Table 4-1. Troubleshooting

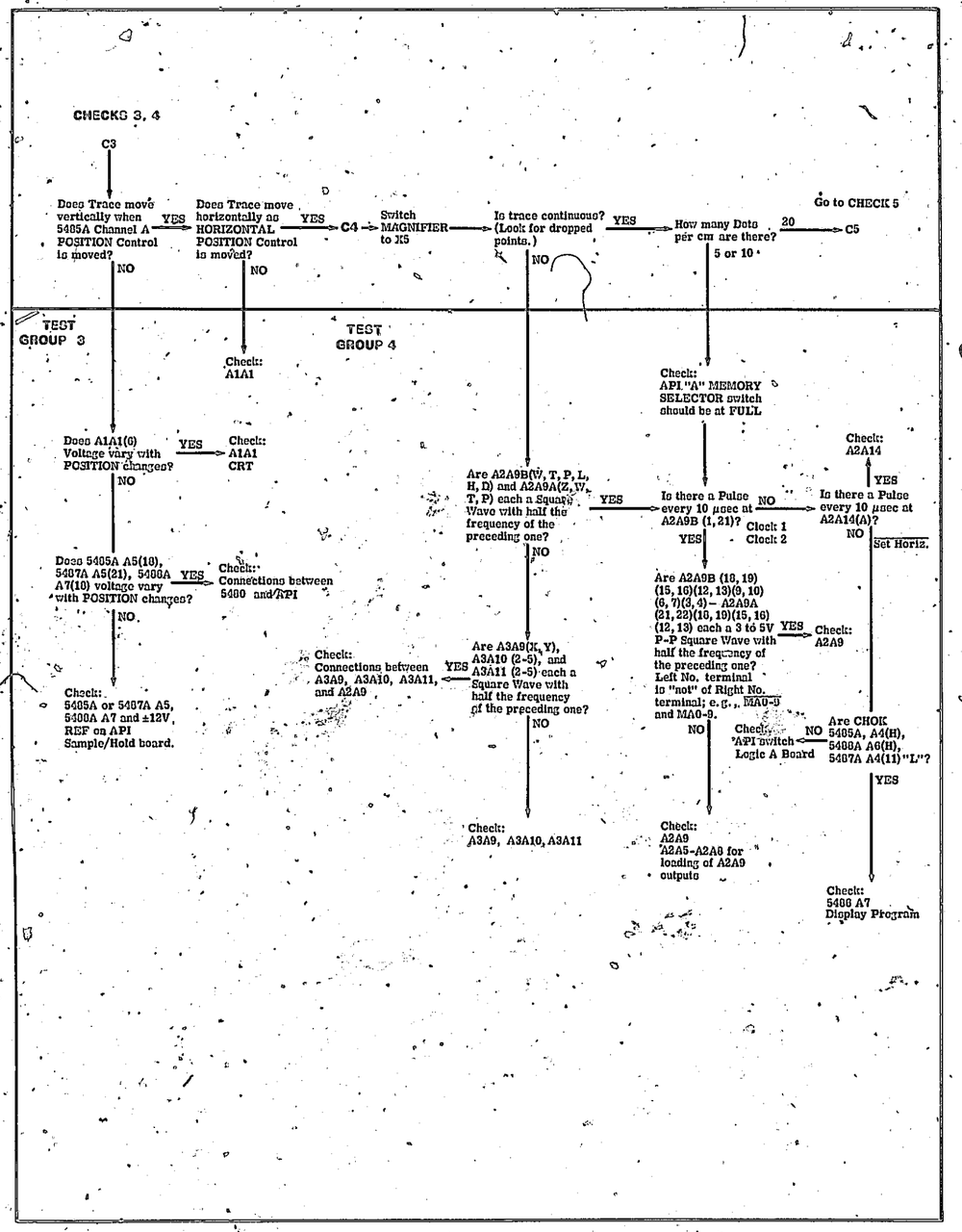


Table 4-1. Troubleshooting

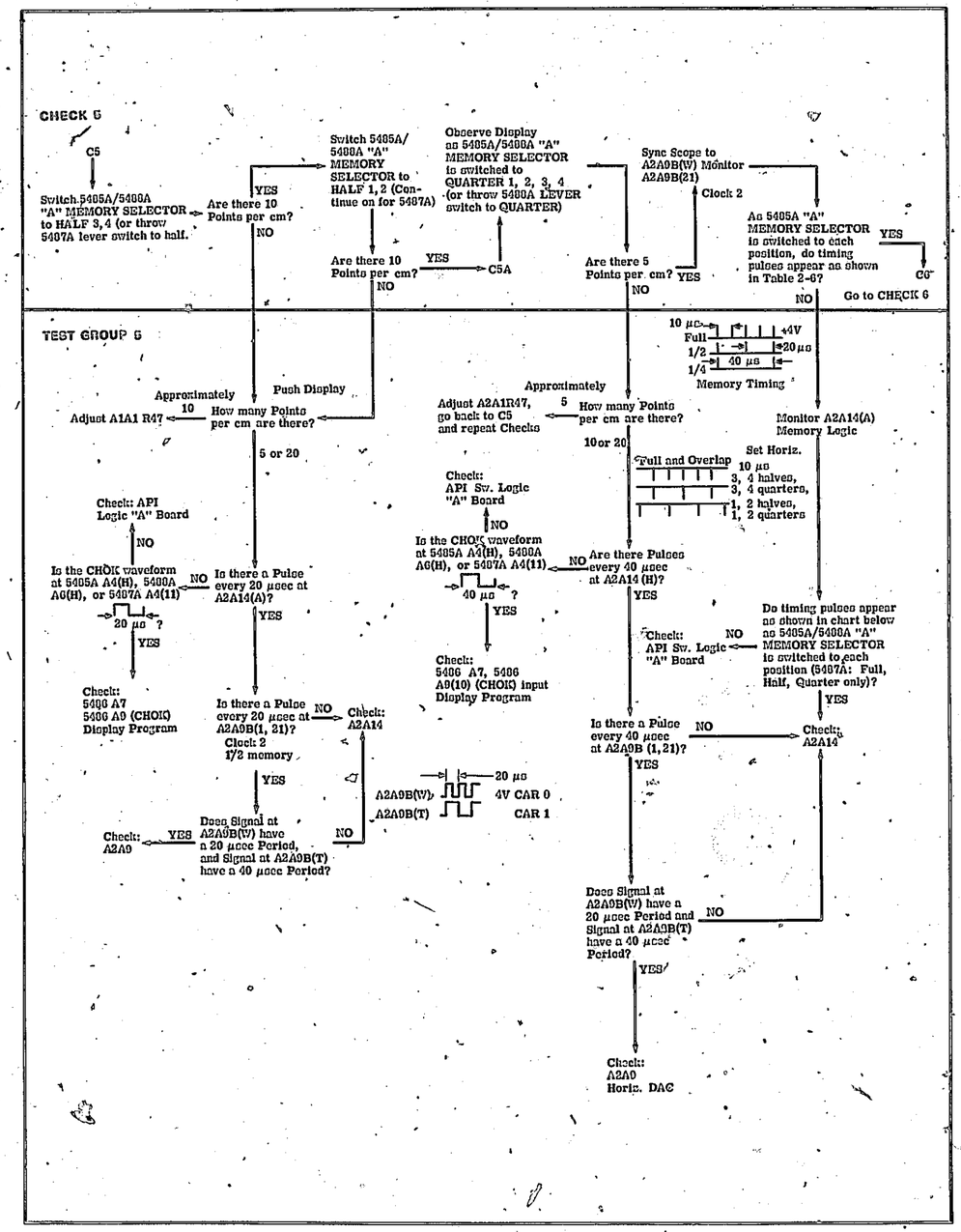


Table 4-1. Troubleshooting

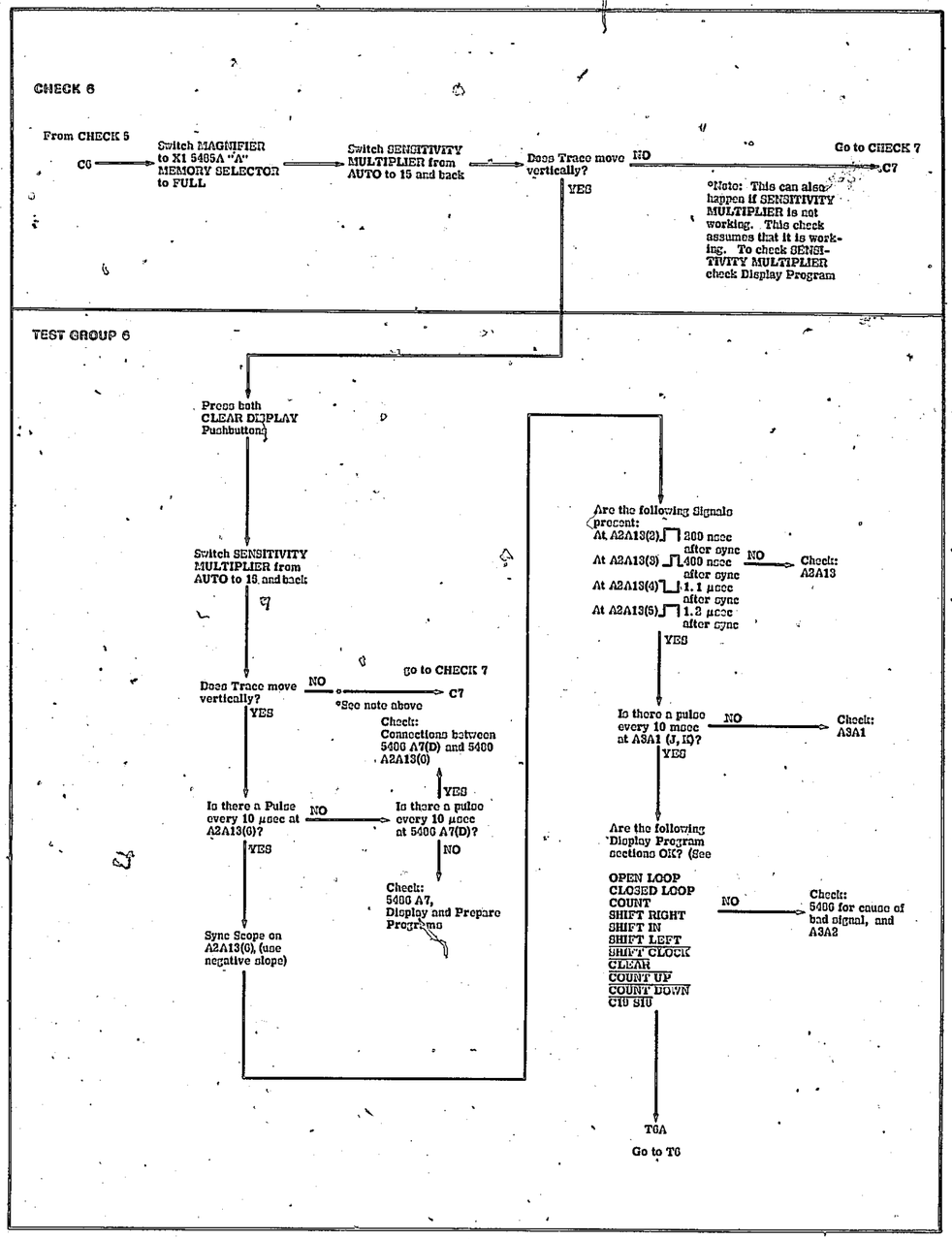


Table 4-1. Troubleshooting

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

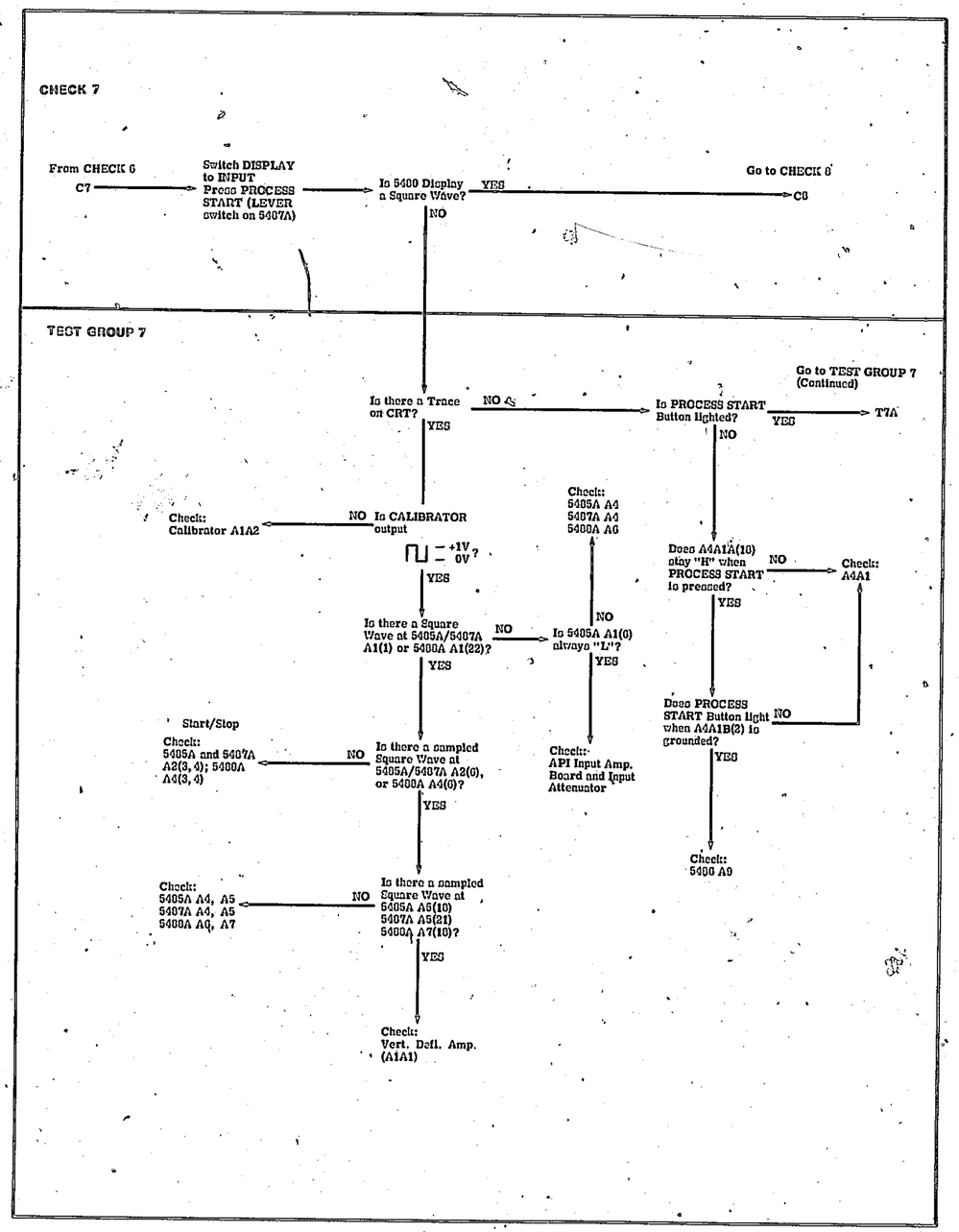


Table 4-1. Troubleshooting

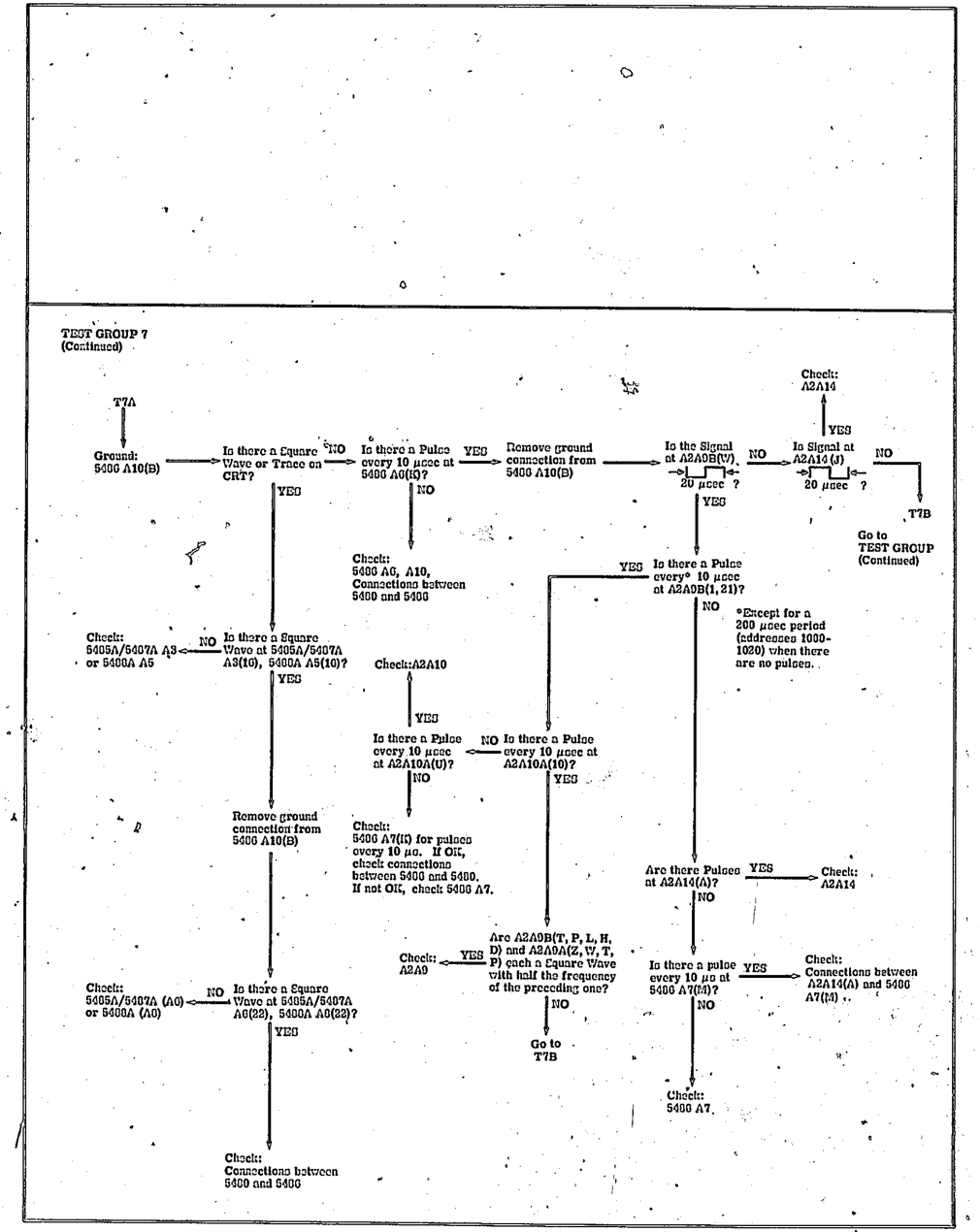


Table 4-1. Troubleshooting

TEST GROUP 7
(Continued)

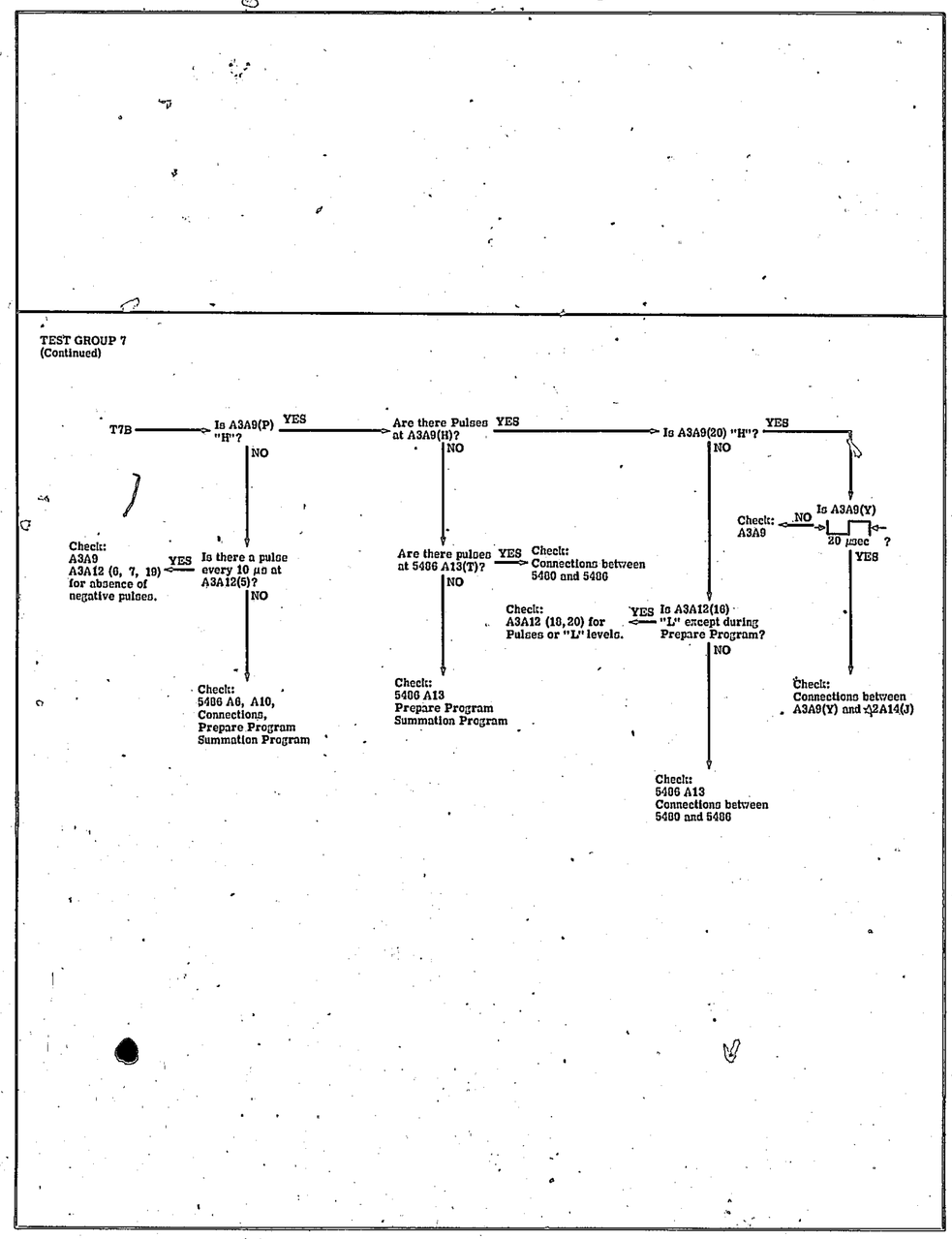


Table 4-1. Troubleshooting

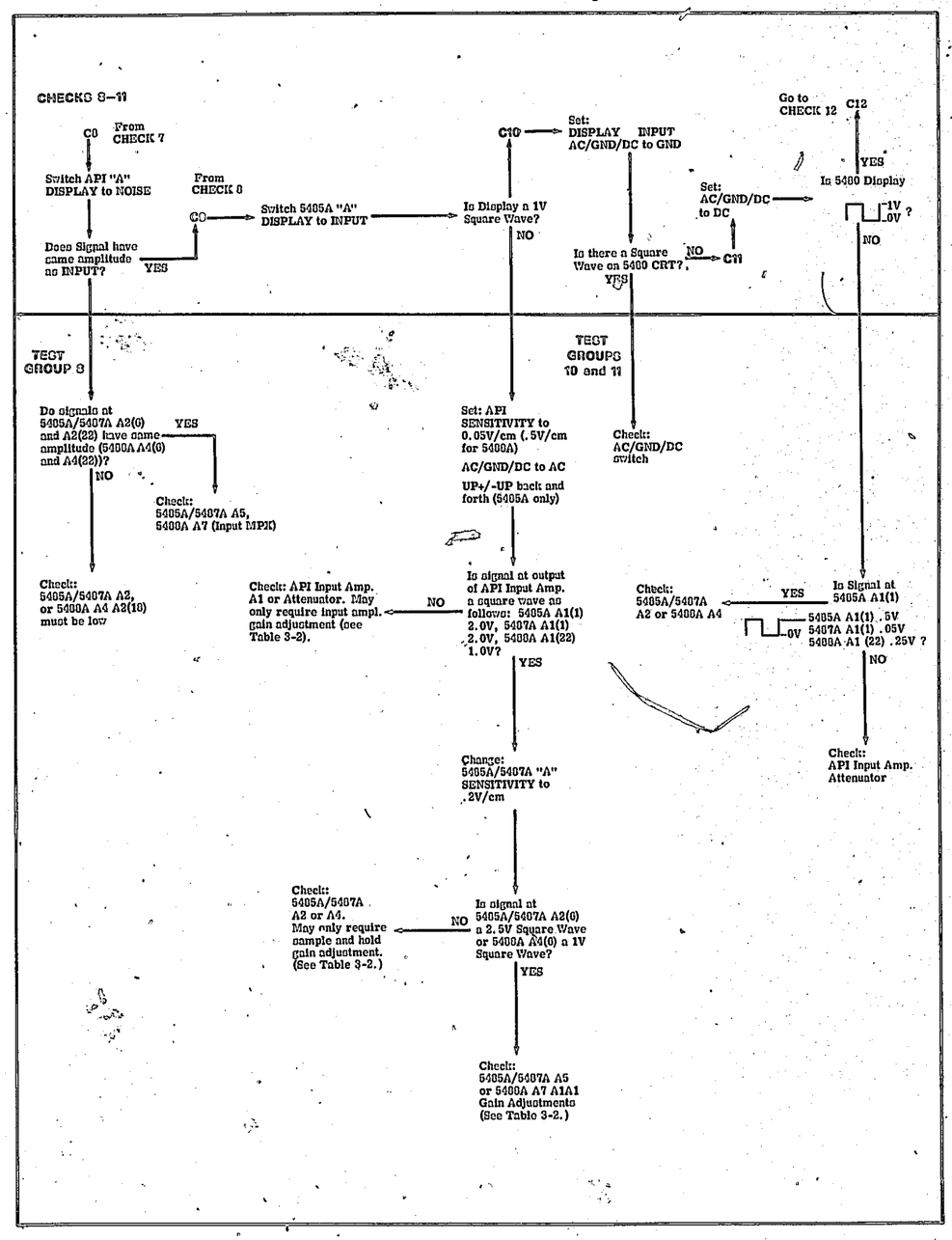


Table 4-1. Troubleshooting

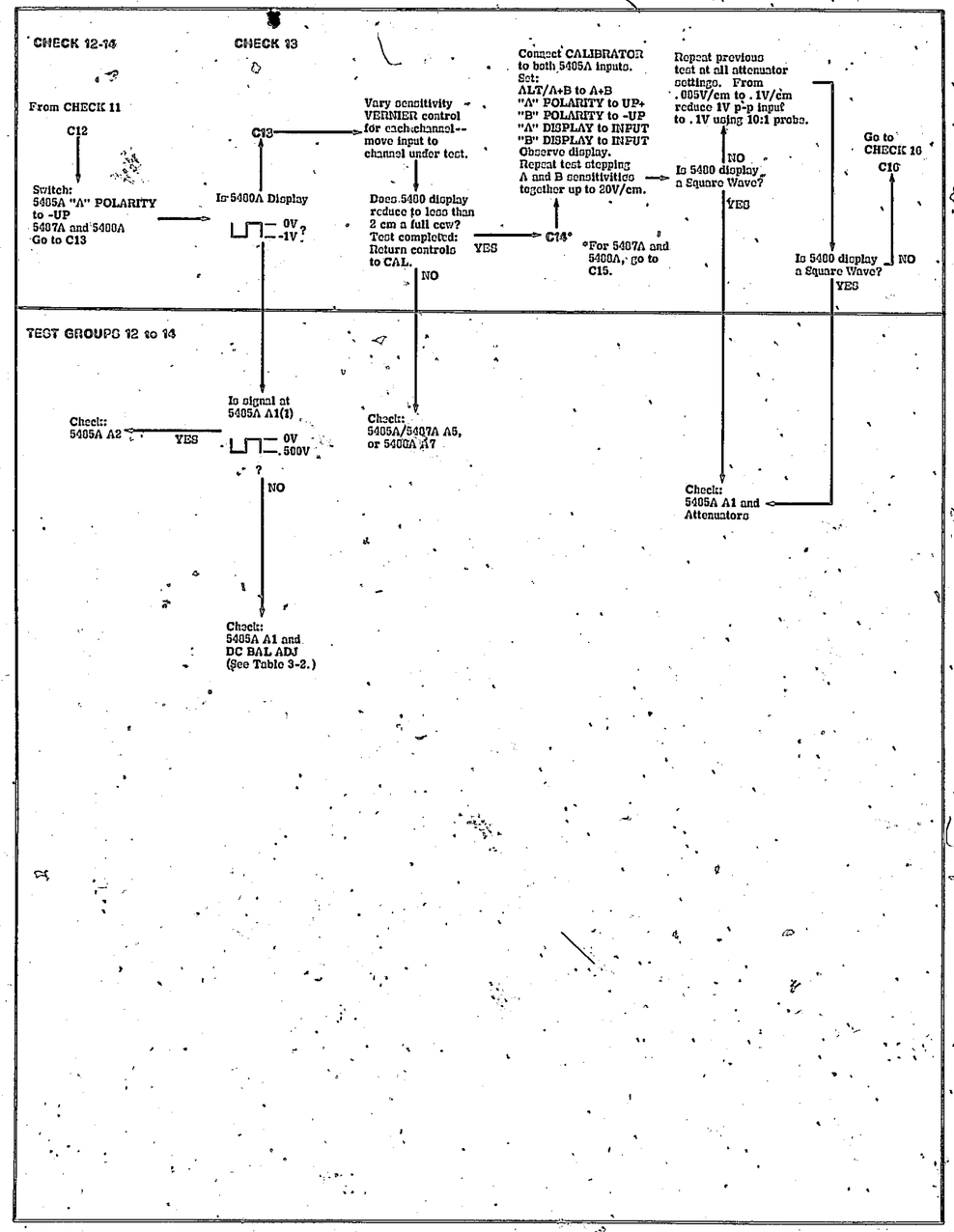


Table 4-1. Troubleshooting

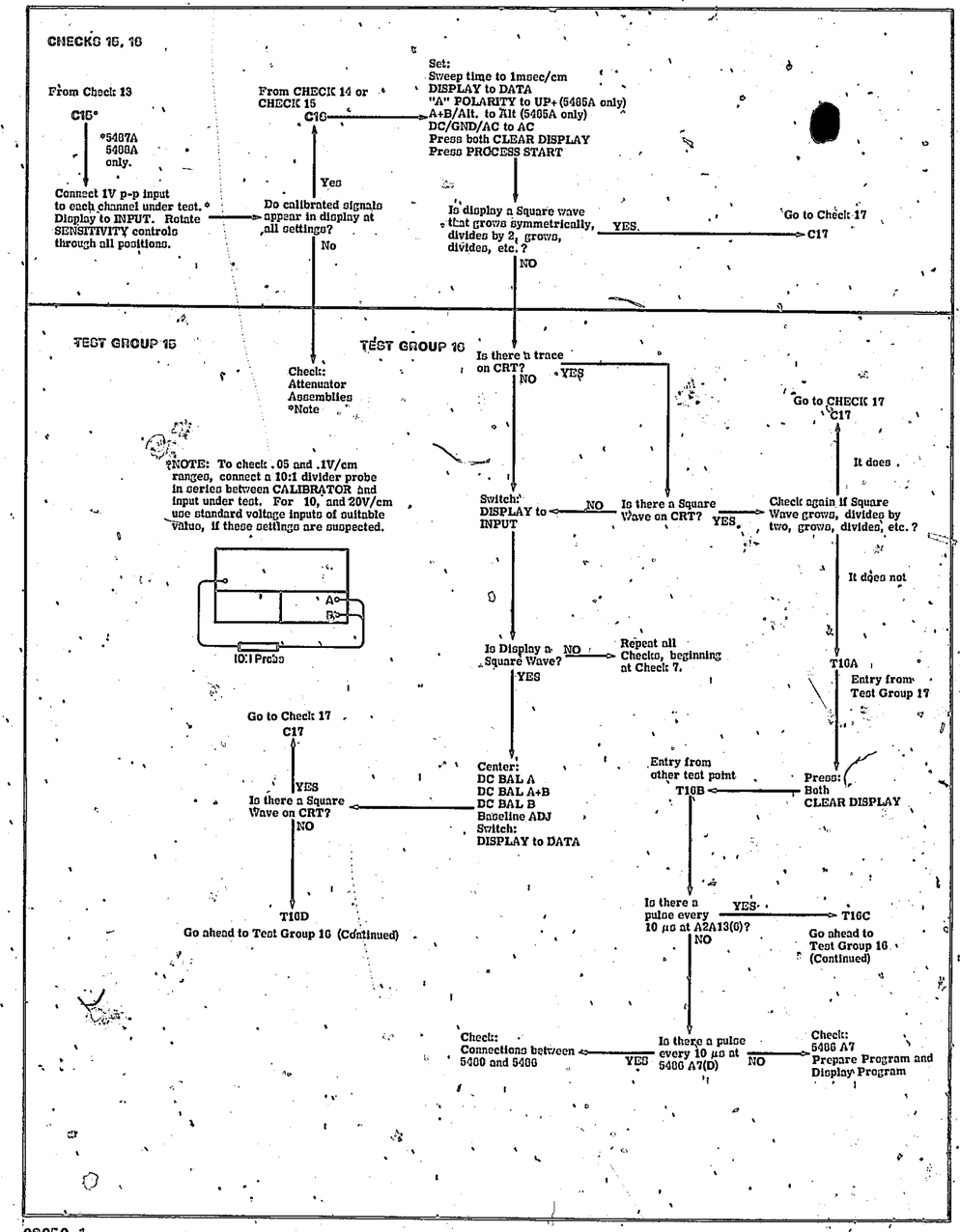


Table 4-1. Troubleshooting

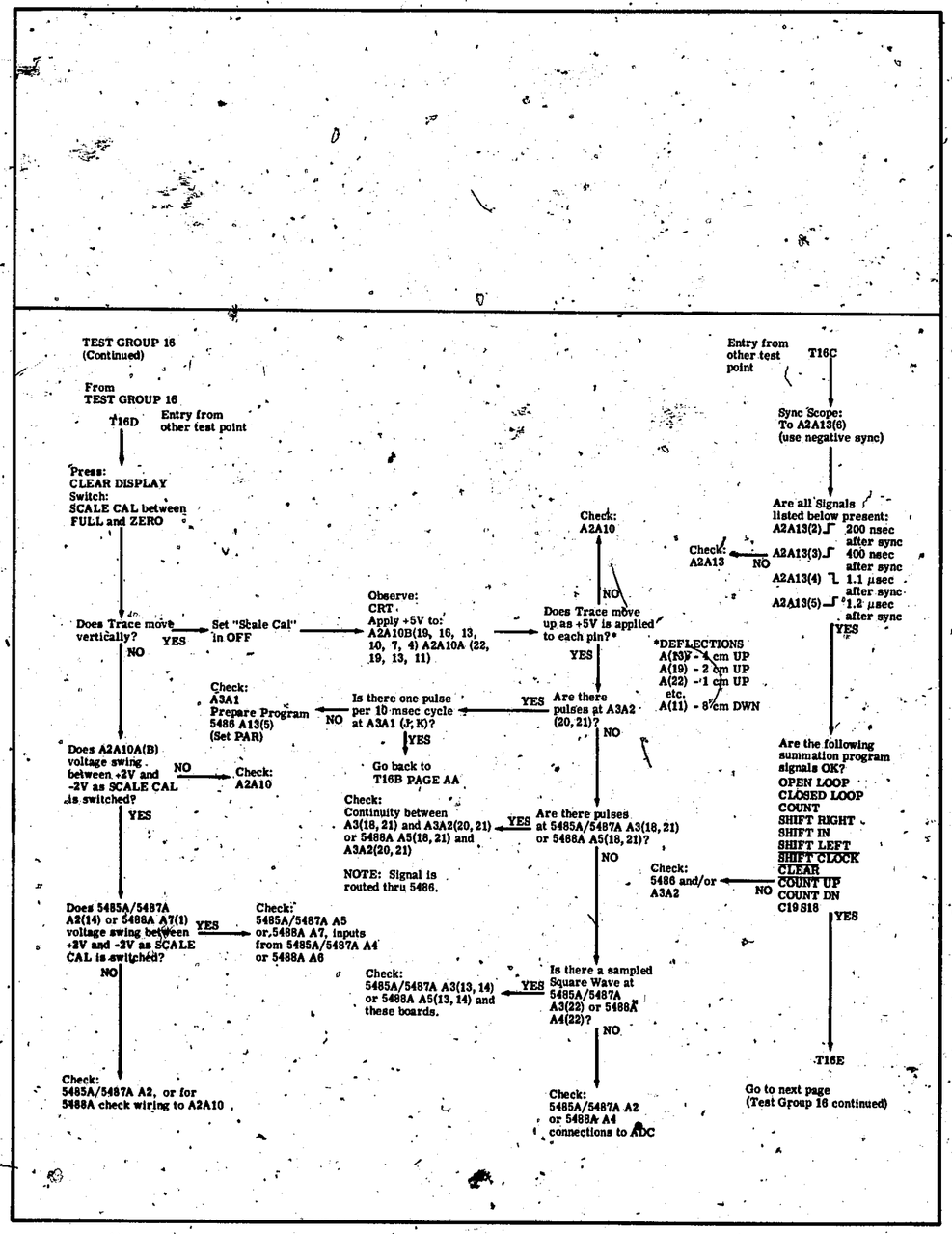


Table 4-1. Troubleshooting

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

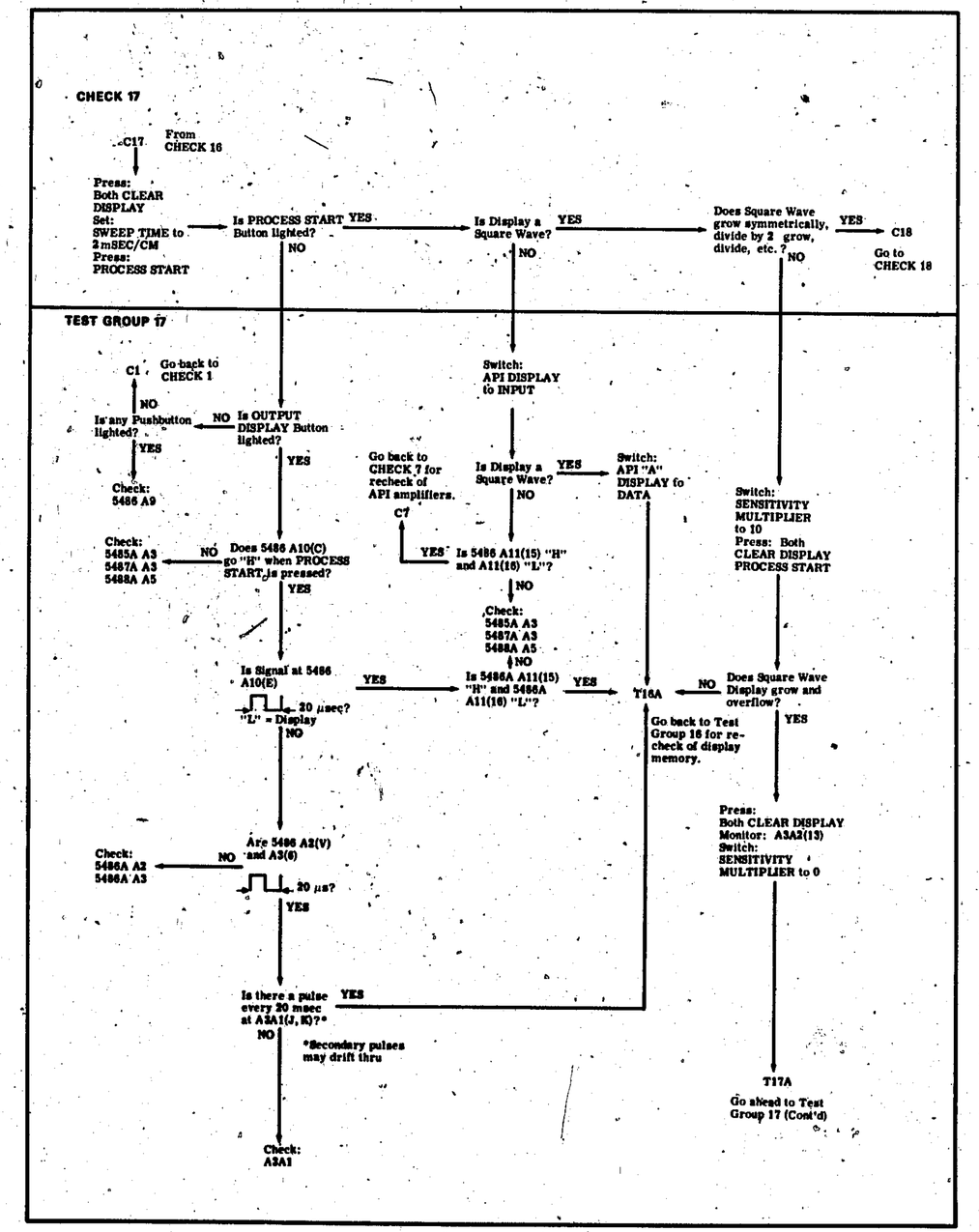


Table 4-1. Troubleshooting

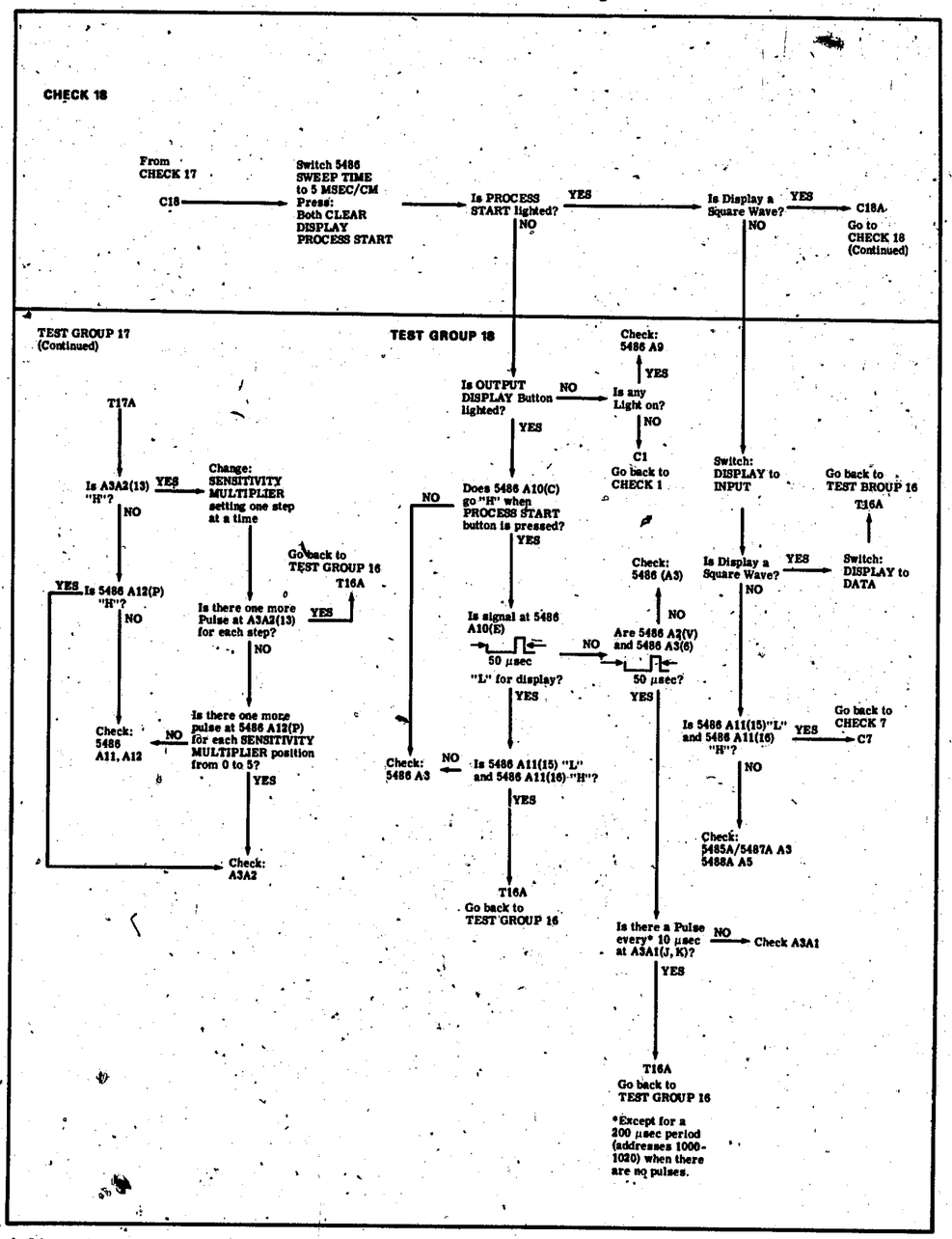


Table 4-1. Troubleshooting

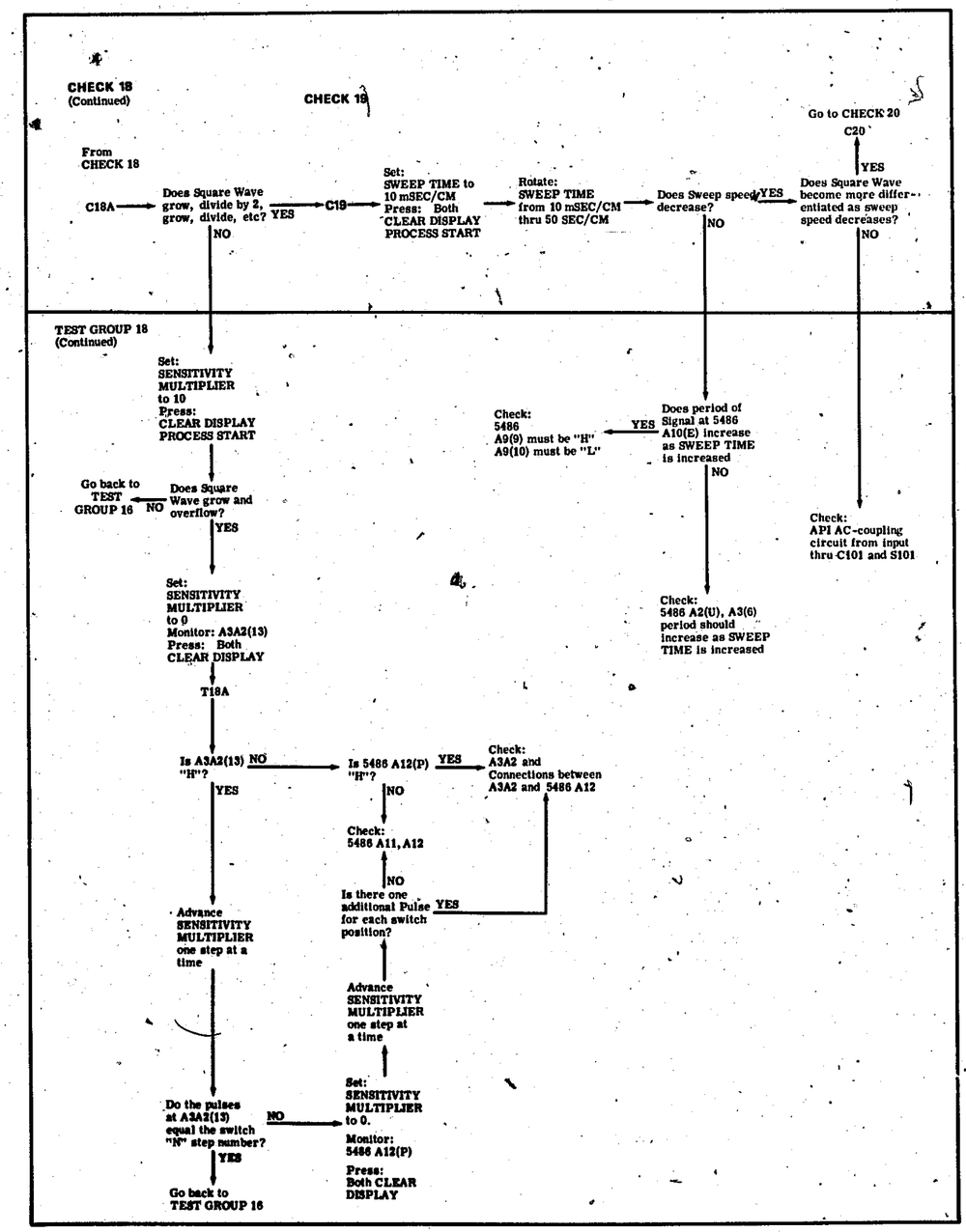
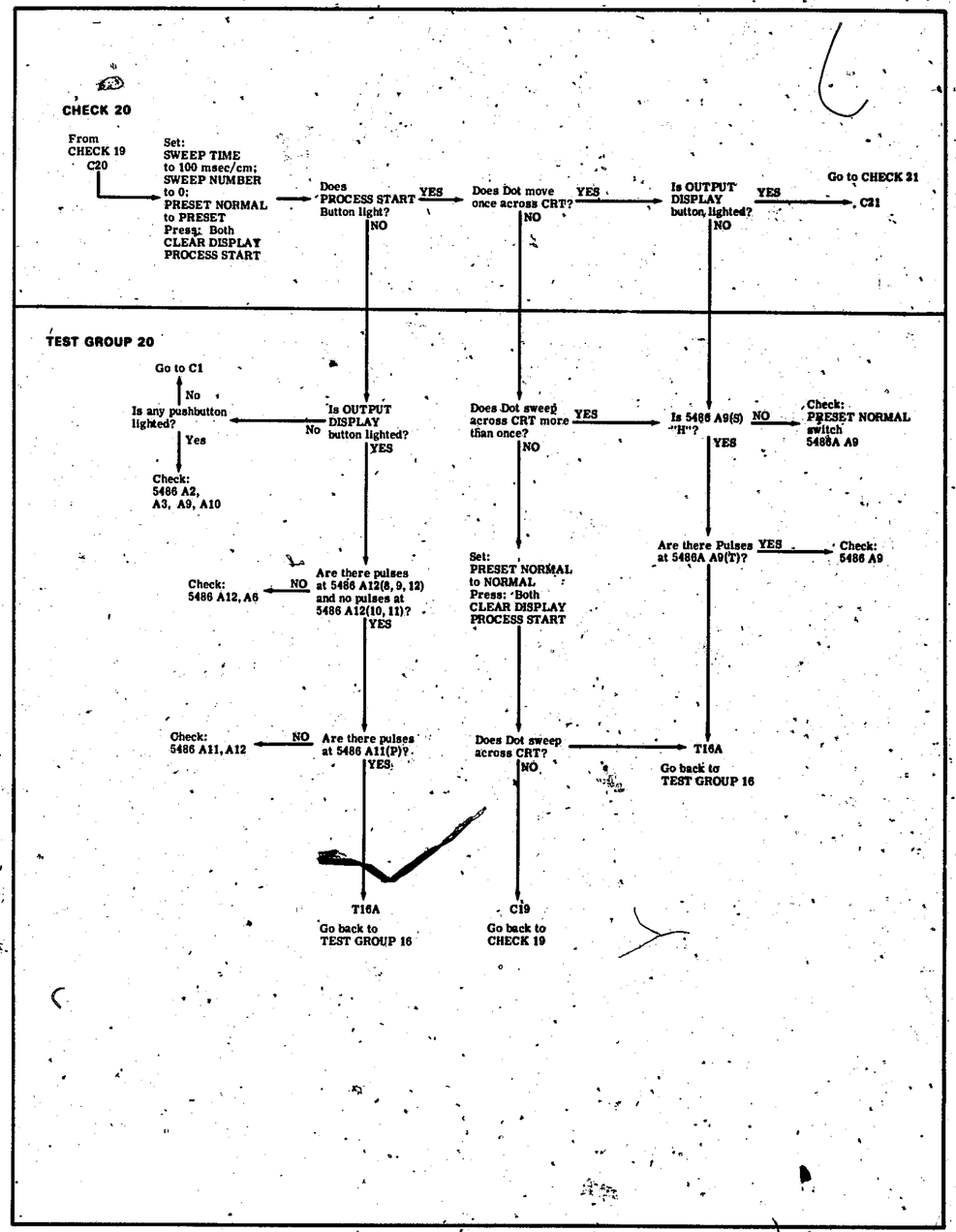
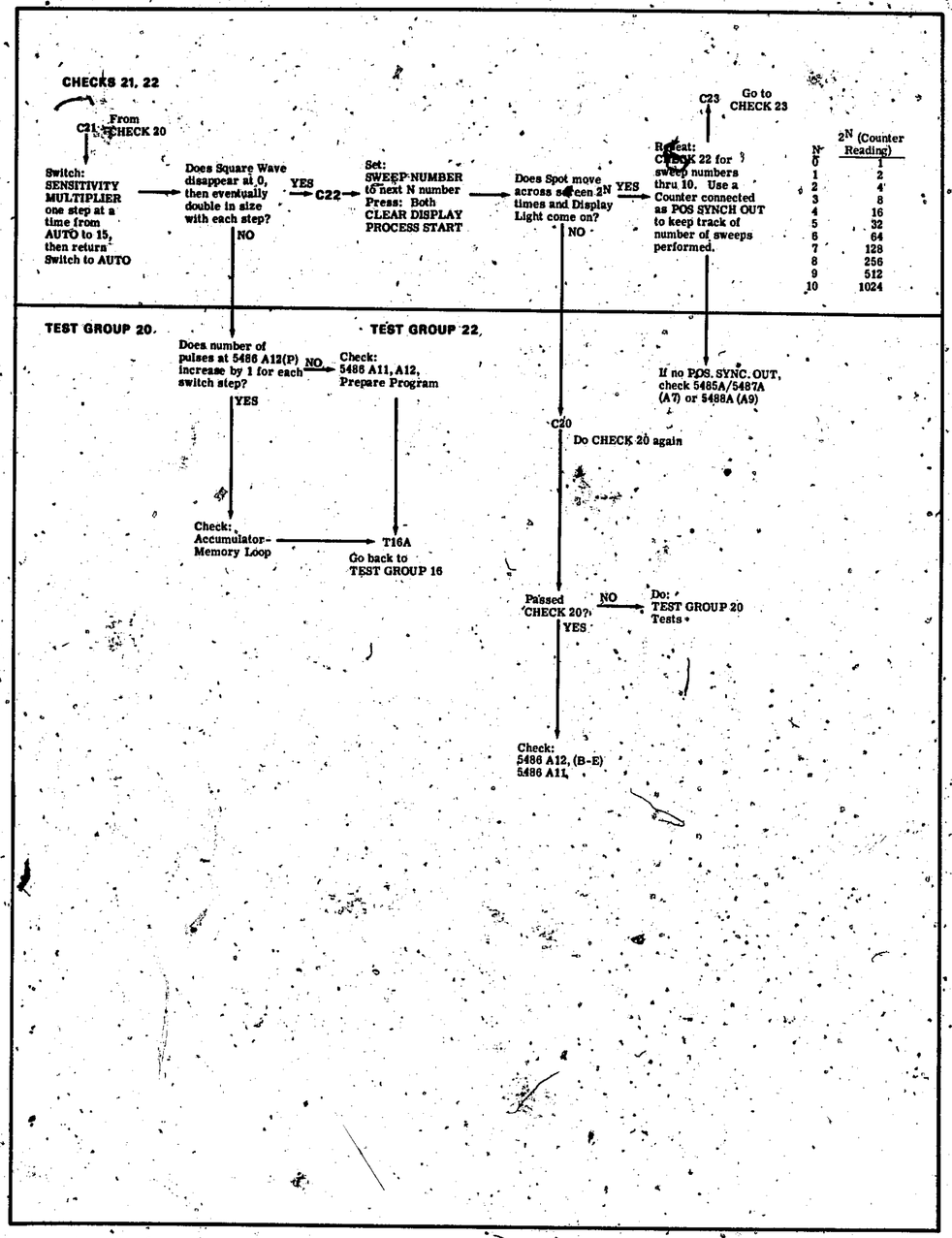


Table 4-1. Troubleshooting



02850-1

Table 4-1. Troubleshooting



02850-1

Table 4-1. Troubleshooting

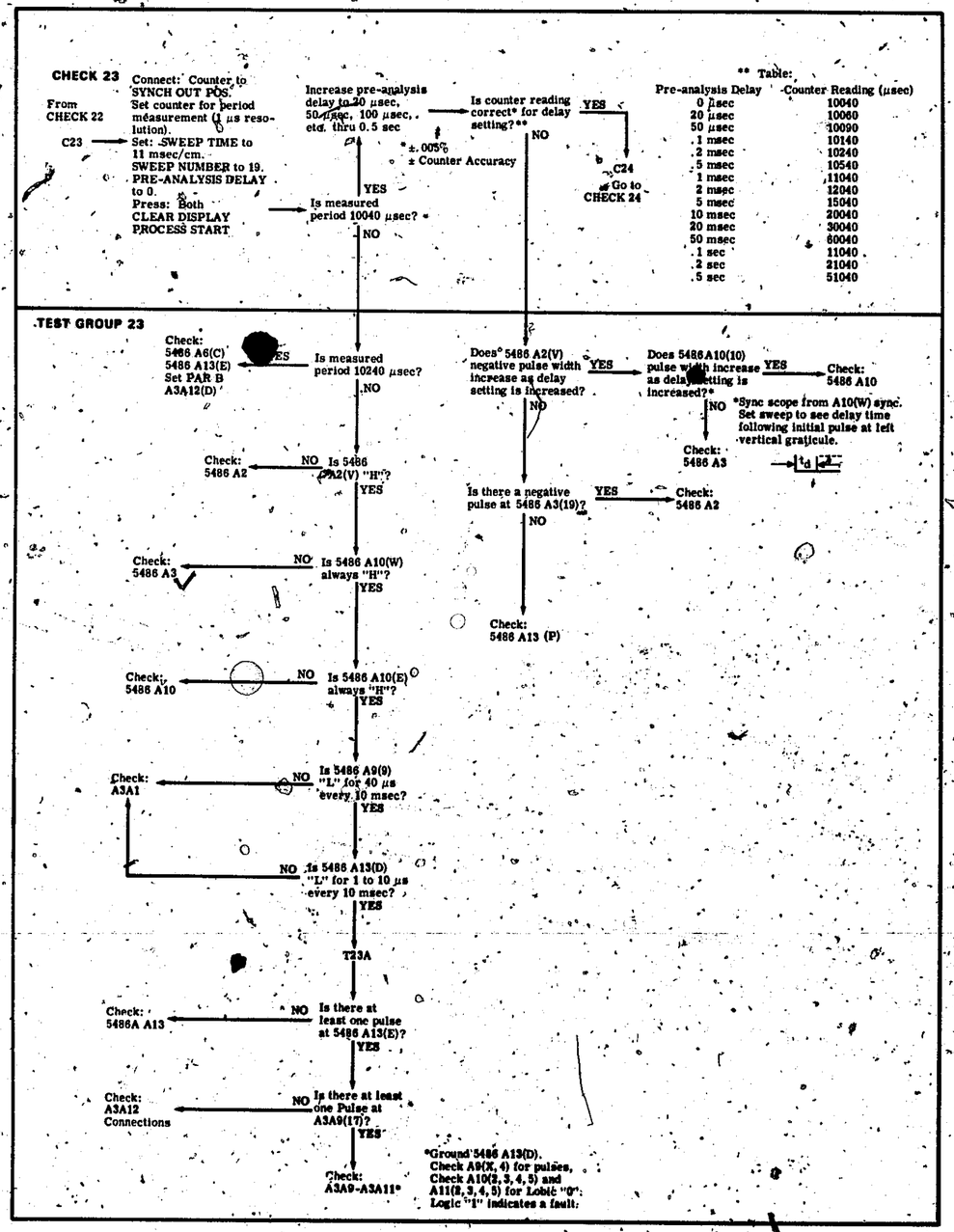


Table 4-1. Troubleshooting

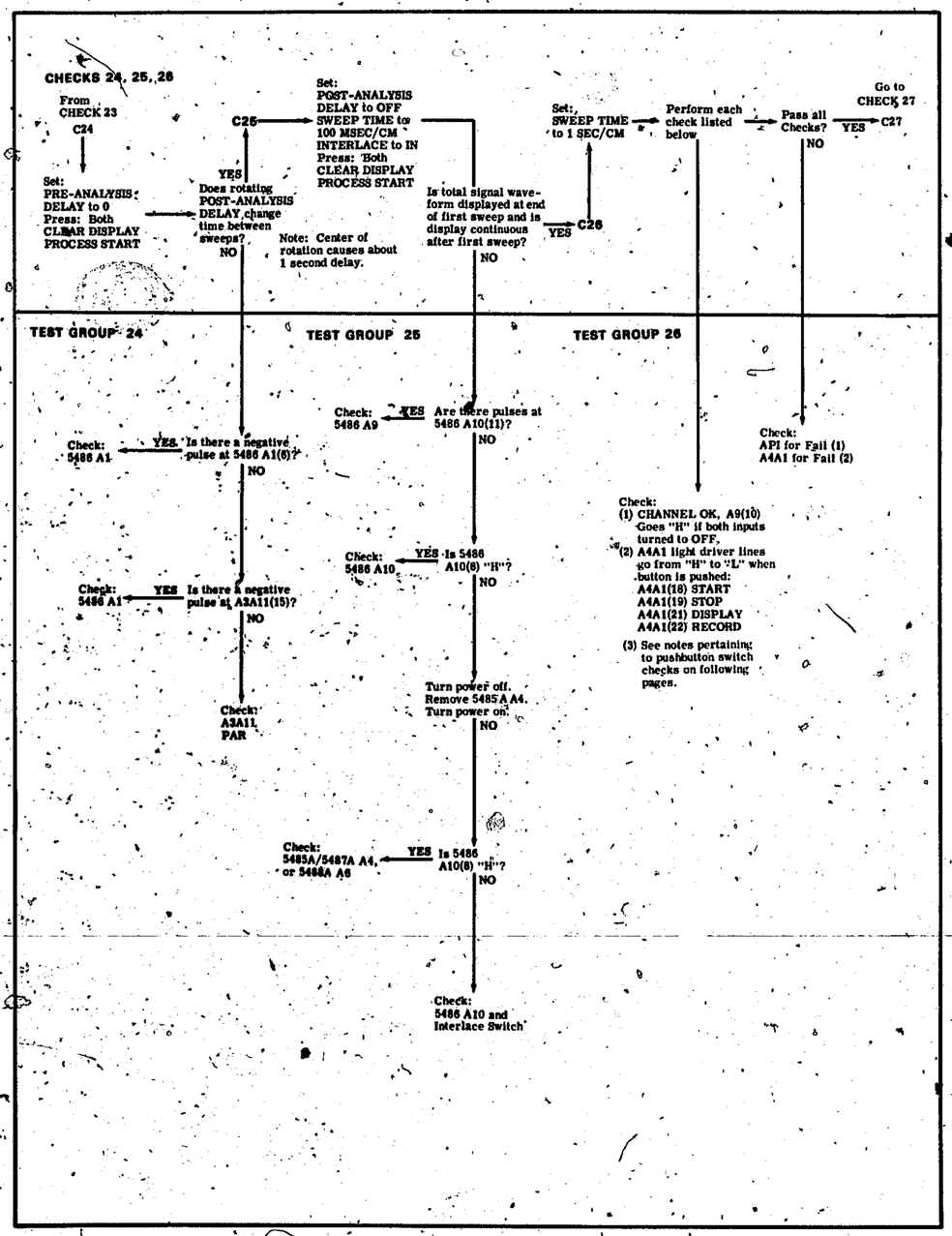


Table 4-1. Troubleshooting

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

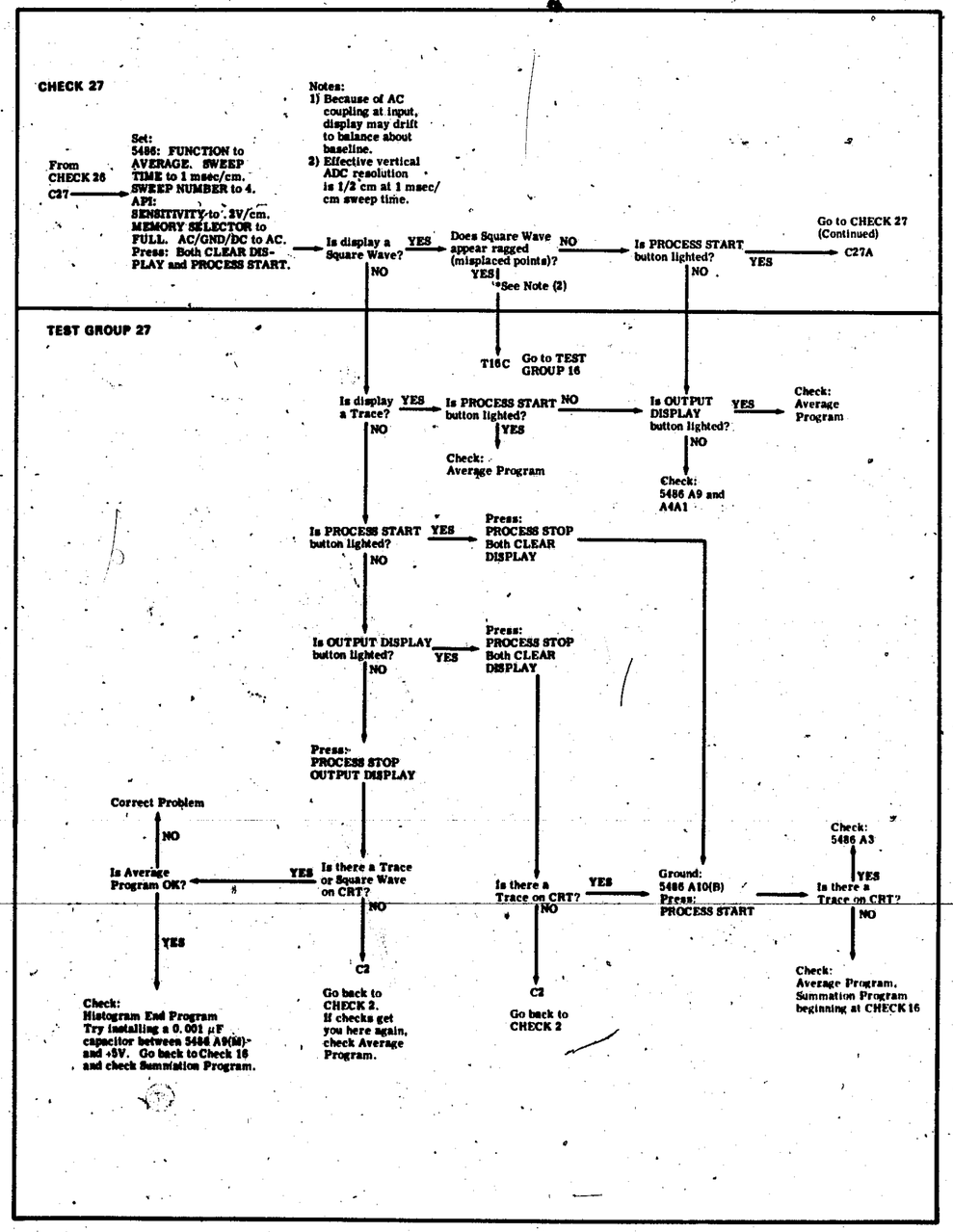


Table 4-1. Troubleshooting

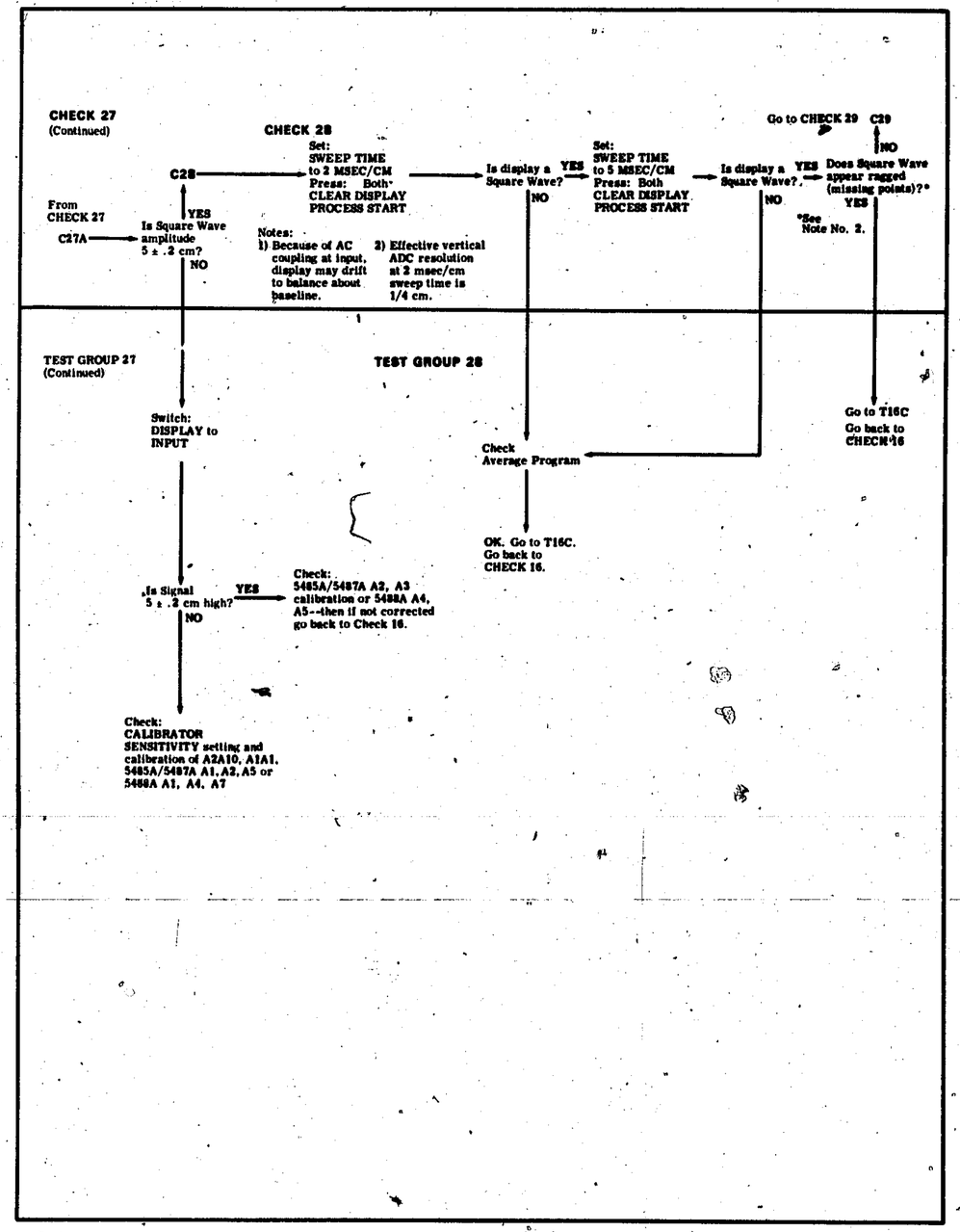


Table 4-1. Troubleshooting

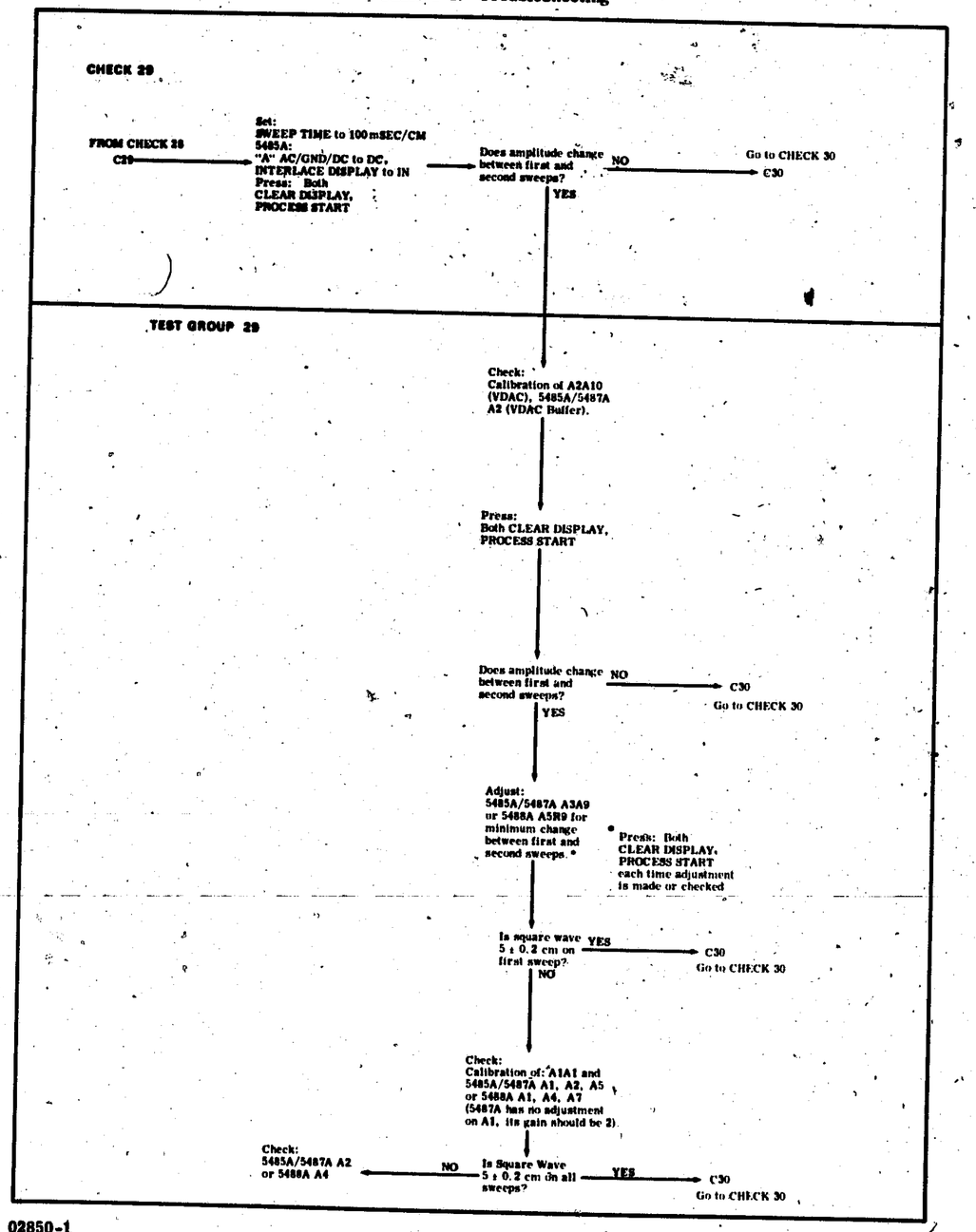


Table 4-1. Troubleshooting

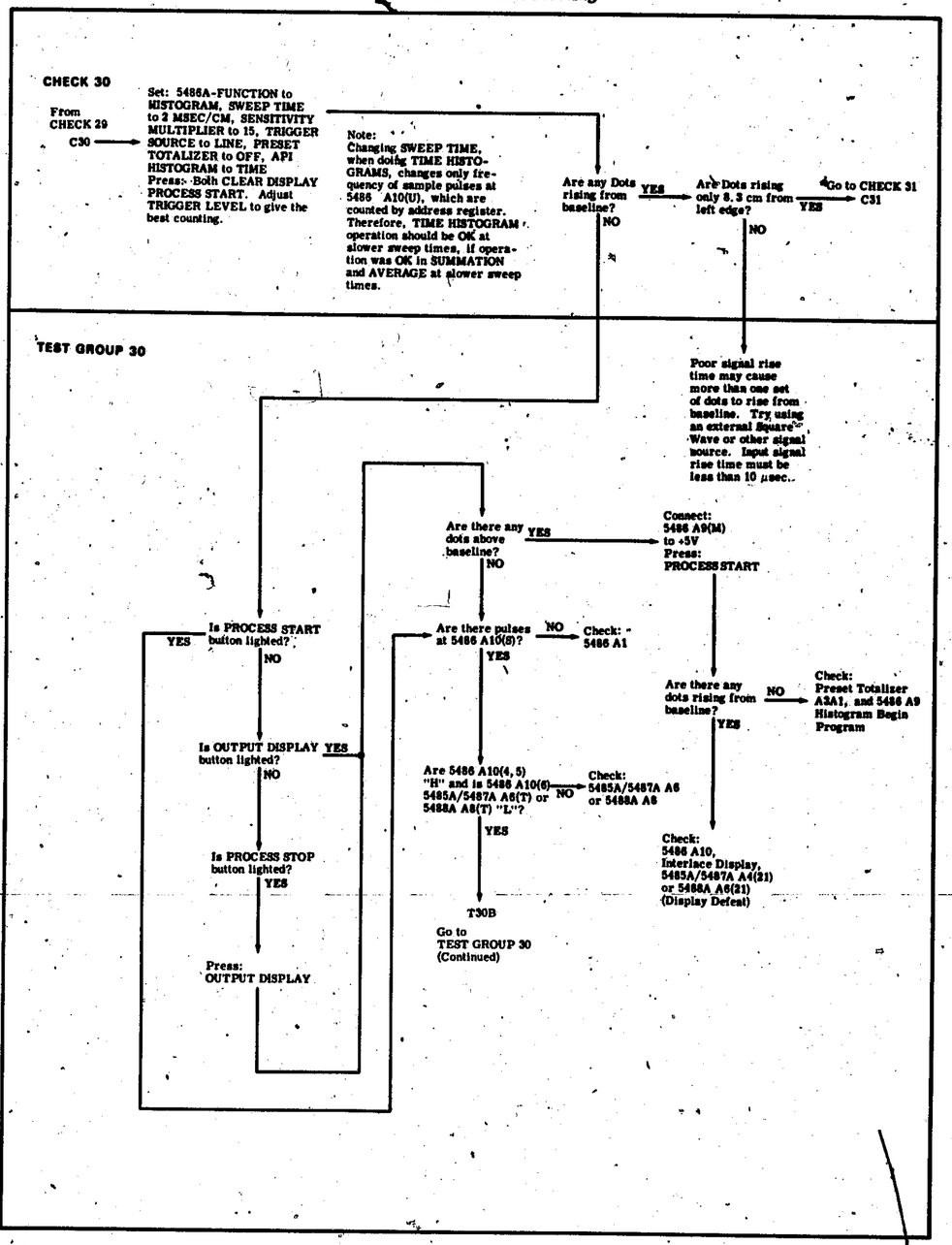


Table 4-1. Troubleshooting

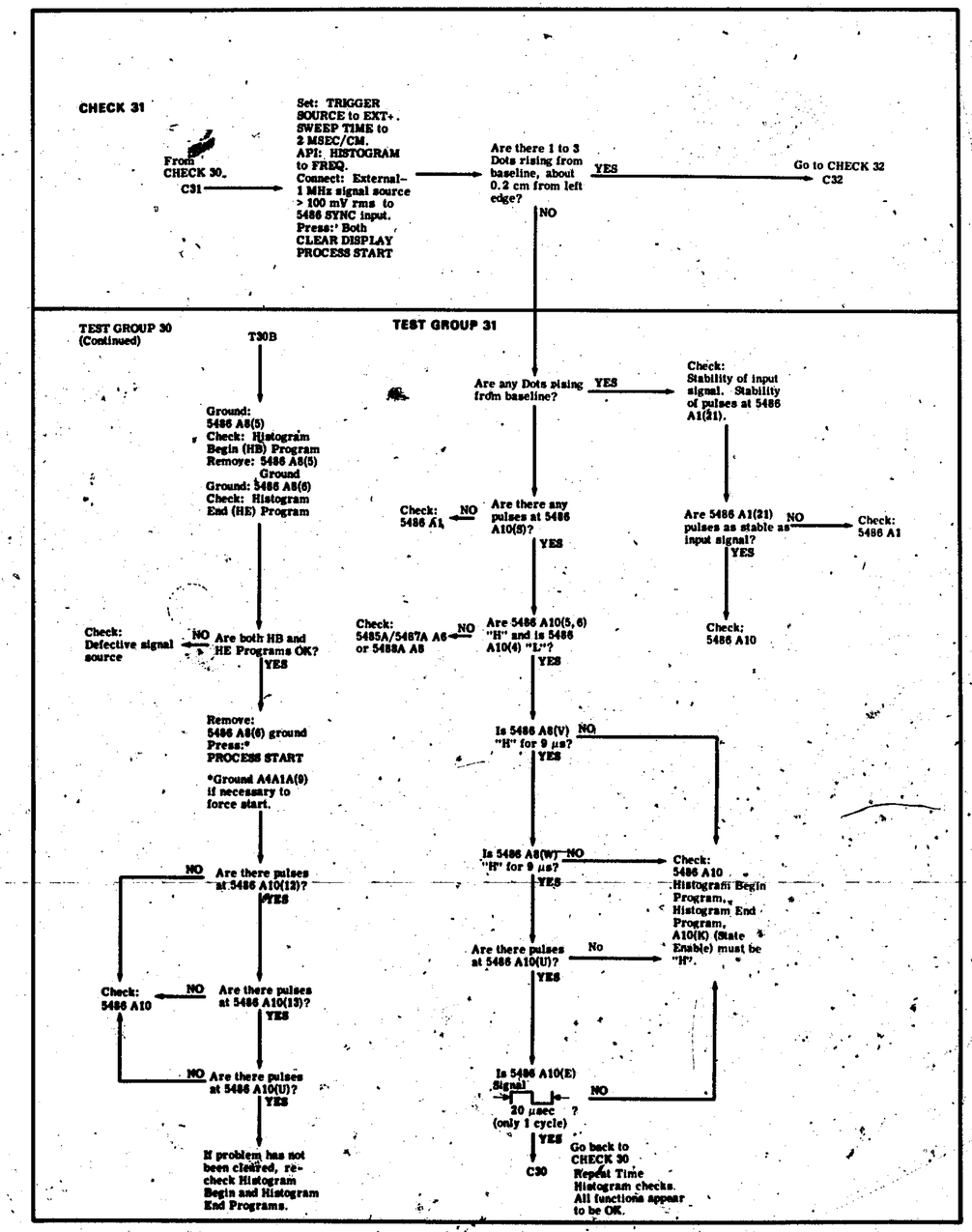


Table 4-1. Troubleshooting

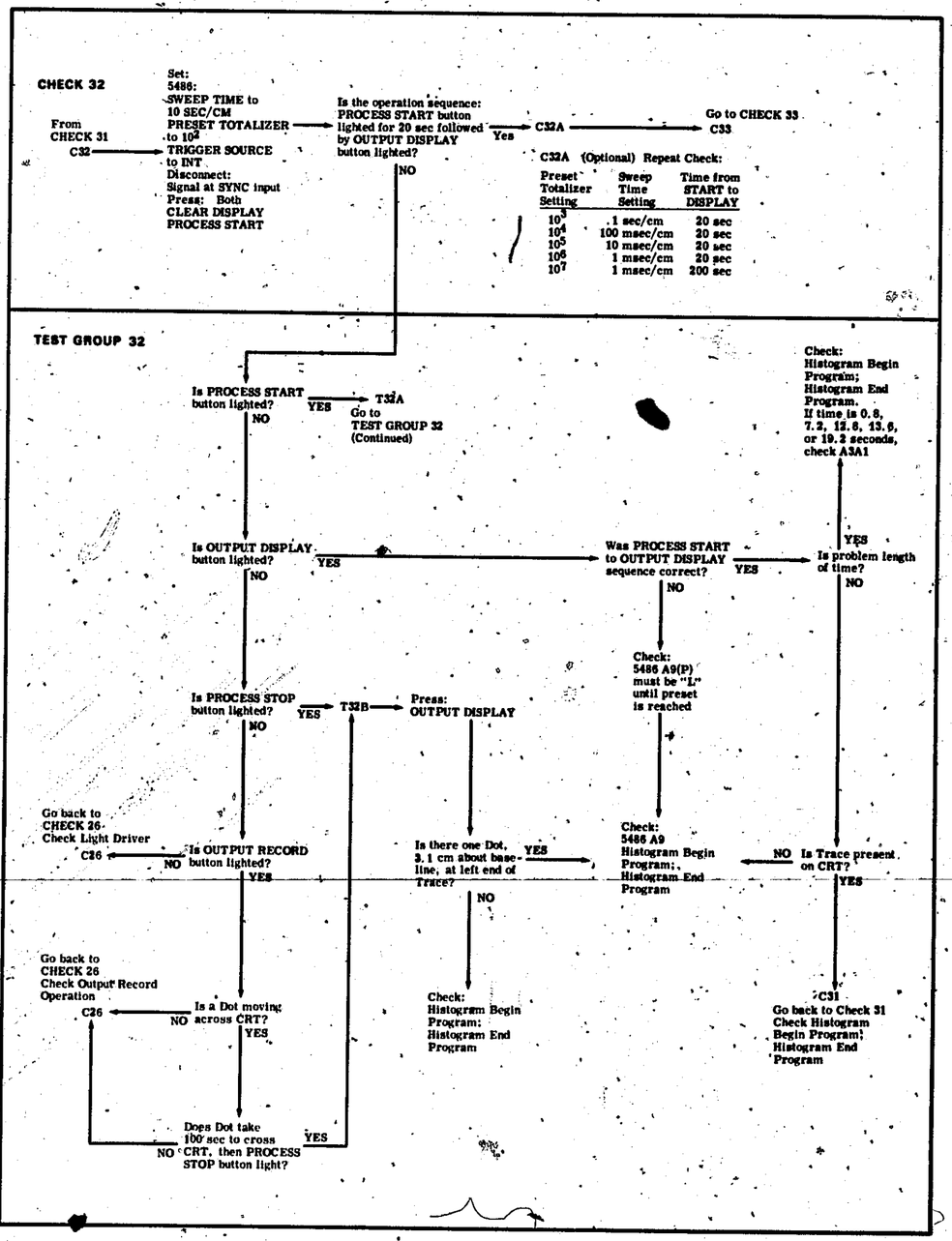


Table 4-1. Troubleshooting

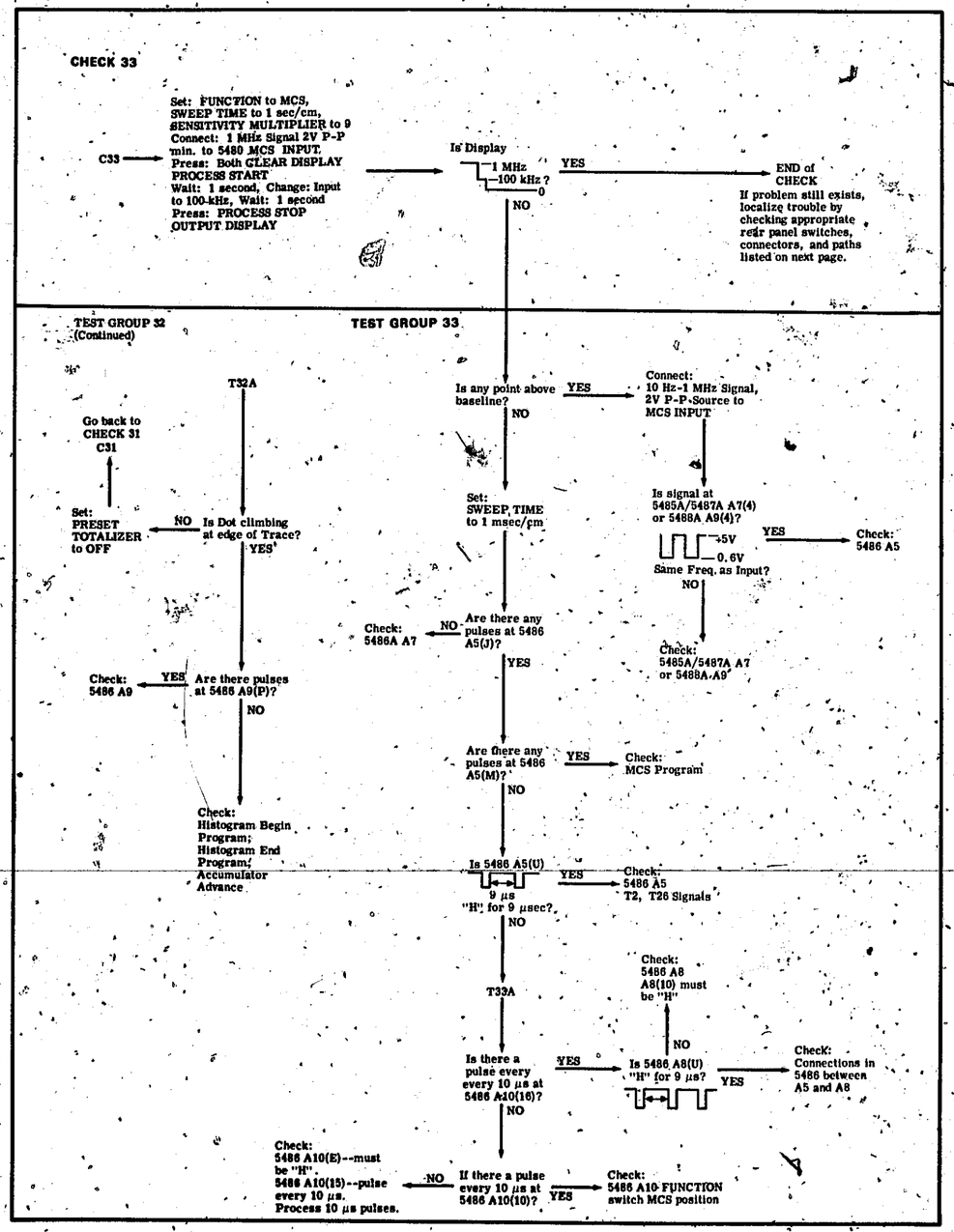


Figure 4-1. Test Points Prepare Program

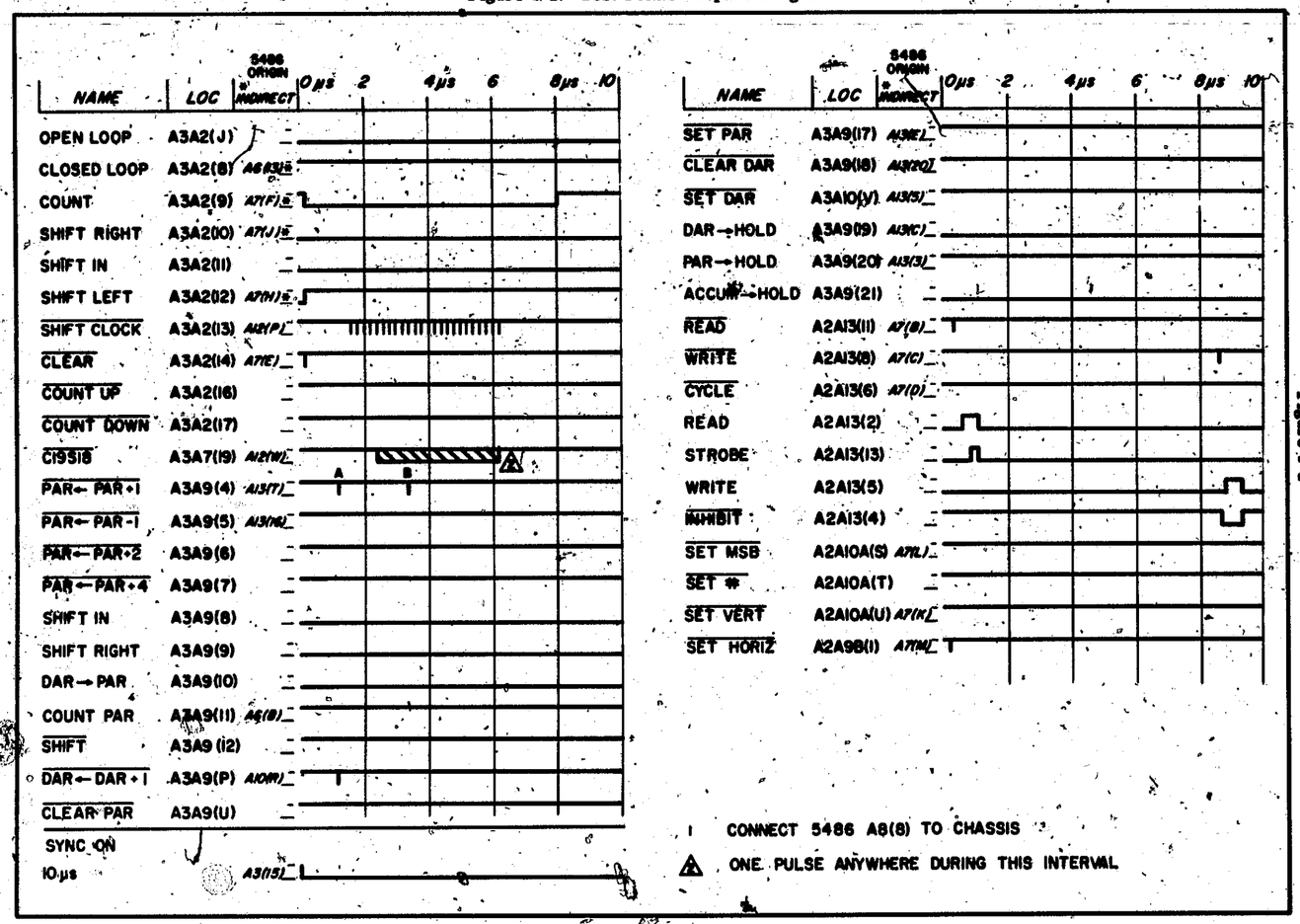


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Figure 4-1. Test Points Prepare Program (Cont'd)

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 T9, if PROCESS START is lighted
A6(C)	Always high
A6(D)	Pulse at T9
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 T2
A7(N)	Always high
A9(B)	High pulse at T98 (.2 μsec before T9)
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

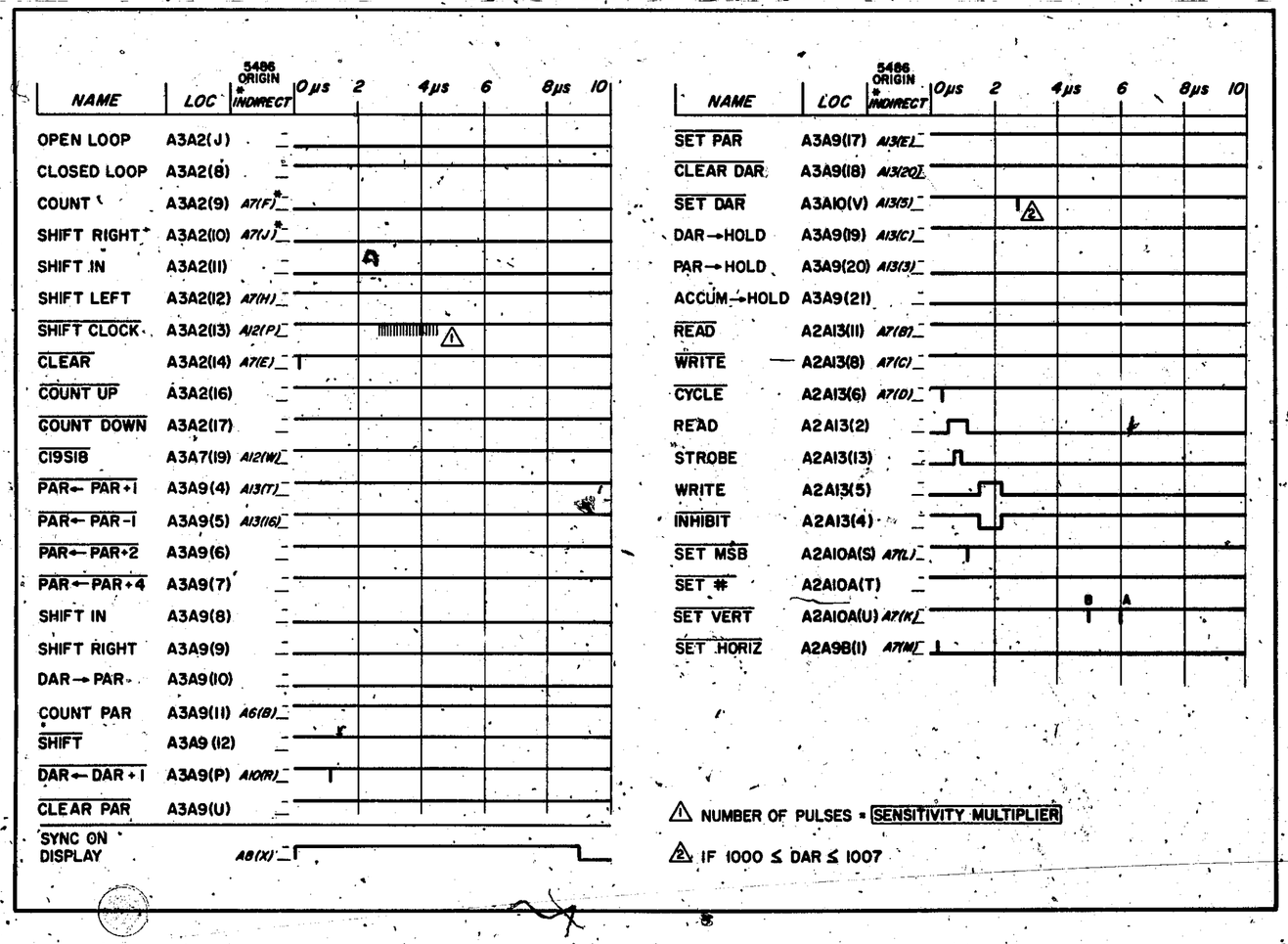

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Figure 4-2. Test Points Display Program (Cont'd)

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 T∅.
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)	5480B: 1) Low pulse at T16 if FUNCTION is set to AVERAGE. 2) Low pulse at T50 if FUNCTION is not set to AVERAGE. 5480A: 1) Low pulse at T2 if FUNCTION set to AVERAGE. 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 T∅), if:
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 (hot 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

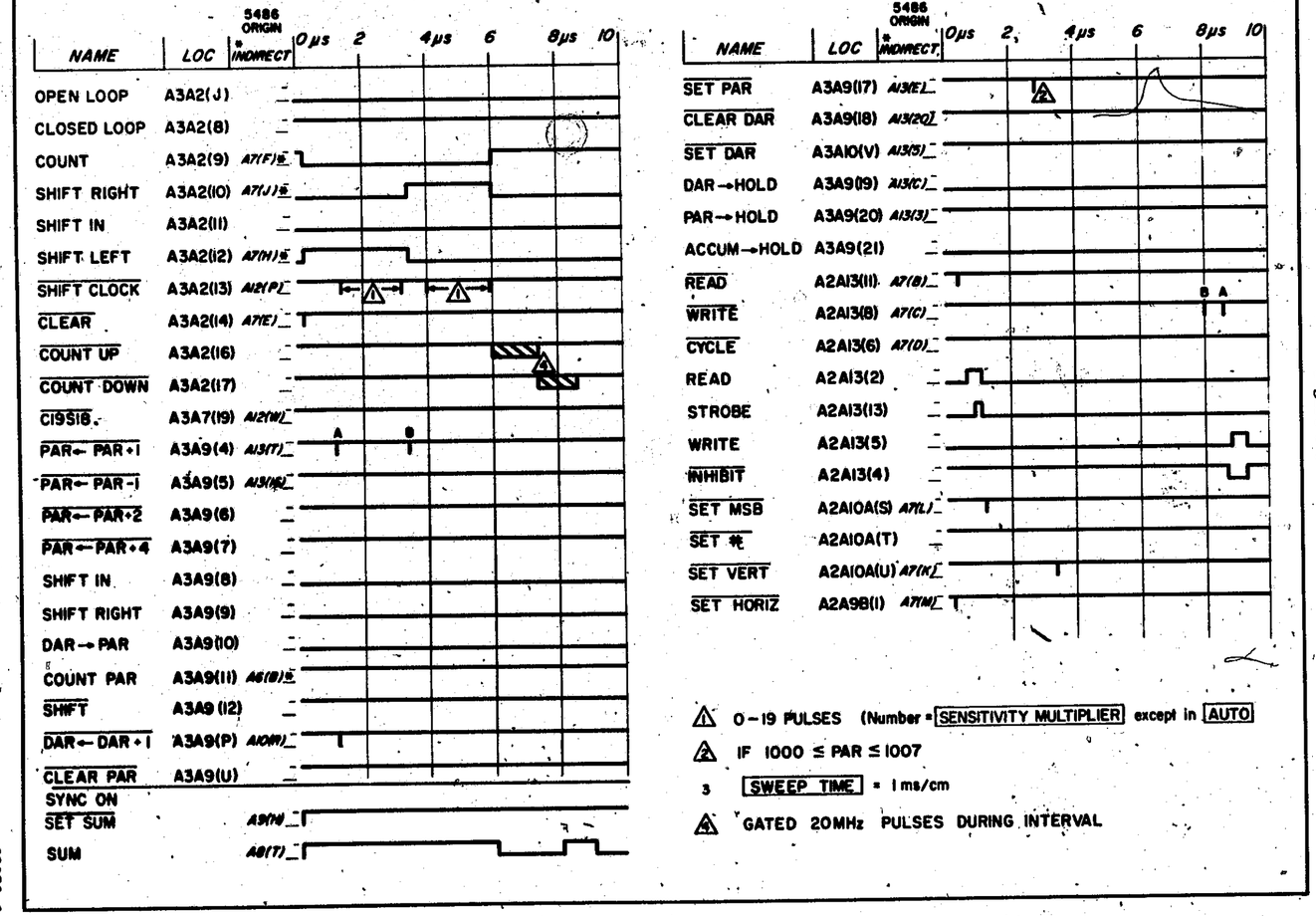

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Figure 4-3. Test Points Summation Program (Cont'd)

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 T0.
A6(C)	Always high.
A6(D)	Pulse at T0.
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

NAME	LOC	5486 SOURCE * 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)*
SHIFT CLOCK	A3A2(13)	A12(P)
CLEAR	A3A2(14)	A7(E)
COUNT UP	A3A2(16)	
COUNT DOWN	A3A2(17)	
C19S18	A3A7(19)	A12(W)
PAR← PAR+1	A3A9(4)	A13(7)
PAR← PAR-1	A3A9(5)	A13(6)
PAR← PAR+2	A3A9(6)	
PAR← PAR+4	A3A9(7)	
SHIFT IN	A3A9(8)	
SHIFT RIGHT	A3A9(9)	
DAR→ PAR	A3A9(10)	
COUNT PAR	A3A9(11)	A6(B)*
SHIFT	A3A9 (12)	
DAR← DAR+1	A3A9(P)	A10(R)
CLEAR PAR	A3A9(U)	A6(F)*
SYNC ON AVERAGE		A8(S)
SET AVG		A9(F)

NAME	LOC	5486 SOURCE * INDIRECT
SET PAR	A3A9(17)	A13(E)
CLEAR DAR	A3A9(18)	A13(20)
SET DAR	A3A10(V)	A13(5)
DAR→HOLD	A3A9(9)	A13(C)
PAR→HOLD	A3A9(20)	A13(3)
ACCUM→HOLD	A3A9(21)	
READ	A2A13(11)	A7(8)
WRITE	A2A13(8)	A7(C)
CYCLE	A2A13(6)	A7(D)
READ	A2A13(2)	
STROBE	A2A13(13)	
WRITE	A2A13(5)	
INHIBIT	A2A13(4)	
SET MSB	A2A10A(S)	A7(L)
SET #	A2A10A(T)	
SET VERT	A2A10A(U)	A7(K)
SET HORIZ	A2A9B(1)	A7(M)

1. 0 - 19 PULSES
2. IF 1000 ≤ PAR ≤ 1007
3. SWEEP TIME = 1 ms/cm
4. GATED 20MHz PULSES DURING INTERVAL

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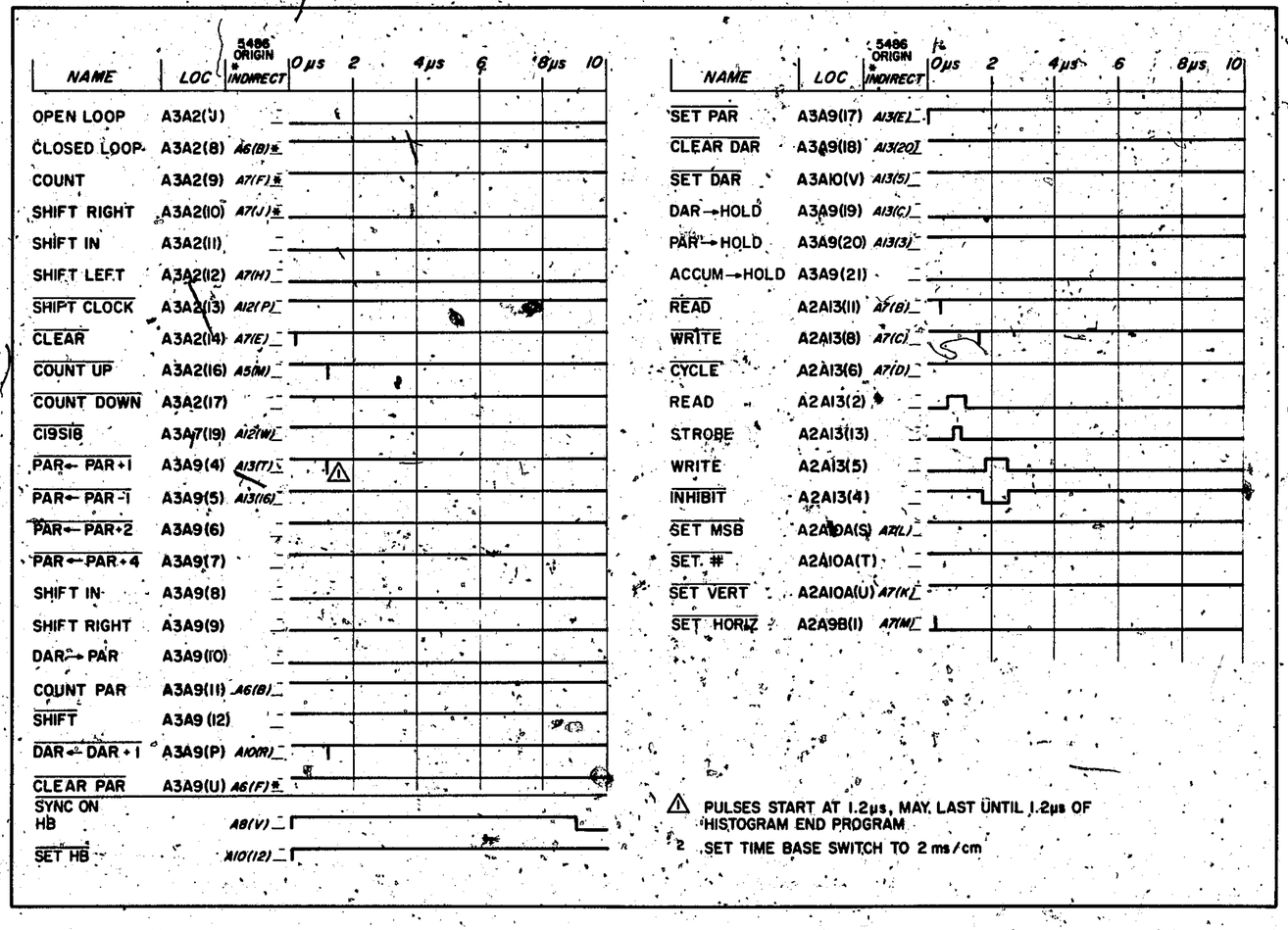
Figure 4-4. Test Points Average Program (Cont'd)

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 (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



⚠ 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

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

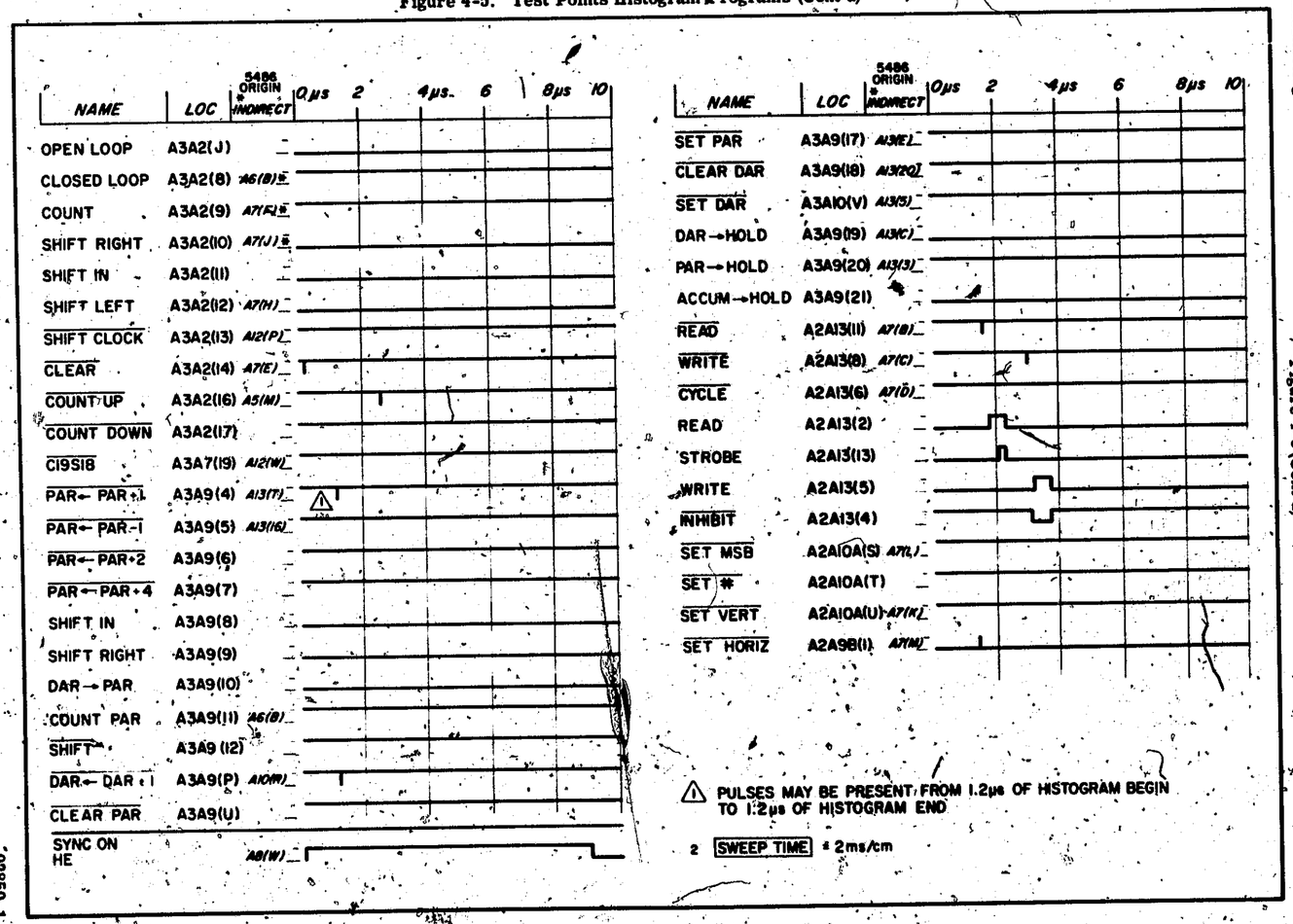

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Figure 4-5. Test Points Histogram Programs (Cont'd)

5486A/B Signals, HISTOGRAM END Program:

LOCATION	SIGNAL
A5(2)	Always high
A5(3)	Always low
A5(L)	Always low
A5(M)	Pulse at T26
A5(N)	Always high
A5(P)	Always high
A5(R)	Always high
A6(B)	Pulse at TØ if 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)	Always high
A6(K)	Always high
A6(20)	Always high
A7(B)	Pulse at T16
A7(C)	5486B: Pulse at T28; 5486A: Pulse at T30
A7(D)	Always high
A7(E)	Pulse at T2
A7(F)	Pulse at T16
A7(H)	Always high
A7(J)	Always high
A7(K)	Always high
A7(L)	Always high
A7(M)	Pulse at T14
A7(N)	Pulse at T80
A9(B)	Always high
A9(C)	Pulse at T98 (0.2 μsec before TØ)
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

LOCATION	SIGNAL
A10(C)	Always low
A10(D)	Always high
A10(E)	Goes low at T40 if PRESAMPLE is low. Goes high at T40 if PRESAMPLE goes high.
A10(9)	Pulse at T98 if PRESAMPLE is high
A10(10)	Pulse at T98 if processing
A10(11)	Pulse at T98 if displaying
A10(12)	Always high
A10(N)	Pulse at T98 if PRESAMPLE is high
A10(13)	Pulse at T98 if: 1) Histogram is in process (e.g., we are between end of HISTOGRAM BEGIN program and beginning of HISTOGRAM END program) and 2) 5480 is processing.
A10(R)	Pulse at T12
A10(19)	Always high
A10(U)	Pulses, ending at T12
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 at 1000 or more
A13(E)	Always high
A13(F)	Always low
A13(H)	Always high
A13(J)	Always high
A13(P)	Pulse at T90 if address register is being reset from 1023 to Ø.
A13(T)	Sample or external sync pulses, starting at T12
A13(W)	Always high
A13(20)	High; pulse at T16 if: 1) Address register is 1000 or more and 2) 5480 is displaying and 3) OUTPUT DISPLAY is lighted.