HEWLETT hp PACKARD

OPERATING AND SERVICE MANUAL

CHAPTER A

8505A
NETWORK ANALYZER
500 kHz to 1.3 GHz

SERIAL NUMBERS

Chapter A of this manual applies directly to HP Model 8505A Network Analyzers with serial number prefix 1816A. Chapters B and on apply directly to instruments with serial number prefix 1628A. For instruments with serial number lower than these, refer to the Manual Changes section of each chapter.

1400 FOUNTAIN GROVE PARKWAY, SANTA ROSA, CALIFORNIA 95404 U.S.A.

MANUAL PART NO. 08505-90002
Microfiche Part No. 08505-90003

Printed: SEPTEMBER 1978

MANUAL CHANGES

MANUAL IDENTIFICATION
Model Number: 8505A
Date Printed: September 1978
Part Number: 08505-90002

This supplement contains important information for correcting manual errors and for adapting the manual to instruments containing improvements made after the printing of the manual.

To use this supplement:

Make all ERRATA corrections

Make all appropriate serial number related changes indicated in the tables below.

Serial Prefix or Number	Make Manual Changes
1628A00240 and thru 1631A prefix	1
1644A, 1653	1,2
1646A	1,3
1602A00112	4
1710A	1,2,5
1712A	1,2,5,6,7
1716A	1,2,5,6,7,8
1720A	1,2,5,6,7,8,9
1723A	1,2,5,6,7,8,9,10
1733A	1,2,5 – 11
1735A, 1739	1,2,5 – 12
1745A	1,2,5 – 13
1747A	1,2,5 – 14
1802A	1,2,5 – 15
1804A	1,2,5 – 16

Serial Prefix or Number	Make Manual Changes
1806A	1,2,5 – 17
1816A	1,2,5 – 18
1831A	1,2,5 – 19
1833A	1,2,5 – 20
1845A	1,2,5–21
► 1928A	1,2,5–22
► 1930A, 1932A	1,2,5–23

► NEW ITEM

NOTE

Manual change supplements are revised as often as necessary to keep manuals as current and accurate as possible. Hewlett-Packard recommends that you periodically request the latest edition of this supplement. Free copies are available from all HP offices. When requesting copies quote the manual identification information from your supplement, or the model number and print date from the title page of the manual.

The following Service Notes are available from your local HP Sales and Service Office.

SERVICE NOTE	SERIAL NUMBER	DESCRIPTION
8505A-1A	1716A00380 and below	*INCREASED POWER SUPPLY RELIABILITY*
8505A-2	1602A00111 thru 1610A00140	*REDUCED 50 HZ LINE RELATED VARIATIONS ON CRT TRACE*
8505A-3	1622A00185 and below	*RECOMMENDED REPLACEMENT FOR OP AMP*
8505A-4	1606A00130 and below	*IMPROVED OPERATION OF A3A11 GROUP DELAY CIRCUIT*
8505A-5	1723A00396 and below	*AIR FILTER RETAINER*
8505A-6A	All serials	*A3A11 GROUP DELAY DETECTOR TROUBLESHOOTING*
8505A-7	All serials	*A3A4 PROCESSOR INTERFACE BOARD TROUBLESHOOTING*
8505A-8	1716A00380 and below	*ELIMINATION OF MARKER GLITCHES ON CRT WHEN 8505A IS USED WITH HP8501A STORAGE NORMALIZER*
8505A-9	1710A00350 and below	*ELIMINATION OF ERRONEOUS DATA TAKING BY HP-IB AT "TURN ON"*
8505A-10A	All serials	*A3A5 PROCESSOR D/A TROUBLESHOOTING*
8505A-12	All serials	*CRT CONTROL CIRCUITS TROUBLESHOOTING*
8505A-17	All serials	*A3A17 MARKER I ASSEMBLY TROUBLESHOOTING*
8505A-18	All serials	*A3A18 MARKER II ASSEMBLY TROUBLESHOOTING*

ERRATA

All references to "Option 001" should be deleted throughout the manual and the phrase "HP-IB" substituted in their place.

Page A4-24, Paragraph A4-18:
In step a, "On A3 Signal Processor, Channel 1", change MODE switch position to PHASE.

Page B2-8, Table B2-2:
Change A1A15J1 thru J5 to HP Part Number 1250-0691.

Page B2-10, Table B2-2:
Add another entry after A1A15A1Y1 as follows:
HP Part No. 0410-0675, Crystal, Matched Set, A1A15A1Y1 9.9 MHz Crystal and A2A12Y1 100 MHz Crystal.

Page C2-4, Table C2-2:
Add Reference Designation A2A1W3S1 to the replaceable switch (3101-2025) which is part of Line Switch Cable Assembly A2A1W3.
Change A2A1A1DS1 thru DS14 to HP Part Number 1990-0503.

Page C2-5, Table C2-2:
Change A2A1A1U2 to HP Part Number 1820-1823.
Change A2A1A1U3 to HP Part Number 1820-1823.
Change A2A1A1U5 to HP Part Number 1820-1823.

Page C2-8, Table C2-2:
Change A2A3U28 to HP Part Number 1820-1823.
Change A2A3U29 to HP Part Number 1820-1823.
Change A2A3U30 to HP Part Number 1820-1823.
Change A2A3U31 to HP Part Number 1820-1823.
Change A2A3U32 to HP Part Number 1820-1823.
Change A2A3U33 to HP Part Number 1820-1823.

Page C2-10, Table C2-2:
► Change A2A4U2 to HP Part No. 1826-0229, OP AMP LOW DRIFT TO-99.
► Change A2A4U5 to HP Part No. 1826-0229, OP AMP LOW DRIFT TO-99.
Add A2A5C35, 0160-0571, CAPACITOR-FXD 470PF +-20% 100 WVDC CER
Add A2A5C36, 0160-3879, CAPACITOR-FXD .01 UF +-20% 100 WVDC CER

Page C2-12, Table 2-2:
Change A2A5U12 to HP Part Number 1820-1823.
Change A2A5U13 to HP Part Number 1820-1823.
Change A2A5U14 to HP Part Number 1820-1823.
Change A2A5U15 to HP Part Number 1820-1823.

►Page C2-15, Table C2-2:
Change A2A7U1 to HP Part No. 1826-0229, OP AMP LOW DRIFT TO-99.
Change A2A7U2 to HP Part No. 1826-0229, OP AMP LOW DRIFT TO-99.
Change A2A7U3 to HP Part No. 1826-0229, OP AMP LOW DRIFT TO-99.
Change A2A7U11 to HP Part No. 1826-0229, OP AMP LOW DRIFT TO-99.
Change A2A7U12 to HP Part No. 1826-0229, OP AMP LOW DRIFT TO-99.

►Page C2-18, Table C2-2:
Change A2A8U17 to HP Part No. 1826-0229, OP AMP LOW DRIFT TO-99.
Change A2A8U19 to HP Part No. 1826-0229, OP AMP LOW DRIFT TO-99.

Page C2-20, Table C2-2:
Change A2A10CR4 and A2A10CR5 to HP Part Number 1901-0743, DIODE-PWR RECT IN4004 400V 1A DO-41.

Page C2-24, Table C2-2:
Add another entry after A2A12Y1 as follows:
HP Part Number 0410-0675, Crystal, Matched Set, A1A15A1Y1 9.9 MHz Crystal and A2A12Y1 100 MHz Crystal.

ERRATA (Cont'd)

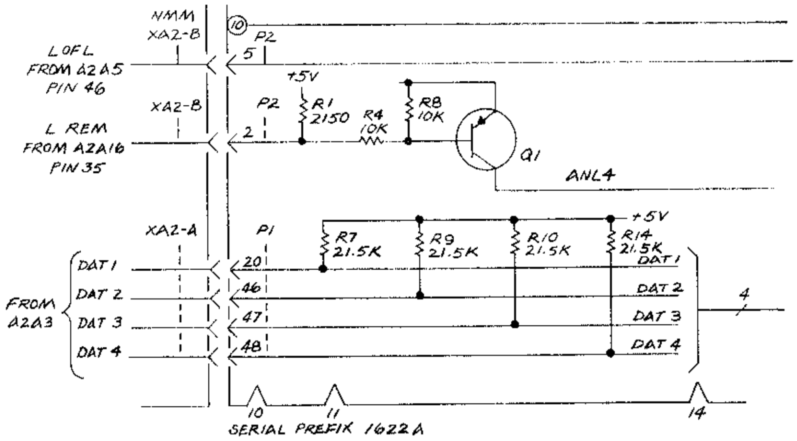
Page C2-25, Table C2-2:
Add additional entries for A2A19 as follows:
A2A19, HP Part Number 08505-60227, YIG OSCILLATOR, NEW (includes A2A11R22 and A2A11R40 Selected Value Resistors).
A2A19, HP Part Number 08505-60228, YIG OSCILLATOR, REBUILT (includes A2A11R22 and A2A11R40 Selected Value Resistors).

Page C2-27, Table C2-2:
Add A2A23, HP Part Number 5086-7005, PREAMP 0.1 - 1300 MHz.

Page C2-28, Figure C2-1:
Change Reference Designation 69 part number to 08505-00135.

►Page C3-33, Table C3-1:
In signal line "MPX H", delete entry in "LOCAL" column and add "A2A15-30" in "REMOTE" column.

Page C3-49, Figure C3-22:
Change notations on connector plugs and jacks as shown in the Partial Schematic.



P/O Figure C3-22. A2A2 Display Logic Schematic (ERRATA)

Page C3-81, Figure C3-31:
Change CR1 to CR3 and CR3 to CR1.

Page C3-81, Figure C3-32:
Change "R58" at input pin 2 of U9A to "R38."

Page C3-93, Figure C3-39:
Change R43 to R42.
Change C9 to C8.
Change R42 to R41.
Change C8 to C9.
Change R41 to R43.

Page C3-93, Figure C3-40:
Change R41 to 10K.
Change R43 to 147K.

Page C3-99, Figure C3-44:
Change "+2V SERIES REGULATORS" to "+20V SERIES REGULATOR".

ERRATA (Cont'd)

Page C3-105, Figure C3-47:
Change references to NOTE 5 on Q1, Q2 and Q3 to NOTE 3.

Page D2-4, Table D2-2:
Change A3F1 from HP Part Number 2110-0059 to HP Part Number 2110-0304, FUSE 1.5 AT 250V SLO-BLO.
Change Reference Designation "A3F2" to A3F1.
Change A3S1 to HP Part Number 3101-1235.
Change A3V1 to HP Part Number 08505-60196, CRT ASSEMBLY WITH OVERLAY TAB MOUNTS.

Page D2-5, Table D2-2:
Add HP Part Number 08505-60154 to the Overlay Kit listed in the table.
Change A3A1DS20-22, 24-26, 28 and 29 to HP Part Number 1990-0503.

Page D2-7, Table D2-2:
Change A3A3C8 to HP Part Number 0180-0116 CAPACITOR-FXD 6.8UF 35VDC.

►Page D2-14, Table D2-2:
Change A3A8VR1 to HP Part No. 1902-3082, DIODE–ZNR 4.64V 5% DO-7 PO = .2W TC = -.016%.

Page D2-30, Table D2-2:
Change A3A24CR2 to HP Part Number 1901-0743, DIODE-PWR RECT IN4004 400V 1A DO-41.

Page D2-31, Table D2-2:
Change Part Number of A3A25R1, A3A25R4, A3A25R5, and A3A25R7 to 2100-3476.
Change Part Number of A3A25R2 to 2100-3473.
Change Part Number of A3A25R3 to 2100-3475.
Change Part Number of A3A25R6 to 2100-3474.

Page D2-32, Table D2-2:
Change A3A26VR1 and A3A26VR2 to HP Part No. 2140-0015, LAMP-GLOW C2A 115/58 VDC 1.9 mA T-2-BULB (Recommended Replacement).

►Change A3A27 to HP Part No. 08505-60237. 08505-60237 is a preferred replacement for 08505-60172.

Page D2-35, Table D2-2:
Change A3A28R20 to A3A28R26, A3A28R24 to A3A28R20, and A3A28R26 toA3A28R24.
Change A3A30C1 to A3A30C2, A3A30C2 to A3A30C5, A3A30C4 to A3A30C1 and A3A30C5 to A3A30C4.

Page D2-36, Figure D2-1:
Add after Item 1 and 5 the following attaching hardware:
0570-1171, SCREW; COVER MTG; 6-32 THD; 0.460-IN LG
0510-0043, RETAINER-RING .141-DIA STL CD-PL
Change Item 16 to HP Part Number 01332-02201.
Change Item 33 to HP Part Number 1490-0968.
►Change Item 34 to HP Part No. 08505-20219, DIVIDER, FRONT FRAME, VERTICAL.
Change Item 36A to HP Part Number 5001-1043.

Page D2-37, Figure D2-1:
Add Item 111, HP Part Number 5001-0432, GUSSET-SIDE.
Change Reference Designation 101 part number to 08505-00135.

Page D3-63, Figure D3-24:
Change C8 to 6.8 UF.

ERRATA (Cont'd)

►Page D3-81, Figure D3-34:
Change the notation on VR1 to "4.64V."
Just above C8, add a notation under "–4.6V" as follows: "TYPICALLY –3.9V."

►Page D3-118, Figure D3-52B:
Change U6 to Up.

►Page D3-131/132, Figure D3-56B:
Change the resistor between C7 and Q8 on the Parts Location drawing from R24 to R26.

Page E4-4, Table E4-2:
Change A2A13U4 to HP Part Number 1820-1823.
Change A2A13U6 to HP Part Number 1820-1823.
Change A2A13U8 to HP Part Number 1820-1823.

Page E4-5, Table E4-2:
Change A2A14U6 to HP Part Number 1820-1823.
Change A2A14U10 to HP Part Number 1820-1823.
Change A2A14U14 to HP Part Number 1820-1823.
Change A2A15U14 to HP Part Number 1820-1823.

Page E4-6, Table E4-2:
Change A2A16U11 to HP Part Number 1820-1823.
Change A2A16U16 to HP Part Number 1820-1823.

Page E4-7, Table E4-2:
Change A3A19U14 to HP Part Number 1820-1823.
Change A3A19U15 to HP Part Number 1820-1823.
Change A3A20U13 to HP Part Number 1820-1823.

Page E4-8, Table E4-2:
Change A3A21U11 to HP Part Number 1820-1823.

Page F4-21/F4-22, Figure F4-15 (Option 005 Supplement):
Change A2A101L1 and A2A101L2 to 270UH.

CHANGE 1

NOTE

This change is required with divide-by-ten IC A2A5U1, Part Number 1820-1636 with "H" at the end of the Manufacturer's Part Number.

Page C2-10, Table C2-2:
Delete A2A5C3, A2A5C8, A2A5C18.

Page C2-11, Table C2-2:
Delete A2A5CR2, A2A5L2, A2A5R2, and A2A5R3.
Change A2A5R1 to HP Part Number 0698-7206, RESISTOR 56.2 OHMS 2% .05W F TC=0+–100.
Change A2A5R4 to HP Part Number 0698-7229 RESISTOR 511 OHM 2% .05W F TC=0+–100.

Page C3-70, Figure C3-27:
Change Parts Location for A2A5 in the manual for Parts Location in this change sheet.

Page C3-71, Figure C3-28:
Change A2A5U1 Circuit as shown in the partial schematic in this change sheet.

CHANGE 2

Pages C2-18, C2-19, and C2-20, Table C2-2:
Change Discriminator Board A2A9 to HP Part Number 08505-60169 and change all component parts per the A2A9 parts list contained in this change sheet.

Page C2-26, Table C2-2:
Change Transistor A2A21Q8 to HP Part Number 1854-0271, Transistor NPN.
Change Resistor A2A21R2 to HP Part Number 0698-3447, Resistor 422 OHM, 1% .125W F TC=0+–100.

CHANGE 1 (Cont'd)

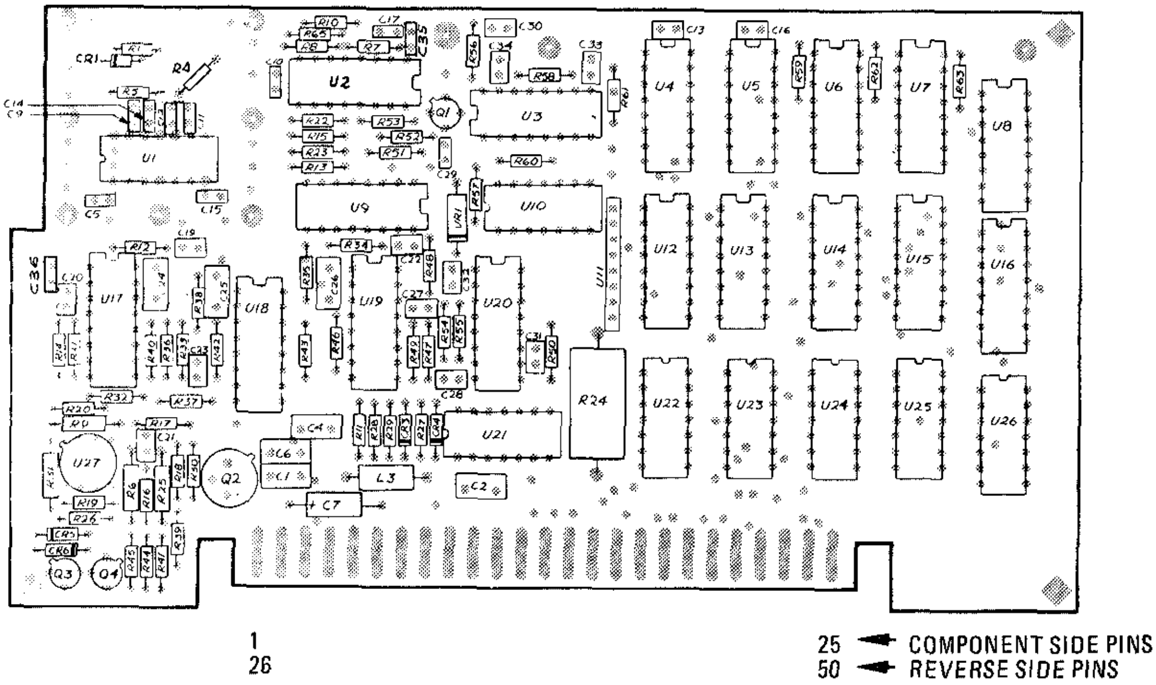
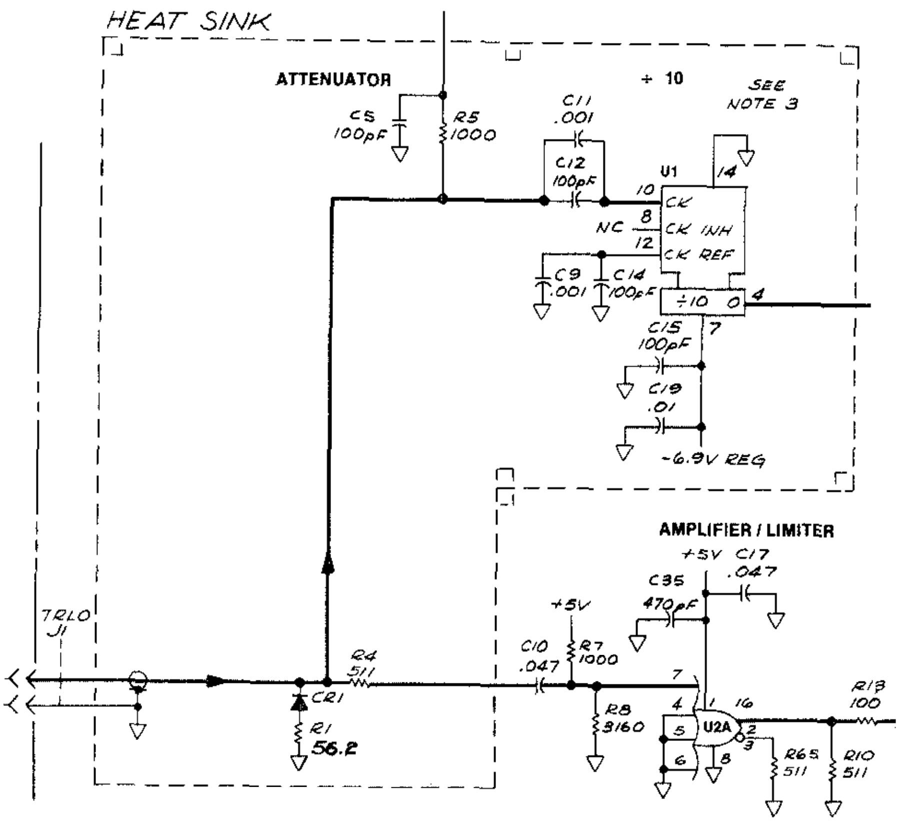


Figure C3-27. A2A5 Prescaler/Counter Parts Locations (CHANGE 1)



P/O Figure C3-28. Partial Schematic of A2A5 (CHANGE 1)

CHANGE 2 (Cont'd)

Pages C3-83 thru C3-90:
Replace pages in the manual for A2A9 Service with new pages contained in this change sheet.

Page C3-103, Figure C3-46:
Change A2A21R2 to 422 Ohms.

Page D2-6, Table D2-2:
Change A3A1S1 thru A3A1S6, A3A1S11 thru A3A1S16, and A3A1S21 thru A3A1S24 to HP Part Number 08505-4(
INCREMENT Button.
Change A3A1S9 and A3A1S19 to HP Part Number 08505-40011, MRK Button.
Change A3A1S7 and A3A1S17 to HP Part Number 08505-40012, REF Button.
Change A3A1S10, A3A1S20, and A3A1S25 to HP Part Number 08505-40013, ZRO Button.
Change A3A1S8, A3A1S18, and A3A1S26 to HP Part Number 08505-40014, CLR Button.

Page D2-36, Figure D2-1:
Delete Items 21, 22, 26, 31, and 32 in Reference Designator column and on photo.

Page F4-13, Figure F4-5:
Replace schematic of A2A9 with new one in this change sheet for Figure 3-36 (Change 2).

CHANGE 3

Page C2-7, Table C2-2:
►Delete A2A3C22 and A2A3CR12.

Page C2-8, Table C2-2:
Delete A2A3Q2 and A2A3R41.
Change A2A3Q3 to A2A3Q2, A2A3Q4 to A2A3Q3, A2A3Q5 to A2A3Q4, A2A3Q6 to A2A3Q5, A2A3Q7 to A2A3
and A2A3Q8 to A2A3Q7.

Page C2-18, Table C2-2:
Delete A2A9C10.
Change A2A9C17 to HP Part Number 0180-0197, CAPACITOR-FXD 2.2UF +–10% 20 VDC TA.

Page C2-26, Table C2-2:
Change Transistors A2A21Q1 to A2A21Q6, A2A21Q2 to A2A21Q7, A2A21Q3 to A2A21Q8, A2A21Q4 to A2A21(
A2A21Q5 to A2A21Q2, A2A21Q6 to A2A21Q4, A2A21Q7 to A2A21Q3, and A2A21Q8 to A2A21Q5.
Change A2A21Q5 to HP Part Number 1854-0271.

Page C3-61/62, Figure C3-23:
Delete C22, CR12, Q2, and R41.
Change Q3 to Q2, Q4 to Q3, Q5 to Q4, Q6 to Q5, Q7 to Q6, and Q8 to Q7.

Page C3-61/62, Figure C3-24:
Change A2A3Q3 to Q2, Q4 to Q3, Q5 to Q4, and Q6 to Q5.

CHANGE 3 (Cont'd)

Page C3-63, Figure C3-24:
Delete C22, CR12, Q2, and R41.
Change Q7 to Q6, and Q8 to Q7.

Page C3-89, Figure C3-36:
Delete Capacitor A2A9C10.
Change Capacitor A2A9C17 to 2.2UF.

Page C3-103, Figure C3-45 and C3-46:
Change Resistor A2A21R2 to 422 Ohms.
Change Transistors Q1 to Q6, Q2 to Q7, Q3 to Q8, Q4 to Q1, Q5 to Q2, Q6 to Q4, Q7 to Q3, and Q8 to Q5.

CHANGE 4 (SERIAL NUMBER 1602A00112 ONLY)

Page C4-1, Table C4-1:
Change entry for 1602A Serial Number Prefix 1602A to: "1602A, Make Changes A, B, C,E."

Page E6-1, Table E6-1:
Add to second line entry in Table, "Serial Prefix 1602A to Make Changes A, B."
Delete Serial Prefix 1602A from fourth line entry in Table.

P/O Table C2-2. A2A9 Parts List (CHANGE 2) (1 of 4)

Reference Designator	HP Part Number	Description
A2A9	08505-60169	BOARD ASSEMBLY, DISCRIMINATOR
A2A9C1	0180-0197	CAPACITOR-FXD 2.2UF +—10% 20VDC TA
A2A9C2	0180-0197	CAPACITOR-FXD 2.2UF +—10% 20VDC TA
A2A9C3	0180-0197	CAPACITOR-FXD 2.2UF +—10% 20VDC TA
A2A9C4	0180-0116	CAPACITOR-FXD 6.8UF 35V TA
A2A9C5 thru A2A9C8		NOT ASSIGNED
A2A9C9	0160-0575	CAPACITOR-FXD .047UF +—20% 50WVDC CER
A2A9C10	0180-0116	CAPACITOR-FXD 6.8UF 35V TA
A2A9C11	0180-0116	CAPACITOR-FXD 6.8UF 35V TA
A2A9C12	0180-0116	CAPACITOR-FXD 6.8UF 35V TA
A2A9C13		NOT ASSIGNED
A2A9C14	0160-4084	CAPACITOR-FXD .1UF +—20% 50WVDC CER
A2A9C15	0180-0116	CAPACITOR-FXD 6.8UF 35V TA
A2A9C16	0160-0174	CAPACITOR-FXD .47UF +80—20% 25WVDC CER
A2A9C17	0160-0174	CAPACITOR-FXD .47UF +80—20% 25WVDC CER
A2A9C18	0160-4084	CAPACITOR-FXD .1UF +—20% 50WVDC CER
A2A9C19	0160-4084	CAPACITOR-FXD .1UF +—20% 50WVDC CER
A2A9C20	0160-0174	CAPACITOR-FXD .1UF +—20% 50WVDC CER
A2A9C21	0160-0174	CAPACITOR-FXD .1UF +—20% 50WVDC CER
A2A9C22	0160-2306	CAPACITOR-FXD 27PF +—5% 300WVDC MICA
A2A9C23	0180-0197	CAPACITOR-FXD 2.2UF +—10% 20VDC TA
A2A9C24	0160-2256	CAPACITOR-FXD 9.1PF +—.25PF 500WVDC CER
A2A9C25	0160-0168	CAPACITOR-FXD .1UF +—10% 200WVDC POLYE
A2A9C26	0160-0161	CAPACITOR-FXD .01UF +—10% 200WVDC POLYE
A2A9C27	0160-3533	CAPACITOR-FXD 470PF +—5% 100WVDC MICA
A2A9C28	0160-0945	CAPACITOR-FXD 910PF +—5% 100WVDC MICA
A2A9C29	0160-0174	CAPACITOR-FXD .1UF +—20% 50WVDC CER
A2A9C30	0160-0174	CAPACITOR-FXD .1UF +—20% 50WVDC CER
A2A9C31	0180-0116	CAPACITOR-FXD 6.8UF 35V TA
A2A9C32	0160-0174	CAPACITOR-FXD .47UF +80—20% 25WVDC CER
A2A9C33	0160-3456	CAPACITOR-FXD 1000PF +—10% 1000WVDC CER
A2A9C34	0160-0174	CAPACITOR-FXD .47UF +80—20% 25WVDC CER
A2A9C35	0160-0174	CAPACITOR-FXD .47UF +80—20% 25WVDC CER
A2A9C36	0160-0574	CAPACITOR-FXD .022UF +—20% 100WVDC CER
A2A9C37	0160-2437	CAPACITOR-FD THRU 5000PF +80—20% 200V
A2A9C38	0160-4083	CAPACITOR-FD THRU 10PF 10% 200V CERAMIC
A2A9C39	0160-0570	CAPACITOR-FXD 220PF +—20% 100WVDC CER
A2A9C40 thru A2A9C99		NOT ASSIGNED
A2A9C100	0180-0116	CAPACITOR-FXD 6.8UF 35V TA
A2A9C101	0160-0570	CAPACITOR-FXD 220PF +—20% WVDC CER
A2A9CR1	1901-0050	DIODE-SWITCHING 80V 200MA 2NS DO-7
A2A9CR2	1901-0050	DIODE-SWITCHING 80V 200MA 2NS DO-7
A2A9CR3	1901-0050	DIODE-SWITCHING 80V 200MA 2NS DO-7
A2A9CR4	1901-0050	DIODE-SWITCHING 80V 200MA 2NS DO-7
A2A9CR5	1901-0050	DIODE-SWITCHING 80V 200MA 2NS DO-7
A2A9CR6	1901-0050	DIODE-SWITCHING 80V 200MA 2NS DO-7
A2A9CR7	1901-0050	DIODE-SWITCHING 80V 200MA 2NS DO-7
A2A9CR8	1901-0539	DIODE-SCHOTTKY
A2A9DS1	1990-0404	LED-VISIBLE LUM-INT-300UCD IF=50MA-MAX
A2A9FL1	9135-0002	FILTER-LOW PASS SOLDER -TERMS
A2A9FL2	9135-0002	FILTER-LOW PASS SOLDER-TERMS
A2A9J1	08443-00041	TEST POINT CONNECTOR
A2A9J2	1250-0691	CONNECTOR-SGL CONT SKT .022-IN-BSC-SZ
A2A9L1	9100-1641	COIL-MLD 240UH 5% Q65 .155DX .375LG
A2A9L2	9100-1641	COIL-MLD 240UH 5% Q65 .155DX .375LG

P/O Table C2-2. A2A9 Parts List (CHANGE 2) (2 of 4)

Reference Designator	HP Part Number	Description
A2A9L3	9140-0114	COIL-MLD 10UH 10% Q=55 .155DX .375LG
A2A9L4	9100-2257	COIL-MLD 820NH 10% Q=32 .095DX .25LG
A2A9L5	9100-2254	COIL-MLD 390NH 10% Q=35 .095DX .25LG
A2A9L6	9100-2248	COIL-MLD 120NH 10% Q=34 .095DX .25LG
A2A9L7	9100-1641	COIL-MLD 240UH 5% Q=65 .155DX .375LG
A2A9MP1	0520-0128	SCREW-MACH 2-56 .25-IN-LG PAN-HD-POZI
A2A9MP2	0520-0169	SCREW-MACH 2-56 .625-IN-LG 82 DEG
A2A9MP3	0590-0519	THREADED INSERT-NUT 4-40 .062-LG
A2A9MP4	0610-0003	NUT-HEX-DBL-CHAM 2-56-THD .062-IN-THK
A2A9MP5	2190-0014	WASHER-LK INTL T NO.2 .089-IN-ID
A2A9MP6	2190-0123	WASHER-FL MTLC NO.1 .08-IN-ID
A2A9MP7	2190-0910	WASHER-LK NO.4 .12-IN-ID .275-IN-OD STL
A2A9MP8	2200-0101	SCREW-MACH 4-40 .188-IN-LG PAN-HD-POZI
A2A9MP9	2200-0105	SCREW-MACH 4-40 .312-IN-LG PAN-HD-POZI
A2A9MP10	2200-0168	SCREW—MACH 4-40 .438-IN-LG 82 DEG
A2A9MP11	08505-20154	KNOB-PULL
A2A9MP12	08505-00127	TOP COVER
A2A9MP13	08505-00128	COVER
A2A9MP14	08505-20196	RF SHIELD
A2A9MP15	08505-20197	BOTTOM COVER
A2A9Q1	5081-8120	TRANSISTOR NPN SI TO-18 PD=360MW
A2A9Q2	1854-0330	TRANSISTOR NPN SI
A2A9Q3	1853-0075	TRANSISTOR-DUAL PNP PD=400MW
A2A9Q4	1854-0345	TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW
A2A9Q5	1854-0345	TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW
A2A9Q6	1853-0007	TRANSISTOR PNP 2N3251 51 TO-18 PD=360MW
A2A9Q7	1853-0007	TRANSISTOR PNP 2N3251 51 TO-18 PD=360MW
A2A9Q8	1853-0007	TRANSISTOR PNP 2N3251 51 TO-18 PD=360MW
A2A9Q9	1853-0007	TRANSISTOR PNP 2N3251 51 TO-18 PD=360MW
A2A9Q10	1855-0020	TRANSISTOR J-FET N-CHAN D-MODE TO-18 SI
A2A9Q11	1855-0020	TRANSISTOR J-FET N-CHAN D-MODE TO-18 SI
A2A9Q12	1855-0020	TRANSISTOR J-FET N-CHAN D-MODE TO-18 SI
A2A9Q13	1855-0020	TRANSISTOR J-FET N-CHAN D-MODE TO-18 SI
A2A9Q14	1855-0020	TRANSISTOR J-FET N-CHAN D-MODE TO-18 SI
A2A9Q15	1854-0404	TRANSISTOR NPN SI TO-18 PD=360MW
A2A9Q16	1854-0404	TRANSISTOR NPN SI TO-18 PD=360MW
A2A9Q17	1853-0007	TRANSISTOR PNP 2N3251 51 TO-18 PD=360MW
A2A9Q18	1853-0007	TRANSISTOR PNP 2N3251 51 TO-18 PD=360MW
A2A9Q19	1854-0404	TRANSISTOR NPN SI TO-18 PD=360MW
A2A9Q20	1854-0404	TRANSISTOR NPN SI TO-18 PD=360MW
A2A9Q22	1855-0020	TRANSISTOR J-FET N-CHAN D-MODE TO-18 SI
A2A9R1		NOT ASSIGNED
A2A9R2	0811-3247	RESISTOR 150 1% 7.5W PW TC=0+—20
A2A9R3	0757-0465	RESISTOR 100K 1% .125W F TC=0+—100
A2A9R4	0757-0465	RESISTOR 100K 1% .125W F TC=0+—100
A2A9R5 thru A2A9R11		NOT ASSIGNED
A2A9R12	0757-0465	RESISTOR 100K 1% .125W F TC=0+—100
A2A9R13	0757-0458	RESISTOR 51.1K 1% .125W F TC=0+—100
A2A9R14	0757-0465	RESISTOR 100K 1% .125W F TC=0+—100
A2A9R15	0757-0458	RESISTOR 51.1K 1% .125W F TC=0+—100
A2A9R16	0757-0465	RESISTOR 100K 1% .125W F TC=0+—100
A2A9R17	0757-0465	RESISTOR 100K 1% .125W F TC=0+—100
A2A9R18		NOT ASSIGNED
A2A9R19	0757-0458	RESISTOR 51.1K 1% .125W F TC=0+—100

P/O Table C2-2. A2A9 Parts List (CHANGE 2) (3 of 4)

Reference Designator	HP Part Number	Description
A2A9R22 thru A2A9R26		NOT ASSIGNED
A2A9R27	0757-0401	RESISTOR 100% .125W F TC=0+—100
A2A9R28	0757-0416	RESISTOR 511 1% .125W F TC=0+—100
A2A9R29	0757-0416	RESISTOR 511 1% .125W F TC=0+—100
A2A9R30	0757-0465	RESISTOR 100K 1% .125W F TC=0+—100
A2A9R31	0757-0416	RESISTOR 511 1% .125W F TC=0+—100
A2A9R32	0698-3445	RESISTOR 348 1% .125W F TC=0+—100
A2A9R33	0698-3153	RESISTOR 3.83K 1% .125W F TC=0+—100
A2A9R34	0811-2813	RESISTOR 1 5% .75W PW TC=0+—50
A2A9R35	0757-0398	RESISTOR 75 1% .125W F TC=0+—100
A2A9R36	0698-3454	RESISTOR 215K 1% .125W F TC=0+—100
A2A9R37	0757-0416	RESISTOR 511 1% .125W F TC=0+—100
A2A9R38	0757-0416	RESISTOR 511 1% .125W F TC=0+—100
A2A9R39	0698-3454	RESISTOR 215K 1% .125W F TC-0+—100
A2A9R40	0698-3441	RESISTOR 215 1% .125W F TC=0+—100
A2A9R41	0757-0416	RESISTOR 511 1% .125W F TC=0+—100
A2A9R42	0757-0379	RESISTOR 12.1 1% .125W F TC=0+—100
A2A9R43	0757-0289	RESISTOR 13.3K 1% .125W F TC=0+—100
A2A9R44	0757-0465	RESISTOR 100K 1% .125W F TC=0+—100
A2A9R45	0698-3435	RESISTOR 38.3 1% .125W F TC=0+—100
A2A9R46	0757-0405	RESISTOR 162 1% .125W
A2A9R47	0698-3438	RESISTOR 147 1% .125W F TC=0+—100
A2A9R48	0757-0465	RESISTOR 100K 1% .125W F TC=0+—100
A2A9R49	0757-0280	RESISTOR 1K 1% .125W F TC=0+—100
A2A9R50	0757-0398	RESISTOR 75 1% .125W F TC=0+—100
A2A9R51	0698-8640	RESISTOR 4.734K .1% .125W F TC=0+—25
A2A9R52	0698-3454	RESISTOR 215K 1% .125W F TC=0+—100
A2A9R53	0698-3441	RESISTOR 215 1% .125W F TC=0+—100
A2A9R54	0757-0416	RESISTOR 511 1% 125W F TC=0+—100
A2A9R55	0683-5655	RESISTOR 5.6 M 5% .25W FC TC=900/+1100
A2A9R56	0698-3435	RESISTOR 38.3 1% .125W F TC=0+—100
A2A9R57	2100-3349	RESISTOR TRMR 100 10% C SIDE-ADJ 1-TURN
A2A9R58	0698-6862	RESISTOR 1.153K .25% .125W F TC=0+—50
A2A9R59	0698-6620	RESISTOR 150K .1% .125W F TC=0+—25
A2A9R60	0698-3447	RESISTOR 422 1% .125W F TC=0+—100
A2A9R61	0698-8052	RESISTOR 590 .1% .25 F TC=0+—25
A2A9R62	0698-7205	RESISTOR 51.1 1% .05W F TC=0+—100
A2A9R63	0757-0317	RESISTOR 1.33K 1% .125W F TC=0+—100
A2A9R64	0757-0278	RESISTOR 1.78K 1% .125W F TC=0+—100
A2A9R65	0757-0199	RESISTOR 21.5K 1% .125W F TC=0+—100
A2A9R66	0757-0465	RESISTOR 100K 1% .125W F TC=0+—100
A2A9R67	0757-0458	RESISTOR 51.1K 1% .125W F TC=0+—100
A2A9R68	2100-3052	RESISTOR-TRMR 50 20% C SIDE-ADJ 17-TURN
A2A9R69	0698-3442	RESISTOR 237 1% .125W F TC=0+—100
A2A9R70	0698-5552	RESISTOR 1K 1% .125W F TC=0+—100
A2A9R71	0757-0199	RESISTOR 21.5K 1% .125W F TC=0+—100
A2A9R72	0757-0458	RESISTOR 51.1K 1% .125W F TC=0+—100
A2A9R73	0757-0442	RESISTOR 10K 1% .125W F TC=0+—100
A2A9R74	0698-5552	RESISTOR 1K 1% .125W F TC-0+—25
A2A9R75	0698-3454	RESISTOR 215K 1% .125W F TC=0+—100
A2A9R76	0757-0442	RESISTOR 10K 1% .125W F TC=0+—100
A2A9R77	0698-3156	RESISTOR 14.7K 1% .125W F TC=0+—100
A2A9R78	0698-5552	RESISTOR 1K 1% .125W F TC=0+—100

P/O Table C2-2. A2A9 Parts List (CHANGE 2) (4 of 4)

Reference Designator	HP Part Number	Description
A2A9R79	0757-0199	RESISTOR 21.5K 1% .125W F TC=0+—100
A2A9R80	0698-3160	RESISTOR 31.6K 1% .125W F TC=0+—100
A2A9R81	0757-0447	RESISTOR 16.2K 1% .125W F TC=0+—100
A2A9R82	0698-0084	RESISTOR 2.15K 1% .125W F TC=0+—100
A2A9R83	0757-0443	RESISTOR 11K 1% .125W F TC=0+—100
A2A9R84	0698-3458	RESISTOR 348K 1% .125W F TC=0+—100
A2A9R85	0757-0442	RESISTOR 10K 1% .125W F TC=0+—100
A2A9R86 thru A2A9R99		NOT ASSIGNED
A2A9R100	0757-0420	RESISTOR 750 1% .125W F TC=0+—100
A2A9R101	0698-3442	RESISTOR 237 1% .125W F TC=0+—100
A2A9R102	0757-0442	RESISTOR 10K 1% .125W F TC=0+—100
A2A9R103	0698-3152	RESISTOR 3.48K 1% .125W F TC=0+—100
A2A9R104	0757-0447	RESISTOR 16.2K 1% .125W F TC=0+—100
A2A9R105	0698-3159	RESISTOR 26.1K 1% .125W F TC=0+—100
A2A9R106	0698-3158	RESISTOR 23.7K 1% .125W F TC=0+—100
A2A9R107	0757-0401	RESISTOR 100 1% .125W F TC=0+—100
A2A9TP1	1251-0600	CONTACT-CONN U/W-POST-TYPE MALE DPSLDR
A2A9U1	1826-0013	IC 741 OP AMP
A2A9U2	1820-1308	IC-DIGITAL MC10116L ECL TPL 2 LINE RCVR
A2A9U3	1826-0302	IC MC 1741SC OP AMP
►A2A9U4	1826-0249	IC AD 504J OP AMP
A2A9U5	1826-0026	IC LM 311 COMPARATOR
►A2A9U6	1820-1538	IC-DIGITAL MC14011UBCL CMOS QUAD 2 NAND
►A2A9U7	1820-1531	IC-DIGITAL MC14013BCL CMOS DUAL D-TYPE
►A2A9U8	1820-1538	IC-DIGITAL MC14011UBCL CMOS QUAD 2 NAND
A2A9VR1		NOT ASSIGNED
A2A9VR2	1902-3071	DIODE-ZNR 4.22V 2% DO-7 PD= .4W TC= .038%
►A2A9VR3	1902-0692	DIODE-ANR 6.3V 1% PD= .4W
A2A9VR4	1902-3048	DIODE-ZNR 3.48V 5% DO-7 PD=.4W TC=.058%
A2A9VR5	1902-3048	DIODE-ZNR 3.48V 5% DO-7 PD=.4W TC=.058%
A2A9VR6 thru A2A9VR99		NOT ASSIGNED
A2A9VR100	1902-0025	DIODE-ZNR 10V 5% DO-7 PD=.4W TC=+.06%

A2A9 DISCRIMINATOR (CHANGE 2)

General Description

The Discriminator is part of the Automatic Frequency Control (AFC) Loop, which also includes the Prescaler/Counter (A2A5) and FM Driver (A2A10). The RF output of the Source/Converter is first fed to the Prescaler/Counter, where its frequency is prescaled, and then applied to the input (PTLO) of the Discriminator. The Discriminator generates a current proportional to the frequency of the RF input and compares it with a current which is proportional to the Tuning Voltage (V TUN). The difference between these currents, a measure of the frequency error of the Source/Converter, is amplified and fed to the FM Driver (A2A10) as V FM. The FM Driver further amplifies this error signal to drive the FM coil of the YIG-tuned Oscillator (A2A19), thereby closing the AFC loop. This feedback reduces the drift and residual FM of the Source/Converter. The AFC loop operates only in the 13 MHz and 130 MHz ranges; in the 1300 MHz range the Discriminator output is disconnected from the FM Driver.

The Discriminator has five major parts: Frequency-to-Current Converter, Summing Amplifier, Frequency Range Logic and FET Drivers, Low-Frequency Clamp, and Search Control (See Figure C3-34E).

Frequency-to-Current Converter

The Frequency-to-Current Converter generates a current which is proportional to the frequency of the RF signal from the Source/Converter. There are four elements: Amplifier-Limiter, Delay Line Driver, Delay Line, and Current Switch.

Two differential amplifiers from an ECL line receiver (U2) make up the Amplifier-Limiter, which shapes the RF pulses (PTLO) from the Prescaler/Counter (A2A5). The first amplifier is connected as a single-input amplifier with a differential output. The second amplifier is a Schmitt trigger whose differential output is ac-coupled to the Delay Line Driver. The base bias supply of the differential amplifiers is tapped at U2 pin 11 to provide a stable reference voltage for the input (pin 4) of the first stage.

The Delay Line Driver consists of the differential pair Q4 and Q5 with positive feedback. Positive feedback causes the driver to act as the second Schmitt trigger in the input chain. The normal state of the driver is Q5 ON, Q4 OFF, with the base of Q4 biased near 0 volts ($V_{be}4 = 0$ volts). When the input to the driver causes Q4 to turn ON, the current flowing through Q5 is diverted to the Delay Line. This causes the voltage at the collector of Q5 to rise, which turns Q4 on harder. Because of this positive feedback, the state of the driver changes rapidly to Q4 ON, Q5 OFF. The exact inverse occurs when Q4 is turned OFF by the input. The output of the driver is thus a square wave of current into the Delay Line.

The Delay Line, consisting of L4-6, C21, C22, and C24, is a lumped approximation of a shorted transmission line with an 11 nsec delay. The current wave applied to the Delay Line by the Driver is converted to constant width voltage pulses. (See Figure C3-34A.) These pulses are then applied to the Current Switch.

The Current Switch, Q3A and Q3B, is a differential pair with emitter current fixed by VR3, CR7, R61, and R68. The emitter current is adjusted with R68 for a high frequency reading of 20.000 MHz ±0.2 MHz on the FREQ COUNTER readout . The normal state of the Current Switch is Q3A ON, Q3B OFF. When the voltage pulse from the Delay Line goes

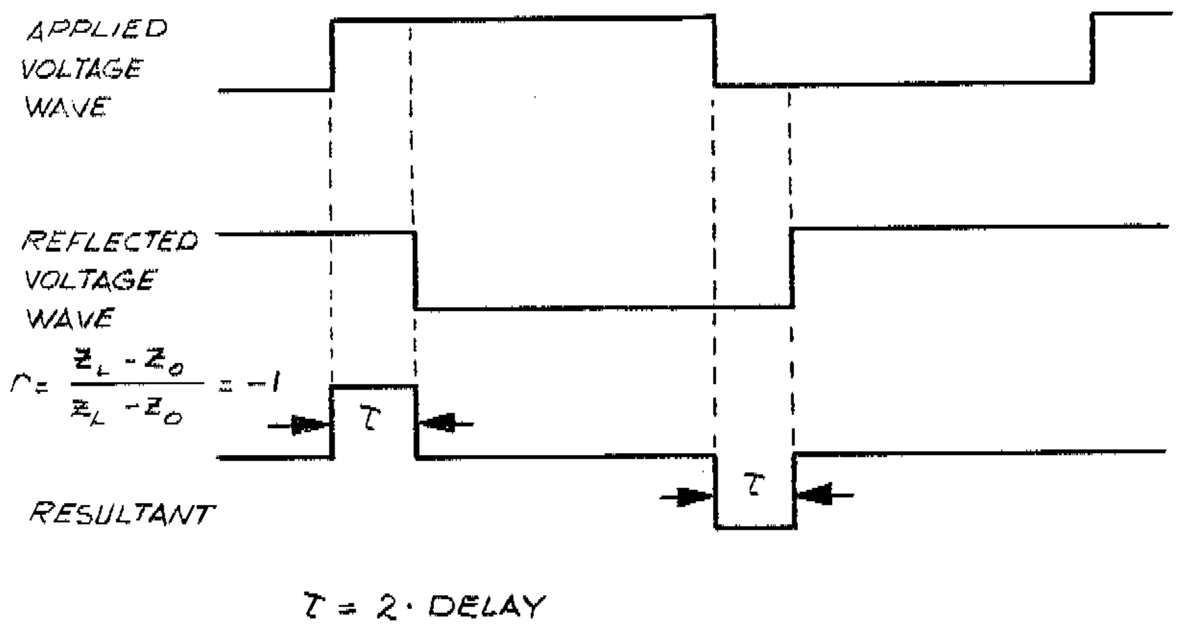


Figure C3-34A. Shorted Delay Line Principle

high, Q3A is turned OFF and Q3B is turned ON, switching the emitter current to C28, L7, and R54, the low-pass filter. The average current through the filter is proportional to the frequency of the input signal, PTLO.

Summing Amplifier

The Tuning Voltage, V TUN, is converted by R51 to a current and summed with the output of the Frequency-to-Current Converter by U4. The difference between these two currents is amplified by U4 to produce the output voltage V FM. V FM drives the FM Driver to correct any frequency errors of the YTO. Feedback capacitors C25 and C26 set the AFC loop compensation and bandwidth. The capacitors are selected by Q9, which is driven by the Frequency Range Logic. The offset voltage at U4 pin 3 is changed by FET Q10 when the frequency range of the instrument is changed; the offset is approximately +100 mV in the 13 MHz range and about +10 mV in the 130 MHz range. In the 1300 MHz (undiscriminated) range, the Frequency Range Logic turns FET Q11 on, reducing the gain of U4 to zero. R57 is used to adjust the offset for a low frequency indication of 5.000 MHz ±0.010 MHz on the FREQ COUNTER readout.*

Frequency Range Logic and FET Drivers

The Frequency Range Logic consists of CMOS NAND Gates (U6) connected as inverters driving level shifters Q6 —Q9. The level shifters turn on and off the FET's (Q10, Q11, Q12, Q13, and Q14) used as switches in the Summing Amplifier and Low-Frequency Clamp.

The Frequency Range Logic detects the frequency range of the instrument and adjusts the AFC loop compensation capacitors (C25, C26), offset voltages at U4 pin 3, and V TUN clamp voltages for proper operation of the AFC loop. The offset voltages are required because the RF input to the Discriminator, PTLO, is offset by 100 kHz from the RF output of the source. Compensation changes are needed because the source RF frequency is divided by one in the 13 MHz range and by 10 in the 130 MHz range before it reaches the Discriminator. The change in division ratio is an effective change in AFC loop gain and bandwidth which is compensated for by the change in feedback capacitance.

* See adjustment procedure, paragraph A5-21.

Low-Frequency Clamp

A Low-Frequency Clamp is used to accurately set the low frequency of the RF source and prevent the RF from going through zero frequency (where the instrument is unspecified and the Discriminator is unlocked). U3 clamps the tuning voltage, V TUN, to about −400 mV in the 13 MHz range and −40 mV in the 130 MHz range. The clamp voltage is selected by Q13, which is driven by the Frequency Range Logic. This voltage is applied to pin 3 of U3. When V TUN goes above the voltage at pin 3, the output of U3 goes low, pulling V TUN more negative. The output of U3 also drives Q15, which generates one of the blanking pulses (BP2) to the Sweep Select Board, A2A8.

When the instrument is put in the 1300 MHz range, Q7 drives FET Q14 ON, pulling U3 pin 3 up to +1.5 volts. Since V TUN cannot go this positive, the Low-Frequency Clamp is effectively removed from the circuit in the 1300 MHz range.

Search Control

A detailed block diagram of the Search Control is shown in Figure C3-34F. This block diagram will be referred to in the following description.

The function of the Search Control is to keep the Discriminator output, V FM, in the range where the AFC loop will lock. The Search Control detects when V FM goes above or below an allowable range (about −3V to +3V). If V FM goes too positive, the positive limit detector (VR4 and Q20) sets flip-flop U7A, turning Q13 ON; this injects a search current into the summing junction which causes the output of U4 to slew in the negative direction. When V FM reaches the negative limit, the negative limit detector (VR5 and Q21) sets flip-flop U7B. Since the outputs of the two flip-flops are ANDed to drive both of their reset inputs, flip-flop U7A is reset at this point; flip-flop U7B remains set since its set input is held high by the negative limit detector. The high output of U7B turns Q19 ON, injecting a search current into the summing junction which causes V FM to slew in the positive direction. As V FM goes through +1.5V, the output of the reset comparator goes high, applying a reset pulse to flip-flop U7B and turning off the search current. With V FM at this reset voltage (+1.5V) the AFC loop will lock.

The no-lock state (either flip-flop set) turns on the no-lock indicator DS1. In the 130 MHz range, FET Q12 is driven ON in the no-lock state to increase the feedback capacitance of U4 and thus decrease the slope of V FM during the search. Capacitor C9 keeps Q12 ON for a period following the search current reset (both flip-flops reset) to allow the AFC loop to stabilize before the bandwidth is increased.

Typical search waveforms and a description of Search Control operation are presented in the Troubleshooting section which follows.

A2A9 Discriminator — Troubleshooting Information

Equipment:

Oscilloscope

Frequency-to-Current Converter

The Frequency-to-Current Converter produces a current which is proportional to the frequency of the prescaled source RF signal, PTLO, in all frequency ranges.

The operation of this portion of the Discriminator may be checked by setting the front panel controls of the Frequency Control as follows:

RANGE MHz .... 0.5—1300
SCAN TIME SEC.................................. .01
MODE ....LIN FULL

Connect the oscilloscope to C38 feedthrough. Set TIME/DIV to 2 msec and VOLTS/DIV to 0.2V. The voltage should look like the waveform of Figure C3-34B.

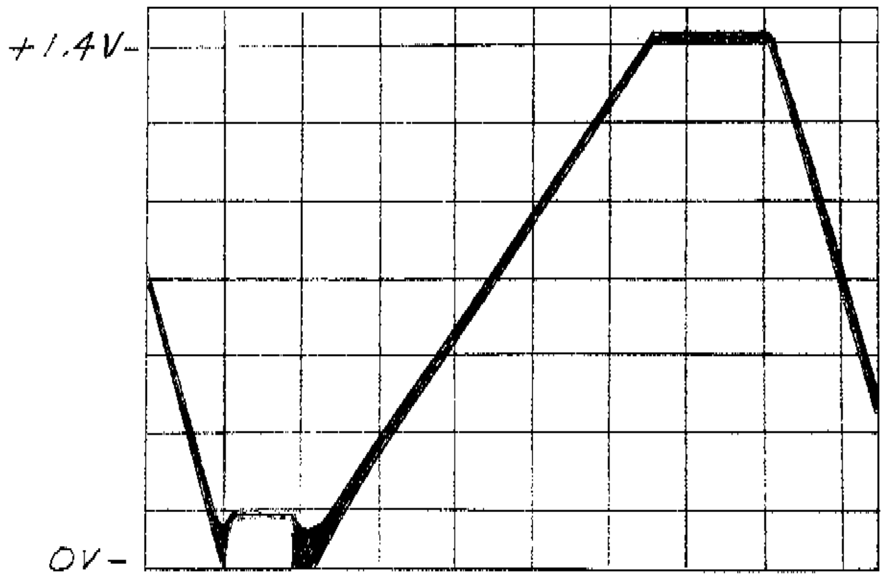


Figure C3-34B. Output of Frequency-to-Current Converter (C38 feedthrough)

The voltage at C38 is proportional to the average current output of the Current Switch and thus to the frequency of the RF input signal, PTLO, as it varies from 600 kHz to 1300.1 MHz.

If this waveform is not present, then one or more of the following components may be faulty: (1) Current Switch: Q3, (2) Delay Line Driver: Q4, Q5, or VR2, (3) Amplifier-Limiter: U2. Also, operational amplifier U4 may not be maintaining a virtual ground at U4 pin 2.

Search Control

The operation of the Search Control may be checked in the two discriminated frequency ranges as described below.

0.5 — 13 MHz Range

1. Set the front-panel controls as follows:

RANGE MHz .... 0.5 — 13
MODE ....LIN EXP
WIDTH.....................................CW±ΔF
SCAN TIME SEC.............................. .01
CW FREQUENCY MHz........................... 0
ΔF FREQUENCY MHz........................... 0

2. Disconnect PTLO at J2.

With PTLO disconnected, frequency feedback is prevented from reaching the summing junction of the Discriminator and the AFC loop will be unable to lock. The Tuning Voltage (V TUN) should be clamped at – 400 mV by the Low-Frequency Clamp and the voltage off set at U4 pin 3 should be +100mV.

Connect the oscilloscope to pin 25 or 50. Set TIME/DIV to 0.5 msec and VOLT/DIV to 1 volt. Since there is no frequency feedback, the Discriminator output (V FM) should look like the search waveform of Figure C3-34C.

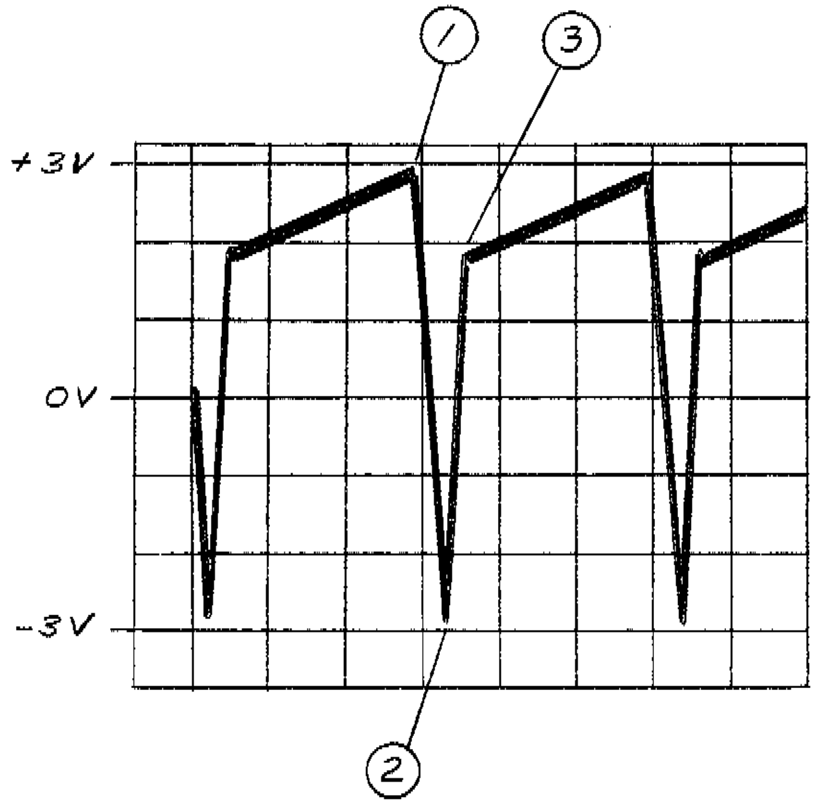


Figure C3-34C. Search Waveform, 0.5 – 13 MHz Range (Pin 25, 50)

The waveform of Figure C3-34C is generated by the Search Control as it attempts to keep V FM in the allowable range and bring it to + 1.5 volts, where the AFC loop will lock if there is frequency feedback. The numbered points of the waveform are described below:

Point 1: Positive limit detector (VR4 and Q20) turns on Q18, causing V FM to slew in the negative direction.

Point 2: Negative limit detector (VR5 and Q21) turns on Q19 (Q18 is turned off since U8A and U8B apply a reset to flip-flop U7A at this point), causing V FM to slew in the positive direction.

Point 3: Reset comparator (U5) turns off Q19 so that no search current is injected into the summing junction. The only current flowing into the summing junction is due to the clamped Tuning Voltage. V FM slews in the positive direction at the reduced slope determined by the Tuning Voltage (clamped at – 400 mV), the offset voltage at U4 pin 3 (+100 mV), and the feedback capacitance on U4 (Q12 should be on, providing maximum feedback capacitance.

0.5 — 130 MHz Range

The front panel controls should be set as for the 0.5 — 13 MHz range except that the RANGE MHz control should be set to 0.5 — 130. The RF input, PTLO, should be disconnected at J2.

With these control settings, the tuning voltage (V TUN) should be clamped at – 40 mV and the offset at U4 pin 3 should be + 10 mV.

Connect the oscilloscope to pin 25 or 50. Set TIME/DIV to 1 msec and VOLT/DIV to 1 volt. The absence of frequency feedback should cause the Search Control and Summing Amplifier to generate the search waveform of Figure C3-34D at the Discriminator output (pin 25, 50).

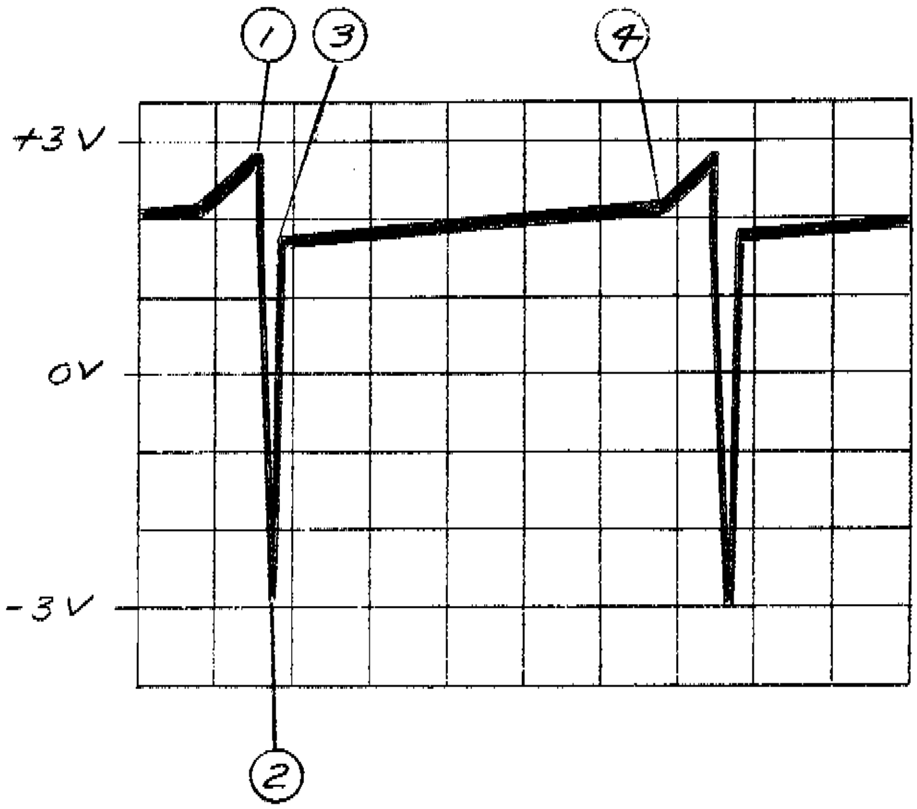


Figure C3-34D. Search Waveform, 0.5 – 130 MHz Range (Pin 25, 50)

Points 1 and 2 of the search waveform in Figure C3-34D correspond exactly to points 1 and 2 in Figure C3-34C, described above. Points 3 and 4 are described below:

Point 3: Reset comparator (U5) turns off Q19 so that no search current is injected into the summing junction. The only current flowing into the summing junction is due to the clamped Tuning Voltage. V FM slews in the positive direction with a reduced slope determined by the Tuning Voltage (clamped at –40mV), the offset voltage at U4 pin 3 (+10 mV), and the feedback capacitance on U4 (since C9 has been discharged by Q16, Q12 should be on, providing maximum capacitance.

Point 4: FETQ12 is turned off by Q9 (C9 is now charged), reducing the feedback capacitance on U4. This causes V FM to slew with an increased slope until the positive limit is reached.

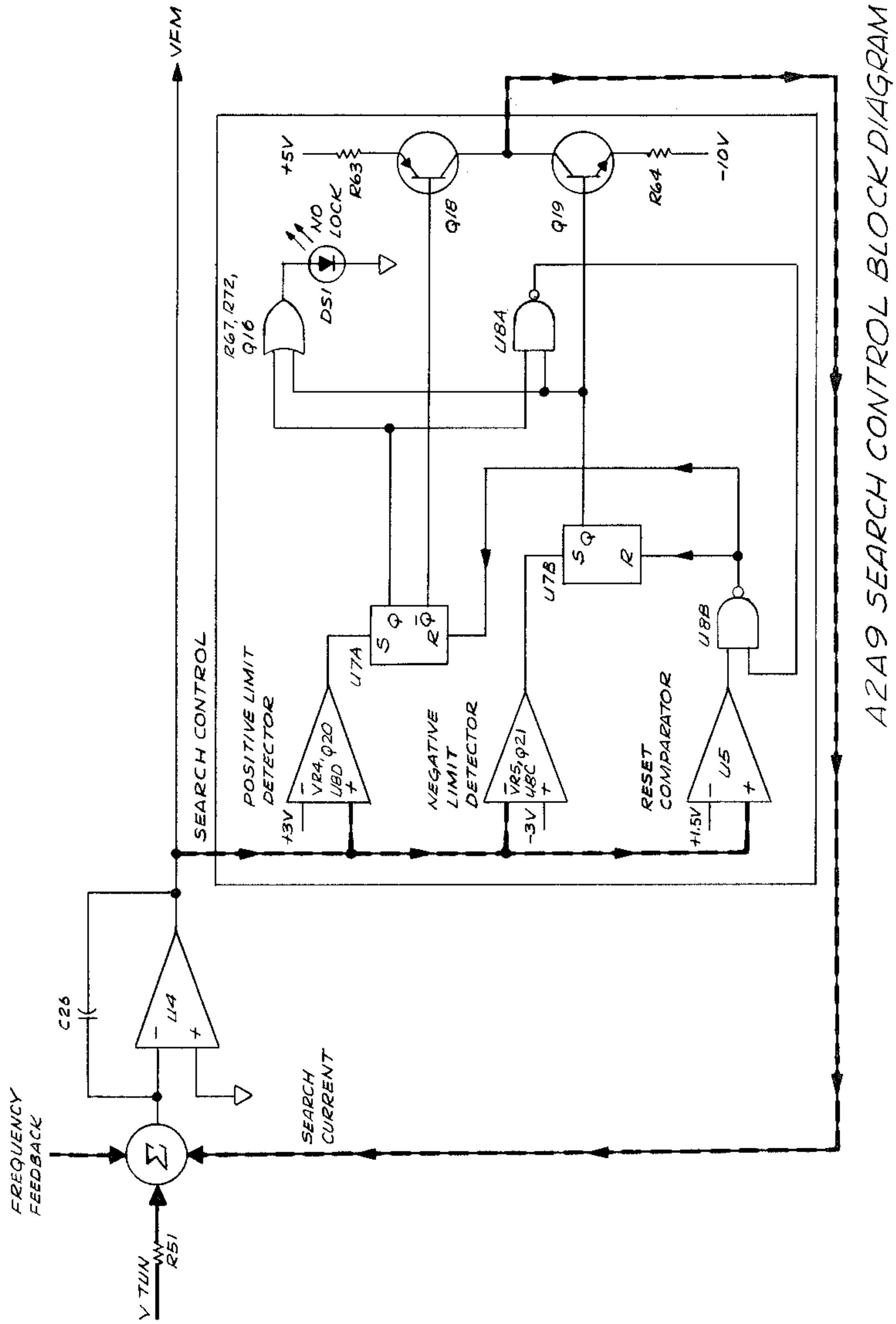
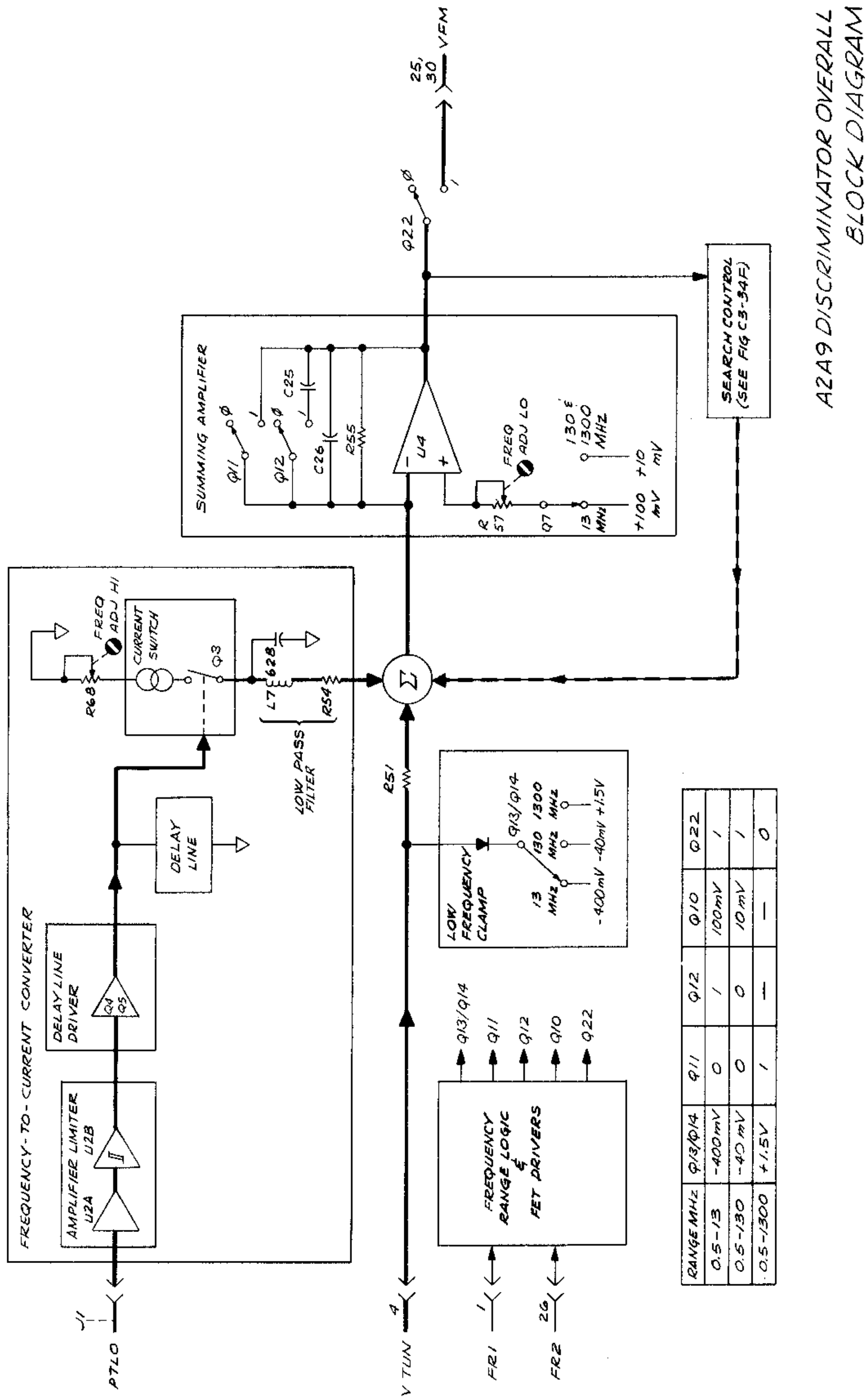


Figure C3-34E. A2A9 Discriminator, Block Diagram (Change 2)



RANGE MHz	Q13/Q14	Q11	Q12	Q10	Q22
0.5-13	-400mV	0	1	100mV	1
0.5-130	-40mV	0	0	10mV	1
0.5-1300	+1.5V	1	—	—	0

Figure C3-34F. A2A9 Discriminator Search Control Circuit, Block Diagram (Change 2)

A2A9

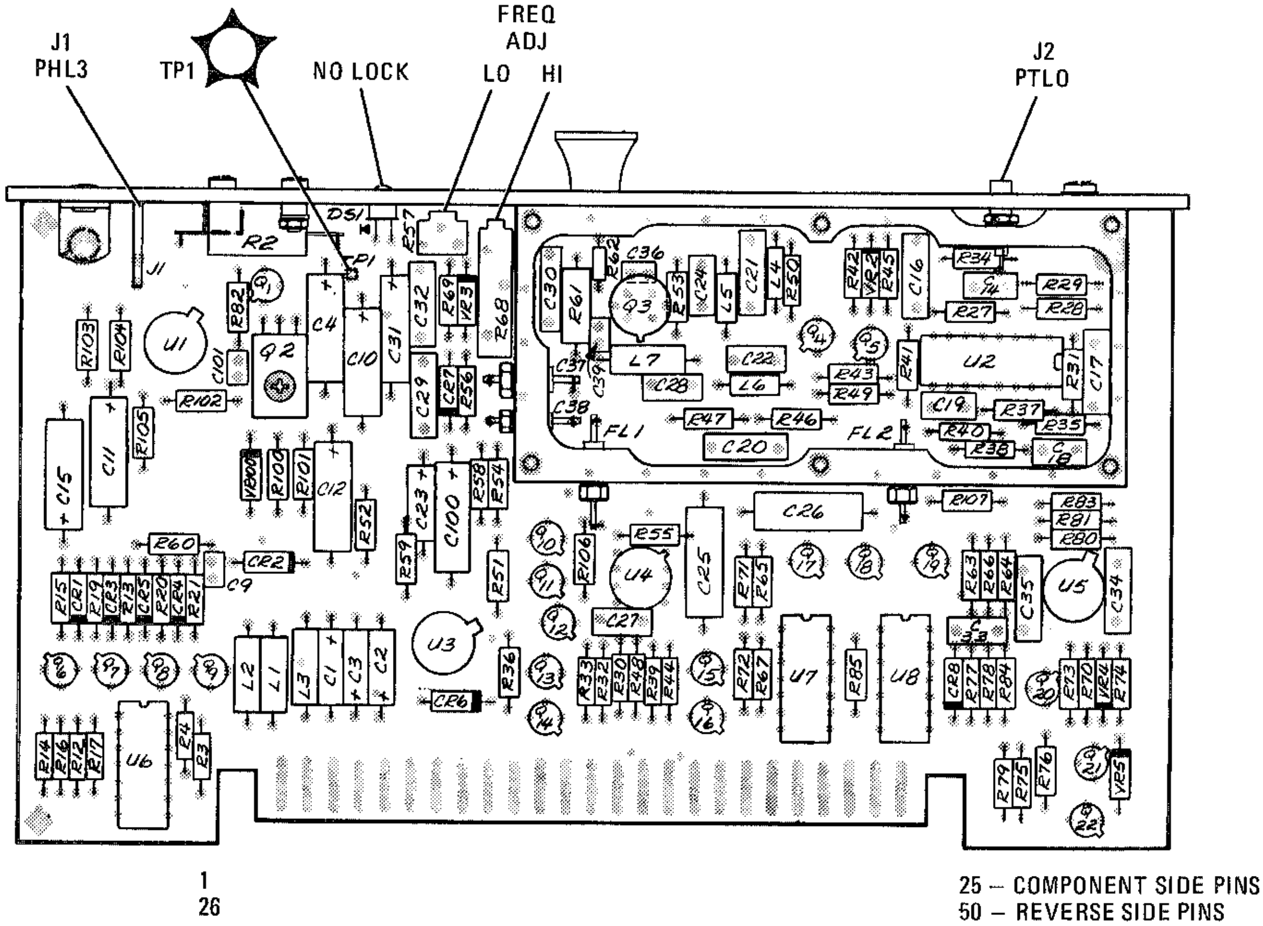
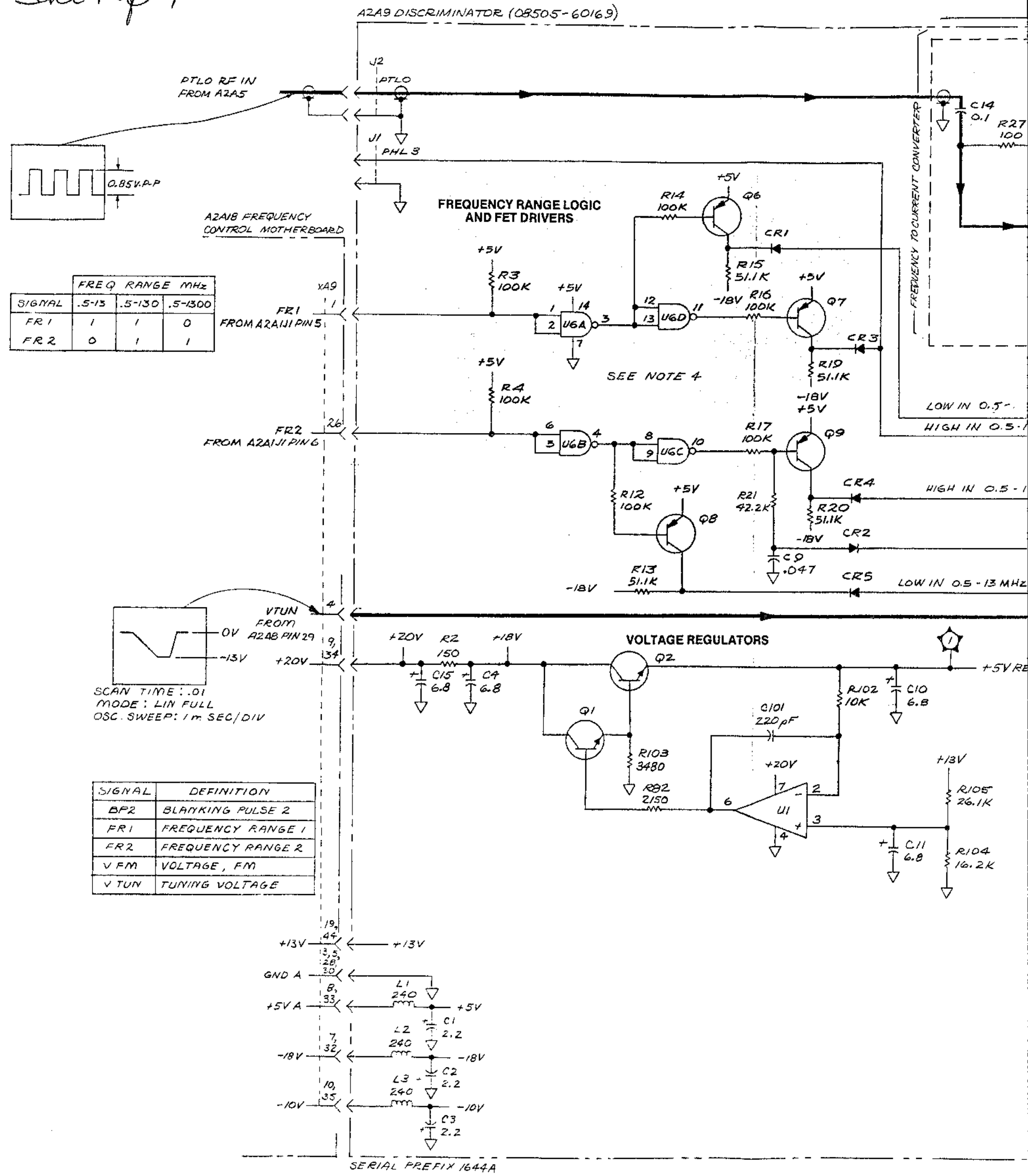


Figure C3-35. A2A9 Discriminator Parts Locations (Change 2)

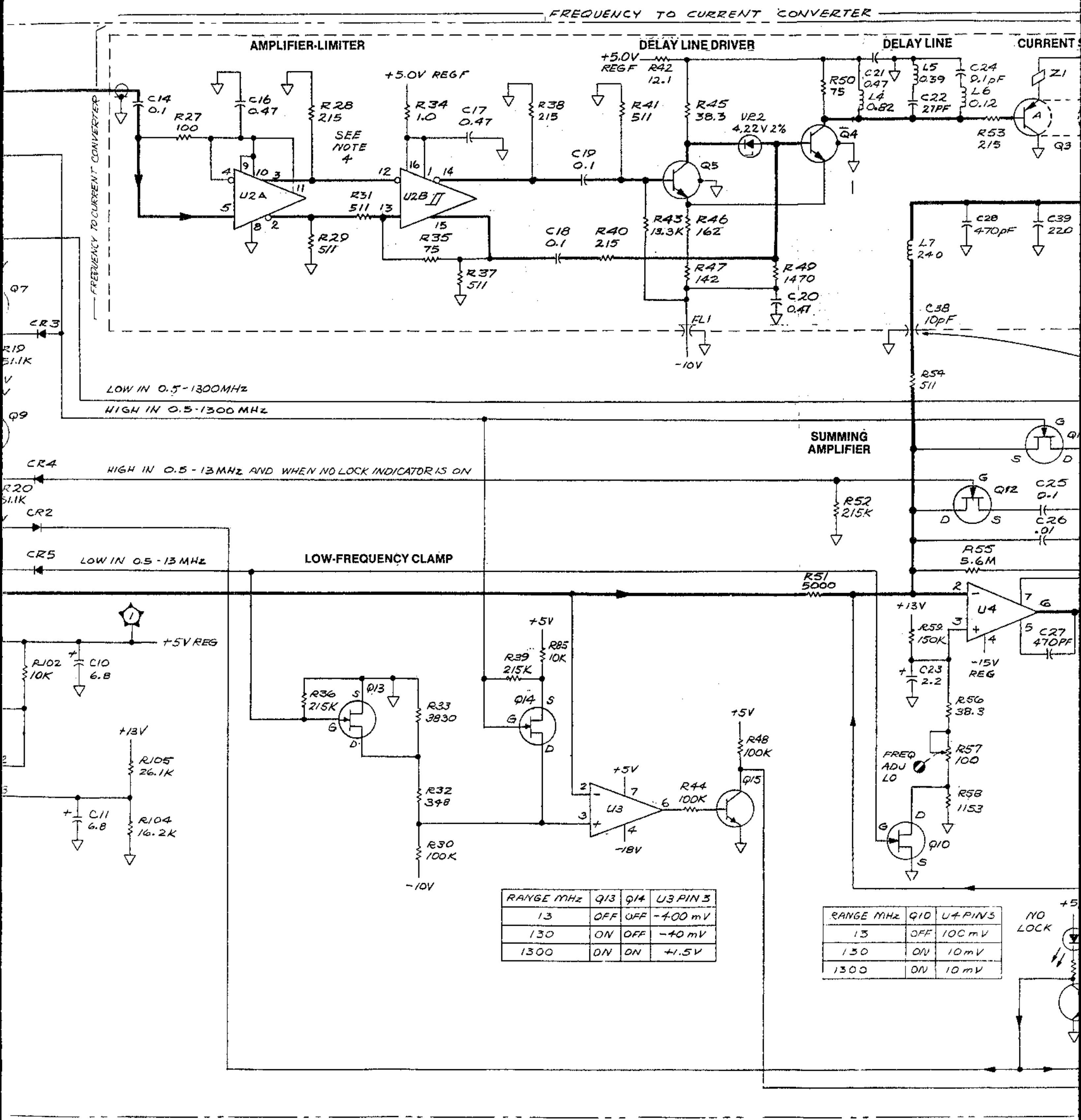
Fig. 3-36
Sht 1 of 4



	FREQ RANGE MHz		
SIGNAL	.5-13	.5-130	.5-1300
FR1	1	1	0
FR2	0	1	1

SIGNAL	DEFINITION
BP2	BLANKING PULSE 2
FR1	FREQUENCY RANGE 1
FR2	FREQUENCY RANGE 2
VFM	VOLTAGE, FM
VTUN	TUNING VOLTAGE

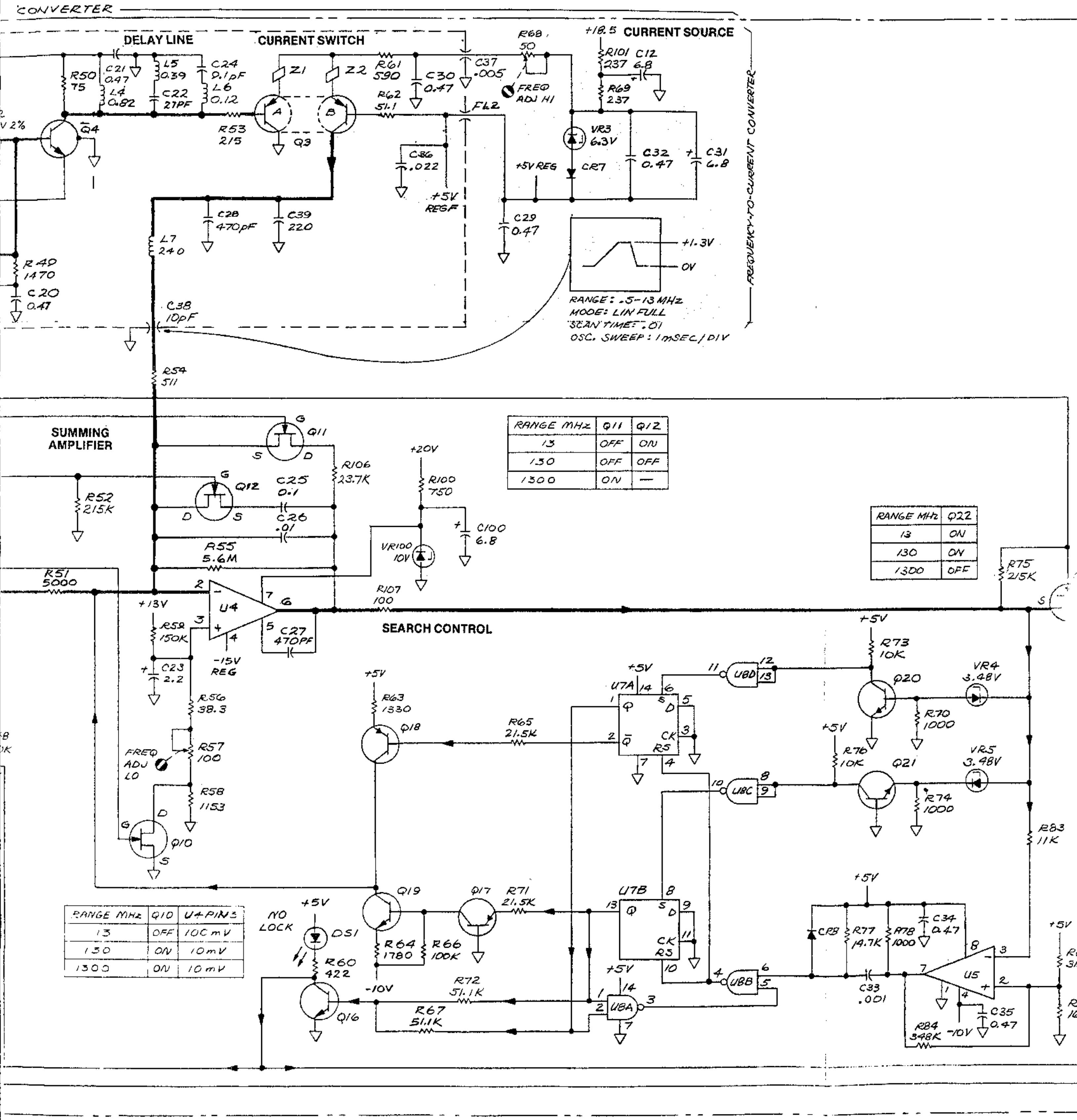
Fig. 3-36
Sht 2 of 4



RANGE MHz	Q13	Q14	U3 PIN 3
13	OFF	OFF	-400 mV
130	ON	OFF	-40 mV
1300	ON	ON	+1.5V

RANGE MHz	Q10	U4 PIN 5
13	OFF	10C mV
130	ON	10 mV
1300	ON	10 mV

Fig 3-36
Sht 3 of 4

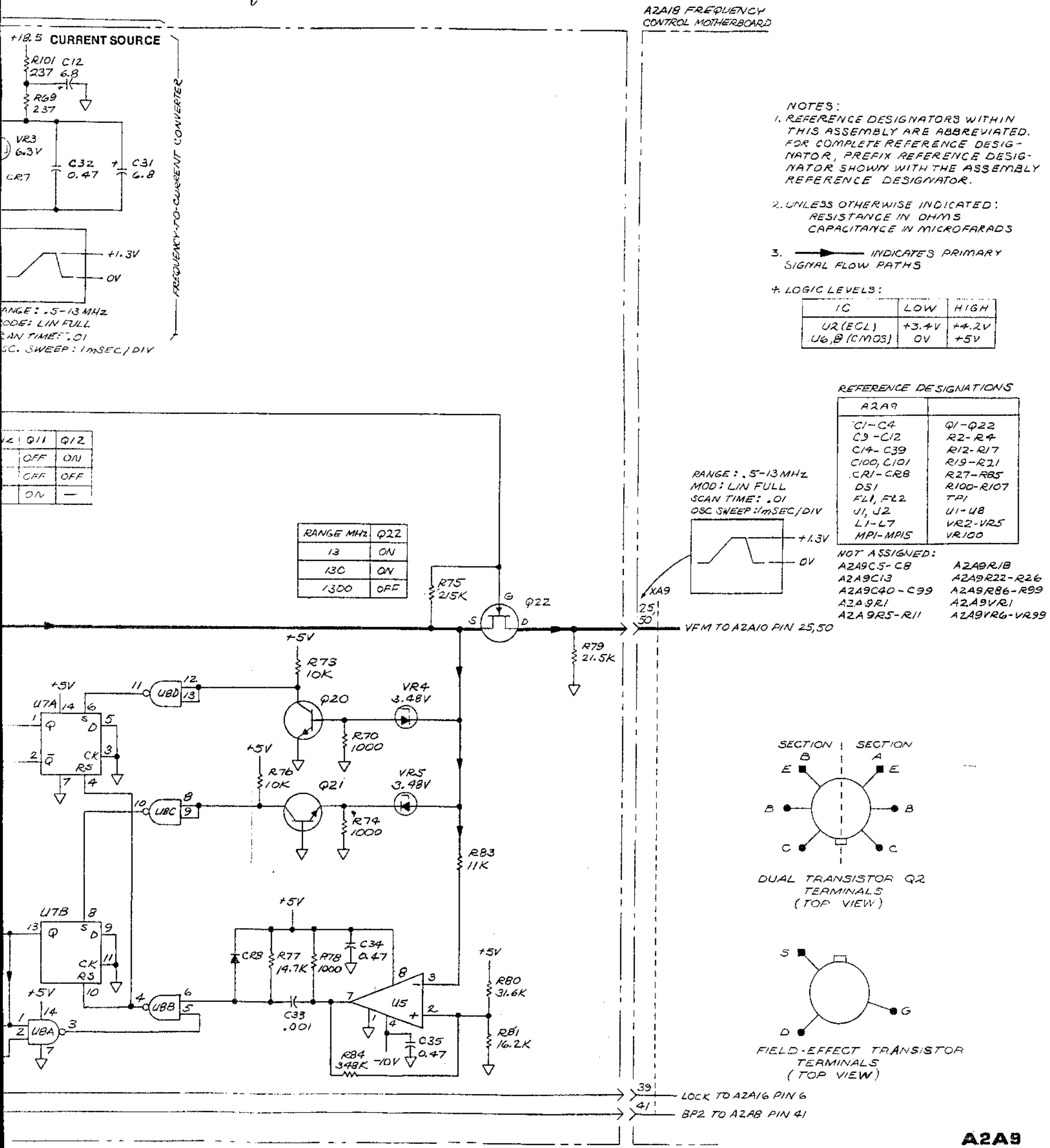


RANGE MHz	Q11	Q12
13	OFF	ON
130	OFF	OFF
1300	ON	—

RANGE MHz	Q22
13	ON
130	ON
1300	OFF

RANGE MHz	Q10	U4 PINS
13	OFF	100 mV
130	ON	10 mV
1300	ON	10 mV

Fig 3-36
Sht 4 of 4



RANGE MHz	Q22
13	ON
130	ON
1300	OFF

NOTES:
1. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. FOR COMPLETE REFERENCE DESIGNATOR, PREFIX REFERENCE DESIGNATOR SHOWN WITH THE ASSEMBLY REFERENCE DESIGNATOR.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS
   CAPACITANCE IN MICROFARADS
3. ——▶—— INDICATES PRIMARY SIGNAL FLOW PATHS
4. LOGIC LEVELS:

IC	LOW	HIGH
U2 (ECL)	+3.4V	+4.2V
U6,8 (CMOS)	0V	+5V

REFERENCE DESIGNATIONS

A2A9	
C1-C4	Q1-Q22
C9-C12	R2-R4
C14-C39	R12-R17
C100, C101	R19-R21
CR1-CR8	R27-R85
DS1	R100-R107
FL1, FL2	TP1
J1, J2	U1-U8
L1-L7	VR2-VR5
MP1-MP15	VR100

NOT ASSIGNED:
A2A9C5-C8
A2A9C13
A2A9C40-C99
A2A9R1
A2A9R5-R11
A2A9R18
A2A9R22-R26
A2A9R86-R99
A2A9VR1
A2A9VR6-VR99

Figure 3-36. A2A9 Discriminator, Schematic (CHANGE 2)

CHANGE 5

Page B2-9, Table B2-2:
Add A1A15A1CR4, HP Part No. 1901-0033, DIODE-GEN PRP 180V 200MA DO-7

Page B2-10, Table B2-2:
Change A1A15A1U1 to HP Part No. 1820-0681, IC GATE TTL S NAND QUAD 2-INP
Change A1A15A2U1 to HP Part No. 1820-0681, IC GATE TTL S NAND QUAD 2-INP

Page B3-45, Figure B3-40:
Add CR4 to A1A15A1 as shown in parts location drawing in this change sheet.

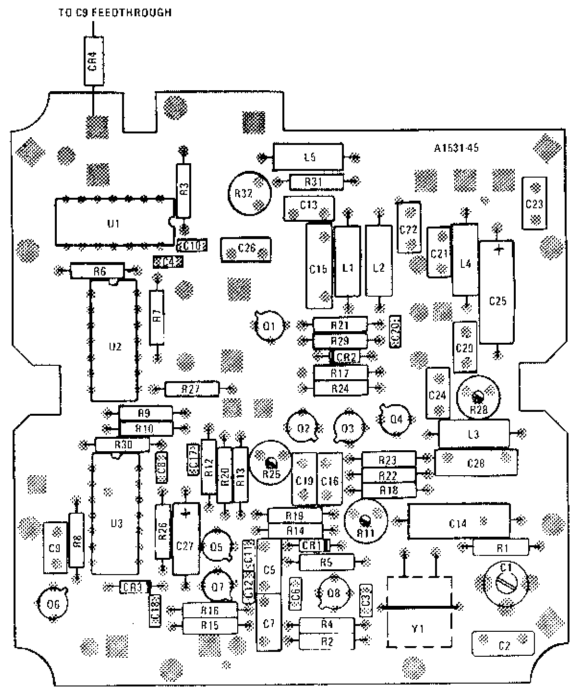
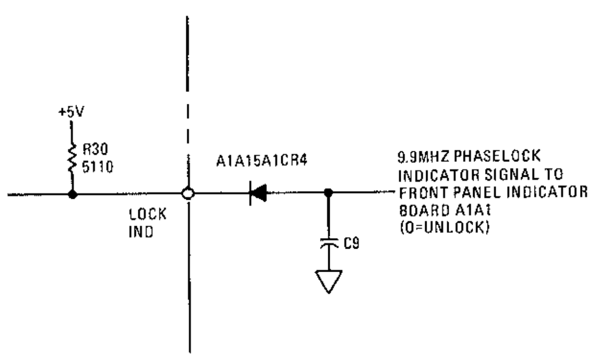


Figure B3-40. A1A15A1 9.9 MHz Phase Lock Board Assembly Parts Locations (CHANGE 5)

Page B3-45, Figure B3-41:
Add Diode A1A15A1CR4 to schematic as shown below.



CHANGE 5 (Cont'd)

Page C2-4, Table C2-2:
Delete A2W15.
Add A2W20, HP Part No. 1250-0669, BARREL MALE TO MALE.
Add A2W107, HP Part Number 08505-60193, CABLE ASSEMBLY, VTN 1, BLUE.
Add A2W108, HP Part Number 08505-60194, CABLE ASSEMBLY, VTN 2, GRAY/BLUE.

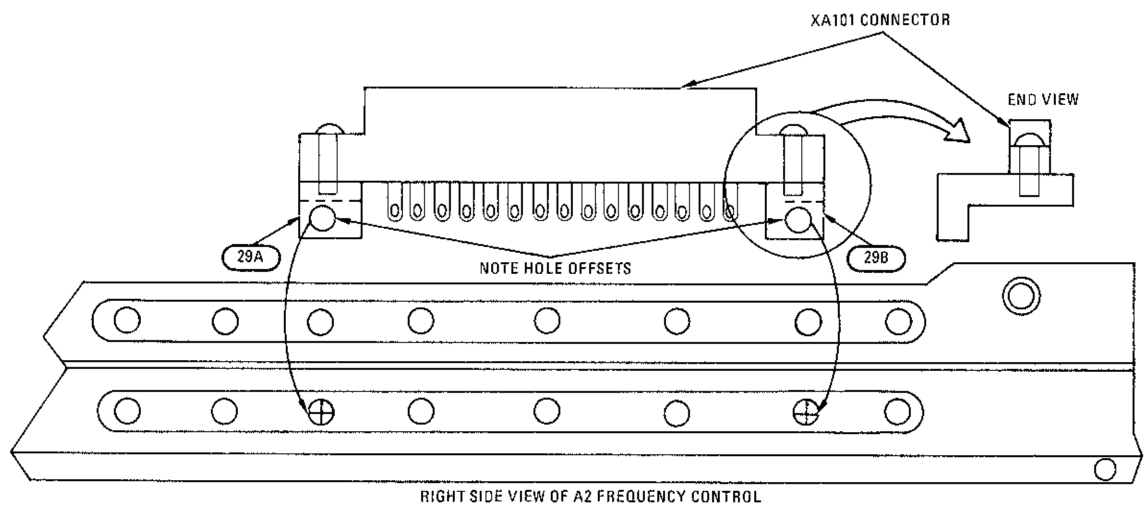
Page C2-9, Table C2-2:
Change A2A4 to HP Part Number 08505-60185 and a complete new listing of component parts for the Scaling Board in this change sheet.

Page C2-20, Table C2-2:
Change A2A10 to HP Part Number 08505-60184 and a complete new listing of component parts for the FM Driver Board in this change sheet.

Page C2-27, Table C2-2:
Add A2XA101, HP Part Number 08505-60186, Connector Assembly.

Page C2-28, Figure C2-1:
Change Item 29 to HP Part Number 08505-00126.
Add Item 29A, HP Part Number 08505-20178, Phase Lock Bracket, Right Hand.
Add Item 29B, HP Part Number 08505-20179, Phase Lock Bracket, Left Hand.
Change Item 32 to HP Part Number 08505-00130.
Change Item 36 to HP Part Number 08505-00131.
Change Item 66 to HP Part Number 08505-00129.

Page C2-30, Figure C2-1 (4 of 4):
Add drawing showing connector XA101 and mounting hardware as shown in this change sheet.



P/O Figure C2-1. A2 Frequency Control Mechanical Parts Location (4 of 4) (CHANGE 5)

P/O Table C2-2. Replaceable Parts (CHANGE 5)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			A2A4 SCALER BOARD		
A2A4	08505-60185	1	BOARD ASSEMBLY, SCALER	28480	08505-60185
A2A4C1	0180-1746	4	CAPACITOR-FXD 15UF+-10% 20VDC TA	04200	150D156X9020B2
A2A4C2	0180-2206	1	CAPACITOR-FXD 60UF+-10% 6VDC TA	04200	150D606X9006B2
A2A4C3	0180-1746		CAPACITOR-FXD 15UF+-10% 20VDC TA	04200	150D156X9020B2
A2A4C4	0180-0116	1	CAPACITOR-FXD 6.8UF+-10% 35VDC TA	04200	150D685X9035B2
A2A4C5	0180-0197	1	CAPACITOR-FXD 2.2UF+-10% 20VDC TA	04200	150D225X9020A2
A2A4C6	0160-2199	1	CAPACITOR-FXD 30PF +-5% 300VDC	28480	0160-2199
A2A4C7	0140-0200	1	CAPACITOR-FXD 390PF +-5% 300VDC MICA	04522	DM15F391J0300WV1CR
A2A4C8	0140-0193	1	CAPACITOR-FXD 82PF +-5% 300VDC	04522	DM15E820J0300WV1CR
A2A4C9			DELETED		
A2A4C10			DELETED		
A2A4C11	0160-0127	1	CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A2A4CR1	1901-0033	7	DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A2A4CR2	1901-0033		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A2A4CR3	1901-0033		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A2A4CR4	1901-0033		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A2A4CR5	1901-0033		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A2A4CR6	1901-0033		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A2A4CR7	1901-0539	2	DIODE-SCHOTTKY	28480	1901-0539
A2A4CR8	1901-0539		DIODE-SCHOTTKY	28480	1901-0539
A2A4CR9	1901-0033		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A2A4J1	1250-0543	2	CONNECTOR-RF SM-SNP M PC 50-OHM	05769	51-053-0000
A2A4J2	08443-00041	1	TEST POINT	28480	08443-00041
A2A4L1	9100-1623	1	COIL-MLD 27UH 5% Q=60 .155DX.375LG	02172	15-4455-2J
A2A4L2	9100-1645	3	COIL-MLD 390UH 5% Q=65 .19DX.44LG	02172	19-1331-25J
A2A4L3	9100-1645		COIL-MLD 390UH 5% Q=65 .19DX.44LG	02172	19-1331-25J
A2A4L4	9100-1645		COIL-MLD 390UH 5% Q=65 .19DX.44LG	02172	19-1331-25J
A2A4MP1	5000-9043	2	PIN:P.C. BOARD EXTRACTOR	28480	5000-9043
A2A4MP2	5040-6848	1	EXTRACTOR, BOARD, YELLOW	28480	5040-6848
A2A4MP3	08505-00131	1	COVER, SCALING BOARD	28480	08505-00131
A2A4Q1	1855-0020	3	TRANSISTOR J-FET N-CHAN D-MODE TO-18 SI	28480	1855-0020
A2A4Q2	1853-0050	1	TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0050
A2A4Q3	1854-0404	5	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A2A4Q4	1854-0404		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A2A4Q5	1854-0404		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A2A4Q6	1854-0404		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A2A4Q7	1855-0020		TRANSISTOR J-FET N-CHAN D-MODE TO-18 SI	28480	1855-0020
A2A4Q8	1854-0404		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A2A4Q9	1855-0020		TRANSISTOR J-FET N-CHAN D-MODE TO-18 SI	28480	1855-0020
A2A4R1	0757-0465	10	RESISTOR 100K 1% .125W F TC=0+-100	03292	C4-1/8-T0-1003-F
A2A4R2	0757-0465		RESISTOR 100K 1% .125W F TC=0+-100	03292	C4-1/8-T0-1003-F
A2A4R3	0757-0465		RESISTOR 100K 1% .125W F TC=0+-100	03292	C4-1/8-T0-1003-F
A2A4R4	0757-0465		RESISTOR 100K 1% .125W F TC=0+-100	03292	C4-1/8-T0-1003-F
A2A4R5	0757-0438	7	RESISTOR 5.11K 1% .125W F TC=0+-100	03292	C4-1/8-T0-5111-F
A2A4R6	0757-0465		RESISTOR 100K 1% .125W F TC=0+-100	03292	C4-1/8-T0-1003-F
A2A4R7	0757-0458	5	RESISTOR 51.1K 1% .125W F TC=0+-100	03292	C4-1/8-T0-5112-F
A2A4R8	0757-0465		RESISTOR 100K 1% .125W F TC=0+-100	03292	C4-1/8-T0-1003-F
A2A4R9	0757-0465		RESISTOR 100K 1% .125W F TC=0+-100	03292	C4-1/8-T0-1003-F
A2A4R10	0757-0458		RESISTOR 51.1K 1% .125W F TC=0+-100	03292	C4-1/8-T0-5112-F
A2A4R11	0757-0458		RESISTOR 51.1K 1% .125W F TC=0+-100	03292	C4-1/8-T0-5112-F
A2A4R12	0757-0458		RESISTOR 51.1K 1% .125W F TC=0+-100	03292	C4-1/8-T0-5112-F
A2A4R13	0757-0465		RESISTOR 100K 1% .125W F TC=0+-100	03292	C4-1/8-T0-1003-F
A2A4R14	2100-3273	1	RESISTOR-TRMR 2K 10% C SIDE-ADJ 1-TRN	04568	72-144-0
A2A4R15	0698-3440	1	RESISTOR 196 1% .125W F TC=0+-100	03292	C4-1/8-T0-196R-F
A2A4R16	2100-3352	1	RESISTOR-TRMR 1K 10% C SIDE-ADJ 1-TRN	04568	72-143-0
A2A4R17	0683-1055	1	RESISTOR 1M 5% .25W FC TC=-800/+900	01607	CB1055
A2A4R18	0698-3162	1	RESISTOR 46.4K 1% .125W F TC=0+-100	03292	C4-1/8-T0-4642-F
A2A4R19	0698-3136	1	RESISTOR 17.8K 1% .125W F TC=0+-100	03292	C4-1/8-T0-1782-F
A2A4R20	0757-0401	1	RESISTOR 100 1% .125W F TC=0+-100	03292	C4-1/8-T0-101-F
A2A4R21	0757-0438		RESISTOR 5.11K 1% .125W F TC=0+-100	03292	C4-1/8-T0-5111-F
A2A4R22	0757-0438		RESISTOR 5.11K 1% .125W F TC=0+-100	03292	C4-1/8-T0-5111-F
A2A4R23	0757-0438		RESISTOR 5.11K 1% .125W F TC=0+-100	03292	C4-1/8-T0-5111-F
A2A4R24	2100-3350	2	RESISTOR-TRMR 200 10% C SIDE-ADJ 1-TRN	04568	72-141-0
A2A4R25	2100-3350		RESISTOR-TRMR 200 10% C SIDE-ADJ 1-TRN	04568	72-141-0
A2A4R26	0757-0465		RESISTOR 100K 1% .125W F TC=0+-100	03292	C4-1/8-T0-1003-F
A2A4R27	0757-0438		RESISTOR 5.11K 1% .125W F TC=0+-100	03292	C4-1/8-T0-5111-F
A2A4R28	0698-3457	4	RESISTOR 316K 1% .125W F TC=0+-100	02995	MF4C-1
A2A4R29	0698-3457		RESISTOR 316K 1% .125W F TC=0+-100	02995	MF4C-1
A2A4R30	0757-0346	6	RESISTOR 10 1% .125W F TC=0+-100	03292	C4-1/8-T0-10R0-F

P/O Table C2-2. Replaceable Parts (CHANGE 5)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A2A4R31	0757-0346		RESISTOR 10 1% .125W F TC=0+-100	03292	C4-1/8-T0-10R0-F
A2A4R32	0757-0346		RESISTOR 10 1% .125W F TC=0+-100	03292	C4-1/8-T0-10R0-F
A2A4R33	0698-3457		RESISTOR 316K 1% .125W F TC=0+-100	02995	MF4C-1
A2A4R34	0698-3457		RESISTOR 316K 1% .125W F TC=0+-100	02995	MF4C-1
A2A4R35	0757-0346		RESISTOR 10 1% .125W F TC=0+-100	03292	C4-1/8-T0-10R0-F
A2A4R36	0757-0346		RESISTOR 10 1% .125W F TC=0+-100	03292	C4-1/8-T0-10R0-F
A2A4R37	0757-0346		RESISTOR 10 1% .125W F TC=0+-100	03292	C4-1/8-T0-10R0-F
A2A4R38	0698-3449	1	RESISTOR 28.7K 1% .125W F TC=0+-100	03292	C4-1/8-T0-2872-F
A2A4R39	0757-0458		RESISTOR 51.1K 1% .125W F TC=0+-100	03292	C4-1/8-T0-5112-F
A2A4R40	2100-3207	1	RESISTOR-TRMR 5K 10% C SIDE-ADJ 1-TRN	04568	72-145-0
A2A4R41	0698-7236	1	RESISTOR 1K 1% .05W F TC=0+-100	03292	C3-1/8-T0-1001-G
A2A4R42	0757-0199	1	RESISTOR 21.5K 1% .125W F TC=0+-100	03292	C4-1/8-T0-2152-F
A2A4R43	0757-0465		RESISTOR 100K 1% .125W F TC=0+-100	03292	C4-1/8-T0-1003-F
A2A4U1	1810-0221	2	NETWORK-RES 14-PIN-DIP .1-PIN-SPCG	28480	1810-0221
A2A4U2	1826-0249	1	IC OP AMP	03285	AD504J
A2A4U3	1820-1545	10	IC DSEL/MULTIPLXR CMOS TPL	02037	MC14053BCL
A2A4U4	1820-1545		IC DSEL/MULTIPLXR CMOS TPL	02037	MC14053BCL
A2A4U5	1826-0229	2	IC OP AMP	02180	OP-05CJ
A2A4U6	1810-0221		NETWORK-RES 14-PIN-DIP .1-PIN-SPCG	28480	1810-0221
A2A4U7	1820-1536	2	IC GATE CMOS EXCL-OR QUAD 2-INP	01921	CD4030AF
A2A4U8	1820-1545		IC DSEL/MULTIPLXR CMOS TPL	02037	MC14053BCL
A2A4U9	1820-1545		IC DSEL/MULTIPLXR CMOS TPL	02037	MC14053BCL
A2A4U10	1820-1545		IC DSEL/MULTIPLXR CMOS TPL	02037	MC14053BCL
A2A4U11	1820-1545		IC DSEL/MULTIPLXR CMOS TPL	02037	MC14053BCL
A2A4U12	1820-1536		IC GATE CMOS EXCL-OR QUAD 2-INP	01921	CD4030AF
A2A4U13	1820-1534	3	IC GATE CMOS NOR QUAD 2-INP	01921	CD4001AF
A2A4U14	1820-1545		IC DSEL/MULTIPLXR CMOS TPL	02037	MC14053BCL
A2A4U15	1820-1545		IC DSEL/MULTIPLXR CMOS TPL	02037	MC14053BCL
A2A4U16	1820-1545		IC DSEL/MULTIPLXR CMOS TPL	02037	MC14053BCL
A2A4U17	1820-1545		IC DSEL/MULTIPLXR CMOS TPL	02037	MC14053BCL
A2A4U18	1820-1534		IC GATE CMOS NOR QUAD 2-INP	01921	CD4001AF
A2A4U19	1820-1540	6	IC LCH CMOS D-TYPE QUAD	01921	CD4042AF
A2A4U20	1820-1540		IC LCH CMOS D-TYPE QUAD	01921	CD4042AF
A2A4U21	1820-1540		IC LCH CMOS D-TYPE QUAD	01921	CD4042AF
A2A4U22	1820-1538	4	IC GATE CMOS NAND QUAD 2-INP	01921	CD4011AF
A2A4U23	1820-1534		IC GATE CMOS NOR QUAD 2-INP	01921	CD4001AF
A2A4U24	1820-1531	1	IC FF CMOS D-TYPE POS-EDGE-TRIG DUAL	01921	CD4013AF
A2A4U25	1820-1538		IC GATE CMOS NAND QUAD 2-INP	01921	CD4011AF
A2A4U26	1820-1538		IC GATE CMOS NAND QUAD 2-INP	01921	CD4011AF
A2A4U27	1820-1538		IC GATE CMOS NAND QUAD 2-INP	01921	CD4011AF
A2A4U28	1820-1540		IC LCH CMOS D-TYPE QUAD	01921	CD4042AF
A2A4U29	1820-1540		IC LCH CMOS D-TYPE QUAD	01921	CD4042AF
A2A4U30	1820-1540		IC LCH CMOS D-TYPE QUAD	01921	CD4042AF
			A2A10 FM DRIVER BOARD		
A2A10	08505-60184	1	BOARD ASSEMBLY, FM DRIVER	28480	08505-60184
A2A10C1	0160-2307	1	CAPACITOR-FXD 47PF +-5% 300VDC	28480	0160-2307
A2A10C2	0160-2230	3	CAPACITOR-FXD 3300PF +-5% 300VDC	28480	0160-2230
A2A10C3	0160-2230		CAPACITOR-FXD 3300PF +-5% 300VDC	28480	0160-2230
A2A10C4	0160-0945	1	CAPACITOR-FXD 910PF +-5% 100VDC MICA0+70	28480	0160-0945
A2A10C5	0160-2209	1	CAPACITOR-FXD 360PF +-5% 300VDC MICA0+70	28480	0160-2209
A2A10C6	0160-3539	1	CAPACITOR-FXD 820PF +-5% 100VDC MICA0+70	28480	0160-3539
A2A10C7	0160-2230		CAPACITOR-FXD 3300PF +-5% 300VDC	28480	0160-2230
A2A10C8	0180-2141	1	CAPACITOR-FXD 3.3UF+-10% 50VDC TA	04200	150D335X9050B2
A2A10C9	0160-0161	3	CAPACITOR-FXD .01UF +-10% 200VDC POLYE	04200	292P10392
A2A10C10	0160-3537	1	CAPACITOR-FXD 680PF +-5% 100VDC MICA0+70	28480	0160-3537
A2A10C11	0180-1746		CAPACITOR-FXD 15UF+-10% 20VDC TA	04200	150D156X9020B2
A2A10C12	0160-0161		CAPACITOR-FXD .01UF +-10% 200VDC POLYE	04200	292P10392
A2A10C13	0180-1746		CAPACITOR-FXD 15UF+-10% 20VDC TA	04200	150D156X9020B2
A2A10C14	0160-0161		CAPACITOR-FXD .01UF +-10% 200VDC POLYE	04200	292P10392
A2A10CR1	1901-0040	3	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2A10CR2	1901-0040	2	DIODE-SWITCHING 1N4004 30V 50MA 2NS DO-35	28480	1901-0040
A2A10CR3	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2A10CR4	1901-0743		DIODE-PWR RECT 400V 1 AMP DO-41	01698	1N4004
A2A10CR5	1901-0743		DIODE-PWR RECT 1N4004 400V 1 AMP DO-41	01698	1N4004
A2A10J1	1250-0543		CONNECTOR-RF SM-SNP M PC 50-OHM	05769	51-053-0000
A2A10L1	9100-2585	2	COIL-MLD 10MH 10% Q=40 .156DX.375LG	02172	15B-103K
A2A10L2	9100-2585		COIL-MLD 10MH 10% Q=40 .156DX.375LG	02172	15B-103K
A2A10MP1	5000-9043		PIN:P.C. BOARD EXTRACTOR	28480	5000-9043
A2A10MP2	5040-6843	1	EXTRACTOR, P.C. BOARD	28480	5040-6843
A2A10MP3	0340-0162	2	INSULATOR-XSTR ALUMINUM	28480	0340-0162
A2A10MP4	0340-0162		INSULATOR-XSTR ALUMINUM	28480	0340-0162
A2A10MP5	0590-0519	8	THREADED INSERT-NUT 4-40 .062-LG STL	28480	0590-0519
A2A10MP6	0590-0519		THREADED INSERT-NUT 4-40 .062-LG STL	28480	0590-0519
A2A10MP7	0590-0519		THREADED INSERT-NUT 4-40 .062-LG STL	28480	0590-0519
A2A10MP8	0590-0519		THREADED INSERT-NUT 4-40 .062-LG STL	28480	0590-0519
A2A10MP9	0590-0519		THREADED INSERT-NUT 4-40 .062-LG STL	28480	0590-0519
A2A10MP10	0590-0519		THREADED INSERT-NUT 4-40 .062-LG STL	28480	0590-0519

P/O Table C2-2. Replaceable Parts (CHANGE 5)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A2A10MP11	0590-0519		THREADED INSERT-NUT 4-40 .062-LG STL	28480	0590-0519
A2A10MP12	0590-0519		THREADED INSERT-NUT 4-40 .062-LG STL	28480	0590-0519
A2A10MP13	2200-0103	4	SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	28480	2200-0103
A2A10MP14	2200-0103		SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	28480	2200-0103
A2A10MP15	2200-0103		SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	28480	2200-0103
A2A10MP16	2200-0103		SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	28480	2200-0103
A2A10MP17	2200-0113	4	SCREW-MACH 4-40 .625-IN-LG PAN-HD-POZI	28480	2200-0113
A2A10MP18	2200-0113		SCREW-MACH 4-40 .625-IN-LG PAN-HD-POZI	28480	2200-0113
A2A10MP19	2200-0113		SCREW-MACH 4-40 .625-IN-LG PAN-HD-POZI	28480	2200-0113
A2A10MP20	2200-0113		SCREW-MACH 4-40 .625-IN-LG PAN-HD-POZI	28480	2200-0113
A2A10MP21	08505-20135	1	SHIELD	28480	08505-20135
A2A10MP22	08505-20136	1	BASE, SHIELD	28480	08505-20136
A2A10MP23	1205-0012	1	HEAT SINK TO-18-PKG	28480	1205-0012
A2A10MP24	08505-00130	1	FM DRIVER COVER	28480	08505-00130
A2A10Q1	1853-0007	1	TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	02037	2N3251
A2A10Q2	1854-0237	1	TRANSISTOR NPN SI TO-66 PD=20W FT=10MHZ	28480	1854-0237
A2A10Q3	1854-0039	1	TRANSISTOR NPN 2N3053S SI TO-39 PD=1W	02037	2N3053
A2A10Q4	1853-0052	1	TRANSISTOR PNP 2N3740 SI TO-66 PD=25W	02037	2N3740
A2A10Q5	1854-0475	1	TRANSISTOR-DUAL NPN PD=750MW	28480	1854-0475
A2A10R1	0698-3160	1	RESISTOR 31.6K 1% .125W F TC=0+-100	03292	C4-1/8-T0-3162-F
A2A10R2	0757-0442	2	RESISTOR 10K 1% .125W F TC=0+-100	03292	C4-1/8-T0-1002-F
A2A10R3	0757-0438		RESISTOR 5.11K 1% .125W F TC=0+-100	03292	C4-1/8-T0-5111-F
A2A10R4	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	03292	C4-1/8-T0-1002-F
A2A10R5	0698-3151	1	RESISTOR 2.87K 1% .125W F TC=0+-100	03292	C4-1/8-T0-2871-F
A2A10R6	0698-0084	2	RESISTOR 2.15K 1% .125W F TC=0+-100	03292	C4-1/8-T0-2151-F
A2A10R7	0757-0422	3	RESISTOR 909 1% .125W F TC=0+-100	03292	C4-1/8-T0-909R-F
A2A10R8	0757-0438		RESISTOR 5.11K 1% .125W F TC=0+-100	03292	C4-1/8-T0-5111-F
A2A10R9	0757-0290	1	RESISTOR 6.19K 1% .125W F TC=0+-100	02995	MF4C1/8-T0-6191-F
A2A10R10	0757-0280	1	RESISTOR 1K 1% .125W F TC=0+-100	03292	C4-1/8-T0-1001-F
A2A10R11	0698-3132	1	RESISTOR 261 1% .125W F TC=0+-100	03292	C4-1/8-T0-2610-F
A2A10R12	0757-0422		RESISTOR 909 1% .125W F TC=0+-100	03292	C4-1/8-T0-909R-F
A2A10R13	0757-0422		RESISTOR 909 1% .125W F TC=0+-100	03292	C4-1/8-T0-909R-F
A2A10R14	0698-3631	1	RESISTOR 330 5% 2W MO TC=0+-200	03412	FP-42
A2A10R15	0698-3430	3	RESISTOR 21.5 1% .125W F TC=0+-100	01992	PME55-1/8-T0-21R5-F
A2A10R16	0757-1090	1	RESISTOR 261 1% .5W F TC=0+-100	02995	MF7C1/2-T0-261R-F
A2A10R17	0698-3430		RESISTOR 21.5 1% .125W F TC=0+-100	01992	PME55-1/8-T0-21R5-F
A2A10R18	0698-3430		RESISTOR 21.5 1% .125W F TC=0+-100	01992	PME55-1/8-T0-21R5-F
A2A10R19	0698-3607	1	RESISTOR 18 5% 2W MO TC=0+-200	03412	FP42-2-T00-18R0-J
A2A10R20	0757-0394	1	RESISTOR 51.1 1% .125W F TC=0+-100	03292	C4-1/8-T0-51R1-F
A2A10R21	0698-3603	1	RESISTOR 12 5% 2W MO TC=0+-200	03412	FP42-2-T00-12R0-J
A2A10R22	0698-0084		RESISTOR 2.15K 1% .125W F TC=0+-100	03292	C4-1/8-T0-2151-F
A2A10U1	1826-0229		IC OP AMP	02180	OP-05CJ

CHANGE 5 (Cont'd)

Page C3-66, Figure C3-25:
Replace Figure C3-25 with new Parts Location drawing of A2A4 in this change sheet.

Page C3-67, Figure C3-26:
Replace Figure C3-26 with new Schematic of A2A4 in this change sheet.

Page C3-91, Figure C3-37:
Replace Figure C3-37 with new Parts Location drawing of A2A10 in this change sheet.

Page C3-91, Figure C3-38:
Replace Figure C3-38 with new Schematic of A2A10 in this change sheet.

Page C3-105/106:
Add new Figures C3-48 and C3-49 in this change sheet.

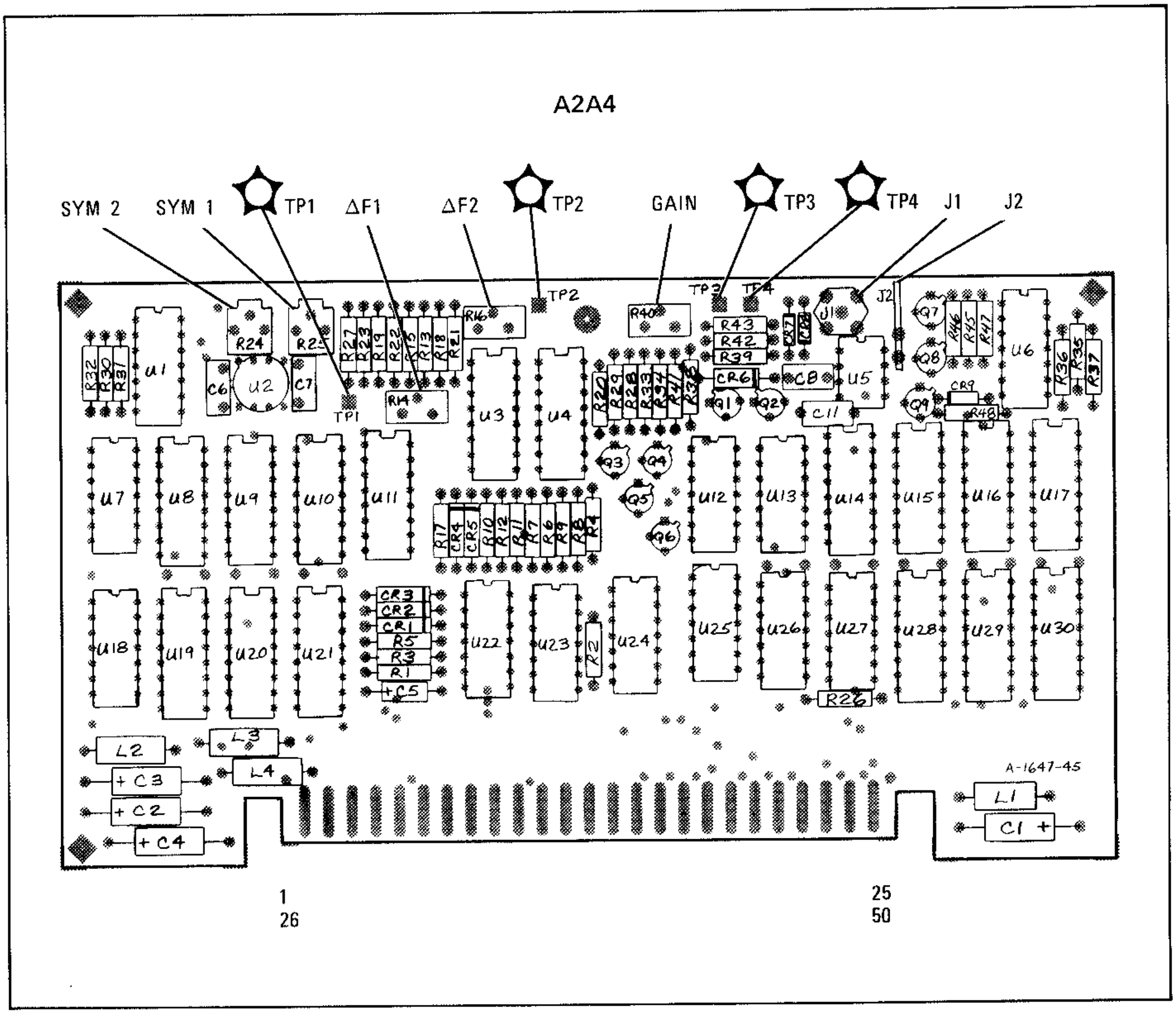
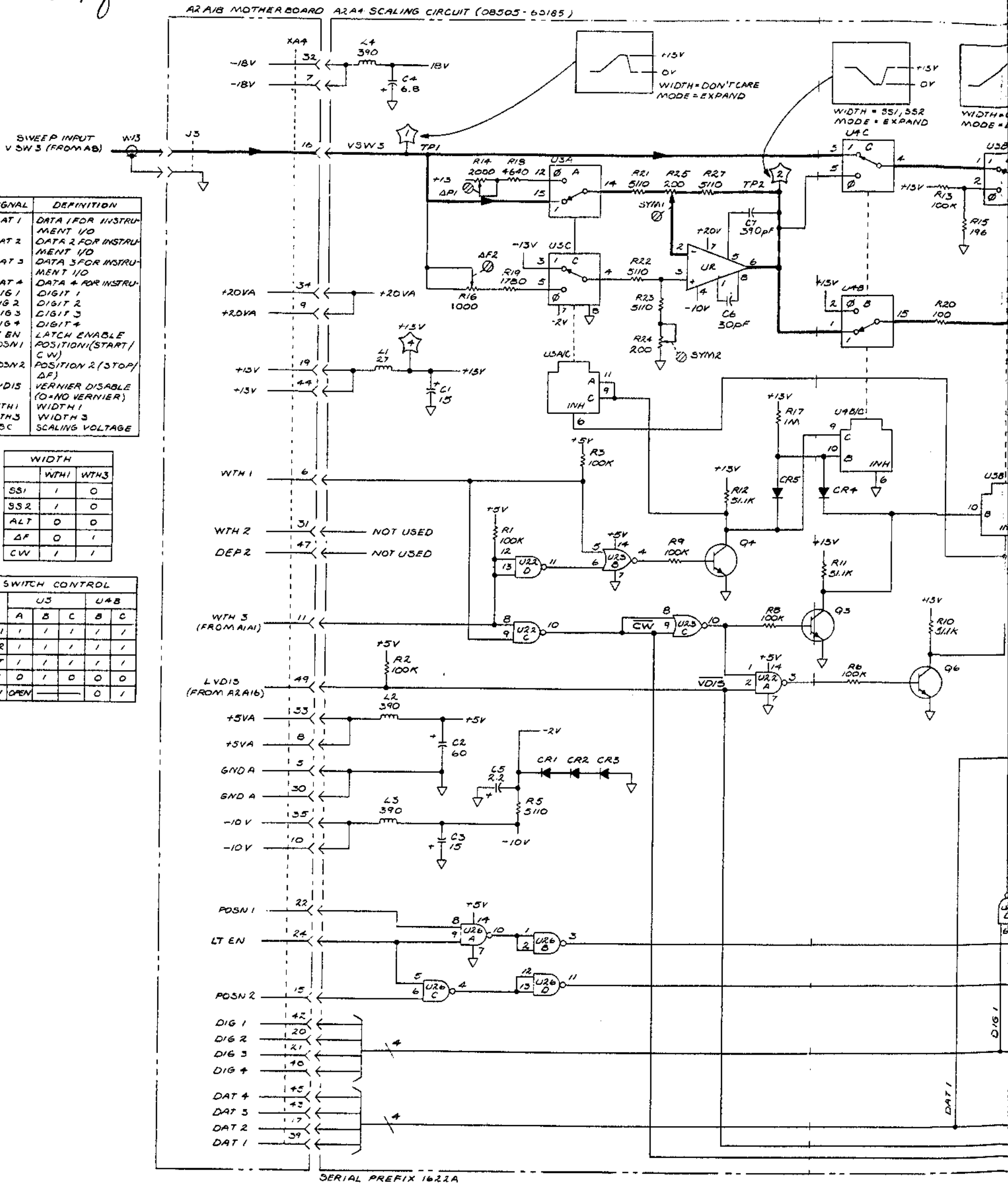


Figure C3-25. A2A4 Scaling Circuit, Parts Location (CHANGE 5)

Fig C3-26
Sht 1 of 5



SIGNAL	DEFINITION
DAT 1	DATA 1 FOR INSTRUMENT I/O
DAT 2	DATA 2 FOR INSTRUMENT I/O
DAT 3	DATA 3 FOR INSTRUMENT I/O
DAT 4	DATA 4 FOR INSTRU-
DIG 1	DIGIT 1
DIG 2	DIGIT 2
DIG 3	DIGIT 3
DIG 4	DIGIT 4
LT EN	LATCH ENABLE
POSN 1	POSITION 1 (START/CW)
POSN 2	POSITION 2 (STOP/ΔF)
LVDIS	VERNIER DISABLE (0=NO VERNIER)
WTH 1	WIDTH 1
WTH 3	WIDTH 3
VSC	SCALING VOLTAGE

WIDTH		
	WTH1	WTH3
SS1	1	0
SS2	1	0
ALT	0	0
ΔF	0	1
CW	1	1

SWITCH CONTROL					
	U3			U4B	
	A	B	C	B	C
SS1	1	1	1	1	1
SS2	1	1	1	1	1
ALT	1	1	1	1	1
ΔF	0	1	0	0	0
CW	OPEN	—	—	0	1

Fig. C3-26
Sht 2 of 5

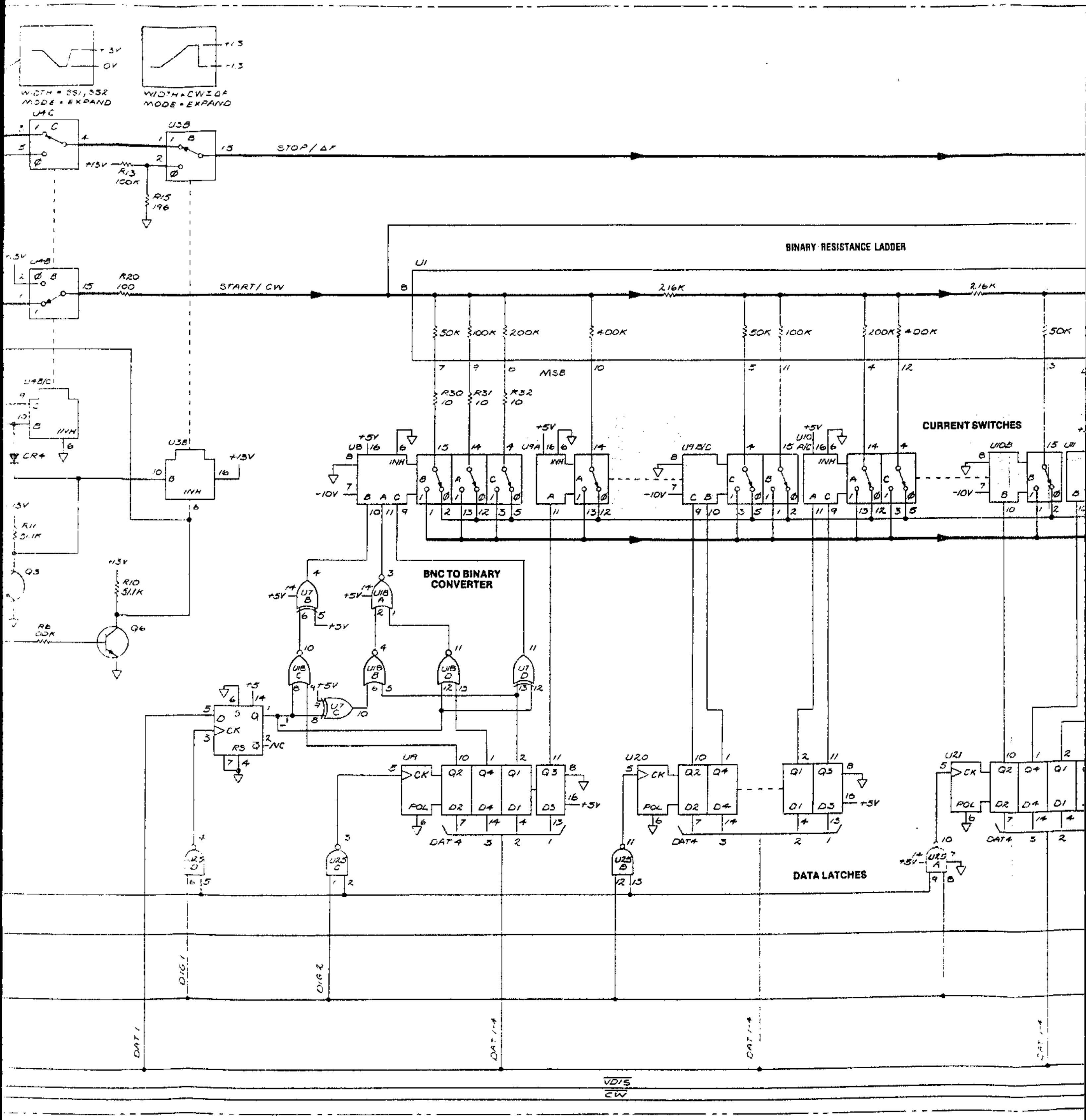


Fig. C3-26
Sht 3 of 5

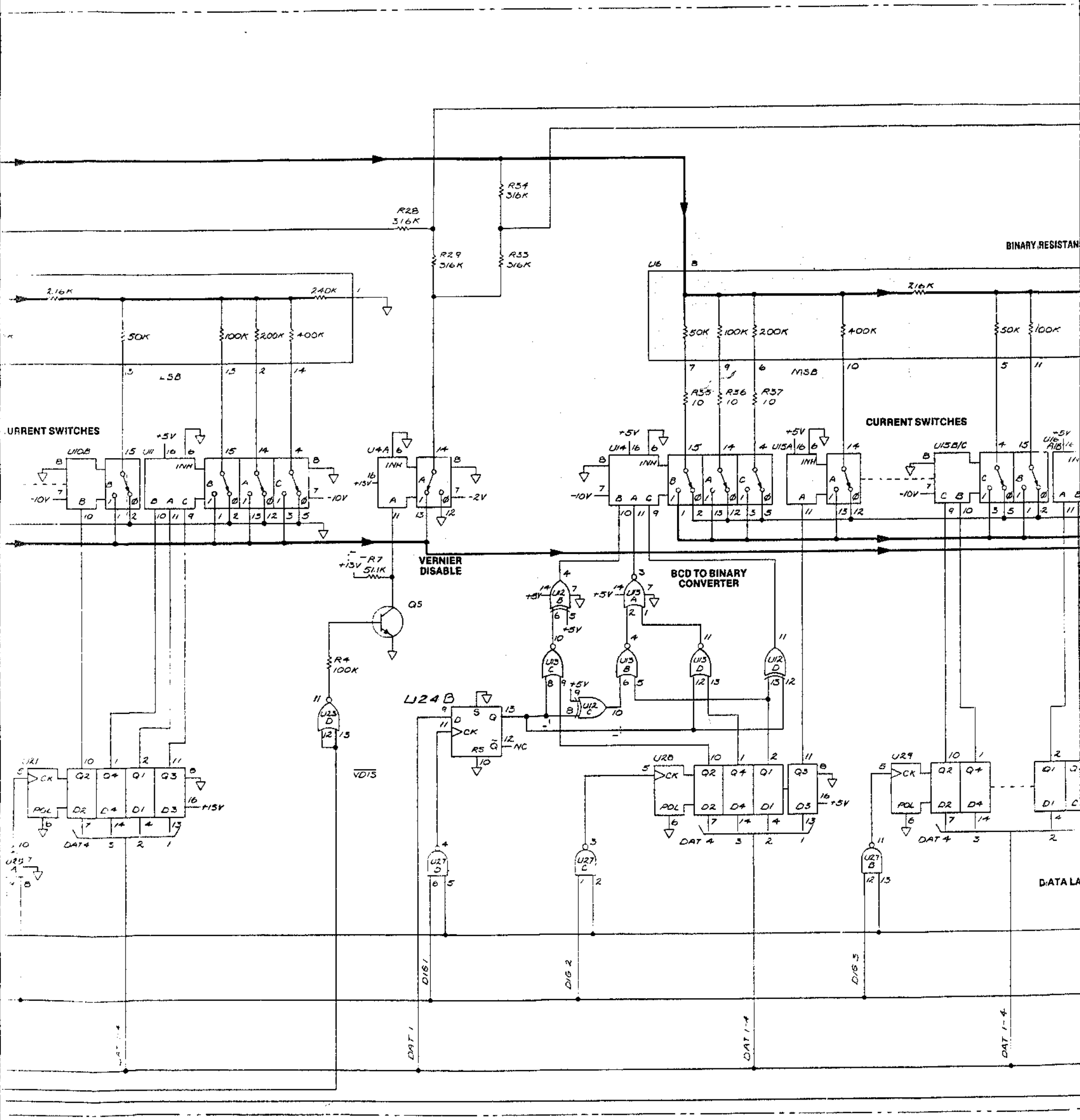


Fig C3-26
Sht 4 of 5

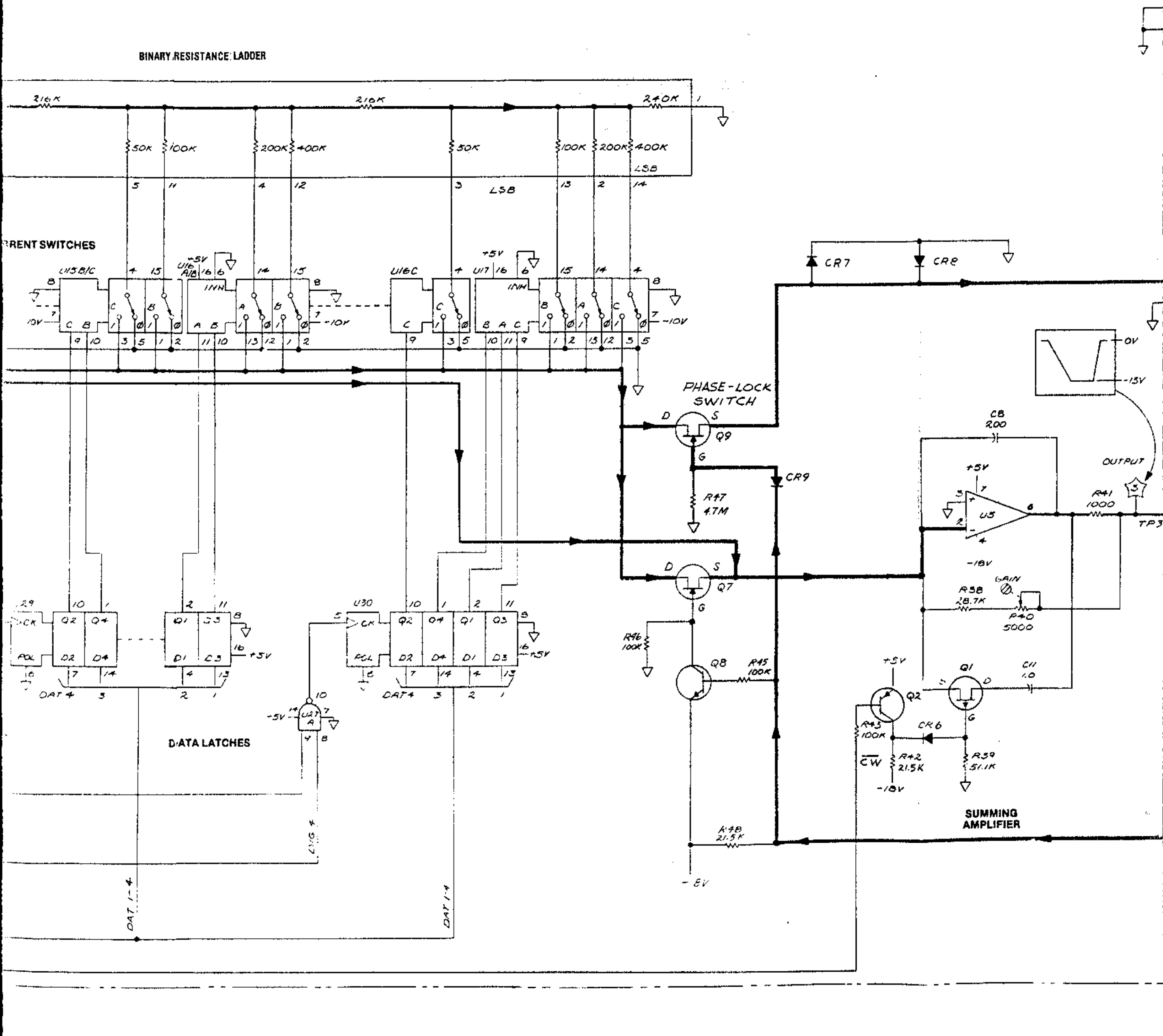
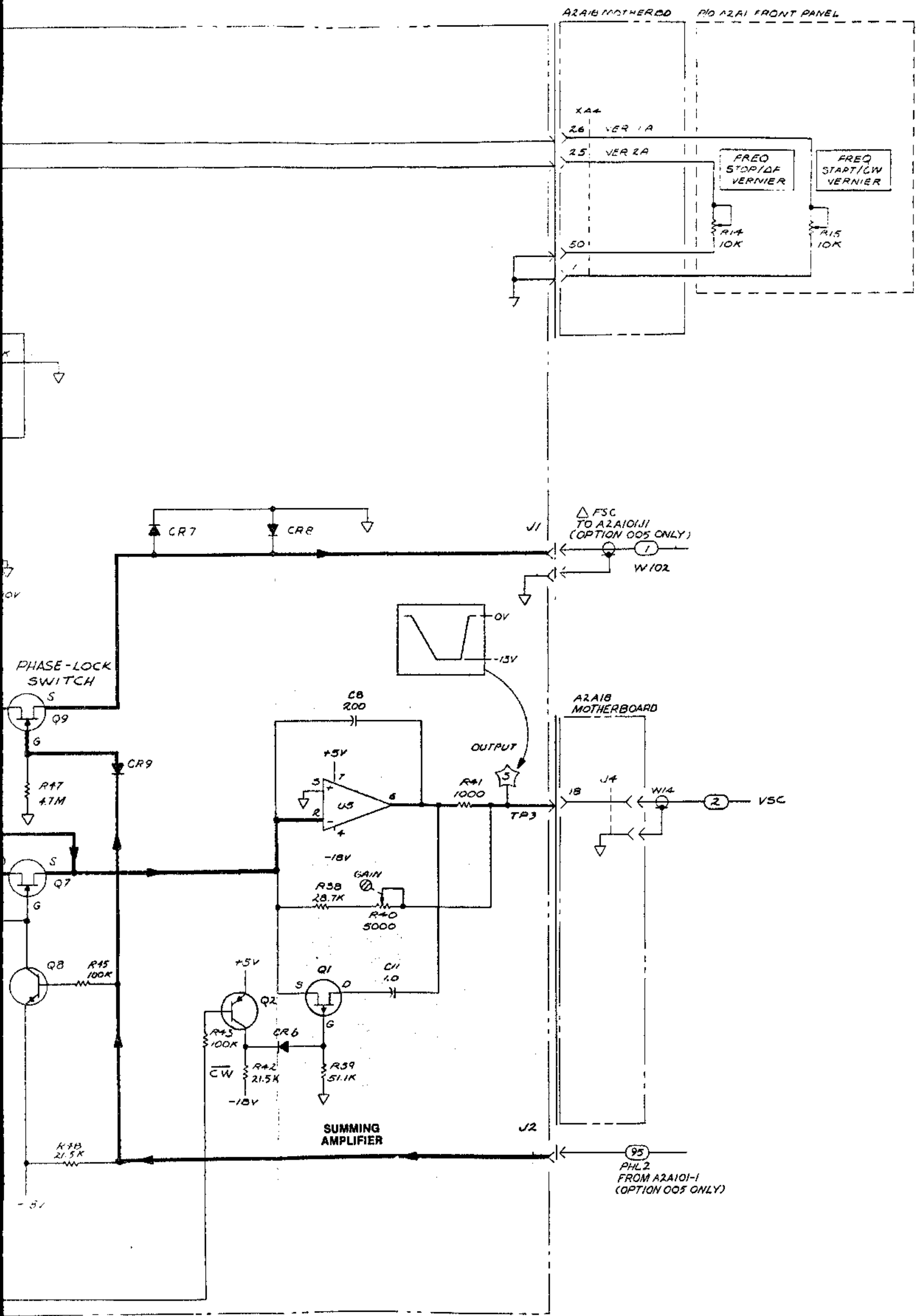


Fig. C3-26
Sht 5 of 5



NOTES
1. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. FOR COMPLETE REFERENCE DESIGNATOR, PREFIX REFERENCE SHOWN WITH THE ASSEMBLY REFENCE DESIGNATOR.
2. UNLESS OTHERWISE INDICATED RESISTANCE IN OHMS CAPACITANCE IN MICROFARADS
3. INTERCONNECTION SYMBOL FOR (1)
4. LOGIC LEVELS ARE: LOW = 0 = < 0.8V HIGH = 1 = > 2.2V

REFERENCE DESIGNATORS

NO PREFIX
W13, W14
A2A1
R14, R15
A2A4
C1-C8, C11 CR1-CR9 L1-L4 Q1-Q9 R1-R47 U1-U30
A2A18
XA4 J3, J4

NOT ASSIGNED
A2A4C9
A2A4C10

Figure C3-26. A2A4 Scaling, Schematic (CHANGE 5)

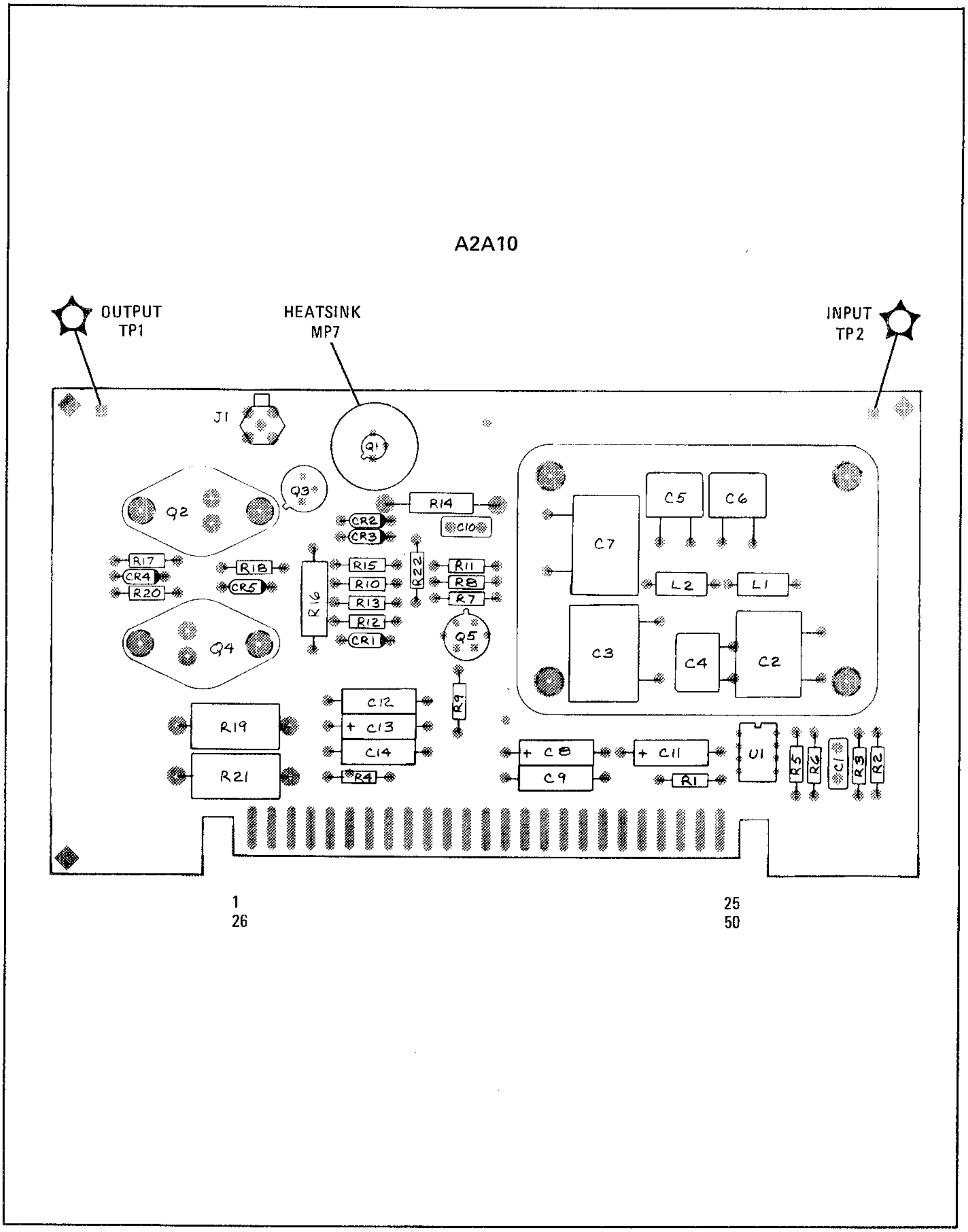


Figure C3-37. A2A10 FM Driver, Parts Location (CHANGE 5)

Fig. C3-38, Sht 1 of 4

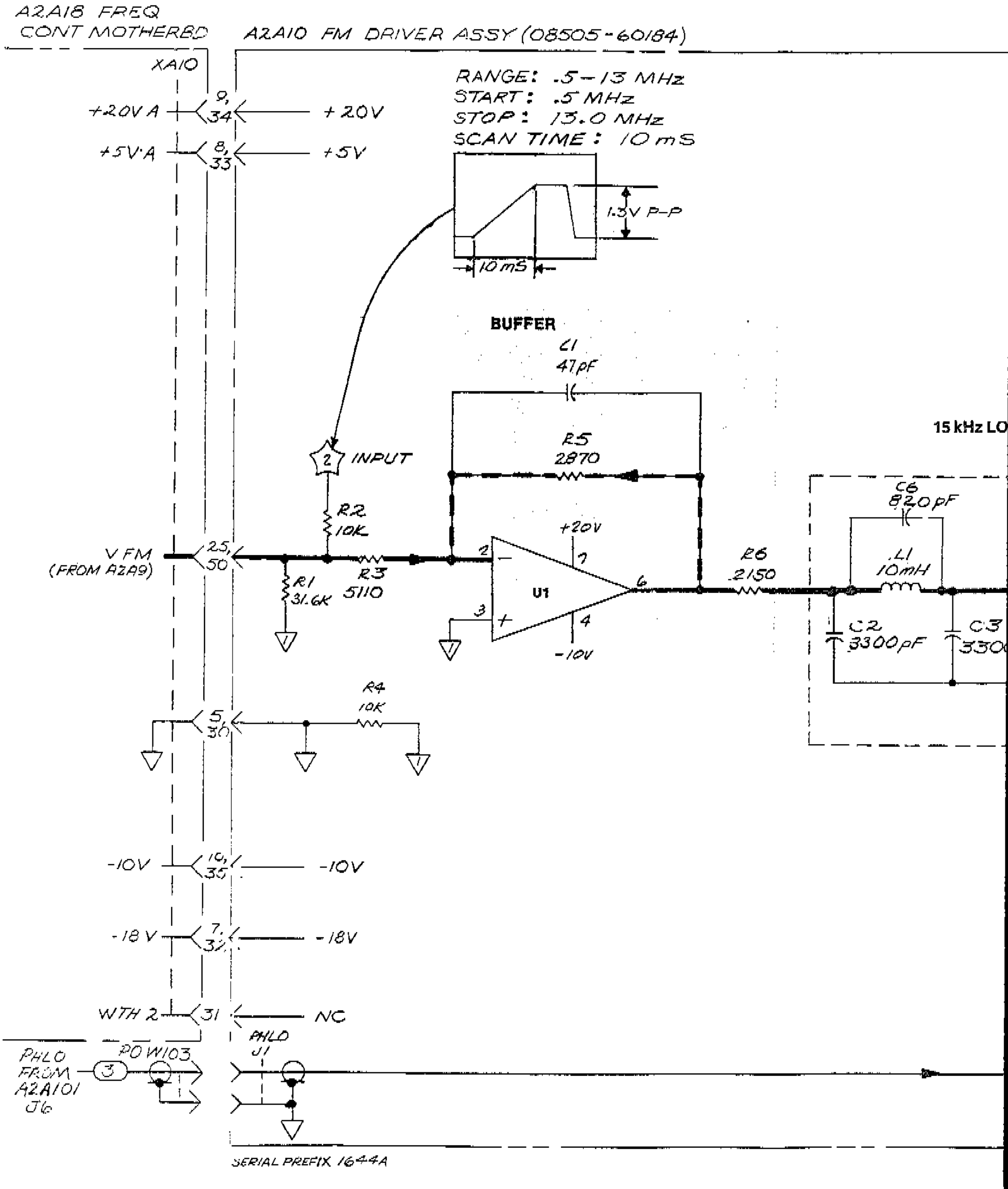


Fig C3-38
Sht 2 of 4

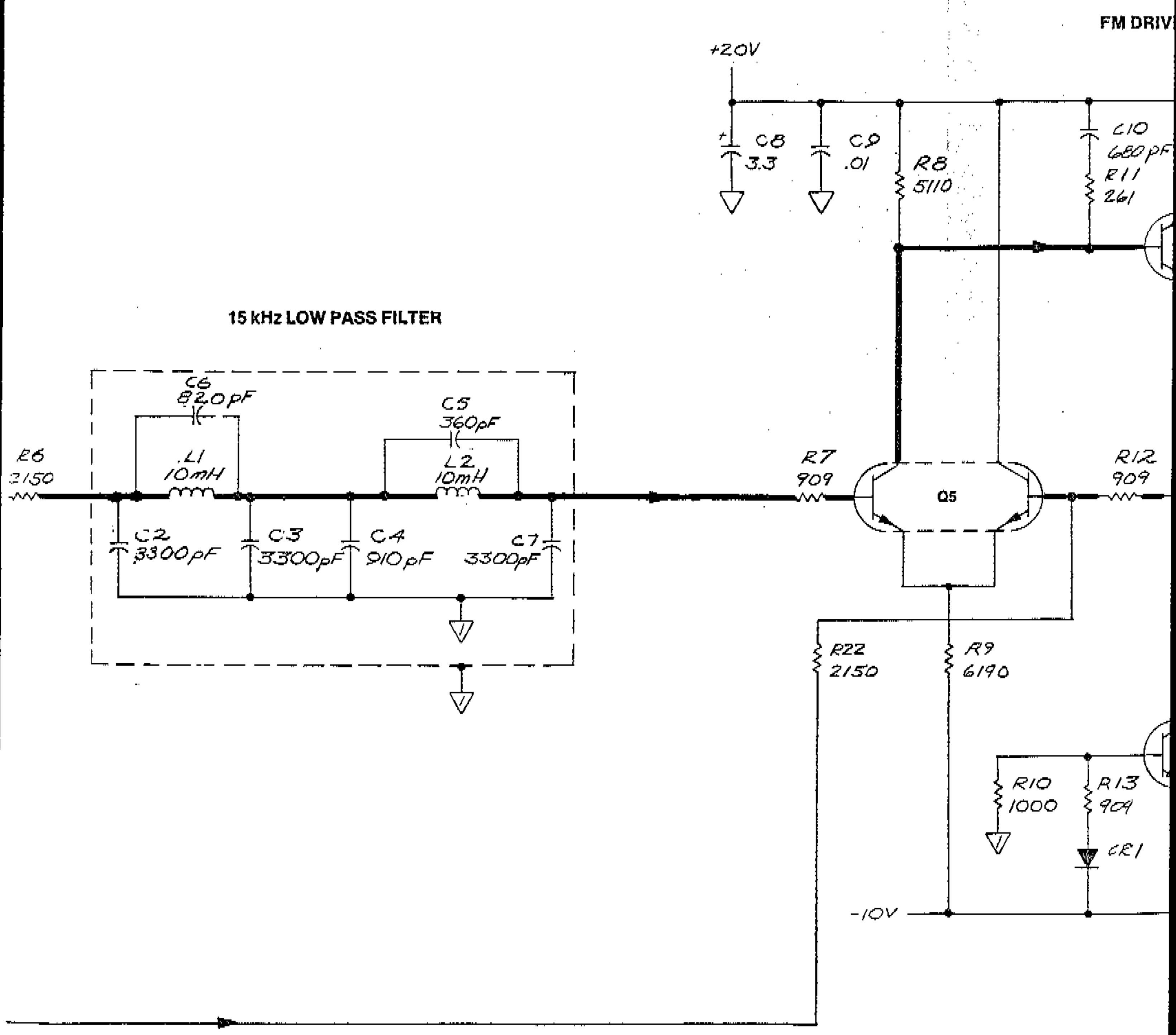


Fig C3-38
Sht 3 of 4

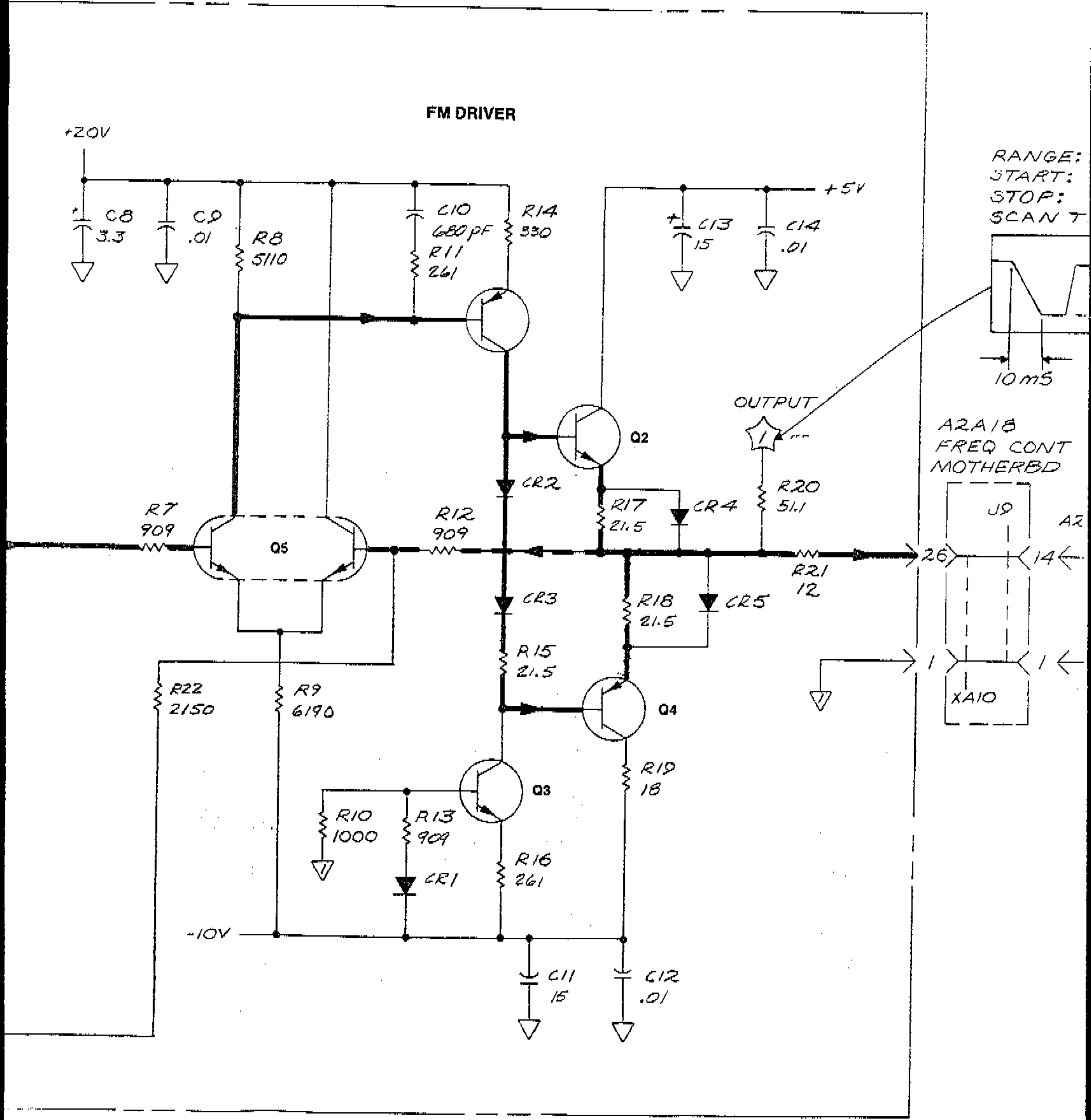
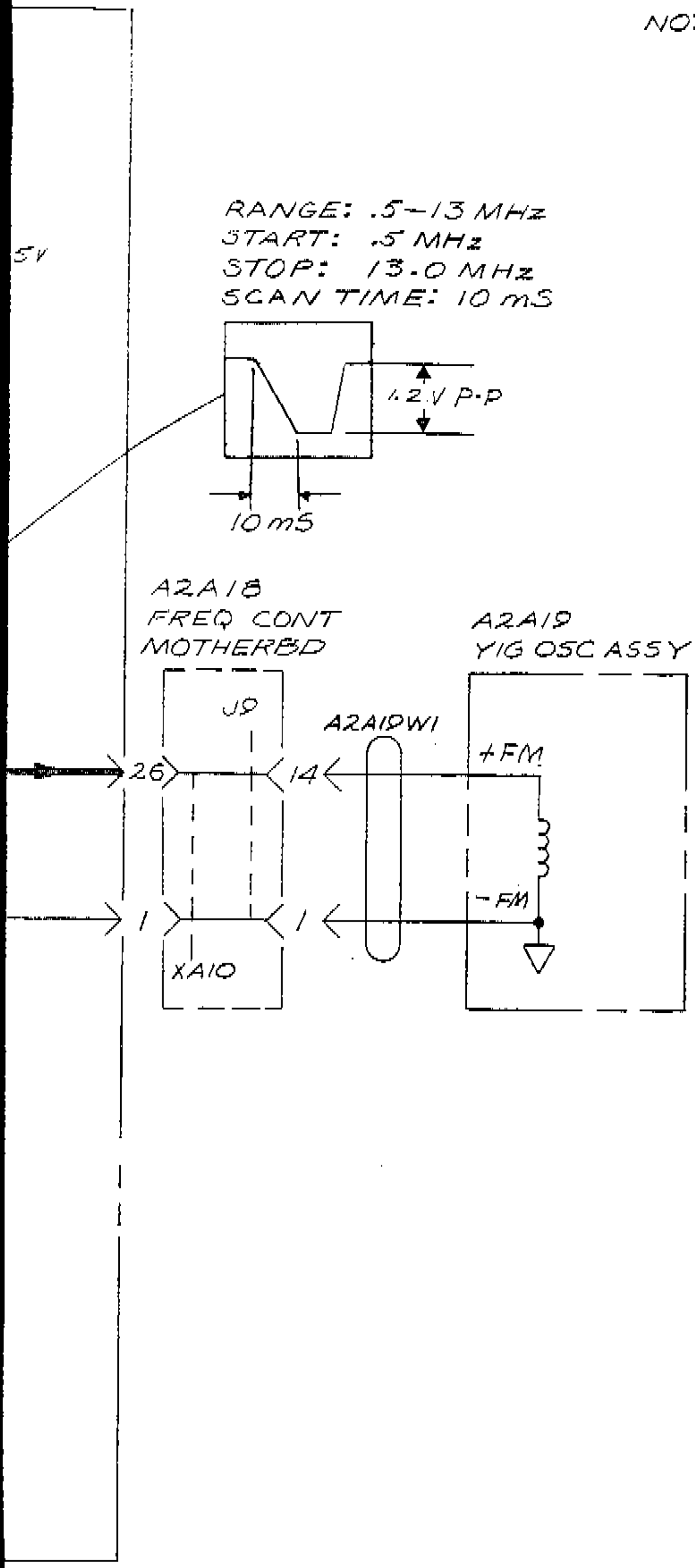


Fig. C3-38
Sht 4 of 4



NOTES:

1. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. FOR COMPLETE REFERENCE DESIGNATOR, PREFIX REFERENCE DESIGNATOR SHOWN WITH THE ASSEMBLY REFERENCE DESIGNATOR.
2. UNLESS OTHERWISE INDICATED, RESISTANCE IN OHMS CAPACITANCE IN MICROFARADS

REFERENCE DESIGNATIONS

A2A10
C1-C14
CR1-CR5
L1, L2
Q1-Q5
R1-R22
U1

3. ——▶—— INDICATES PRIMARY SIGNAL FLOW PATH; — —▶— — INDICATES PRIMARY FEEDBACK PATH.

Figure C3-38. A2A10 FM Driver Schematic (CHANGE 5)

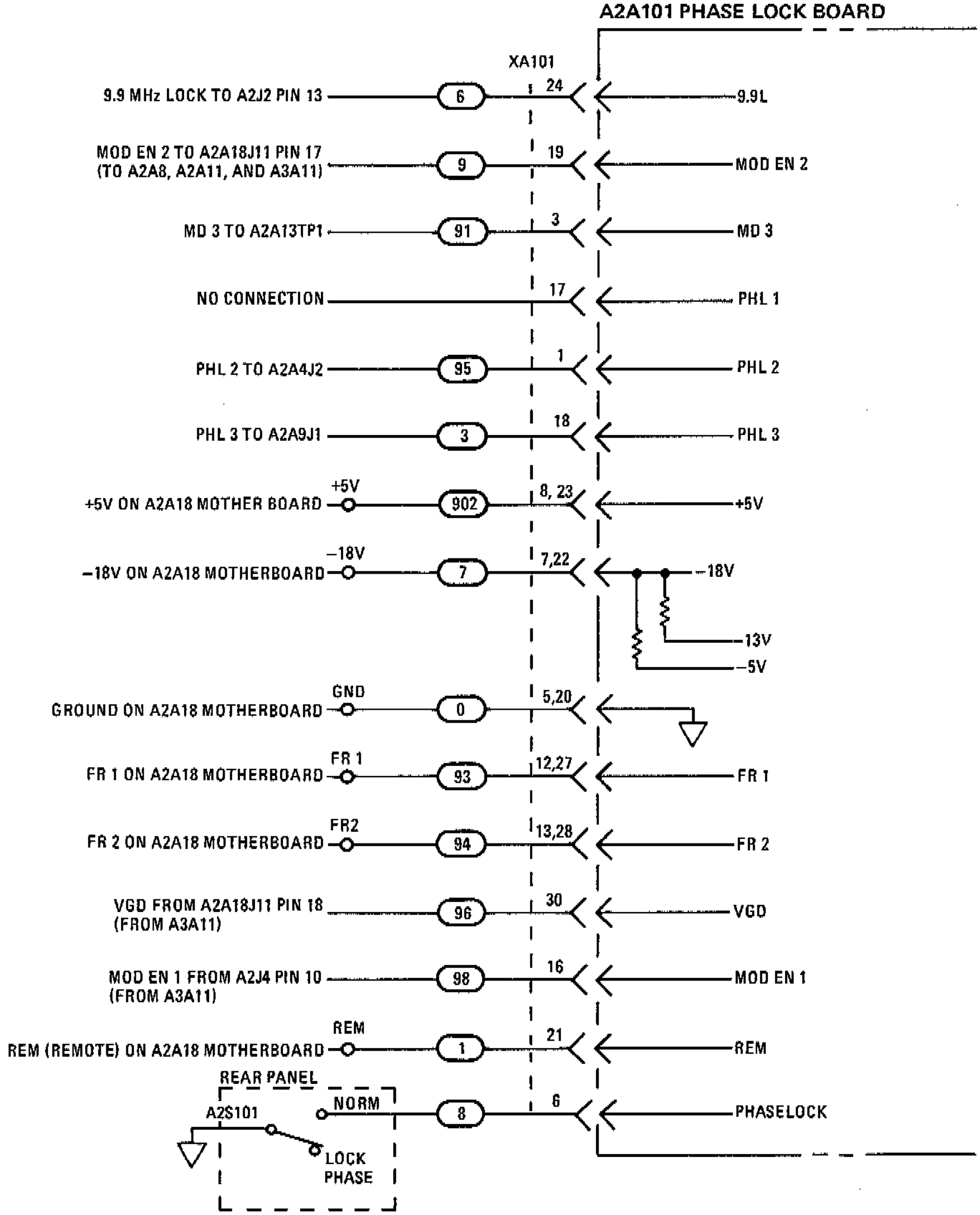


Figure C3-48. Wiring to Connector A2XA101 (CHANGE 5)

CHANGE 5 (Cont'd)

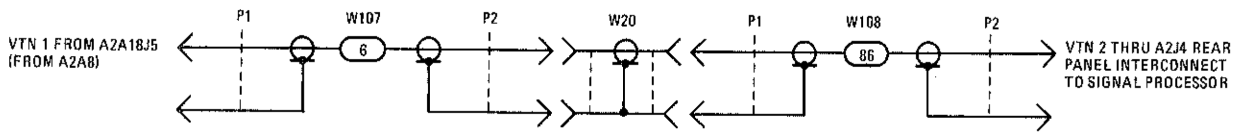


Figure C3-49. Tuning Voltage Cable Interconnect for Standard Instrument without Opt. 005 (CHANGE 5)

Page E4-4, Table E4-2:
Change A2A13 to HP Part Number 08505-60198 and a complete new listing of component parts for the Switch Register Board in this change sheet.

Page E5-5, Figure E5-1C:
Replace Figure E5-1C with new Parts Location drawing of A2A13 in this change sheet.

Page E5-5, Figure E5-2:
Replace Figure E5-2 with new schematic of A2A13 in this change sheet.

P/O Table E4-2. Replaceable Parts (CHANGE 5)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			A2A13 SWITCH REGISTER BOARD		
A2A13	08505-60198	1	SWITCH REGISTER STORAGE ASSEMBLY	28480	08505-60198
A2A13C1	0180-0197	1	CAPACITOR-FXD 2.2UF+-10% 20VDC TA	04200	150D225X9020A2
A2A13C2	0160-2055	5	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2A13C3	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2A13C4	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2A13C5	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2A13C6	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2A13MP1	5000-9043	1	PIN:P.C. BOARD EXTRACTOR	28480	5000-9043
A2A13MP2	5040-6852	1	EXTRACTOR, ORANGE	28480	5040-6852
A2A13R1	0757-0416	1	RESISTOR 511 1% .125W F TC=0+-100	03292	C4-1/8-T0-511R-F
A2A13R2	0757-0199	6	RESISTOR 21.5K 1% .125W F TC=0+-100	03292	C4-1/8-T0-2152-F
A2A13R3	0757-0199		RESISTOR 21.5K 1% .125W F TC=0+-100	03292	C4-1/8-T0-2152-F
A2A13R4	0757-0199		RESISTOR 21.5K 1% .125W F TC=0+-100	03292	C4-1/8-T0-2152-F
A2A13R5	0757-0199		RESISTOR 21.5K 1% .125W F TC=0+-100	03292	C4-1/8-T0-2152-F
A2A13R6	0757-0199		RESISTOR 21.5K 1% .125W F TC=0+-100	03292	C4-1/8-T0-2152-F
A2A13R7	0757-0199		RESISTOR 21.5K 1% .125W F TC=0+-100	03292	C4-1/8-T0-2152-F
A2A13R8	2100-3103	1	RESISTOR-TRMR 10K 10% C SIDE-ADJ 17-TRN	03744	3006P-1-103
A2A13R9	0757-0438	2	RESISTOR 5.11K 1% .125W F TC=0+-100	03292	C4-1/8-T0-5111-F
A2A13R10	2100-3054	1	RESISTOR-TRMR 50K 10% C SIDE-ADJ 17-TRN	03744	3006P-1-503
A2A13R11	0757-0438		RESISTOR 5.11K 1% .125W F TC=0+-100	03292	C4-1/8-T0-5111-F
A2A13R12	0757-0401	1	RESISTOR 100 1% .125W F TC=0+-100	03292	C4-1/8-T0-101-F
A2A13R13	0757-0123	1	RESISTOR 34.8K 1% .125W F TC=0+-100	02273	CEA-993
A2A13R14	0757-0465	1	RESISTOR 100K 1% .125W F TC=0+-100	03292	C4-1/8-T0-1003-F
A2A13U1	1820-1216	1	IC DCDR TTL LS 3-TO-8-LINE 3-INP	01698	SN74LS138N
A2A13U2	1826-0092	1	IC OP AMP	28480	1826-0092
A2A13U3	1820-1538	1	IC GATE CMOS NAND QUAD 2-INP	01921	CD4011AF
A2A13U4	1820-1823	3	IC BFR CMOS NON-INV HEX 1-INP	03406	MM80C97N
A2A13U5	0960-0442	1		28480	0960-0442
A2A13U6	1820-1823		IC BFR CMOS NON-INV HEX 1-INP	03406	MM80C97N
A2A13U7	1820-1552	1	IC GATE CMOS NAND TPL 3-INP	01921	CD4023BF
A2A13U8	1820-1823		IC BFR CMOS NON-INV HEX 1-INP	03406	MM80C97N
A2A13U9	1820-1544	8	IC FF CMOS D-TYPE POS-EDGE-TRIG COM	01921	CD4076AF
A2A13U10	1820-1544		IC FF CMOS D-TYPE POS-EDGE-TRIG COM	01921	CD4076AF
A2A13U11	1820-1547	3	IC DSEL/MULTIPLXR CMOS	02037	MC14051BCL
A2A13U12	1820-1544		IC FF CMOS D-TYPE POS-EDGE-TRIG COM	01921	CD4076AF
A2A13U13	1820-1547		IC DSEL/MULTIPLXR CMOS	02037	MC14051BCL
A2A13U14	1820-1547		IC DSEL/MULTIPLXR CMOS	02037	MC14051BCL
A2A13U15	1820-1544		IC FF CMOS D-TYPE POS-EDGE-TRIG COM	01921	CD4076AF
A2A13U16	1820-1544		IC FF CMOS D-TYPE POS-EDGE-TRIG COM	01921	CD4076AF
A2A13U17	1820-1544		IC FF CMOS D-TYPE POS-EDGE-TRIG COM	01921	CD4076AF
A2A13U18	1820-1544		IC FF CMOS D-TYPE POS-EDGE-TRIG COM	01921	CD4076AF
A2A13U19	1810-0224	4	NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	02483	750-83-R33K
A2A13U20	1810-0224		NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	02483	750-83-R33K
A2A13U21	1810-0224		NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	02483	750-83-R33K
A2A13U22	1810-0224		NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	02483	750-83-R33K
A2A13U23	1820-1544		IC FF CMOS D-TYPE POS-EDGE-TRIG COM	01921	CD4076AF

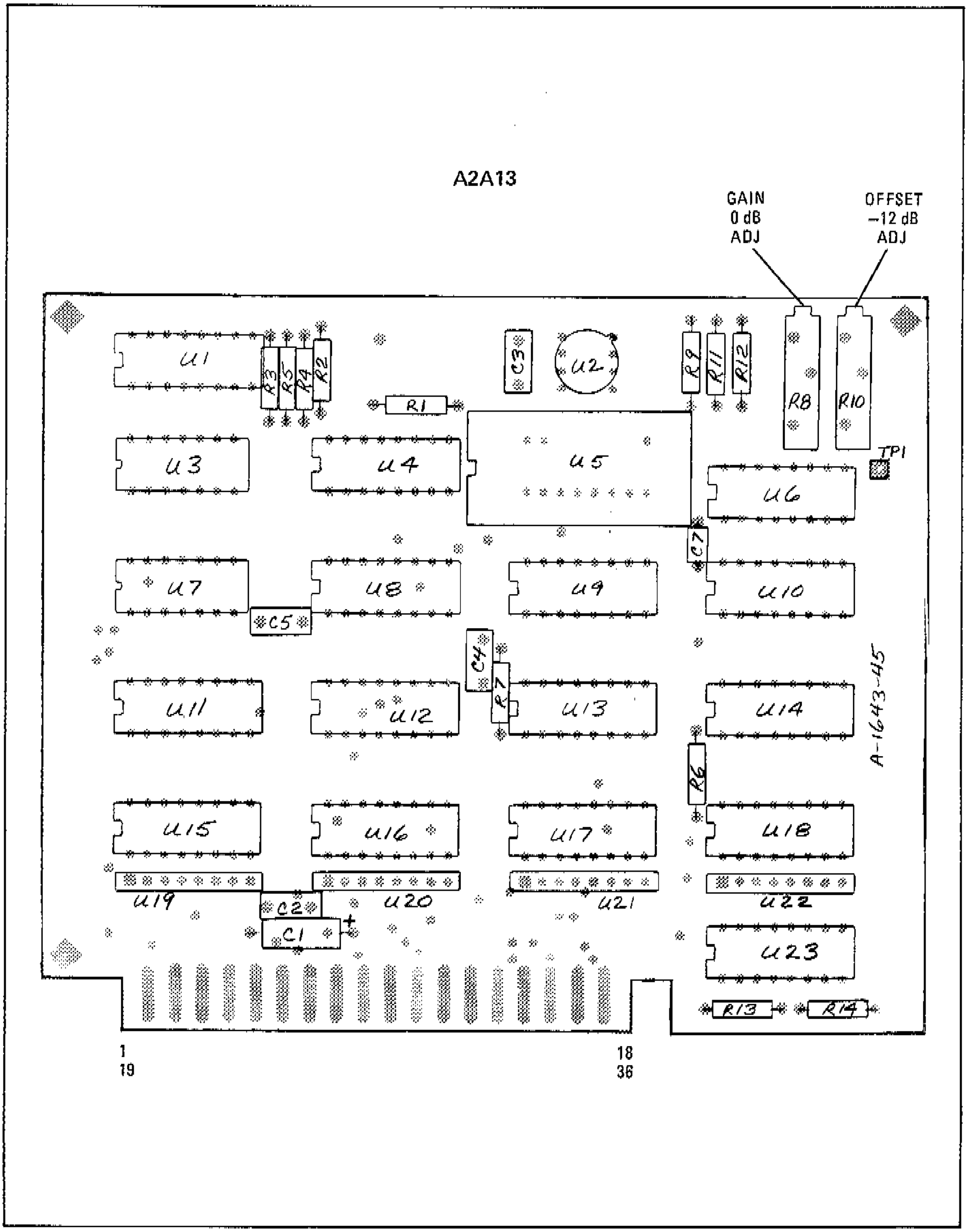


Figure E5-1C. A2A13 Frequency Control Switch Register Storage Board Parts Locations (CHANGE 5)

Fig. E5-2
Sht 1 of 4

INPUT SWITCH TRUTH TABLE

CONTROLLER CODE	I1	I2
INPUT LEVEL dBm MAX	-30dBm MAX	-10dBm MAX
IFG (IF GAIN)	0	1

RANGE SWITCH TRUTH TABLE

CONTROLLER CODE	R1	R2	R3
FREQ. RANGE MHz	.5-13	.5-130	.5-1300
FR1	1	1	0
FR2	0	1	1

WIDTH SWITCH TRUTH TABLE

CONTROLLER CODE	W1	W2	W3	W4	W5
WIDTH:	START/STOP			CW I&F	CW
	1	2	ALT		
WTH 1	1	1	0	0	1
WTH 2	0	1	1	1	1
WTH 3	0	0	0	1	1

SCAN TIME SWITCH TRUTH TABLE

CONTROLLER CODE	S1	S2	S3	S4	S5
SCAN TIME SEC:	MANUAL	100-10	10-1	1-.1	.1-.01
SCT 1	1	1	0	0	1
SCT 2	0	1	1	1	1
SCT 3	0	0	0	1	1

OUTPUT LEVEL TRUTH TABLE

CONTROLLER CODE	FRONT PANEL OUTPUT LEVEL SWITCH	10dB ATTEN. (PIN 34)	20dB ATTEN. (PIN 15)	40dB ATTEN. (PIN 17)
08	+10	1	1	1
07	0	0	1	1
06	-10	1	0	1
05	-20	0	0	1
04	-30	1	1	0
03	-40	0	1	0
02	-50	1	0	0
01	-60	0	0	0

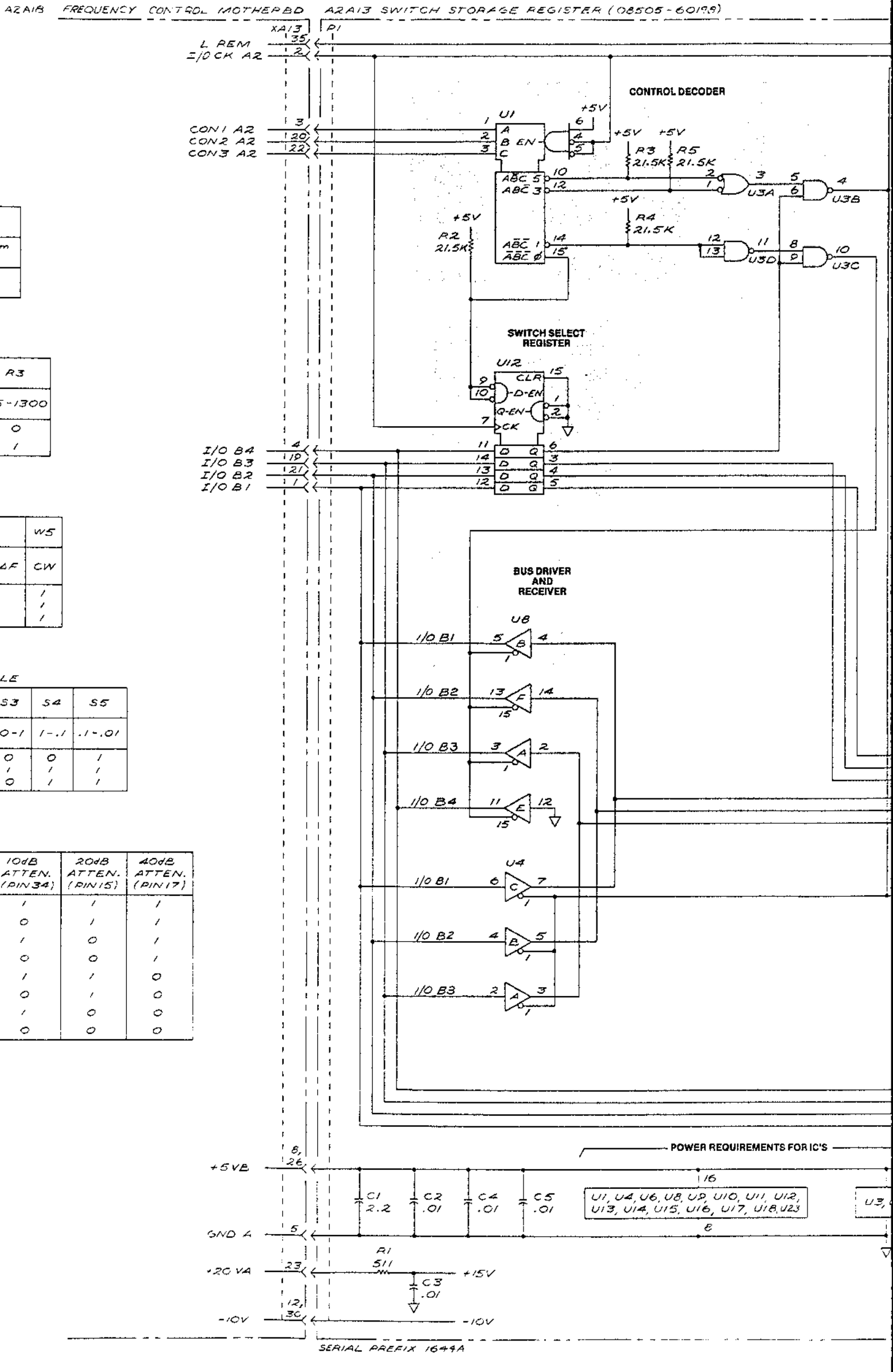


Fig E5-2, Skt 2 of 4

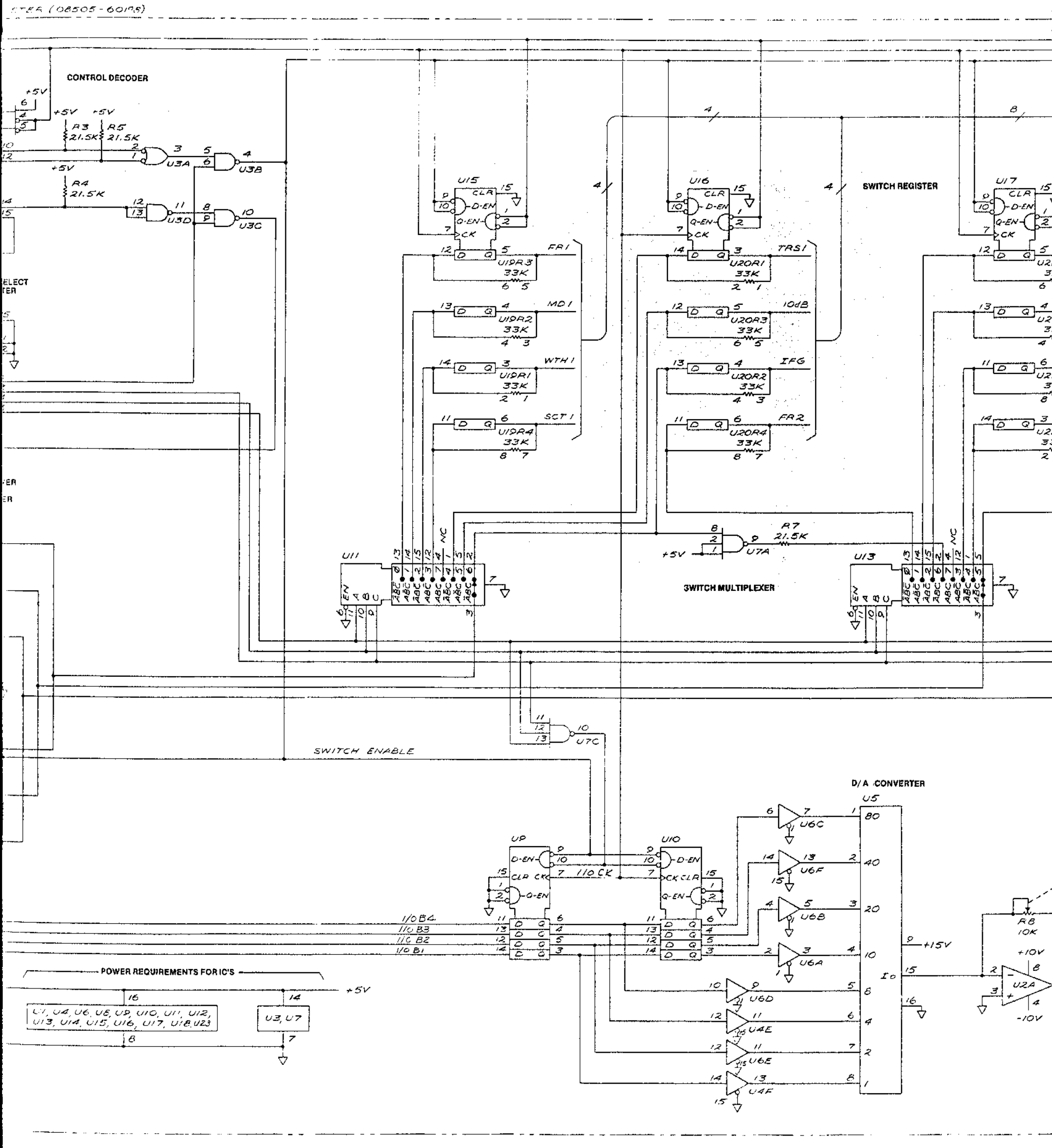


Fig. E5-2
Sht 3 of 4

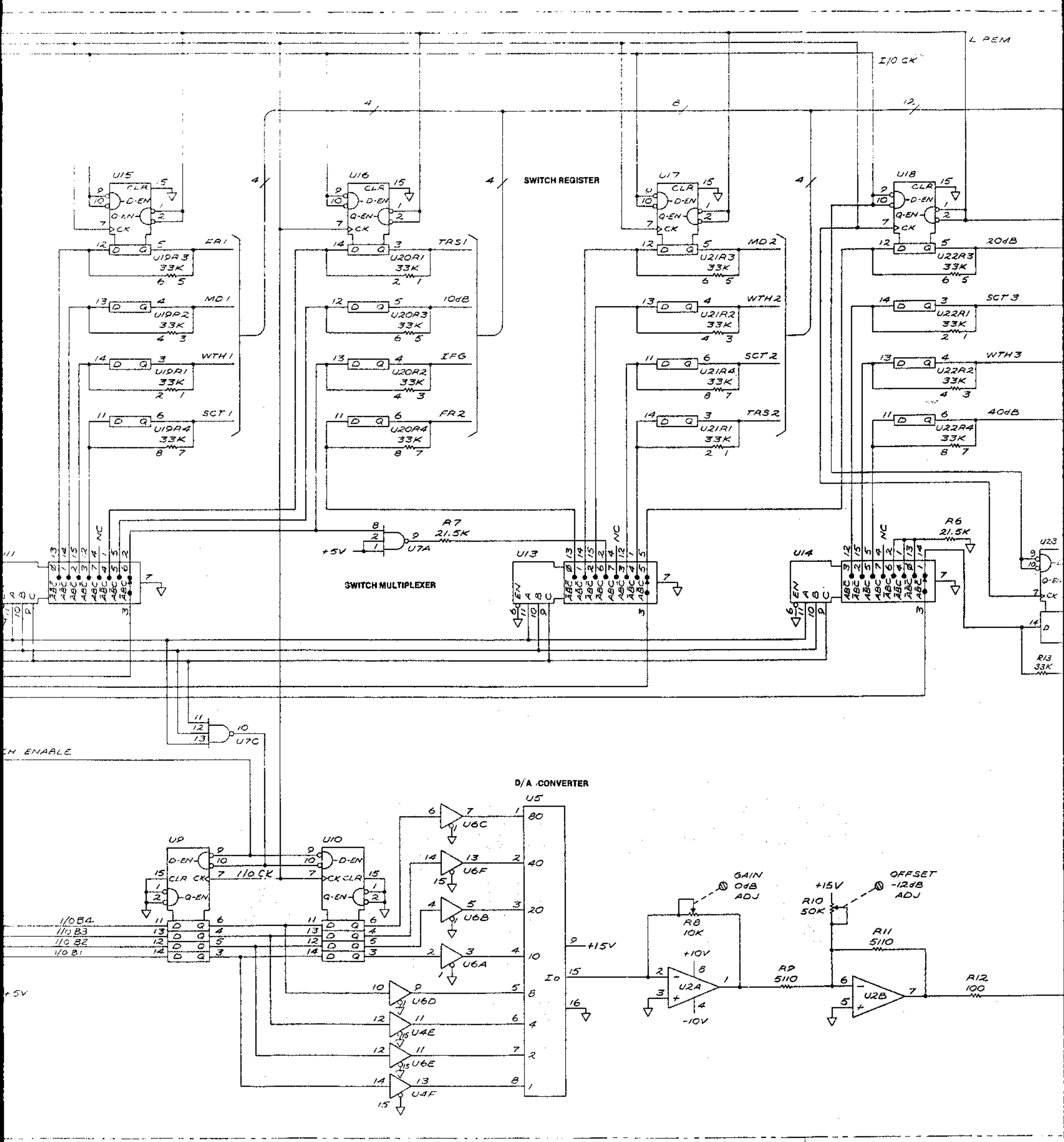
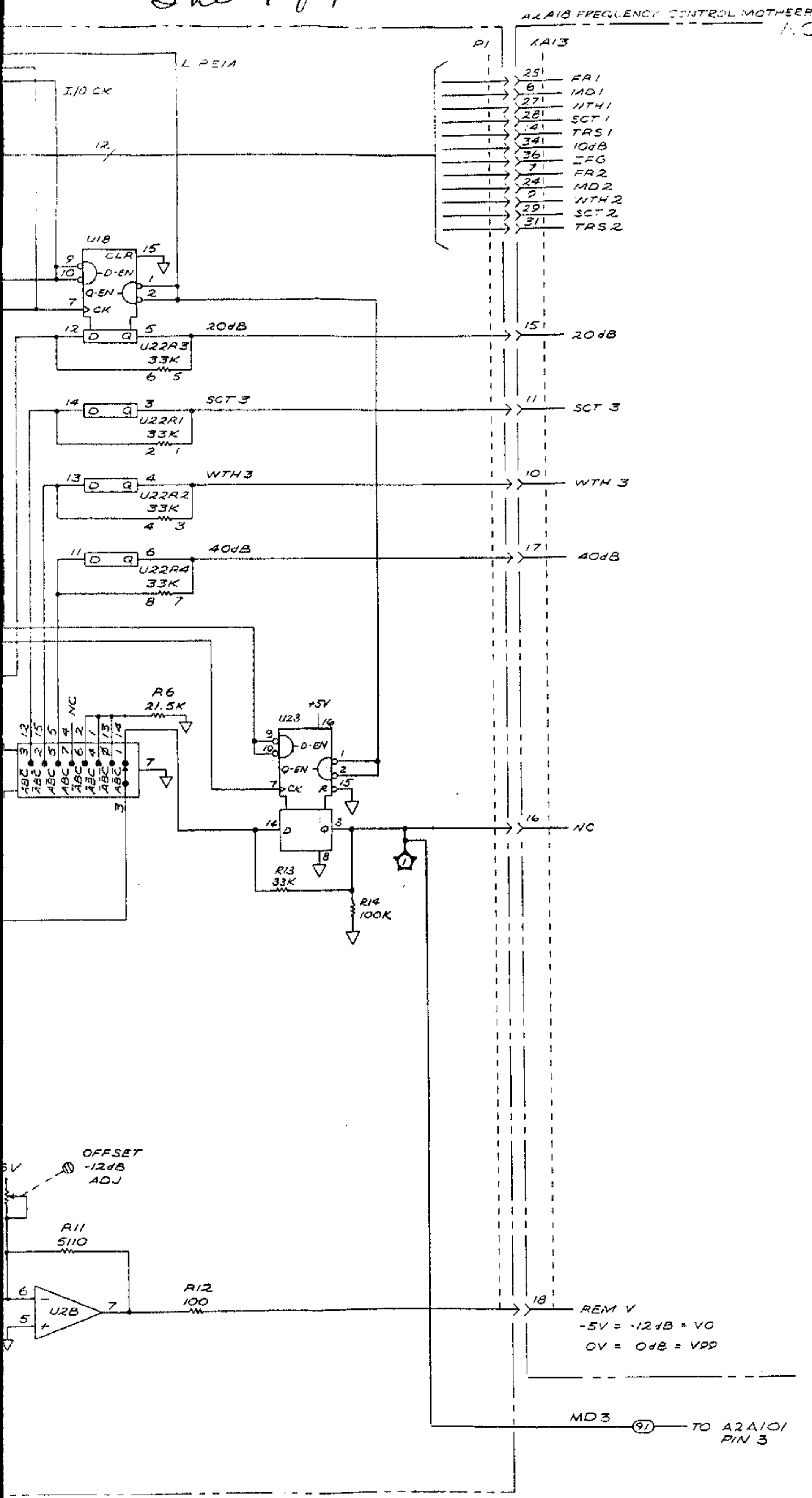


Fig E5-2
Sht 4 of 4



NOTES:

1. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. FOR COMPLETE REFERENCE DESIGNATOR, PREFIX REFERENCE DESIGNATOR SHOWN WITH THE ASSEMBLY REFERENCE DESIGNATOR.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS
   CAPACITANCE IN MICROFARADS
3. ABBREVIATIONS:
   CK = CLOCK
   CLR = CLEAR
   EN = ENABLE
   D-EN = DATA INPUT ENABLE
   Q-EN = Q OUTPUT ENABLE
4. LOGIC LEVELS ARE:
   0 = LOW = < 0.8V
   1 = HI = > 2.2V

   EXCEPT INPUTS OF U1 (1,2,3) WHICH ARE:
   0 = LOW = < 1.5V
   1 = HI = > 3.5V

REFERENCE DESIGNATORS

A2A13
C1-7
R1-14
U1-23

MODE SWITCH TRUTH TABLE

CONTROLLER CODE	M1	M2	M3
MODE:	LOG FULL	LIN FULL	LIN EXPAND
MD 1	1	1	0
MD 2	0	1	1

TRIGGER SWITCH TRUTH TABLE

CONTROLLER CODE	T1	T2	T3	NONE
TRIGGER	AUTO	LINE	EXT	SINGLE
TRS 1	1	1	0	0
TRS 2	0	1	1	1

A2A13

Figure E5-2. A2A13 Switch Register Storage, Schematic (CHANGE 5)

CHANGE 6

Page C2-27, Table C2-2:
Delete A2A22U1.
Add the following:
A2A24, HP Part Number 08505-60199, PLUS 5 VOLT RECTIFIER BOARD ASSEMBLY
A2A24C1, HP Part Number 0160-4300, CAPACITOR-FXD .047 UF +80 −20% 100 WVDC CER.
A2A24CR1 through A2A24CR4, HP Part Number 1901-0662, DIODE PWR RECT 100V 6A
A2A24E1 and A2A24E2, HP Part Number 2110-0269, FUSEHOLDER-CLIP TYPE 0.25 FUSE
A2A24F1, HP Part Number 2110-0036, FUSE 8A 125A FAST-BLO

Page C3-97/98, Figure C3-97/98, Figure C3-42A:
Delete A2A22U1.
Replace A2A22U1 Rectifier circuit with A2A24 +5 Volt Rectifier Board as shown in the partial schematic in this change sheet.

Page C3-99/100, Figure C3-44:
Delete A2A22U1.
Replace A2A22U1 Rectifier circuit with A2A24 +5 Volt Rectifier Board as shown in the partial schematic in this change sheet.

Page C3-105/106:
Add Figure C3-46A, A2A24 Parts Location, as shown in this change sheet.

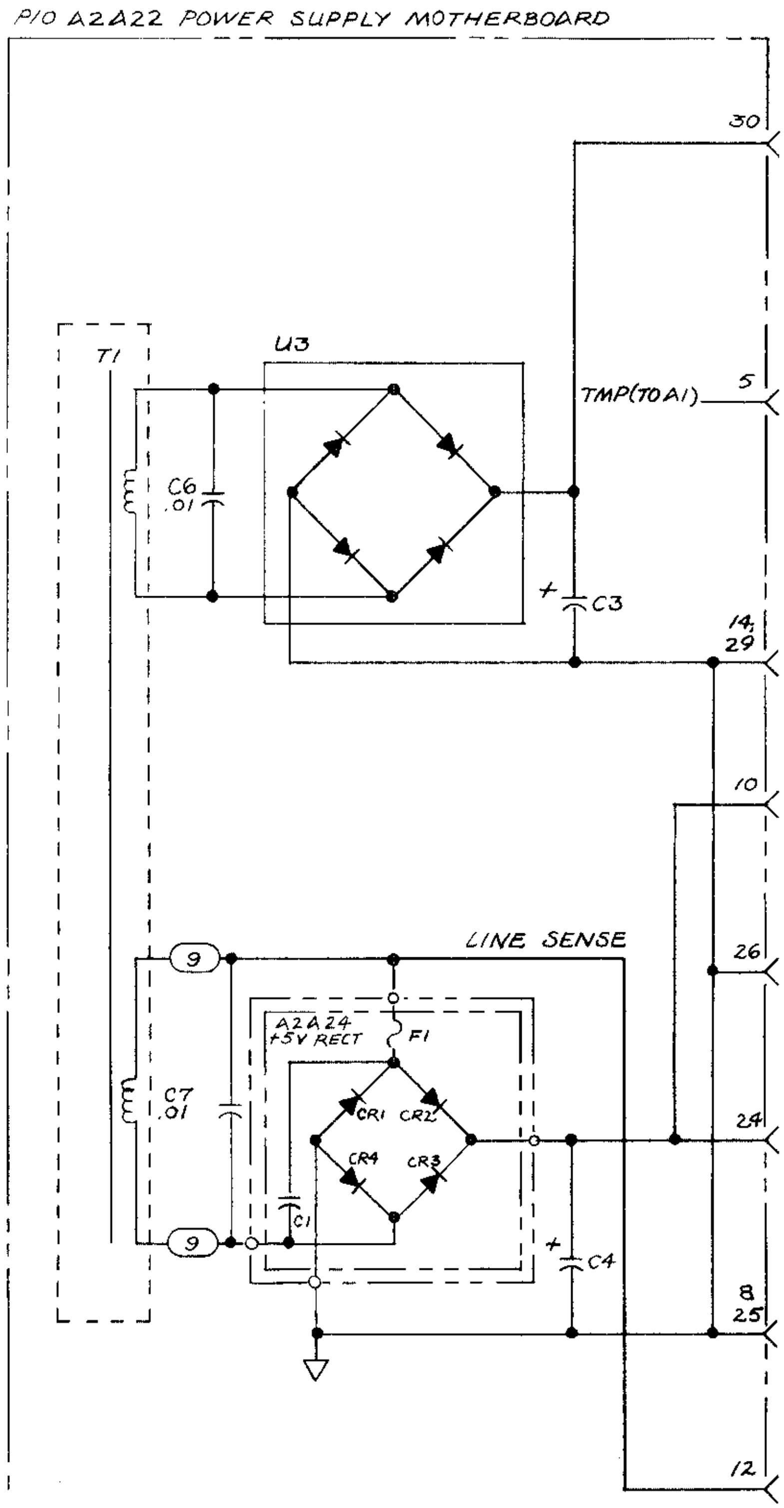
Page C3-105/106, Figure C3-47:
Delete A2A22U1.
Replace A2A22U1 Rectifier circuit with A2A24 +5 Volt Rectifier Board as shown in the partial schematic in this change sheet.

Page E4-6, Table E4-2:
Change A3A19C11 to HP Part Number 0180-0106, CAPACITOR-FXD, 60UF +−20% 6VDC TA.

Page E4-7, Table E4-2:
Change A3A19R8 to HP Part Number, 0698-3157, RESISTOR 19.6K 1% .125W F TC=0+−100.

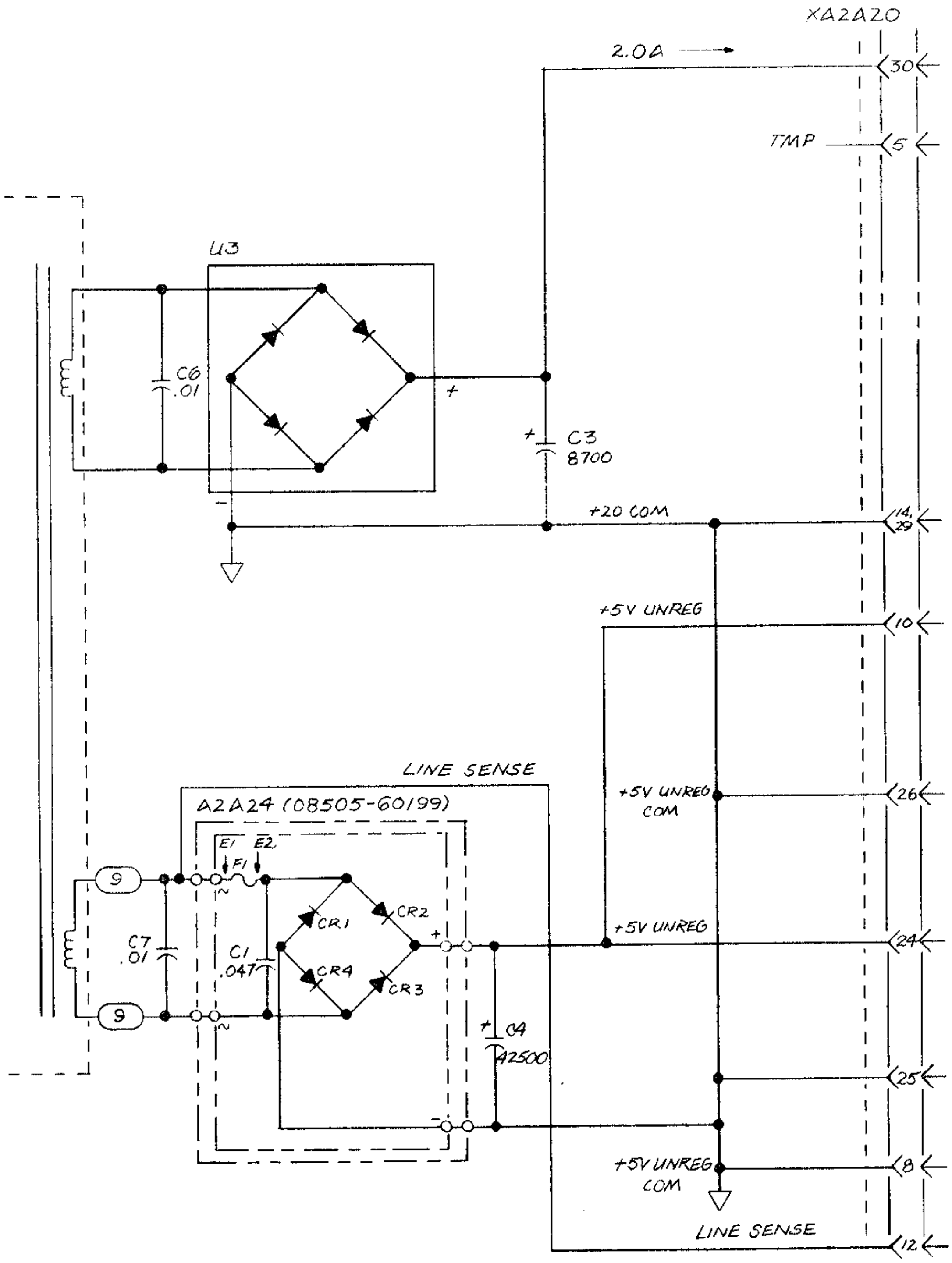
Page E5-33, Figure E5-10:
Change A3A19R8 to 19.6KΩ.
Change A3A19C11 to 60μF.

CHANGE 6 (Cont'd)



P/O Figure C3-42A. A2A20 Positive Voltage Regulator Block Diagram (CHANGE 6)

CHANGE 6 (Cont'd)



P/O Figure C3-44. A2A20 Positive Voltage Regulator, Schematic (CHANGE 6)

CHANGE 6 (Cont'd)

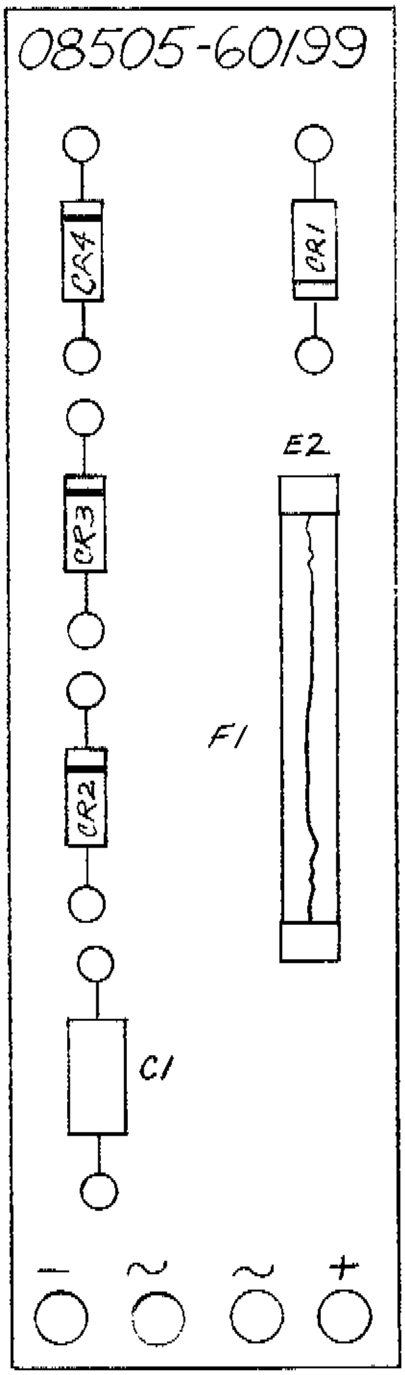
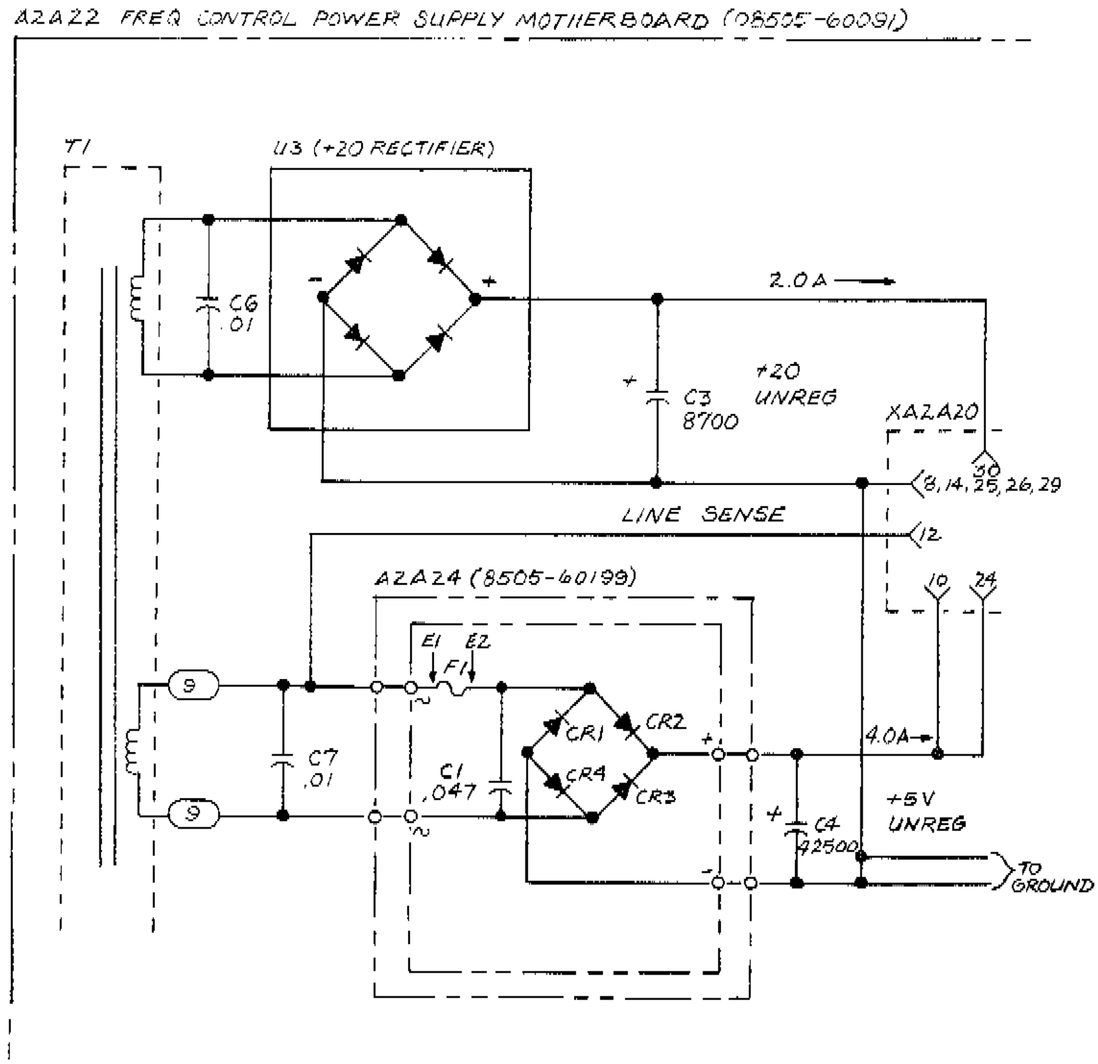


Figure C3-46A. A2A24 Plus 5 Volt Rectifier Board Parts Location (CHANGE 6)

CHANGE 6 (Cont'd)



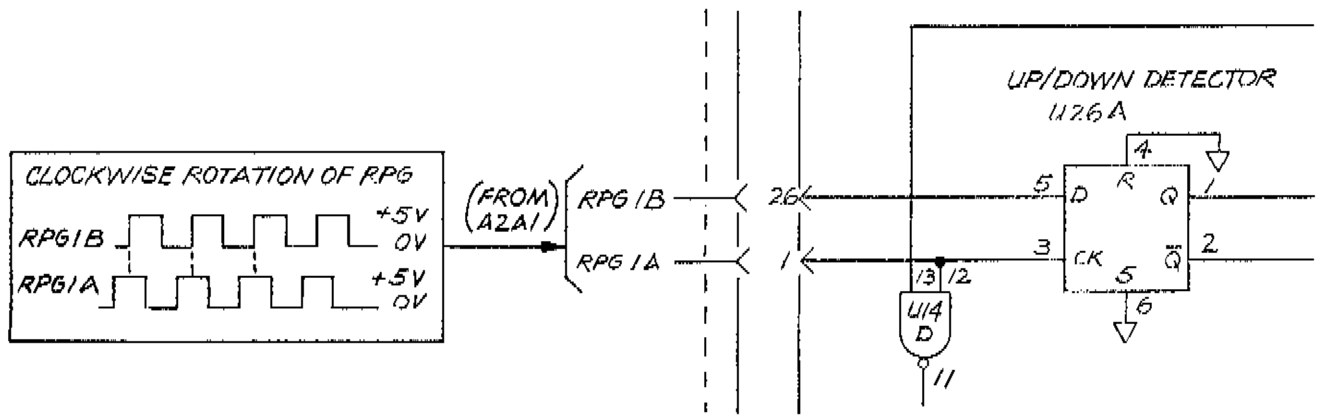
P/O Figure C3-47. A2A22 Frequency Control Power Supply, Schematic (CHANGE 6)

CHANGE 7

Page C2-5, Table C2-2:
Change A2A1A2 to HP Part Number 08505-60203 and delete all components listed for A2A1A2.
Change A2A1A3 to HP Part Number 08505-60203.

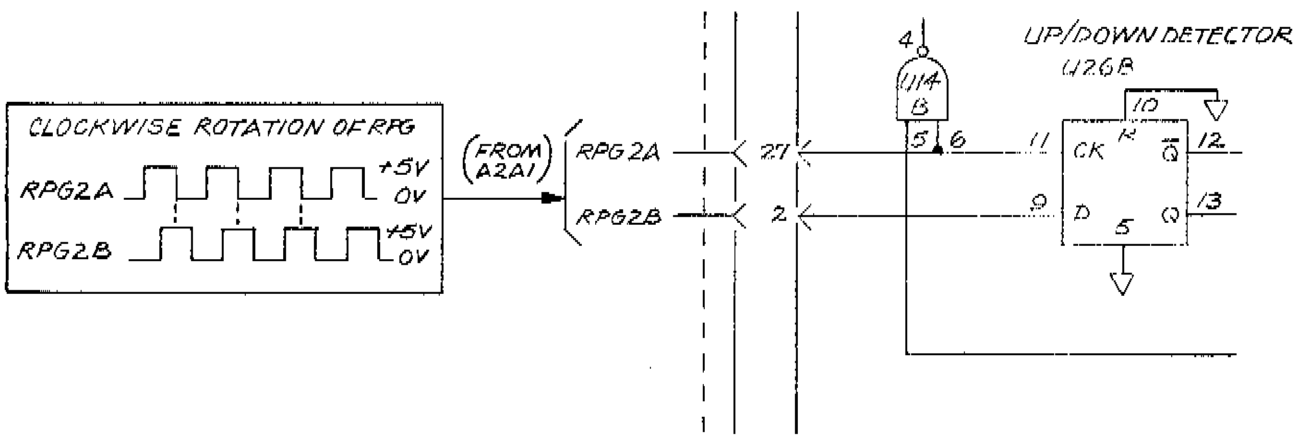
Page C3-43, Figure C3-20A:
Delete Figure C3-20A, A2A1A2/A3 Schematic.

Page C3-61, Figure C3-24:
Change A2A3U26A Circuit as shown in the partial schematic in this change sheet.



P/O Figure C3-24. Partial Schematic of A2A3 (CHANGE 7)

Change A2A3U26B Circuit as shown in the partial schematic in this change sheet.



P/O Figure C3-24. Partial Schematic of A2A3 (CHANGE 7)

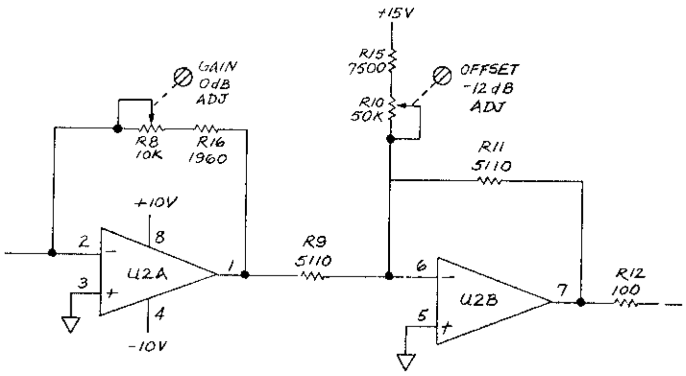
CHANGE 8

Page C2-25, Table C2-2:
Change A2A20 R2 to HP Part Number 0757-0447, RESISTOR 16.2K 1% .125W F TC=0+–100.

►Page C3-99/100:
Change Resistor A2A20R2 to 16.2K Ohm.

Page E4-4, Table E4-2:
Add A2A13R15, 0757-0440, RESISTOR 7.5K 1% .125W TC=0+–100.
Add A2A13R16, 0698-0083, RESISTOR 1.96K 1% .125W TC=0+–1.00.

Page E5-5, Figure E5-2:
Change A2A13U2 circuit as shown in the partial schematic in this change sheet.



P/O Figure E5-2. Partial Schematic of A2A13 (CHANGE 8)

CHANGE 9

Page C2-25, Table C2-2:
Change A2A20R15 to HP Part Number 0698-0082, RESISTOR 464 1% .125W F TC=0+–100

►Page C3-99/100, Figure C3-44:
Change A2A20R15 to 464 Ohms.

CHANGE 9 (Cont'd)

Page D2-5, Table D2-2:
Change A3W18 to HP Part Number 08505-60176.
Change A3W19 to HP Part Number 08505-60177.
Change A3W20 to HP Part Number 08505-60179.
Change A3W21 to HP Part Number 08505-60180.
Change A3W22 to HP Part Number 08505-60181.

Page D2-11, Table D2-2:
Add A3A7C21 and A3A7C22, HP Part Number 0160-3451, CAPACITOR-FXD .01UF +80-20% 100Vdc CER.

Page D2-12, Table D2-2:
Change A3A8 to HP Part number 08505-60205.

Page D2-14, Table D2-2:
Add A3A8R93 and A3A8R95, HP Part Number 2100-2031, RESISTOR-TRMR 50K 10% C TOP-ADJ 1 TRN.
Add A3A8R94 and A3A8R96, HP Part Number 0683-6845, RESISTOR 680K 5% .25W FC TC=-800/+900.

Page D2-30, Table D2-2:
Change A3A24 to HP Part Number 08505-60175.
Change A3A24MP1 to HP Part Number 08505-00115.

Page D2-31, Table D2-2:
Change A3A25R1, A3A25R4, A3A25R5, and A3A25R7 to HP Part Number 2100-3476.
Change A3A25R2 to HP Part Number 2100-3473.
Change A3A25R3 to HP Part Number 2100-3475.
Change A3A25R6 to HP Part Number 2100-3474.
Change A3A25S1 to HP Part number 08505-80006.
Change A3A25S2 to HP Part Number 3101-1982.

Page D2-32, Table D2-2:
Change A3A27 to HP Part Number 08505-60172.
Add A3A27E5, 0340-0614, INSULATOR-XSTR.

Page D2-34, Table D2-2:
Change A3A28 to HP Part Number 08505-60173.

Page D2-35, Table D2-2:
Change A3A29 to HP Part Number 08505-60173.
Change A3A30 to HP Part Number 08505-60174.
Add A3A30E29—A3A30E35, 1251-2039, CONNECTOR-SGL CONT SKT .041-IN-BSC-SZ.

Page D2-36, Figure D2-1:
Change 15 to HP Part Number 08505-00108.
Change 18 to HP Part Number 08505-00112.
Change 19 to HP Part Number 08505-00111.
Change 37 to HP Part Number 08505-00109.
Change 39 to HP Part Number 08505-00122.
Change 42 to HP Part Number 1220-0203.
Change 44 to HP Part Number 08505-00119.
Change 52 to HP Part Number 08505-00123.
Change 53 to HP Part Number 08505-00124.
Change 61 to HP Part Number 08505-00121.
Change 66 to HP Part Number 08505-00118.
Change 67 to HP Part Number 08505-00117.
Change 68 to HP Part Number 08505-00116.

CHANGE 9 (Cont'd)

Page D2-37, Figure D2-1:
Change 86 to HP Part Number 08505-00120.
Change 87 to HP Part Number 08505-00113.
Change 88 to HP Part Number 08505-00107.
Change 95 to HP Part Number 08505-00106.
Change 108 to HP Part Number 08505-00110.
Change 117 to HP Part Number 08505-00114.
Add the following hardware after item 117:

HP PART NUMBER	DESCRIPTION
0510-0062	RETAINER-PUSH ON RECT EXT .125-DIA STL
0520-0164	SCREW-MACH 2-56 .25-IN-LG-82 DEG
1251-2942	LOCK-SUBMIN D CONN
1400-0082	CLAMP-CABLE .125-DIA .375 WD NYL
2190-0004	WASHER-LK INTL T NO. 6 .115-IN-ID
2190-0017	WASHER-LK HLCL NO. 8 .168-IN-ID
2190-0045	WASHER-LK HLCL NO. 2 .088-IN-ID
2190-0047	WASHER LK 82 CTSK EXT T NO. 6 .142-IN-ID
2190-0067	WASHER-LK INTL T 1/4 IN .256-IN-ID
2200-0139	SCREW-MACH 4-40 .250-IN-LG PAN-HD-POZI
2360-0116	SCREW-MACH 6-32 .312-IN-LG 82 DEG
2360-0181	SCREW-MACH 6-32 .25-IN-LG 82 DEG
2360-0194	SCREW-MACH 6-32 .312-IN-LG 100 DEG
2360-0201	SCREW-MACH 6-32 .5-IN-LG PAN-HD-POZI
2360-0331	SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI
2510-0137	SCREW-MACH 8-32 2.75-IN-LG PAN-HD-POZI
2580-0003	NUT-HEX-W/LKWR 8-32-THD .125-IN THK
2950-0072	NUT-HEX-DBL-CHAM 1/4-32-THD .062-IN-THK
2950-0153	NUT-HEX-DBL-CHAM 1/4-32-THD .29-IN-THK
3030-0083	SCREW-SET 2-56 .188-IN-LG SMALL CUP-PT
3050-0001	WASHER-FL MTLC NO. 8 .172-IN-ID
3050-0010	WASHER-FL MTL NO. 6 .147-IN-ID
3050-0105	WASHER-FL MTLC NO. 4 .125-IN-ID
3050-0152	WASHER-SHLDR NM NO. 8 .172-IN-ID
3050-0226	WASHER-FL MTLC NO. 10 .203-IN-ID
7120-3812	LABEL-WARNING
7120-4192	LABEL-INFO
7120-4829	LABEL-INFO

Page D3-77, Figure D3-32:
Add C21, .01 UF, from pin 14 of U1A Signal Multiplexer to ground.
Add C22, .01 UF, from pin 14 of U11A Signal Multiplexer to ground.

Page D3-80, Figure D3-33:
Replace Figure D3-33 with new Parts Location drawing of A3A8 in this change sheet.

A3A8

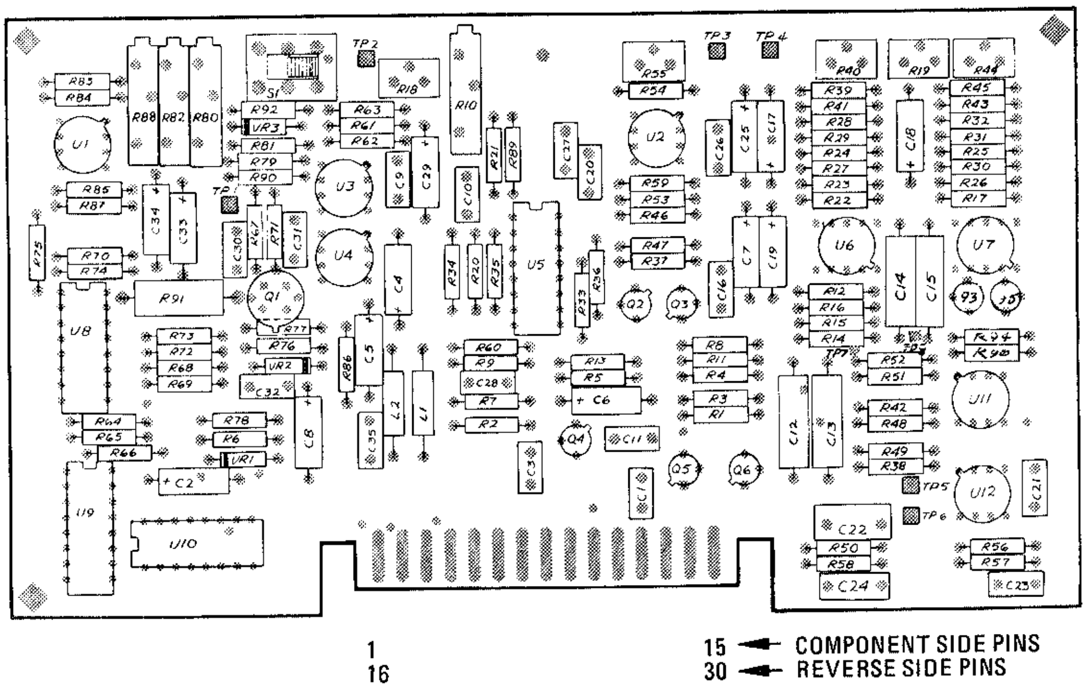


Figure D3-33. A3A8 Polar Converter Parts Locations (Change 9)

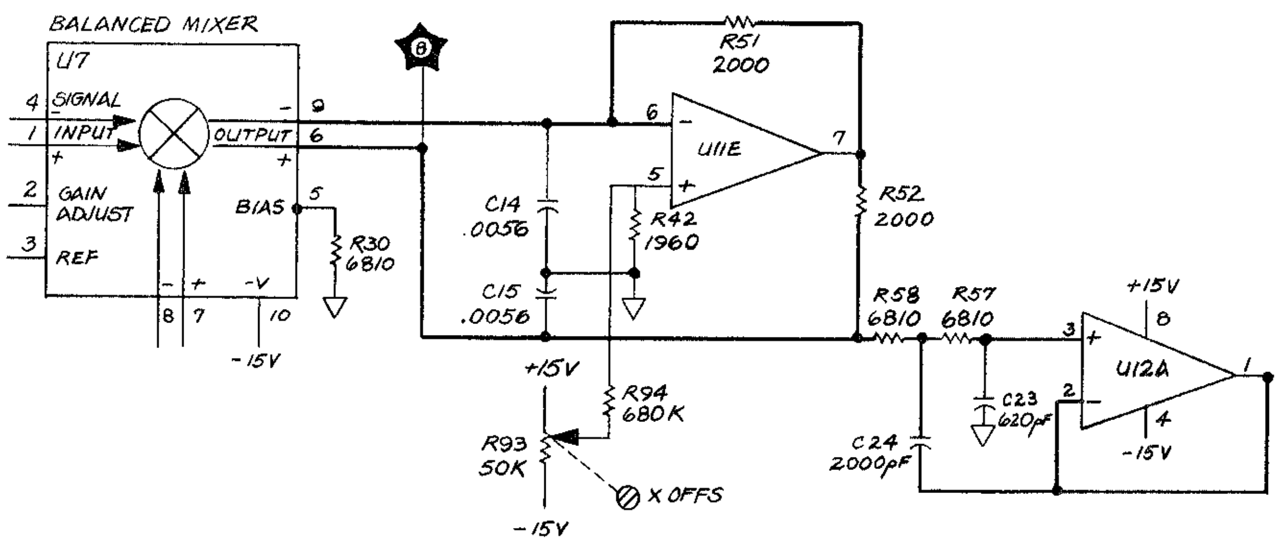
CHANGE 9 (Cont'd)

Page D3-81, Figure D3-34:

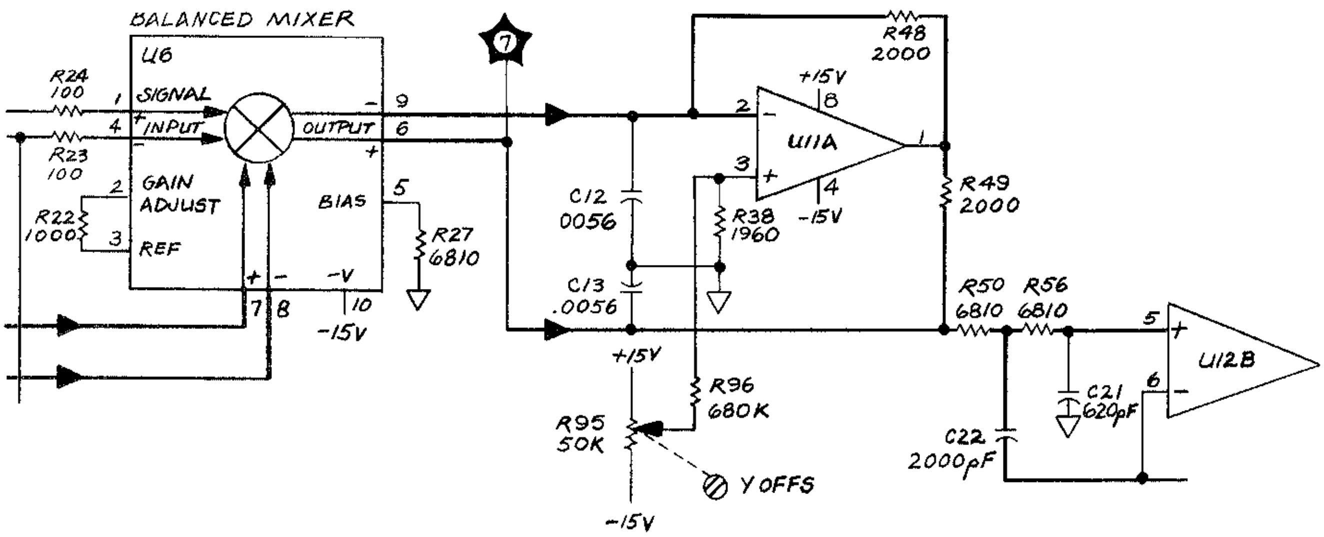
Change the circuit for U11A and U11B as shown in the partial schematic in this change sheet.

Change the HP Part Number for A3A8 at the top of schematic to 08505-60205.

X AXIS OUTPUT MIXER AND FILTER



Y AXIS OUTPUT MIXER AND FILTER



P/O Figure D3-34. Partial Schematic of A3A8 (CHANGE 9)

CHANGE 9 (Cont'd)

Page E4-7, Table E4-2:
Change "A3A20C10" to A3A20C10* HP Part Number 0160-0571, CAPACITOR-FXD 470PF (FACTORY SELECTED VALUE).
Change "A3A20R11" to A3A20R11* HP Part Number 0698-0083, RESISTOR 1.96K 1% .125W (FACTORY SELECTED VALUE).

Page E5-45, Figure E5-12:
Change "A3A20R11" to A3A20R11* 1.96K and change "A3A20C10" to A3A20C10* 470 pf.

CHANGE 10

Page D2-4, Table D2-2:
Change A3FL1 to HP Part Number 9135-0052, Filter RFI.

Page D2-36, Figure D2-1:
Change Item 36A to HP Part Number 9135-0052, Filter RFI.

Page D2-23, Table D2-2:
Change A3A13C44 and A3A13C45 to HP Part Number 0160-3459. CAPACITOR-FXD .02μF, +–10%, 250 WVDC, CER.

Page D3-99, Figure D3-44:
Change value of C44 and C45 to .02μF.

CHANGE 11

Page C2-25, Table C2-2:
Add at end of description for A2A19 the statement, "Alternate replacement for 5086-7268".
Add prior to the existing entry for A2A19, a listing for A2A19, HP Part Number 5086-7268, YIG OSCILLATOR 4.2 – 5.5 GHz.

Page D2-15, Table D2-2:
Add A3A9C32, HP Part Number 0170-0066, CAPACITOR-FXD .027UF+–10% 200VDC POLYE.

Page D2-31, Table D2-2:
Change A3A25R2 to HP Part Number 2100-3684, RESISTOR-VARIABLE CONTROL CC 50 10% LIN.

Page D3-85, Figure D3-36:
Add A3A9C32, 0.027UF Capacitor, between U5 pin 6 and ground.

Page D3-121, Figure D3-54:
Change A3A25R2 to 50 Ohm.

CHANGE 12

Page D2-14, Table D2-2:
Change A3A8R82 to HP Part Number 2100-3161, RESISTOR-TRMR 20K 10% C SIDE-ADJ 17-TURN

Page D2-19, Table D2-2:
Change A3A11R12* to HP Part Number 0757-0199, RESISTOR 21.5K 1% .125W F TC=0+–100 (*FACTORY SELECTED PART, TYPICAL VALUE GIVEN.)

Page D3-81, Figure D3-34:
Change A3A8R82 to 20K.

CHANGE 12 (Cont'd)

Page D3-91, Figure D3-40:
Change A3A11R12 to 21.5K.

CHANGE 13

Page C2-21, Table C2-2:
Add A2A11C11, HP Part Number 0160-4256, CAPACITOR-FXD .047UF 200 WVDC MICA.

Page C3-93, Figure C3-39:
Add C11 between the left end of R42 and the bottom end of R30 (but not connected to R30).

Page C3-93, Figure C3-40:
Add C11, a .047UF capacitor between pins 1 and 28 of A2A11 board.

CHANGE 14

P/O Table C2-2, A2A9 Parts List, CHANGE 2 of this Change Sheet:
Change the entry for A2A9R65 to HP Part Number 0757-0280, RESISTOR 1K 1% .125W F TC=0+–100.

Page C2-27, Table C2-2:
Change A2A22 to HP Part Number 08505-60209.
Delete A2A22C6 thru C10.
Add A2A22T1P1, HP Part Number 1251-3389, Connector-Receptacle 10 contact.
Delete A2A22U1 thru U5.
Add A2A22XA25, HP Part Number 1251-2035, CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS.
Add A2A25, HP Part Number 08505-60210, Rectifier Board Assembly.
Add Component Parts of A2A25 as follows:
A2A25C1 thru C5, HP Part Number 0170-0060, CAPACITOR-FXD .047UF 400V.
A2A25CR1 thru CR12, HP Part Number 1902-0662, DIODE-POWER RECT 100V 6A.
A2A25F1, HP Part Number 2110-0036, FUSE 8A 125V F.
A2A25J1, HP Part Number 1251-3750, CONNECTOR-POST 10 CONTACT.
A2A25U1 and U2, HP Part Number 1906-0094, DIODE-FW BRIDGE 400V 1.5A.
A2A25XF1, HP Part Number 2110-0269, FUSE HOLDER CLAMP (2 REQUIRED).

Page C2-28, Figure C2-1:
Change Reference Designator 27 Quantity to 6.

►Page C3-105/106, Figure C3-47:
Change schematic as shown in Partial Schematic contained in this change sheet.
►Add Figure C3-46A contained in this change sheet.

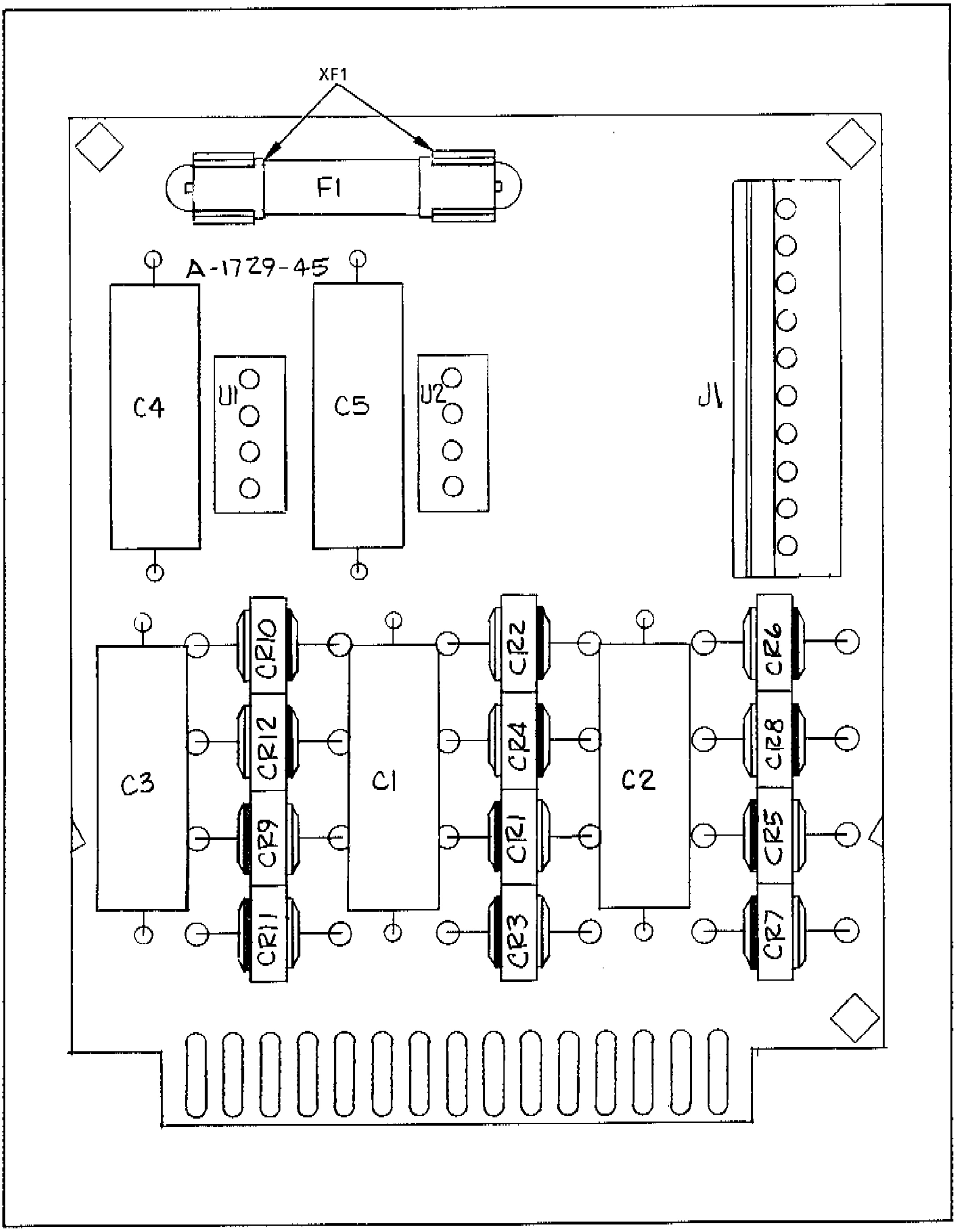
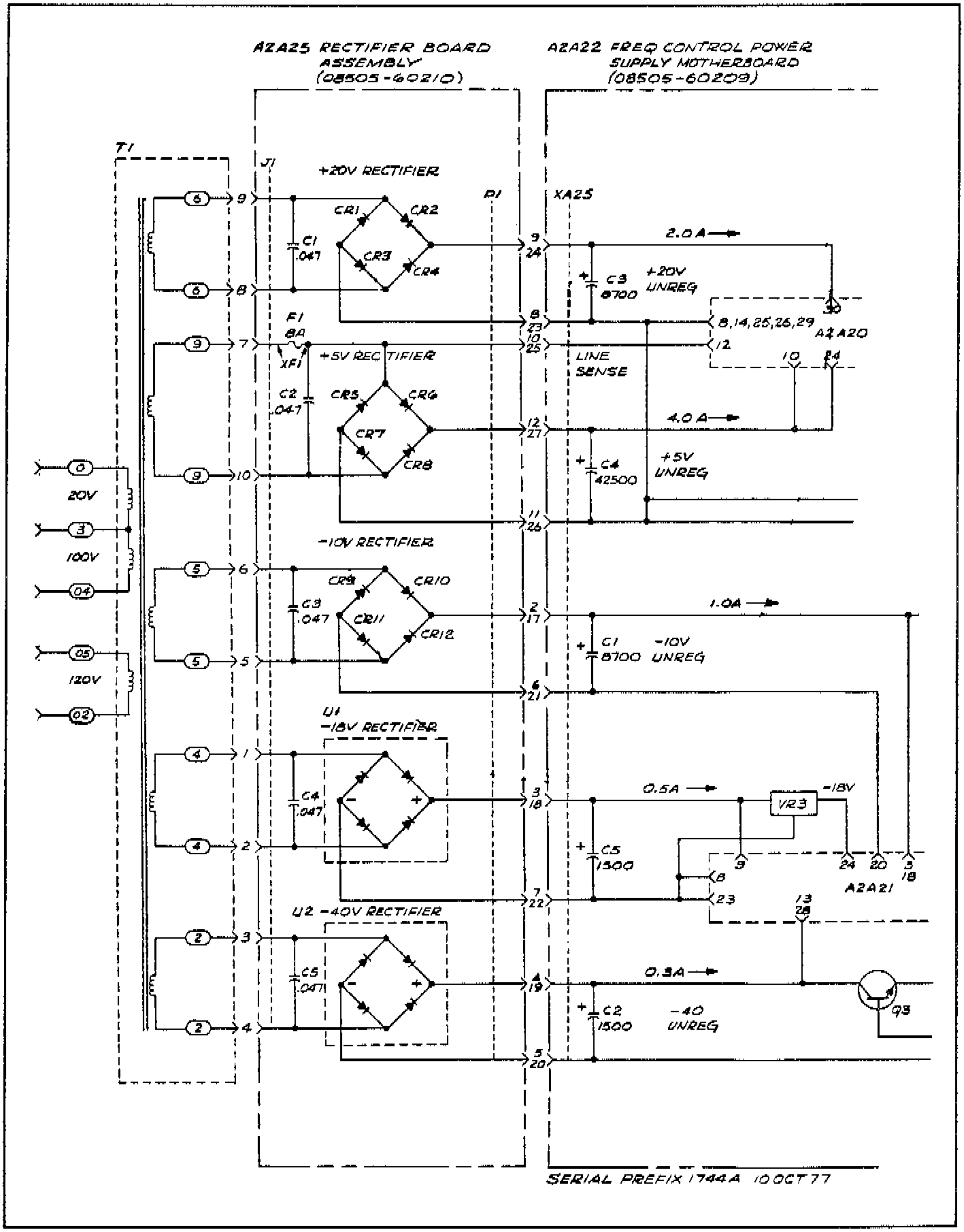


Figure C3-46A. A2A25 Rectifier Board Assembly, Parts Location (CHANGE 14)



P/O Figure C3-47. A2A22 Frequency Control Power Supply, Schematic (CHANGE 14)

CHANGE 15

Page D2-29, Table D2-2:
Change A3A18C1 to HP Part Number 0140-0198, CAPACITOR-FXD 200pF +-5% 300 WVDC MICA.
Change A3A18C2 to HP Part Number 0160-2203, CAPACITOR-FXD 91pF +-5% 300 WVDC MICA.

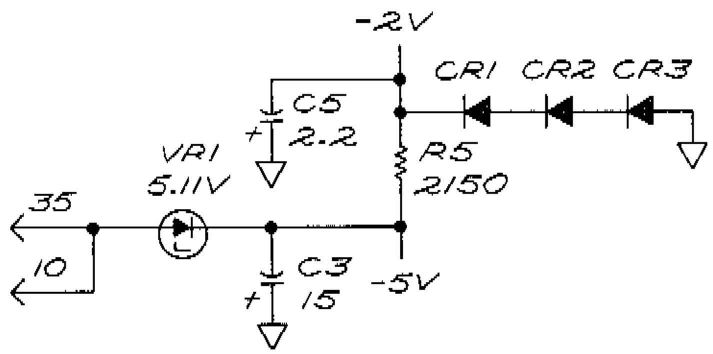
Page D3-115/116, Figure D3-52:
Change A3A18C1 to 200pF.
Change A3A18C2 to 91pF.

CHANGE 16

In this Change Sheet, Table C2-2, CHANGE 5:
Change the Parts List in Change 5 of this change sheet as follows:
Delete A2A4L3.
Add A2A4MP4 through MP13, HP Part Number 1200-0507, IC SOCKET 16 CONTACT.
Change A2A4R5 to HP PART NUMBER 0698-0084, RESISTOR 2.15K 1% .125W F TC=0+−100.
Add A2A4VR1, HP PART NUMBER 1902-0041, DIODE-ZNR 5.11V 5% DO-7 PD= .4W TC=−.009%.

In this Change Sheet, Figure C3-25, CHANGE 5:
Change L3 to VR1.

In this Change Sheet, Figure C3-26, CHANGE 5:
Delete L3 and add VR1 in its place, change the value of R5, and change −10V to −5V as shown in the partial schematic below.



Change the "−10V" notation to "−5V" on U2, U8 through U11, and U14 through U17.

Page C2-23, Table C2-2:
Change A2A11VR1 to HP Part Number 1902-1336.

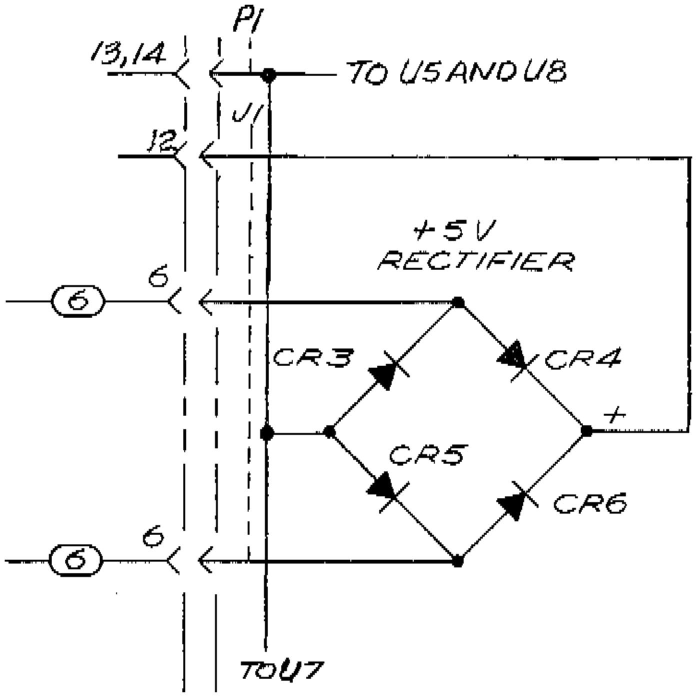
Page D2-30, Table D2-2:
Add A3A24CR3 through CR6, HP Part Number 1901-0662, DIODE PWR RECT 100V 6A.

Page D2-31, Table D2-2:
Change A3A24U5 through U8 to HP Part Number 1906-0094, DIODE-MULT FULL WAVE BRIDGE 400V 1.5A.
Delete A3A24U9.

►CHANGE 16 (Cont'd)

Page D3-118, Figure D3-52B:
Replace Figure D3-52B with new Parts Location Drawing of A3A24 in this change sheet.

►Page D3-119/120, Figure D3-53:
Delete A3A24U6 and add in its place A3A24CR3 through CR6 as shown in the partial schematic below:



A3A24

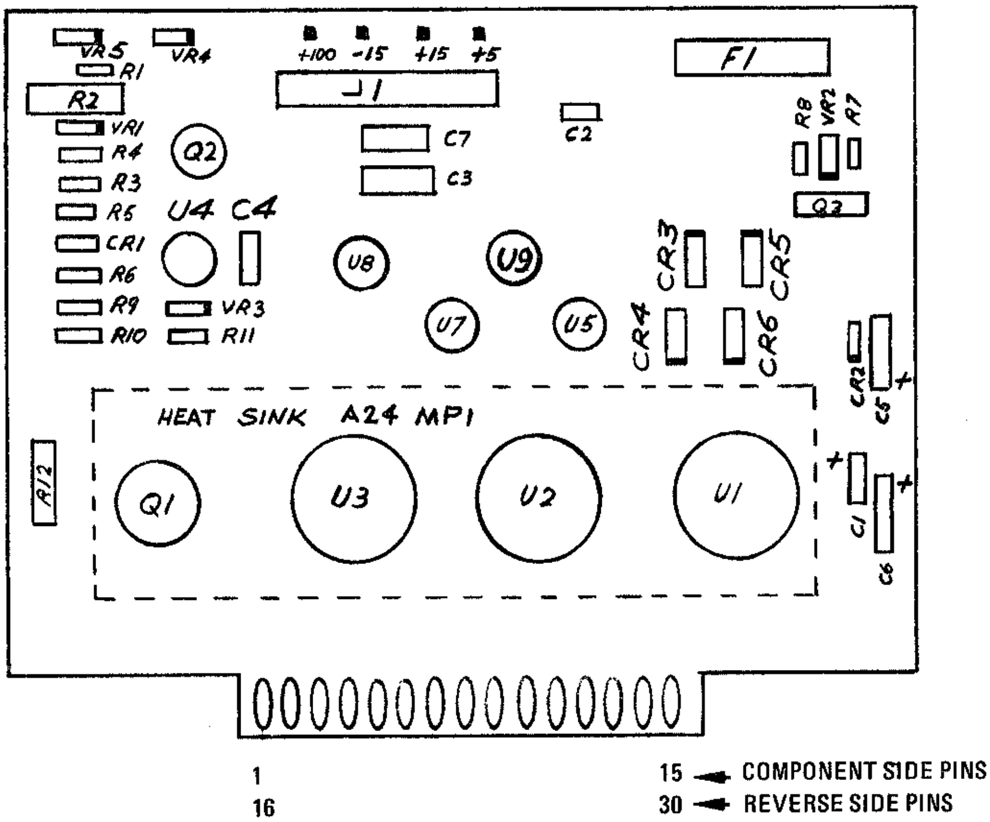


Figure D3-52B. A3A24 Voltage Regulator Board Parts Locations (Change 16)

CHANGE 17

Page C2-4, Table C2-2:
Change A2A1A1DS1 through DS14 to MFR PART NUMBER 1990-0503.

Page D2-25, Table D2-2:
Change A3A13R83 to HP Part Number 0757-0442, RESISTOR 10K 1% .125W F TC=0+–100.
Change A3A13R91 to HP Part Number 2100-3154, RESISTOR-TRMR 1K 10% C SIDE-ADJ 17-TURN.

Page D2-28, Table D2-2:
Delete A3A17C19.

Page D2-29, Table D2-2:
Change A3A17U5 to HP Part Number 1826-0371, IC OP AMP TO-99.

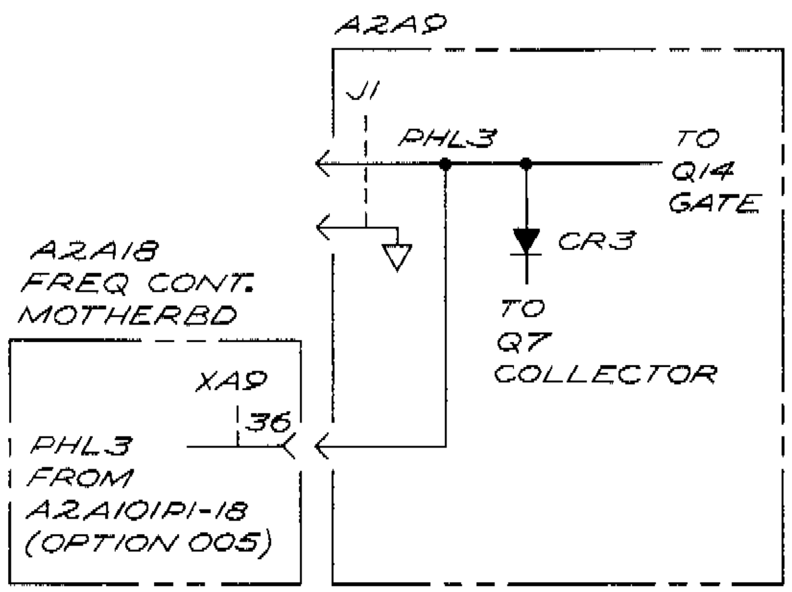
Page D2-36, Figure D2-1:
Change Reference Designator 66 to HP Part Number 08505-00136.

Page D2-37, Figure D2-1:
Change Reference Designator 95 to HP Part Number 08505-00137.
Change Machine Screw, HP Part Number 2510-0137, to 2510-0136.

Page D3-99, Figure D3-44:
Change R83 to 10K.
Change R91 to 1000.

In this Change Sheet, Table C2-2, A2A9 Part List, CHANGE 2:
Change A2A9 to HP Part Number 08505-60211.

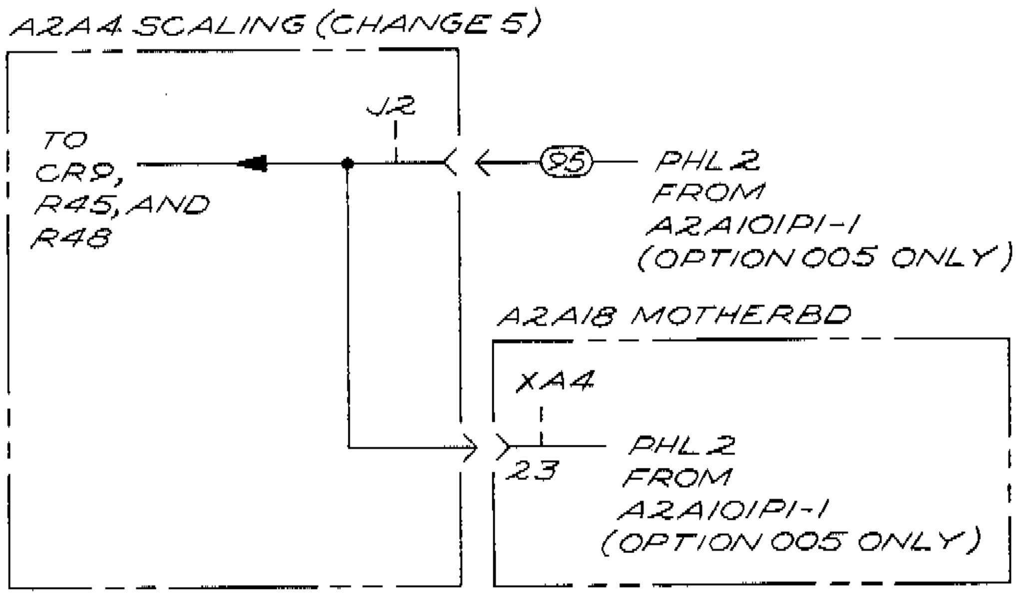
In this Change Sheet Figure C3-36, A2A9 Discriminator Schematic CHANGE 2; and Figure F4-5, in Option 005 Supplement:
Change Part Number of A2A9 in upper left hand corner to 08505-60211.
►Change the phase lock circuit for Option 005 as shown in the partial schematic following:



CHANGE 17 (Cont'd)

In this Change Sheet, Table C2-2 CHANGE 5:
Change A2A4 to Part Number 08505-60212.

In this Change Sheet, Figure C3-26, A2A4 Scaling Schematic, CHANGE 5:
Change the phase lock circuit for Option 005 as shown in the partial schematic following:



CHANGE 18

Page C2-4, Table C2-2:
Change A2W107 to HP Part Number 08505-60217.
Change A2W108 to HP Part Number 08505-60218.
Change A2W8 to HP Part Number 08505-60219.
Change A2W9 to HP Part Number 08505-60220.
Change A2W10 to HP Part Number 08505-60221.
Change A2W16 to HP Part Number 08505-60216.

Page C2-5, Table C2-2:
Change A2A1A1U2, A2A1A1U3, and A2A1A1U5 to HP Part Number 1820-1823.

Page C2-7, Table C2-2:
Delete A2A3C22.

Page C2-8, Table C2-2:
Change A2A3U28, A2A3U29, and A2A3U30 to HP Part Number 1820-1823.

CHANGE 18 (Cont'd)

Page C2-9, Table C2-2:
Change A2A3U31, A2A3U32, and A2A3U33 to HP Part Number 1820-1823.

Page C2-12, Table C2-2:
Change A2A5U12 thru A2A5U15 to HP Part Number 1820-1823.

Page C2-24, Table C2-2:
Change A2A18 to HP Part Number 08505-60214.

Page C2-28, Figure C2-1:
Change Item 29 to HP Part Number 08505-00141.
Delete Items 29A and 29B.
Change Item 30 to HP Part Number 08505-20216.
Change Item 33 to HP Part Number 08505-20217.

Page C3-63, Figure C3-24:
Delete A2A3C22.

Page D2-11, Table D2-2:
Change A3A7C21 and A3A7C22 to HP Part Number 0160-2055.

Page E4-4, Table E4-2:
Change A2A13U4, A2A13U6, and A2A13U8 to HP Part Number 1820-1823.

Page E4-5, Table E4-2:
Change A2A14U6, A2A14U10, A2A14U14, and A2A15U14 to HP Part Number 1820-1823.

Page E4-6, Table E4-2:
Change A2A16C3 to HP Part Number 0180-0116, CAPACITOR-FXD 6.8 UF +-10% 35VDC TA.
Change A2A16U11 and A2A16U16 to HP Part Number 1820-1823.

Page E4-7, Table E4-2:
Change A3A19U14, A3A19U15, and A3A20U13 to HP Part Number 1820-1823.

Page E4-8, Table E4-2:
Change A3A21U11 and A3A21U17 to HP Part Number 1820-1823.

Page E5-29, Figure E5-8:
Change A2A16C3 to 6.8 UF.

CHANGE 19

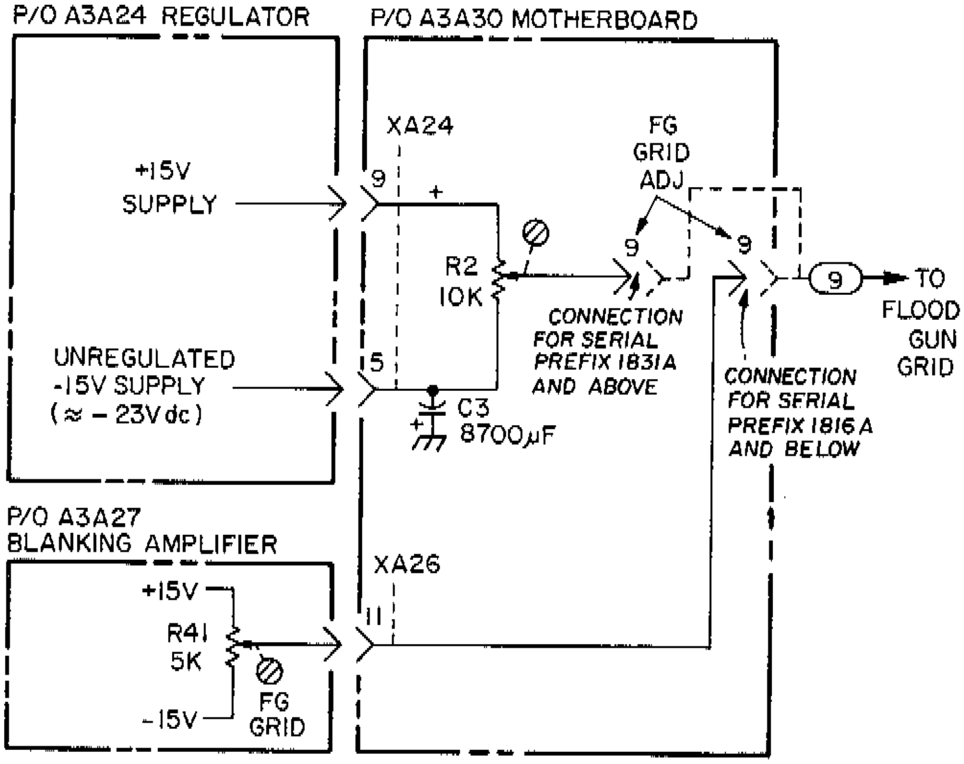
Page A5-67, Paragraph A5-36:
Add the following Flood Gun adjustment:
Flood Gun
ac-1. Set front-panel SCALE control fully clockwise to turn on flood gun. For instruments with serial prefix 1831A and above, adjust FG GRID ADJ control A3A30R2 on the bottom center of Display Motherboard A3A30 for the most uniform illumination on the screen. For instruments with serial prefix 1816A and below, adjust "FG GRID" control A3A27R41 for the most uniform illumination on the screen.
ac-2. If illumination is too bright, increase resistance of A3A30R1 (½ watt resistor). If illumination is too dark, decrease value of A3A30R1. Do not make any smaller value than 6.8 ohms ½ watt or damage to filament may occur.

CHANGE 19 (Cont'd)

Page D2-4, Table D2-2:
Change A3V1 to HP Part Number 08505-60232, CRT ASSEMBLY WITH OVERLAY TAB MOUNTS.

Page D2-35, Table D2-2:
Change A3A30 to HP Part Number 08505-60230.

Page D3-127, Figure D3-56:
Add Partial Schematic of flood gun grid circuit shown in this change sheet.



P/O Figure D3-56. A3A27 Blanking Amplifier, Schematic (CHANGE 19)

In Chapters A and E, delete all references to "Option 001" and substitute "HP-IB" as appropriate. Option 001 HP-IB is now a standard part of the 8505A and is included with all instruments starting at Prefix 1831A.

CHANGE 20

Page C2-5A, Table C2-2:
Change A2A1A2 to HP Part Number 5060-9444.
Change A2A1A3 to HP Part Number 5060-9444.

NOTE

Part Number 5060-9444 is the recommended replacement for A2A1A2 and A2A1A3 in all instruments.

CHANGE 21

Page A1-0, Figure A1-1:
Change part number under Interconnect Cable to 08505-60231.

Page A1-4, Paragraph A1-41:
Change the part number of "Interconnect Cable" to 08505-60231.

Page B2-13, Figure B2-1:
Change item 14 to HP Part Number 08505-00139.
Change item 33 to HP Part Number 08505-00140.

CHANGE 21 (Cont'd)

Page D2-31, Table D2-2:
Add A3A25R10 through A3A25R14, HP Part Number 0757-0280, RESISTOR 1K 1% .125W TC=0+--100.
Change the HP Part Number of A3A26 to 08505-60215.

Page D2-32, Table D2-2:
Add A3A26MP8, HP Part Number 85662-20042, GUIDE-HIGH VOLTAGE BD.
Change A3A26R13 to HP Part Number 0698-8992, RESISTOR 8M 2% 1W C TC=0+--250.
Change A3A26R14 to HP Part Number 2100-3626.
Change A3A26R15 to HP Part Number 0698-8993, RESISTOR 14M 2% 1W C TC=0+--250.
Change A3A26VR1 and A3A26VR2 to HP Part Number 2140-0015, LAMP-GLOW C2A 115/58 VDC 1.9 mA BULB (Recommended Replacement).

Page D2-36, Figure D2-1:
Change item 52 to HP Part Number 08505-00144, COVER-HIGH VOLTAGE.
Change item 67 to HP Part Number 08505-00138.

Page D2-37, Figure D2-1:
Change item 88 to HP Part Number 08505-00145.

► Page D3-121, Figure D3-54:
Add A3A25R10, 1K RESISTOR, in the "3" line between W22 and the wiper of R1.
Add A3A25R11, 1K RESISTOR, in the "5" line between W22 and the wiper of R4.
Add A3A25R12, 1K RESISTOR, in the "9" line between W22 and the wiper of R5.
Add A3A25R13, 1K RESISTOR, in the "1" line between W22 and the wiper of R7.
Add A3A25R14, 1K RESISTOR, in the "7" line between W22 and the wiper of R8.

Page D3-123, Figure D3-55:
Change the Part Number of A3A26 at top of schematic to 08505-60215.
Change the value of VR1 and VR2 to 115V.
Change the value of R13 to 8M.
Change the value of R15 to 14M.

Page E4-8, Table E4-2:
Change A3A21C7 to HP Part Number 0180-0116, CAPACITOR-FXD 6.8UF +--10% 35VDC TA.

Page E5-49, Figure E5-14:
Change A3A21C7 (located in parallel with R2 in POWER-ON RESET circuit) to 6.8UF.

►CHANGE 22

Page C2-9, Table C2-2:
Change A2A4R16 to HP Part No. 2100-3273, RESISTOR-TRMR 2K 10% C Side-Adj 1-Trn, Mfr Part No. 3386-Y46-202.
Change A2A4R24 to HP Part No. 2100-3351, RESISTOR-TRMR 500 10% C Side-Adj 1-Trn, Mfr Part No. 3386-Y46-501.

Page C2-26, Table C2-2:
Change A2A21 to HP Part No. 08505-60235, Mfr Part No. 08505-60235.
Change A2A21Q3 to HP Part No. 1884-0261, THYRISTOR-SCR TO-220AB Mfr Code 01698, Mfr Part No. S2060A.
Change A2A21Q7 to HP Part No. 1854-0271, TRANSISTOR NPN SI TO-39 PD = 1W FT 150MHZ, Mfr Code 02037, Mfr Part No. SS92.

Page C3-67, Figure C3-26:
Change the value of R16 to 2000 ohms.
Change the value of R24 to 500 ohms.

Page C3-103/104, Figure C3-46:
Change A2A21 to HP Part No. 08505-60235.

Page D2-9, Table D2-2:
Change A3A5R42 to HP Part No. 0698-3444, RESISTOR 316 10% .125W, Mfr Part No. C4-1/8-TO-316R-F.
Change A3A5R45 to HP Part No. 2100-3351, RESISTOR-TRMR 500 10% C Side-Adj 1-Trn, Mfr Part No. 3386-Y46-501.

Page D2-31, Table D2-2:
Delete A3A25R10 thru A3A25R14.

Page D2-35, Table D2-2:
Change A3A30 to HP Part No. 08505-60236.
Add A3A30R2 thru A3A30R6, HP Part No. 0757-0280, RESISTOR, 1K 1% .125W TC = 0+-100.

Page D3-71, Figure D3-28:
Change the value of R42 to 316 ohms.
Change the value of R45 to 500 ohms.

Page D3-121, Figure D3-54:
Change the position of the 1K RESISTORS A3A25R10 thru A3A25R14 to the A3A30 Mother Board. Change the reference designators as follows:

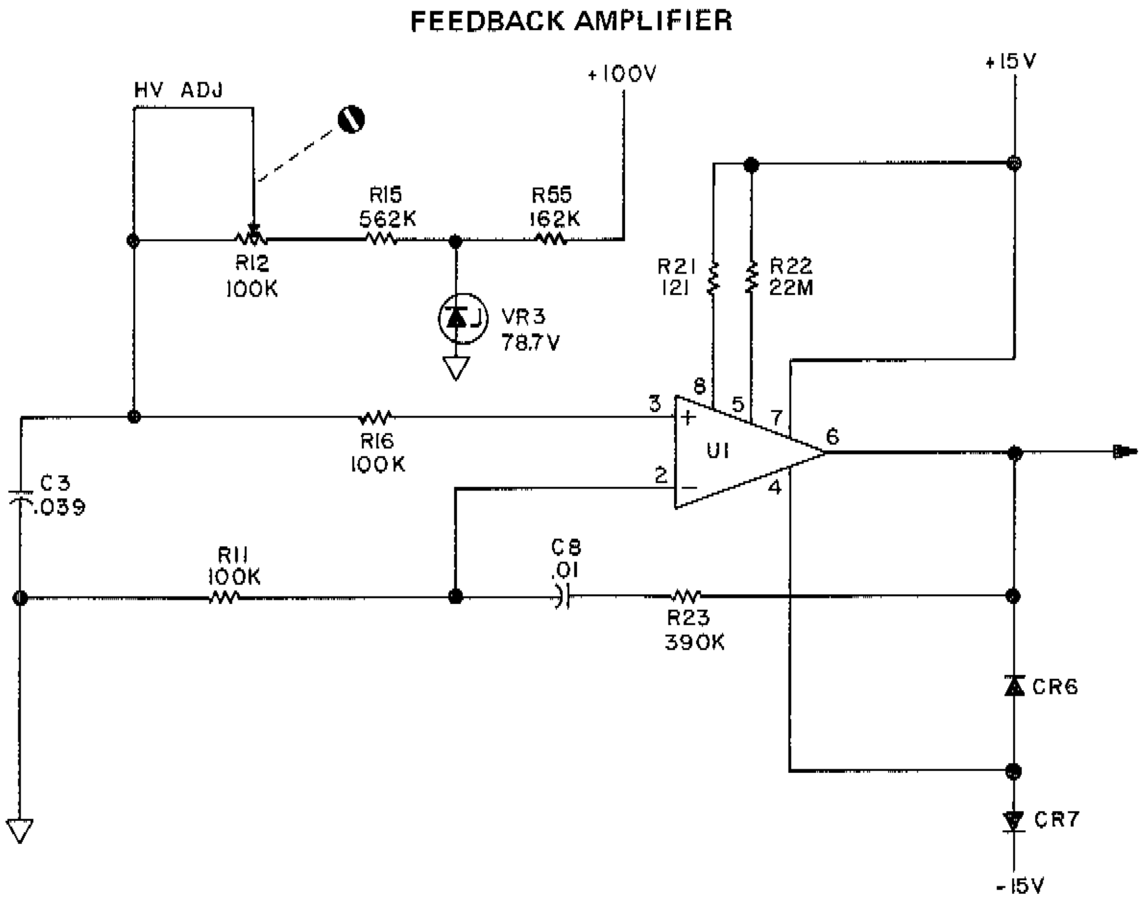
Old Reference Designator	New Reference Designator	Move From A3A25	To New Location on A3A30
A3A25R10	A3A30R2	In "3" line from wiper of R1	In line to pin J1FP-7
A3A25R11	A3A30R3	In "5" line from wiper of R4	In line to pin J1FP-8
A3A25R12	A3A30R4	In "9" line from wiper of R5	In line to pin J1FP-5
A3A25R13	A3A30R5	In "1" line from wiper of R7	In line to pin J1FP-6
A3A25R14	A3A30R6	In "7" line from wiper of R8	In line to pin J1FP-4

►CHANGE 23

Page D2-32, Table D2-2:
Change A3A27 to HP Part No. 08505-60237.
Change A3A27R12 to HP Part No. 2100-2655, RESISTOR-TRMR, 100K 10% TOP-ADJ, 1-TRN.
Change A3A27R15 to HP Part No. 0698-8824, RESISTOR, 562K 1% .125W F TC = 0+-100.
Add A3A27R55, HP Part No. 0757-0470, RESISTOR, 162K 1% .125W F TC = 0+-100.
Add A3A27VR3, HP Part No. 1902-3400, DIODE-ZNR 78.7V 2% DO-7 PD = .4W TC = +.08%.

Page D3-127, Figure D3-55B:
Replace Figure D3-55B with Figure D3-55B (Change 23) of this Manual Change.

Page D3-127, Figure D3-56:
Change FEEDBACK AMPLIFIER, A3A27 Circuit as shown in the partial schematic following:



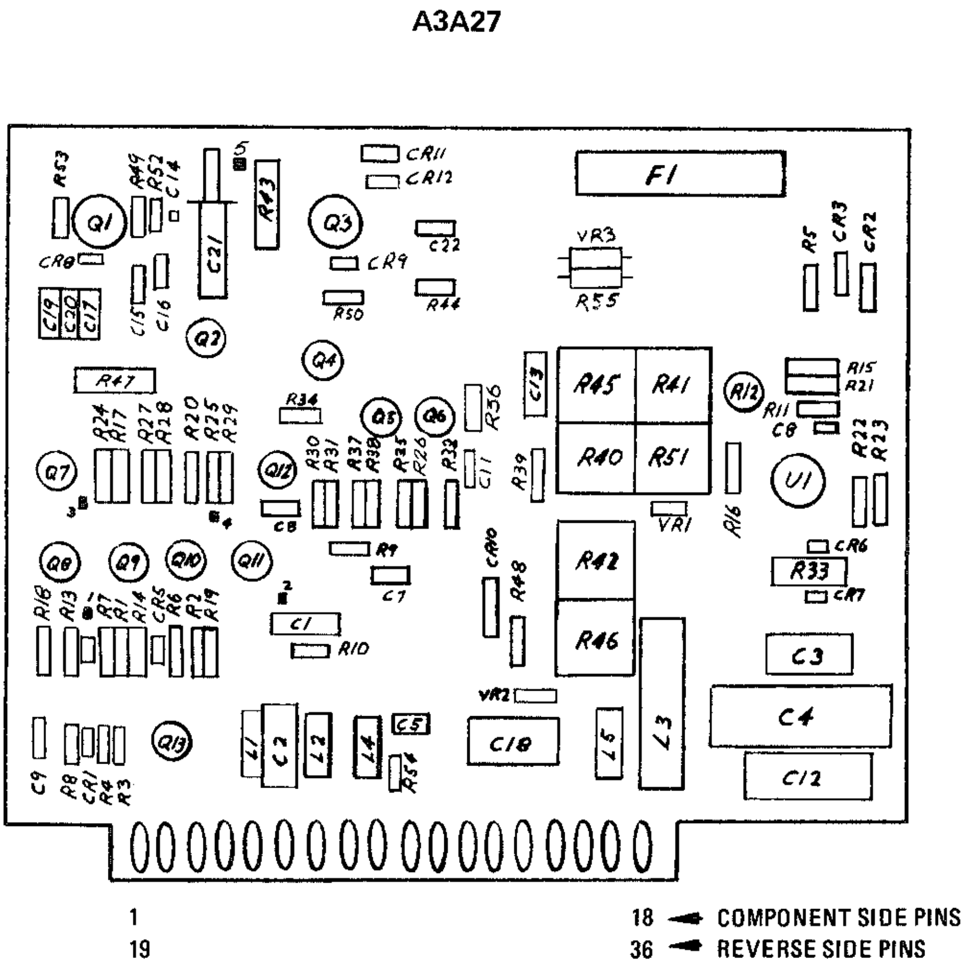


Figure D3-55B. A3A27 Blanking Amplifier Parts Locations (CHANGE 23)

CONTENTS

CHAPTER A
MODEL 8505A NETWORK ANALYZER

CONTENTS (Cont'd)

CHAPTER B
RF SOURCE/CONVERTER

CONTENTS (Cont'd)

CHAPTER C
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ILLUSTRATIONS

CHAPTER A
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ILLUSTRATIONS (Cont'd)

ILLUSTRATIONS (Cont'd)

CHAPTER B
RF SOURCE/CONVERTER

ILLUSTRATIONS (Cont'd)

CHAPTER C
FREQUENCY CONTROL

ILLUSTRATIONS (Cont'd)

CHAPTER D
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ILLUSTRATIONS (Cont'd)

TABLES

CHAPTER A
MODEL 8505A NETWORK ANALYZER

CHAPTER B
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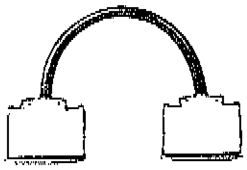
CHAPTER C
FREQUENCY CONTROL

CHAPTER D
SIGNAL PROCESSOR

MODEL 8505A NETWORK ANALYZER
(Shown with Option 907, Front Handles)

INTERCONNECT CABLE
(08505-60021)



NOTE

The following accessories supplied with the 8505A are not shown:

1. Smith and Log Chart CRT Overlays
2. AC Power Cable
3. PC Board Extenders (4) (See Accessories Supplied, Paragraph A1-40)

Figure A1-1. Model 8505A Network Analyzer

CHAPTER A
MODEL 8505A NETWORK ANALYZER

SECTION I
GENERAL INFORMATION

A1-1. INTRODUCTION

A1-2. The Model 8505A Network Analyzer comprises three functionally separate but physically integrated major assemblies: RF Source/Converter Assembly A1, Frequency Control Assembly A2, and Signal Processor Assembly A3. (A1, A2, and A3 are reference designators used to identify these assemblies throughout the manual.) The building-block approach used in construction of the 8505A is also used in the arrangement of the manual. Chapter A is divided into six sections containing information pertaining to the entire 8505A. This includes specifications, operating instructions, performance tests, adjustments, and sufficient theory and troubleshooting data to enable you to isolate a malfunction to a particular one of the three major assemblies.

A1-3. Chapters B, C, and D each cover one major assembly: Chapter B, the RF Source/Converter Assembly A1; Chapter C, the Frequency Control Assembly A2; and Chapter D, the Signal Processor Assembly A3. Each of these three chapters is divided into three sections containing general information about the assembly, a complete parts list for the assembly, the assembly theory of operation and schematic diagrams, and sufficient data for isolation of a failure within the assembly to the malfunctioning stage or component.

A1-4. DESCRIPTION

A1-5. The 8505A Network Analyzer measures network performance in the frequency range of 500 kHz to 1300 MHz. Three test input ports, A, B, and R, each provide 100 dB of dynamic range. The three test inputs are electrically identical, with R used as the reference for ratio measurements. A front-panel adjustable "line stretcher," with an associated readout in meters and centimeters, enables the electrical length of the R input to be changed to match the electrical length of the test input. This feature is used to compensate for differences in test cable lengths, and to measure the electrical length of a network under test.

A1-6. Any one of the three test inputs, or the ratio of A/R or B/R, can be selected for presentation on one or both of two identical but independent display channels: CHANNEL 1 and CHANNEL 2. These two channels each display signal magnitude, phase, deviation from linear phase, and group delay of the under-test device's transmission or reflection characteristics. A selector switch enables all of these characteristics except group delay to be displayed in either rectangular or polar coordinates. Group delay is displayed in rectangular coordinates only. Digital readouts of the displayed characteristics are also provided on the 8505A.

A1-7. The 8505A's internal signal source provides seven selectable test signal modes: logarithmic full-range sweep, linear full-range sweep, linear expanded sweep (selected start/stop end points) No. 1, linear expanded sweep No. 2, linear expanded sweeps No. 1 and No. 2 alternately displayed on display channels 1 and 2 respectively, CW $\pm\Delta F$, and CW. Logarithmic full-range and linear full-range swept signals are provided in three selectable ranges: 500 kHz to 13 MHz, 500 kHz to 130 MHz, and 500 kHz to 1300 MHz.

A1-8. The Hewlett-Packard Interface Bus (HP-IB) sllows both the Frequency Control and the Signal Processor of the 8505A to either receive instructions from or send data to a remote controller. The Learn Mode of the HP-IB enables the controller to store or "learn" the state of the 8505A manually-set front-panel controls so it can recall this information as needed.

A1-9. The three major assemblies (A1, A2, and A3) of the 8505A are contained in two chassis units, stacked one on top of the other and mechanically locked together. The lower unit contains the RF Source/Converter Assembly (A1) and the Frequency Control Assembly (A2). The top unit contains the Signal Processor Assembly (A3) and its associated CRT display. Each unit has its own ac power input receptacle and dc power supplies.

A1-10. INSTRUMENTS COVERED BY THE MANUAL

A1-11. Attached to the upper and lower units of the instrument are two identical serial number plates, both inscribed with the same serial number. As shown in Figure A1-2, the serial number is in two parts. The first four digits and the letter are the serial number prefix; the last five digits are the suffix. The prefix is the same for all identical instruments; it changes only when a change is made to the instrument. The suffix, however, is assigned sequentially and is different for each instrument. The contents of this manual apply to instruments with the serial number prefix(es) listed under SERIAL NUMBERS on the title page.

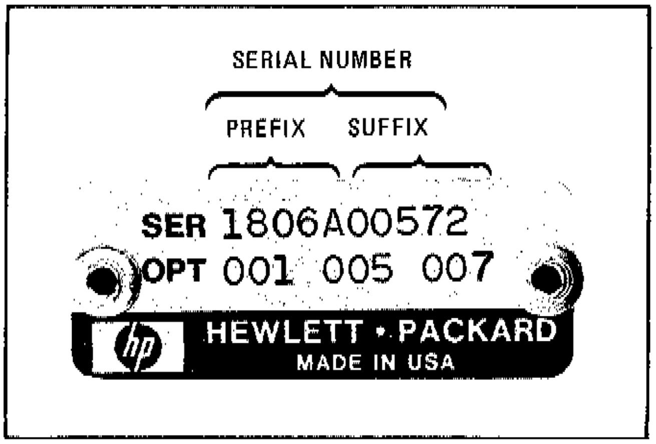


Figure A1-2. Serial Number Plate

A-12. Occasionally the manual will be accompanied by a yellow Manual Changes supplement. The Manual Changes supplement contains changes that have not yet been incorporated in the manual. A box in the upper right corner of the Manual Changes supplement identifies the affected manual by part number and print date. The supplement also identifies the serial numbers or serial number prefixes of instruments affected by it.

A1-13. The Manual Changes supplement (when there is one) is available for updating manuals already shipped from the factory. To obtain the latest Manual Changes supplement, contact your nearest Hewlett-Packard office.

A1-14. SAFETY CONSIDERATIONS

A1-15. General

A1-16. This is a Safety Class I instrument. This instrument has been designed and tested according to International Safety Requirements for Electronic Measuring Apparatus.

A1-17. Safety Symbols

Instruction manual symbol: the apparatus will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect the apparatus against damage.

Indicates dangerous voltages.

Earth terminal (sometimes used in manual to indicate circuit connected to grounded chassis).

WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in injury or loss of life. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the equipment. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

A1-18. Operation

CAUTION

BEFORE APPLYING POWER make sure the instrument's TWO ac inputs are set for the available ac line voltage, that the correct fuses are installed, and that all normal safety precautions have been taken.

A1-19. Service

A1-20. Although the instrument has been designed in accordance with international safety standards, the information, cautions, and warnings in this manual must be followed to ensure safe operation and to keep the instrument safe. SERVICE AND ADJUSTMENTS SHOULD BE PERFORMED ONLY BY QUALIFIED SERVICE PERSONNEL.

A1-21. Adjustment or repair of the opened instrument with the ac power connected should be avoided as much as possible and, when unavoidable, should be performed only by a skilled person who knows the hazard involved.

A1-22. Capacitors inside the instrument may still be charged even though the instrument has been disconnected from its source of supply.

A1-23. Make sure only fuses of the required current rating and type (normal blow, time delay, etc.) are used for replacement. Fuse requirements are indicated on the instrument's rear panels. Do not use repaired fuses or short-circuit fuse holders.

A1-24. Whenever it is likely that the protection has been impaired, make the instrument inoperative and secure it against any unintended operation.

WARNING

If this instrument is to be energized through an auto-transformer (for voltage reduction), make sure the common terminal is connected to the earthed pole of the power source.

BEFORE SWITCHING ON THE INSTRUMENT, the protective earth terminals of the instrument must be connected to the protective conductor of the (mains) power cord. The mains plug shall only be inserted in a socket outlet provided with protective earth contact. The protection action must not be negated by using an extension cord (power cable) without a protective grounding conductor. Grounding one conductor of a two-conductor outlet is not sufficient protection.

Any interruption of the protective (grounding) conductor, inside or outside the instrument, or disconnection of the protective earth terminal is likely to make this instrument dangerous. Intentional interruption of the earth ground is prohibited. Whenever it is likely that the protection has been impaired, the instrument must be secured against any unintended operation.

Servicing this instrument often requires that you work with the instrument's protective covers removed and with ac power connected. Be very careful; the energy at many points in the instrument may, if contacted, cause personal injury.

WARNING

At the top left rear of the Signal Processor Assembly A3, under the top cover, there is a two-position NORM/BY-PASS switch. When this switch is set to NORM, the front-panel LINE ON/OFF switch controls the primary power into the entire 8505A. When it is set to BY-PASS, however, only the lower unit (Source/Converter and Frequency Control Assemblies) is affected by operation of the LINE switch, the Processor Assembly will have power applied to it as long as the line cord (power cable) is connected to an ac source regardless of the position of the LINE switch. DO NOT assume there are no dangerous voltages present in the Signal Processor Assembly until you have checked the position of the NORM/BY-PASS switch.

A1-25. SPECIFICATIONS

A1-26. Operating specifications for the 8505A Network Analyzer are listed in Table A1-1. These are the performance standards the instrument is tested against. A list of typical operating characteristics is provided in Table A1-2. They are included as additional information only; they are not specifications and performance to them is not guaranteed.

A1-27. OPTIONAL 8505A EQUIPMENT

A1-28. Option 005 Phase Lock

A1-29. Option 005 provides the capability for phase-locking the HP 8505A to an external stable signal source such as the HP 8660A/C Synthesized Signal Generator or HP 8640A/B Signal Generator. When phase-locked, the residual FM of the system approaches that of the external signal source. This system is useful in making very narrow band measurements. See Chapter E for further information.

A-30. Option 007 Labeling Interface

A1-31. Option 007 provides the capability to obtain data from the 8505A to 8501A. Data obtained from the 8505A includes front-panel control settings, frequency, and Channel 1 and 2 marker measurement information. The 8501A processes this data and displays it on the 8505A CRT as labels and graphics. See Chapter F for further information.

A1-32. Option 907 Front Handles Kit

A1-33. Option 907 consists of four front handles, two for each 8505A chassis unit, and the necessary hardware for attaching the handles. The kit part number is HP 5061-0089. See Figure A2-2.

A1-34. Option 908 Rack Flange Kit

A1-35. Option 908 contains the flanges and hardware required to mount the 8505A in an equipment rack with 482.6 mm (19 inches) horizontal spacing. The kit part number is HP 5061-0077. See Figure A2-2.

A1-36. Option 909 Rack Flange/Front Handle Kit

A1-37. Option 909 consists of one Option 907 Front Handle Kit and one Option 908 Rack Flange Kit. (See above.) The kit part number is HP 5061-0083. See Figure A2-2.

A1-38. Option 910 Additional 8505A Manual

A1-39. Option 910 provides an additional 8505A Operating and Service Manual.

A1-40. ACCESSORIES SUPPLIED

A1-41. Accessories supplied with 8505A are:

Table of Accessories

Accessory	HP Part Number
Interconnect Cable	08505-60021
HP-IB Cable (0.5 meter)	10631D
HP-IB Cable (2 meter)	10631B
*One Y-Type AC Power Cable	8120-2231 or
Two AC Power Cables	8120-1351 or
Two AC Power Cables	8120-1369 or
Two AC Power Cables	8120-1689 or
Two AC Power Cables	8120-0698
One Set Smith and Log Chart CRT Overlays	08505-60154
One 8505A Operating Instructions Sheet	08505-90074
One 12-Pin (Dual 6-Pin) Extender Board	08505-60109
Two 30-Pin (Dual 15-Pin) Extender Board	08505-60041
One 36-Pin (Dual 18-Pin) Extender Board	08505-60042
One 50-Pin (Dual 25-Pin) Extender Board	08505-60108

*Power cable supplied depends on configuration of ac power receptacle at user's location. Y-type cable connects to both top and bottom units of 8505A.

Table A1-1. 8505A Network Analyzer Specifications (1 of 3)

SOURCE

FREQUENCY CHARACTERISTICS

Frequency Range: 500 kHz to 1.3 GHz in three ranges; 500 kHz to 13 MHz, 500 kHz to 130 MHz and 500 kHz to 1.3 GHz.

Swept Frequency Accuracy: ±1% of range for linear sweep.

CW Frequency Accuracy: ±2 counts ±time-base accuracy.

Frequency Stability: better than ±0.01% of reading ±0.01% of frequency range over 10 minutes after warm up.

FREQUENCY COUNTER CHARACTERISTICS

Frequency counter measurements are made at any one of five continuously variable marker positions without interrupting the swept RF signal.

Accuracy:

Counter: ±2 counts ±time-base accuracy.

Marker Frequency: ±0.002% of scan width ±counter accuracy.

Time Base Accuracy: ±5 ppm ±1 ppm/°C ±3 ppm/90 days

OUTPUT CHARACTERISTICS

Power:

Range: +10 dBm to −72 dBm.

Accuracy:

Attenuator: ±1.5 dB over 70 dB range.

Vernier: ±1 dB

Levelling: ±0.5 dB from 500 kHz to 1.3 GHz.

Impedance: 50Ω; ⩾16 dB return loss at −10 dBm output level (<1.38 SWR).

Spectral Purity:

Residual FM:

Frequency Range (MHz)	0.5 to 13	0.5 to 130	0.5 to 1300
Residual FM (Hz rms)	20 Hz	200 Hz	2 kHz
Measurement Bandwidth	20 Hz – 1 kHz	20 Hz – 1 kHz	20 Hz – 10 kHz

Harmonics: >25 dB below main signal at +10 dBm output level. Typically >40 dB below main signal at −12 dB setting of vernier.

Sub-harmonics and Spurious Signals: Below −50 dBm at +10 dBm output level.

RECEIVER

FREQUENCY RANGE

500 kHz to 1.3 GHz.

INPUT CHARACTERISTICS

Input Channels: Three channels (R, A, and B) with 100 dB dynamic range.

Maximum Input Level (Selectable): −10 dBm or −30 dBm input level.

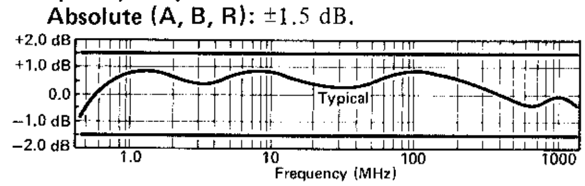
Noise (10 kHz BW): −110 dBm from 10 to 1300 MHz; −100 dBm from 2 to 10 MHz; −95 dBm from 0.5 to 2 MHz. Typically, −120 dBm using the −30 dBm input level position and 1 kHz BW.

Impedance: 50Ω: ⩾20 dB return loss (<1.22 SWR). Typically >26 dB return loss (<1.11 SWR).

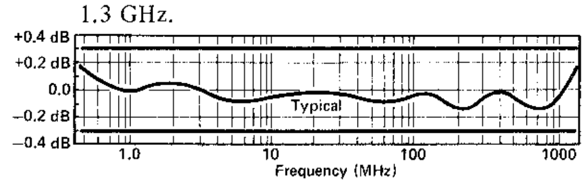
MAGNITUDE CHARACTERISTICS

Frequency Response:

Absolute (A, B, R): ±1.5 dB.



Ratio (A/R, B/R): ±0.3 dB from 0.5 MHz to 1.3 GHz.



Dynamic Accuracy:

± 0.01 dB/dB from −20 to −40 dBm.
± 0.2 dB from −10 to −50 dBm.
± 0.5 dB from −50 to −70 dBm.
± 1.0 dB from −70 to −90 dBm.
± 2.0 dB from −90 to −100 dBm.
± 4.0 dB from −100 to −110 dBm.

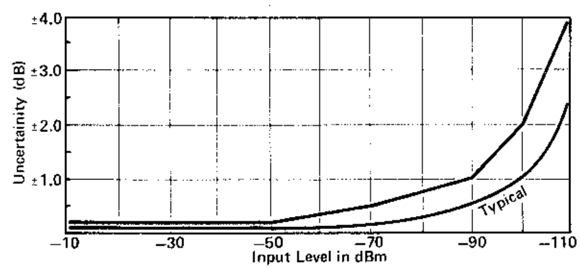
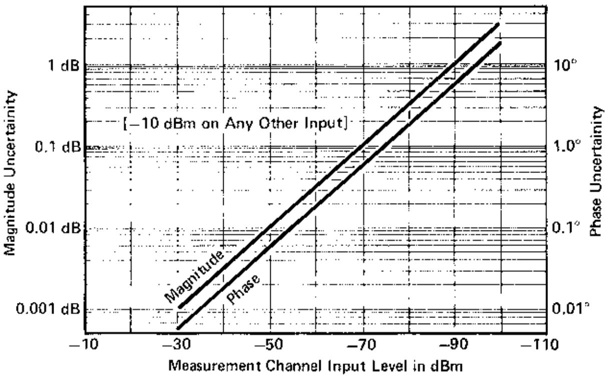


Table A1-1. 8505A Network Analyzer Specifications (2 of 3)

Crosstalk Error Limits: (≥100 dB isolation between inputs.)



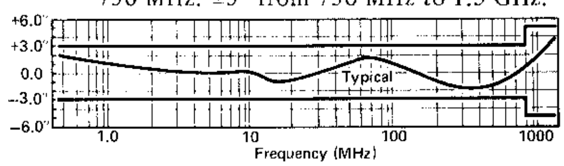
Reference Offset:
Range: ±199.9 dB.
Accuracy: ±0.03 dB ±0.003 dB/dB of offset.

Resolution:
Marker Measurement: 0.01 dB over any <10 dB range; 0.1 dB for ≥10 dB range.

CRT Display: 0.1 dB to 20 dB/division in 1, 2, 5 sequence.

PHASE CHARACTERISTICS

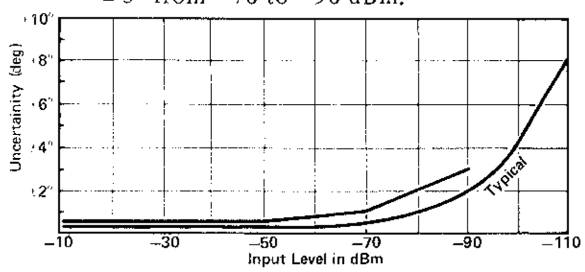
Frequency Response: ±3° from 500 kHz to 750 MHz. ±5° from 750 MHz to 1.3 GHz.



Range: ±180°.

Accuracy: ±0.01°/degree for ±170°
±0.01°/degree ±0.5° for ±180°

Dynamic Accuracy (in 10 kHz Bandwidth):
± 0.02°/dB from −20 to −40 dBm.
± 0.5° from −10 to −50 dBm.
± 1° from −50 to −70 dBm.
± 3° from −70 to −90 dBm.



Crosstalk: See amplitude crosstalk specifications.

Reference Offset:
Range: ±1700 degrees.

Accuracy: ±0.3° ±0.5% of offset.

Resolution:
Marker Measurement: 0.1° over <100° range and 1° for ≥100° range.

CRT Display: 1° to 180° per division in 8 steps.

POLAR CHARACTERISTICS

Frequency Response, Dynamic Response, Reference Offset and Marker Measurement specifications are the same as magnitude and phase characteristics.

CRT Display Accuracy: Actual value is within less than a 3 mm circle of the displayed value.

Tracking Between dB Offset Controls and Polar Full switch positions: ≤0.2 dB.

CRT Display Resolution: Magnitude graticules at 20% of full scale spacing; phase graticules at 10° increments around unit circle.

DELAY CHARACTERISTICS

Frequency Response: ±1 ns from 500 kHz to 1.3 GHz

Delay Accuracy[3]: ±3% of reading ±3 units. (Units = 1 nsec for 0.5 to 1300 MHz range, 10 nsec for 0.5 to 130 MHz range, and 100 nsec for 0.5 to 13 MHz range.)

Range, Resolution and Aperture[2]

Frequency Range (MHz)	0.5 to 13	0.5 to 130	0.5 to 1300
Range	0 to 80 μs	0 to 8 μs	0 to 800 ns
Resolution CRT: Marker: Marker over limited Range:	 100 ns 100 ns 10 ns (<1 μs)	 10 ns 10 ns 1 ns (≤ 100 ns)	 1 ns 1 ns 0.1 ns (≤ 10 ns)
Aperture[2]	7 kHz	20 kHz	200 kHz

Reference Offset:
Range: ±1999 units.

Accuracy: ±0.3 units ±0.3% of offset.

Table A1-1. 8505A Network Analyzer Specifications (3 of 3)

ELECTRICAL LENGTH/REF. PLANE EXTENSION CHARACTERISTICS

Calibrated Electrical Length: Range and Resolution:[3]

Frequency Range (MHz)		0.5 to 13	0.5 to 130	0.5 to 1300
Range	x1	±19.9 m	±1.99 m	±19.9 cm
	x10	±100 m	±10 m	±1 m
Resolution	x1	10 cm	1 cm	0.1 cm
	x10	1 m	10 cm	1 cm

[1] +3 Units may be calibrated out.
[2] Typical measurement Aperture using linear FM modulation technique.
[3] Vernier provides continuous adjustment of electrical length.

Accuracy: ±3% of reading ±1% of range.

Resolution: 10°

Vernier Range: Continuously variable over >10° range.

Accuracy: ±3% of reading ±10°/scan.

Phase Compensation Linearity: < ±0.2% of phase slope inserted.

Dimensions: 426 mm wide, 279 mm high, 553 mm deep (16-3/4 in. x 11 in. x 21-3/4 in.).

Weight:
Net, 36 kg (86 lb)
Shipping, 48 kg (106 lb)

Table A1-2. Typical Operating Characteristics (1 of 2)

SOURCE

Swept Frequency Resolution: (Verniers provide continuous frequency adjustment.)

Frequency Range (MHz)	0.5 to 13	0.5 to 130	0.5 to 1300
Start/Stop	10 kHz	100 kHz	1 MHz
CW ±ΔF	10 kHz 1 kHz	100 kHz 10 kHz	1 MHz 100 kHz
CW	100 Hz	1 kHz	10 kHz

Frequency Counter Resolution: (Least Significant digit)

Frequency Range (MHz)	0.5 to 13	0.5 to 130	0.5 to 1300
10 ms Sweep Time	10 kHz	100 kHz	1 MHz
100 ms Sweep Time	1 kHz	10 kHz	100 kHz
>1 second Sweep Time	100 Hz	1 kHz	10 kHz

Typical CW Noise (SSB in 1 Hz BW):

Frequency Range (MHz)	0.5 to 13	0.5 to 130	0.5 to 1300
dB below carrier	70	85	100
Frequency offset from carrier	1 kHz	10 kHz	150 kHz

SOURCE
General Characteristics:

Sweep Modes: Linear Full, Log Full, Start/Stop 1, Start/Stop 2, Alternate, CW ±ΔF, and CW.

Sweep Times: 10 ms to 100 seconds in decade ranges with vernier adjustment or manual sweep using vernier.

Trigger Modes: Auto, line sync., single scan or external sync. up to 50 kHz rate with ≥2 Vpp and ≥1 μs trigger signal.

RF Output Connector: Type N Female.

Table A1-2. Typical Operating Characteristics (2 of 2)

RECEIVER

Input Damage Level: +20 dBm or ≥50 Vdc.

Full Scale Polar Magnitude Range: 1 to 0.01 in a 1, 0.5, 0.2 sequence.

Electrical Length Linearity: $\Delta\phi$ = 0.5% x 1.2f (MHz) x 1 (meters)

Linear Phase Substitution (degrees/scan):

Range: ±1700° per scan with 0° offset.

$$\frac{\pm 1.4\ \text{km}}{\text{scan width (MHz)}} \text{ or } \frac{\pm 4.7\ \mu\text{sec}}{\text{scan width (MHz)}}$$

Magnitude Offset

Typical Maximum Offset between −10 and −30 dBm Input Level Position: ±0.2 dB (excluding dynamic accuracy).

Typical Maximum Offset between 10 kHz and 1 kHz BW Positions: ±0.2 dB (exluding dynamic accuracy).

Phase Offset

Typical Maximum Offset between −10V and −30 dBm Input Level Position: ≤± 2.0° (excluding dynamic accuracy).

Typical Maximum Offset between 10 kHz and 1 kHz BW Position: ≤± 5° (excluding dynamic accuracy).

General Characteristics:

RF Input Connectors: Type N Female.

CRT Reference Position: Reference lines for Channel 1, Channel 2, and beam center (in Polar) may be independently set to any position on the CRT Display.

General Characteristics (Cont'd)

Display Bandwidth: Selectable IF bandwidths of 10 kHz and 1 kHz. A video filter position is also provided.

CRT Background Illumination: Illumination control provided for CRT photography.

CRT Overlays: Smith Charts (3.16, 1, 0.5, 0.2, 0.1 full scale), Log Charts (10 MHz, 100 MHz and 1000 MHz). HP Part No. 08505-60154.

CRT Camera Adaptor: Hewlett-Packard 197A Option 006 camera is a direct fit. Camera bezel adaptor model 10375A is required to convert the standard 197A camera to fit the 8505A display.

Auxiliary Outputs:

Channel 1 and 2 Outputs: 0.25 V/display division with 2 kΩ source impedance.

Sweep Output: 0.25 V/display division with 2 kΩ source impedance.

Pen Lift: DC coupled, 200 mA current sink.

Power Requirements: 100, 120, 220, or 240 Vac +5% −10%, 50 to 60 Hz, approximately 275 watts. (Total for Signal Processor and Source/Converter-Frequency Control units.)

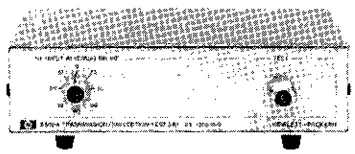
A1-42. TEST SETS AND ACCESSORIES AVAILABLE

A1-43. Test sets and accessories available for use with the 8505A are listed with their specifications in Table A1-3.

A1-44. RECOMMENDED TEST EQUIPMENT

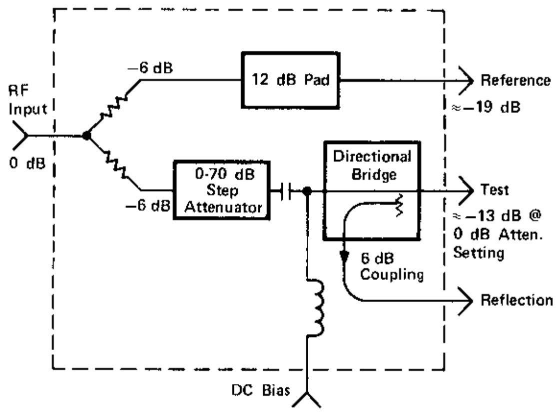
A1-45. Equipment recommended for testing and troubleshooting the 8505A Network Analyzer is listed in Table A1-4. Other equipment may be substituted for the equipment listed, providing it meets or exceeds the critical specifications indicated in the table.

Table A1-3. Test Sets and Accessories (1 of 7)



8502A
50 Ω TRANSMISSION/REFLECTION TEST SET

8502B
75 Ω TRANSMISSION/REFLECTION TEST SET[1]



8502A RF Schematic

Frequency Range: 500 kHz to 1.3 GHz.

Impedance: 8502A, 50 Ω; 8502B, 75 Ω.

Directivity: ⩾ 40 dB.

Frequency Response[2]:
Transmission: ⩽±0.8 dB Magnitude and ⩽±8° Phase.

Reflection: ⩽±1.5 dB Magnitude and ⩽±15° Phase from 0.5 to 1300 MHz; ⩽±10° Phase from 2 to 1300 MHz.

Port Match:
Test Port: ⩾26 dB Return Loss from 2 to 1300 MHz (⩽1.12 SWR) ⩾20 dB Return Loss from 0.5 to 2 MHz (1.22 SWR).

Test Port Open/Short Ratio: ±0.75 dB Magnitude and ±6° Phase from 2 to 1000 MHz; ±0.9 dB Magnitude and ±7° Phase from 1000 to 1300 MHz; ±1.25 dB Magnitude and ±10° Phase from 0.5 to 2 MHz.

Reference and Reflection Port[2]: ⩾25 dB Return Loss from 2 to 1000 MHz (⩽1.12 SWR); ⩾23 dB Return Loss 0.5 to 1300 MHz (⩽1.15 SWR).

Input Port[3]: ⩾23 dB Return Loss (⩽1.15 SWR).

Insertion Loss:
Input to Test Port: 13 dB.

Input to Reference Port: 19 dB.

Input to Reflection Port: 19 dB.

Maximum Operating Level: ⩽+20 dBm.

Damage Level: >1 watt CW.

RF Attenuator Range: 0 to 70 dB in 10-dB steps.

DC Bias Input Range: ±30 V dc, ±200 mA, some degradation of RF specification 0.5 to 100 MHz; 500 mA maximum.

RF Connectors: 8502A, 50 Ω Type N Female; 8502B Test Port 75 Ω Type N Female, all other RF connectors 50 Ω Type N Female.

DC Bias Input Connector: BNC Female.

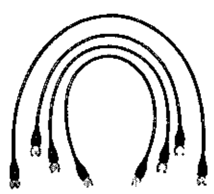
Includes: 8502B includes a 50 Ω to 75 Ω minimum loss pad (11852A).

Recommended Accessory: 11851A Cable Kit:
11853A 50 Ω N Accessory Kit for 8502A.
11855A 75 Ω N Accessory Kit for 8502B.

Dimensions: 101 mm wide, 61.5 mm high, 204 mm deep (7½ in. x 2-7/16 in. x 8 in.).

Weight:
Net, 1.7 kg (3-3/4 lb).
Shipping, 3.1 kg (7 lb).

[1] Tentative specification for 8502B.
[2] ±degrees specified as deviation from linear phase.
[3] Other ports terminated in their characteristic impedance.



11851A
RF CABLE KIT

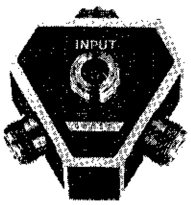
Function: Provides the necessary RF interconnections and RF shielding required for 8505A Network Analyzer measurements when using the 8502A, 8502B Transmission Reflection Test Sets or the 11850A, 11850B Power Splitters.

Kit Includes: Three 61 cm (24 in.) 50 Ω cables, phase matched to 4° at 1.3 GHz and one 86 cm (34 in.).

Connectors: 50 Ω Type N Male.

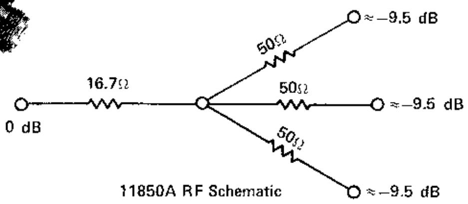
Weight: Net 0.91 kg (2 lb). Shipping, 1.36 kg (3 lb).

Table A1-3. Test Sets and Accessories (2 of 7)



11850A
50 Ω POWER SPLITTER

11850B
75 Ω POWER SPLITTER



11850A RF Schematic

Frequency Range: 500 kHz to 1.3 GHz.

Frequency Response (Absolute): Input to Output ⩽±0.2 dB.

Nominal Insertion Loss: 9.54 dB for 11850A; 7.78 dB for 11850B.

Impedance: 11850A, 50 Ω; 11850B, 75 Ω.

Tracking Between Any Two Output Ports: ⩽0.1 dB Magnitude and ⩽1.5° Phase.

Port Match:
Output Ports: ⩾32 dB Return Loss (⩽1.05 SWR).

Input Port: ⩾20 dB Return Loss (⩽1.2 SWR).

Maximum Operating Level: ⩽+20 dBm input.

Burn-out Level: ⩾1 watt CW.

RF Connectors: 11850A, 50 Ω Type N Female; 11850B Test Ports (3) 75 Ω Type N Female, RF input 50 Ω Type N Female.

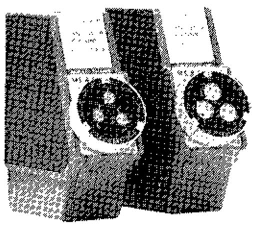
Recommended Accessory: 11851A Cable Kit.

Includes: 11850B includes three 50 Ω to 75 Ω minimum loss pads (11852A).

Dimensions: 67 mm wide, 46 mm high, 67 mm deep (2-5/8 in. x 1-7/8 in. x 2-5/8 in.).

Weight: Net, 1.8 kg (4 lb).
Shipping, 3.1 kg (7 lb)

[1] Tentative specification for 11850B.



11600B/11602B
TRANSISTOR
FIXTURES

Function: These units allow RF measurements to be made on leaded transistors. Either fixture provides common emitter, base, and collector for bipolars, and common source, gate, and drain for FET's. Other devices also fit the fixtures (tunnel diodes, diodes, etc.).

Transistor Base Patterns:
Model 11600B: Accepts TO-18/TO-72 packages. Will also accept any 3 or 4 lead packages with leads that lie on a 0.1-inch circle and whose diameters are 0.016 to 0.019 inch.

Model 11602B: Accepts TO-5/TO-12 packages. Will also accept any 3 or 4 lead package with leads that lie on a 0.2-inch circle and whose diameters are 0.016 to 0.019 inch.

Calibration References: Included for calibration of the transistor fixtures are two calibration references; a short circuit termination and a 50 Ω through-section.

Lead Lengths: Up to 1.5 inches long.

Frequency Ranges: DC to 2 GHz.

Impedance: 50 Ω nominal.

Return Loss: >26 dB, 100 MHz to 1.0 GHz; >21 dB from 1 to 2 GHz.

Connectors: Hybrid APC-7 precision connections.

Option 001: Type N Female connectors.

Recommended Accessory: The 11858A Rigid RF cable Interconnect Adapter is recommended for measurements using the 8503A S-parameter Test Set.

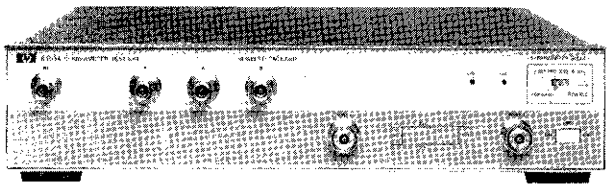
Option 003: Includes 11858A Rigid Interconnect Adapter for use with 8503A.

Maximum Power: 10W including RF signals.

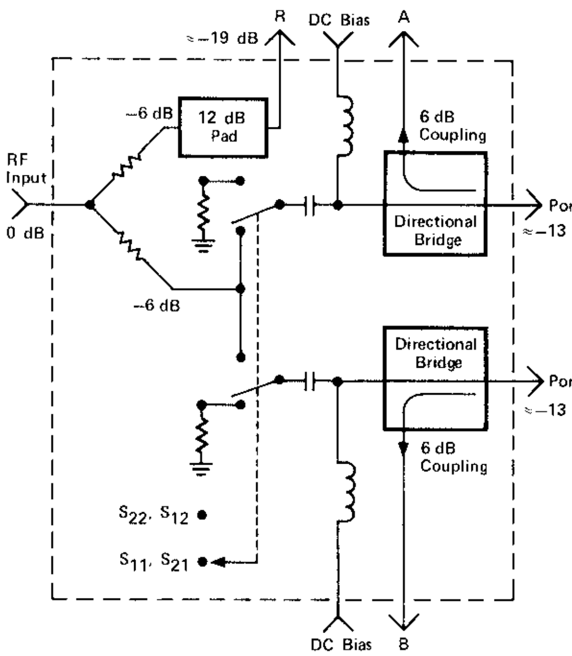
Weight:
Net, 1.1 kg (2-3/8 lb).
Shipping, 1.8 kg (4 lb).

Dimensions:
44 mm wide, 152 mm high, 229 mm deep (1-3/4 in. x 6 in. x 9 in.).

Table A1-3. Test Sets and Accessories (3 of 7)



8503A
50 Ω S-PARAMETER TEST SET
8503B
75Ω S-PARAMETER TEST SET



8503A RF Schematic

Frequency Range: 500 kHz to 1.3 GHz.

Impedance: 50 Ω.

Directivity: ⩾40 dB.

Frequency Response:
- **Transmission[1] (S21, S12):** ±1 dB, ±12° from 0.5 to 1300 MHz.
- **Reflection[1] (S11, S22):** ±2 dB, ±20° from 0.5 to 1300 MHz, ±15° from 2 to 1300 MHz.

Port Match[2]:
- **8503A, Test Port 1 and 2:** ⩾28 dB Return Loss from 2 to 1000 MHz; ⩾26 dB Return Loss from 1000 to 1300 MHz (⩽1.11 SWR); ⩾20 dB Return Loss from 0.5 to 2 MHz (⩽1.22 SWR).
- **8503B, Test Port 1 and 2:** ⩾24 dB Return Loss from 2 to 1300 MHz; ⩾18 dB Return Loss from 0.5 to 2 MHz.
- **8503A, Test Port 1 and 2 Open/Short Ratio:** ⩽±0.75 dB Magnitude and ±6° from 2 to 1000 MHz: ⩽0.9 dB Magnitude and ±7.5° from 1000 MHz to 1300 MHz; ±1.25 dB Magnitude, ±10° Phase from 0.5 to 2 MHz
- **8503B, Test Port 1 and 2 Open/Short Ratio:** ⩽±0.9 dB Magnitude and ±7.5° from 2 to 1300 MHz; ⩽±1.25 dB Magnitude and ±10° from 0.5 to 2 MHz.

Reference and Return Ports: ⩾23 dB Return Loss from 2 to 1000 MHz (⩽1.15 SWR); ⩾20 dB Return Loss from 0.5 to 2 MHz and 1000 to 1300 MHz (⩽1.22 SWR).

RF Input Port: ⩾20 dB Return Loss from 0.5 to 1300 MHz (⩽1.22 SWR).

Tracking Between Reference and Test Port 1 and 2:
- **Transmission[1] (S21, S12):** ⩽±0.5 dB Magnitude and ⩽±4° Phase.
- **Reflection[1] (S11, S22):** ⩽±0.75 dB Magnitude and ⩽±6° Phase.
- **RF Input to Test Port 1 or 2:** ⩽±1.5 dB.

Insertion Loss:
- **Input to Port 1 and 2:** 13 dB Nominal
- **Input to Port A, B, or R:** 19 dB Nominal

Maximum Operating Level: +20 dBm

Damage Level: 1 watt CW

Connectors:
- **Test Ports:** APC-7.
- **All Other RF Ports:** 50 Ω Type N Female.
- **DC Bias Inputs:** BNC Female.

DC Bias Input Range: ±30 Vdc, ±200 mA, some degradation of RF specifications 0.5 to 100 MHz; 500 mA maximum.

Includes: Four 19 cm (7½ in.) cables with Type N Male connectors for connection to 8505A.

Recommended Accessory: 11857A Test Port Extension Cables.

Power: Selection of 100, 120, 220, or 240V +5%−10%, 50 or 60 Hz., approximately 10 watts.

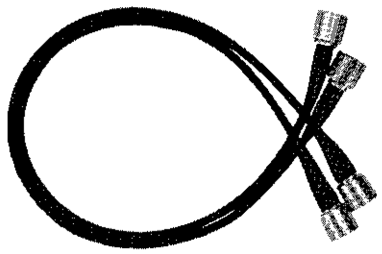
Dimensions: 432 mm wide, 90 mm high, 495 mm deep (17 in. x 3½ in. x 19½ in.).

Weight: Net, 9.1 kg (20 lb). Shipping, 11.3 kg (25 lb).

[1] ±Degrees, specified as deviation from Linear Phase.
[2] Effective Port match for ratio measurement.

Table A1-3. Test Sets and Accessories (4 of 7)

11857A/B/C[1]
TEST PORT EXTENSION CABLES



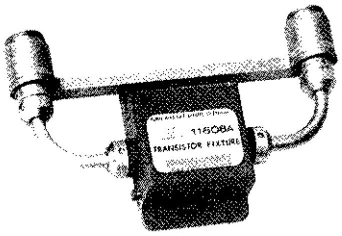
Function: Two precision cables extend the 8503A test ports for convenient measurement of devices having any two-port geometry.

Kit Includes: Two 61 cm (24 in.) cables, phase matched to 2° at 1.3 GHz

Connectors: APC-7.

Weight:
Net, 0.91 kg (2 lb).
Shipping, 1.36 kg (3 lb).

[1] 11857A is 50 ohm cable with APC-7 connectors.
11857B is 75 ohm cable with Type-N 75 ohm male connectors on one end and Type-N 75 ohm female connectors on the other end.
11857C is 75 ohm cable with Type-N 75 ohm male connectors on one end and GR-900 75 ohm connectors on the other end.



11608A
TRANSISTOR FIXTURE

Function: Provides the capability of completely characterizing stripline transistors in either the TO-51 or HPAC-200 package styles. For special package styles, a through-line microstrip and bolt-in grounding structure machinable by customer is available.

Frequency Range: DC to 12.4 GHz.

Impedance: 50 Ω nominal.

Return Loss: >26 dB dc to 4 GHz; >23 dB 4.0 to 8.0 GHz; >19 dB to 12.4 GHz.

Microstrip Material: 0.031 in. polyphenylene oxide (P.P.O.); 0.080 in. wide 50 Ω stripline.

Package Styles:
Option 001: Through-line microstrip (P.P.O. plastic) and bolt-in grounding structure machinable by customer for special package styles.

Option 002: TO-51 (0.250 in. dia.).

Option 003: HPAC-200 (0.205 in. dia.).

Calibration References: Options 002 and 003 are supplied with two calibration references; a short circuit termination and a 50 Ω through-section.

Connectors: APC-7 Hybrid connectors. Mates with 8503A and 8746B S-parameter Test Units. Option 100: Type N Female connectors.

Maximum Power: 10 W including RF signals.

Weight: Net, 0.9 kg (2 lb).
Shipping, 1.4 kg (3 lb).

Dimensions: 143 mm wide, 25 mm high, 89 mm deep (5-5/8 in. x 1 in. x 3½ in.).

1121A
AC PROBE

Function: For making signal measurements without disturbing circuitry and for measuring voltage transfer functions in impedance systems radically different from 50 Ω. Furnished with 10:1 and 100:1 divider and BNC adapter.

Bandwidth (3 dB): 1 kHz to >500 MHz.

Gain: 0 dB ±1 dB.

Frequency Response: 1 kHz to 100 MHz, ±0.5 dB, ±2°.

Input Impedance: 100 kΩ, shunt capacitance 3 pF at 100 MHz. With 10:1 or 100:1 divider, 1 MΩ shunt capacitance 1 pF at 100 MHz.

Output Impedance: 50 Ω nominal.

Maximum Input: 300 mV rms, ±100 V dc.
With 10:1 divider, 3 V rms, ±350 V dc.
With 100:1 divider, 30 V rms, ±350 V dc.

Power: Supplied by 8505A through PROBE PWR jacks. Warning: The output of the 1121A is direct coupled and has an output voltage of approximately −2 to −4 V. The output must not be dc coupled or the probe may be permanently damaged. If using the 1121A with instruments other than the 8505A, or if an attenuator pad is to be used at the probe output, be sure a blocking capacitor is provided. Model 10240B or equivalent can be used.

Weight: Net, 0.7 kg (1.5 lb). Shipping 1.2 kg (2.5 lb).

Table A1-3. Test Sets and Accessories (5 of 7)

11852A
50 Ω to 75 Ω Minimum Loss Pad

Function: A low SWR impedance conversion is required for accurate transmission measurements of 75 Ω devices using the 8505A Receiver (50 Ω). The Minimum Loss Pad provides a matched impedance in both directions, 50 Ω to the 8505A and 75 Ω to the device under test.

Frequency Range: DC to 1.3 GHz.
Insertion Loss: 5.7 dB
Return Loss: ≥30 dB (≤1.06 SWR).
Maximum Input Power: 250 mW (+24 dBm).
Connectors: 50 Ω Type N Female to 75 Ω Type N Female
Dimensions: Diameter 14 mm, length 70 mm (9/16 in. x 2-3/4 in.).
Weight: Net 0.11 kg (4 oz). Shipping, 0.26 kg (9 oz).

11853A
50 Ω Type N Accessory Kit

Function: The 11853A furnishes the RF components generally required when using the 8502A, 11850A, and 8503A (8503A requires 85032A also) when measuring devices having 50 Ω Type N connectors. The characteristics of the components in this kit insure high quality RF measurements for those devices having 50 Ω Type N connectors.

Kit Includes:

Qty.	Description
1	Type N Female short circuit
1	Type N Male short circuit
2	Type N Male Barrel
2	Type N Female Barrel
1	Storage Case

Dimensions: 254 mm wide, 64 mm high, 191 mm deep (10 in. x 2½ in. x 7½ in.).
Weight: Net 0.91 kg (2 lb). Shipping, 1.36 kg (3 lb).

11854A
50 Ω BNC Accessory Kit

Function: The 11854A furnishes the RF components generally required when using the 8502A, 11850A, and 8503A (8503A requires the 85032A also) when measuring devices having 50 Ω BNC connectors. The characteristics of the components in this kit insure high quality RF measurements for those devices having 50 Ω BNC connectors.

Kit Includes:

Qty.	Description
2	Type N Male to BNC Female adapter
2	Type N Male to BNC Male adapter
2	Type N Female to BNC Male adapter
2	Type N Female to BNC Female adapter
1	BNC Male short circuit
1	Storage Case

Dimensions: 254 mm wide, 64 mm high, 191 mm deep (10 in. x 2½ in. x 7½ in.).
Weight: Net 1.13 kg (2½ lb). Shipping, 1.59 kg (3½ lb).

11855A
75 Ω Type N Accessory Kit

Function: Provides the RF connecting hardware generally required for 75 Ω Type N component measurements using the 8502B Reflection/Transmission Test Set.

Kit Includes:

Qty.	Description
2	75 Ω Type N Male barrel.
2	75 Ω Type N Female barrel.
1	75 Ω Type N Male short circuit
1	75 Ω Type N Female short circuit
1	Storage Case

Dimensions: 254 mm wide, 64 mm high, 191 mm deep (10 in. x 2½ in. x 7½ in.).
Weight: Net 0.91 kg (2 lb). Shipping, 1.36 kg (3 lb).

11856A
75Ω BNC Accessory Kit

Function: Provides the BNC connecting hardware required for test setups using the HP 8502B Transmission/Reflection Test Set, the HP 8503B S–Parameter Test Set, or the HP 11850B Power Splitter (75-ohm) to make measurements on devices with 75Ω BNC connectors.

Kit Includes:

Qty	Description
2	75Ω Type N Male to BNC Female adapter
2	75Ω Type N Male to BNC Male adapter
2	75Ω Type N Female to BNC Male adapter
2	75Ω Type N Female to BNC Female adapter
1	75Ω BNC Male short circuit
1	BNC Male 75Ω termination
1	Storage Case

Dimensions: 168 mm wide, 114 mm deep, 51 mm high (6–5/8 in. x 4–1/2 in. x 2 in.)
Weight: Net: 0.91 kg (2 lb). Shipping: 1.36 kg (3 lb).

11858A
Rigid Interconnect Adapter

Function: Provides a rigid RF cable interconnection (horizontal to vertical test port orientation) between the 8503A S-parameter Test Set and the 11600B/11602B Transistor Fixtures and 11604A Universal Extension (11604A information provided in 8410S data sheet).

Connectors: APC-7

Dimensions: 254 mm wide, 64 mm high, 191 mm deep (10 in. x 2½ in. x 7½ in.).

Weight: Net 0.91 kg (2 lb). Shipping 1.36 kg (3 lb).

Table A1-3. Test Sets and Accessories (6 of 7)

85010A/B
8507A/B–8501A Application PAC

Function: Provides a cassette program that supplements the 85030A/B Application PAC. It provides faster data transfer and incorporates the normalization and averaging features of the 8501A.

Includes: Cassette and Operating/Programming Manual.

85030A
8507A/9830A Application PAC
85030B
8507B/9825A Application PAC

Function: Provides three cassette programs. The Accuracy Enhancement Program (AIM-30 or AIM-25) improves measurement accuracy by removing mismatch, directivity and frequency tracking errors for both one-and two-port devices. The Verification Program operationally checks calculator/network analyzer interfaces. The Basic Measurements Program makes the features of Learn Mode and data printing, plotting (with 9862A Plotter), and normalization available to the non-programmer.

Includes: Cassettes and Operating/Programmers Manual

Weight: Net 0.91 kg (2 lb). Shipping 1.36 kg (3 lb).

85031A
Verification and APC-7 Calibration Kit

Function: This kit is furnished with the 8507A Automatic Network Analyzer and is used for verification of measurement system performance. 3 dB and 50 dB Pads are included for use with the 8507A's verification program which functionally checks all parts of the 8507A system. Test data on the pads is also provided.

Kit Includes:

Qty.	Description
1	APC-7 50 Ω Termination <1.005 SWR at 2 GHz
1	APC-7 Short Circuit
1	APC-7 3 dB Pad with Test Data
1	APC-7 50 dB Pad with Test Data
1	Storage Case

Dimensions: 254 mm wide, 64.0 mm high, 19 mm deep (10 in. x 2½ in. x 7½ in.).

Weight: Net 0.91 kg (2 lb). Shipping, 1.36 kg (3 lb).

85032A
50 Ω Type N Calibration Kit

Function: This kit is recommended for use with the 8503A S-parameter Test Set or 8507A Automatic Network Analyzer for measurement of devices having Type N RF connectors.

Kit Includes:

Qty.	Description
2	APC-7 to Type N Female adapter
2	APC-7 to Type N Male adapter
1	50 Ω Type N Female termination with <1.005 SWR at 2 GHz
1	50 Ω Type N Male termination with <1.005 SWR at 2 GHz
1	Type N Female short circuit
1	Type N Male short circuit
1	Storage Case

Dimensions: 254 mm wide, 64 mm high, 191 mm deep (10 in. x 2½ in. x 7½ in.).

Weight: Net 1.13 kg (2½ lb). Shipping 1.59 kg (3½ lb).

85033A
SMA Calibration Kit

Function: This kit is recommended for use with the 8503A S-parameter Test Set or 8507A Automatic Network Analyzer for measurement of devices having SMA RF connectors.

Kit Includes:

Qty.	Description
2	APC-7 to SMA Male adapter
2	APC-7 to SMA Female adapter
1	50 Ω SMA Female termination
1	50 Ω SMA Male termination
1	SMA Female short circuit
1	SMA Male short circuit
1	Storage Case

Dimensions: 254 mm wide, 64 mm high, 191 mm deep (10 in. x 2½ in. x 7½ in.).

Weight: Net 1.13 kg (2½ lb). Shipping, 1,59 kg (3½ lb).

85036A
75Ω Type N Calibration Kit

Function: This calibration kit contains 75Ω Type N connector adapters, short circuits, and terminations. This hardware is required for making error-corrected measurements in accuracy enhancement program (AIM) test setups that use equipment with 75Ω Type N connectors.

Kit Includes:

Qty	Description
1	75Ω Type N Male to Type N Male adapter
1	75Ω Type N Female to Type N Female adapter
1	75Ω Type N Male short circuit
1	75Ω Type N Female short circuit
1	Type N Male 75Ω termination
1	Type N Female 75Ω termination
1	Storage Case

Dimensions: 168 mm wide, 114 mm deep, 51 mm high (6-5/8 in. x 4-1/2 in. x 2 in.).

Weight: Net: 0.91 kg (2 lb). Shipping: 1.36 kg (3 lb).

Table A1-3. Test Sets and Accessories (7 of 7)

8505A TEST SET AND ACCESSORY RECOMMENDATIONS

	TRANSISTOR S-PARAMETERS TO-18/TO-72 TO-5/TO-12 TO-51 HPAC-200				S-PARAMETERS APC-7 (50 Ω) Type N (50 Ω) BNC (50 Ω)			TRANSMISSION/ REFLECTION MEASUREMENTS Type N (50 Ω) BNC (50 Ω) Type N (75 Ω)			TRANSMISSION MEASUREMENTS Only Type N (50 Ω) BNC (50 Ω) Type N (75 Ω)		
8505A Network Analyzer	■	■	■	■	■	■	■	■	■	■	■	■	■
8502A 50 Ω Transmission/ Reflection Test Set									■	■			
8502B 75 Ω Transmission/ Reflection Test Set								■					
11850A 50 Ω Power Splitter												■	■
11850B 75 Ω Power Splitter											■		
8503A 50 Ω S-Parameter Test Set	■	■	■	■	■	■	■						
11600B Transistor Fixture				■									
11602B Transistor Fixture			■										
11608A Option 002 Stripline Transistor Fixture		■											
11608A Option 003 Stripline Transistor Fixture	■												
11851A RF Cable Kit								■	■	■	■	■	■
11852A 50 Ω to 75 Ω Minimum Loss Pad								◪			◪		
11853A 50 Ω Type N Accessory Kit										■			
11854A 50 Ω BNC Accessory Kit									■				
11855A 75 Ω Type N Accessory Kit								■					
11857A Test Port Extension Cables					■	■	■						
11858A Rigid Interconnect Adapter			◩										
85032A 50 Ω Type N Calibration Kit					■	■							

◩ Can be ordered as 11600B/11602B Option 003

◪ Three 50 to 75 Ω Minimum Loss Pads provided with 11852A, one Minimum Loss Pad provided with 8502B.

Table A1-4. Recommended Test Equipment (1 of 3)

Instrument	Recommended Model	Critical Specifications	Use*
Electronic Counter	HP 5340A	Freq Range: 400 kHz to 5.52 GHz Accuracy: ±1 count Sensitivity: −5 dBm	P,A,T
Power Meter and Sensor	HP 435A/8482A/ 8484A or HP 436A/8482A/ 8484A	Freq Range: 500 kHz to 1300 MHz Power Range: +20 to −60 dBm Accuracy: ±0.5 dB at 1300 MHz	P,A,T
Spectrum Analyzer	HP 141T/8552B/ 8553B/8555A	Freq Range: 500 kHz to 5.5 GHz Impedance: 50 ohms Dynamic Range: 60 dB Frequency identification capability	P,A,T
Oscilloscope	HP 180C/1801A/ 1820A/1804A	Vertical Bandwidth: 20 MHz minimum Vertical Sensitivity: 5 mV/Div Horizontal Sweep Rate: 1 μs/Div Channels: 4 (with 1804A plug-in)	A,T
Digital Voltmeter, AC/DC	HP 3490A	AC Range: 0 to 300V, 50 to 400 Hz DC Range: 0 to 200V Accuracy: ±5% Resolution: to 5 digits	A,T
AM-FM Signal Generator	HP 8640A/B	Frequency: 5 – 500 MHz Residual FM: < 5 Hz	P
Frequency Meter	HP 5210A	Must have internal 12 kHz filter	P
Function Generator	HP 3310A	Output: +1V p-p square wave, 10 kHz and 100 kHz Adjustable DC offset.	A
RMS Voltmeter	HP 3400A	True RMS Response: 1 mV-1V, 10 Hz to 10 MHz	P
Double Balanced Mixer	HP 10514A	Frequency Range: 7 MHz to 500 MHz	P
40 dB Low Noise Amplifier	HP 08640-60506	Input/Output Impedance: 50 ohms Low Frequency Response: 20 ±4 Hz Noise: < 3 dB	P
AC Probe	HP 1121A	No substitution	A
Coaxial Step Attenuator	HP 8496A	Attenuation: 0 to 110 dB in 10 dB increments Frequency: Calibrated at 30 MHz SWR: 1.5 Connectors: Type N, male	P,A

Table A1-4. Recommended Test Equipment (2 of 3)

Instrument	Recommended Model	Critical Specifications	Use*
Directional Coupler	HP 778D	Freq Range: 100 MHz to 1300 MHz Directivity: 32 dB	P
3-Way Power Splitter	HP 11850A	Impedance: 50 ohms Freq Range: 500 kHz to 1.3 GHz Connectors: Type N, female Freq Response: Input to output ≤±0.2 dB	P,A,T
50-Ohm Transmission/Reflection Test Set	HP 8502A	No substitution	P,T
Matched Type N Coaxial Cables (3 required)	HP 11851A	50-ohm double-shielded coaxial cables 61 cm (24 inches) long, phase matched to 2° at 1300 MHz	P,A,T
50-Ohm Termination (3 required)	HP 909A Option 012	Freq Range: 500 kHz to 1.3 GHz Impedance: 50 ohms Connector: Type N, male SWR: < 1.4	P,A
10 dB Attenuator	HP 8491B	Attenuation: 10 dB ±0.5 dB SWR: < 1.3	P,T
50-Ohm Feed-through Termination	HP 10100C	Connector: BNC	P
Type N Female Short	HP 11511A		P
BNC to Type N Adapter (2 required)	HP 1250-0780	Impedance: 50 ohms	P
10 kHz Low-Pass Filter	HP 08505-60155	Impedance: 50 ohms Type: 5-pole Butterworth	P
1 kHz Low-Pass Filter	HP 08505-60156	Impedance: 50 ohms Type: 5-pole Butterworth	P
12-Pin (Dual 6-Pin) Extender Board	HP 08505-60109		A,T

Table A1-4. Recommended Test Equipment (3 of 3)

Instrument	Recommended Model	Critical Specifications	Use*
30-Pin (Dual 15-Pin) Extender Board (2 required)	HP 08505-60041		A,T
36-Pin (Dual 18-Pin) Extender Board (3 required)	HP 08505-60042		A,T
50-Pin (Dual 25-Pin) Extender Board	HP 08505-60108		A,T
182.88 cm (72 inches) Coaxial Cable with Type N Connectors (2 required)	HP 11500A	50-ohm coaxial cable 182.88 cm long, terminated on both ends with UG-21D/U type N Male connectors	P
15.24 plus Meters (50 plus feet) of 50Ω Coaxial Cable		50-ohm type RG 223/U coaxial cable with BNC connectors on both ends	P,A
Type N Right Angle Adapter	HP 1250-0176		P
Type N Male-to-Male Adapter	HP 1250-0778		P
Type N Female-to-Female Adapter	HP 1250-0777		P
Service Interconnect Cable 61 cm (24 inches)	HP 08505-60202		T
Signature Analyzer	HP 5004A	No Substitute	T
Logic Pulser	HP 546A	No Substitute	T
Logic Probe	HP 545A	No Substitute	T
16-Pin IC Clip-on Connector (6 required)	HP 1400-0734	Any IC Clip	T

* P = Performance Test; A = Adjustment; T = Troubleshooting

CHAPTER A
MODEL 8505A NETWORK ANALYZER

SECTION II
INSTALLATION & INCOMING INSPECTION

A2-1. INTRODUCTION

A2-2. This section provides instructions for setting up the Model 8505A Network Analyzer on a bench or installing it in a standard equipment rack. Information about receiving inspection, operation verification, operating and storage environmental limitations, and packing requirements for reshipment are also included.

A2-3. RECEIVING INSPECTION

A2-4. Inspect the shipping container. If it or the cushioning material is damaged, keep it until the entire shipment has been checked for completeness, and the instrument has been checked mechanically and electrically. Check the equipment received in the shipment against the shipping manifest and equipment illustrations in Section I. Check the 8505A operation with the Incoming Inspection Tests in paragraph A2-49. If the shipment is incomplete, or if the equipment is damaged or will not pass the Incoming Inspection Tests, notify the nearest Hewlett-Packard office. If, in addition, the shipping container is damaged or the cushioning material shows signs of stress, notify the carrier as well as the Hewlett-Packard office. Keep the shipping materials for the carrier's inspection. The Hewlett-Packard office will arrange for repair or replacement of damaged equipment without waiting for a claim settlement.

A2-5. ENVIRONMENTAL LIMITATIONS

A2-6. Environmental limitations for the Model 8505A Network Analyzer are:

Temperature – 0° C to +55° C Operating; –40° C to +75° C, stored or in shipment.

Altitude (Barometric) – To 4572 metres (15 000 feet) operating. To 15240 metres (50 000 feet) stored or in shipment.

Humidity — To 95%, however, instrument must be protected from temperature extremes that could cause condensation to form in it.

A2-7. BENCH USE

A2-8. For bench use, the two chassis units of the 8505A are locked together with the lower unit sitting on the bench or on an 8503A S-Parameter Test Set. On the rear corners of each chassis unit there are feet which allow the units to be set down front-panel up as long as no cables are connected to the rear panel connectors. The bottom two feet on the Signal Processor and display unit, and the upper two feet on the Source/Converter Frequency Control unit fasten together with thumbscrews to lock the two units together at the rear (See Figure A2-1). In the front, four hook-shaped flanges on the top of the lower unit engage corresponding slots in the top unit. To fasten the two units together, proceed as follows:

a. Set the Signal Processor on top of the Source/Converter-Frequency Control, with the front edge of the Signal Processor overlapping the front edge of the bottom unit approximately 1/4-inch.

b. Slide the top unit back until its front edge is even with the front edge of the lower unit. This should lock the fronts of the two units together. Make sure they are locked by lifting up on the front of the top unit.

c. Tighten the thumb-screws on the bottom rear feet of the top unit into the top rear feet of the bottom unit.

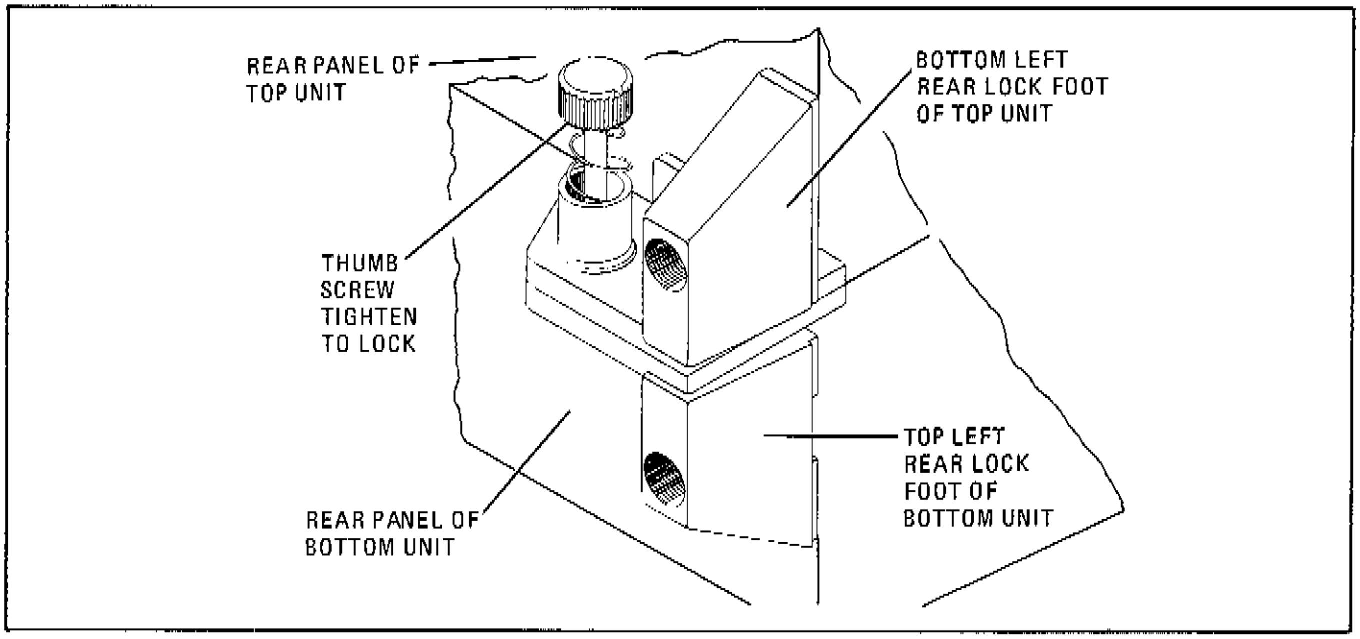


Figure A2-1. Lock Feet, Left Side

A2-9. RACK MOUNTING

A2-10. Two rack-mounting kits are available for the 8505A. One, Option 908, is for 8505A's that do not have or need front handles. The other rack mounting kit, Option 909, includes both the rack-mounting hardware and the front handles. Parts supplied with the two kits are listed in Table A2-1; the manner in which these parts attach to the 8505A is shown in Figure A2-2.

Table A2-1. Rack-Mounting Kits for 8505A

Description	HP Part Number	Quantity
OPTION 908 (HP 5061-0077) Includes:		
Rack Flange	5020-8862	4
Machine Screw, Pan Head, 8-32 x 0.375 inch	2510-0193	12
Option 909 (HP 5061-0083) Includes:		
Handle Assembly	5060-9899	4
Rack Flange	5020-8874	4
Machine Screw, Pan Head, 8-32 x 0.625 inch	2510-0194	12

NOTE

Rack-mounting kits and other options are shipped with the instrument as part of the original order only; they are not supplied separately. If you already have an 8505A and want to add the optional equipment, order the kit, assemblies, attaching hardware or other materials you need by their HP Part Numbers, rather than by option number, from your nearest HP office.

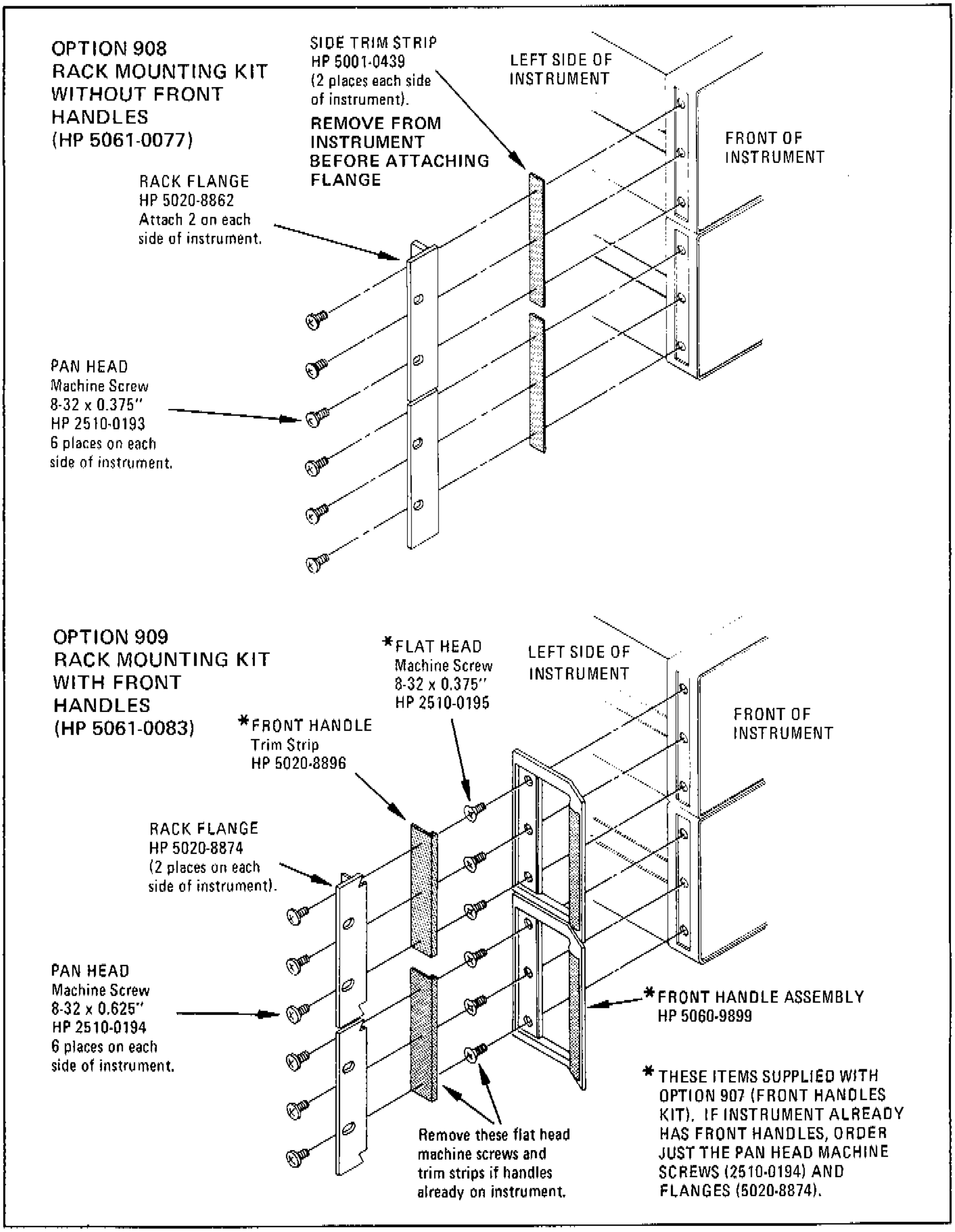


Figure A2-2. Attaching Rack Mounting Hardware and Handles

A2-11. PRE-OPERATION SET UP

A2-12. Power Requirements

A2-13. The Model 8505A requires a power source of 100, 120, 220, or 240 Vac, +5% −10%, 50 to 60 Hz, single-phase. Power Consumption is approximately 275 watts.

A2-14. Line Voltage and Fuse Selection

WARNING

BEFORE THIS INSTRUMENT IS SWITCHED ON, its protective earth terminals must be connected to the protective conductor of the mains power cable (cord). The mains power cable plug shall only be inserted in a socket outlet provided with a protective earth contact. DO NOT negate the earth-grounding protection by using an extension cable, power cable, or autotransformer without a protective ground conductor. Failure to ground the instrument properly can result in serious personal injury or death.

CAUTION

BEFORE SWITCHING ON THIS INSTRUMENT, make sure it is adapted to the voltage of the ac power source. You must set the voltage selector cards correctly in both the top and bottom units of the 8505A to adapt it to the power source. Failure to set the ac power inputs of the instrument for the correct voltage level could cause it to be severly damaged when switched on.

A2-15. Select the line voltage and fuses in both the top and bottom units of the 8505A as follows:

a. Measure the ac line voltage you will be applying to the 8505A.

b. See Figure A2-3. At each of the instrument's two rear-panel power line modules, select the line voltage (100V, 120V, 220V, or 240V) closest to the voltage you measured in step a. Note that the available line voltage must be within +5% or −10% of the line voltage selection as shown below. If it is not, you must use an autotransformer between the ac source and the 8505A.

Line Voltage	Selection
90 to 105 Vac	100V
108 to 126 Vac	120V
198 to 231 Vac	220V
216 to 252 Vac	240V

c. Make sure the fuses in the power module fuse holder are of the correct type and rating. Fuse requirements for the different line voltage selections are indicated next to the power modules.

A2-16. HP-IB Address Selection

A2-17. The talk/listen address pair for the signal processor/display is different than the talk/listen address pair for the frequency control-source/converter. The pre-set factory selected address pair for the signal processor/display is Talk Address P (Octal 120) and Listen Address Ø (Octal 060); the address pair for the frequency control-source/converter is Talk Address S (Octal 123) and Listen Address 3 (Octal 063). Before installing the HP-IB interface assemblies, other talk/listen address pairs shown in Table A2-2 may be selected. (The code selected must of course be compatible with the system.) The addresses are selected with switch S1 on the A3A21 and A2A16 HP-IB Buffer Assemblies. The numbers 1 through 5 on the two buffer assemblies correspond to b_1 through b_5 respectively in Table A2-2. The address is selected by pressing the desired switch to the open position. (See Figure A2-4.) The switches in Figure A2-4 are set to My Listen Address (MLA) in the ASCII character "3" address code (Octal 063) or to My Talk Address (MTA) in the ASCII alpha character "S" (Octal 123).

A2-18. Cable Connections

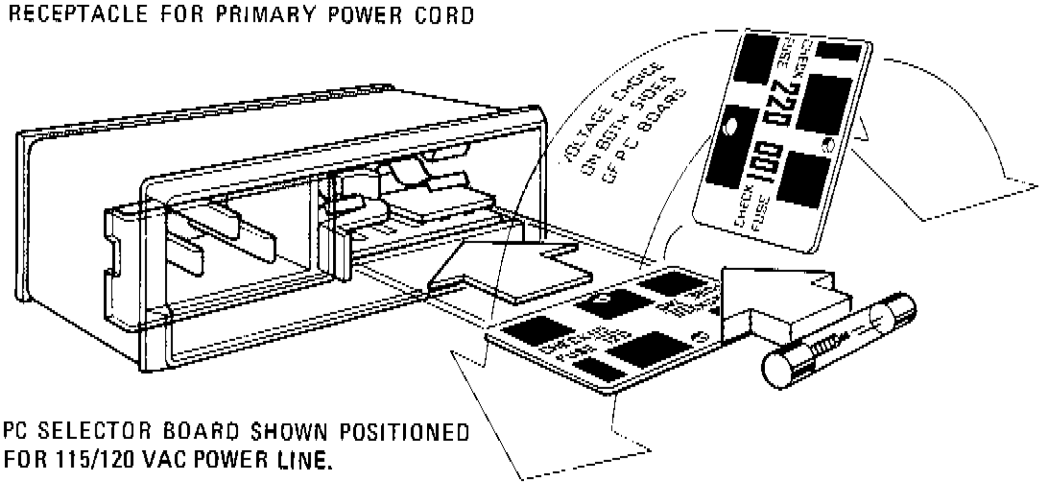
A2-19. All cable connections to the 8505A, except those to the device under test, are made at the rear panels. The rear-panel connectors and their reference designators are shown in Figure A2-5.

A2-20. Power Cable

WARNING

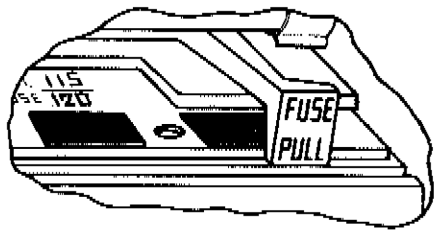
If this instrument is to be energized through an autotransformer, make sure the common terminal of the autotransformer is connected to the protective earth contact of the power source outlet socket. The protective earth terminals of the 8505A must be connected through the protective conductor of the power cable to the power source outlet socket protective earth contact. This protection must not be negated through the use of an extension cord (power cable) without a protective ground conductor. Any interruption of the protective ground, inside or outside the 8505A, can make the 8505A a dangerous electric shock hazard.

RECEPTACLE FOR PRIMARY POWER CORD



PC SELECTOR BOARD SHOWN POSITIONED FOR 115/120 VAC POWER LINE.

OPERATING VOLTAGE APPEARS IN MODULE WINDOW.



SELECTION OF OPERATING VOLTAGE

1. SLIDE OPEN POWER MODULE COVER DOOR AND PUSH FUSE-PULL LEVER TO LEFT TO REMOVE FUSE.
2. PULL OUT VOLTAGE-SELECTOR PC BOARD. POSITION PC BOARD SO THAT VOLTAGE NEAREST ACTUAL LINE VOLTAGE LEVEL WILL APPEAR IN MODULE WINDOW. PUSH BOARD BACK INTO ITS SLOT.
3. PUSH FUSE-PULL LEVER INTO ITS NORMAL RIGHT-HAND POSITION.
4. CHECK FUSE TO MAKE SURE IT IS OF CORRECT RATING AND TYPE FOR INPUT AC LINE VOLTAGE. FUSE RATINGS FOR DIFFERENT LINE VOLTAGES ARE INDICATED BELOW POWER MODULE.
5. INSERT CORRECT FUSE IN FUSEHOLDER.

Figure A2-3. Line Voltage Selection with Power Module PC Board

Table A2-2. Talk and Listen Addresses

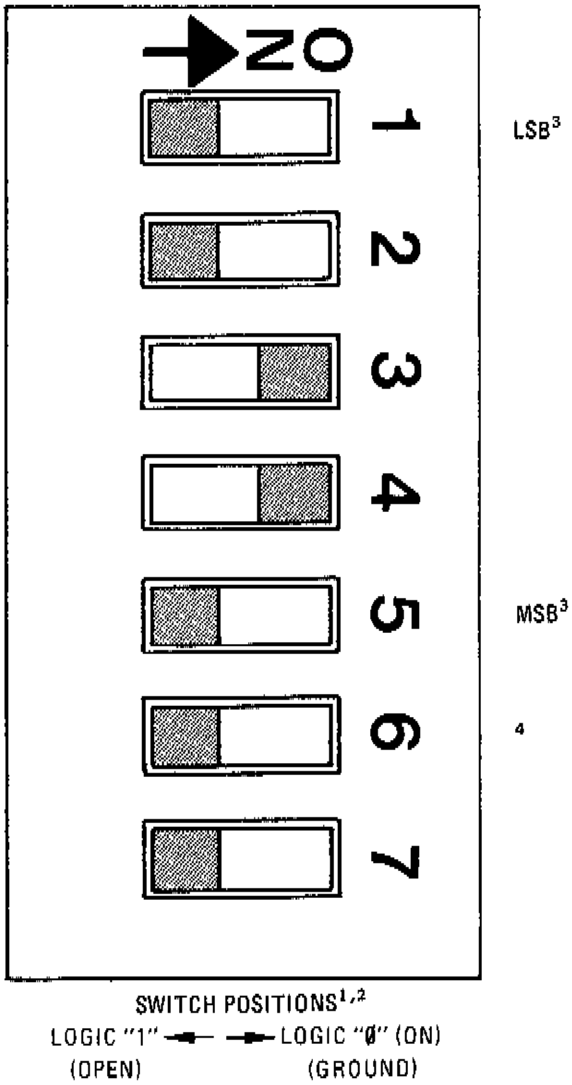
b_5	b_4	b_3	b_2	b_1	Talk Address Character	Listen Address Character	Decimal Value
0	0	0	0	0	@	SP	00
0	0	0	0	1	A	!	01
0	0	0	1	0	B	"	02
0	0	0	1	1	C	#	03
0	0	1	0	0	D	$	04
0	0	1	0	1	E	%	05
0	0	1	1	0	F	&	06
0	0	1	1	1	G	'	07
0	1	0	0	0	H	(	08
0	1	0	0	1	I	)	09
0	1	0	1	0	J	*	10
0	1	0	1	1	K	+	11
0	1	1	0	0	L	,	12
0	1	1	0	1	M	—	13
0	1	1	1	0	N	.	14
0	1	1	1	1	O	/	15
*1	0	0	0	0	P	Ø	16
1	0	0	0	1	Q	1	17
1	0	0	1	0	R	2	18
**1	0	0	1	1	S	3	19
1	0	1	0	0	T	4	20
1	0	1	0	1	U	5	21
1	0	1	1	0	V	6	22
1	0	1	1	1	W	7	23
1	1	0	0	0	X	8	24
1	1	0	0	1	Y	9	25
1	1	0	1	0	Z	:	26
1	1	0	1	1	[	;	27
1	1	1	0	0	\	<	28
1	1	1	0	1	]	=	29
1	1	1	1	0	⌒	>	30

*Preset Address of Signal Processor.

**Preset Address of Frequency Control.

A2A16S1
A3A21S1

TOP



NOTES

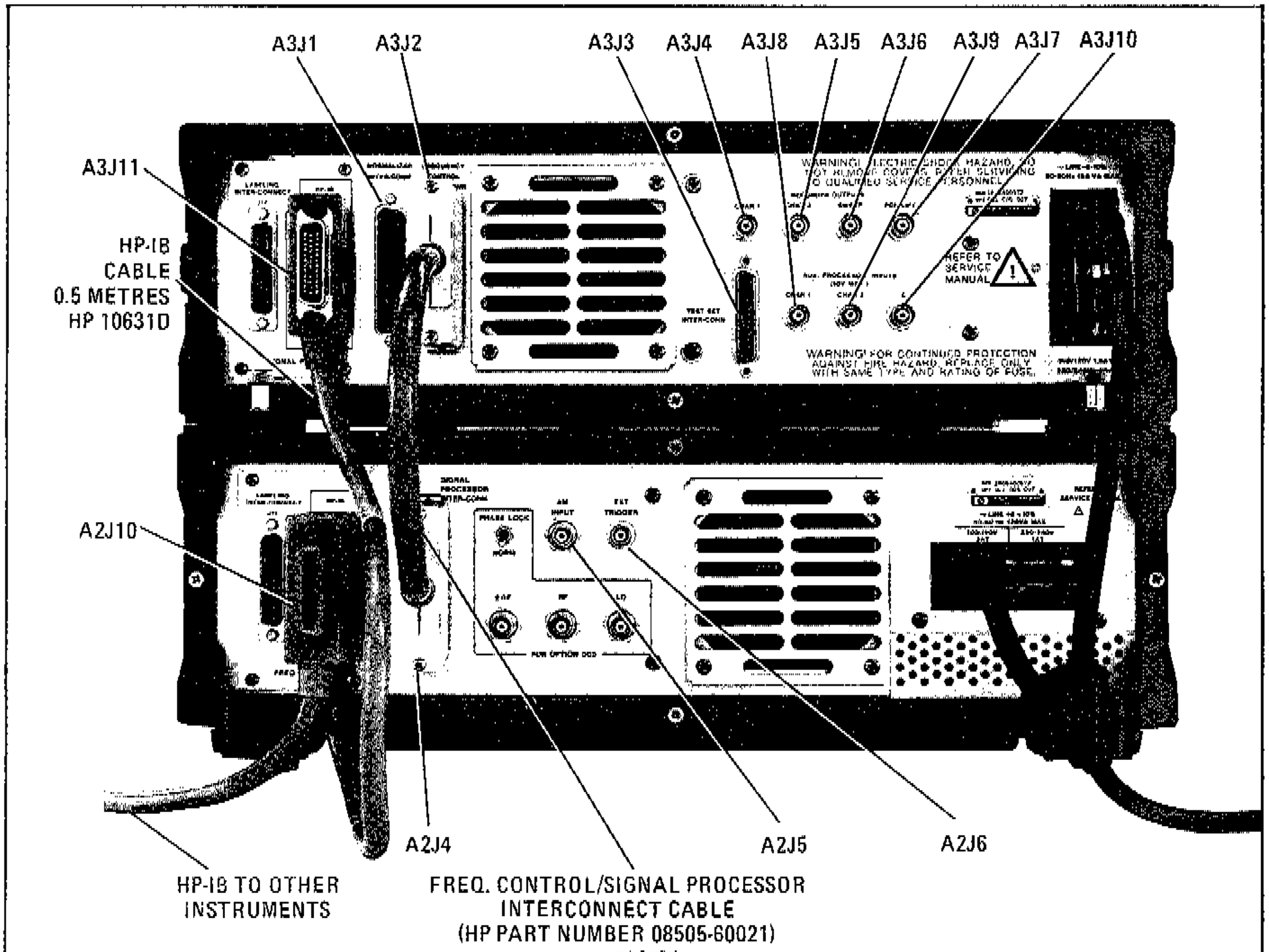
1. Darkened side of switch is pushed in.

2. Switch is shown in ASCII code "3" for Listen Address or "S" for Talk Address.

3. LSB - Least Significant Bit; MSB - Most Significant Bit.

4. Positions 6 and 7 are spares and disconnected on board.

Figure A2-4. HP-IB Address Switch



NOTE
ON 8505A NETWORK ANALYZERS HAVING SERIAL NUMBER PREFIXES 1544A AND LOWER, POSITIONS OF FREQUENCY CONTROL INTERCONNECT RECEPTACLE A3J2 AND NORMALIZER INTERCONNECT RECEPTABLE A3J1 ARE REVERSED SO THAT A3J2 IS LOCATED NEXT TO HP-IB CONNECTOR A3J11.

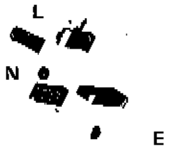
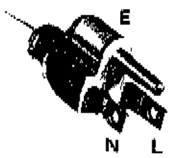
Figure A2-5. 8505A Rear Panel Connectors

A2-21. In compliance with international safety standards, this instrument is equipped with a three-wire power cable. When connected to a properly installed power line outlet, this cable grounds the 8505A chassis. Figure A2-6 shows the different kinds of mains plugs available for the power cable supplied with the 8505A. The number shown under each plug is the HP part number for the 8505A power cable with that particular kind of mains plug.

A2-22. The power cable supplied with the 8505A is selected to be compatible with power line outlet sockets in the country of destination. If the cable you receive does not fit your power line outlet sockets, refer to Figure A2-6 to determine which cable is the correct one. Order the required cable by the HP Part Number shown from the nearest Hewlett Packard office.

A2-23. Frequency Control-Signal Processor Interconnect Cable

A-24. Connect the Frequency Control-Signal Processor cable (HP Part No. 08505-60021) between FREQUENCY CONTROL INTER-CONN receptacle A3J2 and SIGNAL PROCESSOR INTER-CONN receptacle A2J4 as shown in Figure A2-5.

Plug Type	Cable HP Part Number	Plug Description	Cable Length (inches)	Cable Color	For Use In Country
250V 	8120-1351 8120-1703	Straight*BS1363A 90°	90 90	Mint Gray Mint Gray	Great Britain , Cyprus, Nigeria , Rhodesia , Singapore , So. Africa, India
250V 	8120-1369 8120-0696	Straight*NZSS198/ASC112 90°	79 87	Gray Gray	Australia , New Zealand
250V 	8120-1689 8120-1692	Straight*CEE7-Y11 90°	79 79	Mint Gray Mint Gray	East and West Europe, Saudi Arabia, United Arab Republic (unpolarized in many nations)
125V 	8120-1348 8120-1398 8120-1754	Straight*NEMA5-15P 90° Straight*NEMA5-15P	80 80 36	Black Black Black	United States , Canada , Japan (100 or 200V) , Mexico , Phillippines , Taiwan
	8120-1378 8120-1521 8120-1676	Straight*NEMA5-15P 90° Straight*NEMA5-15P	80 80 36	Jade Gray Jade Gray Jade Gray	
250V 	8120-2104	Straight*SEV1011 1959-24507 Type 12	79	Gray	Switzerland
250V 	8120-0698	Straight*NEMA6-15P			
250V 	8120-1860	Straight*CEE22-VI			

* Part number shown for plug is industry identifier for plug only. Number shown for cable is HP Part Number for complete cable including plug.

E = Earth Ground; L = Line; N = Neutral

Figure A2-6. AC Power Plug Connectors and Power Cable Part Numbers

A2-25. Hewlett-Packard Interface Bus Cables

CAUTION

Do not mate HP-IB silver and black fasteners to each other. This device is equipped with metric thread fasteners (colored black). To avoid damaging the threads, mate only with other metric threaded devices. English threaded fasteners are colored silver.

A2-26. When the 8505A is used in automatic mode, and is being controlled through the Hewlett-Packard Interface Bus (HP-IB), the HP-IB interconnect cables are connected as follows. The 0.5 metre cable (HP 10631D) is connected between A2J10 on Frequency Control and A3J11 on Signal Processor. Another HP-IB cable is connected in "piggy-back" fashion to one of the connectors and the other end connected to the desk-top-computer, test set, or other instrument in the system. Signal lines in the HP-IB cables are identified in Figure A2-7.

A2-27. As many as 15 instruments can be connected in parallel on the Hewlett-Packard Interface bus. To achieve design performance on the bus, proper voltage levels and timing relationships must be maintained. If the system cable is too long or if the accumulated cable length between instruments is too long, the data and control lines cannot be driven properly and the system may fail to perform. Therefore, the following restrictions must be observed:

a. With two instruments in a system, the cable length must not exceed three meters (9 feet).

b. When more than two instruments are connected on the bus, the cable length to each instrument cannot exceed two meters (six feet) per unit.

c. The total cable length between all units cannot exceed 20 meters (65 feet).

A2-28. Normalizer Interconnect Cable

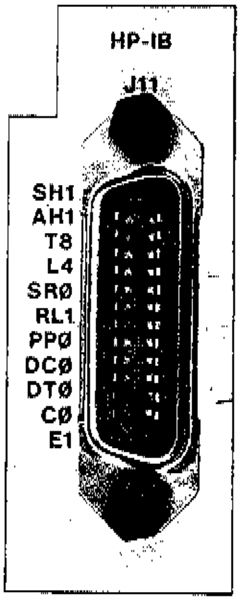
A2-29. When an 8501A Normalizer is used with the 8505A Network Analyzer, the Normalizer Interconnect Cable connects to NORMALIZER INTER-CONN receptacle A3J1. Signal lines in the Normalizer Interconnect Cable are identified in Figure A2-8.

A2-30. Test Set Interconnect Cable

A2-31. When an 8503A or B S-Parameter Test Set is used with the 8505A, the Test Set Interconnect

Signal	Pin	Pin	Signal
SIGNAL GROUND	24	12	SHIELD — Connected to earth ground by System Controller
P/O Twisted Pair with 11	23	11	ATN
P/O Twisted Pair with 10	22	10	SRQ
P/O Twisted Pair with 9	21	9	IFC
P/O Twisted Pair with 8	20	8	NDAC
P/O Twisted Pair with 7	19	7	NRFD
P/O Twisted Pair with 6	18	6	DAV
REN	17	5	EOI
DIO8	16	4	DIO4
DIO7	15	3	DIO3
DIO6	14	2	DIO2
DIO5	13	1	DIO1

Should be grounded near termination of other wire of twisted pair (pins 18–23)



HP-IB Logic Levels:
True (low) State <0.8 Vdc; False (high) State >+2.4 Vdc.

Figure A2-7. HP-IB Connectors, A2J10 and A3J11, Signals and Pin Configuration

Cable connects to TEST SET INTER-CONN receptacle A3J3. Signal lines in the Test Set Interconnect Cable are identified in Figure A2-9.

A2-32. Recorder Output Connections

A2-33. BNC connector receptacles A3J4 through A3J7 furnish channel 1, channel 2, X-axis sweep, and pen-lift outputs which can be applied to an X-Y recorder. See Table A1-2, Auxiliary outputs, for output signal characteristics. See Table A2-3 for outputs with various combination of front-panel control settings.

A2-34. Display Input Connections

A2-35. BNC connector receptacles A3J8 through A3J10 can be used to apply signals from external sources to the Signal Processor CRT display.

A2-36. AM Input Connection

A2-37. BNC connector receptacle A2J5 (AM INPUT) enables an external signal to be applied to the Source/Converter ALC control circuit to amplitude-modulate the RF signal.

A2-38. External Trigger Input Connection

A2-39. BNC connector A2J6 (EXT TRIGGER) enables the Frequency Control sweep to be triggered from an external source when the Frequency Control assembly's front-panel TRIGGER switch is set to EXT.

A2-40. PREPARATION FOR RESHIPMENT

A2-41. Original Packaging

A2-42. If you must reship the 8505A and you have not retained the original packing materials, the same kinds of containers and materials used for the original shipment can be obtained through the nearest Hewlett-Packard Sales or Service office. See Figure A2-10.

A2-43. If the instrument is being returned to Hewlett-Packard for servicing, attach a tag indicating the service required, return address, instrument model number (i.e., 8505A), and the instrument's full serial number. Mark the container or containers FRAGILE to ensure careful handling.

A3-44. In any correspondence, refer to the instrument by model number and its full serial number.

A2-45. Other Packaging Materials

A2-46. The following general instructions should be followed when repackaging with commercially available materials:

a. Wrap the instrument in heavy paper or plastic. If you are shipping the instrument to a Hewlett-Packard Service office or center, attach a tag indicating the kind of service required, return address, model number, and full serial number.

b. Place the wrapped instrument in a strong shipping container. A double-wall carton made of 350-pound test material is adequate.

c. Place enough shock-absorbing material (a three-inch to four-inch layer) around all sides of the instrument to provide a firm cushion and prevent any movement of the instrument inside the container.

d. Seal the shipping container or containers carefully and mark it or them FRAGILE to ensure careful handling.

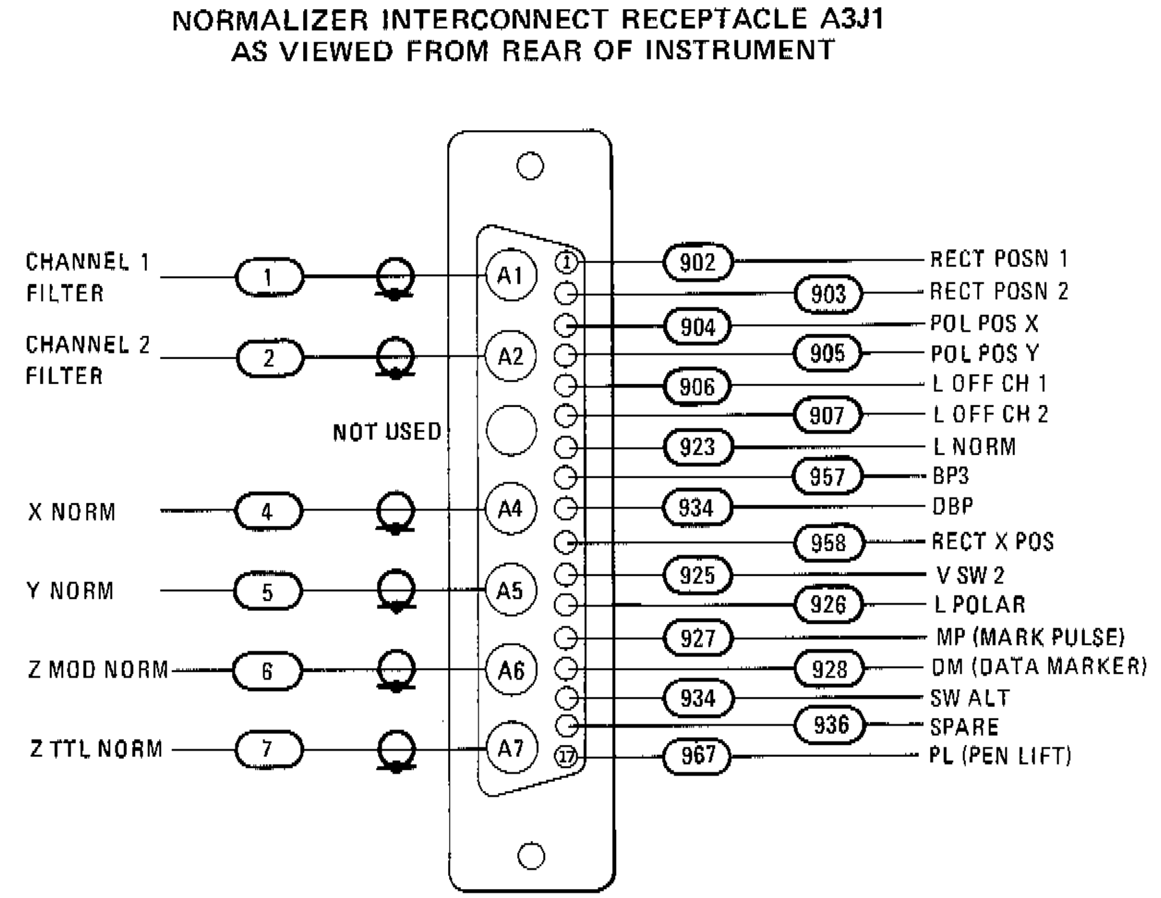
A2-47. INCOMING INSPECTION TEST

A2-48. These procedures test the salient specifications of the instrument and should be used for incoming inspection. They functionally test all major operating modes, and test the major specifications of the instrument. If certification is required, use the more lengthy procedure in Section IV, which tests all of the detailed specifications of the instrument.

A2-49. EQUIPMENT REQUIRED

A2-50. The equipment required to perform the incoming inspection is listed in Table A2-4 and shown in Figure A2-11. If substitution is necessary for any of the equipment, the alternate models must meet or exceed the critical specifications.

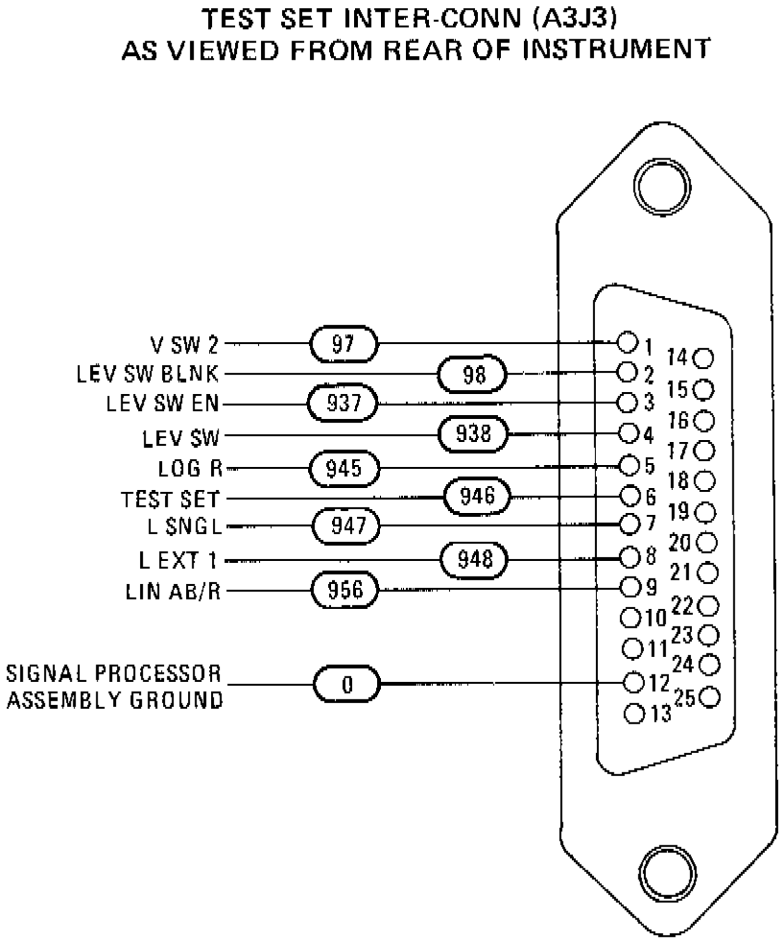
(Text continued on page A2-19)



MNEMONICS TABLE

Pin	Mnemonic	Description
1	RECT POSN 1	Rectangular position, Channel 1
2	RECT POSN 2	Rectangular position, Channel 2
3	POL POS X	Display Polar Offset, X axis
4	POL POS Y	Display Polar Offset, Y axis
5	L OFF CH 1	Channel 1 on/off to Normalizer. Low = off
6	L OFF CH 2	Channel 2 on/off to Normalizer. Low = off
7	L NORM	Normalizer inputs enable. Low = inputs enable
8	BP3	Blanking Pulse 3
9	DBP	Display Blanking Pulse. High = blank
10	RECT X POS	Rectangular X Position
11	V SW 2	Sweep voltage to +13 Vdc to Signal Processor
12	L POLAR	Low polar alternate. Low = polar display
13	MARK PULSE	Marker pulse to Normalizer. High = display marker
14	DATA MARKER	Data marker. High = display marker and measure
15	SW ALT	Sweep alternate, Signal Processor to Normalizer High = Channel 1, Low = Channel 2
16	SPARE	
17	PL	Pen lift

Figure A2-8. Normalizer — 8505A Interconnecting Signal Lines and Receptacle Terminals



MNEMONICS TABLE

Pin	Mnemonic	Description
1	V SW 2	Sweep voltage independent of frequency or mode
2	LEV SW BLNK	Level sweep blanking
3	LEV SW EN	Level sweep enable
4	LEV SW	Level sweep
5	LOG R	Log magnitude of input R
6	TEST SET	Test Set (8503A) control line
7	L SNGL	Low Single sweep (Return to LOCAL)
8	L EXT 1	External signal control line
9	LIN AB/R	Linear ratio output of A or B over R

Figure A2-9. 8503A S-Parameter Test Set — 8505A Interconnecting Signal Lines and Receptacle Terminals

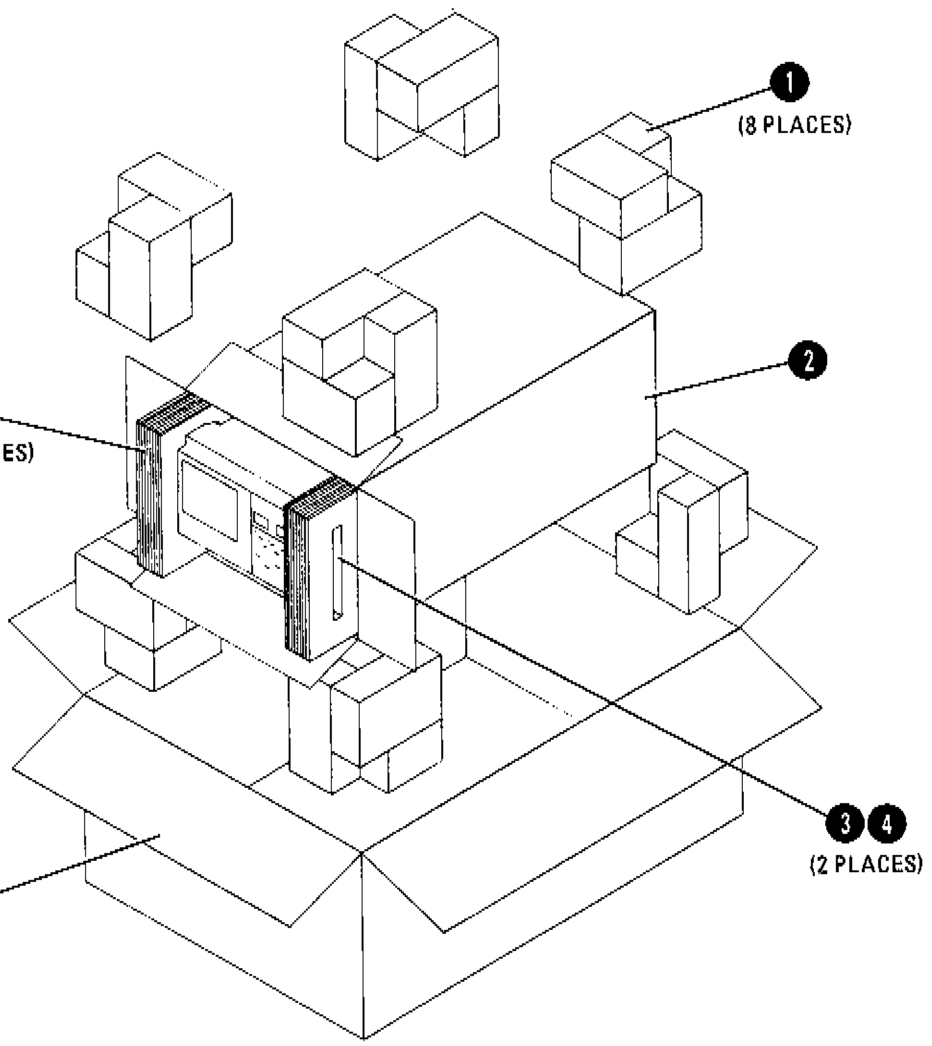
Table A2-3. Rear Panel Recorder Outputs with Combinations of Front-Panel Settings

Channel 1 MODE	OFF		MAG A or MAG A/R		MAG B or MAG B/R		MAG R		PHASE A/R or DELAY A/R		PHASE B/R or DELAY B/R		POLAR A/R or POLAR B/R	
Channel 2 MODE	**OFF**													
Consecutive Sweep Number*	1	2	1	2	1	2	1	2	1	2	1	2	1	2
Rear Panel CH1	Ø	Ø	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1P	Y1P
RECORDER CH2	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	X1P	X1P
OUTPUTS SWR	X	X	X	X	X	X	X	X	X	X	X	X	X1P	X1P
Channel 2 MODE	**MAG A or MAG A/R**													
Rear Panel CH1	Ø	Ø	Y1	Y1	Y1	Ø	Y1	Y1	Y1	Y1	Y1	Ø	Y1P	Ø
RECORDER CH2	Y2	Y2	Y2	Y2	Ø	Y1	Y2	Y2	Y2	Y2	Ø	Y2	X1P	Y2
OUTPUTS SWP	X	X	X	X	X	X	X	X	X	X	X	X	X1P	X
Channel 2 MODE	**MAG B or MAG B/R**													
Rear Panel CH1	Ø	Ø	Y1	Ø	Y1	Y1	Y1	Y1	Y1	Ø	Y1	Y1	Y1P	Ø
RECORDER CH2	Y2	Y2	Ø	Y2	Y2	Y2	Ø	Y2	Ø	Y2	Y2	Y2	X1P	Y2
OUTPUTS SWP	X	X	X	X	X	X	X	X	X	X	X	X	X1P	X
Channel 2 MODE	**MAG R**													
Rear Panel CH1	Ø	Ø	Y1	Y1	Y1	Ø	Y1	Y1	Y1	Y1	Y1	Ø	Y1P	Ø
RECORDER CH2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	X1P	Y2
OUTPUTS SWP	X	X	X	X	X	X	X	X	X	X	X	X	X1P	X
Channel 2 MODE	**PHASE A/R or DELAY A/R**													
Rear Panel CH1	Ø	Ø	Y1	Y1	Y1	Ø	Y1	Y1	Y1	Y1	Y1	Ø	Y1P	Ø
RECORDER CH2	Y2	Y2	Y2	Y2	Ø	Y2	Y2	Y2	Y2	Y2	Ø	Y2	X1P	Y2
OUTPUTS SWP	X	X	X	X	X	X	X	X	X	X	X	X	X1P	X
Channel 2 MODE	**PHASE B/R or DELAY B/R**													
Rear Panel CH1	Ø	Ø	Y1	Ø	Y1	Y1	Y1	Y1	Y1	Ø	Y1	Y1	Y1P	Ø
RECORDER CH2	Y2	Y2	Ø	Y2	Y2	Y2	Ø	Y2	Ø	Y2	Y2	Y2	X1P	Y2
OUTPUTS SWR	X	X	X	X	X	X	X	X	X	X	X	X	X1P	X
Channel 2 MODE	**POLAR A/R or POLAR B/R**													
Rear Panel CH1	Y2P	Y2P	Y1	Y2P	Y1	Y2P	Y1	Y2P	Y1	Y2P	Y1	Y2P	Y1P	Y2P
RECORDER CH2	X2P	X2P	Ø	X2P	Ø	X2P	Ø	X2P	Ø	X2P	Ø	X2P	X1P	X2P
OUTPUTS SWR	X2P	X2P	X	X2P	X	X2P	X	X2P	X	X2P	X	X2P	X1P	X2P

*Recorder outputs are multiplexed between channel 1 and channel 2 for certain combinations of mode and input settings. This causes the outputs to change on alternate sweeps from channel 1 to channel 2. If the entries in the table for 1 and 2 are the same, the outputs are the same for each sweep. However, if the entries are different for 1 and 2, the outputs are different for alternate sweeps.

Abbreviations:

X = Rectangular X, both channels
X1P = Polar X, channel 1
X2P = Polar X, channel 2
Y1 = Rectangular Y, channel 1
Y2 = Rectangular Y, channel 2
Y1P = Polar Y, channel 1
Y2P = Polar Y, channel 2
Ø = Invalid Output



Item	Qty	HP Part No.	Description
1	16	9220-2732	FOAM PADS–TOP, CORNER; BOTTOM CORNER
2	2	9211-2729	CARTON–INNER
3	4	5021-1722	BARS–SHIPPING, ALUMINUM
4	8	2510-0061	SCREW–FOR ATTACHING SHIPPING BARS
5	2	9211-2730	CARTON–OUTER
6	4	9220-2775	SIDE PADS, CORRUGATED CARDBOARD

NOTE: Quantities given are for two containers.

Figure A2-10. Packaging for Shipment Using Factory Packaging Materials

Table A2-4. List of Equipment Required for Incoming Inspection Test

Instrument	Critical Specifications	Recommended Model
Electronic Counter	Frequency Range: to 10 MHz Accuracy: ±1 count Sensitivity: –5 dBm	HP 5340A
Power Meter and Sensor	Power Range: +10 to –20 dBm Frequency Range: 0.5 to 1300 MHz Accuracy: ±0.5 dB at 1300 MHz	HP 435A/8482A
0 – 110 dB Step Attenuator	Attenuation: 0 to 110 dB in 10 dB increments Frequency: Calibrated at 30 MHz SWR: < 1.5 Connectors: Type N Male	HP 8496A
3-Way Power Splitter	Impedance: 50 Ohms Frequency Range: 0.5 to 1300 MHz Connectors: Type N Female Frequency Response: Input to output ⩽±0.2 dB	HP 11850A
Matched Coaxial Cables (Set of 3)	50-ohm double-shielded coaxial cables 61 cm (24 inches) long, phase matched to 4° at 1300 MHz Connectors: Type N Male	HP 11851A
50-Ohm Termination (3 Required)	Frequency Range: 0.5 – 1300 MHz Impedance: 50 Ohms Connectors: Type N Male SWR: < 1.4	HP 909A Option 012
Type-N to BNC Adapter (2 required)		HP 1250-0780
15.24 plus Meters (50 plus feet) of Coaxial Cable	50-ohm type RG 223/U coaxial cable with BNC male connectors on both ends	
10 dB Attenuator	Attenuation: 10 dB ±0.5 dB SWR: < 1.3	HP 8491B Option 010

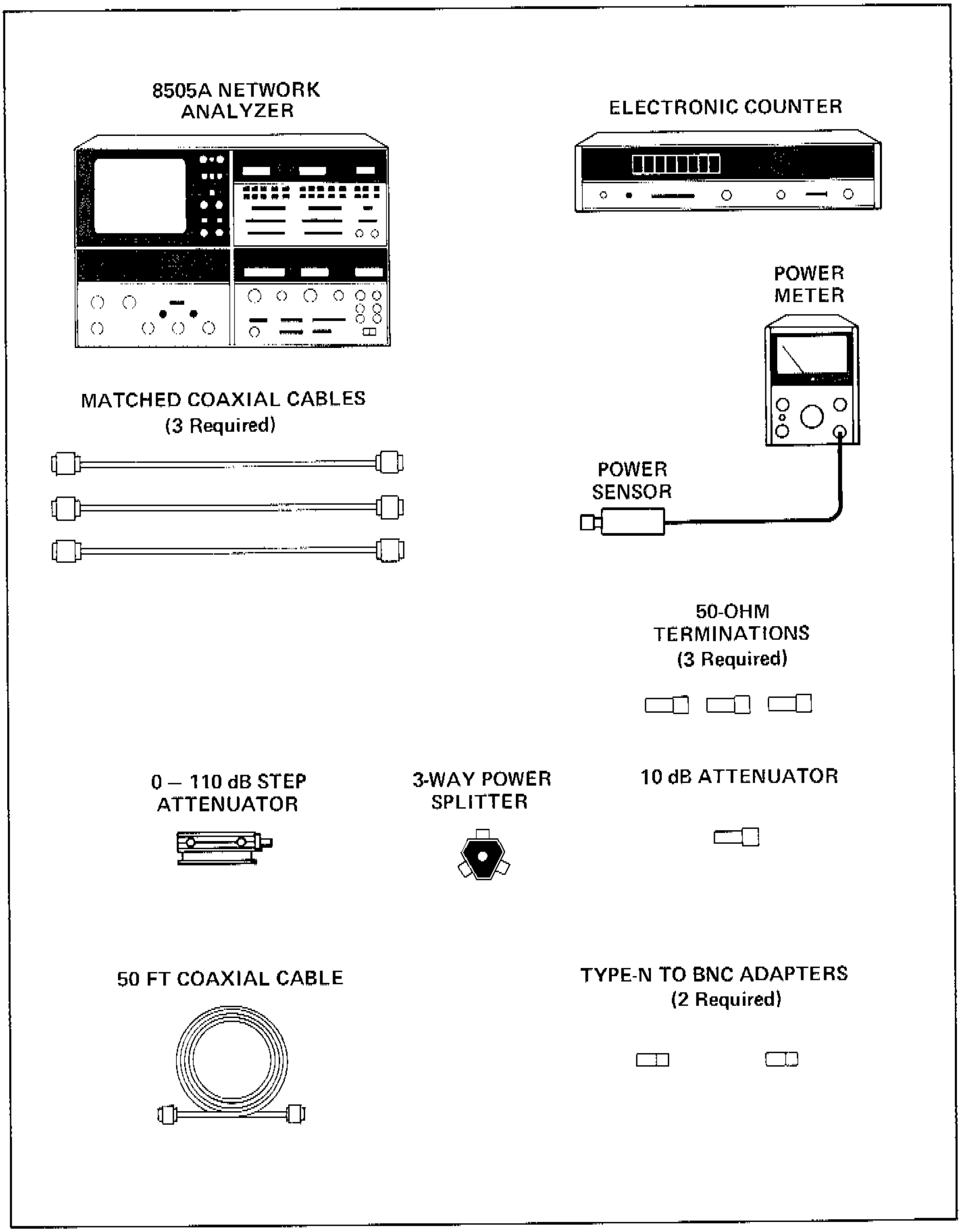


Figure A2-11. Equipment Required for Incoming Inspection Test

A2-51. FREQUENCY RANGE AND ACCURACY TEST

NOTE

Allow one hour warm-up time before making the incoming inspection.

SPECIFICATIONS:

CW Mode Accuracy ± 2 counts of LSD ± time-base accuracy*
Swept Frequency Accuracy: ±1% of range for linear sweep
Counter Accuracy: ±2 counts ± time-base accuracy*

*Time-base Accuracy = 5 ppm ±1 ppm/°C ±3 ppm/90 days.

DESCRIPTION:

The 8505A built-in frequency counter calibration is checked against a known good electronic counter by monitoring the CW RF signal. In CW ±ΔF mode, the FREQUENCY READOUT is compared to the counter readout. If necessary, the CW RF signal is adjusted to match the FREQUENCY readout. This calibrates the digital FREQUENCY readout to the actual RF OUTPUT signal being read on the built-in counter. The START/STOP sweep signal frequency is measured using an external counter to monitor the frequencies with both START and STOP frequencies the same.

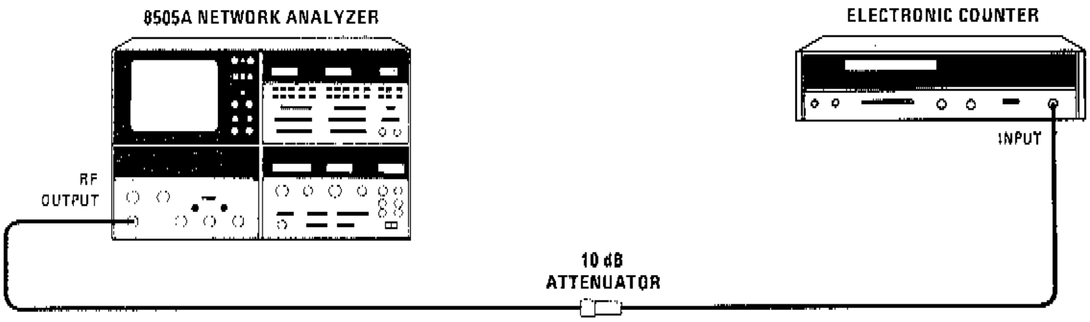


Figure A2-12. Frequency Accuracy Test Setup

EQUIPMENT:

Electronic Counter .... HP 5340A
10 dB Attenuator .... HP 8491B Option 010

A2-51. FREQUENCY RANGE AND ACCURACY TEST (Cont'd)

PROCEDURE:

COUNTER ACCURACY

a. Set 8505A Controls as follows:

On A1 Source/Converter
- OUTPUT LEVEL dBm .... −10
- OUTPUT LEVEL VERNIER 0

On A2 Frequency Control:
- RANGE MHz .... .5 — 1300
- MODE .... LIN EXPAND
- WIDTH .... CW
- SCAN TIME SEC .... 10 — 1
- VERNIER SCAN TIME .... Clockwise
- TRIGGER .... AUTO
- MARKERS 1
- Marker 1 .... Mid position

b. Connect equipment as shown in Figure A2-12 and set external counter resolution to 100 Hz.

c. Set CW FREQUENCY control and VERNIER control for 10.000 MHz indication on external Electronic Counter. The 8505A CW FREQUENCY digital display should indicate 0010.00 MHz ±0.02 MHz. (If the indication is not within tolerance, the built-in counter is malfunctioning; go to troubleshooting in Chapter C.)

FREQUENCY CALIBRATION

d. Set A2 Frequency Control WIDTH switch to CW ±ΔF.

e. Set CW FREQUENCY to 10 MHz and set CW FREQUENCY VERNIER to 0.

f. Set ±ΔF FREQUENCY to 000.0, and set ±ΔF FREQUENCY VERNIER to 0.

g. Remove the front-panel window of A2 Frequency Control (Figure A2-13).

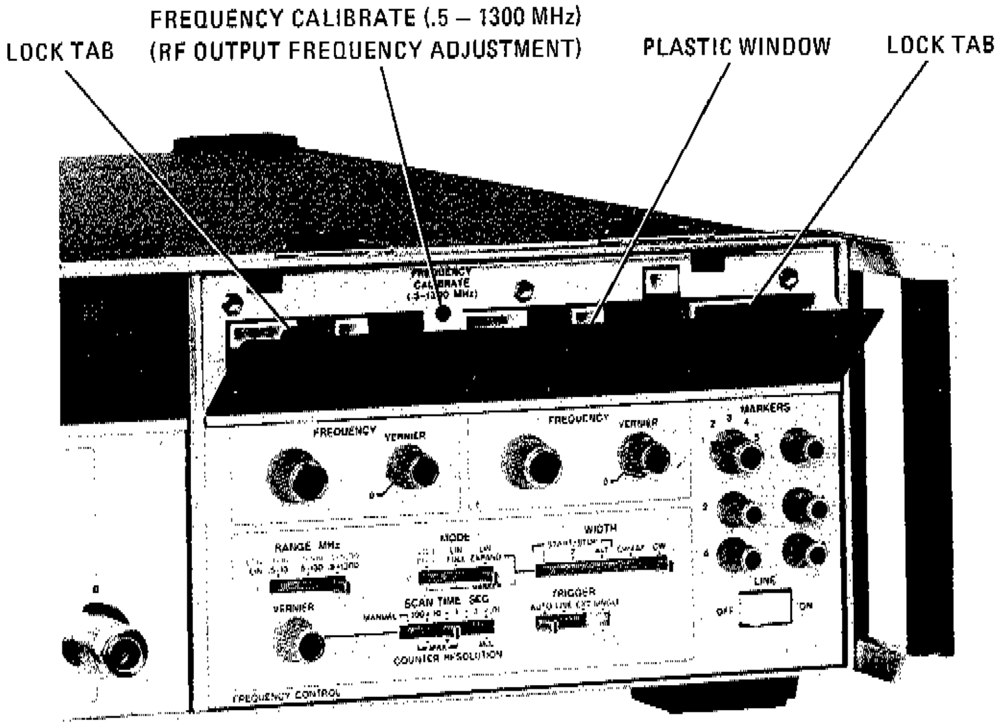
h. Adjust FREQUENCY CALIBRATE (.5 — 1300 MHz) screwdriver adjustment in the middle of exposed subpanel so the FREQ COUNTER MHz reads 10.00 MHz plus or minus 2 counts of least significant digit (LSD).

i. Reinstall the window.

SWEPT FREQUENCY ACCURACY

j. At A2 Frequency Control, set RANGE MHz switch to .5 — 1300, MODE switch to LIN EXPAND, WIDTH switch to START/STOP 1, and SCAN TIME SEC switch to .1 — .01. Set RANGE MHz switch and START and STOP frequency as listed in Table A2-5 below and read the frequency on the internal counter.

A2-51. FREQUENCY RANGE AND ACCURACY TEST (Cont'd)



1. MOVE LOCK TABS TO LEFT ABOUT 1/2 INCH UNTIL THEY UNLATCH WINDOW.
2. REMOVE WINDOW BY PULLING OUT ON LOCK TAB.

Figure A2-13. Frequency Control Front-Panel Window Removal

Table A2-5. Frequency Accuracy Table

RANGE MHz Switch Set At A2 Frequency Control	START and STOP FREQUENCY Digital Readout Set At A2 Frequency Control	Frequency Indicated On Internal Freq Counter
.5 - 1300	1300. MHz	1300 MHz ± 13 MHz
.5 – 130	130.0 MHz	130.0 MHz ± 1.3 MHz
.5 - 13	13.00 MHz	13.00 MHz ± 0.13 MHz
.5 – 1300	0100. MHz	0100. MHz ± 13 MHz
.5 – 130	010.0 MHz	010.0 MHz ± 1.3 MHz
.5 – 13	01.00 MHz	01.00 MHz ± 0.13 MHz

A-52. POWER OUTPUT LEVELING TEST AND ABSOLUTE POWER CALIBRATION

SPECIFICATION:

Power Output Range: +10 dBm to −72 dBm
Attenuator Accuracy: ±1.5 dB over the 70 dB range
Output Leveling: ±0.5 dB from 0.5 to 1300 MHz
Output Level Vernier Accuracy: ±1 dB

DESCRIPTION:

The power output is measured directly with a power meter.

The power output is monitored on a power meter while the frequency band is tuned with CW FREQUENCY control. The highest and lowest power spots are noted and the total difference must be less than the specification.

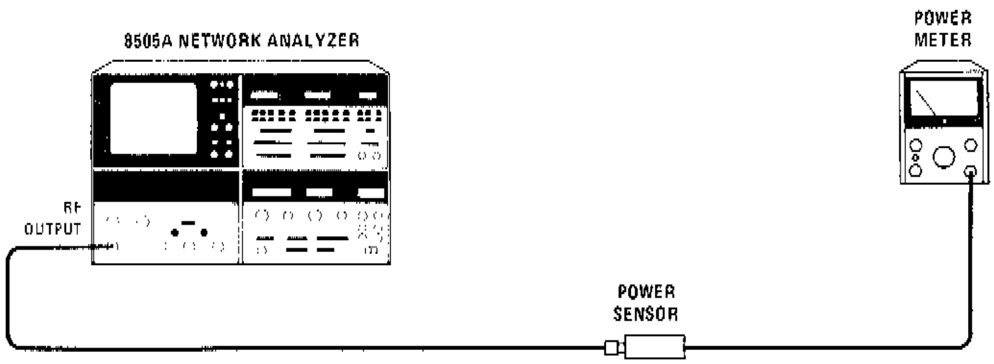


Figure A2-14. Power Output Range Test Setup

EQUIPMENT:

Power Meter .... HP 435A
Power Sensor .... HP 8482A

PROCEDURE:

POWER OUTPUT RANGE

a. Set 8505A controls as follows:

On A1 Source/Converter:
OUTPUT LEVEL dBm .... +10
OUTPUT LEVEL Vernier 0

On A2 Frequency Control:
RANGE MHz .... .5 — 1300
MODE .... LIN EXPAND
WIDTH .... CW
SCAN TIME SEC .... 1 — .1
CW FREQUENCY MHz .... 30.0 MHz

A2-52. POWER OUTPUT LEVELING TEST AND ABSOLUTE POWER CALIBRATION (Cont'd)

b. Connect equipment as shown in Figure A2-14 and set Power Meter range to +15 dBm.

c. Measure power output at the OUTPUT LEVEL dBm settings of +10 dBm to −20 dBm. All readings should be within ±1.5 dB ± tolerance of power meter. (The HP 435A/8482A power meter has an uncertainty of ±0.4 dB.)

OUTPUT LEVEL VERNIER

d. Set power meter to +15 dBm range. Set OUTPUT LEVEL dBm switch to +10 dBm.

e. Turn the OUTPUT LEVEL dBm VERNIER from 0 to −12 dB position and the power meter indication should change by −12 dB ±1 dB ± tolerance of power meter used. (If slightly out of tolerance, go to Paragraph A5-14 for adjustment.)

POWER LEVELING

f. While watching the power meter, turn the CW FREQUENCY control through the entire band. The total variation between the highest power and the lowest power indication across the band should be ≤1 dB (or ±0.5 dB).

A2-53. CROSSTALK ISOLATION AND RECEIVER NOISE FLOOR

SPECIFICATION:

Crosstalk Error Limits: >100 dB isolation between inputs.

Noise floor in 10 kHz Bandwidth: −95 dBm (0.5 to 2 MHz)
−100 dBm (2 to 10 MHz)
−110 dBm (10 to 1300 MHz)

DESCRIPTION:

The noise floor is measured by offsetting the reference line −95 dB (0.5 to 2 MHz), −100dB (2 to 10 MHz), and −110 dB (10 to 1300 MHz).

In the Crosstalk Isolation test, a signal of −10 dBm is applied to the "R" Channel input. The "A" and "B" Channels are terminated and the signal is displayed on the CRT. The displayed signal of Channel "A" should be 100 dB below the −10 dBm level of the "R" port showing isolation between ports. The other ports are checked in the same manner.

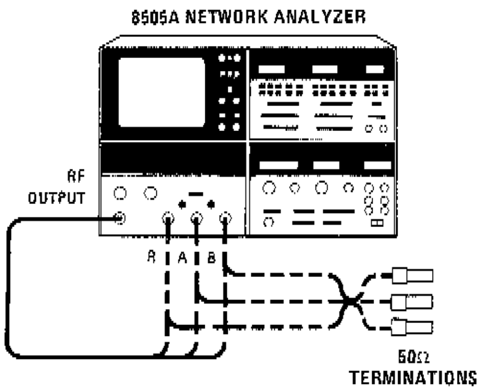


Figure A2-15. Crosstalk Isolation and Noise Floor Test Setup

EQUIPMENT:
50 Ohm Termination (3 required) . . . . HP 909A Option 012

A2-53. CROSSTALK ISOLATION AND RECEIVER NOISE FLOOR (Cont'd)

PROCEDURE:

a. Connect equipment as shown in Figure A4-15 with the three terminations on A, B, and R ports.

b. Set 8505A Controls as follows:

On A1 Source/Converter:
- OUTPUT LEVEL dBm . . . . —60 dBm
- OUTPUT LEVEL VERNIER . . . . 0 dB
- INPUT LEVEL dBm MAX . . . . —30 dBm

On A2 Frequency Control:
- RANGE MHz . . . . 0.5 — 13
- MODE . . . . LIN EXPAND
- WIDTH . . . . START/STOP 1
- START FREQUENCY . . . . 00.50 MHz
- STOP FREQUENCY . . . . 02.00 MHz
- MARKERS 1
- Marker 1 . . . . Center of CRT
- SCAN TIME SEC . . . . 10 — 1
- SCAN TIME Vernier . . . . Fully Clockwise
- TRIGGER . . . . AUTO

On A3 Signal Processor:
- Channel 1
  - INPUT . . . . R
  - MODE . . . . MAG
  - SCALE/DIV . . . . 10 dB/DIV
- Channel 2
  - MODE . . . . OFF
- CRT Display
  - BANDWIDTH kHz . . . . 10 kHz
  - VIDEO FILTER . . . . ON (in)

NOISE FLOOR FROM 0.5 to 2 MHz

c. Connect 50-Ohm terminations to "R", "A", and "B" ports. On Signal Processor Display, press REF LINE POSN, then adjust CH1 control to place the CRT reference trace on the center graticule line. Press REF LINE POSN again for normal operation.

d. At Channel 1, press DISPLAY REF, then CLR pushbutton until REL light goes out (if it was lit). (This clears all previous offsets in R, A, and B inputs of Channel 1.)

e. At Channel 1, press REF OFFSET pushbuttons to obtain —95 dB offset. The CRT trace should be below the center graticule line. This shows the noise floor below —95 dBm.

f. Set Channel 1 INPUT switch to "A". The CRT trace should be below the center graticule line.

g. Set Channel 1 INPUT switch to "B". The CRT trace should be below the center graticule line.

A2-53. CROSSTALK ISOLATION AND RECEIVER NOISE FLOOR (Cont'd)

NOISE FLOOR FROM 2 TO 10 MHz

h. Set START frequency to 02.00 MHz and STOP frequency to 10.00 MHz. At Channel 1, press DISPLAY REF, then REF OFFSET pushbuttons to obtain −100 dB offset. The CRT trace should be below the center graticule line. This shows the noise floor below −100 dBm.

i. Set Channel 1 INPUT switch to "A". The CRT trace should be below the center graticule line.

j. Set Channel 1 INPUT switch to "R". The CRT trace should be below the center graticule line.

NOISE FLOOR FROM 10 TO 1300 MHz

k. Set RANGE MHz switch to .5 − 1300 MHz. Set START frequency to 0010 MHz and STOP frequency to 1300 MHz. At Channel 1, press DISPLAY REF, then REF OFFSET pushbuttons to obtain −110 dB offset. The CRT trace should be below the center graticule line. This shows the noise floor below −110 dBm.

l. Set Channel 1 INPUT switch to "A". The CRT trace should be below the center graticule line.

m. Set Channel 1 INPUT switch to "B". The CRT trace should be below the center graticule line.

CROSSTALK ISOLATION

n. Connect equipment as shown in Figure A2-15, with RF OUTPUT cable connected to "R" input and the two 50-Ohm terminations to "A" and "B" input ports. Set OUTPUT LEVEL dBm switch to −10 dBm.

o. At Channel 1, press DISPLAY REF, then REF OFFSET pushbuttons to obtain −110 dB of offset. Set INPUT switch to "A". The CRT trace should be below the center graticule line for 100 dB of isolation.

p. At Channel 1, set INPUT switch to "B" and the CRT trace should be below the center graticule line.

q. Move the RF OUTPUT cable to "A" input port and connect the two 50-Ohm terminations to "R" and "A" input ports. Set INPUT switch to "R" and the CRT trace should be below the center graticule line for 100 dB of isolation.

t. At Channel 1, set INPUT switch to "A" and the CRT trace should be below the center graticule line.

A2-54. MAGNITUDE DYNAMIC ACCURACY TEST

SPECIFICATION:

Magnitude Dynamic Accuracy: $\leq \pm 0.01$ dB/dB from -20 to -40 dBm
$\leq \pm 0.2$ dB from -10 to -50 dBm
$\leq \pm 0.5$ dB from -50 to -70 dBm
$\leq \pm 1$ dB from -70 to -90 dBm
$\leq \pm 2$ dB from -90 to -100 dBm
$\leq \pm 4$ dB from -100 to -110 dBm

DESCRIPTION:

The signal level into the receiver is adjusted by setting the external step attenuator. The signal trace is monitored on the CRT and deviation from the expected position of the trace on the graticule is noted.

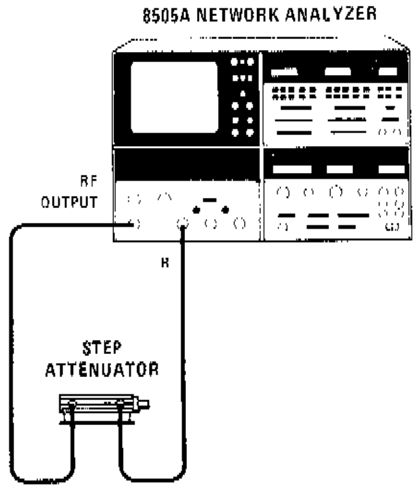


Figure A2-16. Dynamic Range Test Setup

EQUIPMENT:

0 — 110 dB STEP ATTENUATOR
(calibrated at 30 MHz) .... HP 8496A

PROCEDURE:

a. On 8505A, set the controls as follows:

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

On A2 Frequency Control:
RANGE MHz .... .5 — 13
MODE .... LIN EXPAND
WIDTH .... CW
CW FREQUENCY .... 30.0 MHz

A2-54. MAGNITUDE DYNAMIC ACCURACY TEST (Cont'd)

On A3 Signal Processor:
- Channel 1
  - INPUT .... R
  - MODE .... MAG
  - SCALE/DIV .... .5 dB
- Channel 2
  - MODE .... OFF
- Electrical Length
  - MODE .... OFF
- Display Section
  - BANDWIDTH KHz .... 10 kHz ON (in)
  - REF LINE POSN .... Ref line to center graticule line
  - VIDEO FILTER .... ON (in)

b. Connect equipment as shown in Figure A2-16.

c. Set step attenuator to 30 dB. Press Channel 1 DISPLAY MKR, then ZRO pushbuttons until trace settles. Press CHAN 1 DISPLAY REF pushbutton. As attenuator is stepped down, offset —10 dB/step with Channel 1 REF OFFSET pushbutton to bring trace back to reference line within limits shown in Table A2-6. (It may be necessary to change CHAN 1 SCALE/DIV to a less sensitive setting if trace is off screen.)

d. Repeat step c with attenuator connected to "A" input and Channel 1 INPUT switch to "A".

e. Repeat step c with attenuator connected to "B" input and Channel 1 INPUT switch to "B".

Table A2-6. Dynamic Accuracy Table

External Attenuator Setting	Channel 1 REF OFFSET	OFFSET from REF LINE (Plus attenuator tolerance)
10 dB	+20.0 dB	± 0.20 dB
20 dB	+10.0 dB	± 0.1 dB
30 dB	0 dB	± 0.00 dB
40 dB	−10.0 dB	± 0.1 dB
50 dB	−20.0 dB	± 0.2 dB
60 dB	−30.0 dB	± 0.4 dB
70 dB	−40.0 dB	± 0.6 dB
80 dB	−50.0 dB	± 0.8 dB
90 dB	−60.0 dB	± 1 dB
100 dB	−70.0 dB	± 2 dB
110 dB	−80.0 dB	± 4 dB

A2-55. PHASE DYNAMIC RANGE

SPECIFICATION:

Phase Dynamic Accuracy (in 10 kHz Bandwidth):
±0.02 degree/dB from −20 to −40 dBm
±0.5 degree from −10 to −50 dBm
±1 degree from −50 to −70 dBm
±3 degrees from −70 to −90 dBm

DESCRIPTION:

A phase reference level is established on the CRT. Then the signal at the receiver is changed through the dynamic range of the instrument and the change in phase indication is noted.

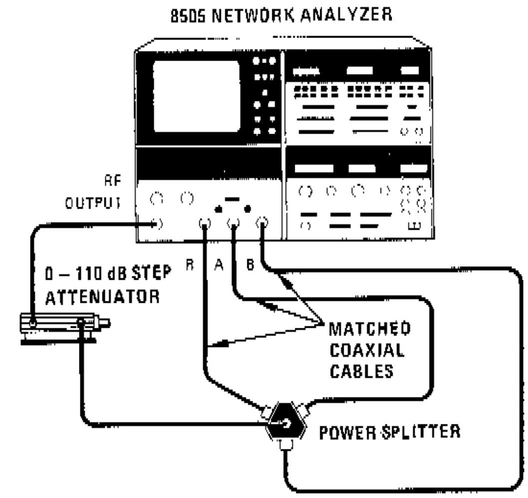


Figure A2-17. Phase Dynamic Range Test Setup

EQUIPMENT:

RF Cable Kit . . . . HP 11851A
3-Way Power Splitter. . . . . HP 11850A
Step Attenuator, 0 — 110 dB . . . . HP 8496A

PROCEDURE:

a. On 8505A, set controls as follows:

On A1 Source/Converter
OUTPUT LEVEL dBm . . . . +10
OUTPUT LEVEL VERNIER 0
INPUT LEVEL dBm MAX . . . . −10

On A2 Frequency Control:
RANGE MHz . . . . .5 — 130
MODE. . . . . LIN EXPAND
WIDTH . . . . .CW ± ΔF
SCAN TIME SEC . . . . .1 — .01
CW FREQUENCY. . . . . 30 MHz
±ΔF FREQUENCY 00.0
MARKERS 1
Marker 1 . . . . Center of CRT screen

A2-55. PHASE DYNAMIC RANGE (Cont'd)

On A3 Signal Processor:

Channel 1

INPUT . . . . A/R
MODE . . . . PHASE
SCALE/DIV . . . . 1 degree

Channel 2

MODE . . . . OFF

Electrical Length

MODE . . . . OFF

Display Section

BANDWIDTH kHz . . . . 10 kHz On (in)
VIDEO FILTER . . . . On (in)
REF LINE POSN . . . . Adjust Reference Line to CRT center graticule line

b. Connect equipment as shown in Figure A2-17.

c. Set external step attenuator to 10 dB. If "R" OVERLOAD light comes on, adjust OUTPUT LEVEL VERNIER to clear overload. Press Channel 1 DISPLAY MKR, then ZRO pushbuttons to place the CRT trace on the center graticule line.

d. Step external step attenuator from 10 to 50 dB position. (This applies −50 dBm to ports "A" and "R".) The CRT trace should be within ±0.5 degree of Reference Line.

e. Step the external attenuator from 50 to 70 dB position. (This applies −70 dBm to ports "A" and "R".) The CRT trace should be within ±1 degree of Reference Line.

f. Step the external attenuator from 70 to 90 dB position. (This applies −90 dBm to ports "A" and "R".) The CRT trace should be within ±3 degrees of Reference Line.

A2-56. MAGNITUDE, PHASE, AND GROUP DELAY FREQUENCY RESPONSE

SPECIFICATION:

Absolute Magnitude Frequency Response: $\leqslant\pm1.5$ dB

Magnitude Tracking Frequency Response: $\leqslant\pm0.3$ dB

Phase Frequency Response: $\leqslant\pm3°$ from 0.5 to 750 MHz; $\leqslant\pm5°$ from 750 to 1300 MHz

Group Delay Frequency Response: $\leqslant\pm1$ ns (0.5 to 1300 MHz).

DESCRIPTION:

The receiver magnitude frequency response is tested by applying the RF OUTPUT first directly to the three individual ports. If the indication is slightly out of specifications, the RF OUTPUT is sent through a power splitter to one of the INPUT ports and to a power meter. The common mode power variations due to the source as indicated on the power meter is subtracted from the variations on the CRT trace, giving a resultant variation due only to the receiver and display section.

The receiver frequency response in ratio measurement mode may be red directly from the CRT display since all common mode variations due to the source are cancelled. Also,

A2-56. MAGNITUDE, PHASE, AND GROUP DELAY FREQUENCY RESPONSE (Cont'd)

frequency response in group delay mode is read directly from the CRT trace by noting the deviation from the center graticule reference.

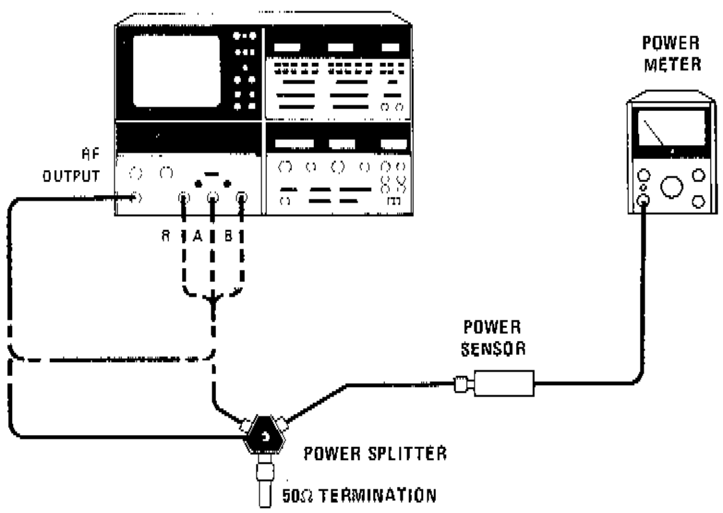


Figure A2-18. Absolute Magnitude Frequency Response Test Setup

EQUIPMENT:

Power Meter . . . . HP 435A
Power Sensor. . . . . HP 8482A
Three-Way Power Splitter . . . . HP 11850A
50-Ohm Termination. . . . . HP 909A Option 012

PROCEDURE:

ABSOLUTE MAGNITUDE FREQUENCY RESPONSE

a. On 8505A, set the controls as follows:

On A1 Source/Converter:
OUTPUT LEVEL dBm . . . . −20
OUTPUT LEVEL VERNIER . . . . −10
INPUT LEVEL dBm MAX . . . . −10

On A2 Frequency Control:
RANGE MHz . . . . .0.5 — 1300
MODE. . . . . LIN FULL
WIDTH . . . . .START/STOP 1

NOTE

It may be necessary to make slight adjustment at 0.50 MHz of Frequency Calibrate pot behind FREQUENCY CONTROL front panel. (See paragraph A2-51, steps d through i.)

MARKERS 1
Marker 1 . . . . Midrange

A2-56. MAGNITUDE, PHASE, AND GROUP DELAY FREQUENCY RESPONSE (Cont'd)

On A3 Signal Processor:

Channel 1
INPUT . . . . R
MODE . . . . MAG
SCALE/DIV . . . . 0.5 dB/DIV

Channel 2
MODE . . . . OFF

CRT Display
REF LINE POSN . . . . Center Graticule Line
BW . . . . 10 kHz On (in)
VIDEO FILTER . . . . Off (out)

b. Connect equipment as shown in Figure A2-18 with "R" INPUT cable connected directly to RF OUTPUT connector.

c. Press DISPLAY CLR, MKR, then ZRO pushbuttons. Observe the highest and lowest point on the CRT trace between 0.5 and 1300 MHz. They should not be greater than 3 dB difference. If the CRT trace is within tolerance, go to step h and check "A" input port. If "A" port has been checked, go to step i and check "B" input port. If the CRT trace is out of tolerance, go to step d and cancel the affect of the RF source variations to see if the receiver section is actually within tolerance.

d. Connect equipment as shown in Figure A2-18 with RF OUTPUT to center of Power Splitter and one leg of power splitter to port "R" and the other leg to Power Sensor and Power Meter.

e. Set Marker 1 to the point on CRT trace that is maximum. Note Marker reading and Power Meter reading.

f. Set Marker 1 to the point on CRT trace that is minimum. Adjust OUTPUT LEVEL VERNIER and step attenuator to set Power Meter to the same indication noted in step e.

g. The difference between the Marker indication noted in step e and the displayed marker reading in step f should be ≤ 3 dB.

h. Disconnect RF Cable from "R" INPUT and connect to "A" INPUT. Set Signal Processor Channel 1 INPUT switch to A. Repeat preceding step c and observe the power level variations for "A" INPUT.

i. Disconnect RF Cable from "A" INPUT and connect to "B" INPUT. Set Signal Processor Channel 1 INPUT switch to B. Repeat preceding step c and observe the power level variations for "B" INPUT.

A2-56. MAGNITUDE, PHASE, AND GROUP DELAY FREQUENCY RESPONSE (Cont'd)

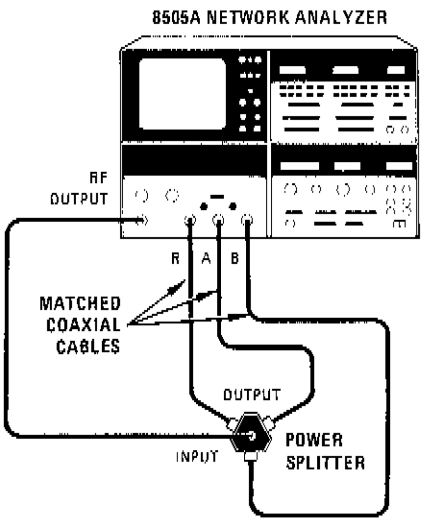


Figure A2-19. Ratio Frequency Response Test Setup

EQUIPMENT:

Three-way POWER SPLITTER .... HP 11850A
Matched Cable Kit............................ HP 11851A

RATIO MEASUREMENT MAGNITUDE FREQUENCY RESPONSE

j. Connect equipment as shown in Figure A2-19 with the power splitter connected to "R", "A", and "B" inputs and Power Meter disconnected from setup.

k. On A2 Frequency Control, set RANGE MHz switch to 0.5 — 1300 MHz position, set MODE to LIN FULL, WIDTH to START/STOP 1, SCAN TIME SEC to 1 — .1, and TRIGGER to AUTO. Set MARKERS switch to 1 position and Marker 1 control to approximately 640 MHz.

l. On A3 Signal Processor, set CHANNEL 1 INPUT switch to A/R, set MODE to MAG, set SCALE/DIV switch to 0.1 dB position and set VIDEO FILTER off (out). Press DISPLAY MKR, then ZRO pushbutton.

m. On A2 Frequency Control, adjust MARKER 1 frequency control between 0.5 MHz (left end of CRT trace) and 1300 MHz (right end of CRT trace). Note the highest and lowest reading on the Signal Processor Channel 1 readout. The difference between the highest and lowest reading (peak-to-peak variation due to frequency response) should be ≤0.6 dB.

n. Set Signal Processor Channel 1 INPUT switch to B/R. Press DISPLAY MKR, then ZRO pushbuttons. Repeat preceding step m.

A2-56. MAGNITUDE, PHASE, AND GROUP DELAY FREQUENCY RESPONSE (Cont'd)

PHASE MEASUREMENT FREQUENCY RESPONSE

o. Set MODE to LIN EXPAND, WIDTH to START/STOP 1, MARKERS switch to 1 position, and Marker 1 control to mid-position. Set START to 0000. MHz, STOP to 0750 MHz. Set Channel 1 INPUT to B/R, MODE to PHASE, and SCALE/DIV to 2 degrees.

p. Set ELECTRICAL LENGTH INPUT to B and MODE to LENGTH X1. Press LENGTH pushbuttons to make the overall CRT trace as horizontal as possible. (It may be necessary to press Channel 1 DISPLAY MKR, then ZRO to bring trace on CRT.)

q. Press Channel 1 DISPLAY MKR, then ZRO pushbutton to position the trace near the center graticule line. The maximum trace deviation from the highest point to the lowest point should be ≤6 degrees (3 divisions). If the reading is out of tolerance, the power splitter tracking may be at fault. Check the power splitter tracking as follows. Reverse the connections to the power splitter legs, then make the phase measurements again and subtract the two readings. The difference in readings is the power splitter tracking error. Correct the original phase measurements by subtracting one-half the power splitter tracking error.

r. Set START to 750 MHz and STOP to 1300 MHz and repeat steps p and q for the 750 to 1300 MHz range. The trace deviation should be ≤10 degrees (5 divisions).

s. Repeat steps o through t for A/R measurement. Set all switches the same, except set Channel 1 INPUT switch to A/R in step o and set ELECTRICAL LENGTH INPUT switch to A in step p.

GROUP DELAY FREQUENCY RESPONSE

t. On A3 Signal Processor, set Channel 1 INPUT switch to A/R, MODE switch to DLY and set SCALE/DIV switch to 1 ns. Set Frequency Control MODE switch to LIN FULL.

u. Press Electrical Length DISPLAY CLR pushbutton. Press Channel 1 DISPLAY MKR then ZRO pushbuttons to center CRT trace about center graticule line and zero digital readout.

v. On A2 Frequency Control, adjust MARKER 1 frequency control between 0.5 and 1300 MHz and note the highest and lowest reading on the Signal Processor Channel 1 readout. The difference between the highest and the lowest reading (peak-to-peak variation due to frequency response) should be ≤2 ns.

w. Repeat steps t through v for B/R measurement. Set all switches the same except set Channel 1 INPUT switch to B/R in step t.

A2-57. PHASE ACCURACY AND ELECTRICAL LENGTH TEST

SPECIFICATION:

Phase Accuracy:

±0.01 degrees/degree for ±170 degrees

±0.01 degrees/degree ±0.5 degrees for ±180 degrees.

A2-57. PHASE ACCURACY AND ELECTRICAL LENGTH TEST (Cont'd)

Polar Accuracy:
Actual value is within less than a 3 mm circle of displayed value.

Electrical Length Accuracy: ±3% of reading ±1% of length range.

DESCRIPTION

The hysteresis loop is observed to see that the 180 degree transition occurs at precisely +180 degrees and −180 degrees. The electrical length offset is checked by inserting two phase cyles and reading the resultant Electrical Length digital readout of 720 degrees.

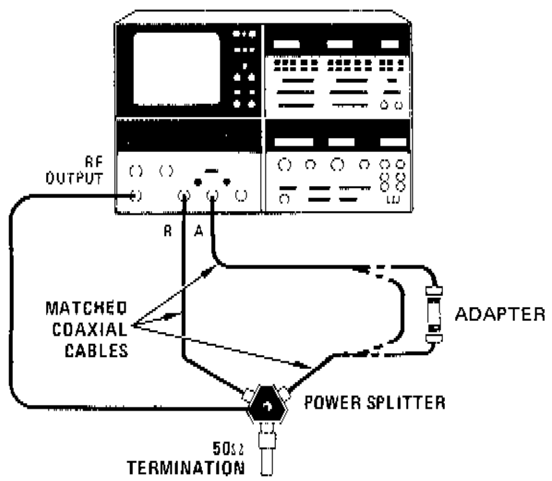


Figure A2-20. Phase Accuracy Test Setup

EQUIPMENT:

3-Way Power Splitter	HP 11850A
RF Cable Kit	HP 11851A
Type N Female to Type N Female Adapter	HP 1250-0777
50-ohm Termination	HP 909A Option 012

PROCEDURE:

PHASE ACCURACY TEST

a. On the 8505A, set the controls as follows:

On A1 Source/Converter

OUTPUT LEVEL dBm	−10
OUTPUT LEVEL VERNIER	.0
INPUT LEVEL dBm MAX	−10

On A2 Frequency Control

RANGE MHz	0.5 — 130
MODE	LIN EXPAND
WIDTH	CW ±ΔF
CW FREQUENCY	60 MHz
±ΔF FREQUENCY	6.0 MHz
SCAN TIME SEC	0.1 —.01

A2-57. PHASE ACCURACY AND ELECTRICAL LENGTH TEST (Cont'd)

A2 Frequency Control (Cont'd)
TRIGGER . . . . AUTO
MARKERS 1
Marker 1 . . . . 60 MHz

On A3 Signal Processor
Channel 1
INPUT . . . . A/R
MODE . . . . PHASE
SCALE/DIV . . . . 90°/DIV

Channel 2
MODE . . . . OFF

CRT Display
BW (Bandwidth) . . . . 10 kHz
Video Filter . . . . Off (out)

ELECTRICAL LENGTH Panel
MODE . . . . OFF

b. Connect equipment as shown in Figure A2-20 with two 24-inch matched cables connected in series between Port "A" and the 3-way power splitter.

c. Offset the phase trace with the Channel 1 REF OFFSET pushbuttons to place a phase transition to the right of midscreen as shown in Figure A2-21.

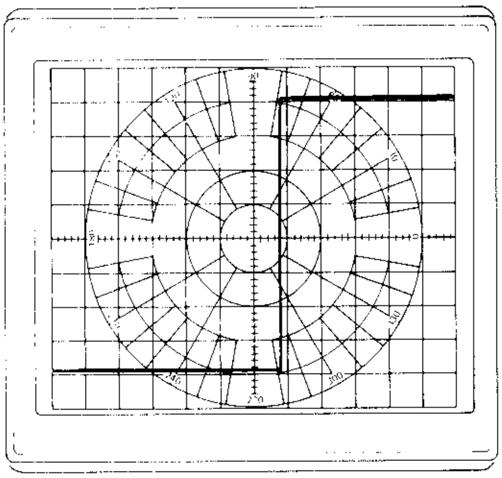


Figure A2-21. CRT Trace of Phase Transition

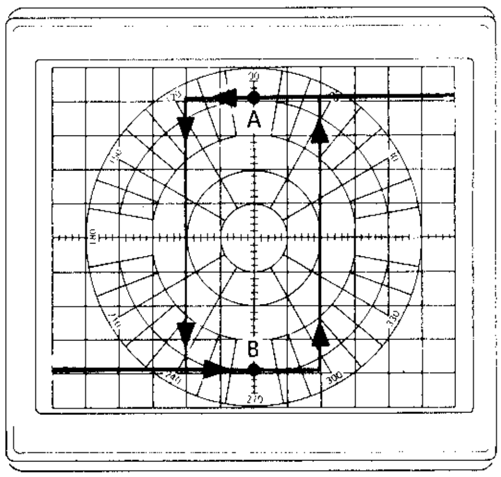


Figure A2-22. Hysteresis Loop of Phase Trace

d. Set SCAN TIME SEC to MANUAL. Sweep through the transition in both forward and reverse direction using the Manual sweep control. Note the hysteresis loop as shown in Figure A2-22.

e. Adjust both CW FREQUENCY and ±ΔF FREQUENCY to make the hysteresis loop six divisions wide and centered on the vertical center line of CRT. (See Figure A2-22.)

NOTE

If either step f or g is out of tolerance, refer to Section V for adjustment of A3A12 Phase Detector.

A2-57. PHASE ACCURACY AND ELECTRICAL LENGTH TEST (Cont'd)

f. Press Channel 1 DISPLAY MKR. Center trace dot on the vertical center line at point "A" on Figure A2-22 trace. The marker readout should be +180 degrees ±3.3 degrees.

g. Center trace dot on the vertical center line at point "B" on Figure A2-22 trace. The Channel 1 marker readout should be −180 degrees ±3.3 degrees.

ELECTRICAL LENGTH LINE STRETCHER TEST

h. Remove extra 24-inch cable and adapter and reconnect Port "A" to the three-way power splitter through one of the matched cables.

i. On Frequency Control, set:

RANGE MHz .... 0.5 — 1300 MHz
MODE .... LIN EXPAND
WIDTH .... CW ±ΔF
±ΔF FREQUENCY .... 0 MHz
CW FREQUENCY
(read on FREQ COUNTER MHz panel) .... 1000 MHz

On Signal Processor, set:

Channel 1:
INPUT .... A/R
MODE .... POLAR MAG
SCALE/DIV .... POLAR FULL 1

CRT Display:
BW (Bandwidth) .... 10 kHz On (in)
VIDEO FILTER .... Off (out)

j. At ELECTRICAL LENGTH panel, set:

INPUT .... A
MODE LENGTH X10
VERNIER A .... 0 (fully counterclockwise)
DISPLAY CLR .... Press and release

k. On Channel 1, press DISPLAY MKR, then ZRO pushbuttons. Set Channel 1 MODE Switch to POLAR PHASE, then press DISPLAY ZRO. This should place the trace dot within 3 mm of the outside circle and zero degrees.

l. Press ELECTRICAL LENGTH pushbuttons to add +30 cm length. The trace dot should move around the outside circle back to 0 degrees ±10 degrees.

m. Set ELECTRICAL LENGTH MODE switch to LENGTH X1 position. Press ELECTRICAL LENGTH pushbuttons to read +15 cm. The trace dot should be at 180 degrees ±5 degrees. The same indication appearing on the CRT should appear on the Channel 1 digital readout.

LINEAR PHASE RANGE

n. Set Channel 1 MODE to PHASE and SCALE/DIV to 90 degrees. Set ELECTRICAL LENGTH MODE switch to PHASE X10 degrees/SCAN. Press Channel 1 DISPLAY REF, then CLR and press ELECTRICAL LENGTH DISPLAY CLR.

A2-57. PHASE ACCURACY AND ELECTRICAL LENGTH TEST (Cont'd)

o. With ELECTRICAL LENGTH offset pushbuttons, put in +1800 degrees of electrical length. (The electrical length readout displays +180.) Verify that five transistions are displayed and that the linear phase display limits over approximately the last 5% of the trace. (See Figure A2-23, Photo A.)

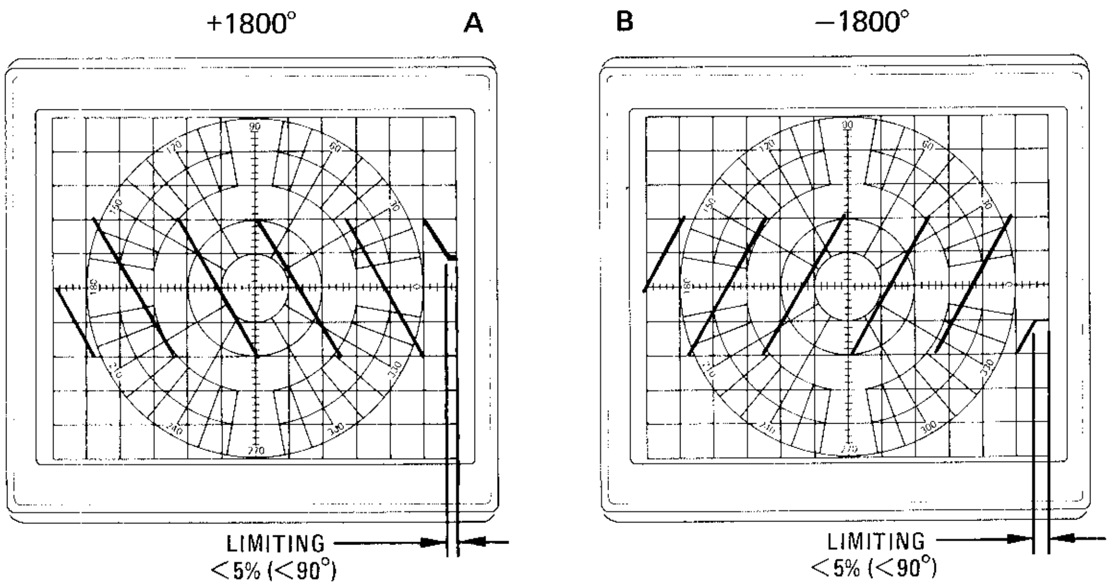


Figure A2-23. Phase Trace with Maximum Electrical Length Added

p. Reduce electrical length with LENGTH pushbuttons until the limiting section just goes off-screen. The digital readout at ELECTRICAL LENGTH panel should be ⩾+173 (⩾1730 degrees).

q. With ELECTRICAL LENGTH offset pushbuttons, put in −1800 degrees of electrical length. (The electrical length readout displays −180.) Verify that five transitions are displayed and that the linear phase display limits over approximately the last 5% of the trace. (See Figure A2-23, photo B.)

r. Reduce electrical length with LENGTH pushbuttons until the limiting section just goes off-screen. The digital readout at ELECTRICAL LENGTH panel should be equal to or more negative than −173 (equal to or more negative than −1730 degrees).

LINEAR PHASE ACCURACY

s. On ELECTRICAL LENGTH panel, set MODE switch to PHASE X 10 degrees/SCAN, set VERNIER A to zero, then press DISPLAY CLR pushbutton.

t. On Channel 1, set MODE switch to PHASE. Press DISPLAY REF, then CLR pushbuttons. Press MKR, then ZRO pushbuttons. Press DISPLAY REF, then REF OFFSET pushbuttons to place −180 degrees of offset in Channel 1.

u. On ELECTRICAL LENGTH panel, press LENGTH pushbutton to obtain two complete phase cycles on the CRT screen. The ELECTRICAL LENGTH digital readout should be ±72 ±2, corresponding to ±720 degrees ±20 degrees of electrical length.

A2-58. GROUP DELAY ACCURACY TEST

SPECIFICATIONS:

Group Delay Accuracy: ≤±3% of reading ±1 ns for 0.5 to 1300 MHz range, or ±10 ns for 0.5 to 130 MHz range, or ±100 ns for 0.5 to 13 MHz range.

DESCRIPTION:

A 50-foot coaxial cable is measured for group delay using the phase function of the 8505A. The group delay mode is then used to measure the 50-foot cable to obtain a direct group delay reading.

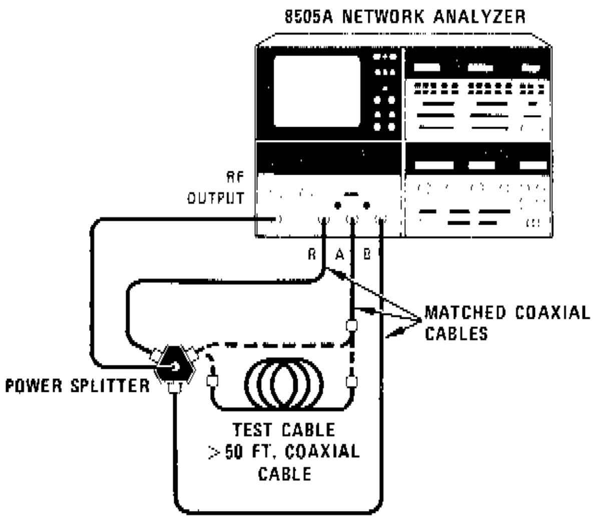


Figure A2-24. Test Setup to Measure Group Delay of Test Cable

EQUIPMENT:

3-Way Power Splitter	HP 11850A
Matched Type-N Coaxial Cables	HP 11851A
Test Cable	≥50 foot of coaxial cable (RG-223/u or similar)
BNC to Type-N Adapters	HP 1250-0780

PROCEDURE:

a. A coaxial cable greater than 50 feet in length is used as a standard in the group delay test. Group delay of the test cable is measured with the 8505A in phase mode as follows:

(1) Connect the "Test Cable" in A channel between the matched cable and the power splitter as shown in Figure A2-24.

(2) Set 8505A controls as follows:

On A1 Source/Converter:

OUTPUT LEVEL dBm	−10
OUTPUT LEVEL VERNIER	.0
INPUT LEVEL dBm MAX	−10

A2-58. GROUP DELAY ACCURACY TEST (Cont'd)

On A2 Frequency Control:

RANGE MHz . . . . 0.5 — 1300
MODE . . . . LIN EXPAND
WIDTH . . . . CW
SCAN TIME SEC . . . . 0.1 — .01
TRIGGER . . . . AUTO
MARKERS 1
SCAN TIME SEC Vernier . . . . Midrange

On A3 Signal Processor:

Channel 1
INPUT . . . . A/R
MODE . . . . PHASE
SCALE/DIV . . . . 45 DEG

Channel 2
MODE . . . . OFF

Electrical Length
INPUT . . . . A
MODE . . . . OFF

(3) Press Electrical Length DISPLAY CLR pushbutton. Set A2 Frequency Control CW FREQUENCY and VERNIER for 700.00 MHz. Press Channel 1 DISPLAY MKR pushbutton, then ZRO pushbutton to zero the digital readout.

(4) On A2 Frequency Control, adjust CW FREQUENCY up in frequency until the marker digital readout again indicates 0 degrees. Record frequency for use in later calculation. (NOTE: The phase change between the two zero points is 360 degrees.)

Frequency = ________________ MHz

(5) Calculate the group delay of the "Test Cable".

$$t_D = \frac{\text{(Phase change in degrees)}}{360 \text{ X (Change in Frequency in Hz)}}$$

EXAMPLE

Change in Phase = 360 degrees
Change in Frequency = 713 MHz −700 MHz
= 13 MHz

$$t_D = \frac{360 \text{ degrees}}{360\ (13 \text{ X } 10^6 \text{ Hz})} = \frac{1}{13 \text{ X } 10^6 \text{ Hz}}$$

= 77 ns

A2-58. GROUP DELAY ACCURACY TEST (Cont'd)

b. Connect equipment as shown in Figure A2-24 with both matched cables and adapters connected to power splitter and "test cable" not connected in circuit.

c. On 8505A, set controls as follows:

On A1 Source/Converter:
- OUTPUT LEVEL dBm . . . . —10
- OUTPUT LEVEL VERNIER 0
- INPUT LEVEL dBm MAX . . . . —10

On A2 Frequency Control:
- RANGE MHz . . . . 0.5 — 1300
- MODE. . . . . LIN FULL
- WIDTH . . . . .START/STOP 1
- SCAN TIME SEC . . . . 1 — .1
- SCAN TIME VERNIER . . . . Fully clockwise
- MARKERS 1
- Marker 1 . . . . Midrange
- TRIGGER. . . . . AUTO

On A3 Signal Processor:
- Channel 1
  - INPUT. . . . . A/R
  - MODE. . . . . .DLY
  - SCALE/DIV . . . . .DELAY 100 ns
- Channel 2
  - MODE. . . . . .OFF
- Electrical Length
  - INPUT. . . . . A
  - MODE. . . . . .OFF

d. Press Electrical Length DISPLAY CLR pushbutton.

e. Press Channel 1 DISPLAY REF pushbutton, then CLR pushbutton until REL light goes out (if it was lit). Then press MKR pushbutton.

f. Connect "Test Cable" between adapters in the A channel. The Channel 1 digital readout should indicate the group delay calculated for the "Test Cable" in step a (5) above ± (1 ns +3% of reading).

SECTION III
OPERATING AND PROGRAMMING INSTRUCTIONS

A3-1. INTRODUCTION

A3-2. This section of the manual contains instructions showing how to make transmission and reflection measurements in both manual and automatic modes.

A3-3. Included are step-by-step instructions on manual operation supplied in Application Note 219, as well as detailed instructions for programming the 8505A in automatic mode from an external controller through the Hewlett-Packard Interface Bus (HP-IB).

A3-4. Manual Operation

A3-5. Application Note 219 is included in this section to introduce you to the various manual operating modes, and to give you a step-by-step sequence of operations to make specific measurements on a device.

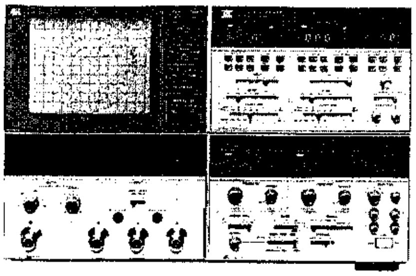
A3-6. If you are interested in the operation of specific controls on the 8505A, go to Figures A3-1 through A3-4. In these figures, the function of each control is described in detail.

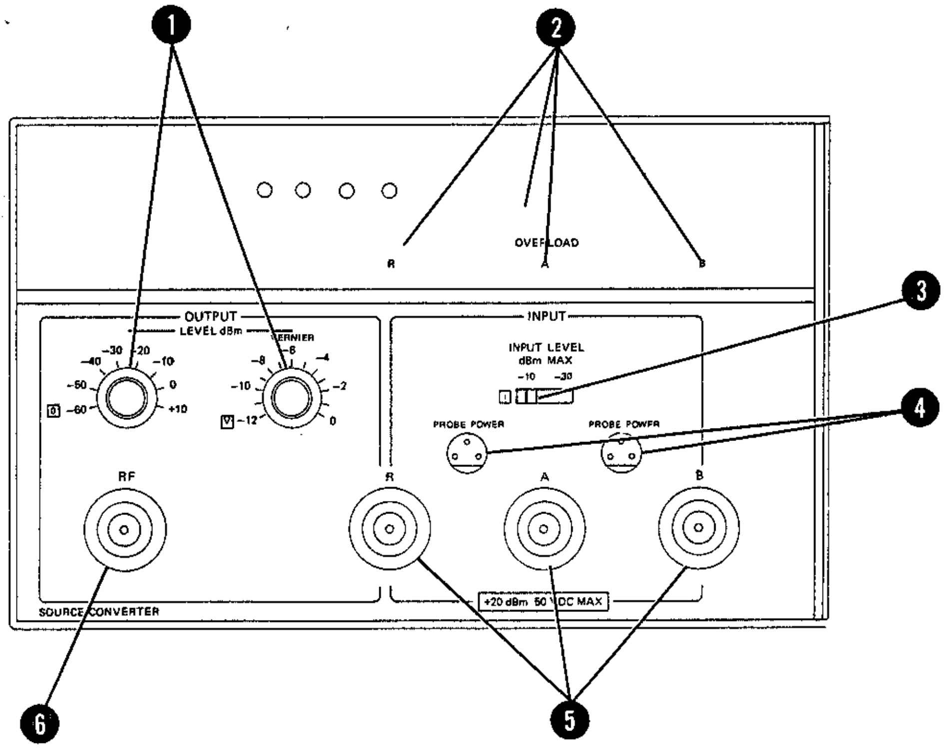
A3-7. Remote Operation and Programming

A3-8. The HP 8505A has a remote programming interface using the Hewlett-Packard Interface Bus (HP-IB). All measurements that can be taken by the standard 8505A Network Analyzer can be automatically programmed and controlled remotely via the HP-IB. This provides a remote operator with the same control of the instrument as does a manual (local) operator. Remote control is maintained by a system controller (desk-top computer, etc.) that sends commands or instructions to and receives data from the 8505A using the HP-IB. The HP-IB is Hewlett-Packard's implementation of the IEEE Standard 488-1975. A complete general description of the HP-IB is provided in the manual entitled "Condensed Description of the Hewlett-Packard Interface Bus," HP Part Number 59401-90030.

A3-9. Programming information for the 8505A is given in Paragraph A3-14 and on. Specific examples are given for HPL and BASIC languages: the HP 9825A Desk-top Computer in HPL and the HP 9830A/B in BASIC. A table of HP-IB commands together with sample command statements are given in Table A3-1. A glossary of HP-IB terms is given in Table A3-7. A summary of codes to command the 8505A is given in Tables A3-2 and A3-3. Figure A3-5 gives the 8505A programming codes in pictorial form. Some programming functions require programmed time delays to allow completion of an operation. These are listed in Table A3-4.

Fig. A3-1
Sht 1 of 2





1

2

3

Fig. A3-1
Sht 2 of 2

❶ **OUTPUT LEVEL dBm Switch and VERNIER.** Adjusts RF output signal. The signal level in dBm is the setting of −60 to +10 switch plus setting of −12 to 0 dB VERNIER control. The combination of the two controls provides a continuously variable RF signal level of −72 dBm to +10 dBm.

❷ **R, A, B, and OVERLOAD Lamps.** If any of these indicators are lit, the RF input signal level is too high at one or more of the input ports. The "OVERLOAD" light alerts the operator that one of the three other indicators is lit. Valid measurements can not be taken until the overload is cleared. Normally, an overload is corrected by reducing poer output from the RF signal source.

❸ **INPUT LEVEL dBm MAX Switch.** With switch in −30 dBm position, accuracy of low-level measurements is enhanced significantly. This switch also sets overload threshold level. If input signal exceeds switch setting (−10 dBm or −30 dBm), OVERLOAD lamp and lamps for overloaded channels (R, A, and B) will light.

❹ **PROBE POWER Connectors (Two).** Provides +15 Vdc and −12.6 Vdc for test probe power.

❺ **B, A, and R INPUT Connector.** Input connectors for B, A, and R Channels.

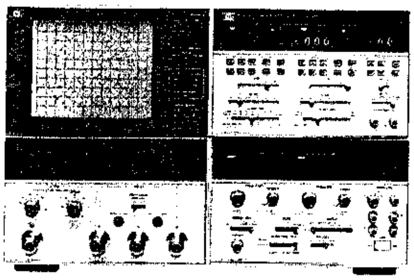
CAUTION

Do not apply input signals greater than +20 dBm or 50 Vdc to an INPUT connector. Higher levels can damage the instrument.

❻ **RF OUTPUT Connector.** Connects RF output of Source/Converter Assembly to device under test. Signal level is controlled by the two OUTPUT LEVEL dBm controls above the connector. Frequency and modulation of the RF OUTPUT signal is selected at the Frequency Control Section.

Figure A3-1. Source/Converter A1 Controls and Indicators

Model 8505A Fig. A3-2 Sht 1 of 4



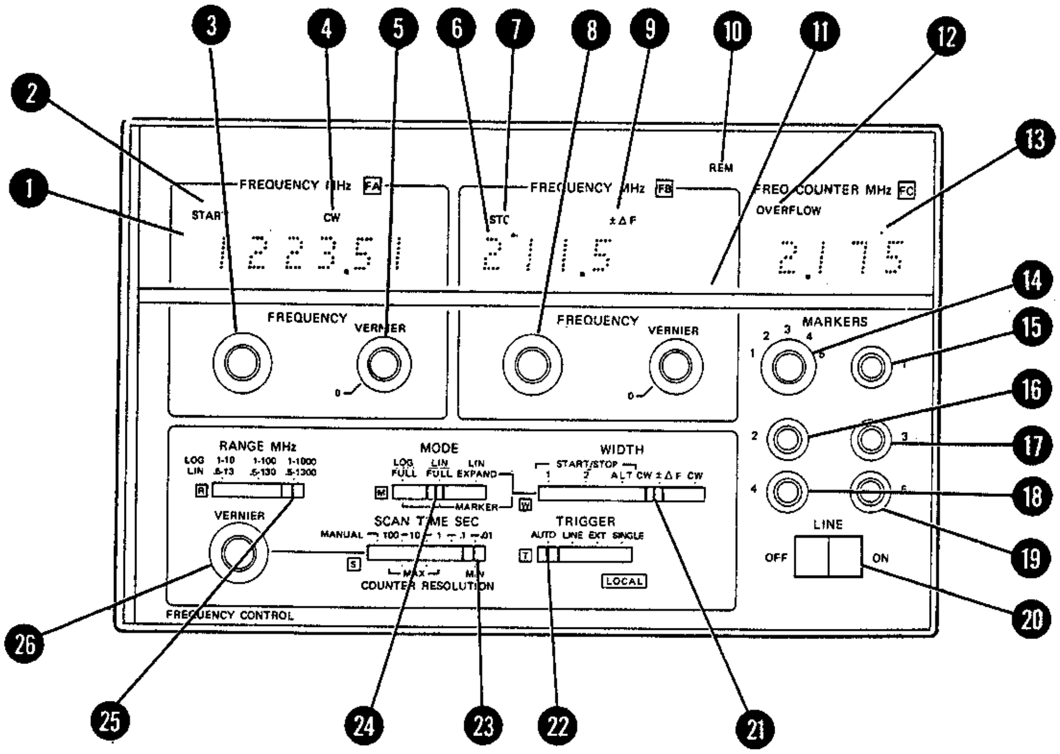


Fig. A3-2
Sht 2 of 4

1 **FREQUENCY MHz Readout.** Indicates START frequency for either START/STOP 1 or START/STOP 2 sweep modes, center frequency in CW ±ΔF sweep mode, or CW frequency in single-frequency CW mode. In CW mode, this readout displays the built-in counter frequency measurement.

2 **START Lamp.** Lights when START/STOP 1, START/STOP 2, or ALTernate mode of operation is selected at WIDTH switch 21. Lighted START lamp indicates START frequency is being displayed on readout.

3 **FREQUENCY Control.** Selects START frequency for START/STOP mode or CW frequency (displayed on readout above FREQUENCY control). FREQUENCY control provides coarse adjustment and works with VERNIER (fine tuning) control 5 for precise frequency selection. In CW mode, frequency readout 1 is the frequency measurement from the built-in frequency counter.

4 **CW Lamp.** Lights when either CW ±ΔF or CW mode is selected at WIDTH switch 21. Lighted CW lamp indicates CW frequency is being displayed on readout.

5 **VERNIER FREQUENCY Control.** Operates with coarse FREQUENCY control 3 to its left for precise setting of START and CW frequency. Small frequency change produced by the VERNIER control is displayed on the readout 1 in CW mode, but not in sweep modes.

6 **FREQUENCY MHz Readout.** Indicates STOP frequency for START/STOP 1, START/STOP 2, or ALTernate sweep modes, or frequency sweep from CW center frequency in CW ±ΔF sweep mode. Frequency displayed on readout depends on position of WIDTH switch 21. When WIDTH switch 21 is set to CW, this readout turns off.

7 **STOP Lamp.** Lights when START/STOP 1, START/STOP 2 or ALTernate mode of operation is selected at WIDTH switch 21. Lighted STOP lamp indicates STOP frequency is being displayed on readout.

8 **FREQUENCY Control.** Selects STOP frequency for START/STOP mode, or frequency sweep from CW center frequency for ±ΔF mode for display on readout above FREQUENCY control. Provides coarse FREQUENCY adjustment and is used with VERNIER (fine tuning) control 11 for precise frequency selection.

9 **±ΔF Lamp.** Lights when WIDTH switch 21 is set to CW ±ΔF position. Lighted ±ΔF lamp indicates frequency being displayed on readout is the selected sweep from center frequency (ΔF mode).

10 **REMote Lamp.** Has no function when instrument is operated manually. When instrument is part of an automatic system with desk-top computer in control, a lighted REM lamp indicates 8505A Frequency Control front-panel controls are ineffective and all control is from the desk-top computer. Local manual control can be restored by setting TRIGGER switch 22 to LOCAL.

11 **VERNIER FREQUENCY Control.** Operates with coarse FREQUENCY control 8 to its left for precise setting of STOP frequency and ΔF sweep width.

12 **OVERFLOW (FREQ COUNTER MHz) Lamp.** Lights when an overflow has occurred at frequency counter for marker selected with MARKERS selector switch 14. Marker overflow can be eliminated by setting SCAN TIME SEC switch 23 to .1 – .01 position (MIN COUNTER RESOLUTION). After the most significant digits on readout are noted, SCAN TIME SEC switch 23 may be set to a higher MARKER RESOLUTION position and marker frequency may be fine-tuned. Complete marker frequency can be obtained by inserting previously noted most significant digits in front of the frequency readout.

13 **FREQ COUNTER MHz Readout.** Indicates frequency of marker selected with MARKERS selector switch 14. Resolution of this frequency is determined by setting of SCAN TIME SEC switch 23. MAX COUNTER RESOLUTION positions will usually cause readout overflow and the most significant digits will be missing from front of readout numbers. Most significant digits may be inserted in front of frequency readout number to obtain complete marker frequency number.

14 **MARKERS Selector Switch.** Has two main funtions: it selects marker to be displayed on frequency counter readout 13, and it selects the

Fig. A3-2
Sht 3 of 4

number of markers to be displayed on trace of CRT display. Selection of position 1 causes frequency of marker 1 to be displayed on readout **13** and marker 1 diamond-shaped marker to be displayed on CRT above the trace. When position 2 is selected, diamond-shaped marker of marker 2 is displayed on top of CRT trace and marker 1 diamond moves to a position below CRT trace. Also, marker 2 frequency is displayed on readout **13**. This same pattern occurs for each of the MARKER switch's five positions (i.e, position 5 produces five markers on the CRT). Marker 5 is being monitored on frequency counter and appears on the top of CRT trace. All other markers appear on bottom of trace.

15 16 17 18 19

Marker Frequency Controls. Set position of individual markers 1, 2, 3, 4, and 5 respectively on CRT trace. For example, marker 2 is set by marker 2 control **16**, and the frequency is read on the FREQ COUNTER readout above the control when MARKERS selector switch **14** is set to marker 2 position.

20 **LINE OFF/ON Switch.** Applies power to both chassis of 8505A instrument when set to ON. A NORM/BYPASS switch located in the Signal Processor negates the Frequency Control LINE switch when set to BYPASS position.

21 **WIDTH Switch.** Selects sweep mode or CW mode of operation. START/STOP 1 and START/STOP 2 positions give two separate start-stop sweep ranges. In START/STOP 1 position, left-hand frequency readout is START frequency and frequency on center readout is STOP frequency. The same is true for START/STOP 2 position. In ALT (alternate) position, the CRT trace sweeps START/STOP 1 and then START/STOP 2 alternately, displaying both traces on CRT display. If both Channel 1 and 2 are turned on, START/STOP 1 frequencies are displayed at digital readout. If Channel 1 is turned off, Channel 2 Start and Stop frequencies will be displayed. In CW ±ΔF position, trace sweeps above and below CW center frequency. CW center frequency is displayed on left-hand readout **1** and sweep width from center frequency is displayed on center readout **6**. In CW position, CW frequency is displayed on left readout **1**.

22 **TRIGGER Switch.** Selects source of sweep trigger pulse. In AUTO (automatic) position, sweep trigger pulse is derived from internal sweep oscillator and sweep system is free running. In LINE position, sweep is triggered by power-line sinewave. In EXT (external) position, sweep is triggered by external trigger pulse applied through rear-panel EXT TRIGGER connector.

In SINGLE (single sweep) position, switch has a spring return to EXT position. Each time switch is pushed to SINGLE position, a single sweep is initiated when released, switch returns to EXT position. On lower side of TRIGGER switch is a boxed "LOCAL" position (same as SINGLE). This control is used when 8505A is in remote operation being controlled by a desk-top computer and commands "GO TO LOCAL," restoring front-panel control. NOTE: After using this switch for a "GO TO LOCAL" command, be sure to switch back to "AUTO" for normal operation.

23 **SCAN TIME SEC/COUNTER RESOLUTION Switch.** Sets range of sweep time. The four sweep ranges provide sweep times between 100 seconds and 0.01 second. Vernier control **26** to left of switch allows adjustment within selected range. Scan time setting also affects resolution of marker readout. If marker overflow lamp lights, overflow can be cleared as follows: SCAN TIME SEC switch to .1 – .01 position (MINimum COUNTER RESOLUTION). Next, note the three most significant digits of frequency readout and then return SCAN TIME SEC switch to a slower speed. If the marker OVERFLOW lamp lights, the most significant digits may be added to the left side of the readout number and the marker may be adjusted for maximum resolution. When SCAN TIME SEC switch is set to MANUAL, the VERNIER control allows manual sweep for the frequency through the selected start/stop frequency range.

24 **MODE Switch.** Selects logarithmic or linear calibration of display. In LOG FULL and LIN FULL positions, entire band selected by RANGE MHz switch **25** is swept. In LOG FULL and LIN FULL positions, seven markers are available. The five markers controlled by the marker selector **14** plus the START and STOP markers. In LIN EXPAND position, CRT displays trace between START marker and STOP marker, expanded to fill entire CRT screen.

Fig. A3-2
Sht 4 of 4

Selects source of sweep trig-
(automatic) position, sweep
ed from internal sweep oscil-
em is free running. In LINE
riggered by power-line sine-
rnal) position, sweep is trig-
rigger pulse applied through
GER connector.

weep) position, switch has a
position. Each time switch
E position, a single sweep is
sed, switch returns to EXT
side of TRIGGER switch is
position (same as SINGLE).
when 8505A is in remote
rolled by a desk-top compu-
"GO TO LOCAL," restoring
NOTE: After using this switch
CAL" command, be sure to
O" for normal operation.

/COUNTER RESOLUTION
sweep time. The four sweep
p times between 100 sec-
. Vernier control 26 to left
stment within selected range.
affects resolution of marker
verflow lamp lights, overflow
ows: SCAN TIME SEC switch
ion (MINimum COUNTER
t, note the three most signifi-
ncy readout and then return
itch to a slower speed. If the
lamp lights, the most signifi-
dded to the left side of the
the marker may be adjusted
ion. When SCAN TIME SEC
UAL, the VERNIER control
for the frequency through
frequency range.

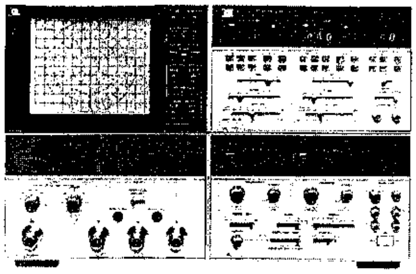
s logarithmic or linear calib-
LOG FULL and LIN FULL
d selected by RANGE MHz
t. In LOG FULL and LIN
n markers are available. The
led by the marker selector
and STOP markers. In LIN
CRT displays trace between
TOP marker, expanded to fill

25 **RANGE MHz Switch.** Selects frequency range to be displayed on CRT trace. Both log and linear ranges are shown for the three switch positions. MODE switch 24 position determines whether LOG or LIN range notations should be followed.

26 **MANUAL Tuning/SCAN TIME SEC VERNIER Control.** A single control used for two different functions. When SCAN TIME SEC switch 23 is set to MANUAL, VERNIER control allows manual sweep through selected start/stop frequency range. When SCAN TIME SEC switch 23 is set to scan time range, VERNIER control allows continuous adjustment through selected time range.

Figure A3-2. Frequency Control Assembly A2 Controls and Indicators.

Fig. A3-3
Sht 1 of 2



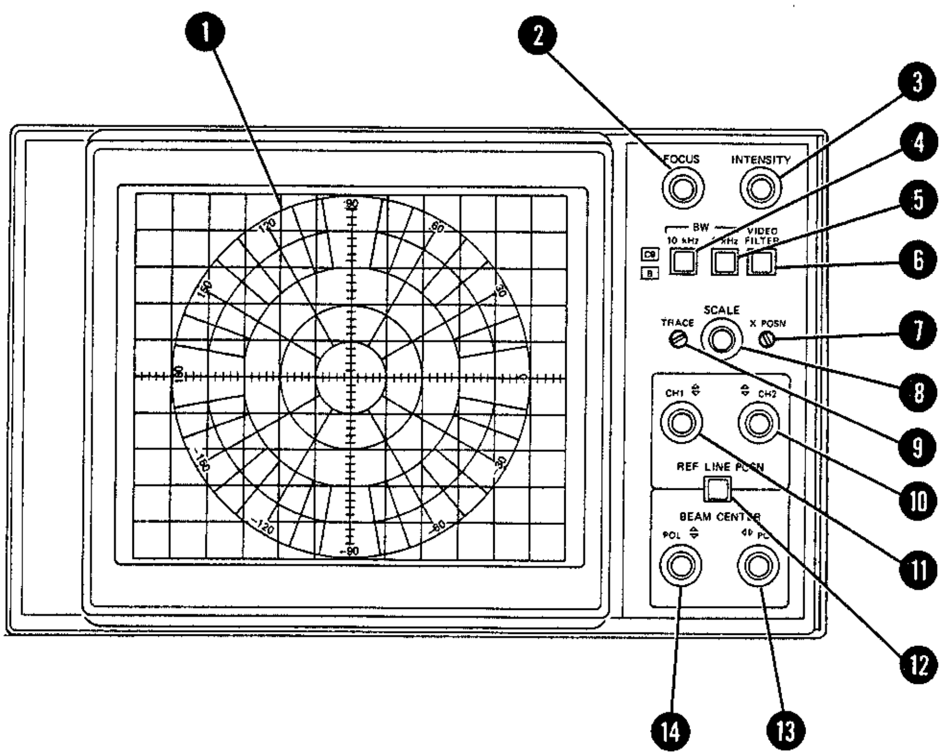


Fig. A3-3
Sht 2 of 2

1 **CRT Display Screen.** Displays measurement traces. CRT graticule has both rectangular and polar scales.

2 **FOCUS Control.** Adjusts focus of CRT trace.

3 **INTENSITY Control.** Adjusts brightness of CRT trace.

4 **10 kHz BW (Bandwidth) Pushbutton.** Sets. I.F. bandwidth to 10 kHz.

5 **1 kHz BW (Bandwidth) Pushbutton.** Sets I.F. band width to 1 kHz.

6 **VIDEO FILTER Pushbutton.** Inserts smoothing filter between signal processing output and CRT display to remove excessive noise from displayed signal. Scan time should be slow for maximum effectiveness. It provides bandwidth of approximately 30 Hz.

7 **X POSN Control.** Screwdriver adjustments moves trace right and left on CRT. Does not affect trace length.

8 **SCALE Control.** Adjusts illumination of CRT screen background.

9 **TRACE Control.** Screwdriver adjustment to eliminate tilt from horizontal trace.

10 **CH 2 REF LINE POSN Vertical Adjustment Control.** Operates only for rectangular displays. Moves Channel 2 zero reference line up and down.

11 **CH 1 REF LINE POSN Vertical Adjustment Control.** Operates only for rectangular displays. Moves Channel 1 zero reference line up and down.

12 **REF LINE POSN/BEAM CENTER Pushbutton.** In rectangular modes, pressing the REF LINE POSN pushbutton connects a zero reference to the vertical axis during retrace. Therefore, both the zero reference line and the signal trace appear together on the CRT. The reference line can be positioned anywhere on the screen with applicable CH 1 or CH 2 REF LINE POSN vertical adjustment control, 10 or 11 .

Pressing REF LINE POSN pushbutton, 12 a second time pops the pushbutton out and removes the ground, allowing operation with the reference line blanked.

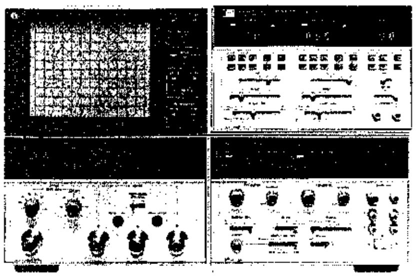
In polar mode, pressing the BEAM CENTER pushbutton connects a ground (zero signal) to both the horizontal and vertical polar axis during retrace. Therefore, both the beam center trace and the signal trace appear together on the CRT. The reference dot is adjusted to the center of the graticule with POLar up-down and left-right controls 13, and 14 .

13 **BEAM CENTER Horizontal POlar Adjustment Control.** Used in polar mode to move CRT beam right or left. See 12.

14 **BEAM CENTER Vertical POLar Adjustment Control.** Used in polar mode to move CRT beam up or down. See 12.

Figure A3-3. Signal Processor Assembly A3 CRT Display Controls

Fig. A3-4, sht 1 of 4



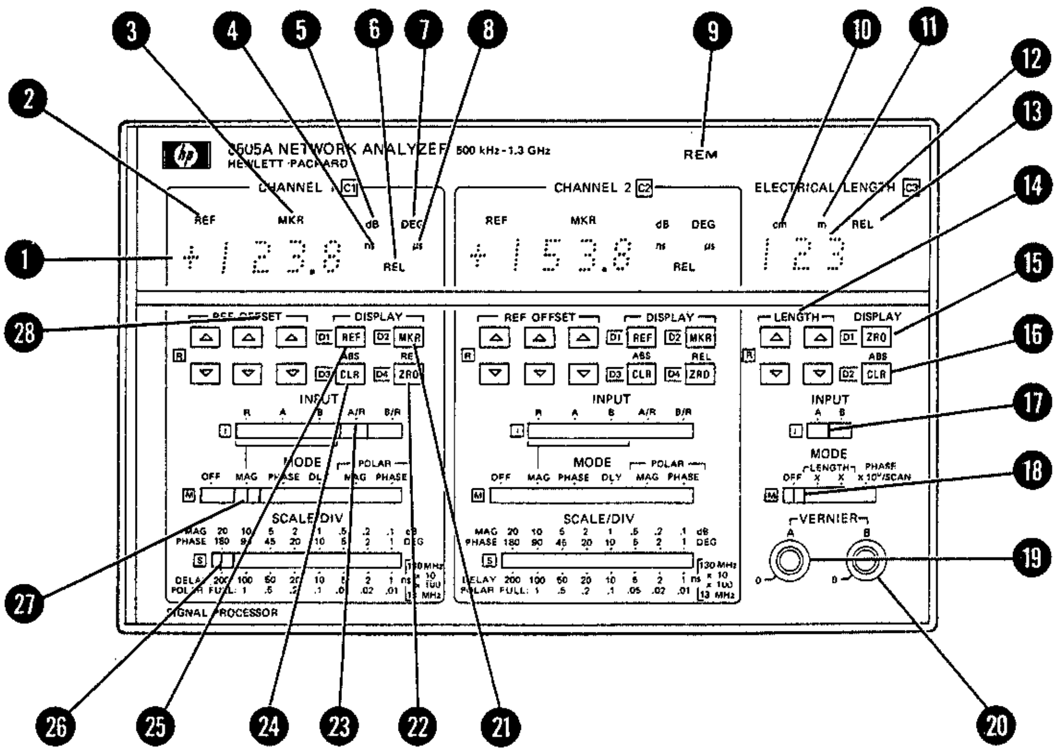


Fig. A3-4
Sht 2 of 4

NOTE

Channel 2 controls and indicators have the same function as the corresponding Channel 1 control or indicator.

1 **CHANNEL 1 Readout.** Indicates either of two major functions: reference offset value at reference position line, or marker-parameter value at Marker frequency relative to reference line, depending on DISPLAY pushbutton 21 or 25 pressed. Displays magnitude in dB, phase in degrees, and delay in nanoseconds or microseconds, depending on position of MODE switch 27

2 **REFerence Lamp.** Lights when DISPLAY REF pushbutton 25 is pressed.

3 **MKR (Marker) Lamp.** Lights when DISPLAY MKR pushbutton 21 is pressed.

4 **ns (nanosecond) Lamp.** This lamp or μs (microsecond) lamp 8 lights when MODE switch 27 is in DLY (group delay) position. The ns lamp is on in 1300 MHz frequency range only. The μs lamp lights in 130 MHz and 13 MHz range.

5 **dB Lamp.** Lights when MODE switch 27 is set to MAG (magnitude) or POLAR MAG (polar magnitude).

6 **RELative Lamp.** Lights whenever the stored calibration offset for the selected measurement is not equal to zero.

7 **DEGree Lamp.** Lights when MODE switch 27 is set to PHASE or POLAR PHASE. With this on, digital display 1 indicates phase reference level in degrees, or the phase angle at marker frequency if the MKR lamp 3 is on. (See 6 REL Lamp.)

8 μs (microsecond) See 4.

9 **REMote Lamp.** Has no function when instrument is operated manually. When instrument is part of an automatic system with calculator control, a lighted REM lamp indicates 8505A Signal Processor front-panel controls are ineffective and all control is from the calculator. Local manual control can be restored by setting Frequency Control TRIGGER switch to LOCAL.

10 **CM (Centimeter) Electrical Length Lamp.** Lights when offset electrical length displayed on digital readout 12 is in centimeters.

11 **m (Meters) Electrical Length Lamp.** Lights when offset electrical length displayed on digital readout 11 is in meters.

12 **ELECTRICAL LENGTH Readout.** Reads out electrical length of offset inserted in A or B port. In most phase measurements, both the test and reference channels must be of equal electrical length. Electrical length is equalized by extending test (A) or (B) port electrically until any phase shift across swept frequency band is cancelled.

Maximum electrical length that can be added depends on position of RANGE switch on Frequency Control Assembly panel. In 0.5 to 1300 MHz range, maximum offset is 1.99 meters, in 0.5 to 130 MHz range, maximum offset is 19.9 meters, and in 0.5 to 13 MHz range, maximum offset is 199 meters. With MODE switch in PHASE X10 degrees/SCAN position, the maximum length offset is 1800 degrees.

13 **RELative Lamp.** Lights whenever the stored calibration offset for the selected measurement is not equal to zero.

14 **LENGTH Pushbuttons.** Add or subtract electrical line length to A or B inputs. Electrical length is shown on digital display 12.

15 **ZRO (zero) DISPLAY Pushbutton.** When pressed, transfers reference offset from display register into length-offset register, then zeros digital display. If additional electrical length is added or subtracted with LENGTH pushbuttons, it can be added to value in length-offset register by again pressing DISPLAY ZRO pushbutton. Again digital display will also be cleared to zero.

16 **DISPLAY CLR (clear) Pushbutton.** Pressing and holding pushbutton down longer than two seconds clears readout register, setting all readout display digits 12 to zeros. Also clears length-offset register, removing all electrical length. Pressing this pushbutton momentarily (less than two seconds) clears only display register and zeros display, but does not clear value stored in length-offset register.

Fig. A3-4
Sht 3 of 4

17 **INPUT Switch.** Selects input port, A or B, to be affected by switch operations in this section of the panel. Offset of selected port is displayed on ELECTRICAL LENGTH readout.

When MODE switch **18** is set to OFF, INPUT switch **17** may be cycled through both A and B positions to remove offset effect from both ports. However, offsets stored in the A and B length-offset registers are not cleared, but again become operative when MODE switch is set to position other than OFF.

18 **MODE Switch.** Turns ELECTRICAL LENGTH section on and off, and controls range of LENGTH pushbuttons. In OFF position, offset is removed from selected port.

In "X1" or "X10" positions, amount of electrical length is displayed on electrical length readout in either cm or meters. "X10" position has ten times the range and 1/10th the resolution of "X1" position. In PHASE position, multiplying readout by 10 gives effective electrical length in degrees per scan. PHASE position is useful for removing large amounts of electrical length over narrow scan widths.

19 **VERNIER A Control.** Allows fine adjustment of electrical length of A input channel and is the vernier for the four LENGTH pushbuttons **14** .

20 **VERNIER B Control.** Same as VERNIER A control **19** except it is for B input.

21 **DISPLAY MKR (Marker) Pushbutton.** When marker is pressed, it causes digital display to indicate displacement from reference line. Magnitude, phase, or group delay of marker may be monitored at digital display **1** .

22 **DISPLAY ZRO (zero) Pushbutton.** When DISPLAY REF pushbutton **25** is pressed, selecting reference mode, pressing DISPLAY ZRO pushbutton zeros digital display without affecting offset of CRT trace. After zeroing digital display, additional offset may be selected with REF OFFSet Pushbuttons **28** . If DISPLAY ZRO **22** is again pressed, digital display goes to zero and CRT trace stays in same offset position. This is because each time DISPLAY ZRO pushbutton is pressed, display register value is added to stored calibration offset register. The stored calibration register holds the sum of all offsets from display register until DISPLAY CLR pushbutton **24** is pressed. If both Channel 1 and 2 are set on same INPUT and MODE position, both channels share same stored calibration register. Therefore, if DISPLAY ZRO is pressed on one channel, the other channel CRT trace will shift by the amount added to common stored calibration register.

When DISPLAY MKR pushbutton **21** is pressed, selecting marker mode, pressing DISPLAY ZRO pushbutton zeros digital display by moving entire CRT trace until marker is on zero reference line.

23 **INPUT Switch.** Selects input signal to be displayed on Channel 1. R, A, and B positions display only the magnitude function of R, A, and B signals. A/R position displays ratio of "A" signal to "R" signal. B/R position displays ratio of "B" signal to "R" signal. Each INPUT position in combination with each MODE switch **27** position has a register for the stored calibration offset.

24 **DISPLAY CLR (clear) Pushbutton.** Pressing this pushbutton clears channel 1 display reference offset and turns off REL light **6** if lit. If held down more than three seconds, it clears stored calibration register for function set by the combination of INPUT switch **23** position and MODE switch **27** position. If held down, DISPLAY CLR pushbutton returns CRT trace back to absolute calibration by eliminating all offset for set function. Stored calibration registers are assigned to every combination of settings of INPUT switch **23** A/R and B/R positions and all positions of MODE switch **27** . Also, with MODE switch **27** in MAG position, individual registers store settings of R, A, and B.

25 **DISPLAY REF (reference) Pushbutton.** Selects reference mode of operation for Channel 1.

26 **SCALE/DIV Switch.** Sets the sensitivity for the CRT display. Scale used depends on position of MODE switch **27** . In MAG (magnitude) mode, display sensitivity is selective from 20 dB per division to 0.1 dB per division with SCALE/DIV switch. In PHASE mode, display sensitivity is selective from 180 degrees per division to 1 degree per division. In group delay (DLY) mode, display

Fig. A3-4
Sht 4 of 4

sensitivity depends on setting of sweep RANGE switch on Frequency Control Assembly. When RANGE switch is set to 0.5 – 1300 MHz range, DELAY scale sensitivity values under SCALE/DIV switch 26 are read exactly as shown: from 200 ns per division to 1 ns per division. When RANGE switch is set to 0.5 – 130 MHz, DELAY scale sensitivity values must be multiplied by 10, reading, therefore, from 2000 ns per division to 10 ns per division. When RANGE switch is set to 0.5–13 MHz, DELAY scale must be multiplied by 100, reading, therefore, from 20,000 ns (20 μs) per division to 100 ns (0.1 μs) per division. Below DELAY scale is POLAR FULL scale for setting magnitude of polar display, with positions from 1.0 to 0.01. Note that blue color code matches POLAR positions of MODE switch 27.

27 **MODE Switch.** Selects parameter to be displayed on CRT trace and digital display. In OFF position, channel 1 trace on CRT is removed and channel 1 digital display turns off. In MAG (magnitude) position, CRT trace displays magnitude of input signal selected at INPUT switch 23. Digital display shows magnitude of offset if DISPLAY REF pushbutton 25 is pressed, or magnitude of marker if DISPLAY MKR pushbutton 21 is pressed. Likewise, PHASE, DLY (delay), POLAR MAG (magnitude), and POLAR PHASE positions produce CRT trace of signal and digital display of either offset from reference or of marker position from reference.

28 **REF OFFSET Pushbuttons.** These pushbuttons offset the reference line value for that channel; the offset is displayed on the digital readout 1 above the pushbuttons.

Each pushbutton controls the digit above it in the digital display. For example, the two up/down pushbuttons on the right control the least significant digit on the right end of displayed number.

The amount of offset entered with REF OFFSET pushbuttons depends on the position of SCALE/DIV switch 26 and value stored in reference-offset register. For instance, in 20, 10, 5, or 2 dB position of SCALE/DIV switch 26, the six REF OFFSET pushbuttons increment 10 dB, 1 dB, or 0.1 dB (left to right) each time one of them is pressed. When SCALE/DIV switch 26 is set to 1, .5, .2, or .1 dB position and displayed offset is less than 8.0. dB, the six REF OFFSET pushbuttons increment 1 dB, 0.1 dB or 0.01 dB each time one of them is pressed. If offset is greater than 9.99 dB, the pushbuttons retain the same incremental sensitivity they had in the 20, 10, 5, and 2 dB/divisions positions.

Figure A3-4. Signal Processor Assembly A3 Controls and Indicators.

Table A3-1. HP-IB Commands (1 of 2)

Message Name	Function	Sample Statement Forms	
		9825A	9830A/B
Commands to Signal Processor			
Data	Write data to 8505A Read data from 8505A	wrt 716 red 716	CMD "?UØ", "<data>" CMD "?P5", <variable>
Remote	Set HP-IB to Remote; (required only after lcl 7)	rem 7	10 CMD "?UØ" 20 FORMAT B 30 OUTPUT (13, 20) 768;
	Set 8505A to Remote; (required only after lcl 716)	wrt 716	CMD "?UØ", "<data>"
Local	Set HP-IB to Local	lcl 7	10 CMD "?UØ" 20 FORMAT B 30 OUTPUT (13, 20) 1024;
	Set 8505A to Local	lcl 716	10 CMD "?UØ" 20 FORMAT 3B 30 OUTPUT (13, 20) 256. 1, 512;
Local Lockout	Disable Local Pushbutton	llo 7	10 CMD "?UØ" 20 FORMAT 3B 30 OUTPUT (13, 20) 256, 17, 512;
Clear Local Lockout/Set Local	Clear Local Lockout, set 8505A to Local, enable Remote	lcl 7, rem 7	10 CMD "?UØ" 20 FORMAT 2B 30 OUTPUT (13,20) 1024, 768;
Abort	Clear interface, clear binary input mode, clear text mode	cli 7	Not available
Commands to Frequency Control			
Data	Write data to 8505A Read data from 8505A	wrt 719 red 719	CMD "?U3", "<data>" CMD "?S5", <variable>
Remote	Set HP-IB to Remote; (required only after lcl 7)	rem 7	10 CMD "?U3" 20 FORMAT B 30 OUTPUT (13, 20) 768;
	Set 8505A to Remote; (required only after lcl 719)	wrt 719	CMD "?U3", "<data>"
Local	Set HP-IB to Local	lcl 7	10 CMD "?U3" 20 FORMAT B 30 OUTPUT (13, 20) 1024;
	Set 8505A to Local	lcl 719	10 CMD "?U3" 20 FORMAT 3B 30 OUTPUT (13,20) 256, 1, 512;
Local Lockout	Disable Local Pushbutton	llo 7	10 CMD "?U3" 20 FORMAT 3B 30 OUTPUT (13,20) 256, 17, 512;

Table A3-1. HP-IB Commands (2 of 2)

Message Name	Function	Sample Statement Forms	
		9825A	**9830A/B**
Commands to Frequency Control			
Clear Local Lockout/Set Local	Clear Local Lockout, set 8505A to Local, enable Remote	lcl 7, rem 7	10 CMD "?U3" 20 FORMAT 2B 30 OUTPUT (13,20) 1024, 768;
Abort	Clear interface, clear binary input mode, clear text mode.	cli 7	Not available

Table A3-2. Summary of Programming Codes for Source/Converter and Frequency Control (1 of 2)

ASCII Code and Sequence	Functions and Comments
	OUTPUT LEVEL dBm
O	RF Output, Coarse control in 10 dB steps
O1	−60 dBm
O2	−50 dBm
O3	−40 dBm
O4	−30 dBm
O5	−20 dBm
O6	−10 dBm
O7	0 dBm
O8	+10 dBm
	OUTPUT LEVEL dBm VERNIER
V	RF Output, Vernier control. LLO must be set (true) to program. Non-learned programming code. The code is V_{XX}, where attenuation $= \frac{xx}{99} \times 12$ dB.
	Examples:
VØ	−12 dB
V22	−10 dB (approx. value in Remote).
V25	−9 dB
V50	−6 dB
V75	−3 dB
V99	0 dB
	INPUT LEVEL dBm MAX
I	Maximum input level before overload.
I1	−10 dBm max.
I2	−30 dBm max.

ASCII Code and Sequence	Functions and Comments
	RANGE MHz
R	Frequency Range
R1	.5 – 13 MHz
R2	.5 – 130 MHz
R3	.5 – 1300 MHz
	MODE
M	Sweep Mode
M1	LOG FULL, sweeps full band
M2	LIN FULL, sweeps full band
M3	LIN EXPAND, WIDTH switch selects which Start/Stop sweep ranges or CW.
	WIDTH
W	Frequency displayed is between START and STOP Markers. Program M3 prior to a "W" code.
W1	START/STOP 1
W2	START/STOP 2
W3	START/STOP ALTernately 1 and 2*
W4	CW ±ΔF
W5	CW
	*Not normally used in remote.
	SCAN TIME SEC
S	SCAN TIME VERNIER defaults to maximum (CW) when LLO is set.
S1	MANUAL
S2	100 10 seconds
S3	10 – 1 seconds
S4	1 – .1 seconds
S5	.1 – .01 seconds

Table A3-2. Summary of Programming Codes for Source/Converter and Frequency Control (2 of 2)

ASCII Code and Sequence	Functions and Comments
	TRIGGER
T	SINGLE not programmable. Position is used to select LOCAL.
T1	AUTO
T2	LINE
T3	EXTernal
	START-STOP FREQUENCY
FA	START or CW FREQUENCY MHz
FB	STOP or ΔF FREQUENCY MHz
	NOTE FREQUENCY VERNIER controls default to minimum (CCW) when LLO is set. RANGE MHz codes determine placement of decimal point.

ASCII Code and Sequence	Functions and Comments
	FREQ COUNTER MHz (0 = START, 99 = STOP)
FC	Non-learned programming code.
	Only one marker available in REMOTE.
	0 - 99 = Percentage of Sweep Width.
	PROGRAMMING EXAMPLE
FC10	With Start (FA) = 800 MHz and Stop (FB) = 1000 MHz, therefore, Sweep Width = FB-FA = 200 MHz
	200 X 10% = 20 MHz, so the marker position is at 820 MHz.
	TERMINATOR (EXECUTE)
E	Followed by CR, LF

Table A3-3. Summary of Programming Codes for Signal Processor and Display (1 of 2)

ASCII Code and Sequence	Functions and Comments
	BW VIDEO FILTER (Display bandwidth)
CØB	Selects bandwidth and video filter IN or OUT.
CØB1	BW = 10 kHz, Video Filter OUT
CØB2	BW = 1 kHz, Video Filter OUT
CØB3	BW = 10 kHz, Video Filter IN
CØB4	BW = 1 kHz, Video Filter IN
	SET CHANNEL, INPUT, AND MODE
C1	Channel 1 (left channel)
C2	Channel 2 (right channel)
	The channel code above must precede the INPUT and MODE codes. The following codes show channel 1 selected, however, they also apply to channel 2 by changing C1 to C2.
	INPUT
I	Selects input port being processed
C1I1	R Input
C1I2	A Input
C1I3	B Input
C1I4	A/R Inputs Ratioed
C1I5	B/R Inputs Ratioed

ASCII Code and Sequence	Functions and Comments
	MODE
M	Selects parameter being processed.
C1M1	OFF
C1M2	MAGnitude
C1M3	PHASE
C1M4	DLY (Delay)
C1M5	POLAR MAGnitude
C1M6	POLAR PHASE
	SCALE/DIV (Selects sensitivity or resolution for CRT display in units/division)
S	Values for positions S1 through S8 depend on MODE selected. For group delay, Frequency RANGE is also a determining factor.
	DISPLAY REF
C1D1	Display indicates value of REFerence line.
	DISPLAY MKR
C1D2	Display indicates parameter value at Marker frequency.

Table A3-3. Summary of Programming Codes for Signal Processor and Display (2 of 2)

ASCII Code and Sequence	Functions and Comments
	ABS CLR
C1D3	ABSolute Clear; sets reference line to zero.
	REF OFFSET (Up/down pushbuttons offset reference line)
R±19999	Decimal position automatically inserted and depends on MODE and SCALE/DIV. Displayed resolution increases at S = >5. Up/Down pushbuttons are not programmable but their position (valid value) at time of local-to-remote transition is loaded directly.
	PROGRAMMING EXAMPLES
C1R45Ø	45° in M3 Mode
C1R2ØØØ	20 dB in M2 Mode
	CALIBRATION (ZERO) REGISTER
O ±1999	Not displayed on front panel. Value goes to reference offset register with REL ZRO pressed. Value equals zero with ABSolute CLR pressed.
	ELECTRICAL LENGTH
C3	Amount of electrical length added is determined by position of RANGE MHz on Frequency Control panel. (When cm and m lights, electrical lengths displayed in centimeters and meters respectively.)
	INPUT
I	Selects input port being processed
C3I 1	A Input Connector
C3I 2	B Input Connector
	MODE
M	Maximum value depends on frequency range.
C3M1	OFF
C3M2	LENGTH x; minimum calibrated (length) range.
C3M3	LENGTH X; maximum calibrated (length) range.
C3M4	PHASE x 10°/SCAN; uncalibrated x 10°/SCAN.
	DISPLAY
D	Non-learned programming code.

ASCII Code and Sequence	Functions and Comments
	ABS CLR
C3D1	ABSolute Clear; sets reference line to zero.
	LENGTH Offset
C3R ±nnn	Position of decimal point and lamps m or cm ON is determined by RANGE MHz switch and MODE LENGTH switch. Up/Down pushbuttons are not programmable but position (valid value) at time of local-to-remote transition, is loaded directly. EXAMPLES of RANGE, MODE, and lamps lit: **RANGE MHz** — **C3M2** — **C3M3** R1 — XX.X m — XXX.m R2 — XXX. cm — XX.X m R3 — XX.X cm — XXX. cm
	VERNIER A AND B
	Vernier controls for LENGTH Offset switches. (Length offset adjusted by VERNIER controls is not stored in length-offset register.) VERNIER A and B default to zero (CCW) when LLO is set.
	CALIBRATION REGISTER
C3O ±199	Not displayed on front panel. Similar to "R" except value goes to offset calibrate register instead of length offset register.
	TERMINATOR (EXECUTE
E	Terminator is needed after each R, D, and O. EXAMPLES: Incorrect: "C1D1R45ØO9ØE" Correct:. "C1D1EC1R45ØEC1O9ØE"

Programming

8505 Programming Codes

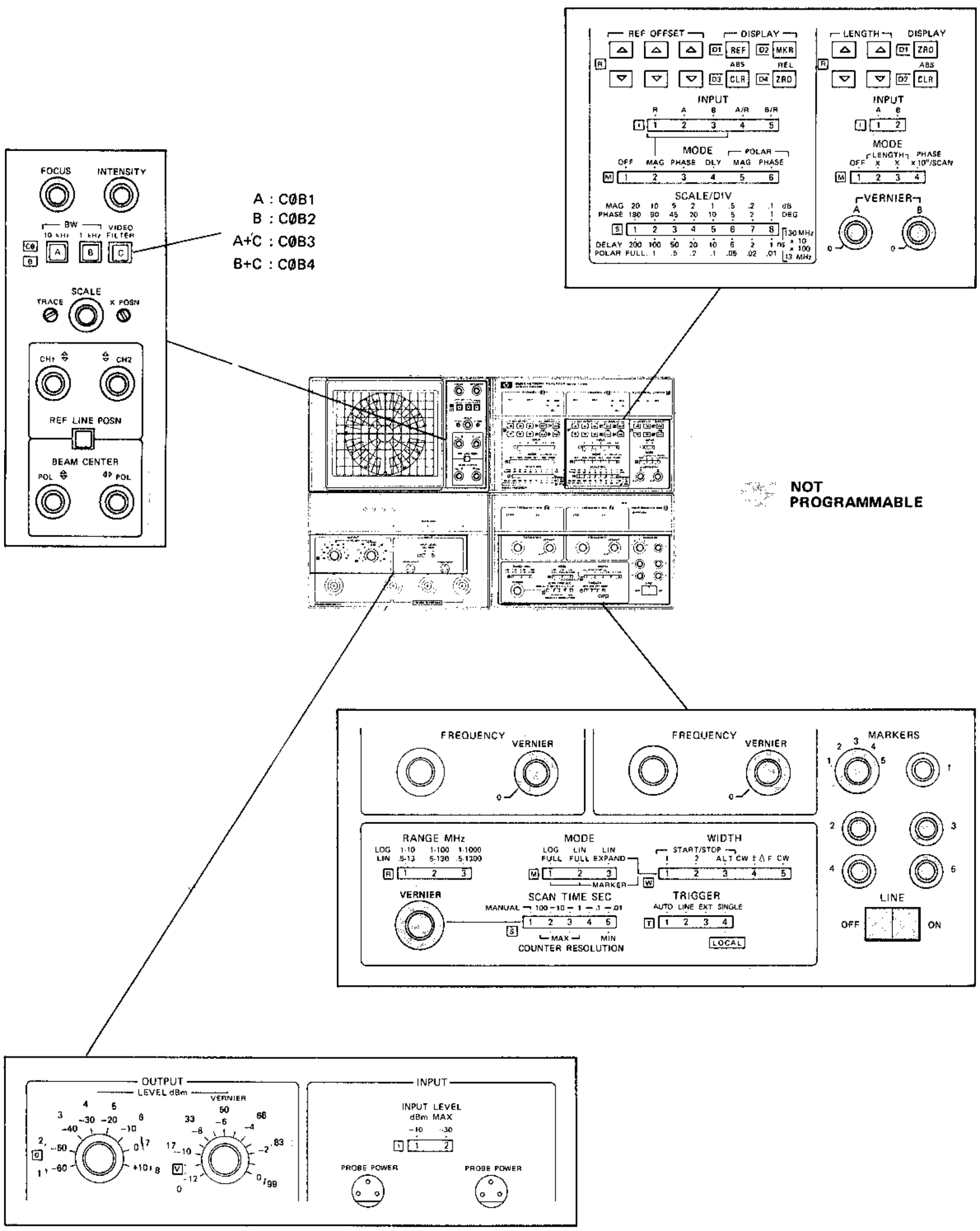


Figure A3-5. 8505A Programming Codes

Table A3-4. 8505A Timing Requirements

Operation	Timing Delay Required
SIGNAL PROCESSOR	
Front Panel Programming Overhead	
Per digit or character	0.2 ms*
Per "E"	60 ms*
Settling	
Smoothing	
10 kHz	10 ms
1 kHz	25 ms
Video Filter	300 ms
Channel 1, Channel 2	
Any change affecting Reference Level (includes REF OFFSET, CLR, INPUT, MODE, and 8503A Test Set switching.)	3000 ms (to 0.01%) 1000 ms (to 1%)
ZRO (MKR mode) ZRO (REF mode), CLR, INPUT, MODE, and SCALE/DIV	At least 3 sweep times per channel + 3,000 ms
Electrical Length	
Any change affecting LENGTH (includes LENGTH, CLR, Channel 1 and 2 MODE, INPUT, and 8503A Test Set switching).	3000 ms
ZRO, CLR, INPUT, and MODE	20 ms
Read Marker value and determine if autoranging occurs (resolution changes):	
Resolution constant:	1 sweep/Channel +25 ms
Autoranging	2 sweeps/Channel +100 ms
SOURCE/CONVERTER	
Front Panel Programming Overhead	
Per digit or character	0.2 ms*
Per "E"	6 ms
Settling	
OUTPUT, INPUT LEVEL dBm MAX	20 ms
SCAN TIME SEC, TRIGGER	20 ms
RANGE, MODE, WIDTH, FREQUENCY	
START/STOP, ±ΔF	120 ms
CW (to 0.01%)	1000 ms (first freq.) 360 ms (next freqs.)

*Indicates hardwired holdoff. All other timing requirements must be handled using programmed delays.

A3-14. PROGRAMMING THE 8505A

A3-15. HP-IB Addresses

A3-16. The instrument "address" distinguishes one instrument from another in parallel with it on the HP-IB (similar to the phone number in a telephone system). An HP-IB device may have either a *TALK* address, a *LISTEN* address or both. Using the appropriate address code, all instruments in the system can be either talkers or listeners. The 8505A Network Analyzer uses two sets of codes; one for the Frequency Control, bottom half (see Figure A3-6) and one for the Signal Processor/Display, top half (see Figure A3-7). The Frequency Control listens when switches or registers are being programmed; the talk output consists of frequency counter readings and the learn mode string. Likewise, the Signal Processor listens while being programmed and talks with marker parameter readings or learn mode strings.

A3-17. The 8503A Test Set is a listener while being switched and talks with a "learn mode" value for the state of its switch. Instruments shipped from the factory as an HP 8507A/B system have the factory preset addresses listed in Table A3-5.

Table A3-5. Address Table (Preset Addresses)

Instrument	Talk	Listen	5-Bit Decimal Value
8505A Source/Converter	S	3	19
8505A Processor/Display	P	Ø	16
8503A Test Set	T	4	20
9825A or 9830A/B Desk-top Computer	U	5	21

These addresses may be modified by removing instrument covers and manipulating appropriate slide switches or jumpers on various circuit cards. For detailed instructions, see the applicable Operating and Service Manual. To change the addresses in the 8505A, see Paragraph A2-16.

A3-18. Programming Code Conventions

A3-19. 8505A functions are programmed using a two-character format:

a. The first letter of the control or switch name (for example, "R" for Range).

b. Plus a number indicating the position of the control beginning with 1 at the left or full CCW position. Thus the 130 MHz RANGE (the second position from the left) is programmed "R2".

Since the Signal Processor has duplicate controls for each display channel, a prefix code is used to indicate what channel is being programmed, as follows:

a. "C1" is used for CHANNEL 1.

b. "C2" is used for CHANNEL 2.

c. "C3" is used for ELECTRICAL LENGTH controls.

d. "CØ" is used for the bandwidth programming on the display.

The letter "E" is used to indicate the end of programming information and must be used when controls are programmed. Any controls not programmed will assume their "front panel" state (as manually positioned). Programming code notations on the front panel of the 8505A are shown in Figure A3-5. A summary of

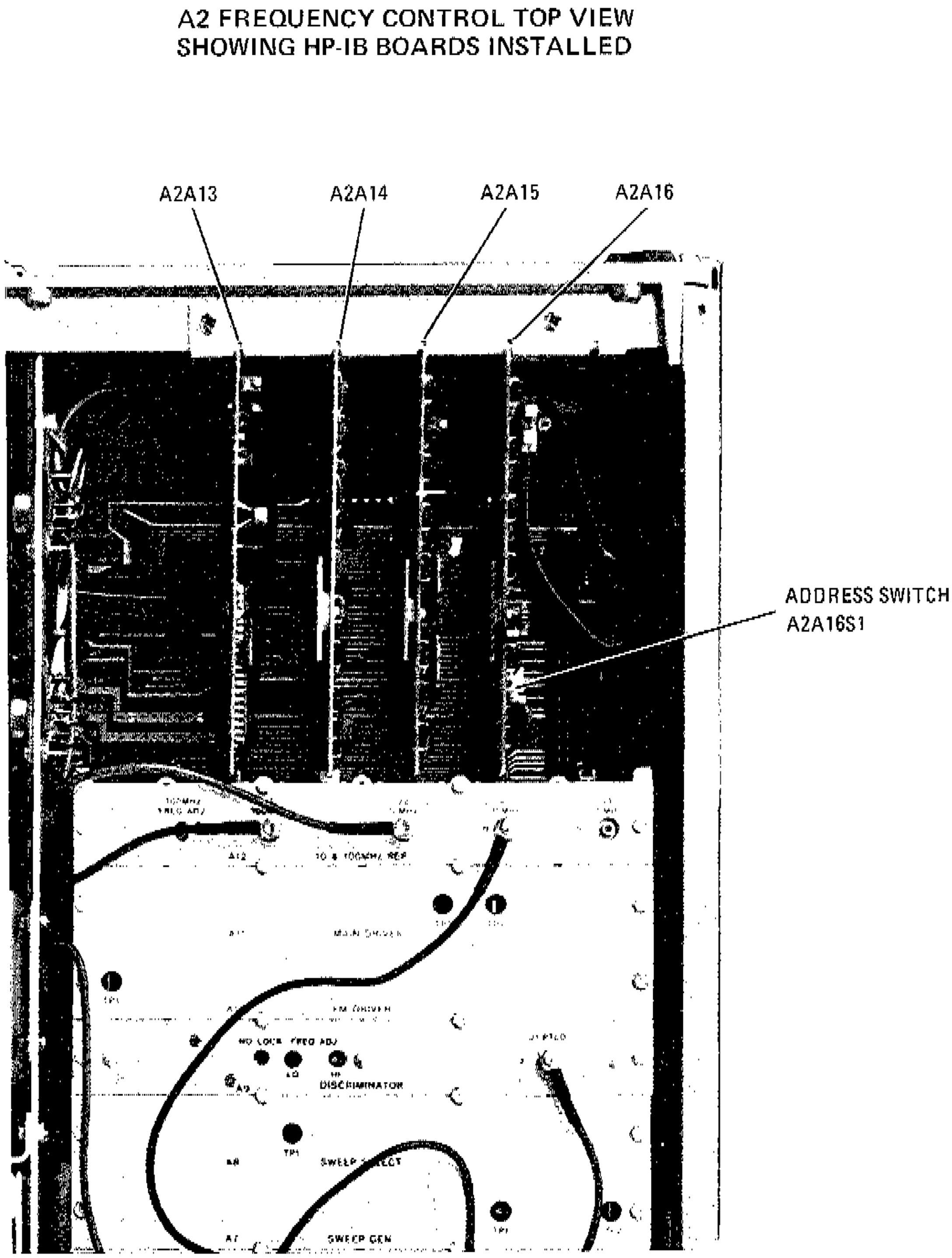


Figure A3-6. Frequency Control HP-IB Assemblies

A3 SIGNAL PROCESSOR TOP VIEW
SHOWING HP-IB BOARDS INSTALLED

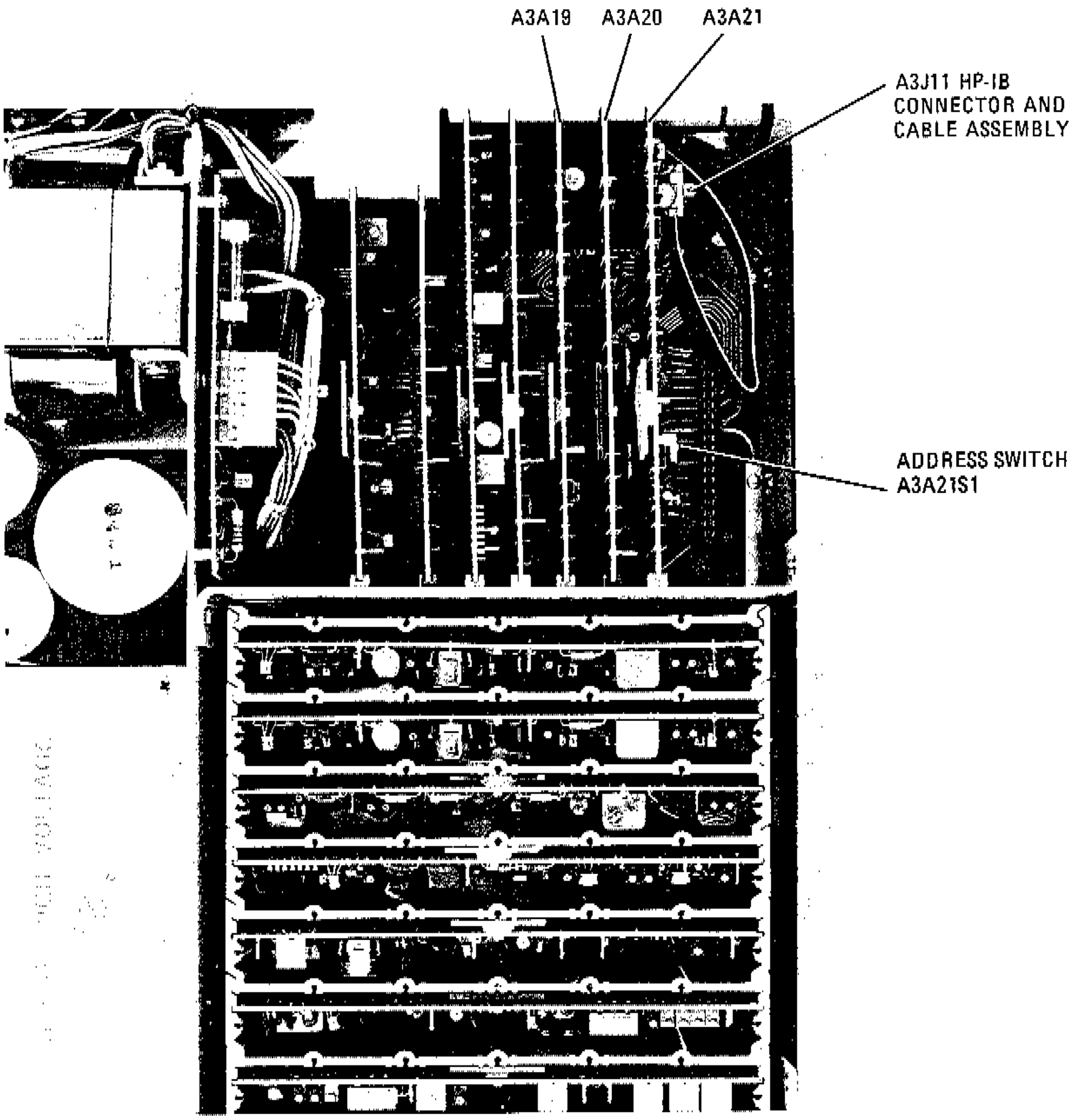


Figure A3-7. Signal Processor HP-IB Assemblies

Codes for the Source/Converter and Frequency Control are given in Table A3-2. Codes for the Signal Processor and Display are given in Table A3-3.

Examples:

a. Code for source SCAN TIME in 1 — 10 sec position.

```
        S3E ← End of data
SCAN TIME    3rd switch position
```

b. Code for Signal Processor CHANNEL 1 INPUT to B/R and MODE to PHASE:

```
C1I5M3E
```

c. Calculator sets source OUTPUT attenuator to 0 dBm position:

9825A

```
cmd 7, "U?3", "Ø7E"
```

HP-IB SELECT CODE — Calculator talks — Unlisten command — Source to listen

9830A/B

```
CMD "U?3", "07E"
```

Calculator talks — Unlisten command — Source to listen

d. Calculator tells Processor: CHANNEL 1: MODE to DLY (delay) and CHANNEL 2: INPUT to A/R, MODE to PHASE:

9825A

```
1Ø: cmd 7, "U?Ø", "C1M4C2I4M3E"
```

or

```
1Ø: wrt 716, "C1M4C2I4M3E"
```

9830A/B

```
1Ø CMD "U?Ø", "C1M4C2I4M3E"
```

A3-20. Using Variable Values as Program Codes

A3-21. It is often necessary to program an instrument using a code that takes the value of a variable stored in the calculator. Applications of this are : (a) cycle through all attenuator steps, and (b) branch if a switch is in a specific position.

The *fmt* and *wrt* statements can be used to output the variable value. The *wrt* also performs the addressing function, eliminating the need to *cmd 7*.

Example: to cycle through all MODE settings, using CHANNEL 1 of the Processor:

9825A

```
Ø: for I = 1 to 6
1: fmt 1, "C1M", f, Ø, "E", Z
2: wrt 716.1, I
3: wait 1ØØØ
4: next I
```

9830A/B

```
1Ø FOR I = 1 TO 6
2Ø CMD "U?Ø"
3Ø FORMAT "C1M", F1ØØØ.Ø, "E"
4Ø OUTPUT (13, 30) I
5Ø WAIT 1ØØØ
6Ø NEXT I
```

In the above example, f.0 (9825A) or F1000.0 (9830A/B) is a special format code used to suppress leading blanks. The Z suppresses the carriage return and line feed that can cause the Processor to fail to update the new codes. Details are contained in the Extended I/O ROM Programming Manual.

A3-22. Local/Remote

A3-23. Each of the 8505A instruments goes to REMOTE when addressed. To return to local (front panel operation) either:

a. Slide the TRIGGER switch first to its extreme right position and then to the trigger mode desired in local operation. Both source and Processor are switched to local.

OR

b. Program a GO TO LOCAL:

9825A	9830A/B
Ø: lcl 7	1Ø CMD "U?Ø3" — Listen addresses for all instruments desired. 2Ø FORMAT 3B 3Ø OUTPUT (13, 2Ø) 256, 1, 512;

All front panel controls except the verniers are disabled in REMOTE.

A3-24. Local Lockout

A3-25. To disable the verniers as well as the front panel GO TO LOCAL (TRIGGER switch), program LOCAL LOCKOUT:

9825A	9830A/B
Ø: llo 7	1Ø CMD "U?" 2Ø FORMAT 3B 3Ø OUTPUT (13, 2Ø) 256, 17, 512;

To restore manual vernier control in REMOTE after LOCAL LOCKOUT has been commanded:

9825A	9830A/B
Ø: lcl 7; rem 7	1Ø CMD "U?" 2Ø FORMAT 2B 3Ø OUTPUT (13, 2Ø) 1024, 768;

This commands the bus to LOCAL, then enables REMOTE (toggling the REN line which clears local LOCKOUT). Upon the next addressing sequence, the addressed instrument switches to REMOTE (with manual vernier control).

A3-26. Programming Frequency

A3-27. There are three recommended ways to program the frequency at which parameter measurements are made. Basically the CW $\pm\Delta F$ ($\Delta F = 0$) mode is the most generally useful. The MARKER/SWEPT mode is the fastest while the CW mode has the greatest resolution and potential accuracy. The following section has more details.

NOTE

To prevent errors in the Start/Stop Frequencies displayed, the WIDTH switch must be programmed in the Data String prior to the START and STOP FREQUENCY MHz registers.

NOTE

Changing the frequency of "FA" or "FB" when in "W3" (ALT sweep) or entering a frequency > 1300 MHz will cause errors in the frequency readout.

A3-28. In general, when programming the frequency registers, the decimal point is *not* accepted. Its position is assumed and changes with the frequency range switch setting:

Range 1 (.5 — 13 MHz) —	XX.XX MHz
Range 2 (.5 — 130 MHz) —	XXX.X MHz
Range 3 (.5 — 1300 MHz) —	XXXX MHz

For example, FA1ØØØ programs 10 MHz on Range 1 while FAØØ1Ø programs 10 MHz on Range 3. This shift in decimal points, the determination of the frequency range switch setting, R, and scale factor, T (9825A) or FØ (9830A/B), are easily determined for any frequency, F (in MHz):

9825A

```
Ø:  1 + (F > 13) + (F > 13Ø) → R
1:  tn↑ (3-R) → T
2:  TF → F
```

9830A/B

```
1Ø  R=1 + (F > 13) + (F > 13Ø)
2Ø  FØ = 1Ø↑ (3-R)
3Ø  F = F * FØ
```

A3-29. Fast CW Mode. For most automatic applications, the CW ±ΔF mode with ΔF set to zero is recommended. In this mode (and all swept modes) the capacitive filter used in CW is bypassed so that the wait to settle to 0.1% of frequency step is 130 ms. This is effectively a fast CW mode with four digit resolution.

Example: To set 1113 MHz in "fast CW":

9825A

```
Ø:  cmd 7, "U?3", "R3M3W4FBØE"
1:  1113→F
2:  fmt 1, "FA", f.Ø, "E"
3:  wrt 719.1, F
4:  wait 13Ø
```

9830A/B

```
1Ø  CMD "U?3", "R3M3W4FBØE"
2Ø  F=1113
3Ø  CMD "U?3"
4Ø  OUTPUT (13, 5Ø) F
5Ø  FORMAT "FA", F1ØØØ.Ø,"E"
6Ø  WAIT 2ØØ
```

Typically a program would be structured so that line Ø (9825A) or 1Ø (9830A/B) was executed only once. To program 10.14 MHz the code would be "R1M3. . ." and F would be 1014.

A3-30. CW Mode. This mode is programmed by cmd 7 "U?3", "M3W5E" (9825A) or CMD "U?3", "M3W5E" (9830A/B). The actual frequency is programmed by "FAXXXXE" where XXXX is the coarse frequency.

A3-31. To achieve greater resolution in CW you may use "FAXXXZFBYYYYE". FBYYYY is essentially a vernier in CW where 1000 counts in FB equal 2 counts in the Z position of FA. The following examples show how various frequencies would be programmed using the FAXXXZBYYYY format:

12.36 286 MHz	110.5 732 MHz	1126. 382 MHz
FA = 1236, FB = 143	FA = 1105, FB = 366	FA = 1126, FB = 191

9825A

```
3:  llo 7; cmd 7, "U?3", "M3W5E"
4:  fmt 1, "R", f.Ø, "FA", f.Ø, "FB", f.Ø, "E"
5:  wrt 719.1, R, int (F), 5ØØ (F--int (F))
6:  wait 15ØØ
```

9830A/B

```
4Ø  CMD "U?3", "M3W5E"
5Ø  OUTPUT (13, 6Ø) R, INT (F), (F—INT (F)) * 5ØØ
6Ø  FORMAT "R", F1ØØØ.Ø, "FA", F1ØØØ.Ø , "FB",F1ØØØ.Ø, "E"
7Ø  WAIT 15ØØ
```

A3-32. While this mode provides highest resolution, the absolute accuracy of the digital-to-analog converters (1%) are not compatible with this resolution. However, the DAC's offset and linearity errors can be removed by using the frequency counter to feedback corrections. (See Paragraph A3-43.) To provide best residual FM in this mode, capacitive filtering is employed. This filter requires a wait after setting frequency of 1500 ms to settle to 0.1% of frequency stepped.

A3-33. Marker Swept Modes. Displaying the full sweep while taking data at a single frequency is a new technique in automatic testing. It allows you to actually "see" the data being taken. It is accomplished by first programming the instrument to either START/STOP 1, START/STOP 2, or CW ±ΔF and then programming the frequency marker. Any swept mode is programmed by entering the frequency limits into the FA and FB registers. For example, in START/STOP 1 or 2:

START/STOP 1 or 2: FA = start frequency
FB = stop frequency

Example: to sweep between 50 and 100 MHz on START/STOP 2 in RANGE 2:

9825A

```
cmd 7, "U?3","R2M3W2FA5ØØFB1ØØØE"
```

9830A/B

```
CMD "U?3", "R2M3W2FA5ØØFB1ØØØE"
```

CW ±ΔF: FA = center frequency
FB = ±ΔF * 10

Example: To sweep 10 ± 0.5 MHz (9.5 to 10.5 MHz) in RANGE 1:

9825A

```
cmd 7, "U?3", "R1M3W4FA1ØØØFB5ØØE"
```

9830A/B

```
CMD "U?3", "R1M3W4FA1ØØØFB5ØØE"
```

Once a sweep has been programmed, the *frequency marker* is positioned on the display using FCXX. XX corresponds to screen position in % of screen from left to right with 1% to 99% in 1% steps equal to the range of allowable positions.

Example: To set up a 100 — 300 MHz display with the marker at 180 MHz:

9825A

```
Ø: cmd 7, "U?3", "R3M3W1FA1ØØFB3ØØE"
1: (18Ø — 1ØØ) 1ØØ/(3ØØ — 1ØØ) →F
2: fmt 1, "FC", f.Ø, "E"
3: wrt 719.1, F
```

9830A/B

```
1Ø CMD "U?3", "R3M3W1FA1ØØFB3ØØ"
2Ø F = (18Ø − 1ØØ) * 1ØØ/(3ØØ — 1ØØ)
3Ø OUTPUT (13, 4Ø) F
4Ø FORMAT "FC", F1ØØØ.Ø, "E"
```

To set up a 50 MHz center frequency with a 5 MHz total window and the marker at 49 MHz, the line 0 code would be "R2M3W4FA500FB25E" and F would be (49 — 47.5) * 100/5, or 30.

A3-34. Different applications may well require any of the three frequency setting techniques. For example, in production testing, it is often fastest to set up in a swept/marker mode. Adjustments are made, then representative data is taken using the marker at 5% or 10% steps. The operator can quickly visually check for glitches eliminating the need for testing at 100 — 500 individual points. On the other hand, to take the highest accuracy data it might be necessary to use CW with counter feedback. This is particularly true when the device characteristics change rapidly with frequency or when vector errors are being stored for complex setups. The accuracy of the error correction depends on the ability to return to the same frequency during each of the calibration and measurement cycles. Characteristics of the various methods of setting frequency are listed in Table A3-6.

Table A3-6. Characteristics of Frequency Setting Modes

		CW	Fast CW	Marker/Swept
Resolution:	13 MHz	.02 kHz	.01 MHz	1 — 99% of Sweep Span in 1% Steps
	130 MHz	0.2 kHz	0.1 MHz	
	1300 MHz	2 kHz	1 MHz	
*Wait time**		1500 MS	130 MS	130 MS
Accuracy		**	1% of Range	1% of Range

*Time to settle to 0.1% of frequency stepped.

**Can be corrected to counter accuracy ($1/10^5$).

A3-35. Reading the Frequency Counter

A3-36. The counter reading is output by simply telling the source to talk.

Example: Read counter and place value in variable F.

9825A	9830A/B
Ø : red 719, F	1Ø CMD "S?5" 2Ø ENTER (13, *)F1

The frequency reading is in Hz with the decimal point positioned correctly.

On the 9825A, *red* like *wrt* also performs the addressing function, eliminating the need to *cmd 7.*

The counter output depends on the mode selected:

a. **In CW:** Reading is actual frequency with maximum resolution.

b. **In Swept Modes:** Frequency at the FREQ COUNTER MARKER (FC) with output resolution dependent on sweep speed (highest resolution at "S3").

The counter output of zero may occur under the following conditions:

a. When the FREQ COUNTER MARKER is positioned too near the end of the sweep (typically ⩾97) on the fastest scan time.

b. When the counter and I/O are not properly synchronized. This will be avoided if each counter request is preceded by an "E".

A3-37. The counter has a built-in delay after the "E" is passed to the source to compensate for scantime settings. It will delay until a sweep is completed before outputting a frequency. Therefore, it is not necessary to wait between setting the marker and reading the counter. However, there is *no* built-in delay for oscillator *settling time.* WAIT's in accordance with Table A3-6 should be programmed.

A3-38. Reading Magnitude, Phase, and Delay

A3-39. The Processor can output the marker values for each display channel. These are the same parameter values that appear in the LED display when MKR is pushed. Both channels output after the Processor is addressed to talk.

9825A

```
Ø: red 716, D, A
```

9830A/B

```
10 CMD "P?5"
20 ENTER (13, *) C1, C2
```

Channel 1 and 2 marker values are automatically measured on alternate sweeps when both channels are ON. No delays are built-in so WAIT's for two sweeps should be programmed prior to requesting Processor readings with two channels turned on. W = 3 * 10 ↑ (7 — S) where W = wait in ms and S = setting of SCAN-TIME switch This allows the scan vernier to be set anywhere. (If vernier is set at MAXIMUM, sweep can be faster.) If a request is made prior to completion of a sweep, the last valid processor reading will be output. This will also be the case when a channel or channels are switched off.

A3-40. With slow sweep speeds, it will be to your advantage to program a frequency counter operation in the marker mode. This will allow faster repetitive readings. This mode can provide an adaptive holdoff until the sweep reaches the marker settings. Then the sweep may be retriggered with an "E" and the counter process used again to update the second processor channel prior to outputting both processor marker values. This avoids a fixed wait for two full slow sweeps at each marker position (particularly wasteful when the marker is positioned at the beginning of the sweep).

A3-41. As in manual operation, the *resolution* of the data output can vary with the SCALE/DIV setting. If readings meet the conditions in List A below, the outputs will be at maximum resolution with an automatic factor of ten reduction in resolution, independent of the SCALE/DIV switch setting, if the limits are exceeded. The Processor can be forced to produce valid maximum resolution readings when the conditions of List B are met by programming SCALE/DIV to position 5 (S5) and switching to the REF mode. If S5 is set and the conditions of List B are exceeded, invalid readings equal to List B values will result.

MODE	LIST A	LIST B
MAG	<± 8.0 dB	<± 19.99 dB
PHASE	<± 80.0 DEG	<± 199.9 DEG
DELAY (13 MHz)	<± 8.0 μs	<± 19.99 μs
DELAY (130 MHz)	<± 0.8 μs	<± 1.999 μs
DELAY (1300 MHz)	<± 80.0 ns	<± 199.9 ns

NOTE

The MKR mode when autoranging can require up to a 3-second wait for settling time.

NOTE

When programming the Signal Processor with a *wrt* statement, the terminating carriage return-line feed may suppress data updating. To eliminate this problem, use *cmd* instead of *wrt*, or use format "z" with *wrt*.

NOTE

To guarantee 0.1° phase resolution independent of angle, it is necssary to switch to REF mode with reference of 0 degrees: cmd7, "U?Ø", "C2M3RØEC2D1E" (9825A) or CMD "U?Ø", "C2M3RØEC2D1E" (9830A/B).

A3-42. Example Measurement Programs

A3-43. Marker Swept Mode Example. In the following example, it is assumed that Channels 1 and 2 of the Signal Processor have been programmed to the appropriate mode and input settings, and that the source has been programmed to the desired S/S1, S/S2, or CW ±ΔF settings with the SCAN TIME set to the 10 ms (fastest) position.

Example: Read Frequency, CHAN 1 Marker, and CHAN 2 Marker at 19 points across the CRT display and print out the results.

9825A

```
0: for J=1 to 96 by 5
1: fmt 1, "FC", f.0, "E"
2: wrt 719.1, J
3: wait 130
4: red 719, F
5: red 716, D, A
6: prt F/1e6, D, A
7: next J
8: end
```

9830A/B

```
10 FOR J=1 TO 96 STEP 5
20 CMD "U?3"
30 FORMAT "FC", F1000.0, "E"
40 OUTPUT (13, 30) J
50 WAIT 200
60 CMD "?S5"
70 ENTER (13, *) F
80 CMD "P?5"
90 ENTER (13, *) C1, C2
100 PRINT F/1E+06, C1, C2
110 NEXT J
120 END
```

A3-44. Counter Feedback Technique Example. Counter feedback should be used when the best possible frequency accuracy is desired. The technique uses the 8505A's built-in counter and the CW Frequency mode in the following multi-step process:

a. Coarse tune FA only with FB set to zero. (Set FA slightly lower than desired frequency.)

b. Count resultant frequency.

c. Output corrected FA and initial FB value.

d. Count again.

e. Correct FB.

Repeat steps d and e for greater accuracy, if desired. This technique can correct for non-linearity and offset in both FA and FB DAC's. It does not provide any improvement in short term (residual FM) characteristics.

Example: Set frequency from 100 to 1000 MHz in steps of 100 MHz using the counter feedback technique. Print frequency (MHz), Channel 1 and Channel 2 marker values.

9825A

```
0: dim F[3]
1: llo 7; wrt 719, "M3W5E"
2: for J=100 to 1000 by 100
3: gsb "FREQ"
4: red 719, F
5: red 716, D, A
6: prt F/1e6, D, A
7: next J
8: stp
```

(cont'd)

9830A/B

```
10 CMD "?U"
20 FORMAT 3B
30 OUTPUT (13, 20) 256, 17, 512;
40 FOR J=100 TO 1000 STEP 100
50 GOSUB 200
60 CMD "?S5"
70 ENTER (13, *) F
80 CMD "P?5"
90 ENTER (13, *) C1, C2
```

(cont'd)

9825A	9830A/B
9: "FREQUENCY FEEDBACK SUBROUTINE":	100 PRINT F/1 E + Ø6, C1, C2
1Ø: "FREQ":	110 NEXT J
11: fmt 1, "FA", f . Ø, "FB", f . Ø, "E"	12Ø END
12: wrt 719. 1, J, Ø	2ØØ REM FREQ FEEDBACK SUBROUTINE
13: wait 15ØØ	21Ø CMD "U?3"
14: for I = 1 to 2	22Ø FORMAT "FA", F 1ØØ.Ø, "FB", F1ØØØ.Ø, "E"
15: red 719, F; F/1e6→F	23Ø OUTPUT (13, 22Ø) J, Ø
16: if I > 1; gto "fine"	24Ø FOR I=1 TO 2
17: J + (J – F) → F [1]	25Ø WAIT 15ØØ
18: int (F [1]) → F [2]	26Ø CMD "S?5"
19: 5ØØ (F [1] – F [2]) → F [3]	27Ø ENTER (13, *) F
2Ø: gto +2	28Ø F=F/1E+Ø6
21: "fine" : F [3] + 5ØØ (J – F)→ F [3]	29Ø IF I > 1 THEN 34Ø
22: wrt 719.1, F [2] , F [3] ; wait 15ØØ	3ØØ F1 = J + (J–F)
23: next I; ret	31Ø F2 = INT (F1)
24: end	32Ø F3 = (F1–F2) *5ØØ
	33Ø GOTO 35Ø
	34Ø F3 = F3 + ((J–F) *5ØØ)
	35Ø CMD "U?3"
	36Ø OUTPUT (13,22Ø) F2, F3
	37Ø NEXT I
	38Ø RETURN

A3-45. Learn Mode

A3-46. The unique learn mode capability allows the calculator to command the instrument to output the state of its manually setup switches and registers in a mult-character code string which can be stored in the calculator. Then at a later time this string can be used to recall the previous instrument setup.

This is simply implemented by programming the character "L" to the instrument and then addressing it to talk:

Example: To learn the signal source's current settings:

9825A	9830A/B
1: rem 7; wrt 719, "L"	2Ø CMD "U?3", "L", "S?5"
2: red 719, S$	3Ø ENTER (13, *) S$

In this case the code string from the source is stored in S$. A typical string is shown below:

S$ = "O7I1R3M3W1S5T1, FAØ1ØØ, FBØ2ØØ, E"

Example: To learn the signal processor's current settings:

9825A	9830A/B
3: wrt 716, "L"	4Ø CMD "U?Ø", "L", "P?5"
4: red 716, P$	5Ø ENTER (13, *) P$

P$ = "CØB1C1I4M2S3RO8OOOC2 . . . . "

The string variables must initially be dimensioned properly. 30 characters are in the source learn string and 82 in the Processor learn string. The dimension statement is shown below:

9825A	9830A/B
Ø: dim S$ [3Ø] , P$ [82]	1Ø: DIM S$ [3Ø] , P$ [82]

Table A3-4 defines both the source and processor strings. Even though the learned data will vary, the string position of each switch code remains the same and is therefore easily decoded. The SCANTIME switch position code is the 12th character in the source string. In the example (Table A3-7), its value is extracted from S$ and stored in "A".

Table A3-7. "LEARN MODE" Strings

```
SOURCE:
"Ox   Ix   Rx   Mx   Wx   Sx   Tx,   FAxxxx,   FBxxxx,   E"
 |    |    |    |    |    |    |      |         |
 2    4    6    8    10   12   14     18        25

PROCESSOR:
"CØ Bx,  C1  Ix  Mx  Sx  R±xxxxxx,  C2  Ix  Mx  Sx  R±xxxxx,
    |        |   |   |   |              |   |   |   |
    4        9   11  13  15             25  27  29  31

C3  Ix  Mx  Sx  R±xxx,  E,  C1  O±xxxxx,  C2  O±xxxxx,  C3  O±xxx,  E"
    |   |   |   |               |             |             |
    41  43  45  47              57            67            77
```

Example: To determine the SCAN TIME setting:

9825A	9830A/B
Ø: val (S$[12]) →A	1Ø A=VAL (S$[12]

A3-47. While the learned strings include the current values of switch positions and reference registers, this may not be a complete definition of the state of the instrument. This can be important for polar displays where both phase and mag references may be necessary and for alternate sweep where the FA, FB for both Start Stop 1 and Start Stop 2 are necessary. For electrical length a code SX (val P$(45)) is provided to indicate the mode switch position for the non-switched input. In these cases it may be necessary to switch modes and learn the other registers to have a complete definition of the state of the machine. The "learn" strings used in the Basic Measurement Program have this "enhanced" capability.

A3-48. Verniers. The state of *verniers cannot be learned.* Thus, it is important to leave vernier settings untouched between the "learn" time and when they are recalled. For longer term storage, it is recommended controls be set to the "preset" position (shown below) before "learning." When the instrument is switched to the remote state, the verniers are *not* automatically set to the preset state. This allows the convenient use of the verniers to fine tune measurement even in automatic operation. However, all verniers are automatically "preset" by using LOCAL LOCKOUT.

9825A	9830A/B
Ø: llo 7	1Ø CMD "U?"
	2Ø FORMAT 3B
	3Ø OUTPUT (13, 2Ø) 256, 17, 512;

LOCAL LOCKOUT also disables the manual LOCAL capability on the TRIGGER switch.

VERNIER CONTROL	"PRESET" POSITION
Output Level Vernier	—10 dBm
Scantime Vernier	MAX CW (Fastest Sweep)
Frequency Verniers (2)	0 Position MAX CCW
Electrical Length Verniers (2)	0 Position MAX CCW

A3-49. Learn Mode Example Program. In the following example the manually set controls of the 8505A are "learned" and the instrument then switched back to local. The instrument's settings can then be switched to any other position. When CONTINUE (9825A) or SPACE BAR EXECUTE (9830A/B) is pressed, the instrument will return to its exact original settings.

9825A

```
0: dim S$[30], P$[82] ;lcl 7; stp
1: rem 7; wrt 716, "L"
2: red 716, P$
3: wrt 719, "L"
4: red 719, S$
5: lcl 7
6: dsp "NEXT SETUP"; stp
7: rem 7; wrt 716, P$
8: wrt 719, S$
9: end
```

9830A/B

```
10 DIM S$[39], P$[82]
20 CMD "U?0", "L", "P?5"
30 ENTER (13, *) P$
40 CMD "U?3", "L", "S?5"
50 ENTER (13, *) S$
60 CMD "U?30"
70 FORMAT 3B
80 OUTPUT (13, 70) 256, 1, 512;
90 DISP "NEXT SETUP";
100 INPUT X$
110 CMD "U?3", S$, "U?0", P$
120 END
```

A3-50. Advanced Programming Techniques

A3-51. Expanded Codes. Programming codes are not limited to a single letter. It may be desirable in some cases to use all the letters of the name of the control, e.g., "RANGE 2" instead of "R2". However, some names will produce the wrong code if letters of the name are recognized as a valid code. Example: "FREQUENCY A" will uncode as "FC" and code the "Frequency Counter" rather than START frequency.

A3-52. Programming Register Values. Values for Channels 1 and 2 *Reference Register* and the corresponding *Stored Reference* (MKR, ZRO) registers are programmed with R or O followed by five digits with a maximum stored value of 19999.

Reference	R±XXXXX
Stored Reference	O±XXXXX

The decimal point is not programmed; its position is assumed as a function of mode.

MAG	XXX.XX dB
PHASE	XXXX.X degrees
DELAY (13 MHz)	XXX.XX μs
DELAY (130 MHz)	XX.XXX μs
DELAY (1300 MHz)	XXXX.X ns

Reference registers may take up to 1.5 seconds to settle after being programmed.

A3-53. Electrical Length Registers. Electrical Length Registers for reference and stored reference are programmed with R or O followed by three digits with a maximum value of 199.

Reference	R±XXX
Stored Reference	O±XXX

Again, the decimal point is not programmed. Its position is assumed depending on the Source RANGE and Signal Processor MODE switch settings:

RANGE	MODE x 1	MODE x 10	MODE x10°/SCAN
13 MHz	XX.X m	XXX m	X10 DEG/SCAN
130 MHz	X.XX m	XX.X m	X10 DEG/SCAN
1300 MHz	XX.X cm	XXX cm	X10 DEG/SCAN

A3-54. DAC Settling Time. All reference registers may take up to three seconds to settle. This means whenever there is a change in INPUT (B, A/R, etc.), MODE (MAG, PHASE, etc.), or 8503A/B Test Set state (forward or reverse), there will be a change of reference registers. If the value of the register changes, no new program codes or reading of data should be done until the DAC has settled.

A3-55. Multiple E's. If Reference and Stored Reference registers (R & O) are to be programmed in the same string, separate "E" or end-of-data commands are required for each.

Example: "C1 R+18900O0100E" – Incorrect

C1 R+18900EC1O0100E" – Correct

Note that the C1 or C2 Signal Processor prefix codes also need to be repeated when changing both the "O" and "R" registers. The repeated "E" and "C1"/"C2" requirement also applies to the "D" codes used for switching between the Reference (REF) and Markers (MKR) data readout modes.

Example: C1D2EC1R+08000EC1O0100E"

A3-56. Serial Poll. When the source is used in serial poll mode, the SRQ line can report loss of phaselock or RF input overload.

Example: To check for valid measurement conditions on the source:

9825A

```
0: rds (719)→A
1: if bit (6, rds (719)) = 0; gto +2
2: prt "OVERLOAD"; stp
3: prt "GOOD"; stp
```

9830A/B

```
10  GOSUB 110
20  IF (STAT13) THEN 200
30  PRINT "MEASUREMENT VALID"
.
.
200 GOSUB 110
210 IF A$64 THEN 30
220 PRINT"OVERLOAD"
```

(cont'd)

9825A	9830A/B	
	11Ø CMD "U?" 12Ø FORMAT 3B 13Ø OUTPUT (13, 12Ø) 256, 24, 512;	Set Serial Poll Enable
	14Ø CMD "S?5" 15Ø A=RBYTE13	Read Source Status
	16Ø CMD "U?" 17Ø OUTPUT (13, 12Ø)256, 25, 512;	Clear Serial Poll Enable

A3-57. Phase Measurement Speed Limitations. At phase crossovers (±180° transitions) the response time of the system is such that readings can occur on the transition slope at the faster scantimes. Invalid Phase Readings in Swept Modes can be eliminated by programming SCANTIME to position S4. There are no problems with the CW or FAST CW Modes.

A3-58. Polar Output. Marker parameter output can be switched into real and imaginary format by issuing a "CØD3C1I6C2I6E" to the Processor. Channel 1 then reads −Y and Channel 2 reads −X with a reading of 250 corresponding to full scale (unity circle). "CØDØE" switches back to the standard dB and angle format.

A3-59. Programming ZRO. To ensure a correct marker zero for all measurement conditions, use the following program code. (The Channel 2 zero could also be done at the same time.)

9825A	9830A/B
Ø: wrt "P", "C1RØEC1OØE"	1Ø: CMD "U?Ø", "C1RØEC1OØE"
1: wait 3ØØØ	2Ø: WAIT 3ØØØ
2: wrt "P", "C1D4E"	3Ø: CMD "U?Ø", "C1D4E"
3: wait 3ØØØ	4Ø: WAIT 3ØØØ
4: wrt "P", "C1D2E"	5Ø: CMD "U?Ø", "C1D2E"

For slower sweep speeds, wait three seconds plus three sweep times for each channel.

A3-60. Programming CLR. Programming D3 is equivalent to momentarily pressing the CLR pushbutton (only the reference offset register "R" is cleared). To clear the calibration register "O" and the reference offset register "R" (equivalent to manually holding down the CLR pushbutton), use the following program code.

9825A	9830A/B
0: wrt "P", "C1RØEC1OØE"	10 CMD "U?Ø", "C1RØEC1OØE"
1: wait 3ØØØ	20 WAIT 3ØØØ

Table A3-7. Glossary of HP-IB Term (1 of 2)

ADDRESS – A 7-bit code applied to the HP-IB in "Command Mode" that enables instruments, capable of responding, to listen and/or talk on the Bus.

ADDRESSED COMMANDS – These commands allow the Bus controller to initiate simultaneous actions from addressed instruments which are capable of responding.

ATN – Mnemonic referring to the attention control line on the HP-IB. This refers to the Command Mode of operation on the HP-IB, or the control line that places the HP-IB in this mode.

BIT – The smallest part of an HP-IB character (Byte) that contains intelligible information.

BUS COMMANDS – A group of Special Codes that initiate certain types of operation instruments capable of responding to these codes. Each instrument on the HP-IB is designed to respond to those codes that have useful meaning to the device and ignore all others. (See Table E2-2.)

BYTE – An HP-IB character sent over the Data Input/Output (DIO) lines, normally consisting of eight-bits.

COMMAND MODE – In this mode, devices on the HP-IB can be addressed or unaddressed as talkers or listeners. Bus commands are also issued in this mode.

CONTROLLER – Any device on the HP-IB that is capable of setting the ATN line and addressing instruments on the Bus as talkers and listeners. (Also see System Controller.)

DEVICE CLEAR (DCL) – ASCII character DC4 (Octal 024)which, when sent on the HP-IB, will return all devices capable of responding to pre-defined states.

DATA MODE – The HP-IB is in this mode when the ATN control line is high (false). In this mode, data or instructions are transferred between instruments on the HP-IB.

DAV – Mneumonic referring to the Data Valid control line on the HP-IB. This line is used in the HP-IB Handshake sequence.

DIO – Mnemonic referring to the eight Data Input/Output lines of the HP-IB.

EOI – Mnemonic referring to the control line End or Identify on the HP-IB. This line is used to indicate the end of a message on the Bus. It is also used in parallel polling.

EXTENDED LISTENER – An instrument that requires two HP-IB bytes to address it as a listener. (Also see Listener.)

EXTENDED TALKER – An instrument that requires two HP-IB bytes to address it as a talker. (Also see Talker.)

GO TO LOCAL (GTL) – ASCII character SOH (Octal 001) which, when sent on the HP-IB, will return devices addressed to listen (and capable of responding) back to local control.

GROUP EXECUTE TRIGGER (GET) – ASCII character BS (Octal 010) which, when sent on the HP-IB, initiates simultaneous actions by devices addressed to listen and capable of responding to this command.

HANDSHAKE – Refers to the sequence of events on the HP-IB during which each data byte is transferred between addressed devices. The conditions of the HP-IB handshake sequence are as follows:

a. NRFD, when false, indicates that a device is ready to receive data.

b. DAV, when true, indicates that data on the DIO lines is stable and available to be accepted by the receiving device.

Table A3-7. Glossary of HP-IB Term (2 of 2)

c. NDAC, when false, indicates to the transmitting device that data has been accepted by the receiver.

HP-IB – An abbreviation that refers to the Hewlett-Packard Interface Bus.

IFC – Mnemonic referring to the Interface Clear control line on the HP-IB. Only the system controller can activate this line. When IFC is set (true), all talkers and listeners on the HP-IB are unaddressed and controllers go to the inactive state.

LISTENER – A device which has been addressed to receive data or instructions from other instruments on the HP-IB. (Also see Extended Listener.)

LOCAL LOCKOUT (LLO) – ASCII character DC1 (Octal 021) which, when sent on the HP-IB, disables the front panel controls of responding devices.

NDAC – Mnemonic referring to the Data Not Accepted control line on the HP-IB. This line is used in the Handshake sequence.

NRFD – Mnemonic referring to the Not Ready For Data control line on the HP-IB. This line is used in the HP-IB Handshake sequence.

PARALLEL POLLING – A method of simultaneously checking status on up to eight instruments on the HP-IB. Each instrument is assigned a DIO line with which to indicate whether it requested service or not.

PRIMARY COMMANDS – The group of ASCII characters which are typically used on the HP-IB. (See Table E2-2.

REN – Mnemonic referring to the Remote Enable control line on the HP-IB. This line is used to enable Bus-compatible instruments to respond to commands from the controller or another talker. It can be issued only by the system controller.

SECONDARY COMMANDS – The group of ASCII characters that are used to increase the address length of extended talkers and listeners to two bytes.

SELECTIVE DEVICE CLEAR (SDC) – ASCII character EOT (Octal 004) which, when sent on the HP-IB, returns addressed devices capable of responding to a predetermined state.

SERIAL POLLING – The method of sequentially determining which device connected to the HP-IB has requested service. Only one instrument is checked at a time.

SERIAL POLL DISABLE (SPD) – ASCII character EM (Octal 031) which, when sent on the HP-IB, will cause the Bus to go out of serial-poll mode.

SRQ – Mnemonic referring to the Service Request control line on the HP-IB. This line is set low (true) by any instrument requesting service.

SYSTEM CONTROLLER – An instrument on the HP-IB having all the features of a standard controller with the added ability to control the IFC and REN lines. (Also see Controller.)

TALKER – A device addressed to transmit data on the HP-IB. (Also see Extender Talker.)

UNADDRESS COMMANDS – These commands are the Unlisten Command (?) and the Untalk Command (–). When the Unlisten Command (?) is transmitted on the HP-IB, all devices on the Bus will be unaddressed as listeners. When the Untalk Command (–) is transmitted, all devices will be unaddressed as talkers.

UNIVERSAL COMMANDS – These commands affect every device capable of responding on the HP-IB, regardless of whether they have been addressed or not; e.g., Serial Poll Enable (SPE) and Serial Poll Disable (SPD).

UNLISTEN COMMAND – See UNADDRESS COMMANDS.

UNTALK COMMAND – See UNADDRESS COMMANDS.

CHAPTER A
MODEL 8505A NETWORK ANALYZER

SECTION IV
PERFORMANCE TEST

A4-1. INTRODUCTION

A4-2. The procedures in this section test the electrical performance of the instrument using the specifications of Table A1-1 as the performance standards. All tests can be performed without access to the interior of the instrument. A simpler operational test is included in Paragraphs A3-1 through A3-10.

A4-3. The performance test procedures should be performed in the sequence given. If a test measurement is slightly out of tolerance, go to Section V and perform the appropriate adjustment procedures. If a function fails to operate, go to Section VI Troubleshooting to find which major assembly has failed, then to the appropriate assembly section to troubleshoot to the printed circuit or assembly that has the trouble.

A4-4. EQUIPMENT REQUIRED

A4-5. Equipment required for the performance tests is listed in the Recommended Test Equipment in Table A1-4. Any equipment that satisfies the critical specifications given in the table may be substituted for the recommended model.

A4-6. TEST RECORD

A4-7. Results of the performance tests may be tabulated on the Test Record at the end of the procedures. The Test Record lists all of the tested specifications and their acceptable limits. Test results recorded at incoming inspection can be used for comparison in periodic maintenance and troubleshooting and after repairs or adjustments.

PERFORMANCE TESTS

A4-8. FREQUENCY RANGE AND ACCURACY TEST

NOTE

Allow one hour warm-up time before making the Performance Tests or Adjustments.

SPECIFICATIONS:

CW Mode Accuracy: ± 2 counts of LSD ± time-base accuracy*
Swept Frequency Accuracy: ±1% of range for linear sweep

Counter Accuracy: ±2 counts ± time-base accuracy*

*Time-base Accuracy = 5 ppm ±1 ppm/°C ±3 ppm/90 days.

PERFORMANCE TESTS

A4-8. FREQUENCY RANGE AND ACCURACY TEST (Cont'd)

DESCRIPTION:

The 8505A built-in frequency counter calibration is checked against a known good electronic counter by monitoring the CW RF signal. In CW $\pm\Delta F$ mode, the FREQUENCY READOUT is compared to the counter readout. If necessary, the CW RF signal is adjusted to match the FREQUENCY readout. This calibrates the digital FREQUENCY readout to the actual RF OUTPUT signal being read on the built-in counter. The START/STOP sweep signal frequency is measured using an external counter to monitor the frequencies with both START and STOP frequencies the same.

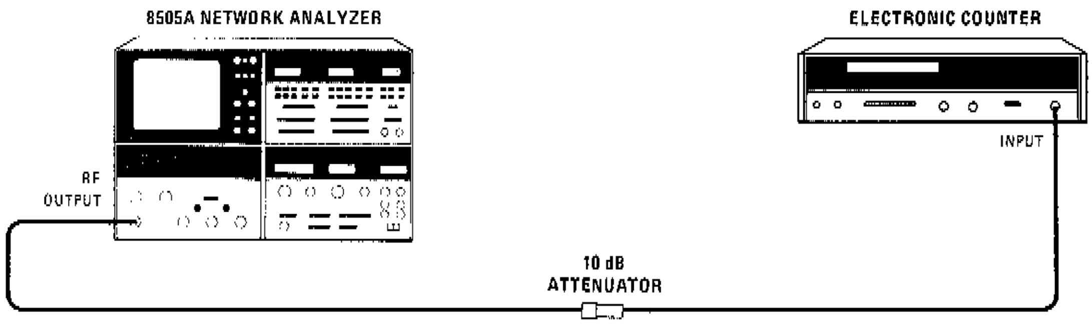


Figure A4-1. Frequency Accuracy Test Setup

EQUIPMENT:

Electronic Counter . . . . HP 5340A
10 dB Attenuator . . . . HP 8491B Option 010

PROCEDURE:

COUNTER ACCURACY

a. Set 8505A controls as follows:

On A1 Source/Converter
OUTPUT LEVEL dBm . . . . −10
OUTPUT LEVEL VERNIER 0

On A2 Frequency Control:
RANGE MHz . . . . .5 — 1300
MODE . . . . LIN EXPAND
WIDTH . . . . CW
SCAN TIME SEC . . . . 10 — 1
VERNIER SCAN TIME . . . . Clockwise
TRIGGER . . . . AUTO
MARKERS 1

b. Connect equipment as shown in Figure A4-1 and set external counter resolution to 100 Hz.

PERFORMANCE TESTS

A4-8. FREQUENCY RANGE AND ACCURACY TEST (Cont'd)

c. Set CW FREQUENCY control and VERNIER control for 10.000 MHz indication on external Electronic Counter. The 8505A CW FREQUENCY digital display should indicate 0010.00 MHz ±0.02 MHz. (If the indication is not within tolerance, the built-in counter is malfunctioning; go to Troubleshooting in Chapter C.

FREQUENCY CALIBRATION

d. Set A2 Frequency Control WIDTH switch to CW ±ΔF.

e. Set CW FREQUENCY to 10 MHz and set CW FREQUENCY VERNIER to 0.

f. Set ±ΔF FREQUENCY to 000.0, and set ±ΔF FREQUENCY VERNIER to 0.

g. Remove the front-panel window of A2 Frequency Control (Figure A4-2).

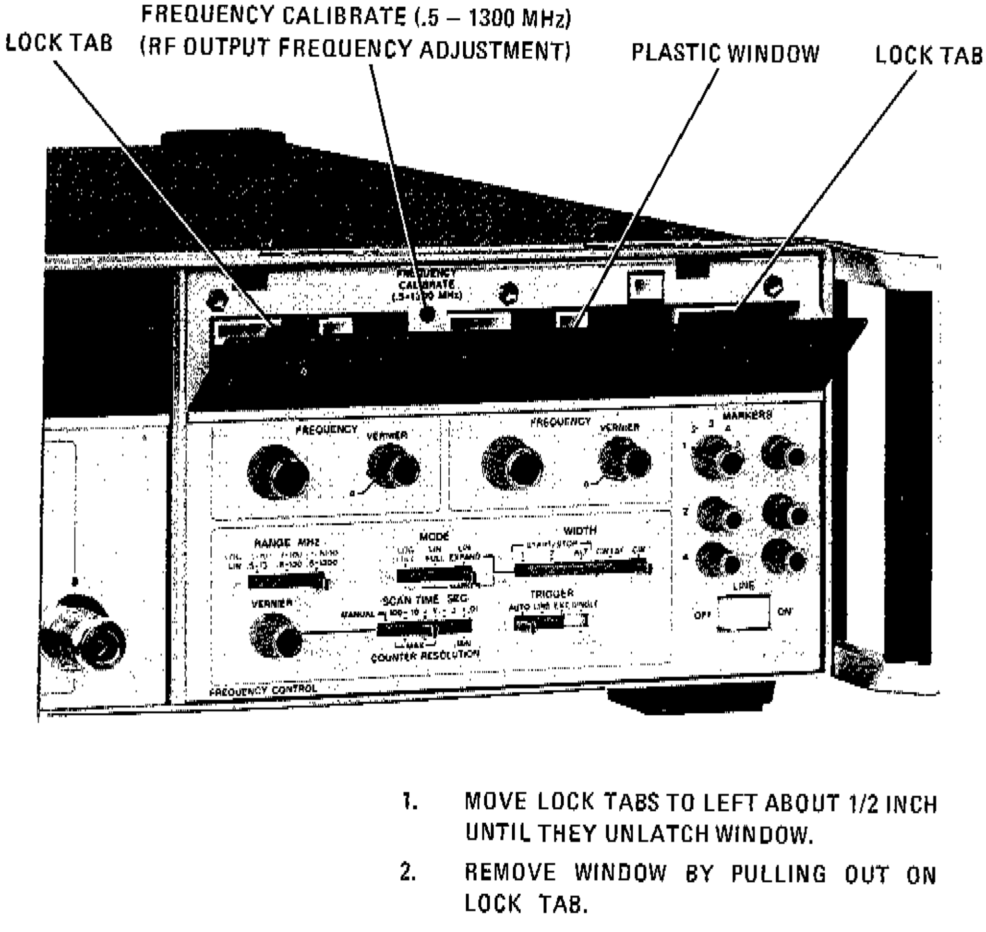


Figure A4-2. Frequency Control Front-Panel Window Removal

PERFORMANCE TESTS

A4-8. FREQUENCY RANGE AND ACCURACY TEST (Cont'd)

h. Adjust FREQUENCY CALIBRATE (.5– 1300 MHz) screwdriver adjustment in the middle of exposed subpanel so the FREQ COUNTER MHz reads 10.00 MHz plus or minus 2 counts of least significant digit (LSD).

i. Reinstall the window.

SWEPT FREQUENCY ACCURACY

j. At A2 Frequency Control, set RANGE MHz switch to .5 — 1300, MODE switch to LIN EXPAND, WIDTH switch to START/STOP 1, and SCAN TIME SEC switch to .1 — .01. Set A2 Frequency Control RANGE MHz switch and START and STOP frequency as listed in the table below and read the frequency on the external Electronic Counter.

RANGE MHz Switch Set At A2 Frequency Control	START and STOP FREQUENCY Digital Readout Set At A2 Frequency Control	Frequency Indicated on External Electronic Counter
.5 – 1300	1300. MHz	1300 MHz ± 13 MHz
.5 – 130	130.0 MHz	130.0 MHz ± 1.3 MHz
.5 – 13	13.00 MHz	13.00 MHz ± 0.13 MHz
.5 – 1300	0700. MHz	700 MHz ± 13 MHz
.5 – 130	070.0 MHz	70.00 MHz ± 1.3 MHz
.5 – 13	07.00 MHz	7.00 MHz ± 0.13 MHz
.5 – 1300	0010. MHz	10.0 MHz +13, –9 MHz
.5 – 130	001.0 MHz	1.00 MHz +1.3, –0.9 MHz
.5 – 13	01.00 MHz	1.00 MHz ± 0.13 MHz

PERFORMANCE TESTS

A4-9. CW FREQUENCY STABILITY TEST

SPECIFICATION:

Frequency Stability over 10 Minute period after one hour initial warmup: better than ±0.01% of reading ±0.01% of frequency range.

DESCRIPTION:

The frequency of the RF output signal is indicated on an external Electronic Counter over a period of 10 minutes (after an initial warmup period of one hour).

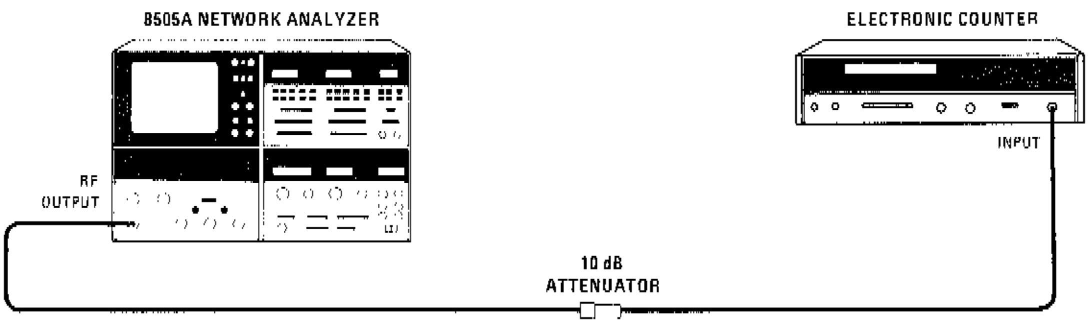


Figure A4-3. Frequency Stability Test Setup

EQUIPMENT:

Electronic Counter .... HP 5340A
10 dB Attenuator .... HP 8491B Option 010

PROCEDURE:

a. Set 8505A controls as follows:

On A1 Source/Converter:
OUTPUT LEVEL dBm .... −10

On A2 Frequency Control:
RANGE MHz .... .5 — 13
MODE .... LIN EXPAND
WIDTH .... CW
CW FREQUENCY MHz and VERNIER 10.000

b. Connect equipment as shown in Figure A4-3.

c. Allow one hour warmup for the 8505A temperature to stabilize. If the instrument has been operating more than one hour, wait three minutes for frequency to stabilize, then proceed with the test.

d. Record frequency indicated by external electronic counter. Allow 10 minutes of operation then record electronic counter indication again. The second reading should be within ±2.3 kHz of the first reading.

PERFORMANCE TESTS

A4-10. POWER OUTPUT LEVELING TEST AND ABSOLUTE POWER CALIBRATION

SPECIFICATION:

Output Leveling: ±0.5 dB from 0.5 to 1300 MHz
Output Level Vernier Accuracy: ±1 dB

DESCRIPTION:

The power output is monitored on a power meter while the frequency band is tuned manually. The highest and lowest power spots are noted and the total difference must be less than the specification. The output level vernier is adjusted through its range and the change in power level is read on the power meter.

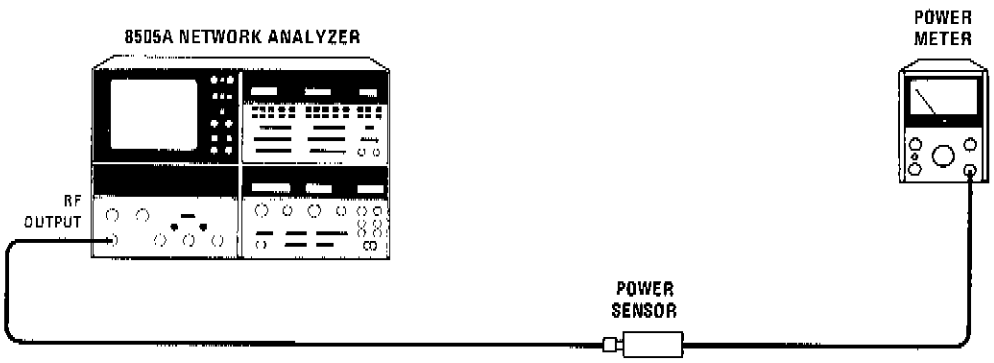


Figure A4-4. Output Leveling Test Setup

EQUIPMENT:

Power Meter . . . . HP 435A
Power Sensor . . . . HP 8482A

PROCEDURES:

a. Set 8505A controls as follows:

On A1 Source/Converter:
OUTPUT LEVEL dBm . . . . 0 dBm
OUTPUT LEVEL Vernier . . . . 0 dB

On A2 Frequency Control:
RANGE MHz . . . . .0.5 – 1300
MODE. . . . . LIN FULL
WIDTH . . . . .START/STOP 1
SCAN TIME SEC . . . . .MANUAL

b. Connect equipment as shown in Figure A4-4.

PERFORMANCE TESTS

A4-10. POWER OUTPUT LEVELING TEST AND ABSOLUTE POWER CALIBRATION (Cont'd)

POWER LEVELING

NOTE

If excessive variation occurs at the low or high end of the band, check the high and low end frequencies with a counter to be sure frequency is within the 0.5 to 1300 MHz band.

c. While watching the power meter, turn the MANUAL sweep control from fully counterclockwise to clockwise position. The total variation between the highest power and the lowest power indication across the band should be ≤1 dB (or ±0.5 dB).

OUTPUT LEVEL VERNIER

d. On A1 Source/Converter, set OUTPUT LEVEL dBm to +10 dBm and VERNIER to 0.

On A2 Frequency Control, set:

MODE . . . . LIN EXPAND
WIDTH . . . . CW
CW FREQUENCY . . . . 30.0 MHz

The power meter should indicate +10 dBm ±1 dB ± tolerance of power meter used. Set OUTPUT LEVEL dBm VERNIER to −12 dB and power meter should indicate −2 dBm ± 1 dBm ± tolerance of the power meter. (If slightly out of tolerance, go to Paragraph A5-14 for adjustment.)

A4-11. POWER OUTPUT RANGE TEST

SPECIFICATIONS:

Power Output Range: +10 dBm to −72 dBm
Attenuator Accuracy: ±1.5 dB over the 70 dB range.

DESCRIPTION:

The power output and attenuator accuracy is measured by substitution, using an external step attenuator.

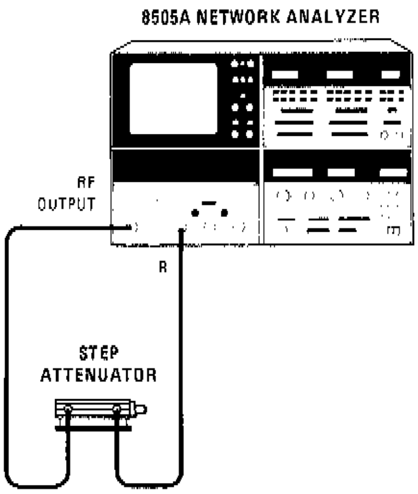


Figure A4-5. Power Output Range Test Setup

PERFORMANCE TESTS

A4-11. POWER OUTPUT RANGE TEST (Cont'd)

EQUIPMENT:

0 — 110 dB Step Attenuator (calibrated at 30 MHz) . . . . HP 8496A

PROCEDURES:

a. Set 8505A controls as follows:

On A1 Source/Converter:
- OUTPUT LEVEL dBm . . . . +10 dBm
- OUTPUT LEVEL VERNIER . . . . 0 dB
- INPUT LEVEL dBm MAX . . . . −10 dBm

On A2 Frequency Control:
- RANGE MHz . . . . 0.5 — 130
- MODE . . . . LIN EXPAND
- WIDTH . . . . CW±ΔF
- SCAN TIME SEC . . . . 0.1 — .01
- CW FREQUENCY MHz . . . . 30.0 MHz
- ±ΔF FREQUENCY . . . . 00.00 MHz
- MARKERS 1
- Markers 1 . . . . Center of CRT

On A3 Signal Processor:

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

Channel 2:
- MODE . . . . OFF

CRT Display:
- BW (Bandwidth) . . . . 10 kHz
- VIDEO FILTER . . . . On (in)

b. Connect equipment as shown in Figure A4-5. Set external step attenuator to 80 dB.

c. On Signal Processor CRT Display, press REF LINE POSN and adjust CH 1 up-down control to place the trace on the center line; press REF LINE POSN pushbutton again for normal operation.

d. Press Channel 1 DISPLAY MKR, then ZRO to place CRT trace on the center graticule line.

e. Step the OUTPUT LEVEL dBm switch to each 10 dB step between +10 dBm and −60 dBm and step the external step attenuator as listed in the following table. The step-to-step accuracy should be within ±1.5 major divisions of the center line (i.e., ±1.5 dB) ± calibration correction of the external attenuator at each step.

PERFORMANCE TESTS

A4-11. POWER OUTPUT RANGE TEST (Cont'd)

OUTPUT LEVEL dBm SETTING	EXTERNAL STEP ATTENUATOR SETTING
+10 dBm	80 dB
0 dBm	70 dB
—10 dBm	60 dB
—20 dBm	50 dB
—30 dBm	40 dB
—40 dBm	30 dB
—50 dBm	20 dB
—60 dBm	10 dB

A4-12. MAGNITUDE REFERENCE OFFSET AND MARKER ACCURACY TEST

SPECIFICATION:

Magnitude Reference Offset:
Range: ±199.9 dB
Accuracy: ±0.03 dB ±0.003 dB/dB of offset.

DESCRIPTION:

The trace is zeroed on the center reference line, then the trace is offset by ±190 dB. The resultant position of the trace is read on the marker.

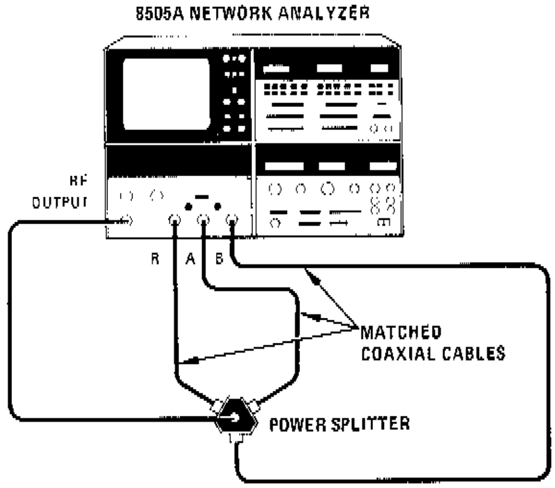


Figure A4-6. Marker Accuracy Test Setup

EQUIPMENT:

Three-Way Power Splitter . . . . HP 11850A
Matched Cable Kit. . . . . HP 11851A

A4-12. MAGNITUDE REFERENCE OFFSET AND MARKER ACCURACY TEST (Cont'd)

PROCEDURE:

RECTANGULAR MARKER ZERO

a. Connect equipment as shown in Figure A4-6.

b. On 8505A, set the controls as follows:

On A1 Source/Converter:
- OUTPUT LEVEL dBm .... −10 dBm
- OUTPUT LEVEL VERNIER .... 0 dB
- INPUT LEVEL dBm MAX .... −10 dBm

On A2 Frequency Control:
- RANGE MHz .... 0.5 − 130
- MODE .... LIN EXPAND
- WIDTH .... CW ±ΔF
- CW FREQUENCY .... 30.0 MHz
- ±ΔF FREQUENCY 00.0
- MARKERS 1
- Marker 1 .... Marker at Center Screen

On A3 Signal Processor:

Channel 1:
- INPUT .... A/R
- MODE .... MAG
- SCALE/DIV .... 0.1 dB/DIV

Channel 2:
- MODE .... OFF

Electrical Length:
- MODE .... OFF

CRT Display Section:
- BANDWIDTH (BW) .... 10 kHz
- VIDEO FILTER .... On (in)

Press REF LINE POSN, adjust CH1 up-down control to place the reference line at the center of the CRT, then press REF LINE POSN again for normal operation.

c. Press Channel 1 DISPLAY MKR pushbutton, then press and hold ZRO pushbutton approximately 10 seconds until the trace settles on center graticule line. The Channel 1 marker readout should indicate 0.00 dB ± 0.01 dB.

POLAR MARKER ZERO

d. Set Channel 1 MODE switch to POLAR MAG. Set SCALE/DIV to POLAR 1. On CRT Display panel, press BEAM CENTER pushbutton. Adjust up-down and left-right controls to center polar dot at center of CRT graticule. Press BEAM CENTER again for normal operation.

PERFORMANCE TESTS

A4-12. MAGNITUDE REFERENCE OFFSET AND MARKER ACCURACY TEST (Cont'd)

e. Press Channel 1 DISPLAY MKR, then ZRO pushbuttons. The dot (and marker) should be displayed within ±3 mm of the outside circle on CRT graticule.

f. Set Channel 1 MODE switch to POLAR PHASE. Press DISPLAY ZRO pushbutton. The dot trace (and marker) should be at 0 degrees ±1 degree on CRT graticule.

MARKER ACCURACY

g. Set 8505A controls as follows:

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

Channel 2:
MODE . . . . OFF

h. On Channel 1, press DISPLAY MKR, then ZRO pushbuttons to place the trace on the center line of CRT.

i. Press Channel 1 DISPLAY REF, then press REF OFFSET pushbuttons to offset the trace by +190.0 dB as indicated on the digital readout.

j. Press Channel 1 DISPLAY MKR and the digital readout should be −190.0 dB ±0.6 dB.

k. Press Channel 1 DISPLAY ZRO pushbutton to place the CRT trace on the center line.

l. Press Channel 1 DISPLAY REF, then press REF OFFSET pushbuttons to offset the trace by −190.0 dB as indicated on the digital readout.

m. Press Channel 1 DISPLAY MKR and the digital readout should be +190.0 dB ±0.6 dB.

A4-13. RECEIVER NOISE FLOOR

SPECIFICATION:

Noise floor in 10 kHz Bandwidth: − 95 dBm (0.5 to 2 MHz)
− 100 dBm (2 to 10 MHz)
− 110 dBm (10 to 1300 MHz)

DESCRIPTION:

The noise floor is measured by offsetting the reference −95 dB (0.5 to 2 MHz), −100 dB (2 to 10 MHz), and −110 dB (10 to 1300 MHz). Each signal at the three input ports is compared with the −95 dBm, −100 dBm, or −110 dBm reference line to verify that the noise floor is below −95 dBm, −100 dBm, or −110 dBm.

PERFORMANCE TESTS

A4-13. RECEIVER NOISE FLOOR (Cont'd)

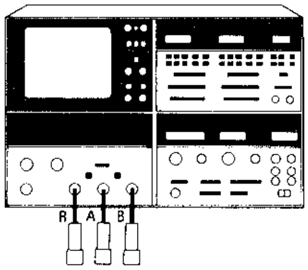


Figure A4-7. Noise Floor Test Setup

EQUIPMENT:

50 Ohm Termination (3 required) . . . . HP 909A Option 012

PROCEDURE:

a. Connect equipment as shown in Figure A4-7.

b. Set 8505A Controls as follows:

On A1 Source/Converter:

OUTPUT LEVEL dBm . . . . –60 dBm
OUTPUT LEVEL VERNIER . . . . 0 dB
INPUT LEVEL dBm MAX . . . . –30 dBm

On A2 Frequency Control:

RANGE MHz . . . . 0.5 – 13
MODE . . . . LIN EXPAND
WIDTH . . . . START/STOP 1
START FREQUENCY . . . . 00.50 MHz
STOP FREQUENCY . . . . 02.00 MHz
MARKERS 1
Marker 1 . . . . Center of CRT
SCAN TIME SEC . . . . 10 – 1
SCAN TIME Vernier . . . . Fully Clockwise
TRIGGER . . . . AUTO

On A3 Signal Processor:

Channel 1:

INPUT . . . . R
MODE . . . . MAG
SCALE/DIV . . . . 10 dB/DIV

Channel 2:

MODE . . . . OFF

PERFORMANCE TESTS

A4-13. RECEIVER NOISE FLOOR (Cont'd)

CRT Display:
BANDWIDTH kHz . . . . 10 kHz
VIDEO FILTER . . . . On (in)

NOISE FLOOR FROM 0.5 to 2 MHz

c. On Signal Processor Display, press REF LINE POSN pushbutton, then adjust CH 1 up-down control to place the CRT reference trace on the center graticule line. Press REF LINE POSN pushbutton again for normal operation.

d. At Channel 1, press DISPLAY REF, then CLR pushbutton until REL light goes out (if it was lit). (This clears all previous offsets in Channel 1.)

e. At Channel 1, press REF OFFSET pushbuttons to obtain −95 dB offset. The CRT trace should be below the center graticule line. This shows the noise floor below −95 dBm.

f. Set Channel 1 INPUT switch to "A". The CRT trace should be below the center graticule line.

g. Set Channel 1 INPUT switch to "B". The CRT trace should be below the center graticule line.

NOISE FLOOR FROM 2 TO 10 MHz

h. Set START frequency to 02.00 MHz and STOP frequency to 10.00 MHz. At Channel 1, press DISPLAY REF, then REF OFFSET pushbuttons to obtain −100 dB offset. The CRT trace should be below the center gratidule line. This shows the noise floor below −100 dBm.

i. Set Channel 1 INPUT switch to "A". The CRT trace should be below the center graticule line.

j. Set Channel 1 INPUT switch to "R". The CRT trace should be below the center graticule line.

NOISE FLOOR FROM 10 TO 1300 MHz

k. Set RANGE switch to .5 − 1300 MHz. Set START frequency to 0010 MHz and STOP frequency to 1300 MHz. At Channel 1, press DISPLAY REF, then REF OFFSET pushbuttons to obtain −110 dB offset. The CRT trace should be below the center graticule line. This shows the noise floor below −110 dBm.

l. Set Channel 1 INPUT switch to "A". The CRT trace should be below the center graticule line.

m. Set Channel 1 INPUT switch to "B". The CRT trace should be below the center graticule line.

A4-14. CROSSTALK ISOLATION

SPECIFICATION:

Crosstalk Error Limits: >100 dB isolation between inputs.

PERFORMANCE TESTS

A4-14. CROSSTALK ISOLATION (Cont'd)

DESCRIPTION:

A signal of –10 dBm is applied to the "R" Channel inputs. The "A" and "B" Channels are terminated and the channel signal is displayed on the CRT display. The displayed signal of Channel "A" should be 100 dB below the –10 dBm level of the "R" port showing isolation between ports. The other ports are checked in the same manner.

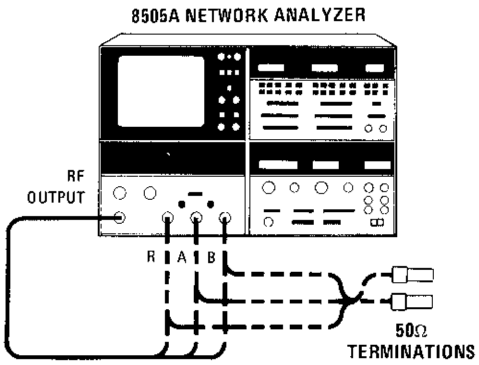


Figure A4-8. Crosstalk Isolation Test Setup

EQUIPMENT:

50 Ohm Termination (2 required) . . . . HP 909A Option 012

PROCEDURE:

NOTE

It is possible to verify the 100 dB crosstalk specifications only over the 10–1300 MHz range where the noise level is below –110 dBm.

a. Set 8505A Controls as follows:

On A1 Source/Converter:
- OUTPUT LEVEL dBm . . . . –10 dBm
- OUTPUT LEVEL VERNIER . . . . 0 dB
- INPUT LEVEL dBm MAX . . . . –10 dBm

On A2 Frequency Control:
- RANGE MHz . . . . 0.5 – 1300
- MODE . . . . LIN FULL
- WIDTH . . . . START/STOP 2
- START FREQUENCY . . . . 0010 MHz
- STOP FREQUENCY . . . . 1300 MHz
- MARKERS 1
- Marker 1 . . . . Midscreen
- SCAN TIME SEC . . . . 10 – 1
- SCAN TIME VERNIER . . . . Fully Clockwise
- TRIGGER . . . . AUTO

A4-14. CROSSTALK ISOLATION (Cont'd)

On A3 Signal Processor:

Channel 1:

INPUT . . . . A
MODE . . . . MAG
SCALE/DIV . . . . 10 dB/DIV

Channel 2:

MODE . . . . OFF

CRT Display:

BANDWIDTH kHz . . . . 10 kHz
VIDEO FILTER . . . . Off (out)

b. Connect equipment as shown in Figure A4-8 with the RF output cable connected to "R" port and "A" and "B" ports terminated with 50-ohm loads.

c. At Channel 1, press CLR pushbutton until REL light goes out (if it was lit). (This clears all previous offsets in Channel 1.)

d. At Channel 1, press DISPLAY REF, then REF OFFSET pushbuttons to obtain —110 dB offset. The CRT trace should be below the center graticule line for 100 dB of isolation.

e. Set Channel 1 INPUT switch to "B" and the CRT trace should be below the center graticule line.

f. Change setup by moving 50-ohm loads to port "R" and "B" and connect cable to port "A". Set Channel 1 INPUT switch to "R". Repeat steps c, d, and e.

g. Change setup by moving 50-ohm load to port "R" and "A" and connect cable to port "B". Set Channel 1 INPUT switch to "R". Repeat steps c and d.

h. Set Channel 1 INPUT switch to "A" and the CRT trace should be below the center graticule line.

A4-15. MAGNITUDE, PHASE, AND GROUP DELAY FREQUENCY RESPONSE

SPECIFICATION:

Absolute Magnitude Frequency Response: $\leqslant \pm 1.5$ dB

Magnitude Tracking Frequency Response: $\leqslant \pm 0.3$ dB

Phase Frequency Response: $\leqslant \pm 3°$ from 0.5 to 750 MHz
$\leqslant \pm 5°$ from 750 to 1300 MHz

Group Delay: ±1 ns from 0.5 to 1300 MHz.

DESCRIPTION:

The receiver magnitude frequency response is tested by applying the RF OUTPUT first directly to the three individual ports. If the indication is slightly out of specifications, the RF OUTPUT is sent through a power splitter to one of the INPUT ports and to a power meter. The common mode power variations due to the source as indicated on the power meter is subtracted from the variations on the CRT trace, giving a resultant variation due only to the receiver and display section.

PERFORMANCE TESTS

A4-15. MAGNITUDE, PHASE, AND GROUP DELAY FREQUENCY RESPONSE (Cont'd)

The receiver frequency response in ratio measurement mode may be read directly from the CRT display since all common mode variations due to the source are cancelled.

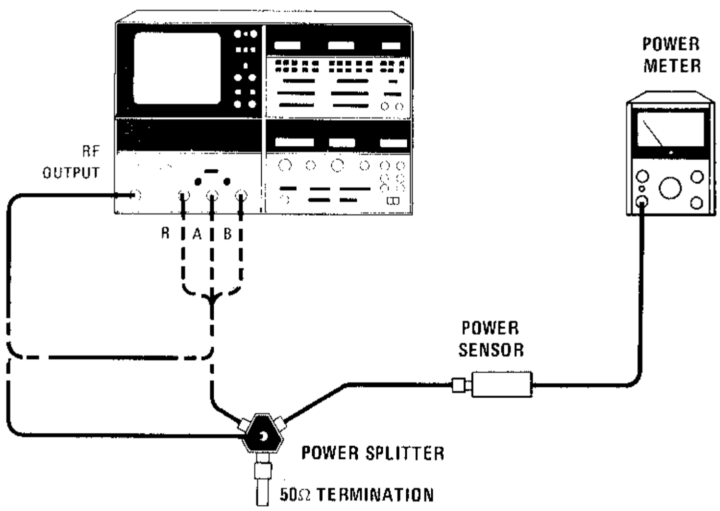


Figure A4-9. Absolute Magnitude Frequency Response Test Setup

EQUIPMENT:

Power Meter	HP 435A
Power Sensor	HP 8482A
Three-way Power Splitter	HP 11850A
50-Ohm Termination	HP 909A Option 012

PROCEDURE:

ABSOLUTE MAGNITUDE FREQUENCY RESPONSE

a. On 8505A, set the controls as follows:

On A1 Source/Converter:

OUTPUT LEVEL dBm	−20 dB
OUTPUT LEVEL VERNIER	−10 dB
INPUT LEVEL dBm MAX	−10

On A2 Frequency Control:

RANGE MHz	0.5 − 1300
MODE	LIN FULL
WIDTH	START/STOP 1

NOTE

It may be necessary to make slight adjustment at 0.50 MHz of Frequency Calibrate pot behind FREQUENCY CONTROL front panel. (See paragraph A4-8.)

MARKERS	1
Marker 1	Midrange

PERFORMANCE TESTS

A4-15. MAGNITUDE, PHASE, AND GROUP DELAY FREQUENCY RESPONSE (Cont'd)

On A3 Signal Processor:
Channel 1:
INPUT . . . . R
MODE . . . . MAG
SCALE/DIV . . . . 0.5 dB/DIV

Channel 2:
MODE . . . . OFF

CRT Display:
REF LINE POSN . . . . Center Graticule Line
BW . . . . 10 kHz On (in)
VIDEO FILTER . . . . Off (out)

b. Connect equipment as shown in Figure 4-9 with "R" INPUT cable connected directly to RF OUTPUT connector.

c. Press DISPLAY CLR, MKR, then ZRO pushbuttons. Observe the highest and lowest point on the CRT trace between 0.5 and 1300 MHz. They should not be greater than 3 dB difference. If the CRT trace is within tolerance, go to step h and check "A" input port. If "A" port has been checked, go to step i and check "B" input port. If the CRT trace is out of tolerance, go to step d and cancel the effect of the RF source variations to see if the receiver section is actually within tolerance.

d. Connect equipment as shown in Figure A4-9, with RF OUTPUT to center of Power Splitter and one leg of power splitter to port "R" and the other leg to Power Sensor and Power Meter.

e. Set Marker 1 to the point on CRT trace that is maximum. Note Marker reading and Power Meter reading.

f. Set Marker 1 to the point on CRT trace that is minimum. Adjust OUTPUT LEVEL VERNIER and step attenuator to set Power Meter to the same indication noted in step e.

g. Subtract the Marker indication noted in step e from the displayed marker reading. The difference should be $\leq$3 dB.

h. Disconnect RF Cable from "R" INPUT and connect to "A" INPUT. Set Signal Processor Channel 1 INPUT switch to A. Repeat preceding step c and observe the power level variations for "A" INPUT.

i. Disconnect RF Cable from "A" INPUT and connect to "B" INPUT. Set Signal Processor Channel 1 INPUT switch to B. Repeat preceding step c and observe the power level variations for "B" INPUT.

RATIO MEASUREMENT MAGNITUDE FREQUENCY RESPONSE

j. Connect equipment as shown in Figure A4-10 with the power splitter connected to "R", "A", and "B" inputs and Power Meter disconnected from setup.

k. On A2 Frequency Control, set RANGE MHz switch to 0.5 — 1300 MHz position, set MODE to LIN FULL, WIDTH to START/STOP 1, SCAN TIME SEC to 1 — .1, and TRIGGER to AUTO. Set MARKER switch to 1 position and Marker 1 control to approximately 640 MHz.

l. On A3 Signal Processor, set CHANNEL 1 INPUT switch to A/R, set MODE to MAG, and set SCALE/DIV switch to 0.1 dB position. Press DISPLAY MKR, then ZRO pushbutton.

PERFORMANCE TESTS

A4-15. MAGNITUDE, PHASE, AND GROUP DELAY FREQUENCY RESPONSE (Cont'd)

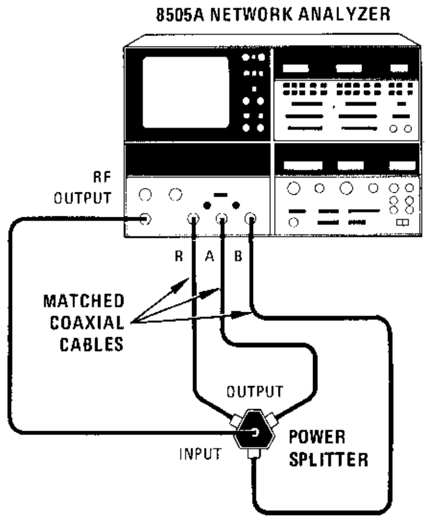


Figure A4-10. Ratio Frequency Response Test Setup

EQUIPMENT:

Three-way Power Splitter . . . . HP 11850A
Matched Cable Kit. . . . . HP 11851A

m. On A2 Frequency Control, adjust MARKER 1 frequency control between 0.5 MHz (left end of CRT trace) and 1300 MHz (right end of CRT trace). Note the highest and lowest reading on the Signal Processor Channel 1 readout. The difference between the highest and lowest reading (peak-to-peak variation due to frequency response) should be ≤0.6 dB.

n. Set Signal Processor Channel 1 INPUT switch to B/R. Press DISPLAY MKR then ZRO pushbuttons. Repeat preceding step.

PHASE MEASUREMENT FREQUENCY RESPONSE

o. Set MODE to LIN EXPAND, WIDTH to START/STOP 1. Set START to 00000. MHz, STOP to 750 MHz. Set Channel 1 INPUT to B/R, MODE to PHASE, and SCALE/DIV to 2 degrees.

p. Set ELECTRICAL LENGTH INPUT to B and MODE to LENGTH X1. Press LENGTH pushbuttons to make the overall CRT trace as horizontal as possible.

q. Press Channel 1 DISPLAY MKR, then ZRO pushbutton to position the trace near the center graticule line. The maximum trace deviation from the highest point to the lowest point should be ≤6 degrees (3 divisions). If the reading is out of tolerance, the power splitter tracking may be at fault. Check the power splitter tracking as follows. Reverse the connections to the power splitter legs, then make the phase measurements again and subtract the two readings. The difference in readings is the power splitter tracking error. Correct the original phase measurements by subtracting the power splitter tracking error.

r. Set START to 750 MHz and STOP to 1300 MHz and repeat steps p and q for the 750 to 1300 MHz range. The trace deviation should be ≤10 degrees (5 divisions).

s. Repeat steps o through r for A/R measurement except set Channel 1 INPUT switch to A/R in step o and set ELECTRICAL LENGTH INPUT switch to A in step p.

PERFORMANCE TESTS

A4-15. MAGNITUDE, PHASE, AND GROUP DELAY FREQUENCY RESPONSE (Cont'd)

GROUP DELAY FREQUENCY RESPONSE

t. On A3 Signal Processor, set Channel 1 INPUT switch to A/R, MODE switch to DLY and set SCALE/DIV switch to 1 ns. Set Frequency Control MODE switch to LIN FULL.

u. Press Electrical Length DISPLAY CLR Pushbutton. Press Channel 1 DISPLAY MKR, then ZRO pushbuttons to center CRT trace about center graticule line and zero digital readout.

v. On A2 Frequency Control, adjust MARKER 1 frequency control between 0.5 and 1300 MHz and note the highest and lowest reading on the Signal Processor Channel 1 readout. The difference between the highest and the lowest reading (peak-to-peak variation due to frequency response) should be $\leqslant$2 ns.

w. Repeat steps t through v for B/R measurements. Set all switches the same except set Channel 1 INPUT switch to B/R in step t.

A4-16. MAGNITUDE DYNAMIC ACCURACY TEST

SPECIFICATION:

Magnitude Dynamic Accuracy: $\leqslant \pm 0.01$ dB/dB from -20 to -40 dBm
$\leqslant \pm 0.2$ dB from -10 to -50 dBm
$\leqslant \pm 0.5$ dB from -50 to -70 dBm
$\leqslant \pm 1$ dB from -70 to -90 dBm
$\leqslant \pm 2$ dB from -90 to -100 dBm
$\leqslant \pm 4$ dB from -100 to -110 dBm

DESCRIPTION:

The signal level into the receiver is adjusted by setting the external step attenuator. The signal trace is monitored on the CRT and deviation from the expected position of the trace on the graticule is noted.

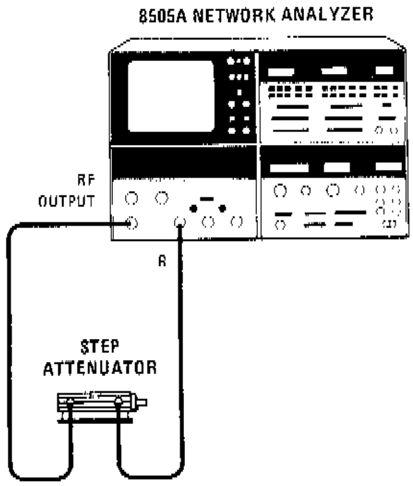


Figure A4-11. Dynamic Range Test Setup

EQUIPMENT: 0 — 110 dB Step Attenuator (calibrated at 30 MHz) . . . . HP 8496A

PERFORMANCE TESTS

A4-16. MAGNITUDE DYNAMIC ACCURACY TEST (Cont'd)

PROCEDURE:

a. On 8505A, set the controls as follows:

On A1 Source/Converter:
OUTPUT LEVEL dBm 0
OUTPUT LEVEL VERNIER 0
INPUT LEVEL dBm MAX . . . . —10

On A2 Frequency Control:
RANGE MHz . . . . 0.5 — 130
MODE . . . . LIN EXPAND
WIDTH . . . . CW±ΔF
CW FREQUENCY . . . . 30.0 MHz
±ΔF FREQUENCY 00.0

On A3 Signal Processor:
Channel 1:
INPUT . . . . R
MODE . . . . MAG
SCALE/DIV . . . . 0.2 dB/DIV

Channel 2:
MODE . . . . OFF

Electrical Length:
MODE . . . . OFF

Display Section:
BANDWIDTH kHz . . . . 10 kHz On (in)
REF LINE POSN . . . . Reference Line to Center Graticule Line
VIDEO FILTER . . . . On (in)

b. Connect equipment as shown in Figure A4-11.

c. Connect calibrated attenuator between RF output and input "R", and set to 30 dB. Press Channel 1 DISPLAY MKR, then ZRO pushbuttons until trace settles. Press CHAN 1 DISPLAY REF pushbutton. As attenuator is stepped down, offset —10 dB/step to bring trace back to reference line within limits shown in following table. (It may be necessary to change CHAN 1 SCALE/DIV to less sensitivity settings if trace is off screen.)

d. Repeat step c with attenuator connected to "A" input and Channel 1 INPUT switch to "A".

e. Repeat step c with attenuator connected to "B" input and Channel 1 INPUT switch to "B".

PERFORMANCE TESTS

A4-16. MAGNITUDE DYNAMIC ACCURACY TEST (Cont'd)

External Attenuator Setting	Channel 1 REF OFFSET	OFFSET from REF LINE (Plus attenuator tolerance)
10 dB	+20.0	±0.20 dB
20 dB	+10.0 dB	±0.1 dB
30 dB	0 dB	±0.00 dB
40 dB	−10.0 dB	±0.1 dB
50 dB	− 20.0 dB	±0.2 dB
60 dB	− 30.0 dB	±0.4 dB
70 dB	− 40.0 dB	±0.6 dB
80 dB	− 50.0 dB	±0.8 dB
90 dB	− 60.0 dB	±1 dB
100 dB	− 70.0 dB	±2 dB
110 dB	− 80.0 dB	±4 dB

A4-17. PHASE DYNAMIC RANGE

SPECIFICATION:

Phase Dynamic Accuracy (in 10 kHz Bandwidth):
- ±0.02 degree/dB from −20 to −40 dBm
- ±0.5 degree from −10 to −50 dBm
- ±1 degree from −50 to −70 dBm
- ±3 degrees from −70 to −90 dBm

DESCRIPTION:

A phase reference level is established on the CRT. Then the signal at the receiver is changed through the dynamic range of the instrument and the change in phase indication is noted.

PERFORMANCE TESTS

A4-17. PHASE DYNAMIC RANGE (Cont'd)

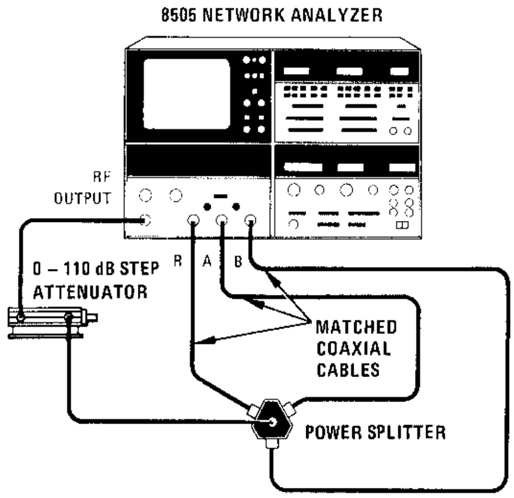


Figure A4-12. Phase Dynamic Range Test Setup

EQUIPMENT:

RF Cable Kit	HP 11851A
3-Way Power Splitter	HP 11850A
Step Attenuator, 0 — 110 dB	HP 8496A

PROCEDURE:

a. On 8505A, set controls as follows:

On A1 Source/Converter:

OUTPUT LEVEL dBm	+10 dB
OUTPUT LEVEL VERNIER	.0
INPUT LEVEL dBm MAX	—10

On A2 Frequency Control

RANGE MHz	0.5 — 130
MODE	LIN EXPAND
WIDTH	CW ±ΔF
SCAN TIME SEC	.1 — .01
CW FREQUENCY	30 MHz
±ΔF FREQUENCY	00.0
MARKERS	1
Marker 1	Center of CRT Screen

On A3 Signal Processor:

Channel 1:

INPUT	A/R
MODE	PHASE
SCALE/DIV	1 degree

PERFORMANCE TESTS

A4-17. PHASE DYNAMIC RANGE (Cont'd)

Channel 2:
MODE . . . . OFF

Electrical Length:
MODE . . . . OFF

Display Section:
BANDWIDTH kHz . . . . 10 kHz On (in)
VIDEO FILTER . . . . On (in)
REF LINE POSN . . . . Adjust Reference Line to CRT center graticule line

b. Connect equipment as shown in Figure A4-12.

c. Set external step attenuator to 10 dB. If "R" OVERLOAD light comes on, adjust OUTPUT LEVEL VERNIER to clear overload. Press Channel 1 DISPLAY MKR, then ZRO pushbuttons to place the CRT trace on the center graticule line.

d. Step external step attenuator from 10 to 50 dB position. (This applies −50 dBm to ports "A" and "R".) The trace should be within ±0.5 degree of Reference Line.

e. Step the external attenuator from 50 to 70 dB position. (This applies −70 dBm to ports "A" and "R".) The CRT trace should be within ±1 degree of Reference Line.

f. Step the external attenuator from 70 to 90 dB position. (This applies −90 dBm to ports "A" and "R".) The CRT trace should be within ±3 degrees of Reference Line.

A4-18. PHASE REFERENCE OFFSET

SPECIFICATION:

Phase Reference Offset:

Range: ±1700 degrees
Accuracy: ±0.3° ±0.5% of offset

DESCRIPTION:

The CW phase signal is observed on the CRT. The signal is offset multiples of 360 degrees and observed if it returns to the reference line.

PERFORMANCE TESTS

A4-18. PHASE REFERENCE OFFSET (Cont'd)

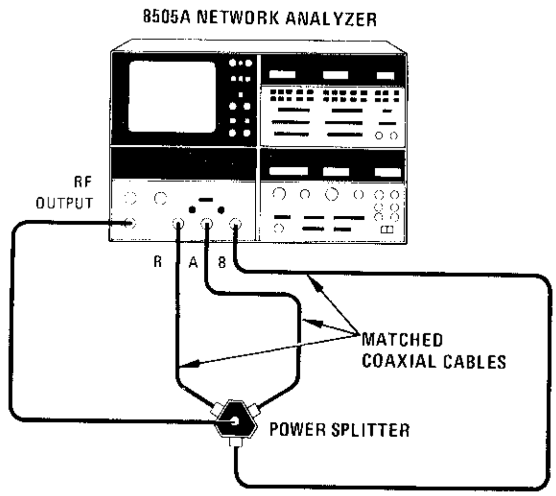


Figure A4-13. Phase Reference Offset Test Setup

EQUIPMENT:

3-Way Power Splitter . . . . HP 11850A
Matched Type-N Coaxial Cables . . . . HP 11851A

PROCEDURE:

a. On 8505A, set controls as follows:

On A1 Source/Converter:
OUTPUT LEVEL dBm . . . . −10
OUTPUT LEVEL VERNIER 0
INPUT LEVEL dBm MAX . . . . −10

On A2 Frequency Control:
RANGE MHz . . . . 0.5 − 130
MODE . . . . LIN EXPAND
WIDTH . . . . CW $\pm\Delta$F
SCAN TIME SEC . . . . .1 − .01
SCAN TIME VERNIER . . . . Fully Clockwise
TRIGGER . . . . AUTO
CW FREQUENCY . . . . 60 MHz
$\pm\Delta$F FREQUENCY . . . . 4.5 MHz

On A3 Signal Processor:
Channel 1:
INPUT . . . . A/R
MODE . . . . POLAR PHASE
SCALE/DIV . . . . 1°/DIV

Channel 2:
MODE . . . . OFF

PERFORMANCE TESTS

A4-18. PHASE REFERENCE OFFSET (Cont'd)

Electrical Length:
INPUT . . . . A
MODE . . . . OFF

CRT Display:
BANDWIDTH kHz 10
REF LINE POSN . . . . Adjust Reference Line to center of CRT
VIDEO FILTER . . . . On (in)

b. Connect equipment as shown in Figure A4-13.

c. Press Channel 1 DISPLAY MKR, then ZRO pushbuttons to place the CRT trace on the reference line. If trace is not on CRT center line, make slight adjustment with CRT Display CH 1 to place the trace directly on the center line.

d. Press Channel 1 DISPLAY REF. Press REF OFFSET pushbuttons to obtain offset shown below, then check that the phase trace is within the limits of the reference line listed below.

REF OFFSET	TRACE ACCURACY FROM CENTER LINE
±360°	≤± 2.1°
±720°	≤± 3.9°
±1080°	≤± 5.7°
±1440°	≤± 7.5°

A4-19. PHASE ACCURACY AND ELECTRICAL LENGTH TEST

SPECIFICATION:

Phase Accuracy: ±0.01 degrees/degree for ±170 degrees
±0.01 degrees/degree ±0.5 degrees for ±180 degrees.

Polar Accuracy: actual value is within less than a 3 mm circle of displayed value.

Electrical Length Accuracy: ±3% of reading ±1% of length range.

DESCRIPTION:

The hysteresis loop is observed to see that the 180 degree transition occurs at precisely +180 degrees and −180 degrees. The electrical length offset is checked by inserting two phase cycles and reading the resultant Electrical Length digital readout of 720 degrees.

PERFORMANCE TESTS

A4-19. PHASE ACCURACY AND ELECTRICAL LENGTH TEST

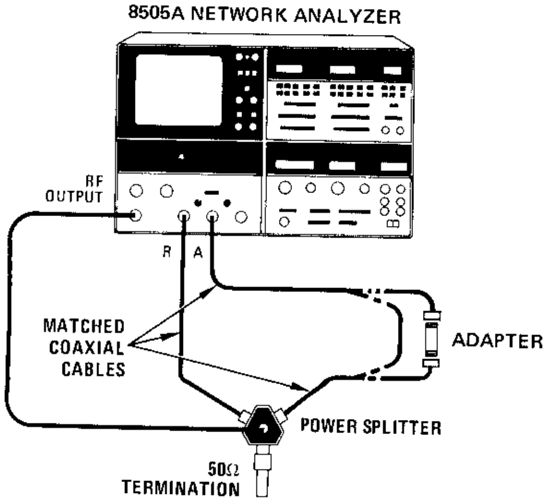


Figure A4-14. Phase Accuracy Test Setup

EQUIPMENT:

50-Ohm Termination. . . . . .HP 909A Option 012
Type-N Female to Type-N Female Adapter. . . . . HP 1250-0777
3-Way Power Splitter. . . . . HP 11850A
RF Cable Kit. . . . . HP 11851A

PROCEDURE:

PHASE ACCURACY TEST

a. On 8505A, set the controls as follows:

On A1 Source/Converter:
OUTPUT LEVEL dBm . . . . —10
OUTPUT LEVEL VERNIER 0
INPUT LEVEL dBm MAX . . . . —10

On A2 Frequency Control:
RANGE MHz . . . . 0.5 — 130
MODE. . . . . LIN EXPAND
WIDTH . . . . CW ±ΔF
CW FREQUENCY. . . . . 60 MHz
±ΔF FREQUENCY . . . . 6.0 MHz
SCAN TIME SEC . . . . .1 — .01
TRIGGER. . . . . AUTO
MARKERS 1
Marker 1 . . . . 60 MHz

PERFORMANCE TESTS

A4-19. PHASE ACCURACY AND ELECTRICAL LENGTH TEST (Cont'd)

On A3 Signal Processor:

Channel 1:
- INPUT . . . . A/R
- MODE . . . . PHASE
- SCALE/DIV . . . . 90°/DIV

Channel 2:
- MODE . . . . OFF

CRT Display:
- BW (Bandwidth) . . . . 10 kHz
- Video Filter . . . . Off (out)

Electrical Length Panel:
- MODE . . . . OFF

b. Connect equipment as shown in Figure A4-14 with two 24-inch matched cables connected in series between Port "A" and the 3-way power splitter.

c. Offset the phase trace with the Channel 1 REF OFFSET pushbuttons to place a phase transistion to the right of midscreen as shown in Figure A4-15.

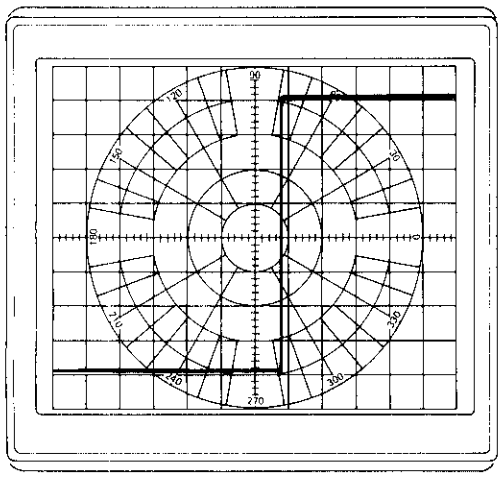


Figure A4-15. CRT Trace of Phase Transistion

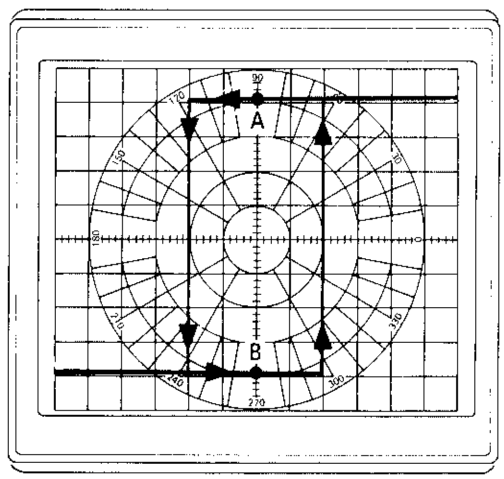


Figure A4-16. Hysteresis Loop of Phase Trace

d. Set SCAN TIME SEC to MANUAL. Sweep through the transition in both forward and reverse direction using the Manual sweep control. Note the hysteresis loop as shown in Figure A4-16.

e. Adjust both CW FREQUENCY and ±ΔF FREQUENCY to make the hysteresis loop six divisions wide and centered on the vertical center line of CRT. (See Figure A4-16.)

NOTE

If either step f or g is out of tolerance, refer to Section V for adjustment of A3A12 Phase Detector.

f. Press Channel 1 DISPLAY MKR. Center trace dot on the vertical center line at point "A" on Figure A4-16 trace. The marker readout should be +180 degrees ±2 degrees.

PERFORMANCE TESTS

A4-19. PHASE ACCURACY AND ELECTRICAL LENGTH TEST (Cont'd)

g. Center trace dot on the vertical center line at point "B" on Figure A4-16 trace. The Channel 1 marker readout should be —180 degrees ±2 degrees.

ELECTRICAL LENGTH LINE STRETCHER TEST

h. Remove extra 24-inch cable and adapter and reconnect Port "A" to the three-way power splitter through one of the matched cables.

i. On Frequency Control, set:
RANGE MHz . . . . 0.5 — 1300 MHz
MODE . . . . LIN EXPAND
WIDTH . . . . CW ±ΔF
±ΔF FREQUENCY . . . . 0 MHz
CW FREQUENCY (read on FREQ COUNTER MHz panel) . . . . 1000 MHz

On Signal Processor, set:
Channel 1:
INPUT . . . . A/R
MODE . . . . POLAR MAG
SCALE/DIV . . . . POLAR FULL 1

CRT Display:
BW (Bandwidth) . . . . 10 kHz On (in)
VIDEO FILTER . . . . Off (out)

j. At ELECTRICAL LENGTH Panel, set:
INPUT . . . . A
MODE LENGTH X10
VERNIER A . . . . 0 (fully counterclockwise)
DISPLAY CLR . . . . Press and release

k. On Channel 1, press DISPLAY MKR, then ZRO pushbuttons. Set Channel 1 MODE switch to POLAR PHASE, then press DISPLAY ZRO. This should place the trace dot within 3 mm of the outside circle and zero degrees.

l. Press ELECTRICAL LENGTH pushbuttons to add +30 cm length. The trace dot should move around the outside circle back to 0 degrees ±10 degrees.

m. Set ELECTRICAL LENGTH MODE switch to LENGTH X1 position. Press ELECTRICAL LENGTH pushbuttons to read +15 cm. The trace dot should be at 180 degrees ±5 degrees. The same indication appearing on the CRT should appear on the Channel 1 digital readout.

LINEAR PHASE RANGE

n. Set Channel 1 MODE to PHASE and SCALE/DIV to 90 degrees. Set ELECTRICAL LENGTH MODE switch to PHASE X10 degrees/SCAN. Press Channel 1 DISPLAY REF, then CLR and press ELECTRICAL LENGTH DISPLAY CLR.

PERFORMANCE TESTS

A4-19. PHASE ACCURACY AND ELECTRICAL LENGTH TEST (Cont'd)

o. With ELECTRICAL LENGTH offset pushbuttons, put in +1800 degrees of electrical length. (The electrical length readout displays +180.) Verify that five transitions are displayed and that the linear phase display limits over approximately the last 5% of the trace. (See Figure A4-17, Photo A.)

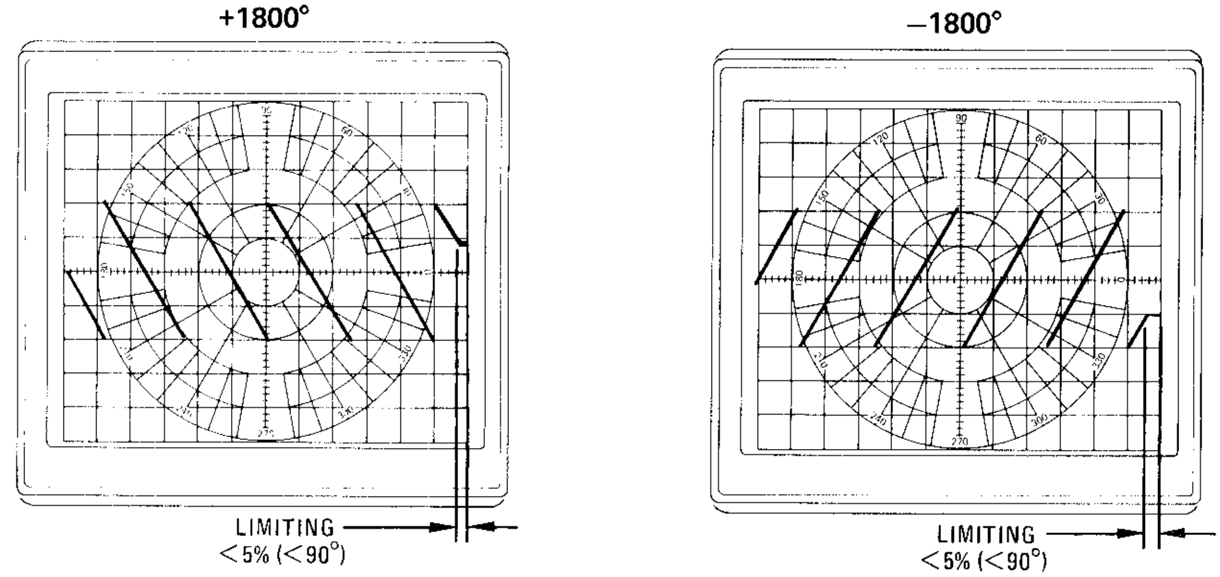


Figure A4-17. Phase Trace with Maximum Electrical Length Added

p. Reduce electrical length with LENGTH pushbuttons until the limiting section just goes off-screen. The digital readout at ELECTRICAL LENGTH panel should be ⩾+173 (⩾+1730 degrees).

q. With ELECTRICAL LENGTH offset pushbuttons, put in −1800 degrees of electrical length. (The electrical length readout displays −180.) Verify that five transitions are displayed and that the linear phase display limits over approximately the last 5% of the trace. (See Figure A4-17, Photo B.)

r. Reduce electrical length with LENGTH pushbuttons until the limiting section just goes off-screen. The digital readout at ELECTRICAL LENGTH panel should be equal to or more negative than −173 (equal to or more negative than −1730 degrees).

LINEAR PHASE ACCURACY

s. On ELECTRICAL LENGTH panel, set MODE switch to PHASE X 10 degrees/SCAN, set VERNIER A to zero, then press DISPLAY CLR pushbutton.

t. On Channel 1, set MODE switch to PHASE. Press DISPLAY REF, then CLR pushbuttons. Press MKR, then ZRO pushbuttons. Press DISPLAY REF, then REF OFFSET pushbuttons to place −180 degrees of offset in Channel 1.

u. On ELECTRICAL LENGTH panel, press LENGTH pushbutton to obtain two complete phase cycles on the CRT screen. The ELECTRICAL LENGTH digital readout should be ±72 ±2, corresponding to ±720 degrees ±20 degrees of electrical length.

PERFORMANCE TESTS

A4-20. GROUP DELAY ACCURACY TEST

SPECIFICATIONS:

Group Delay Accuracy: ≤±3% of reading ±1 ns for 0.5 to 1300 MHz range, or ±10 ns for 0.5 to 130 MHz range,or ±100 ns for 0.5 to 13 MHz range.

DESCRIPTON:

A 50-foot coaxial cable is measured for group delay using the phase function of the 8505A. The group delay mode is then used to measure the 50-foot cable to obtain a direct group delay reading.

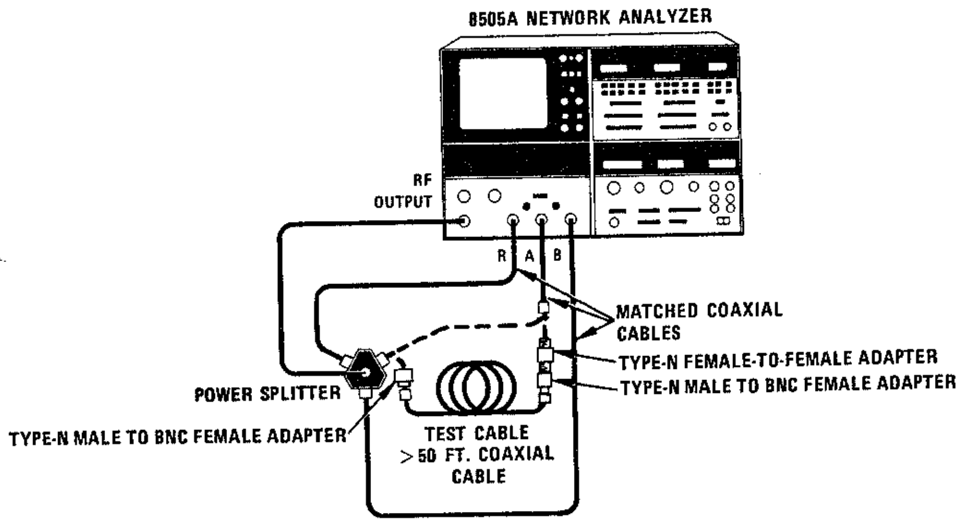


Figure A4-18. Test Setup to Measure Group Delay of Test Cable

EQUIPMENT:

3-Way Power Splitter.. HP 11850A
Matched Type-N Coaxial Cables .... HP 11851A
Test Cable .... ≥50 feet of coaxial cable (RG-223/U or similar)
BNC to Type-N Adapters (2 required)........................ HP 1250-0780
Type-N female to Type-N female Adapter .... HP 1250-0777

PROCEDURE:

a. A coaxial cable greater than 50 feet in length is used as a standard in the group delay test. Group delay of the test cable is measured with the 8505A in phase mode as follows:

(1) Connect the "Test Cable" in A channel between the matched cable and the power splitter as shown in Figure A4-18.

(2) Set 8505A controls as follows:

On A1 Source/Converter:
OUTPUT LEVEL dBm .... –10
OUTPUT LEVEL Vernier 0
INPUT LEVEL dBm MAX .... –10

MANUAL CHANGE

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PERFORMANCE TESTS

A4-20. GROUP DELAY ACCURACY TESTS (Cont'd)

On A2 Frequency Control:

RANGE MHz	0.5 — 1300
MODE	LIN EXPAND
WIDTH	CW
SCAN TIME SEC	.1 — .01
TRIGGER	AUTO
MARKERS	1
SCAN TIME SEC VERNIER	Midrange

On A3 Signal Processor:

Channel 1

INPUT	A/R
MODE	PHASE
SCALE/DIV	45 DEG

Channel 2

MODE	OFF

Electrical Length

INPUT	A
MODE	OFF

(3) Set A2 Frequency Control CW FREQUENCY and VERNIER for 700.00 MHz. Press Channel 1 DISPLAY MKR pushbutton, then ZRO pushbutton to zero the digital readout.

(4) On A2 Frequency Control, adjust CW FREQUENCY up in frequency until the marker digital readout again indicates 0 degrees. Record frequency for use in later calculation. (NOTE: The phase change between the two zero points is 360 degrees.)

Frequency = ________ MHz

(5) Calculate the group delay of the "Test Cable"

$$t_D = \frac{\text{(Phase change in degrees)}}{360 \times \text{(Change in Frequency in Hz)}}$$

EXAMPLE

Change in Phase = 360 degrees

Change in Frequency = 713 MHz − 700 MHz

= 13 MHz

$$t_D = \frac{360 \text{ degrees}}{360\ (13 \times 10^6 \text{ Hz})} \doteq \frac{1}{13 \times 10^6 \text{ Hz}}$$

= 77 ns

A4-20. GROUP DELAY ACCURACY TEST (Cont'd)

b. Connect equipment as shown in Figure A4-18 with both matched cables connected to power splitter and "test cable" with adapters not connected in circuit.

c. On 8505A, set controls as follows:

On A1 Source/Converter:
OUTPUT LEVEL dBm . . . . −10
OUTPUT LEVEL VERNIER 0
INPUT LEVEL dBm MAX . . . . −10

On A2 Frequency Control:
RANGE MHz . . . . 0.5 — 1300
MODE . . . . LIN FULL
WIDTH . . . . START/STOP 1
SCAN TIME SEC . . . . 1 — .1
SCAN TIME VERNIER . . . . Fully clockwise
MARKERS 1
Marker 1 . . . . Midrange
TRIGGER . . . . AUTO

On A3 Signal Processor:
Channel 1
INPUT . . . . A/R
MODE . . . . DLY
SCALE/DIV . . . . DELAY 1 ns*

Channel 2
MODE . . . . OFF

Electrical Length
INPUT . . . . A
MODE . . . . OFF

d. Press Channel 1 DISPLAY REF pushbutton, then CLR pushbutton until REL light goes out (if it was lit). Then press MKR pushbutton.

e. Connect "Test Cable" between adapters in the A channel. The channel 1 digital readout should indicate the group delay calculated for the "Test Cable" in step a (5) above ±(1 ns +3% of reading).

*SCALE/DIV is set to 1 ns to obtain 0.1 ns resolution. The CRT trace may be off screen.

PERFORMANCE TESTS

A4-21. INPUT IMPEDANCE TEST

SPECIFICATION:

Input Impedance: 50 Ohms
Return Loss: ⩾20 dB (⩽1.22 SWR)

DESCRIPTION:

A short is placed on the TEST port of the Transmission/Reflection Test Set and a reference level is established. The Test Set is then connected to a port and the return loss is the difference between the reference level and the measured level of signal.

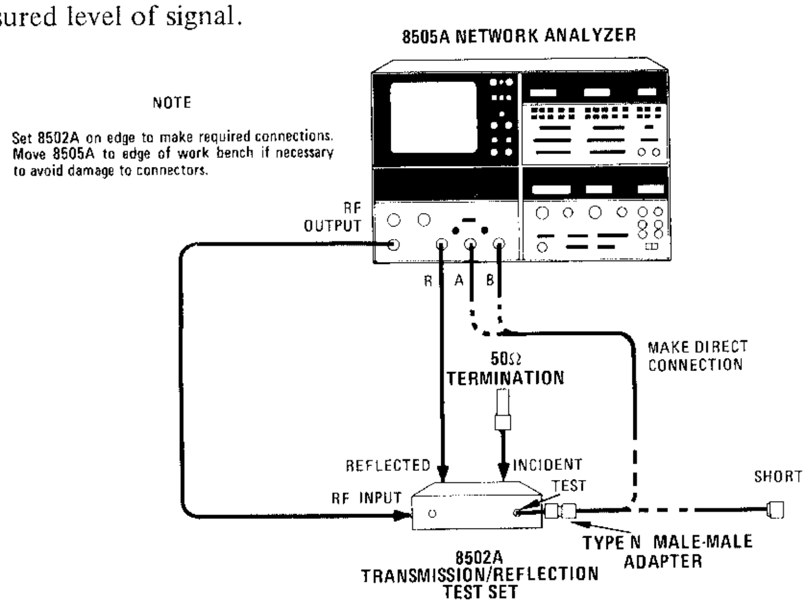


Figure A4-19. Input Impedance Test Setup

EQUIPMENT:

Matched Cable Kit	HP 11851A
Transmission/Reflection Test Set	HP 8502A
Type-N Female Short	HP 11511A
Type-N Male-Male Adapter	HP 1250-0778
50-Ohm Termination	HP 909A Option 012

PROCEDURE:

a. On 8505A, set controls as follows:

On A1 Source/Converter:

OUTPUT LEVEL dBm	−10
OUTPUT LEVEL VERNIER	.0
INPUT LEVEL dBm MAX	−10

On A2 Frequency Control:

RANGE MHz	0.5 − 1300
MODE	LIN FULL
WIDTH	START/STOP 1
SCAN TIME SEC	1 − 0.1

PERFORMANCE TESTS

A4-21. INPUT IMPEDANCE TEST (Cont'd)

A2 Frequency Control (cont'd)
- SCAN TIME VERNIER . . . . Clockwise
- MARKERS 1
- Marker 1 . . . . Midscreen

On A3 Signal Processor:

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

Channel 2:
- MODE . . . . OFF

CRT Display:
- BW (Bandwidth) . . . . 10 kHz
- VIDEO FILTER . . . . Off (out)

b. Connect equipment as shown in Figure A4-19 with the short connected to the TEST port of the 8502A Transmission/Reflection Test Set and RF INPUT ATTENUATION switch set to 0 dB.

c. Press Channel 1 DISPLAY MKR, then ZRO pushbuttons to center trace on the CRT.

CAUTION

Use only water soluble "grease pencil" on CRT.

d. Draw a grease pencil mark over the trace on the CRT display.

e. Remove short from the TEST connector of the test set and connect the TEST port directly to the 8505A "A" port (no coaxial cable between).

NOTE

One dB is added to the 20 dB return loss specification to account for the directivity of the 8502A Test Set.

f. Press Channel 1 DISPLAY REF pushbutton. Press Channel 1 REF OFFSET pushbuttons to obtain -21 dB at digital display.

g. Compare the CRT trace to the grease pencil reference line. The CRT trace should be below the grease pencil mark for ≥ 20 dB of return loss (≤ 1.22 SWR).

h. Disconnect Test Set TEST port from "A" port and connect to "B" port. Repeat step g above.

i. Remove grease pencil marks from CRT display. Disconnect Test Set TEST port from "B" port and connect a short on the TEST port. Disconnect REFLECTED port of Test Set from 8505A "R" port and connect it to "A" port. Set Channel 1 INPUT switch to A.

PERFORMANCE TESTS

A4-21. INPUT IMPEDANCE TEST (Cont'd)

j. Press Channel 1 DISPLAY MKR then ZRO pushbutton to center the trace on the CRT. Draw a grease pencil mark over the trace on the CRT display.

k. Remove short from the Test Set TEST port and connect port to 8505A "R" port.

l. Press Channel 1 DISPLAY REF pushbutton. Press Channel 1 REF OFFSET pushbuttons to obtain −21 dB at digital display.

m. Compare the CRT trace to the grease pencil reference line. The CRT trace should be below the grease pencil mark for ≥20 dB of return loss (≤1.22 SWR).

A4-22. SOURCE IMPEDANCE TEST

SPECIFICATION:

Impedance: 50 Ohms; ≥16 dB return loss at −10 dBm output level (<1.38 SWR).

DESCRIPTION:

The incident signal from the Source/Converter is measured using a directional coupler and the receiver portion of the 8505A. The incident signal contains (1) the initial signal from the source, and (2) the reflected signal. The reflected signal is developed as follows. The original source signal travels down the 50-ohm coaxial cable, sees the open end, and is reflected back to the source. If the reflected signal going into the RF OUTPUT connector sees a perfect 50-ohm source match, no signal is reflected back out of the source. However, the greater the mismatch, the greater the reflected signal out of the source. This reflected signal adds and subtracts in and out of phase with the incident signal and is displayed on the CRT.

PERFORMANCE TESTS

A4-22. SOURCE IMPEDANCE TEST (Cont'd)

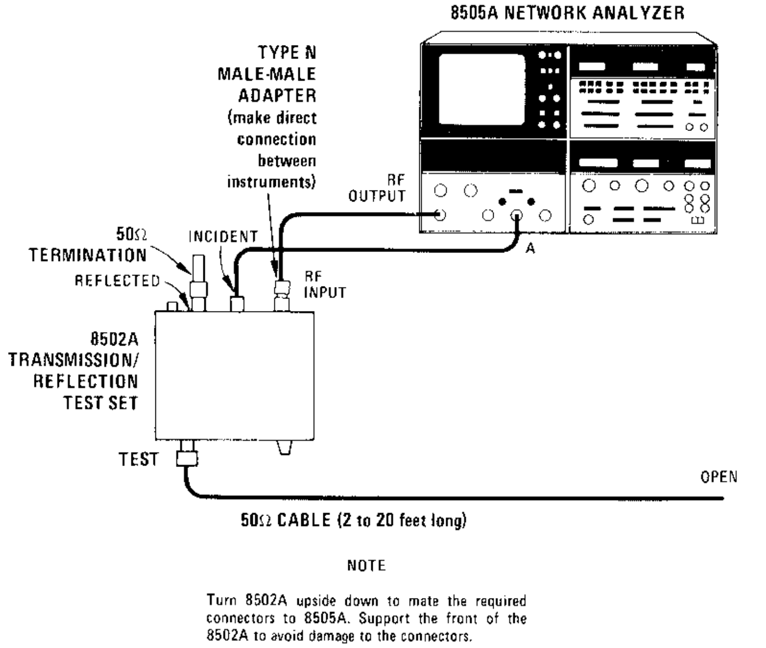


Figure A4-20. Test Setups for Equivalent Source Match

EQUIPMENT:

2-to-20 ft. 50-Ohm Coaxial Cable (Type N)	RG214/U or equivalent
50-Ohm Termination	HP 909A Option 012
Transmission/Reflection Test Set	HP 8502A
Type-N Male Barrel	HP 1250-1475

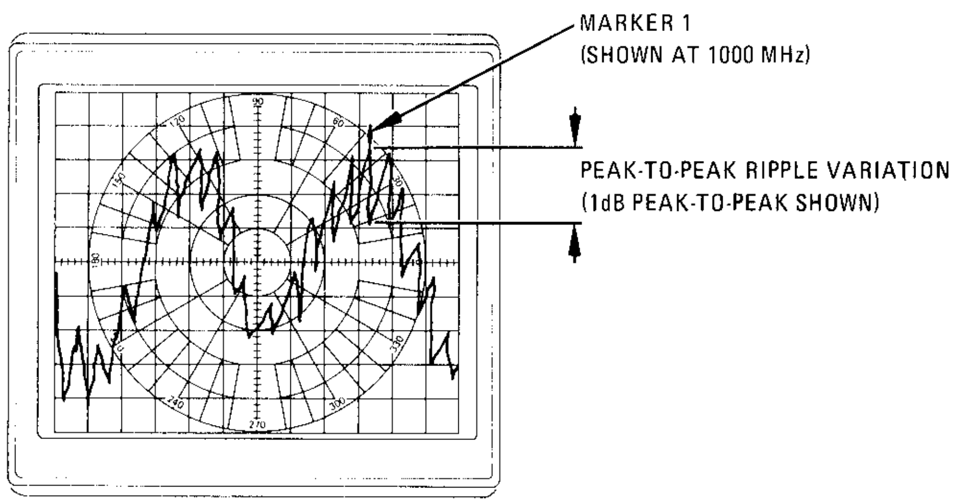


Figure A4-21. Typical Trace of Source Impedance Ripple

PERFORMANCE TESTS

A4-22. SOURCE IMPEDANCE TEST (Cont'd)

PROCEDURE:

a. On 8505A, set controls as follows:

On A1 Source/Converter:

OUTPUT LEVEL dBm	−10 dBm
OUTPUT LEVEL Vernier	0
INPUT LEVEL dBm MAX	−10

On A2 Frequency Control:

RANGE MHz	.5 — 1300
MODE	LIN EXP
WIDTH	START/STOP 1
SCAN TIME SEC	1 — 0.1
SCAN TIME Vernier	Fully Counterclockwise
TRIGGER	AUTO
START FREQUENCY	100 MHz
STOP FREQUENCY	1300 MHz
MARKERS	1

On A3 Signal Processor:

Channel 1

INPUT	A
MODE	MAG
SCALE/DIV	0.5 dB

Channel 2

MODE	OFF

b. Connect equipment as shown in Figure A4-20. Set 8502A RF INPUT ATTENUATION to 0 dB.

NOTE

A single section of 2 to 20 feet of 50 ohm cable is required to avoid mismatch of connectors.

c. Press Channel 1 DISPLAY MKR then ZRO pushbuttons. The trace should be displayed on CRT.

d. Select point on trace near the top or bottom of trace where adjacent ripple cycles may be measured. Adjust Marker 1 to place the Marker 1 diamond on the area where the ripples are measured as shown in Figure A4-21. Read the MARKER 1 frequency from FREQ COUNTERdigital display.(EXAMPLE: 1000 MHz.) Note maximum ripple in this area. (EXAMPLE: 1 dB peak-to-peak.)

e. Use Table A4-1 to calculate the loss in the coaxial cable in the test setup and Figure A4-7 to determine the return loss and SWR that corresponds to the ripple measured in step d. The SWR should be ≤1.38 (≥16 dB RETURN LOSS).

PERFORMANCE TESTS

A4-22. SOURCE IMPEDANCE TEST (Cont'd)

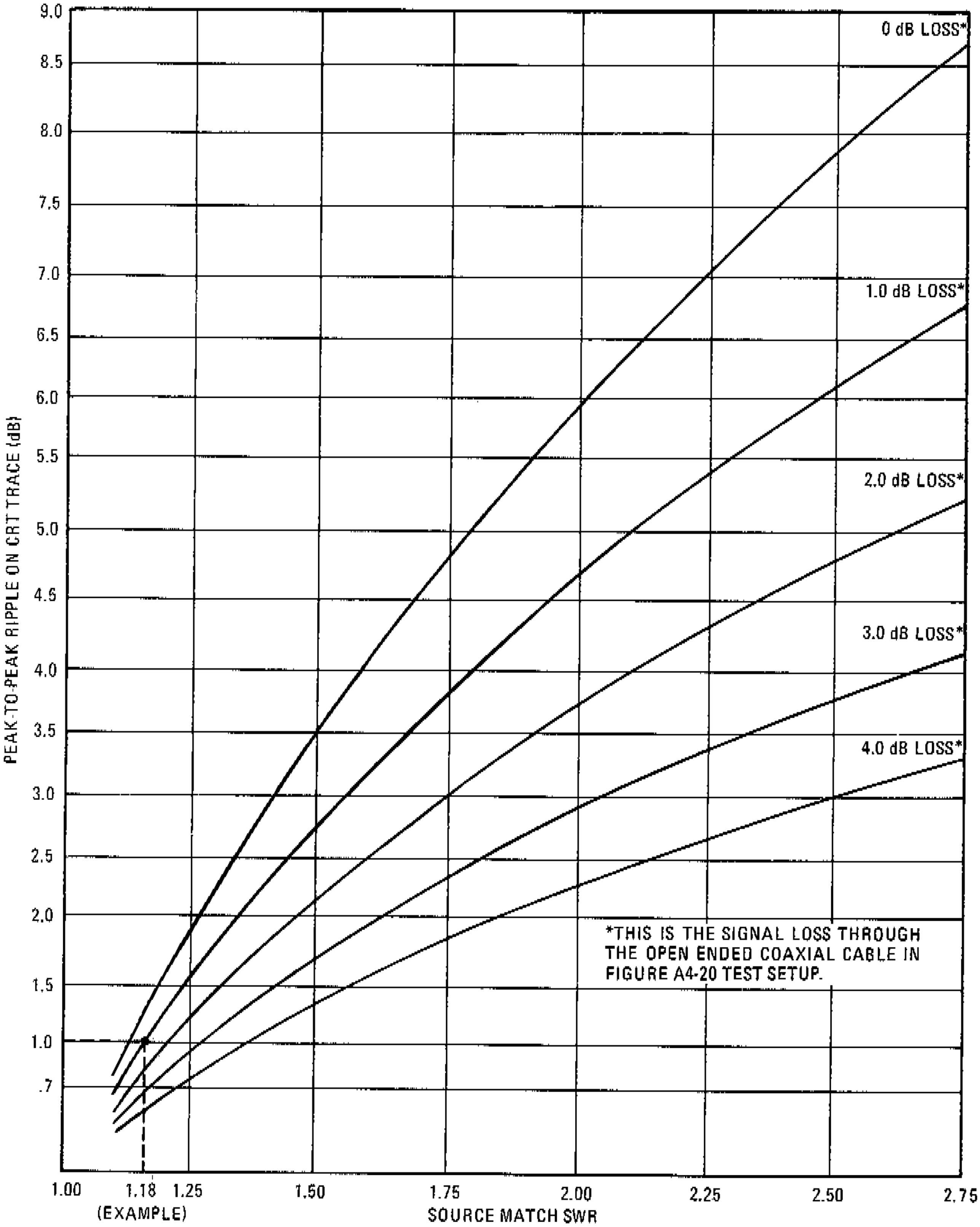


Figure A4-22. Graph to Convert Ripple on Trace to Source Match SWR

PERFORMANCE TESTS

A4-22. SOURCE IMPEDANCE TEST (Con t'd)

Table A4-1. Loss in Coaxial Cable

RG Cable Type	Loss in dB Per 100 Feet					
	0.1 GHz	0.2 GHz	0.4 GHz	0.6 GHz	1 GHz	3 GHz
58/U	2.4	3.6	5.2	6.6	8.8	16.7
98/U	2.3	3.4	5.2	6.5	9.0	17
55A/U	4.8	7.0	10.5	13.0	17	32
58A/U	6.2	9.2	14.0	17.5	23.5	45
58C/U	6.2	9.2	14.0	17.5	23.5	45
177/U	0.95	1.5	2.4	3.2	4.5	9.5
212/U	2.4	3.6	5.2	6.6	8.8	16.7
213/U	2.1	3.1	5.0	6.5	8.8	17.5
214/U	2.3	3.4	5.2	6.5	9.0*	17
215/U	2.1	3.1	5.0	6.5	8.8	16.7
217/U	1.5	2.3	3.5	4.4	6.0	11.7
218/U	0.95	1.5	2.4	3.2	4.5	9.5
219/U	0.95	1.5	2.4	3.2	4.5	9.5
220/U	0.69	1.12	1.85	—	3.6	7.7
221/U	0.69	1.12	1.85	—	3.6	7.7
223/U	4.8	7.0	10.5	13.0	17.0	32
224/U	1.5	2.3	3.5	4.4	6.0	11.7

* Example: 9 dB/100 ft. for RG214/U at 1 GHz. Therefore, 12 ft. = 1 dB loss.

EXAMPLE

(1) On Table A4-1, look under 1 GHz (1000 MHz) for Coaxial Cable type RG 214/U used in test setup. 100 ft. length has a loss of 9.0 dB. Therefore a 12 ft. length has a loss of approximately 1.0 dB.

(2) On Figure A4-22, select the 1.0 dB loss curve.

(3) The ripple shown in Figure A4-21 is 1 dB peak-to-peak. Therefore, Figure A4-22 shows SWR = 1.18 or Return Loss of 21.6 dB.

PERFORMANCE TESTS

A4-23. SPECTRAL PURITY TEST

SPECIFICATION:

Spectral Purity

Harmonics: ⩾25 dB below main signal at +10 dBm output level

Sub-harmonic and Spurious Signals: Below −50 dBm at +10 dBm output level

Residual FM: ⩽20 Hz rms on 0.5 — 13 MHz range in 1 kHz Bandwidth
⩽200 Hz rms on 0.5 — 130 MHz range in 1 kHz Bandwidth
⩽2,000 Hz rms on 0.5 — 1300 MHz range in 10 kHz Bandwidth

HARMONICS:

DESCRIPTION:

The CW RF output signal as well as harmonics and spurious signals are observed on the spectrum analyzer.

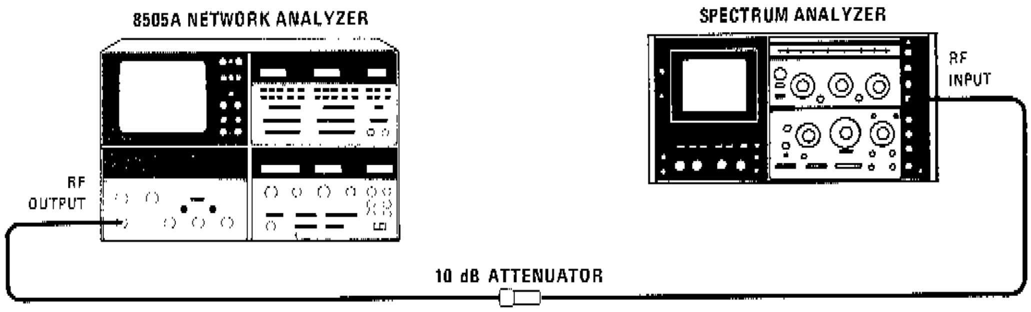


Figure A4-23. Harmonics and Spurious Signal Test Setup

EQUIPMENT:

Spectrum Analyzer .... HP 8553B/8555A/8552B/141T
10 dB Attenuator .... HP 8491A Option 010

PROCEDURE:

a. Set 8505A controls as follows:

On A1 Source/Converter
OUTPUT LEVEL dBm .... +10
OUTPUT LEVEL VERNIER 0

PERFORMANCE TESTS

A4-23. SPECTRAL PURITY TEST (Cont'd)

On A2 Frequency Control:

RANGE MHz	.5 — 1300
MODE	LIN FULL
TRIGGER	AUTO
SCAN TIME SEC	MANUAL

b. Connect equipment as shown in Figure A4-23. Allow equipment to warm up for a minimum of one hour.

c. Slowly sweep manually through .5 — 1300 MHz range and observe harmonics and spurious signals. Identify signal in question as harmonic or non-harmonic and measure the difference in dB between this signal level and the level of the fundamental. Harmonics should be >25 dB below the fundamental (<−15 dBm). Non-harmonic spurious signals should be below −50 dBm.

NOTE

The spectrum analyzer originates some mixing harmonics that may appear on the display. If a signal is in question, increase the spectrum analyzer input attenuation by 10 dB. Note if signal decreases in amplitude by 10 dB, then return the attenuator to the original position. If the signal in question comes from an external source, it will change by 10 dB. If the signal in question originates in the spectrum analyzer, the level will either change by greater or less than 10 dB or may not change at all.

RESIDUAL FM

DESCRIPTION:

The CW output of the 8505A is down-converted to 100 kHz by using a reference signal generator and a mixer. The down-converted signal (100 kHz) is discriminated and the output of the discriminator is amplified and filtered and then measured with an RMS voltmeter. The voltmeter reading in mVrms, is proportional to the frequency instability (residual FM) of the 8505A.

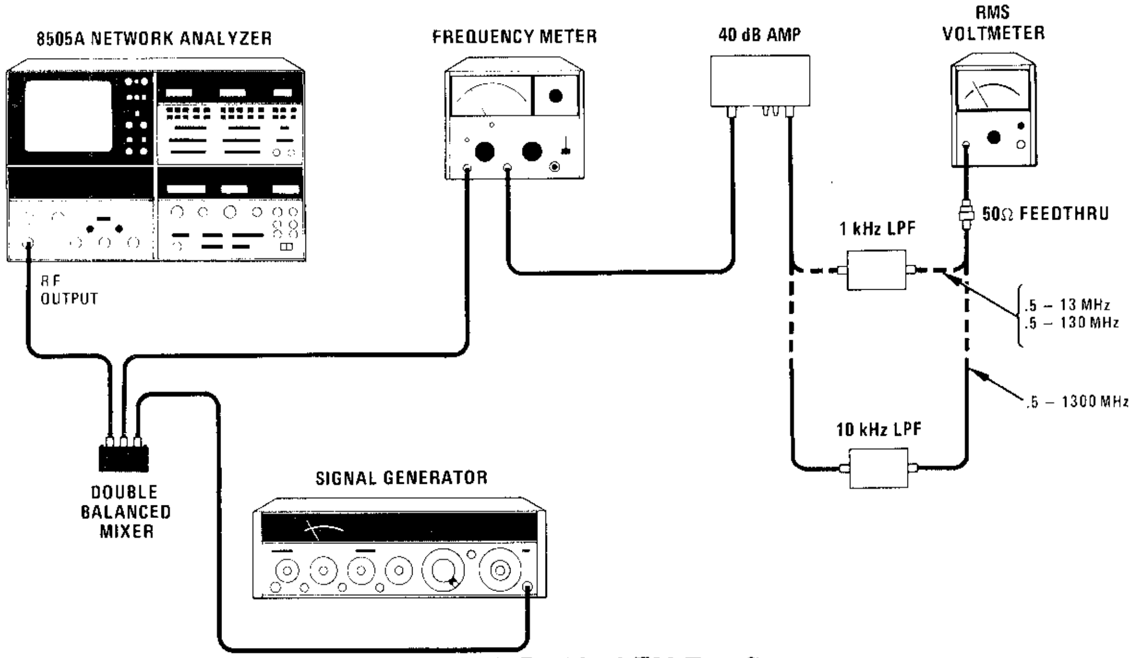


Figure A4-24. Residual FM Test Setup

PERFORMANCE TESTS

A4-23. SPECTRAL PURITY TEST (Cont'd)

EQUIPMENT:

Reference Signal Generator .... HP 8640A/B
Balanced Mixer .... HP 10514A
Frequency Meter .... HP 5210A
12 kHz Filter from Filter Kit .... HP 10531A
40 dB Low Noise Amplifier .... HP 08640-60506
RMS Voltmeter .... HP 3400A
1 kHz Low Pass Filter .... HP 08505-60156
10 kHz Low Pass Filter .... HP 08505-60155
50 Ohm Feedthrough Termination .... HP 10100C

PROCEDURE:

d. Set controls as follows:

8505A

OUTPUT LEVEL dBm .... +10
RANGE MHz .... .5 — 13
MODE .... LIN EXPAND
WIDTH .... CW±ΔF
SCAN TIME SEC .... 100 — 10
CW FREQ .... 7.00 MHz
±ΔF FREQ 0.000
ΔF VERNIER 0
SCAN TIME SEC VERNIER .... Fully clockwise
TRIGGER .... AUTO

5210A:

SENSITIVITY .... 0.01 Volts
RANGE .... 100 kHz
METER .... NORMAL

e. Connect equipment as shown in Figure A4-24 with the 1 kHz Low Pass Filter connected between the 40 dB Amplifier and the 3400A rms voltmeter. Set 3400A range to 10 mV.

Frequency Meter Calibration

f. Install internal shorting board into model 5210A Frequency Meter.

g. Set sensitivity (volts RMS) to CAL (100 kHz) and range to 100 kHz. The meter should display a full scale indication. If not, adjust screwdriver CAL (100 kHz) as necessary.

h. Adjust rear panel DISC GAIN CONTROL for −1 volt dc at DISC OUT jack of 5210A Frequency Meter.

i. Reset SENSITIVITY (volts RMS) to 0.01 Vrms.

j. Set range to 100 kHz. The DISC OUT is now calibrated for 100 kHz/volt or 100 Hz per millivolt.

PERFORMANCE TESTS

A4-23. SPECTRAL PURITY TEST (Cont'd)

Residual FM Test

k. Remove internal shorting board and install the 12 kHz Butterworth low pass filter in 5210A Frequency Meter.

l. Set 8640A/B Reference Signal Generator output to −10 dBm and frequency of 7.1 MHz. Fine tune frequency to obtain a full scale reading of 100 kHz on 5210A Frequency Meter.

m. Voltmeter indication should be less than 7.4 mVrms corresponding to residual FM of <20 Hz rms.

n. Set 8505A WIDTH to CW and fine tune frequency to obtain a full scale reading of 100 kHz on 5210A Frequency Meter. Repeat step j.

o. Change 8505A RANGE MHz to 0.5 — 130 and set WIDTH to CW±ΔF. Set CW Frequency to 70.0 MHz. Change 3400A rms Voltmeter range to 100 mV.

p. Change 8640A/B generator frequency to 70.1 MHz and fine tune to obtain a full scale reading of 100 kHz on 5210A Frequency Meter.

q. Voltmeter indication should be less than 74 mVrms corresponding to residual FM of <200 Hz rms.

r. Set 8505A WIDTH to CW and fine tune frequency to obtain a full scale reading of 100 kHz on 5210A Frequency Meter. Repeat step n.

s. Change 8505A RANGE MHz to 0.5 — 1300. Set WIDTH to CW±ΔF. Set CW frequency to 500 MHz.

t. Replace 1 kHz LPF with 10 kHz LPF as shown in Figure A4-24.

u. Set 5210A Frequency Meter range to 1 MHz.

v. Change 8640A/B generator frequency to 500.2 and fine tune to obtain a reading of 200 kHz on the 5210A Frequency Meter.

w. Voltmeter indication should be less than 88 mVrms corresponding to residual FM of ⩽ 2 kHz rms.

x. Set 8505A WIDTH to CW and fine tune frequency to obtain a reading of 200 kHz on the 5210A Frequency Meter. Repeat step w.

Table A4-2. Performance Test Records (1 of 4)

HEWLETT-PACKARD
Model 8505A Network Analyzer

Test Performed By: ______________________

Serial Number: ______________________

Date: ______________________

Para. No.	Description	Lower Limit	Measured Value	Upper Limit
A4-8	**Frequency Range & Accuracy Test**			
	j. START and STOP Frequency:			
	1300. MHz	1287 MHz	________	1313. MHz
	130. MHz	128.7 MHz	________	131.3 MHz
	13.0 MHz	12.87 MHz	________	13.13 MHz
	0700. MHz	687 MHz	________	713 MHz
	070.0 MHz	68.7 MHz	________	71.3 MHz
	07.00 MHz	6.87 MHz	________	7.13 MHz
	0010. MHz	1 MHz	________	23 MHz
	001.0 MHz	0.1 MHz	________	2.3 MHz
	01.00 MHz	0.87 MHz	________	1.13 MHz
A4-9	**CW Frequency Stability Test**			
	d. Frequency Change after 10 minutes	−2.3 kHz	________	+2.3 kHz
A4-10	**Power Output Leveling Test and Absolute Power Calibration**			
	c. Power Leveling: variation across band		________	±0.5 dB
	d. Output Level Vernier: 0—12 dB range	−3 dBm	________	−1 dBm
A4-11	**Power Output Range Test**			
	e. Accuracy at all settings of OUTPUT LEVEL Control		________	±1.5 dB
A4-12	**Magnitude Reference Offset and Marker Accuracy Test**			
	c. Rectangular Marker Zero	−0.01 dB	________	+0.01 dB
	e. Polar Marker Zero — Magnitude	−3 mm of Outside Circle	________	+3 mm of Outside Circle
	f. Polar Marker Zero — Phase	−1 degree	________	+1 degree
	j. Offset +190 dB & read marker	−184 dB	________	−196 dB
	n. Offset −190 dB & read marker	+184 dB	________	+196 dB
A4-13	**Receiver Noise Floor**			
	e. 0.5 to 2 MHz, "R" Port		________	−95 dBm
	f. 0.5 to 2 MHz, "A" Port		________	−95 dBm

Table A4-2. Performance Test Records (2 of 4)

Para. No.	Description	Lower Limit	Measured Value	Upper Limit
A4-13	**Receiver Noise Floor (cont'd)**			
	g. 0.5 to 2 MHz, "B" Port		______	−95 dBm
	h. 2 to 10 MHz, "B" Port		______	−100 dBm
	i. 2 to 10 MHz, "A" Port		______	−100 dBm
	j. 2 to 10 MHz, "R" Port		______	−100 dBm
	k. 10 to 1300 MHz, "R" Port		______	−110 dBm
	l. 10 to 1300 MHz, "A" Port		______	−110 dBm
	m. 10 to 1300 MHz, "B" Port		______	−110 dBm
A4-14	**Crosstalk Isolation**			
	d. Crosstalk between "R" and "A" Port	100 dB	______	
	e. Crosstalk between "R" and "B" Port	100 dB	______	
	f. Crosstalk between "A" and "R" Port	100 dB	______	
	Crosstalk between "A" and "B" Port	100 dB	______	
	g. Crosstalk between "B" and "R" Port	100 dB	______	
	h. Crosstalk between "B" and "A" Port	100 dB	______	
A4-15	**Magnitude, Phase and Group Delay Frequency Response**			
	c. Port "R" Frequency Response		______	3 dB
	h. Port "A" Frequency Response		______	3 dB
	i. Port "B" Frequency Response		______	3 dB
	m. A/R Ratio Measurement Magnitude Frequency Response		______	0.6 dB
	n. B/R Ratio Measurement Magnitude Frequency Response		______	0.6 dB
	q. B/R Phase Measurement Frequency Response 0.5 to 750 MHz		______	6 degrees
	r. B/R Phase Measurement Frequency Response 750 to 1300 MHz		______	10 degrees
	s. A/R Phase Measurement Frequency Response 0.5 to 750 MHz		______	6 degrees
	A/R Phase Measurement Frequency Response 750 to 1300 MHz		______	10 degrees
	v. A/R Group Delay Frequency Response		______	2 ns
	w. B/R Group Delay Frequency Response		______	2 ns
A4-16	**Magnitude Dynamic Accuracy Test**			
	c. Input "R" REF OFFSET: +20 dB	−0.2 dB	______	+0.2 dB
	+10 dB	−0.1 dB	______	+0.1 dB
	0 dB (Ref)	0 dB	______	0 dB
	−10 dB	−0.1 dB	______	+0.1 dB
	−20 dB	−0.2 dB	______	+0.2 dB
	−30 dB	−0.4 dB	______	+0.4 dB
	−40 dB	−0.6 dB	______	+0.6 dB
	−50 dB	−0.8 dB	______	+0.8 dB
	−60 dB	− 1 dB	______	+ 1 dB
	−70 dB	− 2 dB	______	+ 2 dB
	−80 dB	− 4 dB	______	+ 4 dB

Table A4-2. Performance Test Records (3 of 4)

Para. No.	Description	Lower Limit	Measured Value	Upper Limit
A4-16	**Magnitude Dynamic Accuracy Test (cont'd)**			
	d. Input "A" REF OFFSET:			
	+20 dB	−0.2 dB	______	+0.2 dB
	+10 dB	−0.1 dB	______	+0.1 dB
	0 dB (Reference)	0 dB	______	0 dB
	−10 dB	−0.1 dB	______	+0.1 dB
	−20 dB	−0.2 dB	______	+0.2 dB
	−30 dB	−0.4 dB	______	+0.4 dB
	−40 dB	−0.6 dB	______	+0.6 dB
	−50 dB	−0.8 dB	______	+0.8 dB
	−60 dB	− 1 dB	______	+ 1 dB
	−70 dB	− 2 dB	______	+ 2 dB
	−80 dB	− 4 dB	______	+ 4 dB
	e. Input "B" REF OFFSET:			
	+20 dB	−0.2 dB	______	+0.2 dB
	+10 dB	−0.1 dB	______	+0.1 dB
	0 dB (Reference)	0 dB	______	0 dB
	−10 dB	−0.1 dB	______	+0.1 dB
	−20 dB	−0.2 dB	______	+0.2 dB
	−30 dB	−0.4 dB	______	+0.4 dB
	−40 dB	−0.6 dB	______	+0.6 dB
	−50 dB	−0.8 dB	______	+0.8 dB
	−60 dB	− 1 dB	______	+ 1 dB
	−70 dB	− 2 dB	______	+ 2 dB
	−80 dB	− 4 dB	______	+ 4 dB
A4-17	**Phase Dynamic Range**			
	d. −10 to −50 dBm Range, CRT trace tolerance from reference line	−0.5 degree	______	+0.5 degree
	e. −50 to −70 dBm Range, CRT trace tolerance from reference line	−1 degree	______	+1 degree
	f. −70 to −90 dBm Range, CRT trace tolerance from reference line	−3 degrees	______	+3 degrees
A4-18	**Phase Reference Offset**			
	d. Reference Offset, CRT trace tolerance from reference line:			
	± 360 degrees	−2.1 degrees	______	+2.1 degrees
	± 720 degrees	−3.9 degrees	______	+3.9 degrees
	±1080 degrees	−5.7 degrees	______	+5.7 degrees
	±1440 degrees	−7.0 degrees	______	+7.5 degrees

Table A4-2. Performance Test Records (4 of 4)

Para. No.	Description	Lower Limit	Measured Value	Upper Limit
A4-19	**Phase Accuracy and Electrical Length Test**			
	Phase Accuracy Test:			
	f. +180 degree transistion	+182 degrees	______	+178 degrees
	g. −180 degree transition	−182 degrees	______	−178 degrees
	Electrical Length (Line Stretcher) Test:			
	l. 30 cm at 1000 MHz	+10 degrees	______	−10 degrees
		(370 degrees)	______	(350 degrees)
	m. 15 cm at 1000 MHz	185 degrees	______	175 degrees
	Linear Phase Range:			
	p. Maximum Positive Electrical Length	+1730 degrees	______	
	r. Maximum Negative Electrical Length	−1730 degrees	______	
	Linear Phase Accuracy:			
	u. Length in degrees added for two phase cycles	+700 degrees	______	+740 degrees
A4-20	**Group Delay Accuracy Test**			
	a. Group delay of "test cable" by calculation		______	
	f. Group delay by direct measurement	(1)	______	(2)
	(1) Lower Limit — same value as (a) above −(1 ns +3% of reading) (2) Upper Limit — same value as (a) above +(1 ns +3% of reading)			
A4-21	**Input Impedance Test**			
	g. Return Loss of Port "A"	20 dB	______	
	h. Return Loss of Port "B"	20 dB	______	
	m. Return Loss of Port "R"	20 dB	______	
A4-22	**Source Impedance Test**			
	e. SWR of RF OUTPUT port		______	1.38 SWR
A4-23	**Spectral Purity Test**			
	c. Harmonics below fundamental at +10 dBm		______	−15 dBm
	Non-harmonic spurious signals with fundamental at +10 dBm		______	−50 dBm
	m. Residual FM at 7. MHz		______	20 Hz rms (7.4 mV rms on voltmeter).
	q. Residual FM at 70 MHz		______	200 Hz rms (74 mV rms on voltmeter)
	w. Residual FM at 500 MHz		______	2 kHz rms (88 mV rms on voltmeter)
	x. Residual FM in CW mode at 500 MHz		______	2 kHz rms (88 mVrms on voltmeter)

CHAPTER A
MODEL 8505A NETWORK ANALYZER

SECTION V
ADJUSTMENTS

A5-1. INTRODUCTION

A5-2. This section provides adjustment procedures for the Model 8505A Network Analyzer. These procedures should not be performed as a routine maintenance procedure but should be used (1) after replacement of a part or component, (2) when the performance test shows that the specifications of Table A1-1 cannot be met, or (3) when instructed to do so in the troubleshooting procedure. Table A5-1 lists the adjustment procedure and the function of each control.

WARNING

With the top cover removed, terminals are exposed that have ac voltages capable of causing death. The adjustments in this section should be performed only by a skilled person who knows the hazard involved.

NOTE

Before performing any adjustments, allow 1 hour warmup time for the instrument.

A5-3. EQUIPMENT REQUIRED

A5-4. Table A1-5 lists the equipment required for the adjustment procedure. If the test equipment recommended is not available, other equipment may be used if its performance meets the "Critical Specifications" listed in the table.

A5-5. FACTORY SELECTED COMPONENTS

A5-6. Some adjustments within the instrument are done by selecting different values of components. These are included in Table A5-1 with the other adjustments. Factory selected components are identified on the schematic diagram with an asterisk (*).

A5-7. RELATED ADJUSTMENTS

A5-8. There are some circuits that require adjustment in a specific order. The procedure assumes that if a specific adjustment is made in the middle of the procedure, all adjustments before that one must be correct. If the sequence in the procedure is followed, a minimum of interaction between controls is present.

Table A5-1. Adjustments in Reference Designator Order (1 of 5)

Reference Designator	Name on Board	Function	Paragraph Number
A1A3R7	−12 dBm	RF POWER Vernier Calibration	A5-14
A1A3R15	0 dBm	RF POWER Vernier Calibration	A5-14
A1A4C8	PHASE	Phase Calibration in "R" Channel	A5-16
A1A4C10*	None	Selected Capacitor for phase calibration "R" Channel	A5-16
A1A4R6	MAGNITUDE ADJ	Adjusts gain of "R" Channel IF Amplifier	A5-15, A5-31
A1A5C8	PHASE	Phase Calibration in "A" Channel	A5-16
A1A5C10*	None	Selected Capacitor for phase calibration "A" Channel	A5-16
A1A5R6	MAGNITUDE ADJ	Adjusts gain of "A" Channel IF Amplifier	A5-15, A5-31
A1A6C8	PHASE	Phase Calibration in "B" Channel	A5-16
A1A6C10*	None	Selected Capacitor for phase calibration "B" Channel	A5-16
A1A6R6	MAGNITUDE ADJ	Adjusts gain of "B" Channel IF Amplifier	A5-15, A5-31
A1A15A1C1	9.9 TUNE	Adjusts 9.9 MHz Oscillator Frequency	A5-11
A1A15A1R11	Wn	Reduces noise sidebands on 4.2099 GHz signal	A5-11
A1A15A1R25	BAL	Nulls 9.9 MHz signal	A5-11
A1A15A1R28	TUNE	Adjusts for +8.0 Vdc output	A5-11
A1A15A1R32	MOD	Adjusts Modulator Drive to A1A15A5	A5-11
A1A15A2R7	Wn	Reduces noise sidebands on 4.210 GHz signal	A5-12
A1A15A2R13	TUNE	Adjusts for +8.0 Vdc output	A5-12
A1A15A2R15	BAL	Nulls 10.0 MHz signal	A5-12
A1A15A3C18	A	Peaks 100 MHz drive to A1A15A5	A5-13
A1A15A3C24	B	Peaks 100 MHz drive to A1A15A5	A5-13
A1A15A4C18	A	Peaks 100 MHz drive to A1A15A6	A5-13
A1A15A4C24	B	Peaks 100 MHz drive to A1A15A6	A5-13
A2A1A1R13	FREQUENCY CAL	Adjusts frequency of YIG Oscillator	A5-20
A2A1A2R5	ILLUMINATOR ADJ	Adjusts intensity of DS1 on RPG	Factory Adj.

Table A5-1. Adjustments in Reference Designator Order (2 of 5)

Reference Designator	Name on Board	Function	Paragraph Number
A2A1A3R5	ILLUMINATOR ADJ	Adjusts intensity of DS1 on RPG	Factory Adj.
A2A4R14	ΔF1	Adjusts ±ΔF high end	A5-18
A2A4R16	ΔF2	Adjusts ±ΔF low end	A5-18
A2A4R24	SYM 2	Adjusts high end of 130 MHz band	A5-18
A2A4R25	SYM 1	Adjusts high end of 1300 MHz band	A5-18
A2A4R40	GAIN	Summing Amp Gain	A5-18
A2A7R49	+13V	Adjusts +13V Supply	A5-17, A5-18
A2A7R61	SWP ADJ	Sweep Adjust	A5-18
A2A8R58	EXP GAIN	Adjusts gain of expotential circuit	A5-19
A2A8R75	EXP OFFSET A	Adjusts EXP waveform	A5-19
A2A8R79	EXP OFFSET B	Adjusts top of EXP waveform for offset	A5-19
A2A9R57	FREQ ADJ LO	Adjusts low frequency limit	A5-21
A2A9R68	FREQ ADJ HI	Adjusts high frequency limit	A5-21
A2A11R17	MAIN DRIVER (1300 MHz)	Drive to Tuning Current Source Adjust at High-frequency end of band	A5-20
A2A11R22*	E1/E2	Selected Value for range. Nominal Value 19.6K	A5-20
A2A11R40*	E3/E4	Selected Value for range. Nominal Value 10K	A5-20
A2A12C10	100 MHZ ADJ	Tunes 100 MHz Osc. frequency	A5-10
A2A13R8	0 dB ADJ	Voltage Ramp Gain	A5-37
A2A13R10	−12 dB ADJ	Voltage Ramp Gain	A5-37
A2A15R12	"99" ADJ (right)	Adjusts marker at "99" and right edge	A5-38
A2A15R22	"0" ADJ (left)	Adjusts marker at "0" and left edge	A5-38
A2A20R23	20V ADJ	Adjusts +20V supply output	A5-9
A3A5R27	P OFS 2	Phase Offset Channel 2	A5-23
A3A5R28	OFS 2	Channel 2 Magnitude Offset	A5-23
A3A5R29	OFS 1	Channel 1 Magnitude Offset	A5-23
A3A5R45	BAL	+ Balance	A5-23
A3A5R48	SCL	Scale	A5-23
A3A5R70	LS	Line Stretcher Offset	A5-23

Table A5-1. Adjustments in Reference Designator Order (3 of 5)

Reference Designator	Name on Board	Function	Paragraph Number
A3A6R7	RATIO OFFS	Ratio Offset	A5-24
A3A6R13	CH 1 OFFS	Channel 1 Offset	A5-24
A3A6R14	CH 2 OFFS	Channel 2 Offset	A5-24
A3A7R8	CH 1	Channel 1 Offset	A5-26
A3A7R9	CH 2	Channel 2 Offset	A5-26
A3A8R10	IF BAL	IF Reference Balance, smallest dot	A5-34
A3A8R18	MAG BAL	Magnitude Balance, smallest dot	A5-34
A3A8R19	X-Y GAIN	Gain Balance	A5-34
A3A8R40	Y-BAL	Y-Axis Balance	A5-34
A3A8R44	X-BAL	X-Axis Balance	A5-34
A3A8R55	QUAD	Round Trace, quadrature balance	A5-34
A3A8R80	"C"	Linear Scaling	A5-34
A3A8R82	"B"	Full Scale	A5-34
A3A8R88	"A"	Expotential scale, Outer Circle Calibration	A5-34
A3A8R93	X OFFS	Centers X output at zero	A5-34
A3A8R95	Y OFFS	Centers Y output at zero	A5-34
A3A9L10	89 KHz NULL	Nulls 89 kHz Harmonic	A5-33
A3A9R16	"C"	Offset Calibration	A5-33
A3A9R26	"E"	– Clamp max, negative line stretcher limit	A5-33
A3A9R27	"D"	+ Clamp max, positive line stretcher limit	A5-33
A3A9R29	"B"	Offset	A5-33
A3A9R42	"A"	Frequency Adjustment	A5-33
A3A10C17*	None	Select for min. 793 kHz	A5-33
A3A10L4	100 KHz	100 kHz Peak	A5-33
A3A10L5	992 KHz	992 kHz Trap	A5-33
A3A10R8	BAL	Balanced Mod Balance Adj	A5-33
A3A10R45	ϕTRIM	Phase Trim	A5-33
A3A11R12*	None	Select resistor for course adjustment for 100 kHz Clock	A5-35
A3A11R13	CK	Clock Frequency	A5-35
A3A11R26	BAL	Balance	A5-35

Table A5-1. Adjustments in Reference Designator Order (4 of 5)

Reference Designator	Name on Board	Function	Paragraph Number
A3A11R43	G	Gain	A5-35
A3A11R74	T	Delay Offset	A5-35
A3A11R75	M	Modulation Offset	A5-35
A3A11R79	F	Offset	A5-35
A3A12L7	Rϕ	Zero phase difference, Reference	A5-32
A3A12L8	Tϕ	180 degree phase difference, Test	A5-32
A3A12L11	LSϕ	Line stretcher zero phase	A5-32
A3A12R19	REF BAL 1	Nulls 200 kHz 2nd Harmonic in Reference	A5-32
A3A12R20	TEST BAL 1	Nulls 200 kHz 2nd Harmonic in Test	A5-32
A3A12R31	REF BAL 2	Nulls 200 kHz 2nd Harmonic in Reference	A5-32
A3A12R32	TEST BAL 2	Nulls 200 kHz 2nd Harmonic in Test	A5-32
A3A12R50	SCL	Scale	A5-32
A3A12R54	OFF	+0.9 Vdc to U7 Phase Det	A5-32
A3A13C26	100 KHz TRIM	Adjusts for 100 kHz	A5-30
A3A13L3	PHASE	Adjusts phase of 100 kHz signal	A5-30
A3A13L4	B	Low end peaking	A5-30
A3A13R54	AMP	Amplitude	A5-30
A3A13R71	A	Rectifier feedback	A5-30
A3A13R91	SCL	Scale	A5-30, A5-31
A3A13R96	I OFF	Initial offset	A5-30
A3A13R99	"Y"	Gain offset (no change between –10 and –30)	A5-30
A3A14C26	100 KHz TRIM	Adjusts for 100 kHz	A5-30
A3A14L3	PHASE	Adjusts phase of 100 kHz Signal	A5-30
A3A14L4	B	Low end peaking	A5-30
A3A14R54	AMP	Amplitude	A5-30
A3A14R71	A	Rectifier feedback	A5-30
A3A14R91	SCL	Scale	A5-30, A5-31
A3A14R96	I OFF	Initial offset	A5-30
A3A14R99	"Y"	Gain offset (no change between –10 and –30)	A5-30

Table A5-1. Adjustments in Reference Designator Order (5 of 5)

Reference Designator	Name on Board	Function	Paragraph Number
A3A15R1	SWP WIDTH	X Sweep Width	A5-27
A3A15R8	INT	Intensity Limit	A5-27
A3A15R31	CH 2 Y	Channel 2 Y Gain	A5-27
A3A15R33	CH 1 Y	Channel 1 Y Gain	A5-27
A3A17R10	IN OFS	Input Offset (Marker)	A5-25
A3A17R30	A/D OFS	Analog-to-Digital Offset	A5-25
A3A17R31	SYM	Symmetry	A5-25
A3A17R41	SCL	Scale	A5-25
A3A25R8	X POSN	Adjust position of trace in Horizontal direction	Front panel control
A3A25R9	TRACE ALIGN	Adjusts alignment of trace to CRT graticule	Front panel control
A3A26R14	FOCUS LIM	Limit of Front Panel Focus Control	A5-36
A3A27C21	HF ADJ 2	High Frequency Adjust 2	A5-36
A3A27R12	H V ADJ	High Voltage Adjust	A5-36
A3A27R40	INT LIM	Intensity Limit	A5-36
A3A27R41	F G GRID	Flood Gun Grid	A5-36
A3A27R42	ASTIG	Astigmatism Adjust	A5-36
A3A27R45	H F ADJ 1	High Frequency Adjust 1	A5-36
A3A27R46	ORTH	Orthogonal Adjust	A5-36
A3A27R51	PATTERN	Trace Pattern	A5-36
A3A28R15	POS	Position	A5-28
A3A28R27	GAIN	Deflection Amp. Gain	A5-28
A3A28R29	HF ADJ	High Frequency Damping	A5-28
A3A29R15	POS	Position	A5-29
A3A29R27	GAIN	Deflection Amp. Gain	A5-29
A3A29R29	H F ADJ	High Frequency Damping	A5-29
A3A30R1*	None	Scale Illumination	A5-36

*Factory Selected Component.

ADJUSTMENTS

A5-9. A2A20 POSITIVE VOLTAGE REGULATOR and A2A21 NEGATIVE VOLTAGE REGULATOR

EQUIPMENT:

Digital Voltmeter (DVM) . . . . HP 3490A

a. Connect digital voltmeter (DVM) to A2A20TP6.

NOTE

If +20V supply is within the tolerance listed, do not make adjustment, as this will affect instrument calibration.

b. Adjust +20V (A2A20R23) for +20.00 Vdc ±0.01 Vdc. (See Figure A5-1.)

c. Check remaining power supply voltages as listed in Table A5-2.

Table A5-2. Power Supply Voltages

Test Point	Voltage	Tolerance (Vdc)	Ripple (mV p-p)
+20	+20.00	±0.01	4
+15	+15.00	±0.25	10
+5A	+ 5.00	±0.25	10
+5B	+ 5.00	±0.25	10
10	−10.00	±0.25	4
12.6	−12.60	+1.0 – 0.0	10
−18	−18.00	±0.90	10
−40	−40.00	±0.50	10

A5-10. A2A12 10/100 MHz REFERENCE OSCILLATOR

EQUIPMENT:

Frequency Counter . . . . HP 5340A
Spectrum Analyzer . . . . HP 141T/8552/8555A

a. Disconnect cable from A2A12J1 100 MHz output (Figure A5-2) and connect a frequency counter to J1. The counter should indicate 100 MHz ±10 Hz. If not, adjust "100 MHz ADJ" trimmer A2A12C10 for correct frequency. Use a non-metallic alignment tool.

ADJUSTMENTS

A5-10. A2A12 10/100 MHz REFERENCE OSCILLATOR (Cont'd)

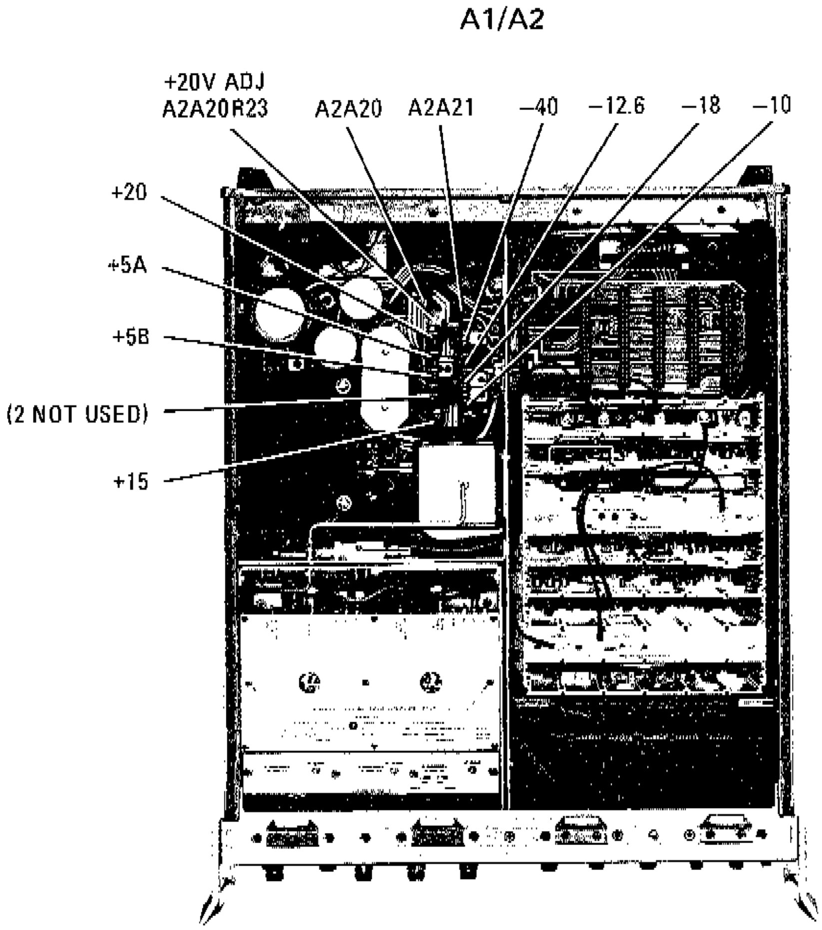


Figure A5-1. A2A20 and A2A21 Power Supplies

b. Connect counter to A2A12J2. The counter should indicate 10 MHz ±1.0 Hz.

c. Check 100 MHz signal level at A2A12J1 with Spectrum Analyzer. It should be +6 dBm ±2 dB.

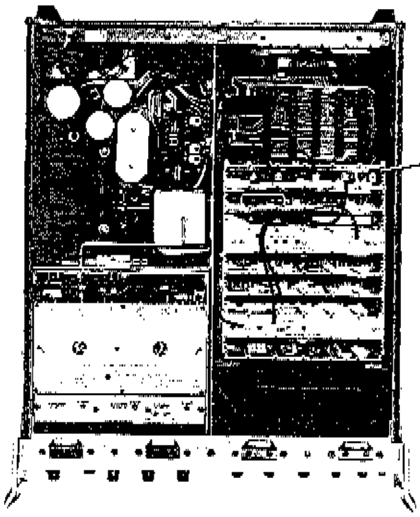
d. Check 10 MHz signal level at A2A12J2. It should be +4 dBm ±2 dB.

e. Reconnect cables to A2A12J1 and J2.

ADJUSTMENTS

A5-10. A2A12 10/100 MHz REFERENCE OSCILLATOR (Cont'd)

A1/A2



A2A12

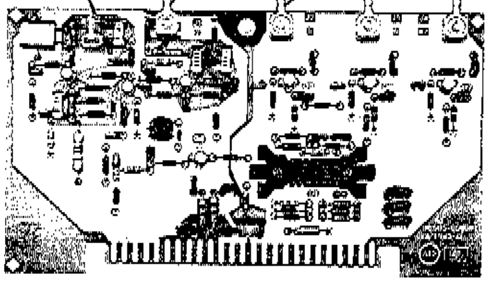


Figure A5-2. A2A12 10/100 MHz Reference Oscillator Adjustment Locations

A5-11. A1A15A1 9.9 MHz PHASE LOCK BOARD

EQUIPMENT:

Frequency Counter	HP 5340A
Digital Voltmeter (DVM)	HP 3490A
Oscilloscope w/10:1 Probe	HP 180/1801/1820
Spectrum Analyzer	HP 141/8552/8555
Power Meter	435A/8482A

a. Connect a frequency counter to A15J2 (Figure A5-3). Adjust "9.9 TUNE" A1A15A1C1 for 9.9000 MHz ±10 Hz (with cover on A1A15A1).

b. Remove cover from A1A15A1 and A2. Connect DVM to TP3 and adjust "BAL" A1A15A1R25 for 1.8 Vdc.

c. Connect jumper from TP2 to ground to disable search oscillator.

d. Connect DVM to test point Vc (TP4). Adjust "TUNE" R28 for +8.0 Vdc ±0.1 Vdc on DVM. Disconnect DVM.

e. Connect Oscilloscope 10:1 probe to TP1. Adjust "BAL" A1A15A1R25 for minimum signal amplitude.

f. Remove jumper from TP2.

ADJUSTMENTS

A5-11. A1A15A1 9.9 MHz PHASE LOCK BOARD (Cont'd)

g. On A2 Frequency Control, set RANGE MHz switch to .5 - 1300. At bottom of A1 Source/Converter, disconnect cable W9 from A9J1. Connect HP Model 8555A Spectrum Analyzer to the end of cable W9, "4.2099 GHz" output. Set Spectrum Analyzer for 3 kHz bandwidth. Adjust "Wn" A1A15A1R11 control for the least peaking of the noise sidebands (See Figure A5-4.)

h. Remove black coax cable from A1A9J1 and connect power meter to cable. Adjust "MOD" A1A15A1R32 for −12 dBm ±1 dB.

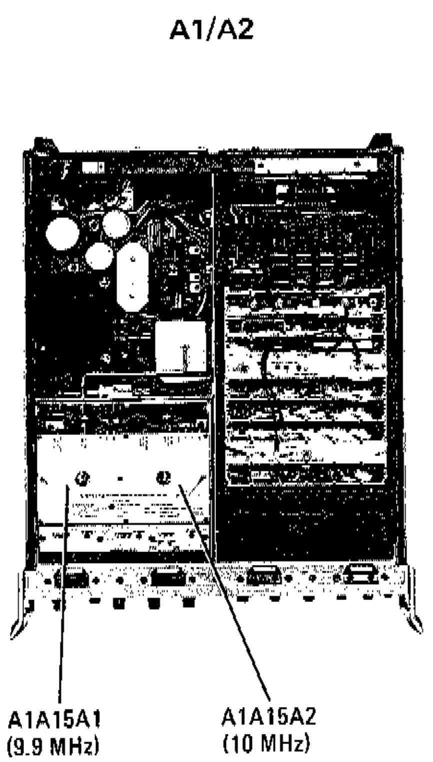
i. Disconnect test equipment. Reconnect W9 to A9J1. The "9.9 MHz LOCK" fault light on A1 front panel should be off indicating proper phase lock.

A5-12. A1A15A2 10 MHz PHASE LOCK

EQUIPMENT:

Digital Voltmeter (DVM)	HP 3490A
Oscilloscope w/10:1 probe	HP 180/1801/1820
Spectrum Analyzer	HP 141/8552/8555A

a. On A1A15A2, connect DVM to TP3 and adjust "BAL" R15 for +1.8 Vdc. (See Figure A5-3.)



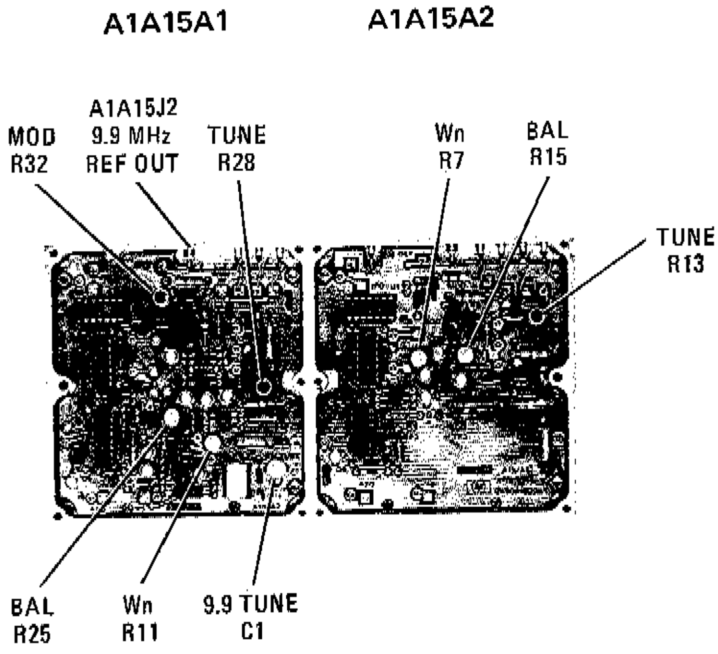


Figure A5-3. A1A15A1/A2 Adjustment Locations

ADJUSTMENTS

A5-12. A1A15A2 10 MHz PHASE LOCK (Cont'd)

b. Connect jumper from TP2 to ground to disable search.

c. Connect DVM to Test Point VC. Adjust "TUNE" R13 for +8.0 Vdc ±0.1 Vdc on DVM. Disconnect DVM.

d. Connect Oscilloscope 10:1 probe to TP1. Adjust "BAL" R15 for minimum signal amplitude.

e. Remove jumper from TP2.

f. At bottom of A1 Source/Converter, disconnect cable W8 from A11J1. Connect HP Model 8555A Spectrum Analyzer to the end of cable W8, "4.210 GHz" output. Set Spectrum Analyzer for 3 kHz bandwidth. Adjust "Wn" R7 control for the least peaking of noise sidebands. (See Figure A5-4.)

g. Disconnect test equipment and reinstall cover on A15A1 and A2. Reconnect W8 to A11J1. The "10 LOCK" fault light on A1 front panel should be off indicating proper phase lock.

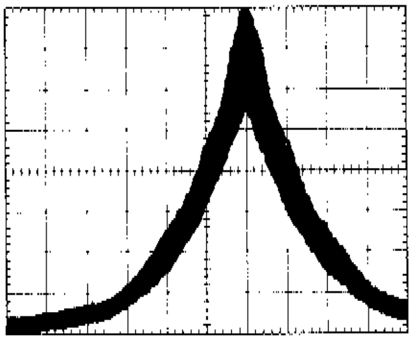


Figure A5-4. 4.2099 and 4.210 GHz Waveform on Spectrum Analyzer

A5-13. A1A15A3 and A1A15A4 IF DRIVER BOARD

NOTE

Do NOT perform this adjustment unless repairs have been made to A1A15A3 or A4.

EQUIPMENT:

Spectrum Analyzer	HP 141/8552/8553
Attenuator	HP 8496A
Adapter, Snap-on Jack-to-Type N Jack	HP 1250-0671
Adapter, Snap-on Plug-to-Type N Male	HP 1250-0673
Adapter, Type N Male-to-Type N Male	HP 1250-0778

a. Disconnect cable from A2A12J1 and insert an external attenuator between A2A12J1 and cable. Set attenuator to 30 dB.

ADJUSTMENTS

A5-13. A1A15A3 and A1A15A4 IF DRIVER BOARD (Cont'd)

b. Remove cover from A1A15A3.

c. Connect Spectrum Analyzer to 100 MHz output at test point "DRI" on A1A15A3. (See Figure A5-5.) Adjust "A" A3C18 and "B" A3C24 for highest amplitude 100 MHz signal. Replace cover.

d. Remove cover from A1A15A4.

e. Connect Spectrum Analyzer to 100 MHz output at test point "DRI" on A1A15A4. Adjust "A" A4C18 and "B" A4C24 for highest amplitude 100 MHz signal. Replace cover.

f. Remove attenuator and reconnect cable to A2A12J1.

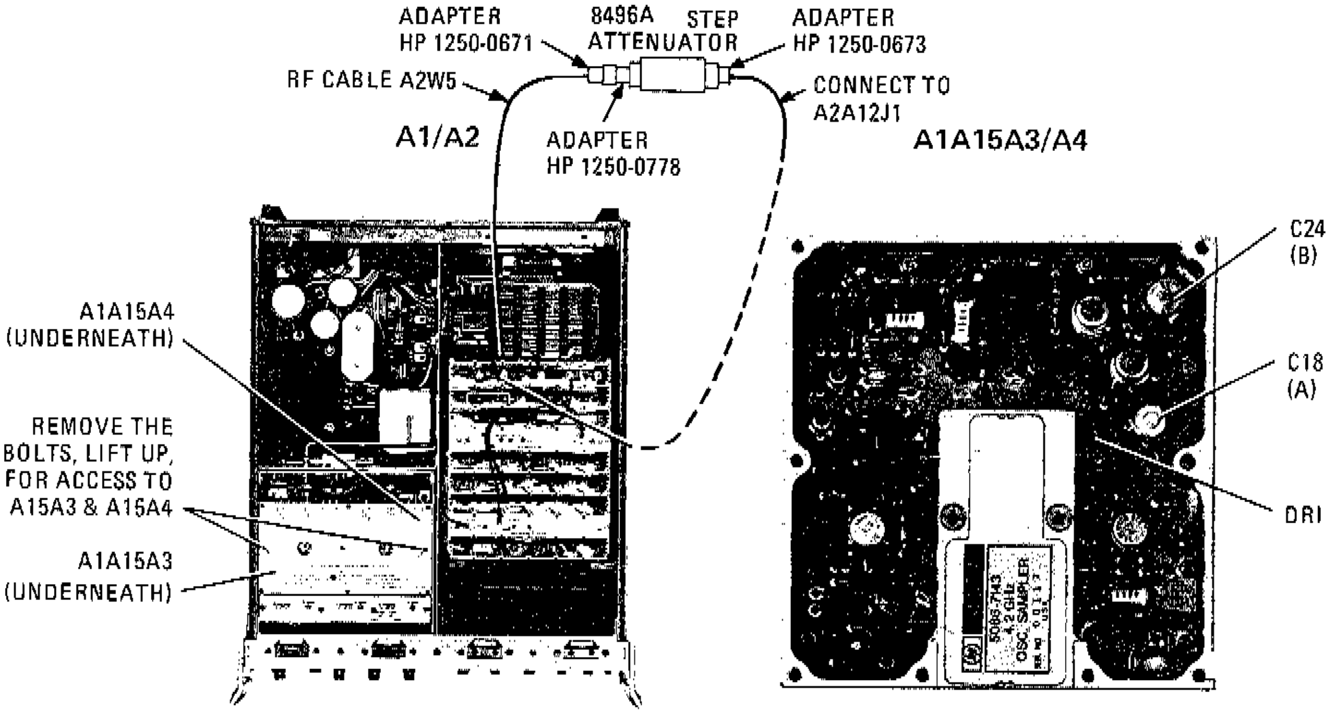


Figure A5-5. A1A15A3/A4 IF Driver Adjustment Locations

A5-14. A1A3 ALC and ATTENUATOR DRIVER (RF POWER OUTPUT ADJUSTMENT)

EQUIPMENT:

Power Meter .... HP 435A/8482A
10 dB Attenuator .... HP 8491A Opt. 010

a. Connect power meter to RF OUTPUT connector using a 10 dB attenuator.

b. On A1 Source/Converter, set OUTPUT LEVEL dBm switch to +10 dBm and set OUTPUT LEVEL Vernier to 0 dB. On A2 Frequency Control, set RANGE MHz switch to .5—130, set WIDTH switch to CW, and set CW FREQUENCY to 30 MHz.

ADJUSTMENTS

A5-14. A1A3 ALC AND ATTENUATOR DRIVER (RF POWER OUTPUT ADJUSTMENT) (Cont'd)

c. Adjust 0 dB control A1A3R15 (Figure A5-6) for 0 dBm indication on power meter.

d. Adjust OUTPUT LEVEL Vernier to −12 dB. Adjust −12 dB control A1A3R7 for −12 dBm ±1 dBm indication on power meter.

A1/A2

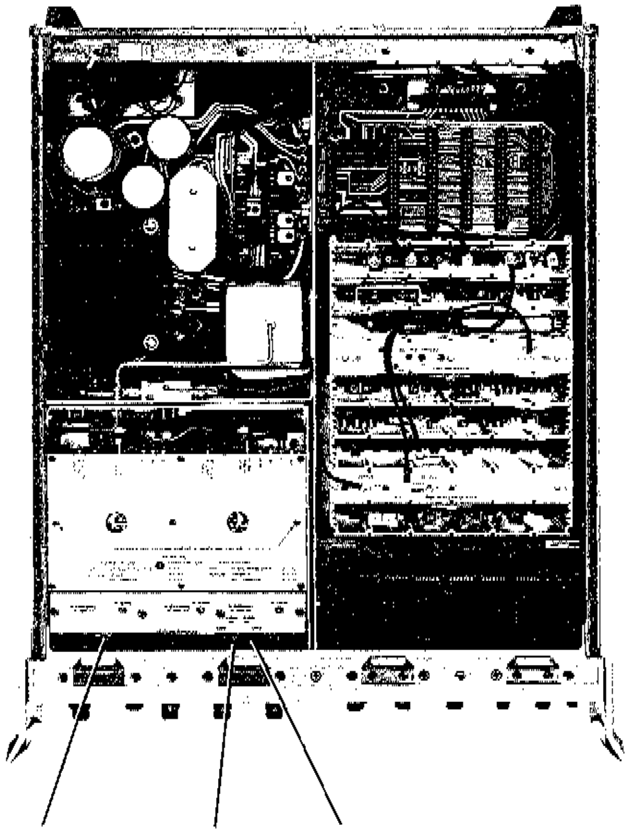


Figure A5-6. Power Output Adjustment Controls

ADJUSTMENTS

A5-15. A1A4, A1A5, and A1A6 RECEIVER IF AMPLIFIERS

a. Connect equipment as shown in Figure A5-7 with RF OUTPUT connected to R INPUT. Connect AC Digital Voltmeter (DVM) to pin 9 of XA4 as shown in Figure A5-8.

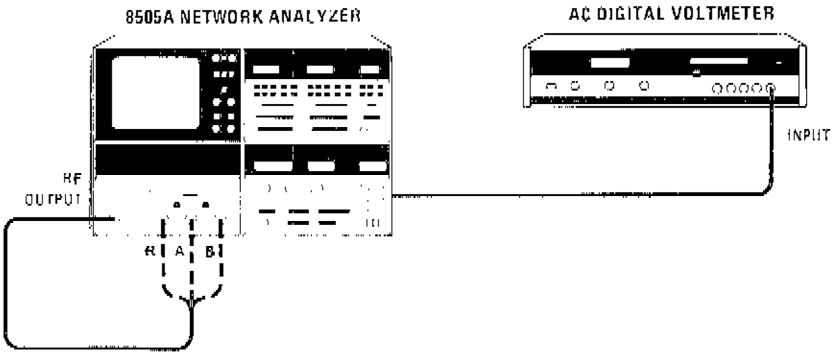


Figure A5-7. Receiver Output Test Setup

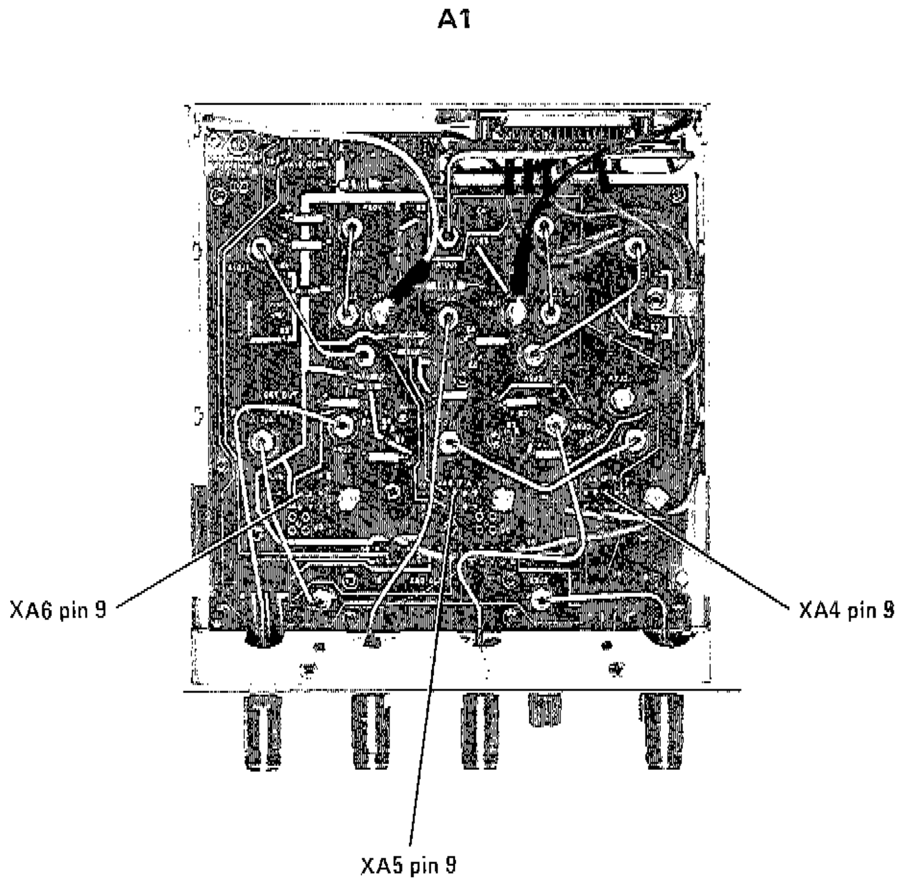


Figure A5-8. IF Amplifier Signal Test Points on A1A14 Mother Board.

ADJUSTMENTS

A5-15. A1A4, A1A5, AND A1A6 RECEIVER IF AMPLIFIERS (Cont'd)

b. On A1 Source/Converter

OUTPUT LEVEL dBm	–10
OUTPUT LEVEL Vernier	0
INPUT LEVEL dBm MAX	–10

On A2 Frequency Control

RANGE MHz	.5 — 130
WIDTH	CW
CW FREQUENCY	30 MHz

c. Adjust MAGNITUDE ADJ A1A4R6 on "R" Channel IF amplifier A4 (Figure A5-9) for a DVM indication of 0.35 VRMS ±0.02 VRMS.

d. Disconnect coaxial cable from the front panel R INPUT and connect it to A INPUT. Disconnect the DVM from Pin 9 of XA4 and connect it to Pin 9 of XA5 (Figure A5-8). Adjust MAGNITUDE ADJ A1A5R6 on A Channel IF amplifier A5 (Figure A5-9) for a DVM indication of 0.35 VRMS ±0.02 VRMS.

A1/A2

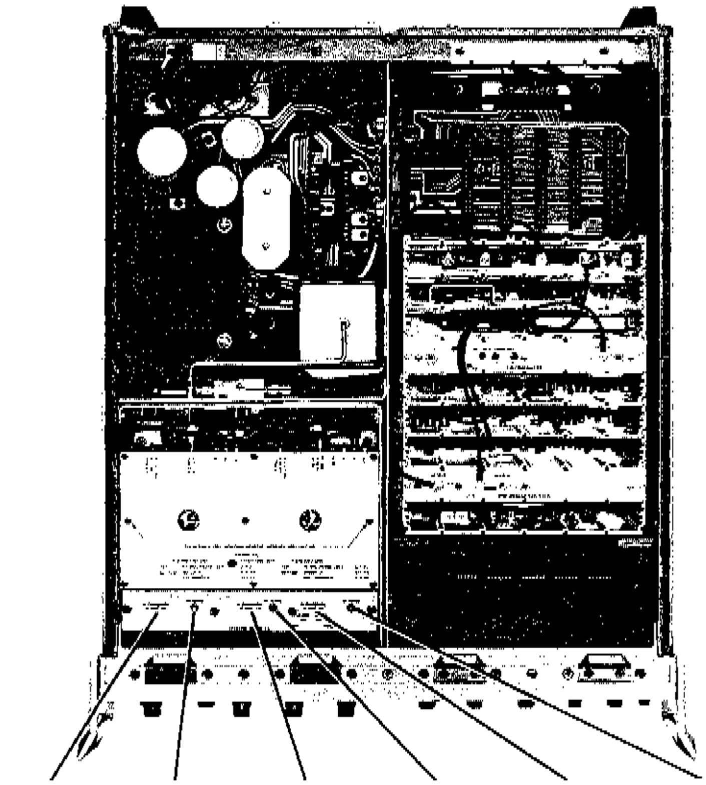


Figure A5-9. IF Amplifier A1A4/A5/A6 Adjustment Locations

ADJUSTMENTS

A5-15. A1A4, A1A5, AND A1A6 RECEIVER IF AMPLIFIERS (Cont'd)

c. Disconnect cable from the front panel A INPUT and connect it to B INPUT. Disconnect the DVM from Pin 9 of XA5 and connect it to Pin 9 of XA6 (Figure A5-8). Adjust MAGNITUDE ADJ A1A6R6 on B Channel IF amplifier A6 (Figure A-9) for a DVM indication of 0.35 VRMS ±0.02 VRMS.

NOTE

The preceding adjustments set the IF Amplifiers to produce the correct drive for the magnitude detector adjustments. A final "fine tuning" of the IF Amplifiers for absolute power calibration is done in Paragraph A5-31.

A5-16. A1A4, A1A5 and A1A6 PHASE ADJUSTMENTS

NOTE

Do not make phase adjustment of A1A4, A1A5, or A1A6 unless you are replacing one of these boards. The following phase adjustment is to remove $\Delta\phi$ in the filter on the board and is NOT an RF adjustment.

EQUIPMENT:

Power Splitter .... HP 11850A
RF Cable Kit .... HP 11851A

a. On 8505A, set controls as follows:

On A1 Source/Converter
OUTPUT LEVEL dBm .... −10 dBm
OUTPUT LEVEL Vernier .... 0 dB
INPUT LEVEL dBm MAX .... −10

On A2 Frequency Control
RANGE MHz .... .5 — 13
MODE .... LIN EXPAND
WIDTH .... CW
SCAN TIME SEC .... .1 — .01
TRIGGER .... AUTO
CW FREQUENCY .... 2 MHz

On A3 Signal Processor
Channel 1
INPUT .... A/R
MODE .... PHASE
SCALE/DIV .... 1 Deg

Channel 2
MODE .... OFF

Electrical Length
MODE .... OFF

ADJUSTMENTS

A5-16. A1A4, A1A5 and A1A6 PHASE ADJUSTMENTS (Cont'd)

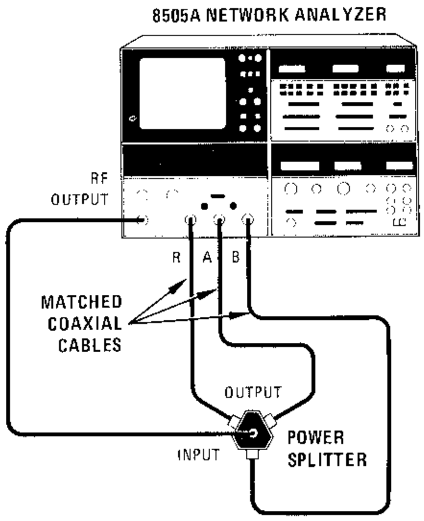


Figure A5-10. Test Setup for Phase Adjustment of A1A4, A1A5, and A1A6.

b. Connect equipment as shown in Figure A5-10.

c. Temporarily tag A1A4 as "1", A1A5 as "2" and A1A6 as "3".

d. Press Channel 1 DISPLAY REF, then CLR until REL light goes out (if lit).

e. Press DISPLAY MKR and note MKR reading.

f. Set Channel 1 INPUT switch to B/R and note MKR reading.

g. Using the readings noted in steps e and f, decide which of the following measurement combinations your instrument has:

(1) If both A/R and B/R measurements are positive, determine which is more positive. If A/R is greater than B/R, the "2" board should be installed in A4 position. If B/R is greater than A/R, the "3" board should be installed in A4 position.

(2) If both A/R and B/R measurements are negative, leave the boards where they are installed.

(3) If A/R is positive and B/R is negative, install the "2" board in A4 position.

(4) If B/R is positive and A/R is negative, install "3" board in A4 position.

NOTE

Whichever board is selected to be "A4" will not require A1A4C8 and A1A4C10 to be adjusted.

h. Set Channel 1 INPUT switch to A/R. (The measurement should be negative.) Adjust A1A5C8 for zero degree ±0.5 degree indication on MKR digital readout. If that reading cannot be obtained, select the value of A1A5C10 that will bring A1A5C8 within range of zero degree.

i. Set Channel 1 INPUT switch to B/R. (The measurement should be negative.) Adjust A1A6C8 for zero degrees ±0.5 degree indication on MKR digital readout. If that reading cannot be obtained, select the value of A1A6C10 that will bring A1A6C8 within range of zero degrees.

j. Recheck Magnitude adjustment in paragraph A5-15 if A1A4/A5/A6 boards are now in a different position.

ADJUSTMENTS

A5-17. A2A7 SWEEP GENERATOR +13V SUPPLY

EQUIPMENT:

Digital Voltmeter (DVM) .... HP 3490A

a. Connect DVM to A2A7TP1 (+13V).

NOTE

If +13V supply is within the tolerance listed, do not make adjustment.

b. Adjust A2A7R49 for +13.010 Vdc ±0.005 Vdc (See Figure A5-11).

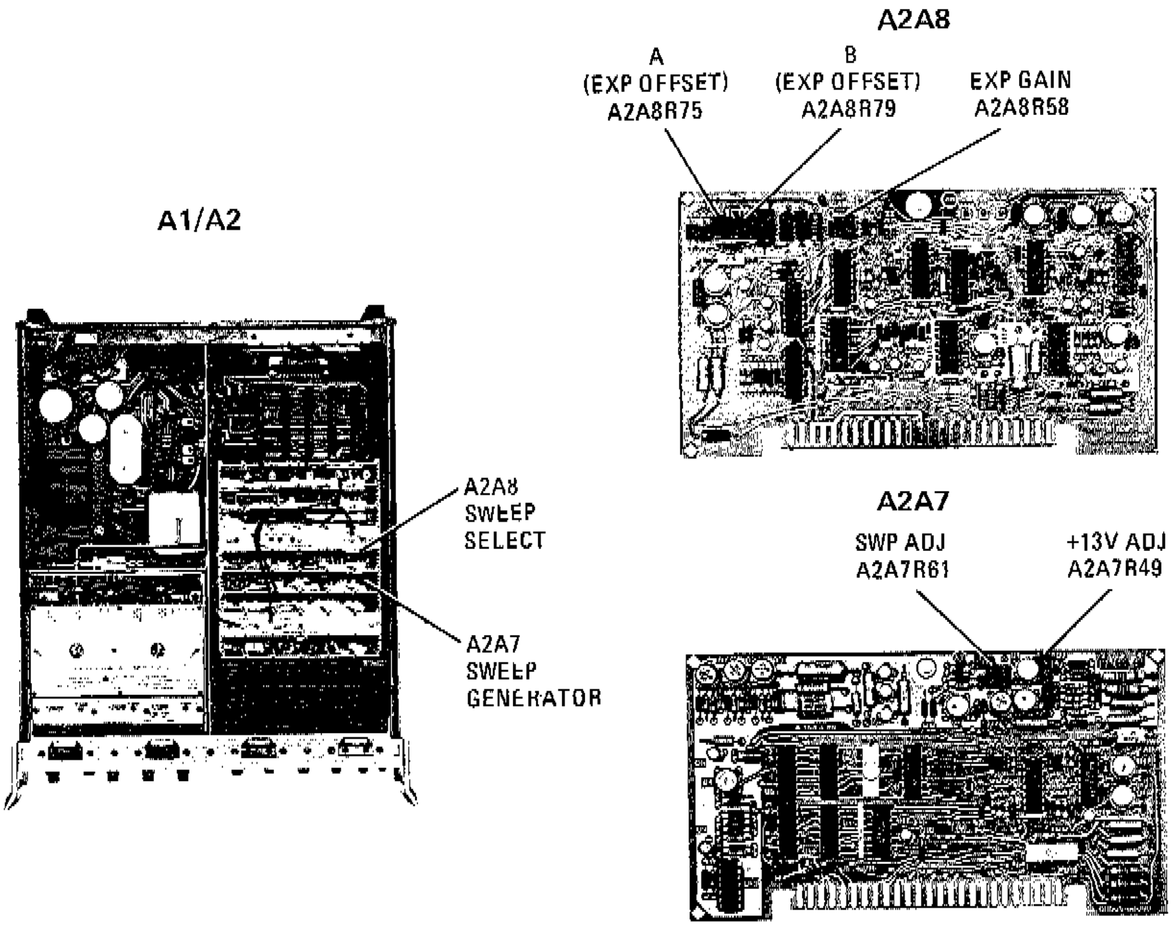


Figure A5-11. +13V Power Supply and Sweep Select Adjustment Locations

ADJUSTMENTS

A5-18. A2A4 SCALING ADJUSTMENT

EQUIPMENT:

Digital Voltmeter (DVM) .... HP 3490A

a. Connect DVM to A2A4TP4 and indication should be +13.000 Vdc +0.005, −0.000 Vdc. (If indication is out of tolerance, adjust "+13 V ADJ" A2A7R49 in +13 Volt power supply (Figure A5-11) to obtain the correct voltage.)

b. Connect A2A7TP2 to ground. Connect DVM to A2A4TP1. Adjust "SWP ADJ" A2A7R61 for +13.000 Vdc +0.005, −0.000 Vdc. Remove ground clip.

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

On A2 Frequency Control
- RANGE MHz .... .5 — 1300
- MODE .... LIN EXPAND
- WIDTH .... CW ±ΔF

On A3 Signal Processor

Channel 1
- INPUT .... R
- MODE .... MAG
- SCALE/DIV .... 10 dB

Channel 2
- MODE .... OFF

Display Section
- BANDWIDTH kHz 10

c. On Frequency Control, set CW FREQUENCY to 1300 MHz and CW±ΔF to 000.0 MHz. Connect DVM to A2A4TP3 and adjust "GAIN" control A2A4R40 for −13.000 Vdc ±0.002 Vdc (Figure A5-12).

d. On A2 Frequency Control, set WIDTH to START/STOP 1. Set START and STOP FREQUENCY controls to 1200 MHz and FREQUENCY VERNIER controls to 0.

e. On A2A7, connect jumper from A2A7TP2 to ground (Figure A5-12). Adjust "SYM 1 (START/STOP)" control A2A4R25 (Figure A5-12) for −12.000 Vdc ±0.002 Vdc.

f. Remove jumper from A2A7TP2 and place jumper between A2A7TP3 and ground. Adjust "SYM 2 (START/STOP)" control A2A4R24 for −12.000 Vdc ±0.002 Vdc indication on DVM.

g. Repeat steps e and f until both steps are within the specified limits without adjustment.

h. Connect jumper from A2A7TP3 to ground. On A2 Frequency Control, set WIDTH to CW±ΔF. Set CW FREQUENCY MHz to 1000 MHz and set ±ΔF FREQUENCY to 000.0 MHz. Set both VERNIERS to 0.

ADJUSTMENTS

A5-18. A2A4 SCALING ADJUSTMENT (Cont'd)

i. Set FREQUENCY MHz and VERNIER so that DVM indicates −10.000 Vdc ±0.001 Vdc.

j. Tune ±ΔF to 130.0 MHz. Connect jumper between A2A7TP2 and ground. Adjust "ΔF2" A2A4R16 for −11.300 Vdc ±0.002 Vdc.

k. Disconnect jumper from A2A7TP2 and connect it between A2A7TP3 and ground. Adjust "ΔF1" A2A4R14 for −8.700 Vdc ±0.002 Vdc.

l. Repeat steps j and k until both steps are within the specified limits without readjusting controls.

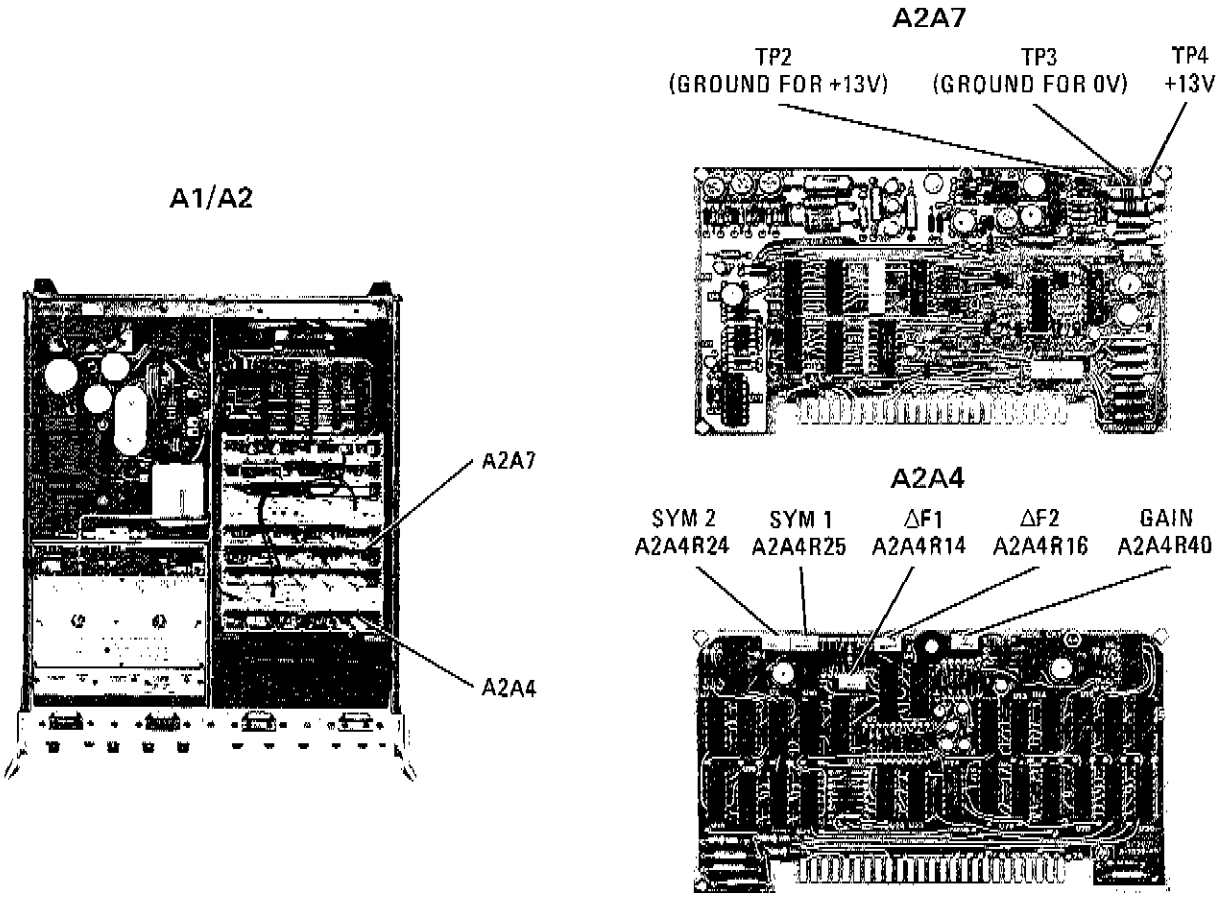


Figure A5-12. A2A4 Scaling Circuit and Sweep Control Test Points on A2A7

ADJUSTMENTS

A5-19. A2A8 SWEEP SELECT BOARD (LOG SWEEP ADJUSTMENT)

a. On 8505A A2 Frequency Control, set RANGE MHz switch to LOG 1-10, MODE switch to LOG FULL, WIDTH to START/STOP 1, SCAN TIME SEC to .1 — .01, and TRIGGER switch to AUTO.

NOTE

Grounding Test Points 2 and 3 in the following procedures should be done only briefly during the adjustment, then the ground should be disconnected. This will prevent errors due to differential heating of the circuits.

NOTE

The high end of the range (−10 Vdc) is most sensitive to the "EXP GAIN" control in the 1 — 1000 MHz Range and the low end of the range is most sensitive to the "OFFS A" control in the 1 — 10 MHz range.

b. Connect DVM to LOG Test Point A2A8TP1. On A2A7 Sweep Generator board, connect A2A7TP3 to ground to select zero volts on VSW1 line into A8, pin 14. Adjust "EXP OFFSET A" control A2A8R75 for −1.000 Vdc ±0.2 Vdc on DVM. Disconnect ground from A2A7TP3 (Figure A5-11).

c. Set RANGE MHz to LOG 1 — 1000 Range. On A2A7 Sweep Generator Board, connect A2A7TP2 to ground to select +13 Vdc on VSW1 line. Adjust "EXP GAIN" control A2A8R58 for −10.000 Vdc ±0.200 Vdc on DVM. Disconnect ground from A2A7TP2.

d. On A2 Frequency Control, set RANGE MHz switch to 1 — 10 position. Connect A2A7TP2 to ground to select +13 volts on VSW1 line. Adjust "EXP OFFSET A" control A2A8R75 for −10.0 Vdc ±0.2 Vdc on DVM. Disconnect ground from A2A7TP2.

e. Set RANGE MHz to LOG 1 — 1000 Range. Connect A2A7TP2 to ground to select +13 Vdc on VSW1 line. Adjust "EXP GAIN" A2A8R58 for −10.0 Vdc ±0.2 Vdc. Repeat steps b through e.

f. Set A2 Frequency Control RANGE MHz switch to 1 — 1000 MHz. Ground A2A7 TP3 to select low end of band. Adjust "EXP OFFSET B" control A2A8R79 for −0.01 Vdc ±0.002 Vdc.

g. Recheck the low and high end of each band to verify that they are all within specifications listed in Table A5-3.

Table A5-3. A2A8 Adjustment Tolerance

Frequency Range	Low End (±20%) (Short A7TP3 to Ground)	High End (±2%) (Short A7TP2 to Ground)
LOG 1−10 MHz	−1.00 Vdc ±0.20 Vdc	−10.00 Vdc ± 0.20 Vdc
LOG 1−100 MHz	−0.100 Vdc ±0.020 Vdc	−10.00 Vdc ± 0.20 Vdc
LOG 1−1000 MHz	−0.01 Vdc ±0.002 Vdc	−10.00 Vdc ± 0.20 Vdc

ADJUSTMENTS

A5-20. A2A11 MAIN DRIVER

EQUIPMENT:

Counter .... HP 5340A

a. Set 8505A A2 Frequency Control as follows:

RANGE MHz	.5 — 1300 MHz
MODE	LIN EXPAND
WIDTH	CW $\pm\Delta$F
SCAN TIME SEC	100 — 10
SCAN TIME SEC Vernier	Fully Clockwise
TRIGGER	AUTO

On A1 Source/Converter, set OUTPUT LEVEL dBm to −10.

b. Connect equipment as shown in Figure A5-13. Connect counter to 8505A RF Output Connector.

c. Set CW FREQUENCY to 0010. MHz and CW VERNIER to 0. Set $\pm\Delta$F FREQUENCY to 000.0 and $\pm\Delta$F VERNIER to 0. Remove plastic window from the front of the Frequency Control panel (See Figure A5-15) and adjust FREQUENCY CALIBRATE screwdriver adjustment for 10.00 MHz on external frequency counter.

d. Set CW FREQUENCY to 1300 MHz. Adjust "FREQ ADJ" A2A11 R17 for 1300.0 MHz (Figure A5-14).

NOTE

If either low frequency adjustment or high frequency adjustment runs out of range, proceed as follows:

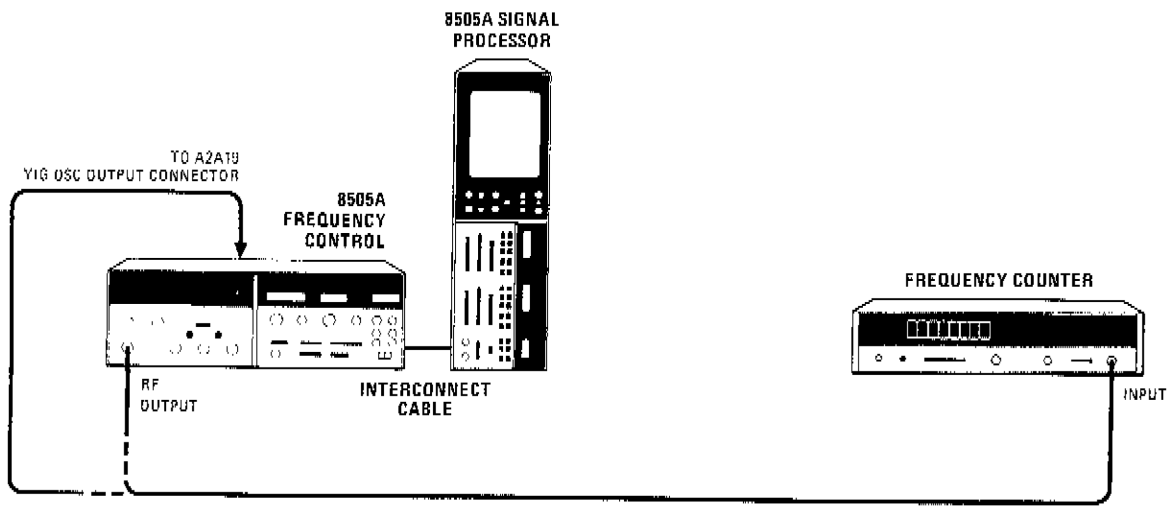


Figure A5-13. A2A11 Main Driver Test Setup

ADJUSTMENTS

A5-20. A2A11 MAIN DRIVER (Cont'd)

e. At front panel, set FREQUENCY CALIBRATE screwdriver adjust potentiometer A2A1A1R13 to midrange. On Main Driver board A2A11, set FREQ ADJ potentiometer A2A11R17 to midrange and place Main Driver board A2A11 on an extender.

f. Remove RF cable from top of YTO assembly A2A19 and connect frequency counter directly to output connector of YTO. See Figure A5-14.

g. If low frequency adjustment runs out of range, proceed with step h. If only the high frequency adjustment runs out of range, proceed to step l.

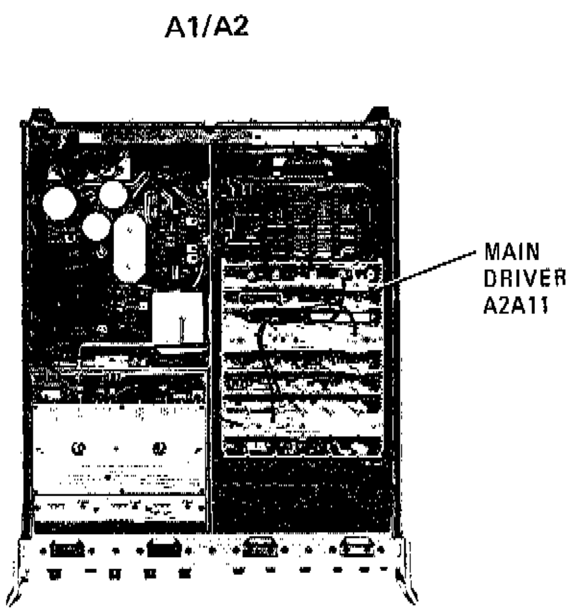
h. Remove factory selected resistor (A2A11R40) from between standoffs E3 and E4 on Main Driver board A2A11. See Figure A5-14.

i. At front panel, set RANGE MHz to .5 – 1300 MHz, CW FREQUENCY to 0000 MHz, and ±ΔF to 000.0 MHz.

j. Note YTO frequency indication on external frequency counter and record it.

Frequency = ______________ MHz

k. From right side of Table A5-4, select appropriate resistor value using frequency noted in step j. Install resistor between standoffs E3 and E4.



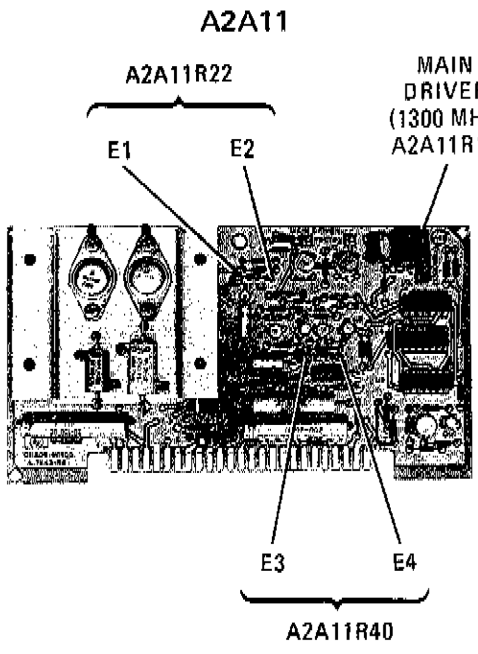


Figure A5-14. A2A11 Main Driver Adjustment Location

ADJUSTMENTS

A5-20. A2A11 MAIN DRIVER (Cont'd)

l. Remove factory selected resistor (A2A11R22) from between standoffs E1 and E2 on Main Driver board A2A11. See Figure A5-14.

m. At front panel, set RANGE MHz to .5 – 1300 MHz, CW FREQUENCY to 1300 MHz, and ±ΔF to 000.0 MHz.

n. Note YTO frequency indication on external frequency counter and record it.

Frequency = ______________ MHz

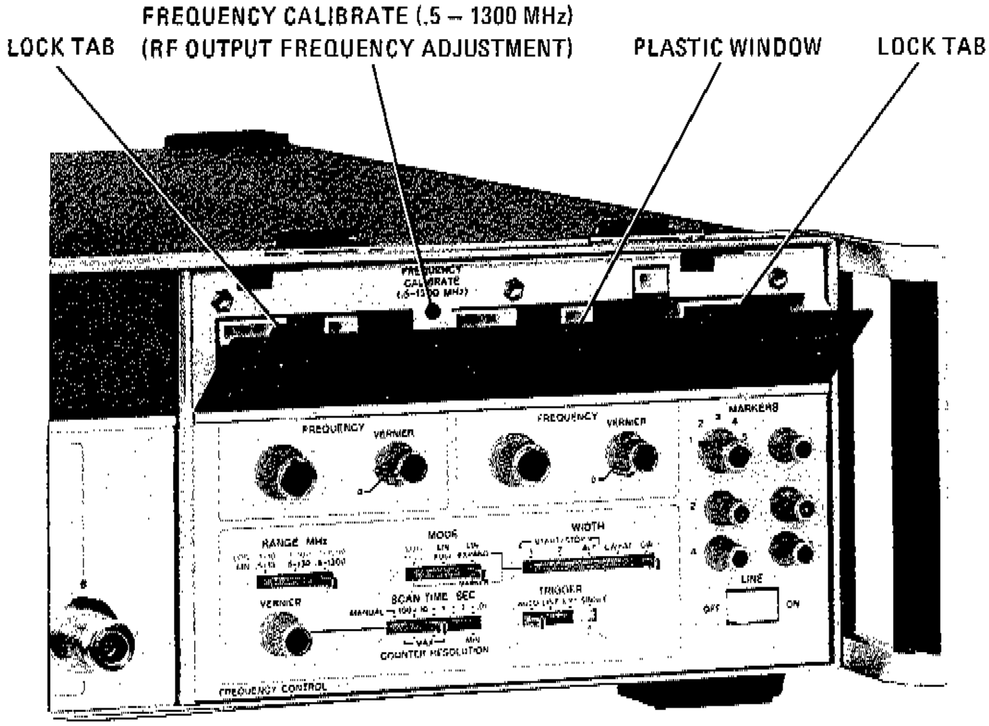
o. From left side of Table A5-4, select appropriate resistor value using frequency noted in step n. Install resistor between standoffs E1 and E2.

p. Remove extender and plug Main Driver board A2A11 into its receptacle.

q. Disconnect external frequency counter from output connector on top of YTO assembly A2A19 and reconnect RF cable that was removed in step f.

r. Repeat steps c and d.

s. Reinstall plastic window (Figure A5-15) in front panel of Frequency Control Assembly.



1. MOVE LOCK TABS TO LEFT ABOUT 1/2 INCH UNTIL THEY UNLATCH WINDOW.
2. REMOVE WINDOW BY PULLING OUT ON LOCK TAB.

Figure A5-15. Removal of Plastic Front Panel Window and Location of Front Panel FREQUENCY CAL control.

ADJUSTMENTS

A5-20. A2A11 MAIN DRIVER (Cont'd)

Table A5-4. Table for Selecting Resistors on A2A11 Main Driver

If YIG Osc. Frequency is Between	Then Use for A2A11R22 (E1 and E2)	HP Part Number	If YIG Osc. Frequency is Between	Then Use for A2A11R40 (E3 and E4)	HP Part Number
5.4446 GHz			4.5676 GHz		
	8.25k	0698-7258		8.25k	0698-7258
5.4498 GHz			4.5416 GHz		
	9.09k	0698-7259		9.09k	0698-7259
5.455 GHz			4.5167 GHz		
	10.0k	0698-7260		10.0k	0698-7260
5.4598 GHz			4.4889 GHz		
	11.0k	0698-7261		11.0k	0698-7261
5.4643 GHz			4.4636 GHz		
	12.1k	0698-7262		12.1k	0698-7262
5.4683 GHz			4.4406 GHz		
	13.3k	0698-7263		13.3k	0698-7263
5.472 GHz			4.4193 GHz		
	14.7k	0698-7264		14.7k	0698-7264
5.4755 GHz			4.3999 GHz		
	16.2k	0698-7265		16.2k	0698-7265
5.4785 GHz			4.3824 GHz		
	17.8k	0698-7266		17.8k	0698-7266
5.4814 GHz			4.3668 GHz		
	19.6k	0698-7267		19.6k	0698-7267
5.4839 GHz			4.3527 GHz		
	21.5k	0698-7268		21.5k	0698-7268
5.4862 GHz			4.3398 GHz		
	23.7k	0698-7269		23.7k	0698-7269
5.4884 GHz			4.3228 GHz		
	26.1k	0698-7270		28.7k	0698-7271
5.4903 GHz			4.3032 GHz		
	28.7k	0698-7271		34.7k	0698-7273
5.4928 GHz			4.2869 GHz		
	34.8k	0698-7273		42.2k	0698-7275
5.4958 GHz			4.2736 GHz		
	42.2k	0698-7275		51.1k	0698-7277
5.4983 GHz			4.2604 GHz		
	51.1k	0698-7277		68.1k	0698-7280
5.5003 GHz			4.2479 GHz		
	61.9k	0698-7279		90.0k	0698-7283
5.502 GHz			4.2386 GHz		
	75.0k	0698-7281		121k	0698-7286
5.5034 GHz			4.2324 GHz		
	90.9k	0698-7283		147k	0698-7288
5.5048 GHz			4.2204 GHz		
	121k	0698-7286			
5.5058 GHz					
	147k	0698-7288			
5.508 GHz					

ADJUSTMENTS

A5-21. A2A9 DISCRIMINATOR

a. On A2 Frequency Control, set controls as follows:

RANGE MHz	.5 — 130 MHz
MODE	LIN EXPAND
WIDTH	CW ±ΔF
SCAN TIME SEC	10 — 1
SCAN TIME SEC Vernier	Fully Clockwise
TRIGGER	AUTO
MARKERS	1

b. Set CW FREQUENCY VERNIER to 0, set CW FREQUENCY to 100.0 MHz, and set ±ΔF FREQUENCY to 00.00.

NOTE

In some measurements, the FREQUENCY COUNTER MHz OVERFLOW light should be lit, indicating that the counter is reading the frequency with high resolution but is not displaying the most significant digits of the measured frequency. These most significant digits are shown in parentheses in the following text.

c. Adjust "FREQ ADJ HI" control A2A9R68 for (10) 0.000 MHz ±0.2 MHz indication on FREQ COUNTER digital readout (See Figure A5-16).

A1/A2

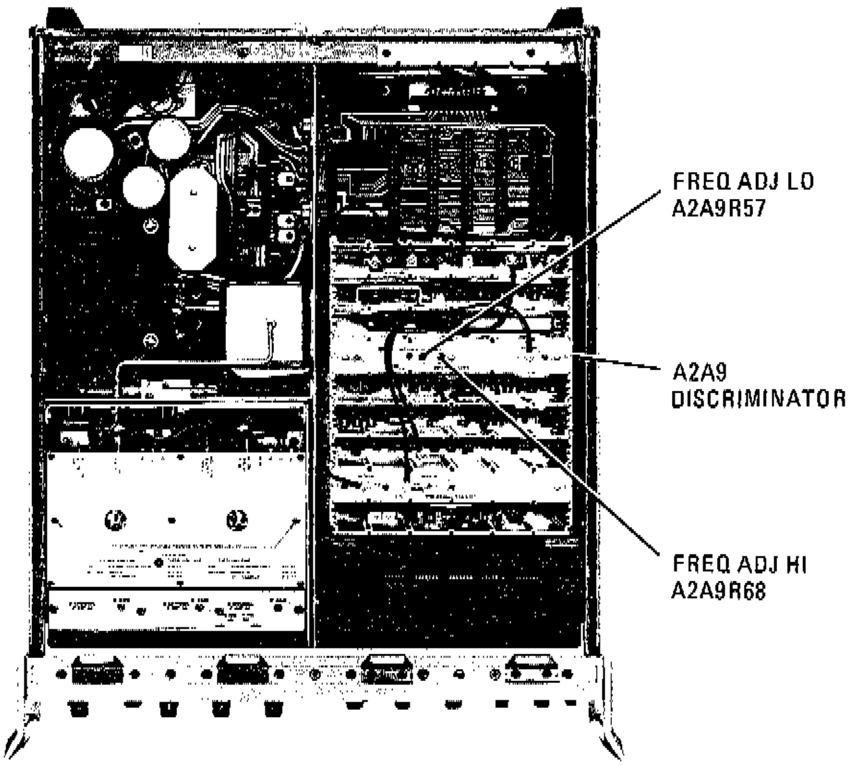


Figure A5-16. A2A9 Discriminator Adjustment Locations

ADJUSTMENTS

A5-21. A2A9 DISCRIMINATOR (Cont'd)

d. Set CW FREQUENCY to 005.0 MHz. Adjust "FREQ ADJ LO" control A2A9R57 for 5.000 MHz± 0.010 MHz indication on FREQ COUNTER digital readout.

e. Repeat steps b through d until both frequencies are within tolerance without further adjustment.

f. Set CW FREQUENCY to 020.0 MHz. Adjust "FREQ ADJ HI" control A2A9R68 for (2) 0.000 MHz ±0.2 MHz indication on FREQ COUNTER digital readout.

NOTE

The overall accuracy of the discriminator will be improved even though it will raise the 100 MHz reading slightly.

A5-22. A3A24 POWER SUPPLY

EQUIPMENT:

Digital Voltmeter (DVM) . . . . HP 3490A

a. Connect DVM to test points on A3A24 as listed in Table *A5-5*.

Table A5-5. *Power Supply Voltages*

Test Point	Voltage	Tolerance (Vdc)	Ripple (mV p-p)
+ 5	+ 5.00	± .25	10
+ 15	+ 15.00	± .75	10
− 15	− 15.00	± .75	10
+100	+100.00	±3.00	50

ADJUSTMENTS

A5-23. A3A5 PROCESSOR DIGITAL-TO-ANALOG CONVERTER

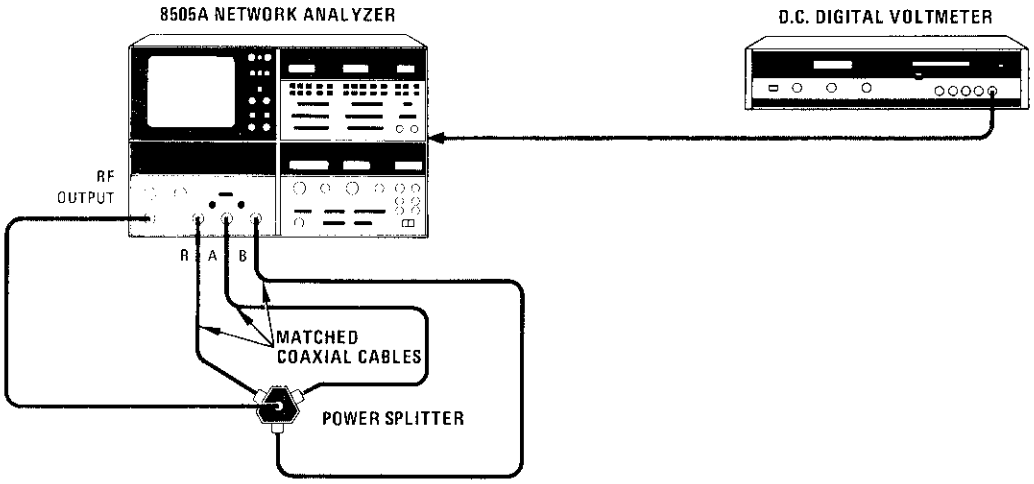


Figure A5-17. A3A5 D/A Converter Adjustment Test Setup

EQUIPMENT:

3-Way Power Splitter	HP 11850A
DC Digital Voltmeter (DVM)	HP 3490A
Matched Coaxial Cable Kit	HP 11851A

PROCEDURE:

NOTE

Ground return for all DVM measurements should be A3A5TP3.

a. Set 8505A controls as follows:

On A1 Source/Converter

OUTPUT LEVEL dBm	−10
OUTPUT LEVEL Vernier	0
MAXIMUM INPUT dBm	−10

On A2 Frequency Control

FREQUENCY RANGE MHz	.5 — 130
MODE	LIN EXPAND
WIDTH	CW $\pm\Delta$F
SCAN TIME SEC	.1 — .01
TRIGGER	AUTO
CW FREQUENCY	30 MHz
ΔF FREQUENCY	00.00

ADJUSTMENTS

A5-23. A3A5 PROCESSOR DIGITAL-TO-ANALOG CONVERTER (Cont'd)

On A3 Signal Processor
Channel 1
INPUT . . . . A/R
MODE . . . . MAG
SCALE/DIV . . . . 10 dB

Channel 2
INPUT . . . . A/R
MODE . . . . OFF
SCALE/DIV . . . . 10 dB

Electrical Length
MODE . . . . OFF

b. Connect equipment as shown in Figure A5-17.

c. On A3 Processor, press Channel 1 DISPLAY REF then CLR pushbutton until REL light goes off (if lit).

d. Connect Digital Voltmeter (DVM) to A3A5TP4 and adjust "OFS 1" (Channel 1 offset) control A3A5R29 for 0.000 Vdc ±0.001 Vdc. (See Figure A5-18.)

e. Press Channel 1 REF OFFSET switches for +100.0 dB offset at digital display. Adjust "SCL" (scale) control A3A5R48 for −5.000 Vdc± 1 mVdc.

f. Press Channel 1 REF OFFSET switches for −100.0 dB offset at digital display. Adjust "BAL" (+ balance) control A3A5R45 for +5.000 Vdc ±1 mVdc. Press Channel 1 DISPLAY CLR pushbutton until REL light goes out (if lit). Set Channel 1 MODE switch to OFF.

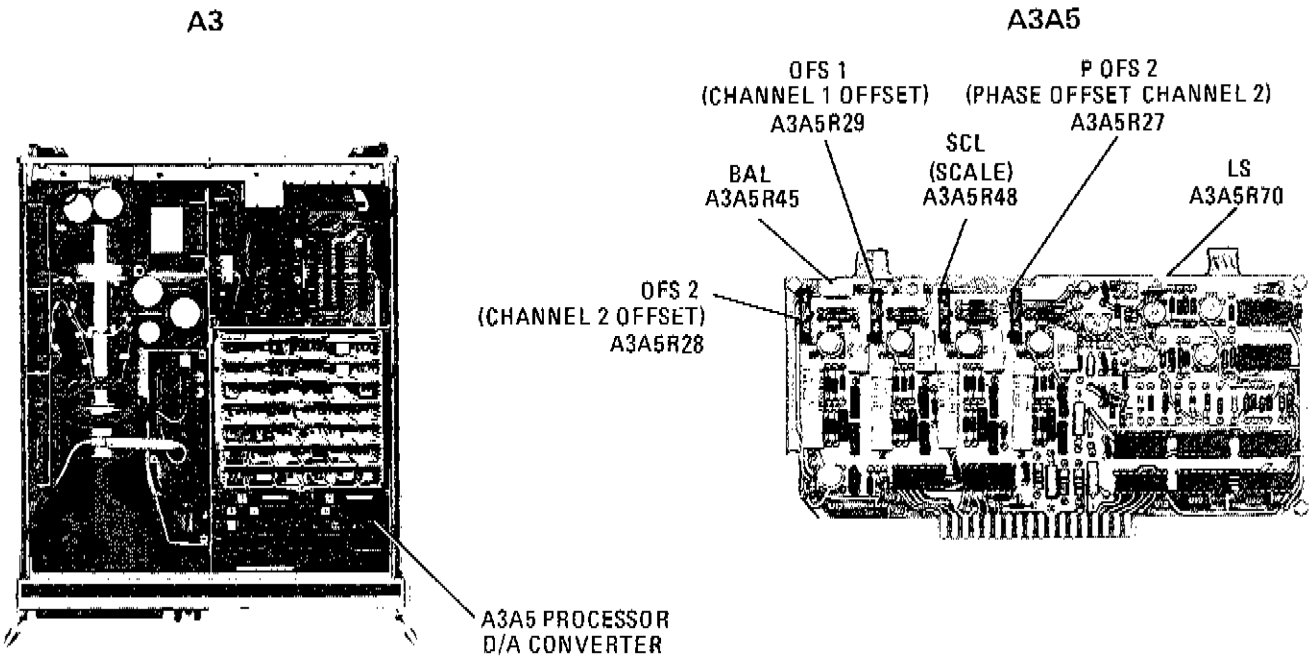


Figure A5-18. A3A5 Processor Digital-To-Analog Converter Adjustment Locations

ADJUSTMENTS

A5-23. A3A5 PROCESSOR DIGITAL-TO-ANALOG CONVERTER (Cont'd)

g. Set Channel 2 MODE switch to MAG. Press Channel 2 DISPLAY REF then CLR until REL light goes out (if lit). Connect DVM to A3A5TP2. Adjust "OFS 2" (Channel 2 offset) control A3A5R28 for 0.000 Vdc ±0.001 Vdc.

h. Set Channel 2 MODE switch to OFF and set Channel 1 MODE switch to PHASE. Press Channel 1 DISPLAY REF then CLR until REL light goes out (if lit).

i. Connect DVM to A3A5TP5 and record DVM reading of offset.

j. Set Channel 1 MODE switch to OFF and set Channel 2 MODE switch to PHASE. Press Channel 2 DISPLAY REF then CLR Until REL light goes out (if lit). Adjust "P OFS 2" (Channel 2 phase offset) control A3A5R27 for DVM reading the same as the offset recorded in step i above ±0.001 Vdc.

k. Set Channel 1 MODE to PHASE, and SCALE/DIV to 5 degrees. Set Channel 2 MODE to OFF.

l. Press DISPLAY MKR then ZRO to bring CRT trace to center graticule line.

m. Set ELECTRICAL LENGTH INPUT to A and MODE to PHASE x 10°/SCAN. Press ELECTRICAL LENGTH DISPLAY CLR pushbutton until REL light goes out (if lit).

n. Offset electrical length from +00 to −01 and adjust "LS" offset control A3A5R70 so that beginning of CRT trace does not move (left hand edge of CRT trace pivots about Reference Line).

A5-24. A3A6 INPUT MULTIPLEX

NOTE

Ground return for all DVM measurements should be A3A5TP3.

EQUIPMENT:

DC Digital Voltmeter (DVM) .... HP 3490A
Extender board (18 pin) .... HP 08505-60042

PROCEDURE:

a. Set Channel 1 MODE to MAG and Channel 2 MODE to OFF.

b. Put A3A6 on an extender board. Remove the two magnitude detectors, A3A13 and A3A14 from instrument. (Note the position of each detector before removing it from instrument so that it can be reinstalled in the same place.)

c. Short test points A3A4TP9 and A3A4TP10 to ground. (This selects "Test Mode" and grounds the inputs to A3A6U2 and A3A6U4.) Ground A3A6TP2 and TP4. Set A3 Signal Processor Channel 1 and 2 INPUT switches to "R".

d. Connect DVM to A6TP1 and adjust "CH 1 OFFSET" control A3A6R13 (Figure A5-19) for 0.000 Vdc ±0.001 Vdc.

ADJUSTMENTS

A5-24. A3A6 INPUT MULTIPLEX (Cont'd)

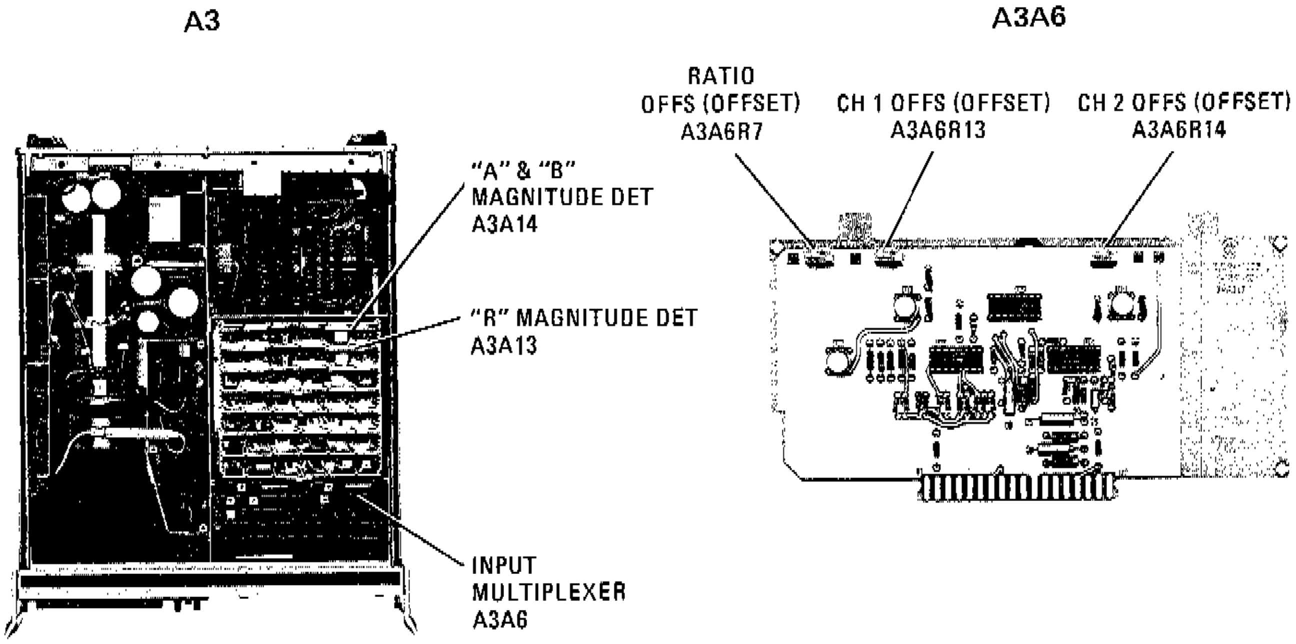


Figure A5-19. A3A6 Adjustment Locations

e. Connect DVM to A6TP3 and adjust "CH 2 OFFSET" control A3A6R14 for 0.000 Vdc ±0.001 Vdc.

f. Remove ground from A3A6TP2 and TP4 and ground A3A6 pins 21 and 23.

g. Connect DVM to pin 22 on A3A6 and adjust "RATIO OFFSET" control A3A6R7 for 0.000 Vdc ±0.001 Vdc. Disconnect DVM and remove ground from A3A6 pins 21 and 23.

h. Remove extender board and reinstall A3A6. Reinstall A3A13 and A3A14 magnitude detectors. Remove ground from pins 2 and 3 of A3A4P1, except if next paragraph is performed.

A5-25. A3A17 MARKER 1

EQUIPMENT:

Digital Voltmeter (DVM) .... HP 3490A

PROCEDURE:

a. Connect pins 2 and 3 of A3A4P1 to ground to put Processor in "TEST" mode.

A5-25. A3A17 MARKER 1 (Cont'd)

b. Set the 8505A controls as follows:

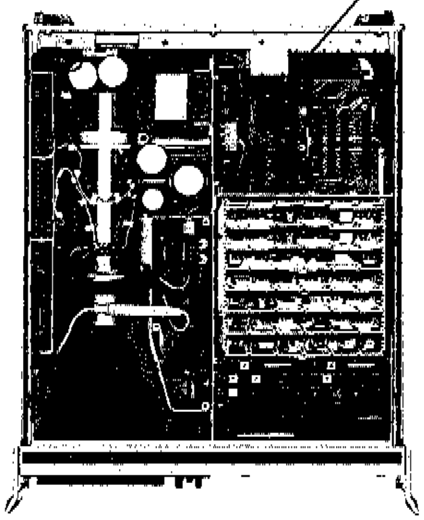
On A2 Frequency Control
RANGE MHz .... 0.5 — 1300
MODE .... LIN EXPAND
WIDTH .... CW
SCAN TIME SEC .... 0.1 — .01
TRIGGER .... AUTO
MARKERS 1

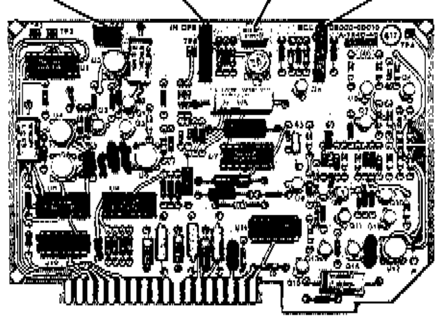
On A3 Signal Processor
Channel 1
INPUT .... R
MODE .... MAG
SCALE/DIV .... 20 dB

Channel 2
MODE .... OFF

c. On A3 Signal Processor, press DISPLAY REF, then CLR until REL light goes off (if lit) to clear offset memory.

d. Connect DVM to A3A17TP2 (Figure A5-20) and note DVM reading. Set Channel 1 SCALE/DIV to .1 dB and adjust "IN OFS" (input offset) control A3A17R10 for the same DVM reading noted above ±1 mV. Repeat setting Channel 1 SCALE/DIV switch between 20 and 0.1 dB position until no further adjustment of A3A17R10 is necessary.





A5-20. A3A17 Marker Test Points and Adjustments

ADJUSTMENTS

A5-25. A3A17 MARKER 1 (Cont'd)

e. Set Channel 1 SCALE/DIV switch to .1 dB position. Press A3 Signal Processor Channel 1 DISPLAY MKR pushbutton. Adjust "A/D OFS" (A/D offset) control A3A17R30 for an indication of 0.00 dB on the front panel Channel 1 MARKER readout.

f. Set Channel 1 SCALE/DIV switch to 20 dB position. (Channel 1 MARKER readout should still be 00.0 dB.) Press Channel 1 DISPLAY REF pushbutton. Press Channel 1 REF OFFSET switches to select +100 dB of offset.

g. Press Channel 1 DISPLAY MKR and indication should be −100.0 dB ±0.1 dB. If not, adjust "SCL" (scale) control A3A17R41 for −100.0 dB ±0.1 dB.

h. Press Channel 1 DISPLAY REF pushbutton. Press Channel 1 REF OFFSET switches to select −100 dB of offset.

i. Press Channel 1 DISPLAY MKR and indication should be +100.0 dB ±0.1 dB. If not, adjust "SYM" (symmetry) control A3A17R31 for +100.0 dB ±0.1 dB.

j. Repeat steps f through i until no further adjustment is necessary.

k. Remove ground from pins 2 and 3 of A3A4P1.

A5-26. A3A7 RESOLUTION CONTROL

EQUIPMENT:

Digital Voltmeter . . . . HP 3490A
3-Way Power Splitter . . . . HP 11850A
Matched Coaxial Cable Kit . . . . HP 11851A
Extender Board (18 pin) . . . . HP 08505-60042

PROCEDURE:

a. On 8505A, set controls as follows:

OUTPUT LEVEL dBm . . . . −10
OUTPUT LEVEL Vernier 0
INPUT LEVEL dBm MAX . . . . −10
TRIGGER . . . . EXT

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

Channel 2
INPUT . . . . R
MODE . . . . MAG
SCALE/DIV . . . . 20 dB

ADJUSTMENTS

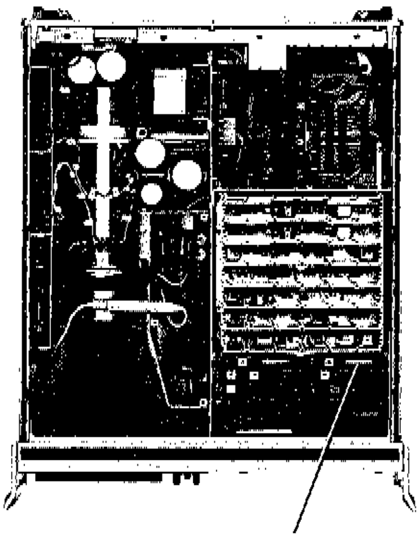
A5-26. A3A7 RESOLUTION CONTROL (Cont'd)

b. Connect equipment as shown in Figure A5-17.

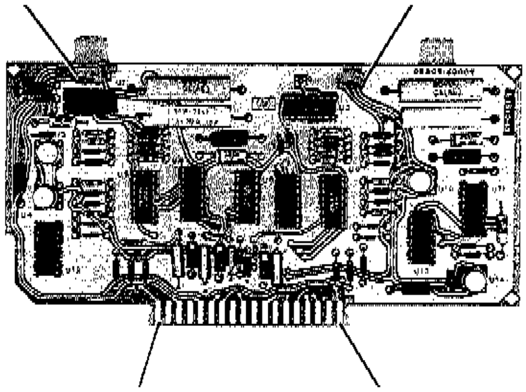
c. On A3A4, ground test points A3A4TP9 and A3A4TP10. On A3A6, ground test points A3A6TP2 and A3A6TP4. Connect DVM to A3A6TP1 and A3A6TP3. DVM should indicate ≤ 1 mVdc. If it does not, refer to paragraph A5-24 and adjust A3A6 in accordance with procedures a through h.

d. Connect DVM to A3A7TP1. (See Figure A5-21.)

A3



A3A7



A5-26. A3A7 RESOLUTION CONTROL (Cont'd)

e. Set Channel 2 MODE to OFF.

f. Press Channel 1 DISPLAY REF then CLR pushbuttons until REL light goes out (if lit) to clear Channel 1 offsets.

g. Note DVM indication.

h. Set SCALE/DIV to .1 dB and adjust "CH 1" offset control A3A7R8 for the same DVM indication that was noted in step g.

i. Repeat steps g and h until no further adjustment is required.

j. Connect DVM to A3A7TP2.

k. Set Channel 1 MODE to OFF and Channel 2 MODE to MAG.

l. Press Channel 2 DISPLAY REF then CLR pushbuttons until REL light goes out (if lit) to clear Channel 2 offsets.

m. Note DVM indication.

n. Set SCALE/DIV to .1 dB and adjust "CH 2" offset control A3A7R9 for the same DVM indication that was noted in step m.

o. Repeat steps m and n until no further adjustment is required.

p. Remove grounding jumpers from test points on boards A3A4 and A3A6.

A5-27. A3A15 ANALOG DISPLAY MULTIPLEX

EQUIPMENT:

Digital Voltmeter (DVM) .... HP 3490A

PROCEDURE:

a. On 8505A, set controls as follows:

On A1 Source/Converter
- OUTPUT LEVEL dBm .... −10
- OUTPUT LEVEL VERNIER 0
- INPUT LEVEL dBm MAX .... −10

On A2 Frequency Control
- RANGE MHz .... .5 — 130
- MODE .... LIN EXPAND
- WIDTH .... CW
- CW FREQUENCY .... 30 MHz

ADJUSTMENTS

A5-27. A3A15 ANALOG DISPLAY MULTIPLEX (Cont'd)

On A3 Signal Processor
Channel 1
INPUT . . . . R
MODE . . . . MAG
SCALE/DIV . . . . 5 dB

Channel 2
INPUT . . . . R
MODE . . . . MAG
SCALE/DIV . . . . 5 dB

Electrical Length
MODE . . . . OFF

Display Section
BANDWIDTH KHz 10

b. Connect equipment as shown in Figure A5-22.

Y-Deflection

c. On DISPLAY panel, press REF LINE POSN switch and place Channel 1 and Channel 2 traces on CRT center graticule line. Release switch.

d. Set Channel 2 MODE to OFF.

e. Press Channel 1 DISPLAY REF then CLR pushbuttons until REL light goes out (if lit).

f. Connect DVM to A3A15TP2.

g. Set voltage at A3A15TP2 to −0.500 Vdc ±0.001 Vdc with OUTPUT LEVEL dBm VERNIER.

h. Add +10 dB of offset with REF OFFSET pushbuttons. Voltage at A3A15TP2 should have changed 500 mVdc ±10 mVdc. If not, adjust "CH 1 Y" control A3A15R33 until 10 dB of offset produces a 500 mV change.

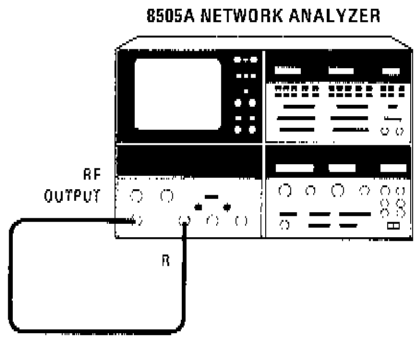


Figure A5-22. Display Multiplex and Deflection Amplifiers Test Setup

ADJUSTMENTS

A5-27. A3A15 ANALOG DISPLAY MULTIPLEX (Cont'd)

i. Repeat steps g and h until no further adjustment is necessary.

j. Set Channel 1 MODE to OFF and Channel 2 MODE to MAG.

k. Press Channel 2 DISPLAY REF then CLR pushbuttons until REL light goes out (if lit).

l. Connect DVM to A3A15TP3.

m. Set voltage at A3A15TP3 to −0.500 Vdc ±0.001 Vdc with OUTPUT LEVEL dBm VERNIER.

n. Add +10 dB of offset with REF OFFSET pushbuttons. Voltage at A3A15TP3 should have changed 500 mVdc ±10 mVdc. If not, adjust "CH 2 Y" control A3A15R31 until 10 dB of offset produces a 500 mV change.

o. Repeat steps m and n until no further adjustment is necessary.

p. Add 20 dB of offset with REF OFFSET pushbuttons. CRT trace should move 4 divisions. If not, refer to paragraph A5-29 Y-Deflection Amplifier.

X-Deflection

q. Connect DVM to A3A15TP1.

r. Set SCAN TIME SEC to MAN and SCAN TIME SEC VERNIER to full counterclockwise position.

s. Using display panel X POSN control, place CRT dot on the left most graticule line of the CRT.

t. Note DVM indication.

u. Set SCAN TIME SEC VERNIER to full clockwise position.

v. Note DVM indication.

w. The difference in DVM readings in steps t and v should be 3.00 Vdc ±0.05 Vdc. If not, adjust "SWP WIDTH" control A3A15R1 and repeat steps r through w.

x. Set CRT dot to the fourth graticule line from the left edge of the CRT with the SCAN TIME SEC VERNIER and note DVM indication.

y. Move CRT dot to the right until DVM indication is one volt greater than that noted in step x.

z. CRT dot should have moved to the right by four divisions. If not, refer to paragraph A5-28 X-Deflection Amplifier.

Intensity

aa. Set INTENSITY control on CRT display panel to 1/4 turn from fully counterclockwise position and adjust "INT" control A3A15R8 to the point where the CRT trace just disappears.

ADJUSTMENTS

A5-28. A3A28 X-DEFLECTION AMPLIFIER

NOTE

If the adjustment of A3A15 Analog Display Multiplex in Paragraph A5-27 was successfully completed, do not adjust X-Deflection Amplifier Gain control A3A28R27 in the following steps.

EQUIPMENT:

Digital Voltmeter (DVM) .... HP 3490A
Extender Board (15 pin) .... HP 08505-60041

PROCEDURE:

a. Set 8505A controls as follows:
On A1 Source/Converter
OUTPUT LEVEL dBm .... −10
OUTPUT LEVEL VERNIER 0
INPUT LEVEL dBm MAX .... −10

On A2 Frequency Control
RANGE MHz .... .5 — 130
MODE .... LIN EXPAND
WIDTH .... CW
CW FREQUENCY .... 30 MHz
SCAN TIME SEC .... MAN
TRIGGER .... AUTO

On A3 Signal Processor
Channel 1
INPUT .... R
MODE .... MAG
SCALE/DIV .... 5 dB

Channel 2
MODE .... OFF

Electrical Length
MODE .... OFF

Display Section
BANDWIDTH KHz 10

b. Connect equipment as shown in Figure A5-22. Put A3A28 X-Deflection Amplifier on extender board (See Figure A5-23).

c. Connect DVM to A3A15TP1

d. Press DISPLAY MKR then ZRO pushbuttons to place CRT trace on center graticule line.

ADJUSTMENTS

A5-28. A3A28 X-DEFLECTION AMPLIFIER (Cont'd)

Gain Adjustment

e. Set CRT dot to the second graticule line from the left edge of the CRT with the SCAN TIME SEC VERNIER and note DVM indication.

f. Move CRT dot to the right until DVM indication is exactly two volts greater than indiction noted in step e.

g. CRT dot should have moved to the right by eight divisions. If not, adjust "GAIN" control A3A28R27.

h. Repeat steps e through g until no further adjustment is necessary.

X Position

i. Set SCAN TIME SEC to .1 — .01 position. Press REF LINE POSN pushbutton. Set front-panel X POSN control to the center of its range. Adjust POS (position) control A3A28R15 to center reference line on CRT graticule.

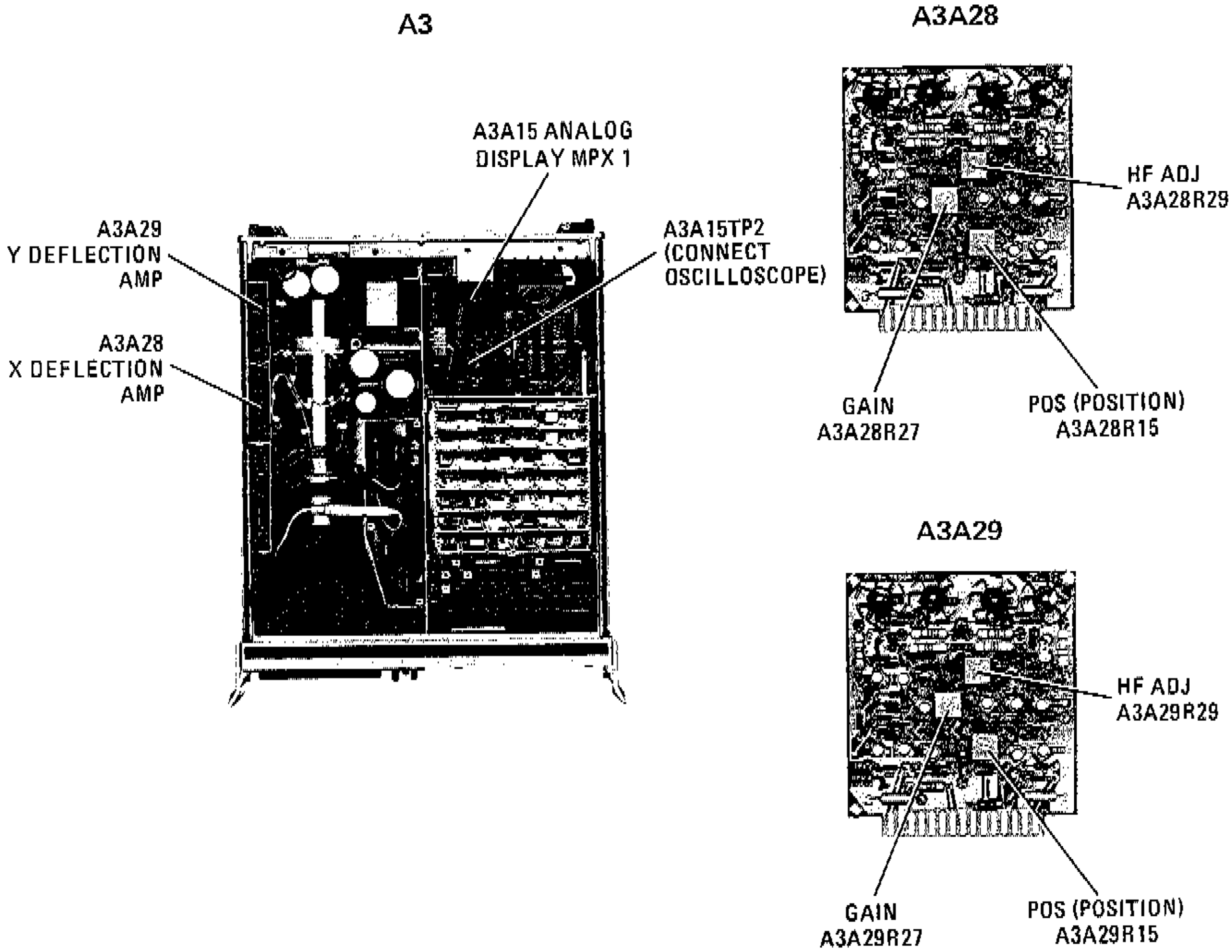


Figure A5-23. Adjustment Locations for X and Y Deflection Amps

A5-28. A3A28 X-DEFLECTION AMPLIFIER (Cont'd)

High Frequency Adjustment

j. Connect pulse generator output to the monitor oscilloscope vertical input; terminate line in 50Ω load.

k. Adjust pulse generator for a positive +1 Vp-p square wave, 100 kHz output with a 50% duty cycle pulse width. Disconnect from oscilloscope.

l. Remove Blanking Logic A3A16 and install extender board in its place. Connect pulse generator output to pin 22 of extender board.

m. Connect monitor oscilloscope vertical input through a 10:1 divider probe to output pin 6 at top of A3A28 PC board. The displayed waveform should be approximately 25 Vp-p.

n. Adjust HF ADJ (high frequency adjust) A3A28R29 for best square wave pulse shape.

o. Remove extender and reinstall A3A28 and A3A16.

A5-29. A3A29 Y-DEFLECTION AMPLIFIER

NOTE

If the adjustment of A3A15 Analog Display Multiplex in Paragraph A5-27 was successfully completed, do not adjust Y-Deflection Amplifier GAIN control A3A2R27 in the following steps.

EQUIPMENT:

Digital Voltmeter (DVM) .... HP 3490A
Extender Board (15 pin) .... HP 08505-60041

PROCEDURE:

a. Put A3A29 Y-Deflection Amplifier on extender board and set 8505A controls as follows:

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

On A2 Frequency Control
RANGE MHz .... .5 — 130
MODE .... LIN EXPAND
WIDTH .... CW ±ΔF
CW FREQUENCY .... 30 MHz
±ΔF 00.00
SCAN TIME SEC .... .1 — .01

ADJUSTMENTS

A5-29. A3A29 Y-DEFLECTION AMPLIFIER (Cont'd)

On A3 Signal Processor
Channel 1
INPUT .... R
MODE .... MAG
SCALE/DIV .... 5 dB

Channel 2
MODE .... OFF

Electrical Length
MODE .... OFF

Display Section
BANDWIDTH KHz 10

b. Connect equipment as shown in Figure A5-22 and connect DVM to A3A15TP2.

c. Ground pins 2 and 3 on A3A4P1 to put Processor in "TEST" mode.

d. Ground A3A6TP2.

e. Press Channel 1 DISPLAY REF then CLR pushbuttons.

f. Set CH1 REF LINE POSN control on Display panel for 0.000 Vdc ±0.005 Vdc indication on DVM and adjust "POS" control A3A29R15 to place CRT trace on center graticule line. (See Figure A5-23.)

g. Set CH1 REF LINE POSN control for +1.000 Vdc ±0.005 Vdc indication on DVM and adjust "GAIN" control A3A29R27 for a CRT trace deflection of four divisions above the center graticule line.

h. Set CH 1 REF LINE POSN control for −1.000 Vdc ±0.005 Vdc indication on DVM. The CRT trace should reflect four divisions below the center graticule line. If not, a slight adjustment of "GAIN" control A3A29R27 may be necessary.

High Frequency Adjustment

i. Connect pulse generator output to the monitor oscilloscope vertical input; terminate line in 50Ω load.

j. Adjust pulse generator for a positive +1 Vp-p square wave, 100 kHz output with a 50% duty cycle pulse width. Disconnect from oscilloscope.

k. Remove Blanking Logic A3A16 and install extender board in its place. Connect pulse generator output to pin 24 of extender board.

l. Connect monitor oscilloscope vertical input through a 10:1 divider probe to output pin 6 at top of A3A29 PC board. The displayed waveform should be approximately 25 Vp-p.

m. Adjust HF ADJ (high frequency adjust) A3A29R29 for best square wave pulse shape.

n. Remove extender and reinstall A3A29 and A3A16.

ADJUSTMENTS

A5-30. A3A13 AND A3A14 MAGNITUDE DETECTORS MAGNITUDE ADJUSTMENT

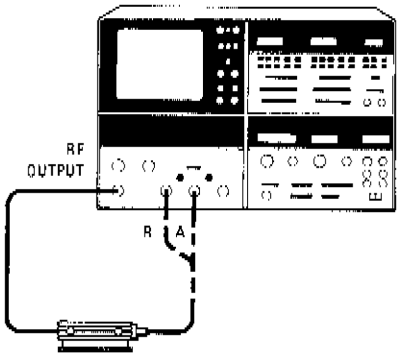


Figure A5-24. Magnitude Detector Adjustment Test Setup

EQUIPMENT:

Oscilloscope	HP 180/1801/1820
10:1 Probes (2)	HP 10004D
Digital Voltmeter (DVM)	HP 3490A
Attenuator	HP 8496A
Extender Board (15 pin)	HP 08505-60041

NOTE

The Processor Digital-to-Analog Converter Adjustment (Paragraph A5-23), the Resolution Adjustment (Paragraph A5-26), the Analog Display Multiplex Adjustment (Paragraph A5-27), and the Y-Deflection Amplifier Adjustment (Paragraph A5-29) must be checked before the magnitude detectors are adjusted in the following steps.

a. Put A3A13 on extender board. (See Figure A5-25.) Set 8505A controls as follows:

On A1 Source/Converter

OUTPUT LEVEL dBm	−10
OUTPUT LEVEL Vernier	0
INPUT LEVEL dBm MAX	−10

ADJUSTMENTS

A5-30. A3A13 AND A3A14 MAGNITUDE DETECTORS MAGNITUDE ADJUSTMENT (Cont'd)

On A2 Frequency Control
- FREQUENCY RANGE MHz .... .5 — 130
- MODE .... LIN EXPAND
- WIDTH .... CW ±ΔF
- SCAN TIME SEC .... .1 — .01
- TRIGGER .... AUTO
- CW FREQUENCY .... 30 MHz
- ΔF FREQUENCY 00.00

On A3 Signal Processor

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

Channel 2
- MODE .... OFF

CRT Display Panel
- BANDWIDTH KHz 10
- VIDEO FILTER .... ON

Electrical Length
- MODE .... OFF

b. Connect equipment as shown in Figure A5-24 with step attenuator connected to "R" input and to RF OUTPUT.

c. Set external attenuator to 10 dB. Set oscilloscope A Channel to positive polarity and B Channel to negative polarity. Connect one 10:1 probe of oscilloscope to pin 1 and the other 10:1 probe to pin 13. Adjust the vertical gain of the oscilloscope for equal height of the two traces. Expand oscilloscope to display one half cycle.

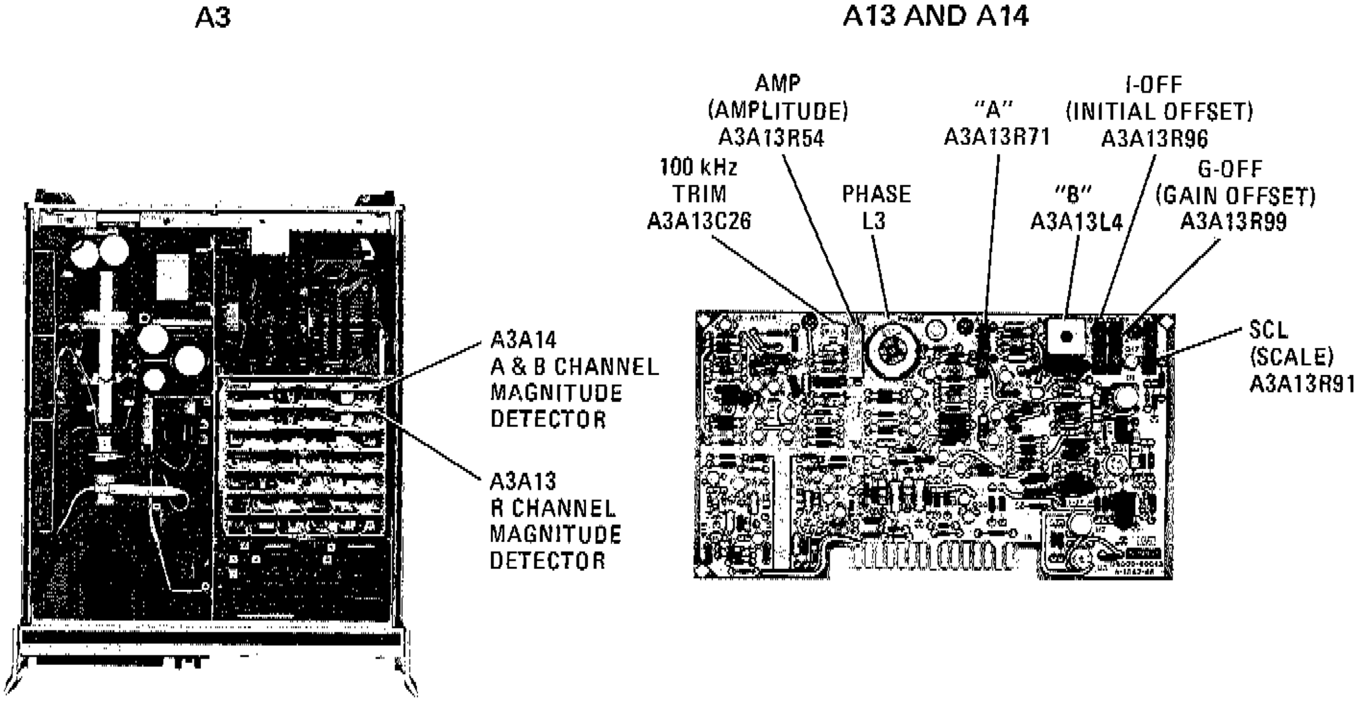
d. "Adjust "PHASE" control A3A13L3 and "100 kHz TRIM" A3A13C26 for zero degree phase difference between the two traces.

e. Switch between BANDWIDTH 10 KHz and 1 KHz and fine tune "PHASE" control A3A13L3 for zero phase difference between Bandwidths.

f. On display, press REF LINE POSN, adjust Channel 1 trace to center line, then press REF LINE POSN again for normal operation.

g. Set Channel 1 SCALE/DIV to 0.1 dB. Press Channel 1 DISPLAY MKR then ZRO pushbuttons to place the CRT trace on the center graticule line.

A5-30. A3A13 AND A3A14 MAGNITUDE DETECTORS MAGNITUDE ADJUSTMENT (Cont'd)



A5-25. Magnitude Adjustments on A13 and A14

h. On display section, select 10 kHz bandwidth, then 1 kHz and adjust "AMP" control A3A13R54 (Figure A5-25) for ≤0.2 dB change in trace position when bandwidth is changed.

i. Set front panel Channel 1 SCALE/DIV switch to .2 dB. Press DISPLAY MKR then ZRO then REF pushbuttons.

j. Step external attenuator from −10 to −40 dB. As attenuator is stepped 10 dB, add 10 dB of offset with REF OFFSET pushbuttons to bring trace back to Reference line.

k. Adjust "SCL" control A3A13R91 for accurate 10 dB steps.

l. Step external attenuator from −50 to −90 dB (−60 to −100 dBm signal level at "R" INPUT). As attenuator is stepped 10 dB, add 10 dB of offset with REF OFFSET pushbuttons to bring CRT trace back to Reference line. Adjust "A" control A3A13R71 and "B" control A3A13L4 for accurate 10dB steps on CRT display in the input range of −70 to −110 dBm. See Figure A5-26 for area that each control affects.

m. Set external step attenuator to zero dB. Set OUTPUT LEVEL dBm to −10 dBm. Connect DVM to pin 1 of A13 connector at extender board. Adjust front panel OUTPUT LEVEL Vernier for a reading of 0.35 VRMS ±0.02 VRMS.

n. Set external attenuator to 20 dB. Connect DVM to A13TP4 and adjust "I OFF" control A3A13R96 for an indication on the DVM of −1.50 Vdc ±0.01 Vdc. Return OUTPUT LEVEL Vernier to 0 dB.

ADJUSTMENTS

A5-30. A3A13 AND A3A14 MAGNITUDE DETECTORS MAGNITUDE ADJUSTMENT (Cont'd)

NOTE

Use non-metallic adjusting tool for A13L4.

NOTE

The step from −110 dBm to −120 dBm may not indicate a full 10 dB change of trace position but can show noise floor at about −115 dBm.

o. Set external step attenuator to −30 dB and set front panel OUTPUT LEVEL dBm switch to −10 dBm. Set SCALE/DIV to 0.1 dB. Press Channel 1 DISPLAY MKR then ZRO to place trace on center graticule line. Switch front panel INPUT LEVEL dBm MAX switch from −10 to −30 dBm. Adjust "Y" (G–OFF) control A3A13R99 for ≤.02 dB change between −10 and −30 dBm switch position.

p. Check the entire INPUT range from −10 dBm to −110 dBm by stepping the external step attenuator. Repeat adjustments in steps j through o to get accurate 10 dB steps through the entire input range.

q. Remove extender board and reinstall A3A13. Put A3A14 on extender board.

r. Connect external step attenuator to "A" INPUT and set Channel 1 INPUT switch to "A". Repeat adjustments in steps c through p for A3A14 A and B Channel magnitude detector.

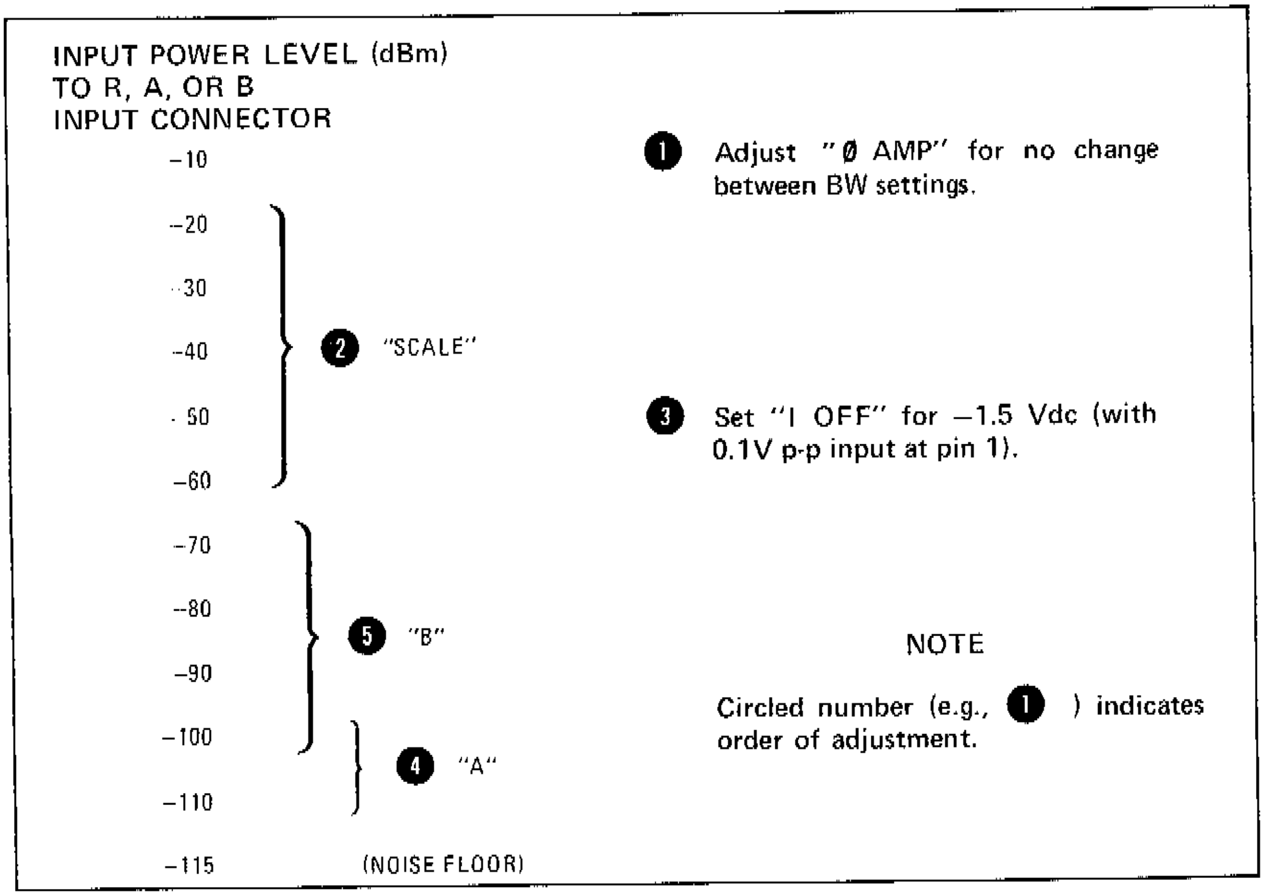


Figure A5-26. Graph of A3A13 and A3A14 Magnitude Detector Adjustments

ADJUSTMENTS

A5-31. ABSOLUTE MAGNITUDE CALIBRATION

EQUIPMENT:

3-Way Power Splitter .... HP 11850A
Matched Coaxial Cable Kit .... HP 11851A

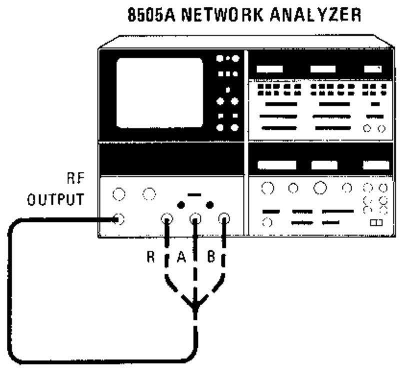


Figure A5-27. Absolute Magnitude Test Setup

a. Set 8505A controls as follows:

On A1 Source/Converter
- OUTPUT LEVEL dBm 10 dB/step .... −10
- OUTPUT LEVEL Vernier 0
- MAXIMUM INPUT dBm .... −10

On A2 Frequency Control
- FREQUENCY RANGE MHz .... .5 — 130
- MODE .... LIN EXPAND
- WIDTH .... CW ±ΔF
- SCAN TIME SEC .... .1 — .01
- TRIGGER .... AUTO
- CW FREQUENCY .... 30 MHz
- ΔF FREQUENCY .... 00.00 MHz

On A3 Signal Processor

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

Channel 2
- MODE .... OFF

Electrical Length
- MODE .... OFF

Display Panel
- BANDWIDTH KHz 10
- VIDEO FILTER .... OFF

ADJUSTMENTS

A5-31. ABSOLUTE MAGNITUDE CALIBRATION (Cont'd)

b. Connect equipment as shown in Figure A5-27 with RF OUTPUT connected to INPUT "R".

c. On display section, press CH 1 REF LINE POSN pushbutton and adjust CRT trace to the center graticule line. Press CH 1 REF LINE POSN again for normal operation.

d. Press Channel 1 DISPLAY REF pushbutton then CLR pushbutton until REL light goes off (if lit). Press upper 10 dB REF OFFSET pushbutton to place – 10 dB of offset at the digital readout. The trace should be on the CRT. Adjust A1A4 "R" IF Amplifier "MAGNITUDE ADJ" control A1A4R6 (Figure A5-28) to place the trace directly on the center graticule line. (This calibrates for INPUT R absolute magnitude measurement.)

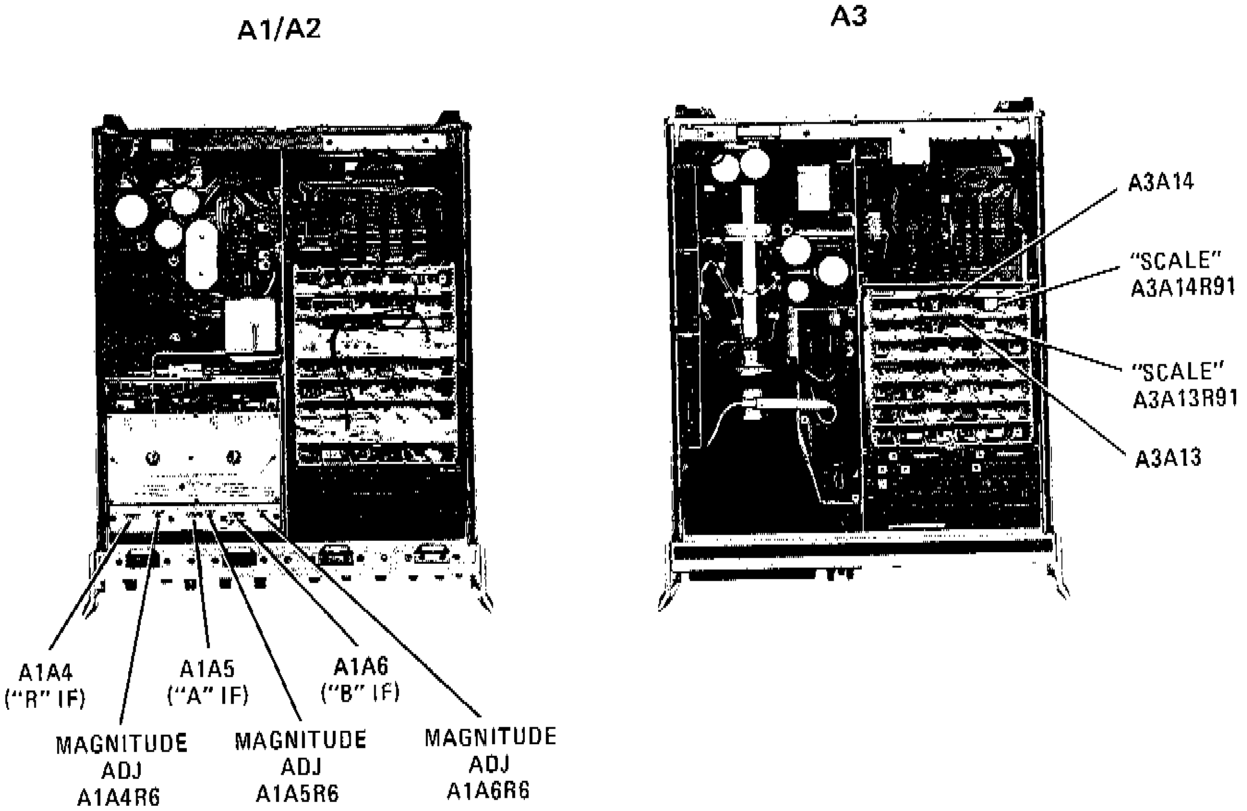


Figure A5-28. Absolute Magnitude Calibration Adjustment Locations

e. Disconnect coaxial cable from front panel INPUT R and connect it to INPUT A connector. Set Channel 1 INPUT switch to "A". Adjust A1A5 "A" IF Amplifier "MAGNITUDE ADJ" control A1A5R6 (Figure A5-28) to place the trace directly on the center graticule line. (This calibrates for INPUT A absolute magnitude measurement.)

f. Disconnect coaxial cable from front panel INPUT A and connect it to INPUT B connector. Set Channel 1 INPUT switch to "B". Adjust A1A6 "B" IF Amplifier "MAGNITUDE ADJ" control A1A6R6 (Figure A5-28) to place the trace directly on the center graticule line. (This calibrates for INPUT B absolute magnitude measurement.)

ADJUSTMENTS

A5-31. ABSOLUTE MAGNITUDE CALIBRATION (Cont'd)

g. Connect power splitter as shown in Figure A5-29. Set Channel 1 INPUT to A/R. Press DISPLAY REF, then CLR until REL light goes off (if lit).

h. Step A1 Source/Converter OUTPUT LEVEL dBm switch to each 10-dB position between −10 dBm and −50 dBm and the CRT trace should stay on the center graticule line (±0.05 dB or ½ division). If not, make fine adjustments to "SCL" controls A3A13R91 and A3A14R91 on the two magnitude detectors. Set Channel 1 SCALE/DIV switch to 0.1 dB and make fine adjustment of "SCL" controls for best tracking through the +10 to −50 dBm range.

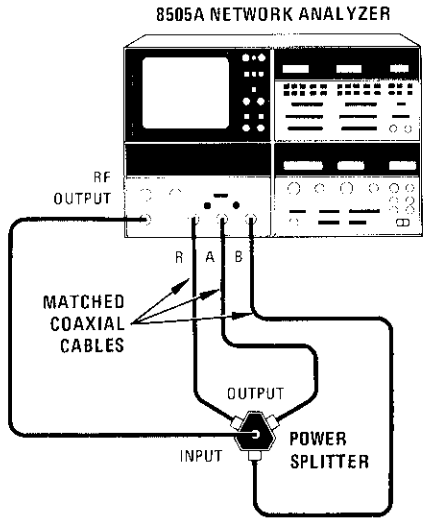


Figure A5-29. Ratio Test Setup

A5-32. A3A12 PHASE DETECTOR ADJUSTMENT

EQUIPMENT:

Spectrum Analyzer	HP 141/8552/8553
Active Probe	HP 1121A
Oscilloscope	HP 180/1801/1820
10:1 probes (2)	HP 10004D
Digital Voltmeter (DVM)	HP 3490A
Attenuator	HP 8496A
3-Way Power Splitter	HP 11850A
Coaxial Cable Kit	HP 11851A
Extender Board (15 pin)	HP 08505-60041
Type N-to-N Female Adapter	HP 1250-0777

PROCEDURE:

a. Remove A3A10 Phase Offset I board, place A3A12 Phase Detector board on extender, and place a short jumper between pins 4 and 6 of the extender board. (This eliminates any phase change through the electrical line stretcher.)

ADJUSTMENTS

A5-32. A3A12 PHASE DETECTOR ADJUSTMENT (Cont'd)

b. Set 8505A controls as follows:

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

On A2 Frequency Control
- RANGE MHz .... .5 – 130
- MODE .... LIN EXPAND
- WIDTH .... CW ±ΔF
- SCAN TIME SEC .... 1 — .1
- TRIGGER .... AUTO
- CW FREQUENCY .... 30 MHz
- ±ΔF FREQUENCY 00.00

On A3 Signal Processor

Channel 1
- INPUT .... A/R
- MODE .... PHASE
- SCALE/DIV .... 90 DEG

Channel 2
- MODE .... OFF

c. Connect equipment as shown in Figure A5-30. Set external attenuator to 40 dB.

d. Connect the Spectrum Analyzer to A3A12TP2 using HP 1121A probe. Adjust "REF BAL 1" control A3A12R19 (Figure A5-31) to null the 200 kHz second harmonic signal.

e. Connect Spectrum Analyzer to A3A12TP8 using HP 1121A probe. Adjust "TEST BAL 1" control A3A12R20 to null the 200 kHz second harmonic signal.

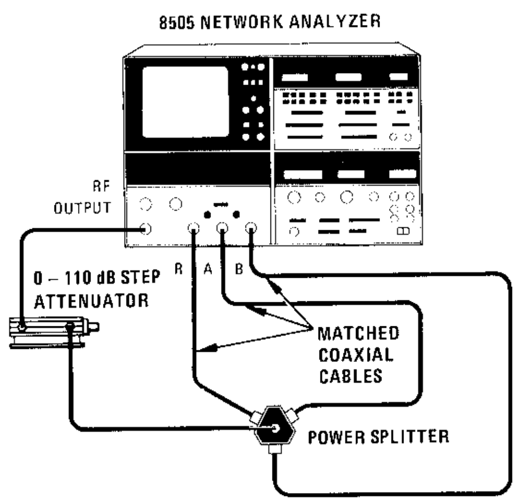


Figure A5-30. A3A12 Phase Detector Test Setup

ADJUSTMENTS

A5-32. A3A12 PHASE DETECTOR ADJUSTMENT (Cont'd)

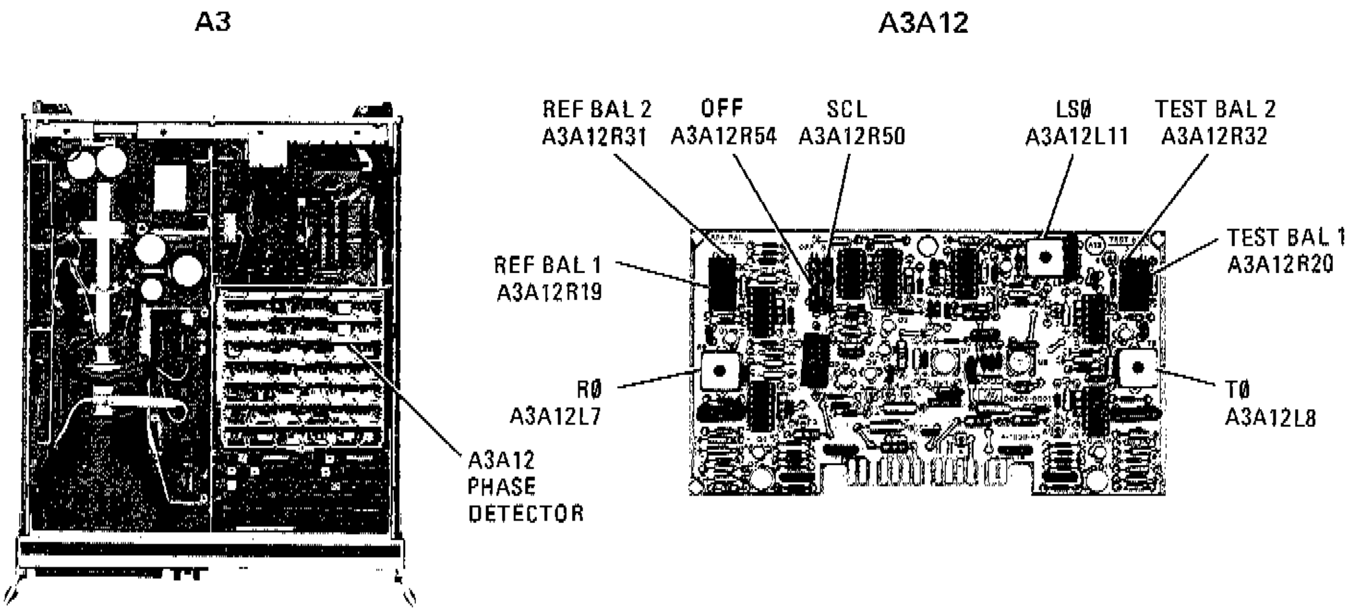


Figure A5-31. A3A12 Phase Detector Adjustments Location

f. Connect the two vertical oscilloscope probes (which have identical electrical lengths) to A3A12TP1 and A3A12TP2. Adjust "Rϕ" control A3A12L7 for zero phase difference between the two CRT traces (one trace superimposed on the other).

g. Connect the two vertical oscilloscope probes to A3A12TP7 and A3A12TP8. Adjust "Tϕ" control A3A12L8 for 180 degree phase difference between the two CRT traces. (Change polarity of oscilloscope Channel B to negative to superimpose one trace on the other.) Remove oscilloscope probes.

h. Set A1 Source/Converter OUTPUT LEVEL dBm switch to −30 dBm. Connect Spectrum Analyzer to A3A12TP1 using HP 1121A Probe. Adjust "REF BAL 2" control A3A12R31 to null the 200 kHz second harmonic signal.

i. Connect Spectrum Analyzer to A3A12TP7 using HP 1121A probe. Adjust "TEST BAL 2" control A3A12R32 to null the 200 KHz second harmonic signal.

j. On 8505A, set controls as follows:

On A2 Frequency Control
WIDTH . . . . CW ±ΔF
CW FREQUENCY . . . . 30 MHz
ΔF FREQUENCY . . . . 0.2 MHz

On A3 Signal Processor
Channel 1
SCALE/DIV . . . . PHASE 1 DEG

A5-32. PHASE DETECTOR ADJUSTMENTS (Cont'd)

Electrical Length Panel
INPUT . . . . A
MODE . . . . OFF

CRT Display
BANDWIDTH KHz 10
VIDEO FILTER . . . . ON

k. On CRT Display, press REF LINE POSN and adjust CH 1 position control to place the CRT trace on the center graticule line. Press REF LINE POSN pushbutton again for normal operation.

l. On A3 Signal Processor Channel 1, press DISPLAY REF pushbutton then CLR pushbutton until REL light goes out (if it was lit).

m. Observe the trace on the CRT. If it is not 0 degrees ± 1 degree, adjust "LS ϕ" control A3A12L11 to place the CRT trace on 0 degree (center graticule line) ± 1 degree.

n. Set Channel 1 SCALE/DIV switch to PHASE 45 DEG. Disconnect the coaxial cable from "B" port of 8505A and from the 3-way power splitter. Use this cable to extend the "A" port cable to twice its length. (The "A" port cable is now twice the length of the "R" port cable.) Use a Type N female adapter to connect the two cables.

o. Connect DVM to A3A12TP9. On A2 Frequency Control, set RANGE MHz switch to .5 — 1300 MHz. Adjust CW FREQUENCY control through the range until a phase transition occurs as shown in Figure A5-32.

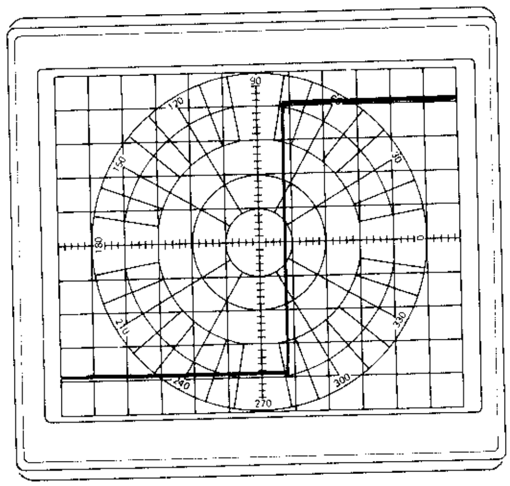


Figure A5-32. Phase Transition Waveform

A5-32. PHASE DETECTOR ADJUSTMENTS (Cont'd)

p. Set A2 Frequency Control SCAN TIME SEC switch to MANUAL. Rotate MANUAL sweep control slowly clockwise and note point at which a negative to positive transition occurs as in Figure A5-33. Then rotate MANUAL sweep control slowly counterclockwise and note point at which a positive to negative transition occurs. Adjust ±ΔF FREQUENCY sweep width until the hysteresis loop is at least four divisions wide as shown in Figure A5-33.

q. Set CRT trace dot to the right-hand edge of the CRT with the MANUAL sweep control, then bring the dot back to a point half-way between transitions (Point A on Figure A5-33).

r. Indication on DVM should be +900 mV ±1 mV. If indication is out of tolerance, adjust "OFF" control A3A12R54 (Figure A5-31) for +900 mV ±1 mV.

s. Set CRT trace dot to the left-hand edge of the CRT with the MANUAL sweep control, then bring the dot back to a point half-way between transitions (Point B on Figure A5-33). DVM should indicate −900 mV ±1 mV. If not, adjust "SCL" control A3A12R50 for −900 mV ±1 mV.

t. Remove extender and reinstall A3A12. Put A3A10 on extender for the following adjustment.

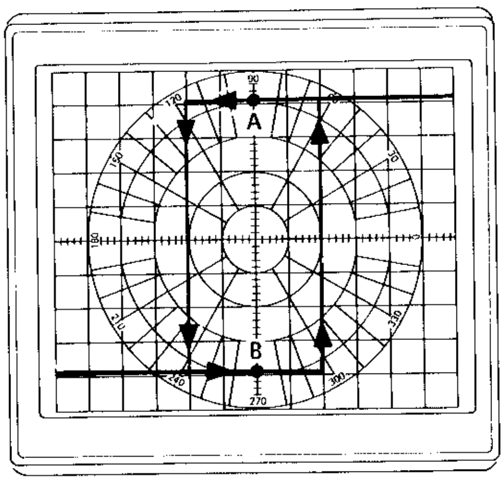


Figure A5-33. Hysteresis Loop Waveform

ADJUSTMENTS

A5-33. A3A10 PHASE OFFSET 1 and A3A9 PHASE OFFSET II

EQUIPMENT:

3-Way Power Splitter .... HP 11850A
RF Cable Kit .... HP 11851A
Spectrum Analyzer .... HP 141/8552/8553
Active probe .... HP 1121A
Counter .... HP 5340A
Digital Voltmeter (DVM). .... HP 3490A
Extender Board (15 pin) .... HP 08505-60041

a. Put A3A10 Phase Offset 1 board on extender and set 8505A controls as follows:

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

On A2 Frequency Control
RANGE MHz .... .5 — 130
MODE .... LIN EXPAND
WIDTH .... CW ±ΔF
SCAN TIME .... 1 — .1
TRIGGER .... AUTO
CW FREQUENCY .... 030.0 MHz
ΔF FREQUENCY .... 10.00 MHz

On A3 Signal Processor
Channel 1
INPUT .... A/R
MODE .... POLAR PHASE
SCALE/DIV .... POLAR 1

Channel 2
MODE .... OFF

Electrical Length
INPUT .... A
MODE .... OFF
VERNIERS A and B 0

CRT Display
BANDWIDTH KHz 10
VIDEO FILTER .... OFF

b. Connect equipment as shown in Figure A5-29.

c. Press Channel 1 DISPLAY REF pushbutton then CLR pushbutton until REL light goes off (if lit). Press Electrical Length DISPLAY CLR pushbutton.

ADJUSTMENTS

A5-33. A3A10 PHASE OFFSET I AND A3A9 PHASE OFFSET II (Cont'd)

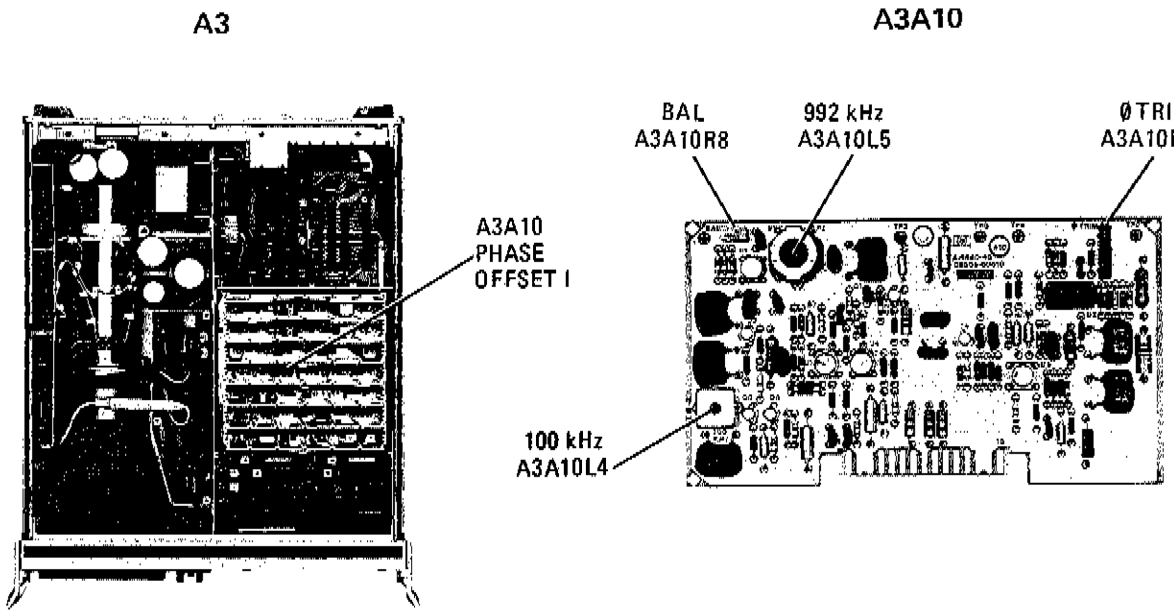


Figure A5-34. A3A10 Adjustment Locations

Filter Adjustment

d. Set NORM-ALIGN switch S1 on A3A9 PHASE OFFSET 2 board to NORM (left). Connect 8553B Spectrum Analyzer to A3A10TP1 using 1121A probe. Adjust "100 KHZ" control A3A10L4 (Figure A5-34) for maximum 100 KHz signal.

e. Connect 8553B Spectrum Analyzer to A3A10TP3 using 1121A probe. Center the 893 KHz signal on the Spectrum Analyzer screen as shown in Figure A5-35.

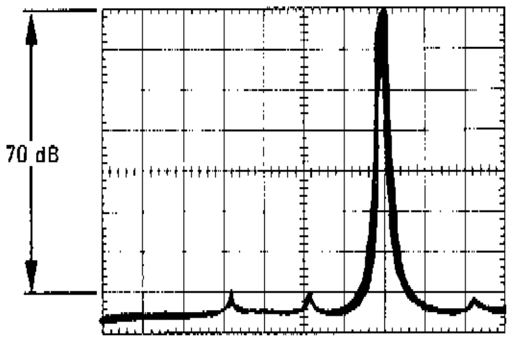


Figure A5-35. Waveform at A3A10TP3 Displayed on Spectrum Analyzer

A5-33. A3A10 PHASE OFFSET I AND A3A9 PHASE OFFSET II (Cont'd)

NOTE

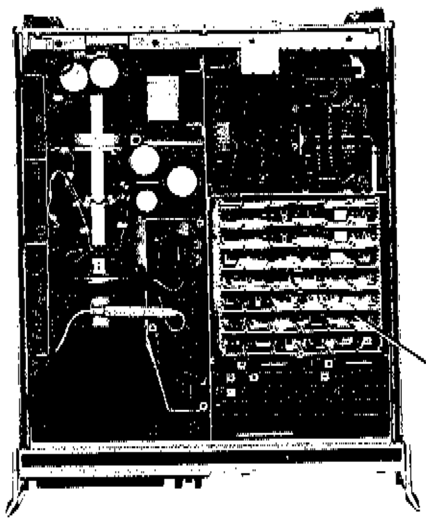
If the signals displayed are ≥70 dB down from 993 kHz signal as shown in Figure A5-35, no adjustment of "BALANCE" or "992 KHz PEAK" is necessary.

f. Adjust "BAL" control A3A10R8, if necessary, for minimum 893 kHz signal (down > 70 dB from 992 kHz signal).

g. Adjust "992 KHz PEAK" control A3A10L5 for maximum 992 kHz signal.

h. Observe the 793 kHz signal (if it can be seen). Adjust the 793 kHz signal to minimum by selecting the value of A3A10C17. If the 793 kHz signal is below the 992 kHz signal by > 70 dB, C17 does not have to be changed.

i. Install A3A10 and put A3A9 on extender board.



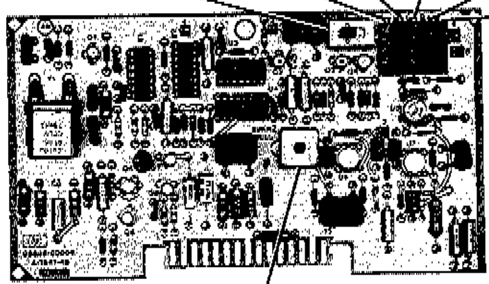


Figure A5-36. A3A9 Phase Offset II Adjustment Locations

ADJUSTMENTS

A5-33. A3A10 PHASE OFFSET I AND A3A9 PHASE OFFSET II (Cont'd)

j. On A3 CRT display section, press BEAM CENTER pushbutton. Adjust Polar controls to place CRT dot in the center of the polar graticule. Press BEAM CENTER pushbutton again to resume normal operation.

k. Press Channel 1 DISPLAY REF pushbutton, then CLR pushbutton until REL light goes out (if it was lit). Press ELECTRICAL LENGTH DISPLAY CLR pushbutton.

l. Set A3A9S1 TEST switch to TEST position (right). (See Figure A5-36).

m. Connect external Frequency Counter to pin 15 of A3A9 connector. (Use a 10:1 oscilloscope probe to avoid loading circuit.) If the counter indicates 893 kHz ±3 kHz, go to next step. Adjust ''A'' control A3A9R42 (Figure A5-36) for an output frequency of 893 kHz ±3 kHz. Disconnect Frequency Counter.

n. Set A3A9S1 TEST switch to NORMAL position (left). Connect DVM to A3A9TP2 and adjust ''A'' control for −0.5 Vdc ±0.2 Vdc. Disconnect DVM.

o. Connect 8553B Spectrum Analyzer to A3A9TP3 using 1121A probe, and adjust "89 KHz NULL" A3A9L10 with a nonmagnetic adjustment tool for minimum 89 kHz signal amplitude. Disconnect Spectrum Analyzer.

Phase Offset Zero

p. Press Channel 1 DISPLAY REF pushbutton then CLR pushbutton until REL light goes out (if it was lit). Observe the CRT trace. If the trace dot is not on zero degrees ±2 degrees, adjust ''B'' control A3A9R29 phase offset to place the dot at zero degrees.

q. Set Channel 1 MODE switch to PHASE and set SCALE/DIV switch to PHASE 1 DEG/DIV position. Press Channel 1 DISPLAY REF pushbutton, then CLR pushbutton until the REL light goes out (if it was lit).

r. Press REF LINE POSN pushbutton, adjust CRT trace to the center graticule line, then press REF LINE POSN pushbutton again for normal operation.

s. Observe the CRT trace. If the trace is not o the center graticule line, adjust "ϕ TRIM" control A3A10R45 to place the trace on the center graticule line ±0.2 degrees (Figure A5-34).

Offset Accuracy

t. Press Channel 1 REF OFFSET pushbuttons to select +360 degrees offset. The CRT trace should return to the center graticule line ±0.5 degrees. If not, adjust "C" control A3A9R16 phase offset cal. adjustment to place the trace on the center graticule line ±0.5 degrees.

Positive Offset Clamp

u. Set Channel 1 SCALE/DIV switch to PHASE 90 DEG position. Press Channel 1 DISPLAY REF then CLR pushbutton until REL light goes out (if it was lit).

v. On A3 Signal Processor Electrical Length panel, set INPUT switch to ''A'' and set MODE switch to PHASE X 10 degrees/SCAN position. Press DISPLAY CLR Pushbutton. Press LENGTH pushbuttons to place +175 on digital display. (+175 on display represents +1750 degrees/scan.)

ADJUSTMENTS

A5-33. A3A10 PHASE OFFSET I AND A3A9 PHASE OFFSET II (Cont'd)

w. The display should look like Figure A5-37. Increase the phase offset with LENGTH pushbuttons to +177 and clamping action should be observed at right end of trace. (Clamping action appears as a horizontal line at the right end of trace.) If clamping does not occur between +175 and +177, adjust "D" control A3A9R27 for clamping action in this range.

x. Press Electrical Length DISPLAY CLR.

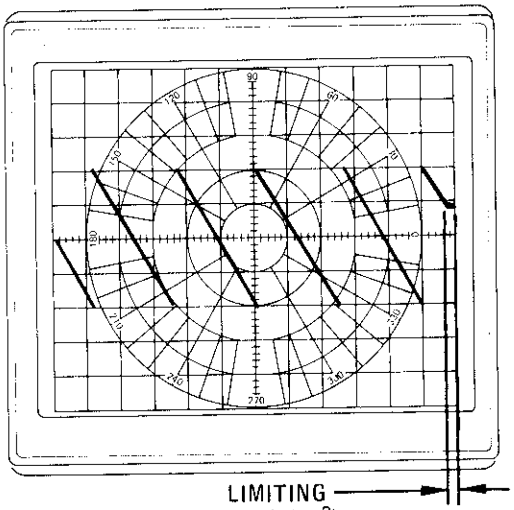


Figure A5-37. Waveform of Positive Offset Clamp

Negative Offset Clamp

y. Press LENGTH pushbuttons to place −175 on digital display. (−175 on display represents −1750 degrees/scan.)

z. The display should look like Figure A5-38. Increase the phase offset with LENGTH pushbutton to −177 and clamping action should be observed at right end of trace. If clamping does not occur between −175 and −177 , adjust "E" control A3A9R26 for clamping action in this range.

aa. Remove extender and reinstall A3A9.

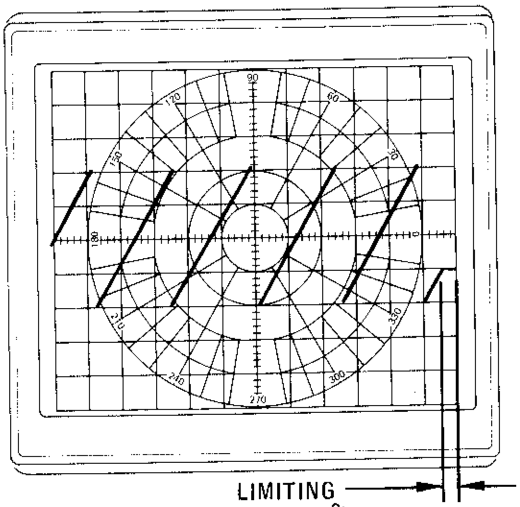


Figure A5-38. Waveform of Negative Offset Clamp

ADJUSTMENTS

A5-34. A3A8 POLAR CONVERTER

EQUIPMENT:

3-Way Power Splitter . . . . HP 11850A
RF Cable Kit . . . . HP 11851A
Spectrum Analyzer . . . . HP 141/8552/8553
Active Probe . . . . HP 1121A
Digital Voltmeter (DVM) . . . . HP 3490A
Extender Board (15 pin) . . . . HP 08505-60041

a. Put A3A8 on extender board. Set 8505A controls as follows:

On A1 Source/Converter
OUTPUT LEVEL dBm . . . . −10
OUTPUT LEVEL Vernier 0
MAXIMUM INPUT dBm . . . . −10

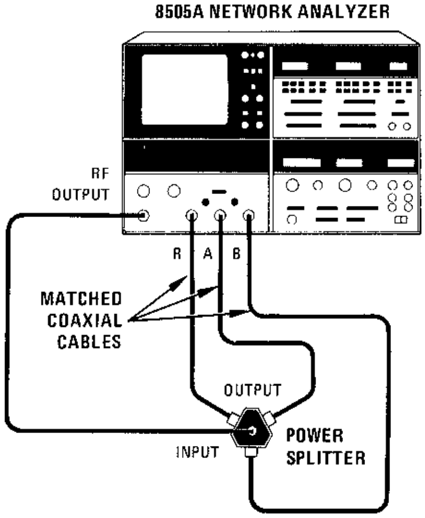


Figure A5-39. A3A8 Polar Converter Test Setup

On A2 Frequency Control
FREQUENCY RANGE MHz . . . . .5 — 130
MODE . . . . LIN EXPAND
WIDTH . . . . CW±ΔF
SCAN TIME SEC . . . . .1 — .01
TRIGGER . . . . AUTO
CW FREQUENCY 30.00
ΔF FREQUENCY 10.00

On A3 Signal Processor
Channel 1
INPUT . . . . A/R
MODE . . . . POLAR MAG
SCALE/DIV . . . . POLAR 1

ADJUSTMENTS

A5-34. A3A8 POLAR CONVERTER (Cont'd)

Channel 2
MODE .... OFF

Electrical Length
INPUT .... A
MODE .... LENGTH X10°/SCAN
LENGTH .... +36

b. Connect equipment as shown in Figure A5-39.

c. On A3 Display, press BEAM CENTER pushbutton. Adjust POL centering controls to place the dot at the center of the graticule. Do NOT release BEAM CENTER pushbutton.

d. Adjust "MAG BAL" control A3A8R18 (Figure A5-40) to the center of its range. Adjust "IF BAL" control A3A8R10 for the smallest dot. Readjust "MAG BAL" control for the smallest dot. Release BEAM CENTER pushbutton. Set ELECTRICAL LENGTH MODE to OFF.

e. Connect HP 8553B Spectrum Analyzer to A3A8TP7 using HP 1121A probe. Adjust "Y BAL" control A3A8R40 for minimum 100 kHz signal amplitude.

f. Connect HP 8553B Spectrum Analyzer to A3A8TP8 using HP 1121A probe. Adjust "X BAL" control A3A8R44 for minimum 100 kHz signal amplitude.

g. Connect DVM to A3A8TP5 and adjust "YOFFS" control A3A8R95 for 0.000 Vdc ±0.005 Vdc.

h. Connect DVM to A3A8TP6 and adjust "XOFFS" control A3A8R93 for 0.000 Vdc ±0.005 Vdc.

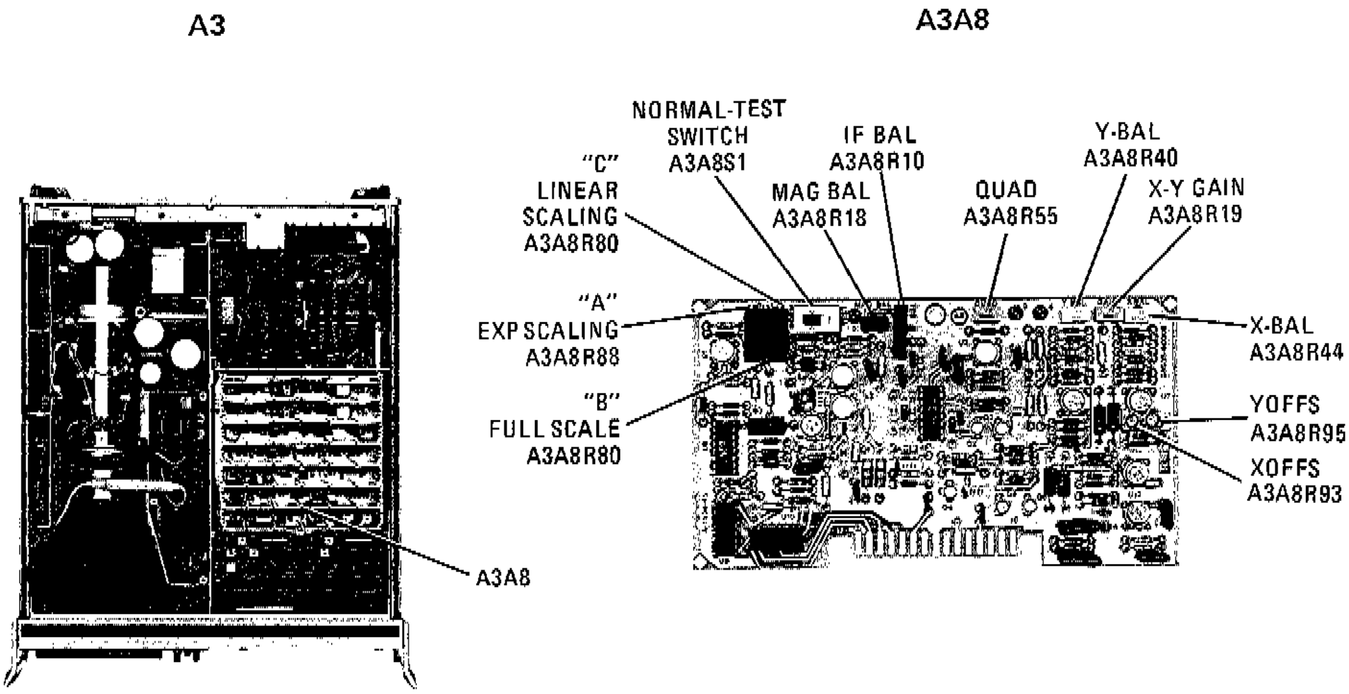


Figure A5-40. A3A8 Polar Converter Adjustments Location

ADJUSTMENTS

A5-34. A3A8 POLAR CONVERTER (Cont'd)

i. Set ELECTRICAL LENGTH MODE TO X10°/SCAN and LENGTH pushbuttons for +36. A full circle should be displayed on the CRT.

j. Adjust "QUAD" control A3A8R55 and "X-Y GAIN" control A3A8R19 for best circularity of circle on the CRT.

k. Connect DVM to A3A8TP2 and record indication.

l. Add +40.0 dB of offset with REF OFFSET pushbuttons and note DVM indication, it should be 1.0% of the value recorded in step k ±5 mVdc. If not, adjust "A" (EXP SCALE) control A3A8R88.

m. Repeat steps k and l until no further adjustment is necessary.

n. Set Channel 1 MODE to MAG and SCALE/DIV to .1 dB. Offset with REF OFFSET pushbuttons to place trace exactly on center graticule reference line.

o. Set Channel 1 MODE to POLAR MAG and SCALE/DIV to POLAR 1. The trace should be coincident with the outer circle of the CRT. If not, adjust "B" (FULL SCALE) control A3A8R82.

p. On A3 Signal Processor press REF OFFSET pushbuttons to obtain +40 dB of offset on the digital display, then set Channel 1 SCALE/DIV switch to POLAR .01 position. The CRT trace should be a circle on the outside graticule line. If not, adjust "C" (LINEAR SCALE CONTROL) A3A8R80 to obtain the trace on the outside graticule line.

q. Remove extender and reinstall A3A8.

A5-35. A3A11 GROUP DELAY

EQUIPMENT:

3-Way Power Splitter .... HP 11850A
RF Cable Kit .... HP 11851A
Counter .... HP 5340A
Digital voltmeter (DVM) .... HP 3490A
10:1 Scope probe
Extender Board (15 pin) .... HP 08505-60041
50 ft. Test Cable

a. A coaxial cable greater than 50 feet in length is used as a standard in the group delay adjustments. Group delay of the test cable is measured with the 8505A in phase mode as follows:

(1) Connect the "Test Cable" in the A channel between the matched cable and the power splitter as shown in Figure A5-41.

(2) Set 8505A controls as follows:

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

ADJUSTMENTS

A5-35. A3A11 GROUP DELAY (Cont'd)

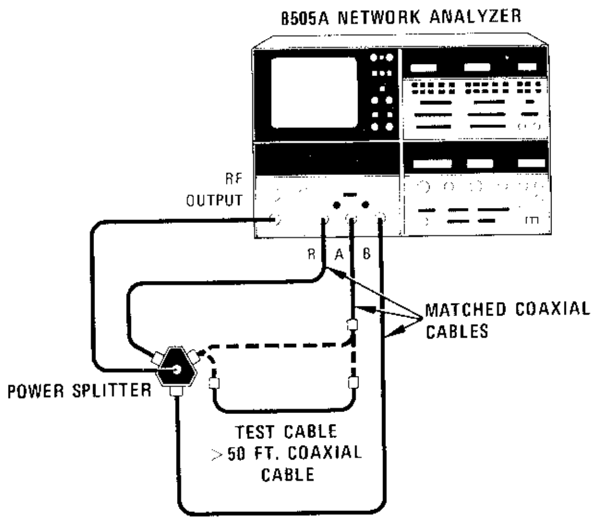


Figure A5-41. Test Setup to Measure Test Cable Group Delay

On A2 Frequency Control
- RANGE MHz . . . . .5 — 1300
- MODE . . . . LIN EXPAND
- WIDTH . . . . CW
- SCAN TIME SEC . . . . .1 — .01
- TRIGGER . . . . AUTO

On A3 Signal Processor

Channel 1
- INPUT . . . . A/R
- MODE . . . . PHASE
- SCALE/DIV . . . . 90 DEG

Channel 2
- MODE . . . . OFF

Electrical Length
- MODE . . . . OFF

(3) On A3 Signal Processor CRT Display, press REF LINE POSN pushbutton and adjust CH1 control to place the trace on the center graticule line. Press REF LINE POSN again for normal operation.

(4) Set A2 Frequency Control CW FREQUENCY TUNING and VERNIER for 700.00 MHz. Press Channel 1 DISPLAY MKR pushbutton then ZRO pushbutton to place the CRT trace on the center graticule.

ADJUSTMENTS

A5-35. A3A11 GROUP DELAY (Cont'd)

(5) On A2 Frequency Control, adjust CW FREQUENCY up in frequency until the CRT trace comes back to the center graticule line and the marker digital readout indicates 0 degrees. Note frequency for use in later calculation.

CW FREQUENCY =__________ MHz

NOTE

The phase change between the two zero points is 360 degrees.

(6) Calculate the group delay of the "Test Cable" with the following formula:

EXAMPLE

Change in Phase = 360 degrees

Change in Frequency = 713 MHz − 700 MHz

= 13 MHz

$$t_D = \frac{\text{(Phase Change in degrees)}}{360 \text{ X (Change in freq. in Hz)}}$$

$$t_D = \frac{360 \text{ degrees}}{360\ (13 \times 10^6 \text{ Hz})}$$

$$t_D = 77 \text{ ns}$$

b. Connect equipment as shown in Figure A5-42. Install A2A11 on extender board.

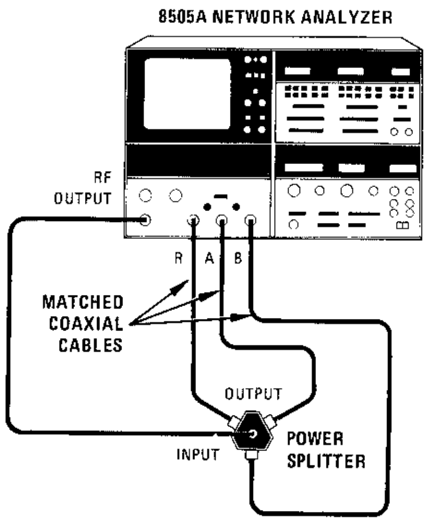


Figure A5-42. A3A11 Group Delay Test Setup

ADJUSTMENTS

A5-35. A3A11 GROUP DELAY (Cont'd)

c. Set A2 Frequency Control TRIGGER switch to EXT. Connect Frequency Counter (use a 10:1 scope probe to avoid loading circuit) to the Collector of Q13 and adjust "CK" 100 KHz clock control A3A11R13 (Figure A5-43) for 100 KHz ±10 Hz (period of 10μs). If the range on the control is not enough to reach 100 KHz, select a value of A3A11R12 in the range of 10K to 40K that allows adjustment to 100 KHz.

d. Disconnect counter and connect a DVM to A3A11TP1. Adjust "BAL" (discriminator balance) control A3A11R26 for minimum indication on the DVM.

e. On 8505A, set controls as follows:

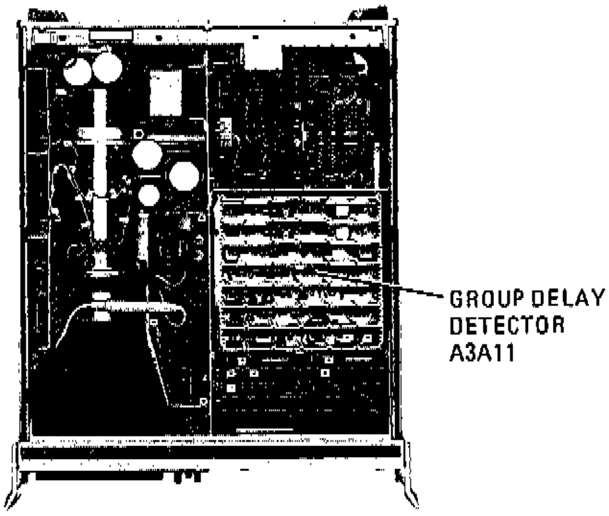
On A1 Source/Converter

OUTPUT LEVEL dBm	−10
OUTPUT LEVEL Vernier	0
INPUT LEVEL dBm MAX	−10

On A2 Frequency Control

RANGE MHz	LOG 1 — 10
MODE	LOG FULL
WIDTH	START/STOP 1
SCAN TIME SEC	1 — .1
TRIGGER	AUTO
MARKERS	1
MARKER 1	MIDRANGE

A3



A3A11

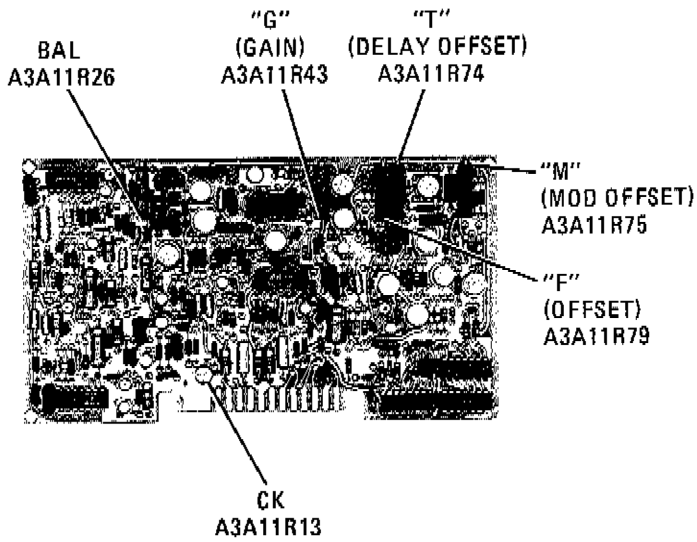


Figure A5-43. A3A11 Group Delay Adjustments Location

ADJUSTMENTS

A5-35. A3A11 GROUP DELAY (Cont'd)

On A3 Signal Processor
Channel 1
INPUT . . . . A/R
MODE . . . . DLY
SCALE/DIV . . . . DELAY 1

Channel 2
MODE . . . . OFF

Electrical Length
MODE . . . . OFF

f. Set SCAN TIME VERNIER for a CRT Display as shown in Figure A5-44A.

g. Connect a ground to A3A11TP4. Press Channel 1 DISPLAY MKR pushbutton then ZRO pushbutton. (This places the trace in the center of the CRT.)

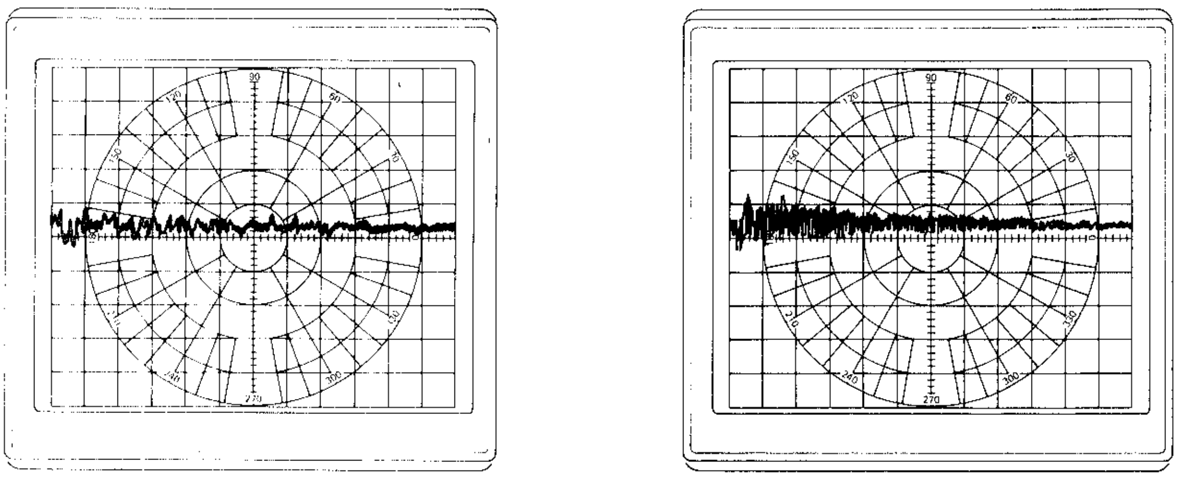
h. Set Channel 1 SCALE/DIV switch to DELAY 1 ns. Adjust "F" (ΔF offset) control A3A11R79 for a straight signal envelope across the CRT. (See Figure A5-44B.)

i. Set Channel 1 SCALE/DIV switch to DELAY 20 ns and set A2 Frequency Control RANGE MHz switch to 1—1000. Press Channel 1 DISPLAY MKR than ZRO pushbuttons to center trace on CRT. Adjust "M" (modulation offset) control A3A11R75 for a straight signal envelope across the CRT.

j. Repeat steps g through i until no further adjustment is necessary. Remove ground from A3A11TP4.

k. Set MARKER 1 to a smooth spot near the center of the trace. On A2 Frequency Control, set SCAN TIME SEC VERNIER control fully clockwise. Press Channel 1 DISPLAY REF then, CLR pushbutton until REL light goes off (if it was lit), then MKR pushbutton. Adjust "T" delay offset control A3A11R74 for a zero marker readout on Channel 1.

l. Connect "Test Cable" in the A channel. Set A2 Frequency Control MODE switch to LIN EXPAND. Adjust "G" (gain) control A3A11R43 for the group delay calculated for the "Test Cable" in step a (6) above.



A B

Figure A5-44. Group Delay Display with Sampling Disabled (TP4 grounded)

ADJUSTMENTS

A5-36. A3A27 BLANKING AMPLIFIER and A3A26 HV POWER SUPPLY

EQUIPMENT:

Digital Voltmeter (DVM) .... HP 3490A
100:1 Divider Probe .... HP 11044A
Oscilloscope w/10:1 Probe .... HP 180/1801/1820
Function Generator .... HP 3310A
Extender Board (18 pin) .... HP 08505-60042

NOTE

Adjustment of A3A27 Blanking Amplifier should not be a routine maintenance procedure. Adjustment should only be done when the blanking amplifier or HV Power Supply is repaired or replaced.

High Voltage Power Supply

NOTE

Use a non-metallic screwdriver for adjustments in A3A27 Blanking Amplifier.

NOTE

The position of a trace on the CRT always refers to the center of the trace, and the distance between traces always refers to the orthogonal distance from trace center to trace center; or, from the edge of one trace to the corresponding edge of the other trace.

NOTE

If an assembly or an adjustable component is replaced, set all adjustments on the replaced assembly to midrange (except intensity, which should be set fully counterclockwise) before turning the instrument on. If the CRT is replaced, verify CRT is biased off before applying power.

a. Put A3A27 Blanking Amplifier on extender and connect DVM to A3A24TP1 (See Figure A5-45).

b. Measure output of +100-volt power supply at A3A24TP1 and note reading.

c. Connect 100:1 divider probe to digital voltmeter.

d. Set digital voltmeter to 1 volt range.

e. Measure +100-volt power supply through 100:1 divider probe and note reading.

f. Divide reading noted in step b into reading noted in step e.

WARNING

The following procedure probes 4,000 Volt Circuit.

ADJUSTMENTS

A5-36. A3A27 BLANKING AMPLIFIER AND A3A26 HV POWR SUPPLY (Cont'd)

g. Using 100:1 HV probe, measure output of high voltage CRT cathode power supply on board assembly A3A26 at HVTP (blue wire).

h. Adjust HV ADJ A3A27R12 (Figure A5-45)for a reading of −40 times value calculated in step f.

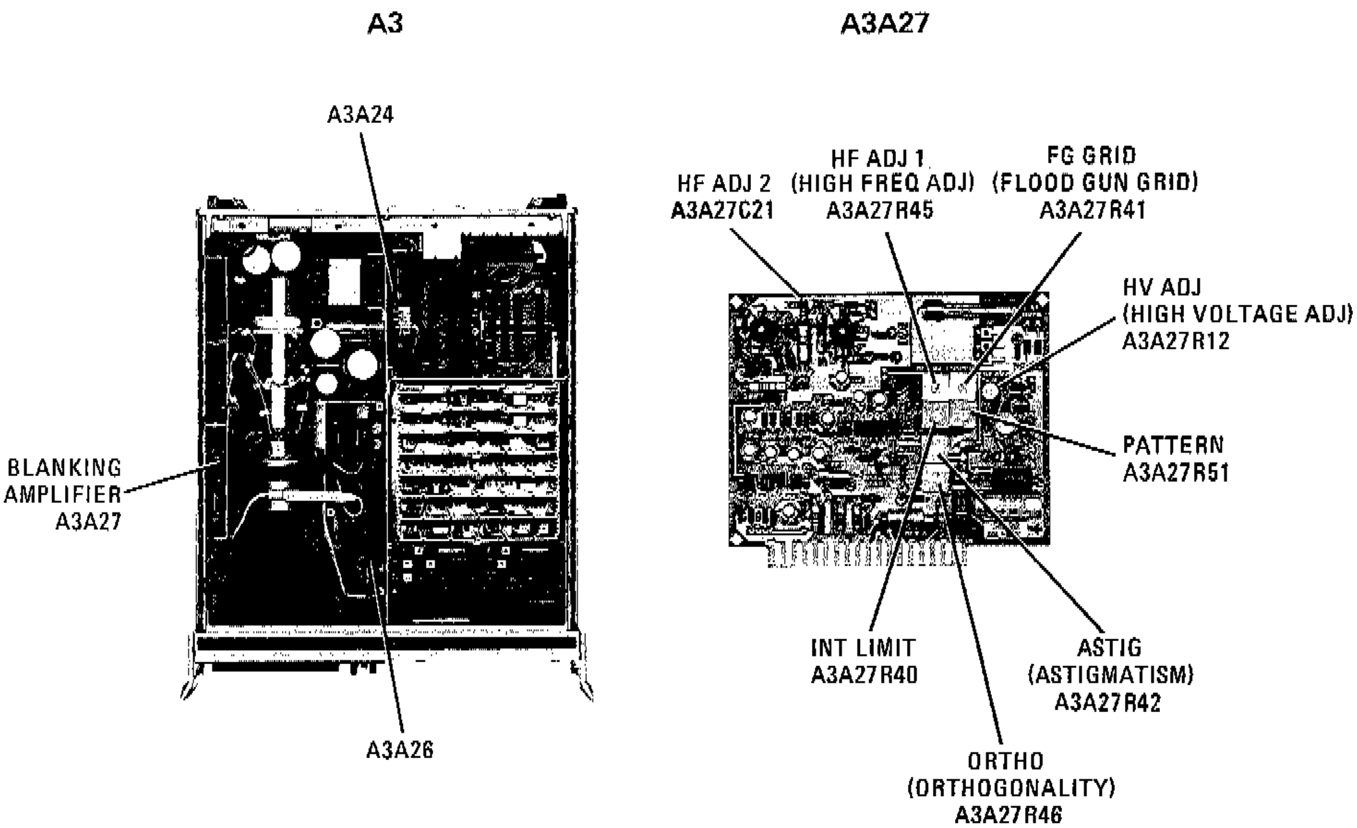


Figure A5-45. A3A27 Blanking Amplifier Adjustment Locations

Focus Centering

i. Connect equipment as shown in Figure A5-46.

j. Set A2 Frequency Control WIDTH switch to START/STOP 1 and SCAN TIME SEC switch to MANUAL. On A3 Signal Processor, set Channel 1 INPUT switch to "R" and MODE to MAG. Press DISPLAY MKR then ZRO pushbuttons. Adjust MANUAL sweep control to place the trace dot in the center of the CRT screen.

k. Adjust front panel INTENSITY control for a spot of normal viewing intensity and set FOCUS control to midrange.

l. Adjust FOCUS LIMIT control A3A26R14 and ASTIG astigmatism) control A3A27R42 for sharply focused round spot.

ADJUSTMENTS

A5-36. A3A27 BLANKING AMPLIFIER and A3A26 HV POWER SUPPLY (Cont'd)

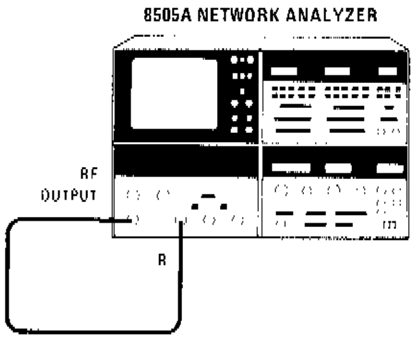


Figure A5-46. A3A27 Blanking Amplifier Adjustment Test Setup

Intensity Limit

m. Connect monitor oscilloscope through 10:1 divider probe to A3A26TP1.

n. Set REF LINE POSN CH 1 control to place the trace dot off screen. Adjust front panel INTENSITY control fully clockwise.

o. Adjust INTENSITY LIMIT control A3A27R40 for a 10 V p-p amplitude at A3A26TP1.

p. Measure dc voltage at Z-amplifier output A3A27TP5. Note reading.

q. Adjust front panel INTENSITY control counterclockwise for a voltage reading of 52 Volts less than measured in step p.

r. Adjust front panel REF LINE POSN CH 1 control to the center of its range. If the spot is visible, readjust INTENSITY LIMIT A3A27R40 until the spot is cut off.

Trace Alignment and Orthogonality

s. Set A2 Frequency Control SCAN TIME SEC switch to .1 — .01 position.

t. Remove A3A16 Blanking Logic board and install extender board in its place. Connect sine-wave oscillator output to extender board pin 24.

u. Set oscillator frequency to 10 kHz and amplitude for 8-division display.

v. Position trace to center screen using dc offset of function generator.

w. Align trace with center graticule line using front-panel TRACE control A3A25R9.

x. Disconnect sine-wave oscillator output from extender board pin 24 and connect it to pin 22.

y. Adjust sine-wave oscillator amplitude for 10-division display.

z. Position trace to center screen using dc offset of function generator.

ADJUSTMENTS

A5-36. A3A27 BLANKING AMPLIFIER AND A3A26 HV POWER SUPPLY (Cont'd)

aa. Align trace with center graticule line, using ORTHO control A3A27R46.

ab. Reinstall A3A16.

Flood Gun

ac. Set front-panel SCALE control fully clockwise to turn on flood gun. Adjust "F G GRID" (flood gun grid) control A3A27R41 for the most uniform illumination on the screen. If illumunation is too bright, increase resistance of A3A30R1 (1/2 watt resistor). If illumination is too dark, decrease value of A3A30R1. Do not make a smaller value than 6.8 ohms 1/2 watt or damage to filament may occur.

Pattern

ad. Set A2 Frequency Control SCAN TIME SEC switch to .1 — .01 position. Press REF LINE POSN pushbutton to place reference line on CRT.

ae. Adjust reference line to the top graticule line on CRT. Adjust "PATTERN" control A3A27R51 for a straight reference line.

af. Adjust the reference line to the bottom graticule line on CRT. If necessary, make slight adjustment of "PATTERN" control A3A27R51 for a straight line.

Z-Axis High Frequency

ag. Set REF LINE POSN CH 1 control full clockwise to put trace off CRT screen.

ah. Set INTENSITY control fully counterclockwise.

ai. Connect pulse generator output to the monitor oscilloscope vertical input; terminate line in 50 ohm load.

aj. Adjust pulse generator for a positive +1 Vp-p square wave, 100 kHz output with a 50% duty cyle pulse width. Disconnect from oscilloscope.

ak. Remove Display Multiplex 1 A3A15 and install extender board in its place. Connect pulse generator output to pin 31 of extender board.

al. Connect monitor oscilloscope vertical input through a 10:1 divider probe to Z-Axis output A3A27TP5.

am. The displayed waveform should go from the baseline of less than +5 Vdc to a peak of greater than +55 Vdc.

an. Adjust HF ADJ 1 A3A27R45 and HF ADJ 2 A3A27C21 for best pulse shape with a rise time of ≤150 ns.

ao. Remove extender and reinstall A3A27 and A3A15.

ADJUSTMENTS

A5-37. A2A13 REMOTE OUTPUT LEVEL dBm VERNIER CALIBRATION

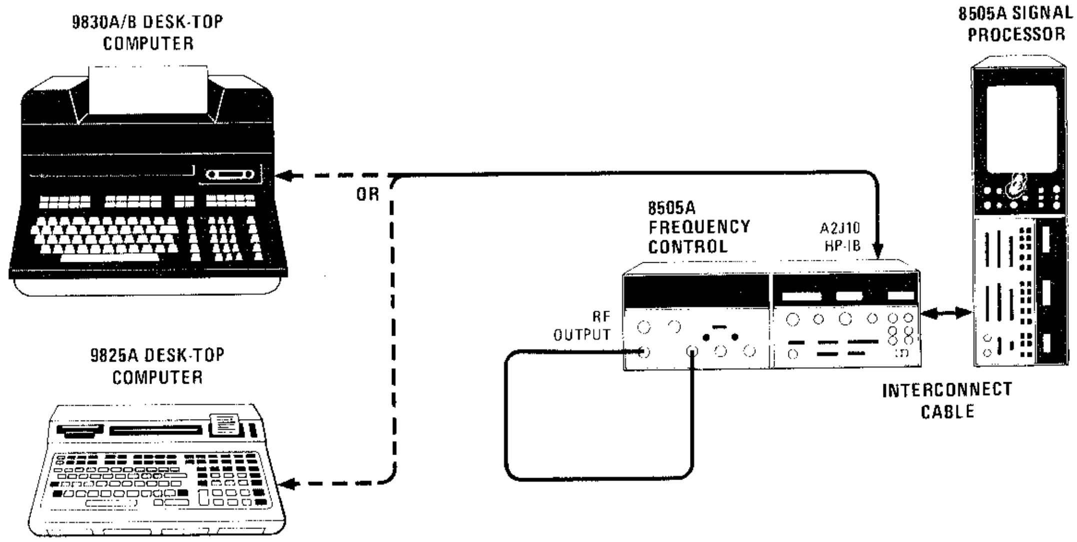


Figure A5-47. Remote Output Level dBm Vernier and Remote Marker Test Setup

EQUIPMENT:

Desk-Top Computer . . . . .HP 9830A/B or 9825A
HP-IB Interface (for 9830A/B only) . . . . HP 59405A
HP-IB Interface Cable . . . . .HP 10631A/B/C
RF Cable. . . . . HP 11851A

PROCEDURE:

a. Set 8505A to LOCAL operation and set the controls as follows:

On A1 Source/Converter:
OUTPUT LEVEL dBm . . . . –20
OUTPUT LEVEL Vernier 0
INPUT LEVEL dBm MAX . . . . –10

On A2 Frequency Control:
RANGE MHz . . . . .0.5 – 1300
MODE. . . . . LIN EXPAND
WIDTH . . . . CW ±ΔF
CW FREQUENCY. . . . . 30 MHz
±ΔF. . . . . .000.0 MHz
SCAN TIME SEC . . . . 0.1 – .01
TRIGGER. . . . . AUTO
MARKERS 1
Marker 1 . . . . .Mid position

A5-37. A2A13 REMOTE OUTPUT LEVEL dBm VERNIER CALIBRATION (Cont'd)

On A3 Signal Processor:

Channel 1 . . . .

INPUT . . . . R
MODE . . . . MAG
SCALE/DIV . . . . 20 dB

Channel 2

MODE . . . . OFF

Electrical Length

MODE . . . . OFF

Display Section

BANDWIDTH kHz 10
REFERENCE LINE on CRT . . . . Center graticule line
VIDEO FILTER . . . . OFF

b. Connect equipment as shown in Figure A5-47 with the RF output connected directly to Channel R Input.

c. The 8505A must be given a LOCAL LOCKOUT (LLO) command to disable the front panel OUTPUT LEVEL dBm VERNIER and be able to program the vernier remotely.

Enter the following program:

9830A/B:

```
10   CMD "?U3"
20   FORMAT 3B
30   OUTPUT (13, 2Ø) 256, 17, 512;
40   END
```

9825A:

```
llo 7
```

d. Press Channel 1 DISPLAY MKR, then CLR pushbuttons. This enables Channel 1 digital readout to display an absolute power measurement.

e. Program OUTPUT LEVEL dBm VERNIER to −12 dBm:

9830A/B:

```
CMD "?U3", "VØE"
```

9825A:

```
wrt 719, "VØE"
```

f. Adjust "−12 dBm Adj" control A2A13R10 for −32 dBm ±1 dB on Channel 1 digital readout.

g. Program OUTPUT LEVEL dBm VERNIER to Ø dBm:

9830A/B:

```
CM "?U3", "V99E"
```

ADJUSTMENTS

A5-37. A2A13 REMOTE OUTPUT LEVEL dBm VERNIER CALIBRATION (Cont'd)

9825A:
```
wrt 719, "V99E"
```

h. Adjust "Ø dBm Adj" control A2A13R8 for −20 dBm ±1 dB on Channel 1 digital readout.

i. Repeat steps e through h until no further adjustment is necessary.

j. Disable Local Lockout (LLO) command to 8505A as follows:

9830A/B:
```
10   CMD "?U3"
20   FORMAT 2B
30   OUTPUT (13, 2Ø) 1024, 768;
40   END
```

9825A:
```
lcl 7; rem 7
```

A5-38. A2A15 REMOTE MARKET POSITION CALIBRATION (08505-60195 BOARD ASSY ONLY)

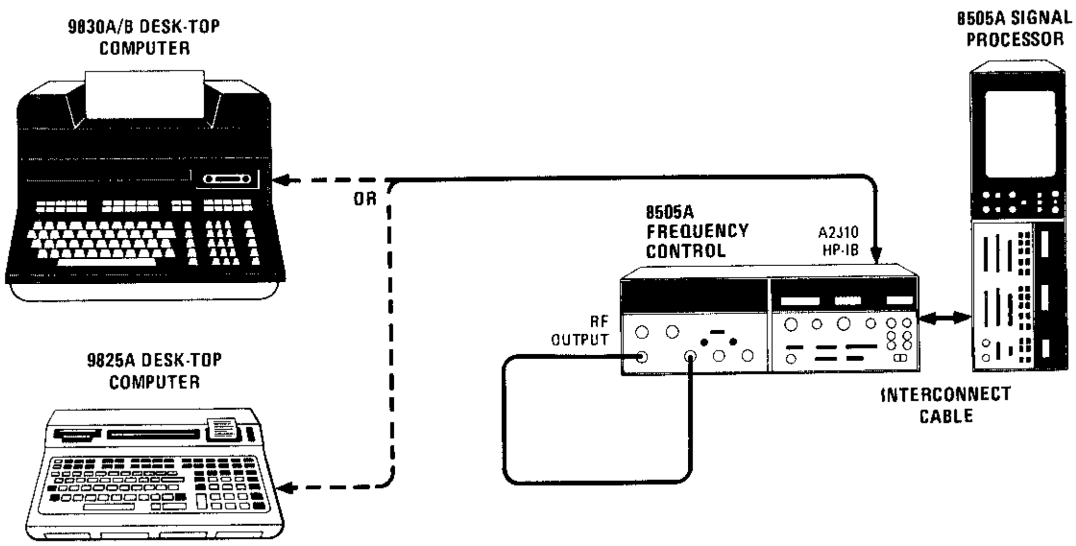


Figure A5-48. Remote Output Level dBm Vernier and Remote Marker Test Setup

EQUIPMENT:

Desk-Top Computer	HP 9830A/B or 9825A
HP-IB Interface (for 9830A/B only)	HP 59405A
HP-IB Interface Cable	HP 10631A/B/C
RF Cable	HP 11851A

ADJUSTMENTS

A5-38. A2A15 REMOTE MARKER POSITION CALIBRATION (08505-60195 BOARD ASSY ONLY) (Cont'd)

a. Set 8505A to LOCAL operation and set the controls as follows:

On A1 Source/Converter:
- OUTPUT LEVEL dBm . . . . . . −20
- OUTPUT LEVEL Vernier 0
- INPUT LEVEL dBm MAX . . . . . . −10

On A2 Frequency Control:
- RANGE MHz . . . . . . 0.5 — 1300
- MODE . . . . . . LIN EXPAND
- WIDTH . . . . . . CW ±ΔF
- CW FREQUENCY . . . . . . 30 MHz
- ±ΔF . . . . . . 000.0 MHz
- SCAN TIME SEC . . . . . . 0.1 — .01
- TRIGGER . . . . . . AUTO
- MARKERS 1
- Marker 1 . . . . . . Mid position

On A3 Signal Processor:

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

Channel 2
- MODE . . . . . . OFF

Electrical Length
- MODE . . . . . . OFF

Display Section
- BANDWIDTH kHz 10
- REFERENCE LINE on CRT . . . . . . Center graticule line
- VIDEO FILTER . . . . . . OFF

b. Connect equipment as shown in Figure A5-48 with the RF output connected directly to Channel R Input.

c. Rotate SCAN TIME SEC Vernier to full counterclockwise position.

d. Program Frequency marker (FC) to left edge of CRT trace:

9830A/B:
```
CMD "?U3", "FCØE"
```
9825A:
```
wrt 719, "FCØE"
```

e. Adjust "0" ADJ control A2A15R22 to place marker on left edge of CRT trace. The marker diamond must be pointing up and the FREQUENCY COUNTER readout must be unblanked.

ADJUSTMENTS

A5-38. A2A15 REMOTE MARKER POSITION CALIBRATION (08505-60195 BOARD ASSY ONLY) (Cont'd)

f. Rotate SCAN TIME SEC Vernier to full clockwise position.

g. Program Frequency Marker (FC) to right edge of CRT trace:

```
9830A/B:
  CMD "?U3", "FC99E"

9825A:
  wrt 719, "FC99E"
```

h. Adjust "99" ADJ control A2A15R12 to place marker on right edge of CRT trace. The marker diamond must be pointing up but the FREQUENCY COUNTER readout must be blanked.

i. Program Frequency Marker (FC) to "98":

```
9830A/B:
  CMD "?U3", "FC98E"

9825A:
  wrt 719, "FC98E"
```

j. FREQUENCY COUNTER readout must be *unblanked* at this setting. If not, adjust "99" ADJ control A2A15R12 slightly clockwise until FREQUENCY COUNTER readout is unblanked and repeat steps f through j until no further adjustment is necessary.

CHAPTER A
MODEL 8505A NETWORK ANALYZER

SECTION VI
SERVICE

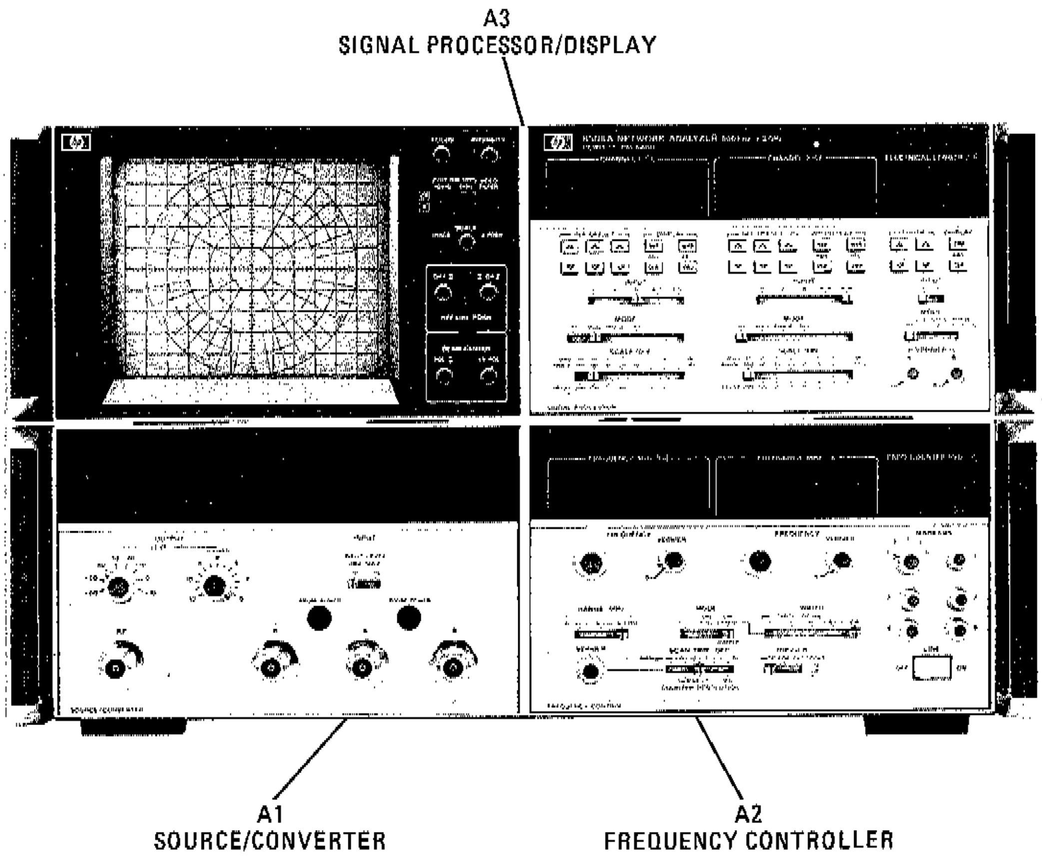


Figure A6-1. Major Sections of 8505A Network Analyzer

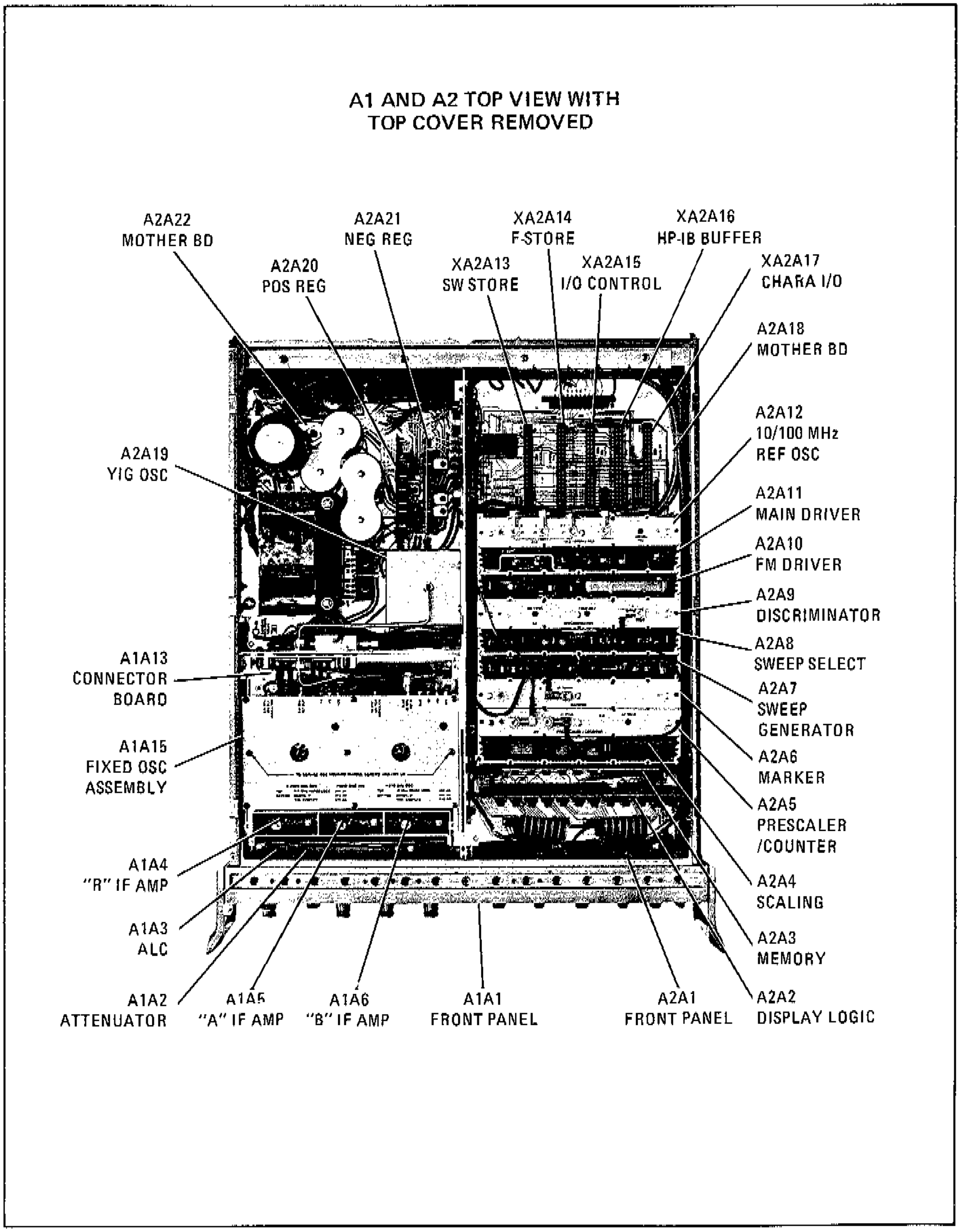


Figure A6-2. A1 and A2 Major Assemblies

A2 FRONT VIEW WITH FRONT PANEL TILTED FORWARD

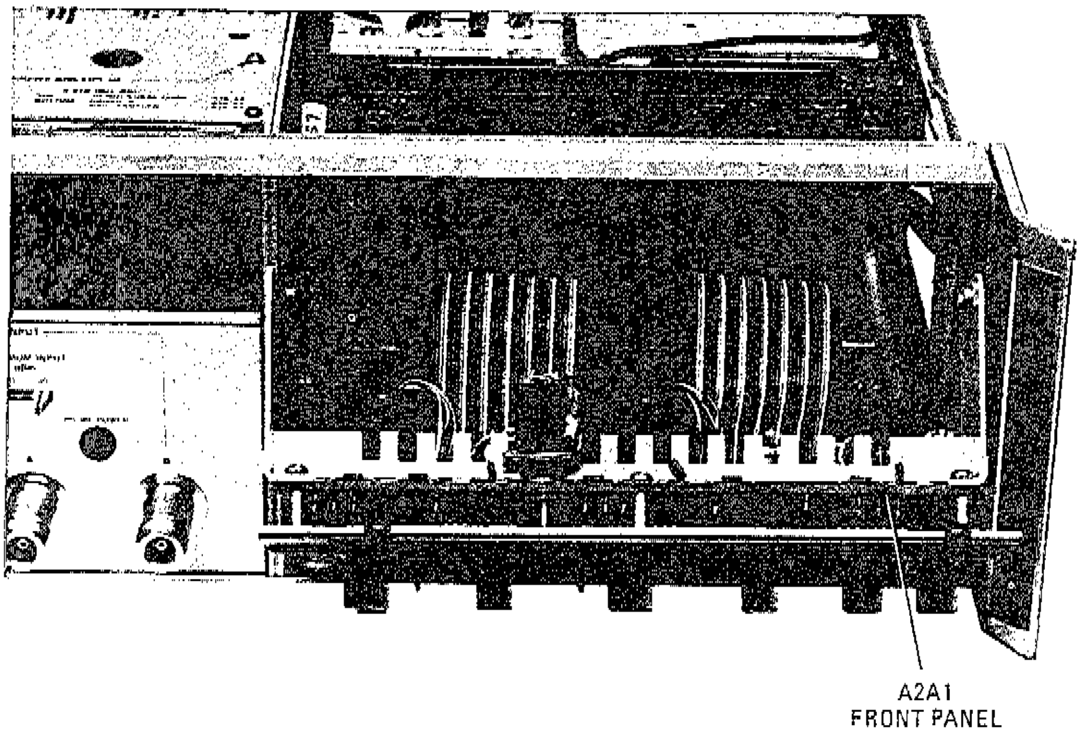


Figure A6-3. A2A1 Front Panel Folded Out

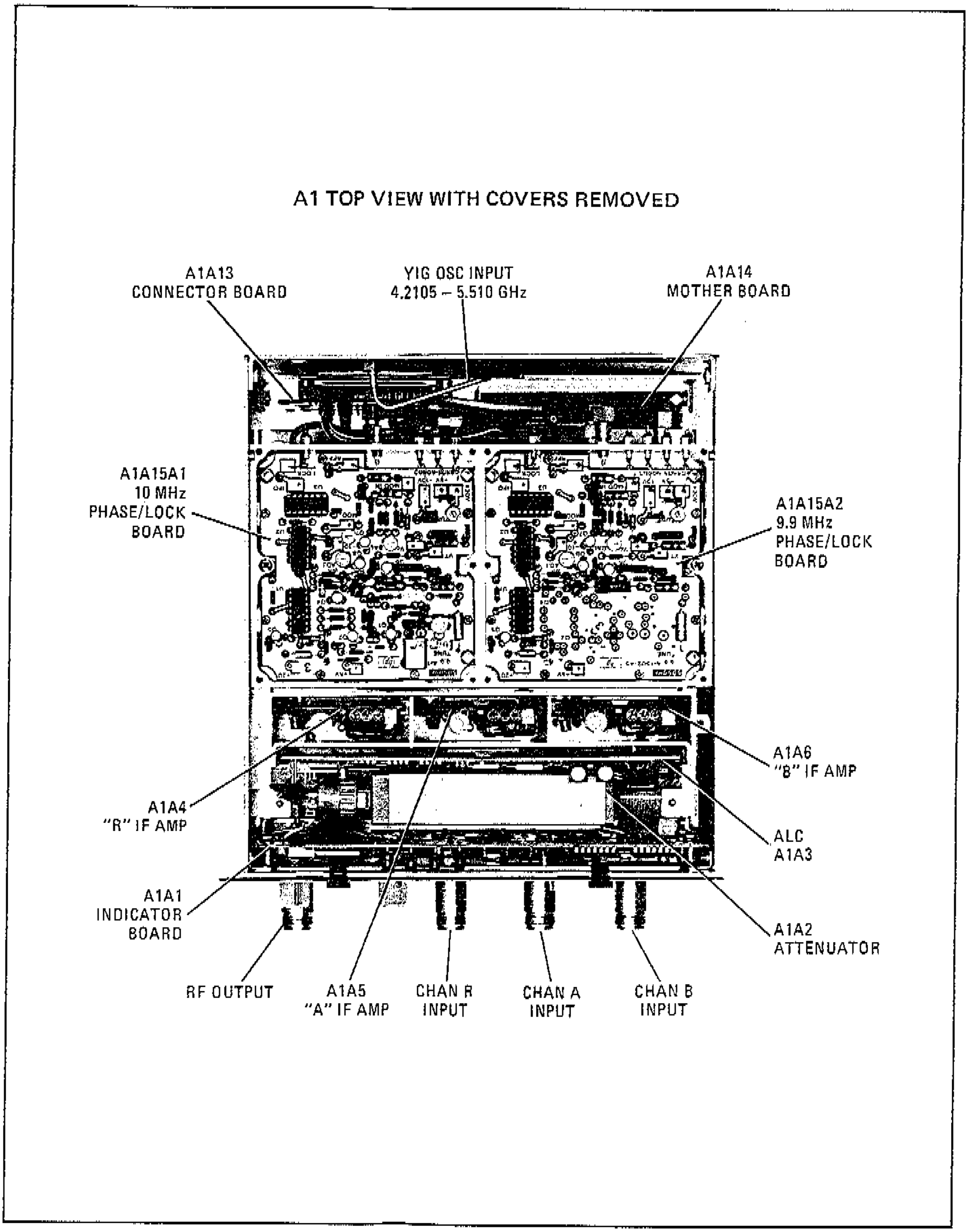


Figure A6-4. A1 Major Assemblies and Subassemblies

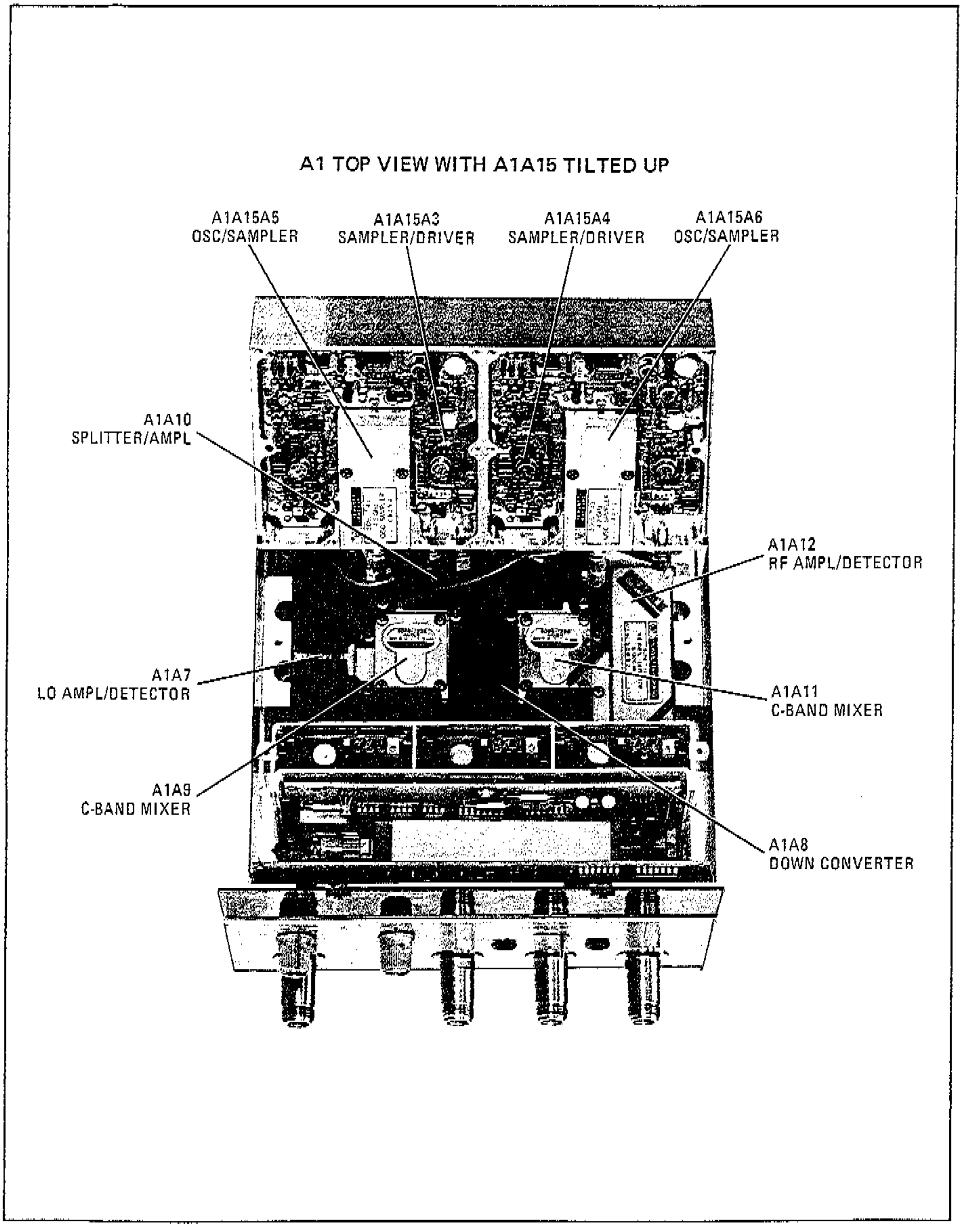


Figure A6-5. A1 Disassembled Showing Internal Assemblies

A1 BOTTOM VIEW

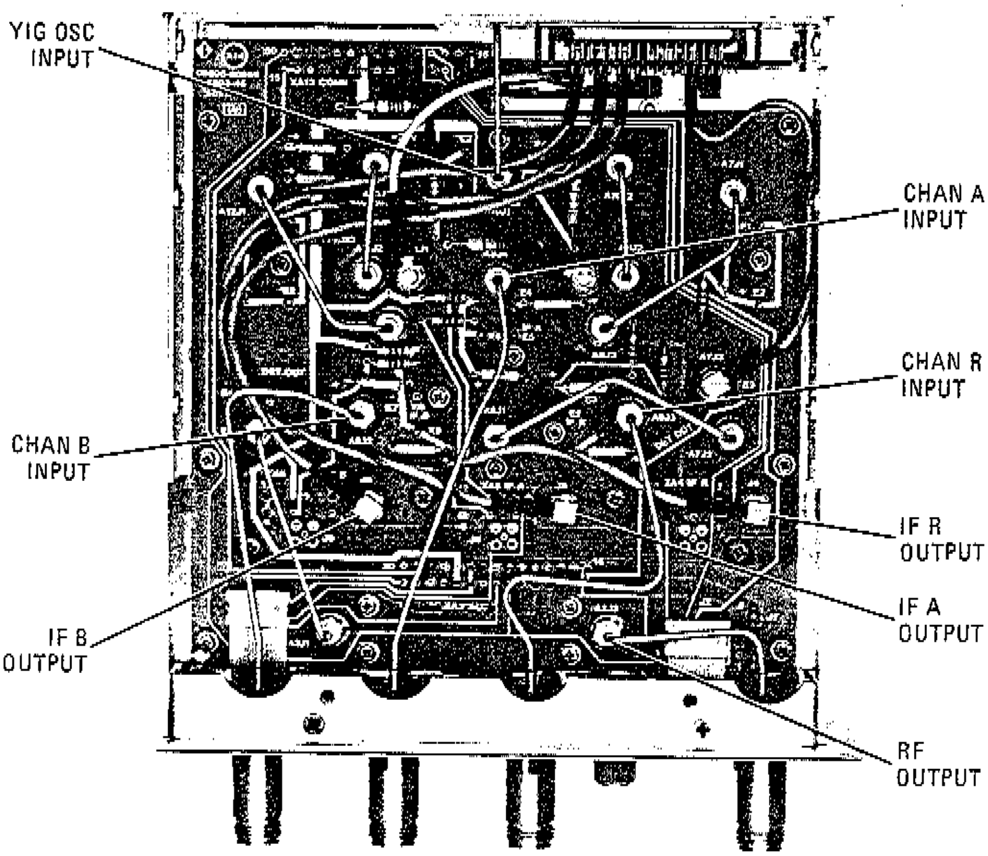


Figure A6-6. A1 Bottom View Showing Interface Connections to Mother Board

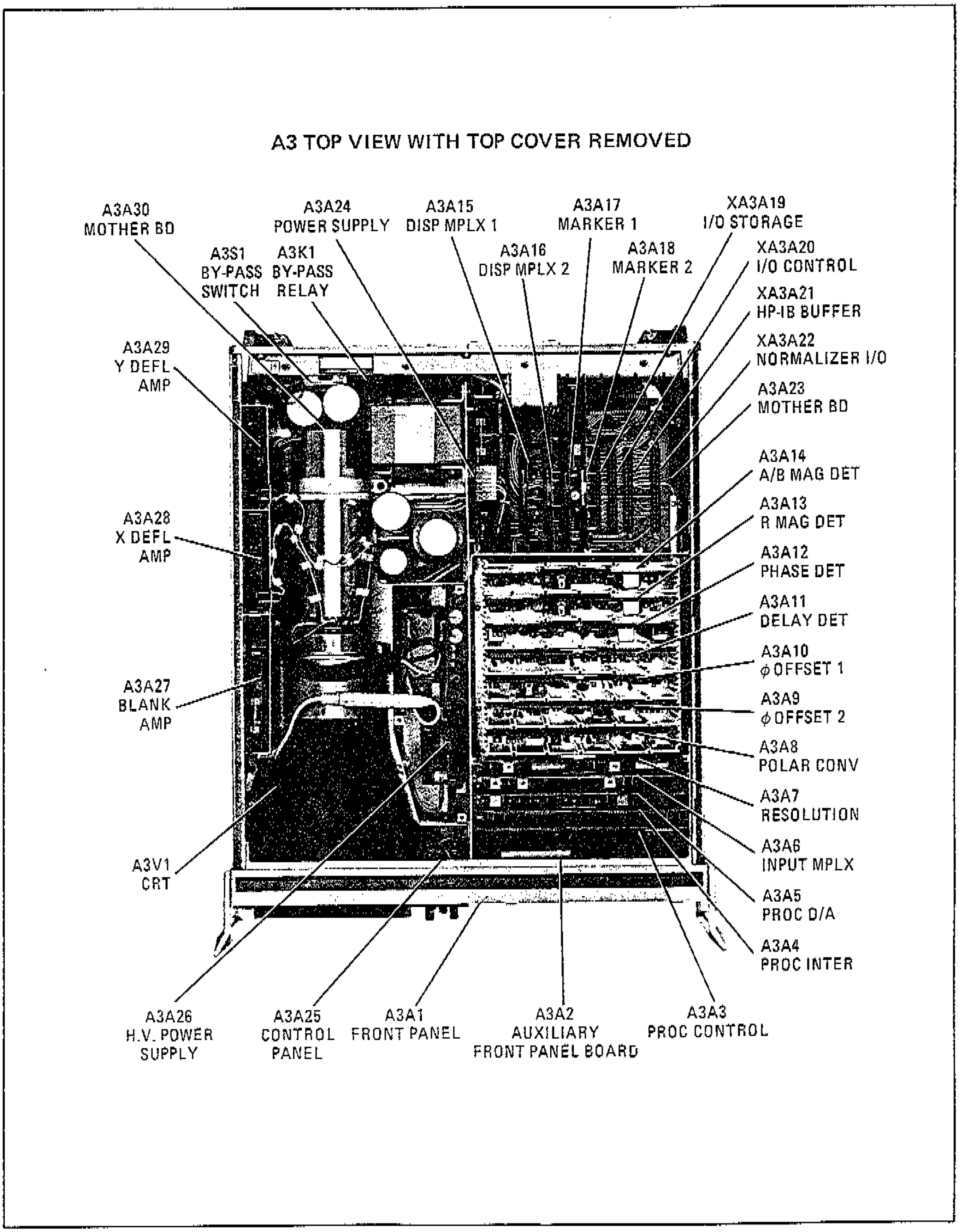


Figure A6-7. A3 Major Assemblies

A3 FRONT VIEW WITH FRONT PANEL TILTED FORWARD

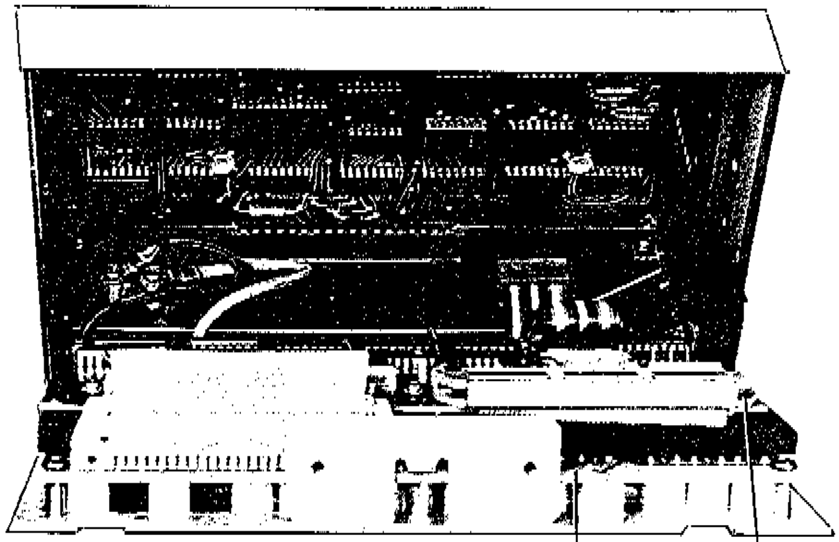


Figure A6-8. A3A1 and A3A2 Showing Front Panel Folded Out

Fig A6-9
Sht 1 of 2

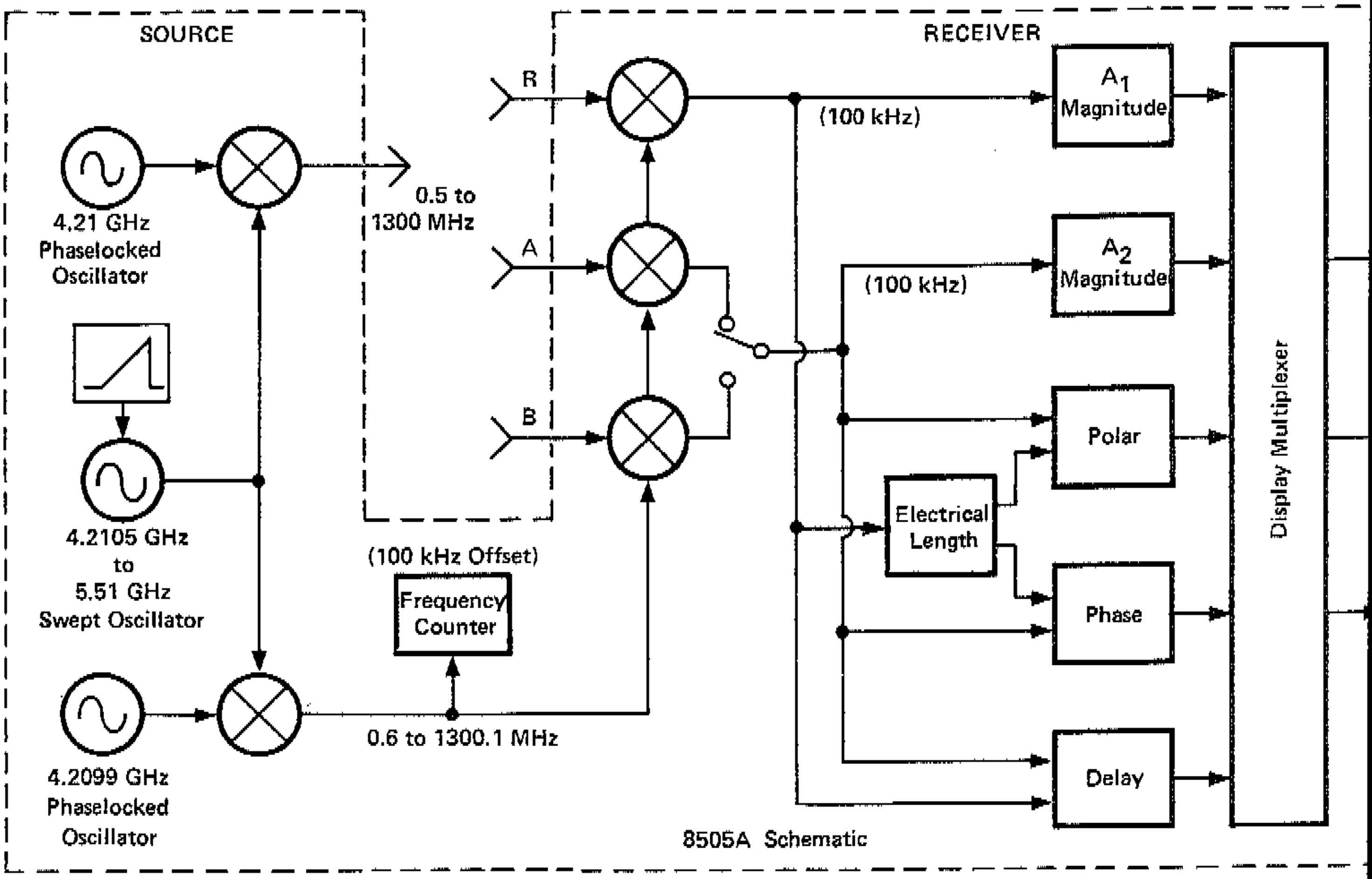


Figure A6-9. Simplifi

Fig. A6-9
Sht 2 of 2

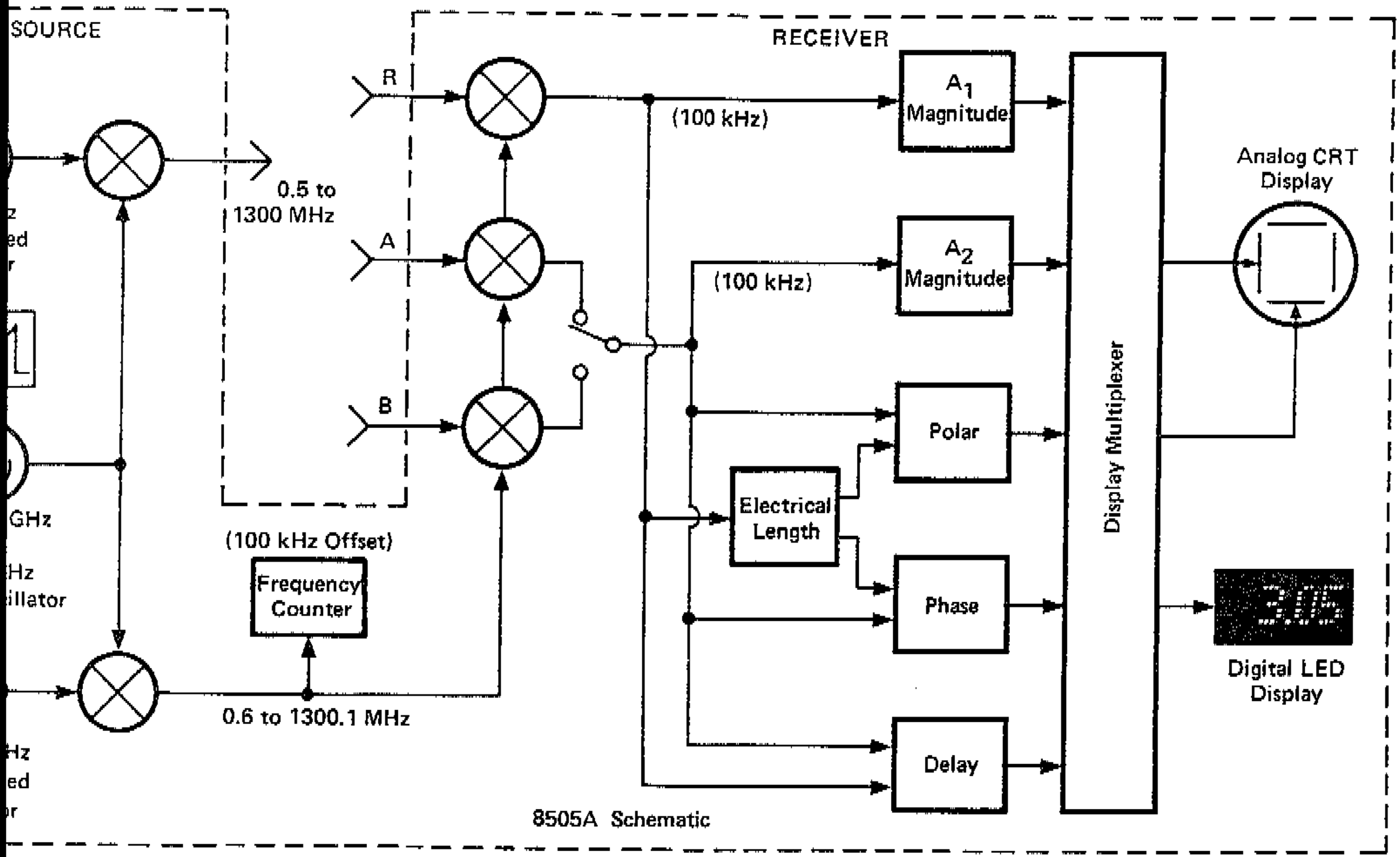


Figure A6-9. Simplified Block Diagram

Model 8505A

Fig A6-10
Sht 1 of 3

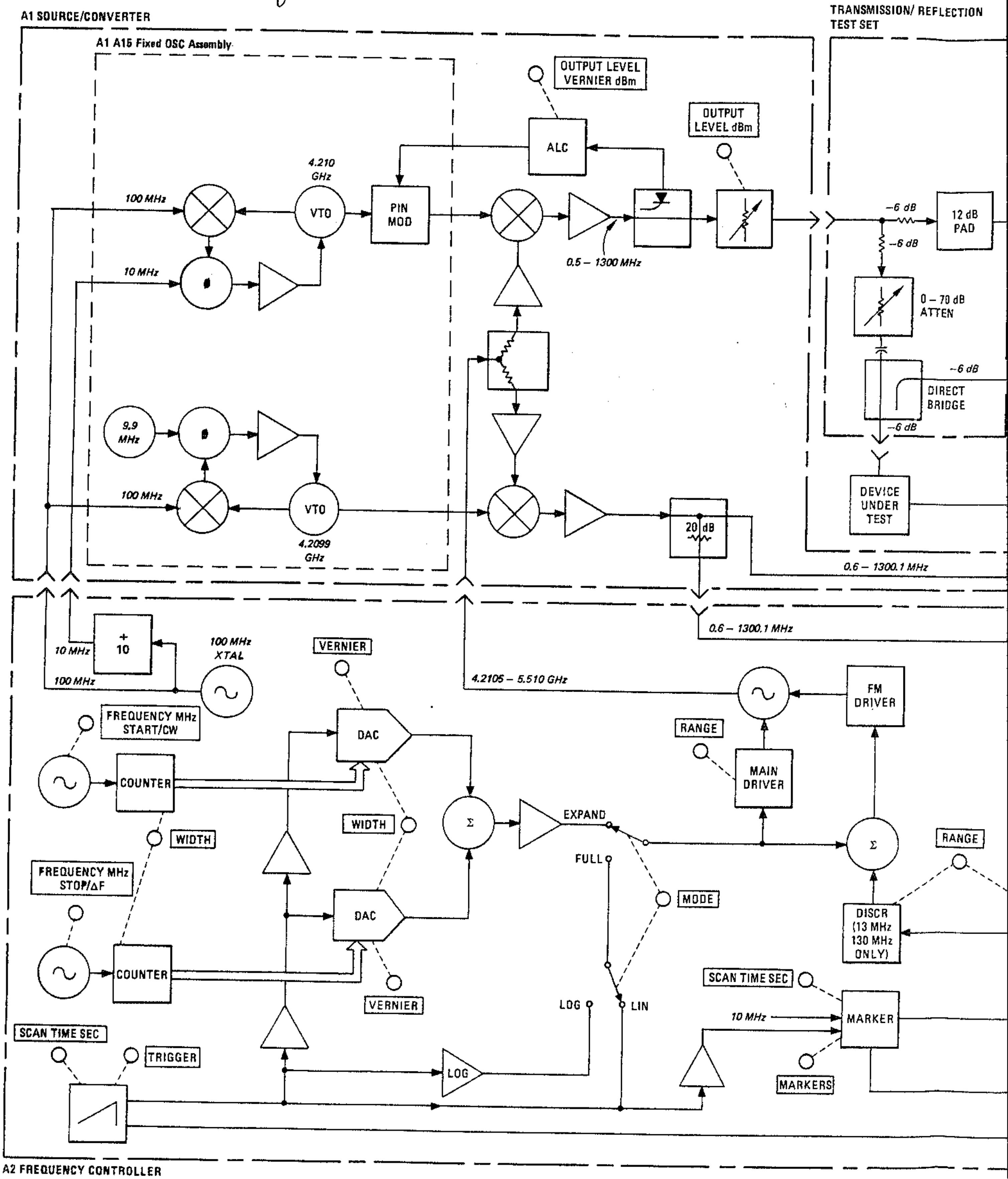


Fig. A6-10
Sht 2 of 3

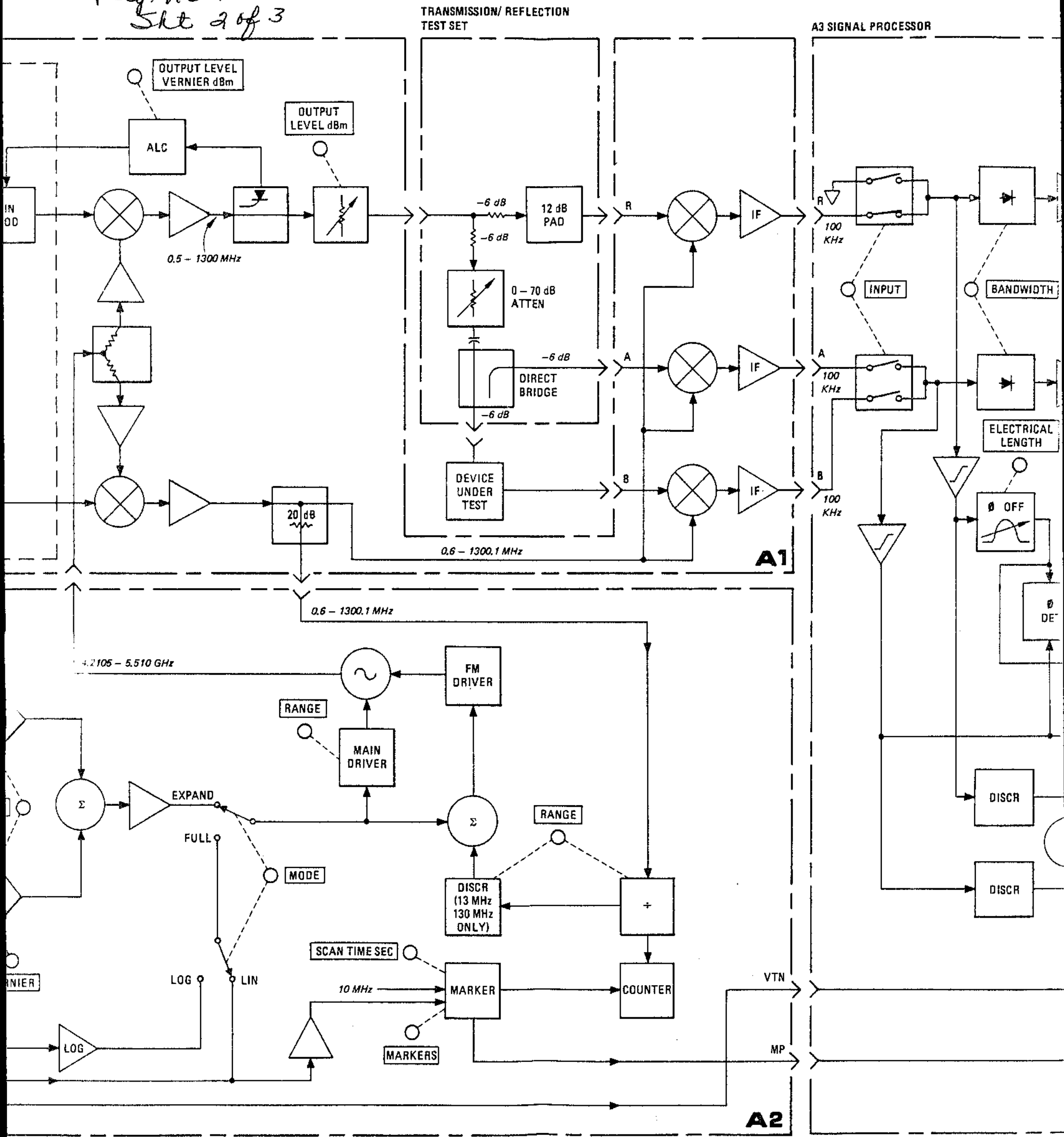


Fig A6-10
Sht 3 of 3

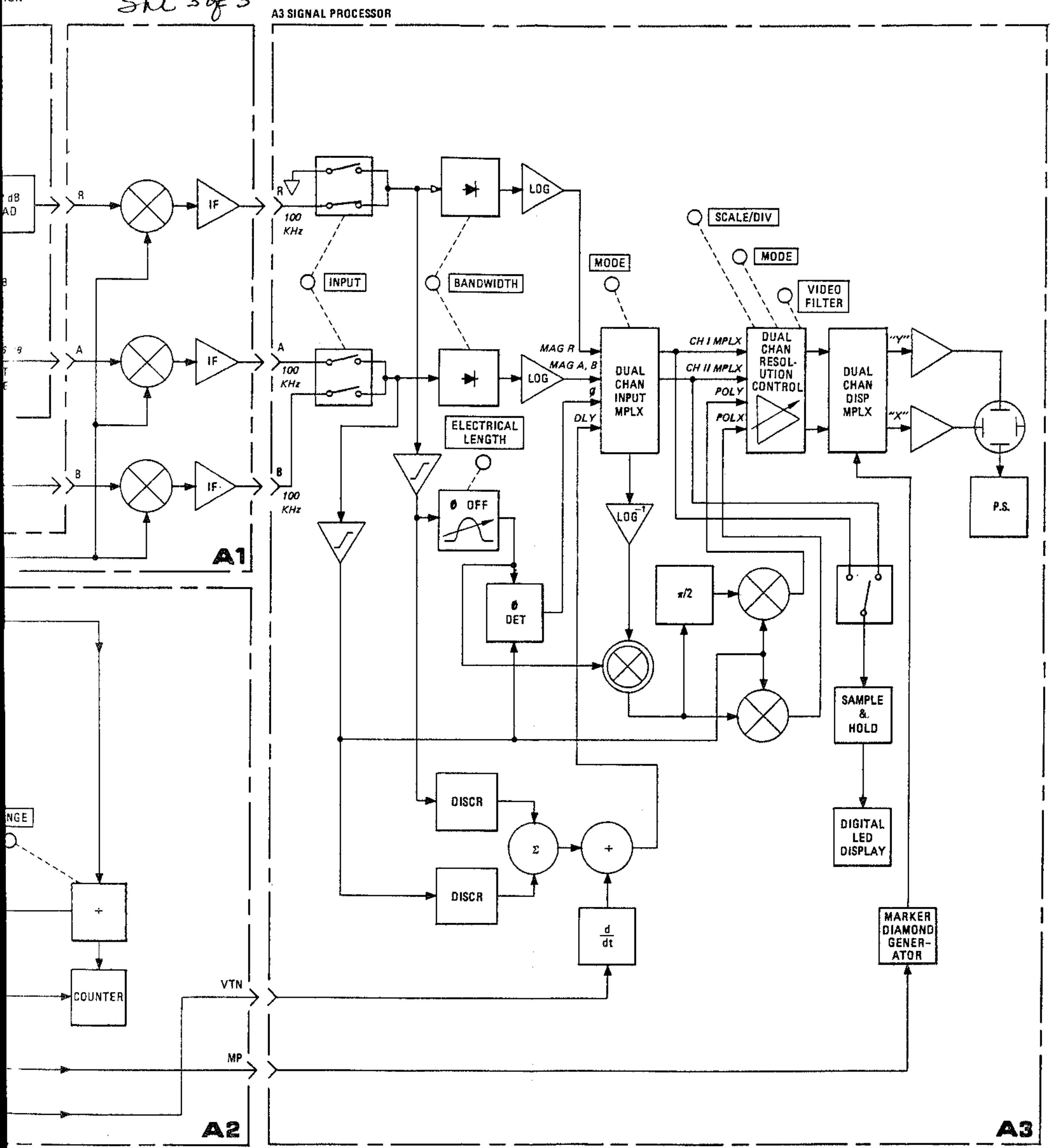
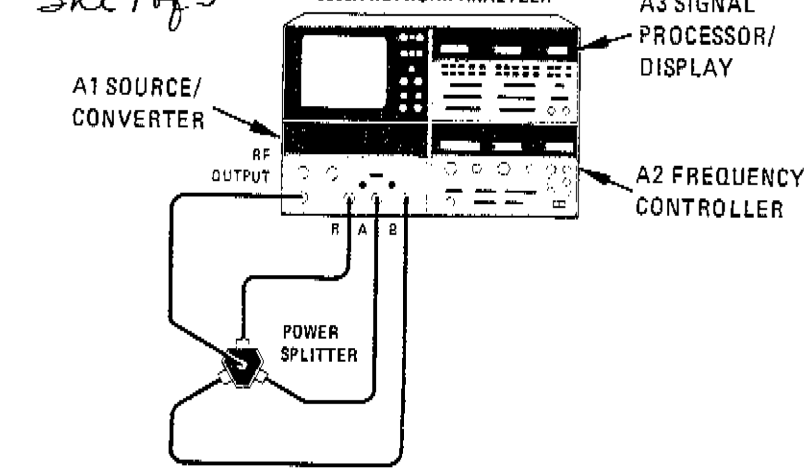


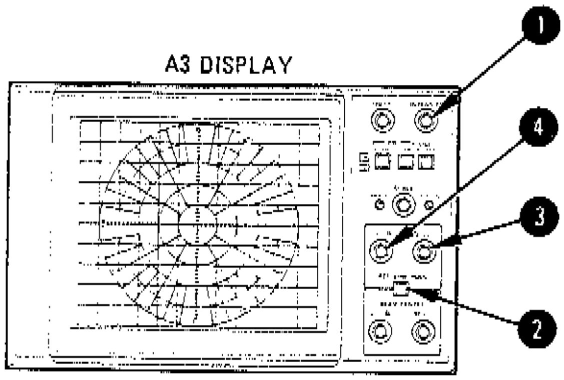
Figure A6-10. 8505A Overall Detailed Block Diagram

Fig A6-11
Sht 1 of 5

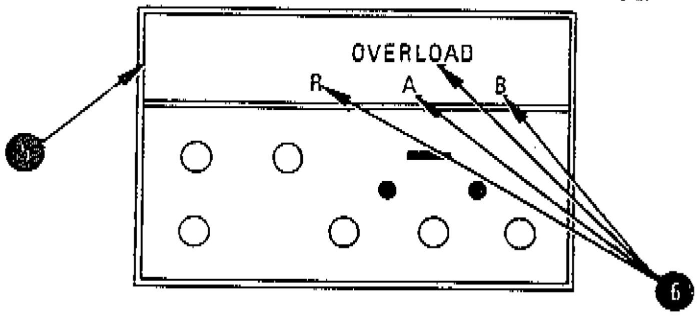
TEST SETUP



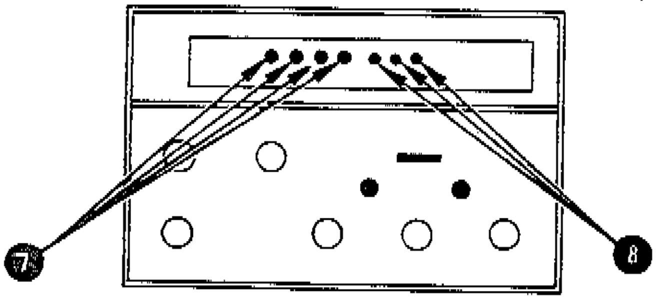
A3 DISPLAY



A1 SOURCE CONVERTER (INDICATOR PANEL IN PLACE)



A1 SOURCE CONVERTER (INDICATOR PANEL REMOVED)



TEST SETUP

Connect RF OUTPUT to "R" and "A" INPUT Channels as shown in TEST SETUP.

On SOURCE/CONVERTER set:
LEVEL dBm 10 dB/Step. . . . . +10
LEVEL dBm Vernier. 0
INPUT LEVEL dBm MAX. . . . . −10

On FREQUENCY CONTROL Set:
MODE . . . . .CW

On SIGNAL PROCESSOR Set:
Channel 1:
INPUT . . . . .A
MODE . . . . MAG
SCALE/DIV. . . . . 20 dB
Channel 2: 2:
INPUT . . . . .B
MODE . . . . MAG
SCALE/DIV. . . . . 20 dB

CHANNEL 1 DISPLAY TRACE

On A3 Display panel, depress REF LINE POSN pushbutton 2 . Adjust CH 1 up-down position control 4 to place the CRT trace one graticule line above center. If graticule line adjusts OK, press REF LINE POSN pushbutton again for normal operation.

NO CHANNEL 1 CRT TRACE

CHANNEL 1 DOESN'T ADJ

CHANNEL 1 TRACE OK

CHANNEL 2 DISPLAY TRACE

On A3 Display panel, depress REF LINE POSN pushbutton 3 . Adjust CH 2 up-down position control to place the CRT trace one graticule line below center. If CH 2 graticule line adjust OK, press REF LINE POSN pushbutton again for normal operation.

CHANNEL 2 DOESN'T ADJ

CHANNEL 2 TRACE OK

Set Siganl Processor Channel 1 MODE switch to POLAR MAG position. On A3 Display panel, depress BEAM CENTER switch 2 . Adjust the two positioning controls to place the CRT dot trace in the center of the graticule. If the dot trace adjusts OK, press BEAM CENTER again for normal operation. Set Siganl Processor Channel 1 MODE switch to MAG position.

DOT WILL NOT ADJUST

NO CRT DOT TRACE

POLAR DISPLAY OK

Fig A6-11
Sht 2 of 5

"A" INPUT

. . . . . +10
. 0
. . . . . −10

. . . . . .CW

. . . . .A
. . . . MAG
. . . . 20 dB
2:
. . . . .B
. . . . MAG
. . . . 20 dB

Adjust Display Panel INTEN fully clockwise. If still no trace, proceed to next block.

NO CRT TRACE

A3 POWER SUPPLY

On A3A24, check for +5V, +15V, −15V, a[cut off] at appropriate test points.

ALL VOLTAGE[cut off]

Troubleshoot A3 Display Section. See [cut off] shooting Procedures, Chapter D, Section III.

RF SIGNAL TO OVERLOAD LIGHTS

Check that the OVERLOAD, "R," "A," a[cut off] lights 6 are lit, indicating RF signals ab[cut off] dBm are reaching the output of A1 Source/C[cut off] IF amplifiers.

OVERLOAD, R, [cut off]
INDICATORS AR[cut off]

_LINE POSN
own position
ine graticule
s OK, press
ormal oper-

NO CHANNEL 1 CRT TRACE

CHANNEL 1 DOESN'T ADJUST

LINE POSN
own position
raticule line
t OK, press
ormal opera-

CHANNEL 2 DOESN'T ADJUST

switch to
panel, de-
just the two
ot trace in
race adjusts
rmal opera-
DE switch

DOT WILL NOT ADJUST

NO CRT DOT TRACE

Troubleshoot A3 Display Section, see Troubleshooting Procedures, Chapter D, Section III.

Connect oscilloscope to A3A13 pin 1 for C[cut off] "R," A3A14 pin 1 for Channel "A," and [cut off] pin 4 for Channel "B." Waveform should be [cut off] kHz signal 1.1 VP-P, ±0.1 VP-P.

YES

100 kHz IF signals correct into A3 Signal Pro[cut off] Trouble is in A3 processor. Go to Troublesh[cut off] Procedures in Chapter D, Section III.

OK

Fig A6-11
Sht 3 of 5

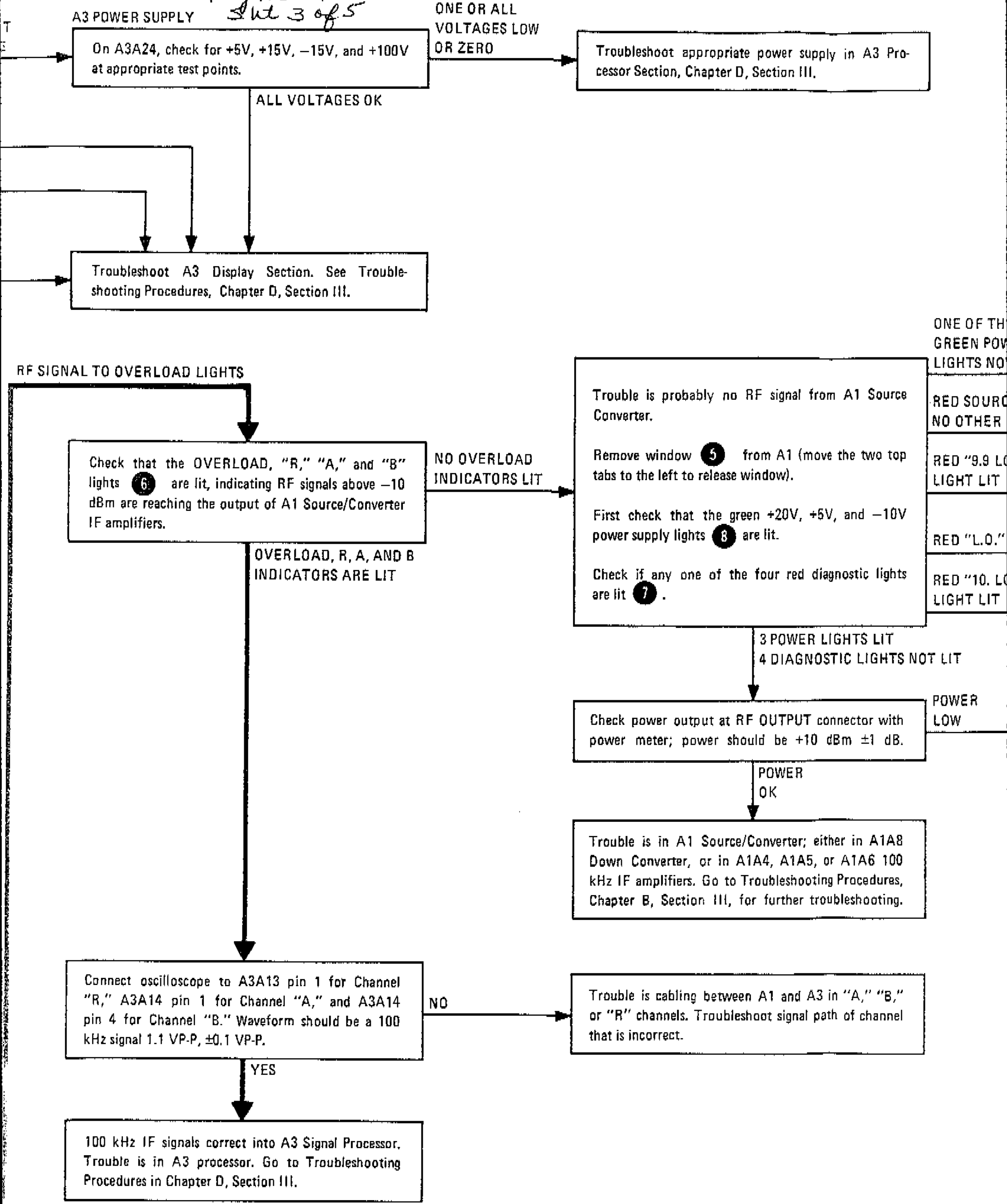


Fig A6-11, Sht 4 of 5

…te power supply in A3 Pro-
…D, Section III.

ONE OF THE THREE GREEN POWER SUPPLY LIGHTS NOT LIT

Correct trouble in A2 power supply. Go to Chapter C, Section III.

… RF signal from A1 Source

… from A1 (move the two top … window).

…een +20V, +5V, and −10V … are lit.

…e four red diagnostic lights

RED SOURCE LIGHT LIT BUT NO OTHER RED LIGHTS LIT

When the "SOURCE" l… OUTPUT from A1 SOUR…

Check with power meter… >+12 dBm from A2A1… nector on top of housing…

Check with power met… signal >+2 dBm from A2…

Check with power mete… signal >+6 dBm from A2…

Trouble is in A1 Sourc… shooting Procedures in Ch…

RED "9.9 LOCK" LIGHT LIT

Red "9.9 LOCK" light lit means the 9.9 MHz phase lock loop is misadjusted or malfunctioning. First, connect Frequency Counter to A1A15J2 and signal should be 9.900 MHz ±10 Hz. If not, adjust A1A15-A1C25 for correct frequency and the "9.9 LOCK" light should go out. If trouble cannot be corrected by adjustment, go to A1 Troubleshooting Procedures in Chapter B, Section III.

RED "L.O." LIGHT LIT

Trouble is bad local oscillator signal in A1. Go to A1 Troubleshooting Procedures in Chapter B, Section III.

RED "10. LOCK LIGHT LIT

Red "10 LOCK" light lit means the 10 MHz phase lock loop is malfunctioning. First, check that power level at A2A12J2 is >+2 dBm. If not, go to A1 Troubleshooting Procedures in Chapter B, Section III.

3 POWER LIGHTS LIT
4 DIAGNOSTIC LIGHTS NOT LIT

…RF OUTPUT connector with … hould be +10 dBm ±1 dB.

POWER LOW

Trouble probably is A1A2 programmable attenuator.

POWER OK

…r/Converter; either in A1A8 … A1A4, A1A5, or A1A6 100 … Troubleshooting Procedures, …for further troubleshooting.

…en A1 and A3 in "A," "B," …shoot signal path of channel

Fig A6-11
Sht 5 of 5

. Go to Chapter C,

he 9.9 MHz phase
unctioning. First,
A15J2 and signal
ot, adjust A1A15-
the "9.9 LOCK"
nnot be corrected
ooting Procedures

in A1. Go to A1
ter B, Section III.

e 10 MHz phase
check that power
f not, go to A1
ter B, Section III.

nable attenuator.

NOTE

When the "SOURCE" light is lit it indicates no RF OUTPUT from A1 SOURCE/CONVERTER.

Check with power meter and counter for 5 GHz signal >+12 dBm from A2A19 YIG Oscillator at the connector on top of housing.

NO → Troubleshoot the 5 GHz signal path in A2 to YIG Oscillator. Go to Troubleshooting Procedures in Chapter C, Section III.

Check with power meter and counter for 10 MHz signal >+2 dBm from A2A12J2.

NO → Troubleshoot the 10 MHz signal path in A2 to Reference Oscillator. Go to Troubleshooting Procedures in Chapter C, Section III.

Check with power meter and counter for 100 MHz signal >+6 dBm from A2A12J1.

NO → Troubleshoot the 100 MHz signal path in A2 Reference Oscillator. Go to Troubleshooting Procedures in Chapter C, Section III.

YES ↓

Trouble is in A1 Source/Converter. Go to Troubleshooting Procedures in Chapter B, Section III.

Figure A6-11. Overall Troubleshooting Procedure

CHAPTER A
MODEL 8505A NETWORK ANALYZER

SECTION VII
MANUAL CHANGES

A7-1. INTRODUCTION

A7-2. This section contains instructions for adapting this chapter of the manual to 8505A Network Analyzers having serial numbers lower than those listed on the title page. To adapt this chapter to your 8505A, refer to Table A7-1 and make all the changes listed opposite the serial number or serial number prefix indicated on the serial number plates on the top and bottom units of your 8505A.

Table A7-1. Chapter A Changes by 8505A Serial Number

Serial Number Prefix	Make Changes
1720A thru 1806A	No Changes
1602A00112, 1618A, 1622A, 1625A, 1628A, 1631A, 1644A, 1646A, 1653A, 1710A, 1712A, 1716A	A
1614A	A, B
1606A, 1610A	A, B, C

A7-3. CHAPTER A CHANGE INSTRUCTIONS

CHANGE A

Paragraph A5-34:
 Change Test Point in procedure "e" to A3A8TP5.
 Change Test Point in procedure "f" to A3A8TP6.
 Delete steps g and h.
 Change the picture of A3 and A3A8 in Figure A5-40 to the one shown in Figure A7-1 in this change.

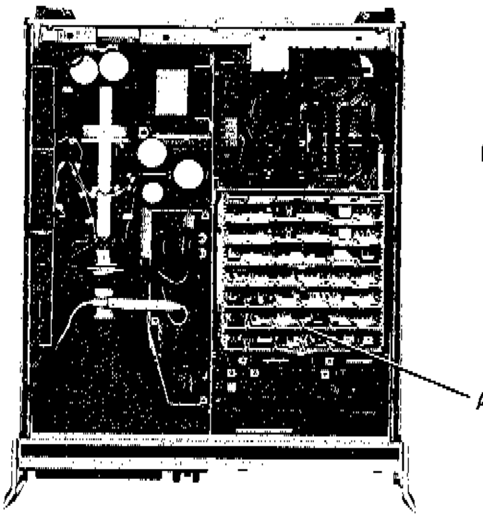
CHANGE B

Replace paragraphs A5-37 and A5-38 with the following procedures:

A5-37. A2A13 MAGNITUDE CALIBRATION (Serial Prefix 1614A and Below)

a. Connect a power meter to the front panel Source/Converter RF OUTPUT connector. On calculator, program output verier to —12 dB (VO). Adjust A2A13R10 "—12 dB ADJ" control for 0 dBm output.

b. On calculator, program output vernier to 0 dB. Adjust A2A13R8 "0 dB" control for +12 dBm output.



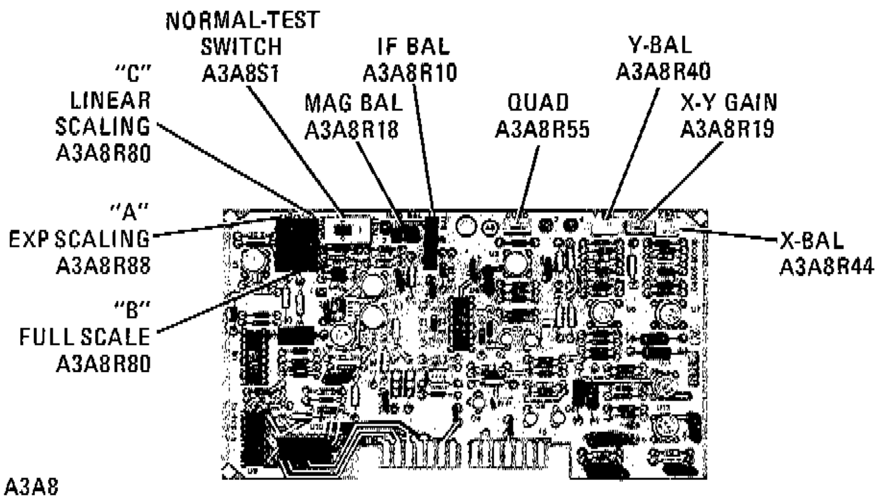


Figure A7-1. "Figure A5-40. A3A8 Polar Converter Adjustments Location" (P/O Change A)

A5-38. A2A15 MARKER CALIBRATION (Serial Prefix 1614A and Below)

a. Program START/STOP 1 sweep mode and select "R" Channel. Connect equipment as shown in Figure A5-46.

b. Program 50% Marker position on marker number 1.

c. Adjust "MARKER" control A2A15R12 to place the marker on the center graticule line of the CRT.

CHANGE C

Table A1-1:

Change RECEIVER INPUT CHARACTERISTICS, Noise (10 kHz BW): to read "−110 dBm from 10 to 1300 MHz; −100 dBm from 0.5 to 10 MHz. Typically, −120 dBm using the −30 dBm input level position and 1 kHz BW.

Paragraph A2-53:

Change SPECIFICATION for noise floor to read:

Noise floor in 10 kHz Bandwidth: −100 dBm (0.5 to 10 MHz)
−110 dBm (10 to 1300 MHz)

Change first paragraph under DESCRIPTION to read: The noise floor is measured by offsetting the reference line 100 dB (0.5 to 10 MHz) or 110 dB (10 to 1300 MHz). Each signal at the three input ports is compared with the −100 dBm or −110 dBm reference line to verify that the noise floor is below the −100 dBm or −110 dBm level.

Change STOP FREQUENCY in step b to read: 0010 MHz.

Change side head before step c to read: NOISE FLOOR FROM 0.5 to 10 MHz.

Change steps c throuh j to read as follows: (Do not change steps k through m.)

c. Connect 50-Ohm terminations to "R" and "A" ports.

CHANGE C (Cont'd)

d. At Channel 1, press CLR pushbutton until REL light goes out (if it was lit). (This clears all previous offsets in Channel 1.)

e. At Channel 1, press DISPLAY REF, then REF OFFSET pushbuttons to obtain —100 dB offset. The CRT trace should be below the center graticule line between 0.5 MHz (Marker 1) and 10.0 MHz. This shows the noise floor below —100 dBm.

f. Set Channel 1 INPUT switch to "A". The CRT trace should be below the center graticule line between 0.5 MHz (Marker 1) and 10.0 MHz.

g. Remove the termination from port "R" and connect it to port "B". Set Channel 1 INPUT switch to "B". The CRT trace should be below the center graticule line between 0.5 MHz (Marker 1) and 10.0 MHz.

NOISE FLOOR FROM 10 TO 1300 MHz

h. At Channel 1, press DISPLAY REF, then REF OFFSET pushbuttons to obtain —110 dB offset. The CRT trace should be below the center graticule line between 10.0 MHz (STOP Marker) and 1300 MHz. This shows the noise floor below —110 dBm.

i. Set Channel 1 INPUT switch to "A". The CRT trace should be below the center graticule line between 10.0 and 1300 MHz.

j. Set Channel 1 INPUT switch to "R". Disconnect the 50-Ohm termination from the "B" port and connect it to the "R" port. The CRT trace should be below the center graticule line between 10.0 and 1300 MHz.

Paragraph A4-13:
Change Noise floor specifications to read:
Noise floor in 10 kHz Bandwidth: —100 dBm (0.5 to 10 MHz)
—110 dBm (10 to 1300 MHz)

Change DESCRIPTION to read: The noise floor is measured by the reference —100 dB (0.5 to 10 MHz) and —110 dB (10 to 1300 MHz). Each signal at the three input ports is compared with the —100 dB or —110 dB reference line to verify that the noise floor is below —100 dBm or —110 dBm.

Paragraph A4-14:
Delete steps c through m and add steps c through j shown below:

NOISE FLOOR FROM 0.5 to 10 MHz

c. Connect 50-Ohm terminations to "R" and "A" ports. Adjust Signal Processor Display REF LINE POSN CH1 control to place the CRT trace on the center graticule line.

d. At Channel 1, press CLR pushbutton until REL light goes out (if it was lit). (This clears all previous offsets in Channel 1.)

e. At Channel 1, press DISPLAY REF, then REF OFFSET pushbuttons to obtain —100 dB offset. The CRT trace should be below the center graticule line between 0.5 MHz (Marker 1) and 10 MHz. This shows the noise floor below —100 dBm.

f. Set Channel 1 INPUT switch to "A". The CRT trace should be below the center graticule line between 0.5 MHz (Marker 1) and 10. MHz.

CHANGE C (Cont'd)

g. Remove the termination from port "R" and connect it to port "B". Set Channel 1 INPUT switch to "B". The CRT trace should be below the center graticule line between 0.5 MHz (Marker 1) and 10 MHz.

NOISE FLOOR FROM 10 to 1300 MHz

h. Set START frequency to 0010 MHz and STOP frequency to 1300 MHz. At Channel 1, press DISPLAY REF, then REF OFFSET Pushbuttons to obtain −110 dB offset. The CRT trace should be below the center graticule line between 10.0 MHz and 1300 MHz. This shows the noise floor below −110 dBm.

i. Set Channel 1 INPUT switch to "A". The CRT trace should be below the center graticule line between 10.0 and 1300 MHz.

j. Set Channel 1 INPUT switch to "R". Disconnect the 50-Ohm termination from the "B" port and connect it to the "R" port. The CRT trace should be below the center graticule line between 10.0 and 1300 MHz.