PERFORMANCE TESTS

4-11. TEST PORT OPEN/SHORT RATIO TEST (Cont'd)

CONFIGURATION B
(Frequency Range: 0.5 — 2 MHz)

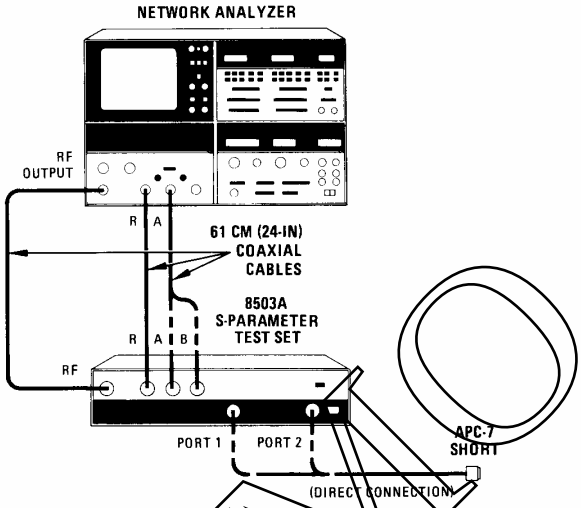


Figure 4-7. Test Port Open/Short Ratio Test (2 of 2)

EQUIPMENT:

Network Analyzer	HP 8505A
Type N Female Short	HP 11511A
APC-7 Short	HP 11565A
Adapter, APC-7 to Type N Female	HP 11524A
6-Ft. Coaxial Cable, Type RG-214, with Type N Male Connector on One End and Type N Female Connector on the Other end	HP 11501A
6-Ft. Coaxial Cable, Type RG-214, with Type N Male Connectors on Each End (2 required)	HP 11500A
24-In. 50Ω Matched Coaxial Cable with Type N Male Connectors on Each End (3 required)	HP 11851A

4-11. TEST PORT OPEN/SHORT RATIO TEST (Cont'd)

PROCEDURE:

a. Set 8505A controls as follows:

A1 Source/Converter:
- OUTPUT LEVEL dBm ..... −10
- OUTPUT LEVEL Vernier 0
- INPUT LEVEL dBm MAX ..... −10

A2 Frequency Control:
- RANGE MHz ..... .5 — 1300
- MODE ..... LIN EXPAND
- WIDTH ..... START/STOP 1
- SCAN TIME SEC ..... 1 — .1
- VERNIER ..... Fully clockwise
- TRIGGER ..... AUTO
- START FREQUENCY ..... 1000 MHz
- STOP FREQUENCY ..... 1300 MHz
- MARKER 1 ..... Mid-range

A3 Signal Processor:

Channel 1:
- INPUT ..... A/R
- MODE ..... MAG
- SCALE/DIV ..... .5 dB

Channel 2:
- INPUT ..... A/R
- MODE ..... PHASE
- SCALE/DIV ..... 90° DEG

Electrical Length:
- INPUT ..... A
- MODE X10

b. Connect equipment as shown in Figure 4-7, Configuration A with 8503A port A connected to 8505A INPUT A and adapter, 6-ft. coaxial cable, and short connected to PORT 1. Set S-PARAMETER SELECT switch to FORWARD.

c. On 8505A CRT display, depress REF LINE POSN pushbutton. Adjust CH 1 and CH 2 controls until traces are positioned to center of screen. Press REF LINE POSN pushbutton again to return system to normal operation.

d. On 8505A Signal Processor, set Channel 2 MODE switch to OFF.

e. To measure the test port open/short magnitude ratio, move 8505A Frequency Control MARKER 1 to upper peak where maximum separation between upper and lower peaks occur.

4-11. TEST PORT OPEN/SHORT RATIO TEST (Cont'd)

(1) On the 8505A Signal Processor Channel 1, press DISPLAY MKR then ZRO pushbuttons to place marker on reference line and to zero digital readout.

(2) Set MARKER 1 to corresponding lower peak (see Figure 4-8) and record peak-to-peak variation indicated on Channel 1 MKR digital readout.

PORT 1 Magnitude: 1000 to 1300 MHz =_____dB

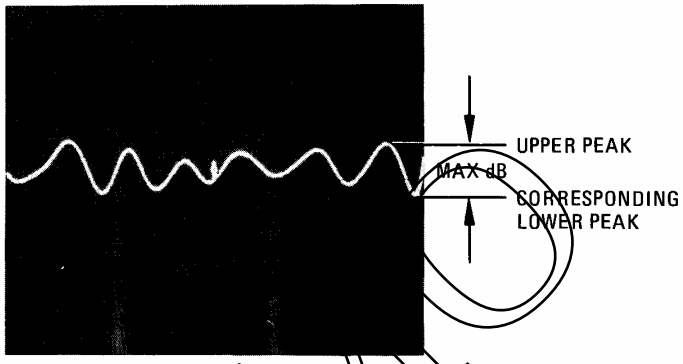


Figure 4-8. Test Port Open/Short Ratio Magnitude, >2 MHz

NOTE

If peak-to-peak measurement is made in an area where there is some slope, a corrected reading can be obtained by connecting two adjacent upper peaks with a dotted line. Extend a vertical line up from the lower peak until it intersects the dotted line. This constructed vertical line is the averaged or corrected peak-to-peak measurement to be used (Figure 4-9). Avoid making peak-to-peak measurements at extreme slope changes.

4-11. TEST PORT OPEN/SHORT RATIO TEST (Cont'd)

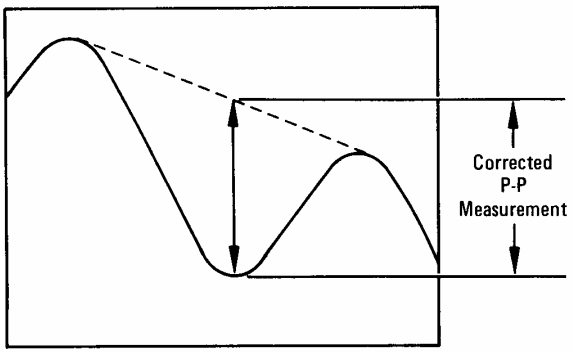


Figure 4-9. Slope Peak-to-Peak Measurement

f. Connect 8503A port B to 8505A INPUT A and connect adapter, 6-ft. coaxial cable, and short to PORT 2. Set S-PARAMETER SELECT switch to REVERSE.

g. Repeat step e and record the results:

PORT 2 Magnitude: 1000 to 1300 MHz = _____dB

h. Calculate the actual maximum open/short magnitude ratio by dividing the measured values (recorded in steps e and g or step m) by the reflection coefficient of the test cable used (Table 4-1, 1000 MHz Column) as shown below:

$$\frac{\text{MEASURED VALUE dB}}{\text{REFLECTION COEFFICIENT OF TEST CABLE}} = \text{ACTUAL OPEN/SHORT RATIO MAGNITUDE}$$

The actual open/short ratio magnitude for 1000 to 1300 MHz should be $\leq$1.8 dB ($\leq\pm$0.9 dB) for both 8503A test ports (PORT 1 and PORT 2).

PERFORMANCE TESTS

4-11. TEST PORT OPEN/SHORT RATIO TEST (Cont'd)

Table 4-1. Loss of Typical Coaxial Cable Used for 6-Ft. "Test" Cable

Cable Type	600 MHz ρ for 12-Ft. (out & back)	1000 MHz ρ for 12 Ft. (out & back)
RG-214/U	0.91	0.88
RG-58/U	0.91	0.88
RG-218/U	0.96	0.95

i. To measure the test port open/short phase ratio:

(1) Set 8505A Signal Processor Channel 1 MODE switch to OFF and Channel 2 MODE switch to PHASE.

(2) On 8505A Signal Processor channel 2 press DISPLAY MKR then ZRO pushbuttons.

(3) On 8505A Signal Processor Electrical Length, press LENGTH pushbuttons and adjust VERNIER A control to display a horizontal trace on the CRT. Set Channel 2 SCALE/DIV switch to 5 DEG. Press DISPLAY MKR then ZRO pushbuttons and readjust LENGTH and VERNIER A control to position average slope of trace parallel to horizontal graticule lines.

(4) On 8505A Frequency Control, set MARKER 1 to upper peak where maximum separation between upper and lower peaks occur.

(5) On 8505A Signal Processor Channel 1, press DISPLAY MKR then ZRO pushbuttons to place marker on reference line and to zero digital readout.

(6) Set MARKER 1 to corresponding lower peak (see Figure 4-10) and record peak-to-peak variation indicated on Channel 1 MKR digital readout. (See NOTE preceding Figure 4-9).

PORT 2 Phase: 1000 to 1300 MHz = _____ DEG

j. Connect 8503A port A to 8505A INPUT A and connect adapter, 6-ft. coaxial cable, and short to PORT 1. Set S-PARAMETER SELECT switch to FORWARD. Adjust 8505A Electrical Length controls, if necessary, to position average slope of trace parallel to horizontal graticule lines.

k. Repeat steps i (4) through i (6) and record results:

PORT 1 Phase: 1000 to 1300 MHz = _____ DEG

4-11. TEST PORT OPEN/SHORT RATIO TEST (Cont'd)

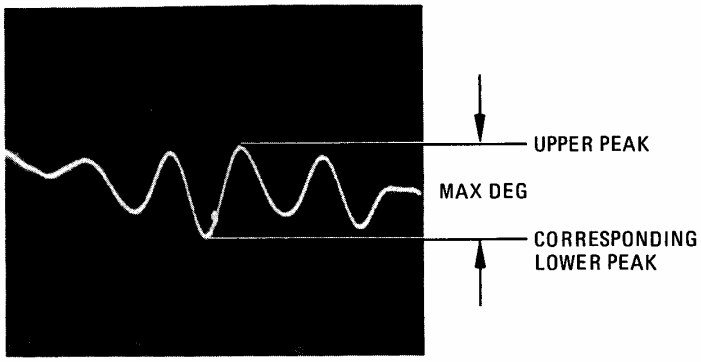


Figure 4-10. Test Port Open/Short Ratio Phase, >2 MHz

l. Calculate the actual maximum open/short ratio phase by dividing the measured values (recorded in steps i and k or step n) by the reflection coefficient of the test cable used (Table 4-1, 1000 MHz Column), or:

$$\frac{\text{MEASURED VALUE DEG}}{\text{REFLECTION COEFFICIENT OF TEST CABLE}} = \text{ACTUAL OPEN/SHORT RATIO PHASE}$$

The actual open/short ratio phase for 1000 to 1300 MHz should be $\leq 15°$ ($\leq \pm 7.5°$) for both 8503A test ports (PORT 1 and PORT 2).

m. To measure the test port open/short magnitude ratio between 2 and 1000 MHz:

(1) Set 8505A Frequency Control START FREQUENCY to 2 and STOP FREQUENCY to 1000.

(2) Set 8505A Signal Processor Channel 2 MODE switch to OFF and Channel 1 MODE switch to MAG.

(3) Repeat steps e through g except that the measured values for the 2 to1000 MHz frequency range are:

(e) PORT 1 Magnitude: 2 to 1000 MHz = _____dB
(g) PORT 2 Magnitude: 2 to 1000 MHz = _____dB

4-11. TEST PORT OPEN/SHORT RATIO TEST (Cont'd)

(4) To calculate the actual open/short magnitude for the 2 to 1000 MHz frequency range repeat step h except use the 600 MHz column in Table 4-1 to find the reflection coefficient of the test cable used. The actual open/short ratio magnitude for 2 to 1000 MHz should be ≤1.5 dB (≤±.75 dB) for both 8503A test ports (PORT 1 and PORT 2).

n. To measure the Test port open/short ratio phase between 2 and 1000 MHz, connect 8503A port B to 8505A INPUT A and connect adapter, 6-ft. coaxial cable, and short to PORT 2. Set S-PARAMETER SELECT switch to REVERSE and repeat steps i through l. The actual phase open/short ratio value for 2 to 1000 MHz should be ≤12° (≤±6°) for both 8503A test ports.

(i) PORT 2 Phase: 2 to 1000 MHz =_____DEG
(k) PORT 1 Phase: 2 to 1000 MHz =_____DEG

o. To measure magnitude and phase open/short ratios below 2 MHz connect equipment as shown in Figure 4-7, Configuration B with 8503A port A connected to 8505A INPUT A and both 8503A test ports open.

(1) Set 8505A Frequency Control RANGE MHz switch to .5 — 13.

(2) Set 8505A Frequency Control START FREQUENCY to 00.50 and STOP FREQUENCY to 02.00.

(3) Set 8505A Signal Processor Channel 1 MODE switch to MAG and Channel 2 MODE switch to OFF. Set 8503A S-PARAMETER SELECT switch to FORWARD.

(4) On 8505A Signal Processor Channel 1, press MKR then ZRO pushbuttons to bring trace to on-screen position.

(5) On 8505A Frequency Control, set MARKER 1 to beginning of sweep on CRT.

(6) On 8505A Signal Processor Channel 1, press MKR then ZRO pushbuttons to place marker on reference line and to zero digital readout.

p. To measure the test port open/short ratio magnitude between 0.5 to 2 MHz:

(1) Connect short directly to PORT 1.

(2) 8505A Signal Processor Channel 1 MKR digital display should indicate ≤2.50 dB (≤±1.25 dB).

(3) Connect 8503A port B to 8505A INPUT A and set S-PARAMETER SELECT switch to REVERSE. Press Channel 1 DISPLAY MKR then ZRO.

(4) Connect short directly to PORT 2. 8505A Signal Processor Channel 1 MKR digital display should indicate ≤2.50 dB (≤±1.25 dB).

q. To measure the test port open/short ratio phase between 0.5 and 2 MHz:

(1) Remove short from PORT 2.

4-11. TEST PORT OPEN/SHORT RATIO TEST (Cont'd)

(2) Set 8505A Signal Processor Channel 1 MODE switch to OFF and Channel 2 MODE switch to PHASE.

(3) On 8505A Signal Processor Electrical Length, press LENGTH pushbuttons and adjust VERNIER A control to display a horizontal trace on the CRT. If necessary, change 8505A Signal Processor Channel 2 SCALE/DIV switch to a lower sensitivity to position trace to a horizontal positon. Return SCALE/DIV switch to 5 DEG setting before going on with test.

(4) On 8505A Signal Processor Channel 2, press DISPLAY MKR then ZRO then REF pushbuttons.

(5) On 8505A Signal Processor Channel 2, press REF OFFSET Pushbuttons to indicate +180 DEG on digital display.

(6) On 8505A Signal Processor Channel 2, press DISPLAY MKR pushbutton.

(7) Connect short directly to PORT 2.

(8) Digital display should indicate $\leq 20°$ ($\leq \pm 10°$).

(9) Connect 8503A port A to 8505A INPUT A and remove short from PORT 2. Set S-PARAMETER SELECT switch to FORWARD.

(10) On 8505A Signal Processor Channel 2, press DISPLAY MKR then ZRO to zero digital readout.

(11) Repeat steps q (3) through q (6).

(12) Connect short directly to PORT 1.

(13) Digital display should indicate $\leq 20°$ ($\leq \pm 10°$).

4-12. TEST PORT RETURN LOSS TEST

SPECIFICATION:

Test Port 1 and 2 Return Loss: ≥ 26 dB (≤ 1.11 SWR) from 2 to 1300 MHz
≥ 20 dB (≤ 1.22 SWR) from 0.5 to 2 MHz

DESCRIPTION:

Perform the Directivity (Incoming Inspection Test, Figure 2-4) and the Test Port Open/Short Ratio Test (Paragraph 4-11). These two tests confirm that PORT 1 and PORT 2 Return Loss of the 8503A is within specification. If a more direct and accurate test is required for the Test Port Return Loss specification, refer to the 85030A Accuracy Enhancement Program (AIM) procedure for the method of making an error-corrected Return Loss measurement. An 8542B Automatic Network Analyzer may also be used to make this measurement between 100 and 1300 MHz.

4-13. PORT RETURN LOSS TESTS

SPECIFICATIONS:

Reference and Return Ports (R, A, B):

≥20 dB Return Loss (≤1.22 SWR) from 0.5 to 2 MHz
≥23 dB Return Loss (≤1.15 SWR) from 2 to 1000 MHz
≥20 dB Return Loss (≤1.22 SWR) from 100 to 1300 MHz

RF Input Port:

≥20 dB Return Loss (≤1.22 SWR) from 0.5 to 1300 MHz

DESCRIPTION:

The system is calibrated by shorting or opening the main line TEST Port of the Directional Coupler to establish a 0 dB reference line on the CRT display. Ports R, A, B and RF of the 8503A are in turn connected in place of the short to the Dual Direcitonal coupler or Directional Bridge with all other ports terminated in 50 ohms. The Return Loss is measured directly with the 8505A MARKER digital display and the CRT trace. When using this method to measure Return Loss, ambiguity due to "imperfect" directivity of the directional device is introduced. The ambiguity of the measurement may be as great as ±2 dB. If a more direct and accurate test is required for the port Return Loss specifications, refer to the 85030A Accuracy Enhancement Program (AIM) procedure for the method of making an error-corrected Return Loss measurement.

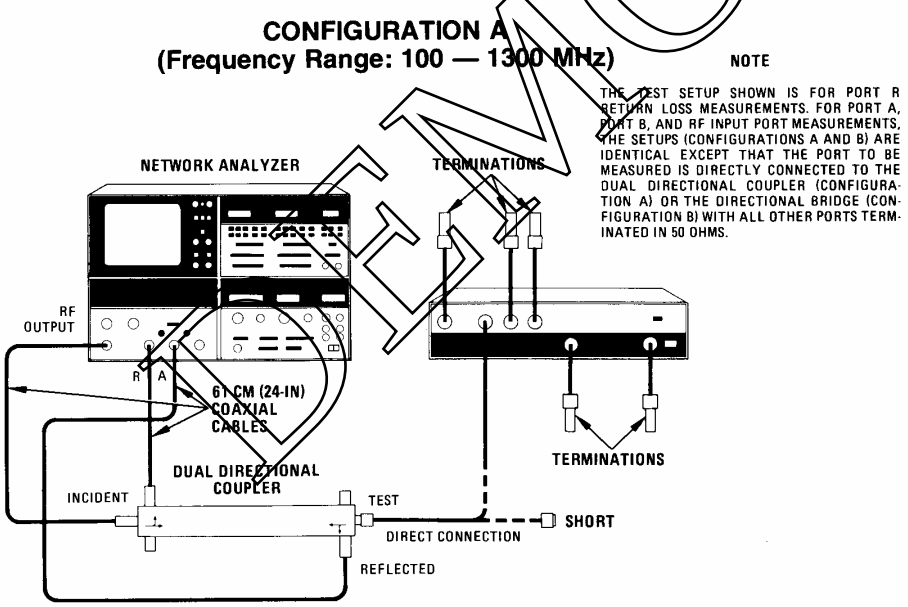


Figure 4-11. Port Return Loss Test Setup (1 of 2)

4-13. PORT RETURN LOSS TESTS (Cont'd)

CONFIGURATION B
(Frequency Range: 0.5 — 100 MHz)

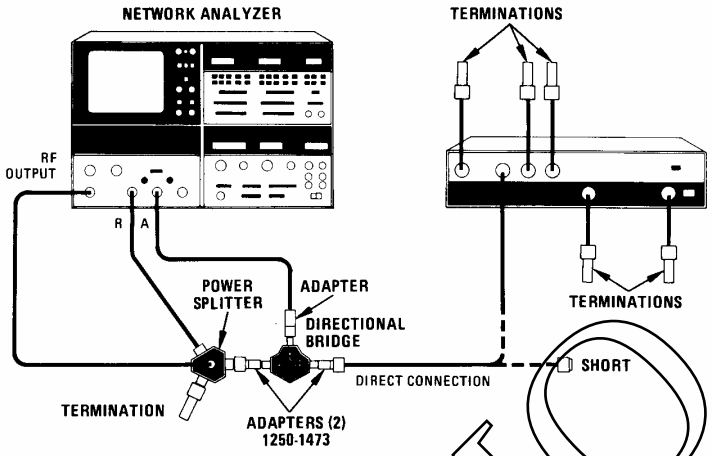


Figure 4-11. Port Return Loss Test Setup (2 of 2)

EQUIPMENT:

Network Analzyer	HP 8505A
Dual Directional coupler	HP 778D
Directional Bridge*	HP 8721A
3-Way Power Splitter	HP 11850A
Short, Type N Female	HP 11511A
Termination, 50Ω Type N Male (4 required)	HP 909A Option 012
Termination, 50Ω APC-7 (2 required)	HP 909A
Adapter, Type N Male to BNC Male (2 required)**	HP 1250-1473
Adapter, Type N Female to BNC Male **	HP 1250-1477

*Part of HP 11652A Transmission/Refection Kit.
**Part of HP 11854A 50 Ohm BNC Accessory Kit.

4-13. PORT RETURN LOSS TESTS (Cont'd)

PROCEDURE:

a. Set 8505A controls as follows:

A1 Source/Converter:
- OUTPUT LEVEL dBm ..... −10
- OUTPUT LEVEL Vernier 0
- INPUT LEVEL dBm MAX ..... −10

A2 Frequency Control:
- RANGE ..... .5 — 1300
- MODE ..... LIN EXPAND
- WIDTH ..... START/STOP 1
- SCAN TIME SEC ..... 1 — .1
- VERNIER ..... Fully clockwise
- TRIGGER ..... AUTO
- MARKERS Switch 1
- START FREQUENCY ..... 100 MHz
- STOP FREQUENCY ..... 1300 MHz
- MARKER 1 ..... 1000 MHz

A3 Signal Processor:

Channel 1:
- INPUT ..... A/R
- MODE ..... MAG
- SCALE/DIV ..... 20 dB

Channel 2:
- MODE ..... OFF

Electrical Length:
- MODE ..... OFF

b. Connect equipment as shown in Figure 4-11, Configuration A, with no connection to mainline TEST Port of Directional Coupler.

c. On 8505A display, depress REF LINE POSN Pushbutton. Adjust CH 1 control until trace is positioned to center of screen. Press REF LINE POSN pushbutton again to return system to normal operation.

d. Set 8505A Frequency Control MARKERS switch to 2.

e. Place 8505A Frequency Control MARKER 2 on center graticule line.

f. To calibrate the system for Return Loss measurement, attach short directly to Dual Directional Coupler mainline TEST Port. On 8505A Signal Processor Channel 1, press DISPLAY MKR then ZRO pushbuttons to place MARKER 2 on reference line and to zero digital readout.

4-13. PORT RETURN LOSS TESTS (Cont'd)

g. To measure Return Loss for the frequency range 1000 to 1300 MHz:

(1) Remove short and connect dual Directional Coupler directly to 8503A port R with all other 8503A ports terminated.

(2) Move 8505A Frequency Control MARKER 2 to worst-case Return Loss between 100 and 1300 MHz as Indicated on CRT (the point closest to calibration line to the right of MARKER 1 as shown in Figure 4-12).

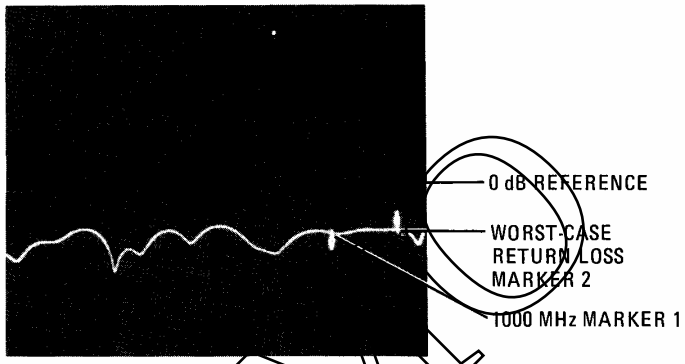


Figure 4-12. Port Return Loss (1000 – 1300 MHz)

(3) Read worst-case Return Loss from 8505A Signal Processor Channel 1 digital display. The indication should be ≥20 dB below the zero dB reference level for the frequency range 1000 to 1300 MHz.

h. To measure Return Loss for the frequency range 100 to 1000 MHz:

(1) Move 8505A Frequency Control MARKER 2 control to worst-case Return Loss between 100 and 1000 MHz as indicated on CRT (the point closest to calibration line to left of MARKER 1 as shown in Figure 4-13).

(2) Read worst-case Return Loss from 8505A Signal Processor Channel 1 digital display. The indication should be ≥23 dB below the zero dB reference level for the frequency range 100 to 1000 MHz.

4-13. PORT RETURN LOSS TESTS (Cont'd)

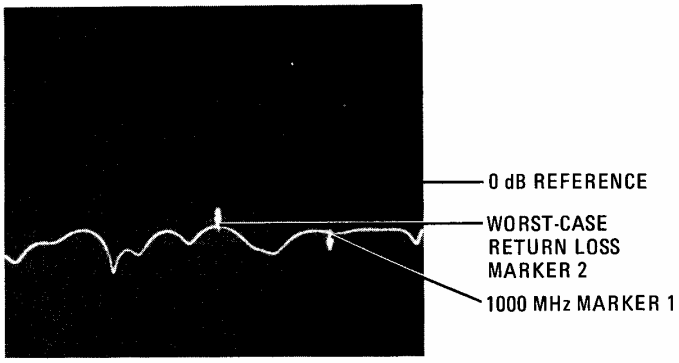


Figure 4-13. Port Return Loss (100 – 1000 MHz)

i. For port A and B Return Loss measurements from 100 MHz to 1300 MHz, repeat steps a through h except directly connect the port being measured to the dual Directional Coupler with all other 8503A ports terminated in 50 ohms.

j. To determine Return Loss for the frequency range 2 to 100 MHz, connect equipment as shown in Figure 4-11, Configuration B with LOAD port on Directional Bridge shorted. Set 8505A Frequency Control RANGE MHz switch to .5 – 130. Set START FREQUENCY to 2 MHz and STOP FREQUENCY to 100 MHz.

k. To calibrate system for Return Loss measurement:

(1) Set 8505A Frequency Control MARKERS switch to 1 and set MARKER 1 to center graticule line.

(2) On 8505A Signal Processor Channel 1, press DISPLAY MKR then ZRO pushbuttons to place MARKER 1 on reference line and to zero digital readout.

l. To measure the Return Loss for 2 to 100 MHz:

(1) Remove short and connect 8503A port R to Directional Bridge LOAD port with all other 8503A ports terminated.

(2) Move 8505A Frequency Control MARKER 1 to worst-case Return Loss between 2 and 100 MHz as indicated on CRT (the point closest to calibration line as shown in Figure 4-14).

4-13. PORT RETURN LOSS TESTS (Cont'd)

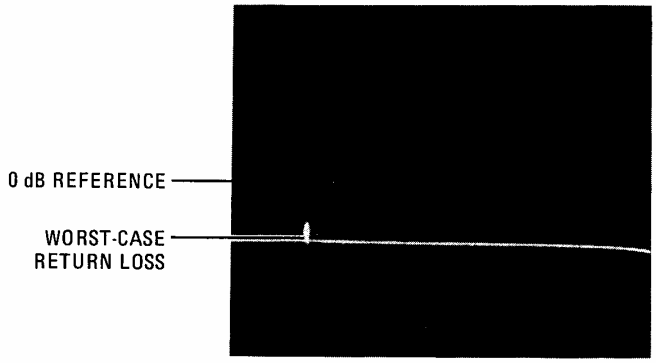


Figure 4-14. Port Return Loss (2 – 100 MHz)

(3) Read worst-case Return Loss from 8505A Signal Processor Channel 1 digital display. The indication should be ≥23 dB below the zero dB reference level for the frequency range 2 to 100 MHz.

m. For port A and port B Return Loss measurements from 2 MHz to 100 MHz, repeat step 1 except connect the port being measured to Directional Bridge LOAD port with all other 8503A ports terminated in 50 ohms.

n. To determine Return Loss for the frequency range 0.5 to 2 MHz:

(1) Set 8505A Frequency Control RANGE MHz switch to .5 to 13. Set START FREQUENCY to 0.5 MHz and STOP FREQUENCY to 2 MHz. Connect short to Directional Bridge LOAD port.

(2) Repeat steps k and l except that the indication should be ≥20 dB below the zero dB reference level for the frequency range 0.5 to 2 MHz (Figure 4-15).

o. For port A and port B Return Loss measurements, repeat step 1, except connect the port being measured to the Directional Bridge with all other 8503A ports terminated in 50 ohms.

p. For RF port Return Loss measurement, repeat steps a through f.

q. To measure Return Loss for the frequency range 100 to 1300 MHz:

(1) Remove short and connect Dual Directional Coupler directly to 8503A RF port.

4-13. PORT RETURN LOSS TESTS (Cont'd)

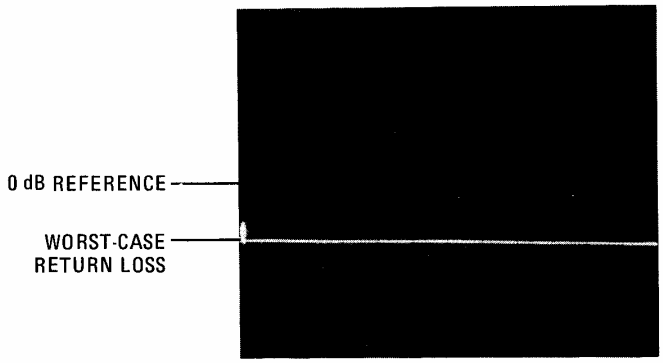


Figure 4-15. Port Return Loss (0.5 – 2 MHz)

(2) Move 8505A Frequency Control MARKER 2 to worst case Return Loss as indicated on CRT (point closest to calibration line).

(3) Read worst-case Return Loss from 8505A Signal Processor Channel 1 digital display. The indication should be ≥20 dB below the zero dB reference level for frequency range 100 to 1300 MHz.

r. To calibrate the system for Return Loss measurement from 0.5 to 100 MHz:

(1) Connect equipment as shown in Figure 4-11, Configuration B with LOAD port on Directional Bridge shorted.

(2) On 8505A Frequency Control, set RANGE MHz switch to .5 – 130. Set START FREQUENCY to 0.5 MHz and STOP FREQUENCY to 100 MHz.

(3) Set 8505A Frequency Control MARKERS switch to 1 and set MARKER 1 to center graticule line.

(4) On 8505A Signal Processor Channel 1, press DISPLAY MKR then ZRO pushbuttons to place MARKER 1 on reference line and to zero digital readout.

s. To measure Return Loss for 0.5 to 100 MHz:

(1) Remove short and connect 8503A RF port to Directional Bridge LOAD Port with all other 8503A ports terminated.

4-13. PORT RETURN LOSS TESTS (Cont'd)

(2) Move 8505A Frequency Control MARKER 1 to worst-case Return Loss as indicated on CRT (point closest to calibration line).

(3) Read worst-case Return Loss from 8505A Signal Processor Channel 1 digital display. The indication should be ≥20 dB below zero dB reference level for frequency range 0.5 to 100 MHz.

Table 4-2. Model 8503A Performance Test Record (1 of 3)

Hewlett-Packard Model 8503A
S-Parameter Test Set

Test Performed By: _____

Serial Number: _____ Date: _____

Para. No.	Description	Lower Limit	Measured Value	Upper Limit
4-8.	**DIRECTIVITY TEST**			
	PORT 1	40 dB	_____	
	PORT 2	40 dB	_____	
4-9.	**TRANSMISSION FREQUENCY RESPONSE TEST**			
	Magnitude:			
	h. FORWARD (S_{21})		_____	±1 dB
	i. REVERSE (S_{12})		_____	±1 dB
	Phase:			
	p. REVERSE (S_{12})		_____	±12°
	q. FORWARD (S_{21})		_____	±12°
4-10.	**REFLECTION FREQUENCY RESPONSE TEST**			
	Magnitude:			
	h. FORWARD (S_{11})		_____	±2 dB
	j. REVERSE (S_{22})		_____	±2 dB
	Phase; 0.5 to 1300 MHz:			
	l(4). REVERSE (S_{22})		_____	±20°
	m. FORWARD (S_{11})		_____	±20°
	Phase; 2 to 1300 MHz:			
	o (2). FORWARD (S_{11})		_____	±15°
	o (4). REVERSE (S_{22})		_____	±15°
4-11.	**TEST PORT OPEN/SHORT RATIO TEST**			
	Magnitude; 1000 to 1300 MHz:			
	h. PORT 1		_____	1.8 dB (±0.9 dB)
	h. PORT 2		_____	1.8 dB (±0.9 dB)
	Phase; 1000 to 1300 MHz:			
	l. PORT 1		_____	15° (±7.5°)
	l. PORT 2		_____	15° (±7.5°)

Table 4-2. Model 8503A Performance Test Record (2 of 3)

Para. No.	Description	Lower Limit	Measured Value	Upper Limit
4-11.	**TEST PORT OPEN/SHORT RATIO TEST (Cont'd)**			
	Magnitude; 2 to 1000 MHz:			
	m (4). PORT 1		_____	1.5 dB (±0.75 dB)
	m (4). PORT 2		_____	1.5 dB (±0.75 dB)
	Phase; 2 to 1000 MHz:			
	n. PORT 1		_____	12° (±6°)
	n. PORT 2		_____	12° (±6°)
	Magnitude; 0.5 to 2 MHz:			
	p (2). PORT 1		_____	2.5 dB (±1.25 dB)
	p (4). PORT 2		_____	2.5 dB (±1.25 dB)
	Phase; 0.5 to 2 MHz:			
	q (8). PORT 2		_____	20° (±10°)
	q (13). PORT 1		_____	20° (±10°)
4-12.	**TEST PORT RETURN LOSS TEST**			
	2 to 1300 MHz:			
	PORT 1	26 dB	_____	
	PORT 2	26 dB	_____	
	0.5 to 2 MHz:			
	PORT 1	20 dB	_____	
	PORT 2	20 dB	_____	
4-13.	**PORT RETURN LOSS TESTS**			
	1000 to 1300 MHz:			
	g (3). Port R	20 dB	_____	
	i. Port A	20 dB	_____	
	i. Port B	20 dB	_____	

Table 4-2. Model 8503A Performance Test Record (3 of 3)

Para. No.	Description	Lower Limit	Measured Value	Upper Limit
4-13.	**PORT RETURN LOSS TESTS (Cont'd)**			
	100 to 1000 MHz:			
	h (2). Port R	23 dB	_____	
	i. Port A	23 dB	_____	
	i. Port B	23 dB	_____	
	2 to 100 MHz:			
	l (3). Port R	23 dB	_____	
	m. Port A	23 dB	_____	
	m. Port B	23 dB	_____	
	0.5 to 2 MHz:			
	n (2). Port R	20 dB	_____	
	o. Port A	20 dB	_____	
	o. Port B	20 dB	_____	
	RF Input Port:			
	q (3). 100 to 1300 MHz	20 dB	_____	
	s (3). 0.5 to 100 MHz	20 dB	_____	

SECTION V
ADJUSTMENTS

5-1. INTRODUCTION

5-2. The 8503A S-Parameter Test Set has no adjustment controls.

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 6-2 lists all replaceable parts in reference designator order. Table 6-3 contains names and addresses that correspond to the manufacturer's code numbers.

6-3. ABBREVIATIONS

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

6-5. REPLACEABLE PARTS LIST

6-6. Table 6-2 is the list of replaceable parts and is organized as follows:

a. Electrical assemblies and their components in alpha-numerical order by reference designation.

b. Chassis-mounted parts in alpha-numeric order by reference designation.

c. Miscellaneous parts.

d. Illustrated parts breakdown, if appropriate.

The information given for each part consists of the following:

a. The Hewlett-Packard part number

b. The total quantity (Qty) in the instrument.

c. The description of the part.

d. The typical manufacturer of the part in a five-digit code.

e. Manufacturer code number for the part.

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, quote the Hewlett-Packard part number, indicate 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, include the instrument model number, instrument serial number, the description and function of the part, and the number of parts required. Address the order to the nearest Hewlett-Packard office.

Table 6-1. Reference Designations and Abbreviations

REFERENCE DESIGNATIONS

A . . . . . assembly
AT . . attenuator; isolator; termination
B . . . . . fan; motor
BT . . . . . battery
C . . . . . capacitor
CP . . . . . coupler
CR . . . . . diode; diode thyristor; varactor
DC . . . directional coupler
DL . . . . . delay line
DS . . . . . annunciator; signaling device (audible or visual); lamp; LED
E . . . . . miscellaneous electrical part
F . . . . . fuse
FL . . . . . filter
H . . . . . hardware
HY . . . . . circulator
J . . . electrical connector (stationary portion); jack
K . . . . . relay
L . . . . . coil; inductor
M . . . . . meter
MP . . . . . miscellaneous mechanical part
P . . . electrical connector (movable portion); plug
Q . . . . . transistor; SCR; triode thyristor
R . . . . . resistor
RT . . . . . thermistor
S . . . . . switch
T . . . . . transformer
TB . . . . . terminal board
TC . . . . . thermocouple
TP . . . . . test point
U . . . . . integrated circuit; microcircuit
V . . . . . electron tube
VR . . . . voltage regulator; breakdown diode
W . . . . cable; transmission path; wire
X . . . . . socket
Y . . . . crystal unit (piezoelectric or quartz)
Z . . . . tuned cavity; tuned circuit

ABBREVIATIONS

A . . . . . ampere
ac . . . . alternating current
ACCESS . . . . . accessory
ADJ . . . . . adjustment
A/D . . . . analog-to-digital
AF . . . . . audio frequency
AFC . . . . . automatic frequency control
AGC . . . . . automatic gain control
AL . . . . . aluminum
ALC . . . . . automatic level control
AM . . . amplitude modulation
AMPL . . . . . amplifier
APC . . . . automatic phase control
ASSY . . . . . assembly
AUX . . . . . auxiliary
avg . . . . . average
AWG . . . . American wire gauge
BAL . . . . . balance
BCD . . . . . binary coded decimal
BD . . . . . board
BE CU . . . . . beryllium copper
BFO . . . . . beat frequency oscillator
BH . . . . . binder head
BKDN . . . . . breakdown
BP . . . . . bandpass
BPF . . . . . bandpass filter
BRS . . . . . brass
BWO . . . . . backward-wave oscillator
CAL . . . . . calibrate
ccw . . counter-clockwise
CER . . . . . ceramic
CHAN . . . . . channel
cm . . . . . centimeter
CMO . . cabinet mount only
COAX . . . . . coaxial
COEF . . . . . coefficient
COM . . . . . common
COMP . . . . . composition
COMPL . . . . . complete
CONN . . . . . connector
CP . . . . . cadmium plate
CRT . . . cathode-ray tube
CTL . . . . complementary transistor logic
CW . . . . . continuous wave
cw . . . . . clockwise
cm . . . . . centimeter
D/A . . . . digital-to-analog
dB . . . . . decibel
dBm . . . . decibel referred to 1 mW
dc . . . . . direct current
deg . . degree (temperature interval or difference)
° . . . . . degree (plane angle)
°C . . . . . degree Celsius (centigrade)
°F . . . . degree Fahrenheit
°K . . . . . degree Kelvin
DEPC . . deposited carbon
DET . . . . . detector
diam . . . . . diameter
DIA . . . diameter (used in parts list)
DIFF AMPL . . differential amplifier
div . . . . . division
DPDT . . . . . double-pole, double-throw
DR . . . . . drive
DSB . . . . double sideband
DTL . . . . diode transistor logic
DVM . . . digital voltmeter
ECL . . . . emitter coupled logic
EMF . . electromotive force
EDP . . . . . electronic data processing
ELECT . . . . . electrolytic
ENCAP . . . . encapsulated
EXT . . . . . external
F . . . . . farad
FET . . . . . field-effect transistor
F/F . . . . . flip-flop
FH . . . . . flat head
FIL H . . . . . fillister head
FM . . frequency modulation
FP . . . . . front panel
FREQ . . . . . frequency
FXD . . . . . fixed
g . . . . . gram
GE . . . . . germanium
GHz . . . . . gigahertz
GL . . . . . glass
GND . . . . . ground(ed)
H . . . . . henry
h . . . . . hour
HET . . . . . heterodyne
HEX . . . . . hexagonal
HD . . . . . head
HDW . . . . . hardware
HF . . . . . high frequency
HG . . . . . mercury
HI . . . . . high
HP . . . . . Hewlett-Packard
HPF . . . . . high pass filter
HR . . . . . hour (used in parts list)
HV . . . . . high voltage
Hz . . . . . Hertz
IC . . . . integrated circuit
ID . . . . . inside diameter
IF . . . . . intermediate frequency
IMPG . . . . . impregnated
in . . . . . inch
INCD . . . . . incandescent
INCL . . . . . include(s)
INP . . . . . input
INS . . . . . insulation
INT . . . . . internal
kg . . . . . kilogram
kHz . . . . . kilohertz
kΩ . . . . . kilohm
kV . . . . . kilovolt
lb . . . . . pound
LC . . . . . inductance-capacitance
LED . . light-emitting diode
LF . . . . . low frequency
LG . . . . . long
LH . . . . . left hand
LIM . . . . . limit
LIN . . . linear taper (used in parts list)
lin . . . . . linear
LK WASH . . . lock washer
LO . . . low; local oscillator
LOG . . . . logarithmic taper (used in parts list)
log . . . . . logrithm(ic)
LPF . . . . . low pass filter
LV . . . . . low voltage
m . . . . . meter (distance)
mA . . . . . milliampere
MAX . . . . . maximum
MΩ . . . . . megohm
MEG . . . . meg (10^6) (used in parts list)
MET FLM . . . . metal film
MET OX . . metallic oxide
MF . . . medium frequency; microfarad (used in parts list)
MFR . . . . . manufacturer
mg . . . . . milligram
MHz . . . . . megahertz
mH . . . . . millihenry
mho . . . . . mho
MIN . . . . . minimum
min . . . . . minute (time)
. . .' . . . . . minute (plane angle)
MINAT . . . . . miniature
mm . . . . . millimeter

NOTE

All abbreviations in the parts list will be in upper-case.

Table 6-1. Reference Designations and Abbreviations (cont'd)

MOD . . . . . modulator
MOM . . . . . momentary
MOS . . . . . metal-oxide semiconductor
ms . . . . . millisecond
MTG . . . . . mounting
MTR . . . meter (indicating device)
mV . . . . . millivolt
mVac . . . . . millivolt, ac
mVdc . . . . . millivolt, dc
mVpk . . . . millivolt, peak
mVp-p . . . millivolt, peak-to-peak
mVrms . . . . millivolt, rms
mW . . . . . milliwatt
MUX . . . . . multiplex
MY . . . . . mylar
μA . . . . . microampere
μF . . . . . microfarad
μH . . . . . microhenry
μmho . . . . . micromho
μs . . . . . microsecond
μV . . . . . microvolt
μVac . . . . . microvolt, ac
μVdc . . . . . microvolt, dc
μVpk . . . microvolt, peak
μVp-p . . . microvolt, peak-to-peak
μVrms . . . . microvolt, rms
μW . . . . . microwatt
nA . . . . . nanoampere
NC . . . . . no connection
N/C . . . . normally closed
NE . . . . . neon
NEG . . . . . negative
nF . . . . . nanofarad
NI PL . . . . . nickel plate
N/O . . . . . normally open
NOM . . . . . nominal
NORM . . . . . normal
NPN . . . negative-positive-negative
NPO . . . . negative-positive zero (zero temperature coefficient)
NRFR . . not recommended for field replacement
NSR . . . . . not separately replaceable
ns . . . . . nanosecond
nW . . . . . nanowatt
OBD . . . order by description
OD . . . . . outside diameter
OH . . . . . oval head
OP AMPL . . . operational amplifier
OPT . . . . . option
OSC . . . . . oscillator
OX . . . . . oxide
oz . . . . . ounce
Ω . . . . . ohm
P . . . . peak (used in parts list)
PAM . . . . pulse-amplitude modulation
PC . . . . . printed circuit
PCM . . pulse-code modulation; pulse-count modulation
PDM . . . . . pulse-duration modulation
pF . . . . . picofarad
PH BRZ phosphor bronze
PHL . . . . . Phillips
PIN . . . positive-intrinsic-negative
PIV . . . . . peak inverse voltage
pk . . . . . peak
PL . . . . . phase lock
PLO . . . . . phase lock oscillator
PM . . . . phase modulation
PNP . . . positive-negative-positive
P/O . . . . . part of
POLY . . . . . polystyrene
PORC . . . . . porcelain
POS . . positive; position(s) (used in parts list)
POSN . . . . . position
POT . . . . . potentiometer
p-p . . . . . peak-to-peak
PP . . . peak-to-peak (used in parts list)
PPM . . . . . pulse-position modulation
PREAMPL . . . preamplifier
PRF . . . . pulse-repetition frequency
PRR . . . . pulse repetition rate
ps . . . . . picosecond
PT . . . . . point
PTM . . . . . pulse-time modulation
PWM . . . . . pulse-width modulation
PWV . . . . . peak working voltage
RC . . . . . resistance-capacitance
RECT . . . . . rectifier
REF . . . . . reference
REG . . . . . regulated
REPL . . . . . replaceable
RF . . . . . radio frequency
RFI . . . . radio frequency interference
RH . . . . round head; right hand
RLC . . . . . resistance-inductance-capacitance
RMO . . . rack mount only
rms . . . . root-mean-square
RND . . . . . round
ROM . . read-only memory
R&P . . . . . rack and panel
RWV . . . reverse working voltage
S . . . scattering parameter
s . . . . . second (time)
. . . " . second (plane angle)
S-B . . . . . slow-blow (fuse) (used in parts list)
SCR . . . silicon controlled rectifier; screw
SE . . . . . selenium
SECT . . . . . sections
SEMICON . . . . semiconductor
SHF . . . . superhigh frequency
SI . . . . . silicon
SIL . . . . . silver
SL . . . . . slide
SNR . . signal-to-noise ratio
SPDT . . . . single-pole, double-throw
SPG . . . . . spring
SR . . . . . split ring
SPST . . . . single-pole, single-throw
SSB . . . . single sideband
SST . . . . stainless steel
STL . . . . . steel
SQ . . . . . square
SWR . . standing-wave ratio
SYNC . . . . . synchronize
T . . timed (slow-blow fuse)
TA . . . . . tantalum
TC . . . . . temperature compensating
TD . . . . . time delay
TERM . . . . . terminal
TFT . . thin-film transistor
TGL . . . . . toggle
THD . . . . . thread
THRU . . . . . through
TI . . . . . titanium
TOL . . . . . tolerance
TRIM . . . . . trimmer
TSTR . . . . . transistor
TTL . . transistor-transistor logic
TV . . . . . television
TVI television interference
TWT . . traveling wave tube
U . . . . micro (10^{-6}) (used in parts list)
UF . . . microfarad (used in parts list)
UHF . . ultrahigh frequency
UNREG . . . . unregulated
V . . . . . volt
VA . . . . . voltampere
Vac . . . . . volts, ac
VAR . . . . . variable
VCO . . . voltage-controlled oscillator
Vdc . . . . . volts, dc
VDCW . . volts, dc, working (used in parts list)
V(F) . . . . . volts, filtered
VFO . . variable-frequency oscillator
VHF . . . . . very-high frequency
Vpk . . . . . volts, peak
Vp-p . . volts, peak-to-peak
Vrms . . . . . volts, rms
VSWR . . . voltage standing wave ratio
VTO . . . . . voltage-tuned oscillator
VTVM . . . . vacuum-tube voltmeter
V(X) . . . . . volts, switched
W . . . . . watt
W/ . . . . . with
WIV . . . . working inverse voltage
WW . . . . . wirewound
W/O . . . . . without
YIG . . yttrium-iron-garnet
Z_o . . . . . characteristic impedance

NOTE

All abbreviations in the parts list will be in upper-case.

MULTIPLIERS

Abbreviation	Prefix	Multiple
T	tera	10^{12}
G	giga	10^{9}
M	mega	10^{6}
k	kilo	10^{3}
da	deka	10
d	deci	10^{-1}
c	centi	10^{-2}
m	milli	10^{-3}
μ	micro	10^{-6}
n	nano	10^{-9}
p	pico	10^{-12}
f	femto	10^{-15}
a	atto	10^{-18}

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1	08503-60042	1	BOARD ASSY, FRONT PANEL SWITCH	28480	08503-60042
A1DS1	1990-0487	1	LED-VISIBLE, YELLOW	28480	1990-0487
A1DS2	1990-0485	1	LED-VISIBLE, GREEN	28480	1990-0485
A1J1	1200-0507	1	SOCKET-IC 16 CONT	06776	ICN-163-S3W
A1SW1			NOT ASSIGNED		
A1SW2	5060-9436	1	SWITCH, PC BOARD (LOCAL)	28480	5060-9436
	5020-3440	1	SPRING, DETENT (LOCAL)	28480	5020-3440
	5040-0122	1	PUSHBUTTON (LOCAL)	28480	**5040-0122**
A1SW3	08503-20003	1	SWITCH, PC SLIDE (S-PARAMETER SELECT)	28480	08503-20003
A2	5086-7240	1	SPLITTER/DIRECTIONAL BRIDGE ASSY NOT FIELD REPAIRABLE	28480	5086-7240
A3	5086-7229	1	DIRECTIONAL BRIDGE ASSY NOT FIELD REPAIRABLE	28480	5086-7229
A4	08503-60013	1	BOARD ASSY, POWER SUPPLY; DOES NOT INCLUDE A4U1 AND U2	28480	08503-60013
A4C1	0180-2594	1	CAPACITOR-FXD; 7200 UF	28480	0180-2594
A4C2	0180-0116	1	CAPACITOR-FXD; 6.8 UF +—10% 35 VDC TA	56289	150D685X903582
A4C3	0180-0291	2	CAPACITOR-FXD; 1UF +—10% 35 VDC	56289	150D105X9035A2
A4C4	0160-2055	2	CAPACITOR-FXD; .01 UF +80 —20%	28480	0160-2055
A4C5	0160-4298	1	CAPACITOR-FXD; 4700 PF +—20% 250 WVDC CER	56289	C067F251H472MS22-CDH
A4C6	0180-2217	2	CAPACITOR-FXD; 350 UF +75 —10% 50 VDC AL	56289	39D357G050FL4
A4C7	0180-0291		CAPACITOR-FXD; 1 UF +—10% 35 VDC	56289	150D105X9035A2
A4C8	0160-4084	4	CAPACITOR-FXD; .1 UF +—20% 50 WVDC	28480	0160-4084
A4C9	0180-2217		CAPACITOR-FXD; 350 UF +75 —10% 50 VDC AL	56289	39D357G050FL4
A4F1	2110-0003	1	FUSE 3A 250V NORM-BLOW	71400	AGC-3
A4F2	2110-0001	1	FUSE 1A 250V NORM-BLOW	71400	AGC-1
A4J1	1251-3305	2	CONNECTOR, 4-PIN MALE	27264	09-65-1041 (2244-4A)
A4MP1	1400-0249	2	CABLE TIE	06383	PLT1M-M-8
A4MP2	1400-0249		CABLE TIE	06383	PLT1M-M-8
A4R1	0757-0438	1	RESISTOR 5.11K 1% .125W F	24546	C4-1/8-TO-5111-F
A4R2	0757-0279	1	RESISTOR 3.16K 1% .125W F	24546	C4-1/8-TO-3161-F
A4U1	1826-0181	1	IC LM323K REGULATOR	27014	LM323K
A4U2	1826-0203	1	IC REGULATOR	07263	7815KC
A4U3	1906-0021	1	DIODE, BRIDGE RECTIFIER	28480	1906-0021
A4U4	1901-0638	1	DIODE, BRIDGE RECTIFIER	28480	1901-0638
A4VR1	1902-3149	1	DIODE-ZNR 9.09V 5% PD=.4W	04713	SZ 10939-170
A5	08503-60035	1	ASSEMBLY, COAXIAL SWITCH	28480	08503-60035
A6	08503-60012	1	BOARD ASSY, DECODER/DRIVER	28480	08503-60012
A6C1	0180-0197	1	CAPACITOR-FXD; 2.2 UF +—10% 20 VDC TA	56289	150D225X9020A2
A6C2	0160-2055		CAPACITOR-FXD; .01 UF +80 —20% 100 WVDC CER	28480	0160-2055
A6C3	0180-1819	1	CAPACITOR-FXD; 100 UF +75 —10% 50 VDC AL	56289	30D107G050DH2
A6CR1	1901-0539	1	DIODE-SCHOTTKY	28480	1901-0539
A6CR2	1901-0050	14	DIODE-SWITCHING 80V 200MA 2NS	28480	1901-0050
A6CR3	1901-0050		DIODE-SWITCHING 80V 200MA 2NS	28480	1901-0050
A6CR4	1901-0050		DIODE-SWITCHING 80V 200MA 2NS	28480	1901-0050
A6CR5	1901-0050		DIODE-SWITCHING 80V 200MA 2NS	28480	1901-0050
A6CR6	1901-0050		DIODE-SWITCHING 80V 200MA 2NS	28480	1901-0050
A6CR7	1901-0050		DIODE-SWITCHING 80V 200MA 2NS	28480	1901-0050
A6CR8	1901-0050		DIODE-SWITCHING 80V 200MA 2NS	28480	1901-0050
A6CR9	1901-0050		DIODE-SWITCHING 80V 200MA 2NS	28480	1901-0050
A6CR10	1901-0050		DIODE-SWITCHING 80V 200MA 2NS	28480	1901-0050
A6CR11	1901-0050		DIODE-SWITCHING 80V 200MA 2NS	28480	1901-0050
A6CR12	1901-0050		DIODE-SWITCHING 80V 200MA 2NS	28480	1901-0050

Table 6-2. Replaceable Parts (Cont'd)

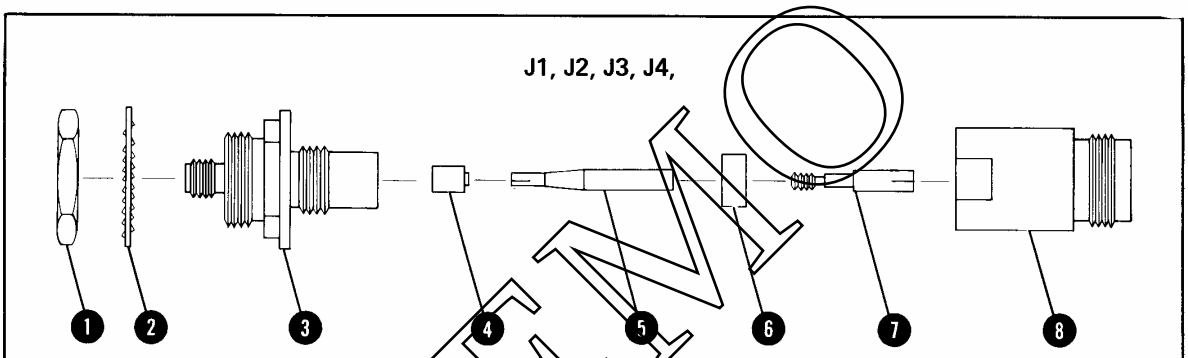
Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A6CR13	1901-0050		DIODE-SWITCHING 80V 200MA 2NS	28480	1901-0050
A6CR14	1901-0050		DIODE-SWITCHING 80V 200MA 2NS	28480	1901-0050
A6CR15	1901-0050		DIODE-SWITCHING 80V 200MA 2NS	28480	1901-0050
A6MP1	4040-0754	2	EXTRACTOR, PC BOARD, BLUE	28480	4040-0754
A6MP2	4040-0754		EXTRACTOR, PC BOARD, BLUE	28480	4040-0754
A6MP3	1480-0059	4	ROLL PIN, EXTRACTOR	00000	OBD
A6MP4	1480-0059		ROLL PIN, EXTRACTOR	00000	OBD
A6R1	0698-3441	2	RESISTOR 215 1% .125 F	16299	C4-1/8-TO-215R-F
A6R2	0698-3441		RESISTOR 215 1% .125 F	16299	C4-1/8-TO-215R-F
A6R3	0757-0199	1	RESISTOR 21.5K 1% .125W F	24546	C4-1/8-TO-2152-F
A6U1	1820-1542	3	IC CD4049AY BUFFER	02735	CD4049AY
A6U2	1820-1542		IC CD4049AY BUFFER	02735	CD4049AY
A6U3	1820-1266	1	IC MM80C 97N BUFFER	27014	MM80C97N
A6U4	1820-0535	5	IC SN75 451BP DRIVER	01295	SN75451BP
A6U5	1820-0535		IC SN75 451BP DRIVER	01295	SN75451BP
A6U6	1820-0535		IC SN75 451BP DRIVER	01295	SN75451BP
A6U7	1820-0535		IC SN75 451BP DRIVER	01295	SN75451BP
A6U8	1820-0535		IC SN75 451BP DRIVER	01295	SN75451BP
A6U9	1810-0207	2	NETWORK-RES 8-PIN-SIP	11236	750-81-R22K
A6U10	1810-0037	1	NETWORK-RES 16-PIN-DIP	11236	760 SERIES/16 PIN
A6U11	1810-0207		NETWORK-RES 8-PIN-SIP	11236	750-81-R22K
A7			NOT ASSIGNED		
A8	08503-60016	1	BOARD ASSY, HP-IB (OPT 001 ONLY)	28480	08503-60016
A8C1	0180-0229	1	CAPACITOR-FXD; 33 UF +—10% 10 VDC TA-SOLID	56289	150D336X9010B2
A8C2	0160-3879	7	CAPACITOR-FXD; .01 UF +—20% 100 WVDC CER	28480	0160-3879
A8C3	0160-3879		CAPACITOR-FXD; .01 UF +—20% 100 WVDC CER	28480	0160-3879
A8C4	0160-3879		CAPACITOR FXD; .01 UF +—20% 100 WVDC CER	28480	0160-3879
A8C5	0160-3879		CAPACITOR FXD; .01 UF +—20% 100 WVDC CER	28480	0160-3879
A8C6	0160-3879		CAPACITOR FXD; .01 UF +—20% 100 WVDC CER	28480	0160-3879
A8C7	0160-3879		CAPACITOR FXD; .01 UF +—20% 100 WVDC CER	28480	0160-3879
A8C8	0160-4084		CAPACITOR-FXD; 1 UF +—20% 50 WVDC	28480	0160-4084
A8C9	0160-3879		CAPACITOR-FXD; .01 UF +—20% 100 WVDC CER	28480	0160-3879
A8C10	0160-3877	1	CAPACITOR-FXD; 100 PF +—20% 200 WVDC CER	28480	0160-3877
A8C11	0160-4084		CAPACITOR-FXD; .1 UF +—20% 50 WVDC	28480	0160-4084
A8C12	0160-4084		CAPACITOR-FXD; .1 UF +—20% 50 WVDC	28480	0160-4084
A8CR1	1901-0033	1	DIODE-GEN PRP 180V 200 MA	28480	1901-0033
A8L1	08503-80001	1	COIL, TOROID	28480	08503-80001
A8MP1	4040-0747	2	EXTRACTOR, PC BOARD, GRAY	28480	4040-0747
A8MP2	4040-0747		EXTRACTOR, PC BOARD, GRAY	28480	4040-0747
A8MP3	1480-0059		ROLL PIN, EXTRACTOR	00000	OBD
A8MP4	1480-0059		ROLL PIN, EXTRACTOR	00000	OBD
A8R1	0698-7260	1	RESISTOR 10K 2% .05W F	24546	C3-1/8-TO-1002-G
A8R2	0757-0465	2	RESISTOR 100K 1% .125W F	24546	C4-1/8-TO-1003-F
A8R3	0757-0465		RESISTOR 100K 1% .125W F	24546	C4-1/8-TO-1003-F
A8R4	0757-0280	1	RESISTOR 1K 1% .125W F	24546	C4-1/8-TO-1001-F
A8R5	0698-7230	2	RESISTOR 562 2% .05W F	24546	C3-1/8-TO-562R-G
A8R6	0698-7230		RESISTOR 562 2% .05W F	24546	C3-1/8-TO-562R-G
A8U1	1820-1144	2	IC SN74LS 02 N GATE	01295	SN74LS02N
A8U2	1820-1201	1	IC SN74LS 08 N GATE	01295	SN74LS08N
A8U3	1820-1194	1	IC SN74LS193N COUNTER	01295	SN74LS193N

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A8U4	1820-1205	1	IC SN74LS 21 N GATE	01295	SN74LS21N
A8U5	1820-1544	1	IC CD4076BY FLIP-FLOP	02735	CD4076BY
A8U6			NOT ASSIGNED		
A8U7	1810-0204	1	NETWORK-RES 8-PIN-SIP	11236	750-81-R1K
A8U8	1820-1546	1	IC CD4052AY MUXR	02735	CD4052AY
A8U9	1820-1112	1	IC SN74LS 74 N FLIP-FLOP	01295	SN74LS74N
A8U10	1820-1144		IC SN74LS 02 N GATE	01295	SN74LS02N
A8U11	1820-1199	1	IC SN74LS 04 N INV	01295	SN74LS04N
A8U12	1820-1202	1	IC SN74LS 10 N GATE	01295	SN74LS10N
A8U13	1820-1206	1	IC SN74LS 27 N GATE	01295	SN74LS27N
A8U14	1820-0904	1	IC COMPARATOR	07263	93L24DC
A8U15	1820-1542		IC CD4049AY BUFFER	02735	CD4049AY
A8U16	1820-1212	1	IC SN74LS112 N FLIP-FLOP	01295	SN74LS112N
A8U17	1820-1197	1	IC SN74LS 00 N GATE	01295	SN74LS00N
A8U18	1820-1522	4	IC MC 3440P DIGITAL	04713	MC3440P
A8U19	1820-1522		IC MC 3440P DIGITAL	04713	MC3440P
A8U20	1820-1522		IC MC 3440P DIGITAL	04713	MC3440P
A8U21	1820-1522		IC MC 3440P DIGITAL	04713	MC3440P
A8U22	1820-1244	1	IC SN74LS153 N DATA SEL	01295	SN74LS153N
A9			NOT ASSIGNED		
A10	08503-60011	1	BOARD ASSY, INTERCONNECT	28480	08503-60011
A10J1	1251-3141	1	CONNECTOR, 50-PIN M RECTANGULAR	76381	3433-1002
A10J2	1251-0064	1	CONNECTOR, 25-PIN F D SERIES	71785	DBM-25S
A10J3	1251-3283	1	CONNECTOR, 24-CONT FEM MICRORIBBON	28480	1251-3283
A11			NOT ASSIGNED		
A12	08503-60041	1	BOARD ASSY, MOTHER	28480	08503-60041
A12J1			NOT REPLACEABLE		
A12J2			NOT REPLACEABLE		
A12J3	1251-3305		CONNECTOR, 4-PIN MALE	27264	09-65-1041 (2244-4A)
A12J4	1251-3751	1	CONNECTOR, 8-PIN MALE	27264	09-65-1081
A12XA4	1251-0478	1	CONNECTOR-PC 12 CONTACT	71785	252-06-30-340
A12XA5			NOT ASSIGNED		
A12XA6	1251-1887	3	CONNECTOR, PC 44 CONTACT	71785	252-22-30-340
A12XA7			NOT ASSIGNED		
A12XA8	1251-1887		CONNECTOR, PC 44 CONTACT	71785	252-22-30-340
A12XA9	1251-1887		CONNECTOR, PC 44 CONTACT	71785	252-22-30-340
			CHASSIS PARTS		
F1	2110-0012	1	FUSE .5A 250V (100-120V)	71400	AGC 1/2
	2110-0004		FUSE .25A 250V (220-240V)	71400	AGC 1/4
FL1	0960-0448	1	LINE MODULE ASSY	28480	0960-0448
J1					
J2			SEE FIGURE 6-1		
J3					
J4					
J5	1250-0083	2	CONNECTOR, BNC (DC BIAS)		
J6	1250-0083		CONNECTOR, BNC (DC BIAS)		
P1	1251-3167	2	CONNECTOR, 4-PIN FEMALE (TRANSFORMER)	27264	09-50-3041
	1251-0679	4	CONTACT, CONNECTOR FEMALE	27264	08-50-0106
P2	1251-3167		CONNECTOR, 4-PIN FEMALE (COAXIAL SWITCH)	27264	09-50-3041
	1251-2992	3	CONTACT, CONNECTOR FEMALE	27264	08-50-0106
S1	3101-2025	1	SWITCH, DPST (LINE)	28480	3101-2025
T1	9100-3847	1	TRANSFORMER	28480	9100-3847
W1	8120-1348	1	CABLE, AC POWER	28480	8120-1348
W2	08503-60001	1	CABLE, RIBBON (M.B. TO F.P.)	28480	08503-60001
W3	08503-60003	1	CABLE, RIBBON (M.B. TO R.P.)	28480	08503-60003
W4	08503-20033	1	CABLE, COAXIAL (A2 TO A5)	28480	08503-20033
W5	08503-20032	1	CABLE, COAXIAL (A2 TO A5)	28480	08503-20032

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
W6	08503-20034	1	CABLE, COAXIAL (A3 TO A5)	28480	08503-20034
W7	08503-20031	1	CABLE, COAXIAL (A2 TO RF PORT)	28480	08503-20031
W8	08503-20035	1	CABLE, COAXIAL (A2 TO PORT A)	28480	08503-20035
W9	08503-20037	1	CABLE, COAXIAL (A2 TO BLK HD)	28480	08503-20037
W10	08503-20038	1	CABLE, COAXIAL LOOP	28480	08503-20038
W11	08503-20039	1	CABLE, COAXIAL (BLK HD TO PORT R)	28480	08503-20039
W12	08503-20036	1	CABLE, COAXIAL (A3 TO PORT B)	28480	08503-20036
W13	08503-60004	1	CABLE, AC LINE SWITCH	28480	08503-60004
			MISCELLANEOUS		
	8120-2289	4	CABLE, RF CONNECTING	28480	8120-2289
	08503-60005	1	CABLE, SIG PROC INTERCONN	28480	08503-60005
	10631A	1	CABLE, HP-IB INTERCONN	28480	10631A
	08503-60044	1	EXTENDER BOARD	28480	08503-60044
	5040-7221	4	FOOT, REAR	28480	5040-7221
	1600-0367	4	LOCK LINK, VERTICAL	28480	1600-0367
	08505-20155	1	LOCK FOOT, UPPER LEFT	28480	08505-20155
	08505-20156	1	LOCK FOOT, LOWER LEFT	28480	08505-20156
	08505-20157	1	LOCK FOOT, UPPER RIGHT	28480	08505-20157
	08505-20158	1	LOCK FOOT, LOWER RIGHT	28480	08505-20158



Reference Designation	HP Part Number	Qty	Description
1	2950-0079	1	Nut: Hex
2	2190-0120	1	Washer: Lock
3	08505-20072	1	Body: Bulkhead
4	08761-2027	1	Insulator
5	08555-20093	1	Contact: Jack
6	5040-0306	1	Insulator
7	1250-0915	1	Contact: RF Connector
8	1250-0914	1	Body: RF Connector

Figure 6-1. Type N Connector Assembly, Exploded View

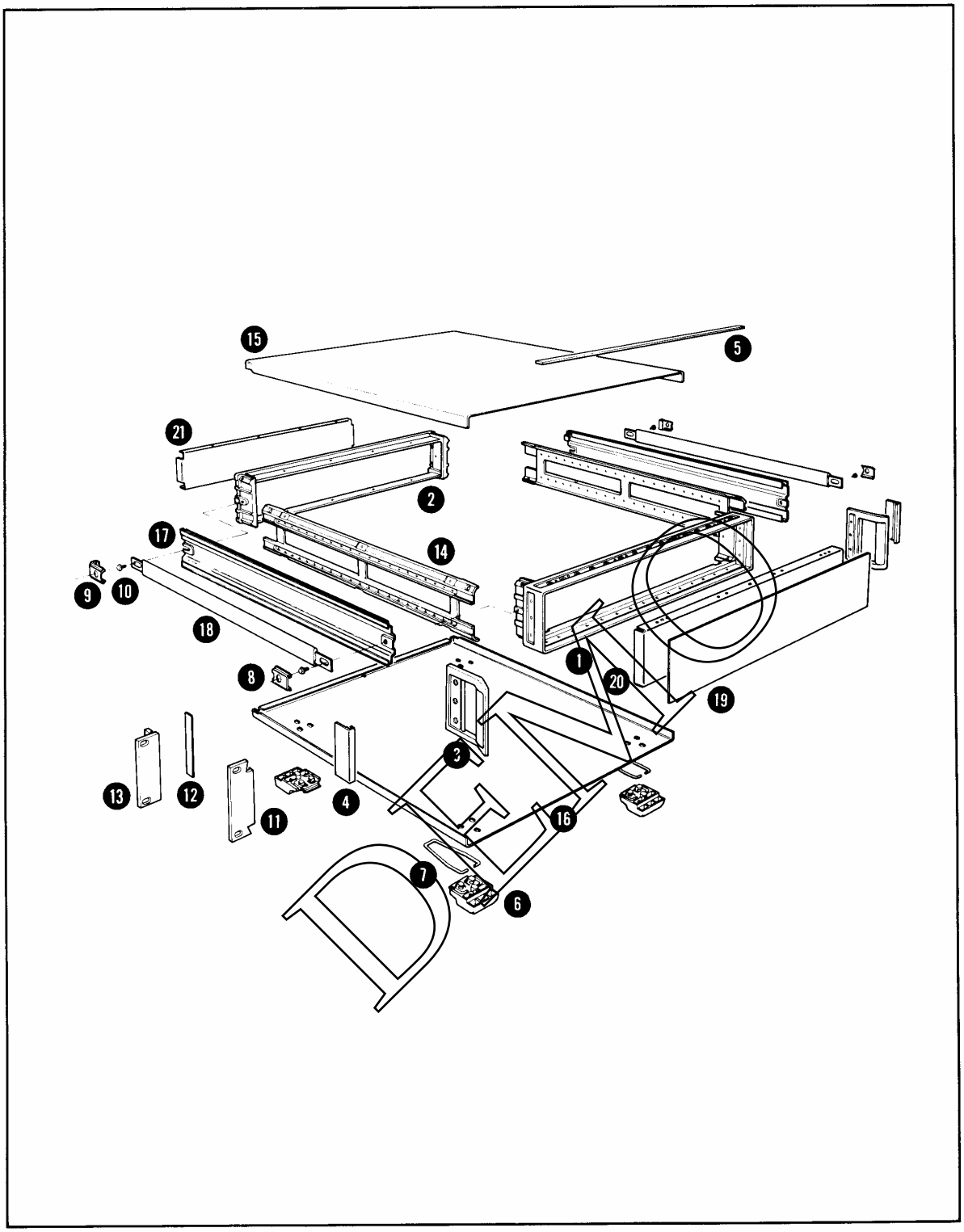


Figure 6-2. Cabinet Parts, Exploded View (1 of 2)

Reference Designation	HP Part Number	Qty	Description
1	5020-8801	1	Frame, Front
2	5020-8802	1	Frame, Rear
3	5060-9898	2	Front Handle Assembly
4	5020-8895	2	Trim, Front Handle
5	5040-7202	1	Top Trim, Front Frame
6	5040-7201	4	Foot
7	1460-1345	2	Tilt Stand
8	5040-7219	2	Front Cap, Strap Handle
9	5040-7220	2	Rear Cap, Strap Handle
10	0570-1170	4	Retainer Screw, Strap Handle
11	5020-8873	2	Rack Flange (with Front Handle)
12	5001-0438	2	Side Trim Front Frame (without Front Handle)
13	5020-8861	2	Rack Flange (without Front Handle)
14	5020-8832	2	Side Strut
15	5060-9835	1	Cover, Top
16	5060-9847	1	Cover, Bottom
17	5060-9876	2	Cover, Side
18	5060-9804	2	Strap Handle Assembly
19	08503-00001	1	Panel, Front Dress
20	08503-00014	1	Panel, Front Sub
21	08503-00003	1	Panel, Rear

Figure 6-2. Cabinet Parts, Exploded View (2 of 2)

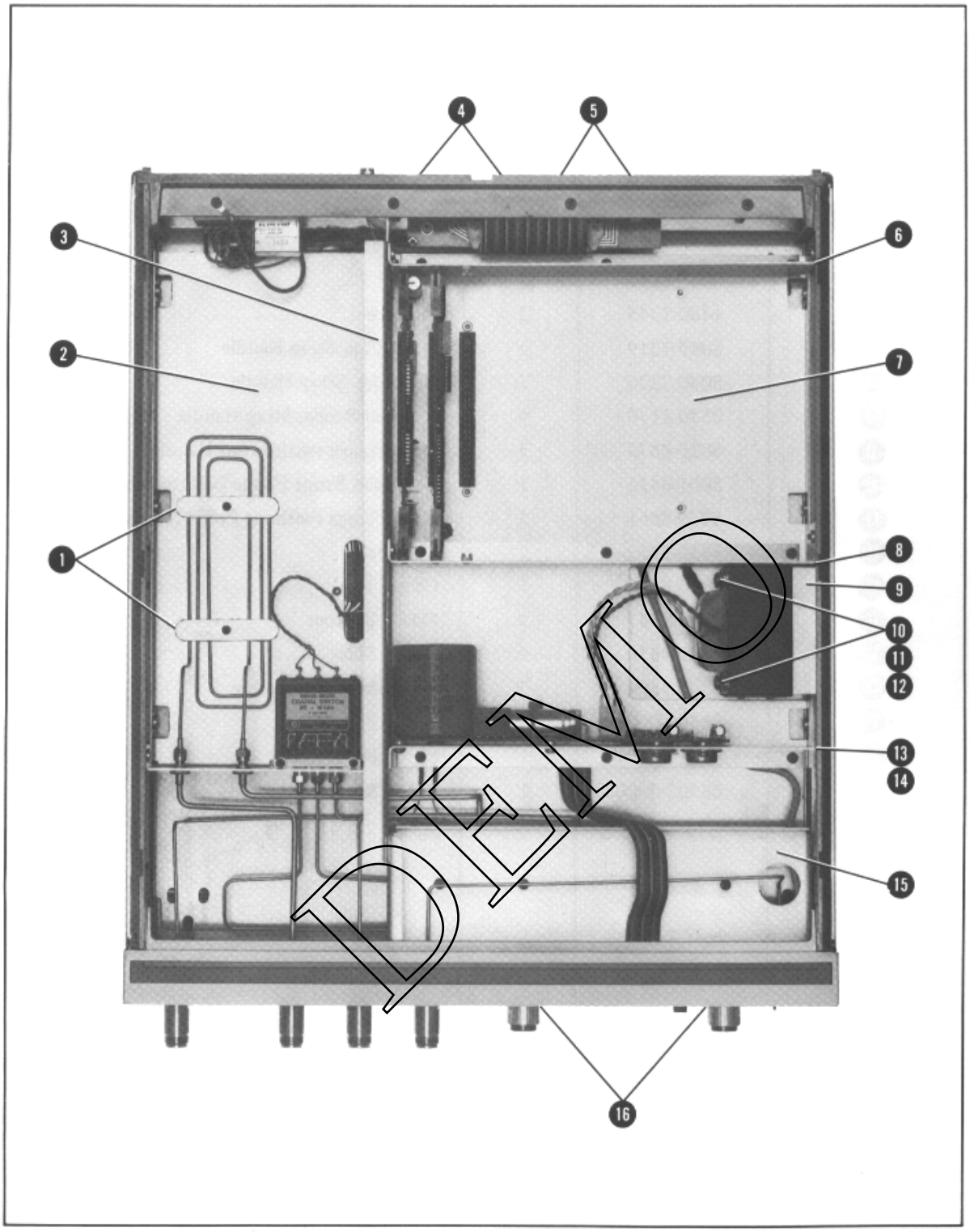


Figure 6-3. Mechanical Parts Location (1 of 2)

Reference Designation	HP Part Number	Qty	Description
1	08503-00011	2	Cable Clamp
2	08503-00005	1	Deck, Main
3	08503-00010	1	Gusset, Deck
4	1251-2942	2	Lock-Submin D Connector
5	0380-0644	2	Standoff-Hex (HP-IB Conn. Lock)
6	08503-00017	1	Gusset, Rear
7	08503-00015	1	Deck, Card Support
8	08503-00016	1	Gusset, Center
9	08503-20001	2	Spacer, Transformer
10	3050-0005	8	Washer, Fiber Shoulder
11	3050-0253	4	Washer, Flat .195-IN ID
12	2360-0101	4	Screw-Mach 6-32 3.25-IN-LG
13	08503-00007	1	Gusset, Power Supply
14	08503-20014	1	Board, Insulator
15	08503-00004	1	Deck, Bridge
16	08503-20008	2	Washer, Dress

Figure 6-3. Mechanical Parts Location (2 of 2)

Table 6-3. Code List of Manufacturers

MFR. NO.	MANUFACTURER NAME	ADDRESS	ZIP CODE
01295	TEXAS INSTR INC SEMICOND CMPNT DIV	DALLAS TX	75231
02735	RCA CORP SOLID STATE DIV	SOMMERVILLE NJ	08876
04713	MOTOROLA SEMICONDUCTOR PRODUCTS	PHOENIX AZ	85008
06776	ROBINSON NUGENT INC	NEW ALBANY IN	47150
07263	FAIRCHILD SEMICONDUCTOR DIV	MOUNTAIN VIEW CA	94040
11236	CTS OF BERNE INC	BERNE IN	46711
16299	CORNING GL WK ELEC CMPNT DIV	RALEIGH NC	27604
24546	CORNING GLASS WORKS (BRADFORD)	BRADFORD PA	16701
27014	NATIONAL SEMICONDUCTOR CORP	SANTA CLARA CA	95051
27264	MOLEX PRODUCTS CO	DOWNERS GROVE IL	60515
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO CA	94304
56289	SPRAGUE ELECTRIC CO	NORTH ADAMS MA	01247
71400	BUSSMAN MFG DIV OF MCGRAW-EDISON CO	ST LOUIS MO	63017
71785	TRW ELEK COMPONENTS CINCH DIV	ELK GROVE VILLAGE IL	60007
75915	LITTLEFUSE INC	CHICAGO IL	60618
76381	3M COMPANY	ST PAUL MN	55101

SECTION VII
MANUAL CHANGES

7-1. INTRODUCTION

7-2. This section normally contains information for adapting this manual to instruments for which the content does not apply directly. Since this manual does apply directly to instruments having serial numbers listed on the title page, no change information is given here. Refer to INSTRUMENTS COVERED BY MANUAL in Section I for additional important information about serial number coverage.

SECTION VIII
SERVICE

8-1. INTRODUCTION

8-2. This section provides instructions for troubleshooting and repairing the Model 8503A S-Parameter Test Set. Circuit descriptions and simplified block diagrams are included with the schematic diagrams of the assemblies. Component location illustrations are also contained in this section. Schematic presentations in this manual show electrical circuit operation and are not intended to serve as wiring diagrams.

8-3. ASSEMBLY SERVICE SHEETS

8-4. The schematics are arranged by service sheets. The service sheet numbers appear in the lower right-hand corner of the schematics (large number above assembly number). Included in the service sheet is the schematic as well as the accompanying circuit theory, component-parts location photo, simplified block diagrams, and schematic-level troubleshooting.

8-5. THEORY OF OPERATION

8-6. Detailed circuit description for each individual schematic diagram is placed on the facing left-hand foldout page. This places material needed for printed-circuit-level diagnosis in one location and allows easy correlation between function and specific circuitry.

8-7. TROUBLESHOOTING

WARNING

With the ac power cable connected, the ac line voltage is present at the terminals of power line assembly FL1 (mounted on rear panel) and at the LINE switch, whether the LINE switch is on or off. With the top cover removed, these terminals are exposed. Care must be taken to avoid contact with these terminals.

8-8. Troubleshooting is generally divided into two maintence levels in this manual. The first level isolates a trouble to a circuit or assembly. This is done by using troubleshooting block diagrams that provide signal levels and techniques to isolate the cause of a malfunction and identify the defective assembly.

8-9. The second maintenance level isolates the trouble to the component. Schematic diagrams and circuit descriptions for each assembly aid in troubleshooting to the component level.

8-10. When troubleshooting a transistor stage, check for a forward bias condition of the base-emitter junction. If this condition exists, the next step is to remove this forward bias by shorting the base to the emitter and checking to see if the collector voltage rises to the approximate level of the supply. The next check that can be made, if it is known that the transistor is not operating in a saturated condition, is to check for a voltage drop between emitter and collector. These serve only as quick checks and will help in getting started with the problem.

8-11. RECOMMENDED TEST EQUIPMENT

8-12. Test equipment and accessories required to maintain the Model 8503A are listed in Table 1-8. If the equipment listed is not available, equipment that meets the minimum specifications shown may be substituted.

8-13. REPAIR

8-14. Directional Bridges

8-15. The Splitter/Directional Bridge A2 and Directional Bridge A3 are not field-repairable. If one of these units fails, return the defective unit to the nearest Hewlett-Packard office or service center.

8-16. After Service Product Safety Checks

8-17. Visually inspect interior of instrument for any signs of abnormal internally generated heat, such as discolored printed circuit boards or components, damaged insulation, or evidence of arcing. Determine and remedy cause of any such condition.

8-18. Using a suitable ohmmeter, check resistance from instrument enclosure to ground pin on power cord plug. The reading must be less than one ohm. Flex the power cord while making this measurement to determine whether intermittent discontinuities exist.

8-19. Check resistance from instrument enclosure to line and neutral (tied together) with the line switch ON and the power source disconnected. The minimum acceptable resistance is two megohms. Replace any component which results in failure to meet this minimum.

8-20. Check line fuse to verify that a correctly rated fuse is installed.

SCHEMATIC DIAGRAM NOTES

R, L, C	Resistance is in ohms, inductance is in microhenries, capacitance is in microfarads. unless otherwise noted.
P/O	Part of.
*	Asterisk denotes a factory-selected value. Value shown is typical.
○	Panel control.
⊘	Screwdriver adjustment.
▭	Encloses front panel designation.
⬚	Encloses rear panel designation.
—— - - ——	Circuit assembly borderline.
- - - - - -	Other assembly borderline.
——▶——	Heavy line with arrows indicates path and direction of main signal.
——▶——	Heavy dashed line with arrows indicates path and direction of main feedback.
CW	Wiper moves toward CW with clockwise rotation of control as viewed from shaft or knob.
⬭	Encloses wire color code. Code used (MIL-STD-681) is the same as the resistor color code. First number identifies the base color, second number the wider stripe, and the third number identifies the narrower stripe; e.g. (947) denotes white base, yellow wide stripe, violet narrow stripe.
2A	Number = Service Sheet number for off-page connection. Letter = off-page connection.
	Light-emitting diode.
	Breakdown diode.

Figure 8-1. Schematic Diagram Notes (1 of 3)

SCHEMATIC DIAGRAM NOTES

Test point location. Number denotes test point number.

Assembly ground.

Chassis ground.

Earth ground.

Indicates "WARNING: HAZARDOUS VOLTAGE."

Refers serviceman or operator to CAUTIONS in Operating and Service Manual.

Voltages noted within circuits are ±10% tolerance unless otherwise stated.

Conditions for dc voltages on schematics are as follows:

a. 8503A with no interconnections to Network Analyzer.

b. 8503A S-PARAMETER SELECT switch in FORWARD position and LINE switch ON.

Figure 8-1. Schematic Diagram Notes (2 of 3)

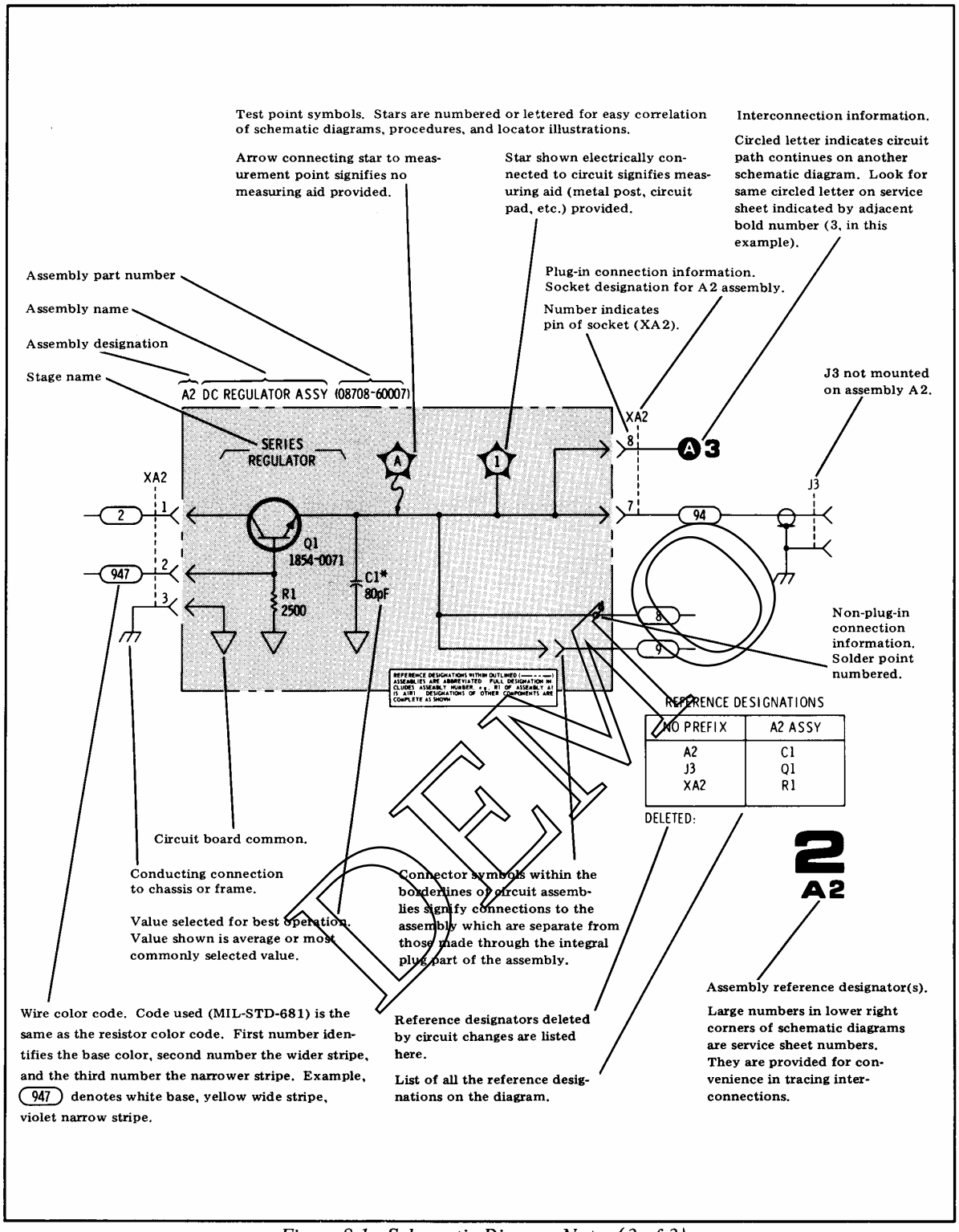


Figure 8-1. Schematic Diagram Notes (3 of 3)

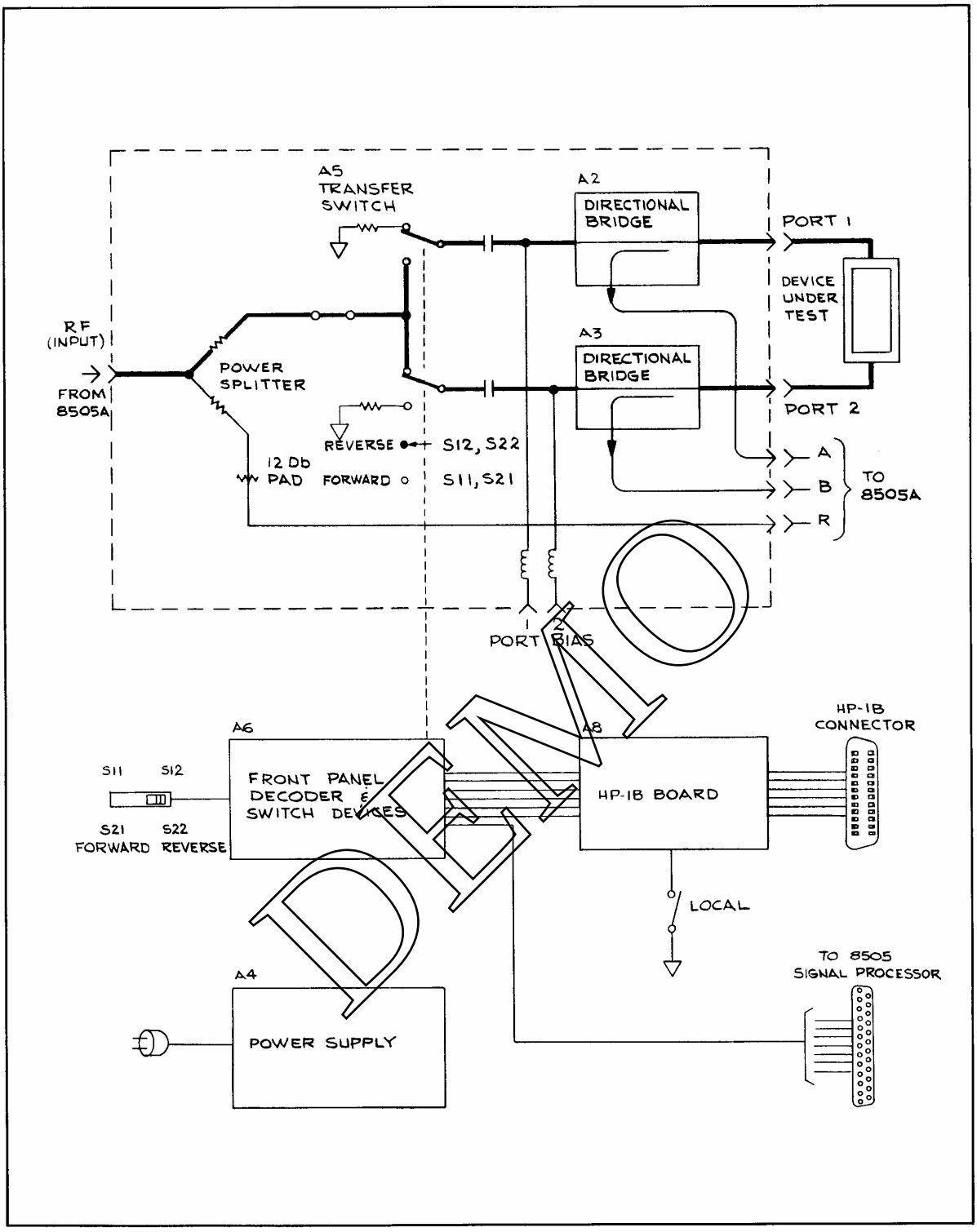


Figure 8-2. Simplified Block Diagram of 8503A, Including Option 001 (HP-IB)

OVERALL TROUBLESHOOTING PROCEDURE

a. If failure is in RF path, refer to RF Troubleshooting Procedure.

b. If front-panel switches or indicators have failed, refer to Switch and Indicator Control Troubleshooting Procedure.

c. If failure is in HP-IB circuitry, refer to Service Sheet 3, HP-IB Circuit Description.

RF TROUBLESHOOTING PROCEDURE

a. Check directivity of both directional bridges. (See Section II, Figure 2-6). If directivity is less than 40 dB, tighten connectors on directional bridges and check PORT 1 and PORT 2 connectors for possible damage to center conductor. Recheck directivity. If directivity is still less than 40 dB, replace directional bridge.

b. Apply an RF signal of 0 dBm at approximately 1000 mHz to the 8503A RF input port. The 8505A Source/Converter is a convenient source.

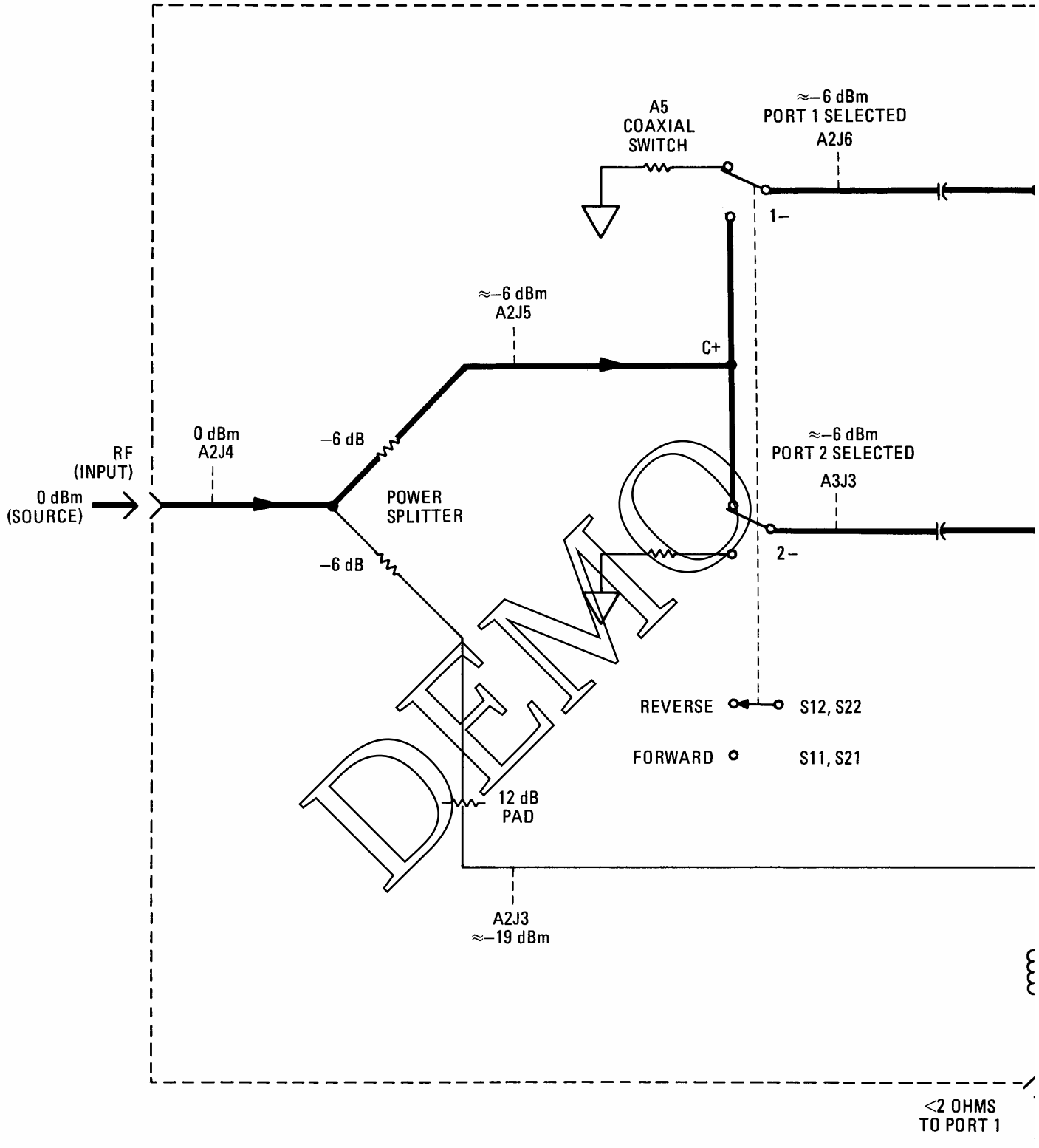
c. Disconnect RF cables one at a time and check for power levels indicated in Figure 8-3. When checking signal level at Coaxial Switch outputs, switch 8503A S-PARAMETER SELECT switch to insure that A5 is functioning properly.

SWITCH AND INDICATOR CONTROL TROUBLESHOOTING PROCEDURE

a. Check Power Supply for +5 volts and +24 volts at test points on A4.

b. With 8503A front-panel S-PARAMETER SELECT switch in the FORWARD position and 8503A in LOCAL mode, check for proper indications as shown in Figure 8-4.

c. Set front-panel S-PARAMETER SELECT Switch to REVERSE and check for proper indications (all LOW's shown in Figure 8-4 should now be HI and all HI's should be LOW).


A5
COAXIAL
SWITCH
≈–6 dBm
PORT 1 SELECTED
A2J6
1–
≈–6 dBm
A2J5
C+
0 dBm
A2J4
–6 dB
RF
(INPUT)
0 dBm
(SOURCE)
POWER
SPLITTER
≈–6 dBm
PORT 2 SELECTED
A3J3
2–
–6 dB
REVERSE
S12, S22
FORWARD
S11, S21
12 dB
PAD
A2J3
≈–19 dBm
<2 OHMS
TO PORT 1

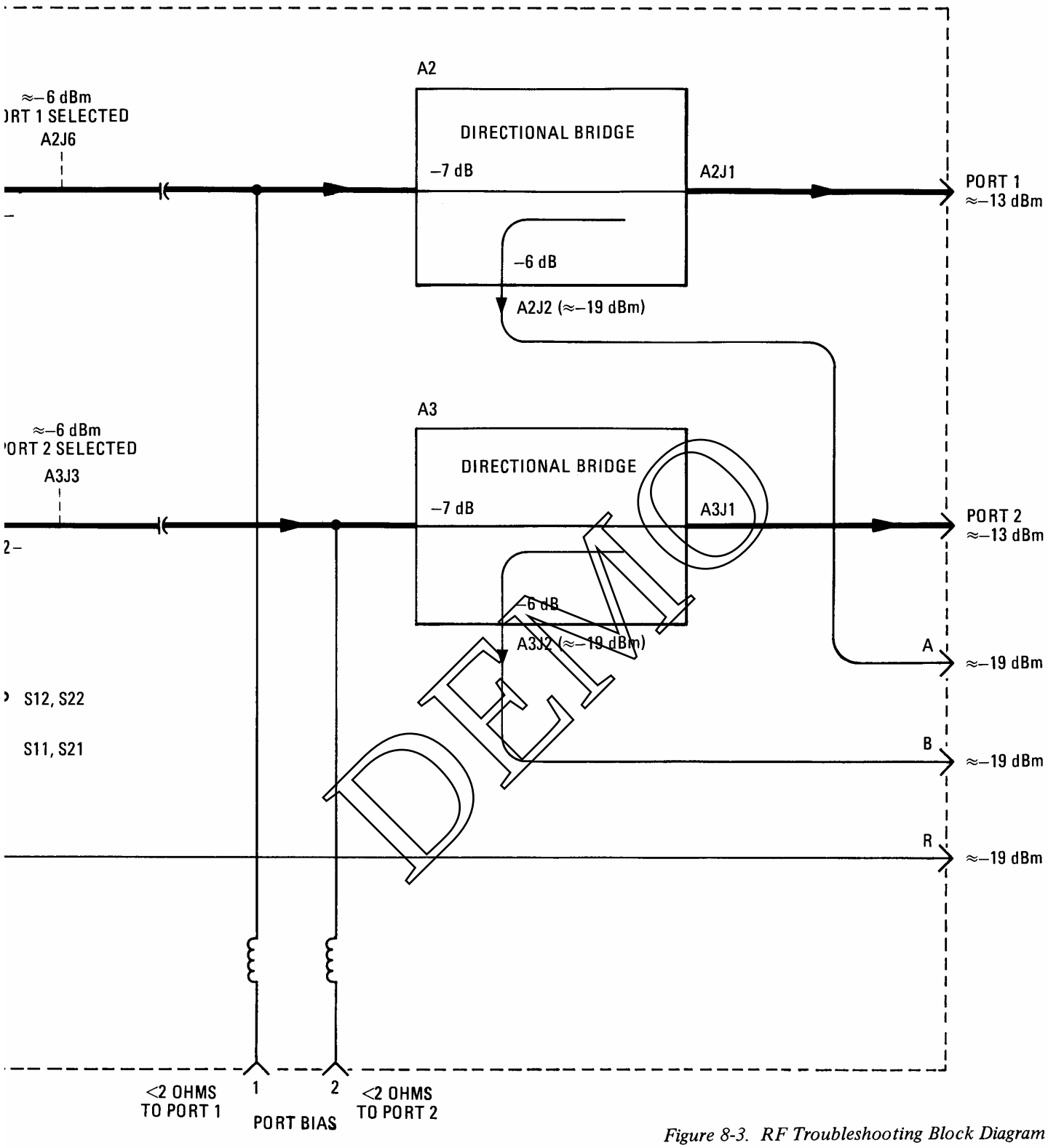
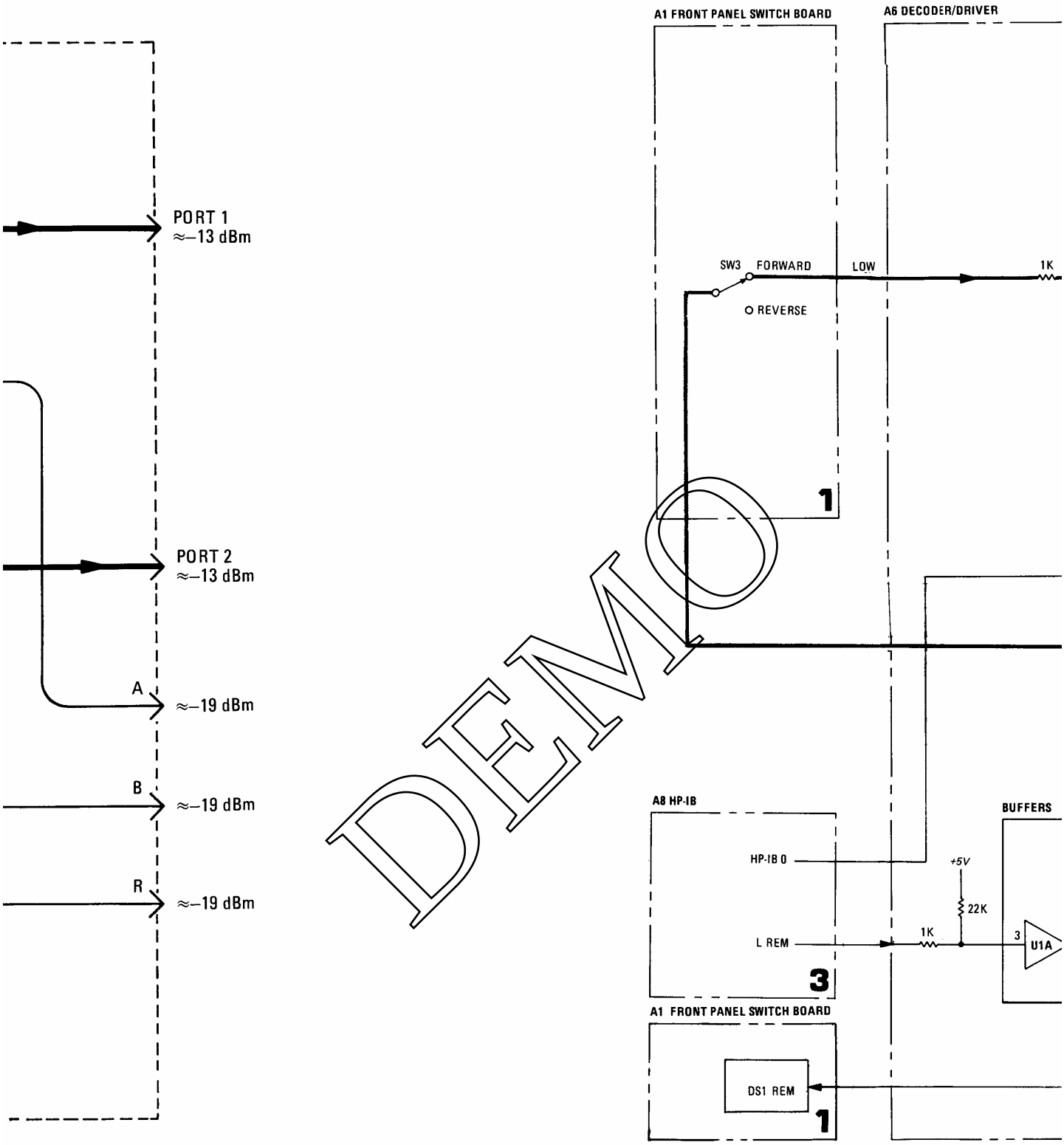


Figure 8-3. RF Troubleshooting Block Diagram



Troubleshooting Block Diagram

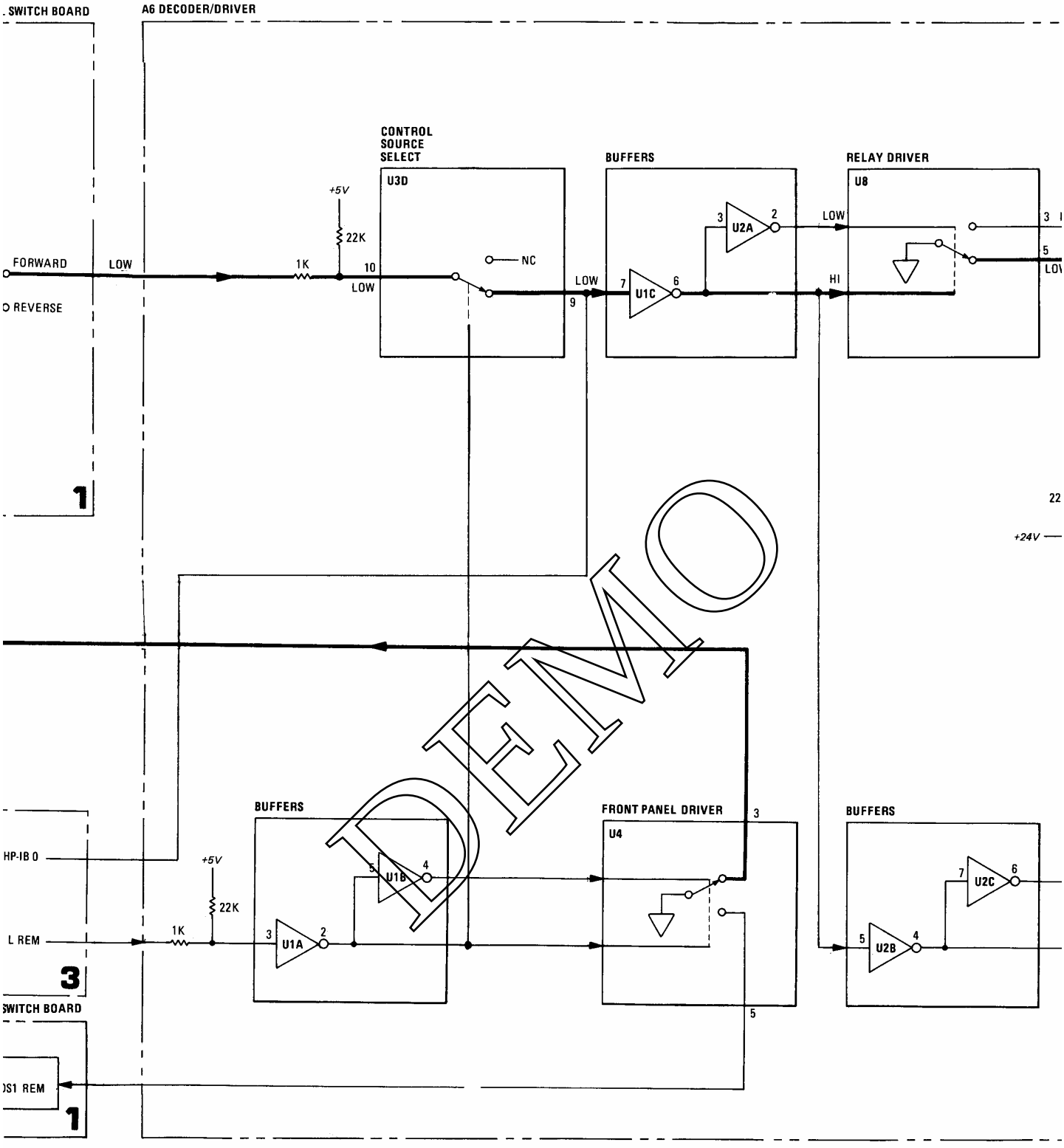


Figure 8-4. Switch Control an

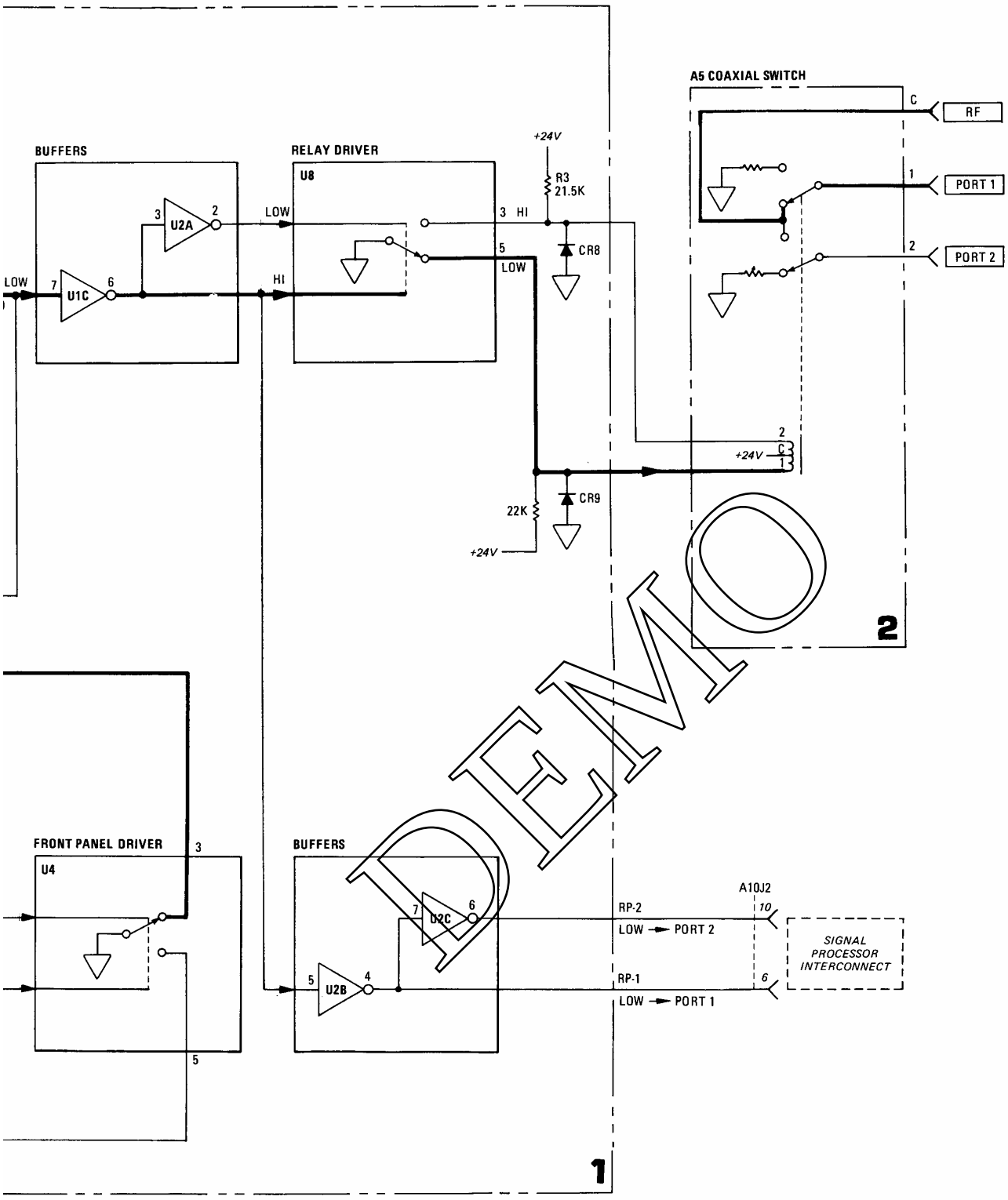


Figure 8-4. Switch Control and Front Panel Indicator Troubleshooting Block Diagram

SERVICE SHEET 1

A1 FRONT PANEL SWITCH BOARD ASSEMBLY, CIRCUIT DESCRIPTION

The Front Panel Switch Board assembly is the source for selecting PORT 1 or PORT 2 (FORWARD or REVERSE, respectively) in the LOCAL mode. When S-PARAMETER SELECT switch A1SW3 is in the FORWARD position, a LOW (≈0V) is placed at the input of A6U3D (pin 10) resulting in selection of PORT 1. When S-PARAMETER SELECT switch is in the REVERSE position, the LOW is removed and input of A6U3D is pulled HI (≈+5V) resulting in selection of PORT 2.

The Front Panel Switch Board also contains two LED indicators, A1DS1 and DS2, and a LOCAL reset pushbutton switch A1SW2. A1DS1 is lit when 8503A is in REMOTE mode. A1DS2 is lit when 8503A LINE switch is ON and +5 volts is available from the Power Supply Assembly A4. The LOCAL reset pushbutton switch A1SW2 transfers control of Coaxial Switch A5 from HP-IB to front-panel S-PARAMETER SELECT switch (A1SW3). It overrides the REM signal from the HP-IB Assembly A8 and returns the 8503A Option 001 to LOCAL mode. Once the LOCAL pushbutton is pressed, the 8503A will remain in LOCAL mode until again programmed to REMOTE by operator's input to the calculator.

A6 DECODER/DRIVER ASSEMBLY, CIRCUIT DESCRIPTION

General

The Decoder/Driver Assembly provides four major functions:

1. Selection of control source (REMOTE or LOCAL).
2. Buffering.
3. Driving (Coaxial Switch A5 and front panel REM indicator).
4. Protection of drivers.

Control Source Select

Integrated circuit U3 is a tri-state buffer. U3D is used to select the source to control Coaxial Switch A5. In LOCAL mode, U1A pin 3 is pulled HI through resistor package U9. The output of U1A pin 2 is therefore pulled LOW. This places a LOW on pin 1 of U3D and a LOW on U4 pin 2 allowing A1SW3 to control the port selection. The LOW at U4 pin 2 is NANDed with a HI at U4 pin 1. The base of the top transistor of U4 is therefore HI (transistor turned ON) and U4 pin 3 is virtually grounded. When the 8503A is programmed to go to REMOTE mode, the L REM line (XA6 pin 14) pulls U1A pin 3 LOW. The output of U1A (pin 2) is therefore pulled HI. This places a HI on pin 1 of U3D which gates U3D OFF. Thus, the input from the S-PARAMETER

SELECT switch A1SW3 is disabled, allowing the HP-IB to control the port selection. U3A, B, C, E, and F are presently not used in the 8503A.

Front Panel Drivers

In LOCAL Mode, U1A pin 3 is pulled HI through resistor package U9. The output of U1A is therefore pulled LOW placing a HI at U4 pin 6 (inverted output of U1B). The HI on U4 pin 6 is NANDed with HI on U4 pin 7 placing a LOW at the base of the bottom transistor of U4. This places U4 pin 5 at a high impedance to ground (open) and A1DS1 will not be on.

In REMOTE mode, U1A pin 3 is pulled LOW (L REM line) so its output (pin 2) is HI. This places a LOW at U4 pin 6 which places a HI at the base of the bottom transistor of U4 (transistor turned ON). In this state U4 pin 5 is virtually grounded, completing the path for A1DS1 REM indicator to light.

Buffers

Integrated circuits U1 and U2 are CMOS buffers which translate the CMOS control bus levels into TTL compatible levels. Two complementary outputs (from U2B pin 4 and U2C pin 6) go to the rear-panel SIGNAL PROCESSOR INTERCONNECT for interface to companion instruments such as the 8505A. These two lines, RP-1 and RP-2, tell the companion instrument which 8503A test port is selected. RP-1 goes LOW when PORT 1 is selected (FORWARD); RP-2 goes LOW when PORT 2 is selected (REVERSE). U1A/B/C and U2A/B/C are the only portions of U1 and U2 presently used in the 8503A.

Relay Drivers

Integrated circuit U8 is only Relay Driver presently used in the 8503A. Complementary signals at the input (pins 2 and 6) of U8 control the transistor "switches" of U8. When PORT 1 is selected, the bottom transistor is turned ON and pin 5 of U8 is near ground potential (LOW). Pin 3 is pulled high (+24V) through pull-up resistor R3. When PORT 2 is selected, the top transistor is turned ON and pin 3 of U8 is near ground potential. Pin 5 is pulled high (+24V) through pull-up resistor in resistor package U11 (pin 2). Thus, the DR-1 line to A5 Coaxial Switch Assembly is LOW when PORT 1 is selected and the DR-2 line to A5 is LOW when PORT 2 is selected.

Driver Protection

Relay Driver U8 is protected by diodes CR8, CR9, and two diodes internal to the Coaxial Switch A5. These four diodes limit the inductive switching transients which occur when the Coaxial Switch current changes.

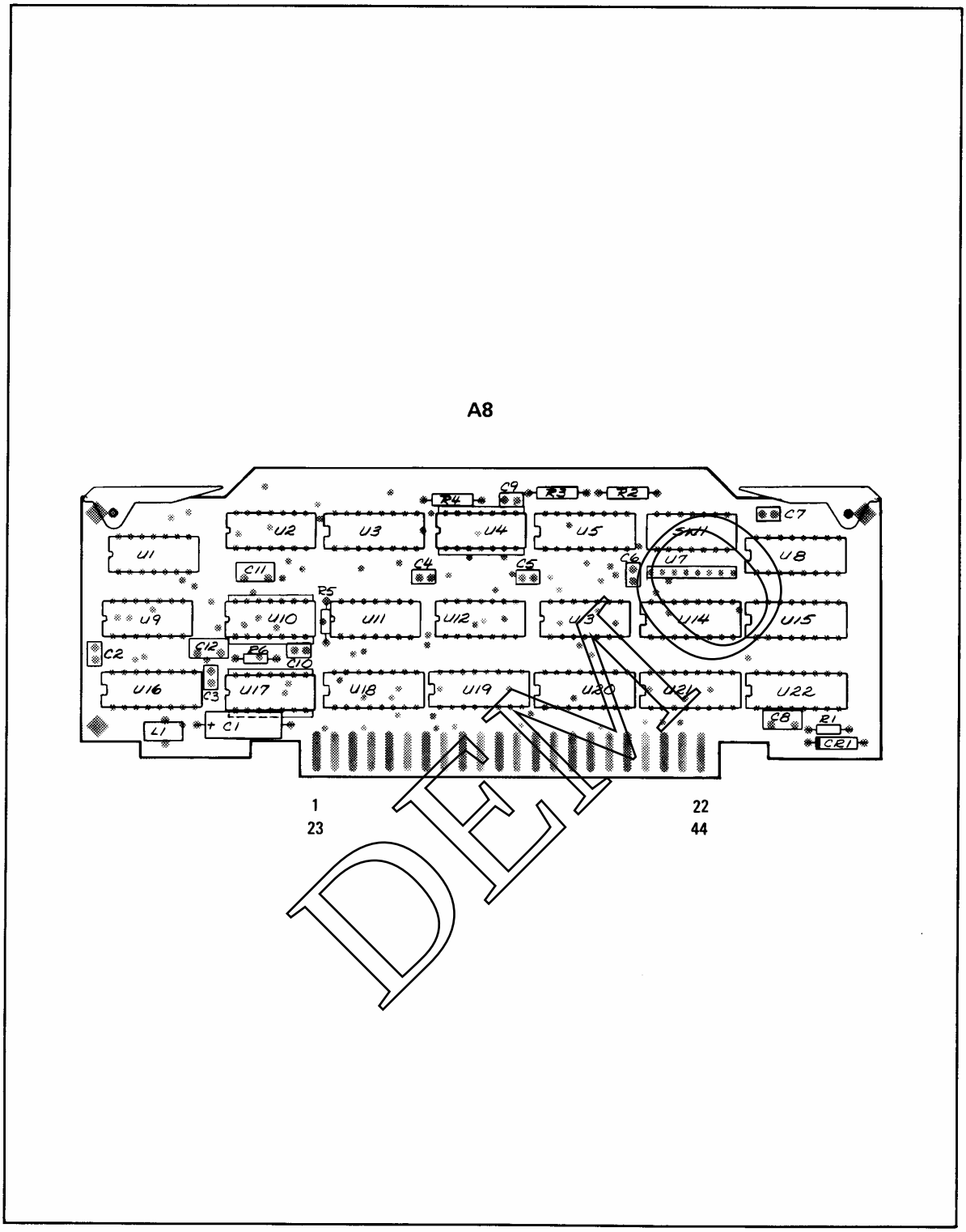
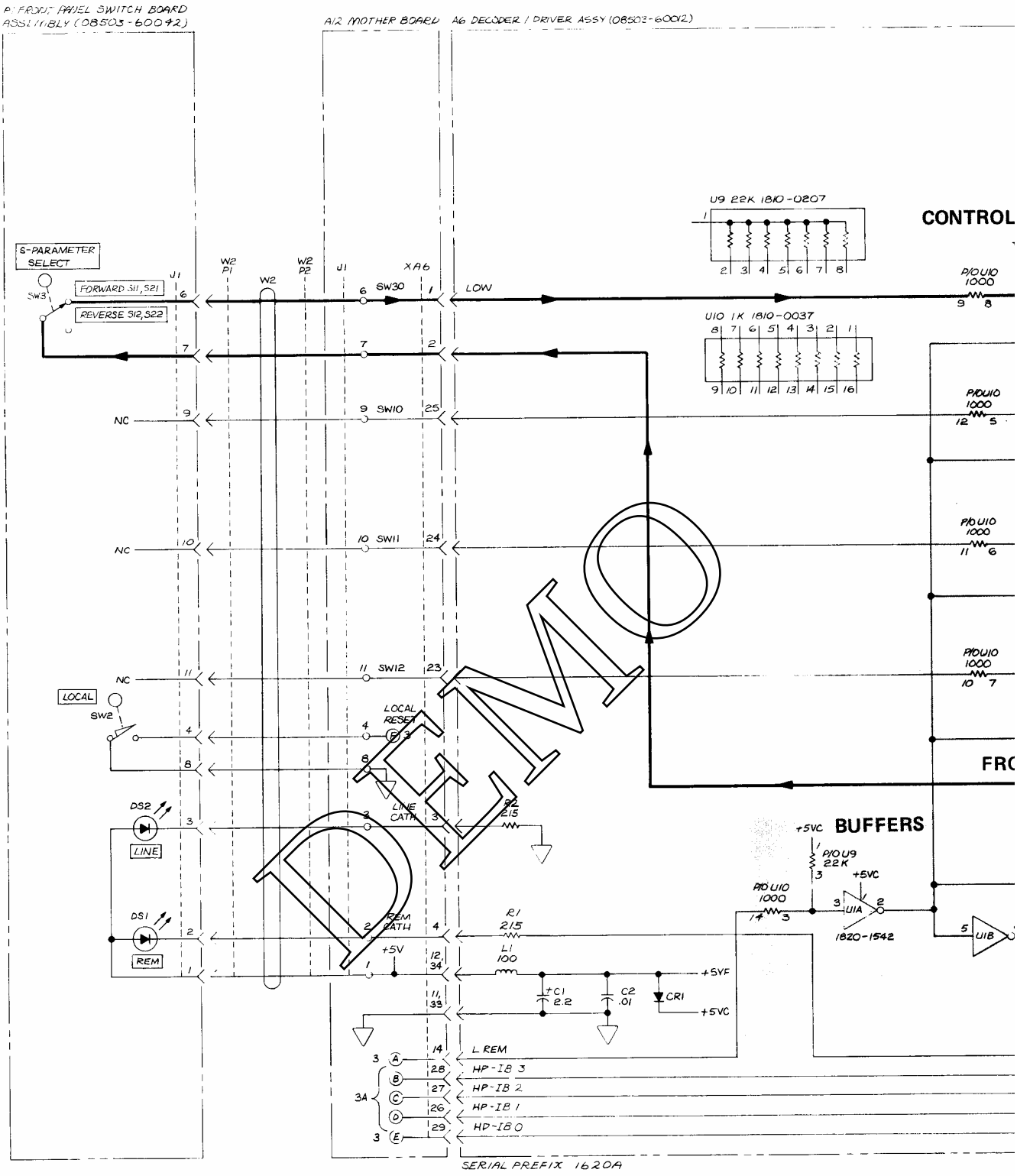
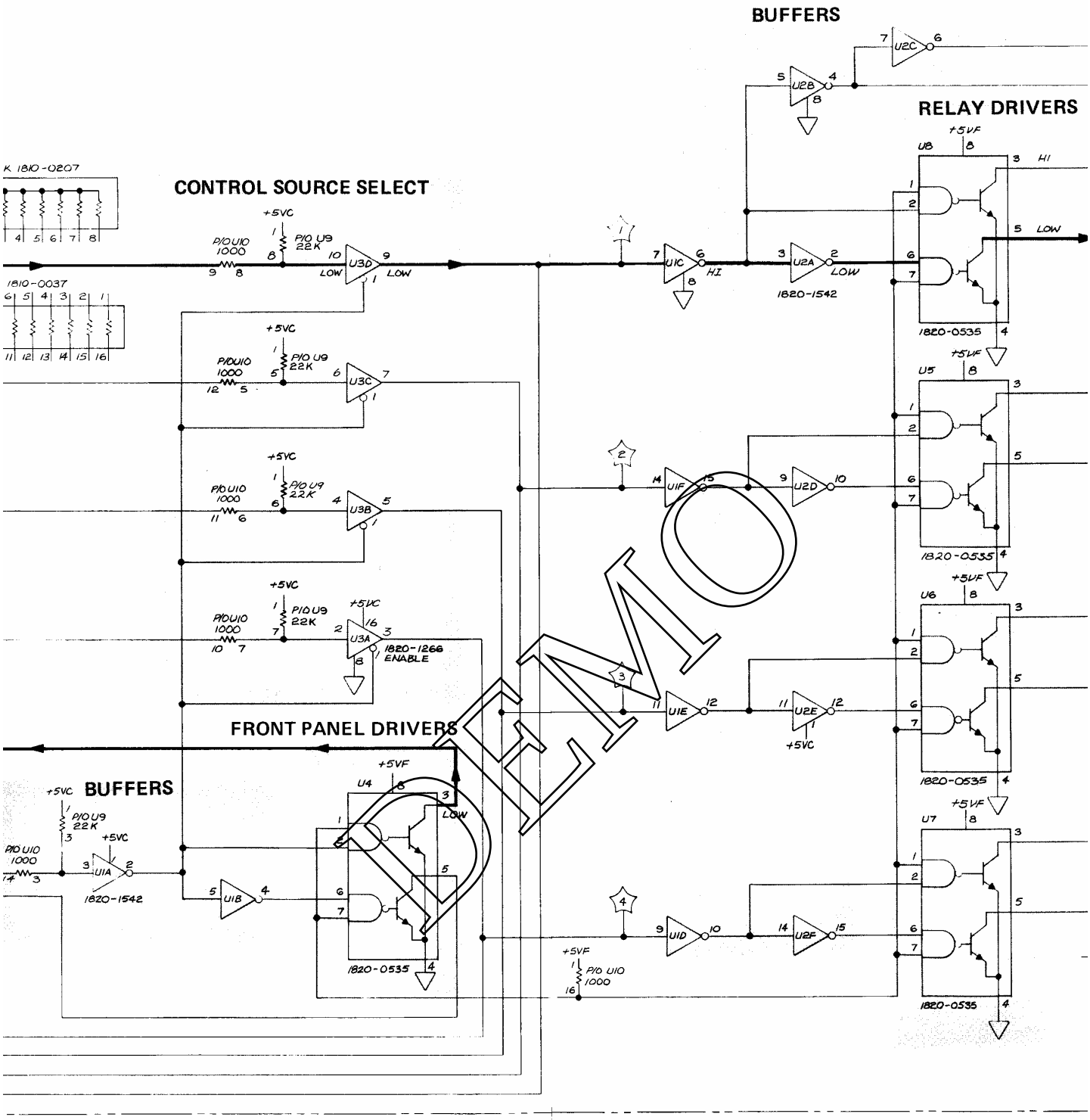


Figure 8-9. A8 HP-IB Assembly, Component Locations


A1 FRONT PANEL SWITCH BOARD ASSEMBLY (08503-60042)
A12 MOTHER BOARD
A6 DECODER / DRIVER ASSY (08503-60012)
U9 22K 1810-0207
U10 1K 1810-0037
CONTROL
S-PARAMETER SELECT
SW3
FORWARD S11, S21
REVERSE S12, S22
J1
W2 P1
W2
W2 P2
J1
XA6
SW30
LOW
P/O U10 1000
NC
SW10
SW11
SW12
LOCAL
SW2
LOCAL RESET
LINE CATH
R2 215
DS2
LINE
DS1
REM
REM CATH
+5V
R1 215
L1 100
C1 2.2
C2 .01
CR1
+5VF
+5VC
BUFFERS
P/O U9 22K
P/O U10 1000
U1A
1820-1542
U1B
L REM
HP-IB 3
HP-IB 2
HP-IB 1
HP-IB 0
SERIAL PREFIX 1620A
DEMO


BUFFERS
RELAY DRIVERS
CONTROL SOURCE SELECT
FRONT PANEL DRIVERS
BUFFERS
1820-1542
1820-0535
1820-1266
ENABLE
HI
LOW
+5VC
+5VF
P/O U10
1000
P/O U9
22K
DEMO

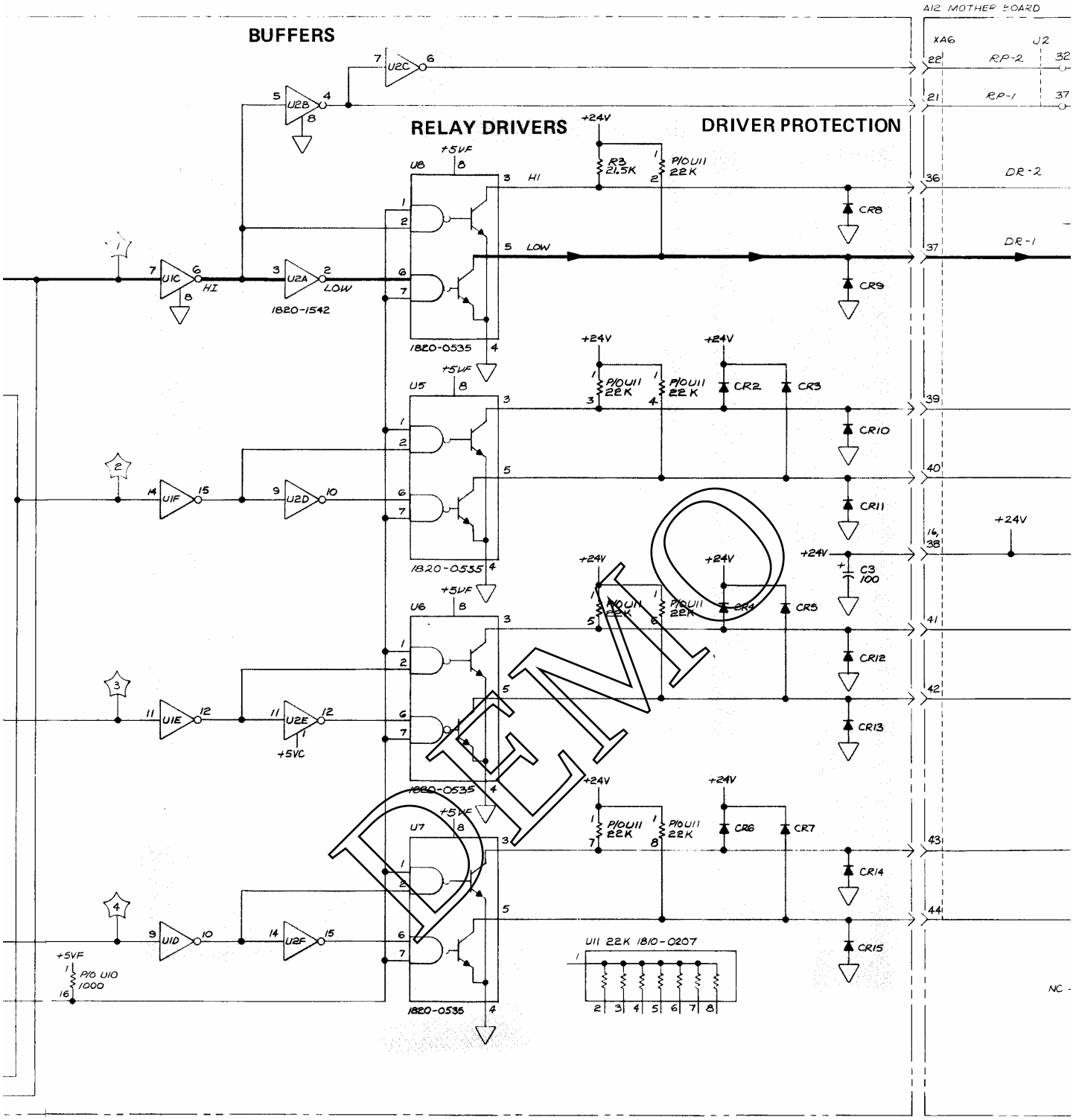
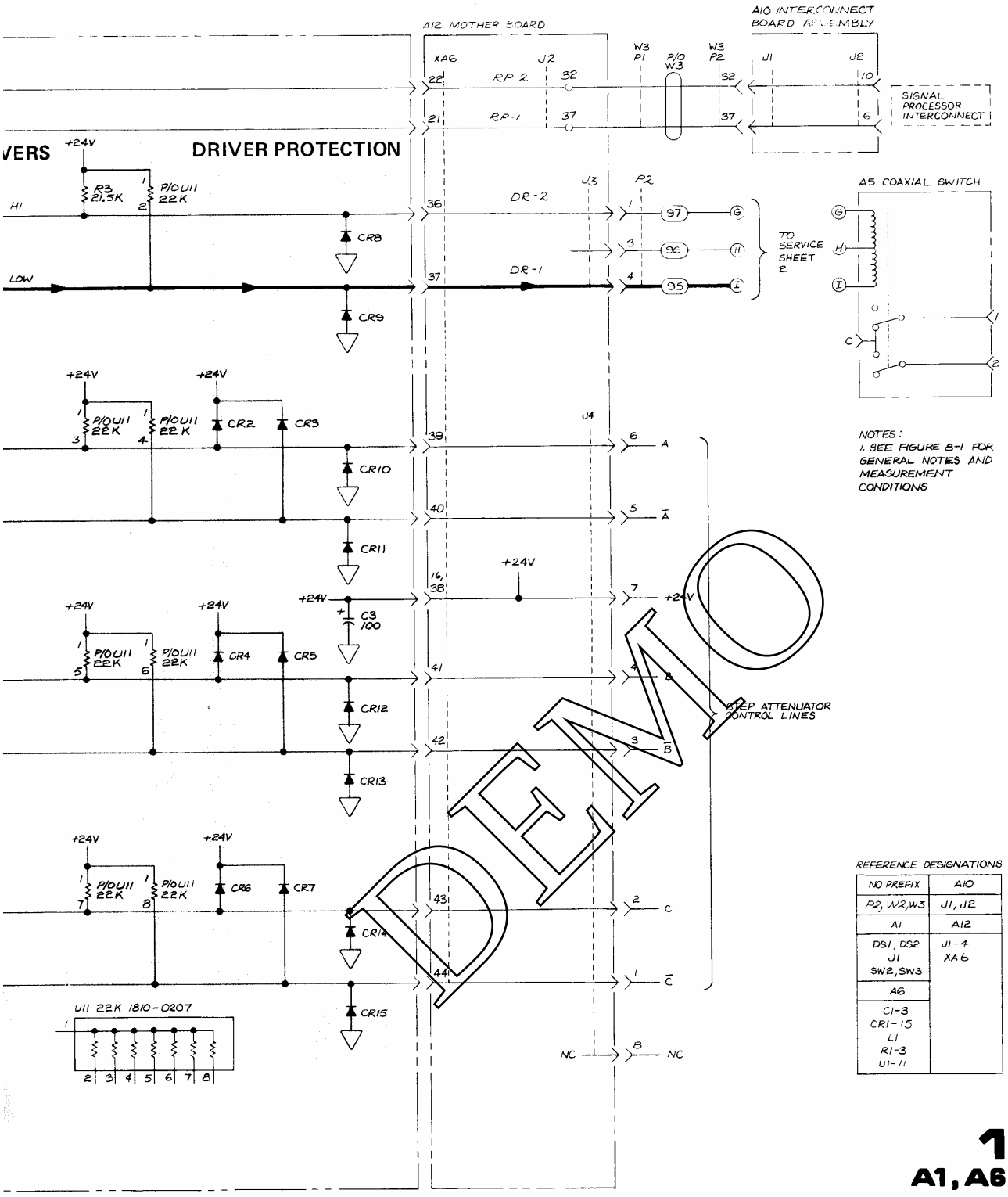


Figure 8-6. A1 Front Pan
Assembly, Sch



1
A1, A6

Figure 8-6. A1 Front Panel Switch Board Assembly and A6 Decoder/Driver Assembly, Schematic

SERVICE SHEET 2

A2/A3 DIRECTIONAL BRIDGE ASSEMBLIES, CIRCUIT DESCRIPTION

General

The A2 Splitter/Directional Bridge Assembly is essentially the same as the A3 Directional Bridge Assembly except the A2 Assembly contains a power splitter.

Power Splitter

The power splitter in the A2 Assembly splits the RF input power between the "measurement line" (to A5 Coaxial Switch) and the "reference line" (to port R). The signal in the reference line is compensated (Compensating Electrical Length and 12 dB Compensating Pad) so the signal level at port R (from A2J3) will be approximately equal to the level at ports A or B (from A2J2 or A3J2). Coaxial loop W10 makes the reference port path (to port R) approximately one metre longer in electrical length than the paths to the test ports. This one-metre offset permits full utilization of the 8505A Electrical Length line-stretching capability in X10 MODE (+1 to −1 metre at 1300 MHz) outside the test ports of the 8503A. The offset also provides ability to calibrate the S-Parameter Test Set when 11857A Test Port Extension Cables are used. Since the electrical length of one 11857A cable is approximately 86 centimetres, the out "and back" calibration signal sees an electrical length of over 172 centimetres. Without the one-metre offset in the 8503A reference port path, the 8505A Electrical Length line stretcher would not be able to compensate for this added external line length. If use of X1 MODE (8505A Electrical Length) is required for higher resolution, refer to Table 8-1 for proper cable configuration.

Directional Bridge

The Directional Bridge of A2 and A3 is a high directivity device (greater than 40 dB, 500 kHz to 1.3 GHz). It is this high directivity that allows reflection measurements (S_{11}, S_{22}) with lowest possible ambiguity. Care should be taken to properly maintain PORT 1 and PORT 2 front-panel connectors (see Section III, Figure 3-5). A damaged or dirty connector can degrade the directivity of the Directional Bridge, thus increasing the degree of error in the measurement.

A1 Front Panel Switch Board Assembly
A6 Decoder/Driver Assembly
SERVICE SHEET 1

Table 8-1. Cable Configurations for X1 MODE (8505A Electrical Length)

Measurement	Test Fixture or Calibration	RF Connecting Cables			
		RF	R	A	B
Transmission Only	One HP 8120-2291 cable* and HP 11567A 20 cm air line between test ports.	8120-2289	8120-2289	8120-2289	8120-2289
Transmission and Reflection	11600B/11858A Transistor Fixture/ Adapter				
	11602B/11858A Transistor Fixture/ Adapter				
	One HP 8120-2291 cable* connected to each test port.	8120-2289	8120-2292**	8120-2289	8120-2289
	11608A Transistor Fixture	8120-2289	8120-2289	8120-2289 Plus 8120-2292** and 1250-0777 adapter	8120-2289 Plus 8120-2292** and 2350-0777 adapter
Reflection Only	Short connected directly to test ports.				

*Part of HP 11857A Test Port Extension Cables.
**Part of HP 11851A RF Cable Kit.

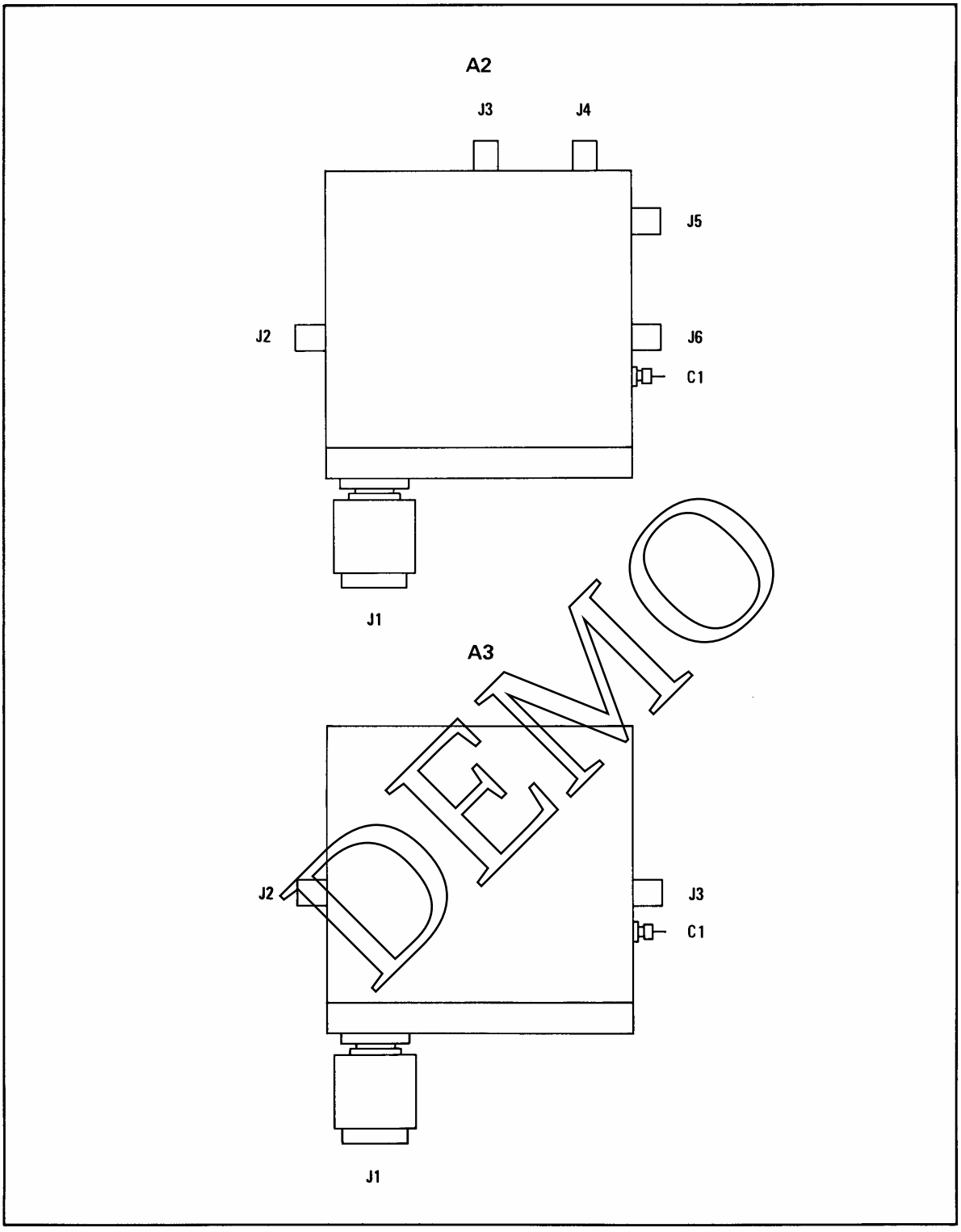
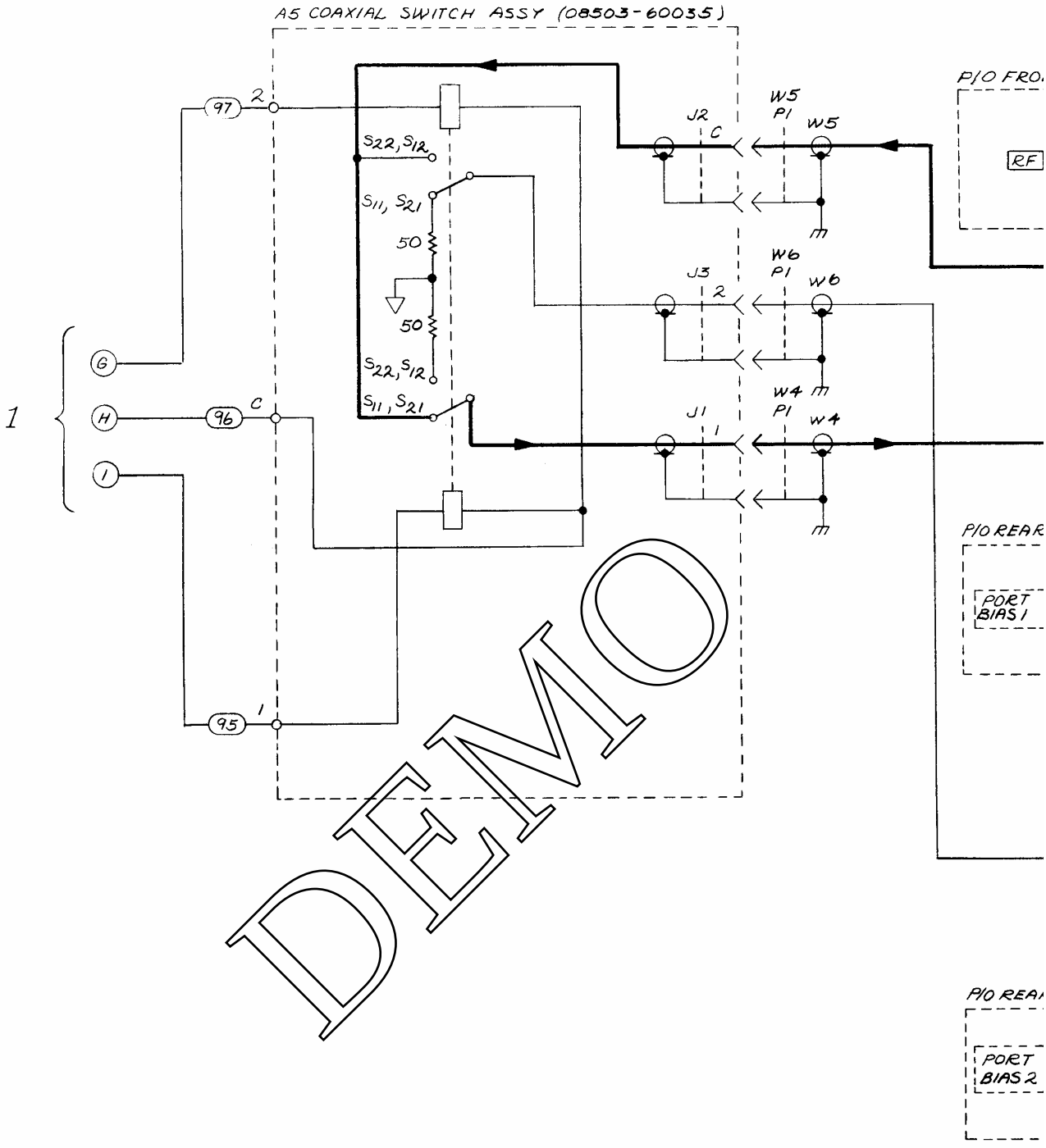
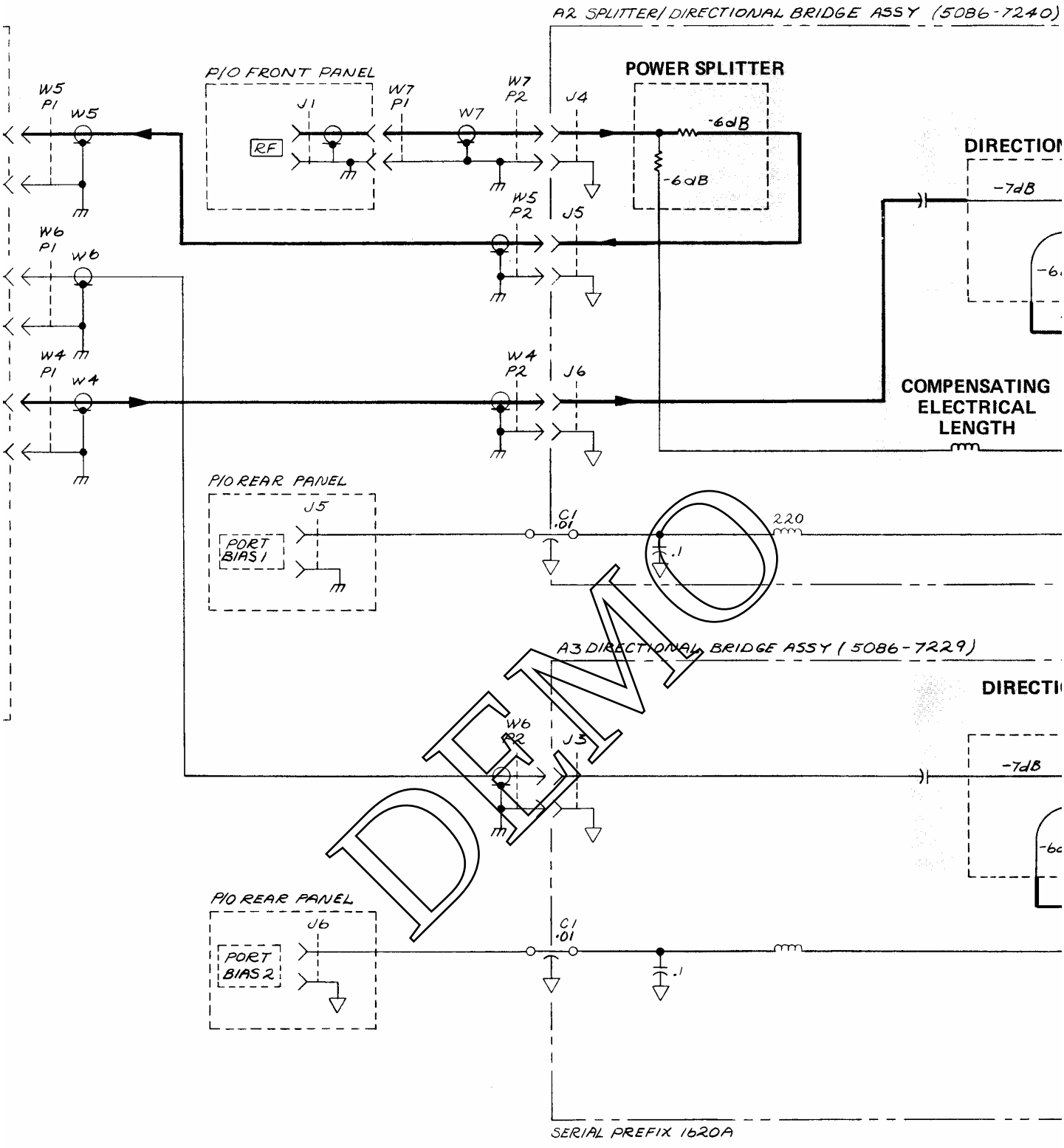


Figure 8-7. A2 Splitter/Directional Bridge and A3 Directional Bridge, Connector Locations


A5 COAXIAL SWITCH ASSY (08503-60035)
97
2
96
C
95
1
G
H
I
1
S22, S12
S11, S21
50
50
S22, S12
S11, S21
J2
C
J3
2
J1
1
W5
P1
W5
W6
P1
W6
W4
P1
W4
P/O FRO
RF
P/O REAR
PORT
BIAS 1
P/O REA
PORT
BIAS 2


A2 SPLITTER/DIRECTIONAL BRIDGE ASSY (5086-7240)
POWER SPLITTER
P/O FRONT PANEL
W5 P1
W5
J1
RF
W7 P1
W7
W7 P2
J4
-6dB
-6dB
W5 P2
J5
W6 P1
W6
W4 P1
W4
W4 P2
J6
DIRECTION
-7dB
COMPENSATING ELECTRICAL LENGTH
P/O REAR PANEL
J5
PORT BIAS 1
C1 .01
.1
220
A3 DIRECTIONAL BRIDGE ASSY (5086-7229)
DIRECTI
W6 P2
J5
-7dB
P/O REAR PANEL
J6
PORT BIAS 2
C1 .01
.1
SERIAL PREFIX 1620A

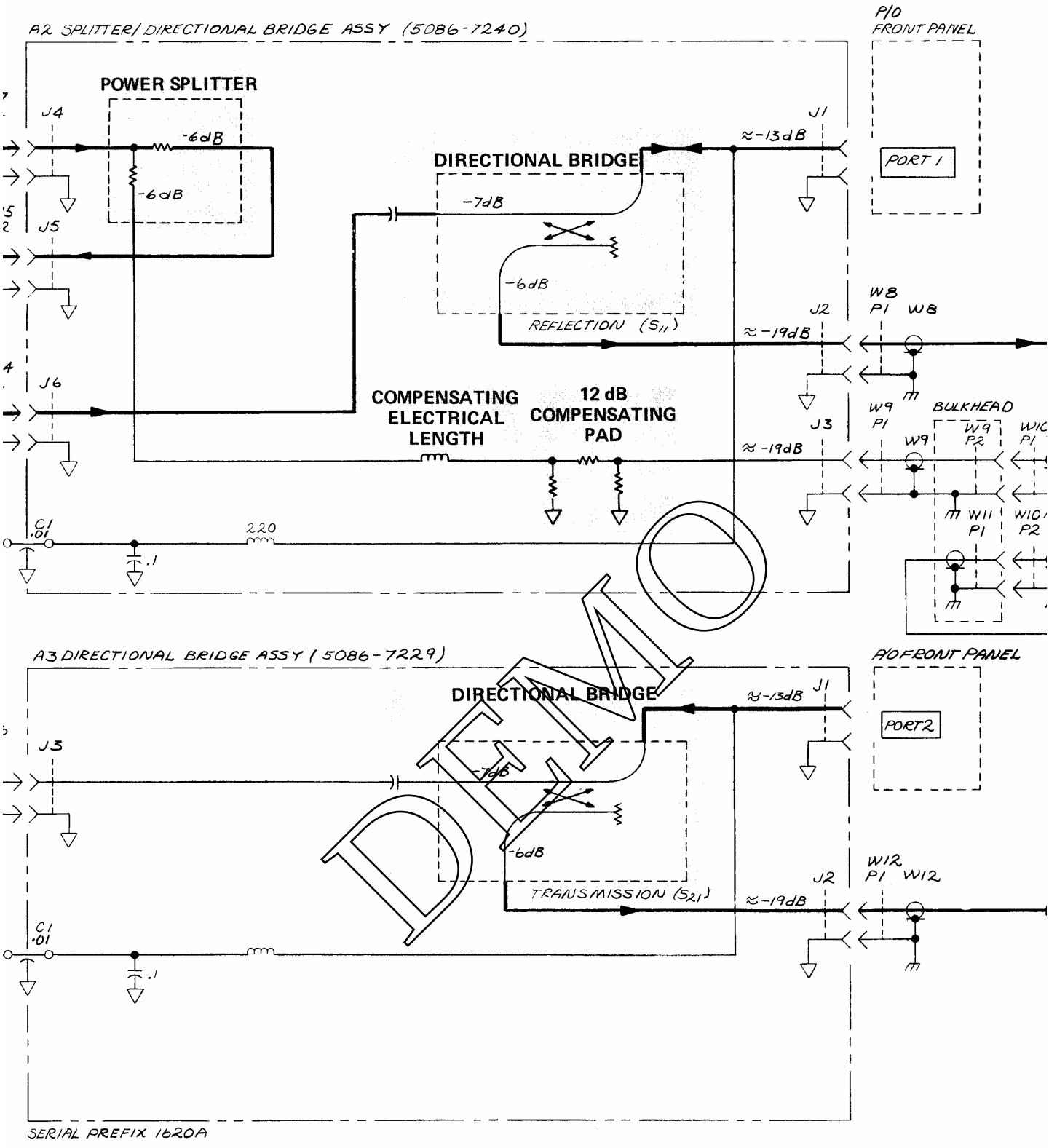
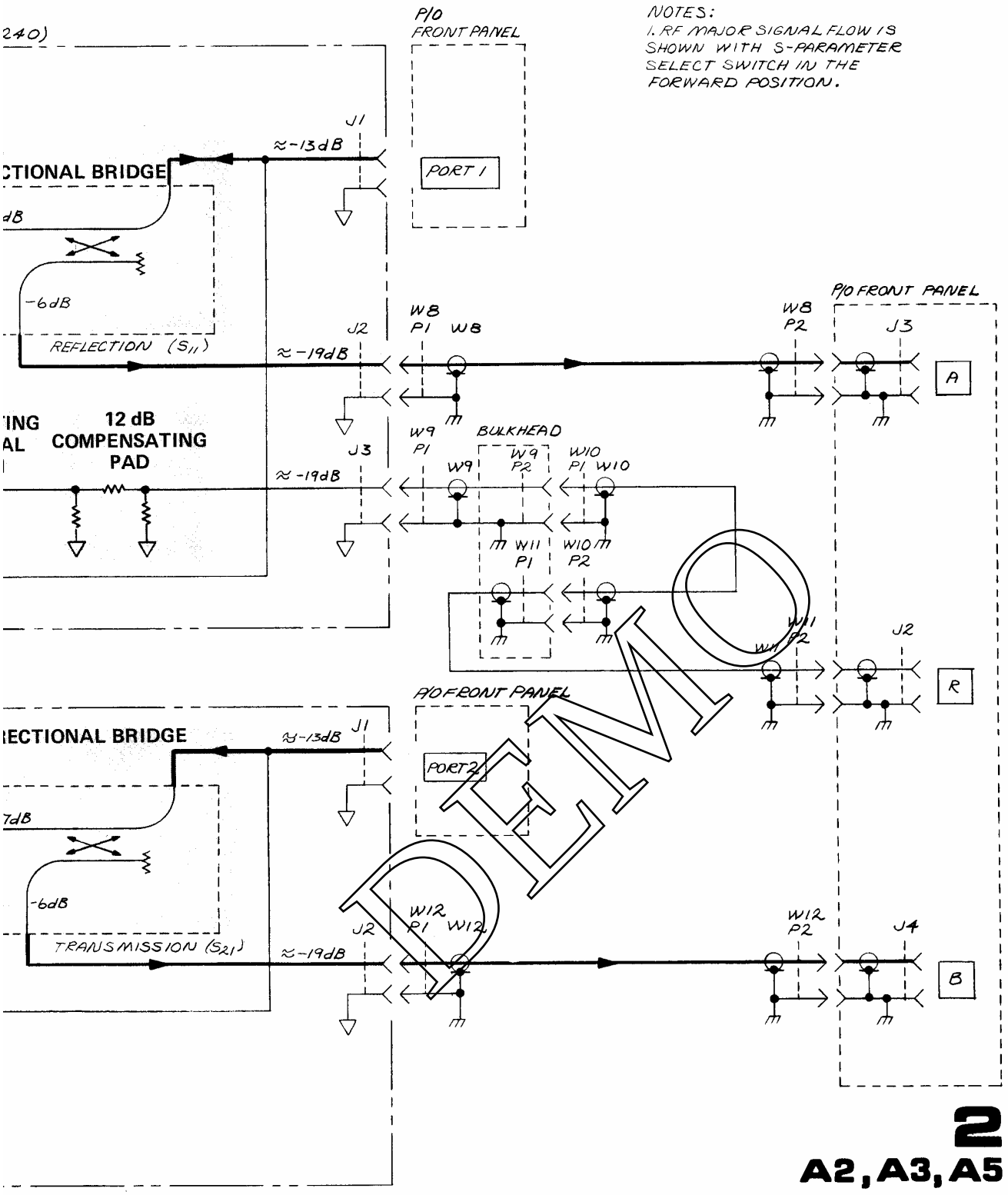


Figure 8-8. A2 Splitter/Di
Assembly, and



2
A2, A3, A5

Figure 8-8. A2 Splitter/Directional Bridge Assembly, A3 Directional Bridge Assembly, and A5 Coaxial Switch Assembly, Schematic

SERVICE SHEET 3

A8 HP-IB ASSEMBLY, CIRCUIT DESCRIPTION

General

The Hewlett-Packard Interface Bus (HP-IB) provides a means of communication between instruments. The Bus provides two way data flow over a single cable using standardized interface techniques. The interface design allows forming a system with only two instruments or up to fourteen instruments, and a controller (calculator or computer). The HP-IB uses sixteen signal lines to connect all units of a system in parallel. Eight of these lines carry data bits and three coordinate the flow of data. The remaining five are Bus management lines. Each device of an instrumentation system using the HP-IB follows a strict protocol that enables Bus operations to proceed in an orderly manner.

The 8503A Option 001 allows the 8503A S-Parameter Set to be remotely switched via the Hewlett-Packard Interface Bus. The HP-IB controller (calculator or computer) can also sense the position of the coaxial input switch while the 8503A is in local operation. The following is a description of how this is accomplished.

Bus Transceiver

The data and handshake signals of the HP-IB use logic "0" as TRUE and the logic "1" as FALSE. For use in the 8503A these signals are buffered and inverted by the bus transceivers.

The bus transceivers consist of U18 through U21. These quad-bus transceivers provide proper termination for the bus and invert the bus data received while the 8503A is in Listen Mode. Each transceiver drives and inverts data to HP-IB when in Talk Mode.

Handshake Logic

The Handshake Logic consists of U11A, U11D, U11E, U1B, U2D, U1C, U17B and U17C. Its operation is as follows:

Listen Mode. When the 8503A is on the HP-IB and addressed to listen, the handshake sequence is as follows:

The controller sets ATN low (U18-9). The resulting HI at U1C-9 enables U18 to be a bus driver. A HI at U11D-8 drives NDAC low (U18-2) and the LOW at U11E-10 drives NRFD HI (U18-7). This condition tells the Controller the 8503A is ready and data is put on the data bus lines (DI01 thru DI07). When this data is stable, the controller sets DAV low (U19-9).

The falling edge of DAV (U19-9) is used to clock the data and other information into latches (discussed later). DAV going LOW will place a HI at U11D-9 setting NDAC HI (U18-2) and setting NRFD LOW (U18-7), which tells the controller that the data has been accepted and to remove it from the bus.

The controller responds to the NDAC line by setting DAV HI (U19-9) and completing one handshake cycle.

Talk Mode. In the talk mode the 8503A will sense the NRFD and NDAC lines at U1B-6 and U2D-13. U19 is enabled as a bus driver by U17C-8 being LOW. When the controller/listener on the bus sets NDAC LOW and NFRD HI, the output of U2D-11 will drive DAV LOW. The network of R4 and C9 will delay DAV long enough to allow the data on the data bus to settle. NRFD will then be pulled LOW and NDAC pulled HI by the controller/listener. DAV (U19-9) will then go HI allowing the process to be repeated until all data is transferred.

How the 8503A puts data on the bus will be discussed later.

Troubleshooting the Handshake Logic

If there is an 8503A handshake malfunction, the controller will wait indefinitely for either NRFD or NDAC valid. The 8503A handshake circuitry can be checked for proper operation without a controller in the following manner.

1. Disconnect the Bus cable.

2. Ground the ATN line (Pin 11 of the HP-IB connector).

3. Apply approximately +5 volts to DAV line (Pin 6 of the HP-IB connector) either with a power supply or a 10526T logic pulser probe.)

4. Verify that NDAC (Pin 8 of HP-IB connector) is LOW (≈0 volts) when DAV is HI (≈+5 volts) and that the opposite is true.

5. Verify that NRFD (Pin 7 of HP-IB connector) is HI (≈+5 volts) when DAV is HI (≈+5 volts) and that the opposite is true.

Address Comparator

The Address Comparator consists of U14, a five-bit digital comparator, SW1, U2A, U2C and U12A. U14 will compare the data lines DI01 through DI05 with the setting of SW1 (see Section III, Figure 3-4 for instructions on setting SW1). When the two-five bit words agree, U14-14 will go HI indicating "MY ADDRESS."

U2C and U12B are used to determine whether the address received is a talk or listen address and will compare DI06 and DI07. If DI06 is HI then a listen address is present on the Data line. If DI07 is HI it is a talk address.

U2C receives DI06 on Pin 9 and the inverted DI07 on Pin 10. U2C-8 is then "ANDed" with "MY ADDRESS" at U2A to generate "MY LISTEN ADDRESS" (MLA) when DI06 is HI. U12B will "AND" DI07, the inverted DI06, and "MY ADDRESS" to form "MY TALK ADDRESS" ($\overline{\text{MTA}}$) when DI07 is HI.

Remote Flip-Flop

Remote Flip-Flop (U16A) sets the 8503A into remote operation, energizes the front panel light, allows switching data to be latched into the 8503A, and disables the front panel switch.

The remote Flip-Flop is set in the following manner. The controller will address the 8503A to listen and pull REN LOW (U19-15). The HI REN at U2B-5 is "ANDed" with the HI MLA at U2B-4 which places a HI at the J input of U16A (pin 3). U10C-10 will pull the K input of U16B (Pin 2) LOW. With the ATN line LOW (U18-9) a HI is present on U17A-1. When DAV is pulled LOW as discussed above, the negative going edge of $\overline{\text{CMD CLK}}$ from U17A-3 will clock U16A. Pin 6 (LREM) will go LOW putting the 8503A in remote.

Listen Flip-Flop

The Listen Flip-Flop (U16B) Operates as Follows:

MLA is applied to the J input U16B-11. The LOW output of U17D is applied to the K input U16B-12. When the $\overline{\text{CMD CLK}}$ line goes LOW as previously described, the flip-flop will set with U16B-9 HI (LISTEN) and U16B-7 LOW. Before being clocked, U16B-7 was HI. This HI held the output of U10C LOW ensuring that the remote flip-flop would not change state when the $\overline{\text{CMD CLK}}$ was generated.

Talk Flip-Flop

When the 8503A is addressed to talk, the $\overline{\text{MTA}}$ line will go LOW. This LOW is applied to U17D-13, which places a HI on the K input of U16B (listen FF) and on the D input of U9 Pin 2. When $\overline{\text{CMD CLK}}$ goes LOW, the listen and remote FF are reset and U9-6 will go HI enabling the TALK line. U13A will NAND $\overline{\text{DI07}}$, DI06 and $\overline{\text{CMD CLK}}$ to form the positive going clock signal for U9 (TALK FF).

Remote Programming of the Coaxial Switch Position

The remote programming feature may be thought of as a sub of the front panel with information in a programmable latch. The front panel is controlled by LREM. A LOW causes the front panel data selector, A6U3, to be disabled and, at the same time, enables the output of the programmable latch, U5 pin 3.

Since the Decoder/Driver is connected to both the front panel and the programmable latch, whichever one is enabled will control the Coaxial Switch position.

To program the 8503A, a bi-directional data buffer is employed. It is divided into two major IC's, U8 and U5.

1. U8 serves as the "Data Direction Control."

2. U5 serves as the "Data Latch."

3. The Data Direction Control is a dual 4 position analog switch. The switch position is controlled by two lines: "DATA VALID" (A) and "TALK" (B). Table 8-2 shows control codes, switch position, and resulting function.

Table 8-2. Data Direction Control Operation

	U8-9 B	U8-10 A	Selector Conn	Result
Listen, Invalid Data	0	0	0 U5-3	D latch senses its own output U5-3 and reclocks it into the latch upon data clk (DAV TRUE)
Listen, Data Valid	0	1	1 Data from bus applied to input of latch.	Bus data available for loading into latch.
Talk, Don't care about input data being valid or invalid.	1 1	0 1	2 S-Parameter 3 select switch position is sensed through resistor.	S-Parameter Select switch position is "LEARNED" thru sense resistor R3, buffered by U15E and U15D and applied to encoder.

Remote programming of the Coaxial Switch position is accomplished if:

1. Interface is in remote (REM U16A-6 LOW).
2. Interface LISTEN FF is set (U16B-9 HI).
3. Valid data code on data bus (U8-10 HI).
4. "DATA" on bus is not a CMD code (ATN U10B-6 HI).

The codes accepted by the valid data detector are, for Port 1, ASCII "1" or "3", and for Port 2, ASCII "2" or "0."

The data is loaded by the edge of DAV going TRUE (U19-9 LOW).

Remote Sensing of the Front-Panel S-PARAMETER SELECT Switch Position and Interface "TALK" Mode:

Remote sensing is accomplished when 8503A interface encodes the front panel S-PARAMETER SELECT switch position and sends appropriate bytes to the controller.

The encoding of data is performed by U22, U1C, U11F and U3 (Data Sequencer and Encoder).

The codes, in the order sent, are given in Table 8-3:

Table 8-3. 8503A HP-IB Output Data

Output Data	Octal	Binary
Front Panel Data	061 or 062*	1100XX
Carriage Return (CR)	015	001101
Line Feed (LF)	012	001010
* 061 = Port 1 062 = Port 2		

The circuit operation may be understood if it is realized that U3, a presetable counter, is serving a dual purpose: it not only sequences the sending of the codes, but its outputs are also part of the codes.

Thus, the two least significant bits (LSB) of the counter drive U22. The outputs of U22 drive DIO 1 and 2. The same two LSB are gated by U1C and U11F to generate the codes for DIO 3, 4, 5, and 6.

A summary of the codes generated or controlled by the two LSB of the counter, U3, are given in Table 8-4.

Table 8-4. Summary of Codes Generated by Data Sequencer and Encoder

	U22 Input		U22 Outputs (DIO)		U3 Outputs (DIO)				
	U22-2	U22-14	1	2	3	4	5	6	Information
	0	1	0 or 1	1 or 0	0	0	1	1	Front Panel Data
	1	0	1	0	1	1	0	0	Carriage Return
	1	1	0	1	0	1	0	0	Line Feed
Source	Two LSB of U3 Counter Output		Gen. by U22, (MUX)		Gen. by U1D, U11E				

The actual transfer of the front panel "LEARNED" information is done with the three-wire handshake, but with the 8503A acting as the "TALKER"

The transfer is enabled if the interface has been addressed to talk (FF U9 Pin 6 HI) and if ATN is false (ATN HI, U18-9). Note that the counter, U3, is preset to 0001 by ATN going true. This is done to insure that each time the 8503A interface is addressed to talk (ATN goes LOW) the talk sequence begins at the same point, namely, data first.

The Talk handshake is enabled and terminated by the QC bit of counter U3.

There are actually three "HANDSHAKES" which occur. Each time the listener accepts a data byte, DAC (U3 Pin 5) will go LOW then HI, clocking the counter.

After the third HI-going DAC (U3-5) the QC counter bit will go HI, disabling U1B and inhibiting any further handshaking by pulling DAV HI (U19-9).

Troubleshooting the Data Sequences and Encoder

The operation of the Data Sequencer and Encoder may be verified without the use of the controller in the following manner.

1. Ground U17C-8 (or clock U9-3 Talk FF with a logic pulser probe leaving ATN U18-9 floating).

2. With +5 volt power supply or logic pulser probe, apply a momentary logic HI to NDAV line (Pin 8 of rear-panel HP-IB connector or U18-2).

3. With a scope, voltmeter, or logic probe, verify the logic levels on DIO 1 through DIO 6. See Table 8-4 for correct levels. (If levels are checked at HP-IB connector, they will be the inverse of those in Table 8-4.)

4. Repeat steps 2 and 3 until U3-6 goes HI (three clock pulses of NDAC line). Then verify that the handshake DAV goes HI at HP-IB connector Pin 6 or U19-9.

Set to Local and Power-Up Clear

The Interface State Memory (Listen FF, Remote FF, Talk FF) can be cleared by any of the following means.

1. At Power turn-on R1 and C10 form a time delay to hold U15A-3 low momentarily. The resulting HI at U15A-2, pulls U10A-1 and U10D-13 LOW reseting the Interface State Memory.

2. A front panel LOCAL reset push button on the 8503A may be depressed. This will place a LOW at U15A-3 and the above sequence will be repeated.

3. The Listen and Talk flip-flops can be cleared by the controller sending an Interface Clear (IFC) U18-15 LOW. The resulting HI at U18-14 is applied to U10A-2.

4. The Remote FF can be cleared by the controller sending a REN FALSE (HI at U19-15). The logic at U19-14 is applied to U11A-1, inverted and sent to U10D-11 to reset the Remote FF.

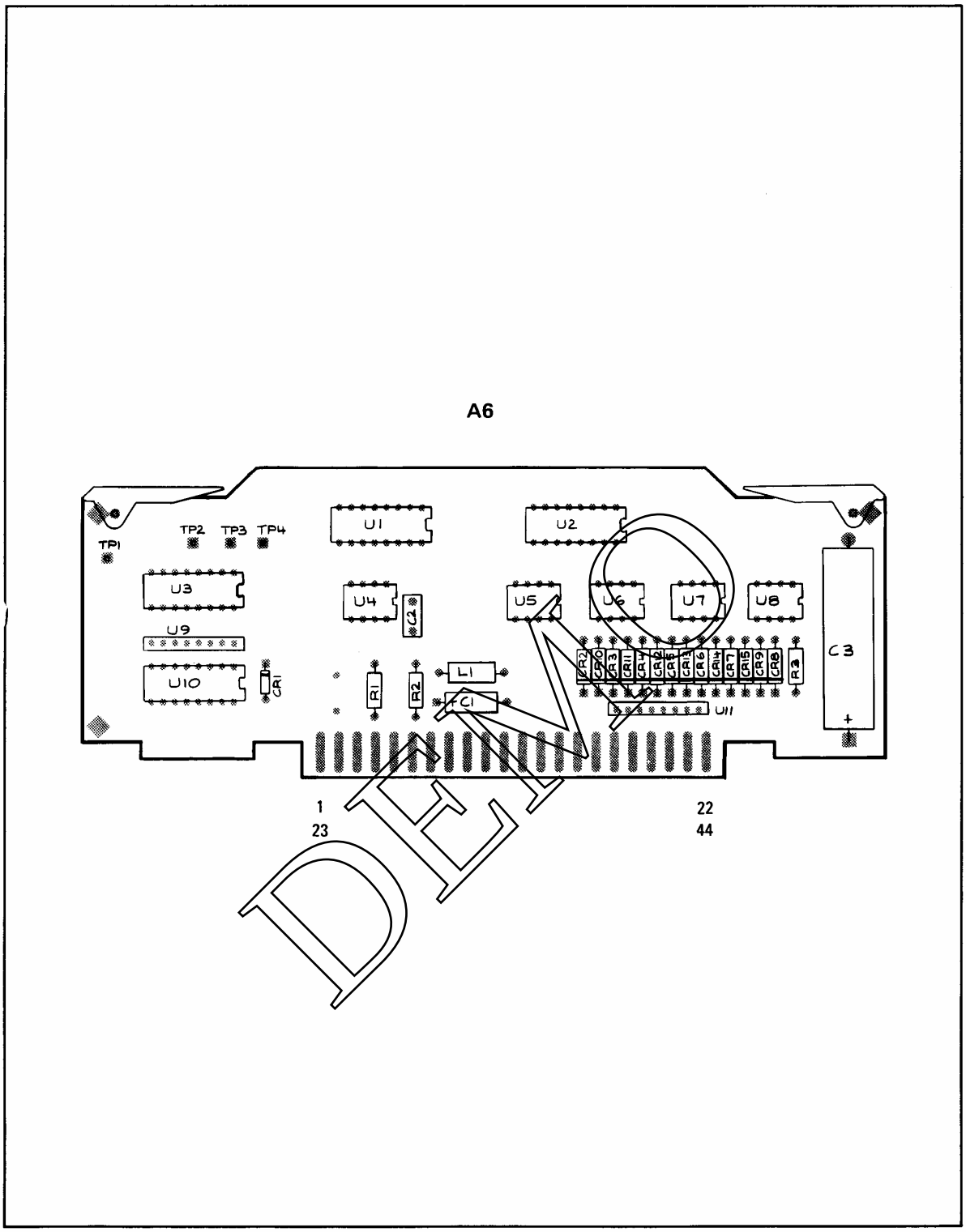
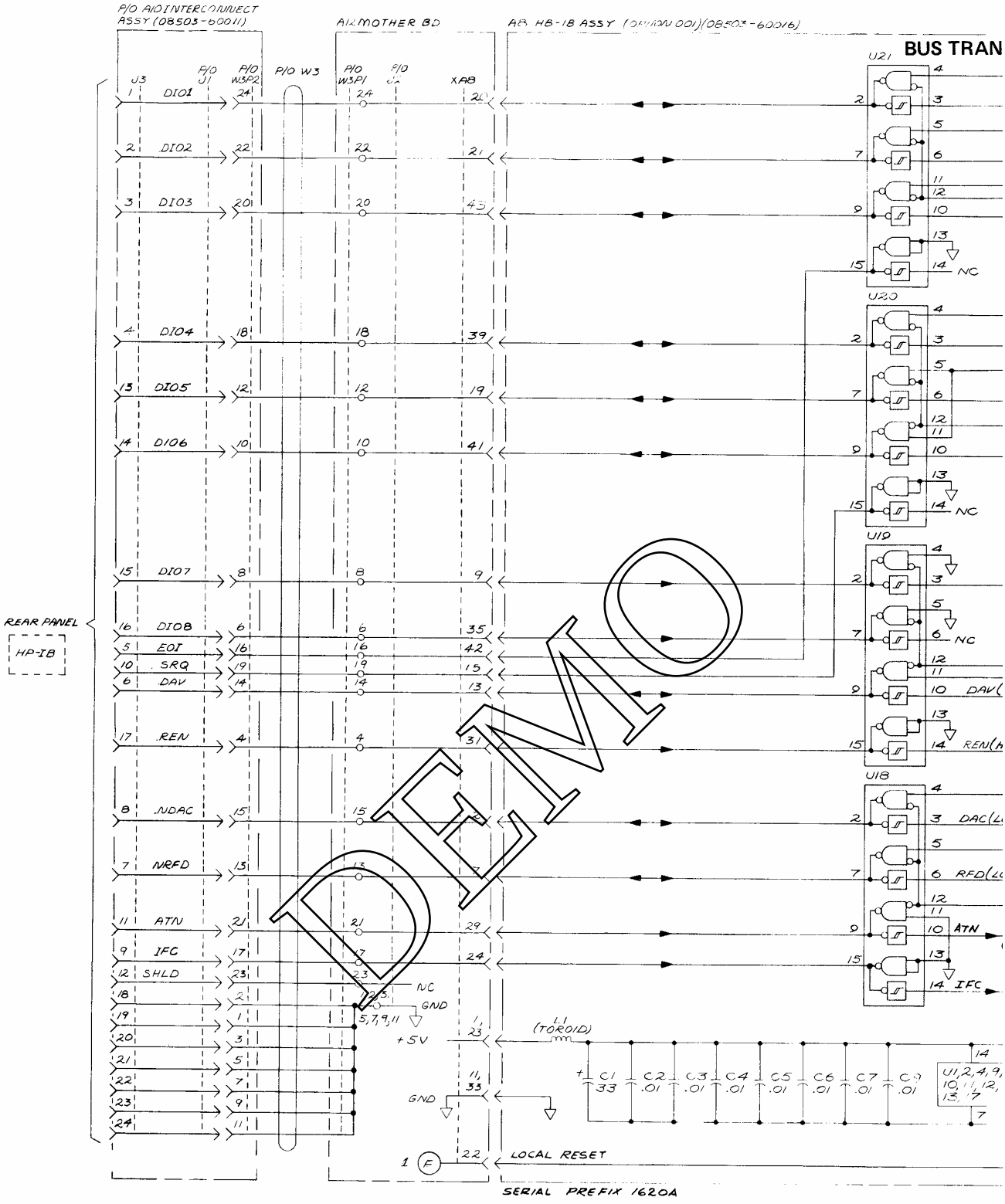
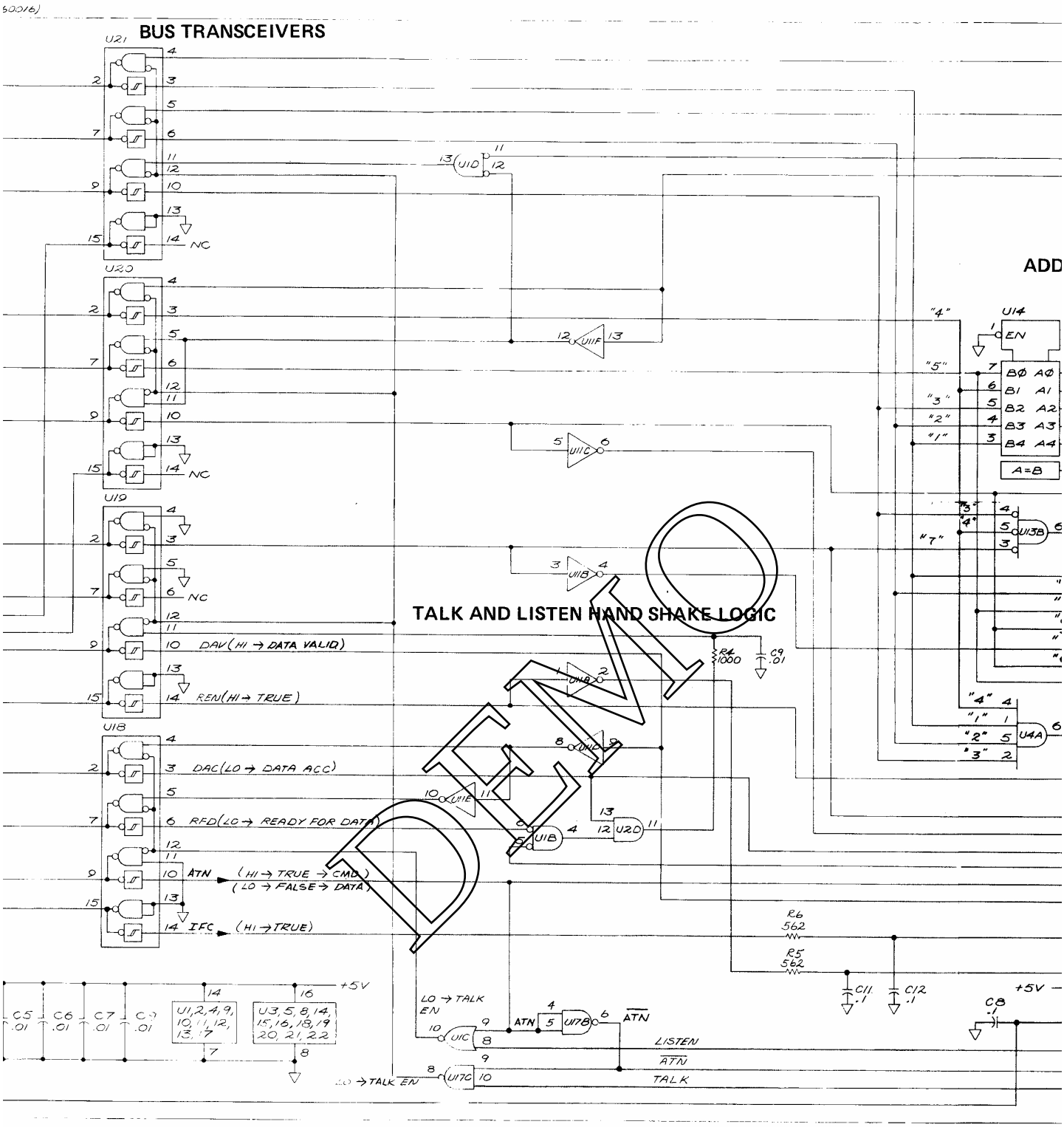
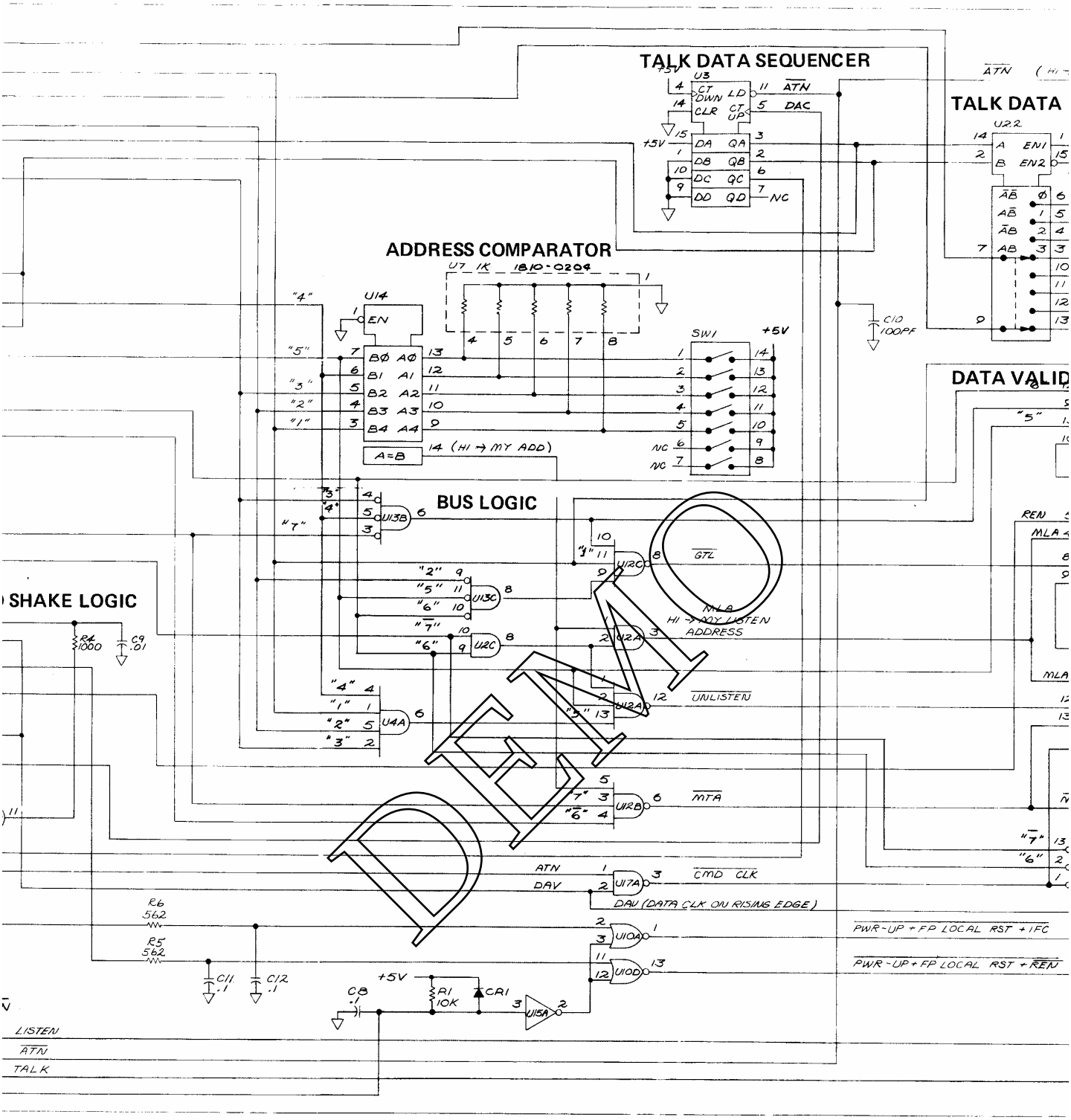
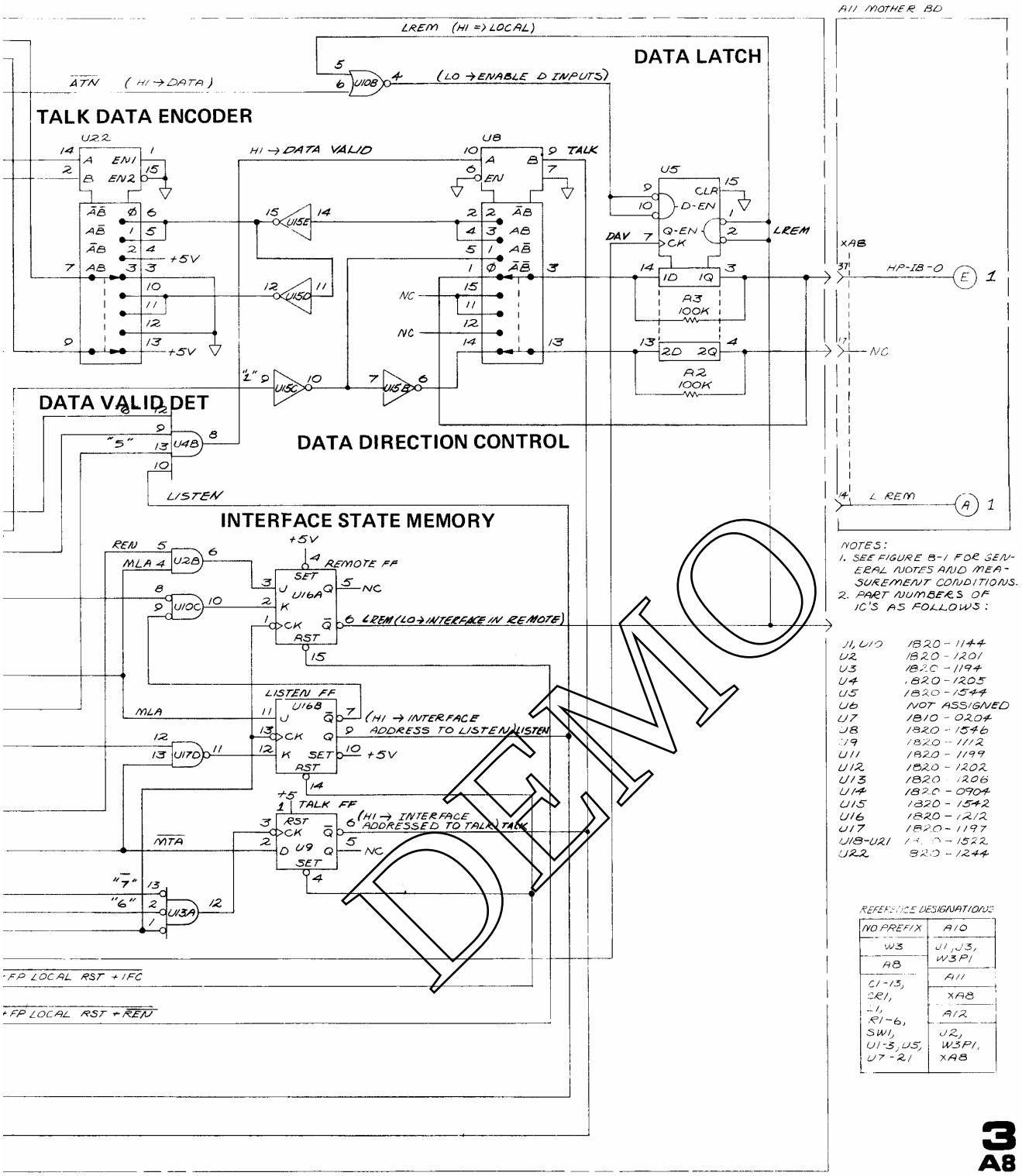


Figure 8-5. A6 Decoder/Driver Assembly, Component Locations


P/O A10 INTERCONNECT ASSY (08503-60011)
A1 MOTHER BD
A8 HB-1B ASSY (08503-60001)(08503-60016)
BUS TRAN
REAR PANEL
HP-IB
DIO1
DIO2
DIO3
DIO4
DIO5
DIO6
DIO7
DIO8
EOI
SRQ
DAV
REN
NDAC
NRFD
ATN
IFC
SHLD
NC
GND
+5V
(TOROID)
LOCAL RESET
SERIAL PREFIX 1620A
DEMO


BUS TRANSCEIVERS
TALK AND LISTEN HAND SHAKE LOGIC
DAV (HI → DATA VALID)
REN (HI → TRUE)
DAC (LO → DATA ACC)
RFD (LO → READY FOR DATA)
ATN
(HI → TRUE → CMD)
(LO → FALSE → DATA)
IFC
(HI → TRUE)
LO → TALK EN
LISTEN
TALK
+5V
NC
A=B
DEMO


TALK DATA SEQUENCER
U3
CT DWN LD
CLR CT UP
ATN
DAC
DA QA
DB QB
DC QC
DD QD
NC
+5V
TALK DATA
U22
EN1
EN2
ADDRESS COMPARATOR
U7 1K 1810-0204
U14
EN
B0 A0
B1 A1
B2 A2
B3 A3
B4 A4
A=B
14 (HI → MY ADD)
SW1
"4"
"5"
"3"
"2"
"1"
"7"
"6"
BUS LOGIC
U13B
U13C
U12C
U4A
U12D
U12A
U12B
GTL
MLA
HI → MY LISTEN ADDRESS
UNLISTEN
MTA
CMD CLK
DAV (DATA CLK ON RISING EDGE)
SHAKE LOGIC
R4 1000
C9 .01
R6 562
R5 562
C11 .1
C12 .1
C8 .1
R1 10K
CR1
U15A
U17A
U10A
U10D
C10 100PF
DATA VALID
REN
MLA
PWR-UP + FP LOCAL RST + IFC
PWR-UP + FP LOCAL RST + REN
LISTEN
ATN
TALK
DEMO



3
A8

Figure 8-10. A8 HP-IB Assembly, Schematic

SERVICE SHEET 4

A4 POWER SUPPLY ASSEMBLY, CIRCUIT DESCRIPTION

General

The Power Supply assembly provides the 8503A with two regulated voltages, +5 volts and +24 volts. Both of these supplies are fused on the A4 assembly. If only one of the supply voltages is not preset, check the fuse for that supply before further troubleshooting. If both of the supply voltages are not present, check the line fuse in the rear-panel Line Module. U1 and U2 are three-terminal IC's in a TO-3 package. They are both internally provided with current limiting and thermal overload protection.

+5 Vdc Supply

The output of full-wave bridge rectifier U4 is approximately 8.9 Vdc to 15 Vdc. This dc voltage is applied to pin 1 of U1 voltage regulator which provides a +5 Vdc regulated output. Capacitor C1 provides filtering and C2 provides bypass for switching transients. Capacitor C3 provides stability for U1 voltage regulator.

+24 Vdc Supply

The output of full-wave bridge rectifier U3 is approximately 27 Vdc to 41 Vdc. This dc voltage is applied to pin 1 of U2 voltage regulator and divider network R1/R2. Integrated circuit U2 is a 15 volt regulator. Since +24V is required, breakdown diode VR1 is placed effectively in series with the regulated +15 volts to provide the +24 volt regulated output. Resistor network R1/R2 provides the proper voltage to pin 3 of U2. Resistor R2 also provides a current sink for U2 so it will continue to conduct when high switching currents are drawn. Capacitor C6 provides filtering and C7 provides bypass for switching transients. Capacitor C8 provides stability for U2 voltage regulator and C9 helps provide switching current during the nulls of the full-wave rectified (U3) output.

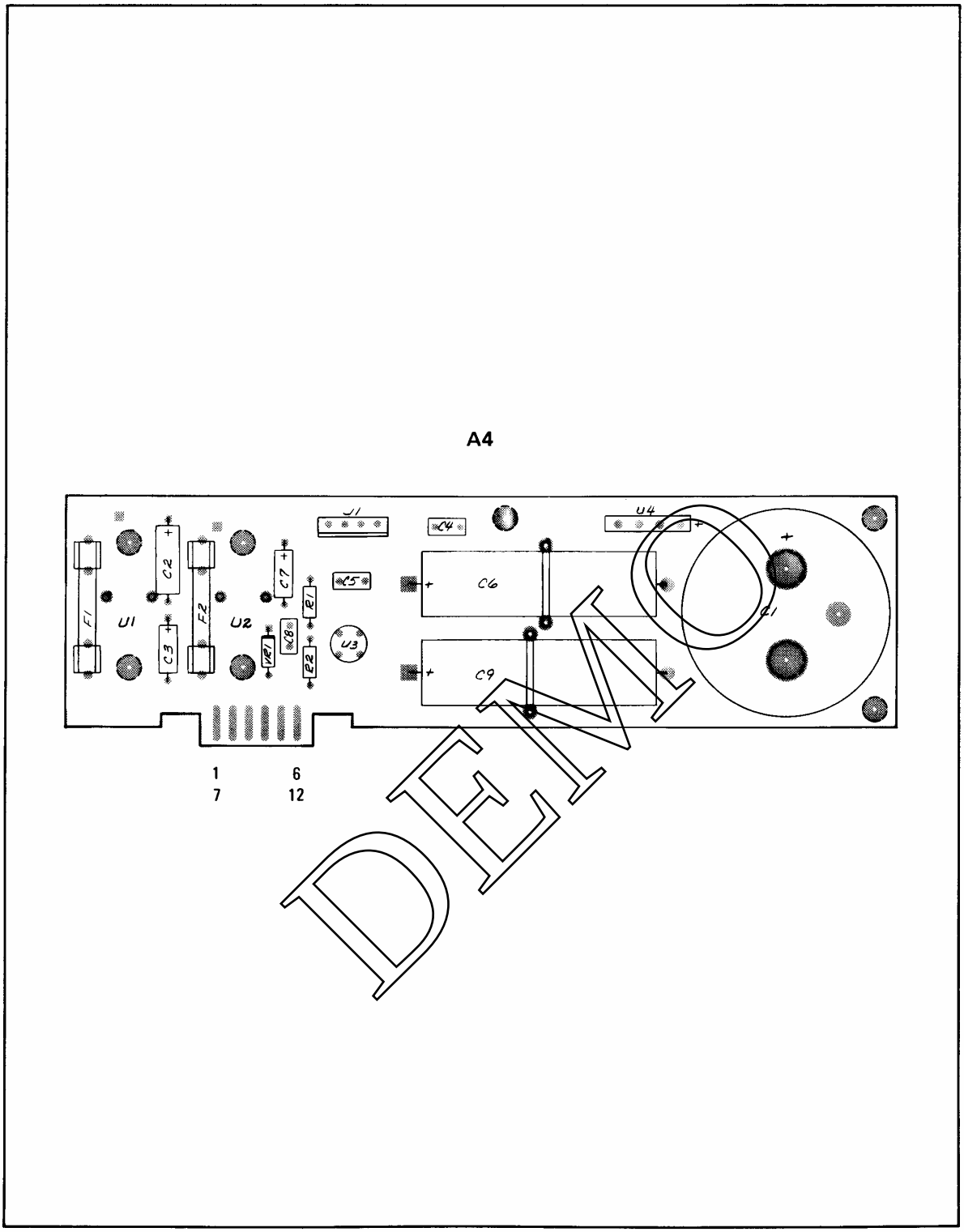
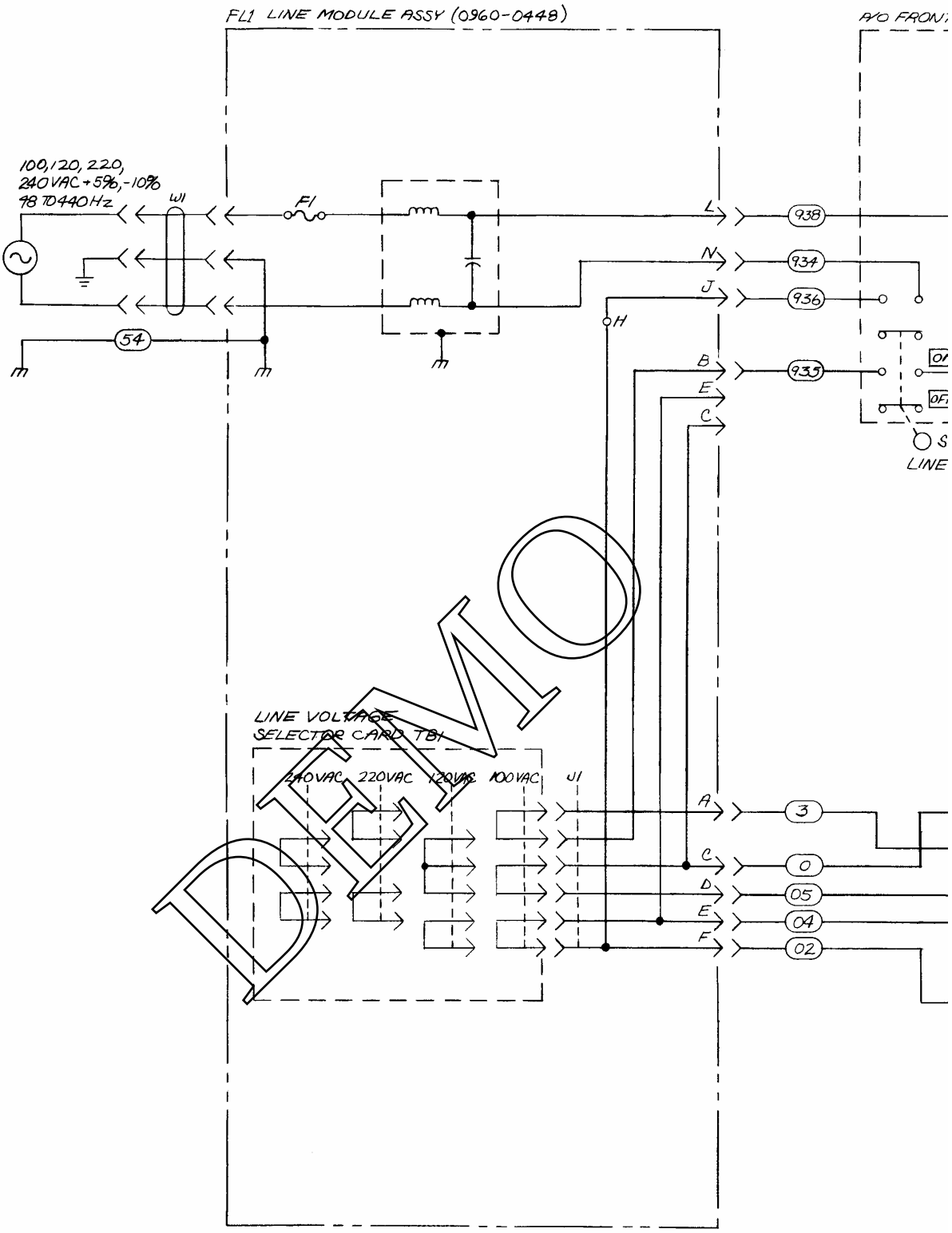
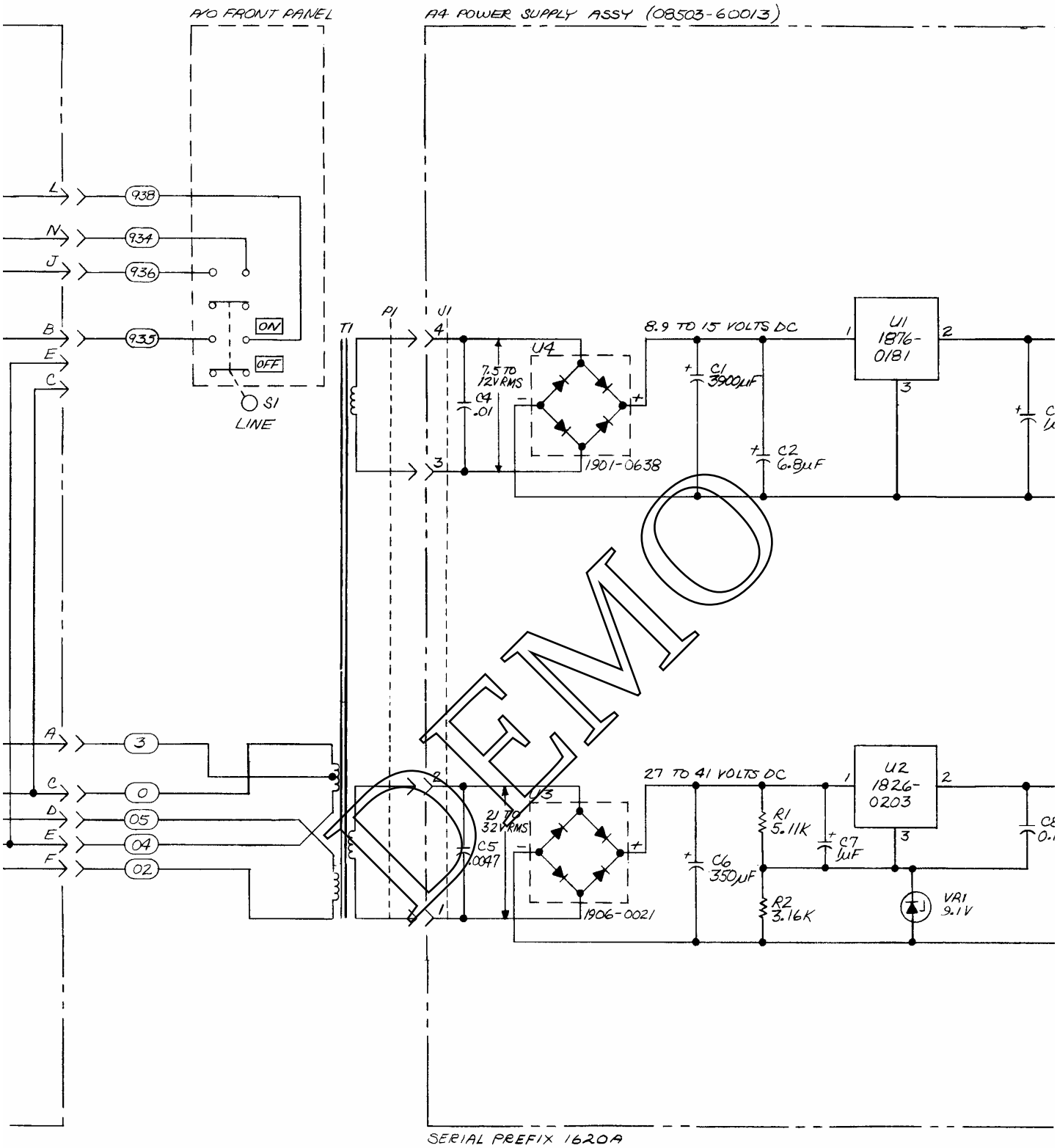
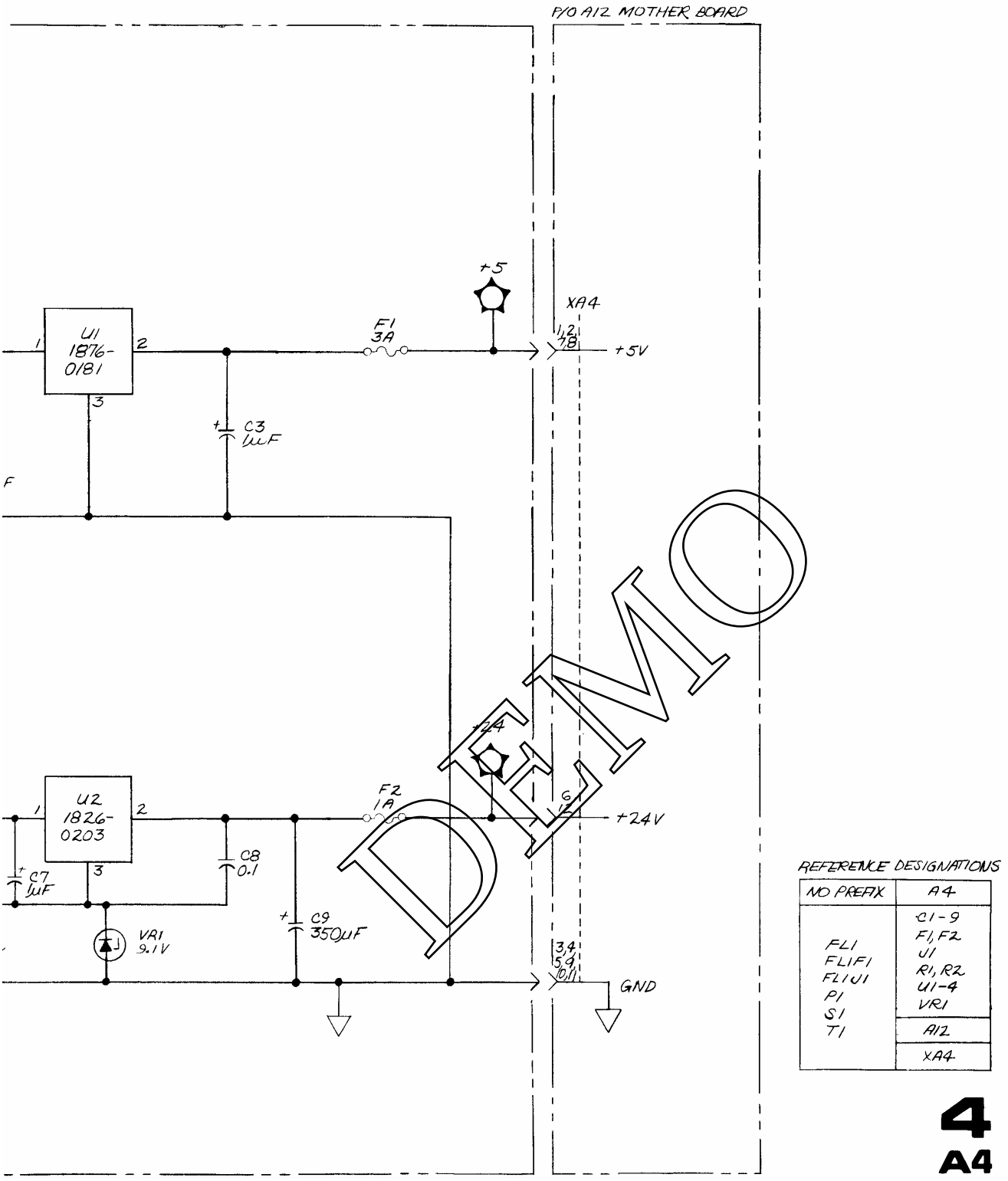


Figure 8-11. A4 Power Supply Assembly, Component Locations


FL1 LINE MODULE ASSY (0960-0448)
100,120,220,
240VAC +5%,-10%
48 TO 440Hz
W1
F1
L
N
J
H
B
E
C
938
934
936
935
54
LINE VOLTAGE
SELECTOR CARD TB1
240VAC
220VAC
120VAC
100VAC
J1
A
C
D
E
F
3
0
05
04
02
LINE


A/O FRONT PANEL
A4 POWER SUPPLY ASSY (08503-60013)
L
N
J
B
E
C
A
C
D
E
F
938
934
936
935
3
0
05
04
02
ON
OFF
S1
LINE
T1
P1
J1
4
3
2
1
U4
1901-0638
7.5 TO 12V RMS
C4 .01
8.9 TO 15 VOLTS DC
C1 3900µF
C2 6.8µF
U1 1876-0181
U3
1906-0021
21 TO 32V RMS
C5 .0047
27 TO 41 VOLTS DC
C6 350µF
R1 5.11K
R2 3.16K
C7 1µF
U2 1826-0203
VR1 9.1V
SERIAL PREFIX 1620A



REFERENCE DESIGNATIONS

NO PREFIX	A4
FL1 FL1F1 FL1U1 P1 S1 T1	C1-9 F1, F2 U1 R1, R2 U1-4 VR1
	A12
	XA4

4
A4

Figure 8-12. A4 Power Supply Assembly, Schematic