HEWLETT
PACKARD

SERVICE MANUAL

HP 4145B

SEMICONDUCTOR PARAMETER ANALYZER

SERIAL NUMBERS

This manual applies directly to instruments with serial number 2830J- and above.

With changes described in Section VII, this manual also applies to instruments with serial numbers prefixed 2608J-.

For additional important information about serial numbers, see INSTRUMENTS COVERED BY MANUAL in Section I, Operation Manual.

Manual Part No. 04145-90320
Microfiche Part No. 04145-90370

Printed: April 1989

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Manual Organization

The *Operation Manual* and *Service Manual* are necessary for servicing the HP 4145B. Both manuals are supplied with the HP 4145B. These manuals are organized as follows:

HP 4145B *Operation Manual*

Section 1	General Information
Section 2	Installation
Section 3	Operation

HP 4145B *Service Manual*

Section 4	Performance Tests
Section 5	Adjustment
Section 6	Replaceable Parts
Section 7	Manual Changes
Section 8	Service

CERTIFICATION

Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility, and to the calibration facilities of other International Standards Organization members.

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This Hewlett-Packard instrument product is warranted against defects in material and workmanship for a period of one year from date of shipment, except that in the case of certain components listed in Section 1 of this manual, the warranty shall be for the specified period. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products which prove to be defective.

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ASSISTANCE

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For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

Herstellerbescheinigung

Hiermit wird bescheinigt, daß das Gerät HP 4145B (Semiconductor Parameter Analyzer) in Übereinstimmung mit den Bestimmungen von Postverfügung 1046/84 funkentstört ist.

Der Deutschen Bundespost wurde das Inverkehrbringen dieses Gerätes angezeigt und die Berechtigung zur Überprüfung der Serie auf Einhaltung der Bestimmungen eingeräumt.

Anm: Werden Meß- und Testgeräte mit ungeschirmten Kabeln und/oder in offenen Meßaufbauten verwendet, so ist vom Betreiber sicherzustellen, daß die Funk-Entstörbestimmungen unter Betriebsbedingungen an seiner Grundstücksgrenze eingehalten werden.

Manufacturer's Declaration

This is to certify that this product, the HP 4145B Semiconductor Parameter Analyzer, meets the radio frequency interference requirements of directive 1046/84. The German Bundespost has been notified that this equipment was put into circulation and was granted the right to check the product type for compliance with these requirements.

Note: If test and measurement equipment is operated with unshielded cables and/or used for measurements on open setups, the user must insure that under these operating conditions, the radio frequency interference limits are met at the border of his premises.

SAFETY SUMMARY

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings given elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Hewlett-Packard Company assumes no liability for the customer's failure to comply with these requirements.

GROUND THE INSTRUMENT

To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical ground. The instrument is equipped with a three-conductor ac power cable. The power cable must either be plugged into an approved three-contact electrical outlet or used with a three-contact to two-contact adapter with the grounding wire (green) firmly connected to an electrical ground (safety ground) at the power outlet. The power jack and the mating plug of the power cable meet International Electrotechnical Commission (IEC) safety standards.

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE

Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

KEEP AWAY FROM LIVE CIRCUITS

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified maintenance personnel. Do not replace components with power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power and discharge circuits before touching them.

DO NOT SERVICE OR ADJUST ALONE

Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

USE CAUTION WHEN EXPOSING OR HANDLING THE CRT

Breakage of the cathode-ray tube (CRT) causes a high velocity scattering of glass fragments (implosion). To prevent CRT implosion, avoid rough handling or jarring of the instrument. Handling of the CRT shall be done only by qualified maintenance personnel using approved safety mask and gloves.

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the instrument. Return the instrument to a Hewlett-Packard Sales and Service Office for service and repair to ensure that safety features are maintained.

DANGEROUS PROCEDURE WARNINGS

Warnings, such as the example below, precede potentially dangerous procedures throughout this manual. Instructions contained in the warnings must be followed.

WARNING

Dangerous voltages, capable of causing death, are present in this instrument. Use extreme caution when handling, testing, and adjusting.

TABLE OF CONTENTS

Table 4-1. Recommended Test Equipment

Equipment	Critical Specifications	Recommended Model	Use*1
Digital DC Voltmeter	Voltage range : 100mV to 200V f.s. Sensitivity : 100μV Accuracy : 0.002% Input impedance: > 10MΩ	HP 3456A	P, A, T
Oscilloscope	Band width : > 10MHz Vertical Sensitivity: 0.001 Volt/DIV Channel : dual	HP 1740A*2	P, A, T
RC Box	Range : $10^2\Omega$ - $10^{11}\Omega$ Accuracy: 0.1% - 1% Furnished accessories: (1) Triaxial (Male)-to-Triaxial (Male) Cable (HP P/N: 16053-61002) (2) BNC (Male)-to-BNC (Male) Cable (HP P/N: 16053-61003) (3) Triaxial (Male)-BNC (Female) Adapter (HP P/N: 1250-0595) (4) BNC T Type Adapter (HP P/N: 1250-0781)	HP 16340A	P
Personal Computer	For HP-IB controller	HP 85	P
HP-IB Interface		HP 82937A	P
I/O ROM		HP P/N 00085-15003	P
ROM DRAWER		HP 82936A	P
Test Fixture with Furnished Accessories		HP 16058A	A
Cables	Alligator Clips-to-Dual Banana Plug Test Lead	HP 11002A	P, A, T
	Probe and Alligator Clip-to-Dual Banana Test Lead	HP 11003A	
	BNC (Male)-to-BNC (Male), 61cm	HP 11170B	
	BNC (Male)-to-Dual Banana Plug Test Lead	HP 11001A	
	BNC (Male)-to-BNC (Male), 23cm	HP 10502A	

*1: P = Performance Test, A = Adjustment, T = Troubleshooting

*2: The waveforms shown in Section V were obtained with the 1741A.

Table 4-1. Recommended Test Equipment (Cont'd)

Equipment	Critical Specifications	Recommended Model	Use*1
Cable	BNC(Male)-to-Alligator Clips Test Lead		A, T
Probes	10:1 Divider Probe Input impedance: 10MΩ	HP 10004A	A, T
	1:1 Probe	HP 10007B	
SMU Test Adapter		HP P/N: 04145-65001	P, A, T
Shorting Terminator		HP P/N: 04145-65002	P, A, T
Extender Board (22-pin Single)		HP P/N: 04145-66520	P, A, T
Extender Board (22-pin Dual)		HP P/N: 04145-66521	P, A, T
System Disc		HP P/N: 04145-61501	P, A, T
Shorting Connector		HP P/N: 04145-61623	P, A, T
Signature Analyzer		HP 5005B	T

SECTION IV

PERFORMANCE TESTS

4-1. INTRODUCTION

4-2. This section describes the tests and procedures used to verify the instrument specifications listed in Table 1-1. All tests can be performed without access to the interior of the instrument. A simpler, automatic operational test is presented in Section III under Self Test (paragraph 3-9). The performance tests described here can also be used to perform incoming inspection of the instrument and to verify that the instrument meets specified performance after troubleshooting and/or adjustment. If the performance tests indicate that the instrument is operating outside specified limits, check that the controls on the instruments used in the test and the test set-up itself are correct, then proceed with adjustments and/or troubleshooting.

Note

1. To ensure proper test results and instrument operation, Hewlett-Packard suggest a 40 minute warm-up and stabilization period before performing any of the performance tests.

2. Initial control settings described in paragraph 3-13 must be used for each performance test. Exceptions to these settings will be noted as they occur. After completing a performance test, return 4145B controls to the initial control settings.

4-3. EQUIPMENT REQUIRED

4-4. Equipment required for performance tests is listed in Table 4-1. Any equipment that satisfies the critical specifications given in the table may be substituted for the recommended model(s).

Note

Equipment should be calibrated by an instrument traceable to NBS or an equivalent standards; or calibrated directly by an authorized calibration organization such as NBS. The calibration cycle should be in accordance with stability specifications of each component.

4-5. TEST RECORD

4-6. Performance test results can be recorded on the Test Record at the completion of the test. The Test Record is at the end of this section. It lists all test specifications and acceptable limits. The results recorded at incoming inspection can be used for comparison in periodic maintenance, troubleshooting, and after repairs or adjustments.

4-7. CALIBRATION CYCLE

4-8. This instrument requires periodic verification of performance. Depending on the conditions under which the instrument is used, e.g., environmental conditions or frequency of use, the instrument should be checked with the performance tests described here, at least once a year. To keep instrument down-time to a minimum and to insure optimum operation, preventive maintenance should be performed at least twice a year.

4-9. GRAPHICS DISPLAY UNIT INTENSITY AND FOCUS CHECK

PURPOSE: This check visually verifies that the writing beam of the Graphics Display Unit (GDU) has the correct intensity and is properly focused.

PROCEDURE:

1. Turn on the 4145B, then display the DIAGNOSTICS page by pressing the DIAG softkey.
2. Display the test pattern for the GDU as shown in Figure 4-1 by pressing the G.D. TEST softkey.
3. Verify that the brightness of the writing beam for lines 1, 2, 3, and 4 is as described below:

   line 1 : full brightness
   line 2 : dim
   line 3 : half brightness
   line 4 : second brightness

4. Verify that the writing beam is properly focused for sharp, well-defined trace at points A, B, C, and D, and over the entire CRT display.

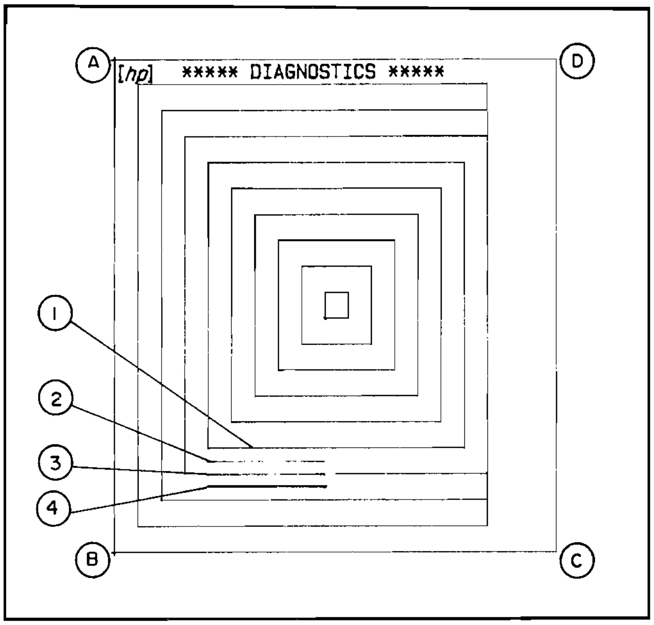


Figure 4-1. Test Pattern for GDU.

PERFORMANCE TESTS

Note

If intensity and focus of the writing beam need adjustment, perform Graphic Display Unit Intensity and Focus Adjustment in Section V of this manual. If any trace distortion is observed, perform performance tests and adjustments in Section IV and V of the 1345A's Operating and Service Manual, located at the back of this binder.

Note

When the procedures in Section IV and V of the 1345A's manual are performed, the connector on the A1 GDU Control Board must be disconnected. Refer to Figure 4-2 for its location.

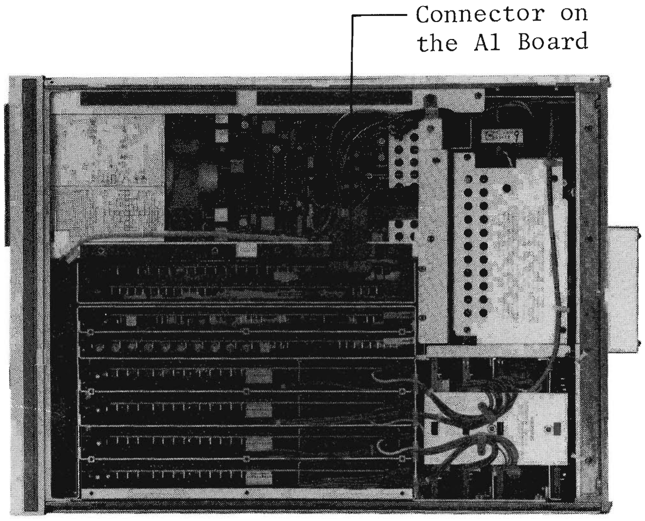


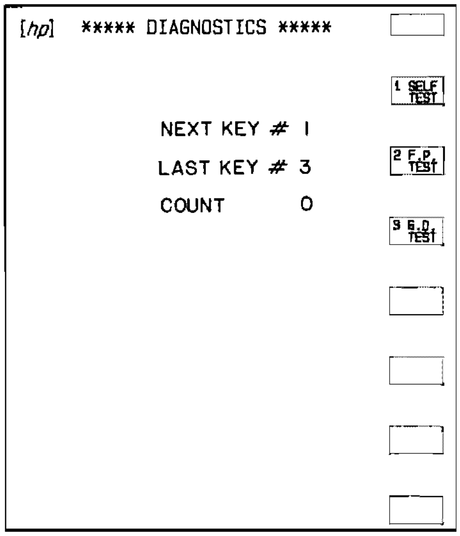
Figure 4-2. GDU Connector Location.

4-10. PAGE AND KEY FUNCTION CHECK

PURPOSE: This check verifies that the thirteen pages, including MENU, CHANNEL DEFINITION, DIAGNOSTICS, and so on, can be displayed without error codes or error messages. Also, this check verifies that the sixty-six keys function properly.

PROCEDURE:

1. Insert the system disc (system disc furnished with the 4145B) into the flexible-disc drive, then turn on the 4145B.
2. Verify that each of the thirteen pages is displayed without any error codes or error messages, by pressing the MENU key, PREV key, NEXT key, and softkeys. Refer to Section III of this manual for details on page control.
3. Display the MENU page, then display the DIAGNOSTICS page by pressing the DIAG softkey.
4. Obtain the display shown Figure 4-3 by pressing the F.P. TEST softkey.
5. Check that the LED indicator lamps and sixty-six keys function properly as described in Figure 3-34 in Section III of this manual.



```
[hp]  ***** DIAGNOSTICS *****

            NEXT KEY #  1
            LAST KEY #  3
            COUNT       0
```

Figure 4-3. Display for Key Function Check.

4-11. SMU ACCURACY TEST

DESCRIPTION :

The SMU Accuracy Test consists of four tests :

(1) Voltage Control Accuracy Test

(2) Voltage Measurement Accuracy Test

(3) Current Measurement Accuracy Test

(4) Current Control Accuracy Test

(1) VOLTAGE CONTROL ACCURACY TEST

PURPOSE : This test verifies that the specified output voltage is correctly output from each SMU channel.

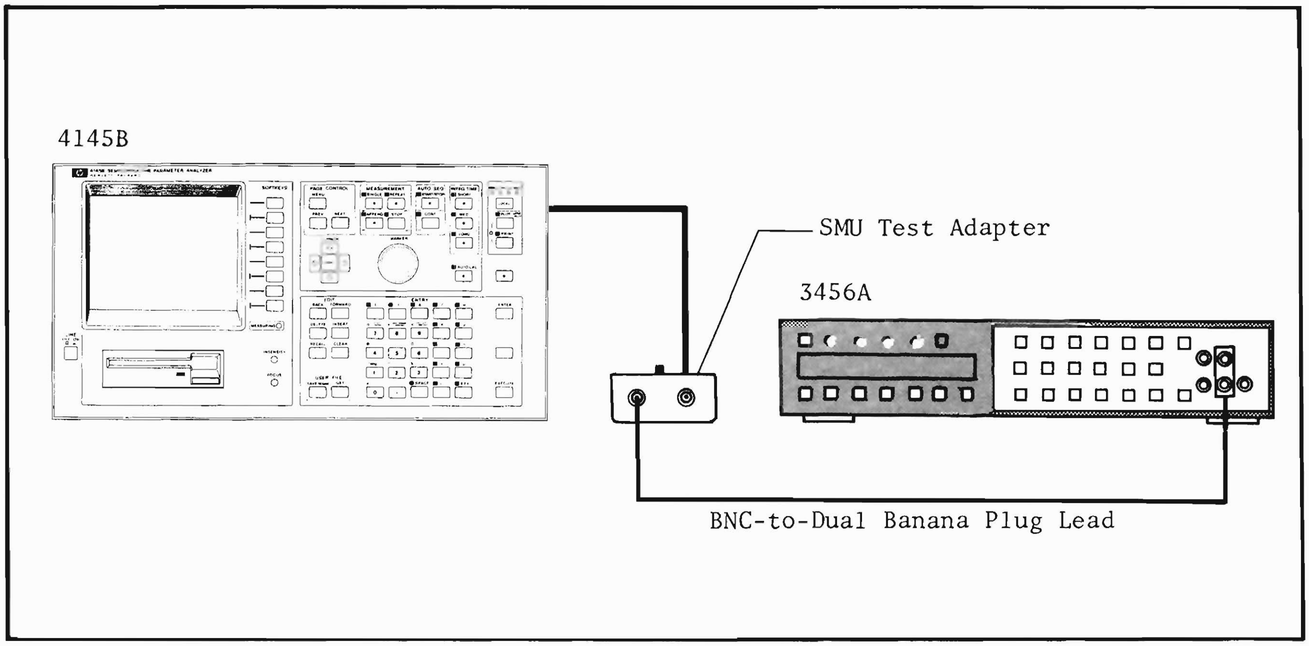


Figure 4-4. Voltage Control Accuracy Test Setup.

PERFORMANCE TESTS

EQUIPMENT :

DVM	HP MODEL 3456A*
SMU Test Adapter	HP P/N 04145-65001
BNC (Male)-to-Dual Banana Plug Test Lead	HP MODEL 11001A
Shorting Connector	HP P/N 04145-61623

* The 3456A must be calibrated before testing.

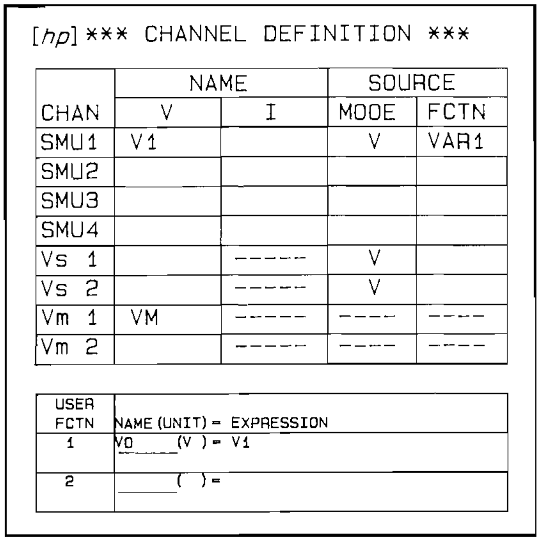
PROCEDURE :

1. Connect the adapter (HP P/N : 04145-65001) to the 4145B's SMU channel 1 connector on the rear panel.
2. Connect the shorting connector to the 24 pin connector (labeled "TO 16058A TEST FIXTURE") on the rear panel.
3. Connect the 3456A to the adapter's BNC connector and set the adapter's selector switch to Vo.
4. Set the 3456A's controls* as follows :

FUNCTION	⎓V
RANGE	AUTO
TRIGGER	INTERNAL
MATH	OFF
AUTO ZERO	OFF
HIGH RESOLUTION	ON

* This setting is the same for all SMU accuracy tests.

5. Set the 4145B's controls as follows :



[hp] *** CHANNEL DEFINITION ***

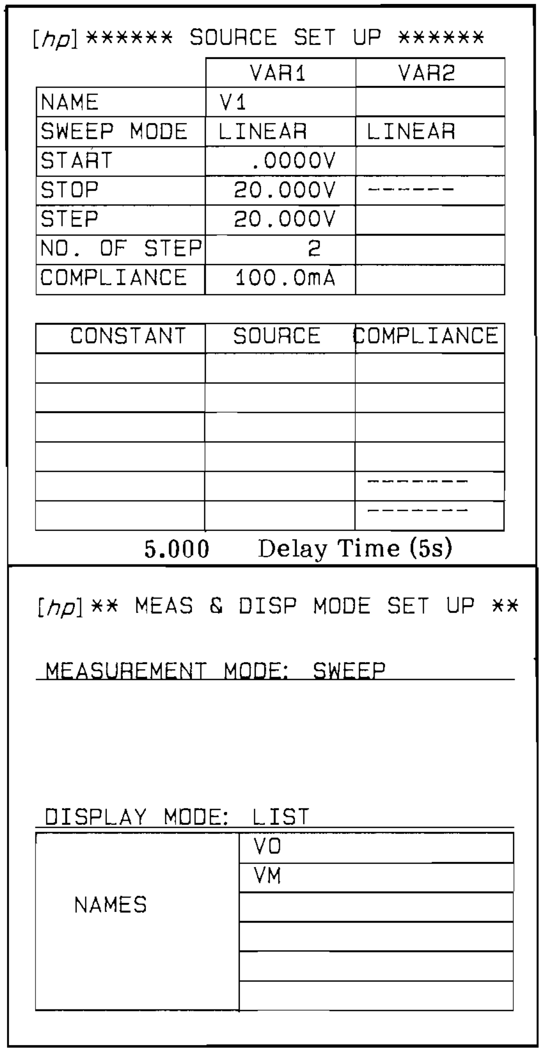
CHAN	NAME		SOURCE	
	V	I	MODE	FCTN
SMU1	V1		V	VAR1
SMU2				
SMU3				
SMU4				
Vs 1		------	V	
Vs 2		------	V	
Vm 1	VM	------	-----	-----
Vm 2		------	-----	-----

USER FCTN	NAME (UNIT) = EXPRESSION
1	VO (V) = V1
2	( ) =

Figure 4-5. Measurement Setup.

i) On the CHANNEL DEFINITION page :

Set up the page as shown in Figure 4-5. To define SMU1, press the NOT USE softkey to delete the line, then assign V name, SOURCE MODE, and SOURCE FCTN. VM is used as a dummy to display V1's output after measurement.



[hp] ****** SOURCE SET UP ******

	VAR1	VAR2
NAME	V1	
SWEEP MODE	LINEAR	LINEAR
START	.0000V	
STOP	20.000V	------
STEP	20.000V	
NO. OF STEP	2	
COMPLIANCE	100.0mA	

CONSTANT	SOURCE	COMPLIANCE

5.000 Delay Time (5s)

[hp] ** MEAS & DISP MODE SET UP **

MEASUREMENT MODE: SWEEP

DISPLAY MODE: LIST

NAMES	VO
	VM

Figure 4-5. Measurement Setup (Cont'd).

ii) On the SOURCE SET UP page :

Set the source channel parameters as shown in Figure 4-5. Set HOLD TIME and DELAY TIME to 0 seconds and 5 seconds, respectively.

iii) On the MEAS & DISP MODE SET UP page :

Select LIST as the display mode for the measurement results.

iv) INTEG TIME .... LONG

6. Perform measurement by pressing the REPEAT key.

7. Record the readings on the 3456A for the start voltage (0 volts) and stop voltage (20 volts) when they are output, then verify that the recorded readings satisfy the test limits listed in Table 4-3.

8. Press the STOP key to end measurement.

9. Repeat steps 5 through 8 for each Source Setup listed in Table 4-2. The source parameters—START, STOP, and STEP—on the SOURCE SET UP page in step 4 must be changed as listed in the table.

10. Repeat steps 5 through 9 for SMU channels 2, 3, and 4.

Table 4-2. Source Parameter Changes

	Source Setup (xxx Volts to xxx volts)				
Source Parameters	-20 to -20	0 to 40	-40 to -40	0 to 100	-100 to -100
START	-20.000V	.0000V	-40.000V	.0000V	-100.00V
STOP	-20.000V	40.000V	-40.000V	100.00V	-100.00V
STEP	20.000V	40.000V	40.000V	100.00V	100.00V
DELAY TIME	0 s	5 s	0 s	5 s	0 s

Table 4-3. Test Limits for Voltage Control Accuracy Test

Range of SMU Channel Tested	Voltage Sweep (xxx volts to xxx volts)	Output Voltage from SMU (Volt)	Test Limit
20 volt	0 to 20	.0000	0 volts ± 0.01 volts
		20.000	20 volts ± 0.03 volts
	-20 to -20	-20.000	-20 volts ± 0.03 volts
40 volt	0 to 40	.0000	0 volts ± 0.02 volts
		40.000	40 volts ± 0.06 volts
	-40 to -40	-40.000	-40 volts ± 0.06 volts
100 volt	0 to 100	.0000	0 volts ± 0.05 volts
		100.00	100 volts ± 0.15 volts
	-100 to -100	-100.00	-100 volts ± 0.15 volts

(2) VOLTAGE MEASUREMENT ACCURACY TEST

PURPOSE: This test verifies that the SMU accurately performs voltage measurements.

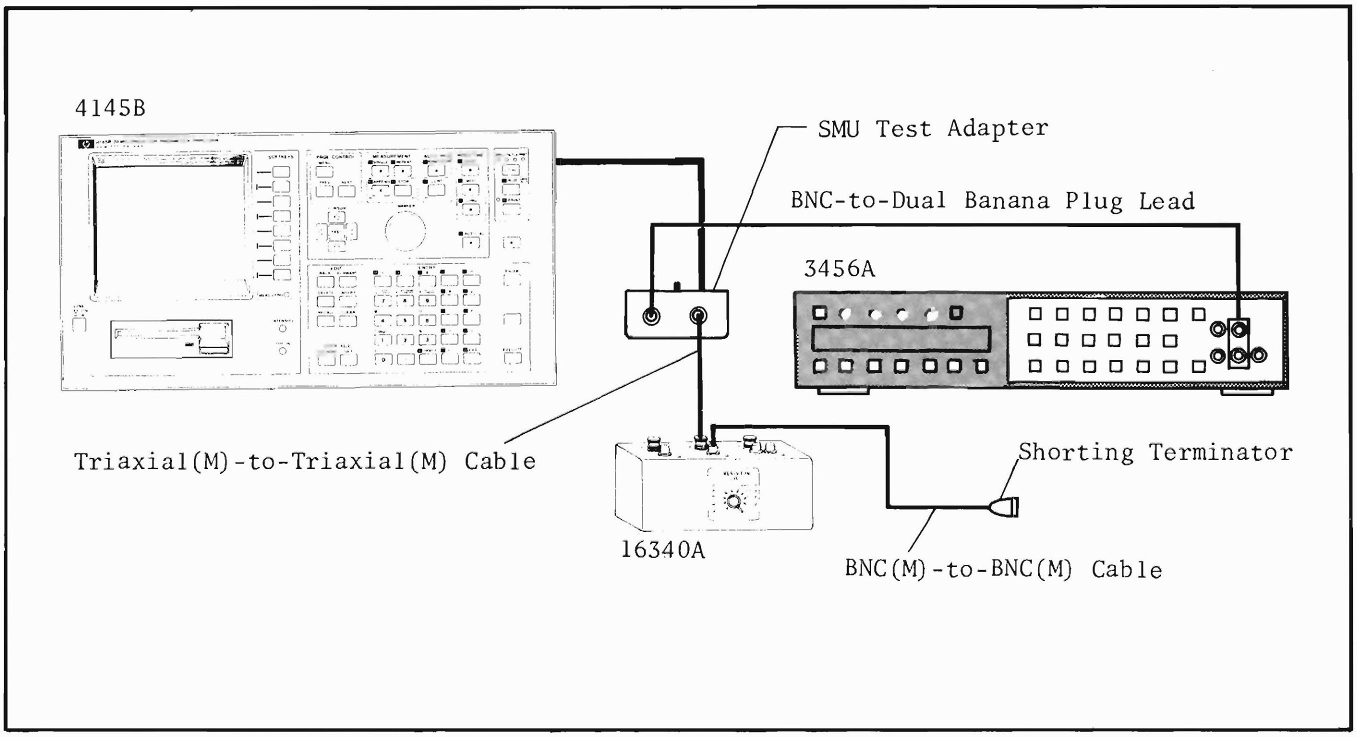


Figure 4-6. Voltage Measurement Accuracy Test Setup.*

* This setup is the same as for the Current Measurement Test and Current Control Accuracy Test.

EQUIPMENT:

DVM	HP MODEL 3456A
RC Box	HP MODEL 16340A
SMU Test Adapter	HP P/N 04145-65001
BNC (Male)-to-Dual Banana Plug Test Lead	HP MODEL 11001A
Triaxial (Male)-to-Triaxial (Male) Cable	HP P/N 16053-61002*
BNC (Male)-to-BNC (Male) Cable	HP P/N 16053-61003*
Shorting Connector	HP P/N 04145-61623
Shorting Terminator	HP P/N 04145-65002

* furnished with the 16340A

PROCEDURE:

1. Connect the adapter (HP P/N : 04145-65001) to the 4145B's SMU channel 1 connector on the rear panel.

2. Connect the 3456A and the 16340A's female triaxial connector (for the $10^2\Omega$ - $10^{10}\Omega$ range) to the female BNC connector (labeled "MONITOR") and the female triaxial connector (labeled "TO 16340A") of the adapter, respectively. Use BNC (male)-to-dual banana test lead and triaxial (male)-to-triaxial (male) cable.

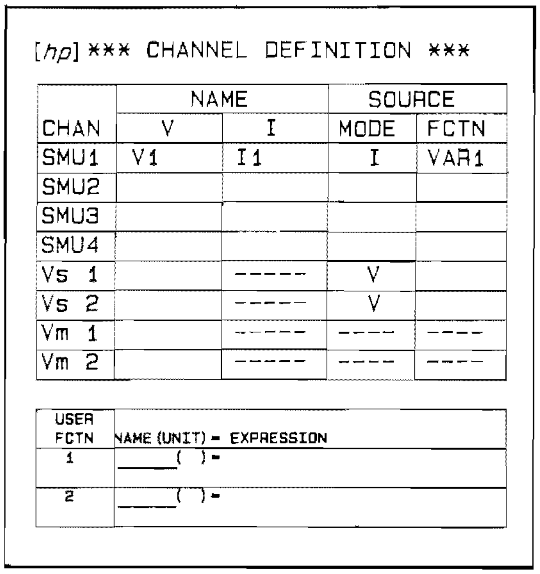
3. Connect the BNC-to-BNC cable (furnished with the 16340A) to the female BNC connector (for the $10^2\Omega$-$10^{10}\Omega$ range), then terminate the cable with the shorting terminator.

4. Connect the shorting connector to the 24 pin connector (labeled "TO 16058A TEST FIXTURE") on the rear panel.

5. Set the adapter's SELECTOR switch to V_G, then set the 16340A's range to $10^8\Omega$.

6. Set the 3456A's controls as described in step 3 of the Voltage Control Accuracy Test.

7. Set the 4145B's controls as follows :



[hp] *** CHANNEL DEFINITION ***

	NAME		SOURCE	
CHAN	V	I	MODE	FCTN
SMU1	V1	I1	I	VAR1
SMU2				
SMU3				
SMU4				
Vs 1		-----	V	
Vs 2		-----	V	
Vm 1		-----	----	----
Vm 2		-----	----	----

USER FCTN	NAME (UNIT) = EXPRESSION
1	____( )=
2	____( )=

Figure 4-7. Measurement Setup.

i) On the CHANNEL DEFINITION page :

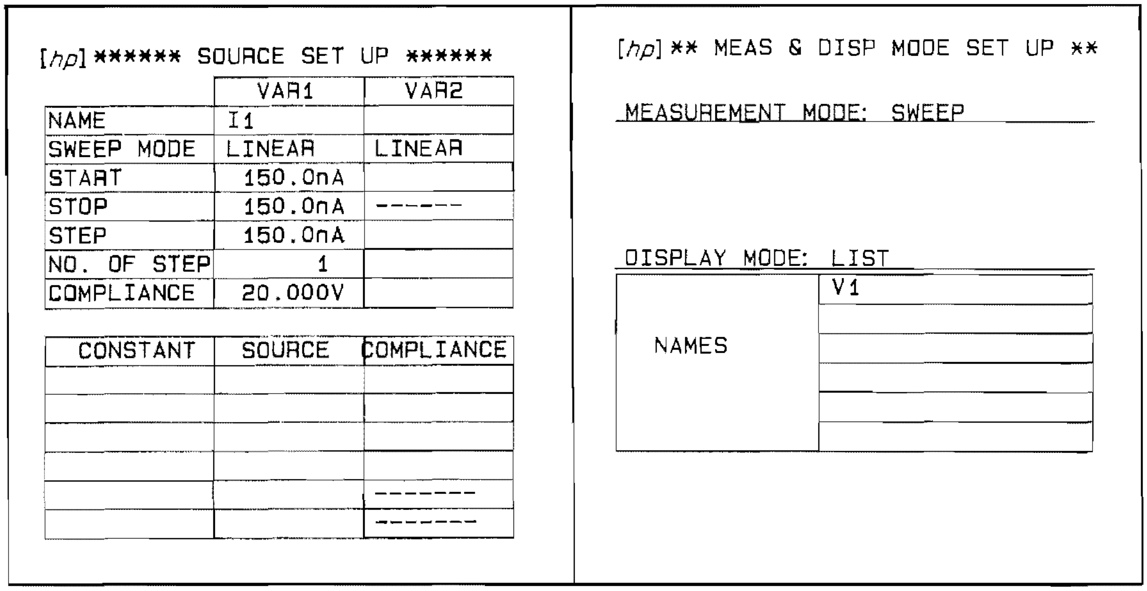
Set up the page as shown in Figure 4-7.

ii) On the SOURCE SET UP page :

Set up the page as shown in Figure 4-7.

iii) On the MEAS & DISP MODE SET UP page :

Select LIST as the display mode for measurement results.



[hp] ****** SOURCE SET UP ******

	VAR1	VAR2
NAME	I1	
SWEEP MODE	LINEAR	LINEAR
START	150.0nA	
STOP	150.0nA	------
STEP	150.0nA	
NO. OF STEP	1	
COMPLIANCE	20.000V	

CONSTANT	SOURCE	COMPLIANCE

[hp] ** MEAS & DISP MODE SET UP **

MEASUREMENT MODE: SWEEP

DISPLAY MODE: LIST

NAMES	V1

Figure 4-7. Measurement Setup (Cont'd).

8. Perform the first measurement for the SMU's 20 volt range by pressing the REPEAT key.

9. Record the readings on the 4145B for the monitored voltage value V1a and on the 3456A for Va, then end measurement by pressing the STOP key.

10. Change the source parameters—START and STOP—to -150.0nA on the SOURCE SET UP page for the second measurement.

11. Perform the second measurement by pressing the REPEAT key.

12. Record the readings on the 4145B for the monitored voltage value V1b and on the 3456A for Vb, then end measurement by pressing the STOP key.

13. Verify that the error and offset defined by the following equations satisfy the test limit listed in Table 4-5.

$$\text{error} = \frac{V1a - V1b}{Va - Vb} - 1$$

$$\text{offset} = V1a - (1 + \text{error})*Va$$

14. Repeat steps 7 through 13 for the 40 volt range and 100 volt range. The source parameters--START, STOP, STEP, and COMPLIANCE—on the SOURCE SET UP page must be changed as listed in Table 4-4.

15. Repeat steps 7 through 14 for SMU channels 2, 3, and 4.

Table 4-4. Source Parameter Changes

	SMU Range Tested	40 volt		100 volt	
	Measurement	1st	2nd	1st	2nd
Source Parameter	START	350.0nA	-350.0nA	900.0nA	-900.0nA
	STOP	350.0nA	-350.0nA	900.0nA	-900.0nA
	STEP	350.0nA	350.0nA	900.0nA	900.0nA
	COMPLIANCE	40.000V	40.000V	100.00V	100.00V

Table 4-5. Test Limits for Voltage Measurement Accuracy Test

SMU Range Tested	20 volt	40 volt	100 volt
Error (%)	±0.1	±0.1	±0.1
Offset	±10mV	±20mV	±50mV

(3) CURRENT MEASUREMENT ACCURACY TEST

PURPOSE: This test verifies that the SMU accurately performs current measurements.

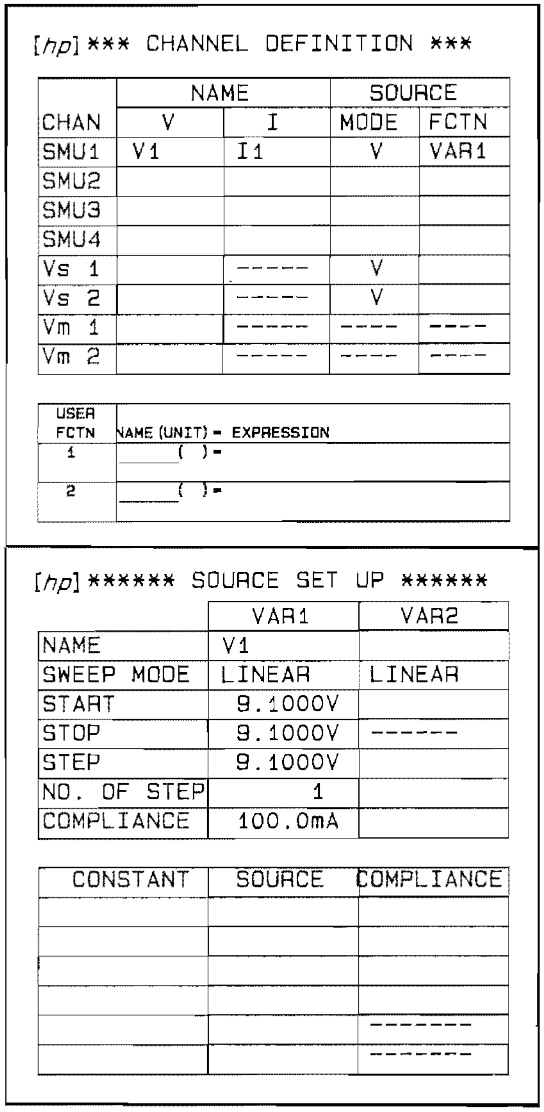
EQUIPMENT:

The equipment required is the same as that for the Voltage Measurement Accuracy Test.

PROCEDURE:

1. Perform steps 1 through 6 of the Voltage Measurement Accuracy Test described on pages 4-9 to 4-12.

2. Set the adapter's SELECTOR switch to V_0, and the 16340A's range to $10^2\Omega$.



[hp] *** CHANNEL DEFINITION ***

	NAME		SOURCE	
CHAN	V	I	MODE	FCTN
SMU1	V1	I1	V	VAR1
SMU2				
SMU3				
SMU4				
Vs 1		-----	V	
Vs 2		-----	V	
Vm 1		-----	----	----
Vm 2		-----	----	----

USER FCTN	NAME (UNIT) = EXPRESSION
1	_____( )=
2	_____( )=

[hp] ****** SOURCE SET UP ******

	VAR1	VAR2
NAME	V1	
SWEEP MODE	LINEAR	LINEAR
START	9.1000V	
STOP	9.1000V	------
STEP	9.1000V	
NO. OF STEP	1	
COMPLIANCE	100.0mA	

CONSTANT	SOURCE	COMPLIANCE

Figure 4-8. Measurement Setup.

3. Set the 3456A's controls as described in step 3 of the Voltage Control Accuracy Test.

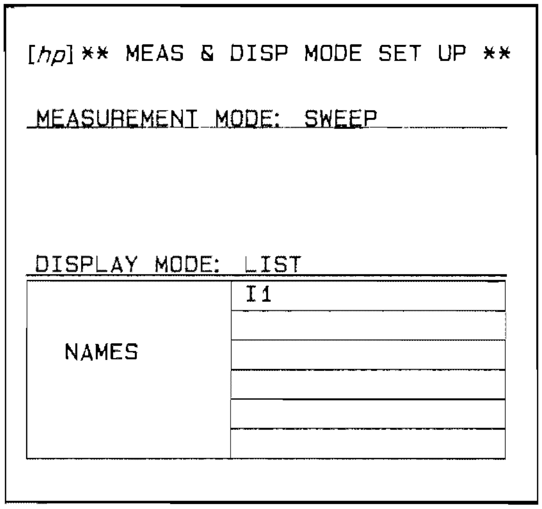
4. Set the 4145B's controls as follows:

   i) On the CHANNEL DEFINITION page:

      Set up the page as shown in Figure 4-8.

   ii) On the SOURCE SET UP page:

      Set up the page as shown in Figure 4-8.



[hp] ** MEAS & DISP MODE SET UP **

MEASUREMENT MODE: SWEEP

DISPLAY MODE: LIST

NAMES	I1

Figure 4-8. Measurement Setup (Cont'd).

iii) On the MEAS & DISP MODE SET UP page :

Select LIST as the display mode for the measurement results.

iv) INTEG TIME .... LONG

5. Perform measurement by pressing the REPEAT key.
6. Record the readings on the 4145B for monitored current value Ila and on the 3456A for Va.
7. End measurement by pressing the STOP key.
8. Change the source parameters--START, STOP, and STEP—on the SOURCE SET UP page to -9.1000V, then perform measurement by pressing the REPEAT key.
9. Record the readings on the 4145B for monitored current value Ilb and on the 3456A for Vb, then end measurement by pressing the STOP key.
10. Verify that the error and offset defined by the following equations satisfy the test limits listed in Table 4-7.

$$\text{error} = \frac{\text{I1a} - \text{I1b}}{\frac{\text{Va} - \text{Vb}}{\text{R}}} - 1$$

R: Calibrated value of the 16340A's resistor

$$\text{offset} = \text{I1a} - (1+\text{error}) * \frac{\text{Va}}{\text{R}}$$

11. Repeat steps 2 through 8 for ranges $10^3\Omega$ through $10^9\Omega$. The required source parameter and adaptor SELECTOR switch position must be changed as listed in Table 4-6.
12. Repeat steps 2 through 9 for SMU channels 2, 3, and 4.

PERFORMANCE TESTS

Table 4-6. Source Parameter Changes

	16340A's Range								
Source Parameter	$10^{3}\Omega$	$10^{4}\Omega$	$10^{5}\Omega$	$10^{6}\Omega$	$10^{7}\Omega$	$10^{8}\Omega$	$10^{9}\Omega$	$10^{9}\Omega$	
START	——	——	——	——	——	——	——	.91	-.91
STOP	——	——	——	——	——	——	——	.91	-.91
STEP	——	——	——	——	——	——	——	.91	-.91
COMPLIANCE	10.00mA	1.000mA	100.0μA	10.00μA	1.000μA	100.0nA	10.00nA	1.000nA	
Selector Switch Position	V_O			V_G					

Table 4-7. Test Limits for Current Measurement Accuracy Test

16340A's Range	$10^{2}\Omega$	$10^{3}\Omega$	$10^{4}\Omega$	$10^{5}\Omega$	$10^{6}\Omega$	$10^{7}\Omega$	$10^{8}\Omega$	$10^{9}\Omega$	$10^{9}\Omega$
Error (%)	±0.3	±0.3	±0.3	±0.3	±0.3	±0.5	±0.5	±1	±1
Offset	±0.12mA	±12μA	±1.2μA	±0.12μA	±12nA	±1.2nA	±0.12nA	±17pA	±6.2pA

(4) CURRENT CONTROL ACCURACY TEST

PURPOSE : This test verifies that the specified output current is correctly output from each SMU channel.

EQUIPMENT :

Same as that for the Voltage Measurement Accuracy Test.

PROCEDURE :

1. Perform steps 1 through 4 of the Voltage Measurement Accuracy Test described on pages 4-9 to 4-12.
2. Set the adapter's SELECTOR switch to Vo, and the 16340A's range to $10^2\Omega$.
3. Set the 3456A's controls as described in step 3 of the Voltage Control Accuracy Test.
4. Set the 4145B's controls as follows:

   i) On the CHANNEL DEFINITION page:

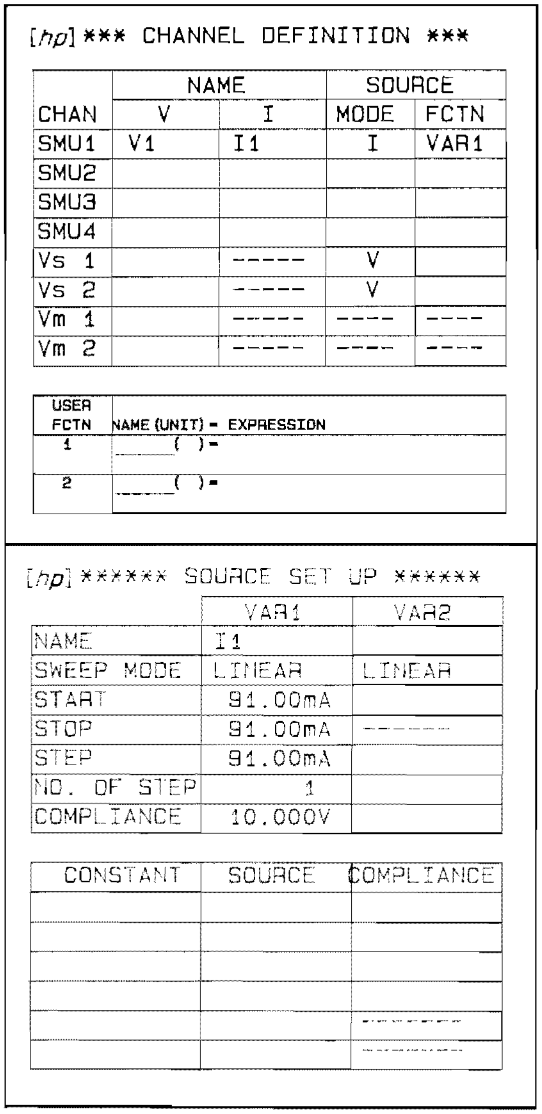
   Set up the page as shown in Figure 4-9.

   ii) On the SOURCE SET UP page:

   Set up the page as shown in Figure 4-9.

ii) On the SOURCE SET UP page :

Set up the page as shown in Figure 4-9.



[hp] *** CHANNEL DEFINITION ***

	NAME		SOURCE	
CHAN	V	I	MODE	FCTN
SMU1	V1	I1	I	VAR1
SMU2				
SMU3				
SMU4				
Vs 1		-----	V	
Vs 2		-----	V	
Vm 1		-----	----	----
Vm 2		-----	----	----

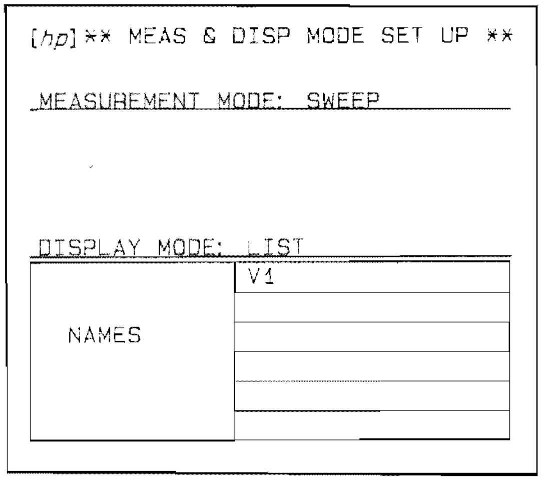
USER FCTN	NAME (UNIT) = EXPRESSION
1	( )=
2	( )=

[hp] ****** SOURCE SET UP ******

	VAR1	VAR2
NAME	I1	
SWEEP MODE	LINEAR	LINEAR
START	91.00mA	
STOP	91.00mA	-------
STEP	91.00mA	
NO. OF STEP	1	
COMPLIANCE	10.000V	

CONSTANT	SOURCE	COMPLIANCE

Figure 4-9. Measurement Setup.



[hp] ** MEAS & DISP MODE SET UP **

MEASUREMENT MODE: SWEEP

DISPLAY MODE: LIST

NAMES	V1

Figure 4-9. Measurement Setup (Cont'd).

iii) On the MEAS & DISP MODE SET UP page :

Select LIST as the display mode for the measurement results.

iv) INTEG TIME .... LONG

5. Perform the first measurement by pressing the REPEAT key.
6. Record the reading on the 3456A for Va.
7. End the measurement by pressing the STOP key.
8. Change the source parameters—START, STOP, and STEP—on the SOURCE SET UP page to 11mA, then perform the second measurement by pressing the REPEAT key.
9. Record the reading on the 3456A for Vb, then end measurement by pressing the STOP key.
10. Verify that the error and offset defined by the following equations satisfy the test limits listed in Table 4-9.

$$\text{error} = \frac{\frac{Va - Vb}{R}}{I1 - I2} - 1$$

R: Calibrated value of the 16340A's resistor

$$\text{offset} = \frac{Va}{R} - (1+\text{error}) * I1$$

I1,I2: START values set on the SOURCE SET UP page for the measurements of Va and Vb.

11. Repeat steps 2 through 8 for ranges $10^2\Omega$ and $10^3\Omega$. The source parameters must be changed as described in Table 4-8.
12. Repeat steps 2 through 9 for SMU channels 2, 3, and 4.

Table 4-8. Source Parameter Changes

<table>
<tr><th></th><th></th><th colspan="4">Source Parameter</th></tr>
<tr><th>16340A's Range</th><th>Meas. (Measurement)</th><th>START</th><th>STOP</th><th>STEP</th><th>COMPLIANCE</th></tr>
<tr><td rowspan="2">$10^2\Omega$</td><td>1st</td><td colspan="2">-91.000mA</td><td>91.000mA</td><td rowspan="6">10.000V</td></tr>
<tr><td>2nd</td><td colspan="2">-11.000mA</td><td>11.000mA</td></tr>
<tr><td rowspan="4">$10^3\Omega$</td><td>1st</td><td colspan="2">9.1000mA</td><td>9.1000mA</td></tr>
<tr><td>2nd</td><td colspan="2">1.1000mA</td><td>1.1000mA</td></tr>
<tr><td>1st</td><td colspan="2">-9.1000mA</td><td>9.1000mA</td></tr>
<tr><td>2nd</td><td colspan="2">-1.1000mA</td><td>1.1000mA</td></tr>
</table>

Table 4-9. Test Limits for Current Control Accuracy Test

16340A's Range	$10^2\Omega$	$10^3\Omega$
Error (%)	±0.3	±0.3
Offset	±0.12mA	±12μA

4-12. VS ACCURACY TEST

PURPOSE: This test verifies that the specified output voltage is correctly output from each VS (Voltage Source) channel.

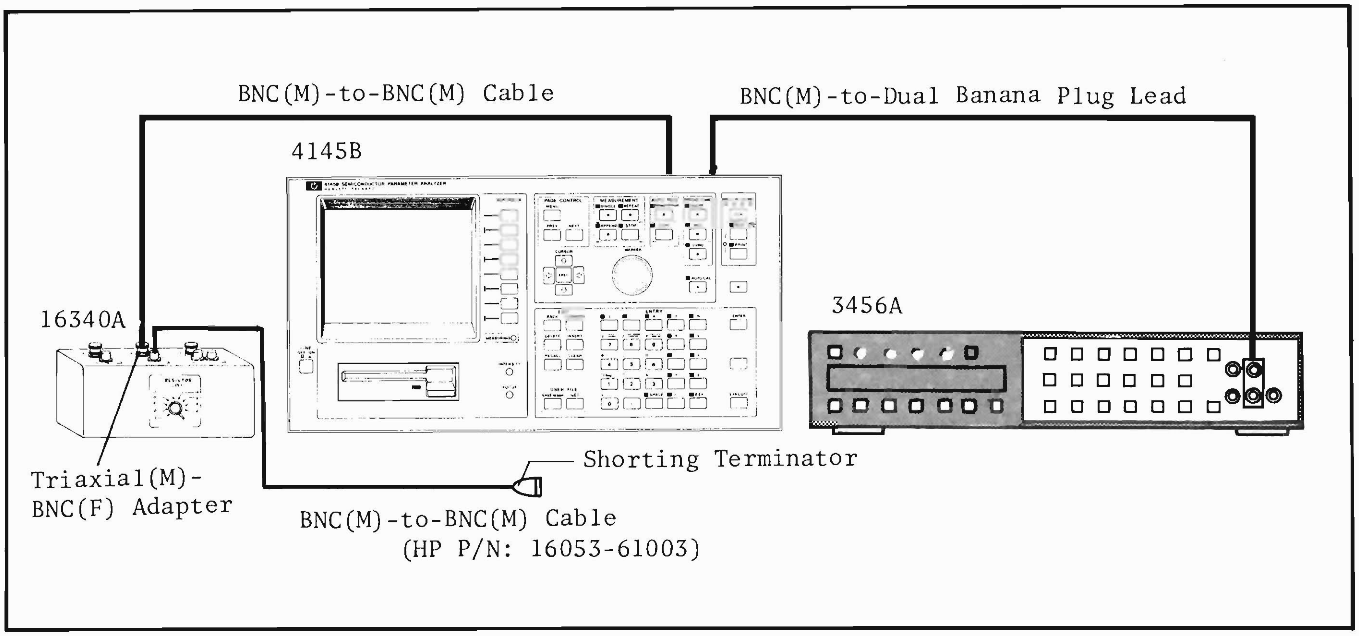


Figure 4-10. VS Accuracy Test Setup.

EQUIPMENT:

DVM	HP MODEL 3456A
RC Box	HP MODEL 16340A
BNC (Male)-to-Dual Banana Plug Test Lead	HP MODEL 11001A
BNC (Male)-to-BNC (Male) Cable	HP P/N 16053-61003*
Triaxial (Male)-BNC (Female) Adapter	HP P/N 1250-0595*
BNC T Type Adapter	HP P/N 1250-0781*
BNC (Male)-to-BNC (Male) Cable	HP P/N 11170B
Shorting Terminator	HP P/N 04145-65002

* furnished with the 16340A

PROCEDURE:

1. Connect the triaxial (male)-BNC (female) adapter and BNC (male)-to-BNC (male) cable (HP P/N: 16053-61003) to the 16340A's female triaxial connector and female BNC connector for ranges $10^2\Omega$ to $10^{10}\Omega$, respectively.
2. Terminate the BNC cable with the shorting terminator. See Figure 4-10.
3. Connect the BNC T type adapter to VS channel 1 (Vs1), then connect the 3456A and the 16340A to the VS channel 1 (Vs1) as shown in Figure 4-10.

4. Set the 16340A's range to $10^4\,\Omega$.

5. Set the 3456A's controls as follows :

   FUNCTION .... ⎓V
   RANGE .... AUTO
   TRIGGER .... INTERNAL
   MATH .... OFF
   AUTO ZERO .... OFF
   HIGH RESOLUTION .... ON

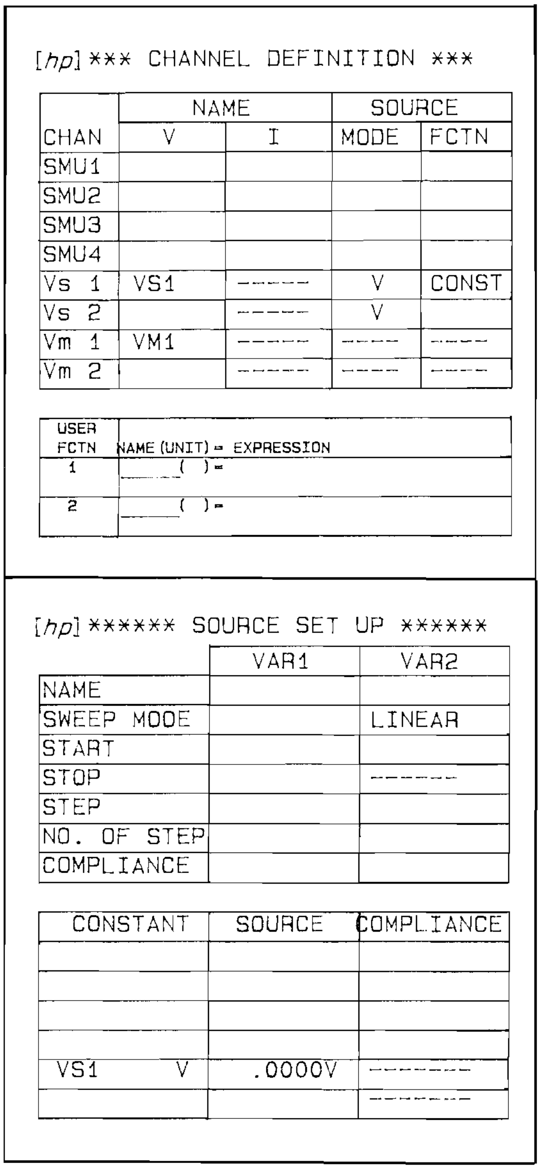
6. Set the 4145B's controls as follows :

i) On the CHANNEL DEFINITION page:

Set up the page as shown in Figure 4-11. VM1 is used as a dummy to display Vs1's output after measurement.

ii) On the SOURCE SET UP page :

Set up the page as shown in Figure 4-11.



[hp] *** CHANNEL DEFINITION ***

	NAME		SOURCE	
CHAN	V	I	MODE	FCTN
SMU1				
SMU2				
SMU3				
SMU4				
Vs 1	VS1	-----	V	CONST
Vs 2		-----	V	
Vm 1	VM1	-----	----	----
Vm 2		-----	----	----

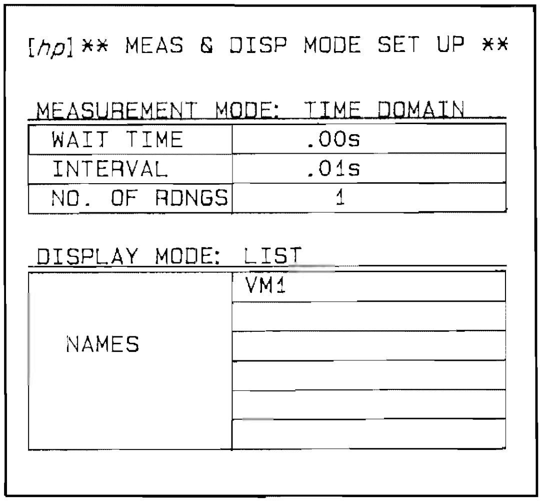
USER FCTN	NAME (UNIT) = EXPRESSION
1	( ) =
2	( ) =

[hp] ****** SOURCE SET UP ******

	VAR1	VAR2
NAME		
SWEEP MODE		LINEAR
START		
STOP		------
STEP		
NO. OF STEP		
COMPLIANCE		

CONSTANT	SOURCE	COMPLIANCE
VS1 V	.0000V	-------

Figure 4-11. Measurement Setup.



[hp] ** MEAS & DISP MODE SET UP **

MEASUREMENT MODE: TIME DOMAIN

WAIT TIME	.00s
INTERVAL	.01s
NO. OF RDNGS	1

DISPLAY MODE: LIST

NAMES	VM1

Figure 4-11. Measurement Setup (Cont'd).

iii) On the MEAS & DISP MODE SET UP page:

Select LIST as the display mode for measurement results.

7. Perform measurement by pressing the REPEAT key.
8. Record the reading on the 3456A, then verify that the reading satisfies the test limit listed in Table 4-10.
9. End the measurement by pressing the STOP key.
10. Repeat steps 6 through 9 for VS's outputs 20 volts and -20 volts.
11. Repeat steps 6 through 10 for VS channel 2.

Table 4-10. Test Limits for VS Accuracy Test

VS Output (volt)	0	20	-20
Test Limit	0V ± 0.01V	20V ± 0.11V	-20V ± 0.11V

4-13. VM ACCURACY TEST

PURPOSE: This test verifies that each of VM (Voltage Monitor) channels (Vm1 and Vm2) accurately perform voltage monitoring.

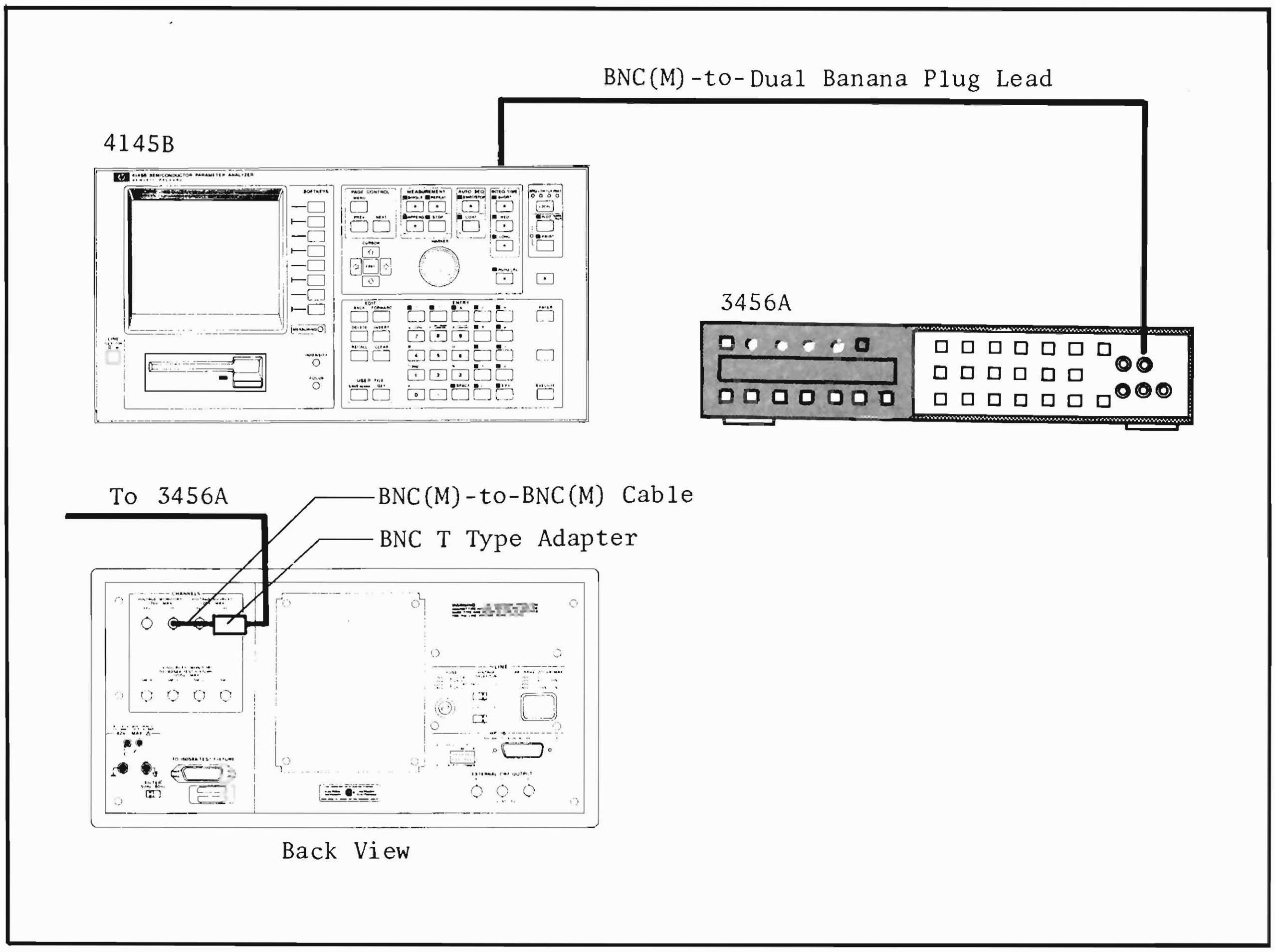


Figure 4-12. MU Accuracy Test Setup.

EQUIPMENT:

DVM	HP MODEL 3456A
BNC (male)-to-Dual Banana Plug Test Lead	HP MODEL 11001A
BNC (Male)-to-BNC (Male) Cable	HP MODEL 10502A
BNC T Type Adapter	HP P/N 1250-0781

PROCEDURE:

1. Connect the BNC T type adapter to the 4145B's VS channel 1 (Vs1) connector on the rear panel.
2. Connect VM channel 1 (Vm1) and the 3456A to VS channel 1 (Vs1) as shown in Figure 4-12.

3. Set the 3456A's controls as follows :

FUNCTION	⎓V
RANGE	AUTO
TRIGGER	INTERNAL
MATH	OFF
AUTO ZERO	OFF
HIGH RESOLUTION	ON

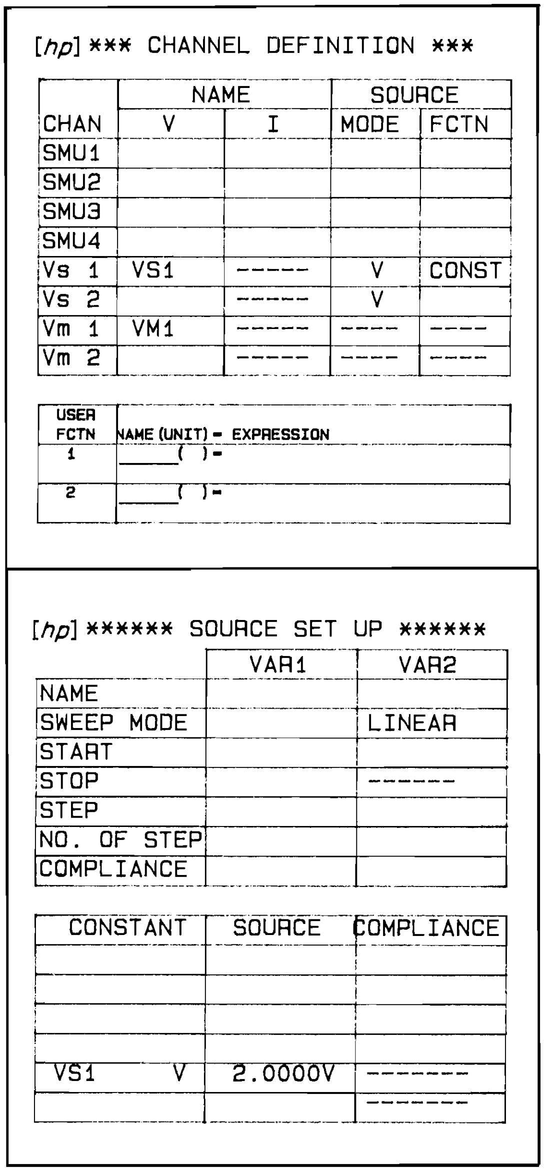
4. Set the 4145A's controls as follows :

i) On the CHANNEL DEFINITION page :

Set up the page as shown in Figure 4-13.

ii) On the SOURCE SET UP page :

Set up the page as shown in Figure 4-13.



[*hp*] *** CHANNEL DEFINITION ***

	NAME		SOURCE	
CHAN	V	I	MODE	FCTN
SMU1				
SMU2				
SMU3				
SMU4				
Vs 1	VS1	-----	V	CONST
Vs 2		-----	V	
Vm 1	VM1	-----	-----	-----
Vm 2		-----	-----	-----

USER FCTN	NAME (UNIT) = EXPRESSION
1	_____( )=
2	_____( )=

[*hp*] ****** SOURCE SET UP ******

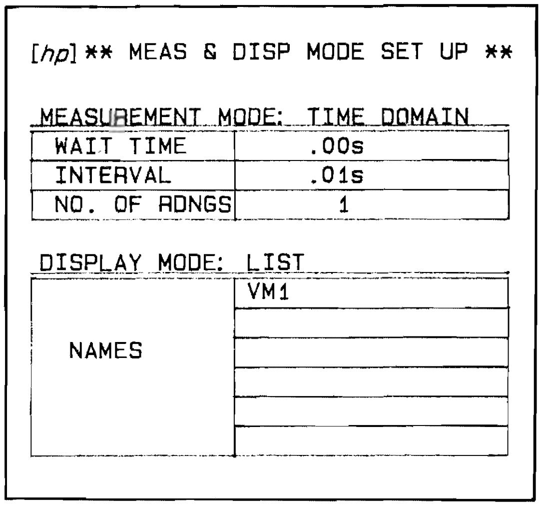
	VAR1	VAR2
NAME		
SWEEP MODE		LINEAR
START		
STOP		------
STEP		
NO. OF STEP		
COMPLIANCE		

CONSTANT	SOURCE	COMPLIANCE
VS1 V	2.0000V	-------

Figure 4-13. Measurement Setup.

iii) On the MEAS & DISP MODE SET UP page:

Select LIST as the display mode for the measurement results.



[hp] ** MEAS & DISP MODE SET UP **

MEASUREMENT MODE: TIME DOMAIN

WAIT TIME	.00s
INTERVAL	.01s
NO. OF RDNGS	1

DISPLAY MODE: LIST

NAMES	VM1

Figure 4-13. Measurement Setup (Cont'd).

5. Perform measurement by pressing the REPEAT key.
6. Record the readings on the 4145B for monitored voltage value VM1a and on the 3456A for Va, then end measurement by pressing the STOP key.
7. Repeat steps 4 through 6 for VS output -2 volts, then record the readings on the 4145B for monitored voltage value VM1b and on the 3456A for Vb.
8. Verify that the error and offset defined by the following equations satisfy the test limits listed in Table 4-11.

$$\text{error} = \frac{\text{VM1a} - \text{VM1b}}{\text{Va} - \text{Vb}} - 1$$

$$\text{offset} = \text{VM1a} - (1 + \text{error}) * \text{Va}$$

9. Repeat steps 4 through 7 for VS outputs 20 volts and -20 volts.

Table 4-11. Test Limits for VM Accuracy Test

VM Range Tested	2 volt		20 volt	
VS Output (volt)	2	-2	20	-20
Error (%)	± 0.5		± 0.2	
Offset	±10mV		±10mV	

4-14. EXTERNAL CRT X-Y-Z OUTPUT CHECK

PURPOSE : This check verifies that the external CRT X-Y-Z-signal is properly output.

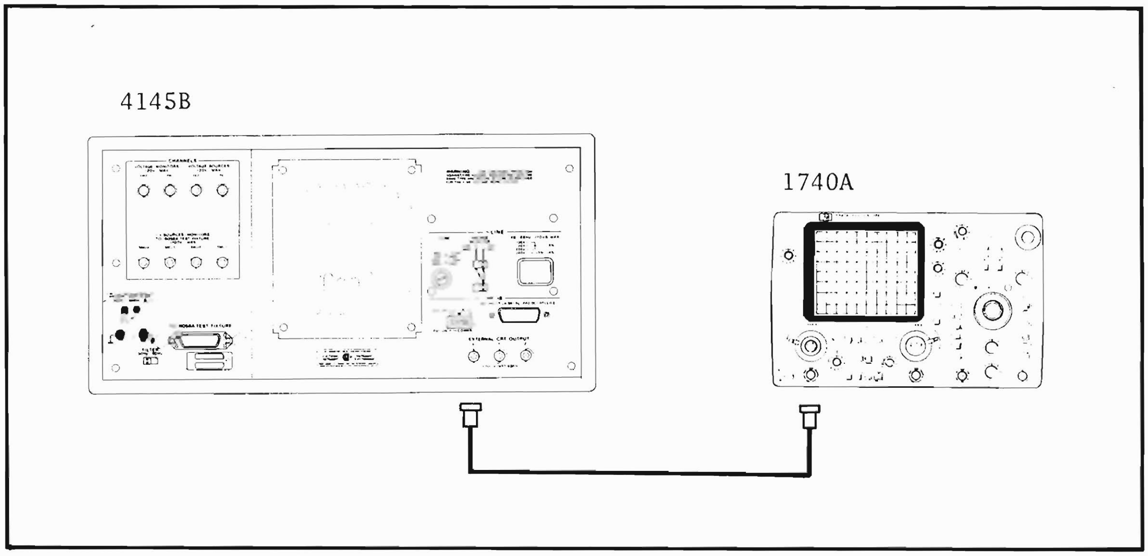


Figure 4-14. External CRT X-Y-Z Output Check Setup.

EQUIPMENT :

Oscilloscope	HP MODEL 1740A
BNC (Male)-BNC (Male) Cable	HP MODEL 11170B

PROCEDURE :

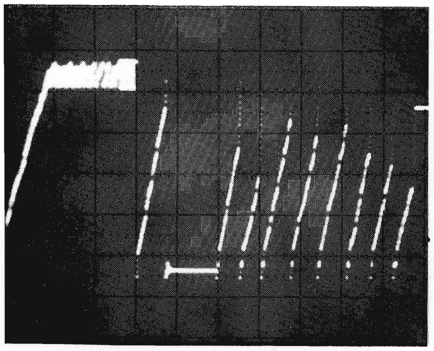
1. Turn off the 4145B.
2. Connect channel A (or channel B) input to the EXTERNAL CRT X-output as shown in Figure 4-14.
3. Set the 1740A's controls as follows :

VOLT/DIV	0.2
COUPLING	DC
TIME/DIV	0.5msec
TRIGGER	INT channel A

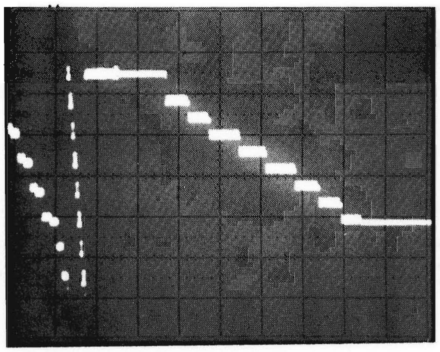
4. Insert one of the discs (software discs furnished with the 4145B) into the flexible-disc drive, then turn on the 4145B and the oscilloscope. The MENU page will be displayed on the CRT display.

5. Verify that 0V-1V signal is observed as shown in Figure 4-15.

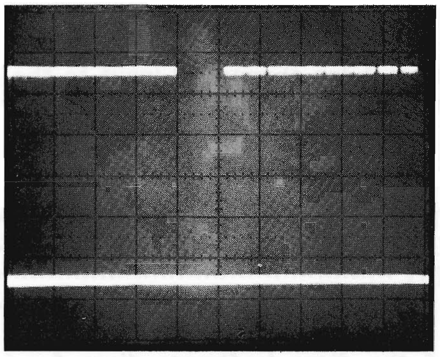
6. Perform steps 1 through 5 for EXTERNAL CRT Y-output and Z-output. Verify that the scope displays are observed as shown in Figure 4-15.



X-output



Y-output



Z-output

Figure 4-15. Scope Displays of X-Y-Z Output (Example).

4-15. HP-IB INTERFACE TEST

PURPOSE : This test verifies the instrument's HP-IB capabilities (see Table 3-8).

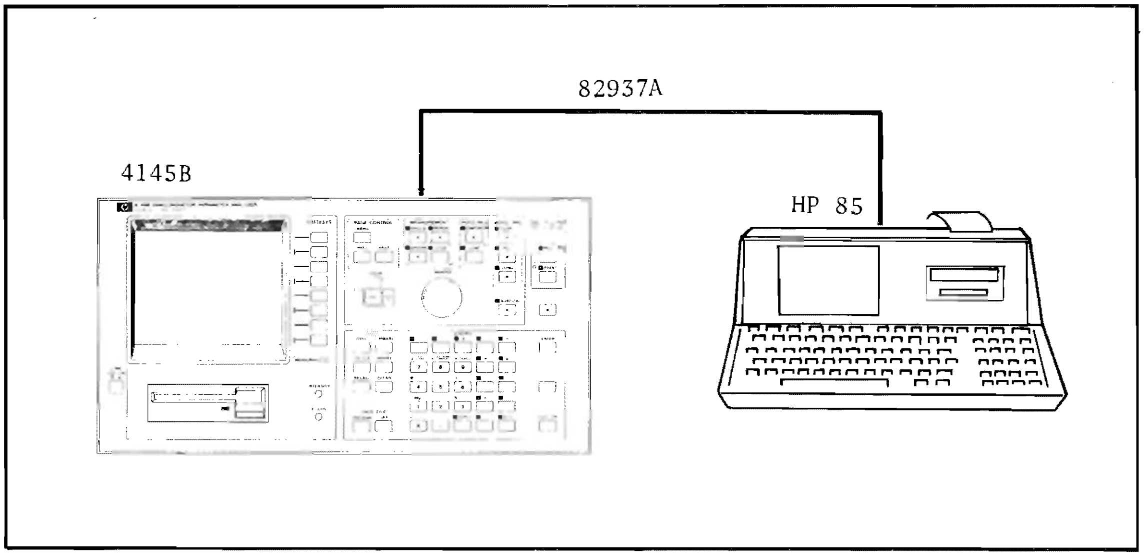


Figure 4-16. HP-IB Interface Test Setup.

EQUIPMENT :

Personal Computer	HP MODEL 85
Interface Card with Cable	HP MODEL 82937A
I/O ROM	HP P/N 00085-15003
ROM Drawer	HP MODEL 82936A

PROCEDURE :

1. Turn off both the 4145B and the HP85.
2. Using the 82937A HP-IB Interface, interconnect the HP85 and the 4145B as shown in Figure 4-16.
3. Install the 00085-15003 I/O ROM into the HP85.
4. Set the HP-IB control switch, located on the rear panel, as follows :

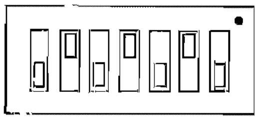
   bits 1 - 5 : 10101 (21)
   bit 6 : 0
   bit 7 : 1

5. Turn on the 4145B.
6. After the MENU page has been displayed, verify that the HP-IB status message on the system message line is as follows :

   HP-IB (21 , COMMA ,)

7. Turn off the 4145B, then reset the HP-IB control switch as follows :

   bits 1 - 5 : 01010 (10₁₀)
   bit 6 : 1
   bit 7 : 0

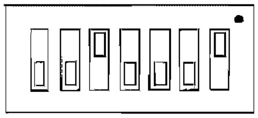


8. Turn on the 4145B, then verify that the HP-IB status message on the system message line is as follows :

   HP-IB (10, CR/LF, EOI)

9. Turn off the 4145B, then reset the HP-IB control switch as follows :

   bits 1 - 5 : 10001 (17₁₀)
   bit 6 : 0
   bit 7 : 0



10. Turn on the HP85 and the 4145B.

11. Load the HP-IB Interface Test Program into the personal computer (controller). The test program, listed in Figure 4-17, includes eight tests, listed in Table 4-12.

12. Execute the program and follow the prompts and instructions output by the controller. Details on controller instructions and appropriate operator responses are given in Table 4-13. An error message is printed out if any step of the test fails, then the test is discontinued. See Table 4-14 for explanations of error messages.

Note

The 16058A Test Fixture or shorting connector (P/N 04145-61623) must be connected to the 4145B and the fixture lid must be closed during the HP-IB interface Test.

Table 4-12. HP-IB Interface Test Program

HP-IB INTERFACE TEST PROGRAMS

DESCRIPTION:

The HP-IB Interface Test Program tests the 4145B's HP-IB interface capabilities. With the test program, The tests listed below are performed in the order listed.

TEST NO.	Test	(HP-IB) Capabilities Tested
1	PLOT FUNCTION TEST	PLOT Function of the 4145B
2	Listener and Remote/Local Test	1. Listener 2. Remote/Local
3	Talker Test *	Talker
4	EOI Test	EOI (End or Identify) Output
5	IFC Test	Response of the 4145B to Interface Clear Command from the Controller
6	Device Clear Test	Device Clear
7	Trigger Test	Response of the 4145B to Group Execute Trigger
8	SRQ Line Test*	1. Service Request 2. Serial Poll

* The test for EOI output and the SRQ Line Test are performed automatically without operator response.

```
10 !
20 !  HP-IB Performance Test
30 !          REV. 2.1 01FEB86
40 !
50 !
60 DIM A$[500],B$[500],D$[32],E$[32],G$[50],R$[1]
70 !
80 GOSUB 210 ! SETUP
90 GOSUB 360 ! PLOT TEST
100 GOSUB 680 ! LISTENER REMOTE/LOCAL TEST
110 GOSUB 1310 ! TALKER TEST
120 GOSUB 1540 ! EOI TEST
130 GOSUB 1750 ! IFC TEST
140 GOSUB 1930 ! DCL TEST
150 GOSUB 2130 ! TRG TEST
160 GOSUB 2330 ! SRQ TEST
170 GOSUB 2640 ! PRINT RESULT
180 !
190 END
200 !
210 ! SETUP
220 !
230 CLEAR
240 !
250 DISP "Input 4145B HP-IB Address ";
260 INPUT M1@ M1=M1+700
270 RESET 7
280 CLEAR M1
290 LOCAL 7
300 U,V,E,F=0
310 U=BINCMP(U)
320 PRINT "**   HP-IB PERFORMANCE TEST   **"
330 PRINT
340 RETURN
350 !
360 ! PLOT TEST
370 !
380 CLEAR
390 E$="PLOT FUNCTION TEST"
400 DISP E$ @ DISP
410 DISP "The PLOT FUNCTION TEST is"
420 DISP "now in progress."
430 REMOTE M1
440 OUTPUT M1 ;"PL 200,200,7400,4800"
450 E=0
460 STATUS 7,2 ; R
470 IF BIT(R,3) THEN PRINT "FAIL EOI LINE LOW" @ E=1
480 FOR I=1 TO 50
490 ENTER M1 USING "#,B" ; R
500 U=BINAND(R,U)
510 V=BINIOR(R,V)
520 NEXT I
530 U=BINEOR(U,V)
540 D$[1,15]="X X X X X X X X"
550 FOR I=0 TO 7
560 K=15-2*I
570 IF BIT(U,I) THEN 600
580 D$[K,K]="H"
590 IF BIT(R,I) THEN D$[K,K]="L"
600 NEXT I
610 IF D$[1,15]#"H X X X X X X X" THEN GOSUB 2530 ! PRTDIO
```

Figure 4-17. Program Listing of HP-IB Interface Test (Sheet 1 of 5).

```
620 IF E=0 THEN PRINT "PASS "&E$ ELSE PRINT "FAIL "&E$ @ F=1
630 REMOTE M1
640 OUTPUT M1 ;"PF"
650 S=SPOLL(M1)
660 RETURN
670 !
680 ! LISTENER REMOTE/LOCAL TEST
690 !
700 CLEAR
710 U,V,E=0
720 U=BINCMP(U)
730 E$="LISTENER REMOTE/LOCAL TEST"
740 DISP E$ @ DISP
750 REMOTE M1
760 BEEP
770 DISP "Are HP-IB Status Indicators"
780 DISP "correct?"
790 DISP " SRQ:OFF LTN:ON TLK:OFF RMT:ON"
800 DISP
810 DISP "     K1  YES"
820 DISP "     K2  NO"
830 ON KEY# 1,"YES" GOTO 880
840 ON KEY# 2,"NO" GOTO 870
850 KEY LABEL
860 GOTO 860
870 E=1
880 OFF KEY# 1 @ OFF KEY# 2
890 !
900 REMOTE M1
910 CLEAR
920 BEEP
930 DISP "Press the 4145B's LOCAL key."
940 DISP @ DISP "Are HP-IB Status Indicators"
950 DISP "correct?"
960 DISP " SRQ:OFF LTN:ON TLK:OFF RMT:OFF"
970 DISP
980 DISP "     K1 YES"
990 DISP "     K2 NO"
1000 ON KEY# 1,"YES" GOTO 1050
1010 ON KEY# 2,"NO" GOTO 1040
1020 KEY LABEL
1030 GOTO 1030
1040 E=1
1050 OFF KEY# 1 @ OFF KEY# 2
1060 !
1070 REMOTE M1
1080 LOCAL LOCKOUT 7
1090 E$="LOCAL LOCKOUT TEST"
1100 CLEAR
1110 BEEP
1120 DISP E$ @ DISP
1130 DISP "Press the LOCAL key again."
1140 DISP "Are HP-IB Status Indicators"
1150 DISP "correct?"
1160 DISP " SRQ:OFF LTN:ON TLK:OFF RMT:ON"
1170 DISP
1180 DISP "     K1 YES"
1190 DISP "     K2 NO"
1200 ON KEY# 1,"YES" GOTO 1250
1210 ON KEY# 2,"NO" GOTO 1240
1220 KEY LABEL
```

Figure 4-17. Program Listing of HP-IB Interface Test (Sheet 2 of 5).

```
1230 GOTO 1230
1240 E=1
1250 OFF KEY# 1 @ OFF KEY# 2
1260 IF E THEN PRINT "FAIL "&E$ @ F=1 ELSE PRINT "PASS "&E$
1270 RETURN
1280 !
1290 ! TALKER TEST
1300 !
1310 LOCAL 7
1320 REMOTE 7
1330 SEND 7 ; TALK M1-700
1340 E$="TALKER TEST"
1350 E=0
1360 CLEAR
1370 BEEP
1380 DISP E$ @ DISP
1390 DISP "Are HP-IB Status Indicators"
1400 DISP "correct?"
1410 DISP " SRQ:OFF LTN:OFF TLK:ON RMT:OFF"
1420 DISP
1430 DISP "      K1 YES"
1440 DISP "      K2 NO"
1450 ON KEY# 1,"YES" GOTO 1500
1460 ON KEY# 2,"NO" GOTO 1490
1470 KEY LABEL
1480 GOTO 1480
1490 E=1
1500 OFF KEY# 1 @ OFF KEY# 2
1510 IF E THEN PRINT "FAIL "&E$ @ F=1 ELSE PRINT "PASS "&E$
1520 RETURN
1530 !
1540 ! EOI TEST
1550 !
1560 E$="EOI TEST"
1570 E=0
1580 CLEAR
1590 DISP E$ @ DISP
1600 DISP "The EOI TEST is now"
1610 DISP "in progress."
1620 ABORTIO 7
1630 REMOTE M1
1640 OUTPUT M1 ;"US BC TV1"
1650 WAIT 100
1660 ENTER M1 USING "#%,#%K" ; A$
1670 L=LEN(A$)
1680 IF A$[L-1,L-1]#CHR$(13) THEN PRINT "FAIL EOI LOW FOR [CR]" @ E=1
1690 IF A$[L.L]#CHR$(10) THEN PRINT "FAIL EOI HIGH FOR [LF]" @ E=1
1700 IF E=0 THEN PRINT "PASS "&E$ ELSE F=1
1710 RETURN
1720 !
1730 ! IFC TEST
1740 !
1750 LOCAL 7
1760 ABORTIO 7
1770 E$="IFC TEST"
1780 CLEAR
1790 BEEP
1800 DISP E$ @ DISP
1810 DISP "Are all HP-IB Status Indicators off?"
1820 DISP
1830 DISP "      K1 YES"
```

Figure 4-17. Program Listing of HP-IB Interface Test (Sheet 3 of 5).

```
1840 DISP "      K2 NO"
1850 ON KEY≠ 1,"YES" GOTO 1900
1860 ON KEY≠ 2,"NO" GOTO 1890
1870 KEY LABEL
1880 GOTO 1880
1890 E=1
1900 OFF KEY≠ 1 @ OFF KEY≠ 2
1910 IF E THEN PRINT "FAIL "&E$ @ F=1 ELSE PRINT "PASS "&E$
1920 RETURN
1930 !
1940 ! DEVICE CLEAR TEST
1950 !
1960 E$="DEVICE CLEAR TEST"
1970 CLEAR
1980 DISP E$ @ DISP
1990 DISP "The DEVICE CLEAR TEST is"
2000 DISP "now in progress."
2010 CLEAR 7
2020 OUTPUT M1 ;"PL"
2030 ENTER M1 ; A$
2040 OUTPUT M1 ;"PF"
2050 S=SPOLL(M1)
2060 E=1
2070 FOR I=1 TO 497
2080 IF A$[I.I+3]="MENU" THEN E=0 @ GOTO 2100
2090 NEXT I
2100 IF E THEN PRINT "FAIL "&E$ @ F=1 ELSE PRINT "PASS "&E$
2110 RETURN
2120 !
2130 ! TRIGGER TEST
2140 !
2150 CLEAR
2160 E$="TRIGGER TEST"
2170 DISP E$ @ DISP
2180 DISP "The TRIGGER TEST is now"
2190 DISP "in progress."
2200 OUTPUT M1 ;"DECH2:CH3;CH4;SMIN.5;DM2LI'I1';MD"
2210 TRIGGER M1
2220 WAIT 2000
2230 OUTPUT M1 ;"BC DD'I1'"
2240 ENTER M1 ; A$
2250 B$[1,6]="LVXCTN"
2260 E=1
2270 FOR I=1 TO 6
2280 IF A$[1,1]=B$[I.I] THEN E=0
2290 NEXT I
2300 IF E THEN PRINT "FAIL "&E$ @ F=1 ELSE PRINT "PASS "&E$
2310 RETURN
2320 !
2330 ! SRQ TEST
2340 !
2350 CLEAR
2360 E$="SRQ LINE TEST"
2370 DISP E$ @ DISP
2380 DISP "The SRQ LINE TEST is now"
2390 DISP "in progress."
2400 CLEAR M1
2410 E=0
2420 STATUS 7,2 ; R
2430 IF BIT(R,5) THEN PRINT "FAIL SRQ LINE LOW" @ E=1
2440 OUTPUT M1 ;"Q"
```

Figure 4-17. Program Listing of HP-IB Interface Test (Sheet 4 of 5).

```
2450 STATUS 7,2 : R
2460 IF BIT(R,5)=0 THEN PRINT "FAIL SRQ LINE HIGH" @ E=1
2470 IF E=1 THEN F=1 @ GOTO 2510
2480 S=SPOLL(M1)
2490 IF S#66 THEN PRINT "SERIAL POLL ERROR","STATUS BYTE is ";S @ GOTO 2510
2500 PRINT "PASS "&E$
2510 RETURN
2520 !
2530 ! PRTDIO
2540 !
2550 PRINT "** STUCK BUS **"
2560 PRINT "** DIO LINES **"
2570 PRINT "8-7-6-5-4-3-2-1"
2580 PRINT D$[1,15]
2590 PRINT "DIO8 must be H"
2600 PRINT
2610 E=1
2620 RETURN
2630 !
2640 ! PRINT RESULT
2650 !
2660 PRINT
2670 PRINT "HP-IB PERFORMANCE TEST ";
2680 IF F THEN PRINT "FAIL" ELSE PRINT "PASS"
2690 PRINT
2700 PRINT "** HP-IB PERFORMANCE TEST END **"
2710 PRINT @ PRINT @ PRINT @ PRINT
2720 CLEAR
2730 DISP "** HP-IB PERFORMANCE TEST END **"
2740 RETURN
```

Figure 4-17. Program Listing of HP-IB Interface Test (Sheet 5 of 5).

Table 4-13. Controller Instructions and Operator Responses for HP-IB Interface Test Program

Controller Instructions Displayed	Operator Response/Description
Input 4145B HP-IB Address	Input the 4145B's HP-IB address (17), then press the "END LINE" key.
** HP-IB PERFORMANCE TEST **	
PLOT FUNCTION TEST	
PASS PLOT FUNCTION TEST	If all steps of the PLOT Function Test are correct, this message is printed.
LISTENER REMOTE/LOCAL TEST	
Are HP-IB Status Indicators correct ? SRQ;XX LTN;XX TLK;XX RMT;XX	Verify that the SRQ, LTN, and RMT lamps of the 4145B are the instructions displayed, then press k1 YES softkey. If the wether of the lamps is not the instructions displayed, press the k2 NO softkey.
Press the 4145B's LOCAL key.	
Press the LOCAL key again.	Press the 4145B's LOCAL key.
PASS LISTENER REMOTE/LOCAL TEST	If all steps of the LISTENER REMOTE/LOCAL TEST are correct, this message is printed.
TALKER TEST	
PASS TALKER TEST	If all steps of the TALKER TEST are correct, this message is printed.
EOI TEST	The EOI TEST is performed automatically.
PASS EOI TEST	If all steps of the EOI TEST are correct, this message is printed.
IFC TEST	
Are all HP-IB Status Indicators off ?	Verify that the all HP-IB Status Indicators of the 4145B are off, then press k1 YES softkey. If the wether of the lamps is on, press k2 NO softkey.
PASS IFC TEST	If the all steps of the IFC TEST are correct, this message is printed.
DEVICE CLEAR TEST	The DEVICE CLEAR TEST is performed automatically.
PASS DEVICE CLEAR TEST	If all steps of the DEVICE CLEAR TEST are correct, this message is printed.
TRIGGER TEST	The TRIGGER TEST is performed automatically.
PASS TRIGGER TEST	If all steps of the TRIGGER TEST are correct, this message is printed.

Table 4-13. Controller Instructions and Operator Responses for HP-IB Interface Test Program (Cont'd)

Controller Instructions Displayed	Operator Response/Description
SRQ LINE TEST	The SRQ LINE TEST is performed automatically.
PASS SRQ LINE TEST	If all steps of the SRQ LINE TEST are correct, this message is printed.
HP-IB PERFORMANCE TEST PASS	The HP-IB PERFORMANCE TEST has been passed.
** HP-IB PERFORMANCE TEST END **	The 4145B HP-IB PERFORMANCE TEST is completed.

Table 4-14. Error Messages for HP-IB Interface Test Program

(1) STUCK BUS ERROR

Any of the DIO lines (DIO 1 - 8) are shorted or disconnected. An example of the STUCK BUS ERROR message is described below.

```
** STUCK BUS **
** DIO LINES **
8-7-6-5-4-3-2-1
H X X X X L X X
DIO8 must be H
```

The DIO3 line is stuck at low level, but the DIO8 line is at high level.

Note

This message is displayed only in the PLOT FUNCTION TEST.

(2) FAIL LISTENER REMOTE/LOCAL (LRL) TEST

This message is displayed if the 4145B does not reapond to addressed command LRL.

(3) FAIL TALKER TEST

This message is displayed if the 4145B does not respond to addressed TALKER command.

(4) FAIL EOI TEST

The EOI line is disconnected or shorted. Examples of the FAIL EOI TEST message are described below:

```
FAIL EOI LINE LO
W FOR [CR]
```

The EOI line is at Low level when the CR (carriage return) signal is output.

```
FAIL EOI HIGH FO
R [LF]
```

The EOI line is at HIGH level when the LF (line feed) signal is output.

Note

When the HP-IB control switch for the EOI is turned off, this message is displayed.

Table 4-14. Error Messages for HP-IB Interface Test Program (Cont'd)

(5) FAIL DEVICE CLEAR (DCL) TEST

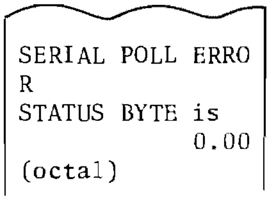
This message is displayed if the 4145B does not respond to universal command DCL.

(6) FAIL TRIGGER TEST

This message is displayed if the 4145B does not respond properly to addressed command GET (Group Execute Trigger).

(7) SERIAL POLL ERROR

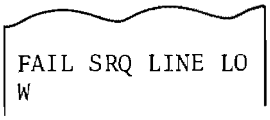
After the Service Request function of the 4145B has been verified, this message is displayed along with status byte information of the 4145B if Serial Poll is not performed properly. In the test program, the Serial Poll test has been passed when the status byte from the 4145B is 102 (octal). An example of the SERIAL POLL ERROR message described below:



```
SERIAL POLL ERRO
R
STATUS BYTE is
            0.00
(octal)
```

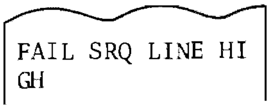
(8) FAIL SRQ LINE TEST

The SRQ line is disconnected or shorted. There are two kinds of FAIL SRQ Line TEST messages as described below.



```
FAIL SRQ LINE LO
W
```

The SRQ line stays LOW.



```
FAIL SRQ LINE HI
GH
```

The SRQ line stays HIGH.

PERFORMANCE TEST RECORD

Hewlett-Packard
Model 4145B
SEMICONDUCTOR PARAMETER ANALYZER

Tested by ____________________

Serial Number ____________________

Date ____________________

Paragraph	Test and Result	
4-9	Graphic Display Unit Intensity and Focus Check	Pass . Fail *
4-10	Page and Key Function Check	Pass . Fail *
4-11	SMU Accuracy Test	
4-11-(1)	Voltage Coutrol Accuracy Test	

SMU Range Tested	Output from SMU	Test Limit	Actual Result			
			SMU1	SMU2	SMU3	SMU4
20V	0V	0V±0.01V	______	______	______	______
	20V	20V±0.03V	______	______	______	______
	-20V	-20V±0.03V	______	______	______	______
40V	0V	0V±0.02V	______	______	______	______
	40V	40V±0.06V	______	______	______	______
	-40V	-40V±0.06V	______	______	______	______
100V	0V	0V±0.05V	______	______	______	______
	100V	100V±0.15V	______	______	______	______
	-100V	-100V±0.15V	______	______	______	______

Paragraph	Test and Result
4-11-(2)	Voltage Measurement Accuracy Test

SMU Range Tested	Error/ Offset	Test Limit	Actual Result			
			SMU1	SMU2	SMU3	SMU4
20V	Error	±0.1%	______%	______%	______%	______%
	Offset	±10mV	______	______	______	______
40V	Error	±0.1%	______%	______%	______%	______%
	Offset	±20mV	______	______	______	______
100V	Error	±0.1%	______%	______%	______%	______%
	Offset	±50mV	______	______	______	______

* check (√) either Pass or Fail.

PERFORMANCE TEST RECORD

Paragraph	Test and Result
4-11-(3)	Current Measurement Accuracy Test

16340A Range	Error/ Offset	Test Limit	Actual Result			
			SMU1	SMU2	SMU3	SMU4
$10^2\Omega$	Error	±0.3%	____%	____%	____%	____%
	Offset	±0.12mA	____	____	____	____
$10^3\Omega$	Error	±0.3%	____%	____%	____%	____%
	Offset	±12μA	____	____	____	____
$10^4\Omega$	Error	±0.3%	____%	____%	____%	____%
	Offset	±1.2μA	____	____	____	____
$10^5\Omega$	Error	±0.3%	____%	____%	____%	____%
	Offset	±0.12μA	____	____	____	____
$10^6\Omega$	Error	±0.3%	____%	____%	____%	____%
	Offset	±12nA	____	____	____	____
$10^7\Omega$	Error	±0.5%	____%	____%	____%	____%
	Offset	±1.2nA	____	____	____	____
$10^8\Omega$	Error	±0.5%	____%	____%	____%	____%
	Offset	±0.12nA	____	____	____	____
$10^9\ \Omega$	Error	±1%	____%	____%	____%	____%
	Offset	±17pA	____	____	____	____
$10^9\ \Omega$	Error	±1%	____%	____%	____%	____%
	Offset	±6.2pA	____	____	____	____

Paragraph	Test and Result
4-11-(4)	Current Control Accuracy Test

16340A Range	Error/ Offset	Test Limit	Actual Result			
			SMU1	SMU2	SMU3	SMU4
$10^2\Omega$	Error	±0.3%	____%	____%	____%	____%
	Offset	±0.12mA	____	____	____	____
$10^3\Omega$	Error	±0.3%	____%	____%	____%	____%
	Offset	±12μA	____	____	____	____

Paragraph	Test and Result
4-12	VS Accuracy Test

Output From VS	Test Limit	Actual Result	
		VS1	VS2
0V	0V±0.01V		
20V	20V±0.11V		
-20V	-20V±0.11V		

PERFORMANCE TEST RECORD

Paragraph	Test and Result				
4-13	VM Accuracy Test				
	VM Range Tested	Error/ Offset	Test Limit	Actual Result	
				VM1	VM2
	2V	Error	±0.5%	________ %	________ %
		Offset	±10mV	________	________
	20V	Error	±0.2%	________ %	________ %
		Offset	±10mV	________	________
4-14	External CRT X-Y-Z Output Check	Output	Result*		
		X-output	Pass · Fail		
		Y-output	Pass · Fail		
		Z-output	Pass · Fail		
4-15	HP-IB Interface Test	Result*			
	(1) HP-IB Control Switch Function "HP-IB (21, COMMA,)" and "HP-IB (21, CR/LF, EOI)" are displayed on the CRT.	Pass · Fail			
	(2) PLOT FUNCTION TEST "PASS PLOT FUNCTION TEST" is displayed on the HP 85.	Pass · Fail			
	(3) Listener and Remote/Local Test "PASS LOCAL LOCKOUT TEST" is displayed on the HP 85.	Pass · Fail			
	(4) Talker Test "PASS TALKER TEST" is displayed on the HP 85.	Pass · Fail			
	(5) EOI Test "PASS EOI TEST" is displayed on the HP 85.	Pass · Fail			
	(6) IFC Test "PASS IFC TEST" is displayed on the HP 85.	Pass · Fail			

* check (✓) either Pass or Fail.

PERFORMANCE TEST RECORD

Paragraph	Test and Result	
4-15	(7) Device Clear Test "PASS DEVICE CLEAR TEST" is displayed on the HP 85.	Pass • Fail
	(8) Trigger Test "PASS TRIGGER TEST" is displayed on the HP 85.	Pass • Fail
	(9) SRQ Line Test "PASS SRQ LINE TEST" is displayed on the HP 85.	Pass • Fail

* check (✓) either Pass or Fail.

SECTION V
ADJUSTMENT

5-1. INTRODUCTION

5-2. This section provides the information needed to adjust the 4145B to the specifications listed in Table 1-1. The prime purpose of adjustment is to return the instrument to its peak operating capabilities after repairs have been made. The instrument should be tested and adjusted whenever a part or component has been replaced. If the instrument falls out of adjustment, readjustment alone often returns the instrument to normal operating conditions without repairs. Adjustment procedures should also be performed periodically to maintain top operating performance. The recommended adjustment schedule for the 4145B is every six months. All adjustable components referred to in individual tests are listed in Table 5-1. If proper performance cannot be achieved after adjustment procedures have been performed, refer to the troubleshooting procedures described in Section VIII.

Note

> To ensure proper adjustment and instrument operation, allow 40 minute warm-up time to stabilize operating conditions before performing any of the adjustment procedures described herein.

5-3. SAFETY REQUIREMENTS

5-4. Although the instrument has been designed in accordance with international safety standards, this manual contains supplementary information, cautions, and warnings which must be followed to ensure safe operating conditions (see Section II and III). Adjustments described in this section should be performed only by qualified service personnel.

WARNING

> ANY DISTURBANCE OF THE PROTECTIVE (GROUNDED) CONDUCTOR INSIDE OR OUTSIDE THE INSTRUMENT, OR DISCONNECTION OF THE PROTECTIVE GROUND TERMINAL CAN MAKE THE INSTRUMENT UNSAFE. INTENTIONAL INTERRUPTION FOR ANY REASON IS PROHIBITED.

5-5. Opening covers in order to remove parts, except those which can be accessed by hand, exposes live components and terminals. Use appropriate caution.

5-6. Capacitors in the instrument may still be charged after the instrument has been disconnected from the power source.

WARNING

> ADJUSTMENTS DESCRIBED IN THIS SECTION ARE PERFORMED WITH POWER SUPPLIED TO THE INSTRUMENT AND WITH PROTECTIVE COVERS REMOVED. ELECTRICAL CURRENT EXISTING AT MANY POINTS MAY, IF CONTACTED, RESULT IN SERIOUS PERSONAL INJURY.

5-7. EQUIPMENT REQUIRED

5-8. Equipment needed to adjust the 4145B is listed in Table 4-1. Each piece of equipment listed in Table 4-1 must be calibrated to satisfy its own specifications and required characteristics. If the recommended model is not available, any instrument whose specifications equal to or surpass the required specifications may be substituted.

5-9. ADJUSTMENT RELATIONSHIPS

5-10. The adjustment procedures described in this section, beginning with paragraph 5-24, should be performed in the order described because each step is interactive. Neglecting or changing the order of the procedures may make it impossible to obtain optimum instrument performance. Table 5-2 lists necessary adjustment procedures after the instrument has been repaired.

5-11. ADJUSTMENT LOCATIONS

5-12. To help locate the appropriate adjustment points, brief descriptions of their locations are given in each adjustment section. Refer to Section VIII for overall component locations. The locations, connectors, and other components related to the adjustment are shown in the individual board assembly component illustrations (fold-out service sheets).

Table 5-1. Adjustable Components

Paragraph	Reference Disignator	Name of Control	Description
5-23	INTENSITY FOCUS	INTENSITY FOCUS	Adjusts the writing beam intensity and focus.
5-24	A11R17	V ADJ	Adjusts the power supply voltage by adjusting switching duty cycle.
5-25	A3R30	C ADJ	Eliminates AC offset generated in the sample hold switch.
5-26	A4C1 A4C2 A4C3 A4C4 A4C5 A4C6 A4C7 A4C8 A4C9 A4C10	I1 V1 I2 V2 I3 V3 I4 V4 E1 E2	Eliminates AC offset generated in the demultiplexer.
5-27	A4R11	GAIN	Adjusts the gain of the D-A converter for analog output.
5-28	A3R1	AD GAIN	Adjusts the gain of the A-D converter.
5-29	A16R4 A16R104	G ADJ G ADJ	Adjusts the gain of Voltage Monitor 1 (Vm 1) and Voltage Monitor (Vm 2).
5-30	A5R167	CMR ADJ	Adjusts the CMRR of the SMU.

5-13. INITIAL OPERATING PROCEDURES

5-14. Before making the adjustments described starting in paragraph 5-23, perform the procedures described in paragraph 5-15 through 5-22 to locate and to gain access to adjustment controls. These procedures provide access to the various adjustment points and facilitate thoroughgoing adjustment. The Initial Control Settings described in paragraph 3-13 must be used for each adjustment, and COM (COMMON)-GROUND terminals, located on the rear panel, must be shorted using the shorting bar.

5-15. BASIC OPERATING CHECKS

5-16. Check that the instrument's line voltage selector switches, located on the rear panel, are set for the local line voltage. This should be performed before making any adjustments.

After the recommended 40 minute warm-up period, the instrument should pass the SELF TEST (no error messages appear), and the initial control settings should be automatically set in preparation for measurement. If the instrument displays an error message or does not have the correct initial control settings, refer to the troubleshooting procedures given in Section VIII.

5-17. TOP COVER REMOVAL

5-18. Remove the top cover in order to gain access to the adjustment controls as follows :

(1) Fully loosen the retaining screw at the rear of the top cover.

(2) Slide the top cover towards the rear and lift off.

5-19. BOTTOM COVER REMOVAL

5-20. Remove the bottom cover in order to gain access to the adjustment controls as follows:

(1) Fully loosen the retaining screw at the rear of the bottom cover.

(2) Slide the bottom cover towards the rear and lift off.

WARNING

> WHEN TOP COVER OR BOTTOM COVER IS REMOVED, LIVE COMPONENTS ARE EXPOSED.

5-21. A3 BOARD ACCESS

5-22. The following adjustments procedure and A3S1 switch settings are facilitated by extending the A3 SMU Control and A-D Converter Board with an extender board (HP P/N : 04145-66521). The seven bits of A3S1 are initially set to all zeros (0000000) and changed as necessary to set the 4145B in test mode. Refer to each adjustment procedure for the required setting.

(1) Sample Hold Switch AC Offset Adjustment

(2) D-A Converter Gain Adjustment

(3) Demultiplexer Noise Rejection Adjustment

(4) A-D Converter Gain Adjustment

Note

> For the above adjustments, the following messages are displayed on the system message line in the order given after the 4145B has been turned on.
>
> (1) Busy
>
> (2) Error A01
> — about 30 second interval
>
> (3)* HP-IB (XX, COMMA, EOI)
> FILTER (XX HZ)
> CHAN (DOWN)
>
> * This message is displayed on the MENU page.
>
> These messages are shown only because the 4145B is in the test mode, and indicate that the 4145B is functioning properly.

WARNING

> TO GUARD AGAINST ELECTRICAL SHOCK, USE INSULATED TOOLS FOR ALL ADJUSTMENTS.

Table 5-2. Adjustment Requirements

Assembly Repaired or Replaced	Required Checks/Adjustments
A1 Graphics Display Control Board (P/N: 04145-66551)	None
A2 Microprocessor Digital Control Board (P/N: 04145-66562)	None
A3 SMU Control and A-D Converter Board (P/N: 04145-66533)	Para. 5-25 and -28
A4 D-A Converter Board (P/N: 04145-66504)	Para. 5-26 and -27
A5 SMU Board (P/N: 04145-66525)	Para. 5-30
A9 HP-IB and MSU Control Board (P/N: 04145-66559)	None
A10 Keyboard and Display Control Board (P/N: 04145-66510)	None
A11 Switching Power Supply Board (P/N: 04145-66511)	Para. 5-24
A12 DC Power Supply Board (P/N: 04145-66512)	None
A13 SMU Power Source Board (P/N: 04145-66513)	None
A15 Floating Power Supply Board (P/N: 04145-66515)	None
A16 Vs/Vm Board (P/N: 04145-66516)	Para. 5-29
Graphics Display Unit (HP 1345A)	Refer to the 1345A's manual.

5-23. GRAPHICS DISPLAY UNIT INTENSITY AND FOCUS CHECK AND ADJUSTMENT

PURPOSE: This check and adjustment sets intensity and focus of the 4145B Graphic Display Unit (GDU) for clear display.

PROCEDURE:

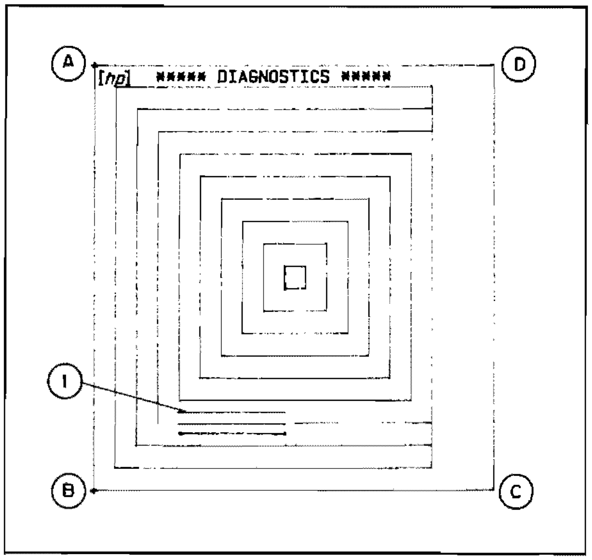


Figure 5-1. Test Pattern for GDU.

1. Obtain the DIAGNOSTICS page by pressing the EXTN softkey and the DIAG softkey while viewing the MENU page.
2. Display the test pattern (Figure 5-1) by pressing the G.D. TEST softkey.
3. Adjust INTENSITY with an insulated screwdriver until line 1 (see Figure 5-1) is just barely visible. Refer to Figure 5-2 for the INTENSITY adjustment location.
4. Adjust FOCUS for sharp, well-defined trace at points A, B, C, and D first, then over the entire CRT. Refer to Figure 5-2 for the FOCUS adjustment location.

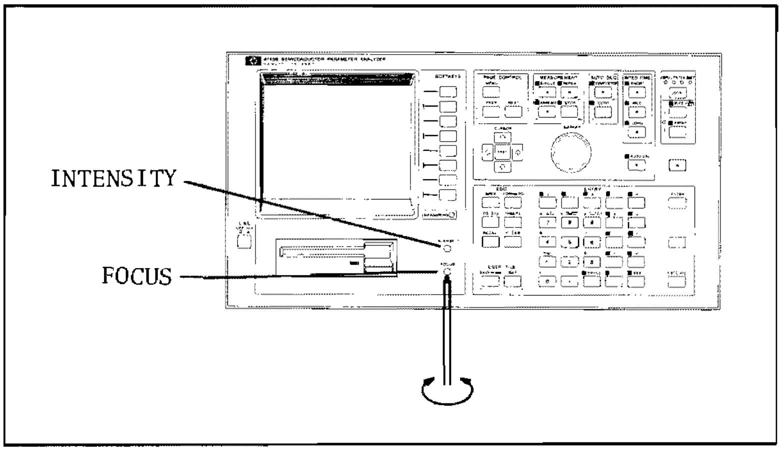


Figure 5-2. INTENSITY and FOCUS Locations.

Note 1

If the writing beam intensity and focus cannot be properly adjusted or if any distortion of trace is observed, refer to Section IV and V of the 1345A's Operating and Service Manual, located at the back of this binder.

Note 2

When the procedures in Section IV and V of the 1345A's Operating and Service manual are performed, the connector on the 4145B's A1 GDU Control Board must be disconnected. See Figure 5-3 for the connector location.

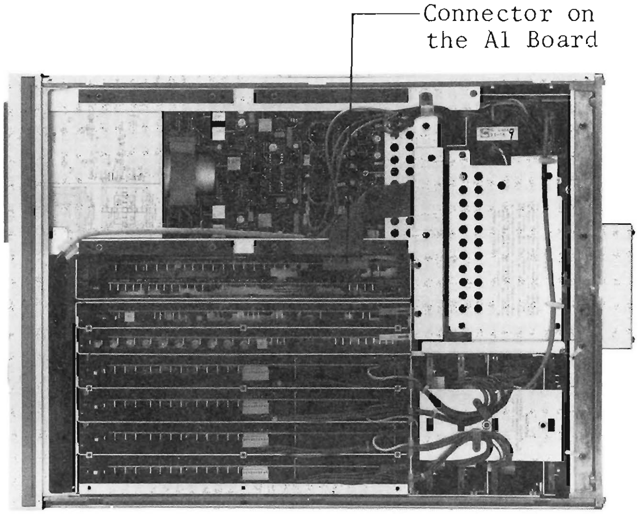


Figure 5-3. Connector Location.

5-24. DC POWER SUPPLY ADJUSTMENT

PURPOSE: This adjustment accurately sets the regulated power supply output voltage for all sections of the 4145B.

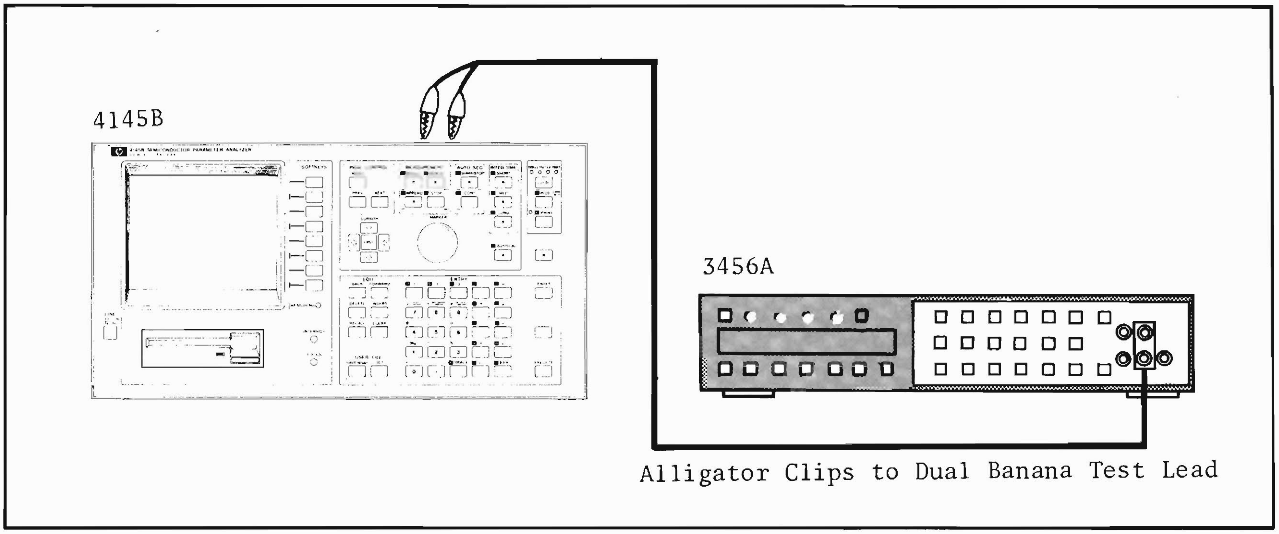


Figure 5-4. DC Power Supply Adjustment Setup.

EQUIPMENT:

DVM*	HP MODEL 3456A
Test Lead (alligator clips to dual banana plug)	HP MODEL 11002A
Test Lead (probe and alligator clip to dual banana plug)	HP MODEL 11003A

*DVM must have at least 3 1/2 digit display capability.

PROCEDURE:

1. Connect the DVM HI input to A2TP10 (+5V) (see Figure 5-7 for the location), and the LOW input to the chassis using an alligator clip-to-dual banana plug test lead.

2. Turn on the 3456A, then set the 3456A's controls as follows:

FUNCTION	$\overline{\overline{\ \ }}$ V
RANGE	AUTO
TRIGGER	INTERNAL

3. Disconnect the test fixture and cables from the 4145B, then turn on the 4145B.

Note

Perform adjustment and checks while viewing the MENU page.

4. Adjust A11R17 (see Figure 5-6 for location) until the reading on the DVM is between 5.040V and 5.065V when 100 volt power line voltage is used. Use an insulated screwdriver.

Note

When 115 or 220 volt power line voltage is used, the limit is between 5.050V and 5.075V.

WARNING

A11R17 IS LOCATED BENEATH THE SHIELD ON THE A11 BOARD. DO NOT REMOVE THE SHIELD FOR THIS ADJUSTMENT. DC VOLTAGES EXCEEDING 100V ARE PRESENT ON THE A11 BOARD.

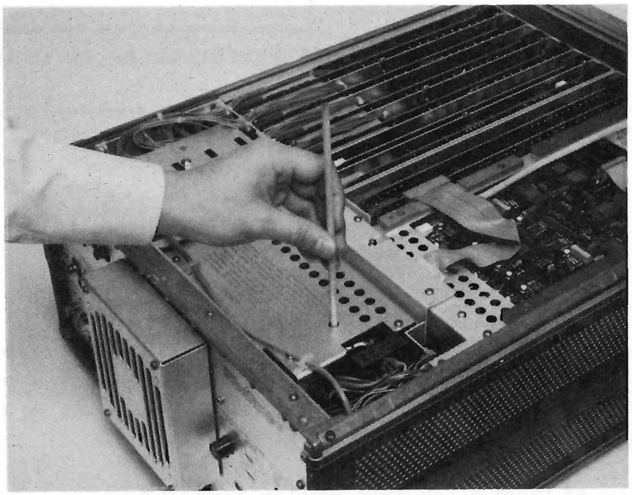


Figure 5-5. A11R17 Adjustment.

5. Connect the DVM to the points listed in Table 5-3, and verify that the DVM readout at each point is within the limits given in the table. Refer to Figure 5-7 for the locations of the points listed in Table 5-3.

WARNING

WHEN A5J1 PIN 1 AND A5J1 PIN10 ARE CHECKED, THE 11003A TEST LEAD (PROBE AND ALLIGATOR CLIP TO DUAL BANANA) SHOULD BE USED FOR THE CHECK. IF THE TEST LEAD IS NOT AVAILABLE, USE THE 11002A TEST LEAD WITH A SHORT WIRE AS SHOWN IN FIGURE 5-6, BUT BE CAREFUL. DC VOLTAGE EXCEEDING 100V IS PRESENT AT THE CHECK POINT.

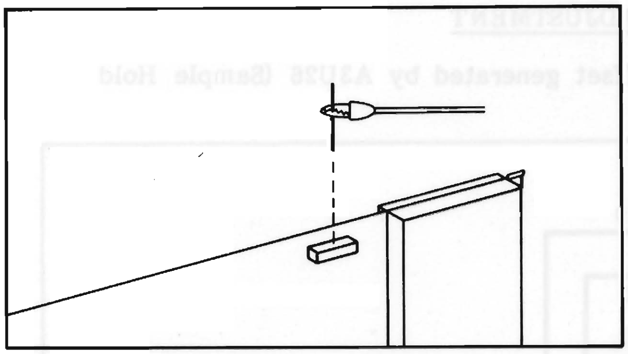


Figure 5-6. A5J1 Check.

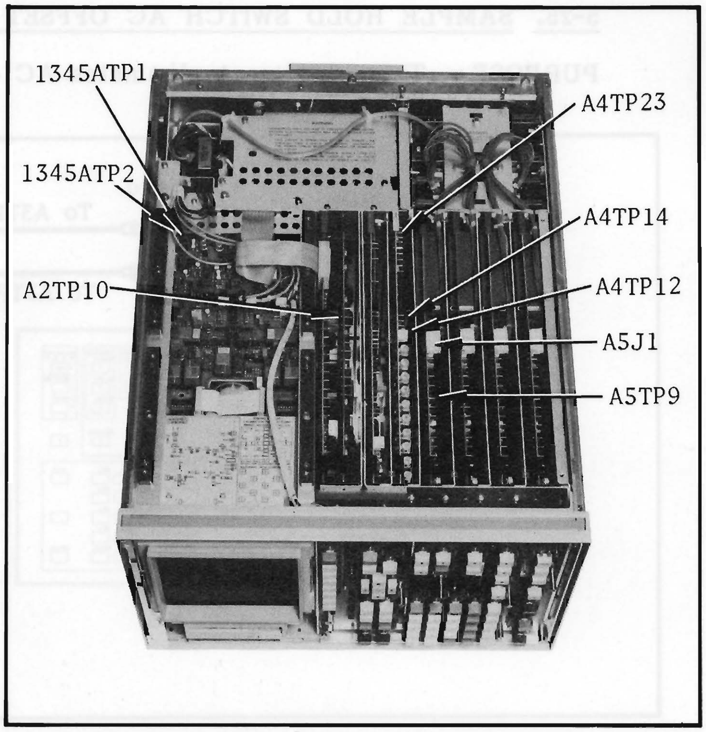


Figure 5-7. Check Point Locations.

Table 5-3. Check Points and Limits

Grounded Section			Floated Section		
Test Lead Connection		Limit	Test Lead Connection		Limit
HI input	LOW input		HI input	LOW input	
A2TP10	GND (CHASSIS)	5V±0.25V	A4TP12	A5TP9 (CM*)	15V±0.5V
1345A TP1	GND (CHASSIS)	-15V±0.75V	A4TP14	A5TP9 (CM*)	-15V±0.5V
1345A TP2	GND (CHASSIS)	15V±0.75V	A4TP23	A5TP9 (CM*)	5V±0.25V
			A5J1 pin 1	A5TP9 (CM*)	130V-13V+26V
			A5J1 pin10	A5TP9 (CM*)	-130V+13V-26V

* CM: COMMON

5-25. SAMPLE HOLD SWITCH AC OFFSET ADJUSTMENT

PURPOSE: This adjustment eliminates AC offset generated by A3U26 (Sample Hold Switch).

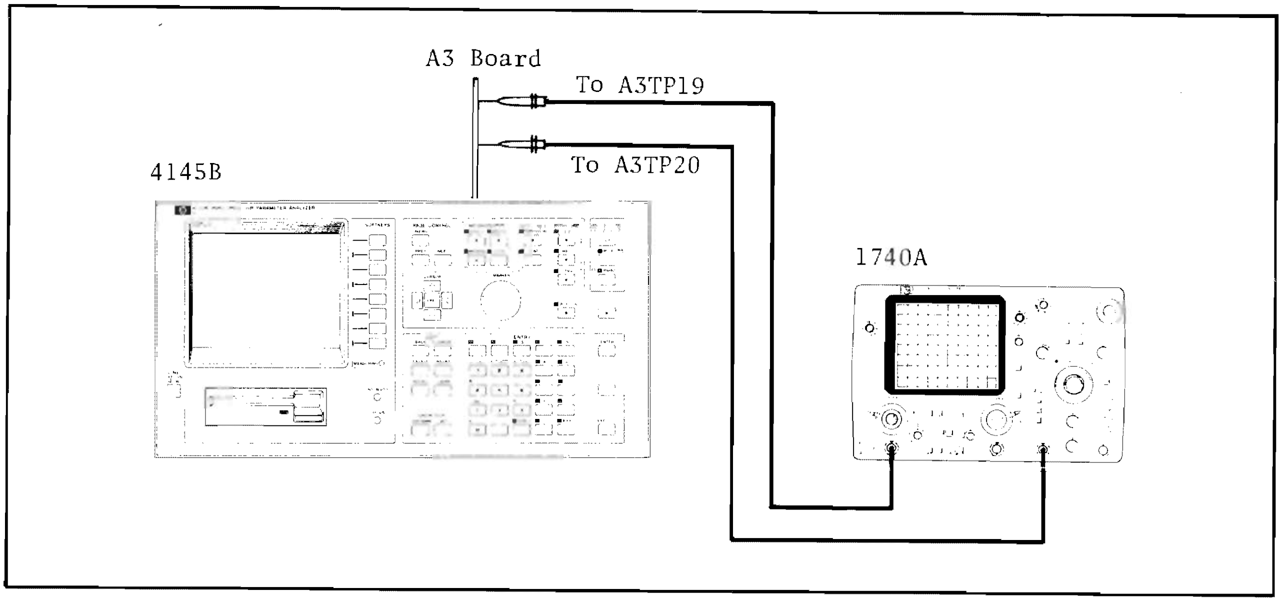


Figure 5-8. Sample Hold Switch AC Offset Adjustment Setup.

EQUIPMENT:

Oscilloscope	HP MODEL 1740A
1 : 1 Probe (2 ea)	HP MODEL 10007B
Extender Board	HP P/N 04145-66521

PROCEDURE:

1. Extend the A3 SMU Control and A-D Converter Board with the extender board (HP P/N : 04145-26521).
2. Set A3S1 (SW1) to 1001011. See Figure 5-10 for the location of A3S1.
3. Verify that A3W2 through A3W6 are set to N (Normal Mode).
4. Connect the channel A or B input to A3TP19 and the EXT TRIGGER input to A3TP20 (see Figure 5-10 for the locations). Obtain channel A or B input GND (ground) from A3TP3.

CAUTION

BE CAREFUL NOT TO TOUCH THE GND CLIP TO A3TP2 and A3TP4. ±15 VOLTS IS PRESENT AT THE TEST POINTS.

5. Set the 1740A's controls as follows :

VOLT/DIV	0.005
COUPLING	AC
TIME/DIV	0.1msec
TRIGGER	EXT
SWEEP MODE	NORM
MAGx5	ON

6. Disconnect the test fixture and cables from the 4145B, then turn on the 4145B and the 1740A.
7. Adjust A3R30 (see Figure 5-10 for the location) until the height of the pulse at A3TP19 is minimized (less than 0.5mV) as shown in Figure 5-9.

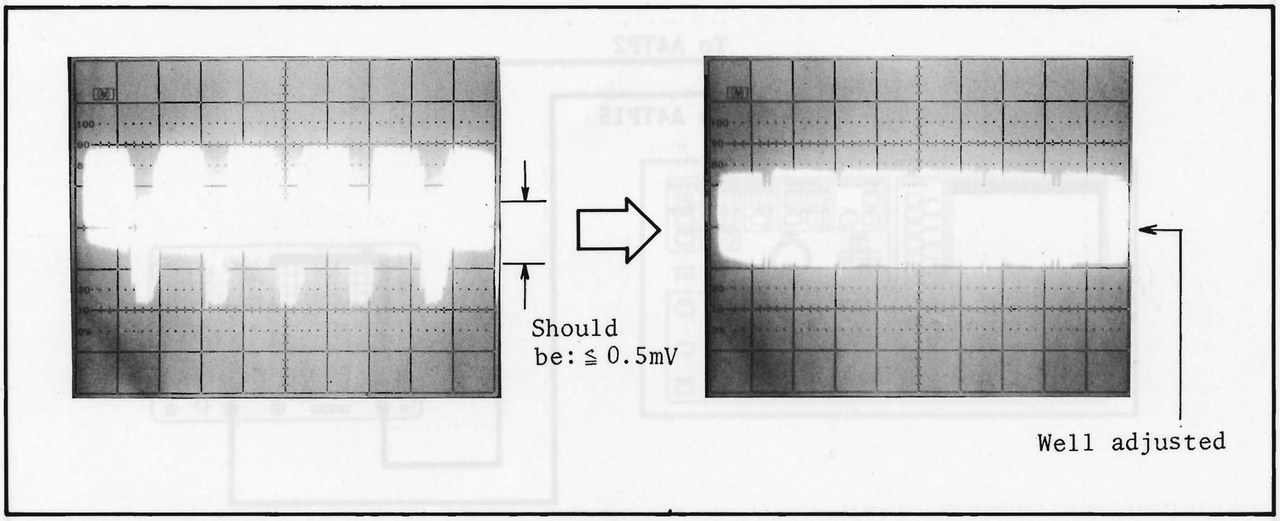


Figure 5-9. AC Offset Adjustment.

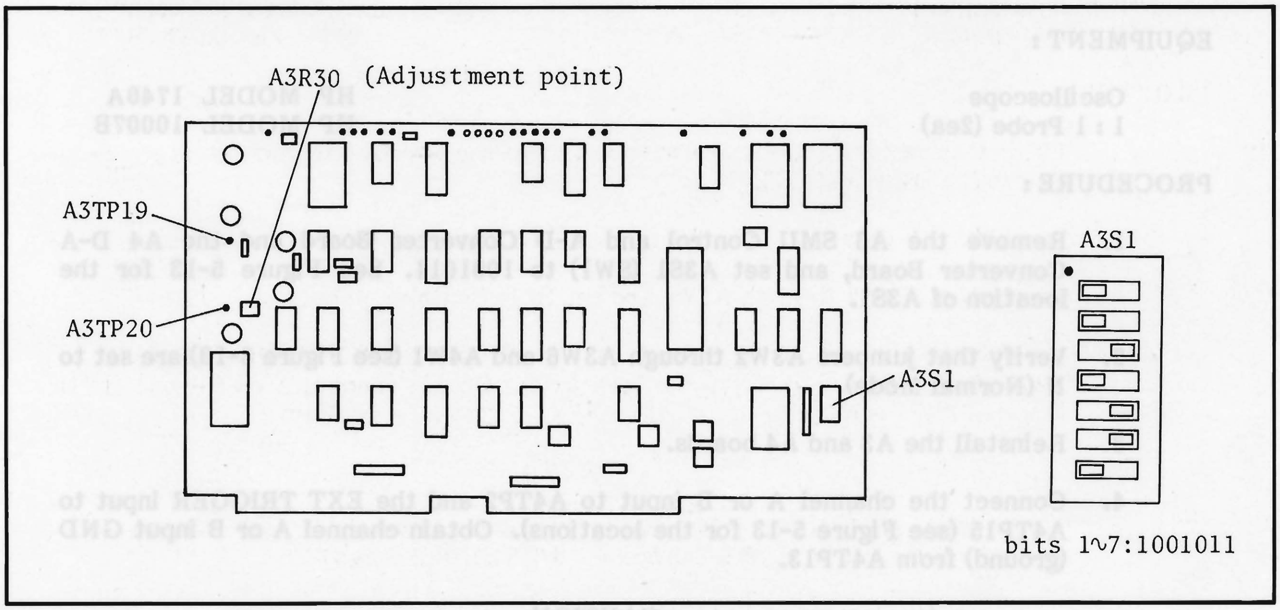


Figure 5-10. Check/Adjustment Point Locations.

5-26. DEMULTIPLEXER NOISE REJECTION ADJUSTMENT

PURPOSE: This adjustment eliminates AC offset generated by the demultiplexer (Sample Hold Switch) on the A4 board.

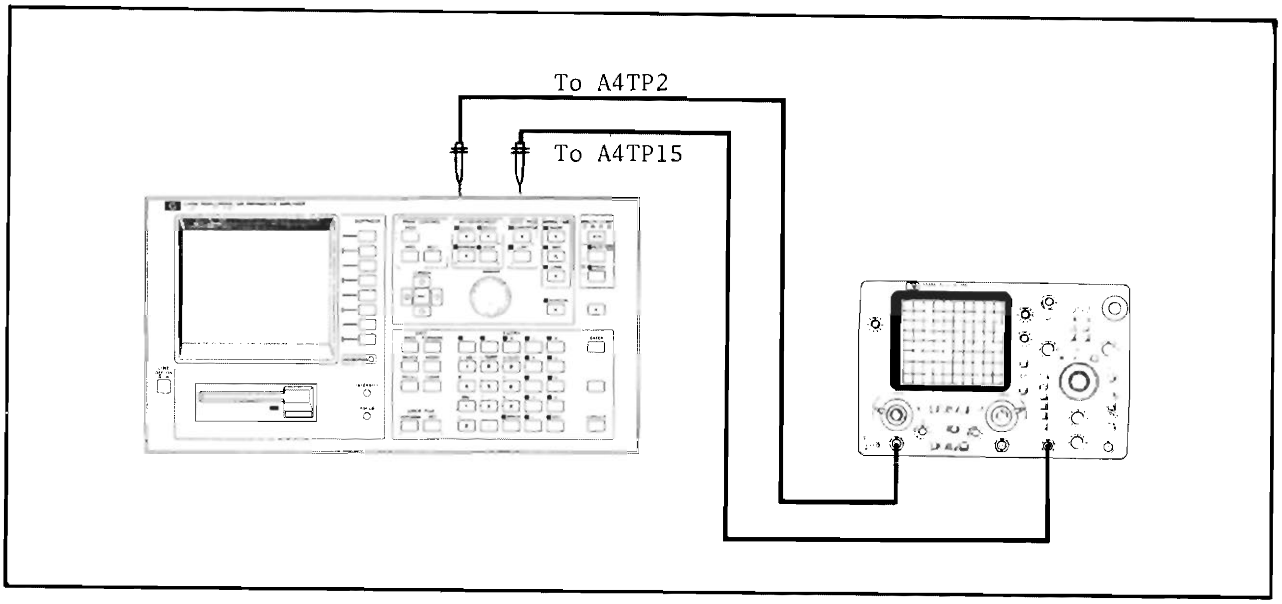


Figure 5-11. Demultiplexer Noise Rejection Adjustment Setup.

EQUIPMENT:

Oscilloscope	HP MODEL 1740A
1 : 1 Probe (2ea)	HP MODEL 10007B

PROCEDURE:

1. Remove the A3 SMU Control and A-D Converter Board and the A4 D-A Converter Board, and set A3S1 (SW1) to 1001011. See Figure 5-13 for the location of A3S1.

2. Verify that jumpers A3W2 through A3W6 and A4W1 (see Figure 5-13) are set to N (Normal Mode).

3. Reinstall the A3 and A4 boards.

4. Connect the channel A or B input to A4TP2 and the EXT TRIGGER input to A4TP15 (see Figure 5-13 for the locations). Obtain channel A or B input GND (ground) from A4TP13.

CAUTION

BE CAREFUL WHEN CONNECTING THE GND CLIP. ±15 VOLTS IS PRESENT AT A4TP12 AND A4TP14.

ADJUSTMENTS

5. Set the 1740A's controls as follows :

VOLT/DIV	0.005
COUPLING	AC
TIME/DIV	0.2msec
TRIGGER	EXT
SWEEP MODE	NORM
MAGx5	ON

6. Disconnect the test fixture and cables from the 4145B, then turn on the 4145B and 1740A.

7. Adjust A4C1 until the height of the pulse at A4TP2 is minimized (less than 0.5mV) as shown in Figure 5-14.

8. Perform step 7 for each test point/trimmer capacitor combination listed in Table 5-4.

Table 5-4. Test Point/Trimmer Capacitor Combinations

Test Point/Trimmer Capacitor Combinations	
Test Point	Trimmer Adjusted
A4TP3	A4C2
A4TP4	A4C3
A4TP5	A4C4
A4TP6	A4C5
A4TP7	A4C6
A4TP8	A4C7
A4TP9	A4C8
A4TP10	A4C9
A4TP11	A4C10

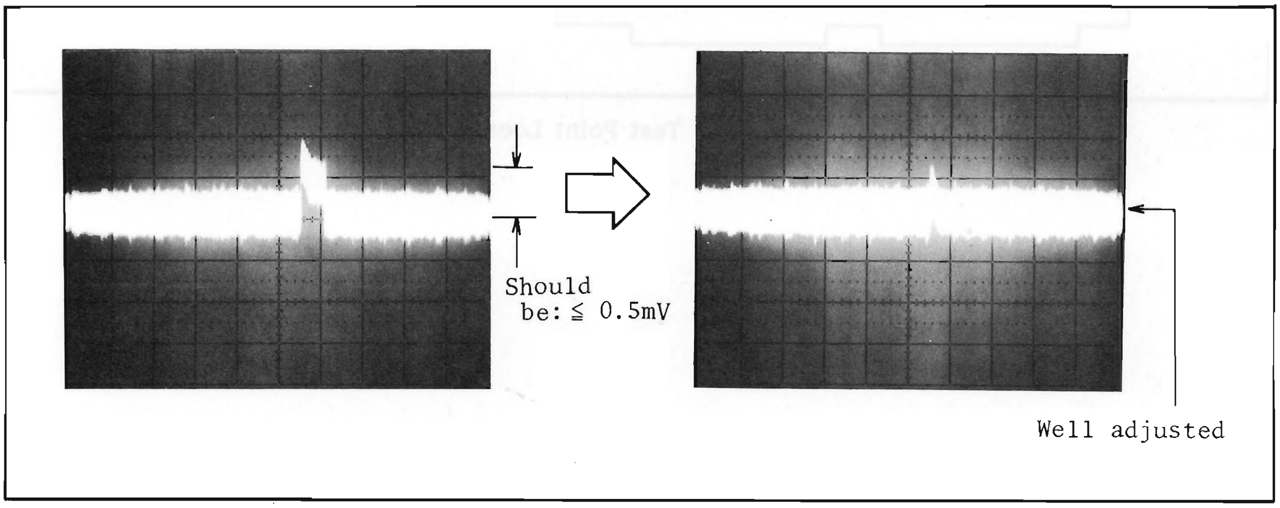


Figure 5-12. Scope Display for Adjustment.

ADJUSTMENTS

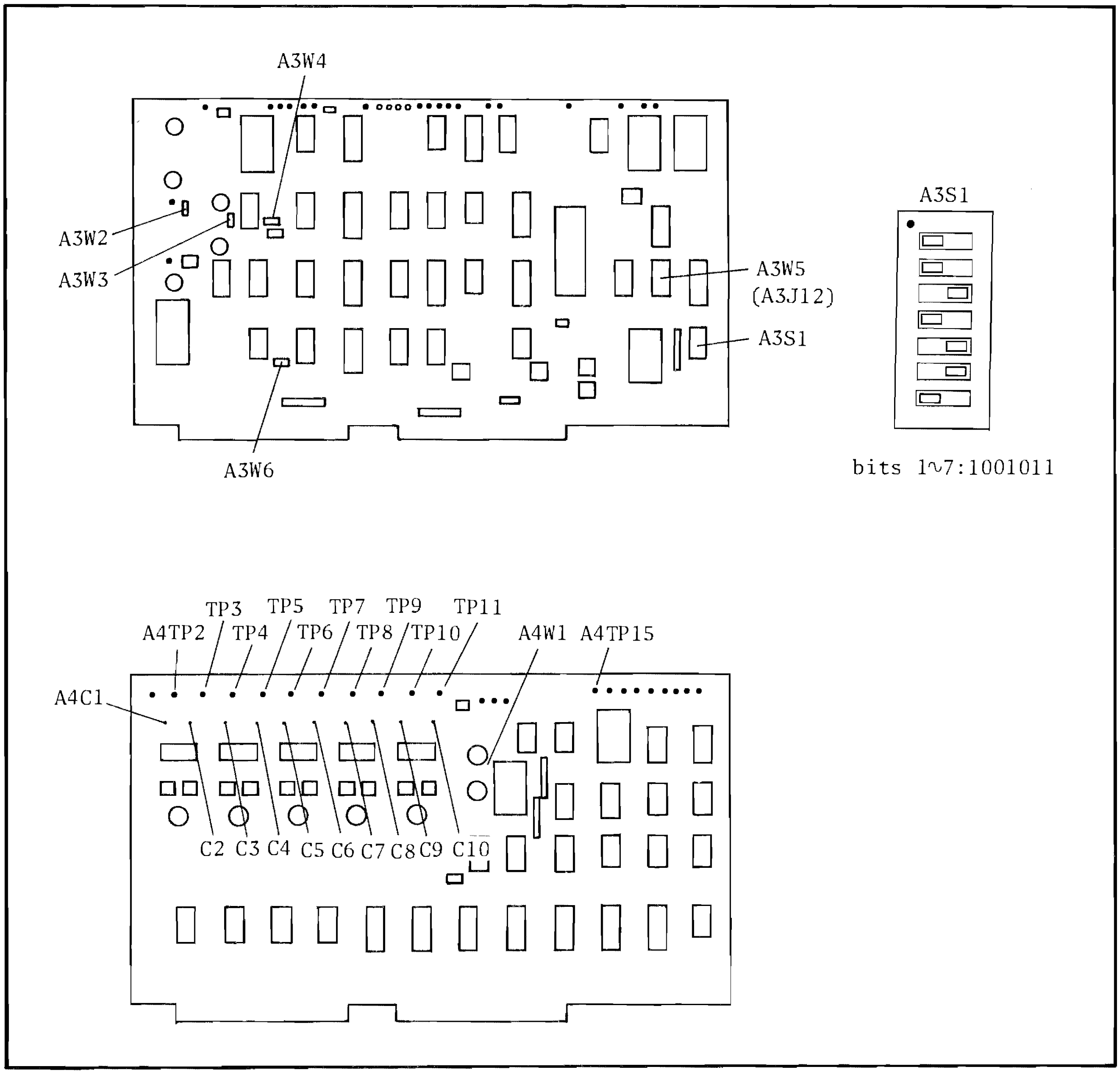


Figure 5-13. Test Point Locations.

5-27. D-A CONVERTER GAIN ADJUSTMENT

PURPOSE: This adjustment accurately sets the gain of the D-A Converter for analog output.

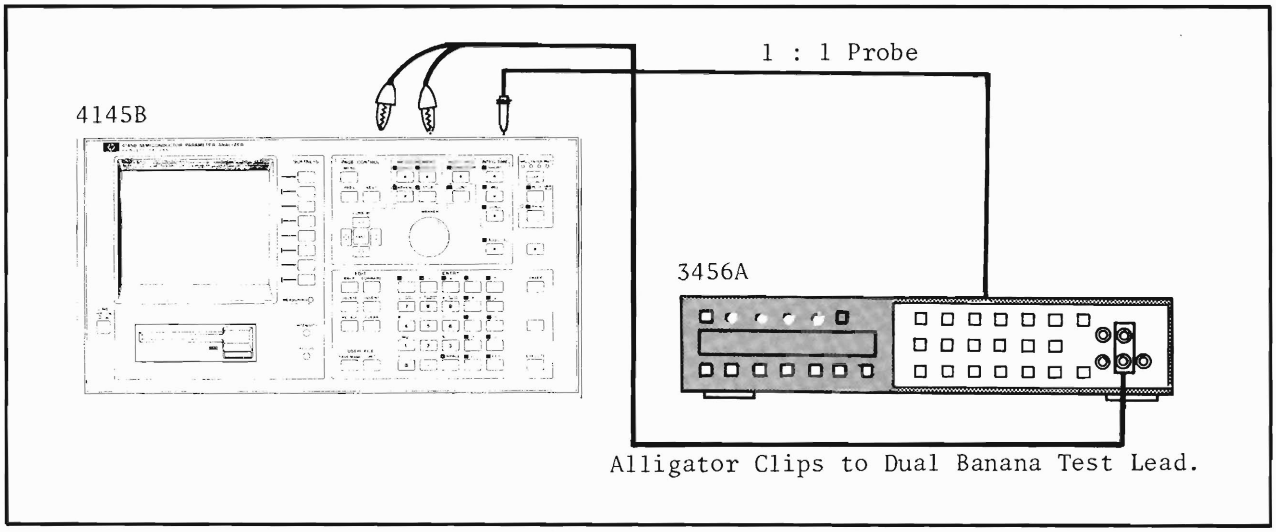


Figure 5-14. D-A Converter Gain Adjustment Setup.

EQUIPMENT:

DVM	HP MODEL 3456A*
Test Lead (alligator clips to dual banana plug)	HP MODEL 11002A
1 : 1 Probe	HP MODEL 10007B

* The 3456A must be calibrated before this adjustment.

PROCEDURE:

1. Remove the A3 SMU Control and A-D Converter Board and A4 D-A Converter Board, and set A3S1 (SW1) to 1001100. See Figure 5-15 for the location of A3S1.

2. Verify that jumpers A3W2 through A3W6 and A4W1 (see Figure 5-15 for the locations) are set to N (Normal Mode).

3. Reinstall the A3 and A4 boards.

4. Connect DVM HI input to A4TP2 (-10V), LOW input to A4TP13 (AGND : analog ground), and EXT TRIGGER input to A4TP15 (see Figure 5-15 for the locations).

CAUTION

BE CAREFUL WHEN THE LOW INPUT IS CONNECTED TO A4TP13. ±15V IS PRESENT AT A4TP12 AND A4TP14.

5. Turn on the 3456A, then set the 3456A's controls as follows :

   FUNCTION V
   RANGE .... AUTO
   TRIGGER .... EXT

6. Disconnect the test fixture and cables from the 4145B, then turn on the 4145B.

7. Adjust A4R11 (see Figure 5-15 for location) until the reading on the DVM is -10.000V±0.5mV. Use an insulated screwdriver. The voltage at A4TP2 is a staircase signal. Adjust A4R11 only at the -10V step.

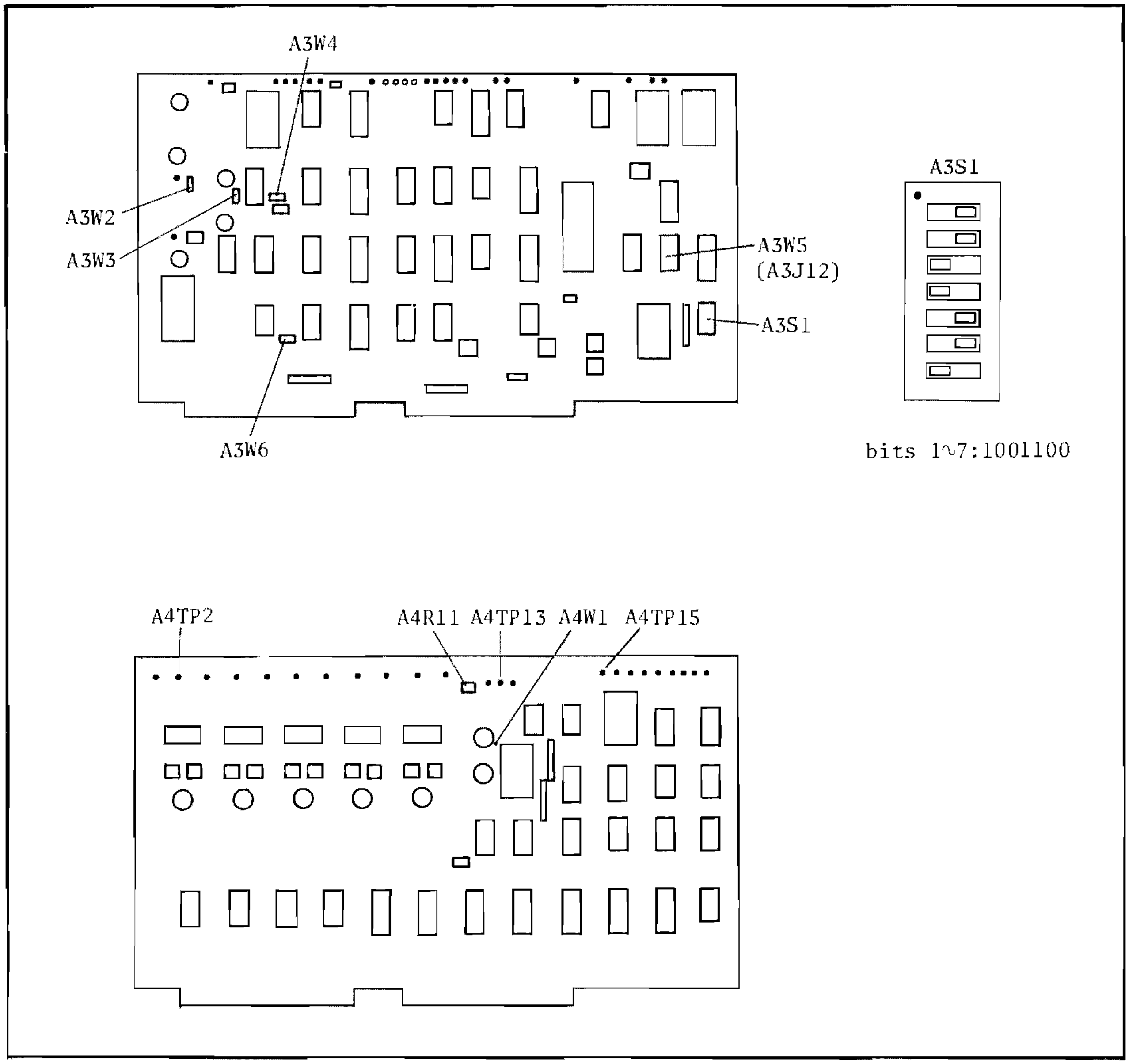


Figure 5-15. Check/Adjustment Point Locations.

5-28. A-D CONVERTER GAIN ADJUSTMENT

PURPOSE : This adjustment accurately sets the gain of the A-D converter.

1. Remove the A3 SMU Control and A-D Converter Board and the A4 D-A Converter Board, and set A3S1 (SW1) to 1001101. See Figure 5-17 for the location of A3S1.
2. Verify that jumpers A3W2 through A3W6 and A4W1 (see Figure 5-16 for the locations) are set to N (Normal Mode).
3. Reinstall the A3 and A4 boards.
4. Disconnect the test fixture and cables from the 4145B, then turn on the 4145B.
5. Adjust A3R1 (see Figure 5-17 for the location) until the LED announciator (A3DS1∿4) pattern indicates "pass" as shown in Figure 5-16.

RESULT	Announciators				Description
	DS1	DS2	DS3	DS4	
Pass	○	○	○	○	Adjustment is accurately set.
Fail	●	●	○	○	Gain is under-adjusted. Adjust A3R1 clockwise.
Fail	○	○	●	●	Gain is over-adjusted. Adjust A3R1 counterclockwise.

○ : ON (blinking) , ● : OFF

Figure 5-16. Results from LED Announciators.

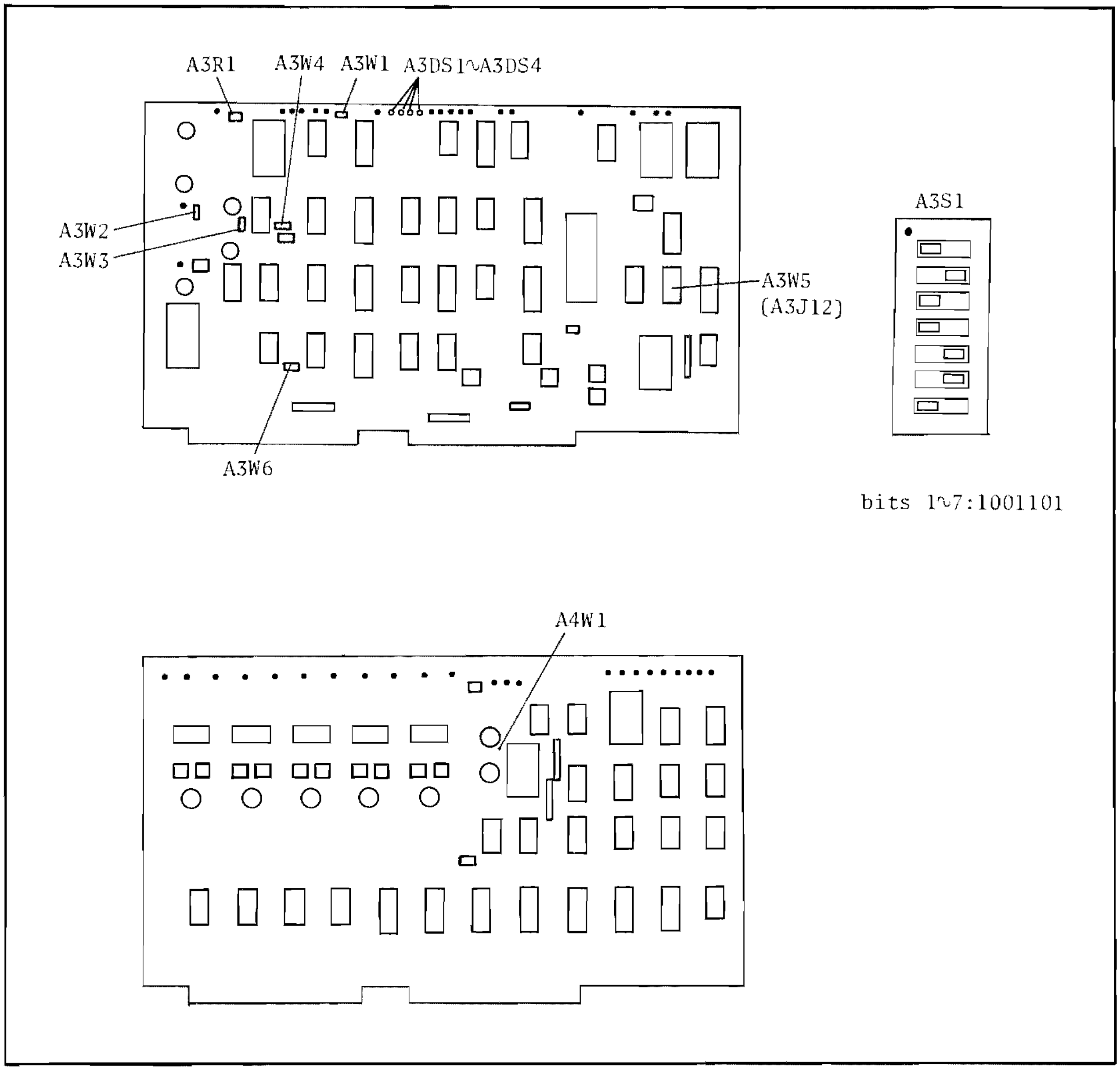


Figure 5-17. Check/Adjustment Point Locations.

5-29. VM RANGE ADJUSTMENT

PURPOSE : This adjustment accurately sets the gain of the Voltage Monitor 1 (Vm1) and Voltage Monitor 2 (Vm2).

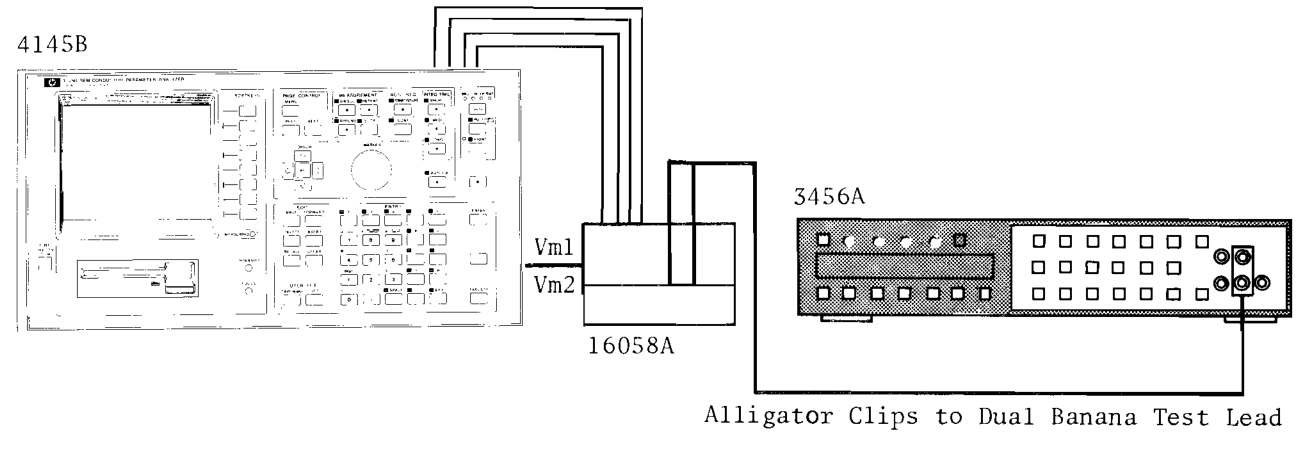


Figure 5-18. VM Range Adjustment Setup.

EQUIPMENT :

DVM	HP MODEL 3456A
Test Fixture (with cables and socket boards)	HP MODEL 16058A
TEST Lead (alligator clips to dual banana plug)	HP MODEL 10007B

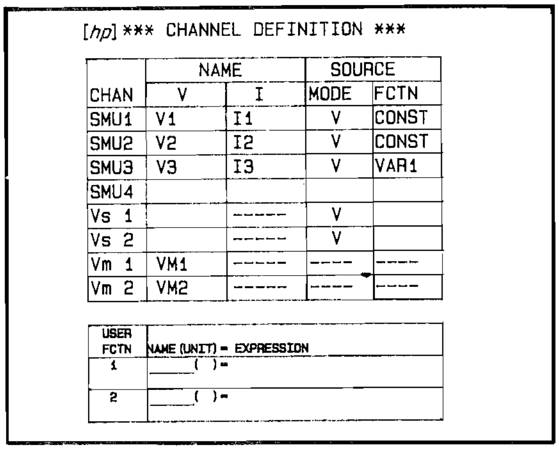
PROCEDURE :

1. Connect the 16058A and the 4145B with the triaxial cables and the system cable (furnished with the 16058A).

2. Set the 4145B's controls as follows :

   i) On the CHANNEL DEFINITION page :

   Set up the page as shown in the figure.



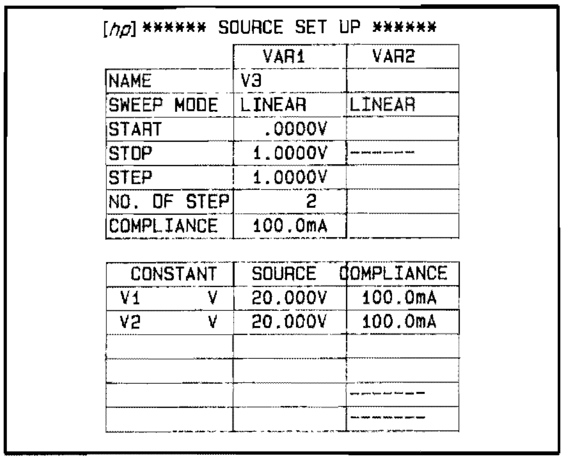
[*hp*] *** CHANNEL DEFINITION ***

	NAME		SOURCE	
CHAN	V	I	MODE	FCTN
SMU1	V1	I1	V	CONST
SMU2	V2	I2	V	CONST
SMU3	V3	I3	V	VAR1
SMU4				
Vs 1		-----	V	
Vs 2		-----	V	
Vm 1	VM1	-----	----	----
Vm 2	VM2	-----	----	----

USER FCTN	NAME (UNIT) = EXPRESSION
1	____( )=
2	____( )=

ii) On the SOURCE SET UP page and MEAS & DISP MODE SET UP page :

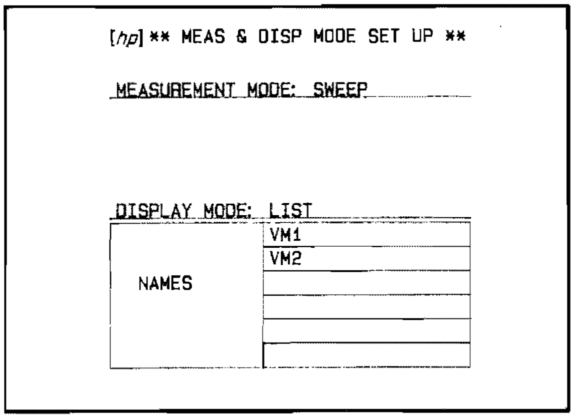
Set up the pages as shown in the figure below :



[hp] ****** SOURCE SET UP ******

	VAR1	VAR2
NAME	V3	
SWEEP MODE	LINEAR	LINEAR
START	.0000V	
STOP	1.0000V	------
STEP	1.0000V	
NO. OF STEP	2	
COMPLIANCE	100.0mA	

CONSTANT	SOURCE	COMPLIANCE
V1 V	20.000V	100.0mA
V2 V	20.000V	100.0mA



[hp] ** MEAS & DISP MODE SET UP **

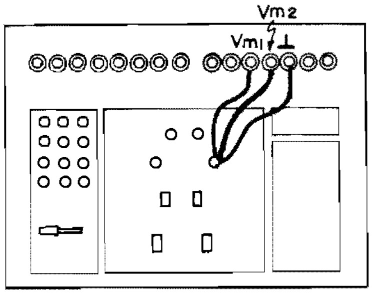
MEASUREMENT MODE: SWEEP

DISPLAY MODE: LIST

NAMES	VM1
	VM2

iii) INTEG TIME LONG

3. Connect the cables between the Personality Board and socket board as shown below. Use any of the socket boards and miniature banana-pin plug cables* (furnished with the 16058A).



4. Perform measurement by pressing the REPEAT key.

5. Record the readings on the 4145B for offset value VM1o (for Vm1) and VM2o (for Vm2).

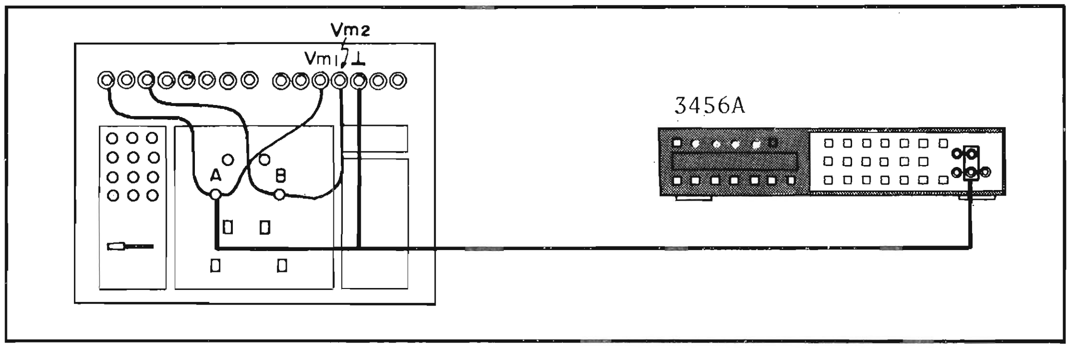
6. End measurement by pressing the STOP key.

ADJUSTMENTS

7. Turn on the 3456A, then set the 3456A's controls as follows :

   FUNCTION .... ⎓ V
   RANGE .... AUTO
   TRIGGER .... INTERNAL

8. Change the cable connection to monitor the voltage value between point A and the ground terminal with the 3456A as shown below. Then press the REPEAT key.



9. Adjust A16R4 (see Figure 5-19 for the location) for Vm1 gain until VM1 (value displayed on the 4145B) and Vdvm1 (reading on the 3456A) satisfy the following inequality. Then press the STOP key.

   VM1-5/2VM1o-10 counts ≦ Vdvm1 ≦ VM1-5/2VM1o+10 counts

10. Change the 3456A's connection to point B, then press the REPEAT key.

11. Adjust A16R104 (see Figure 5-19 for the location) for Vm2 gain until VM2 (value displayed on the 4145B) and Vdvm2 (reading on the 3456A) satisfy the following inequality. Then press the STOP key.

    VM2-5/2VM2o-10 counts ≦ Vdvm2 ≦ VM2-5/2VM2o+10 counts

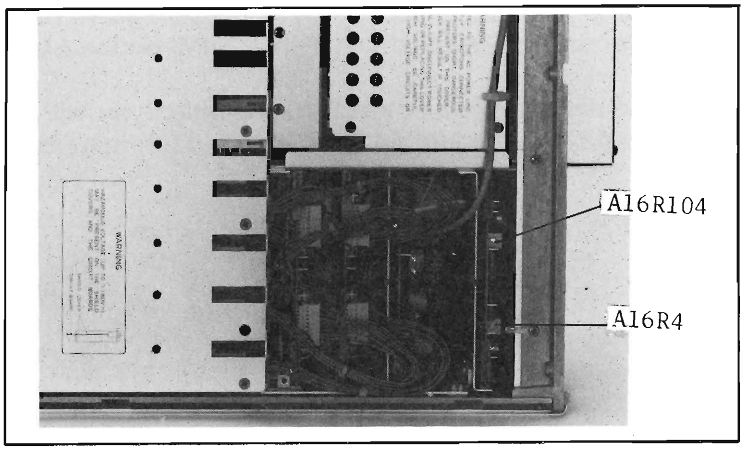


Figure 5-19. Adjustment Point Locations.

5-30. SMU CMRR ADJUSTMENT

PURPOSE: This adjustment accurately sets the Common Mode Rejection Ratio (CMRR) of the SMU.

NOTE

Perform this adjustment only when you replace A5R164, A5R165, A5R166, A5R167, or A5R168. In other cases, you do not need to perform this adjustment.

To perform this adjustment, the Vm1 (or Vm2) in your 4145B must have passed the performance test.

EQUIPMENT:

Test Lead (BNC to alligator clips)
Extender Board (HP P/N 04145-66521)
Shorting Connector (HP P/N 04145-61623)

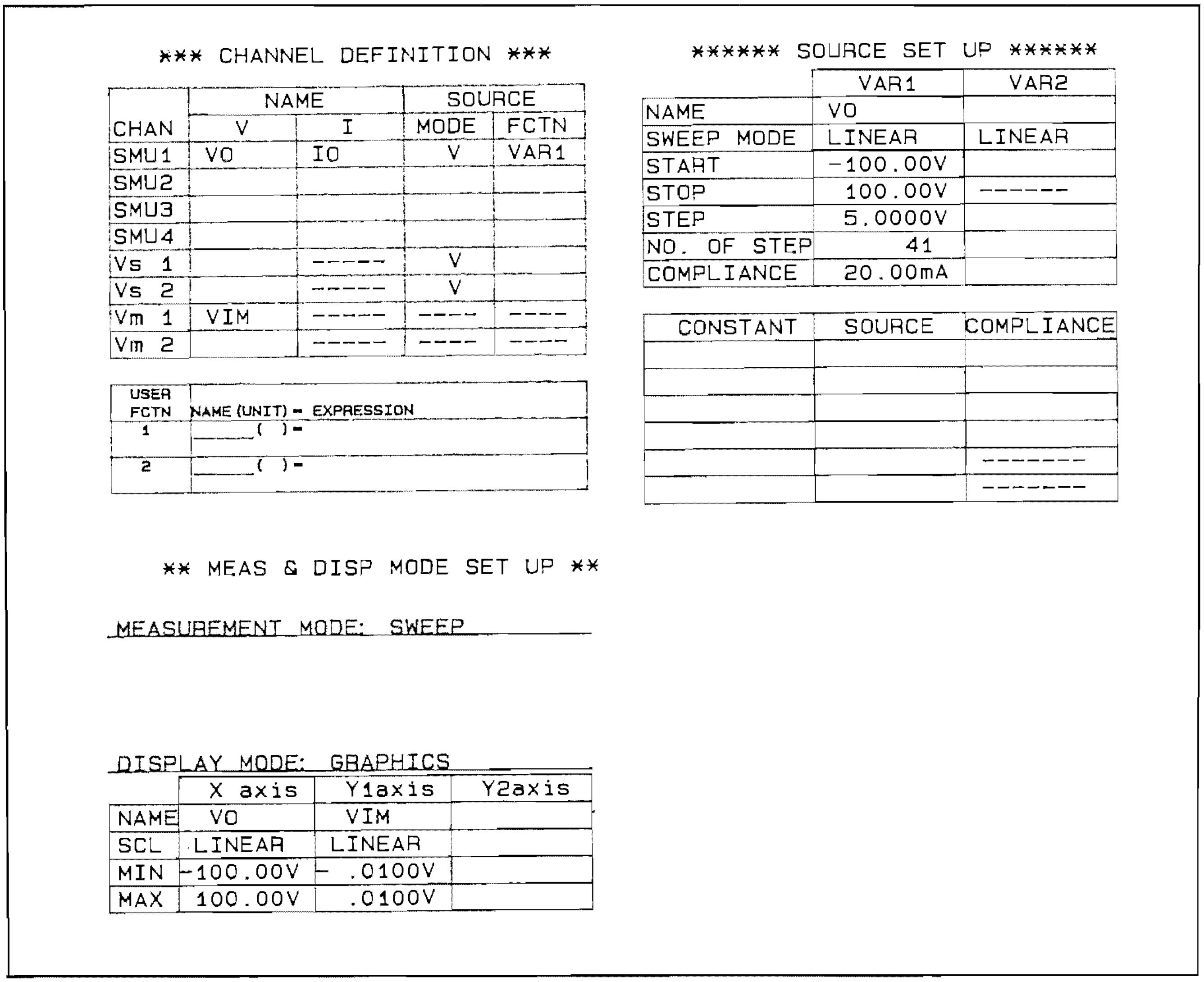
PROCEDURE:

1. Disconnect the test fixture and cables from the 4145B.
2. Connect the Shorting Connector to the 24-pin connector (labeled "TO 16058A TEST FIXTURE") on the 4145B's rear panel.
3. With the extender board, extend the SMU board on which you will perform the adjustment.
4. Connect the Vm1 on the 4145B's rear panel and the test points of the extended SMU board using the Test Lead (BNC to alligator clips) as follows:

Outer conductor of Vm1 terminal:	TP9 (COMMON) on the SMU board
Center conductor of Vm1 terminal:	TP2 (IM) on the SMU board

5. Set the measurement controls of the SMU on which you will perform the adjustment and Vm1 as shown Figure 5-20. (In Figure 5-20, the SMU being adjusted is SMU1.)

ADJUSTMENT



*** CHANNEL DEFINITION ***

	NAME		SOURCE	
CHAN	V	I	MODE	FCTN
SMU1	VO	IO	V	VAR1
SMU2				
SMU3				
SMU4				
Vs 1		-----	V	
Vs 2		-----	V	
Vm 1	VIM	-----	----	----
Vm 2		-----	----	----

USER FCTN	NAME (UNIT) = EXPRESSION
1	_____( )=
2	_____( )=

****** SOURCE SET UP ******

	VAR1	VAR2
NAME	VO	
SWEEP MODE	LINEAR	LINEAR
START	-100.00V	
STOP	100.00V	------
STEP	5.0000V	
NO. OF STEP	41	
COMPLIANCE	20.00mA	

CONSTANT	SOURCE	COMPLIANCE

** MEAS & DISP MODE SET UP **

MEASUREMENT MODE: SWEEP

DISPLAY MODE: GRAPHICS

	X axis	Y1axis	Y2axis
NAME	VO	VIM	
SCL	LINEAR	LINEAR	
MIN	-100.00V	- .0100V	
MAX	100.00V	.0100V	

Figure 5-20. Measurement Setup for SMU CMRR Adjustment

6. Set the INTEG TIME to MED.

7. Press the REPEAT key.

8. Adjust A5R167 (labeled "CMR ADJ") until the maximum value and the minimum value of VIM (TP2's voltage) for VO = -100V to VO = +100V satisfy the following expression:

   | (Maximum value of VIM) - (Minimum value of VIM) | $\leq$ 2mV

   Figure 5-21 shows an output waveform for this adjustment.

NOTE

If it is impossible to adjust within 2mV, or if VIM value at VO = 0V is not within 0V ± 7mV, the amplifier A5U4 may be defective. Replace A5U4 and readjust.

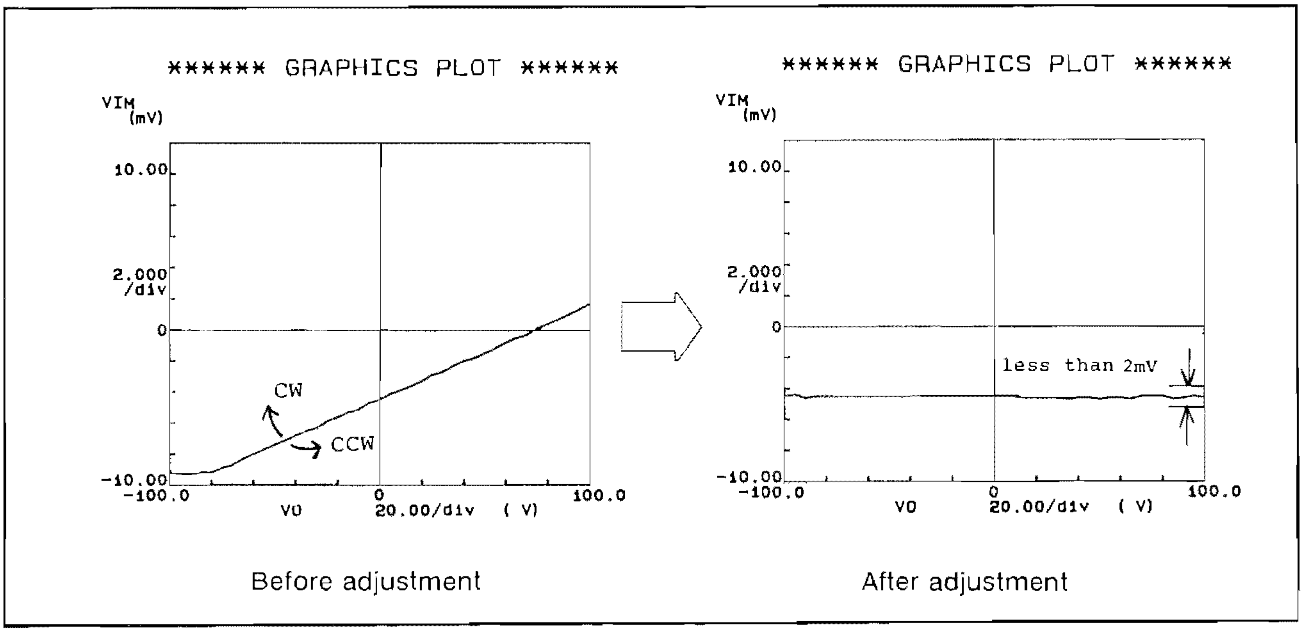


Figure 5-21. SMU CMRR Adjustment

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION

6-2. This section contains information for ordering parts. Table 6-1 lists abbreviations used in the parts list and throughout the manual. Table 6-3 lists all replaceable parts in reference designator order. Table 6-2 contains the names and addresses that correspond to the manufacturer's code numbers.

6-3. ABBREVIATIONS

6-4. Table 6-1 lists abbreviations used in parts list, schematics and throughout the manual. In some cases, two forms of abbreviations are used, one in all capital letters, and one in partial capitals or no capitals. This occurs because the abbreviations in parts list are always all capitals. However, in the schematic and in other parts of the manual, other abbreviation forms with both lower case and upper case letters are used.

6-5. REPLACEABLE PARTS LIST

6-6. Table 6-3 is a list of replaceable parts and is organized as follows :

a. Electrical assemblies and their components in alphanumerical order by reference designation.
b. Chassis-mounted parts in alphanumerical order by reference disignation.
c. Miscellaneous parts.
d. Illustrated parts breakdowns, if appropriate.

The information for each part includes :

a. The Hewlett-Packard part number.
b. The total quantity (Qty) in the instrument.
c. A description of the part.
d. A typical manufacturer of the part in a five-digit code.
e. The manufacturer's number for the part.

Table 6-1. List of Reference Designators and Abbreviations

REFERENCE DESIGNATORS

A = assembly
B = motor
BT = battery
C = capacitor
CP = coupler
CR = diode
DL = delay line
DS = device signaling (lamp)

E = misc electronic part
F = fuse
FL = filter
J = jack
K = relay
L = inductor
M = meter
MP = mechanical part

P = plug
Q = transistor
R = resistor
RT = thermistor
S = switch
T = transformer
TB = terminal board
TP = test point

U = integrated circuit
V = vacuum, tube, neon bulb, photocell, etc.
VR = voltage regulator
W = cable
X = socket
Y = crystal

ABBREVIATIONS

A = amperes
A. F. C. = automatic frequency control
AMPL = amplifier

B. F. O. = beat frequency oscillator
BE CU = beryllium copper
BH = binder head
BP = bandpass
BRS = brass
BWO = backward wave oscillator

CCW = counter-clockwise
CER = ceramic
CMO = cabinet mount only
COEF = coefficient
COM = common
COMP = composition
COMPL = complete
CONN = connector
CP = cadmium plate
CRT = cathode-ray tube
CW = clockwise

DEPC = deposited carbon
DR = drive

ELECT = electrolytic
ENCAP = encapsulated
EXT = external

F = farads
f = femto = 10^{-15}
FH = flat head
FIL H = fillister head
FXD = fixed

G = giga = 10^{9}
GE = germanium
GL = glass
GRD = ground(ed)

H = henries
HEX = hexagonal
HG = mercury
HR = hour(s)
Hz = hertz

IF = intermediate freq.
IMPG = impregnated
INCD = incandescent
INCL = include(s)
INS = insulation(ed)
INT = internal

k = kilo = 1000

LH = left hand
LIN = linear taper
LK WASH = lock washer
LOG = logarithmic taper
LPF = low pass filter

m = milli = 10^{-3}
M = meg = 10^{6}
MET FLM = metal film
MET OX = metallic oxide
MFR = manufacturer
MINAT = miniature
MOM = momentary
MTG = mounting
MY = "mylar"

n = nano = 10^{-9}
N/C = normally closed
NE = neon
NI PL = nickel plate
N/O = normally open
NPO = negative positive zero (zero temperature coefficient)

NPN = negative-positive-negative
NRFR = not recommended for field replacement
NSR = not separately replaceable

OBD = order by description
OH = oval head
OX = oxide

P = peak
PC = printed circuit
p = pico = 10^{-12}
PH BRZ = phosphor bronze
PHL = Phillips
PIV = peak inverse voltage
PNP = positive-negative-positive
P/O = part of
POLY = polystyrene
PORC = porcelain
POS = position(s)
POT = potentiometer
PP = peak-to-peak
PT = point
PWV = peak working voltage

RECT = rectifier
RF = radio frequency
RH = round head or right hand
RMO = rack mount only
RMS = root-mean square

RWV = reverse working voltage

S-B = slow-blow
SCR = screw
SE = selenium
SECT = section(s)
SEMICON = semiconductor
SI = silicon
SIL = silver
SL = slide
SPG = spring
SPL = special
SST = stainless steel
SR = split ring
STL = steel

TA = tantalum
TD = time delay
TGL = toggle
THD = thread
TI = titanium
TOL = tolerance
TRIM = trimmer
TWT = traveling wave tube

μ = micro = 10^{-6}

VAR = variable
VDCW = dc working volts

W/ = with
W = watts
WIV = working inverse voltage
WW = wirewound
W/O = without

The total quantity for each part is given only once — at the first appearance of the part number in the list.

6-7. ORDERING INFORMATION

6-8. To order a part listed in the replaceable parts table, give the Hewlett-Packard part number, indicate the quantity required, and address the order to the nearest Hewlett-Packard office.

6-9. To order a part that is not listed in the replaceable parts table, state the full instrument model and serial number, and description and function of the part, and the number of parts required. Address your order to the nearest Hewlett-Packard office.

6-10. DIRECT MAIL ORDER SYSTEM

6-11. Within the USA, Hewlett-Packard can supply parts through a direct mail order system. Advantages of using the system are :

a. Direct ordering and shipment from the HP Parts Center in Mountain View, California.

b. No maximum or minimum on any mail order (there is a minimum order amount for parts ordered through a local HP Office when the orders require billing and invoicing).

c. Prepaid transportation (there is a small handling charge for each order).

d. No invoices — to provide these advantages, a check or money order must accompany each order.

6-14. Mail order forms and specific ordering information are available through your local HP Office. Addresses and phone numbers are located at the back of this manual.

Table 6-2. Manufacturers Code Lists

MFR NO.	MANUFACTURER NAME	ADDRESS	ZIP CODE
S0167	FUJITSU LTD	TOKYO JP	
S0545	NIPPON ELECTRIC CO	TOKYO JP	
00000	ANY SATISFACTORY SUPPLIER		
01121	ALLEN-BRADLEY CO	MILWAUKEE WI	53204
01295	TEXAS INSTR INC SEMICOND CMPNT DIV	DALLAS TX	75222
02114	FERROXCUBE CORP	SAUGERTIES NY	12477
04713	MOTOROLA SEMICONDUCTOR PRODUCTS	PHOENIX AZ	85008
06383	PANDUIT CORP	TINLEY PARK IL	60477
06665	PRECISION MONOLITHICS INC	SANTA CLARA CA	95050
07263	FAIRCHILD SEMICONDUCTOR DIV	MOUNTAIN VIEW CA	94042
12969	UNITRODE CORP	WATERTOWN MA	02172
14099	SEMTECH CORP	NEWBURY PARK CA	91320
14936	GENERAL INSTR CORP SEMICON PROD GP	HICKSVILLE NY	11802
17856	SILICONIX INC	SANTA CLARA CA	95054
19701	MEPCO/ELECTRA CORP	MINERAL WELLS TX	76067
24355	ANALOG DEVICES INC	NORWOOD MA	02062
24546	CORNING GLASS WORKS (BRADFORD)	BRADFORD PA	16701
27014	NATIONAL SEMICONDUCTOR CORP	SANTA CLARA CA	95051
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO CA	94304
3L585	RCA CORP SOLID STATE DIV	SOMERVILLE NJ	
34649	INTEL CORP	MOUNTAIN VIEW CA	95051
52763	STETTNER-TRUSH INC	CAZENOVIA NY	13035
56289	SPRAGUE ELECTRIC CO	NORTH ADAMS MA	01247
72136	ELECTRO MOTIVE CORP	FLORENCE SC	06226
75042	TRW INC PHILADELPHIA DIV	PHILADELPHIA PA	19108
75915	LITTELFUSE INC	DES PLAINES IL	60016
8E175	BURR BROWN CO	TUCSON AZ	35801
91637	DALE ELECTRONICS INC	COLUMBUS NE	68601
98291	SEALECTRO CORP	MAMARONECK NY	10544

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1	04145-66551	2	1	GRAPHICS DISPLAY CONTROL BOARD ASS'Y	28480	04145-66551
A1C1	0180-2205	3	1	CAPACITOR-FXD .33UF+-10% 35VDC TA	56289	150D334X9035A2
A1C2	0160-4832	4	17	CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A1C3	0160-4835	7	181	CAPACITOR-FXD .1UF +-10% 50VDC CER	28480	0160-4835
A1C4	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A1C5	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A1C6	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A1C7	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A1C8	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A1C9	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A1C10	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A1C11	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A1C12	0140-0196	3	5	CAPACITOR-FXD 150PF +-5% 300VDC MICA	72136	DM15F151J0300WV1CR
A1C13	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A1C14	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A1C15	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A1C16	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A1C17	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A1C18	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A1C19	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A1C20	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A1C21	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A1C22	0180-0228	6	4	CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X901582
A1C23	0160-6561	7		CAPACITOR-FXD. 1UF +-20% 50VDC CER	28480	0160-6561
A1C24	0180-0197	7		CAPACITOR-FXD 2.2F+-10% 20VDC TA	28480	0160-4835
A1DS1	1990-0486	6	10	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4684
A1J1	1251-4822	6	20	CONNECTOR 3-PIN M POST TYPE	28480	1251-4822
A1J2	1251-4822	6		CONNECTOR 3-PIN M POST TYPE	28480	1251-4822
A1J3	1251-4822	6		CONNECTOR 3-PIN M POST TYPE	28480	1251-4822
A1J4	1251-4822	6		CONNECTOR 3-PIN M POST TYPE	28480	1251-4822
A1J5	1251-4822	6		CONNECTOR 3-PIN M POST TYPE	28480	1251-4822
A1L1	9100-3139	5	9	INDUCTOR 75UH 15% .5DX.875LG	28480	9100-3139
A1L2	9100-1788	6	4	CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/48
A1R1	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1R2	0757-0467	8		RESISTOR 121K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1213-F
A1R3	0757-0444	1		RESISTOR 12.1K .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A1R4	0757-0199	3		RESISTOR 21.5K .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A1R5	0757-0417			RESISTOR 432 1% .125W TF TC=0+-100	24546	C4-1/8-T0-432R-F
A1R6	0698-3455	4	1	RESISTOR 261K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2613-F
A1R7	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1R8	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1R9	0757-0402	1		RESISTOR 110 1% .125W F TC=0+-100	24546	C4-1/8-T0-111-F
A1R10	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A1R11	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A1R12	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1R13	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A1R14	0757-0442	9		RESISTOR 10K 1% .125W F TC=+-100	24546	C4-1/8-T0-1002-F
A1U1	1826-0180	0	1	IC TIMER TTL MONO/ASTBL	01295	NE555P
A1U2	1820-1423	4	1	IC MV TTL LS MONOSTBL RETRIG DUAL	01295	SN74LS123N
A1U3	1820-1197	9	7	IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A1U4	1820-0511	9	1	IC GATE TTL AND QUAD 2-INP	01295	SN7408N
A1U5	1820-1194	6	8	IC CNTR TTL LS BIN UP/DOWN SYNCHRO	01295	SN74LS193N
A1U6	1820-1194	6		IC CNTR TTL LS BIN UP/DOWN SYNCHRO	01295	SN74LS193N
A1U7	1820-1194	6		IC CNTR TTL LS BIN UP/DOWN SYNCHRO	01295	SN74LS193N
A1U8	1820-1194	6		IC CNTR TTL LS BIN UP/DOWN SYNCHRO	01295	SN74LS193N
A1U9	1820-1430	3	4	IC CNTR TTL LS BIN SYNCHRO POS-EDGE-TRIG	01295	SN74LS161AN
A1U10	1820-1112	8	13	IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A1U11	1820-1208	3	5	IC GATE TTL LS OR QUAD 2-INP	01295	SN74LS32N
A1U12	1820-1416	5	2	IC SCHMITT-TRIG TTL LS INV HEX 1-INP	01295	SN74LS14N
A1U13	1820-1470	1	4	IC MUXR/DATA-SEL TTL LS 2-TO-1-LINE QUAD	01295	SN74LS157N
A1U14	1820-1470	1		IC MUXR/DATA-SEL TTL LS 2-TO-1-LINE QUAD	01295	SN74LS157N
A1U15	1820-1470	1		IC MUXR/DATA-SEL TTL LS 2-TO-1-LINE QUAD	01295	SN74LS157N
A1U16	1820-1470	1		IC MUXR/DATA-SEL TTL LS 2-TO-1-LINE QUAD	01295	SN74LS157N
A1U17	1820-1196	8	4	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174N
A1U18	1820-1997			IC FF TTL LS D-TYPE POS-EDGE-TRIG PRL-IN	01295	SN74LS374N
A1U19	1820-1997	7	7	IC FF TTL LS D-TYPE POS-EDGE-TRIG PRL-IN	01295	SN74LS374N
A1U20	1820-2024	3		IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1U21	1820-2024	3		IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
A1U22	1820-1433	6	1	IC SHF-RGTR TTL LS R-S SERIAL-IN PRL-OUT	01295	SN74LS164N
A1U23	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A1U24	1820-1411	0	1	IC LCH TTL LS D-TYPE 4-BIT	01295	SN74LS75N
A1U25	1820-1194	6		IC CNTR TTL LS BIN UP/DOWN SYNCHRO	01295	SN74LS193N
A1U26	1820-1194	6		IC CNTR TTL LS BIN UP/DOWN SYNCHRO	01295	SN74LS193N
A1U27	1820-1194	6		IC CNTR TTL LS BIN UP/DOWN SYNCHRO	01295	SN74LS193N
A1U28	1820-1194	6		IC CNTR TTL LS BIN UP/DOWN SYNCHRO	01295	SN 74S193N
A1U29	1820-1730	6		IC FF TTL LA D-TYPE POS-EDGE-GRIG COM	01295	SN74LS273N
A1U30	1818-3198	9		IC CMOS 65536 (64K) STAT RAM 120-NS 3-S		
A1U31	1818-3198	9		IC CMOS 65536 (64K) STAT RAM 120-NS 3-S		
A1U33	1820-1216	3	5	IC DCDR TTL LS 3-TO-8-LINE 3-INP		
A1U34	1820-1216	3	5	IC DCDR TTL LS 3-TO-8-LINE 3-INP		
A1U35	1820-0174	0	1	IC INV TTL HEX	01295	SN7404N
A1U36	1820-2024	3		IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
A1U37	1820-2024	3		IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
A1U38	1820-2024	3		IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
A1U39	1820-2024	3		IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
A1U40	1820-2024	3		IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
A1U41	1820-2024	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG PRL-IN	01295	SN74LS374N
A1U42	1820-1997	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG PRL-IN	01295	SN74LS374N
A1U43	1820-1997	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG PRL-IN	01295	SN74LS374N
A1U44	1820-1997	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG PRL-IN	01295	SN74LS374N
A1U45	1820-1997					
A1W1	1258-0141	8	24	JUMPER-REM	28480	1258-0141
A1W2	1258-0141	8		JUMPER-REM	28480	1258-0141
A1W3	1258-0141	8		JUMPER-REM	28480	1258-0141
A1W4	1258-0141	8		JUMPER-REM	28480	1258-0141
A1W5	1258-0141	8		JUMPER-REM	28480	1258-0141
A1Y1	1813-0463	5		KXO-01 20.0MHZ	28480	1813-0463
A2	04145-66562	3	1	MICROPROCESSOR DIGITAL CONTROL BOARD ASS'Y	28480	04145-66562
A2C1	0160-6561	7		CAPACITOR-FXD .1UF+-20% 50VDC CER	28480	0160-6561
A2C2	0160-6561	7		CAPACITOR-FXD .1UF+-20% 50VDC CER	28480	0160-6561
A2C3	0160-6561	7		CAPACITOR-FXD .1UF+-20% 50VDC CER	28480	0160-6561
A2C4	0160-6561	7		CAPACITOR-FXD .1UF+-20% 50VDC CER	28480	0160-6561
A2C5	0160-6561	7		CAPACITOR-FXD .1UF+-20% 50VDC CER	28480	0160-6561
A2C6	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A2C7	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A2C10	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A2C11	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A2C12	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A2C13	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
		7				
A2C15	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A2C16	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A2C17	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A2C18	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A2C19	0160-2200	6		CAPACITOR-FXD 43PF +-5% 300VDC MICA	28480	0160-2200
A2C20	0140-0196	7		CAPACITOR-FXD 150PF +-5% 300VDC MICA	72136	DM15F151J0300WV1CR
A2C21	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A2C22	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A2C23	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A2C24	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A2C25	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A2C26	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A2C27	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A2C28	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-2200
A2C29	0160-2203	9		CAPACITOR-FXD 91PF +-5% 300VDC MICA 0+70	28480	0160-2203
A2C30	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A2C31	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A2C32	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A2C33	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A2C34	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A2C35	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A2C36	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A2C37	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A2C38	0180-0229	7		CAPACITRO-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A2C39	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2C40	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A2C41	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A2C42	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A2C43	0180-0229	3		CAPACITOR-FXD 150PF +-5% 300VDC MICA	72136	DM15F151J0300WV1CR
A2C44	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A2DS1	1990-0685	7		LED-LAMP LUM-INT=200UCD		
A2DS2	1990-0685	7		LED-LAMP LUM-INT=200UCD		
A2DS3	1990-0685	7		LED-LAMP LUM-INT=200UCD		
A2J3	1200-0567	1		SOCKET-IC 28-CONT DIP DIP-SLDR	28480	1200-0567
A2J5	1200-0607	1		SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0607
A2J6	1200-0607	1		SOCKET-IC 16-CONT DIP DIP-SLDR	24840	1200-0607
		1				
A2J7	1251-4822	1		CONNECTOR 3-PIN M POST TYPE	28480	1251-4822
A2J8	1251-4822	1		CONNECTOR 3-PIN M POST TYPE	28480	1251-4822
A2L1	9100-1788	6		CHOKE WIDE BAND ZMAX-600 OHM@ 100MHZ	02114	VK200 20/40
A2L2	9100-3139	5		INDUCOTR 75UH 15% .5DX.875LG	28480	9100-3139
A2R1	0757-0442	9		RESISTOR 10K 1% .125W F TC =0+-100	24546	C4-1/8-T0-1002-F
A2R2	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R3	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R4	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R5	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R6	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R7	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R8	0698-3438	3		RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/B-T0-147-F
A2R9	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R10	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R11	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R12	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R13	0757-0442	9		RESISTOR 10L 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R14	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R15	0757-0465	6	1	RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2RA1 (R16)	1810-0269	3		NETWORK-RES 9-SIP10.0K OHM X 8	28480	1810-0269
A2RA2 (R17)	1810-0269	3		NETWORK-RES 9-SIP10.0K OHM X 8	28480	1818-0269
A2RA3 (R18)	1810-0269	3		NETWORK-RES 9-SIP10.0K OHM X 8	28480	1818-0269
A2S1	3101-1973	7	3	SWITCH-SL 7-1A DIP-SLIDE-ASSY .1A 50VDC	28480	3101-1973
A2U1	1818-3198	9		IC CMOS 65536 (64K) STAT RAM 120-NS 3-5		
A2U2	1818-3198	9		IC CMOS 65536 (64K) STAT RAM 120-NS 3-5		
A2U3	1818-3198	9		IC CMOS 65536 (64K) STAT RAM 120-NS 3-5		
A2U4	1818-3198	9		IC CMOS 65536 (64K) STAT RAM 120-NS 3-5		
A2U5	1818-3198	9		IC CMOS 65536 (64K) STAT RAM 120-NS 3-5		
A2U6	04145-85203	9		EP ROM		
A2U7	1818-3198	9		IC CMOS 65536 (64K) STAT RAM 120-NS 3-5		
A2U8	1818-3198	9		IC CMOS 65536 (64K) STAT RAM 120-NS 3-5		
A2U9	1818-3198	9		IC CMOS 65536 (64K) STAT RAM 120-NS 3-5		
A2U10	1818-3198	9		IC CMOS 65536 (64K) STAT RAM 120-NS 3-5		
A2U11	1818-3198	9		IC CMOS 65536 (64K) STAT RAM 120-NS 3-5		
A2U14	1820-1196	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174N
A2U15	1820-1196	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174N

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2U17	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A2U18	1820-1216	3	5	IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A2U19	1820-2075	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP		
A2U20	1820-1425	6	2	IC SCHMITT-TRIG TTL LS NAND QUAD 2-INP	01295	SN74LS132N
A2U21	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A2U22	1820-1991	1	3	IC CNTR TTL LS DECD DUAL 4-BIT	01295	SN74LS390N
A2U23	1820-1991	1	3	IC CNTR TTL LS DECD DUAL 4-BIT	01295	SN74LS390N
A2U24	1820-1199	1		IC INV TTL LS HEX 1-TNP	01295	SN74LS04N
A2U25	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A2U26	1820-1208	3		IC GATE TTL LS OR WUAD 2 INP	01295	SN74LS32N
A2U27	1820-1470	1		IC MUXR/DATA SEL TTL LS 2-TO-1-LINE QUAD	01295	SN74LS157N
A2U28	1820-1208	3		IC GATE TTL LS OR QUAD 2 INP	01295	SN74LS32N
A2U29	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A2U30	1820-2024	3		IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
A2U31	1820-2293	8	1	IC-MPU; CLK FREQ=2MHZ	04713	MC68B00P
A2U32	1820-2746	7		IC CNTR TTL LS BIN DUAL 4-BIT	07263	74LS393PC
A2U33	1820-1491	6	4	IC BFR TTL LS NON-INV HEX 1-INP	01295	SN74LS367AN
A2U34	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A2U35	1820-1989	7		IC CNTR TTL LS BIN DUAL 4-BIT	07263	74LS393PC
A2U36	1820-1201	6	3	IC GATE TTL LS AND QUAD 2-INP	01295	SN74LS08N
A2U37	1820-1216	3	5	IC DCDR TTL LS 3-TO-B-LINE 3-INP	01295	SN74S138N
A2U38	1820-3210	1	1	IC-ASYNCH. COMMN INTERFACE ADAPTER	04713	MC68B50P
A2U39	1820-1216	3	5	IC DCDR TTL LS 3-TO-B-LINE 3-INP	01295	SN74LS138N
A2U40	1820-1144	6		IC GATE TTL LS NOR QUAD 2-INP	01295	SN74LS02N
A2U41	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A2U42	1820-1201	6	3	IC GATE TTL LS AND QUAD 2-INP	01295	SN74LS08N
A2U43	1820-1199	1		IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A2U44	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A2U45	1820-2024	3		IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
A2U46	1820-1199	1		IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A2U47	1820-1491	6		IC BFR TTL LS NON-INV HEX 1-INP	01295	SN74LS367AN
A2U48	1820-1201	6	3	IC GATE TTL LS AND QUAD 2-INP	01295	SN74LS08N
A2U49	1820-1491	6		IC BFR TTL LS NON-INV HEX 1-INP	01295	SN74LS367AN
A2U50	1820-1491	6		IC BFR TTL LS NON-INV HEX 1-INP	01295	SN74LS367AN
A2U51	1820-2075	4		IC MISC TTL LS	01295	SN74LS245N
A2U52	1820-2024	3		IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
A2U53	1820-1216	3	5	IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A2W1	1251-4787	2	2	SHUNT-DIP B-POSITION	28480	1251-4787
A2W2	1258-0141	8		JUMPER-REM	28480	1258-0141
A2W3	1258-0141	8		JUMPER-REM	28480	1258-0141
A2X1	0410-1377	7	1	CRYSTAL B MHZ	28480	0410-1377
	8159-0005	0		RESISTOR-ZERO OHMS 22 AWG LEAD DIA	28480	8159-0005
A3	04145-66533	4	1	SMU CONTROL AND A-D CONVERTER BOARD ASS'Y	28480	04145-66533
A3C1	0160-0301	4	1	CAPACITOR-FXD .012UF +-10% 200VDC POLYE	28480	0160-0301
A3C2	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A3C3	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A3C4	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A3C5	0160-0127	2	17	CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A3C6	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A3C7	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A3C8	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A3C9	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A3C10	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A3C11	0160-4822	2	3	CAPACITOR-FXD 1000PF +-5% 100VDC CER	28480	0160-4822
A3C12	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A3C13	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A3C14	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A3C15	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A3C16	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A3C17	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A3C18	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A3C19	0160-2306	3		CAPACITOR-FXD 27PF +-5% 300VDC MICA	28480	0160-2306
A3C20	0160-2306	3		CAPACITOR-FXD 27PF +-5% 300VDC MICA	28480	0160-2306
A3C21	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A3C22	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A3C23	0180-1746	5	7	CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A3C24	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A3C25	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3C26	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A3C27	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A3C28	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A3C29	0160-5432	2	1	CAPACITOR-FXD 0.01UF	28480	0160-5432
A3C30	0160-4791	4	1	CAPACITOR-FXD 10PF +-5% 100VDC CER 0+-30	28480	0160-4791
A3C31	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A3C32	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A3C33	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A3C34	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A3C35	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A3C36	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A3C37	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A3C38	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A3C39	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A3C40	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A3C41	0160-5493	7		CAPACITOR-FXD .1UF		
A3C42	0160-5493	7		CAPACITOR-FXD .1UF		
A3C43	0160-5493	7		CAPACITOR-FXD .1UF		
A3C44	0160-5493	7		CAPACITOR-FXD .1UF		
A3C45	0160-5493	7		CAPACITOR-FXD .1UF		
A3C46	0160-5493	7		CAPACITOR-FXD .1UF		
A3C47	0160-5493	7		CAPACITOR-FXD .1UF		
A3C48	0160-5493	7		CAPACITOR-FXD .1UF		
A3C49	0160-5493	7		CAPACITOR-FXD .1UF		
A3C50	0160-5493	7		CAPACITOR-FXD .1UF		
A3C51	0160-5493	7		CAPACITOR-FXD .1UF		
A3C52	1810-0585	6	3	CAPACITOR-FXD 470PF X 8	28480	1810-0585
A3C53	1810-0585	6		CAPACITOR-FXD 470PF X 8	28480	1810-0585
A3C54	0160-4822	2		CAPACITOR-FXD 1000PF +-5% 100VDC CER	28480	0160-4822
A3C55	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3C56	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A3C57	0180-1083	3		CAPACITOR-FXD 33UF 25VDC AL	28480	0180-1083
A3CP1	1990-0494	6	1	OPTO-ISOLATOR LED-PDIO/XSTR IF=20MA-MAX	28480	5082-4370
A3CP2	1990-0444	6	6	OPTO-ISOLATOR LED-PDIO/XSTR IF=25MA-MAX	28480	6N136
A3CP3	1990-0444	6		OPTO-ISOLATOR LED-PDIO/XSTR IF=25MA-MAX	28480	6N136
A3CR1	1902-0064	1	2	DIODE-ZNR 7.5V 5% DO-35 PD=.4W TC=+.05%	28480	1902-0064
A3CR2	1902-0064	1		DIODE-ZNR 7.5V 5% DO-35 PD=.4W TC=+.05%	28480	1902-0064
A3CR3	1901-0518	8	4	DIODE-SM SIG SCHOTTKY	28480	1901-0518
A3CR4	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A3CR5	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR6	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3DS1	1990-0486	6		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4684
A3DS2	1990-0486	6		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4684
A3DS3	1990-0486	6		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4684
A3DS4	1990-0486	6		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4684
A3J1	1200-0541	1		SOCKET-IC 24-CONT DIP DIP-SLDR	28480	1200-0541
A3J2	1251-4822	6		CONNECTOR 3-PIN M POST TYPE	28480	1251-4822
A3J5	1200-0567	1		SOCKET-IC 28-CONT DIP DIP-SLDR	28480	1200-0567
A3J6	1200-0567	1		SOCKET-IC 28-CONT DIP DIP-SLDR	28480	1200-0567
A3J7	1251-4822	6		CONNECTOR 3-PIN M POST TYPE	28480	1251-4822
A3J8	1251-4822	6		CONNECTOR 3-PIN M POST TYPE	28480	1251-4822
A3J9	1251-4822	6		CONNECTOR 3-PIN M POST TYPE	28480	1251-4822
A3J10	1200-0654	7		SOCKET-IC 40-CONT DIP DIP-SLDR	28480	1200-0654
A3J11	1200-0607	0		SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0607
A3J12	1200-0607	0		SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0607
A3J13	1251-4822	6		CONNECTOR 3-PIN M POST TYPE	28480	1251-4822
A3J14	1251-4822	6		CONNECTOR 3-PIN M POST TYPE	28480	1251-4822
A3J15	1251-4484	6		CONNECTOR 4-PIN M POST TYPE	28480	1251-4484
A3J16	1200-0541	1		SOCKET-IC 24-CONT DIP DIP-SLDR	28480	1200-0541
A3L1	9140-0114	4	12	INDUCTOR RF-CH-MLD 10UH 10% .166DX.385LG	28480	9140-0114
A3L2	9140-0114	4		INDUCTOR RF-CH-MLD 10UH 10% .166DX.385LG	28480	9140-0114
A3L3	9140-0114	4		INDUCTOR RF-CH-MLD 10UH 10% .166DX.385LG	28480	9140-0114
A3L4	9140-0114	4		INDUCTOR RF-CH-MLD 10UH 10% .166DX.385LG	28480	9140-0114
A3L5	9140-0114	4		INDUCTOR RF-CH-MLD 10UH 10% .166DX.385LG	28480	9140-0114
A3L6	9100-3139	5		INDUCTOR 75UH 15% .5DX.875LG	28480	9100-3139
A3Q1	1853-0281	9	4	TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A3Q2	1854-0477	7	4	TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A3Q3	1853-0459	3	19	TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A3Q4	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A3Q5	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3R1	2100-3354	9	2	RESISTOR-TRMR 50K 10% C SIDE-ADJ 1-TRN	28480	2100-3354
A3R2	0698-3156	2	1	RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A3R3	0698-3159	5	1	RESISTOR 26.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2612-F
A3R4	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R5	0698-8824			RESISTOR 562K 1% .125W F TC=0+-100	28480	U698-8824
A3R6	0699-0752	0	1	RESISTOR 1.78K .1% TF TC=0+-25	24546	
A3R7	0757-0278	9	3	RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1781-F
A3R8	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4- -T0-101-F
A3R9	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4- -T0-2611-F
A3R10	0757-0442	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A3R11	0698-0083	8	1	RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A3R12	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4- -T0-10R0-F
A3R13	0698-3455	4		RESISTOR 261K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2613-F
A3R14	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R15	0757-0419	0		RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1 8-T0-681R-F
A3R16	0757-0419	0		RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1 8-T0-681R-F
A3R17	0757-0419	0		RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1 8-T0-681R-F
A3R18	0757-0419	0		RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1 8-T0-681R-F
A3R19	0757-0317	7	1	RESISTOR 1.33K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1331-F
A3R20	0699-0597	1	2	RESISTOR 2.26K .1% .125W F TC=0+-25	28480	0699-0597
A3R21	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1 8-T0-C001-F
A3R22	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R23	0757-0442	9		RESISTOR 10K 1% .125W F-TC=0+-100	24546	C4-1/8-T0-1002-F
A3R24	0757-0442	9		RESISTOR 10K 1% .125W F-TC=0+-100	24546	C4-1/8-T0-1002-F
A3R25	0699-0918	0	2	RESISTOR-22.65K OHM 0.1%	28480	0699-0918
A3R26	0699-0919	1	1	RESISTOR-4.096K OHM 0.1%	28480	0699-0919
A3R27	0757-0442	9		RESISTOR 10K 1% .125W F-T =0+-100	24546	C4-1/8-T0-1002-F
A3R28	0757-0442	9		REISITOR 10K 1% .125W F-T =0+-100	24546	C4-1/8-T0-1002-F
A3R29	0757-0442	9		RESISTOR 10K 1% .125W F-T =0+-100	24546	C4-1/8-T0-1002-F
A3R30	2100-3210	6		RESISTOR-TRMR 10K 10% TKF TOP-ADJ 1-TRN		
A3R31	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R32	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R33	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T010R0-F
A3R34	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R35	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R37	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A3R38	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A3R39	0698-3430	5		RESISTOR 21.5 1% .125W F TC=0+-100	03888	RME55-1/8-T0-21R5-F
A3R40	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R41	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A3R42	0757-0401	0		RESOSTPR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3R43	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A3R44	0698-3439	4		RESISTOR 178 1% .125W F TC=0+-100	24546	C4-1/8-T0-178R-F
A3R45	0698-3459	8		RESISTOR 383K 1% .125W F TC=0+-100	28480	0698-3459
A3R46	0757-0200	7		RESISTOR 5.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5621-F
A3R47	1810-0269	3		NETWOR-RES 9-SIP10.0K OHM X 8	28480	1810-0269
A3R48	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R49	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R50	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R51	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R52	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R53	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R54	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R55	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R56	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R57	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R58	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R59	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R60	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R61	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A3R62	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R63	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R64	0757-1094	9		RESISTOR 1.47K 1% .125Q F TC=0+-100	24546	C4-1/8-T0-1471-F
A3R65	0698-3459	8	3	RESISTOR 383K 1% .125W F TC=0+-100	24546	
A3R66	0757-0200	7		RESISTOR 5.62K 1% .125W F TC=+-100	24546	C4-1/8-T0-5621-F
A3R67	0698-3439	4		RESISTOR 178 1% .125W F TC=0+-100	24546	C4-1/8-T0-178R-F
A3R68	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-TP+1002-F
A3S1	3101-1973	7		SW-DIP 7-1A SL		
A3T1	9100-4212	7	1	TRANSFORMER-PULSE 132F1	28480	9100-4212
A3U1	1826-0013	8	3	IC OP AMP LOW-NOISE TO-99 PKG	06665	SSS741CJ
A3U2	1826-1846	7		D/A 16-BIT 24-CERDIP BPLR	8E175	DAC71-CSB-IS (SELECTED)
A3U3	1820-2738	6	2	IC-DEG AM2503PC	27014	DM2503CN
A3U4	1820-1794	2		IC BFR TTL LS NON-INV OCTL	27014	DM81LS95N
A3U5	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN

See introduction to this section for ordering information
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Table 6-3. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3U6	1820-1858	9	5	IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A3U7	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A3U8	1820-1197	4		IC GATE TTL LS NAND QUAD 2-INP		SN74LS00
A3U9	04145-85058	4		IC NMOS 131072 (128K) EPROM 200-NS 3-S		MBM27 128
A3U12	1826-0013	8		IC OP AMP LOW-NOISE TO-99 PKG	06665	SSS741CJ
A3U13	1826-0497	2	1	IC COMPARATOR PRCN TO-99 PKG	27014	LF311H
A3U14	1826-0550	8	2	IC CONV 8-B-D/A 16-DIP-P PKG	07263	UA0801EPC
A3U16	1820-2738	6		IC-DEG AM2503PC	27014	DM2503CN
A3U17	1820-1794	2		IC BFR TTL LS NON-INV OCTL	27014	DM81LS95N
A3U18	1820-1991	1		IC CNTR TTL LS DECD DUAL 4-BIT	01295	SN74LS390N
A3U19	1820-1430	3		IC CNTR TTL LS BIN SYNCHRO POS-EDGE-TRIG	01295	SN74LS161AN
A3U20	1820-1202	7		IC GATE TTL LS NAND TPL 3-INP	01295	SN74LS10N
A3U21	1820-2024	3		IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
A3U22	1820-2099	2	1	IC MICPROC NMOS 8-BIT	04713	MC6802P
A3U23	1820-1416	5		IC SCHMITT-TRIG TTL LS INV HEX 1-INP	01295	SN74LS14N
A3U24	1818-3198			65536 (64K)STAT RAM		HM6264
A3U26	1826-0503	1	1	IC SMPL/HOLD TO-99 PKG	27014	LF398H
A3U27	1826-0319	7	1	IC OP AMP LOW-BIAS-H-IMPD TO-99 PKG	04713	LF356G
A3U28	1820-1430	3		IC CNTR TTL LS BIN SYNCHRO POS-EDGE-TRIG	01295	SN74LS161AN
A3U29	1820-1460	9	1	IC MISC TTL QUAD	01295	SN74265N
A3U30	1820-1428	9	1	IC MUXR/DATA-SEL TTL LS 2-TO-1-LINE QUAD	01295	SN74LS158N
A3U31	1820-1858	9		IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A3U32	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A3U33	1820-2075	4		IC MISC TTL LS	01295	SN74LS245N
A3U34	1820-1425	6		IC SCHMITT-TRIG TTL LS NAND QUAD 2-INP	01295	SN74LS132N
A3U35	1820-2024	3		IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
A3U36	1820-1794	2		IC BFR TTL LS NON-INV OCTL	27014	DM81LS95N
A3U37	1826-0602	1	1	IC MULTIPLXR 16-CHAN-ANLG 28-DIP-C PKG	24355	AD7506KD
A3U38	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A3U39	1820-1430	3		IC CNTR TTL LS BIN SYNCHRO POS-EDGE-TRIG	01295	SN74LS161AN
A3U40	1820-1794	2		IC BFR TTL LS NON-INV OCTL	27014	DM81LS95N
A3U41	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A3U42	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A3U43	1820-1645	2	1	IC BFR TTL LS BUS QUAD	01295	SN74LS126AN
A3U44	1820-2470	3	1	IC-DIGITAL MC6850P	28480	1820-2470
A3W1	1258-0141	8		JUMPER-REM	28480	1258-0141
A3W2	1258-0141	8		JUMPER-REM	28480	1258-0141
A3W3	1258-0141	8		JUMPER-REM	28480	1258-0141
A3W4	1258-0141	8		JUMPER-REM	28480	1258-0141
A3W5	1251-4787	2		SHUNT-DIP 8-POSITION	28480	1251-4787
A3W6	1258-0141	8		JUMPER-REM	28480	1258-0141
A3W7	1258-0141	8		JUMPER-REM	28480	1258-0141
A3W8	1258-0141	8		JUMPER-REM	28480	1258-0141
A3W9	1258-0141	8		JUMPER-REM	28480	1258-0141
A3Y1	0410-1378 8159-0005	8	1	CRYSTAL-3.84 MHZ RESISTOR-ZERO OHMS 22AWG LEAD DIA	28480	0410-1378
A4	04145-66504	5	1	D-A CONVERTER BAORD ASS'Y	28480	04145-66504
A4C1	0121-0105	4	10	CAPACITOR-V TRMR-CER 9-35PF 200V PC-MTG	52763	304324 9/35PF N650
A4C2	0121-0105	4		CAPACITOR-V TRMR-CER 9-35PF 200V PC-MTG	52763	304324 9/35PF N650
A4C3	0121-0105	4		CAPACITOR-V TRMR-CER 9-35PF 200V PC-MTG	52763	304324 9/35PF N650
A4C4	0121-0105	4		CAPACITOR-V TRMR-CER 9-35PF 200V PC-MTG	52763	304324 9/35PF N650
A4C5	0121-0105	4		CAPACITOR-V TRMR-CER 9-35PF 200V PC-MTG	52763	304324 9/35PF N650
A4C6	0121-0105	4		CAPACITOR-V TRMR-CER 9-35PF 200V PC-MTG	52763	304324 9/35PF N650
A4C7	0121-0105	4		CAPACITOR-V TRMR-CER 9-35PF 200V PC-MTG	52763	304324 9/35PF N650
A4C8	0121-0105	4		CAPACITOR-V TRMR-CER 9-35PF 200V PC-MTG	52763	304324 9/35PF N650
A4C9	0121-0105	4		CAPACITOR-V TRMR-CER 9-35PF 200V PC-MTG	52763	304324 9/35PF N650
A4C10	0121-0105	4		CAPACITOR-V TRMR-CER 9-35PF 200V PC-MTG	52763	304324 9/35PF N650
A4C11	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A4C12	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A4C13	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A4C14	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A4C15	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A4C16	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A4C17	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A4C18	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A4C19	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A4C20	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A4C21	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A4C22	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A4C23	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A4C24	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A4C25	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204

See introduction to this section for ordering information
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Table 6-3. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A4C26	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A4C27	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A4C28	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A4C29	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A4C30	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A4C31	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A4C32	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A4C33	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A4C34	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A4C35	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A4C36	0160-5433	3	10	CAPACITOR-FXD 0.1UF	28480	0160-5433
A4C37	0160-5433	3		CAPACITOR-FXD 0.1UF	28480	0160-5433
A4C38	0160-5433	3		CAPACITOR-FXD 0.1UF	28480	0160-5433
A4C39	0160-5433	3		CAPACITOR-FXD 0.1UF	28480	0160-5433
A4C40	0160-5433	3		CAPACITOR-FXD 0.1UF	28480	0160-5433
A4C41	0160-5433	3		CAPACITOR-FXD 0.1UF	28480	0160-5433
A4C42	0160-5433	3		CAPACITOR-FXD 0.1UF	28480	0160-5433
A4C43	0160-5433	3		CAPACITOR-FXD 0.1UF	28480	0160-5433
A4C44	0160-5433	3		CAPACITOR-FXD 0.1UF	28480	0160-5433
A4C45	0160-5433	3		CAPACITOR-FXD 0.1UF	28480	0160-5433
A4C46	0160-4830	8	10	CAPACITOR-FXD 2200PF +-5% 100VDC CER	28480	0160-4810
A4C47	0160-4830	8		CAPACITOR-FXD 2200PF +-5% 100VDC CER	28480	0160-4810
A4C48	0160-4830	8		CAPACITOR-FXD 2200PF +-5% 100VDC CER	28480	0160-4810
A4C49	0160-4830	8		CAPACITOR-FXD 2200PF +-5% 100VDC CER	28480	0160-4810
A4C50	0160-4830	8		CAPACITOR-FXD 2200PF +-5% 100VDC CER	28480	0160-4810
A4C51	0160-4830	8		CAPACITOR-FXD 2200PF +-5% 100VDC CER	28480	0160-4810
A4C52	0160-4830	8		CAPACITOR-FXD 2200PF +-5% 100VDC CER	28480	0160-4810
A4C53	0160-4830	8		CAPACITOR-FXD 2200PF +-5% 100VDC CER	28480	0160-4810
A4C54	0160-4830	8		CAPACITOR-FXD 2200PF +-5% 100VDC CER	28480	0160-4810
A4C55	0160-4830	8		CAPACITOR-FXD 2200PF +-5% 100VDC CER	28480	0160-4810
A4C56	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A4C57	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A4C58	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A4C59	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A4C60	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A4C61	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A4C62	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A4C63	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A4C64	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A4C65	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A4C66	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A4C67	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A4C68	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A4C69	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A4C70	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A4C71	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A4C72	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A4C73	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A4C74	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A4C75	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A4C76	0180-1083	3		CAPACITOR-FXD 33UF 25VDC AL	28480	0180-1083
A4C77	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A4C78	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A4C79	0180-1083	3		CAPACITOR-FXD 33UF 25VDC AL	28480	0180-1083
A4C80	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A4C81	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A4C82	0160-4822	2		CAPACITOR-FXD 1000PF +-5% 100VDC CER	28480	0160-4822
A4C83	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A4C84	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A4C85	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A4C86	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A4C87	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A4C88	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A4C89	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A4C90	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A4C91	0180-0229	7	1	CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A4C92	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A4C93	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A4CR1	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A4CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A4DS1	1990-0486	6		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4684
A4DS2	1990-0486	6		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4684
A4J1	1200-0541	1		SOCKET-IC 24-CONT DIP DIP-SLDR	28480	1200-0541
A4J2	1251-4822	6		CONNECTOR 3-PIN M POST TYPE	28480	1251-4822

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A4L1	9140-0114	4		INDUCTOR RF-CH-MLD 10UH 10% .166DX.385LG	28480	9140-0114
A4L2	9140-0114	4		INDUCTOR RF-CH-MLD 10UH 10% .166DX.385LG	28480	9140-0114
A4L3	9100-1788	6		CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/4B
A4L4	9100-3139	5		INDUCTOR 75UH 15% .5DX.875LG	28480	9100-3139
A4Q1	1853-0281	9		TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A4Q2	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A4R1	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A4R2	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A4R3	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A4R4	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A4R5	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A4R6	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A4R7	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A4R8	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A4R9	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A4R10	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A4R11	2100-3354	9		RESISTOR-TRMR 50K 10% C SIDE-ADJ 1-TRN	28480	2100-3354
A4R12	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A4R13	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A4R14	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-1002-F
A4R15	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A4R16	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A4R17	0698-3455	4		RISISTOR 261K 1% .125W F TC=0+-100	24546	CT4-1/8-T0-2613-F
A4R18	0757-0180	2	2	RESISTOR 31.6 1% .125W F TC=0+-100	24546	
A4R19	0757-0180	2		RESISTOR 31.6 1% .125W F TC=0+-100	24546	
A4R20	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A4R21	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A4R22	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A4R23	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A4R24	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A4R25	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A4R26	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A4R27	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A4R28	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A4R29	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A4R30	0699-0918	0		RESISTOR-22.65K OHM 0.1%	28480	0699-0918
A4R31	1810-0269	3		NETWORK-RES 9-SIP10.0K OHM X 8	28480	1810-0269
A4R32	1810-0269	3		NETWORK-RES 9-SIP10.0K OHM X 8	28480	1810-0269
A4R33	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A4R34	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A4R35	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A4R36	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A4R37	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A4R38	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A4R39	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A4R40	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A4R41	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A4R42	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A4R43	0698-3438	3		RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-1470-F
A4R44	0698-3438	3		RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-1470-F
A4R45	0698-3438	3		RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-1470-F
A4R46	0698-3438	3		RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-1470-F
A4R47	0698-3438	3		RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-1470-F
A4R48	0698-3438	3		RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-1470-F
A4R49	0698-3438	3		RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-1470-F
A4R50	0698-3438	3		RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-1470-F
A4R51	0698-3438	3		RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-1470-F
A4R52	0698-3438	3		RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-1470-F
A4R53	0699-0597	1		RESISTOR 2.26K .1% .125W F TC=0+-25	28480	0699-0597
A4R54	0699-0752	0		RESISTOR 1.78K .1% .125W F TC=0+-25	28480	0699-0752
A4R55	0757-0278	9		RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1781-F
A4R56	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4R57	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4R58	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4R59	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4R60	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	
A4U1	1820-1374	4	5	IC SWITCH ANLG QUAD 16-DIP-P PKG	24355	AD7510DIJN
A4U2	1820-1374	4		IC SWITCH ANLG QUAD 16-DIP-P PKG	24355	AD7510DIJN
A4U3	1820-1374	4		IC SWITCH ANLG QUAD 16-DIP-P PKG	24355	AD7510DIJN
A4U4	1820-1374	4		IC SWITCH ANLG QUAD 16-DIP-P PKG	24355	AD7510DIJN
A4U5	1820-1374	4		IC SWITCH ANLG QUAD 16-DIP-P PKG	24355	AD7510DIJN
A4U6	1826-0668	9	1	IC OP AMP LOW-BIAS-H-IMPD TO-99 PKG	04713	LF356AG
A4U7	1820-1199	1		IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A4U8	1820-1199	1		IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A4U9	1820-0495	8		IC DCDR TTL 4-TO-16-LINE 4-INP	01295	SN74154N
A4U10	1820-1429	0	1	IC CNTR TTL LS DECD SYNCHRO	01295	SN74LS160AN

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	CD	Qty	Description	Mfr Code	Mfr Part Number
A4U11	1820-1194	6		IC CNTR TTL LS BIN UP/DOWN SYNCHRO	01295	SN74LS193N
A4U12	1826-1127	7	7	IC OP AMP PRCN DUAL 8-TO-99 PKG	27014	LF412CH
A4U13	1826-1127	7		IC OP AMP PRCN DUAL 8-TO 99 PKG	27014	LF412CH
A4U14	1826-1127	7		IC OP AMP PRCN DUAL 8-TO-99 PKG	27014	LF412CH
A4U15	1826-1127	7		IC OP AMP PRCN DUAL 8-TO-99 PKG	27014	LF412CH
A4U16	1826-1127	7		IC OP AMP PRCN DUAL 8-TO-99-PKG	27014	LF412CH
A4U17	1826-0013	8		IC OP AMP LOW-NOISE TO-99 PKG	06665	SSS741CJ
A4U18	1826-1846	7		D/A 16-BIT 24-CERDIP BPLR	8E175	DAC71-CSB-IS(SELECTED)
A4U19	1820-0628	9	4	IC TTL 64-BIT STAT RAM 60-NS 0-C	01295	SN7489N
A4U20	1820-0628	9		IC TTL 64-BIT STAT RAM 60-NS 0-C	01295	SN7489N
A4U21	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A4U22	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A4U24	1826-0550	8		IC CONV 8-B-D/A 16-DIP-P PKG	07263	UA0801EPC
A4U25	1820-0628	9		IC TTL 64-BIT STAT RAM 60-NS 0-C	01295	SN7489N
A4U26	1820-0628	9		IC TTL 64-BIT STAT RAM 60-NS 0-C	01295	SN7489N
A4U27	1820-1989	7		IC CNTR TTL LS BIN DUAL 4-BIT	07263	74LS393PC
A4U28	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A4U29	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A4U30	1826-0416	5	3	IC SWITCH ANLG QUAD 16-DIP-C PKG	27014	LF13331D
A4U31	1826-0416	5		IC SWITCH ANLG QUAD 16-DIP-C PKG	27014	LF13331D
A4U32	1826-0416	5		IC SWITCH ANLG QUAD 16-DIP-C PKG	27014	LF13331D
A4U33	1820-1962	6	1	IC DCDR CMOS BCD-TO-DEC	3L585	CD4028BE
A4U34	1820-1858	9		IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A4U35	1820-1873	8	1	IC BFR TTL LS INV OCTL 2-INP	27014	DM81LS98N
A4U36	1820-1794	2		IC BFR TTL LS NON-INV OCTL	27014	DM81LS95N
A4U37	1820-1794	2		IC BFR TTL LS NON-INV OCTL	27014	DM81LS95N
A4U38	1820-1794	2		IC BFR TTL LS NON-INV OCTL	27014	DM81LS95N
A4U39	1820-1858	9		IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A4U40	1820-1794	2		IC BFR TTL LS NON-INV OCTL	27014	DM81LS95N
A4U41	1820-1201	6		IC GATE TTL LS AND QUAD 2-INP	01295	SN74LS08N
A4W1	1258-0141	8		JUMPER-REM	28480	1258-0141
	0340-0092	2	32	TERMINAL-STUD SPCL-FDTHRU PRESS-MTG	28480	0340-0092
	0340-0060	4	20	TERMINAL-STUD SPCL-FDTHRU PRESS-MTG	98291	011-6809 000 209
	8150-4681	8	36	WIRE-ELECTRICAL 24 BLK		
A5	04145-66525	6	1	SMU BOARD ASS'Y (SHIELD COVERS ARE NOT INCLUDED)	28480	04145-66525
A5C1	0160-6561	7		CAPACITOR-FXD .1UF +- 20% 50VDC CER	28480	0160-6561
A5C2	0160-4795	8	2	CAPACITOR-FXD 4.7PF +-.5PF 100VDC CER	28480	0160-4795
A5C3	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A5C4	0140-0196	3		CAPACITOR-FXD 150PF +-5% 300VDC MICA	72136	DM15F151J0300WV1CR
A5C5	0160-2261	9	2	CAPACITOR-FXD 15PF +-5% 500VDC CER 0+-30	28480	0160-2261
A5C6	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A5C7	0160-4834	6	2	CAPACITOR-FXD .047UF +-10% 100VDC CER	28480	0160-4834
A5C8	0160-6561	7		CAPACITOR-FXD .1UF +- 20% 50VDC CER	28480	0160-6561
A5C9	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A5C10	0160-4834	6		CAPACITOR-FXD .047UF +-10% 100VDC CER	28480	0160-4834
A5C11	0160-2254	0	1	CAPACITOR-FXD 7.5PF +-.25PF 500VDC CER	28480	0160-2254
A5C12	0160-6561	7		CAPACITOR-FXD .1UF +- 20% 50VDC CER	28480	0160-6561
A5C13	0160-2199	2	3	CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
A5C14	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A5C15	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A5C16	0160-6561	7		CAPACITOR-FXD .1UF +- 20% 50VDC CER	28480	0160-6561
A5C17	0160-6561	7		CAPACITOR-FXD .1UF +- 20% 50VDC CER	28480	0160-6561
A5C18	0160-0363	8	1	CAPACITOR-FXD 620PF +-5% 300VDC MICA	28480	0160-0363
A5C19	0160-2199	2		CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
A5C20	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A5C21	0160-2199	2		CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
A5C22	0160-6561	7		CAPACITOR-FXD .1UF +- 20% 50VDC CER	28480	0160-6561
A5C23	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A5C24	0160-0161	4	6	CAPACITOR-FXD .01UF +-10% 200VDC POLYE	28480	0160-0161
A5C25	0160-0161	4		CAPACITOR-FXD .01UF +-10% 200VDC POLYE	28480	0160-0161
A5C26	0170-0040	9	2	CAPACITOR-FXD .047UF +-10% 200VDC POLYE	56289	292P47392
A5C27	0170-0040	9		CAPACITOR-FXD .047UF +-10% 200VDC POLYE	56289	292P47392
A5C28	0160-6561	7		CAPACITOR-FXD .1UF +- 20% 50VDC CER	28480	0160-6561
A5C29	0160-4795	8		CAPACITOR-FXD 4.7PF +-.5PF 100VDC CER	28480	0160-4795
A5C30	0160-6561	7		CAPACITOR-FXD .1UF +- 20% 50VDC CER	28480	0160-6561
A5C31	0140-0196	3		CAPACITOR-FXD 150PF +-5% 300VDC MICA	72136	DM15F151J0300WV1CR
A5C32	0160-2261	9		CAPACITOR-FXD 15PF +-5% 500VDC CER 0+-30	28480	0160-2261
A5C33	0160-4805	1	2	CAPACITOR-FXD 47PF +-5% 100VDC CER 0+-30	28480	0160-4805
A5C34	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A5C35	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A5C36	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A5C37	0160-0160	3	1	CAPACITOR-FXD 8200PF +-10% 200VDC POLYE	28480	0160-0160
A5C38	0160-4822	2	4	CAPACITOR-FXD 1000PF +-5% 100VDC CER	28480	0160-4822
A5C39	0180-1066	2	5	CAPACITOR, FXD 47 MF AL	28480	0180-1066
A5C40	0180-1066	2		CAPACITOR, FXD 47 MF AL	28480	0180-1066
A5C41	0180-1066	2		CAPACITOR, FXD 47 MF AL	28480	0180-1066
A5C42	0160-4822	2		CAPACITOR-FXD 1000PF +-5% 100VDC CER	28480	0160-4822
A5C43	0160-4822	2		CAPACITOR-FXD 1000PF +-5% 100VDC CER	28480	0160-4822
A5C44	0180-1085	5	1	CAPACITOR-FXD 4.7UF 16VDC TA	28480	0180-1085
A5C45	5080-3080	2		CAPACITOR-FXD 2pF +-1pF 125VWDC		
A5C46	0160-0155	6	2	CAPACITOR-FXD 3300PF +-10% 200VDC POLYE	28480	0160-0155
A5C47	0160-0155	6		CAPACITOR-FXD 3300PF +-10% 200VDC POLYE	28480	0160-0155
A5C48	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A5C49	0180-1066	2		CAPACITOR, FXD 47 MF AL	28480	0180-1066
A5C50	0180-1066	2		CAPACITOR, FXD 47 MF AL	28480	0180-1066
A5C51	0160-4830	2	3	CAPACITOR-FXD 2200PF +-10% 100VDC CER	28480	0160-4830
A5C52	0160-4830	2		CAPACITOR-FXD 2200PF +-10% 100VDC CER	28480	0160-4830
A5C53	0160-4830	2		CAPACITOR-FXD 2200PF +-10% 100VDC CER	28480	0160-4830
A5C54	0160-4802	8	1	CAPACITOR-FXD 82PF +-5% 100VDC CER 0+-30	28480	0160-4802
A5C55	0160-4792	5	1	CAPACITOR-FXD 8.2PF +-.5PF 100VDC CER	28480	0160-4792
A5C56	0160-4805	1		CAPACITOR-FXD 47PF +-5% 100VDC CER 0+-30	28480	0160-4805
A5C57	0160-5064	6	1	CAPACITOR-FXD	28480	0160-5064
A5C58	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A5C59	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A5C60	0160-4833	5	4	CAPACITOR-FXD .022UF +-10% 100VDC CER	28480	0160-4833
A5C61	0160-4833	5		CAPACITOR-FXD .022UF +-10% 100VDC CER	28480	0160-4833
A5C62	0160-4833	5		CAPACITOR-FXD .022UF +-10% 100VDC CER	28480	0160-4833
A5C63	0160-4833	5		CAPACITOR-FXD .022UF +-10% 100VDC CER	28480	0160-4833
A5C64	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A5CP1	1990-0444	6		OPTO-ISOLATOR LED-PDIO/XSTR IF=25MA-MAX	28480	6N136
A5CP2	1990-0444	6		OPTO-ISOLATOR LED-PDIO/XSTR IF=25MA-MAX	28480	6N136
A5CP3	1990-0444	6		OPTO-ISOLATOR LED-PDIO/XSTR IF=25MA-MAX	28480	6N136
A5CR1	1901-0040			DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A5CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A5CR3	1901-0376	1		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A5CR4	1901-0376	6	16	DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A5CR5	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A5CR6	1902-3122	8	2	DIODE-ZNR 6.65V 2% DO-35 PD=.4W	28480	1902-3122
A5CR7	1901-0033	2	27	DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
						1901-0376
A5CR8	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A5CR9	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A5CR10	1902-3105	7	3	DIODE-ZNR 5.62V 2% DO-35 PD=.4W	28480	1902-3105
A5CR11	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A5CR12	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A5CR13	1902-3114	8	2	DIODE-ZNR 6.19V 2% DO-35 PD=.4W	28480	1902-3114
A5CR14	1902-3105	7		DIODE-ZNR 5.62V 2% DO-35 PD=.4W	28480	1902-3105
A5CR15	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35		
A5CR16	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A5CR17	1902-3114	8		DIODE-ZNR 6.19V 2% DO-35 PD=.4W	28480	1902-3114
A5CR18	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A5CR19	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A5CR20	1901-1201	8		DIODE-VRTS 100V 150MA		
A5CR21	1901-0025	2	16	DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A5CR22	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A5CR23	1901-1201	8		DIODE-VRTS 100V 150MA	28480	1901-0460
A5CR24	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A5CR25	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A5CR26	1901-1201	8		DIODE-VRTS 100V 150MA		
A5CR27	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A5CR28	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A5CR29	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A5CR30	1901-1201	8		DIODE-VRTS 100V 150MA		
A5CR31	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A5CR32	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A5CR33	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A5CR34	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A5CR35	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A5CR36	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A5CR37	1902-3122	8		DIODE-ZNR 6.65V 2% DO-35 PD=.4W	28480	1902-3122
A5CR38	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A5CR39	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A5CR40	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A5CR41	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A5CR42	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A5CR43	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A5CR44	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A5CR45	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A5CR46	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A5CR47	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A5CR48	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A5CR49	1902-3059	0	2	DIODE-ZNR 3.83V 5% DO-35 PD=.4W	28480	1902-3059
A5CR50	1902-3059	0		DIODE-ZNR 3.83V 5% DO-35 PD=.4W	28480	1902-3059
A5CR51	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A5CR52	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A5CR53	1902-3205	8	2	DIODE-ZNR 15V 5% DO-35 PD=.4W TC=+.057%	28480	1902-3205
A5CR54	1902-3205	8		DIODE-ZNR 15V 5% DO-35 PD=.4W TC=+.057%	28480	1902-3205
A5CR55	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A5CR56	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A5CR57	1902-3182	0	3	DIODE-ZNR 12.1V 5% DO-35 PD=.4W	28480	1902-3182
A5CR58	1902-3182	0		DIODE-ZNR 12.1V 5% DO-35 PD=.4W	28480	1902-3182
A5CR59	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A5CR60	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A5CR61	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A5CR62	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A5CR63	1902-3182	0		DIODE-ZNR 12.1V 5% DO-35 PD=.4W	28480	1902-3182
A5CR64	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A5CR65	1902-0184	6	1	DIODE-ZNR 16.2V 5% DO-35 PD=.4W	28480	1902-0184
A5CR66	1902-3105	7		DIODE-ZNR 5.62V 2% DO-35 PD=.4W	28480	1902-3105
A5J1	1251-7406	8	8	CONNECTOR-10-PIN MALE	28480	1251-7406
A5J2	1250-1810	4		CONNECTOR-RF SMB M PC 50-OHM		
A5J3	1251-4822	6		CONNECTOR 3-PIN M POST TYPE	28480	1251-4822
A5J4	1251-4822	6		CONNECTOR 3-PIN M POST TYPE	28480	1251-4822
A5K1	0490-1137	5	6	RELAY-REED 1A	28480	0490-1137
A5K2	0490-1137	5		RELAY-REED 1A	28480	0490-1137
A5K3	0490-1137	5		RELAY-REED 1A	28480	0490-1137
A5K4	0490-1137	5		RELAY-REED 1A	28480	0490-1137
A5K5	0490-1325	3	3	RELAY-REED	28480	0490-1325
A5K6	0490-1325	3		RELAY-REED	28480	0490-1325
A5K7	0490-1325	3		RELAY-REED	28480	0490-1325
A5K8	0490-1326	4	1	RELAY-REED	28480	0490-1326
A5L1	9140-0114	4		INDUCTOR RF-CH-MLD 10UH 10% .166DX.385LG	28480	9140-0114
A5L2	9140-0114	4		INDUCTOR RF-CH-MLD 10UH 10% .166DX.385LG	28480	9140-0114
A5L3	9140-0114	4		INDUCTOR RF-CH-MLD 10UH 10% .166DX.385LG	28480	9140-0114
A5L4	9140-0114	4		INDUCTOR RF-CH-MLD 10UH 10% .166DX.385LG	28480	9140-0114
A5L5	9140-0114	4		INDUCTOR RF-CH-MLD 10UH 10% .166DX.385LG	28480	9140-0114
A5Q1	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A5Q2	1854-0810	2	11	TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A5Q3	1855-0414	4	8	TRANSISTOR J-FET 2N4393 N-CHAN D-MODE	04713	2N4393
A5Q4	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A5Q5	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A5Q6	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A5Q7	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A5Q8	1854-0474	4	3	TRANSISTOR NPN SI PD=310MW FT=100MHZ	04713	2N5551
A5Q9	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A5Q10	1853-0336	5	1	TRANSISTOR PNP SI PD=625MW FT=50MHZ	04713	MPSA92
A5Q11	1854-0637	1	1	TRANSISTOR NPN 2N2219A SI TO-5 PD=800MW	01295	2N2219A
A5Q12	1853-0314	9	1	TRANSISTOR PNP 2N2905A SI TO-39 PD=600MW	04713	2N2905A
A5Q13	1855-0386	9	4	TRANSISTOR J-FET 2N4392 N-CHAN D-MODE	04713	2N4392
A5Q14	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A5Q15	1854-0575	6	2	TRANSISTOR NPN SI PD=625MW FT=50MHZ	04713	MPS-A42
A5Q16	1854-0575	6		TRANSISTOR NPN SI PD=625MW FT=50MHZ	04713	MPS-A42
A5Q17	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A5Q18	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A5Q19	1855-0414	4		TRANSISTOR J-FET 2N4393 N-CHAN D-MODE	04713	2N4393
A5Q20	1855-0414	4		TRANSISTOR J-FET 2N4393 N-CHAN D-MODE	04713	2N4393
A5Q21	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A5Q22	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A5Q23	1855-0414	4		TRANSISTOR J-FET 2N4393 N-CHAN D-MODE	04713	2N4393
A5Q24	1855-0414	4		TRANSISTOR J-FET 2N4393 N-CHAN D-MODE	04713	2N4393
A5Q25	1855-0414	4		TRANSISTOR J-FET 2N4393 N-CHAN D-MODE	04713	2N4393
A5Q26	1855-0280	2	2	TRANSISTOR J-FET N-CHAN D-MODE TO-92 SI	17856	E107
A5Q27	1855-0414	4		TRANSISTOR J-FET 2N4393 N-CHAN D-MODE	04713	2N4393
A5Q28	1855-0280	2		TRANSISTOR J-FET N-CHAN D-MODE TO-92 SI	17856	E107
A5Q29	1855-0414	4		TRANSISTOR J-FET 2N4393 N-CHAN D-MODE	04713	2N4393
A5Q30	1855-0386	9		TRANSISTOR J-FET 2N4392 N-CHAN D-MODE	04713	2N4392
A5Q31	1855-0386	9		TRANSISTOR J-FET 2N4392 N-CHAN D-MODE	04713	2N4392
A5Q32	1855-0386	9		TRANSISTOR J-FET 2N4392 N-CHAN D-MODE	04713	2N4392
A5Q33	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A5R1	0683-3355	2	2	RESISTOR 3.3M 5% .25W FC TC=-900/+1100	01121	CB3355
A5R2	0757-0279	0	4	RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A5R3	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	25546	C4-1/8-T0-101-F
A5R4	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A5R5	0698-3260	9	3	RESISTOR 464K 1% .125W F TC=0+-100	24546	

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A5R6	0699-0912	4	4	RESISTOR-100K OHM 0.01%	28480	0699-0912
A5R7	0699-0912	4		RESISTOR-100K OHM 0.01%	28480	0699-0912
A5R8	0698-3446	3	3	RESISTOR 383 1% .125W F TC=0+-100	24546	C4-1/8-T0-383R-F
A5R9	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A5R10	0683-1065	7	8	RESISTOR 10M 5% .25W CC TC=-900/+1100	01121	CB1065
A5R11	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A5R12	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A5R13	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A5R14	0757-0439	4	8	RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A5R15	0757-0420	3	2	RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A5R16	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A5R17	0757-0439	4		RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A5R18	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A5R19	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A5R20	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A5R21	0699-0909	9	2	RESISTOR-100K OHM 0.01%	28480	0699-0909
A5R22	0699-0910	2	4	RESISTOR-50K OHM 0.01%	28480	0699-0910
A5R23	0699-0910	2		RESISTOR-50K OHM 0.01%	28480	0699-0910
A5R24	0699-0911	3	2	RESISTOR-16.6666K OHM	28480	0699-0911
A5R25	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A5R26	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A5R27	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A5R28	0757-0465	6	2	RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A5R29	0683-2255	9	1	RESISTOR 2.2M 5% .25W FC TC=-900/+1100	01121	CB2255
A5R30	0698-3260	9		RESISTOR 464 1% .125W F TC=0+-100	24546	
A5R31	0757-0274	5	5	RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1211-F
A5R32	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A5R33	0698-4037	0	4	RESISTOR 46.4 1% .125W F TC=0+-100	24546	
A5R34	0698-4037	0		RESISTOR 46.4 1% .125W F TC=0+-100	24546	
A5R35	0683-0335	2	8	RESISTOR 3.3 5% .25W FC TC=-400/+500	01121	CB33G5
A5R36	0757-0395	1	2	RESISTOR 56.2 1% .125W F TC=0+-100	24546	C4-1/8-T0-56R2-F
A5R37	0683-0335	2		RESISTOR 3.3 5% .25W FC TC=-400/+500	01121	CB33G5
A5R38	0757-0395	1		RESISTOR 56.2 1% .125W F TC=0+-100	24546	C4-1/8-T0-56R2-F
A5R39	0698-4444	3	3	RESISTOR 4.87K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4871-F
A5R40	0698-8824	1		RESISTOR 562K 1% .125W F TC=0+-100	24546	
A5R41	0698-4037	0		RESISTOR 46.4 1% .125W F TC=0+-100	24546	
A5R42	0698-4037	0		RESISTOR 46.4 1% .125W F TC=0+-100	24546	
A5R43	0683-1065	7		RESISTOR 10M 5% .25W CC TC=-900/+1100	01121	CB1065
A5R44	0698-8827	4	3	RESISTOR 1M 1% .125W F TC=0+-100	24546	
A5R45	0757-0419	0		RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1/8-T0-681R-F
A5R46	0698-3446	3		RESISTOR 383 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A5R47	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A5R48	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A5R49	0683-3355	2		RESISTOR 3.3M 5% .25W FC TC=-900/+1100	01121	CB3355
A5R50	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A5R51	0757-0401	0		RESISTOR 100 5% .25W FC TC=-400/+500	24546	C4-1/8-T0-101-F
A5R52	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A5R53	0757-0467	8	1	RESISTOR 121K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1231-F
A5R54	0699-0912	4		RESISTOR-100K OHM 0.01%	28480	0699-0912
A5R55	0699-0912	4		RESISTOR-100K OHM 0.01%	28480	0699-0912
A5R56	0698-3446	3		RESISTOR 383 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A5R57	0757-0280	3		RESISTOR 1K 5% .25W FC TC=-400/+600	24546	C4-1/8-T0-1001-F
A5R58	0683-1065	7		RESISTOR 10M 5% .25W CC TC=-900/+1100	01121	CB1065
A5R59	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A5R61	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A5R62	0757-0288	1	1	RESISTOR 9.09K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-9091-F
A5R63	0699-0909	9		RESISTOR-100K OHM 0.01%	28480	0699-0909
A5R64	0699-0910	2		RESISTOR-50K OHM 0.01%	28480	0699-0910
A5R65	0699-0910	2		RESISTOR-50K OHM 0.01%	28480	0699-0910
A5R66	0699-0911	3		RESISTOR-16.6666K OHM	28480	0699-0911
A5R67	0698-3136	8	1	RESISTOR 17.8K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1782-F
A5R68	0698-3157	3	1	RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A5R69	0757-0459	8	7	RESISTOR 56.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5622-F
A5R70	0698-3459	8		RESISTOR 383K 1% .125W F TC=0+-100	24546	
A5R71	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A5R72	0757-0459	8		RESISTOR 56.9K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5622-F
A5R73	0698-3459	8		RESISTOR 383K 1% .125W F TC=0+-100	24546	CB3945
A5R74	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A5R75	0699-0913	5	3	RESISTOR-10K OHM 0.01%	28480	0699-0913
A5R76	0699-0913	5		RESISTOR-10K OHM 0.01%	28480	0699-0913
A5R77	0698-4444	3		RESISTOR 4.87K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4871-F
A5R78	0757-1094	9	1	RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A5R79	0698-4497	6	1	RESISTOR 48.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4872-F
A5R80	0698-3260	9		RESISTOR 464K 1% .125W F TC=0+-100	24546	

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A5R81	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A5R82	0698-3155	1	6	RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A5R83	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A5R84	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A5R85	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A5R86	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A5R87	0698-8825	2	2	RESISTOR 681K 1% .125W F TC=0+-100	24546	
A5R88	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A5R89	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A5R90	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A5R91	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A5R92	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A5R93	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A5R94	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A5R95	0698-8825	2		RESISTOR 681K 1% .125W F TC=0+-100	24546	
A5R96	0698-3454	3	3	RESISTOR 215K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2153-F
A5R97	0683-1065	7		RESISTOR 10M 5% .25W CC TC=-900/+1100	01121	CB1065
A5R98	0683-1065	7		RESISTOR 10M 5% .25W CC TC=-900/+1100	01121	CB1065
A5R99	0698-3454	3		RESISTOR 215K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2153-F
A5R100	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A5R101	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A5R102	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A5R103	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A5R104	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A5R105	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A5R106	0757-0419	0		RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1/8-T0-681R-F
A5R107	0757-0419	0		RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1/8-T0-681R-F
A5R108	0757-0419	0		RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1/8-T0-681R-F
A5R109	0698-3454	3		RESISTOR 215K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2153-F
A5R110	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A5R111	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A5R112	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A5R113	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A5R114	0757-0401	0	1	RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A5R115	0757-0279	0		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A5R116	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A5R117	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A5R118	0698-8827	4		RESISTOR 1M 1% .124W F TC=0+-100	24546	C4-1/8-T0-1001-F
A5R119	0699-0913	5		RESISTOR-10K OHM 0.01%	28480	0699-0913
A5R120	0699-0915	7	1	RESISTOR-1.11111K OHM	28480	0699-0915
A5R121	0699-0907	7	1	RESISTOR-1 G	28480	0699-0907
A5R122	0757-0280	3	1	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A5R123	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A5R124	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A5R125	0698-6369	5	1	RESISTOR 1M .1% .25W F TC=0+-25	28480	0698-6369
A5R126	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A5R127	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A5R128	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A5R129	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A5R130	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A5R131	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A5R132	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A5R133	0699-0916	8	1	RESISTOR-1.00045K OHM	28480	0699-0916
A5R134	0699-0908	8	1	RESISTOR-10.0013	28480	0699-0908
A5R135	0699-0914	6	1	RESISTOR-100.975K OHM	28480	0699-0914
A5R136	0699-0906	6	1	RESISTOR-10.1 MEGOHM	28480	0699-0906
A5R137	0698-8827	4		RESISTOR 1M 1% .125W F TC=0+-100	24546	
A5R138	0683-1065	7		RESISTOR 10M 5% .25W CC TC=-900/+1100	01121	CB1065
A5R139	0683-1065	7		RESISTOR 10M 5% .25W CC TC=-900/+1100	01121	CB1065
A5R140	0683-1065	7		RESISTOR 10M 5% .25W CC TC=-900/+1100	01121	CB1065
A5R141	0757-1094	9		RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A5R142	0698-3452	1	4	RESISTOR 147K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1473-F
A5R143	0698-3452	1		RESISTOR 147K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1473-F
A5R144	0698-3452	1		RESISTOR 147K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1473-F
A5R145	0698-3452	1		RESISTOR 147K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1473-F
A5R146	0757-0441	8	1	RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A5R147	0757-1094	9		RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A5R148	0698-3156	2	4	RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A5R149	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A5R150	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A5R151	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=+-100	24546	C4-1/8-T0-1472-F
A5R152	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A5R153	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A5R154	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A5R155	0698-3155	1		RESOSTPR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A5R156	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-TO-4642-F
A5R157	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-TO-4642-F
A5R158	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-TO-4642-F
A5R159	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-TO-4642-F
A5R160	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-TO-2611-F

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A5R161	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-TO-3162-F
A5R164	0699-2662			RESISTOR-PAIR 100K +-0.01% .3W	28480	0699-2662
A5R165	1810-1117	2		NETWORK-RES 3-SIP MULTI-VALUE	28480	1810-1117
A5R166	0699-2658			RESISTOR 100K +-0.01% .3W	28480	0699-2658
A5R167	2100-0568	1		RESISTOR-TRMR 100 10% C TOP-ADJ 1-TRN	28480	2100-0568
A5R168	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	12482	CT4-1/8-TO-511R-F
A5U1	1826-1071	0	3	IC OP AMP PRCN 8-TO-99 PKG	27014	LF411CH
A5U2	1826-1071	0		IC OP AMP PRCN 8-TO-99 PKG	27014	LF411CH
A5U3	1826-1071	0		IC OP AMP PRCN 8-TO-99 PKG	27014	LF411CH
		1				
A5U4	1826-1148	2	3	IC OP AMP PRCN 8-TO-99-PKG	27014	LF411ACH
A5U5	1826-1127	2		IC OP AMP PRCN DUAL 8-TO-99-PKG	27014	LF412CH
A5U6	1826-1127	2		IC OP AMP PRCN DUAL 8-TO-99-PKG	27014	LF412CH
A5U7	1858-0049	7	2	TRANSISTOR ARRAY 16-PIN PLSTC DIP	28480	1858-0049
A5U8	1826-0065	0	1	IC COMPARATOR PRCN 8-DIP-P PKG	S0545	UPC311C
A5U9	1820-1858	9		IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A5U10	1820-1641	8	1	IC DRVR TTL LS BUS DRVR HEX 1-INP	01295	SN74LS365AN
A5U11	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A5U12	1826-1148	2		IC OP AMP PRCN 8-TO-99 PKG	27014	LF411ACH
A5U13	1826-1148	2		IC OP AMP PRCN 8-TO-99 PKG	27014	LF411ACH
A5U14	1826-1650	1		IC OP AMP LOW-NOISE 8-TO-99 PKG	8E175	OPA111AM
A5U15	1858-0049	7		TRANSISTOR ARRAY 16-PIN PLSTC DIP		1858-0049
A5U16	1820-1662	3	2	IC SHF-RGTR CMOS SERIAL-IN PRL-OUT 8-BIT	3L585	CD4094BE
A5U17	1820-1662	3		IC SHF-RGTR CMOS SERIAL-IN PRL-OUT 8-BIT	3L585	CD4094BE
A5U18	1858-0077	1	1	TRANSISTOR ARRAY 14-PIN PLSTC TO-116	04713	MPQ2222P
A5U19	1858-0076	0	1	TRANSISTOR ARRAY 14-PIN PLSTC TO-116	04713	MPQ2907P
A5W1	1258-0141	8		JUMPER-REM	28480	1258-0141
A5W2	1258-0141	8		JUMPER-REM	28480	1258-0141
	0340-0060	4		TERMINAL-STUD SPCL-FDTHRU PRESS-MTG	98291	011-6809 000 209
	0340-0092	2		TERMINAL-STUD SPCL-FDTHRU PRESS-MTG	28480	0340-0092
	8159-0005	0	7	RESISTOR-ZERO OHMS 22 AWG LEAD DIA	28480	8159-0005
	04145-00613	9	1	SHIELD-COVER (PATTERN SIDE)	28480	04145-00613
	04145-00614	0	1	SHIELD-COVER (COMPONENT SIDE)	28480	04145-00614
A9	04145-66559	0	1	HP-IB AND MSU CONTROL BOARD ASS'Y	28480	04145-66559
A9C1	0180-0229	7			56239	150D336X9010B2
A9C2	0160-6561	7		CAPACITOR-FXD .1UF +- 20% 50VDC CER	28480	0160-6561
A9C3	0160-6561	7		CAPACITOR-FXD .1UF +- 20% 50VDC CER	28480	0160-6561
A9C4	0160-6561	7		CAPACITOR-FXD .1UF +- 20% 50VDC CER	28480	0160-6561
A9C5	0180-0229	3		CAPACITOR-FXD 33UF+-5% 100VDC CER	52389	150D336X9010B2
A9C6	0160-6561	7		CAPACITOR-FXD .1UF +- 20% 50VDC CER	28480	0160-6561
A9C7	0160-6561	7		CAPACITOR-FXD .1UF +- 20% 50VDC CER	28480	0160-6561
A9C8	0160-6561	7		CAPACITOR-FXD .1UF +- 20% 50VDC CER	28480	0160-6561
A9C9	0160-6561	7	1	CAPACITOR-FXD .1UF +- 20% 50VDC CER	28480	0160-6561
A9C10	0160-6561	7		CAPACITOR-FXD .1UF +- 20% 50VDC CER	28480	0160-6561
A9C11	0160-6561	7		CAPACITOR-FXD .1UF +- 20% 50VDC CER	28480	0160-6561
A9C12	0160-6561	7		CAPACITOR-FXD .1UF +- 20% 50VDC CER	28480	0160-6561
A9C13	0160-4801	7		CAPACITOR-FXD 100PF +-5% 100VDC CER	28480	0160-4835
A9C14	0160-4830	8		CAPACITOR-FXD 2200PF +-5% 100VDC CER	28480	0160-4810
A9C15	0160-4832	4	17	CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A9J3	0360-1901	6		CABLE TRANSITION	28480	0360-1901
A9J4	1251-4617	7		CONNECTOR 4-PIN M UTILITY	28480	1251-4617
A9J5	1251-8601	7		CONN-POST-TP-HDR		
A9J6	1251-4822	6		CONNECTOR 3 PIN M POST TYPE	28480	1251-4822
A9J7	1251-4822	6		CONNECTOR 3 PIN M POST TYPE	28480	1251-4822
A9L1	9100-3139	5		INDUCTOR 75UH 15% .5DX.875LG	28480	9100-3139
A9R1	0757-0200	7		RESISTOR 5.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5621-F
A9R2	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A9R3	0698-0084	9		REISOTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1251-F
A9R4	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A9R5	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A9R6	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A9RA1-3	1810-0280	8		NETWARK-RES 10-SIP 10.0K OHMx9		
A9U1	1820-1197	9		IC GATE TTL LS QUAD 2-INP	01295	SN74LS00N
A9U2	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG-COM	01295	SN74LS273N
A9U3	1820-2075	4		IC MISC TTL LS	01295	SN74LS245N
A9U4	1820-1199	1		IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A9U5	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LD00N
A9U6	1820-2058	3	4	IC MISC TTL S QUAD	01295	SN74LS32N
A9U7	1820-0621	2		IC BFR TTL NAND QUAD 2-INP		
A9U8	1820-3006	3		IC-MPU MB8876A	S0167	MB8876A
A9U9	1820-1144	6		IC GATE TTL LS NOR QUAD 2-INP	01295	SN74LS02N
A9U10	1820-1208	3		IC GATE TTL LS OR QUAD 2-INP	01295	SN74LS32N

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A9U11	1820-2058	3		IC MISC TTL S QUAD	07263	MC3448AL
A9U12	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A9U13	1820-2058	3		IC MISC TTL S QUAD	07263	MC3448AL
A9U14	1820-1416	5		IC SCHMITT-TRIG TTL LS INV HEX 1-INP	01295	SN74LS14N
A9U15	1826-1408	7		IC MB4107	S0167	MB4107
A9U16	1820-2549	7		IC-8291A P HPIB	28480	1820-2549
A9U17	1820-2058	3		IC MISC TTL S QUAD	07263	MC3448AL
A9U18	1820-1416	5	2	IC SCHMITT-TRIG TTL LS INV HEX 1-INP	01295	SN74LS14N
A9U19	1820-2024	3		IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
A9W1	1258-0141	8		JUMPER-REM	28480	1258-0141
A9W2	1258-0141	8		JUMPER-REM	28480	1258-0141
	8159-0005	0		RESISTOR-ZERO OHMS 22 AWG LEAD DIA	28480	8159-0005
	04145-61640	6	1	CABLE ASSEMBLY	28480	04145-61640
A10	04145-66510	3	1	KEYBOARD AND DISPLAY CONTROL BOARD ASS'Y	28480	04145-66510
A10C1	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A10C2	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A10C3	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A10C4	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A10C5	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A10C6	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A10C7	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A10C8	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A10C9	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A10DS1	1990-0487	7	5	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4584
A10DS2	1990-0487	7		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4584
A10DS3	1990-0487	7		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4584
A10DS4	1990-0487	7		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4584
A10DS5	1990-0670	0	8	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	1990-0670
A10DS6	1990-0670	0		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	1990-0670
A10DS7	1990-0670	0		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	1990-0670
A10DS8	1990-0670	0		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	1990-0670
A10DS9	1990-0670	0		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	1990-0670
A10DS10	1990-0670	0		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	1990-0670
A10DS11	1990-0487	7		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4584
A10DS12	1990-0670	0		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	1990-0670
A10DS13	1990-0665	3	1	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	1990-0665
A10DS14	1990-0670	0		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	1990-0670
A10DS15	1990-0517	4	1	LED-LAMP LUM-INT=3MCD IF=20MA-MAX BVR=5V	28480	5082-4655
A10J1	0360-1901	6		CABLE TRANSITION 34-TERM GL-FLD POLYE		
A10R1	1810-0279	5	2	NETWORK-RES 10-SIP4.7K OHM X 9	01121	210A472
A10R2	1810-0283	1	2	NETWORK-RES 16-DIP270.0 OHM X 8	28480	1810-0283
A10R3	1810-0283	1		NETWORK-RES 16-DIP270.0 OHM X 8	28480	1810-0283
A10R4	1810-0279	5		NETWORK-RES 10-SIP4.7K OHM X 9	01121	210A472
A10S1-S66	5060-9436	7	66	PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A10U1	1820-1207	2	1	IC GATE TTL LS NAND 8-INP	01295	SN74LS30N
A10U2	1820-1199	1		IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A10U3	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A10U4	1820-2096	9	1	IC CNTR TTL LS BIN DUAL 4-BIT	01295	SN74LS393N
A10U5	1820-1461	0	2	IC FF TTL D-TYPE POS-EDGE-TRIG CLEAR	01295	SN74273
A10U6	1820-1461	0		IC FF TTL D-TYPE POS-EDGE-TRIG CLEAR	01295	SN74273
A10U7	1820-1208	3		IC GATE TTL LS OR QUAD 2-INP	01295	SN74LS32N
A10U8	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A10U9	1820-1473	4	1	IC ENCDR TTL 8-INP	01295	SN74148N
A10U10	1820-1443	8		IC CNTR TTL LS BIN ASYNCHRO	01295	SN74LS293N
A10U11	1820-1427	8	1	IC DCDR TTL LS 2-TO-4-LINE DUAL 2-INP	01295	SN74LS156N
	04145-61618	2	1	CABLE ASSEMBLY	28480	04145-61618
	5041-0059	2	4	KEY CAP-PALM-BRN-PRL	28480	5041-0059
	5041-0063	8	1	KEY CAP-PALM-BRN-PRL	28480	5041-0063
	5041-0277	6	21	KEY CAP-PRL	28480	5041-0277
	5041-0286	7	8	KEY CAP-HALF, L-PRL	28480	5041-0286
	5041-0343	7	13	KEY CAP-HALF	28480	5041-0343
	5041-0376	6	4	KEY CAP-HALF	28480	5041-0376
	5041-0451	8	1	KEY CAP-HALF	28480	5041-0451
	5041-0475	6	1	KEY CAP-HALF	28480	5041-0475
	5041-0508	6	1	KEY CAP-HALF	28480	5041-0508
	5041-0808	9	1	KEY CAP-HALF,SMOKE-SMST	28480	5041-0808
	5041-0811	4	1	KEY CAP-HALF,SMOKE-SMST	28480	5041-0811
	5041-0812	5	1	KEY CAP-HALF,SMOKE-SMST	28480	5041-0812
	5041-0813	6	1	KEY CAP-HALF,SMOKE-SMST	28480	5041-0813
	5041-0814	7	1	KEY CAP-HALF,SMOKE-SMST	28480	5041-0814
	5041-0815	8	1	KEY CAP-HALF,SMOKE-SMST	28480	5041-0815

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
	5041-0816	9	2	KEY CAP-HALF,SMOKE-SMST	28480	5041-0816
	5041-0817	0	1	KEY CAP-HALF,SMOKE-SMST	28480	5041-0817
	5041-0818	1	1	KEY CAP-HALF,SMOKE-SMST	28480	5041-0818
	5041-0819	2	1	KEY CAP	28480	5041-0819
	5041-1881	0	1	KEY CAP-HALF	28480	5041-1881
	2950-0001	8		NUT-HEX-DBL-CHAM		
	0960-0683	1		ROTARY PULSE GENERATOR INPUT POWER: 5VDC		
	04191-40002	0	1	INSULATOR	28480	04191-40002
	5040-3328		1	INSULATOR	28480	
	5040-3322	6	1	INSULATOR	28480	5040-3322
	2190-0016			WSHR-LK INTL T		
A11	04145-66511	4		SWITCHING POWER SUPPLY BOARD ASS'Y (COMPONENT SIDE SHIELD COVER IS NOT INCLUDED)	28480	04145-66511
A11C1	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A11C2	0180-1050	4	1	CAPACITOR-FXD 100UF 25VDC	28480	0180-1050
A11C3	0180-3184	9	3	CAPACITOR-FXD 2200UF 35VDC AL	28480	0180-3184
A11C4	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A11C5	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A11C6	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A11C7	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A11C8	0180-3168	9	2	CAPACITOR-FXD 10UF 250VDC AL	28480	0180-3168
A11C9	0180-3168	9		CAPACITOR-FXD 10UF 250VDC AL	28480	0180-3168
A11C10	0160-3969	6	2	CAPACITOR-FXD .015UF +-20PF 250VAC(RMS)	28480	0160-3969
A11C11	0160-3969	6		CAPACITOR-FXD .015UF +-20PF 250VAC(RMS)	28480	0160-3969
A11C12	0180-3179	2	2	CAPACITOR-FXD 330UF 200VDC	28480	0180-3179
A11C13	0180-3179	2		CAPACITOR-FXD 330UF 200VDC	28480	0180-3179
A11C14	0160-4824	4	1	CAPACITOR-FXD 680PF +-5% 100VDC CER	28480	0160-4824
A11C15	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A11C16	0180-1704	5	1	CAPACITOR-FXD 47UF+-10% 6VDC TA	56289	150D476X9006B2
A11C17	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A11C18	0160-3456	6	1	CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A11C19	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A11C20	0160-6228	5	1	CAPACITOR-FXD 1.5UF +-20% 400VDC	28480	0160-6228
A11C21	0160-4822	2		CAPACITOR-FXD 1000PF 5% 100 VDC CER	55680	
A11CP1	1990-0444	6		OPTO-ISOLATOR LED-PDIO/XSTR IF=25MA-MAX	28480	6N136
A11CP2	1990-0663	1	2	OPTO-ISOLATOR LED-PXSTR IF=40MA-MAX	28480	1990-0663
A11CP3	1990-0663	1		OPTO-ISOLATOR LED-PXSTR IF=40MA-MAX	28480	1990-0663
A11CR1	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A11CR2	1906-0051	4	3	DIODE-FW BRDG 100V 1A	28480	1906-0051
A11CR3	1906-0080	9	1	DIODE-FW BRDG 600V 10A	28480	1906-0080
A11CR4	1906-0051	4		DIODE-FW BRDG 100V 1A	28480	1906-0051
A11CR5	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A11CR6	1901-1065	2	2	DIODE-PWR RECT 1N4936 400V 1A 200NS	14936	1N4936
A11CR7	1901-1065	2		DIODE-PWR RECT 1N4936 400V 1A 200NS	14936	1N4936
A11F1	2110-0663		1	FUSE-THERMAL		
A11F2	2110-0304	4	1	FUSE 1.5A 250V TD 1.25X.25 UL	28480	2110-0304
A11F3	2110-0381	7	1	FUSE 3A 250V TD 1.25X.25	28480	2110-0381
A11J1	1251-4246	8	2	CONNECTOR 3-PIN M POST TYPE	28480	1251-4246
A11J2	1251-4246	8		CONNECTOR 3-PIN M POST TYPE	28480	1251-4246
A11J3	1251-7406	8		CONNECTOR-10 PIN MALE	28480	1251-7406
A11J4	1251-7463	7		CONNECTOR-12 PIN MALE	28480	1251-7463
A11J5	1251-7406	8	4	CONNECTOR-10 PIN MALE	28480	1251-7406
A11J6	1251-3837	1	1	CONNECTOR 4-PIN M UTILITY	28480	1251-3837
A11K1	0490-1312	8	1	RELAY	28480	0490-1312
A11L1	9140-0401	2	2	COIL-FXD 64 UH	28480	9140-0401
A11L2	9140-0401	2		COIL-FXD 64 UH	28480	9140-0401
A11L3	9140-0674	1	1	COIL-FXD 3.3MH X 2	28480	9140-0674
A11Q1	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A11Q2	1853-0281	9		TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A11Q3	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A11Q4	1853-0281	9		TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A11Q5	1854-0232	2	1	TRANSISTOR NPN SI TO-39 PD=1W FT=15MHZ	28480	1854-0232
A11Q6	1854-0624	6	2	TRANSISTOR NPN 2N6308 SI TO-3 PD=125W	04713	2N6308
A11Q7	1854-0624	6		TRANSISTOR NPN 2N6308 SI TO-3 PD=125W	04713	2N6308
A11R1	0698-3452	1	1	RESISTOR 147K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1473-F
A11R2	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A11R3	2100-3210	6		RESISTOR-TRMR 10K 10% C TOP-ADJ 1-TRN	28480	2100-3210
A11R4	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A11R5	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A11R6	0757-0346	2		RESISTOR 10 1% .125W TF TC=0+-100		
A11R7	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A11R8	0757-0317	9		RESISTOR 1.33K 1% .125W F TC=0+-100		
A11R9	0698-4539	7	2	RESISTOR 402K 1% .125W F TC=0+-100	28480	0698-4539
A11R10	0698-4539	7		RESISTOR 402K 1% .125W F TC=0+-100	28480	0698-4539
A11R11	0761-0083	3	2	RESISTOR 68K 5% 1W MO TC=0+-200	28480	0761-0083

See introduction to this section for ordering information
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Table 6-3. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A11R12	0761-0083	3		RESISTOR 68K 5% 1W MO TC=0+-200	28480	0761-0083
A11R13	0811-3621	4	2	RESISTOR 8 5% 2W PW TC=0+-400		
A11R15	0757-0444	1	1	RESISTOR 12.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1212
A11R16	0757-0294	9	1	RESISTOR 17.8 1% .125W F TC=0+-100	24546	
A11R17	2100-3211	7	1	RESISTOR-TRMR 1K 10% C TOP-ADJ 1-TRN	28480	2100-3211
A11R18	0812-0021	8	1	RESISTOR .47 5% 3W PW TC=0+-90	91637	CW2B1 3-T2-47/100-J
A11R19	0764-0015	7	1	RESISTOR 560 5% 2W MO TC=0+-200	28480	0764-0015
A11R20	0683-0335	2		RESISTOR 3.3 5% .25W FC TC=-400/+500	01121	CB33G5
A11R21	0757-0346	2		RESISTOR 10 1% .125W TF TC=0+-100		
A11R22	0683-0335	2		RESISTOR 3.3 5% .25W FC TC=-400/+500	01121	CB33G5
A11R23	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	
A11R24	0698-4444	3		RESISTOR 4.87K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4871-F
A11R25	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A11R26	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A11R27	0757-0379	1	1	RESISTOR 12.1K 1% .125W F TC=0+-100	24546	
A11R28	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A11R29	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A11RV1	0837-0106	2	2	VARISTOR	28480	0837-0106
A11RV2	0837-0106	2		VARISTOR	28480	0837-0106
A11T1	9140-0710	9	1	TRANSFORMER-POWER	28480	PPNR72943
A11T2	9140-0711	0	2	TRANSFORMER-DRIVE	28480	PPNR72944
A11T3	9140-0711	0		TRANSFORMER-DRIVE	28480	PPNR72944
A11U1	1826-0138	8	1	IC COMPARATOR GP QUAD 14-DIP-P PKG	01295	LM339N
A11U2	1826-0910	4	1	IC-LINEAR	28480	1826-0910
A11U3	1826-0099	0	1	IC V RGLTR TO-220	07263	7812UC
A11U4	1813-0255	3	1	IC SW-M CKT 22 PKG	28480	1813-0255
	0340-0039	7	4	TERMINAL BUSHING - TEFLON: MOUNTS IN	28480	0340-0039
	0340-0092	2		TERMINAL-STUD SPCL-FDTHRU PRESS-MTG	28480	0340-0092
	0340-0220	8	5	BEADS	28480	0340-0220
	1205-0310	7	2	HEAT SINK	28480	1205-0310
	1205-0373	2	1	HEAT SINK	28480	1205-0373
	2110-0269	0		FUSEHOLDER-CLIP TYPE.250-FUSE	28480	2110-0269
	1400-0249	0	11	CABLE TIE .062-.625-DIA .091-WD NYL	06383	PLT1M-8
	2360-0115	4	11	SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2360-0119	8	1	SCREW-MACH 6-32 .438-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2360-0121	2	4	SCREW-MACH 6-32 .5-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2420-0006	0	2	NUT-HEX-W/LKWR 6-32-THD .109-IN-THK	00000	ORDER BY DESCRIPTION
	3050-0010	2	1	WASHER-FL MTLC NO. 6 .147-IN-ID	28480	3050-0010
	04145-00611	7	1	SHIELD-COVER(PATTERN SIDE)	28480	04145-00611
	04192-01208	7	1	HEAT SINK	28480	04192-01208
	04145-00612	8	1	SHIELD-COVER(COMPONENT SIDE)	28480	04145-00612
A12	04145-66512	5	1	DC POWER SUPPLY BOARD ASS'Y	28480	04145-66512
A12C1	0180-2980	1	9	CAPACITOR-FXD 1000UF+-20% 35VDC AL	28480	0180-2980
A12C2	0180-2980	1		CAPACITOR-FXD 1000UF+-20% 35VDC AL	28480	0180-2980
A12C3	0180-3184	9		CAPACITOR-FXD 2200 UF 35VDC	28480	0180-3184
A12C4	0180-3184	9		CAPACITOR-FXD 2200 UF 35VDC	28480	0180-3184
A12C5	0180-2980	1		CAPACITOR-FXD 1000UF+-20% 35VDC AL	28480	0180-2980
A12C6	0180-2980	1		CAPACITOR-FXD 1000UF+-20% 35VDC AL	28480	0180-2980
A12C7	0180-2980	1		CAPACITOR-FXD 1000UF+-20% 35VDC AL	28480	0180-2980
A12C8	0180-2980	1		CAPACITOR-FXD 1000UF+-20% 35VDC AL	28480	0180-2980
A12C9	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A12C10	0160-6561	7		CAPACITOR-FXD .1UF +- 20% 50VDC CER	28480	0160-6561
A12C11	0160-6561	7		CAPACITOR-FXD .1UF +- 20% 50VDC CER	28480	0160-6561
A12C12	0160-6561	7		CAPACITOR-FXD .1UF +- 20% 50VDC CER	28480	0160-6561
A12C13	0180-0116	1	1	CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A12C14	0180-0291	3	13	CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A12C15	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A12CR1	1902-0041	4	1	DIODE-ZNR 5.11V 5% DO-35 PD=.4W	28480	1902-0041
A12CR2	1902-1232	7	1	DIODE-ZNR 1N3997RA 5.6V 5% DO-4 PD=10W	04713	1N3997RA
A12CR3	1906-0053	6	1	DIODE-FW BRDG 100V 5A	28480	1906-0053
A12CR4	1901-0765	7	2	DIODE-PWR RECT 1N5812 50V 20A 35NS DO-4	12969	1N5812
A12CR5	1901-0765	7		DIODE-PWR RECT 1N5812 50V 20A 35NS DO-4	12969	1N5812
A12CR6	1901-0988	6		DIODE-STEP RCVY 200V 3A 150NS		
A12CR7	1901-0988	6		DIODE-STEP RCVY 200V 3A 150NS		
A12J1	1251-7463	7		CONNECTOR-12 PIN MALE	28480	1251-7463
A12J2	1251-4617	7	1	CONNECTOR 4-PIN M UTILITY	28480	1251-4617
A12J3	1251-7406	8		CONNECTOR-10 PIN MALE	28480	1251-7406
A12J4	1200-0485	2	1	SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-0485
A12J5	0360-1901	6		CABLE TRANSITION		
A12J6	1251-7463	7		CONNECTOR-12 PIN MALE	28480	1251-7463
A12J7	1251-7406	8		CONNECTOR-10 PIN MALE	28480	1251-7406
A12L1	9100-3139	5		INDUCTOR 75UH 15% .5DX.875LG	28480	9100-3139
A12L2	9100-3139	5		INDUCTOR 75UH 15% .5DX.875LG	28480	9100-3139
A12L3	9100-3139	5		INDUCTOR 75UH 15% .5DX.875LG	28480	9100-3139
A12L4	9100-3139	5		INDUCTOR 75UH 15% .5DX.875LG	28480	9100-3139
A12L5	9140-0672	9	1	COIL- 2.2MH	28480	9140-0672

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A12L6	9140-0702	4	1	COIL- 2MH X 2	28480	PPNR72930
A12L7	9140-0675	2	1	COIL- 150UH	28490	9140-0675
A12L8	9140-0673	0	1	COIL- 1MH	28480	9140-0673
A12R1	0698-3404	3	1	RESISTOR 383 1% .5W F TC=0+-100	28480	0698-3404
A12R2	0757-0816	1	2	RESISTOR 681 1% .5W F TC=0+-100	28480	0757-0816
A12R3	0757-0816	1		RESISTOR 681 1% .5W F TC=0+-100	28490	0757-0816
A12R4	0698-0090	7	2	RESISTOR 464 1% .5W F TC=0+-100	28480	0698-0090
A12R5	0698-0090	7		RESISTOR 464 1% .5W F TC=0+-100	28480	0698-0090
A12R6	0757-0459	8		RESISTOR 56.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5622-F
A12R7	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A12R8	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A12S1	3101-1973	7		SWITCH-SL 7-1A DIP-SLIDE-ASSY .1A 50VDC	28480	3101-1973
A12U1	1820-1994	4	1	IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS243N
A12U2	1820-1201	6		IC GATE TTL LS AND QUAD 2-INP	01295	SN74LS08N
A12U3	1820-1437	0		IC MV TTL LS MONOSTBL DUAL	01295	SN74LS221N
A12U4	1826-0904	6	1	IC-LINEAR	28480	1826-0904
A12W1	04145-61621	7	1	CABLE ASSEMBLY	28480	04145-61621
	0360-1901	6	2	CABLE TRANSITION	28480	0360-1901
	0361-0079	9	2	RIVET-SEMITUBULAR	28480	0361-0079
	8150-0038	1		WIRE- 22 Y	28480	8150-0038
	04145-61607	9	1	WIRING ASSEMBLY	28480	04145-61607
	04192-01207	6	1	HEAT SINK	28480	04192-01207
	2740-0003	5	2	NUT HEX-W/LKWR 10-32-THD .125-IN-THK	00000	ORDER BY DESCRIPTION
	1251-3283		1	CONNECTOR-24 PIN	28480	1251-3283
A13	04145-66513	6	1	SMU POWER SOURCE BOARD ASS'Y	28480	04145-66513
A13C1	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A13C2	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A13C3	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A13C4	0180-3185	0	4	CAPACITOR-FXD 100UF 35 VDC AL	28480	0180-3185
A13C5	0180-3185	0		CAPACITOR-FXD 100UF 35 VDC AL	28480	0180-3185
A13C101	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A13C102	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A13C103	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A13C104	0180-3185	0		CAPACITOR-FXD 100UF 35 VDC AL	28480	0180-3185
A13C105	0180-3185	0		CAPACITOR-FXD 100UF 35 VDC AL	28480	0180-3185
A13CR1	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A13CR2	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A13CR3	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A13CR4	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A13CR5	1906-0076	3	4	DIODE-FW BRDG 400V 1A	28480	1906-0076
A13CR101	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A13CR102	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A13CR103	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28490	1901-0033
A13CR104	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A13CR105	1906-0076	3		DIODE-FW BRDG 400V 1A	28480	1906-0076
A13J1	1251-7406	8		CONNECTOR-10 PIN MALE	28480	1251-7406
A13J2	1251-7406	8		CONNECTOR-10 PIN MALE	28480	1251-7406
A13L1	9140-0704	6	2	COIL-5 MH X 2	28480	PPNR72932
A13L101	9140-0704	6		COIL-5 MH X 2	28480	PPNR72932
A13Q1	1854-0918	1	2	TRANSISTOR NPN TO-220AB PD=1.5W	28480	1854-0918
A13Q2	1853-0514	1	2	TRANSISTOR PNP TO-220AB PD=1.5W	28480	1853-0514
A13Q3	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A13Q4	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28490	1853-0459
A13Q5	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A13Q6	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A13Q7	1854-0523	4	6	TRANSISTOR NPN SI TO-39 PD=1W FT=150MHZ	28480	1854-0523
A13Q8	1853-0232	0	6	TRANSISTOR PNP SI TO-39 PD=1W FT=200MHZ	28480	1853-0232
A13Q9	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A13Q10	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A13Q11	1854-0523			TRANSISTOR NPN SI TO-39 PD=1W FT=150MHZ	28480	1854-0523
A13Q12	1853-0232	4		TRANSISTOR PNP SI TO-39 PD=1W FT=200MHZ	28480	1853-0232
A13Q101	1854-0918	0		TRANSISTOR NPN TO-220AB PD=1.5W	28480	1854-0918
A13Q102	1853-0514	1		TRANSISTOR PNP TO-220AB PD=1.5W	28480	1853-0514
A13Q103	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A13Q104	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A13Q105	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28490	1854-0810
A13Q106	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A13Q107	1854-0523	4		TRANSISTOR NPN SI TO-39 PD=1W FT=150MHZ	28480	1854-0523
A13Q108	1853-0232	0		TRANSISTOR PNP SI TO-39 PD=1W FT=200MHZ	28480	1853-0232
A13Q109	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A13Q110	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A13Q111	1854-0523	4		TRANSISTOR NPN SI TO-39 PD=1W FT=150MHZ	28480	1854-0523
A13Q112	1853-0232	0		TRANSISTOR PNP SI TO-39 PD=1W FT=200MHZ	28480	1853-0232
A13R1	0683-0475	2		RESISTOR 4.7 5% .25W FC TC=-400/+500	01121	CB33G5
A13R2	0757-0424	7	4	RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A13R3	0757-0273	4	4	RESISTOR 3.01K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3011-F
A13R4	0757-0273	4		RESISTOR 3.01K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3011-F
A13R5	0757-0424	7		RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A13R6	0683-0475	2		RESISTOR 4.7 5% .25W FC TC=-400/+500	01121	CB33G5
A13R7	0698-3162	0		RESISTOR 46.4K 1% .125W TF TCO+-100	24546	CT4-1/8-TO-4642-F
A13R8	0683-0825	5	4	RESISTOR 8.2 5% .25W FC TC=-400/+500	01121	CB82G5
A13R9	0683-0825	5		RESISTOR 8.2 5% .25W FC TC=-400/+500	01121	CB82G5
A13R10	0698-3162	0		RESISTOR 46.4K 1% .125W TF TCO+-100	24546	CT4-1/8-TO-4642-F
A13R11	0698-3159	5		RESISTOR 26.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2612-F
A13R12	0698-3430	5	4	RESISTOR 21.5 1% .125W F TC=0+-100	24546	
A13R13	0698-3430	5		RESISTOR 21.5 1% .125W F TC=0+-100	24546	
A13R14	0698-3159	5		RESISTOR 26.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2612-F
A13R15	0757-0439	4		RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A13R16	0698-4425	0	2	RESISTOR 1.54K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1541-F
A13R17	0757-0403	2	3	RESISTOR 121 1% .125W F TC=0+-100	24546	C4-1/8-T0-121R-F
A13R101	0683-0475	1		RESISTOR 4.7 5% .25W FC TC=-400/+500	01121	CB33G5
A13R102	0757-0424	7		RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A13R103	0757-0273	4		RESISTOR 3.01K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3011-F
A13R104	0757-0273	4		RESISTOR 3.01K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3011-F
A13R105	0757-0424	7		RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A13R106	0683-0475	2		RESISTOR 4.7 5% .25W FC TC=-400/+500	01121	CB33G5
A13R107	0698-3162	0		RESISTOR 46.4K 1% .125W TF TCO+-100	24546	CT4-1/8-TO-4642-F
A13R108	0683-0825	5		RESISTOR 8.2 5% .25% FC TC=-400/+500	01121	CB82G5
A13R109	0683-0825	5		RESISTOR 8.2 5% .25W FC TC=-400/+500	01121	CB82G5
A13R110	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A13R111	0698-3159	5		RESISTOR 26.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2612-F
A13R112	0698-3430	5		RESISTOR 21.5 1% .125W F TC=0+-100	24546	
A13R113	0698-3430	5		RESISTOR 21.5 1% .125W F TC=0+-100	24546	
A13R114	0698-3159	5		RESISTOR 26.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2612-F
A13R115	0757-0439	4		RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A13R116	0698-4425	0		RESISTOR 1.54K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1541-F
A13R117	0757-0403	2		RESISTOR 121 1% .125W F TC=0+-100	24546	C4-1/8-T0-121R-F
A13T1	9140-0708	7	2	TRANSFORMER-FLOATING	28480	PPNR72941
A13T101	9140-0708	7		TRANSFORMER-FLOATING	28480	PPNR72941
A13U1	1826-0353	0	2	IC 7815 V RGLTR TO-220	04713	MC7815CP
A13U2	1826-0558	6		IC V RGLTR-ADJ-NEG 1.2/37V TO-39 PKG	27014	LM337H
A13U101	1826-0353	0		IC 7815 V RGLTR TO-220	04713	MC7815CP
A13U102	1826-0558	6		IC V RGLTR-ADJ-NEG 1.2/37V TO-39 PKG	27014	LM337H
	04145-01210		4	ANGLE		
	2360-0115	4		SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A15	04145-66515	8	1	FLOATING POWER SUPPLY BOARD ASS'Y	28480	04145-66515
A15C1	0180-3186	1	4	CAPACITOR-FXD 100UF 100VDC AL	28480	0180-3186
A15C2	0180-3186	1		CAPACITOR-FXD 100UF 100VDC AL	28480	0180-3186
A15C3	0180-3187	2	2	CAPACITOR-FXD 220UF 100VDC AL	28480	0180-3187
A15C4	0180-3186	1		CAPACITOR-FXD 100UF 100VDC AL	28480	0180-3186
A15C5	0180-3186	1		CAPACITOR-FXD 100UF 100VDC AL	28480	0180-3186
A15C6	0180-3187	2		CAPACITOR-FXD 220UF 100VDC AL	28480	0180-3187
A15C7	0180-2980	1		CAPACITOR-FXD 1000UF 35VDCV	28480	0180-2980
A15C8	0180-2980	1		CAPACITOR-FXD 1000UF 35VDCV	28480	0180-2980
A15C9	0180-2980	1		CAPACITOR-FXD 1000UF 35VDCV	28480	0180-2980
A15C10	0160-4832	4		CAPACITOR-FXD .01UF +-10% 100VDC CER	28480	0160-4832
A15C11	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A15C12	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A15C13	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A15C14	0180-3169	0	6	CAPACITOR-FXD 4.70UF 250VDC AL	28480	0180-3169
A15C15	0180-3169	0		CAPACITOR-FXD 4.70UF 250VDC AL	28480	0180-3169
A15C16	0180-3169	0		CAPACITOR-FXD 4.70UF 250VDC AL	28480	0180-3169
A15C17	0180-3169	0		CAPACITOR-FXD 4.70UF 250VDC AL	28480	0180-3169
A15C18	0180-3169	0		CAPACITOR-FXD 4.70UF 250VDC AL	28480	0180-3169
A15C19	0180-3169	0		CAPACITOR-FXD 4.70UF 250VDC AL	28480	0180-3169
A15C20	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A15C21	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A15C22	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A15CR1	1906-0273	2		DIODE-HV RECT 1.2KV 800MA		
A15CR2	1906-0273	2		DIODE-HV RECT 1.2KV 800MA		
A15CR3	1906-0273	2		DIODE-HV RECT 1.2KV 800MA		
A15CR4	1906-0273	2		DIODE-HV RECT 1.2KV 800MA		
A15CR5	1906-0076	3		DIODE-FW BRDG 400V 1A	28480	1906-0076

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A15CR6	1906-0076	3		DIODE-FW BRDG 400V 1A	28480	1906-0076
A15CR7	1906-0076	3		DIODE-FW BRDG 400V 1A		
A15CR8	1901-0685	0		DIODE-PWR RECT 250V 5A 200NS		
A15CR9	1901-0685	0		DIODE-PWR RECT 250V 5A 200NS		
A15CR10	1901-0025	2		DIDDE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A15CR11	1902-3199	9	2	DIODE-ZNR 14V 2% DO-35 PD=.4W TC=+.056%	28480	1902-3199
A15CR12	1902-3199	9		DIODE-ZNR 14V 2% DO-35 PD=.4W TC=+.056%	28480	1902-3199
A15CR14	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A15L1	9140-0705	7	1	COIL-50MH X 2	28480	PPNR72933
A15L2	9140-0706	8	1	COIL-20MH X 2	28480	PPNR72934
A15L3	9140-0707	9	1	COIL-10MH X 2	28480	PPNR72935
A15L4	9140-0748	0		INDUCTOR 250UH 25% .25DX .5LG Q=3		
A15L5	9140-0748	0		INDUCTOR 250UH 25% .25DX .5LG Q=3		
A15L6	9140-0748	0		INDUCTOR 250UH 25% .25DX .5LG Q=3		
A15L7	9140-0748	0		INDUCTOR 250UH 25% .25DX .5LG Q=3		
A15L8	9140-0748	0		INDUCTOR 250UH 25% .25DX .5LG Q=3		
A15L9	9140-0748	0		INDUCTOR 250UH 25% .25DX .5LG Q=3		
A15L10	9100-4707	5	1	TRANSFORMER-BALUN L=2x4mH @ 1KHz	28480	
A15L11	9140-0671	8	1	COIL-470MH	28480	9140-0671
A15R1	0811-1670	3	1	RESISTOR 2.2 5% 2W PW TC=0+-400	75042	BWH2-2R2-J
A15R2	0698-3423	6	2	RESISTOR 46.4K 1% .5W F TC=0+-100	28480	0698-3423
A15R3	0698-3423	6		RESISTOR 46.4K 1% .5W F TC=0+-100	28480	0698-3423
A15R4	0757-0839	8	2	RESISTOR 10K 1% .5W F TC=0+-100	28480	0757-0839
A15R5	0757-0839	8		RESISTOR 10K 1% .5W F TC=0+-100	28480	0757-0839
A15R6	0757-0834	3	2	RESISTOR 5.62K 1% .5W F TC=0+-100	28480	0757-0834
A15R7	0757-0834	3		RESISTOR 5.62K 1% .5W F TC=0+-100	28480	0757-0834
A15R8	0698-3439	4	2	RESISTOR 178 1% .125W F TC=0+-100	24546	C4-1/8-T0-178R-F
A15R9	0698-3439	4		RESISTOR 178 1% .125W F TC=0+-100	24546	C4-1/8-T0-178R-F
A15R10	0575-0346	2		RESISTOR 10 1% .125W TF TC=0+-100		
A15R11	0698-3446	3	1	RESISTOR 383 1% .125W F TC=0+-100	24546	C4-1/8-T0-383R-F
A15R12	0757-0440	7	1	RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A15R13	0757-0403	2		RESISTOR 121 1% .125W F TC=0+-100	24546	C4-1/8-T0-121R-F
A15T1	9140-0709	8	1	TRANSFORMER-POWER	28480	PPNR72942
A15U1	1826-0539	3	1	IC LM317H TO-220	27014	LM317H
A15U2	1826-0558	6		IC V RGLTR-ADJ-POS 1.2/37V TO-39 PKG	27014	LM337H
A15U3	1826-0724	8	1	IC-LM350K	28480	1826-0724
A15W1	04145-61605	7	1	CABLE ASSEMBLY	28480	04145-61605
	1205-0310		1	HEAT SINK SGL TO-3-36		
	2360-0115	4		SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	1205-0475	0	2	HEAT SINK		
A16	04145-66516	9	1	VS/VM BOARD ASS'Y	28480	04145-66516
A16C1	0160-4789	0	2	CAPACITOR-FXD 15PF +-5% 100VDC CER 0+-30	28480	0160-4789
A16C3	0160-4811	9	2	CAPACITOR-FXD 270PF	28480	0160-4811
A16C4	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A16C5	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A16C6	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A16C7	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A16C8	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A16C9	0160-4801	7	2	CAPACITOR-FXD 100PF +-5% 100VDC CER	28480	0160-4801
A16C10	0180-1083	3		CAPACITOR-FXD 33UF 25VDC AL	28480	0180-1083
A16C11	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A16C12	0180-1083	3		CAPACITOR-FXD 33UF 25VDC AL	28480	0180-1083
A16C13	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A16C14	0180-1083	3		CAPACITOR-FXD 33UF 25VDC AL	28480	0180-1083
A16C15	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A16C101	0160-4789	0		CAPACITOR-FXD 15PF +-5% 100VDC CER 0+-30	28480	0160-4789
A16C103	0160-4811	9		CAPACITOR-FXD 270PF	28480	0160-4811
A16C104	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A16C105	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A16C106	0160-6561	7		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-6561
A16C109	0160-4801	7		CAPACITOR-FXD 100PF +-5% 100VDC CER	28480	0160-4801
A16CR1	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A16CR2	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A16CR3	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A16CR4	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A16CR5	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A16CR6	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A16CR7	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A16CR8	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A16CR9	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A16CR10	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A16CR11	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A16CR101	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A16CR102	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A16CR103	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A16CR104	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A16CR105	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A16CR106	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A16CR107	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A16CR108	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A16CR109	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A16CR110	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A16CR111	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A16K1	0490-1137	5		RELAY-REED 1A	28480	0490-1137
A16K101	0490-1137	5		RELAY-REED 1A	28480	0490-1137
A16L1	9140-0137	1	5	INDUCTOR RF-CH-MLD 1MH 5% .2DX.45LG Q=60	28480	9140-0137
A16L2	9140-0137	1		INDUCTOR RF-CH-MLD 1MH 5% .2DX.45LG Q=60	28480	9140-0137
A16L3	9140-0137	1		INDUCTOR RF-CH-MLD 1MH 5% .2DX.45LG Q=60	28480	9140-0137
A16L4	9140-0137	1		INDUCTOR RF-CH-MLD 1MH 5% .2DX.45LG Q=60	28480	9140-0137
A16L5	9140-0137	1		INDUCTOR RF-CH-MLD 1MH 5% .2DX.45LG Q=60	28480	9140-0137
A16Q1	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A16Q2	1853-0264	8	2	TRANSISTOR PNP SI PD=310MW FT=100MHZ	04713	2N5401
A16Q3	1854-0474	4		TRANSISTOR NPN SI PD=310MW FT=100MHZ	04713	2N5551
A16Q4	1854-0523	0		TRANSISTOR NPN SI TO-39 PD=1W FT=150MHZ	28480	1854-0523
A16Q5	1853-0232	4		TRANSISTOR PNP SI TO-39 PD=1W FT=200MHZ	28480	1853-0232
A16Q101	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A16Q102	1853-0264	8		TRANSISTOR PNP SI PD=310MW FT=100MHZ	04713	2N5401
A16Q103	1854-0474	4		TRANSISTOR NPN SI PD=310MW FT=100MH	04713	1853-0232
A16Q104	1854-0523	4		TRANSISTOR NPN SI TO-39 PD=1W FT=150MHZ	28480	1854-0523
A16Q105	1853-0232	0		TRANSISTOR PNP SI TO-39 PD=1W FT=200MHZ	28480	2N5551
A16R1	0699-0738	2	2	RESISTOR 990K .1% .25W F TC=0+-25	28480	0699-0738
A16R2	0698-8954	8	2	RESISTOR 500K .1% .125W F TC=0+-10	28480	0698-8954
A16R3	0699-0917	9	2	RESISTOR-FXD 4.5 MEGOHM	28480	0699-0917
A16R4	2100-3273	1	2	RESISTOR-TRMR 2K 10% C SIDE-ADJ 1-TRN	28480	2100-3273
A16R5	0698-3152	8	2	RESISTOR 3.48K 1% .125W F TC=0+-100	24546	C4-1/8-TO-3481-F
A16R6	0698-3495	2	2	RESISTOR 866 1% .125W F TC=0+-100	24546	C4-1/8-TO-866R-F
A16R7	0698-5450	3	2	RESISTOR 50K .1% .125W F TC=0+-50	19701	MF4C1/8-T2-5002-B
A16R8	0698-6358	2	2	RESISTOR 100K .1% .125W F TC=0+-25	28480	0698-6358
A16R9	0757-0280	3		RESISTOR 1K 1% .125W TF TC=0+-100	24546	CT4-1/8-TO-1001-F
A16R10	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A16R11	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A16R12	0757-0274	5		RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1211-F
A16R13	0757-0274	5		RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1211-F
A16R14	0757-0439	4		RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A16R15	0757-0439	4		RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A16R16	0698-3438	3		RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-147R-F
A16R17	0757-0821	8	4	RESISTOR 1.21K 1% .5W F TC=0+-100	28480	0757-0821
A16R18	0757-0821	8		RESISTOR 1.21K 1% .5W F TC=0+-100	28480	0757-0821
A16R19	0757-0280	3		RESISTOR 1K 1% .125W TF TC=0+-100	24546	CT4-1/8-TO-1001-F
A16R20	0698-8833	2	2	RESISTOR 10K .1% .125W F TC=0+-10	28480	0698-8833
A16R101	0699-0738	2		RESISTOR 990K .1% .25W F TC=0+-25	28480	0699-0738
A16R102	0698-8954	8		RESISTOR 500K .1% .125W F TC=0+-10	28480	0698-8954
A16R103	0699-0917	9		RESISTOR-FXD 4.5 MEGOHM	28480	0699-0917
A16R104	2100-3273	1		RESISTOR-TRMR 2K 10% C SIDE-ADJ 1-TRN	28480	2100-3273
A16R105	0698-3152	8		RESISTOR 3.48K 1% .125W F TC=0+-100	24546	C4-1/8-TO-3481-F
A16R106	0698-3495	2		RESISTOR 866 1% .125W F TC=0+-100	24546	C4-1/8-TO-866R-F
A16R107	0698-5450	3		RESISTOR 50K .1% .125W F TC=0+-50	19701	MF4C1/8-T2-5002-B
A16R108	0698-6358	2		RESISTOR 100K .1% .125W F TC=0+-25	28480	0698-6358
A16R109	0757-0280	3		RESISTOR 1K 1% .125W TF TC=0+-100	24546	CT4-1/8-TO-1001-F
A16R110	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A16R111	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A16R112	0757-0274	5		RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1211-F
A16R113	0757-0274	5		RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1211-F
A16R114	0757-0439	4		RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A16R115	0757-0439	4		RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A16R116	0698-3438	3		RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-147R-F
A16R117	0757-0821	8		RESISTOR 1.21K 1% .5W F TC=0+-100	28480	0757-0821
A16R118	0757-0821	8		RESISTOR 1.21K 1% .5W F TC=0+-100	28480	0757-0821
A16R120	0698-8833	2		RESISTOR 10K .1% .125W F TC=0+-10	28480	0698-8833
		1				
A16U1	1826-0909	1	4	IC-LINEAR LM11CH	27014	LM11CH
A16U2	1826-0909	1		IC-LINEAR LM11CH	27014	LM11CH
A16U3	1826-0909	1		IC-LINEAR LM11CH	27014	LM11CH
A16U4	1826-0909	1		IC-LINEAR LM11CH	27014	LM11CH

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A17	04145-66567	0	1	MOTHER BOARD ASS'Y (FRONT)	28480	04145-66567
A17J1	1251-7463	7		CONNECTOR-12 PIN MALE	28480	1251-7463
A17W1	8120-3470	8	3	CABLE,MULTI-CONDUCTOR	28480	8120-3470
A17W2	8120-3470	8		CABLE,MULTI-CONDUCTOR	28480	8120-3470
A17W3	8120-3470	8		CABLE,MULTI-CONDUCTOR	28480	8120-3470
A17XA1L	1251-5564	5		CONNECTOR-PC 2 X 22 CONTACTS	28480	1251-5564
A17XA1R	1251-5564	5		CONNECTOR-PC 2 X 22 CONTACTS	28480	1251-5564
A17XA2L	1251-5564	5		CONNECTOR-PC 2 X 22 CONTACTS	28480	1251-5564
A17XA2R	1251-5564	5		CONNECTOR-PC 2 X 22 CONTACTS	28480	1251-5564
A17XA3L	1251-5564	5		CONNECTOR-PC 2 X 22 CONTACTS	28480	1251-5564
A17XA3R	1251-5564	5		CONNECTOR-PC 2 X 22 CONTACTS	28480	1251-5564
A17XA4L	1251-5564	5		CONNECTOR-PC 2 X 22 CONTACTS	28480	1251-5564
A17XA4R	1251-5564	5		CONNECTOR-PC 2 X 22 CONTACTS	28480	1251-5564
A17XA5L	1251-5564	5		CONNECTOR-PC 2 X 22 CONTACTS	28480	1251-5564
A17XA5R	1251-5564	5		CONNECTOR-PC 2 X 22 CONTACTS	28480	1251-5564
A17XA6L	1251-5564	5		CONNECTOR-PC 2 X 22 CONTACTS	28480	1251-5564
A17XA6R	1251-5564	5		CONNECTOR-PC 2 X 22 CONTACTS	28480	1251-5564
A17XA7L	1251-5564	5		CONNECTOR-PC 2 X 22 CONTACTS	28480	1251-5564
A17XA7R	1251-5564	5		CONNECTOR-PC 2 X 22 CONTACTS	28480	1251-5564
A17XA8L	1251-5564	5		CONNECTOR-PC 2 X 22 CONTACTS	28480	1251-5564
A17XA8R	1251-5564	5		CONNECTOR-PC 2 X 22 CONTACTS	28480	1251-5564
A18	04145-66518	1	1	MOTHER BOARD ASS'Y (REAR)	28480	04145-66518
A18C1	1810-0585	6		CAPACITOR-FXD 470PF X 8	28480	1810-0585
A18J1	1251-7406	8		CONNECTOR-10 PIN MALE	28480	1251-7406
A18J2	1251-0292	6	1	CONNECTOR 24-PIN F MICRO RIBBON	28480	1251-0292
A18W1	8120-3526	5	1	CABLE, MULTI-CONDUCTOR	28480	8120-3526
A18W2	8120-3527	6	1	CABLE, MULTI-CONDUCTOR	28480	8120-3527
A18XA13	1251-5564	5		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-5564
A18XA14	1251-5564	5		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-5564
A18XA15	1251-5564	5		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-5564
A18XA16	1251-5564	5		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-5564
A19	04145-66519	2	1	SMU FILTER BOARD ASS'Y	28480	04145-66519
A19C1	0150-0075	8	2	CAPACITOR-FXD 4700PF +100-0% 500VDC CER	28480	0160-0075
A19C2	0150-0075	8		CAPACITOR-FXD 4700PF +100-0% 500VDC CER	28480	0160-0075
A19C3	0160-0161	4		CAPACITOR-FXD .01UF +-10% 200VDC POLYE	28480	0160-0161
A19C4	0160-4807	3	4	CAPACITOR-FXD 33PF +-5% 100VDC CER 0+-30	28480	0160-4807
A19C5	0160-0161	4		CAPACITOR-FXD .01UF +-10% 200VDC POLYE	28480	0160-0161
A19C6	0160-4807	3		CAPACITOR-FXD 33PF +-5% 100VDC CER 0+-30	28480	0160-4807
A19C7	0160-4807	3		CAPACITOR-FXD 33PF +-5% 100VDC CER 0+-30	28480	0160-4807
A19C8	0160-0161	4		CAPACITOR-FXD .01UF +-10% 200VDC POLYE	28480	0160-0161
A19C9	0160-4807	3		CAPACITOR-FXD 33PF +-5% 100VDC CER 0+-30	28480	0160-4807
A19C10	0160-0161	4		CAPACITOR-FXD .01UF +-10% 200VDC POLYE	28480	0160-0161
	0340-0078	4		TERMINAL-STUD SPCL-FDTHRU PRESS-MTG	98291	011-6809 000 209
	1400-0249	0		CABLE TIE .062-.625-DIA .091-WD NYL	06383	PLT1M-8
	04145-00621	9	3	SHIELD-PLATE	28480	04145-00621
A19W1	04145-61631		2	CABLE ASS'Y		
A19W2	04145-61632		2	CABLE ASS'Y		
A19W5	04145-61601		1	CABLE ASS'Y		
A19W6	04145-61602		1	CABLE ASS'Y		
A19W7	04145-61603		1	CABLE ASS'Y		
A19W8	04145-61604		1	CABLE ASS'Y		

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
1*	04145-04001		1	FAN COVER		
2*	04145-00204		1	REAR PANEL		
3*	3160-0465		1	FAN		
4*	2110-0569		1	NUT-FUSEHOLDER		
5*	2110-0564		1	FUSE HOLDER		
6*	04145-00101		1	CHASSIS		
7*	04145-00102		1	CHASSIS		
8	1250-0118		4	CONNECTOR-RF BNC		
8	2190-0016		4	WASHER		
8	2950-0001		4	NUT		
9	5040-4503		5	FASTNER INSULATOR		
10	04145-00205		1	REAR PANEL		
11	04145-00610		1	PLATE		
12	1251-0292		1	CONNECTOR 24-PIN FEMALE		
13	1250-1906			CONNECTOR-RF TRIAXIAL		
14	3101-0010		1	SWITCH (SLIDE)		
15	0515-0064		1	SCREW		
16	5021-5808		1	REAR FRAME		
17	04145-00617		1	PLATE		
18	2420-0001		2	NUT		
19	04145-00602		1	PLATE		
20	04145-00605		1	SHIELD PLATE		
21	04145-00105		1	CHASSIS		
22	04145-00604		1	SHIELD PLATE		
23	04145-00607		1	SIDE PLATE		
24	04145-00603		3	SHIELD PLATE		
25	5062-3736		1	TOP COVER		
26	04145-00616		1	PLATE		
27	0515-0889		20	SCREW		
28	5021-5838		4	STRUT		
29	04145-00103		1	CHASSIS		
30	5062-3848		2	SIDE COVER		
31	5021-8407		1	FRONT FRAME		
32	04145-00109		1	CHASSIS		
33	04145-00609		1	SHIELD PLATE		
34	04145-00663		1	PLATE		
35	04145-24009		4	WASHER		
36	2200-0165		4	SCREW		
37	04145-00231		1	FRONT PANEL (HP)		
37	04145-00232		1	FRONT PANEL (YHP)		
38	04145-01211		1	ANGLE		
39	1345A		1	DIGITAL DISPLAY		
40	0950-1752		1	FLEXIBLE-DISC DRIVE		
41	04145-01212		1	ANGLE		
42	2360-0115		4	SCREW		
43	0515-0924		4	SCREW		
44	2190-0584		4	WASHER		
45	7120-1254		1	TRADE MARK (HP)		
45	7120-0478		1	TRADE MARK (YHP)		
46	04145-24002		2	NUT		
47	2100-3972		1	RESISTOR-VARIABLE 1K		
48	2100-3971		1	RESISTOR-VARIABLE 20K		
49	04145-00131		1	CHASSIS		
50	5041-0564		1	KEY CAP		
51	04145-25003		1	ROD		
52	04145-00629		2	PLATE		
53	04145-01213		1	ANGLE		
54	5062-3748		1	BOTTOM COVER		
55	5041-8801		2	FOOT		
56	1460-1345		2	WIREFORM		
57	2360-0333		4	SCREW		
58	0515-1331		16	SCREW		
59	04145-00606		1	CENTER PLATE		
60	04145-40001		3	PLATE		
61	04145-40001		1	PLATE		
62	04145-00104		1	SHASSIS		
63	1510-0130			BINDING POST		
63	3050-0014		5	WASHER		
63	2190-0084		2	WASHER		
63	2950-0006		2	NUT		
64	5041-8819		2	STRAP-HANDLE-CAP (FRONT)		
65	0515-1132		4	SCREW		
66	04145-00608		1	SIDE PLATE		
67	5062-3705		2	STRAP-HANDLE		
68	5041-8820		2	STRAP-HANDLE-CAP (REAR)		

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
69*	04145-61626		1	C2 (P/N 0180-3178) ASSEMBLY		
70*	2360-0115		4	SCREW		
71*	04145-61627		1	C3 (P/N 0180-3178) ASSEMBLY		
72	04192-40002		1	COUPLER		
73*	04145-00601		1	SHIELD COVER		
74*	0515-0150		2	SCREW		
75*	3101-2216		1	SWITCH		
76*	04145-01202		1	ANGLE		
77*	04145-01201		1	ANGLE		
78*	2950-0001		3	NUT		
79*	1251-8695		9	CONNECTOR-AC PWR CEE22 MALE CA-MTG		
80*	3101-2298		2	SLIDE SWITCH		
81*	1250-0118		3	CONNECTOR-RF BNC		
82*	2110-0015		1	FUSE 2.5AT 250V		
	2110-0305		1	FUSE 1.25AT 250V		
83*	2110-0565		1	FUSE HOLDER CAP		
84	04145-01230		2	ANGLE		
85*	04145-00630		1	PLATE		

* The parts reference-numbered with * are components of the Power Supply Assembly (HP P/N: 04145-69003). The Power Supply Assembly also includes a filter (HP P/N: 9135-0084) and a transformer (HP P/N: 9100-4518), not shown in Figure 6-1.

Note 1: The part numbers of the cables that connect the X, Y, and Z output terminals on the A1 (PN:01345-66501) of the 1345A to the X, Y, and Z external output terminals on the rear panel of the 4145A are as follows:

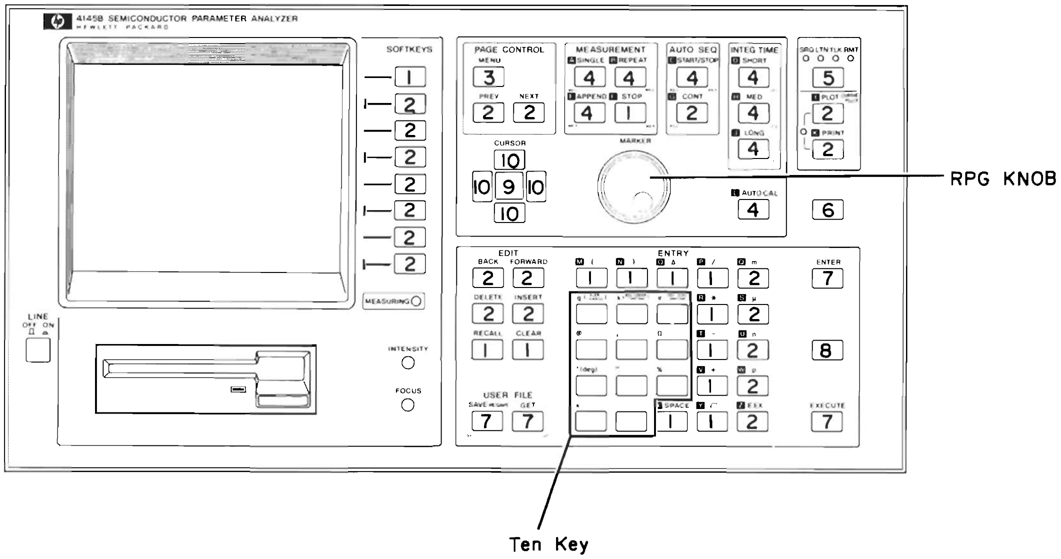
X-axis output	04145-61613
Y-axis output	04145-61614
Z-axis output	04145-61615

Note 2: The part numbers of the screw and washer that retain the HP-IB connector (PN:1251-0292) are as follows:

SCREW	0380-0644
WASHER	2190-0577

Note 3: The part number of the cable assembly that is between the 1345A and the A12 Board is as follows:

CABLE ASSEMBLY	04145-61610



Item	Part Number	Q'ty	Description
1	5041-0343	13	BROWN
2	5041-0277	21	PARL
3	5041-0475	1	GOLD
4	5041-0286	8	PARL
5	5041-1881	1	"LOCAL"
6	5041-0451	1	BLUE
7	5041-0376	4	BROWN
8	5041-0508	1	GREEN
9	5041-0063	1	"FAST"
10	5041-0059	4	"ARROW"
Ten Key	5041-0808	1	"."
	5041-0811	1	"1"
	5041-0812	1	"2"
	5041-0813	1	"3"
	5041-0814	1	"4"
	5041-0815	1	"5"
	5041-0816	2	"6", "9"
	5041-0817	1	"7"
	5041-0818	1	"8"
	5041-0819	1	"0"
RPG KNOB	0370-3033	1	RPG KNOB

Figure 6-2. Part Numbers for the Front Panel Key Caps.

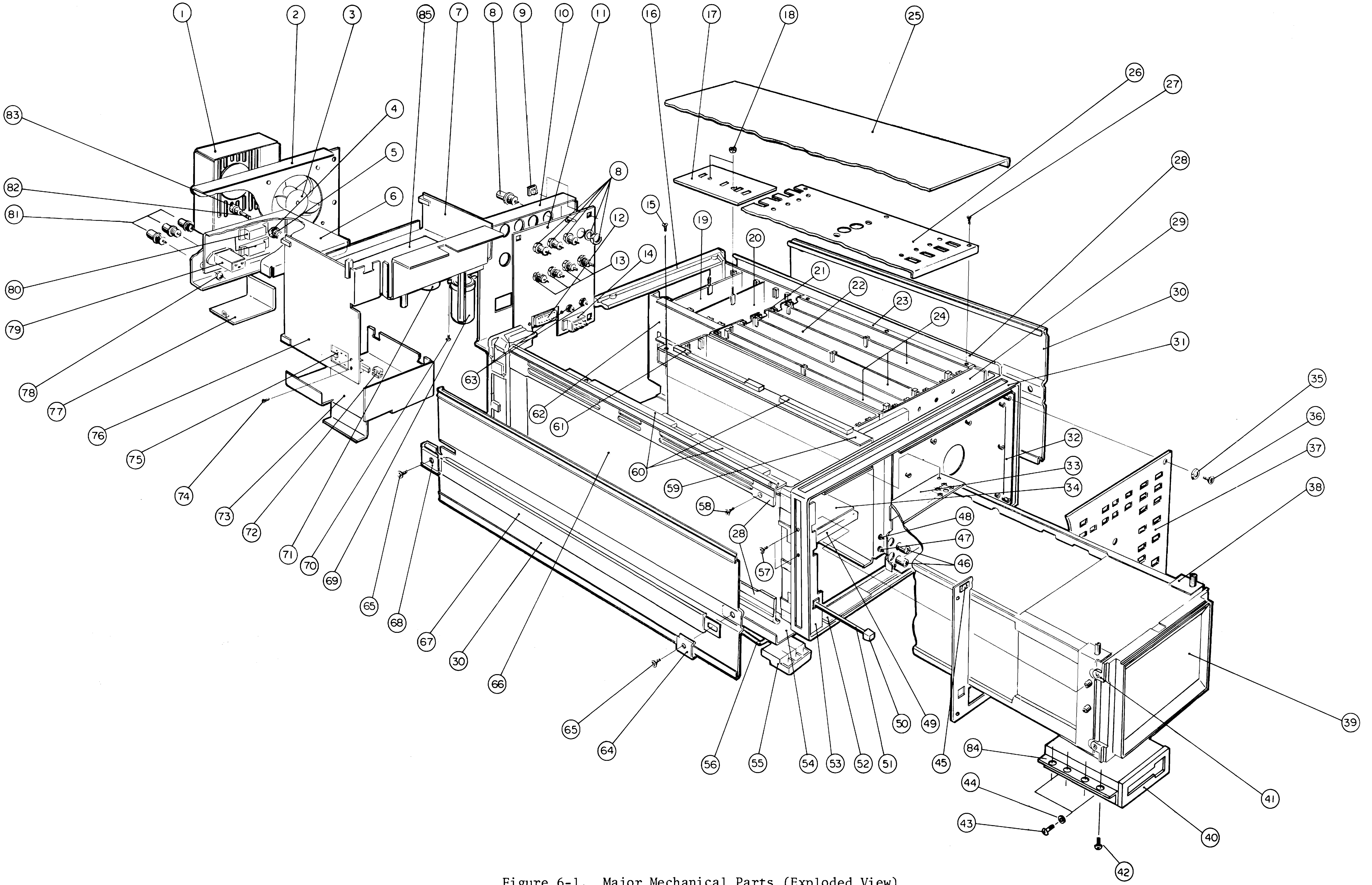


Figure 6-1. Major Mechanical Parts (Exploded View).

SECTION VII

MANUAL CHANGES

7-1. INTRODUCTION

7-2. HP 4145Bs may vary slightly depending on the serial number. This section contains information for customizing the *Operation Manual* and this manual, so that all the information pertains to the HP 4145B that you are using.

7-3. MANUAL CHANGES

7-4. To customize the *Operation Manual* and this manual (*Service Manual*) for your HP 4145B, refer to Table 7-1 and 7-2, respectively, and make all of the manual changes listed opposite your HP 4145B's serial number.

Table 7-1. Manual Changes in the *Operation Manual*

Serial Number	Make Manual Changes
2608J00311 and below	1, 6
2608J01429 and below	6

Table 7-2. Manual Changes in the *Service Manual*

Serial Number	Make Manual Changes
2608J00498 and below	2, 3, 5, 6
2608J00817 and below	3, 4, 5, 6
2608J00822 and below to 2608J00499	4, 5, 6
2608J00915 and below	5, 6
2608J01429 and below	6

- **CHANGE 1**

Change the OLD text to NEW text as shown below:

Page 1-4, paragraph 1-28:

OLD: (P/N: 16058-60004 through 16058-60005, 16058-60007 through 16058-60011, and 16147-60002)
NEW: (P/N: 16058-60004 through 16058-60011)

Page 1-15, Table 1-2, Reference Data (Sheet 3 of 3):

OLD: 16147-60002 (28-pin DIP)
NEW: 16058-60006 (24-pin DIP)

Page 1-17, Table 1-3, Accessories Supplied (Sheet 2 of 5):

OLD: 16147-60002, 28 pin
NEW: 16058-60006, 24 pin

- **CHANGE 2**

Change the OLD text to NEW text as shown below:

Page 8-44, Figure 8-16, A3 Board Troubleshooting Flow Diagram (Sheet 2 of 9):

OLD:

Test Point	Signature
A3U9-pin 11	6460
A3U9-pin 12	5501
A3U9-pin 13	888P
A3U9-pin 15	A5AP
A3U9-pin 16	0F61
A3U9-pin 17	5648
A3U9-pin 18	C02C
A3U9-pin 19	CCFU

Part number of A3U9
A3U9
04145-85058

NEW:

Test Point	Signature
A3U9-pin 11	272P
A3U9-pin 12	2444
A3U9-pin 13	292P
A3U9-pin 15	1C46
A3U9-pin 16	PU2P
A3U9-pin 17	FFF9
A3U9-pin 18	F461
A3U9-pin 19	C27A

Part number of A3U9
A3U9
04145-85038

- **CHANGE 3**

Page 4-B, Table 4-1, Recommended Test Equipment:

Delete "BNC (Male) to Alligattor Clips Test Lead A, T"

Change the OLD text to NEW text as shown below:

OLD: Shorting Connector P, A, T
NEW: Shorting Connector P

Page 5-2, Table 5-1, Adjustable Componesnt:

Delete "5-30 A5R167 CMR ADJ Adjusts the CMRR of the SMU."

Page 5-4, Table 5-2, Adjustment Requirements:

Change the OLD text to NEW text as shown below:

OLD: A5 SMU Board (P/N: 04145-66525) Para. 5-30
NEW: A5 SMU Board (P/N: 04145-66505) None

Page 5-22 through 5-24, paragraph 5-30:

Delete paragraph 5-30.

Page 6-17, Table 6-3, Replaceable Parts:

Change the OLD text to NEW text as shown below:

OLD:	A5R164		0699-2662	RESISTOR-PAIR 100K +-0.01%
	A5R165	2	1810-1117	NETWORK-RES 3-SIP
	A5R166		0699-2658	RESISTOR 100K +-0.01%
	A5R167	1	2100-0568	RESISTOR-TRMR 100 10%
	A5R168	7	0757-0416	RESISTOR 511 1%
NEW:	A5R60	5	1810-0604	RESISTIVE NETWORK

Page 8-96, Figure 8-35, A5 Board Troubleshooting Flow Diagram (Sheet 2 of 9):

Change the OLD text to NEW text as shown below:

OLD: Check U13, R164 to R168, and C46.
NEW: Check U13, R60 and C46.

OLD: Replace R164 through R168.
NEW: Replace R60.

Delete "*A: If you replace one or more of R164 through R168, adjust R167."

Page 8-97, Figure 8-35, A5 Board Troubleshooting Flow Diagram (Sheet 3 of 9):

Change the OLD text to NEW text as shown below:

OLD: Check U4, R164 to R168, Q23, and Q24.
NEW: Check U4, R60, Q23, and Q24.

Delete "*A: If you replace one or more of R164through R168, adjust R167."

Page 8-112, Figure 8-47, A5 SMU Board Assembly Component Locations,
Page 8-114, Figure 8-47, A5 SMU Board Assembly Component Locations:

Change the figure as shown on page 7-6.

Page 8-113, Figure 8-48, A5 SMU Board Assembly Schematic Diagram (Sheet 1 of 2):

Change the OLD text to NEW text as shown below:

OLD: (P/N: 04145-66525)
NEW: (P/N: 04145-66505)

Page 8-115, Figure 8-48, A5 SMU Board Assembly Schematic Diagram (Sheet 2 of 2):

Change the figure as shown on page 7-7.

NOTES

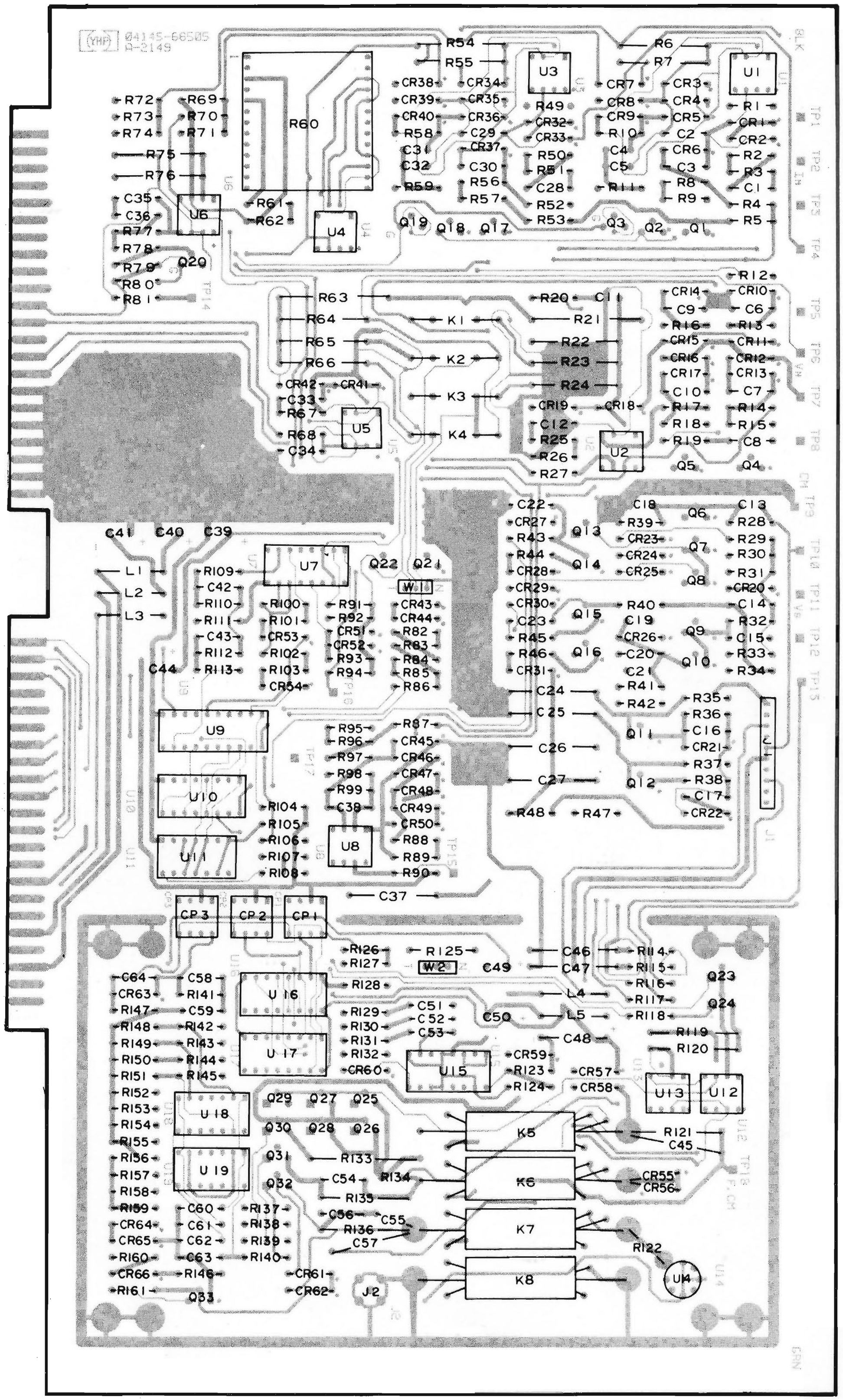
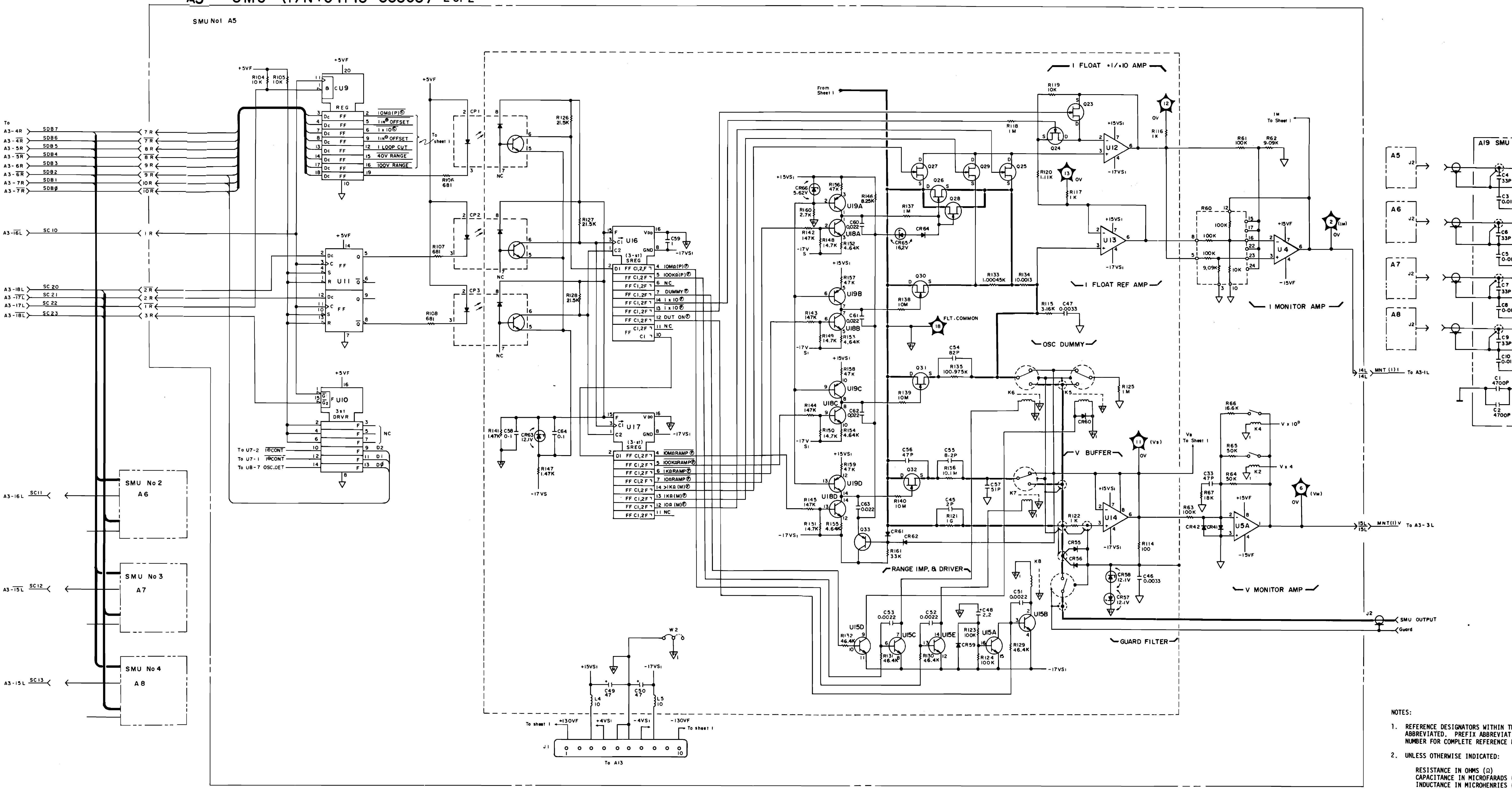


Figure 8-47. A5 SMU Board Assembly Component Locations.

A5 SMU (P/N:04145-66505) 2 OF 2



NOTES:

1. REFERENCE DESIGNATORS WITHIN T
ABBREVIATED. PREFIX ABBREVIAT
NUMBER FOR COMPLETE REFERENCE

2. UNLESS OTHERWISE INDICATED:

RESISTANCE IN OHMS (Ω)
CAPACITANCE IN MICROFARADS
INDUCTANCE IN MICROHENRIES

A5 BOARD

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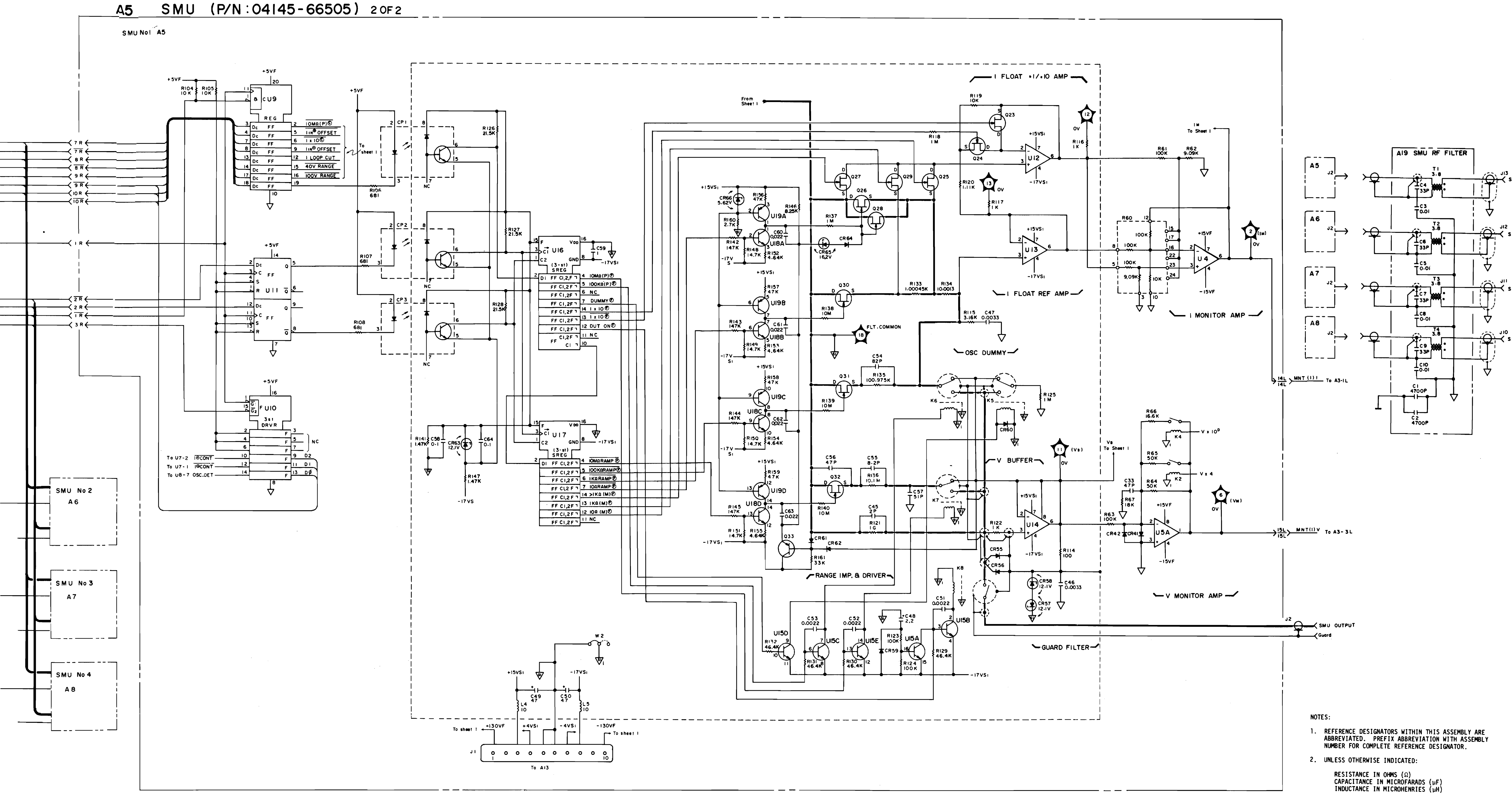
Figure 8-48. A5 SMU Board Assembly Schematic Diagram (Sheet



NOTES:

1. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. PREFIX ABBREVIATION WITH ASSEMBLY NUMBER FOR COMPLETE REFERENCE DESIGNATOR.

2. UNLESS OTHERWISE INDICATED:

RESISTANCE IN OHMS (Ω)
CAPACITANCE IN MICROFARADS (μF)
INDUCTANCE IN MICROHENRIES (μH)

A5 BOARD

Figure 8-48. A5 SMU Board Assembly Schematic Diagram (Sheet 2 of 2).

- **CHANGE 5**

Change the OLD text to NEW text as shown below:

Page 5-4, Table 5-2, Adjustment Requirements,
Page 8-83, Figure 8-26, A2 Microprocessor Digital Control Board Assembly Schematic Diagram (Sheet 2 or 2):

OLD: (P/N: 04145-66562)
NEW: (P/N: 04145-66552)

Page 6-5, Table 6-3, Replaceable Parts:

OLD: A2U6 04145-85203 EPROM
NEW: A2U6 04145-85201 EPROM
A2U16 04145-85202 EPROM

Page 8-25, Figure 8-14, A1 Board Troubleshooting Flow Diagram (Sheet 1 of 5),
Page 8-31, Figure 8-15, A2 Board Troubleshooting Flow Diagram (Sheet 1 of 11),
Page 8-37, Figure 8-15, A2 Board Troubleshooting Flow Diagram (Sheet 7 of 11),
Page 8-60, Figure 8-18, A9 Board Troubleshooting Flow Diagram (Sheet 2 of 11),
Page 8-64, Figure 8-18, A9 Board Troubleshooting Flow Diagram (Sheet 6 of 11),
Page 8-67, Figure 8-18, A9 Board Troubleshooting Flow Diagram (Sheet 9 of 11):

OLD: 1) Turn off the 4145B.
2) Jumper setting:
A2W3: T
NEW: 1) Turn off the 4145B.
2) Remove A2U6 and A2U16. Insert A2U16 (Test ROM) into A2U6's socket.

Page 8-34, Figure 8-15, A2 Board Troubleshooting Flow Diagram (Sheet 4 of 11):

OLD: Regardless of the setting of A2W3, this Flow Diagram can be performed.
NEW: Regardless of the ROM that is installed in A2U6's socket, this Flow Diagram can be performed.

Page 8-38, Figure 8-15, A2 Board Troubleshooting Flow Diagram (Sheet 8 of 11),
Page 8-39, Figure 8-15, A2 Board Troubleshooting Flow Diagram (Sheet 9 of 11),
Page 8-40, Figure 8-15, A2 Board Troubleshooting Flow Diagram (Sheet 10 of 11),
Page 8-41, Figure 8-15, A9 Board Troubleshooting Flow Diagram (Sheet 11 of 11):

OLD: Note: Be sure jumper setting: A2W3: T
NEW: Note: Be sure that Test ROM (A2U16) is installed in A2U6's socket.

Page 8-15, Figure 8-12, Flow Diagram Notes (sheet 2 of 5):

Add the following text and NOTE.

4) The 4145B is equipped with a special Test ROM which contains the programs necessary to exercise the digital circuits on the A1, A2, and A9 boards. During normal instrument operation, the Test ROM is installed in a dummy socket (A2U16's socket) on the A2 board. For certain troubleshooting procedures, however, it must be installed in the A2U6's socket on the A2 board. Instructions on when to use the Test ROM are given in the flow diagrams.

NOTE

After troubleshooting has been performed and repairs completed, the Test ROM must be removed from the A2U6's socket and reinstalled in the dummy socket (A2U16's socket), and the standard A2U6 ROM must be installed in the A2U6's socket.

Page 8-80, Figure 8-25, A2 Microprocessor Digital Control Board Assembly Component Locations,
Page 8-82, Figure 8-25, A2 Microprocessor Digital Control Board Assembly Component Locations:

Change the figure as shown on page 7-12.

Page 8-81, Figure 8-26, A2 Microprocessor Digital Control Board Assembly Schematic Diagram (Sheet 1 of 2):

Change the figure as shown on page 7-13.

NOTES

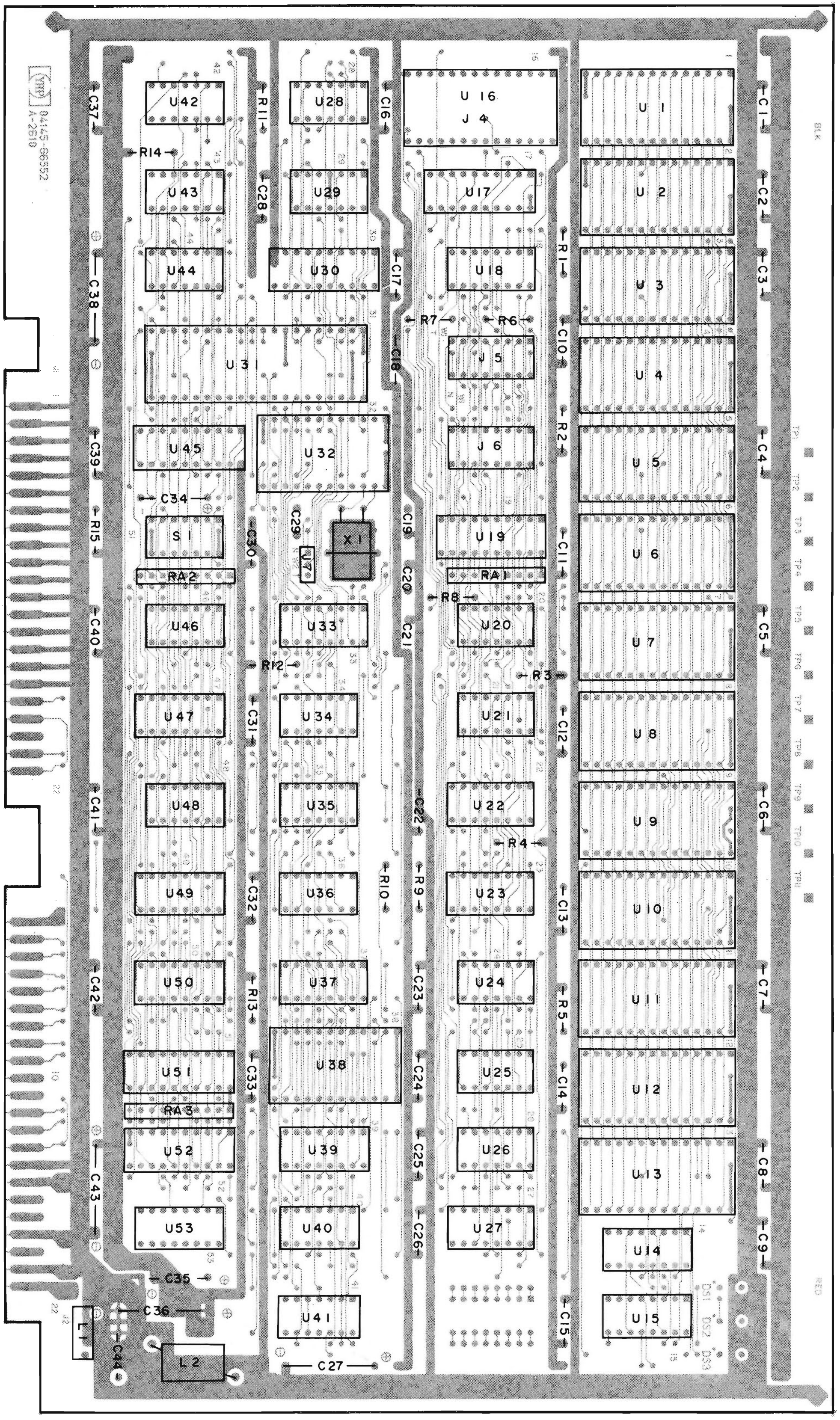


Figure 8-25. A2 Microprocessor Digital Control Board Assembly Component Locations.

A2 MICROPROCESSOR DIGITAL CONTROL (P/N: 04145-66552) 1 OF 2

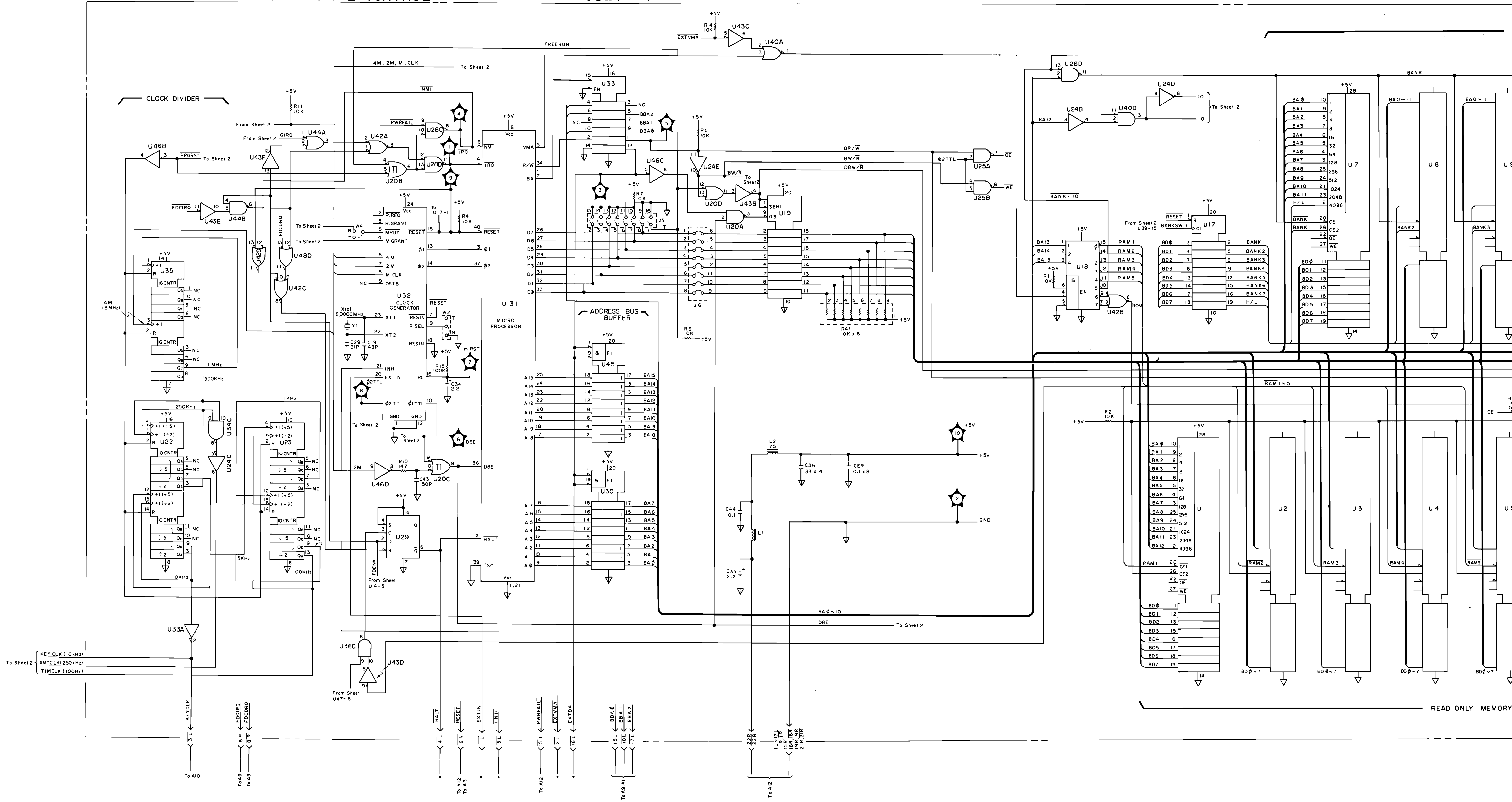
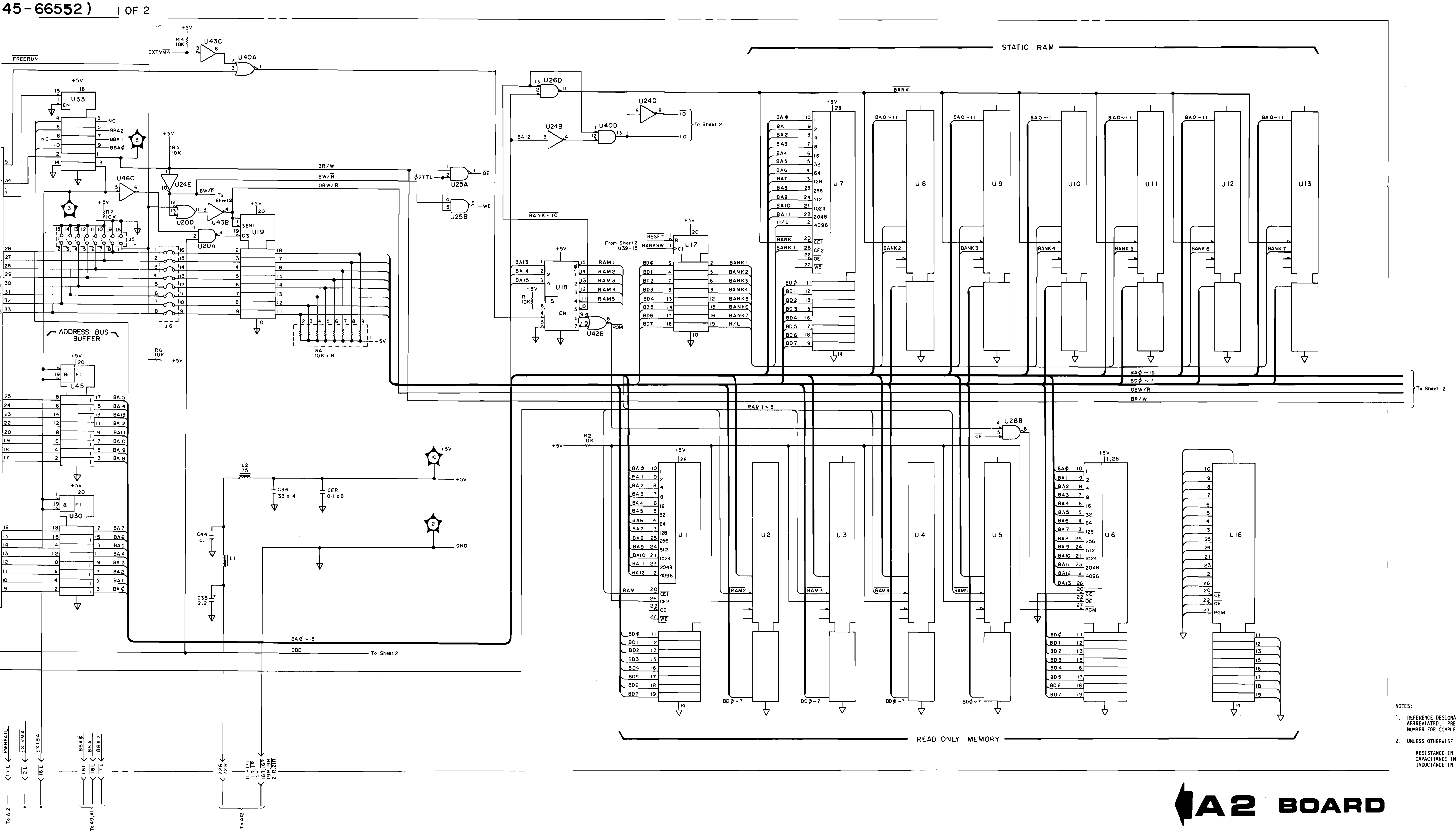


Figure 8-26. A2 Microprocessor Digi



A2 BOARD

Figure 8-26. A2 Microprocessor Digital Control Board Assembly Schematic Diagram (Sheet 1 of 2).

NOTES:

1. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. PREFIX ABBREVIATION WITH ASSEMBLY NUMBER FOR COMPLETE REFERENCE DESIGNATOR.
2. UNLESS OTHERWISE INDICATED:

   RESISTANCE IN OHMS (Ω)
   CAPACITANCE IN MICROFARADS (µF)
   INDUCTANCE IN MICROHENRIES (µH)

SECTION VIII

SERVICE

8-1. INTRODUCTION

8-2. This section provides information and instructions for troubleshooting and repairing the Model 4145B Semiconductor Parameter Analyzer, exclusive of the digital display. (For service information on the 1345A Digital Display, refer to the 1345A Operating and Service Manual, located at the back of this binder.) A block-diagram discussion, troubleshooting guide, and complete circuit schematics are included. Component locators are given on the page facing each board assembly schematic. An illustration of the instrument's interior is shown in Figure 8-2.

8-3. SAFETY CONSIDERATIONS

8-4. This section contains warnings and cautions that must be observed to ensure the safety of service personnel and to prevent damage to the instrument.

WARNING

MAINTENANCE DESCRIBED HEREIN IS PERFORMED WITH POWER SUPPLIED AND PROTECTIVE COVERS REMOVED. SUCH MAINTENANCE SHOULD BE PERFORMED ONLY BY SERVICE TRAINED PERSONNEL AWARE OF THE HAZARDS INVOLVED. WHERE MAINTENANCE CAN BE PERFORMED WITHOUT POWER APPLIED, THE POWER SHOULD BE REMOVED. AFTER ANY REPAIR IS COMPLETED, ENSURE THAT ALL SAFETY FEATURES ARE INTACT AND FUNCTIONING PROPERLY AND THAT ALL NECESSARY PARTS ARE CONNECTED TO THEIR MEANS OF PROTECTIVE GROUNDING.

8-5. RECOMMENDED TEST EQUIPMENT

8-6. Test equipment required for troubleshooting and repairing the 4145B is listed in Table 4-1. If the recommended model is not available, equipment which meets or exceeds the listed specifications may be used.

8-7. TROUBLESHOOTING

8-8. Before troubleshooting the 4145B, make sure that the failure is not caused by a faulty disc or a dirty read head. If the disc is damaged or worn because of prolonged use or improper handling or storage, or if the read head in the flexible-disc drive is dirty, the instrument may not be able to correctly or completely read the operating system software. Checking both of these possibilities, before troubleshooting, will effectively eliminate time wasted in tracking down a nonexistent hardware failure. If the failure is not caused by the disc or read head, refer to the troubleshooting guide given in paragraph 8-15. It provides step-by-step procedures, in flow diagram form, designed to isolate most failures to a component or circuit level.

8-9. REPAIR

8-10. Instructions for removing major assemblies are given in paragraphs 8-17 through 8-35. Take special care when removing or working near the digital display. For instructions on removal of the CRT itself, refer to the 1345A Operating and Service Manual, located at the back of this binder.

8-11. BLOCK-DIAGRAM DISCUSSION

8-12. The overall block diagram of the 4145B is shown in Figure 8-2. An explanation of the various ground references used throughout the instrument will be given first, followed by descriptions of the four major sections--measurement section, measurement control section, digital control section, and power supply section. (Refer to Figure 8-1.)

When the shorting-bar on the rear panel is connected, the digital and analog grounds (▽D and ▽) in the floating section (enclosed in dashed lines) are tied directly to chassis ground. Complete isolation between the floating and grounded sections is obtained by disconnecting the shorting bar. Regardless of whether the shorting-bar is connected or not, output from the SMUs and voltages sources is always referenced to analog ground (▽). To ensure proper ground isolation between the floating circuits and grounded circuits, optocouplers are used for data transmission between the A2 and A3 microprocessors. SMU power source commons (▽S1 , ▽S2 , ▽S3 , ▽S4) are independent of each other, and each is floating above analog ground. The level at which each SMU common is floating is primarily determined by the specified output from the corresponding SMU, and it can range from 0V to greater than ±100V. The ground reference (▽) for the switching circuits on the A11 board is floating at approximately 120 - 160Vdc below chassis ground. Functionally, the 4145B has four major circuit sections : (1) Measurement Section, (2) Measurement Control Section, (3) Digital Control Section, and (4) Power Supply Section. Each is briefly discussed below.

(1) Measurement Section :

The measurement section consists of four SMUs (A5 through A8), two voltage sources and two voltage monitors (A16), and four SMU filters (A19). Each SMU has two modes of operation : (1) V mode--voltage source/current monitor, and (2) I mode--current source/voltage monitor. In V mode, the SMU outputs up to ±100V; in I mode, up to ±100mA. The basic circuit of one SMU consists of a power amplifier, a voltage monitor, a current monitor, range resistor, and various control circuits. The power amplifier amplifies a precise reference voltage which is proportional to the specified SMU output voltage or current. The load seen by the power amplifier consists of the range resistor and DUT connected in series. The voltage monitor is connected across the DUT, and the current monitor is connected across the range resistor. In V mode operation, the voltage across the DUT is fed back to the input of the power amplifier, where it is summed with the reference voltage to control the output from the power amplifier and to keep the voltage across the DUT constant when the DUT resistance changes. Because the range resistor and DUT are connected in series, the current flowing through the DUT must also flow through the range resistor. The range resistor value is known. The current monitor measures the voltage drop across the range resistor, and the microprocessor calculates the DUT current from the known range resistor value and measured range resistor voltage using a standard Ohm's law equation. The result is sent to the A2 board for display and is also used for current compliance control. I mode operation is almost identical to V mode operation. The current through the DUT is measured by the current monitor and is fed back to the input of the power amplifier, where it is summed with the reference voltage (different from that used in V mode) to control the output from the power amplifier and to keep the current through the DUT constant when the DUT resistance changes. The voltage across the DUT is measured by the voltage monitor. The result is sent to the A2 board for display and is also used for voltage compliance control. Two reference voltages are used : one for V mode operation and one for I mode operation. Both are supplied from the D-A converter on the A4 board and are normalized at 0V to ±10V. Also, voltage and current measurement results are normalized at 0V to ±10V and then applied to the A-D converter on the A3 board before being sent to the A2 board.

The A16 board contains two voltage sources and two voltage monitors. Each voltage source is a constant gain (x2) amplifier which amplifies a reference voltage. Each has a complementary—symmetry output stage which keeps the voltage applied to the DUT constant when the DUT resistance changes. Each voltage monitor is simply an amplifier whose gain is x5 for input voltages less than ±2V, and x0.5 for input voltages higher than ±2V. Maximum allowable input is ±20V.

The A19 board contains four low-pass filters (one for each SMU) which reject normal mode noise picked up by the measurement cables.

(2) Measurement Control Section :

This section consists of the A3 and A4 boards, and it controls the SMUs, voltage sources, and voltage monitors. Basically, the A3 board contains a microprocesser, a successive-approximation A-D converter, and a ten-channel multiplexor. The A3 microprocessor directly controls the measurement circuits as directed by the host microprocessor on the A2 board. Data transmission between the A3 microprocessor and the A2 microprocessor is via optocouplers to insure proper ground isolation. The V monitor and I monitor outputs from each SMU and the outputs from the two voltage monitors on the A16 board are applied to the A3 A-D converter through the ten-channel multiplexor. The multiplexor sequentially selects one channel for A-D conversion. Only channels used in the measurement are selected for A-D conversion. For example, if SMU1 is not selected on the CHANNEL DEFINITION page (see Figure 3-21), the multiplexor will not select the SMU1 V monitor and I monitor inputs.

The A4 board contains a D-A converter, a ten-channel demultiplexor, and ten sample/hold amplifier. It provides the reference voltages used by the SMUs and voltage sources. The reference voltages, which range from 0V to ±10V with.5mV resolution, are generated by the D-A converter in response to digital data sent from the A3 microprocessor. The output from the D-A converter is applied to the demultiplexor, which distributes the reference voltage to the appropriate sample/hold amplifier.

(3) Digital Control Section :

This section consists of the A1, A2, A9, and A10 boards, the flexible-disc drive, and the 1345A Digital Display. The A2 provides overall instrument control. It contains an 8-bit microprocessor, 16K bytes of read-only memory, 96K bytes of random-access memory, and asynchronous communication interface adapter for serial data transfer to and from the A3 board. Data transfer to and from the A1 and A9 boards is via an 8-bit-parallel data bus.

The A1 board contains the interface for data transfer between the A2 and A10 boards. It also contains an 8-bit to 16-bit I/O converter, a data buffer, a display data latch, a display RAM, and various control circuits for the 1345A Digital Display.

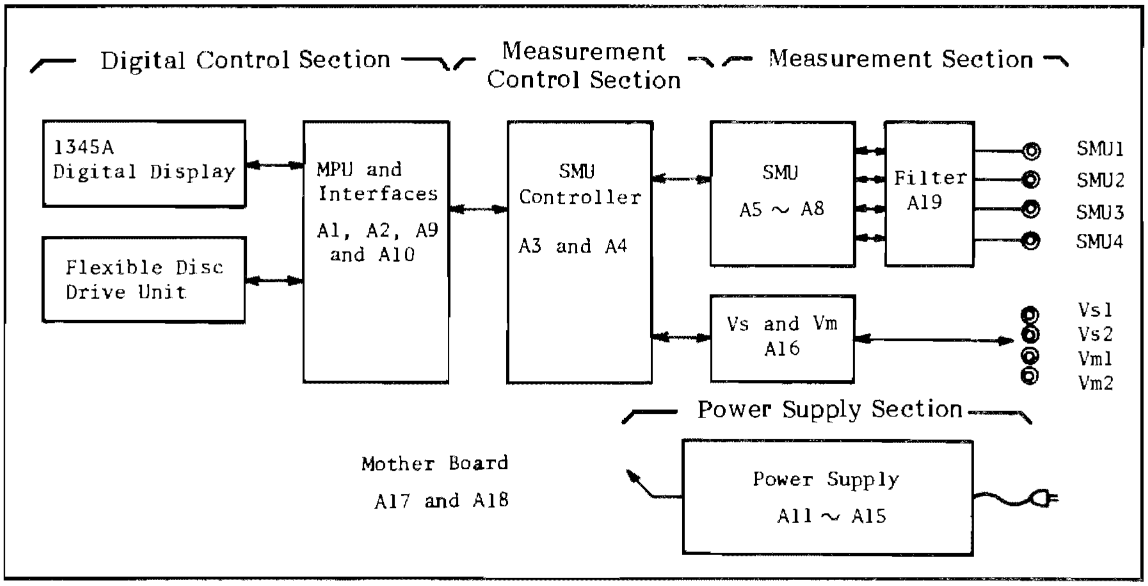


Figure 8-1. Four Major Sections of the 4145B

The A9 board is divided into two sections: (1) HP-IB control and (2) flexible-disc drive control. Each section has its own control IC which handles data transfer operations.

The A10 board is located behind the front panel, and contains the rotary pulse generator for marker control, and various keys and LEDs. Key depressions and rotations of the rotary pulse generator are encoded by the circuits on the A10 board, and then output to the A2 microprocessor via the data bus interface on the A1 board.

The flexible-disc drive accepts a 3.5-inch disc which functions as the 4145B's mass storage unit. Read/Write operations are controlled by the A2 microprocessor via the flexible-disc drive control IC on the A9 board, which converts the 8-bit parallel data into serial data.

(4) Power Supply Section :

This section consists of the A11 through A15 boards, and provides the required DC power for the floating and grounded sections. The A11 Switching Power Supply converts line voltage into high frequency (23kHz) pulses. This allows the use of a smaller power transformer, without sacrificing power output capability. In addition to the switching circuits, the A11 board contains a power on detection circuit which resets the A2 and A3 microprocessors, and a power loss detection circuit. The A12 DC Power-Supply rectifies the pulses from the A11 board, and provides the filtering and regulation for the 5V, 12V, and 15V used by the instrument's grounded circuits. The A15 board is the power supply for the floating circuits. It provides +5V, -15V, and +15V for the measurement control section and the measurement section, and ±130Vdc, ±60Vdc, ±40dc, and low level ac for the A13 and A14 SMU power sources.

The A13 and A14 boards are identical, and each provides the voltages necessary to drive two SMUs. A13 drives A6 and A7; and A14 drives A5 and A8.

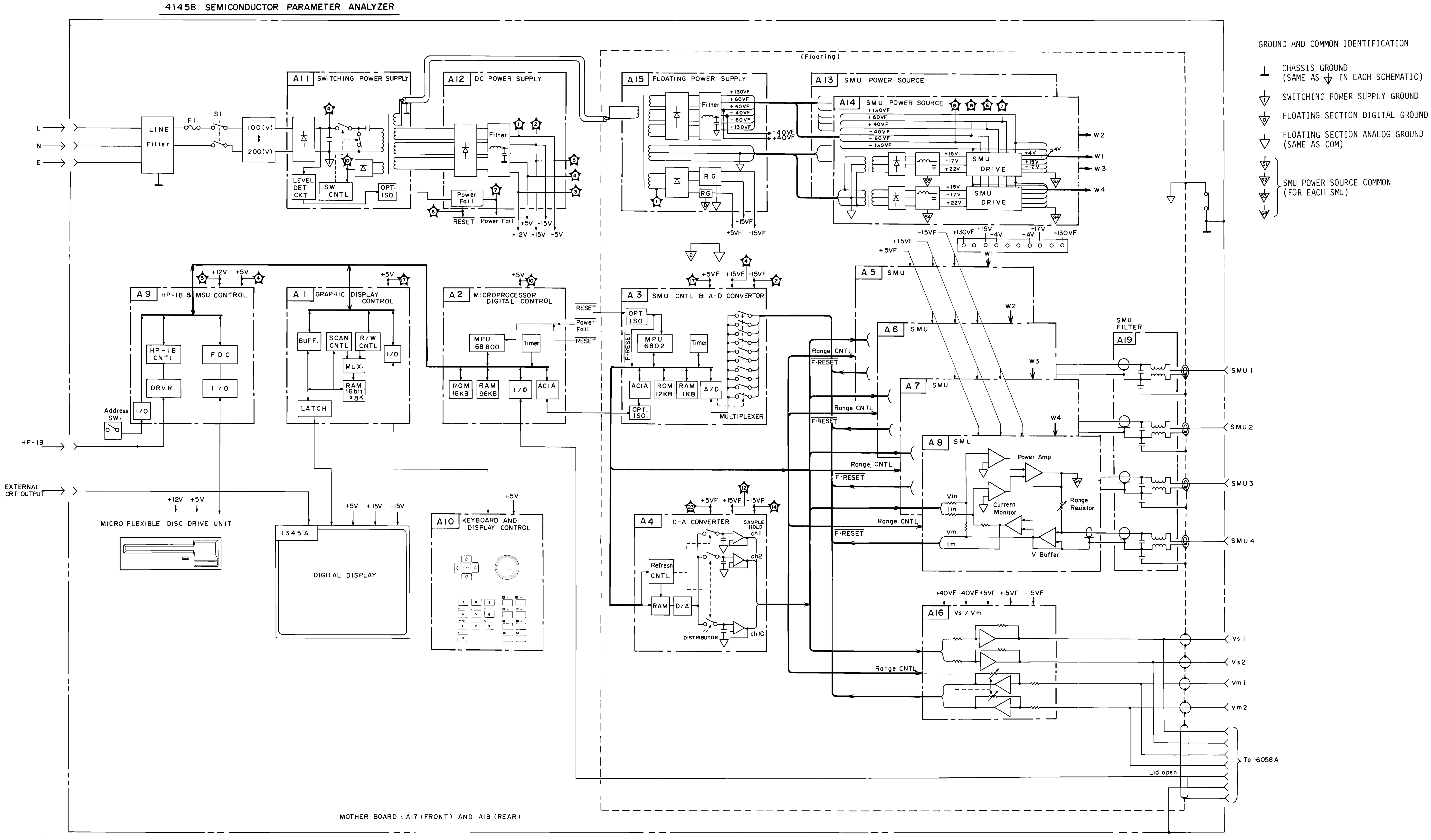


Figure 8-2. Overall Block Diagram.

Table 8-1. Hardware-related Error Codes

Error Code	Meaning
ROM errors (Did not pass the check-sum test.)	
Error P06	P06: A2U6
RAM errors (Did not pass the read/write test.)	
Error P01 ≀ P05 P07 ≀ P11	P01: A2U1 P7: A2U7 P02: A2U2 P8: A2U8 P03: A2U3 P9: A2U9 P04: A2U4 P10: A2U10 P05: A2U5 P11: A2U11
IRQ Circuit errors (*: Appears only when the test ROM is used.)	
Error P20	Bank RAM select signal from A2U17 is disable.
P21	The timer status flip-flop (A2U21) is not set or reset.
P22*	IRQ signal from A2U21 is disabled.
P23*	The ACIA (A2U38) loop back test failed.
P24*	IRQ signal from A2U38 is disabled.
P25*	IRQ signal disabled.
MSU (Mass Strage Unit: FDD and Disc) errors	
Error M08	Spare directory was read.
M09	Neither main nor spare directory can be read.
M10	Directory can not be rewritten.
M11	Data in the RAM and data written onto the disc are not identical.
M12	Time out error.
M13	Track 00 signal was not detected.
M14	The specified track signal can not be detected.
M15	Track address can not be detected.
M16	CRC (Cyclic Redundancy Check) error.
M17	Incorrect handshake timing.
M18	Write operation was shut down.
M02	FDD Ready signal was not detected.
SMU control circuit error	
Error A01	SMU control circuit (A3 and A4) is not functioning properly.

8-15. TROUBLESHOOTING GUIDE

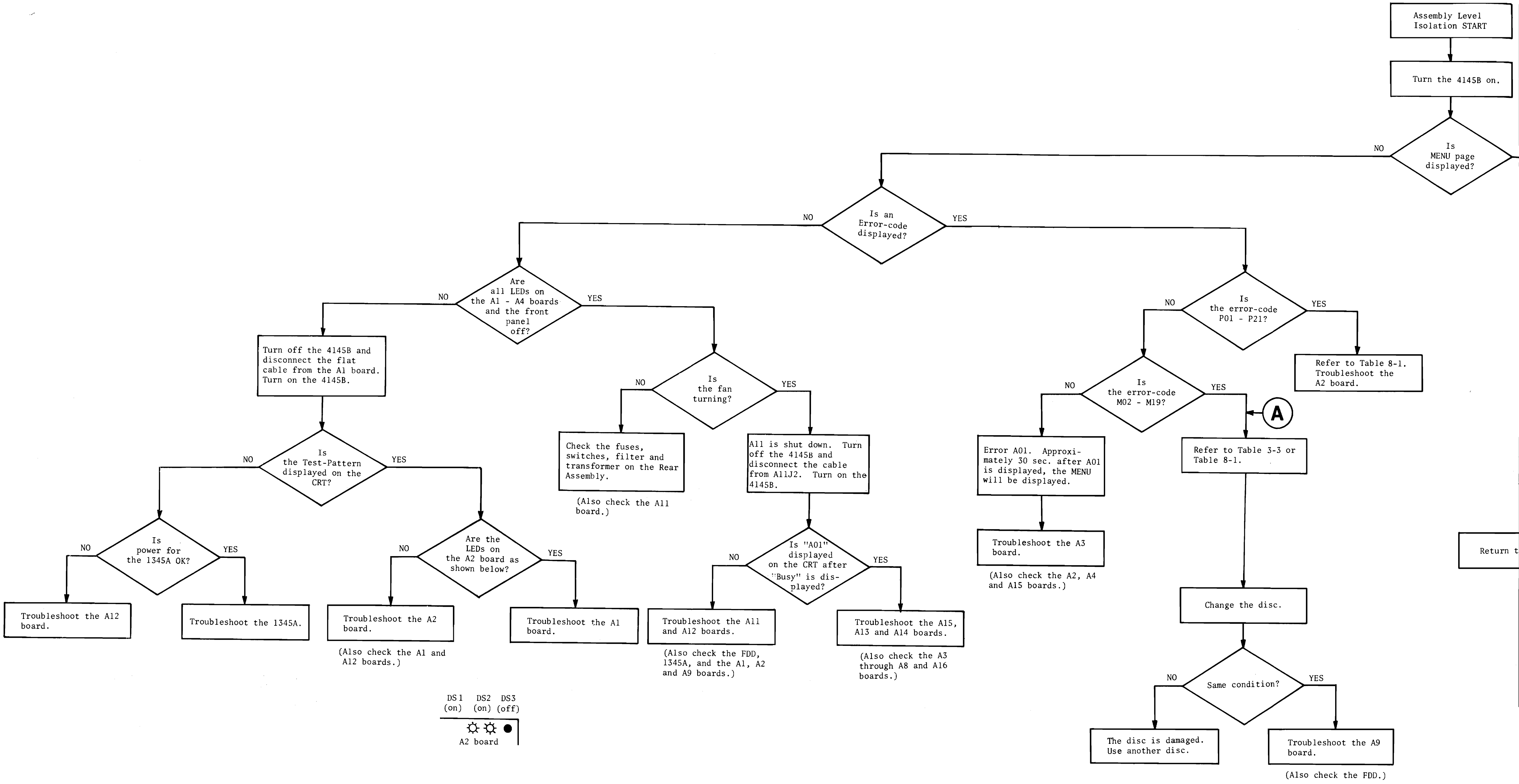
8-16. Board level isolation of most instrument failures can be quickly accomplished by using the troubleshooting flow diagram of Figure 8-3. Turn the 4145B off and follow the instructions given in the flow diagram. When the faulty board has been isolated, proceed to the component level troubleshooting flow diagram for that board. Table 8-1 lists error codes related to certain hardware failures and can be used for quick failure isolation. Table 8-2 lists SMU status.

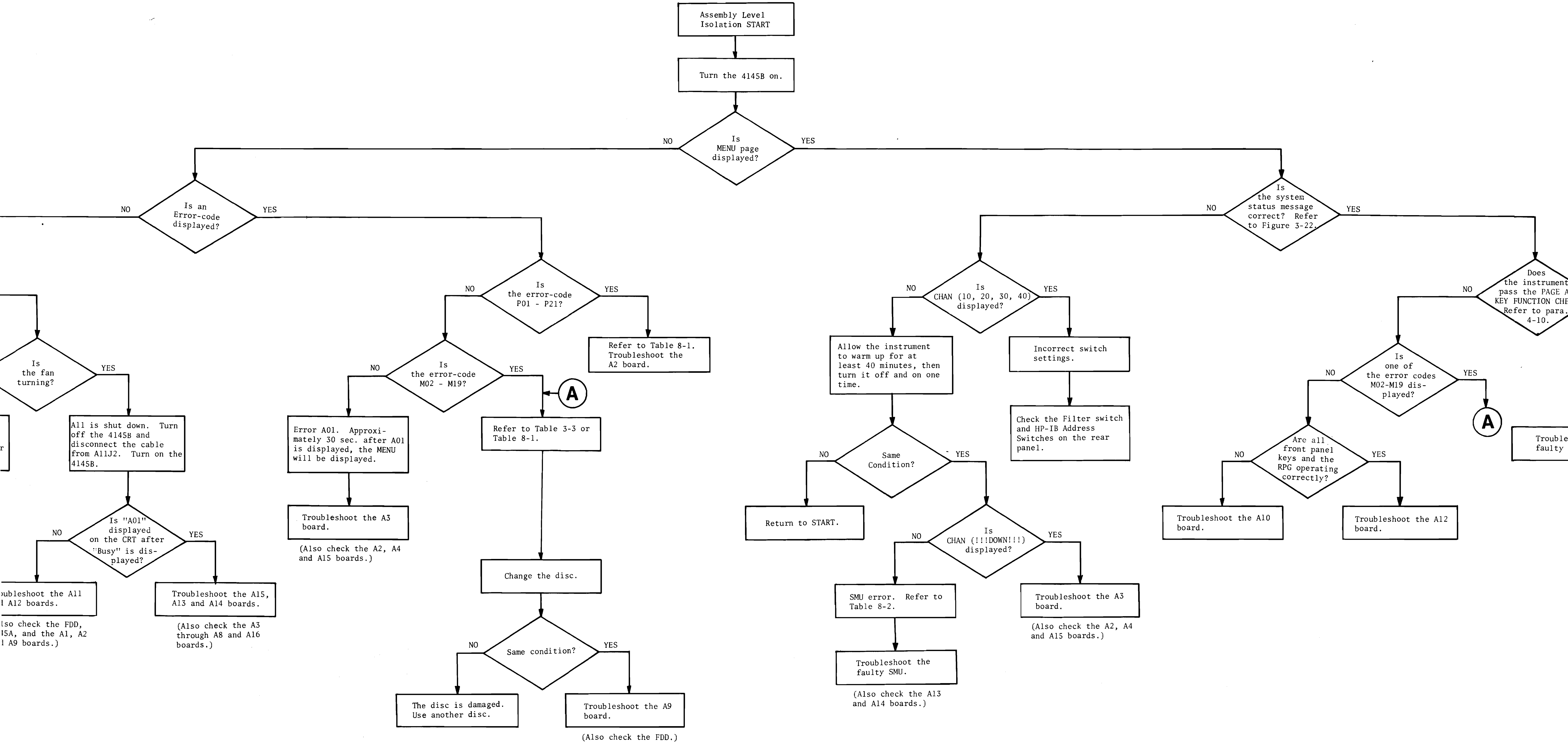
Note

One of the error codes listed in Table 8-1 and 8-2 may be displayed if the instrument is turned on after experiencing an extreme change of ambient temperature. In this case, allow the instrument to fully warm up (ignor the displayed error code), and then turn it off and on one time.

Table 8-2. SMU Status

Display	Meaning
CHAN (!!!DOWN!!!)	SMU control circuit (A3 and A4) is not functioning properly.
CHAN (xx, xx, xx, xx)	xx Error Code Channel No. 0: No error 1: V offset error 2: I offset error 3: I leak 4: V range error 5: I range error 6: Iin offset error 7: Loop Change Detector error


Assembly Level Isolation START
Turn the 4145B on.
Is MENU page displayed?
NO
Is an Error-code displayed?
NO
YES
Are all LEDs on the A1 - A4 boards and the front panel off?
NO
YES
Turn off the 4145B and disconnect the flat cable from the A1 board. Turn on the 4145B.
Is the Test-Pattern displayed on the CRT?
NO
YES
Is power for the 1345A OK?
NO
YES
Troubleshoot the A12 board.
Troubleshoot the 1345A.
Are the LEDs on the A2 board as shown below?
NO
YES
Troubleshoot the A2 board.
(Also check the A1 and A12 boards.)
Troubleshoot the A1 board.
DS1 (on)
DS2 (on)
DS3 (off)
A2 board
Is the fan turning?
NO
YES
Check the fuses, switches, filter and transformer on the Rear Assembly.
(Also check the A11 board.)
A11 is shut down. Turn off the 4145B and disconnect the cable from A11J2. Turn on the 4145B.
Is "A01" displayed on the CRT after "Busy" is displayed?
NO
YES
Troubleshoot the A11 and A12 boards.
(Also check the FDD, 1345A, and the A1, A2 and A9 boards.)
Troubleshoot the A15, A13 and A14 boards.
(Also check the A3 through A8 and A16 boards.)
Is the error-code P01 - P21?
NO
YES
Refer to Table 8-1. Troubleshoot the A2 board.
Is the error-code M02 - M19?
NO
YES
A
Error A01. Approximately 30 sec. after A01 is displayed, the MENU will be displayed.
Troubleshoot the A3 board.
(Also check the A2, A4 and A15 boards.)
Refer to Table 3-3 or Table 8-1.
Change the disc.
Same condition?
NO
YES
The disc is damaged. Use another disc.
Troubleshoot the A9 board.
(Also check the FDD.)
Return t


Assembly Level Isolation START
Turn the 4145B on.
Is MENU page displayed?
NO
YES
Is an Error-code displayed?
NO
YES
Is the fan turning?
YES
r
All is shut down. Turn off the 4145B and disconnect the cable from A11J2. Turn on the 4145B.
Is "A01" displayed on the CRT after "Busy" is displayed?
NO
YES
ubleshoot the A11
l A12 boards.
lso check the FDD,
l5A, and the A1, A2
l A9 boards.)
Troubleshoot the A15, A13 and A14 boards.
(Also check the A3 through A8 and A16 boards.)
Is the error-code P01 - P21?
NO
YES
Refer to Table 8-1. Troubleshoot the A2 board.
Is the error-code M02 - M19?
NO
YES
Error A01. Approximately 30 sec. after A01 is displayed, the MENU will be displayed.
Troubleshoot the A3 board.
(Also check the A2, A4 and A15 boards.)
A
Refer to Table 3-3 or Table 8-1.
Change the disc.
Same condition?
NO
YES
The disc is damaged. Use another disc.
Troubleshoot the A9 board.
(Also check the FDD.)
Is the system status message correct? Refer to Figure 3-22.
NO
YES
Is CHAN (10, 20, 30, 40) displayed?
NO
YES
Allow the instrument to warm up for at least 40 minutes, then turn it off and on one time.
Same Condition?
NO
YES
Return to START.
Is CHAN (!!!DOWN!!!) displayed?
NO
YES
SMU error. Refer to Table 8-2.
Troubleshoot the faulty SMU.
(Also check the A13 and A14 boards.)
Troubleshoot the A3 board.
(Also check the A2, A4 and A15 boards.)
Incorrect switch settings.
Check the Filter switch and HP-IB Address Switches on the rear panel.
Does the instrument pass the PAGE A
KEY FUNCTION CHE
Refer to para.
4-10.
NO
Is one of the error codes M02-M19 displayed?
NO
YES
A
Are all front panel keys and the RPG operating correctly?
NO
YES
Troubleshoot the A10 board.
Troubleshoot the A12 board.
Trouble
faulty

Note

When the faulty board has been isolated, proceed to the component level troubleshooting flow diagram for that board. If the failure is in the A1, A2, A3, A4, A9 or A10 board, see Figure 8-12 Digital Section Troubleshooting Notes, first.

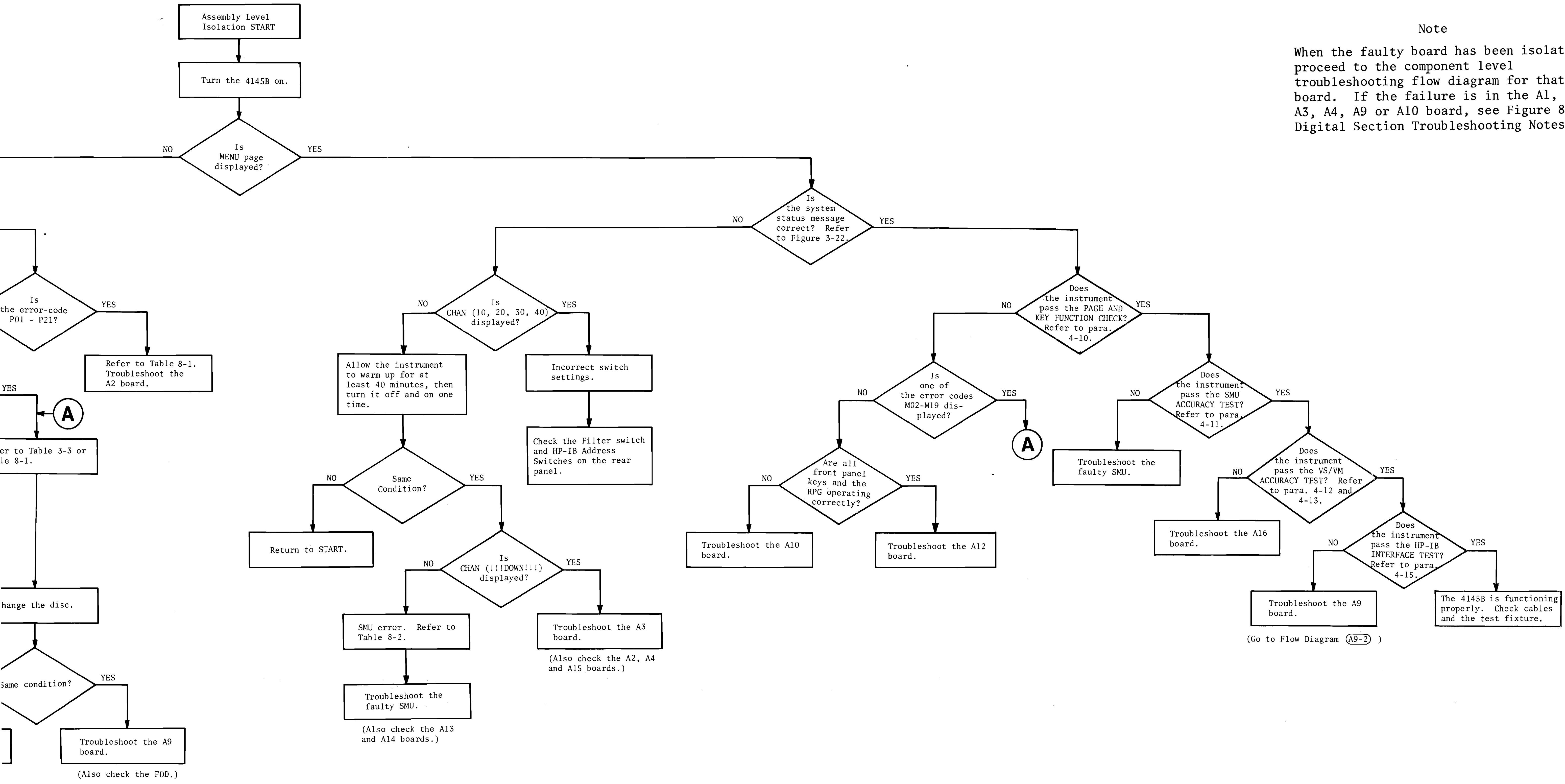


Figure 8-3. Assembly Level Trouble Isolation Flow Diagram.

8-17. ASSEMBLY REMOVAL

WARNING

DISCONNECT THE INSTRUMENT FROM THE AC SOURCE BEFORE PROCEEDING WITH ASSEMBLY REMOVAL.

CAUTION

BOTH INCH AND METRIC HARDWARE ARE USED IN THIS INSTRUMENT.

8-18. ASSEMBLY LOCATIONS

8-19. Assembly locations are shown in Figure 8-2.

The A11 and A12 boards are mounted on rear assembly A; the A19 board is mounted on rear assembly B. Refer to Figures 8-7 and 8-9, respectively.

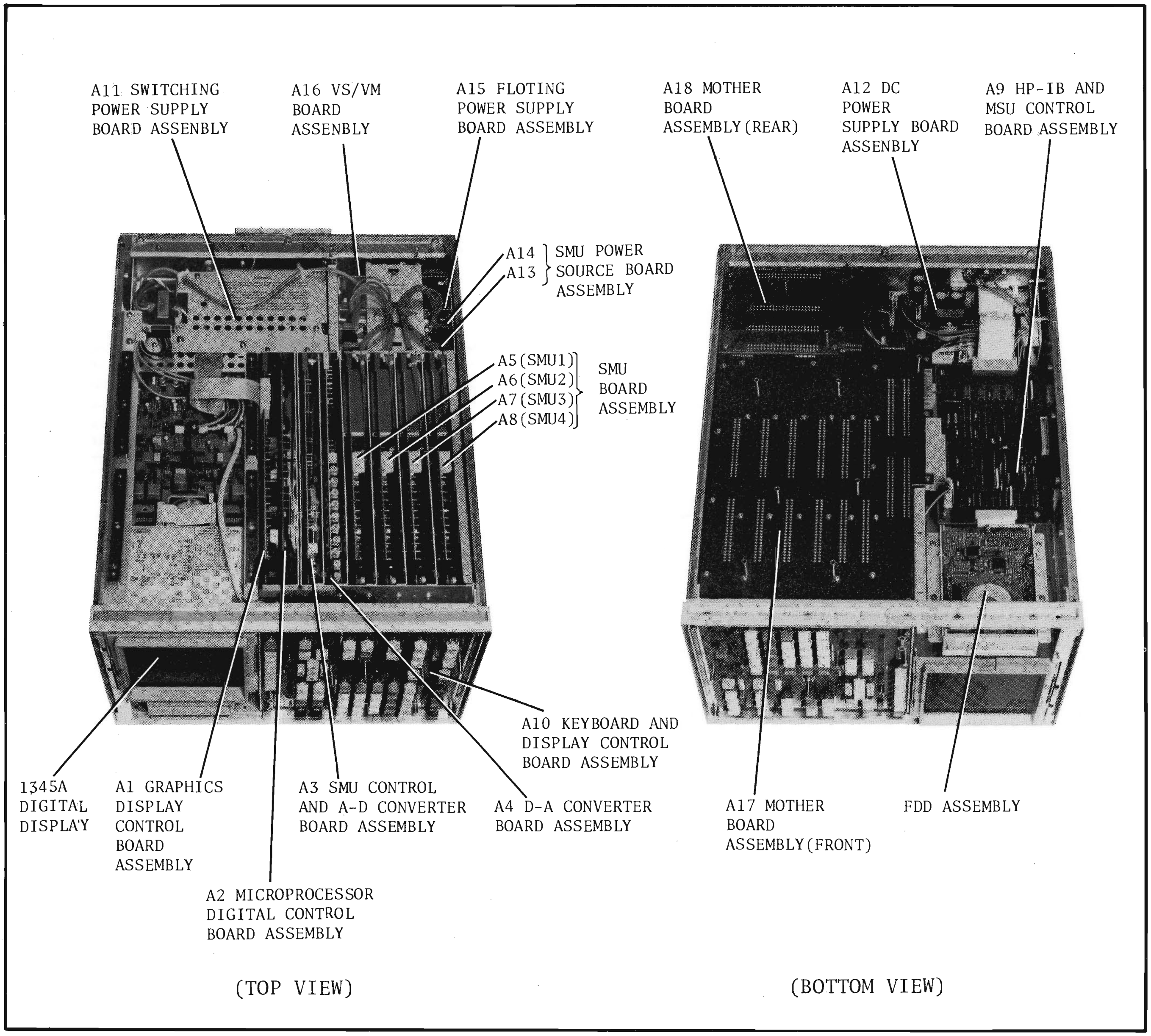


Figure 8-4. Assembly Locations.

8-20. A1 THROUGH A8 BOARD REMOVAL

8-21. To remove the A1 through A8 boards, perform as follows:

(1) Remove the top cover.

(2) Remove the large shield plate.

(3) To remove the A2, A3 or A4 boards, grasp the color-coded tabs mounted on the ends of each board and pull up. To remove the A1 board, first disconnect the blue flat-cable and then use the color-coded tabs to pull the board from its slot. To remove the A5, A6, A7 or A8 board, first raise the board halfway out of its slot and disconnect the cables from J1 and J2, then pull the board from its slot.

Note

The A5, A6, A7 and A8 boards are identical, and, as such, have the same color-coded tabs.

8-22. A13 THROUGH A16 BOARD REMOVAL

8-23. To remove the A13 through A16 boards, perform as follows:

(1) Remove the top cover.

(2) Remove the small plate covering the boards.

(3) To remove the A16 board, grasp the color-coded tabs mounted on the ends of the board and pull up. To remove the A15 board, first disconnect the cable from A11J2 and then use the color-coded tabs to pull the A15 board from its slot. To remove the A13 or A14 board, first disconnect the cables from J1 and J2, and then use the color-coded tabs to pull the board from its slot.

8-24. FRONT PANEL REMOVEL

8-25. To remove the 1345A or the A10 board, the front panel must first be removed. To remove the front panel, perform as follows:

(1) Remove the screws from each corner of the front panel.

(2) Remove the Marker Control Dial. Use a .062mm Hex Driver.

(3) Remove the front panel as shown in Figure 8-5.

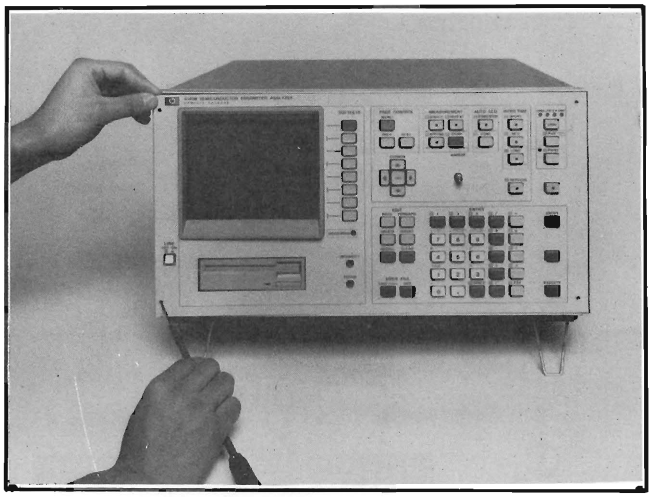


Figure 8-5. Front Panel Removel.

8-26. DISPLAY (1345A) REMOVAL

8-27. To remove the 1345A, perform as follows :

(1) Remove the top cover.

(2) Remove the large shield plate.

(3) Remove the front panel (refer to paragraph 8-25).

(4) Remove screws ①, ② and ③. Refer to Figure 8-6 (a).

(5) Carefully remove the plastic trim strip from the top of the front frame (use a screwdriver).

(6) Remove the adhesive-backed trim strip from the left side of the front frame.

(7) Remove screws ④, ⑤, ⑥ and ⑦. Refer to Figure 8-6 (a).

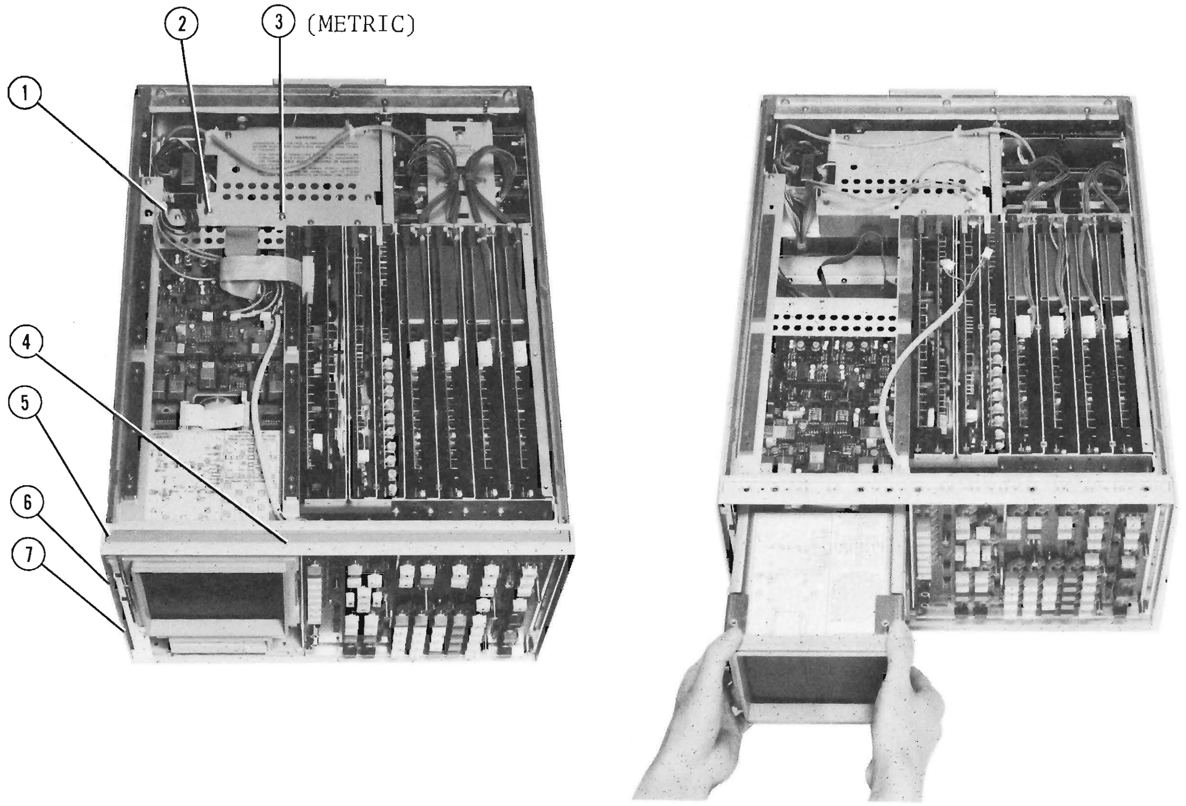
(8) Disconnect the blue flat-cable from the A1 board, and disconnect the focus/intensity control cable and the X, Y, and Z analog output cables from the 1345A.

(9) Carefully slide the 1345A about halfway out of the 4145B as shown in Figure 8-6 (b).

(10) Disconnect the power cable connected to the rear of the 1345A and then slide the 1345A completely out of the 4145B.

Note

The power cable for the 1345A is long enough to permit operation of the 1345A outside the 4145B.



(a) Screw Locations (b) Removal

Figure 8-6. 1345A Removal.

8-28. REAR ASSEMBLY A REMOVAL

8-29. To remove Rear Assembly A, perform as follows:

(1) Remove the top and bottom covers.

(2) Remove the left side-cover.

(3) Remove screws ① through ⑫. Refer to Figure 8-7 (a).

(4) Disconnect all cables.

(5) Carefully pull out the assembly as shown in Figure 8-7 (b).

8-30. A11 AND A12 BOARD REMOVAL

8-31. To remove the A11 and A12 boards, perform as follows:

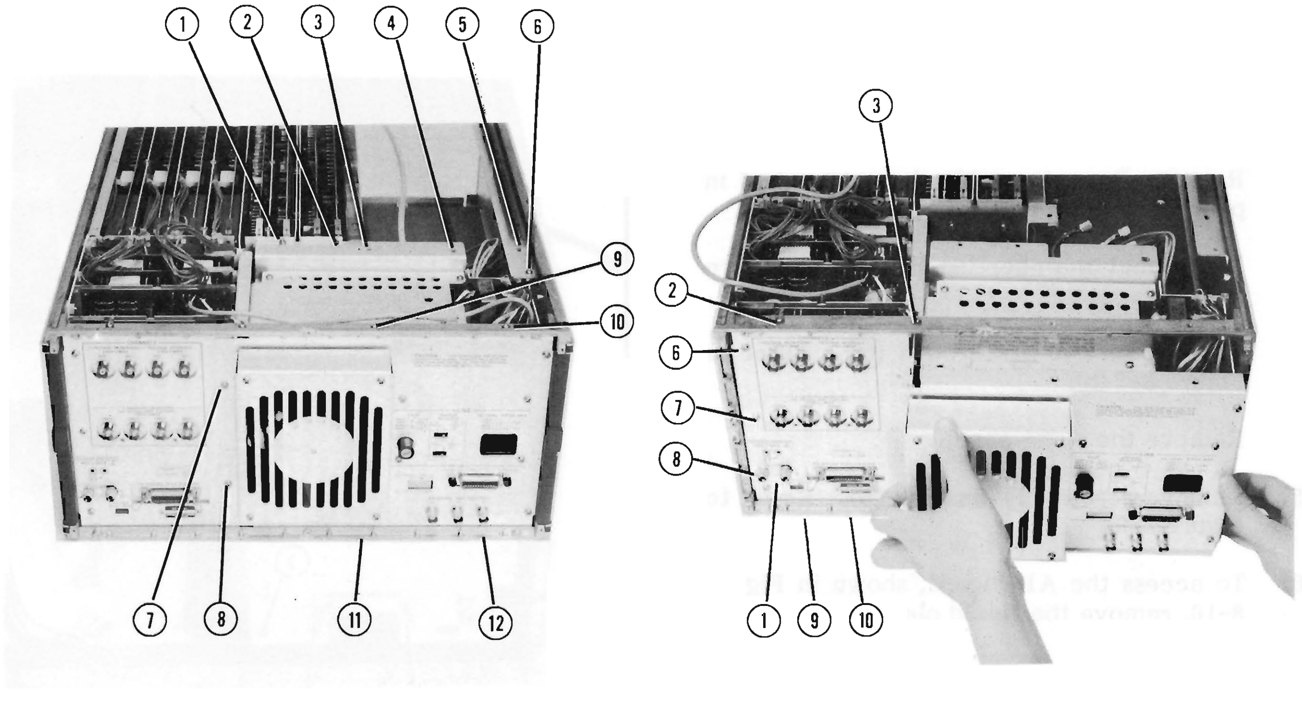
(1) Remove rear assembly A as described in paragraph 8-28.

(2) The A11 or A12 board can be removed by disconnecting all cables and removing the screws that secure the board to the assembly. Refer to Figure 8-8 (a).

(3) If screws 1 through 5 shown in Figure 8-8 (a) are removed, the line filter can be accessed, as shown in Figure 8-8 (b).

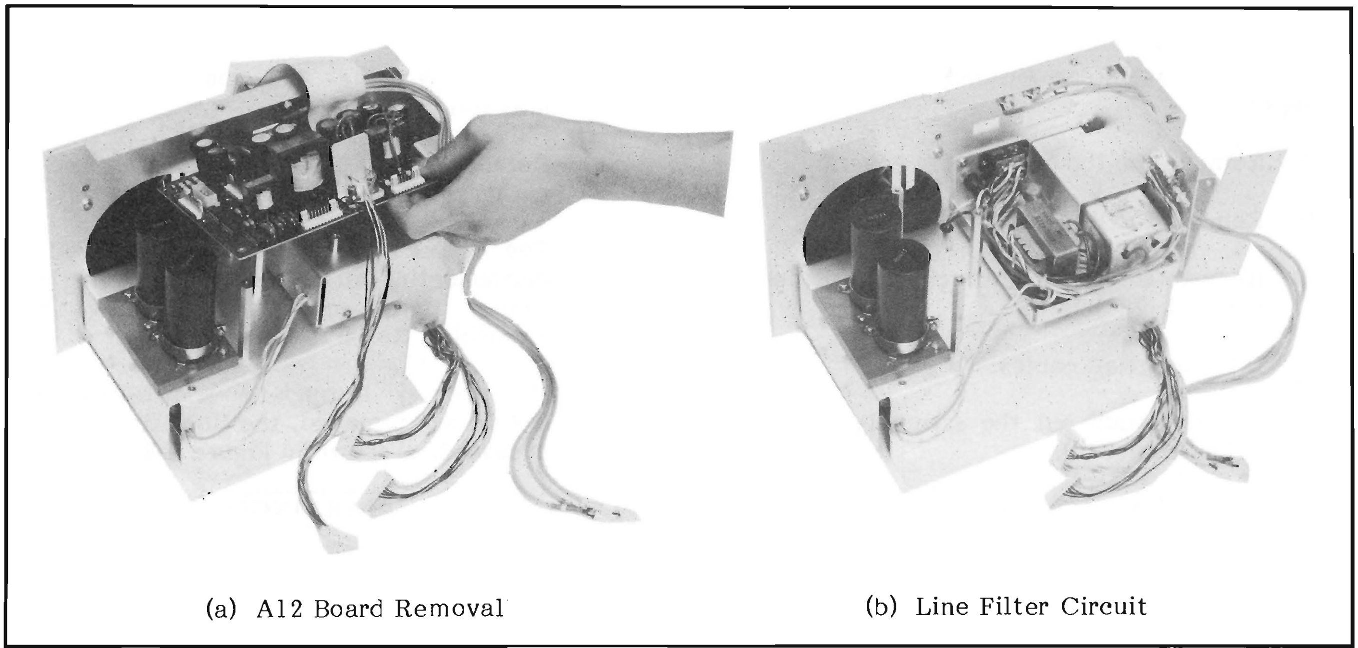
WARNING

POTENTIAL SHOCK HAZARD. DANGEROUS VOLTAGES MAY BE PRESENT ON THE A11 BOARD EVEN AFTER THE 4145A HAS BEEN TURNED OFF.



(a) Screw Locations (b) Removal

Figure 8-7. Rear Assembly A Removal.



(a) A12 Board Removal (b) Line Filter Circuit

Figure 8-8. A11 and A12 Board Removal.

8-32. REAR ASSEMBLY B REMOVAL

8-33. To remove Rear Assembly B, perform as follows:

(1) Remove Rear Assembly A as described in paragraph 8-28.

(2) Disconnect the Shorting Bar (① in Figure 8-7 (b)).

(3) Remove screws ② through ⑩. Refer to Figure 8-7 (b).

(4) Remove the outer panel.

(5) Remove screws ① through ⑤. Refer to Figure 8-9.

(6) To access the A19 board, shown in Figure 8-10, remove the shield plate.

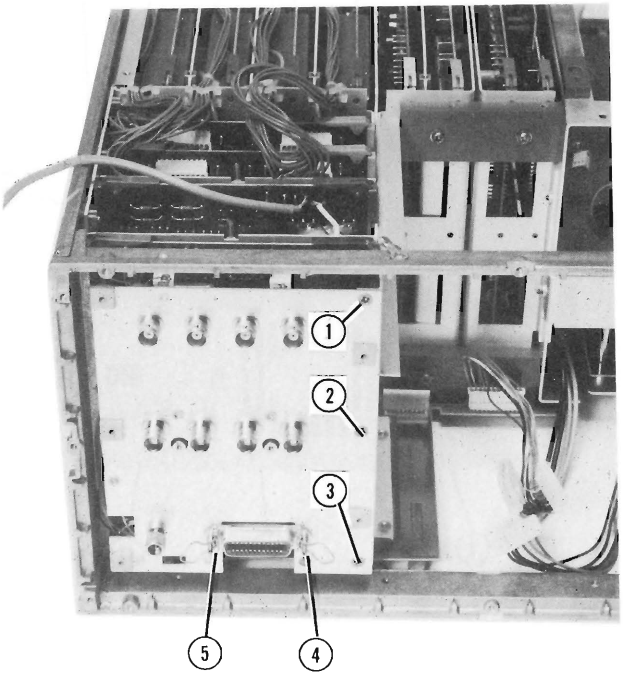


Figure 8-9. Rear Assembly B Removal.

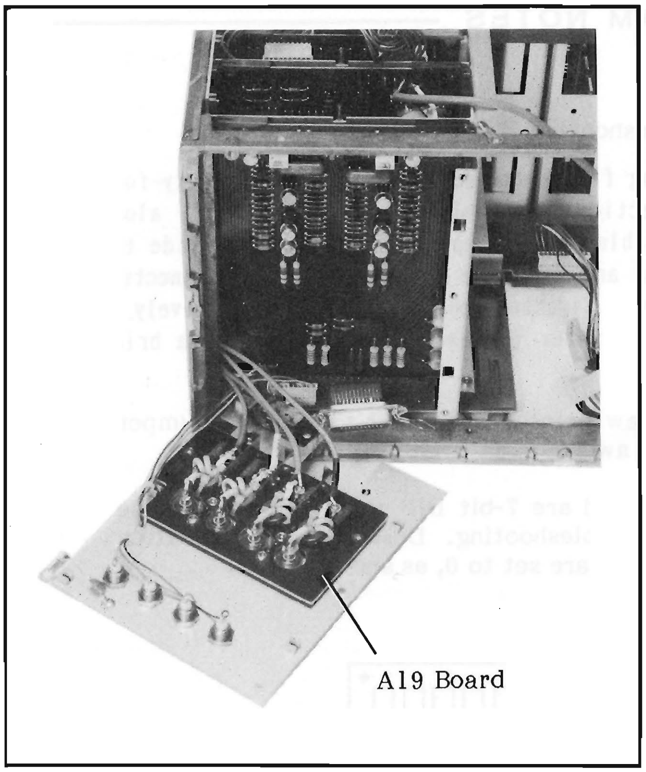


Figure 8-10. A19 Board Assembly.

8-34. FDD AND A9 BOARD REMOVAL

8-35. To remove the FDD (Flexible Disc Drive) and the A9 board, perform as follows :

(1) Remove the bottom cover.

(2) Remove screws ① through ④ shown in Figure 8-11.

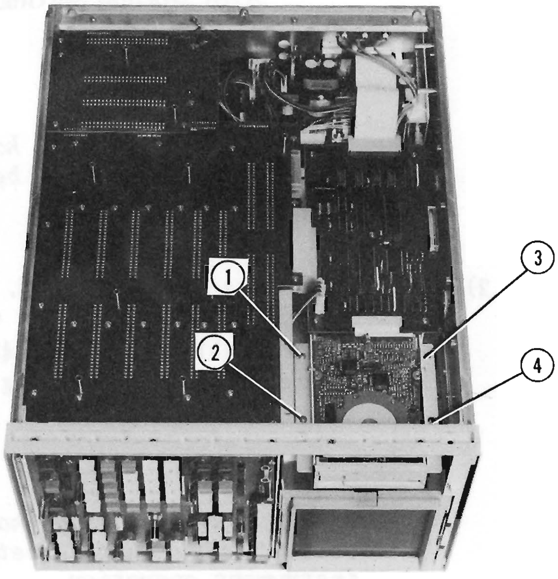
CAUTION

THE FOUR SCREWS ARE METRIC THREADED. BE SURE TO USE THE SAME SCREWS WHEN RE-INSTALLING THE FDD.

(3) Carefully pull out the FDD through the front panel.

(4) Remove the flat cables connected to the A9 board.

(5) Remove the screws securing the A9 board to the chassis.



Screws ① through ④ are Metric.

Figure 8-11. FDD and A9 Board Removal.

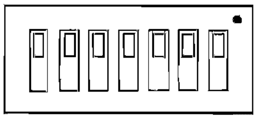
FLOW DIAGRAM NOTES

Digital Section Troubleshooting Notes

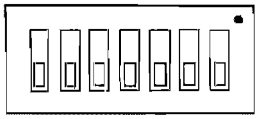
There are fifty digital section troubleshooting flow diagrams-six primary and forty-four secondary. A complete listing of all digital section troubleshooting flow diagrams, along with a brief description of each, is given in Table 8-4. These flow diagrams provide the instructions, signature analyzer control settings, and signature analyzer probe and connection points necessary for component level troubleshooting. Signature analysis is used extensively. If you are not familiar with signature analysis, refer to Figure 8-13. It gives a brief description of the technique.

Before troubleshooting the 4145B, there are a few points concerning switch and jumper settings, test ROM usage, etc., that you should be aware of.

1) A2S1 on the A2 board and A3S1 on the A3 board are 7-bit DIP switches that set the 4145B to the appropriate test mode during troubleshooting. During normal operation all bits of A2S1 are set to 1, and all bits of A3S1 are set to 0, as shown below.



A2S1 Normal Setting



A3S1 Normal Setting

NOTE

After troubleshooting has been performed and repairs completed, A2S1 and A3S1 must be set as shown above to allow normal instrument operation.

2) There are twenty jumpers, in all, on the A1 through A4 and A9 boards. The settings of these jumpers are changed to set the 4145B to the appropriate test mode as occasion calls while troubleshooting the 4145B. The correct jumper settings are given in the Flow Diagrams. The normal setting for each jumper is pictorially given in Table 8-3, along with a brief description.

NOTE

After troubleshooting has been performed and repairs completed, each jumper must be set to its normal setting to allow normal instrument operation.

Figure 8-12. Flow Diagram Notes (Sheet 1 of 5).

FLOW DIAGRAM NOTES

3) The flat-cable connected between the FDD (flexible-disc drive) PC board and the A9 board must be disconnected and then connected to the A9 board as instructed in troubleshooting flow diagram when troubleshooting the A9 board. The procedure for connecting the cable to the A9 board is described below:

   1) Turn off the 4145B and remove the bottom cover.

   2) Remove the flexible-disc drive and disconnect the flat-cable from FDD PC board.

   3) Connect the cable to the A9 board as shown below :

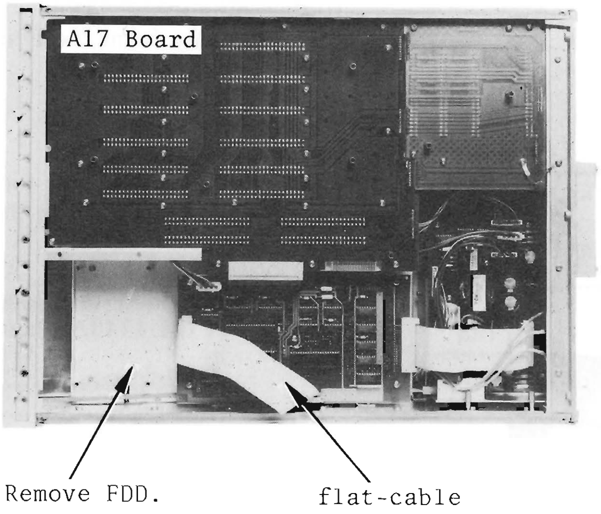
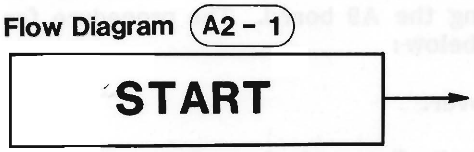


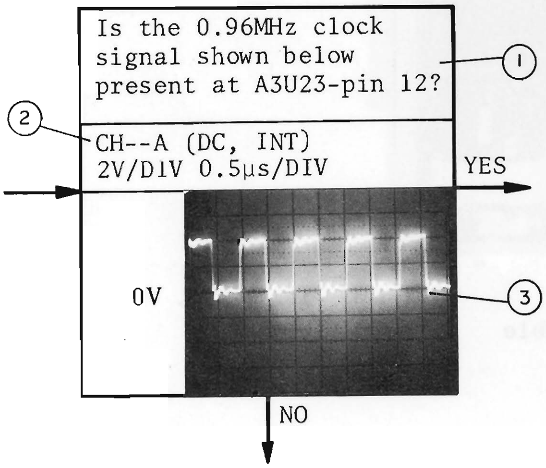
Figure 8-12. Flow Diagram Notes (Sheet 2 of 5).

FLOW DIAGRAM NOTES

Troubleshooting Flow Diagram Notes



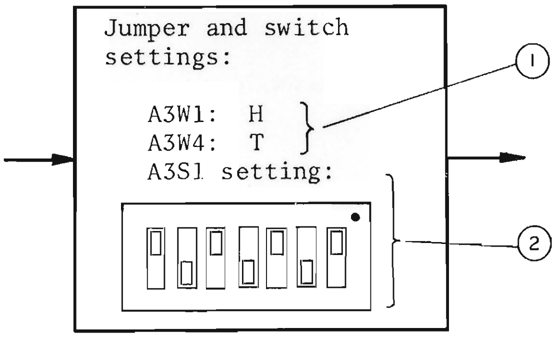
Indicates the lead-in, or initial, troubleshooting flow diagram for a faulty board isolated by the Assembly Level Isolation Flow Diagram. If the Assembly Level Isolation Flow Diagram instructs you to troubleshoot the A2 Board, for example, go to the flow diagram labelled A2-1. Do not go directly to a higher-numbered flow diagram--A2-2 or A2-3, for example. Higher-numbered flow diagrams, if any, originate only from the lead-in flow diagram.



① Compare the actual (observed) clock signal with the one given in the figure (③).

② Connect channel A of the 1740A (recommended oscilloscope) to A3U23-pin 12. Set the 1740A's controls as follows :

COUPLING	DC
DISPLAY	Channel A
TRIGGER	INT
VOLT/DIV	2
TIME/DIV	0.5 μs

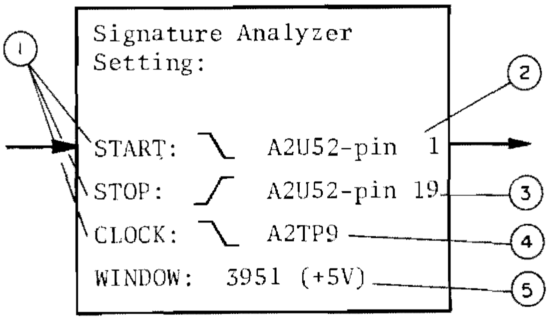


① Set the listed jumpers to the indicated settings. In the example given, A3W1 should be set to H, and A3W4 to T. Leave all other jumpers as they are, change the settings of those listed only. After troubleshooting has been performed and repairs completed, be sure to set all jumpers to their normal settings (refer to Table 8-3).

② Set the bit-switches of the indicated switch as shown. In the example given, A3S1 should be set to 1010101. After troubleshooting, set A2S1 and A3S1 to their initial settings (refer to the figure on page 8-14).

Figure 8-12. Flow Diagram Notes (Sheet 3 of 5).

FLOW DIAGRAM NOTES

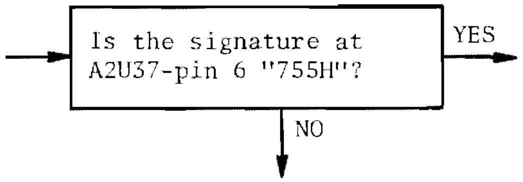


① Set the Signature Analyzer's START, STOP and CLOCK controls as indicated (╱: ▨ OUT) (╲: ▬ IN).

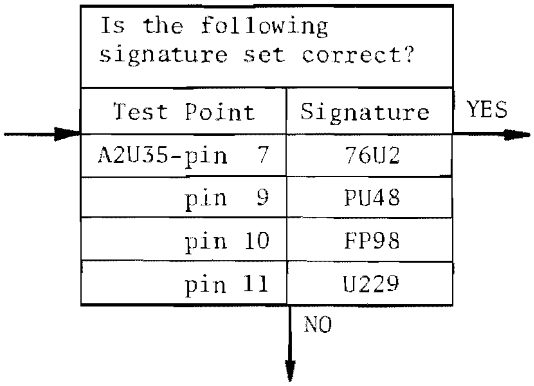
②, ③, ④

Connect the START, STOP and CLOCK leads of the Signature Analyzer's active pod to the indicated points. In the example given, START should be connected to A2U52-pin 1, STOP to A2U52-pin 19, and CLOCK to A2TP9.

⑤ This is the signature for the window test (+5V). It should be displayed on the signature analyzer. If the correct signature is not displayed, press the RESET button on the probe. If the window is still incorrect, check the component from which the window signal or clock signal is taken. In the example given, A2U52 and the component directly connected to A2TP9.



Check that the signature at A2U37-pin 6 is 755H.

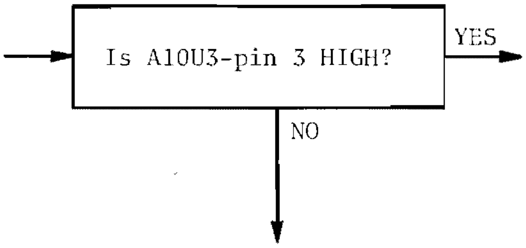


Test Point	Signature
A2U35-pin 7	76U2
pin 9	PU48
pin 10	FP98
pin 11	U229

Check that the signature set shown is correct.

Figure 8-12. Flow Diagram Notes (Sheet 4 of 5).

FLOW DIAGRAM NOTES



Check that the logic level at A10U3-pin 3 is HIGH.

Figure 8-12. Flow Diagram Notes (Sheet 5 of 5).

Table 8-3. Jumper Settings (Sheet 1 of 2)

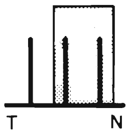
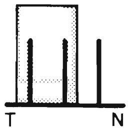
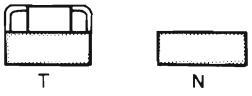
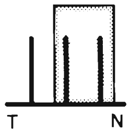
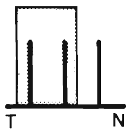
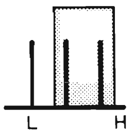
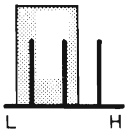
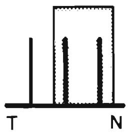
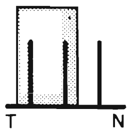
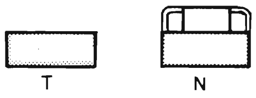
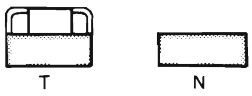
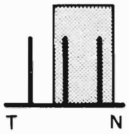
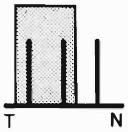
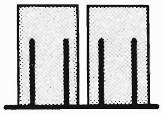
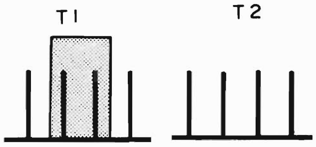
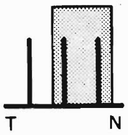
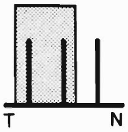
Reference Designation	Normal Setting	Test Setting	Note
A1W1 A1W2 A1W3 A1W4 A1W5			
A2W1			
A2W2 A2W3			
A3W1			
A3W2 A3W3 A3W4			
A3W5			

Table 8-3. Jumper Settings (Sheet 2 of 2)

Reference Designation	Normal Setting	Test Setting	Note
A3W6 A3W7			
A3W8·9			There are two test settings for A3W8·9: T1 and T2.
A4W1 A9W1 A9W2			

Note:
T: Test
N: Normal
L: LOW
H: HIGH
T/N: Test/Normal
E: EXERCISER

Signature Analysis

Signature Analysis is a unique technique for component-level troubleshooting. The signature analyzer detects and displays the unique digital signature of the data at a given node in the circuit under test. By comparing the actual signature to the correct one, the service technician can quickly back-trace to the faulty node, and, ultimately, to the faulty component. To represent the signature, a nonstandard character set (123456789 ACFHPU) was chosen for readability and compatibility with 7-segment displays.

Stated simply, the signature analyzer displays a compressed four-digit "fingerprint" of the data stream present at a node. This "fingerprint" is unique for a good node. Any fault associated with a device on that node will force a change in the data stream and, consequently, result in an incorrect signature. If, for example, the signature at the input of a device is correct but the signature at the output is not, the device is regarded as faulty and should be replaced.

This technique is especially useful in troubleshooting microprocessor based instruments like the 4145B, where data streams are long and complex and where there are no conventional means to efficiently troubleshoot to the component level.

The signature analyzer's active logic probe and active pod detect and develop the signature for display on the signature analyzer. The logic probe is applied to the desired node in the circuit under test and transfers the data to the signature analyzer. The four leads on the active pod are connected to appropriate points on the 4145B, and provide the necessary START, STOP, and CLOCK signals and GND reference. The START signal opens the measurement "window" and instructs the signature analyzer to prepare to receive data from the logic probe; the STOP signal closes the "window." The CLOCK signal provides the appropriate measurement timing pulses. Probe points; connection locations for START, STOP, and CLOCK; and control settings for the signature analyzer are given in the troubleshooting flow diagrams.

MEASUREMENT GATING EXAMPLE, POSITIVE EDGE START, STOP, AND CLOCK

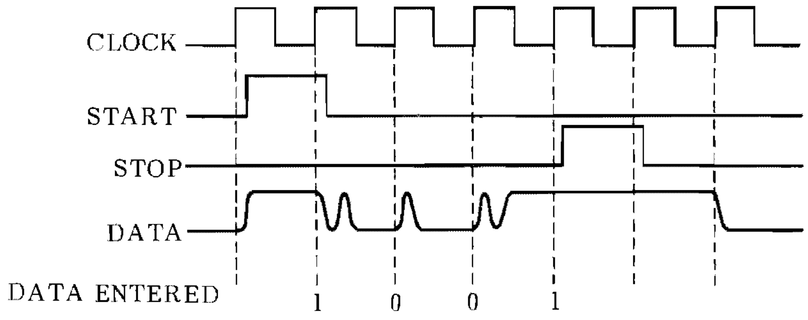


Figure 8-13. Signature Analysis.

Table 8-4. List of Digital Section Troubleshooting Flow Diagrams (Sheet 1 of 3)

Flow Diagram	Description (Purpose)
Flow Diagram (A1 - 1)	Contains the 1345A SELF Test and checks the clock signals and data bus lines (IOD0 through IOD7)
Flow Diagram (A1 - 2)	Contains A1 Board Self Test (Memory Pointer Test, Read/Write Test, Handshake Test and Jump Test), and indicates whether the Memory R/W Control, Handshake Control, Jump Control, Memory R/W Pointer, MPX, Static RAM or Output Latch is defective.
Flow Diagram (A1 - 3) **Flow Diagram** (A1 - 4)	Checks the Read/Write operation of the Memory R/W Control circuit, Memory R/W Pointer circuit, MPX circuit and Static RAMs.
Flow Diagram (A1 - 5)	Checks the Handshake Control circuit, Scan Pointer circuit, MPX circuit and Output Latch circuit for correct handshake between the 1345A and the A1 board.
Flow Diagram (A1 - 6)	Checks the Jump Control circuit and Scan Pointer circuit.
Flow Diagram (A2 - 1) **Flow Diagram** (A2 - 2)	Checks the dc voltage supplied from the A12 board, clock signals, and DBE signal.
Flow Diagram (A2 - 3)	Isolates instrument failures to ROM-related circuits, RAM-related circuits, Timer circuit or the ACIA (Asynchronous Communication Interface Adapter).
Flow Diagram (A2 - 4)	Checks the Clock Generator (A2U32) and the Address Decode & Wait circuit.
Flow Diagram (A2 - 5) **Flow Diagram** (A2 - 6) **Flow Diagram** (A2 - 7) **Flow Diagram** (A2 - 8)	Checks the ROMs (A2U6), MPU, address bus and data bus.
Flow Diagram (A2 - 9)	Checks the RAMs (A2U1 through A2U13).
Flow Diagram (A2 - 10)	Checks the Clock Divider circuit (including A2U35, U22 and U23) and Timer (A2U21).

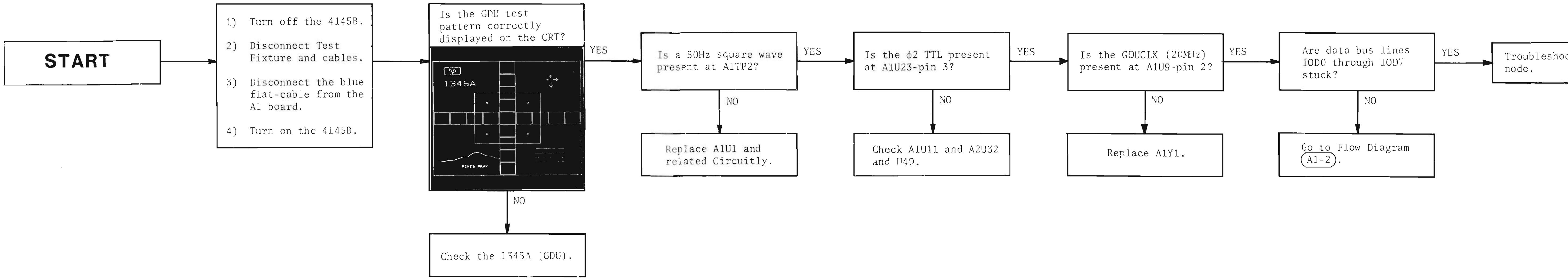
Table 8-4. List of Digital Section Troubleshooting Flow Diagrams (Sheet 2 of 3)

Flow Diagram	Description (Purpose)
Flow Diagram A2 - 11	Checks the ACIA (A2U38) and A2U27.
Flow Diagram A3 - 1 **Flow Diagram A3 - 2**	Checks the dc voltage supplied from the A15 board, checks the clock and reset signals used by the MPU, and contains the A3/A4 board Self Test, which indicates a defective A3/A4 circuit by the A3DS1 through A3DS4 (LEDs) display pattern.
Flow Diagram A3 - 3	Checks the ROMs (A3U9) by performing the ROM Check Sum Test.
Flow Diagram A3 - 4	Checks the RAMs (A3U24) by performing the RAM Pattern Test.
Flow Diagram A3 - 5 **Flow Diagram A3 - 6** **Flow Diagram A3 - 7**	Checks the Interval Timer circuit (A3U5, U18 and U19) and the interrupt signal flow to the MPU.
Flow Diagram A3 - 8 **Flow Diagram A3 - 9** **Flow Diagram A3 - 10** **Flow Diagram A3 - 11**	Checks the A-D Converter circuit.
Flow Diagram A3 - 12 **Flow Diagram A3 - 13**	Checks ACIA (Asynchronous Communication Interface Adapter, A3U44) and the optocouplers, which handle data transfer between the host processor (A2 board) and the A3 board.
Flow Diagram A4 - 1 **Flow Diagram A4 - 4**	Checks the Multiplex Timing Controller circuit.
Flow Diagram A4 - 2	Checks the MPU Bus Interface (A4U35, U36 and U37) and Data Memory (A4U19, U20, U25 and U26).
Flow Diagram A4 - 3	Checks the D-A converter circuit, including A4U18 and the I/V Converter circuit.

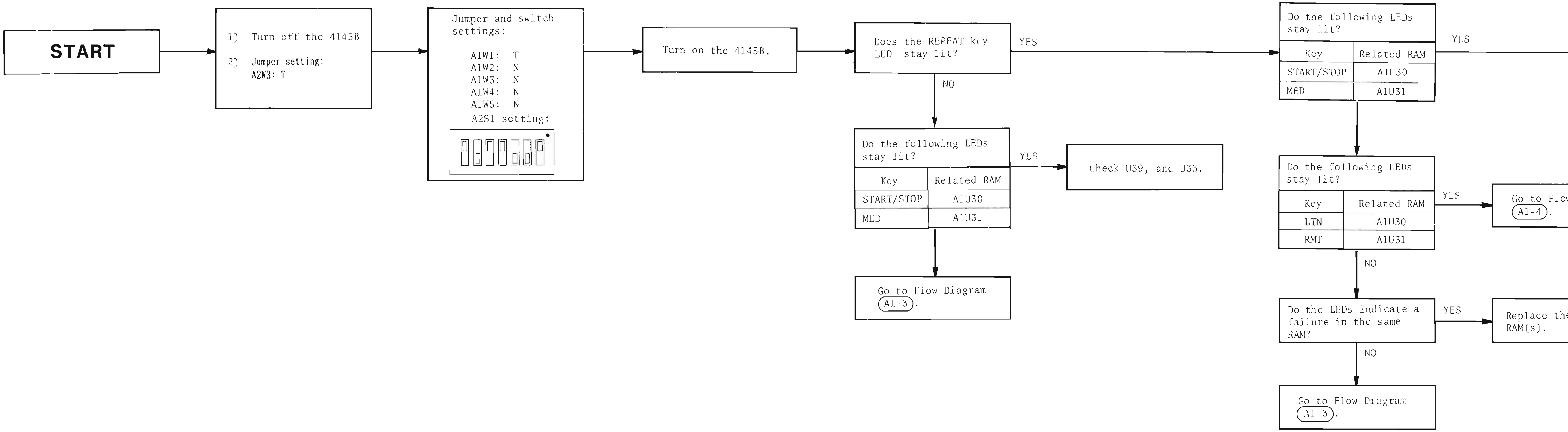
Table 8-4. List of Digital Section Troubleshooting Flow Diagrams (Sheet 3 of 3)

Flow Diagram	Description (Purpose)
Flow Diagram (A4 - 5) **Flow Diagram** (A4 - 6)	Checks the Analog Demultiplexer S/H Switching circuit and S/H Amplifier circuit.
Flow Diagram (A9 - 1)	Checks the dc voltage supplied from the A12 board and isolates failures in the MSU (Mass Storage Unit).
Flow Diagram (A9 - 2)	Checks all clock signals and gives instructions for further troubleshooting.
Flow Diagram (A9 - 3) **Flow Diagram** (A9 - 4)	Checks the HP-IB Bus Tranceiver circuit (A9U6, U11, U17 and U13) and the HP-IB Interface Adapter (A9U16).
Flow Diagram (A9 - 5)	Checks the HP-IB Address SW Buffer (A9U19) to verify that the HP-IB address switch is correctly read.
Flow Diagram (A9 - 6) **Flow Diagram** (A9 - 7) **Flow Diagram** (A9 - 8) **Flow Diagram** (A9 - 9) **Flow Diagram** (A9 - 10)	Checks the MSU Interface circuit (A9U8, A9U14 and A9U15) and verifies the MSU Interface Write and step functions.
Flow Diagram (A9 - 11)	Checks A9U14, U16, U17, etc., to verify the MSU Interface Read function.
Flow Diagram (A10 - 1)	Isolates a front panel failure to the LED decode circuit, RPG (Rotary Pulse Generator) control circuit, or Key control/decode circuits. Also checks the LED decode circuit and RPG control circuit.
Flow Diagram (A10 - 2) **Flow Diagram** (A10 - 3)	Checks the Key control/decode circuits.

Flow Diagram A1 - 1



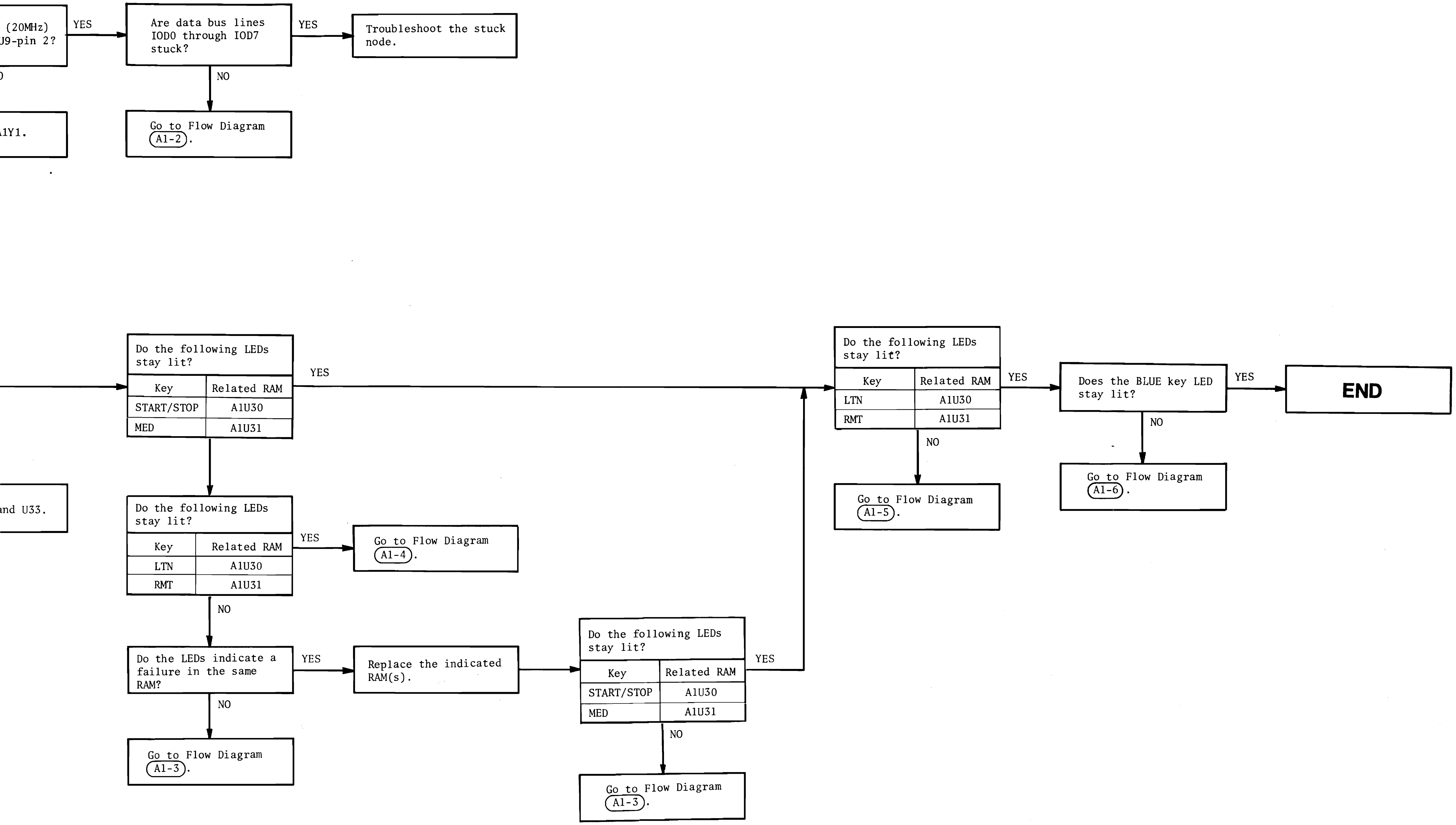
Flow Diagram A1 - 2



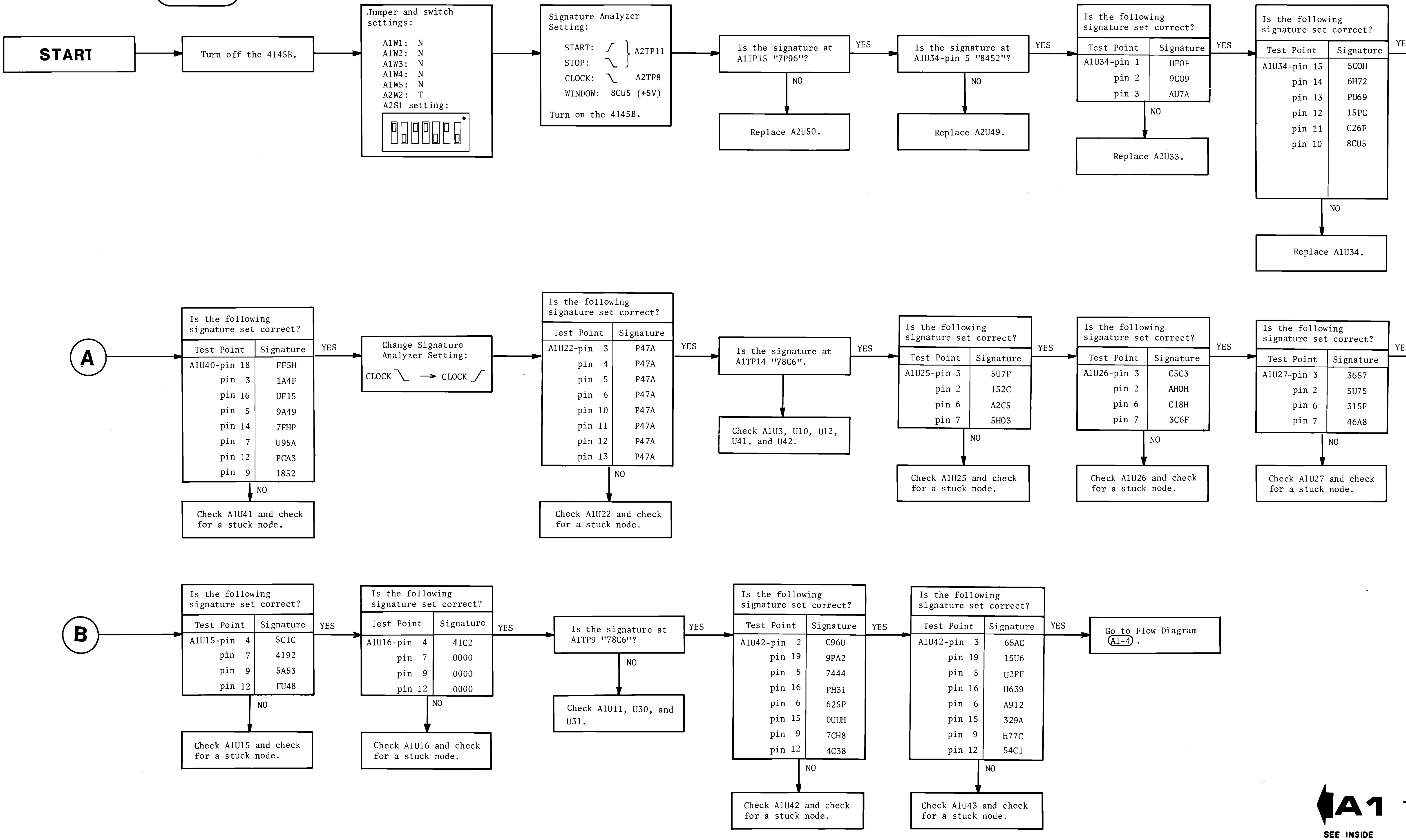
Key	Related RAM
START/STOP	A1U30
MED	A1U31

Key	Related RAM
START/STOP	A1U30
MED	A1U31

Key	Related RAM
LTN	A1U30
RMT	A1U31


(20MHz)
J9-pin 2?
YES
Are data bus lines IOD0 through IOD7 stuck?
YES
Troubleshoot the stuck node.
NO
Go to Flow Diagram (A1-2).
1Y1.
Do the following LEDs stay lit?
Key | Related RAM
START/STOP | A1U30
MED | A1U31
YES
nd U33.
Do the following LEDs stay lit?
Key | Related RAM
LTN | A1U30
RMT | A1U31
YES
Go to Flow Diagram (A1-4).
NO
Do the LEDs indicate a failure in the same RAM?
YES
Replace the indicated RAM(s).
NO
Go to Flow Diagram (A1-3).
Do the following LEDs stay lit?
Key | Related RAM
START/STOP | A1U30
MED | A1U31
YES
NO
Go to Flow Diagram (A1-3).
Do the following LEDs stay lit?
Key | Related RAM
LTN | A1U30
RMT | A1U31
YES
NO
Go to Flow Diagram (A1-5).
Does the BLUE key LED stay lit?
YES
END
NO
Go to Flow Diagram (A1-6).

Flow Diagram (A1 - 3)



Turn off the 4145B.

Jumper and switch settings:

A1W1: N
A1W2: N
A1W3: N
A1W4: N
A1W5: N
A2W2: T
A2S1 setting:

Signature Analyzer Setting:

START: ⟋ } A2TP11
STOP: ⟍
CLOCK: ⟍ A2TP8
WINDOW: 8CU5 (+5V)

Turn on the 4145B.

Is the signature at A1TP15 "7P96"? — NO: Replace A2U50.

Is the signature at A1U34-pin 5 "8452"? — NO: Replace A2U49.

Is the following signature set correct?

Test Point	Signature
A1U34-pin 1	UF0F
pin 2	9C09
pin 3	AU7A

NO: Replace A2U33.

Is the following signature set correct?

Test Point	Signature
A1U34-pin 15	5C0H
pin 14	6H72
pin 13	PU69
pin 12	15PC
pin 11	C26F
pin 10	8CU5

NO: Replace A1U34.

A

Is the following signature set correct?

Test Point	Signature
A1U40-pin 18	FF5H
pin 3	1A4F
pin 16	UF15
pin 5	9A49
pin 14	7FHP
pin 7	U95A
pin 12	PCA3
pin 9	1852

NO: Check A1U41 and check for a stuck node.

Change Signature Analyzer Setting:

CLOCK ⟍ → CLOCK ⟋

Is the following signature set correct?

Test Point	Signature
A1U22-pin 3	P47A
pin 4	P47A
pin 5	P47A
pin 6	P47A
pin 10	P47A
pin 11	P47A
pin 12	P47A
pin 13	P47A

NO: Check A1U22 and check for a stuck node.

Is the signature at A1TP14 "78C6". — Check A1U3, U10, U12, U41, and U42.

Is the following signature set correct?

Test Point	Signature
A1U25-pin 3	5U7P
pin 2	152C
pin 6	A2C5
pin 7	5H03

NO: Check A1U25 and check for a stuck node.

Is the following signature set correct?

Test Point	Signature
A1U26-pin 3	C5C3
pin 2	AH0H
pin 6	C18H
pin 7	3C6F

NO: Check A1U26 and check for a stuck node.

Is the following signature set correct?

Test Point	Signature
A1U27-pin 3	3657
pin 2	5U75
pin 6	315F
pin 7	46A8

NO: Check A1U27 and check for a stuck node.

B

Is the following signature set correct?

Test Point	Signature
A1U15-pin 4	5C1C
pin 7	4192
pin 9	5A53
pin 12	FU48

NO: Check A1U15 and check for a stuck node.

Is the following signature set correct?

Test Point	Signature
A1U16-pin 4	41C2
pin 7	0000
pin 9	0000
pin 12	0000

NO: Check A1U16 and check for a stuck node.

Is the signature at A1TP9 "78C6"? — NO: Check A1U11, U30, and U31.

Is the following signature set correct?

Test Point	Signature
A1U42-pin 2	C96U
pin 19	9PA2
pin 5	7444
pin 16	PH31
pin 6	625P
pin 15	0UUH
pin 9	7CH8
pin 12	4C38

NO: Check A1U42 and check for a stuck node.

Is the following signature set correct?

Test Point	Signature
A1U42-pin 3	65AC
pin 19	15U6
pin 5	U2PF
pin 16	H639
pin 6	A912
pin 15	329A
pin 9	H77C
pin 12	54C1

NO: Check A1U43 and check for a stuck node.

YES: Go to Flow Diagram (A1-4).

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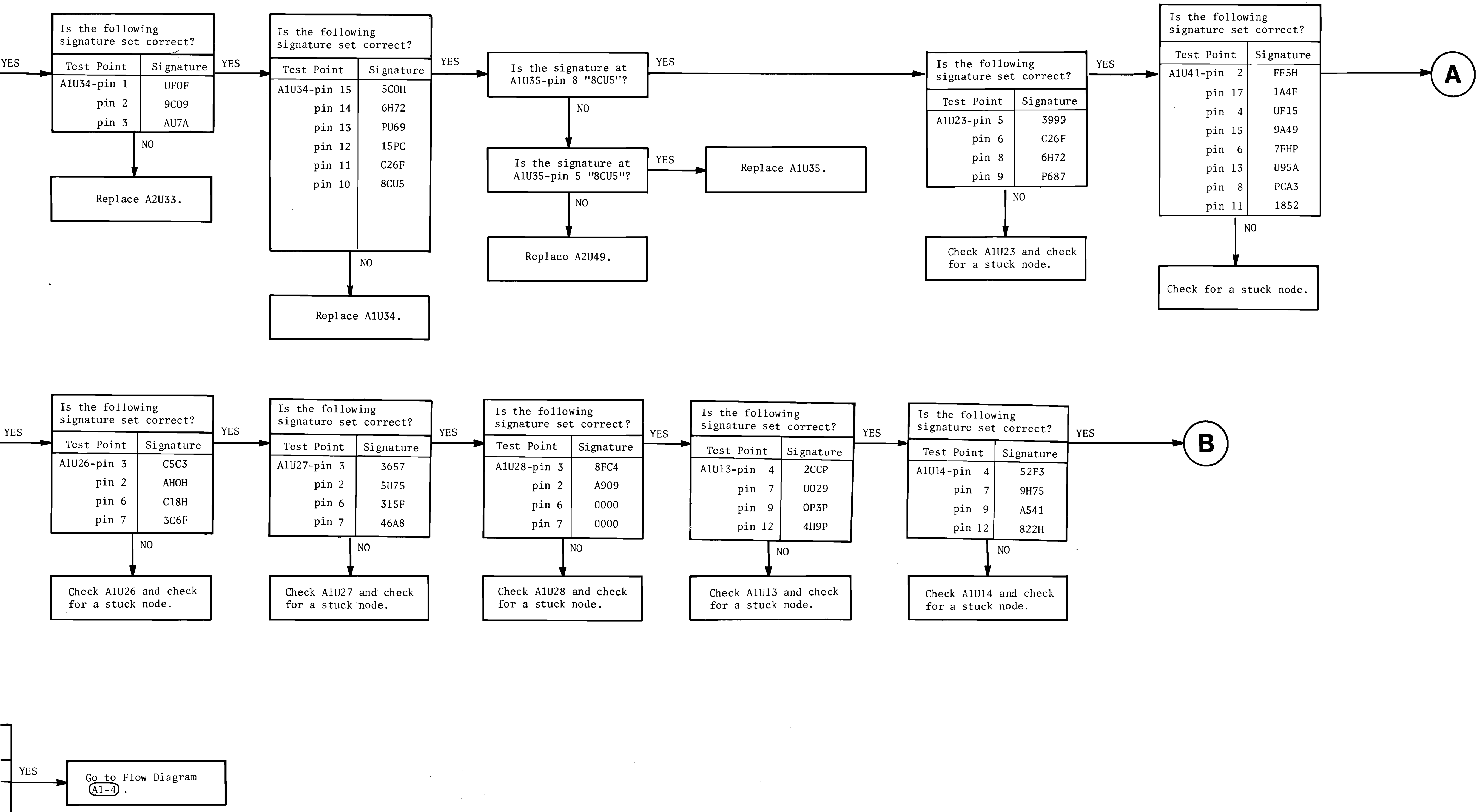
A1

SEE INSIDE

Figure 8-14. A



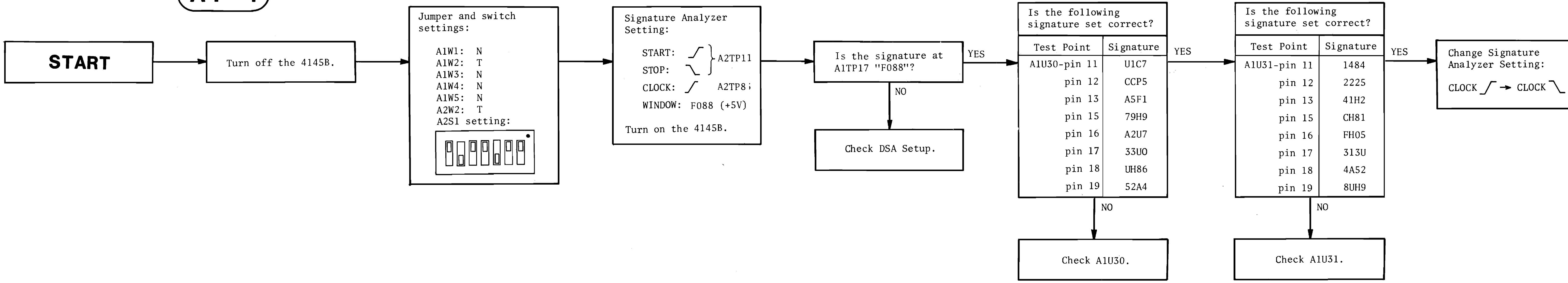
A1 Troubleshooting Flow Diagram

SEE INSIDE

Figure 8-14. A1 Board Troubleshooting Flow Diagram (Sheet 1 of 5).

Figure 8-14. A1 Board Troubleshooting Flow Diagram (Sheet 2 of 5).

Flow Diagram (A1-4)

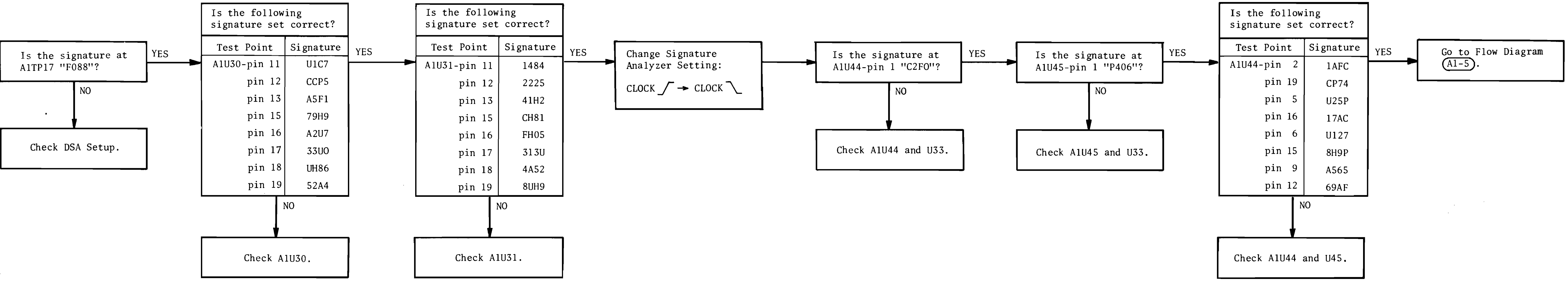


Is the following signature set correct?

Test Point	Signature
A1U30-pin 11	U1C7
pin 12	CCP5
pin 13	A5F1
pin 15	79H9
pin 16	A2U7
pin 17	33U0
pin 18	UH86
pin 19	52A4

Is the following signature set correct?

Test Point	Signature
A1U31-pin 11	1484
pin 12	2225
pin 13	41H2
pin 15	CH81
pin 16	FH05
pin 17	313U
pin 18	4A52
pin 19	8UH9



Is the signature at A1TP17 "F088"?

Check DSA Setup.

Is the following signature set correct?

Test Point	Signature
A1U30-pin 11	U1C7
pin 12	CCP5
pin 13	A5F1
pin 15	79H9
pin 16	A2U7
pin 17	33U0
pin 18	UH86
pin 19	52A4

Check A1U30.

Is the following signature set correct?

Test Point	Signature
A1U31-pin 11	1484
pin 12	2225
pin 13	41H2
pin 15	CH81
pin 16	FH05
pin 17	313U
pin 18	4A52
pin 19	8UH9

Check A1U31.

Change Signature Analyzer Setting:

CLOCK _/‾ → CLOCK ‾_

Is the signature at A1U44-pin 1 "C2F0"?

Check A1U44 and U33.

Is the signature at A1U45-pin 1 "P406"?

Check A1U45 and U33.

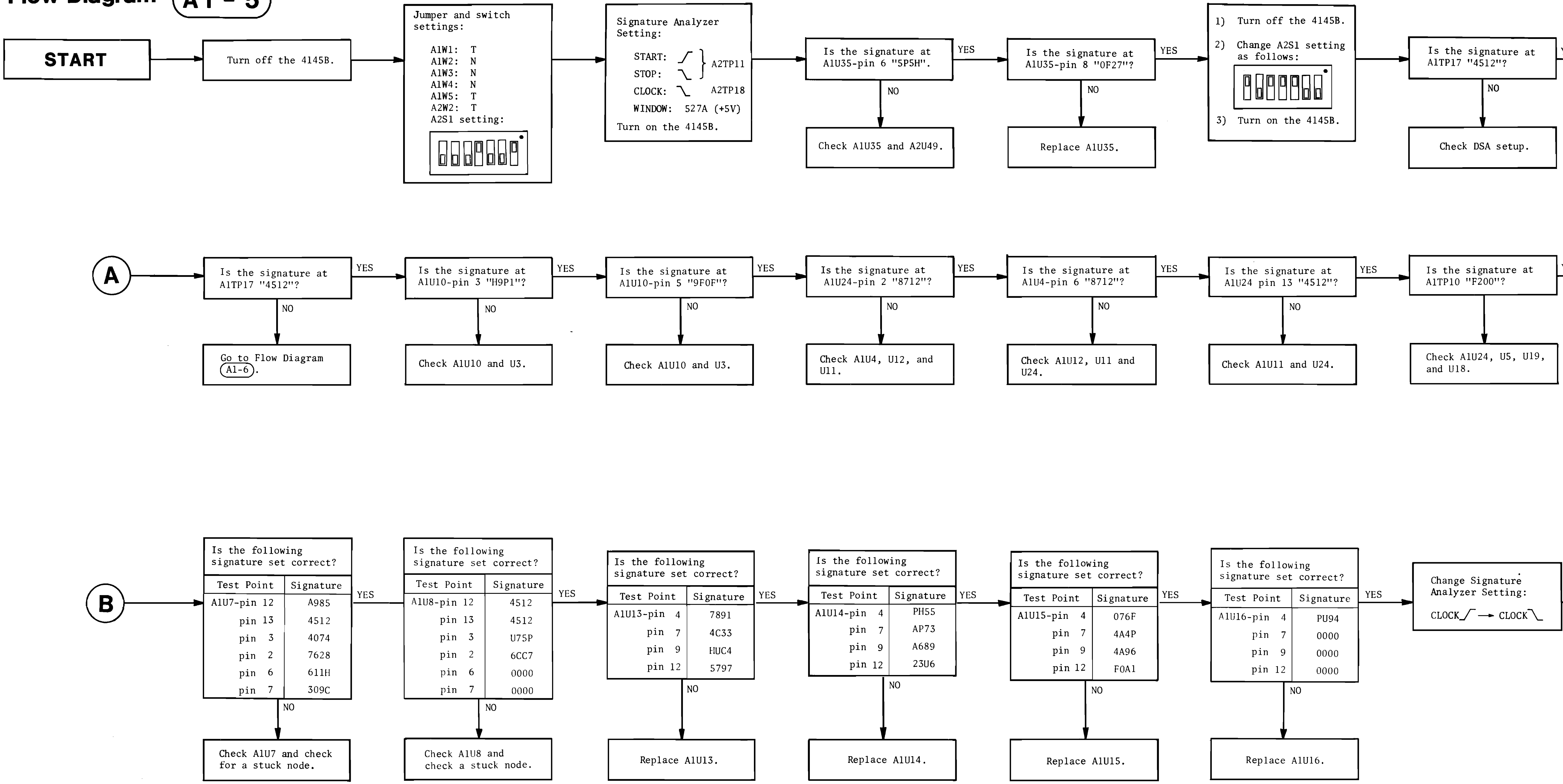
Is the following signature set correct?

Test Point	Signature
A1U44-pin 2	1AFC
pin 19	CP74
pin 5	U25P
pin 16	17AC
pin 6	U127
pin 15	8H9P
pin 9	A565
pin 12	69AF

Check A1U44 and U45.

Go to Flow Diagram (A1-5).

Flow Diagram (A1 - 5)



Turn off the 4145B.

Jumper and switch settings:

A1W1: T
A1W2: N
A1W3: N
A1W4: N
A1W5: T
A2W2: T
A2S1 setting:

Signature Analyzer Setting:

START: ⎍ } A2TP11
STOP: ⎍
CLOCK: ⎍ A2TP18
WINDOW: 527A (+5V)
Turn on the 4145B.

Is the signature at A1U35-pin 6 "5P5H".

Check A1U35 and A2U49.

Is the signature at A1U35-pin 8 "0F27"?

Replace A1U35.

1) Turn off the 4145B.
2) Change A2S1 setting as follows:
3) Turn on the 4145B.

Is the signature at A1TP17 "4512"?

Check DSA setup.

Is the signature at A1TP17 "4512"?

Go to Flow Diagram (A1-6).

Is the signature at A1U10-pin 3 "H9P1"?

Check A1U10 and U3.

Is the signature at A1U10-pin 5 "9F0F"?

Check A1U10 and U3.

Is the signature at A1U24-pin 2 "8712"?

Check A1U4, U12, and U11.

Is the signature at A1U4-pin 6 "8712"?

Check A1U12, U11 and U24.

Is the signature at A1U24 pin 13 "4512"?

Check A1U11 and U24.

Is the signature at A1TP10 "F200"?

Check A1U24, U5, U19, and U18.

Is the following signature set correct?

Test Point	Signature
A1U7-pin 12	A985
pin 13	4512
pin 3	4074
pin 2	7628
pin 6	611H
pin 7	309C

Check A1U7 and check for a stuck node.

Is the following signature set correct?

Test Point	Signature
A1U8-pin 12	4512
pin 13	4512
pin 3	U75P
pin 2	6CC7
pin 6	0000
pin 7	0000

Check A1U8 and check a stuck node.

Is the following signature set correct?

Test Point	Signature
A1U13-pin 4	7891
pin 7	4C33
pin 9	HUC4
pin 12	5797

Replace A1U13.

Is the following signature set correct?

Test Point	Signature
A1U14-pin 4	PH55
pin 7	AP73
pin 9	A689
pin 12	23U6

Replace A1U14.

Is the following signature set correct?

Test Point	Signature
A1U15-pin 4	076F
pin 7	4A4P
pin 9	4A96
pin 12	F0A1

Replace A1U15.

Is the following signature set correct?

Test Point	Signature
A1U16-pin 4	PU94
pin 7	0000
pin 9	0000
pin 12	0000

Replace A1U16.

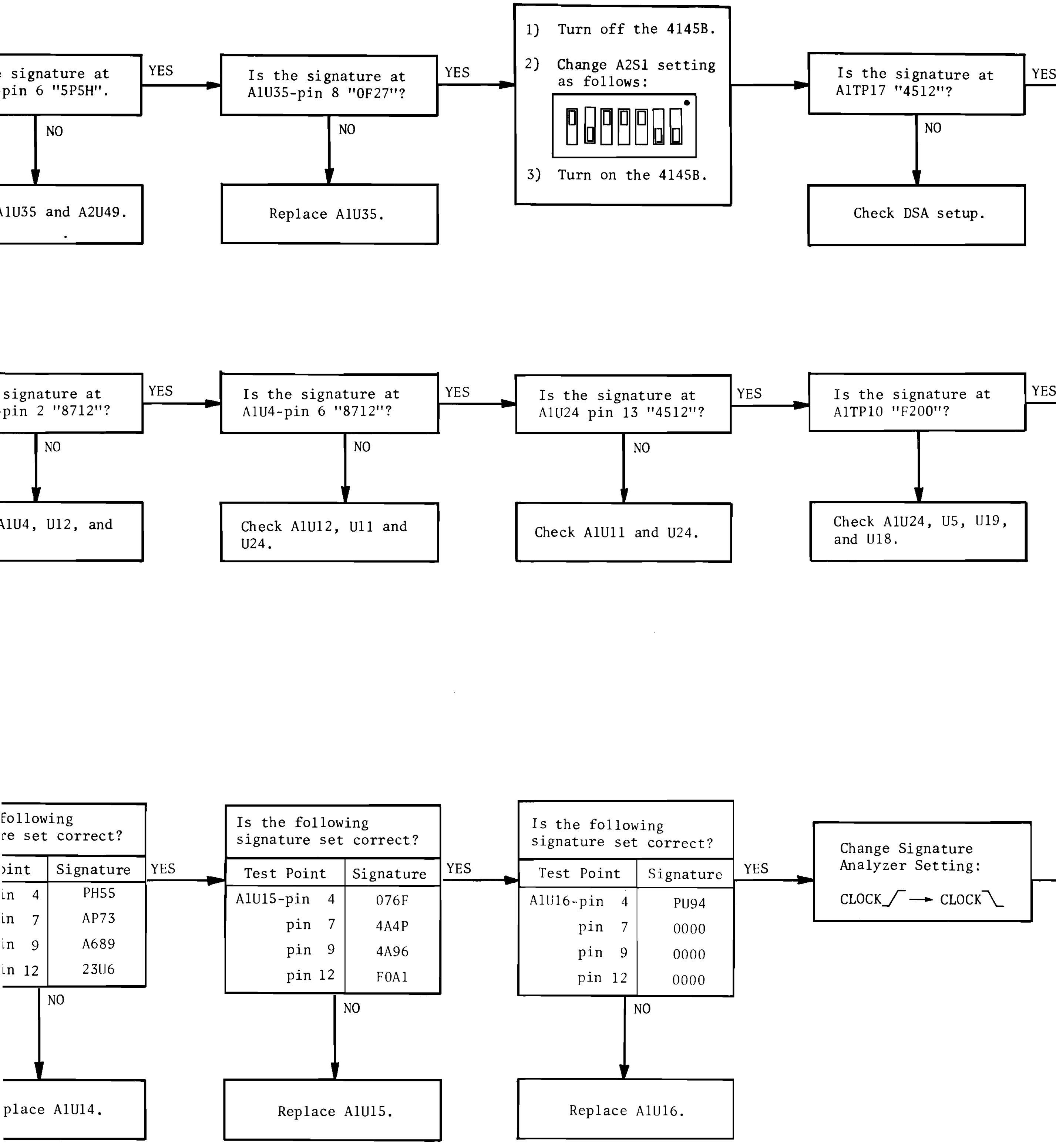
Change Signature Analyzer Setting:

CLOCK ⎍ → CLOCK ⎍

A1 Troubleshooting Flow Dia

SEE INSIDE

Figure 8-14. A1 Board Troubleshooting Flow



int	Signature
in 4	PH55
in 7	AP73
in 9	A689
in 12	23U6

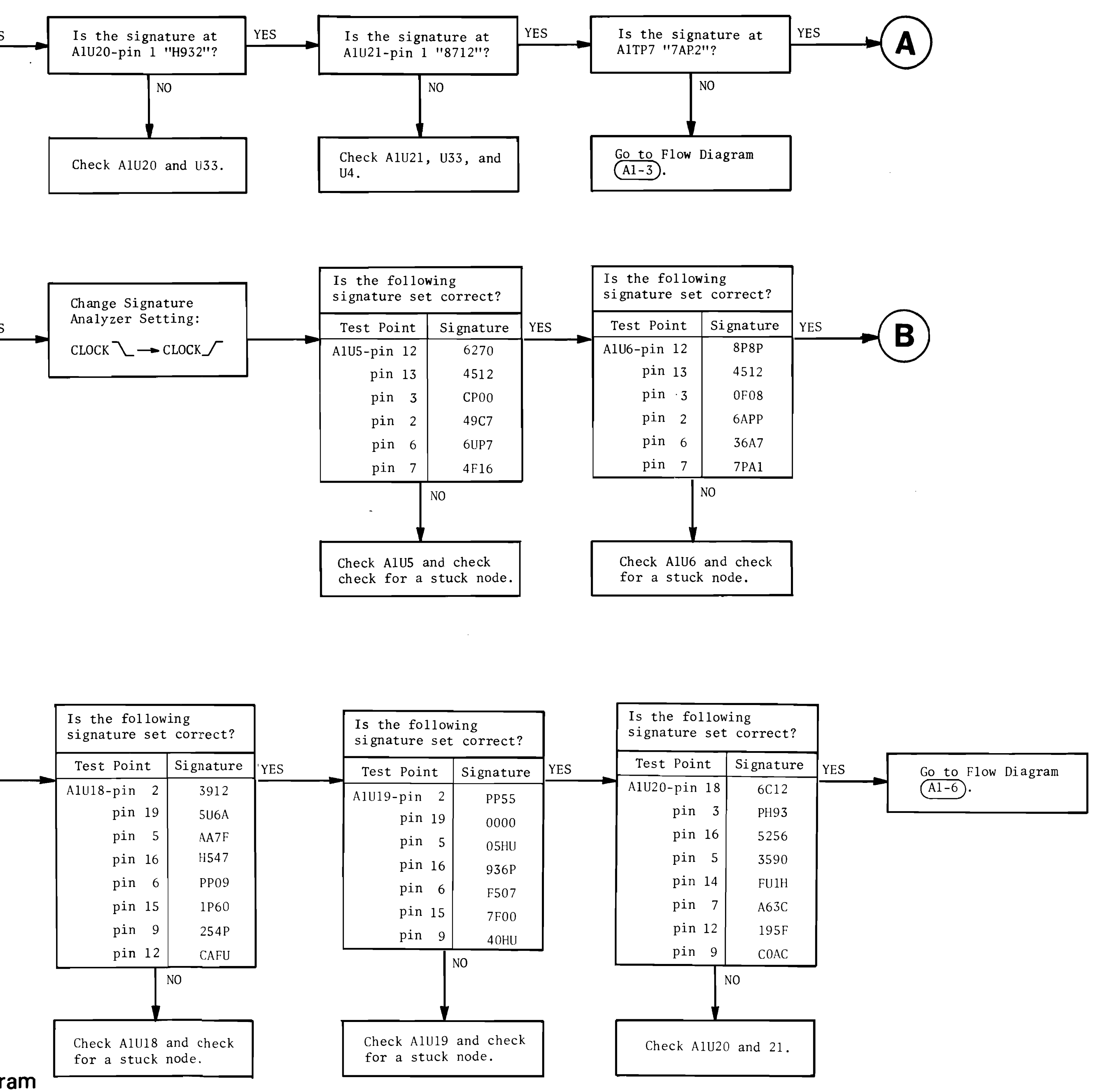
Test Point	Signature
A1U15-pin 4	076F
pin 7	4A4P
pin 9	4A96
pin 12	F0A1

Test Point	Signature
A1U16-pin 4	PU94
pin 7	0000
pin 9	0000
pin 12	0000

A1 Troubleshooting Flow Diagram

SEE INSIDE

Figure 8-14. A1 Board Troubleshooting Flow Diagram (Sheet 3 of 5).



Test Point	Signature
A1U5-pin 12	6270
pin 13	4512
pin 3	CP00
pin 2	49C7
pin 6	6UP7
pin 7	4F16

Test Point	Signature
A1U6-pin 12	8P8P
pin 13	4512
pin 3	0F08
pin 2	6APP
pin 6	36A7
pin 7	7PA1

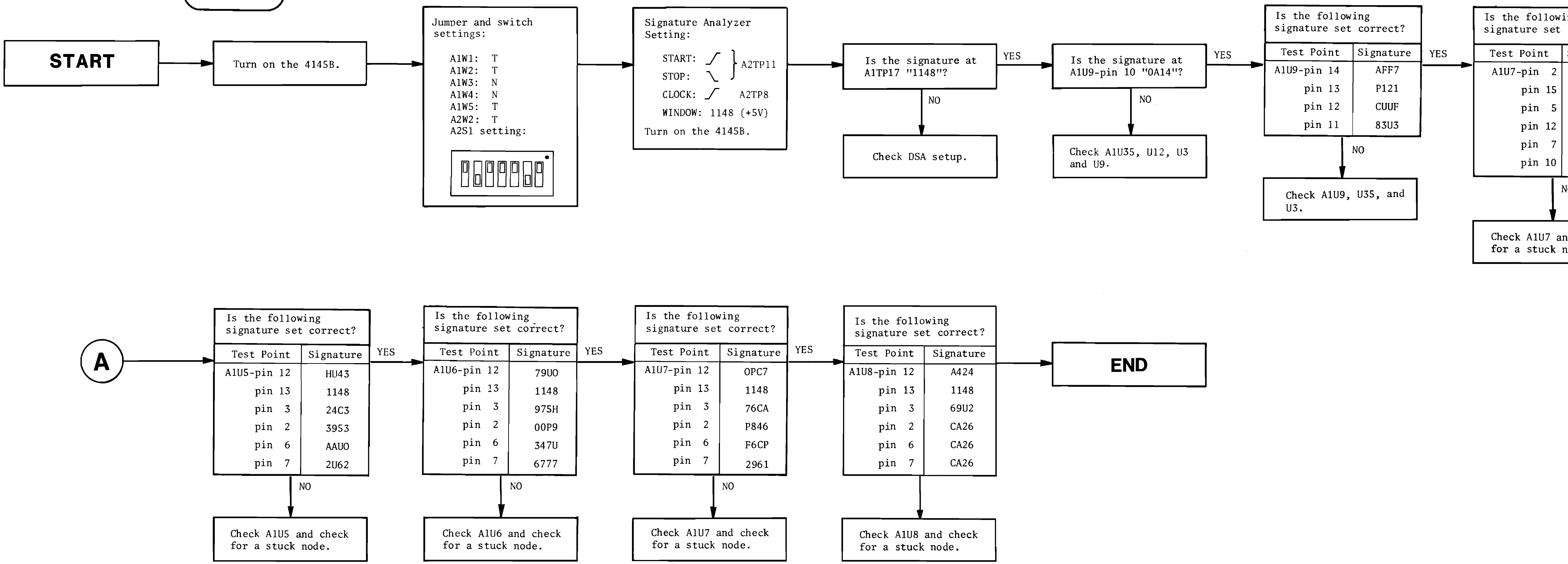
Test Point	Signature
A1U18-pin 2	3912
pin 19	5U6A
pin 5	AA7F
pin 16	H547
pin 6	PP09
pin 15	1P60
pin 9	254P
pin 12	CAFU

Test Point	Signature
A1U19-pin 2	PP55
pin 19	0000
pin 5	05HU
pin 16	936P
pin 6	F507
pin 15	7F00
pin 9	40HU

Test Point	Signature
A1U20-pin 18	6C12
pin 3	PH93
pin 16	5256
pin 5	3590
pin 14	FU1H
pin 7	A63C
pin 12	195F
pin 9	C0AC

Figure 8-14. A1 Board Troubleshooting Flow Diagram (Sheet 4 of 5).

Flow Diagram (A1 - 6)



Jumper and switch settings:

A1W1: T
A1W2: T
A1W3: N
A1W4: N
A1W5: T
A2W2: T
A2S1 setting:

Signature Analyzer Setting:

START: ⟋ A2TP11
STOP: ⟍ A2TP11
CLOCK: ⟋ A2TP8
WINDOW: 1148 (+5V)
Turn on the 4145B.

Is the signature at A1TP17 "1148"?

NO: Check DSA setup.

Is the signature at A1U9-pin 10 "0A14"?

NO: Check A1U35, U12, U3 and U9.

Is the following signature set correct?

Test Point	Signature
A1U9-pin 14	AFF7
pin 13	P121
pin 12	CUUF
pin 11	83U3

NO: Check A1U9, U35, and U3.

Is the followi
signature set

Test Point
A1U7-pin 2
pin 15
pin 5
pin 12
pin 7
pin 10

N
Check A1U7 an
for a stuck n

Is the following signature set correct?

Test Point	Signature
A1U5-pin 12	HU43
pin 13	1148
pin 3	24C3
pin 2	3953
pin 6	AAU0
pin 7	2U62

NO: Check A1U5 and check for a stuck node.

Is the following signature set correct?

Test Point	Signature
A1U6-pin 12	79U0
pin 13	1148
pin 3	975H
pin 2	00P9
pin 6	347U
pin 7	6777

NO: Check A1U6 and check for a stuck node.

Is the following signature set correct?

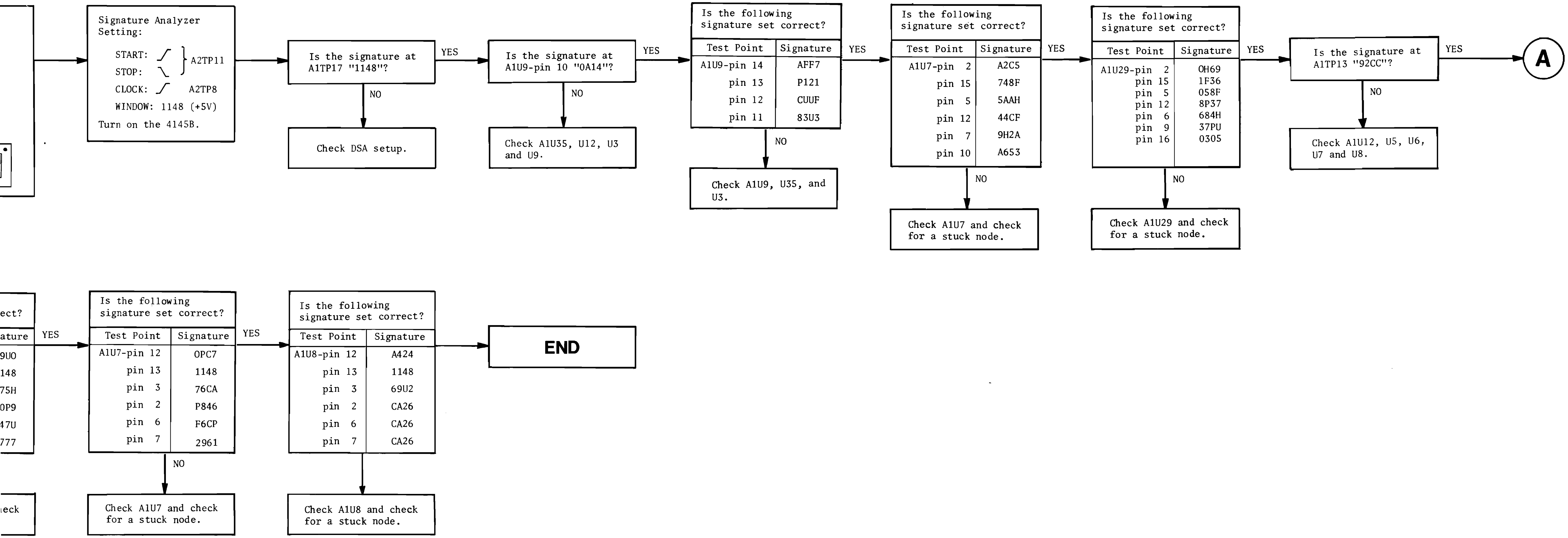
Test Point	Signature
A1U7-pin 12	0PC7
pin 13	1148
pin 3	76CA
pin 2	P846
pin 6	F6CP
pin 7	2961

NO: Check A1U7 and check for a stuck node.

Is the following signature set correct?

Test Point	Signature
A1U8-pin 12	A424
pin 13	1148
pin 3	69U2
pin 2	CA26
pin 6	CA26
pin 7	CA26

NO: Check A1U8 and check for a stuck node.



Signature Analyzer Setting:

START: ⎛ A2TP11
STOP: ⎝ A2TP11
CLOCK: A2TP8
WINDOW: 1148 (+5V)
Turn on the 4145B.

Is the signature at A1TP17 "1148"?

Check DSA setup.

Is the signature at A1U9-pin 10 "0A14"?

Check A1U35, U12, U3 and U9.

Is the following signature set correct?

Test Point	Signature
A1U9-pin 14	AFF7
pin 13	P121
pin 12	CUUF
pin 11	83U3

Check A1U9, U35, and U3.

Is the following signature set correct?

Test Point	Signature
A1U7-pin 2	A2C5
pin 15	748F
pin 5	5AAH
pin 12	44CF
pin 7	9H2A
pin 10	A653

Check A1U7 and check for a stuck node.

Is the following signature set correct?

Test Point	Signature
A1U29-pin 2	0H69
pin 15	1F36
pin 5	058F
pin 12	8P37
pin 6	684H
pin 9	37PU
pin 16	0305

Check A1U29 and check for a stuck node.

Is the signature at A1TP13 "92CC"?

Check A1U12, U5, U6, U7 and U8.

ect?

	ature
	9U0
	148
	75H
	0P9
	47U
	777

ieck

Is the following signature set correct?

Test Point	Signature
A1U7-pin 12	0PC7
pin 13	1148
pin 3	76CA
pin 2	P846
pin 6	F6CP
pin 7	2961

Check A1U7 and check for a stuck node.

Is the following signature set correct?

Test Point	Signature
A1U8-pin 12	A424
pin 13	1148
pin 3	69U2
pin 2	CA26
pin 6	CA26
pin 7	CA26

Check A1U8 and check for a stuck node.

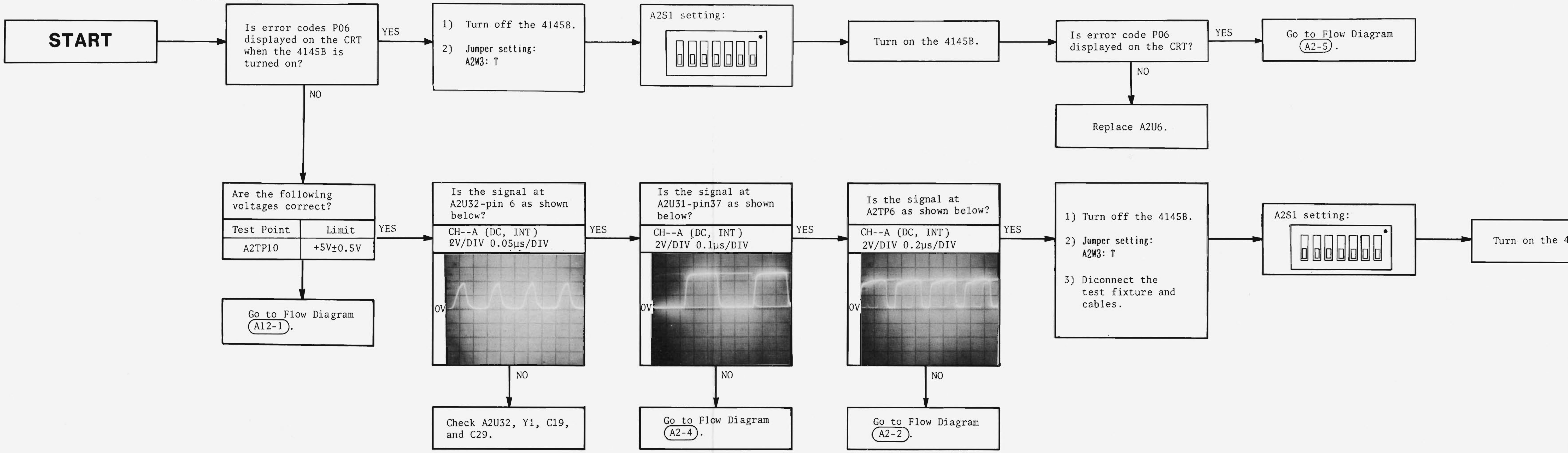
END

A1 Troubleshooting Flow Diagram

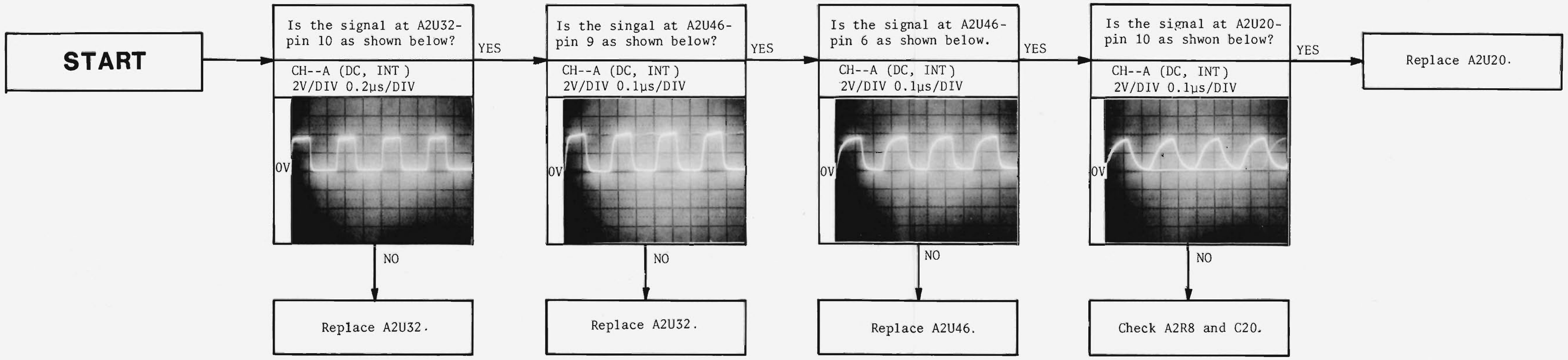
SEE INSIDE

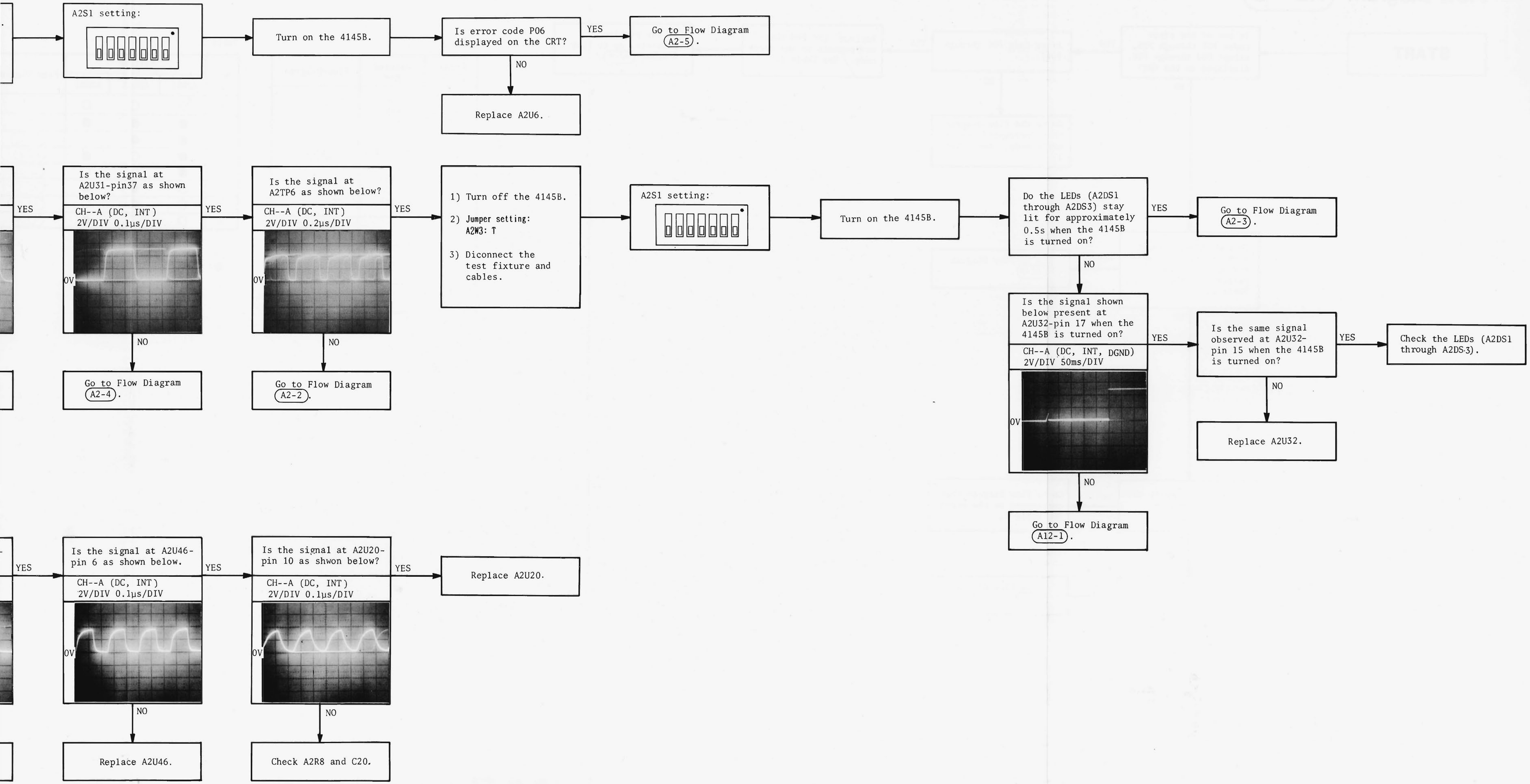
Figure 8-14. A1 Board Troubleshooting Flow Diagram (Sheet 5 of 5).

Flow Diagram (A2 - 1)

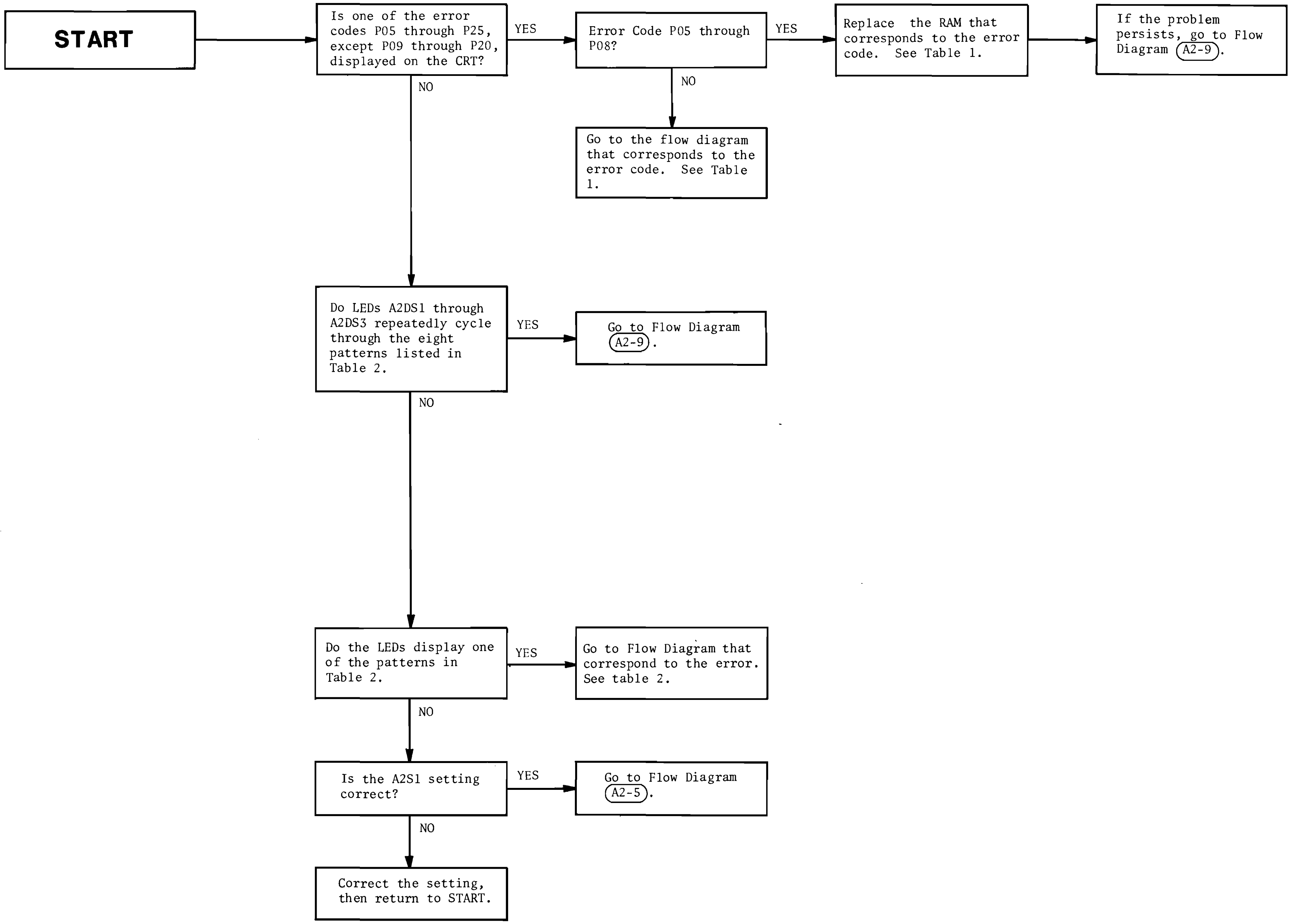


Flow Diagram (A2 - 2)




A2S1 setting:
Turn on the 4145B.
Is error code P06 displayed on the CRT?
YES
Go to Flow Diagram (A2-5).
NO
Replace A2U6.
YES
Is the signal at A2U31-pin37 as shown below?
CH--A (DC, INT)
2V/DIV 0.1µs/DIV
0V
NO
Go to Flow Diagram (A2-4).
YES
Is the signal at A2TP6 as shown below?
CH--A (DC, INT)
2V/DIV 0.2µs/DIV
0V
NO
Go to Flow Diagram (A2-2).
YES
1) Turn off the 4145B.
2) Jumper setting: A2W3: T
3) Diconnect the test fixture and cables.
A2S1 setting:
Turn on the 4145B.
Do the LEDs (A2DS1 through A2DS3) stay lit for approximately 0.5s when the 4145B is turned on?
YES
Go to Flow Diagram (A2-3).
NO
Is the signal shown below present at A2U32-pin 17 when the 4145B is turned on?
CH--A (DC, INT, DGND)
2V/DIV 50ms/DIV
0V
YES
Is the same signal observed at A2U32-pin 15 when the 4145B is turned on?
YES
Check the LEDs (A2DS1 through A2DS3).
NO
Replace A2U32.
NO
Go to Flow Diagram (A12-1).
YES
Is the signal at A2U46-pin 6 as shown below.
CH--A (DC, INT)
2V/DIV 0.1µs/DIV
0V
NO
Replace A2U46.
YES
Is the signal at A2U20-pin 10 as shwon below?
CH--A (DC, INT)
2V/DIV 0.1µs/DIV
0V
YES
Replace A2U20.
NO
Check A2R8 and C20.

Flow Diagram (A2 - 3)



Is one of the error codes P05 through P25, except P09 through P20, displayed on the CRT?

Error Code P05 through P08?

Replace the RAM that corresponds to the error code. See Table 1.

If the problem persists, go to Flow Diagram (A2-9).

Go to the flow diagram that corresponds to the error code. See Table 1.

Do LEDs A2DS1 through A2DS3 repeatedly cycle through the eight patterns listed in Table 2.

Go to Flow Diagram (A2-9).

Do the LEDs display one of the patterns in Table 2.

Go to Flow Diagram that correspond to the error. See table 2.

Is the A2S1 setting correct?

Go to Flow Diagram (A2-5).

Correct the setting, then return to START.

Table 1

Error Code	Related RAM	Flow Diagram
P01	A2U1	A2-9
P02	A2U2	
P03	A2U3	
P04	A2U4	
P05	A2U5	
P07	A2U07	
P08	A2U08	
P09	A2U09	
P10	A2U10	
P11	A2U11	
P20		A2-12
P21 P22 P25		A2-10
P23 P24		A2-11

Table 2

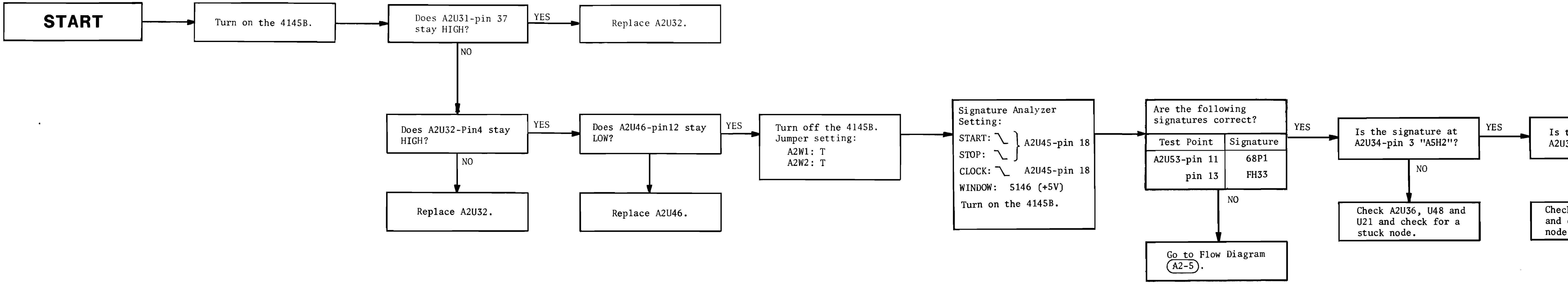
No.	Pattern			Flow Diagram
	A2DS1	A2DS2	A2DS3	
1	○	○	○	
2	●	●	●	
3	●	●	○	A2-12
4	●	○	●	A2-9
5	●	○	○	A2-11
6*	○	●	●	A2-5
7	○	●	○	A2-10
8	○	○	●	A2-9

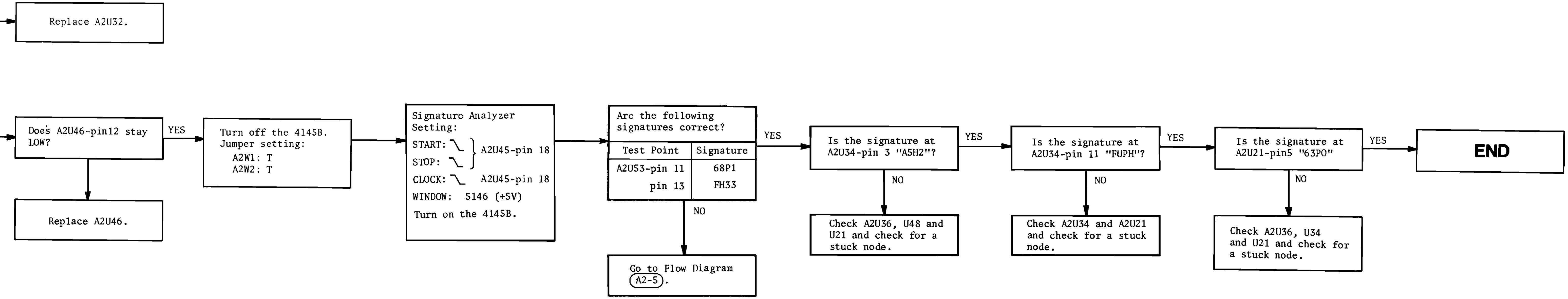
○: ON
●: OFF

*: A2DS1 blinks for approximately 10s.

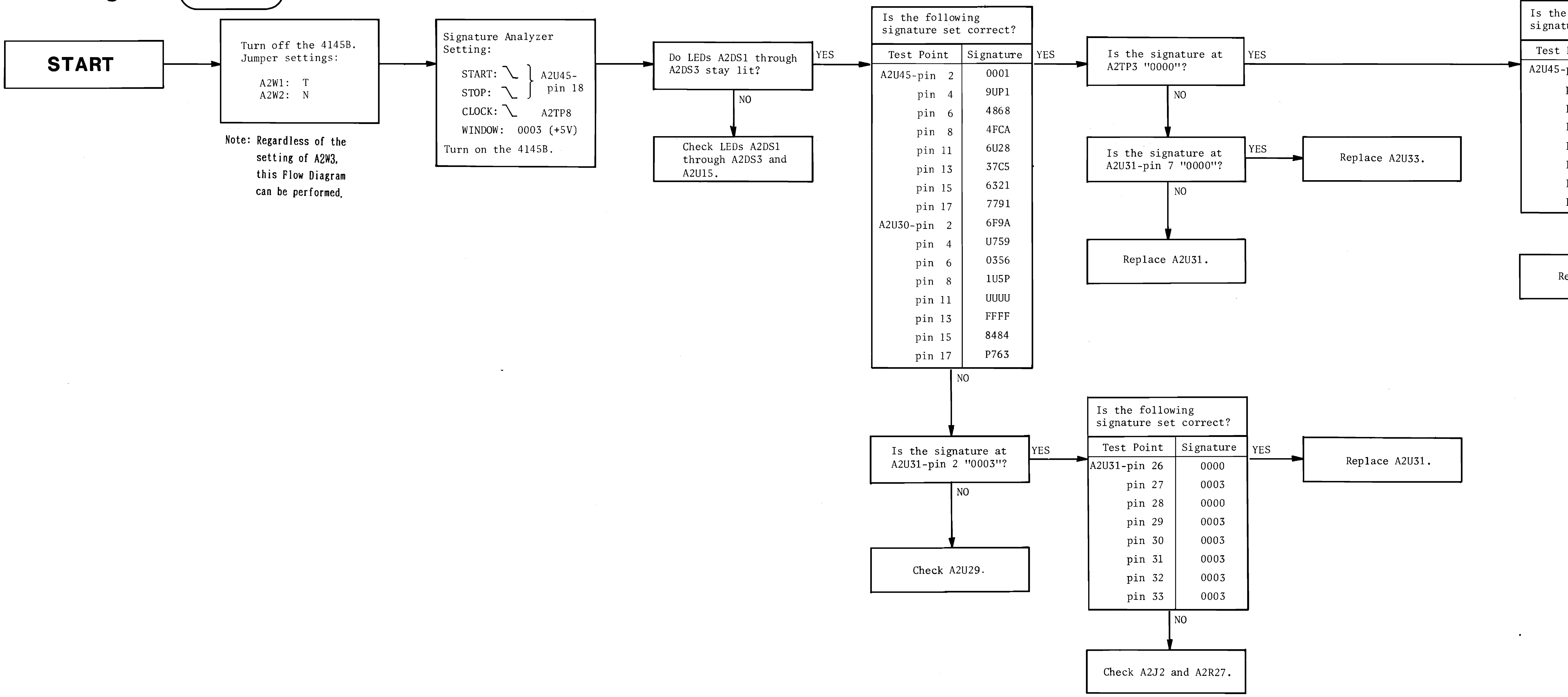
Figure 8-15. A2 Board Troubleshooting Flow Diagram (Sheet 1 of 11).

Flow Diagram (A2 - 4)




Replace A2U32.
Does A2U46-pin12 stay LOW?
YES
Replace A2U46.
Turn off the 4145B.
Jumper setting:
A2W1: T
A2W2: T
Signature Analyzer Setting:
START: ⌝_
STOP: ⌝_
A2U45-pin 18
CLOCK: ⌝_ A2U45-pin 18
WINDOW: 5146 (+5V)
Turn on the 4145B.
Are the following signatures correct?
Test Point
Signature
A2U53-pin 11
68P1
pin 13
FH33
NO
Go to Flow Diagram (A2-5).
YES
Is the signature at A2U34-pin 3 "A5H2"?
NO
Check A2U36, U48 and U21 and check for a stuck node.
YES
Is the signature at A2U34-pin 11 "FUPH"?
NO
Check A2U34 and A2U21 and check for a stuck node.
YES
Is the signature at A2U21-pin5 "63PO"
NO
Check A2U36, U34 and U21 and check for a stuck node.
YES
END

Flow Diagram (A2 - 5)

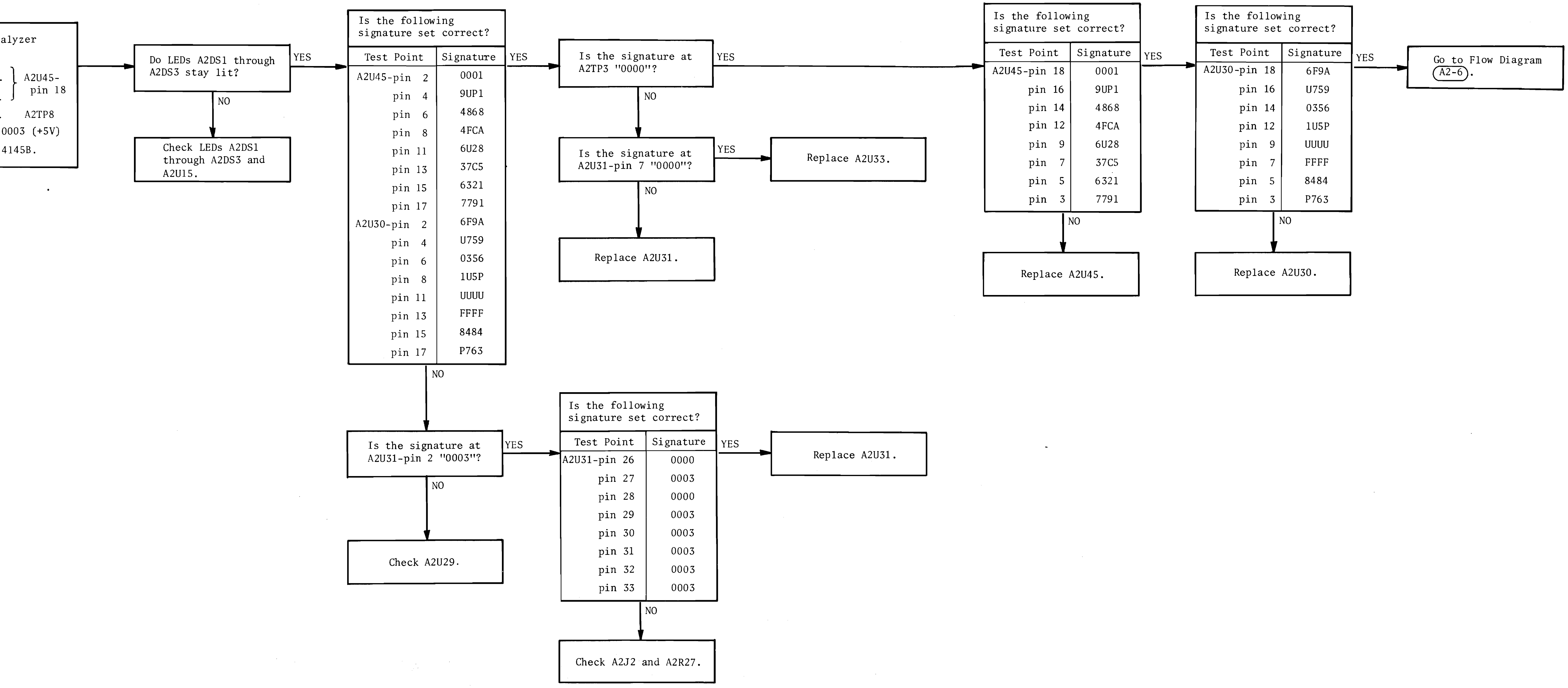


Is the following signature set correct?

Test Point	Signature
A2U45-pin 2	0001
pin 4	9UP1
pin 6	4868
pin 8	4FCA
pin 11	6U28
pin 13	37C5
pin 15	6321
pin 17	7791
A2U30-pin 2	6F9A
pin 4	U759
pin 6	0356
pin 8	1U5P
pin 11	UUUU
pin 13	FFFF
pin 15	8484
pin 17	P763

Is the following signature set correct?

Test Point	Signature
A2U31-pin 26	0000
pin 27	0003
pin 28	0000
pin 29	0003
pin 30	0003
pin 31	0003
pin 32	0003
pin 33	0003



Test Point	Signature
A2U45-pin 2	0001
pin 4	9UP1
pin 6	4868
pin 8	4FCA
pin 11	6U28
pin 13	37C5
pin 15	6321
pin 17	7791
A2U30-pin 2	6F9A
pin 4	U759
pin 6	0356
pin 8	1U5P
pin 11	UUUU
pin 13	FFFF
pin 15	8484
pin 17	P763

Test Point	Signature
A2U45-pin 18	0001
pin 16	9UP1
pin 14	4868
pin 12	4FCA
pin 9	6U28
pin 7	37C5
pin 5	6321
pin 3	7791

Test Point	Signature
A2U30-pin 18	6F9A
pin 16	U759
pin 14	0356
pin 12	1U5P
pin 9	UUUU
pin 7	FFFF
pin 5	8484
pin 3	P763

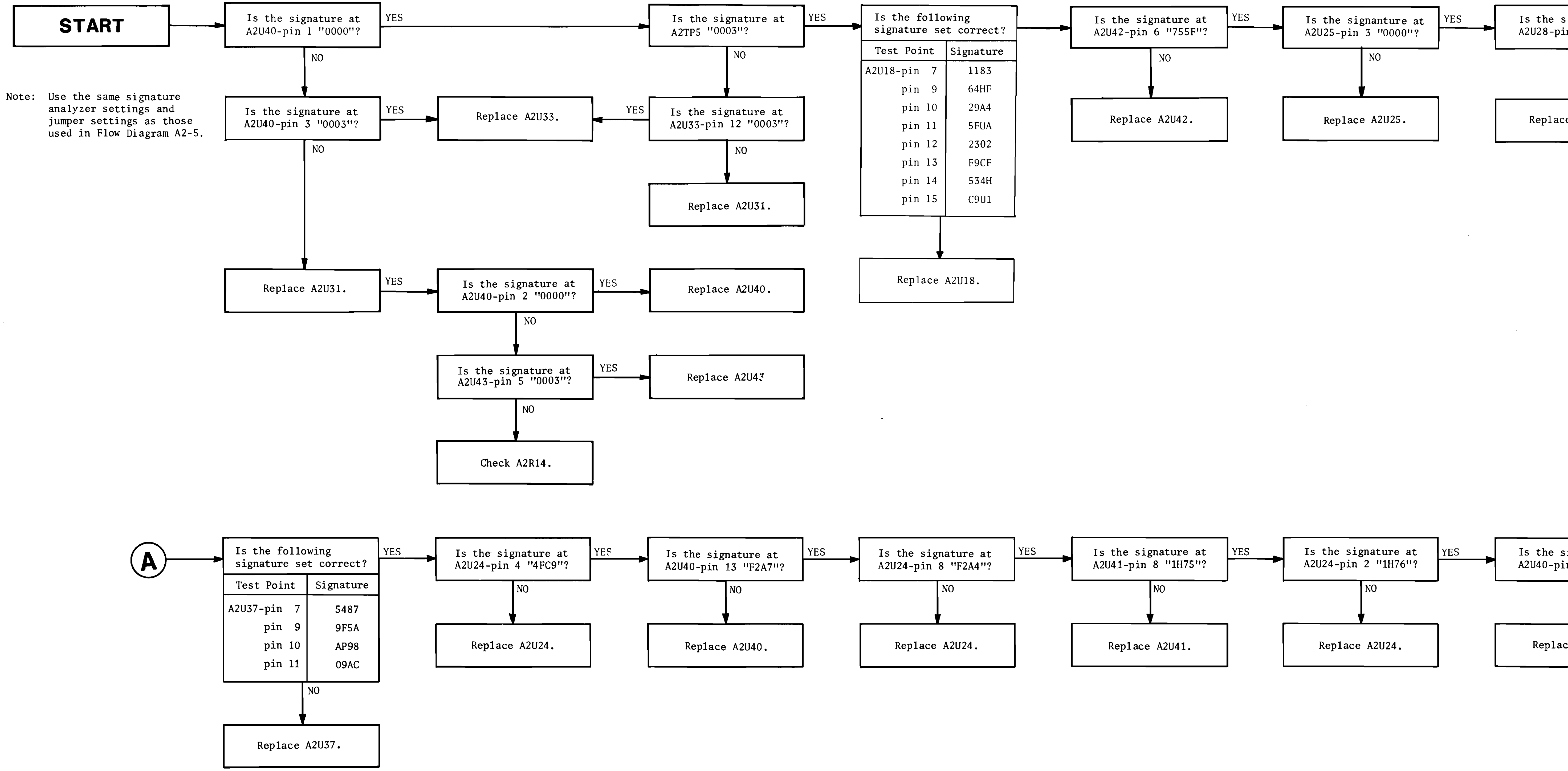
Test Point	Signature
A2U31-pin 26	0000
pin 27	0003
pin 28	0000
pin 29	0003
pin 30	0003
pin 31	0003
pin 32	0003
pin 33	0003

A2 Troubleshooting Flow Diagram

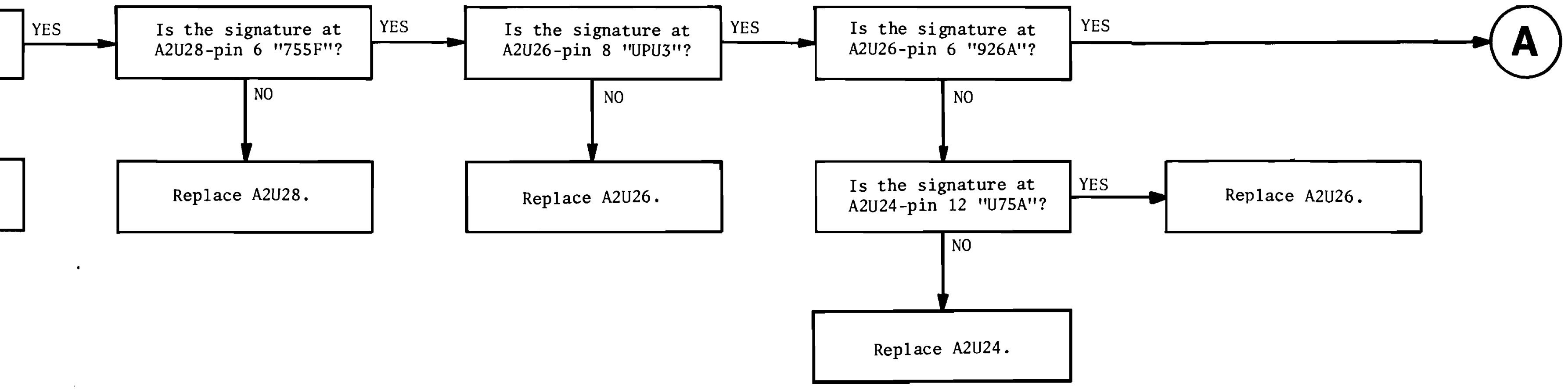
SEE INSIDE

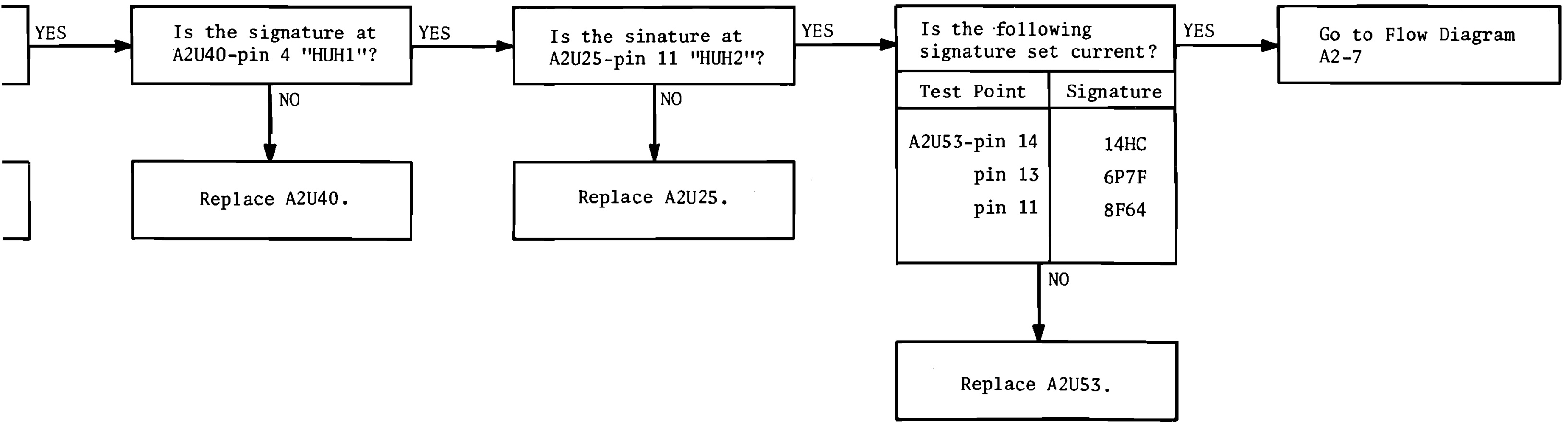
Figure 8-15. A2 Board Troubleshooting Flow Diagram (Sheet 3 of 11).

Flow Diagram (A2 - 6)

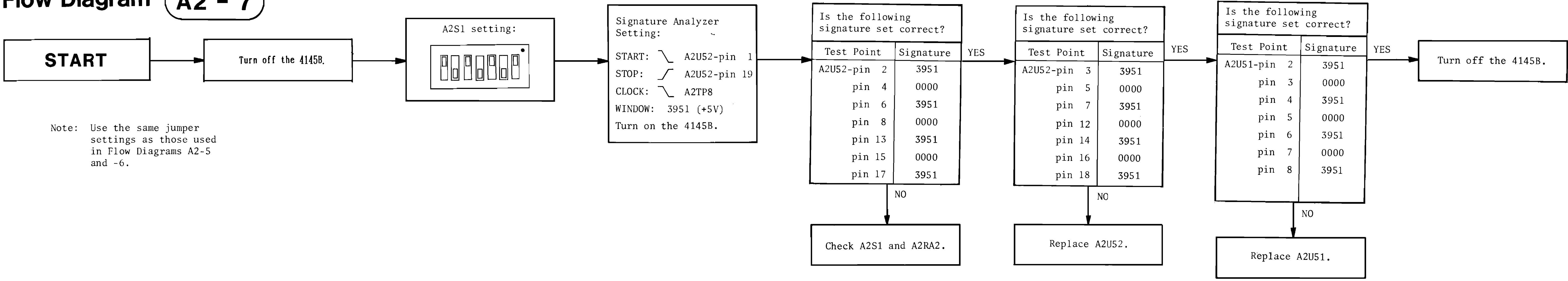


Note: Use the same signature analyzer settings and jumper settings as those used in Flow Diagram A2-5.


YES
Is the signature at A2U28-pin 6 "755F"?
YES
Is the signature at A2U26-pin 8 "UPU3"?
YES
Is the signature at A2U26-pin 6 "926A"?
YES
A
NO
Replace A2U28.
NO
Replace A2U26.
NO
Is the signature at A2U24-pin 12 "U75A"?
YES
Replace A2U26.
NO
Replace A2U24.


YES
Is the signature at A2U40-pin 4 "HUH1"?
YES
Is the sinature at A2U25-pin 11 "HUH2"?
YES
Is the following signature set current?
Test Point
Signature
A2U53-pin 14
14HC
pin 13
6P7F
pin 11
8F64
YES
Go to Flow Diagram A2-7
NO
Replace A2U40.
NO
Replace A2U25.
NO
Replace A2U53.

Flow Diagram (A2 - 7)



Is the following signature set correct?

Test Point	Signature
A2U52-pin 2	3951
pin 4	0000
pin 6	3951
pin 8	0000
pin 13	3951
pin 15	0000
pin 17	3951

Is the following signature set correct?

Test Point	Signature
A2U52-pin 3	3951
pin 5	0000
pin 7	3951
pin 12	0000
pin 14	3951
pin 16	0000
pin 18	3951

Is the following signature set correct?

Test Point	Signature
A2U51-pin 2	3951
pin 3	0000
pin 4	3951
pin 5	0000
pin 6	3951
pin 7	0000
pin 8	3951

Note: Use the same jumper settings as those used in Flow Diagrams A2-5 and -6.

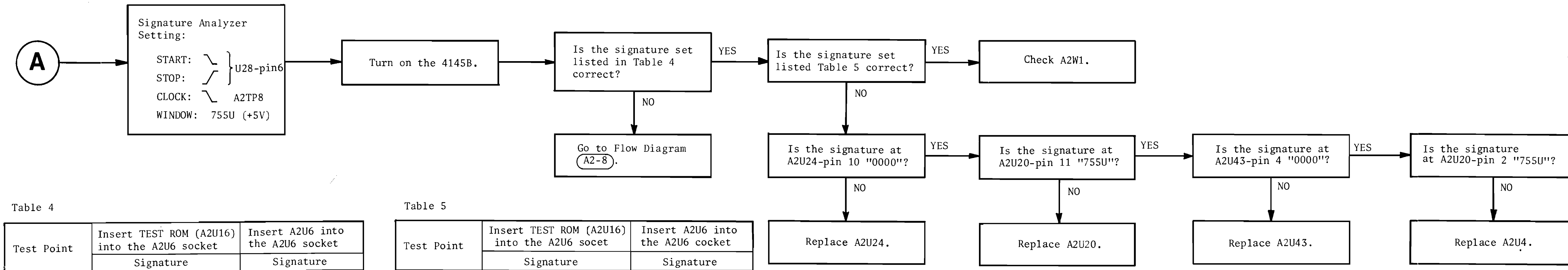


Table 4

Test Point	Insert TEST ROM (A2U16) into the A2U6 socket	Insert A2U6 into the A2U6 socket
	Signature	Signature
A2U19-pin 2	5162	COUO
pin 3	AC39	HH05
pin 4	8H62	94F8
pin 5	P174	5550
pin 6	01FA	1669
pin 7	319C	9041
pin 8	08CF	2A2A
pin 9	7H12	H4U6

Table 5

Test Point	Insert TEST ROM (A2U16) into the A2U6 socet	Insert A2U6 into the A2U6 cocket
	Signature	Signature
A2U19-pin 11	7H12	H4U6
pin 12	08CF	2A2A
pin 13	319C	9041
pin 14	01FA	1669
pin 15	P174	5550
pin 16	8H62	94F8
pin 17	AC39	HH05
pin 18	5162	COUO

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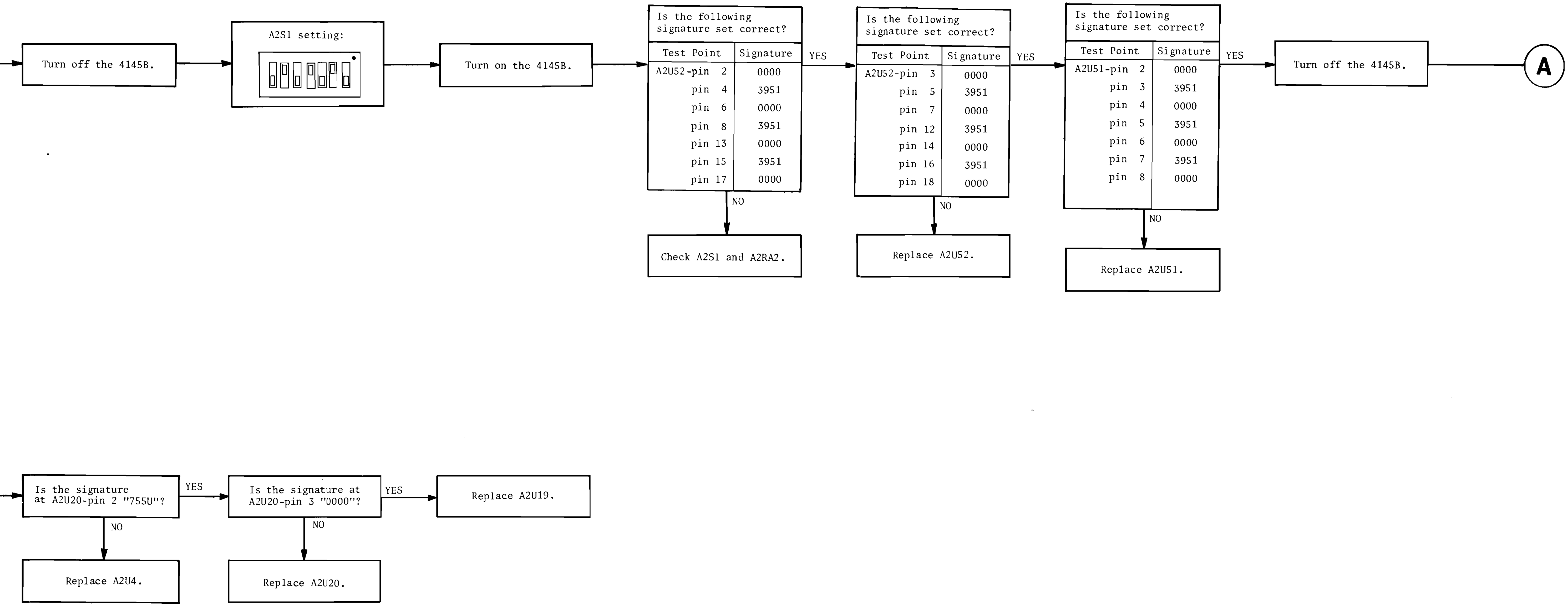


Test Point	Signature
A2U52-pin 2	0000
pin 4	3951
pin 6	0000
pin 8	3951
pin 13	0000
pin 15	3951
pin 17	0000

Test Point	Signature
A2U52-pin 3	0000
pin 5	3951
pin 7	0000
pin 12	3951
pin 14	0000
pin 16	3951
pin 18	0000

Test Point	Signature
A2U51-pin 2	0000
pin 3	3951
pin 4	0000
pin 5	3951
pin 6	0000
pin 7	3951
pin 8	0000

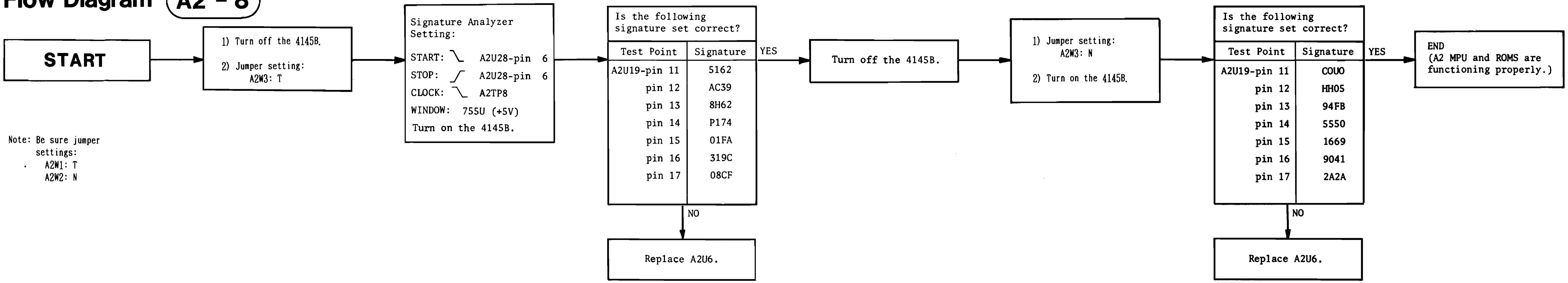
A2 Troubleshooting Flow Diagram

SEE INSIDE

Figure 8-15. A2 Board Troubleshooting Flow Diagram (Sheet 5 of 11).

Figure 8-15. A2 Board Troubleshooting Flow Diagram (Sheet 6 of 11).

Flow Diagram A2 - 8



Signature Analyzer Setting:

START: ⌐ A2U28-pin 6
STOP: ⌐ A2U28-pin 6
CLOCK: ⌐ A2TP8
WINDOW: 755U (+5V)
Turn on the 4145B.

Is the following signature set correct?

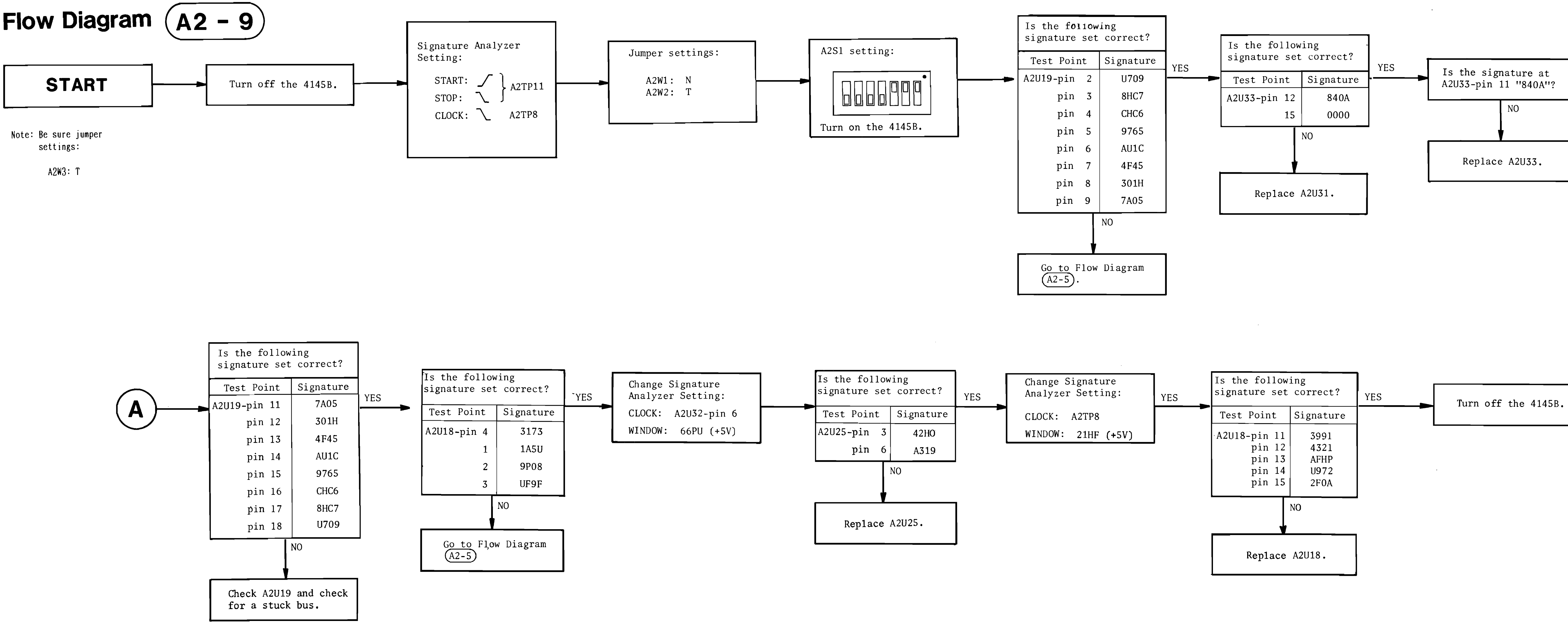
Test Point	Signature
A2U19-pin 11	5162
pin 12	AC39
pin 13	8H62
pin 14	P174
pin 15	01FA
pin 16	319C
pin 17	08CF

Is the following signature set correct?

Test Point	Signature
A2U19-pin 11	C0U0
pin 12	HH05
pin 13	94FB
pin 14	5550
pin 15	1669
pin 16	9041
pin 17	2A2A

Note: Be sure jumper settings:
A2W1: T
A2W2: N

Flow Diagram (A2 - 9)



Test Point	Signature
A2U19-pin 2	U709
pin 3	8HC7
pin 4	CHC6
pin 5	9765
pin 6	AU1C
pin 7	4F45
pin 8	301H
pin 9	7A05

Test Point	Signature
A2U33-pin 12	840A
15	0000

Test Point	Signature
A2U19-pin 11	7A05
pin 12	301H
pin 13	4F45
pin 14	AU1C
pin 15	9765
pin 16	CHC6
pin 17	8HC7
pin 18	U709

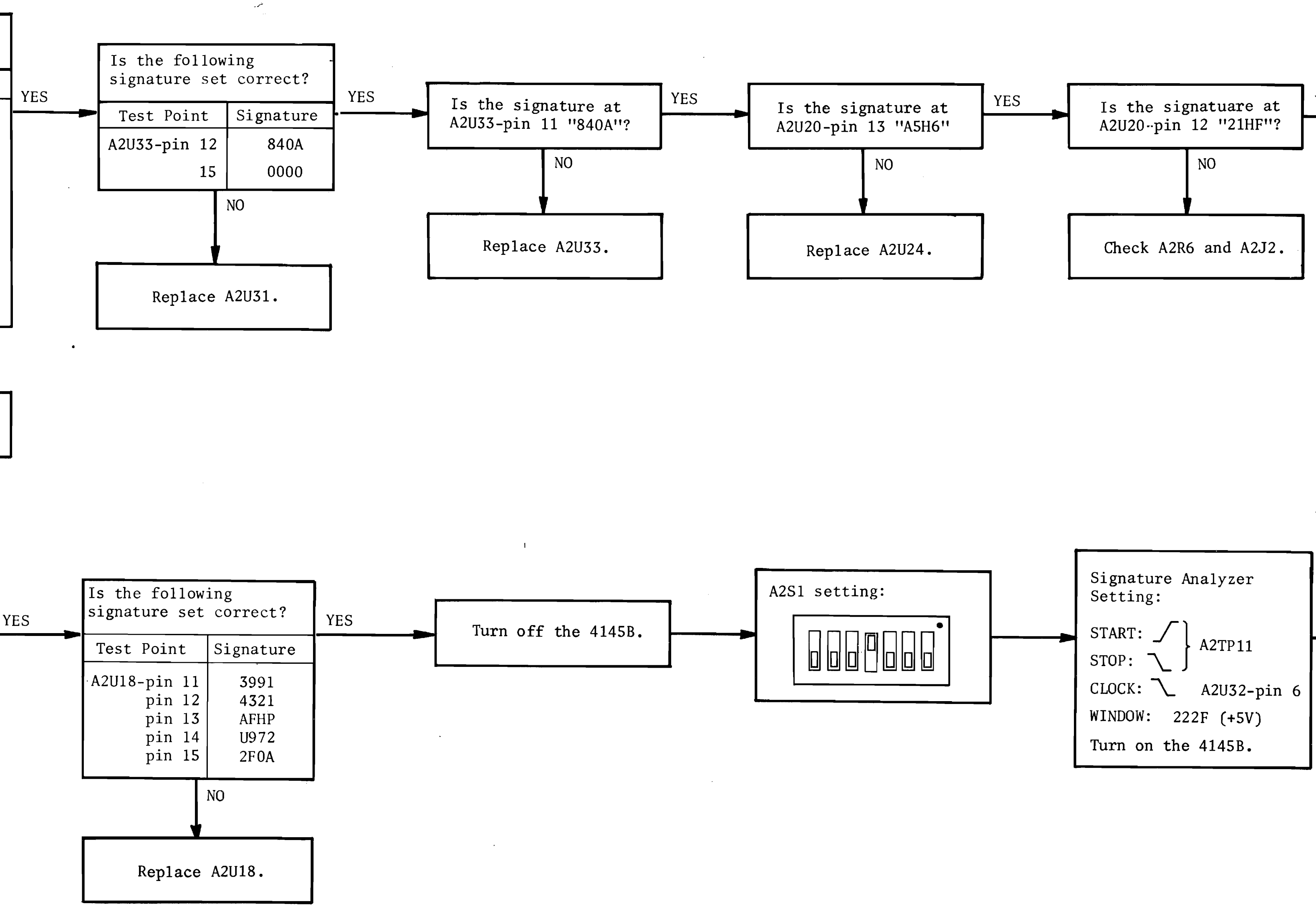
Test Point	Signature
A2U18-pin 4	3173
1	1A5U
2	9P08
3	UF9F

Test Point	Signature
A2U25-pin 3	42H0
pin 6	A319

Test Point	Signature
A2U18-pin 11	3991
pin 12	4321
pin 13	AFHP
pin 14	U972
pin 15	2F0A

A2
SEE INSIDE

Figure 8-



A2 Troubleshooting Flow Diagram

SEE INSIDE

Figure 8-15. A2 Board Troubleshooting Flow Diagram (Sheet 7 of 11).

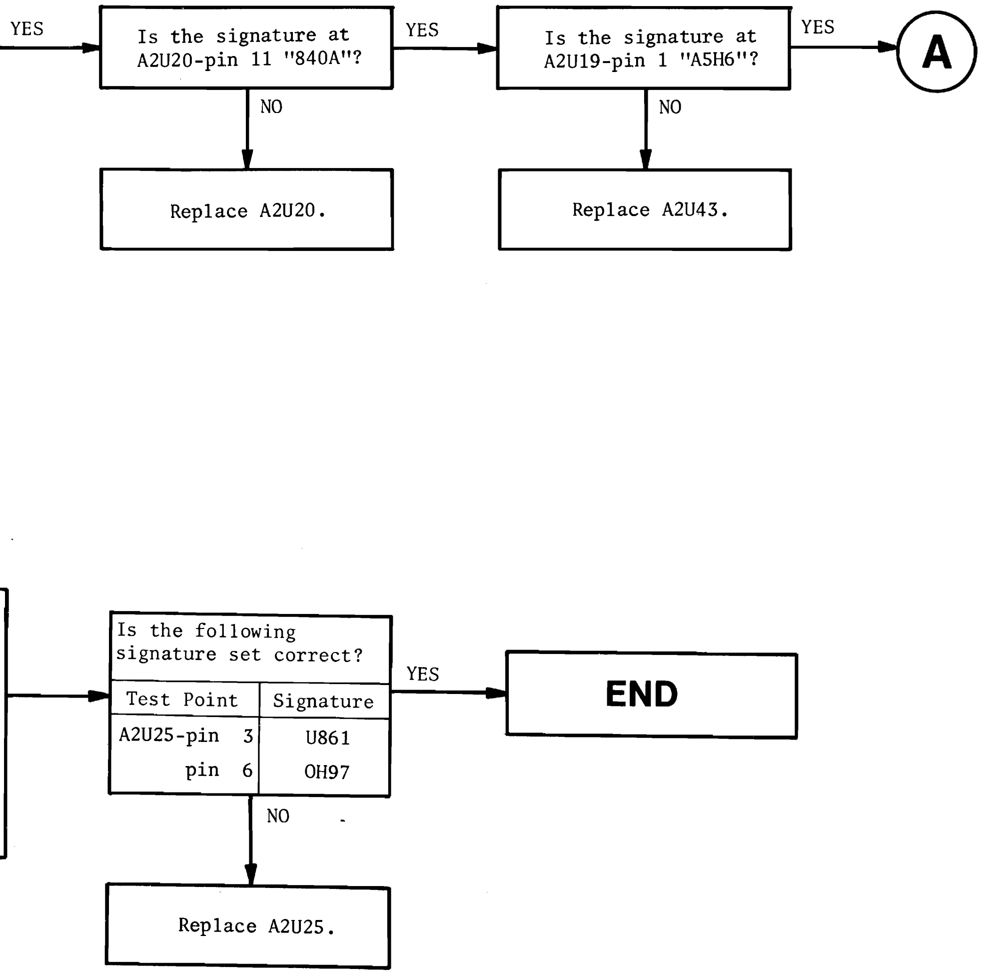


Figure 8-15. A2 Board Troubleshooting Flow Diagram (Sheet 8 of 11).

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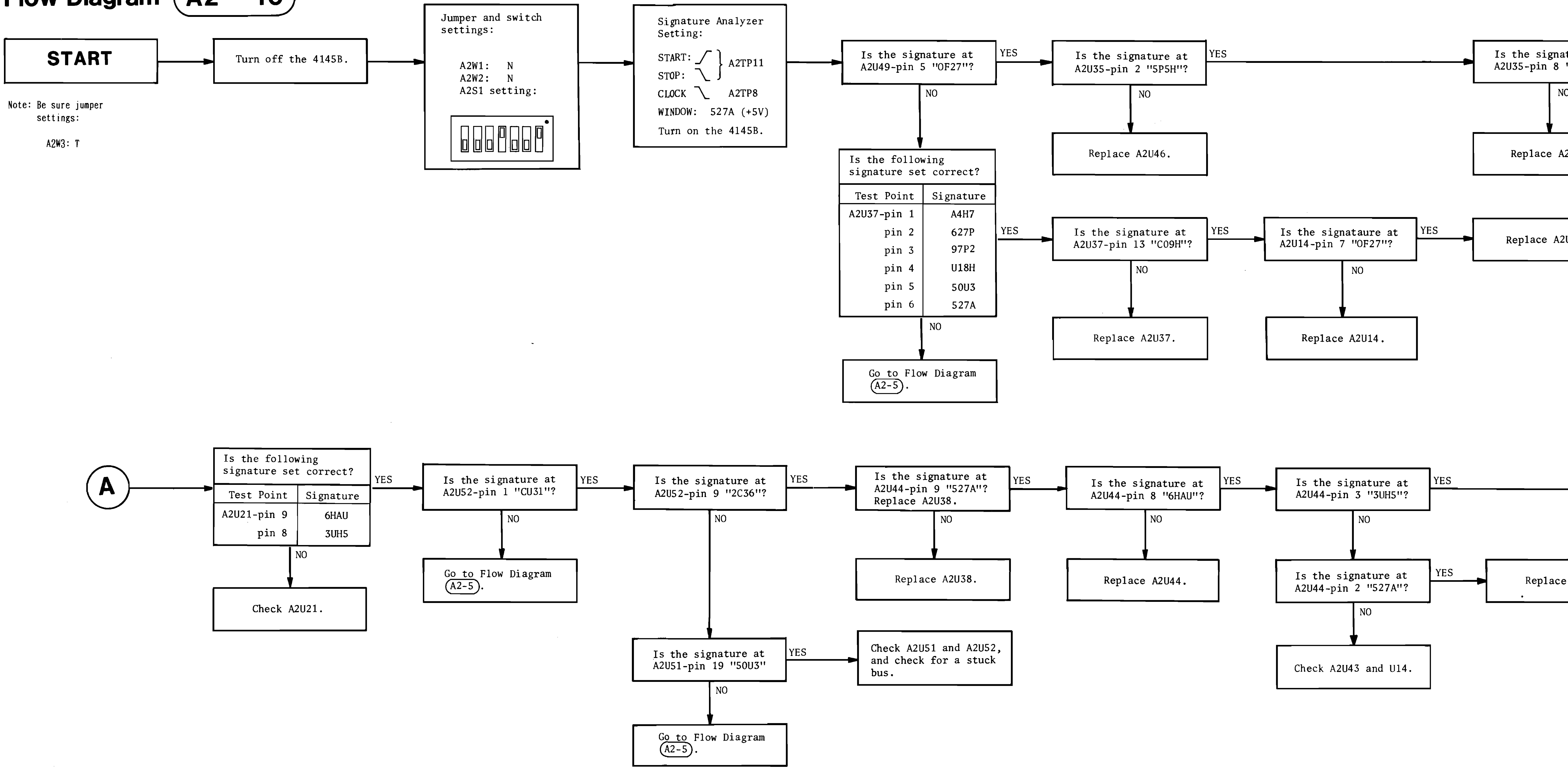
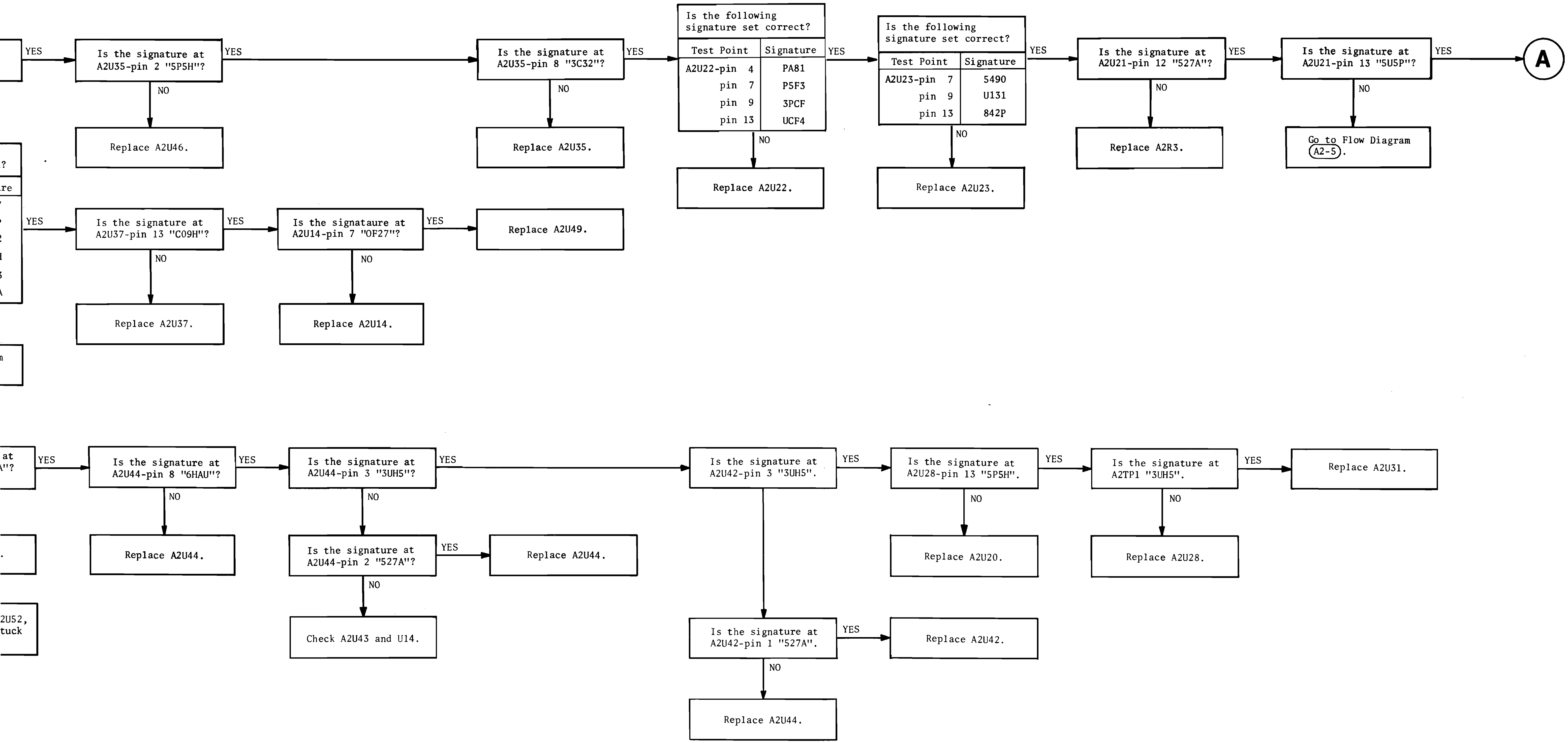
Flow Diagram (A2 - 10)



Test Point	Signature
A2U37-pin 1	A4H7
pin 2	627P
pin 3	97P2
pin 4	U18H
pin 5	50U3
pin 6	527A

Test Point	Signature
A2U21-pin 9	6HAU
pin 8	3UH5


YES
Is the signature at A2U35-pin 2 "5P5H"?
NO
Replace A2U46.
YES
Is the signature at A2U35-pin 8 "3C32"?
NO
Replace A2U35.
YES
Is the following signature set correct?
Test Point | Signature
A2U22-pin 4 | PA81
pin 7 | P5F3
pin 9 | 3PCF
pin 13 | UCF4
NO
Replace A2U22.
YES
Is the following signature set correct?
Test Point | Signature
A2U23-pin 7 | 5490
pin 9 | U131
pin 13 | 842P
NO
Replace A2U23.
YES
Is the signature at A2U21-pin 12 "527A"?
NO
Replace A2R3.
YES
Is the signature at A2U21-pin 13 "5U5P"?
NO
Go to Flow Diagram (A2-5).
YES
A
?
re
YES
Is the signature at A2U37-pin 13 "C09H"?
NO
Replace A2U37.
YES
Is the signataure at A2U14-pin 7 "0F27"?
NO
Replace A2U14.
YES
Replace A2U49.
at
"?
YES
Is the signature at A2U44-pin 8 "6HAU"?
NO
Replace A2U44.
YES
Is the signature at A2U44-pin 3 "3UH5"?
NO
Is the signature at A2U44-pin 2 "527A"?
YES
Replace A2U44.
NO
Check A2U43 and U14.
2U52,
tuck
Is the signature at A2U42-pin 3 "3UH5".
YES
Is the signature at A2U28-pin 13 "5P5H".
NO
Replace A2U20.
YES
Is the signature at A2TP1 "3UH5".
NO
Replace A2U28.
YES
Replace A2U31.
Is the signature at A2U42-pin 1 "527A".
YES
Replace A2U42.
NO
Replace A2U44.

Flow Diagram (A2 - 11)

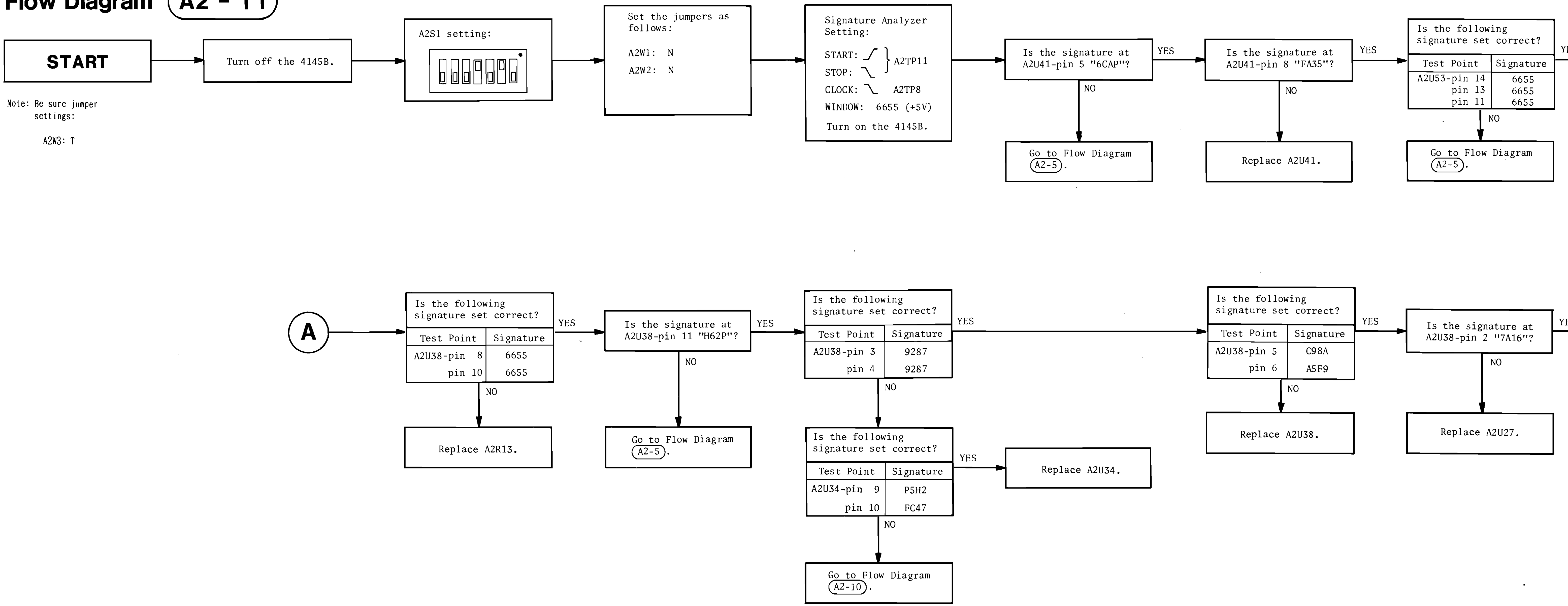
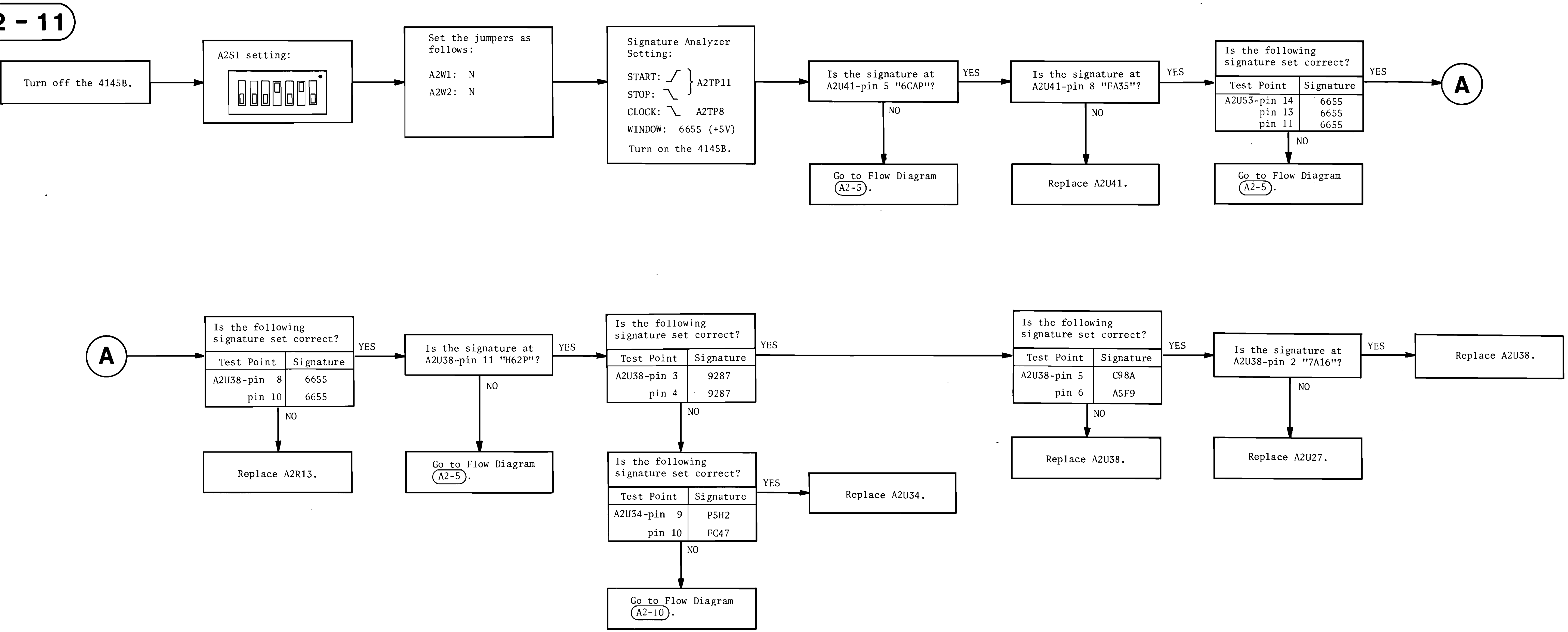


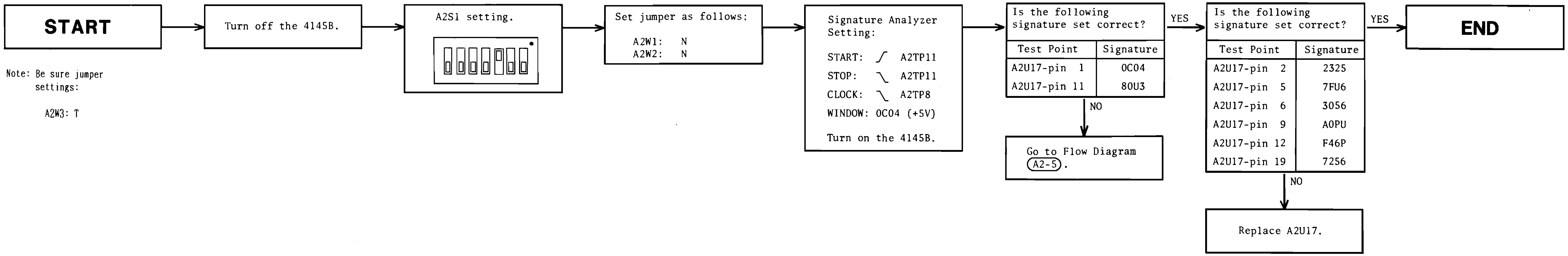
Figure 8-15. A2 Board Troublesho



A2 Troubleshooting Flow Diagram
SEE INSIDE

Figure 8-15. A2 Board Troubleshooting Flow Diagram (Sheet 9 of 11).

Flow Diagram (A2 - 12)



Note: Be sure jumper settings:

A2W3: T

Turn off the 4145B.

A2S1 setting.

Set jumper as follows:

A2W1: N
A2W2: N

Signature Analyzer Setting:

START: ∫ A2TP11
STOP: ⟍ A2TP11
CLOCK: ⟍ A2TP8
WINDOW: 0C04 (+5V)

Turn on the 4145B.

Is the following signature set correct?

Test Point	Signature
A2U17-pin 1	0C04
A2U17-pin 11	80U3

Go to Flow Diagram (A2-5).

Is the following signature set correct?

Test Point	Signature
A2U17-pin 2	2325
A2U17-pin 5	7FU6
A2U17-pin 6	3056
A2U17-pin 9	A0PU
A2U17-pin 12	F46P
A2U17-pin 19	7256

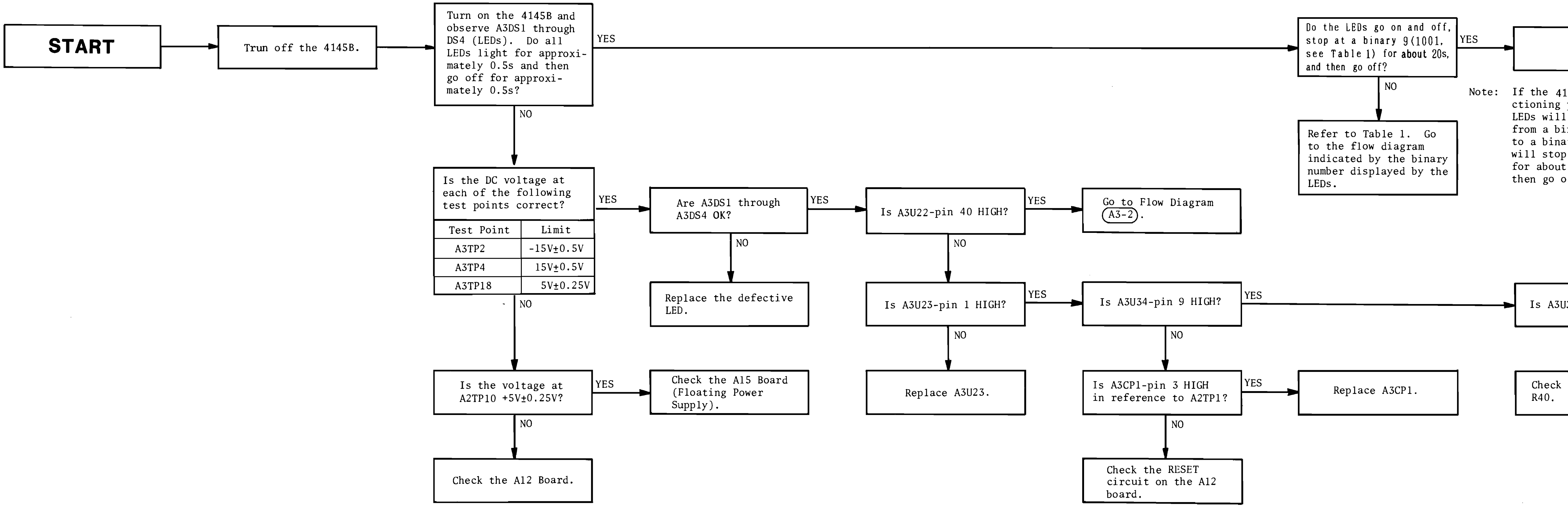
Replace A2U17.

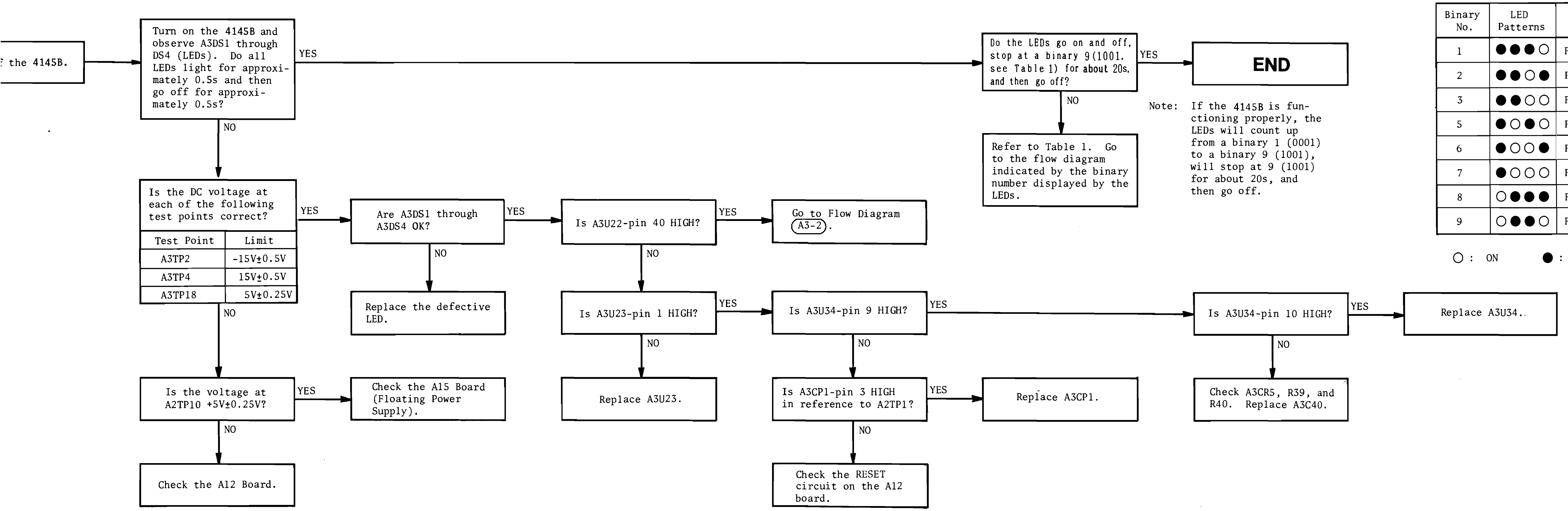
A2 Troubleshooting Flow Diagram

SEE INSIDE

Figure 8-15. A2 Board Troubleshooting Flow Diagram (Sheet 11 of 11).

Flow Diagram (A3 - 1)





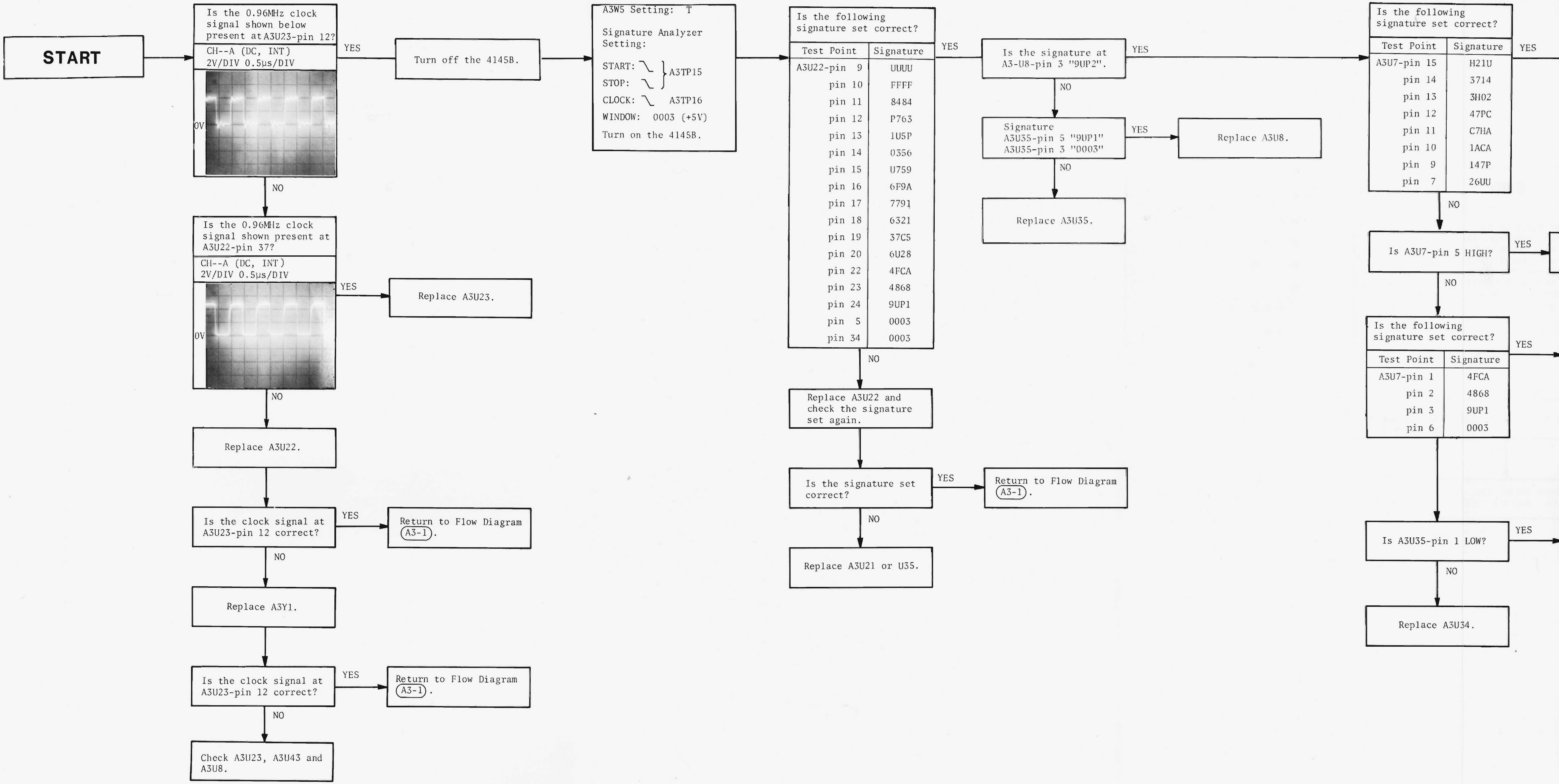
Note: If the 4145B is functioning properly, the LEDs will count up from a binary 1 (0001) to a binary 9 (1001), will stop at 9 (1001) for about 20s, and then go off.

Table 1

Binary No.	LED Patterns	Flow Diagram to Go for Next
1	●●●○	Flow Diagram (A3-3)
2	●●○●	Flow Diagram (A3-4)
3	●●○○	Flow Diagram (A3-5)
5	●○●○	Flow Diagram (A3-8)
6	●○○●	Flow Diagram (A4-1)
7	●○○○	Flow Diagram (A4-5)
8	○●●●	Flow Diagram (A4-6)
9	○●●○	Flow Diagram (A3-13)

○ : ON ● : OFF

Flow Diagram (A3 - 2)



Is the 0.96MHz clock signal shown below present at A3U23-pin 12?

CH--A (DC, INT)
2V/DIV 0.5μs/DIV

Turn off the 4145B.

A3W5 Setting: T

Signature Analyzer Setting:

START: ⌝ } A3TP15
STOP: ⌝
CLOCK: ⌝ A3TP16
WINDOW: 0003 (+5V)

Turn on the 4145B.

Is the 0.96MHz clock signal shown present at A3U22-pin 37?

CH--A (DC, INT)
2V/DIV 0.5μs/DIV

Replace A3U23.

Replace A3U22.

Is the clock signal at A3U23-pin 12 correct?

Return to Flow Diagram (A3-1).

Replace A3Y1.

Is the clock signal at A3U23-pin 12 correct?

Return to Flow Diagram (A3-1).

Check A3U23, A3U43 and A3U8.

Is the following signature set correct?

Test Point	Signature
A3U22-pin 9	UUUU
pin 10	FFFF
pin 11	8484
pin 12	P763
pin 13	1U5P
pin 14	0356
pin 15	U759
pin 16	6F9A
pin 17	7791
pin 18	6321
pin 19	37C5
pin 20	6U28
pin 22	4FCA
pin 23	4868
pin 24	9UP1
pin 5	0003
pin 34	0003

Replace A3U22 and check the signature set again.

Is the signature set correct?

Return to Flow Diagram (A3-1).

Replace A3U21 or U35.

Is the signature at A3-U8-pin 3 "9UP2".

Signature
A3U35-pin 5 "9UP1"
A3U35-pin 3 "0003"

Replace A3U8.

Replace A3U35.

Is the following signature set correct?

Test Point	Signature
A3U7-pin 15	H21U
pin 14	3714
pin 13	3H02
pin 12	47PC
pin 11	C7HA
pin 10	1ACA
pin 9	147P
pin 7	26UU

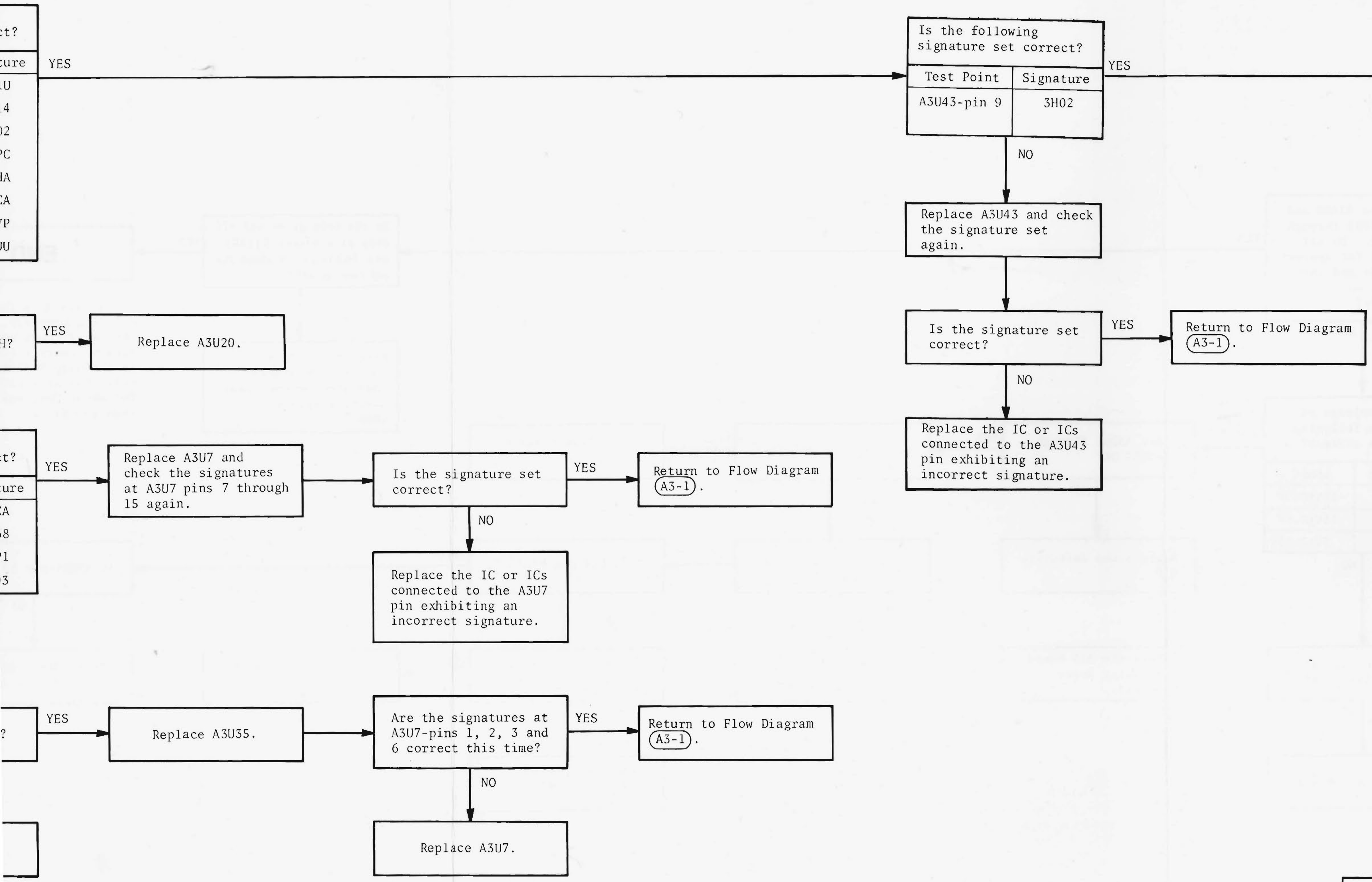
Is A3U7-pin 5 HIGH?

Is the following signature set correct?

Test Point	Signature
A3U7-pin 1	4FCA
pin 2	4868
pin 3	9UP1
pin 6	0003

Is A3U35-pin 1 LOW?

Replace A3U34.



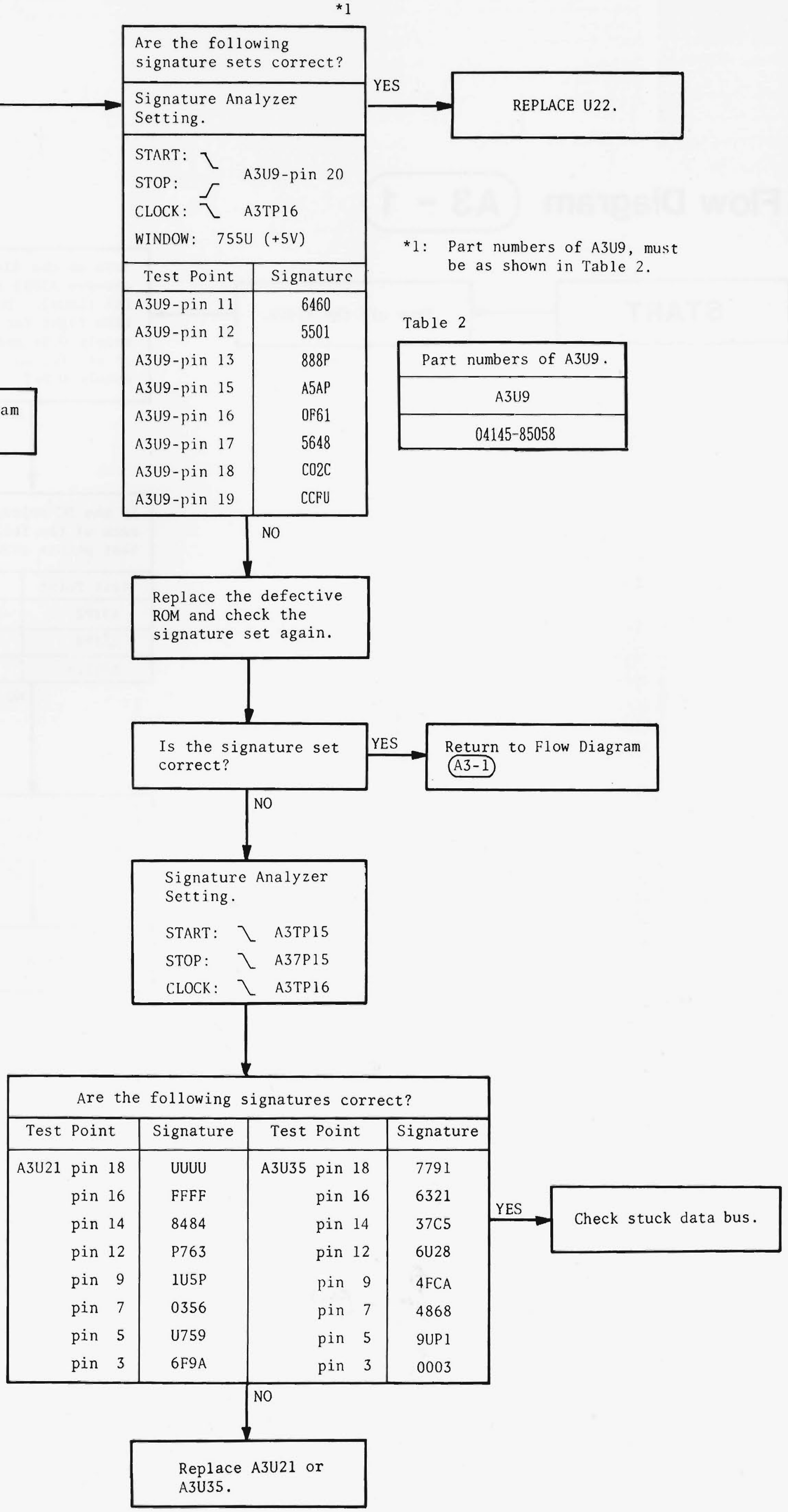
Is the following signature set correct?

Test Point	Signature
A3U43-pin 9	3H02

A3 Troubleshooting Flow Diagram

SEE INSIDE

Figure 8-16. A3 Board Troubleshooting Flow Diagram (Sheet 1 of 9).



Are the following signature sets correct?

Signature Analyzer Setting.

START: ╲ A3U9-pin 20
STOP: ╱
CLOCK: ╲ A3TP16
WINDOW: 755U (+5V)

Test Point	Signature
A3U9-pin 11	6460
A3U9-pin 12	5501
A3U9-pin 13	888P
A3U9-pin 15	A5AP
A3U9-pin 16	0F61
A3U9-pin 17	5648
A3U9-pin 18	C02C
A3U9-pin 19	CCFU

*1: Part numbers of A3U9, must be as shown in Table 2.

Table 2

Part numbers of A3U9.
A3U9
04145-85058

Signature Analyzer Setting.

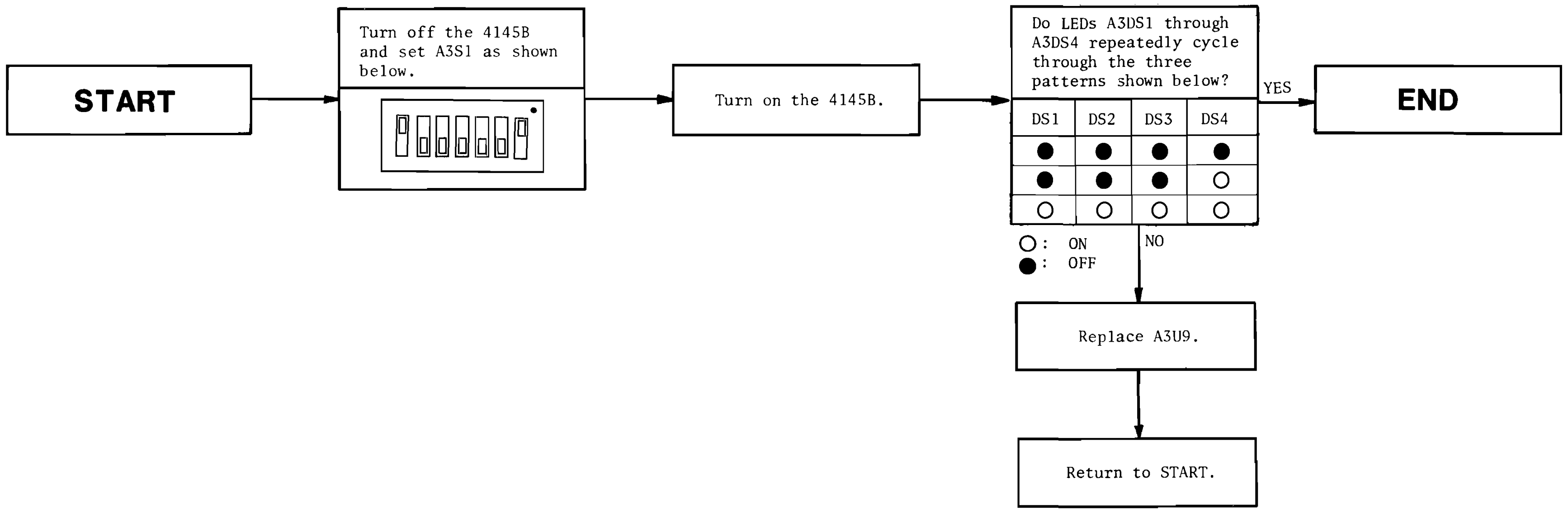
START: ╲ A3TP15
STOP: ╲ A37P15
CLOCK: ╲ A3TP16

Are the following signatures correct?

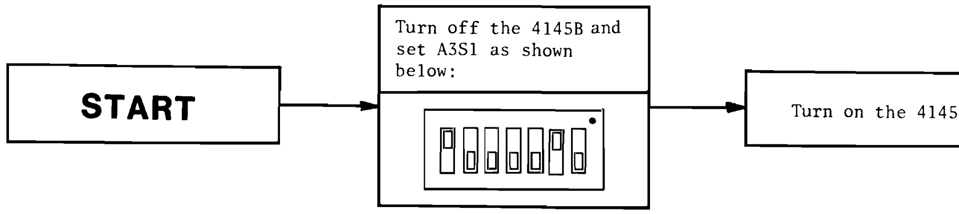
Test Point	Signature	Test Point	Signature
A3U21 pin 18	UUUU	A3U35 pin 18	7791
pin 16	FFFF	pin 16	6321
pin 14	8484	pin 14	37C5
pin 12	P763	pin 12	6U28
pin 9	1U5P	pin 9	4FCA
pin 7	0356	pin 7	4868
pin 5	U759	pin 5	9UP1
pin 3	6F9A	pin 3	0003

Figure 8-16. A3 Board Troubleshooting Flow Diagram (Sheet 2 of 9).

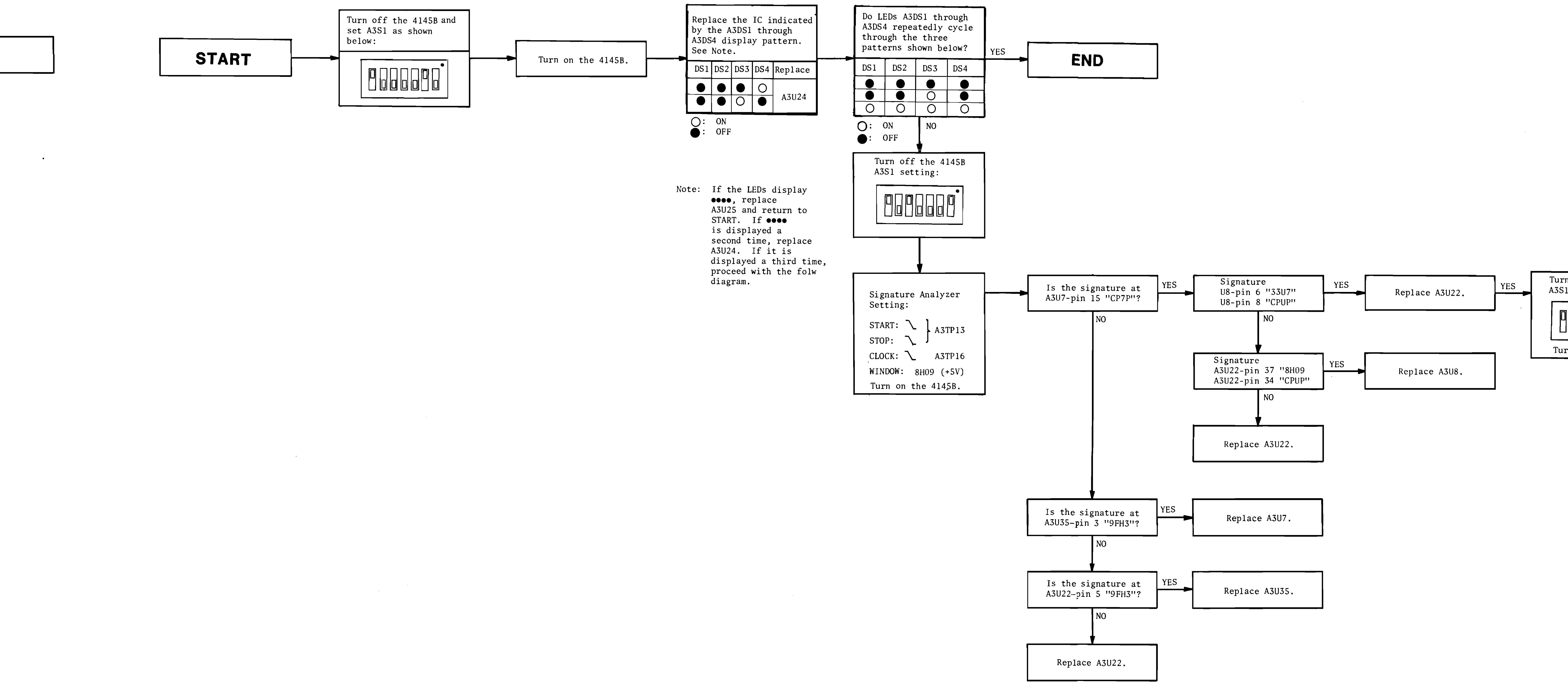
Flow Diagram (A3 - 3)



Flow Diagram (A3 - 4)



Flow Diagram (A3 - 4)



START

Turn off the 4145B and set A3S1 as shown below:

Turn on the 4145B.

Replace the IC indicated by the A3DS1 through A3DS4 display pattern. See Note.

DS1	DS2	DS3	DS4	Replace
●	●	●	○	A3U24
●	●	○	●	

○: ON
●: OFF

Note: If the LEDs display ●●●●, replace A3U25 and return to START. If ●●●● is displayed a second time, replace A3U24. If it is displayed a third time, proceed with the folw diagram.

Do LEDs A3DS1 through A3DS4 repeatedly cycle through the three patterns shown below?

DS1	DS2	DS3	DS4
●	●	●	●
●	●	○	●
○	○	○	○

○: ON
●: OFF

END

Turn off the 4145B A3S1 setting:

Signature Analyzer Setting:

START: ⌄ } A3TP13
STOP: ⌄
CLOCK: ⌄ A3TP16
WINDOW: 8H09 (+5V)
Turn on the 4145B.

Is the signature at A3U7-pin 15 "CP7P"?

Signature
U8-pin 6 "33U7"
U8-pin 8 "CPUP"

Replace A3U22.

Turn
A3S1
Tur

Signature
A3U22-pin 37 "8H09
A3U22-pin 34 "CPUP"

Replace A3U8.

Replace A3U22.

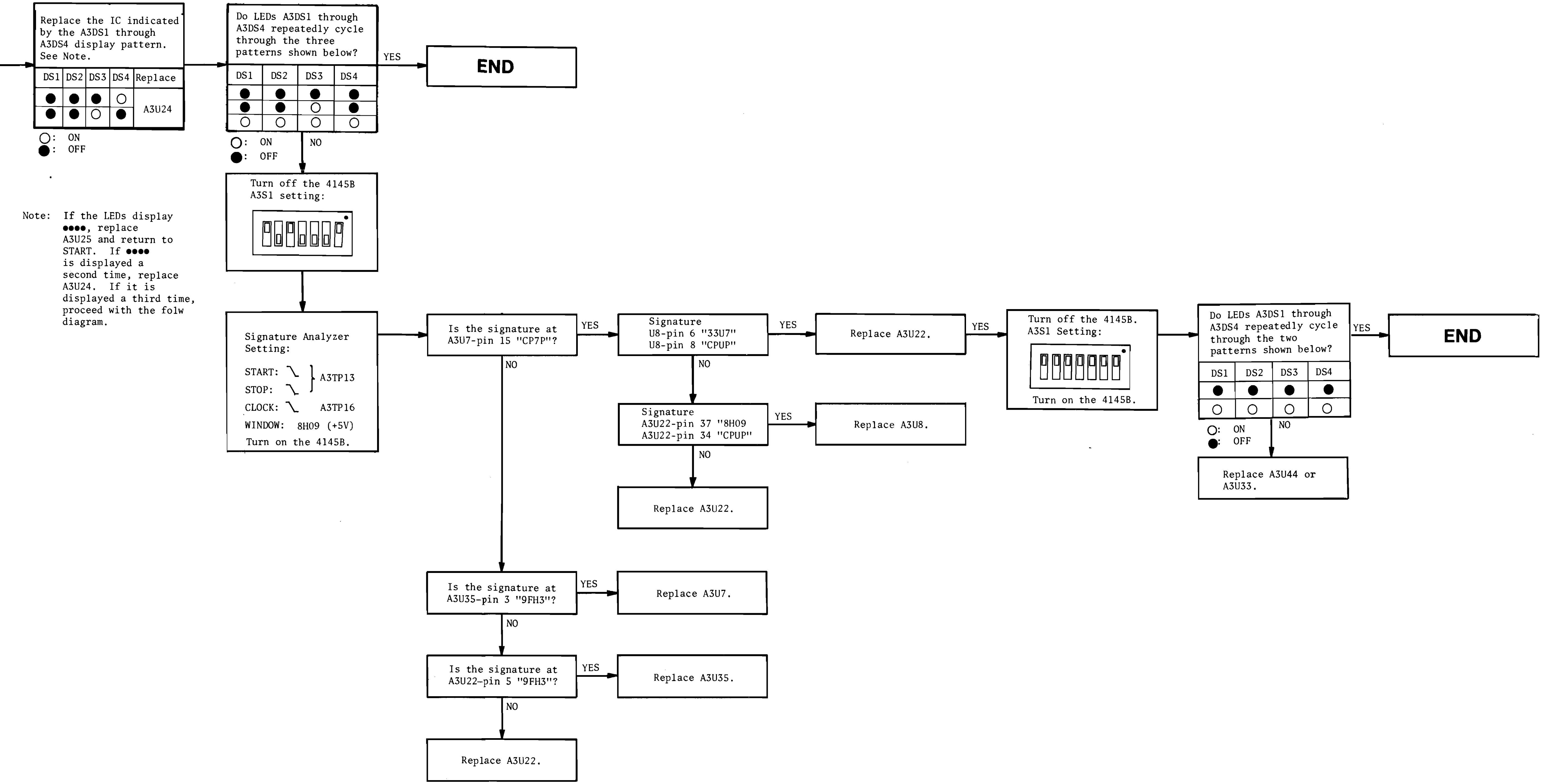
Is the signature at A3U35-pin 3 "9FH3"?

Replace A3U7.

Is the signature at A3U22-pin 5 "9FH3"?

Replace A3U35.

Replace A3U22.



Note: If the LEDs display ●●●●, replace A3U25 and return to START. If ●●●● is displayed a second time, replace A3U24. If it is displayed a third time, proceed with the folw diagram.

Flow Diagram (A3 - 5)

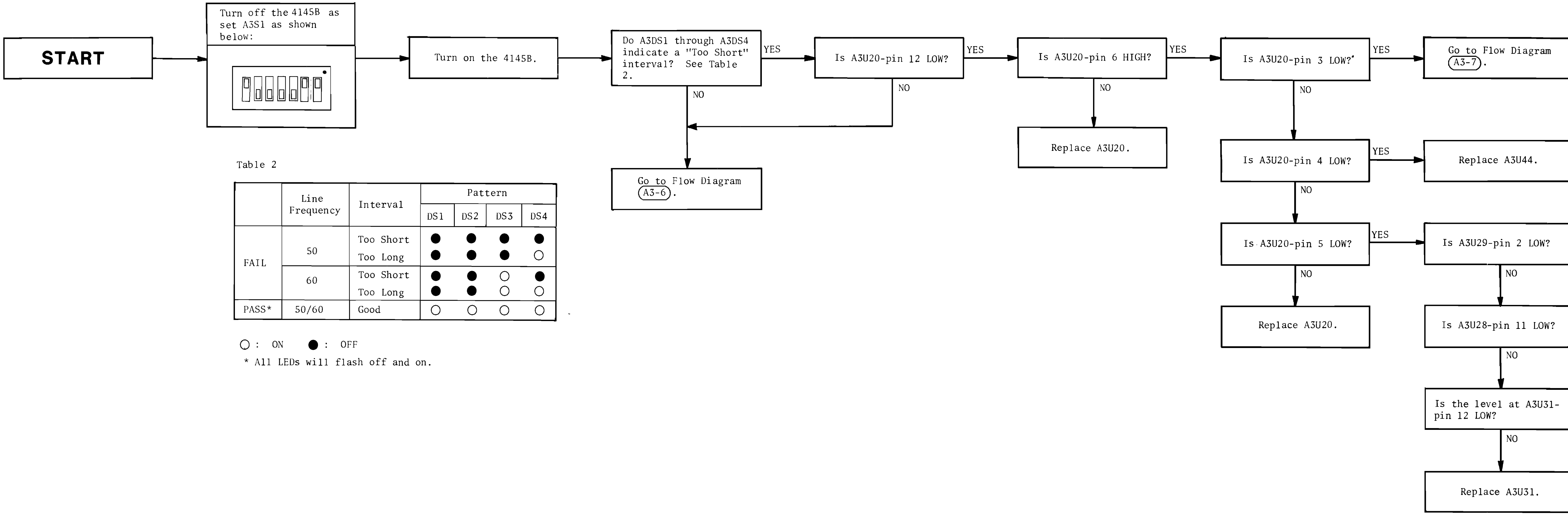
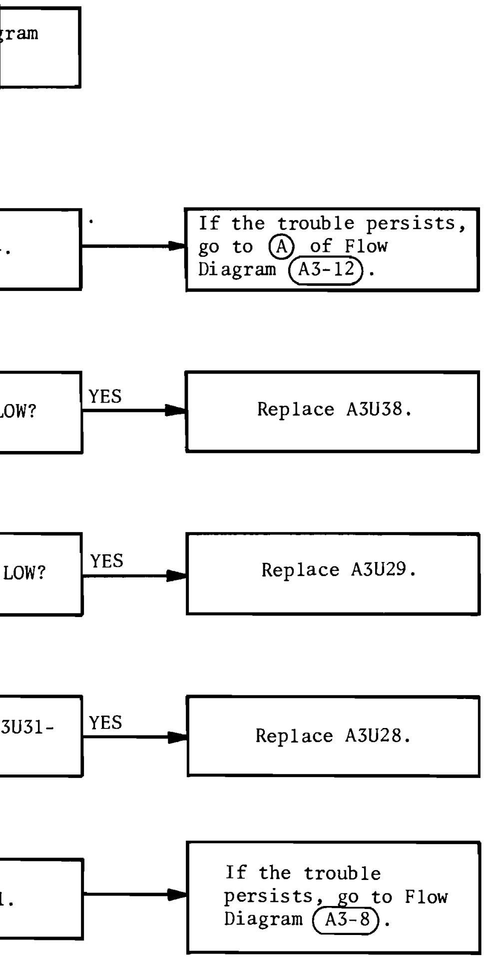


Table 2

	Line Frequency	Interval	Pattern			
			DS1	DS2	DS3	DS4
FAIL	50	Too Short	●	●	●	●
		Too Long	●	●	●	○
	60	Too Short	●	●	○	●
		Too Long	●	●	○	○
PASS*	50/60	Good	○	○	○	○

○ : ON ● : OFF

* All LEDs will flash off and on.



A3 Troubleshooting Flow Diagram

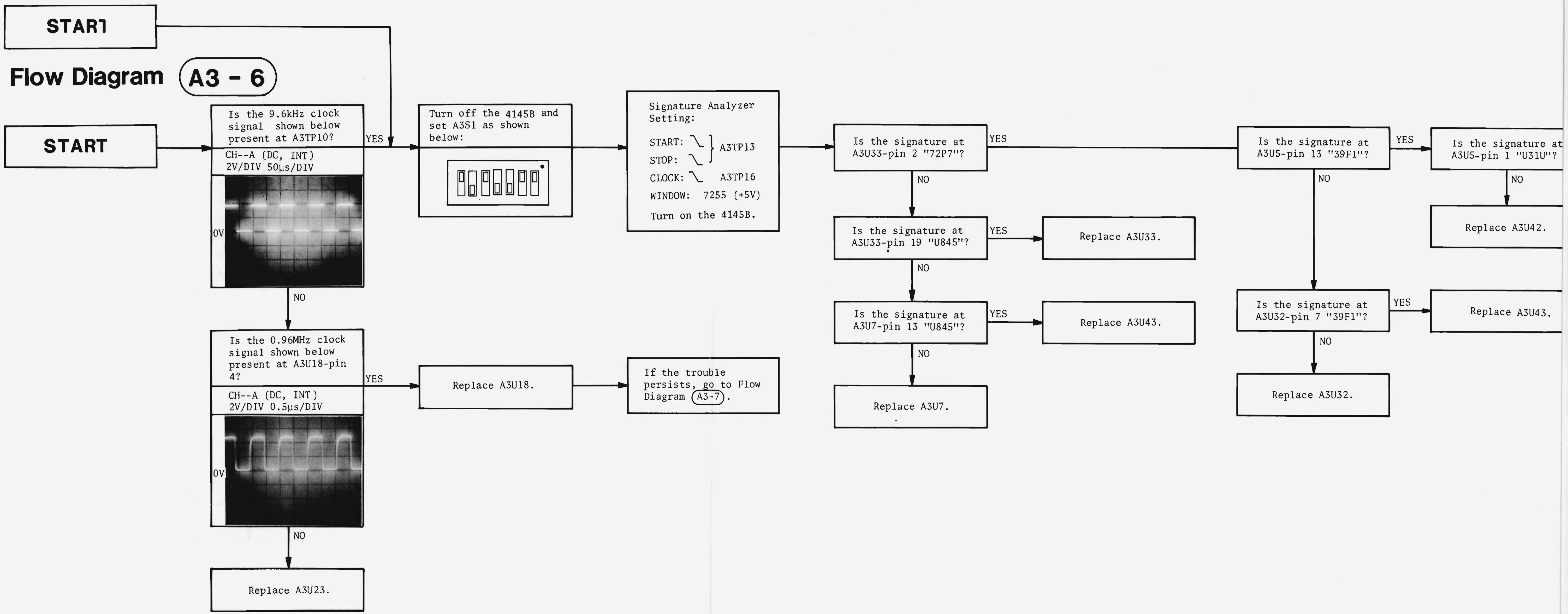
SEE INSIDE

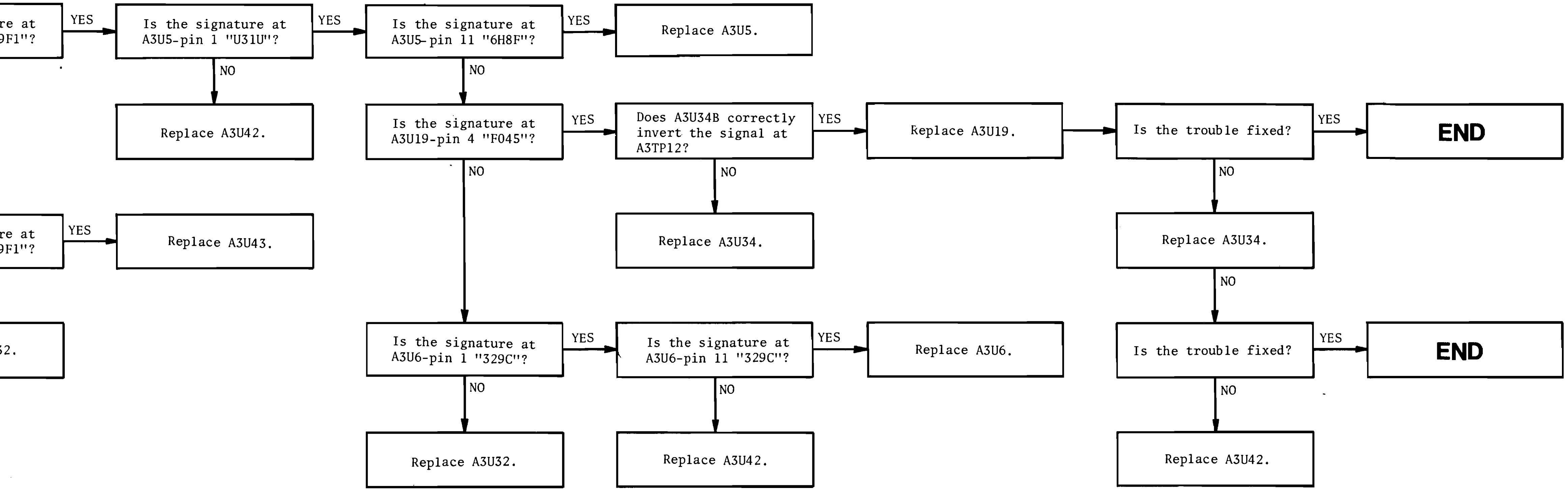
Figure 8-16. A3 Board Troubleshooting Flow Diagram (Sheet 3 of 9).

Figure 8-16. A3 Board Troubleshooting Flow Diagram (Sheet 4 of 9).

Flow Diagram (A3 - 7)

Flow Diagram (A3 - 6)




re at
9F1"?
YES
Is the signature at A3U5-pin 1 "U31U"?
YES
Is the signature at A3U5-pin 11 "6H8F"?
YES
Replace A3U5.
NO
Replace A3U42.
NO
Is the signature at A3U19-pin 4 "F045"?
YES
Does A3U34B correctly invert the signal at A3TP12?
YES
Replace A3U19.
Is the trouble fixed?
YES
END
NO
NO
Replace A3U34.
NO
Replace A3U34.
re at
9F1"?
YES
Replace A3U43.
NO
2.
Is the signature at A3U6-pin 1 "329C"?
YES
Is the signature at A3U6-pin 11 "329C"?
YES
Replace A3U6.
Is the trouble fixed?
YES
END
NO
Replace A3U32.
NO
Replace A3U42.
NO
Replace A3U42.

Flow Diagram (A3 - 8)

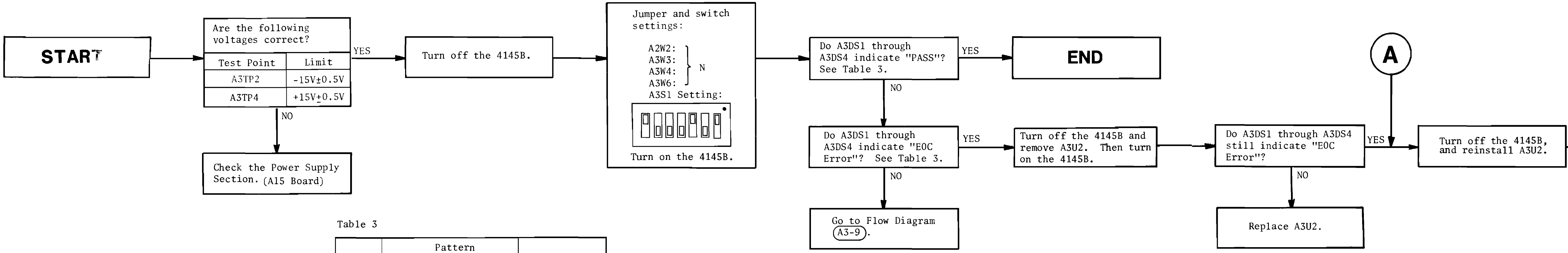
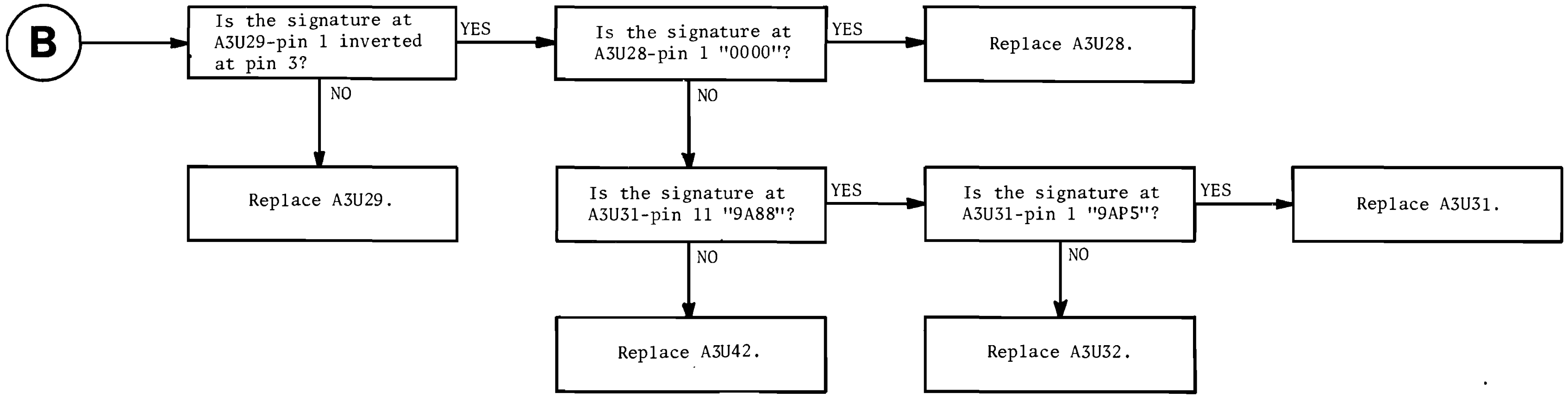


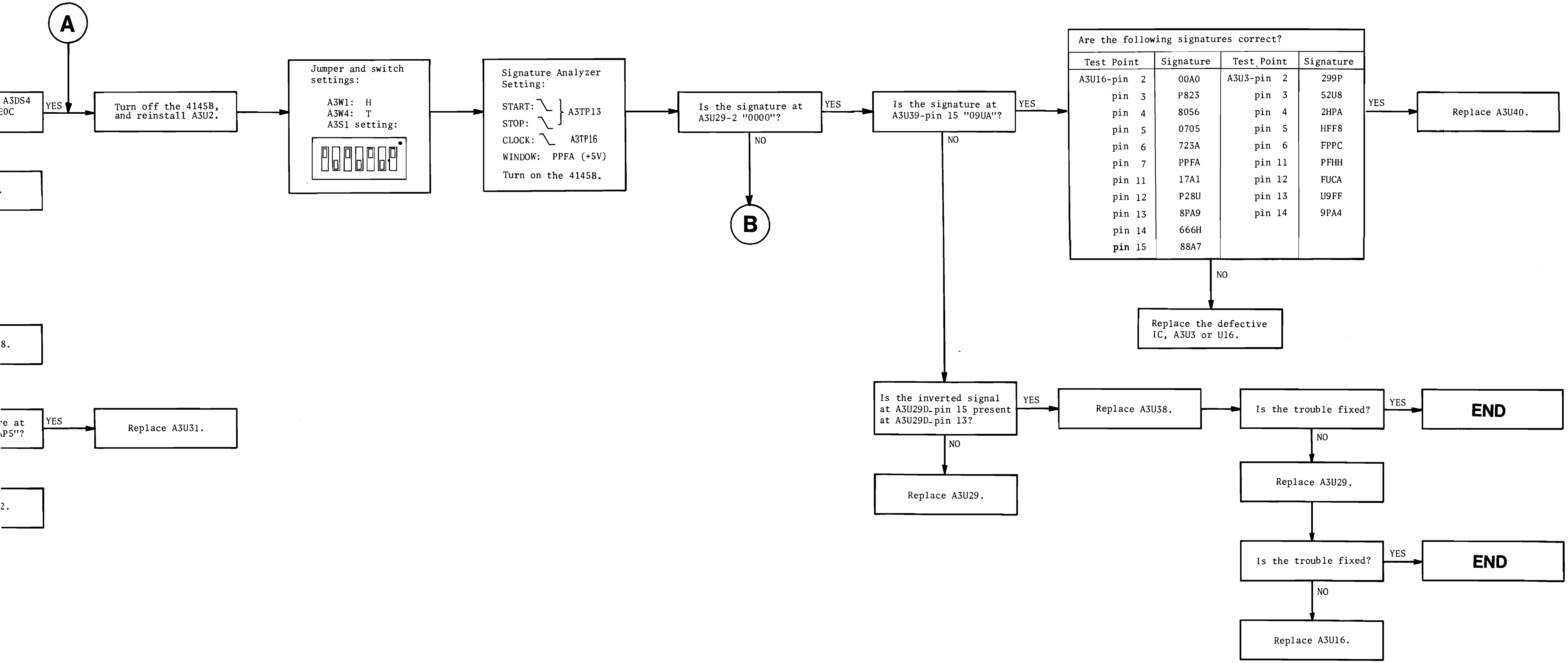
Table 3

	Pattern				Description
	DS1	DS2	DS3	DS4	
FAIL	●	●	●	○	NO IRQ Error
	●	●	○	●	Data Error
	●	●	○	○	EOC Error
PASS*	○	○	○	○	

○ : ON ● : OFF

* The LEDs will repeatedly cycle through a 0 (0000), 5 (0101), 15 (1111) count sequence.





Are the following signatures correct?

Test Point	Signature	Test Point	Signature
A3U16-pin 2	00A0	A3U3-pin 2	299P
pin 3	P823	pin 3	52U8
pin 4	8056	pin 4	2HPA
pin 5	0705	pin 5	HFF8
pin 6	723A	pin 6	FPPC
pin 7	PPFA	pin 11	PFHH
pin 11	17A1	pin 12	FUCA
pin 12	P28U	pin 13	U9FF
pin 13	8PA9	pin 14	9PA4
pin 14	666H		
pin 15	88A7		

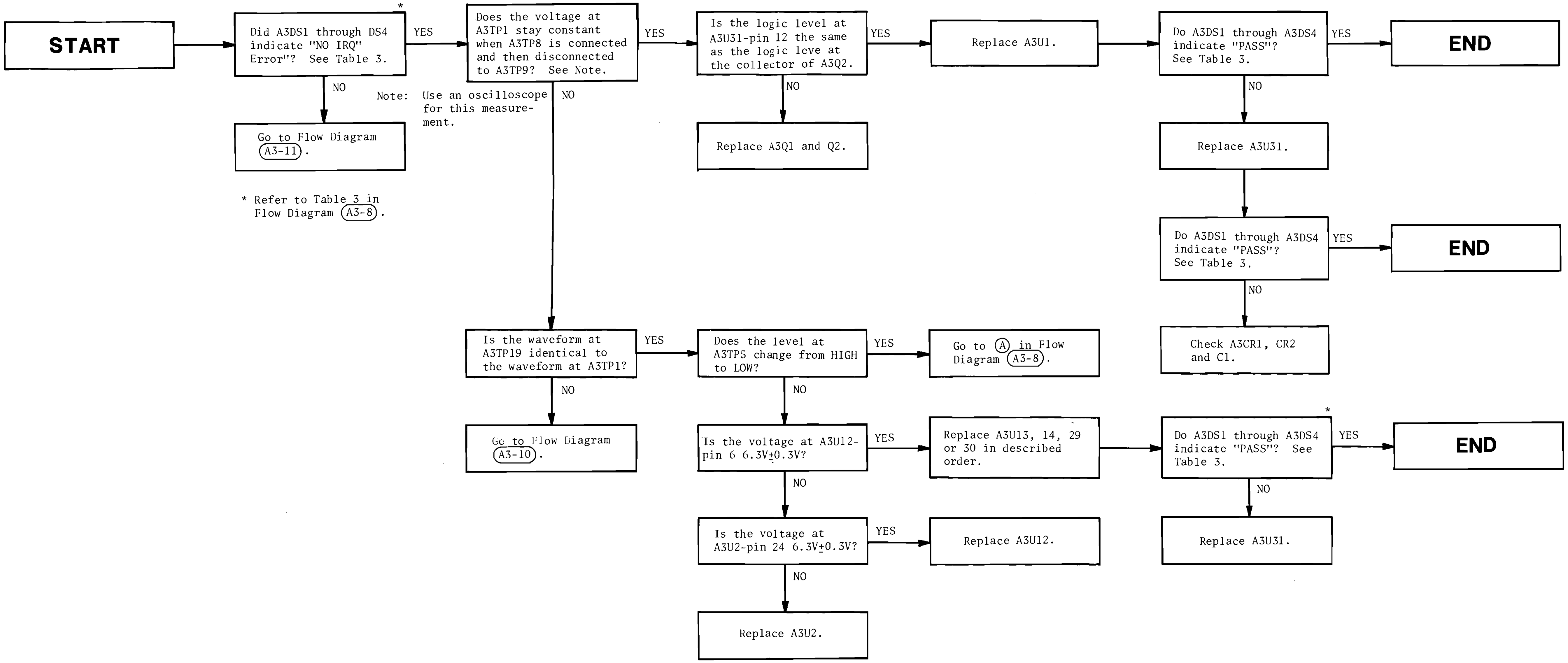
A3 Troubleshooting Flow Diagram

SEE INSIDE

Figure 8-16. A3 Board Troubleshooting Flow Diagram (Sheet 5 of 9).

Figure 8-16. A3 Board Troubleshooting Flow Diagram (Sheet 6 of 9).

Flow Diagram (A3 - 9)



Did A3DS1 through DS4 indicate "NO IRQ" Error"? See Table 3. *

Go to Flow Diagram (A3-11).

* Refer to Table 3 in Flow Diagram (A3-8).

Does the voltage at A3TP1 stay constant when A3TP8 is connected and then disconnected to A3TP9? See Note.

Note: Use an oscilloscope for this measurement.

Is the logic level at A3U31-pin 12 the same as the logic leve at the collector of A3Q2.

Replace A3Q1 and Q2.

Replace A3U1.

Do A3DS1 through A3DS4 indicate "PASS"? See Table 3.

Replace A3U31.

Do A3DS1 through A3DS4 indicate "PASS"? See Table 3.

Check A3CR1, CR2 and C1.

Is the waveform at A3TP19 identical to the waveform at A3TP1?

Go to Flow Diagram (A3-10).

Does the level at A3TP5 change from HIGH to LOW?

Go to Ⓐ in Flow Diagram (A3-8).

Is the voltage at A3U12-pin 6 6.3V±0.3V?

Replace A3U13, 14, 29 or 30 in described order.

Do A3DS1 through A3DS4 indicate "PASS"? See Table 3. *

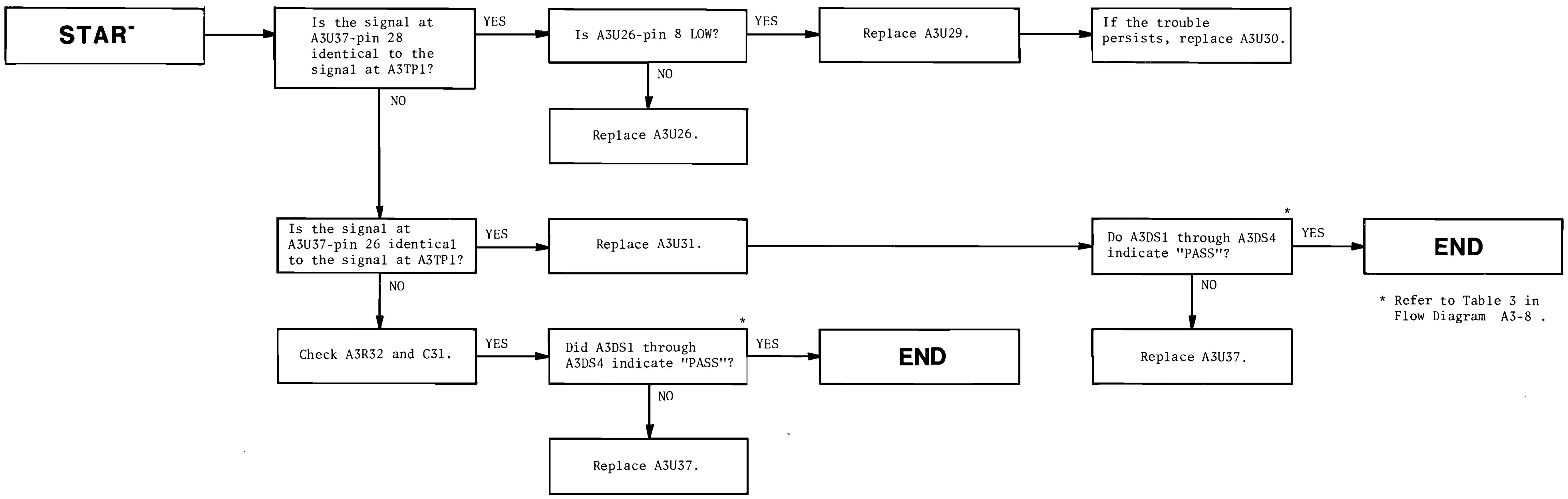
Replace A3U31.

Is the voltage at A3U2-pin 24 6.3V±0.3V?

Replace A3U12.

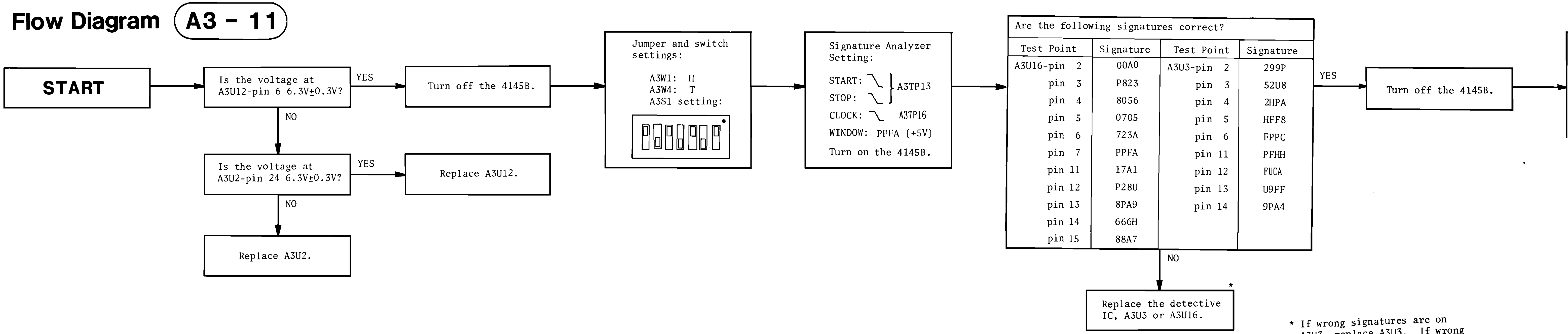
Replace A3U2.

Flow Diagram A3 - 10



* Refer to Table 3 in Flow Diagram A3-8 .

Flow Diagram A3 - 11



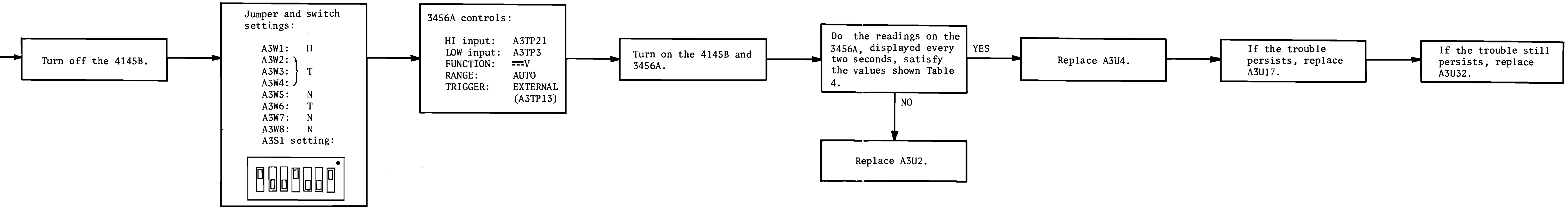
Are the following signatures correct?

Test Point	Signature	Test Point	Signature
A3U16-pin 2	00A0	A3U3-pin 2	299P
pin 3	P823	pin 3	52U8
pin 4	8056	pin 4	2HPA
pin 5	0705	pin 5	HFF8
pin 6	723A	pin 6	FPPC
pin 7	PPFA	pin 11	PFHH
pin 11	17A1	pin 12	FUCA
pin 12	P28U	pin 13	U9FF
pin 13	8PA9	pin 14	9PA4
pin 14	666H		
pin 15	88A7		

* If wrong signatures are on A3U3, replace A3U3. If wrong signatures are on A3U3 and A3U16, replace A3U16, then A3U3.

Table 4

No.	Reading on the 3456A
0	4096mV±15mV
1	2048mV±15mV
2	1024mV±15mV
3	512mV±15mV
4	256mV±15mV
5	128mV±15mV
6	64mV±15mV
7	32mV±15mV
8	16mV±15mV
9	8mV±15mV
10	4mV±15mV
11	2mV±15mV
12	1mV±15mV
13	0.5mV±15mV
14	0mV±15mV
15	0mV±15mV
16	0mV±15mV



signatures are on
place A3U3. If wrong
es are on A3U3 and A3U16,
A3U16, then A3U3.

A3 Troubleshooting Flow Diagram

SEE INSIDE

Figure 8-16. A3 Board Troubleshooting Flow Diagram (Sheet 7 of 9).

Figure 8-16. A3 Board Troubleshooting Flow Diagram (Sheet 8 of 9).

Flow Diagram (A3 - 13)

Flow Diagram (A3 - 12)

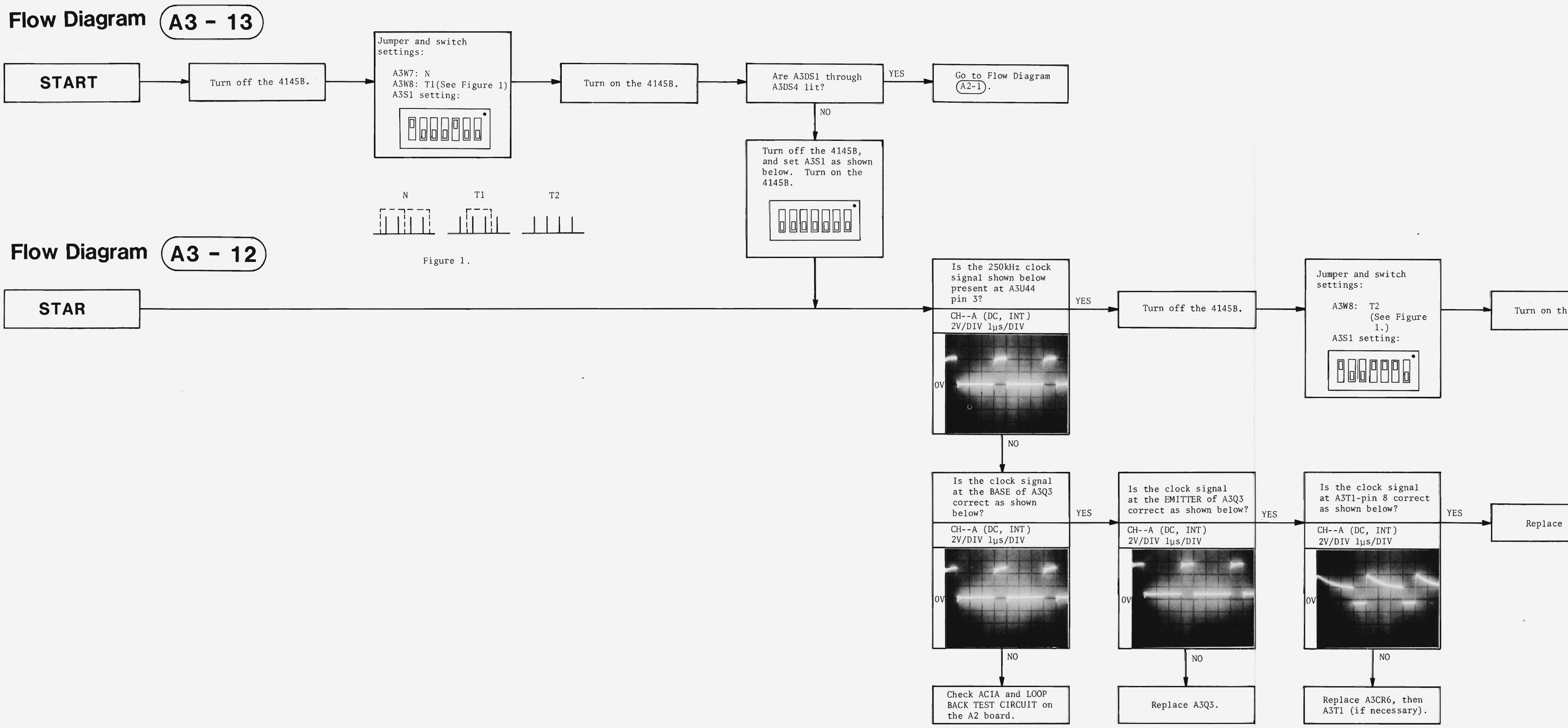
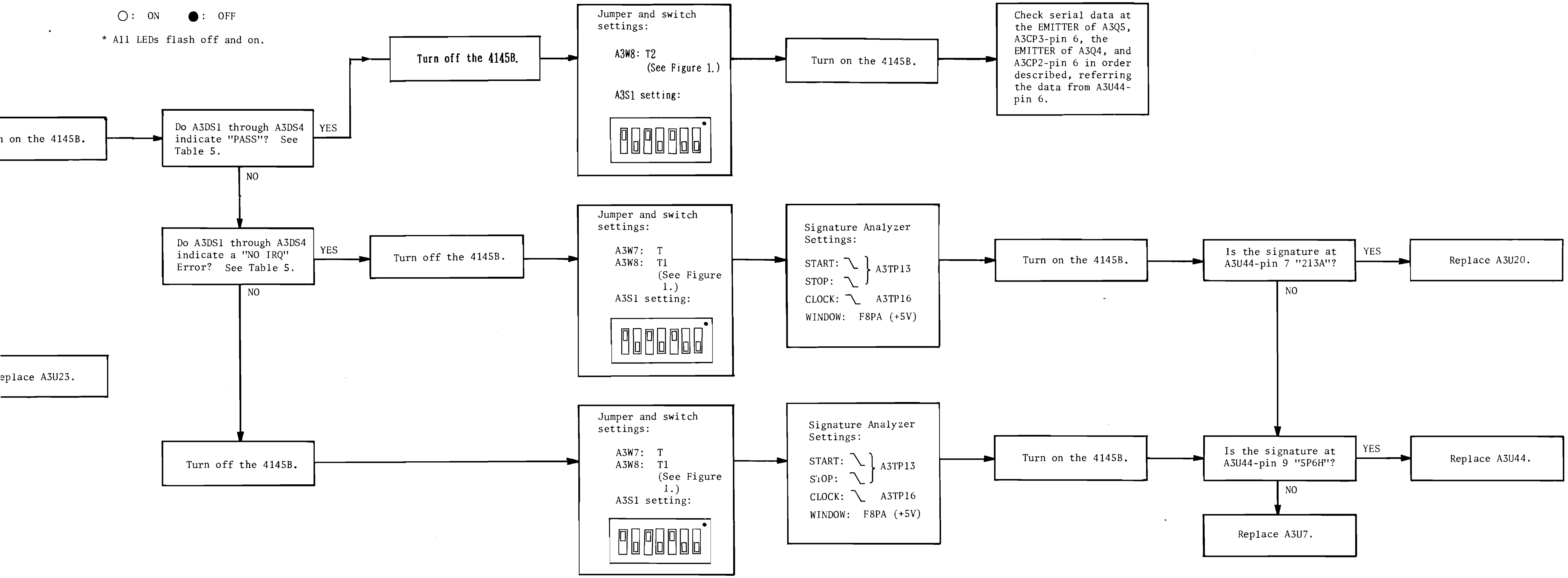


Table 5.

	Pattern				Description
	DS1	DS2	DS3	DS4	
PASS*	○	○	○	○	
FAIL	●	●	●	○	Data Error
	●	●	○	●	Flag Error
	●	○	●	●	No IRQ Error

○: ON ●: OFF

* All LEDs flash off and on.



A3 Troubleshooting Flow Diagram

SEE INSIDE

Figure 8-16. A3 Board Troubleshooting Flow Diagram (Sheet 9 of 9).

Flow Diagram A4 - 4

Flow Diagram A4 - 1

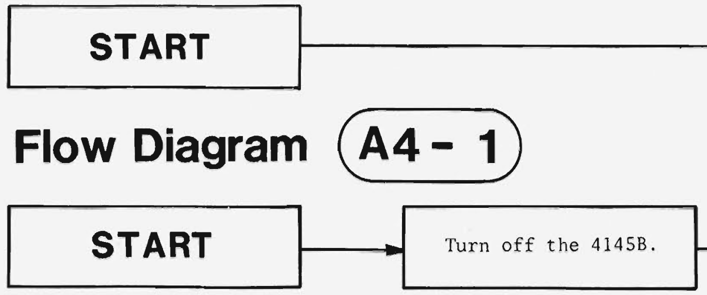
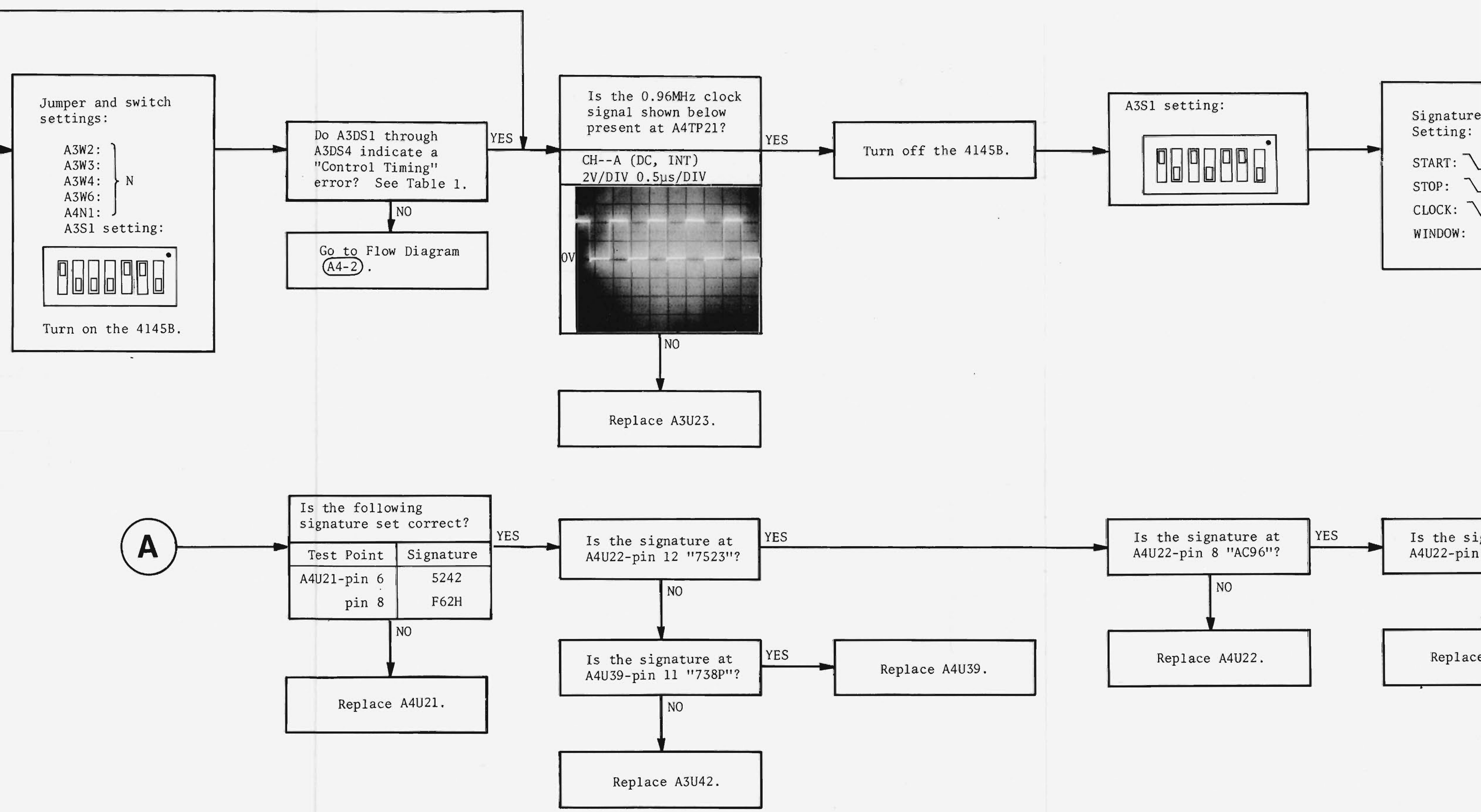


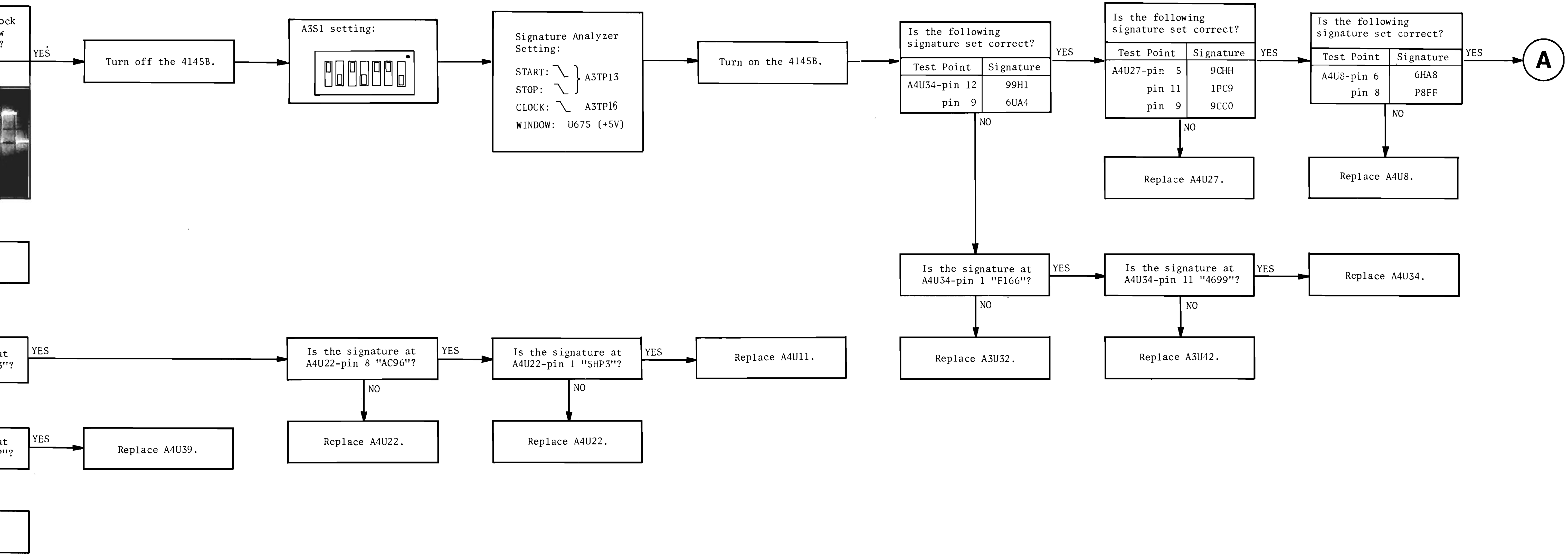
Table 1

	LED Pattern				Description	
	DS1	DS2	DS3	DS4		
FAIL 1	●	●	●	○	RAM Error	Error related to A4U19
FAIL 2	●	●	○	●		Error related to A4U20
FAIL 3	●	●	○	○		Error related to A4U25
FAIL 4	●	○	●	●		Error related to A4U26
FAIL 5	●	○	●	○	Control Timing error	
FAIL 6	●	○	○	●	D-A Converter error	
PASS*	○	○	○	○		

○: ON ●: OFF

* All LEDs flash off and on.



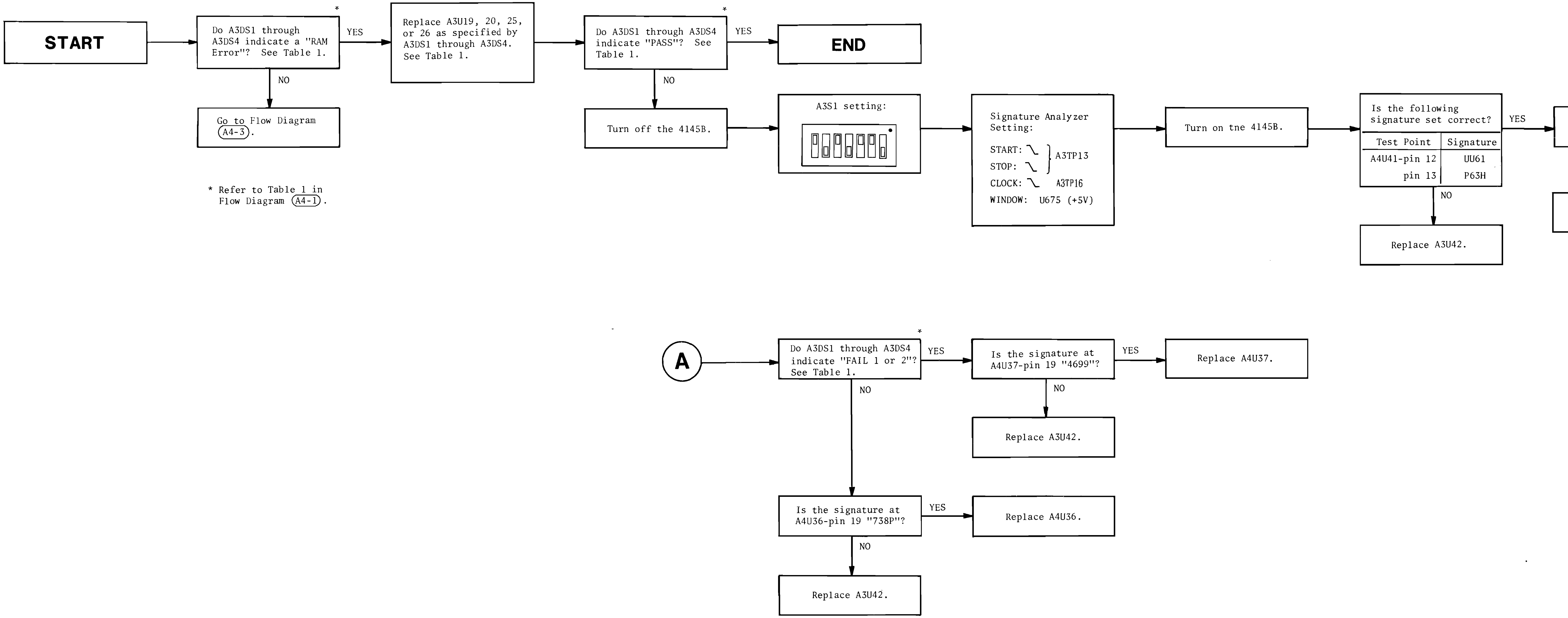


Test Point	Signature
A4U34-pin 12	99H1
pin 9	6UA4

Test Point	Signature
A4U27-pin 5	9CHH
pin 11	1PC9
pin 9	9CC0

Test Point	Signature
A4U8-pin 6	6HA8
pin 8	P8FF

Flow Diagram (A4 - 2)

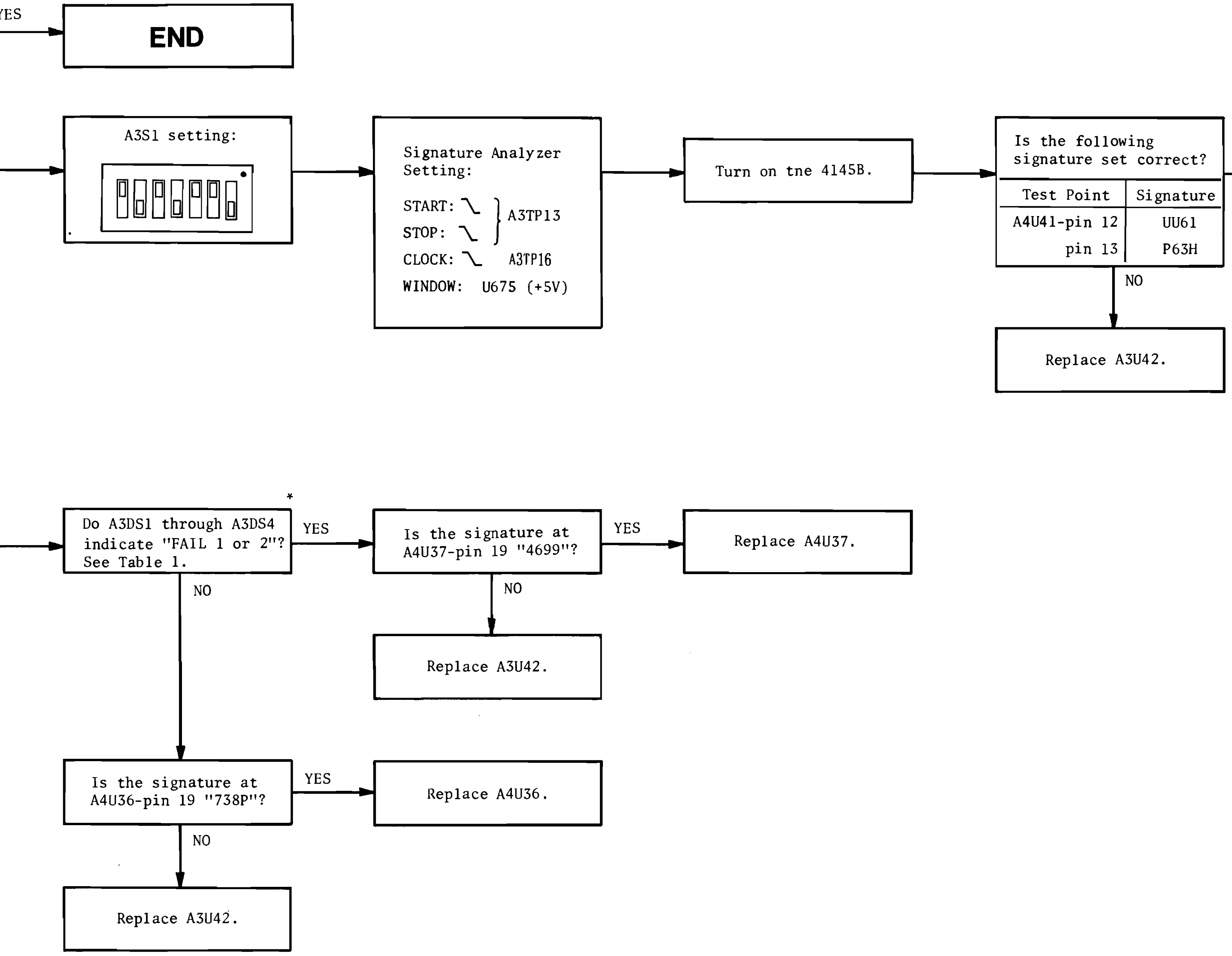


* Refer to Table 1 in Flow Diagram (A4-1).

A4 Troubleshooting Flow Diagram

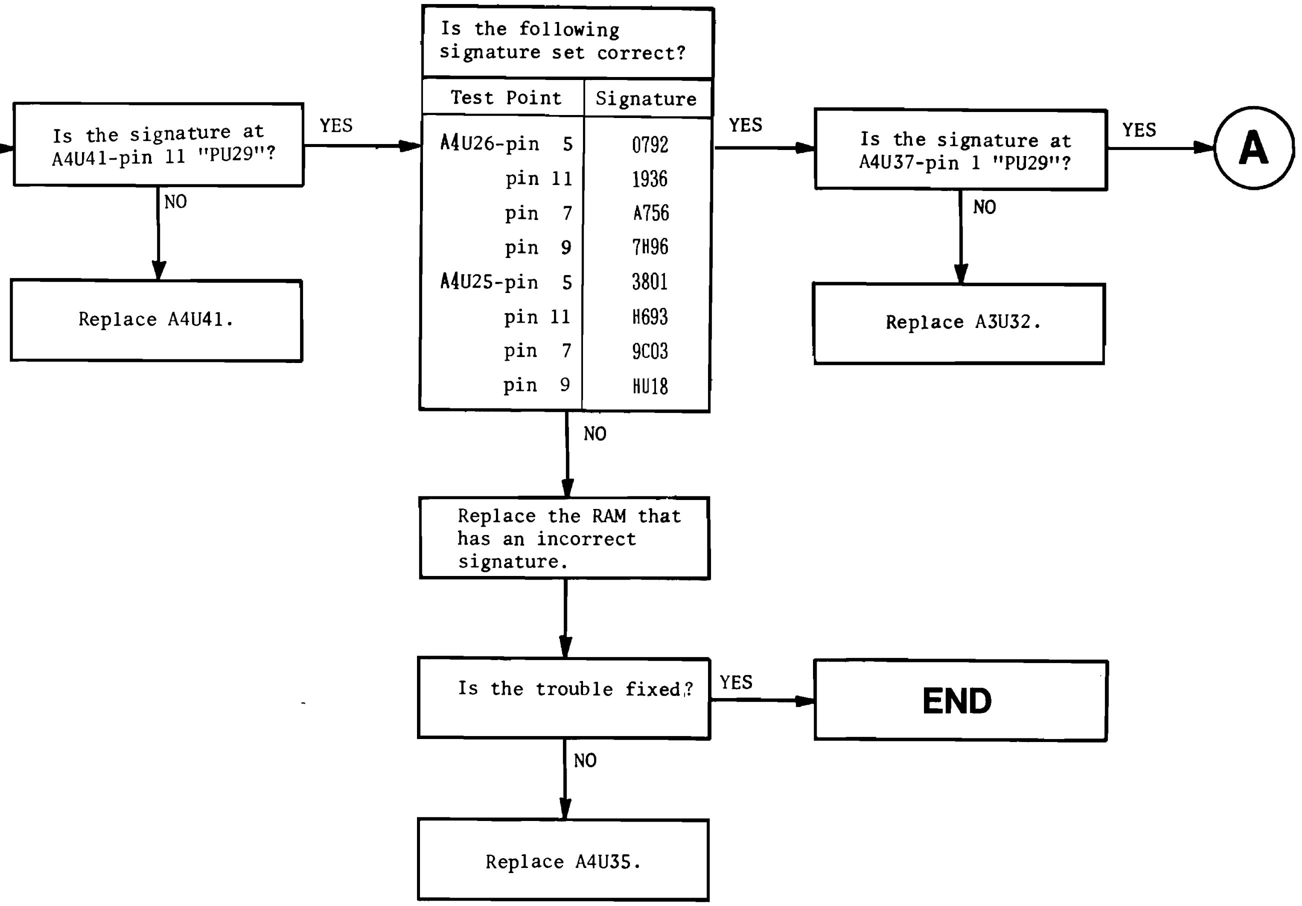
SEE INSIDE

Figure 8-17. A4 Board Troubleshooting Flow Diagram (Sheet 1 of 5).



Test Point	Signature
A4U41-pin 12	UU61
pin 13	P63H

Figure 8-17. A4 Board Troubleshooting Flow Diagram (Sheet 1 of 5).

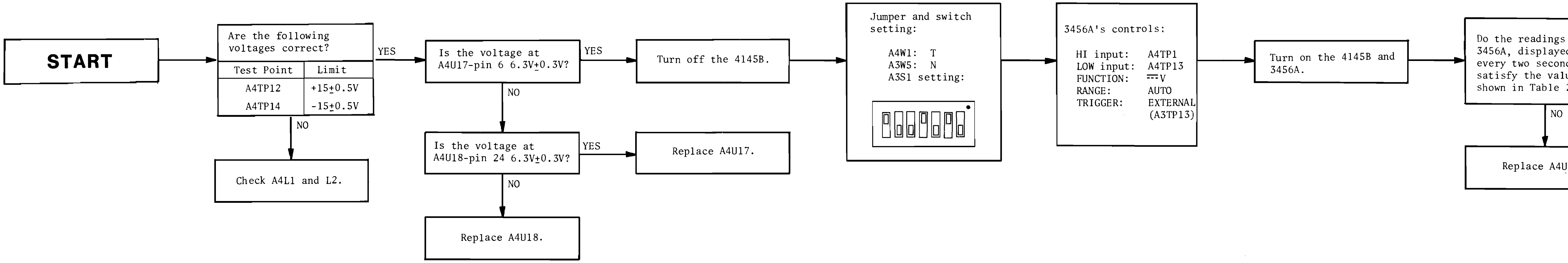


Test Point	Signature
A4U26-pin 5	0792
pin 11	1936
pin 7	A756
pin 9	7H96
A4U25-pin 5	3801
pin 11	H693
pin 7	9C03
pin 9	HU18

Figure 8-17. A4 Board Troubleshooting Flow Diagram (Sheet 2 of 5).

A4 Troubleshooting Flow Diagram
SEE INSIDE

Flow Diagram (A4 - 3)



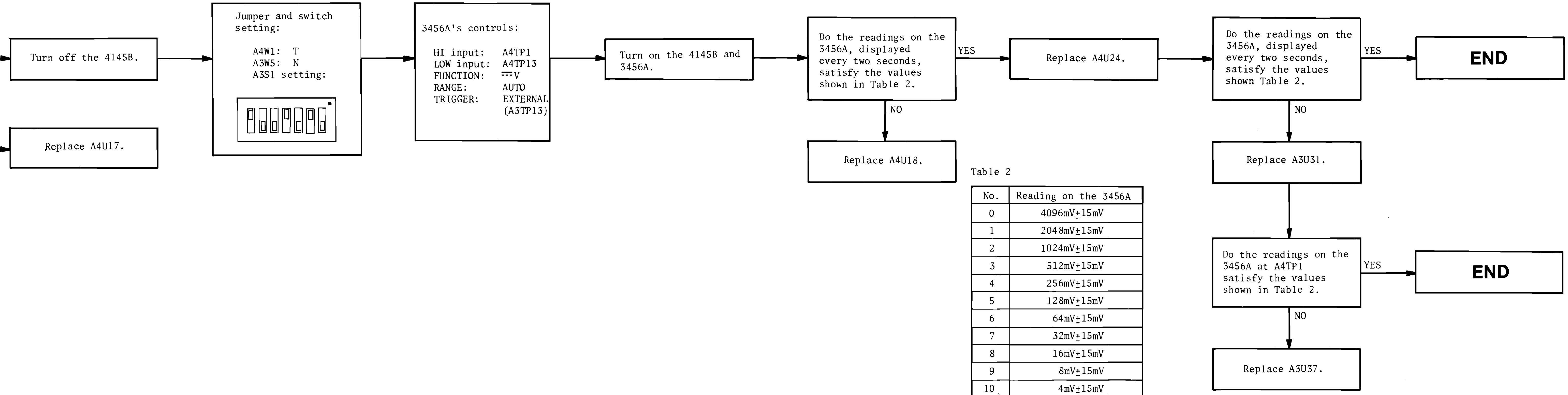
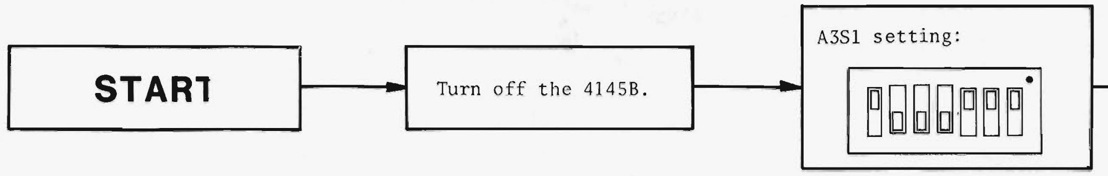
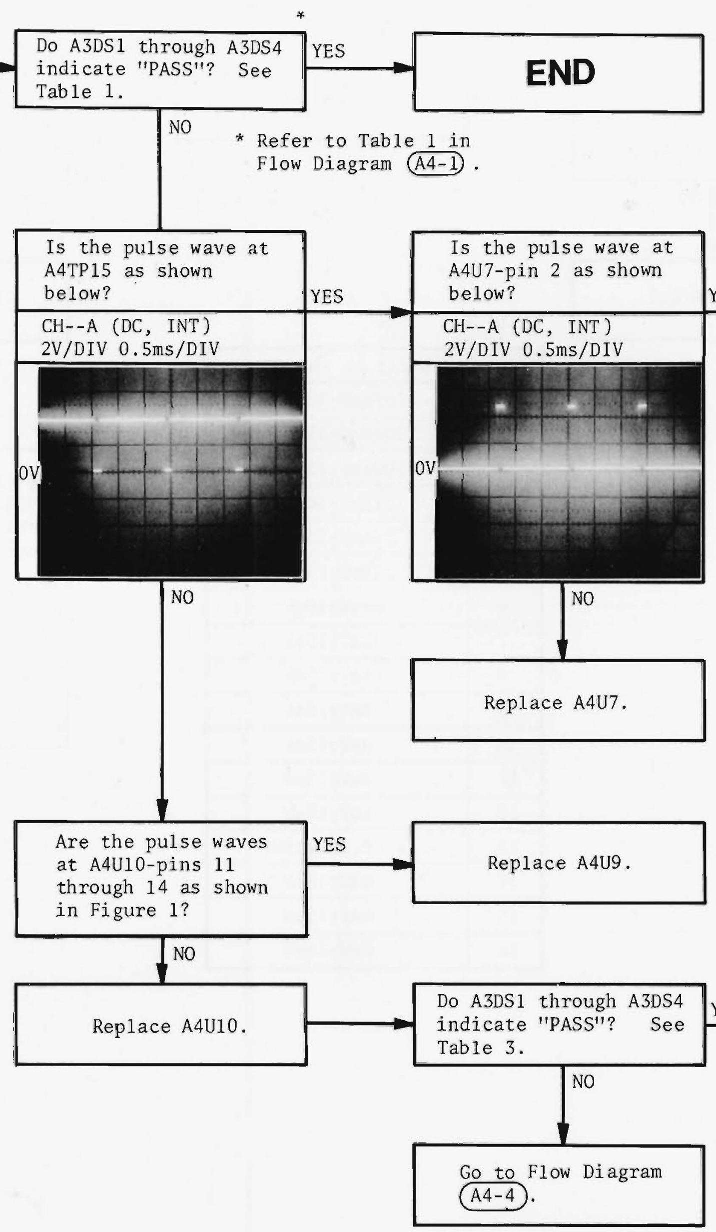


Table 2

No.	Reading on the 3456A
0	4096mV±15mV
1	2048mV±15mV
2	1024mV±15mV
3	512mV±15mV
4	256mV±15mV
5	128mV±15mV
6	64mV±15mV
7	32mV±15mV
8	16mV±15mV
9	8mV±15mV
10	4mV±15mV
11	2mV±15mV
12	1mV±15mV
13	0.5mV±15mV
14	0mV±15mV
15	0mV±15mV
16	0mV±15mV

Flow Diagram (A4 - 5)



START

Turn off the 4145B.

A3S1 setting:

Turn on the 4145B.

Do A3DS1 through A3DS4 indicate "PASS"? See Table 1. * — YES: END — NO:

* Refer to Table 1 in Flow Diagram (A4-1).

Is the pulse wave at A4TP15 as shown below? CH--A (DC, INT) 2V/DIV 0.5ms/DIV — YES: Is the pulse wave at A4U7-pin 2 as shown below? CH--A (DC, INT) 2V/DIV 0.5ms/DIV — NO: Replace A4U7.

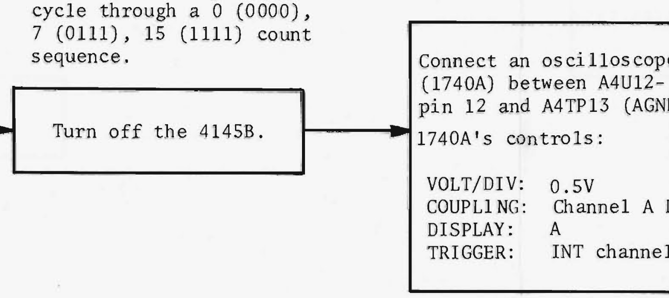
Is the pulse wave at A4TP15 as shown below? — NO: Are the pulse waves at A4U10-pins 11 through 14 as shown in Figure 1? — YES: Replace A4U9. — NO: Replace A4U10.

Replace A4U10. → Do A3DS1 through A3DS4 indicate "PASS"? See Table 3. — YES: END — NO: Go to Flow Diagram (A4-4).

Table 3

	LED Pattern			
	DS1	DS2	DS3	DS4
FAIL	●	●	●	●
PASS*	○	○	○	○

* The LEDs will repeatedly cycle through a 0 (0000), 7 (0111), 15 (1111) count sequence.


Is the pulse wave at A4U7-pin 2 as shown below? — YES: Turn off the 4145B. → Connect an oscilloscop (1740A) between A4U12- pin 12 and A4TP13 (AGN

1740A's controls:

VOLT/DIV: 0.5V
COUPLING: Channel A
DISPLAY: A
TRIGGER: INT channel

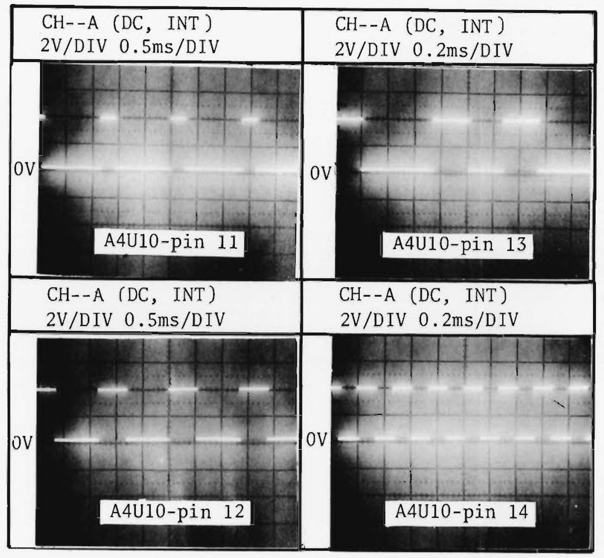


Figure 1.

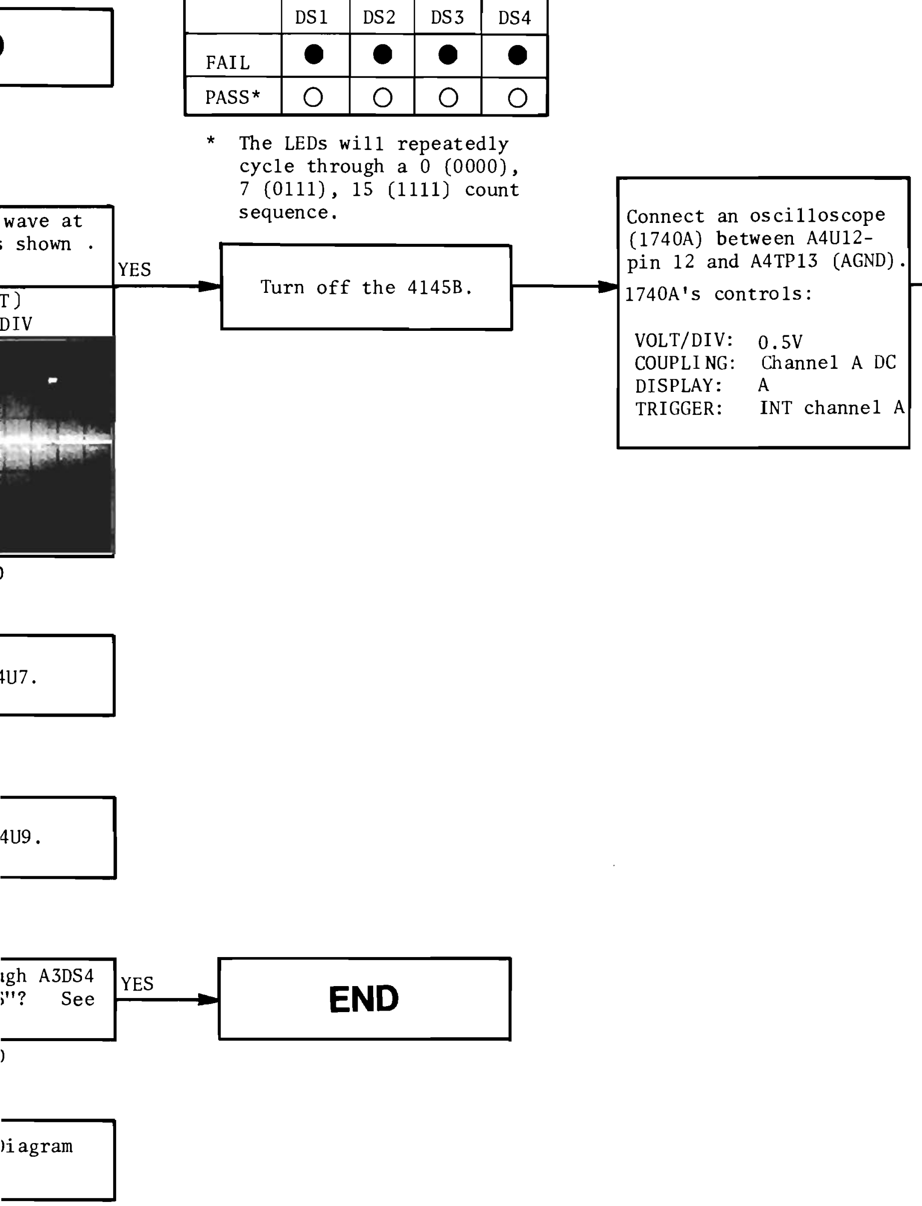
SEE

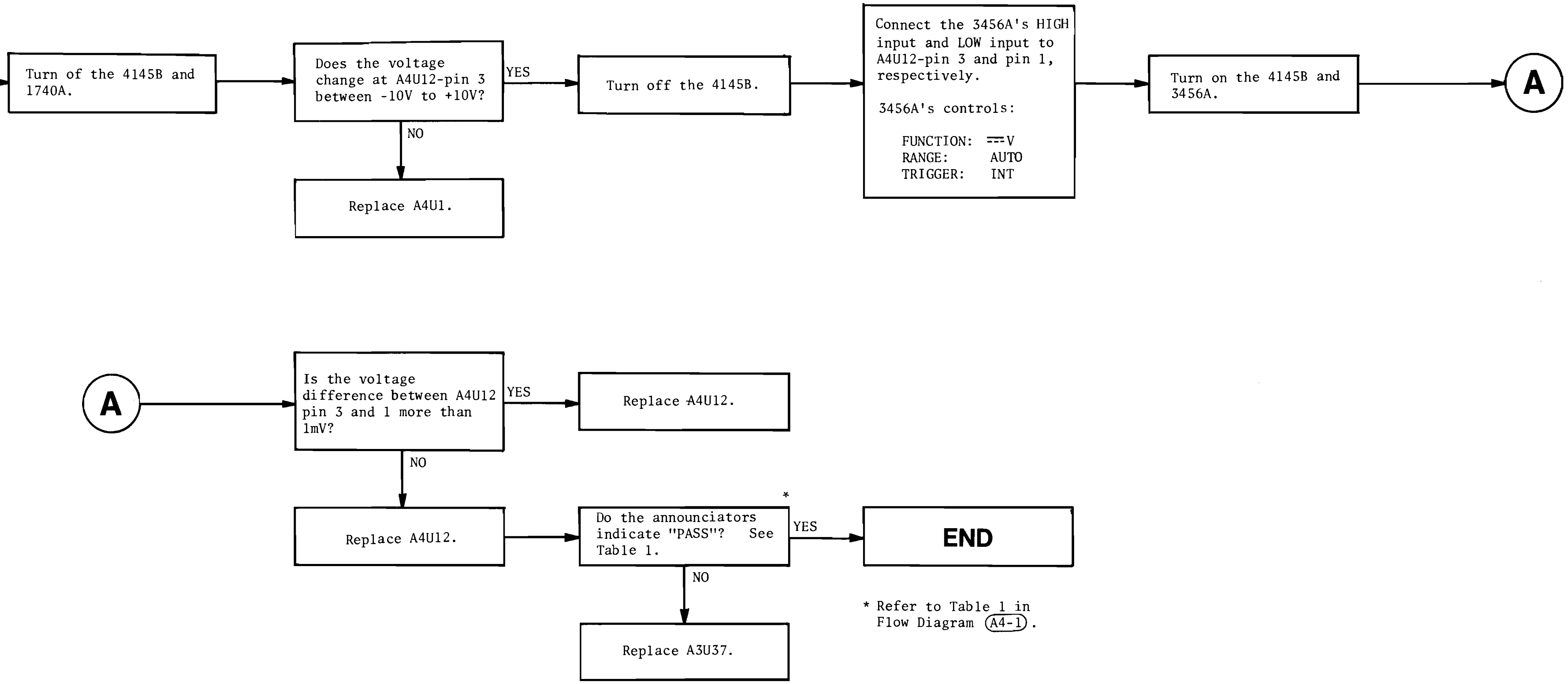
Fig

Table 3

	LED Pattern			
	DS1	DS2	DS3	DS4
FAIL	●	●	●	●
PASS*	○	○	○	○

* The LEDs will repeatedly cycle through a 0 (0000), 7 (0111), 15 (1111) count sequence.





A4 Troubleshooting Flow Diagram

SEE INSIDE

Figure 8-17. A4 Board Troubleshooting Flow Diagram (Sheet 3 of 5).

Figure 8-17. A4 Board Troubleshooting Flow Diagram (Sheet 4 of 5).

Flow Diagram (A4 - 6)

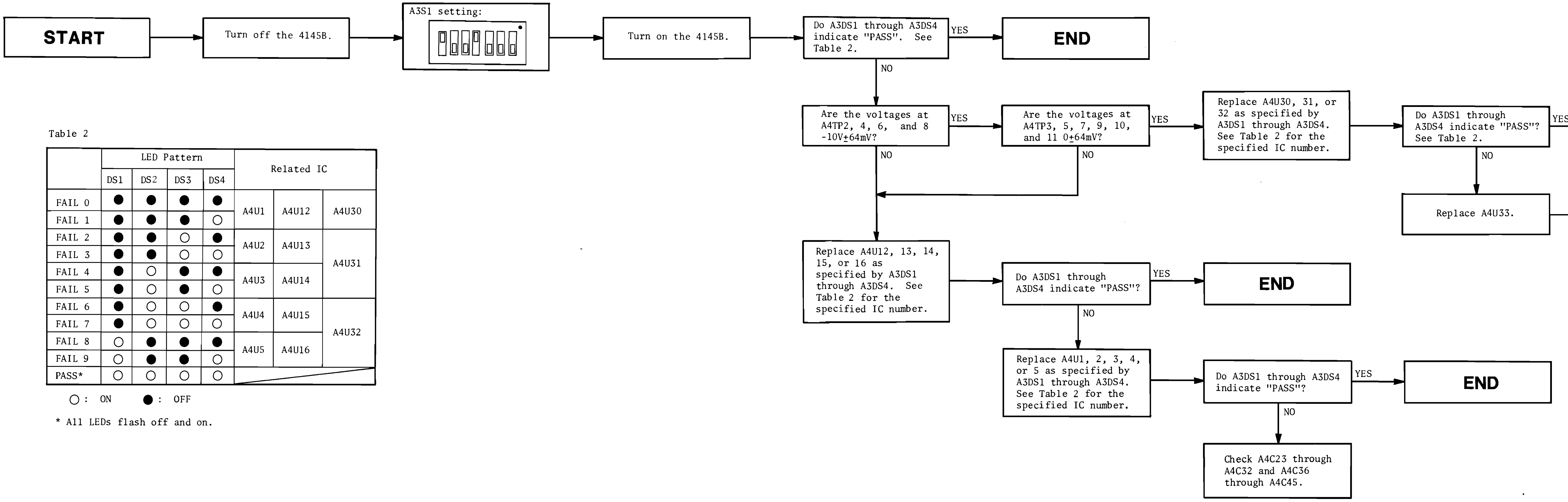
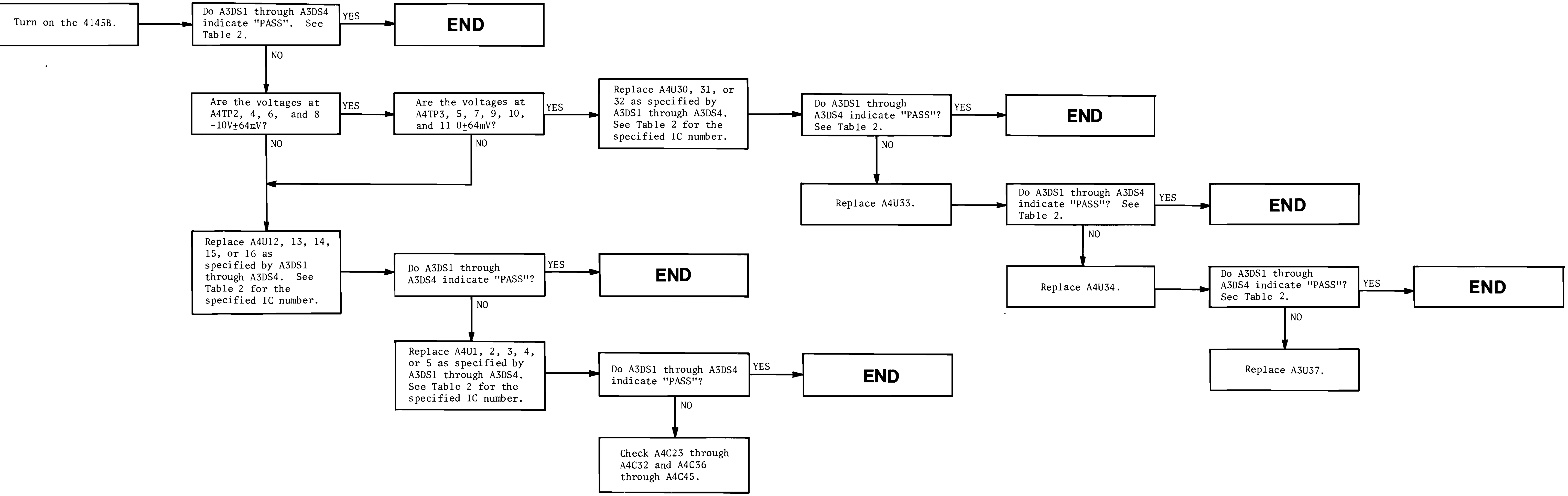


Table 2

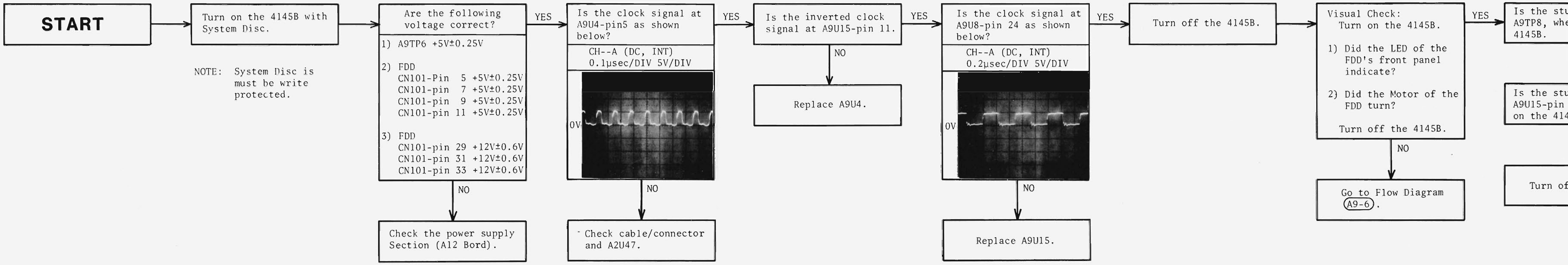
	LED Pattern				Related IC		
	DS1	DS2	DS3	DS4			
FAIL 0	●	●	●	●	A4U1	A4U12	A4U30
FAIL 1	●	●	●	○			
FAIL 2	●	●	○	●	A4U2	A4U13	A4U31
FAIL 3	●	●	○	○			
FAIL 4	●	○	●	●	A4U3	A4U14	
FAIL 5	●	○	●	○			
FAIL 6	●	○	○	●	A4U4	A4U15	A4U32
FAIL 7	●	○	○	○			
FAIL 8	○	●	●	●	A4U5	A4U16	
FAIL 9	○	●	●	○			
PASS*	○	○	○	○			

○ : ON ● : OFF

* All LEDs flash off and on.


Turn on the 4145B.
Do A3DS1 through A3DS4 indicate "PASS". See Table 2.
YES
END
NO
Are the voltages at A4TP2, 4, 6, and 8 -10V±64mV?
YES
Are the voltages at A4TP3, 5, 7, 9, 10, and 11 0±64mV?
YES
Replace A4U30, 31, or 32 as specified by A3DS1 through A3DS4. See Table 2 for the specified IC number.
Do A3DS1 through A3DS4 indicate "PASS"? See Table 2.
YES
END
NO
Replace A4U33.
Do A3DS1 through A3DS4 indicate "PASS"? See Table 2.
YES
END
NO
Replace A4U34.
Do A3DS1 through A3DS4 indicate "PASS"? See Table 2.
YES
END
NO
Replace A3U37.
NO
NO
Replace A4U12, 13, 14, 15, or 16 as specified by A3DS1 through A3DS4. See Table 2 for the specified IC number.
Do A3DS1 through A3DS4 indicate "PASS"?
YES
END
NO
Replace A4U1, 2, 3, 4, or 5 as specified by A3DS1 through A3DS4. See Table 2 for the specified IC number.
Do A3DS1 through A3DS4 indicate "PASS"?
YES
END
NO
Check A4C23 through A4C32 and A4C36 through A4C45.

Flow Diagram (A9 - 1)



START

Turn on the 4145B with System Disc.

NOTE: System Disc is must be write protected.

Are the following voltage correct?

1) A9TP6 +5V±0.25V

2) FDD
   CN101-Pin 5 +5V±0.25V
   CN101-pin 7 +5V±0.25V
   CN101-pin 9 +5V±0.25V
   CN101-pin 11 +5V±0.25V

3) FDD
   CN101-pin 29 +12V±0.6V
   CN101-pin 31 +12V±0.6V
   CN101-pin 33 +12V±0.6V

Check the power supply Section (A12 Bord).

Is the clock signal at A9U4-pin5 as shown below?

CH--A (DC, INT)
0.1μsec/DIV 5V/DIV

Check cable/connector and A2U47.

Is the inverted clock signal at A9U15-pin 11.

Replace A9U4.

Is the clock signal at A9U8-pin 24 as shown below?

CH--A (DC, INT)
0.2μsec/DIV 5V/DIV

Replace A9U15.

Turn off the 4145B.

Visual Check:
Turn on the 4145B.

1) Did the LED of the FDD's front panel indicate?

2) Did the Motor of the FDD turn?

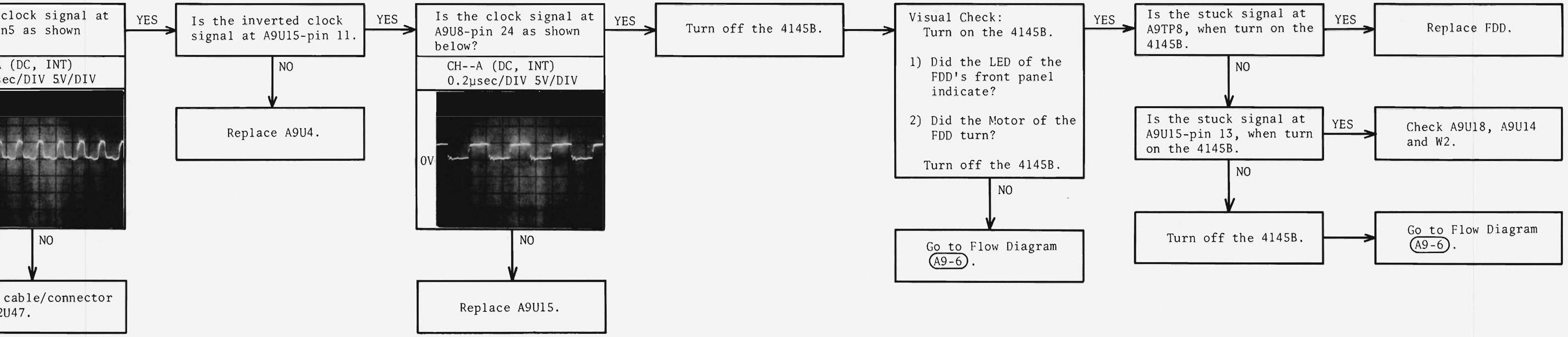
Turn off the 4145B.

Go to Flow Diagram (A9-6).

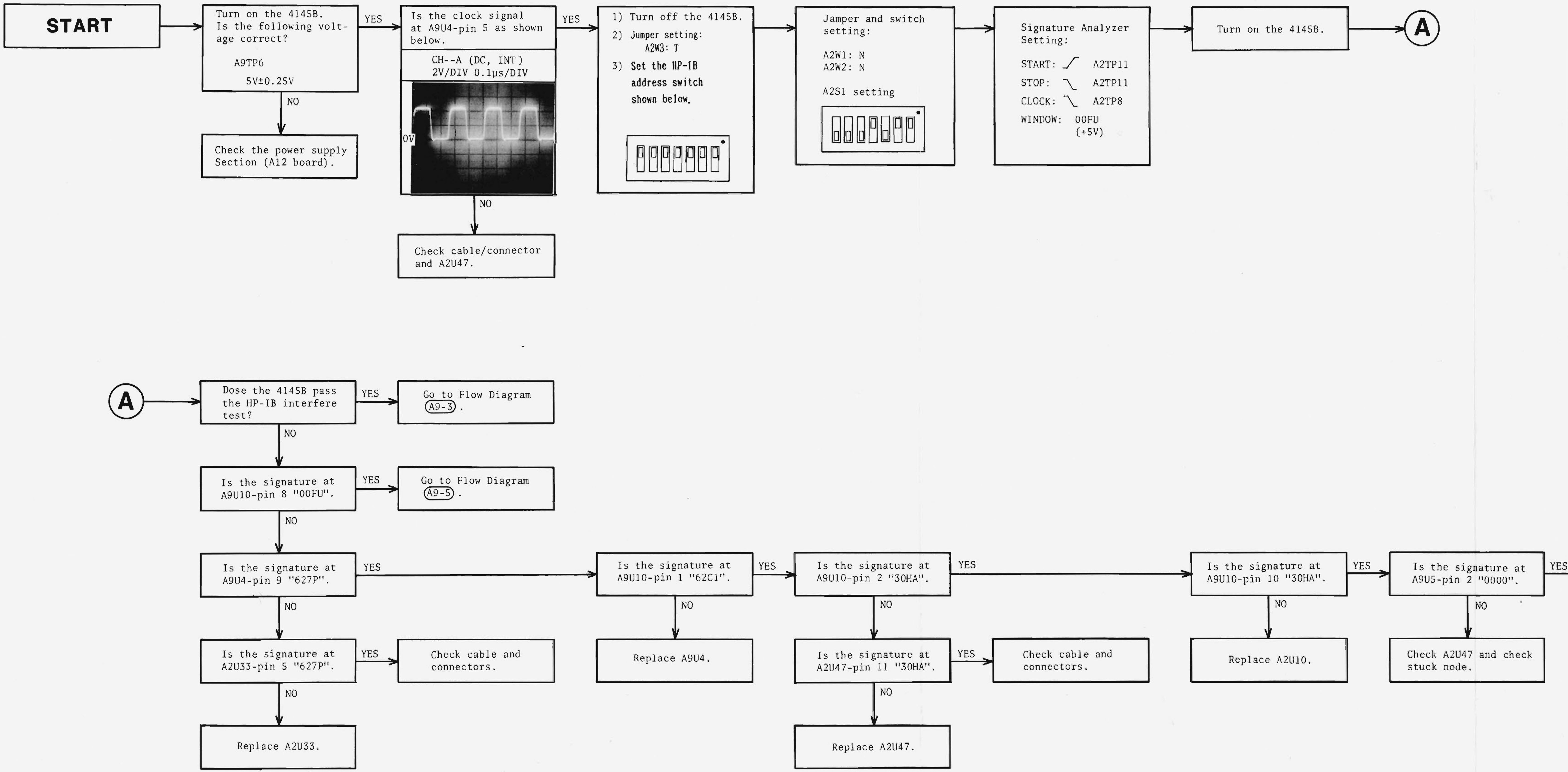
Is the stu
A9TP8, whe
4145B.

Is the stu
A9U15-pin
on the 414

Turn of


clock signal at
n5 as shown
(DC, INT)
ec/DIV 5V/DIV
YES
NO
cable/connector
2U47.
Is the inverted clock signal at A9U15-pin 11.
YES
NO
Replace A9U4.
Is the clock signal at A9U8-pin 24 as shown below?
CH--A (DC, INT)
0.2μsec/DIV 5V/DIV
0V
YES
NO
Replace A9U15.
Turn off the 4145B.
Visual Check:
Turn on the 4145B.
1) Did the LED of the FDD's front panel indicate?
2) Did the Motor of the FDD turn?
Turn off the 4145B.
YES
NO
Go to Flow Diagram A9-6.
Is the stuck signal at A9TP8, when turn on the 4145B.
YES
Replace FDD.
NO
Is the stuck signal at A9U15-pin 13, when turn on the 4145B.
YES
Check A9U18, A9U14 and W2.
NO
Turn off the 4145B.
Go to Flow Diagram A9-6.

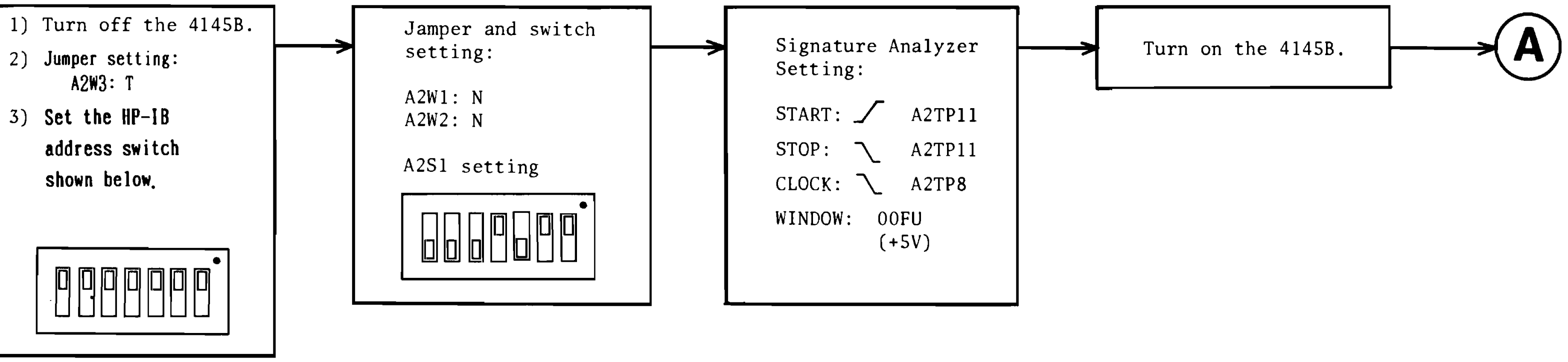
Flow Diagram (A9 - 2)

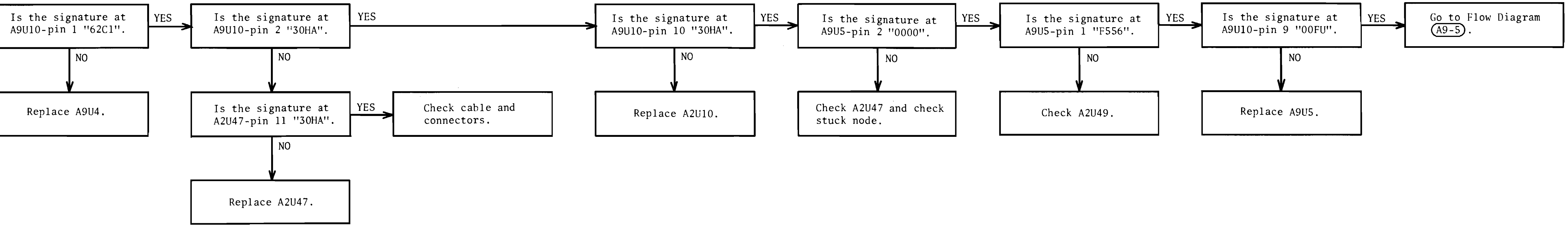


A9 Troubleshooting Flow Diagram

SEE INSIDE

Figure 8-18. A9 Board Troubleshooting Flow Diagram (Sheet 1 of 11).





A9 Troubleshooting Flow Diagram

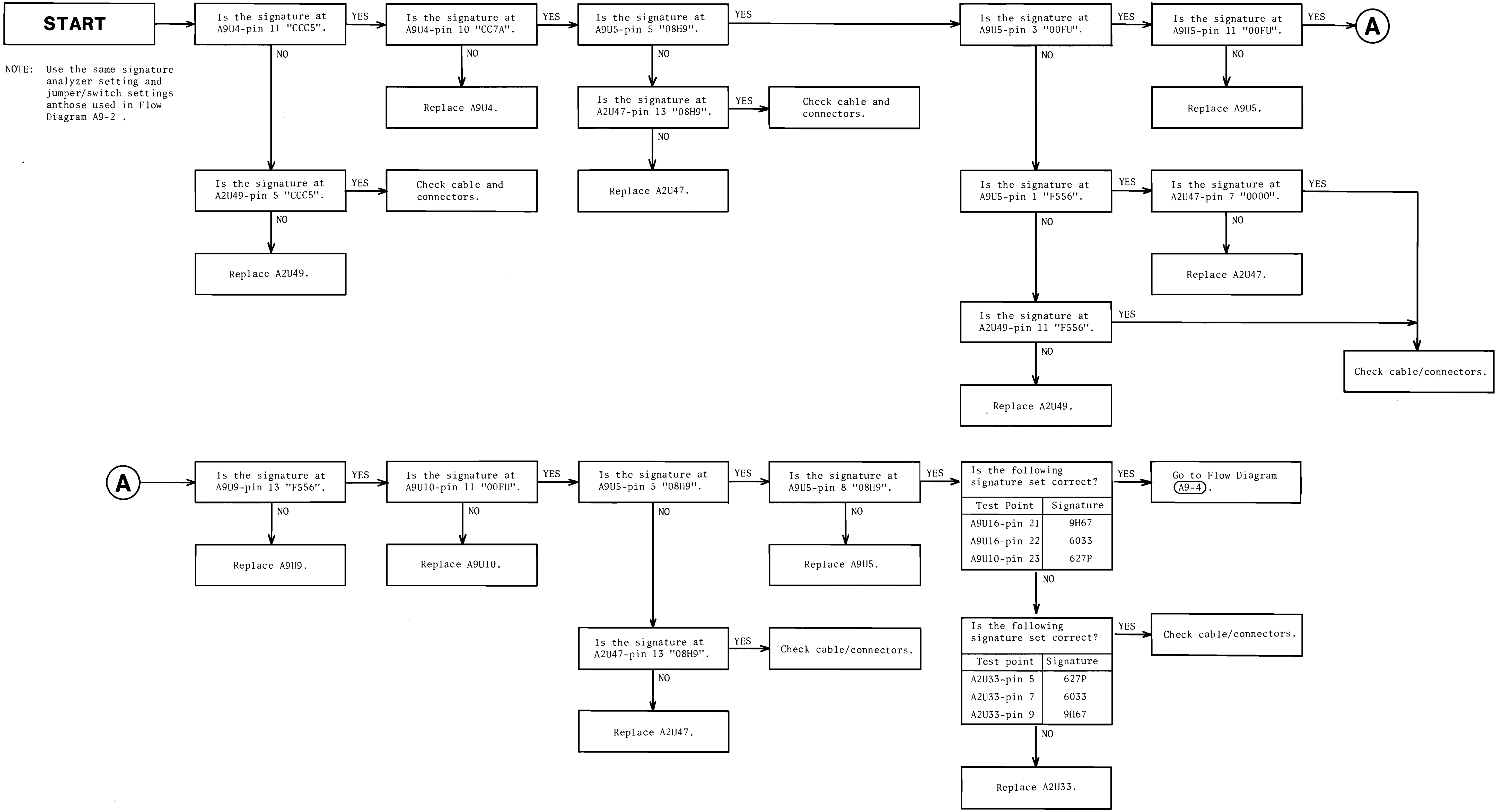
SEE INSIDE

Figure 8-18. A9 Board Troubleshooting Flow Diagram (Sheet 1 of 11).

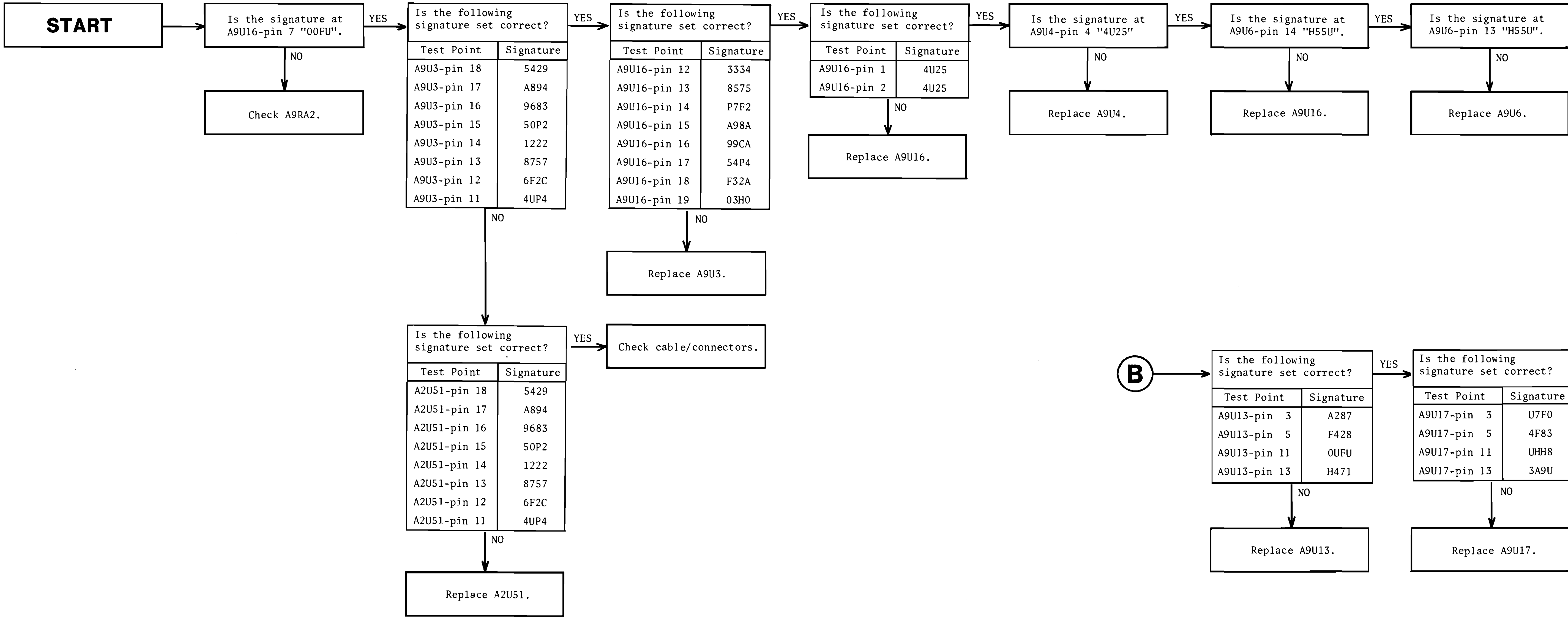
Figure 8-18. A9 Board Troubleshooting Flow Diagram (Sheet 2 of 11).

Flow Diagram (A9 - 3)

NOTE: Use the same signature analyzer setting and jumper/switch settings anthose used in Flow Diagram A9-2 .



Flow Diagram (A9 - 4)



Test Point	Signature
A9U3-pin 18	5429
A9U3-pin 17	A894
A9U3-pin 16	9683
A9U3-pin 15	50P2
A9U3-pin 14	1222
A9U3-pin 13	8757
A9U3-pin 12	6F2C
A9U3-pin 11	4UP4

Test Point	Signature
A9U16-pin 12	3334
A9U16-pin 13	8575
A9U16-pin 14	P7F2
A9U16-pin 15	A98A
A9U16-pin 16	99CA
A9U16-pin 17	54P4
A9U16-pin 18	F32A
A9U16-pin 19	03H0

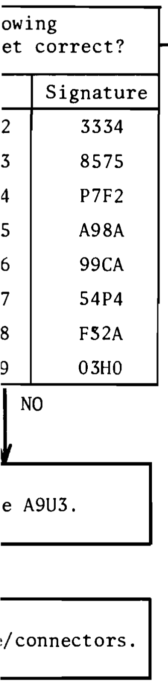
Test Point	Signature
A9U16-pin 1	4U25
A9U16-pin 2	4U25

Test Point	Signature
A2U51-pin 18	5429
A2U51-pin 17	A894
A2U51-pin 16	9683
A2U51-pin 15	50P2
A2U51-pin 14	1222
A2U51-pin 13	8757
A2U51-pin 12	6F2C
A2U51-pin 11	4UP4

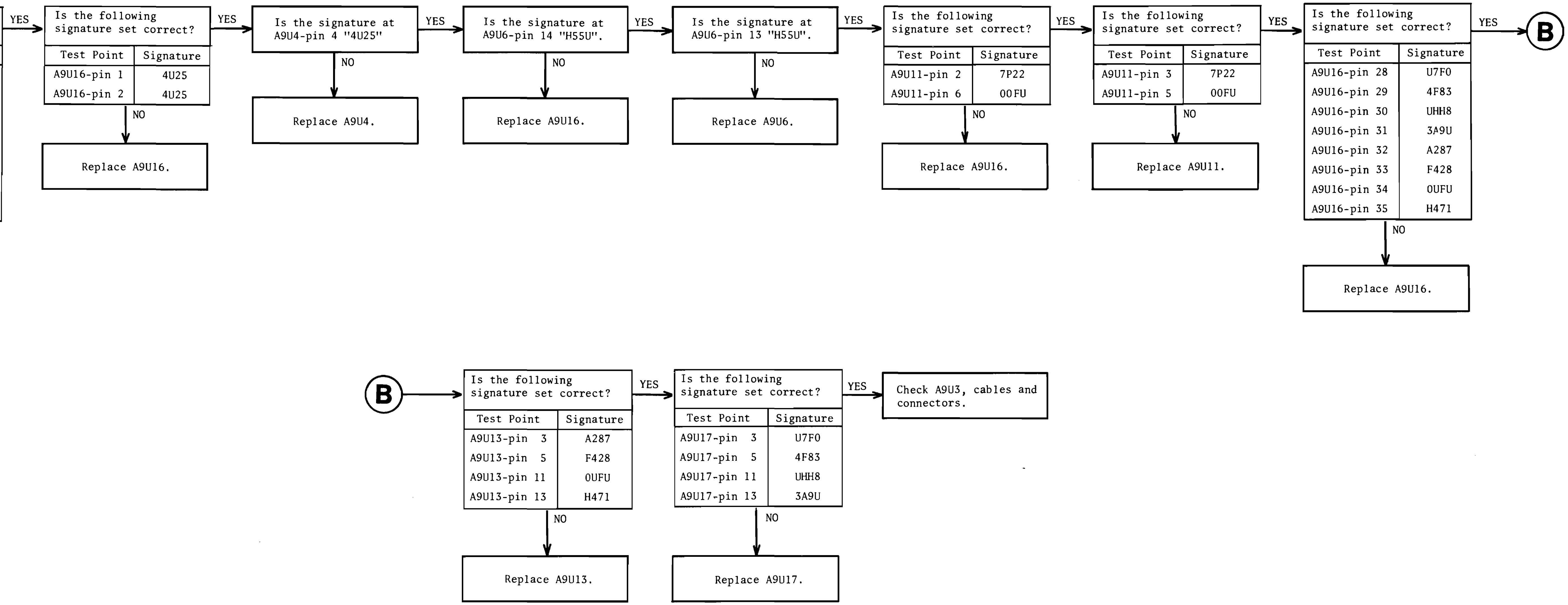
Test Point	Signature
A9U13-pin 3	A287
A9U13-pin 5	F428
A9U13-pin 11	0UFU
A9U13-pin 13	H471

Test Point	Signature
A9U17-pin 3	U7F0
A9U17-pin 5	4F83
A9U17-pin 11	UHH8
A9U17-pin 13	3A9U

Figure 8-18. A9 Board Troubleshooting Flow Diagram (Sheet 3 of 11).



	Signature
2	3334
3	8575
4	P7F2
5	A98A
6	99CA
7	54P4
8	F52A
9	03H0



Is the following signature set correct?

Test Point	Signature
A9U16-pin 1	4U25
A9U16-pin 2	4U25

YES → Is the signature at A9U4-pin 4 "4U25"

NO → Replace A9U16.

YES → Is the signature at A9U6-pin 14 "H55U".

NO → Replace A9U4.

YES → Is the signature at A9U6-pin 13 "H55U".

NO → Replace A9U16.

YES → Is the following signature set correct?

NO → Replace A9U6.

Test Point	Signature
A9U11-pin 2	7P22
A9U11-pin 6	00FU

NO → Replace A9U16.

YES → Is the following signature set correct?

Test Point	Signature
A9U11-pin 3	7P22
A9U11-pin 5	00FU

NO → Replace A9U11.

YES → Is the following signature set correct?

Test Point	Signature
A9U16-pin 28	U7F0
A9U16-pin 29	4F83
A9U16-pin 30	UHH8
A9U16-pin 31	3A9U
A9U16-pin 32	A287
A9U16-pin 33	F428
A9U16-pin 34	0UFU
A9U16-pin 35	H471

NO → Replace A9U16.

YES → B

B → Is the following signature set correct?

Test Point	Signature
A9U13-pin 3	A287
A9U13-pin 5	F428
A9U13-pin 11	0UFU
A9U13-pin 13	H471

NO → Replace A9U13.

YES → Is the following signature set correct?

Test Point	Signature
A9U17-pin 3	U7F0
A9U17-pin 5	4F83
A9U17-pin 11	UHH8
A9U17-pin 13	3A9U

NO → Replace A9U17.

YES → Check A9U3, cables and connectors.

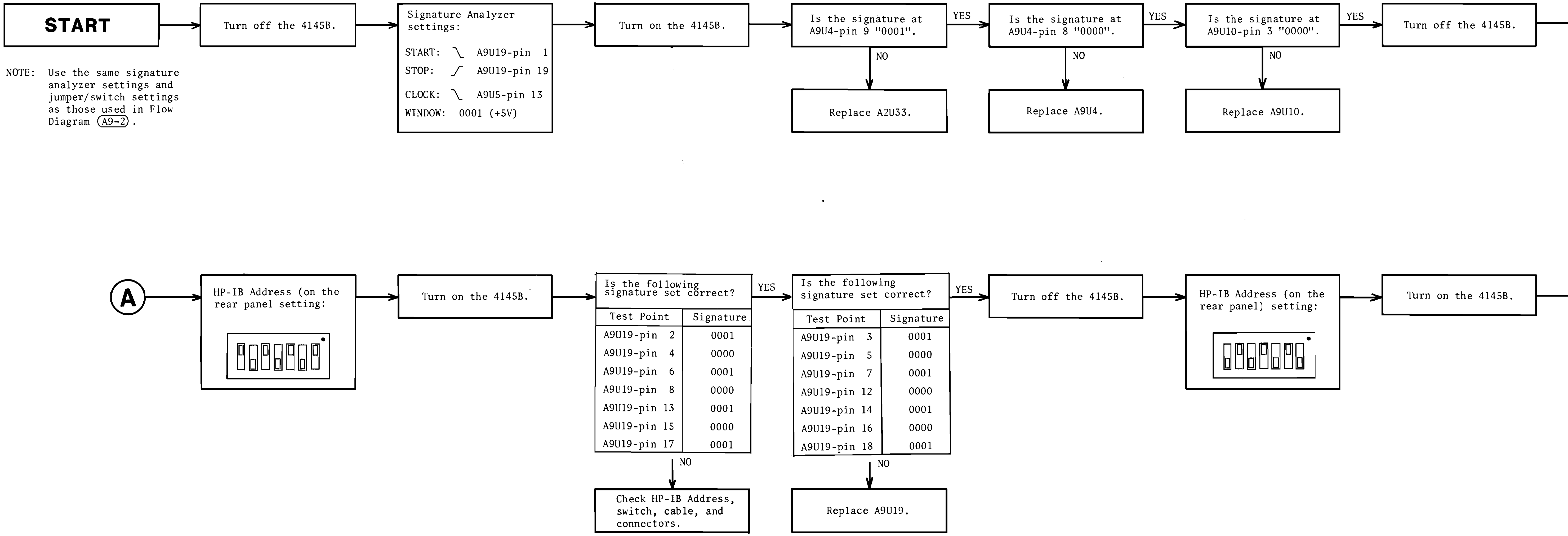
A9 Troubleshooting Flow Diagram

SEE INSIDE

Figure 8-18. A9 Board Troubleshooting Flow Diagram (Sheet 3 of 11).

Figure 8-18. A9 Board Troubleshooting Flow Diagram (Sheet 4 of 11).

Flow Diagram (A9-5)



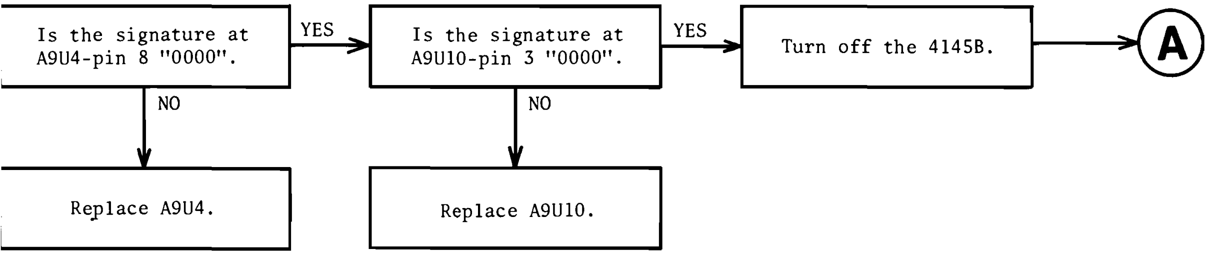
NOTE: Use the same signature analyzer settings and jumper/switch settings as those used in Flow Diagram (A9-2).

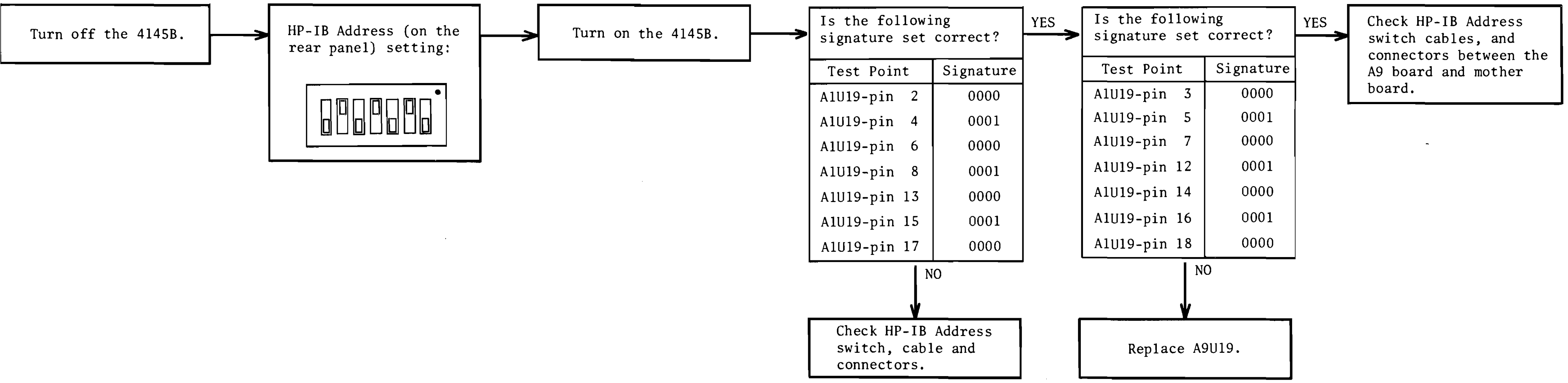
Is the following signature set correct?

Test Point	Signature
A9U19-pin 2	0001
A9U19-pin 4	0000
A9U19-pin 6	0001
A9U19-pin 8	0000
A9U19-pin 13	0001
A9U19-pin 15	0000
A9U19-pin 17	0001

Is the following signature set correct?

Test Point	Signature
A9U19-pin 3	0001
A9U19-pin 5	0000
A9U19-pin 7	0001
A9U19-pin 12	0000
A9U19-pin 14	0001
A9U19-pin 16	0000
A9U19-pin 18	0001

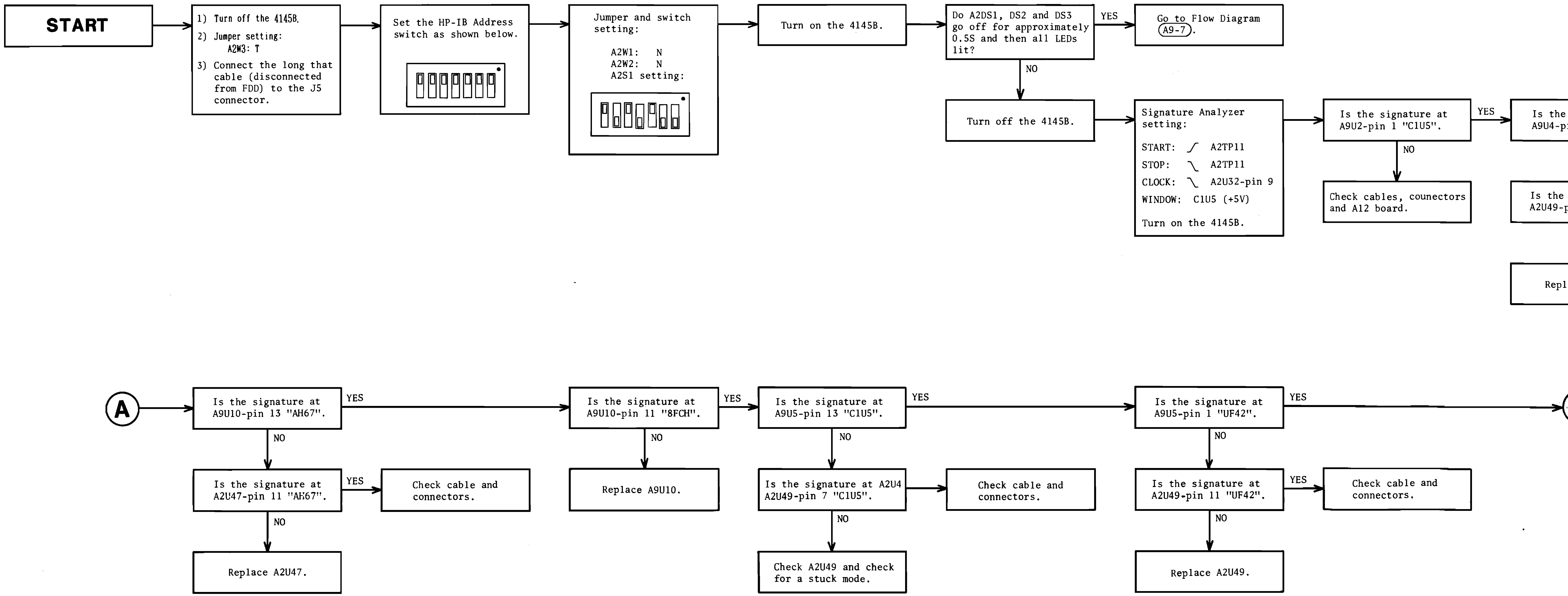




Test Point	Signature
A1U19-pin 2	0000
A1U19-pin 4	0001
A1U19-pin 6	0000
A1U19-pin 8	0001
A1U19-pin 13	0000
A1U19-pin 15	0001
A1U19-pin 17	0000

Test Point	Signature
A1U19-pin 3	0000
A1U19-pin 5	0001
A1U19-pin 7	0000
A1U19-pin 12	0001
A1U19-pin 14	0000
A1U19-pin 16	0001
A1U19-pin 18	0000

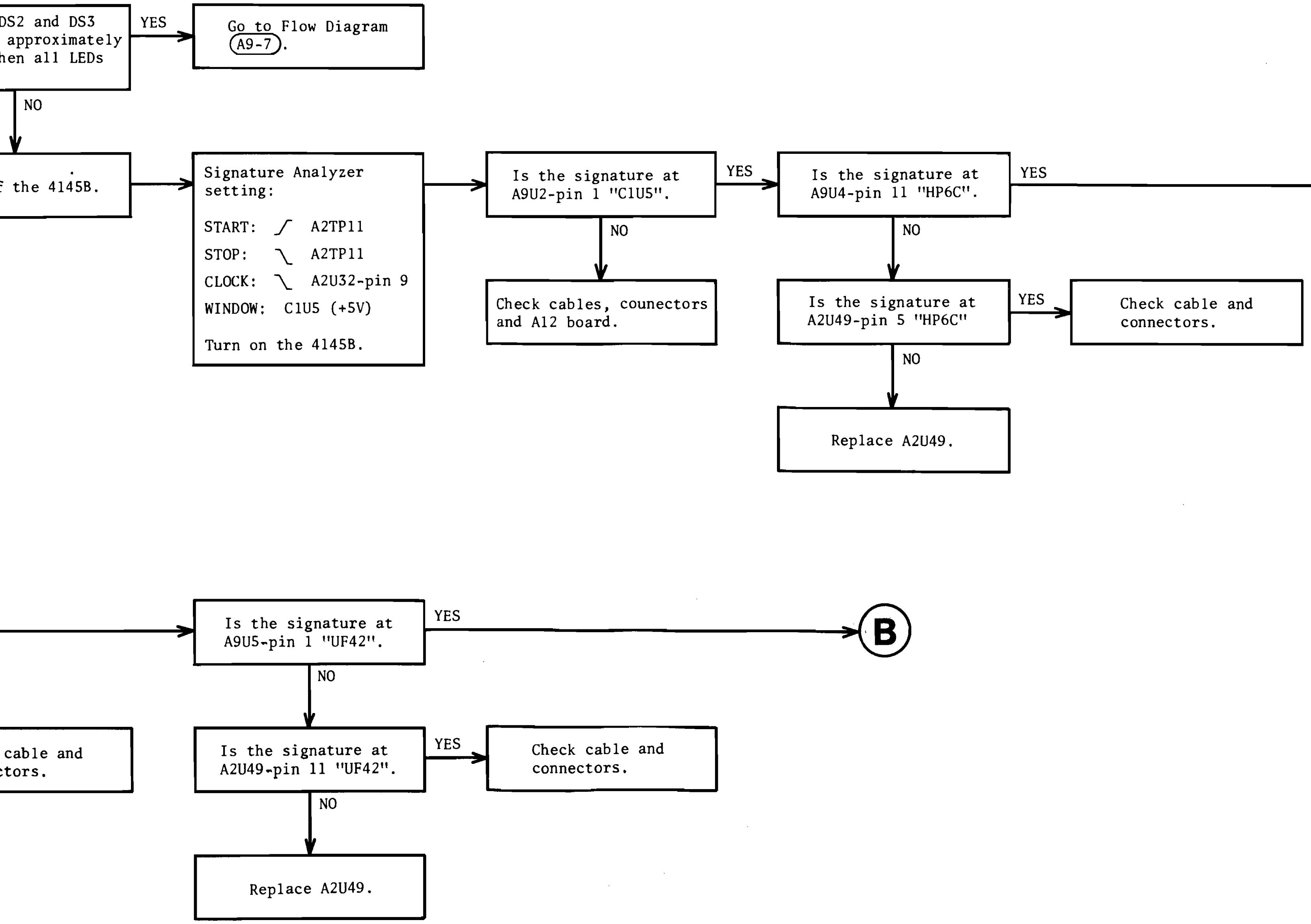
Flow Diagram (A9 - 6)



A9 Troubleshoo

SEE INSIDE

Figure 8-18. A9 Board Troub



A9 Troubleshooting Flow Diagram

SEE INSIDE

Figure 8-18. A9 Board Troubleshooting Flow Diagram (Sheet 5 of 11).

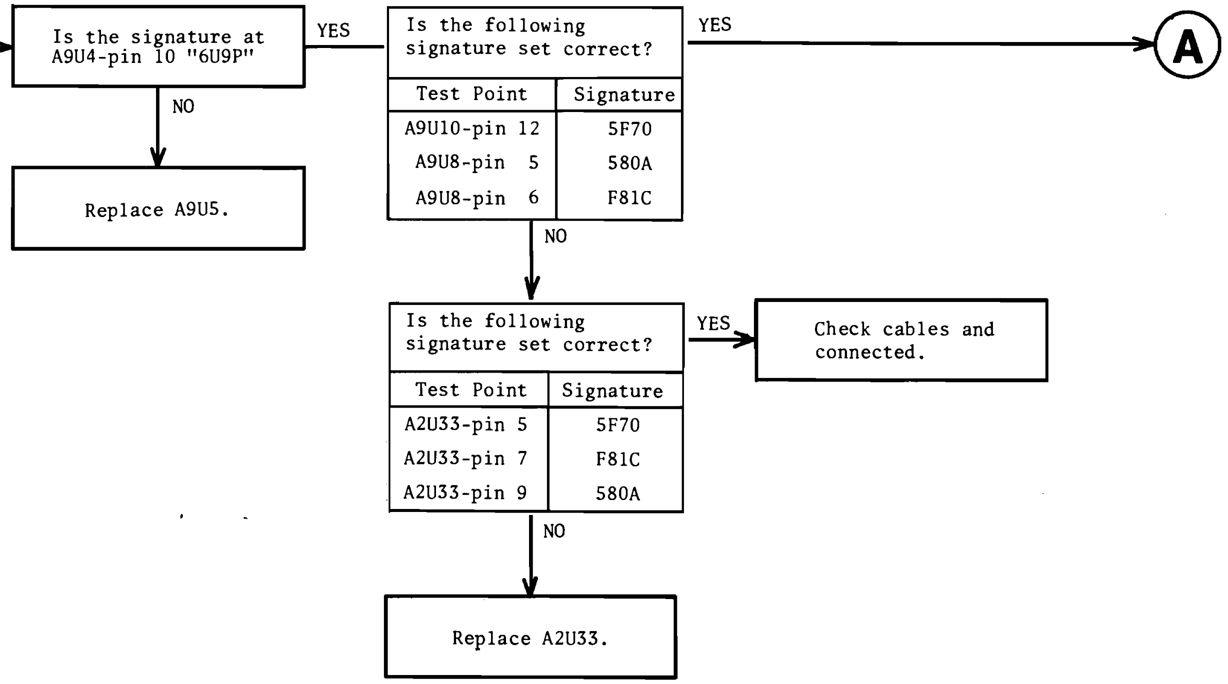
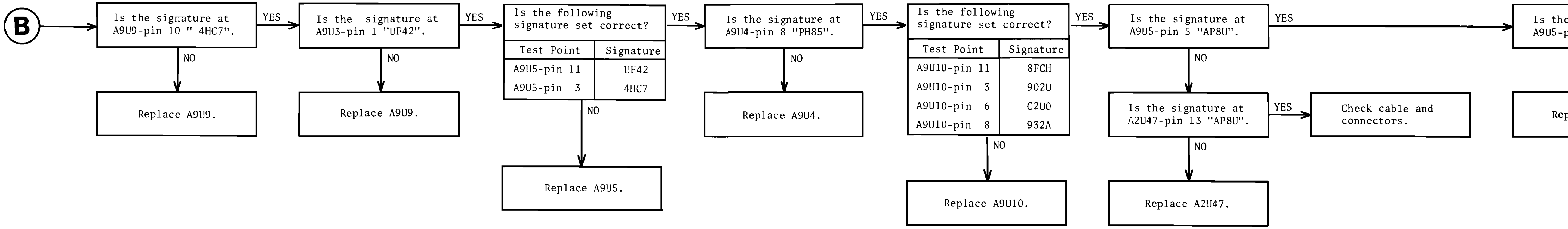
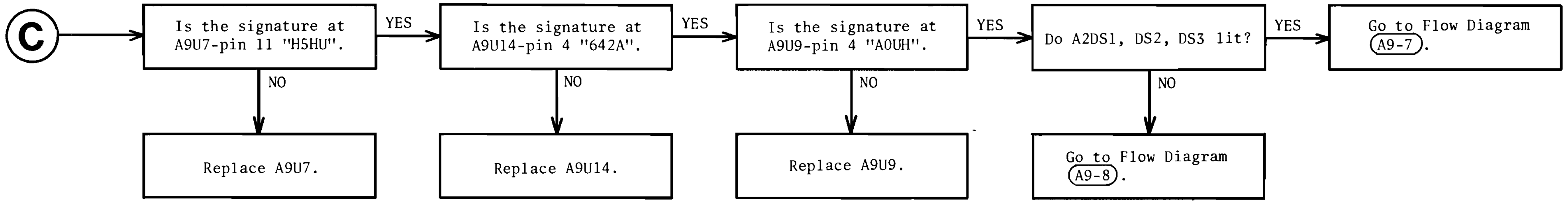
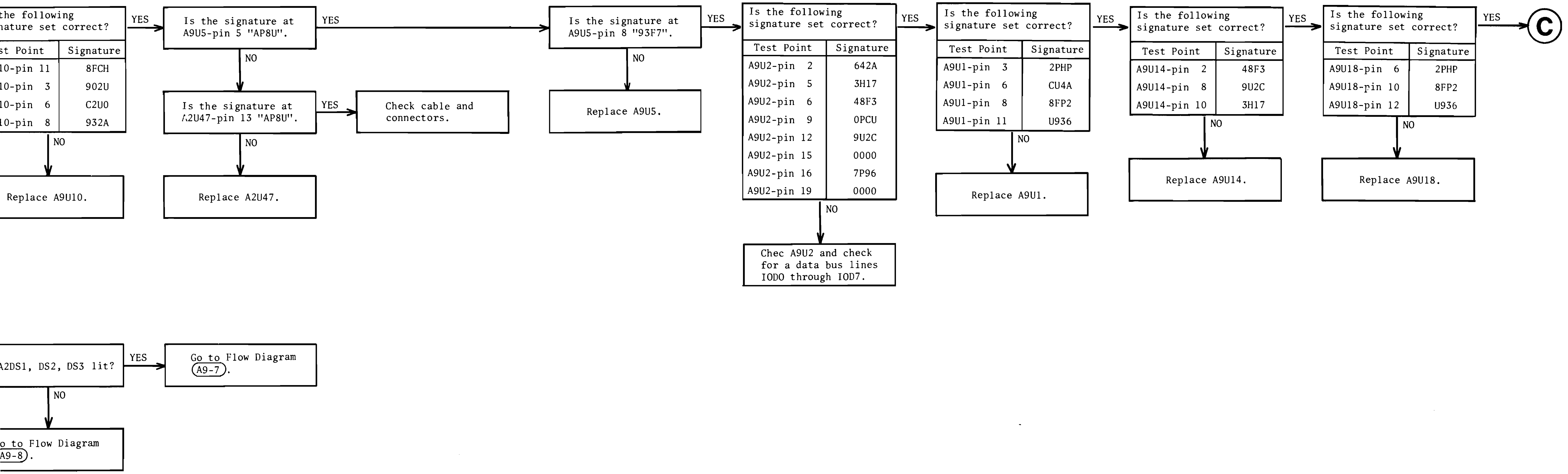


Figure 8-18. A9 Board Troubleshooting Flow Diagram (Sheet 6 of 11).


B
Is the signature at A9U9-pin 10 " 4HC7".
YES
NO
Replace A9U9.
Is the signature at A9U3-pin 1 "UF42".
YES
NO
Replace A9U9.
Is the following signature set correct?
Test Point
Signature
A9U5-pin 11
UF42
A9U5-pin 3
4HC7
YES
NO
Replace A9U5.
Is the signature at A9U4-pin 8 "PH85".
YES
NO
Replace A9U4.
Is the following signature set correct?
Test Point
Signature
A9U10-pin 11
8FCH
A9U10-pin 3
902U
A9U10-pin 6
C2U0
A9U10-pin 8
932A
YES
NO
Replace A9U10.
Is the signature at A9U5-pin 5 "AP8U".
YES
NO
Is the signature at A2U47-pin 13 "AP8U".
YES
Check cable and connectors.
NO
Replace A2U47.
Is the
A9U5-p
Rep


C
Is the signature at A9U7-pin 11 "H5HU".
YES
NO
Replace A9U7.
Is the signature at A9U14-pin 4 "642A".
YES
NO
Replace A9U14.
Is the signature at A9U9-pin 4 "A0UH".
YES
NO
Replace A9U9.
Do A2DS1, DS2, DS3 lit?
YES
Go to Flow Diagram (A9-7).
NO
Go to Flow Diagram (A9-8).



st Point	Signature
10-pin 11	8FCH
10-pin 3	902U
10-pin 6	C2U0
10-pin 8	932A

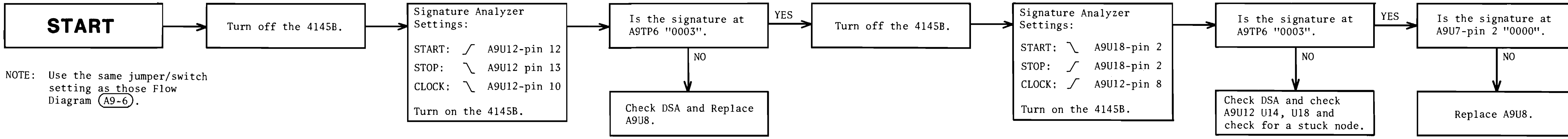
Test Point	Signature
A9U2-pin 2	642A
A9U2-pin 5	3H17
A9U2-pin 6	48F3
A9U2-pin 9	0PCU
A9U2-pin 12	9U2C
A9U2-pin 15	0000
A9U2-pin 16	7P96
A9U2-pin 19	0000

Test Point	Signature
A9U1-pin 3	2PHP
A9U1-pin 6	CU4A
A9U1-pin 8	8FP2
A9U1-pin 11	U936

Test Point	Signature
A9U14-pin 2	48F3
A9U14-pin 8	9U2C
A9U14-pin 10	3H17

Test Point	Signature
A9U18-pin 6	2PHP
A9U18-pin 10	8FP2
A9U18-pin 12	U936

Flow Diagram (A9 - 7)

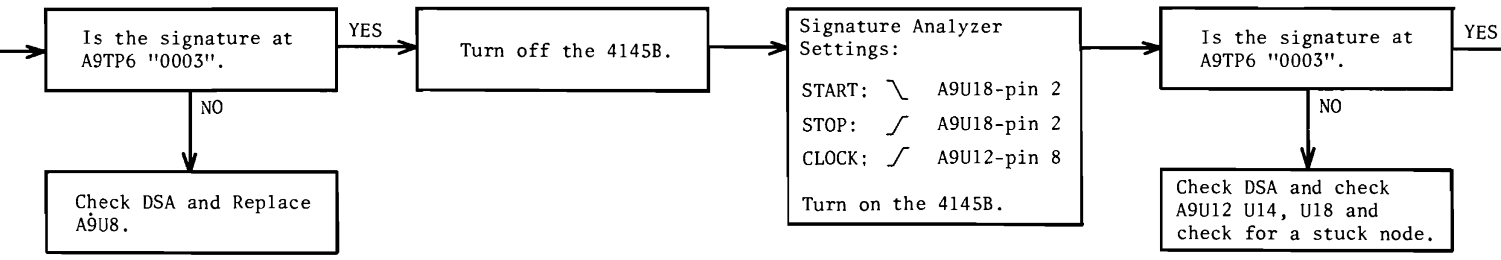


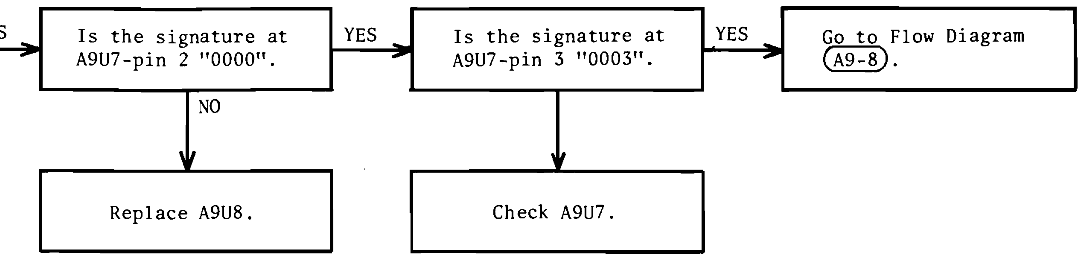
NOTE: Use the same jumper/switch setting as those Flow Diagram (A9-6).

A9 Troubleshooting Flow Diagram

SEE INSIDE

Figure 8-18. A9 Board Troubleshooting Flow Diagram (Sheet 7 of 11).





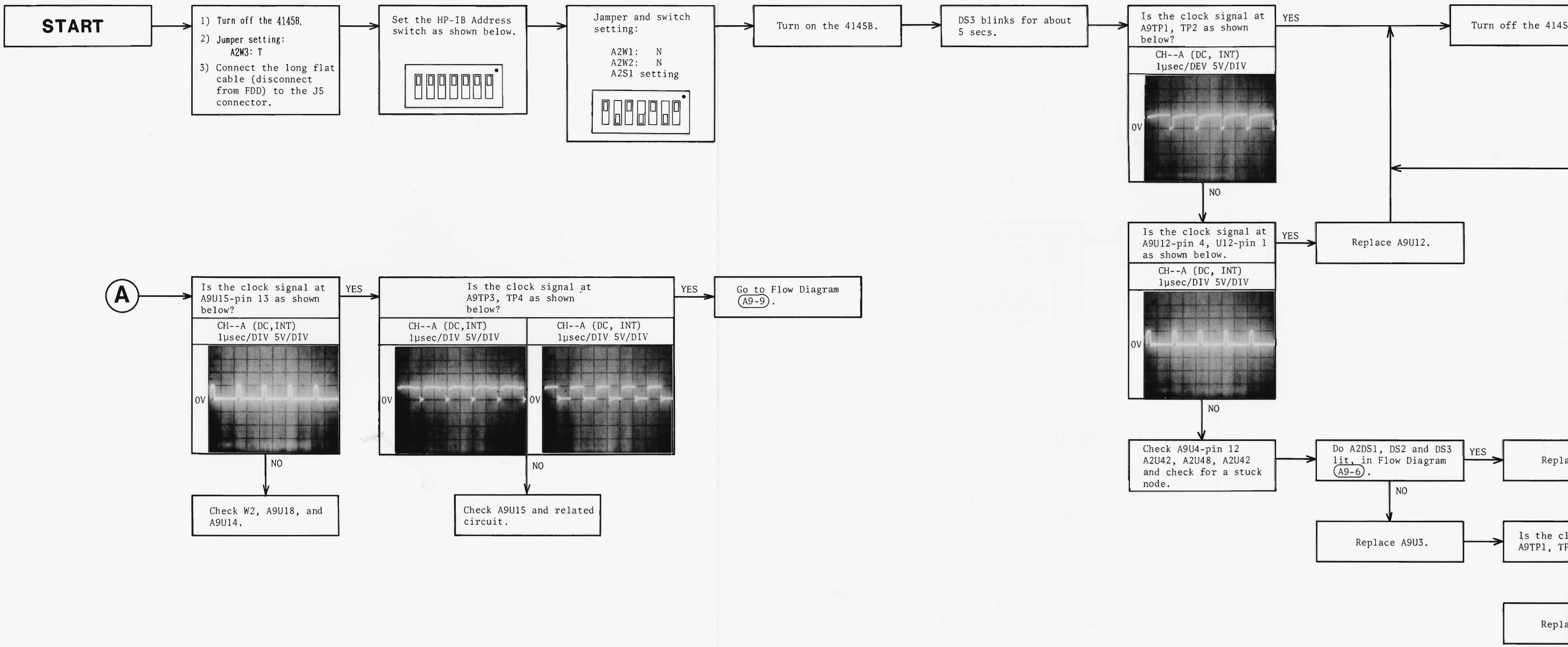
A9 Troubleshooting Flow Diagram

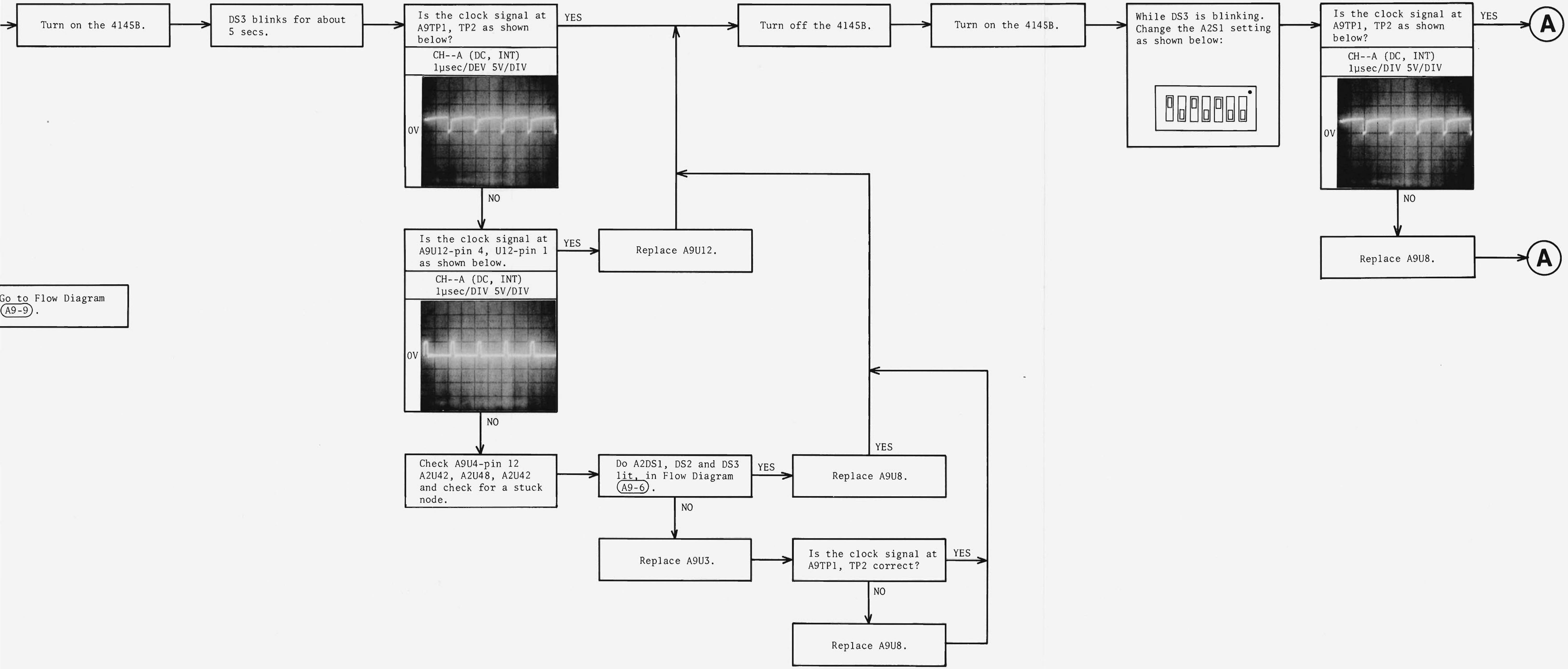
SEE INSIDE

Figure 8-18. A9 Board Troubleshooting Flow Diagram (Sheet 7 of 11).

Figure 8-18. A9 Board Troubleshooting Flow Diagram (Sheet 8 of 11).

Flow Diagram (A9 - 8)




Turn on the 4145B.
DS3 blinks for about 5 secs.
Is the clock signal at A9TP1, TP2 as shown below?
CH--A (DC, INT) 1μsec/DEV 5V/DIV
0V
YES
NO
Turn off the 4145B.
Turn on the 4145B.
While DS3 is blinking. Change the A2S1 setting as shown below:
Is the clock signal at A9TP1, TP2 as shown below?
CH--A (DC, INT) 1μsec/DIV 5V/DIV
0V
YES
A
NO
Replace A9U8.
A
Is the clock signal at A9U12-pin 4, U12-pin 1 as shown below.
CH--A (DC, INT) 1μsec/DIV 5V/DIV
0V
YES
Replace A9U12.
NO
Go to Flow Diagram (A9-9).
Check A9U4-pin 12 A2U42, A2U48, A2U42 and check for a stuck node.
Do A2DS1, DS2 and DS3 lit, in Flow Diagram (A9-6).
YES
Replace A9U8.
YES
NO
Replace A9U3.
Is the clock signal at A9TP1, TP2 correct?
YES
NO
Replace A9U8.

Flow Diagram (A9 - 9)

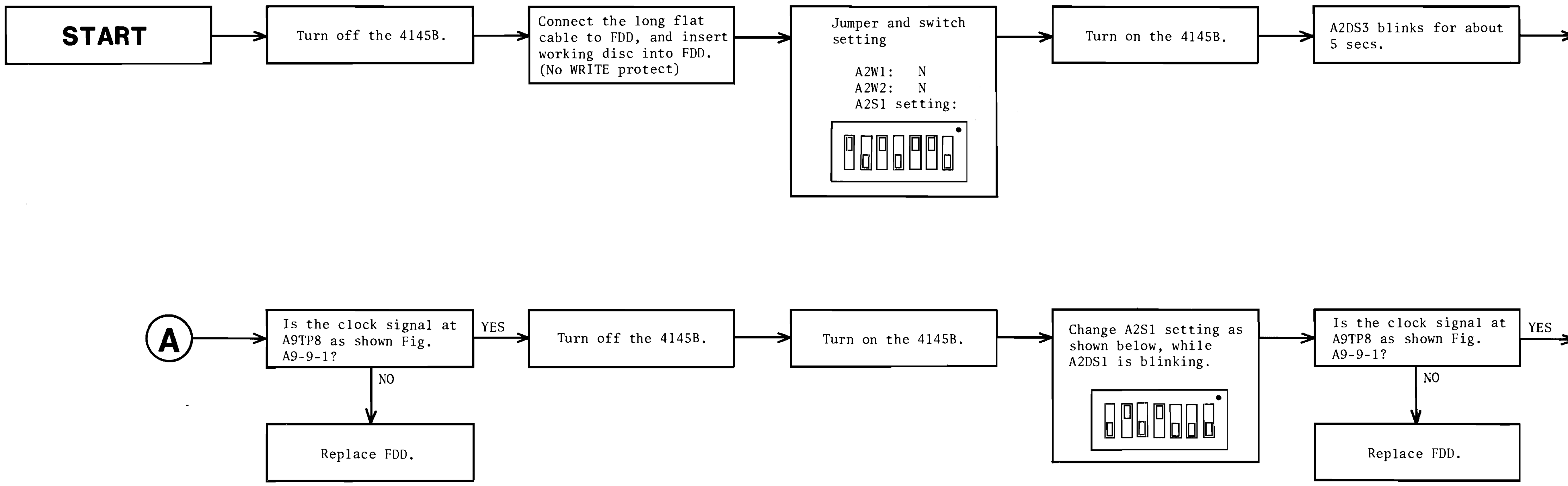
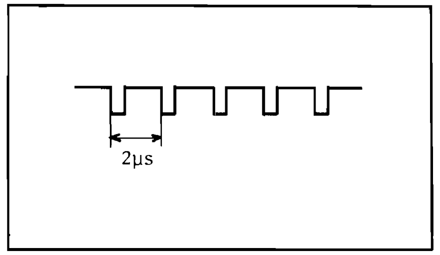


Fig. A9-9-1



Scans by ArtekMedia => 2010

Figure 8-18. A9 Board Troubleshooting Flow Diagram (Sheet 9 of 11).

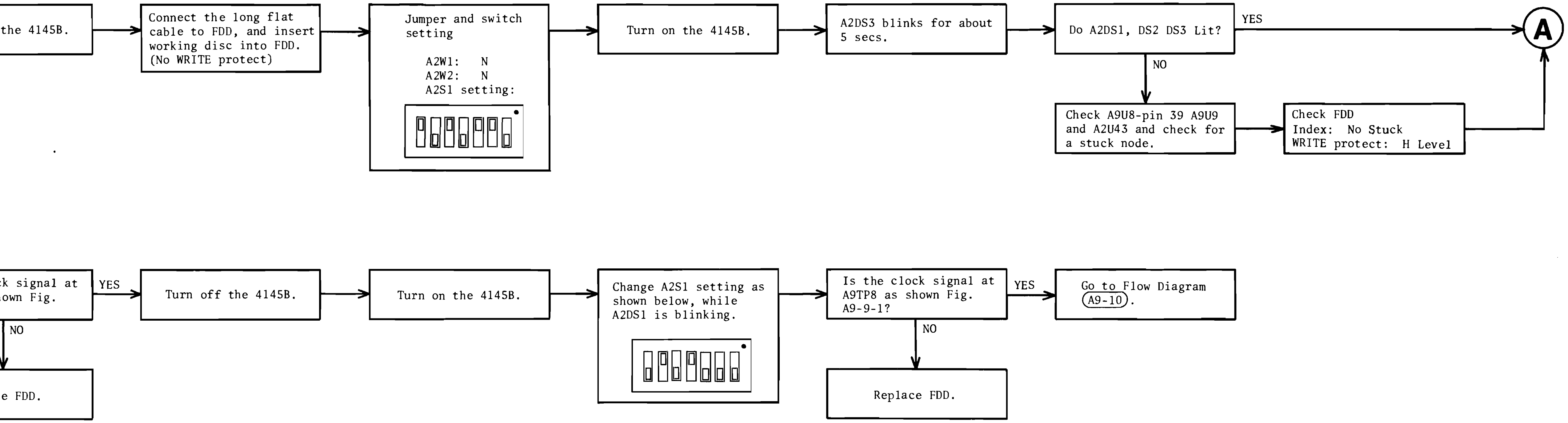
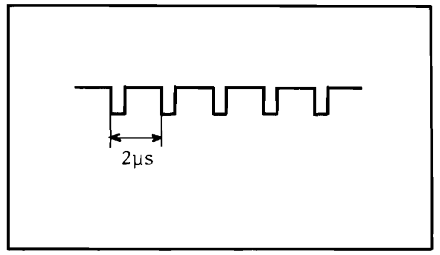


Fig. A9-9-1



NOTE: The disc that was used for A9-9 needs initialize operation for normal operation.

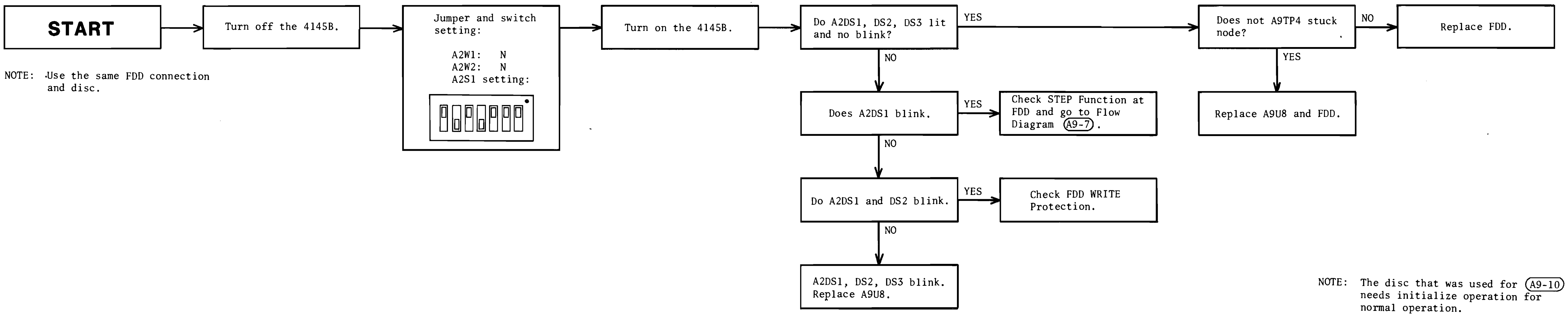
A9 Troubleshooting Flow Diagram

SEE INSIDE

Figure 8-18. A9 Board Troubleshooting Flow Diagram (Sheet 9 of 11).

Figure 8-18. A9 Board Troubleshooting Flow Diagram (Sheet 10 of 11).

Flow Diagram (A9 - 10)



NOTE: Use the same FDD connection and disc.

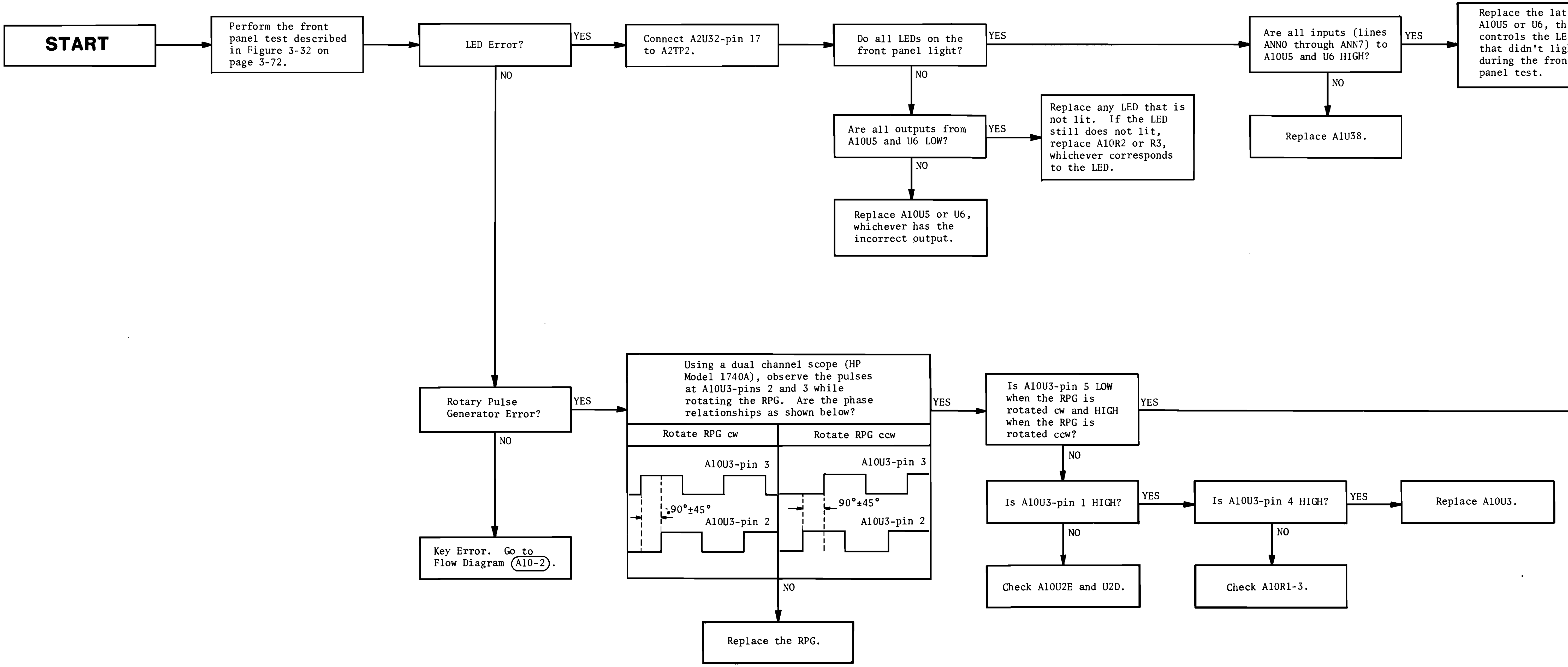
NOTE: The disc that was used for (A9-10) needs initialize operation for normal operation.

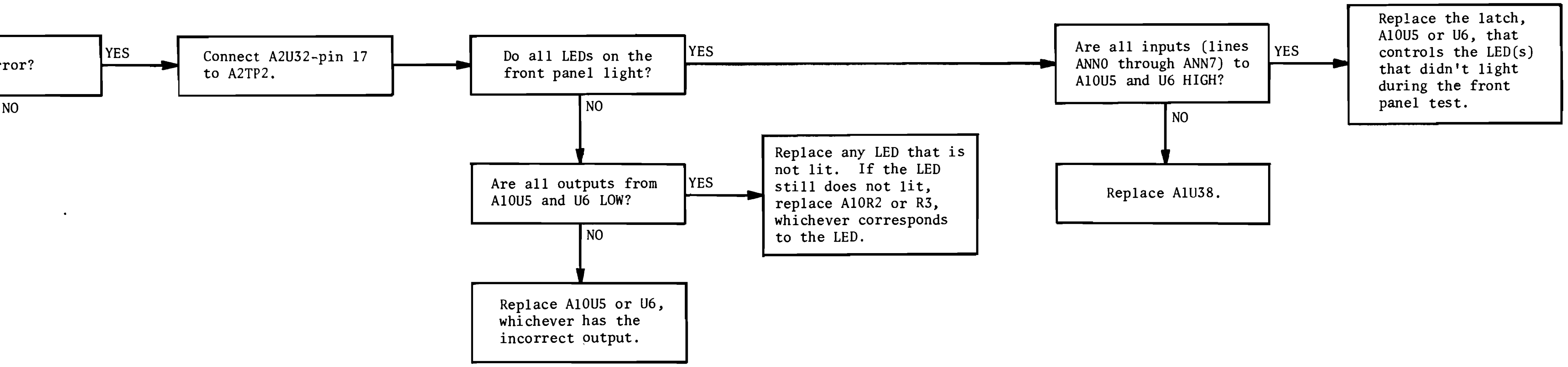
A9 Troubleshooting Flow Diagram

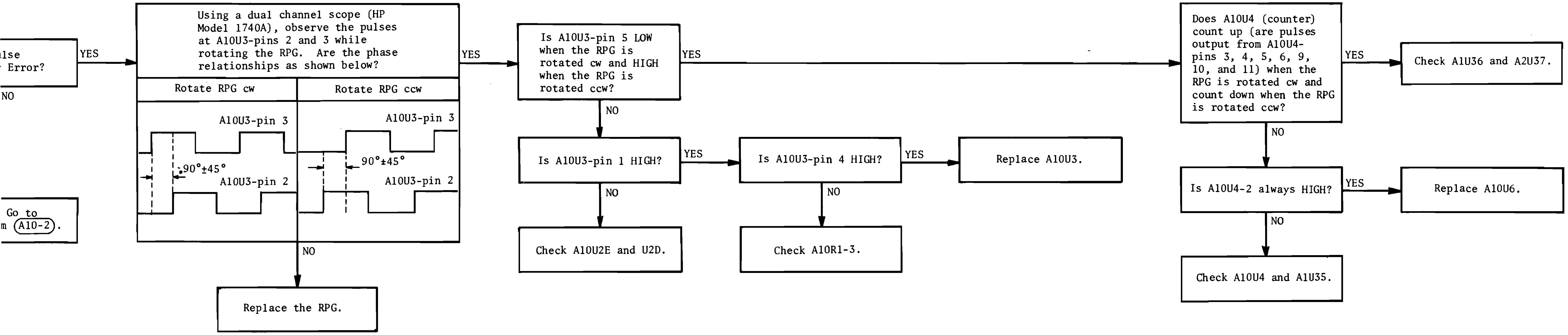
SEE INSIDE

Figure 8-18. A9 Board Troubleshooting Flow Diagram (Sheet 11 of 11).

Flow Diagram (A10 - 1)




rror?
YES
NO
Connect A2U32-pin 17 to A2TP2.
Do all LEDs on the front panel light?
YES
NO
Are all outputs from A10U5 and U6 LOW?
YES
NO
Replace any LED that is not lit. If the LED still does not lit, replace A10R2 or R3, whichever corresponds to the LED.
Replace A10U5 or U6, whichever has the incorrect output.
Are all inputs (lines ANN0 through ANN7) to A10U5 and U6 HIGH?
YES
NO
Replace A1U38.
Replace the latch, A10U5 or U6, that controls the LED(s) that didn't light during the front panel test.


lse
Error?
YES
NO
Go to
m (A10-2).
Using a dual channel scope (HP Model 1740A), observe the pulses at A10U3-pins 2 and 3 while rotating the RPG. Are the phase relationships as shown below?
Rotate RPG cw
Rotate RPG ccw
A10U3-pin 3
90°±45°
A10U3-pin 2
A10U3-pin 3
90°±45°
A10U3-pin 2
YES
NO
Replace the RPG.
Is A10U3-pin 5 LOW when the RPG is rotated cw and HIGH when the RPG is rotated ccw?
YES
NO
Is A10U3-pin 1 HIGH?
YES
NO
Check A10U2E and U2D.
Is A10U3-pin 4 HIGH?
YES
NO
Check A10R1-3.
Replace A10U3.
Does A10U4 (counter) count up (are pulses output from A10U4-pins 3, 4, 5, 6, 9, 10, and 11) when the RPG is rotated cw and count down when the RPG is rotated ccw?
YES
NO
Check A1U36 and A2U37.
Is A10U4-2 always HIGH?
YES
NO
Replace A10U6.
Check A10U4 and A1U35.

Flow Diagram (A10 - 2)

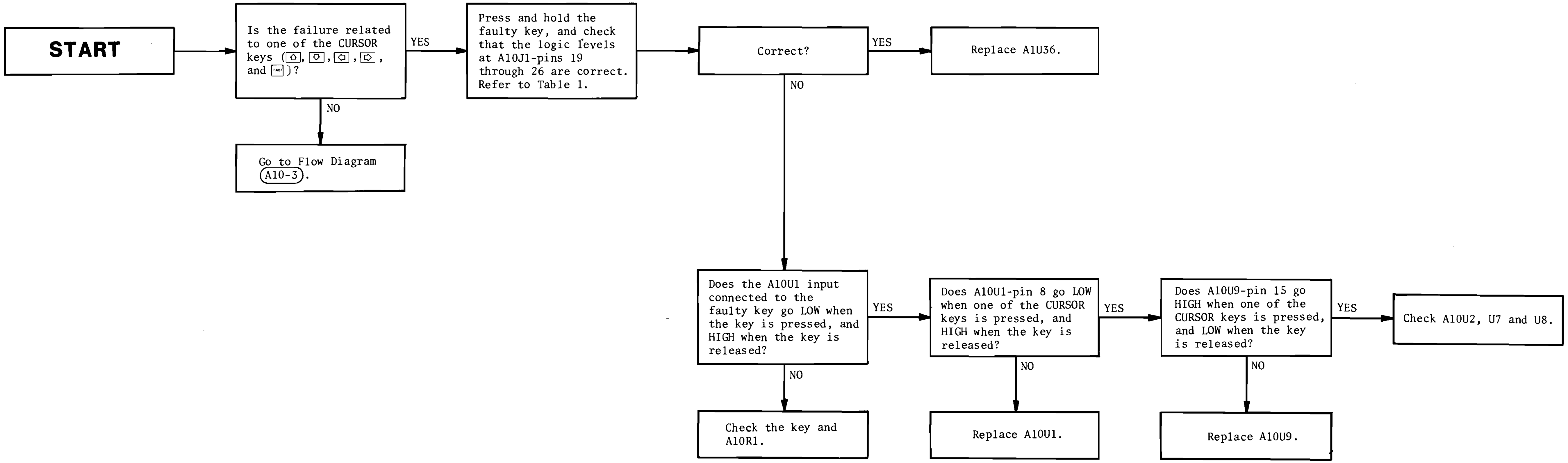


Table 1

Key Name	A10U10 p				
	–	–	–	–	–
	A10J1				
	26	25	24	23	2
EXTN	0	0	0	0	0
SOFT KEY 1	0	0	0	0	0
SOFT KEY 2	0	0	0	0	0
SOFT KEY 3	0	0	0	0	0
SOFT KEY 4	0	0	0	0	0
SOFT KEY 5	0	0	0	0	0
SOFT KEY 6	0	0	0	0	0
SOFT KEY 7	0	0	0	0	0
MENU	0	0	0	0	1
PREV	0	0	0	0	1
NEXT	0	0	0	0	1
BACK	0	0	0	0	1
DELETE	0	0	0	0	1
RCL	0	0	0	0	1
SAVE	0	0	0	0	1
SINGLE	0	0	0	1	0
APPEND	0	0	0	0	0
FORWARD	0	0	0	0	0
INSERT	0	0	0	0	0
CLEAR	0	0	0	0	0
GET	0	0	0	0	0
REPEAT	0	0	0	0	1
STOP	0	0	0	0	1
AUTO CAL	0	0	0	0	1
(	0	0	0	0	1
7	0	0	0	0	1
4	0	0	0	0	1
1	0	0	0	0	1
0	0	0	0	0	1

0: LOW level

1: HIGH level

A10 Troubleshooting Flow Diagram

SEE INSIDE

Figure 8-19. A10 Board Troubleshooting Flow Diagram (Sheet 1 of 3).

Figur

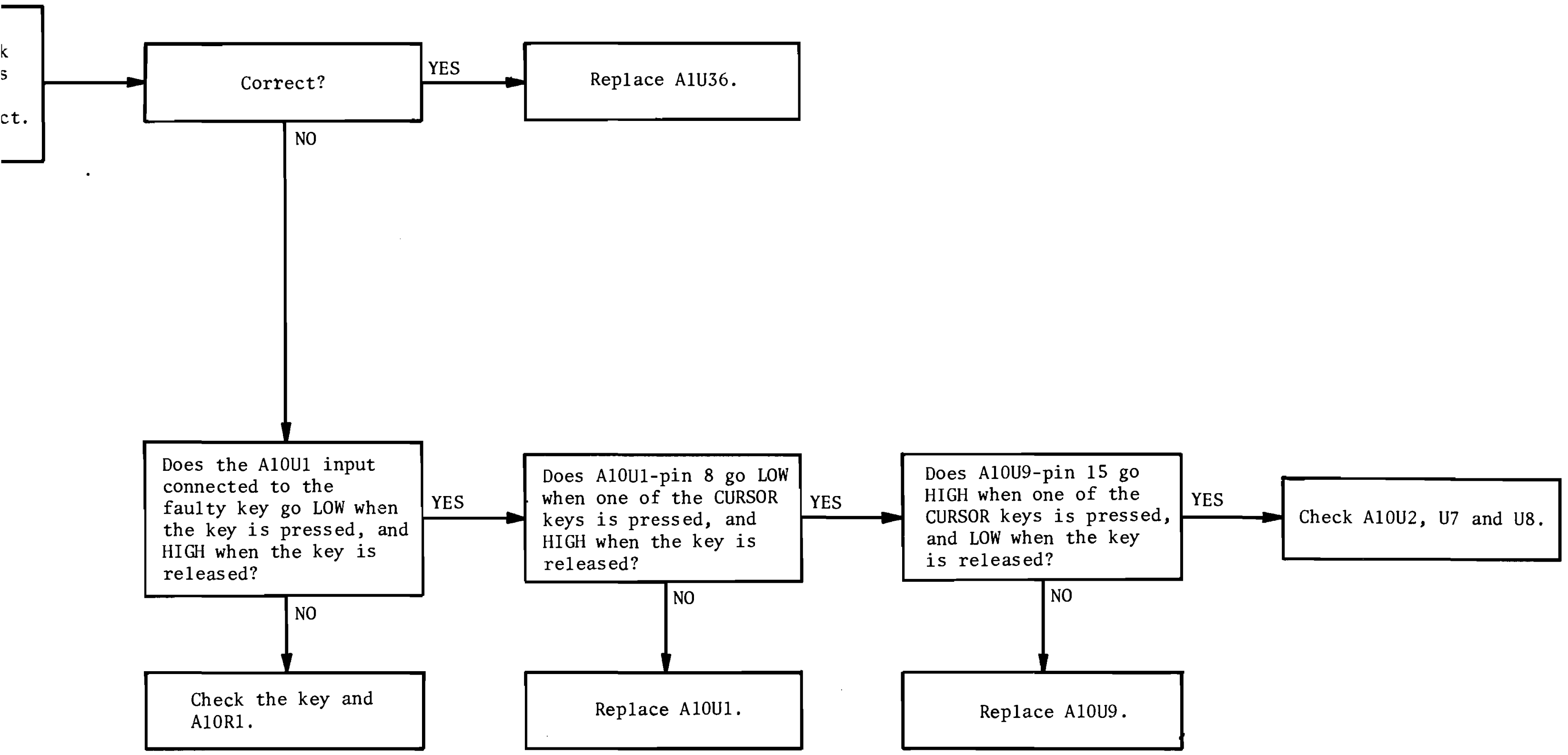


Table 1

Key Name	A10U10 pins							
	–	–	–	–	–	8	4	5
	A10J1 Pins							
	26	25	24	23	22	21	20	19
EXTN	0	0	0	0	0	0	0	0
SOFT KEY 1	0	0	0	0	0	0	0	1
SOFT KEY 2	0	0	0	0	0	0	1	0
SOFT KEY 3	0	0	0	0	0	0	1	1
SOFT KEY 4	0	0	0	0	0	1	0	0
SOFT KEY 5	0	0	0	0	0	1	0	1
SOFT KEY 6	0	0	0	0	0	1	1	0
SOFT KEY 7	0	0	0	0	0	1	1	1
MENU	0	0	0	0	1	0	0	0
PREV	0	0	0	0	1	0	0	1
NEXT	0	0	0	0	1	0	1	0
BACK	0	0	0	0	1	1	0	0
DELETE	0	0	0	0	1	1	0	1
RCL	0	0	0	0	1	1	1	0
SAVE	0	0	0	0	1	1	1	1
SINGLE	0	0	0	1	0	0	0	0
APPEND	0	0	0	0	0	0	0	1
FORWARD	0	0	0	0	0	1	0	0
INSERT	0	0	0	0	0	1	0	1
CLEAR	0	0	0	0	0	1	1	0
GET	0	0	0	0	0	1	1	1
REPEAT	0	0	0	0	1	0	0	0
STOP	0	0	0	0	1	0	0	1
AUTO CAL	0	0	0	0	1	0	1	0
(	0	0	0	0	1	0	1	1
7	0	0	0	0	1	1	0	0
4	0	0	0	0	1	1	0	1
1	0	0	0	0	1	1	1	0
ø	0	0	0	0	1	1	1	1

Key Name	A10U10 pins							
	–	–	–	–	–	8	4	5
	A10J1 Pins							
	26	25	24	23	22	21	20	19
START/STOP	0	0	1	0	0	0	0	0
CONT	0	0	0	0	0	0	0	1
PRINT	0	0	0	0	0	0	1	0
)	0	0	0	0	0	0	1	1
8	0	0	0	0	0	1	0	0
5	0	0	0	0	0	1	0	1
2	0	0	0	0	0	1	1	0
●	0	0	0	0	0	1	1	1
SHORT	0	0	0	0	1	0	0	0
MED	0	0	0	0	1	0	0	1
LONG	0	0	0	0	1	0	1	0
Δ	0	0	0	0	1	0	1	1
9	0	0	0	0	1	1	0	0
6	0	0	0	0	1	1	0	1
3	0	0	0	0	1	1	1	0
Space	0	0	0	0	1	1	1	1
LOCAL	0	0	1	1	0	0	0	0
PLOT	0	0	1	1	0	0	0	1
Blue	0	0	1	1	0	0	1	0
/	0	0	1	1	0	0	1	1
*	0	0	1	1	0	1	0	0
-	0	0	1	1	0	1	0	1
+	0	0	1	1	0	1	1	0
√‾	0	0	1	1	0	1	1	1
ENTER	0	0	1	1	1	0	0	0
Green	0	0	1	1	1	0	0	1
EXECUTE	0	0	1	1	1	0	1	0
m	0	0	1	1	1	0	1	1
μ	0	0	1	1	1	1	0	0
n	0	0	1	1	1	1	0	1
p	0	0	1	1	1	1	1	0
EEX	0	0	1	1	1	1	1	1

Key Name								
	A10J1 Pins							
	26	25	24	23	22	21	20	19
FAST	0	1	0	0	0	0	0	1
→	0	1	0	0	0	0	1	0
↑	0	1	0	0	0	1	0	0
←	0	1	0	0	1	0	0	0
↓	0	1	0	1	0	0	0	0
All Keys off	1	0	0	0	0	-	-	-

0: LOW level

1: HIGH level

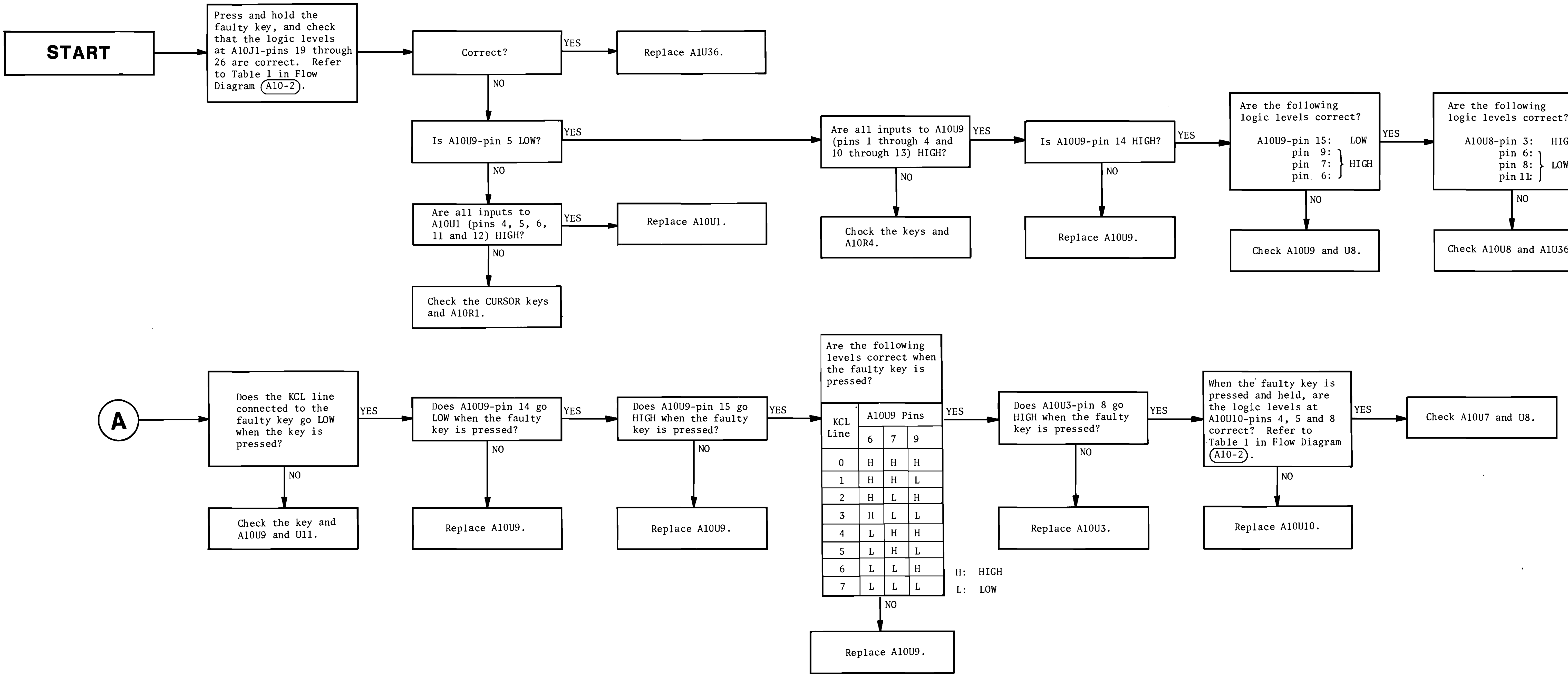
A10 Troubleshooting Flow Diagram

SEE INSIDE

Figure 8-19. A10 Board Troubleshooting Flow Diagram (Sheet 1 of 3).

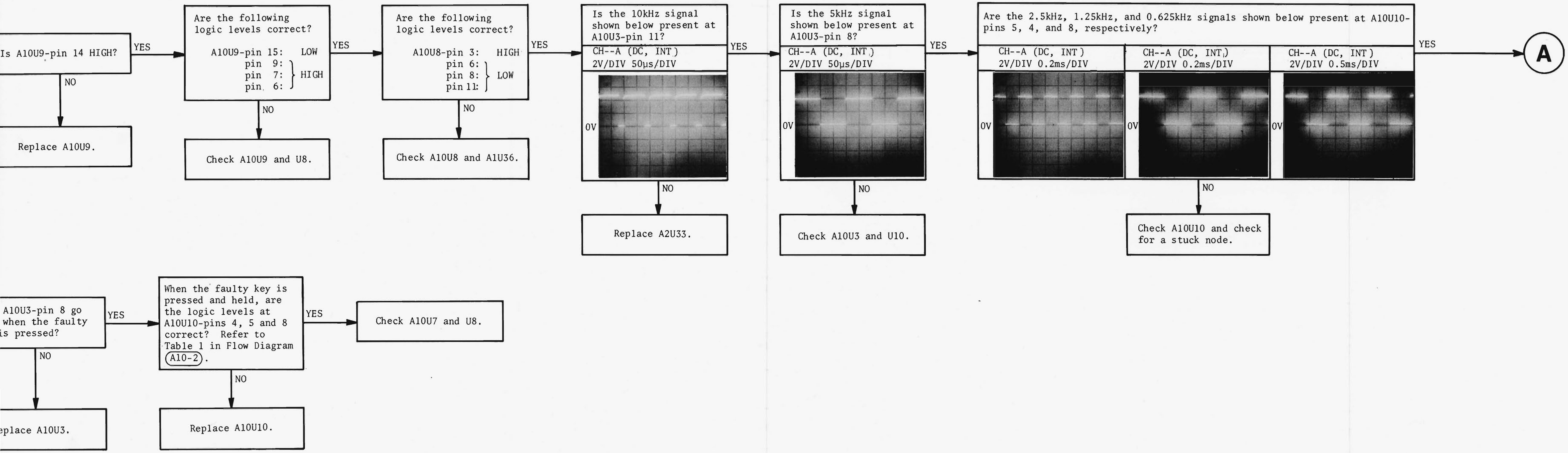
Figure 8-19. A10 Board Troubleshooting Flow Diagram (Sheet 2 of 3).

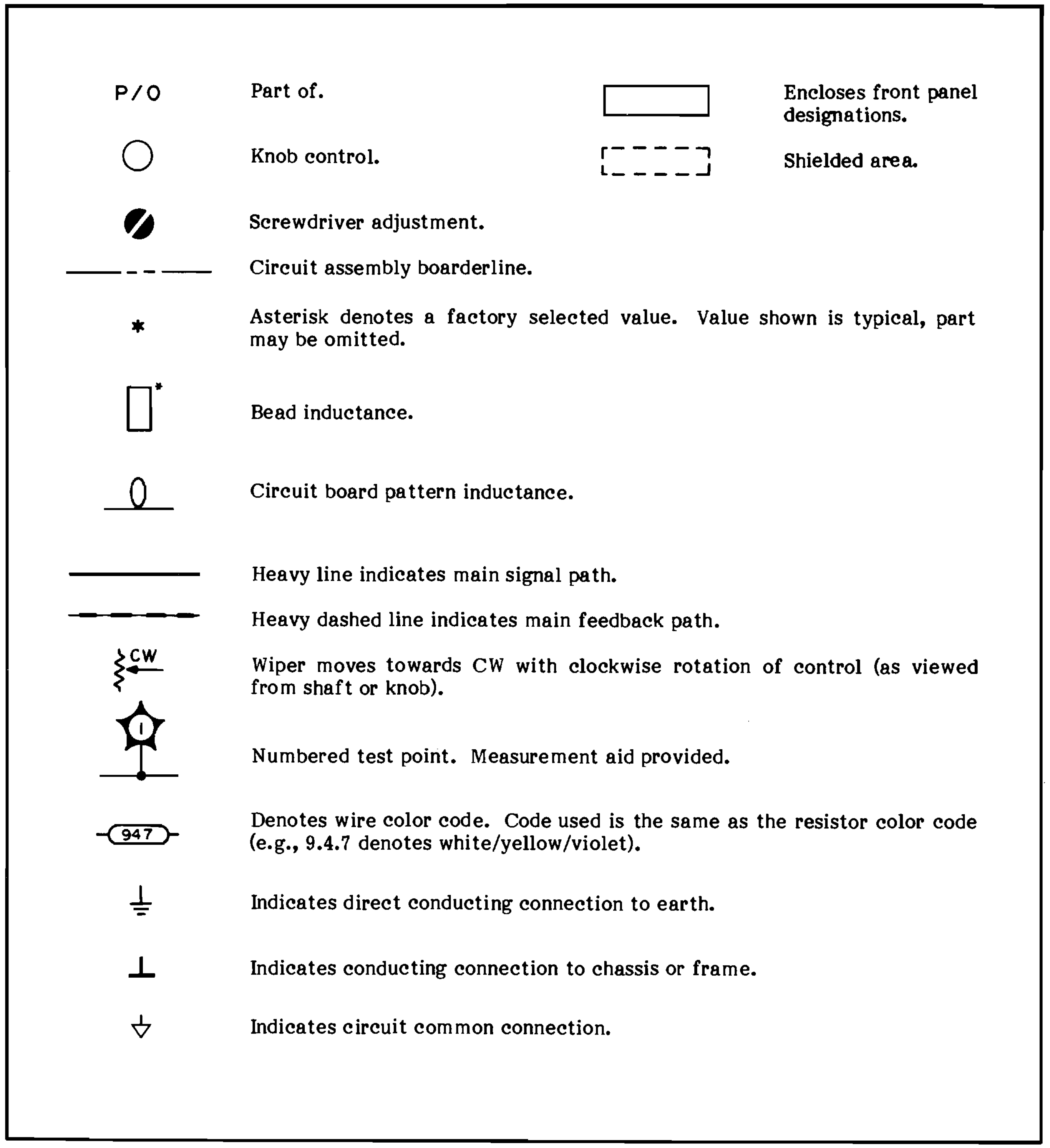
Flow Diagram (A10 - 3)



KCL Line	A10U9 Pins		
	6	7	9
0	H	H	H
1	H	H	L
2	H	L	H
3	H	L	L
4	L	H	H
5	L	H	L
6	L	L	H
7	L	L	L

H: HIGH
L: LOW


Is A10U9-pin 14 HIGH?
YES
NO
Replace A10U9.
Are the following logic levels correct?
A10U9-pin 15: LOW
pin 9:
pin 7: HIGH
pin 6:
YES
NO
Check A10U9 and U8.
Are the following logic levels correct?
A10U8-pin 3: HIGH
pin 6:
pin 8: LOW
pin 11:
YES
NO
Check A10U8 and A1U36.
Is the 10kHz signal shown below present at A10U3-pin 11?
CH--A (DC, INT)
2V/DIV 50μs/DIV
0V
YES
NO
Replace A2U33.
Is the 5kHz signal shown below present at A10U3-pin 8?
CH--A (DC, INT)
2V/DIV 50μs/DIV
0V
YES
NO
Check A10U3 and U10.
Are the 2.5kHz, 1.25kHz, and 0.625kHz signals shown below present at A10U10-pins 5, 4, and 8, respectively?
CH--A (DC, INT)
2V/DIV 0.2ms/DIV
0V
CH--A (DC, INT)
2V/DIV 0.2ms/DIV
0V
CH--A (DC, INT)
2V/DIV 0.5ms/DIV
0V
YES
NO
Check A10U10 and check for a stuck node.
A
A10U3-pin 8 go
when the faulty
is pressed?
YES
NO
eplace A10U3.
When the faulty key is pressed and held, are the logic levels at A10U10-pins 4, 5 and 8 correct? Refer to Table 1 in Flow Diagram (A10-2).
YES
NO
Replace A10U10.
Check A10U7 and U8.



P/O Part of.

Encloses front panel designations.

Knob control.

Shielded area.

Screwdriver adjustment.

Circuit assembly boarderline.

* Asterisk denotes a factory selected value. Value shown is typical, part may be omitted.

Bead inductance.

Circuit board pattern inductance.

Heavy line indicates main signal path.

Heavy dashed line indicates main feedback path.

Wiper moves towards CW with clockwise rotation of control (as viewed from shaft or knob).

Numbered test point. Measurement aid provided.

Denotes wire color code. Code used is the same as the resistor color code (e.g., 9.4.7 denotes white/yellow/violet).

Indicates direct conducting connection to earth.

Indicates conducting connection to chassis or frame.

Indicates circuit common connection.

Figure 8-20. Schematic Diagram Notes.

A10 Troubleshooting Flow Diagram

SEE INSIDE

Figure 8-19. A10 Board Troubleshooting Flow Diagram (Sheet 3 of 3).

8-36. A1 GRAPHIC DISPLAY CONTROL BOARD

8-37. The A1 board handles all data transfer operations between the 1345A Digital Display and the microprocessor on the A2 board. Data transfer is via a 16-bit data bus, which provides asynchronous handshake. The A1 board contains a 8K x 16-bit Display RAM, which functions as Option 704 of the 1345A. It is also used for the PLOT and PRINT functions. Refer to paragraphs 3-94 and 3-96, respectively. Figure 8-21 shows the overall block diagram of the A1 board.

[Display RAM]

The 1345A is controlled by 16-bit commands sent from the microprocessor and stored in the Display RAM, U30 - U31. The Display RAM stores all commands required to draw lines and alphanumeric characters on the CRT, and sequentially sends the stored commands to the 1345A. Display refresh is handled by the Scan Pointer and Jump Control. The Scan Pointer, U5 - U8, is incremented by the Timing Controller and addresses the RAM via the SCA 0 - 11 lines. When a "MEMORY JUMP" instruction (bit 15 = 1) is output from the RAM, Jump Control, U17 and U29, sets the Scan Pointer to the restart address.

[Write Operation]

To draw a new figure on the CRT, the R/W Memory Pointer, U25 - U28, addresses the RAM and data is sent from the microprocessor to the RAM via the 8-line/16-line converter, U41 and U42.

[Read Operation]

When the PLOT key is pressed, display data stored in the RAM is output to the HP-IB via the 16-line/8-line converter, U44 and U45.

[Self Test]

Self-test checks the operation of the A1 Board. U20 and U21 return the output data to the microprocessor to confirm the write operation. Also, the Monitor Buffer, U39 and U40, returns the R/W address and handshake control line to the microprocessor.

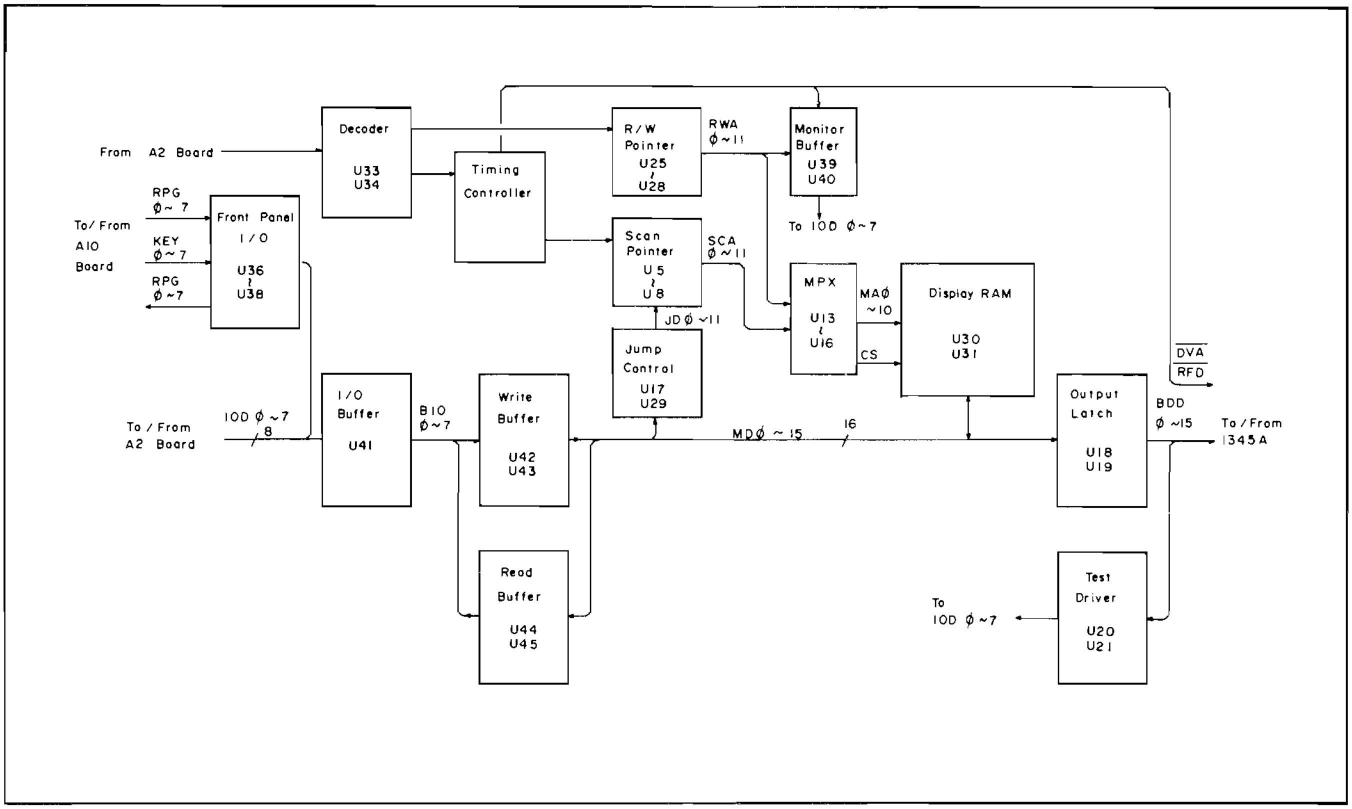


Figure 8-21. Block Diagram of A1 Board.

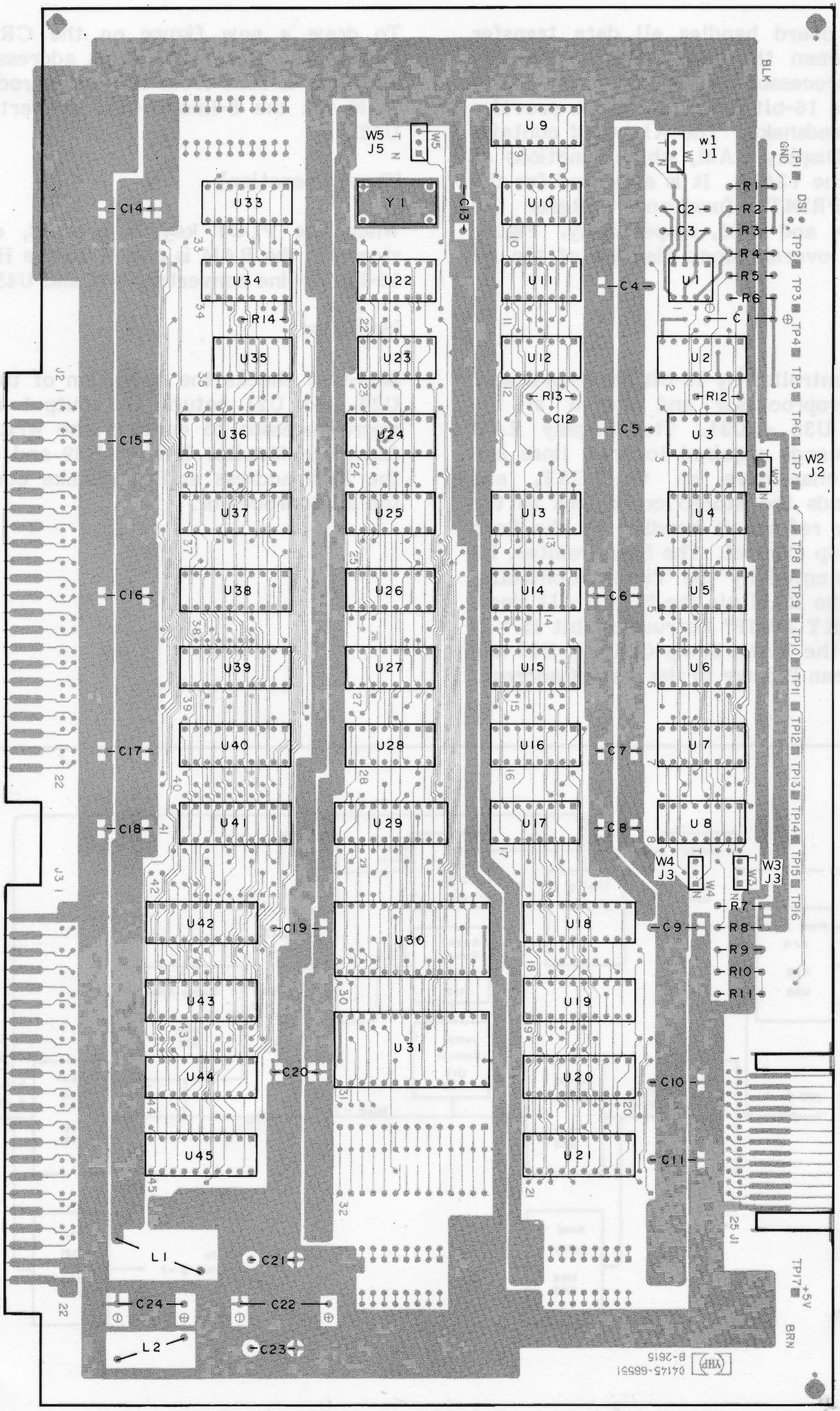
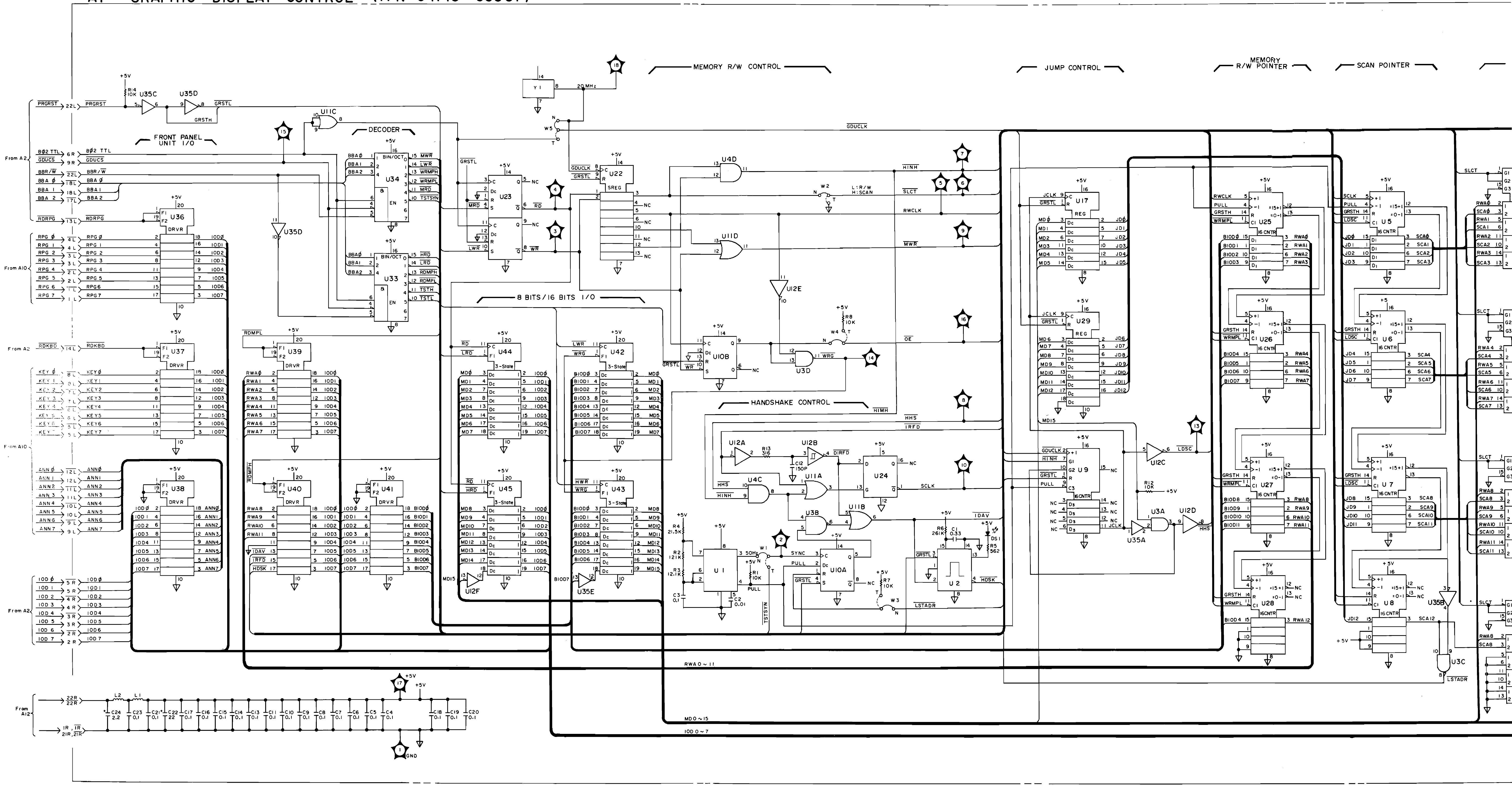
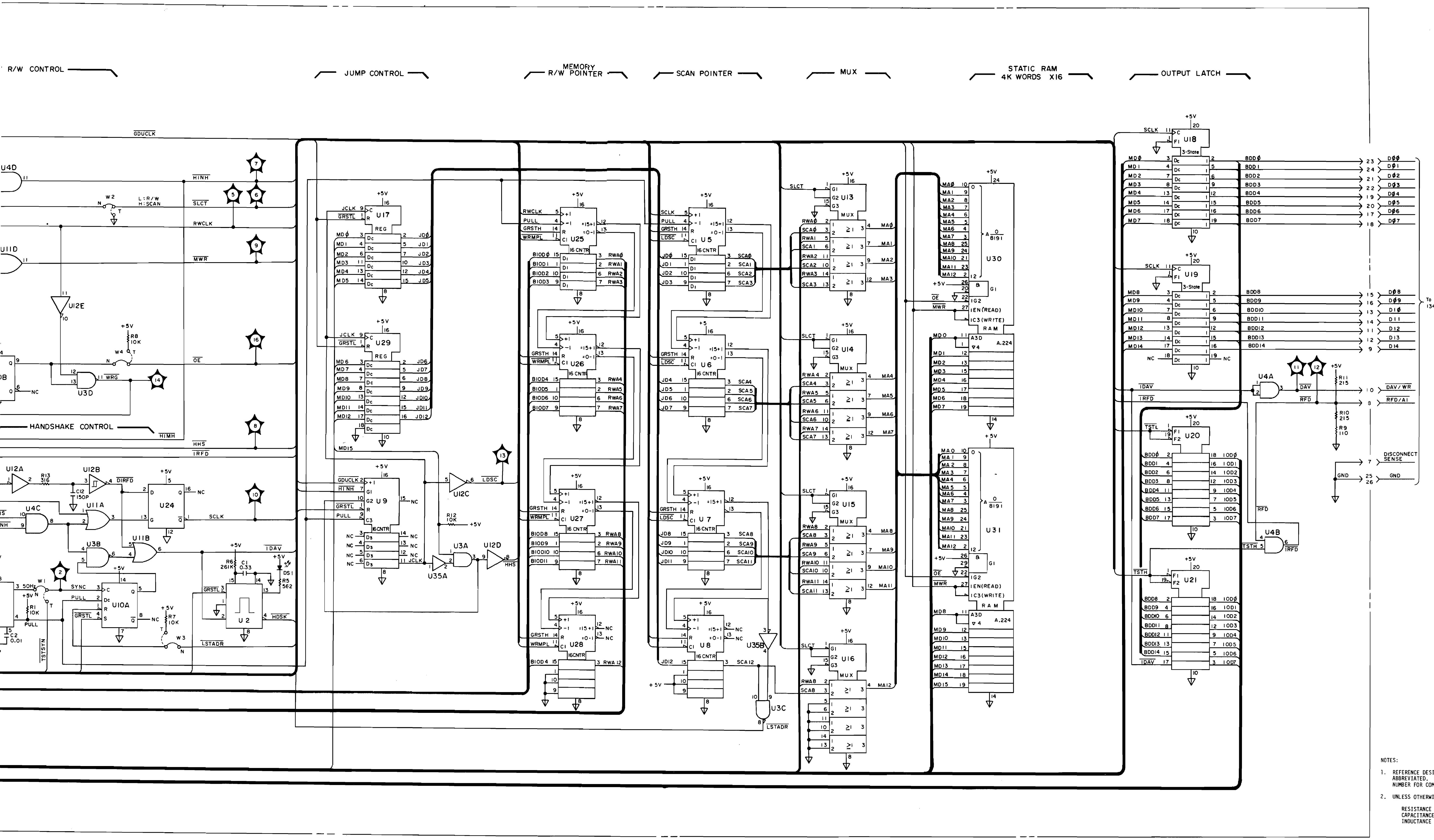


Figure 8-22. A1 Graphic Display Control Board Assembly Component Locations.

A1 GRAPHIC DISPLAY CONTROL (P/N:04145-66551)





NOTES:

1. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. PREFIX ABBREVIATION WITH ASSEMBLY NUMBER FOR COMPLETE REFERENCE DESIGNATOR.

2. UNLESS OTHERWISE INDICATED:

RESISTANCE IN OHMS (Ω)
CAPACITANCE IN MICROFARADS (μF)
INDUCTANCE IN MICROHENRIES (μH)

8-38. A2 MICROPROCESSOR DIGITAL CONTROL BOARD

8-39. The A2 board contains the host microprocessor and provides overall instrument control. Figure 8-24 shows the block diagram of the A2 board.

Basic software routines are stored in the 16k byte ROM and consist, mainly, of monitor programs and subprograms for the flexible-disc drive, graphics display unit, and HP-IB.

Operating system software, recorded on the flexible disc, is loaded into the 96k byte static RAM (U1 through U5, and U7 through U13) when the 4145B is turned on.

Data transfer to and from the microprocessor on the A3 board is performed serially via the asynchronous communication interface adapter (ACIA), U38. Ground isolation between the A2 board and the A3 board is maintained by optocouplers on the A3 board, Data transfer to and from the A1 and A9 boards, however, is via the 8-bit bidirectional data bus (IOD 0-7).

Timing for all instrument operations is controlled by the clock generator U32 the clock divider circuit—U35, U22 and U23.

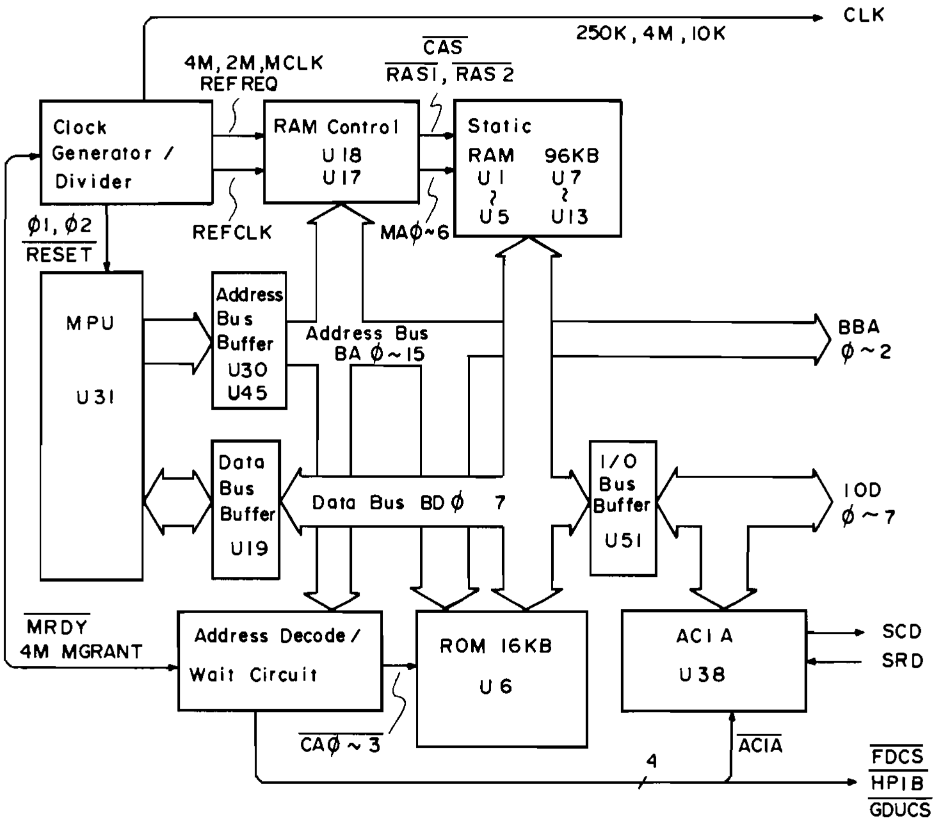


Figure 8-24. Block Diagram of the A2 Board.

[Signal Identification]

IOD 0 - 7 (I/O Data Bus):
Bidirectional data bus lines

BBA 0 - 2 (Address Lines):
Lower 3 bits of the external I/O address bus

Control Lines:
Bϕ2 TTL:
Timing signals between the MPU and external I/O

BBR/$\overline{\text{W}}$:
Read/Write signal for external I/O

Chip Select:
$\overline{\text{HP-IB}}$: HP-IB select signal

$\overline{\text{FDCCS}}$: FDD controller select signal

$\overline{\text{GDUCS}}$: A1 board I/O select signal for the 1345A

Strobe Signal:
$\overline{\text{LATCHA}}$, $\overline{\text{LATCHB}}$:
Select signal for the display latches on the A10 board.

$\overline{\text{RDKBD}}$: A1 board I/O select signal for the keyboard

$\overline{\text{RDRPG}}$: A1 board I/O select signal for the RPG

Latched Control Signals:
$\overline{\text{FDSEL}}$: Enables the FDD.

$\overline{\text{PRGRST}}$ (Program Reset):
Reset signal from the program being executed.

Serial Communication Lines:
SCD (Serial Command Data):
Signal to the A3 board

SRD (Serial Response Data):
Signal from the A3 board

SCK (Serial Clock):
Clock for serial data transfer

Clock Signals:
B4MHz: Clock for the FDD circuit
KEYCLK: Scan clock for the keyboard

Direct Input Signals:
OPEN/CLOSE:
Sense signal for the test fixture lid

Interrupt Request Lines:
$\overline{\text{PERIRQ}}$ (Peripheral Interrupt Request):
Interrupt signal from HP-IB and FDD.

$\overline{\text{PWRFAIL}}$ (Power Fail):
Signal which indicates transient power loss.

Reset Signal:
$\overline{\text{RESET}}$: Reset signal when the instrument is turned on.

Test Control Signal:
$\overline{\text{INH}}$: External clock select signal

EXTIN: External clock signal

$\overline{\text{HALT}}$: Halt signal for the MPU

EXTBA: Address bus enable signal when the MPU is halted.

[Software]

Software for the 4145B is divided into three parts: OS (Operating System), Utility Programs, and Tasks (Application Program).

OS consists of the following programs:

Task Control Program
Timer Control Program
I/O Control Program
Interrupt Control Program
Program Control Program
Arithmetic Control Program
Initialize Control Program

Utility Programs consist of subroutines used by the Application Programs.

A task is the minimum unit of a program, and is controlled by the OS. The 4145B can perform various jobs by performing various Tasks. Following are key Tasks which control lower level Tasks:

Keyboard Task
RPG Task
HP-IB Task
Page Control Task
ASP Interpreter

Table 8-5 (Fold-out page) lists the program locations. All programs are initially stored in the ROM or on the disc. Programs on the disc are divided into 12 files, files 0 through 11. All files are loaded into the RAM when the instrument is turned on.

Table 8-5. Program Locations

File No.	Primary Program Contents
ROM U6	Utility Program, Keyboard Task, SMU control
File 0	Page control, Utility Program
File 1	SOURCE SETUP page, MEAS & DISP MODE SETUP page
File 2	GRAPHICS PLOT page, Measurement control
File 3	Mathematics control, Interpreter/Translater
File 4	Graphics Analysis control
File 5	LIST DISPLAY page, MATRIX DISPLAY page, SCHMOO PLOT page
File 6	PLOT, OUTPUT SEQ SETUP page
File 7	Data display, ASP Editor
File 8	OPERATION GUIDE page
File 9	CATALOG page, DIAGNOSTICS page
File 10	User graphics
File 11	MENU page, DEFINITION page

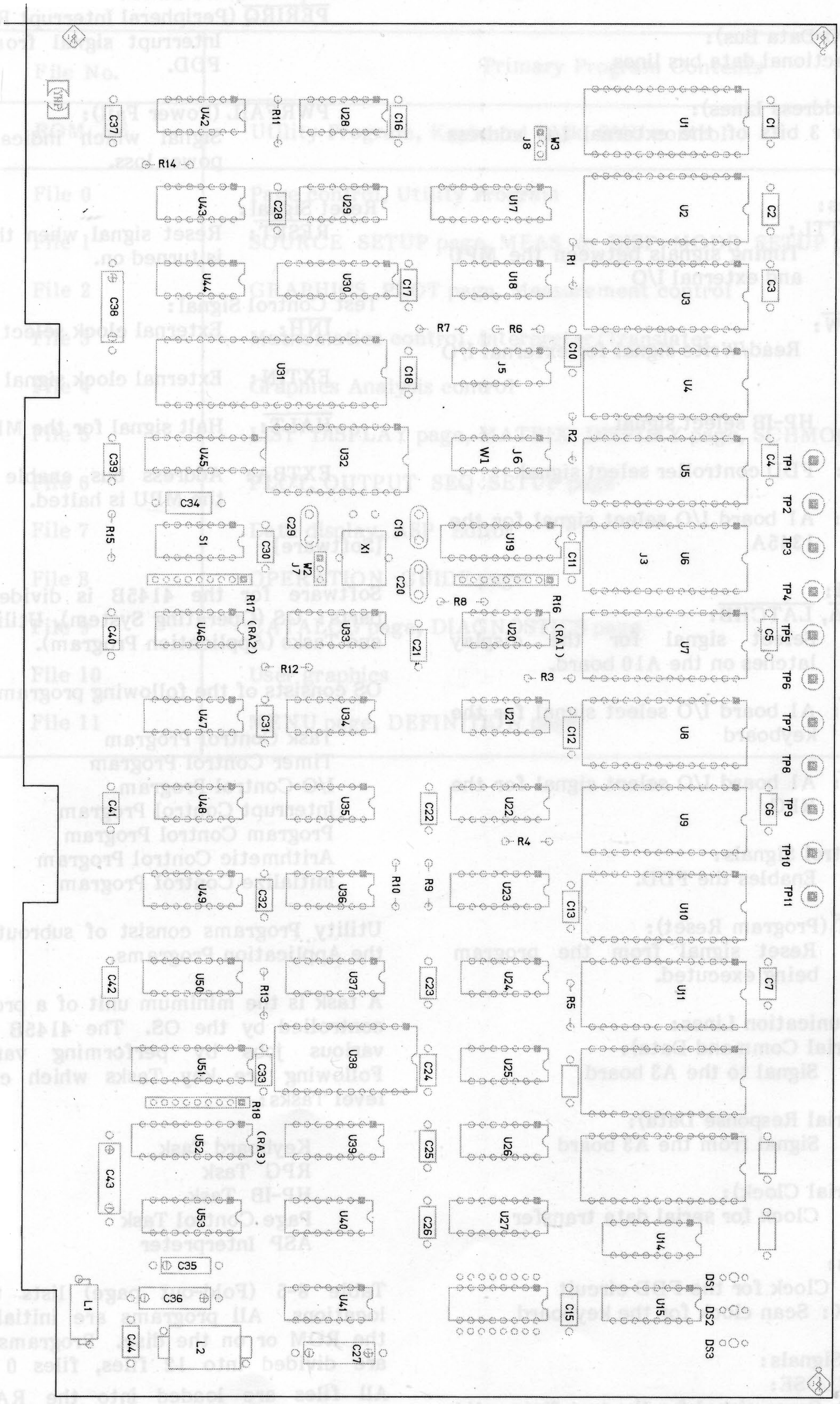


Figure 8-25. A2 Microprocessor Digital Control Board Assembly Component Locations.

A2 MICROPROCESSOR DIGITAL CONTROL (P/N:04145-66562) 1 OF 2

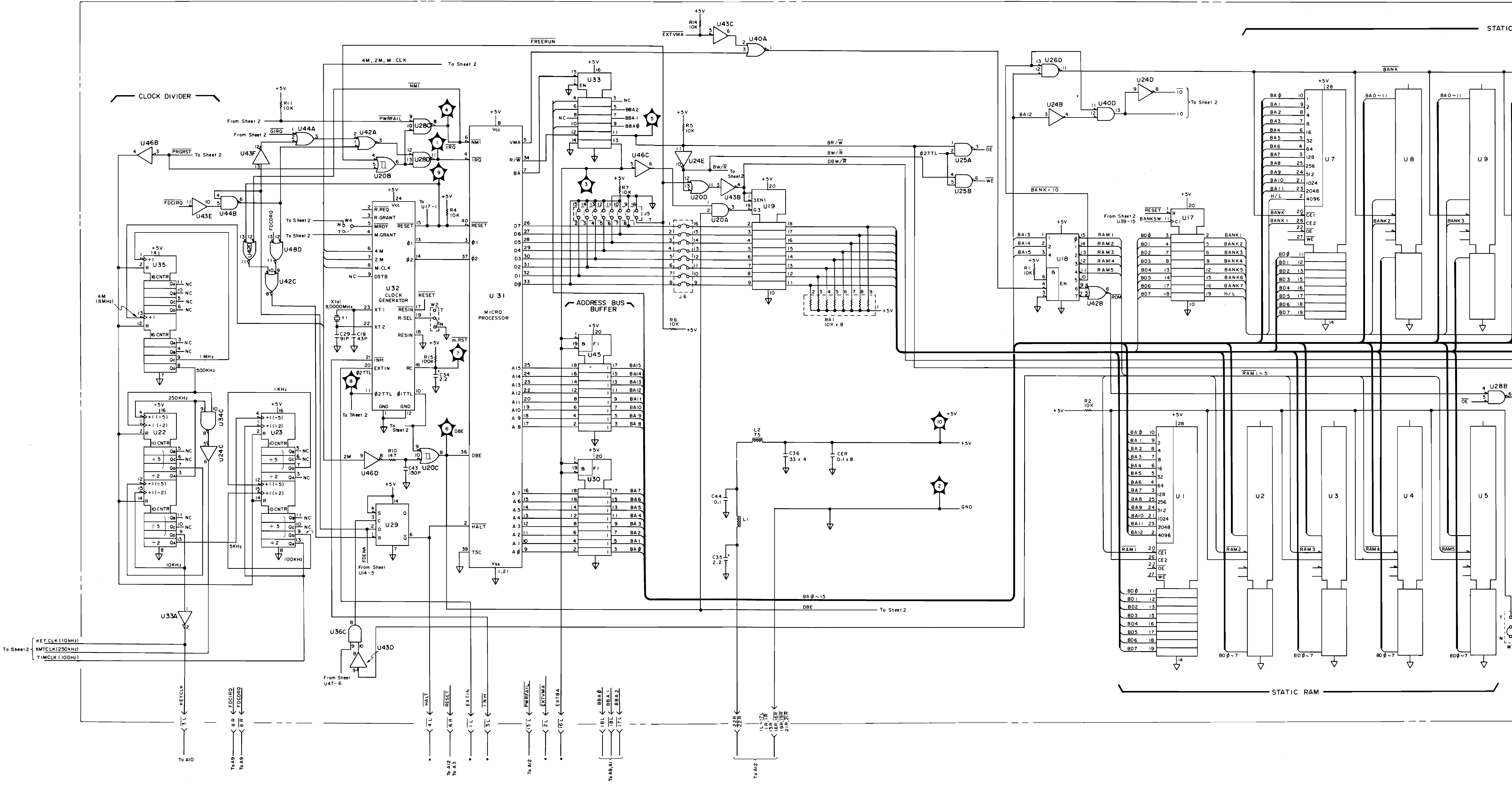
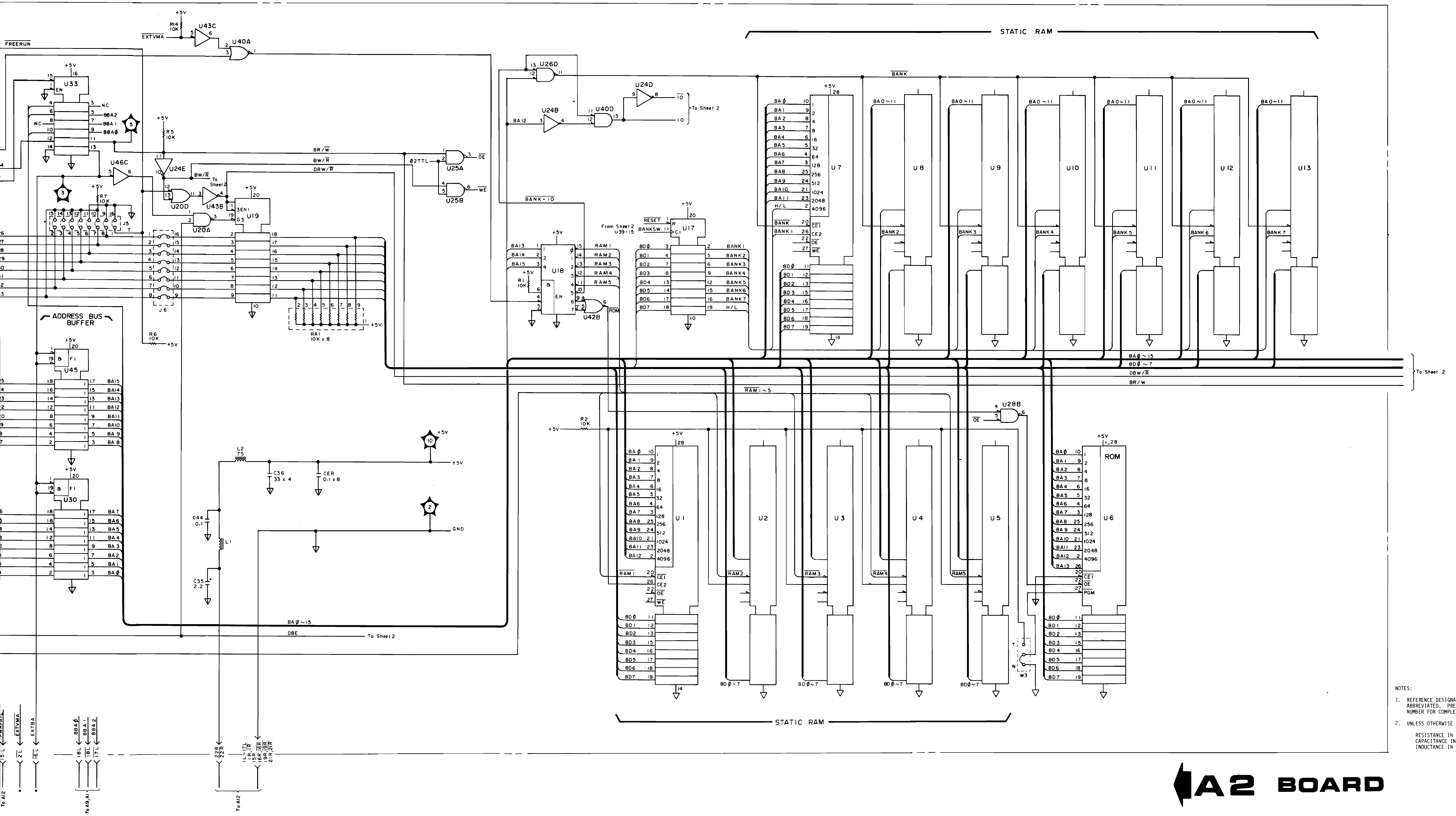


Figure 8-26. A2 Microprocessor Digital

5-66562) 1 OF 2



A2 BOARD

NOTES:

1. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. PREFIX ABBREVIATION WITH ASSEMBLY NUMBER FOR COMPLETE REFERENCE DESIGNATOR.

2. UNLESS OTHERWISE INDICATED:

RESISTANCE IN OHMS (Ω)
CAPACITANCE IN MICROFARADS (μF)
INDUCTANCE IN MICROHENRIES (μH)

Figure 8-26. A2 Microprocessor Digital Control Board Assembly Schematic Diagram (Sheet 1 of 2).

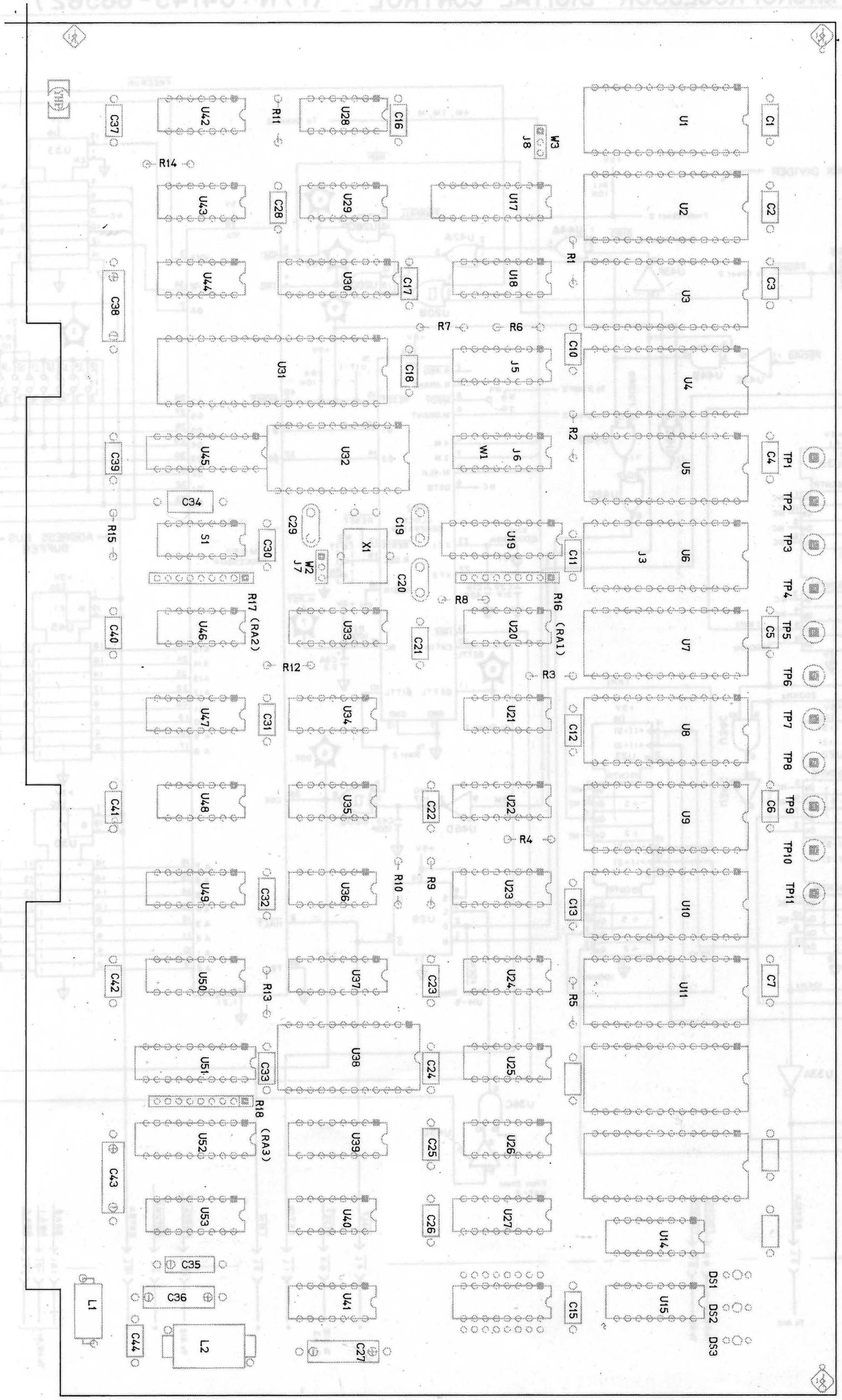
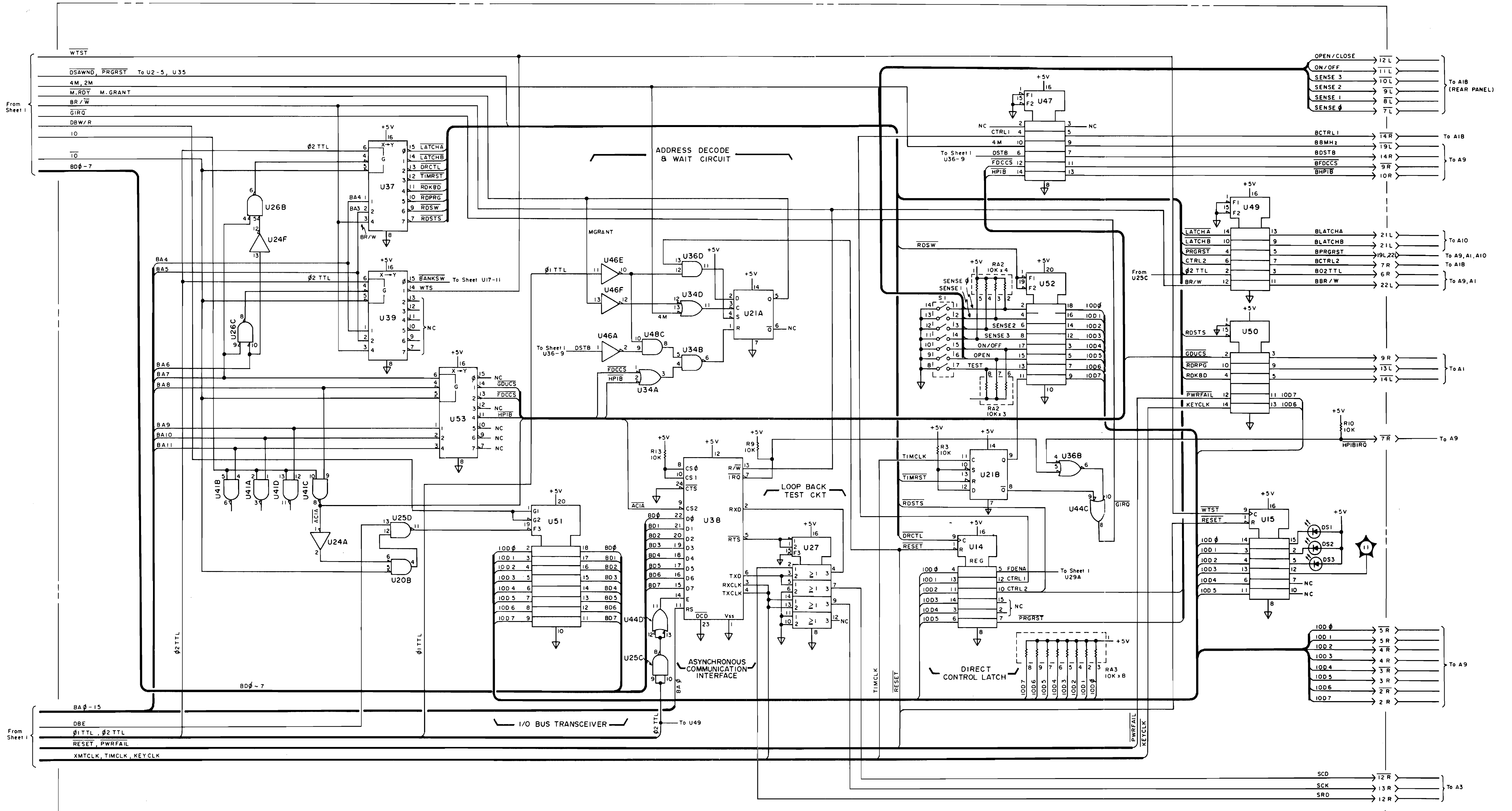


Figure 8-25. A2 Microprocessor Digital Control Board Assembly Component Locations.

A2 MICROPROCESSOR DIGITAL CONTROL (P/N : 04145-66562) 2 OF 2



NOTES:

1. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. PREFIX ABBREVIATION WITH ASSEMBLY NUMBER FOR COMPLETE REFERENCE DESIGNATOR.
2. UNLESS OTHERWISE INDICATED:

RESISTANCE IN OHMS (Ω)
CAPACITANCE IN MICROFARADS (μF)
INDUCTANCE IN MICROHENRIES (μH)

A2 BOARD

Figure 8-26. A2 Microprocessor Digital Control Board Assembly Schematic Diagram (Sheet 2 of 2).

8-40. A3 A-D CONVERTER BOARD

8-41. The A3 board controls the SMUs, voltage sources, and voltage monitors as directed by the microprocessor on the A2 board. It contains a 16-bit successive approximation ADC and a microprocessor based digital control section.

Figure 8-27 (a) shows the block diagram of the ADC. The voltage and current monitor signals from the SMUs and voltage monitors, which are normalized to ±10 volts full scale, are applied directly to the inputs of the multiplexer, U37. The control register, U31, instructs the multiplexer to sequentially select each valid input for A-to-D conversion.

Note

Only inputs from SMUs and voltage monitors that are used in the measurement (have been assigned on the CHANNEL DEFINITION page) are valid. Outputs from unused SMUs and voltage monitors are not selected for A-to-D conversion. Also, the order in which the inputs are selected is determined by the order specified on the OUTPUT SEQUENCE SETUP page (see Figure 3-31).

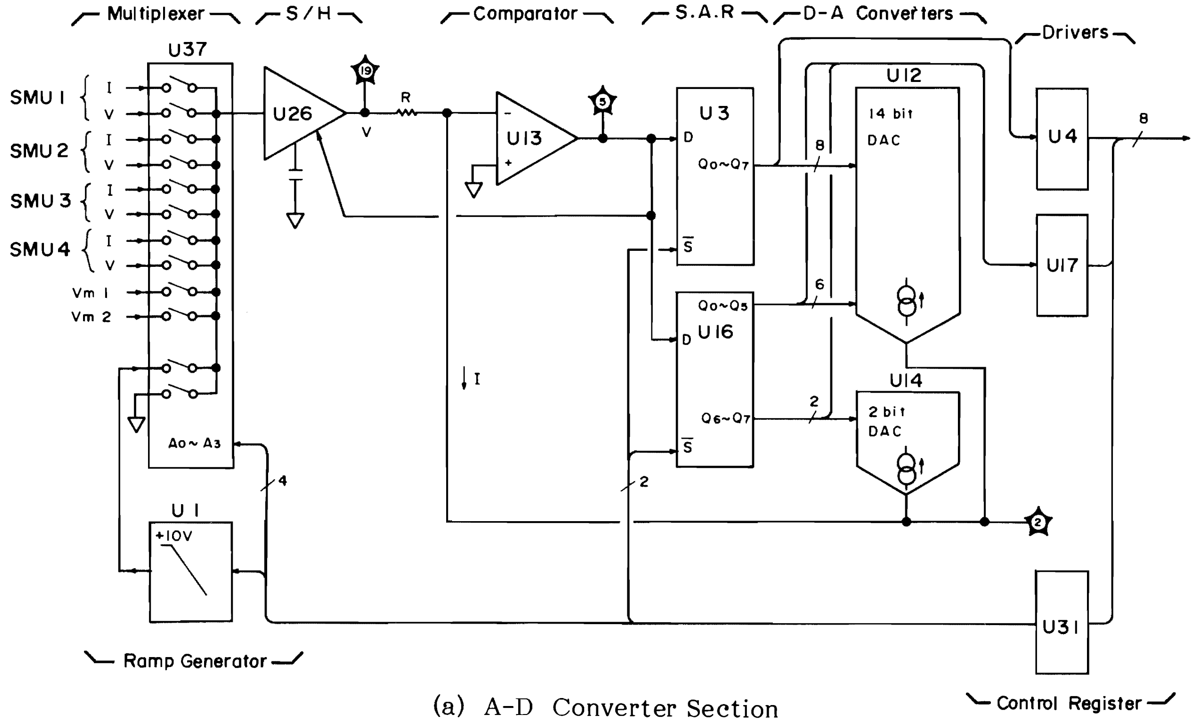
The selected input is applied to the sample-hold circuit, U26 and U29B, and is held until A-to-D conversion is completed. The A-to-D conversion process is briefly described below

(1) The first clock pulse resets the DAC (U2 and U14) and the SAR (U3 and U16), so that the MSB of the DAC is 1 and all others are 0. Thus, the output from the DAC is half of full scale.

(2) The outputs from the DAC and the sample-hold circuit are compared by the comparator, U13. If the output from the sample-hold circuit is greater than the DAC output, the MSB of the SAR will remain at 1 and the next lower bit will be set to 1 on the next clock pulse. If otherwise, the MSB will be set to 0 and the next lower bit will be set to 1.

(3) Step (2) is repeated until the LSB of the DAC has been set.

(4) The SAR then sets the comparison-complete bit HIGH, informing the microprocessor that A-to-D conversion is finished.



(a) A-D Converter Section

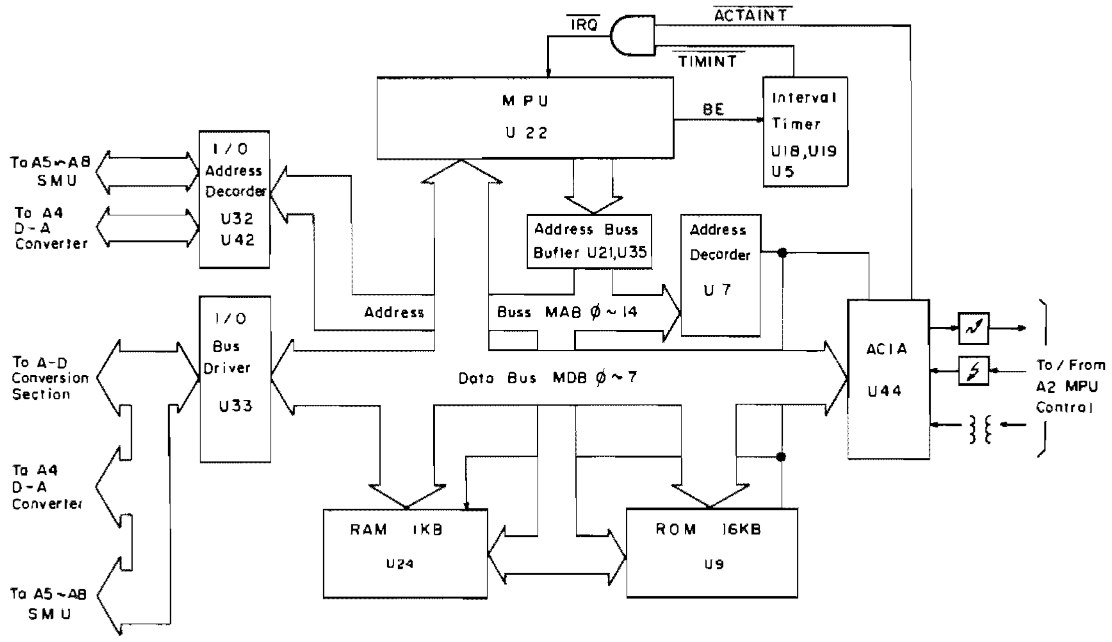
Figure 8-27. Block Diagram of the A3 Board.

(5) The microprocessor read the value in the SAR, which is the digital value of the analog voltage.

The 16-bit DAC consists of two separate DACs. One is a 16-bit DAC (U2) wired for 14-bit operation. It provides only the lower-order 14-bits in order to improve A-to-D conversion monotonicity. The other is an 8-bit DAC (U14) wired for 2-bit operation. It provides the two higher-order bits and extends the measurement range of the 14-bit DAC.

To maintain optimum accuracy at all times, the DAC is automatically calibrated every minute. The ramp generator, U1, is used for this. It establishes accurate reference levels for each DAC range. Also, comparison with ground is performed to establish and accurate ground reference.

Figure 8-27 (b) shows the block diagram of the digital control section of the A3 Board. The digital section mainly contains of an 8-bit MPU (Microprocessor Unit), four 12k Byte ROMs, two 1k Byte RAMs, Address Decoder, ACIA (Ascynchronous Communication Interface Adapter), optocouplers, and Interval Timer.



(b) Digital Control Section

Figure 8-27. Block Diagram of the A3 Board.

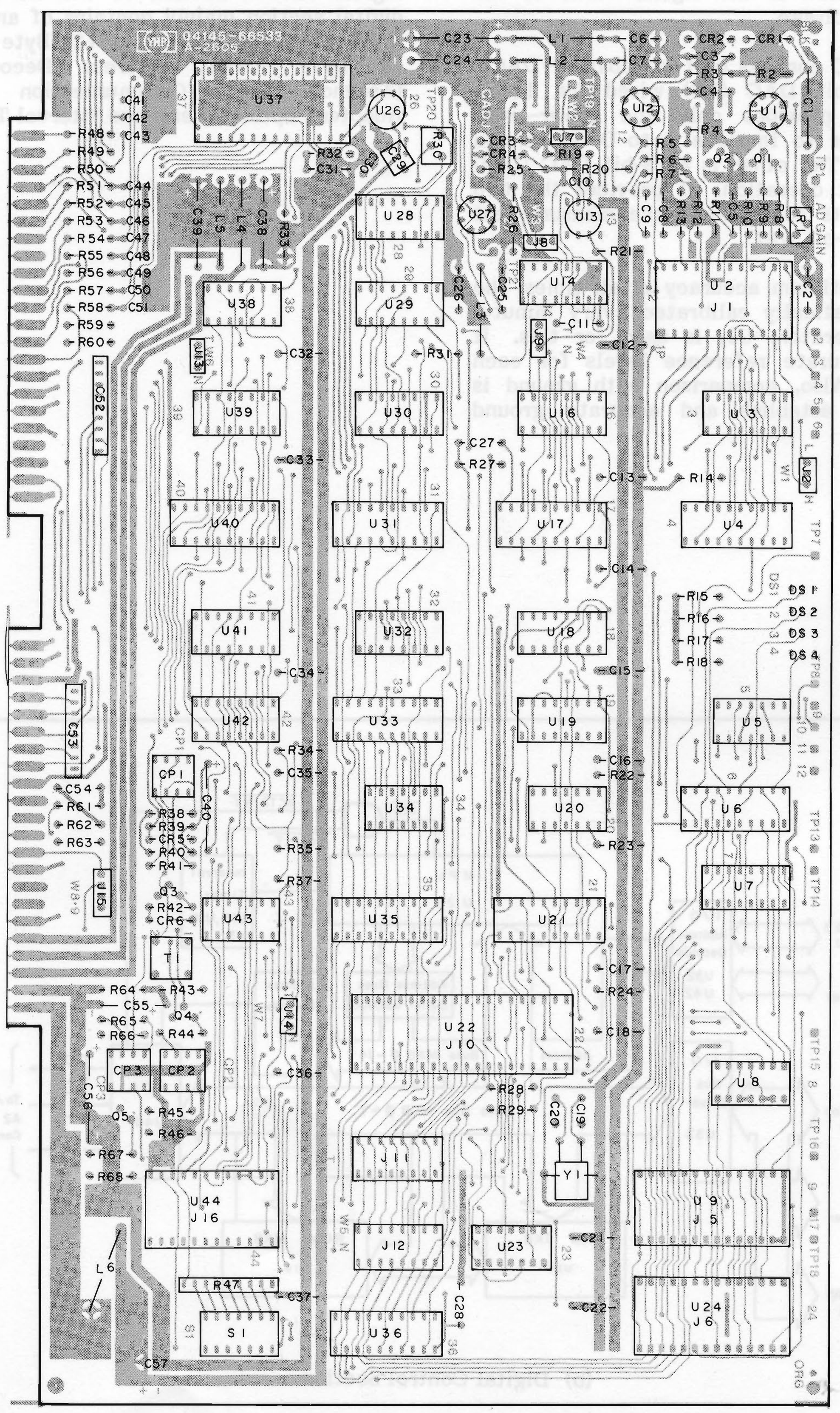
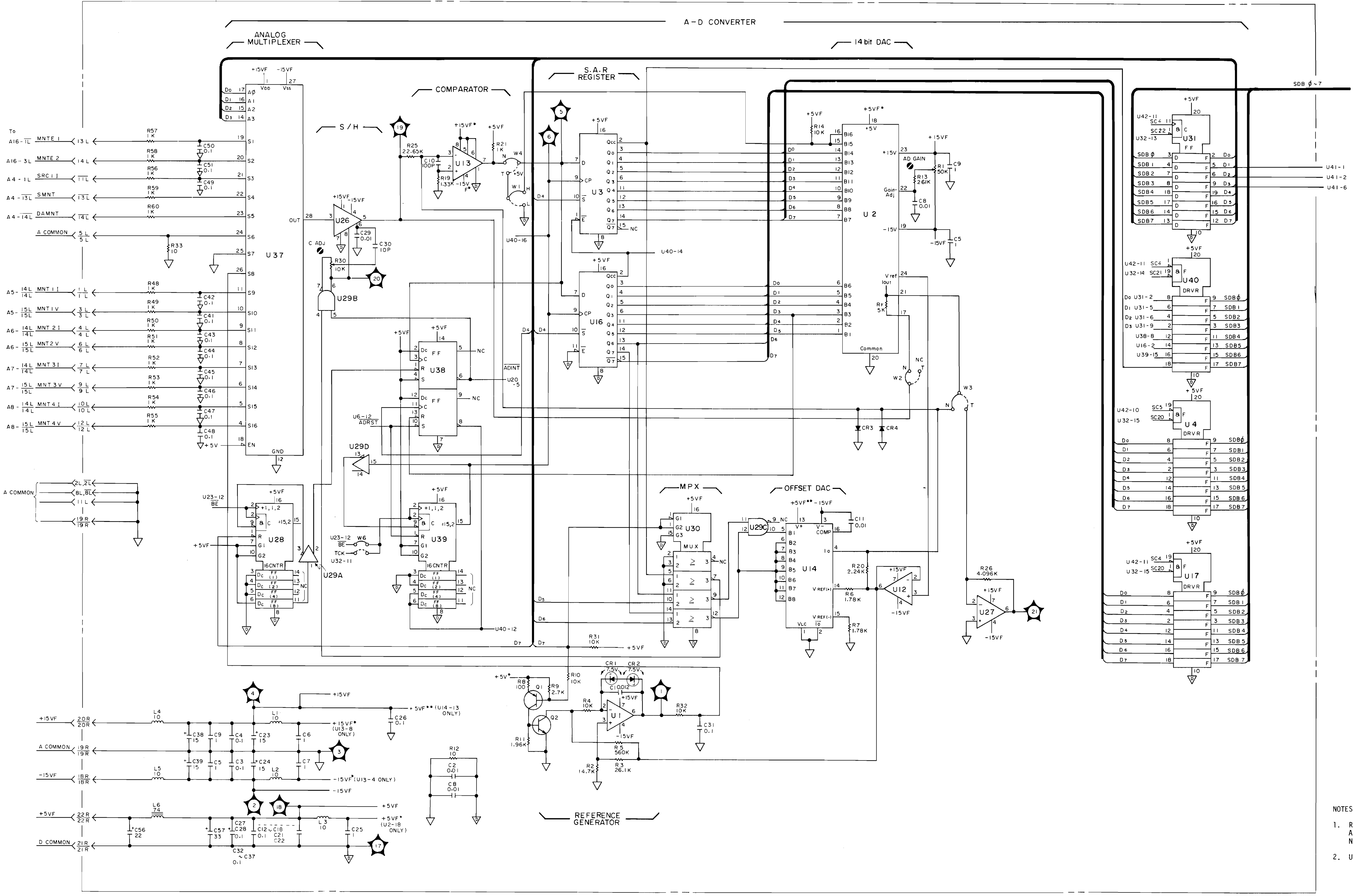


Figure 8-28. A3 SMU Control and A-D Converter Board Assembly Component Locations.

A3 SMU CONTROL & A-D CONVERTER (P/N:04145-66533) 1 OF 2



NOTES:

1. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. PREFIX ABBREVIATION WITH ASSEMBLY NUMBER FOR COMPLETE REFERENCE DESIGNATOR.

2. UNLESS OTHERWISE INDICATED:

RESISTANCE IN OHMS (Ω)
CAPACITANCE IN MICROFARADS (μF)
INDUCTANCE IN MICROHENRIES (μH)

A3 BOARD

Figure 8-29. A3 SMU Control and A-D Converter Board Assembly Schematic Diagram (Sheet 1 of 2).

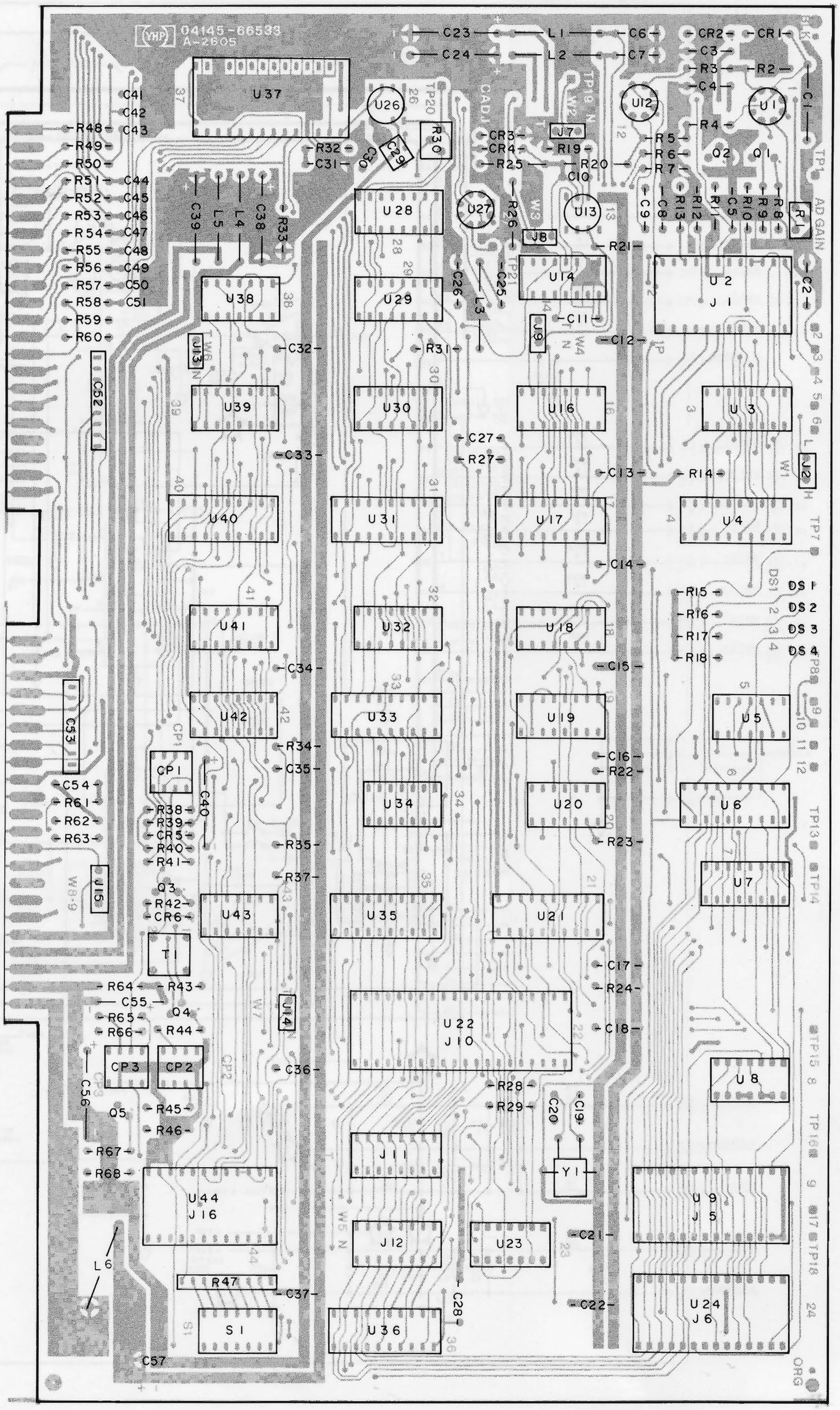
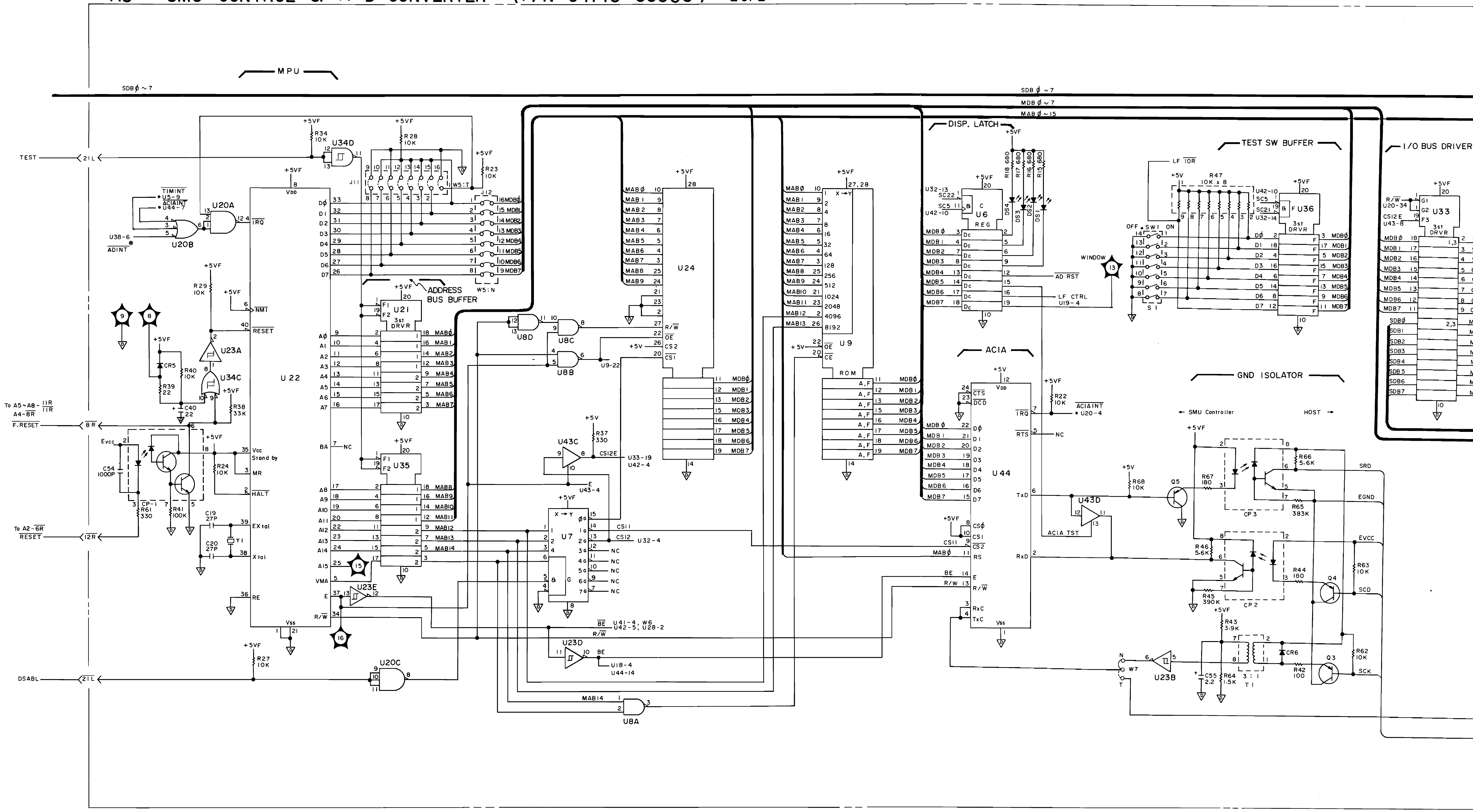
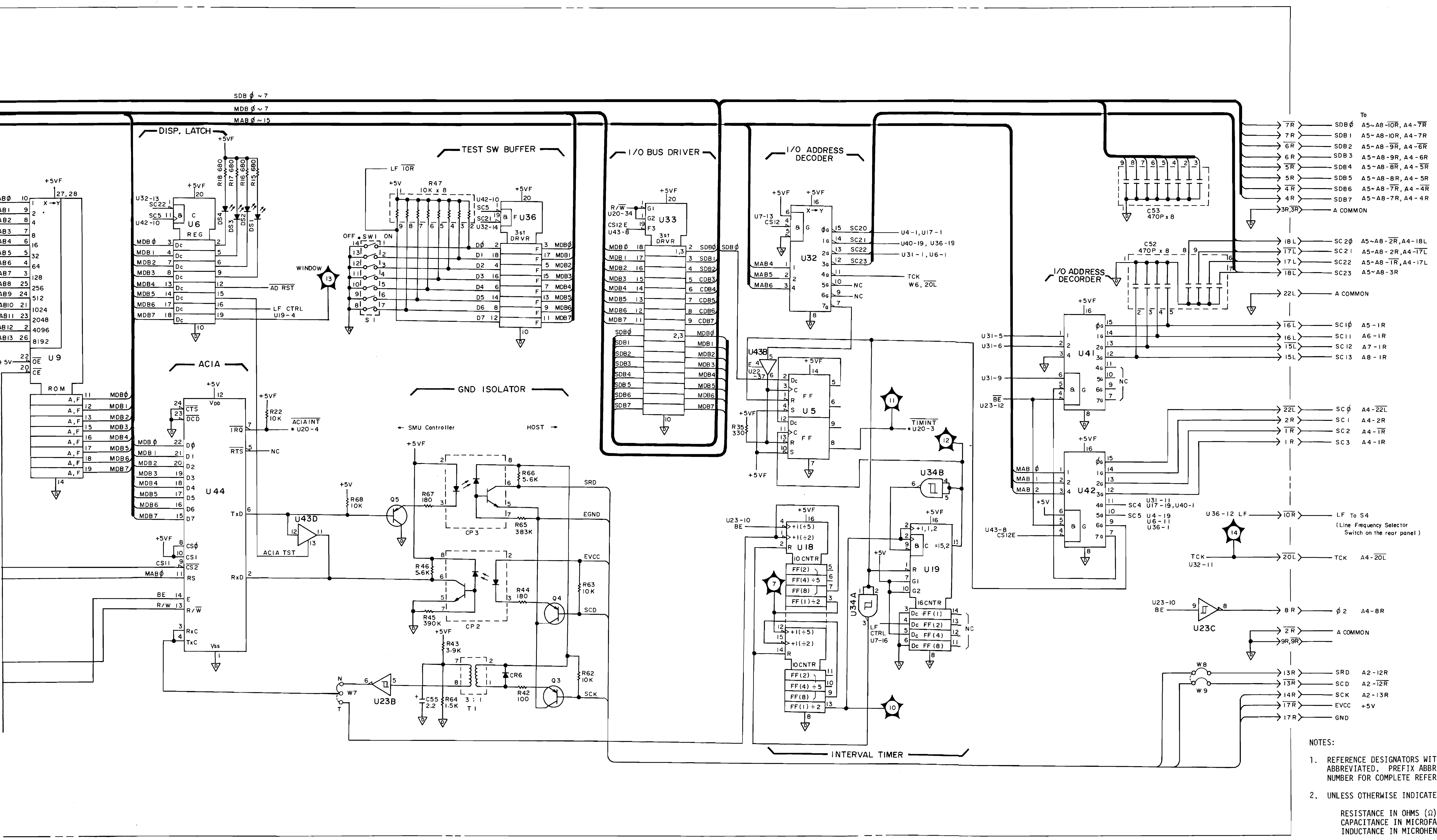


Figure 8-28. A3 SMU Control and A-D Converter Board Assembly Component Locations.

A3 SMU CONTROL & A-D CONVERTER (P/N:04145-66533) 2OF2





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2. UNLESS OTHERWISE INDICATED:

RESISTANCE IN OHMS (Ω)
CAPACITANCE IN MICROFARADS (µF)
INDUCTANCE IN MICROHENRIES (µH)

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8-42. A4 D-A CONVERTER BOARD

8-42. Figure 8-30 shows a simplified block diagram of the A4 board. It consists of four 64-bit static RAMs, a 16-bit D-A converter, an I-V converter, a 10-channel demultiplexer, and ten sample-hold circuits. The entire board functions to provide the requisite reference voltages for the four SMUs and the two voltage sources. All reference voltages provided by this board are determined by the digital data sent from the A3 board and are normalized to values ranging from 0 to ±10V. Resolution is 0.5mV.

Output data (voltage and current values) set on the SOURCE SETUP page (refer to Figure 3-22) are sent from the A3 board and stored in the four RAMs—U1 through U5, U7 through U13. The 16-bit D-A converter--U18 and U24—and the I-V converter—U6, Q1 and Q2--convert the digital data output from the RAMs into an analog voltage, which is then applied to the input of the appropriate sample-hold circuit by the 10-channel demultiplexer.

Other circuits on this board are the Multiplex Timing Controller, which handles RAM Read/Write addressing and demultiplexer timing; the Bus Interface for data memory; SMU Loop Change Detector, which monitors the operation mode (V or I) of each SMU; and the Test Switch circuit, which is used during self-test to check the D-A converter.

[D-A Converter]

The D-A converter on this board consists of a 14-bit D-A converter, U18, and an 8-bit offset D-A converter, U24, wired for 2-bit operation. It is similar to the D-A converter on the A3 board. Output from the D-A converter is a current that is proportional to the binary value provided by the RAMs.

[I/V Converter]

Because the DAC is a current driven type, an I/V converter is used to convert the output current into voltage. Figure 8-31 shows the output waveform at TP1 when the 4145B is in an idle condition (measurement is not being made).

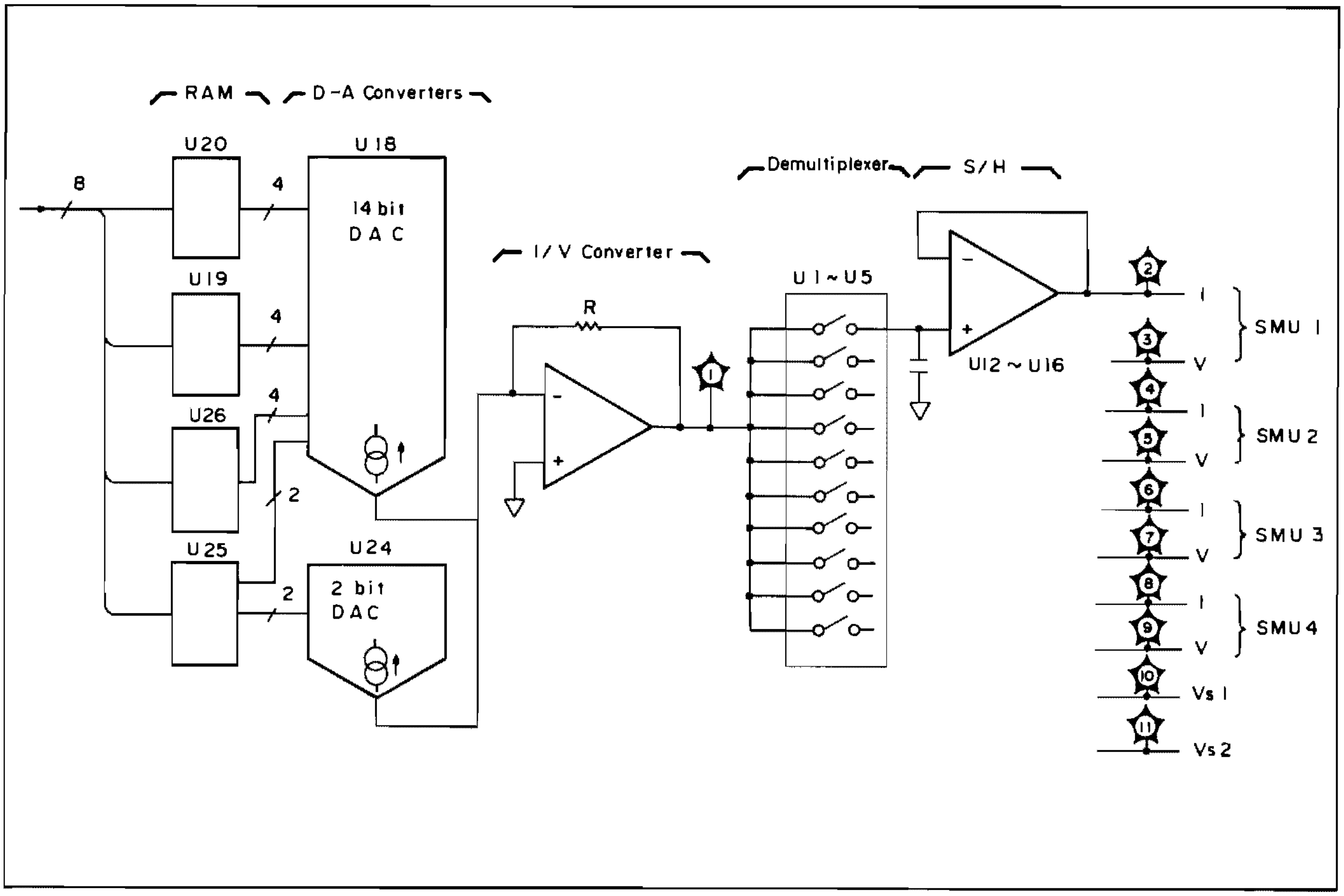


Figure 8-30. Block Diagram of A4 Board.

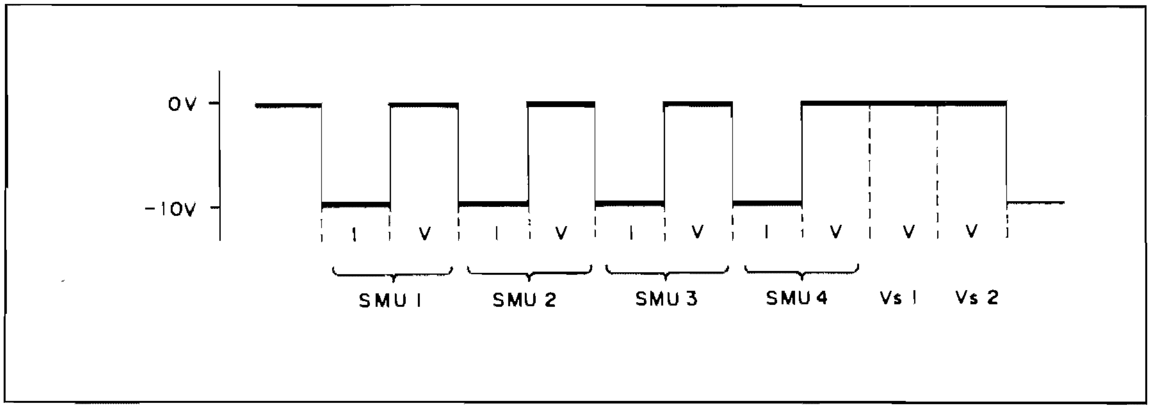


Figure 8-31. I-V Converter Output.

[Demultiplexer]

The demultiplexer contains analog switches, U1 through U5, and distributes the ten reference voltages provided by the DAC and I/V converter to appropriate sample-hold circuit. Figure 8-32 shows circuitry for each demultiplexer channel. Two FET switches are driven by a control signal provided by the Timing Controller. To isolate the sample-hold circuit in sample mode from the I/V converter, an isolation capacitor is connected between the two switches. Also, to cancel the drive signal transmitted through gate-drain capacitor of the FET switch, an opposite signal is applied through the injection capacitor.

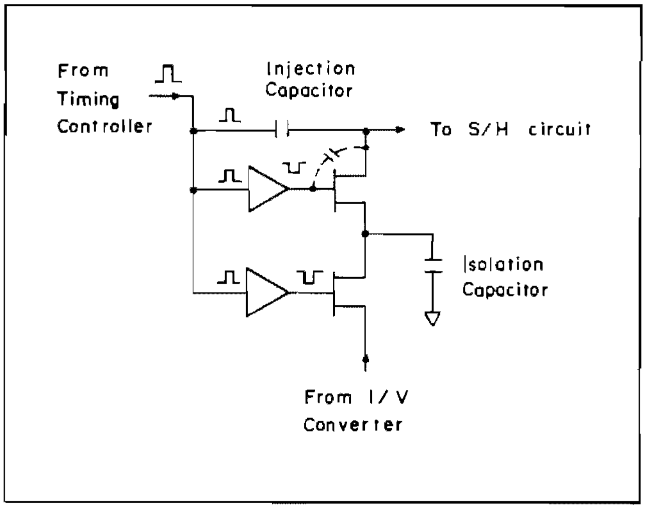


Figure 8-32. Analog Switch.

[Loop Back Test]

The test switch selector, U33, and the test switches--U30, U31 and U32--are used during the loop back test portion of the self-test. The loop back test confirms correct operation of the A4 D-A converter and the A3 A-D converter.

When self-test is executed, the microprocessor on the A3 board stores a predetermined binary value in the A4 RAMs. The DAC converts this value into an analog voltage which is distributed to each output channel by the demultiplexer. The test switch selector controls the test switches so that each channel is, in turn, selected for output to the ADC on the A3 board. After A-D conversion, the microprocessor compares the original binary value with that output from the ADC, thus confirming correct DAC and ADC operation.

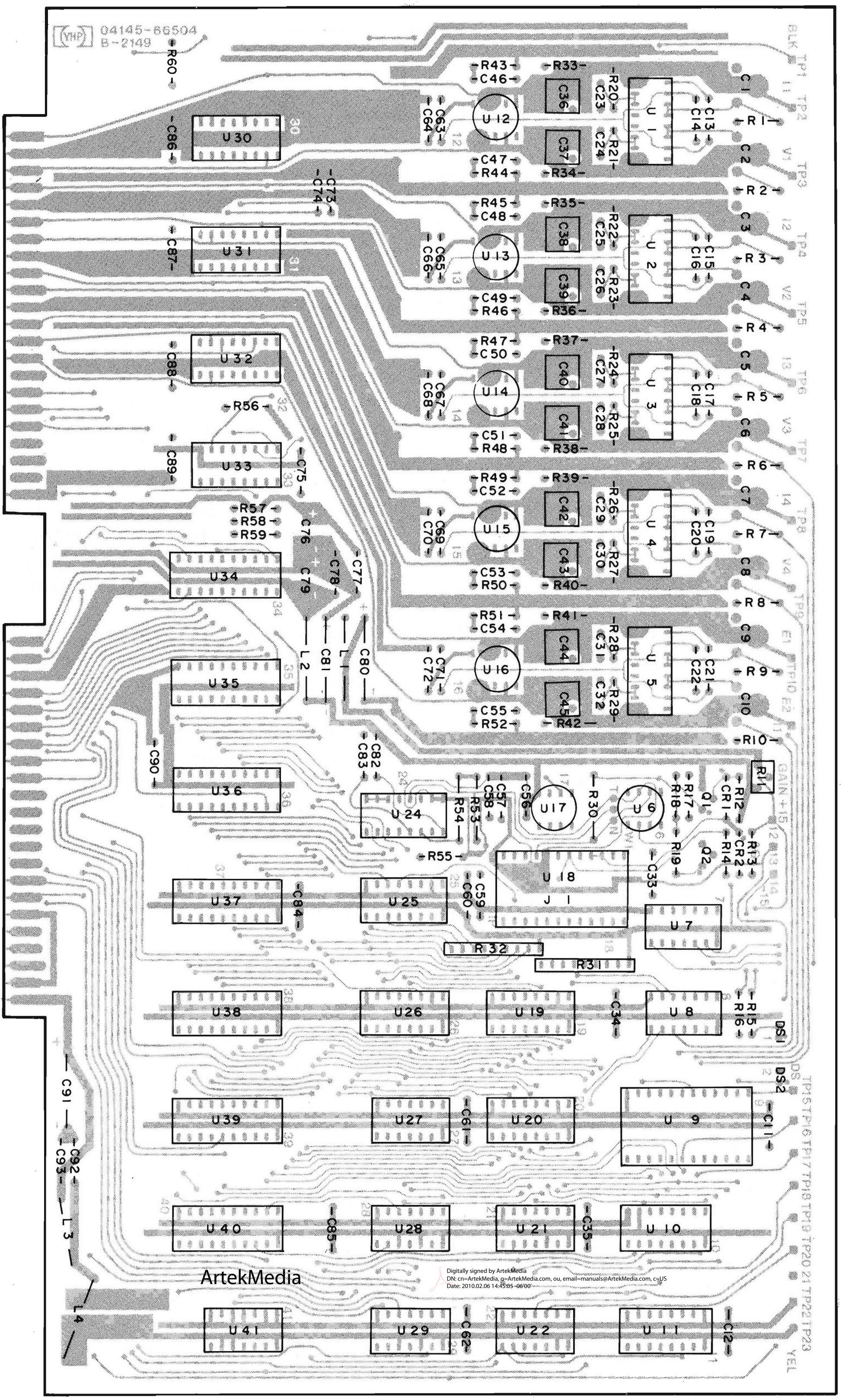
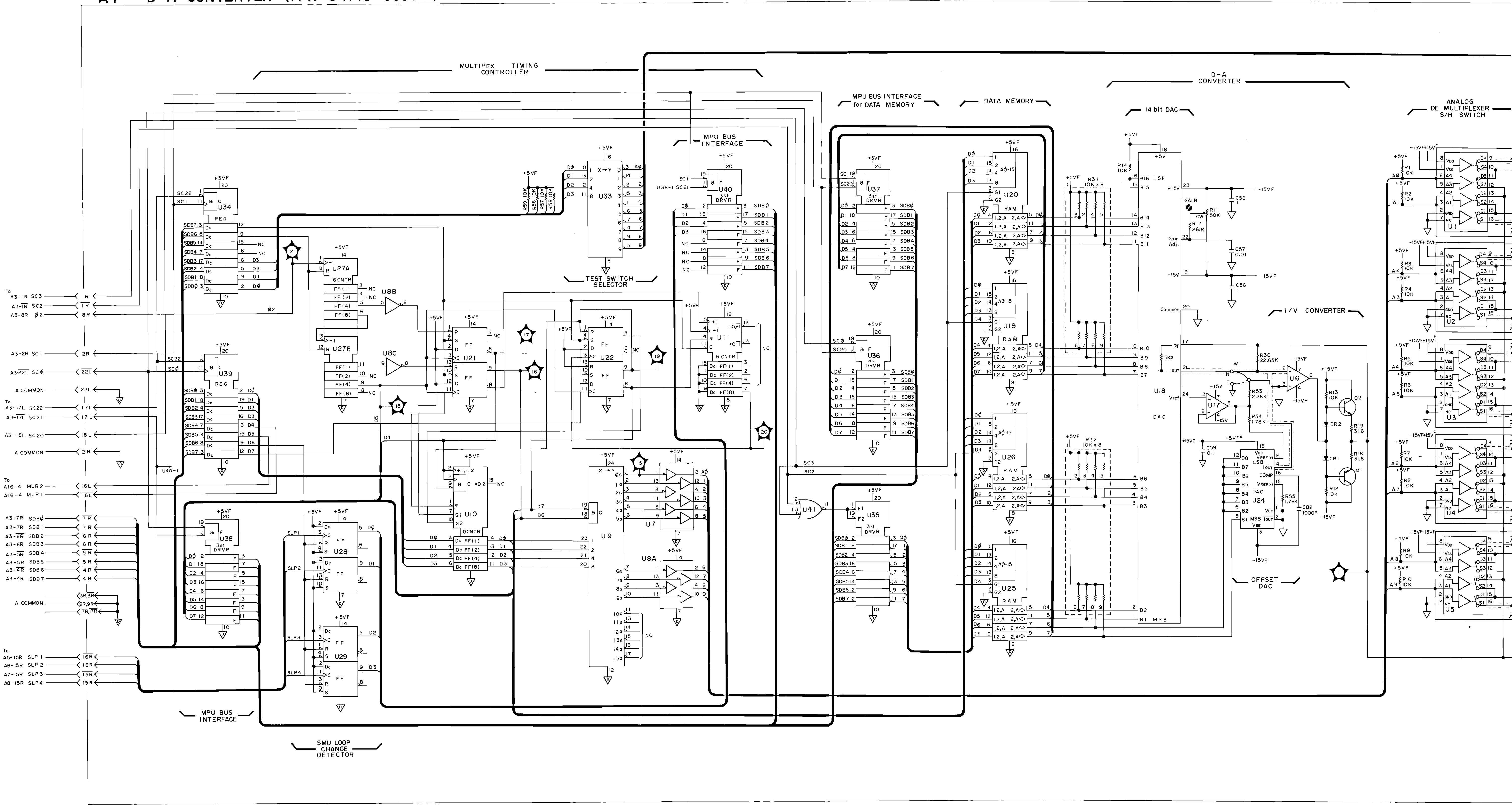
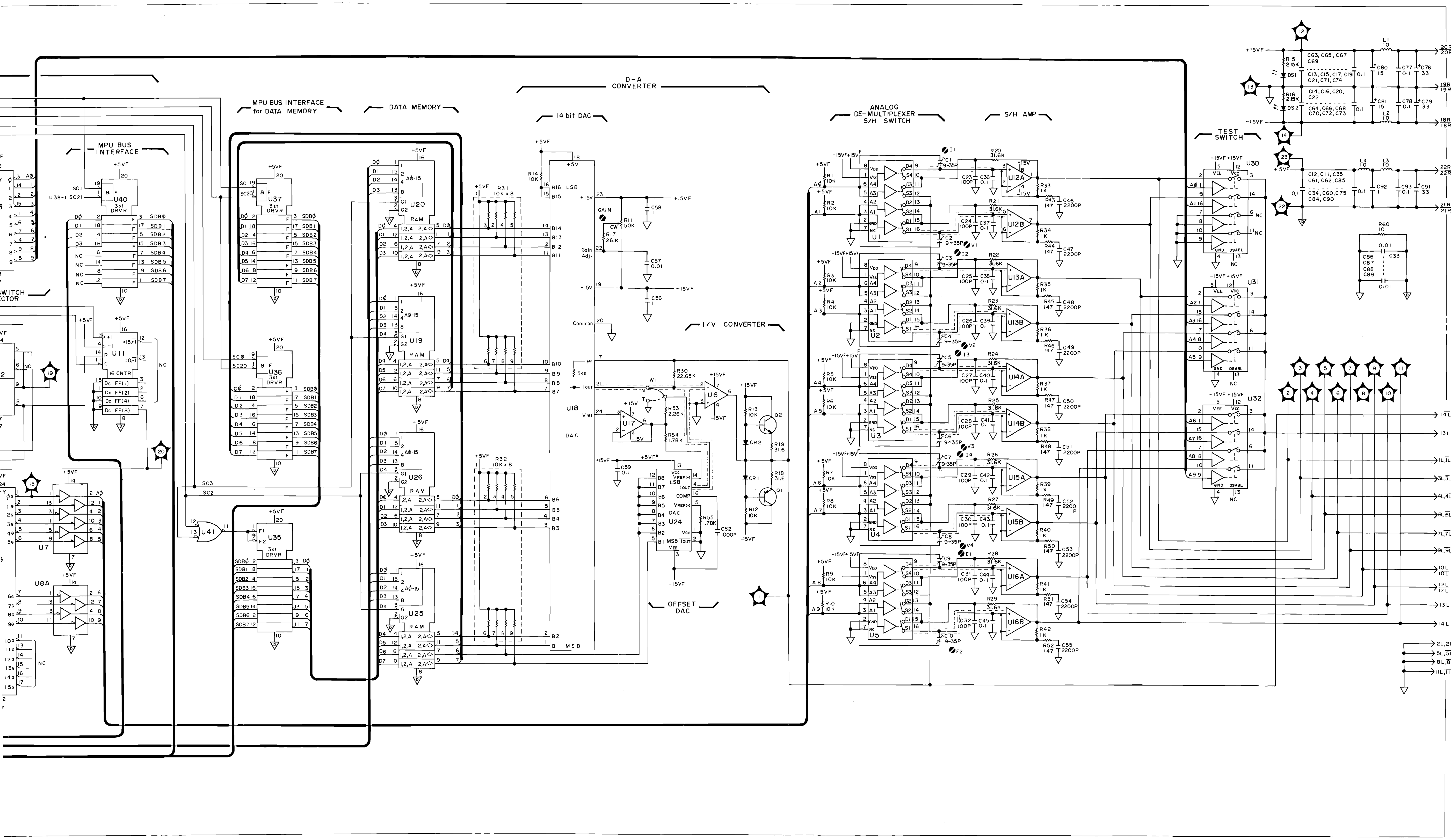


Figure 8-33. A4 D-A Converter Board Assembly Component Locations.

A4 D-A CONVERTER (P/N:04145-66504)





NOTES:

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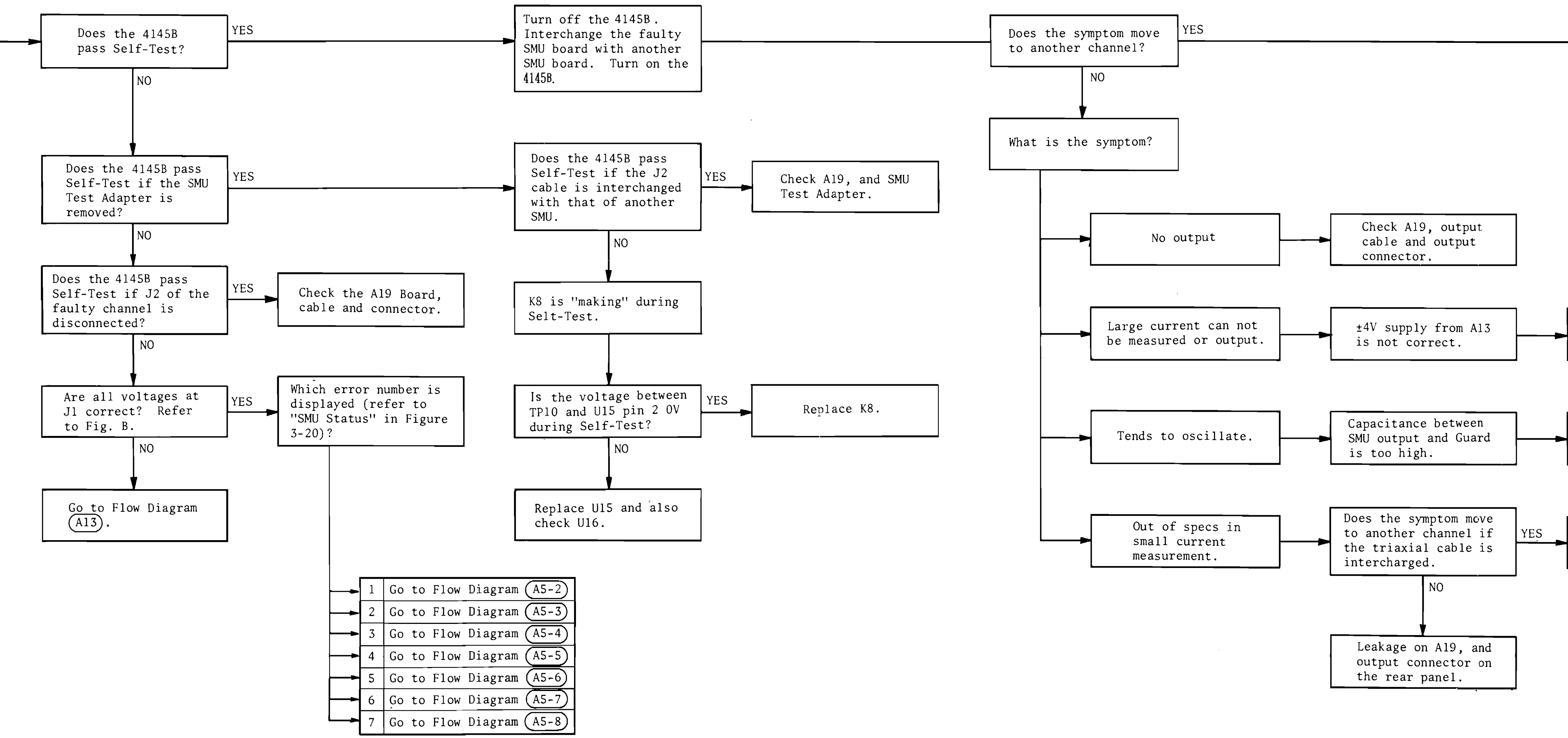
2. UNLESS OTHERWISE INDICATED:

RESISTANCE IN OHMS (Ω)
CAPACITANCE IN MICROFARADS (μF)
INDUCTANCE IN MICROHENRIES (μH)

Flow Diagram (A5 - 1)



To short the SMU output, use the SMU Test Adapter (P/N 04145-65001), BNC Shorting Connector (P/N 04145-65002) and BNC (m) -to-BNC (m) adapter. Connection is shown below:

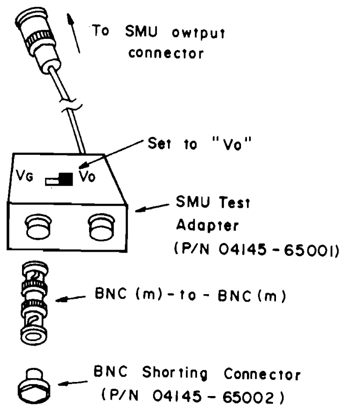


Figure A

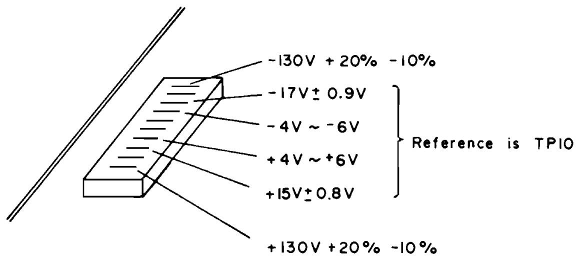
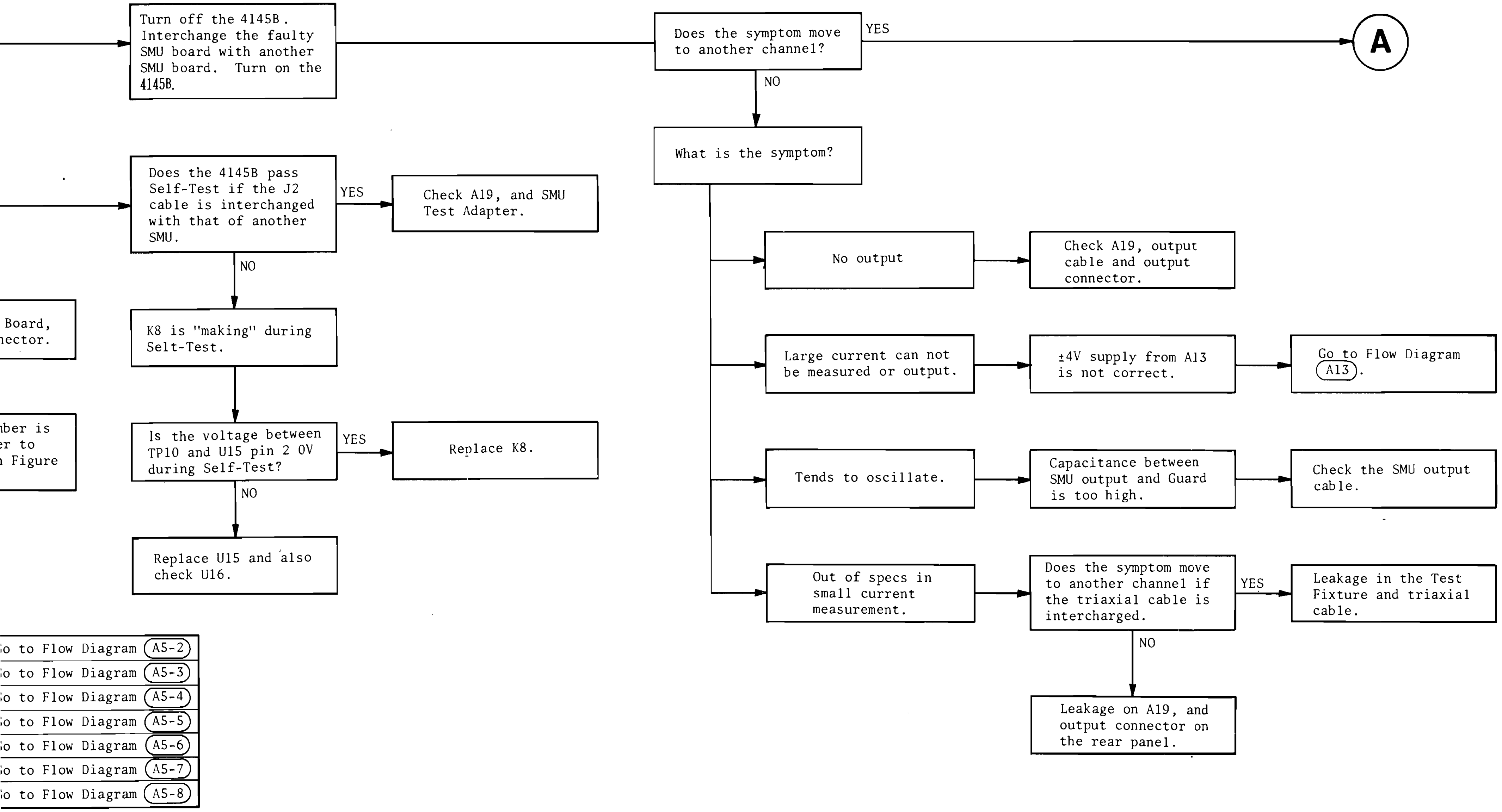


Figure B

A4 BOARD

SEE INSIDE

Figure 8-34. A4 D-A Converter Board Assembly Schematic Diagram.

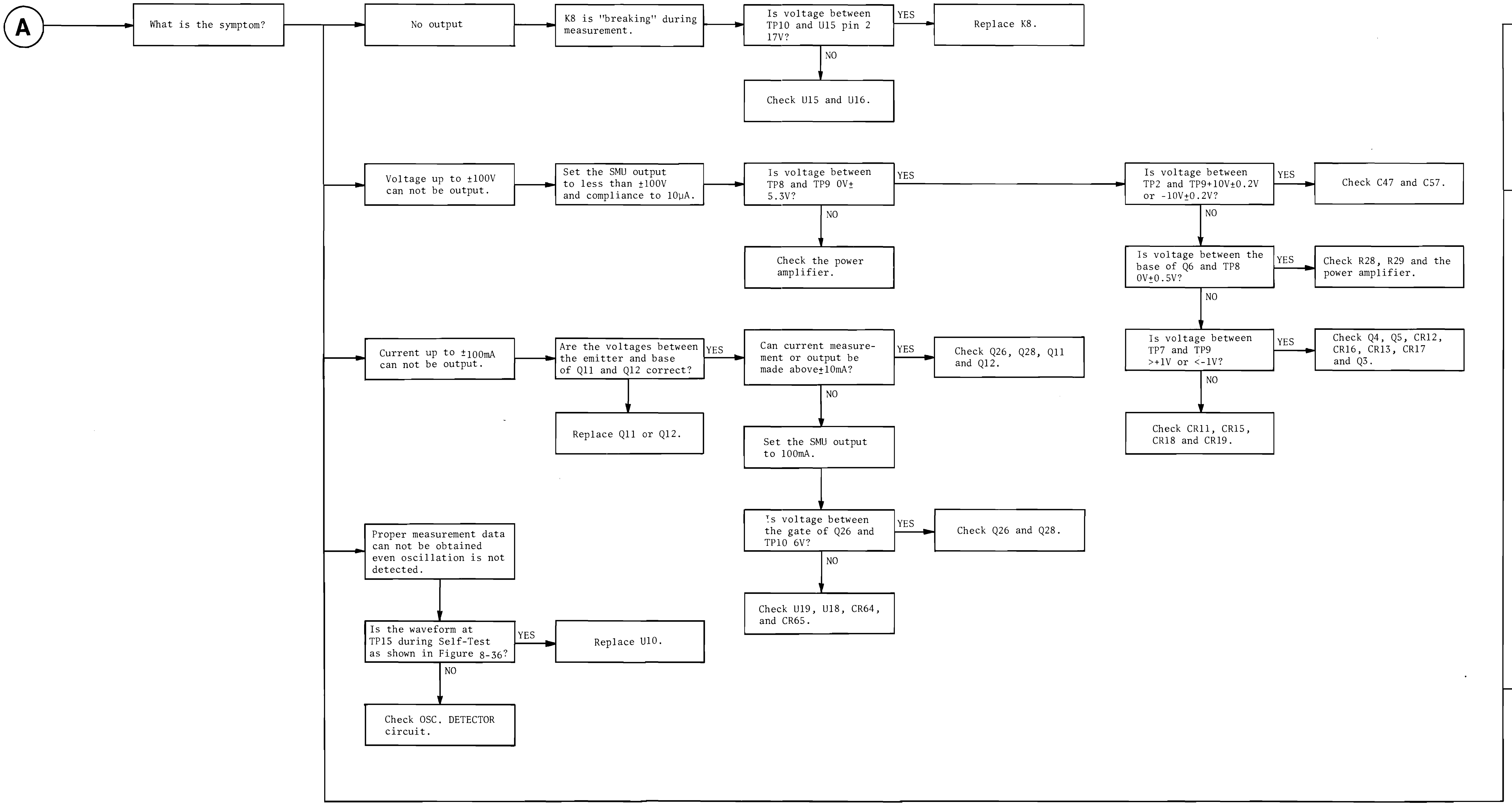


A4 BOARD

SEE INSIDE

Figure 8-34. A4 D-A Converter Board Assembly Schematic Diagram.

Figure 8-35. A5 Board Troubleshooting Flow Diagram (Sheet 1 of 9).


A
What is the symptom?
No output
K8 is "breaking" during measurement.
Is voltage between TP10 and U15 pin 2 17V?
YES
Replace K8.
NO
Check U15 and U16.
Voltage up to ±100V can not be output.
Set the SMU output to less than ±100V and compliance to 10μA.
Is voltage between TP8 and TP9 0V± 5.3V?
YES
NO
Check the power amplifier.
Is voltage between TP2 and TP9+10V±0.2V or -10V±0.2V?
YES
Check C47 and C57.
NO
Is voltage between the base of Q6 and TP8 0V±0.5V?
YES
Check R28, R29 and the power amplifier.
NO
Is voltage between TP7 and TP9 >+1V or <-1V?
YES
Check Q4, Q5, CR12, CR16, CR13, CR17 and Q3.
NO
Check CR11, CR15, CR18 and CR19.
Current up to ±100mA can not be output.
Are the voltages between the emitter and base of Q11 and Q12 correct?
YES
Replace Q11 or Q12.
Can current measurement or output be made above±10mA?
YES
Check Q26, Q28, Q11 and Q12.
NO
Set the SMU output to 100mA.
Is voltage between the gate of Q26 and TP10 6V?
YES
Check Q26 and Q28.
NO
Check U19, U18, CR64, and CR65.
Proper measurement data can not be obtained even oscillation is not detected.
Is the waveform at TP15 during Self-Test as shown in Figure 8-36?
YES
Replace U10.
NO
Check OSC. DETECTOR circuit.

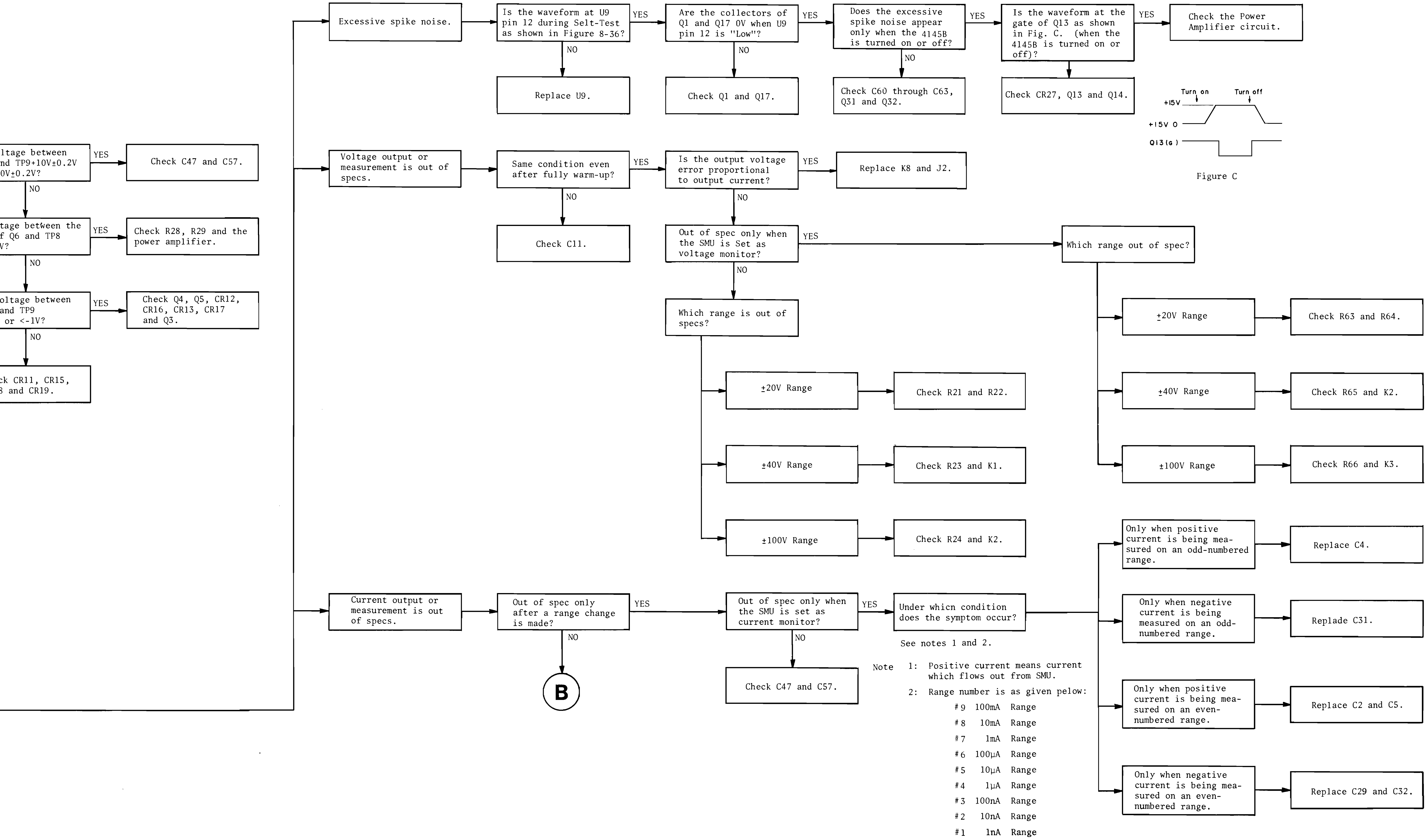


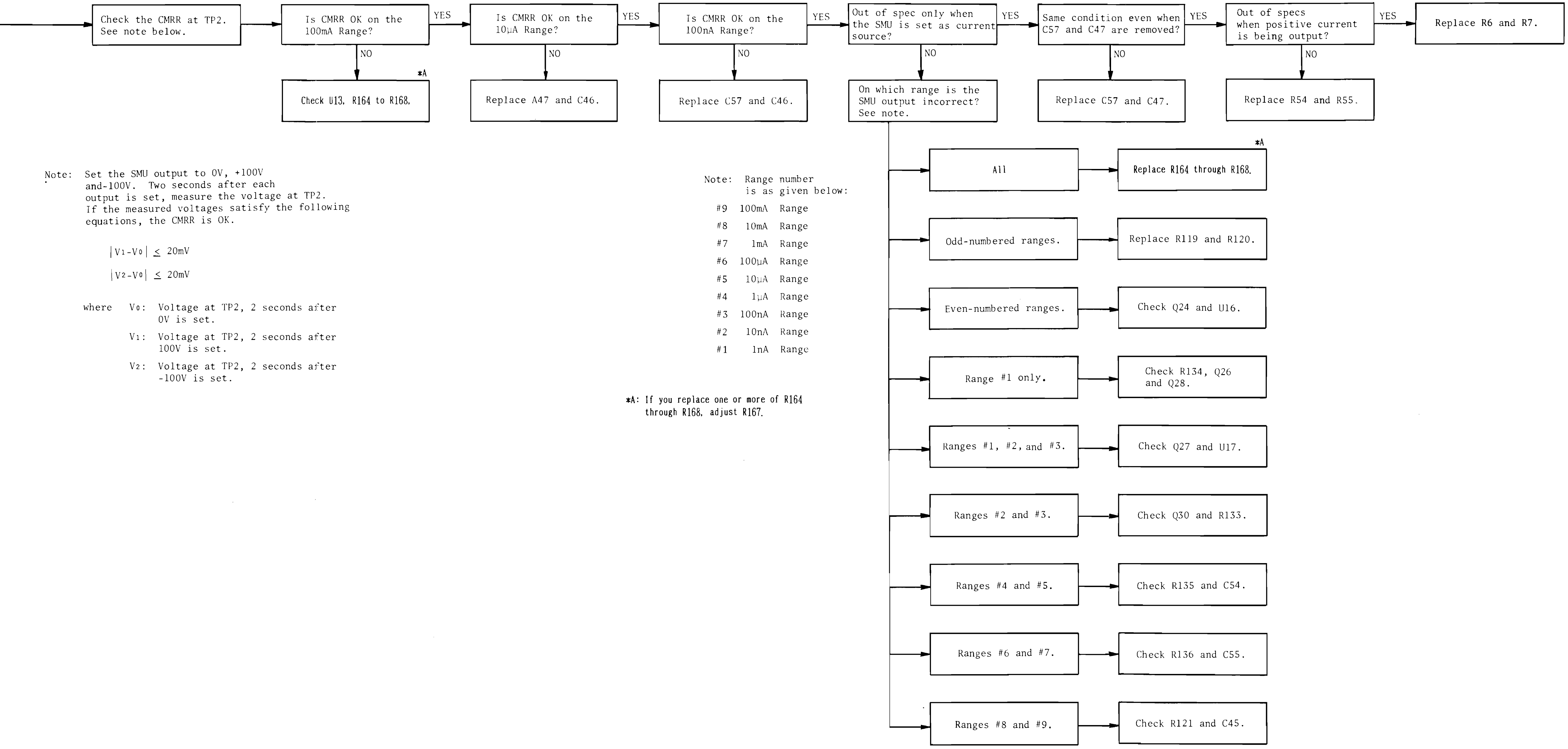
Figure C

See notes 1 and 2.

Note 1: Positive current means current which flows out from SMU.

2: Range number is as given pelow:

#9	100mA	Range
#8	10mA	Range
#7	1mA	Range
#6	100μA	Range
#5	10μA	Range
#4	1μA	Range
#3	100nA	Range
#2	10nA	Range
#1	1nA	Range



Note: Set the SMU output to 0V, +100V and-100V. Two seconds after each output is set, measure the voltage at TP2. If the measured voltages satisfy the following equations, the CMRR is OK.

$$|V_1 - V_0| \leq 20mV$$

$$|V_2 - V_0| \leq 20mV$$

where V_0: Voltage at TP2, 2 seconds after 0V is set.

V_1: Voltage at TP2, 2 seconds after 100V is set.

V_2: Voltage at TP2, 2 seconds after -100V is set.

Note: Range number is as given below:

#9	100mA	Range
#8	10mA	Range
#7	1mA	Range
#6	100μA	Range
#5	10μA	Range
#4	1μA	Range
#3	100nA	Range
#2	10nA	Range
#1	1nA	Range

*A: If you replace one or more of R164 through R168, adjust R167.

A5 Troubleshooting Flow Diagram

SEE INSIDE

Figure 8-35. A5 Board Troubleshooting Flow Diagram (Sheet 2 of 9).

Figure 8-35. A5 Board Troubleshooting Flow Diagram (Sheet

Flow Diagram (A5 - 2)

START

(SMU Status Error 1)

Unless otherwise indicated, waveforms are those observed during the Self-Test sequence for Error 1. Execute the self-test on the "DIAGNOSTICS" page and refer to Fig. 8-36.

YES

Is the waveform at TP11 between -10V and 10V?

NO: Connect TP8 to TP9. After this, Self-Test is not necessary. Use a DVM to check the voltages. Unless otherwise indicated, refference is TP9.

Check the voltages at L1, L2, L3, CR10 and CR14. Refer to Fig. D.

Are all voltages correct?

NO: Check Lk, L2, L3 CR10 and CR14, also C6, C9 for leakage.

YES: Is the voltage at TP10 0V±1V?

NO: Check the voltages at J1. See Fig. E.

Are the ±130V and ±4V correct?

YES: Check the power amplifier circuit.

NO: Go to Flow Diagram (A13).

YES: Is the voltage at TP2 0V±0.1V?

YES: Are the voltages at TP1 and TP14 +10V ±0.2V and -10V±0.2V, respectively?

NO: Check U6.

YES: Is the voltage at TP3 +1.2V±0.2V?

NO: Check U1, CR4 and CR8.

YES: Is the -1.2V

Check U

NO: Is the voltage between TP12 and 13 0V±0.1V?

YES: Check U4, R164 to R168, Q23, and Q24. *A

*A: If you replace one or more of R164 through R168, adjust R167.

NO: Check the voltages at J1. See Fig. E.

Are the +15V and -17V correct? Also, are the voltages across CR66 and CR63 correct?

NO: Check L4 and L5, CR66 and CR63.

YES: Check the logic levels at the following points. Reference is TP10.

H: -17V, L: 0V

U16 pin 4:	H	U17 pin 4:	L
pin 5:	H	pin 5:	L
pin 7:	L	pin 6:	H
pin 12:	H	pin 7:	H
pin 13:	L	pin 12:	L
pin 14:	H	pin 13:	L
		pin 14:	H

Are all correct?

NO: Check U16, U17, Q23, Q24, Q25, Q27 and Q29.

YES

YES (from Is the waveform at TP11 between -10V and 10V?): Is the waveform at TP1 correct? *1

NO: Check U6.

*1: The waveform at TP14 is 180° out of phase with the waveform at TP1.

YES: Is the waveform at TP11 correct?

NO: (C)

YES: Observe the waveform at TP2. Are the portions enclosed in circles in Fig. F ±1V±0.2V and 0V±0.2V?

NO: Check K5, K6 and K7, and their drive circuits.

YES: Is the waveform at TP6 less than $20mV_{p-p}$?

NO: Check U5.

YES: Is the waveform at TP16 correct?

NO: Check the control Loop Detector circuit.

YES: Is

Chec Dete

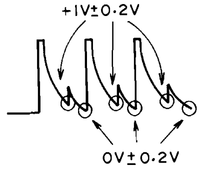


Figure F

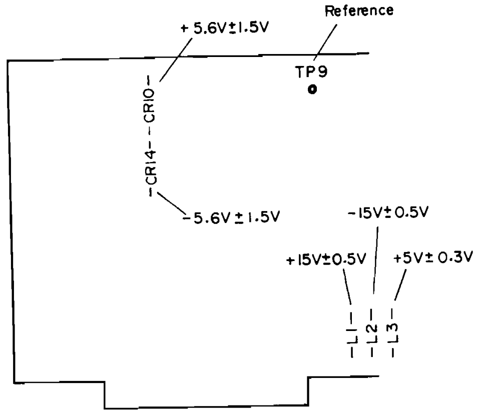


Figure D

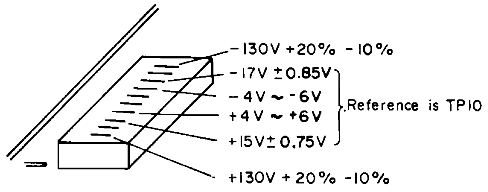
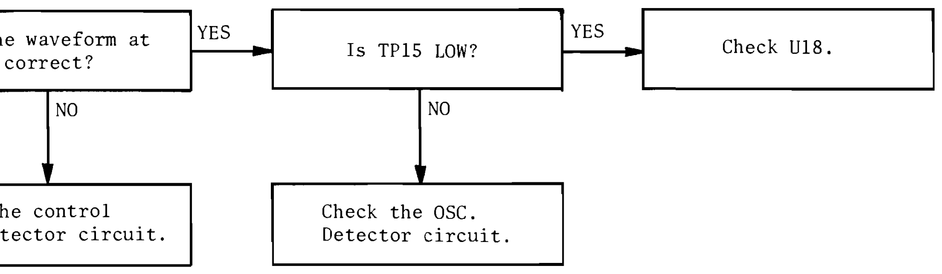


Figure E



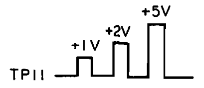
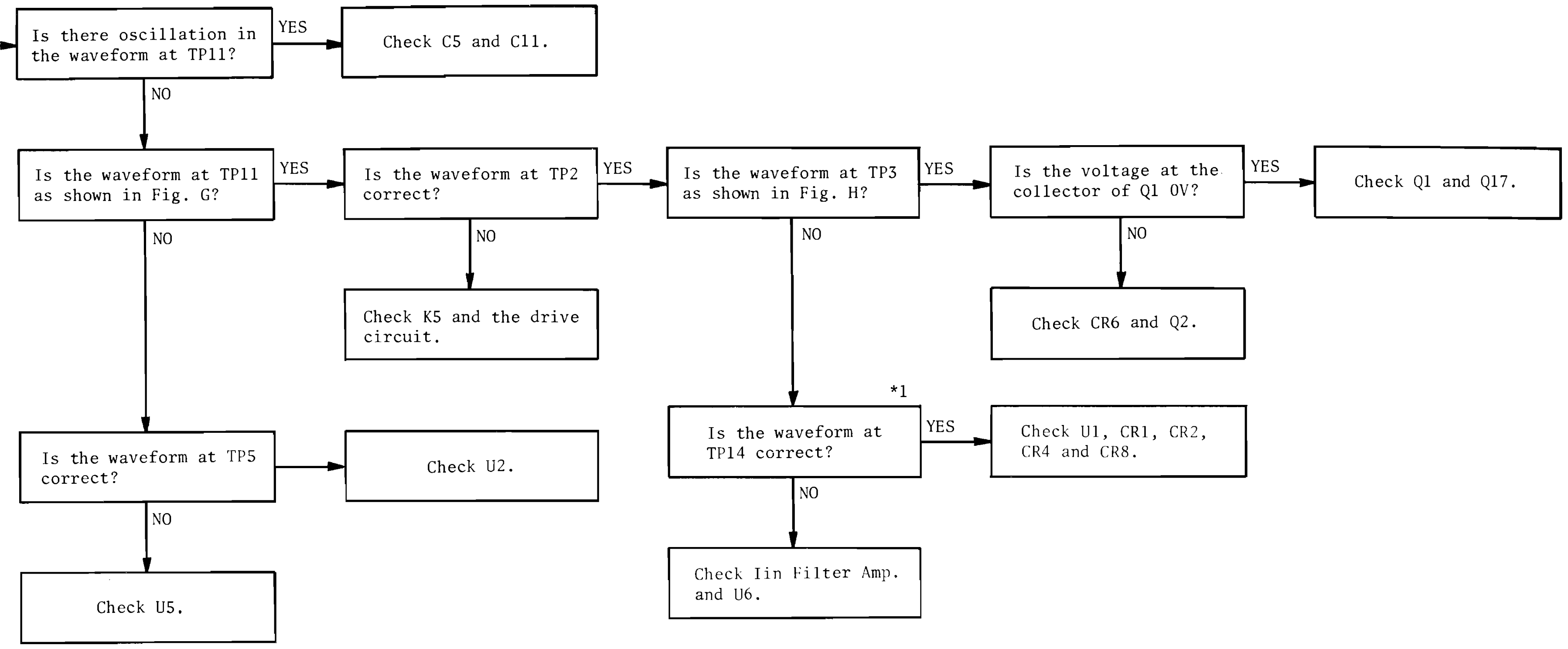
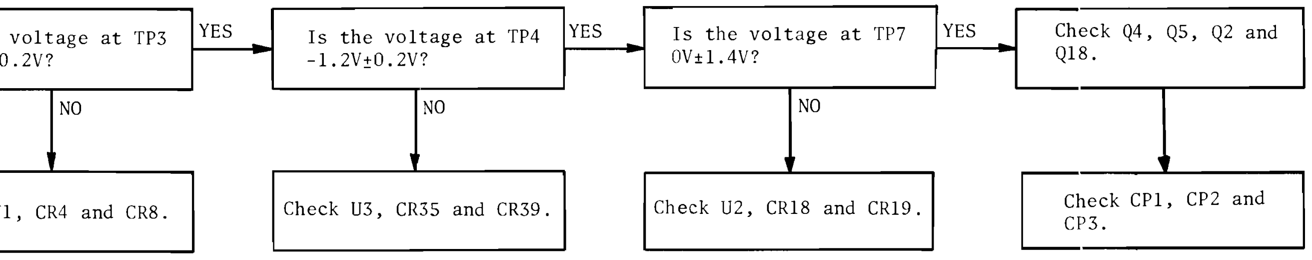


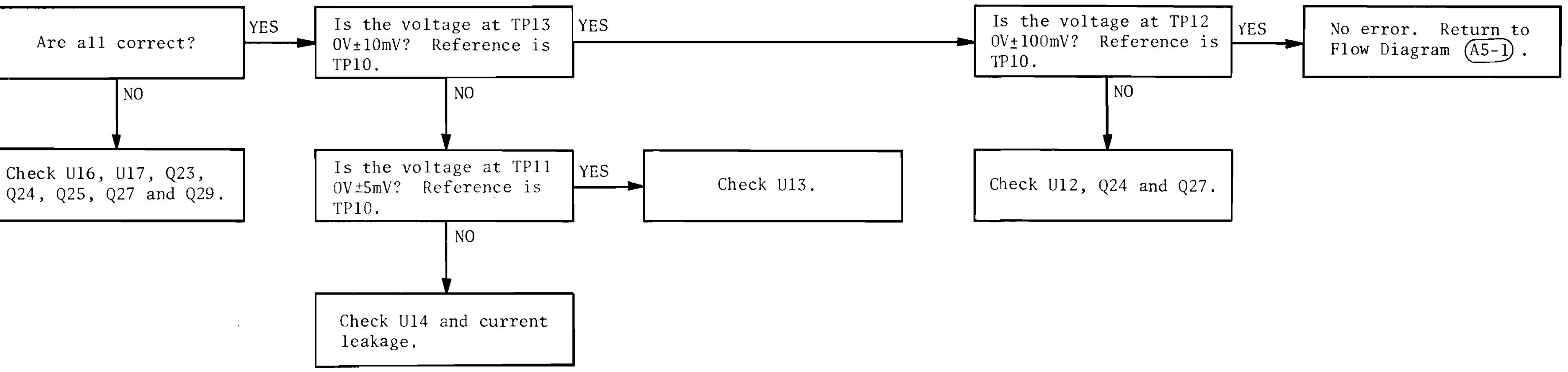
Figure G

Figure H

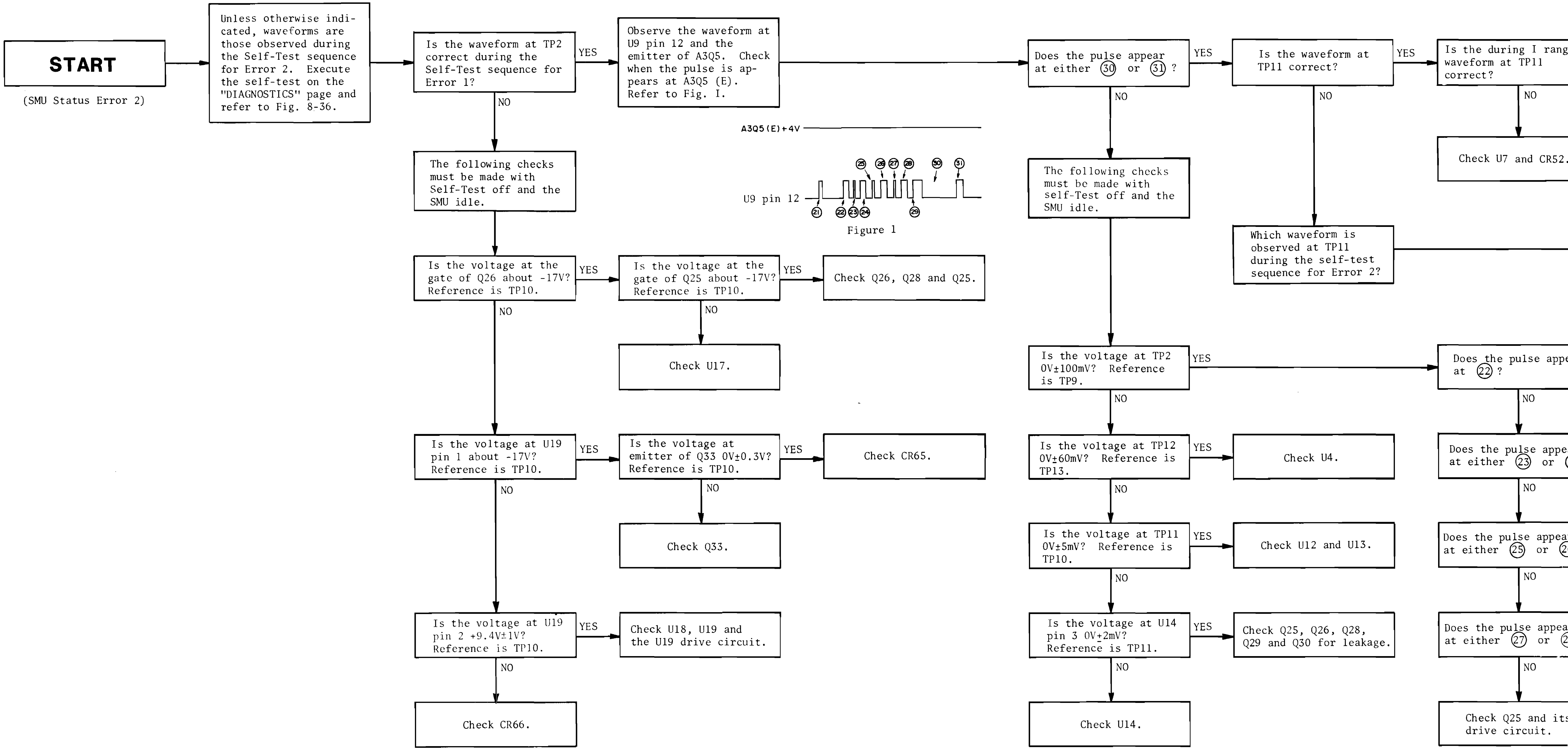




place one or more of R164
168, adjust R167.



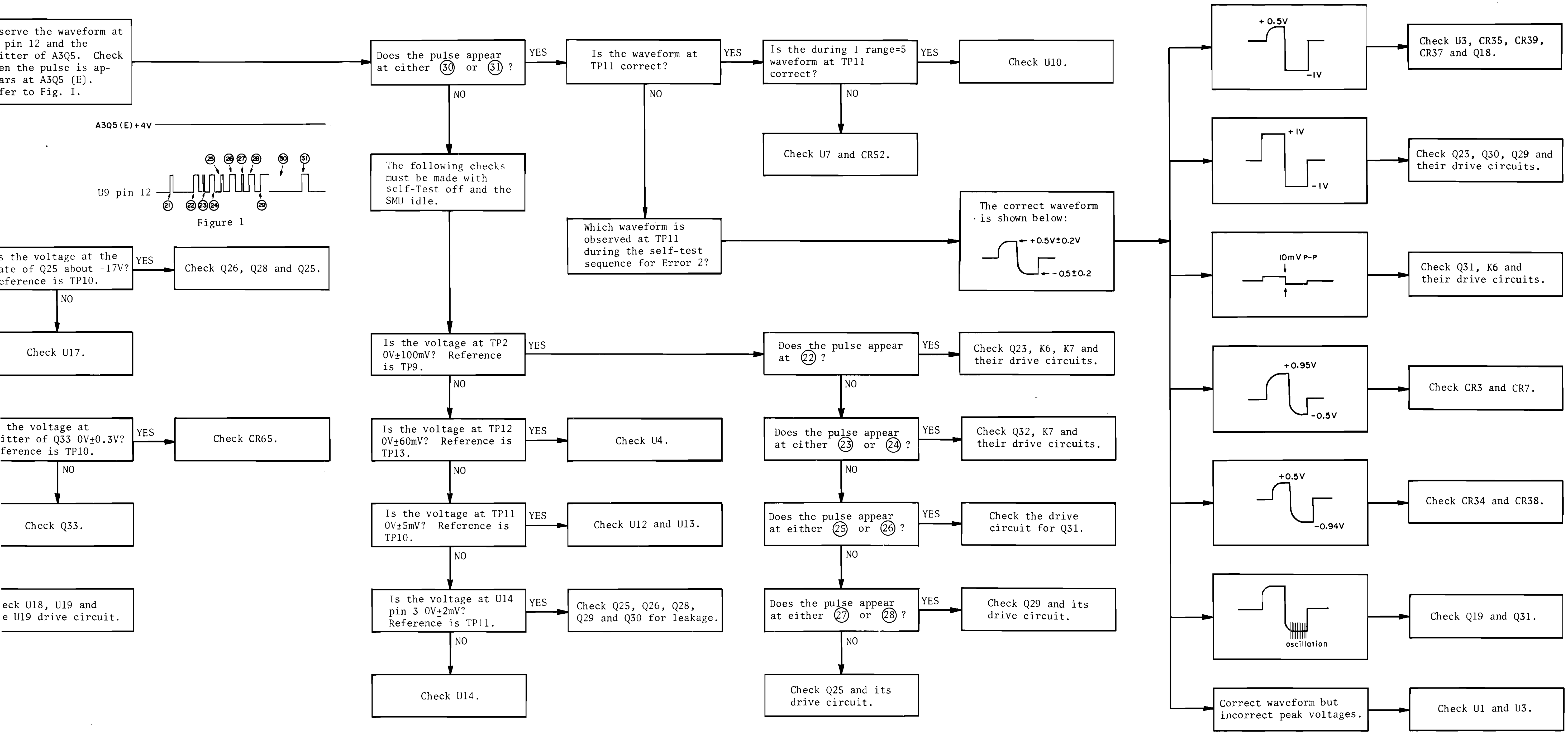
Flow Diagram (A5 - 3)



A5 Troubleshooting Flow Diagram

SEE INSIDE

Figure 8-35. A5 Board Troubleshooting Flow Diagram (Sheet 4 of 9).



serve the waveform at pin 12 and the itter of A3Q5. Check en the pulse is ap- ars at A3Q5 (E). fer to Fig. I.

Figure 1

s the voltage at the ate of Q25 about -17V? eference is TP10.

Check Q26, Q28 and Q25.

Check U17.

the voltage at itter of Q33 0V±0.3V? ference is TP10.

Check CR65.

Check Q33.

eck U18, U19 and e U19 drive circuit.

Does the pulse appear at either ㉚ or ㉛ ?

The following checks must be made with self-Test off and the SMU idle.

Is the voltage at TP2 0V±100mV? Reference is TP9.

Is the voltage at TP12 0V±60mV? Reference is TP13.

Check U4.

Is the voltage at TP11 0V±5mV? Reference is TP10.

Check U12 and U13.

Is the voltage at U14 pin 3 0V±2mV? Reference is TP11.

Check Q25, Q26, Q28, Q29 and Q30 for leakage.

Check U14.

Is the waveform at TP11 correct?

Which waveform is observed at TP11 during the self-test sequence for Error 2?

Is the during I range=5 waveform at TP11 correct?

Check U10.

Check U7 and CR52.

The correct waveform is shown below:

Does the pulse appear at ㉒ ?

Check Q23, K6, K7 and their drive circuits.

Does the pulse appear at either ㉓ or ㉔ ?

Check Q32, K7 and their drive circuits.

Does the pulse appear at either ㉕ or ㉖ ?

Check the drive circuit for Q31.

Does the pulse appear at either ㉗ or ㉘ ?

Check Q29 and its drive circuit.

Check Q25 and its drive circuit.

Check U3, CR35, CR39, CR37 and Q18.

Check Q23, Q30, Q29 and their drive circuits.

Check Q31, K6 and their drive circuits.

Check CR3 and CR7.

Check CR34 and CR38.

Check Q19 and Q31.

Correct waveform but incorrect peak voltages.

Check U1 and U3.

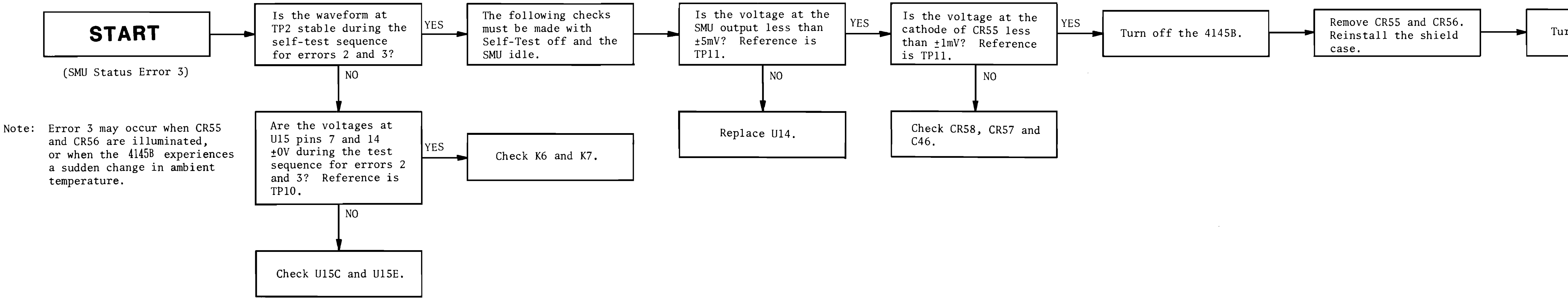
A5 Troubleshooting Flow Diagram

SEE INSIDE

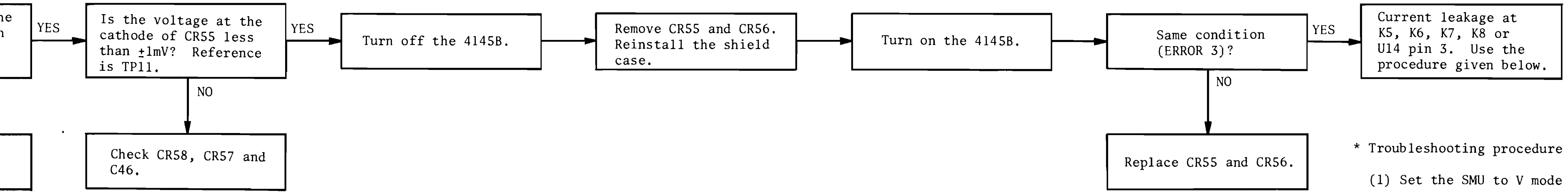
Figure 8-35. A5 Board Troubleshooting Flow Diagram (Sheet 4 of 9).

Figure 8-35. A5 Board Troubleshooting Flow Diagram (Sheet 5 of 9).

Flow Diagram A5 - 4



Note: Error 3 may occur when CR55 and CR56 are illuminated, or when the 4145B experiences a sudden change in ambient temperature.



* Troubleshooting procedure for leakage current.

(1) Set the SMU to V mode (I measurement).

(2) Connect nothing to the SMU's output (open).

(3) Peform a REPEAT measurement.

(4) Monitor the voltage at TP2.

(5) Breath upon the suspected component. Use a 3mmϕ tube.

(6) If the voltage at TP2 increases, replace the component.

Flow Diagram (A5 - 5)

START

(SMU Status Error 4)

Refer to Fig. J.
Execute the Self-Test and observe the waveforms at TP5 and the emitter of A3Q5. Check for a pulse at A3Q5 (E).

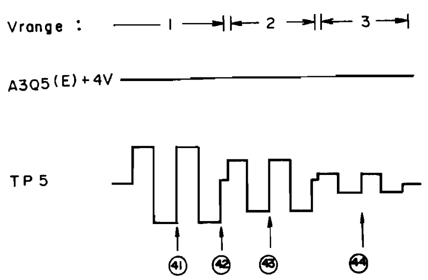
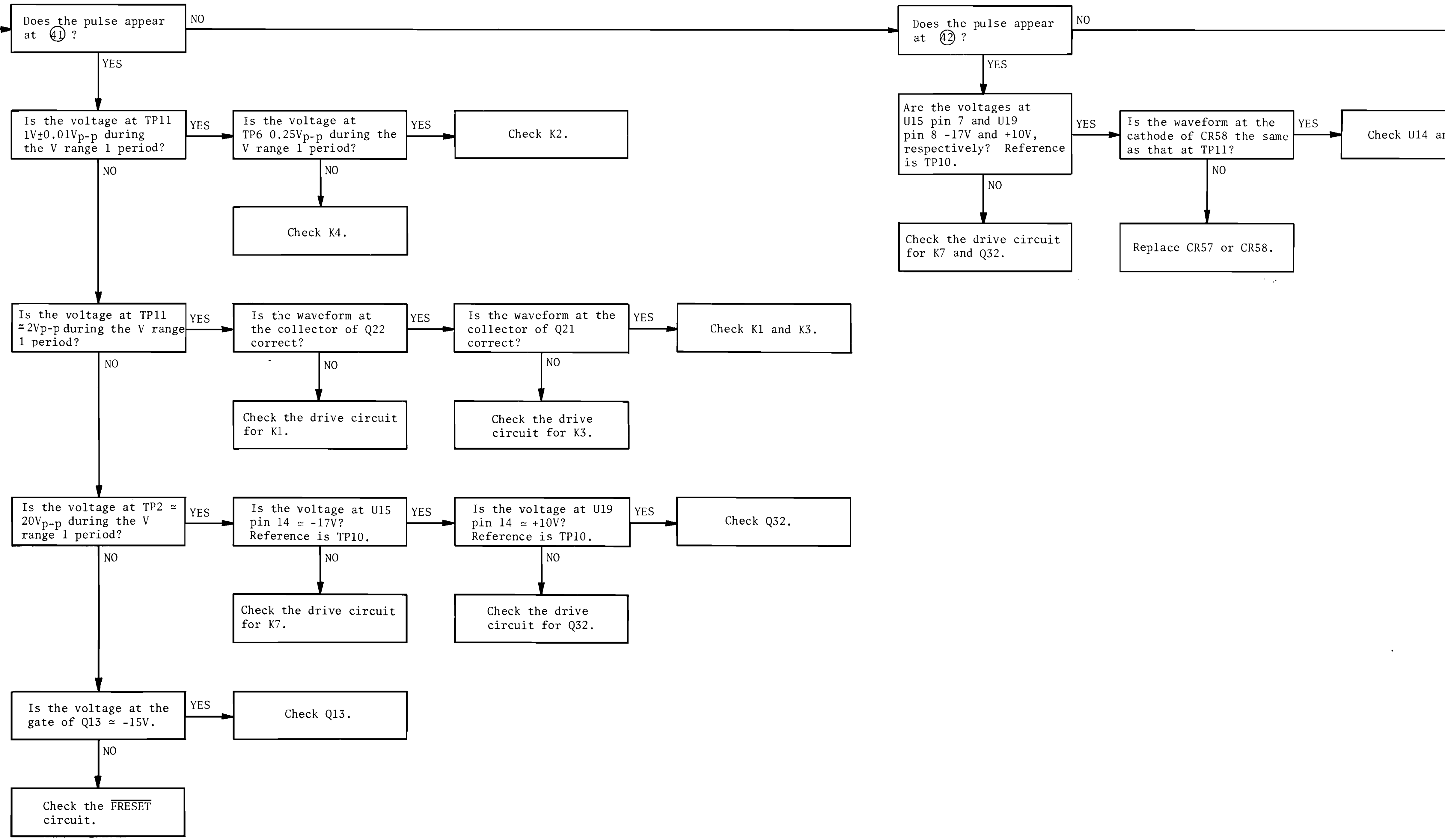


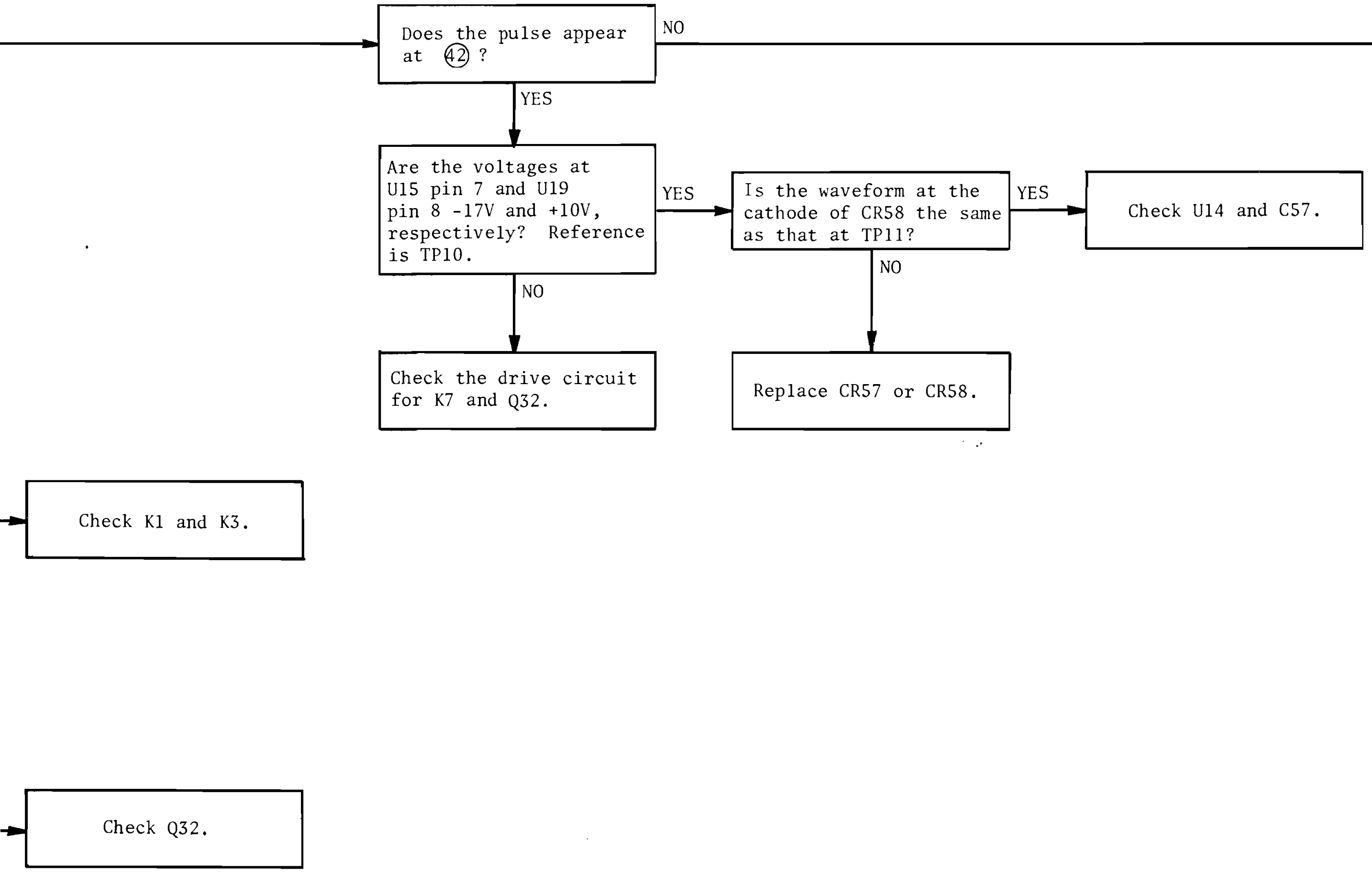
Figure J

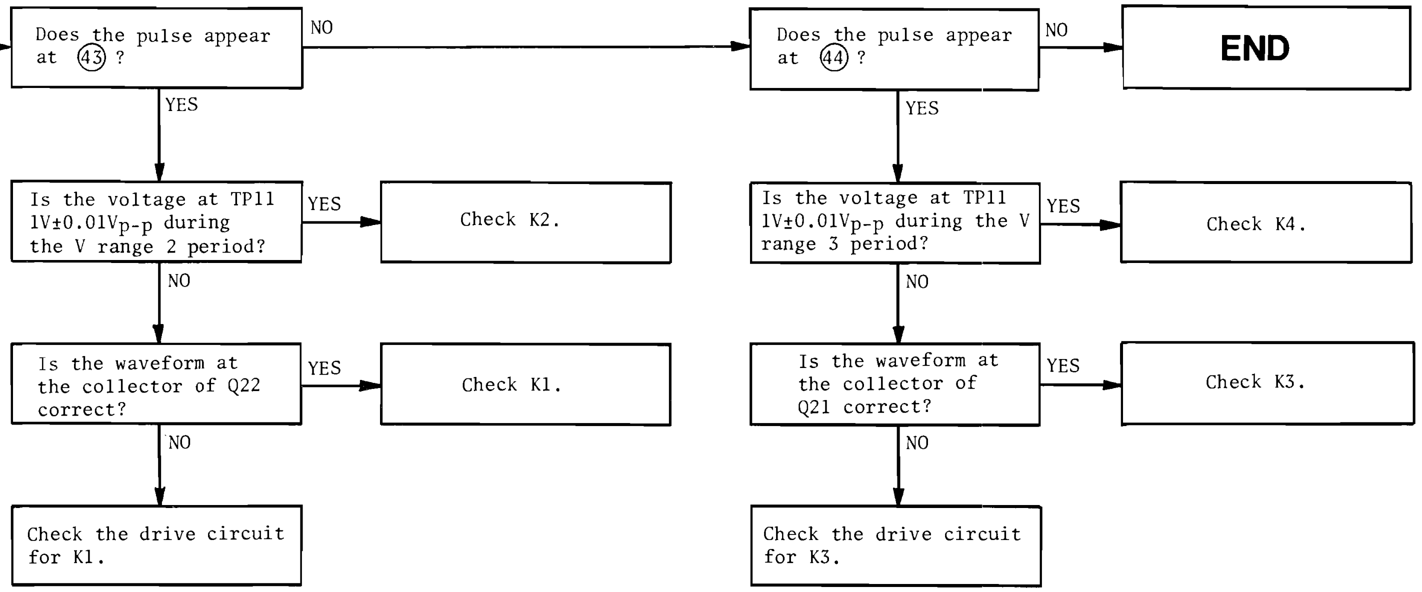


A5 Troubleshooting Flow Diagram

SEE INSIDE

Figure 8-35. A5 Board Troubleshooting Flow Diagr





A5 Troubleshooting Flow Diagram

SEE INSIDE

Figure 8-35. A5 Board Troubleshooting Flow Diagram (Sheet 6 of 9).

Figure 8-35. A5 Board Troubleshooting Flow Diagram (Sheet 7 of 9).

Flow Diagram (A5 - 6)

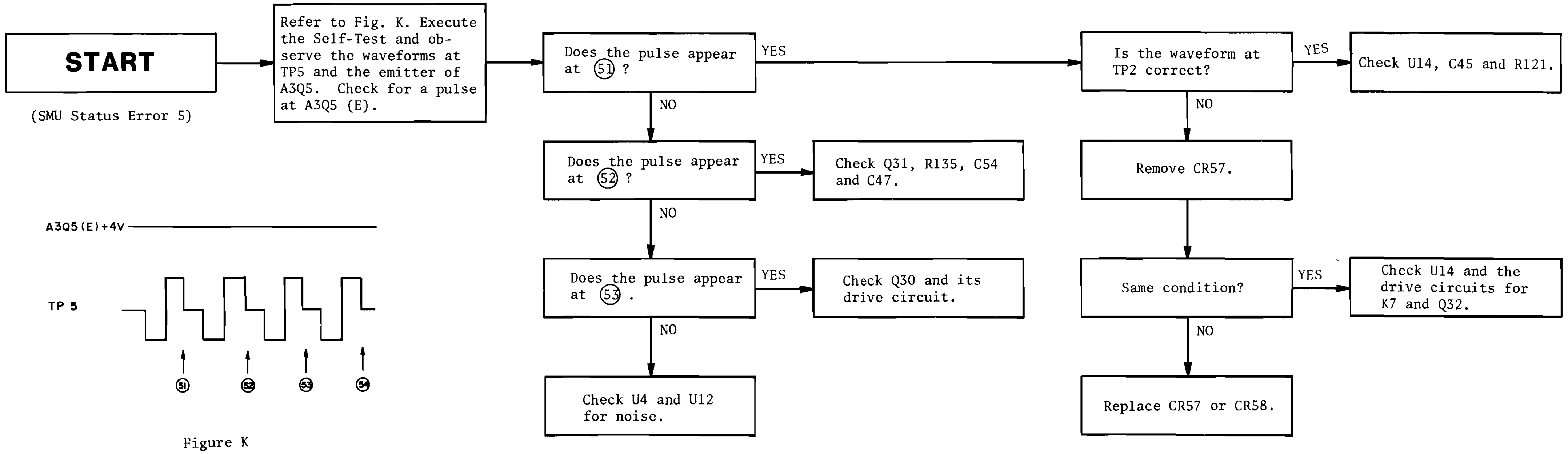
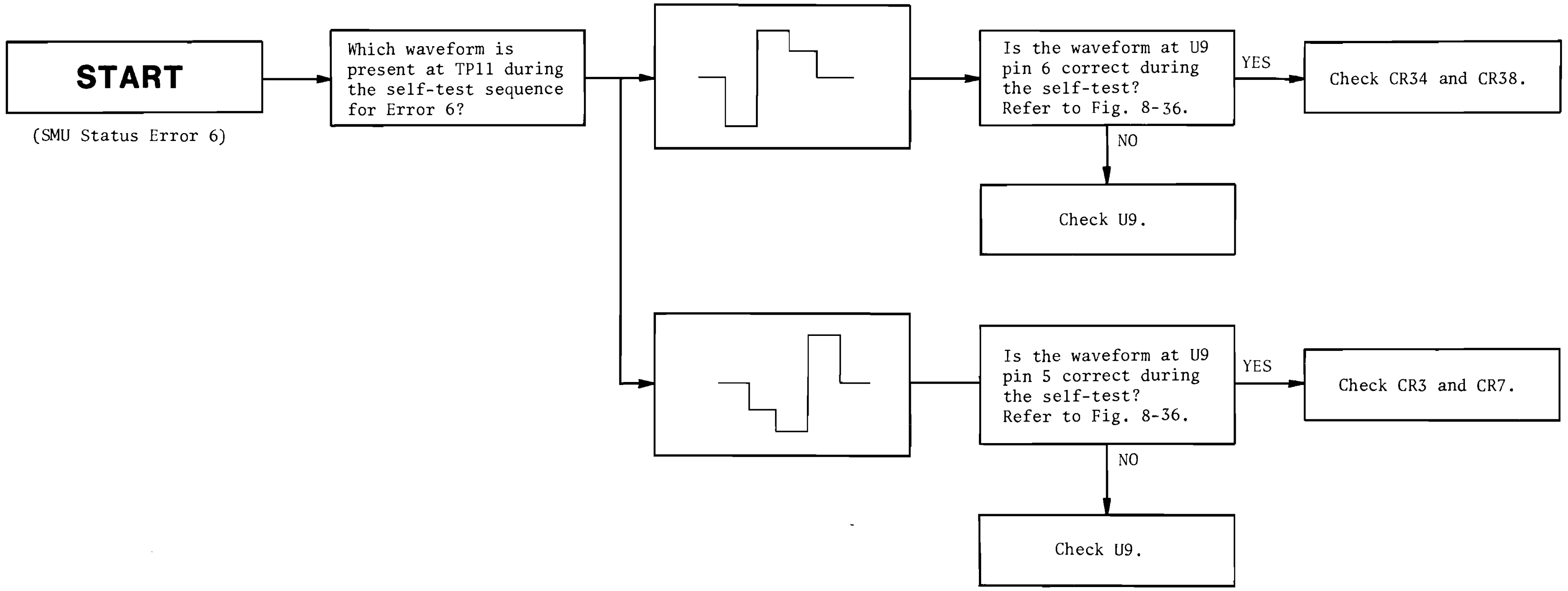
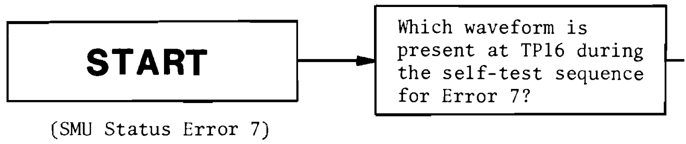


Figure K

Flow Diagram (A5 - 7)



Flow Diagram (A5 - 8)

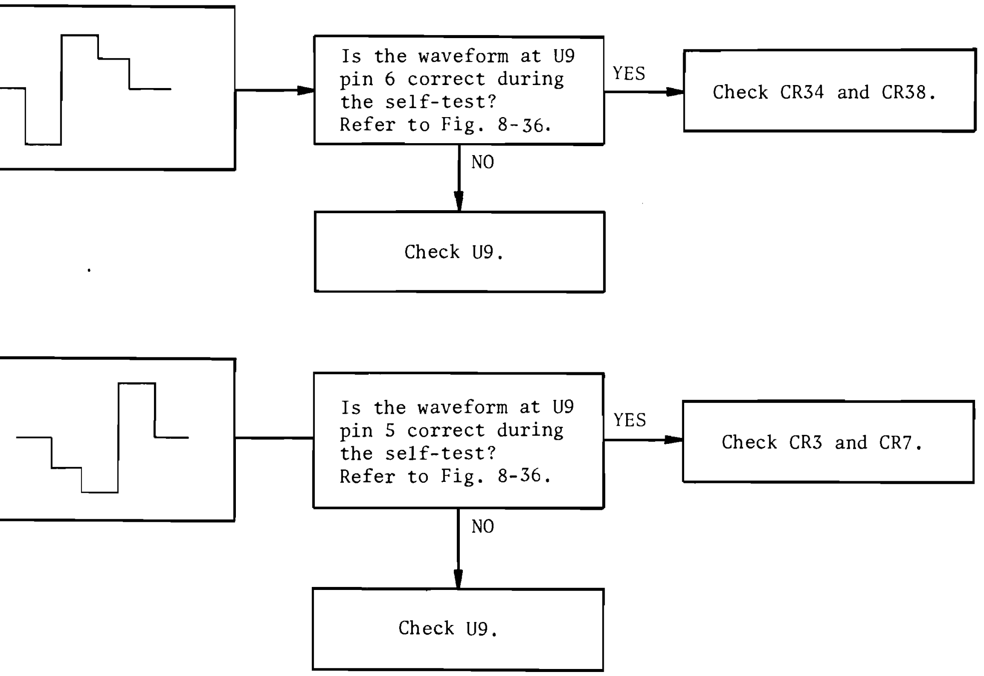


A5 Troubleshooting Flow Diagram

SEE INSIDE

Figure 8-35. A5 Board Troubleshooting Flow Diagram (Sheet 8 of 9).

Figure 8-3



A5 Troubleshooting Flow Diagram

SEE INSIDE

Figure 8-35. A5 Board Troubleshooting Flow Diagram (Sheet 8 of 9).

Flow Diagram A5 - 8

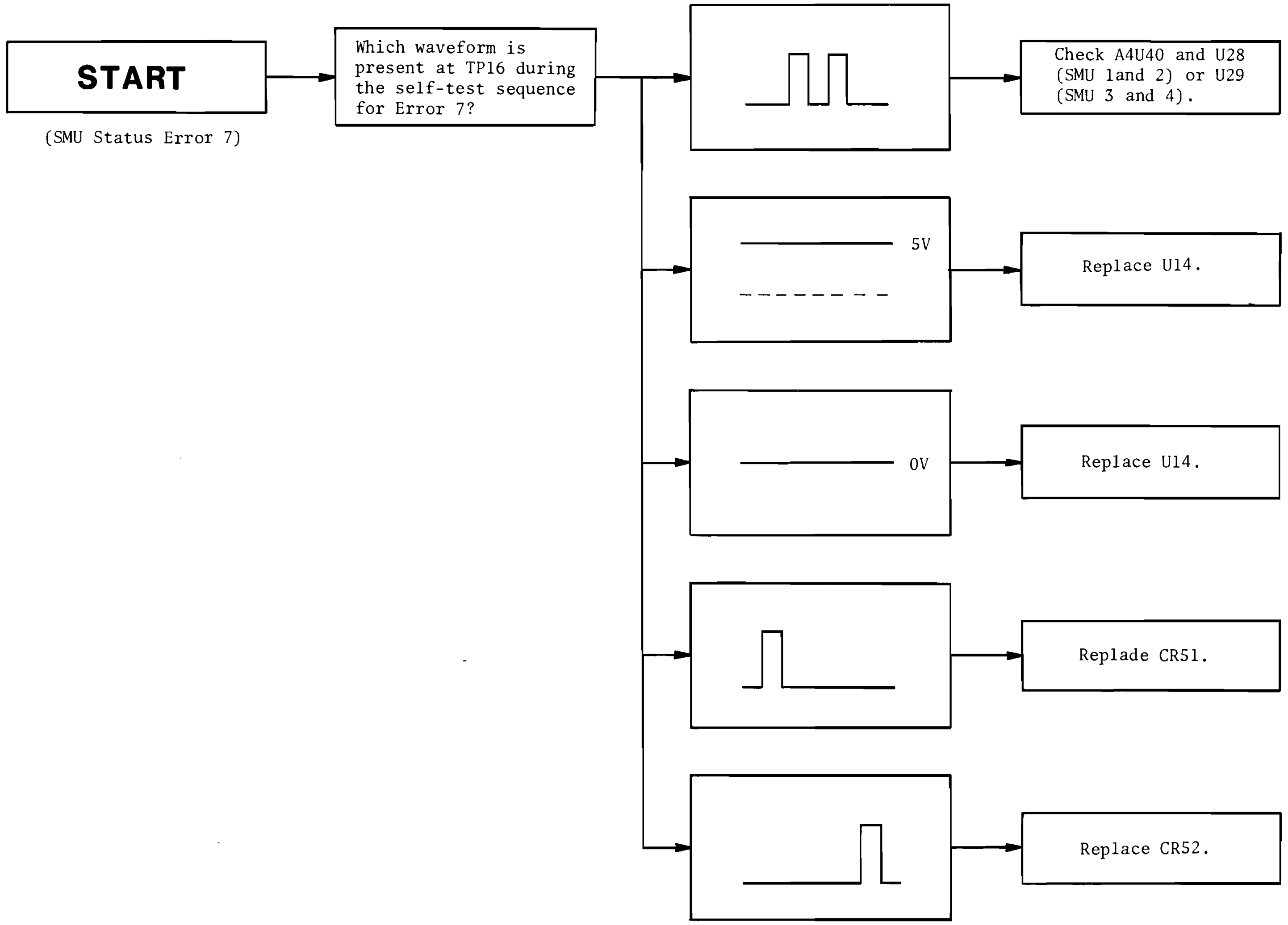


Figure 8-35. A5 Board Troubleshooting Flow Diagram (Sheet 9 of 9).

SMU Self-Test Waveforms

The waveforms shown in this figure will appear at the indicated SMU test points when Self-Test is executed. Each time a flow diagram instructs you to check the waveform at a certain test point, connect the oscilloscope to the indicated test point, start the self-test by pressing the Self-Test softkey on the DIAGNOSTICS page (refer to Figure 3-32), and compare the displayed waveform with the corresponding waveform given here.

Self-Test is divided into two parts. The first part checks the SMU controller and the second part checks the SMUs one at a time, starting with SMU1. Thus, if you are troubleshooting SMU4, the last SMU tested, the waveforms shown in this figure will not appear until about seven or eight seconds after Self-Test is executed. The Self-Test for one SMU lasts about two seconds and is divided into six steps, each related to one or two of the seven possible SMU status error codes (refer to "SMU Status" in Table 8-2). Also, because the SMU Self-Test is slow and non-repetitive, a dual channel storage oscilloscope is required for making these measurements.

Control settings for the oscilloscope are as follows :

STORAGE	ON
AUTO/NORMAL	NORMAL
SINGLE	ON
TIME/DIV	.2 sec/div
VOLTS/DIV	.5V/div (for 10:1 probe)
TRIGGER	EXT, POSITIVE (TP17)*
TRIGGER LEVEL	POSITIVE

* Trigger signal is taken from TP17 of the SMU being checked.

Figure 8- 36. SMU Self-Test Waveforms.

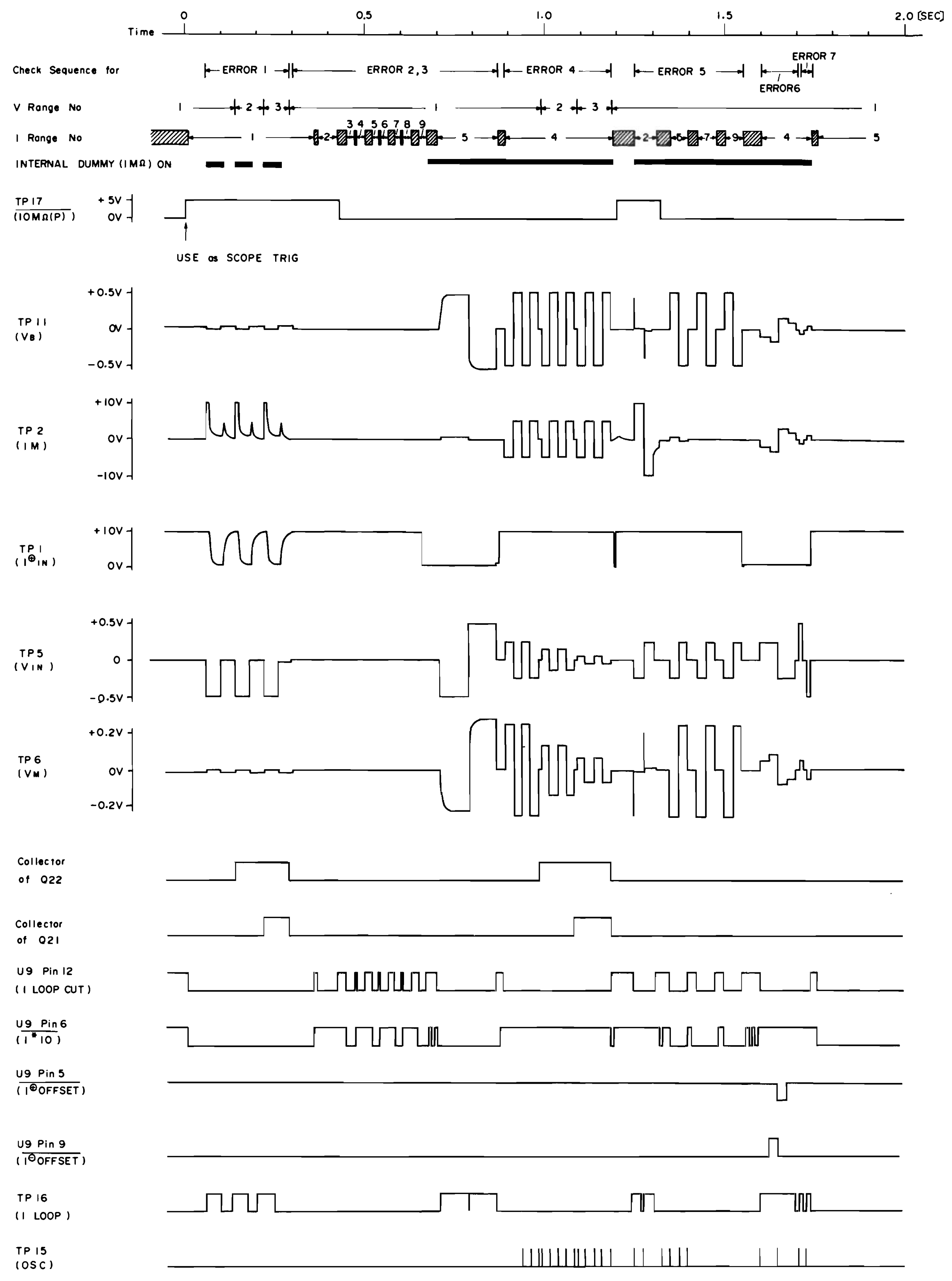


Figure 8- 36. SMU Self-Test Waveforms.

8-44. A5 SMU BOARD

8-45. Theory of operation of the SMUs is described in the following paragraphs. An overall block diagram is shown in Figure 8-37.

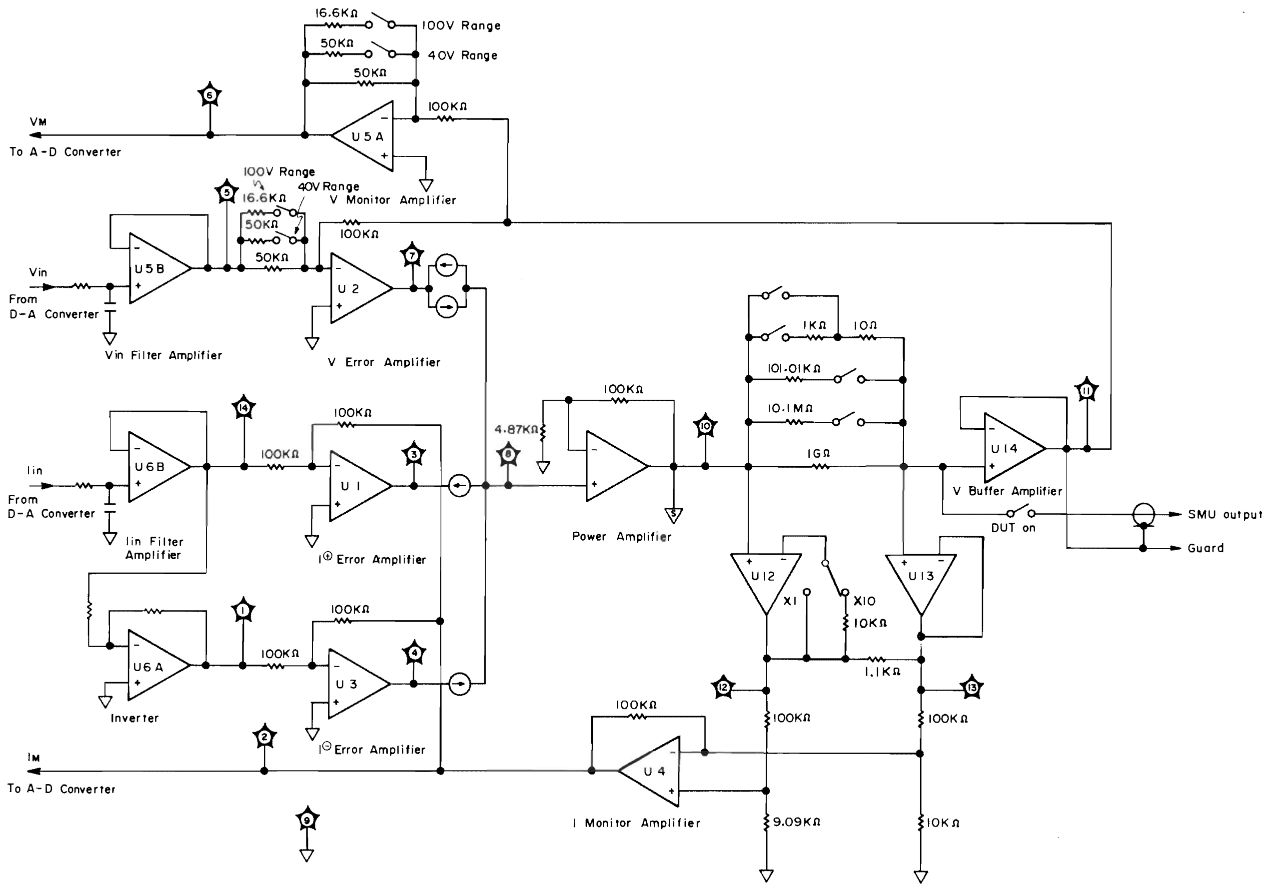


Figure 8-37. SMU Board Block Diagram.

Each SMU has two modes of operation: V mode (voltage source/current monitor) and I mode (current source/voltage monitor). The equivalent circuits for each mode are shown in Figures 8-38 and 8-39, respectively. V mode operation will be described first.

Output voltage, Vout, is determined by Vref, R_1, and R_2, and can be calculated by first noting that, because negative feed-back is employed, the inverting input of the Error Amplifier is at virtual ground. Hence, the voltage at the inverting terminal is calculated as

$$\frac{Vref}{R_1} + \frac{Vout}{R_2} = 0 \quad \cdots\cdots\cdots \quad (8\text{-}1)$$

Solving for Vout, we have

$$Vout = -\frac{R_2}{R_1} \cdot Vref \quad \cdots\cdots\cdots \quad (8\text{-}2)$$

Also, the current output from the SMU can be obtained by measuring the voltage drop across the range resistor Rr. If the gain of the Differencial Amplifier is 1, output current Iout is simply calculated from the differencial amplifier's output voltage I_M and the value of Rr as

$$Iout = \frac{I_M}{Rr} \quad \cdots\cdots\cdots \quad (8\text{-}3)$$

Figure 8-39 shows SMU operation in I mode (Current output/Voltage monitor). Output current is determined by R_1, R_2, Rr and Vref as

$$Iout = -\frac{R_2}{R_1} \cdot \frac{Vref}{Rr} \quad \cdots\cdots\cdots \quad (8\text{-}4)$$

Also, the output voltage obtained from the V Buffer output is

$$Vout = V_M \quad \cdots\cdots\cdots \quad (8\text{-}5)$$

In the actual circuit, these two modes of operation are implemented by one circuit.

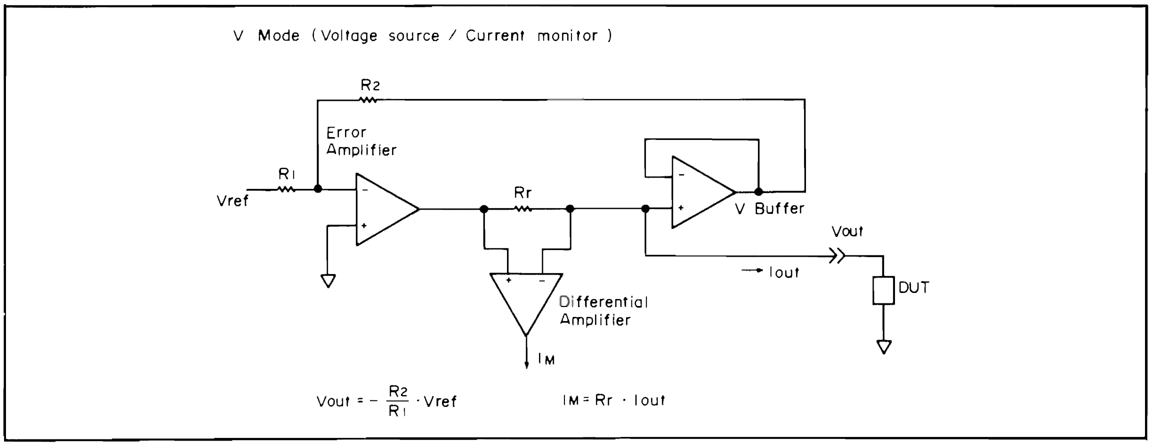


Figure 8-38. SMU V Mode Operation.

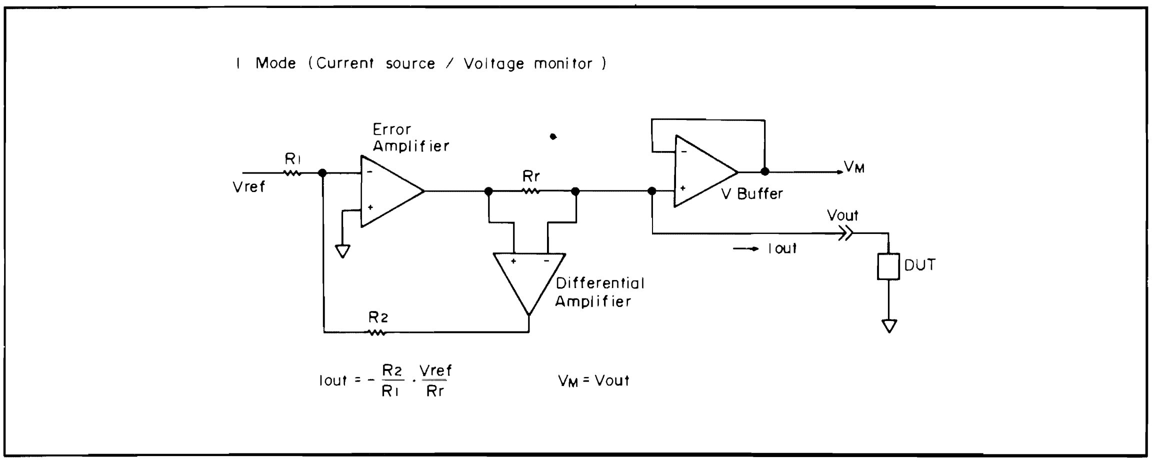


Figure 8-39. SMU I Mode Operation.

[Error Amplifiers]

As shown in Figure 8-37, there are three error amplifiers: V, I$^{\oplus}$, and I$^{\ominus}$. Input reference voltages are applied to the error amplifiers through the filter amplifiers. The input reference voltage for the I$^{\ominus}$ error amplifier is inverted. Two input reference voltages, Vin and Iin, are applied at all times. One specifies the SMU output value and the other specifies the compliance value. Vin is from -10 volts to +10 volts depending on the programmed output. Also, Iin is from 0 to -10 volts.

Assume that a resistive load is connected to the SMU in V Mode (voltage output/current measurement). If a voltage sweep and current measurement is made, and if the resistance of the load is not so high, measurement results displayed on the CRT will be as shown in Figure 8-40. Output current is limited by positive and negative compliance. Normally, output voltage is controlled by the V error amplifier. However, when the output current reaches positive or negative compliance, the corresponding I$^{\oplus}$error or I$^{\ominus}$error amplifier controls the output current.

Also, in I Mode (current output/voltage monitor), I$^{\oplus}$error amplifier controls positive current (flow out) and I$^{\ominus}$error amplifier controls negative current (flow in). The V error amplifier specifies the voltage compliance value. These conditions are called (1) V control mode, (2) I$^{\oplus}$control mode, and (3) I$^{\ominus}$control mode.

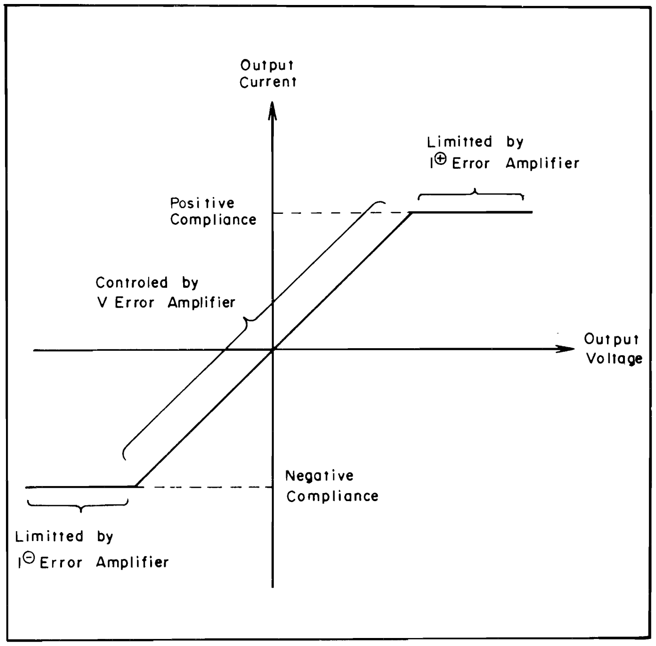


Figure 8-40. Current Compliance in V Mode.

One of the three error amplifiers--U1, U2 and U3 in the actual schematic--controls the SMU output. Figure 8-41 shows the V error amplifier and a simplified drawing of its output circuitry. The voltage at point Ⓐ in the figure changes according to the input reference voltage.

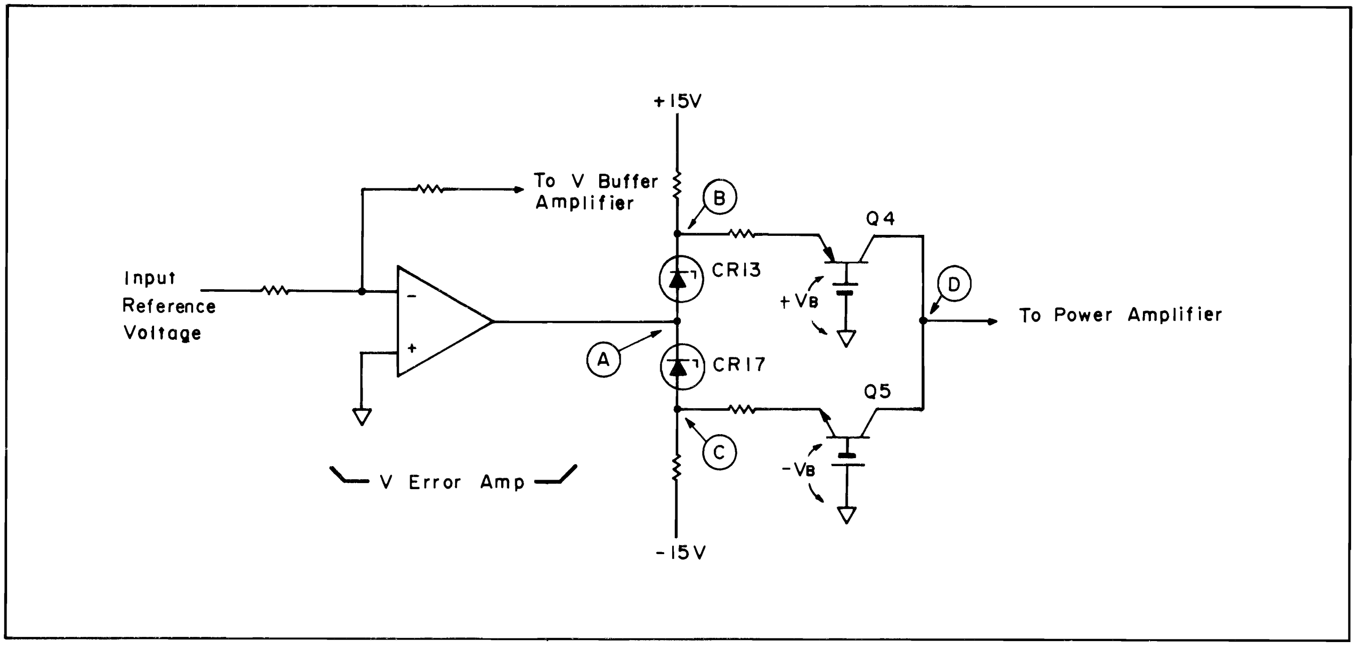


Figure 8-41. V Error Amplifier.

Assume that the voltage at point Ⓐ is initially zero. The voltages at points Ⓑ and Ⓒ, then, are of the same magnitude but with opposite polarities.

The voltage at point Ⓑ is slightly higher than $+V_B$. This forward biases the emitter-base junction of Q4, allowing current to flow out from Q4. Similarly, the voltage at point Ⓒ forward biases Q5, allowing current to flow into Q5. If the voltage at point Ⓐ increases, the voltage at point Ⓑ will increase and the voltage at point Ⓒ will decrease, causing more current to flow out of Q4 and less current to flow into Q5.

Finally, the current flows into the Power Amplifier from point Ⓓ. If the voltage at point Ⓐ decreases, however, the current flows in the opposite direction.

The $I^{\oplus}$ and $I^{\ominus}$ error amplifiers also have circuitry much like this. The $I^{\oplus}$ error amplifier, however, doesn't have CR13 and Q4, and the $I^{\ominus}$ amplifier doesn't have CR17 and Q5. This means that the $I^{\oplus}$ error amplifier can only sink current and the $I^{\ominus}$ error amplifier can only source current.

The outputs from the three error amplifiers are all tied directly to the noninverting input of the power amplifier.

As described earlier, the SMU is in one of three conditions--(1) V control mode, (2) $I^{\oplus}$ control mode, or (3) $I^{\ominus}$ control mode—depending on which error amplifier is controlling the output.

(1) V control mode:

Figure 8-42 (a) shows the V control mode. Output voltage from V error amplifier is approximately zero, and idle current flows from I_1 to I_2.

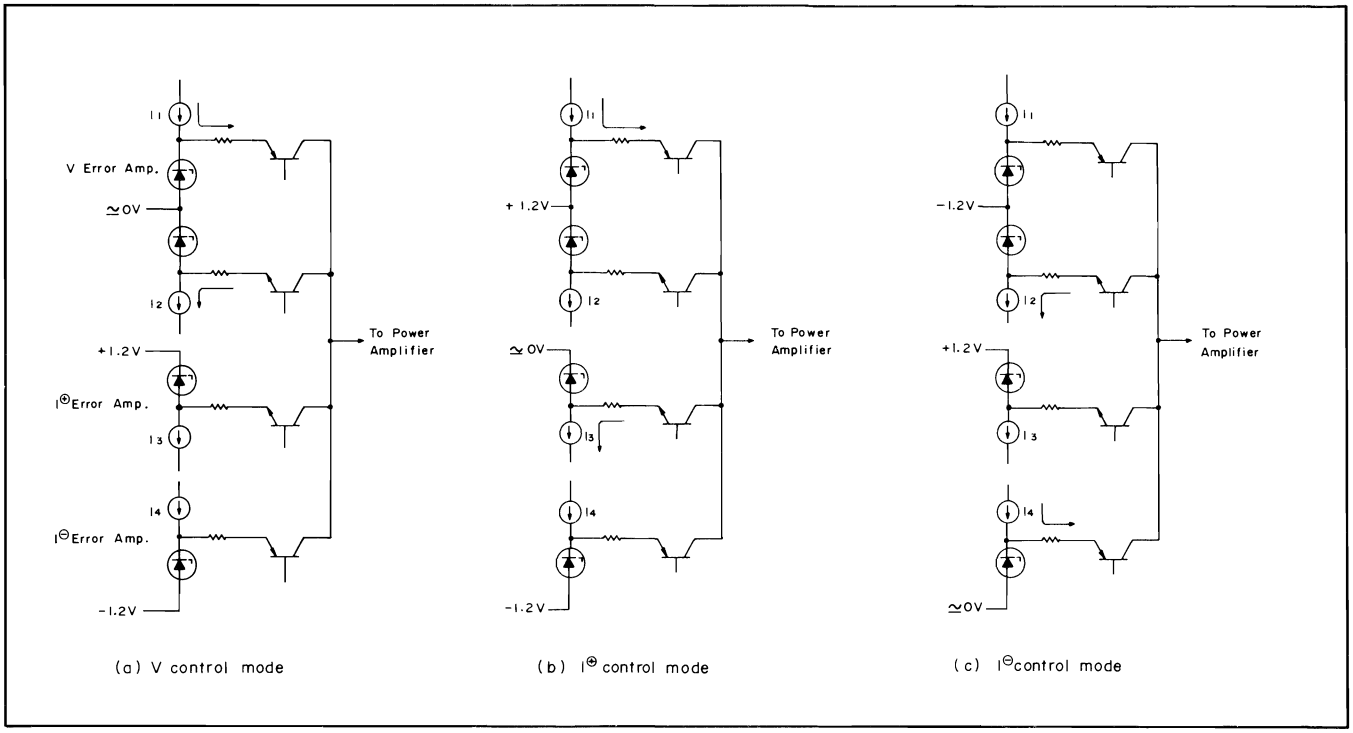
On the other hand, the $I^{\oplus}$ Error amplifier and the $I^{\ominus}$ Error Amplifier output no current because their input voltages are not zero.

(2) $I^{\oplus}$ control mode:

Figure 8-42 (b) shows $I^{\oplus}$ control mode. Output voltage from $I^{\oplus}$ error amplifier is approximately zero, and idle current flows from I_1 to I_3.

(3) $I^{\ominus}$ control mode:

Figure 8-42 (c) shows $I^{\ominus}$ control mode. Output voltage from $I^{\ominus}$ error amplifier is approximately zero, and idle current flows from I_4 to I_2.



(a) V control mode (b) $I^{\oplus}$ control mode (c) $I^{\ominus}$ control mode

Figure 8-42. Three Control Modes.

When the error amplifier is not controlling power amplifier output, the voltage at its noninverting input is not zero.

The error amplifier will be saturated and output will increase up to the positive or negative voltage supply. In this condition, it is difficult to recover to the normal condition quickly. To prevent this, a feed-back loop with diodes is used. Figure 8-43 shows an example of diode dc feed-back.

Output voltage is held constant at the voltage drop caused by two diodes (approximately +1.2V or -1.2V).

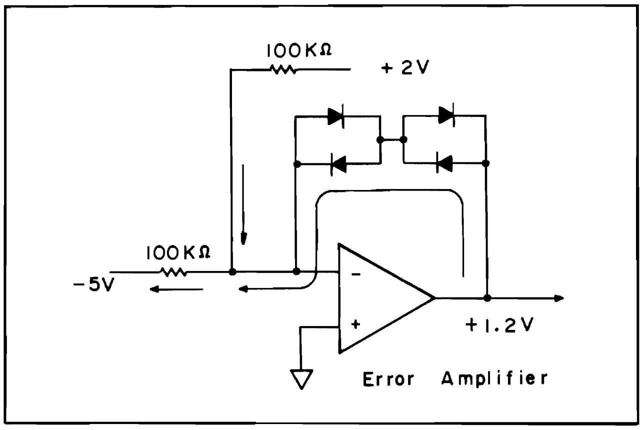


Figure 8-43. Example of Diode Feedback.

[Control Loop Detector]

The control loop detector, U7, detects which error amplifier is controlling the output. It also informs the SMU controller of compliance, causing an error message to be displayed. The input is connected to, TP7, output of the V error amplifier.

If the V error amplifier controls the output, TP7 is approximately zero, and both U7A and U7B are off, forcing $\overline{\text{I}^{\oplus}\text{ CONT}}$ and $\overline{\text{I}^{\ominus}\text{ CONT}}$ HIGH. If the $\text{I}^{\oplus}$ error amplifier controls the output, the V error amplifier is saturated and its output is held at approximately +1.2 volts. Positive voltage turns on U7B and $\overline{\text{I}^{\oplus}\text{ CONT}}$ goes LOW. Conversely, if the $\text{I}^{\ominus}$ error amplifier controls the output, U7A turns on, and $\overline{\text{I}^{\ominus}\text{ CONT}}$ goes LOW. The base of U7E is connected to $\overline{\text{I}^{\oplus}\text{ CONT}}$ and $\overline{\text{I}^{\ominus}\text{ CONT}}$ lines through CR51 and CR52.

If either $\overline{\text{I}^{\oplus}\text{ CONT}}$ or $\overline{\text{I}^{\ominus}\text{ CONT}}$ goes LOW, the collector of U7E (connected to SLP) goes HIGH. The microprocessor monitors SMU status by monitoring these signals, and displays error messages if necessary.

[Power Amplifier]

The power amplifier is of the non-inverting type. The gain of this amplifier is determined by R28 and R39, and is approximately 21.5.

The input stage is a difference amplifier consisting of Q6 and Q7. Q15 is a constant current source. Base voltage for Q15 is obtained from the voltage drop across CR30.

Q8 converts the low voltage input signal into a high voltage signal. This is to transmit the output signal of Q7 (operated in low voltage) to Q9 (operated in high voltage) via the voltage drop across R31. CR24, CR25, CR28 and CR29 protect Q6 and Q7. CR20, R40 and CR30 provides bias voltage for Q10 and Q16. Q9 controls Q10 and Q16.

The output stage is a complementary-symmetry amplifier consisting of Q11 and Q12. The collectors of Q11 and Q12 are connected to the SMU Power Source Board and held constant at +4V and -4V, respectively, above and below TP10 (FLT.COMMON), as shown in Figure 8-44.

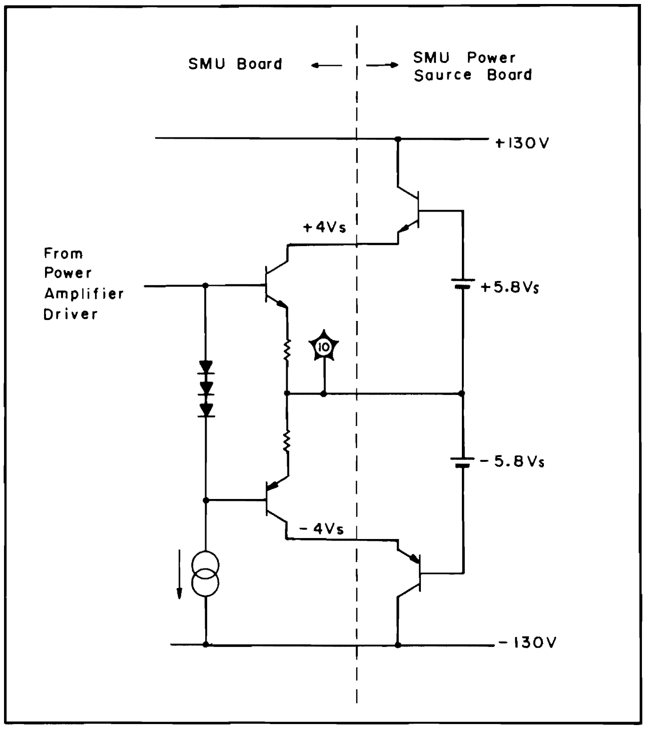


Figure 8-44. Power Amplifier Output Stage.

Since the SMU Power Source (A13 and A14) dissipates most of the power that is output from any one of the SMUs, Q11 and Q12 need not be high power devices.

CR21 and CR22 improve the transient response of Q11 and Q12.

[Reset Circuit]

Q14 drives Q13 to reset the power amplifier to prevent the SMU from outputting a spike when the 4145B is turned on or off. If the $\overline{\text{FRESET}}$ line goes to LOW, Q14 turns on and Q13 also turns on.

[Range Resistors]

Current measurement is made by measuring the voltage drop across the range resistor. As the resolution and dynamic range of A-D converter is specified, if various range resistors are used, various current ranges, from 1nA range to 100mA range, are provided. Also, the voltage drop across the range resistor is measured by the I monitor amplifier, which has a gain of X1 or X10.

Therefore, with a combination of five range resistors and two multipliers, ten current measurement ranges are possible. Only nine ranges, however, are used in the actual circuit. A simplified drawing of the range resistor circuit is shown in Figure 8-45, and the nine ranges are listed in Table 8-6.

As shown in Figure 8-46, ranging is performed by four FET switches driven by ramp waves. If these switches were turned on and off by a step function, a spike would appear at the SMU output because the voltage drop across the range resistor would change rapidly. To prevent this, the FET switches are turned on gradually. The ramp waves are generated by the ramp generator, U18 and U19. U19 functions as a constant current source and U19 is normally on.

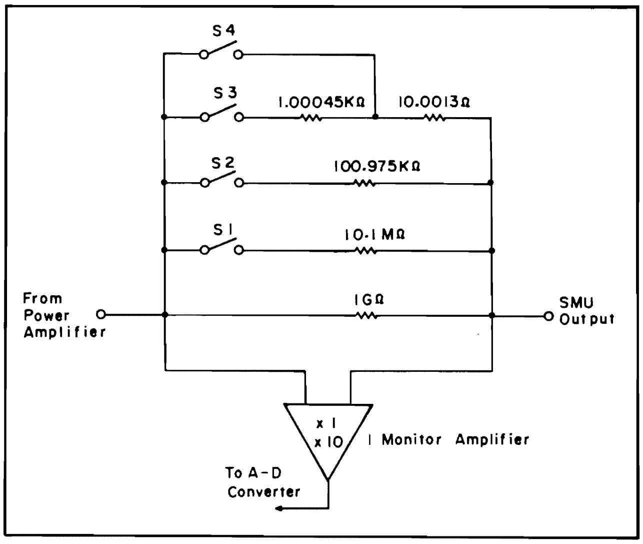


Figure 8-45. Range Resistors.

If U18 is turned off, U19 gradually charges the capacitor connected at the collector of U18.

Since the channel resistance of an FET switch is neither zero when on nor infinite when off, relays are used in conjunction with the FET switches for the 100kΩ and 10MΩ range resistors. Also, to minimize leakage current when the relay breaks, the relay is connected to guard. For the 10Ω and 1kΩ range resistors, additional FETs (Monitor Point Selector) are used to select the appropriate monitor point.

Table 8-6. Relationship between Current Ranges and Range Resistors

Range #	Full Scale	Resistance of Range Resistor	Gain of I Monitor Amplifier	S1 S2 S3 S4
1	100mA	10Ω	X10	on on on on
2	10mA	1kΩ	X1	on on on off
3	1mA		X10	
4	100μA	100kΩ	X1	on on off off
5	10μA		X10	
6	1μA	10MΩ	X1	on off off off
7	100nA		X10	
8	10nA	1GΩ	X1	off off off off
9	1nA		X10	

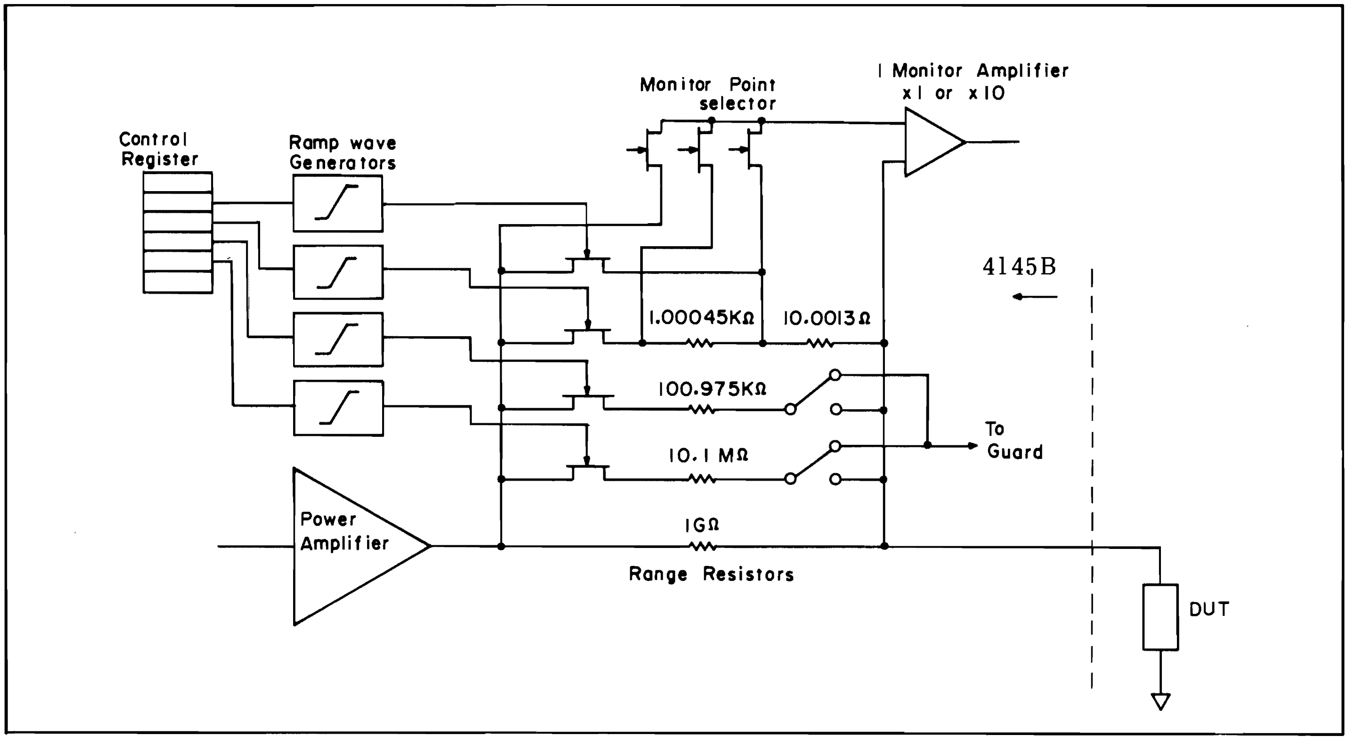


Figure 8-46. Range Resistor Circuit.

[Oscillation Detector]

If the SMU oscillates because of a reactive load, the Oscillation Detector detects it and sends the detection signal to the SMU controller. The detector monitors the output of the power amplifier, which is part of the SMU's feed-back loop, through the high-pass filter (C37 and R89). Oscillations, if they occur, are rectified and applied to the input of U8, whose output goes HIGH, informing the SMU controller that the SMU and device under test is oscillating.

CR49 and CR50 limit the input oscillation signal to 9Vp-p.

[V Monitor Amplifier]

The V Monitor Amplifier, U5A, is an inverting amplifier with three multipliers—X .5, X .25 and X .1--for the 20V, 40V and 100V ranges, respectively. The multipliers are determined by the ratio of input resistor R63 and feed-back resistors R64 through R66. Ranging is performed by K2 and K4 (Refer to Table 8-7.). The amplifier outputs an inverted 0 - ±10V, depending on the voltage at the V Buffer Amplifier's output, which is at the same voltage as the output voltage of the SMU.

Table 8-7. V Monitor Amplifier Ranging

Range	Multiplier	K2	K4
20V	X .5	OFF	OFF
40V	X .25	ON	OFF
100V	X .1	ON	ON

[I Monitor Amplifier]

The I Monitor Amlifier consists of a difference amplifier and two voltage followers. The two voltage followers output the voltage difference across the range resistor and have a combined gain of X1 or X10. (X10 effectively multiplies the value of the selected range resistor by ten.) When Q23 is on and Q24 is off, the voltage difference between the outputs of U12 and U13 is the same as the input. When Q23 is off and Q24 is on, however, the output is ten times the input. U4 outputs the voltage difference to the A-D converter and to the input circuit (I⊕and I⊖Error Amps) for feed-back.

Also, to minimize the noise effects and leakage at the input of U4, guarding is used.

[Auto Calibration]

Each SMU is automatically calibrated every five minutes by the SMU controller. The SMU controller connects a 1MΩ dummy load (R125 to the SMU by activating K5. It then provides a known reference to the input of the error amplifiers and measures the SMU output on all ranges. Differences between the expected and measured values are stored in memory and used to compensate subsequent measurements.

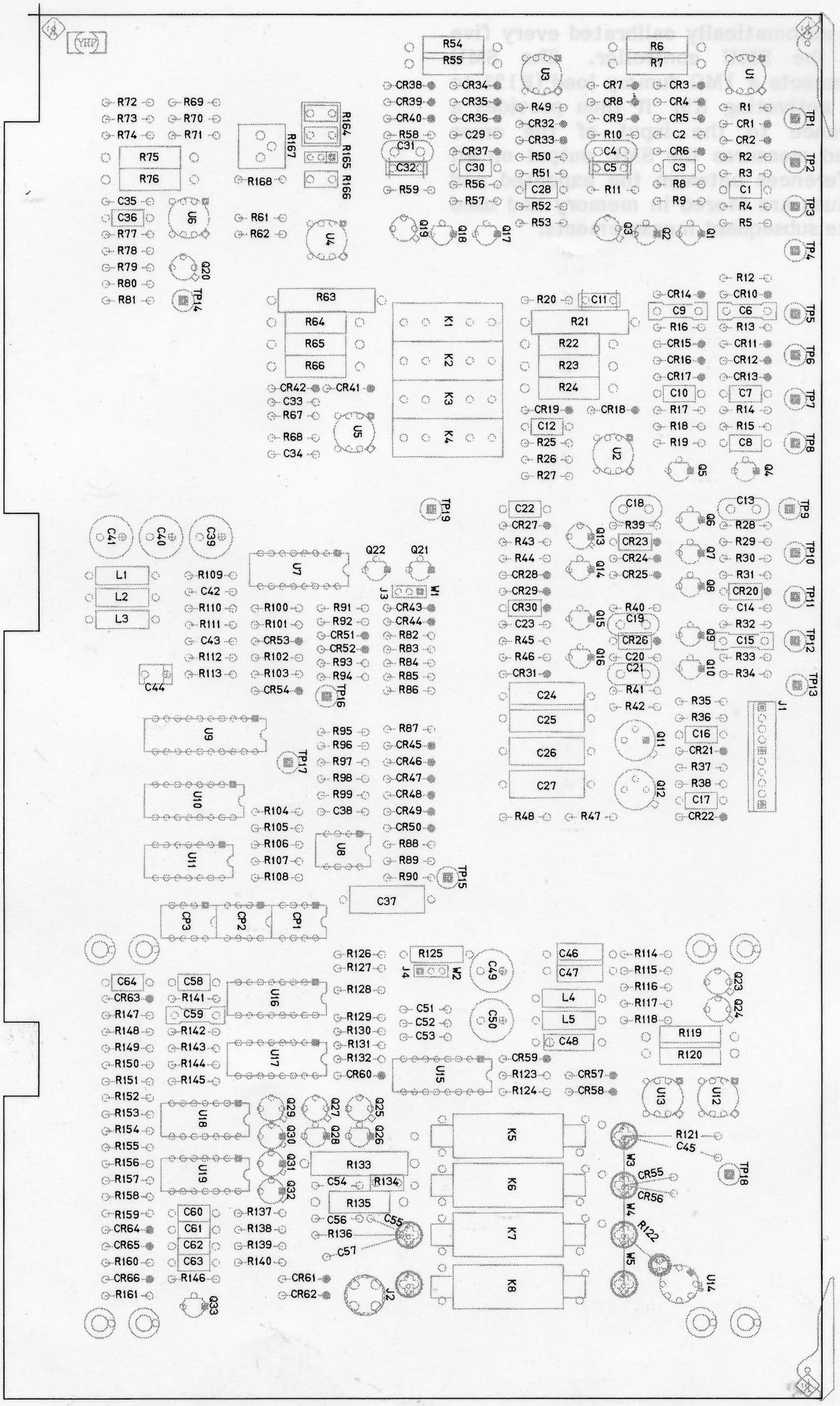
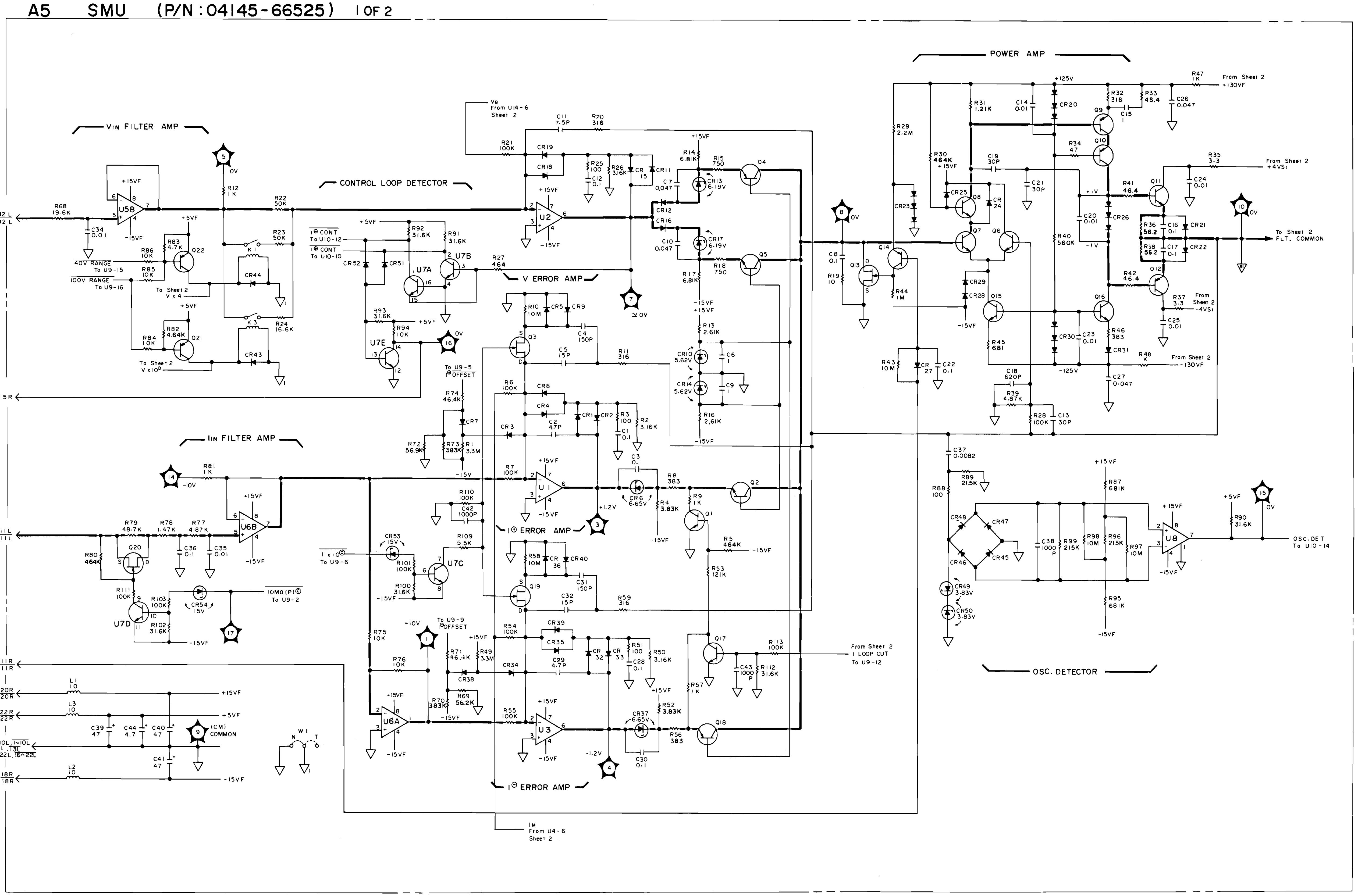


Figure 8-47. A5 SMU Board Assembly Component Locations.



▽ FLOATING SECTION ANALOG GROUND (SAME AS COM)

▽ ANALOG GROUND FOR TESTING

▽ SMU COMMON

▽ SMU COMMON FOR TESTING

NOTES:

1. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. PREFIX ABBREVIATION WITH ASSEMBLY NUMBER FOR COMPLETE REFERENCE DESIGNATOR.

2. UNLESS OTHERWISE INDICATED:

   RESISTANCE IN OHMS (Ω)
   CAPACITANCE IN MICROFARADS (μF)
   INDUCTANCE IN MICROHENRIES (μH)

A5 BOARD

Figure 8-48. A5 SMU Board Assembly Schematic Diagram (Sheet 1 of 2).

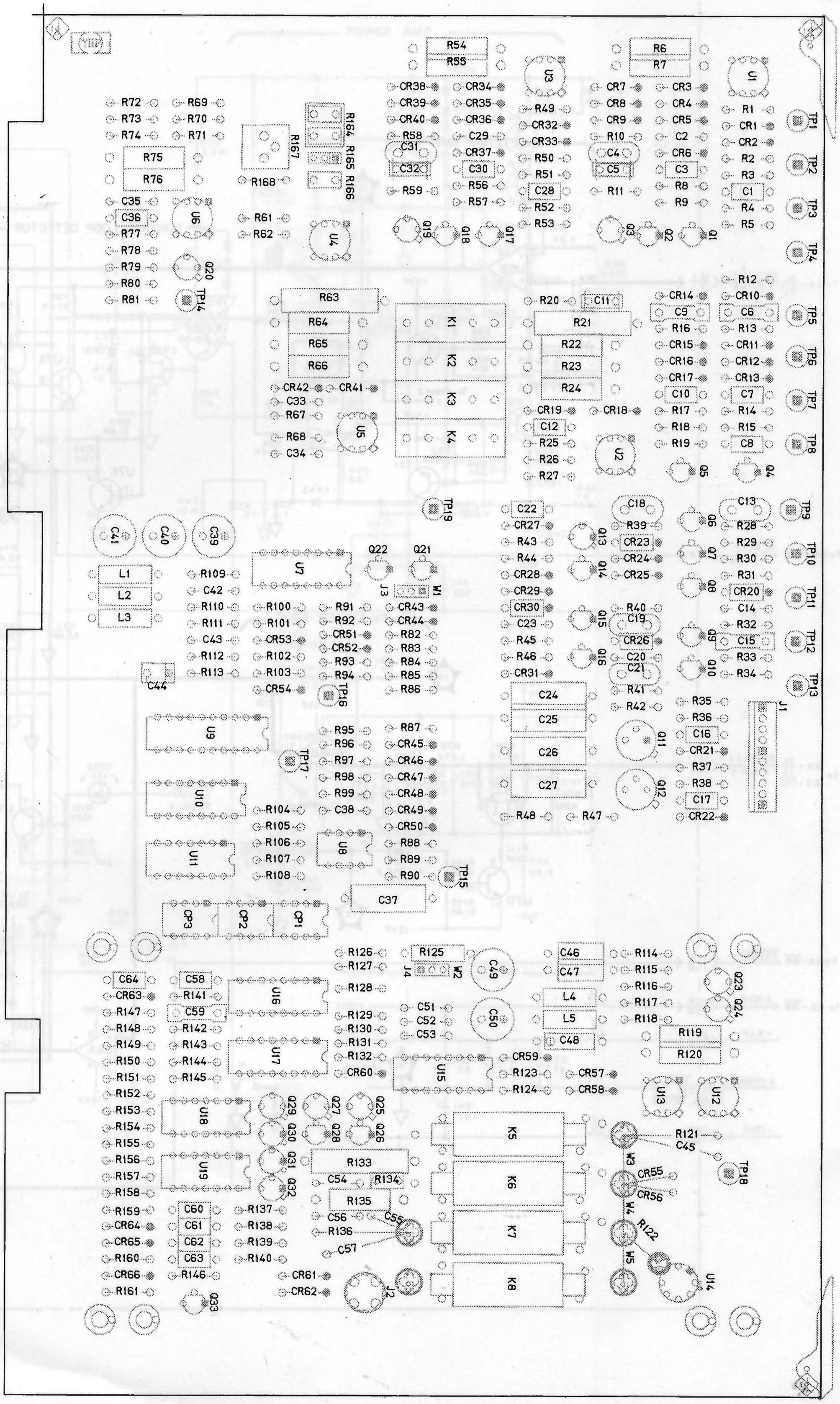
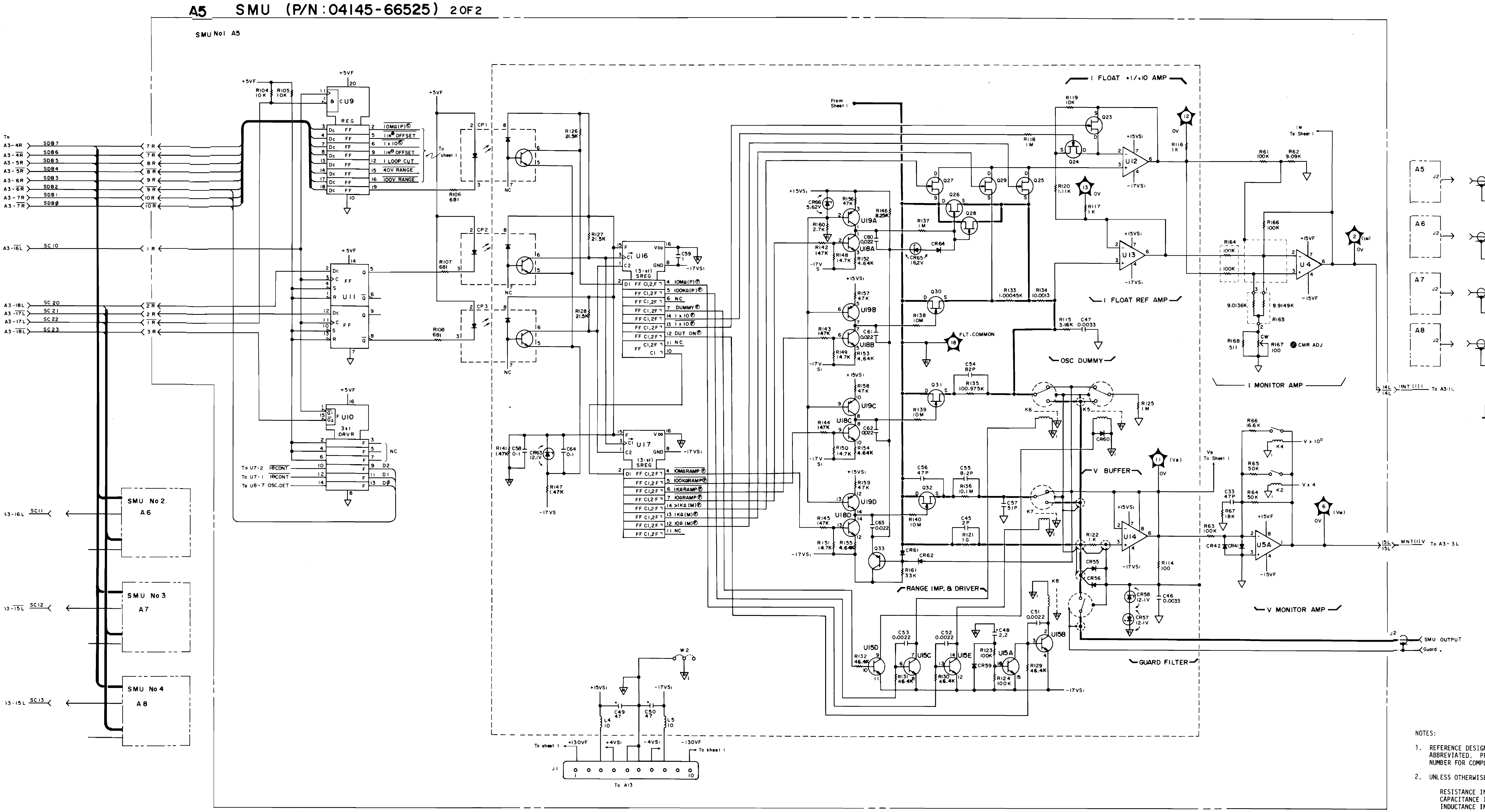


Figure 8-47. A5 SMU Board Assembly Component Locations.



NOTES:

1. REFERENCE DESIG
ABBREVIATED. P
NUMBER FOR COMPL

2. UNLESS OTHERWISE

RESISTANCE I
CAPACITANCE I
INDUCTANCE I

A5 BOARD

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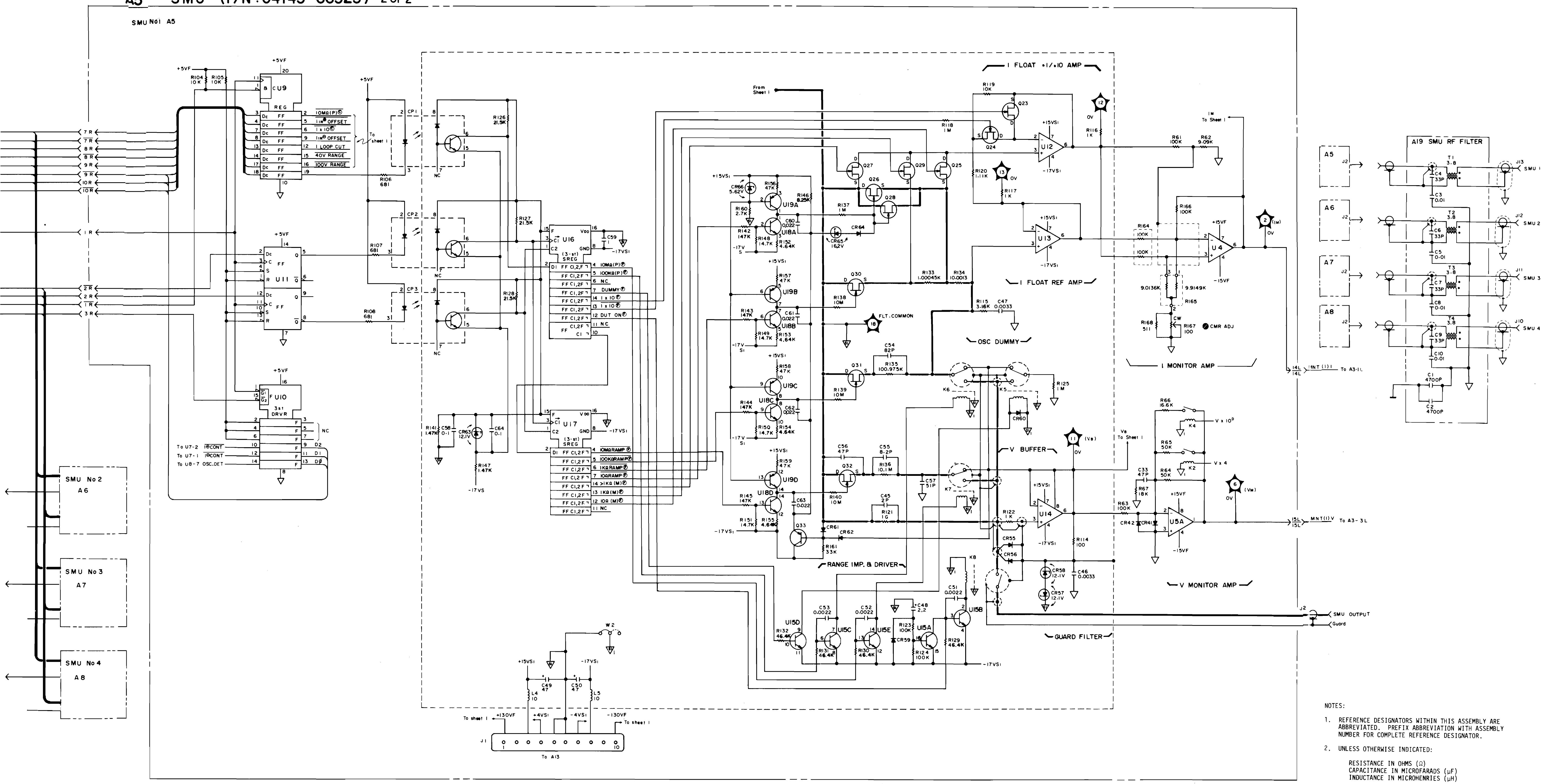
Figure 8-48. A5 SMU Board Assembly Schematic Diagra

A5 SMU (P/N:04145-66525) 2 OF 2



NOTES:

1. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. PREFIX ABBREVIATION WITH ASSEMBLY NUMBER FOR COMPLETE REFERENCE DESIGNATOR.

2. UNLESS OTHERWISE INDICATED:

   RESISTANCE IN OHMS (Ω)
   CAPACITANCE IN MICROFARADS (μF)
   INDUCTANCE IN MICROHENRIES (μH)

A5 BOARD

Figure 8-48. A5 SMU Board Assembly Schematic Diagram (Sheet 2 of 2).

8-46. A9 HP-IB AND MSU CONTROL BOARD

8-47. The A9 Board consists of two sections: the HP-IB control section and the MSU (Mass Storage Unit: FDD and Disc) control section.

[HP-IB Control Section]

All HP-IB interface functions are handled by the U7 HP-IB Interface Adapter. The Interface Adapter controls the "handshake" between the microprocessor and external HP-IB equipment connected to the 4145B.

[MSU Control Section]

U8 controls the FDD (Flexible Disc Drive) through the open-collector drivers. It also performs parallel-to-serial and serial-to-parallel data conversion for the FDD's serial read/write operation. Main control lines are described below:

$\overline{\text{FDCCS}}$ (FDC Chip Select):
Chip select signal for U8.

DRIVE SELECT 1 through 3:
Drive select signal.

MOTOR ON:
Turn-on signal for the drive motor. Drive motor is on when this line is set to "LOW."

STEP:
Drive signal for the step motor.

DIRECTION IN:
Determines step direction for the step motor. Motor steps in toward the center of the disc when this line is set to "LOW."

HEAD LOAD:
Engages the R/W Head.

WRITE GATE:
Enables the write gate on the FDD when data is sent to FDD.

WRITE DATA:
Frequency-modulated data is serially sent to the FDD.

READY:
FDD ready signal. When a disc is inserted and the drive is turning, this line is set to "LOW."

INDEX:
Index hole detection signal.

TRACK 00:
Indicates that the R/W Head is on the outermost track (track 0).

WRITE PROTECT
Detects write-protected discs.

READ DATA
Data signal sent from FDD.

HEAD SELECT
Head select signal.

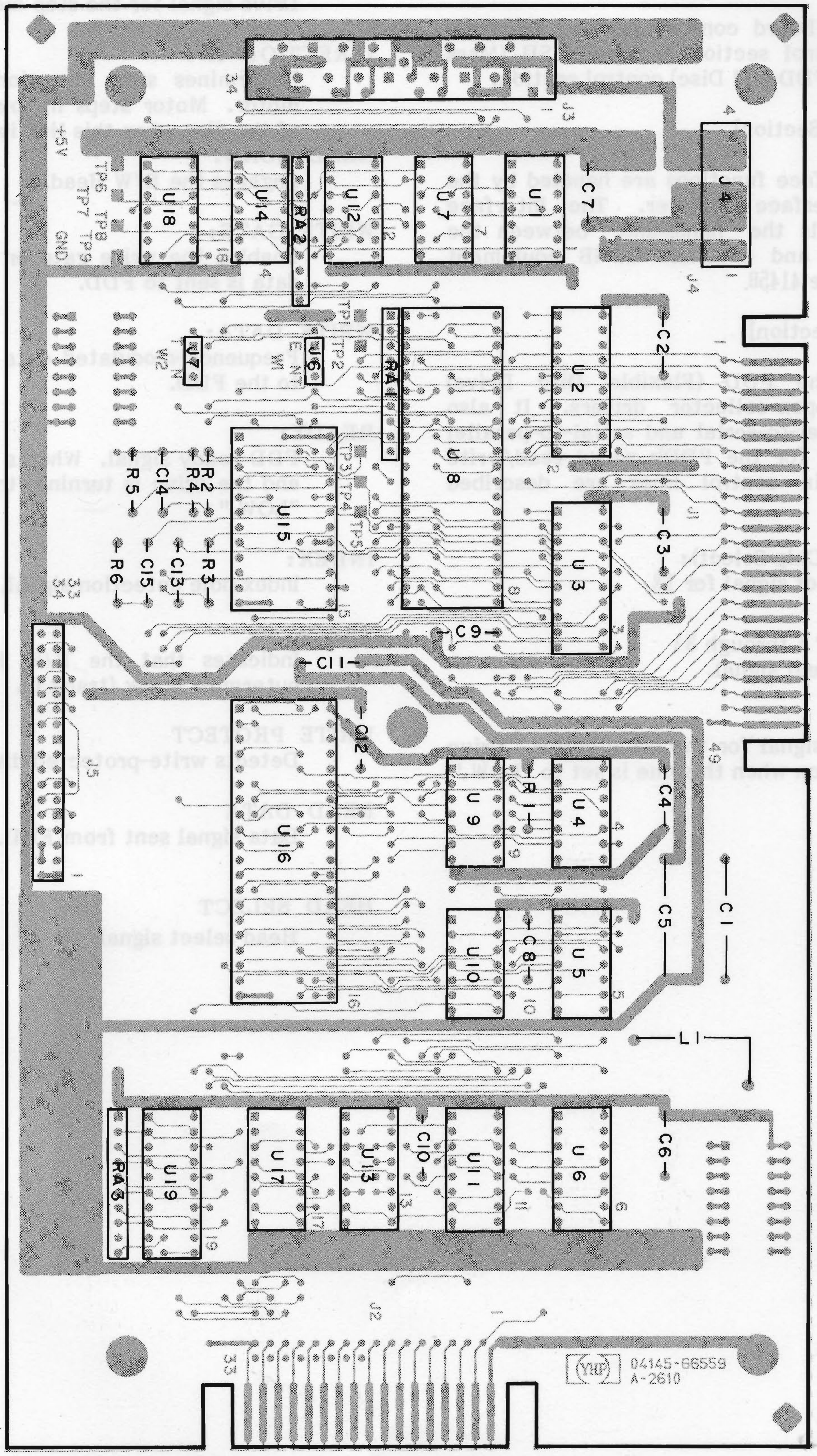


Figure 8-49. A9 HP-IB and MSU Control Board Assembly Component Locations.

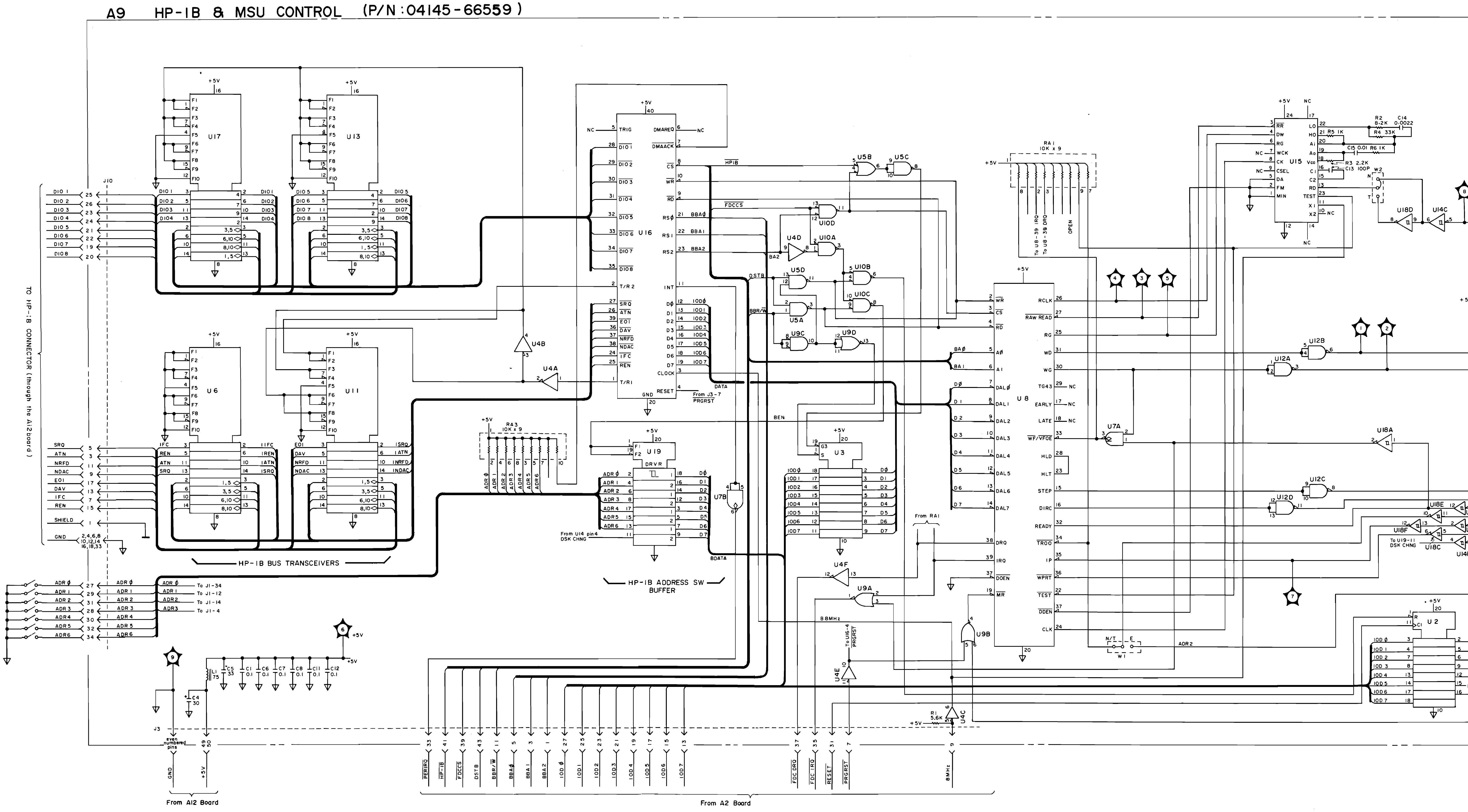
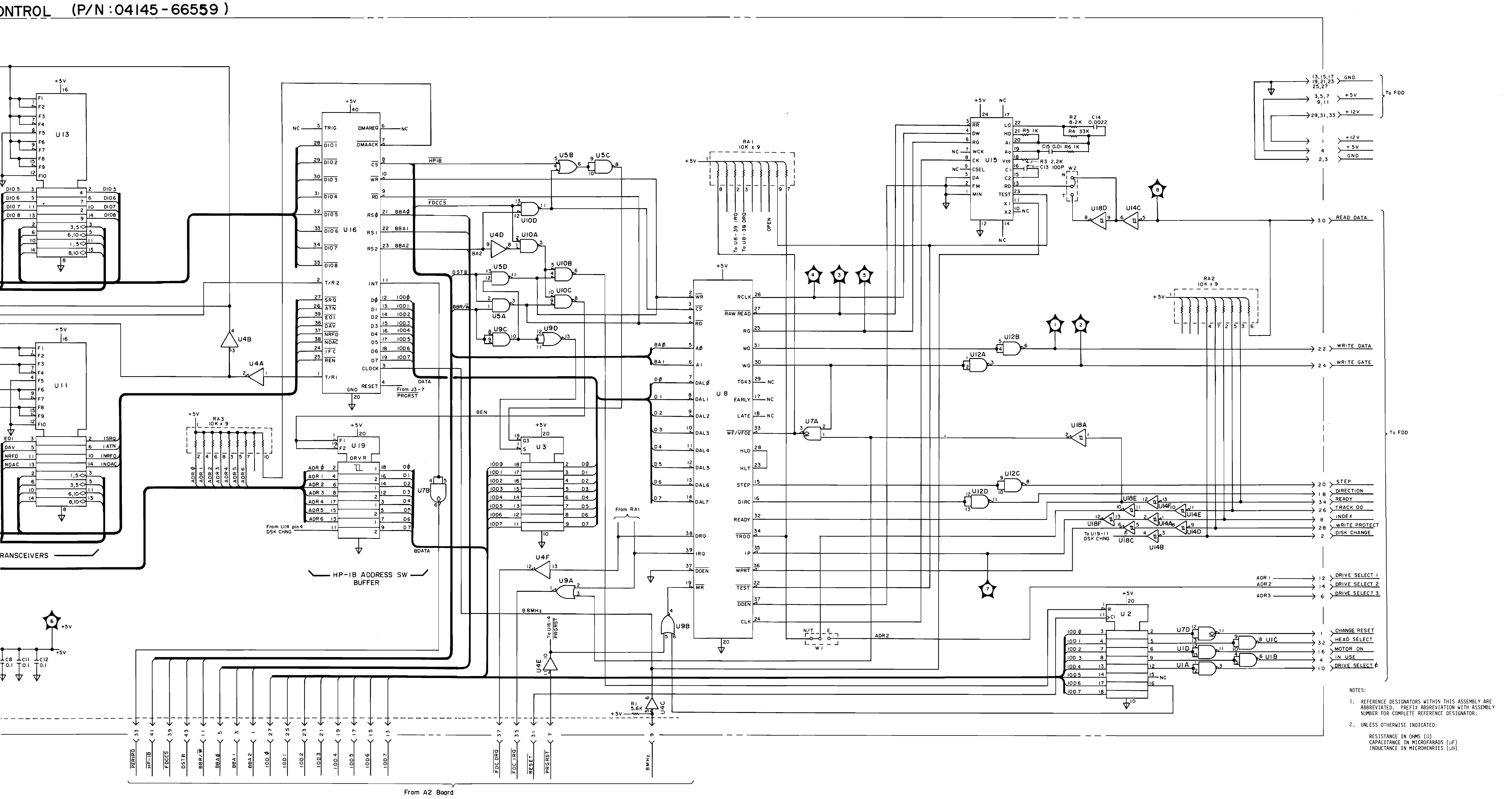


Figure 8-50. A9 HP-IB and MSU



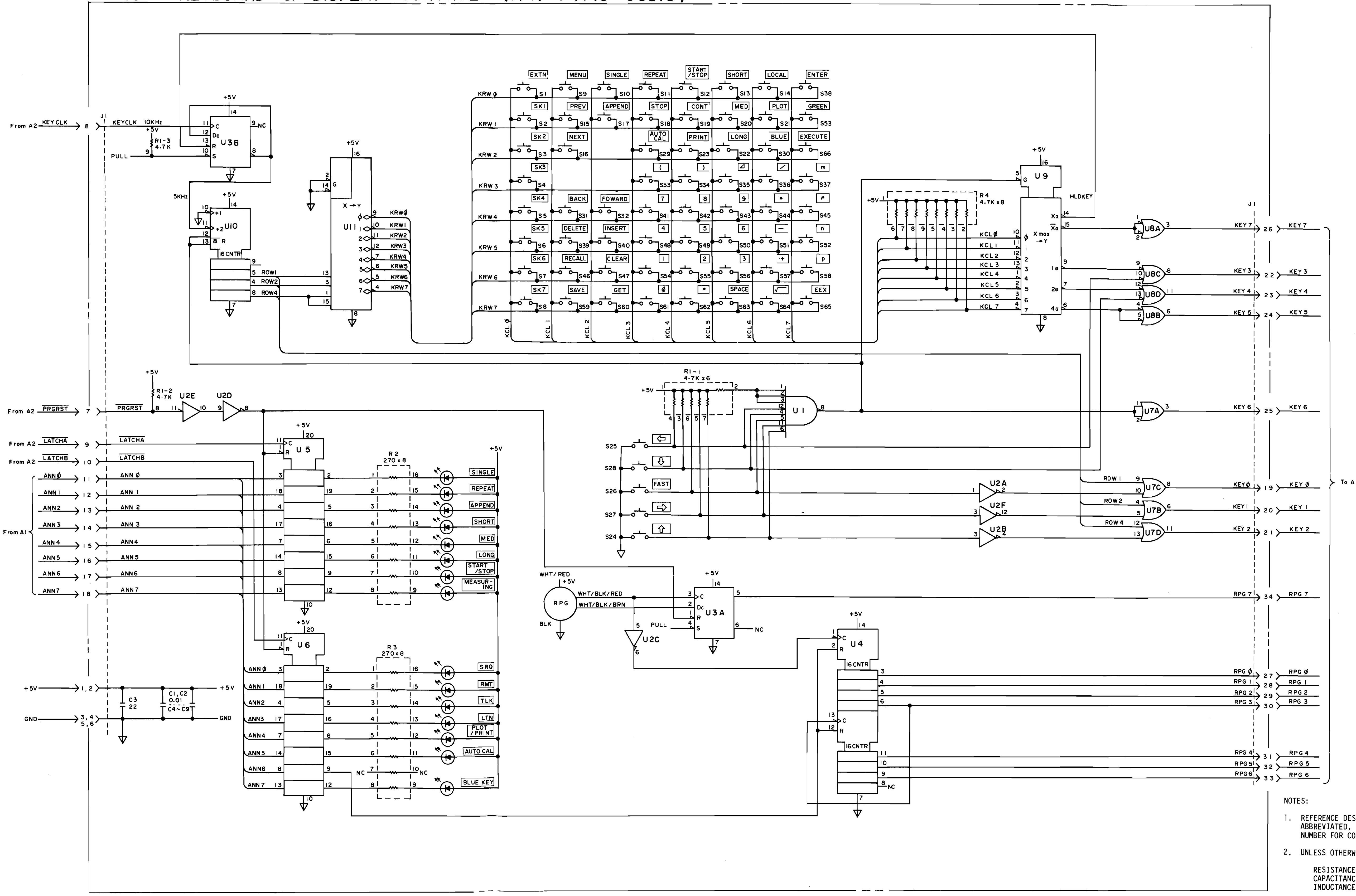
A9 BOARD

Scans by ArtekMedia => 2010

Figure 8-50. A9 HP-IB and MSU COntrol Board Assembly Schematic Diagram.

Scans by Artekmedia => 2010

A10 KEYBOARD & DISPLAY CONTROL (P/N:04145-66510)



NOTES:

1. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY
ABBREVIATED. PREFIX ABBREVIATION WITH ASSE
NUMBER FOR COMPLETE REFERENCE DESIGNATOR.

2. UNLESS OTHERWISE INDICATED:

RESISTANCE IN OHMS (Ω)
CAPACITANCE IN MICROFARADS (μF)
INDUCTANCE IN MICROHENRIES (μH)

8-48. A10 KEYBOARD & DISPLAY CONTROL BOARD

8-49. The A10 board is divided into three sections: key control section, LED control section, and RPG control section.

[Key Control Section]

Figure 8-51 shows a simplified block diagram of the key control section. U3B and U10 count down the 10kHz keyboard clock signal. U10 outputs three signals: ROW1 (2.5kHz), ROW2 (1.25kHz) and ROW4 (625Hz). U11 decodes the ROW1, ROW2 and ROW4 signals into the key scan signals (KRW0 - KRW7), which are applied to each row of the key matrix. If one of the keys in the key matrix is pressed, U9 encodes the column data into a 3-bit signal. The MPU reads the row (U7) and column (U8) data to determine which key is being pressed.

The arrow keys and the FAST key are not included in the key matrix because more than one of these keys can be pressed at the same time. When one of these keys is pressed, U1 disables the key matrix and data for arrow keys and FAST key are read by the microprocessor.

[RPG Control Section]

The RPG (Rotary Pulse Generator), when rotated, outputs pulses indicating the direction and number of rotations. U3 outputs direction data and U4 outputs the number of rotations.

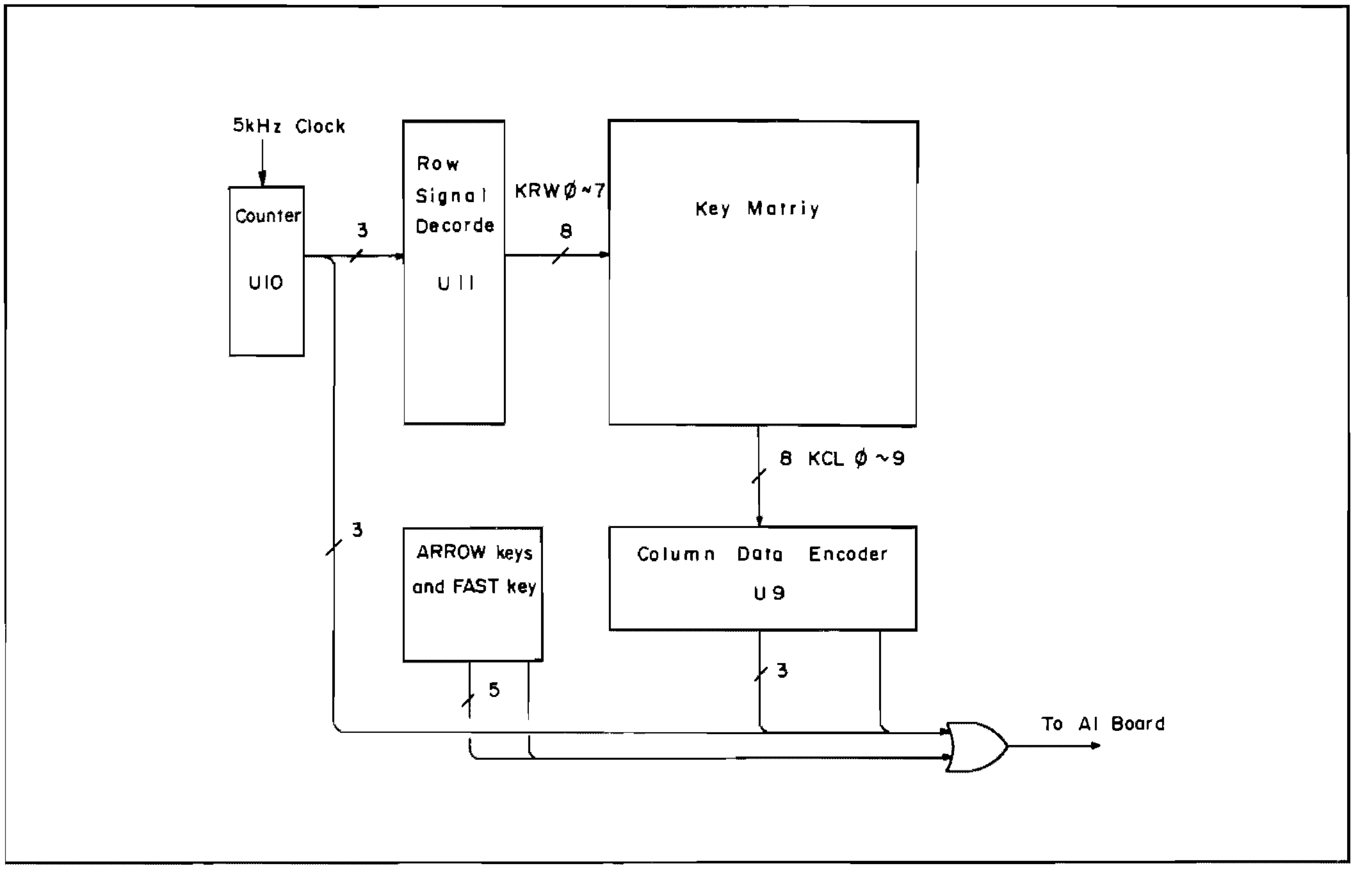


Figure 8-51. Block Diagram of Key Control Section.

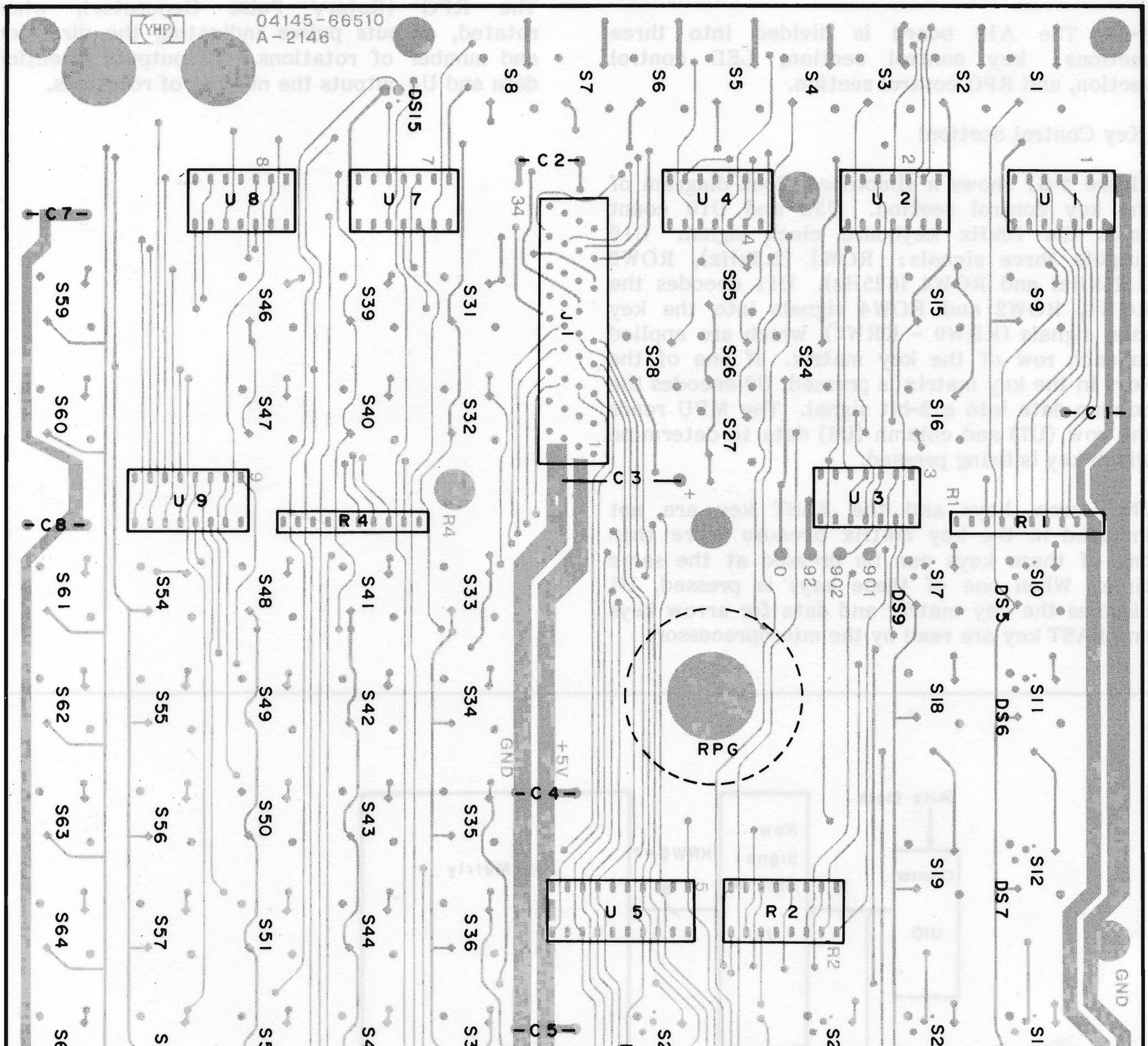
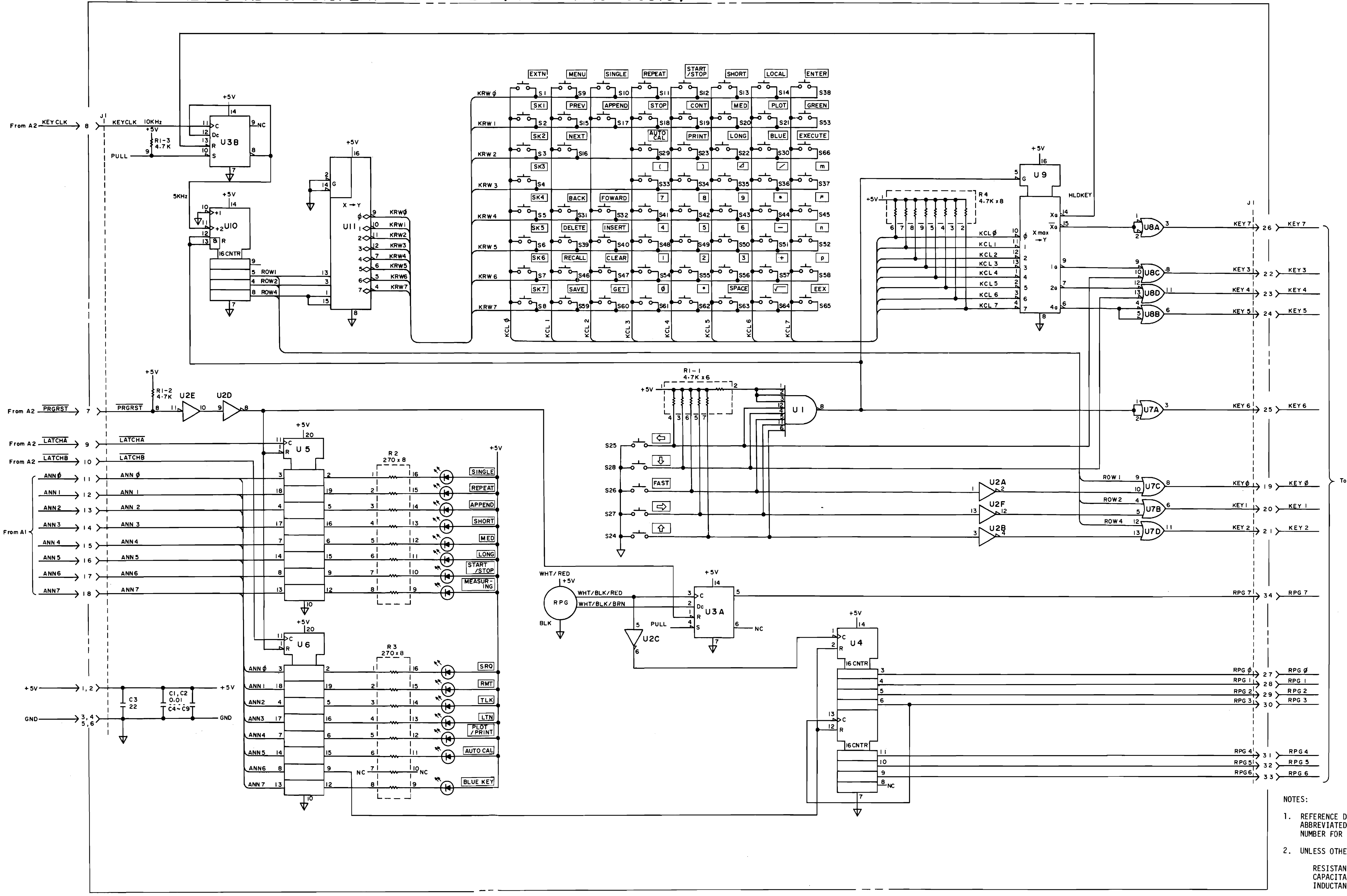


Figure 8-52. A10 Keyboard and Display Control Board Assembly Component Locations.

A10 KEYBOARD & DISPLAY CONTROL (P/N:04145-66510)



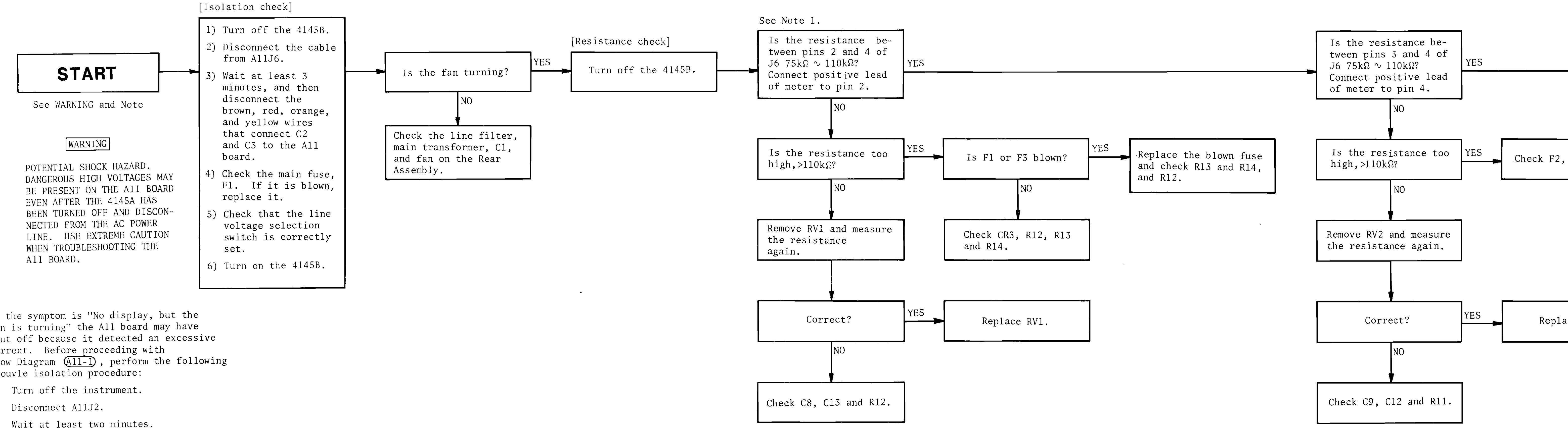
NOTES:

1. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. PREFIX ABBREVIATION WITH ASSEMBLY NUMBER FOR COMPLETE REFERENCE DESIGNATOR.

2. UNLESS OTHERWISE INDICATED:

   RESISTANCE IN OHMS (Ω)
   CAPACITANCE IN MICROFARADS (μF)
   INDUCTANCE IN MICROHENRIES (μH)

Flow Diagram (A11 - 1)

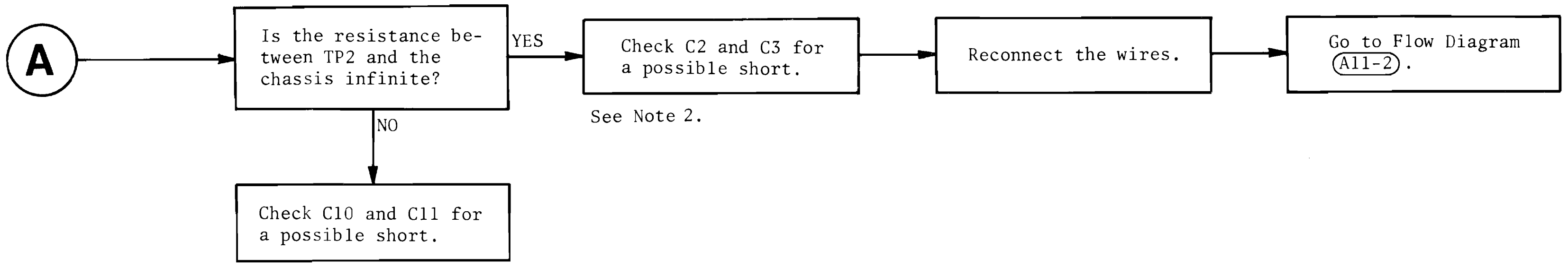


WARNING

POTENTIAL SHOCK HAZARD. DANGEROUS HIGH VOLTAGES MAY BE PRESENT ON THE A11 BOARD EVEN AFTER THE 4145A HAS BEEN TURNED OFF AND DISCONNECTED FROM THE AC POWER LINE. USE EXTREME CAUTION WHEN TROUBLESHOOTING THE A11 BOARD.

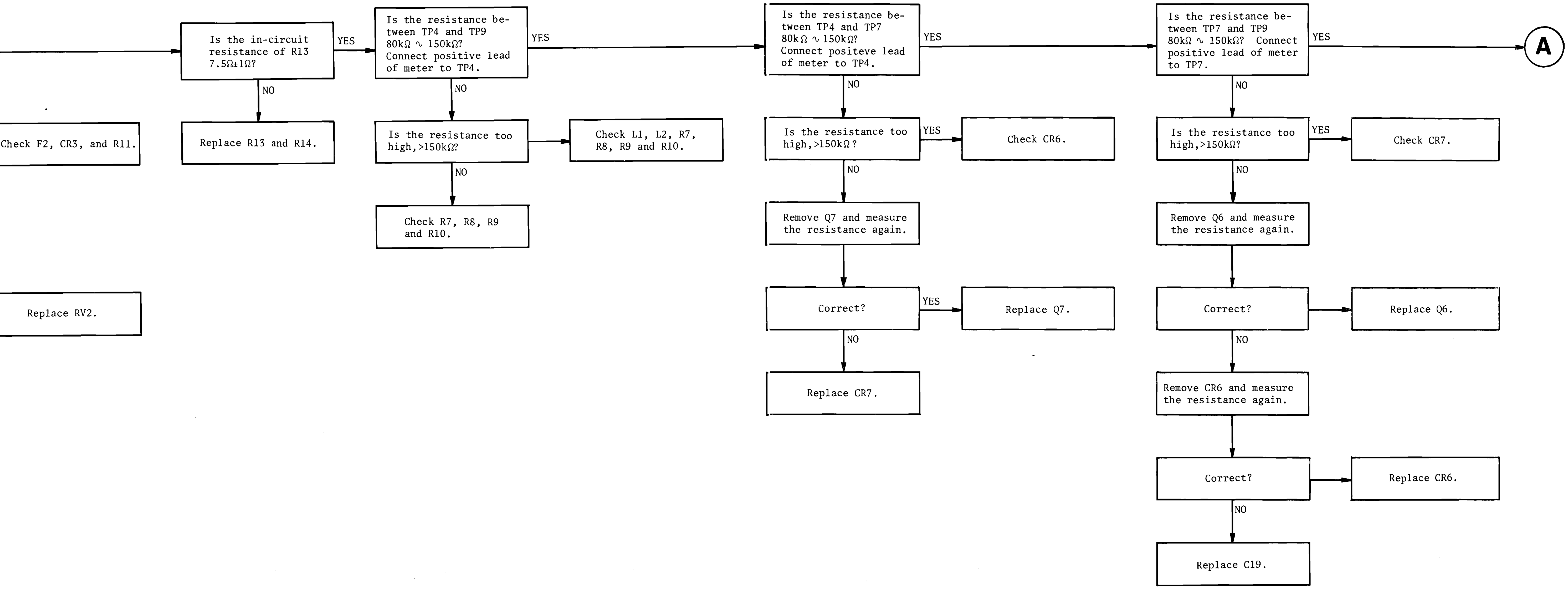
Note: If the symptom is "No display, but the fan is turning" the A11 board may have shut off because it detected an excessive current. Before proceeding with Flow Diagram (A11-1), perform the following trouvle isolation procedure:

1) Turn off the instrument.
2) Disconnect A11J2.
3) Wait at least two minutes.
4) Turn on the instrument.
5) If "Busy" and "Error A01" are successively displayed, the failure is not on the A11 board, Go to Flow Diagram (A15-1).



Notes:

1. When making the resistance measurements described in this flow diagram keep in mind that there are often one or two large capacitors in the circuit being measured which may cause the initial reading to be too low. Before deciding whether a reading is incorrect or not, wait a few seconds in order to allow the capacitors to charge.
2. C2 and C3 are mounted on Rear Assembly A. Refer to Figure 8-6.



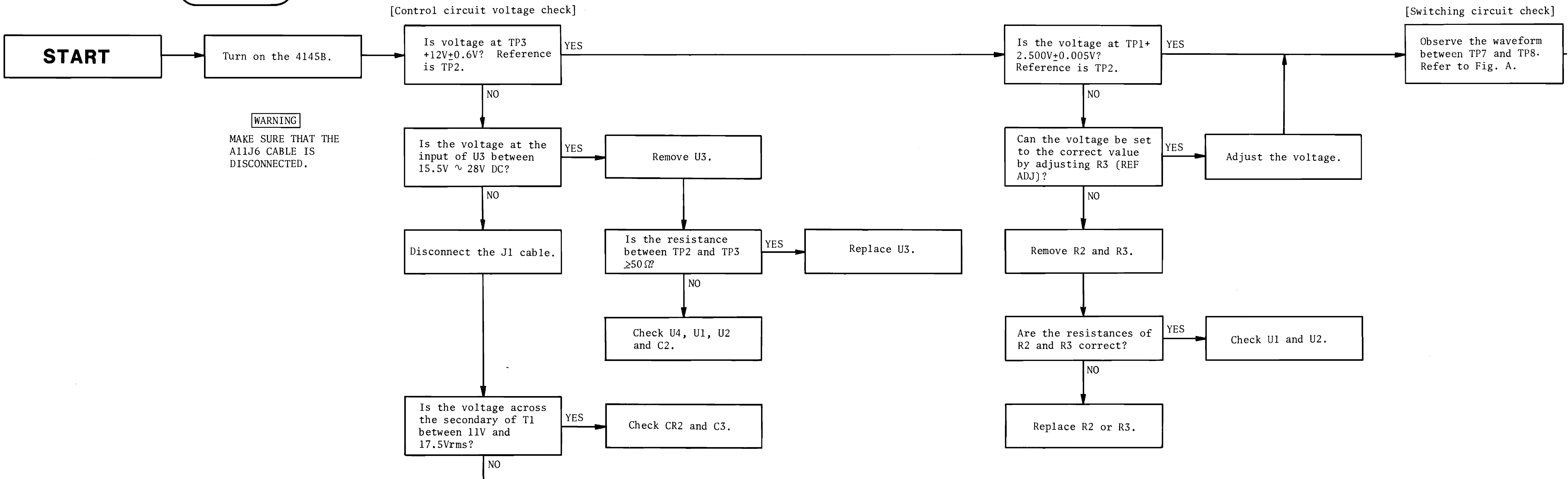
A10 BOARD

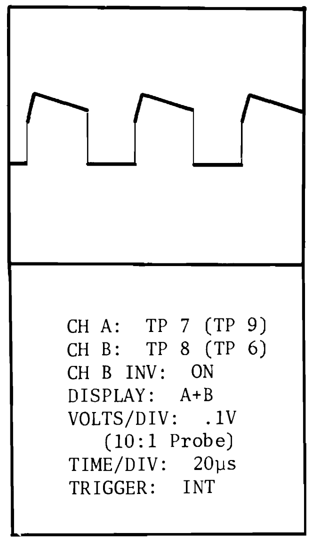
SEE INSIDE

Figure 8-53. A10 Keyboad and Display Board Assembly Component Locations.

Figure 8-54. All Board Troubleshooting Flow Diagram (Sheet 1 of 2).

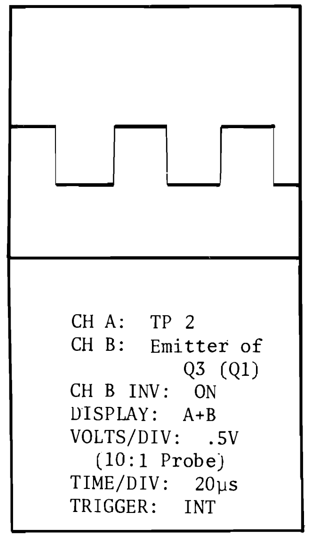
Flow Diagram A11 - 2





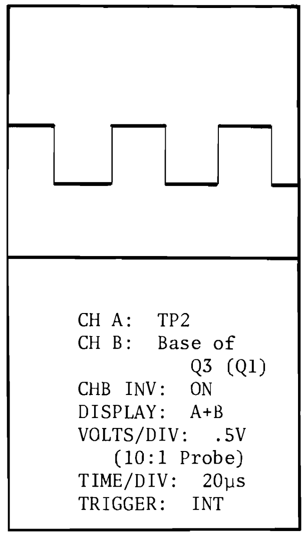
CH A: TP 7 (TP 9)
CH B: TP 8 (TP 6)
CH B INV: ON
DISPLAY: A+B
VOLTS/DIV: .1V
(10:1 Probe)
TIME/DIV: 20μs
TRIGGER: INT

Figure A



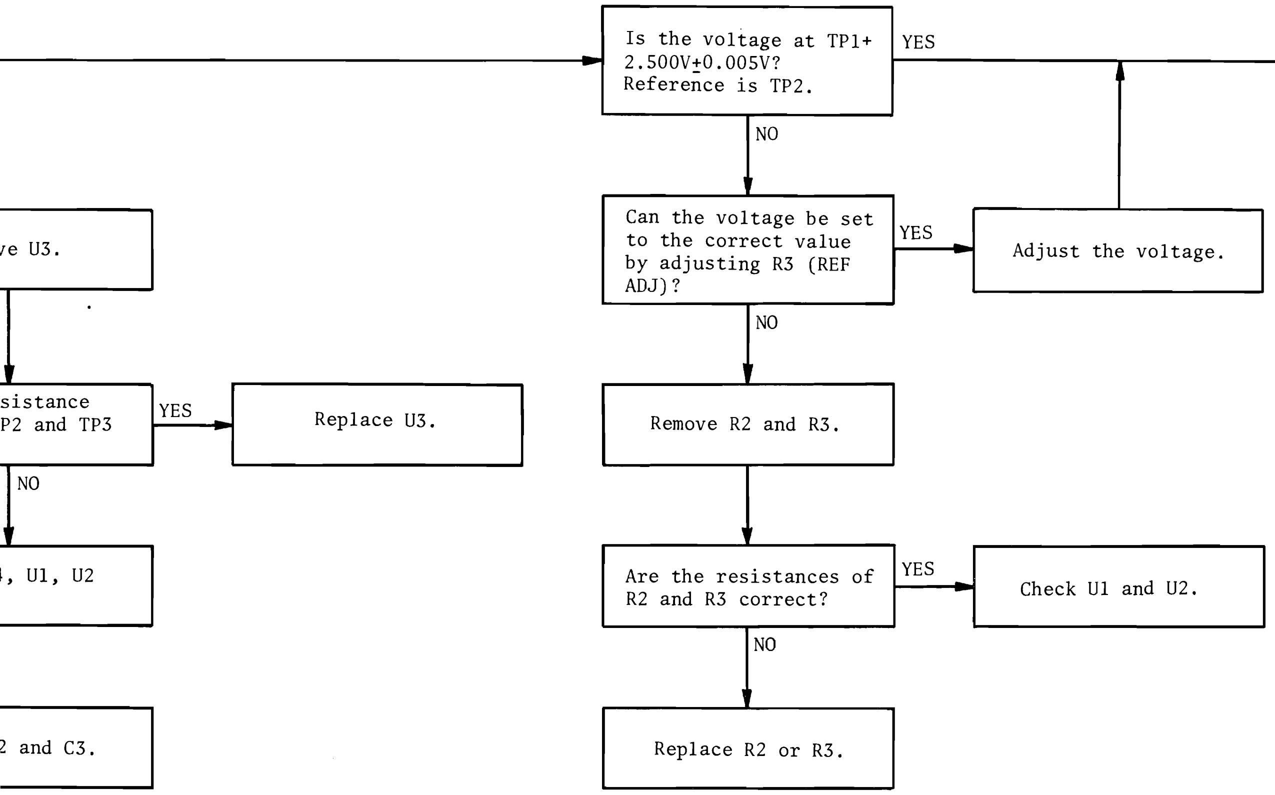
CH A: TP 2
CH B: Emitter of Q3 (Q1)
CH B INV: ON
DISPLAY: A+B
VOLTS/DIV: .5V
(10:1 Probe)
TIME/DIV: 20μs
TRIGGER: INT

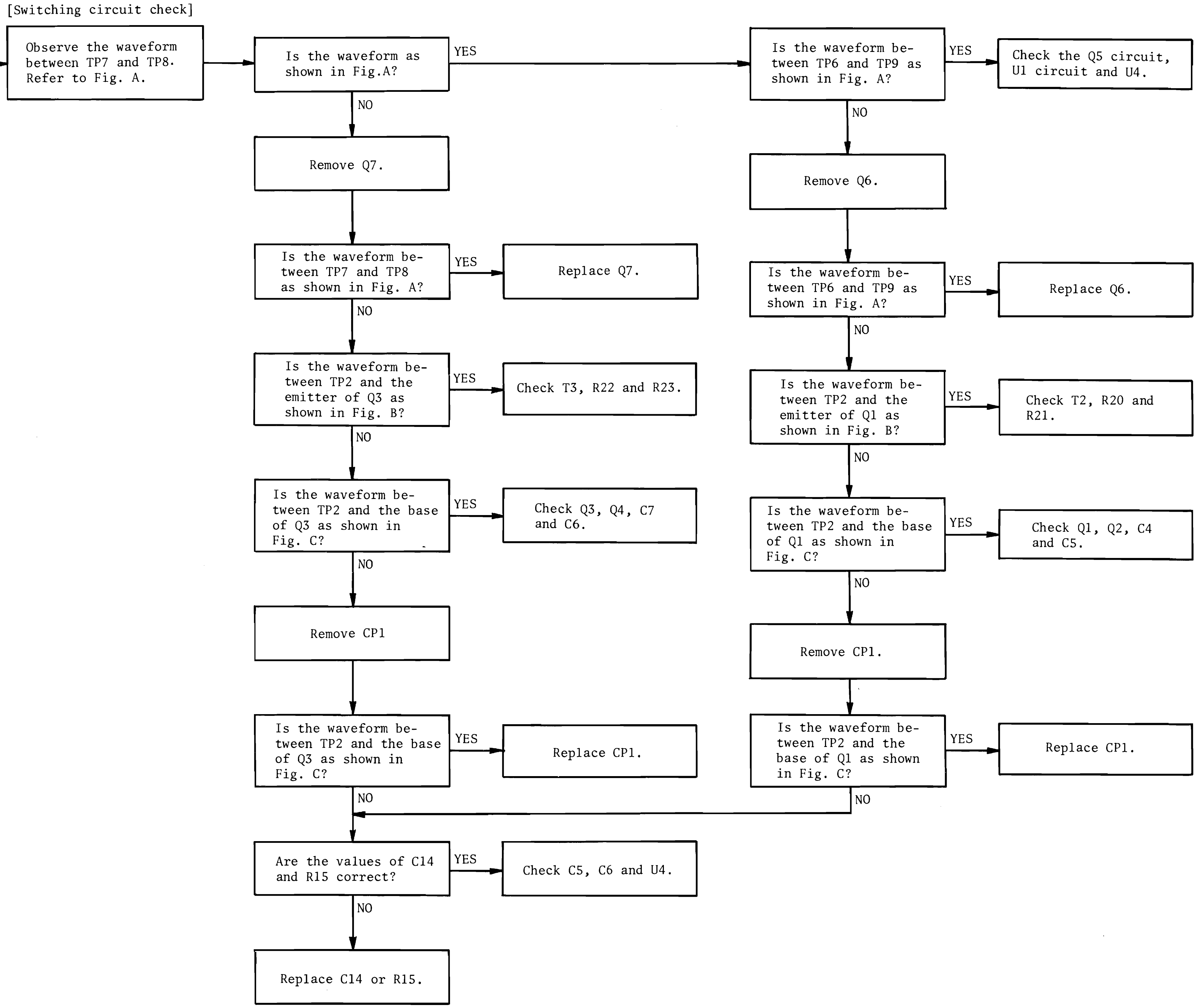
Figure B



CH A: TP2
CH B: Base of Q3 (Q1)
CHB INV: ON
DISPLAY: A+B
VOLTS/DIV: .5V
(10:1 Probe)
TIME/DIV: 20μs
TRIGGER: INT

Figure c





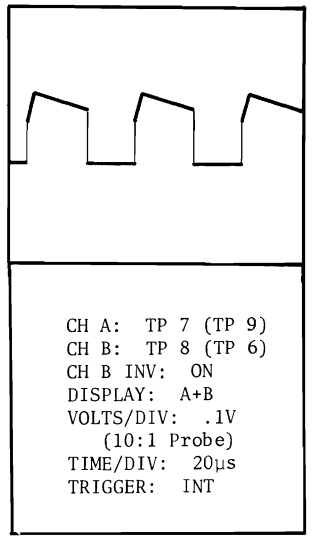


Figure A

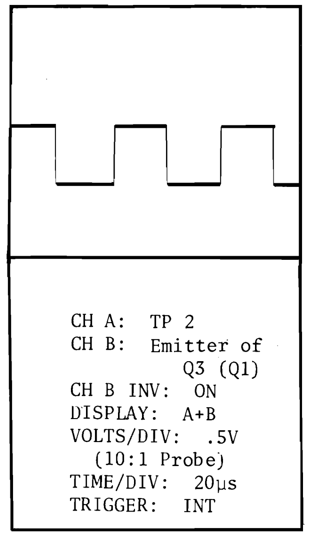


Figure B

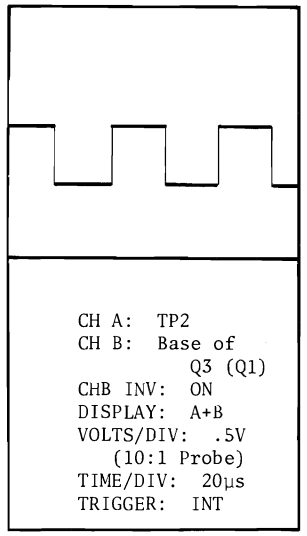
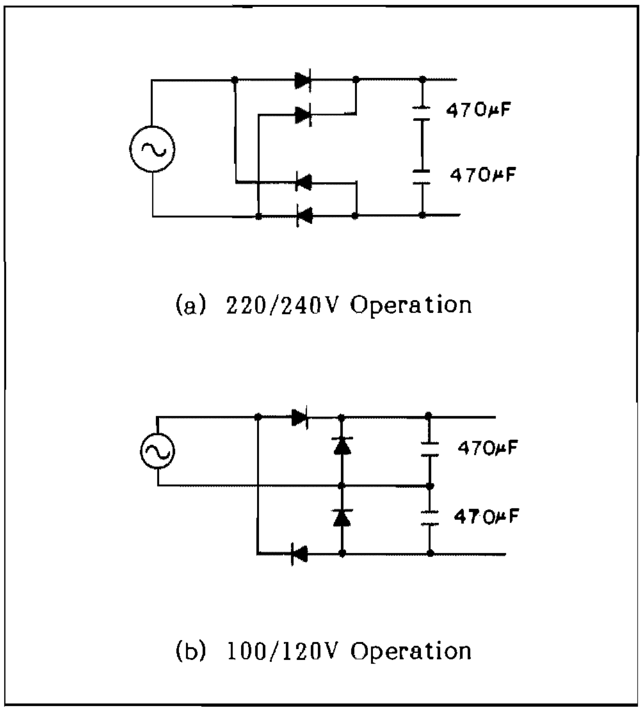


Figure c

8-50. A11 SWITCHING POWER SUPPLY BOARD

8-51. The switching power regulator on the A11 board constructs a light weight, powerful dc power supply, upgrading the mobility of the instrument. When the instrument is turned on, ac line voltage is applied to CR3 before being stepped down to the required voltages by T1. In 220/240V operation, the CR3 circuitry acts as a bridged rectifier (Figure 8-55 (a)). In 100/120V operation, the line voltage selector switches transform the configuration of the CR3 circuitry into a voltage doubler which provides a dc voltage almost equal to that obtained in 220/240V operation (Figure 8-55 (b)).



(a) 220/240V Operation

(b) 100/120V Operation

Figure 8-55. Rectifier Circuit.

RV1 and RV2 (varisters) protect the instrument from excessive voltage that may blow the power fuse. To suppress turn-on surge current, K1 allows R13 and R14 to restrict the line current for a brief period after the instrument is turned on.

The high dc voltage from the rectifier circuit is periodically chopped by Q6 and Q7, which are alternately turned on and off at approx. 23kHz by the switching controller, U4. (Figure 8-56)

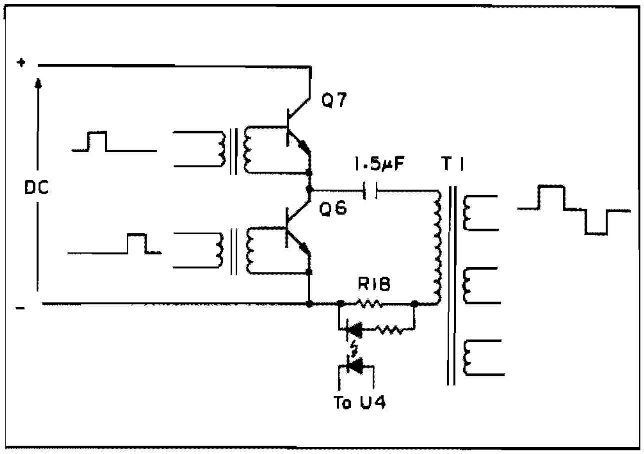


Figure 8-56. Switching Circuit.

U4 also controls the duty cycle of the pulses at the T1 primary by monitoring the DC output from CR4. If the monitored DC is too high, U4 decreases the duty cycle of the Q6 and Q7 switching pulses; if the monitored DC is too low, U4 increases the duty cycle. Thus, the DC component of T1 output pulses is kept constant for all values of AC line voltage.

If excessive current flows through R18, U4 will detect it via CP1 optocoupler and stop generating the Q6 and Q7 switching pulses, thus shutting off the power supply.

DC power for U4 is provided by CR2, U3 and C3. C3 is large—2200μF—because U4 must be turned off only after all other circuits are off when the 4145B is turned off.

U1A and U1B monitor the dc voltage output from CR3. See Figure 8-57. When the power is removed, U1A sends a RESET signal to the MPU to reset the entire instrument. If the power loss is of a short duration, however, the instrument will recover and will display "Recovered from power down ! " These brief power failures are detected by U1B.

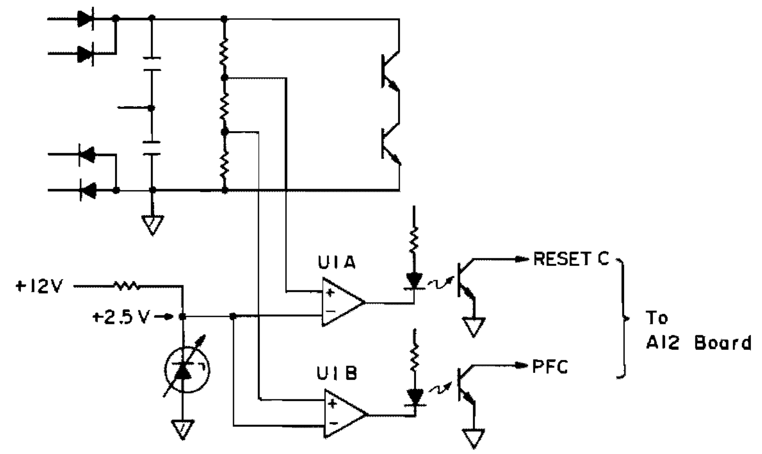


Figure 8-57. Power Loss Detection Circuit.

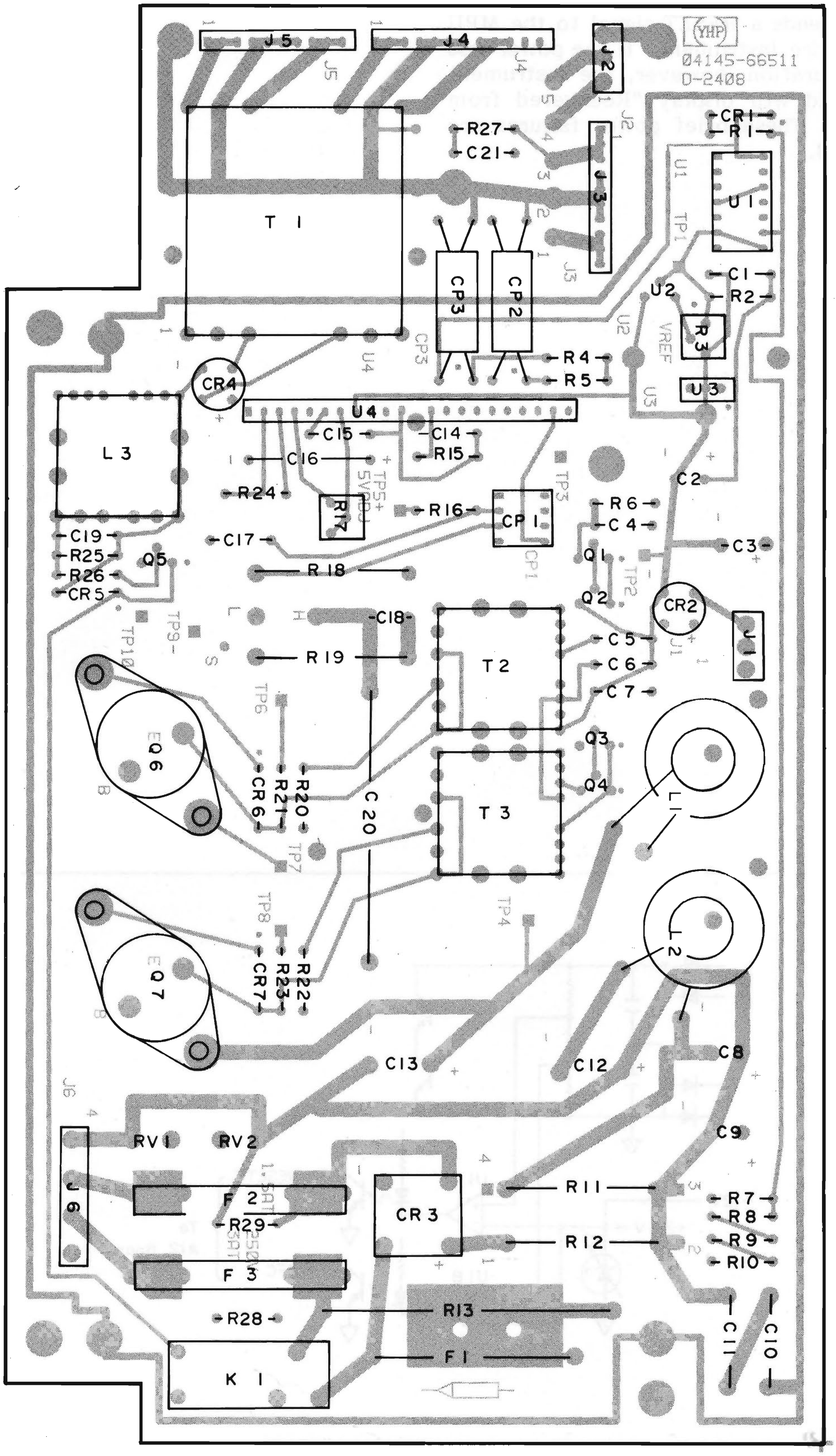
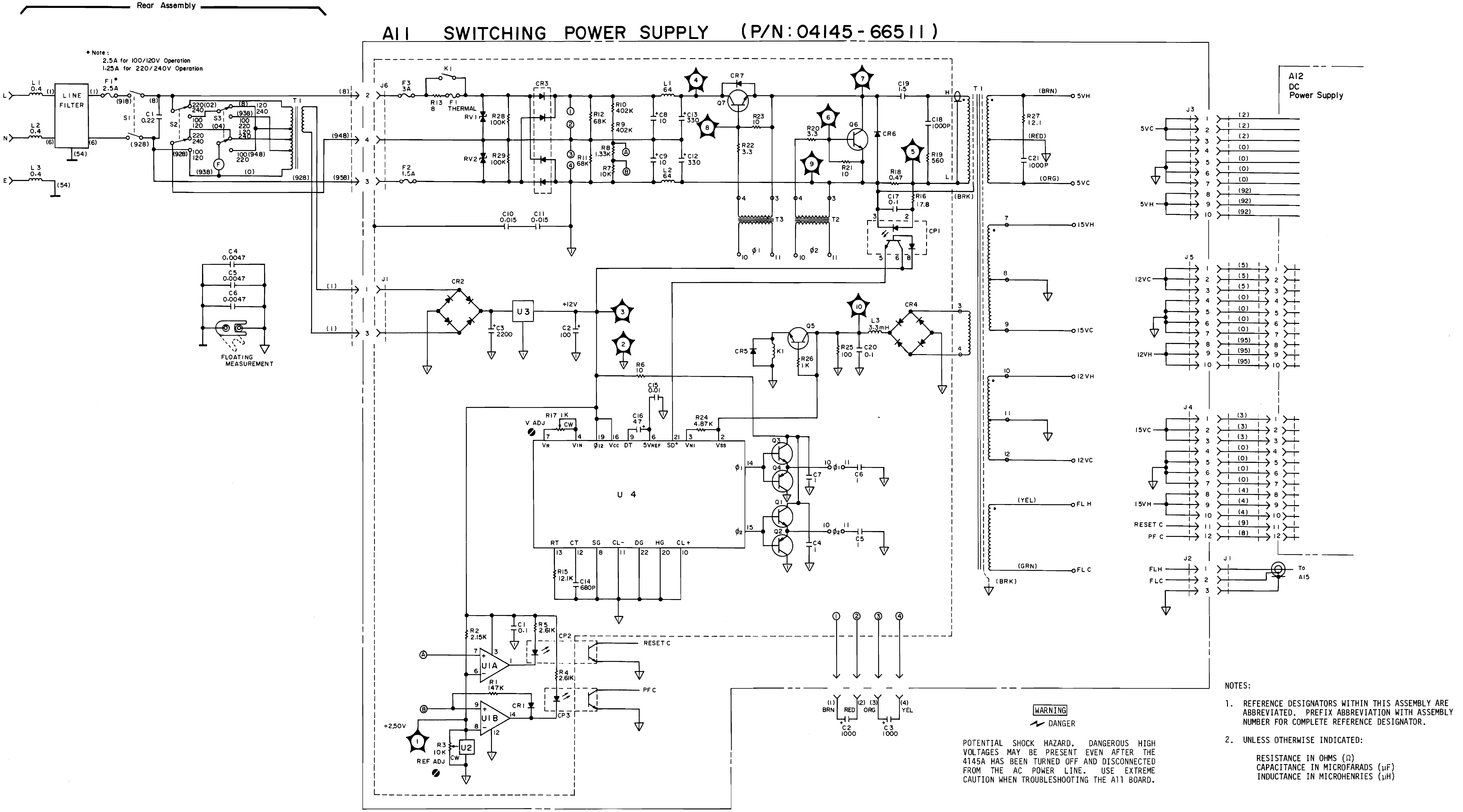


Figure 8-58. A11 Switching Power Supply Board Assembly Component Locations.

A11 SWITCHING POWER SUPPLY (P/N:04145-66511)



WARNING

DANGER

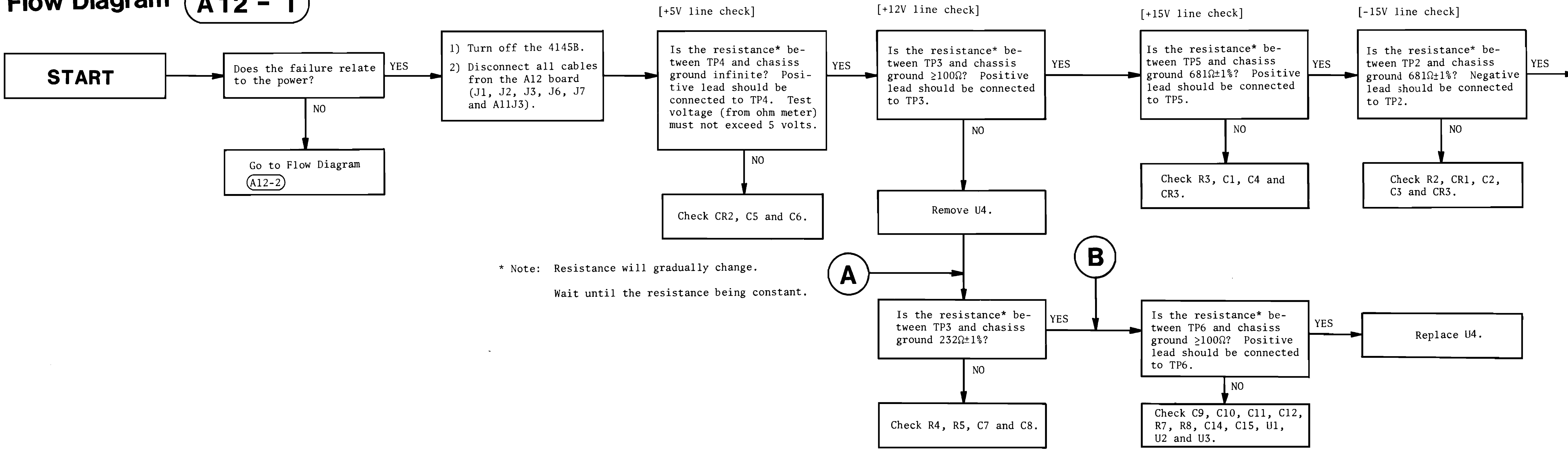
POTENTIAL SHOCK HAZARD. DANGEROUS HIGH VOLTAGES MAY BE PRESENT EVEN AFTER THE 4145A HAS BEEN TURNED OFF AND DISCONNECTED FROM THE AC POWER LINE. USE EXTREME CAUTION WHEN TROUBLESHOOTING THE A11 BOARD.

NOTES:

1. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. PREFIX ABBREVIATION WITH ASSEMBLY NUMBER FOR COMPLETE REFERENCE DESIGNATOR.
2. UNLESS OTHERWISE INDICATED:

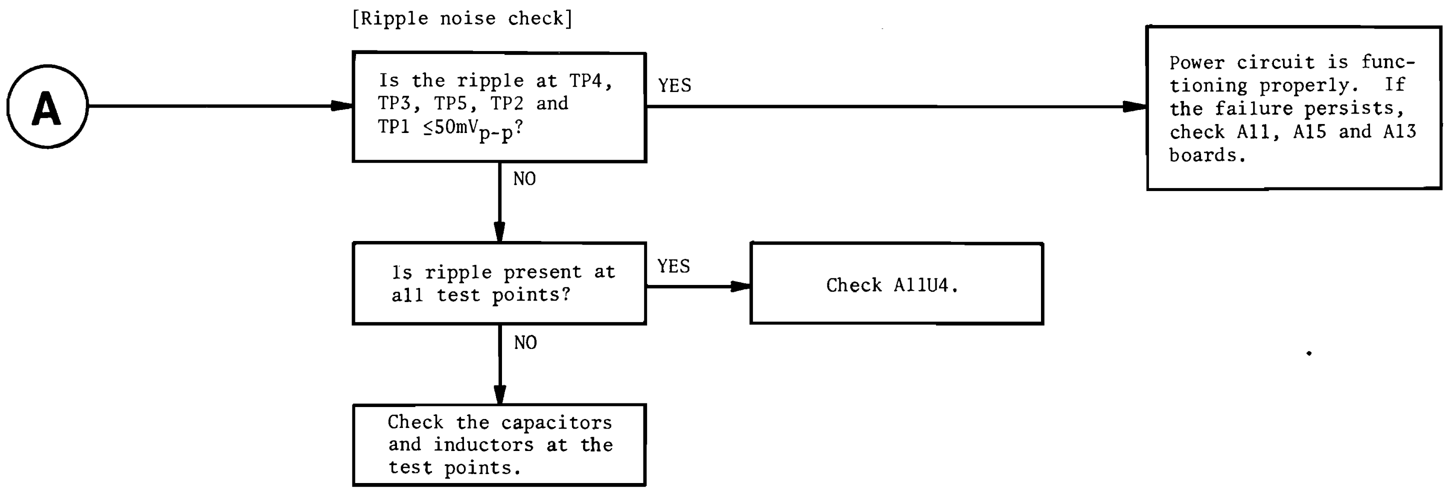
   RESISTANCE IN OHMS (Ω)
   CAPACITANCE IN MICROFARADS (μF)
   INDUCTANCE IN MICROHENRIES (μH)

Flow Diagram A12 - 1



* Note: Resistance will gradually change.

Wait until the resistance being constant.



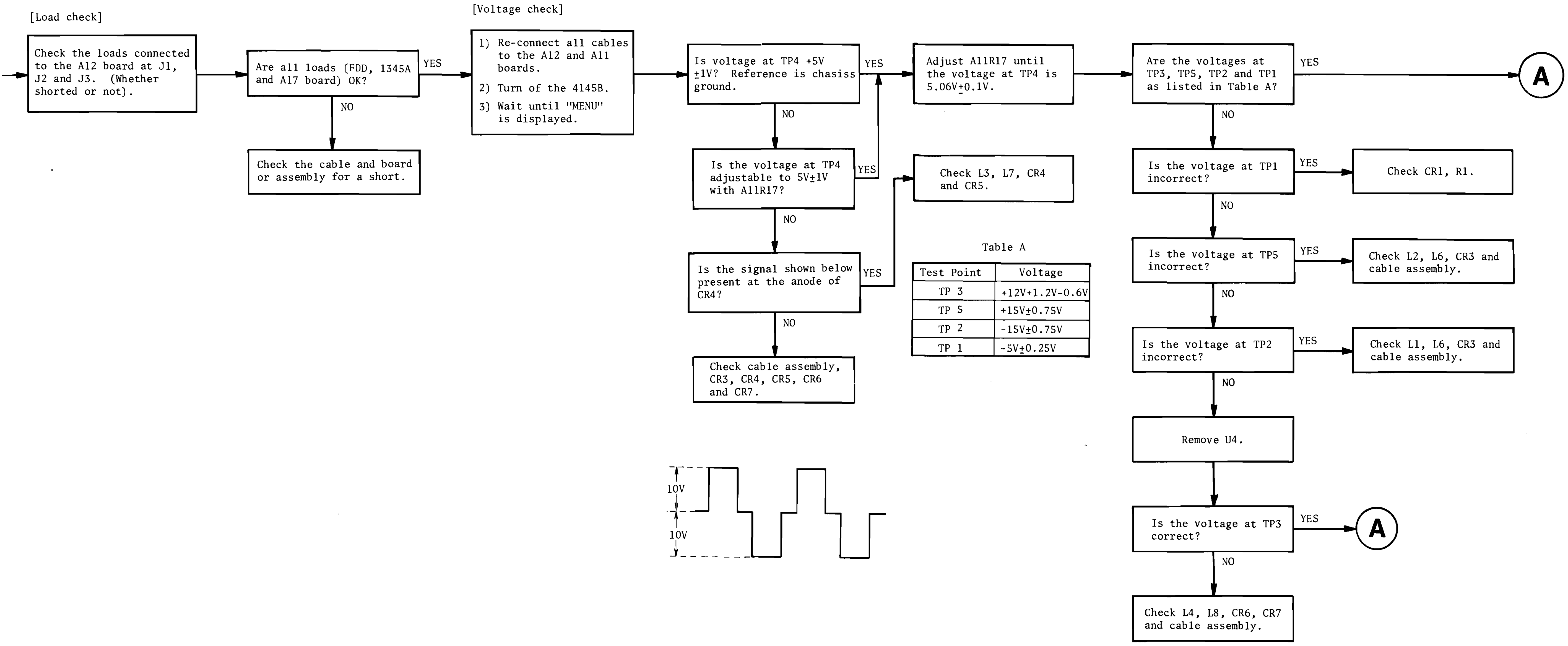


Table A

Test Point	Voltage
TP 3	+12V+1.2V-0.6V
TP 5	+15V±0.75V
TP 2	-15V±0.75V
TP 1	-5V±0.25V

A11 BOARD

SEE INSIDE

Figure 8-59. A11 Switching Power Supply Board Assembly Schematic Diagrams.

Figure 8-60. A12 Board Troubleshooting Flow Diagram (Sheet 1 of 2).

Flow Diagram (A12 - 2)

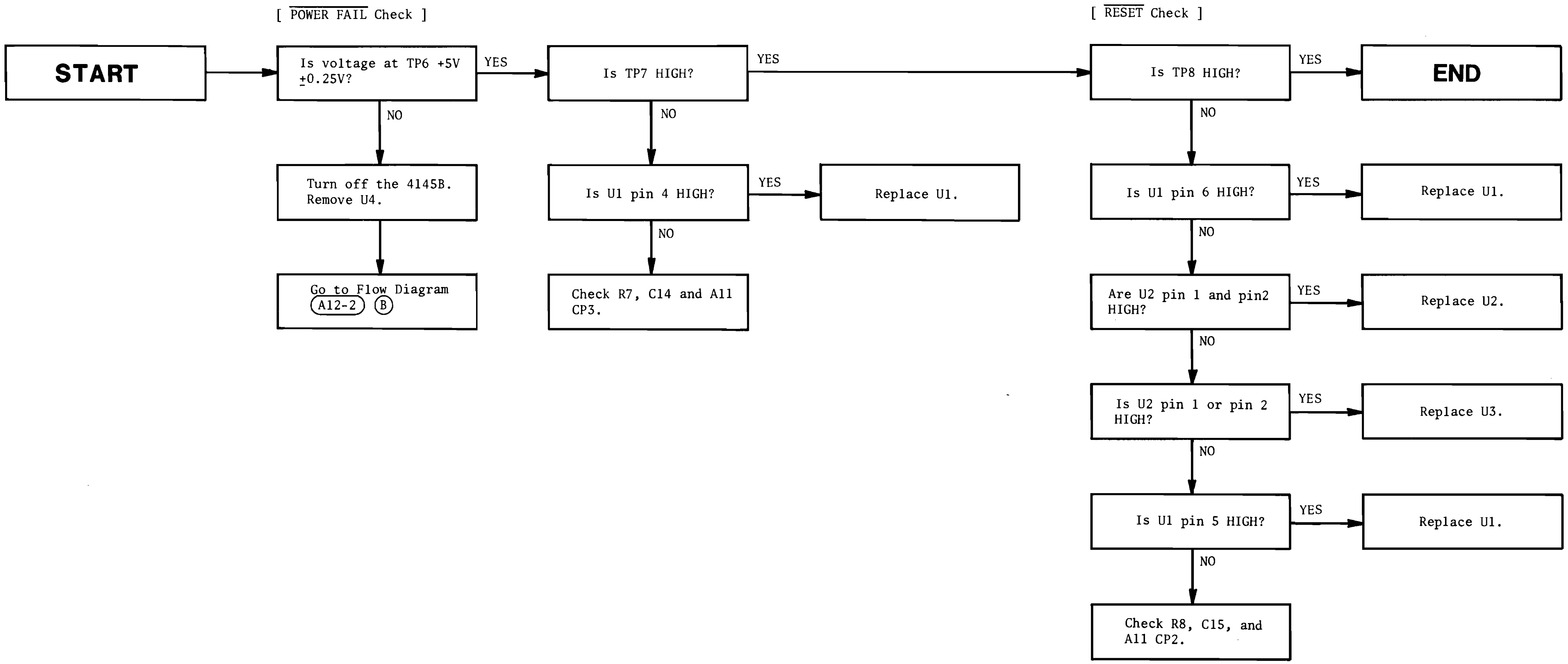


Figure 8-60. A12 Board Troubleshooting Flow Diagram (Sheet 2 of 2).

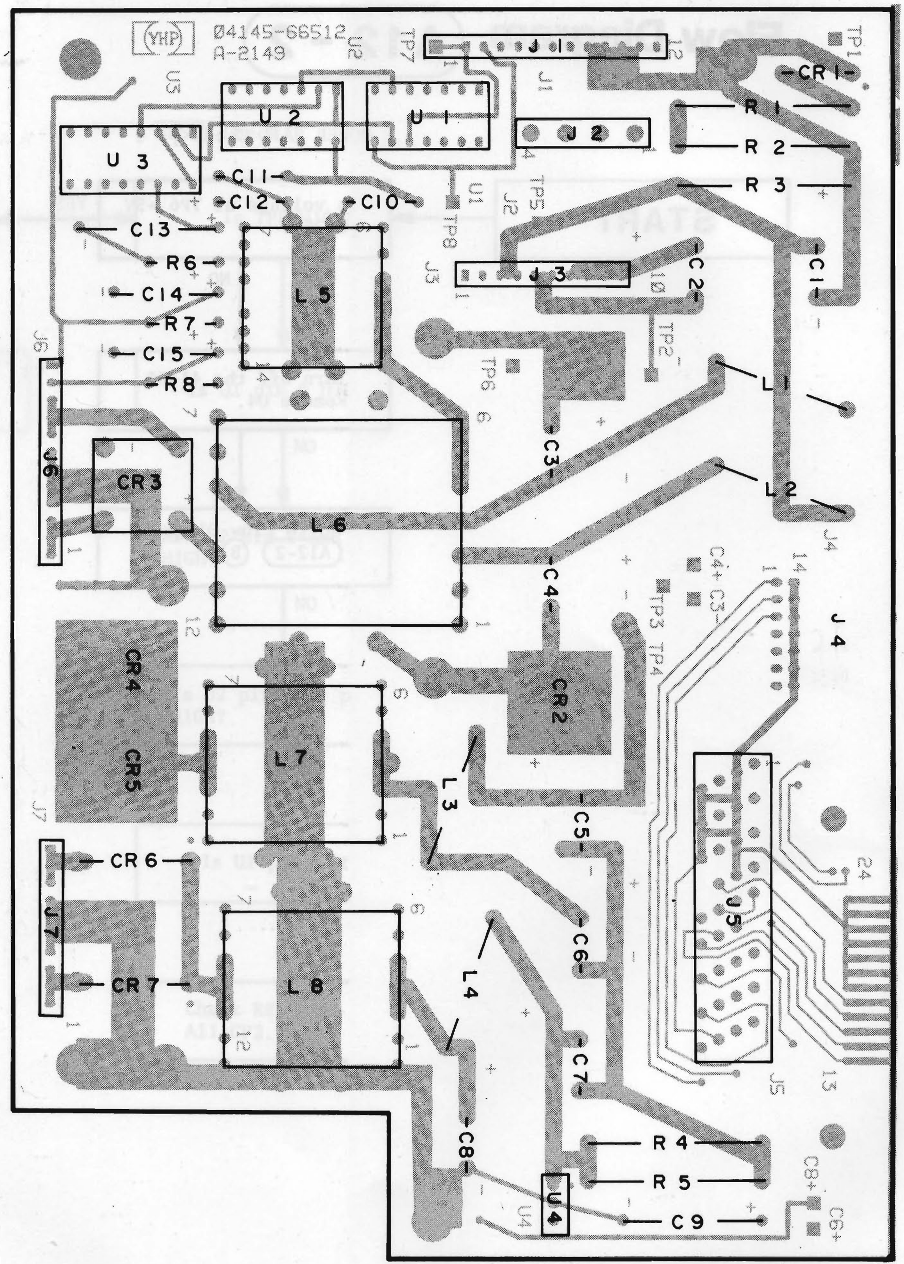
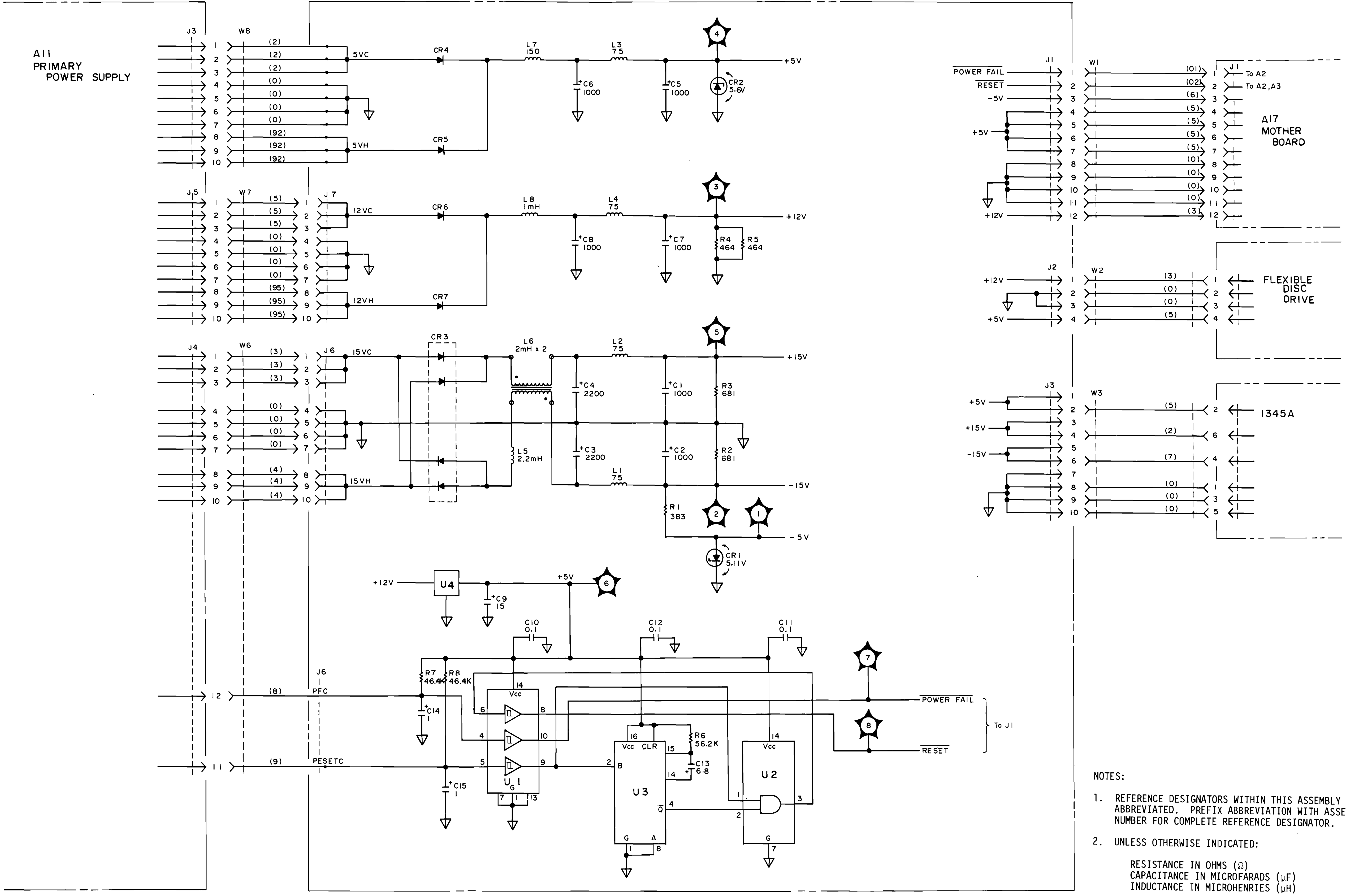


Figure 8-61. A12 DC Power Supply Board Assembly Component Locations.

A12 DC POWER SUPPLY (P/N:04145-66512)



NOTES:

1. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. PREFIX ABBREVIATION WITH ASSEMBLY NUMBER FOR COMPLETE REFERENCE DESIGNATOR.

2. UNLESS OTHERWISE INDICATED:

   RESISTANCE IN OHMS (Ω)
   CAPACITANCE IN MICROFARADS (μF)
   INDUCTANCE IN MICROHENRIES (μH)

Flow Diagram A13

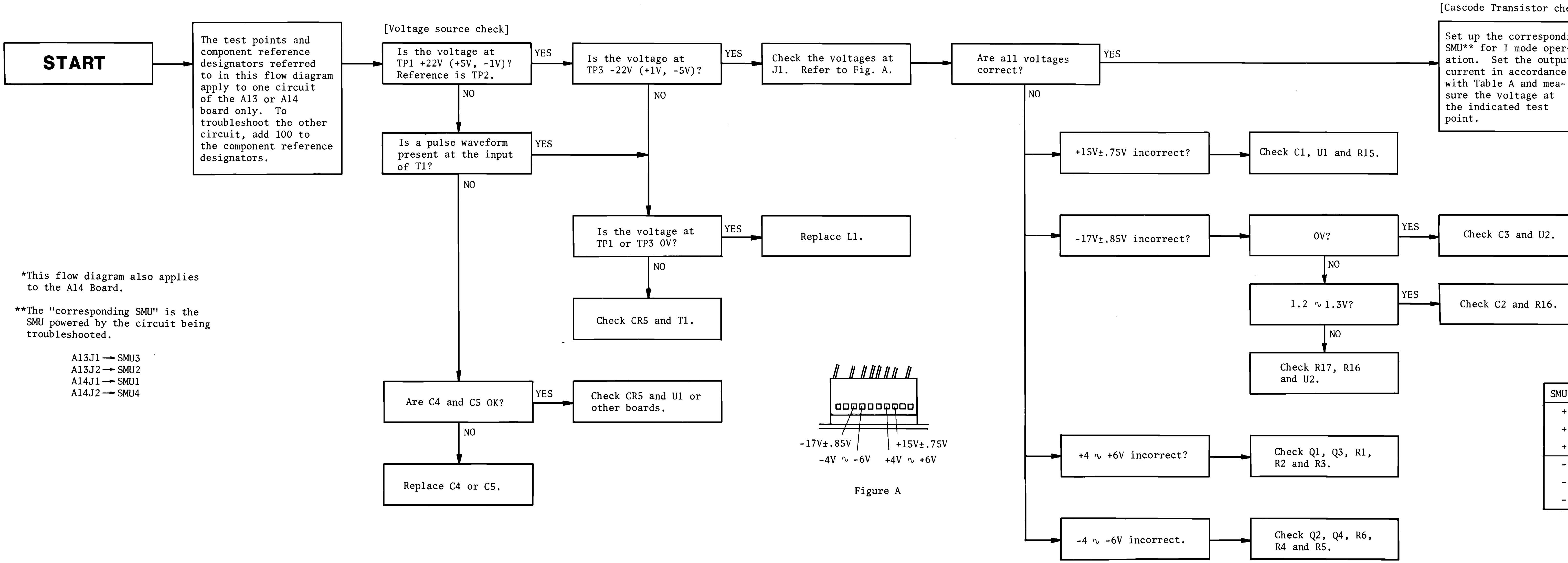


Figure A

Notes: *This flow diagram also applies to the A14 Board.

**The "corresponding SMU" is the SMU powered by the circuit being troubleshooted.

A13J1 → SMU3
A13J2 → SMU2
A14J1 → SMU1
A14J2 → SMU4

A12 BOARD
SEE INSIDE

Figure 8-62. A12 DC Power Supply Board Assembly Schematic Diagram.

Figure 8-6

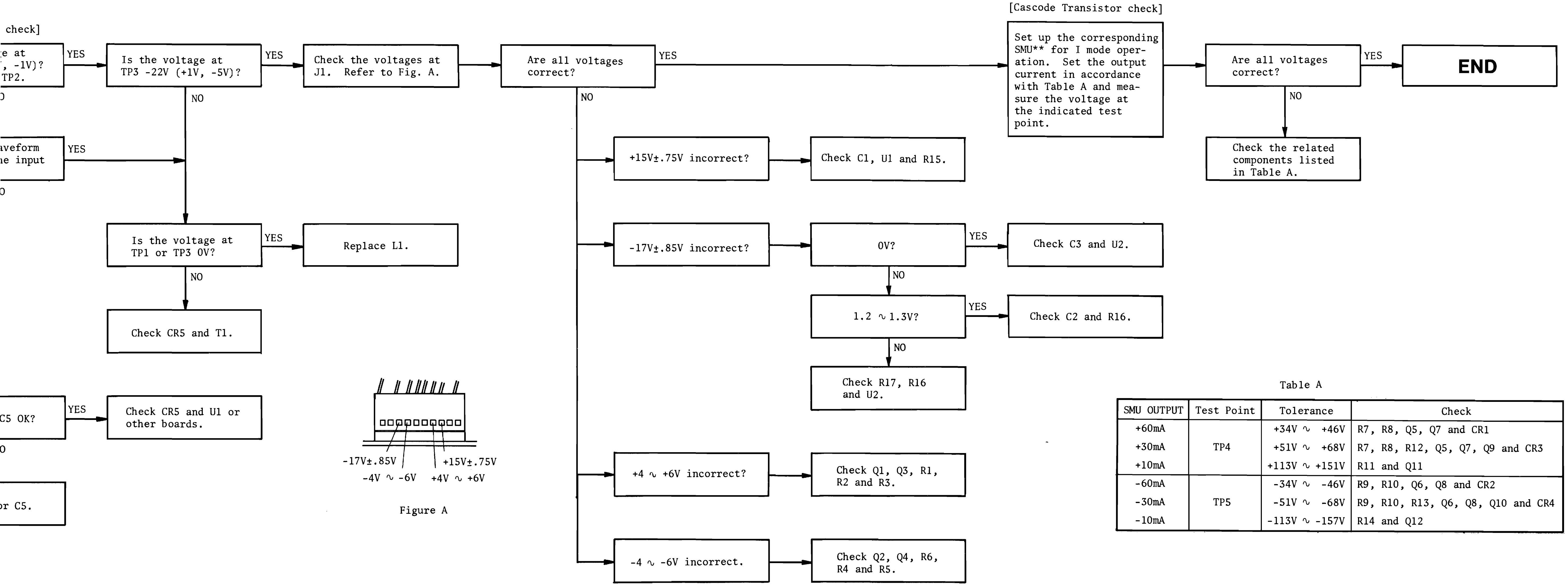


Figure A

Table A

SMU OUTPUT	Test Point	Tolerance	Check
+60mA	TP4	+34V ∿ +46V	R7, R8, Q5, Q7 and CR1
+30mA		+51V ∿ +68V	R7, R8, R12, Q5, Q7, Q9 and CR3
+10mA		+113V ∿ +151V	R11 and Q11
-60mA	TP5	-34V ∿ -46V	R9, R10, Q6, Q8 and CR2
-30mA		-51V ∿ -68V	R9, R10, R13, Q6, Q8, Q10 and CR4
-10mA		-113V ∿ -157V	R14 and Q12

Figure 8-63. A13 Board Troubleshooting Flow Diagram.

A12 BOARD
SEE INSIDE

Figure 8-62. A12 DC Power Supply Board Assembly Schematic Diagram.

8-52. A13 SMU POWER SOURCE BOARDS

8-53. Each A13 board provides dc power for two of the four SMUs. The output stage of the power amplifier on the SMU board is connected to the A13 board (Refer to Figure 8-44). As for the positive voltage circuitry, Q1 is biased by R2 and R3. Initially Q1, Q7 and Q11 are on, and Q3, Q5 and Q9 are off. So +130V is applied to the collector of Q1. Q5 and Q9 change the voltage applied to Q1 according to output current to obtain an optimum power consumption. Figure 8-64 shows partial schematics. Change sequence is as follows:

(1) When I is low, Q11 is biased by R11 and held on, and dc power is provided from +130V.

(2) If I increases, the voltage drop across R12 also increases, turning on Q9 and turning off Q11.

(3) DC power is then provided from the +60V supply.

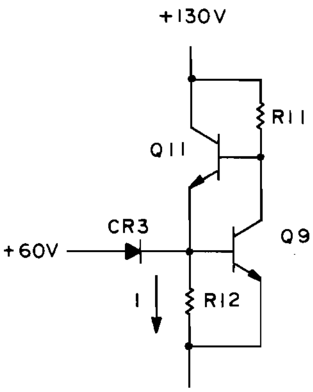


Figure 8-64. Voltage Change Sequence.

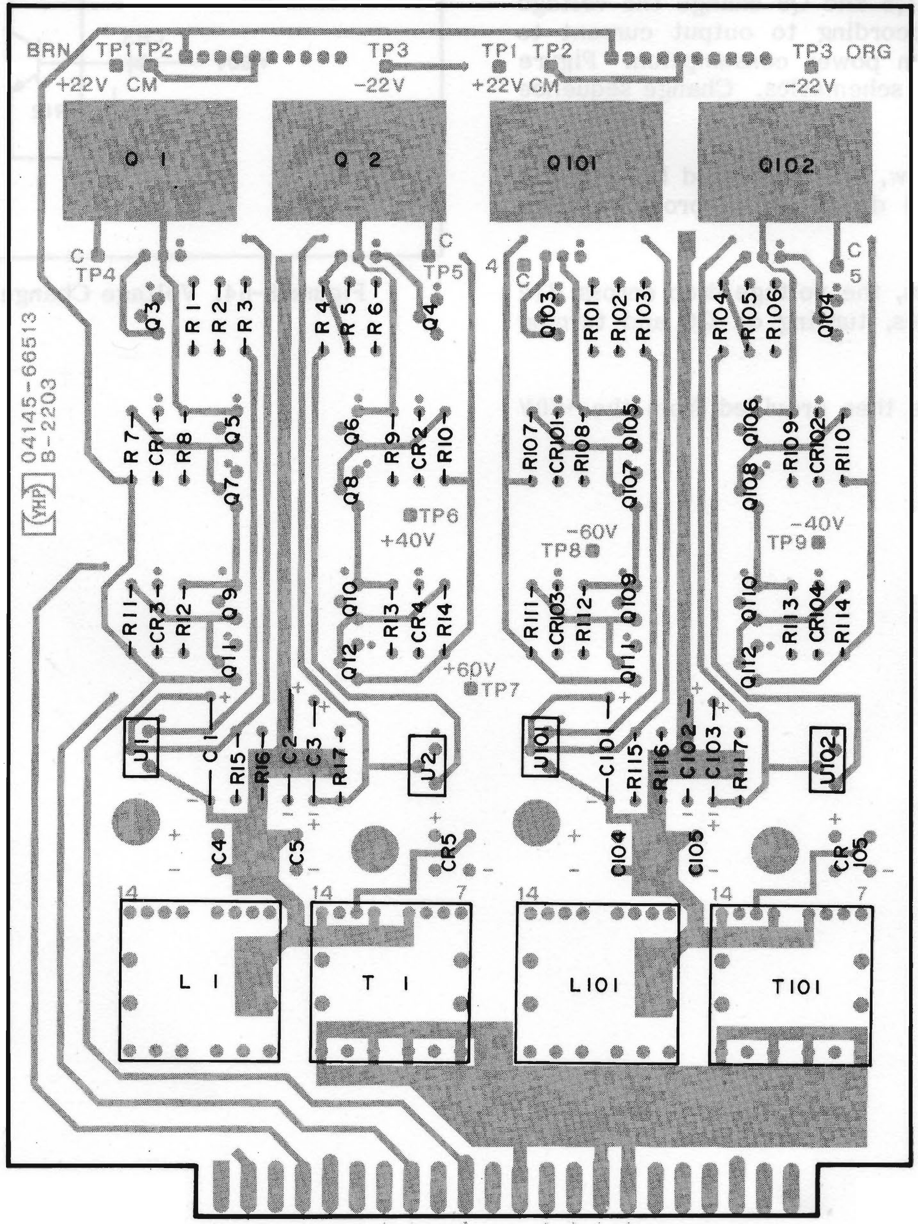
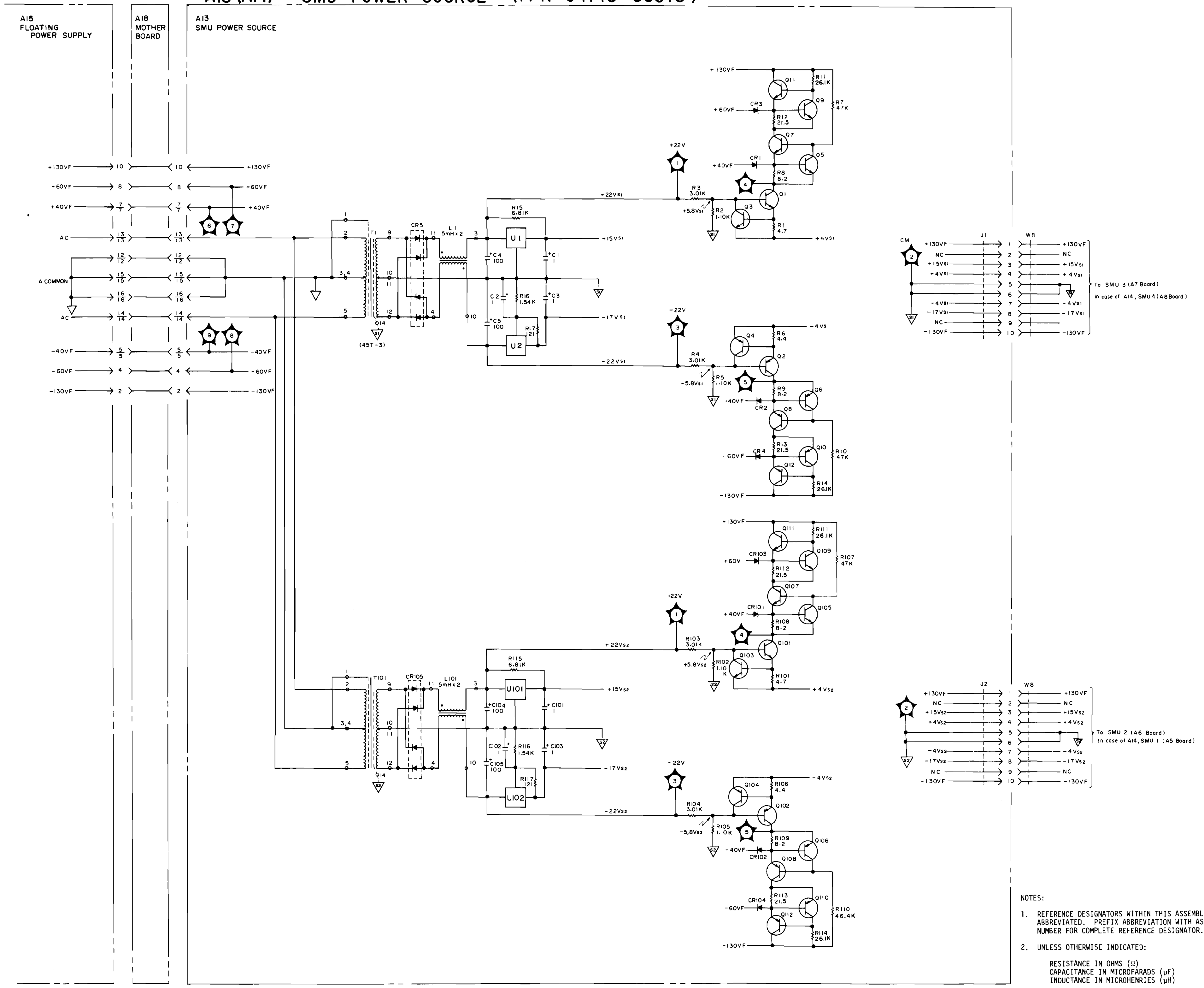


Figure 8-65. A13 SMU Power Source Board Assembly Component Locations.

A13 (A14) SMU POWER SOURCE (P/N:04145-66513)

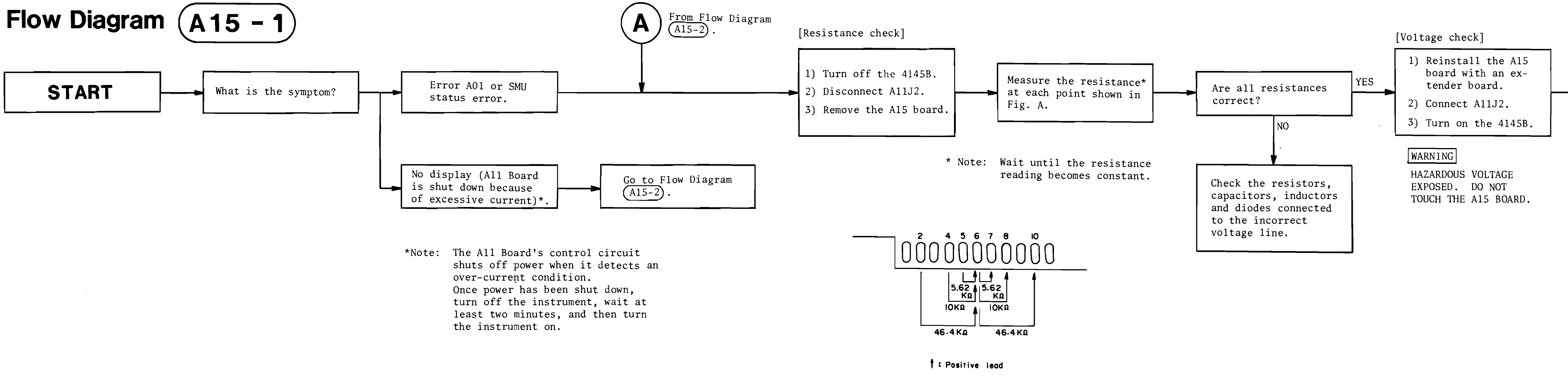


NOTES:

1. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. PREFIX ABBREVIATION WITH ASSEMBLY NUMBER FOR COMPLETE REFERENCE DESIGNATOR.
2. UNLESS OTHERWISE INDICATED:

   RESISTANCE IN OHMS (Ω)
   CAPACITANCE IN MICROFARADS (μF)
   INDUCTANCE IN MICROHENRIES (μH)

Flow Diagram (A15 - 1)



WARNING

HAZARDOUS VOLTAGE EXPOSED. DO NOT TOUCH THE A15 BOARD.

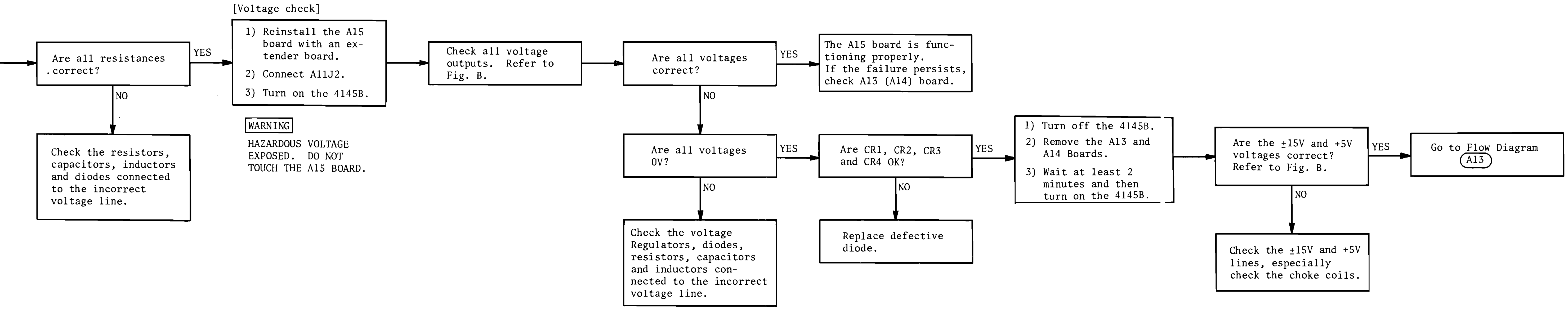
*Note: The A11 Board's control circuit shuts off power when it detects an over-current condition. Once power has been shut down, turn off the instrument, wait at least two minutes, and then turn the instrument on.

* Note: Wait until the resistance reading becomes constant.

Figure A

SEE INS

Figure



Are all resistances correct?

Check the resistors, capacitors, inductors and diodes connected to the incorrect voltage line.

[Voltage check]

1) Reinstall the A15 board with an extender board.
2) Connect A11J2.
3) Turn on the 4145B.

WARNING

HAZARDOUS VOLTAGE EXPOSED. DO NOT TOUCH THE A15 BOARD.

Check all voltage outputs. Refer to Fig. B.

Are all voltages correct?

The A15 board is functioning properly. If the failure persists, check A13 (A14) board.

Are all voltages 0V?

Check the voltage Regulators, diodes, resistors, capacitors and inductors connected to the incorrect voltage line.

Are CR1, CR2, CR3 and CR4 OK?

Replace defective diode.

1) Turn off the 4145B.
2) Remove the A13 and A14 Boards.
3) Wait at least 2 minutes and then turn on the 4145B.

Are the ±15V and +5V voltages correct? Refer to Fig. B.

Go to Flow Diagram (A13)

Check the ±15V and +5V lines, especially check the choke coils.

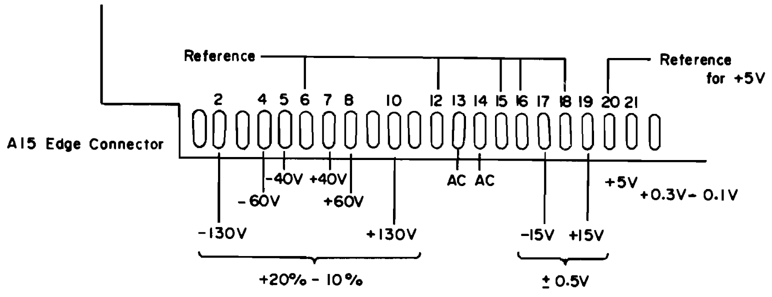


Figure B

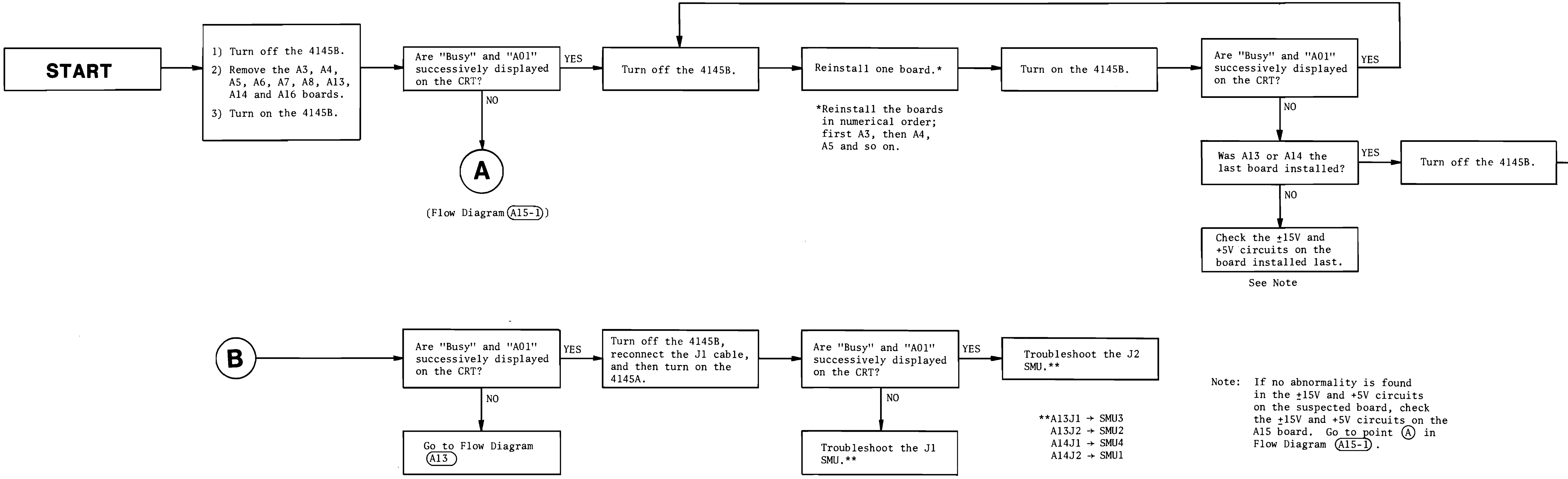
A13 BOARD

SEE INSIDE

Figure 8-66. A13 SMU Power Source Board Assembly Schematic Diagram.

Figure 8-67. A15 Board Troubleshooting Flow Diagram (Sheet 1 of 2).

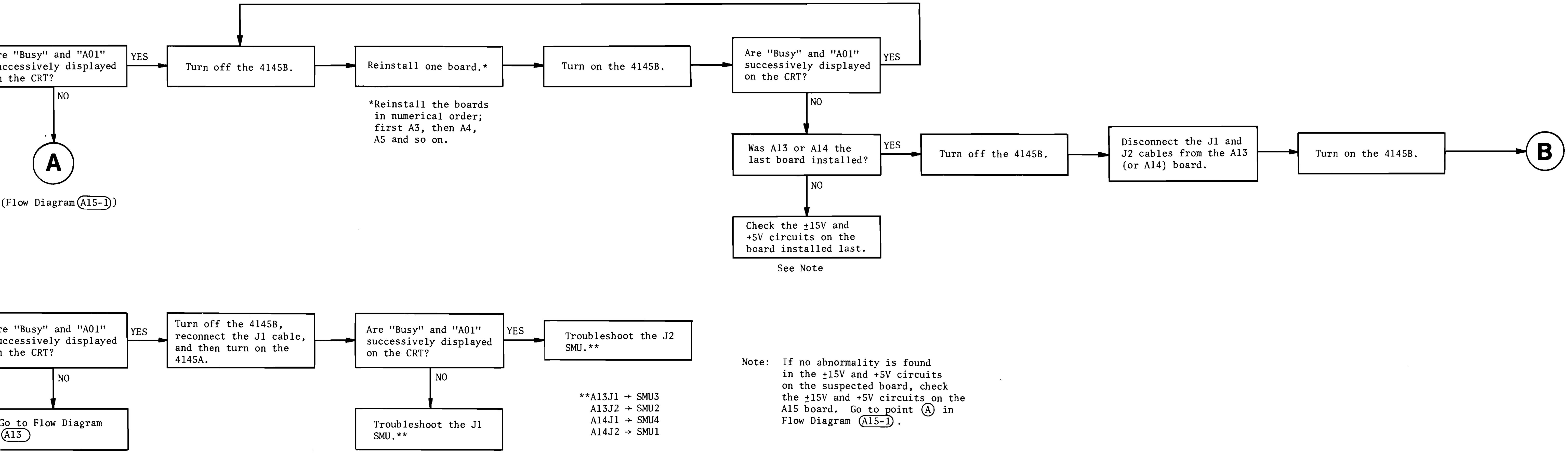
Flow Diagram (A15 - 2)



*Reinstall the boards in numerical order; first A3, then A4, A5 and so on.

**A13J1 → SMU3
A13J2 → SMU2
A14J1 → SMU4
A14J2 → SMU1

Note: If no abnormality is found in the ±15V and +5V circuits on the suspected board, check the ±15V and +5V circuits on the A15 board. Go to point Ⓐ in Flow Diagram (A15-1).



*Reinstall the boards in numerical order; first A3, then A4, A5 and so on.

**A13J1 → SMU3
A13J2 → SMU2
A14J1 → SMU4
A14J2 → SMU1

Note: If no abnormality is found in the ±15V and +5V circuits on the suspected board, check the ±15V and +5V circuits on the A15 board. Go to point Ⓐ in Flow Diagram (A15-1).

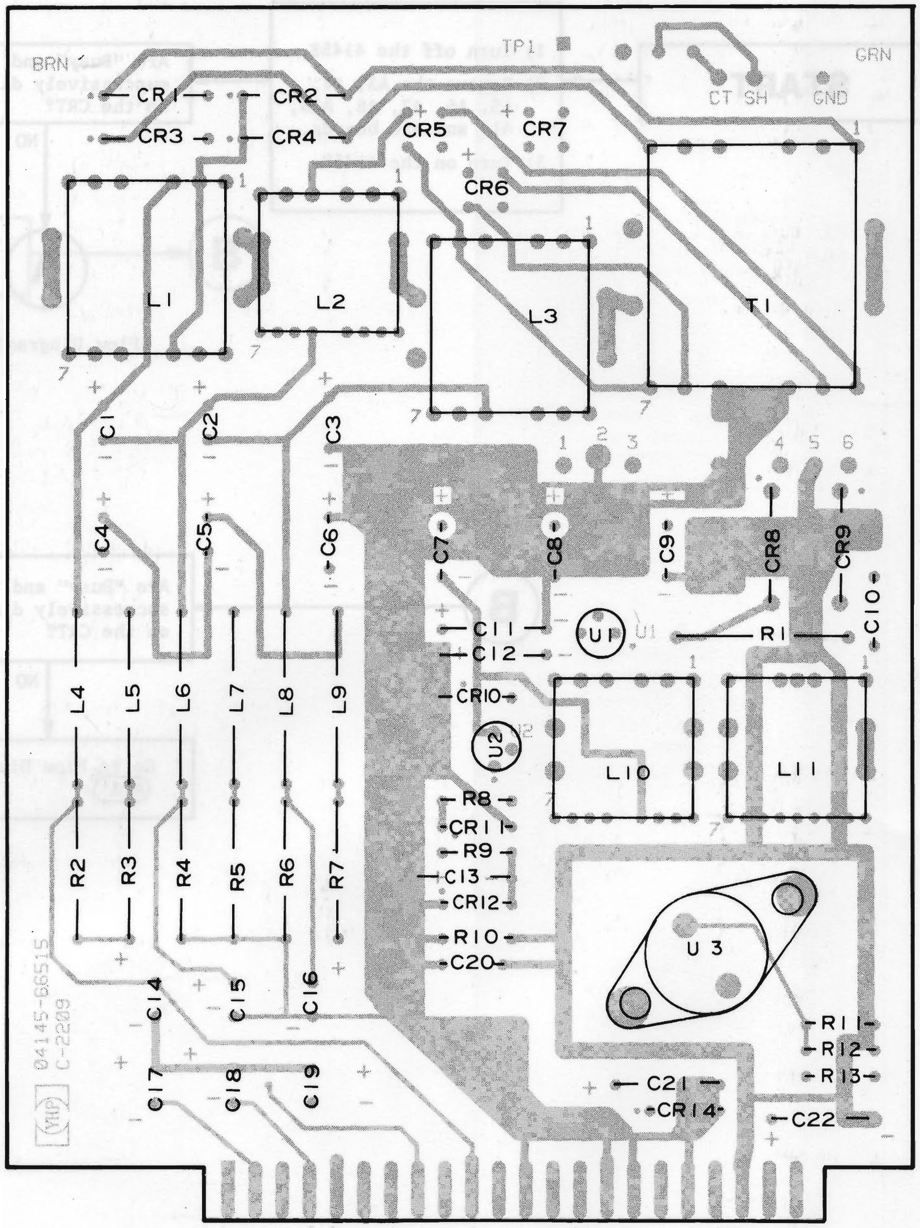
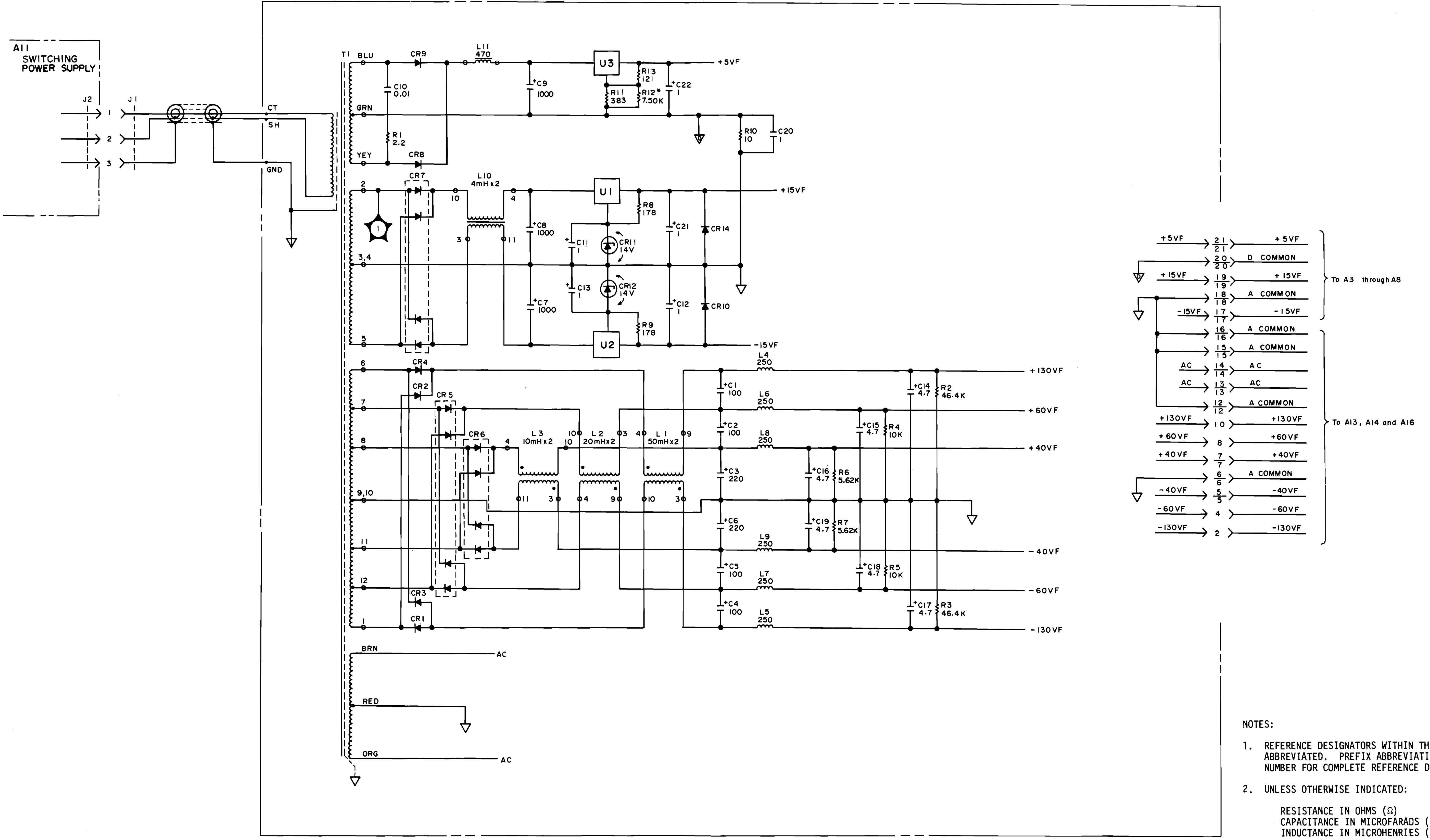


Figure 8-68. A15 Floating Power Supply Board Assembly Component Locations.

A15 FLOATING POWER SUPPLY (P/N: 04145-66515)

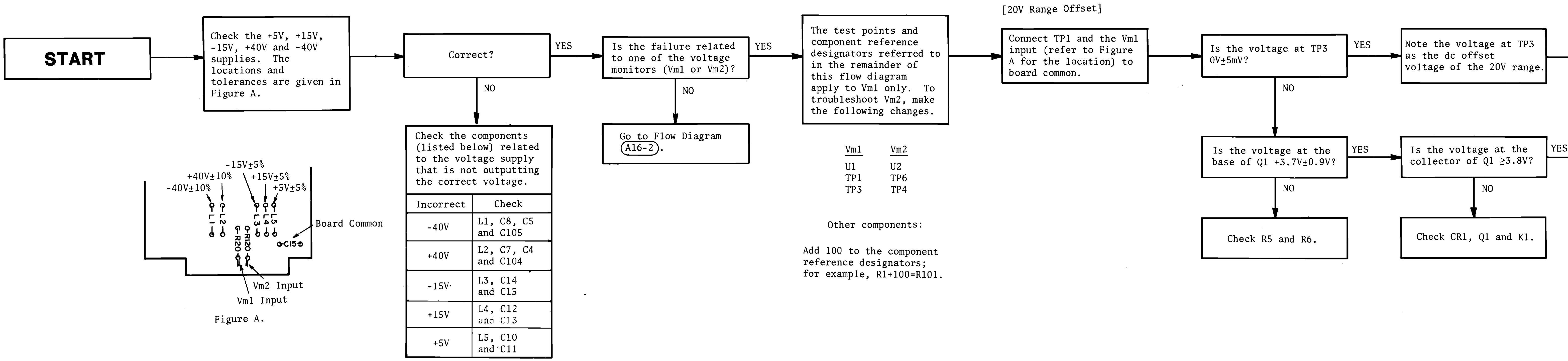


NOTES:

1. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. PREFIX ABBREVIATION WITH ASSEMBLY NUMBER FOR COMPLETE REFERENCE DESIGNATOR.
2. UNLESS OTHERWISE INDICATED:

   RESISTANCE IN OHMS (Ω)
   CAPACITANCE IN MICROFARADS (μF)
   INDUCTANCE IN MICROHENRIES (μH)
3. PARTS MARKED WITH AN ASTERISK (*) ARE FACTORY SELECTED PART. THEY MAY NOT BE INSTALLED ON YOUR BOARD.

Flow Diagram (A16 - 1)



Check the +5V, +15V, -15V, +40V and -40V supplies. The locations and tolerances are given in Figure A.

Correct?

Check the components (listed below) related to the voltage supply that is not outputting the correct voltage.

Incorrect	Check
-40V	L1, C8, C5 and C105
+40V	L2, C7, C4 and C104
-15V	L3, C14 and C15
+15V	L4, C12 and C13
+5V	L5, C10 and C11

Is the failure related to one of the voltage monitors (Vm1 or Vm2)?

Go to Flow Diagram (A16-2).

The test points and component reference designators referred to in the remainder of this flow diagram apply to Vm1 only. To troubleshoot Vm2, make the following changes.

Vm1	Vm2
U1	U2
TP1	TP6
TP3	TP4

Other components:

Add 100 to the component reference designators; for example, R1+100=R101.

[20V Range Offset]

Connect TP1 and the Vm1 input (refer to Figure A for the location) to board common.

Is the voltage at TP3 0V±5mV?

Note the voltage at TP3 as the dc offset voltage of the 20V range.

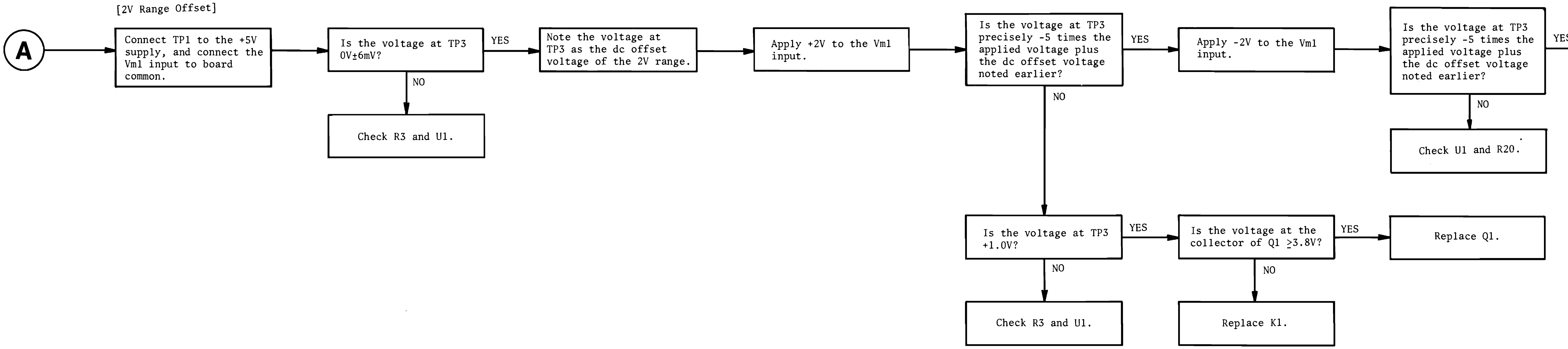
Is the voltage at the base of Q1 +3.7V±0.9V?

Check R5 and R6.

Is the voltage at the collector of Q1 ≥3.8V?

Check CR1, Q1 and K1.

Figure A.



[2V Range Offset]

Connect TP1 to the +5V supply, and connect the Vm1 input to board common.

Is the voltage at TP3 0V±6mV?

Check R3 and U1.

Note the voltage at TP3 as the dc offset voltage of the 2V range.

Apply +2V to the Vm1 input.

Is the voltage at TP3 precisely -5 times the applied voltage plus the dc offset voltage noted earlier?

Apply -2V to the Vm1 input.

Is the voltage at TP3 precisely -5 times the applied voltage plus the dc offset voltage noted earlier?

Check U1 and R20.

Is the voltage at TP3 +1.0V?

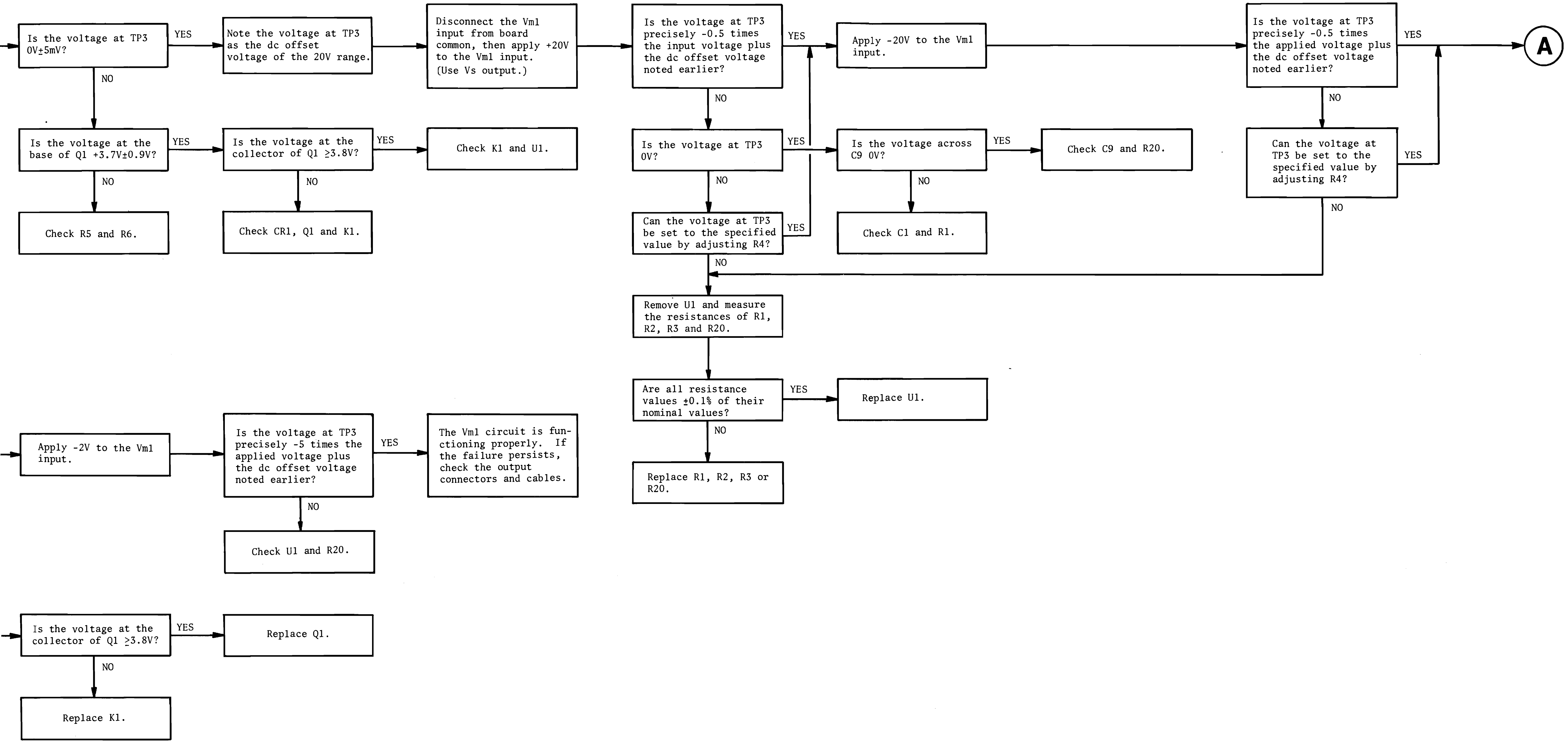
Check R3 and U1.

Is the voltage at the collector of Q1 ≥3.8V?

Replace Q1.

Replace K1.

Figure

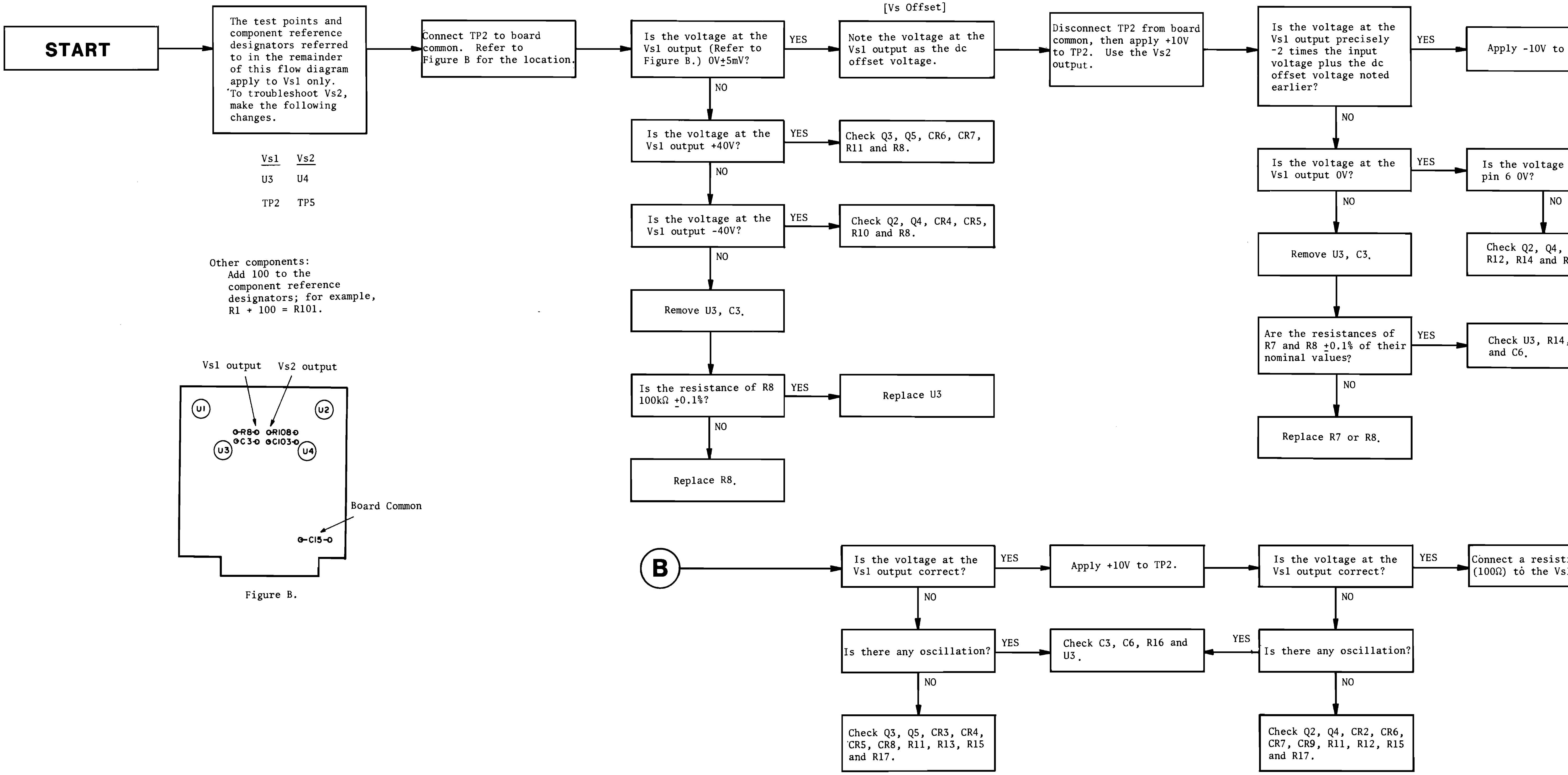


A15 BOARD

Figure 8-69. A15 Floating Power Supply Board Assembly Schematic Diagram.

Figure 8-70. A16 Board Troubleshooting Flow Diagram (Sheet 1 of 2).

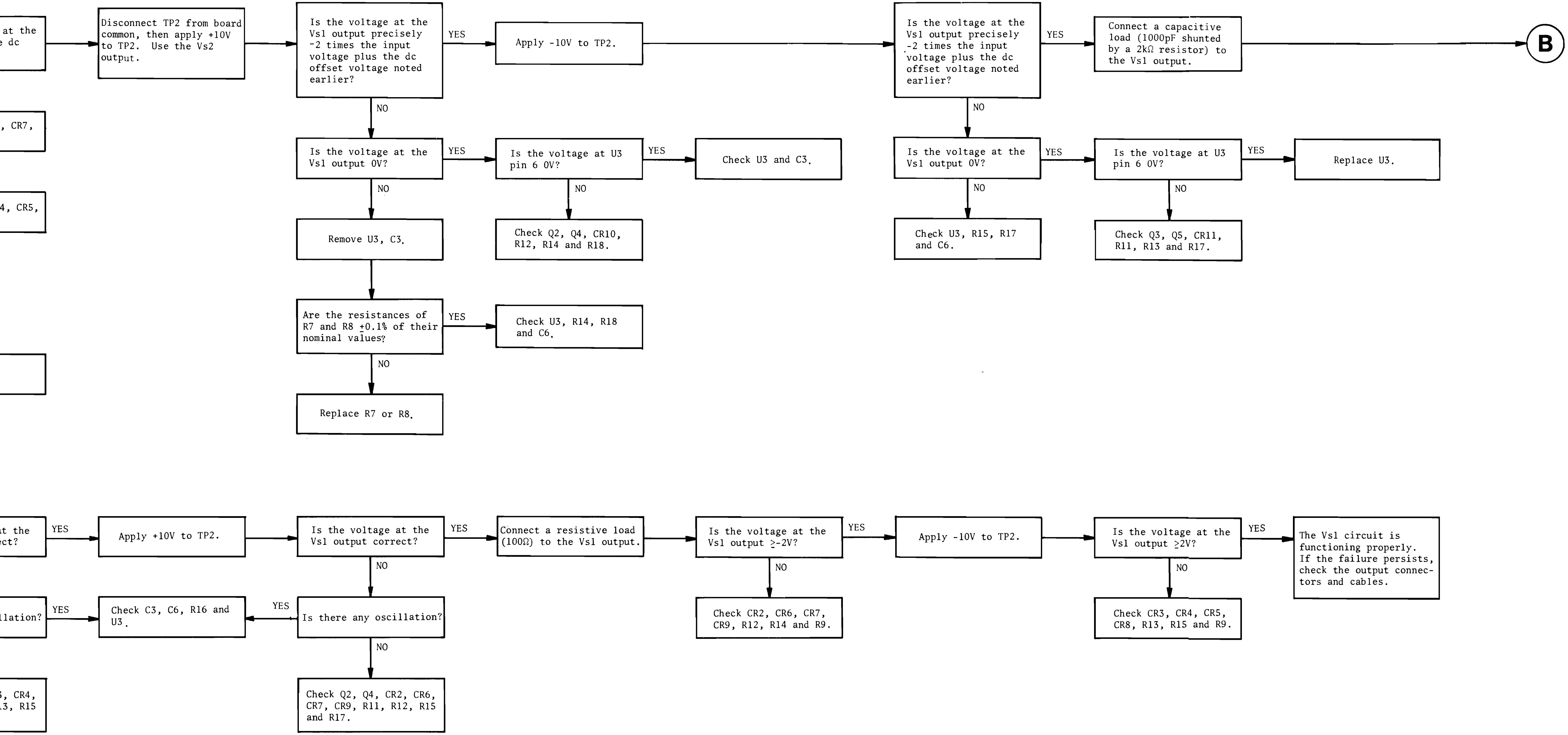
Flow Diagram A16 - 2



Vs1	Vs2
U3	U4
TP2	TP5

Other components:
Add 100 to the component reference designators; for example, R1 + 100 = R101.

Figure B.


at the
e dc
Disconnect TP2 from board common, then apply +10V to TP2. Use the Vs2 output.
Is the voltage at the Vs1 output precisely -2 times the input voltage plus the dc offset voltage noted earlier?
YES
Apply -10V to TP2.
Is the voltage at the Vs1 output precisely -2 times the input voltage plus the dc offset voltage noted earlier?
YES
Connect a capacitive load (1000pF shunted by a 2kΩ resistor) to the Vs1 output.
B
NO
NO
, CR7,
Is the voltage at the Vs1 output 0V?
YES
Is the voltage at U3 pin 6 0V?
YES
Check U3 and C3.
Is the voltage at the Vs1 output 0V?
YES
Is the voltage at U3 pin 6 0V?
YES
Replace U3.
NO
NO
NO
NO
4, CR5,
Remove U3, C3.
Check Q2, Q4, CR10, R12, R14 and R18.
Check U3, R15, R17 and C6.
Check Q3, Q5, CR11, R11, R13 and R17.
Are the resistances of R7 and R8 ±0.1% of their nominal values?
YES
Check U3, R14, R18 and C6.
NO
Replace R7 or R8.
t the
ect?
YES
Apply +10V to TP2.
Is the voltage at the Vs1 output correct?
YES
Connect a resistive load (100Ω) to the Vs1 output.
Is the voltage at the Vs1 output ≥-2V?
YES
Apply -10V to TP2.
Is the voltage at the Vs1 output ≥2V?
YES
The Vs1 circuit is functioning properly. If the failure persists, check the output connectors and cables.
NO
NO
NO
llation?
YES
Check C3, C6, R16 and U3.
YES
Is there any oscillation?
Check CR2, CR6, CR7, CR9, R12, R14 and R9.
Check CR3, CR4, CR5, CR8, R13, R15 and R9.
NO
, CR4,
3, R15
Check Q2, Q4, CR2, CR6, CR7, CR9, R11, R12, R15 and R17.

8-54. A16 Vs/Vm BOARD

8-55. The A16 board contains two voltage sources and two voltage monitors. Figure 8-71 shows a simplified block diagram of one of the voltage sources. Each voltage source is simply an inverting X2 DC amplifier that amplifies the reference voltages supplied from the A4 board. Figure 8-72 shows a block diagram of one of the voltage monitors. Each voltage monitor, like the voltage sources, is an inverting DC amplifier. Gain, however, is determined by the input voltage and is controlled by the A3 microprocessor. On the 2 volt range, gain is X5; on the 20 volt range, gain is X .5.

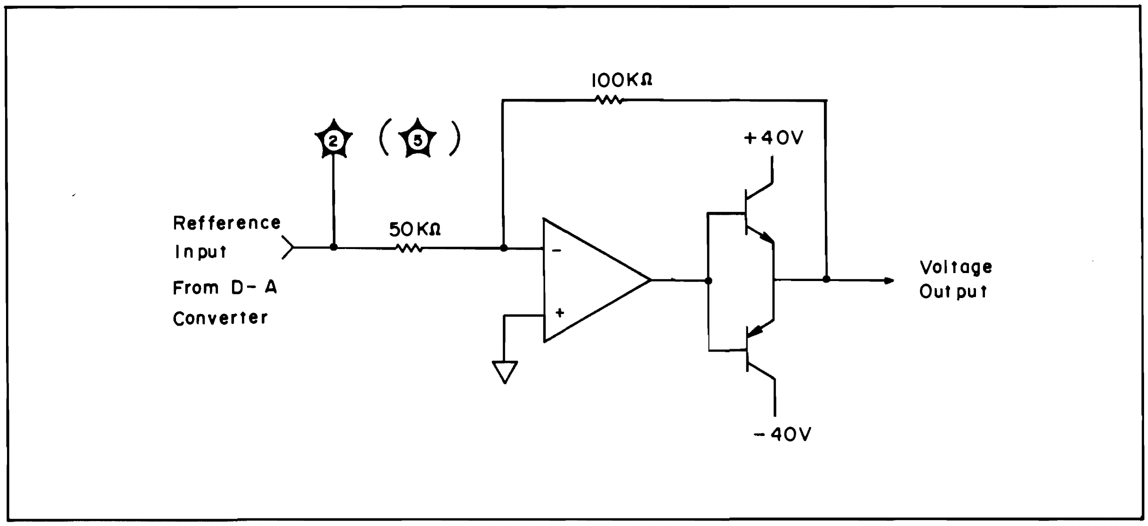


Figure 8-71. Vs Block Diagram.

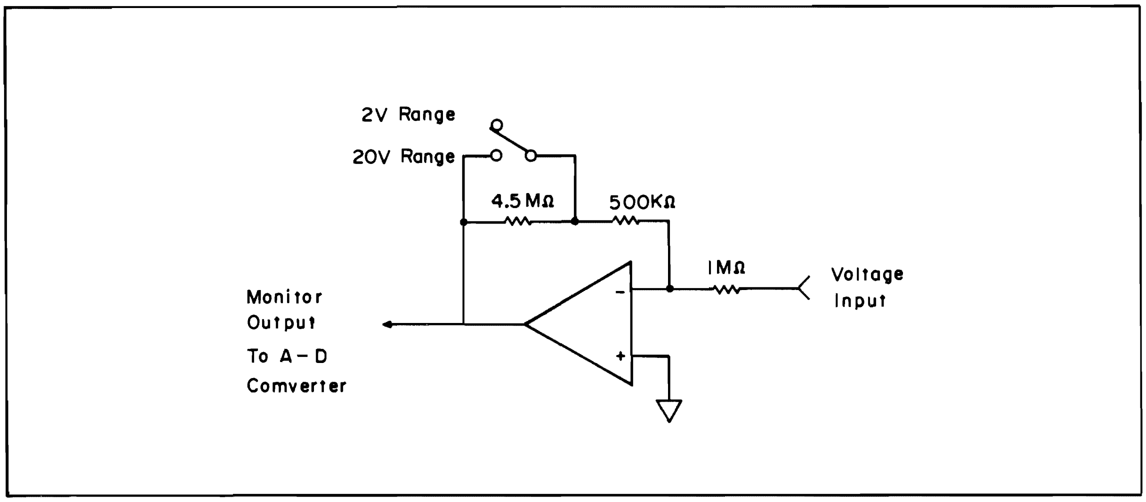


Figure 8-72. Vm Block Diagram.

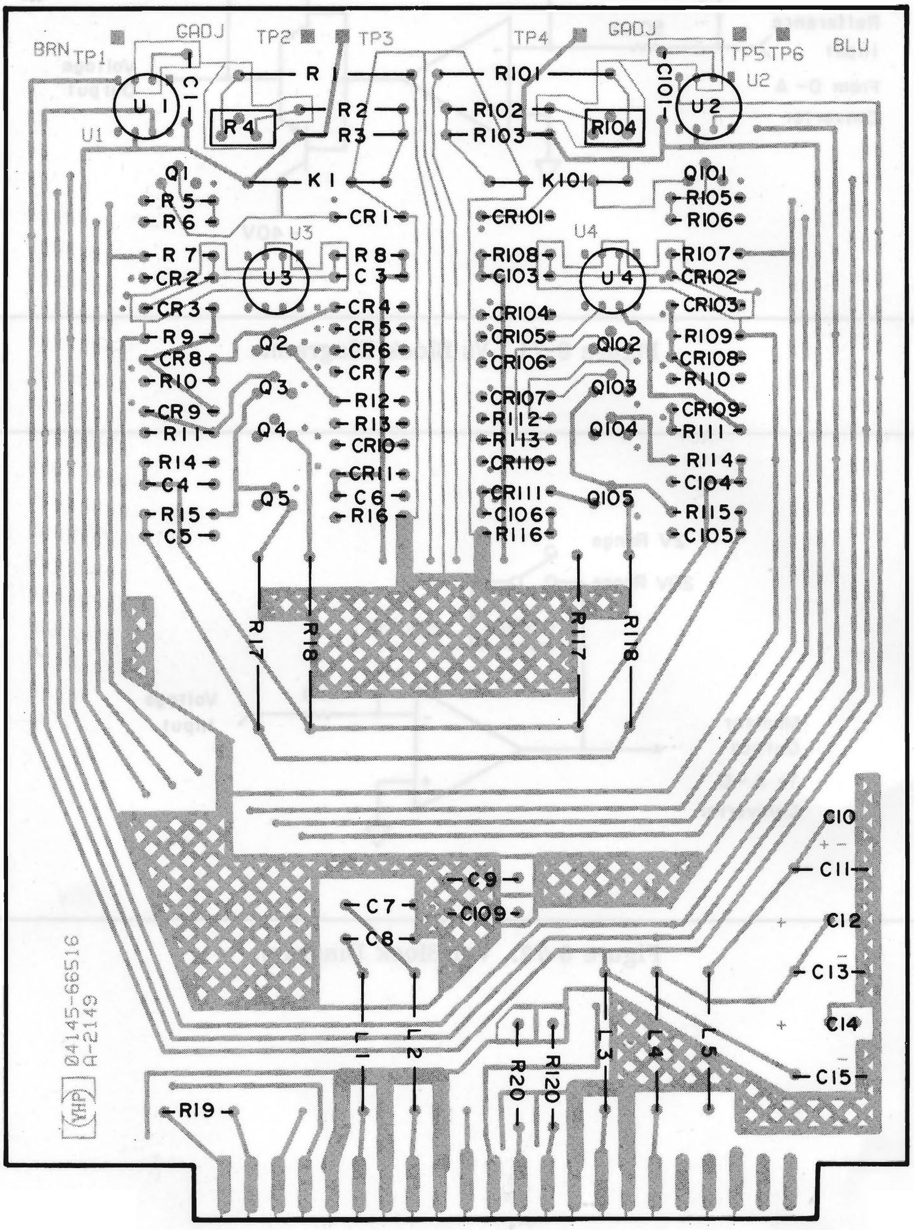
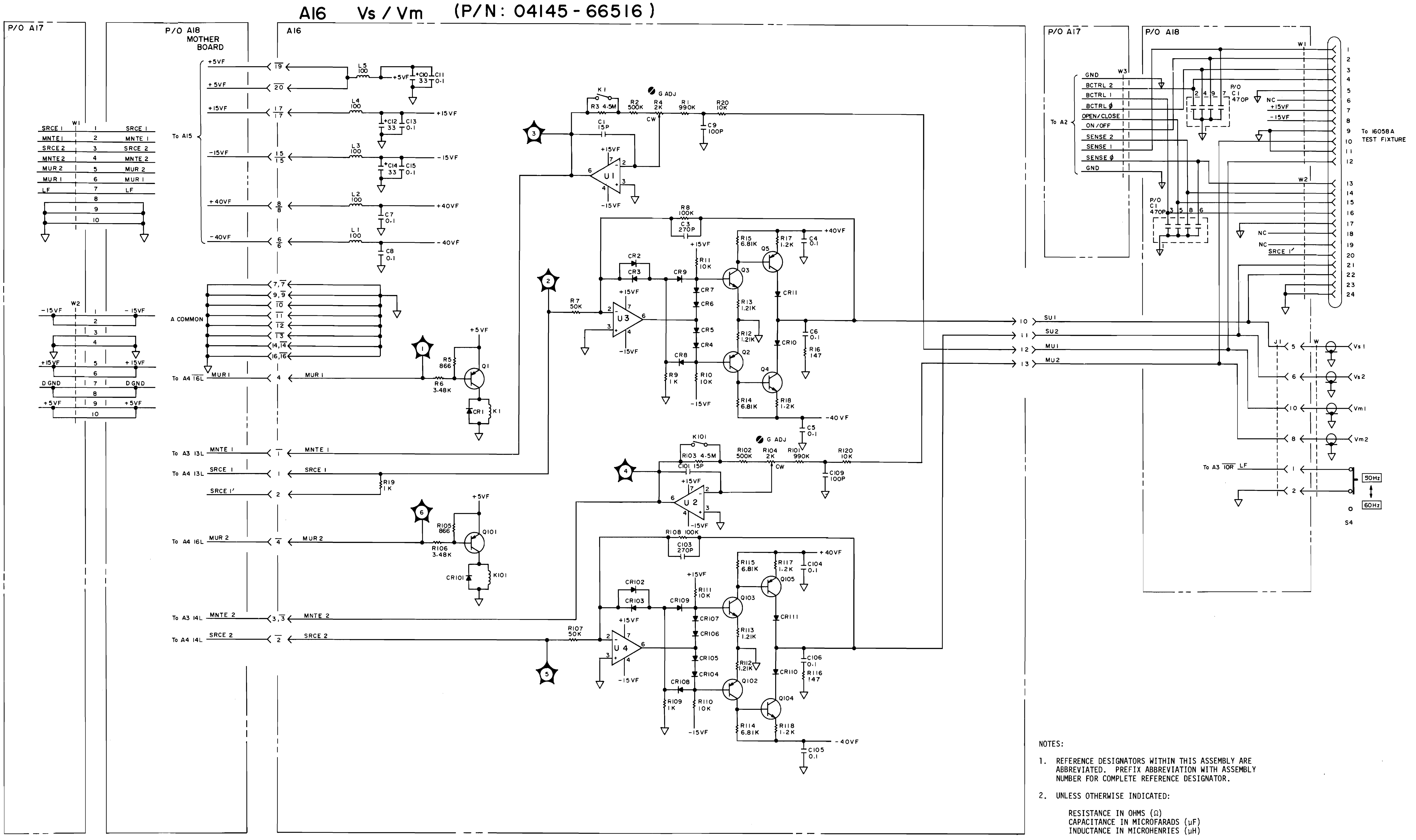


Figure 8-73. A16 Vs/Vm Board Assembly Component Locations.



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2. UNLESS OTHERWISE INDICATED:

RESISTANCE IN OHMS (Ω)
CAPACITANCE IN MICROFARADS (μF)
INDUCTANCE IN MICROHENRIES (μH)

A16 BOARD

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Figure 8-74. A16 Vs/Vm Board Assembly Schematic Diagram.