Always high.
A7(B)	Always high.
A7(C)	Always high.
A7(D)	Low pulse at T4.
A7(E)	Low pulse at T2.
A7(F)	Always high.
A7(H)	Low pulse at T12.
A7(J)	Always high.
A7(K)	5486B: Low pulse at T50 if FUNCTION is not set to AVERAGE. 5486A: 1) Low pulse at T2. 2) Low pulse at T60 if FUNCTION not to AVERAGE.
A7(L)	Low pulse at T12.
A7(M)	Pulse at T2.
A7(N)	Always high.
A9(B)	Always high.
A9(C)	Pulse at T98 (0.2 μsec before TØ), if:

LOCATION	SIGNAL
A9(C) (cont'd)	1) Address is less than 1000 and 2) Channel is in selected memory quarter (CHOK) and 3) 5480 is not processing.
A9(E)	Always low.
A9(F)	Always high.
A9(H)	Always high.
A9(M)	5480B: Pulse at T94 if State Enable occurs 5480A: Pulse at T90 if State Enable occurs
A9(U)	Set L DISPLAY enabled before Display Program can begin
A9(V)	Always high.
A9(W)	Always high.
A9(X)	Pulse at T90 if PROCESS START button pressed.
A9(U)	Always high.
A10(C)	Always low.
A10(D)	Always high.
A10(E)	High from T40 of Display to T40 of next process program.
A10(9)	Low pulse at T98.
A10(10)	Always low.
A10(N)	High pulse at T98.
A10(11)	Pulse at T98 of preceding process program.
A10(12)	Always high.
A10(13)	Always high.
A10(16)	Always high.
A10(R)	Low pulse at T12.
A10(U)	Always high.
A13(3)	High if displaying (not processing).
A13(C)	High if processing (not displaying).
A13(5)	Pulse at T34 if address register if 1000 or greater, and 5480 is displaying.
A13(E)	Always high.
A13(F)	Always high.
A13(H)	Always high.
A13(J)	Always high.
A13(P)	Always high.
A13(16)	Always high.
A13(T)	Always high.
A13(W)	Always high.
A13(20)	Pulse at T16 if: 1) Address register is at 1000 or greater and 2) 5480A is displaying (not proc.) and 3) PROCESS START is lighted.

Figure 4-3. Test Points Summation Program



1. 0-19 PULSES (Number = SENSITIVITY MULTIPLIER except in AUTO)
2. IF 1000 ≤ PAR ≤ 1019
3. SWEEP TIME = 1 ms/cm
4. GATED 20MHz PULSES DURING INTERVAL

Figure 4-3. Test Points Summation Program (Cont'd)

5486A/B Signals, SUMMATION Program:

LOCATION	SIGNAL
A5(2)	Pulses between T12 and T40
A5(3)	Pulses between T12 and T40 if SENSITIVITY MULTIPLIER set to AUTO
A5(L)	Always low.
A5(M)	Always high.
A5(N)	Always high.
A5(P)	Pulse at T58.
A5(R)	Pulse at T12.
A6(B)	Pulse at TØ.
A6(C)	Always high.
A6(D)	Pulse at TØ.
A6(E)	Pulse at T80.
A6(F)	Always high.
A6(H)	Always low.
A6(J)	Pulse at T60.
A6(K)	Pulse at T80.
A6(20)	Always high.
A7(B)	Pulse at T4.
A7(C)	5480B: Pulse at T80; 5480A: Pulse at T86
A7(D)	Always high.
A7(E)	Pulse at T2
A7(F)	Pulse at T60
A7(H)	Pulse at T2
A7(J)	Pulse at T34
A7(K)	Pulse at T34
A7(L)	Pulse at T12
A7(M)	Pulse at T2
A7(N)	Pulse at T86
A9(B)	Always high.
A9(C)	Always high.
A9(E)	Always low.
A9(F)	Always high.
A9(H)	Pulse at T98 of process program.
A9(M)	5486B: Pulse at T94; 5486A: Pulse at T90
A9(U)	Always high.
A9(V)	Always high.
A9(W)	Always high.
A9(X)	Pulse at T90.
A9(Y)	Always high.

LOCATION	SIGNAL
A10(C)	5480B: High from T86 to T98 5480A: High from T80 to T98
A10(D)	Always high.
A10(E)	High until T40 if PRESAMPLE is high, or high at T40 of Display after PRESAMPLE
A10(9)	Pulse at T98 if PRESAMPLE is high.
A10(10)	Pulse at T98 if processing.
A10(11)	Always low.
A10(12)	Always high.
A10(N)	Pulse at T98 if PRESAMPLE is high.
A10(13)	Always high.
A10(16)	Always high.
A10(R)	Pulse at T12.
A10(U)	Always high.
A13(3)	Low if displaying.
A13(C)	High if processing (changes at T40)
A13(5)	High: pulse at T34 is displaying and address register is 1000 or more.
A13(E)	High; pulse at T34 if Address Register is 1000 or more.
A13(F)	Always high.
A13(H)	Always high.
A13(J)	Always high.
A13(P)	High; pulse at T90 if Address Register is being reset.
A13(16)	Always high.
A13(T)	5486B: Pulse at T34 5486A: Pulse at T12
A13(W)	Always high.
A13(20)	High; pulse at T16 if: 1) Address register is 1000 or greater and 2) PROCESS START is lighted and 3) 5480 is doing a display program

Figure 4-4. Test Points Average Program

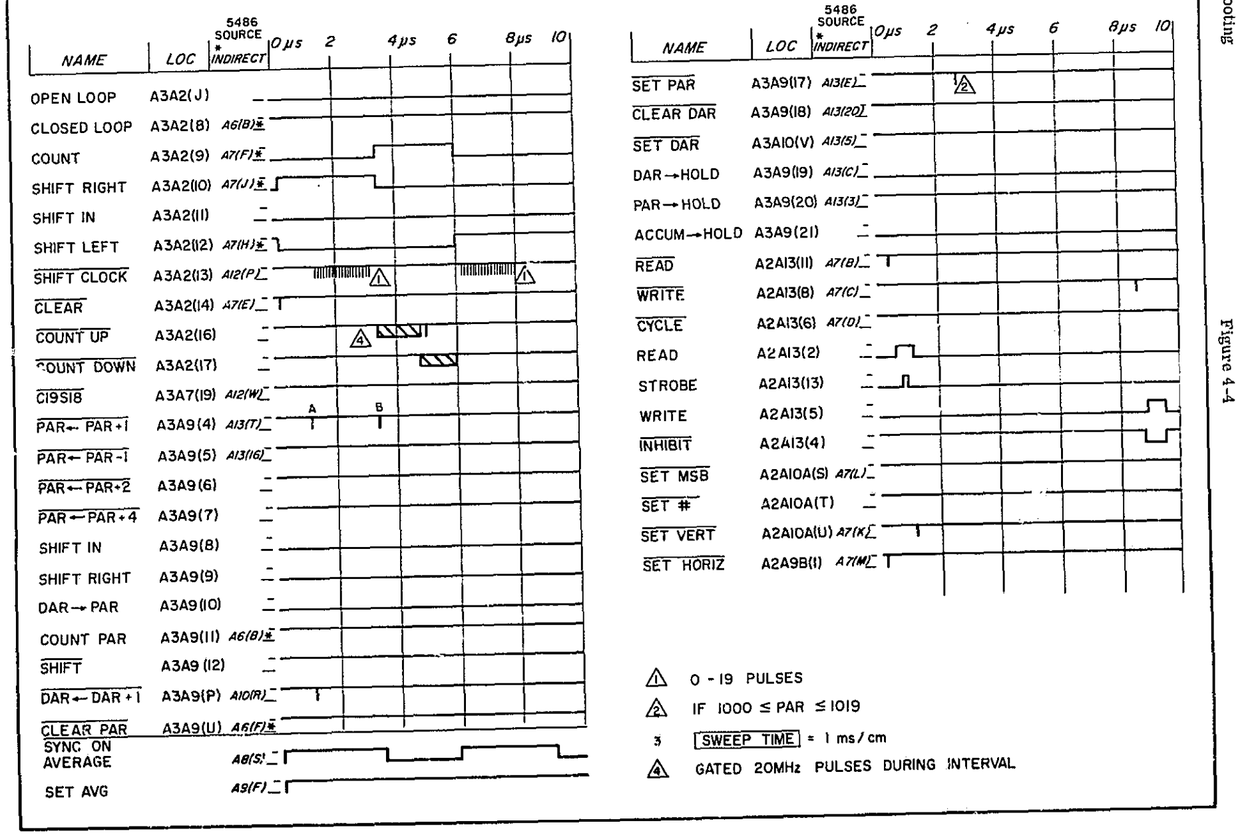


Figure 4-4. Test Points Average Program (Cont'd)

5486A/B Signals, AVERAGE Program:

LOCATION	SIGNAL
A5(2)	Pulses at T12 and T60
A5(3)	Pulses at T12 and T60
A5(L)	Always low
A5(M)	Always high
A5(N)	Always high
A5(P)	Pulse at T34
A5(R)	Pulse at T12
	Pulse at T98 if Channel is not in selected memory quarter ($\overline{CHOK}$)
A6(B)	Pulse at TØ if 5480 is processing
A6(C)	Always high
A6(D)	Pulse at TØ
A6(E)	Pulse at T80
A6(F)	Always high
A6(H)	Always low
A6(J)	5486B: Pulse at T36; 5486A: Pulse at T34
A6(K)	Pulse at T58 if ADC is finished
A6(20)	Always high
A7(B)	Pulse at T4
A7(C)	Pulse at T86
A7(D)	Always high
A7(E)	Pulse at T2
A7(F)	Pulse at T34
A7(H)	Pulse at T60
A7(J)	Pulse at T2
A7(K)	Pulse at T12
A7(L)	Always high
A7(M)	Pulse at T2
A7(N)	Pulse at T80
A9(B)	Always high
A9(C)	Always high
A9(E)	Always low
A9(F)	High; pulse at T98 (0.2 μsec before TØ) or prev. prog.
A9(H)	Always high
A9(M)	5486B: Pulse at T94; 5486A: Pulse at T90
A9(U)	Always high
A9(V)	Always high
A9(W)	Always high
A9(X)	Pulse at T90
A9(Y)	Always high

LOCATION	SIGNAL
A10(C)	May be high from T34 to T80
A10(D)	Always high
A10(E)	High until T40 if PRESAMPLE is low. High at T40 if PRESAMPLE is high.
A10(9)	Low pulse at T98 if PROCESS START lighted
A10(10)	High pulse at T98 if 5480 is processing
A10(11)	Always low
A10(12)	Always high
A10(N)	High pulse at T98
A10(13)	Always high
A10(16)	Always high
A10(R)	Low pulse at T12
A10(U)	Always high
A13(3)	Low if displaying (changes at T40)
A13(C)	High if processing
A13(5)	High; pulse at T34 if displaying and address register is 1000 or more
A13(E)	High; pulse at T34 if address register is 1000 or more
A13(F)	Always high
A13(H)	Always high
A13(J)	Always high
A13(P)	High; pulse at T90 if address register is being reset from 1023 to Ø
A13(T)	5486B: Pulse at T34; 5486A: Pulse at T12
A13(16)	Always high
A13(W)	Always high
A13(20)	Pulse at T16 if: 1) PROCESS START is lighted and 2) 5480 is displaying and 3) Address register is at 1000 or greater

Figure 4-5. Test Points Histogram Programs

NAME	LOC	5486 ORIGIN * INDIRECT
OPEN LOOP	A3A2(J)	
CLOSED LOOP	A3A2(8)	A6(B)*
COUNT	A3A2(9)	A7(F)*
SHIFT RIGHT	A3A2(10)	A7(J)*
SHIFT IN	A3A2(11)	
SHIFT LEFT	A3A2(12)	A7(H)
$\overline{\text{SHIFT CLOCK}}$	A3A2(13)	AI2(P)
$\overline{\text{CLEAR}}$	A3A2(14)	A7(E)
$\overline{\text{COUNT UP}}$	A3A2(16)	A5(M)
$\overline{\text{COUNT DOWN}}$	A3A2(17)	
$\overline{\text{C19S18}}$	A3A7(19)	AI2(W)
$\overline{\text{PAR} \leftarrow \text{PAR}+1}$	A3A9(4)	AI3(T)
$\overline{\text{PAR} \leftarrow \text{PAR}-1}$	A3A9(5)	AI3(16)
$\overline{\text{PAR} \leftarrow \text{PAR}+2}$	A3A9(6)	
$\overline{\text{PAR} \leftarrow \text{PAR}+4}$	A3A9(7)	
SHIFT IN	A3A9(8)	
SHIFT RIGHT	A3A9(9)	
DAR → PAR	A3A9(10)	
COUNT PAR	A3A9(11)	A6(B)
$\overline{\text{SHIFT}}$	A3A9 (12)	
$\overline{\text{DAR} \leftarrow \text{DAR}+1}$	A3A9(P)	AI0(R)
$\overline{\text{CLEAR PAR}}$	A3A9(U)	A6(F)*
SYNC ON HB	A8(V)	
$\overline{\text{SET HB}}$	AI0(12)	

NAME	LOC	5486 ORIGIN * INDIRECT
$\overline{\text{SET PAR}}$	A3A9(17)	AI3(E)
$\overline{\text{CLEAR DAR}}$	A3A9(18)	AI3(20)
$\overline{\text{SET DAR}}$	A3AI0(V)	AI3(5)
DAR → HOLD	A3A9(19)	A, Y(C)
PAR → HOLD	A3A9(20)	AI3(3)
ACCUM → HOLD	A3A9(21)	
$\overline{\text{READ}}$	A2AI3(11)	A7(B)
$\overline{\text{WRITE}}$	A2AI3(8)	A7(C)
$\overline{\text{CYCLE}}$	A2AI3(6)	A7(D)
READ	A2AI3(2)	
STROBE	A2AI3(13)	
WRITE	A2AI3(5)	
$\overline{\text{INHIBIT}}$	A2AI3(4)	
$\overline{\text{SET MSB}}$	A2AIOA(S)	A7(L)
$\overline{\text{SET \#}}$	A2AIOA(T)	
$\overline{\text{SET VERT}}$	A2AIOA(U)	A7(K)
$\overline{\text{SET HORIZ}}$	A2A9B(I)	A7(M)

⚠ PULSES START AT 1.2μs, MAY LAST UNTIL 1.2μs OF HISTOGRAM END PROGRAM

2 SET TIME BASE SWITCH TO 2 ms/cm

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Figure 4-5. Test Points Histogram Programs (Cont'd)

5486A/B Signals, HISTOGRAM BEGIN Program (Set Histogram to FREQ)

LOCATION	SIGNAL
A5(2)	Always high
A5(3)	Always low
A5(L)	Pulse at T16
A5(M)	Pulse at T12
A5(N)	Pulse at T2
A5(P)	Always high
A5(R)	Always high
A6(B)	Pulse at TØ if processing
A6(C)	Pulse at TØ
A6(D)	Pulse at TØ
A6(E)	Pulse at T80
A6(F)	5486B: Pulse at T4; 5486A: Pulse at T12
A6(H)	Always low
A6(J)	Always high
A6(K)	Always high
A6(20)	Always high
A7(B)	Pulse at T4
A7(C)	Pulse at T16
A7(D)	Always high
A7(E)	Pulse at T2
A7(F)	Pulse at T2
A7(H)	Always high
A7(J)	Always high
A7(K)	Always high
A7(L)	Always high
A7(M)	Pulse at T2
A7(N)	Always high
A9(B)	Always high
A9(C)	Always high
A9(E)	Always low
A9(F)	Always high
A9(H)	Always high
A9(M)	5486B: Pulse at T94; 5486A: Pulse at T90
A9(U)	Always high
A9(V)	Always high
A9(W)	Always high
A9(X)	Pulse at T90
A9(Y)	Always high
A10(C)	Always low
A10(D)	Always high
A10(E)	Goes low at T40 if PRESAMPLE goes low. Goes high at T40 is PRESAMPLE goes high.
A10(9)	Pulse at T98 if PRESAMPLE is high.
A10(10)	Pulse at T98 is processing
A10(11)	Pulse at T98 if displaying
A10(12)	Pulse at T98 if: 1) Processing of displaying and 2) HISTOGRAM is set to OFF and 3) there is no histogram in process (e.g., we are not between the end of a HISTOGRAM BEGIN program and the beginning of a HISTOGRAM END program.)
A10(N)	Pulse at T98 is PRESAMPLE is high
A10(13)	Always high
A10(R)	Pulse at T12
A10(16)	Always high
A10(U)	Sample pulses or external sync signal, occurring from T12 of HISTOGRAM BEGIN program until T12 of HISTOGRAM END program.
A13(3)	Low; inverse of P/D
A13(C)	High; follows P/D
A13(5)	High; pulse at T34 if displaying and address register is 1000 or more
A13(E)	Pulse at T34 if address register is 1000 or more (see A6(C).)
A13(F)	Always low
A13(H)	Always high
A13(J)	Always high
A13(P)	High; pulse at T90 if address register is being reset from 1023 to Ø.
A13(16)	Always high
A13(T)	Sample pulses or External sync signal, occurring from T12 of HISTOGRAM BEGIN program until T12 of HISTOGRAM END program.
A13(W)	Always high
A13(20)	High; pulse at T16 if: 1) Address register is 1000 or more and 2) 5480 if displaying and 3) PROCESS START is lighted