HEWLETT PACKARD

SERVICE MANUAL

MODEL 3582A SPECTRUM ANALYZER

Serial Numbers: 1747A00101 thru 1747A00125
And 1809A00126 and greater

IMPORTANT NOTICE

This manual applies to instruments with the above serial number prefixes. As changes are made in the instrument to improve performance and reliability, the appropriate pages will be revised to include this information.

WARNING

To help minimize the possibility of electrical fire or shock hazards, do not expose this instrument to rain or excessive moisture.

Manual Part No. 03582-90004

Microfiche Part No. 03582-90054

P.O. Box 301, Loveland, Colorado 80537

Printed: February 1981

HEWLETT PACKARD

CERTIFICATION

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

WARRANTY

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

For warranty service or repair, this product must be returned to a service facility designated by -hp-. Buyer shall prepay shipping charges to -hp- and -hp- shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to -hp- from another country.

Hewlett-Packard warrants that its software and firmware designated by -hp- for use with an instrument will execute its programming instructions when properly installed on that instrument. Hewlett-Packard does not warrant that the operation of the instrument, or software, or firmware will be uninterrupted or error free.

LIMITATION OF WARRANTY

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. HEWLETT-PACKARD SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

EXCLUSIVE REMEDIES

THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES. HEWLETT-PACKARD SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

ASSISTANCE

Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.

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

TABLE OF CONTENTS

Section Page

I. GENERAL INFORMATION....1-1
1-1. Introduction....1-1
1-5. Specifications....1-1
1-7. Safety Considerations....1-1
1-9. ⚠ Instruction Manual Symbol....1-1
1-11. Instruments Covered By Manual....1-1
1-16. Description....1-2
1-27. Options....1-3
1-29. Accessories Supplied....1-3
1-31. Accessories Available....1-4
1-33. Recommended Test Equipment....1-4

Section Page

II. INSTALLATION....2-1
2-1. Introduction....2-1
2-3. Initial Inspection....2-1
2-5. Power Requirements....2-1
2-7. Line Voltage And Fuse Selection....2-1
2-9. Power Cable And Grounding Requirements....2-2
2-11. Operating Environment....2-2
2-12. Temperature....2-2
2-14. Humidity....2-2
2-16. Altitude....2-2
2-18. Cooling Fan....2-2
2-20. Thermal Cutout....2-2
2-22. Installation....2-3
2-23. Mounting....2-3
2-26. HP-IB System Interface Connections....2-3
2-30. Cable Length Restrictions....2-4
2-32. HP-IB Address Selection....2-5/2-6
2-34. Storage and Shipment....2-5/2-6
2-35. Environment....2-5/2-6
2-37. Packaging....2-5/2-6

Section Page

III. OPERATING REFERENCE....1

Section Page

IV. PERFORMANCE TESTS....4-1
4-1. Introduction....4-1

PART I
OPERATIONAL VERIFICATION

4-3. Operational Verification....4-1
4-5. Required Test Equipment....4-1
4-7. Preset....4-1
4-9. Instrument Warmup....4-1
4-12. DC BAL Verification....4-3
4-15. ROM Self Test....4-3
4-19. Display Accuracy....4-4
4-24. Calibrator Accuracy....4-4
4-29. Amplitude Accuracy and Flatness....4-4
4-34. Noise Level....4-5
4-39. Harmonic Distortion....4-6
4-44. Common Mode Rejection....4-7
4-49. Frequency Accuracy....4-8

Section Page

4-54. Phase Accuracy....4-9
4-59. Amplitude and Phase Match Between Channels....4-10

PART II
AUTOMATED PERFORMANCE TEST

4-64. Introduction....4-11
4-66. Applicability....4-11
4-68. The Tape Cartridge....4-11
4-70. Cartridge Organization....4-11
4-77. Equipment Required....4-12
4-81. Connecting The Test Equipment....4-14
4-83. General Considerations....4-14
4-84. Warm-up Time....4-14
4-86. Order Of Testing....4-14
4-89. Operator Instructions....4-15
4-91. Print Mode....4-15
4-93. Channel Selection....4-15
4-95. Instrument Identification....4-15
4-97. Auto Or Manual....4-15
4-100. DC Balance....4-15
4-104. Addresses....4-16
4-108. Phase Accuracy....4-16
4-110. Running The Tests....4-17
4-112. Inserting The 3582A/9825A Test Cartridge....4-17
4-114. Loading A Tape File....4-17
4-116. HP-IB Verification (File 1)....4-18
4-112. Basic Adjustments (File 2)....4-19
4-126. Semi-Auto Performance Test (File 3)....4-19
4-130. Auto Performance Test (File 4)....4-22
4-141. Basic Operating Instructions....4-23
4-153. Error Messages....4-25

PART III
MANUAL PERFORMANCE TEST

4-154. Introduction....4-27
4-156. Applicability....4-27
4-158. Organization....4-27
4-160. Required Test Equipment....4-27
4-162. Preset....4-28
4-164. Instrument Warmup....4-28
4-167. DC BAL Verification....4-28
4-170. Conducting The Performance Tests....4-29/4-30
4-173. Noise Floor....4-31/4-32
4-178. Harmonic Distortion....4-33/4-34
4-181. Instrument Control Settings....4-33/4-34
4-184. Intermodulation Distortion And Vernier Range....4-35/4-36
4-187. Recommended Test Equipment....4-35/4-36
4-188. Instrument Control Settings....4-35/4-36
4-190. Common Mode Rejection....4-37/4-38
4-192. Recommend Equipment....4-37/4-38
4-193. Instrument Test Setups....4-37/4-38
4-195. Instrument Control Setting....4-37/4-38
4-197. Cross Talk....4-39/4-40

TABLE OF CONTENTS (Cont'd)

Section Page

4-199. Recommended Test Equipment 4-39/4-40
4-200. Instrument Control Settings ... 4-39/4-40
4-202. Input Impedance Test 4-41/4-42
4-206. Recommended Test Equipment 4-41/4-42
4-207. Instrument Control Settings ... 4-41/4-42
4-209. Noise Source Output Impedance 4-43/4-44
4-211. Recommended Test Equipment 4-43/4-44
4-212. Test Equipment Setup 4-43/4-44
4-214. Instrument Control Setting 4-43/4-44
4-216. Noise Source Amplitude 4-45/4-46
4-218. Recommended Test Equipment 4-45/4-46
4-219. Test Equipment Setup 4-45/4-46
4-221. Instrument Control Setting 4-45/4-46
4-223. Calibration Accuracy 4-47/4-48
4-225. Instrument control Settings 4-47/4-48
4-227. Frequency Accuracy 4-49/4-50
4-229. Recommended Test Equipment 4-49/4-50
4-230. Test Equipment Setup 4-49/4-50
4-232. Instrument Control Settings ... 4-49/4-50
4-234. Linearity 4-51/4-52
4-236. Recommended Test Equipment 4-51/4-52
4-238. Instrument Control Settings ... 4-51/4-52
4-240. Attenuator Accuracy 4-53/4-54
4-242. Recommended Test Equipment 4-53/4-54
4-243. Test Equipment Setup 4-53/4-54
4-245. Instrument Control Settings ... 4-53/4-54
4-247. Input Filter And Analog To Digital Converter Flatness 4-55/4-56
4-249. Recommended Test Equipment 4-55/4-56
4-250. Test Equipment Setup 4-55/4-56
4-252. Instrument Control Settings ... 4-55/4-56
4-254. Attenuator Flatness 4-57/4-58
4-256. Recommended Test Equipment 4-57/4-58
4-257. Test Equipment Setup 4-57/4-58
4-258. Instrument Control Settings ... 4-57/4-58
4-261. Local Oscillator/Mixer Spurs ... 4-59/4-60
4-263. Recommended Test Equipment 4-59/4-60
4-264. Test Equipment Setup 4-59/4-60
4-266. Instrument Control Settings ... 4-59/4-60
4-268. Digital Filter Noise 4-61/4-62
4-270. Recommended Test Equipment 4-61/4-62
4-271. Test Equipment Setup 4-61/4-62
4-273. Instrument Control Settings ... 4-61/4-62
4-275. Digital Filter Operation 4-63/4-64
4-277. Recommended Test Equipment 4-63/4-64

Section Page

4-278. Test Equipment Setup 4-63/4-64
4-280. Instrument Control Settings ... 4-63/4-64
4-282. AC Coupling 4-65/4-66
4-284. Recommended Test Equipment 4-65/4-66
4-285. Test Equipment Setup 4-65/4-66
4-287. Instrument Control Settings ... 4-65/4-66
4-289. Special Spurs 4-67/4-68
4-291. Recommended Test Equipment 4-67/4-68
4-292. Test Equipment Setup 4-67/4-68
4-294. Instrument Control Settings ... 4-67/4-68
4-296. Phase Accuracy 4-69/4-70
4-298. Recommended Test Equipment 4-69/4-70
4-299. Test Equipment Setup 4-69/4-70
4-301. Instrument Control Settings ... 4-69/4-70

Section Page

V. ADJUSTMENT PROCEDURES 5-1
5-1. Introduction 5-1
5-3. Test Point And Adjustment Locations 5-1
5-5. Safety Considerations 5-1
5-7. Adjustment Sequence 5-2
5-9. Control Settings 5-2
5-11. Pre-Adjustment Set-Up 5-2
5-13. Power Supply Adjustments 5-3
5-15. A17 Adjustments 5-3
5-16. A16 Adjustments (+5.1 Volt Power Supply) 5-4
5-17. A18 Adjustment (−15 Volt Power Supply) 5-5
5-18. A13 Adjustments (High Voltage) 5-6
5-19. CRT Control Adjustments 5-8
5-21. Display Calibration Adjustments 5-10
5-23. 45.8752 MHz Adjustment 5-13
5-24. Back-Gate Bias Adjustment 5-14
5-25. Input Board Adjustments (channels A and B) 5-15
5-27. A-to-D Clock Adjustment 5-16
5-28. Sample-and-Hold Dc Adjustment 5-16
5-29. Amplitude Calibration 5-17
5-31. Periodic-Random Noise Source DC Adjustment 5-19/5-20

Section Page

VI. REPLACEABLE PARTS 6-1
6-1. Introduction 6-1
6-4. Ordering Information 6-1
6-6. Non-Listed Parts 6-1
6-8. Proprietary Parts 6-1
6-10. Printed Circuit Assemblies 6-1

Section Page

VII. BACKDATING 7-1
7-1. Introduction 7-1
7-3. General Information 7-1
7-6. Procedural Changes 7-1

TABLE OF CONTENTS (Cont'd)

Section		Page
VIII.	SERVICE INFORMATION	8-1
8-1.	Getting Started	8-1
8-3.	Service Section Organization	8-1
8-5.	General Troubleshooting	8-2
8-7.	Service Group	8-2
8-9.	General Troubleshooting	8-2
8-12.	Troubleshooting Guidelines	8-2
8-14.	Preliminary Troubleshooting	8-3
8-16.	Basic Instrument Operation (Preset Conditions)	8-4
8-18.	Primary Troubleshooting	8-4
8-21.	Blank Display	8-5
8-23.	Data Loading Light Not Flashing	8-6
8-25.	Troubleshooting Hints	8-6
8-26.	Introduction	8-6
8-28.	Front Panel Accessible Self-Test	8-10
8-29.	To Start	8-10
8-31.	To Select A Test Routine	8-10
8-33.	Display	8-10
8-36.	Status Code	8-11
8-38.	Test Programs	8-11
8-40.	Front Panel Test (000000)	8-11
8-47.	Display Test (000001)	8-15
8-53.	A5 Digital Filter Board Test (000002)	8-15
8-62.	A6 ROM Board Test (000003)	8-16
8-68.	A8 RAM Board "GALPAT" Test (000004)	8-17
8-74.	Recorder Output Test (000005)	8-18
8-79.	Special Test (000006)	8-18
8-86.	Block Diagram Description	8-19
8-87.	Understanding The Instrument	8-19
8-90.	Signal Flow	8-19
8-92.	Input p/o A1 (A)	8-19
8-96.	Sample Hold and Analog to Digital Converter p/o A1 (B)	8-19
8-98.	Interface and Timing A3 (C)	8-20
8-103.	Digital Filter A5 (D)	8-20
8-105.	Digital Local Oscillator p/o A4 (E)	8-21
8-108.	Processor A7 (F)	8-21
8-111.	ROM A6 (G)	8-21
8-113.	RAM A8 (H)	8-21
8-115.	Display Controller p/o A9 (I)	8-22
8-117.	Digital Display Driver p/o A9 (J)	8-22
8-119.	Analog Display Driver p/o A10 (K)	8-22
8-123.	XYZ Amplifiers p/o A12 (L)	8-22
8-125.	High Voltage Section p/o A13 and A65 (M)	8-23
8-129.	Supporting Boards and Circuits	8-23
8-131.	Instrument Control	8-23
8-133.	Front Panel Controls A11 and A12 (N)	8-23
8-136.	HP-IB A2 (0)	8-23
8-138.	Instrument Outputs	8-23
8-140.	Pseudo Random Noise p/o A4 (P)	8-24
8-142.	X-Y Recorder p/o A10 (Q)	8-24
8-144.	Power Supplies A14 (R), A15 (S), A16 (T), A19-A17 (U), A18 (V)	8-24

SERVICE GROUPS

1.	Input	8-1-1
2.	Timing	8-2-1
3.	Digital Filter and Local Oscillator	8-3-1
4.	Processor	8-4-1
5.	The Display Section	8-5-1
6.	High Voltage Section	8-6-1
7.	Front Panel Service Group	8-7-1
8.	HP-IB	8-8-1
9.	Pseudo Random Noise	8-9-1
10.	X-Y Recorder	8-10-1
11.	Power Supply	8-11-1
12.	Chassis Mounted Components	8-12-1

LIST OF ILLUSTRATIONS

Figure Page
2-1. Line Voltage And Fuse Selection....2-1
2-2. Power Cables....2-2
2-3. Typical HP-IB System Interconnection....2-3
2-4. HP-IB Connector....2-4
4-1. HP-IB Connection Diagram....4-14
4-2. HP-IB Interface, Select Code 7....4-17
4-3. Inserting The Tape Cartridge....4-17
4-4. Adjustment Locations....4-20
4-5. Test Set-up Intermodulation Distortion....4-21
4-6. Construction A Feedthrough Load....4-21
4-7. -hp- 9825A Calculator....4-24
4-8. Noise Floor Test....4-31/4-32
4-9. Harmonic Distortion....4-33/4-34
4-10. Intermodulation Distortion Test Setup....4-35/4-36
4-11. Sample Spectrum....4-35/4-36
4-12. Intermodulation Distortion & Vernier Range....4-35/4-36
4-13. Test Setup A....4-37/4-38
4-14. Test Setup B....4-37/4-38
4-15. Common Mode Rejection....4-37/4-38
4-16. Cross Talk Measured On Channel B....4-39/4-40
4-17. Cross Talk....4-39/4-40
4-18. Input Compensation Network....4-41/4-42
4-19. Effects Of The Compensation Network On Input....4-41/4-42
4-20. Input Impedance....4-41/4-42
4-21. Noise Source Output Impedance....4-43/4-44
4-22. Noise Source Amplitude....4-45/4-46
4-23. Calibration Accuracy....4-47/4-48
4-24. Frequency Accuracy....4-49/4-50
4-25. Linearity....4-51/4-52
4-26. Attenuator Accuracy....4-53/4-54
4-27. Input Filter And Analog To Digital Converter Flatness....4-55/4-56
4-28. Attenuator Flatness....4-57/4-58
4-29. Local Oscillator Mixer Spurs....4-59/4-60
4-30. Digital Filter Noise....4-61/4-62
4-31. Digital Filter Operation....4-63/4-64
4-32. AC Coupling....4-65/4-66
4-33. Special Spurs....4-67/4-68
4-34. Sample Phase Display....4-69/4-70
4-35. Phase Accuracy....4-69/4-70
5-1. Power Supply Control Board, A17....5-3
5-2. +5 V Power Supply Board, A16....5-4
5-3. Linear Supply Board, A18....5-5
5-4. High Voltage Board, A65....5-7
5-5. "Test" Display and Graphics Alignment Adjustment Summary....5-9
5-6. Self-Test Display 3 and Display Calibration Adjustment Summary....5-11
5-7. Analog Display Driver Board, A10....5-12
5-8. Self-Test Display 2 and Marker Bin Position....5-12
5-9. Timing and Digital Interface Board, A3....5-14
5-10. HP-IB Board, A2....5-15
5-11. Pseudo-Random Noise Generator Board, A4....5-19/5-20
5-12. X, Y, Z Amplifier and Display High Voltage control Board, A13. REV C.5-21/5-22
5-13. Input Board, A1....5-21/5-22
5-13. Adjustment and Test Point Locations....5-21/5-22
7-A-1Input Attenuator and LPF (Backdating). REV A....7-A-1/7-A-2
7-D. Digital Filter (Backdating)....7-D-5/7-D-6
7-J-1.Digital Display Driver (Backdating)....7-J-1/7-J-2
7-P. Pseudo Random Noise Generator (Backdating)REV A....7-P-3/7-P-4
8-1. The Channel A CAL Signal....8-5
8-2. Display Test Signal....8-6
8-3. Display Test Readouts....8-10
8-4. 3582A Block Diagram....8-25/8-26

LIST OF TABLES

Table Page
1-1. Options....1-3
1-2. Accessories Supplied....1-3
1-3. Accessories Available....1-4
1-4. Recommended Test Equipment....1-4
1-5. Specifications....1-5
2-1. HP-IB Cables....2-5/2-6
2-2. Address Selection....2-5/2-6
4-1. Recommended Test Equipment For Operational Verification....4-2
4-2. Recommended Test Accessories....4-2
4-3. Amplitude Accuracy and Fltaness....4-5
4-4. Equipment Required....4-13
4-5. Semi-Automatic Performance Test Summary....4-22
4-6. Automatic Performance Test Summary....4-23
4-7. Recommended Test Equipment For Manual Performance Test....4-27
4-8. 3582A Test Limits....4-51/4-52
4-9. 3582A Attenuator Accuracy....4-53/4-54
4-10. 3325A Frequency Settings (kHz)....4-55/4-56
4-11. 3325A Frequency Settings (kHz)....4-55/4-56
4-12. 3325A Amplitude Settings....4-57/4-58
4-13. 3325A Frequency Settings....4-61/4-62
4-14. 3325A Frequency Settings....4-63/4-64
6-1. List of Abbreviations....6-2
6-2. Code List Of Manufacturers....6-2
6-3. Replaceable Parts....6-3/6-4
7-1. Circuit Board Revisions....7-2
7-G-1ROM SA Troubleshooting....7-G-3/7-G-4
8-1. Troubleshooting Hints....8-7
8-2. Condition Codes....8-12
8-3. ROM and RAM Error Code....8-17

HEWLETT PACKARD

CATHODE-RAY TUBE WARRANTY AND INSTRUCTIONS

The cathode-ray tube (CRT) supplied in your Hewlett-Packard Instrument and replacement CRT's purchased from -hp- are warranted by the Hewlett-Packard Company against electrical failure for a period of one year from the date of shipment from Colorado Springs. Broken tubes and tubes with phosphor or mesh burns are not included under this warranty. No other warranty is expressed or implied.

INSTRUCTION TO CUSTOMERS

If the CRT is broken when received, a claim should be made with the responsible carrier. All warranty claims with Hewlett-Packard should be processed through your nearest Hewlett-Packard Sales/Service Office (listed at rear of instrument manual).

INSTRUCTIONS TO SALES/SERVICE OFFICE

Return defective CRT in the replacement CRT packaging material. If packaging material is not available, contact CRT Customer Service in Colorado Springs. The Colorado Springs Division must evaluate all CRT claims for customer warranty, Material Failure Report (MFR) credit, and Heart System credit. A CRT Failure Report form (see reverse side of this page) must be completely filled out and sent with the defective CRT to the following address:

HEWLETT-PACKARD COMPANY
1900 Garden of the Gods Road
Colorado Springs, Colorado 80907

Parcel Post Address:
P.O. Box 2197
Colorado Springs, Colorado 80901

Attention: CRT Customer Service

Defective CRT's not covered by warranty may be returned to Colorado Springs for disposition. These CRT's, in some instances, will be inspected and evaluated for reliability information by our engineering staff to facilitate product improvements. The Colorado Springs Division is equipped to safely dispose of CRT's without the risks involved in disposal by customers or field offices. If the CRT is returned to Colorado Springs for disposal and no warranty claim is involved, write "Returned for Disposal Only" in item No. 5 on the form.

Do not use this form to accomplish CRT repairs. In order to have a CRT repaired, it must be accompanied by a customer service order (repair order) and the shipping container must be marked "Repair" on the exterior.

HEWLETT PACKARD

SAFETY SUMMARY

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Hewlett-Packard Company assumes no liability for the customer's failure to comply with these requirements. This is a Safety Class 1 instrument.

GROUND THE INSTRUMENT

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

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE

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

KEEP AWAY FROM LIVE CIRCUITS

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

DO NOT SERVICE OR ADJUST ALONE

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

USE CAUTION WHEN EXPOSING OR HANDLING THE CRT

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

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT

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

DANGEROUS PROCEDURE WARNINGS

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

WARNING

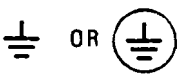
Dangerous voltages, capable of causing death, are present in this instrument. Use extreme caution when handling, testing, and adjusting.

SAFETY SYMBOLS

General Definitions of Safety Symbols Used On Equipment or In Manuals.

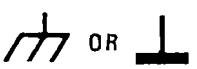
Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect against damage to the instrument.

Indicates dangerous voltage (terminals fed from the interior by voltage exceeding 1000 volts must be so marked).



Protective conductor terminal. For protection against electrical shock in case of a fault. Used with field wiring terminals to indicate the terminal which must be connected to ground before operating equipment.

Low-noise or noiseless, clean ground (earth) terminal. Used for a signal common, as well as providing protection against electrical shock in case of a fault. A terminal marked with this symbol must be connected to ground in the manner described in the installation (operating) manual, and before operating the equipment.



Frame or chassis terminal. A connection to the frame (chassis) of the equipment which normally includes all exposed metal structures.

Alternating current (power line).

Direct current (power line).

Alternating or direct current (power line).

DANGER

The DANGER sign denotes a hazard. It calls attention to an operating procedure, practice, condition or the like, which could result in injury or death to personnel even during normal operation.

WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, condition or the like, which, if not correctly performed or adhered to, could result in injury or death to personnel.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, condition or the like, which,if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product.

NOTE: The NOTE sign denotes important information. It calls attention to procedure, practice, condition or the like, which is essential to highlight.

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. The Operating Manual contains information required to install, operate, and verify the instrument's operational capabilities.

1-3. The Service Manual contains the necessary information to test, adjust, and service the 3582A Spectrum Analyzer.

1-4. The part number of this manual is listed on the title page. Also listed on the title page is a Microfiche part number. This number can be used to order 4×6 inch microfilm transparencies of the manual. Each microfiche contains photo-duplicates of up to 96 manual pages. The microfiche package also includes the latest Manual Changes supplement as well as pertinent Service Notes.

1-5. SPECIFICATIONS.

1-6. Instrument specifications are listed in Table 1-5. These specifications are the performance standards against which the instrument is tested.

1-7. SAFETY CONSIDERATIONS.

1-8. This product is a Safety Class 1 instrument (provided with a 3-wire cord). The instrument and manual should be reviewed for safety markings and instructions before operation.

1-9. ⚠ INSTRUCTION MANUAL SYMBOL.

1-10. Wherever the 3582A instrument is marked with this symbol, the user should refer to the instruction manual in order to protect against damage to the instrument. This symbol is found primarily in the Service Manual.

1-11. INSTRUMENTS COVERED BY MANUAL.

1-12. Attached to the instrument is a serial number plate. The serial number is in the form: 0000A00000. It is in two parts; the first four digits and the letter are the serial prefix and 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 serial number prefix(es) listed under SERIAL NUMBERS on the title page.

1-13. An instrument manufactured after the printing of this manual may have a serial number prefix that is not listed on the title page. This unlisted serial number prefix indicates the instrument is different from those described in this manual. The manual for this newer instrument is accompanied by a yellow Manual Changes supplement. This supplement contains "change information" that explains how to adapt the manual to the newer instrument.

1-14. In addition to change information, the supplement may contain information for correcting errors in the manual. To keep this manual as current and accurate as possible, Hewlett-Packard recommends that you periodically request the latest Manual Changes supplement. The supplement for this manual is identified with the manual part number, which also appears on the manual title page. Complimentary copies of the supplement are available from Hewlett-Packard.

1-15. For information concerning a serial number prefix that is not listed on the title page or in the Manual Changes supplement, contact your nearest Hewlett-Packard Sales and Service Office.

1-16. DESCRIPTION.

1-17. The -hp- Model 3582A is a dual-channel spectrum analyzer covering the frequency range of 0.02 Hz to 25.6 kHz. By combining advanced digital processing techniques and a powerful micro-computer, it can provide measurement capability previously found only in complicated computer systems.

1-18. The performance features of the instrument provide optimal solutions to the problems of low frequency spectrum analysis. Frequency spans from 1 Hz to 25 kHz full scale allow great flexibility in selecting the portion of the spectrum to be analyzed. The spans from 5 Hz up to 25 kHz can be positioned anywhere within the frequency range of the instrument to provide exceptionally good frequency resolution.

1-19. Without resorting to external signal conditioning, the instrument can measure input from +30 dBV (31.6 volts) down to −120 dBV (1 microvolt). Even with this high sensitivity, the input circuits are protected against overloads of up to 100 volts. For measurements where the signal of interest exists in the presence of large unwanted signals, the wide 70 dB dynamic range of the instrument is important.

1-20. These spectrum measurements are made with "real-time" speed for frequency spans less than 500 Hz. Here real-time means that processing time is less than data acquisition time so that no input data is "lost" while waiting for processing. Data acquisition time must be increased for narrower spans to provide the required resolution. For broader spans, data acquisition time is small and processing speed becomes the limiting factor.

1-21. The Model 3582A can also measure the phase of the various spectral components or transfer function. This makes it possible to fully characterize a signal and can provide new insight into the operation of complex electrical or mechanical devices.

1-22. The most significant additional measurement capabilities of the instrument result from having two input channels that operate simultaneously. Not only can independent input signals be examined for common characteristics, but also device input/output relationships can be evaluated. The instrument directly provides both amplitude and phase information of the transfer function of a device. A built-in pseudo-random noise or a built-in random "band limited white noise" source can be used to drive the device under test to perform low frequency network analysis.

NOTE

The random "band limited white noise" source is not available on instruments with serial numbers prefixed 1747A.

1-23. Many signals cannot be analyzed with conventional spectrum analyzers because they are not stable. Digital signal processing techniques allow the Model 3582A to capture and analyze transient signals that last for only a few milliseconds.

1-24. In the Model 3582A, the large-screen CRT makes the measurement results avilable in a highly usable form. In addition to two simultaneous information traces, the display provides four lines of alphanumeric data giving measurement configuration and results. The alphanumeric marker makes it possible to read results directly in absolute or relative units. In addition to measurement results, the CRT is also used to display operational diagnostic messages.

1-25. In order to provide maximum confidence in the operation of the instrument, self test routines have been built in. These tests, in conjunction with the internal calibration signal, make it possible to quickly verify the calibration of the instrument before beginning a critical measurement sequence.

1-26. Virtually all of the measurement functions of the Model 3582A are remotely programmable via the Hewlett-Packard Interface Bus (HP-IB). Since actual measurement data can be remotely input or output, it is possible with a computing controller to extend the basic measurement capability.

1-27. OPTIONS.

1-28. Table 1-1 lists the options which are available for the 3582A. These options may be ordered with the instrument or installed later.

Table 1-1. Options.

3582A Option	-hp- Part Number	Description
001	—	High Transfer Function Accuracy
07	5061-0090	Front Handle Kit
908	5061-0078	Rack Flange Kit
909	6061-0084	Rack Flange and Handle Kit
910	03582-90000	Extra Operating Manual
910	03582-90001	Extra Service Manual
009	03582-80009	Japanese Pullout Card

1-29. ACCESSORIES SUPPLIED.

1-30. Table 1-2 lists the accessories supplied with the -hp- Model 3582A Spectrum Analyzer.

Table 1-2. Accessories Supplied.

Item	Quantity	-hp- Part Number
Accessory Kit (includes the following):	1 ea.	03582-84401
PC Board Extender	1 ea.	03582-66531
PC Board Extender	1 ea.	03582-66532
PC Board Extender	1 ea.	03582-66533
Fuse .25 amp 250 V Slow Blo	1 ea.	2110-0201
Fuse 1.5 amp 250 V Normal Blo	2 ea.	2110-0043
For use in the Familiarization Exercise:		
Capacitor, 3000 pF 5% 300 V	1 ea.	0160-2229
Resistor, 10 kΩ 1% ¼W	1 ea.	0757-0442

1-31. ACCESSORIES AVAILABLE.

1-32. Table 1-3 indicates the accessories which are available for the -hp- 3582A. These accessories may be obtained through your -hp- Sales and Service Office.

Table 1-3. Accessories Available.

Accessory	-hp- Model
10:1 Voltage Divider Probe	10001A
HP-IB Cables	10631A 1 meter (3.3 feet) 10631B 2 meters (6.6 feet) 10631C 4 meters (13.2 feet)
Scope Camera	Model 197A Option 006
Slide Rack Mount	Standard Slide Kit (-hp- Part No. 1497-0017) Tilt Slide Kit (-hp- Part No. 1494-0020)
Test Leads	11000A 112 cm (44 in);dual banana both ends 11001A 112 cm (44 in);dual banana to BNC

1-33. RECOMMENDED TEST EQUIPMENT.

1-34. Equipment required to maintain the Model 3582A is listed in Table 1-4. Other equipment may be substituted if it meets or exceeds the critical specifications listed in the table.

1-35. Note that the Performance Test is automatic and controlled via the Hewlett-Packard Interface Bus (HP-IB). Thus, the calculator and HP-IB compatability for the instruments is not strictly required. However, the full manual test will take about 10 times longer than the automatic test.

1-36. If manual testing must be done, it is recommended that only the Performance Test appropriate to a specific problem and/or repair be done, supplemented by the Operational Verification given at the end of Section III.

Table 1-4. Recommended Test Equipment.

Instrument	Required Characteristics	Recommended Model(s)	Use*
Audio Oscillator	Harmonics, Hum and Noise Down at least 86 dB Freq. Range: 10 Hz - 25 kHz Output Level: 10 dBV (3.16 Vrms)	-hp- 239A/339A (See Note 1)	P
Bus Analyzer	Bus System Analyzer Meeting I.E.E.E. 488-1975 Standards	-hp- 59401A	T
Calculator (Controller)	(See Note 2)	-hp- 9825A (Option 002)	P
HP-IB Interface	(See Note 2)	-hp- 98034A	P
Calculator ROM's	(See Note 2)	-hp- 98210A -hp- 98211A -hp- 98214A	P
Counter	6 Digits Frequency Range: 200 HZ - 200 kHz Sensitivity: 50 mV rms Input Impedance: 1 MΩ, <50 pF	-hp- 5328A	T,A

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

Digital Voltmeter	HP-IB Capability (see Note 3) AC Function: Frequency Range: 200 HZ - 100 kHz Accuracy: ± (0.1% of RDNG + 0.025% of range) DC Function: Accuracy: ±(0.005% of RDNG +0.001% of range)	-hp- 3455A	P, T
High Voltage Probe	1000:1 Division 1% Accuracy at 4 kV	-hp- 3440A-K05	A, T
Logic Probe	TTL Compatible	-hp- 10525A	T
Oscilloscope	50 MHz; range down to 5 mV/Div	-hp- 1740A -hp- 10007A Probe -hp-10004-67605 Spanner Tip	T,A
Signature Analyzer		-hp-5004A	T
Synthesizer:	HP-IB Capability (see Note 3) Frequency Range: 0.02 Hz to 100 Hz Amplitude Range: −80 dBm to +13 dBm (50 ohms) Amplitude Accuracy: ±0.2 dB at 10 kHz and -70 dBm	-hp- 3330B (Option 005) -hp- 3325A (Option 002)	P,T,A
50 Ω Termination	50 ± 0.1 ohm; Feedthru	-hp- 11048C	P,T,A,
Function Generator	Square and Triangle Outputs	-hp- 3310A -hp- 3311A -hp- 3312A -hp- 3325A	P
Load Resistor	2.5Ω, 5%, 10W	-hp- 0811-2844	A
Test Cartridge	Automatic Performance Test Software	-hp-03582-10002	P

NOTE 1: The 339A is a distortion measurement set with built-in low distortion oscillator. The oscillator alone is available as the 239A.

NOTE 2: Performance test software is written for the -hp- 9825A Calculator and 9866B Printer. Use of a different printer will require program modification. The test can be run using the 9825A's Printer, but the printout will be pass/fail rather than the full explanation given with the 9866B.

NOTE 3: HP-IB capability required for automatic testing.

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

Table 1-5. Specifications

FREQUENCY

FREQUENCY MODES:

0-25 kHz Span: The selected measurement is performed over the fixed frequency range of 0 Hz to 25 kHz independent of the FREQUENCY SPAN control.

0-Start: The selected measurement is performed over the frequency range defined by the FREQUENCY SPAN control and with a fixed start frequency of 0 Hz.

Set Center: The selected measurement is performed over a frequency range with a width determined by the FREQUENCY SPAN control and with a center frequency variable with 1 Hz resolution.

Set Start: The selected measurement is performed over a frequency range with a width determined by the FREQUENCY SPAN control and with a start frequency variable with 1 Hz resolution.

FREQUENCY RANGE: 0.02 Hz to 25.5 kHz. The low frequency limit is the result of the DC response.

FREQUENCY SPANS:

0 Start Mode: 1 Hz full scale to 25 kHz full scale in a 1-2.5-5-10 sequence.

Table 1-5. Specifications (Cont'd).

Set Start Or Set Center Mode: 5 Hz span to 25 kHz span in a 1-2.5-5-10 sequence.

FREQUENCY ACCURACY: The frequency accuracy is ±0.003% of the display center frequency.

FREQUENCY RESOLUTION: The marker resolution is equal to the calculated point spacing for the selected frequency span and number of channels.

FILTER PASSBAND SHAPE:

	Flat Top	Hanning	Uniform
3 dB Bandwidth: (single-channel)	(1.4 ± 0.1)% of span	(0.58 ± 0.05)% of span	(0.35 ± 0.02)% of span
Shape Factor:	2.6 ± .1	9.1 ± .2	716 ± 20

$\left[\frac{\text{60 dB bandwidth}}{\text{3 dB bandwidth}}\right]$

The FLAT TOP PASSBAND SHAPE provides optimum amplitude accuracy. The UNIFORM PASSBAND SHAPE is optimized for use with transients and for use with the PERIODIC NOISE SOURCE, and the HANNING PASSBAND SHAPE provides an amplitude/frequency resolution compromise and is used for general noise measurements.

Single-Channel Analysis Parameters:

Frequency Span	Time Record Length (NΔt)	Calculated Point Spacing (Δf)	Equivalent Noise Bandwidth: Flat Top	Hanning	Uniform
1 Hz	250 sec	4 mHz	14.5 mHz	6.00 mHz	4 mHz
2.5 Hz	100 sec	10 mHz	36.3 mHz	15 mHz	10.0 mHz
5 Hz	50 sec	20 mHz	72.4 mHz	30 mHz	20 mHz
10 Hz	25 sec	40 mHz	145 mHz	60 mHz	40 mHz
25 Hz	10 sec	100 mHz	362 mHz	150 mHz	100 mHz
50 Hz	5 sec	200 mHz	725 mHz	300 mHz	200 mHz
100 Hz	2.5 sec	400 mHz	1.45 Hz	600 mHz	400 mHz
250 Hz	1 sec	1 Hz	3.63 Hz	1.50 Hz	1.00 Hz
500 Hz	500 msec	2 Hz	7.24 Hz	3.00 Hz	2.00 Hz
1 kHz	250 msec	4 Hz	14.5 Hz	6.00 Hz	4.00 Hz
2.5 kHz	100 msec	10 Hz	36.3 Hz	15.0 Hz	10.0 Hz
5 kHz	50 msec	20 Hz	72.5 Hz	30.0 Hz	20.0 Hz
10 kHz	25 msec	40 Hz	145 Hz	60.0 Hz	40.0 Hz
25 kHz	10 msec	100 Hz	362 Hz	150 Hz	100 Hz

The corresponding dual-channel parameters are found by doubling the calculated point spacing and equivalent noise bandwidths and taking one half the time record length.

AMPLITUDE

AMPLITUDE MEASUREMENT MODES: 256 point amplitude spectra are measured in the single-channel mode. Two 128 point amplitude spectra are measured in the dual-channel mode.

AMPLITUDE DISPLAY MODES:

Log: 10 dB/major division
2 dB/major division

Linear: Constant voltage/major division

AMPLITUDE MEASUREMENT RANGE:

Log: The calibrated attenuator range is +30 dBV to -50 dBV single tone RMS maximum input level in 10 dB ± 0.2 dB steps. The continuous vernier provides >10 dB of additional uncalibrated sensitivity between the 10 dB steps.

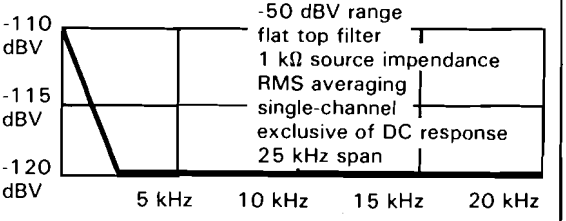
Linear: The calibrated attenuator range is +30 volts RMS to 3 millivolts single tone RMS maximum input in a 1-3-10 sequence. The vernier provides continuous coverage between the major steps. The AMPLITUDE REFERENCE LEVEL provides 8 additional ranges down to 8 microvolts full scale.

DYAMIC RANGE:

Distortion Products: >70 dB below the maximum input level.

Spurious Responses: >70 dB below the maximum input level.

Noise:



DC Response: Adjustable to >40 dB below the maximum input level with the front panel DC balance adjustment.

Table 1-5. Specifications (Cont'd).

AMPLITUDE (Cont'd)

AMPLITUDE ACCURACY:

	Log
Accuracy At The Passband Center: (Full Scale)	±0.5 dB
Flat Top Filter:	+0, -0.1 dB
Hanning Filter:	+0, -1.5 dB
Uniform Filter:	+0, -4.0 dB

Overall accuracy is the sum of the accuracy at the passband center and the filter accuracy.

AMPLITUDE RESOLUTION:

Log: 0.1 dB with the marker

Linear: 3 digits with the marker

AMPLITUDE LINEARITY:

±0.2 dB ± 0.02% of full scale

AMPLITUDE CALIBRATOR: The internal calibration signal is a line spectrum with nominal 1 kHz frequency spacing and a fundamental level of 22 ± 0.2 dBV on the log scales and 20 ± 0.5 volts on the linear scale.

AMPLITUDE OVERLOAD LIMITS:

Log: Overload occurs at 100% of the maximum input level which is equal to full scale when the AMPLITUDE REFERENCE LEVEL is set to NORMAL. When overload occurs spurious products may be displayed.

Linear: Overload occurs at 100% of the maximum input level which, depending on the input attenuator setting, is at 6/8 or 5/8 of full scale when the AMPLITUDE REFERENCE LEVEL is set to NORMAL. When overload occurs spurious products may be displayed.

PHASE

PHASE MEASUREMENT MODES: 256 point phase spectra are measured in the single-channel mode. Two 128 point phase spectra are measured in the dual channel mode.

PHASE DISPLAY RANGE: From 200 degrees to -200 degrees.

PHASE ACCURACY: ± 10 degrees

PHASE RESOLUTION:

Display: 50 degrees/major division

Marker: 1 degree

TRANSFER FUNCTION

TRANSFER FUNCTION MEASUREMENT MODES: Dual-channel 128-point transfer functions are measured.

TRANSFER FUNCTION DISPLAY MODES:

Log Amplitude: 10 dB/major division
2 dB/major division

Linear Amplitude: Constant floating point fraction/major division

Phase: Constant 50 degrees/major division

TRANSFER FUNCTION MEASUREMENT RANGE:

Log Amplitude: Calibrated ranges of + 160 dB full scale to -80 dB full scale in 10 dB steps. The uncalibrated verniers provide continuous coverage between the 10 dB steps.

Linear Amplitude: Calibrated ranges of 4.0×10^{8} full scale to 4.0×10^{-8} full scale in factor of 10 steps. The uncalibrated verniers provide continuous coverage between the factor of 10 steps.

Phase Display Range: + 200 degrees to -200 degrees.

TRANSFER FUNCTION ACCURACY (STANDARD):
Amplitude: ±0.8 dB
Phase: ± 5 degrees

TRANSFER FUNCTION ACCURACY (OPTION 001):

	.02Hz	5kHz	25.5kHz
Amplitude:	.4dB	±.8dB	
Phase:	± 2°	± 5°	

TRANSFER FUNCTION RESOLUTION:
Log Amplitude: 0.1 dB with the marker

Linear Amplitude: 3 digit scientific notation with the marker

Phase: 1 degree with the marker

COHERENCE FUNCTION

COHERENCE FUNCTION MEASUREMENT MODE: Dual-channel 128 point coherence functions are measured with RMS averaging only.

COHERENCE MEASUREMENT RANGE: The bottom display line is 0.0 and the top display line is 1.0.

COHERENCE FUNCTION RESOLUTIION:

Display: 0.125/major division

Marker: 0.01

Table 1-5. Specifications (Cont'd).

TRIGGER

TRIGGER MODES:

Free Run: A new measurement is initiated by the completion of the previous measurement.

External: A rear panel switch allows new measurements to be initiated by an external TTL pulse.

Input Signal: A new measurement is initiated when the input signal meets the specified trigger condition.

TRIGGER CONDITIONS:

Signal Conditions: Triggering can be selected to occur on a positive or negative going transition through the trigger level. The trigger level is adjusted between the time record overload limits by a continuous vernier.

Single/Multiple Triggers: Single-shot triggering is specified by taking the instrument out of the REPETITIVE mode. The ARM control sensitizes the instrument to take another measurement in the non-repetitive mode.

INPUT CHANNELS

INPUT IMPEDANCE: $10^6\Omega \pm 5\%$ shunted by < 60 pf from input high to low for less than 75% relative humidity.

DC ISOLATION: Input low may be connected to chassis ground or floated up to 30 volts to reduce the effects of ground loops on the measurement.

INPUT COUPLING: The input circuit may be AC or DC coupled. The low frequency 3 dB roll off of the AC coupling is < 1 Hz.

COMMON MODE REJECTION:

50 Hz: > 60 dB

60 Hz: > 58 dB

INPUT CHANNEL CROSSTALK: < -140 dB between channels with 1 kΩ source impedance driving one channel and the other channel terminated in 1 kΩ.

OUTPUT SIGNALS

X-Y RECORDER:

Vertical: 0 to 5.25V ± 5%

Horizontal: 0 to 5.25V ± 5%

Impedance: 1kΩ

Pen Lift: Contact closure during sweep.

NOISE SOURCE:

Periodic: Pseudorandom noise signal with spectral line spacings that match the calculated point spacing for the selected frequency span. The noise spectrum is band limited and band translated to match the selected measurement.

Random: Random noise signal; the noise spectrum is band limited and band translated to match the selected measurement.

Level: Vernier control from < 10 mV to > 500 mV RMS into a load of $\geq 50\Omega$ when measured with a broadband True RMS voltmeter.

Periodic Noise Frequency Response: ± 1 dB with UNIFORM PASSBAND SHAPE and -10 dBV level.

Impedance: $< 2\Omega$

IMPULSE SOURCE: A TTL low to high pulse with a period equal to the time record length.

DISPLAY

CRT:

Screen Size: 11.9 cm (4.7 in.) wide by 9.6 cm (3.8 in.) high.

Graticule: 10 major division horiztonal by 8 major divisions vertical with internal illumination for CRT photography.

Text: Maximum of four 32 character lines of alphanumeric text.

ALPHANUMERIC ANNOTATION: Single or dual-channel configuration, input or stored trace, frequency calibration,amplitude calibration, equivalent noise bandwidth, relative or absolute marker frequency, relative or absolute marker phase, relative or absolute marker coherence, RMS noise density at the marker, time record collection time.

DISPLAY ACCURACY: Display accuracy is 3% of total height or width for 25 ± 15°C. Note that if numeric readings are taken visually from the displayed trace, this factor must be added to the basic accuracy specification.

TRACE STORAGE: A maximum of two independent traces may be digitally stored and recalled. Annotation information is not stored with the traces.

Table 1-5. Specifications (Cont'd).

AVERAGE

AVERAGING MODES:

RMS: For each calculated frequency point the displayed amplitude is

$$\sqrt{\frac{1}{N}\sum_{i}^{N} A_i^2(f)} \quad \text{and the phase is} \quad \frac{1}{N}\sum_{i}^{N} \phi_i(f)$$

Peak: For each calculated frequency point the displayed amplitude is MAX Ai(f) and the phase is the corresponding value for the retained amplitude point.

Time: For each time record point the amplitude is

$$\frac{1}{N}\sum_{i} Ai(t)$$

The averaged time record is transformed to give the corresponding amplitude and phase.

NUMBER OF AVERAGES: 4 to 256 in a binary sequence plus exponential. Exponential in the RMS mode gives a running average with new spectral data weighted 1/4 and the previous result by 3/4. Exponential in the peak mode gives a continuous peak hold operation.

REMOTE OPERATION

PROGRAMMING: All analyzer front panel controls except the CRT controls, NOISE SOURCE LEVEL and TYPE, TRIGGER LEVEL, AMPLITUDE VERNIERS, and GROUND ISOLATION are remotely programmable via the HP-IB.

DATA INPUT: Time records, amplitude and phase spectra, coherence functions, transfer functions and alphanumeric text can be input to the analyzer via the HP-IB.

DATA OUTPUT: Time records, amplitude and phase spectra, coherence functions, transfer functions, alphanumeric text, marker values and control settings can be output via the HP-IB.

GENERAL

ENVIRONMENTAL:

Operating Temperature: 0°C to +55°C.

Non-operating Temperature: -40°C to +75°C.

Humidity: To 95% relative humidity at 40°C.

Operating Altitude: 4600 Meters (15,000 feet).

Non-operating Altitude: 6300 Meters (25,000 feet).

Shock: 30 G, 11 msec half sine wave on each of six sides.

Vibration: 10 Hz to 55 Hz at 0.010 inch peak-to-peak excursion.

OPERATING POWER: Switch selection of 110V +5, -10% or 230V + 5, -10% 48-66 Hz; less than 150 VA.

PHYSICAL PARAMETERS:

Size: 425.5 mm (16.75 inches) wide
552.5 mm (21.75 inches) deep
188 mm (7.4 inches) high

Net Weight: 24.5 kg (54 lbs.).

Shipping Weight: 29 kg (63 lbs.).

SECTION II
INSTALLATION

2-1. INTRODUCTION.

2-2. This section contains instructions for installing and interfacing the Model 3582A Spectrum Analyzer. Included are initial inspection procedures, power and grounding requirements, environmental requirements, installation instructions, interfacing procedures and instructions for repacking and shipment.

2-3. INITIAL INSPECTION.

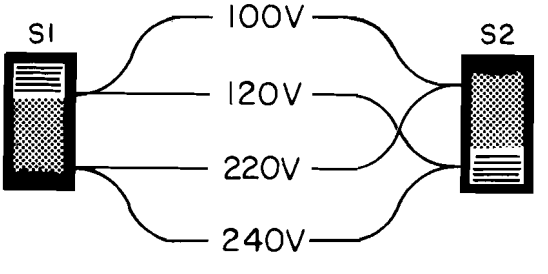
2-4. This instrument was carefully inspected both mechanically and electrically before shipment. It should be free of mars or scratches and in perfect electrical order upon receipt. To confirm this, the instrument should be inspected for physical damage incurred in transit. If the instrument was damaged in transit, file a claim with the carrier. Check for supplied accessories (listed in Section I) and test the electrical performance using the Operational Verification given in Section IV Part I. If there is damage or deficiency, see the warranty in the front of this manual.

2-5. POWER REQUIREMENTS.

2-6. The Model 3582A can be operated from any power source supplying 100V, 120V, 220V or 240V (-10% to +5%), 48 Hz to 66 Hz single phase. Power consumption is less than 150 VA.

2-7. Line Voltage And Fuse Selection.

2-8. Figure 2-1 gives information for line voltage and fuse selection. The voltage and proper fuse have been factory selected for 120V ac operation.



LINE VOLTAGE	S1	S2
100 V	UP	UP
120 V	UP	DOWN
220 V	DOWN	UP
240 V	DOWN	DOWN

Line Setting	Fuse Type	-hp- Part No.
100V/120V	3A 250V Normal Blo	2110-0003
220V/240V	1.5A 250V Normal Blo	2110-0043

Figure 2-1. Line Voltage And Fuse Selection.

2-9. Power Cable And Grounding Requirements.

2-10. To protect operating personnel, the National Electrical Manufacturer's Association (NEMA) recommends that the instrument panel and cabinet be grounded. The Model 3582A is equipped with a three-conductor power cord which, when plugged into an appropriate receptacle, grounds the instrument cabinet. The type of power cable plug shipped with each instrument depends on the country of destination. Refer to Figure 2-2 for the part number of the power cable and plug configurations available.

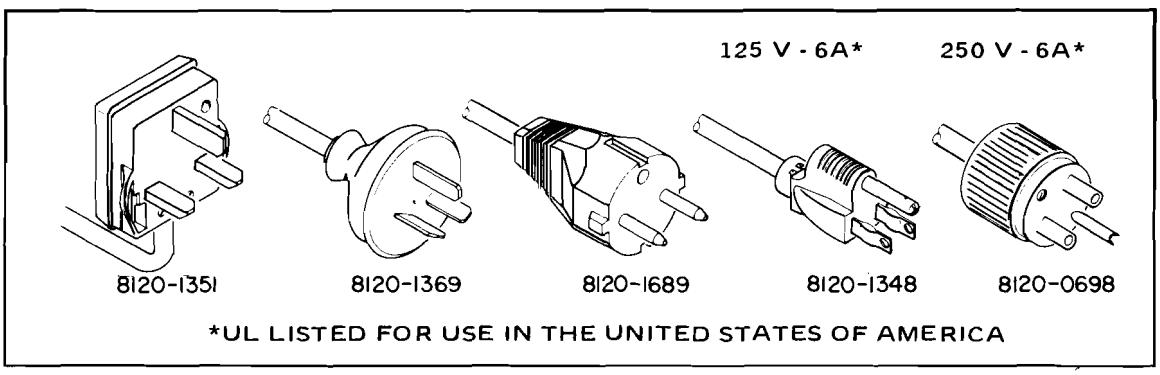


Figure 2-2. Power Cables.

2-11. OPERATING ENVIRONMENT.

2-12. Temperature.

2-13. The instrument may be operated in temperatures from 0°C to +55°C.

2-14. Humidity.

2-15. The instrument may be operated in environments with humidity up to 95%. However, the instrument should be protected from temperature extremes which cause condensation within the instrument.

2-16. Altitude.

2-17. The instrument may be operated at altitudes up to 4600 meters (15,000 feet).

2-18. Cooling Fan.

2-19. The 3582A is equipped with a cooling fan mounted on the rear panel. The instrument should be mounted so that air can freely circulate through it. The filter for the cooling fan should be removed and cleaned every 30 days by flushing with soapy water.

2-20. Thermal Cutout.

2-21. The 3582A is equipped with a thermal cutout switch which automatically removes line voltage whenever the internal temperature becomes excessive. The temperature at which this will occur is dependent upon line voltage and airflow but with proper airflow will not occur in less than a 55°C ambient at high line. The switch resets automatically when the instrument cools. If a thermal cutout occurs, check for fan stoppage, clogged fan parts and other conditions that could obstruct airflow or otherwise cause excessive heating.

NOTE

The thermal cutout will operate at any external temperature down to +15°C if the airflow is blocked.

2-22. INSTALLATION.

2-23. Mounting.

2-24. The 3582A is shipped with plastic feet and tilt stand in place, ready for use as a bench instrument. the plastic feet are shaped so that the 3582A may be mounted on top of other -hp- equipment. Plastic feet mounted on the rear panel enable the 3582A to be placed in a vertical position if desired. When operating the instrument, choose a location that provides at least three inches of clearance at the rear and at least one inch for each side. Failure to provide adequate air clearance will result in excessive internal temperature, reducing instrument reliability. The clearances provided by the plastic feet in bench stacking and the filler strip in rack mounting allow air passage across the top and bottom cabinet surfaces.

2-25. Option 908 (Rack Mount Kit) enables the 3582A to be mounted in an equipment cabinet. The rack mount for the 3582A is an EIA standard width of 19 inches. Installation instructions are included with the Rack Mount Kit. Option 908 may be ordered from the nearest -hp- Sales and Service Office under -hp- part number 5061-0078.

2-26. HP-IB SYSTEM INTERFACE CONNECTIONS.

2-27. The Model 3582A instrument is compatible with the Hewlett-Packard Interface Bus (HP-IB).

NOTE

The HP-IB is Hewlett-Packard implementation of IEEE std. 488-1975, "Standard Digital Interface for Programmable Instrumentation".

2-28. The instrument is connected to the HP-IB by connecting an HP-IB interface cable to the connector located on the rear panel. Figure 2-3 illustrates a typical HP-IB System interconnection.

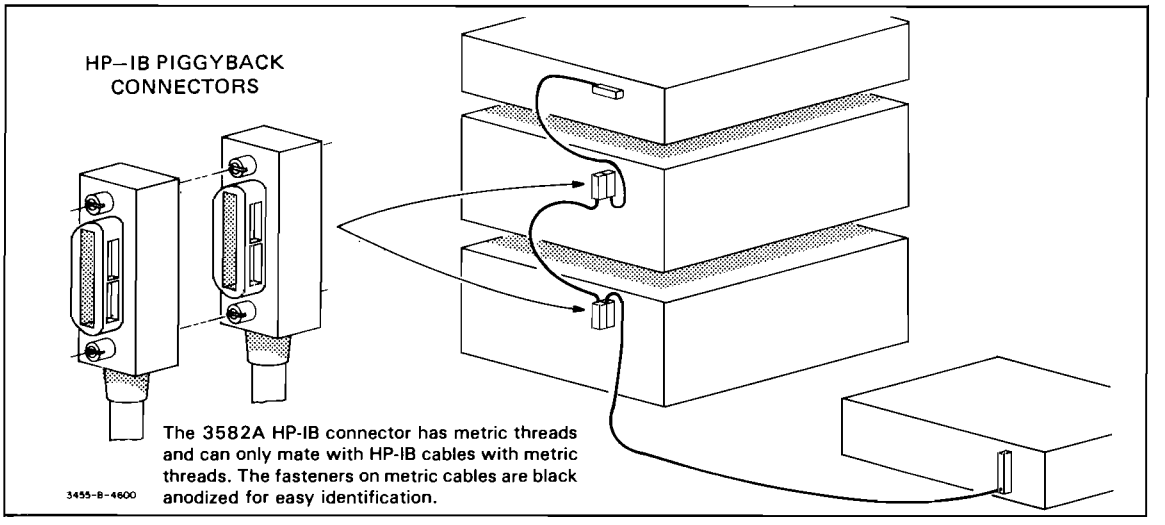


Figure 2-3. Typical HP-IB System Interconnection.

2-29. With the HP-IB system, you can interconnect up to 15 HP-IB compatible instruments. The -hp- 10631 HP-IB cables have identical "piggy-back" connectors on both ends so that several cables can be connected to a single source without special adapters or switch boxes. You can interconnect system components and devices in virtually any configuration you desire. There must, of course, be a path from the calculator (or other controller) to every device operating on the bus. As a practical matter, avoid stacking more than three or four cables on any one connector. If the stack gets too long, any force on the stack produces great leverage which can damage the connector mounting. Be sure that each connector is firmly screwed in place to keep it from working loose during use. The 3582A uses all the available HP-IB lines, therefore, any damaged connector pins may adversely affect HP-IB operation (see Figure 2-4).

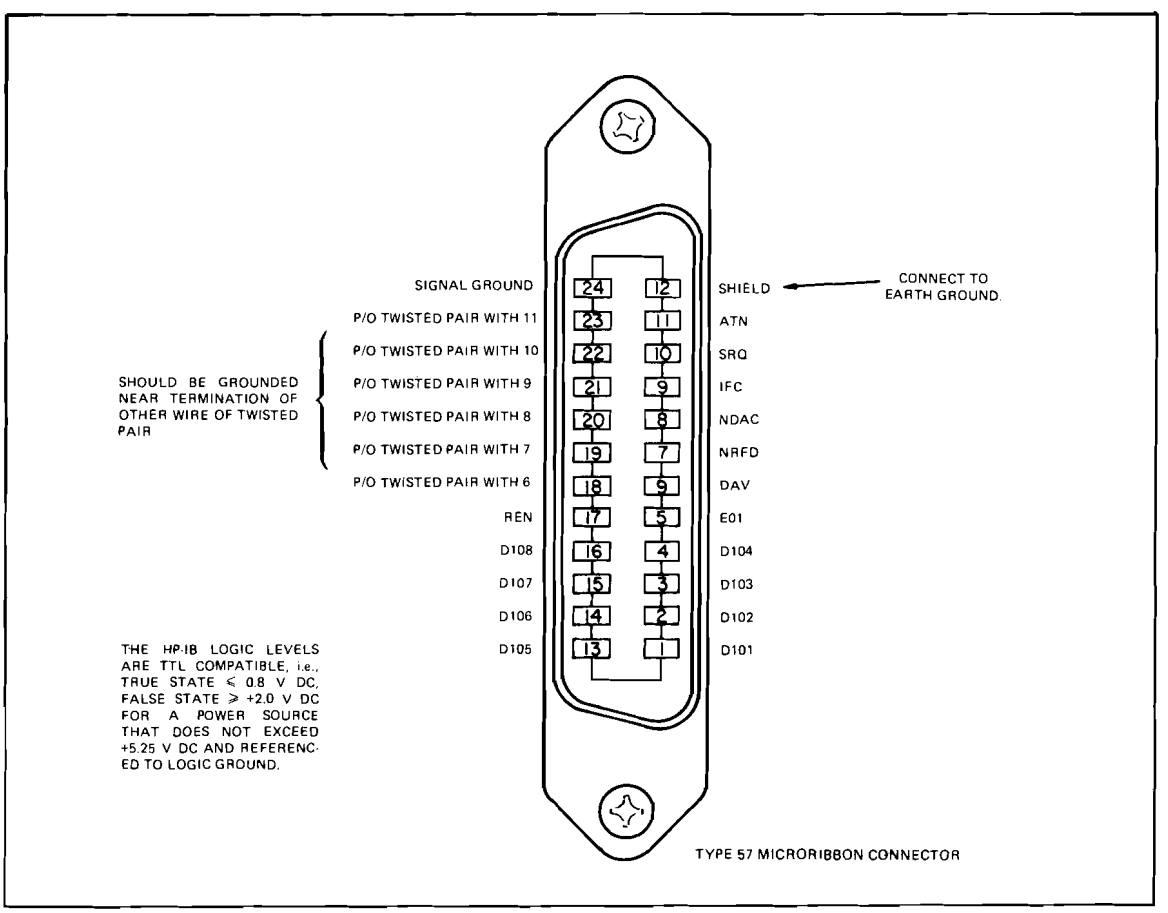


Figure 2-4. HP-IB Connector.

2-30. Cable Length Restrictions.

2-31. To achieve design performance with the HP-IB, proper voltage levels and timing relationships must be maintained. If the system cable is too long, the lines cannot be driven properly and the system will fail to perform (see Table 2-1 for HP-IB cable lengths). Therefore, when interconnecting an HP-IB system, it is important to observe the following rules:

a. The total cable length for the system must be less than or equal to 20 meters (65 feet).

b. The total cable length for the system must be less than or equal to 2 meters (6 feet) times the total number of devices connected to the bus.

Table 2-1. HP-IB Cables With Metric Fasteners.

HP-IB Cable	Length
10631A	1m
10631B	2m
10631C	4m
10631D	.5m

2-32. HP-IB Address Selection.

2-33. The "talk" and "listen" addresses for the instrument are selected by the Instrument Bus Address switch. This switch is the seven section "DIP" switch located on the A2 HP-IB board under the front right card nest cover in the instrument. the five switches labeled 1 through 5 are used to select the unique talk and listen address. The HP-IB Address is set at the factory to 11 (listen address + and talk address K). You can leave the instrument at this address or change it to any of the alternatives in Table 2-2.

WARNING

Access to the HP-IB Address switch requires removal of the instrument top cover, exposing potentially lethal voltages. To avoid electrical shock, do not attempt to check or change the switch setting unless you are properly service trained.

2-34. STORAGE AND SHIPMENT.

2-35. Environment.

2-36. The instrument may be stored or shipped in environments within the following limits:

Temperature.....-40°C to +75°C
Humidity.....Up to 95%
Altitude.....Up to 7,630 meters (25,000 feet)

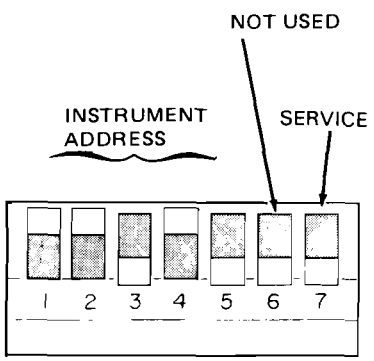
The instrument should also be protected from temperature extremes which cause condensation within the instrument.

2-37. Packaging.

2-38. Original Packaging. Containers and materials identical to those used in factory packaging are available through Hewlett-Packard offices. If the instrument is being returned to Hewlett-Packard for servicing, attach a tag indicating the type of service required, return address, model number, and full serial number. Also, mark the container FRAGILE to ensure careful handling. In any correspondence, refer to the instrument by model number and full serial number.

Table 2-2. Address Selection.

ASCII Code Character		Address Switches					5-bit
Listen	Talk	A5	A4	A3	A2	A1	*Decimal Code*
SP	@	0	0	0	0	0	00
!	A	0	0	0	0	1	01
"	B	0	0	0	1	0	02
#	C	0	0	0	1	1	03
$	D	0	0	1	0	0	04
%	E	0	0	1	0	1	05
&	F	0	0	1	1	0	06
'	G	0	0	1	1	1	07
(	H	0	1	0	0	0	08
)	I	0	1	0	0	1	09
*	J	0	1	0	1	0	10
+	K	0	1	0	1	1	11
,	L	0	1	1	0	0	12
—	M	0	1	1	0	1	13
.	N	0	1	1	1	0	14
/	O	0	1	1	1	1	15
Ø	P	1	0	0	0	0	16
1	Q	1	0	0	0	1	17
2	R	1	0	0	1	0	18
3	S	1	0	0	1	1	19
4	T	1	0	1	0	0	20
5	U	1	0	1	0	1	21
6	V	1	0	1	1	0	22
7	W	1	0	1	1	1	23
8	X	1	1	0	0	0	24
9	Y	1	1	0	0	1	25
:	Z	1	1	0	1	0	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



1 POSITION (UP)
Ø POSITION (DOWN)

2-39. Other Packaging. The following general instructions should be used for repacking with commercially available materials:

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

b. Use a strong shipping container. A double-wall carton made of 350-pound test material is adequate.

c. Use a layer of shock-absorbing material 70 to 100 mm (3 to 4 inch) thick around all sides of the instrument to provide firm cushioning and prevent movement inside of the container. Protect the control panel with cardboard.

d. Seal shipping container securely.

e. Mark shipping container FRAGILE to ensure careful handling.

f. In any correspondence, refer to the instrument by model number and full serial number.

WARNING

The Model 3582A is not intended for outdoor use. Do not expose it to rain or other excessive moisture.

SECTION III
OPERATING REFERENCE

3-1. INTRODUCTION.

3-2. This section contains a brief collection of data, which concerns both manual and remote operation. Also covered is a fundamental theory of operation and some application information.

3-3. USING SECTION III.

3-4. For quick reference to operating subject matter, refer to the Table of Contents below.

Table of Contents

I. **Introduction** 5

II. **Instrument Control Details**.....6
- A. Input Section
- B. Frequency Section
- C. Display Section
- D. Trigger Section
- E. Passband Section
- F. Average Section
- G. Marker Section
- H. Noise Source Section

III. **Spectrum Analyzer Performance**....12
- A. Frequency Range
- B. Frequency Resolution
- C. Measurement Range
- D. Dynamic Range
- E. "Real Time" Measurement Speed
- F. Accuracy
- G. Averaging
- H. Noise Source

IV. **New Measurement Capability**.....16
- A. Phase Spectrum
- B. Transient Capture
- C. Transfer Functions
- D. Coherence Function

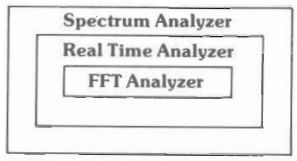
V. **Some Specific Topics**.....19
- A. Time Records and the Time Display
- B. Passband Shapes and Window Functions
- C. Real Time Analysis and Real Time Bandwidth
- D. Noise Source Characteristics

VI. **Operating Details**.....22
- A. Instrument Preset
- B. Important Control Settings
- C. Single Channel Amplitude Spectrum
- D. Single Chanel Phase Spectrum
- E. Transient Capture
- F. Dual Channel Transfer Function
- G. Dual Channel Coherence Function
- H. Operational Diagnostics
- I. Overloads

VII. **Basic Measurements**.....33
- A. Traditional Electronics and Telecommunications
  1. Harmonic Analysis
  2. Spurious Tones, etc.
  3. Close-in Phase Noise
  4. Modulation
  5. Intermodulation
  6. Crosstalk
  7. Filter Characterization
  8. Electrical Impedance
  9. Amplifier Rejection Characteristics
- B. Mechanical Systems
  1. Rotating Machinery Signatures
  2. Rotating Machinery Balance
  3. Mechanical Impedance Data
  4. Electromechanical Servo Loops

VIII. **Appendices** 37
- A. Theory of Operation
- B. Remote Operation

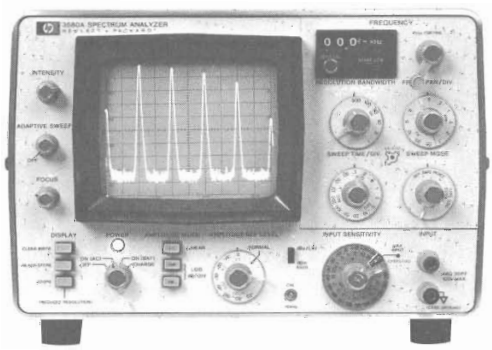
I. Introduction



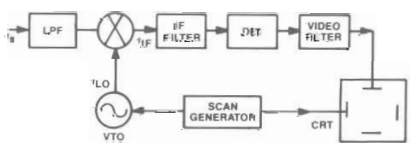
What are these things and how are they related?
The answer to this question is hinted at by the graphic. All three are spectrum analyzers—but not all spectrum analyzers are real time analyzers. Each is a more specific description as you will see.

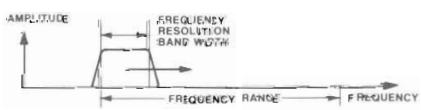
Swept Analyzer

The most common technique for implementing a spectrum analyzer is the swept IF technique. The HP Model 3580A is an example of a product that uses this technique.



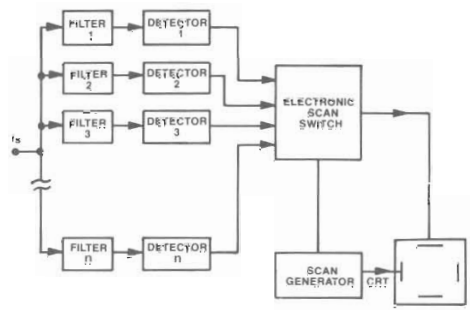
Conceptually, this technique can be viewed as moving a single filter over the frequency range of interest as follows.

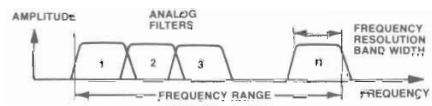




This approach has some disadvantages—particularly at low frequencies. The most noticeable is that it is quite slow for narrow resolution bandwidths. This is a fundamental limitation of the technique and not the result of a particular implementation.

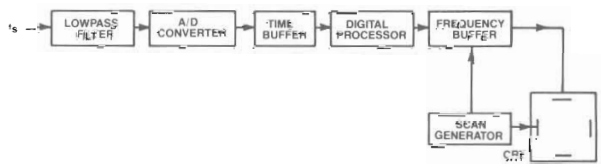
In order to get around this limitation, several types of "real time" analyzers have been developed. From a conceptual point of view, the parallel bank of filters is the simplest to understand.

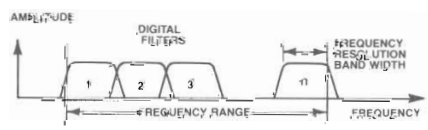




Here, rather than a single filter that has to traverse the frequency span of interest, the filters are fixed and just have to be examined. Clearly, this is substantially faster than the swept technique. Because of the large number of filters, it is also more expensive.

The Fast Fourier Transform or FFT gets around this problem by effectively implementing the parallel filters digitally.





As a result of this computation process, the FFT can also provide phase information and some other advantages—but basically it is a means of performing spectrum analysis.

II. Instrument Control Details

The front panel of the HP Model 3582A is logically divided into groupings of controls that have related functions. This chapter is intended to provide a good working knowledge of how these controls are used in making typical measurements. Chapter VI further illustrates this with step-by-step checklists for the more common measurement sequences.

TRACE STORAGE SECTION: Two independent display traces can be digitally stored and recalled.

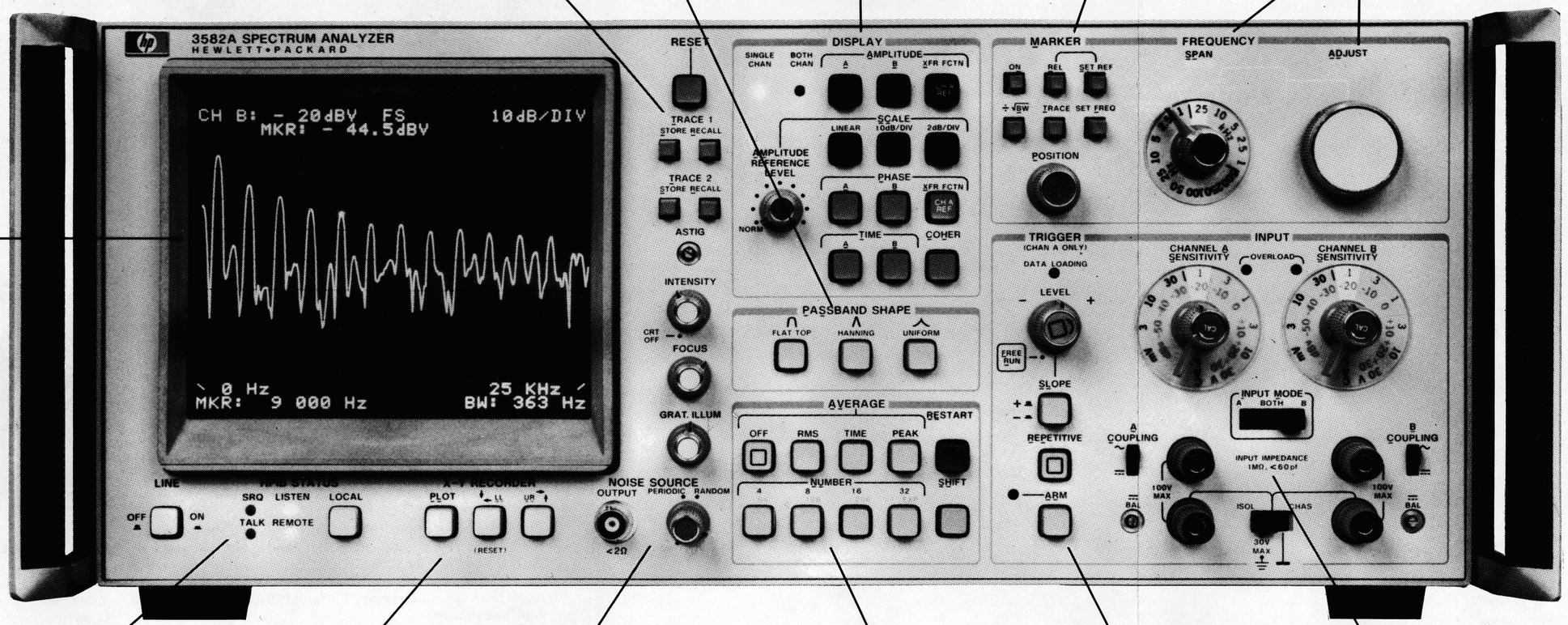
PASSBAND SHAPE SECTION: Passband filter shapes are optimized for various situations and can be changed without having to redo a measurement unless averaging has been selected.

DISPLAY SECTION: Amplitude or phase of either or both channels or the transfer function can be displayed. The sampled time waveform and a measurement called the coherence function can also be displayed.

MARKER SECTION: Absolute or relative readout of the X and Y values of the intensified dot marker simplify interpretation of results.

FREQUENCY SECTION: 0-Start spans down to 1 Hz full scale and set center or set start spans down to 5 Hz full scale can be selected. In the set center or set start mode the RPG knob tunes the start or center display frequency.

CRT SECTION: Two digitally stored display traces plus four lines of alpha numeric data provide complete annotated results.



HP-IB* STATUS SECTION: HP-IB is standard and provides full remote programming and flexible data input and output.

X-Y RECORDER SECTION: Front panel controls facilitate the interface with analog X-Y recorders.

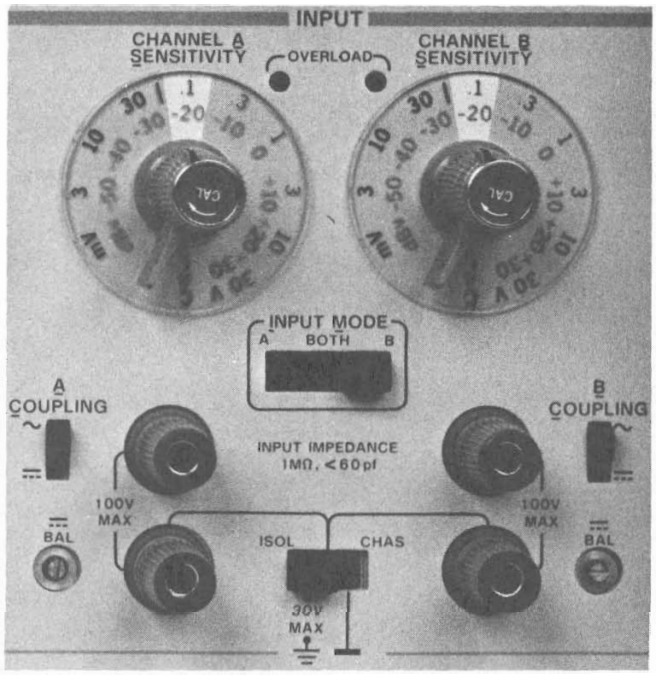
NOISE SOURCE SECTION: A built-in noise source serves as the "real-time" equivalent of a conventional tracking generator.

AVERAGE SECTION: Digital averaging gives precise, repeatable analysis of random or time varying data.

TRIGGER SECTION: Multiple or single shot triggering of a measurement can be initiated by an input signal on Channel A of the proper slope and level.

INPUT SECTION: Two independent input signals can be measured separately or simultaneously. The input circuits can be AC or DC coupled and can be floated.

*HP-IB is Hewlett-Packard's implementation of IEEE Std 488-1975, "Standard Digital Interface for Programmable Instrumentation."



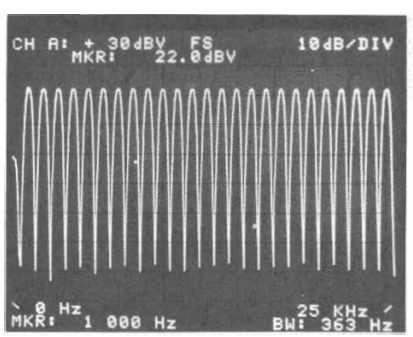
A. Input Section

The INPUT section serves two major functions. First, it contains the controls that define which input channel or channels are to be active. Second, it contains the input sensitivity controls for both input channels.

The INPUT MODE slide switch defines which of the input channels is sampled. For maximum resolution, it should be set to either A or B. When set to BOTH the number of samples from each channel is cut from 1024 to 512. Normally BOTH is used only for transfer function or coherence measurements.

The SENSITIVITY knob selects the maximum input signal level that can be applied to the instrument without overloading. When the signal level is not known, the appropriate input sensitivity is obtained by down-ranging until the LED comes on and then backing off one position. Overloads in the Model 3582A are somewhat unusual and are discussed in Section VI.

The difference between the reference level and the overload point in the linear mode is important and is also discussed in Section VI. When set to the CAL position, an internally generated calibration signal is connected to the measurement path. The signal has a spectral line every 1 kHz and an amplitude of 22 dBV (20V) as shown:

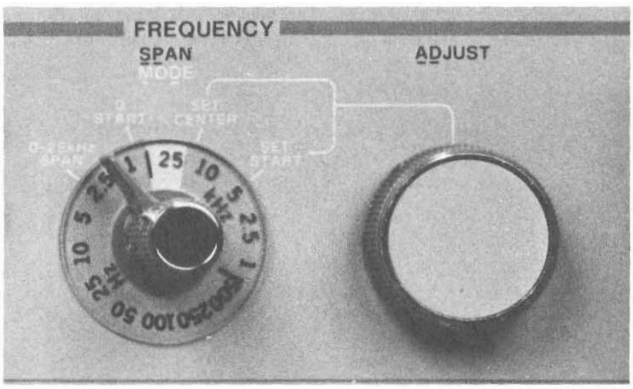


As long as the sensitivity VERNIER is in the CAL position, the measurement results will be calibrated and can be read in voltage or dBV (1 volt rms = 0 dBV). The sensitivity VERNIER provides an additional 11 dB of attenuation for continuous coverage between the major 10 dB steps. When not in the CAL positions, the alphanumeric text indicates that display and marker results are uncalibrated. When not in the CAL position, only relative marker operations are valid. Note that this control is not programmable.

The ISOL/CHAS switch determines whether the input circuit is "floating" or single-ended. Normally this switch is set to ISOL. In this mode, a maximum of 30 volts can be applied between the chassis ground and the input terminal.

The COUPLING switch selects AC (~) or DC (--) coupling of the input circuit. When AC coupled a series capacitor removes DC signals and drifts from the input signal. For inputs with valid information at very low frequencies this is unacceptable; the coupling capacitor removes the signal information also. For these low frequency signals, DC coupling should be selected. DC coupling is used for signals with components of interest below about 10 Hz.

The actual inputs are GR type connectors and have 10^6 Ω in parallel with nominally 60 pf. This makes it possible to use 10:1 divider probes such as the HP Model 10001A. The noise source and transfer function amplitude display is a great way to accomplish probe compensation.

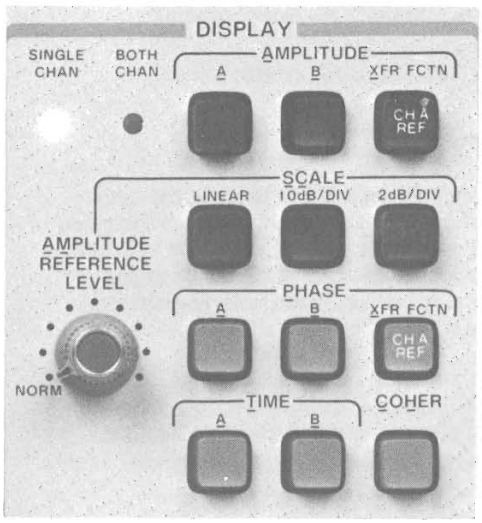


B. Frequency Section

The FREQUENCY section controls what portion of the frequency range is analyzed. As shown, there are four major operational modes. Normally, the 0-25kHz span mode is used as an initial quick look. In this mode, the analysis is independent of the other frequency controls. In the 0 start mode, only the span control is active. It defines the stop frequency with the start frequency fixed at 0 Hz. There are 14 of these baseband spans from 1Hz full scale to 25kHz full scale.

The set start and set center spans are used to achieve significant improvements in resolution by selecting only portions of the spectrum for analysis. All 256 resolution elements can be located in a frequency span of 5Hz to 25kHz. The location of the analysis band can be set in two ways. The most common way is to use the SET FREQ marker feature. The intensified dot marker frequency becomes the new start or center frequency depending on the selected mode. The second way is to use the ADJUST knob. This control directly tunes either the start or center frequency depending on the selected mode. The tuned

frequency is displayed alphanumerically in the lower left corner of the display and is updated as it is tuned. The tuning knob is an endless turns knob with three tuning rates depending on how rapidly it is turned. Note that tuning is locked out when the instrument is in an averaging sequence to prevent the collection of invalid data.



C. Display Section

The DISPLAY section defines what measured data is to be displayed and what display format is to be used. Three amplitude functions, three phase functions, and coherence are available as latching display buttons. A maximum of two traces from this group or the stored trace group can be selected simultaneously.

The Amplitude Controls select one or more amplitude displays. These buttons must agree with the INPUT MODE switch or a diagnostic (see section VI) is generated.

The Phase Controls select one or more phase displays. As with the amplitude displays these buttons must agree with the INPUT MODE switch or you get the same diagnostic. The scale on these displays is fixed at 50 degrees/division with foldover at ± 200 degrees. Interpretation and use of the single channel phase display is covered in Section IV.

The XFR FCTN buttons select the display of the magnitude and/or phase of the transfer function. The magnitude is given in dB or as a floating point ratio if the linear display is selected.

The Scale Controls define the display as 80 dB or 16 dB high in log modes or as voltage in the linear mode. The difference between the reference level and the overload level in the linear mode is important and is discussed in Section VI.

The AMPLITUDE REFERENCE LEVEL switch in conjunction with the SENSITIVITY controls set the full scale sensitivity. In the log display modes, each step offsets the display by 10 dB without changing the maximum input level. In the linear mode, the full scale sensitivity is modified in a 40-16-8-4 sequence.

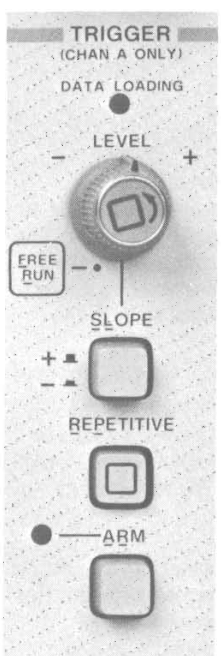
In all cases this is just an arithmetic scaling operation and does not affect the input level that will cause overloading. Also, since its a 16 bit arithmetic operation, it does not contribute to the accuracy specification like an IF attenuator would. The most common uses for this control are:

1. To properly scale a transfer function amplitude display.
2. To examine signals below 10% of full scale in the linear mode.

The COHER control selects the display of the coherence function. The most common use of this display is as a check on the validity of a transfer function measurement. The coherence function is a measure of the proportion of the power in the output signal caused by the input signal. A coherence value of 1.0 would indicate that the cause/effect relationship is ideal—and the transfer function ratio at that frequency is valid. It is only valid in the dual-channel mode with RMS averaging selected. Any other configuration results in a diagnostic (see section VI). The scale is a fixed 0.0 to 1.0 percentage scale. Application Note 245-2 titled "Measuring the Coherence Function with the HP 3582A Spectrum Analyzer" treats this particular measurement in detail.

The TIME display buttons supersede the other display controls. Only one time display can be selected at a time and all other displays are suspended. The time display is active only as long as the pushbutton is held in.

The Model 3582A is **not** a digital time domain oscilloscope. In the baseband mode the display is composed of every other time sample (The display circuitry can take only 512 points.) of the input. For input signals well below the span width, the reproduction can be pretty good—but for frequencies near the span width, the reproduction is very poor. When in the band analysis mode, the display consists of the "real" points after filtering. These "real" points for a single tone will appear as the difference frequency between the input tone and the band analysis local oscillator.



D. Trigger Section

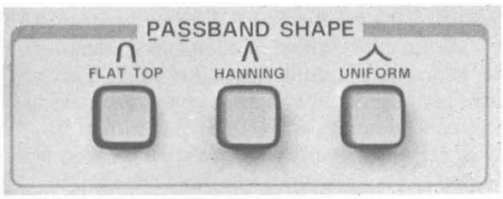
The TRIGGER section defines the conditions under which a new block of data is collected and analyzed. The most common mode is with the REPETITIVE button in and the LEVEL set to FREE RUN. Under these conditions, the new block of data is collected when the previous measurement is completed.

When the LEVEL control is not in the detented position, it specifies a trigger level in the time domain. When viewing the TIME display, the control will vary the trigger level over the entire non-overloaded input range. The vertical position is nominally about a zero level.

The SLOPE button defines whether the trigger is to occur on a positive or negative slope transition through the selected level.

The ARM control is used in conjunction with the REPETITIVE button to define single shot trigger mode. The ARM button sensitizes the trigger path to initiate data collection the next time all other trigger conditions are satisfied. Unless re-ARMed no subsequent trigger conditions will be recognized. When the trigger circuit is sensitized, the ARM light is on.

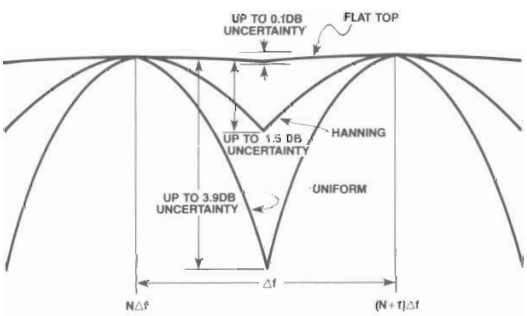
The DATA LOADING light indicates when data collection is taking place and stays on during the collection process. When this light is not flashing, the instrument is not collecting new data—and may appear to be "hung up." Checking the framed buttons will indicate the reason new data is not being collected.



E. Passband Shape

The PASSBAND SHAPE controls determine the frequency domain filter shape or equivalently the time domain "window" function.

Each of the passband shapes represents a tradeoff between amplitude uncertainty and frequency resolution. The amplitude uncertainty problem is illustrated in the following figure.

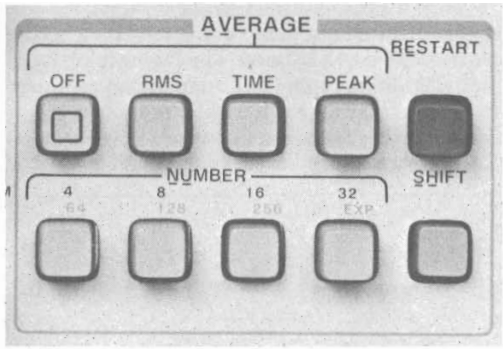


As shown, the filter-to-filter spacing Δf is fixed by the sampling rate. As the actual spectral line moves from $N\Delta f$ to $(N+1)\Delta f$ it traces out the top of the passband as shown. The uncertainty is maximum when the actual component falls midway between the filters. As the filter passband becomes flatter on top, the uncertainty is reduced—but so is the frequency resolution.

The FLAT TOP passband is optimized for minimum amplitude uncertainty and contributes less than 0.1 dB. The frequency resolution is correspondingly poorer than the other two filters. Normally this passband is used for measuring discrete spectral lines.

The HANNING passband is a traditional "window" found on most real time analyzers. It offers a compromise between the FLAT TOP and the UNIFORM shape. Its worst case uncertainty is 1.5 dB but it has a 3 dB bandwidth that is about 40% of that or the FLAT TOP filter. It is most commonly used for random noise measurements.

The UNIFORM passband is the result of using no time domain "window" weighting. It has a worst case amplitude uncertainty of 3.9 dB and a 3 dB bandwidth that is 60% of that of the HANNING window. It is used for transient measurements and whenever the built-in periodic noise source is used.



F. Average Section

The AVERAGE controls are used to average the noise displayed on the CRT. Operationally it replaces the video filtering or display smoothing usually found on spectrum analyzers. The major advantages of digital averaging are repeatability, and predictability. The TIME average does offer a unique capability of actually enhancing the signal-to-noise ratio.

The RMS average mode combines a new spectrum with a partial result on a point-by-point basis using an RMS calculation. At any point in the cycle the amplitude at some frequency A(f) is given as

$$A(f) = \sqrt{1/n\left[A_1^2(f) + A_2^2(f) + \cdots + A_n^2(f)\right]}$$

The phase is $\phi(f) = 1/n\,[\phi_1(f) + \phi_2(f) + \quad + \phi_n(f)]$.
This averaging results in smoothing of the noise variations, but does **not** reduce the level of the noise. RMS averaging must be used when making coherence measurements.

The TIME average mode involves time domain averaging. When a synchronizing trigger is available successive time records are averaged point-by-point. Signal variations that are synchronous with the trigger will average to some value while noise that is not synchronous will average to zero. This eliminates the noise prior to the transformation to the frequency domain. Time averaging is unique in that it does result in an enhancement of the signal-to-noise ratio. It is also by far the fastest averaging mode and should probably be used any time a synchronizing trigger is available.

If you try to TIME average without a trigger you get a diagnostic (see Section VI).

The PEAK mode is not truly an averaging mode, but rather is the result of keeping the maximum value at each frequency point. The phase point retained is the phase of the retained point at each frequency. PEAK averaging is useful for measurements such as monitoring signal drift, etc.

The NUMBER of averages is selectable between 4 and 256 in a binary sequence. The SHIFT key selects whether the lower case black numbers or the upper case blue numbers are active.

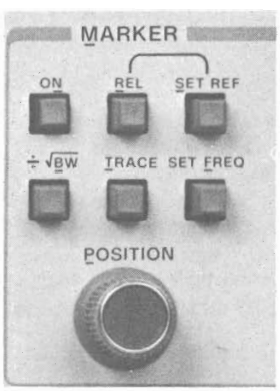
The EXP mode is a continuous averaging process where the new input is weighted ¼ and the old previous average weighted ¾. This causes the most recent data to be most important while the older data dies out in importance at a decaying exponential rate. The exponential accumulation mode works only with RMS averages. It is most useful when the process under consideration exhibits relatively slow time variations and yet some averaging is still desired. The time constant of the exponential weighting is such that it averages

out short term variations, yet follows longer term variations. When EXP is selected in the PEAK mode, the instrument will accumulate PEAK data indefinitely.

In all of the averaging modes except exponential the instrument stops taking new data when the selected number of averages are completed. WHEN THIS OCCURS, THE 3582A MAY APPEAR TO BE "HUNG UP" WHEN ACTUALLY IT IS WAITING FOR FURTHER INSTRUCTIONS. This is the reason the AVERAGE OFF button is highlighted. Any time the 3582A appears to be stopped, this button should be checked. When the instrument has taken the selected number of averages the RESTART button is used to start the next averaging sequence. When the averaging mode is changed, a restart is automatically executed. When the number of averages is changed from one number to a larger number a restart is not required; the instrument continues from where it stopped to the new number of averages.

Note that RESTART actually clears the time record and restarts the measurement process **even** with the averaging turned off. This is probably the easiest way to restart any measurement if you don't like the time record being collected.

Application Note 245-1 titled "Signal Averaging with the HP 3582A Spectrum Analyzer" covers the topic of averaging in detail.



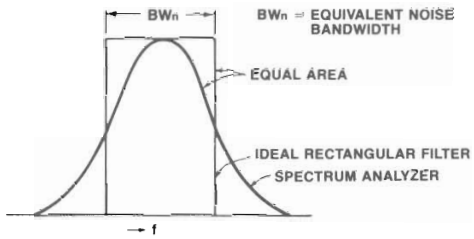
G. Marker Section

The MARKER feature is one of the major conveniences of the instrument. When ON an intensified dot marker appears on one of the traces. The POSITION knob is used to move the dot marker either right or left on the trace. The amplitude and frequency information corresponding to the marker location is read out in alphanumeric form on the display.

As long as the REL button is out both readouts are in absolute units. To get relative measurements, the reference point is first located with the dot marker. Pushing the SET REF button saves the frequency and amplitude values of the marker as a reference. In subsequent measurements when the REL button is in the marker readout will be with respect to the selected reference. When the REL button is out the absolute readout is given.

When there are two active traces the TRACE button causes the dot marker to toggle between the two traces.

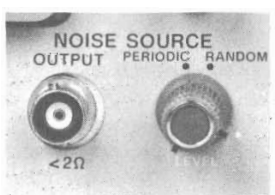
The $\div \sqrt{BW}$ button is used for making measurements of random noise. Normally the level measured at any point with the analyzer is a function of the filter bandwidth and the actual noise density. Since different filter bandwidths will give different answers the comparison of results is difficult. In order to eliminate this problem, it is customary to normalize out the bandwidth factor by dividing the reading by the square root of the EQUIVALENT NOISE BANDWIDTH. This is the width of an ideal rectangular filter with the same response as the actual filter as shown.



The $\div \sqrt{BW}$ button performs this normalization automatically and presents the results directly in dBV/$\sqrt{Hz}$ or voltage/$\sqrt{Hz}$.

The SET FREQ button is used to provide information to the band analysis modes of operation. When pressed, the current frequency of the intensified dot marker is stored to become the band analysis start or center frequency, depending on the frequency mode selected.

The marker frequency resolution on wide bandwidths may cause the display to be not exactly centered when changing modes. Repositioning the marker and doing SET FREQ again will refine the display because the marker resolution is better on narrower spans.



H. Noise Source Section

The NOISE SOURCE is functionally the equivalent of a tracking generator on conventional spectrum analyzers. It is a driving source that stimulates a device under test across a measurement band. Since the 3582A is an FFT analyzer it can be viewed as conceptually measuring 256 parallel filters simultaneously. This is not compatible with a swept signal source.

The 3582A provides two broad band sources. The random noise signal requires extensive averaging to get valid results. The 3582A also has a periodic noise source synchronized to the data collection process. This source places a spectral line at each of the measurement points. More importantly, extensive averaging is not necessary; the variance of the periodic signal when it is analyzed is theoretically zero. The easiest way to get a feel for periodic noise is to simply measure the CAL signal. Rather than directly matching 256 spectral lines with 256 measurement points the calibrator matches 25 spectral lines or about one every tenth measurement points.

The BNC output is a very low (e.g., typically 1Ω) impedance source. When measured with a high impedance voltmeter the LEVEL control will vary the output from nominally 0V to 0.7V rms in the 25kHz span. The full scale position is detented. Note that this control is not programmable.

III. Spectrum Analyzer Performance

There are a number of performance characteristics that are fundamental to a low frequency spectrum analyzer. This section discusses the most important of these characteristics and provides pertinent facts about each of them.

A. Frequency Range

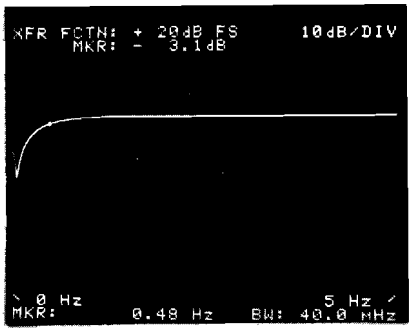
20 mHz ⟨ **Frequency Range** ⟩ **25.5 kHz**

- Minimum baseband span of 1 Hz full scale.
- Resolution to within 20 milliHertz of DC.
- 14 baseband spans (1-2.5-5-10 sequence) for maximum flexibility.
- Filter bandwidth automatically tracks the selected span.

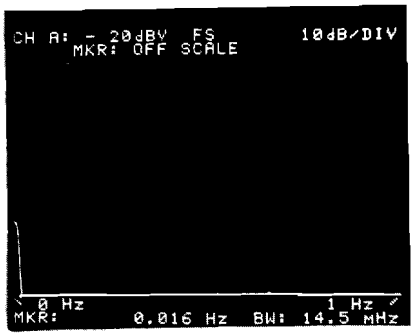
When thinking about the low end of the frequency range, there are several points to keep in mind.

1. As described in Section V the length of time required to collect a time record is inversely related to the selected span. On the 1 Hz span, a single-channel time record is 250 seconds long. While this is long, it is a fundamental physical limitation.

2. In order to prevent the AC coupling of the input circuit from distorting very low frequency signals, the input circuit must be DC coupled. The low frequency roll-off of the AC coupled input is easy to show by monitoring the pseudorandom noise source on the 5 Hz span with AC coupling. You will see the following:



3. On the 1 Hz baseband frequency span, the calculated point spacing is only 4 milliHertz, but the analyzer exhibits a type of "zero response" as shown.



This is not due to L.O. feedthrough as with a conventional analyzer. Rather it is due to DC drifts and offsets in the front end. These obscure the actual DC component of the input signal that the FFT would calculate. The 20 milliHertz low end frequency is somewhat subjective and is the minimum frequency component 70 dB below full scale that can be accurately resolved.

4. Filter bandwidth is a dependent variable. It is the result of selecting a calculated point spacing (by selecting a span width) and a filter shape. Thus the operator does not have to worry about it; he just sets the appropriate span.

B. Frequency Resolution

Frequency ⟩ **20 mHz** ⟨ **Resolution**

- Minimum band analysis span of 5 Hz.
- Resolution bandwidths down to 20 mHz.
- 12 band analysis spans (1-2.5-5-10 sequence) for maximum flexibility.
- Filter bandwidth automatically tracks the selected span.

When thinking about the narrow frequency resolution, there are several points to keep in mind.

1. Again, the length of time required to collect a time record is inversely related to the frequency span. Thus even if a 5 Hz span is located at 20 kHz, it will take 50 seconds to collect a single-channel time record.

2. The calculated point spacing on the 5 Hz span is 20 mHz, but the bandwidth number on the CRT is the equivalent noise bandwidth. The uniform passband shape has an equivalent noise bandwidth equal to the point spacing. Because of the specialized nature of this filter shape, however, it is not generally used. It is more common, when concerned about frequency resolution to use the Hanning filter shape with an equivalent noise bandwidth of about 30 mHz on the 5 Hz span.

3. As with the baseband case, the filter bandwidth tracks the selected frequency span and filter passband shape and is not an independent selection.

C. Measurement Range

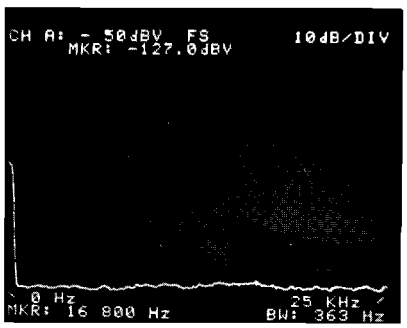
+30 dBV

Measurement Range

-120 dBV Noise Level

- 150 dB of measurement range in calibrated 10 dB steps.

1. The 3582A exhibits a 1/f type noise floor characteristic as shown on the data sheet. As the following plot shows the specifications are rather conservative at room temperature.



2. It is important to note that the noise floor specification applies to the RMS noise level. This does **not** imply that noise peaks will not exceed the specification limit on a random basis.

3. The overload protection circuits are designed to handle ±100 volts DC or 120 volts RMS. Note that the AC limit is time related—with a specification of 1 minute.

D. Dynamic Range

Maximum Input

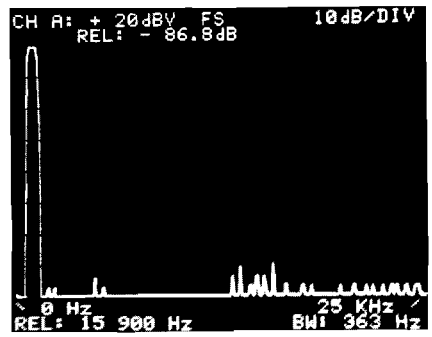
Dynamic Range

-70 dB

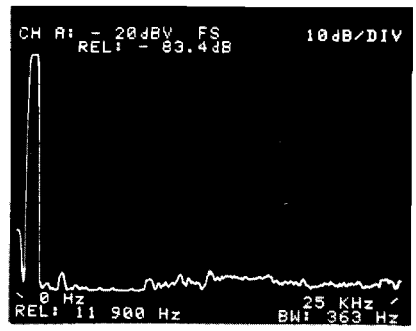
- Full 70 dB dynamic range on all ranges except -50 dBV.

1. Recall that a 12-bit A/D converter inherently only spans 72 dB. Extending this to better than 75 dB is the result of something called "Processing Gain" in the FFT. It requires an **exceptionally** linear A/D converter.

2. The 3582A is actually cleaner than its specification. You can divide the distortion contributors into analog and digital and each can be highlighted individually. The digital contributors are highlighted by synthesizing a time record mathematically with a calculator. With the HP-IB this can be substituted for an input waveform. The resulting FFT distortion is as follows:



As shown, it is well down from full scale. The second example shows the analysis of an actual signal from a 339A oscillator which has harmonics over 100 dB down.



This illustrates the distortions of the entire processing chain—both analog and digital.

E. "Real Time" Measurement Speed

"Real Time" Measurement Speed

- Spans of 1 kHz and over are typically analyzed in less than 400 ms.
- Spans of 1 Hz to 500 Hz (single channel) are limited by time record collection as the following shows:

Span	500 Hz	250	100	50	25	10	5	2.5	1
Time	.5sec	1	2.5	5	10	25	50	100	250

The term "real-time" is often used, but very seldom understood. Technically it is the bandwidth where the time record collection process exceeds the actual transform and display time (see Section V). The following points are worth noting about the 3582A measurement speed.

1. It is certainly faster than a swept analyzer. While the comparisons are not exact, the following table gives a feel for the comparison.

	Typical Swept Analyzer		3582A	
	Bandwidth	**Time**	**Bandwidth**	**Time**
100 Hz SPAN	1 Hz	200 SEC	0.4 Hz	≈3 SEC
500 Hz SPAN	3 Hz	100 SEC	2 Hz	≈9 SEC
1000 Hz SPAN	3 Hz	200 SEC	4 Hz	≈6 SEC

2. The "Real Time" spans are the ones that take the **longest** to measure. On the 1 Hz span the measurement is in "Real-Time" but it takes 250 seconds. On the 25 kHz span the measurement is not in "Real-Time"—but it only takes about 400 milliseconds. It seems backwards, doesn't it? Section V contains a more complete discussion.

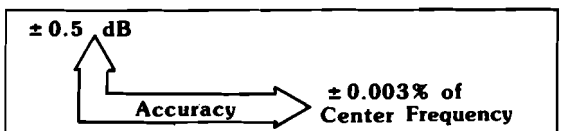
3. The actual measurement time depends on a number of things including the data being analyzed. The following table gives some typical times.

	SINGLE CHANNEL		DUAL CHANNEL	
	AVERAGE		AVERAGE	
	OFF	RMS	OFF	RMS
NO DISPLAY	375 MSEC	475 MSEC	325 MSEC	470 MSEC
AMPLITUDE AND PHASE DISPLAY	520 MSEC	600 MSEC	410 MSEC	550 MSEC
TRANSFER FUNCTION MAGNITUDE AND PHASE DISPLAY			430 MSEC	600 MSEC

These can be expected to vary as much as 20 ms depending on the data being analyzed. Note that for maximum analysis speed in HP-IB type environments, the display should not be activated until necessary.

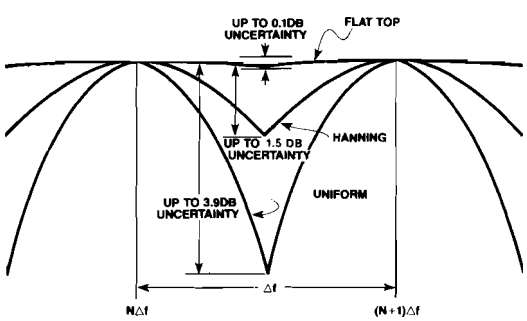
4. It may be worth noting that even on spans that are "Real-Time" the instrument may miss a couple of time domain samples between records. Normally, this time lag between the end of one measurement and the start of the next is only 1 to 2 milliseconds.

F. Accuracy



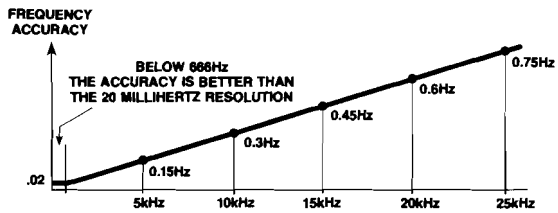
- Basic amplitude accuracy of ± 0.5 dB at the passband center.
- Basic frequency accuracy of ± 0.003% of the band center frequency.

1. The basic 0.5 dB accuracy applies only at the calculated points. If the component of interest is not on a calculated point, the filter passband will also contribute to the absolute accuracy. This is sometimes known as the "picket fence" effect and can be viewed as follows:



All FFT analyzers that use the Hanning window will exhibit this problem.
The Flat Top filter of the 3582A reduces the passband inaccuracy to +0, -0.1 dB.

3. The Frequency accuracy of 0.003% of the center frequency is better than the frequency resolution of 0.02 Hz for frequencies below 666 Hz. For higher frequencies the resolution of the 5 Hz band analysis span is much better than the specified accuracy as shown.



The worst case is at 25 kHz where the accuracy is about ±0.75Hz.

G. Averaging

Averaging

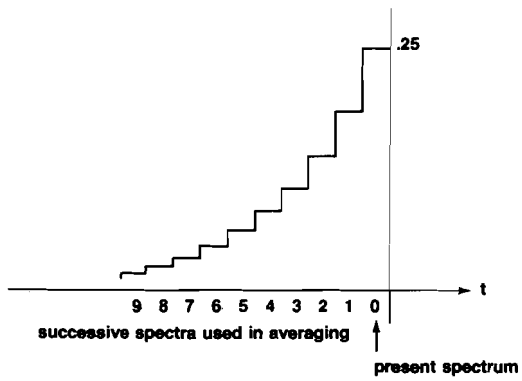
- Precise, repeatable digitally computed results.
- 4 different averaging modes with the number of averages selectable from 4 to 256.
- Application Note 245-1 titled "Signal Averaging with the HP 3582A Spectrum Analyzer" gives details.

The digital averaging of the 3582A is similar to display smoothing or video filtering on conventional spectrum analyzer. The relationship of the two is moderately complex and is discussed in Application Note 245-1.

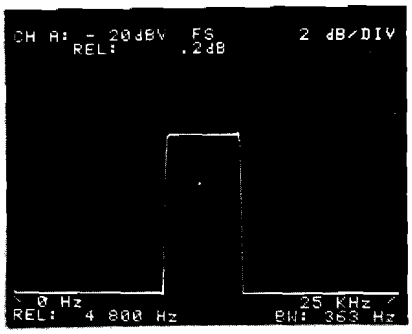
The following points are key:

1. RMS averaging reduces the variance of the estimate of the noise spectrum. It does not reduce the noise level or enhance the signal-to-noise ratio. It corresponds most closely to conventional display smoothing.

2. Exponential averaging in the RMS mode gives a running average with new inputs weighted ¼ and previous results by ¾. This results in an exponentially decaying weight on samples as follows:



3. The PEAK mode is not really an averaging mode. At each calculated frequency point the maximum spectral value is trapped and held. This can be useful for tracing out envelopes of signals that change in frequency with time.



4. Exponential averaging in the PEAK mode gives a continuous peak monitoring function that is stopped by releasing the repetitive trigger button.

5. Time averaging is useful for cases where discrete and random signals are mixed and where it is possible to trigger synchronously with the discrete signal. In this case, averaging provides signal-to-noise enhancement of as much as 24 dB, but does not smooth the variance of the estimate. Time averaging is the only way to obtain signal-to-noise enhancement.

H. Noise Source

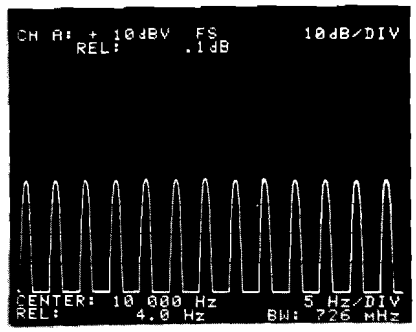
Noise Source

- Both random and periodic noise.
- Low impedance source with variable level.
- Noise bandwidth and location automatically tracks analysis band.
- Frequency response of ± 1 dB on periodic noise with the uniform passband.

Hewlett-Packard's years of experience with spectrum analyzer measurements have pointed out the value of a tracking generator. With an FFT type analyzer, however, a swept sine wave is not an optimum drive dignal. It will show up as a carrier with FM sidebands spaced at the reciprocal of the sweep rate.

What is required is a flat signal that is present at all of the calculated frequency points simultaneously. This is the description of a frequency comb and is exactly what the periodic noise source looks like. The details of how and why are given in Section V. Some of the key points to be aware of include:

1. The periodic noise signal automatically has a spacing exactly equal to the calculated point spacing. Thus, on the 1 kHz span where the calculated point spacing is 4 Hz, the periodic noise spectral line spacing is also 4 Hz as shown.



2. The periodic noise signal is automatically band limited and frequency translated when the analyzer is being used for band analysis. This concentrates the drive energy where it is required without disturbing other critical frequencies.

3. The periodic noise source should always be used with the uniform passband shape; the two are carefully matched. If you look carefully at the periodic noise source, you will notice that it is not exactly flat. When measuring transfer functions, however, even the residual is taken out.

4. The noise source has a crest factor (peak-to-rms ratio) of between 3:1 and 4:1. Measuring the level with an average responding voltmeter can lead to errors. More importantly, this crest factor can cause unexpected overloading of circuits designed to accept a sine wave input. A noise signal will exhibit peak excursion of more than twice what a sine wave with an equivalent RMS value will exhibit.

5. The random noise source is similar to the periodic noise source in that it is band limited and band translated, etc. The major distinction is that RMS averaging and the Hanning passband shape must be used.

IV. New Measurement Capability

The use of advanced digital signal processing techniques allows the HP Model 3582A to perform measurements that are not possible with conventional swept analyzers. This section discusses these and provides useful facts about them.

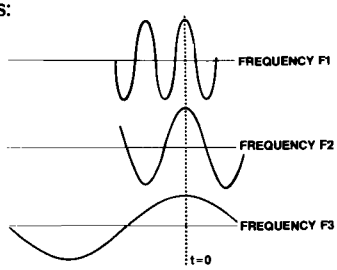
A. Phase Spectrum

Phase Spectrum

- 1 degree marker resolution.
- ± 10 degree accuracy.

Phase is a measure of the time displacement of two waveforms. By convention it is normalized to the basic frequency. Since it is always a relative measurement a t=0 reference is implied. With a network analyzer the input signal serves as this reference.

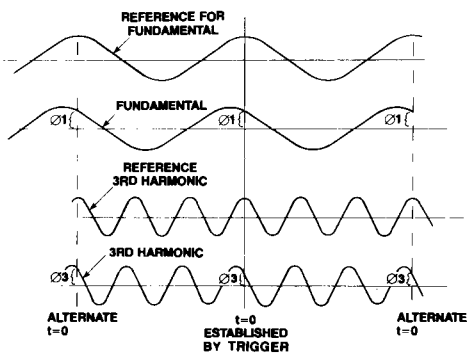
This is equivalent to using the positive slope transition through zero of a cosine as t=0. It is just as easy to define an entire collection of reference signals for a given time reference as follows:



It is this collection of references that is relevant when measuring phase with the Model 3582A. Note carefully that this selection of t=0 at the center of the time record is just a fixed offset from the trigger point.

Varying the trigger point corresponds to varying the t=0 reference and thus the phase value.

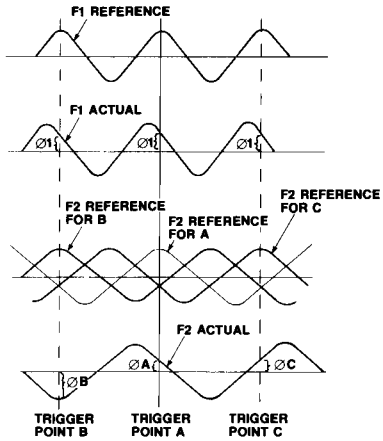
Conceptually the 3582A can be viewed as measuring phase by filtering off the frequency in question and comparing it with the appropriate hypothetical reference cosine. As an example, let's first consider a square wave fundamental and its third harmonic.



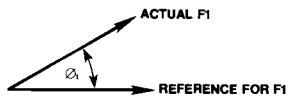
Note that in this representation, three different t=0 references could be selected. As the example shows, all three result in the same results. If the trigger level doesn't vary, the display should remain stable. If the trigger level is varied, the display will vary, but the relative values remain stable.

The next step in conceptual difficulty is to consider two unrelated frequencies.

As before, three different t=0 references can be defined for f_1—all resulting in the same phase value. For each of these references on f_1, however, a new set of hypothetical f_2 reference cosines is generated. If A is selected, the phase of f_2 relative to the A reference cosine is ϕA. If B is the selected reference the phase of f_2 relative to the B reference cosine is ϕB and similarly for C. This means that if a trigger is selected to hold the phase of f_1 constant relative to its reference cosine, the phase of f_2 relative to its **own** reference cosine will vary as shown:

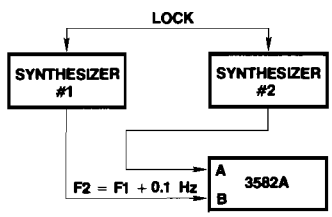


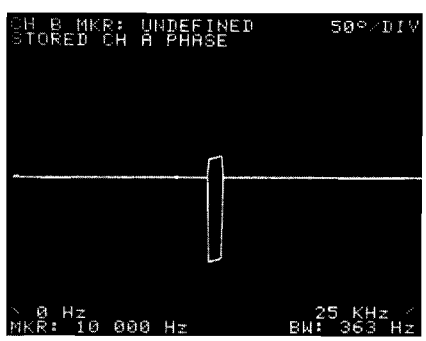
An alternative is to view the two frequencies as vectors rotating at f_1 and f_2. For any single vector the reference cosine corresponds to the line shown:



The phase corresponds to the relative offset as shown. Conceptually at least, all the reference cosine does is to stop the rotation of the vector or equivalently makes the frame of reference rotate at f_1 also. If you now add f_2 to the diagram, it must rotate relative to f_1. This implies that the angle between f_1 and f_2 or equivalently, the relative phase of the two changes predictably with respect to time.

This can be shown by measuring the combined output of two synthesizers offset slightly in frequency as follows:





Here the trigger signal is provided by A which fixes the reference as f_1. By selecting the difference frequency of .1 Hz, the second f_2 vector will "catch up to" the f_1 vector every 10 seconds. The relative phase will go through 360 degrees in 10 seconds. With a 500 Hz frequency span (.5 second time record). This rate of rotation is quite apparent.

Operationally, there are at least three distinct cases of interest.

1. Signal plus harmonics: Once a trigger level is established, a stable display with valid relative phase values results.

2. Signal plus sidebands: Once the trigger level is established, the carrier phase should remain stable but the sideband phases should vary in a predictable fashion. If the modulation is amplitude modulation (AM), the sideband phases average to 0 or 180 degrees. If it is frequency modulation (FM), they average +90 or −90 degrees from the carrier.

3. Mixed signals: About all that can be concluded is that the phases will vary with time.

A few points about the Model 3582A phase measurement capability are in order.

1. The phase of random noise poses a problem; it is also a random variable and results in a meaningless display. In order to prevent this, the 3582A does not display phase values for signals that are more than about 65 dB below the maximum input level. In these areas, it simply displays zero phase.

2. The basic display is ±200 degrees with cycling taking place nominally at ± 180 degrees. In order to generate a more usable display, there is 20 degrees of hysterisis between 180 and 200 degrees. This minimizes situations where the display bounces between ±180 degrees.

3. For passbands that are fairly wide such as the flat top shape, there is more than one point on the phase line and these points exhibit a positive slope. The appropriate phase value is the one corresponding to the maximum amplitude point.

4. With the uniform passband shape, the phase reference is not a hypothetical cosine at the center of the time record, but rather at the start. This is particularly useful for transients.

B. Transient Capture

Transient Capture

- Time records from 10 ms to 250 seconds.
- 1024 point or 512 point time records.
- Single or multiple triggers.
- External TTL trigger or trigger on input signal.
- Selectable trigger level and slope.

The FFT analysis procedure operates on a relatively short block of data called a time record. This makes it possible for the 3582A to capture and analyze transients. There are a few points about this type of operation that are worth remembering.

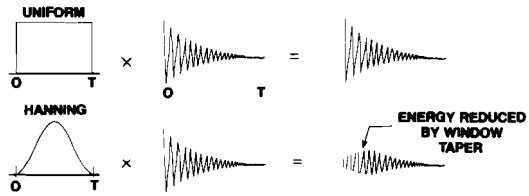
1. In the 3582A the time record length is not directly selected. Instead the frequency span and the time record length are related as:

$$T = \frac{250\ \text{sec}}{\text{span}} \text{ for single channel}$$

or

$$T = \frac{125\ \text{sec}}{\text{span}} \text{ for dual channel}$$

2. The uniform passband shape is virtually always used when analyzing transients because it does not pre-weight the time domain data. Since most transients have the bulk of their energy near the start of the time record either of the two "tapered" time domain weighting functions (Hanning or Flat Top) will distort the signal analyzed as follows.



3. The 3582A does not include pre-trigger capability. In some cases (particularly impulses) it is possible to externally simulate pre-trigger.

4. In most cases, setting the trigger level carefully will minimize the number of points on the transient being missed. You can graphically illustrate this by varying the trigger level and comparing successive analysis.

5. The band analysis functions operate on transient data, but you must recall that the time record length is a function of the frequency span. For the 5 Hz span to be of any value, the analyzer must sample data for 50 seconds.

C. Transfer Function Measurements

Transfer Function Measurements

- Measure amplitude with ± 0.8 dB accuracy and phase with ± 5 degrees accuracy.
- Resolution down to 40 milliHertz over the entire 25.5 kHz frequency range.
- Log measurement range of + 160 dB full scale to -80 dB full scale in 10 dB steps.
- Linear measurement range of 4×10^{8} full scale to 4×10^{-8} full scale in X10 steps.

The transfer function measurement in the Model 3582A is not a simple B/A ratio. It is actually the more "proper" measurement as follows:

$$H(f) = \frac{Gyx(f)}{Gxx(f)} = \frac{\text{cross power spectrum}}{\text{auto power spectrum}}$$

For theoretically ideal conditions, the two approaches would give the same answer. In reality if there are any additive signals such as noise, only this power spectrum approach gives valid answers. A few additional points are worth reviewing:

1. The band analysis functions work in the transfer function mode. You can look at a portion of the transfer function that is as narrow as 5 Hz with 40 milliHertz resolution.

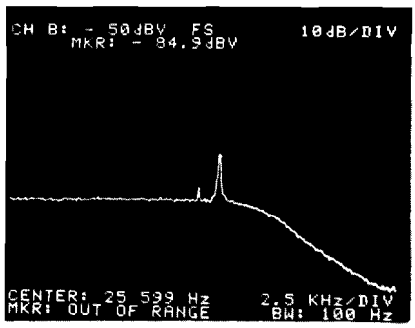
2. The passband shape to be used is determined in the same way it would be for a simple spectrum measurement.

Drive Signal	Passband Shape
Random Noise	Hanning
Periodic Noise	Uniform
Impulse	Uniform

Since the transfer function is measured simultaneously at all frequency points, the drive signal must be present at all frequencies measured. The above three signals fit this criteria.

3. For transfer functions with wide dynamic ranges, it may be possible to achieve better resolution of the low level portions using a swept sine wave and the PEAK averaging mode

5. The valid measurement range of the instrument is specified only to 25.6 kHz and indeed the frequency marker readout quits right there—but the display does not. By setting a center frequency of 25 kHz and using a 25 kHz span, you may see some general shapes out to about 37.5 kHz. Note very carefully that there are some significant compromises in this mode of operation. First, there are at least two out-of-band signals that appear in this range as shown.



To a fairly crude first order approximation, these will divide out in transfer functions. Second, the anti-alias filter roll-off shown places severe restrictions on the dynamic range in this area. Again, to a first order approximation, they divide out—but the signal to noise implications are severe. In short, this is not a recommended mode of operation.

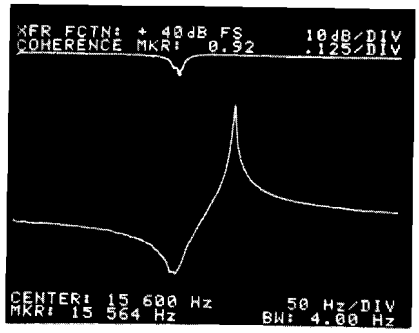
D. Coherence Function

Coherence Function

- A figure of merit check on transfer function measurements.
- Study cause/effect relationships.
- Application Note 245-2 entitled "Measuring the Coherence Function with the HP 3582A Spectrum Analyzer" gives details.

In the most basic sense the coherence function is a normalized measure of the degree of causality between two signals. The subject is considerably more complex than this would indicate. Application Note 245-2 titled "Measuring the Coherence Function with the HP 3582A Spectrum Analyzer" is recommended for a more complete understanding of the subject. Just a few points are in order here.

1. The most common use of the coherence function is with transfer functions as follows:

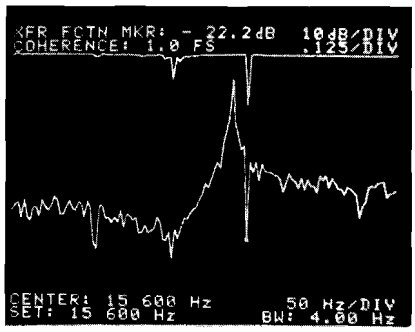


Here the additive signal could be random noise or could be due to non-linearities or an unanticipated input signal. The coherence function is a measure of how significant the additive signal is relative to the measured drive signal. The result can even be related to a signal-to-noise ratio at each frequency.

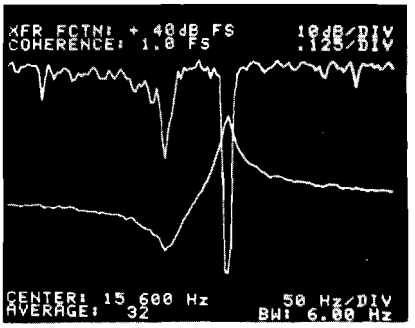
From a practical point of view, the coherence function should be used with transfer functions as a kind of warning flag. If the coherence is not high, the data should be questioned.

2. If the additive signal is common to both measured signals the coherence function will **not** flag the problem. This might occur with 60 Hz line components, for example. Again, reading Application Note 245-2 will more completely discuss the problem.

3. If the periodic noise source is used to drive a non-linear device, the coherence function may not flag the problem. This is because the distortion products of the periodic noise signal remain constant from measurement to measurement. This usually shows up as a "ragged" looking transfer function with high coherence as follows:



One of the more common causes of this is overdriving the device under test. Switching from periodic random to random noise will highlight the problem. This is the same measurement as above but with true random noise.



4. People who are familiar with correlation often ask how it relates to coherence. The answer is that the coherence function is equal to the squared correlation coefficient between the two signals **at each frequency.** Application Note 245-2 provides the mathematics.

V Some Specific Topics

There are a few aspects of the Model 3582A that warrant special attention. These include:

- Time records and the time display
- Passband shapes and window functions
- Real time bandwidth
- Noise source

The following sections provide an overview of these topics.

A. Time Records and The Time Display

The input to the analysis procedure used in the Model 3582A is a block of time domain sample points called a time record. In order to fully understand the operation of the instrument and in particular the time display, it is necessary to be acquainted with the different types of time records. These time records vary depending on whether the analysis is single or dual channel and whether it is baseband or not.

Before actually examining the time records, it is important to consider what they represent. The actual Fourier Transform does not have an explicit time reference; it simply operates on a sequential collection of points. This also implies that it does not have an explicit frequency reference; it simply outputs a sequential collection of points. The only absolute calibration is provided by the sampling rate which is in turn controlled by the frequency span setting.

Baseband Modes

The following simple relationships are key for baseband or O-Start analysis:

$$\Delta t = \frac{1}{4\,FS}$$

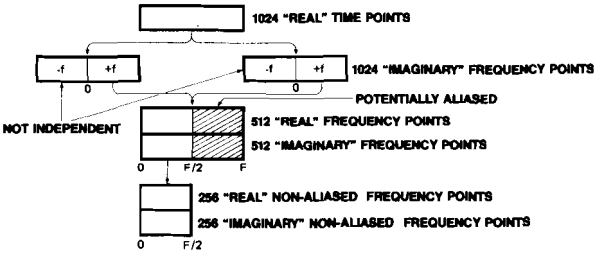
$$T = N\,\Delta t$$

$$\Delta f = \frac{1}{T}$$

where

Δt = the time domain sample spacing
FS = the selected frequency span
N = the number of time domain samples
(1024 for single channel)
(512 for dual channel)
T = the total time record length
Δf = the frequency domain sample spacing

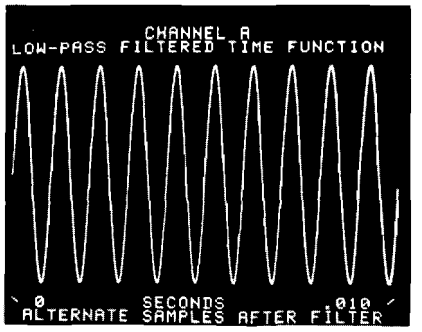
In the baseband modes, the time record is composed of 1024 (single channel) or 512 (dual channel) time samples. These N samples are transformed to N/4 complex frequency points as follows:



SINGLE-CHANNEL BASEBAND

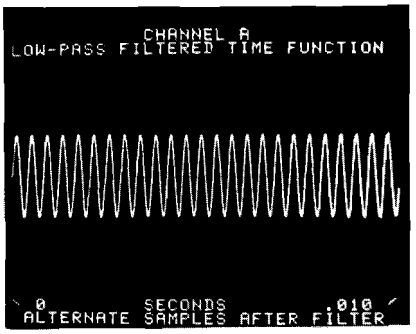
Note that both positive and negative frequency points are calculated but the negative points provide no new information. Also note that the upper half of the frequency points are discarded as potentially aliased.

Since the actual display hardware of the 3582A is only capable of displaying 512 X-Y points, the entire 1024 point single channel baseband time record can't be displayed. The compromise solution is to display only the alternate points as the annotation shown.

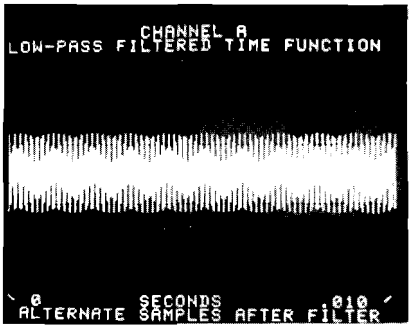


For consistency, this is also the way dual channel baseband time records are displayed.

In using the baseband TIME display function, it is vital to remember that the display is of **samples** of a waveform. These samples do have enough theoretical information to allow reconstruction of the input—but the human eye may not properly perform the reconstruction. The following two examples illustrate this.



1KHz on the 25KHz range



24KHz on the 25KHz range

Both contain sufficient information for complete analysis of a pure sinusoid—but one visually appears quite different after sampling. Quite obviously the 3582A is not a time doman oscillosscope. In fact for signals that are more than about 10% of the frequency span, the visual distortion becomes noticeable.

Band Analysis Modes

The time record is quite different in the band analysis modes since each time domain sample is converted to a complex value with both "real" and "imaginary" parts. This means that there is a factor of two differences between the number of time domain sample points and the number of time record points. The following simple relationships are key for band analysis:

$$\Delta t = \frac{1}{2\,FS}$$

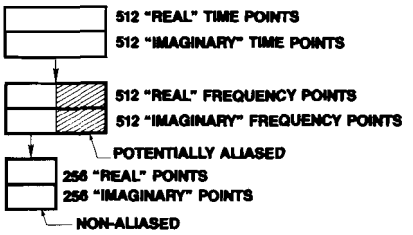
$$T = N\Delta t$$

$$\Delta f = \frac{1}{T}$$

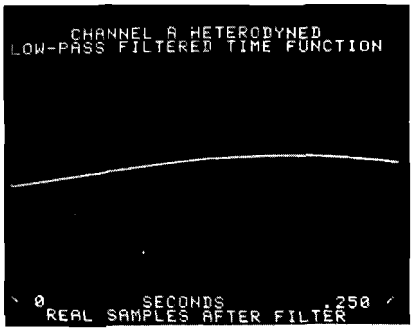
where

Δt = the time domain sample spacing
FS = the selected frequency span
N = the number of time domain samples
(½ the number of time record points)
(512 for single channel)
(256 for dual channel)
T = the total time record length
Δf = the frequency domain sample spacing

The major difference is that the time record is complex. The actual processing proceeds as follows:



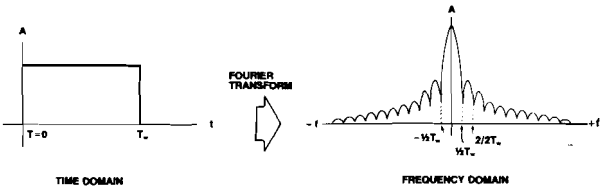
As before, the N complex time point pairs transform to N complex frequency point pairs, but now all N provide necessary information. Of the N, the upper half are still potentially aliased and are discarded resulting in N/2 valid points. As in the baseband case, there are 256 valid pairs in the single channel mode and 128 in the dual-channel mode.



The time display in the band analysis mode is a compromise, since the time record is complex. The display annotation is even more specific calling it low pass filtered, sampled and heterodyned. As shown, the samples displayed are the "real" samples or those multiplied by cosine terms in the band analysis procedure. About the only major use of this display is to see whether or not signals are present. Its physical interpretation is difficult at best. Probably the easiest way to view it is as the difference between the incoming signal frequency and the band analysis local oscillator.

B. Passband Shapes and Window Functions

In a conventional spectrum analyzer, the passband filter shape is a hardware filter with the shape determined by the need to sweep. In an FFT analyzer, the filter shape is the result of the processing done on the collection of the time domain samples as described in Appendix A. As the following illustration shows, the Fourier transform of the time domain weighting is the filter shape.



In fact, the time domain weighting functions are synthesized in order to achieve certain filter characteristics.

The 3582A provides three distinct passband filter shapes for different measurement situations. Each is optimized for a different type of measurement as the following chart illustrates.

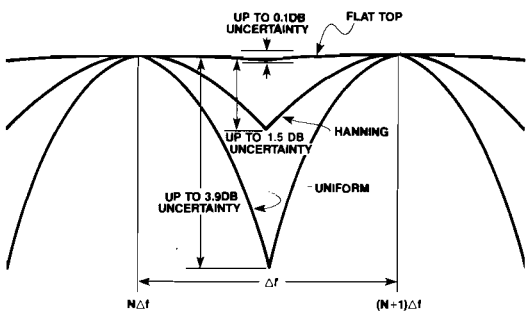
PASSBAND FILTER SHAPE	APPLICATION
FLAT TOP	DISCRETE SPECTRAL LINE MEASUREMENTS
HANNING	RANDOM NOISE MEASUREMENTS
UNIFORM	TRANSIENTS AND THE PERIODIC NOISE SOURCE

Normally this chart is all you need to remember—but in some cases, the concept of the "picket fence" effect or "leakage" will come up.

Picket Fence

As noted in the introduction, the FFT process used in the 3582A effectively uses 256 parallel filters to obtain a display. The spacing between these filters as well as the width of the individual filters is controlled by the frequency span setting. This causes a problem that is sometimes referred to as the "picket fence effect." If a signal falls midway between two adjacent filters, it will not show up at full amplitude, but rather will reflect the roll-off of the filter.

The extent of the problem depends explicitly on the weighting function or passband shape selected. The three passband shapes of the 3582A compare as follows:



Note that this is not a function of the specific product—but rather is characteristic of any FFT analyzer that uses these filters.

Leakage

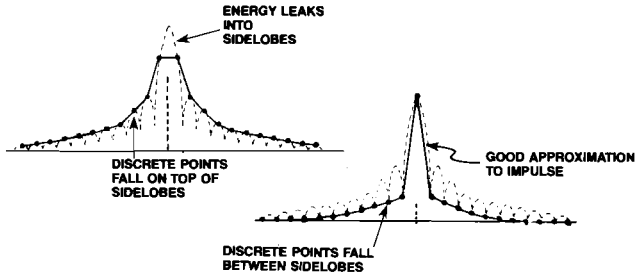
In addition to the "picket fence" effect, the FFT synthesized filters exhibit a behavior referred to as "leakage."

In a conventional spectrum analyzer, the passband filter shape is usually Gaussian. As a spectral line is analyzed, it does not come out as an ideal impulse—but rather it traces out the shape of the filter.

Leakage is very similar in that the spectral line effectively traces out the filter shape. The difference is that the FFT analyzer selects only discrete points off the shape which are then joined with line segments.

The easiest case to examine is the uniform case. The filter shape that corresponds to this time domain function is the $\frac{\sin X}{X}$ shape.

The display that results will depend on where the selected discrete points fall. The following example illustrates two distinct possibilities.



The Hanning passband shape has considerably lower sidelobes—with almost no leakage. The tradeoff is that the basic filter shape is considerably widened for each improvement in leakage reduction.

The real key is, of course, which is used for a specific measurement. That is summarized in the earlier table.

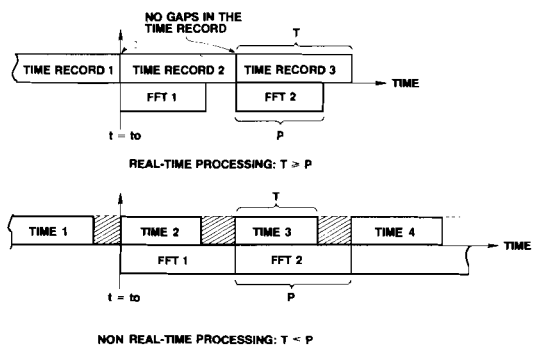
C. Real-Time Analysis and Real Time Bandwidth

The term "real time" can be relatively confusing because it is not consistently defined and thus often is misinterpreted. Three common definitions are:

- One hundred percent processing of incoming time domain information.
- "Very fast" as opposed to the slower processing of a swept filter type analyzer.
- Flicker-free oscilloscope trace presentation.

Technically, only the first definition is correct—but even it does not provide the answer to how fast a measurement can be made.

An FFT based analyzer like the 3582A processes data in two distinct steps. First, a time record must be completely collected and then the entire time record is transformed to a spectrum record. The time required to process a time record is the transform and display time and is a function of the hardware realization. The time required to collect a time record is determined by the FREQUENCY SPAN and, given a fixed time record size, is independent of the hardware. It is the relationship of these two times which determines the "real time bandwidth." When the transform display process is finished before the next time record is collected, the processing is in real time. In this case the physical sampling laws constrain the measurement time. When the time record collection finishes first, there will be gaps in the data being analyzed; the processing is not real-time. The following illustrates both situations.



This still does not indicate what impact a higher real time bandwidth has from a measurement point of view. This is best illustrated by comparing the measurement time that would result from having a higher real time bandwidth as follows:

SPAN	MEASUREMENT TIME	
	500 Hz REAL TIME BANDWIDTH	2500 Hz REAL TIME BANDWIDTH
1Hz	250 SEC	250 SEC
2.5Hz	100 SEC	100 SEC
5Hz	50 SEC	50 SEC
500Hz	≅ 1 SEC	≅ .6 SEC
1000Hz	≅ .75 SEC	≅ .35 SEC
2.5kHz	≅ .6 SEC	≅ .2 SEC
5kHz	≅ .5 SEC	≅ .15 SEC

Where the measurement time is highest (e.g., 250 seconds) you are operating in real-time. Where it is lowest you are not.

D. Noise Source Characteristics

If you view the FFT as implementing 256 parallel filters, it is clear that a swept sine wave is not an optimum stimulus source. A compatible source must stimulate all 256 measured frequencies simultaneously.

Any of the following signals will accomplish this:

Impulse
Gaussian White Noise
Pseudorandom Noise

Each is useful in certain measurement situations and each has some limitations. The impulse signal is easy to generate in mechanical measurements but the extremely high crest factor can cause overloading. Random noise has substantial advantages where the device may be somewhat non-linear, but requires extensive averaging to obtain valid results. Pseudorandom noise provides valid results without averaging but gets into trouble when the device is non-linear. All three signals are provided on the 3582A. Appendix A provides an overview of the actual hardware realization.

In the band analysis modes, the noise signal is first generated as the proper bandwidth at DC. It is then mixed with the band analysis local oscillator which translates the noise to the proper frequency. This minimizes the energy that is applied to portions of the spectrum not being measured.

As long as the device under test is linear, the periodic noise source provides excellent results without averaging. When the device exhibits non-linearity, harmonics of stimulus spectral lines are generated. Since the noise source is periodic with a period equal to the time record length, the harmonics will be consistent from measurement to measurement. This means that they will cause unwanted responses that do not average out. The coherence function will not identify these responses.

In addition, since the periodic noise has a finite spacing between frequency lines, it is possible that very narrowband responses will not be properly stimulated.

In order to minimize these problems, a more nearly random noise signal is also provided. This is generated by simply lengthening the sequence. For all practical purposes, this period of the sequence is so long, two identical time records are separated by substantial periods of time. This means that distortion products, when generated appear as random components; they vary from time record to time record. They will average out of the result and the coherence function will illustrate the extent of the measurement problem. The major disadvantage of the random noise stimulus is that extensive averaging must be used to get valid results.

It is worth noting that the periodic noise signal always has one period in the time record, but the start of the period does not occur at the same point. By using the rear panel impulse signal as an external trigger, the noise signal will be periodic and will always start at the same place in the time record.

From a practical point of view the periodic noise stimulus should be used as long as it gives valid results. Unfortunately, determining when results are valid is difficult. About the only check is to look for a "ragged" response or to compare the result with a random stimulated result.

VI. Operating Details

The Model 3582A is more than just a spectrum analyzer; it is a sophisticated measurement tool with five significant measurement modes. These are:

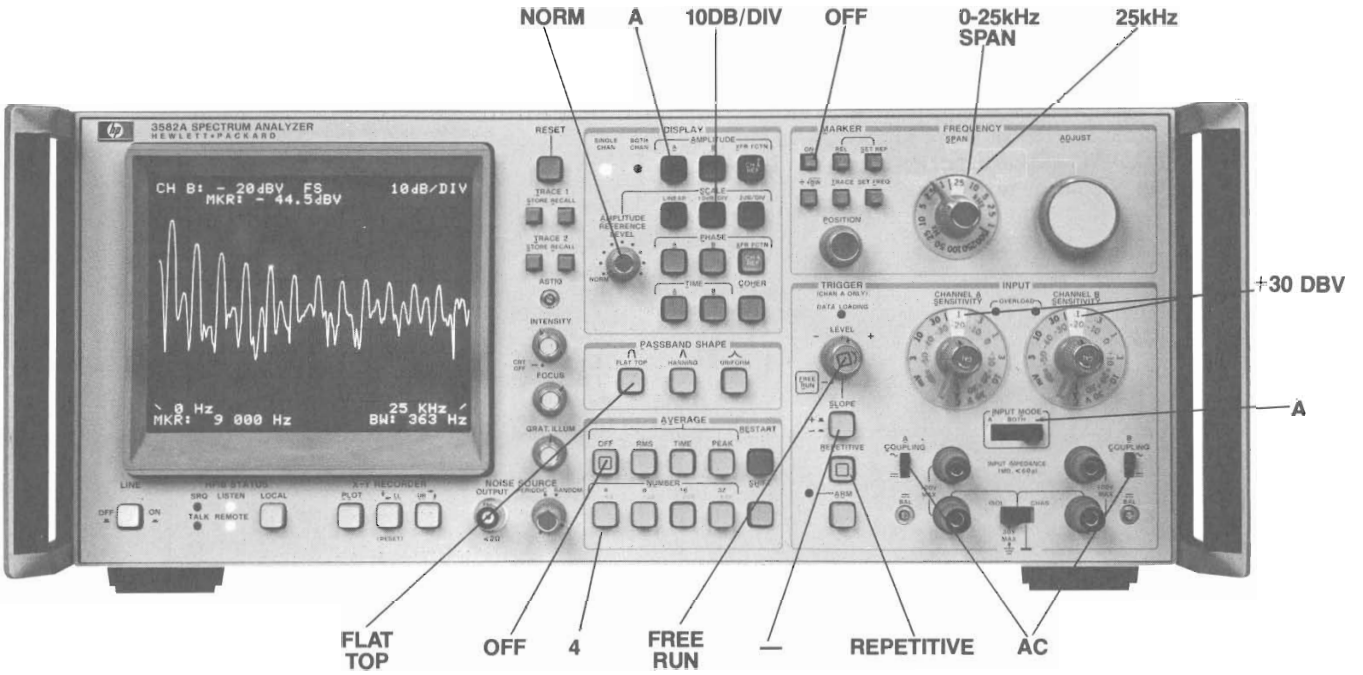
- single channel amplitude spectrum
- single channel phase spectrum
- transient capture and analysis
- dual-channel transfer function
- dual-channel coherence function.

This section provides a concise overview of the operational details of making these measurements. In addition, it also covers some other topics such as overloads and operational diagnostics.

A. Instrument Preset Conditions

Under manual front panel control, the state of the 3582A is defined by the positions of the latching pushbuttons and switches. Unlike an instrument with true keyboard control, there is no single button that presets the instrument to a fixed set of conditions. The reset button only redefines the instrument state to match the front panel control settings.

The HP-IB interface does include an instrument preset command ("PRS") to bring the instrument to a known state. In this state it is basically set to measure a single channel amplitude spectrum over the full 25 kHz span. This is an ideal starting point for setting up most measurements. As the following illustrations show, all of the measurement checklists use the preset state as a starting point. The illustrations only indicate the deviations from the preset state.

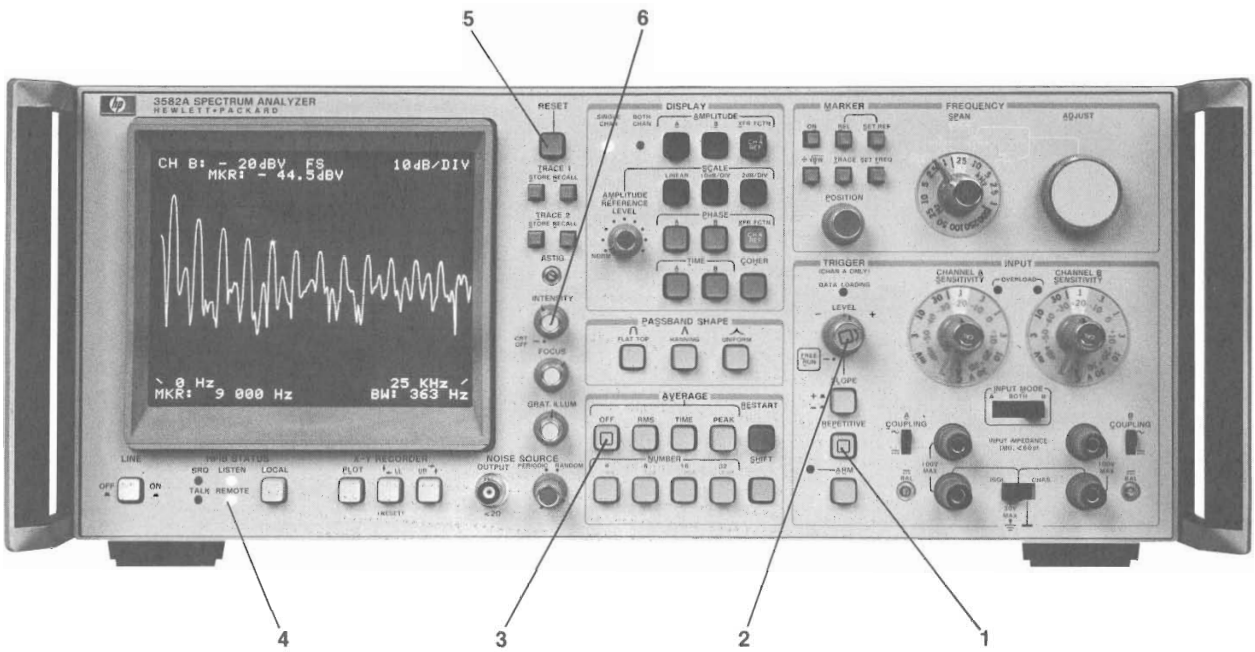


INSTRUMENT PRESET STATE

OPERATING CONTROL	PRESET SETTING
Input Coupling	AC (Both channels)
Input Mode	A
Input Sensitivity	+30 dBV (both channels)
Trigger Slope	—
Trigger Level	Free Run
Trigger Repetitive	On
Frequency Span Mode	0-25 kHz Span
Frequency Span	25 kHz
Marker	Off (all controls)
Display Amplitude	A (only)
Display Scale	10 dB/div.
Amplitude Reference Level	Norm
Display Phase	Off (all controls)
Display Coherence	Off
Passband Shape	Flat Top
Average	Off
Average Number	4 (No shift)
Trace 1 and 2	Off (All controls)

B. Important Control Settings

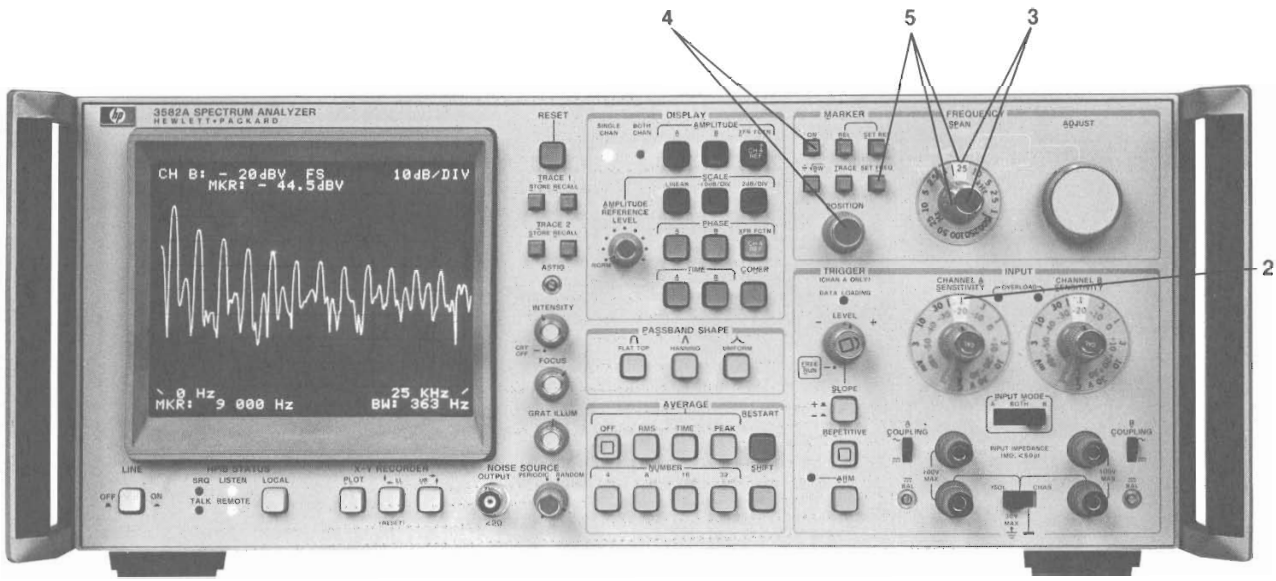
In some operating modes, the Model 3582A will not initiate a new measurement until commanded to do so by the operator. It may appear under these conditions that the instrument is "hung-up" when actually it is simply awaiting further instructions. If the instrument is not sampling—as indicated by the DATA LOADING indicator not flashing—the following control settings should be reviewed.



1.	When in the Non-REPETITIVE mode (button out) the instrument will initiate a new measurement only when ARMed.
2.	When not in FREE RUN the instrument will initiate a new measurement only when the LEVEL and SLOPE trigger conditions are satisfied. The LEVEL will depend on the input SENSITIVITY.
3.	When the instrument completes an average sequence, it stops until RESTARTed or until AVERAGING is turned off.
4.	When the instrument is under remote HP-IB control, it will not respond to front panel changes until returned to local control.
5.	The RESET control executes a power-up sequence which redefines the instrument state to correspond to the front panel switch settings.
6.	When the CRT INTENSITY control is turned off, there will be no display present.
7.	When the rear panel trigger switch is in the EXT position, only the FREE RUN front panel position is valid. When out of FREE RUN, triggering is initiated by rear panel signals.

C. Single Channel Amplitude Spectrum Measurement

The instrument preset condition is essentially the proper set up for single channel amplitude measurements. Normally the only changes required are to the INPUT SENSITIVITY controls and possibly the FREQUENCY SPAN and MODE controls. The MARKER functions will provide direct or relative readout of results.

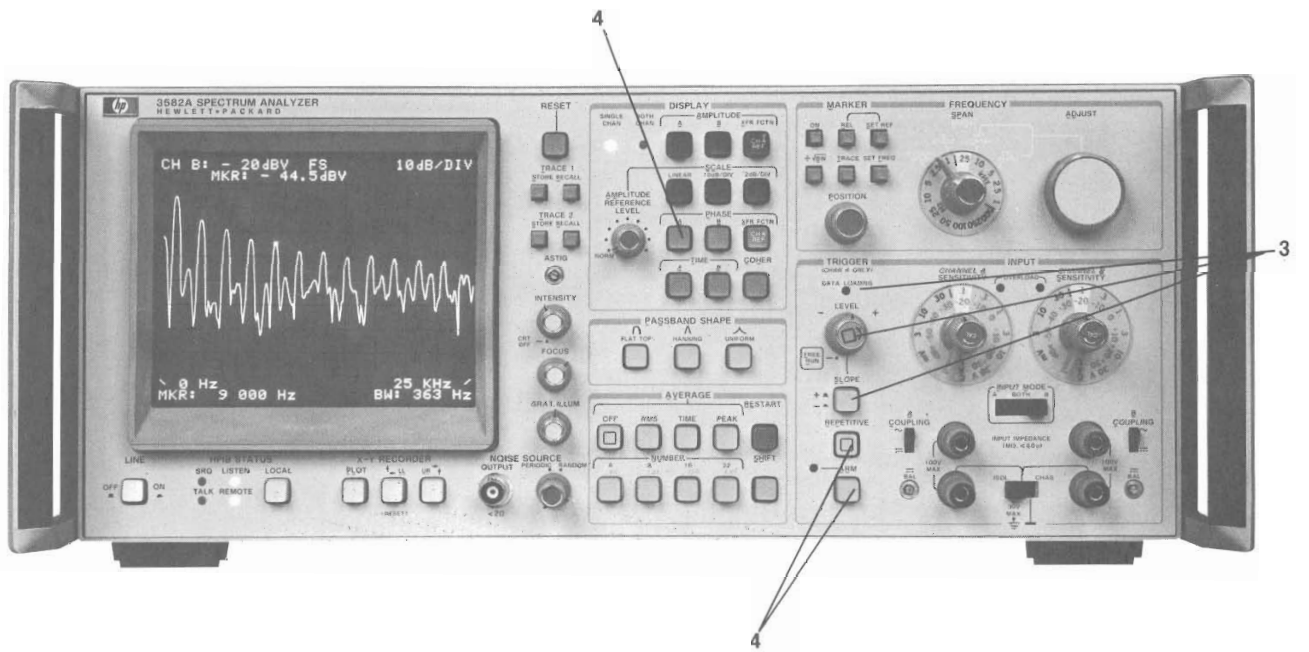


SINGLE CHANNEL AMPLITUDE SPECTRUM

STEP	OPERATIONAL ACTION
1.	Set the instrument to the preset state.
2.	Adjust the input SENSITIVITY control until the overload indicator goes out.
3.	If further analysis is to start at DC, select the 0-START FREQUENCY SPAN mode and the appropriate SPAN.
4.	If further analysis is to be band analysis, turn the intensified dot MARKER on and position it to the signal of interest.
5.	Press SET FREQ. to define the marker frequency as the start or center of the analysis band. Select the appropriate FREQUENCY SPAN MODE and FREQUENCY SPAN.

D. Single Channel Phase Spectrum Measurement

Normally the simplest way to make a single channel phase spectrum measurement is to start with the appropriate single channel amplitude spectrum. In order to get a usable display a trigger condition must be established.

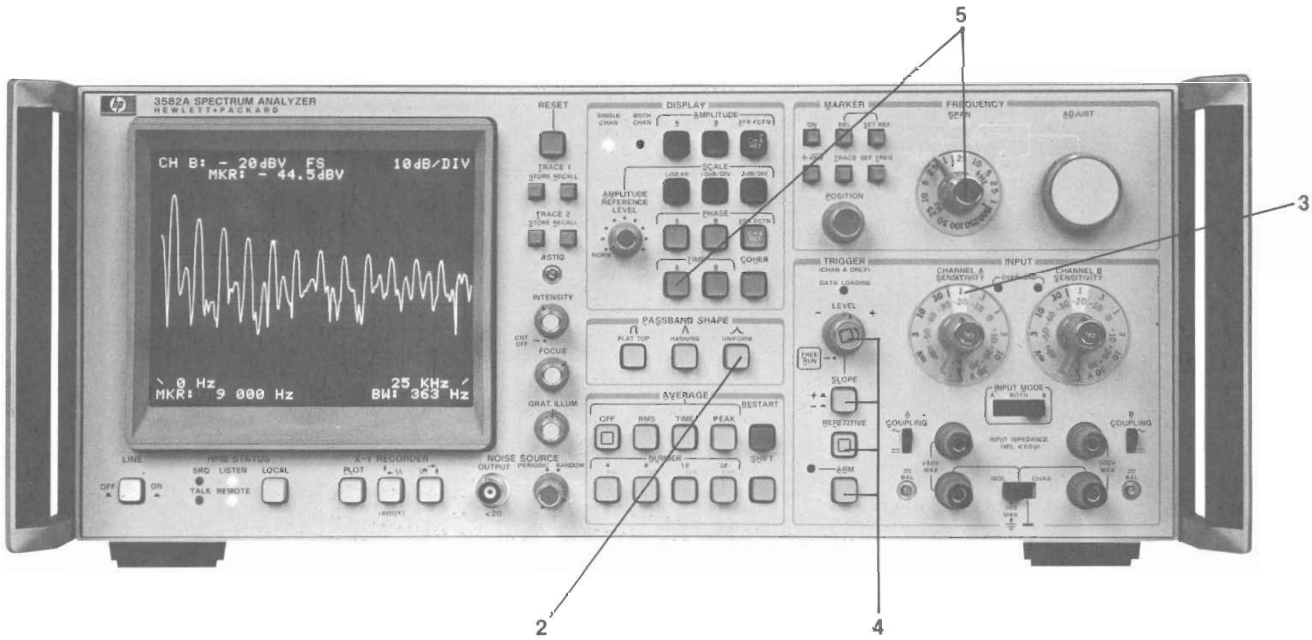


SINGLE CHANNEL PHASE SPECTRUM

STEP	OPERATIONAL ACTION
1.	Set the instrument to the preset state.
2.	Set up the appropriate single channel amplitude spectrum measurement.
3.	Select the desired TRIGGER SLOPE. View the CHANNEL A TIME display and adjust the TRIGGER LEVEL. The unit is triggering with the DATA LOADING light on.
4.	Select the CHANNEL A PHASE display. If the frequency components are not harmonically related the display will vary from measurement to measurement. Selecting NON-REPETITIVE triggering and using the ARM control will trap a single display.

E. Transient Capture and Analysis

The only difference between amplitude measurements is usually the selected trigger conditions and the passband shape. The following illustrates the difference.

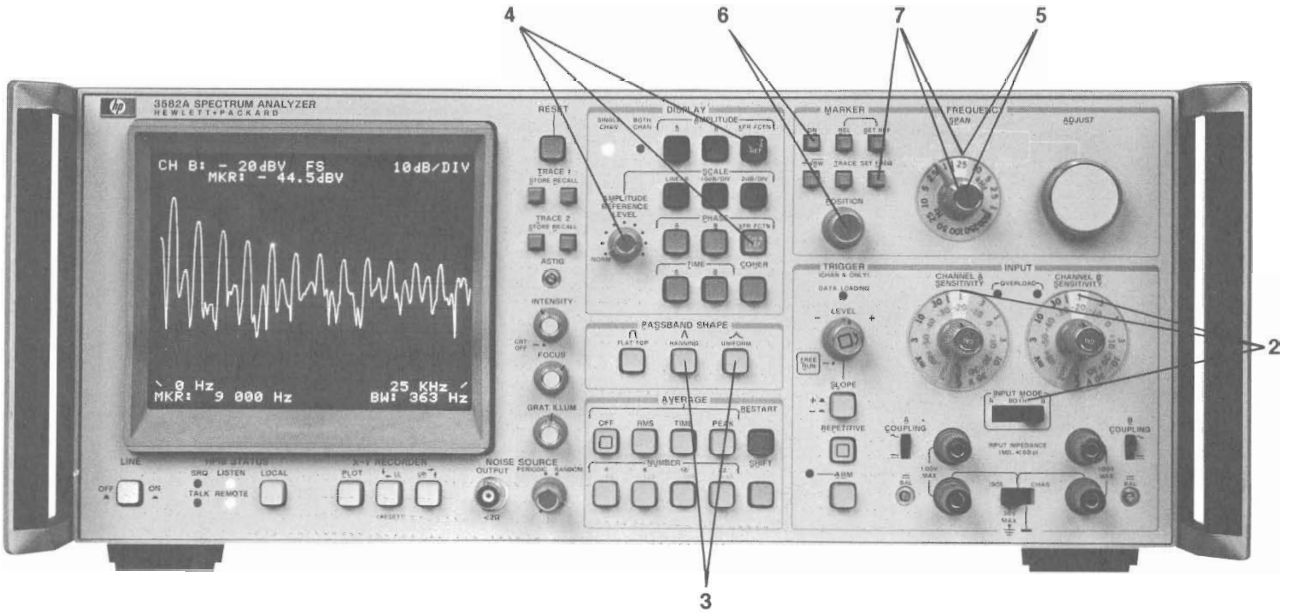


TRANSIENT CAPTURE AND ANALYSIS

STEP	OPERATIONAL ACTION
1.	Set the instrument to the preset state.
2.	Select the UNIFORM PASSBAND SHAPE.
3.	Select the appropriate CHANNEL A SENSITIVITY
4.	Set the proper TRIGGER SLOPE, TRIGGER LEVEL and whether or not triggering is to be REPETITIVE. If non-repetitive triggering is selected, the ARM control must be used.
5.	Select the appropriate time record length by adjusting the FREQUENCY SPAN control and viewing the TIME display.

F. Dual-Channel Transfer Function Measurements

The exact sequence of operations required for making transfer function measurements depends on the type of stimulus source. An impulsive stimulus or the periodic noise stimulus requires the UNIFORM PASSBAND SHAPE. The random noise stimulus requires the HANNING PASSBAND SHAPE and averaging.

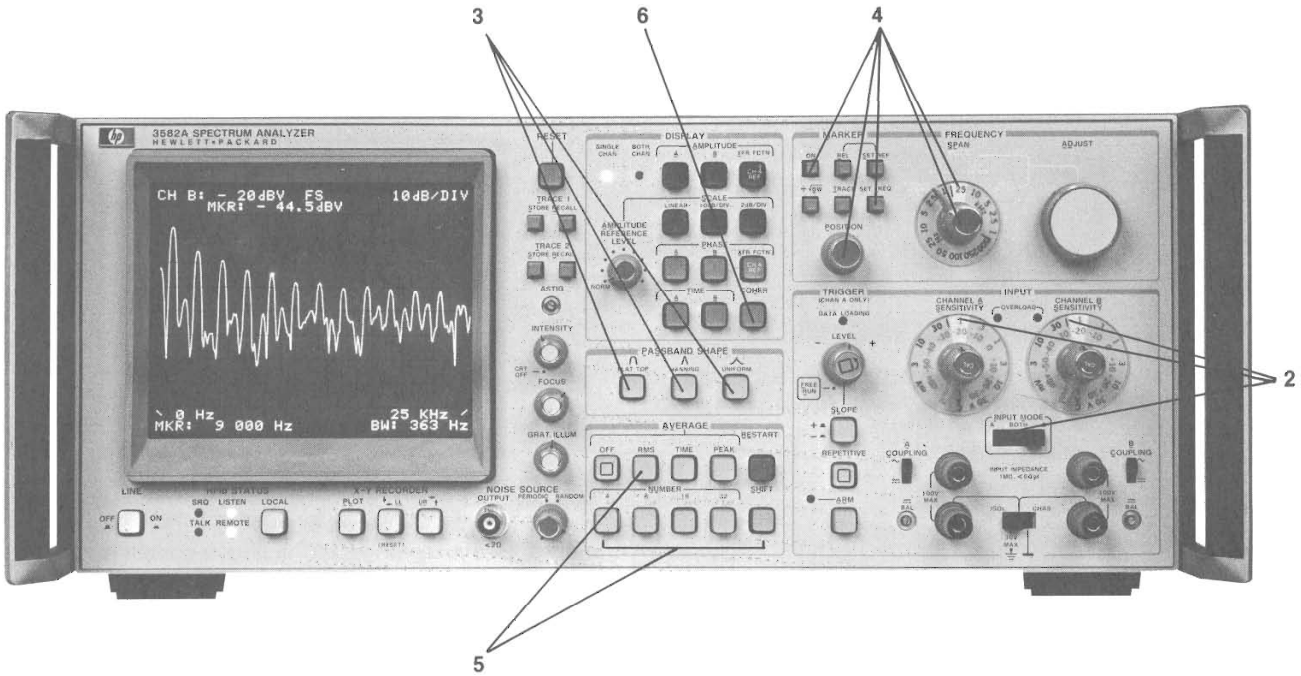


DUAL CHANNEL TRANSFER FUNCTION

STEP	OPERATIONAL FUNCTION
1.	Set the instrument to the preset state.
2.	Select the INPUT MODE of BOTH and adjust both INPUT SENSITIVITIES.
3.	Select the UNIFORM PASSBAND SHAPE if using the built-in PERIODIC NOISE or an impulse for a stimulus. Select the HANNING PASSBAND shape if using a random noise source.
4.	Select the XFR FCTN display of AMPLITUDE and/or PHASE. Use the AMPLITUDE REFERENCE LEVEL control to bring the amplitude display on scale.
5.	If further analysis is to start at DC select the 0-START FREQUENCY SPAN MODE and the appropriate SPAN.
6.	If further analysis is to be band analysis, turn the intensified dot MARKER ON and position it to the signal of interest.
7.	Press SET FREQ to define the marker as the start or center of the analysis band. Select the appropriate FREQUENCY SPAN MODE and FREQUENCY SPAN. Note that the INPUT SENSITIVITIES may have to be readjusted.

G. Dual Channel Coherence Function Measurements

The dual channel coherence function is used in two distinct situations; as a "confidence" overlay on transfer functions and as a way to investigate cause/effect relationships. From a measurement point of view, the two are set up the same way.

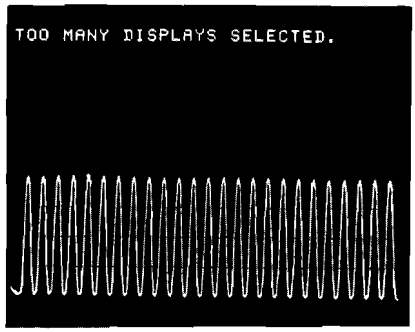


DUAL CHANNEL COHERENCE FUNCTION

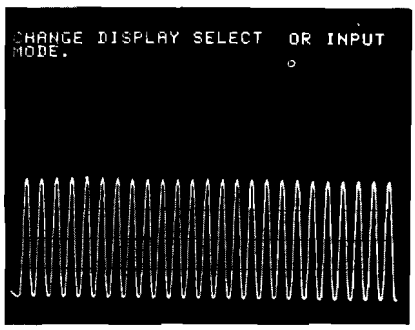
STEP	OPERATIONAL ACTION
1.	Set the instrument to the preset state.
2.	Select the INPUT MODE of BOTH and adjust both INPUT SENSITIVITIES.
3.	Select the UNIFORM PASSBAND SHAPE if the inputs are the built-in PERIODIC NOISE or are impulses. Select the HANNING shape if the inputs are predominantly random. Select the FLAT TOP shape if the inputs are predominantly spectral lines.
4.	Select the appropriate FREQUENCY SPAN MODE, SPAN WIDTH, and if required, the proper display start or center frequency.
5.	Select RMS AVERAGE and the desired number or averages.
6.	Select the COHER DISPLAY and any other display trace desired.

H. Operational Diagnostics

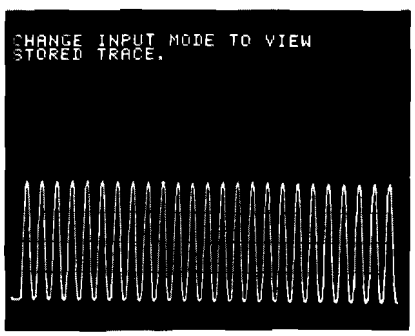
The powerful microcomputer control of the 3582A makes it possible to diagnose most operational mistakes. When an invalid measurement situation is detected, the instrument continues with the last valid state that it was in until the invalid situation is corrected. As long as a diagnostic is on the screen, only the RESET and POWER controls will be recognized. These controls cause the instrument to cease doing anything until the invalid condition is corrected. The following examples illustrate the invalid situations that can occur.



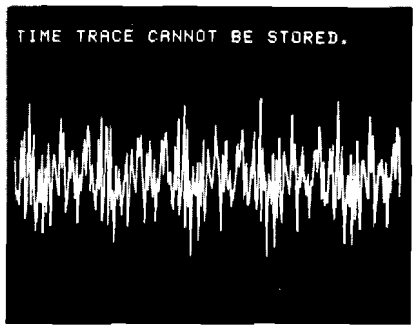
The instrument can display only two traces including stored traces. The display won't change until you are down to only two traces selected.



Trying to display any CHANNEL A data while set to the B INPUT MODE or vice versa is invalid.

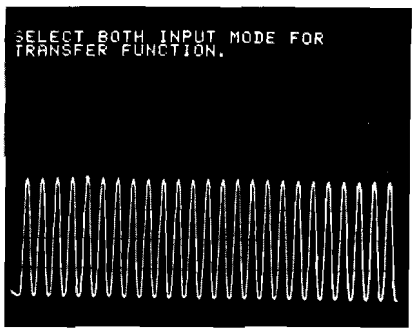


Since dual channel traces are 128 points and single channel traces are 256 points, you can't mix them. This means you can't store a single channel display and compare it with a dual channel display.

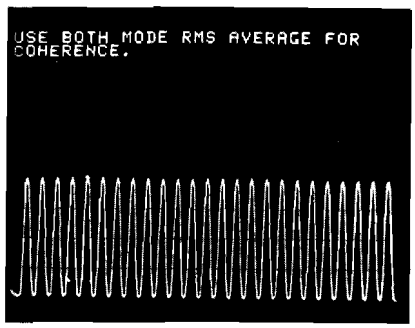


The TIME display is a full 512 points (alternate points of the 1024 point time record). This is twice as big as the storage area so it can't be stored.

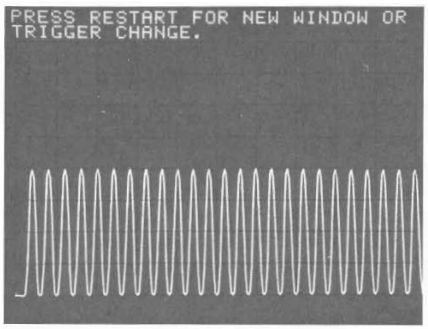
Band analysis spans cover only 5 Hz to 25 kHz. When the 2.5 Hz or 1 Hz span is selected in the SET CENTER or SET START modes, everything is ignored until you correct the span setting.



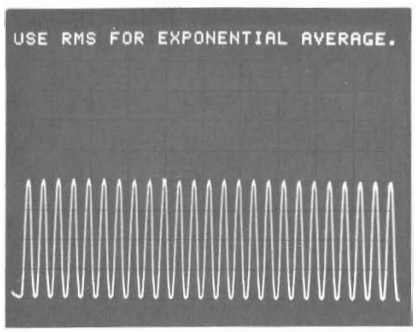
Both input channels must be selected before a transfer function measurement can be made.



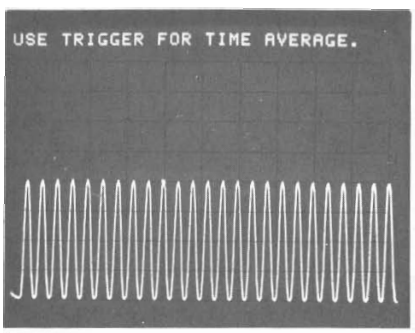
Coherence only makes sense in the dual channel mode and with averaging. See Application Note 245-2 for the detailed reasons why.



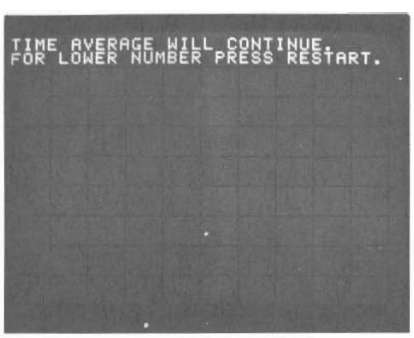
If the PASSBAND SHAPE is changed while doing PEAK or RMS averaging, the results will be invalid. Such changes are ignored until you press RESTART. If a change to or from a FREE RUN trigger is made while averaging, the same problem exists.



There is no exponential TIME average. Note that PEAK average can also be selected, but it is not truly exponential.



TIME average depends upon a synchronizing trigger for valid results. Without it, the measurement would not be useful.

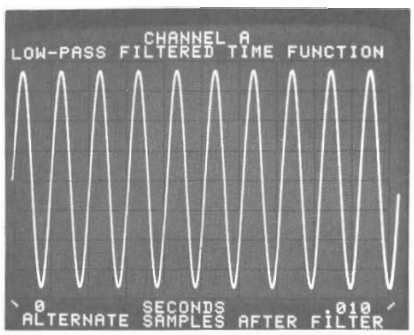


All of the AVERAGE MODES except TIME are properly calibrated as they progress. For example, if an RMS average is stopped at 146 by releasing the REPETITIVE control, the display is valid. This is not true for TIME average. Valid results are obtained only at the specified AVERAGE NUMBER.

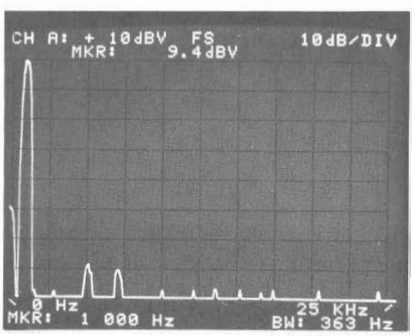
I. Overloads

There are two distinct overload indications on the 3582A and they serve different functions.

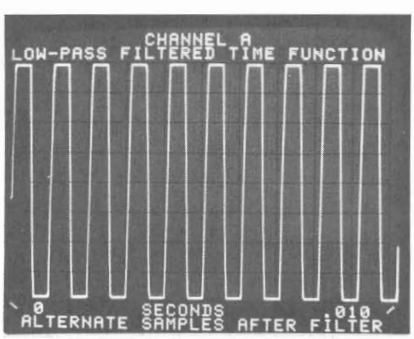
The LED overload indicators show momentary overloading of the input A/D converter or the digital filters. Either of these conditions indicates a "hard" overload as the following example illustrates. When the input is clipped like this, the spectrum display is of the clipped signal—which in this case is similar to a square wave.



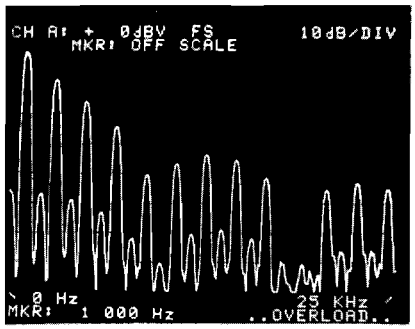
Non-overloaded time domain



Non-overloaded frequency domain



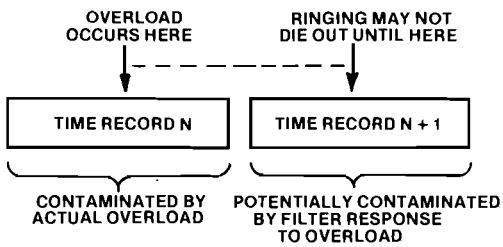
Overloaded time domain



Overloaded frequency domain

Valid measurements require the overload LED indicators to be out. There is no graceful overload of the front end; it is a hard clipping.

The CRT overload is somewhat more subtle. It is more of a warning or caution than anything else. It indicates that one or more of the time samples being analyzed **may** be invalid. For example, with a random noise input it indicates that one or more of the random excursions was clipped by the A/D converter. It also indicates that the data being analyzed may be contaminated by ringing of the digital filters as the following example shows.



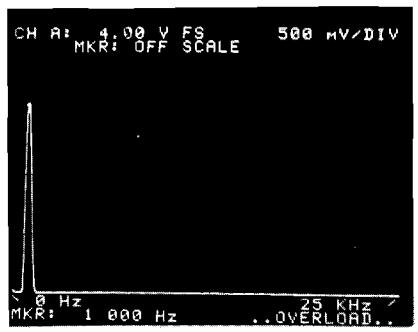
Here the ringing is caused by an occurrence in time record N. Its effects **may or may not** contaminate record N+1. Since an accurate determination of the effects can't be made, the CRT overload indicator is set during the analysis of both records N and N+1.

Similarly, if an overload occurs during any time record that is part of an average sequence, it may contaminate the results. Under these conditions the CRT overload indicator is latched for the duration of the potentially contaminated average sequence.

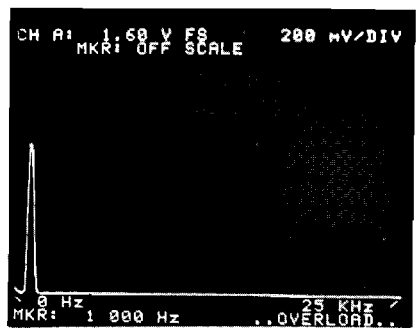
It is worth noting that any change of the INPUT SENSITIVITY control or the FREQUENCY SPAN MODE control cause momentary transients which show up as overloads. These will cause the overload LED to blink and the CRT overload to latch. Pressing RESTART will clear the latched CRT overload.

The actual level at which overloading occurs depends only on the setting of the INPUT SENSITIVITY Control. The AMPLITUDE REFERENCE LEVEL control is only a display scaling operation. With this control set to its normal position, the overload limit is at exactly full scale on the two log amplitude display modes.

The overload limit on the LINEAR amplitude mode is somewhat unusual. With the AMPLITUDE REFERENCE LEVEL control set to normal, the overload limit or maximum input level varies in a 1-3-10 sequence. The display full scale value, however, varies in a 4-8-16-40 sequence. This means that the overload limit is actually at either the 5th or 6th graticule line as follows:



Linear mode overload at 6th graticule



Linear mode overload at 5th graticule

VII. Basic Measurements

There are numerous areas where low frequency spectrum analysis is important. A few of the more significant are:

- Traditional electronics
- Telecommunications
- Mechanical and electromechanical systems
- Audio/acoustical
- Sonar/underwater sound
- Geophysical/seismic
- Biomedical

Within each of these segments, there are unique measurement problems that the 3582A will solve. This section presents a few specific comments about measurements found in these areas.

A. Traditional Electronics and Telecommunications

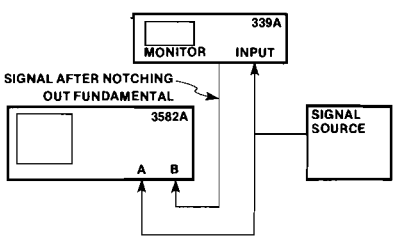
This is certainly the most familiar area of application for the Model 3582A. As such, most of the following measurements are review. The emphasis is on the unique capabilities that allow the 3582A to make the measurements better than before. The number of measurements reviewed indicates the exceptional flexibility of the instrument.

1. Harmonic Analysis

For measuring Total Harmonic Distortion (THD), the HP family of distortion analyzers is great. For analyzing harmonics individually, a spectrum analyzer is required. The 25 kHz frequency range limits the 3582A to low audio frequency signals, but in this range it has some unique capabilities.

The 3582A is unique in that it allows the phase of the harmonics to be measured. Some care must be exercised in setting up the phase reference but valid relative results are simple to obtain.

In some cases the 70 dB dynamic range of the 3582A may not be sufficient to see the harmonics as with the oscillator in the 339A. An interesting solution to this problem is as follows:



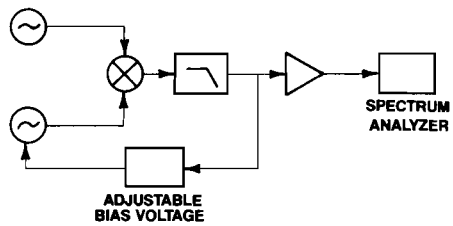
Here the internal notch of the 339A is used to eliminate the high amplitude fundamental and the result or residual output is measured on channel B. Putting the source on channel A provides a trigger signal for the TIME AVERAGE Mode. This allows the signal-to-noise ratio for the harmonics to be improved.

2. Spurious Tones, Sidebands, Etc.

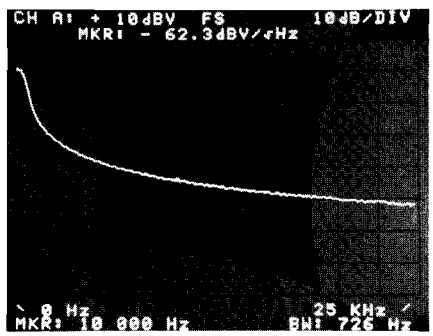
The measurement of spurious tones, etc., is a straightforward spectrum analysis task, but the 3582A offers a couple of unique capabilities. The exceptionally narrow resolution bandwidth makes it possible to resolve tones or sidebands very close together or near the carrier. The marker is capable of very accurate frequency (±0.003%) and amplitude readout of these tones. Again, with the phase capability, it is also possible to gain more information about a signal such as whether sidebands are AM or FM.

3. Close-In Phase Noise

The low end frequency coverage and real time measurement speed of the 3582A make it well suited to measuring close-in phase noise. Application Note AN 207 (Understanding and Measuring Phase Noise in the Frequency Domain) describes the following measurement technique:



A typical plot for a synthesizer looks like this:



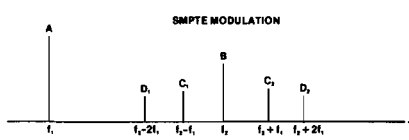
Note that the $\div\sqrt{BW}$ marker function reads out the noise level normalized to a 1 Hz bandwidth directly. This eliminates the need to correct the reading for analyzer characteristics.

4. Modulation Measurement

There aren't a great number of applications where an audio frequency carrier is intentionally modulated—with the exception of modems. Modulation does occur unintentionally and as noted earlier, the phase spectrum can be used to determine the actual type of modulation.

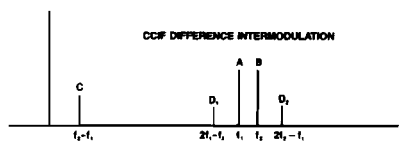
5. Intermodulation Distortion

There are two methods commonly used for measuring intermodulation distortion. One is the SMPTE method:



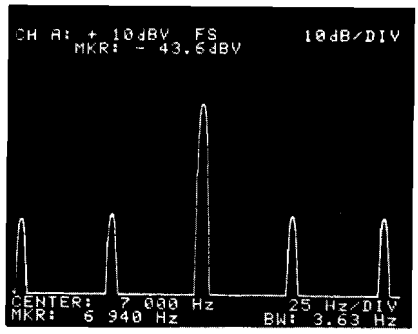
DISTORTION		COMMONLY USED FREQUENCIES
2ND	3RD	
$\frac{C_1+C_2}{B}$	$\frac{D_1+D_2}{B}$	60Hz-6000Hz 60Hz-7000Hz (1 HFM)

The other is the CCIF method.

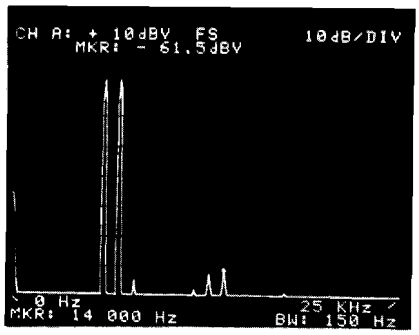


DISTORTION		COMMONLY USED FREQUENCIES
2ND	3RD	
$\frac{C}{A+B}$	$\frac{D_1+D_2}{A+B}$	6000Hz-7000Hz 1200Hz-1400Hz

The 3582A handles both measurements with ease.



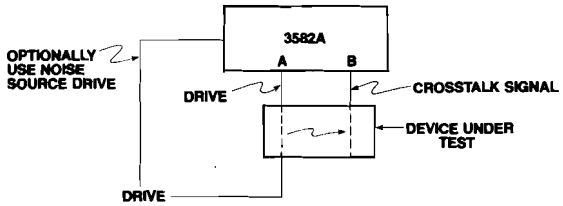
SMPTE method



CCIF method

6. Crosstalk

The dual-channel capability of the 3582A is handy for making crosstalk measurements as follows:

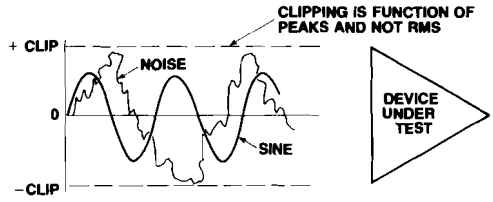


Putting the driven input on CHANNEL A and the crosstalk input on CHANNEL B allows the relative marker to directly read how far down the crosstalk is. Again, triggering on CHANNEL A and using the TIME AVERAGE can improve the ratio of the crosstalk signal to noise. If the built-in noise source is used as the drive source, crosstalk as a function of frequency is displayed with the marker still useful for direct readout. The 140 dB crosstalk specification of the 3582A should not pose problems in this measurement.

7. Filter Characterization

The transfer function capability of the 3582A provides both the gain and phase characteristics of two port networks such as filters. While this is very similar to the common network analyzer measurement, there are some differences:

a. The built-in noise source has a crest factor of between 3:1 and 4:1 as compared with a sine wave crest factor of about 1.4:1. As the following illustrates, additional care must be taken to prevent the device-under-test from clipping the drive signal:



SINE WAVE AND NOISE WITH EQUAL RMS VALUES

b. If the transfer function covers a wide dynamic range, averaging may be required in order to properly resolve the low level portions of the function. In these areas the signal-to-noise ratio is fairly low—but RMS averaging tends to smooth the truly random noise.

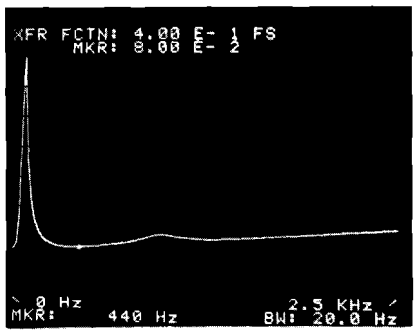
c. The coherence function can give you a qualitative measure of the signal-to-noise ratio at points of the measurement. It also gives confidence measures on the results.

d. It is even possible to obtain transfer function measurements with impulsive inputs—but the crest factor problems can be severe. The impulse can be generated externally and measured on channel A or in some cases, the rear panel impulse can be used.

---

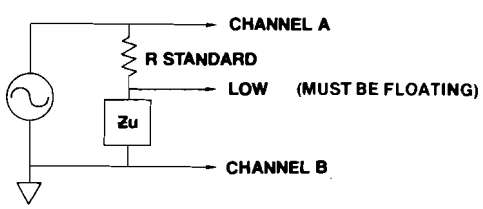
8. Electrical Impedance

Impedance measurements are nothing more than specialized transfer function measurements. They are specialized only in that one of the input signals is a voltage directly proportional to the current. While RLC meters measure impedances at fixed frequencies, this transfer function approach can give more complete results for complex impedances such as loudspeakers as shown:



Also, this approach can give good results at very low impedances.

The most straightforward approach is to use a series sensing resistor as shown:

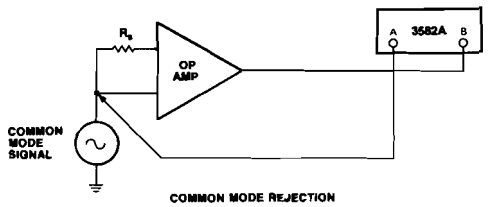


Probably the main thing to remember is that the noise source is capable of only about 10mA of output current so the total load must be 50Ω or greater.

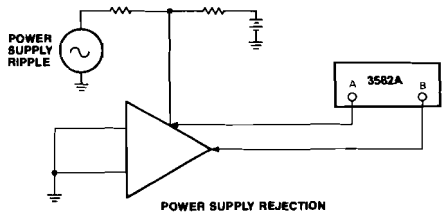
A second approach is to use a current sensing probe such as the Model 456A.

9. Amplifier Rejection Characteristics

The 3582A can be used to characterize both the common mode rejection and power supply rejection characteristics of an amplifier as shown:



COMMON MODE REJECTION



POWER SUPPLY REJECTION

B. Mechanical Systems

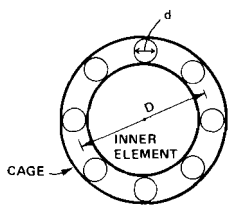
The study of mechanical sound and vibration is another area of application for the HP 3582A. With the appropriate transducers force and motion can be studied in the frequency domain. The following are some of the typical measurements of interest.

1. Rotating Machinery Signatures

Vibration is the motion of a mechanical structure caused by some type of force. One of the more common applications for measuring vibration is in characterizing the "health" of rotating machinery. Every rotating machine exhibits a unique vibration pattern or "signature" that is best viewed in the frequency domain.

Before dealing with the actual measurements, let's look at the sources of the vibration components. If there is an unbalanced mass off center from the rotating shaft, a rotating force vector of magnitude $F=MRW^2$ is generated. When a transducer is mounted at a fixed point, it sees the projection of a vector rotating at $W=2\pi Fr$. In the frequency domain, this is just a spectral line at Fr.

Now let's turn to the ball bearings in which the shaft rotates. As the following shows,



d = BALL DIAMETER
D = PITCH DIAMETER
N = NUMBER OF BALLS
F = ROTATION FREQUENCY

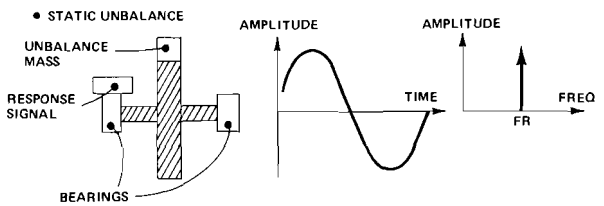
- F_r = ROTATION FREQUENCY
- F_B = BALL ROTATION FREQUENCY
  $= \frac{1}{2} \cdot F_r \cdot \left(\frac{D}{d}\right) \cdot \left[1-\left(\frac{d}{D}\right)^2\right]$
- F_C = CAGE ROTATION FREQUENCY
  $= \frac{1}{2} F_r \cdot \left(1-\frac{d}{D}\right)$
- F_ϕ = OUTER BALL PASSING FREQUENCY
  $= \frac{1}{2} \cdot F_r \cdot N \cdot \left(1-\frac{d}{D}\right)$
- F_I = INNER BALL PASSING FREQUENCY
  $= \frac{1}{2} \cdot F_r \cdot N \cdot \left(1+\frac{d}{D}\right)$

the bearing geometries cause spectral lines—all related to Fr. Modulation and intermodulation products are generated, again related to Fr. Only the true random noise components are not directly related to Fr. Similar results for gear trains can be derived.

The result is a messy spectrum with a relatively high level. The key problem is to identify problems as indicated by component changes. For example if the component Fr changes, the problem is likely to be balance. Other components can even be related to actual geometries.

2. Rotating Machinery Balance

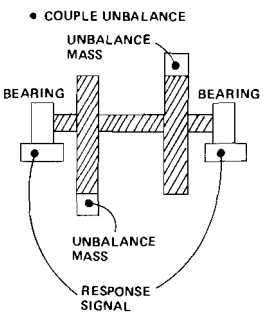
There are at least three major types of unbalance that are routinely discussed. The most common is called STATIC UNBALANCE and is when a single mass is off center as shown:



As mentioned earlier, the transducer effectively sees the projection of a rotating force vector which is just a sinusoid. With a little effort, the 3582A can identify and help correct this problem. First a single tach pulse must be generated to provide a position reference. By triggering with this signal, the phase of the unbalance signal gives the angular location of the unbalance.

Now by experimentally adding a known counterbalance mass at a known location, a new result is generated. Some straightforward vector algebra on the two sets of results will define how large the counterbalance mass should be.

A second type of unbalance is COUPLE UNBALANCE where two unbalanced masses cancel each other statically, but when rotated, set up a twist force.



This problem is solved in much the same way as before. Additional counterbalance weights are experimentally attached to the rotating parts. The number of experimental modifications and the vector algebra are more complex, but the process is fairly similar.

The final type of unbalance is DYNAMIC UNBALANCE which is just a combination of STATIC and COUPLE unbalance.

3. Mechanical Impedance Measurements

Mechanical systems and electrical systems are fundamentally very similar if you just remember the following correspondences.

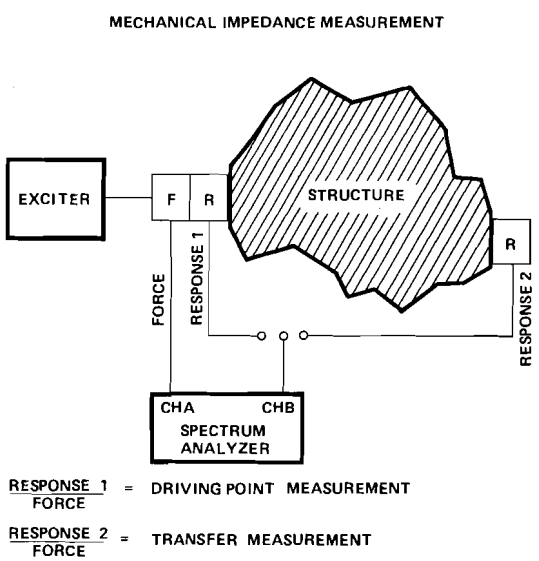
Electrical	Mechanical
Current	Force
Voltage	Velocity
Resistance	Damping
Capacitance	Mass
Inductance	Spring

When you consider mechanical systems as collections of masses, springs, and dampers, it is not surprising that a concept similar to electrical impedance becomes important.

The major difference is that in the electrical world, voltage and current are taken as the basic units. In the mechanical world, force is standard but motion is measured as displacement (X), velocity ($\frac{dx}{dt}$) or acceleration ($\frac{d^2x}{dt^2}$). This leads to six ratios where in the electrical world, there are only two:

RESPONSE PARAMETER	DISPLACEMENT	VELOCITY	ACCELERATION
RESPONSE / FORCE	RECEPTANCE	MOBILITY	INERTANCE
FORCE / RESPONSE	DYNAMIC STIFFNESS	MECHANICAL IMPEDANCE	APPARENT MASS

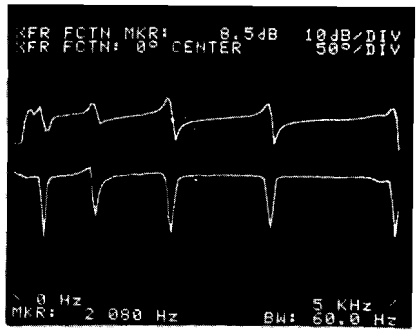
The key, of course, is how you actually measure useful information. That can be viewed as follows:



RESPONSE 1 / FORCE = DRIVING POINT MEASUREMENT

RESPONSE 2 / FORCE = TRANSFER MEASUREMENT

From this type of measurement, the result is typically a plot like this:



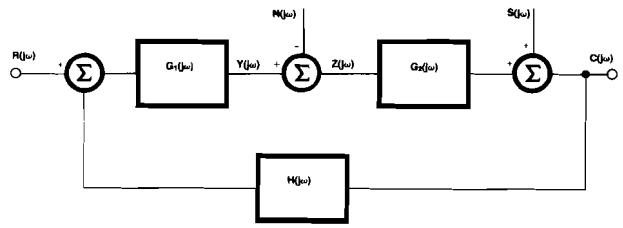
The resonances tend to relatively high Q—e.g. factors of 50 or larger are not uncommon. If the mechanical designer designs his safety margins on the average motion level, he may have to use extremely high margins—or his structure may shake itself apart. Most likely, he would try to modify the structure to dampen the resonances or to move them out of the area of trouble. In many cases, this is done experimentally implying a need for measurement of results.

These mechanical impedance type measurements require dual-channel transfer function capability. A second point is that mechanical resonances tend to be sharp and close together so band selectable analysis is a major requirement.

4. Feedback System Characterization

The designers of feedback systems almost invariably need to know the frequency and phase response of their closed loop system. By adding noise to the system, the Model 3582A can determine the parameters of the operating loop. The technical details of this type of application are discussed in Application Note 140-2.

Basically, the method can be viewed as follows:



Here the noise is added to the forward part of this loop with a summing node.

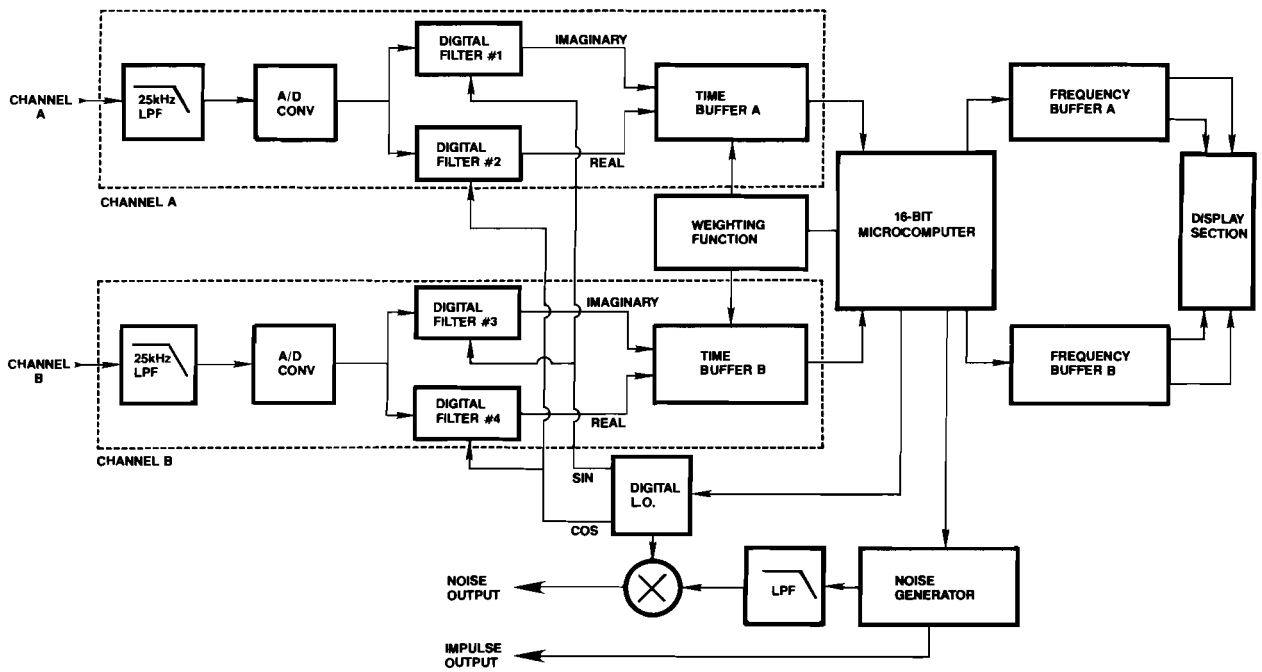
The Model 3582A is used to measure the transfer function Y/N. This is the "test ratio" T described in Application Note 140-2.

Appendix A.

Theory of Operation

The Model 3582A is a dual channel spectrum analyzer based on the calculation of the Discrete Fourier Transform by the use of the highly efficient Fast Fourier Transform algorithm. This section concentrates on the hardware organization. The basic block diagram is shown.

MODEL 3582A SPECTRUM ANALYZER BLOCK DIAGRAM



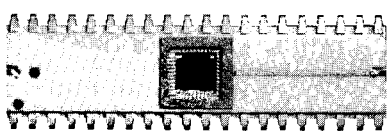
Both of the input channels are identical as shown. Their operation is principally determined by whether or not the frequency span mode is in SET START or SET CENTER or not. The simplest case to consider is the O-START case where the analysis always starts at DC. In this case, only one of the two digital filters is actively producing time sample outputs.

The 25 kHz analog low pass filter serves to eliminate any energy that could be aliased into the range of interest by the sampling process.

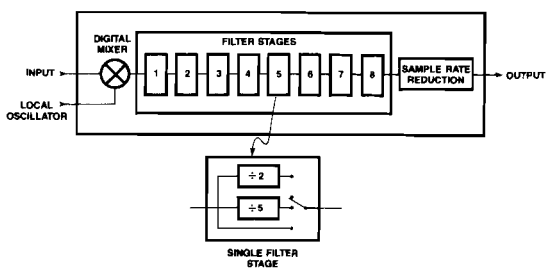
After this initial analog filtering, the input signal is fed into the 12-bit A/D converter. This produces a sequence of samples at a 102.4 kHz rate.* Further anti-alias filtering for all but the 25 kHz span is done digitally.

The four LSI digital filters represent an exceptional technology contribution. They are 200 mils on a side and perform several significant processing operations.

*Actually on the 10 kHz span, the sample rate is dropped to 81.92 kHz to take advantage of the digital filter structure.

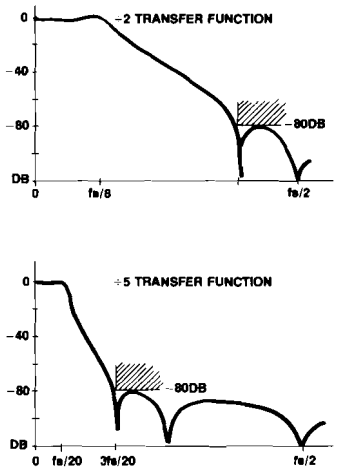


This implementation is critical to the price/performance ratio of the Model 3582A. From a block diagram point of view, the digital filters appear as follows:



Note that it is a cascade of eight distinct filter stages, each of which can reduce the incoming bandwidth by a factor of 0, 2, or 5. Thus, for example, to get the filtering for the 1 Hz range, the original 25 kHz bandwidth must be reduced by 25,000. This is

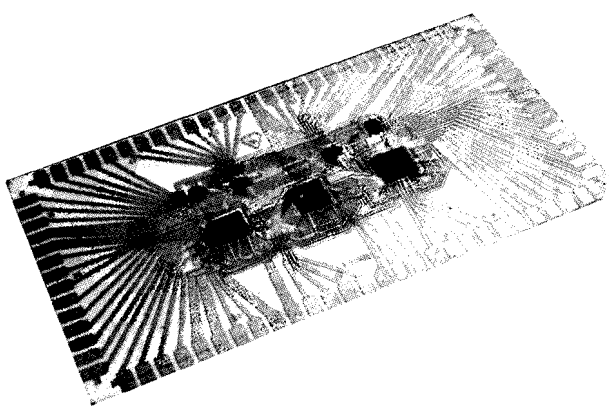
done by cascading five sections of ÷5 and three sections of ÷2 for a result of $(2^3) \cdot (5^5) = 25{,}000$. The characteristics of the ÷2 and ÷5 sections are as follows:



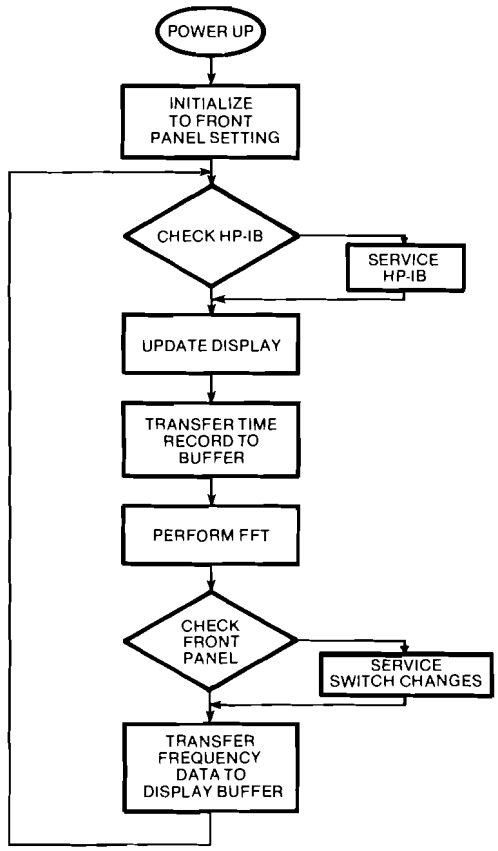
After the signal has been digitally low pass filtered, the samples that appear at the output are no longer independent. This means that parts of the data are theoretically redundant and can be ignored. This function is referred to as sample rate reduction. It essentially involves selecting samples at a rate of four times the span width. For example, on the 1 Hz span, only four samples per second are retained even though 102,400 per second come into the filter. What comes out of the filter is a properly anti-aliased filtered signal sampled at four times its maximum frequency of interest. This data is stored in the time buffer until a full 1024 point (single channel) or 512 point (dual channel) time record is complete.

In the SET START or SET CENTER frequency span modes, the digital filters perform a third function for band translation. In these modes, both digital filters in the input channel are processing data. One of the filters multiplies the incoming digital data by the digital value of the "local oscillator" cosine generator. The other multiplies the incoming data by the digital value of the "local oscillator" sine generator. The output of the first filter is treated as "real" data and the second as "imaginary" data. The result is that the time record that is constructed now consists of 512 complex points (single channel) or 256 complex points (dual channel). The FFT algorithm can process either real or complex data.

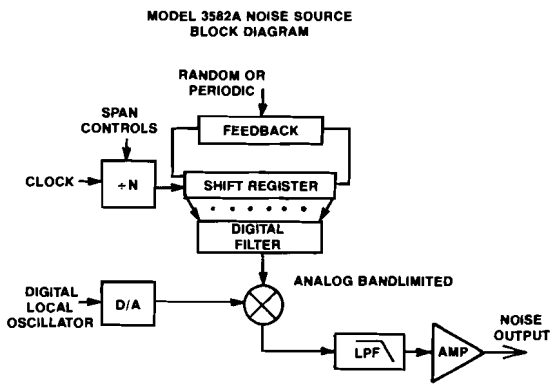
Once a time record is complete in the time buffer, the selected time domain weighting is applied to it. This is just a point by point multiplication of the record and a stored weighting function. The rest of the processing is basically software executed by the same powerful 16 bit microcomputer found in the HP Model 9825A desk top computer.



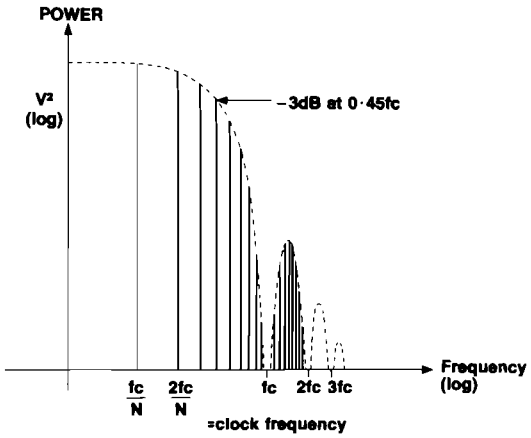
The program executes an FFT that is organized as follows:



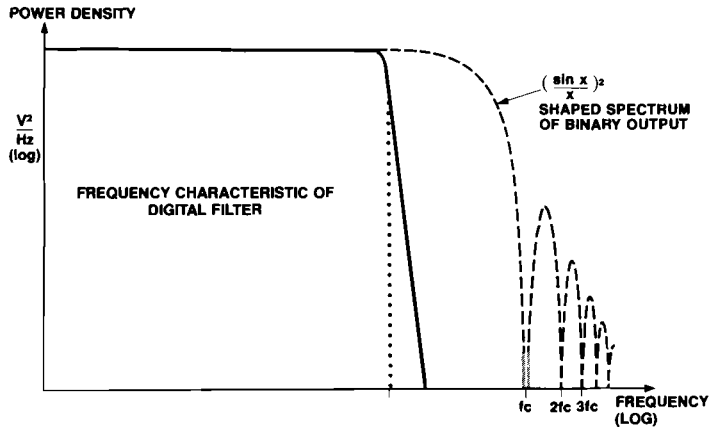
The noise source is based on the generation of a pseudo-random binary sequence which is then filtered. The block diagram is as follows:



In the periodic noise configuration, the shift register outputs a sequence of pseudorandom binary pulses that result in a $(\frac{\sin x}{x})$ line spectrum as follows:



By passing this signal through a good low pass digital filter,



a good approximation to a frequency comb is generated. By carefully selecting the filter cutoff, the slope of the envelope is kept very small. Note that the digital filter automatically tracks the modified clock frequency so it serves all spans.

In order to band translate the noise, the digital numbers that come out of the local oscillator are converted to the equivalent analog cosine signal. This is then mixed with the noise to translate the spectrum to the desired frequency.

In the random noise case, the length of the sequence is extended substantially. This results in a shift register period usually measured in hours and a line spacing that puts several thousand lines between calculated display points.

REMOTE OPERATION

In remote operation, the 3582A has even greater flexibility than in manual operation. The following functions describe how the 3582A may be controlled through the HP-IB.*

Remote Front-Panel Programming
In addition to the normal front panel switch controls, the operation of the 3582A can be controlled by remote commands sent on the HP-IB.

Instrument Data Output
Display data, alphanumerics, switch settings and other useful data can be output from the instrument for the purpose of making plots, additional processing, etc.

Instrument Data Input
Time record data obtained by external means can be input to the instrument for analysis. Also, any of the instrument data output may be reentered into the instrument at a later time.

Instrument Signal Processing Control and Status
Additional Special HP-IB commands allow limited control of the signal processing. An 8-bit status word is available to indicate various states of the signal processing.

I. REMOTE FRONT PANEL PROGRAMMING.

The Command List specifies all of the functions which may be activated by the 3582A via the HP-IB. Note that many of the functions are the remote equivalent of setting a front panel switch manually and may be executed in similar sequences. For example, the arm command (AR) would not be given until all other applicable functions are set for a measurement operation. The Command List is given at the end of this Appendix.

The HP-IB status light "REMOTE," located at the lower left of the front panel, indicates whether the instrument is currently operating under local (front panel switches) or remote control. Remote operation is accomplished only via commands sent on the HP-IB.

When the instrument is in local, the operation is determined solely by the front panel settings. At the time that the instrument is programmed to remote, the operation remains exactly the same as it was in local. Additional commands sent on the HP-IB can change the mode of operation. Returning to local, either by pushing the LOCAL button or by an HP-IB command, causes the instrument to return to front panel switch control.

A. Syntax.

The Command List (actually sent as DATA) is divided into groups of related operations. Each command in a group is divided into a function and a setting (some groups do not have settings). If the function is a front panel switch, the letters will correspond to the underlined letters of the name of that switch on the front panel. The setting indicates a switch position. A zero setting will indicate that the switch is out (OFF) and numbers greater than zero indicate that the switch is in (ON) or set at some other position (rotary switches and slide switches). On rotary and slide switches, a one (1) will indicate a counterclockwise or left most position (COUPLING switches excepted, a one indicates ac).

Adjust Frequency. For Adjust Frequency (AD 0-24999), the setting is a number which corresponds to the CENTER or START frequency in the band analysis modes.

Marker Position. The marker position setting corresponds to a position on the display. For single trace modes of operation, the marker may be programmed to one of 256 horizontal positions. For dual trace operation, the marker may be programmed to one of 128 horizontal positions on the selected trace.

B. Delimiters.

Delimiters are not needed, but if desired, commas, spaces, upper or lower case alphanumerics can be used.

NOTE

The last character needs to be followed by a CRLF, space, or a comma. For example, the 9825A automatically sends this information if the **wrt** *statement is used. If the* **cmd** *statement is used, these additional characters must be supplied. Spaces following characters will not affect the messages sent, except for the write alphanumerics (WTA) command which requires the output string of characters to have a fixed number of characters (32) and may consist of spaces and/or alphanumeric characters.*

```
          -hp- 9825A
Example:  wrt711,"prs, ad442,ac1"
          wrt711,"PRSAD442AC1"
```

II. SPECIAL FRONT PANEL COMMANDS.

Special commands are useful when it is desirable to set the front panel controls for a particular mode of operation. Special sequences are useful when data is being transferred between the 3582A and a controller.

A. Preset.

The preset (PRS) command places the 3582A front panel controls in a mode which is equivalent to that in the Turn-On Procedure. If the 3582A instrument appears to be "hung up" due to an inadvertant programming error, sending the PRS command will often return the instrument to an operating status. Furthermore, it is a good programming practice to "initialize" the front panel controls of the 3582A using the PRS command before entering an extensive programming sequence. See the Command List for the PRS switch settings.

* HP-IB is Hewlett-Packard's implementation of IEEE Std. 488-1975, "Standard Digital Interface for Programmable Instrumentation."

B. Setting the Marker.

The marker position command (MP) combined with a marker position number (0-255 or 0-127) sets the marker horizontal position on the display. The marker position may be determined by the following equations:

$$\text{MARKER POSITION} = \frac{250 \text{ (or } 125^{*})}{\text{SPAN}} \times (fm - fs)$$

Where: fm = Desired marker frequency
fs = START FREQUENCY or
CENTER FREQUENCY - $(\frac{\text{SPAN}}{2})$

***NOTE**

The marker has 128 positions for each trace in dual mode.

Note that on larger spans and dual trace operation, the marker position (derived from the equation) will not be an integer for some frequencies. In this case, round the marker position to the nearest integer number.

III. INSTRUMENT DATA OUTPUT.

The listing commands are used to read control or display data from the 3582A. The general form for initiating a list command requires that the list command be given by the controller which sets the 3582A in a "talk" mode. The 3582A will then output data, as specified by the list command, to the controller which must then be programmed to the "listen" mode.

A. Listing Control Settings.

The position of some front panel control settings, in decimal or exponential format, may be read by the controller through the following list commands:

Command	Description
LAD	List frequency adjust value NNNNN.NN CRLF
LMK	List marker amplitude and frequency ± NNNNNE ± NN, NNNNN.NNN CRLF
LSP	List span (Hz) NNNNN CRLF
LAS	List channel A sensitivity
LBS	List channel B sensitivity ± N.NNE ± NN CRLF
LXS	List Transfer Function sensitivity

Notice that all of the list commands above, except LMK, require one variable in which to store the data in the controller. The LMK instruction requires two variables in which to store data, and both must be available when the LMK command is given. The sensitivities obtained by the LAS, LBS, and LXS commands are the same as those indicated on the display and are the total of the SENSITIVITY switch setting and the AMPLITUDE REFERENCE LEVEL switch setting. The units are either volts or dBV as determined by the LOG/LINEAR switches.

Program Examples.

List frequency adjust value (LAD).

```
0: "program to
 demo LAD comman
 d":
1: fxd 1;wrt
 711,"LAD"
2: red 711,A;
 prt A;dsp "FREQ
 =",A
3: lcl 711;end
*6446
```

List marker amplitude and frequency (LMK).

```
0: "program to
 demo LMK comman
 d":wrt 711,"LMK
 ";red 711,A,B
1: flt 2;prt A,
 B;dsp "A=",A,
 "B=",B
2: lcl 711;end
*17489
```

List span (LSP).

```
0: "program to
 demo LSP comman
 d":
1: fxd 1;wrt
 711,"LSP"
2: red 711,A;
 prt A;dsp "SPAN
 =",A
3: lcl 711;end
*323
```

List channel A sensitivity (LAS).

```
0: "program to
 demo LAS comman
 d":
1: flt 2;wrt
 711,"LAS"
2: red 711,A;
 prt A;dsp "ASEN
 S=",A
3: lcl 711;end
*29531
```

B. Listing Display Data. The display graphics or the display alphanumerics may be listed using the following instructions:

Command	Description
LDS	List display (128, 256, or 512 points in corresponding units) each point ± N.NNE ± NN separated by commas; CRLF
LAN	List alphanumerics (128 ASCII characters, CRLF; representing the four 32 character lines)

The LDS instruction causes the 3582A to output data from the display in three different quantities. The number of points which are ouputted depends upon the particular mode of operation the instrument is in when the LDS command is received as the following table illustrates.

LDS Points Returned.

No. of Points	Mode of Operation
128	Single trace in dual channel mode
256	1. Single trace in single channel mode 2. Dual trace in dual channel mode (128 points for channel A followed by 128 points for channel B) 3. Single time trace in dual channel mode
512	Single trace time in single channel mode

The points are outputted in corresponding units. That is, the SCALE and SENSITIVITY will determine the type of units and the relative magnitude. However, the magnitude of the time points are determined by the SENSITIVITY setting alone. Each group of ASCII coded characters is separated by commas with the CRLF sent after the last point.

Note that if the display is listed when the instrument is in the UNCAL (uncalibrated) mode, the units which are output will be different than when the instrument is in the CAL mode as follows:

Output Units.

Function	CAL	UNCAL
Amplitude	dBV (log) Volts (lin)	0 to 1
Time	−1 to +1	0 to 1
Phase	−200 to +200	0 to 1
Transfer Function	dB	dB

Program Example.

List display points (LDS).

```
0: "program to
 demo LDS comman
 d":
1: fmt 1,f4.0,
 2x,e10.2;wrt
 711,"LDS"
2: red 711
3: for I=0 to 9
4: red 731,A;
 wrt 16.1,I,A
5: next I
6: spc 2;lcl
 711;end
*23532
```

The LAN (list alphanumerics) instruction causes the 3582A to output 128 ASCII coded characters which represent the four alphanumeric display lines. Note that some symbols such as √ (square root) do not have an ASCII equivalent and may require conversion to another code form. The following gives the displayed character and the ASCII equivalent which is sent or received over the HP-IB.

Display-ASCII Equivalents.

LISTEN							LISTEN						
OCT	DEC	CHAR SENT	CHAR DISP	CHAR RETN	OCT	DEC	OCT	DEC	CHAR SENT	CHAR DISP	CHAR RETN	OCT	DEC
40	32				40	32	100	64	@	@	@	100	64
41	33	!	!	!	41	33	101	65	A	A	A	101	65
42	34	"	"	"	042	034	102	66	B	B	B	102	66
43	35	#	#	#	043	035	103	67	C	C	C	103	67
44	36	$	$	$	044	036	104	68	D	D	D	104	68
45	37	%	%		045	037	105	69	E	E	E	105	69
46	38	&	&		046	038	106	70	F	F	F	106	70
47	39	'			047	039	107	71	G	G	G	107	71
50	40	(	(	(	050	040	110	72	H	H	H	110	72
51	41	)	)	)	051	041	111	73	I	I	I	111	73
52	42	*	*	*	052	042	112	74	J	J	J	112	74
53	43	+	+	+	053	043	113	75	K	K	K	113	75
54	44	,	,	,	054	044	114	76	L	L	L	114	76
55	45	-	-	-	055	045	115	77	M	M	M	115	77
56	46	.	.	.	056	046	116	78	N	N	N	116	78
57	47	/	/	/	057	047	117	79	O	O	O	117	79
60	48	0	0	0	060	048	120	80	P	P	P	120	80
61	49	1	1	1	061	049	121	81	Q	Q	Q	121	81
62	50	2	2	2	062	050	122	82	R	R	R	122	82
63	51	3	3	3	063	051	123	83	S	S	S	123	83
64	52	4	4	4	064	052	124	84	T	T	T	124	84
65	53	5	5	5	065	053	125	85	U	U	U	125	85
66	54	6	6	6	066	054	126	86	V	V	V	126	86
67	55	7	7	7	067	055	127	87	W	W	W	127	87
70	56	8	8	8	070	056	130	88	X	X	X	130	88
71	57	9	9	9	071	057	131	89	Y	Y	Y	131	89
72	58	:	:	:	072	058	132	90	Z	Z	Z	132	90
73	59	;	;	;	073	059	133	91	[	[	[	133	91
74	60	<	<	<	074	060	134	92	\	\	\	134	92
75	61	=	=	=	075	061	135	93	]	]	]	135	93
76	62	>	>	>	076	062	136	94	^	^	^	136	94
77	63	?	?	?	077	063	137	95	_	_	_	137	95
100	64	@	@	@	100	064	140	96	`	`	`	140	96
101	65	A	A	A	101	065	141	97	a	a	a	141	97
102	66	B	B	B	102	066	142	98	b	b	b	142	98
103	67	C	C	C	103	067	143	99	c	c	c	143	99
104	68	D	D	D	104	068	144	100	d	d	d	144	100
105	69	E	E	E	105	069	145	101	e	e	e	145	101
106	70	F	F	F	106	070	146	102	f	f	f	146	102
107	71	G	G	G	107	071	147	103	g	g	g	147	103
110	72	H	H	H	110	072	150	104	h	h	h	150	104
111	73	I	I	I	111	073	151	105	i	i	i	151	105
112	74	J	J	J	112	074	152	106	j	j	j	152	106
113	75	K	K	K	113	075	153	107	k	k	k	153	107
114	76	L	L	L	114	076	154	108	l	l	l	154	108
115	77	M	M	M	115	077	155	109	m	m	m	155	109
116	78	N	N	N	116	078	156	110	n	n	n	156	110
117	79	O	O	O	117	079	157	111	o	o	o	157	111
120	80	P	P	P	120	080	160	112	p	p	p	160	112
121	81	Q	Q	Q	121	081	161	113	q	q	q	161	113
122	82	R	R	R	122	082	162	114	r	r	r	162	114
123	83	S	S	S	123	083	163	115	s	s	s	163	115
124	84	T	T	T	124	084	164	116	t	t	t	164	116
125	85	U	U	U	125	085	165	117	u	u	u	165	117
126	86	V	V	V	126	086	166	118	v	v	v	166	118
127	87	W	W	W	127	087	167	119	w	w	w	167	119
130	88	X	X	X	130	088	170	120	x	x	x	170	120
131	89	Y	Y	Y	131	089	171	121	y	y	y	171	121
132	90	Z	Z	Z	132	090	172	122	z	z	z	172	122

Program Example.

List alphanumerics (LAN).

```
0: "program to
 demo LAN comman
 d":
1: dim A$[130];
 fxd 0
2: wrt 711,"LAN"
3: red 711,A$
4: wrt 16,A$[1,
 32]
5: wrt 16,A$[33,
 64]
6: wrt 16,A$[65,
 96]
7: wrt 16,A$[97,
 128]
8: wrt 0,A$[1,
 32];stp
9: wrt 0,A$[33,
 64];stp
10: wrt 0,A$[65,
 96];stp
11: wrt 0,A$[97,
 128];stp
12: lcl 711;end
*5323
```

IV. INSTRUMENT DATA INPUT.

A. Writing Alphanumeric Messages.

Alphanumeric messages may be written into any of the four alphanumeric lines on the display through the use of the following instruction:

WTA 1-4, 32 ASCII Characters

select line 1, 2, 3, or 4 Use blanks to fill up remaining spaces to total 32.

The first part of the instruction (WTA) should be followed immediately by a line number and a comma. The next 32 characters are reserved for the text of the message. For example, to write "A COSINE SPECTRUM" on line 1 of the display, the command and message would appear as follows (Δ means space):

"WTA1,ΔΔΔΔΔΔΔAΔCOSINEΔSPECTRUMΔΔΔΔΔΔΔΔ"

NOTE

The text of the message must have at least 32 characters or the 3582A will not display the message and will appear to be "hung up" while waiting for the completion of the message.

Program Example.

Write alphanumerics (WTA).

```
0: "program to
 demo WTA comman
 d":
1: dim B$[37]
2: "WTA1,"→B$[1,
 5];dsp "Write
 a 32 character
 message";wait
 5000;ent B$[6,
 37]
3: prt B$[6,37];
 wrt 711,B$
4: lcl 711;end
*23868
```

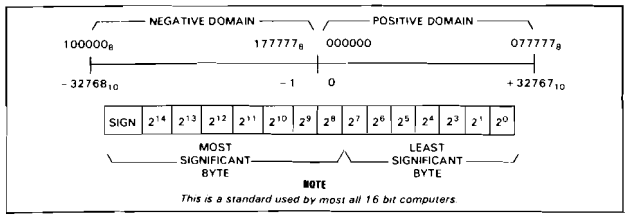
V. WORKING WITH MEMORY.

The RAM (Random Access Memory) contents are completely accessible via the HP-IB. Data in memory is stored in a binary format consisting of 16 bit words. But information is transferred over the HP-IB in 8 bit bytes, therefore, two bytes are required to transmit or receive memory word.

A. The Binary Format.

In order to work with memory data directly, it is important that the binary format of words be understood. The words themselves indicate a magnitude for numerics or a particular code for alphanumerics. There are no units indicated in a numeric word and the word is simply a 2's complement binary number with an equivalent decimal range of from -32768 to +32767 as shown.

Words in Memory.



In the display section of memory, numerics and alphanumerics are mixed together and require a decoding procedure if they are to be interpreted by a controller program as binary data. This will generally not be necessary since the List Display commands perform the decoding operations and transmit the words in ASCII format.

When binary data is transmitted over the bus between the controller and the 3582A, the most significant byte of a 16 bit word is sent first followed by the least significant byte.

B. Memory Instructions.

There are two instructions for working with binary memory data. These commands are primarily for the advanced user who wishes to input his own time record or display or to do special processing:

Command Description

LFM,M,N List from memory
WTM,M,N Write to memory

Where: M = Start address (octal)
N = Number of words to be transferred (decimal)
Data is in 2N 8 bit bytes, most significant byte first

These memory instructions are transmitted via the HP-IB in ASCII format. The controller must be programmed to take the appropriate action directly after the instruction is sent with no intervening messages. Each instruction requires that the memory location (in octal) be specified. For example, if a time record is to be entered into the 3582A for processing, the instruction would appear as follows:

WTM,70000,1024

NOTE

The 3582A starts accepting or sending binary data after the LF character is sent. The CRLF is automatically sent by the 9825A if the **wrt** *command is used. When the LFM or WTM instruction is used, a CR or LF is not sent by the 3582A after the binary string, nor is it looked for after a binary string is received from the controller.*

After the instruction is given, the controller may send the data as a character string or as individual bytes.

C. Memory Locations.

The principal memory locations of interest are given as follows:

Description	Start Address (M, octal)	Number of Words (N, decimal)	Binary Format
Time Record	70000	1024	Numeric
Display	74000	512	Alphanumeric
Front Panel Switches	77454	5	Numeric
Stored Trace 2	75400	256	Numeric

VI. INSTRUMENT SIGNAL PROCESSING CONTROL AND STATUS.

A. Service Request.

Service Request (SRQ) is set only as a result of syntax errors caused by improper HP-IB commands. It is cleared by a DEVICE CLEAR or cleared as the result of a SERIAL POLL. When cleared, the five bit status byte returned will always consist of zeros.

B. Status Word.

The status word may be used to determine what operational state the 3582A is in. The eight bit status word contains the following information:

Bit	Value	Meaning
0	1	Diagnostic on screen. Indicates current switch setting is invalid. Set and cleared by 3582A.
1	2	Arm light is on. Set and cleared by 3582A to agree with arm light on front panel.
2*	4	A overload. Set by 3582A when 1. Time record is moved to FFT area or time record is complete 2. and hardware overload has occurred 3. and A or BOTH INPUT MODE
3*	8	B overload. Same as A.
4*	16	Time record complete. Set when 1024 new time points have been taken since last record complete. Set when time complete data has been FFT'D and displayed. Use LST1 to check this flag! It depends on internal flags which are cleared by LST0.
6*	64	Average complete.
7*	128	X-Y plot complete. If two traces are plotted, it is set after the final trace.

NOTE

The Status Word is not the same as the HP-IB STATUS BYTE. The STATUS BYTE returned as the result of a serial poll will be zeros since the only reason for an SRQ from the 3582A is incorrect HP-IB commands.

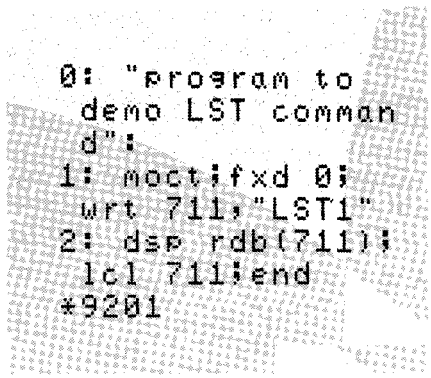
The two commands for obtaining a status word are:

Command	Description
LST1	Reads status word
LST0	Reads status word and then resets*

As with many other HP-IB commands, the controller first gives the command and then reads the returning byte into a variable for decoding. The LST0 command resets the starred bits after they are read so that new information may be entered on the next machine cycle.

Program Example.

List status word (LST).



C. Processor Control Commands.

There are two processor control commands which can be used to improve data transfer rates when large blocks of data are transmitted.

Command	Description
HLT	Unconditional halt at next HP-IB branch point
RUN	Unconditional run

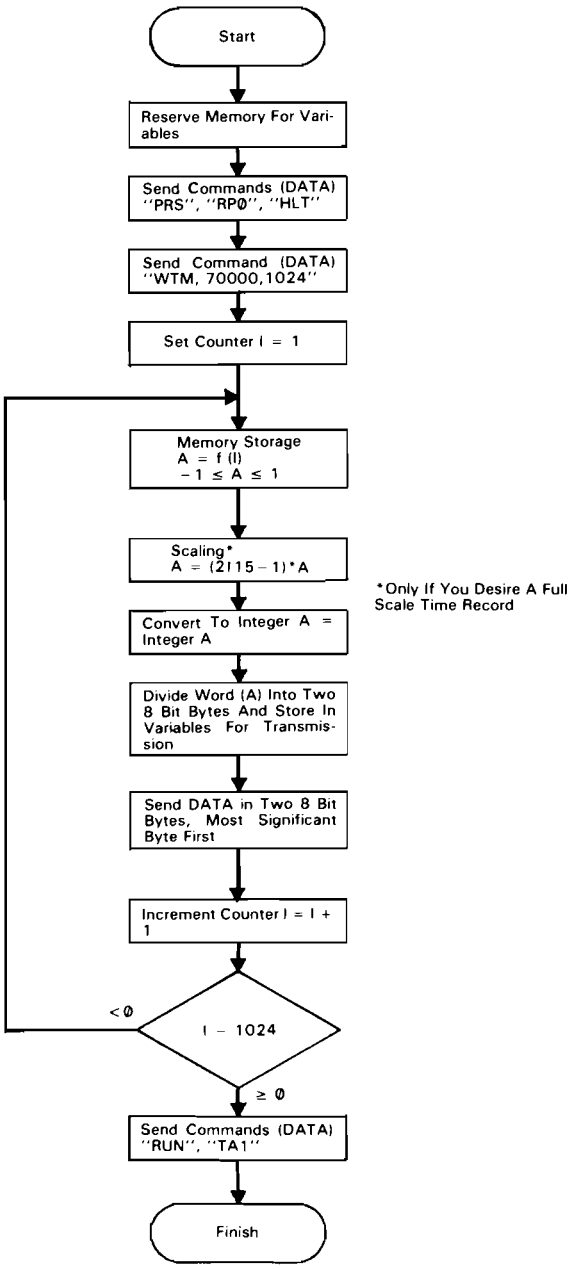
Without the use of these commands, the processor handles the HP-IB in an interrupt mode of operation. When the HLT command is given, the processor is stopped which allows practically direct memory access without unnecessary time delay. After the data is transferred, the processor may be returned to normal operation by giving the RUN command. However, no momentary buttons are processed when the processor is in the HLT mode.

VII. EXAMPLE FLOWCHARTS AND PROGRAMS.

A. Loading a Time Record Into Memory.

The following flowchart presents the fundamental steps needed to load a time record into memory in the baseband 0-25 kHz mode. The time record should consist of 1024 data points with each point being a 16 bit 2's complement number (other magnitude ranges will require scaling). The example flowchart includes scaling for a function which has a range between +1 and −1 and also conversion of the scaled number to an integer.

Storing a Time Record in Memory.



*Only If You Desire A Full Scale Time Record

Program Example: Writing to Memory.

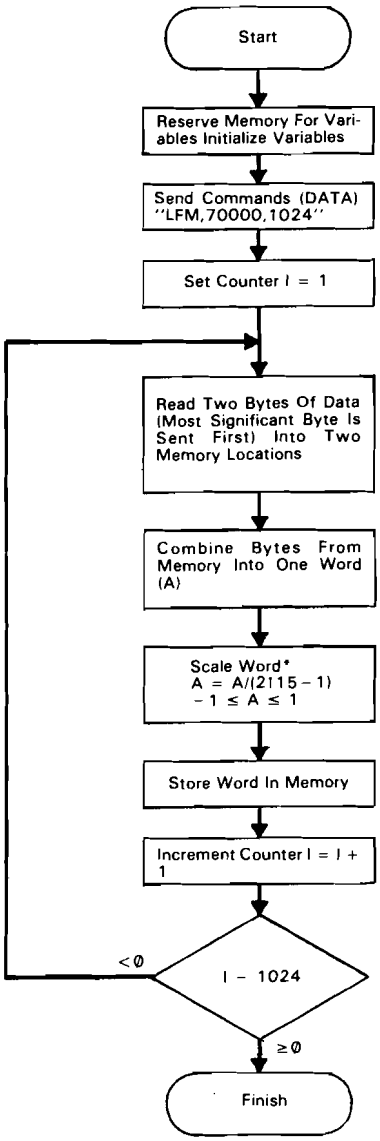
Write to memory (WTM).

```
0: "program to
 demo WTM comman
 d":
1: rad;wrt 711,
 "TA1"
2: mdec;dim A[10
 24]
3: for I=1 to
 1024
4: 20000*cos(2π*
 (I-1)/256)→A[I]
5: next I
6: fmt 1,"WTM,
 70000,1024"
7: wrt 711.1
8: beep
9: for I=1 to
 1024
10: wtb 731,shf(
 A[I],8)
11: wtb 731,band
 (255,A[I])
12: next I
13: beep
14: end
*9460
```

B. Reading Binary Data From Memory.

The following flowchart presents the fundamental steps needed to read data from memory. A very useful function, derived from this operation, is the storage of data for long periods of time. Remember that if the 3582A is turned off, all data in RAM is lost. As an example, switch settings, time records, or the entire display may be stored in the controller and then later written back into the 3582A memory (using a technique similar to entering a time record but without the need for scaling since the data itself is merely being stored and not operated on). The example flowchart includes scaling* but this step may be skipped if the data is only to be stored.

Reading Binary Data From Memory.



*Only Necessary If Data Is Operated On.

C. The Learn Mode.

One method of programming the instrument is to use the PRS (preset) command and then program the control settings as necessary. Another method involves the Learn Mode. To use this method, the instrument controls are set up manually in the LOCAL mode of operation. The switch settings may then be stored in the controller by accessing the five switch registers using the LFM (list from memory) command. At a later time when it is desirable to duplicate the same switch settings, the controller may write the switch settings back into the five switch registers using the WTM (write to memory) command.

Program Example: The Learn Mode (reading and writing to memory).

Learn mode.

```
0: "program to
 demo learn mode
 ":
1: dim A[10]
2: dsp "learn
 mode demonstrat
 ion"
3: wrt 711,"LFM,
 77454,5"
4: rdb(711)→A[1]
5: for I=2 to 10
6: rdb(711)→A[I]
 ;next I
7: beep;dsp "swi
 tch settings
 learned"
8: wait 1000;
 beep
9: lcl 711;beep
10: dsp "press
 cont to reprogr
 am 3582"
11: stp
12: wrt 711,"WTM
 ,77454,5"
13: wtb 711,A[1]
14: for I=2 to
 10
15: wtb 711,A[I]
16: next I
17: beep;end
*8362
```

HP-IB COMMAND LIST

HP-IB Command List.

Group	Command: Function	Command: Setting	Description
Input & Trigger	IM	1-3	Input Mode (A, Both, B)
	AC	1-2	A Coupling (1 = AC, 2 = DC)
	BC	1-2	B Coupling (1 = AC, 2 = DC)
	AS	1-10	CH A Sensitivity: 1 = CAL; 2 = 30 V, +30 dBV; 3 = 10 V, +20 dBV; 4 = 3 V, +10 dBV; 5 = 1 V, +0 dBV; 6 = .3 V, −10 dBV; 7 = .1 V, −20 dBV; 8 = 30 mV, −30 dBV; 9 = 10 mV, −40 dBV; 10 = 3 mV, −50 dBV
	BS	1-10	CH B Sensitivity: 1 = CAL; 2 = 30 V, +30 dBV; 3 = 10 V, +20 dBV; 4 = 3 V, +10 dBV; 5 = 1 V, +0 dBV; 6 = .3 V, −10 dBV; 7 = .1 V, −20 dBV; 8 = 30 mV, −30 dBV; 9 = 10 mV, −40 dBV; 10 = 3 mV, −50 dBV
	SL	1-2	Slope (1 = +, 2 = −)
	AR		Arm
	RP	0-1	Repetitive
	FR	0-1	Free Run
Frequency & Marker	AD	0-24999	Adjust (Frequency) (0 = 0 Hz, 24999 = 24999 Hz)
	MD	1-4	Mode (1 = 0-25 kHz, 2 = 0 Start, 3 = Set Start, 4 = Set Center)
	SP	1-14	Span: 1 = 1 Hz; 2 = 2.5 Hz; 3 = 5 Hz; 4 = 10 Hz; 5 = 25 Hz; 6 = 50 Hz; 7 = 100 Hz; 8 = 250 Hz; 9 = 500 Hz; 10 = 1 kHz; 11 = 2.5 kHz; 12 = 5 kHz; 13 = 10 kHz; 14 = 25 kHz
	MN	0-1	Marker
	MR	0-1	Marker Relative
	MS		Marker Set Ref

HP-IB Command List (Cont'd).

Group	Command		Description
	Function	Setting	
	MB	0-1	Marker / $\sqrt{BW}$
	MT	0-1	Marker Trace
	MF		Marker Set Freq
	MP	0-255	Marker Position (0-127 for dual channel)
	AA	0-1	Amplitude A
	AB	0-1	Amplitude B
	AX	0-1	Amplitude Transfer Function
	SC	1	Scale Linear
	SC	2	Scale 10 dB/Div.
Display	SC	3	Scale 2 dB/Div.
	PA	0-1	Phase A
	PB	0-1	Phase B
	PX	0-1	Phase Transfer Function
	TA	0-1	Time A
	TB	0-1	Time B
	CH	0-1	Coherence
	AM	1-9	Amplitude Ref. Level (Add −10 dB per step, 2 = −10 dB, 9 = −80 dB)
Passband Shape	PS	1	Flattop
	PS	2	Hanning
	PS	3	Uniform
	AV	1	Off
	AV	2	RMS
	AV	3	Time
	AV	4	Peak
Average	RE		Restart
	NU	1	Number 4/64
	NU	2	Number 8/128
	NU	3	Number 16/256
	NU	4	Number 32/Exp
	SH	0-1	Shift
Trace Storage & Recall	TS		Trace 1 Store
	TR	0-1	Trace 1 Recall
	RS		Trace 2 Store
	RR	0-1	Trace 2 Recall
X-Y Recorder	PL		X-Y Plot
	LL		↓←Lower Left & Reset)
	UR		→↑ (Upper Right)

Special Commands

Group	Command	Description
Listing Commands	LAD	List frequency adjust value NNNNN.N CRLF
	LMK	List marker amplitude and frequency ±N.NNNE±NN, NNNNN CRLF
	LSP	List span (Hz) NNNNN CRLF
	LAS	List Ch A sensitivity } ±N.NNE±NN CRLF
	LBS	List Ch B sensitivity } ±N.NNE±NN CRLF
	LXS	List transfer function sensitivity } ±N.NNE±NN CRLF
	LDS	List display (128, 256, or 512 points in corresponding units) each point ±N.NNE±NN separated by commas; CRLF
	LAN	List alphanumerics (128 ASCII characters, CRLF; representing the four 32 character lines)
Binary Memory I/O	LFM,M,N	List from memory
	WTM,M,N	Write to memory M = Start Address (Octal) N = Number of words to be transferred (decimal) Input is in 2N 8-bit bytes Most significant byte first
Writing Display Alpha-numerics	WTA 1–4, 32 ASCII Characters	Inputs a 32 character string to alpha line 1 to 4 (top to bottom) of display. Use blanks where needed to complete 32 character count.
Processor Control	HLT	Unconditional halt at next HP-IB branch point
	RUN	Unconditional run
Status Word	LSTØ LST1	List status word *(LSTØ Resets Bits After Reading) One 8-Bit Byte Bit / Value / Meaning 0 / 1 / Diagnostic on screen. Indicates current switch setting is invalid. Set and cleared by 3582. 1 / 2 / Arm light is on. Set and cleared by 3582 to agree with arm light on front panel. 2* / 4 / A overload. Set by 3582 when: 1)Time record is moved to FFT area or time record is complete 2)and hardware overload has occurred 3)and A or BOTH INPUT MODE. 3* / 8 / B overload. Same as A. 4* / 16 / Time record complete. Set when 1024 new time points have been taken since last record complete.

Special Commands (Cont'd).

Group	Command	Description	
		5* 32	Single sweep spectrum complete. Set when time complete data has been FFT'D and displayed. Use LST1 to check this flag! It depends on internal flags which are cleared by LSTØ.
		6* 64	Average complete.
		7* 128	X–Y plot complete.
Preset	PRS	Preset command Causes instrument to go into the following control state: (25 kHz, 1 channel)	
		Switch	Setting (when applicable)
		Coupling	AC (Channels A & B)
		Input Mode	Channel A
		Sensitivity	30 V (Channels A & B)
		Level	Free Run
		Repetitive	On
		Arm	Off
		Trigger Slope	—
		Marker	Off
		Marker Relative	Off
		Marker ÷ $\sqrt{BW}$	Off
		Mode	0–25 kHz Baseband
		Span	25 kHz
		Amplitude	A (B&XFR-OFF)
		Scale	10 dB/Div
		Phase	None
		Time	None
		Coherence	Off
		Amplitude Ref Lev	Normal
		Passband	Flat Top
		Average	Off
		Average Number	4
		Average Shift	Off
		Trace 1 Store	Off
		Trace 1 Recall	Off
		Trace 2 Store	Off
		Trace 2 Recall	Off

Memory Locations.

Description	Start Address (M, Octal)	Number of Words (N, Decimal)	Binary Format
Time Record	70000	1024	Numeric
Display	74000	512	Alphanumeric
Front Panel Switches	77454	5	Numeric

SECTION IV
PERFORMANCE TESTS

4-1. INTRODUCTION.

4-2. The Performance Test section is divided into three parts:

a. Part I is the Operational Verification which uses common manually operated test equipment to check the 3582A against selected specifications to yield a high (95%) confidence level of instrument performance. This test should be used after minor repairs are made and for incoming inspection. An Operational Verification Test Card is located at the end of this section.

b. Part II is the Automated Performance Test which uses a calculator to run a fully automatic and a semi-automatic test that entirely checks the 3582A against specifications. This test takes approximately four hours to complete and requires HP-IB compatible test equipment.

c. Part III is the Manual Performance Test which fully checks the 3582A against specifications using common manually operated test equipment. Note however, that because of its reiterative nature, the test takes approximately 9 1/2 hours to finish. This test is not as complete as the automatic test.

SECTION IV PART I
OPERATIONAL VERIFICATION

4-3. OPERATIONAL VERIFICATION.

4-4. The following set of tests check selected specifications in their worst-case condition to provide a relatively short but high (95%) confidence level verification for proper operation of the 3582A. This verification should be used for incoming inspection and instrument check out after a minor repair has been completed.

4-5. Required Test Equipment.

4-6. If the recommended equipment is not available, equipment meeting the critical specifications given in Table 4-1 may be substituted. Listed in Table 4-2 are recommended test accessories.

4-7. Preset.

4-8. Preset refers to a mode in which the 3582A front panel switches should be set prior to the initiation of each test sequence. The switch settings are given (line switch excepted) on Page 4-2.

4-9. Instrument Warmup.

4-10. Before any of the Operational Verification tests are performed, be sure that all equipment associated with the test is functioning within specified operating limits. The 3582A requires at least 30 minutes of warmup before any test is performed.

Button Positions: ▬ ON ▀ OFF

Set both framed buttons.....ON
Set AMPLITUDE A.....ON
Set SCALE.....10 dB/DIV
Set PASSBAND SHAPE.....FLAT TOP
Set AVERAGE NUMBER 4.....ON
Set all other buttons.....OFF
AMPLITUDE REFERENCE LEVEL.....NORM (Position 1)
FREQUENCY MODE.....0–25 kHz
SPAN.....25 kHz
TRIGGER LEVEL.....FREE RUN
INPUT CHANNEL A SENSITIVITY.....+30 dBV
VERNIER.....CAL
INPUT CHANNEL B SENSITIVITY.....+30 dBV
VERNIER.....CAL
INPUT MODE.....A

Table 4-1. Recommended Test Equipment for Operational Verification.

Test	Instrument	Critical Specification	Recommended Model
Amplitude Accuracy and Flatness	Sine wave source	Amplitude accuracy of ±0.2 dB, flatness (1 kHz – 25 kHz) ±0.1 dB output ≥3.2 V rms into 50 Ω	-hp- 3330B Opt. 005 or -hp- 3320B or -hp- 3325A Opt. 002
Harmonic Distortion	Sine wave source	All harmonics down at least 80 dB from the fundamental	-hp- 239A
Phase Accuracy	Function Generator	NA	-hp- 3310A -hp- 3311A -hp- 3312A -hp- 3325A
Common Mode Rejection	Sine wave source	NA	Any recommended signal source.
Frequency Accuracy	Sine wave source with counter or Frequency Synthesizer	Frequency accuracy ±0.001% of setting at 25 kHz	-hp- 3330B Opt. 005 or -hp- 3320B or -hp- 3335A

Table 4-2. Recommended Test Accessories.

Description	Part No. (Model No.)
Test Leads:	
112 cm (44 in): dual banana both ends	-hp- Model 11000A
112 cm (44 in): dual banana to BNC	-hp- Model 11001A
Adapters:	
Shielded dual banana to BNC male	Pomona 1555-C-18
Dual banana to BNC male	-hp- Part No. 1251-2277
Dual banana to BNC female	-hp- Model 10110A
Termination:	
50 Ω feedthrough	-hp- Model 11048C
1 kΩ ¼W 5%	-hp- Part No. 0683-1025

4-11. Perform the following steps:

a. Verify that all test equipment is operating under the proper conditions.

b. Connect the 3582A to a suitable power receptacle using the power cord provided with the instrument. DO NOT FLOAT THE 3582A USING A POWER PLUG ADAPTER!

c. Set the 3582A front panel switches to the preset mode and turn the LINE switch to ON.

d. Allow at least 30 minutes of warmup time for the 3582A before performing any of the Operational Verification tests.

4-12. DC BAL Verification.

4-13. Before performing any of the following tests, verify that the DC BAL (offset) is not excessively out of adjustment.

4-14. Perform the following steps:

a. Verify that the 3582A switches are in the preset mode.

b. Short the input terminals of channel A and set the INPUT SENSITIVITY to 10mV.

c. Press the TIME A button and verify that the trace is at the center horizontal graticule. If it is not, correct its position by adjusting the channel A BAL control.

d. Perform steps b and c for channel B after setting the INPUT MODE switch to B, AMPLITUDE A to OFF, and AMPLITUDE B to ON.

4-15. ROM Self Test.

4-16. Because the 3582A is highly dependent upon internal firmware for operation, it is recommended that the ROM Self Test be performed before other tests are initiated. If the test fails, refer to Troubleshooting, Section VIII of the Service Manual.

NOTE

The following test requires that the 3582A be in the LOCAL mode of operation.

4-17. The ROM self test checks the firmware program stored in each ROM by summing together the data bits in a known binary sequence. This sum is then compared to a known result which is stored in the last two locations in each ROM.

4-18. Perform the following steps:

a. Set AVERAGE NUMBER 32 to ON.

b. Hold AVERAGE RESTART button in while RESET (orange button) is pressed and then released. Release the AVERAGE RESTART button and press and release it again.

c. The test will then begin to run as indicated in the upper left-hand corner of the display by a mnemonic RU.

d. After approximately 5 seconds, the RU will change to OK indicating that the test passed or an ER indicating that the test failed. Press RESET to return the instrument to the normal operating mode.

4-19. Display Accuracy.

4-20. The display accuracy test checks the alignment of the trace relative to the CRT graticules.

4-21. Required Test Equipment. None.

4-22. Instrument Control Setup.

a. Enter the Front Panel self-test mode by holding RESTART while pushing and releasing RESET.

b. Select average #8 and push RESTART. Continue pushing RESTART until test #2 is displayed.

4-23. Perform the following steps.

a. Move the marker to the second graticule from the left. The lower number in the upper right-hand corner of the display should read between 000021 and 000041 (nominally 000031).

b. Move the marker to the center graticule. The corresponding number should be between 000165 and 000205 (nominally 000175).

c. Move the marker to the second graticule from the right. The corresponding number should be between 000331 and 000351 (nominally 000341).

4-24. Calibrator Accuracy.

4-25. This procedure checks the level and flatness of the internally generated "CAL" signal.

4-26. Required Test Equipment. None.

4-27. Instrument Control Setup.

3582A: Preset
MARKER.....ON
SCALE.....2dB/DIV
CHANNEL SENSITIVITY (both channels).....CAL

4-28. Perform the following steps:

a. Move the marker to 1 kHz. The marker level readout should be 22.0 dBV ±0.2 dB.

b. Set the 1 kHz level as a relative reference by pressing the Marker SET REF button first and the REL button next. Using this relative reference, measure the amplitudes of all other harmonically related spectra displayed (i.e., 2 kHz, 3 kHz, etc.). The levels should be within ±0.3 dB of the 1 kHz relative reference level.

c. Repeat Steps a and b for channel B after setting the INPUT MODE switch and AMPLITUDE switch for channel B readings.

4-29. Amplitude Accuracy and Flatness.

4-30. This procedure checks the amplitude accuracy and flatness at selected cardinal points

in amplitude and frequency. These points exhibit a worse case condition due to the accumulated errors throughout the instrument. Passing this test assures that all other points are at least as accurate as these points.

4-31. Required Test Equipment.

-hp- 3330B Option 005 or 3320B Synthesizer or 3325A Synthesizer/Function Generator
Compatible shielded (coax) interconnecting cables with appropriate adapters
Termination: 50 ohms

4-32. Instrument Control Settings.

3582A: Preset
MARKER.....ON

3330B:
FREQUENCY.....2.5 kHz
AMPLITUDE.....22.01 dBm
LEVELING(3330B/3320B only).....FAST (ON)

4-33. Perform the following steps.

a. Connect the output of the 3330B to channel A via suitable cables and adapters and terminate in 50 ohms.

b. Verify the amplitude accuracy and flatness by performing the operations indicated in Table 4-3.

c. Connect the 3330B output to channel B. Repeat Step b for channel B by switching the INPUT MODE switch and AMPLITUDE buttons for channel B.

Table 4-3. Amplitude Accuracy and Flatness.

Set 3330B AMPLITUDE dBm 50	Set 3582A SENSITIVITY dBV	Vrms	dBV	Set 3330B FREQUENCY and read MARKER at frequency 2.5 kHz	22.5 kHz
22.01	+30	2.818	+ 9	+ 9 ±0.5	+ 9 ±0.5
22.01	+10	2.818	+ 9	+ 9 ±0.5	+ 9 ±0.5
2.01	−10	.2818	−11	−11 ±0.5	−11 ±0.5

4-34. Noise Level.

4-35. The noise level test insures that all noise internal to the analyzer is at least 70 dB below full scale. The test requires a source with a signal-to-noise ratio of at least 80 dB.

4-36. Required Test Equipment.

-hp- 239A Oscillator
Compatible shielded (coax) interconnecting cables with appropriate adapters
Termination: 1 kΩ ¼W 5%, -hp- Part No. 0683-1025

4-37. Instrument Control Settings.

3582A: Preset
MARKER.....ON
SENSITIVITY (both channels).....−10 dBV
AVERAGE NUMBER.....32
FREQUENCY MODE.....0-START

239A:
OSCILLATOR OUTPUT LEVEL.....0.3 V rms
FREQUENCY.....25 kHz

4-38. Perform the following steps.

a. Connect the oscillator output of the 239A to channel A of the 3582A terminated with a 1 kΩ resistor. Verify that the output level is set at 0.3 V rms and the 3582A SENSITIVITY is set to −10 dBV.

b. Set the 239A output level vernier for a full-scale amplitude on the 3582 without overloading the 3582A. Press AVERAGE RMS and RESTART. The progress of the averaging sequence may be observed by temporarily setting the MARKER ON button to OFF. This will cause the average number to be displayed.

c. Use the marker to verify that all frequencies below 25 kHz have noise less than −85 dBV. Then set the AVERAGE to OFF.

d. Set the 239A output to 3 mV rms. Set the 3582A INPUT SENSITIVITY to −50 dBV.

e. Repeat Steps b and c verifying that the noise levels are less than −120 dBV.

f. Set the 3582A SPAN to 500 Hz and repeat Steps d and e to check for line related noise.

g. Repeat Steps a through f for channel B.

h. Set the 3582A SPAN to 25 kHz, MODE to SET CENTER, and INPUT SENSITIVITY to −10 dBV. Set the FREQUENCY ADJUST control for a center frequency of 5001 Hz. Set AVERAGE to OFF.

i. Set the 239A FREQUENCY to 5 kHz and the output to 0.3 V rms.

j. Repeat Steps b through e verifying that all non-harmonically related noise (do not include 0 Hz and negative frequencies) is within the stated limits. This test checks for Digital Local Oscillator spurs.

4-39. Harmonic Distortion.

4-40. The harmonic distortion test checks for harmonically related signals which are generated within the instrument when a full scale input is present. To perform this test requires a signal source which has a signal with harmonic distortion products less than −80 dB below the fundamental.

4-41. Required Test Equipment.

-hp- 339A Distortion Measuring Set or 239A Low Distortion Oscillator
Compatible shielded (coax) interconnecting cables with appropriate adapters

4-42. Instrument Control Settings.

3582A: Preset
SPAN.....50 Hz
SENSITIVITY (both channels).....0 dBV
AVERAGE NUMBER.....8
AVERAGE.....OFF
FREQUENCY MODE.....0-START
MARKER.....ON

239A:
FREQUENCY.....10 Hz
OSCILLATOR OUTPUT LEVEL.....1.0 V

4-43. Perform the following steps.

a. Connect the output of the 239A to the channel under test via suitable cables and adapters.

b. Set the MARKER POSITION to 10 Hz and adjust the 239A output level for a full scale display without overloading the 3582A. (This can be done faster with a SPAN of 500 Hz.) Set AVERAGE to TIME and 30B to channel A via suitable cables and adapters and terminate in 50 ohms.

c. Set the 3582A AMPLITUDE REFERENCE LEVEL to position 2 (NORM is position 1) and press AVERAGE RESTART.

d. After the average is complete (this takes about 40 seconds), move the marker to the second harmonic. The amplitude of the second harmonic should be less than -70 dB below full scale.

e. Repeat Step d for the third harmonic.

f. Repeat Steps b through e for the other channel after switching the INPUT MODE switch and AMPLITUDE buttons, resetting the AMPLITUDE REFERENCE LEVEL to NORM, and setting AVERAGE to OFF.

4-44. Common Mode Rejection.

4-45. The common mode rejection test verifies the capability of the 3582A to ignore a signal which appears simultaneously and in phase at both input terminals of a single channel.

4-46. Required Test Equipment.

Any recommended signal source
Compatible shielded (coax) interconnecting cables with appropriate adapters

4-47. Instrument Control Settings.

3582A: Preset
MARKER.....ON
FREQUENCY MODE.....0-START
SPAN.....100 Hz

3330B (3320B):
AMPLITUDE.....(4.94V)26.89 dBm
FREQUENCY.....50 Hz
LEVELING(3330B or 3320B only).....SLOW (ON)

4-48. Perform the following steps.

a. Switch the 3582A ISOL-CHAS switch to ISOL and connect the 3330B output, without a load, to the input of the 3582A channel A.

b. Using the MARKER POSITION control, set the marker to 50 Hz and press the MARKER SET REF button.

NOTES

1. If not using a Synthesizer, adjust Oscillator frequency.

2. The NOISE SOURCE OUTPUT BNC connector may be used for a chassis ground.

c. Disconnect the 3330B at the input terminal of channel A. Short the input terminals together. Connect the "high" side of the 3330B output to the shorted connection (input terminals) and the "low" side of the 3330B output to the 3582A chassis.

d. Switch the 3582A SENSITIVITY to +10 dBV and press the MARKER REL button. The amplitude reading should be less than −66 dB.

e. Repeat Steps a through d with the 3330B FREQUENCY set to 60 Hz. The reading in Step d should be less than −64 dB.

f. Repeat Steps a through e for channel B by setting the INPUT MODE switch and AMPLITUDE switches for channel B.

g. Disconnect the signal source from the input terminals.

h. Set ISOL-CHAS switch to CHAS.

4-49. Frequency Accuracy.

4-50. The frequency accuracy test checks the frequency measuring capability in the band analysis (SET START, SET CENTER) mode under narrow bandwidth conditions.

4-51. Required Test Equipment.

-hp- 3330B or 3320B or 3325A Synthesizer

Compatible shielded (coax) interconnecting cables with appropriate adapters
Termination: 50 ohms

4-52. Instrument Control Settings.

3582A: Preset
SENSITIVITY (both channels).....0.3 V
SPAN..... 5 Hz
FREQUENCY MODE.....SET CENTER
FREQUENCY ADJUST..... 25 kHz
MARKER.....ON
SCALE.....LINEAR

3330B:
FREQUENCY..... 25 kHz
AMPLITUDE.....2.05 dBm
LEVELING(3330B/3320B only).....FAST

4-53. Perform the following steps.

a. Connect the output of the 3330B to input channel A of the 3582A using a 50 ohm termination.

b. Using the MARKER POSITION control, set the marker to the maximum amplitude of the 25 kHz signal spectra. The marker frequency displayed should be 25000 Hz ± 0.5 Hz.

c. Repeat Steps a and b for channel B by setting the INPUT MODE switch and AMPLITUDE switches for channel B.

4-54. Phase Accuracy.

4-55. The phase accuracy test checks the phase accuracy by comparing the phase spectral components associated with the harmonics of a triangle wave input.

4-56. Required Test Equipment.

-hp- 3312A or 3325A Function Generator
Compatible shielded (coax) interconnecting cables with appropriate adapters

4-57. Instrument Control Settings.

3582A: Preset
SENSITIVITY (both channels).....0 dBV
FREQUENCY MODE.....SET CENTER
SPAN..... 1 kHz
FREQUENCY ADJUST..... 2750 Hz
MARKER.....ON

3312A:
AMPLITUDE..... 1 V
RANGE..... 1 kHz

Adjust Frequency 2.75kHz
FUNCTION ..... ⋀⋁(triangle)
SYMMETRY ..... CAL
TRIGGER ..... FREE RUN
MODULATION SECTION ..... OFF

4-58. Perform the following steps.

a. Connect the output of the 3312A to the inputs of channels A and B using appropriate cables and adapters.

b. Adjust the frequency of the 3312A to place the fundamental at the center graticule (2750 Hz ±20 Hz). Adjust the 3312A amplitude output to place the amplitude of the fundamental within 3 dB of full scale.

c. Set the 3582A AMPLITUDE A to OFF and the PHASE A to ON. Set the FREQUENCY MODE to 0–25 kHz and the TRIGGER SLOPE to −.

d. Adjust the TRIGGER LEVEL until the phase spectra of the harmonics are as near to zero degrees as possible. Use the MARKER to verify that the center of the sloping portion of the phase components are between ±10°. If they are not, repeat the TRIGGER LEVEL SETTING. Set the TRIGGER REPETITIVE button to OFF.

e. Using the MARKER POSITION control, set the marker to the center of the sloping segment of the phase spectra of the 5th harmonic. Press the MARKER SET REF button.

f. Put the TRIGGER back into the REPETITIVE mode. Press the MARKER REL button and check that the relative phase variation is less than ±10°.

g. Repeat Steps d through f for channel B by setting the INPUT MODE switch and PHASE switches for channel B. Set the MARKER REF to OFF.

4-59. Amplitude and Phase Match Between Channels.

4-60. The amplitude and phase match between channels should be within the given tolerances so that comparative functions such as Transfer Function and Coherence will be accurate.

4-61. Required Test Equipment. None.

4-62. Instrument Control Settings.

3582A: Preset
SENSITIVITY (both channels) ..... +10 dBV
INPUT MODE ..... BOTH
AMPLITUDE XFR ..... ON
AMPLITUDE A ..... OFF
PASSBAND SHAPE ..... UNIFORM
NOISE SOURCE ..... PERIODIC
MARKER ..... ON
AVERAGE TYPE ..... RMS
AVERAGE NUMBER 8

4-63. Perform the following steps:

a. Connect the NOISE SOURCE OUTPUT to the inputs of channels A and B via suitable cables with adapters.

b. Using the MARKER POSITION control, move the marker across the screen noting that each marker amplitude reading does not exceed ±0.8 dB. (±0.4 dB, Option 001)

c. Set the AMPLITUDE XFR button to OFF and set the PHASE XFR button to ON.

d. Move the marker across the screen noting that each marker phase reading does not exceed ±5 degrees. (±2 degrees, Option 001)

SECTION IV PART II
AUTOMATED PERFORMANCE TEST

4-64. INTRODUCTION.

4-65. The Automated Performance Test uses equipment controlled via the Hewlett-Packard Interface Bus (HP-IB) by a 9825A Calculator. A portion of the test uses the calculator to prompt an attendant for performing manual operation of non HP-IB equipment. These tests provide a quick and efficient means to verify that the 3582A meets performance specifications.

4-66. APPLICABILITY.

4-67. The Automated Performance Test takes approximately four hours to run and should be used only when complete specification testing is required. For incoming inspection and testing after small repairs are made, the Operational Verification, given in Section IV Part I is recommended.

4-68. THE TAPE CARTRIDGE.

4-69. A tape cartridge (3582A/9825A Test Cartridge) is available with the manual for use in the 9825A Calculator. Do not attempt to use this cartridge with other controllers, since the incompatibility may result in the erasure of data on the tape. The part number of the tape cartridge is 03582-10002.

4-70. Cartridge Organization.

4-71. The cartridge contains an HP-IB Verification, a short adjustment program and Performance Tests.

4-72. The Performance Tests are divided into two groups: Semi-Automatic and Automatic. Subroutines for each group are contained in relatively large files with tests within the group on individual files. When a test is to be run, the test program is loaded into the subroutine file after the subroutines.

4-73. For each test, the Special Function keys (f0-f11) on the calculator select the test to be run by loading the appropriate file. Thus the user does not need to know file numbers beyond those of the subroutines. Key overlays are included to define the keys. If these aren't available, the key functions can be listed at the start of each performance test group.

4-74. As an example, say that you wish to check Harmonic Distortion. This test is in the Semi-Auto group (test listings are in Table 4-5.) The first thing to do is load the subroutine file. From the list below, this is File 3. After File 3 is loaded, it is run to initialize and dimension variables, and to identify the instrument by serial number. When this has been completed, the display will instruct the operator to "PRESS f-KEY FOR TEST DESIRED." From the overlay or Table 4-5, this is f3. When this test has run, "END" will be displayed and another test can be run in the same fashion.

4-75. Tape contents are listed below. Note that either an -hp- 3330B or 3325A can be used as the test synthesizer. Track 1 is written for the 3330B while track 0 is written for the 3325A.

Track 0:3325A Track 1:3330B

File 0: Contents
File 1: HP-IB Verification
File 2: Basic Adjustments
File 3: Semi-Auto Subroutines
File 4: Auto Subroutines
File 5: Key File (Semi-Auto)
File 6: Key File (Auto)
File 7-18: Test Files (Semi-Auto)
File 19-31: Test Files (Auto)

4-76. The Semi-Auto Test is calculator based, but requires an attendant to change inputs, etc. The Auto Test is fully automatic and should not require attention once it has started. The Semi-Auto Test will typically take a little over an hour while the full Auto Test takes about 2½ hours.

NOTE

For complete testing, BOTH the Semi-Auto and Auto Tests must be performed.

4-77. EQUIPMENT REQUIRED.

4-78. The equipment required for performing these tests and adjustment is given in Table 4-4. Note that other than the allowance for two different synthesizers, there is no real provision for using other than the specified equipment without extensive program modification.

4-79. One exception would be that a different printer (e.g. -hp- 9871A) can be used with modification only to the "wrt" statements. The modification will probably include at least address changes and may include the addition of "wait" statements if a relatively slow printer (such as the 9871A) is used.

4-80. The following points concerning test equipment should be noted:

a. A separate **printer** is required *only* if test data is to be printed out. The tests can be run on a pass/fail basis that uses the 9825A's printer.

b. A **function** generator is required *only* if the 3330B is used as the synthesizer since the 3325A is a synthesizer/function generator.

c. For the performance tests, almost any HP-IB compatible **voltmeter** can be used (with program modification). In fact, since the voltmeter is used only for the relatively short plotter output tests, which can easily be done manually, an HP-IB voltmeter is not strictly required.

However, for greatest accuracy of calibration for the Adjustment program using the 3325A, a voltmeter with AC accuracy equal to the 3455A should be used. (Note that the 3455A is required for the 3325A version of the Adjustment Program and use of a different voltmeter will require program modification.)

d. **A low distortion oscillator** is required for the Semi-Auto Harmonic Distortion Test. The requirement is that all harmonics be at least 80dB below the fundamental. It may be possible to use a low pass filter to clean up the output of an oscillator for these purposes. The frequencies required are 10Hz, 8kHz and 12kHz.

Table 4-4. Equipment Required.

Instrument	Important Characteristics	Required Model	Use*
Calculator	NA	-hp- 9825A (Opt. 001)	A, S, P, H
Calculator ROMs	String Variable/Advanced Programming	-hp- 98210A	A, S, P, H
	Matrix	-hp- 98211A	S, P
	General I/O - Extended I/O	-hp- 98214A	A, S, P, H
HP-IB Interface	NA	-hp- 98034A	A, S, P, H
Printer Interface	Necessary for Data Print-out	-hp- 98032A Opt. 066	S, P
Printer	Necessary for Test Data Print-out. *Not Required* for Pass/Fail	-hp- 9866B	S,P
HP-IB Cables	2 Required, Length Depends on Test Set-up	hp- 10631A (1 meter) -hp- 10631B (2 meters) -hp- 10631C (4 meters)	A, S, P
Synthesizer	Amplitude Accuracy: ± 0.2 dB at 10 kHz	-hp- 3330B (Opt. 004 & 005) or -hp- 3325A (Opt. 002)	A, S, P
Digital Voltmeter	AC Accuracy 0.1% at 20 kHz	-hp- 3455A	A, S, P
Low Distortion Oscillator	Harmonics > 80 dB below Fundamenatal	-hp- 339A † or -hp- 239A	A, S, P
Function Generator	Required *only* if 3330B used as Synthesizer	-hp- 3311A † or -hp- 3310A † or -hp- 3312A †	S
Terminations	Short-Banana Plug	1251-2816 w/short	S
	1 kΩ - Banana Plug (2)	1251-2816 w/1 kΩ	
	1 kΩ - Series (2)	NA	
	1 MEG Series	NA	
	50 Ohm Feedthrough	-hp- 11048C †	
Miscellaneous	Shielded Banana Plug	Pomona 1645 †	S

† Recommended Model (This particular model not strictly required.)
*A = Adjustment; S = Semi-Auto; P = Auto Test; H = HP-IB Verification

4-81. CONNECTING THE TEST EQUIPMENT.

8-82. Using compatible HP-IB cables, connect the test equipment as shown in Figure 4-1. Check that each cable connector is securely mounted to the appropriate mating connector and that mounting fasteners are firmly screwed into place.

CAUTION

Excessive leverage placed on stacked connectors may result in damage to the HP-IB receptacle on the rear panel of an instrument.

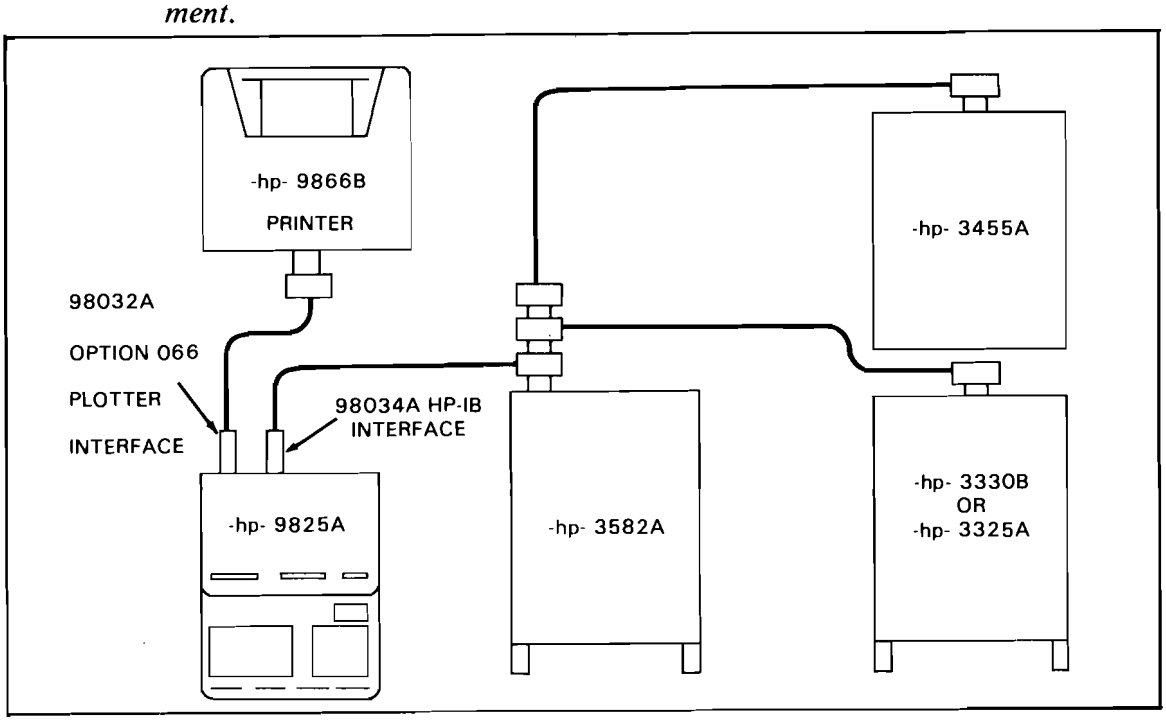


Figure 4-1. HP-IB Connection Diagram.

4-83. GENERAL CONSIDERATIONS.

4-84. Warm-up Time.

4-85. Thirty minutes should be sufficient for warm-up. Note that the DC offsets will change as the instrument warms up so this adjustment should be done only after 30 minutes.

4-86. Order Of Testing.

4-87. Tests and adjustments should be carried out in the order which they appear on the tape unless only some specific parameter is to be tested. The idea here is to test first those things that will prevent further testing (HP-IB Verification) or are most likely to fail and make further testing ill-advised.

4-88. Note that the Adjustment procedure can be quickly carried out with the covers on to check amplitude and frequency calibration. Note also that the first two tests in the Semi-

Auto group are Noise Floor and Harmonic Distortion. If there is a malfunction in the instrument, these two tests are the most likely to fail.

4-89. Operator Instructions.

4-90. Operator actions are prompted by the 9825A's display. When an instruction is given, the calculator will "beep" and stop program execution until CONTINUE is pressed. There will be times (e.g. during long calculations) when nothing seems to be happening. In these cases, *let the 9825A's red "run light" be your guide.* If the light is not on the program has either ended (in which case "END" should be displayed) or has given an instruction and is waiting for CONTINUE to be pressed. If the light is on, *be patient.* A subroutine is provided to inform the operator of an error in execution.

4-91. Print Mode.

4-92. At the beginning of each performance test (Semi-Auto and Auto), the operator will be asked to select the Print Mode. This is accomplished by pressing special function key f0 until the desired mode is displayed and then pressing CONTINUE.

The Print Modes are as follows:

a. Print All: Prints all data on 9866B.
b. Print Errors: Prints only error data on 9866B.
c. Print Pass/Fail: Prints Pass/Fail on 9825A's Printer.

4-93. Channel Selection.

4-94. There will be times when it is desired to test only one channel. This is easily accomplished by using special function key f17 (shifted f5) as in Print Mode selection above.

4-95. Instrument Identification.

4-96. At the beginning of each performance test, the operator will be asked for the date and instrument serial number. Note that the serial number field is 16 characters long and can be any combination of numbers and text.

4-97. Auto Or Manual.

4-98. At the beginning of the Auto Test and Harmonic and IM Tests in the Semi-auto Test, the operator will be asked whether to run the test Auto or Manual. Selecting Auto will cause the Auto Test to sequence through all the tests (actually complete all tests that follow the first one selected). You would choose Manual for the Auto Test if only one test were to be run.

4-99. Selecting Manual in the Semi-Auto Test will allow testing at one frequency in the Harmonic Distortion Test (normally 3 frequencies). Intermodulation distortion is measured at four combinations of input sensitivity and vernier position. Manual mode allows testing at any one of the combinations.

4-100. DC Balance.

4-101. DC offsets in the input section are minimized by adjusting the Bal potentiometer

below each channel's coupling switch. The recommended adjustment procedure is as follows:

a. Short the input.

b. Adjust sensitivity to the 3mV or 10mV range.

c. While holding in the TIME button, adjust the pot until the trace is at the center graticule.

4-102. Alternatively, a 3 or 10mV signal can be applied to the input and the adjustment made to clear the overload light.

4-103. It is extremely important to make this adjustment before testing, especially before the Auto Test. Misadjusted DC balance can cause premature overloads *which will stop program execution.*

4-104. Addresses.

4-105. Standard HP-IB instrument addresses are given below. These are easily changed in "dev" statements at the beginning of the performance tests. Note that the changes must be made in the Adjustment program and both performance test programs. the HP-IB Verification allows the user to enter the correct 3582A address during program execution.

Standard Addresses

3582A("dut"): 711
3325A("syn"): 717
3330B("syn"): 704
3455A("dvm"): 706

4-106. As an example of changing the addresses via the dev statement, the following statement assigns address 702 to the 3582A and 710 to the synthesizer (either 3325A or 3330B):

dev "dut", 702, "syn", 710

4-107. Note that "7" in the above addresses is the interface select code. This can be checked by noting the position of the select switch on the interface (98034A). This is shown in Figure 4-2. If the select code is not 7, it can be changed on the interface or the "dev" statements can be modified. The 98032A Option 066 Printer Interface should be select code 6. If this is incorrect, the interface select code must be changed. (There is no provision for simple program modification.)

4-108. Phase Accuracy.

4-109. The Phase Accuracy Test requires a square wave source and can be done automatically with the 3325A, though obviously not with the 3330B (which has only sine wave output). Thus, phase accuracy is checked in the 3325A Auto Test and the 3330B Semi-Auto Test.

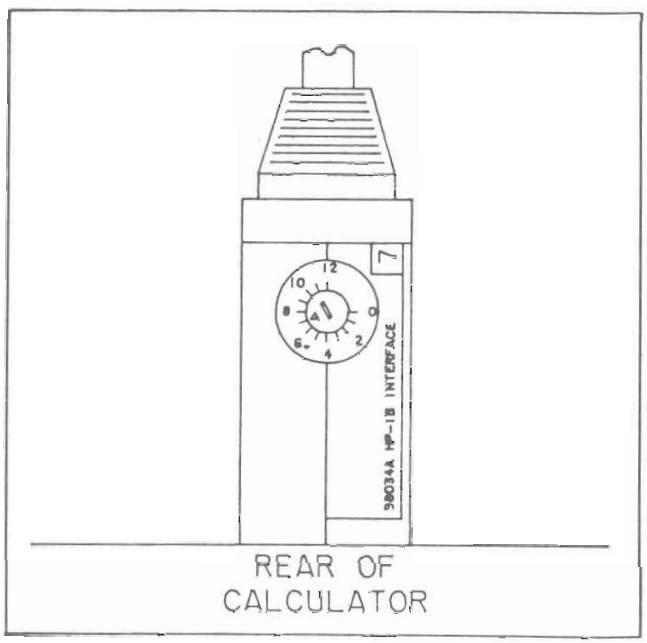


Figure 4-2. HP-IB Interface, Select Code 7.

4-110. RUNNING THE TESTS.

4-111. This section gives the test procedures in the order that they should be performed. If you choose to run the tests in a different order, always run the HP-IB Verification first followed by the tests of your choice.

4-112. Inserting the 3582A/9825A Test Cartridge.

4-113. Insert the tape cartridge so that the label on the cartridge faces the back of the calculator as shown in Figure 4-3.

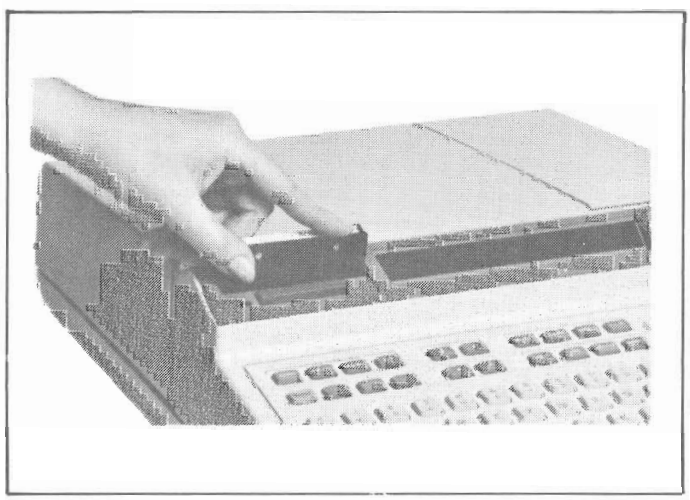
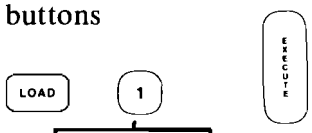


Figure 4-3. Inserting the Tape Cartridge.

4-114. Loading a Tape File.

4-115. To load a tape file into the calculator, perform the following steps:

a. Press calculator buttons



file Number (1 is given as an example)

b. When the tape stops running and the *red run light* is out, press (RUN).

NOTE

When finished with the tests and before removing the tape cartridge, rewind the tape by pressing (REWIND). This protects the contents of the tape from accidental erasure and foreign object damage.

4-116. HP-IB Verification (File 1).

4-117. This test checks bus operation by programming the 3582A and checking displayed data. The tests are as follows:

a. Program the 3582A for a CAL signal display and read out the marker level and frequency at 1kHz.

b. Program the 3582A so that the status indicators will light. These are checked by the operation.

c. Generate a numerical time record and load it directly into the 3582A's read/write memory. This data is then read out and checked against the input.

4-118. As in all tests, the HP-IB address *must* be correct. The 3582A is set for address 11 at the factory. If this has been changed, the correct address can be inserted during program execution. (The calculator will ask if the address is 711 and if not, what the correct address is. Note that 7 is the address of the interface.)

4-119. The HP-IB address can be changed rather easily, although the top cover must be removed.

WARNING

Removing the top cover exposes potentially lethal voltages and should be carried out by service trained personnel only!

4-120. Facing the instrument, the switch is located on the A2 assembly toward the front, right side of the card nest. It is not necessary to remove the shield for purposes of changing the address. Starting at the rear of the instrument the switches are numbered 1 through 6, with 1 being the least significant digit. (Switch 7 is used for testing.)

4-121. To change an address, simply enter the binary equivalent of the desired address moving the bits to be set to the right. for example, for address 11, switches 1,2 and 4 should be to the right of the instrument and all others to the left.

4-122. Basic Adjustments (File 2).

4-123. This program runs the technician through the following adjustments for both channels.

WARNING

To carry out the adjustments below, the top cover must be removed, exposing potentially lethal voltages. These adjustments should be carried out by service trained personnel only.

a. A1-R101: Amplitude calibration at 1kHz.

b. A1-R45: Amplitude calibration at 22.5kHz.

c. A1-R8: CAL signal amplitude calibration.

d. A4-R33: Noise source DC adjustment.

e. A1-C2: 20dB Attenuator compensation.

f. A1-C1: 40dB Attenuator compensation.

g. A3-C1: Frequency calibration.

4-124. When using the 3325A (trk 0), the 3455A is used to calibrate the 3325A before the adjustments are made.

4-125. The following points should be noted:

a. The synthesizer used *must* be a high output voltage option. This is Option 005 for the 3330B and Option 002 for the 3325A.

b. The first amplitude calibration adjustment level should be within a few mV of 95mV. If it isn't, double-check the setup.

c. Adjustment tolerance is 1 digit. That is, the tolerance for 900mV would be ± 1mV while that for 900.1mV would be ± 0.1mV.

4-126. Semi-Auto Performance Test (File 3).

4-127. This test requires changing of inputs or settings on non-HP-IB instruments and thus requires an operator during testing.

4-128. Subroutines for this test are contained in File 3 with the programs for each test contained in Files 7 through 18. When a test is to be run, the body of the test is loaded into File 3 after the subroutines. This minimizes memory requirements while eliminating repetition of subroutines. Table 4-5 summarizes the tests.

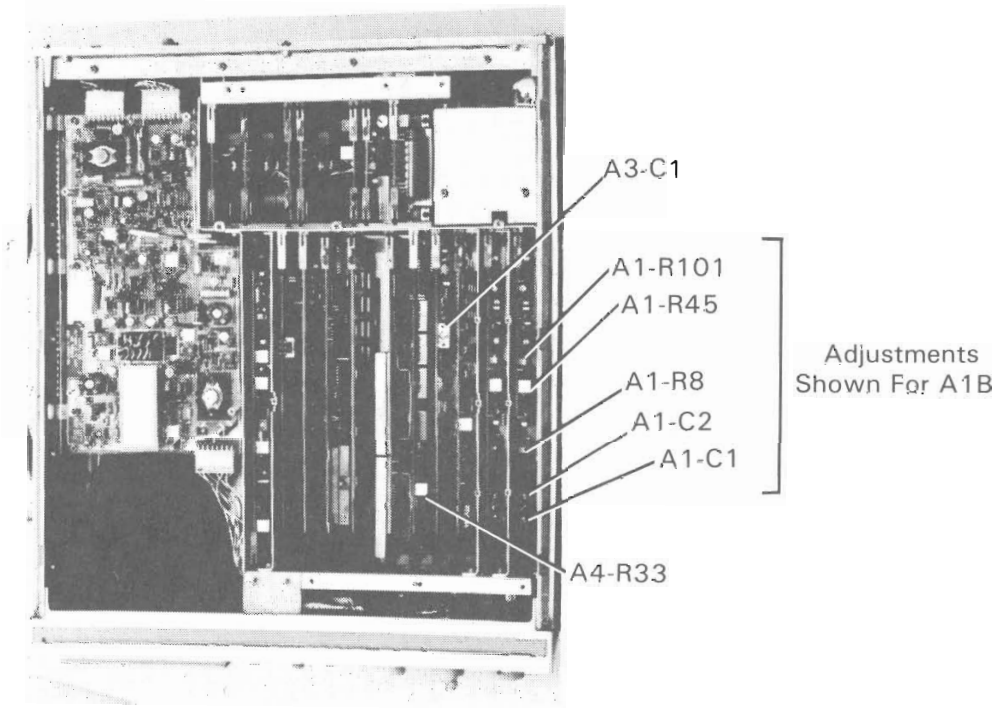


Figure 4-4. Adjustment Locations.

4-129. The following points should be noted:

a. **Harmonic Distortion.** This test is the longest in the group and requires several settings of frequency and level. The hints below should help to speed the process.

1. Frequency is set first using the marker on the 3582A. Be sure to clear overloads before adjusting the frequency.

2. The operator will be asked repeatedly to set the level of the oscillator to 1-3dB below full scale on the 3582A. This is most easily accomplished using the overload lights. That is, adjusting the oscillator output until the light comes on and backing off until it just goes out should insure you of the correct setting.

Note also that the level changes in multiples of 10dB. The same step size as the 339A (or 239A) Attenuator. Thus the oscillator amplitude vernier should not have to be changed once the first amplitude has been set.

3. Run the test manually if only one frequency is to be tested. Also remember that one channel only can be tested by pressing special function key f17 (shifted f5) until the desired test mode is displayed.

4. For best results, the 339A should not be in the oscillator level function. If a 239A is used, the ground should be set to chassis ground. Also, both channels should not be connected at the same time.

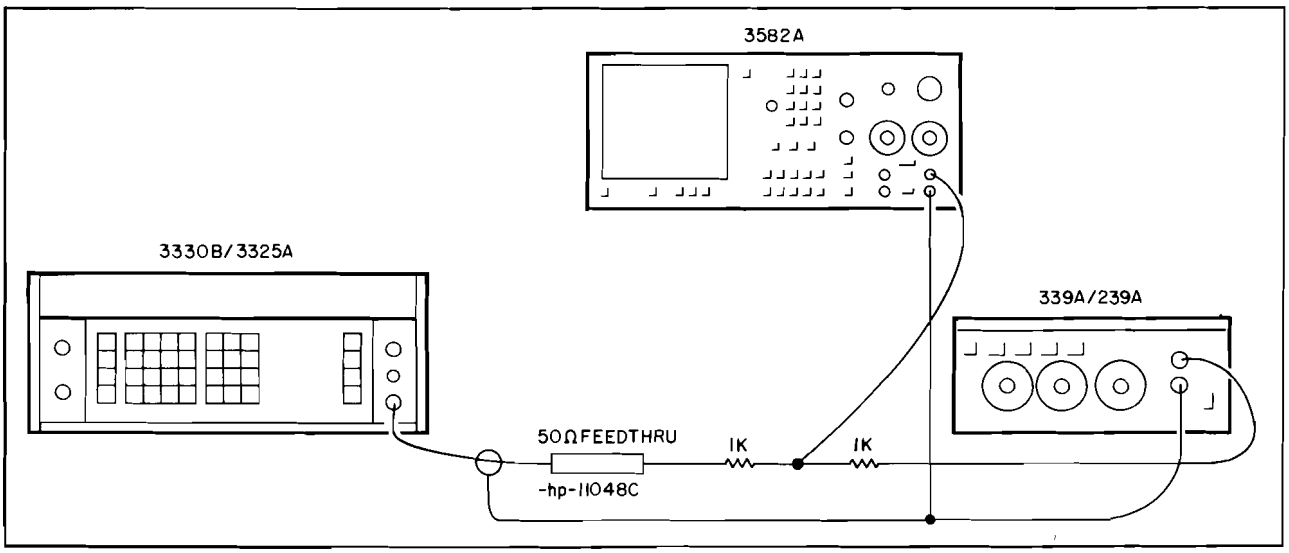


Figure 4-5. Test Set-up Intermodulation Distortion.

NOTE

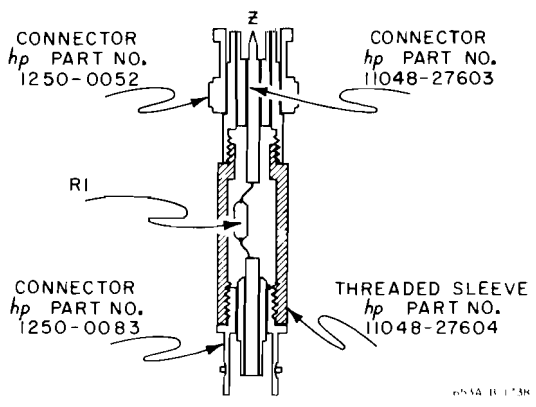
Although the special function key overlay refers to this test as THD for easy identification, only individual harmonic levels are measured and THD is not calculated.

b. The **Intermodulation Distortion** test requires the use of 1K ohm isolation resistors (see Figure 4-6. A small box with the appropriate connectors works well for this. Note that the 50 ohm termination required for the synthesizer must come before the isolation resistor. (Also see Figure 4-5).

c. A handy place to get at chassis ground for the **CMR** test is the noise souce output BNC.

d. A shielded banana plus (such as Pomona 1645) is required to meet **Crosstalk** specifications.

e. The **Input Z** (impedance) test requires a 1 meg series load. This load must come after the 50 ohm termination required for the synthesizer. (See Figure 4-5.)



Resister Values / Part Numbers

1 K / 0575-0280
1 MEG / 0698-7332

One way to construct series feedthru's needed for Intermodulation and Input Z tests. The connector (11048-27603) must be cut and the resistor inserted in such a manner that the connector, which is soldered to the -0083 connector, is held in place in the -0052 connector. Note that this connector has no provision for securely holding the -27603. For the Intermodulation Distortion Test, a BNC "tee" (part number 1250-0791) and a BNC to banana plug adaptor (part number 1250-2277) are also required.

Figure 4-6. Constructing A Feedthrough Load.

4-130. Auto Performance Test (File 4).

4-131. This test is fully automatic and can be run without attention once started. The only test equipment required in addition to the calculator, ROM's, and interface is a 3330B or 3325A, a 50 ohm termination and cables.

4-132. While the tests in the Semi-Auto Test are easily identified with published specifications for the 3582A, some tests in this group require further explanation.

4-133. **Amplitude accuracy** is specified to be 0.5dB at full scale in the center of the passband. The accuracy specification is completed by specifying linearity to be +/-0.2dB + -0.02% of full scale. These specifications include attenuator accuracy and flatness, and A/D flatness.

Table 4-5. Semi-Automatic Performance Test Summary

Test Name	Special Function	File #	Equipment Required*	Possible Causes of Failure
Noise Floor	f2	7	1 K ohm Banana Plug Terminations (2)	A1: Comparator, DAC
Harmonic Dist.	f3	8	-hp- 339A or 239A or Oscillator w/Harmonics down at least 80 dB	A1: Comparator, DAC
IM Dist.	f4	9	-hp- 3330B or 3325A and Oscillator as above. 1 K Series Resistors (2). 50 ohm Termination	
CMR	f5	10	-hp- 3330B or 3325A	
Crosstalk	f6	11	-hp- 3330B or 3325A. Shielded Banana Plug (Pomona 1645).	
Input Z	f7	12	-hp- 3330B or 3325A. I MEG ohm Series Resistor. 50 ohm Termination	
Noise Source Output Z	f8	13	50 ohm Feedthru Termination: -hp- 11048C Recommended.	A4: U19
Noise Source Flatness	f9	14	None other than Cable.	Programming on A3; A4
Amplitude & Phase Match	f10	15		A1: Input Filters
X-Axis Output	f11	16	-hp- 3455A	A10
Phase Accuracy	f16†	17	Function Generator if 3325A not used. -hp- 3311A or 3312A Recommended.	A1:LPF; A3, A4: Phase Latches
Channel Select	f17	—	NA	NA

*All tests require calculator, ROMs and interface as in Table 4-4.

†This file is empty on trk 0 since phase accuracy is measured in the auto test.

4-134. This performance test checks not only absolute accuracy and linearity, but also attenuator flatness, input filter and A/D flatness, and attenuator accuracy. This makes it much easier to define the problem when absolute accuracy does not meet specifications.

4-135. The basic **noise** floor test is done in the Semi-Auto Test. This is essentially testing the input section (A1). To check that the digital filters are not adding noise, the Digital Filter Noise Test checks for excessive noise on all spans.

4-136. The basics of **band translation** consist of proper center frequency generation in the local oscillator (digital) and multiplication with the input on the digital filter chips. The

L.O./Digital Filter Test varies the center frequency and checks that the proper display is given. The Digital Filter Operation Test checks that the display is proper on each span.

4-137. It can be seen from the above that the two Digital Filter Tests are required for complete testing. However, since the measurement time is long on the narrow spans, these tests add roughly an hour and a half to testing time. For this reason, the operator has the option of running these two tests.

4-138. As an example, after a repair to the instrument, it may make sense to run the short version to insure proper repair and let the long version run overnight to double check.

4-139. Certain out-of-band frequencies can mix with the power supply switching frequency to produce in-band spurious responses. The Special Spurs Test checks for these responses.

NOTE

The Special Spurs Test includes a test of the out-of-band overload circuit. Units with serial number prefix 1747A will FAIL this test.

4-140. Table 4-6 summarizes the auto tests.

Table 4-6. Automatic Performance Test Summary.

Test Name	Special Function Key	File	Possible Causes of Failure
Cal Signal Accuracy	f2	19	Both channels bad implies A3. Otherwise, check A1U14 or A1K7
Frequency Accuracy	f3	20	Check that A3-C1 is adjusted correctly
Amplitude Linearity	f4	21	A1: DAC
Attenuator Accuracy	f5	22	
LPF and A/D Flatness	f6	23	
Attenuator Flatness	f7	24	Check that A1C1 and C2 are adjusted
L.O./Digital Filter	f8	25	If both channels, check L.O. One channel implies digital filter.
Digital Filter Noise	f9	26	
Digital Filter Op.	f10	27	
AC Coupling	f11	28	
Special Spurs	f12	29	A1: Comparator; Overload Circuits A1 or A5
Phase Accuracy	f13	30*	Phase counters and latches on A3 and A4
Y-Axis Output	f14	31	A10
Channel Select	f17	—	NA

*This file is empty on trk 1 since phase accuracy is measured in the Semi-Auto tests.

4-141. Basic Operating Instructions.

4-142. The 9825A Desktop Calculator is much closer to a mini-computer in computational power than to most desktop calculators. Although it is very powerful, the 9825A is really quite easy to operate. This section is not intended to replace the Operating Manual, but will help the new user to quickly be able to use the test cartridge.

4-143. For these tests, the operator is required to load the proper program from the cartridge and run it, following connection instructions given on the tape.

4-144. There are certain keys that the operator should become familiar with:

a. **LOAD** - When pressed, "ldf" will appear on the display. Pressing this key and entering the desired file number will load the desired tape file into the 9825A's memory after "EXECUTE" is pressed.

b. **RUN** - Pressing this key will run the program in memory, *starting at line number Ø.*

c. **CONTINUE** - Pressing this key will continue the program from wherever it stopped. For example, the calculator will stop program execution when an instruction is given (e.g., connect 3325A to channel A). After the instruction is carried out, pressing CONTINUE will cause the program to proceed with the test.

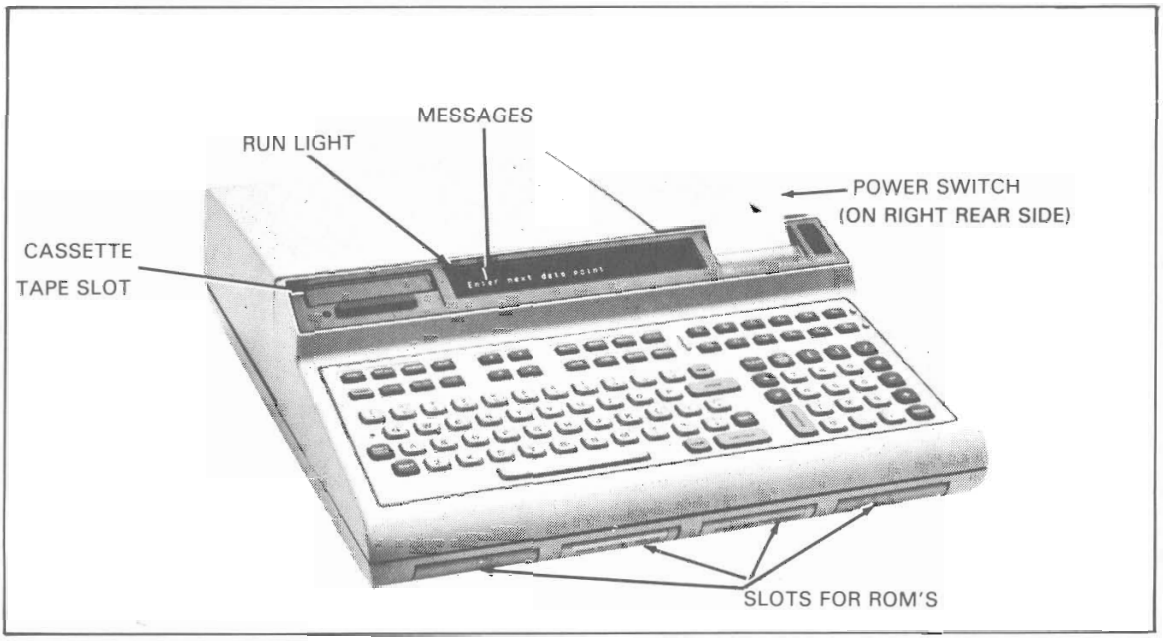


Figure 4-7. -hp- 9825A Calculator.

d. **EXECUTE** - This key executes what is displayed. For example, pressing LOAD and then a file number (e.g., Ø) will cause "ldf Ø" to be displayed. Pressing EXECUTE will load file Ø.

e. **STOP** - Pressing this key will stop the program. Pressing CONTINUE will continue the program from the stopping point.

f. **SPECIAL FUNCTION KEYS** - These keys, f0 - f11 (f12 - f24 using shift) are user definable. For the test cartridge, these keys are automatically programmed to load test files. The overlays included with the tape fit over these keys.

g. **SHIFT** -This key works just like the shift key on a typewriter, with the additional function of adding 12 more special functions keys. That is, holding down SHIFT while pressing f0 will actually get you f12.

4-145. To **load** a program from the tape, insert the cartridge with the label toward the rear of the calculator. Note that the record tab should be away from the cartridge edge to prevent accidental erasure.

4-146. Select the track (as explained below) and file desired and press EXECUTE. Error 41 indicates that the cartridge is in backwards or not in all the way. The yellow light near the tape cartridge slot will be lit while the program is loading. Don't press RUN until this light goes out.

4-147. The process of stopping the program to give an instruction or ask a question is repeated over and over during the tests. Answering yes to a question is always done by typing in a one and pressing CONTINUE. To answer no, simply press CONTINUE (zero is assumed).

4-148. To select the proper tape **Track**, type in "trk" (must be lower case) and Ø or 1. When EXECUTE is pressed, that track will be selected. When the calculator is turned on, track Ø is automatically selected.

4-149. Error messages are given when there is an operator or program error. Refer to Error Messges for a list of the most common errors.

4-150. The red RUN LIGHT in the left hand corner of the calculator's display will be on when a program is running. When the program stops to give an instruction, the light will go out. *let this light be your guide as to when to press CONTINUE.*

NOTE

Some informational display statements are given without stopping the program.

If the light is out, the program has either ended (in which case "end" should be displayed) or is waiting for the operator to press CONTINUE. If the light is on but nothing seems to happening, *be patient.*

4-151. As an example, run the "CONTENTS" file as follows:

1. Type in "trk 0"	
2. Press EXECUTE	This selects track 0
3. Press LOAD	"Idf" should be displayed
4. type in 0	"Idf" should be displayed
5. Press EXECUTE	This loads file 0 from track 0
6. Press RUN	This should print out a table of contents

4-152. After this listing, the calculator will "beep" and display "address info?(yes = 1)." Note that the run light should now be out. To get the address information, type in a "1" and press CONTINUE. Now address information should be printed out.

4-153. Error Messages.

05 - Operation not allowed. Usually caused by trying to execute a line out of the program.

15 - Printer out of paper.

20
29 - ROM missing. The second number (error 29) indicates the missing ROM.

8 - Extended I/O
9 - Advanced Programming
10 - Matrix
12 - General I/O

30 - Special function key not defined. Caused by pressing a special function key before running either File 3 or File 4, where the keys are defined.

31 - Non-exist program line. Same cause as 30.

40 - Insufficient memory for operation. Option 001 (15, 036 Bytes) 9825A is required. (Check inside tape cover.)

41 - No cartridge in tape transport. Insert cartridge and press EXECUTE.

42 - Tape cartridge write protected. (Slide tab to other position for recording.)

CAUTION

When the tab is pushed in the direction of the arrow, write protection is defected and the contents of the tape can be accidentally erased.

44 - Verify has failed. Caused by dirty or bad spot in tape. Try the operation again.

57 - Improper file type. Caused by attempting to load a key file with the load key. To load key files 5 and 6, type in "ldk" and the file number.

60 - Attempt to load an empty file. Check your file number.

64 - Attempt to execute "ldf" or "ldk" while a program is running. Press STOP and then EXECUTE.

66 - Division by zero. This can happen in Phase Accuracy if the function is a sine wave instead of a square wave.

E4 - Timeout error. Caused by non-responding HP-IB instrument hanging the program up.

G8 - Peripheral device down. You'll get this if program is stopped during an I/O operation or an HP-IB instrument is down.

S7 - String not yet allocated. Caused by pressing RUN with only the test file loaded or with the subroutine file loaded but not run.

S9 - String length exceeded. Usually caused by trying to enter more than 16 characters into the serial number field. Shorten the list and press CONTINUE.

SECTION IV PART III
MANUAL PERFORMANCE TEST

4-154. INTRODUCTION.

4-155. The Manual Performance Test is conducted using common manually operated test equipment. Due to its reiterative nature, the test requires 9 1/2 hours to complete. The more comprehensive automatic test is recommended over the manual test if the equipment is available.

4-156. APPLICABILITY.

4-157. The Manual Performance Test should be used only when complete and comprehensive testing of instrument performance to one or more specifications is desired. After minor repairs are made or for incoming inspection, the Operational Verification given in Section IV Part I is recommended.

4-158. ORGANIZATION.

4-159. The test is performed in the same order as the Automated Performance Tests with the most stringent requirements first. This is done so that areas that are most likely to fail are encountered early and repairs and/or adjustments may be carried out before large amounts of test time are accumulated.

4-160. REQUIRED TEST EQUIPMENT.

4-161. If the recommended equipment is not available, equipment meeting the specifications given in Table 4-7 may be substituted.

Table 4-7. Recommended Test Equipment For Manual Performance Test.

Instrument	Important Characteristics	Required Model
Synthesizer	Amplitude Accuracy: ± 0.2 dB at 10 kHz	-hp- 3330B (Opt. 004 & 005) or -hp- 3325A (Opt. 002)
Digital Voltmeter	AC Accuracy 0.1% at 20 kHz	-hp- 3455A
Low Distortion Oscillator	Harmonics > 80 dB below Fundamental	-hp- 339A† or -hp- 239A
Function Generator	Required *only* if 3330B used as Synthesizer	-hp- 3311A† or -hp- 3310A† or -hp- 3312A†
Terminations	Short-Banana Plug	1251-2816 w/short
	1 kΩ - Banana Plug (2)	1251-2816 w/1 kΩ
	1 kΩ - Series (2)	NA
	1 MEG Series	NA
	50 Ohm Feedthrough	-hp- 11048C†
Miscellaneous	Shielded Banana Plug	Pomona 1645†

†Recommended Model (This particular model not strictly required.)

4-162. Preset.

4-163. Preset refers to a mode in which the 3582A front panel switches should be set prior to the initiation of each test sequence. The switch settings are given as follows (line switch excepted):

Button Positions: ▬ ON ▮ OFF

Set both framed buttons.....ON
Set AMPLITUDE A.....ON
Set SCALE.....10 dB/DIV
Set PASSBAND SHAPE.....FLAT TOP
Set AVERAGE NUMBER 4.....ON
Set all other buttons.....OFF
AMPLITUDE REFERENCE LEVEL.....NORM (Position 1)
FREQUENCY MODE.....0-25 kHz
SPAN.....25 kHz
TRIGGER LEVEL.....FREE RUN
INPUT CHANNEL A SENSITIVITY.....+30 dBV
VERNIER.....CAL
INPUT CHANNEL B SENSITIVITY.....+30 dBV
VERNIER.....CAL
INPUT MODE.....A
ISOL-CHAS.....CHAS

4-164. INSTRUMENT WARMUP.

4-165. Before any of the performance tests are conducted, be sure that all equipment associated with the test is functioning within specified operating limits. The 3582A requires 30 minutes of warmup before any test is initiated.

4-166. Perform the following steps:

a. Verify that all test equipment is operating under the proper conditions.

b. Connect the 3582A to a suitable power receptacle using the power cord provided with the instrument. DO NOT FLOAT THE 3582A USING A POWER PLUG ADAPTER!

c. Set the 3582A front panel switches to the preset mode and turn the LINE switch ON.

d. Allow at least 30 minutes of warmup time for the 3582A before initiating any of the performance tests.

4-167. DC BAL VERIFICATION.

4-168. Before performing any of the following tests, verify that the BAL (offset) is not excessively out of adjustment.

4-169. Perform the following steps:

a. Verify that the 3582A switches are in the preset mode.

b. Short the input terminals of channel A.

c. Set the CHANNEL A SENSITIVITY to -50dBV.

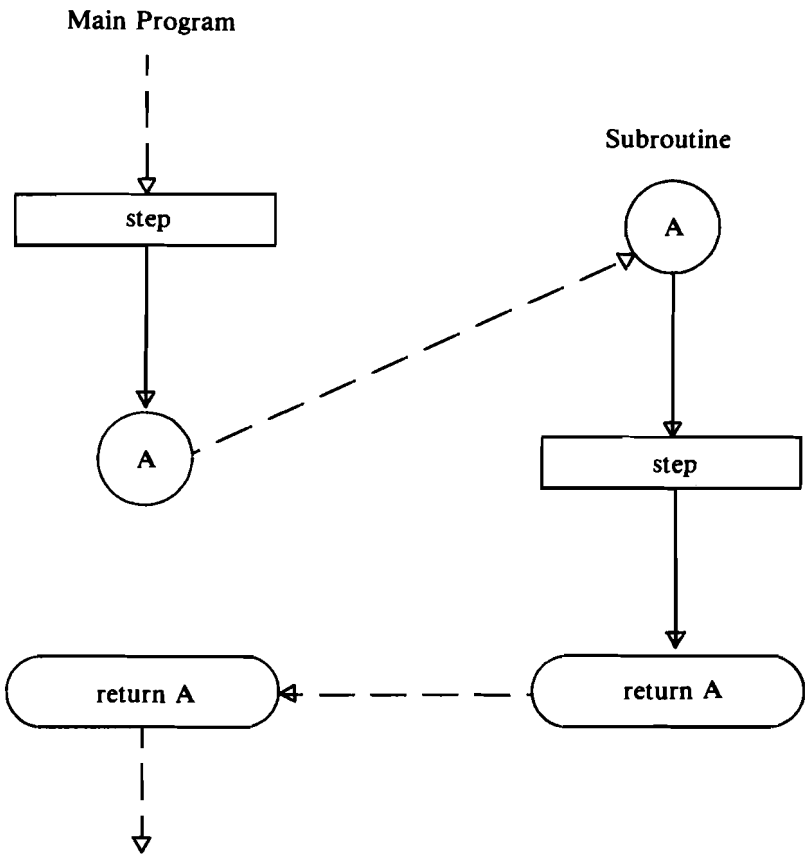
d. Press the TIME A button and verify that the trace is at the center horizontal graticule. If it is not, correct its position by adjusting the channel A BAL control.

e. Perform steps b through d for channel B after setting the INPUT MODE switch to B, AMPLITUDE A to OFF, and AMPLITUDE B to ON.

4-170. CONDUCTING THE PERFORMANCE TESTS.

4-171. Each test is written in flowchart form. Repetitious steps are included in subroutines to reduce complication. Exits to subroutines are indicated by an alphanumeric symbol in a circle. Proceed to the subroutine which starts with the same symbol. When finished with the subroutine, proceed to the RETURN step which immediately followed the exit step.

4-172. Example:



NOTE

Unless otherwise stated, instructions indicated in each step will pertain to the 3582A.

4-173. NOISE FLOOR.

4-174. The noise floor test insures that all noise internal to the analyzer is at least -115dBV between 800Hz and 1.2kHz and that it is at least -120dBV between 2.5kHz and 25kHz.

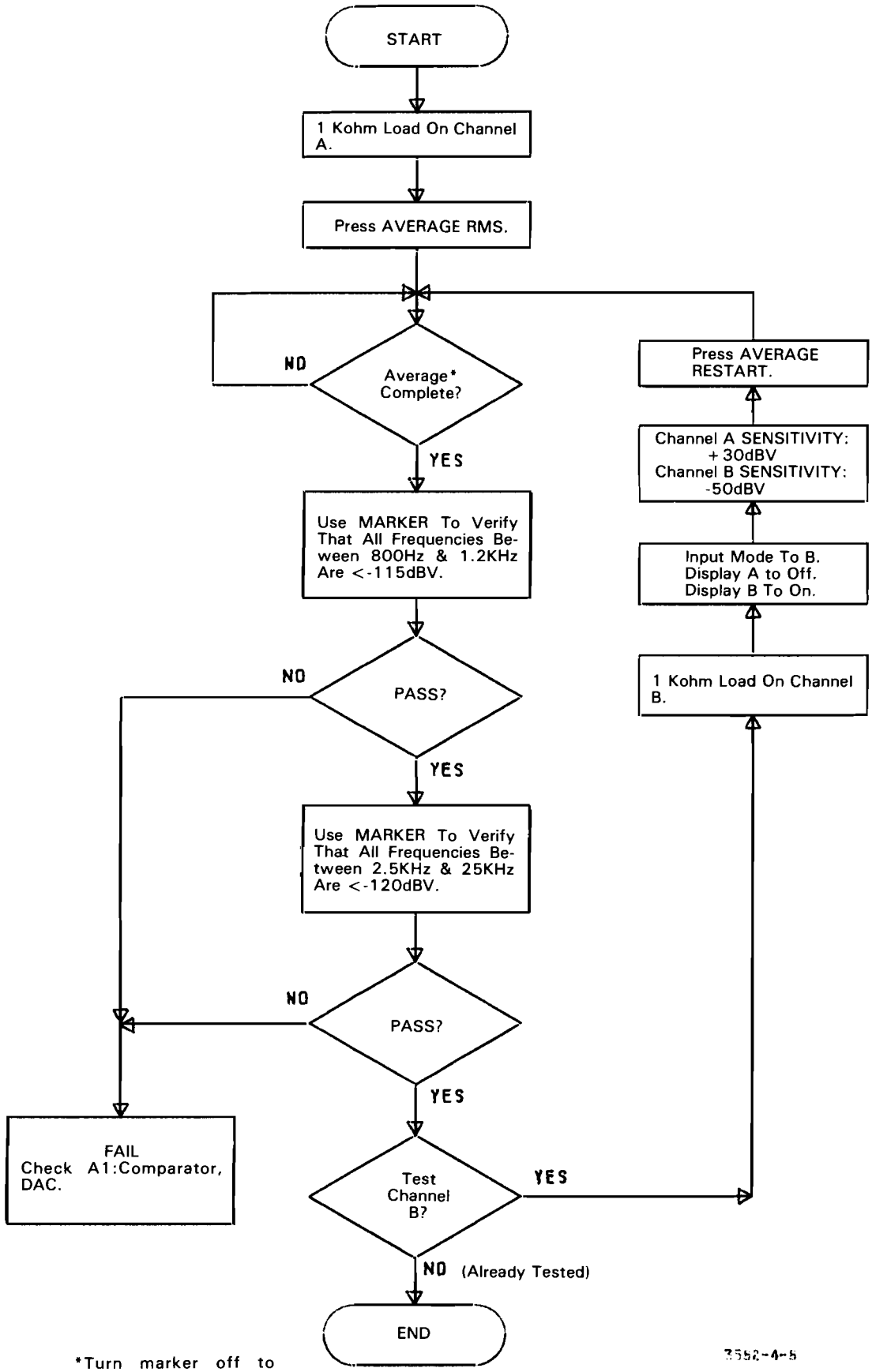
4-175. Recommended Test Equipment:

Termination: 1 Kohm banana plug

4-176. Instrument Control Settings:

3582A: Preset
MARKER.....ON
SENSITIVITY (channel A only).....–50dBV
AVERAGE NUMBER.....32
AMPLITUDE REFERENCE LEVEL.....Position 3
(NORM is position 1)

4-177. Perform the steps as indicated in the flow chart.



*Turn marker off to observe the number of averages completed.

Figure 4-8. Noise Floor Test.

4-178. HARMONIC DISTORTION.

4-179. The harmonic distortion test checks for harmonically related signals which are generated within the instrument when a full scale input is present. To perform this test requires a signal source which has a signal with harmonic distortion products less than 80dB below the fundamental.

4-180. As part of the test, the operator will be asked repeatedly to set the level of the oscillator 1-3dB below full scale as indicated by the 3582A. This is most easily accomplished by increasing the 339A amplitude until the OVERLOAD lights on the 3582A come on and then reducing the amplitude until they go off. In most cases, the vernier amplitude adjustment will not need to be made often since the 339A/239A output attenuator has 10dB increments like the 3582A INPUT SENSITIVITY control.

4-181. Recommended Test Equipment:

339A Distortion Measuring Set or 239A Low Distortion Oscillator

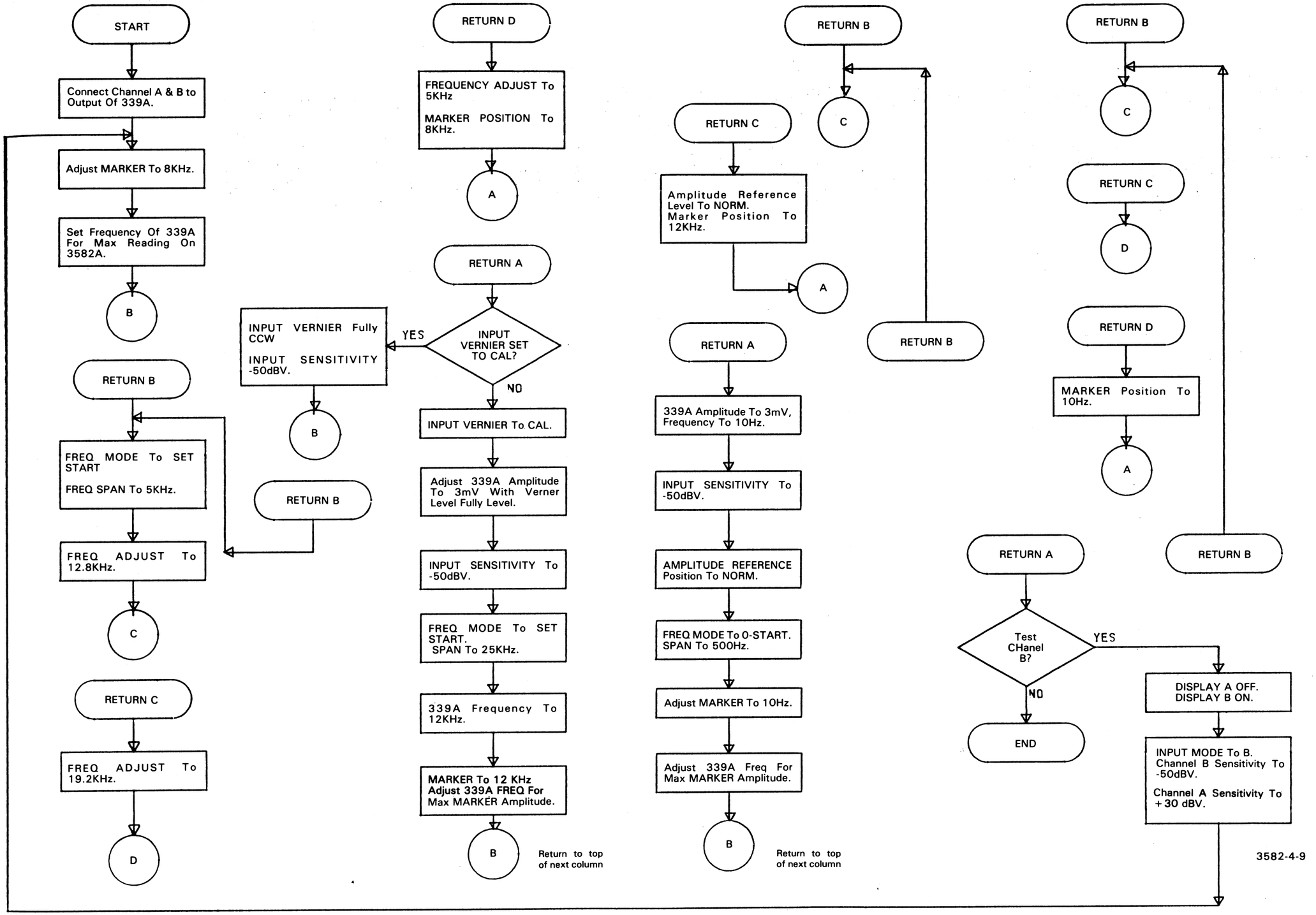
Compatible shielded (coax) interconnecting cables with appropriate adaptors.

4-182. Instrument Control Settings:

3582A: Preset
FREQUENCY MODE.....0-START
FREQUENCY SPAN.....25kHz
SENSITIVITY (channel A only).....–50dBV
AVERAGE NUMBER.....4

339A:
FREQUENCY.....8kHz
AMPLITUDE.....3mV

4-183. Perform the steps as indicated in the flow chart.


START
Connect Channel A & B to Output Of 339A.
Adjust MARKER To 8KHz.
Set Frequency Of 339A For Max Reading On 3582A.
B
RETURN B
FREQ MODE To SET START
FREQ SPAN To 5KHz.
FREQ ADJUST To 12.8KHz.
C
RETURN C
FREQ ADJUST To 19.2KHz.
D
RETURN D
FREQUENCY ADJUST To 5KHz
MARKER POSITION To 8KHz.
A
RETURN A
INPUT VERNIER Fully CCW
INPUT SENSITIVITY -50dBV.
YES
INPUT VERNIER SET TO CAL?
NO
B
RETURN B
INPUT VERNIER To CAL.
Adjust 339A Amplitude To 3mV With Verner Level Fully Level.
INPUT SENSITIVITY To -50dBV.
FREQ MODE To SET START.
SPAN To 25KHz.
339A Frequency To 12KHz.
MARKER To 12 KHz
Adjust 339A FREQ For Max MARKER Amplitude.
B
Return to top of next column
RETURN B
C
RETURN C
Amplitude Reference Level To NORM.
Marker Position To 12KHz.
A
RETURN A
339A Amplitude To 3mV, Frequency To 10Hz.
INPUT SENSITIVITY To -50dBV.
AMPLITUDE REFERENCE Position To NORM.
FREQ MODE To 0-START.
SPAN To 500Hz.
Adjust MARKER To 10Hz.
Adjust 339A Freq For Max MARKER Amplitude.
B
Return to top of next column
RETURN B
C
RETURN C
D
RETURN D
MARKER Position To 10Hz.
A
RETURN A
Test CHanel B?
YES
NO
END
RETURN B
DISPLAY A OFF.
DISPLAY B ON.
INPUT MODE To B.
Channel B Sensitivity To -50dBV.
Channel A Sensitivity To +30 dBV.
A
. Channel SENSITIVITY -50dBV?
YES
Set SENS -10dBV.
NO
Channel SENSITIVITY -10dBV?
YES
Set SENS 0dBV.
NO
Channel SENSITIVITY 0dBV?
YES
Set SENS +10dBv.
NO
RETURN A
*In UNCAL @ + sensitivity, turn level to max am output.
3582-4-9

RETURN B

RETURN B

C

RETURN C

D

RETURN D

MARKER Position To 10Hz.

A

RETURN A

RETURN B

Test CHanel B?

YES

NO

END

DISPLAY A OFF.
DISPLAY B ON.

INPUT MODE To B.
Channel B Sensitivity To -50dBV.

Channel A Sensitivity To +30 dBV.

3582-4-9

A

Channel SENSITIVITY -50dBV?

YES

Set SENSITIVITY To -10dBV.

NO

Channel SENSITIVITY -10dBV?

YES

Set SENSITIVITY To 0dBV.

NO

Channel SENSITIVITY 0dBV?

YES

Set SENSITIVITY To +10dBv.

NO

RETURN A

B

Adjust 339A Amplitude For 3582A Reading Between -3dB & Full Scale.*

*In UNCAL @ +10dBV sensitivity, turn 339A level to max amplitude output.

Push SET REF.

RETURN B

C

Set AMPLITUDE REFERENCE For Position #4.

RMS AVERAGE To ON.

NO

Average Complete?

YES

Read 2nd Harmonic Using 3582A Relative (REL) MARKER.

Relative Amplitude < 70dB?

NO

FAIL

YES

Set AVERAGE To OFF.
MARKER REL To OFF.

RETURN C

D

RMS AVERAGE To On.

Average Complete?

YES

Read 3rd Harmonic Using 3582A Relative (REL) MARKER.

Relative Amplitude < 70dB?

NO

FAIL

YES

AVERAGE To OFF.
MARKER REL To OFF.

AMPLITUDE REF To Position #1 (NORM).

RETURN D

Figure 4-9. Harmonic Distortion Test.

4-184. INTERMODULATION DISTORTION AND VERNIER RANGE.

4-185. The intermodulation distortion test checks for excessive amplitudes of harmonic products which are produced when a complex signal is acted upon by a non-linear circuit. The vernier range is checked for the minimum allowable signal attenuation between the 10dB steps of the INPUT SENSITIVITY switch.

4-186. The complex signal is generated across a resistor network which uses two oscillators for inputs (see test setup Figure 4-10).

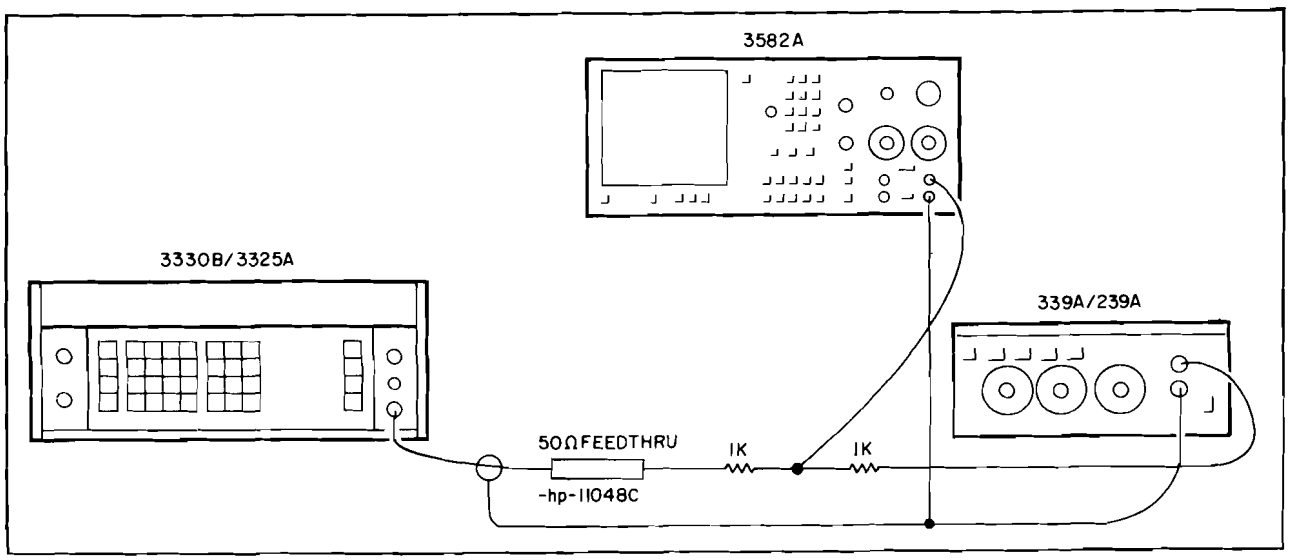


Figure 4-10. Intermodulation Distortion Test Setup.

4-187. Recommended Test Equipment:

3325A Synthesizer/Function Generator
339A Distortion Measuring Set
Compatible interconnecting cables with appropriate adaptors
Terminations: 50 ohms, 2-1 Kohm resistors (-hp- Part No. 0575-0280).

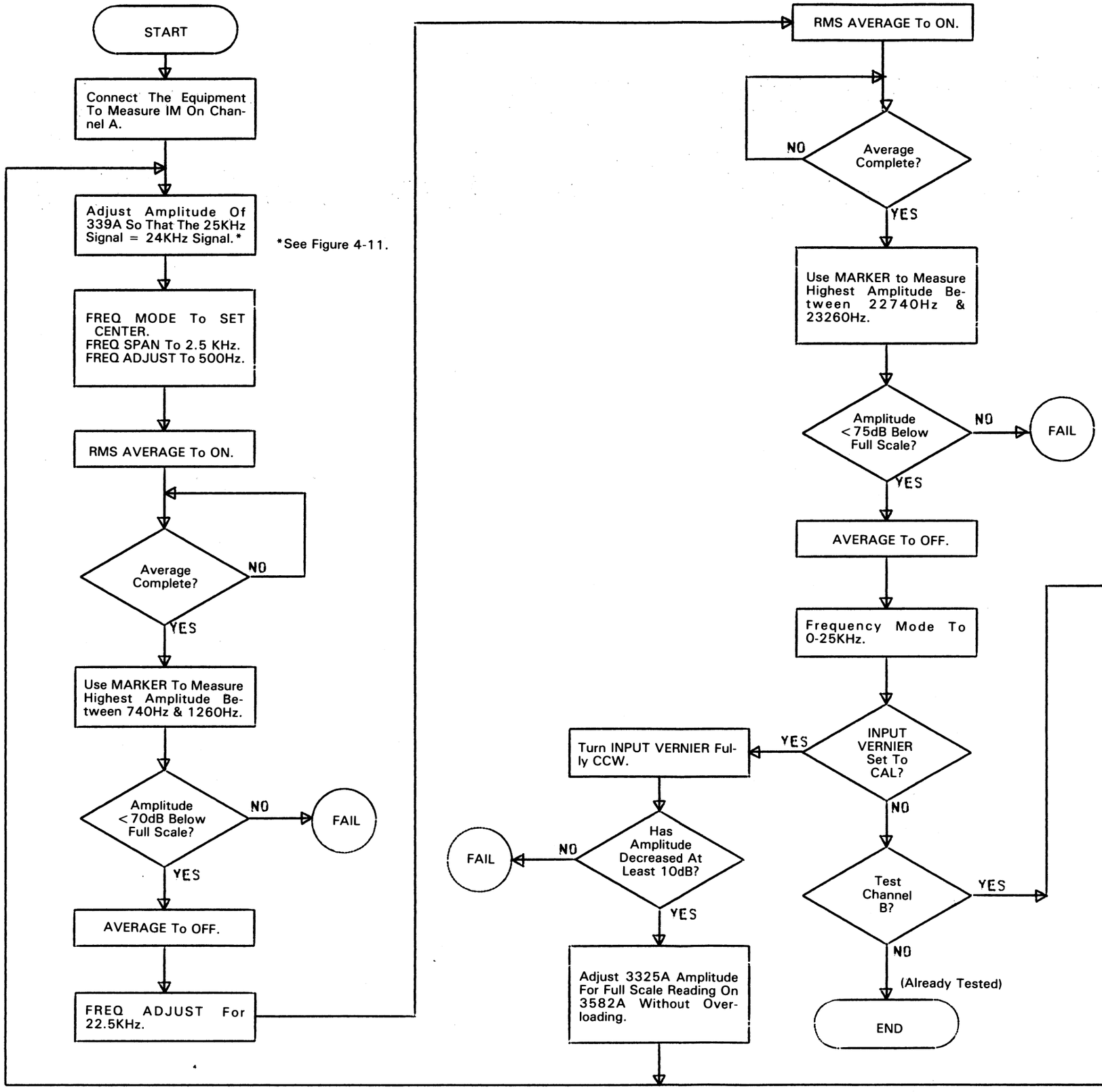
4-188. Instrument Control Settings:

3582A: Preset
MARKER.....ON
SENSITIVITY (channel A only).....-50dBV
AVERAGE NUMBER.....4

3325A:
FREQUENCY.....24kHz
AMPLITUDE.....-39.99dBm
FUNCTION.....SINE WAVE
Termination.....50 ohms

339A:
FREQUENCY.....25kHz
AMPLITUDE.....3mV

4-189. Perform the steps as indicated in the flow chart.



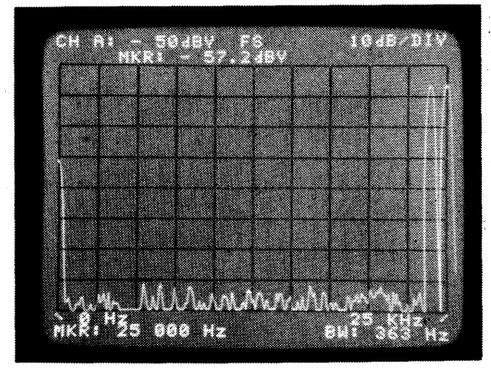


Figure 4-11. Sample Spectrum.

Figure 4-12. Intermodulation Distortion & Vernier Range.

4-190. COMMON MODE REJECTION.

4-191. The common mode rejection test verifies the capability of the 3582A to ignore a signal which appears simultaneously and in phase at both terminals of a single channel.

4-192. Recommended Equipment:

3325A Synthesizer/Function Generator Option 002

Compatible shielded (coax) interconnecting cables with appropriate adaptors.

4-193. Instrument Test Setups.

4-194. Set up the instruments according to Figure 4-13 and 4-14 when instructed to do so by steps in the flow chart.

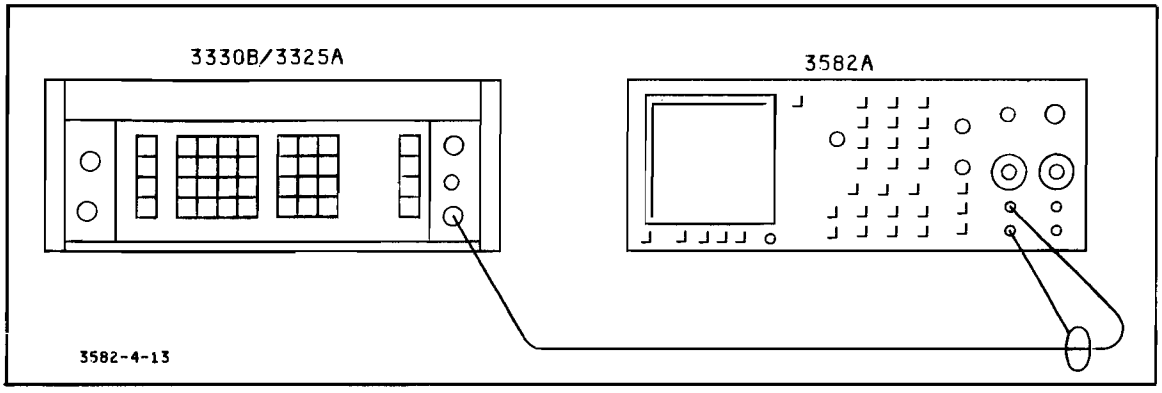


Figure 4-13. Test Setup A.

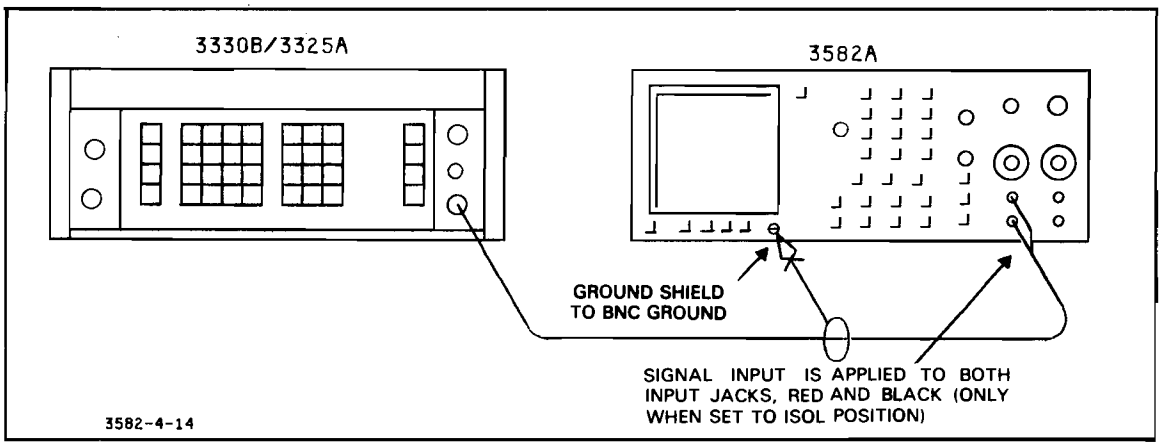


Figure 4-14. Test Setup B.

4-195. Instrument Control Setting.

3582A: Preset
FREQUENCY MODE.....0-START
FREQUENCY SPAN.....500Hz
MARKER.....ON

3325A:
FREQUENCY 50Hz
AMPLITUDE (High Voltage ON) 14.14Vrms
FUNCTION ..... SINE WAVE

-196. Perform the steps as indicated in the flow chart.

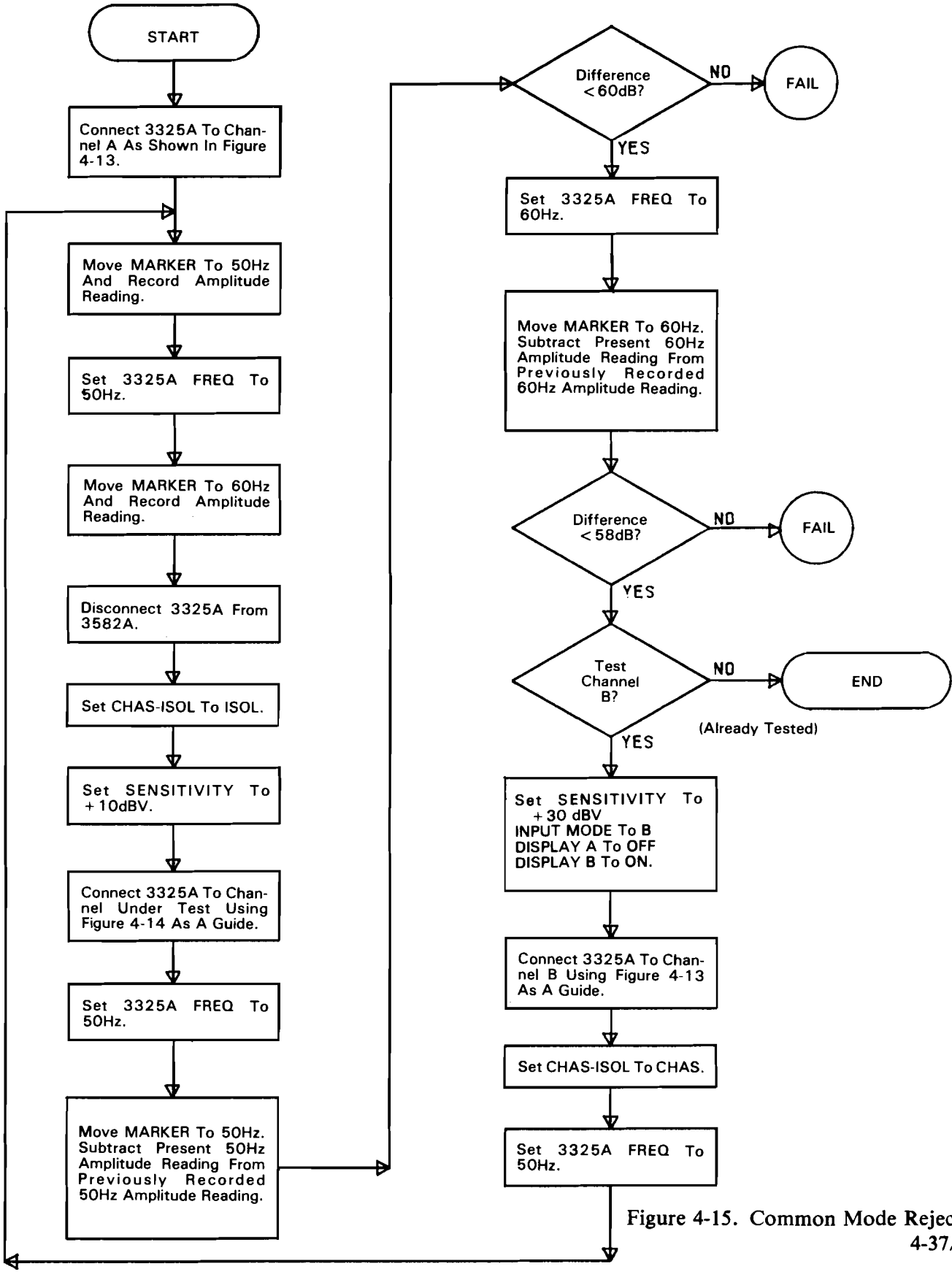


Figure 4-15. Common Mode Rejection.

4-197. CROSS TALK.

4-198. The cross talk test measures the amount of undesirable energy in one channel that has been coupled across from the other channel. This is accomplished by placing a high signal level on one channel and then measuring the relative signal amplitude on the other channel which has a 1K ohm load across the input terminals (see Figure 4-16).

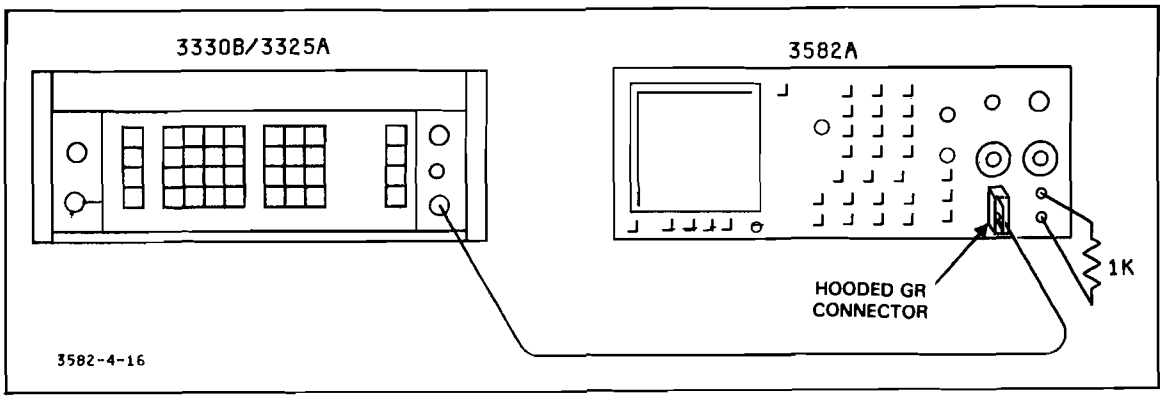


Figure 4-16. Cross Talk Measured On Channel B.

4-199. Recommended Test Equipment.

3325A Synthesizer/Function Generator Option 002

Compatible shielded (coax) interconnecting cables with appropriate adaptors.

Hooded GR Connector

4-200. Instrument Control Settings.

3582A: Preset
FREQUENCY MODE.....SET CENTER
FREQUENCY SPAN.....1kHz
FREQUENCY ADJUST.....25kHz
MARKER.....ON
MARKER POSITION.....Adjust to 25kHz
SENSITIVITY (Channel B).....-50dBV
AVERAGE NUMBER.....8

3325A:
FREQUENCY.....25kHz
AMPLITUDE (High Voltage ON).....14.14Vrms
FUNCTION.....SINE WAVE

4-201. Perform the steps as indicated in the flow chart.

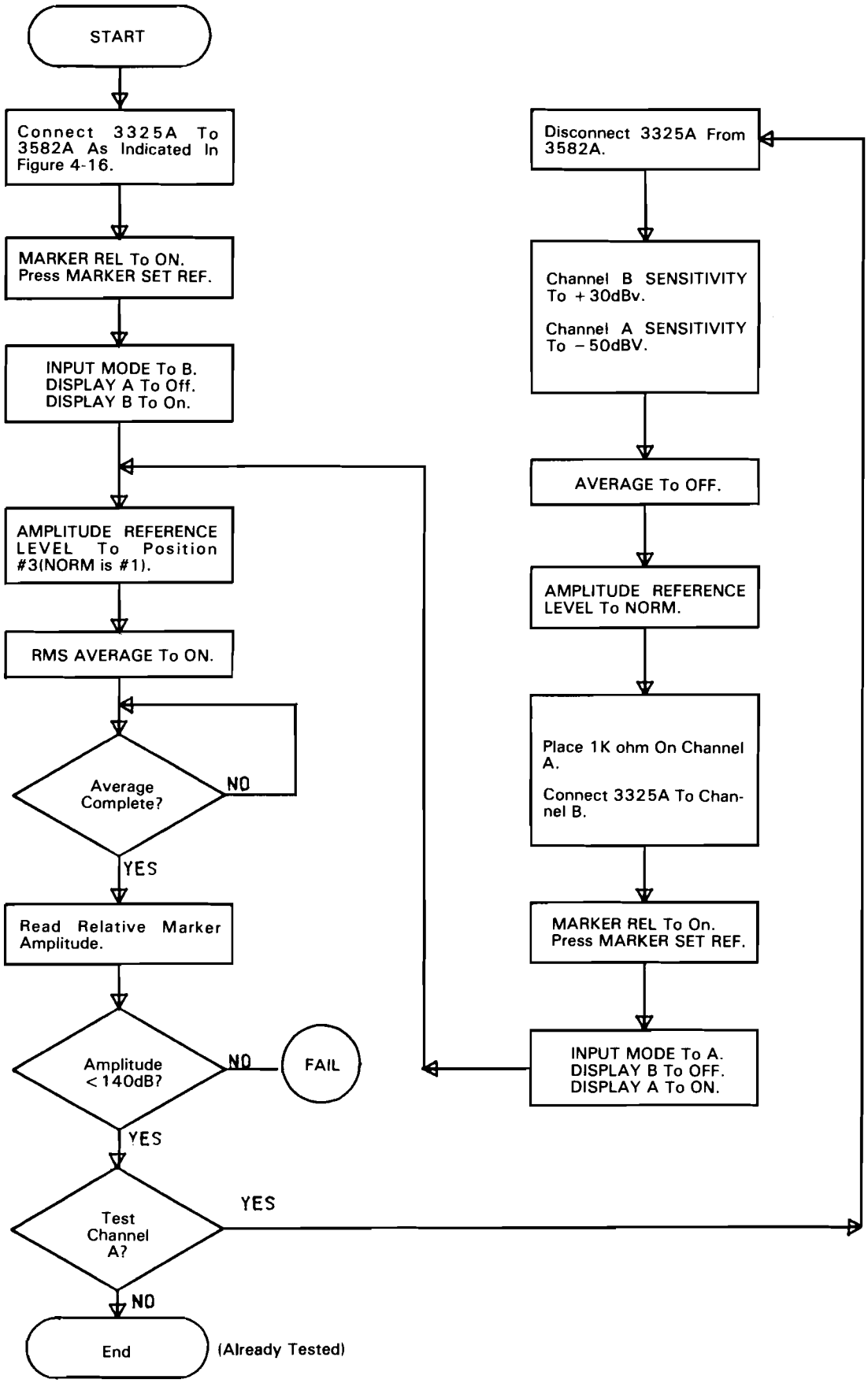


Figure 4-17. Cross Talk.

4-202. INPUT IMPEDANCE TEST.

4-203. The input impedance test verifies that the input resistance is 1 Mohm ±30 Kohm and the capacitance is less than 60pf. The test uses the Periodic Noise source and an attenuator compensation network formed by a series resistance paralleled by a capacitor.

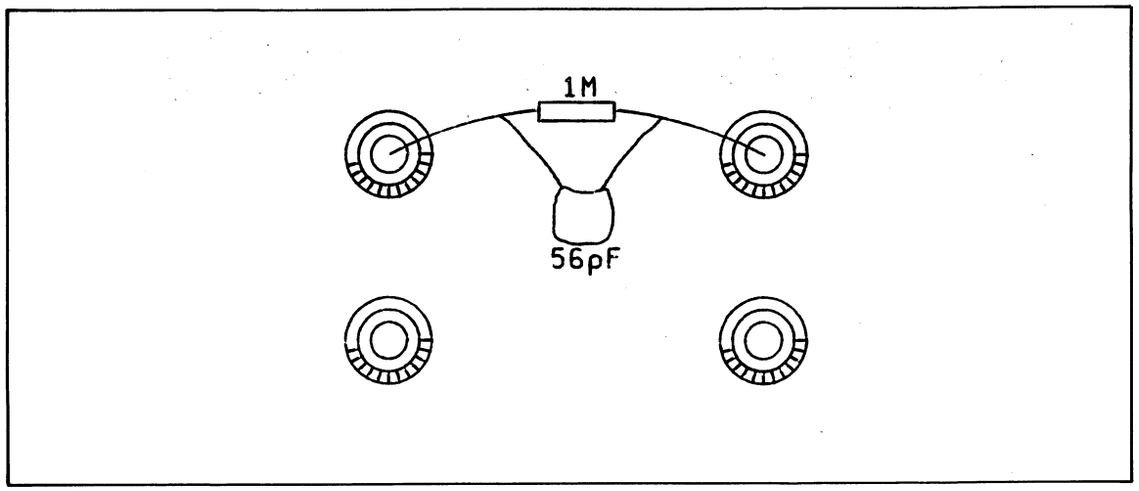
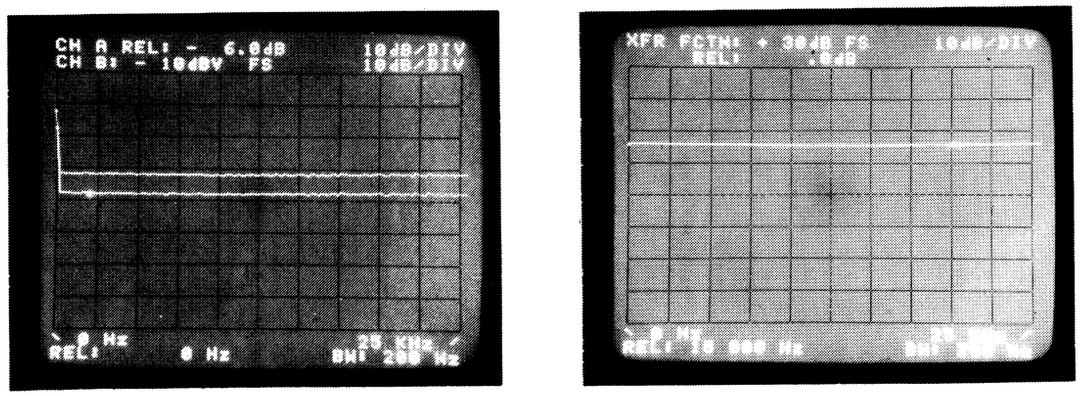


Figure 4-18. Input Compensation Network.

4-204. The network may be made by soldering a 56pf capacitor -hp- Part No. 0140-0191 across a 1 Mohm resistor -hp- Part No. 0698-7332. The network is then connected beween the "high" input terminals of channels A and B (see Figure 4-18).

4-205. The test is then performed by placing the Noise Source Output on one input channel and then measuring the effect of the attenuator on the input of the second channel. By using a dual channel amplitude display and the amplitude transfer function, the input resistance can be measured (ideally a −6dB drop) and the capacitance limits determined (using the



Input Resistance Input Capacitance

Figure 4-19. Effects Of The Compensation Network On Input.

amplitude and slope of the transfer function at higher frequencies, ideally a flat trace indicating 56pf, see Figure 4-19). The input attenuator is checked by using three selected Sensitivity settings.

4-206. Recommended Test Equipment.

Compensation Network: Capacitor 56pf -hp- Part No. 0140-0191
Resistor 1 Mohm 1% -hp- Part No. 0698-7332

4-207. Instrument Control Settings.

3582A: Preset
INPUT SENSITIVITY (both channels).....+20dBV
AVERAGE NUMBER.....32
DISPLAY AMPLITUDE B.....ON
INPUT MODE.....BOTH
MARKER.....ON

4-208. Perform the steps indicated in the flow chart.

: Capacitor 56pf -hp- Part No. 0140-0191
p- Part No. 0698-7332

both channels).....+20dBV
.....32
E B.....ON
.....BOTH
.....ON

the flow chart.

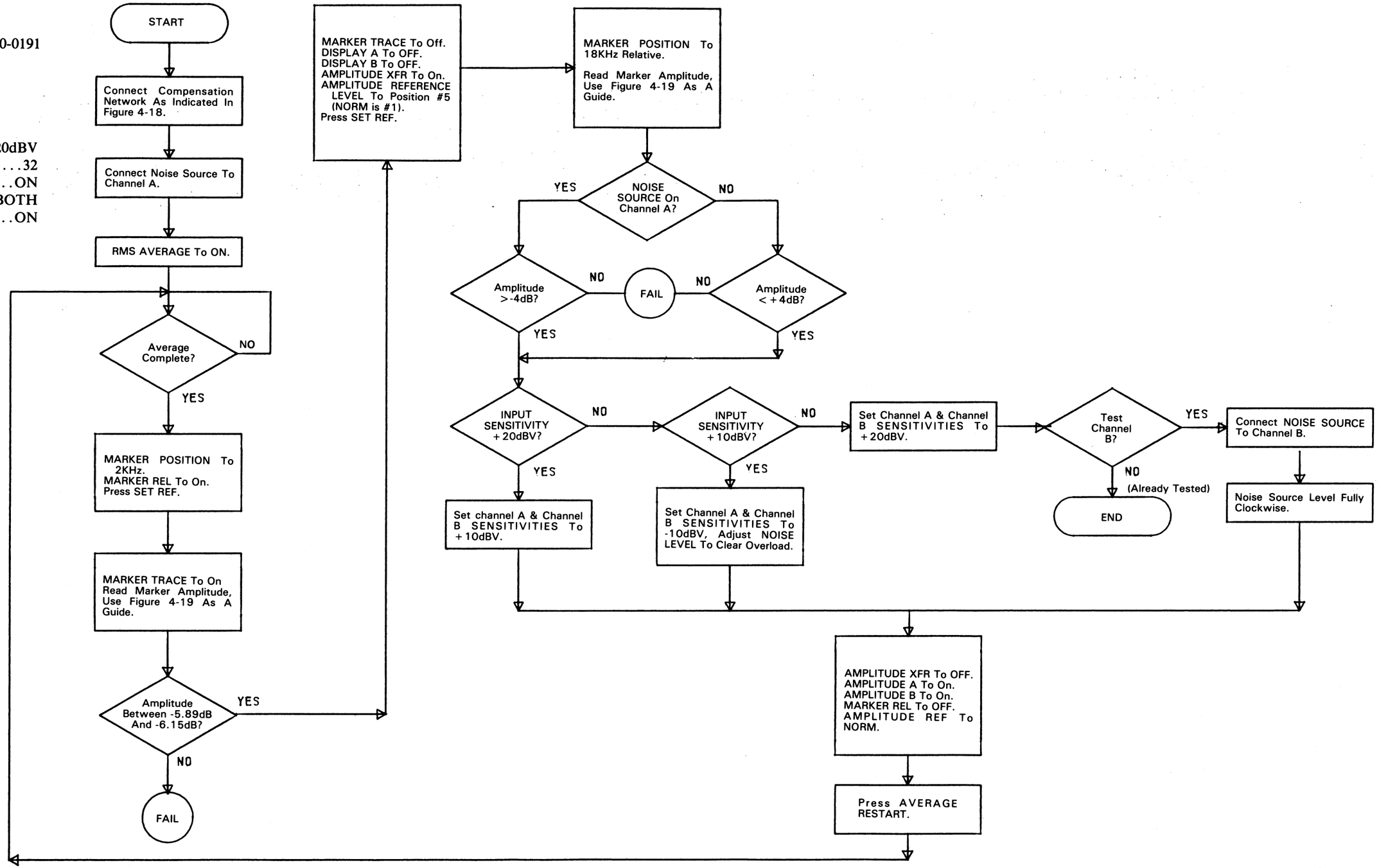


Figure 4-20. Input Impedance.

4-209. NOISE SOURCE OUTPUT IMPEDANCE.

4-210. The noise source output impedance test verifies that the impedance is less than 2 ohms by comparing amplitudes at 25kHz with and without a 50 ohm load.

4-211. Recommended Test Equipment.

Termination: 50 ohms

Compatible shielded (coax) interconnecting cables with appropriate adaptors.

4-212. Test Equipment Setup.

4-213. Connect the IMPULSE output to the TRIGGER input on the rear panel of the 3582A. Then, set the TRIGGER switch to EXT. Connect the NOISE SOURCE OUTPUT to the Channel A input. The NOISE SOURCE LEVEL should be set to maximum and the function set to PERIODIC.

4-214. Instrument Control Setting.

3582A: Preset
INPUT SENSITIVITY (Channel A Only).....3V
COUPLING.....AC
TRIGGER LEVEL.....FREE RUN OFF
MARKER.....ON
SCALE.....LINEAR
AMPLITUDE REFERENCE LEVEL.....Position #5
AVERAGE NUMBER.....8
MARKER POSITION.....25kHz
PASSBAND SHAPE.....UNIFORM

4-215. Perform the steps as indicated in the flow chart.

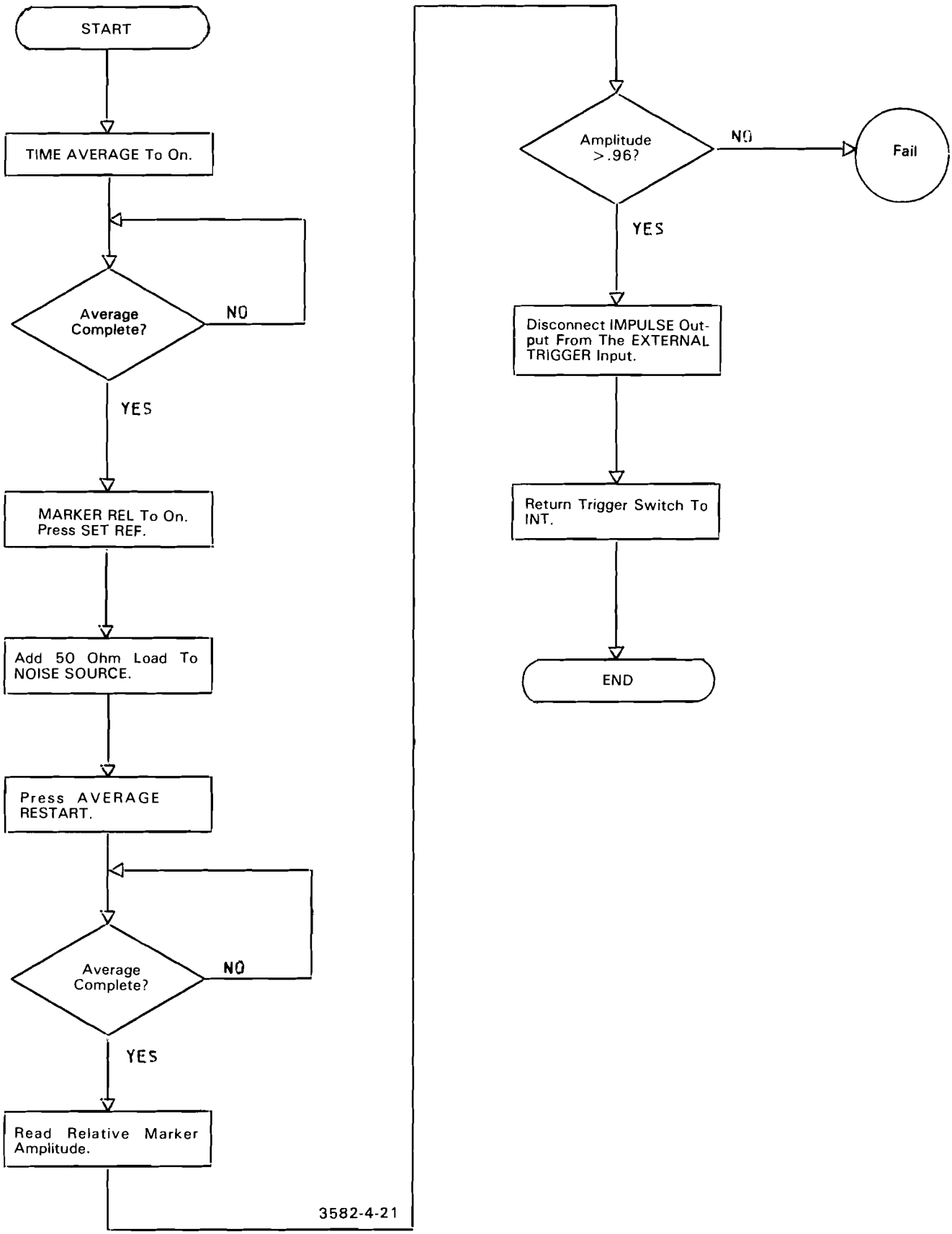


Figure 4-21. Noise Source Output Impedance.

4-216. NOISE SOURCE AMPLITUDE.

4-217. The noise source amplitude test verifies that energy is outputed at a constant level for each span and resulting frequency displayed. In RANDOM, the noise is averaged and the results tested for constant amplitude for all frequencies of the selected span.

4-218. Recommended Test Equipment.

Termination: 50 ohms
Compatible shielded (coax) cables with appropriate adaptors.

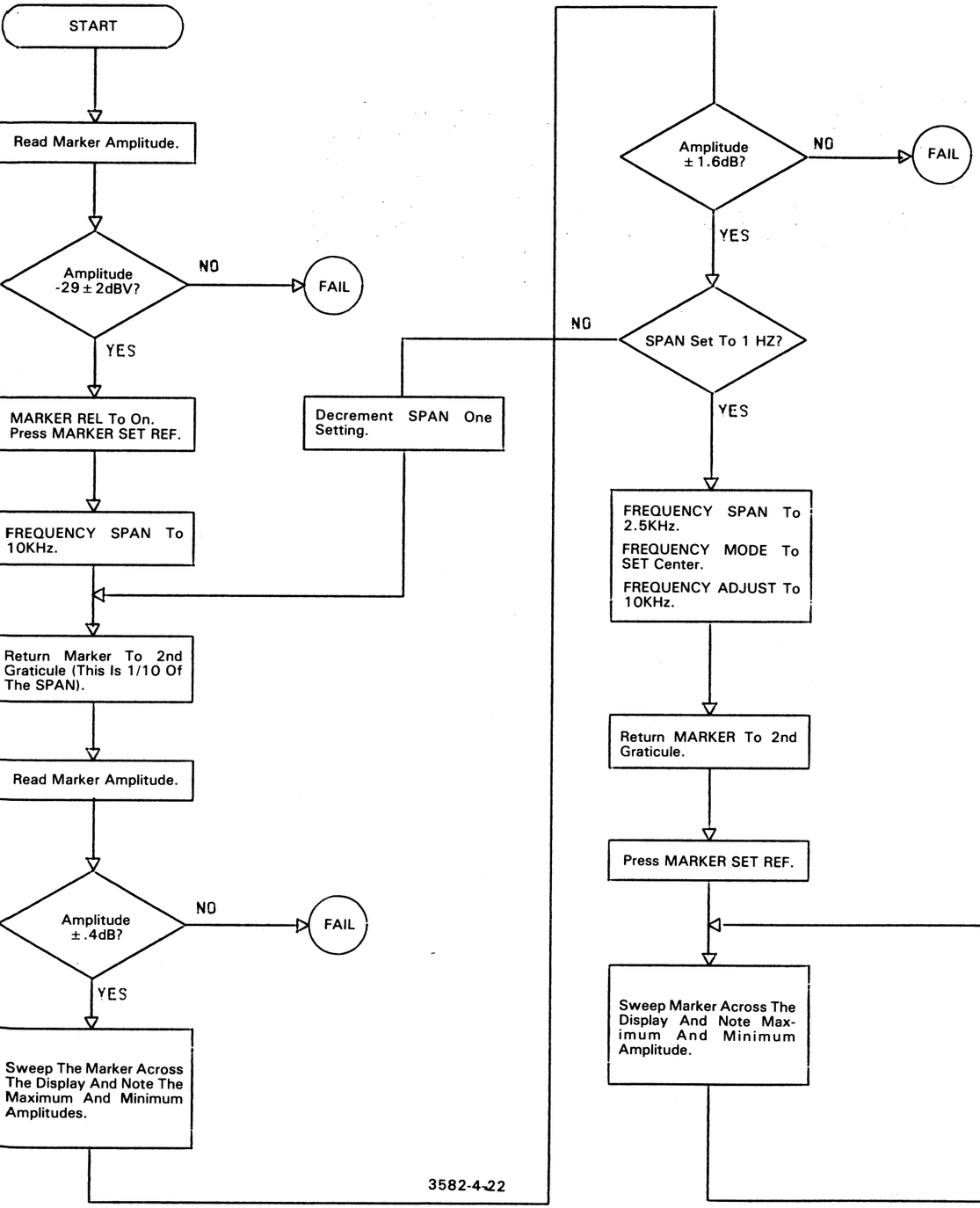
4-219. Test Equipment Setup.

4-220. Connect the NOISE SOURCE OUTPUT to Channel A using a 50 ohm termination. Verify that the NOISE SOURCE LEVEL is in the detented position indicating maximum output amplitude.

4-221. Instrument Control Setting.

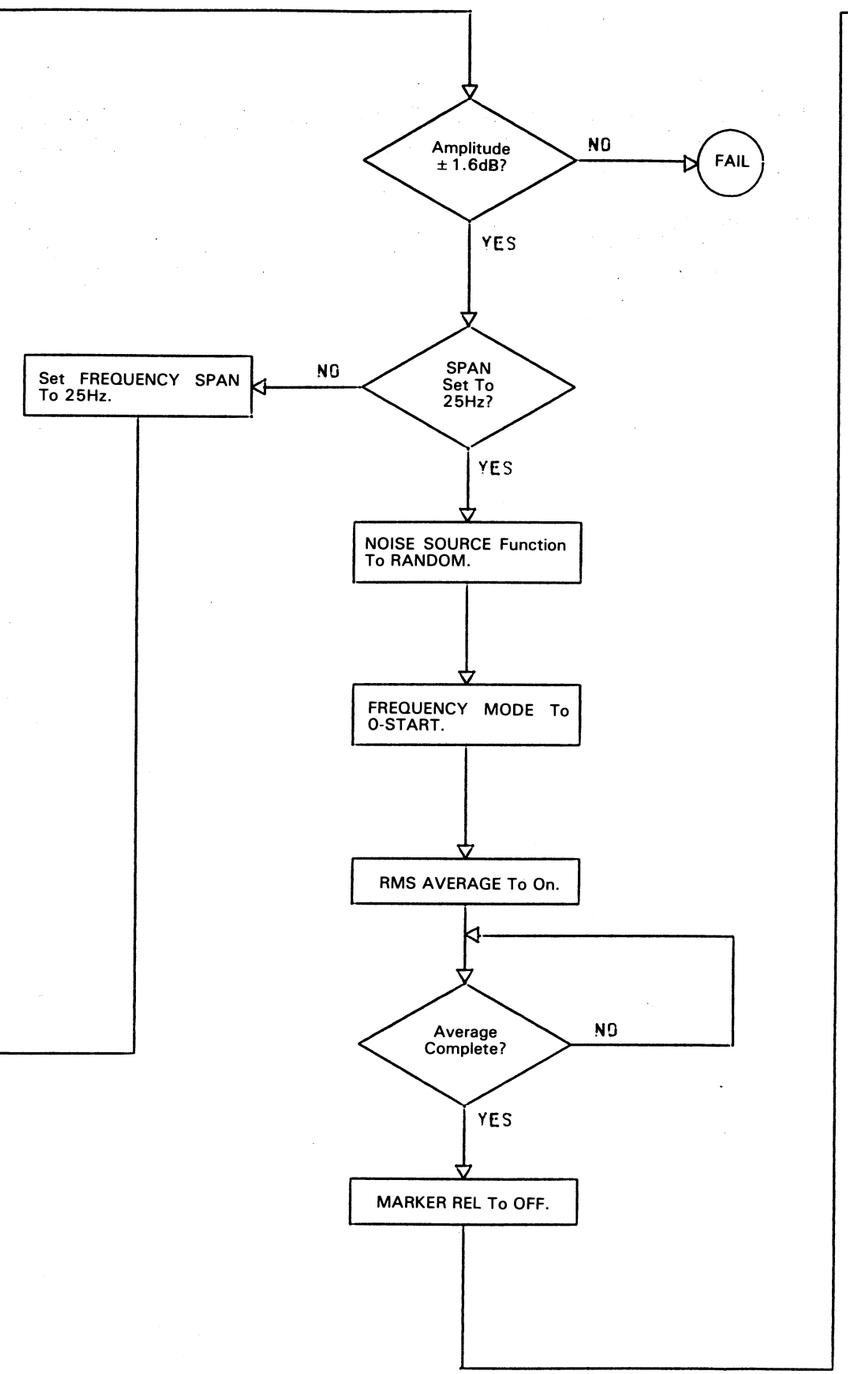
3582A: Preset
INPUT SENSITIVITY (Channel A only).....10dBV
COUPLING.....DC
MARKER.....ON
MARKER POSITION.....1kHz
FREQUENCY MODE.....0-START
PASSBAND SHAPE.....UNIFORM
AVERAGE NUMBER.....8

4-222. Perform the steps as indicated in the flow chart.



Return to top of next column

Return to top of next column



Return to top of next column

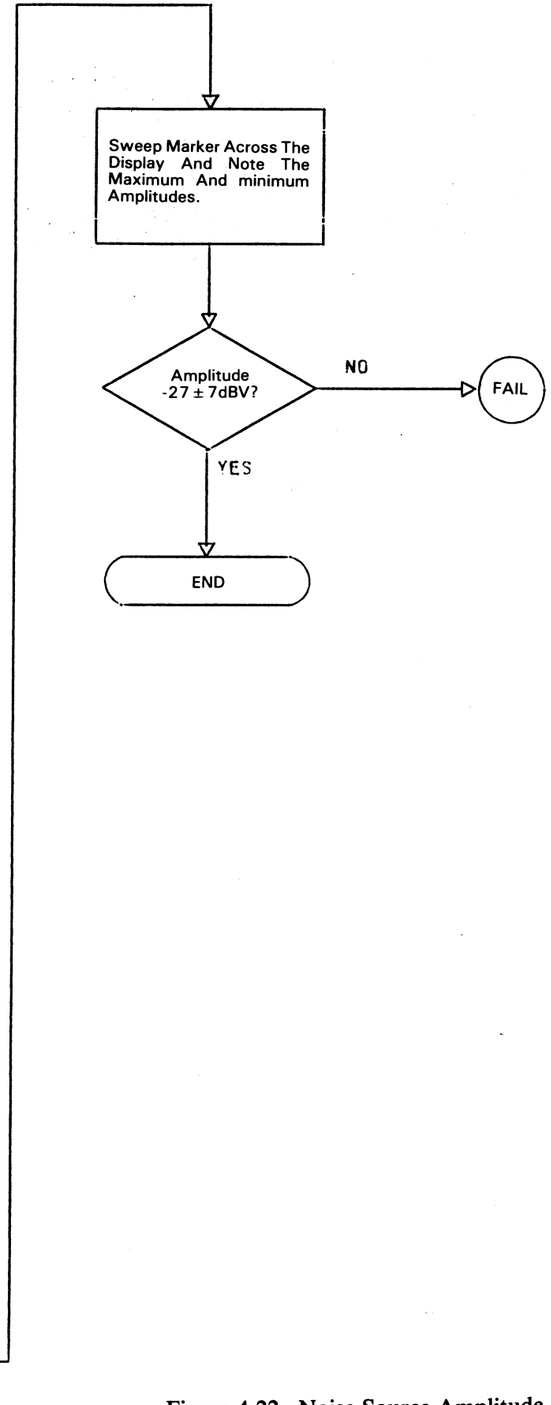


Figure 4-22. Noise Source Amplitude.

4-223. CALIBRATION ACCURACY.

4-224. The calibration accuracy test checks the amplitude of the calibration signal at selected frequencies.

4-225. Instrument Control Settings.

3582A: Preset
SCALE ..... LINEAR
INPUT SENSITIVITY (Both channels) ..... CAL
MARKER ..... ON
MARKER POSITION 1kHz

4-226. Perform the steps as indicated in the flow chart.

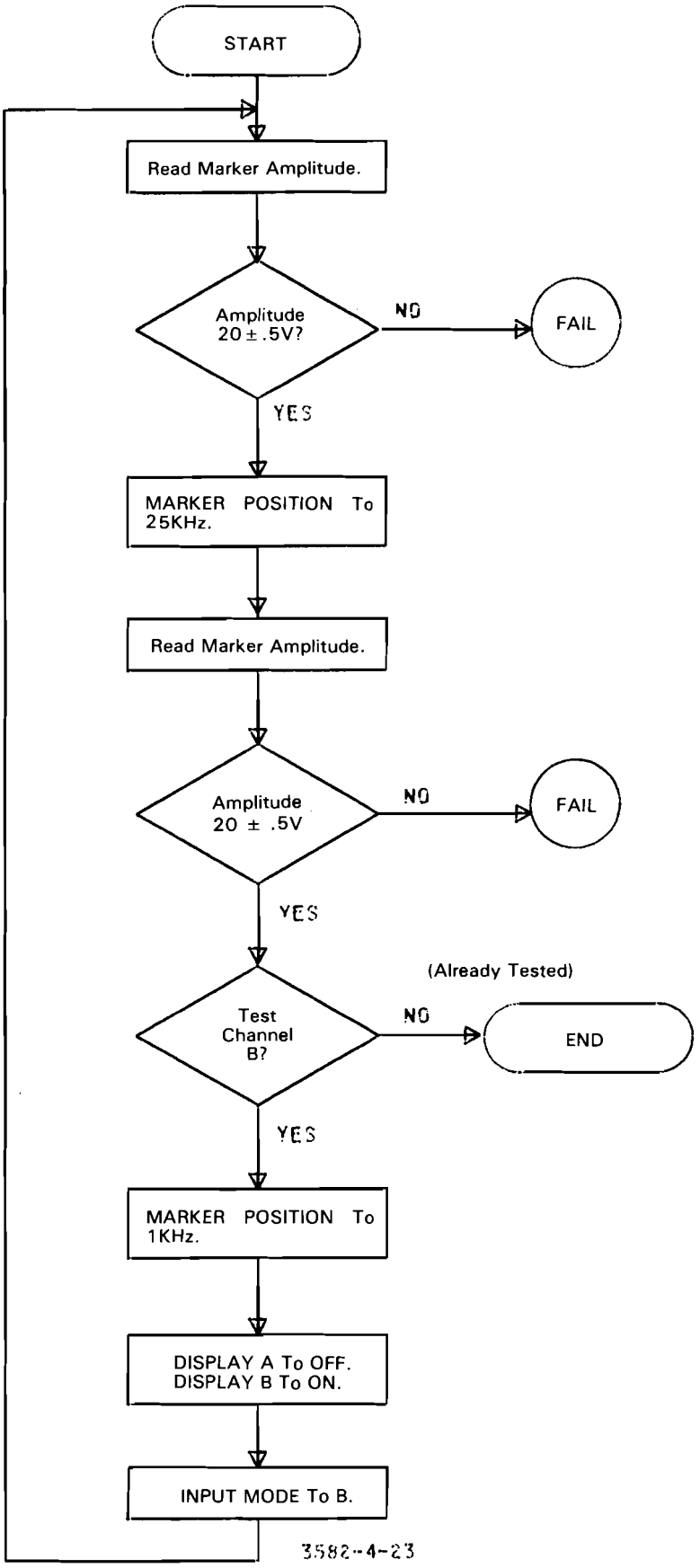


Figure 4-23. Calibration Accuracy.

4-227. FREQUENCY ACCURACY.

4-228. The frequency accuracy test uses an external signal source to verify that the digital local oscillator and marker frequency readout are operating within specifications.

4-229. Recommended Test Equipment.

3325A Synthesizer/Function Generator

Termination: 50 ohms

Compatible shielded (coax) interconnecting cables with appropriate adaptors.

4-230. Test Equipment Setup.

4-231. Connect the 3325A to the Channel A input of the 3582A using a 50 ohm load.

4-232. Instrument Control Settings.

3582A: Preset
INPUT SENSITIVITY (Channel A only).....10dBV
FREQUENCY MODE.....SET CENTER
FREQUENCY ADJUST.....25kHz
FREQUENCY SPAN.....5Hz
MARKER.....ON
PASSBAND SHAPE.....HANNING

3325A:
FREQUENCY.....25kHz
AMPLITUDE.....2.05dBm
FUNCTION.....SINE WAVE

4-233. Perform the steps as indicated in the flow chart.

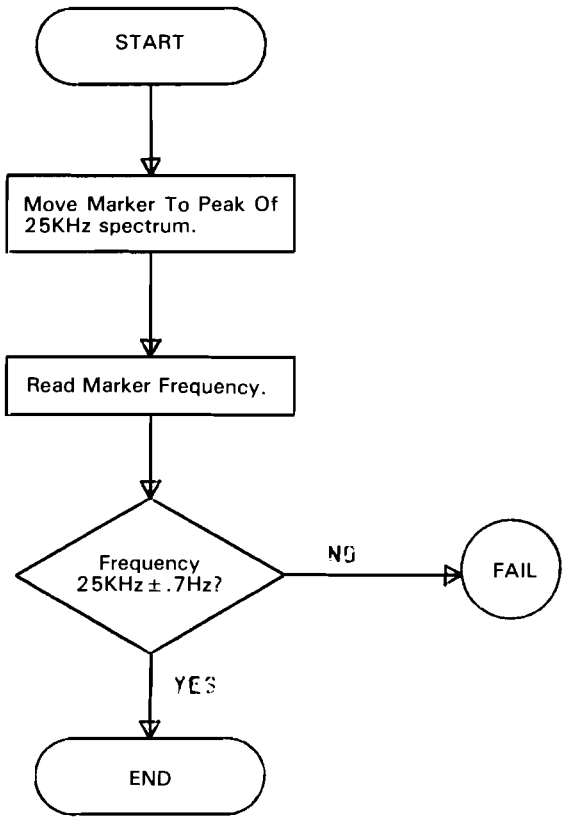


Figure 4-24. Frequency Accuracy.

4-234. LINEARITY.

4-235. The linearity test checks the amplitude accuracy of the 3582A when a signal of less than full scale level is present on the input.

4-236. Recommended Test Equipment.

3325A Synthesizer/Function Generator

Termination: 50 ohms

Compatible shielded (coax) interconnecting cables with appropriate adaptors.

4-237. Connect the 3325A to both channels A and B using one 50 ohm load.

4-238. Instrument Control Settings.

3582A: Preset
INPUT SENSITIVITY (Both channels)..... + 10dBV
MARKER.....ON
MARKER POSITION.....13.2kHz
AVERAGE NUMBER.....16

3325A:
FREQUENCY 13.2kHz
AMPLITUDE 22.01dBm
FUNCTION.....SINE WAVE

4-239. Perform the steps as indicated on the flow chart.

Table 4-8. 3582A Test Limits.

Amplitude Reference Level	3325A Amplitude (dBm)	3582A Test Limits (dB)
#2	12.01	−10.2/− 9.80
#3	2.01	−20.2/−19.8
#4	− 7.99	−30.3/−29.7
#5	−17.99	−40.4/−39.6
#6	−27.99	−50.8/−49.2
#7	−37.99	−62.5/−58.1
#8	−47.99	−81.4/−65.2

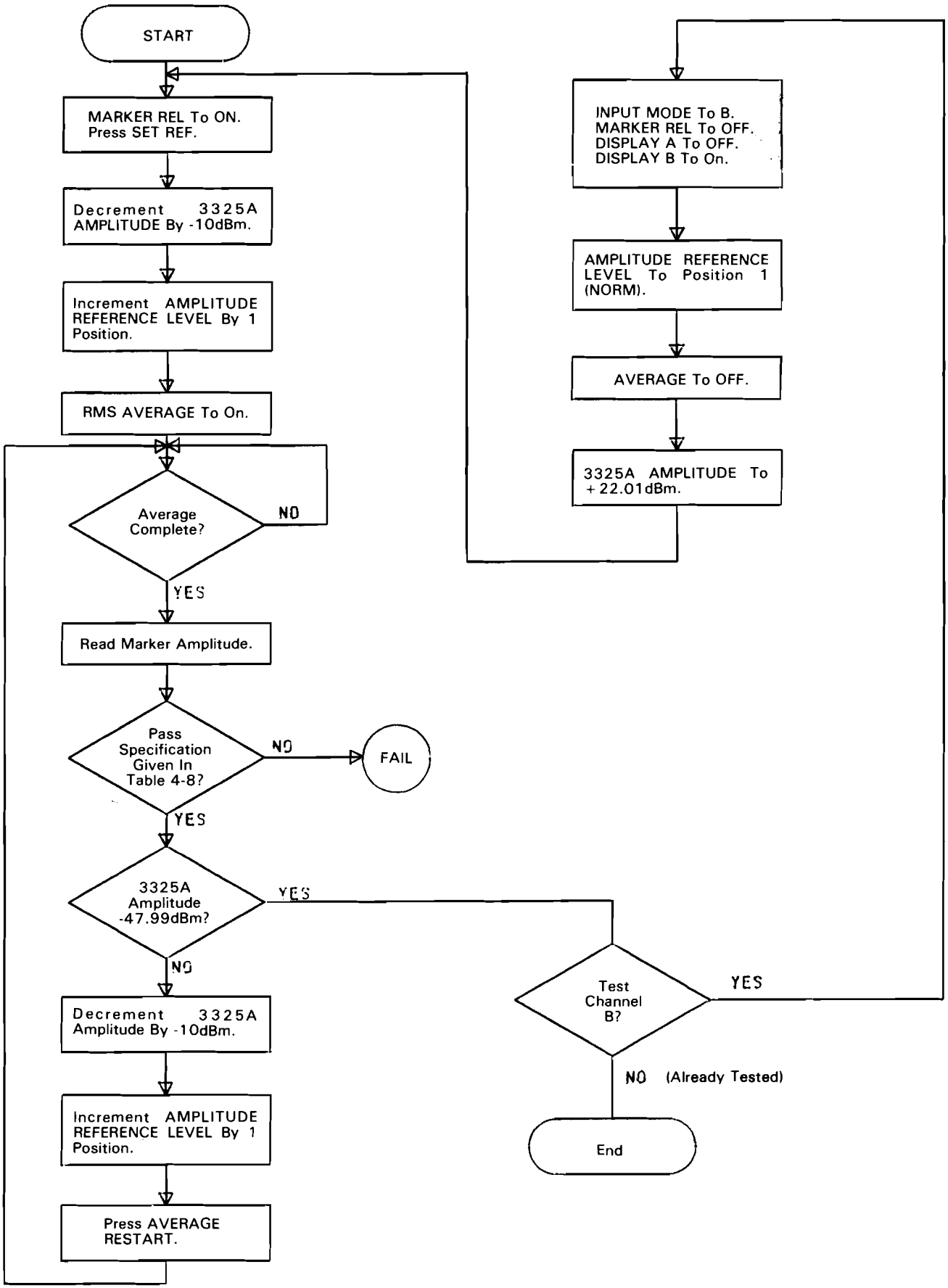


Figure 4-25. Linearity.

4-240. ATTENUATOR ACCURACY.

4-241. The attenuator accuracy test checks the 3582A input attenuator by using the marker amplitude readout to measure a known input level on each attenuator setting.

4-242. Recommended Test Equipment.

3325A Synthesizer/Function Generator

Termination: 50 ohms

Compatible shielded (coax) interconnecting cables with appropriate adaptors.

4-243. Test Equipment Setup.

4-244. Connect the 3325A output to both channels A and B using one 50 ohm load.

4-245. Instrument Control Settings.

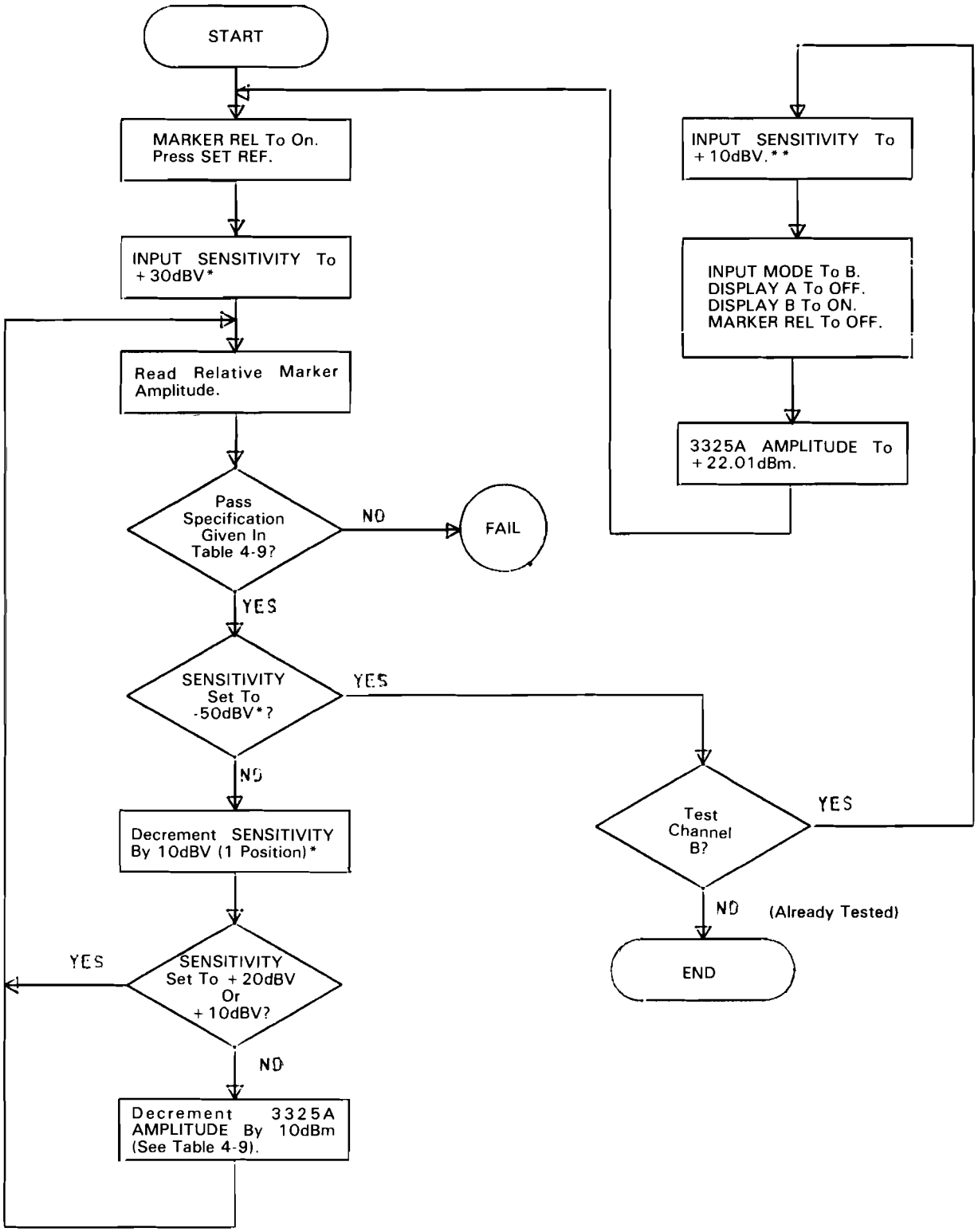
3582A: Preset
INPUT SENSITIVITY (Both channels) ..... +10dBV
MARKER ..... ON
MARKER POSITION 1kHz
CHAS-ISOL ..... ISOL

3325A:
FREQUENCY 1kHz
AMPLITUDE ..... +22.01dBM
FUNCTION ..... SINE WAVE

4-246. Perform the steps as indicated in the flow chart.

Table 4-9. 3582A Attenuator Accuracy.

3582A Sensitivity (dBV)	3325A Amplitude (dBm)	3582A Test Limit (dB REL)
+30	22.01	0±.2
+20	22.01	0±.2
+10	22.01	0±.2
0	12.01	−10±.2
−10	2.01	−20±.2
−20	− 7.99	−30±.2
−30	−17.99	−40±.2
−40	−27.99	−50±.2
−50	−37.99	−60±.2



* On channel under test.
** Both channels.

Figure 4-26. Attenuator Accuracy.

4-247. INPUT FILTER AND ANALOG TO DIGITAL CONVERTER FLATNESS.

4-248. A signal source is used to check the flatness of the input filter and analog to digital converter by providing a sine wave at selected frequency intervals. The variation between the amplitude of the reference frequency and the remaining frequencies is obtained by using the relative marker readout.

4-249. Recommended Test Equipment.

3325A Synthesizer/Function Generator

Termination: 50 ohms

Compatible shielded (coax) interconnecting cables with appropriate adaptors.

4-250. Test Equipment Setup.

4-251. Connect the 3325A to both channels A and B using one 50 ohm load.

4-252. Instrument Control Settings.

3582A: Preset
INPUT SENSITIVITY (Both channels).....0dBV
FREQUENCY MODE.....0-START
FREQUENCY SPAN.....2.5kHz
MARKER.....ON
MARKER POSITION.....2.5kHz

3325A:
FREQUENCY 2.5kHz
AMPLITUDE 12.01dBm
FUNCTION.....SINE WAVE

4-253. Perform the steps as indicated in the flow chart.

Table 4-10. 3325A Frequency Settings (kHz).

1.2	6.2	11.2	16.2	21.2
2.5	7.5	12.5	17.5	22.5
3.7	8.7	13.7	18.7	23.7
5.0	10.0	15.0	20.0	25.0

Table 4-11. 3325A Frequency Settings (kHz).

.480	2.48	4.48	6.48	8.48
1	3	5	7	9
1.48	3.48	5.48	7.48	9.48
2	4	6	8	10

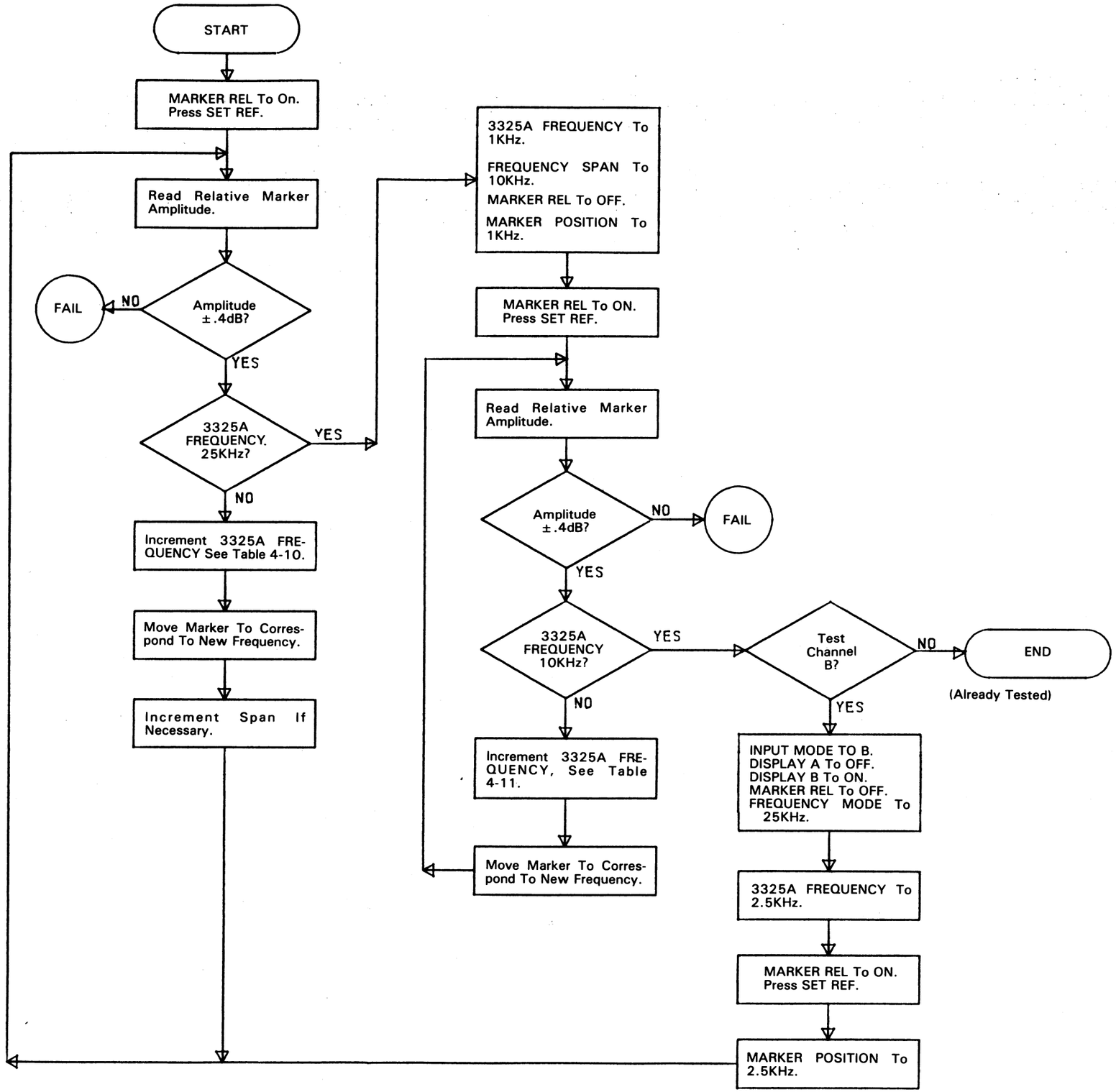


Figure 4-27. Input filter And Analog To Digital Converter Flatness.

4-254. ATTENUATOR FLATNESS.

4-255. The attenuator flatness test uses a signal source, to supply a constant amplitude for several frequencies, in conjunction with the relative marker readout to assure flatness at each attenuator setting.

4-256. Recommended Test Equipment.

3325A Synthesizer/Function Generator

Termination: 50 ohms

Compatible shielded (coax) interconnecting cables with appropriate adaptors.

4-257. Test Equipment Setup.

4-258. Connect the 3325A to both channels A and B using one 50 ohm load.

4-259. Instrument Control Settings.

3582A: Preset
INPUT SENSITIVITY (Both channels).....30dBV
FREQUENCY MODE.....0-START
MARKER.....ON
MARKER POSITION.....2.5kHz
CHAS-ISOL.....ISOL

3325A:
FREQUENCY 2.5kHz
AMPLITUDE 22.01dBm
FUNCTION.....SINE WAVE

4-260. Perform the steps as indicated in the flow chart.

Table 4-12. 3325A Amplitude Settings.

3582A Sensitivity (dBV)	3325A Amplitude (dBm)
+30	22.01
+20	22.01
+10	22.01
0	12.01
−10	2.01
−20	− 7.99
−30	−17.99
−40	−27.99
−50	−37.99

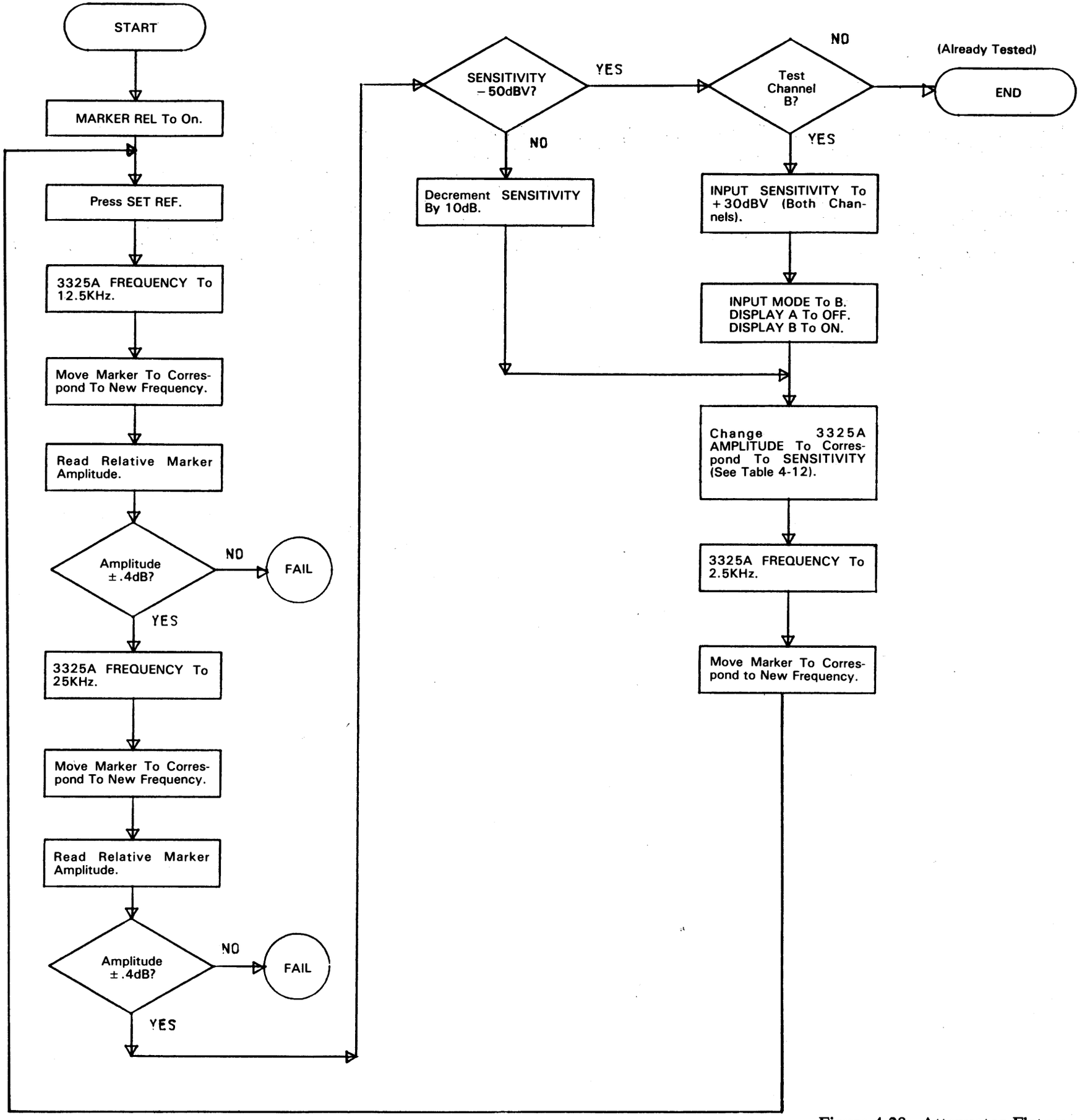


Figure 4-28. Attenuator Flatness.

4-261. LOCAL OSCILLATOR/MIXER SPURS.

4-262. To test for spurs, the local oscillator output is internally mixed with a reference signal (generated by an external source) by using the SET CENTER frequency mode of operation. The marker readout is then used to verify that all frequencies other than the reference frequency, the negative frequency, and 0Hz contain spurious products below specified limits.

4-263. Recommended Test Equipment.

3325A Synthesizer/Function Generator

Termination: 50 ohms

Compatible shielded (coax) interconnecting cables with appropriate adaptors.

4-264. Test Equipment Setup.

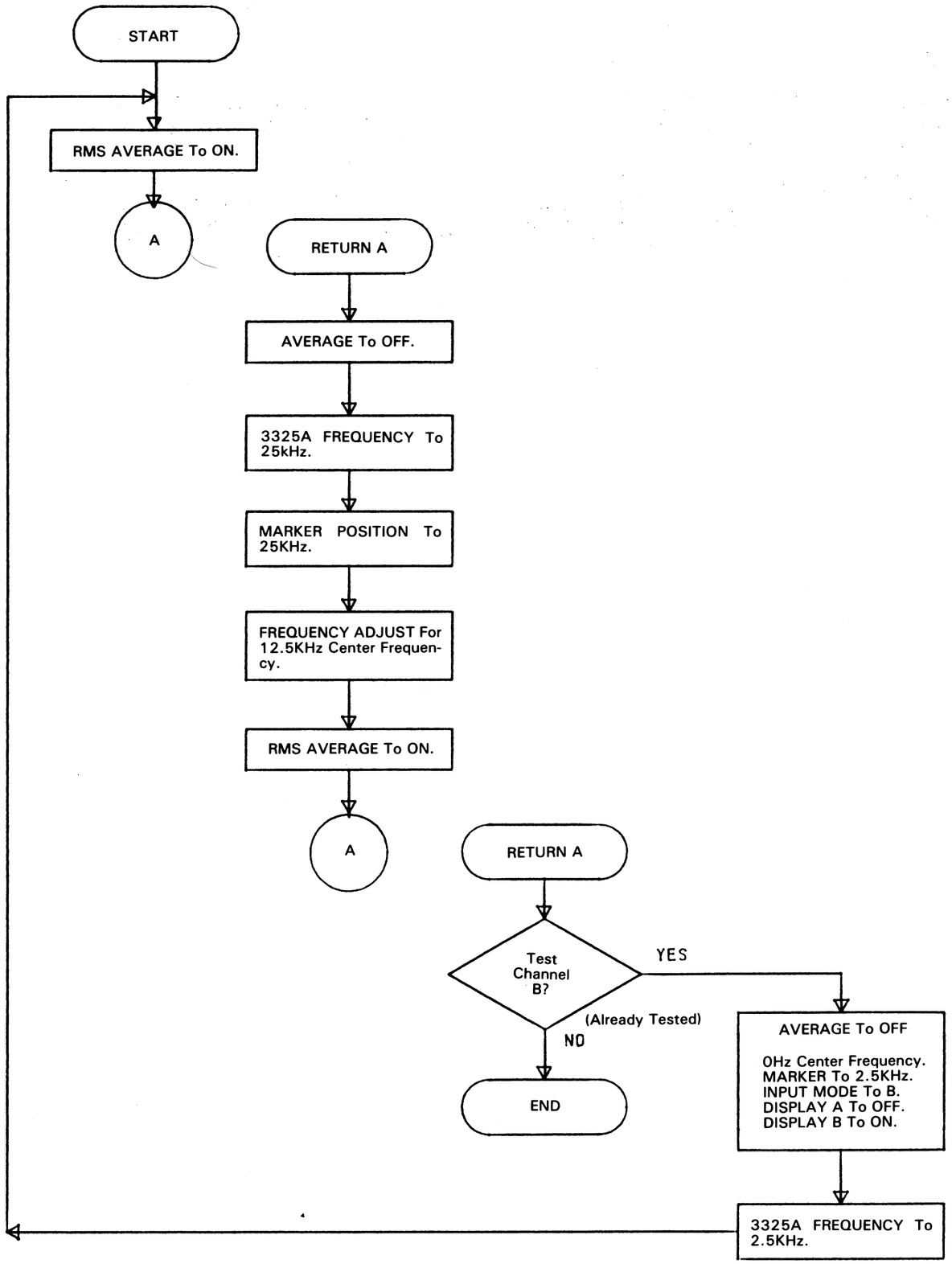
4-265. Connect the 3325A to both channels A and B using one 50 ohm load.

4-266. Instrument Control Settings.

3582A: Preset
INPUT SENSITIVITY (Both channels).....0dBV
FREQUENCY MODE.....SET CENTER
FREQUENCY ADJUST.....2.5kHz
MARKER.....ON
MARKER POSITION.....2.5kHz
PASSBAND SHAPE.....HANNING
AVERAGE NUMBER.....8

3325A:
FREQUENCY 2.5kHz
AMPLITUDE 3.01dBm
FUNCTION.....SINE WAVE

4-267. Perform the steps as indicated in the flow chart.



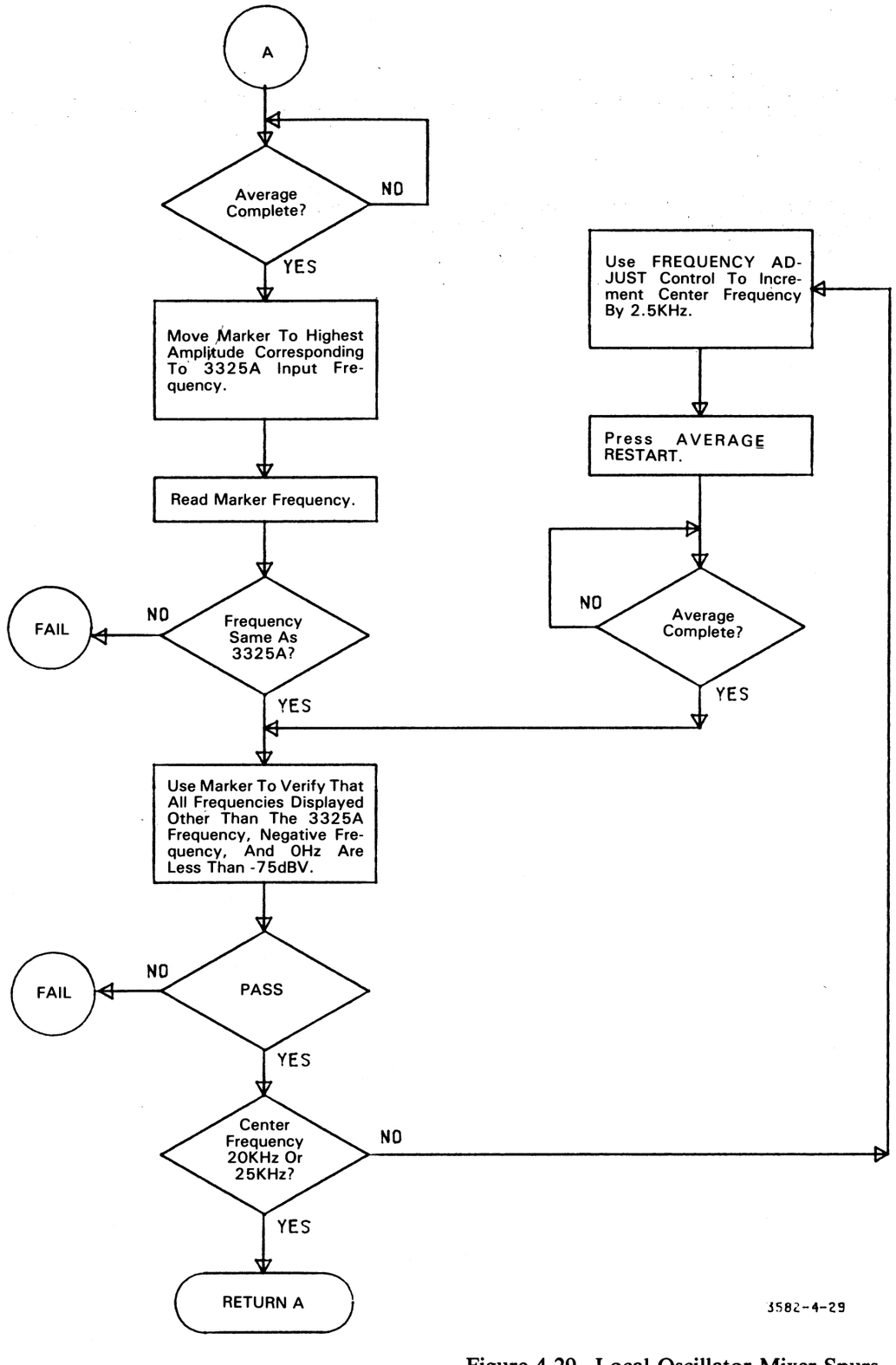


Figure 4-29. Local Oscillator Mixer Spurs.

4-268. DIGITAL FILTER NOISE.

4-269. To check for digital filter noise, a source signal is inputed and adjusted in frequency such that the fundamental is within the range of each span selected. Then for each span, noise (when found above a specified level) appears as spurious responses which are not associated with the fundamental or its harmonics.

4-270. Recommended Test Equipment.

3325A Synthesizer/Function Generator

Termination: 50 ohms

Compatible shielded (coax) interconnecting cables with appropriate adaptors.

4-271. Test Equipment Setup.

4-272. Connect the 3325A to both channels A and B using one 50 ohm load.

4-273. Instrument Control Settings.

3382A: Preset
INPUT SENSITIVITY (Both channels).....0dBV
FREQUENCY MODE.....SET START
MARKER.....ON
AVERAGE NUMBER.....4
FREQUENCY ADJUST.....0Hz

3325A:
FREQUENCY 6.25kHz
AMPLITUDE 12.01dBm
FUNCTION.....SINE WAVE

4-274. Perform the steps as indicated in the flow chart.

Table 4-13. 3325A Frequency Settings.

3582A Span	3325A Frequency	Second Harmonic	Third Harmonic
25 KHz	6250	12500	18750
10 KHz	2500	5000	7500
5 KHz	1250	2500	3750
2.5KHz	650	1250	1875
1 KHz	250	500	750
500	125	250	375
250	62.5	125	187.5
100	25	50	75
50	12.5	25	37.5
25	6.25	12.5	18.75
10	2.5	5	7.5
5	1.25	2.5	3.75

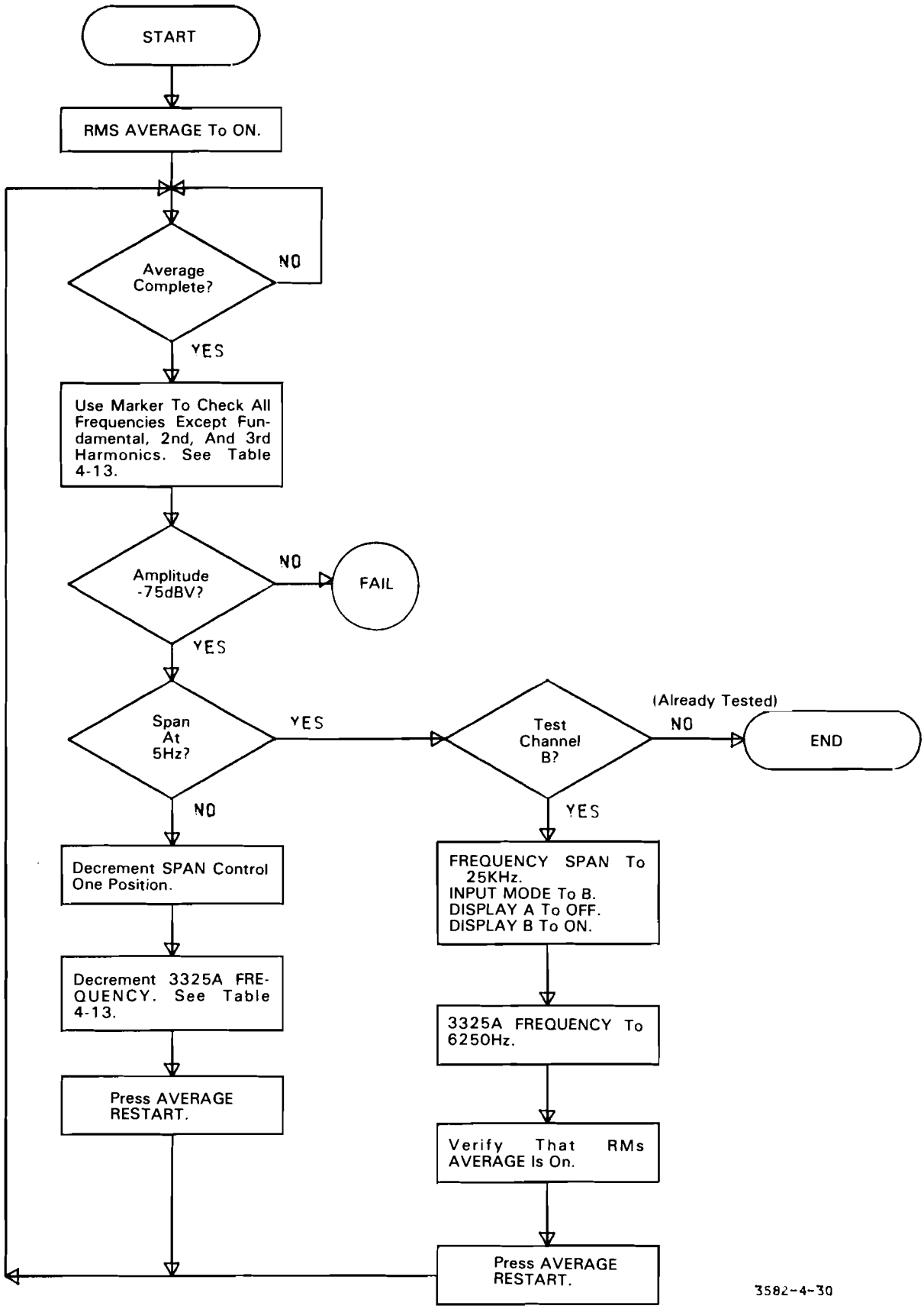


Figure 4-30. Digital Filter Noise.

4-275. DIGITAL FILTER OPERATION.

4-276. An external source is used to check digital filter operation by supplying signals to determine flatness between the frequency limits of each span and also a signal used to check for the aliasing of data about the effective sample rate for each span.

4-277. Recommended Test Equipment.

3325A Synthesizer/Function Generator

Termination: 50 ohms

Compatible shielded (coax) interconnecting cables with appropriate adaptors.

4-278. Test Equipment Setup.

4-279. Connect the 3325A to both channels A and B using one 50 ohm load.

4-280. Instrument Control Settings.

3582A: Preset
INPUT SENSITIVITY (Both channels).....0dBV
FREQUENCY MODE.....SET START
FREQUENCY ADJUST.....0Hz
MARKER.....ON
MARKER POSITION.....2.5kHz
COUPLING.....DC

3325A:
FREQUENCY 2.5kHz
AMPLITUDE 12.01dBm
FUNCTION.....SINE WAVE

4-281. Perform the steps as indicated in the flow chart.

Table 4-14. 3325A Frequency Settings.

3582A Span	3325A Frequency = 1/10 Span	3325A Frequency = 3.996 x Span
25 KHz	2.5KHz	99.9 KHz
10 KHz	1 KHz	39.96KHz
5 KHz	500	19.98KHz
2.5KHz	250	9.99KHz
1 KHz	100	3996
500	50	1998
250	25	999
100	10	399.6
50	5	199.8
25	2.5	99.9
10	1	39.96
5	.5	19.98

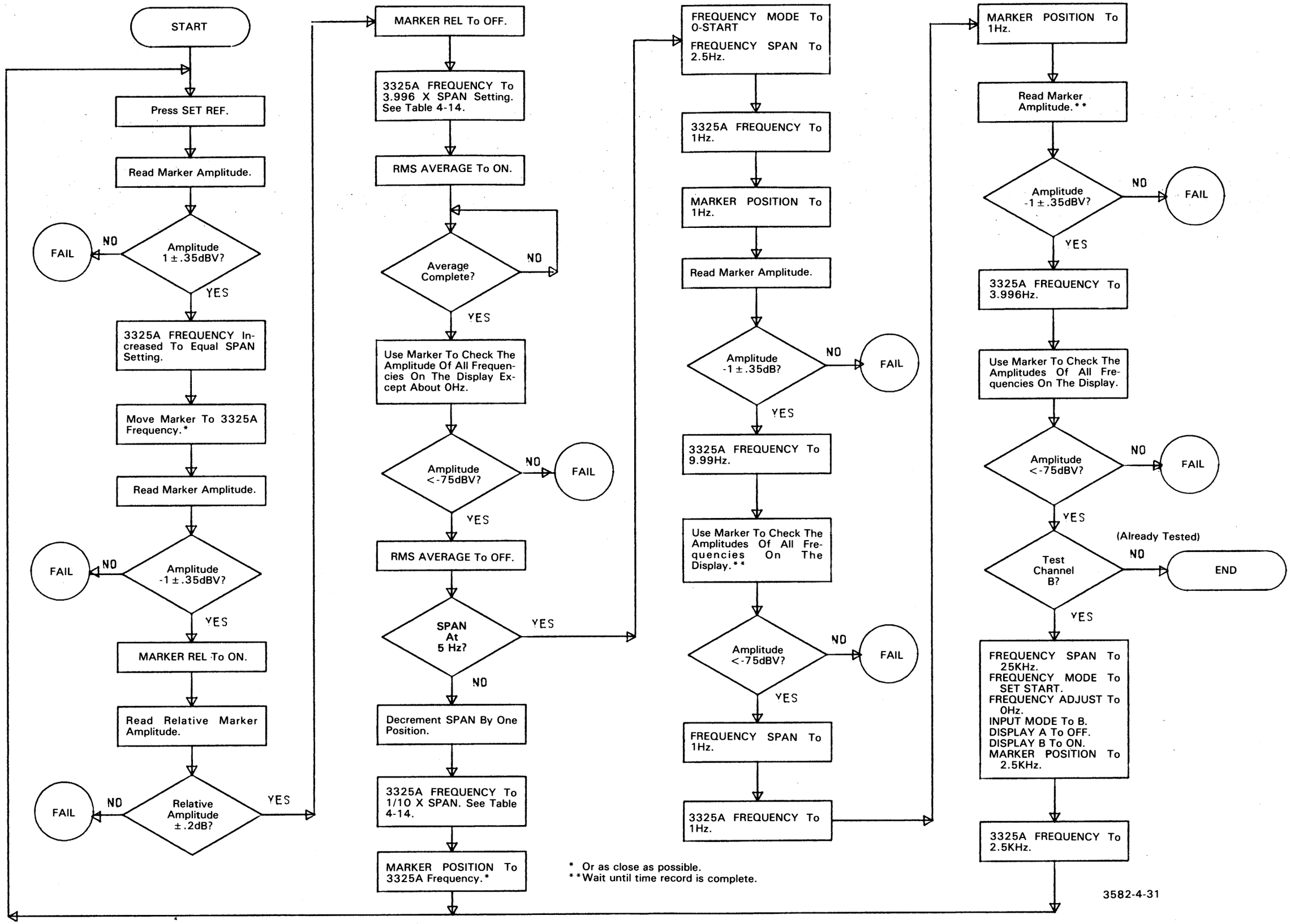


Figure 4-31. Digital Filter Operation.

4-282. AC COUPLING.

4-283. AC Coupling is checked by noting the change in amplitude when the frequency, from an external source, is reduced from 1kHz to 1Hz. 1Hz and lower frequencies are in the region of amplitude attenuation since the AC Coupling network acts as a high pass filter.

4-284. Recommended Test Equipment.

3325A Synthesizer/Function Generator

Termination: 50 ohms

Compatible shielded (coax) interconnecting cables with appropriate adaptors.

4-285. Test Equipment Setup.

4-286. Connect the 3325A to both channels A and B using one 50 ohm load.

4-287. Instrument Control Settings.

3582A: Preset
INPUT SENSITIVITY (Both channels)..... – 10dBV
FREQUENCY MODE.....SET CENTER
FREQUENCY SPAN.....50Hz
FREQUENCY ADJUST.....1kHz
MARKER.....ON
MARKER POSITION.....1kHz
COUPLING.....AC

3325A:
FREQUENCY 1kHz
AMPLITUDE 2.56dBm
FUNCTION.....SINE WAVE

4-288. Perform the steps as indicated in the flow chart.

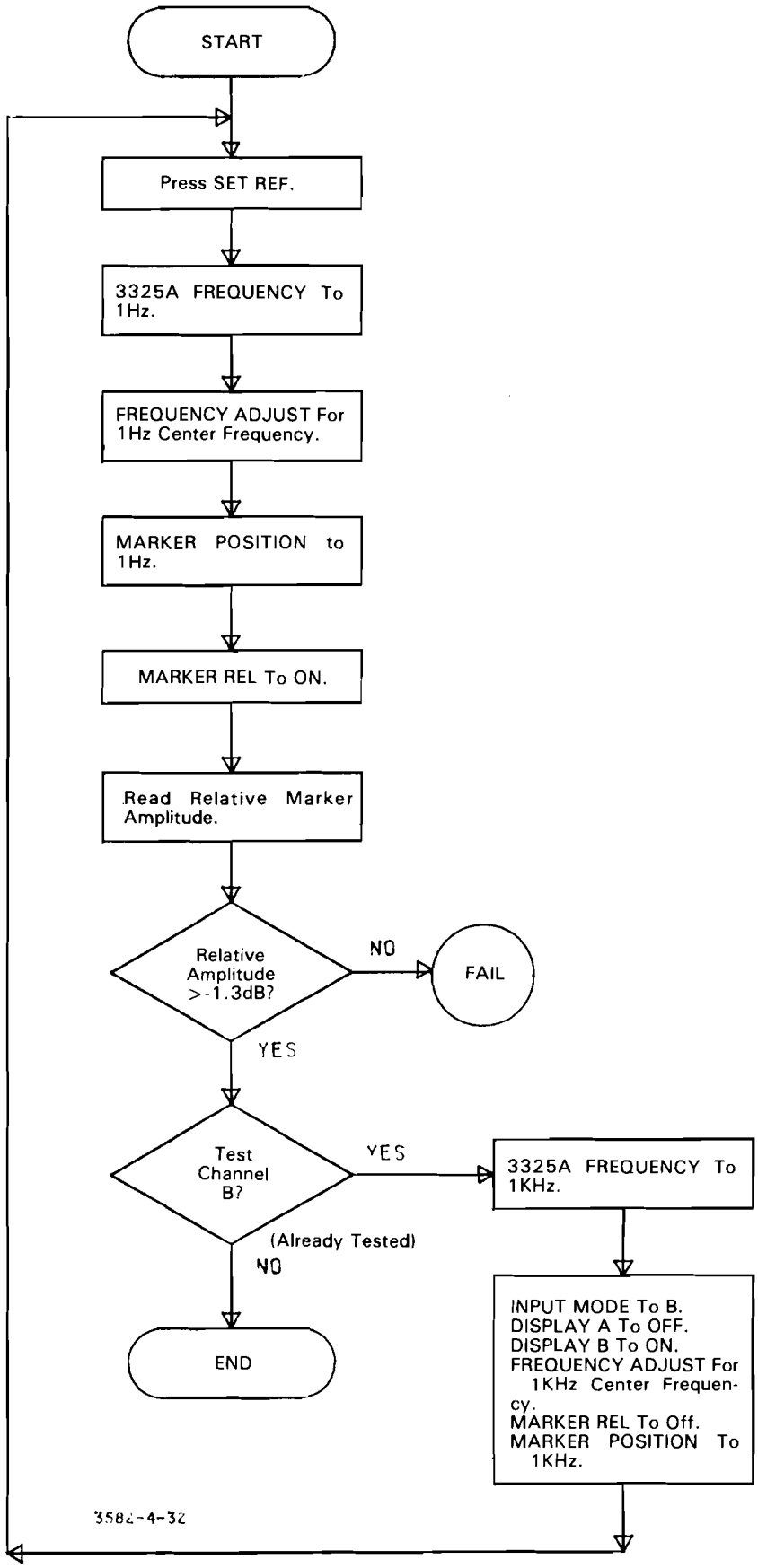


Figure 4-32. AC Coupling.

4-289. SPECIAL SPURS.

4-290. The special spurs test uses an external source to supply signals which are above the upper frequency limit of the 3582A. The marker is then set to specific frequencies where the amplitude is checked to determine if any aliased products of the input appear in the spectral display.

4-291. Recommended Test Equipment.

3325A Synthesizer/Function Generator

Termination: 50 ohms

Compatible shielded (coax) interconnecting cables with appropriate adaptors.

4-292. Test Equipment Setup.

4-293. Connect the 3325A to both channels A and B using one 50 ohm load.

4-294. Instrument Control Settings.

3582A: Preset
INPUT SENSITIVITY (Both channels).....–10dBV
FREQUENCY MODE.....0-START
FREQUENCY SPAN.....10kHz
MARKER.....ON
MARKER POSITION.....10kHz
AVERAGE NUMBER.....16

3325A:
FREQUENCY.....71920Hz
AMPLITUDE.....2.56dBm
FUNCTION.....SINE WAVE

4-295. Perform the steps as indicated in the flow chart.

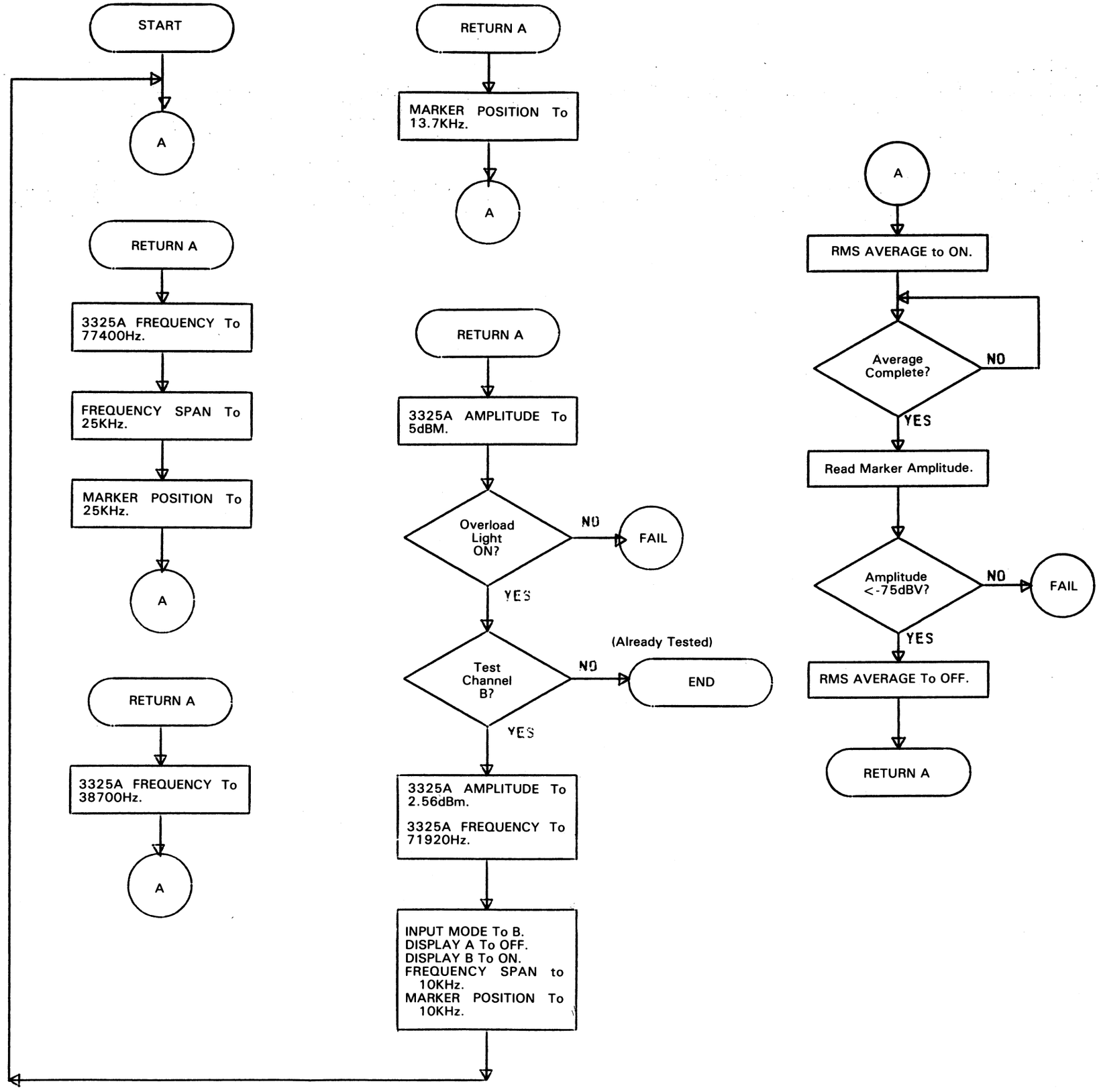


Figure 4-33. Special Spurs.

4-296. PHASE ACCURACY.

4-297. The phase accuracy test checks the relative phase relationship between the harmonics of a square wave signal to determine if the 3582A is within specification in phase with respect to frequency.

4-298. Recommended Test Equipment.

3325A Synthesizer/Function Generator

Termination: 50 ohms

Compatible shielded (coax) interconnecting cables with appropriate adaptors.

4-299. Test Equipment Setup.

4-300. Connect the 3325A to both channels A and B using one 50 ohm load.

4-301. Instrument Control Settings.

3582A: Preset
INPUT SENSITIVITY (Both channels).....0dBV
DISPLAY AMPLITUDE A.....OFF
DISPLAY PHASE A.....ON
TRIGGER LEVEL.....CENTERED
TRIGGER SLOPE.....ON(-)
MARKER.....ON
MARKER POSITION.....1kHz

3325A:
FREQUENCY.....1kHz
AMPLITUDE.....12.1dBm
FUNCTION.....SQUARE WAVE

4-302. Perform the steps as indicated in the flow chart.

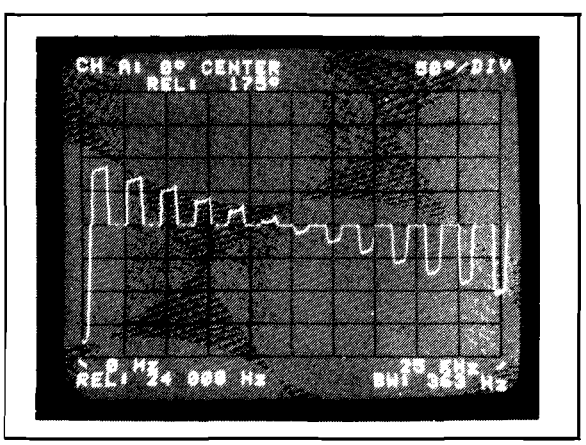


Figure 4-34. Sample Phase Display.

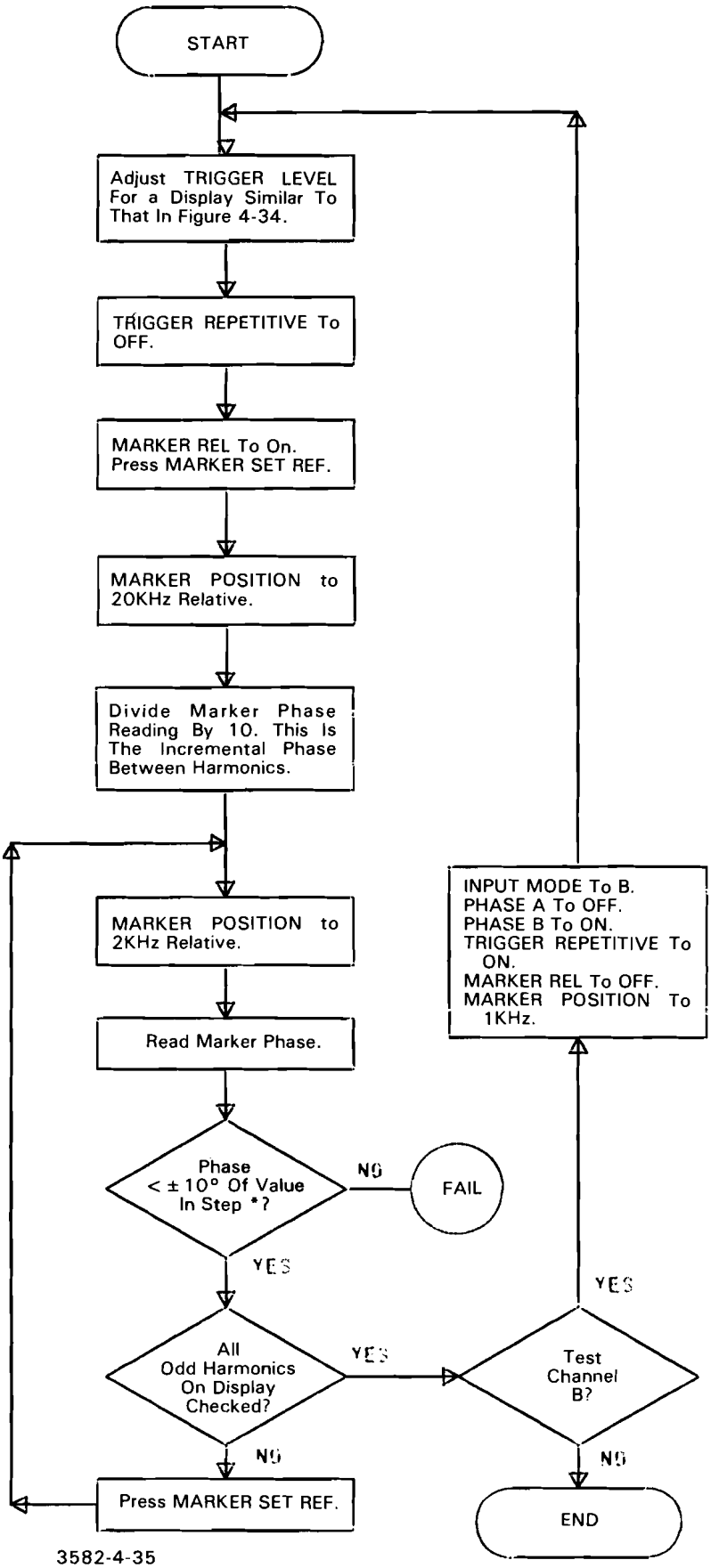


Figure 4-35. Phase Accuracy.

OPERATIONAL VERIFICATION TEST CARD

Hewlett-Packard Model 3582A
Spectrum Analyzer
Serial No. _____

Test Performed By _____
Date _____

ROM Self Test: Pass _____ Fail _____

Display Accuracy:

Frequency (Hz)	012500	25000
Reading ±250 Hz	_____	_____

Calibrator Accuracy:

		Pass	Fail
25 Amplitude Readings	CH A	_____	_____
(1 kHz to 25 kHz) 22.0 ±0.2 dBV	CH B	_____	_____

Amplitude Accuracy and Flatness:

		CH A (±0.5)		CH B (±0.5)	
Frequency (kHz)		2.5	22.5	2.5	22.5
Sensitivity	+30	_____	_____	_____	_____
	+10	_____	_____	_____	_____
	−10	_____	_____	_____	_____

Noise:

Span		25 kHz	25 kHz	500 Hz
		Noise Floor	Noise Floor	Line Related
Test		< −85 dB	< −120 dB	Noise < −120 dB
Noise	CH A	_____	_____	_____
	CH B	_____	_____	_____
L.O. Spurs	CH A	_____	_____	
	CH B	_____	_____	

Harmonic Distortion:

Harmonic	CH A 2nd	CH A 3rd	CH B 2nd	CH B 3rd
Amplitude Reading	_____	_____	_____	_____

Common Mode Rejection:

		Frequency	CH A	CH B
Marker Amplitude Reading	< −66 dB	50 Hz	_____	_____
	< −64 dB	60 Hz	_____	_____

Frequency Accuracy:

Reading at 25 kHz ±0.5 Hz	CH A	_____	CH B	_____

Phase Accuracy:

		Pass	Fail
Maximum Variation at	CH A	_____	_____
5th Harmonic < ±10°	CH B	_____	_____

Amplitude and Phase Match Between Channels:

		CH A Pass	CH A Fail
Marker Reading	< ±0.8 dB	_____	_____
Variation	< ±5°	_____	_____

MANUAL PERFORMANCE TEST CHECK LIST

Test Description	Pass	Fail
Noise Floor	_____	_____
Harmonic Distortion	_____	_____
Intermodulation Distortion and Vernier Range	_____	_____
Common Mode Rejection	_____	_____
Cross Talk	_____	_____
Input Impedance	_____	_____
Noise Source Output Impedance	_____	_____
Noise Source Amplitude	_____	_____
Calibration Accuracy	_____	_____
Frequency Accuracy	_____	_____
Linearity	_____	_____
Attenuator Accuracy	_____	_____
Input Filter and Analog to Digital Converter Flatness	_____	_____
Attenuator Flatness	_____	_____
Local Oscillator Spurs	_____	_____
Digital Filter Noise	_____	_____
Digital Filter Operation	_____	_____
AC Coupling	_____	_____
Special Spurs	_____	_____
Phase Accuracy	_____	_____

WARNING

Maintenance described herein is performed with power supplied to the instrument, and protective covers removed. Such maintenance should be performed only by service-trained personnel who are aware of the hazards involved (for example, fire and electrical shock). Where maintenance can be performed without power applied, the power should be removed.

SECTION V
ADJUSTMENT PROCEDURES

5-1. INTRODUCTION.

5-2. This section describes adjustments and checks required to return the 3582A to peak performance when repairs have been made. Adjustments are presented in the following order:

a. Power Supply Adjustments.
b. CRT Control Adjustments.
c. CRT Calibration Adjustments.
d. 45.8752 MHz Adjustment.
e. Back-gate Bias Adjustment.
f. Input Board Adjustment.
g. Pseudo-random Noise Source DC Adjustment.

NOTE

An automated adjustment procedure is included in the 3582A/9825A Test Cartridge. (See Section IV Paragraph 4-122 of the Service Manual.)

5-3. TEST POINT AND ADJUSTMENT LOCATIONS.

5-4. Test point and adjustment locations are supplied as assembly locators within the text and as an instrument locator (foldout) at the end of this section. Most of the test points and adjustments are accessable with the assemblies in their card nests. Those adjustments requiring extender boards to access these points will indicate so. The High Voltage Adjustment requires access to the high voltage box through the bottom cover of the instrument as well as to the A13 assembly through the top cover. Most other adjustments can be made with only the top cover and metal shield removed.

NOTE

The adjustments requiring extender boards also require the removal of the 3582A metal shield for accessing test points. It is easiest to remove this shield before beginning the adjustment sequence until it is required for the Input Board Adjustments.

5-5. SAFETY CONSIDERATIONS.

5-6. This section contains warnings and cautions that must be followed for your protection and to avoid damage to the instrument.

WARNING

Maintenance described herein is performed with power supplied to the instrument and protective covers removed. Such maintenance should be performed only by service trained personnel who are aware of the hazards involved (for example, fire and electrical shock).

CAUTION

Always turn the 3582A power "off" before removing or replacing any of the printed circuit assemblies.

WARNING

The A13 Display board and A65 High Voltage board contain hazardous voltages capable of causing death. Use extreme caution when working in the proximity of these areas.

5-7. ADJUSTMENT SEQUENCE.

5-8. The adjustment procedures are presented in a logical sequence that will minimize interaction between adjustments. Although the Performance Tests or a servicing process might indicate that only one or two adjustments are needed, we recommend that you start at the beginning and do all of the adjustments in the order in which they are given.

5-9. CONTROL SETTINGS.

5-10. The proper control settings for the 3582A are given in the individual adjustment procedures. If control settings are not given, they do not affect the adjustment being performed.

5-11. Pre-Adjustment Set-Up.

5-12. This procedure will reset the 3582A into its turn-on state and insure minimum instrument-to-instrument discrepency.

a. Set all FRAMED buttons ..... On
b. Set SCALE 10 dB/DIV ..... On
c. Set AVERAGE NUMBER 4 ..... On
d. Set all other buttons ..... Off
e. AMPLITUDE REFERENCE LEVEL ..... Normal
f. FREQUENCY SPAN ..... 0 - 25 kHz
g. TRIGGER LEVEL ..... Free Run
h. INPUT CHANNEL A SENSITIVITY ..... Cal
VERNIER ..... Cal
i. INPUT CHANNEL B SENSITIVITY ..... Cal
VERNIER ..... Cal
j. INPUT MODE ..... A
k. ISOL-CHAS ..... Chas

5-13. POWER SUPPLY ADJUSTMENTS.

5-14. These adjustments set the 27 kHz Power Supply Clock, the + and − 18 V References, the + 5 V supply voltage and current limit point, the − 15 volt power supply, and the CRT high voltage power supply.

CAUTION

The power supply assemblies are located close to the 3582A fan and should be checked to verify adequate fan clearance after reinstallation.

Equipment required:

Electronic Counter (-hp- 5328A)
Digital Voltmeter (-hp- 3455A)
Oscilloscope (-hp- 1740A)
High-Voltage Probe (-hp- 3440A-K05)
10:1 Probe (-hp- 10006D)
Extender board (No. 1) (-hp- 03582-66533)
Load resistor 2.5 Ω 10 watt 5% (-hp- 0811-2844)
Alligator clips (2) (-hp- 1400-0051)

5-15. A17 Adjustments.

a. Verify that the 3582A power is OFF.

b. Remove the metal shield to allow access to adjustments and test points.

c. Place the A17 board on the extender board (No. 1).

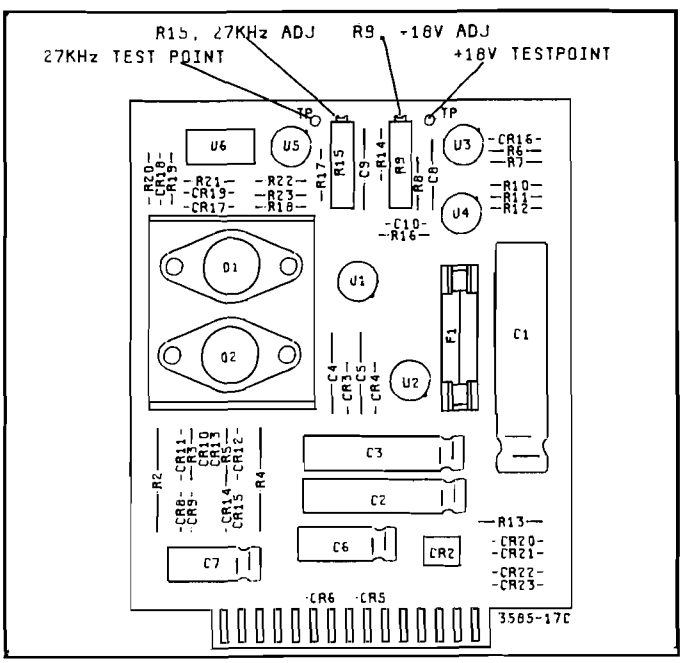


Figure 5-1. Power Supply Control Board, A17 (Rev C).

d. Set the Digital Voltmeter (DVM) to the DCV function, auto-range.

e. Turn the 3582A power ON.

f. Connect the DVM to A17TP +18 V, low lead to Chassis. Adjust A17R9 for a DVM reading between +18.080 V and +18.120 V. A check of the other supplies on A17 would be in order here (no adjustment is required for these). Check the following XA17 edge connector pins for the approximate voltages listed:

Pin	Approximate Voltage
3	−24 V
4	+24 V
5	− 5 V
6	+ 5 V
8	−18 V
15	+150 V

g. Connect the Counter To A17TP27 kHz. Adjust A17R15 for a Counter reading between 26.9000 kHz and 27.1000 kHz. (It may take several seconds for the reading to stabilize.)

h. Turn the power OFF, disconnect the DVM and Counter and replace the A17 assembly into its card nest.

5-16. A16 Adjustments (+5.1 Volt Power Supply).

a. Set the DVM to the DCV function, auto-range.

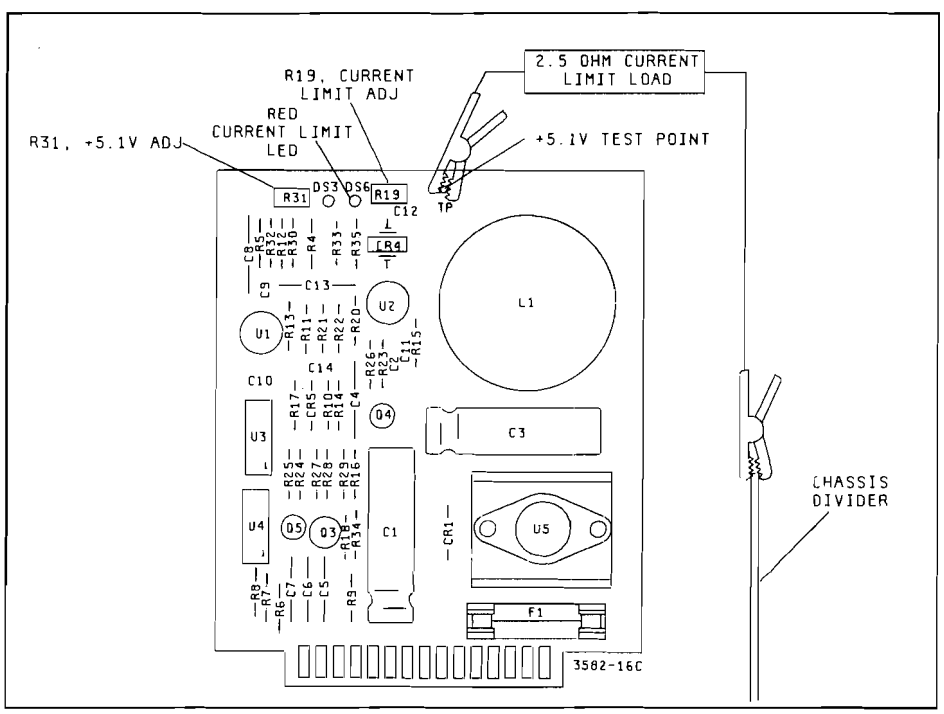


Figure 5-2. +5 V Power Supply Board, A16 (Rev D).

b. Turn the 3582A power ON.

c. Connect the DVM to A16TP +5, low lead to Chassis. Adjust A16R31 for a DVM reading between +5.0900 V and +5.1100 V. This adjustment is made under steady-state current demands of the 3582A (about 4.5 amps).

d. Turn the power OFF and connect the 2.5 Ω current-limit load between A16TP +5 and chassis. Alligator clips are a convenient way to connect the load.

e. Turn the power back ON and adjust R19 until DS3 (red current limit LED) just comes on. This adjusts the +5 V power supply at approximately 2 amps above steady-state demands (about 6.5 amps).

f. Turn the power OFF and disconnect the current-limit load and DVM.

5-17. A18 Adjustment (−15 Volt Power Supply).

a. Set the DVM to the DCV function, autorange.

b. Place the ISOL-CHAS switch in the CHAS position.

c. Turn the 3582A power ON.

d. Connect the DVM to A18TP (−15 V), low lead to Chassis. Adjust A18R2 for a DVM reading between −14.8500 V and −15.4500 V.

e. Turn the power OFF and disconnect the DVM.

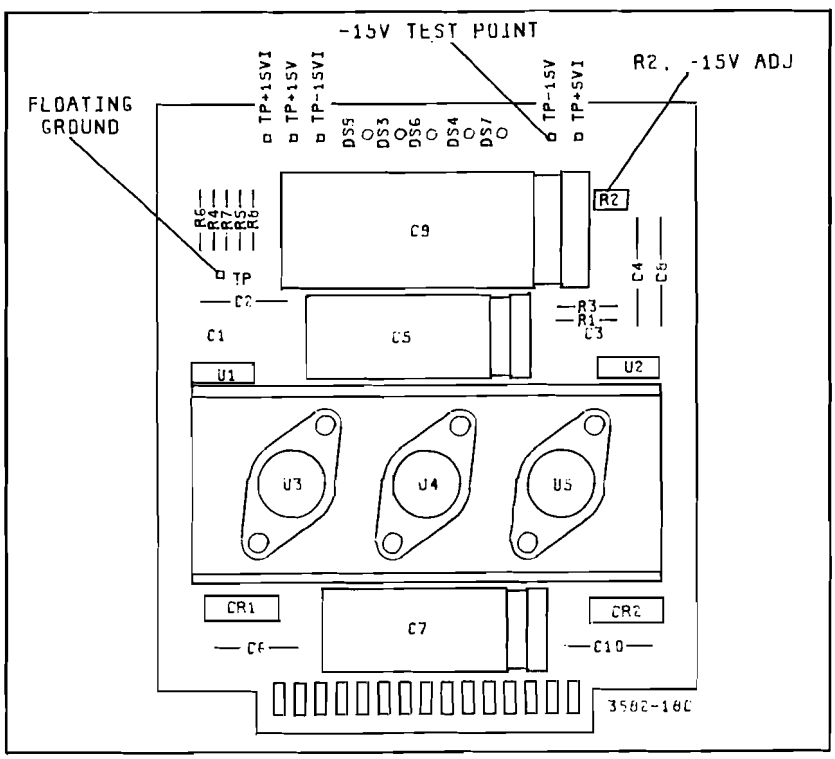


Figure 5-3. Linear Supply Board, A18 (Rev B).

5-18. A13 Adjustments (High Voltage).

WARNING

Lethal voltages are present on surface components of the A13 board. Use extreme care when working in proximity of this board and always leave the protective plexiglass shield in place. Adjustments and test points are accessable through the shield.

NOTE

Foldout and refer to Figure 5-12 (shown at end of Section V) throughout the high voltage CRT control and CRT calibration adjustments as necessary.

a. Verify that the 3582A power is OFF.

b. Set the DVM to the DCV function, autorange.

c. Connect the DVM to A13TP +100 V and adjust A13R38 for a DVM reading between +99.000 V and +101.000 V.

d. Turn the power OFF and disconnect the DVM.

e. Set the 3582A front panel controls as follows:

INTENSITY.....Fully Counter-Clockwise (CCW)(but not off)
ASTIGMATISM.....Center
FOCUS.....Center
GRATICULE ILLUMINATION.....Fully CCW

f. Adjust A13R6 (INT. THRESHOLD) full CCW.

g. Turn the 3582A on its right side and remove the bottom cover.

h. Remove the aluminum cover from the high-voltage box.

WARNING

Lethal voltages up to 18 kV are present inside the high-voltage box. Use extreme caution when the cover is removed.

i. Connect the calibrated High-Voltage Probe to the DVM and set the DVM to the DCV function, 100 V RANGE (an input resistance of 10 MΩ is required by the HV probe).

j. Connect the High-Voltage probe to the plated-hole test point on the High Voltage board. The location of this test poin is shown in Figure 5-4.

k. Turn the 3582A power ON.

l. Adjust A13R46 (HV ADJ) for a DVM reading equal to the voltage marked on the high voltage tag in the high voltage box + or − .25%. If unable to perform this adjustment, recheck the DVM for the proper 100 V range and input resistance before referring to Section VIII, SERVICE.

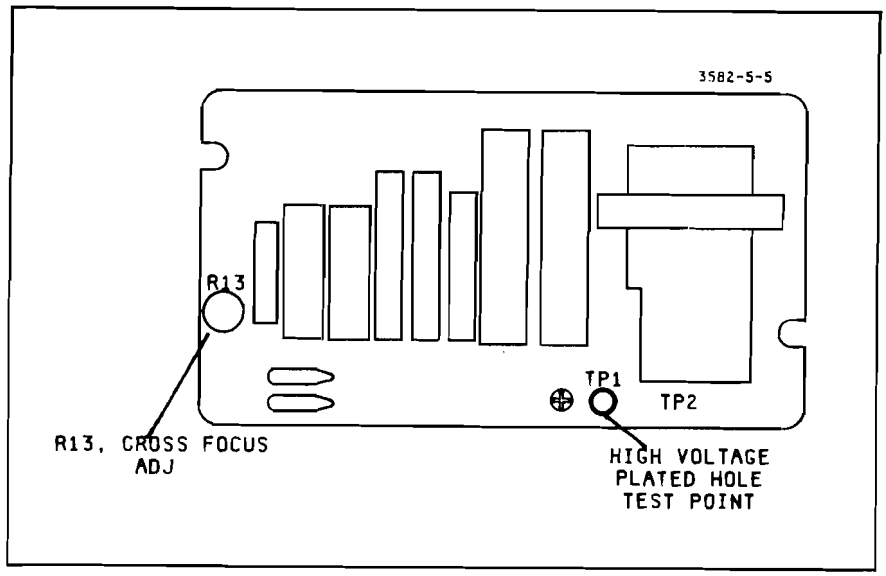


Figure 5-4. High Voltage Board, A65.

NOTE

The closer this adjustment is made, the greater the expected life of the CRT will be. An overall adjustment accuracy better than 1% is desired when the contributions from HV probe, DVM, and tagging accuracy are included.

m. Turn the 3582A power OFF.

n. Make the following preliminary adjustment on the A13 board:

A13R6 (INT THRESHOLD).....Fully CW

o. Turn the 3582A power ON.

p. Slide A9S1 into the "TEST" position (back). The display should appear similar to Figure 5-5.

q. Adjust A13R6 (INT THRESHOLD) until the display just disappears.

r. Turn the front panel INTENSITY control until the display reappears.

s. Adjust A65R13 (GROSS FOCUS) for the best display focus.

t. Adjust the front panel ASTIGMATISM control for the sharpest, most well-defined display.

u. Repeat Steps s and t to obtain the best display focus.

v. Turn the 3582A power OFF. Replace the high voltage box aluminum cover and the bottom cover. Set the 3582A down off its side (normal upright position).

WARNING

Be sure all wires are securely inside the high-voltage box before replacing the aluminum cover.

5-19. CRT CONTROL ADJUSTMENTS.

5-20. These adjustments set the CRT display intensity, positioning, gain, and alignment to optimum levels.

Preliminary

a. Make the following preliminary front panel adjustments:

INTENSITY.....Fully CCW
GRATICULE ILLUMINATION.....Fully CW

b. Turn the 3582A power ON.

c. Adjust A13R105 (FGD) for the most uniform intensity throughout the CRT.

d. Adjust A13R112 (FGN) for a dim flood intensity on the CRT.

e. Verify that A9S1 is still in the "TEST" position from the previous adjustments.

GRAPHICS ALIGNMENT

f. Refer again to Figure 5-5. Graphics alignment should result in a display quality of this order.

g. Adjust A13R59 (X POS), A13R85 (Y POS), A13R54 (X GAIN), and A13R80 (Y GAIN) so that the display is vertically and horizontally aligned with the CRT graticule (Preliminary).

h. Adjust A13R3 (PATT) for the straightest row of A's.

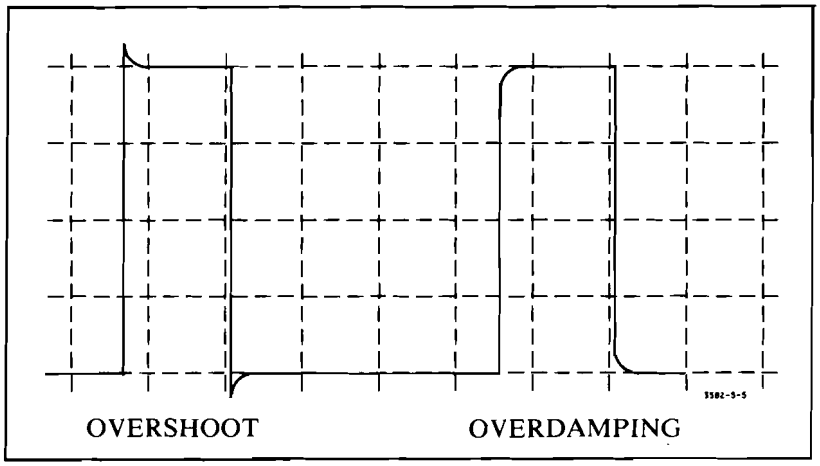
i. Adjust A13R1 (X ALIGN) for the best alignment along the X axis. Align using the row of A's.

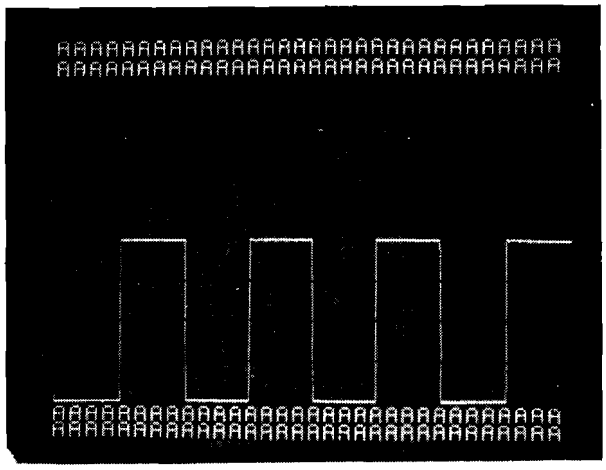
j. Adjust A13R2 (ORTHO) for the best vertical alignment. Align using the square wave edges.

k. Repeat Steps h and j for optimum alignment as in Figure 5-5. Some variations cannot be helped. Use the center of the display as a basis for judging the adjustment quality.

l. Adjust A10R14 to critically damp the square waves (eliminate overshoot and over-damping).

m. This completes the graphics alignment. Slide A9S1 back into the "RUN" position (forward) and turn the 3582A power OFF.





ADJUSTMENT SUMMARY

X POS	Centers display horizontally (between 16th and 17th A).
Y POS	Centers display vertically (top of square waves).
Y GAIN	Fills graticule vertically (bottom of square waves).
X GAIN	Fills screen horizontally (1st and 32nd A's).
PATT	Straightens rows of A's (pincushion adjustment).
ALIGN	Tilts display about X axis.
ORTHO	Adjusts rising and falling square wave edges to be mutually perpendicular to vertical graticule lines.
INTEGRATOR	Adjusts damping on square wave edges.

NOTE

Some variations in these adjustments cannot be helped. The center of the display is the most critical and should be used as a basis for judging adjustment quality.

Figure 5-5. "Test" Display and Graphics Alignment Adjustment Summary.

5-21. DISPLAY CALIBRATION ADJUSTMENTS.

5-22. These adjustments calibrate the CRT display using the internally generated self-test displays.

Equipment required:

Digital Voltmeter (-hp- 3455A)

a. Set the DVM to the DCV function, autorange.

b. Connect the DVM to A10TP + 10V.

c. Turn the 3582A power ON. Adjust A10R202 for a DVM reading between +9.9000 V and +10.1000 V.

d. Set the front panel controls as follows:

NUMBER.....8/128
SHIFT.....Out (released)

e. Enter the self-test mode by holding in the restart pushbutton and momentarily pressing the reset pushbutton. Step to display number 3 with the restart pushbutton.

f. Adjust A13R59 (X POS) to place the start of the graphics on the first vertical graticule line.

g. Adjust A10R53 (X REG) to place the start of the alphanumerics on the first vertical graticule line.

h. Adjust A13R54 (X GAIN) to place the end of the alphanumerics on the last (11th) vertical graticule line. Readjust A13R59 (X POS) to keep the start of the alphanumerics in place as necessary.

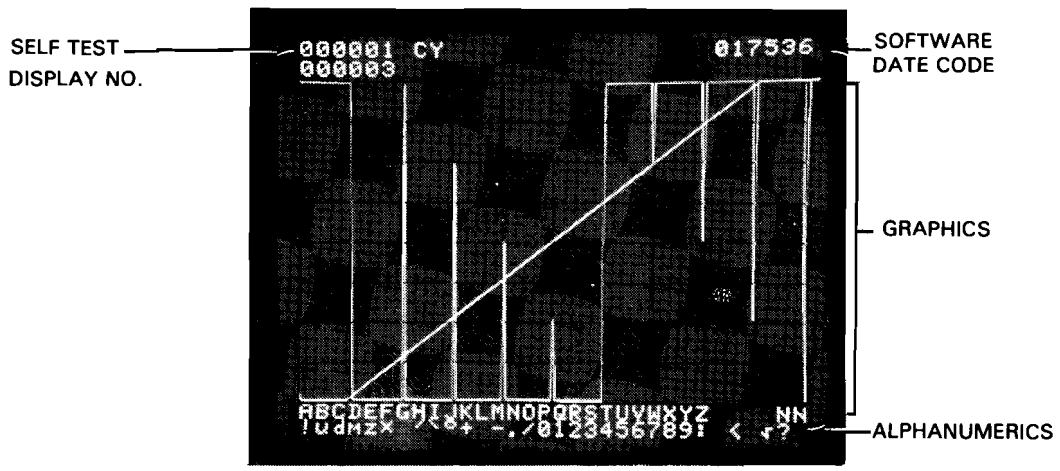
i. Adjust A10R19 (RAMP) to place the last (4th) negative pulse on the last (11th) vertical graticule line.

j. Adjust A13R80 (Y GAIN) and A13R85 (Y POS) to fill the graticule vertically with the graphics.

k. Adjust A10R41 (Y REG) to place the top row of alphanumerics 1 minor division (1/16 inch) below the bottom horizontal graticule line.

l. Adjust A14R42 (Y CHAR) to place the bottom row of the heading 1 minor division above the top horizontal graticule line.

m. Repeat GRAPHICS ALIGNMENT Steps g through j, and m, and DISPLAY CALIBRATION Steps a through l, to obtain the optimum display. All of these adjustments are slightly interactive.



ADJUSTMENT SUMMARY

X POS	Places beginning of graphics on first vertical graticule line.
X REG	Places beginning of alphanumerics on first vertical graticule line.
X GAIN	Fills graticule horizontally with alphanumerics.
RAMP	Places last negative pulse on last vertical graticule line.
Y GAIN	Fills graticule vertically with graphics.
Y POS	Keeps display centered about the horizontal axis.
Y REG	Sets vertical position of alphanumerics.
Y CHAR	Sets vertical position of heading.

NOTE

Some variations in these adjustments cannot be helped. The center of the display is the most critical and should be used as a basis for judging adjustment quality.

Figure 5-6. Self-Test Display 3 and Display Calibration Adjustment Summary.

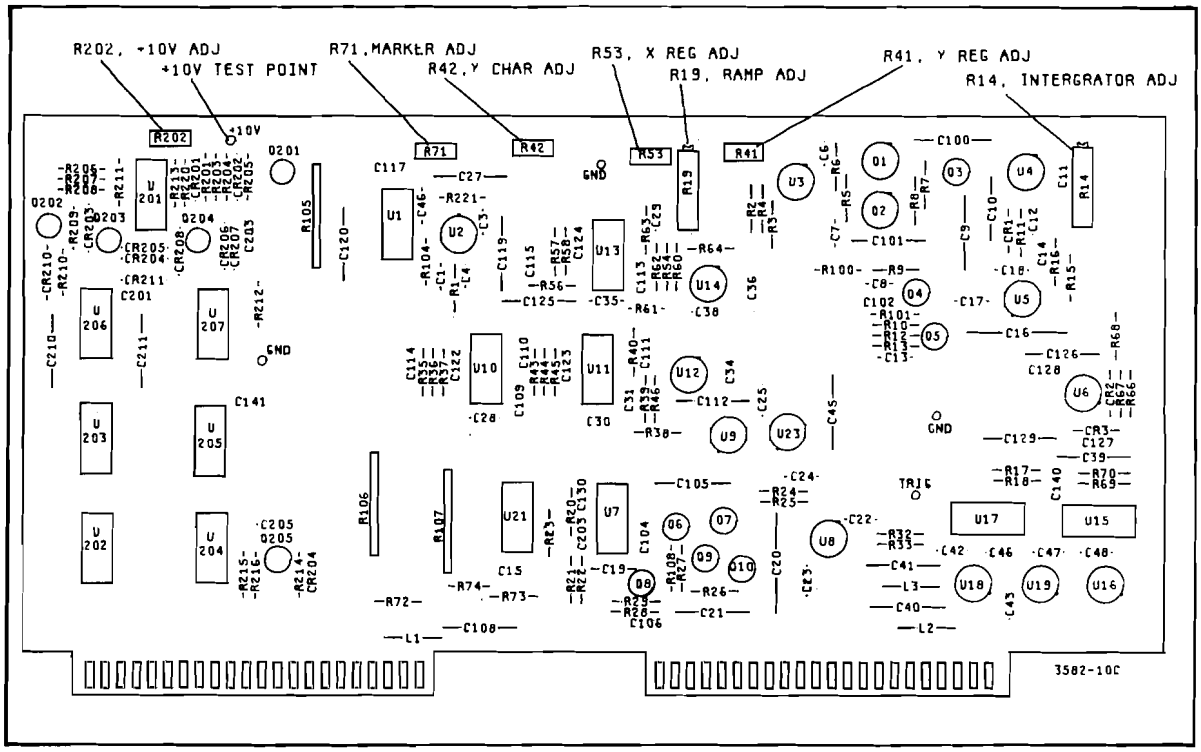


Figure 5-7. Analog Display Driver Board, A10 (Rev C).

n. Step to display number 2 with the RESTART pushbutton, move the marker position potentiometer fully clockwise and back off 1 complete turn.

o. Adjust A10R71 (marker) to just change the marker bin position from 000376 to 000377 as displayed by the 2nd number from the top on the right side of the display.

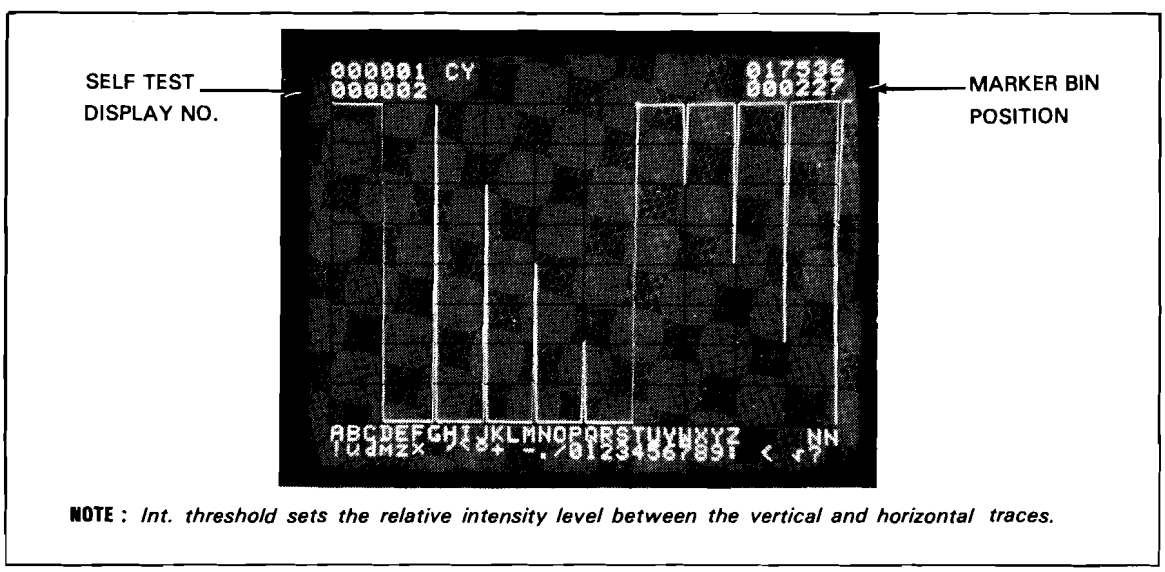


Figure 5-8. Self-Test Display 2 and Marker Bin Position.

p. Adjust A13R6 (INT THRESHOLD) so that the vertical and horizontal lines are equally bright. This occurs when they extinguish at the same time with the front panel intensity control.

q. Set the front panel intensity control to maximum (FULLY CW).

r. Set the oscilloscope controls as follows:

VERTICAL.....1 V/DIV
HORIZONTAL.....1 μs/DIV
INPUT COUPLING.....DC

s. Connect the oscilloscope to A13TPIL with a 10:1 probe. Use the vertical position control on the oscilloscope to position the peaks of the waveform on the top horizontal graticule line.

t. Connect the probe to A13TPZG. Adjust A13R109 for waveform peaks 4 minor divisions (8 V) below the top graticule line on the oscilloscope.

u. Reduce the front panel intensity control to a comfortable level.

v. Turn the 3582A power OFF and disconnect the oscilloscope.

5-23. 45.8752 MHz ADJUSTMENT.

Method I.

Equipment required:

Frequency synthesizer: (-hp- 3325A or -hp- 3330B)

Instrument control settings:

3582A: Preadjustment settings

FREQUENCY MODE.....SET CENTER
FREQUENCY ADJUST.....25KHz
SPAN.....250Hz
SENSITIVITY (Channel A).....+10 dBm
MARKER.....ON
MARKER POSTION.....25 KHz

3325A (or 3330B):

FREQUENCY.....25KHz (sine wave)
AMPLITUDE.....+13.01 dBm

a. Connect the synthesizer output to the 3582A CHANNEL A INPUT.

b. Verify that the marker is at the peak of the displayed spectrum. If it is not, adjust A3-C4.

c. Switch the 3582A FREQUENCY SPAN to 250 Hz. In this span the spectrum will be completed in 10 seconds.

d. Repeat Step b. This insures that frequency calibration is within 0.1 Hz. The specification is 0.75 Hz.

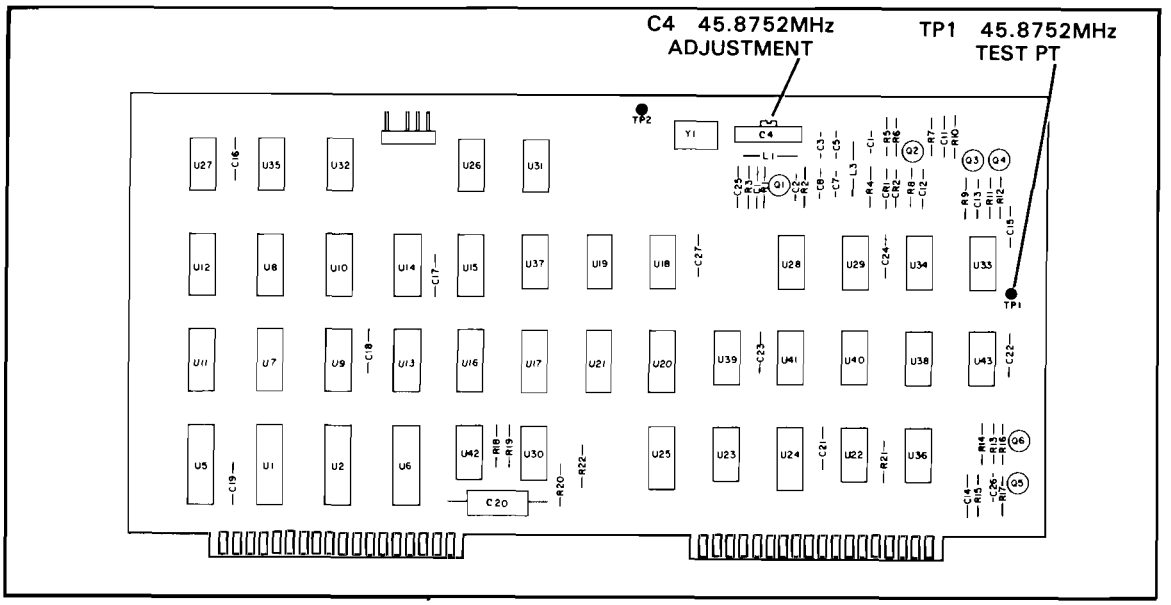


Figure 5-9. Timing and Digital Interface Board, A3 (Rev B).

Method II.

Equipment required:

Electronic counter (-hp- 5328A)
Extender board (No. 2) (-hp- 03582-66531)

a. Verify that the 3582A power is turned OFF.

b. Place the A3 assembly on the extender board (No. 2).

c. Connect the ELECTRONIC COUNTER to A3TP1 (OSC).

d. Turn the 3582A power ON.

e. Adjust A3C4 for a counter reading of 45.8752 MHz ± .0001 MHz.

f. Turn the 3582A power off, disconnect the ELECTRONIC COUNTER and replace the A3 assembly into its card nest.

5-24. BACK-GATE BIAS ADJUSTMENT.

Equipment required:

Digital Voltmeter (-hp- 3455A)

a. With instrument power OFF, remove the A2 assembly and note the voltage marked on A2U16.

b. Set the DVM to the DCV function, autorange.

c. Turn the 3582A power ON.

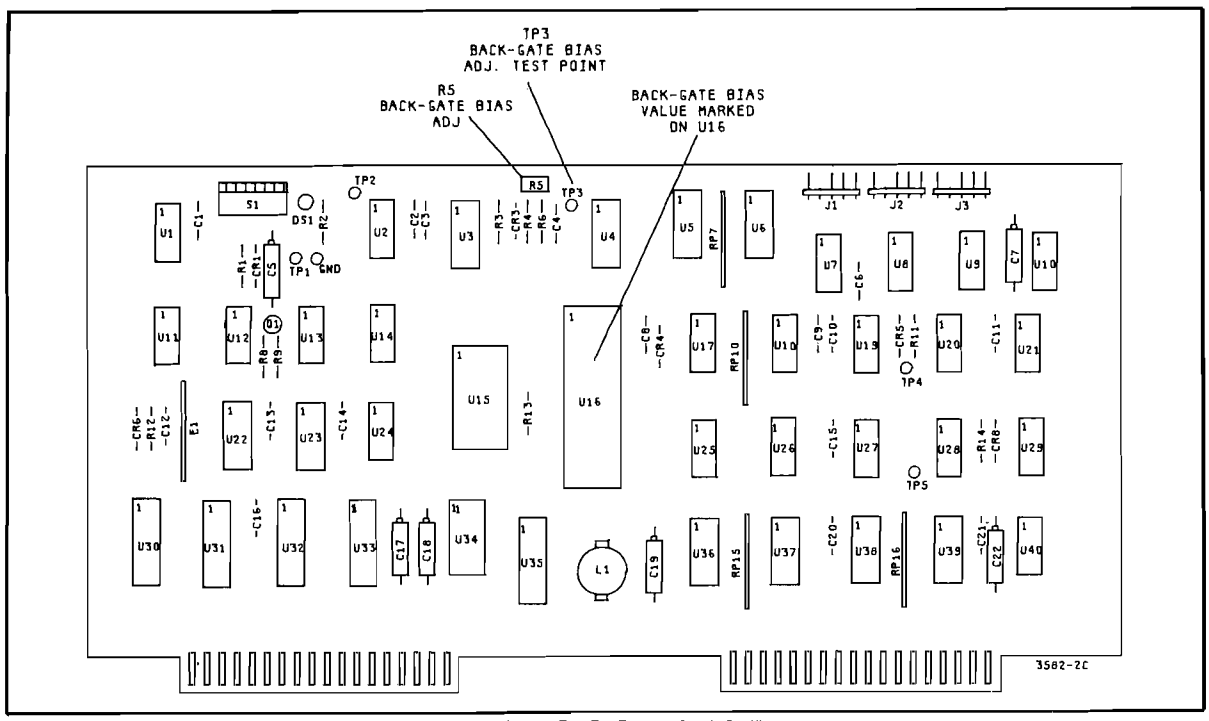


Figure 5-10. HP-IB Board, A2 (Rev B).

d. Connect the DVM to A2TP1 (VBG), adjust A2R5 for a DVM reading equal to the voltage noted in Step A ± 1%.

e. Turn the power OFF and disconnect the DVM.

5-25. INPUT BOARD ADJUSTMENTS (Channels A and B).

5-26. These adjustments set the A to D Clock frequency, Sample-and-Hold DC noise floor, amplitude calibration, and attenuator compensation.

Equipment required:

Oscilloscope (-hp- 1740A)
Synthesizer (-hp- 3330B) Option 005
10:1 probes (2) (-hp- 10006D)
1:1 probe (-hp- 10007A)
Extender board (No. 2) (-hp- 03582-66531)
50 Ω feed thru termination (-hp- 11048C)

NOTE

Foldout and refer to Figure 5-12 (shown at end of Section V) throughout the input board adjustments as necessary.

5-27. A-to-D Clock Adjustment.

a. Verify that the 3582A power is OFF.

b. Place A1 (Channel A) on the extender board (No. 2).

c. Set the 3582A front panel controls to:

INPUT MODE.....A
SENSITIVITY.....30 mV
A COUPLING.....AC (~)

d. Set the OSCILLOSCOPE controls to:

Channel A

VERTICAL.....1V/DIV
INPUT COUPLING.....DC

Channel B

VERTICAL.....005 V/DIV
INPUT COUPLING.....AC

Others

HORIZONTAL.....1 μs/DIV
DISPLAY.....Alternate
TRIGGER SLOPE.....– (negative)
TRIGGER MODE.....External
BANDWIDTH LIMIT.....Off

e. Connect the OSCILLOSCOPE external trigger input to A1TPH/C with a 10:1 probe. Connect the OSCILLOSCOPE Channel A input to A1TPCLK with a 10:1 probe.

f. Turn the 3582A power ON. Adjust A1C145 for 7.7 μs to 7.9 μs between the rising edges of the 1st and 13th pulses.

5-28. Sample-and-Hold DC Adjustment (also see pictures on page 8-1-10).

g. Short A1TPLPF to ground (A1TPGND) and set the Oscilloscope BANDWIDTH LIMIT control to ON.

h. Connect the OSCILLOSCOPE Channel B. Input to A1TPS/H using a 1:1 probe with a low inductance tip.

i. Adjust A1C141 until the DC (noise) levels between H/C pulses are equal.

j. Verify that the droop between the 2nd and 13th pulse is ≤ 1 mV.

k. Turn the 3582A power OFF. Remove the ground from A1TPLPF and disconnect the OSCILLOSCOPE, then replace the A1 (Channel A) board into its card nest.

l. Repeat Steps a through k for Channel B.

5-29. Amplitude Calibration.

m. Set the 3582A front panel controls to:

AMPLITUDE	A & B
SCALE	Linear
AMPLITUDE REFERENCE LEVEL	Fully CCW
PHASE	Both Off
PASS BAND	Flat Top
AVERAGE	Off
TRACE 1 & 2	Off
MARKER	On
REL	Off
FREQUENCY MODE	0 - 25 kHz Span
INPUT MODE	Both
SENSITIVITY	3 mV (both channels)
A & B COUPLING	AC (~)
TRIGGER LEVEL	Free Run
REPETITIVE	On

n. Place a short across the Channel A input. Depress and hold the TIME A pushbutton and adjust the front panel Channel A DC BAL for a display line at the center horizontal graticule. Switch through each Channel A sensitivity to verify a DC level within 1 minor division of center for each. Also verify the 3 mV range with DC coupling to within 1 minor division of center. Release the TIME A pushbutton.

o. Repeat Step n for Channel B.

p. Remove any input shorts. Connect the synthesizer to Channels A and B using a 50 ohm feed thru termination and reset the following 3582A front panel controls to:

AMPLITUDE	A Only (Release B)
INPUT MODE	A
SENSITIVITY (Channel A)	300 mV

q. Set the synthesizer to:

AMPLITUDE	−7.44 dBm
FREQUENCY	1 kHz
LEVELING	FAST

r. Set the 3582A marker to 1 kHz. Adjust A1R101 (GAIN) for a marker amplitude reading of 95.0 mV.

s. Set the SYNTHESIZER and the 3582A marker to 22.5 kHz. Adjust A1R45 (LPF) for a marker amplitude reading of 95.0 mV.

t. Set the 3582A sensitivity to CAL and the marker to 1 kHz. Adjust A1R8 (CAL) for a marker amplitude reading of 20.0 volts.

u. Repeat Steps p through t for the Channel B A1 board.

v. Turn the 3582A power OFF.

5-30. Input Attenuator Compensation.

w. Verify that the 3582A power is OFF.

x. Re-install the metal shield which was removed for the previous 3582A adjustments.

y. Turn the 3582A power ON.

z. Set the 3582A front panel controls to:

AMPLITUDE.....A(Only)
INPUT MODE.....A(Only)
SENSITIVITY (Both Channels).....3 V
MARKER POSITION.....1 kHz

aa. Set the SYNTHESIZER to:

AMPLITUDE.....12.5 dBm
FREQUENCY.....1 kHz

bb. Record the marker amplitude reading, V_{10} _____

cc. Set the SYNTHESIZER and the 3582A marker to 22.5 kHz. Adjust A1C2(10) for the marker amplitude reading, V_{10}, obtained in the previous step.

dd. Repeat Steps z through cc for the Channel B A1 board. Use the "B" setting for the amplitude and input mode controls.

ee. Remove the 50 ohm feed thru termination and set the 3582A front panel controls to:

AMPLITUDE.....A(Only)
INPUT MODE.....A(Only)
SENSITIVITY (Both Channels).....30 V
MARKER POSITION.....1 kHz

ff. Set the Synthesizer to:

AMPLITUDE.....26.54 dBm
FREQUENCY.....1 kHz

gg. Record the marker amplitude reading, V_{100} _____.

hh. Set the SYNTHESIZER and the 3582A marker to 22.5 kHz. Adjust A1C1 (100) for the marker amplitude reading V_{100}, obtained in the previous step.

ii. Repeat Steps ee through hh for the Channel B A1 board. Use the "B" setting for the amplitude and input mode controls.

jj. Disconnect the SYNTHESIZER and turn the 3582A power OFF.

5-31. PERIODIC-RANDOM NOISE SOURCE DC ADJUSTMENT.

a. Set the 3582A front panel controls to:

AMPLITUDE.....A (Only)
SCALE.....2 dB/DIV
PASSBAND.....UNIFORM
SENSITIVITY.....+10 dBV
AMPLITUDE REFERENCE LEVEL.....−20 dBV Full Scale
NOISE SOURCE.....Random
SPAN.....Set Center-500 Hz Span
CENTER FREQUENCY.....1800 to 2000 Hz

b. Connect the noise source output to the Channel A input and turn the noise source level to maximum (FULLY CW). Turn the 3582A power ON.

c. Adjust A4R33 (DC) to eliminate the spike at center frequency.

d. Remove the connection from the noise source output to the Channel A input. Turn the 3582A power OFF.

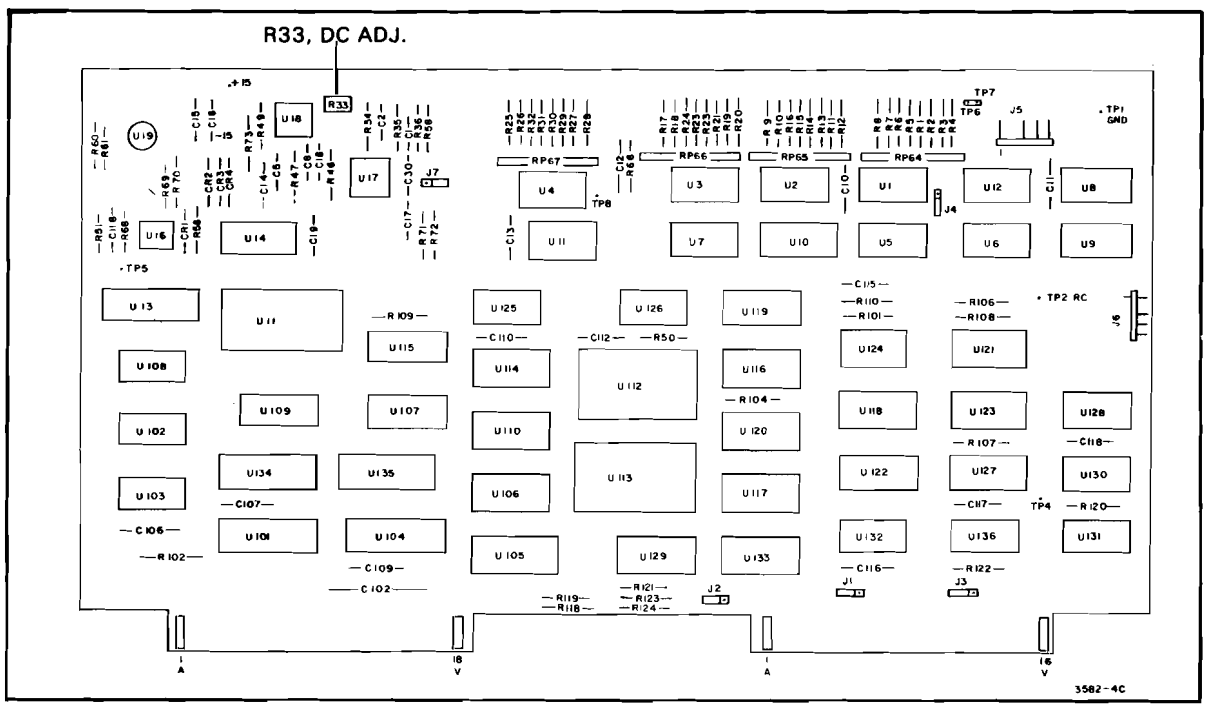


Figure 5-11. Pseudo-Random Noise Generator Board, A4 (Rev D).

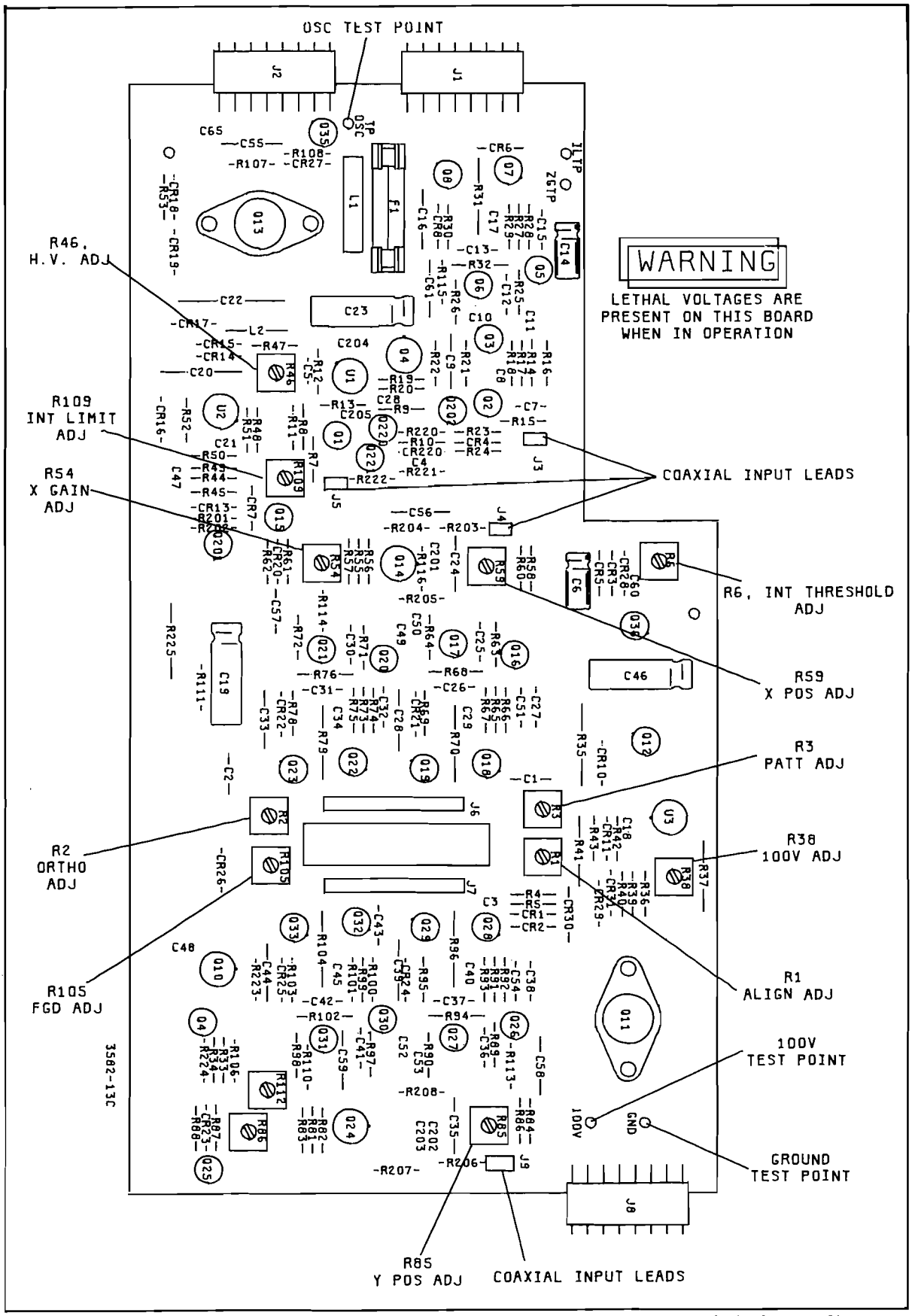
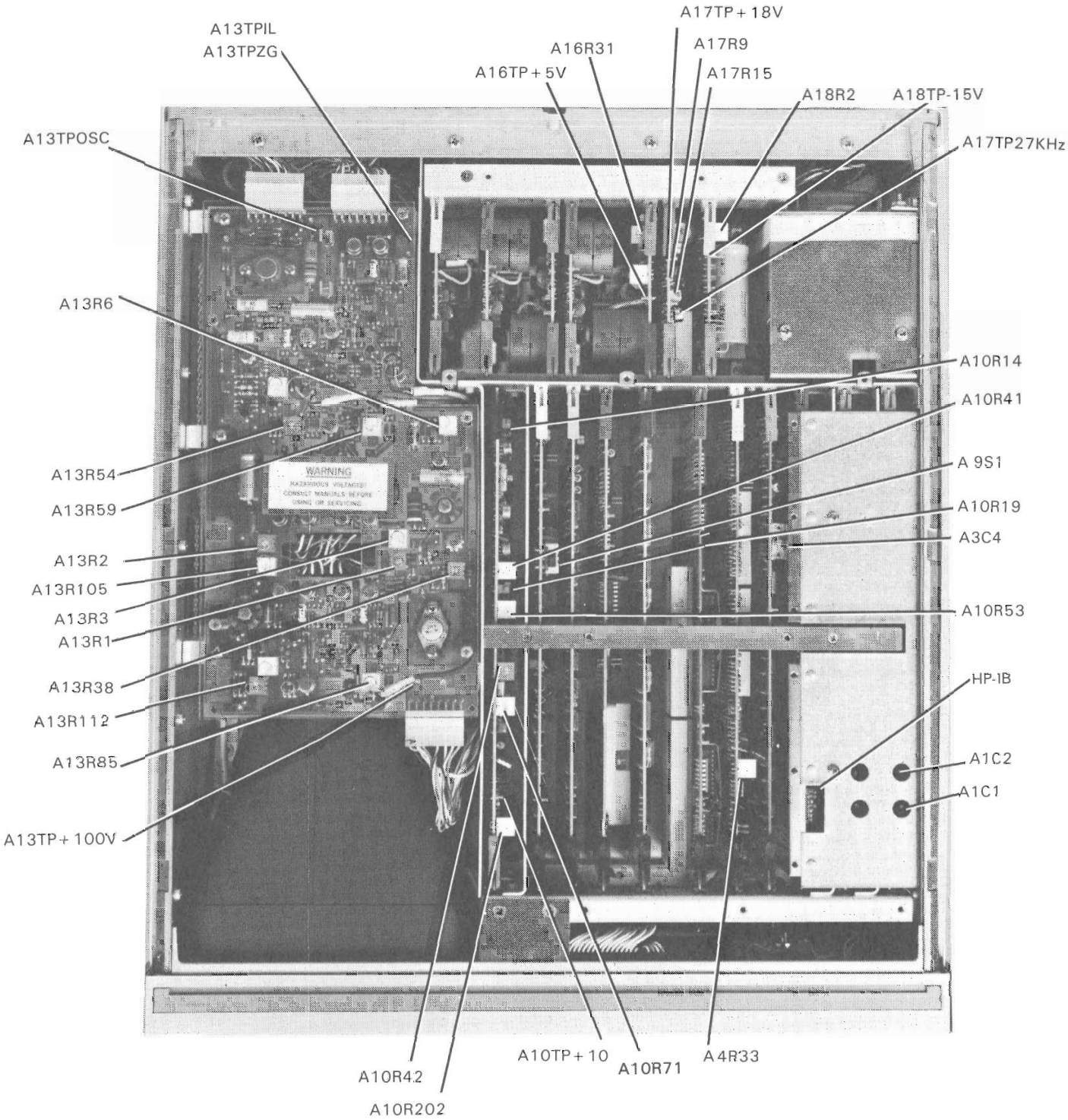


Figure 5-12. X, Y, Z Amplifier and Display High Voltage Control Board, A13 (Rev C).


A13TPIL
A13TPZG
A16R31
A17TP+18V
A17R9
A16TP+5V
A17R15
A18R2
A18TP-15V
A13TPOSC
A17TP27KHz
A13R6
A10R14
A10R41
A13R54
A 9S1
A13R59
A10R19
A3C4
A13R2
A13R105
A13R3
A10R53
A13R1
A13R38
HP-IB
A13R112
A1C2
A13R85
A1C1
A13TP+100V
A10TP+10
A4R33
A10R71
A10R42
A10R202

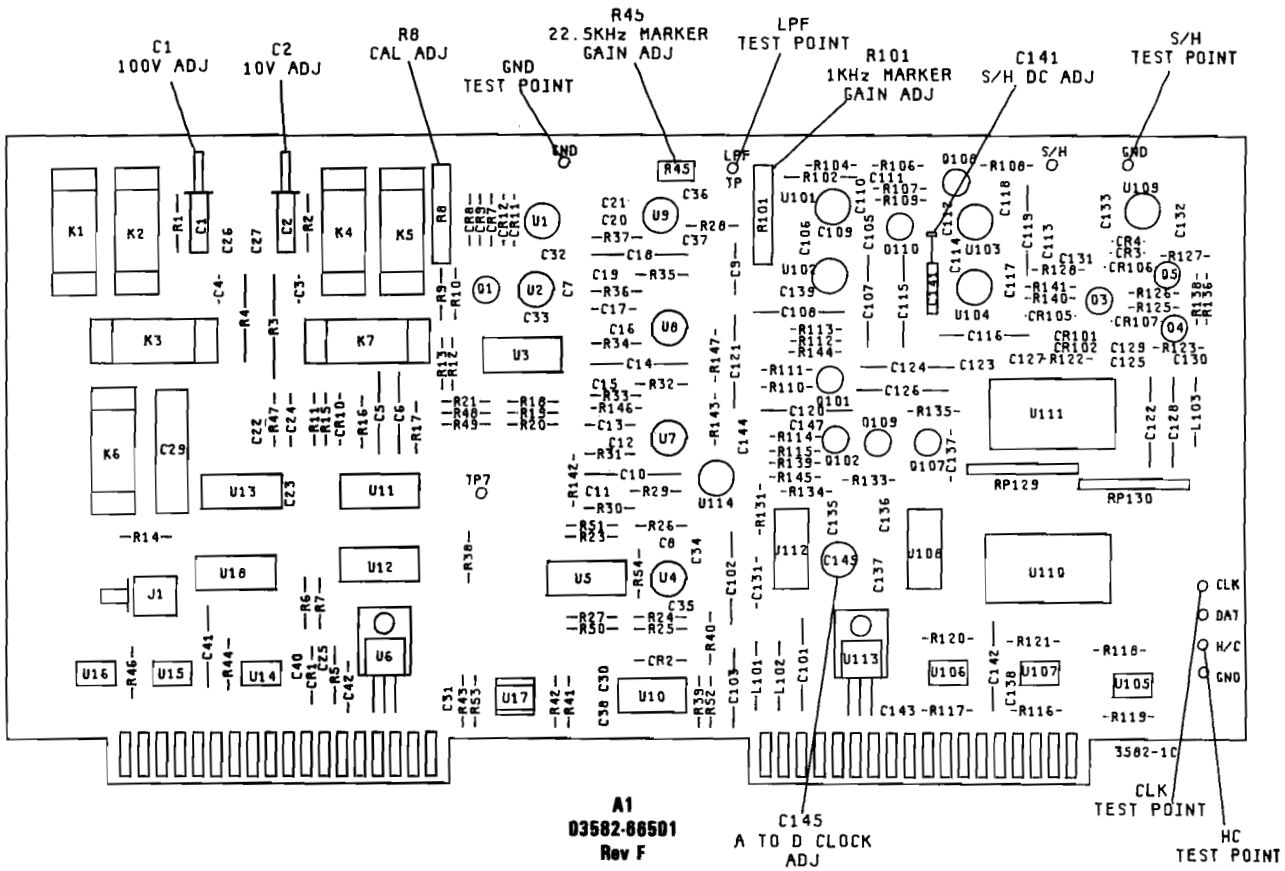


Figure 5-13. Adjustment and Test Point Locations.

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION.

6-2. This section contains information for ordering replacement parts. Table 6-3 lists parts in alphanumeric order of their reference designators and indicates the description, Hewlett-Packard Part Number of each part, together with any applicable notes, and provides the following:

a. Total quantity used in the instrument (Qty column). The total quantity of a part is given the first time the part number appears.

b. Description of the part. (See list of abbreviations in Table 6-1.)

c. Typical manufacturer of the part is a five-digit code. (See Table 6-2 for list of manufacturers.)

d. Manufacturer's part number.

6-3. Miscellaneous parts are listed in Table 6-3 following their respective assemblies. General miscellaneous parts are listed at the conclusion of Table 6-3.

6-4. ORDERING INFORMATION.

6-5. To obtain replacement parts, address order or inquiry to your local Hewlett-Packard Field Office. (See Appendix A for list of office locations.) Identify parts by their Hewlett-Packard part numbers. Include instrument model and serial numbers.

6-6. NON-LISTED PARTS.

6-7. To obtain a part that is not listed, include:

a. Instrument model number.
b. Instrument serial number.
c. Description of the part.
d. Function and location of the part.

6-8. PROPRIETARY PARTS.

6-9. Items marked by a dagger (†) in the reference designator column are available only for repair and service of Hewlett-Packard instruments.

6-10. PRINTED CIRCUIT ASSEMBLIES.

6-11. Printed circuit assemblies are listed in Table 6-3. An itemized parts listing of each assembly is located in the service group associated with the assembly. Table 6-3 indicates the service group associated with each printed circuit assembly.

Table 6-1. List of Abbreviations.

ABBREVIATIONS

Ag	silver	Hz	hertz (cycle(s) per second)	NPO	negative positive zero (zero temperature coefficient)	sl	slide
Al	aluminum					SPDT	single-pole double-throw
A	ampere(s)	ID	inside diameter	ns	nenosecond(s) = 10^{-9} seconds	SPST	single-pole single-throw
Au	gold	impg	impregnated	nsr	not separately replaceable		
		incd	incandescent			Ta	tantelum
C	capacitor	ins	insulation(ed)	Ω	ohm(s)	TC	temperature coefficient
cer	ceramic			obd	order by description	TiO_2	titanium dioxide
coef	coefficient	kΩ	kilohm(s) = 10^{+3} ohms	OD	outside diameter	tog	toggle
com	common	kHz	kilohertz = 10^{+3} hertz			tol	tolerance
comp	composition			p	peak	trim	trimmer
conn	connection	L	inductor	pA	picoampere(s)	TSTR	transistor
		lin	linear taper	pc	printed circuit		
dep	deposited	log	logarithmic taper	pF	picofarad(s) 10^{-12} farads	V	volt(s)
DPDT	double-pole double-throw			piv	peak inverse voltage	vacw	alternating current working voltage
DPST	double-pole single-throw	mA	milliampere(s) = 10^{-3} amperes	p/o	part of	var	variable
		MHZ	megahertz = 10^{+6} hertz	pos	position(s)	vdcw	direct current working voltage
elect	electrolytic	MΩ	megohm(s) = 10^{+6} ohms	poly	polystyrene		
encap	encapsulated	met flm	metal film	pot	potentiometer	W	watt(s)
		mfr	manufacturer	p-p	peak-to-peak	w/	with
F	farad(s)	ms	millisecond	ppm	parts per million	wiv	working inverse voltage
FET	field effect transistor	mtg	mounting	prec	precision (tamperature coefficient, long tarm stability and/or tolerance)	w/o	without
fxd	fixed	mV	millivolt(s) = 10^{-3} volts			ww	wirewound
		μF	microferad(s)				
GaAs	gellium ersenide	μs	microsecond(s)	R	resistor		
GHz	gigahertz = 10^{+9} hertz	μV	microvolt(s) = 10^{-6} volts	Rh	rhodium		
gd	guard(ed)	my	Mylar ®	rms	root-mean-square	*	optimum value selected at factory, average value shown (part may be omitted)
Ge	germanium			rot	rotary	**	no standard type number assigned selected or special type
gnd	ground(ed)	nA	nanoampere(s) = 10_{-9} emperes				
		NC	normally closed	Se	selenium		® Dupont de Nemours
H	henry(ies)	Ne	neon	sect	section(s)		
Hg	mercury	NO	normally open	Si	silicon		

DESIGNATORS

A	assembly	FL	filter	Q	transistor	TS	terminal strip
B	motor	HR	heater	QCR	transistor-diode	U	microcircuit
BT	battery	IC	integrated circuit	R(p)	resistor(pack)	V	vacuum tube, neon bulb, photocell, etc.
C	capacitor	J	jeck	RT	thermistor	W	cabla
CR	diode or thyristor	K	relay	S	switch	X	socket
DL	delay line	L	inductor	T	transformer	XDS	lampholder
DS	lamp	M	meter	TB	terminal board	XF	fuseholder
E	misc electronic part	MP	mechanical part	TC	thermocouple	Y	crystal
F	fuse	P	plug	TP	test point	Z	network

Table 6-2. Code List Of Manufacturers.

Mfr No.	Manufacturer Name	Address
00853	Sangamo Elec Co S Carolina Div	Pickens, SC 29671
01121	Allen-Bradley Co	Milwaukee, WI 53204
01295	Texas Instr Inc Semicond Cmpnt Div	Dallas, TX 75222
01928	RCA Corp Solid State Div	Somerville, NJ 08876
02111	Spectrol Electronics Corp	City of Ind, CA 91745
03888	KDI Pyrofilm Corp	Whippany, NJ 07981
04713	Motorola Semiconductor Products	Phoenix, AZ 85062
06665	Precision Monolithics Inc	Santa Clara, CA 95050
06915	Richco Plastic Co	Chicago, IL 60648
07263	Fairchild Semiconductor Div	Mountain View, CA 94042
08484	Breeze Corporations Inc	Union, NJ 07083
11236	Cts Of Berne Inc	Berne, IN 46711
12954	Siemens Corp Components Group	Scottsdale, AZ 85252
12969	Unitrode Corp	Watertown, MA 02172
13103	Thermalloy Co	Dallas, TX 75234
13606	Sprague Elect Co Semiconductor Div	Concord, NH 03301
14099	Semtech Corp	Newbury Park, CA 91320
18324	Signetics Corp	Sunnyvale, CA 94086
19701	Mepco/Electra Corp	Mineral Wells, TX 76067
22526	Berg Electronic Inc.	Cumberland, PA 17070
23936	Pamotor Div William J. Purdy	Burlingame, CA 94010
24355	Analog Devices Inc.	Norwood, MA 02062
24546	Corning Glass Works (Bradford)	Bradford, PA 16701
27014	National Semiconductor Corp	Santa Clara, CA 95051
27167	Corning Glass Works (Wilmington)	Wilmington, NC 28401
28480	Hewlett-Packard Co Corporate HQ	Palo Alto, CA 94304
29832	Teledyne Philbrick Nexus	Dedham, MA 02026
34335	Advanced Micro Devices Inc.	Sunnyvale, CA 94086
34371	Harris Semicon Div Harris-Intertype	Melbourne, FL 32901
52763	Stettner-Trush Inc	Cazenovia, NY 13035
54294	Cutler-Hammer-Inc Shallcross Mfg Co	Selma, NC 27576
56289	Sprague Electric Co	North Adams, MA 01247
72136	Electro Motive Corp Sub IEC	Willimantic, CT 06226
72982	Erie Technological Products Inc	Erie, PA 16512
75042	TRW Inc Philadelphia Div	Philadelphia, PA 19108
75915	Littelfuse Inc	Des Plaines, IL 60016
91637	Dale Electronics Inc	Columbus, NE 68601
98291	Sealectro Corp	Mamaroneck, NY 10544
99515	Marshall Ind Capacitor Div	Monrovia, CA 91016

Table 6-3. Replaceable Parts.

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1	03582-66501	2	INPUT-A/D (ITEMIZED PARTS LIST IN SERVICE GROUP 1)	28480	03582-66501
A2	03582-66502	1	HP-IB INTERFACE (ITEMIZED PARTS LIST IN SERVICE GROUP 8)	28480	03582-66502
A3	03582-66503	1	TIMING (ITEMIZED PARTS LIST IN SERVICE GROUP 2)	28480	03582-66503
A4	03582-66504	1	LOCAL OSCILLATOR/PRN (ITEMIZED PARTS LIST IN SERVICE GROUPS 3 AND 9)	28480	03582-66504
A5	03582-66505	1	DIGITAL FILTER (ITEMIZED PARTS LIST IN SERVICE GROUP 3)	28480	03582-66505
A6	03582-66506	1	* ROM (ITEMIZED PARTS LIST IN SERVICE GROUP 4)	28480	03582-66506
A7	03582-66507	1	PROCESSOR (ITEMIZED PARTS LIST IN SERVICE (GROUP 4)	28480	03582-66507
A8	03582-66508	1	RAM (ITEMIZED PARTS LIST IN SERVICE GROUP 4)	28480	03582-66508
A9	03582-66509	1	DIGITAL DISPLAY DRIVER (ITEMIZED PARTS LIST IN SERVICE GROUP 5)	28480	03582-66509
A10	03582-66510	1	ANALOG DISPLAY DRIVER (ITEMIZED PARTS LIST IN SERVICE GROUP 5)	28480	03582-66510
A11	03582-66551	1	FRONT PANEL SWITCH ASSY (ITEMIZED PARTS LIST IN SERVICE GROUP 7)	28480	03582-66551
A12	03582-66512	1	ROTARY PULSE GEN ASSY (ITEMIZED PARTS LIST IN SERVICE GROUP 7)	28480	03582-66512
A13	03582-66513	1	X Y Z AMPLIFIER (ITEMIZED PARTS LIST IN SERVICE GROUP 5)	28480	03582-66513
A14	03582-66514	1	-18 V POWER SUPPLY (ITEMIZED PARTS LIST IN SERVICE GROUP 11)	28480	03582-66514
A15	03582-66515	3	+18, +12, +7 V POWER SPLY (ITEMIZED PARTS LIST IN SERVICE GROUP 11)	28480	03582-66515
A16	03582-66516	1	+5 V POWER SUPPLY (ITEMIZED PARTS LIST IN SERVICE GROUP 11)	28480	03582-66516
A17	03582-66517	1	POWER SUPPLY CONTROLLER (ITEMIZED PARTS LIST IN SERVICE GROUP 11)	28480	03582-66517
A18	03582-66518	1	LINEAR POWER SUPPLY (ITEMIZED PARTS LIST IN SERVICE GROUP 11)	28480	03582-66518
A19	03582-66519	1	POWER SUPPLY MOTHER BD (ITEMIZED PARTS LIST IN SERVICE GROUP 11)	28480	03582-66519
A20	03582-66520	1	DIGITAL MOTHER BOARD (ITEMIZED PARTS LIST IN SERVICE GROUP 12)	28480	03582-66520
A65	03582-64201	1	HIGH VOLTAGE POWER SPLY (ITEMIZED PARTS LIST IN SERVICE GROUP 12)	28480	03582-64201
*	*	*	CHASSIS MOUNTED COMP (ITEMIZED PARTS LIST IN SERVICE GROUP 12)		

NOTES

The A7 assembly, 03582-66507 does **not** *include a processor or processor gasket. Order P/N's:*

09825-67907	*Processor hybrid-new*
03582-69507	*Processor hybrid-exchange*
5001-1861	*Processor gasket (Included w/exchange assembly)*

A new processor gasket **must** *be used when replacing the processor. This gasket is fragile and bending can quickly ruin it. The exchange processor assembly includes the gasket.*

SECTION VII
BACKDATING

7-1. INTRODUCTION.

7-2. This section contains backdating changes which make this manual applicable to earlier instruments. The section is divided into procedural changes and schematic changes. Procedural changes are listed by instrument serial number while schematic and parts list changes are listed by board revision designations.

7-3. GENERAL INFORMATION.

7-4. All newer revision circuit boards are usable in older instruments. However, the older instrument may not be able to utilize some of the additional functions (present on the newer circuit boards) which were not supplied as an original capability in the main frame instrument.

7-5. Example:
In instruments with serial numbers prefixed 1747A, replacement of the A4 Pseudo Random Noise board with a later revision board will not permit the utilization of the "RANDOM" noise source capability unless modifications are also made to the Front Panel (A11 board) and the Mother Board (A20). Note that the "PERIODIC" pseudom random noise source capability is still usable as in the original revision board.

7-6. PROCEDURAL CHANGES.

7-7. Current procedures as indicated in the manual apply to all instruments.

SCHEMATIC CHANGES
TABLE OF CONTENTS

Assembly	Schematic	Begins on Page
Gen Info	---	7-1
A1	A	7-A-1
A2	0	7-0-1
A4	E	7-E-1
A4	P	7-P-1
A5	D	7-D-1
A6	G	7-G-1
A7	F	7-F-1
A8	H	7-H-1
A9	J	7-J-1
A10	K	7-K-1
A13	M	7-M-1
A17	U	7-U-1

Table 7-1. Circuit Board Revisions.

Circuit Board Designations																				
Assembly Part Number(Suffix)	66501	66502	66503	66504	66505	66506	66507	66508	66509	66510	66511	66512	66513	66514	66515	66516	66517	66518	66519	66520
Serial Number Suffix	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19	A20
00101 to 00125	A		A	A	A		A	A	B	A	*		A	A	A	A	A	A	A	A
00126 to 00150	B				B				C		A	A		B		B				B
00151 to 00165	C				C	A				B			B			C				
00166 to 00240	D			B			B	B									B			
00241 to 00980		A																		
00981 to 01095																				
01096 to 01255																				
01256 to 01595	E																			
01596 to 01945																				
01946 to 02105				C			C													
02106 to 02365																				
02366 to 02435																				
02436 to	F	B	B	D	D	B	D	C	D	C	B	B	C	C	B	D	C	B	B	C

*66511

NOTE

Some circuit boards are revised for ease of manufacturing and do not necessarily incorporate circuit improvements. For this reason, not all assembly revisions are backdated.

A1, SCHEMATIC A: INPUT BACKDATING

REV A.

Schematic:

Use backdating schematic A(A1) REV A.

Component Locator:

Use component locator on backdating schematic A(A1) REV A.

Parts Lists:

Use parts list for Rev E A1 board with the following exceptions:

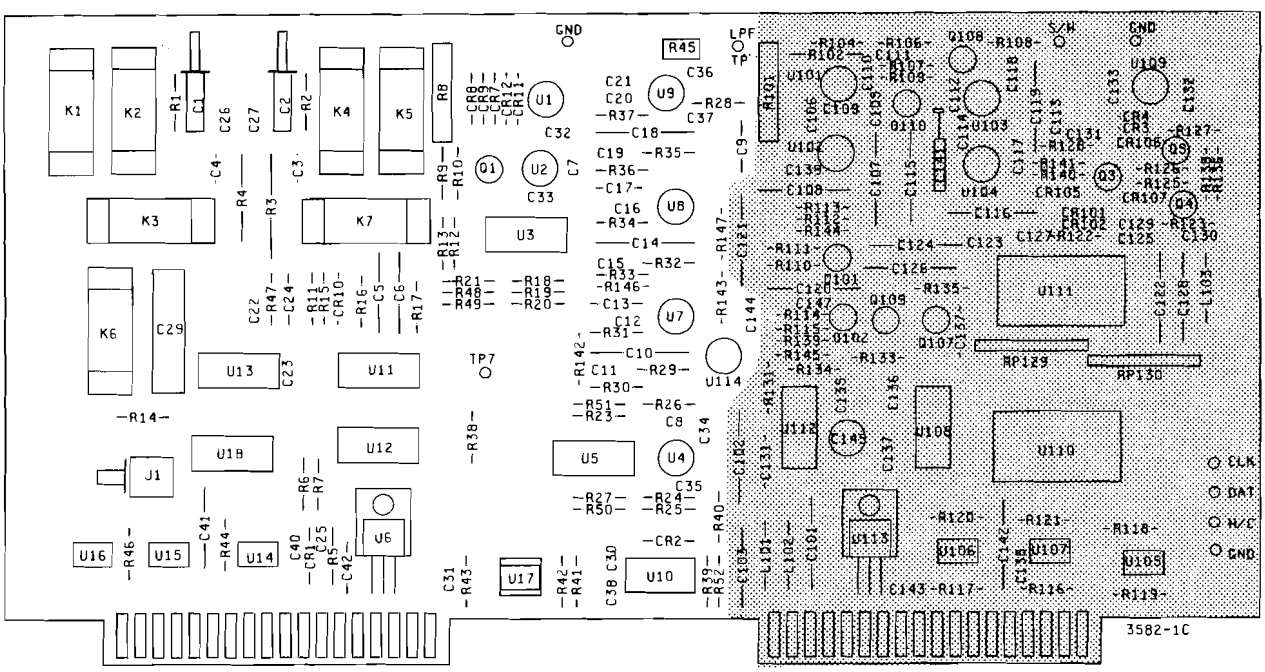
A1 Backdated Parts Changes REV A

Change:

A1C17	0160-2585	C-F 2000PF 100V
A1C30	0160-3622	C-F 0.1UF
A1C31	0160-3622	C-F 0.1UF
A1C38	0160-3622	C-F 0.1UF
A1C39	0160-3622	C-F 0.1UF
A1R38	0683-1336	R-F 13K .05 1/4W
A1R39	0683-1336	R-F 13K .05 1/4W
A1R41	0683-6845	R-F 680K .05
A1R52	0683-6845	R-F 680K .05
A1R118	0757-0160	R-F 604 OHM .01
A1R121	0757-0161	R-F 604 OHM .01
R1U10	1826-0026	V CMPTR LM311H
A1U17	1990-0444	PHOTO-ISO

Delete:

C149	0106-0576 C-F .1μf, 50V
C150	0160-0576 C-F .1μf, 50V
R54	0757-1094 R-F 1.4ke
C23	0160-4571 C-F .1μf
C148	0160-2055 C-F .01μf, 100V



P/O A1 INPUT ATTENUATOR, AMPLIFIER AND LOW PASS FILTER
03582 60501

RELAY NUMBERING VARIATIONS

3 6 4 — 2 4 E — 1 5 — 1 3 A — NOT USED

40dB ATTEN

20dB ATTEN

INPUT W1 — J1 — FPC1 .1

K1 K2 K3 K4 K5 K6 K7

C1 .7-3pF — R1 990K — C26 5.1pF — R4 10.1K — C4 300pF

C2 .7-3pF — R2 900K — C27 3.9pF — R3 111K — C3 4.3pF

R14 4.99K — C29 .33

R10 4.99K — R9 1M

C22 1000pF — R15 1.4K

CR7 — CR11 6.19V — CR8 — CR12 6.19V — CR9 — CR10

Q1A

R12 6980 — R11 24.9K — R13 6980

XA1A — P/O A20 — A11 — H CHA 3 CHB — 7 CHA 2 CHB — 6 CHA 8 CHB — SHIELD — FPR1 500 — BAL

- CABLE BAND - CHA - YELLOW W25 CHB - PLAIN W23

U1 — U2 — U3

R21 1K — R48 1K — R49 1K — R18 1.364K — R19 6.48K — R20 22.64K — C7 12pF

TP7

CABLES ARE IDENTIFIED BY A BAND OF COLOR AT ONE END

SHIELD — CABLE BAND

- CABLE BAND - CHA RED W19 CHB WHITE W20

AMPL VERINER — A11 R15

XA1A — P/O A20

ANTIALIASING LOW P

R54 1.47K — R23 1.74K — U4 — C8 12pF — U5

R24 1.364K — R25 6.48K — R26 22.64K — R27 1K — R50 1K — R51 1K

C10 .01 — R30 787 — R31 787 — C11 312pF — C12 312pF — C13 6250pF — U7 — R29 6190

C14 .01 — R33 1130 — R34 1130 — C15 480pF — C16 480pF — C17 2000pF — R32 5.9K

R40 2.49K — R39 12.4 — CR2

+5V$_I$ FROM U113 — R193 2.49K — U114 — R147 24.9K — C144 910pF — R146 3400 — R142 10

CAL SIGNAL — U14 — R5 1020 — R6 1370 — CR1 6.2V — C25 .1 — R7 374K — R47 22 — C24 .01 — R8 50 — CAL ADJ

XA1A — CAL — XA3A(14) CHA XA3A(15) CHB

P/O A20 MOTHER BD 03582-60520

U13 — U12A — U12B — U12C — U11 — CLR — CLK

D IN — XA4A(5) CHA XA4B(12) CHB — U16 — R46 5600

CLK IN — XA4A(15) CHA XA4B(11) CHB — U15 — R44 5600 — C41 15 — U18A — U18B

CABLES ARE IDENTIFIED BY A BAND OF COLOR AT ONE END

SHIELD

CABLE BAND

- CABLE BAND -
CHA RED W19
CHB WHITE W20

P/O A20 MOTHER BD 03582-66520

ANTIALIASING LOW PASS FILTER

AMPL VERINER

LPF ADJ

LPF TP4

TP7

TO S&H OF A/D ASSEM. B

XA1A

+5V RAW (+10 to +12V) XA1BA(3,C)

ISO GND XA1BA(1,2,AB)

+5V XA1BA(13)

TRIG A XA5A(13)

EXTERNAL TRIGGER INPUT

CLIP A XA5A(6,F)
CHA - (G)
CHB - (F)

CABLE BAND
CHA BLACK W26

TRIGGER LEVEL

FPR2 10K

-15V XA1BA(5,E)

+15V XA1BA(4,D)

- CABLE BAND -
CHA - YELLOW W25
CHB - PLAIN W27

FPR7 500

BAL

CHA 2 CHB

CHA 3 CHB

CHA 8 CHB

SHIELD

CHAS - I/O

FPS1

3582-5-21

A

Figure 7-A-1. Input Attenuator and LPF (Backdating). REV A

A1, SCHEMATIC A: INPUT BACKDATING

REV B

Schematic:

Use A1 REV E schematic.

Component Locator:

Use A1 REV E locator.

Parts List:

Use parts list for REV E with the following exceptions

A1 Backdated Parts Changes REV B

Change:

A1R118	0757-0160	R-F 604 OHM .01
A1R121	0757-0160	R-F 604 OHM .01

Delete:

C149	0160-0576 C-F .1μf, 50V
C150	0160-0576 C-F .1μf, 50V
R54	0757-1094 R-F 1.4ke
C23	0160-4571 C-F .1μf
C148	0160-2055 C-F .01μf, 100V

REV C

Schematic:

Use A1 REV E schematic.

Component Locator:

Use A1 REV E locator.
Parts List:

Use parts list for REV E with the following exceptions.

A1 Backdated Parts Changes REV C

Delete:

C23	0160-4571	C-F .1μf
C148	0160-2055	C-F .01μf, 100V
C149	0160-0576	C-F .1μf, 50V
C150	0160-0576	C-F .1μf, 50 V

REV D

Schematic:

Use A1 REV E schematic.

Component Locator:

Use A1 REV E locator.

Parts List:

Use parts list for REV E with the following exceptions:

Delete:	C149	0160-0576	C-F .1μf, 50V
	C150	0160-0576	C-F .1μf, 50V

REV E.

Correct schematic and parts locator are given in this section.

P/O A1 A/D BOARD 03582 66501 (F)

P/O A20 MOTHER BOARD 03582-66520

BUFFER AMPLIFIER

S/H

DAC

SAR

COMPARATOR

REGISTER CLOCK

DO NOT SHORT TO GROUND

FROM LOW PASS FILTERS

DATA

CLOCK

MSB

LSB

GAIN ADJ

S/H DC ADJ

A/D CLOCK ADJ

TP S/H

H/C

H/C TP

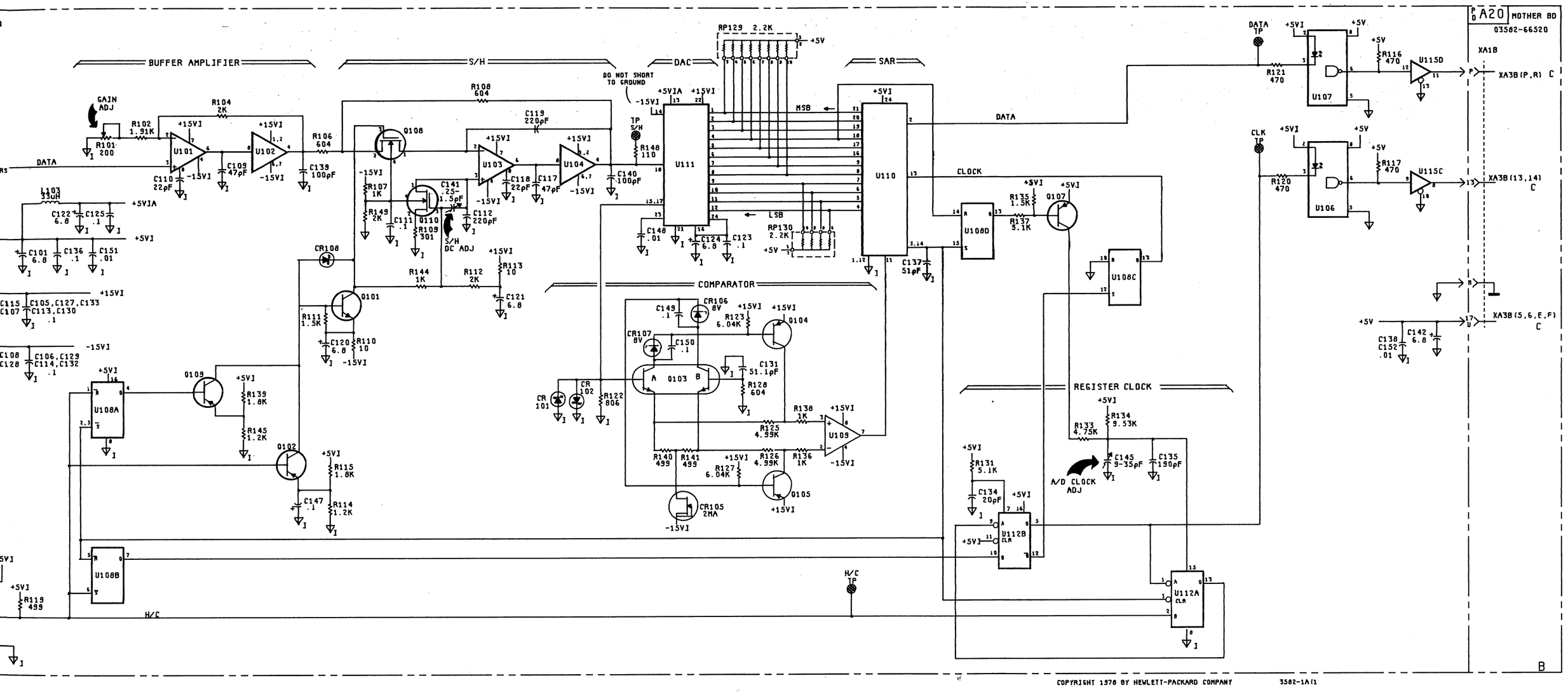
DATA TP

CLK TP

XA1B

C XA3B(12)

Figure 7-A-2. Digi



B

Figure 7-A-2. Digital To Analog Converter
7-A-5/7-A-6

A5, SCHEMATIC D: DIGITAL FILTER BACKDATING

REV A.

Schematic:

Use backdating schematic D(A5) REV A.

Component Locator:

Use component locator on backdating schematic D(A5) REV A.

Parts List:

Use current parts list D(A5) with the exception of the parts listed as follows:

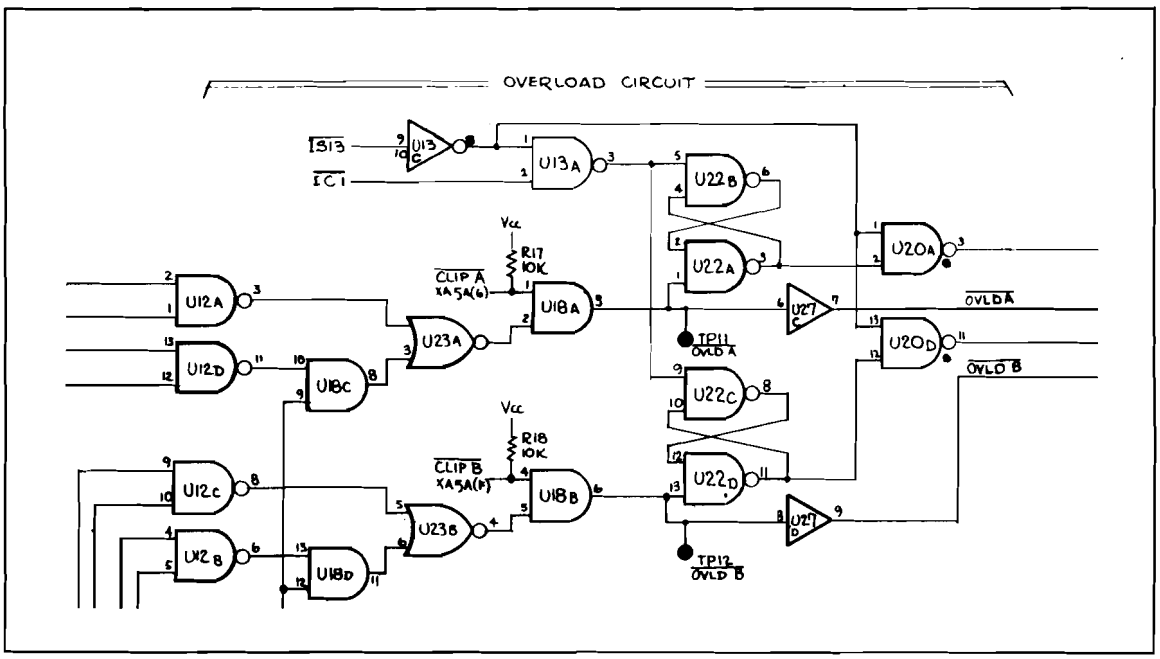
A5 Backdated Parts Changes REV A.

A5C1	0160-2204	C-F 100PF 300V
A5C2	0160-2204	C-F 100PF 300V
A5C3	To C21 Inclusive	
A5C21	0160-3847	C-F .01 50V
A5C25	0160-3847	C-F .01 50V
A5R3	0683-9515	R-F 5.1 OHM .05
A5R4	0683-0515	R-F 5.1 OHM .05
A5R9	0683-1025	R-F 1000 OHM .05
A5R10	0683-1025	R-F 1000 OHM .05
A5U12	1820-1199	TTL INV 74LSON
A5U18	1820-1197	TTL GATE 74LSOON

REV B.

Schematic:

Use backdating schematic D(A5) REV A modified by the addition of the following circuit. See current schematic D(A5) for information pertaining to the connection of signal lines into and out of the circuit.



Component Locator:

Use backdating component locator D(A5) REV A and note the exceptions indicated for REV B.

Parts List:

Use the current parts list D(A5) with the exception of the components listed as follows:

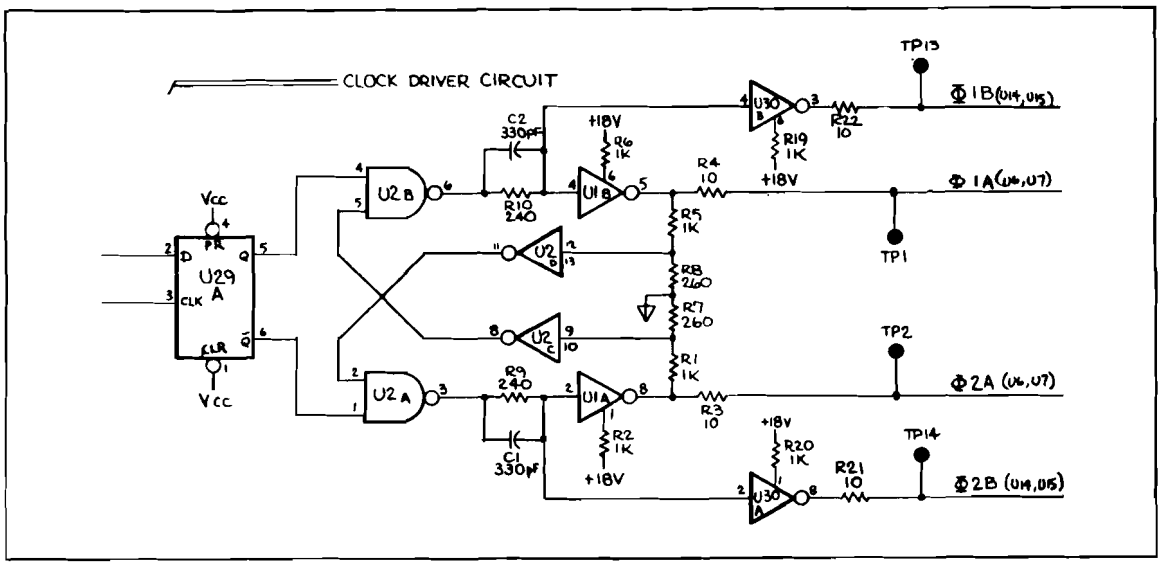
A5 Backdated Parts Changes REV B.

A5C1	0160-2204	C-F 100PF 300V
A5C2	0160-2204	C-F 100PF 300V
A5C3	To C21 Inclusive	
A5C21	0160-3847	C-F .01 50V
A5C25	0160-3847	C-F .01 50V
A5R3	0683-0515	R-F 5.1 OHM .05
A5R4	0683-0515	R-F 5.1 OHM .05
A5R9	0683-1025	R-F 1000 OHM .05
A5R10	0683-1025	R-F 1000 OHM .05

REV C.

Schematic:

Use backdating schematic D(A5) REV A modified by the addition of the following circuit. See current schematic D(A5) for information pertaining to the connection of signal lines into and out of the circuit. Include REVISION B.



Component Locator:

Use backdating component locator D(A5) REV A and note the exceptions indicated for REV C.

Parts List:

Use the current parts list D(A5) with the exception of the components listed as follows:

A5 Backdated Parts Changes REV C.

A5C3	To C21 Inclusive
A5C21	0160-3847 C-F .01 50V
A5C25	0160-3847 C-F .01 50V

A5 DIGITAL FILTER 03582-66505

P/O A20 MOTHER BD 03582-66520

XA5B

C CHA A/D XA3B(10) — 9

F $\overline{IS13}$ XA7B(10) — D ← $\overline{IS13}$ TO U12(9)

E $\overline{ICT}$ XA4B(S) — 15 ← $\overline{ICT}$ TO U13(12)

F XA7B(Y)

C SYNC XA3B(9) — 8

E XA4A(K)

E COS XA4B(A) — A

C CHB A/D XA3B(L) — K

E SIN XA4B(1) — J

XA5A

A TRIG(C) XA1A(B) — 13

XA5B

F OSO XA7B(11) — M

CLIPA — 6 — CLIPA

CLIPB — F — CLIPB

REV B

F $\overline{OS15}$ XA7B(14) — M

$\overline{IS15}$ XA7B(14) — S

$\overline{IC2}$ XA2B(E) — R

$\overline{IPH}$ XA7B(18) — P

BUFFER

RP13 1K

TP5 AD1

TP3 SYNC B

TP10 LO1

TP9 AD2

TP4 LO2

U27A

EN U19

U21A U21B U21C U21D

REV C

CLOCK DRIVER CIRCUIT

C CLK 1 XA3B(M) — 10

C CLK 2 XA3B(11) — L

U29

Vcc

C2 100pF

C1 100pF

R10 1K

R9 1K

R6 1K

R2 1K

R4 5

R5 1K

R8 200

R7 260

R1 1K

R3 5

U2B U2A U2D U2C U1B U1A

TP1 Φ1

TP2 Φ2

+18V

U6 U7 U14 U15

BΦ B1 B2 B3 B4 B5 B6 OS14 Φ1 Φ2 SYNC B CE1 CE2

DΦ D1 D2 D3 D4 D5 D6 D7 D8 D9 D10 D11 D12 D13 D14 D15

+12V +7V

OVL1 OVL2 OVL3 OVL4

"A" REAL

"A" IMAGINARY

"B" REAL

"B" IMAGINARY

DIGITAL FILTERS

REV B

OVERLOAD CIRCUIT

$\overline{IS13}$ $\overline{ICT}$

U12A U12B U12C U12D

U13A U13B U13C U13D

U18A U18B U18C

U22A U22B U22C U22D

U27C U27D

U20A U20B

OVLA OVLB

TP11 OVLD A

TP12 OVLD B

FROM U9(9)

FILTER OUTPUT DATA BUS

DMA REQUEST

CDR1 CDR2 CDR3 CDR4

U8A U8B U8C U8D

U9

TP7 TP8

U19

TRIGGER CIRCUIT

U21 U10

U4A U4B U4C U4D

S15 LAST

BΦ B2 B1

U3B U3A

U10E U10F

RP14 5.6K

CONTROL BUS

CONTROLLER

INTERRUPT

S15 $\overline{S15}$

I515 TO { U24(1,19) U25(1,19)

U13B U10 U23C U19 U20B U23D U20C

U11 U16 U17

RP11 1K RP12 1K

Y0 Y1 Y2 Y3 Y4 Y5 Y6 Y7

DC2 DC1 DCΦ

B11 B10 B9 B0S14

Vcc

COPYRIGHT 1977 BY HEWLETT PACKARD COMPANY

REV B

OVERLOAD CIRCUIT

"A" REAL

"A" IMAGINARY

"B" REAL

"B" IMAGINARY

OVL1

OVL2

OVL3

OVL4

FROM U9(9)

TP11 OVLD A

TP12 OVLD B

OVLA

OVLB

FILTER OUTPUT DATA BUS

OUTPUT BUFFER

U25

U24

I515 FROM XA5B(M)

IOB15

IOBΦ

I/O BUS

I/O BUS FROM ROM A6

P/O A20 MOTHER BD 03582-66520

XA5B

OVL A AIIJ1(K) N

OVL B AIIJ1(13) N

XA5A

DMA REQUEST

CDR1

CDR2

CDR3

CDR4

U9

U8A

U8B

U8C

U21

U4A

TP7

TP8

U19

Vcc

TRIGGER CIRCUIT

DMAR XA3B(15) XA4A(R) C E

GATE XA3B(C) C

S15

LAST

U4D

U4C

U3A

U5A

U3B

U5B

U4B

TP6

RP12 1K

RP13 1K

U26

U28

BUFFER

DLITE XA4A(13) AIIJ1(10) F N

+18V

+12V

+7V

+5V

-18V

C3 .01

C27 6.8

C8,11,15,17 .01

C23 6.8

C9,12,16,19 .01

C24 33

C4,5,6,13,20,21,25 .01

C22 33

C7 10,14,18 .01

R15 2.4K

CR1 3.01V

C26 6.8

XA5B

XA5A

XA7B(S) F

XA7B(U) F

U11

U16

U17

U10

U23C

U23D

U20A

U20B

U20C

U20D

U27

U12

U13

U18

U22

U13A

U13C

U13D

U18C

U18D

U9

U10

RP11 1K

R14 5.6K

R12 1K

CONTROL BUS

CONTROLLER

INTERRUPT

DC2

DC1

DCΦ

3585-E-19

D

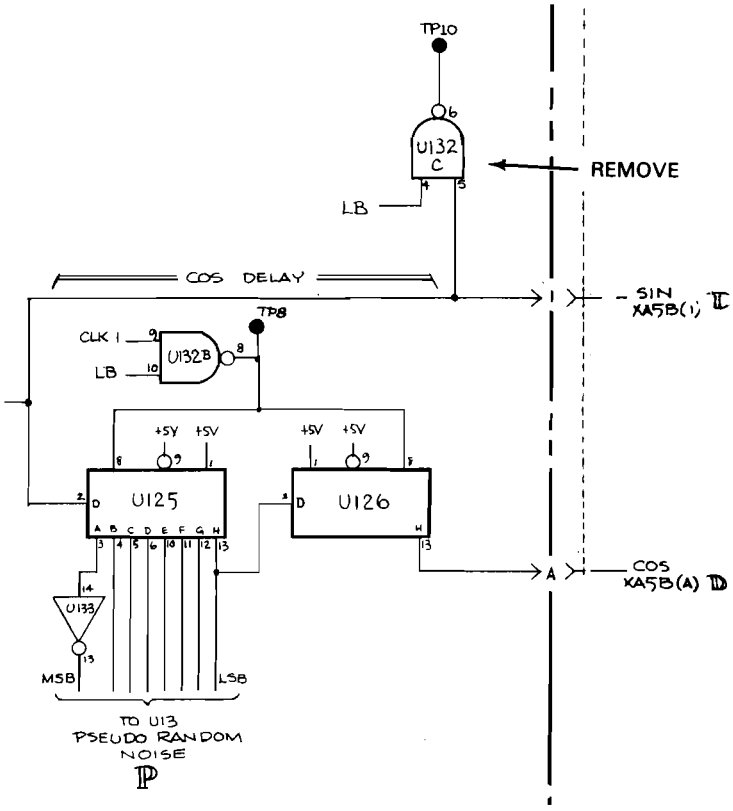
Figure 7-D. Digital Filter (Backdating).

A4, SCHEMATIC E: LOCAL OSCILLATOR

REV A, B, C.

Schematic:

Use the REV D schematic found in service group #3 with the following change:



REV B&C:

Schematic:

Use the REV C schematic as provided in this section.

Parts Locator:

Use the REV C parts locator as provided in this section.

Parts List:

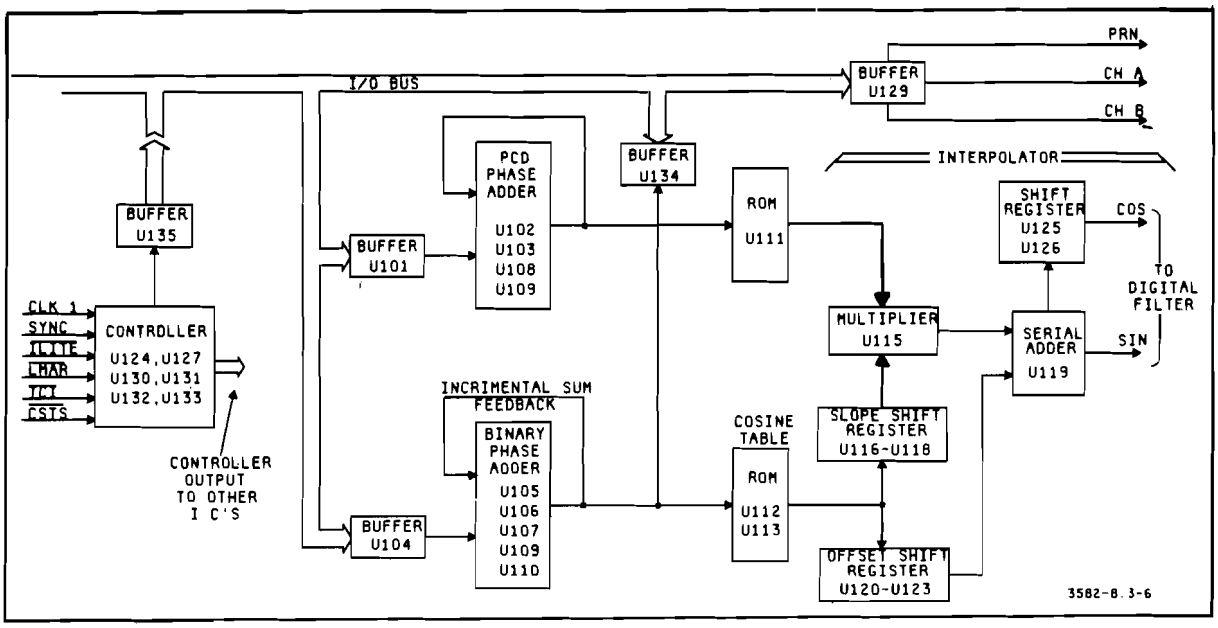
(REV B only) use the REV D parts list in service group three with the following exceptions:

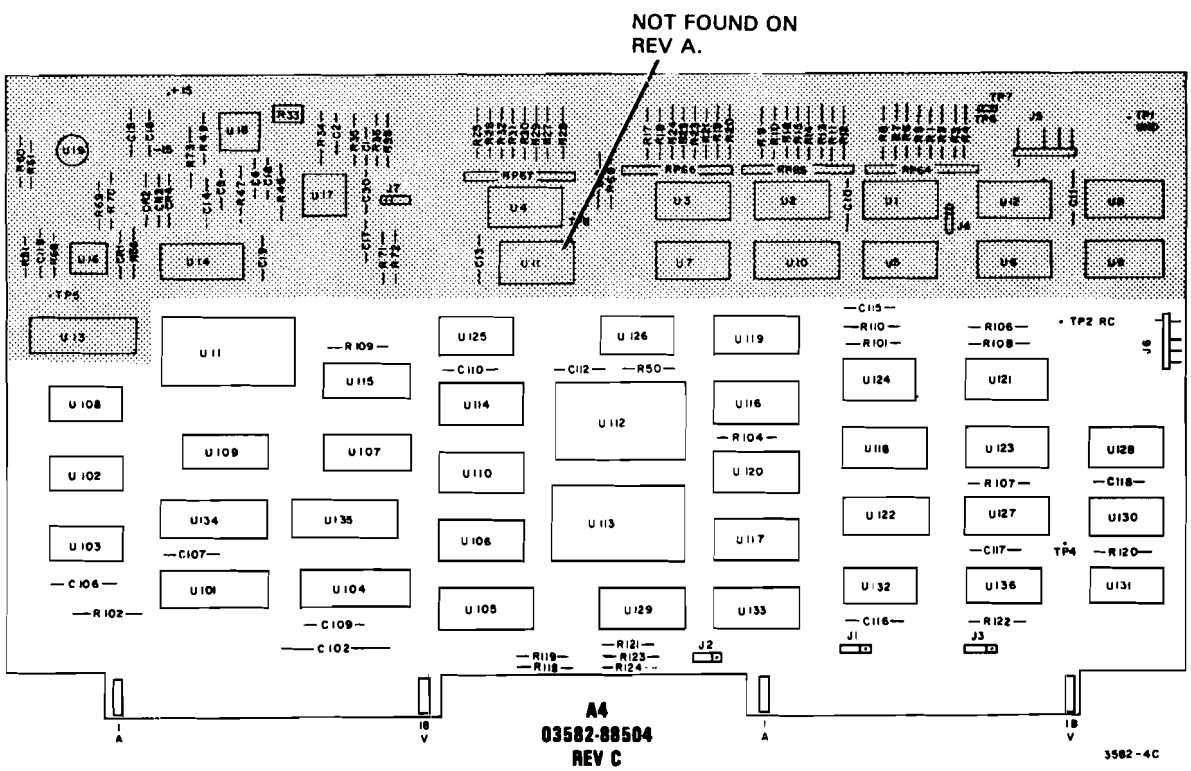
Delete: U132

Parts List:

(REV C only) use the REV D parts list with the following exceptions.

Delete: U132


PRN
CH A
CH B
I/O BUS
BUFFER U129
INTERPOLATOR
BUFFER U135
BUFFER U134
PCD PHASE ADDER U102 U103 U108 U109
ROM U111
SHIFT REGISTER U125 U126
COS
TO DIGITAL FILTER
SIN
BUFFER U101
CLK 1
SYNC
ILLITE
CHAR
TCT
CSTS
CONTROLLER U124,U127 U130,U131 U132,U133
CONTROLLER OUTPUT TO OTHER I C'S
MULTIPLIER U115
SERIAL ADDER U119
INCRIMENTAL SUM FEEDBACK
BINARY PHASE ADDER U105 U106 U107 U109 U110
COSINE TABLE
ROM U112 U113
SLOPE SHIFT REGISTER U116-U118
BUFFER U104
OFFSET SHIFT REGISTER U120-U123
3582-8.3-6

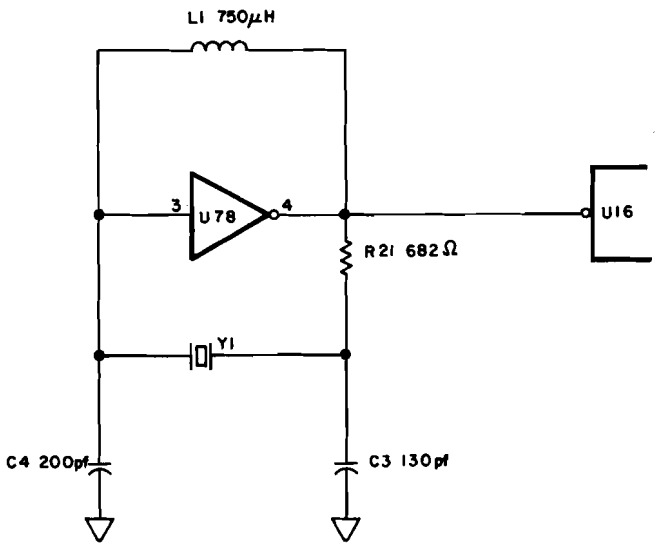

NOT FOUND ON REV A.
A4
03582-88504
REV C
3582-4C

A7, SCHEMATIC F: PROCESSOR BACKDATING

REV A&B:

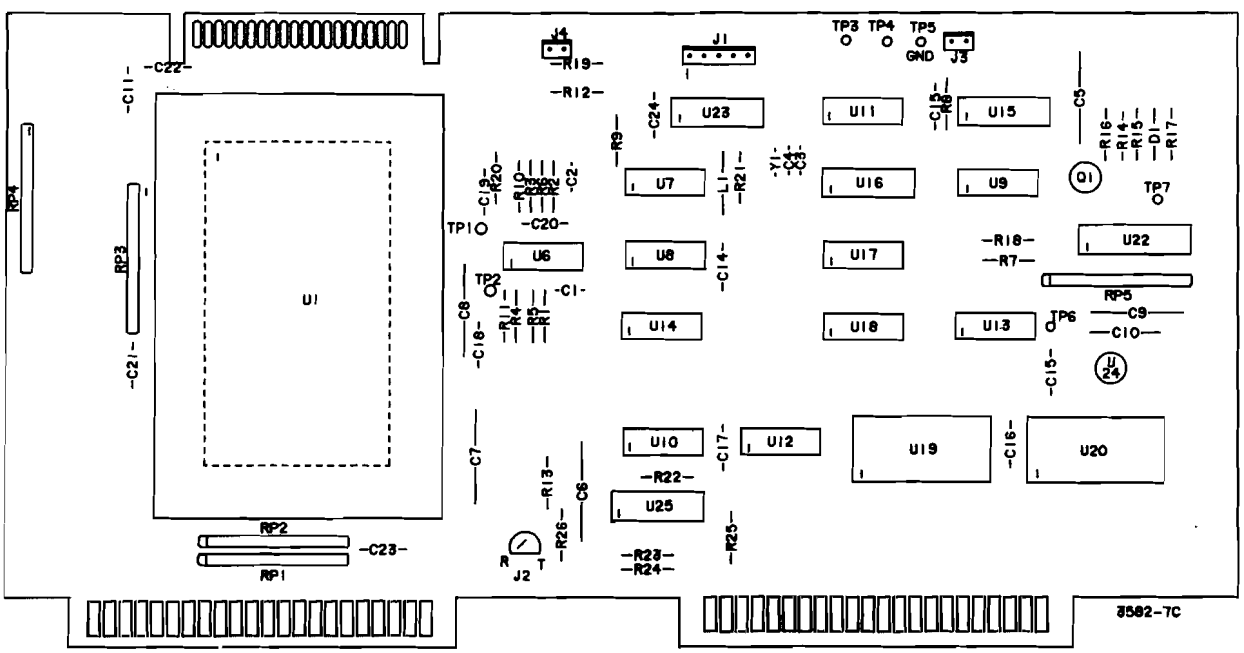
Use the REV D schematic except remove the buffers U23C and U22B. Also, modify the clock circuit as follows:

Schematic:



Parts Locator:

Use the REV A,B parts locator as shown.



A7
03582-66507
Rev A & B

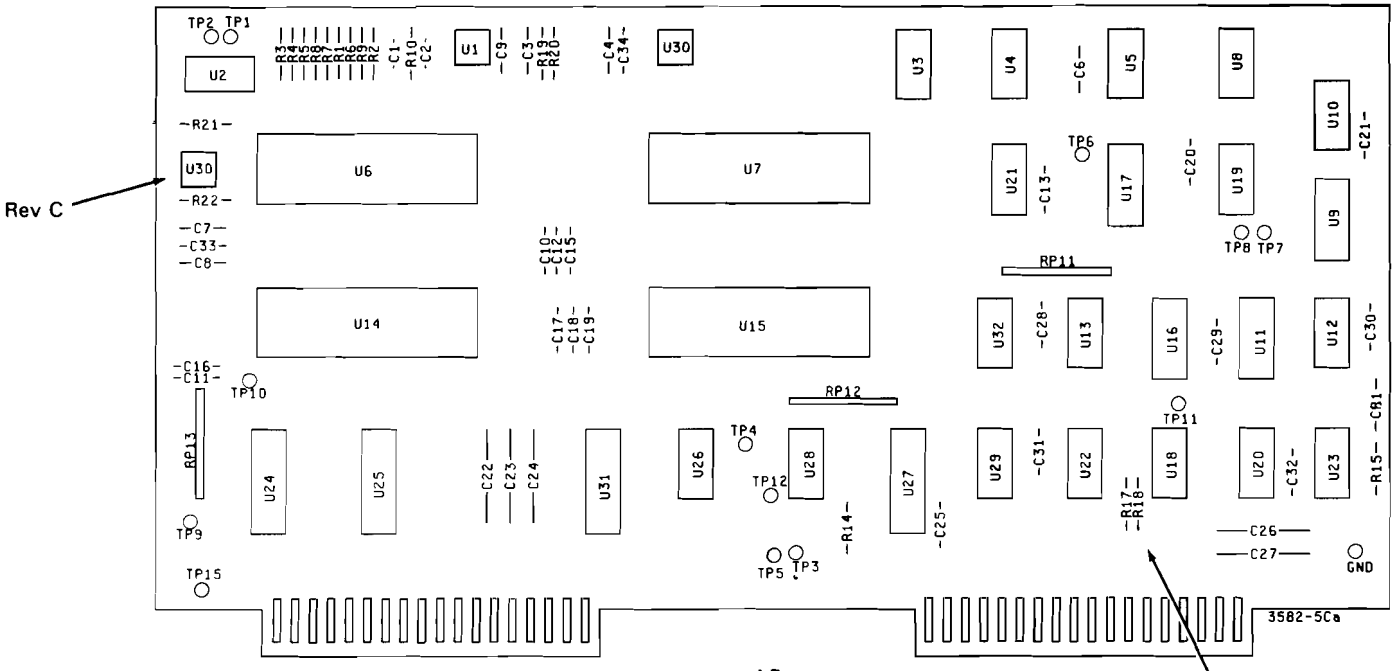
Parts List:

Use the REV D parts list with the following exception.

Change:	C3	0140-0195	C-F, 130pf 300V
	J2	1200-0458	Socket IC, TL5
	R25	0638-5105	R-F, 51Ω, .05
Add:	L1	9100-1651	Coil Choke 750μh
Delete	C26,27	0160-3847	C-F .01μf, 50V
	JR2	1258-0141	Jumper-removeable
	Q23	1854-0215	XSTR-2N3904
	C25	0160-4571	C-F .1μf, .20
	R31	0683-1015	R-F 100Ω, .05
	R33	0683-1025	R-F 1000Ω, .05
	R29	0683-4715	R-F 470Ω, .05
	R32	0683-4725	R-F 4.7kΩ, .05
	R27,28	0683-4735	R-F 47kΩ .05
	R30	0683-5625	R-F 5.6kΩ, .05

REV C:

REV C is the same as REV D except that the buffers U22B and U23C are not used. The parts locator and parts lists are identical and the schematic is modified by deleting U22B and U23C.


Rev C
TP2
TP1
U2
R3
R4
R5
R8
R7
R1
R6
R2
C1
R10
C2
U1
C9
C3
R19
R20
C4
C34
U30
U3
U4
C6
U5
U8
U10
C21
R21
U30
R22
U6
U7
U21
C13
TP6
U17
C20
U19
U9
TP8
TP7
C7
C33
C8
C10
C12
C15
RP11
U14
C17
C18
C19
U15
U32
C28
U13
U16
C29
U11
U12
C30
C16
C11
TP10
RP12
TP11
RP13
U24
U25
C22
C23
C24
U31
U26
TP4
U28
U27
U29
C31
U22
U18
U20
C32
U23
R15
C81
TP12
R14
C25
R17
R18
C26
C27
TP9
TP5
TP3
GND
TP15
3582-5Ca
A5
03582-66505
Rev B

A6, SCHEMATIC G: ROM BACKDATING

NOTE 1

Some early ROM boards (instruments with serial number prefixes 1747A- have them) contain an 1816-1195 in the U28 position and an 1816-1196 in the U27 position. In addition these boards contain different ROMS for U1 and U2.

U1 1816-1197
U2 1816-1198
U27 1816-1196
U28 1186-1195

To retrofit these boards to the current (REV B) status remove U27 and U28 completely. Remove jumper wire W1 and install jumper wire W2. In addition, order and install the following ROMS:

U1 1818-0957
U2 1818-0958
U3 1818-0959
U4 1818-0961

When this modification is complete the new software datecode will be 020151.

NOTE 2

At serial number 1819A01006 approximately, a new set of ROMS was installed in all 3582A's. The new software datecode is now 020151. If you have software datecode 017536, and should U1, U2, U3 or U4 need to be replaced you must order an entire set of the new software as follows:

U1 1818-0957
U2 1818-0958
U3 1818-0959
U4 1818-0961

Signature analysis for the software is provided in this section.

REV A.

Use the REV B schematic, parts locator and parts list with the following exception.

Delete: J1-19 7175-0057 Jumper Wire 19ea

Part 1: Address and Select Lines

Place A7 J2 to Test

Setup:	Clk:	J2(3)	0000 ⌐¯
	Stop:	J2(4)	HH26 ⌐¯
	Start:	J2(5)	HH26 ⌐¯

+5 Signature = 9PA2

Address Bus

Pin #	Address Bus	
(1)*	4PU2	7
2	4326	6
3	306C	5
4	P9UU	4
5	1688	3
6	7POA	2
7	8620	1
8	8A61	0
19	U57U	10
22	5HF8	9
23	CAP2	8

*On any ROM chip except U1,2,28 and 29.

Select Addresses

U24(10)	PPP6	A11
11	7044	$\overline{A11}$
6	U616	A12
14	P254	A13
2	HH26	A14

Chip Selects

TP3	6CC6	$\overline{SC0}$
TP4	FA66	$\overline{SC1}$
TP5	UP98	$\overline{SC2}$
TP6	1FFF	$\overline{SC3}$
U25(11)	6338	$\overline{SC4}$
U25(10)	CP1P	$\overline{SC5}$
TP7	4384	$\overline{SC45}$

$\overline{STROMS}$

U26(3)	0000
11	0000
6	0000

Part 2: Overall Data
Datecode: 020151

Place A7 J2 to Test

Setup:	CLK	J2(3)	⌐¯
	Stop:	J2(4)	⌐¯
	Start:	J2(5)	⌐¯

+5 Signature = 9PA2

M.S. Byte

	Data Line	
U19(2)	7	6UP3
18	6	P932
4	5	PC14
16	4	55F7
6	3	3AF7
14	2	7CU0
8	1	A82U
12	0	UPU3

L.S. Byte

	Data Line	
U20(2)	7	2A60
18	6	062A
4	5	9046
16	4	PU37
6	3	7301
14	2	PH71
8	1	9P12
12	0	17P8

Data for U3,4, and U11,12
Date code 017536

	U3, 4, & 11, 12		U3 and 4 only	
Clk:	J2(3)	⌐¯	J2(3)	⌐¯
Stop:	TP4	⌐¯	TP2	⌐¯
Start:	TP4	¯⌐	TP4	¯⌐
+5 Signature		826P		7A70

M.S. Byte U4 & U12 / M.S. Byte U4

Pin Nos. All ROMs	M.S. Byte U4 & U12		M.S. Byte U4	
17	7	AF92	7	4146
16	6	9C43	6	5APA
15	5	52U8	5	8759
14	4	34H1	4	4725
13	3	P249	3	3369
11	2	UH06	2	5421
10	1	68HC	1	96F5
9	0	8UC5	0	0357

L.S. Byte U3 & 11 / L.S. Byte U3

Pin Nos. All ROMs	L.S. Byte U3 & 11		L.S. Byte U3	
17	7	37C9	7	23UC
16	6	1803	6	U131
15	5	163F	5	2UOA
14	4	AU21	4	A8A3
13	3	U6A4	3	3219
11	2	6UU1	2	21AU
10	1	0FF8	1	F6CF
9	0	A731	0	3HP7

Data for U5,6, and U13,14
Date code 017536

	U5, 6, & 13, 14		U5 and 6 only	
Clk:	J2(3)	⌐¯	J2(3)	⌐¯
Stop:	TP5	⌐¯	TP2	⌐¯
Start:	TP5	¯⌐	TP5	¯⌐
+5 Signature		826P		7A70

M.S. Byte U6 & U14 / M.S. Byte U6

M.S. Byte U6 & U14		M.S. Byte U6	
7	74UC	7	7PP8
6	F9FH	6	P656
5	F39H	5	UAU6
4	P68F	4	10F6
3	520H	3	5FPH
2	A23U	2	AP01
1	973F	1	P5F7
0	5H98	0	42FA

L.S. Byte U5 & 13 / L.S. Byte U5

L.S. Byte U5 & 13		L.S. Byte U5	
7	0136	7	47F5
6	19P6	6	15C2
5	6P02	5	APF4
4	27CO	4	U42C
3	0845	3	U7PO
2	8UC8	2	U02F
1	F8P2	1	6599
0	9COU	0	HOA2

Data for U5,6, and U13,14
Date code 017536

U5, 6, & 13, 14			U5 and 6 only	
	J2(3) ⌐		Clk:	J2(3) ⌐
:	TP5 ⌐		Stop:	TP2 ⌐
:	TP5 ⌙		Start:	TP5 ⌙
Signature	826P		+5 Signature	7A70

Data for U7,8, and U15,16
Date code 017536

U7, 8, & 15, 16			U7 and 8 only	
Clk:	J2(3) ⌐		Clk:	J2(3) ⌐
Stop:	TP6 ⌐		Stop:	TP2 ⌐
Start:	TP6 ⌙		Start:	TP6 ⌙
+5 Signature	826P		+5 Signature	7A70

Data for U9,10, and U17,18
Date code 017536

U9, 10, & 17, 18			U9 and 10 only	
Clk:	J2(3) ⌐		Clk:	J2(3) ⌐
Stop:	TP7 ⌐		Stop:	TP2 ⌐
Start:	TP7 ⌙		Start:	TP7 ⌙
+5 Signature	P254		+5 Signature	7A70

Part 3: Data Test For Patch ROMS U1, 2
Datecode: 017536

Place A7 J2 to Test

Setup:	Clk:	J2(3) ⌐
	Stop:	TP3 ⌐
	Start:	TP3 ⌙
	+5 Signature	105U

NOTE

U28 and 29 are not installed for this software.

M.S. Byte U6 & U14		M.S. Byte U6	
7	74UC	7	7PP8
6	F9FH	6	P656
5	F39H	5	UAU6
4	P68F	4	10F6
3	520H	3	5FPH
2	A23U	2	AP01
1	973F	1	P5F7
0	5H98	0	42FA

M.S. Byte U8 & U16		M.S. Byte U8	
7	943H	7	7125
6	HOH9	6	FU53
5	CUH5	5	374U
4	HAF7	4	9H7C
3	UCC1	3	36HP
2	2743	2	A534
1	7681	1	868U
0	8PO1	0	68H2

M.S. Byte U10 & U18		M.S. Byte U10	
7	331H	7	5PP3
6	8766	6	462U
5	1684	5	7CU7
4	CC20	4	P633
3	PC02	3	1C7H
2	FAHA	2	7C06
1	41UA	1	FA12
0	88H7	0	F39C

M.S. Byte U2	
7	C406
6	CHC4
5	5C3H
4	63FP
3	61C3
2	09FA
1	P7CF
0	14A0

L.S. Byte U5 & 13		L.S. Byte U5	
7	0136	7	47F5
6	19P6	6	15C2
5	6P02	5	APF4
4	27CO	4	U42C
3	0845	3	U7PO
2	8UC8	2	U02F
1	F8P2	1	6599
0	9COU	0	HOA2

L.S. Byte U7 & 15		L.S. Byte U7	
7	U709	7	OUU8
6	5319	6	5UAC
5	OP4F	5	PH51
4	3700	4	HH85
3	H5U7	3	9H17
2	U82C	2	F516
1	3756	1	H901
0	PC92	0	H76H

L.S. Byte U9 & U17		L.S. Byte U9	
7	CP22	7	4692
6	346H	6	6H03
5	UHA9	5	P22U
4	2FOC	4	FHC1
3	PH2C	3	09F9
2	C2A2	2	31F7
1	586U	1	5P26
0	33U7	0	7754

L.S. Byte U1	
7	2309
6	0649
5	8306
4	2AF2
3	HC7C
2	UU18
1	CCF2
0	7C49

Table 7-G-1. ROM SA Troubleshooting.

A8, SCHEMATIC H: RAM BACKDATING

REV A&B:

These boards are electrically identical to the REV C board except for the following exceptions:

Change:	C20	0180-0210	C-F 3.3μf, 15V
	J1	1200-0458	Socket IC, T05

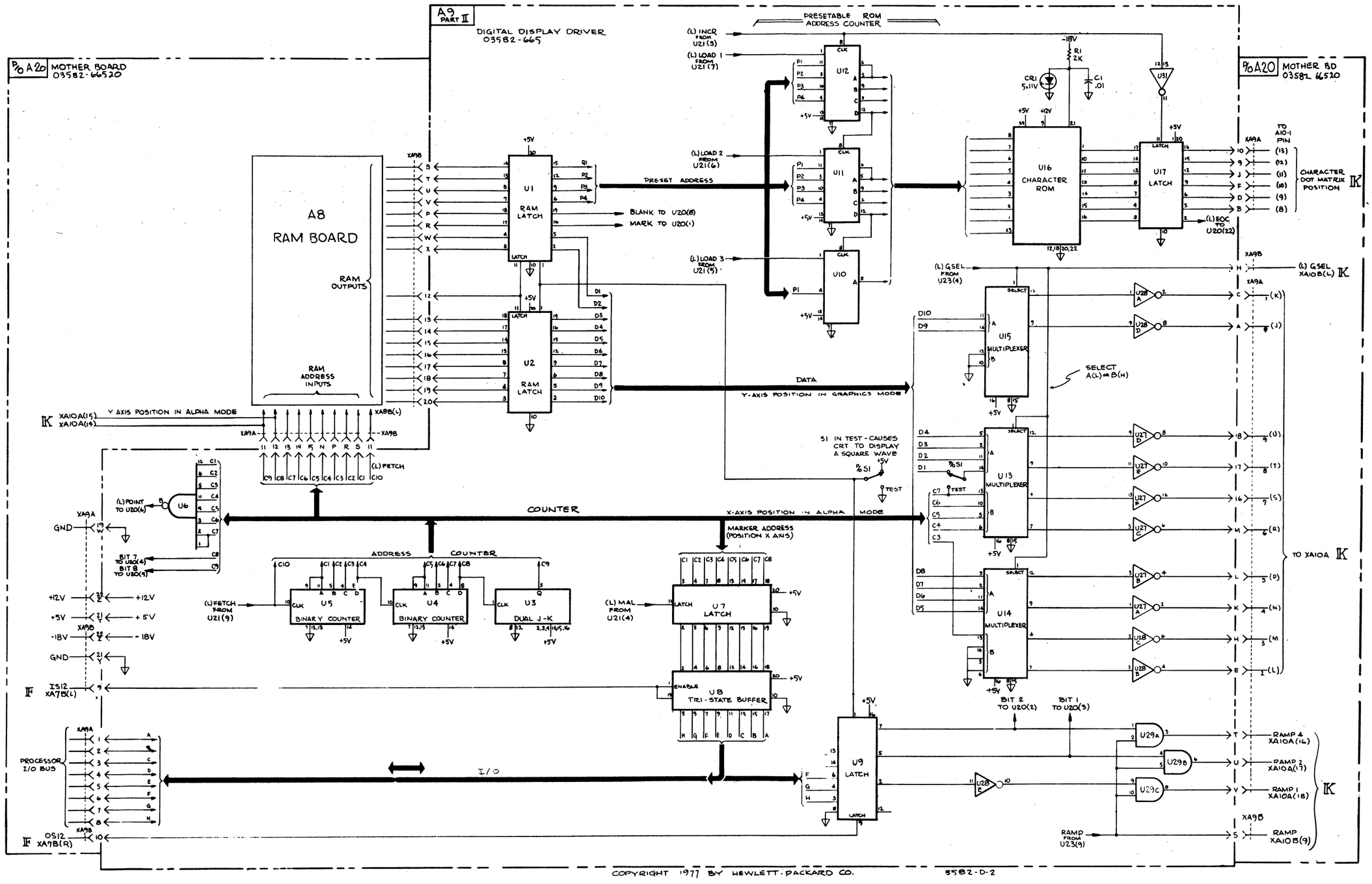


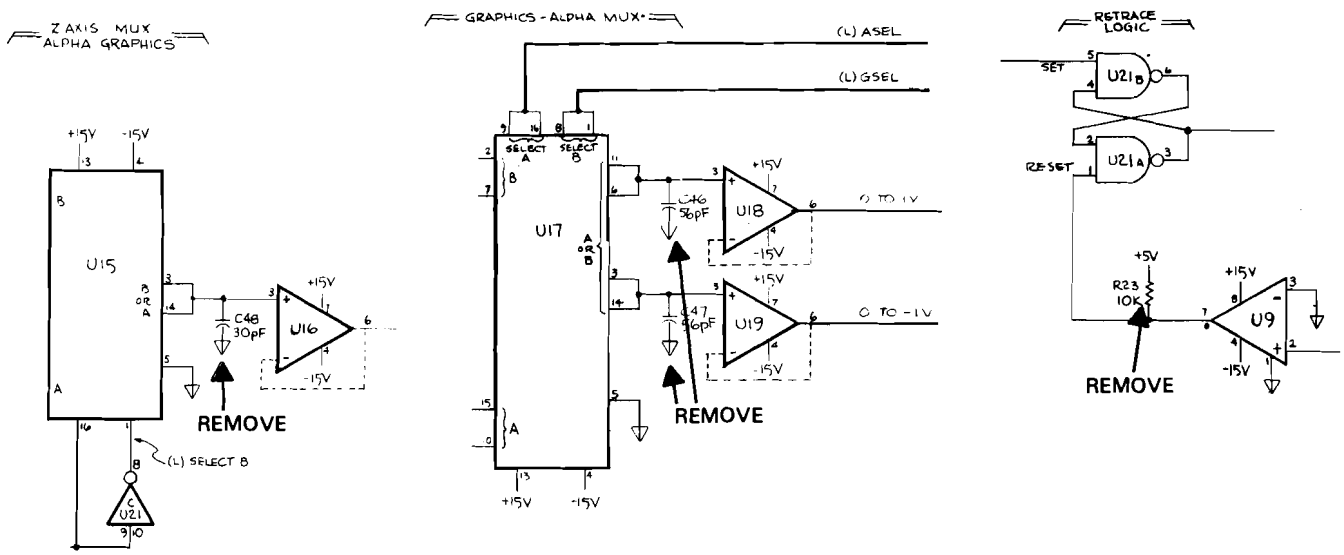
Figure 7-J-1. Digital Display Driver (Backdating).

A10, SCHEMATIC K: ANALOG DISPLAY DRIVER BACKDATING

REV A:

Schematic:

Use the REV C schematic with the following changes:



Parts Locator:

Use the REV C parts locator, deleting the above four components.

Parts List:

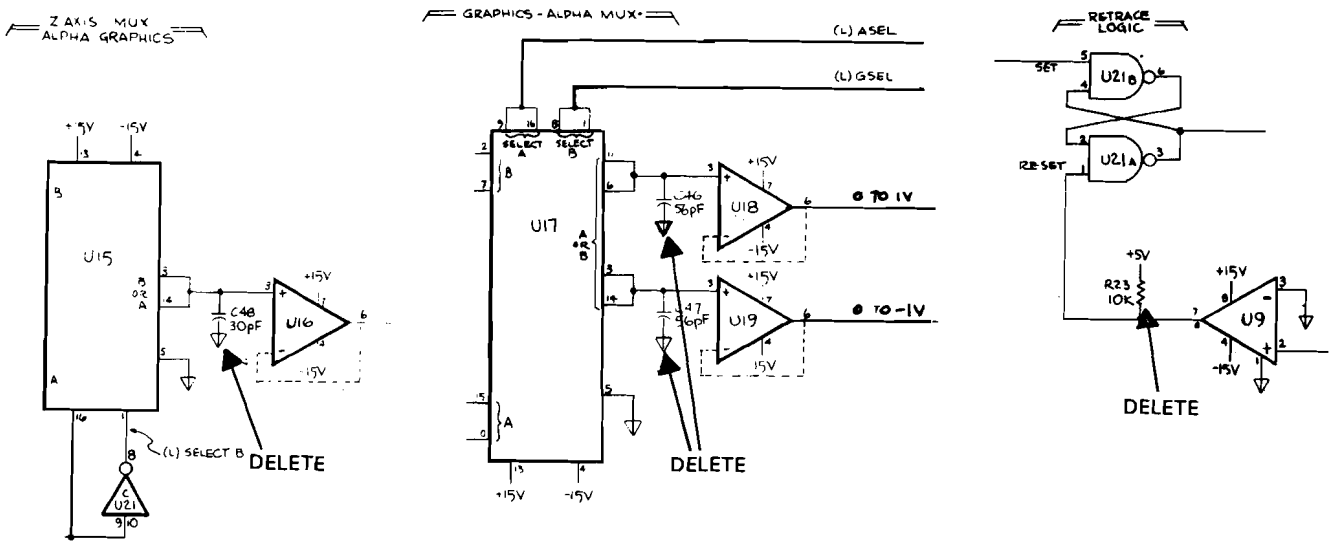
Use the REV C parts list with the following exceptions:

Delete:	C46,47	0140-0191	C-F 56pf, 300V
	C48	0160-2199	C-F 30pf, 300V
	R23	0683-1035	R-F 10k, 5%, ¼W
Change:	R40	0698-4495	R-F 37.4k
	R41	2100-3353	R-F 20k
	R42	2100-3352	R-F 1k
	R43	0698-4443	R-F 4.53k
	R105,106,107	1810-0136	RSTR NTWRK 216C
	Q6	1854-0071	XSTR-NPN sps5103

REV B:

Schematic:

Use the REV C schematic with the following changes:



Parts Locator:

Use the REV C parts locator, deleting R23, C46, C47 and C48.

Parts List:

Use the REV C parts list with the following exceptions:

Delete:	C46,47	0140-0191	C-F 56pf, 300V
	C48	0160-2199	C-F 30pf, 300V
	R23	0683-1035	R-F 10k .05 ¼W

A2, SCHEMATIC 0: HP-IB BACKDATING

REV A.

Use the REV B schematic, parts list and component locator found in the HP-IB service group. REV B is electrically identical to REV A with the jumper J4 removed.

A4, SCHEMATIC P: PSEUDORANDOM NOISE GENERATOR

REV A:

Schematic:

Use the REV A schematic as provided in this section.

Parts Locator:

Use the REV A parts locator as provided in this section.

Parts List:

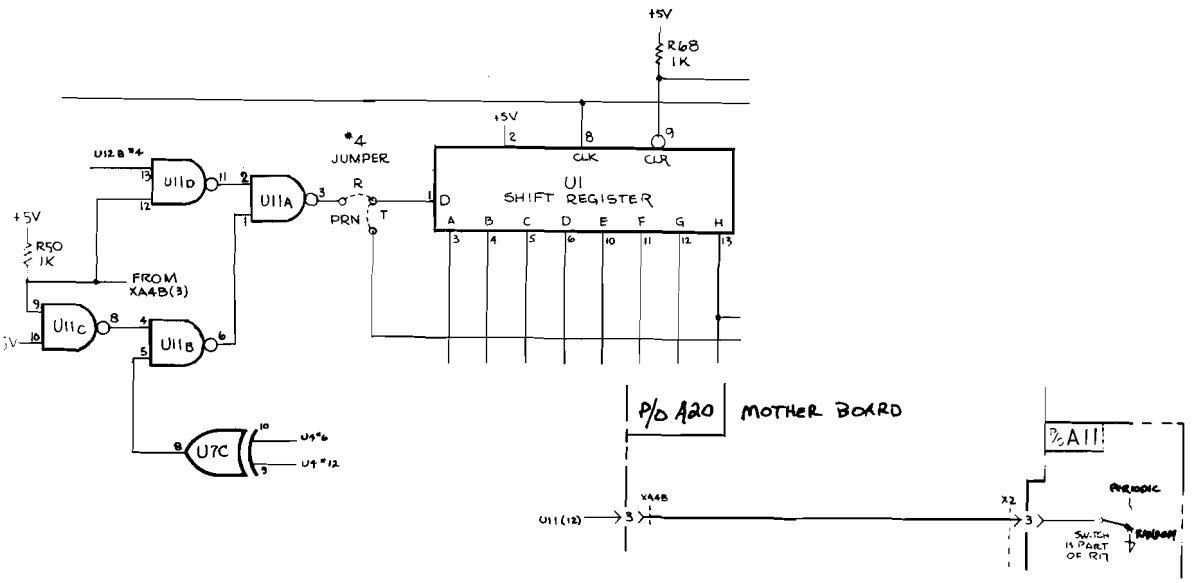
Use the REV D parts list with the following exceptions.

Add:	R64-67	1810-0136	Resistor Network 216C
Delete:	R50	0683-1025	R-F 1000Ω, 5%
	U11	1820-1197	TTL Gazte 74LS00N
Change:	J1-4	1200-0458	Socket, IC T05

REV B:

Schematic:

Use the REV A schematic as provided in this section with the following changes:



Component Locator:

Use the REV D component locator found in service group #3.

Parts List:

Use the REV C parts list located in this section with the following exceptions:

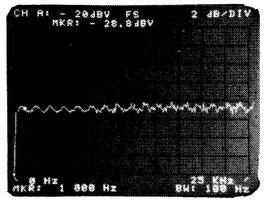
REV A:

Delete:	U11	1820-1197	TTL GATE 74LS00N
	R50	0683-1025	R-F, 1000μ .05
Change:	R64-67	1810-0136	Res. Ntwrk

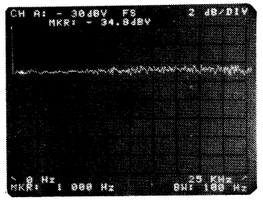
REV B:

Change:	J1-4	1200-0458	Socket IC - T05

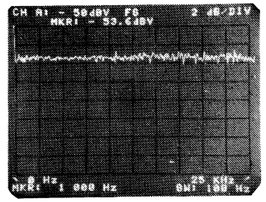
REV C: No changes.



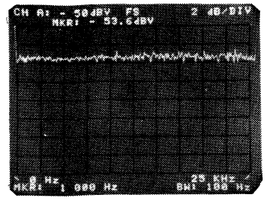
A. Looking at A4U3-3 with 1 volt range; looks at Binary Noise.



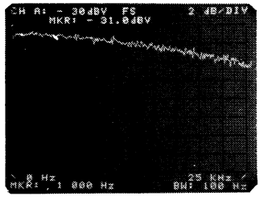
B. A4U17-7. Output of the current summer.



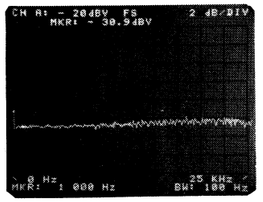
C. A4U15-2. Output of the 4 Quadrant Multiplier.



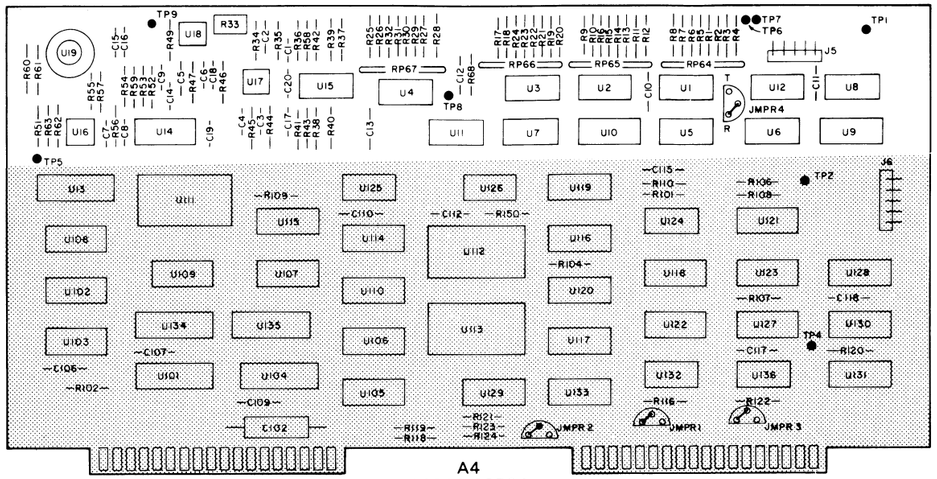
D. A4U15-14. Other output of the Quadrant Multiplier.

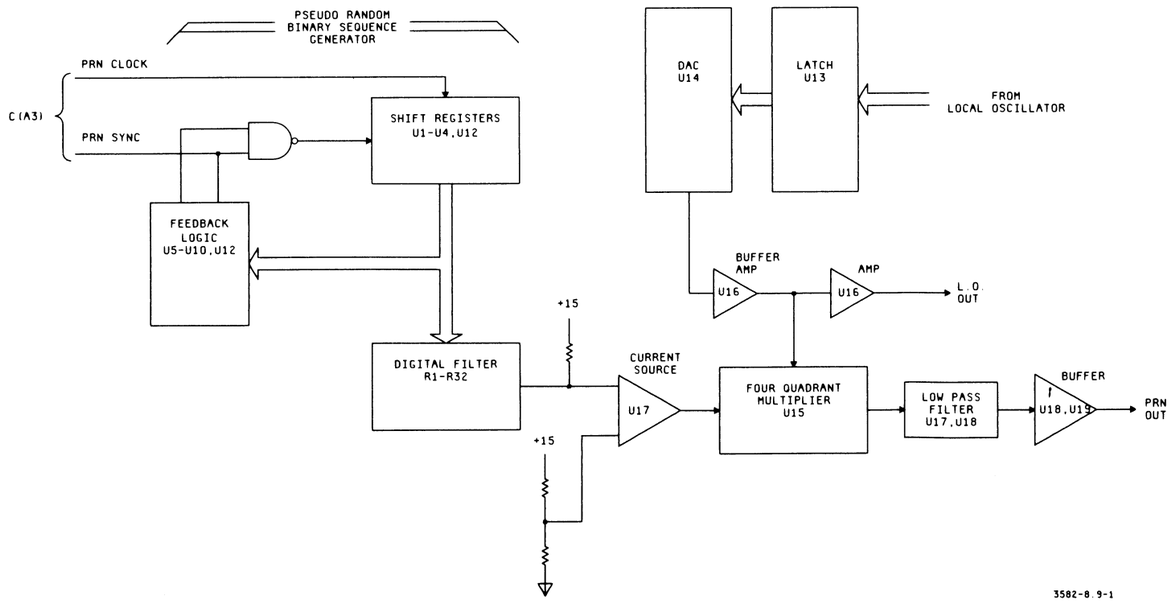


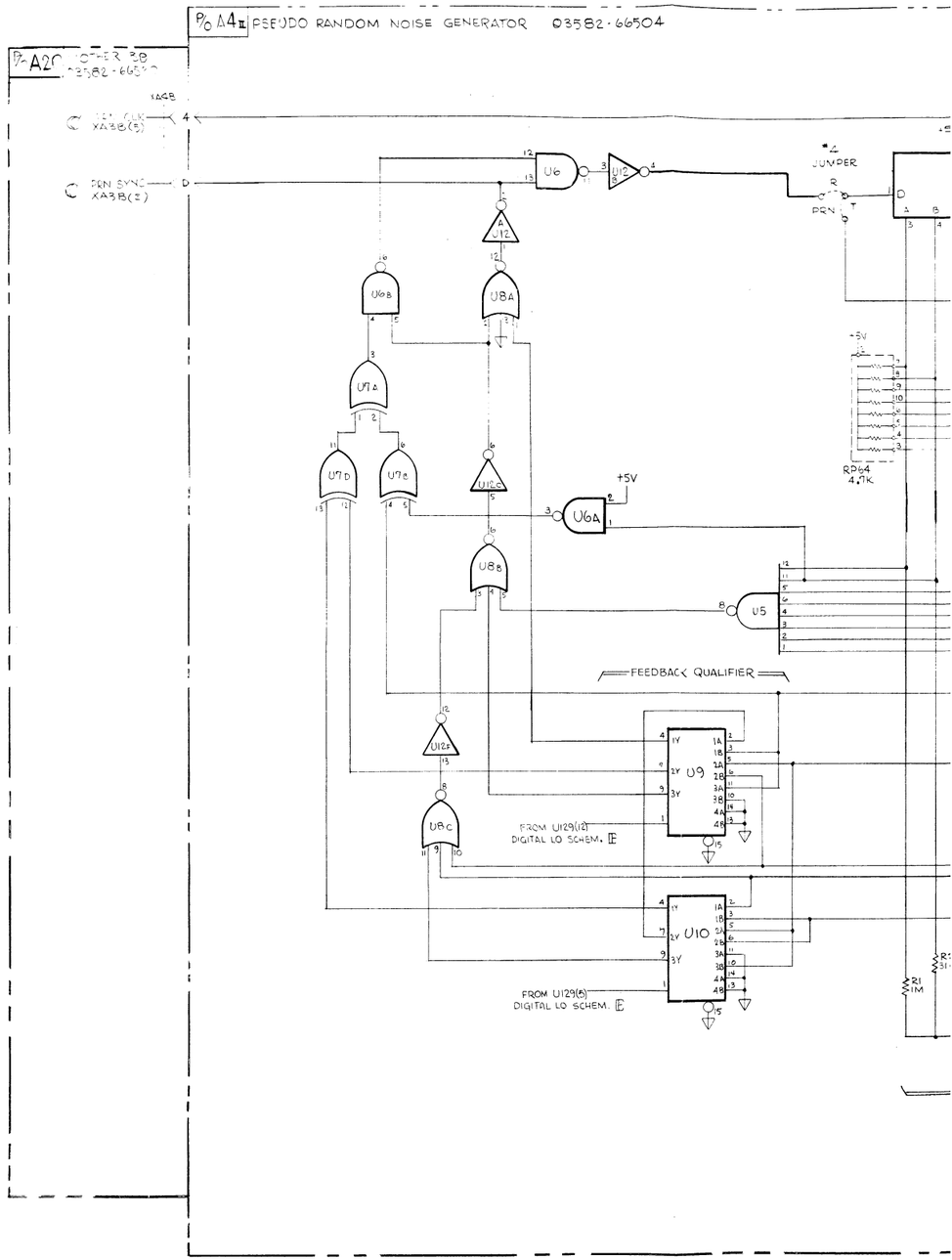
E. A4U17-1. 1st stage of Low Pass Filter.



F. A4U18-1. 2nd stage of Low Pass Filter.







P/O A4 PSEUDO RANDOM NOISE GENERATOR 03582-66504

P/O A20 MOTHER BB 03582-66520

XA4B

PRN CLK XA3B(5)

PRN SYNC XA3B(2)

*4 JUMPER

U1 SHIFT REGISTER

U2 SHIFT REGISTER

U3 SHIFT REGISTER

U4 SHIFT REGISTER

+5V

R68 1K

J5

CLR TP6

TP7

U6 U12 U6B U8A U7A U7D U7B U12C U6A U8B U5 U12E U8C U9 U10

FEEDBACK QUALIFIER

FROM U129(12) DIGITAL LO SCHEM. E

FROM U129(5) DIGITAL LO SCHEM. E

RP64 4.7K

RP65 4.7K

RP66 4.7K

RP67 4.7K

R1 1M R2 316K R3 187K R4 115K R5 86.6K R6 76.8K R7 82.5K R8 143K R9 340K R10 549K R11 267K R12 165K R13 11.8K R14 9530 R15 8250 R16 7680 R17 1680 R18 8250 R19 9530 R20 11.8K R21 165K R22 267K R23 34.9K R24 340K R25 143K R26 82.5K R27 76.8K R28 86.6K R29 115K R30 187K R31 316K R32 1M

DIGITAL FILTER

D/A CONVERTER

+15V -15V

R52 19.6K R53 10K R59 10K R54 10K C8 75pF C9 .1

U14 DAC

TO U133(7) E SYNC

U13 MSB LSB

C7 750pF R56 1K R55 60.4K R57 1K U16 R62 1K R63 4640 R51 604

R40 1780 R41 422Ω R38 13.3K R39 3320 U15 FOUR QUADRANT MULTIPLIER C3 500

CURRENT SUMMER

DC ADJ

R33 50 R34 750 C2 .0015 R35 499 U17 R36 2K R58 1K C1 .1 R37 1.5K

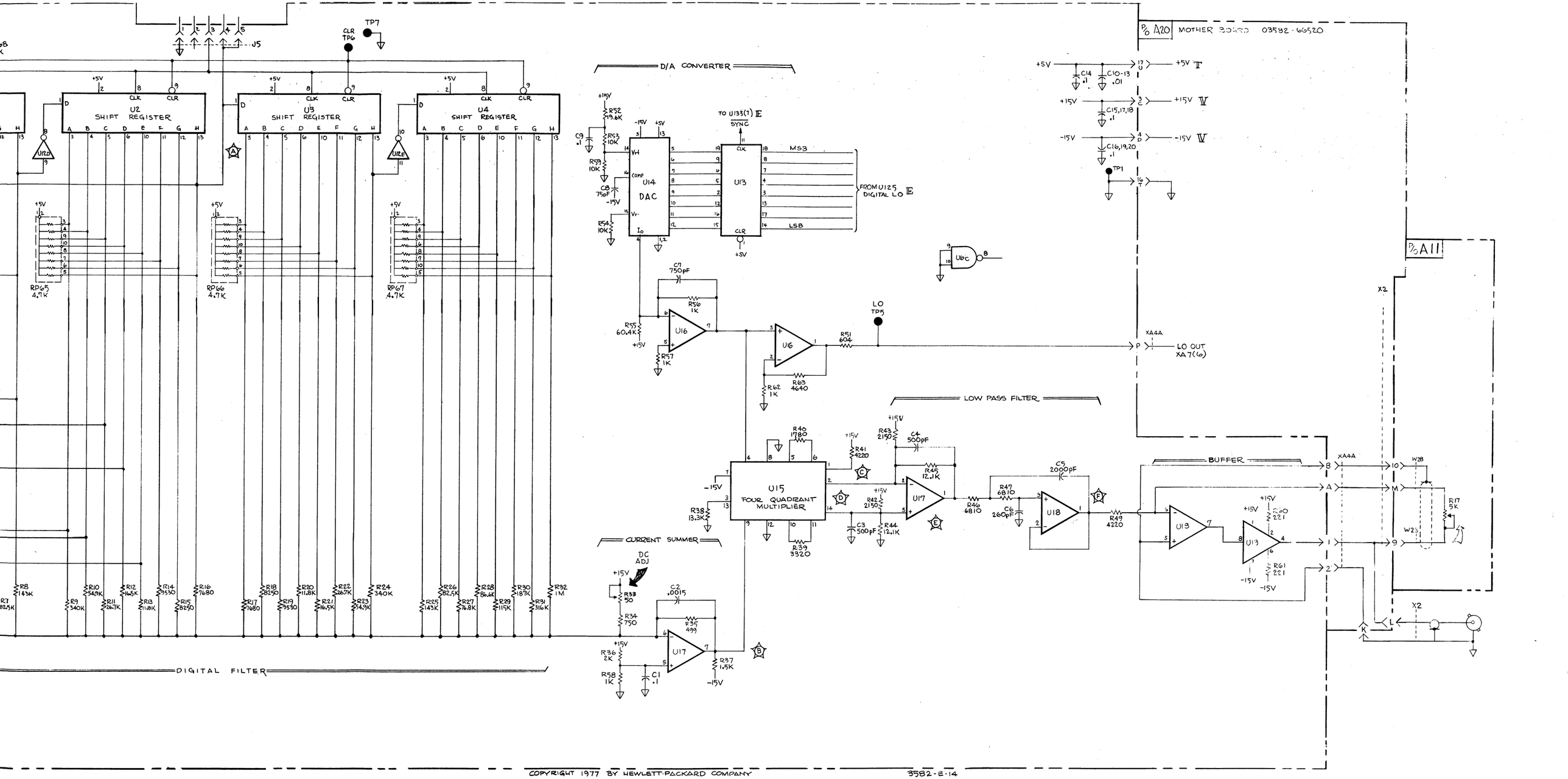


Figure 7-P-1. P/O A4 Pseudo Random Noise Generator. REV A

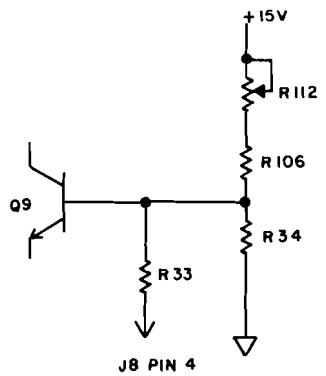
7-P-3/7-P-4

A13, M SCHEMATIC: DISPLAY HIGH VOLTAGE BACKDATING

REV A:

Schematic:

Use the REV C schematic with the following change:



Parts Locator:

Use the REV A AND B parts locator found in this section.

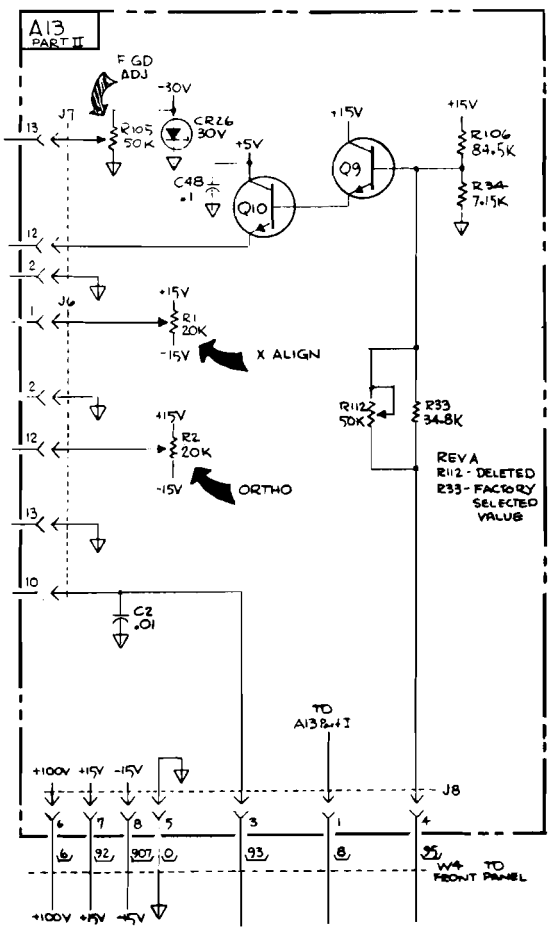
Parts List: Use the REV C parts list with the following exceptions:

Change:	R33	0698-3228	R-F 49.9k 1%
	R34	0757-0442	R-F 10k 1% 1/8W
	R112	2100-3253	R-V 50k 10%
Delete:	CR31	1901-0041	Dio-SI .05Z, 30V
	R223,224	0757-0280	R-F 1000Ω 1%
	R225	0698-3620	R-F 100Ω 2W

REV B:

Schematic:

Use the REV C schematic with the following change:



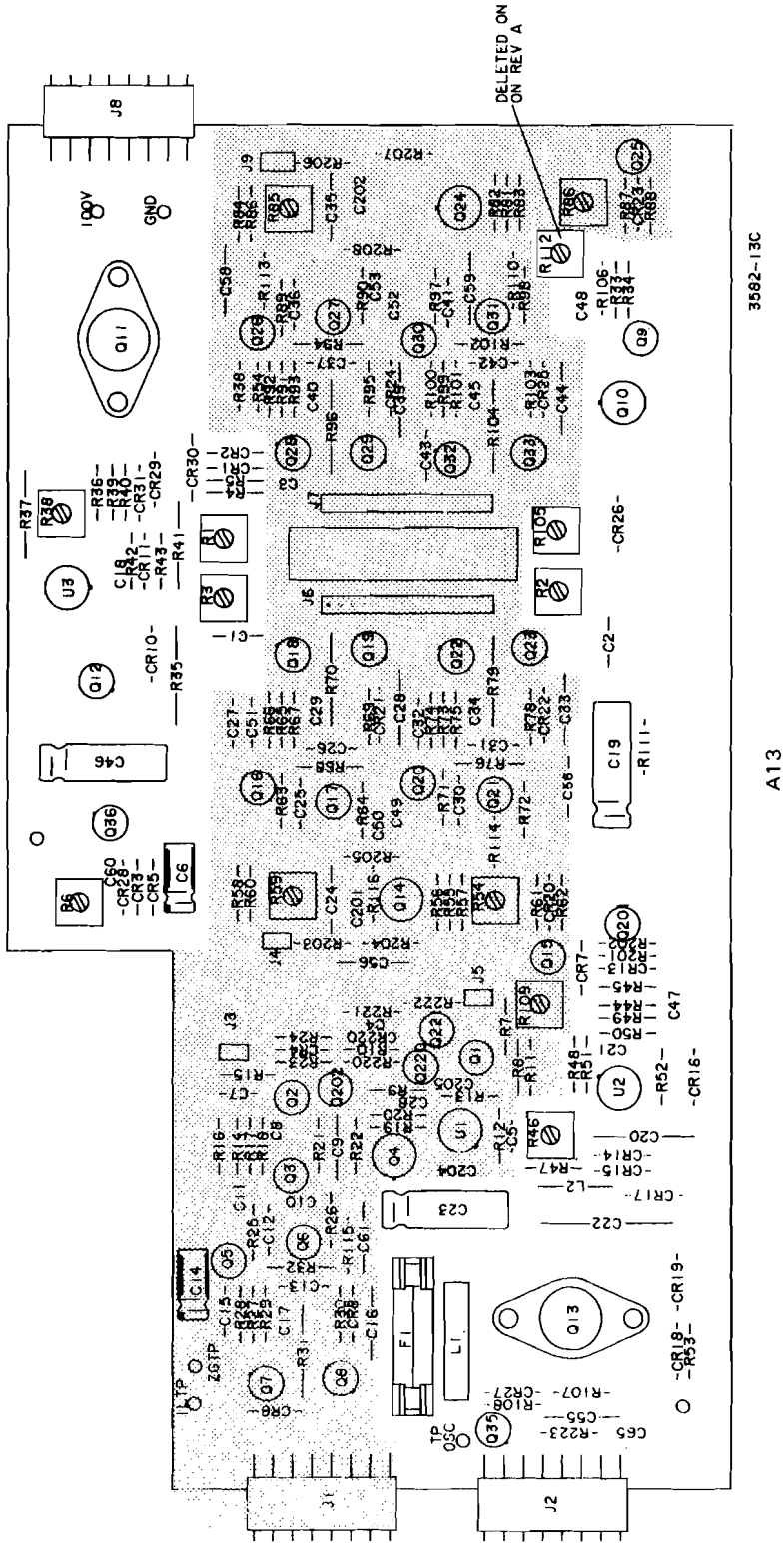
Parts List:

Use the REV C parts list with the following exceptions.

Change:	R33	0698-4479	R-F 14k, 1% 1/8W
	Q10	1854-0234	XSTR 2N3440
	R105	2100-3253	R-V 50k 10%
Delete:	R223,224	0757-0280	R-F 1000Ω 1%
	R225	0698-3620	R-F 100Ω 2W

Parts Locator:

Use the REV A/B parts locator shown:



A17, SCHEMATIC U: POWER SUPPLY CONTROL.

REV A&B:

Schematic:

Use Schematic U except replace diodes CR20 thru CR23 with a diode bridge, CR1.

Component Locator:

Use A17 REV C except replace diodes CR20 thru CR23 with a diode bridge, CR1.

Parts List:

Use the A17 parts list except replace diodes CR20 thru CR23 (p/n 1901-0924) with CR1 (p/n 1906-0069).

SECTION VIII
SERVICE INFORMATION

Circuit Board, Schematic, and Service Group Cross Reference

Circuit Reference Designator	Schematic Designator	Description	Service Group
A1	A	Input Attenuator, LPF	SG1
	B	Analog to Digital Converter	SG1
A2	O	HP-IB Interface	SG8
A3	C	Timing	SG2
A4	E	Local Oscillator	SG3
	P	Pseudo Random Noise	SG9
A5	D	Digital Filter	SG3
A6	G	ROM	SG4
A7	G	Processor	SG4
A8	H	RAM	SG4
A9	I	Digital Display Controller	SG5
	J	Digital Display Driver	SG5
A10	K	Analog Display Driver	SG5
	Q	X-Y Recorder	SG10
A11	N	Front Panel Switches	SG7
A12	N	Rotary Pulse Generator	SG7
A13	L	XYZ Amplifiers	SG6
	M	Display High Voltage	SG6
A14	R	−18 Volt Power Supply	SG11
A15	S	+18, +12, +7 Volt Power Supply	SG11
A16	T	+5 Volt Power Supply	SG11
A17	U	Power Supply Controller	SG11
A18	V	Linear Power Supply	SG11
A19	U	Power Supply Mother Board	SG11
A20		Digital Mother Board	SG12
A65	M	High Voltage Power Supply	SG6
		Chassis Mounted Components	SG12

SECTION VIII
SERVICE INFORMATION

NOTE

Do not remove any of the covers of the 3582A until you have read the following information.

8-1. GETTING STARTED.

8-2. The 3582A has been designed for ease of maintenance. Built-in self test features and dual input channels aid in isolating a problem to a specific area of the instrument or in some cases to a specific component. In order to obtain a minimum of instrument down time and to provide for the greatest amount of troubleshooting efficiency and safety, it is recommended that the Service Information found in General Troubleshooting be read before initiating any troubleshooting procedures.

NOTE

Before removing any of the instrument covers, be aware of the following cautions and warnings.

CAUTION

1. The 3582A contains MOS devices which may become damaged as a result of static discharge.

2. Do not remove circuit boards when the LINE switch is on.

3. Improper adjustment of CRT HIGH VOLTAGE may lead to a shortened CRT life.

WARNING

The display section of the 3582A contains high voltages (up to +18 KV) which may remain present in circuit components **EVEN WHEN THE INSTRUMENT IS OFF.**

8-3. SERVICE SECTION ORGANIZATION.

8-4. The Service Section is divided into General Troubleshooting and 12 service groups.

8-5. General Troubleshooting.

8-6. General Troubleshooting contains procedures which aid in determining the area, board, or components in the instrument which contribute to a malfunction. From this information, the determination of the service groups concerning the problem can be made. The five major areas of General Troubleshooting consist of the following:

a. Preliminary Troubleshooting
b. Troubleshooting Hints
c. Self Tests
d. Block Diagram Description
e. Block Diagram

8-7. Service Groups.

8-8. The service groups consist of schematics, component locators, parts lists, and troubleshooting procedures for one or more related circuit boards. The service groups are arranged in signal flow order as indicated on the main block diagram. There are also service groups for supporting circuit boards such as Front Panel, HP-IB, Pseudo Random Noise, X-Y Recorder Output, Power Supplies, and Chassis Mounted Components.

8-9. GENERAL TROUBLESHOOTING.

8-10. The goal of this section is to define the problem and determine the assembly or assemblies that are the most likely cause. There will be cases when a specific component is isolated as the cause (possibly by the self-tests). Other circumstances may point to several possible assemblies. The point is that different malfunctions will dictate different troubleshooting strategies and we highly recommend following the procedures of this section.

8-11. Unless the technician is very familiar with the instrument and has clearly defined the problem, it is desirable to perform the Preliminary Troubleshooting procedures and then proceed to the troubleshooting hints. These hints will discuss the possible causes of the problem and refer to the appropriate service group(s) for detailed troubleshooting information.

8-12. Troubleshooting Guidelines.

8-13. These are generalized hints that the technician should keep in mind while troubleshooting the 3582A.

a. Use the two channels to help troubleshooting!

1. The input (A1) assemblies, containing attenuator, trigger and A/D conversion functions, are identical. They can be exchanged to isolate a problem to the A1 assembly.

2. The digital local oscillator is shared by the two channels while there are separate digital filters for each. Problems in band-analysis modes especially are usually traceable to one or the other. Therefore, if the problem is with both channels, suspect the local oscillator. Problems with one channel only would indicate the digital filters.

b. Use the built-in self-tests; these are described in this section. In some cases, these tests can lead directly to the bad component and in any case they can be used to eliminate possible problem areas if the test for that function passes.

c. Make sure there is actually a malfunction. This is a complicated instrument and some normal operating characteristics may be interpreted as malfunctions. Look in the Hints Section under the malfunction for more detailed information.

d. Don't condemn the processor prematurely. A "hung-up" instrument that doesn't respond to the front panel, whose data loading light doesn't flash, or whose display is random dots and flashes is a common failure mode for any microprocessor-based instrument. These problems are usually caused by a periferal assembly malfunction (e.g. the digital filter) causing an error or halt in program execution, not a defective processor. Look in the Hints or Service Group 4 for more information.

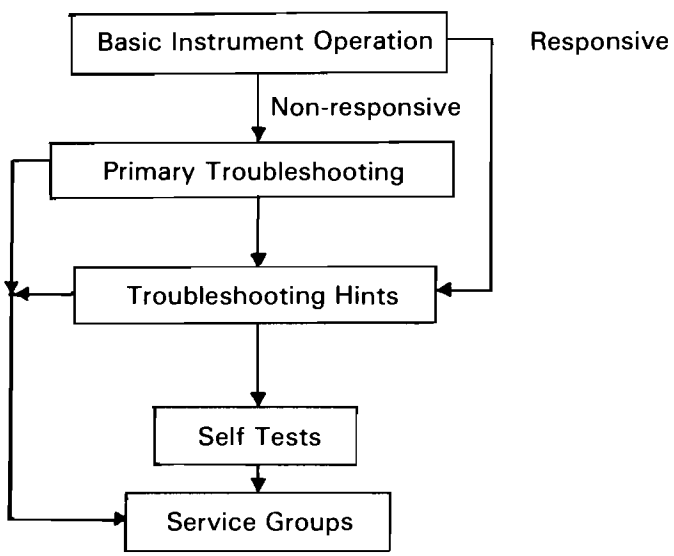
e. Refer to the block diagram description for more background on the malfunction after referring to the hints section.

f. Use "cool spray" to help isolate problems. Circuit cooler sprays are widely available and can be very helpful in isolating problems. The most generally used method is to spray selected components to see if the malfunction can be temporarily "cured". If this can be accomplished, the bad component is then isolated. This method will not work all the time, but can be a great time saver.

g. Use signature analysis. The -hp- 5004A signature analyzer is an extremely powerful troubleshooting tool that allows a "window" on a digital node to give a go/no-go test. Without the analyzer, troubleshooting the digital sections of the instrument is difficult and requires much trial and error. If a 5004A is not available, keep in mind that most digital failures involve a line that is stuck high or low. Thus, a little guided probing using an oscilloscope in the suspected area may find the problem, although this can be very time consuming.

8-14. Preliminary Troubleshooting.

8-15. Preliminary Troubleshooting is organized according to the following flowchart.



8-16. Basic Instrument Operation (Preset Conditions).

8-17. Verify that the instrument is non-responsive by the following procedure.

a. Set the instrument controls as follows: (preset conditon)

Button Positions: ▬ ON ▙ OFF

Set both framed buttons.....ON
Set AMPLITUDE A.....ON
Set SCALE 10 dB/DIV.....ON
Set AVERAGE NUMBER 4.....ON
Set PASSBAND SHAPE.....FLAT TOP
Set all other buttons.....OFF
AMPLITUDE REFERENCE LEVEL.....NORM
FREQUENCY MODE.....0-25kHz
TRIGGER LEVEL.....FREE RUN
INPUT CHANNEL A SENSITIVITY.....CAL
VERNIER.....CAL
INPUT CHANNEL B SENSITIVITY.....CAL
VERNIER.....CAL
INPUT MODE.....A
CRT INTENSITY.....3/4 fully clockwise
TRIGGER (Rear Panel).....INT

b. Verify that the rear panel line switches are set for the proper line voltage.

c. Connect line power to the instrument and set the LINE switch to ON. The instrument cooling fan should began to run. If it does not run, check the line fuse for proper value and condition. If a good fuse does not restore operation, set the LINE switch to OFF and proceed to Primary Troubleshooting.

CAUTION

If the instrument is not responding, do not leave it running as permanent damage to NMOS II devices may result.

d. If the instrument produces a display as shown in Figure 8-1, then fundamental operation can be assumed and specific operating problems can be pursued. In this case, if the areas of deficiency in performance are known, go to the Troubleshooting Hints and see if the problem is listed. If it is not listed, proceed to the Self Test Section.

8-18. Primary Troubleshooting.

8-19. Primary Troubleshooting provides a procedure whereby a basic determination can be made as to whether the display, the processor, or the power supplies are causing improper instrument operation. Where necessary, branching to a service group will be indicated.

8-20. Perform the following procedure:

a. Verify that the instrument is preset as indicated in the Instrument Operation procedure.

b. Verify the line power is connected and the proper line voltage is set on the rear panel switches.

c. Turn the LINE switch to ON.

d. Observe indications on the front panel and proceed immediately to the following paragraph which has the heading which is most applicable to the situation.

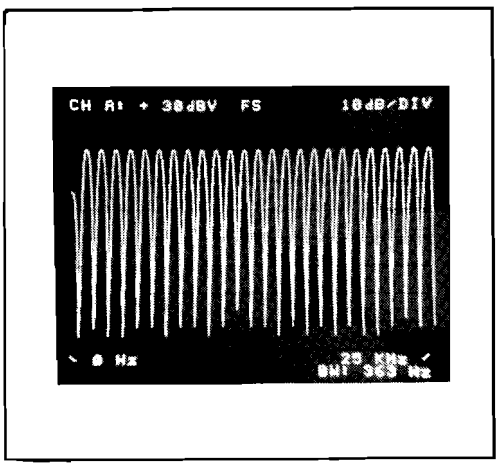


Figure 8-1. The Channel A CAL Signal.

8-21. Blank Display.

8-22. If the display is blank, TURN OFF POWER and remove the top instrument cover by first removing the rear corner top feet. Then while unscrewing the retaining screw on the rear center of the cover, slide the cover backward. Remove the shield covering the card nest. Perform the following checks.

a. **Low Voltage Power Supply Check.** Observe the LED's on the power supply cards located in the rear of the instrument. A green light indicates that there is a voltage output from that power supply. A red light indicates that the power supply is in a current limit condition and further troubleshooting will be necessary. In this case, proceed to Service Group 11, Power Supplies.

b. **High Voltage Power Supply Check.** While observing the CRT face, slowly increase the GRAT ILLUM control on the front panel. A glowing CRT screen indicates that the high voltage supplies are probably working. If there is no glow whatsoever, proceed to Service Group 6, High Voltage Power Supply, for further troubleshooting.

c. **Display Test Pattern Check.** Place the slide switch (S1), located on top of the A9 board, to TEST. A display similar to that shown in Figure 8-2 should be present. If it is not, then proceed to Service Group 5, Display Control, for further troubleshooting.

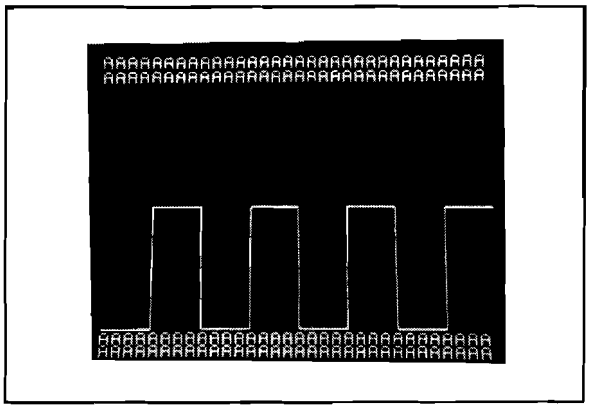


Figure 8-2. Display Test Signal.

8-23. Data Loading Light Not Flashing.

8-24. The DATA LOADING LIGHT on the front panel can give several clues as to the proper operation of the data handling section of the instrument. The main areas of concern are processor operation and digital filter operation. Before beginning the following checks, verify that the instrument is in the preset condition previously described. Perform the following checks.

a. **Input Mode Switch Check.** Switch the INPUT MODE switch between A and BOTH while observing the SINGLE CHANNEL and BOTH CHANNEL annunciator lights, located in the DISPLAY control grouping. Proper operation is indicated if the lights correspond to the INPUT MODE switch setting. If they do not change, proceed to Service Group 4, Processor.

b. **Trigger Lever Check.** Verify that the TRIGGER LEVEL control is in the FREE RUN position and the instrument is in the preset state. If the DATA LOADING light is not flashing but the INPUT MODE SWITCH CHECK passed, proceed to Service Group 3, Digital Filter and Local Oscillator. If the problem is not found there, proceed to Service Group 4, Processor.

8-25. TROUBLESHOOTING HINTS.

8-26. Introduction.

8-27. These hints are intended to simulate what a technician, experienced with the 3582A, would give as advice for fixing a specific malfunction. To save time, they are referenced by malfunction. Find the malfunction from the list below that most closely fits the problem(s) experienced, then go to Table 8-1.

Band-analysis problems
Data loading light not flashing
Display problems
Distortion
Frequency adjust inoperative
Front Panel not responding
Front Panel programming errors
HP-IB problems
Marker problems
No spectrum
Noise source problems
Noisy spectrum
Overload indication
Processor not running
Trace shift
Trigger problems
Turn-on problems
X-Y recorder output

Table 8-1. Troubleshooting Hints.

Band-Analysis Problems. These are problems that are associated with these frequency modes only (set-start and set-center). Typically, the noise floor may meet specifications in 0-25kHz and 0-start and fail in band-analysis. These problems are invariably caused by the digital local oscillator or the digital filters. Fortunately, it is quite easy to isolate the problem.

a. Since the local oscillator signal is shared by both channels, it is most likely the cause if the problem appears on both channels.

b. The front panel digital filter self-test is quite complete and can lead directly to the bad digital filter IC.

If the problem is that the local oscillator frequency is not right, realize that there is a circuit for 100Hz multiples and one for interpolating between these. It is thus possible for the L.O. to be correct for a frequency of 500Hz and incorrect for 501Hz. Note that the L.O. frequency is always the programmed center frequency.

Service information for the L.O. and digital filters is contained in Service Group 3.

Data Loading Light Not Flashing. This light indicates that a new time record is being taken. It won't flash if the processor is "hung-up" or if there is no trigger signal (or a problem with the trigger circuit). The first thing to do is to check for a non-running processor, as in Primary Troubleshooting. If the processor is running and the trigger level control is in free run, check the trigger circuits on the A5 assembly (digital filter), Service Group 3. See also Hints under trigger problems. The signal line for this function is labeled "DLITE".

Display Problems. Display problems can be caused by the display circuits themselves, a defective power supply or the processor, ROM or RAM. The problem can be easily isolated using the test switch on the A9 assembly. This switch, in TEST, will display all "A's" in the alpha, and a square wave. If this test passes, the display circuits are working and the problem is most likely with the processor, ROM or RAM. Test failure points to the display circuits, A9,A10 or High Voltage.

a. Low voltage power supply troubleshooting information can be found in Service Group 11.

b. Processor, ROM and RAM information is in Service Group 4.

c. If graticule illumination is working, the High Voltage Power supplies are probably OK. Refer to Service Group 5 for the display circuits and Service Group 6 for the high voltage section.

NOTE

Graticule illumination is not highly visible in normal room light. This is normal and there is sufficient illumination for taking photographs.

Distortion. Distortion is most usually caused by the buffer, S/H or A/D converter circuits on the input (A1) assembly. The easiest way to track down a bad distortion problem is to probe on the bad channel and run that signal into the working channel. That is, a signal that is taken off the S/H test point on the bad channel should look undistorted when run through the input of the other channel - unless the cause of distortion is before the S/H. The same holds for points before the S/H TP.

The above of course assumes that the problem is on the input board. Always exchange the input boards to make sure that the problem "follows" the suspected assembly. Distortion problems can also be caused by a bad shift register on the data reverse interface (A3, Service Group 2), a bad L.O. or bad digital filter.

Table 8-1. Troubleshooting Hints (Cont'd).

Frequency Adjust Inoperative. This is the control that can be used to adjust the center and start frequencies in band-analysis. There is a test in the front panel switch test. If this doesn't work, first check that the cable is connected to the RPG (Rotary Pulse Generator).

Note that this is not a potentiometer, but rather a pulse generator that puts out pulses proportional to rotational speed and distance. The processor counts the pulses and increments the frequency accordingly. The control actually has three speeds that can increment the frequency in 1Hz to kHz steps.

Front Panel Not Responding. If the instrument is in a valid operating mode, this is caused by a non-running processor (Service Group 4). For valid operation, make sure that there are no diagnostic messages on the screen. If there is no response to the frequency adjust control (RPG), refer to the hints under "Frequency Adjust Inoperative". If there is no response to the trigger level control when out of free run, check that the rear panel int/ext trigger switch is in the correct position.

Keep in mind that the instrument will not respond to any switch except "Local" when in the remote mode as programmed over the HP-IB. However, all the potentiometers will be fully operational. This also holds when the instrument is in the "Plot" mode. It will not respond to front panel inputs until the plot is finished or the RESET button is pushed.

Front Panel Programming Errors. Programming information is latched off the processor I/O bus by A4 U129 and then sent to the A1 assembly. Refer to Service Group 1 for the A1 assembly and Group 3 for the A4.

HP-IB Problems The HP-IB board (A2, Service Group 8) can cause a variety of problems. It can cause the processor to "hang-up" all the time or only in certain modes of operation. It may cause data to be false even though normal bus activity seems to be taking place.

To establish that the HP-IB board is at fault, remove the board from the instrument after turning off the LINE switch. Then, turn the LINE switch to the ON position and check the instrument to see if it functions properly in the manual modes of operation. Other problems with the HP-IB board may be established by consulting Service Group 8.

Marker Problems. If the marker is not working, first check the front panel cable connection to the position control.

The marker control adjusts a voltage that is compared to the sweep ramp. At coincidence, the address in RAM of that display point is latched and sent to the processor upon request. The processor determines the amplitude and frequency of the point and returns instructions to the A9 board which intensify the dot. If an HP-IB controller is available, the problem can be localized as follows:

a. If the marker works when programmed over the HP-IB, the problem is probably with the A9 or A10 boards.

b. If the marker does not work over the HP-IB, the problem is probably with the Processor or RAM circuits (A7 or A8).

No Spectrum (Alphanumerics are OK). If the DATA LOADING light is flashing, the triggering circuits are probably working. If it is not flashing, refer to the Data Loading light hints.

Data passes through the Input board (A1), the Timing board (A3), and the Digital Filter board (A5). See the Block Diagram and check these areas if no spectrum is

Table 8-1. Troubleshooting Hints (Cont'd).

displayed. The Local Oscillator must be operating even if the instrument is not in the band analysis modes. Check the Local Oscillator (A4) for proper data output.

Noise Source Problems. The Noise Source Output (A4 Service Group 9) is derived from a pseudo random binary sequence generator. It receives its inputs from the Timing board (A3) and the Local Oscillator board (lower half of A4). Some apparent problems may be caused by the DC Adjustment being out of tolerance (see Adjustments, Section V). For malfunctions, see Service Group 9 and/or Service Group 3.

Noisy Spectrum. The hints under Band Analysis Problems. Also see Service Group 1.

Overload Indication. The front panel LED's indicate an overload when there is an input which is at or above full scale (in the LOG mode) and will go out when the signal is removed or the SENSITIVITY is increased. CRT indicated overloads remain in effect after the signal is removed for one additional time record period. In the case of an averaging sequence, the overload will remain on until the end of the sequence.

Analog overloads are detected on the Input board (A1), converted to a TTL level, and OR'd with a data overload signal on the Digital Filter board (A5).

Overloads may appear as a result of an illegal turn-on condition (i.e. cycling the LINE switch on and off rapidly).

Processor Not Running. The processor may be "hung-up" by the HP-IB board (A2 Service Group 8), by the Digital Filter board (A5 Service Group 3), by the ROM board (A6 Service Group 4), or by the Front Panel (A11,A12 Service Group 7). It is possible that any board connected to the I/O Bus may hold data lines down giving the appearance of a locked up processor. For troubleshooting, see Service Group 4.

Trace Shift (of recalled or second trace). This is usually caused by A10C20 (Service Group 5) not discharging fully for the second sweep.

Triggering Problems. The trigger circuits initiate data loading except when the instrument TRIGGER LEVEL control is in the FREE RUN position. If the DATA LOADING light does not operate when the TRIGGER LEVEL is in the FREE RUN position, go to the hints concerning the DATA LOADING LIGHT.

With a proper input signal, the TRIGGER LEVEL centered, and no data loading taking place, check the rear panel EXT TRIGGER switch to be sure it is in the INT position. If problems still persist, check the trigger signal paths on the A1 board in Service Group 1 or the trigger generating circuits on the A5 board, Service Group 3.

Turn-On Problems. Instrument turn-on problems are almost always associated with the processor. If the main processor is "hung-up" for any reason, digital data and even some analog paths may be interrupted or completely non-functional. The processor is associated with boards A1 through A12. A most likely suspect is the A2 HP-IB board, see HP-IB Problems in the hints section. The A11 and A12 front panel boards handle the processor CLEAR command and may possibly prohibit turn-on.

On the A7 Processor board itself is the power up circuit. Rapid cycling of the LINE switch may cause the processor to jump into illegal subroutines from which exit is impossible. Allow five seconds between OFF and ON cycles of the LINE switch to assure proper operation of the power up circuit. For more information, see Processor Not Running hints or refer to Service Group 4.

X-Y Recorder Output. The X-Y Recorder outputs are analog signals which are derived form digital to analog converters that receive latched data directly off of the instrument I/O Bus. Therefore, the processor must be operating correctly for proper recorder data output. For troubleshooting, see Service Group 10, A10 X-Y Recorder.

8-28. FRONT PANEL ACCESSIBLE SELF-TEST.

8-29. To Start.

8-30. Hold "AVERAGE RESTART" key in while RESET key is pressed and released.

NOTE

The RESET key will not work if HP-IB status is REMOTE. Return HP-IB status to LOCAL before running self-test.

The self-test software will execute Test 0, the front panel test, when AVERAGE RESTART is released.

8-31. To Select A Test Routine.

8-32. Select the desired test from the list below with the AVERAGE NUMBER and SHIFT keys, then press and release AVERAGE RESTART. Test programs in RU status will not recognize the AVERAGE RESTART key until the test is completed, and some programs in CY status will only recognize the AVERAGE RESTART key afer a noticeable delay. The display is blanked when the AVERAGE RESTART key is recognized.

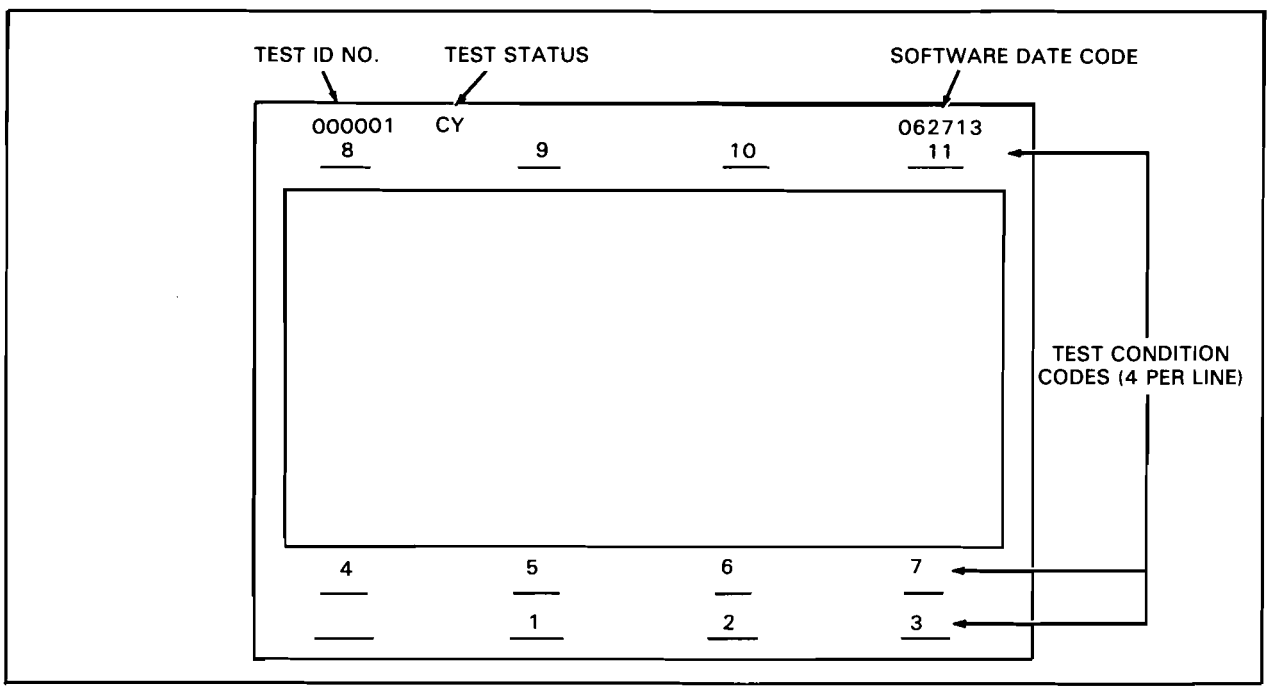


Figure 8-3. Display Test Readouts.

8-33. Display.

8-34. Information concerning the test program and the results of its test is presented on the CRT display in the format shown in Figure 8-3. The top line of the alphanumeric display gives the test ID number as a 6-digit octal number, the test status (2-character alphanumeric) and the software date code (6-digit octal). The meaning of these codes is explained further below.

8-35. Twelve test condition codes 0 thru 11 may be displayed on the remaining lines of the

display in the positions indicated. Test condition codes are always either 6-digit octal numbers or blanks, except for the display test program, where the bottom two lines of the display are used for an alpha test pattern.

8-36. Status Code.

8-37. The test status code may be one of the five codes listed below. The status code indicates the status of the current test and whether or not errors have occurred. Refer to the descriptions of individual test programs for more information.

Status	Meaning
CY	Cycle. The test is cycling and may or may not be testing for errors. If the program is testing for errors, none have occurred.
RU	Run. The test is running and testing for errors. At the end of the test, the status will change to either OK or ER. Programs in RU status ignore the AVERAGE RESTART key.
OK	Test Passed. The test is halted after finding no errors. The AVERAGE RESTART key will be recognized.
ER	Error. The test is halted and errors have occurred. Information about the error or errors which occurred is contained in the condition codes.
XT	No Test. There is no test program running. Choose a different test number.

8-38. Test Programs.

8-39. The following test programs are accessed by setting the AVERAGE NUMBER and SHIFT keys for the average number indicated.

Test ID No. (Octal)	Average Number	Test Function
000000	4	A11 & A12 Front panel board test
000001	8	Display & marker test
000002	16	A4 digital filter board test
000003	32	A6 ROM board test
000004	64	A8 RAM board GALPAT test
000005	128	Recorder output test
000006	256	Special - Refer to Paragraph 8-79

8-40. Front Panel Test (000000).

8-41. Function. Test the switches, RPG circuits, and I/O bus buffers on the A11 & A12 front panel board. Six of the front panel LED indicators (SRQ, LISTEN, TALK, REMOTE, SINGLE CHAN, and DUAL CHAN) are lit when the test is selected. Since these same indicators are extinguished when the AVERAGE RESTART KEY IS RECOGNIZED, THEY SHOULD LIGHT WHEN THIS TEST IS SELECTED AND GO OUT WHEN AVERAGE RESTART is depressed.

8-42. Status Code. CY only. The program does no internal checks for errors.

8-43. Condition codes 6 and 7 show the current RPG count and the most recent RPG increment, respectively. With the FREQUENCY MODE switch in the 0-25 kHz SPAN or 0 START positions these numbers should remain unchanged when the FREQUENCY ADJUST knob is turned. When the FREQUENCY MODE switch is in the SET START or SET CENTER positions, however, condition codes 6 and 7 should respond to the FREQUENCY ADJUST knob.

8-44. Condition code 6, RPG count, should count up or down as the FREQUENCY ADJUST knob is turned right or left, with limits on the RPG count of 000000 thru 061777 (octal).

8-45. Condition code 7, RPG increment, shows the most recent change in the RPG count, and it should be possible to see the values 000001, 000005, and 000036 while turning the FREQUENCY ADJUST knob right at low, medium, and high velocity, respectively. Similarly, turning the FREQUENCY ADJUST knob left at low, medium, and high velocities should give RPG increments of 177777, 177773, and 177742, respectively. When the RPG count arrives at either of its limits, the RPG increment may be left with a value different from those listed above; but, otherwise, errors in the RPG increment indicate front panel malfunctions. In particular, negative increments while adjusting right, or positive increments while adjusting down indicate errors.

8-46. Condition codes 0 thru 4 show the current values of the switch status registers 0 thru 4, respectively, as read from the front panel board. The bits of the switch status words correspond to front panel switches as shown in Table 8-2. Note that the displayed words are an octal representation of the bit pattern (e.g. LSB of displayed word corresponds to bits 0, 1 and 2).

Table 8-2. Condition Codes.

Cond. Code 0:		Bit #
Start Freq Band Analysis		15
Baseband (default: 0-25kH)		14
Unused (always set)		13
Freq Range	X10	12
(default: x 1)	X100	11
	X1 K	10
	X10 K	9
Unused		8
Freq	2.5	7
(default: 1)	5	6
Repetitive Mode		5
Trigger Arm		4
Trigger Mode		3
Hann Passband		2
Flat Top		1
Center Freq Band Analysis		0

Table 8-2. Condition Codes (Cont'd).

Cond. Code 1:		**Bit #**
Trace 1 Store		15
Trace 2 Store		14
Channel Select	B	13
(default: both)	A	12
Trace 1 Recall		11
Trace 2 Recall		10
Time B		9
Time A		8
Ampl Scale	10dB/Div	7
(default: Lin)	2dB/Div	6
	XFR FCTN	5
Phase	B	4
	A	3
	XFR FCTN	2
Amplitude	B	1
	A	0

Cond. Code 2:		**Bit #**
	Pos 2	15
	3	14
Amplitude	4	13
Reference	5	12
(default: pos 1)	6	11
	7	10
	8	9
	9	8
	D	7
Channel B*	C	6
Input Sensitivity	B	5
	A	4
	D	3
Channel A*	C	2
Input Sensitivity	B	1
	A	0

*See Schematic N.

NOTE

Interpreting Table 8-2: An Example.

Say condition code 0 reads 105321. The octal equivalent of the rightmost bit (LSB) is 001. From the table, this implies thast SET CENTER band analysis mode is selected and neither FLAT TOP nor HANNING passband shapes are selected. The binary equivalent of octal 2 is 010. From the table, this implies that the trigger is armed, in free run (not trigger mode) and non-repetitive. The interpretation continues in this fashion.

Table 8-2. Condition Codes (Cont'd).

Cond. Code 3:		Bit #
Marker	On	15
	Rel	14
	Set Ref	13
	Set Freq	12
	Trace	11
	÷ $\sqrt{Hz}$	10
Coherence		9
Average #	Shift	8
	32 (exp)	7
	16 (256)	6
	8 (128)	5
	4 (64)	4
Average Mode (default: off)	Restart	3
	Time	2
	Peak	1
	RMS	0

Cond. Code 4:		Bit #
x-y Recorder	U. Right	15
	L. Left	14
	Plot	13
Uncal	B	12
	A	11
DC Coupling	B	10
	A	9
Local		8
+ Trig Slope		7
unused		6
		5
		4
		3
		2
		1
		0

8-47. Display Test (000001).

8-48. Function. Writes one of 5 display test patterns and 2 lines of alphanumerics test pattern to test the display circuitry. The display test pattern is changed by re-selecting this same test with the AVERAGE NUMBER and AVERAGE RESTART keys. The display marker should appear, and the MARKER POSITION knob should function regardless of the MARKER ON key in display test pattern 2.

8-49. Status Code. CY only. The program performs no internal tests for errors.

8-50. Condition Codes. Condition code 8 shows the current display test pattern number. There are 5 display test patterns numbered 0 thru 4, which all consist of the same basic bit pattern in the RAM display area, displayed with different display board program modes. The correspondence between display test pattern number and display mode is as follows.

Test Pattern #	Display Mode	Blanking
0	4 x 128	last 3 x 128
1	4 x 128	last 2 x 128
2	2 x 256	last 1 x 256
3	2 x 256	none
4	1 x 512	none

8-51. Condition code 11 shows the current marker register only in display test pattern 2. In addition, the marker dot should appear on the display trace and move with the MARKER POSITION knob. Condition code 11 should increment and decrement smoothly between 000000 and 000377.

8-52. Hardware SA tests are available to verify that the A9 digital display driver is receiving the proper data from the A8 RAM board during the display test (see Service Group 5).

8-53. A5 Digital Filter Board Test (000002).

8-54. Function. The digital filter board is tested in one of 8 filter test modes, automatically stepping to the next mode if no errors occur. If an error is detected, the test program is halted, and re-selecting the program with the AVERAGE NUMBER and AVERAGE RESTART keys will manually step the filter test mode.

8-55. The DATA LOADING indicator on the front panel is controlled by the digital filter board, and this indicator should remain on except for a slight flicker when filter test mode changes. This indicator should go out when the test halts because of an error, or when a different test program is selected. The two OVERLOAD indicators may or may not flash regularly or sporadically during this test.

8-56. Status Codes. CY when cycling thru the filter tests modes without error. Status changes to ER when an error is detected, and the program halts.

8-57. Condition Codes. Condition code 8 indicates the filter test mode in which the digital filter board is currently being tested. The 8 test modes are numbered 0 thru 7 and they test the board as follows.

Test Mode (oct)	Filter Chips Tested	Corresponding Instrument Mode
000000	2	None
000001	1	Chan A Baseband
000002	3	Chan B Baseband
000003	1,3	Dual Chan. Baseband
000004	4	None
000005	1,2	Chan A Zoom
000006	3,4	Chan B Zoom
000007	1,2,3,4	Dual Chan Zoom

8-58. When the test status changes from CY to ER, condition code 9 indicates the type of error detected and the digital filter chip or chips from which erroneous outputs were detected. If condition code 9 is 177777, it means that not enough DMA output requests were given by the digital filter board in the allotted time. No tests are made on the data actually received, and no further information is displayed in the condition codes.

8-59. A condition code 9 of other than 177777 means that enough data was received from the digital filter board, but that the data was erroneous. The testing procedure consists of initializing one or more of the digital filter chips in a test configuration, then examining the first 6 samples of the output transient response. If any of these outputs is in error, the program notes the number of the digital filter chip outputting the erroneous data in an octal digit of condition code 9. Thus the digits of condition code 9 form a list of chips from which bad data was received.

8-60. For example, if condition code 9 is 000003, bad data was received from filter chips 1 and 3. If chips 2 and 4 were involved in that particular test mode (condition code 8), their outputs were correct.

8-61. When erroneous output data is received, condition codes 0 thru 5 are the exclusive OR of the 6 samples received and the expected data. That is, a 1 bit in one of these condition codes indicates that the data bit received in that position was wrong - either a 0 for an expected 1 or a 1 for an expected 0. When more than one erroneous chip is indicated in condition code 9, the errors in condition codes 0 thru 5 are from the chip indicated by the rightmost digit of condition code 9.

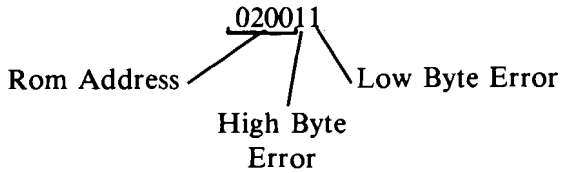
8-62. A6 ROM Board Test (000003).

8-63. Function. Performs a chip-by-chip signature analysis test on the ROM board to detect malfunctioning ROM chips. The last 2 bytes of each ROM chip are special words which make the internal SA-type signature of that chip be 000000. If a signature is found to be other than this, an error has occurred somewhere in the bits output from the ROM chip under test. Since the signature register for each chip is preset with bits representing the start address and byte position (high or low), this test also detects improperly loaded ROMs.

8-64. This program does not test software consistency. If, for example, a software revision requires two ROMs to be replaced, and only one of these has been replaced, the software is inconsistent in that only half the revision has been made. The instrument would probably not function with such a ROM board, but the ROM board test would not indicate any errors.

8-65. Status Codes. Test program status is RU while the test is being performed. After approximately 5 seconds, the status changes to OK or ER, depending upon whether errors were detected. During RU status, the AVERAGE RESTART button is ignored.

8-66. Condition Codes. Condition codes 0 thru 9 indicate the chips from which errors were detected. Condition codes are not written for chips from which no errors are detected. The left-most 4 octal digits of the condition code are a "ROM address" which indicates the pair of ROM chips from which errors were detected. The right-most two digits are set to 1 or 0 to indicate whether or not errors were detected in the high byte and the low byte as in this example:



8-67. Table 8-3 relates error codes to the corresponding bad I. C. for both the ROM and RAM front panel self tests.

Table 8-3. Error Codes for ROM and RAM Tests.

Error Code		Bad Ram Chip
000	001	U1
000	002	U2
000	004	U3
000	010	U4
000	020	U5
000	040	U6
000	100	U7
000	200	U8
000	400	U9
001	000	U10
002	000	U11
004	000	U12
010	000	U13
020	000	U14
040	000	U15
100	000	U16

8-68. A8 RAM Board "GALPAT" Test (000004).

8-69. Function. Performs a "GALPAT" test of the RAM board to try to detect infrequent bit errors, data-sensitive errors, etc. For more catastrophic RAM board malfunctions, the self test programs will probably not work anyway.

8-70. This test produces a number of effects on the display which may seem to be errors or program "bombs". These arise from the fact that the display buffer is tested along with the rest of the RAM array, and the effects are discussed further under "Status Codes" which follow.

8-71. Status Codes. When first selected, the test program goes into the RU status and displays the RU status code in the normal manner. However, this display remains for only a few seconds, until the memory test actually begins. During the memory test, *which lasts approximately 12 minutes,* the display may have blanked alpha and a bright line at the top of the screen or 4 lines of A's and a line at the bottom of the screen. Each of these patterns lasts about 6 minutes and is marked by a moving dot and alpha character about 4 minutes after

the pattern begins. Throughout the 12-minute test, the program is in RU status and cannot be interrupted by the AVERAGE RESET key.

8-72. At the end of the test, the status OK or ER is displayed in the normal status code location, but the test ID number and software date code remain blank.

8-73. Condition Codes. Only in ER status, condition code 9 shows accumulated error bits. Since each RAM chip stores one bit of the 16 bit word, a single bit set in condition code 9 would focus suspicion on a unique RAM chip on the RAM board. See table 8-3.

8-74. Recorder Output Test (000005).

8-75. Function. To test the X-Y recorder DAC's and the pen-up relay. The X-Y recorder output registers are loaded with a word containing a single 1 bit and all the rest zeroes. Both the X and Y registers are loaded with the same number, and the 1 bit is shifted each time this test is re-selected with the AVERAGE NUMBER and AVERAGE RESTART keys. Thus, a voltmeter can be used to check each bit of the DAC outputs.

8-76. For the X-Y output registers, bits 0-9 are X-Y output bits, while bit 10 controls the pen-up relay. When the X-Y output word (see "Condition Code" Paragraph 8-78) is octal 002000, the pen-up relay should close, and the X-Y outputs should be zero.

8-77. Status Code. CY only. Performs no internal checks for errors.

8-78. Condition Code. Condition code 8 displays the octal number loaded into the X-Y output registers.

8-79. Special Test (000006).

8-80. Function. This test is normally not accessible and no test is run if test 6 is selected in the usual manner.

8-81. However, if jumper J4 on the A7 Processor board is shorted, and test 6 is selected, a test program to produce stable SA signatures on the I/O bus is run. The program performs no internal tests for errors, and a digital SA instrument must be used to check for I/O bus errors.

8-82. Note that having jumper J4 on the Processor board shorted at the time the RESET key is released will cause the primitive ROM self-test to be run, rather than these self-test programs. Thus, the Processor board must not be shorted when these self-test procedures are started, but should be shorted before test 6 is selected.

8-83. The test exercises one of the 16 I/O select codes (0 thru 17 octal) one at a time. Reselecting test 6 with the AVERAGE NUMBER and AVERAGE RESTART keys steps the I/O select code number. Since octal 14 is the display mode program I/O select code, running the test for this case produces anomalous behavior of the display which is not harmful to the display hardware, and should not be mistaken for a display malfunction.

8-84. Status Codes. Status code XT is displayed when the Processor board jumper is not present and no test is being run. Status code CY is displayed while the test is actually running.

8-85. Condition Codes. Condition code 8 shows the octal I/O select code currently under test in status CY.

8-86. BLOCK DIAGRAM DESCRIPTION.

8-87. Understanding The Instrument.

8-88. The 3582A incorporates Discrete Fourier Analysis which is primarily a firmware function. Therefore, the majority of the instrument contains the digital logic necessary to implement these functions leaving the analog circuits for input and display purposes. Fold out the block diagram at the end of the Service Section.

8-89. Notice on the block diagram that most of the boards have some connection with the I/O Bus. The I/O bus transmits data and instructions between the processor and other bus connected boards. Each of the boards has an interface buffer that permits the appropriate sequencing to allow only two devices to communicate at one time. The processor controls the I/O buffers and, except for the display section and power supplies, should be operating to facilitate troubleshooting other areas of the instrument.

8-90. Signal Flow.

8-91. With the processor operating the instrument, the signal data flows from the input boards to the CRT display as given by the following description.

8-92. Input p/o A1 (A).

8-93. The channel A and channel B input boards are identical with their function depending on the installed location in the instrument. The signal enters the input boards via a coaxial cable from the front panel. The 1 megohm input termination is located on the board and follows the input attenuator. The signal passes through the termination and into the attenuator, which is programmed by data retained in the program buffer.

8-94. The program buffer receives its data from an I/O buffer located on the A4 Local Oscillator board. Except for the analog input and power supplies, all other inputs and outputs from the board are TTL in nature and optically isolated to allow for a floating input. The attenuator uses reed relays to switch in and out different sections. The CAL signal (which is a pseudo random binary sequence) is switched into the input circuits following the attenuator. Two gain controlled input amplifiers are separated by a 0-11dB variable attenuator. The programmable amplifier gains and the programmable input attenuator offer combinations of gain and attenuation which allow an input signal to be referenced to a full scale value on one of ten input ranges (30V to 3mV).

8-95. The trigger circuit uses this signal in conjunction with a trigger reference voltage (from the front panel trigger level control) to produce a TTL output (on channel A only) for the Digital Filter A4. An out of band low level signal is injected into the main signal path from the dither circuit to exercise the analog to digital converter and improve its response. This combination of signals is applied to the antialiasing 25kHz low pass filter. The signals are now ready for processing by the analog to digital converter.

8-96. Sample Hold and Analog to Digital Converter p/o A1 (B).

8-97. A sample hold and conversion operation is initiated by a pulse from the A3 Interface

and Timing board. The pulse causes a control circuit to produce two additional signals. One signal causes MOSFET switches to hold a voltage for conversion and the other signal starts a variable rate clock which sequences the successive approximation analog to digital converter. The data bits leave the converter in serial form with the most significant bit (MSB) first and are applied to the A3 Timing Board.

8-98. Interface and Timing A3 (C).

8-99. For further manipulation, the data sequence must be converted to another form. The data interface is composed of two shift registers with parallel input and output capabilities. The first shift register used the variable rate clock output to shift in the data from the analog to digital converter in serial MSB form. The data is then reverse parallel loaded into another shift register which then clocks the data out at a constant rate in serial LSB form. The sequencing for the sample hold and conversion and the data interface is controlled by the timing portion of the A3 board.

8-100. A 45.875 MHz XTAL oscillator is divided down to provide timing clocks for various other circuits, some of which are located on other boards. This coordination of operations includes the following circuits:

a. Sample Hold and A/D Converter A1 (B)
b. Data Interface A3 (C)
c. Digital Filter A5 (D)
d. Digital Local Oscillator A4 (E)
e. Pseudo Random Noise A4 (P)
f. CAL Source A3 (C)
g. HP-IB A2 (0)
h. Effective Trigger Rate and Phase A3 (C)
i. Impulse Source A3 (C)

8-101. The sample hold and conversion takes place at a constant rate (approximately 100kHz) while the trigger signal is determined by the input waveform. To obtain the proper phase components of the transformed signal, the processor needs to know the relationship between the trigger signal, effective sample rate, and the sample hold signal. These relationships are determined by the effective sample rate circuit which employs a programmable divide by N counter and a counter with an I/O buffer on the output. The divide by N counter also drives the Pseudo Random Noise clock p/o A4 (P).

8-102. The Pseudo Random Noise and IMPULSE output are both proportional to the selected SPAN setting. The PRN clock divides the output from the divide by N counter by seven which initiates the PRN circuits and provides a signal for the impulse circuit that results in a TTL output equal to the SPAN/8192.

8-103. Digital Filter A5 (D).

8-104. The digital filter receives the serial (LSB first) data from the data interface (located on the A3 board). Essentially, the circuit performs a mathematical low pass filter function which has a bandwidth derived from the SPAN, BANDPASS, and INPUT MODE switch selection. This control data is input from the processor through an I/O buffer and into the digital filter control circuit. This circuit also signals a firmware direct memory access (DMA) operation which loads the filter output through an I/O buffer into the time record section of

random access memory (RAM). The circuit provides a timing signal to the effective trigger delay counter on the A3 Timing board. Overload conditions are sensed and a front panel annunciator is turned on if there is a possible overload in signal data. When SET START or SET CENTER is selected, the input serial data is multiplied by both the sine and cosine digital equivalents of the center frequency, of the segment of the spectrum under analysis, translating the signal to dc. These digital mixing signals are provided by the Digital Local Oscillator.

8-105. Digital Local Oscillator p/o A4 (E).

8-106. The digital local oscillator (L.O.) uses control information from the processor (derived from front panel controls) to establish a mixing frequency. Basically, if a 512 point time record is needed, 512 cosine and sine amplitude words are generated so that a point by point multiplication (mixing) operation in the digital filter can take place. In the L.O., 1024 cosine words are stored in ROM and are modified to obtain intermediate values. The starting phase and incremental value are the main requirements necessary to perform the word lookup routine.

8-107. The L.O. controller coordinates the timing of various L.O. circuits such as the binary incremental phase counter. The initial phase and frequency increment are loaded into the counter which has a feedback loop that adds the previous sum to the increment. Thus, a flow of incremented digital numbers are produced which form the address for the phase and cosine tables (ROMs). The outputs from the cosine and phase ROMs are combined using a slope intercept interpolation technique to produce a sine and cosine digital frequency amplitude word for each input sample.

8-108. Processor A7 (F).

8-109. The processor controls most of the major circuits in the instrument and performs the necessary calculations to implement the discrete analysis techniques. Data as well as control information is transferred over the I/O BUS and the IDA BUS. The I/O Bus is a bi-directional sixteen line bus which has access controlled by the processor. The IDA (instruction, address, and data) bus links the processor to the instruction ROM A6 (G) and the data processing RAM A8 (H). It is comprised of sixteen lines, is bi-directional, and controlled by the processor.

8-110. The processor board contains the circuits which allow for bus buffering, bus access (I/O select), start up, reset, and a XTAL timing clock. Note that the start up and reset circuit has interconnections to other boards which may inhibit the processor from operating, should they malfuncation.

8-111. ROM A6 (G).

8-112. The processor receives its operating instructions from the ROM board. The board contains the integrated circuits which provide approximately 40K of ROM. A control circuit, run by the processor, provides the sequencing of address and data output.

8-113. RAM A8 (H).

8-114. The processor uses the dynamic RAM to store control information and data variables. The digital display driver A9 accesses the RAM through a hardware DMA func-

tion which gives it priority over the processor. By accessing a specified area of the RAM at a constant rate, the display circuits perform a refresh function while obtaining display data. Data for the display section is transferred over a sixteen wire one way bus (XIDA).

8-115. Display Controller p/o A9 (I).

8-116. The display controller is an algorithmic state machine which sequences the activities of the display section. It receives a clock signal from the processor board and instructions via the I/O bus through an I/O buffer.

8-117. Digital Display Driver p/o A9 (J).

8-118. The digital display driver uses the control signals from the display controller to obtain data from the RAM and decode it into graphics and alphanumeric digital data. An address counter supplies the RAM address through the DMA circuit and returning data is latched into a buffer. The data is decoded into addresses for the character dot matrix generator and into X and Y amplitude graphics data. The X amplitude sweep data is actually the address count to the RAM. This data is multiplexed and applied to the analog display driver.

8-119. Analog Display Driver p/o A10 (K).

8-120. The analog display driver uses digital to analog converters to obtain the dc signals which eventually are amplified to drive the CRT. Character data is converted into X and Y position signals and Z axis blanking to provide a 5 x 7 character dot matirx display. The display controller causes each character to be drawn on the CRT until all alphanumeric data is displayed.

8-121. X and Y graphic data is divided as follows. The X axis data is primarily used for character generation in the alpha mode. In the graphics mode however, the X axis is set by the display controller to sweep at a constant rate which depends on the number of traces being displayed. A marker comparator circuit produces a signal when the sweep position voltage is the same as the front panel MARKER POSITION control voltage. The signal causes the RAM address to be latched into an I/O buffer for processor use.

8-122. The Y axis amplitude data is converted and applied to a line drawer which supplies a dc signal to drive the Y axis CRT deflection amplifier. An associated circuit senses the magnitude of the Y axis change and applies a dc signal to control the intensity (Z axis) of the CRT so that large displacements in amplitude will retain the same brightness as the X axis is swept at a constant rate. The dc signals which are developed by the analog display driver are next applied to the XYZ amplifiers.

8-123. XYZ Amplifiers p/o A13 (L).

8-124. The signals to the deflection amplifiers are less than ± 1 volt. The amplifiers boost this voltage to less than ± 100 volts to drive the CRT deflection plates. The Z axis amplifier uses a variable intensity control from the analog display driver in the graphics mode, and a TTL blanking pulse from the display controller for character dot generation in the alpha mode. An intensity input from the front panel controls the overall intensity level. The output from the amplifier is applied to the high voltage rectifier in the high voltage section of the instrument.

8-125. High Voltage Section p/o A13 and A65 (M).

8-126. The high voltage section contains circuits necessary to provide all of the high voltage CRT drives (except the X and Y deflection drives). Extreme caution should be used when servicing or adjusting controls and components mounted on circuit boards in this area due to high voltages (up to +18KV) which may remain present on circuit components EVEN WHEN THE INSTRUMENT IS OFF.

8-127. The high voltage rectifier supplies +18KV to the post accelerator of the CRT. Inside a metal box located underneath the CRT are a transformer which supplies high voltage to a rectifier and voltage multiplier. The transformer receives its primary input from the high voltage oscillator and additional signals form the front panel FOCUS control and the Z axis amplifier. A cable which is connected to the rear of the CRT supplies filament, cathode, control grid, and focus voltages.

8-128. Other circuits located on the A13 board supply flood gun, accelerator, orthogonality, and X align voltages.

8-129. Supporting Boards and Circuits.

8-130. There are several areas of the instrument which do not interact directly with the signal flow. These areas are described as follows.

8-131. Instrument Control.

8-132. Two sections of the instrument affect the control functions by interacting with the processor through the I/O Bus. These are the front panel controls and the HP-IB.

8-133. Front Panel Controls A11 and A12 (N).

8-134. The front panel controls consist mainly of switches which have digital functions (operate at TTL levels). These switch outputs are latched into an I/O buffer where they are interrogated approximately ten times a second. Indicators are driven by the processor (except overload and data loading) which latches the data in an I/O buffer.

8-135. A subassembly mounted on the front panel switch board contains the logic to decode the FREQUENCY ADJUST rotary pulse generator and the processor reset control. Note that reset logic has an input from the front panel and from the HP-IB board.

8-136. HP-IB A2 (O).

8-137. The HP-IB board permits interfacing the HP-IB with the processor through the I/O bus. Mounted on the board is a nano-processor which, with the help of an instruction ROM, translates the HP-IB ASCII code to binary processor coding and handles HP-IB protocol. Also contained on the board are HP-IB isolation circuits, remote control and reset circuits, and an I/O buffer. Note that the processor is run by a clock which has, as its primary input, a signal from the A3 Timing board.

8-138. Instrument Outputs.

8-139. Instrument outputs (except IMPULSE) are located on portions of two boards which

carry primary signal data. In many respects, they operate as independent sections and are therefore shown on separate schematics.

8-140. Pseudo Random Noise p/o A4 (P).

8-141. Pseudo random noise is derived from a modified dc voltage which has been converted from the output of a pseudo random binary sequence generator. The binary sequence generator obtains an input clock from the A3 Timing board and programming from the L.O. portion of the A4 board. A front panel switch selects either PERIODIC or RANDOM noise. Periodic noise is a defined pseudo random binary sequence which is programmed and initiated so that its duration and timing coincides with the SPAN and resulting bandwidth. Random noise is simply extended pseudo random noise (up to 14 minutes) and does not coincide with other measurement activities. The binary output from the generator is converted by a digital to analog converter and applied to a four quadrant multiplier. So that phase and amplitude of the PRN output match the sample frequencies for the SPAN and PASSBAND selected, a cosine word is obtained from the Digital L.O. The cosine word is converted by a digital to analog converter and applied as the other input to the multiplier. The product of the two inputs is amplified and output to a BNC connector on the front panel.

8-142. X-Y Recorder p/o A10 (Q).

8-143. The recorder outputs consist of a digital to analog converter for each of the two axis. The two converters (DACS) transform data directly off the I/O bus buffers. The rate of data transformation is controlled by the processor and approximates a constant slew rate for the X-Y recorder. A reference voltage source supplies the recorder DACS and the display DACS (A10) with a conversion reference voltage. The PEN LIFT relay drive is derived from a latched bit on the Xaxis I/O buffer.

8-144. Power Supplies A14 (R), A15 (S), A16 (T), A19-A17 (U), A18 (V).

8-145. All supply voltages, except those that are used for the floating input section, are derived from switching power supplies. The power supplies switch at a 27kHz rate which is out of the measurement band of the instrument (the power supply clock can be detected in the band analysis modes when the center or start frequency is at 25kHz). The +18, +12, +7 power supply boards are interchangeable, their function depending on the position they occupy in the power supply mother board.

8-146. The control board (A17 and A19) schematic also contains the transformer, power supply clock, rectifiers, and other chassis mounted components. It must be in place and in working order for the other switching supplies to operate.

8-147. The linear power supply A18 can operate independantly and must be operating in order to supply power to the floating input section.

SERVICE GROUP #1 - INPUT

SERVICE GROUP #2 - TIMING

SERVICE GROUP #3 - DIGITAL FILTER & L.O.

SERVICE GROUP #4 -

A1 A INPUT

INPUT A

ATTENUATOR AND CAL SWITCHING

1M

AMPL

VERN 11dB

AMPL

DITHER CIRCUIT

LEVEL

TRIG

25KHz LOW PASS FILTER

PROGRAM BUFFER

A1-B S/H AND A/D

SAMPLE HOLD

A/D CONVERTER

SAMPLE HOLD CONTROL

CLOCK

A3-C INTERFACE AND TIMING

INTERFACE

MSB

LSB

MSB

LSB

CAL SOURCE

CRYSTAL CLOCK & DIVIDER

EFFECTIVE TRIGGER RATE BUFFER & PROGRAMABLE 'N COUNTER

PRN CLOCK

IMPULSE SOURCE

IMPULSE

TRIGGER

INT

EXT

A5-D DIGITAL FILTER

FILTERS DIGITAL

DIGITAL FILTER CONTROLLER

I/O BUFFER

OVERLOAD

A4-E DIGITAL LOCAL OSCILLATOR

PHASE TABLES AND REGISTERS

BINARY INCREMENTAL PHASE ADDER

COSINE SHIFT REGISTER

L.O. TRIG PHASE

LOCAL OSCILLATOR CONTROLLER

TRIG DELAY

INPUT AND PRN PROG

A6 G ROM

ROM 40K

ROM CONTROL

IDA BUS

A7 F PROCESSOR

IDA BUFFER

PROCESSOR

I/O BUFFER

I/O SELECT

XTA

DMA

I/O BUS

A1 A INPUT

INPUT B

ATTENUATOR AND CAL SWITCHING

1M

AMPL

VERN 11dB

AMPL

DITHER CIRCUIT

LEVEL

TRIG

NC

25KHz LOW PASS FILTER

PROGRAM BUFFER

A1-B S/H AND A/D

SAMPLE HOLD CONTROL

CLOCK

SAMPLE HOLD

A/D CONVERTER

A11 N SWITCHES AND INDICATORS

I/O BUFFER

FRONT PANEL SWITCHES AND INDICATORS

A12 N LOGIC

ROTATING PULSE GENERATOR

RESET

A2 O HPIB

I/O BUFFER

CLOCK

NANO-PROCESSOR

ROM

REMOTE ENABLE

BUS ISOLATION

HPIB

A4 P PSEUDO RANDOM NOISE

PSEUDO RANDOM BINARY GENERATOR

D/A CONVERTER (PHASE)

D/A

FOUR QUADRANT MULTIPLIER

NOISE SOURCE OUTPUT

PERIODIC

RANDOM

A1O

SERVICE GROUP #7 - FRONT PANEL

SERVICE GROUP #8 - H P-I B

SERVICE GROUP #9 - P R N

SERVICE GROUP #4 - PROCESSOR

ROM

ROM 40K

ROM CONTROL

A8 H RAM

RAM 4K

RAM CONTROL & DMA

IDA BUS

ESSOR

IDA BUFFER

PROCESSOR

XTAL CLOCK

START UP AND RESET

I/O BUFFER

I/O SELECT

PERIODIC

RANDOM

SERVICE GROUP #5 - DISPLAY CONTROL

A9 J DIGITAL DISPLAY DRIVER

XIDA BUFFER

GRAPHICS ALPHA MUX

ADDRESS GEN

MARKER POSITION BUFFER

CHARACTOR GENERATOR

I/O BUFFER

A10 K ANALOG DISPLAY DRIVER

COMPARATOR

FRONT PANEL MARKER POSITION

RAMP GEN

ALPHA AND GRAPHICS DACS

LINE DRAWER

DOT MATRIC DAC

SUMMING AND MULTI-PLEXING

ASM DISPLAY CONTROLLER

A9 I DISPLAY CONTROLLER

A10 Q X Y RECORDER

REF VOLTAGE SOURCE

TO A10 K DACS

LATCH

LATCH

X D/A

Y D/A

PEN LIFT

PEN

X

Y

SERVICE GROUP #10 - X Y RECORDER

SERVICE GROUP #6 - DISPLAY HIGH VOLTAGE (ANALOG)

A13 L DEFLECTION AMPLIFIERS

X

Y

Z

X DEFL

Y DEFL

Z AXIS CONTROL AND AMPLIFIER

A13 M HIGH VOLTAGE SECTION

WARNING

DANGEROUS VOLTAGE CAPABLE OF CAUSING DEATH ARE PRESENT IN THIS INSTRUMENT

A65 M HIGH VOLTAGE RECTIFIER

HIGH VOLTAGE TRANSFORMER

HIGH VOLTAGE MULTIPLIER

+18KV

CRT

PA

ASTIG

INTENSITY

FOCUS

GRAT ILLUM

A13 M DISPLAY HIGH VOLTAGE

HIGH VOLTAGE OSCILLATOR

CRT ACC GRID X ALIGN ORTHO ADJUSTMENT

FLOOD GUN

3582-50

A14 R

-18V POWER SUPPLY

A15A,B,C S

+18V POWER SUPPLY
+12V POWER SUPPLY
+7V POWER SUPPLY

A16 T

+5V POWER SUPPLY

A19,17 U

TRANSFORMER RECTIFIERS POWER SUPPLY CONTROL

CLOCK

A18 V

LINEAR POWER SUPPLY

(FLOATING INPUT SUPPLY)

SERVICE GROUP #11 - POWER SUPPLIES

Figure 8-4. 3582A Block Diagram.

GENERAL SCHEMATIC NOTES

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX WITH ASSEMBLY OR SUBASSEMBLY DESIGNATION(S) OR BOTH FOR COMPLETE DESIGNATION.

2. COMPONENT VALUES ARE SHOWN AS FOLLOWS UNLESS OTHERWISE NOTED.
   RESISTANCE IN OHMS
   CAPACITANCE IN MICROFARADS
   INDUCTANCE IN MILLIHENRYS

3. DENOTES EARTH GROUND.
   USED FOR TERMINALS WITH NO LESS THAN A NO. 18 GAUGE WIRE CONNECTED BETWEEN TERMINAL AND EARTH GROUND TERMINAL OR AC POWER RECEPTACLE.

4. DENOTES FRAME GROUND.
   USED FOR TERMINALS WHICH ARE PERMANENTLY CONNECTED WITHIN APPROXIMATELY 0.1 OHM OF EARTH GROUND.

5. DENOTES GROUND ON PRINTED CIRCUIT ASSEMBLY. (PERMANENTLY CONNECTED TO FRAME GROUND).

6. DENOTES ASSEMBLY.

7. DENOTES MAIN SIGNAL PATH.

9. DENOTES FEEDBACK PATH.

10. DENOTES FRONT PANEL MARKING.

11. DENOTES REAR PANEL MARKING.

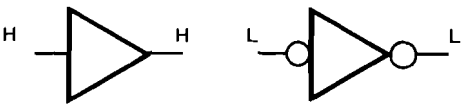
12. DENOTES SCREWDRIVER ADJUST.

13. * AVERAGE VALUE SHOWN, OPTIMUM VALUE SELECTED AT FACTORY. THE VALUE OF THESE COMPONENTS MAY VARY FROM ONE INSTRUMENT TO ANOTHER. THE METHOD OF SELECTING THESE COMPONENTS IS DESCRIBED IN SECTION V OF THIS MANUAL.

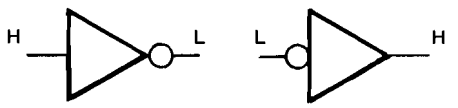
14. DENOTES SECOND APPEARANCE OF A CONNECTOR PIN.

15. (924) DENOTES WIRE COLOR: COLOR CODE SAME AS RESISTOR COLOR CODE. FIRST NUMBER IDENTIFIES BASE COLOR, SECOND NUMBER IDENTIFIES WIDER STRIP, THIRD NUMBER IDENTIFIES NARROWER STRIP. (e.g. (924) = WHITE, RED, YELLOW.)

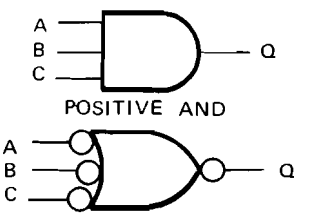
17. ALL RELAYS ARE SHOWN DEENERGIZED.



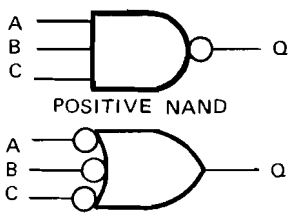
DENOTES BUFFER



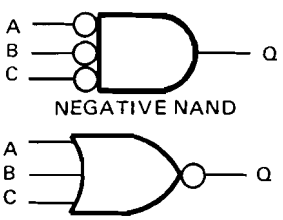
DENOTES INVERTER



A	B	C	Q
L	L	L	L
L	L	H	L
L	H	L	L
L	H	H	L
H	L	L	L
H	L	H	L
H	H	L	L
H	H	H	H



A	B	C	Q
L	L	L	H
L	L	H	H
L	H	L	H
L	H	H	H
H	L	L	H
H	L	H	H
H	H	L	H
H	H	H	L



A	B	C	Q
L	L	L	H
L	L	H	L
L	H	L	L
L	H	H	L
H	L	L	L
H	L	H	L
H	H	L	L
H	H	H	L

A	B	Q
L	L	L
L	H	H
H	L	H
H	H	L

SERVICE GROUP 1
INPUT

TABLE OF CONTENTS

Service Group — Page

1. INPUT 8-1-1
   - 8-1-1. Introduction 8-1-1
   - 8-1-3. General Information 8-1-1
   - 8-1-5. Isolating The Problem 8-1-1
   - 8-1-8. Troubleshooting The Input Attenuator, Amplifier And LP Filters 8-1-1
   - 8-1-9. No Spectrum 8-1-1
   - 8-1-11. Attenuator 8-1-1
   - 8-1-13. CAL Signal 8-1-2
   - 8-1-15. Distortion 8-1-2

Service Group INPUT (Cont'd) — Page

1. 8-1-17. Noise 8-1-3/8-1-4
   - 8-1-19. Troubleshooting The A-D Converter 8-1-9
   - 8-1-21. Checking Power Supplies and H/C TP 8-1-9
   - 8-1-23. Checking The S/H 8-1-9
   - 8-1-25. Troubleshooting The S/H 8-1-10
   - 8-1-29. Troubleshooting The A/D 8-1-10
   - 8-1-34. Troubleshooting The Comparator 8-1-11
   - 8-1-36. The Light Isolators 8-1-11

LIST OF ILLUSTRATIONS

Figure — Page

8-1-1. Schematic A Block Diagram 8-1-2
8-1-2. CAL Signal Indications 8-1-3/8-1-4
8-1-3. Troubleshooting Quick Reference For Schematic A 8-1-5/8-1-6
8-1-4. Input Attenuator, Input Amplifier And Low Pass Filter 8-1-7/8-1-8
8-1-5. H/C TP 8-1-9
8-1-6. 10 kHz Input At LPF and S/H TP's 8-1-9
8-1-7. S/H TP and A/D Clock With LPF TP Shorted To Ground 8-1-10
8-1-8. Register Clock 8-1-11
8-1-9. Output Of DAC With LPF TP Shorted To Ground 8-1-11
8-1-10. Analog To Digital Converter Block Diagram 8-1-12
8-1-11. Schematic B Troubleshooting Quick Reference 8-1-13/8-1-14
8-1-12. Analog To Digital Converter 8-1-15/8-1-16

LIST OF TABLES

Table — Page

8-1-1. Input Programming 8-1-5/8-1-6
8-1-2. Input Board Attenuator Relay And Amplifier Gain 8-1-5/8-1-6
8-1-3. Input Section Voltage Levels (1 kHz) 8-1-5/8-1-6
8-1-4. Replaceable Parts 8-1-17

INPUT
SERVICE GROUP 1

8-1-1. INTRODUCTION.

8-1-2. The Input Service Group provides information pertaining to all the circuits contained on the A1 Input boards. The three major functions are input scaling, anti-aliasing filtering, and analog to digital conversion. Input scaling and the anti-aliasing filter are found on the A (A1) schematic and the analog to digital converter on the B (A1) schematic.

8-1-3. GENERAL INFORMATION.

8-1-4. The input boards are interchangeable, their function depending on the mother board position they occupy. Therefore, even though both boards contain trigger circuitry, only the channel A position utilizes the trigger output. A malfunction on an input board can be quickly verified by exchanging the boards between the two channel positions. Programming data is derived from the I/O Bus via the E (A4) board. Note that the majority of the circuits on the board have floating power supplies and grounds. Be aware of instrument grounding connections when making measurements. Grounds can be made common by moving the ISOL/CHAS switch to the CHAS position.

8-1-5. ISOLATING THE PROBLEM.

8-1-6. The Troubleshooting Quick Reference Diagrams should be used to help isolate a problem. This assumes that one has switched input boards or in some other manner insured that the problem is on the Input (A1) Assembly. If only one of the input assemblies is bad, the other channel can be used as a troubleshooting tool. That is, any point in the signal path up to and including the S/H TP can be run through the other channel and should produce a good spectrum. Use this form of troubleshooting wherever possible.

8-1-7. Another valuable troubleshooting aid is circuit cooler spray. This is especially effective for the A/D converter comparator (U109) and DAC (U111). Many times a defective component can be made to work momentarily by spraying with the cooler spray. In this way, the spray can be used for troubleshooting.

8-1-8. TROUBLESHOOTING THE INPUT ATTENUATOR, AMPLIFIER AND LP FILTERS.

8-1-9. No Spectrum.

8-1-10. If there is no spectrum on only one channel, this is the place to start troubleshooting. Check the level at the LPF TP. With a full-scale input, the level should be about 1.5 volts rms and should look like the input. If this is OK, the problem is with the A/D section (Schematic B). If the signal is not good, refer to the Troubleshooting Block Diagram.

8-1-11. Attenuator.

8-1-12. If the problem is only on some ranges, use Tables 8-1-1 and 8-1-2 with input pro-

gramming and relay and stage gain information. If U11 isn't programming, check the optical isolators U15 and U16 with the front panel I/O Bus Test as follows:

a. Get into the Front Panel self-test by holding RESTART while pushing and releasing RESET.

b. Select average #256, short A7J4 and push restart. (A754 must remain shorted)(Don't short this TP until the instrument is in the self-test mode or it will initiate the primitive ROM test). This allows the instrument to go into the I/O Bus test.

c. Push RESTART until test #10 is displayed (it's the one after 7). This gives a signal at D IN and CLK IN so that the outputs of U15 and 16 are changing. Check for high and low levels (the failure mode is that the output is stuck high). When the test is completed, unshort J4.

8-1-13. CAL Signal.

8-1-14. If the CAL signal isn't displayed on one channel, check the other channel. If this is OK, run the input to U14 (pin 3) into the other channel (3V range). If this is OK, it's probably the isolator (U14). If the signal at U14(3) isn't good, check A3U42. If there's no CAL signal on either board and the attenuators are programming correctly, troubleshoot the CAL circuits on the A3 board. (Schematic C)

8-1-15. Distortion.

8-1-16. If the spectrum is excessively distorted on one channel, run the signal from the LPF TP into the input of the other channel. If this looks OK, go to the A/D section (Schematic B). If it can be determined that the distortion is not caused by the A1 board, use the front panel digital filter, ROM and RAM tests to check these components. Distortion can also be caused by the timing and local oscillator boards.

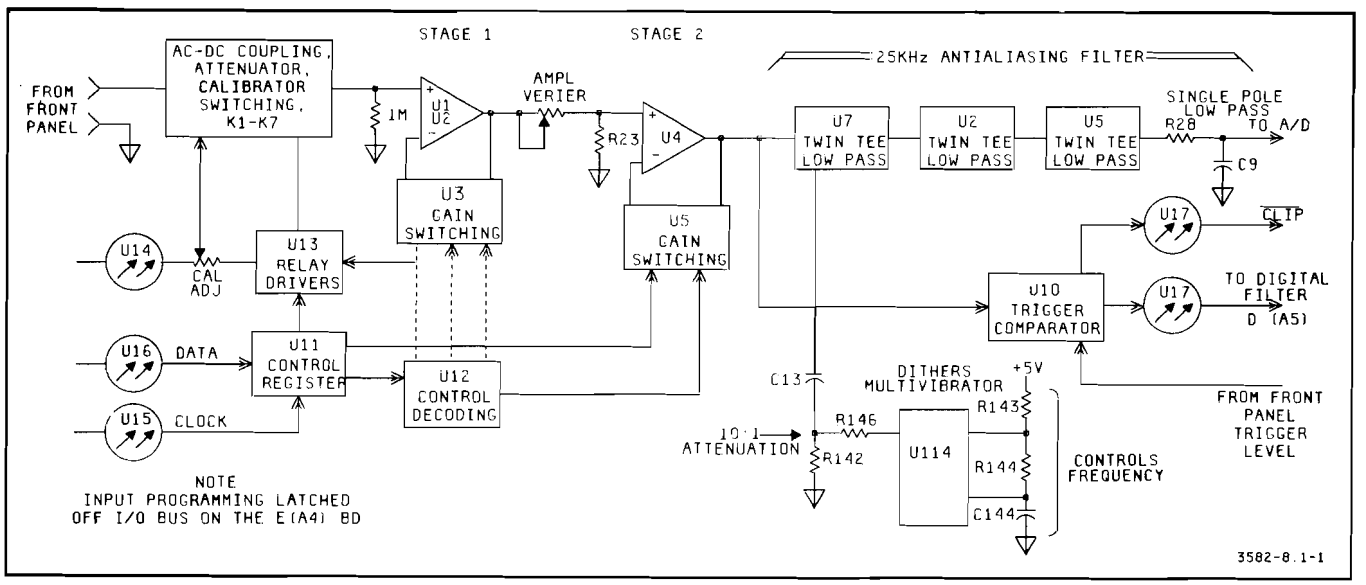
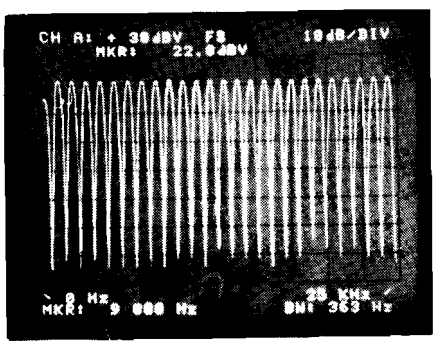


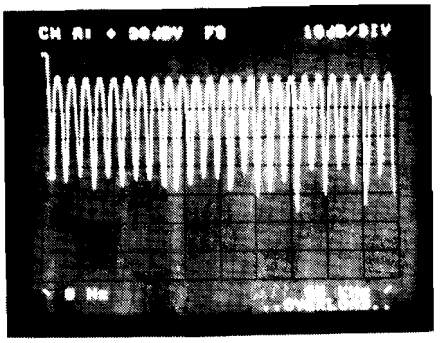
Figure 8-1-1. Schematic A Block Diagram.

8-1-17. Noise.

8-1-18. Excessive noise is usually caused by the A/D section. Figure 8-1-2 shows a CAL signal display with excessive noise. Note that the noise floor has risen. This particular problem was due to the comparator (U109). Again, circuit cooler spray is helpful for isolating this problem.

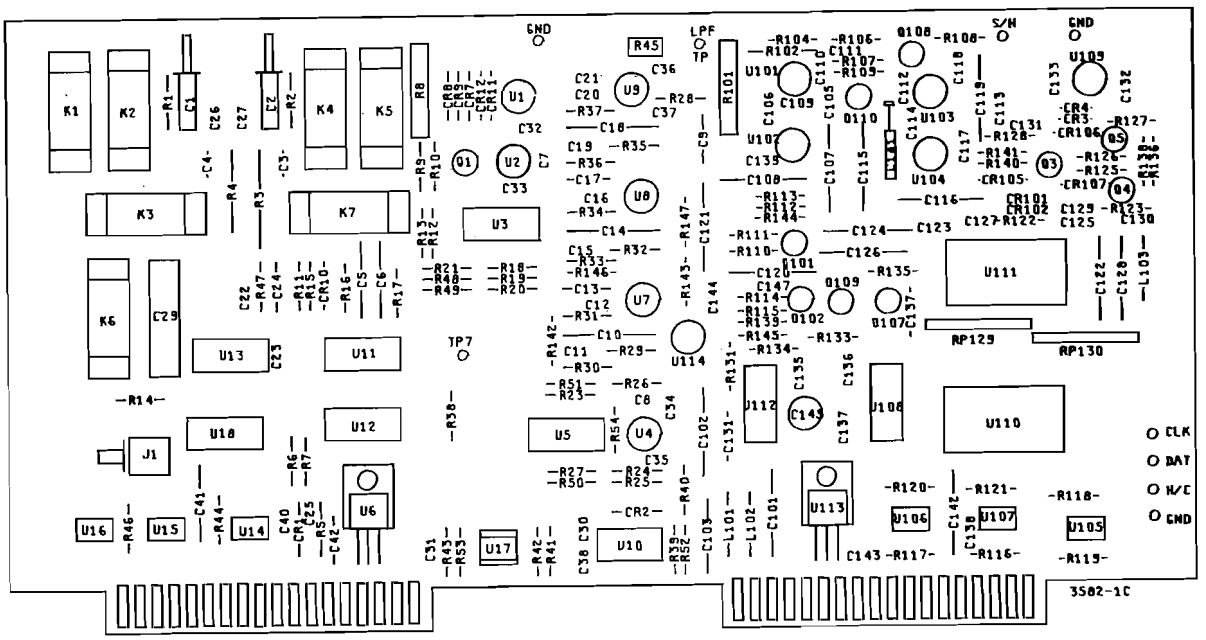


Normal CAL Signal



CAL Signal With Excessive Noise

Figure 8-1-2. CAL Signal Indications.



A1

H-P PART NO. 03582-66501

Table 8-1-1. Input Programming.

Full Scale dBV	Line: U11 Pin:	A 3	B 4	C 5	D 6	E 10	F 11	G 12	H 13
Cal		0	0	0	0	0	0	0	AC = 0; DC = 1
+30		0	0	0	0	0	0	1	
+20		0	0	1	0	0	0	1	
+10		0	0	0	0	1	0	0	
0		0	0	1	0	1	0	0	
−10		0	0	0	0	0	1	0	
−20		0	0	1	0	0	1	0	
−30		1	0	1	0	0	1	0	
−40		1	0	0	1	0	1	0	
−50		0	1	0	1	0	1	0	

0 = 0.2V; 1 ≥ 3.5V

Table 8-1-2. Input Board Attenuator Relay And Amplifier Gain.

Sensitivity	K1	K2	K3	K4	K5	K7	1st Stage Gain	1st Stage Gain
Cal						X	2.364	2.364
30 V (+30)	X			X			2.364	2.364
10 V (+20)	X			X			7.476	2.364
3 V (+10)		X			X		2.364	2.364
1 V (0)		X			X		7.476	2.364
300 mV (−10)			X				2.364	2.364
100 mV (−20)			X				7.476	2.364
30 mV (−30)			X				7.476	7.476
10 mV (−40)			X				23.64	7.476
3 mV (−50)			X				23.64	23.64

INPUT PROGRAMMING. Input programming comes thru optical isolators U15 and U16. To check the isolators:

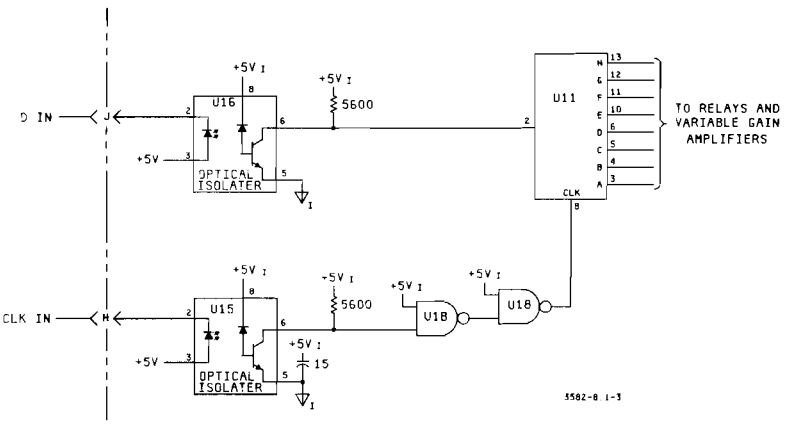
1. Select the front panel self-test mode by pressing RESET while holding down RESTART. When RESTART is released, F.P. self-test 0 will come up.

2. Short A7 J4 and select AVE NUMBER 256.

3. Press RESTART until test 000010 comes up.

4. There should be 0 - 5 V signals on pin 6 of both U15 and U16.

Programming can be checked using Table 8-1-1. When done with this test, unshort A7 J4.



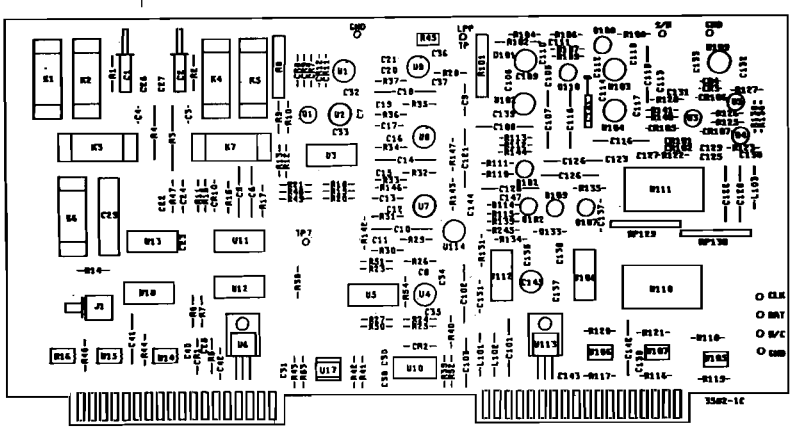
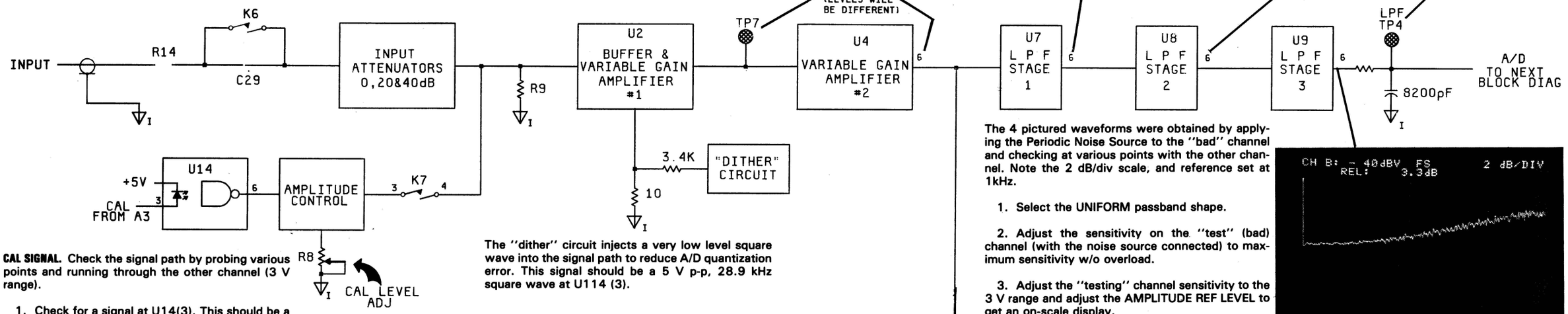
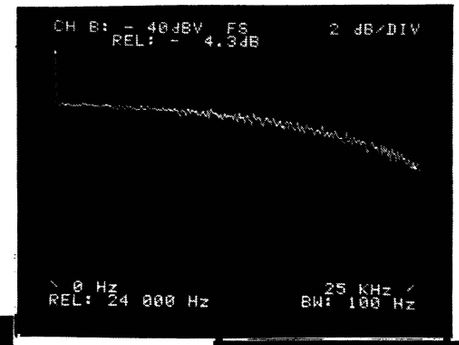


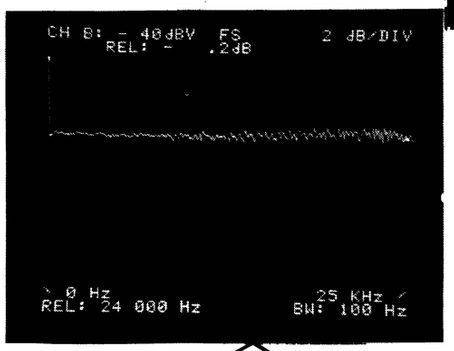
Table 8-1-3. Input Section Voltage Levels (1 kHz).

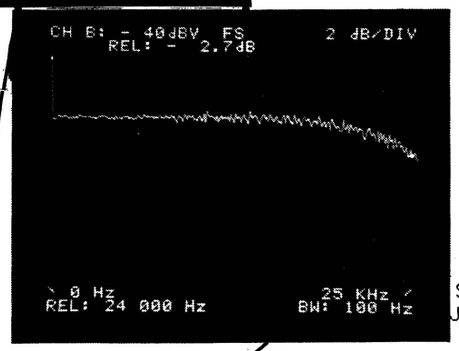
Attenuator	30 dBV	20 dBV	10 dBV	0 dBV	-10 dBV	-20 dBV	-30 dBV	-40 dBV	-50 dBV
Input Level	16 dBV 6.3 VRMS	16 dBV 6.3 VRMS	9 dBV 2.8 VRMS	-1 dBV 0.89 VRMS	-11 dBV 279mVRMS	21 dBV 89mVRMS	-31 dBV 28mVRMS	-41 dBV 9.0mVRMS	51 dBV 3mVRMS
Top of R9	60 mV	60 mV	266 mV	84 mV	279 mV	89 mV	28 mV	9.0 mV	3 mV
Top of R12	62 mV	62 mV	281 mV	89 mV	279 mV	89 mV	28 mV	9.0 mV	3 mV
TP 7	149 mV	468 mV	665 mV	662 mV	663 mV	668 mV	209 mV	211 mV	67 mV
U4 (6)	351 mV	1.108 V	1.576 V	1.568 V	1.569 mV	1.582 V	1.564 V	1.574 V	1.574 V
U7 (6)	351 mV	1.108 V	1.576 V	1.568 V	1.569 mV	1.582 V	1.564 V	1.574 V	1.574 V
U8 (6)	351 mV	1.108 V	1.576 V	1.568 V	1.569 mV	1.582 V	1.564 V	1.574 V	1.574 V
U9 (6)	352 mV	1.109 V	1.578 V	1.569 V	1.570 mV	1.585 V	1.565 V	1.577 V	1.577 V
LPF TP	351 mV	1.108 V	1.576 V	1.568 V	1.569 V	1.582 V	1.564 V	1.574 V	1.574 V

All levels are VRMS; ± 5% · Taken w/ 3455A









CAL SIGNAL. Check the signal path by probing various points and running through the other channel (3 V range).

1. Check for a signal at U14(3). This should be a CAL signal with harmonics around −28 to −29 dBV. If this is bad, check the Timing assembly (A3).

2. Check the isolator output U14(6). This should be around −15 dBV.

3. Check K7 pins 3 and 4. This should be around −34 dBV.

The ''dither'' circuit injects a very low level square wave into the signal path to reduce A/D quantization error. This signal should be a 5 V p-p, 28.9 kHz square wave at U114 (3).

The 4 pictured waveforms were obtained by applying the Periodic Noise Source to the ''bad'' channel and checking at various points with the other channel. Note the 2 dB/div scale, and reference set at 1kHz.

1. Select the UNIFORM passband shape.

2. Adjust the sensitivity on the ''test'' (bad) channel (with the noise source connected) to maximum sensitivity w/o overload.

3. Adjust the ''testing'' channel sensitivity to the 3 V range and adjust the AMPLITUDE REF LEVEL to get an on-scale display.

Note that we are concerned with the shape of the display rather than the absolute levels.

The TRIGGER circuit consists of the comparator on this assembly and logic circuits on the A5 Digital Filer Assembly. Obvious points to check are the comparator output U10 (7) and the isolator output U17 (6) (TRIG). Keep in mind that a bad A5U10 can cause the output of U17 to be bad.

3582-8.1-3

Figure 8-1-3. Troubleshooting Quick Reference For Schematic A.

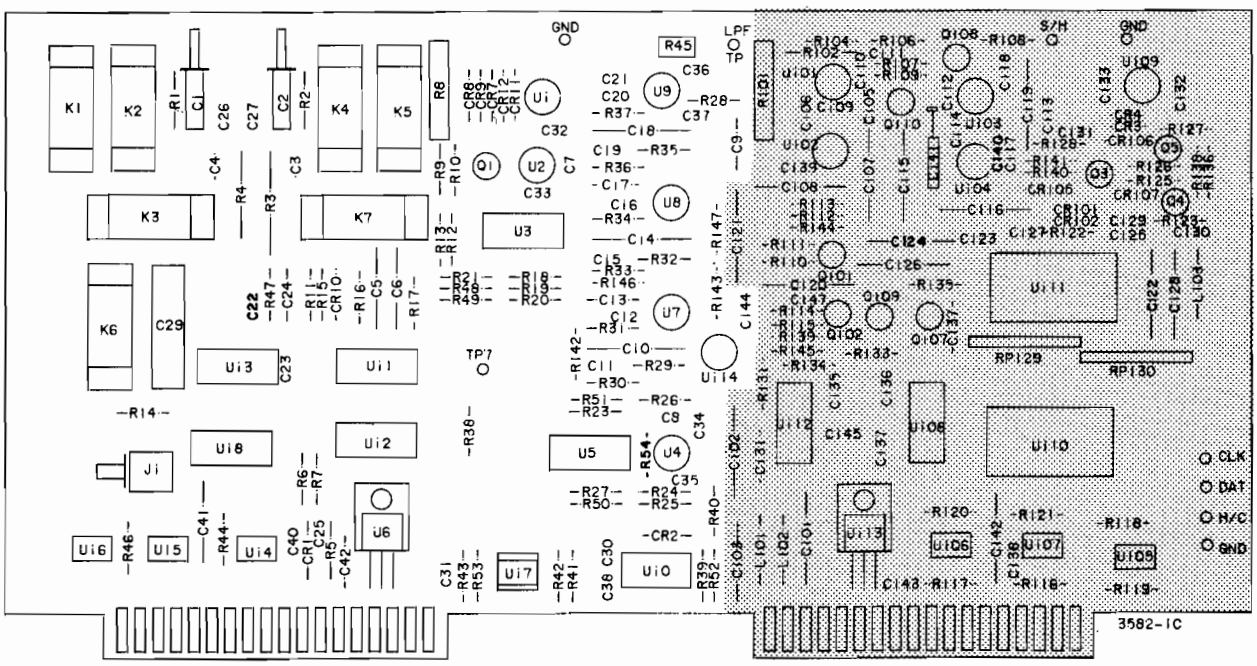
Attenuator	30 dBV	20 dBV	10 dBV	0 dBV	– 10 dBV	– 20 dBV	– 30 dBV	– 40 dBV	– 50 dBV
Input Level	16 dBV 6.3 VRMS	16 dBV 6.3 VRMS	9 dBV 2.8 VRMS	– 1 dBV 0.89 VRMS	– 11 dBV 279mVRMS	– 21 dBV 89mVRMS	– 31 dBV 28mVRMS	– 41 dBV 9.0mVRMS	– 51 dBV 3mVRMS
Top of R9	60 mV	80 mV	266 mV	84 mV	279 mV	89 mV	28 mV	9.0 mV	3 mV
Top of R12	62 mV	62 mV	281 mV	89 mV	279 mV	89 mV	28 mV	9.0 mV	3 mV
TP 7	149 mV	468 mV	665 mV	662 mV	663 mV	668 mV	209 mV	211 mV	67 mV
U4 (6)	351 mV	1.108 V	1.576 V	1.568 V	1.569 mV	1.582 V	1.564 V	1.574 V	1.574 V
U7 (6)	351 mV	1.108 V	1.576 V	1.568 V	1.569 mV	1.582 V	1.564 V	1.574 V	1.574 V
U8 (6)	351 mV	1.108 V	1.576 V	1.568 V	1.569 mV	1.582 V	1.564 V	1.574 V	1.574 V
U9 (6)	352 mV	1.109 V	1.578 V	1.569 V	1.570 mV	1.585 V	1.565 V	1.577 V	1.577 V
LPF TP	351 mV	1.108 V	1.576 V	1.568 V	1.569 V	1.582 V	1.564 V	1.574 V	1.574 V

All levels are VRMS; ± 5% – Taken w/ 3455A

Full Scale dBV	Line: U11 Pin:	A 3	B 4	C 5	D 6	E 10	F 11	G 12	H 13
Cal		0	0	0	0	0	0	0	AC = 0; DC = 1
+30		0	0	0	0	0	0	1	
+20		0	0	1	0	0	0	1	
+10		0	0	0	0	1	0	0	
0		0	0	1	0	1	0	0	
–10		0	0	0	0	0	1	0	
–20		0	0	1	0	0	1	0	
–30		1	0	1	0	0	1	0	
–40		1	0	0	1	0	1	0	
–50		0	1	0	1	0	1	0	

0 = 0.2V; 1 ≥ 3.5V

Sensitivity	K1	K2	K3	K4	K5	K7	1st Stage Gain	1st Stage Gain
Cal						X	2.364	2.364
30 V (+30)	X			X			2.364	2.364
10 V (+20)	X			X			7.476	2.364
3 V (+10)		X			X		2.364	2.364
1 V (0)		X			X		7.476	2.364
300 mV (–10)			X				2.364	2.364
100 mV (–20)			X				7.476	2.364
30 mV (–30)			X				7.476	7.476
10 mV (–40)			X				23.64	7.476
3 mV (–50)			X				23.64	23.64



A1
03582-66501

P/O A1 INPUT ATTENUATOR, AMPLIFIER AND LOW PASS FILTER
03582 66501

P/O A20 MOTHER BD
03582-66520

RELAY NUMBERING VARIATIONS

3 6 4 — USED ON THIS SCHEM
2 4 E — NOT USED

CABLES ARE IDENTIFIED BY A BAND OF COLOR AT ONE END

SHIELD

CABLE BAND

- CABLE BAND -
CHA RED W19
CHB WHITE W20

INPUT W1

J1

FPC1

40dB ATTEN

20dB ATTEN

C1 .7-3pF
C2 .7-3pF
C26 5.1pF
C27 3.9pF
C29 .33
C4 300pF
C3 4.3pF
R1 990K
R2 900K
R3 111K
R4 10.1K
R14 4.99K
R10 4.99K
R9 1M

K1 K2 K3 K4 K5 K6 K7

U1 U2 U3

CR7 CR8 CR9 CR10 CR11 6.19V CR12 6.19V

Q1A

C22 1000pF
R15 1.4K

R12 6980
R11 24.9K
R13 6980

R21 1K
R48 1K
R49 100
R20 2.264K
R19 6.48K
R18 1.364K
C7B 18pF
C7A 18pF

TP7

XA1A

P/O A20

A11 R15 5K

AMPL VERINER

R54 1.47K
R23 1.74K

U4 U5

C8 18pF

R24 1.364K
R25 6.48K
R26 22.64K
R27 1K
R50 1K
R51 1K

ANTIALIASING LOW F

C10 .01
C11 312pF
C12 312pF
C13 6250pF
C14 .01
C15 480pF
C16 480pF
C17 2000pF
R30 787
R31 787
R29 6190
R32 5.9K
R33 1130
R34 1130

U7

+15V
-15V

R39 12.4
R40 2.49K
CR2

DITHER SIGNAL

+5 FROM U113

U116A U116B

R143 2.49K
R147 24.9K
R146 3.4K
R142 10
R152 9.53K
R151 187K
C153 .01μF
C154 910pF
R153 147K

CAL SIGNAL

CAL
XA3A(14) CHA
XA3A(15) CHB

U14

R5 102Ω
R6 1370
R7 3.74K
R47 422
R8 50
CAL ADJ
CR1 6.2V
C25 .1
C24 .01

D IN
XA4A(3) CHA
XA4B(12) CHB

CLK IN
XA4A(15) CHA
XA4B(11) CHB

U16 U15

R56 887
R55 887
R46 6980
R44 6980
C44 .01
C43 .01
C41 15

U11 U13 U18

U12A U12B U12C

U18A U18B U18C U18D U18G U18H

LL1BE LL1BF

+5V +15V -15V +5V_I -5V_I

(1 TYP)

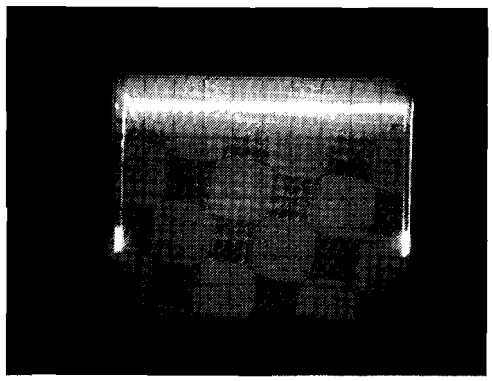
U18 — 1,10,19
U12 — 7
U11 — 7

8-1-19. TROUBLESHOOTING THE A-D CONVERTER.

8-1-20. A common failure with this circuit is excessive distortion. This type of problem can easily be isolated to the A1 board by swapping input boards. Remember that a board must be in the inner slot (Channel A) for triggering.

8-1-21. Checking Power Supplies and H/C TP.

8-1-22. Refer to Figure 8-1-5 for the H/C signal. This must be working for the S/H to work and is used for triggering in further tests.



INT TRIGGER; - SLOPE
1 USEC/DIV
0.1 V/DIV; X10 PROBE; DC CPL.
0VDC 2 CM FROM BOTTOM

Figure 8-1-5. H/C TP.

8-1-23. Checking the S/H.

8-1-24. Check at the S/H TP and refer to Figure 8-1-6.

WARNING

Do not accidentally short S/H TP to ground. This will destroy U104; same with U102 and its output.

CH A TRIG; HOLD OFF MAX
CH A: LPF TP; 0.1 V/DIV
CH B: S/H TP' 0.2 V/DIV
(BOTH ABOVE X10 PROBE)
ALTERNATE SWEEP; 50 USEC/DIV
3582: 0-25 kHZ SPAN; 300 mV RANGE
INPUT: 10 kHz AT 105 mV OR -3.4 dBm, 50 OHMS.

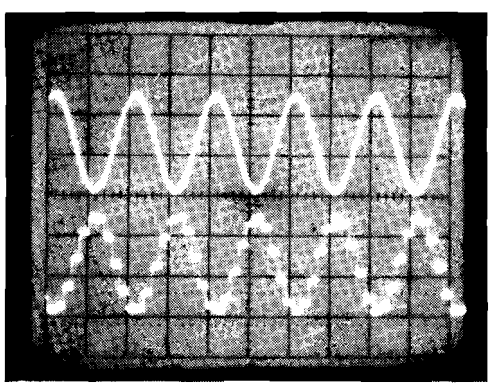


Figure 8-1-6. 10 kHz Input At LPF and S/H TP's.

Adjustment of the trigger level and holdoff will be necessary to get exactly this picture, but this will indicate whether the S/H is working. To check for distortion, connect the S/H TP to the other channel's input. If distortion is evident here and not at the LPF TP, the problem is more than likely in the S/H. Note that the S/H output must "look" sampled. If it looks just like the input, the op-amp or current amp (U103 or U104) is open or the sample FET, Q108 is shorted.

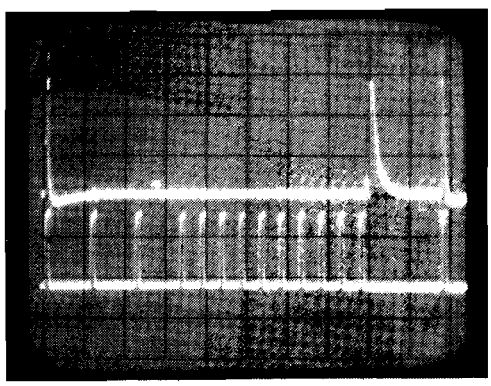
8-1-25. Troubleshooting The S/H.

8-1-26. The most common causes for problems are the FET's, Q108 and Q110 and the current amps U104 and U102. These amps are very easy to damage, so check that U103 and U101 are OK before replacing them.

NOTE

FETS and amps in the S/H and buffer may have to be replaced more than once to eliminate distortion. The FETS have a guarding ring around the leads; leave this on during soldering and then remove it.

8-1-27. Intelligent shotgunning is the most efficient way to troubleshoot these circuits. Figure 8-1-7 below shows the S/H output with the LPF TP shorted to ground, along with the register clock.



EXT TRIGGER ON H/C; - SLOPE
CH A: S/H TP; 0.005 V/DIV; X1 PROBE*
OVDC AT CENTER GRATICULE
CH B: A/D CLOCK; 0.2 V/DIV; X10 PROBE
ALTERNATE SWEEP; 1.0 USEC/DIV
20MHz BW LIMIT

3582: 30 V RANGE; LPF TEST POINT SHORTED TO GROUND

*USE SHORT GROUND LEAD: FOR -HP- PROBE, USE PART NUMBER 10004-67605 SPANNER TIP.

Figure 8-1-7. S/H TP and A/D Clock With LPF TP Shorted To Ground.

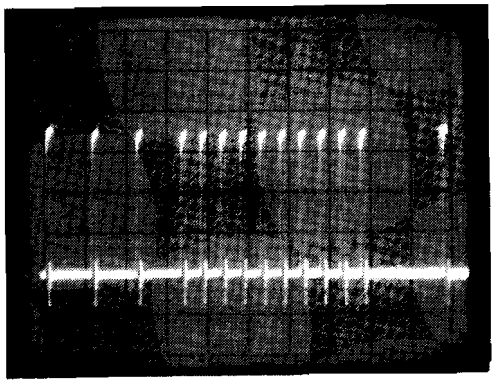
8-1-28. Use a X1 probe with short ground lead to get the S/H signal to look like this. The important things is that the S/H level at the 2nd and 13th clock pulse be within 2 mV and these should be within 2 mV of the level between clock cycles. If these levels are off, suspect the FETS. Note that the S/H TP signal peak amplitude can vary from the value shown on a good unit. If the signal doesn't go all the way to zero, Q108 is probably leaky. If it goes too far below zero, suspect Q110.

8-1-29. Troubleshooting The A/D.

8-1-30. It's difficult to look at specific data signals in this circuit. If the problem is on the input board and the S/H output appears correct through the other channel, it must be the A/D.

8-1-31. The first thing to check is the register clock (CLK TP), see Figure 8-1-8. The clock

rate is slower for the first 3 periods to allow more settling time for the most significant bits. If the clock runs at a constant rate, check U108C and associated circuits.



EXT TRIG. ON H/C; - SLOPE
1 USEC/DIV
0.1 V/DIV; X10 PROBE; DC CPL.
0VDC 2 CM FROM BOTTOM

Figure 8-1-8. Register Clock.

EXT TRIGGER ON H/C; - SLOPE
0.01 V/DIV; X10 PROBE; 0VDC AT CENTER GRATICULE.
1 USEC/DIV SWEEP

NOTE

SIGNAL CAN GO NEGATIVE OR POSITIVE. THE IMPORTANT THING IS THAT IT BE ZERO AT THE START AND END OF THE SWEEP.

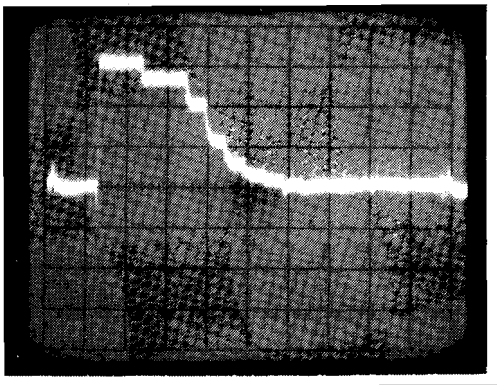


Figure 8-1-9. Output Of DAC With LPF TP Shorted To Ground.

8-1-32. As an overall check of the A/D, look at the DAC output (top of R122) with the LPF TP shorted to ground. This should look like Figure 8-1-9. Depending on the DC offset, this can swing either way at first; the important thing is that it starts and ends at zero.

8-1-33. If it doesn't return to zero, suspect the comparator (see next section) or SAR. If it is inconsistant, suspect the successive approximation register (SAR), U111. This register controls the logic for the A/D. If there is distortion traceable to the A/D, but Figure 8-1-6 looks OK, it's probably the DAC.

8-1-34. Troubleshooting The Comparator.

8-1-35. The inputs to U109 (pins 2 and 3) should "converge". If they do and the DAC output is not getting to zero, the problem is with the balance of the differential preamp. If the inputs aren't converging, suspect U109. Circuit cooler spray is helpful in troubleshooting this circuit.

8-1-36. The Light Isolators.

8-1-37. The light isolators, U105-107, can cause problems, but are easy enough to troubleshoot. The outputs should be TTL levels with failure mode a "stuck high" condition.

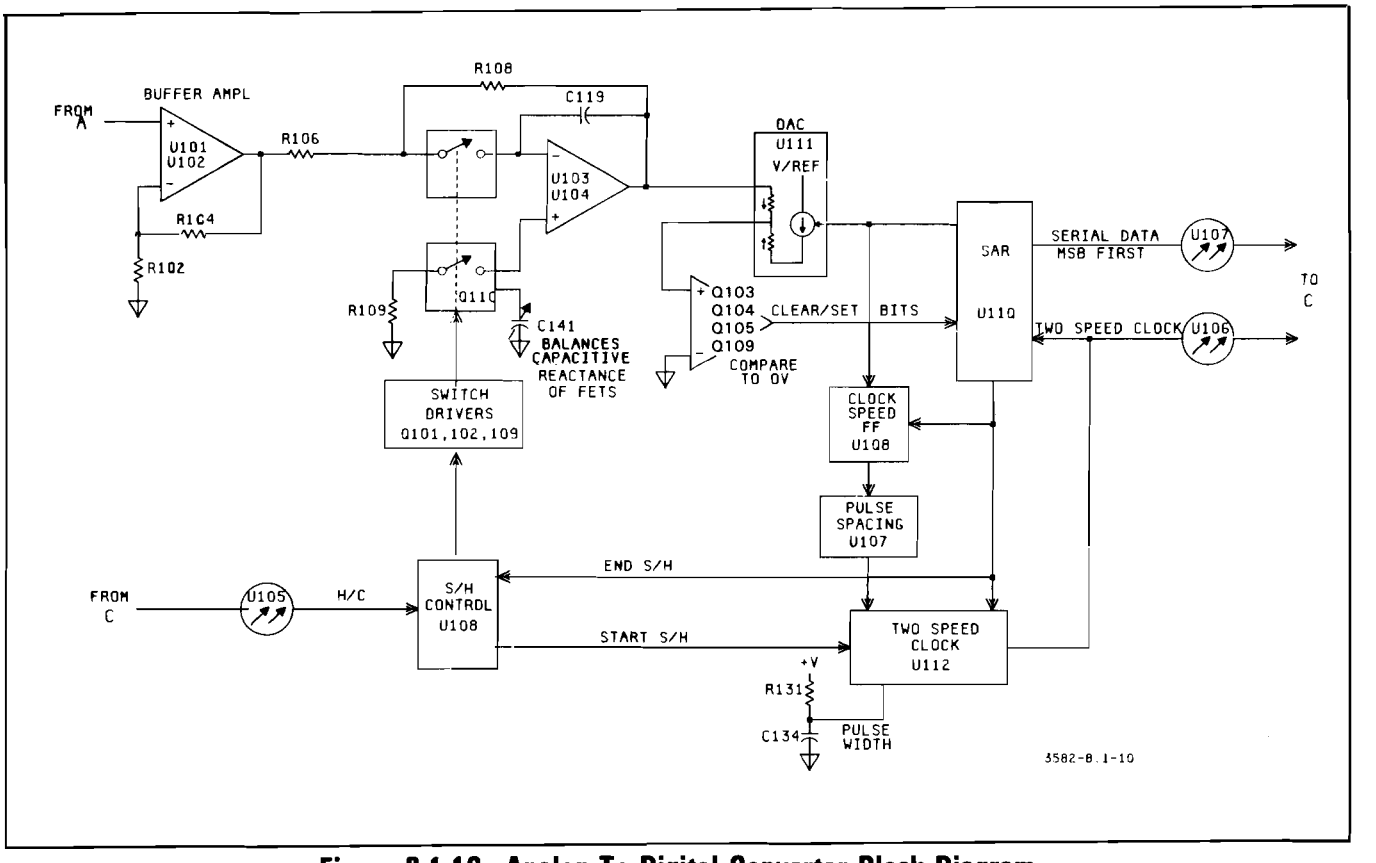


Figure 8-1-10. Analog To Digital Converter Block Diagram.

CABLES ARE IDENTIFIED BY A BAND OF COLOR AT ONE END

SHIELD

CABLE BAND

- CABLE BAND -
CHA RED W19
CHB WHITE W20

P/O A20 MOTHER BD 03582-66520

ANTIALIASING LOW PASS FILTER

DITHER SIGNAL

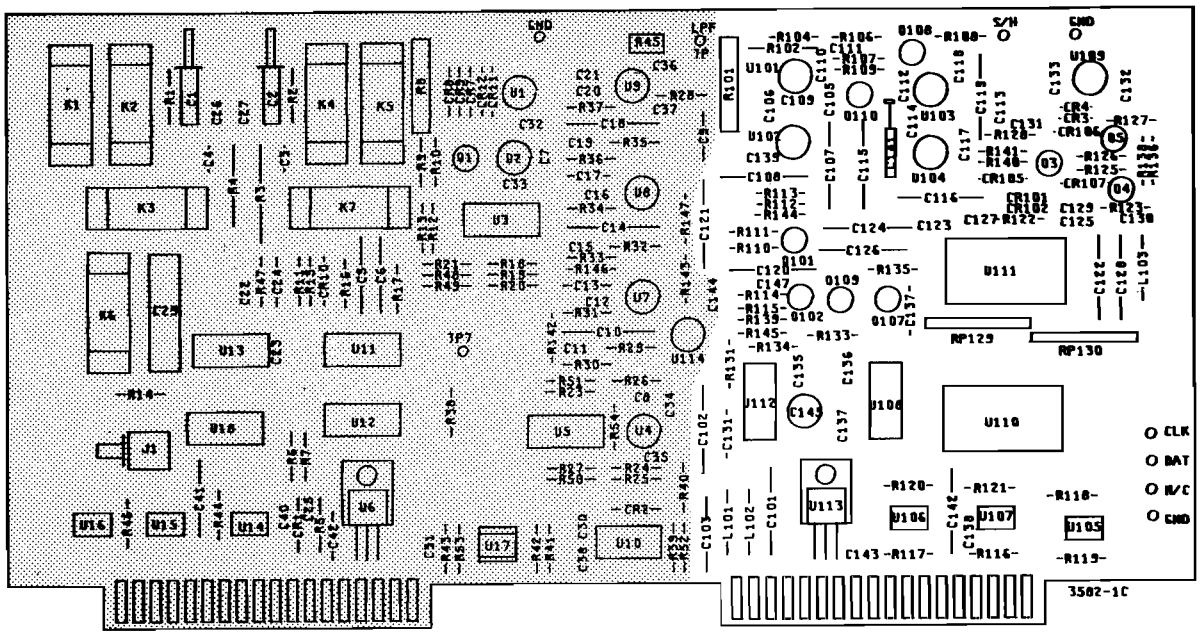
CABLE BAND
CHA BLACK W26

COPYRIGHT 1978 BY HEWLETT PACKARD CO.

3582-E-21

A

Figure 8-1-4. Input Attenuator, Input Amplifier And Low Pass Filter. REV E
8-1-7/8-1-8



A1

H-P PART NO. 03582-66501

INTRODUCTION. This section of the A1 assembly consists of a buffer amplifier, sample and hold circuit, and analog to digital converter (A/D). A simple way to localize the problem is to pick off signals at various locations and feed them through the other channel. A signal from any point in the signal path up to and including the S/H TP can be fed into a spectrum analyzer (such as the other channel) and display a good spectrum.

The output current amplifiers of the Buffer Amplifier and the Sample and Hold are easily damaged by accidently shorting them to ground. Please use caution.

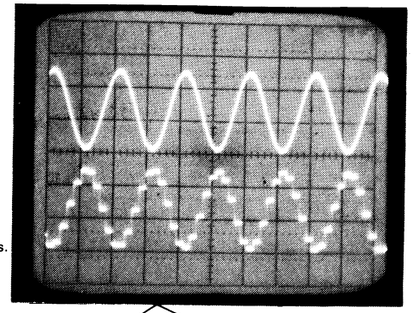
The signal at the S/H TP *must* "look" sampled. A defective S/H will put a signal on the S/H TP that looks very much like that at the LPF TP.

This is a difficult circuit to troubleshoot for *noise* and *distortion* problems that are not too serious. That is, operational amplifiers and other active components may appear to be good and still cause problems. It is appropriate when a problem is localized to replace tested-good circuit components when no other problem can be found.

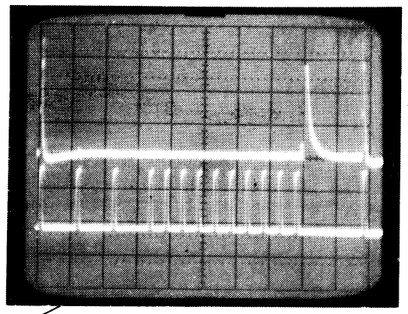
Note that the *A/D Clock* has uneven periods. This is to allow more settling time for the MSB's of the A/D.

A/D CONVERTER. The A/D converter is of the successive approximation type, using an IC DAC. The Successive Approximation Register (SAR) controls the logic for the A/D.

The SAR begins a cycle by setting the MSB input to the DAC. The output of the DAC is a current proportional to the difference between the input (S/H TP) and the analog equivalent of the MSB. This signal goes to the comparator and the comparator output tells the SAR whether the MSB should be set (if the input is higher than the MSB) or not set. This process is continued for the remaining 11 bits in a "successive approximation" that is quite accurate.



10 kHz input at LPF and S/H TP's
Ch A trig; holdoff max.
Ch A: LPF TP; 0.1 V/div.
Ch B: S/H TP; 0.2 V/div
(Both above X10 probe)
Alternate sweep; 50 µsec/div.
3582: 0 - 25 kHz span; 300 mV range
Input: 10 kHz at 105 mV or – 3.4 dBm, 50 ohms.



CAUTION

Do not short S/H TP or U102(4) to ground.

S/H TP and A/D clock with LPF TP shorted to ground.
Ext trigger on H/C; – slope
Ch A: S/H TP; 0.005 V/div; *X1 probe**
0 Vdc at center graticule
Ch B: A/D clock; 0.2 V/div; X10 probe
Alternate sweep; 1.0 µsec/div
20 MHz BW limit
3582: 30 V range

*Use short ground lead

GAIN ADJ

LPF TP4

A/D

R101

BUFFER AMPLIFIER

U102(4)

SAMPLE AND HOLD

S/H TP

U111 DIGITAL TO ANALOG CONVERTER (DAC)

15

U110 SUCCESSIVE APPROX REGISTER (SAR)

11

DATA

TP

R121

U107

6

+5V

R116

TO TIMING ASSY A3

A/D CLOCK

S/H Q108(8)

S/H LOGIC

COMPARATOR Q103, U109

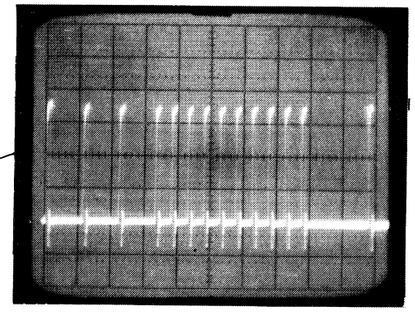
H/C TP

U105

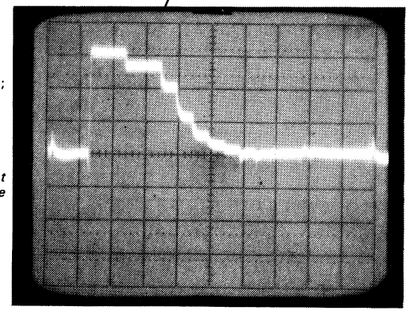
6

H/C FROM TIMING ASSY A3

REGISTER CLOCK



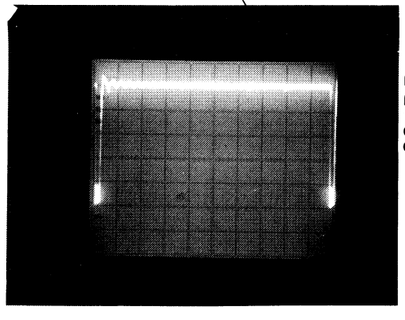
Register Clock
Ext trig. on H/C; – slope
1 µsec/div.
0.1 V/div; X10 probe; DC cpl.
0 Vdc 2 cm from bottom



Output of DAC with LPF TP shorted to ground.
Ext. trigger on H/C; – slope; 0.01 V/div; X10 probe;
0 Vdc at center graticule.
1 µsec/div sweep.

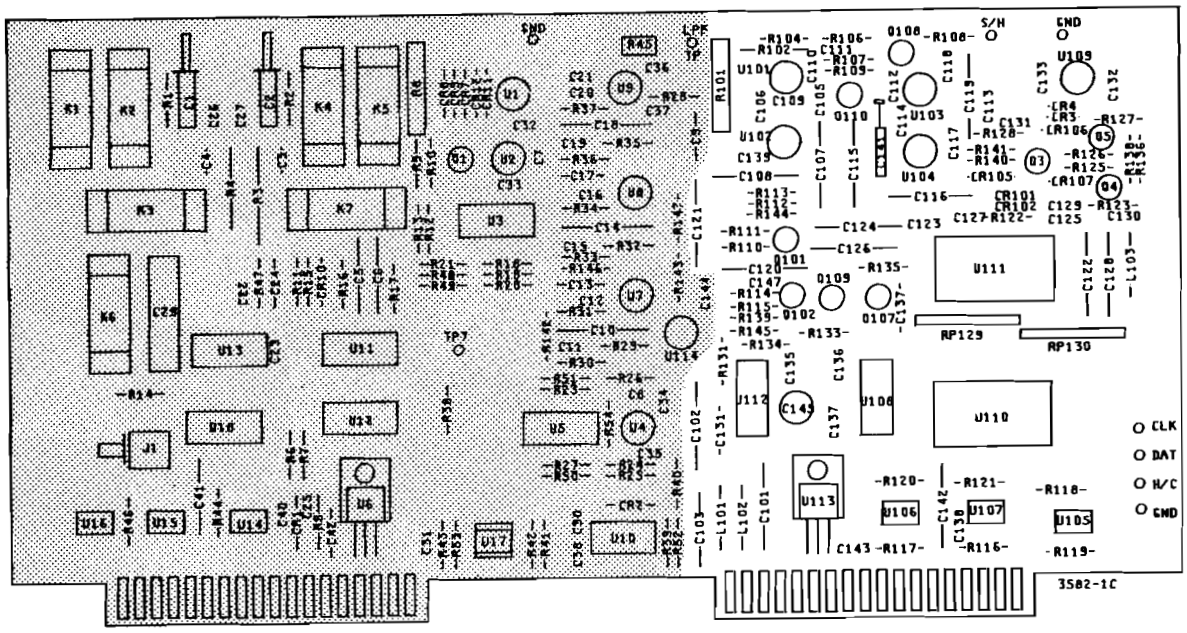
NOTE

Signal can go negative or positive. The important thing is that it be zero at the start and end of the sweep.



H/C TP
Int trigger; – slope
1 µsec/div
0.1 V/div; X10 probe; DC cpl.
0 Vdc 2 cm from bottom

Figure 8-1-11. Schematic B Troubleshooting Quick Reference.



A1

H-P PART NO. 03582-66501

P/O A1 A/D BOARD 03582 66501

P/O A20 MOTHER BOARD 03582-66520

BUFFER AMPLIFIER

S/H

DAC

SAR

COMPARATOR

DO NOT SHORT TO GROUND

GAIN ADJ

R101 200

R102 1.91K

R104 2K

R106 604

R108 604

C109 47pF

C110 22pF

C119 220pF

C139 100pF

C140 100pF

FROM LOW PASS FILTERS

DATA

U101

U102

U103

U104

Q108

C111 .1

R107 1K

R109 301

C112 220pF

C141 .25-1.5pF

Q110

S/H DC ADJ

TP S/H

C117 47pF

C118 22pF

U111

U110

MSB

LSB

DATA

CLOCK

RP129 2.2K

RP130 2.2K

+5V

+5VIA

+15VI

-15VI

+5VI

C148 .01

C124 6.8

C123 .1

C137 51pF

U108C

R135 1.5K

R137 5.1K

XA1B

+5V RAW XA18A(3,C)

+15VI XA18A(4,D)

-15VI XA18A(5,E)

L103

L101

L102

C124 6.8

C125 .1

U113

C143 .1

C101 6.8

C136 .1

C102,C115 6.8

C105,C127,C133 .1

C113,C130 .1

C103,C108 6.8

C116,C128 6.8

C106,C129 .1

C114,C132 .1

R144 1K

R112 2K

R113 10

C121 6.8

Q101

R111 1.5K

C120 6.8

R110 10

Q109

R139 3K

R145 2K

Q102

R115 3K

C147 .1

R114 2K

U108A

U108B

R118 330

R119 350

U105

C XA3B(12)

H/C

C149 .1

CR106 8V

R123 6.04K

Q104

CR107 8V

C150 .1

A Q103 B

C131 51.1pF

R128 604

CR 101

CR 102

R122 806

R138 1K

R125 4.99K

U109

R140 499

R141 499

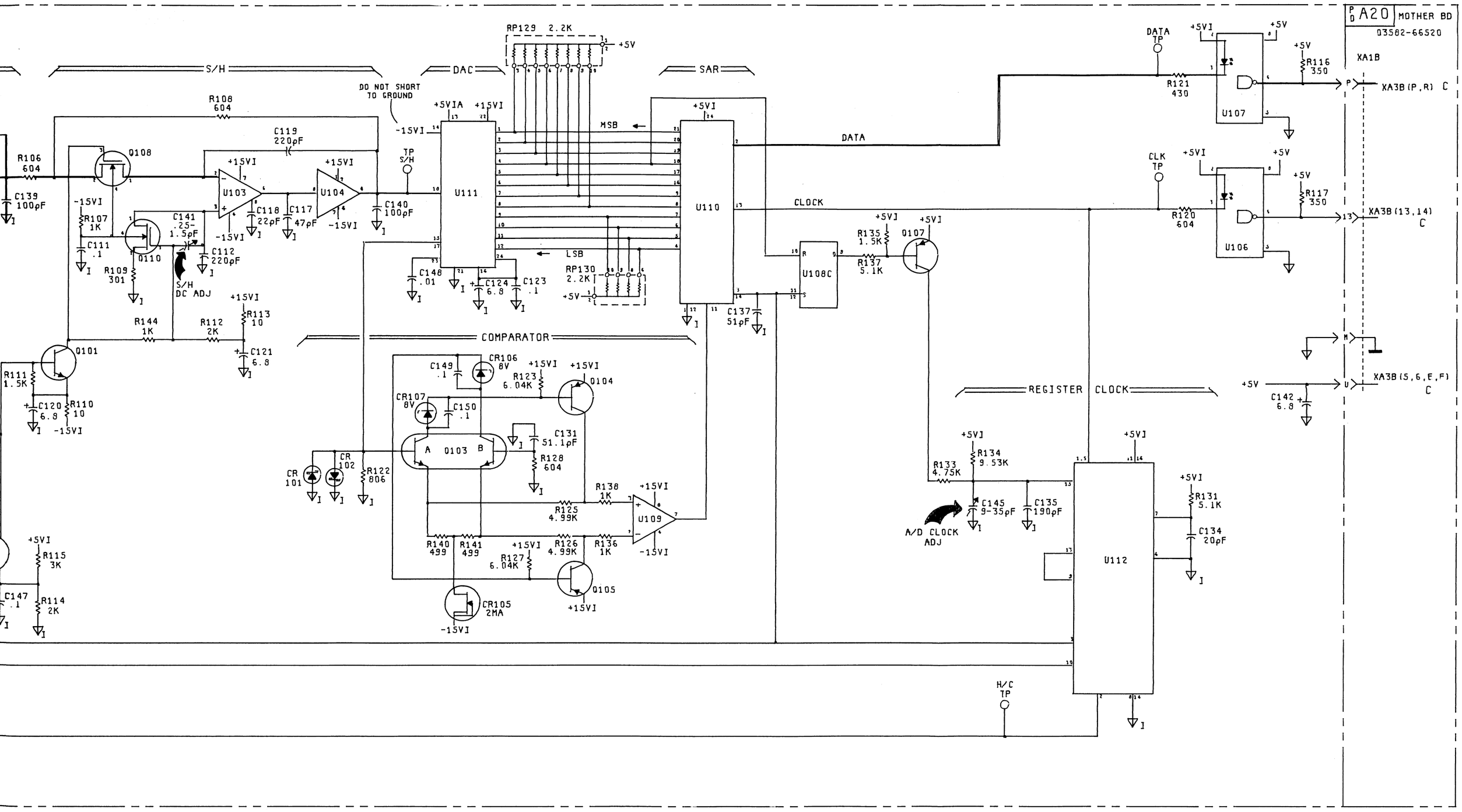
R127 6.04K

R126 4.99K

R136 1K

Q105

CR105 2MA



B

Figure 8-1-12. Analog To Digital Converter. REV E

Table 8-1-4. Replaceable Parts.

Reference Designation	HP Part Number	CD	Qty	Description	Mfr Code	Mfr Part Number
A1	03582-66501	9	1	PC ASSEMBLY, INPUT	28480	03582-66501
C1	0121-0407	9	2	CAPACITOR-V TRMR-PSTN .7-3PF 600V	72982	536-016
C2	0121-0407	9		CAPACITOR-V TRMR-PSTN .7-3PF 600V	72982	536-016
C3	0160-2248	2	1	CAPACITOR-FXD 4.3PF +-.25PF 500VDC CER	28480	0160-2248
C4	0160-2207	3	1	CAPACITOR-FXD 300PF +-5% 300VDC MICA	28480	0160-2207
C5	0180-1746	5	5	CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
C6	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
C7	0160-2259	5	2	CAPACITOR-FXD 12PF +-5% 500VDC CER 0+-30	28480	0160-2259
C8	0160-2259	5		CAPACITOR-FXD 12PF +-5% 500VDC CER 0+-30	28480	0160-2259
C9	0160-2331	4	1	CAPACITOR-FXD 8200PF +-1% 100VDC MICA	28480	0160-2331
C10	0160-5201	3	2	CAPACITOR-FXD .01UF +-1% 200VDC	84411	HEW-249
C11	0160-2708	9	2	CAPACITOR-FXD 312PF +-1% 500VDC MICA	28480	0160-2708
C12	0160-2708	9		CAPACITOR-FXD 312PF +-1% 500VDC MICA	28480	0160-2708
C13	0160-3273	5	1	CAPACITOR-FXD 6250PF +-1% 300VDC MICA	28480	0160-3273
C14	0610-5201	3		CAPACITOR-FXD .01UF +-1% 200VDC	84411	HEW-249
C15	0140-0233	9	2	CAPACITOR-FXD 480PF +-1% 300VDC MICA	72136	DM15F481F0300WV1C
C16	0140-0233	9		CAPACITOR-FXD 480PF +-1% 300VDC MICA	72136	DM15F481F0300WV1C
C17	0160-2301	8	1	CAPACITOR-FXD 2000PF +-1% 100VDC MICA	28480	0160-2301
C18	0160-5202	4	1	CAPACITOR-FXD .033UF +-1% 200VDC	84411	HEW-249
C19	0160-4318	1	2	CAPACITOR-FXD 330PF +-1% 500VDC MICA	28480	0160-4318
C20	0160-4318	1		CAPACITOR-FXD 330PF +-1% 500VDC MICA	28480	0160-4318
C21	0160-3793	4	1	CAPACITOR-FXD 680PF +-1% 100VDC MICA	28480	0160-3793
C22	0160-3878	6	1	CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
C23	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C24	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C25	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C26	0160-2250	6	1	CAPACITOR-FXD 5.1PF +-.25PF 500VDC CER	28480	0160-2250
C27	0160-2247	1	1	CAPACITOR-FXD 3.9PF +-.25PF 500VDC CER	28480	0160-2247
C29	0170-0042	1	1	CAPACITOR-FXD .33UF +-5% 100VDC POLYE	99515	E1-334D
C30	0160-0576	5	5	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
C31	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
C32	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C33	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C34	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C35	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C36	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C37	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C38	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
C40	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C41	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
C42	0160-0127	2	1	CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
C101	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
C102	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
C103	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
C105	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C106	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C107	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
C108	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
C109	0160-4387	4	2	CAPACITOR-FXD 47PF +-5% 200VDC CER 0+-30	28480	0160-4387
C110	0160-3875	3	2	CAPACITOR-FXD 22PF +-5% 200VDC CER 0+-30	28480	0160-3875
C111	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C112	0160-4103	2	1	CAPACITOR-FXD 220PF +-5% 100VDC CER	72982	8121-M100-COG-221J
C113	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C114	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C115	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
C116	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
C117	0160-4387	4		CAPACITOR-FXD 47PF +-5% 200VDC CER 0+-30	28480	0160-4387
C118	0160-3875	3		CAPACITOR-FXD 22PF +-5% 200VDC CER 0+-30	28480	0160-3875
C119	0160-4447	7	1	CAPACITOR-FXD 220PF +-10% 50VDC POLYP	28480	0160-4447
C120	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
C121	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
C122	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
C123	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C124	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
C125	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C126	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
C127	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C128	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
C129	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C130	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C131	0160-2201	7	2	CAPACITOR-FXD 51PF +-5% 300VDC MICA	28480	0160-2201

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

Table 8-1-4. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
C132	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C133	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C134	0160-2264	2		CAPACITOR-FXD 20PF +-5% 500VDC CER 0+-30	28480	0160-2264
C135	0160-3286	0	1	CAPACITOR-FXD 190PF +-1% 300VDC MICA	28480	0160-3286
C136	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C137	0160-2201	7		CAPACITOR-FXD 51PF +-5% 300VDC MICA	28480	0160-2201
C138	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C139	0160-4389	6	2	CAPACITOR-FXD 100PF +-5PF 200VDC CER	28480	0160-4389
C140	0160-4389	6		CAPACITOR-FXD 100PF +-5PF 200VDC CER	28480	0160-4389
C141	0121-0474	0	1	CAPACITOR-V TRMR-PSTN .3-1.5PF 600V	28480	0121-0474
C142	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
C143	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C144	0160-0945	2		CAPACITOR-FXD 910PF +-5% 100VDC MICA	28480	0160-0945
C145	0121-0046	2	1	CAPACITOR-V TRMR-CER 9-35PF 200V PC-MTG	52763	304322 9/35PF N650
C147	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C148	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
C149	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
C150	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
CR1	1902-0777	3	3	DIODE-ZNR 1N825 6.2V 5% DO-7 PD=.4W	04713	1N825
CR2	1901-0518	8	4	DIODE-SCHOTTKY	28480	1901-0518
CR7	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
CR8	1901-0376	6	2	DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
CR9	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
CR10	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
CR11	1902-0049	2		DIODE-ZNR 6.19V 5% DO-7 PD=.4W TC=+.022%	28480	1902-0049
CR12	1902-0049	2		DIODE-ZNR 6.19V 5% DO-7 PD=.4W TC=+.022%	28480	1902-0049
CR101	1901-0518	8		DIODE-SCHOTTKY	28480	1901-0518
CR102	1901-0518	8		DIODE-SCHOTTKY	28480	1901-0518
CR105	1902-0526	0	1	DIODE-CUR RGLTR 1N5305 100V DO-7	04713	1N5305
CR106	1902-3139	7	2	DIODE-ZNR 8.25V 5% DO-7 PD=.4W TC=+.053%	28480	1902-3139
CR107	1902-3139	7		DIODE-ZNR 8.25V 5% DO-7 PD=.4W TC=+.053%	28480	1902-3139
J1	1250-1572	5	1	CONNECTOR-RF SM-BNP M PC 75-OHM	98291	51-153-0000
K1	0490-1168	2	7	RELAY-REED 1A 500MA 200VDC 5VDC-COIL	28480	0490-1168
K2	0490-1168	2		RELAY-REED 1A 500MA 200VDC 5VDC-COIL	28480	0490-1168
K3	0490-1168	2		RELAY-REED 1A 500MA 200VDC 5VDC-COIL	28480	0490-1168
K4	0490-1168	2		RELAY-REED 1A 500MA 200VDC 5VDC-COIL	28480	0490-1168
K5	0490-1168	2		RELAY-REED 1A 500MA 200VDC 5VDC-COIL	28480	0490-1168
K6	0490-1168	2		RELAY-REED 1A 500MA 200VDC 5VDC-COIL	28480	0490-1168
K7	0490-1168	2		RELAY-REED 1A 500MA 200VDC 5VDC-COIL	28480	0490-1168
L101	9100-2556	8		COIL-MLD 33UH 10% Q=45 .156DX.375LG-NOM	28480	9100-2556
L102	9100-2556	8		COIL-MLD 33UH 10% Q=45 .156DX.375LG-NOM	28480	9100-2556
L103	9100-2556	8		COIL-MLD 33UH 10% Q=45 .156DX.375LG-NOM	28480	9100-2556
Q1	1855-0308	5	2	TRANSISTOR-JFET DUAL N-CHAN D-MODE SI	28480	1855-0308
Q101	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	SPS 3611
Q102	1853-0089	5		TRANSISTOR PNP 2N4917 SI PD=200MW	07263	2N4917
Q103	1854-0221	9	1	TRANSISTOR-DUAL NPN PD=750MW	28480	1854-0221
Q104	1853-0089	5		TRANSISTOR PNP 2N4917 SI PD=200MW	07263	2N4917
Q105	1853-0089	5		TRANSISTOR PNP 2N4917 SI PD=200MW	07263	2N4917
Q106	1853-0016	8	3	TRANSISTOR PNP SI TO-92 PD=300MW	28480	1853-0016
Q107	1853-0016	8		TRANSISTOR PNP SI TO-92 PD=300MW	28480	1853-0016
Q108	1855-0269	7	2	TRANSISTOR MOSFET N-CHAN E-MODE SI	18324	SD214
Q109	1853-0089	5		TRANSISTOR PNP 2N4917 SI PD=200MW	07263	2N4917
Q110	1855-0269	7		TRANSISTOR MOSFET N-CHAN E-MODE SI	18324	SD214
R1	0698-5132	8	1	RESISTOR 990K .5% .25W F TC=0+-100	28480	0698-5132
R2	0698-5131	7	1	RESISTOR 900K .5% .25W F TC=0+-100	19701	MF52C1/4-T0-9003-D
R3	0757-0013	0	1	RESISTOR 111K .5% .5W F TC=0+-50	28480	0757-0013
R4	0698-8324	6	1	RESISTOR 10.1K .5% .25W F TC=0+-50	19701	MF52C1/4-T2-1012-D
R5	0698-4195	1	1	RESISTOR 1.02K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1021-F
R6	0698-4423	8	1	RESISTOR 1.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1371-F
R7	0698-4441	0	1	RESISTOR 3.74K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3741-F
R8	2100-3052	4	1	RESISTOR-TRMR 50 20% C SIDE-ADJ 17-TRN	02111	43P500
R9	0698-7332	4		RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-7332
R10	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
R11	0698-4486	3	2	RESISTOR 24.9K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2492-F
R12	0698-4470	5	4	RESISTOR 6.98K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6981-F
R13	0698-4470	5		RESISTOR 6.98K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6981-F
R14	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
R15	0698-4424	9	1	RESISTOR 1.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1401-F
R16	0683-1115	8	1	RESISTOR 110 5% .25W FC TC=-400/+600	01121	CB1115
R17	0683-1515	2		RESISTOR 150 5% .25W FC TC=-400/+600	01121	CB1515
R18	0699-0190	0	2	RESISTOR 1.364K .25% .125W F TC=0+-50	28480	0699-0190
R19	0699-0193	3	2	RESISTOR 6.48K .25% .125W F TC=0+-50	28480	0699-0193
R20	0699-0447	0	2	RESISTOR 2.264K .25% .125W F TC=0+-50	28480	0699-0447

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

Table 8-1-4. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
R21	0698-3358	6	6	RESISTOR 1K ,5% ,125W F TC=0+-100	03888	PME55-1/8-T0-1001-D
R23	0698-3202	9	1	RESISTOR 1.74K 1% ,125W F TC=0+-100	24546	C4-1/8-T0-1741-F
R24	0699-0190	0		RESISTOR 1.364K ,25% ,125W F TC=0+-50	28480	0699-0190
R25	0699-0193	3		RESISTOR 6.48K ,25% ,125W F TC=0+-50	28480	0699-0193
R26	0699-0194	4		RESISTOR 22.64K ,25% ,125W F TC=0+-50	28480	0699-0194
R27	0698-2258	3	1		28480	0698-2258
R28	0698-4464	7	1	RESISTOR 887 1% ,125W F TC=0+-100	24546	C4-1/8-T0-887R-F
R29	0757-0290	5	1	RESISTOR 6.19K 1% ,125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
R30	0698-4014	3	2	RESISTOR 787 1% ,125W F TC=0+-100	24546	C4-1/8-T0-787R-F
R31	0698-4014	3		RESISTOR 787 1% ,125W F TC=0+-100	24546	C4-1/8-T0-787R-F
R32	0698-3515	7	1	RESISTOR 5.9K 1% ,125W F TC=0+-100	24546	C4-1/8-T0-5901-F
R33	0698-4468	1		RESISTOR 1.13K 1% ,125W F TC=0+-100	24546	C4-1/8-T0-1131-F
R34	0698-4468	1		RESISTOR 1.13K 1% ,125W F TC=0+-100	24546	C4-1/8-T0-1131-F
R35	0698-4485	2	1	RESISTOR 23.2K 1% ,125W F TC=0+-100	24546	C4-1/8-T0-2322-F
R36	0698-4465	8	1	RESISTOR 931 1% ,125W F TC=0+-100	24546	C4-1/8-T0-931R-F
R37	0757-0421	4	1	RESISTOR 825 1% ,125W F TC=0+-100	03292	C4-1/8-T0-825R-F
R38	0757-0446	3	1	RESISTOR 15K 1% ,125W F TC=0+-100	24546	C4-1/8-T0-1502-F
R39	0698-3519	1		RESISTOR 12.4K 1% ,125W F TC=0+-100	24546	C4-1/8-T0-1242-F
R40	0698-4435	2		RESISTOR 2.49K 1% ,125W F TC=0+-100	24546	C4-1/8-T0-2491-F
R41	0683-3945	6	2	RESISTOR 390K 5% ,25W FC TC=-800/+900	01121	CB3945
R42	0683-2055	7	1	RESISTOR 2M 5% ,25W FC TC=-900/+1100	01121	CB2055
R43	0683-1525	4		RESISTOR 1.5K 5% ,25W FC TC=-400/+700	01121	CB1525
R44	0698-4470	5		RESISTOR 6.98K 1% .125W F TC=0+-100	01121	C4-1/8-TO-6981-F
R45	2100-3350	5	1	RESISTOR-TRMR 200 10% C SIDE-ADJ 1-TRN	28480	2100-3350
R46	0698-4470	5		RESISTOR 6.98K 1% .125W F TC=0+-100	03292	C4-1/8-TO-6981-F
R47	0698-3447	4	2	RESISTOR 422 1% ,125W F TC=0+-100	24546	C4-1/8-T0-422R-F
R48	0698-3358	6		RESISTOR 1K ,5% ,125W F TC=0+-100	03888	PME55-1/8-T0-1001-D
R49	0698-5438	7		RESISTOR 100 .25% .125W F TC=0+-50	28480	0698-5438
R50	0698-3358	6		RESISTOR 1K ,5% ,125W F TC=0+-100	03888	PME55-1/8-T0-1001-D
R51	0698-3358	6		RESISTOR 1K ,5% ,125W F TC=0+-100	03888	PME55-1/8-T0-1001-D
R52	0683-3945	6		RESISTOR 390K 5% ,25W FC TC=-800/+900	01121	CB3945
R53	0683-2415	3		RESISTOR 240 5% ,25W FC TC=-400/+600	01121	CB2415
R54	0757-1094	9	1	RESISTOR 1.47K 1% ,125W F TC=0+-100	24546	C4-1/8-T0-1471-F
R101	2100-3095	5	1	RESISTOR-TRMR 200 10% C SIDE-ADJ 17-TRN	02111	43P201
R102	0698-4430	7		RESISTOR 1.91K 1% ,125W F TC=0+-100	24546	C4-1/8-T0-1911-F
R104	0757-0283	6		RESISTOR 2K 1% ,125W F TC=0+-100	24546	C4-1/8-T0-2001-F
R106	0757-0161	9		RESISTOR 604 1% ,125W F TC=0+-100	24546	C4-1/8-T0-604R-F
R107	0757-0280	3		RESISTOR 1K 1% ,125W F TC=0+-100	24546	C4-1/8-T0-1001-F
R108	0757-0161	9		RESISTOR 604 1% ,125W F TC=0+-100	24546	C4-1/8-T0-604R-F
R109	0757-0410	1	1	RESISTOR 301 1% ,125W F TC=0+-100	24546	C4-1/8-T0-301R-F
R110	0683-1005	5		RESISTOR 10 5% ,25W FC TC=-400/+500	01121	CB1005
R111	0683-1525	4		RESISTOR 1.5K 5% ,25W FC TC=-400/+700	01121	CB1525
R112	0757-0283	6		RESISTOR 2K 1% ,125W F TC=0+-100	24546	C4-1/8-T0-2001-F
R113	0683-1005	5		RESISTOR 10 5% ,25W FC TC=-400/+500	01121	CB1005
R114	0757-0283	6		RESISTOR 2K 1% ,125W F TC=0+-100	24546	C4-1/8-T0-2001-F
R115	0683-3025	3	2	RESISTOR 3K 5% ,25W FC TC=-400/+700	01121	CB3025
R116	0683-3615	7		RESISTOR 360 5% ,25W FC TC=-400/+600	01121	CB3615
R117	0683-3615	7		RESISTOR 360 5% ,25W FC TC=-400/+600	01121	CB3615
R118	0683-3315	4		RESISTOR 330 5% ,25W FC TC=-400/+600	01121	CB3315
R119	0683-3615	7		RESISTOR 360 5% ,25W FC TC=-400/+600	01121	CB3615
R120	0683-4315	6		RESISTOR 430 5% .25W FC TC=-400/+600	01607	CB4315
R121	0683-4315	6	1	RESISTOR 430 ,25W FC TC=-400/+600	01121	CB4315
R122	0698-3557	7	1	RESISTOR 806 1% ,125W F TC=0+-100	24546	C4-1/8-T0-806R-F
R123	0698-3497	4		RESISTOR 6.04K 1% ,125W F TC=0+-100	24546	C4-1/8-T0-604R-F
R125	0698-3279	0		RESISTOR 4.99K 1% ,125W F TC=0+-100	24546	C4-1/8-T0-4991-F
R126	0698-3279	0		RESISTOR 4.99K 1% ,125W F TC=0+-100	24546	C4-1/8-T0-4991-F
R127	0698-3497	4		RESISTOR 6.04K 1% ,125W F TC=0+-100	24546	C4-1/8-T0-604R-F
R128	0757-0161	9		RESISTOR 604 1% ,125W F TC=0+-100	24546	C4-1/8-T0-604R-F
R131	0683-5125	8		RESISTOR 5.1K 5% ,25W FC TC=-400/+700	01121	CB5125
R133	0757-0437	2		RESISTOR 4.75K 1% ,125W F TC=0+-100	24546	C4-1/8-T0-4751-F
R134	0698-4020	1		RESISTOR 9.53K 1% ,125W F TC=0+-100	24546	C4-1/8-T0-9531-F
R135	0683-1525	4		RESISTOR 1.5K 5% ,25W FC TC=-400/+700	01121	CB1525
R136	0757-0280	3		RESISTOR 1K 1% ,125W F TC=0+-100	24546	C4-1/8-T0-1001-F
R137	0683-5125	8		RESISTOR 5.1K 5% ,25W FC TC=-400/+700	01121	CB5125
R138	0757-0280	3		RESISTOR 1K 1% ,125W F TC=0+-100	24546	C4-1/8-T0-1001-F
R139	0683-3025	3		RESISTOR 3K 5% ,25W FC TC=-400/+700	01121	CB3025
R140	0698-4123	5		RESISTOR 499 1% ,125W F TC=0+-100	24546	C4-1/8-T0-499R-F
R141	0698-4123	5		RESISTOR 499 1% ,125W F TC=0+-100	24546	C4-1/8-T0-499R-F
R142	0757-0346	2		RESISTOR 10 1% ,125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
R143	0698-4435	2		RESISTOR 2.49K 1% ,125W F TC=0+-100	24546	C4-1/8-T0-2491-F
R144	0698-3358	6		RESISTOR 1K ,5% ,125W F TC=0+-100	03888	PME55-1/8-T0-1001-D
R145	0757-0283	6		RESISTOR 2K 1% ,125W F TC=0+-100	24546	C4-1/8-T0-2001-F
R146	0698-4446	9	1	RESISTOR 3.4K 1% ,125W F TC=0+-100	24546	C4-1/8-T0-3401-F

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

Table 8-1-4. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
R147	0698-4486	3		RESISTOR 24.9K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2492-F
RP129-130	1810-0136	3	4	NETWORK-RES 10-PIN-SIP .1-PIN-SPCG	28480	1810-0136
U1	1820-0203	6	3	IC 741 OP AMP TO-99	01928	CA741CT
U2	1826-0109	3	2	IC OP AMP TO-99	34371	HA2-2625-80593
U3	1826-0416	5	2	IC 8W TTL* ANALOG QUAD 16-DIP-C	03406	IC 13331
U4	1826-0109	3		IC OP AMP TO-99	34371	HA2-2625-80593
U5	1826-0416	5		IC 8W TTL* ANALOG QUAD 16-DIP-C	03406	IC 13331
U6	1826-0122	0	2	IC 7805 V RGLTR TO-220	07263	7805UC
U7	1826-0413	2		IC OP AMP TO-99	34371	HA2-2605-5
U8	1826-0413	2		IC OP AMP TO-99	34371	HA2-2605-5
U9	1826-0413	2		IC OP AMP TO-99	34371	HA2-2605-5
U10	1826-0138	8	9	IC 339 COMPARATOR 14-DIP-P	04713	MLM339P
U11	1820-1433	6		IC SHF-RGTR TTL LS R-S SERIAL-IN PRL-OUT	01295	SN74LS164N
U12	1820-1206	1		IC GATE TTL LS NOR TPL 3-INP	01295	SN74LS27N
U13	1858-0047	5	1	TRANSISTOR ARRAY DA-PIN	13606	ULN-2003A
U14	1990-0429	7	4	OPTO-ISOLATOR LED-IC GATE IF=10MA-MAX	28480	1990-0429
U15	1990-0444	6	2	OPTO-ISOLATOR LED-PDIO/XSTR IF=25MA-MAX	28480	5082-4351
U16	1990-0444	6		OPTO-ISOLATOR LED-PDIO/XSTR IF=25MA-MAX	28480	5082-4351
U17	1990-0577	6	1	OPTO-ISOLATOR LED-PDIO/XSTR IF=50MA-MAX	28480	5082-4355
U18	1820-1415	4	1	IC SCHMITT-TRIG TTL LS NAND DUAL 4-INP	01295	SN74LS13N
U101	1826-0089	8		IC 2525 OP AMP TO-99	29832	1322
U102	1820-0224	1		IC OP AMP TO-99	27014	LH0002CH
	1205-0011	0		HEAT SINK TO-5/TO-39-PKG	28480	1205-0011
U103	1826-0089	8		IC 2525 OP AMP TO-99	29832	1322
U104	1820-0224	1		IC OP AMP TO-99	27014	LH0002CH
U105	1990-0429	7		OPTO-ISOLATOR LED-IC GATE IF=10MA-MAX	28480	1990-0429
U106	1990-0429	7		OPTO-ISOLATOR LED-IC GATE IF=10MA-MAX	28480	1990-0429
U107	1990-0429	7		OPTO-ISOLATOR LED-IC GATE IF=10MA-MAX	28480	1990-0429
U108	1820-1440	5		IC LCH TTL LS QUAD	01295	SN74LS279N
U109	1826-0116	2	1	IC COMPARATOR TO-99	06665	CMP-01-CJ
U110	1820-1720	4	1	IC RGTR TTL 12-BIT	27014	DM2504CN
U111	1813-0118	7	1	IC DAC-80 CONV 24-DIP-C	28480	1813-0118
U112	1820-1423	4		IC MV TTL LS MONOSTBL RETRIG DUAL	01295	SN74LS123N
U113	1826-0122	0		IC 7805 V RGLTR TO-220	07263	7805UC
	1205-0353	3	1	HEAT SINK SGL PLSTC-PWR-PKG	13103	6073B
U114	1826-0119	5	1	IC TO-99	18324	NE555T
				MISCELLANEOUS PARTS		
	4040-0748	3		EXTRACTOR-PC BOARD BLK POLYC	28480	4040-0748
	4040-0749	4		EXTRACTOR-PC BOARD BRN POLYC	28480	4040-0749
	6960-0080	8		PLUG-HOLE FL-HD FOR .185-D-HOLE TFE	28480	6960-0080
SK1	1200-0588	6	1	SOCKET-IC 16-CONT DIP-SLDR	28480	1200-0588
SK2	1200-0659	2	1	SOCKET-IC 40-CONT DIP-SLDR	28480	1200-0659
				NOTE: SEE FRONT PANEL SERVICE GROUP FOR DC BAL, TRIGGER POT PART NUMBERS.		

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

SERVICE GROUP 2
TIMING

TABLE OF CONTENTS

Service Group		Page
2.	TIMING	8-2-1
	8-2-1. Introduction	8-2-1
	8-2-3. General Information	8-2-1
	8-2-5. Using The SA Flowcharts	8-2-1
	8-2-7. Troubleshooting The Timing Board	8-2-1
	8-2-9. No Spectrum Or Poor Spectrum	8-2-1
	8-2-11. PRN Not Programming Correctly	8-2-1
	8-2-13. Phase Incorrect	8-2-2
	8-2-15. CAL Source And/Or HP-IB Clock Not Working	8-2-2
	8-2-17. Impulse Output (Rear Panel) Not Working Or Phase In Free Run Incorrect	8-2-2

LIST OF TABLES

Table		Page
8-2-1.	÷N Counter Output SA vs. Span	8-2-3
8-2-2.	Replaceable Parts	8-2-11

LIST OF ILLUSTRATIONS

Figure		Page
8-2-1.	Flowchart 1: No or Poor Spectrum (Clk 1, Clk 2, H/C, A/D)	8-2-2
8-2-2.	Flowchart 2: PRN Programming Incorrect	8-2-3
8-2-3.	Flowchart 3: Phase Incorrect	8-2-4
8-2-4.	Flowchart 4: CAL Source And/Or HP-IB Clock Not Working	8-2-5/8-2-6
8-2-5.	Flowchart 5: Impulse Not Working or Free-Run Phase Incorrect	8-2-5/8-2-6
8-2-6.	Block Diagram. Timing Board	8-2-7/8-2-8
8-2-7.	Timing	8-2-9/8-2-10
8-2-8.	PRN Clock Rates	8-2-11
8-2-9.	Clock Rates	8-2-11
8-2-10.	Pulse Rates At Impulse Out	8-2-12

TIMING
SERVICE GROUP 2

8-2-1. INTRODUCTION.

8-2-2. The Timing board performs two main functions. One is to interface data between the Input board and the Digital Filter board. The other is to provide clock signals to other circuits in the instrument.

8-2-3. GENERAL INFORMATION.

8-2-4. Although an oscilloscope and a frequency counter may be used to troubleshoot the Timing board, an easier and much quicker method involves the use of signature analysis (SA). Since the dividers operate at TTL levels and process serial data, an SA test may be used in several areas of the circuit to verify proper operation. When a trouble area is encountered, a quick check of the line in question with an oscilloscope will confirm noisy or intermittent TTL levels. Suggestion: be sure that the scope probe is properly compensated since high frequency square waves can appear to be distorted with an uncompensated probe.

8-2-5. Using The SA Flowcharts.

8-2-6. Because the signals on the Timing board are derived from a single source, it is easier to troubleshoot different signal paths by working back through the flowchart starting from the end resulting signal. Thus, if the calibration signal was defective, one would go to Flowchart 4 and proceed from the bottom of the diagram to the top.

8-2-7. TROUBLESHOOTING THE TIMING BOARD.

8-2-8. This board produces clocks for many functions on the board. The following problem groupings will help to narrow down the problem area. Before checking anything else, check that the power supplies (+12 and +5) are good and that TP1 is oscillating at 45.875 MHz.

8-2-9. No Spectrum Or Poor Spectrum.

8-2-10. Check CH/A A/D, CH/B A/D, H/C and CLK 1 using Flowchart 1. CLK 2 is the SA clock, so that gets checked automatically. If an "end" signature is bad, work back through the chart. The signatures below the dashed line check the data interface circuits. To provide known data through the interface, the DC balance is adjusted to provide a string of all 1's or all 0's. This is accomplished by setting the INPUT SENSITIVITY to the 3mV range, shorting the input and adjusting the BAL potentiometer either fully clockwise (CW) or counter-clockwise (CCW) as indicated on the flow chart.

8-2-11. PRN Not Programming Correctly.

8-2-12. Go through Flowchart 2. If the signature at U7(15) is correct, the ÷N counters are working properly. If the signature at U7(15) is incorrect, SA cannot be used to troubleshoot

the counters because of the closed loop nature of the circuit. Once you've checked U29(9) for 11.5 or 9.2 MHz, look for stuck counter lines, and check the programming of U1 and U2 given with table at the end of this section.

8-2-13. Phase Incorrect.

8-2-14. This problem involves the effective sample rate trigger delay circuitry. Refer to Flowcharts 2 and 3 for troubleshooting. Also see Flowchart 5.

8-2-15. CAL Source And/Or HP-IB Clock Not Working.

8-2-16. Refer to Flowchart 4 for troubleshooting.

8-2-17. Impulse Output (Rear Panel) Not Working Or Phase In Free Run Incorrect.

8-2-18. Refer to Flowchart 5 for troubleshooting.

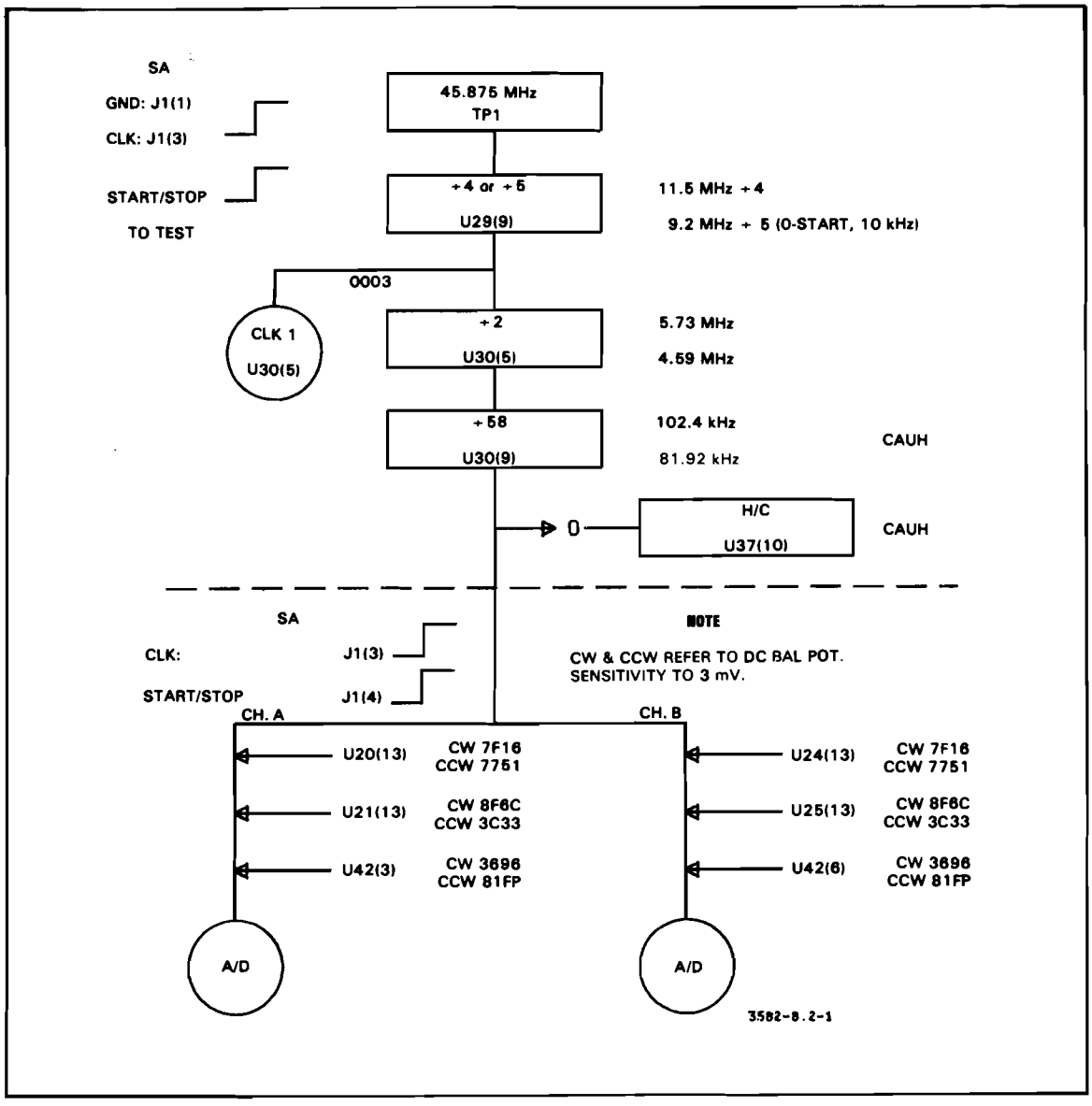


Figure 8-2-1. Flowchart 1: No or Poor Spectrum (Clk 1, Clk 2, H/C, A/D).

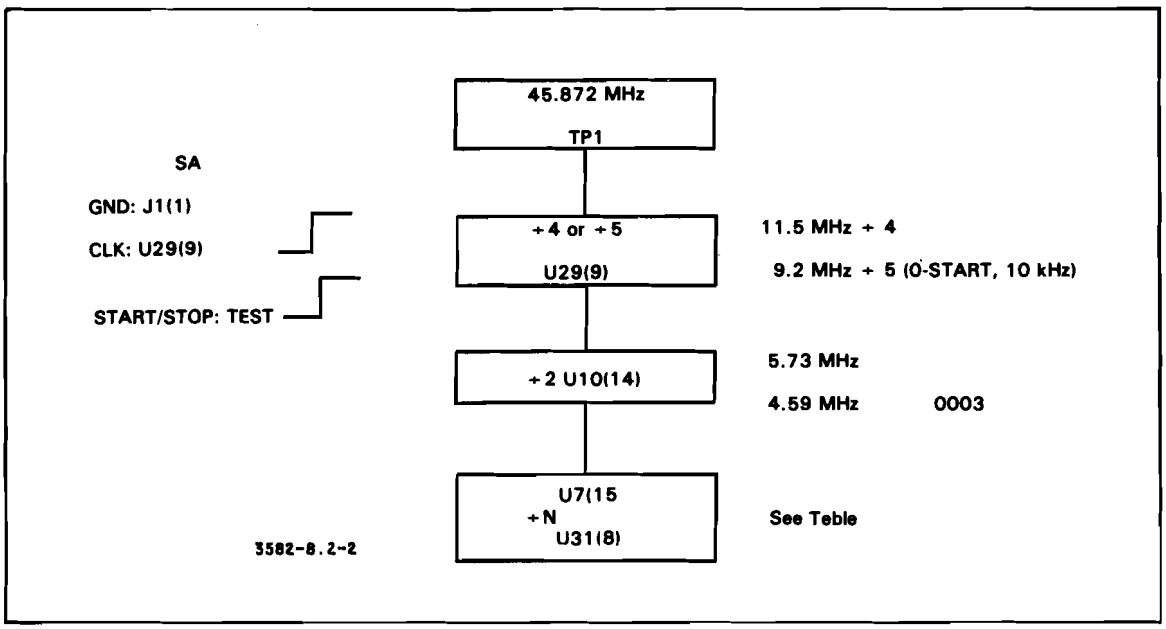


Figure 8-2-2. Flowchart 2: PRN Programming Incorrect.

Table 8-2-1. +N Counter Output SA vs. Span.

Span	0-Start	Zoom
25 kHz	0003	000U
10 kHz	000U	03U9
5 kHz	03U9	P733
2.5 kHz	P733	5159
1 kHz	6692	5C1C
500 Hz	5C1C	7576
250 Hz	7576	0FHH
100 Hz	8844	1F8C
50 Hz	1F8C	P5H2
25 Hz	P5H2	C21U
10 Hz	AHC3	52C9
5 Hz	52C9	53UC
2.5 Hz	53UC	
1 Hz	974F	

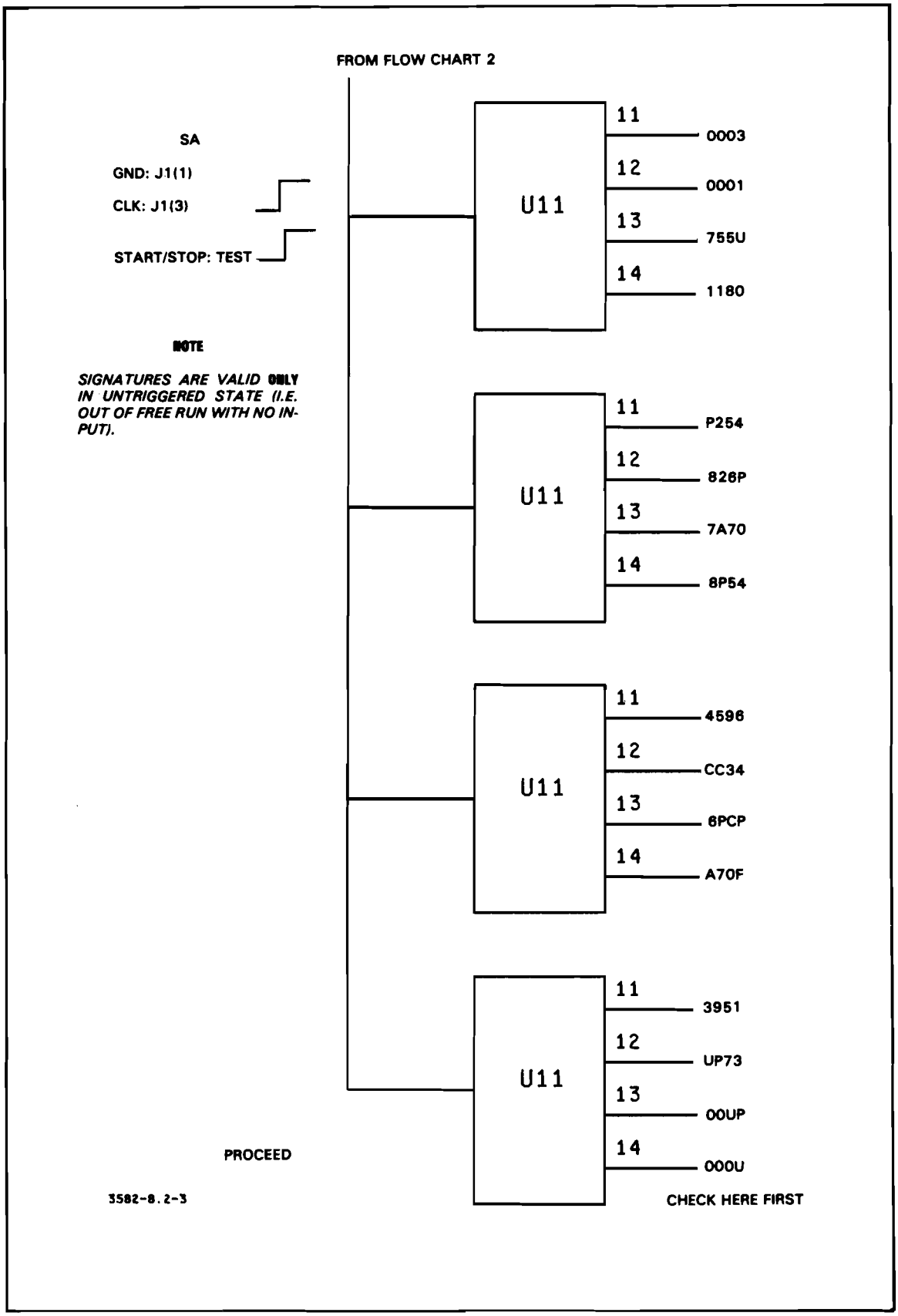


Figure 8-2-3. Flowchart 3: Phase Incorrect.

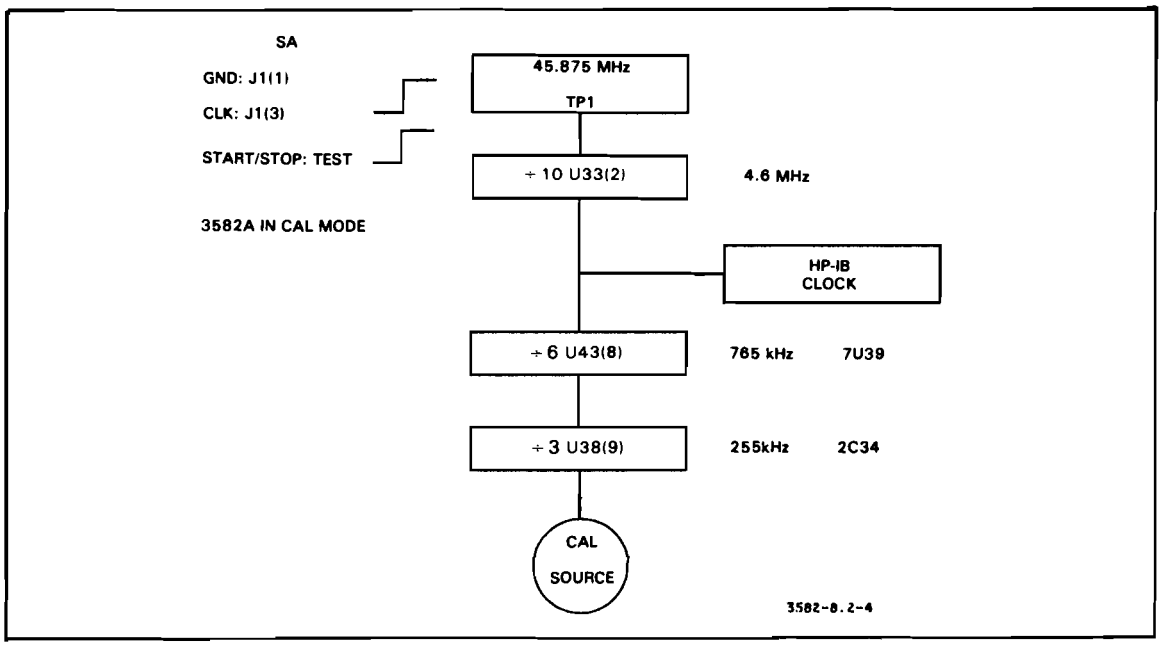


Figure 8-2-4. Flowchart 4: CAL Source And/Or HP-IB Clock Not Working.

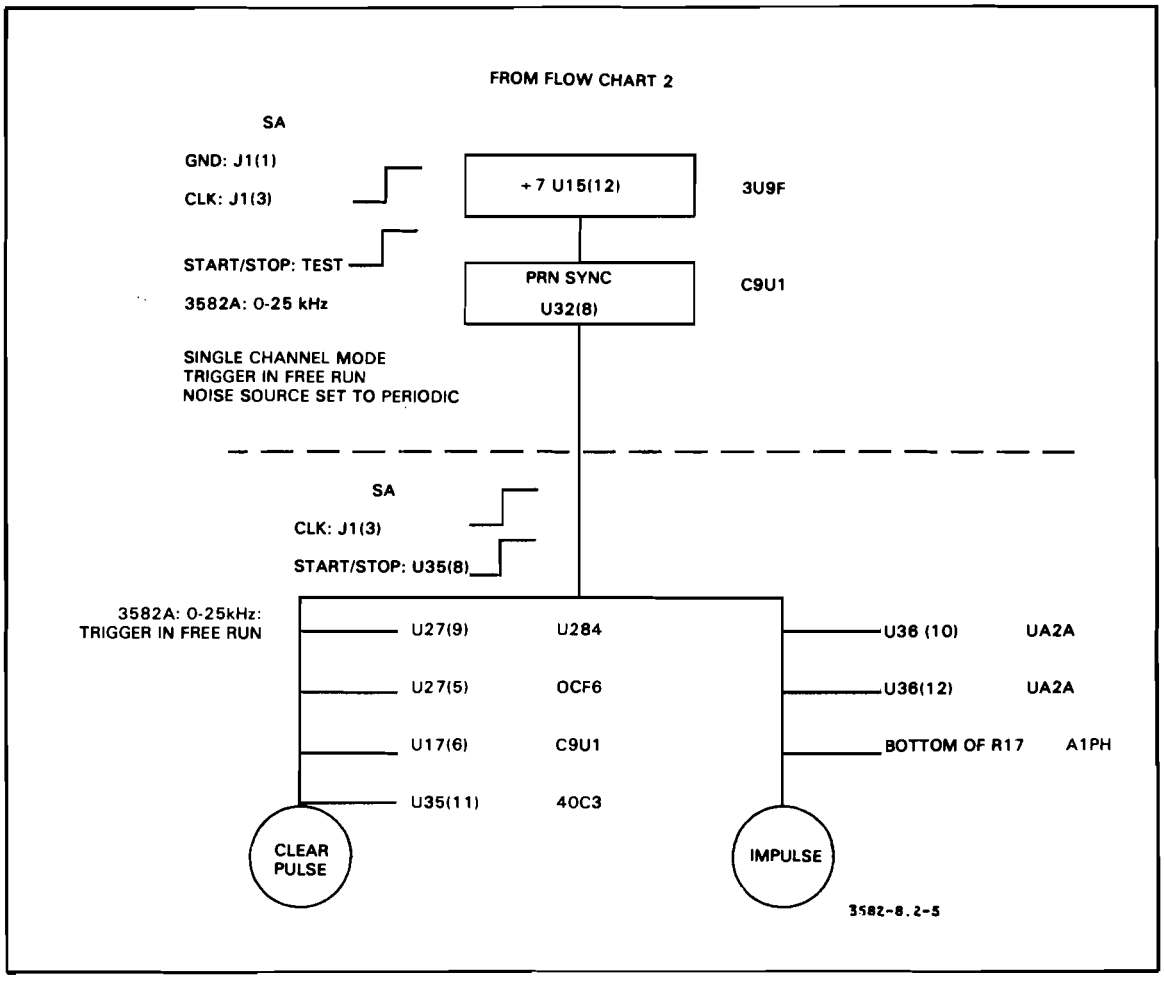


Figure 8-2-5. Flowchart 5: Impulse Not Working or Free-Run Phase Incorrect.

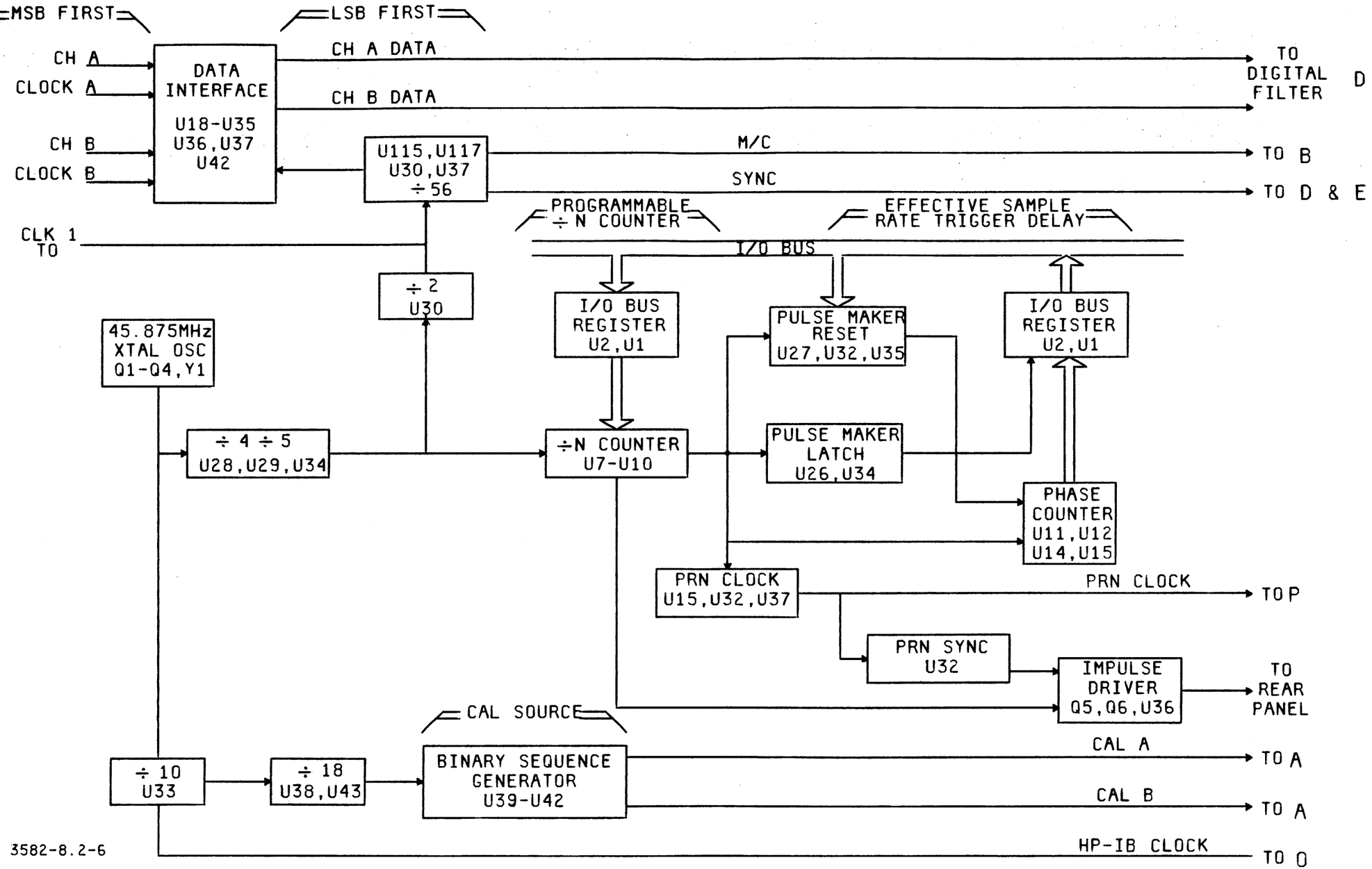
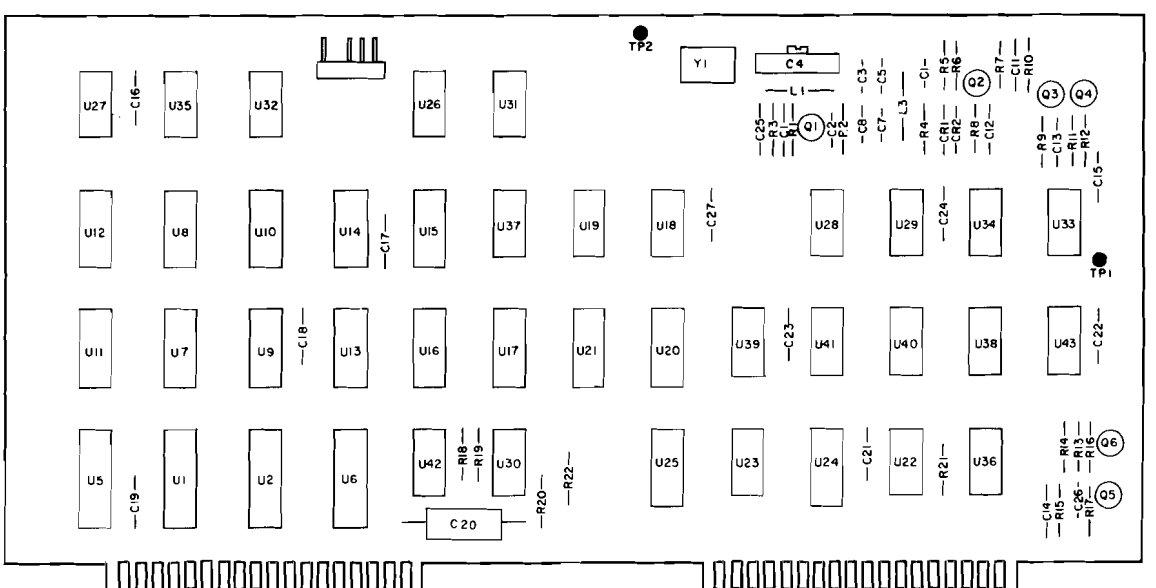


Figure 8-2-6. Block Diagram. Timing Board.

Program Codes (Octal) For A3U1 and U2

Display BW (Hz)	Baseband P. Code (P15 ← Po)	Zoom (P15 ← Po)
25,000	177776	------
10,000	177775	177766
5,000	177766	177754
2,500	177754	177730
1,000	177716	177634
500	177634	177470
250	177470	177160
100	177014	176030
50	176030	174060
25	174060	170140
10	166170	154360
5	154360	120740
2.5	130740	X
1	036260	X



A3
03582-66503
Rev A & B

A3 TIMING BOARD 03582-66503

DATA REVERSE INTERFACE

XA3B

B A DAT XA1B(P) — P
B DAT — R
B B CLK XA1B(13) — 14
A CLK — 13
B CHA & CHB XA1B(M) — 8
CLK 1 — M
D XA5B(10) / E XA4A(M)
D GATE XA5B(3) — C — GATE TO U35(4)

XA3A
+12V — 18 — +12V
C1, 11, 25 .01

+5V — 16 — +5V
C14-C19 .01; C20 150; C21-C24 .01; C27 .01

XA3B
F 05I1 XA7B(14) — J

U42A; U42B

U19; U21; U18; U20; U23; U25; U22; U24

U36A; U36B; U37D; U37E

÷ 256

U16 COUNTER; U17 COUNTER; U30 DELAY; U37F

÷ 2

U30 ÷2

÷ 4 ÷ 5

R22 24

45.875 MHz

OSC TP1 — 0V — 5.5V

+12V
L1 2μH; C3 910pF; R1 7.5K; Q1 (4.5V, 3.8V); R2 4.7K; C2 470pF; R3 470; VI 45.8752 MHz; C4 OSC ADJ; C7 100pF; C8 100pF; L3 .39μH; R4 2K; CR1; CR2; R6 12K; C10 10pF; R5 18K; R7 470; Q2 (4.2V, 3.5V); R8 470; C12 .01; R9 1K; Q3 (5V, 5.7V); R12 100; U34B (3.4V, 0V); Q4 (5V); R11 1K; C13 .01; R10 200; .6V; 1V

U34D — VH

U29; U28; U34C; U29

÷ 10 — U33

÷ 18 — U43; U38

ENABLE — U31; U28

U40 8-BIT SHIFT REGISTER; CAL SOURCE — U39D; U39B; U39C; U39A; U41

U42C; U42D; R19 390; R18 390

GND; CLK; START/STOP — J1 (5A JACK)

CH A A/D; CH B A/D

H/C; SYNC; CLK-2

R20 34; R21 47

05I1 FROM XA5B(J)

U2 REGISTER (I/O 7–0); U1 REGISTER (I/O 15–8)

U10 ÷N COUNTER; U9 ÷N COUNTER; U8 ÷N COUNTER; U7 ÷N COUNTER

U31(2); U32(4)

U31 — CLK-2

SEE FIG. 8-2-9 FOR CLOCK RATES FOUND HERE

P3

U32 — 05Φ

= PRN CLK

PRN FROM 4

U15 ÷7

HPIB CLK

P/O A20 MOTHER BD 03582-66520

GND CLK START/STOP
J1 (5A JACK)

CH A A/D
CH B A/D

H/C
SYNC
CLK-2
R20 24
R21 47

0511 FROM XA3B(J)

EFFECTIVE SAMPLE RATE TRIGGER DELAY

U30 DELAY

U2 REGISTER
U1 REGISTER
U6 REGISTER
U5 REGISTER
I/O BUS

U10 ÷N COUNTER
U9 ÷N COUNTER
U8 ÷N COUNTER
U7 ÷N COUNTER
U14 PHASE COUNTER
U13 PHASE COUNTER
U12 PHASE COUNTER
U11 PHASE COUNTER

U31
U32
U27
U29

PULSE MAKER - LATCH Φ
PULSE MAKER - RESET
U34A
U35A
U35B
U35C
U35D
U26
GATE
RESET

SEE FIG. 8-2-9 FOR CLOCK RATES FOUND HERE

TO U32(3) 05Φ

IMPULSE
U36
R14 820
R15 330
R13 2K
R16 200
C26 20PF
R17 51
Q5
Q6
SEE FIG. 8-2-10 FOR PULSE WIDTHS AND REPETITION RATES FOUND HERE
W33 IMPULSE

CAL SOURCE
÷18
U43
U38
U40 8-BIT SHIFT REGISTER
U41
U39
U42
R19 390
R18 390
CAL A
CAL B

PRN CLK
PRN SYNC
PRN SYNC FROM XA3B(E)
U15 ÷7
SEE FIG. 8-2-8 FOR PRN CLOCK
TO U32(12) PRN SYNC

HP-IB CLK

XA3B
10 CH A A/D XA5B(9) D
L CH B A/D XA5B(K) D
12 H/C XA1B(12) B
9 SYNC XA4A(E) E
11 CLK-2 XA5B(L) D
MSB 12 11 10 9 8 7 6 5 N M L K J H F E LSB
D 0511 XA7B(9) F
F 05Φ XA7B(11) F
15 DMAR XA5B(14) D
E PRN SYNC XA4B(D) P
V IMPULSE TO REAR PANEL BNC OUTPUT
5 PRN CLK XA4B(4) P
XA3A
14 CAL A XA1A(L) A
15 CAL B XA1B(L) A
XA3B
N HP-IB CLK XA2B(N) D

C

Figure 8-2-7. Timing. REV A,B
8-2-9/8-2-10

PRN CLOCK RATES at A3U32#11

Selected Span	0-25 kHz	0-Start	ZOOM
25 kHz	1.638 mHz	1.638 mHz	819.2 kHz
10 kHz	– – –	655.4 kHz	327.2 kHz
5 kHz	– – –	327.7 kHz	163.8 kHz
2.5 kHz	– – –	163.8 kHz	81.9 kHz
1.0 kHz	– – –	65.5 kHz	32.77 kHz
500 Hz	– – –	34.8 kHz	16.38 kHz
250 Hz	– – –	16.4 kHz	8.19 kHz
100 Hz	– – –	6.55 kHz	3.27 kHz
50 Hz	– – –	3.27 kHz	1.638 kHz
25 Hz	– – –	1.638 kHz	818 Hz
10 Hz	– – –	655 Hz	328 Hz
5 Hz	– – –	327.8 Hz	164 Hz
2.5 Hz	– – –	163.8 Hz	– – –
1.0 Hz	– – –	65.4 Hz	– – –

Figure 8-2-8. PRN Clock Rates

CLOCK RATES FOUND AT U31 #8

Selected Span	0-25 kHz	0-Start	Set Start	Set Center
25 kHz	5.734 mHz	5.734 mHz	2.867 mHz	2.867 mHz
10 kHz	– – –	2.294 mHz	1.146 mHz	1.146 mHz
5 kHz	– – –	1.147 mHz	573.4 kHz	573.4 kHz
2.5 kHz	– – –	573.5 kHz	286.7 kHz	186.7 kHz
1.0 kHz	– – –	22.93 kHz	114.7 kHz	114.7 kHz
500 Hz	– – –	114.7 kHz	57.34 kHz	57.35 kHz
250 Hz	– – –	57.34 kHz	28.67 kHz	28.67 kHz
100 Hz	– – –	22.94 kHz	11.468 kHz	11.47 kHz
50 Hz	– – –	11.47 kHz	5.734 kHz	5.73 kHz
25 Hz	– – –	5.73 kHz	2.867 kHz	2.87 kHz
10 Hz	– – –	2.294 kHz	1.147 kHz	1.147 kHz
5 Hz	– – –	1.147 kHz	573.4 Hz	573.4 Hz
2.5 Hz	– – –	573.4 Hz	– – –	– – –
1.0 Hz	– – –	229.4 Hz	– – –	– – –

Figure 8-2-9. Clock Rates Found At U32 Pin 11.

Pulse rates found at the Impulse Out BNC (valid when the front panel noise source is set to periodic).

	Pulse Width			Rep Rate/Frequency	
	0-25	0-Start	Set Start, Set Center		
25 kHz	1.2 μs	2.4 μs	2.4 μs	10 ms	100 Hz
10 kHz	1.2 μs	3 μs	6.1 μs	25 ms	40 Hz
5 kHz	1.2 μs	6 μs	12.2 μs	50 ms	20 Hz
2.5 kHz	1.2 μs	12 μs	24.5 μs	100 ms	10 Hz
1.0 kHz	1.2 μs	31 μs	60.1 μs	250 ms	4 Hz
500 kHz	1.2 μs	61 μs	122 μ ms	500 ms	2 Hz
250 kHz	1.2 μs	122 μs	245 μs	1000 ms	1 Hz
100 kHz	1.2 μs	305 μs	.61 ms	2500 ms	.4 Hz
50 kHz	1.2 μs	.61 ms	1.22 ms	5000 ms	.2 Hz
25 kHz	1.2 μs	1.22 ms	2.45 ms	10000 ms	.1 Hz
10 kHz	1.2 μs	3.05 ms	6.1 ms	25000 ms	.04 Hz
5 kHz	1.2 μs	6.01 ms	12.2 ms	50000 ms	.02 Hz
2.5 kHz	1.2 μs	12.22 ms	12.2 ms	100000 ms	.01 Hz
1.0 kHz	1.2 μs	30.50 ms	12.2 ms	2500 sec.	.004 Hz

Figure 8-2-10. Pulse Rates Found at Impulse Out B.N.C.

Table 8-2-2. Replaceable Parts.

Reference Designation	HP Part Number	CD	Qty	Description	Mfr Code	Mfr Part Number
A3	03582-66503	1	1	PC ASSEMBLY, TIMING	28480	03582-66503
C1	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C2	0160-3455	5	1	CAPACITOR-FXD 470PF +-10% 1KVDC CER	28480	0160-3455
C3	0160-0945	2	2	CAPACITOR-FXD 910PF +-5% 100VDC MICA	28480	0160-0945
C4	0121-0142	9	1	CAPACITOR-V TRMR-MICA 16-150PF 175V	72136	T51417-5 REV. B
C5	0160-2199	2		CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
C7	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
C8	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
C10	0160-2257	3	1	CAPACITOR-FXD 10PF +-5% 500VDC CER 0+-60	28480	0160-2257
C11	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C12	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C13	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C14	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C15	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C16	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C17	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C18	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C19	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C20	0180-0194	5	2	CAPACITOR-FXD 150UF+-10% 15VDC TA	56289	150D157X901582
C21	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C22	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C23	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C24	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C25	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C26	0160-2264	2		CAPACITOR-FXD 20PF +-5% 500VDC CER 0+-30	28480	0160-2264
C27	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
CR1	1901-0347	1	2	DIODE-SCHOTTKY 8V	28480	1901-0347
CR2	1901-0347	1		DIODE-SCHOTTKY 8V	28480	1901-0347
J1	1251-5202	8	12	CONNECTOR 5-PIN M POST TYPE	28480	1251-5202
L1	9100-3345	5	1	COIL-MLD 2UH 5% .155DX.375LG-NOM	28480	9100-3345
L3	9100-2254	3	1	COIL-MLD 390NH 10% Q=35 .095DX.25LG-NOM	28480	9100-2254
Q1	1854-0215	1	8	TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	SPS 3611
Q2	1854-0233	3	2	TRANSISTOR NPN 2N3866 SI TO-39 PD=1W	01928	2N3866
Q3	1853-0203	5	3	TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0203
Q4	1853-0203	5		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0203
Q5	1853-0203	5		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0203
Q6	1854-0019	3	1	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
R1	0683-7525	6	1	RESISTOR 7.5K 5% .25W FC TC=-400/+700	01121	CB7525
R2	0683-4725	2	6	RESISTOR 4.7K 5% .25W FC TC=-400/+700	01121	CB4725
R3	0683-4715	0	4	RESISTOR 470 5% .25W FC TC=-400/+600	01121	CB4715
R4	0683-2025	1		RESISTOR 2K 5% .25W FC TC=-400/+700	01121	CB2025
R5	0683-1835	9	1	RESISTOR 18K 5% .25W FC TC=-400/+800	01121	CB1835
R6	0683-1235	3	1	RESISTOR 12K 5% .25W FC TC=-400/+800	01121	CB1235
R7	0683-4715	0		RESISTOR 470 5% .25W FC TC=-400/+600	01121	CB4715
R8	0683-4715	0		RESISTOR 470 5% .25W FC TC=-400/+600	01121	CB4715
R9	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R10	0683-2015	9	2	RESISTOR 200 5% .25W FC TC=-400/+600	01121	CB2015
R11	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R12	0683-1015	7	6	RESISTOR 100 5% .25W FC TC=-400/+500	01121	CB1015
R13	0683-2025	1		RESISTOR 2K 5% .25W FC TC=-400/+700	01121	CB2025
R14	0683-8215	3		RESISTOR 820 5% .25W FC TC=-400/+600	01121	CB8215
R15	0683-3315	4	2	RESISTOR 330 5% .25W FC TC=-400/+600	01121	CB3315
R16	0683-2015	9		RESISTOR 200 5% .25W FC TC=-400/+600	01121	CB2015
R17	0683-5105	4	4	RESISTOR 51 5% .25W FC TC=-400/+500	01121	CB5105
R18	0683-3915	0		RESISTOR 390 5% .25W FC TC=-400/+600	01121	CB3915
R19	0683-3915	0		RESISTOR 390 5% .25W FC TC=-400/+600	01121	CB3915
R20	0683-2405	1	2	RESISTOR 24 5% .25W FC TC=-400/+500	01121	CB2405
R21	0683-4705	8	2	RESISTOR 47 5% .25W FC TC=-400/+500	01121	CB4705
R22	0683-2405	1		RESISTOR 24 5% .25W FC TC=-400/+500	01121	CB2405
U1	1820-1730	6	14	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
U2	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
U5	1820-1997	7	5	IC FF TTL LS D-TYPE POS-EDGE-TRIG PRL-IN	34335	SN74LS374PC
U6	1820-1997	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG PRL-IN	34335	SN74LS374PC
U7	1820-1430	3		IC CNTR TTL LS BIN SYNCHRO POS-EDGE-TRIG	01295	SN74LS161N
U8	1820-1430	3		IC CNTR TTL LS BIN SYNCHRO POS-EDGE-TRIG	01295	SN74LS161N
U9	1820-1430	3		IC CNTR TTL LS BIN SYNCHRO POS-EDGE-TRIG	01295	SN74LS161N
U10	1820-1430	3		IC CNTR TTL LS BIN SYNCHRO POS-EDGE-TRIG	01295	SN74LS161N
U11	1820-1430	3		IC CNTR TTL LS BIN SYNCHRO POS-EDGE-TRIG	01295	SN74LS161N
U12	1820-1430	3		IC CNTR TTL LS BIN SYNCHRO POS-EDGE-TRIG	01295	SN74LS161N

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

Table 8-2-2. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
U13	1820-1430	3		IC CNTR TTL LS BIN SYNCHRO POS-EDGE-TRIG	01295	SN74LS161N
U14	1820-1430	3		IC CNTR TTL LS BIN SYNCHRO POS-EDGE-TRIG	01295	SN74LS161N
U15	1820-1430	3		IC CNTR TTL LS BIN SYNCHRO POS-EDGE-TRIG	01295	SN74LS161N
U16	1820-1430	3		IC CNTR TTL LS BIN SYNCHRO POS-EDGE-TRIG	01295	SN74LS161N
U17	1820-1430	3		IC CNTR TTL LS BIN SYNCHRO POS-EDGE-TRIG	01295	SN74LS161N
U18	1820-1433	6		IC SHF-RGTR TTL LS R-S SERIAL-IN PRL-OUT	01295	SN74LS164N
U19	1820-1433	6		IC SHF-RGTR TTL LS R-S SERIAL-IN PRL-OUT	01295	SN74LS164N
U20	1820-1922	8	4	IC SHF-RGTR TTL LS PRL-IN SERIAL-OUT	01295	SN74LS166N
U21	1820-1922	8		IC SHF-RGTR TTL LS PRL-IN SERIAL-OUT	01295	SN74LS166N
U22	1820-1433	6		IC SHF-RGTR TTL LS R-S SERIAL-IN PRL-OUT	01295	SN74LS164N
U23	1820-1433	6		IC SHF-RGTR TTL LS R-S SERIAL-IN PRL-OUT	01295	SN74LS164N
U24	1820-1922	8		IC SHF-RGTR TTL LS PRL-IN SERIAL-OUT	01295	SN74LS166N
U25	1820-1922	8		IC SHF-RGTR TTL LS PRL-IN SERIAL-OUT	01295	SN74LS166N
U26	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74N
U27	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74N
U28	1820-0693	8		IC FF TTL S D-TYPE POS-EDGE-TRIG	01295	SN74S74N
U29	1820-0693	8		IC FF TTL S D-TYPE POS-EDGE-TRIG	01295	SN74S74N
U30	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74N
U31	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74N
U32	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74N
U33	1820-0751	9	1	IC CNTR TTL DECD NEG-EDGE-TRIG PRESET	01295	SN74196N
U34	1820-0681	4		IC GATE TTL S NAND QUAD 2-INP	01295	SN74S00N
U35	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
U36	1820-1199	1		IC INV TTL LS HEX 1-INP	01295	SN74LS04N
U37	1820-0683	6		IC INV TTL S HEX 1-INP	01295	SN74S04N
U38	1820-1420	1	2	IC CNTR TTL LS DIV-X-12 ASYNCHRO	01295	SN74LS92N
U39	1820-1211	8		IC GATE TTL LS EXCL-OR QUAD 2-INP	01295	SN74LS86N
U40	1820-1433	6		IC SHF-RGTR TTL LS R-S SERIAL-IN PRL-OUT	01295	SN74LS164N
U41	1820-1207	2		IC GATE TTL LS NAND 8-INP	01295	SN74LS30N
U42	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
U43	1820-1420	1		IC CNTR TTL LS DIV-X-12 ASYNCHRO	01295	SN74LS92N
Y1	0410-1125	3	1	CRYSTAL, 45.8752 MHZ	28480	0410-1125
				MISCELLANEOUS PARTS		
	4040-0748	3	10	EXTRACTOR-PC BOARD BLK POLYC	28480	4040-0748
	4040-0751	8	1	EXTRACTOR-PC BOARD ORN POLYC	28480	4040-0751

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

SERVICE GROUP 3
DIGITAL FILTER AND LOCAL OSCILLATOR

TABLE OF CONTENTS

Service Group — Page

3. DIGITAL FILTER AND LOCAL OSCILLATOR 8-3-1
- 8-3-1. Introduction 8-3-1
- 8-3-3. General Information 8-3-1
- 8-3-5. Troubleshooting The Digital Filter 8-3-1
- 8-3-8. The Clock Driver Circuit 8-3-2
- 8-2-10. Data Input Buffer 8-3-2
- 8-3-12. DMA Request Circuit 8-3-3
- 8-3-16. The Controller 8-3-3
- 8-3-20. The Overload Circuit 8-3-4
- 8-3-25. The Trigger Circuit 8-3-5/8-3-6
- 8-3-28. Troubleshooting The Local Oscillator 8-3-9
- 8-3-32. Signature Analysis Procedures 8-3-10

LIST OF TABLES

Table — Page

8-3-1. Truth Table For ROM U16 8-3-4
8-3-2. Replaceable Parts 8-3-19

LIST OF ILLUSTRATIONS

Figure — Page

8-3-1. Clock Driver Output 8-3-2
8-3-2. Output From Data Input Buffer 8-3-2
8-3-3. Chip Data Ready (CDR) From Digital Filters 8-3-3
8-3-4. Digital Filter 8-3-7/8-3-8
8-3-5. Schematic E Troubleshooting Quick Reference 8-3-15/8-3-16
8-3-6. Digital Local Oscillator 8-3-17/8-3-18

DIGITAL FILTER AND LOCAL OSCILLATOR SERVICE GROUP 3

8-3-1. INTRODUCTION.

8-3-2. The Digital Filter and Digital Local Oscillator work in combination to provide low pass filtering of band translated signals. The Digital Filter operates on the data in quadrature which requires the Local Oscillator to output both SINE and COSINE values. These values are then multiplied by the input data to give both real and imaginary components. Each of the components is filtered and placed in memory through a direct memory access (DMA) firmware routine.

8-3-3. GENERAL INFORMATION.

8-3-4. Both the Digital Filter and the Local Oscillator must be synchronized together which requires that the Timing (A3) board be in operational order. The Digital Filter and Local Oscillator should be troubleshot using the front panel internal self tests before board level troubleshooting is initiated. Digital filter chips are identical and may be switched between sockets to confirm a malfunction. Use extreme caution in handling any of the LSI devices since damage may be caused by static discharge.

8-3-5. TROUBLESHOOTING THE DIGITAL FILTER.

8-3-6. In order to process data, the Digital Filter must have inputs from several other boards. This interdependency makes troubleshooting difficult since all interrelated boards and processes must also be working. This situation indicates a need to troubleshoot (at least at a fundamental level) from a system standpoint. Therefore, overall troubleshooting should begin with the Front Panel Self Tests which will aid in establishing the cause of the malfunction and may even indicate the bad component.

Digital Filter Test Table

Test Mode (oct)	Filter Chips Tested	Corresponding Instrument Mode
000000	2	None
000001	1	Chan A Baseband
000002	3	Chan B Baseband
000003	1,3	Dual Chan Baseband
000004	4	None
000005	1,2	Chan A Zoom
000006	3,4	Chan B Zoom
000007	1,2,3,4	Dual Chan Zoom

8-3-7. If the Digital Filter will not respond to any of the Front Panel Tests, then a procedure (given below) can be used to check the output of the support circuits located on the Digital Filter D (A5) board.

8-3-8. The Clock Driver Circuit.

8-3-9. The clock driver circuit receives its input from the Timing board (A3 -Schematic C). The circuit outputs are two 12 V (nominal) rectangular waveforms which are gated such that one must be low in order for the other to be high at any time. Check TP1 and TP2 and verify that the outputs correspond to the conditions indicated in the following illustration. Then repeat for TP13 and TP14.

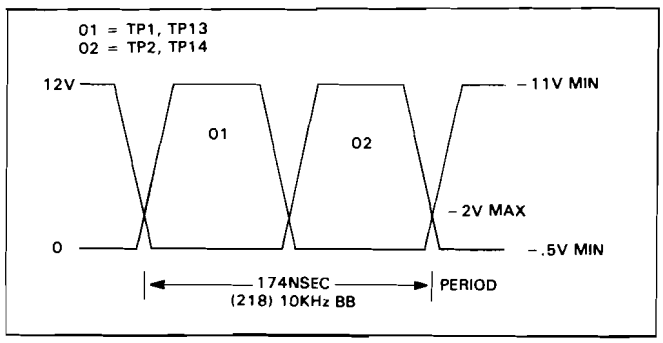


Figure 8-3-1. Clock Driver Output.

8-3-10. Data Input Buffer.

8-3-11. The input data buffer may be checked by verifying that digital data is available on the output lines.

a. Connect a two-channel oscilloscope to test points TP3 and TP5. Set the trigger controls to trigger off the channel connected to TP3. TP3 is the SYNC source for the digital filters and signals the filter chips when data on the other buffer output lines is valid.

b. Use the untriggered channel to confirm that signals are present on the signals lines as indicated in Figure 8-3-2.

NOTE

To check data on TP4 and TP10, the FREQUENCY MODE switch should be set to SET START or SET CENTER.

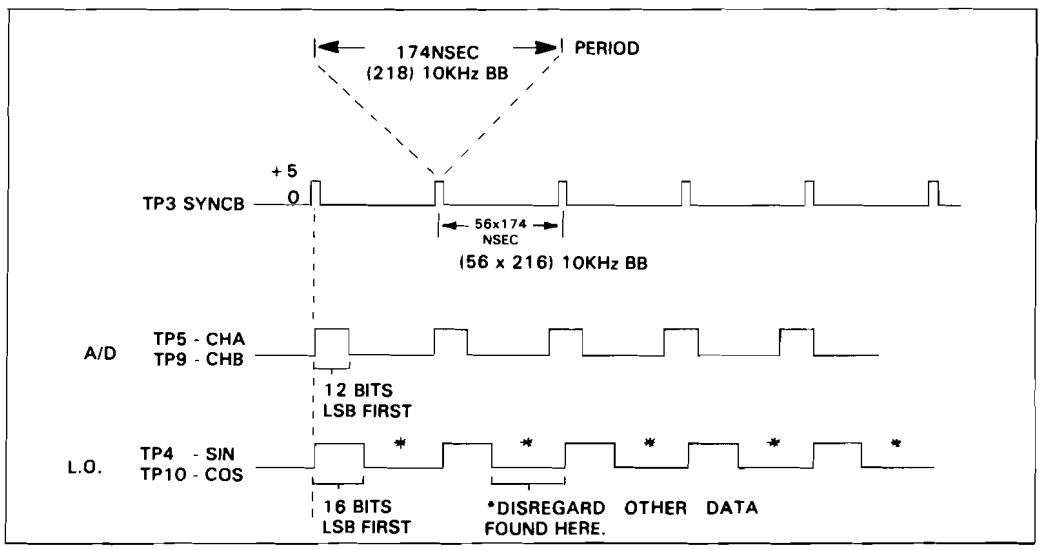


Figure 8-3-2. Output From Data Input Buffer.

8-3-12. DMA Request Circuit.

8-3-13. The DMA (direct memory access) circuit provides a signal to the processor (DMAR) which allows the Digital Filter access to memory through a firmware subroutine. The filter chips send a pulse on their CDR (chip data ready) lines when the input data has been low pass filtered. The AND gates perform logic operations which allow the following combinations of CDR inputs to a one of eight multiplexer.

Multiplexer Input	CDR Line	Function
DØ	CDR2	Cosine (real) Test
D1	CDR1	CH A Baseband
D2	CDR3	CH B Baseband
D3	CDR1 & CDR3	CH A & CH B Baseband
D4	CDR4	Sine (imaginary) Test
D5	CDR1 & CDR2	CH A Zoom (band analysis)
D6	CDR3 & CDR4	CH B Zoom
D7	CDR1, CDR2, CDR3, CDR4	CH A & CH B Zoom

8-3-14. These lines may be checked by using TP3 as a trigger and then placing the non-triggered channel on the selected line. The pulse should appear relative to the SYNC B signal as follows:

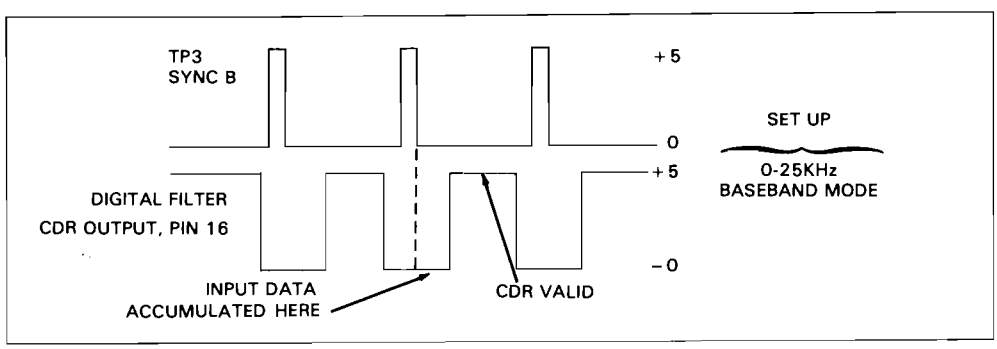


Figure 8-3-3. Chip Data Ready (CDR) From Digital Filters.

8-3-15. The multiplexer (U9) is coded by the controller to select one of the eight combinations for output to a D latch (U19). These signals clock the latch, setting the output $\overline{Q}$ low, to indicate data is ready for memory. The latch is reset by a combination of processor command (IS15) and controller command (LAST).

8-3-16. The Controller.

8-3-17. Once a DMA has been requested, it remains up to the Controller to sequence the output of the digital filter chips onto the 16-line Data Bus. The Controller consists of a data latch, ROM and programmable counter.

8-3-18. The data latch is clocked by the Processor to retain data off the I/O Bus corresponding to the operating mode (single, dual, or combinations thereof). The output of the latch (U17) in combination with the output of a programmable counter (U11) addresses a ROM (U16) which supplies the following outputs:

a. The YØ output is the load command to the programmable counter which sets the counter to zero. Thus, the two output lines from the counter can give four combinations of input address for every latch output.

b. Y2-Y5 are chip enable lines which allow each digital filter chip to output 16 bits of parallel data in sequence on the 16 bit data bus.

c. Y1 goes high when the last chip of the sequence has output data on the data bus.

8-3-19. See Table 8-3-1 which is also a flowchart that describes the states of the inputs and outputs of ROM U16.

Table 8-3-1. Truth Table For ROM U16.

	DC2 E	DC1 D	DCØ C	B	A	Y7	Y6	$\overline{CE4}$ Y5	$\overline{CE3}$ Y4	$\overline{CE2}$ Y3	$\overline{CE1}$ Y2	LAST Y1	LOAD YØ	Octal
Filt #2 Test	0	0	0	0	0			1	1	0	1	1	0	66
CH A BB*	0	0	1	0	0			1	1	1	0	1	0	72
CH B BB	0	1	0	0	0			1	0	1	1	1	0	56
CH A,B BB	0	1	1	0	0			1	1	1	0	0	1	71
	0	1	1	0	1			1	0	1	1	1	0	56
Filt #4 Test	1	0	0	0	0			0	1	1	1	1	0	36
CH A Z	1	0	1	0	0			1	1	1	0	0	1	71
	1	0	1	0	1			1	1	0	1	1	0	66
CH B Z	1	1	0	0	0			1	0	1	1	0	1	55
	1	1	0	0	1			0	1	1	1	1	0	36
CH A, BB, Z	1	1	1	0	0			1	1	1	0	0	1	71
	1	1	1	0	1			1	1	0	1	0	1	65
	1	1	1	1	0			1	0	1	1	0	1	55
	1	1	1	1	1			0	1	1	1	1	0	36

*BB = Baseband; Z = Zoom

8-3-20. The Overload Circuit.

8-3-21. The overload circuit performs two functions:

a. Immediate overloads are sensed which results in a front panel indicator signal.

b. Overload information is latched by an R-S flip-flop and saved for processor interrogation. This data is shown on the display by the printed "OVERLOAD" warning.

8-3-22. The inputs to the overload circuit consist of digital filter chip overload (OVL) and overflow (OVF) outputs, and clipping level indicators (clip A and clip B) from the input

(A1-Schematic A) board. These inputs are decoded by logic gates which drive R-S flip-flops U22 and buffer amplifiers U27.

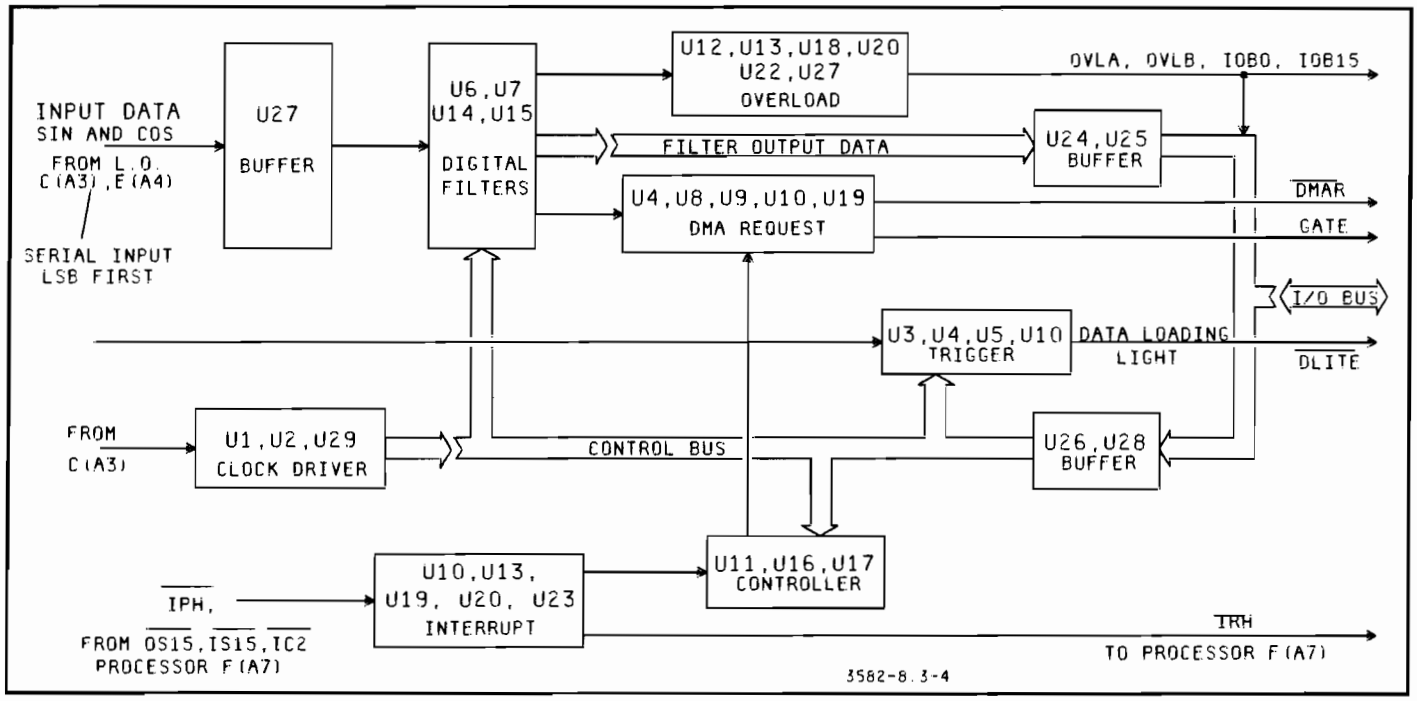
8-3-23. The DC 2 input from the controller gates overload data from digital filter chips #2 (A imaginary) and #4 (B imaginary) for band analysis mode operation. Processor outputs IS13 and IC1 reset U22 and gate U22 outputs onto the I/O Bus (IOB15 and IOBØ).

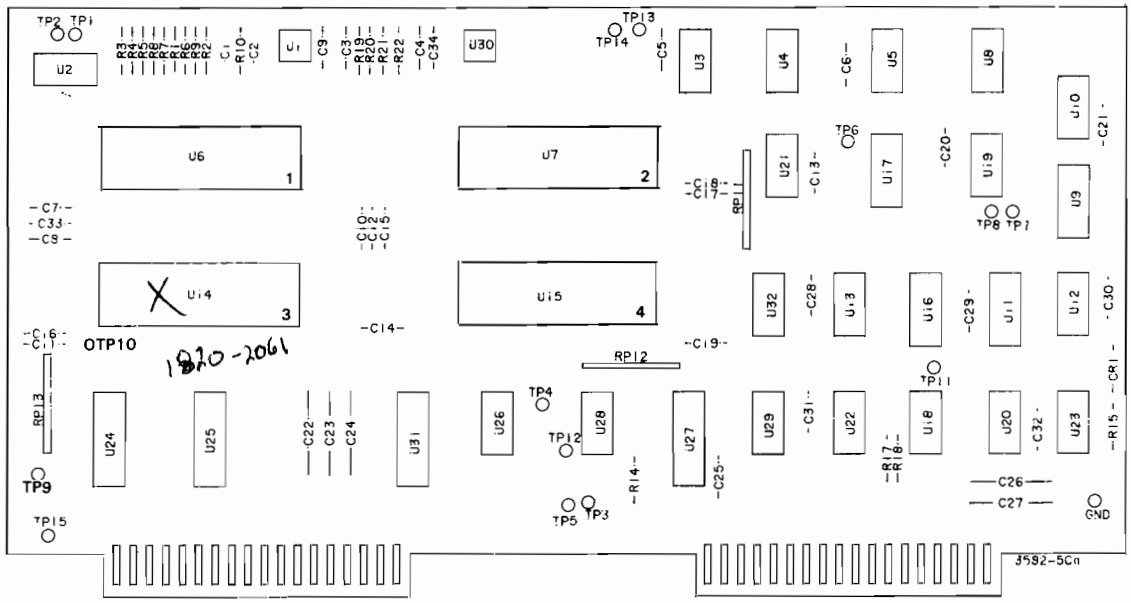
8-3-24. To check the operation of the overload circuit, supply an input signal to each channel. Slowly increase the amplitude until the displayed spectrum approaches the top horizontal graticule. When 100% of full scale is reached, the overload signals should appear at the outputs of the overload circuit. Check every combination of overload by changing the FREQUENCY MODE switch and INPUT MODE switch.

8-3-25. The Trigger Circuit.

8-3-26. The trigger circuit is composed of latches which detect the rising or falling edge of the trigger input signal from the Input(A1) board. Processor signals BØ and B1 set the slope and are latched in U3 by OSØ. A combination of B2 and OSØ resets the slope latches U5. The trigger input is applied to U5B and inverted at U5A. Thus, whichever latch has the D input high will have the correct Q low true output when the trig signal occurs. The trigger circuit output also enables the DMA output latch.

8-3-27. To check the trigger circuit, apply an input signal to Channel A. While observing the TIME display, slowly rotate the TRIGGER LEVEL control. An output signal at TP6 should appear on both negative and positive level settings. Change the setting of the slope switch and observe the TP6 while varying the TRIGGER LEVEL.





A5
03582-66505
Rev D

A5 DIGITAL FILTER 03582-66505

6A20 MOTHER BD 03582-66520

BUFFER

CLOCK DRIVER CIRCUIT

DIGITAL FILTERS

OVERLOAD CIRCUIT

DMA REQUEST

TRIGGER CIRCUIT

CONTROLLER

INTERRUPT

FILTER OUTPUT DATA BUS

CONTROL BUS

CHA A/D XA3B(10)

SYNC XA3B(9) XA4A(K)

COS XA4B(A)

CHB A/D XA3B(L)

SIN XA4B(1)

I513 XA7B(10) TO U12(9)

ICT XA4B(5) XA7B(V) TO U13(2)

CLK 1 XA3B(M)

CLK 2 XA3B(11)

TRIG A XA1A(8) TO U10(3)

OSC XA7B(11)

CLIPA TO U18(1)

CLIPB TO U18(4)

OVERLOAD CKT

I515 TO { U24(1,19) U25(1,19)

OSC XA7B(16)

I515 XA7B(M)

ICZ XA2B(S)

IPH XA7B(18)

"A" REAL

"A" IMAGINARY

"B" REAL

"B" IMAGINARY

CLIP A XA5A(6)

CLIP B XA5A(F)

TP11 OVLD A

TP12 OVLD B

CDR1

CDR2

CDR3

CDR4

SI5

DC2

LAST

TRIG A XA5A(13)

COPYRIGHT 1977 BY HEWLETT PACKARD COMPANY

OVERLOAD CIRCUIT

OUTPUT BUFFER

DMA REQUEST

TRIGGER CIRCUIT

BUFFER

INTERRUPT

CONTROLLER

"A" REAL

"A" IMAGINARY

"B" REAL

"B" IMAGINARY

FILTER OUTPUT DATA BUS

CONTROL BUS

I/O BUS

P/O A20 MOTHER BD 03582-66520

I/O BUS FROM ROM A6

Figure 8-3-4. Digital Filter. REV D
8-3-7/8-3-8

D

8-3-28. TROUBLESHOOTING THE LOCAL OSCILLATOR.

8-3-29. A quick check of the L.O. may be accomplished by performing the following procedure:

a. Verify that the LINE switch is OFF.

b. Place the A4 board on an extender.

c. Set the LINE switch to ON, FREQUENCY MODE to SET CENTER, and FREQUENCY ADJUST for 4779 Hz.

d. Turn the DC BAL on Channel A fully clockwise and move jumper A4J2 to "T" (test).

e. Return the FREQUENCY MODE switch to 0-25 kHz and adjust the SENSITIVITY controls for a proper display.

f. Except for spectral lines at 4779 Hz and 22 kHz, no other spectral displays above the noise floor should be seen. This indicates a properly working L.O. If the L.O. passes this test and there were no phase problems, return A4J2 to "R" (run).

g. Short the input and use the TIME display to set DC BAL for 0 Vdc as indicated by the trace on the center horizontal graticule.

8-3-30. More extensive testing of the L.O. may best be performed with the use of signature analysis. An oscilloscope can be used to check absolute signal levels and noisy signal lines. However, signal data, as referenced to time, varies greatly and is repetitive only over long periods.

8-3-31. As a secondary test of the L.O., see SA Sine and Cosine Quick Check. For phase verification see SA Test g.

8-3-32. Signature Analysis Procedures.

8-3-33. To use the SA procedures, preset the 3582A as follows:

A4J1 to "T" (test); A4J2 and J3 to "R" (run).
FREQUENCY MODE to SET CENTER
FREQUENCY ADJUST to 101 Hz
SPAN to 25 Hz
INPUT MODE to BOTH
TRIGGER REPETITIVE to ON
TRIGGER LEVEL to FREE RUN

8-3-34. Connect the -hp- 5004A Signature Analyzer to test jack J6 as follows:

GND	J6(1)
CLK	J6(3)
START	J6(4)
STOP	J6(5)

The +5 signature should be 35H1.

8-3-35. Sine and Cosine Quick Check. With the 5004A connected to test jack J6, the sine and cosine outputs (serial) may be checked at the following points:

Location	Signature	
TP10	063U	U388 for REV A, B AND C. This signature may be unstable on a working board.
U126 (13)	16H6	

8-3-36. If these signatures check correctly, the L.O. is probably functioning properly. To quickly check the phase output, proceed to SA Test g. If these signature are incorrect, continue.

NOTE

1. For SA to work on this board, the Timing board (A3) and the DMAR signal from the Digital Filter board (A5) must be operational. These inputs may be checked by placing the SA probe on the +5 V supply and obtaining the signature 35H1.

2. If wrong signatures are obtained, recheck the SA setup procedures preceeding each test section.

8-3-37. Perform the following steps:

a. Check the following signatures (timing and control):

U127 (2)	P7A2
6	6572
7	50A3
10	35A5
15	F18U

If ok, go to b, if not check:

U130 (11)	85UP	U131 (14)	AP63
12	U251	13	H8AA
13	3C14		
14	134U		

If ok, check:

U128 (12)	9137
11	A146
10	3538
9	831P

If ok, the problem is probably with U127.

b. Move SA CLK to TP4 and check signatures on the input latches, U101 and U104. (+5 signature C21U)

U101 (12)	C21U	U104 (12)	C21U
9	0000	9	0000
15	0000	15	0000
6	0000	6	0000
16	0000	16	0000
5	0000	5	0000
19	0000	19	0000
2	0000	2	0000

If these check ok, the board is set to correct frequency. Proceed to Part C. If not ok, double check the test setup (set center-101 Hz, 25 Hz, SPAN, DUAL channel mode, repetitive and free run).

If the test set-up is ok, check the latches and I/O bus using front panel I/O bus test #15 as follows:

NOTE

Do this test **only** *if previous signatures are incorrect.*

To perform the front panel self test,

Obtain self-test mode by pressing RESET while holding in RESTART.

Select average #256
Short A7J4 and push RESTART
Push RESTART until you get test #15.

Set up the 5004A as follows:

CLK: OS13 U101(11)
START/STOP: I/O 15 U104(14)
+5 Signature: UFP6

Check the following signature pairs:

U101 (3)	01UF	U101 (2)	026C	U104 (3)	0001	U104 (2)	0295
4	07U3	5	016F	4	0007	5	0296
7	1UFP	6	0H72	7	001U	6	029A
8	7U39	9	3H09	8	007U	9	02AA
13	UP73	12	7HAF	13	00UP	12	02PA
14	3U9F	15	1H5C	14	003U	15	028A
17	0UP7	16	0566	17	000U	16	0292
18	03U9	19	0369	18	0003	19	0294

Remove the short from A7J4 after this test.

c. With the 5004A clock still on TP4, check the latches and adders by checking the signatures in the first column below. If an error is found, work across the table to check preceeding signatures.

U111 (8)	6819	U108 (3)	HA06	U102 (12)	6819
7	98P3	4	638P	1	98P3
6	4H5C	6	356P	2	4H5C
5	HPA7	11	7A9F	3	HPA7
4	85C1	13	16F5	6	9374
3	125C	14	496P	U103 (12)	85C1
2	A89H	U109 (3)	A275	1	125C
1	F3UF	4	0UU3	2	A894
U112 (8)	C24U	6	C35H	3	F3UF
7	U8PF	11	P3C3	6	C30H
6	U63U	13	H8UF	U105 (5)	C24U
5	9073	14	41FH	3	U8PF
4	6481	U110 (3)	9205	14	U63U
3	C36H	4	FHC4	12	9073
2	21FA	6	872A	9	U684
				U106 (5)	6481
1	3675	11	H9H5	3	C36H
23	8C36	13	94U2	14	21FA
22	POUO	14	F7PF	12	3675
		U114 (5)	P53F	9	71FP
U110 (1)	C21U	6	6POA	U107 (5)	P53F
		3	U1UC	3	U1UC
		2	C21U		

d. Move 5004A clock to TP-8 and check the parallel to serial converters as follows:

1. Check for 5A61 at U120 (12).

2. If bad, check back through U121-123.

U121 (12)	C286
U122 (12)	AH66
U123 (12)	4807

If these all have bad signatures, check the ROMS.

3. Move 5004A clock to TP2 and check for U55F at U116 (13).

4. If bad, check back through U117 and U118.

U117 (12)	FA2U
U118 (12)	AU57

If all signatures are ok, the parallel to serial converters are working.

e. Move 5004A clock to TP-4 and check for 2637 at U115 (6). If this is ok, go to f. If bad, check the signatures below:

U115 (5)	8330	U115 (13)	9330
4	6819	12	POUU
3	1H52	11	P141
2	5317	15	FUP3
14	FC98		

If these are ok, U115 is probably bad.

f. Check the following signatures, clocking the 5004A on TP8.*

U119 (7)	32F2	Sin Output*
U126 (13)	17HU	Cos Output
U125 (3)	9961	
4	6279	
5	1UU5	
6	2133	
10	CP50	
11	71P1	
12	9639	
13	65H5	

Signature Table for D2. To be done only if all signatures in Section d, Part 2 are bad. Clock off TP-4.

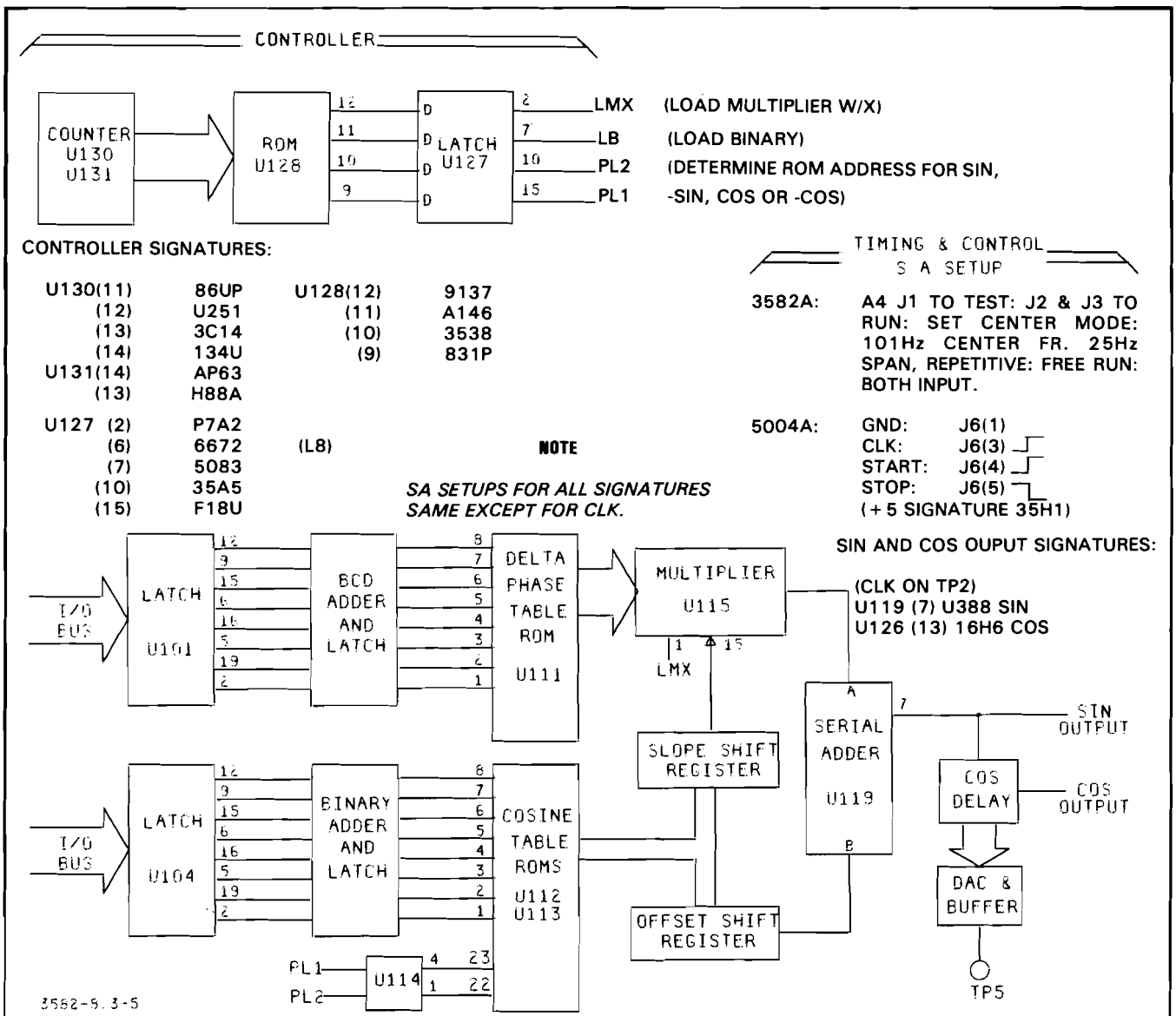
U111 (9)	8330		
10	6819		
		U113 (16)	17AO
11	1H52		
		17	49P6
13	5317		
		22	POUO
14	FC98	23	8C36
15	9330		
16	POUU		
17	P141		
U112 (9)	U7CU		
10	5COU		
11	CFUP		
13	F526		
14	F96A		
15	HCC3		
16	84A8		
17	1412		
U113 (9)	87A1		
10	F8C2		
11	UOFF		
13	AC05		
14	H917		
15	8324		

If the sin output is ok, but U125 and U126 signatures are wrong, it's probably U125. If all the above are wrong, check U119, U124, and U126 signatures. U119 (2) and (3) should have already been checked in Sections d and e.

U119 (4)	4A52	U124 (1)	35H1
5	F070	3	0000
		4	50A3
U126 (9)	35H1		
8	6572		

g. Trigger delay and phase. If phase is incorrect, check U135 and 134 signatures below. Clock on TP2.

U135 (3)	H8AA	U134 (3)	922U
4	86UP	4	C35U
7	3C14	7	3C2U
11	35H1		
		8	U6U7
14	134U	11	35H1
17	U251	13	3427
18	AP63	14	AH17
		17	AOHF
		18	HPUA



U101 & U104 SIGNATURES:* (SAME SETUP AS CONTROLLER EXCEPT CLK ON TP4 ( ) +5 SIGNATURE C21U) U101(12) C21U U104(12) C21U
BOTH IC's: PINS 2,5,6,9,15,16 AND 19: 0000

*IF THESE SIGNATURES ARE INCORRECT, USE THE I/O BUS TEST (DETAILS IN TEXT) TO CHECK THE INPUT.

BINARY ADDER AND LATCH OUTPUT SIGNATURES:

(SETUP AS ABOVE)

U112 (8)	C24U	U112 (3)	C36H
(7)	USPF	(2)	21FA
(6)	U63U	(1)	3675
(5)	9073	(23)	3C36
(4)	6481	(22)	POUO

BCD ADDER & LATCH OUTPUT SIGNATURES:

(SETUP AS AT LEFT)

U111(8)	6819	U111(4)	85C1
(7)	98P3	(3)	125C
(6)	4H5C	(2)	A89H
(5)	HPA7	(1)	F3UH

OFFSET SHIFT REGISTER OUTPUT SIGNATURE:

(CLK ON TP8): 5A61 U120(12)

SLOPE SHIFT REGISTER OUTPUT SIGNATURE:

(CLK ON TP8): A6AP U116(13)

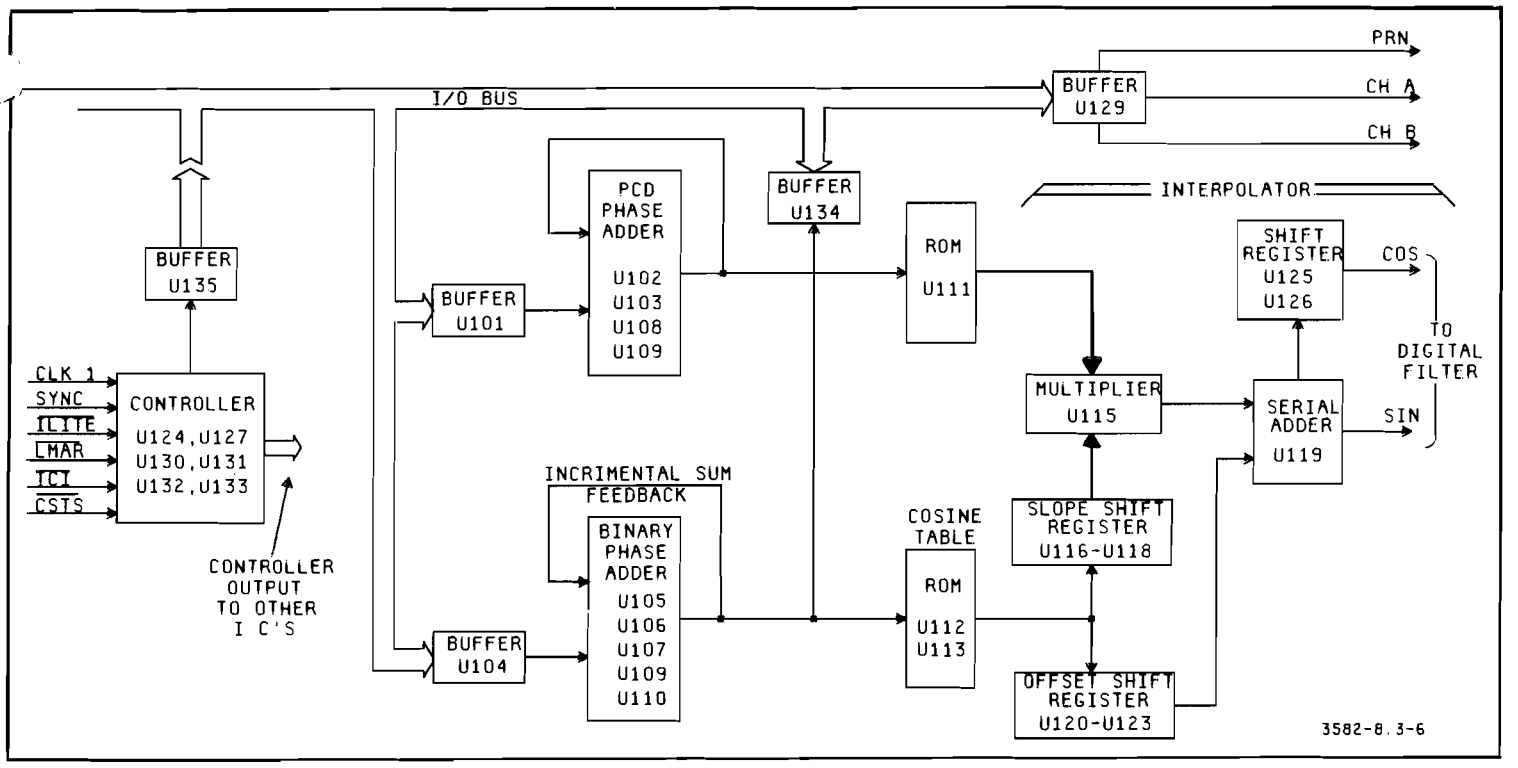
MULTIPLIER OUTPUT SIGNATURE:

(CLK ON TP4): 2637 U115(6)

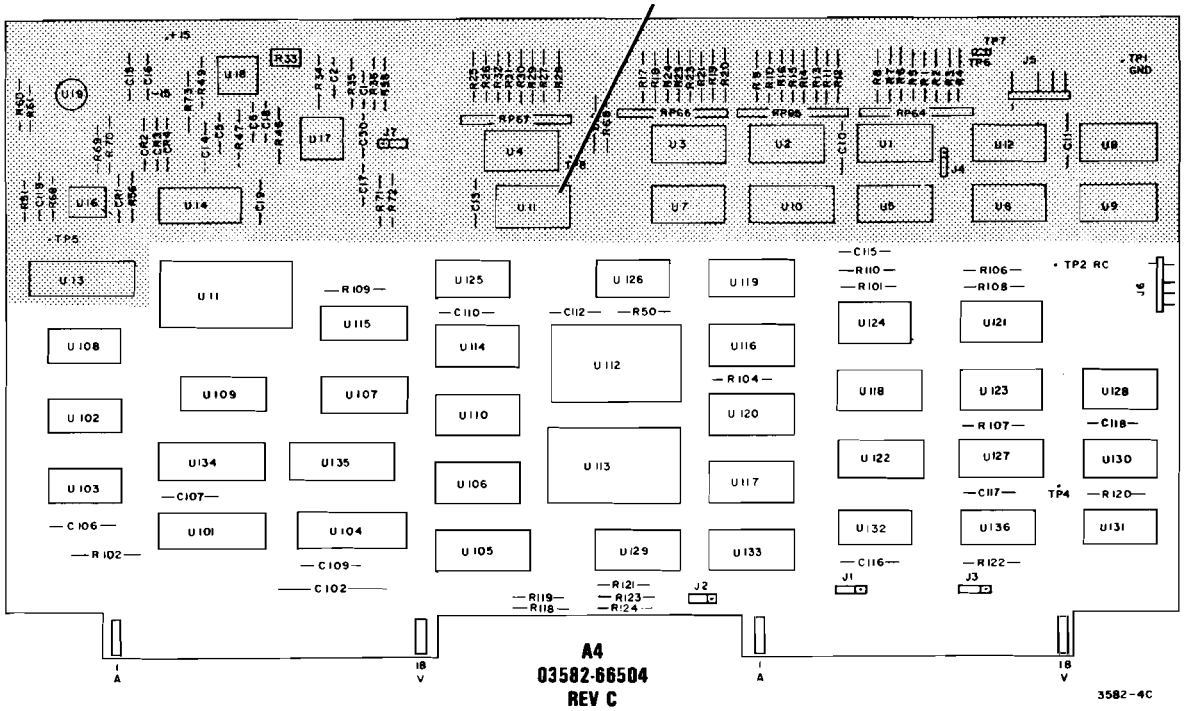
SERIAL ADDER OUTPUT SIGNATURE:

(CHECK SIN OUTPUT AS ABOVE)

Figure 8-3-5. Schematic E Troubleshooting Quick Reference.



NOT FOUND ON REV A.



A4
03582-66504
REV C

3582-4C

P/O A20 MOTHER BD 03582-66520

P/O A4 DIGITAL LO. 03582 66504

XA4A

I/O BUS FROM XA7 F

I/O 0 … I/O 15

F $\overline{\text{ISB}}$ XA7B(K) — $\overline{\text{ISB}}$ TO U134(J)

T +5V — C102 150 — +5V

TP1

XA4B T

100KHz TRIG DELAY U135

TIMING & CONTROL

U130 — N0 N1 N2 N3

U131 — N4 N5

ROM U128

U127

R107 1K +5

TP4 $\overline{\text{LB}}$

R120 1K +5

LMX

LB

PL2

PL1

TP2 RC

RC

$\overline{\text{SYNC}}$

$\overline{\text{SYNC1}}$

U133C — U132

CLK 1 XA3B(M)

SHOWN TWICE +5V R122 1K

U136

CLK-1

DLITE

LTCH

XA4A T

U133A — U133B

C SYNC XA3B(9)

D $\overline{\text{DLITE}}$ XA5B(C)

D $\overline{\text{DMAR}}$ XA5B(14)

JMPR 3

$\overline{\text{DMAR}}$

DSA TEST

CLR

XA4B

F $\overline{\text{FCI}}$ XA7B(V) / D XA5B(15)

U132A — U133D

JMPR 2 — R124 1K +5

JMPR 1

U124

R101 1K +5

TP3 START/STOP

F $\overline{\text{OSI3}}$ XA7B(15)

$\overline{\text{OSI3}}$

J6 — START/STOP — CLK — NC

BCD PHASE ADDER

R102 1K +5

U101 — U102 U108 — U103 U108 U109 — U104 — U105 U109 — U106 U110 — U107 U110 U114

SYNC T — CLR

OSI3

BINARY PHASE ADDER

$\overline{\text{ISB}}$ — LO TRIG PHASE U134 — LTCH

COSINE TABLE

U112 ROM — U113 ROM

U118 — U123

R106 1K +5 LMX

RC — LB

SHOWN TWICE

LMX
LB
PL 2
PL 1
RC
SYNC
SYNC'
CLK-1
DLITE
LTCH
DMAR
CLR
0513

BCD PHASE ADDER

BINARY PHASE ADDER

U101 U102 U103 U104 U105 U106 U107 U108 U109 U110

R102 1K

0513

SYNC'

CLR

158

LO TRIG PHASE U134

LTCH

Δ PHASE TABLE

U111 ROM

INTERPOLATOR

MULTIPLIER U115

R109 1K

LMX RC

COSINE TABLE

U112 ROM

U113 ROM

SLOPE SHIFT REGISTER

SHOWN TWICE

R106 1K R122 1K R104 1K

U118 U117 U116

R107 1K R108 1K

U123 U122 U121 U120

RC LB

OFFSET SHIFT REGISTER

U114

PL1 PL2

LATCH
A&B INPUT BOARD PROGRAMMING
PRN PROGRAMMING

R101 1K

U129

TO U9(1)
TO U10(1)
} ON PRN SCHEMATIC P

R118 390
R123 390
R121 390
R119 390

XA4A XA4B

CHA XA1A(J)
CHB XA1A(J)
CHB XA1A(H)
CHA XA1A(H)
} A

OSB XA7B(13) F

R110 1K

U124

TP10

U132 C

LB

U119 SERIAL ADDER

COS DELAY

U132B

TP8

U125 U126

U133

MSB LSB

TO U13
PSEUDO RANDOM NOISE
P

SIN XA5B(1) D

COS XA5B(A) D

E

Figure 8-3-6. Digital Local Oscillator.
8-3-17/8-3-18

Table 8-3-2. Replaceable Parts.

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A4	03582-66504	2	1	PC ASSEMBLY, LOCAL OSCILLATOR/PRN	28480	03582-66504
C1	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C2	0160-2222	2	1	CAPACITOR-FXD 1500PF +-5% 300VDC MICA	28480	0160-2222
C3	0140-0234	0	2	CAPACITOR-FXD 500PF +-1% 300VDC MICA	72136	DM15F501F0300WV1C
C4	0140-0234	0		CAPACITOR-FXD 500PF +-1% 300VDC MICA	72136	DM15F501F0300WV1C
C5	0160-2585	0	1	CAPACITOR-FXD 2000PF +-1% 100VDC MICA	28480	0160-2585
C6	0140-0223	7	1	CAPACITOR-FXD 260PF +-1% 300VDC MICA	72136	DM15F261F0300WV1C
C7	0160-3538	5	1	CAPACITOR-FXD 750PF +-5% 100VDC MICA	28480	0160-3538
C8	0160-2202	8	1	CAPACITOR-FXD 75PF +-5% 300VDC MICA	28480	0160-2202
C9	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C10	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C11	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C12	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C13	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C14	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C15	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C16	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C17	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C18	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C19	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C20	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C102	0180-0194	5		CAPACITOR-FXD 150UF+-10% 15VDC TA	56289	150D157X9015B2
C106	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C107	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C109	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C110	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C112	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C115	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C116	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C117	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C118	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
J1	1251-4822	6	6	CONNECTOR 3-PIN M POST TYPE	28480	1251-4822
J2	1251-4822	6		CONNECTOR 3-PIN M POST TYPE	28480	1251-4822
J3	1251-4822	6		CONNECTOR 3-PIN M POST TYPE	28480	1251-4822
J4	1251-4822	6		CONNECTOR 3-PIN M POST TYPE	28480	1251-4822
J5	1251-5202	8		CONNECTOR 5-PIN M POST TYPE	28480	1251-5202
J6	1251-5202	8		CONNECTOR 5-PIN M POST TYPE	28480	1251-5202
R1	0698-7332	4	3	RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-7332
R2	0698-3457	6	2	RESISTOR 316K 1% .125W F TC=0+-100	28480	0698-3457
R3	0698-4525	1	2	RESISTOR 187K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1873-F
R4	0698-3271	2	2	RESISTOR 115K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1153-F
R5	0698-4511	5	2	RESISTOR 86.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8662-F
R6	0698-4507	9	2	RESISTOR 76.8K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7682-F
R7	0757-0463	4	2	RESISTOR 82.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8252-F
R8	0698-4520	6	2	RESISTOR 143K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1433-F
R9	0698-4536	4	2	RESISTOR 340K 1% .125W F TC=0+-100	28480	0698-4536
R10	0698-4499	8	2	RESISTOR 54.9K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5492-F
R11	0698-4488	5	2	RESISTOR 26.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2672-F
R12	0698-4481	8	2	RESISTOR 16.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1652-F
R13	0698-3264	3		RESISTOR 11.8K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1182-F
R14	0698-4020	1	4	RESISTOR 9.53K 1% .125W F TC=0+-100	24546	C4-1/8-T0-9531-F
R15	0757-0441	8	2	RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
R16	0698-4472	7	2	RESISTOR 7.68K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7681-F
R17	0698-4472	7		RESISTOR 7.68K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7681-F
R18	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
R19	0698-4020	1		RESISTOR 9.53K 1% .125W F TC=0+-100	24546	C4-1/8-T0-9531-F
R20	0698-3264	3		RESISTOR 11.8K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1182-F
R21	0698-4481	8		RESISTOR 16.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1652-F
R22	0698-4488	5		RESISTOR 26.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2672-F
R23	0698-4499	8		RESISTOR 54.9K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5492-F
R24	0698-4536	4		RESISTOR 340K 1% .125W F TC=0+-100	28480	0698-4536
R25	0698-4520	6		RESISTOR 143K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1433-F
R26	0757-0463	4		RESISTOR 82.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8252-F
R27	0698-4507	9		RESISTOR 76.8K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7682-F
R28	0698-4511	5		RESISTOR 86.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8662-F
R29	0698-3271	2		RESISTOR 115K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1153-F
R30	0698-4525	1		RESISTOR 187K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1873-F
R31	0698-3457	6		RESISTOR 316K 1% .125W F TC=0+-100	28480	0698-3457
R32	0698-7332	4		RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-7332
R33	2100-0552	3	1	RESISTOR-TRMR 50 10% C SIDE-ADJ 1-TRN	28480	2100-0552
R34	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
R35	0698-4123	5		RESISTOR 499 1% .125W F TC=0+-100	24546	C4-1/8-T0-499R-F

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

Table 8-3-2. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
R36	0757-0283	6	5	RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
R37	0757-0427	0	1	RESISTOR 1.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1501-F
R38	0757-0289	2	1	RESISTOR 13.3K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-1332-F
R39	0757-0433	8		RESISTOR 3.32K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3321-F
R40	0757-0278	9	1	RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1781-F
R41	0698-3154	0	2	RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
R42	0698-0084	9	2	RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
R43	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
R44	0757-0444	1	2	RESISTOR 12.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1212-F
R45	0757-0444	1		RESISTOR 12.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1212-F
R46	0757-0439	4	2	RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
R47	0757-0439	4		RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
R49	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
R50	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R51	0757-0161	9		RESISTOR 604 1% .125W F TC=0+-100	24546	C4-1/8-T0-604R-F
R52	0698-3157	3	1	RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
R53	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
R54	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
R55	0698-3572	6	1	RESISTOR 60.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6042-F
R56	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
R57	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
R58	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
R59	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
R60	0757-0719	3	2	RESISTOR 221 1% .25W F TC=0+-100	27167	C5-1/4-T0-221R-F
R61	0757-0719	3		RESISTOR 221 1% .25W F TC=0+-100	27167	C5-1/4-T0-221R-F
R62	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
R63	0698-3155	1	1	RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
R68	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R101	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R102	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R104	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R106	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R107	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R108	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R109	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R110	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R118	0683-3915	0		RESISTOR 390 5% .25W FC TC=-400/+600	01121	CB3915
R119	0683-3915	0		RESISTOR 390 5% .25W FC TC=-400/+600	01121	CB3915
R120	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R121	0683-3915	0		RESISTOR 390 5% .25W FC TC=-400/+600	01121	CB3915
R122	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R123	0683-3915	0		RESISTOR 390 5% .25W FC TC=-400/+600	01121	CB3915
R124	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
RP64	1810-0279	5	7	NETWORK-RES 10-PIN-SIP .1-PIN-SPCG	11236	750-101-R4.7K
RP65	1810-0279	5		NETWORK-RES 10-PIN-SIP .1-PIN-SPCG	11236	750-101-R4.7K
RP66	1810-0279	5		NETWORK-RES 10-PIN-SIP .1-PIN-SPCG	11236	750-101-R4.7K
RP67	1810-0279	5		NETWORK-RES 10-PIN-SIP .1-PIN-SPCG	11236	750-101-R4.7K
TP6	1251-5380	3		CONNECTOR 2-PIN M POST TYPE	28480	1251-5380
TP7	1251-5380	3		CONNECTOR 2-PIN M POST TYPE	28480	1251-5380
U1	1820-1433	6	12	IC SHF-RGTR TTL LS R-S SERIAL-IN PRL-OUT	01295	SN74LS164N
U2	1820-1433	6		IC SHF-RGTR TTL LS R-S SERIAL-IN PRL-OUT	01295	SN74LS164N
U3	1820-1433	6		IC SHF-RGTR TTL LS R-S SERIAL-IN PRL-OUT	01295	SN74LS164N
U4	1820-1433	6		IC SHF-RGTR TTL LS R-S SERIAL-IN PRL-OUT	01295	SN74LS164N
U5	1820-1207	2	3	IC GATE TTL LS NAND 8-INP	01295	SN74LS30N
U6	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
U7	1820-1211	8	2	IC GATE TTL LS EXCL-OR QUAD 2-INP	01295	SN74LS86N
U8	1820-1206	1	2	IC GATE TTL LS NOR TPL 3-INP	01295	SN74LS27N
U9	1820-1470	1	2	IC MUXR/DATA-SEL TTL LS 2-TO-1-LINE QUAD	01295	SN74LS157N
U10	1820-1470	1		IC MUXR/DATA-SEL TTL LS 2-TO-1-LINE QUAD	01295	SN74LS157N
U11	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
U12	1820-1199	1		IC INV TTL LS HEX 1-INP	01295	SN74LS04N
U13	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
U14	1826-0188	8		IC 1408 CONV 16-DIP-C	04713	MC1408L-8
U15	1826-0437	0	1	IC MULTIPLIER 14-DIP-C	04713	MC1495L
U16	1826-0139	9	3	IC 1458 DP AMP 8-DIP-P	01928	CA1458G
U17	1826-0139	9		IC 1458 DP AMP 8-DIP-P	01928	CA1458G
U18	1826-0139	9		IC 1458 DP AMP 8-DIP-P	01928	CA1458G
U19	1820-0224	1	3	IC OP AMP TO-99	27014	LH0002CH
	1205-0011	0		HEAT SINK TO-5/TO-39-PKG	28480	1205-0011
U101	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
U102	1820-1467	6	2	IC ADDR TTL S BCD ADDER 4-BIT	18324	N82S83B
U103	1820-1467	6		IC ADDR TTL S BCD ADDER 4-BIT	18324	N82S83B
U104	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
U105	1820-1441	6	4	IC ADDR TTL LS BIN FULL ADDR 4-BIT	01295	SN74LS283N

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

Table 8-3-2. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	CD	Qty	Description	Mfr Code	Mfr Part Number
U106	1820-1441	6		IC ADDR TTL LS BIN FULL ADDR 4-BIT	01295	SN74LS283N
U107	1820-1441	6		IC ADDR TTL LS BIN FULL ADDR 4-BIT	01295	SN74LS283N
U108	1820-1196	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174N
U109	1820-1196	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174N
U110	1820-1196	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174N
U111	1818-0505	6	1	IC NMOS 8192-BIT ROM 450-NS 3-S(ΔPHASE)	02910	CN2049
U112	1818-0507	8	1	IC NMOS 8192-BIT ROM 450-NS 3-S(LSB)	02910	CN2028
U113	1818-0506	7	1	IC NMOS 8192-BIT ROM 450-NS 3-S(MSB)	02910	CN2029
U114	1820-1441	6		IC ADDR TTL LS BIN FULL ADDR 4-BIT	01295	SN74LS283N
U115	1820-2120	0	1	IC MULTR TTL LS 8-BIT	34335	AM25LS14DC
U116	1820-1300	6	7	IC SHF-RGTR TTL LS R-S PRL-IN PRL-OUT	01295	SN74LS195AN
U117	1820-1300	6		IC SHF-RGTR TTL LS R-S PRL-IN PRL-OUT	01295	SN74LS195AN
U118	1820-1300	6		IC SHF-RGTR TTL LS R-S PRL-IN PRL-OUT	01295	SN74LS195AN
U119	1820-0357	1	1	IC ADDR TTL FULL ADDER DUAL 1-BIT	07263	9304PC
U120	1820-1300	6		IC SHF-RGTR TTL LS R-S PRL-IN PRL-OUT	01295	SN74LS195AN
U121	1820-1300	6		IC SHF-RGTR TTL LS R-S PRL-IN PRL-OUT	01295	SN74LS195AN
U122	1820-1300	6		IC SHF-RGTR TTL LS R-S PRL-IN PRL-OUT	01295	SN74LS195AN
U123	1820-1300	6		IC SHF-RGTR TTL LS R-S PRL-IN PRL-OUT	01295	SN74LS195AN
U124	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74N
U125	1820-1433	6		IC SHF-RGTR TTL LS R-S SERIAL-IN PRL-OUT	01295	SN74LS164N
U126	1820-1433	6		IC SHF-RGTR TTL LS R-S SERIAL-IN PRL-OUT	01295	SN74LS164N
U127	1820-1195	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS175N
U128	1816-1182	3	1	IC TTL 1K ROM 65-NS 3-S	18324	N82S129F PROGRAMMED
U129	1820-1196	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174N
U130	1820-1432	5		IC CNTR TTL LS BIN SYNCHRO POS-EDGE-TRIG	01295	SN74LS163N
U131	1820-1432	5		IC CNTR TTL LS BIN SYNCHRO POS-EDGE-TRIG	01295	SN74LS163N
U132	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
U133	1820-1492	7	1	IC BFR TTL LS INV HEX 1-INP	01295	SN74LS368N
U134	1820-1997	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG PRL-IN	34335	SN74LS374PC
U135	1820-1997	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG PRL-IN	34335	SN74LS374PC
U136	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74N
				MISCELLANEOUS PARTS		
	4040-0748	3		EXTRACTOR-PC BOARD BLK POLYC	28480	4040-0748
	4040-0752	9	2	EXTRACTOR-PC BOARD YEL POLYC	28480	4040-0752

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

Table 8-3-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A5	03582-66505	3	1	PC ASSEMBLY, DIGITAL FILTER	28480	03582-66505
C1	0160-2208	4	2	CAPACITOR-FXD 330PF +-5% 300VDC MICA	28480	0160-2208
C2	0160-2208	4		CAPACITOR-FXD 330PF +-5% 300VDC MICA	28480	0160-2208
C3	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C4	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C5	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C6	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C7	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C8	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C9	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C10	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C11	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C12	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C13	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C14	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C15	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C16	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C17	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C18	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C19	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C20	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C21	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C22	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X901082
C23	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X903582
C24	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X901082
C25	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C26	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X903582
C27	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X903582
C28	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C29	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C30	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C31	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C32	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C33	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C34	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
CR1	1902-3030	7		DIODE-ZNR 3.01V 5% DO-7 PD=.4W TC=-.067%	28480	1902-3030
R1	0683-1025	9	53	RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R2	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R3	0683-1005	5		RESISTOR 10 5% .25W FC TC=-400/+500	01121	CB1005
R4	0683-1005	5		RESISTOR 10 5% .25W FC TC=-400/+500	01121	CB1005
R5	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R6	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R7	0683-2715	6		RESISTOR 270 5% .25W FC TC=-400/+600	01121	CB2715
R8	0683-2715	6		RESISTOR 270 5% .25W FC TC=-400/+600	01121	CB2715
R9	0683-2415	3	3	RESISTOR 240 5% .25W FC TC=-400/+600	01121	CB2415
R10	0683-2415	3		RESISTOR 240 5% .25W FC TC=-400/+600	01121	CB2415
R14	0683-5625	3	3	RESISTOR 5.6K 5% .25W FC TC=-400/+700	01121	CB5625
R15	0683-1225	1	1	RESISTOR 1.2K 5% .25W FC TC=-400/+700	01121	CB1225
R17	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
R18	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
R19	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R20	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R21	0683-1005	5		RESISTOR 10 5% .25W FC TC=-400/+500	01121	CB1005
R22	0683-1005	5		RESISTOR 10 5% .25W FC TC=-400/+500	01121	CB1005
RP11	1810-0030	6	3	NETWORK-RES 8-PIN-SIP .125-PIN-SPCG	28480	1810-0030
RP12	1810-0030	6		NETWORK-RES 8-PIN-SIP .125-PIN-SPCG	28480	1810-0030
RP13	1810-0030	6		NETWORK-RES 8-PIN-SIP .125-PIN-SPCG	28480	1810-0030
U1	1820-2103	9	2	IC DRVR TTL/MOS CLOCK DRVR DUAL	34335	D30056CN
U2	1820-0681	4	3	IC GATE TTL S NAND QUAD 2-INP	01295	SN74S00N
U3	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74L374N
U4	1820-1197	9	18	IC GATE TTL LS NAND QUAD 2-INP	01295	SN74L00N
U5	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74L374N
U6	1820-2061	8	4		28480	1820-2061
U7	1820-2061	8			28480	1820-2061
U8	1820-1201	6		IC GATE TTL LS AND QUAD 2-INP	01295	SN74L08N
U9	1820-1217	4	1	IC MUXR/DATA-SEL TTL LS 8-TO-1-LINE	01295	SN74LS151N
U10	1820-1199	1		IC INV TTL LS HEX 1-INP	01295	SN74L04N
U11	1820-1432	5	3	IC CNTR TTL LS BIN SYNCHRO POS-EDGE-TRIG	01295	SN74LS163N
U12	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74L00N
U13	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74L00N
U14	1820-2061	8			28480	1820-2061
U15	1820-2061	8			28480	1820-2061

Table 8-3-2. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
U16	1816-1199	2	1	IC TTL 256-BIT ROM 40-NS 0-C	01295	SN748188N PROGRAMMED
U17	1820-1196	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174N
U18	1820-1201	6		IC GATE TTL LS AND QUAD 2-INP	01295	SN74LS08N
U19	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74N
U20	1820-1198	0		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS03N
U21	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
U22	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
U23	1820-1144	6		IC GATE TTL LS NOR QUAD 2-INP	01295	SN74LS02N
U24	1820-1873	8	4	IC BFR TTL LS INV OCTL 2-INP	27014	DM81LS98N
U25	1820-1873	8		IC BFR TTL LS INV OCTL 2-INP	27014	DM81LS98N
U26	1820-1199	1		IC INV TTL LS HEX 1-INP	01295	SN74LS04N
U27	1820-1759	9		IC BFR TTL LS NON-INV OCTL	27014	DM81LS97N
U28	1820-1199	1		IC INV TTL LS HEX 1-INP	01295	SN74LS04N
U29	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74N
U30	1820-2103	9		IC DRVR TTL/MOS CLOCK DRVR DUAL	34335	D80056CN
U31	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
U32	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
				MISCELLANEOUS PARTS		
	0340-0677	9	2	INSULATOR MYLAR	28480	0340-0677
	1200-0552	4		SOCKET-IC 40-CONT DIP-SLDR	28480	1200-0552
	03582- 01231	6	2	CLAMP, HEAT SINK	28480	03582-01231
	03582-21101	1	4	HEAT SINK	28480	03582-21101
	4040-0748	3		EXTRACTOR-PC BOARD BLK POLYC	28480	4040-0748
	4040-0753	0		EXTRACTOR-PC BOARD GRN POLYC	28480	4040-0753

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

SERVICE GROUP 4
PROCESSOR

TABLE OF CONTENTS

Service Group — Page

4. PROCESSOR 8-4-1
   - 8-4-1. Introduction 8-4-1
   - 8-4-3. Bus Structure 8-4-1
   - 8-4-5. Internal Tests 8-4-1
   - 8-4-7. Troubleshooting Strategy 8-4-1
   - 8-4-14. Using The Internal Tests 8-4-2
   - 8-4-19. Processor Troubleshooting 8-4-4
   - 8-4-21. Troubleshooting The ROM Assembly 8-4-11
   - 8-4-25. Troubleshooting 8-4-11
   - 8-4-30. Front Panel Self-Test 8-4-11
   - 8-4-32. Signature Analysis Procedures 8-4-12
   - 8-4-34. Troubleshooting The RAM Assembly 8-4-17
   - 8-4-35. Introduction 8-4-17
   - 8-4-38. Troubleshooting 8-4-17
   - 8-4-40. Front Panel Self-Test 8-4-17
   - 8-4-42. Signature Analysis 8-4-42

LIST OF TABLES

Table — Page

8-4-1. IDA Bus Signatures 8-4-3
8-4-2. ROM SA Troubleshooting 8-4-13/8-4-14
8-4-3. Error Codes For RAM Tests 8-4-18
8-4-4. Replaceable Parts 8-4-25

LIST OF ILLUSTRATIONS

Figure — Page

8-4-1. IDA Bus Troubleshooting Quick Reference For Schematic F 8-4-5/8-4-6
8-4-2. I/O Bus Troubleshooting Quick Reference For Schematic F 8-4-7/8-4-8
8-4-3. A7 Processor 8-4-9/8-4-10
8-4-4. A6 Read Only Memory 8-4-15/8-4-16
8-4-5. Random Access Memory 8-4-21/8-4-22

PROCESSOR
SERVICE GROUP 4

8-4-1. INTRODUCTION.

8-4-2. The Processor Service Group consists of the Processor, Random Access Memory (RAM) and Read Only Memory (ROM) Assemblies. Processor instructions are contained in the ROM while data storage is in the RAM. Since this group is so essential to instrument operation, faults can cause a wide variety of problems. On the other hand, several internal self tests are provided to speed troubleshooting.

8-4-3. BUS STRUCTURE.

8-4-4. It is useful to think of processor functions in two groups; I/O Bus and IDA Bus. The I/O Bus communicates data and processor instructions to all peripheral assemblies, except the ROM and RAM. These would include operations such as reading the front panel switch registers or passing data from the digital filters to the RAM. The IDA Bus (instruction, data and address) communicates instructions and addresses to and from the ROM and data and addresses to and from the RAM. Notice that the Troubleshooting Diagrams are divided along these lines.

8-4-5. INTERNAL TESTS.

8-4-6. There are several internal tests that can be used to check circuitry in this group and they can again be divided along the lines given above. For the I/O Bus section, an I/O Bus Test is provided. This test can selectively enable peripheral bus buffers and also puts readable signatures on the I/O Bus lines. For the IDA Bus portion, a basic Processor Test Loop is provided. This exercises the memory control circuits and puts readable signatures on the IDA Bus. In addition to the basic test loop, there are "primitive" ROM and RAM tests which can do overall tests on the memory assemblies in addition to providing readable signatures.

8-4-7. TROUBLESHOOTING STRATEGY.

8-4-8. As previously stated, a malfunction in this group can cause a wide variety of problems. However, it is useful to divide these into two general groups:

a. Instrument not responding to front panel or "hung-up".
b. All other problems with a running instrument.

8-4-9. A *non-responding mode* is caused usually by a peripheral line being in the wrong state and holding up program execution. Once stopped in program execution, the processor will not "get around to" reading the front panel and will thus not respond to changes in front panel settings.

NOTE

When a diagnostic message appears on the screen, the instrument will not respond to changes in front panel settings until the diagnostic is cleared. For example, pressing COHERENCE will cause the message "USE BOTH MODE RMS AVERAGE FOR COHERENCE" unless alredy in that mode. The instrument will not respond unless BOTH mode RMS AVERAGE is selected or COHERENCE is released.

8-4-10. The following procedure provides a quick check as to whether the processor is running:

a. Release the Amplitude and Phase Display pushbuttons and the REPETITIVE pushbutton.

b. Moving the INPUT MODE slide switch from A or B to BOTH should cause the display section LED to move from SINGLE CHAN to BOTH CHAN.

c. If the LED moves, the processor is running.

NOTE

It should be emphasized that a bad processor is not usually the cause of non-response.

8-4-11. To isolate the cause of non-response, follow the procedure below for each of the A2,3,4 and 5 assemblies. Power should be turned off before a board is removed or replaced.

a. Turn the instrument off and remove a board (A2,3,4 or 5).

b. Turn the instrument on and check for a running processor using the procedure in Paragraph 8-4-10.

c. If the processor is now running, the board pulled is the cause. Check the associated control lines to the processor.

d. If the processor is not running, repeat the procedure for the next board.

8-4-12. If this strategy does not result in a running processor, the problem is probably with the processor or one of the memory boards. Refer to information in Using The Internal Tests to help find the problem.

8-4-13. Other problems with the instrument can be found using the internal test information below and specific troubleshooting information given in the rest of this group.

8-4-14. USING THE INTERNAL TESTS.

8-4-15. As stated earlier, the internal tests consist of an I/O Bus test and basic processor, RAM and ROM tests. Information on the I/O Bus test is given in the I/O Bus Section Troubleshooting Diagram. The other tests are described in the following sections.

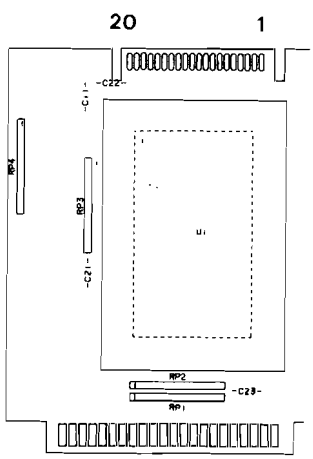
8-4-16. The Basic Processor Test Loop tests the memory control circuits and passing this test indicates that this section of the processor is at least basically working. If the problem is a non-responding instrument, all the circuit boards except A7, 9 and 10 can be pulled out of the card nest to more or less "start from scratch" in troubleshooting. If the processor passes this test, the ROM (A6) board can be added and its basic test run. The process can then be repeated with the RAM board. If the instrument passes the basic processor test loop, it's a good idea to check the IDA Bus signatures before continuing. These signatures are given on the next page and the IDA Bus Section Troubleshooting Diagram. Follow this procedure to enter the basic processor test loop:

a. Move jumper A7 J2 to the "test" position.
b. Set up the 5004 Signature Analyzer as follows:

GND:	J1(1)	
CLK:	J1(3)	
START:	J1(4)	
STOP:	J1(5)	

c. With the probe to +5 and the probe reset button pressed and released, the signature should be 9PA2. Note, it may be necessary to press RESET. If this is correct, the IDA Bus signatures below can be checked.

d. If the +5 signature is incorrect, troubleshooting information is given on the IDA Bus Section Troubleshooting Diagram. Access to these signatures is from the top, backside of the A7 assembly.



BACK SIDE OF A7 (NOT SHOWN)

Table 8-4-1. IDA Bus Signatures.

IDA Bus Line		XA7A		
0	(A20)	14F3	1	F666
1	(A19)	1882	2	7CA8
2	(A18)	POA8	3	8P75
3	(A17)	882A	4	775H
4	(A16)	775H	5	882A
5	(A15)	8P75	6	POA8
6	(A14)	7CA8	7	1882
7	(A13)	F666	8	14F3
8	(A5)	3343	A	9PA2
9	(A6)	97A5	B	P156
10	(A7)	9160	C	AA5F
11	(A8)	5586	D	A412
12	(A9)	A412	F	5586
13	(A10)	AA5F	H	9160
14	(A11)	P156	J	97A5
15	(A12)	9PA2	L	3343

8-4-17. If satisfactory results are obtained from the processor test loop checks, turn off the instrument and install the ROM (A6) board. To enter the primitive ROM test:

a. Move jumper A7 J2 to "run" and turn the instrument on.

b. Short A7 J4 and press RESET (front panel). A754 must remain shorted.

c. Set up the 5004A as in the previous section.

d. The +5 signature should be OH62. Note that this signature will take about 10 seconds

to come up. If this is incorrect, check the IDA Bus signatures in Table 8-4-1 (J2 to test and J4 unshorted) and continue with ROM troubleshooting procedures given later in this section.

e. If the signature is correct, continue with the primitive RAM test.

8-4-18. The primitive RAM test does not completely check the RAM, but provides stable signatures for component level troubleshooting given later in this section. At this point, having passed the basic processor and ROM tests, the front panel self-tests should run; and included in these is a very complete RAM test. Details are given later in this section. To check the +5 signature here, install the RAM board and remove the jumper from A7 J4. For the same 5004A setup as above, the +5 signature should be 89FP, which takes about ten seconds to come up. Note that the tests must be done in the order given. That is, with jumper J2 to run, shorting J4 enters the ROM test mode. Unshorting J4, after pressing RESET, enters the RAM test mode.

8-4-19. PROCESSOR TROUBLESHOOTING.

8-4-20. Processor troubleshooting information is given on the following two Troubleshooting Diagrams. In general, it is difficult to say that one particular section of the assembly is causing a particular problem. In these cases, it is most appropriate to do all the tests given on the diagrams. An exception would be if the problem is with a specific peripheral. In this instance, the I/O select line associated with the peripheral can be checked using the I/O Bus test. This information is given on the I/O Bus Section diagram.

GENERAL TROUBLESHOOTING.

a. *Check The Power Supplies.* First check the power supply LED's for a "green" condition, then make sure the following voltages are getting to the board.

1. *+12:* should be 12.01-12.37 VDC at top of A7 C18.

2. *− 5:* should be −5.5 to −4.5 VDC at right side of A7 C22. If not present, check or −18 VDC on the can of U24.

3. *+ 7:* should be +7 (+0.15, −0.07) at the top of C21.

4. *+ 5:* should be +5 (+0.1, −0.05) at the top of C14.

b. *Clock.* Check that $\emptyset_1$ (TP1) and $\emptyset_2$ (TP2) clocks have high and low levels > 11V and < 1V and cross at less than 1V.

INTRODUCTION.

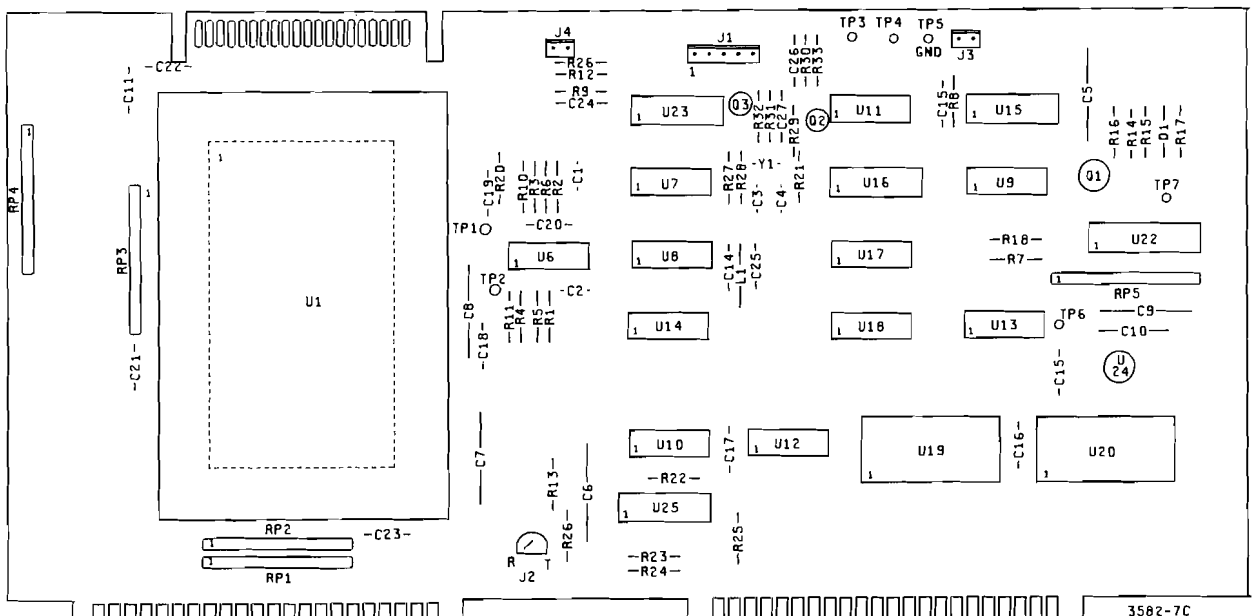
This section of the Processor Assembly handles communications with the ROM (A6) and RAM (A8) memory assemblies. Instructions, data and memory addresses are sent over the "IDA" Bus.

A memory cycle begins with STM (TP3) going low. The RAM/ROM Select circuit determines whether the communication will be with the ROM, RAM or an internal register. An internal register operation is indicated by a high Register Access Line (RAL). The output of the select circuit will be a Start ROM or Start RAM ($\overline{\text{STROM}}$ or $\overline{\text{STRAM}}$).

A $\overline{\text{STROM}}$ or $\overline{\text{STRAM}}$ will start the Memory Control circuit through its count, as long as Memory Busy $\overline{\text{MEB}}$ is high. This line holds off the memory cycle if the RAM assembly is in the middle of a refresh cycle. The purpose of the control circuit is to allow time for data to become valid on the memory board and to pull $\overline{\text{MBE}}$ low (Memory Buffer Enable). This enables memory data onto the IDA Bus.

TROUBLESHOOTING.

The basic processor test loop is used for troubleshooting this portion of the assembly. To enter this test:



A7
03582-66507
REV C

a. Move jumper J2 to the test position.
b. Set up the 5004A Signature Analyzer as follows:

GND:	J1(1)
CLK:	J1(3) ⌐¬
START:	J1(4) ⌐¬
STOP:	J1(5) ⌐¬

NOTE

Pin 1 is on the left when facing the board.

c. The +5 signature should be 9PA2. If this is correct, the memory control circuit is basically working. If the signature is incorrect, use the waveforms given to troubleshoot the RAM/ROM Select, Memory Control Circuits, processor clocks and initialization circuits.

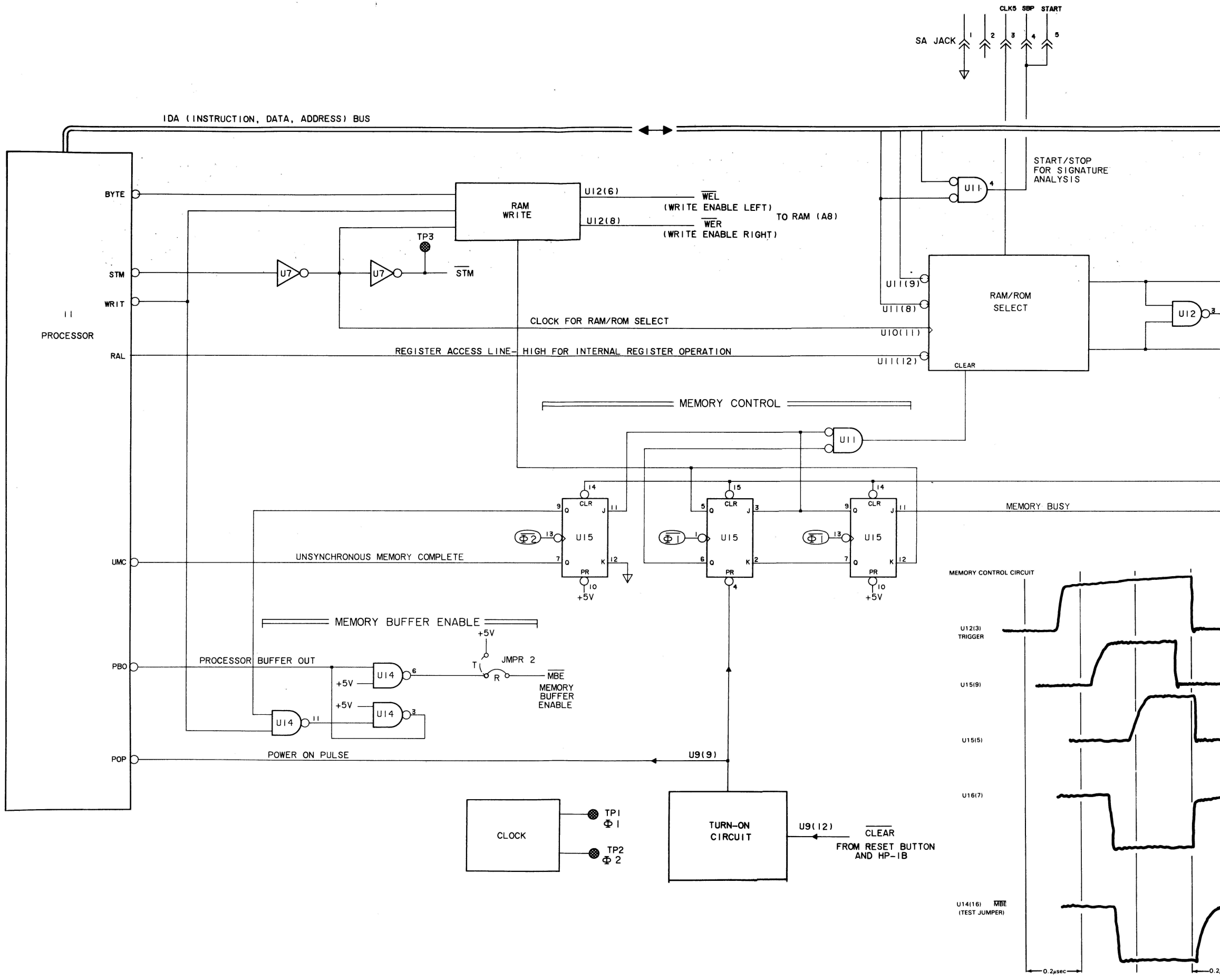
d. Check the IDA bus signatures as given.

NOTE

+5 signature must be correct.

IDA Bus Signatures.

IDA Bus Line		XA7A		
0	(A20)	14F3	1	F666
1	A19)	1882	2	7CA8
2	(A18)	POA8	3	8P75
3	(A17)	882A	4	775H
4	(A16)	775H	5	882A
5	(A15)	8P75	6	POA8
6	(A14)	7CA8	7	1882
7	(A13)	F666	8	14F3
8	(A5)	3343	A	9PA2
9	(A6)	97A5	B	P156
10	(A7)	9160	C	AA5F
11	(A8)	5586	D	A412
12	(A9)	A412	F	5586
13	(A10)	AA5F	H	9160
14	(A11)	P156	J	97A5
15	(A12)	9PA2	L	3343



Conditions: Test Jumper J2 To Test
Press RESET
MEB Must Be High

DA (INSTRUCTION, DATA, ADDRESS) BUS

SA JACK 1 2 3 4 5 — CLK5, SBP, START

15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 → A B C D E F H J I 2 3 4 5 6 7 8 — IDA BUS

START/STOP FOR SIGNATURE ANALYSIS

U11 4

RAM WRITE

U12(6) $\overline{WEL}$ (WRITE ENABLE LEFT)

U12(8) $\overline{WER}$ (WRITE ENABLE RIGHT) TO RAM (A8)

TP3

U7 U7 $\overline{STM}$

U11(9) U11(8) U10(11) U11(12)

RAM/ROM SELECT (CLEAR)

U12 3

$\overline{STRAM}$ (START RAM)

$\overline{STROM}$ (START ROM)

CLOCK FOR RAM/ROM SELECT

REGISTER ACCESS LINE– HIGH FOR INTERNAL REGISTER OPERATION

MEMORY CONTROL

U11

U15 U15 U15 (CLR, J, K, PR, Q)

MEMORY BUSY → $\overline{MEB}$ FROM RAM (A8)

UNSYNCHRONOUS MEMORY COMPLETE

+5V

MEMORY BUFFER ENABLE

PROCESSOR BUFFER OUT

U14 U14 U14 U14

JMPR 2 (T R)

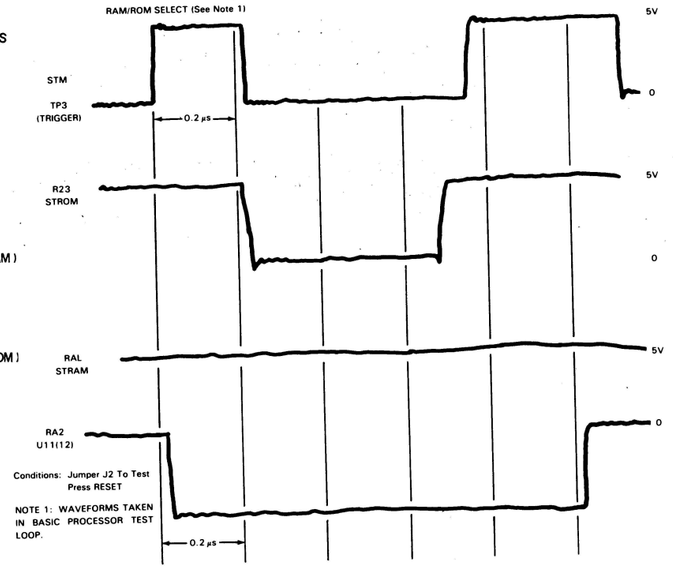
$\overline{MBE}$ MEMORY BUFFER ENABLE

POWER ON PULSE U9(9)

CLOCK → TP1 Φ1, TP2 Φ2

TURN-ON CIRCUIT

U9(12) $\overline{CLEAR}$ FROM RESET BUTTON AND HP-IB



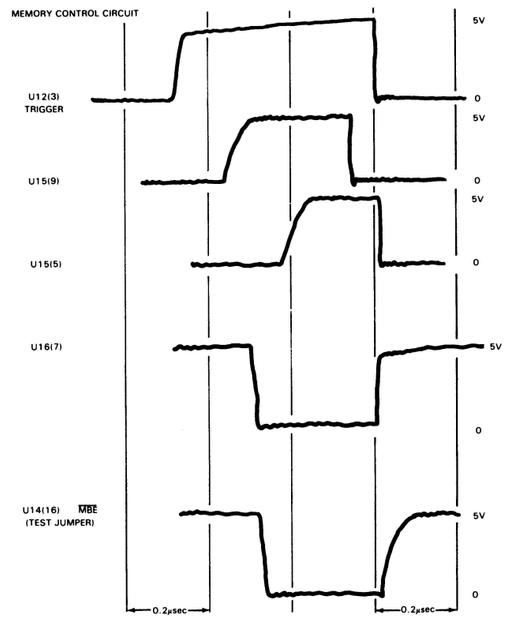


Figure 8-4-1. IDA Bus Troubleshooting Quick Reference For Schematic F. 8-4-5/8-4-6

INTRODUCTION.

This portion of the processor assembly handles I/O communications with all the other boards in the instrument, except the ROM and RAM, which work over the IDA Bus.

The other assemblies are connected to the I/O Bus through tri-state buffers that are enabled by the OS and IS lines 0-15. The I/O Bus test can be used to selectively enable these lines and also to put readable signatures on the I/O Bus lines. There are additional control lines (e.g. IRH) which provide asynchronous timing for the instrument.

I/O BUS TEST.

This test is very powerful for troubleshooting this part of the processor assembly. It can selectively enable the I/O Bus control lines OS 0-15 and IS 0-15. While this test is running, the I/O Bus lines, and IC1 and IC2 will have stable signatures for troubleshooting. To get into this test mode:

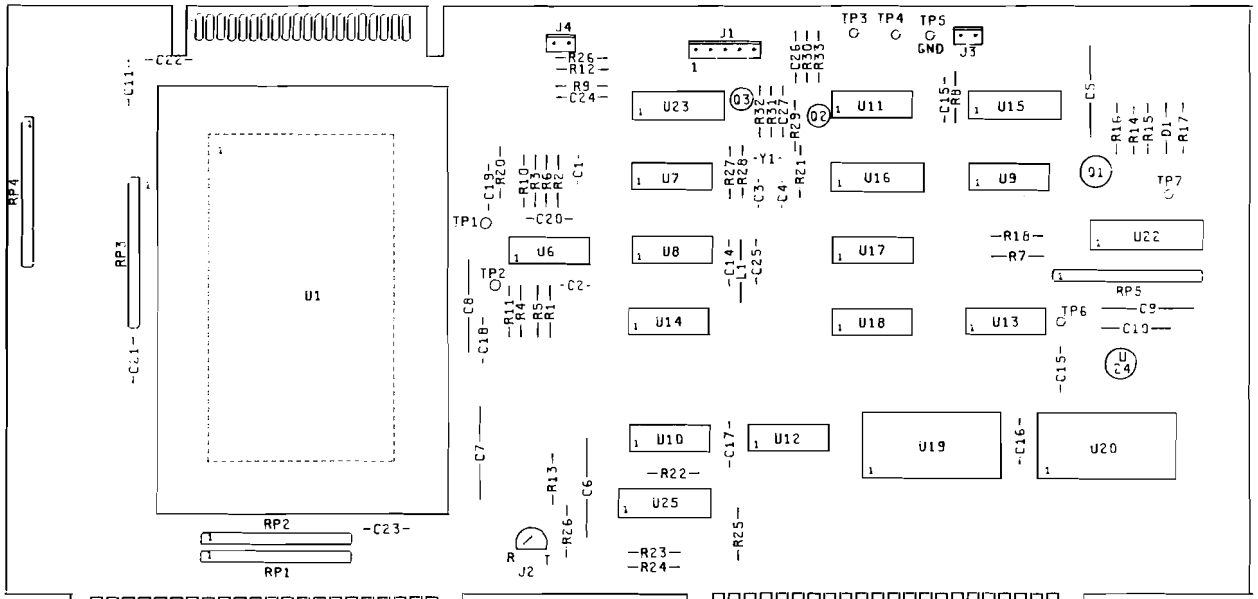
1. Enter the front panel self-test mode by pressing RESET while holding in average RESTART. When RESTART is released, the front panel switch test (Test 0) will come up.

2. Short A7 J4. This must be done *only* after step 1. Unless the instrument is in the front panel self-test mode, shorting J4 will initiate the primitive ROM self-test. Pressing RESET during the bus test will stop the test and steps one and two must be repeated.

3. Select average number 256 and press RESTART. This should get you the I/O Bus test. Pressing RESTART will allow you to select the desired test. Note that the I/O enable lines are decimal numbers while the test numbers are octal. Thus, 0-7 will correspond, while I/O enable lines numbered 8 and higher will use the test number 2 higher. That is, to enable OS13, test 15 should be selected.

NOTE

I/O Test 14 enables the I/O lines to the display section and the display will be unstable.



A7
03582-66507
REV C

TROUBLESHOOTING.

If the problem is a non-running processor, check the I/O control lines first. These are checked with the instrument in normal operating mode and 0-25kHz. For specific problems with peripherals, check the appropriate I/O Bus Select Line using the I/O Bus Test. For general problems, also check the I/O Bus signatures using the I/O Bus Test.

I/O CONTROL LINES. (Use logic probe and 0-25kHz frequency span.)

$\overline{IPH}$ Interrupt Priority High. Should go low once per time record in response to DMAR (DMA Request). U13(6).

$\overline{IPL}$ Interrupt Priority Low. Will pulse low once per time record and put out a string of pulses when the RPG (ADJUST) is turned in SET START or SET CENTER. U13(3).

$\overline{FLG}$ Flag line from HP-IB. Should pulse low during manual operation and stay high during the "blinking light test" (see HP-IB Service Section). U22(17).

$\overline{STS}$ Status line from HP-IB. Should stay high during manual operation and pulse low during the blinking light test. U22(9).

$\overline{IC1}$ Control Line 1. To Digital Filter, HP-IB Interface and Local Oscillator Assemblies. Check with I/O Bus signatures. U22(15).

$\overline{IC2}$ Control Line 2. To Digital Filter and HP-IB Interface Assemblies. Check with I/O Bus signatures. U22(13).

$\overline{IRL}$ Interrupt Request Low. From RPG (ADJUST). Should pulse low when the RPG is turned in SET START or SET CENTER modes. U22(3).

$\overline{IRH}$ Interrupt Request High. From Digital Filters. Should pulse low once per time record. U22(5).

$\overline{DMAR}$ Direct Memory Access Request. Tells processor that digital filter data is ready and needs DMA channel to RAM. Should go low once per time record. U22(7).

NOTE

A time record is one measurement cycle; the data loading light will flash once per time record for spans greater than 500Hz.

I/O BUS SIGNATURES.

1. Enter the front panel self-test mode. (Press RESET while holding in RESTART).

2. Short jumper A7 J4 and select I/O Bus Test #000005. (Jumper remains shorted thru test.)

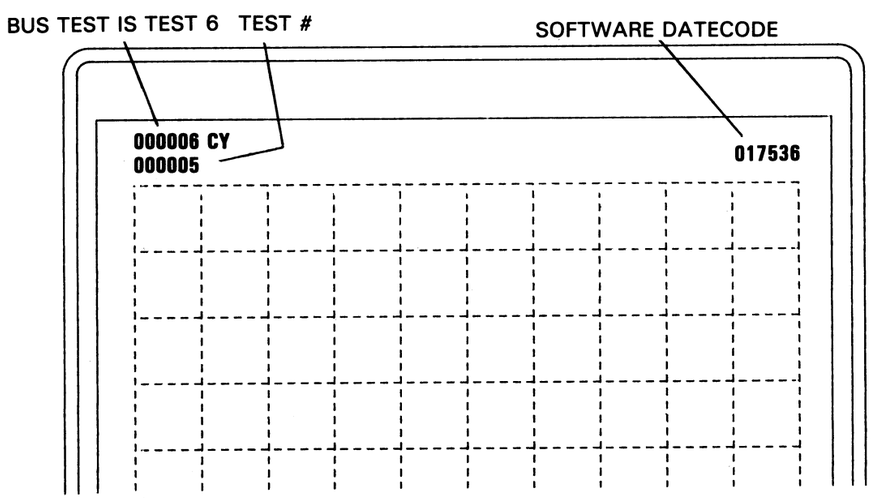
3. Set up the 5004A Signature Analyzer as follows: (Refer to component locator.)

GND	J1(1)
CLOCK	$\overline{10SB}$ U20(18)
START/STOP	IC1(TP7)
+5 signature	7FC2

4. If RESET is pushed in this test mode, the test will stop and steps 1 and 2 will have to be repeated. Note that J4 must be unshorted for step 1.

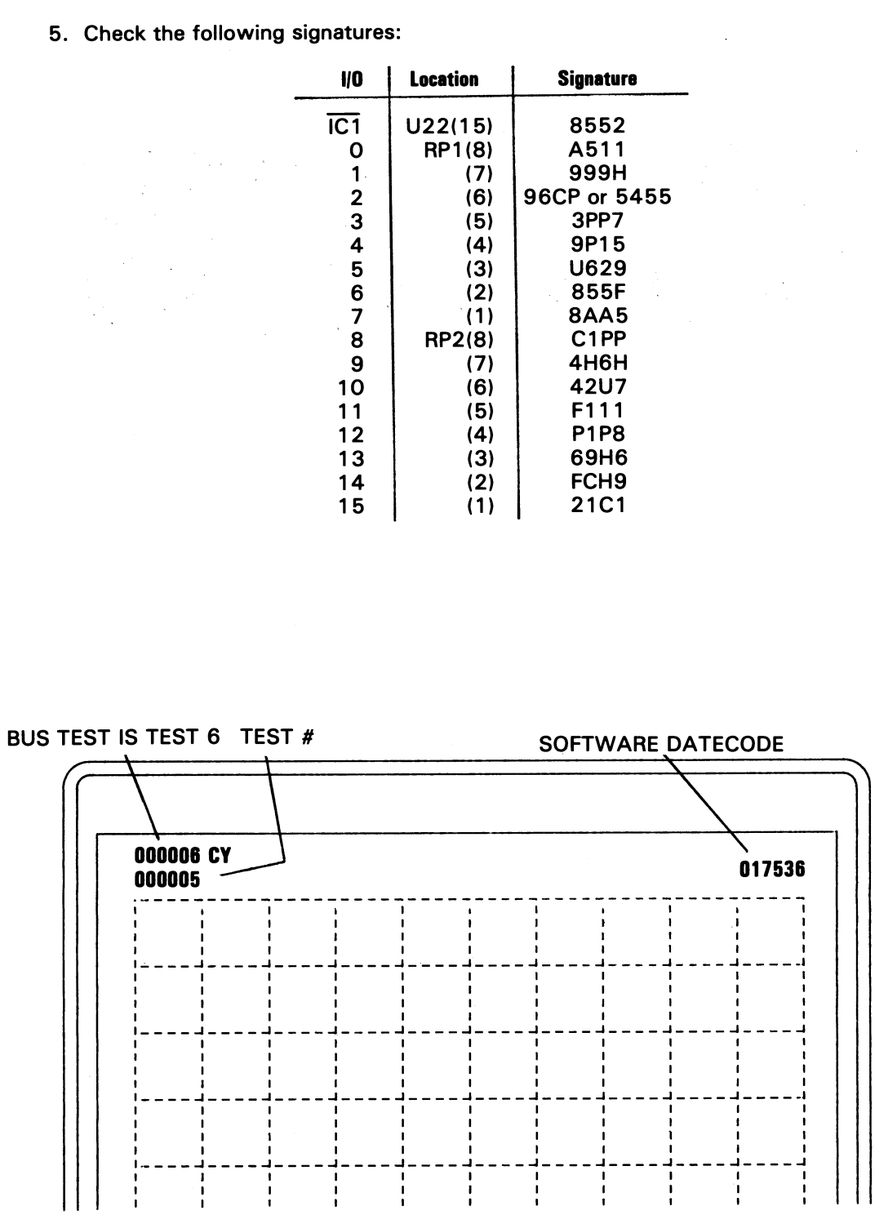
5. Check the following signatures:

I/O	Location	Signature
$\overline{IC1}$	U22(15)	8552
0	RP1(8)	A511
1	(7)	999H
2	(6)	96CP or 5455
3	(5)	3PP7
4	(4)	9P15
5	(3)	U629
6	(2)	855F
7	(1)	8AA5
8	RP2(8)	C1PP
9	(7)	4H6H
10	(6)	42U7
11	(5)	F111
12	(4)	P1P8
13	(3)	69H6
14	(2)	FCH9
15	(1)	21C1



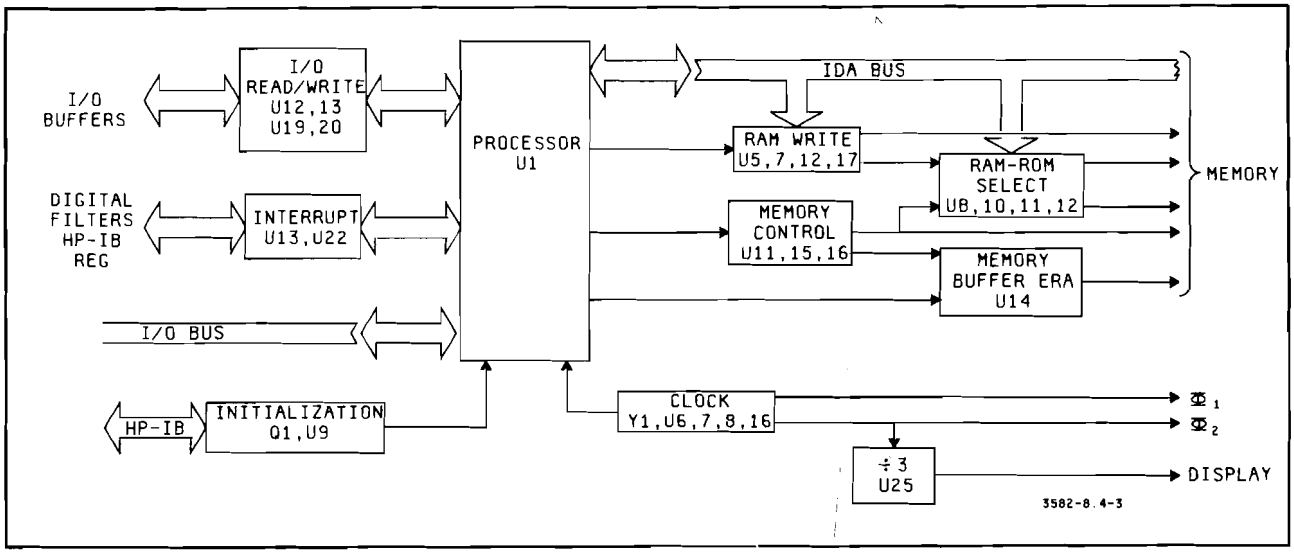
5. Check the following signatures:

I/O	Location	Signature
$\overline{IC1}$	U22(15)	8552
0	RP1(8)	A511
1	(7)	999H
2	(6)	96CP or 5455
3	(5)	3PP7
4	(4)	9P15
5	(3)	U629
6	(2)	855F
7	(1)	8AA5
8	RP2(8)	C1PP
9	(7)	4H6H
10	(6)	42U7
11	(5)	F111
12	(4)	P1P8
13	(3)	69H6
14	(2)	FCH9
15	(1)	21C1

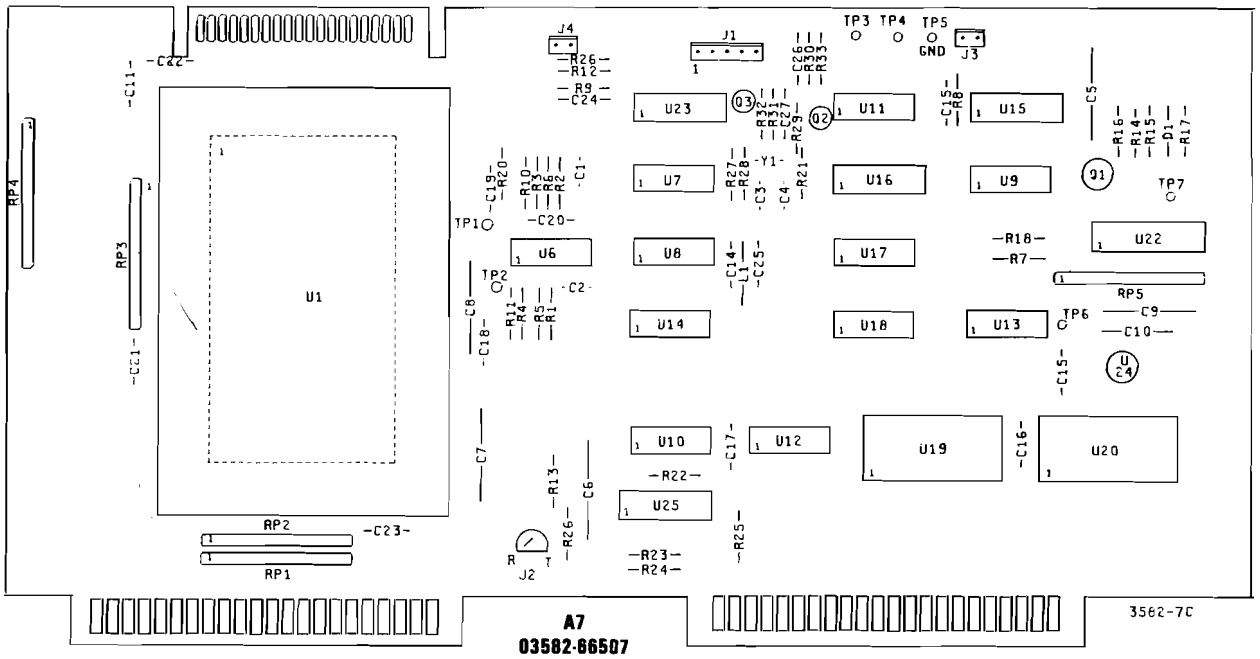


I/O Bus Select Lines			
Line	**Location**	**I/O Bus Test #**	**Description**
$\overline{OS0}$	U20(1)	00	Trigger Control. Clocks programming data into A5 trigger circuit (U3) once per time record.
$\overline{OS3}$	(4)	03	Front Panel LED's.
$\overline{OS6}$	(7)	06	HP-IB. Enables data onto A2 D/I bus from I/O bus.
$\overline{OS8}$	(9)	10	Input Programming. Latches Attenuator/Gain and PRN data into A4 U129.
$\overline{OS9}$	(10)	11	X-Y Recorder Data Latch.
$\overline{OS11}$	(13)	13	Cal Signal/PRN Programming. Latches data on A3. Should pulse low when sensitivity is changed.
$\overline{OS12}$	(14)	14	Graphics Sweep Control. Latches data into A9U9 for # of lines of graphics to display.
$\overline{OS13}$	(15)	15	Local Oscillator Frequency control. Latches data into A4 U101 and U104.
$\overline{OS14}$	(16)	16	Digital Filter Programming. Latches data into A5 U26 and U28.
$\overline{OS15}$	(17)	17	Enables DMAR.
$\overline{IS0}$	U19(1)	00	Front Panel Switch Register 0. Enables data onto I/O bus from A11 U1 and U2. (Corresponds to condition code 0 in self-test.)
$\overline{IS1}$	(2)	01	FP Switch Register 1; A11 U7 and U8.
$\overline{IS2}$	(3)	02	FP Switch Register 2; A11 U3 and U4.
$\overline{IS3}$	(4)	03	FP Switch Register 3; A11 U9 and U10.
$\overline{IS4}$	(5)	04	FP Switch Register 4; A11 U5 and U6.
$\overline{IS5}$	(6)	05	RPG Interrupt. Should pulse low when RPG is turned in SET START or CENTER.
$\overline{IS6}$	(7)	06	HP-IB. Latches data from D/I to I/O bus.
$\overline{IS8}$	(9)	10	L.O. Phase. Enables phase data onto I/O bus from A4 U134 and U135.
$\overline{IS11}$	(13)	13	Phase Count. Enables phase count data from A3 U5 and U6 onto I/O bus.
$\overline{IS12}$	(14)	14	Marker Register. Enables additional count from A9 U8.
$\overline{IS13}$	(15)	15	Overload. Enables OVLD data from A5 (*not* for OVLD lites).
$\overline{IS15}$	(17)	17	Enables digital filter data onto I/O bus.

Figure 8-4-2. I/O Bus Troubleshooting Quick Reference For Schematic F.



CONNECTOR A
(IDA SIGNATURES)



A7
03582-66507
REV C

A7 PROCESSOR BOARD 03582-66507

P/O A20 MOTHER BD. 03582-66520

J2 (TEST): INT B14, SMC B15, ERA A4, SYNC B13, BR B12, EBG B11, GND B1+B10

MSTM B17, MBC B28, STM B19, MWRIT B16, Φ1 A1, Φ2 A2, RESET A3 — J2 (TEST) — XA7A(1B)

IDA BUS

READ/WRITE

XA7B: D XA5B(4) $\overline{DS\Phi}$ 11; N A11J1(9) $\overline{DS3}$ N; O XA2B(M) $\overline{DS6}$ 12; F XA4B(7) $\overline{DS8}$ 13; Q XA10B(1) $\overline{DS9}$ P; C XA3B(J) $\overline{DS11}$ 14; J XA9B(10) $\overline{DS12}$ R; E XA4B(J) $\overline{DS13}$ 15; D XA5B(11) $\overline{DS14}$ S; XA5B(N) $\overline{DS15}$ 16

U20 DECODER: Φ 1, G1 18, G2 19, 9, 8, A 23, B 22, C 21, D 20

N A11J1 (3) $\overline{IS\Phi}$ 5; (4) $\overline{IS1}$ F; (5) $\overline{IS2}$ 6; (6) $\overline{IS3}$ H; (7) $\overline{IS4}$ 7; (8) $\overline{IS5}$ J

U19 DECODER: Φ 1, A 25, B 22, C 21, D 20, G1 18, G2 19, 9

O XA2B(11) $\overline{IS6}$ 8; C XA3B(D) $\overline{IS11}$ 9; J XA9A(9) $\overline{IS12}$ L; D XA5B(12) $\overline{IS13}$ 10; XA5B(5) $\overline{IS15}$ M; E XA4A(14) $\overline{ISR}$ K

D XA5B(P) $\overline{IPH}$ 18; N A11J1(12) $\overline{IPL}$ 17

U13A, U13B, U13C, U13D; $\overline{INT}$ TO J2(14)

T +5V XA7A X 20; C16 22 +5V, C11 .01, C17 .01

XA7B: O XA2B(10) $\overline{FLG}$ X; (SEE TABLE) $\overline{IC1}$ V; $\overline{IC2}$ W; O XA2B(T) $\overline{STS}$ 20; D XA5B(14) $\overline{DMAR}$ 19; XA5B(N) $\overline{IRH}$ U; N A11J1(11) $\overline{IRL}$ T; R -18V Z 22, Y 21

U24: C9 2.2 +, C10 2.2 +, C22 .1, C23 .1, -5V

XA7A: I/ODΦ Φ, 17, 16, 15, 14, 13, 12, 11, 10, U, T, S, R, P, N, M, L, I/OD15

TP5, TP6, TP7

SMC TP4; U23 B 13, 14, 15

R20 2.2K +12V

SMC ERA SYNC BR EBG IDAΦ ... IDA15

IOSB, DOUT, PAΦ, PA1, PA2, PA3, IBO, IBF, INT

+12V, +7V, +5V, -5V

FLG, IC1, IC2, STS, DMAR, IRH, IRL

PBE IODΦ ... IOD15

Φ1 CLK FROM R10; Φ2 CLK FROM R11

U17 B, C, D; U18 A, B, C, D, E, F; U14 A, B, C, D; U22A

RP1 1.8K +5V; RP2 1.8K +5V; RP3 1K +5V; RP4 1K +5V; RP5 1.8K +5V

R17 1K +5V; R18 1K +5V

I/O BUS

U1 PROCESSOR

BYTE 76; STM 30; WRIT 31; RAL 34; HLT 17; UMC 25; PBO 65; POP 11

RAM WRITE

U17C, U17D, U17B, U17A, U12B, U12C

U9 PR, CLR, +5V

MSTM J2(7); U17D; U17C; TP3; STM TO J2 (19)

MWRIT TO J2(16)

TEST

U23A; STROM FROM U10(5)

R19 1K +5V; JMPR 4; SOFTWARE TEST

R9 1K +5V

R12 1K +5V; MBC FROM J2(28)

MEMORY CONTROL

U11A, U15A, U15B, U16 CLR, J, K, PR, Q, $\overline{Q}$

Φ2, Φ1

U23 B; MEM. BUFFER ENABLE; U14B, U14A, U14D

JMPR 2; R226 1K +5V

R7 1K +5V

CLOCK

Y1 13 MHZ; L1 33μH; C13 120pF; R21 47; Q2; C29 .01; R29 470; R30 5.6K; C26 .01; C4 200 PF; R28 47K; R27 47K; C25 .1μF; +12

R32 1K; Q3; R33 1K +5V; U16 PR, CLR, J, K, Q, $\overline{Q}$ +5V

TP1; TP2

C1 390pF; C2 390pF; R2 1K; R3 1K; R10 20; R11 20; R6 360; R5 360; R1 1K; R4 1K; U6 +12V; U8A, U8B, U8D, U7A, U7E

Φ1 CLOCK TO U1(21); Φ1 TO J2(A1); Φ2 TO J2(A2); Φ2 CLOCK TO U1(20)

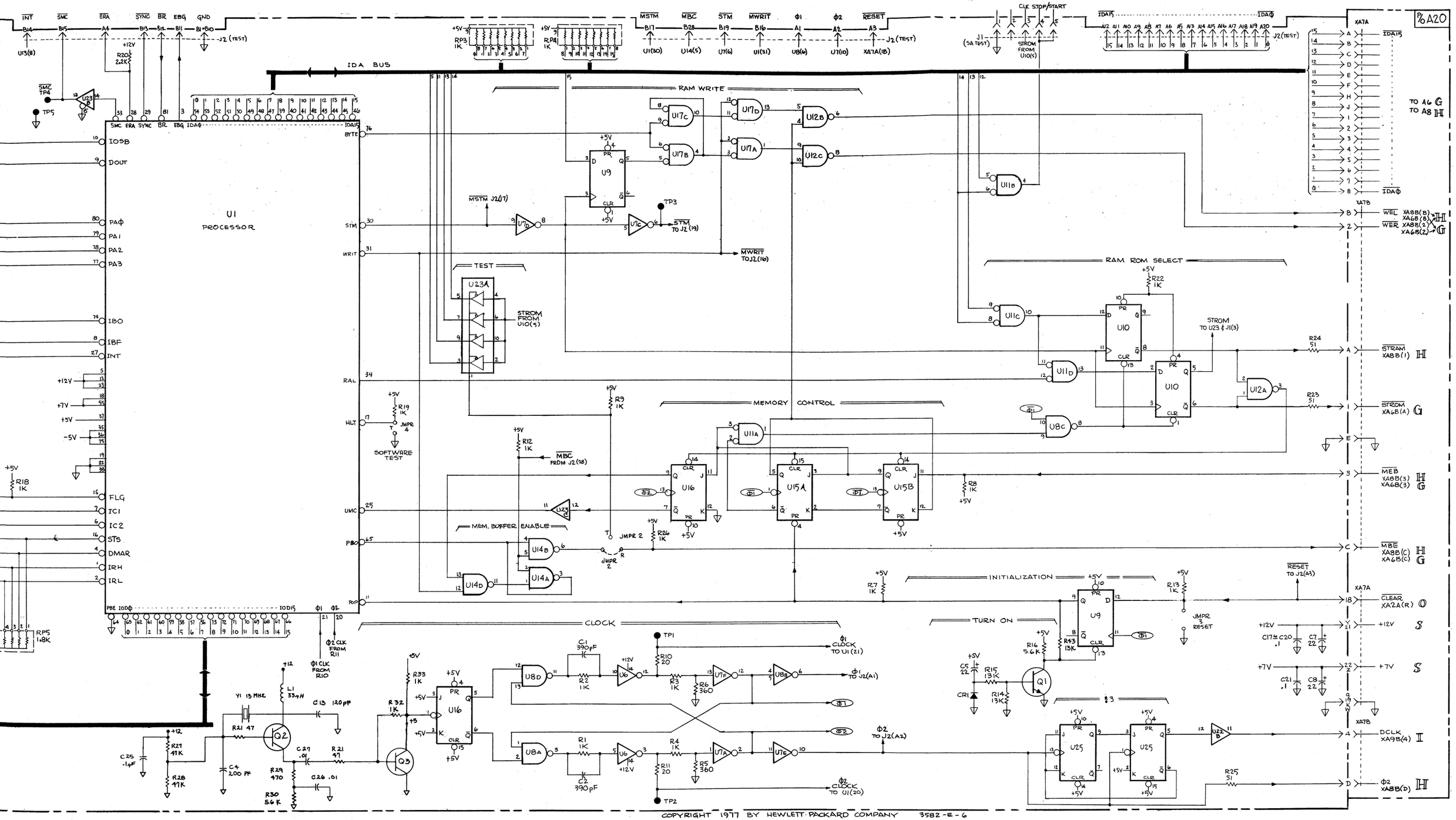


Figure 8-4-3. A7 Processor.
8-4-9/8-4-10

8-4-21. TROUBLESHOOTING THE ROM ASSEMBLY.

8-4-22. Introduction.

8-4-23. This assembly provides programming for the A7 processor. The proper address comes over the IDA Bus from the processor and the correct program code is returned. Note that, unlike the RAM, the ROM is completely static; changing the input address changes the output.

8-4-24. Selection of the proper ROM chip is accomplished by the higher order IDA address bits 11-14. Bits 12-14 go through a 3 to 8 decoder (U25) that selects two pairs of IC's. Note that one pair provides a high order byte and a low order byte to make up the sixteen bit instruction word. Bit 11 selects which pair and also whether U1 and U2 are enabled.

8-4-25. Troubleshooting.

8-4-26. Signature analysis works quite well for troubleshooting this assembly, although a bus conflict problem requires use of an ocilloscope. The first thing to do is to try the front panel self-test. For some ROM failures, the test will point out the bad chip. For other problems, the self-test won't run. In this case, the processor test loop and the primitive ROM test will indicate problems on the board.

8-4-27. The procedure for using signature analysis consists of:

a. Checking address and chip select signatures.

b. Checking overall data output. This will usually indicate at least one bad line. Finding the cause of trouble for that line will probably also fix other bad lines, so go to the next step as soon as a bad line is found.

c. By starting and stopping the signature analyzer at various chip enables, it is possible to isolate signatures to a group of 4; 2 high byte and 2 low byte. It is further possible to isolate signatures to one of the pairs thus enabling one to deduce which is the bad chip.

8-4-28. As an example of step c, one set of ROM signatures might be for chips U3, 4, 11 and 12. That is, the SA measurement cycle lasts through contributions from all four chips. This signature set also would include signatures for only U3 and 4. Thus, if the signatures for all four are incorrect but the signatures for U3 and 4 are correct, U11 or 12 must be bad.

8-4-29. A bus conflict can be a little trickier to find. This happens when the chip enable function is bad and the chip is talking to the bus constantly. This will make data on the bus always incorrect *except* when the bad chip is addressed. This is the key to troubleshooting this type of problem. Note that if the bad chip is one that can't have its signature isolated, signature analysis cannot find the problem. Looking at the bad line, there will be three visible levels when there is conflict: 1) when two chips are "fighting each other", 2) when they are both low and 3) when they are both high. When the bad chip only is addressed, the line will look OK.

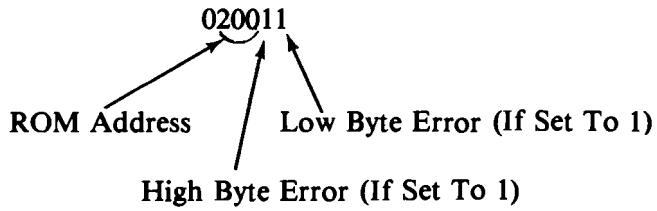
8-4-30. Front Panel Self-Test.

8-4-31. To initiate the ROM self-test mode:

a. Enter the front panel self-test mode by pressing RESET while holding in average RESTART and then releasing RESTART. This should get the front panel switch test (#0). If it doesn't, proceed with the troubleshooting given at the beginning of the service group.

b. Select average number 32 and press RESTART. This should get the ROM test, number 3.

c. The test will display "RU" for about 5 seconds and then display either OK or ER. For ER, condition codes 0-9 (see Section VIII for details) will display an error code.



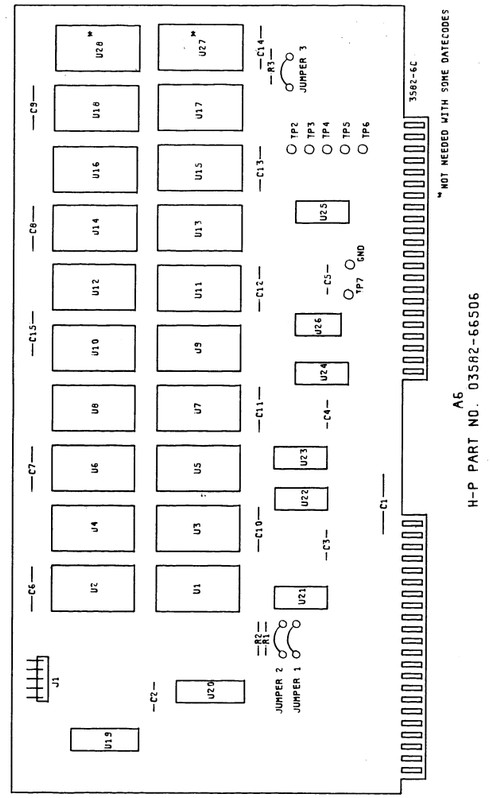
ROM Address In Condition Code	High Byte ROM Ref. Desgn	Low Byte ROM Ref. Desgn
0000	U2	U1
0040	U28	U27
0100	U4	U3
0140	U12	U11
0200	U6	U5
0240	U14	U13
0300	U8	U7
0340	U16	U15
0400	U10	U9
0440	U18	U17

8-4-32. Signature Analysis Procedures.

8-4-33. To use the signature analysis chart effectively, perform Part 1 first. This will establish whether the addressing for the ROMs is correct. If the addressing circuits are working, go to Part 2 to check the overall data outputs at the buffer ICs. Proceed vertically down the chart until an incorrect signature is obtained which indicates a defective data line. Then proceed to the right horizontally and check the signature output from each ROM for that particular data line. Don't forget that each ROM and ROM pair require a different SA setup. Place the ROM board on extenders for troubleshooting and continue with Part 1.

NOTE

ROMS were changed at roughly serial number 1809A01006 resulting in a new signature set which is given in this section. Some earlier instruments have been retrofitted to these new ROMS by replacing U1, U2, U3 and U4 with -hp- part number 1818-0957, 1818-0958, 1818-0959 and 1818-0961 respectively. Instruments with the ROM retrofit will also use the signatures given in this section. To identify which unit you have, access any front panel self test. The ROM datecode given in the upper right hand corner of the displays will be 017536 on old units, 020151 on new units.



Part 1: Address and Select Lines

Place A7 J2 to Test

Setup: Clk: J2(3)

Stop: J2(4)

Start: J2(5)

+5 Signature = 9PA2

Address Bus

Pin #		Address Bus
(1)*	4PU2	7
2	4326	6
3	306C	5
4	P9UU	4
5	1688	3
6	7POA	2
7	8620	1
8	8A61	0
19	U57U	10
22	5HF8	9
23	CAP2	8

*On any ROM chip except U1,2,28 and 29.

Select Addresses

U24(10)	PPP6	A11
11	7044	$\overline{A11}$
6	U616	A12
14	P254	A13
2	HH26	A14

Chip Selects

TP3	6CC6	$\overline{SC0}$
TP4	FA66	$\overline{SC1}$
TP5	UP98	$\overline{SC2}$
TP6	1FFF	$\overline{SC3}$
U25(11)	6338	$\overline{SC4}$
U25(10)	CP1P	$\overline{SC5}$
TP7	4384	$\overline{SC45}$

$\overline{STROMS}$

U26(3)	0000
11	0000
6	0000

Part 2: Overall Data
Datecode: 020151

Place A7 J2 to Test

Setup: CLK J2(3)

Stop: J2(4)

Start: J2(5)

+5 Signature = 9PA2

M.S. Byte

Pin Nos. All ROMs	Data Line		
	U19(2)	7	68FO
17	18	6	100C
16	4	5	2A7C
15	16	4	1CC7
14	6	3	9771
13	14	2	FA56
11	8	1	575P
10	12	0	413A
9			

L.S. Byte

Pin Nos. All ROMs	Data Line		
	U20(2)	7	OP8H
17	18	6	C1AC
16	4	5	7U82
15	16	4	1F37
14	6	3	A879
13	14	2	OPH6
11	8	1	A2A5
10	12	0	9PH9
9			

Da

U3, 4, & 11, 1

Clk: J2(3)

Stop: TP4

Start: TP4

+5 Signature

M.S. Byt
U4 & U1

	7	HC
17	6	3I
16	5	62
15	4	16
14	3	31
13	2	FU
11	1	6U
10	0	14
9		

L.S. Byt
U3 & 1

	7	02
17	6	33
16	5	0
15	4	UC
14	3	93
13	2	C7
11	1	HH
10	0	86
9		

Data for U5,6, and U13,14
Date code 020151

U5, 6, & 13, 14		U5 and 6 only	
Clk:	J2(3)	Clk:	J2(3)
Stop:	TP5	Stop:	TP2
Start:	TP5	Start:	TP5
+5 Signature	826P	+5 Signature	7A70

Data for U7,8, and U15,16
Date code 020151

U7, 8, & 15, 16		U7 and 8 only	
Clk:	J2(3) ⌐¬	Clk:	J2(3) ⌐¬
Stop:	TP6 ⌐¬	Stop:	TP2 ⌐¬
Start:	TP6 ¬⌐	Start:	TP6 ¬⌐
+5 Signature	826P	+5 Signature	7A70

Data for U9,10, and U17,18
Date code 020151

U9, 10, & 17, 18		U9 and 10 only	
Clk:	J2(3) ⌐¬	Clk:	J2(3) ⌐¬
Stop:	TP7 ⌐¬	Stop:	TP2 ⌐¬
Start:	TP7 ¬⌐	Start:	TP7 ¬⌐
+5 Signature	P254	+5 Signature	7A70

Part 3: Data Test For Patch ROMS U1, 2
Datecode: 020151

Place A7 J2 to Test

Setup:	Clk:	J2(3) ⌐¬
	Stop:	TP3 ⌐¬
	Start:	TP3 ¬⌐
	+5 Signature	105U

NOTE

U28 and 29 are not installed for this software.

M.S. Byte U6 & U14		M.S. Byte U6	
7	74UC	7	7PP8
6	F9FH	6	P656
5	F39H	5	UAU6
4	P68F	4	10F6
3	520H	3	5FPH
2	A23U	2	AP01
1	973F	1	P5F7
0	5H98	0	42FA

M.S. Byte U8 & U16		M.S. Byte U8	
7	943H	7	7125
6	HOH9	6	FU53
5	CUH5	5	374U
4	HAF7	4	9H7C
3	UCC1	3	36HP
2	2743	2	A534
1	7681	1	868U
0	8PO1	0	68H2

M.S. Byte U10 & U18		M.S. Byte U10	
7	331H	7	5PP3
6	8766	6	462U
5	1684	5	7CU7
4	CC20	4	P633
3	PC02	3	1C7H
2	FAHA	2	7C06
1	41UA	1	FA12
0	88H7	0	F39C

M.S. Byte U2	
7	349F
6	7H9C
5	504U
4	572H
3	8064
2	60A3
1	C78U
0	P769

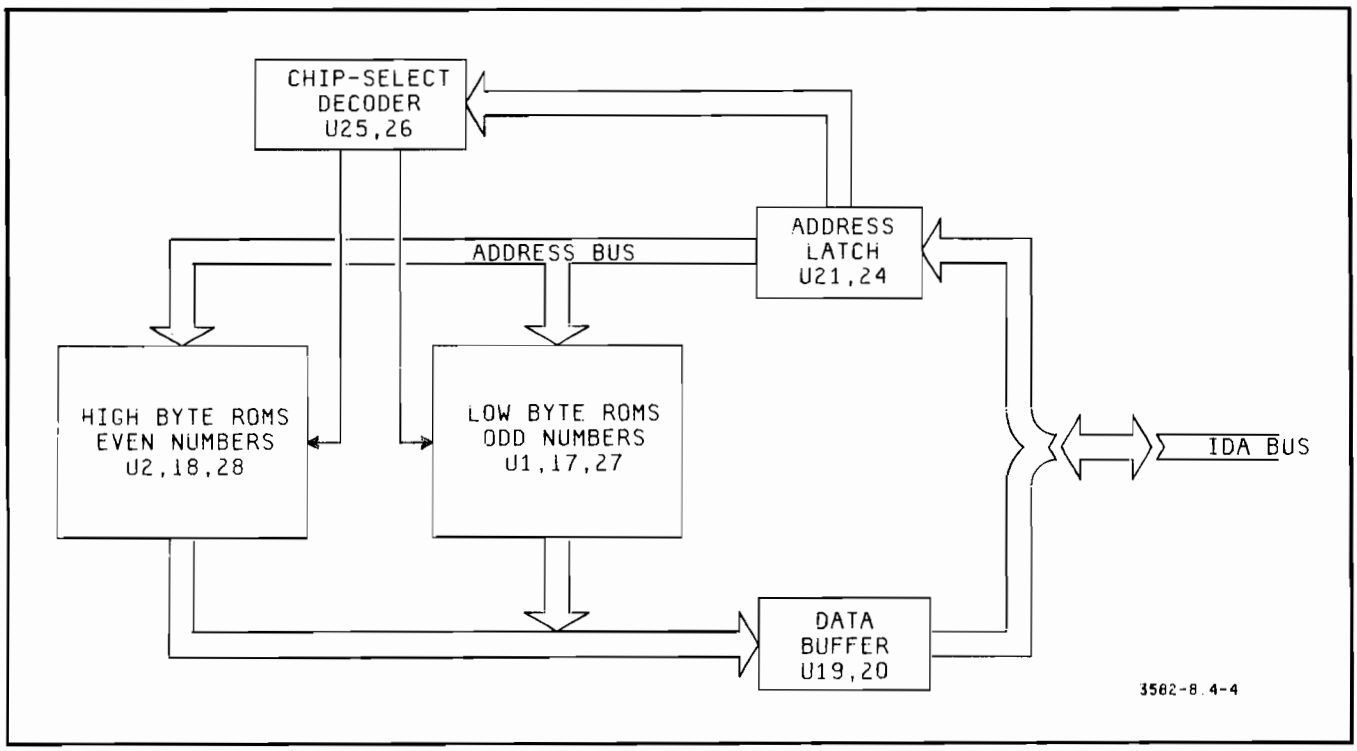
L.S. Byte U5 & 13		L.S. Byte U5	
7	0136	7	47F5
6	19P6	6	15C2
5	6P02	5	APF4
4	27CO	4	U42C
3	0845	3	U7PO
2	8UC8	2	U02F
1	F8P2	1	6599
0	9COU	0	HOA2

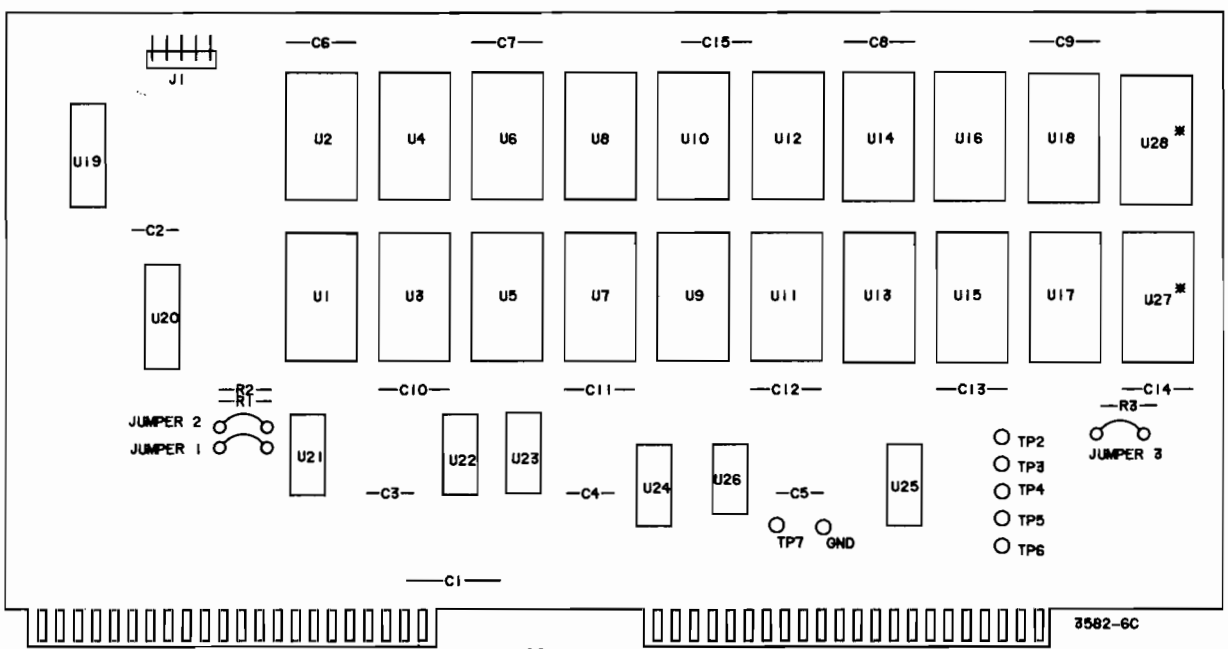
L.S. Byte U7 & 15		L.S. Byte U7	
7	U709	7	OUU8
6	5319	6	5UAC
5	OP4F	5	PH51
4	3700	4	HH85
3	H5U7	3	9H17
2	U82C	2	F516
1	3756	1	H901
0	PC92	0	H76H

L.S. Byte U9 & U17		L.S. Byte U9	
7	CP22	7	4692
6	346H	6	6H03
5	UHA9	5	P22U
4	2FOC	4	FHC1
3	PH2C	3	09F9
2	C2A2	2	31F7
1	586U	1	5P26
0	33U7	0	7754

L.S. Byte U1	
7	7F42
6	P296
5	049U
4	AFH1
3	85F0
2	90CB
1	30C6
0	C18H

Table 8-4-2. ROM SA Troubleshooting.





A6
03582-68506
REV B

*NOT NEEDED WITH SOME DATECODES

A6 ROM BOARD 03582-66506

TP1 GND

TP2

TP3

TP4

TP5

TP6

TP7

CHIP SEL.

U26c

"PATCH" ROMS

+5V

R1 5.1K

JMPR 1

INSTALL WHEN U27 & U28 ARE INSTALLED

INSTALL WHEN U1 & U2 ARE 16K ROMS

INSTALL WHEN U27 & U28 ARE 16K ROMS

JMPR 3

JMPR 2

ADDRESS BUS

U28 U2 U4 U6 U8 U10 U12 U14 U16

U27 U1 U3 U5 U7 U9 U11 U13 U15

R3 5.1K

R2 5.1K

MOST SIGNIFICANT BYTE

LEAST SIGNIFICANT BYTE

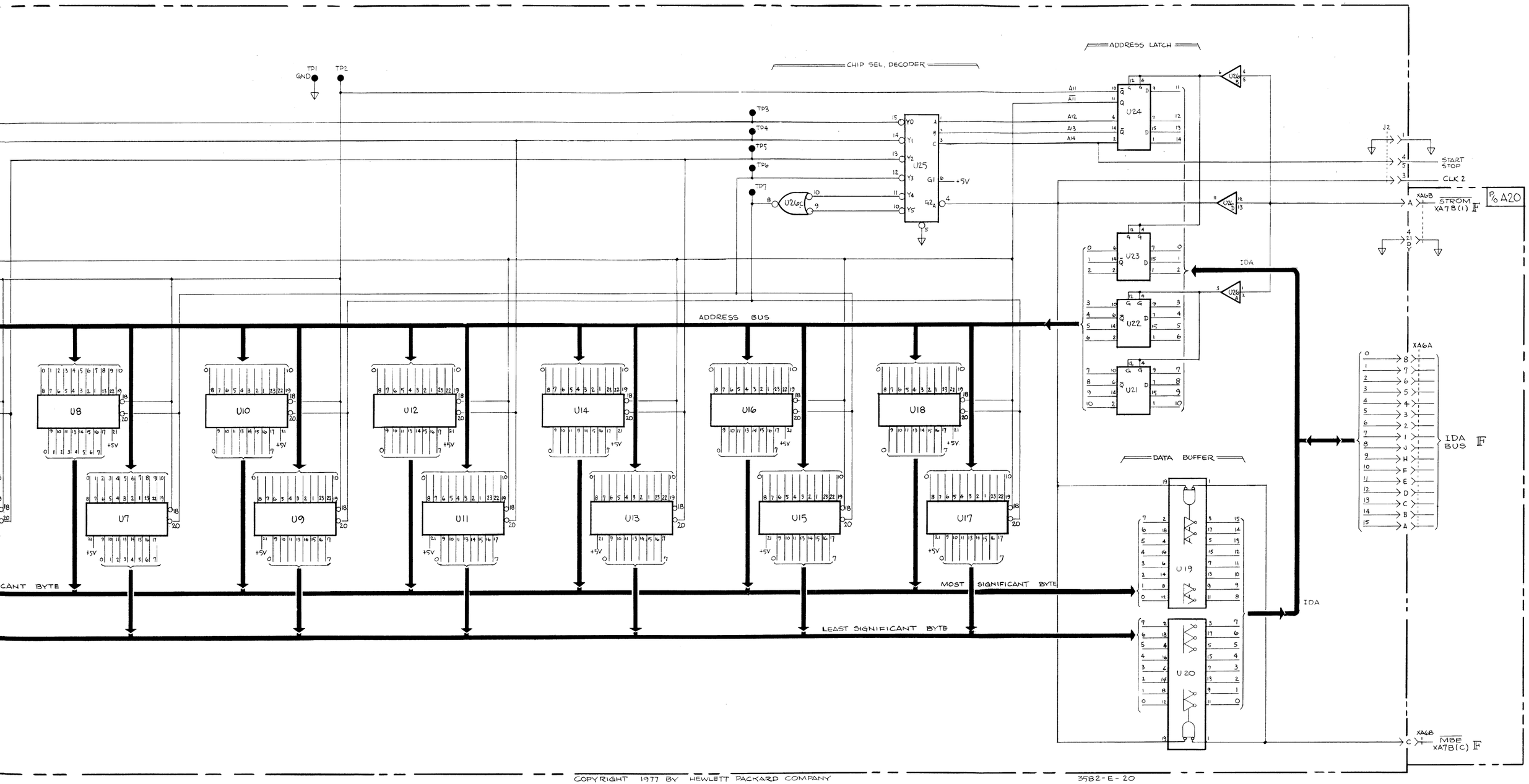
P/O A20 MOTHER BD 03582-66520

+5V

C1 22

C2→C5 .1

C6→C15 4.7



3582-E-20

G

Figure 8-4-4. A6 Read Only Memory.

8-4-34. TROUBLESHOOTING THE RAM ASSEMBLY.

8-4-35. Introduction.

8-4-36. RAM chips U1-U16 are dynamic and must be refreshed by the display circuits. The refresh address comes over the RAD Bus, while data readout of the RAM is sent to the display section over the XIDA Bus.

8-4-37. During normal operation, the processor usually reads and writes into RAM often enough to keep the chips refreshed. Thus, the board may appear to be working with a malfunctioning refresh circuit. The result of this condition would be a non-working display in normal operation, although the internal self-test would pass (switch on the A9 board).

8-4-38. Troubleshooting.

8-4-39. The troubleshooting procedure for this board is the same as for the ROM board:

a. Try the front panel self-test. This can identify the bad component, *if* the test will run. Remember that this is a 12-minute test.

b. Go through the basic tests (processor test loop, primitive ROM and RAM tests). Details are given earlier in this section.

c. Isolate the problem to a component using signature analysis.

8-4-40. Front Panel Self-Test.

8-4-41. To get into the RAM self-test mode, do the following:

a. Initiate the front panel self-test mode by pressing RESET momentarily while holding in average RESTART. When RESTART is released, front panel self-test (0) should come up. If it does not, go to the basic tests at the beginning of the service group.

b. Select average number 64 and press RESTART. This should select RAM test, number 4. Note that this is a twelve-minute test that can only be terminated by pressing RESET, which will cause the instrument to leave the self-test mode.

c. The display will do some rather odd things during the test; this is normal.

d. At the end of the test, either OK or ER will be displayed. When ER is displayed, condition code 9 will display the accumulated error. Since each chip is responsible for one bit, it is easy to isolate the bad chip. For example, if condition code 9 reads 000010, this would imply that the chip responsible for the 4th bit is bad. That is, the first three bits make up the least significant digit, the next three bits, the second digit, etc. As another example, condition code 000040 would imply that the chip for the 6th bit is bad.

Table 8-4-3 **Error Codes for RAM Tests.**

Error Code		Bad Ram Chip
000	001	U1
000	002	U2
000	004	U3
000	010	U4
000	020	U5
000	040	U6
000	100	U7
000	200	U8
000	400	U9
001	000	U10
002	000	U11
004	000	U12
010	000	U13
020	000	U14
040	000	U15
100	000	U16

8-4-42. Signature Analysis.

8-4-43. Address Lines.

Setup: 3582A: Short A7J4 and press RESET.
Unshort J4. This is the primitive RAM test.

5004A: Gnd - A8TP1

Clock - A8TP2 ⎍

Start - A8TP3 ⎍ (read) ⎾ (write)

Stop - A8TP3 ⎾ (read) ⎍ (write)

NOTE

For the address line signatures:

1. Each test point will have two valid signatures.

2. The read and write signatures will be the same and both should be checked.

Address Line	IC & Pin No.	Signatures Read/Write
11	U22 (4)	U81P/U03F
10	(12)	C811/5F08
9	(7)	3771/9CC8
8	(9)	HU4U/CP9P
7	U23 (4)	6064/3032
6	(12)	U253/U929
5	(7)	C177/62PU
4	(9)	OF51/18A2
3	U24 (4)	66CA/335H
2	(12)	40H1/2068
1	(7)	A872/50P5
0	(9)	UF4C/U897

8-4-44. Data Line. (Same setup as Part A)

NOTE

Start/Stop trigger slopes change for read or write. For the IC's listed:

Start ⎍⎾ *Read* ⏋⎽ *Write*
Stop ⏋⎽ *Read* ⎍⎾ *Write*

The Write Signature is on Pin 6, Read on Pin 7.

IC #	Signature Read/Write	IC #	Signature Read/Write	IC #	Signature Read/Write
1	U897/7P25	6	58CC/C5AA	11	AP04/58H5
2	AFAU/5439	7	UHU4/7F94	12	UFF3/UFOU
3	1034/24C5	8	9819/34PU	13	UF4C/UF4A
4	99AP/3780	9	HC92/PUA7	14	H657/A872
5	088F/8628	10	FHHF/9U65	15	2068/925A
				16	ICFO/335H

8-4-45. Refresh.

Setup: Start/Stop - TP5 ⎍⎾
Clock - TP4 ⎍⎾
+5 Signature - 4596

Address Signatures

Address Line	IC & Pin No.	Signature
AAD 11	U22 (4)	0000
AAD 10	(12)	4596
AAD 9	(7)	4596
RAD/AAD 8	(9)	UPA2
RAD/AAD 7	U23 (4)	HFP7
RAD/AAD 6	(12)	41F7
RAD/AAD 5	(7)	FA11
RAD/AAD 4	(9)	8C36
RAD/AAD 3	U24 (4)	CHU8
RAD/AAD 2	(12)	627P
RAD/AAD 1	(7)	PC84
RAD/AAD Ø	(9)	3F8H
Write enable right (WER)	U1-8(12)	4596
Write enable left (WEL)	U9-16(12)	4596

NOTES

1. Verify chip enable signal (CE, U1-16(17). (Trigger on LFETCH XA8B(L).)

2. Address signatures do not depend on display mode.

8-4-46. Output Signatures (XIDA Bus).

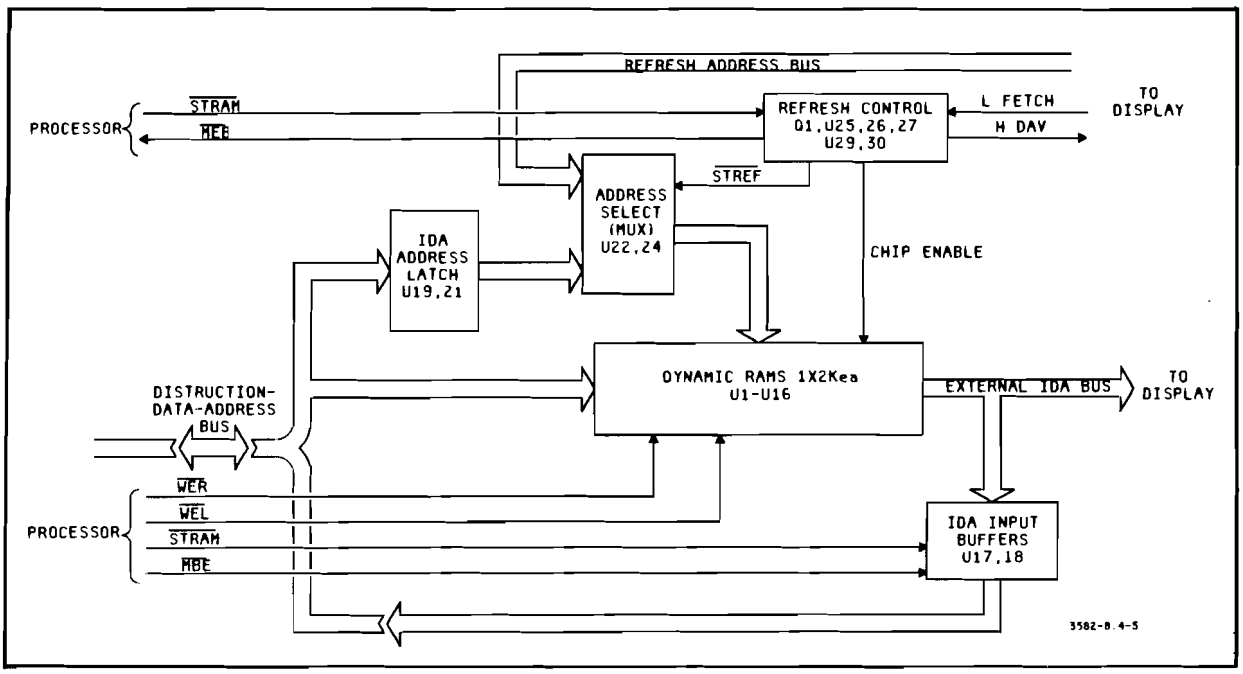
Select display front panel self-test Number 1 (Ave #8).

XIDA Line	Connector Pin	Signature
Ø	XA8B(19)	0950
1	(18)	F1H9
2	(17)	3H81
3	(16)	H2CO
4	(15)	981A
5	(14)	HUCP
6	(13)	OA24
7	(12)	A3H2
8	(S)	6HHF
9	(R)	22P9

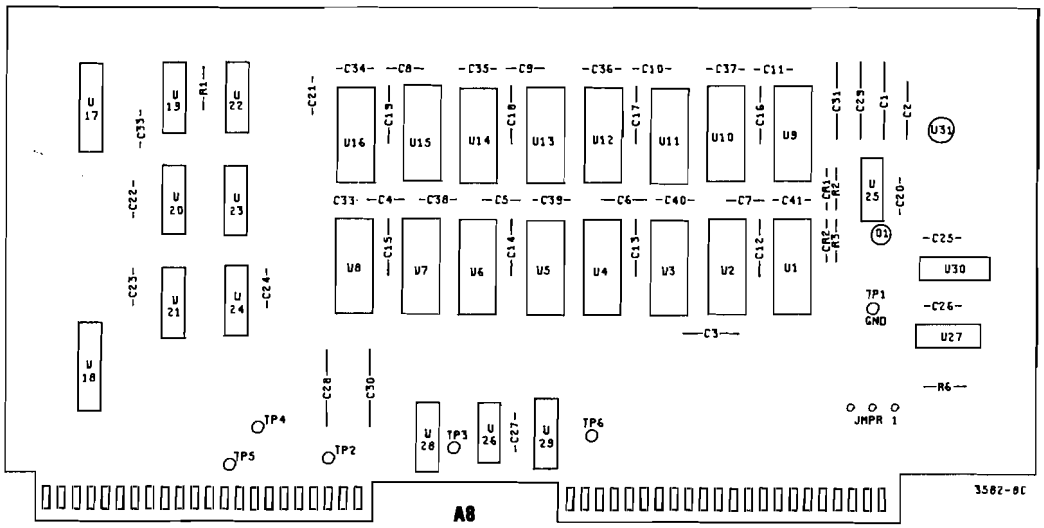
For lines 10-15, signatures depend on self-test number as shown.

Test #	0	1	2*	3	4
X1DA 10 - XA8B(Q)	AUPU	68UF	H2UC	P6HA	P6HA
11 (P)	6A36	U85F	F815	2303	U85F
12 (O)	H752	1041	2008	9P67	1041
13 (N)	6AOP	P428	H461	3U77	U864
14 (M)	0000	0000	66AP	0000	0000
15 (L)	901F	UPA2	UPA2	0000	0000

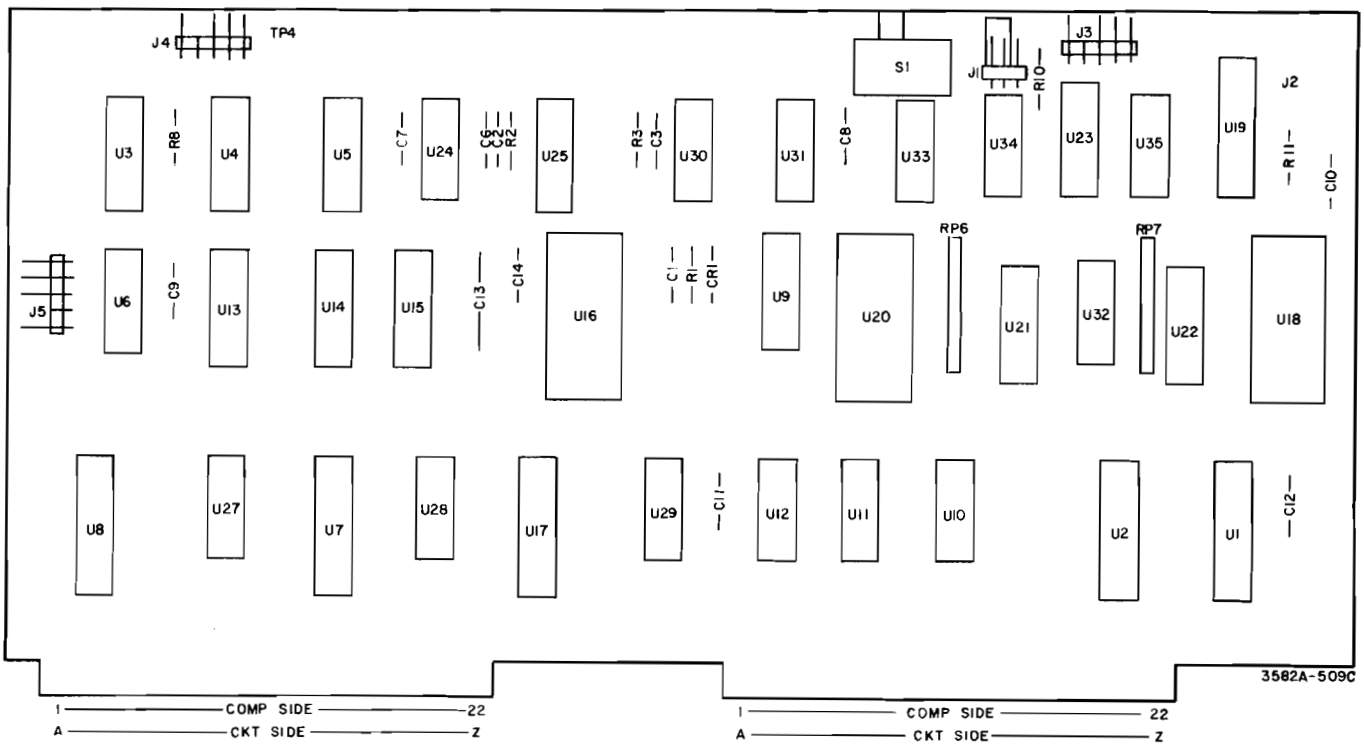
*For Test #2, marker must be at left edge of screen (position 000000).



RAM BLOCK DIAGRAM



A8
03582-68508
REV A,B,C



A9
03582-66509
Rev E

A8 RAM BOARD 03582-66508

%A20 MOTHER BOARD 03582-

XA8B

$\overline{MBE}$ XA7B(C) → $\overline{MBE}$ TO U17(1) U18(1)

Φ2 XA7B(D) → TP6 → Φ2 CLK U29(1,13)

$\overline{WER}$ XA7B(2) → TP3 → U28 → $\overline{WER}$ TO U1→U8(12)

$\overline{WEL}$ XA7B(B) → U28 → $\overline{WEL}$ TO U9→U16(12)

$\overline{MEB}$ XA7B(3)

$\overline{STRAM}$ XA7B(A) → U28 → TP2 → $\overline{STRAM}$ TO U17(10) U18(10)

XMP1

XA8A

IDA ADDR LATCH

U19 U20 U21

ADDR SELECT

U22 U23 U24

R1 1K

TP5

TP4

$\overline{STREF}$

+62 μSEC

IDA BUS

RAD BUS

R6 5.1K

JMPR 1

REFRESH CONTROL

U27A U27B U27C U27D U26A U26B U26C U26D

U29B U30B U29A U30A

Q1 U25

$\overline{STREF}$

AAD BUS

(TYP. PIN CONNECTIONS)

U16 U15 U14 U13 U12 U11 U10 U9 U8 U7 U6

WEL

(TYP) $\overline{STRAM}$ $\overline{MBE}$

U17 U18

R2 39 R3 39 CR1 CR2

XIDA BUS

RAD BUS

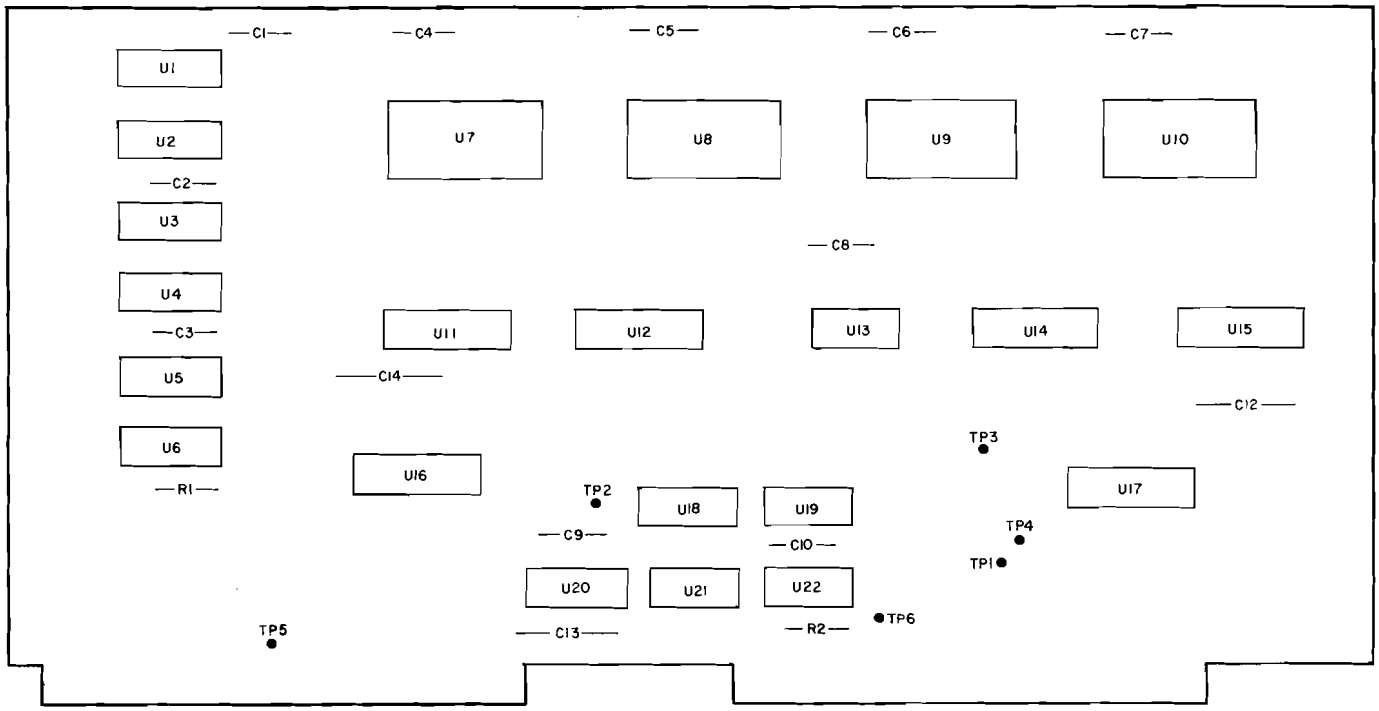
XA8A
C9 12
C8 13
C7 14
C6 15
C5 16
C4 P
C3 R
C2 S
C1 T
RAM ADDRESS A9 J

+5V
R6 5.1K
JMPR 1
REFRESH CONTROL
U27A
U27B
U26C
U26F
U27C
U26A
U27D
U29B
U30B
U29A
U30A
LFETCH
XA8B
L
LFETCH XA9B(11) J
-5V
C4 to C11 .01μF
C2 3.3
U31
C1 2.2
-18V R
TP1
HDAV
HDAV XA9B(12) J
+62 μSEC
+5
STREF
STREF
+12V
Q1
U25
U26D
XA8A
+12V S
C12 to C20 3.3
C30, C31 22
+5V T
C21 to C27 .01
C29 C28 22
C3 3.3

AAD BUS
(TYP. PIN CONNECTIONS)
U15 U14 U13 U12 U11 U10 U9 U8 U7 U6 U5 U4 U3 U2 U1
DI DO WE CE
R2 39
R3 39
CR1
CR2
WER
U17 U18
(TYP)
MBE STRAM
XA8B
XIDA BUS A9 J
XIDA BUS

H

Figure 8-4-5. Random Access Memory.



A8
03582-66528
Rev A

A8 RAM BOARD
03582-66528

%A20 MOTHER BOARD

XA8B

F
- MBE XA7B(C) — C
- Ø2 XA7B(D) — D
- WER XA7B(2) — 2
- WEL XA7B(B) — B
- MEB XA7B(3) — 3
- STRAM XA7B(A) — 1

MBE TO U17(1) U16(1)

TP6

TP3

TP2

STRAM TO U17(19) U16(19)

U20

4 LINES

XA8A

FAT GAG — A B C D E F H J I 2 3 4 5 6 7 8

U1 U2 U3 U4 U5 U6 — 74LS670

R1 1K

TP5

C9

+5V

IDA ADDR LATCH

ADDR SELECT

IDA BUS

TP4 HDAV

U10 U9 U7 — 2K × 8 STATIC CMOS RAM

WEL

WER

U18 COUNTER — CLR, ENT, CLK, LOAD, RCO, ENP, Q_D Q_C Q_B Q_A

U21 U19 U22

U14 U15 U11 U12

STRAM

MBE

U17 U16

XIDA BUS

RAD BUS

XABA

C9 12
C8 13
C7 14
C6 15
C5 16
C4 P
C3 R
C2 S
C1 T

ROM ADDRESS A9 J

XABB

L FETCH XA9B (11) J

TP1 GND

21 Y

H DAV XA9B (12) J

20 X +5V T

+5V

R2 5.1 K

C21 TO C27 C4 - C7 .1

C29,28 22

C3 3.3

U18 COUNTER

CLR ENT CLK LOAD RCO ENP

U10 2K x 8 STATIC CMOS RAM

U9 2K x 8 STATIC CMOS RAM

U7 2K x 8 STATIC CMOS RAM

U8 2K x 8 STATIC CMOS RAM

U14

U15

U11

U12

U16

U17

XIDA BUS A9 J

H

3582-528

Figure 8-4-5. Random Access Memory. REV A
8-4-23/8-4-24

8-4-34. TROUBLESHOOTING THE 03582-66528 RAM ASSEMBLY

8-4-35. Introduction.

8-4-36. This procedure should be used for troubleshooting only the 03582-66528 RAM board; see the backdating section for the 03582-66508 RAM board. The 66528 board is a direct replacement for the 66508 board. The newer 66528 board uses four 2K x8 bit static RAMs instead of sixteen 4K x 1 bit dynamic RAMs. The new board will still be referred to as the A8 assembly.

8-4-37. Although the RAMs do not need to be refreshed, the RAD (Refresh Address) Bus is used by the display (A9) to address the RAMs. Data is read out of the RAM and sent to the display section over the XIDA bus. The processor (A7) also uses the RAM through the IDA bus.

8-4-38. Troubleshooting.

8-4-39. The troubleshooting procedure for this board is the same as for the ROM board:

a. Try the front panel self-test. This can identify the bad component, if the test will run. Remember that this is a 12 minute test.

b. Go through the basic tests (processor test loop, primitive ROM and RAM tests) in sec 8-4-14.

c. Isolate the problem to a component using signature analysis.

8-4-40. Front Panel Self-Test.

8-4-41. To get into the RAM self-test mode, do the following:

a. Initiate the front panel self-test mode by pressing RESET momentarily while holding in average RESTART. When RESTART is released, front panel self-test (0) should come up. If it does not, go to the basic tests at the beginning of the service group.

b. Select average number 64 and press RESTART. This should select RAM test, number 4. Note that this is a 12 minute test that can only be terminated by pressing RESET, which will cause the instrument to leave the self-test mode.

c. The display will do some rather odd things during the test; this is normal.

d. At the end of the test, either OK or ER will be displayed. When ER is displayed, condition code 9 will display the accumulated error. Due to the memory structure, it is not possible to isolate an error to one chip. Rather, each error code indicates bad data from either of two chips.

TABLE 8-4-3 Error Codes for RAM Test

Error code	Bad RAM chip(s)
000 001	U7 or U8
000 002	U7 or U8
000 004	U7 or U8
000 010	U7 or U8
000 020	U7 or U8
000 040	U7 or U8
000 100	U7 or U8
000 200	U7 or U8
000 400	U9 or U10
001 000	U9 or U10
002 000	U9 or U10
004 000	U9 or U10
010 000	U9 or U10
020 000	U9 or U10
040 000	U9 or U10
100 000	U9 or U10

8-4-42. Signature Analysis.

8-4-43. Address Lines. This checks the RAM address lines from the A7 board, and A8 U1 through U6. The A9 board should be removed from the card cage. Only the A6, A7 and A8 boards are needed for this test.

3582A: Short A7J4 and press RESET
Unshort J4. This is the primitive RAM test.

Setup: 5004A:

Gnd: A8TP1
Clock: A8TP2 
Start: A8TP3  (for read)  (for write)
Stop: A8TP3  (for read)  (for write)

Note: Signatures should be checked in both the read and write setup. Each pin will alternate between two signatures during both the read and the write tests. The +5 signature should alternate between 04HH and 826P. The signature at A8TP4 should be the same, if not there is a problem with A8U18 curcuits.

Address Line	IC & Pin No.	Signatures Read / Write
11	U6 (4)	U81P / U03F
10	(12)	C811 / 5F08
9	(7)	3771 / 9CC8
8	(9)	HU4U / CP9P
7	U2 (4)	6064 / 3032
6	(12)	U253 / U929
5	(7)	C177 / 62PU
4	(9)	OF51 / 18A2
3	U4 (4)	66CA / 335H
2	(12)	40H1 / 2068
1	(7)	A872 / 50P5
0	(9)	UF4C / U897

8-4-44. Data Lines During Write. This checks the data lines while data is input into RAM.

Setup: Same as 8-4-43 for write.

IC & Pin No.	Signatures Read/Write
U14 (17)	335H / ICFO
(15)	925A / 2068
(13)	A872 / H657
(11)	UF4A / UF4C
(9)	UFOU / UFF3
(7)	58H5 / APO4
(5)	9U65 / FHHF
(3)	PUA7 / HC92
U11 (17)	34PU / 9819
(15)	7F94 / UHU4
(13)	C5AA / 58CC
(11)	8628 / 088F
(9)	3780 / 99AP
(7)	24C5 / 1034
(5)	5439 / AFAU
(3)	7P25 / U897

8-4-45. Data Lines During Read. This checks the data lines while data is read out of RAM.

Setup: Same as 8-4-43 for read.

IC & Pin No.	Signatures Read/Write
U14 (17)	99AP / 3780
(15)	24C5 / 1034
(13)	AFAU / 5439
(11)	7P25 / U897
(9)	7P61 / U81P
(7)	5F08 / 2F6A
(5)	4UC2 / 9CC8
(3)	HU4U / 6HF9
U11 (17)	1A77 / 3032
(15)	UPUA / U929
(13)	C177 / HAH5
(11)	OF51 / 0446
(9)	335H / 1CFO
(7)	2068 / 925A
(5)	H657 / A872
(3)	UF4C / UF4A

8-4-46. RAD and XIDA bus tests.

This checks the circuits used by the A9 board to read display date from RAM. A9 and A10 boards should be inserted into the card nest now. Push RESET to stop the primitive RAM test. A9S1 should be in RUN.

Setup: 5004A: Gnd: A8TP1

Start: A8TP5 _┐‾

Stop: A8TP5 _┐‾

Clock: A8TP4 _┐‾

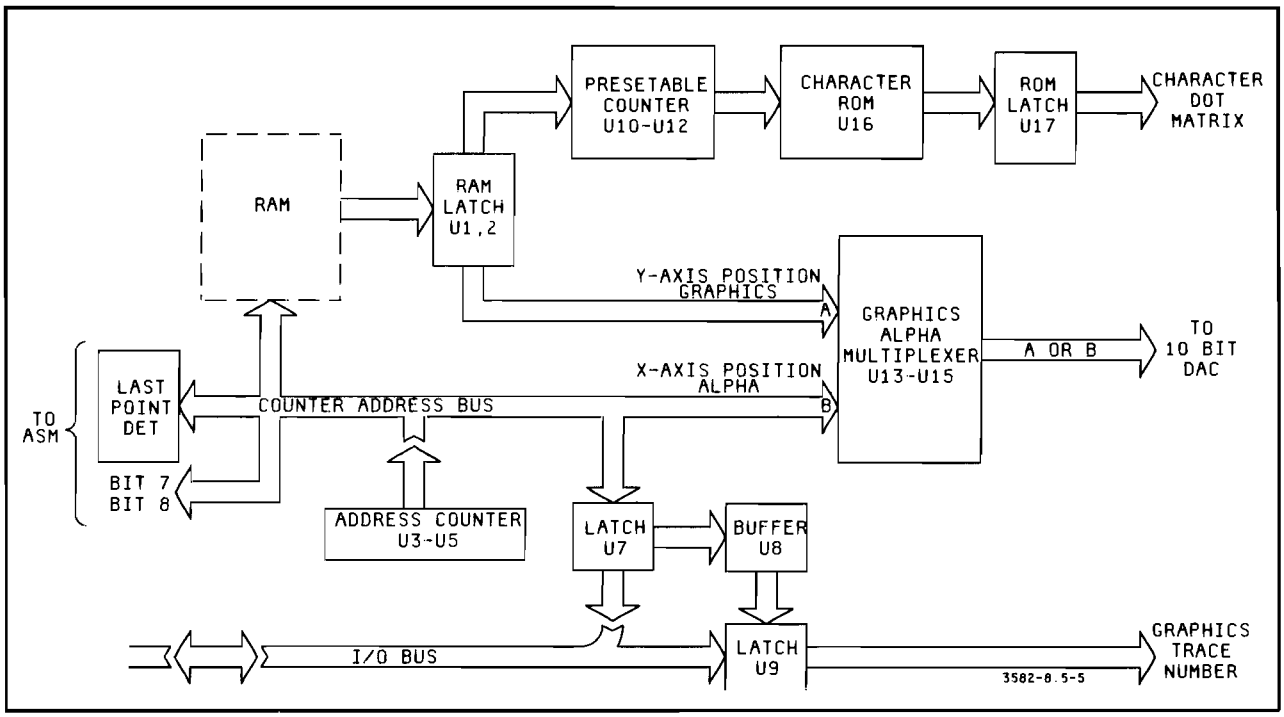
The + signature should be 4596

Initiate the front panel self test mode by pressing RESET while holding RESTART. Select average number 8 and press RESTART. Continue to press RESTART to change TEST# as needed. For test #2, marker must be at the left edge of the screen (position 000000). These signatures are only valid for software date code 020151 (upper right corner of display).

	Test #				
IC & Pin No.	**0**	**1**	**2**	**3**	**4**
A8U15 (17)	901F	UPA2	UPA2	0000	0000
(15)	0000				
(13)	386H				
(11)	U7F5				
(9)	AU2P				
(7)	A8FC				
(5)	22P9				
(3)	6HHF				
U12 (17)	A3H2				
(15)	OA24				
(13)	HUCP				
(11)	981A				
(9)	H2CO				
(7)	3H81				
(5)	F1H9				
(3)	0950				

Software date code 002262 signatures are the same except for the following:

IC & Pin No.	**Test # 0**
A8U15 (13)	U834
(11)	92UA
(9)	1F01
(7)	FH12


PRESETABLE COUNTER U10-U12
CHARACTER ROM U16
ROM LATCH U17
CHARACTER DOT MATRIX
RAM
RAM LATCH U1,2
Y-AXIS POSITION GRAPHICS
A
GRAPHICS ALPHA MULTIPLEXER U13-U15
A OR B
TO 10 BIT DAC
X-AXIS POSITION ALPHA
B
TO ASM
LAST POINT DET
COUNTER ADDRESS BUS
BIT 7
BIT 8
ADDRESS COUNTER U3-U5
LATCH U7
BUFFER U8
I/O BUS
LATCH U9
GRAPHICS TRACE NUMBER
3582-8.5-5

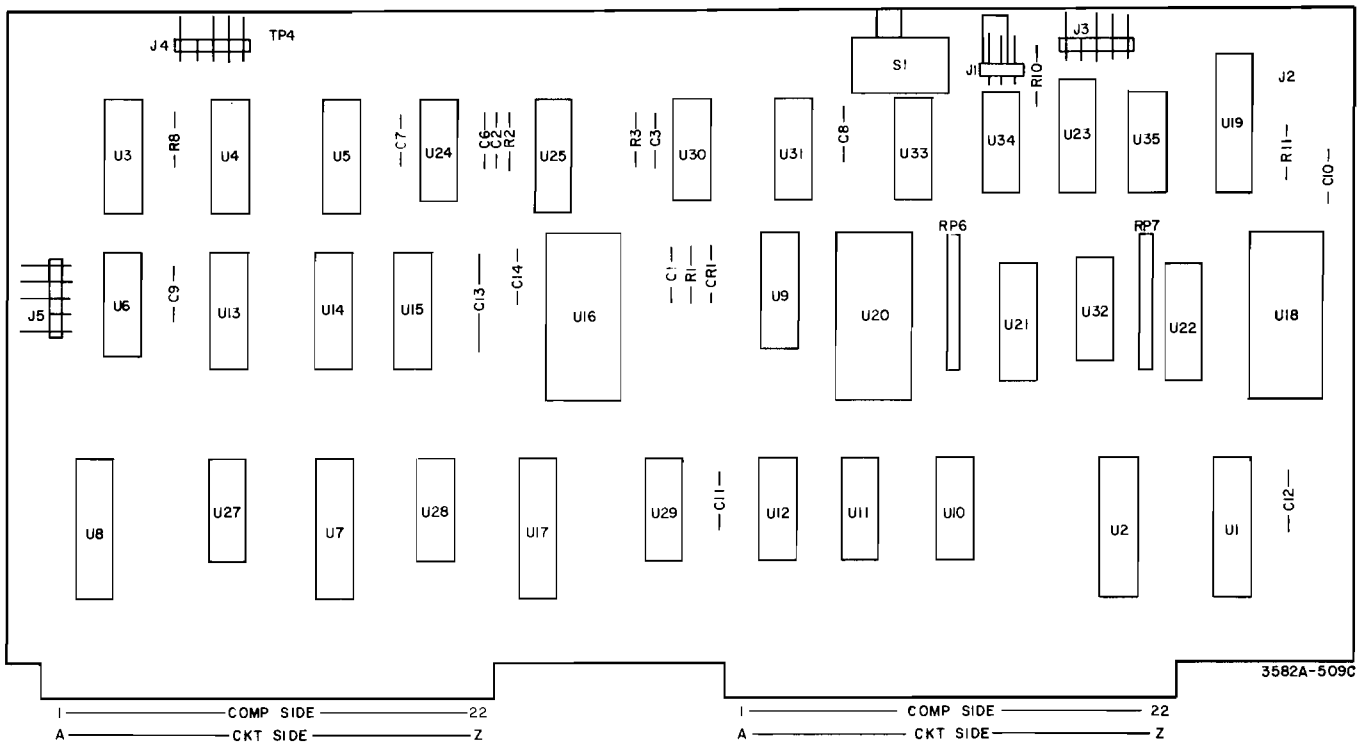

J4
TP4
S1
J1
J3
J2
R10
U3
R8
U4
U5
C7
U24
C6
C2
R2
U25
R3
C3
U30
U31
C8
U33
U34
U23
U35
U19
R11
C10
J5
U6
C9
U13
U14
U15
C13
C14
U16
C1
R1
CR1
U9
U20
RP6
U21
U32
RP7
U22
U18
U8
U27
U7
U28
U17
U29
C11
U12
U11
U10
U2
U1
C12
3582A-509C
1 COMP SIDE 22
A CKT SIDE Z
1 COMP SIDE 22
A CKT SIDE Z

Table 8-4-3. Replaceable Parts.

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A6	03582-66506	4	1	PC ASSEMBLY, ROM	28480	03582-66506
C1	0180-0228	6	13	CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
C2	0160-4571	8	72	CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C3	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C4	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C5	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C6	0180-0309	4		CAPACITOR-FXD 4.7UF+-20% 10VDC TA	56289	150D475X0010A2
C7	0180-0309	4		CAPACITOR-FXD 4.7UF+-20% 10VDC TA	56289	150D475X0010A2
C8	0180-0309	4		CAPACITOR-FXD 4.7UF+-20% 10VDC TA	56289	150D475X0010A2
C9	0180-0309	4		CAPACITOR-FXD 4.7UF+-20% 10VDC TA	56289	150D475X0010A2
C10	0180-0309	4		CAPACITOR-FXD 4.7UF+-20% 10VDC TA	56289	150D475X0010A2
C11	0180-0309	4		CAPACITOR-FXD 4.7UF+-20% 10VDC TA	56289	150D475X0010A2
C12	0180-0309	4		CAPACITOR-FXD 4.7UF+-20% 10VDC TA	56289	150D475X0010A2
C13	0180-0309	4		CAPACITOR-FXD 4.7UF+-20% 10VDC TA	56289	150D475X0010A2
C14	0180-0309	4		CAPACITOR-FXD 4.7UF+-20% 10VDC TA	56289	150D475X0010A2
C15	0180-0309	4		CAPACITOR-FXD 4.7UF+-20% 10VDC TA	56289	150D475X0010A2
J2	1251-5202	8	1	CONNECTOR 5-PIN M POST TYPE	28480	1251-5202
R1	0683-5125	8	10	RESISTOR 5.1K 5% .25W FC TC=-400/+700	01121	CB5125
R2	0683-5125	8		RESISTOR 5.1K 5% .25W FC TC=-400/+700	01121	CB5125
R3	0683-5125	8		RESISTOR 5.1K 5% .25W FC TC=-400/+700	01121	CB5125
U1 *	1818-0957	2	1	IC NMOS 16384-BIT ROM 350-NS 3-S	03794	AM9218CDC MASKED
U2 *	1818-0958	3	1	IC NMOS 16384-BIT ROM 350-NS 3-S	03794	AM9218CDC MASKED
U3 *	1818-0959	4	1	IC NMOS 16384-BIT ROM 350-NS 3-S	03794	AM9218CDC MASKED
U4 *	1818-0961	8	1	IC NMOS 16384-BIT ROM 350-NS 3-S	03794	AM9218CDC MASKED
U5	1818-0517	0	1		34335	AM9218CDC MASKED
U6	1818-0518	1	1	IC NMOS 16384-BIT ROM 350-NS 3-S	34335	AM9218CDC MASKED
U7	1818-0519	2	1	IC NMOS 16384-BIT ROM 350-NS 3-S	34335	AM9218CDC MASKED
U8	1818-0520	5	1	IC NMOS 16384-BIT ROM 350-NS 3-S	34335	AM9218CDC MASKED
U9	1818-0567	0	1	IC NMOS 16384-BIT ROM 350-NS 3-S	28480	1818-0567
U10	1818-0568	1	1	IC NMOS 16384-BIT ROM 350-NS 3-S	28480	1818-0568
U11	1818-0523	8	1	IC NMOS 16384-BIT ROM 350-NS 3-S	34335	AM9218CDC MASKED
U12	1818-0524	9	1	IC NMOS 16384-BIT ROM 350-NS 3-S	34335	AM9218CDC MASKED
U13	1818-0525	0	1	IC NMOS 16384-BIT ROM 350-NS 3-S	34335	AM9218CDC MASKED
U14	1818-0526	1	1	IC NMOS 16384-BIT ROM 350-NS 3-S	34335	AM9218CDC MASKED
U15	1818-0527	2	1	IC NMOS 16384-BIT ROM 350-NS 3-S	34335	AM9218CDC MASKED
U16	1818-0528	3	1	IC NMOS 16384-BIT ROM 350-NS 3-S	34335	AM9218CDC MASKED
U17	1818-0569	2	1		28480	1818-0569
U18	1818-0570	5	1		28480	1818-0570
U19	1820-1872	7		IC BFR TTL LS INV OCTL 2-INP	27014	DM81LS96N
U20	1820-1872	7		IC BFR TTL LS INV OCTL 2-INP	27014	DM81LS96N
U21	1820-1445	0		IC LCH TTL LS 4-BIT	01295	SN74LS375N
U22	1820-1445	0		IC LCH TTL LS 4-BIT	01295	SN74LS375N
U23	1820-1445	0		IC LCH TTL LS 4-BIT	01295	SN74LS375N
U24	1820-1445	0		IC LCH TTL LS 4-BIT	01295	SN74LS375N
U25	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
U26	1820-1201	6		IC GATE TTL LS AND QUAD 2-INP	01295	SN74LS08N
				MISCELLANEOUS PARTS		
	4040-0748	3		EXTRACTOR-PC BOARD BLK POLYC	28480	4040-0748
	4040-0754	1		EXTRACTOR-PC BOARD BLU POLYC	28480	4040-0754

*SOFTWARE

NOTE: IF YOU HAVE TO REPLACE A ROM (DATE CODE 17536) ALL 4 OLD ROMS MUST BE REPLACED.

OLD ROM PART NUMBERS ARE:

U1 1818-0668
U2 1818-0669
U3 1818-0515
U4 1818-0516

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

Table 8-4-3. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A7	03582-66507	5	1	PC ASSEMBLY, PROCESSOR	28480	03582-66507
C1	0140-0200	0	2	CAPACITOR-FXD 390PF +-5% 300VDC MICA	72136	DM15F391J0300WV1CR
C2	0140-0200	0		CAPACITOR-FXD 390PF +-5% 300VDC MICA	72136	DM15F391J0300WV1CR
C3	0140-0195	2	3	CAPACITOR-FXD 130PF +-5% 300VDC MICA	72136	DM15F131J0300WV1CR
C4	0140-0198	5	1	CAPACITOR-FXD 200PF +-5% 300VDC MICA	72136	DM15F201J0300WV1CR
C5	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X901582
C6	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X901582
C7	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X901582
C8	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X901582
C9	0180-1846	6		CAPACITOR-FXD 2.2UF+-10% 35VDC TA	56289	150D225X903582
C10	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
C11	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C12	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C13	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C14	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C15	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C16	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C17	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C18	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C19	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C20	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C21	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C22	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C23	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C24	0160-4571	8		CAPACITDR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
CR1	1901-0033	2	2	DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
J1	1251-5202	8		CONNECTOR 5-PIN M POST TYPE	28480	1251-5202
J2	1200-0458	9		SOCKET-XSTR 3-CONT TO-5 DIP-SLDR	28480	1200-0458
J3	1251-5380	3		CONNECTOR 2-PIN M POST TYPE	28480	1251-5380
J4	1251-5380	3		CONNECTOR 2-PIN M POST TYPE	28480	1251-5380
L1	9100-1651	2	1	COIL-MLD 750UH 5% Q=60 .190X.44LG-NOM	28480	9100-1651
Q1	1854-0071	7	19	TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
R1	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R2	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R3	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R4	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R5	0683-3615	7	5	RESISTOR 360 5% .25W FC TC=-400/+600	01121	CB3615
R6	0683-3615	7		RESISTOR 360 5% .25W FC TC=-400/+600	01121	CB3615
R7	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R8	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R9	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R10	0683-2005	7	2	RESISTOR 20 5% .25W FC TC=-400/+500	01121	CB2005
R11	0683-2005	7		RESISTOR 20 5% .25W FC TC=-400/+500	01121	CB2005
R12	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R13	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R14	0683-1335	4		RESISTOR 13K 5% .25W FC TC=-400/+800	01121	CB1335
R15	0683-1335	4		RESISTOR 13K 5% .25W FC TC=-400/+800	01121	CB1335
R16	0683-5135	0		RESISTOR 51K 5% .25W FC TC=-400/+800	01121	CB5135
R17	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R18	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R19	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R20	0683-2225	3		RESISTOR 2.2K 5% .25W FC TC=-400/+700	01121	CB2225
R21	0683-6815	5	1	RESISTOR 680 5% .25W FC TC=-400/+600	01121	CB6815
R22	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R23	0683-5105	4		RESISTOR 51 5% .25W FC TC=-400/+500	01121	CB5105
R24	0683-5105	4		RESISTOR 51 5% .25W FC TC=-400/+500	01121	CB5105
R25	0683-5105	4		RESISTOR 51 5% .25W FC TC=-400/+500	01121	CB5105
R26	0683-1025	9		RESISTDR 1K 5% .25W FC TC=-400/+600	01121	CB1025
RP1	1810-0076	0	3	NETWORK-RES 9-PIN-SIP .15-PIN-SPCG	28480	1810-0076
RP2	1810-0076	0		NETWORK-RES 9-PIN-SIP .15-PIN-SPCG	28480	1810-0076
RP3	1810-0121	6	2	NETWORK-RES 9-PIN-SIP .15-PIN-SPCG	28480	1810-0121
RP4	1810-0121	6		NETWORK-RES 9-PIN-SIP .15-PIN-SPCG	28480	1810-0121
RP5	1810-0076	0		NETWORK-RES 9-PIN-SIP .15-PIN-SPCG	28480	1810-0076
**U1	09825-67907	7	1	PROCESSOR HYBRID (NOT INCLUDED W/PC ASSY	28480	09825-67907
	09825-67908	8	1	PROCESSOR GASKET (NOT INCLUDED W/PC ASSY	28480	09825-67908
U6	1820-1288	9	1	IC DRVR TTL/MOS CLOCK DRVR 1-INP	04713	MMH0026CL
U7	1820-0683	6	2	IC INV TTL S HEX 1-INP	01295	SN74804N
U8	1820-0681	4		IC GATE TTL S NAND QUAD 2-INP	01295	SN74800N

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

Table 8-4-3. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
U9	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74N
U10	1820-0693	8	3	IC FF TTL S D-TYPE POS-EDGE-TRIG	01295	SN74S74N
U11	1820-1144	6		IC GATE TTL LS NOR QUAD 2-INP	01295	SN74LS02N
U12	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
U13	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
U14	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
U15	1820-1212	9		IC FF TTL LS J-K NEG-EDGE-TRIG	01295	SN74LS112N
U16	1820-1212	9		IC FF TTL LS J-K NEG-EDGE-TRIG	01295	SN74LS112N
U17	1820-1144	6		IC GATE TTL LS NOR QUAD 2-INP	01295	SN74LS02N
U18	1820-1199	1		IC INV TTL LS HEX 1-INP	01295	SN74LS04N
U19	1820-0495	8	2	IC DCDR TTL 4-TO-16-LINE 4-INP	01295	SN74154N
U20	1820-0495	8		IC DCDR TTL 4-TO-16-LINE 4-INP	01295	SN74154N
U22	1820-1759	9		IC BFR TTL LS NON-INV OCTL	27014	DM81LS97N
U23	1820-1491	6		IC BFR TTL LS NON-INV HEX 1-INP	01295	SN74LS367N
U24	1826-0220	9		IC V RGLTR TO-39	27014	LM320H-05
U25	1820-1212	9		IC FF TTL LS J-K NEG-EDGE-TRIG	01295	SN74LS112N
Y1	0410-1126	4	1	CRYSTAL, 13.000 MHZ	28480	0410-1126
				MISCELLANEOUS PARTS		
	0360-0679	3	6	TERMINAL-STUD SPCL-STDF PRESS-MTG	28480	0360-0679
	4040-0748	3		EXTRACTOR-PC BOARD BLK POLYC	28480	4040-0748
	4040-0755	2		EXTRACTOR-PC BOARD VID POLYC	28480	4040-0755

**THE A7 ASSEMBLY, 03582-66507 DOES NOT INCLUDE A PROCESSOR OR PROCESSOR GASKET. ORDER P/N'S:

09825-67907 PROCESSOR HYBRID-NEW
03582-69507 PROCESSOR HYBRID-EXCHANGE
5001-1861 PROCESSOR GASKET (INCLUDED W/EXCHANGE ASSEMBLY)

A NEW PROCESSOR GASKET MUST BE USED WHEN REPLACING THE PROCESSOR. THIS GASKET IS FRAGILE AND BENDING CAN QUICKLY RUIN IT. THE EXCHANGE PROCESSOR ASSEMBLY INCLUDES THE GASKET.

NOTE: THE A7 ASSEMBLY, 03582-66507 DOES NOT INCLUDE A PROCESSOR OR PROCESSOR GASKET. ORDER P/N'S:

09825-67907 PROCESSOR HYBRID-NEW
03582-69507 PROCESSOR HYBRID-EXCHANGE
5001-1861 PROCESSOR GASKET (INCLUDED W/EXCHANGE ASSEMBLY)

A NEW PROCESSOR GASKET MUST BE USED WHEN REPLACING THE PROCESSOR. THIS GASKET IS FRAGILE AND BENDING CAN QUICKLY RUIN IT. THE EXCHANGE PROCESSOR ASSEMBLY INCLUDES THE GASKET.

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

Table 8-4-3. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A8	03582-66508	6	1	PC ASSEMBLY, RAM	28480	03582-66508
C1	0180-1846	6	7	CAPACITOR-FXD 2.2UF+-10% 35VDC TA	56289	150D225X9035B2
C2	0180-0210	6	13	CAPACITOR-FXD 3.3UF+-20% 15VDC TA	56289	150D335X0015A2
C3	0180-0210	6		CAPACITOR-FXD 3.3UF+-20% 15VDC TA	56289	150D335X0015A2
C4	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C5	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C6	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C7	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C8	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C9	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C10	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C11	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C12	0180-0210	6		CAPACITOR-FXD 3.3UF+-20% 15VDC TA	56289	150D335X0015A2
C13	0180-0210	6		CAPACITOR-FXD 3.3UF+-20% 15VDC TA	56289	150D335X0015A2
C14	0180-0210	6		CAPACITOR-FXD 3.3UF+-20% 15VDC TA	56289	150D335X0015A2
C15	0180-0210	6		CAPACITOR-FXD 3.3UF+-20% 15VDC TA	56289	150D335X0015A2
C16	0180-0210	6		CAPACITOR-FXD 3.3UF+-20% 15VDC TA	56289	150D335X0015A2
C17	0180-0210	6		CAPACITOR-FXD 3.3UF+-20% 15VDC TA	56289	150D335X0015A2
C18	0180-0210	6		CAPACITOR-FXD 3.3UF+-20% 15VDC TA	56289	150D335X0015A2
C19	0180-0210	6		CAPACITOR-FXD 3.3UF+-20% 15VDC TA	56289	150D335X0015A2
C20	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C20	0180-0210	6		CAPACITOR-FXD 3.3UF+-20% 15VDC TA	56289	150D335X0015A2
C21	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C22	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C23	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C24	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C25	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C26	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C27	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C28	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
C29	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
C30	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
C31	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
C32	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C33	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C34	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C35	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C36	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C37	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C38	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C39	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C40	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
C41	0160-4571	8		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-4571
CR1	1901-0050	3	10	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
CR2	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
J1	1200-0485	2	1	SKT-IC,14 PIN; PC MTG; RT AGL; CONT	28480	1200-0485
Q1	1853-0405	9	1	TRANSISTOR PNP 2N4209 SI TO-18 PD=300MW	28480	1853-0405
R1	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R2	0683-3905	8	2	RESISTOR 39 5% .25W FC TC=-400/+500	01121	CB3905
R3	0683-3905	8		RESISTOR 39 5% .25W FC TC=-400/+500	01121	CB3905
R6	0683-5125	8		RESISTOR 5.1K 5% .25W FC TC=-400/+700	01121	CB5125
U1	1818-0508	9	16	IC NMOS 4K RAM DYN 270-NS 3-S	03406	MM5280N-5
U2	1818-0508	9		IC NMOS 4K RAM DYN 270-NS 3-S	03406	MM5280N-5
U3	1818-0508	9		IC NMOS 4K RAM DYN 270-NS 3-S	03406	MM5280N-5
U4	1818-0508	9		IC NMOS 4K RAM DYN 270-NS 3-S	03406	MM5280N-5
U5	1818-0508	9		IC NMOS 4K RAM DYN 270-NS 3-S	03406	MM5280N-5
U6	1818-0508	9		IC NMOS 4K RAM DYN 270-NS 3-S	03406	MM5280N-5
U7	1818-0508	9		IC NMOS 4K RAM DYN 270-NS 3-S	03406	MM5280N-5
U8	1818-0508	9		IC NMOS 4K RAM DYN 270-NS 3-S	03406	MM5280N-5
U9	1818-0508	9		IC NMOS 4K RAM DYN 270-NS 3-S	03406	MM5280N-5
U10	1818-0508	9		IC NMOS 4K RAM DYN 270-NS 3-S	03406	MM5280N-5
U11	1818-0508	9		IC NMOS 4K RAM DYN 270-NS 3-S	03406	MM5280N-5
U12	1818-0508	9		IC NMOS 4K RAM DYN 270-NS 3-S	03406	MM5280N-5
U13	1818-0508	9		IC NMOS 4K RAM DYN 270-NS 3-S	03406	MM5280N-5
U14	1818-0508	9		IC NMOS 4K RAM DYN 270-NS 3-S	03406	MM5280N-5
U15	1818-0508	9		IC NMOS 4K RAM DYN 270-NS 3-S	03406	MM5280N-5
U16	1818-0508	9		IC NMOS 4K RAM DYN 270-NS 3-S	03406	MM5280N-5
U17	1820-1872	7	4	IC BFR TTL LS INV OCTL 2-INP	27014	DM81LS96N
U18	1820-1872	7		IC BFR TTL LS INV OCTL 2-INP	27014	DM81LS96N
U19	1820-1445	0	7	IC LCH TTL LS 4-BIT	01295	SN74LS375N
U20	1820-1445	0		IC LCH TTL LS 4-BIT	01295	SN74LS375N

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

Table 8-4-3. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
U21	1820-1445	0		IC LCH TTL LS 4-BIT	01295	SN74LS375N
U22	1820-0762	2	3	IC MUXR/DATA-SEL TTL 2-TO-1-LINE QUAD	01295	SN74157N
U23	1820-0762	2		IC MUXR/DATA-SEL TTL 2-TO-1-LINE QUAD	01295	SN74157N
U24	1820-0762	2		IC MUXR/DATA-SEL TTL 2-TO-1-LINE QUAD	01295	SN74157N
U25	1820-1673	6	1	IC DRVR TTL/MOS DUAL	01295	SN75322N
U26	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
U27	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
U28	1820-1491	6		IC BFR TTL LS NON-INV HEX 1-INP	01295	SN74LS367N
U29	1820-1212	9		IC FF TTL LS J-K NEG-EDGE-TRIG	01295	SN74LS112N
U30	1820-1212	9		IC FF TTL LS J-K NEG-EDGE-TRIG	01295	SN74LS112N
U31	1826-0220	9		IC V RGLTR TO-39	27014	LM320H-05
				MISCELLANEOUS PARTS		
	4040-0747	2		EXTRACTOR-PC BOARD GRA POLYC	28480	4040-0747
	4040-0748	3		EXTRACTOR-PC BOARD BLK POLYC	28480	4040-0748
J1	1251-4822	6		CONNECTOR 3-PIN M POST TYPE	28480	1251-4822
	1200-0458	9		SOCKET-XSTR 3 CONT TO -5 DIP-SLDR	28480	1200-0458

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

SERVICE GROUP 5
THE DISPLAY SECTION

TABLE OF CONTENTS

Service Group	Page
5. THE DISPLAY SECTION	8-5-1
8-5-1. General Description	8-5-1
8-5-5. The ASM Controller I(A9)	8-5-1
8-5-7. The Digital Display Driver J(A9)	8-5-1
8-5-9. Alphanumeric Operations	8-5-2
8-5-12. Graphics Operation	8-5-2
8-5-16. The Test Switch	8-5-2
8-5-18.The Analog Display Driver K(A10)	8-5-3
8-5-22. Alphanumeric Operations	8-5-3
8-5-27. Graphics Operations	8-5-4
8-5-29.The Line Drawer K(A10)	8-5-4
8-5-31. Circuit Description	8-5-4
8-5-33. The Ramp Generator	8-5-4
8-5-35. Circuit Description	8-5-4
8-5-42.Troubleshooting The Display Control Section	8-5-5
8-5-45. Marker Problems	8-5-6
8-5-48. Troubleshooting The Display Controller (I)	8-5-6

LIST OF TABLES

Table	Page
8-5-1. Display Controller Signature Analysis	8-5-7
8-5-2. Display Control	8-5-9/8-5-10
8-5-3. Replaceable Parts	8-5-21

LIST OF ILLUSTRATIONS

Figure	Page
8-5-1. Intensity Correction Simplification	8-5-5
8-5-2. ASM Flowchart	8-5-11/8-5-12
8-5-3. Troubleshooting Quick Reference For Schematics I, J, and K	8-5-13/8-5-14
8-5-4. P/O A9 Display Controller	8-5-15/8-5-16
8-5-5. P/O A9 Digital Display Driver	8-5-17/8-5-18
8-5-6. A10 Analog Display Driver	8-5-19/8-5-20

THE DISPLAY SECTION
SERVICE GROUP 5

8-5-1. GENERAL DESCRIPTION.

8-5-2 The Display Section performs the function of retrieving output data from the processor RAM and converting it to analog signals which control the display CRT. The output data contains alphanumeric information and graphics information. Reading the data from the RAM causes the entire RAM to be refreshed during each 1/10th display cycle.

8-5-3. The Display Section is controlled by an algorithmic state machine (ASM) which also provides instructions for interfacing with the main processor. The processor supplies information concerning the number of traces to be displayed and receives information pertaining to the marker X axis position.

8-5-4. The Display Section can be divided into four main areas contained on three boards:

1. The ASM Controller (A9 Board).
2. The Digital Display Driver (A9 Board).
3. The Analog Display Driver (A10 Board).
4. The High Voltage Amplifiers (A13 Board).

8-5-5. THE ASM CONTROLLER I(A9).

8-5-6. The ASM (Algorithmic State Machine) uses a ROM centered design (refer to Schematic I). The ROM (U18) has an output which is a function of the present state address and the qualifier input. A latch (U19) is inserted into the address feedback loop and is clocked to provide state interval timing. Parts of the present state address are used for qualifier selector (U20) instructions, decoder output enable (U30) instructions, and are decoded by ROM instruction decoders (U21 and U22) to provide instructions to operate other devices in the display section. Some of the instructions from the decoder are latched (U23) or modified by logic (U24,U25,U26) which changes their timing relative to the state clock.

8-5-7. THE DIGITAL DISPLAY DRIVER J(A9).

8-5-8. The ASM Controller establishes the sequence of operations for the Digital Display Driver. Most of the operations fall under two main groups: 1) alphanumeric operations and 2) graphics operations. Both operations require that the main processor RAM be interrogated for the desired display data. Data in the RAM is accessed by the use of addresses supplied by an address counter (U3,U4,U5) which uses the (L) FETCH command from the Display Controller as a clock input. The address counter selects 512 RAM addresses in sequential order. The (L) FETCH command to the RAM allows the display section to have direct memory access and priority over the main processor when executing RAM functions. Data from the RAM is latched by U1 and U2 (see Schematic J).

8-5-9. Alphanumeric Operations.

8-5-10. There are four lines of alphanumeric characters displayed by the CRT with 32 characters in each line. The display data at each RAM address contains both alphanumeric and graphics information. Only one portion is used at a time and it takes 4 addresses to establish one character (the fourth address is not used). This information is latched into the Presettable ROM Address Counter (U12,U11,J10) by the Display Controller instructions (L) LOAD 1, (L) LOAD 2, and (L) LOAD 3. This data presets the counter which is incremented by the Display Controller instruction (L) INCR. The combined output from the counters determines the address to character ROM U16 whose output is latched by U17. Each output word from the ROM contains the X, Y dot matrix coordinates for a single dot. Each dot in a character is written on the display as the Presettable ROM Address Counter is incremented. When the last dot of the character is written, the (L) EOC line is activated which signals the Display Controller that the last dot of the character has been reached.

8-5-11. The X, Y coordinates of each character are determined by parts of the output of the Address Counter. The X axis position of each character (bus lines C3 through C7) is coupled to the Analog Display Driver through a multiplexer (U13,U14,U15) which is controlled by the instruction (L) GSEL from the Display Controller. The Y axis position of each character (bus lines C8 and C9) are connected to the Analog Display Driver through the mother board via XA9A. The last character in a line is indicated by the output from U6 ((L) POINT).

8-5-12. Graphics Operation.

8-5-13. The Digital Display Driver provides the Analog Display Driver with Y axis amplitude data and ramp generator instructions (X axis). The bits from the RAM Latch (U1,U2) comprise the Y axis graphics amplitude data and are coupled to the Analog Display Driver by the Multiplexer (U13,U14,U15) when the (L) GSEL line is activated by the Display Controller. The ramp generator control instructions (RAMP 1, RAMP 2, RAMP 4) and the number of records to be written on the display (BIT 1, BIT 2) are determined by the processor and are sent over the I/O Bus and latched by U9. The ramp generator signals are gated by AND gates (U29) which in turn are controlled by a secondary display controller instruction (RAMP).

8-5-14. The marker amplitude and frequency may be displayed if the processor has the X axis marker address position data. When the graphics trace is at the same X axis position as the marker (potentiometer on the front panel), the display controller activates the (L) MAL instruction to latch the address counter data into U7. When the processor requires the information, it sends an enable instruction to U8 (tri-state buffer) which places the data on the output of U7 and on the processor I/O Bus.

8-5-15. The BLANK and MARK outputs from U1 signal the display controller to modify the graphics presentation. BLANK causes the display intensity to turn off so that the line segment connecting the point where BLANK is given and the following point will not be displayed. MARK causes the intensity to increase the Line Drawer on the Analog Display Driver to hesitate so that the marker is presented as a brighter point on the graphics display.

8-5-16. The Test Switch.

8-5-17. The Test Switch is used to establish a test pattern on the CRT display. When the switch is in the TEST position, the outputs from latches U1,U2, and U9 are set low. This

isolates the Processor RAM and the Processor I/O Bus from the Display Section. The Display Controller continues to run using zeros for RAM output data causing the character "A" to be displayed on all four alphanumeric lines. The section of the Test Switch connected to pin 14 of U13 causes an address counter bit to be switched into the Y axis amplitude data input resulting in a periodic square wave presentation on the CRT display. Note that the display cycle takes place at a rate of about 60 times a second which makes the display appear to be continuous.

8-5-18. THE ANALOG DISPLAY DRIVER K(A10).

8-5-19. The Analog Display Driver receives digital data from the Digital Display Driver. The data is converted to voltage levels by DAC's (digital-to-analog converters) whose outputs are used for several purposes:

a. To provide an input signal to the Line Drawer.
b. To provide a sweep control signal to the Ramp Generator.
c. To provide alphanumeric character control signals to summing amplifiers.

8-5-20. The outputs from the Line Drawer, Ramp Generator, and the summing amplifiers are multiplexed (U17) so that either alphanumeric or graphics control signals are available to the X and Y high voltage grid control amplifiers. The output from the Z Axis Intensity Correction Amplifier (Graphics) or the Z Axis Intensity (Alpha) circuit are multiplexed (U15) for input to the Z Axis high voltage grid control amplifier.

8-5-21. The operations performed by the Analog Display Driver can be divided into two areas:

a. Alphanumeric operations.
b. Graphic operations.

8-5-22. Alphanumeric Operations.

8-5-23. The Display Controller sets the Analog Display Driver for alphanumeric operations by setting the (L) ASEL line LOW and setting the RAMP line LOW. The (L) ASEL signal causes the Graphics-Alpha MUX to switch the alphanumeric signals to the X and Y axis outputs. The absence of the RAMP signal (LOW) causes the Z Axis MUX to place a fixed alphanumeric intensity level from the Z Axis Intensity Alpha circuit on the Z Axis output. This also occurs during marker intensification.

8-5-24. To display alphanumeric characters requires that the character position be defined as well as the position of each dot in the character matrix.

8-5-25. The X Axis character position is defined by the output from DAC U1. U2 is used as a voltage converter with capacitors C116, C118 and C1 providing compensation for the step transition outputs from U1. The output from U2 is scaled by the resistor divider network formed by R60 and R61. The X character dot coordinate is converted by the X Axis Matrix DAC. The output is scaled by the resistor divider network formed by R54 and R62. The position and dot matrix coordinates are summed by the X Summing Amplifier U14. The output from U14 is the X Alpha input to the Graphics-Alpha MUX.

8-5-26. The Y Axis character position is defined by the output from the Y Axis Alpha DAC U11. The Y Axis character dot coordinate is defined by the output from the Y Axis Matrix

DAC U10. This output is scaled by the resistor network comprised of R39 and R46 and summed with the output from U11. The sum is amplified by the Y Summing Amplifier U12 which has an output to the Graphics-Alpha MUX.

8-5-27. Graphics Operations.

8-5-28. The Display Controller sets the Analog Display Driver for graphics operations by setting the (L) GSEL line LOW and the RAMP line HIGH.

8-5-29. THE LINE DRAWER K(A10).

8-5-30. The Line Drawer produces an output which is a linearly changing voltage representing the Y Axis component of a line segment connecting two successive graphic points. A secondary output to the Z Axis Intensity Correction circuit represents the rate of change in the Y Axis deflection. The input to the Line Drawer is formed by DC step voltages which come from the Y Axis Graphics - X Axis Alpha DAC.

8-5-31. Circuit Description.

8-5-32. In the Sample Hold Circuit, Q3 operates like a switch and is controlled by the SAMPLE signal through Q5 and Q4. The summation junction takes the difference between the last point from the integrator and the present point from the output of U2. This is the length of the line to be drawn. This voltage is sampled and causes the Integrator to ramp from the previous point to the next point in a specified amount of time. Note that the integration time is the same for all pairs of points compared. The Line Drawer is sent the same word twice in a row to generate the marker.

8-5-33. The Ramp Generator.

8-5-34. The Ramp Generator provides an output for sweeping the X Axis in the graphics mode of operation. The sweep rate is directly proportional to an input which represents the number of graphics records to be displayed. The sweep time is determined by the Display Controller through the (L) RTRC line. To generate the marker, the Ramp Generator is momentarilly stopped.

8-5-35. Circuit Description.

8-5-36. The impedance converter (Q6) provides a low current source load impedance to the DAC. Q7A and Q7B forms a current mirror circuit. The current out of the collector of Q7B equals the collector current of Q6 (for large transistor betas). The current from Q7B causes the capacitor C20 to charge producing a ramp voltage.

8-5-37. A retrace ((L) RTRC) signal sets the Retrace Logic R-S flip-flop U21 causing Q8 to turn on the Darlington Pair Q9 and Q10 which discharge capacitor C20. When the voltage across C20 becomes negative, comparator U23 resets the Retrace Logic R-S flip-flop U21 turning off the Retrace Current Source.

8-5-38. In the graphics mode of operation, the X axis is swept by the Ramp Generator which has a sweep rate controlled by the output from the Graphics Sweep Rate DAC U7. The sweep is terminated by the Display Controller command (L) RTRC.

8-5-39. The output from the Ramp Generator is also used as an input to the Marker Comparator U23. The position is determined by comparing the X Axis position voltage from the Ramp Generator and the voltage from the Marker Position potentiometer on the front panel. The output from the comparator (COMP) is used to trigger the Marker Comparator Latch (see Schematic I board A9).

8-5-40. The output from U2 defines the Y Axis graphics amplitude in the graphics mode of operation. The DC levels from the DAC U1 form step voltage changes that would represent a series of points on the CRT if they were displayed directly. The step DC levels from U2 form the input to the Line Drawer which has an output representing a line connecting the DC levels (points) as the X Axis is swept. This output from the Line Drawer is the Y Graphics input to the Graphics Alpha MUX. Another output from the Line Drawer is the input to the Z Axis Intensity Correction circuit.

8-5-41. The Z Axis Intensity Correction circuit enables the graphics display to have consistent intensity throughout the length of the graphics trace. The circuit uses an output from the Line Drawer, which represents a positive or negative difference between Y Axis points and converts this difference to an absolute value (always positive). For a simplified representation of the circuit, see Figure 8-5-1.

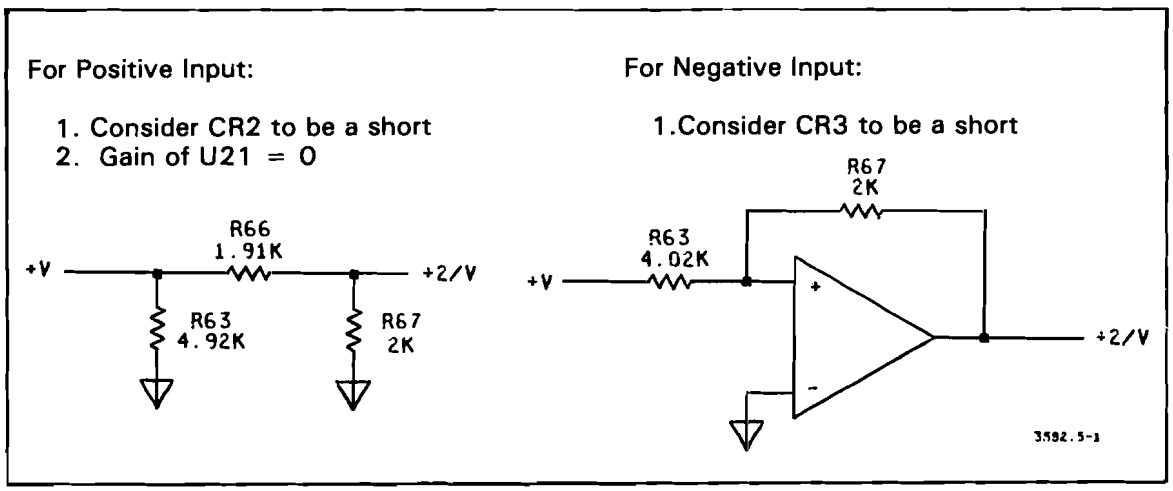


Figure 8-5-1. Intensity Correction Simplification.

8-5-42. TROUBLESHOOTING THE DISPLAY CONTROL SECTION.

8-5-43. The Display Control Section consists of the Digital Controller (Schematic I), Digital Display Driver (Schematic J) and Analog Display Driver (Schematic K). These circuits plus the XYZ Amplifier can be quickly checked using the test switch on the Digital Controller/Display Driver Assembly (A9). All that this test requires from the rest of the instrument is the power supplies (including high voltage) and the processor clock. Moving the switch to test should produce a test pattern.

8-5-44. The display test pattern consists of all A's for the alpha and a square wave for the graphics. If this pattern is correct, the display section is at least basically working. A problem with the character ROM could exist and not be apparent from the test but, in general, the test is complete. Problems with the display not in this section can usually be traced to the Processor Service Group (4), especially the RAM assembly. If the test pattern is incorrect, refer to the Troubleshooting Quick Reference to localize the problem to a schematic.

8-5-45. Marker Problems.

8-5-46. The marker position potentiometer controls the voltage on one side of a comparator (A10 U23); the other side has the sweep ramp for an input. When the voltages are equal, the COMP line to the controller (A9) goes high. This causes the address (in RAM) of that display point to be latched into A9 U7 and sent over the I/O Bus to the processor. The processor then sets bit 14 of the display word at that address true to intensify the dot.

8-5-47. If an HP-IB controller is available, a simple check can be made to determine where the problem is. If the marker works when programmed over the HP-IB, then the processor and the RAM are OK and the problem is with the A9 or A10 circuitry. If the marker does not work over the Bus, the problem is probably with the processor or RAM circuits.

8-5-48. Troubleshooting The Display Controller (I).

8-5-49. Signature Analysis is quite effective in troubleshooting this section. For the ASM, two signature analysis routines are provided. SA test #1 effectively removes the qualifier select from the circuit. In this way, only U18 and U19 are being tested. SA test #2 is essentially normal operation. The troubleshooting procedure would then be to check U18 and U19 with test #1 and proceed to test #2 if this failed to find the bad component.

Table 8-5-1. Display Controller Signature Analysis.

INTRODUCTION - TROUBLESHOOTING THE DIGITAL SECTION OF DISPLAY (A9).

The major difficulty associated with troubleshooting this board is the closed-loop nature of the ASM. To this end, there are two SA routines provided. SA Test #1 effectively isolates the control ROM from the qualifier inputs. This can be used for troubleshooting the ASM. For problems that aren't associated with the ASM (see procedure below), SA Test #2, which is essentially normal operation, is used.

TROUBLESHOOTING PROCEDURE –(Important: For REV B and earilier A9, refer to Backdating.)

1. Check the outputs of the State Latch U19 using Test #2.
2. Check the outputs of the State Latch U19 using Test #1.
3. If both are correct, check other signatures using Test #2.
4. If 1 is incorrect, check other signatures using Test #1.In this case, the qualifiers are incorrect and must be isolated from the ASM for troubleshooting.

NOTE

a. If 2 is incorrect, check especially U18 and U19.
b. If 2 is correct, U18 and U19 are probably OK.

SA TEST #1.

Setup:

1. Move A9 S1 to the "TEST" position.
2. Move A9 J1 to the "T" position.
3. Connect the 5004A as follows:

GND	J5(1) or	GND TP
CLK	J5(3)	⎍ or TP1
START/STOP	J5(4)	⎍ or TP3

4. Momentarily short A9 J2. This should give a rather strange display - NOT THE TEST PATTERN.
5. The +5 signature should be **HFU6.** If this is incorrect, troubleshoot the clock from the processor U19(11) and the address counter (Schematic J) U3,4 and 5.
6. If an incorrect signature is encountered, RECHECK THE SETUP. It may be necessry to repeat Step 4.

Signatures For SA Test #1

IC	U1	U2	U3	U4	U5	U6	U7	U9	U10	U11	U13	IC
Pin 1			7A23				HFU6				U567	1 Pin
2	0000	0000					3C86			0000	0000	2
3							P770				H2FA	3
4							562C				UPF9	4
5	0000	0000	OC12				6HAH		0000	0000	0000	5
6	0000	0000					OAU5				A16F	6
7			HFU6				6FPC				468P	7
8						7153	A16F					8
9	0000	0000					H345			0000	C493	9
10				449A	HFU5		0000				0474	10
11			HFU6	8516	A16F		U567				0000	31
12	0000	0000		37P8	6FPC		3H31			0000	PC1P	12
13			U567	0474	562C		H2FA				37P8	13
14			U567	H2FA	P770		0474				37P8	14
15	0000	0000		68FO	449A		87P6					15
16	0000	0000					A195					16
19	0000	0000					97FA					19

Table 8-5-1. Display Controller Signature Analysis (Cont'd).

Signatures For SA Test #1 (Cont'd)

	IC	U14	U15	U17	U18	U19	U20	U21	U22	U23	U27	U28	U29	IC	
Pin	1	U567	H567				0000	U567	7AC3	U567			0000	1	Pin
	2	0000		HFU6		2991	0000	7AC3	7AC3	7AC3	0000	0000	2991	2	
	3	0000					0000	7AC3	U567	7AC3			0000	3	
	4	HFU6					8516	U567	7AC3	U567	157P	0000	0000	4	
	5	0000		0000		A645	OC12	U567	U567	U567			2991	5	
	6	0000		0000		8UH4	7153	U567	7AC3	7AC3	9A78	0000	0000	6	
	7	HFU6					HFU6	U567	7AC3	U567				7	
	8						0000			0000	37P8	0000	2991	8	
	9	HFU6	HFU6	0000	5322	8UH4	0000	7AC3	U567	2991			HFU6	9	
	10	0000	0000		2991		U567			7AC3	6865	HFU6	2991	10	
	11	0000	0000	A645	7AC3	0000				U567				11	
	12	F988	HFU6	0000		0000				U567	223U	2991		12	
	13	6FPC	0000		7AC3					U567				13	
	14	0000	0000		0000					U567				14	
	15			0000	7AC3	8UH4		5322	5322	7AC3				15	
	16			0000	7AC3	8UH4				HFU6				16	
	17				7AC3									17	
	19					8UH4								19	
	22						HFU6							22	
	23						HFU6							23	

SA TEST #2.

Setup:

1. Move A9 S1 to the "TEST" position.
2. Move A9 J1 to run (R).
3. Connect the 5004A as follows: *(Only REV D and later A9 fitted with J5.)*

GND	J4(1) or GND TP
CLK	J4(3) or TP 1
START/STOP	J4(4) or TP 4

4. The +5 signature should be **FHFF**. IMPORTANT: For instruments with serial number prefix 1747A, remove the A10 assembly or set the marker to the left edge of the display. Move the test switch to RUN to set the marker.

Signatures For SA Test #2

	IC	U3	U4	U5	U7	U9	U16	U17	U18	U19	U20	U21	U22	U23	IC	
Pin	1					0					0	F3FA	PA45		1	Pin
	2	P129			0	0		6HOP		41C4	0	6F16	F32C		2	
	3										0	4U07	488P		3	
	4										27A3	P546	PA45	00AA	4	
	5	9482			0	0		C6UP		2F63	9482	034C	UOC8		5	
	6				0			CA95		8059	4AH9	C9U7	204P		6	
	7					0					9PP3	783F	PA45	H66A	7	
	8										0				8	
	9				0		55FP	233C	7453	F848	0	5H3U	UOC8	PC11	9	
	10		68UC	FHFF			138F		OP92	0	1243				10	
	11		27A3	H60C			UUAP	82FC	56P6	0					11	
	12		5HFP	3861	0			HU48		PAH1					12	
	13		30FA	40AH			7H9A		F704					26HH	13	
	14		7629	H291			2PFA		83U7	C8PO					14	
	15		P129	68UC	0		A98U	U5F4	C8PO			OFA8	OFA8		15	
	16				0		3H3P	C6F8	PFP8	HH59					16	
	17								301A						17	
	19				0					980H					19	
	21										H664				21	
	22										6HOP				22	
	23								P44H		6HOP				23	

Table 8-5-2. Display Control.

Inputs To Data Selector.

1. Bit 1 2. Bit 2	indicate the number of records to be displayed on CRT.
3. Bit 7 4. Bit 8	indicate Address Counter position in memory.
5. Blank	blank trace between two consecutive outputs of RAM graphics data.
6. CNU	comparator not used.
7. (L) COMP	comparator output.
8. (L) EOC	end of character, indicates the last dot in a character matrix.
9. MARK	mark an intensified dot on the graphics display.
10. (L) POINT	last point for a record or alphanumeric character line.

Display Controller Outputs (Primary).

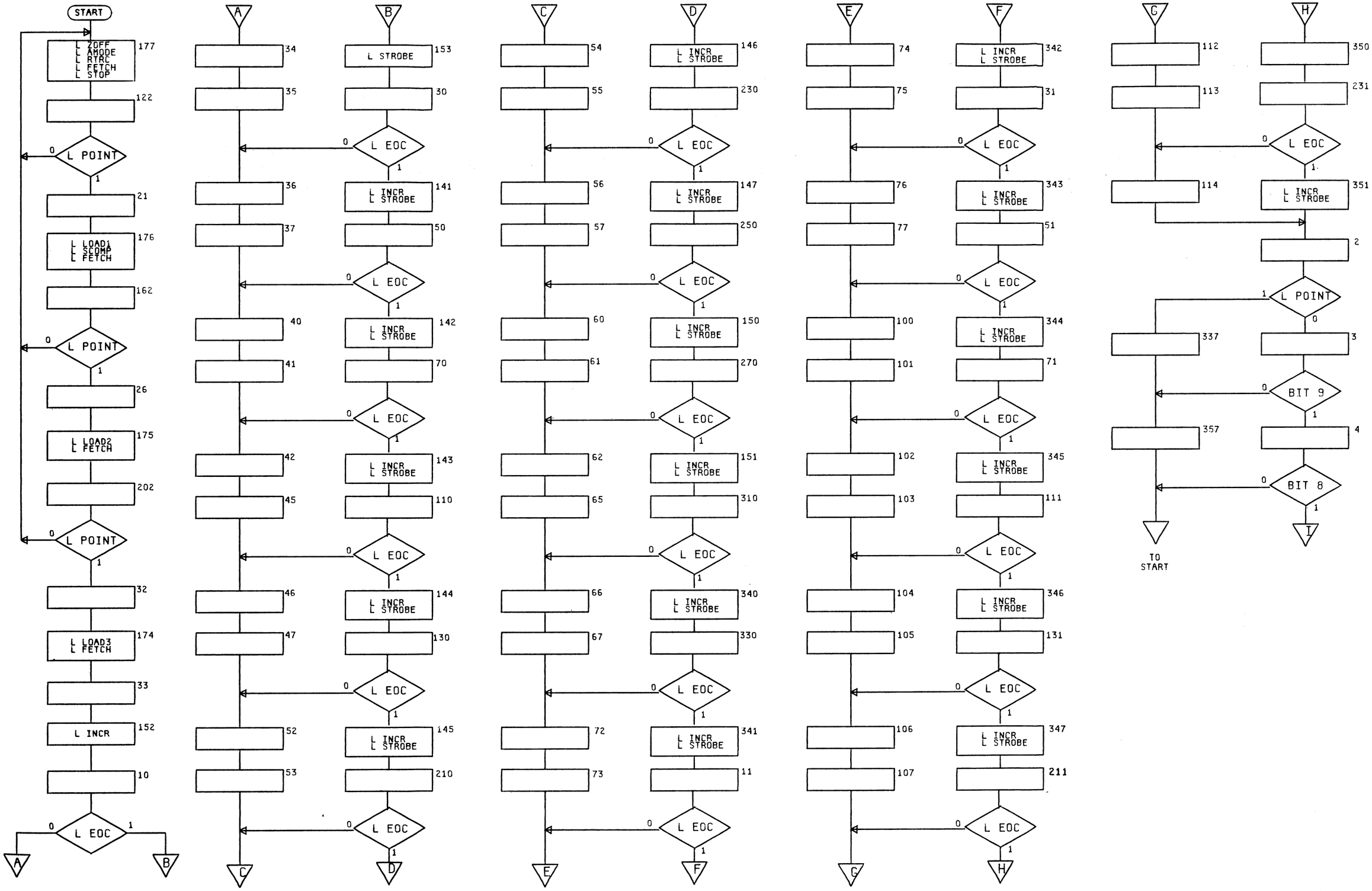
1. (L) A MODE	amplitude mode.
2. (L) FETCH	fetch RAM data, increment Address Counter.
3. (L) G MODE	graphics mode.
4. (L) INCR	increment Presettable ROM Address Counter, latch character ROM output.
5. (L) LOAD 1 6. (L) LOAD 2 7. (L) LOAD 3	loads RAM output data into Presettable ROM Address Counter, three RAM words required (four words per character).
8. (L) MAL	marker address load (latch U7).
9. (L) RTRC	ramp retrace, occurs at the end of a displayed record.
10. (L) S COMP	set comparator latch.
11. (L) START 12. (L) STOP	used to initiate and terminate the display of a record or records.
13. (L) STROBE	strobes one-shot multivibrator U25 used to control Z axis in alphanumeric mode.
14. (L) Z OFF	set and clear R-S flip-flop U23, used in graphics.
15. (L) Z ON	mode to control Z axis.

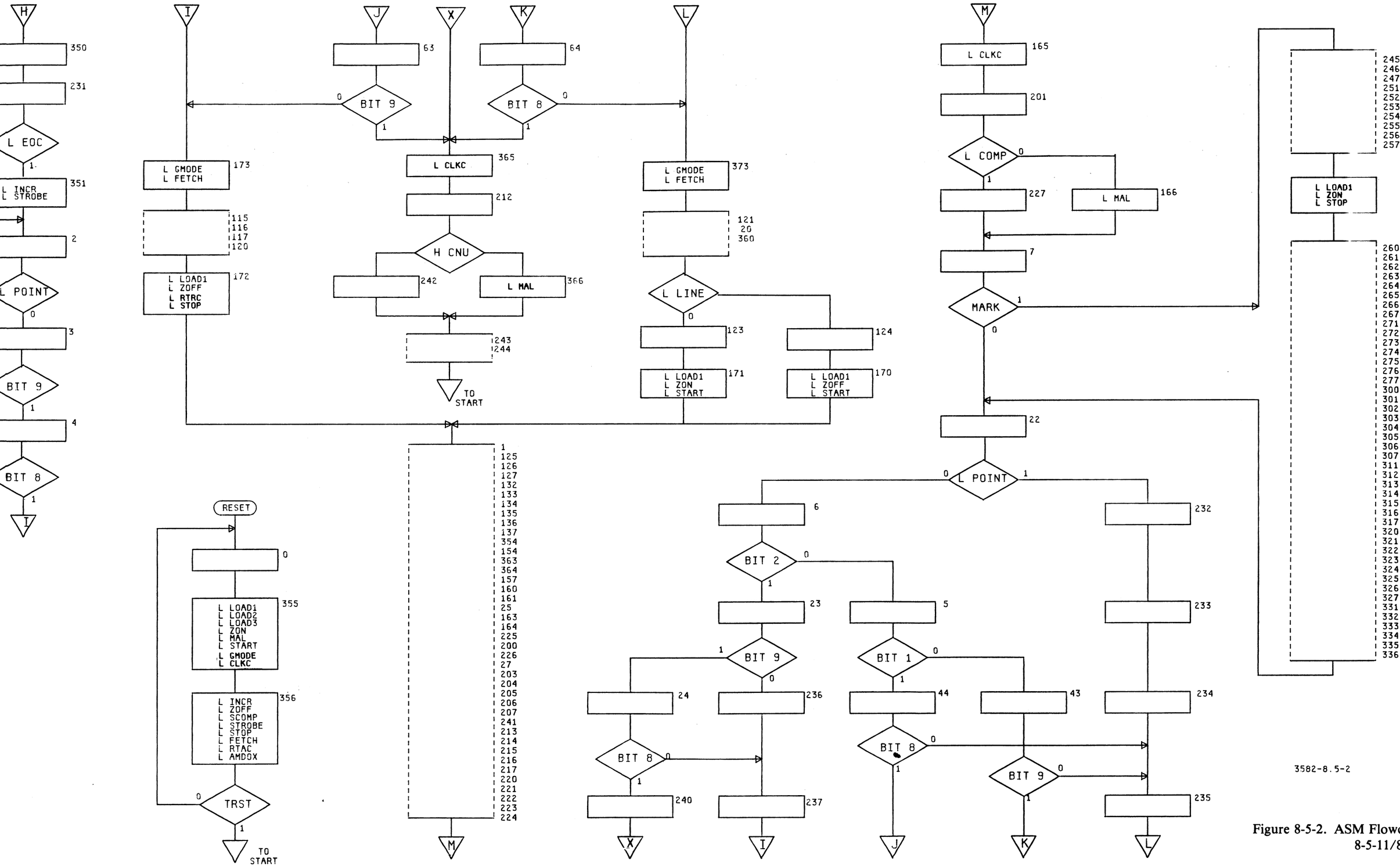
Display Controller Outputs (Secondary).

1. (L) ASEL	alphanumerics select.
2. (L) G SEL	graphics select.
3. RAMP	gates RAMP Generator control signals, also controls analog multiplexer on analog driver board.
4. SAMPLE	activates sample/hold circuit in line drawer, signal derived from (L) Load 1.
5. ZTTL	activates Z axis grid drive, controls intensity.

Instructions From Processor.

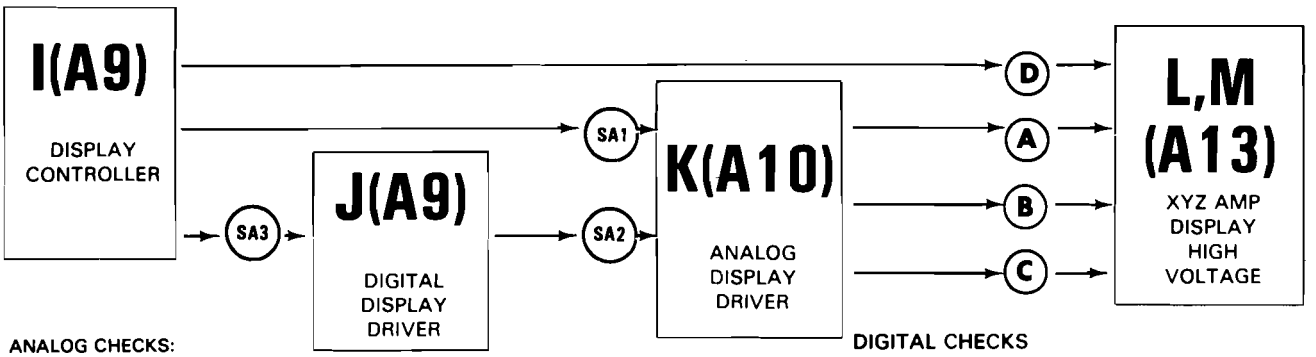
1. RAMP 1	write one record on display.
2. RAMP 2	write two records on display.
3. RAMP 4	write four records on display.


START
L ZOFF
L AMODE
L RTRC
L FETCH
L STOP
177
122
L POINT
21
L LOAD1
L SCOMA
L FETCH
176
162
L POINT
26
L LOAD2
L FETCH
175
202
L POINT
32
L LOAD3
L FETCH
174
33
L INCR
152
10
L EOC
A
B
34
35
36
37
40
41
42
45
46
47
52
53
C
L STROBE
153
30
L EOC
L INCR
L STROBE
141
50
142
70
143
110
144
130
145
210
D
54
55
56
57
60
61
62
65
66
67
72
73
E
L INCR
L STROBE
146
230
147
250
150
270
151
310
340
330
341
11
F
74
75
76
77
100
101
102
103
104
105
106
107
G
342
31
343
51
344
71
345
111
346
131
347
211
H
112
113
114
2
337
3
357
4
BIT 9
BIT 8
TO
START
350
231
351
I
L GMODE
L FETCH
L LOAD1
L ZOFF
L RTRC
L STOP
RE
TI



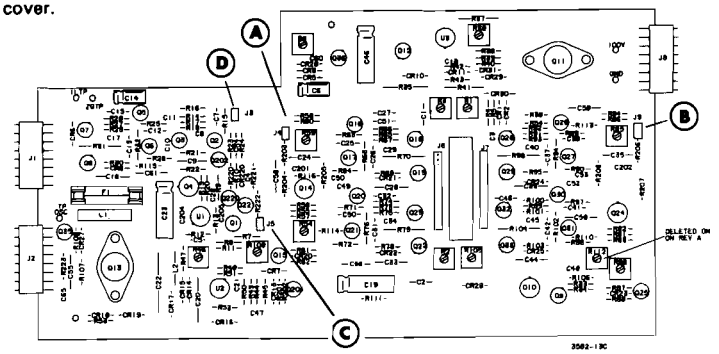
3582-8.5-2

Figure 8-5-2. ASM Flowchart.
8-5-11/8-5-12

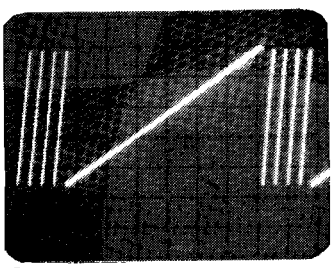


ANALOG CHECKS:

To perform the following analog checks, set the TEST switch on the top of the A9 board to TEST. All of the signal points are accessable through holes provided in the A13 plastic cover.

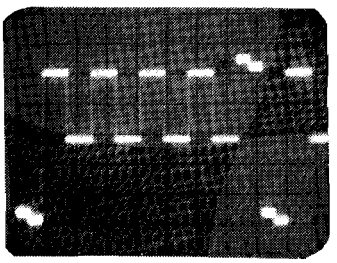


Analog Signal Points



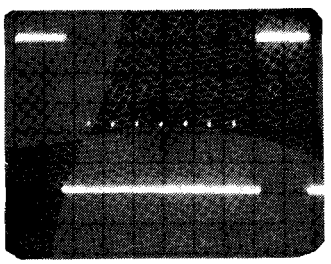
(A) X-axis input to A13

Internal trigger
0.02v/div;X10 probe
0vdc 2.5cm from bottom
2ms/div sweep



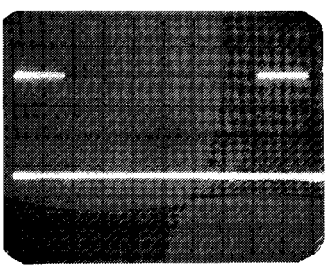
(B) Y-axis input to A13

Internal trigger
0.02v/div;X10 probe
0vdc 2.5cm from top
2ms/div sweep



(C) Z-axis input to A13.

Internal trigger
0.01v/div;X10 probe
0vdc 2cm from bottom
2ms/div sweep
BW limit "ON"



(D) High blank.

0.1v/div;X10 probe
0vdc 2.5cm from bottom
2ms/div sweep
int. trigger

DIGITAL CHECKS

Place the A9 board on extenders. Connect the Signature Analyzer as follows:

CLK	TP1	J5(3)
START		
STOP	TP3	J5(4)

Move A9J1 to the TEST position. Place the instrument LINE switch to ON and momentarily short together the terminals of A9J2.

Using the SA probe, obtain the following signatures:

(SA1)

Location	Pin #	Signature
XA9A	(19)	Observe probe light is flashing
XA9B	(E)	7AC3
	(F)	2991
	(5)	2991

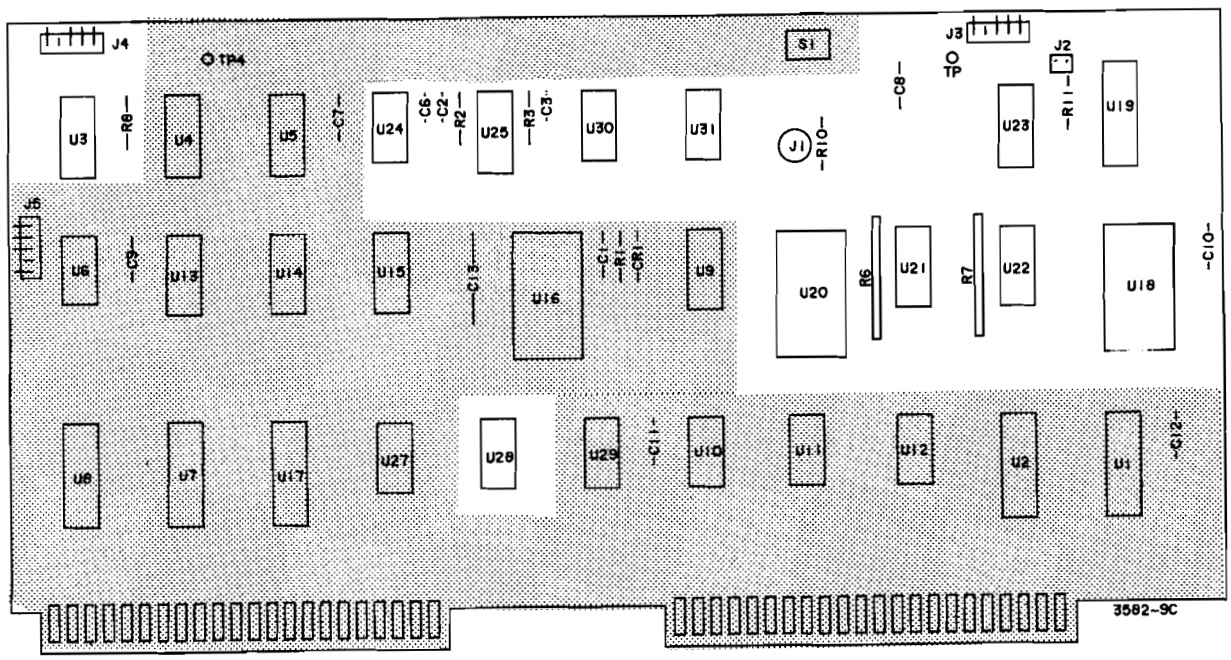
(SA2)

Location	Pin #	Signature
XA9A	(9)	0000
	(10)	0000
	(11)	0C12
	(12)	8516
	(16)	223U
	(17)	6865
	(18)	37P8
	(A,B,C,D,E, F,H)	0000
	(J)	157P
	(K)	9A78
	(L)	A16F
	(M)	6FPC
	(N)	562C
	(O)	P770
	(R)	2991
	(T)	0000
	(U)	HFU6
	(V)	HFU6

(SA3)

Location	Pin #	Signature
A9U21	(1)	U567
	(2)	7AC3
	(3)	7AC3
	(4,5,6,7)	U567

Figure 8-5-3. Troubleshooting Quick Reference For Schematics I, J, and K.



A9
03582-66509
Rev C & D

A9 PART I DISPLAY CONTROLLER 03582-66509

GND CLK START/STOP J3 U19(11) U22(1)
GND CLK START/STOP J4 U19(11) U23(4)
GND CLK START/STOP J5 U19(11) U3(5)

P-A20 MOTHER BD 03582-66520

ALGORITHMIC STATE MACHINE

F CLOCK XA7B(4) XA9B 4 STATE CLOCK 2.17 MHz

T XA9A +5V 20 +5V

+5V JMPR R10 1K

U20 QUALIFIER SELECTOR
STROBE GND
A0 A1 A2 A3 (15 13 12 11)
QUALIFIER

FROM
U17(2) (L)EOC
U9(7) BIT 2
U9(5) BIT 1
XA9A(12) BIT 7
XA9A(11) BIT 8
U6(8) (L) POINT
U1(16) MARK
U1(19) BLANK
J

COMPARATOR LATCH

COMP FROM MARKER ADDRESS COMPARATOR XA10A(W) K W
+5V R8 2K
COMP
U38 J CLR K CLK Q
(L)COMP
(L) CLKC FROM U21(1)
CNU

FROM U21(2) (L)SCOMP
FROM U21(4) (L)MAL
U23B S R Q

PRESENT STATE
A0 A1 A2 A3 A4 A5 A6 A7
U18 ROM 18,19,22,24 12,20 21
NEXT STATE
U19 STATE LATCH CLK
+5V JMPR 2 R11 1K

U31 4 5 6 11 20

U30 A5,9 A6,10 DECODER OUTPUT ENABLE

U21 ROM
A4 A3 A2 A1 A0

U22 ROM
A4 A3 A2 A1 A0

RP6 2K +5V
(L) SCOMP
(L) MAL
TO U23 (5) (4)

TO
(L) MAL U7(11)
(L) FETCH U31(2), XA9B(11)
(L) INCR
(L) LOAD 1 U10(1)
(L) LOAD 2 U11(1)
(L) LOAD 3 U12(1)
(L) CLKC U3(13)
J

USED IN GRAPHICS MODE

U24 MONOSTABLE
C6 82pF
NC
XA9A 19 SAMPLE XA10A(Y) K

RP7 2K +5V
(L) STROBE
(L) Z ON
(L) Z OFF
U23D

U25 DUAL MONOSTABLE
R2 5K C2 250pF
R3 5K C3 30pF
ALPHA Z CONTROL
GRAPHICS Z CONTROL
U29D

XA9B
L H BLANK A13J3(1) L
E (L)RTRC XA10B(8)
H (L)GSEL XA10B(L)
F (L)ASEL XA10B(K) K
5 RAMP XA10B(9)

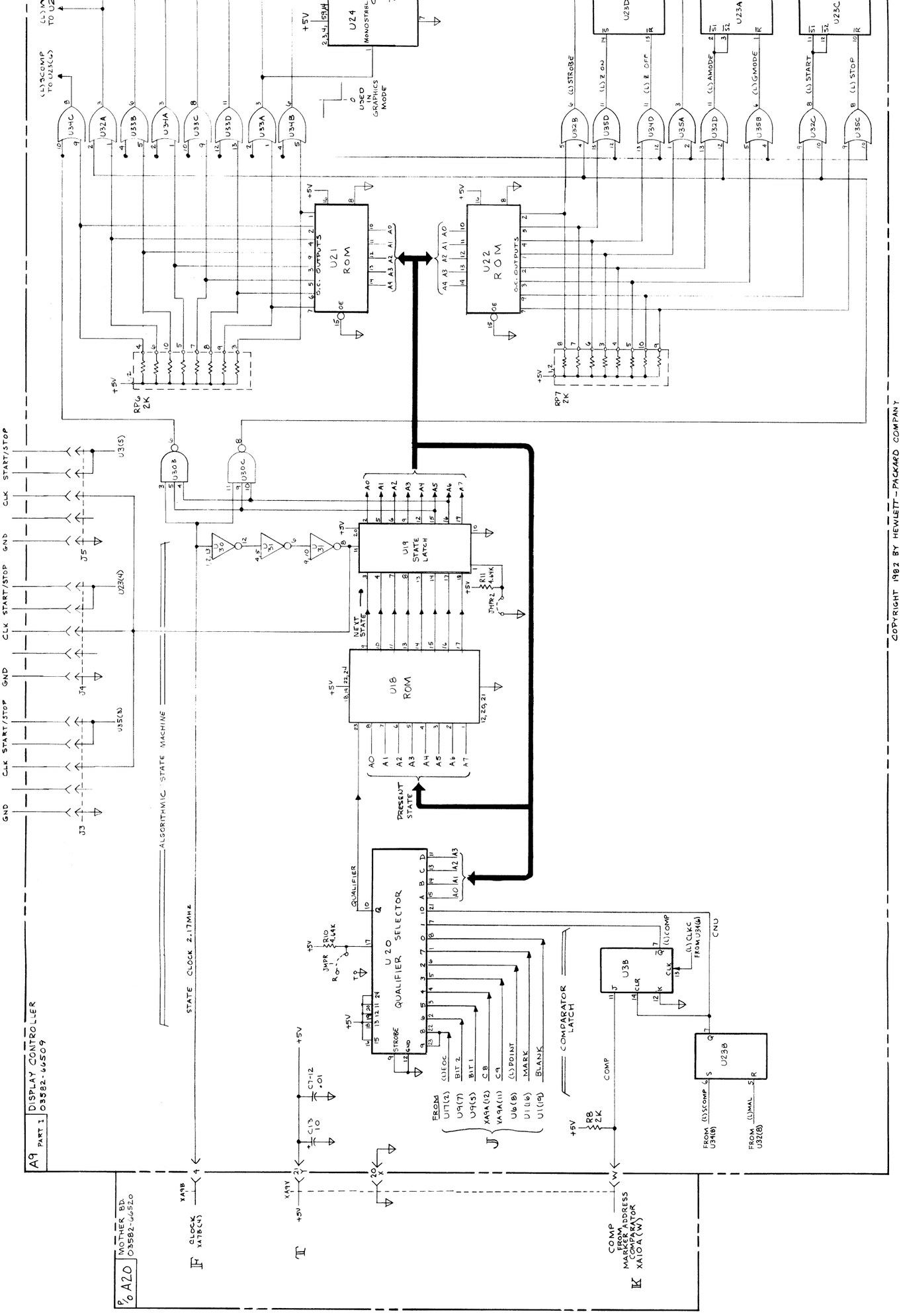
TP4
(L) AMODE
(L) GMODE
U23A
U28
(L) GSEL
(L) ASEL
(L) GSEL TO U13(1), U14(1), U15(1) J

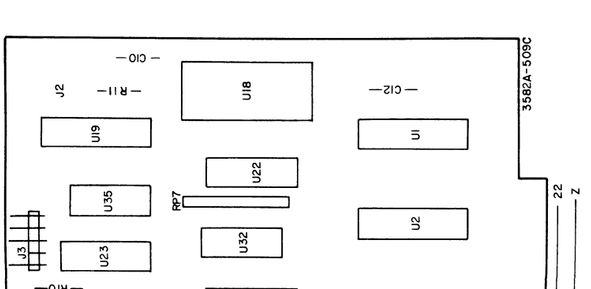
(L) START
(L) STOP
U23C
RAMP TO U29(2,5,10) J

P/O A20 MOTHER BOARD 03582-66520

3582-D-1

Figure 8-5-4. P/O A9 Display Controller. REV A,B,C,D


A9 PART 1 DISPLAY CONTROLLER 03582-66509
P/O A20 MOTHER BD 03582-66520
ALGORITHMIC STATE MACHINE
STATE CLOCK 2.17MHz
U20 QUALIFIER SELECTOR
U18 ROM
U19 STATE LATCH
U21 ROM
U22 ROM
COMPARATOR LATCH
U24 MONOSTABLE
U38
U23B
U23A
U23C
U23D
U34C
U32A
U33B
U34A
U33C
U33D
U33A
U34B
U32B
U35D
U34D
U35A
U32D
U35B
U32C
U35C
U35B
U35A
U35C
U35D
U32B
U32C
U32D
U34C
U32A
U33B
U34A
U33C
U33D
U33A
U34B
RP6 2K
RP7 2K
R8 2K
R10 4.4K
R11 4.4K
C7-12 .01
C13 10
J1
J2
J3
J4
J5
U3(5)
U28(4)
U35(3)
START/STOP
CLK
GND
QUALIFIER
NEXT STATE
PRESENT STATE
STROBE
CODE
BIT 2
BIT 1
C8
C9
(L) POINT
MARK
BLANK
COMP
CLOCK XA7B(4)
COMP FROM MARKER ADDRESS COMPARATOR XA10A(W)
USED IN GRAPHICS MODE
(L) STROBE
(L) Z ON
(L) Z OFF
(L) AMODE
(L) GMODE
(L) START
(L) STOP
(L) SCOMP TO U23(4)
(L) XMAL TO U23(5)
FROM (L) SCOMP U34(8)
FROM (L) MAL U32(8)
FROM (L) COMP U38(9)
FROM (L) CLK FROM U34(6)
CNO
COPYRIGHT 1982 BY HEWLETT-PACKARD COMPANY


3582A-509C
U18
U19
U35
U23
U22
U32
U1
U2
RP7
J2
J3
C10
R11
C12
22
2

A9 PART 1 DISPLAY CONTROLLER 03582-66509

GND CLK START/STOP GND CLK START/STOP GND CLK START/STOP

J3 J4 J5

U35(3) U23(4) U3(5)

ALGORITHMIC STATE MACHINE

STATE CLOCK 2.17MHz

XA9B 4

XA9Y 21

+5V C13 10 C7-12 .01

20

JMPR1 R10 9.69K

QUALIFIER

U20 QUALIFIER SELECTOR

STROBE GND

FROM
U17(2) (L)EOC
U9(7) BIT 2
U9(5) BIT 1
XA9A(12) C8
XA9A(11) C9
U6(8) (L)POINT
U1(16) MARK
U1(19) BLANK

COMPARATOR LATCH

RB 2K COMP

U3B J CLR K CLK Q

(L)COMP

(L)CLKC FROM U34(6)

FROM (L)SCOMP U34(8) U23B S R Q

FROM (L)MAL U32(8)

CNU

PRESENT STATE

U18 ROM

NEXT STATE

U19 STATE LATCH

JMPR2 R11 9.69K

U30B U30C

U30 U31

RP6 2K

U34C U32A U33B U34A U33C U33D U33A U34B

(L)3COMP TO U23(6)

(L)MAL TO U23(5)

(L)CLKC TO U3(13)

(L)MAL TO U7(11)

(L)FETCH TO U31(1,2) U3(1) XA9B(11)

(L)INCR TO U12(8) U31(12,13)

(L)LOAD1 TO U10(1)

(L)LOAD2 TO U11(1)

(L)LOAD3 TO U12(1)

U21 ROM

U22 ROM

O.C. OUTPUTS

USED IN GRAPHICS MODE

U24 MONOSTABLE C6 82pF NC

RP7 2K

U32B (L)STROBE

U35D (L)Z ON

U34D (L)Z OFF

U35A

U32D (L)AMODE

U35B (L)GMODE

U32C (L)START

U35C (L)STOP

U23D U23A U23C

R2 4.64K C2 270pF R3 4.64K C3 33pF

U25 DUAL MONOSTABLE

ALPHA Z CONTROL

GRAPHICS Z CONTROL

U29D

TO J3(4,5)

TP4

U28F

(L)GSEL

(L)ASEL

(L)GSEL TO U13(1), U14(1), U15(1)

RAMP TO U29(2,5,10)

P/O A20 MOTHER BOARD 03582-66520

XA9A

SAMPLE XA10A(V)

XA9B

(H)BLANK A13J3(1)

(L)RTRC XA10B(8)

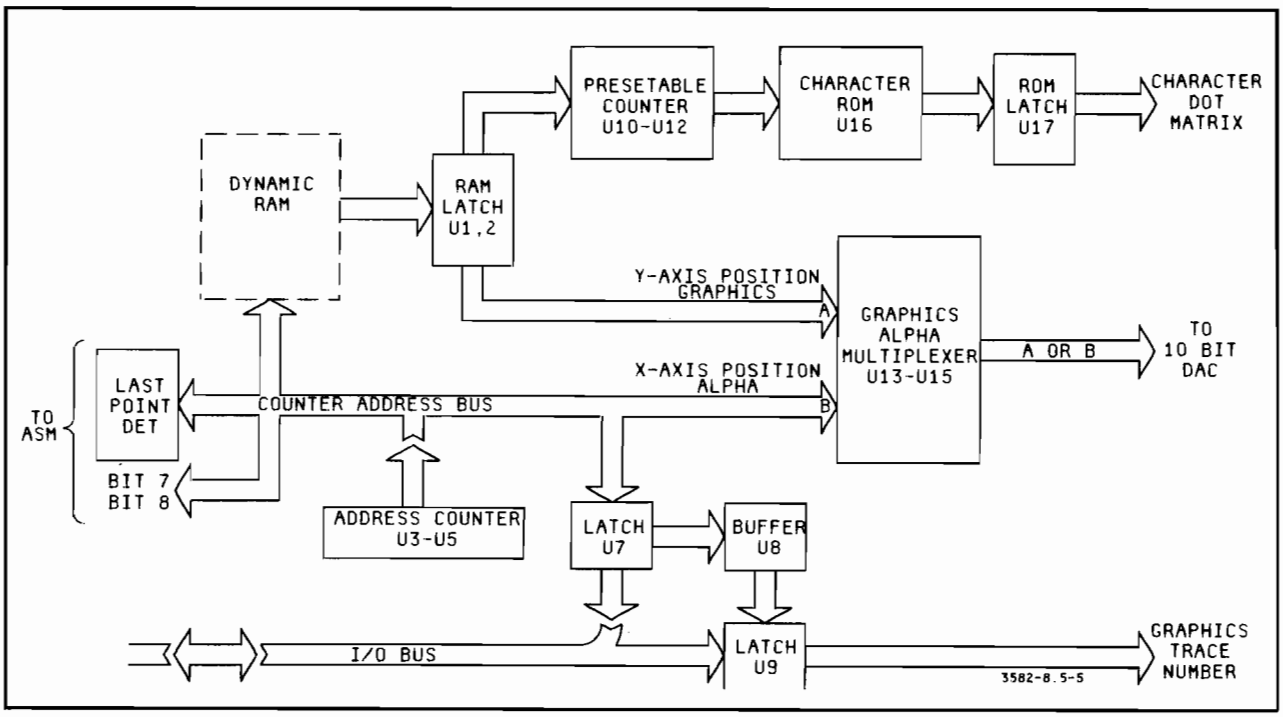
(L)GSEL XA10B(L)

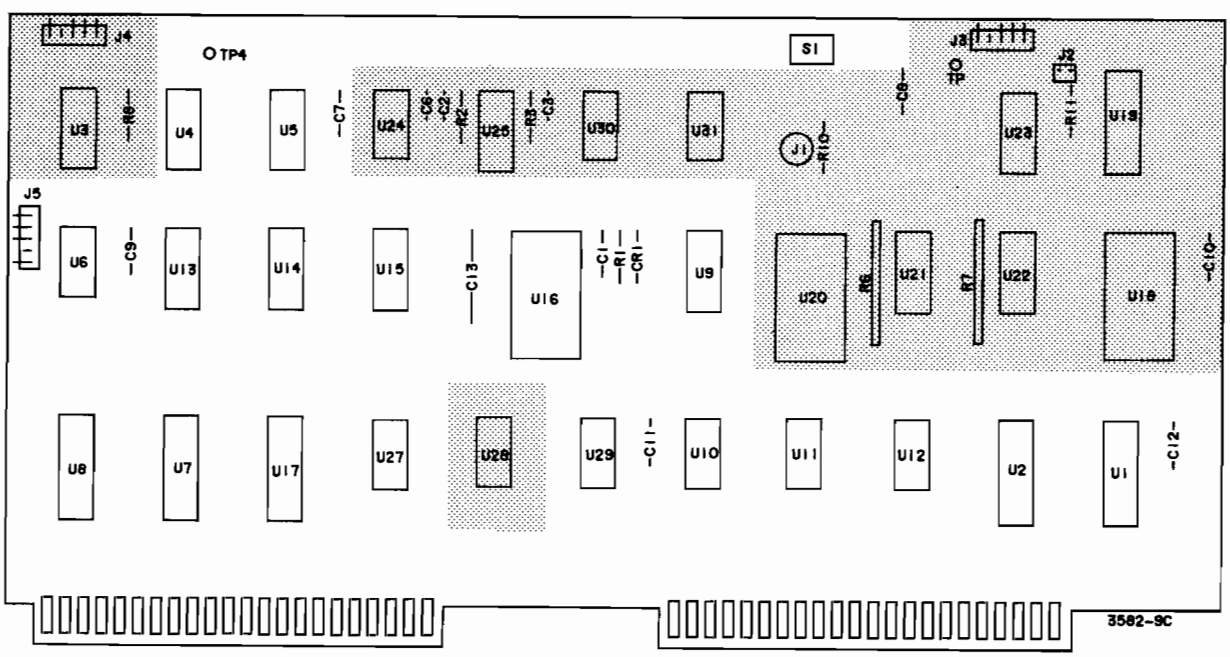
(L)ASEL XA10B(K)

RAMP XA10B(9)

3582A-D-1 REV A

Figure 8-5-4. P/O A9 Display Controller. REV E





A9
03582-66509
Rev C & D

A9 PART II
DIGITAL DISPLAY DRIVER
03582-66509

P/O A20 MOTHER BOARD 03582-66520

A8 RAM BOARD II

X IDA BUS

RAM ADDRESS INPUTS

U1 RAM LATCH

U2 RAM LATCH

PRESET ADDRESS

BLANK TO U20(8)

MARK TO U20(1)

MDAV

DATA

Y-AXIS POSITION IN GRAPHICS MODE

K XA10A(15) XA10A(14) Y AXIS POSITION IN ALPHA MODE

(L) FETCH

PRESETABLE ROM ADDRESS COUNTER

(L) INCR FROM U21(3)

(L) LOAD 1 FROM U21(7)

(L) LOAD 2 FROM U21(6)

(L) LOAD 3 FROM U21(5)

LSB

MSB

U12

U11

U10

-18V R1 2K

CR1 5.11V

C1 .01

U16 CHARACTER ROM

U17 LATCH

U31

TO A10-1 PIN

CHARACTER DOT MATRIX POSITION

(L) EOC TO U20(22)

(L) GSEL FROM U23(4)

(L) GSEL XA10B(L) K

U15 MULTIPLEXER

SELECT A(L) OR B(H)

U13 MULTIPLEXER

U14 MULTIPLEXER

S1 IN TEST - CAUSES CRT TO DISPLAY A SQUARE WAVE

S1

TEST

COUNTER

X-AXIS POSITION IN ALPHA MODE

MARKER ADDRESS (POSITION X AXIS)

ADDRESS COUNTER

U5

U4

U3A

TP3

(L) MAL FROM U21(4)

U7 LATCH

U8 TRI-STATE BUFFER

(L) FETCH FROM U21(9)

U6

(L) POINT TO U20(6)

BIT 7 TO U20(4)

BIT 8 TO U20(5)

BIT 2 TO U20(2)

BIT 1 TO U20(3)

TO XA10A K

U9 LATCH

I/O

PROCESSOR I/O BUS F

IS12 XA7B(L)

OS12 XA7B(R)

RAMP FROM U23(9)

RAMP 4 XA10A(16)

RAMP 2 XA10A(17)

RAMP 1 XA10A(18)

RAMP XA10B(9)

3582-D-2

J

Figure 8-5-5. P/O A9 Digital Display Driver. REV A,B,C,D
8-5-17/8-5-18

P/O A20 MOTHER BOARD 03582-66520

A9 PART II

DIGITAL DISPLAY DRIVER 03582-66509

A8 RAM BOARD III

X IDA BUS

RAM ADDRESS INPUTS

U1 RAM LATCH

U2 RAM LATCH

HDAV

BLANK TO U20(8)

MARK TO U20(1)

PRESET ADDRESS

PRESETABLE ROM ADDRESS COUNTER

(L) INCR FROM U34(3)

(L) LOAD 1 FROM U33(3)

(L) LOAD 2 FROM U33(11)

(L) LOAD 3 FROM U33(3)

LSB

MSB

U12 CLK

U11 CLK

U10 CLK

-18V

R1 2K

CR1 5.1V

C1 .01

U16 CHARACTER ROM

U17 LATCH

(L) EOC TO U20 (22,23)

TO A10-1 PIN

CHARACTER DOT MATRIX POSITION

P/O A20 MOTHER BD 03582-66520

(L) GSEL FROM U23(4)

(L) GSEL XA10B(L)

U15 MULTIPLEXER

U13 MULTIPLEXER

U14 MULTIPLEXER

SELECT A(L) OR B(H)

DATA

Y-AXIS POSITION IN GRAPHICS MODE

S1 IN TEST - CAUSES CRT TO DISPLAY A SQUARE WAVE

%S1

TEST

XA10A(15) Y AXIS POSITION IN ALPHA MODE

XA10A(14)

XA9A

XA9B

XA8B(L)

(L) FETCH

U6

(L) POINT TO U20(6)

BIT 7 TO U20(4)

BIT 8 TO U20(5)

COUNTER

X-AXIS POSITION IN ALPHA MODE

ADDRESS COUNTER

U5

U4

U3A

MARKER ADDRESS (POSITION X AXIS)

(L) MAL FROM U32(3)

U7 LATCH

(L) FETCH FROM U33(6)

U8 TRI-STATE BUFFER

U9 LATCH

I/O

PROCESSOR I/O BUS

IS12 XA7B(L)

OS12 XA7B(R)

+12V

+5V

-18V

C4 .01

BIT 2 TO U20(2)

BIT 1 TO U20(3)

U28 A

U28 D

U28 C

U28 B

U28 E

U29A

U29B

U29C

U27 D

U27 E

U27 F

U27 C

U27 B

U27 A

RAMP 4 XA10A(14)

RAMP 2 XA10A(17)

RAMP 1 XA10A(18)

TO XA10A

RAMP FROM U23(9)

RAMP XA10B(9)

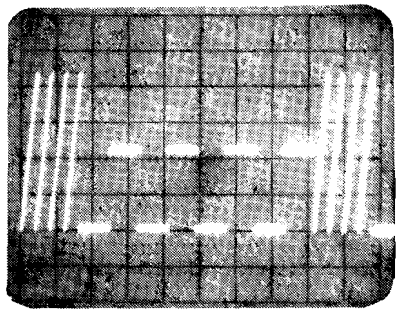
3582-D-2

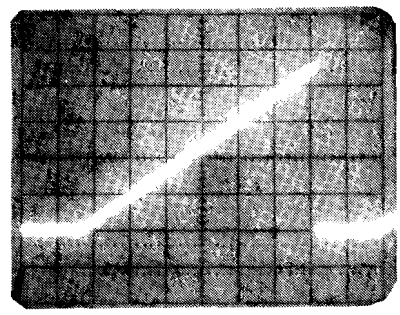
Figure 8-5-5. P/O A9 Digital Display Driver. REV E
8-5-17/8-5-18

Output of U2 (A)

External trigger; A10 TP
0.1v/div;X10 probe
0vdc 2cm from bottom
2ms/div sweep (connect to bottom of R2)

X-Axis Alpha U17(10) (D)
0.2v/div;X10 probe
0vdc 2cm from bottom
2ms/div sweep (connect to bottom of R2)





(D)

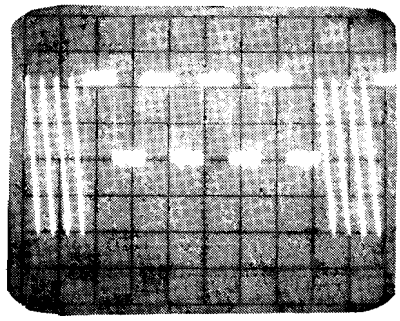
X-axis graphics-U17(7)

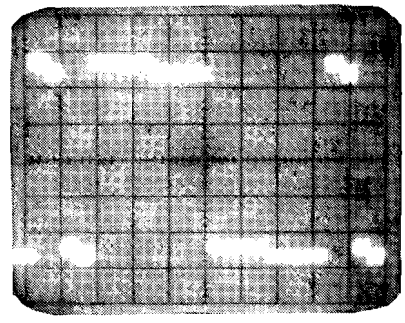
0.02v/div;X10 probe
0vdc 2cm from bottom
2ms/div sweep
External trigger from trigger TP on A10; +slope

(C)

Y-axis graphics-U17(2)

External trigger;A10 TP
0.02v/div;X10 probe
0vdc 2cm from top
2ms/div sweep



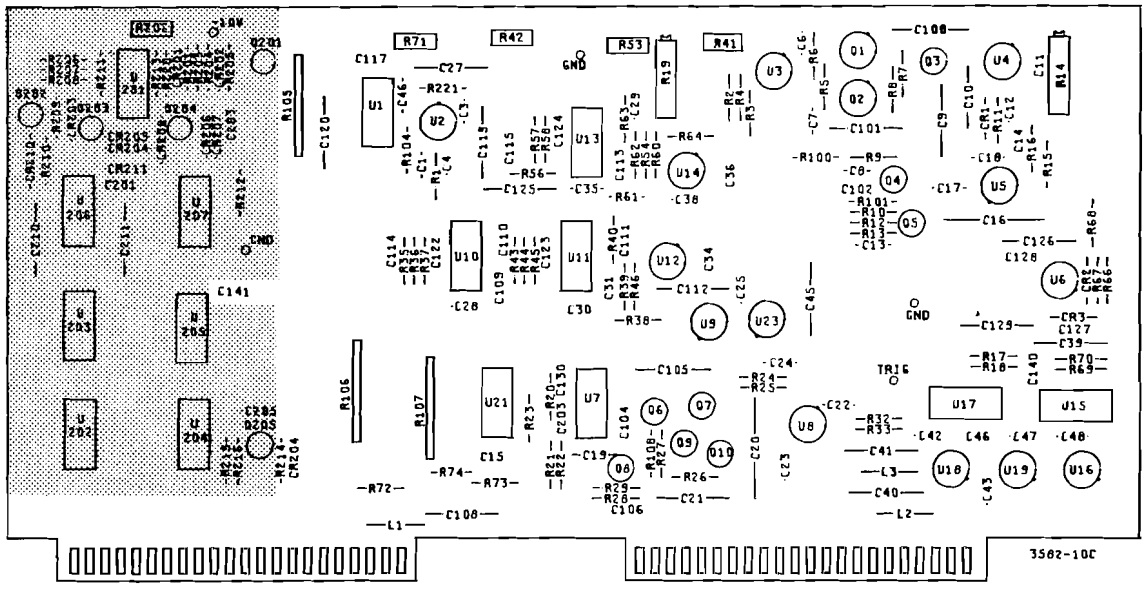


(E)

Y-alpha-U17(15)

0.02v/div;X10 probe
0vdc 2cm from top
2ms/div sweep
External trigger from trigger TP on A10; +slope

A10 Signal Points



A10
H-P PART NO. 03582-66510
REV A.B.C

A10 PART 1 ANALOG DISPLAY DRIVER · 03582-66510

P/O A20 MOTHER BD. 03582-66520

NOTE:
R221 SHOULD BE SELECTED TO MATCH THE RESISTANCE BETWEEN PINS 15 AND 16 OF U1

VALUE	H.P Part No.
4.53K	0698-4443
4.99K	0698-3279
5.90K	0698-3515

Y AXIS GRAPHICS
X AXIS ALPHA POSITION

BUFFER

LINE DRAWER

SAMPLE-HOLD

INTEGRATOR

RAMP GENERATOR

CURRENT MIRROR

GRAPHICS SWEEP RATE

Y AXIS DOT MATRIX

Y AXIS ALPHA POSITION

X AXIS DOT MATRIX

X AXIS ALPHA POSITION

X SUMMING AMPL

RETRACE LOGIC

VOLTAGE FOLLOWER

RETRACE CURRENT SOURCE

XA10A

XA10B

FROM XA9A

SAMPLE XA9A(9)

RAMP XA9B(5)

RAMP TO U21(9)

RAMP 4 XA9A(T)

RAMP 2 XA9A(U)

RAMP 1 XA9A(V)

(L) RTRC XA9B(E)

XA9A(J)

XA9A(9)

XA9A(10)

XA9A(11)

XA9A(12)

XA9A(8)

XA9A(D)

XA9A(F)

Y AXIS

SAMPLE

RAMP

SWEEP RATE CURRENT

RETRACE (L) RTRC

SUMMING NODE

Y ALPHA

X ALPHA

CHARGE

DISCHARGE

0 TO +2V P-P

0 TO -5V P-P

Y GRAPHICS
0 TO -1V P-P

X AXIS GRAPHICS

NOTE:
R221 SHOULD BE SELECTED TO MATCH THE RESISTANCE BETWEEN PINS 15 AND 16 OF U1

VALUE	H.P Part No:
4.53K	0698-4443
4.99K	0698-3279
5.90K	0698-3515

P/O A20 MOTHER BOARD 03582-665

BUFFER
LINE DRAWER
SAMPLE-HOLD
INTEGRATOR
INTEGRATOR ADJ
Y AXIS GRAPHICS
SAMPLE
Y GRAPHICS 0 TO -1V P-P
0 TO -5V P-P
Z AXIS INTENSITY CORRECTION (GRAPHICS)
Z AXIS MUX ALPHA GRAPHICS
Z AXIS INTENSITY ALPHA
(L) SELECT A
(L) SELECT B
RAMP FROM XA10B(9)
MARKER ADJ
Z AXIS A13J5(1) L
RAMP GENERATOR
CURRENT MIRROR
VOLTAGE FOLLOWER
SWEEP RATE CURRENT
CHARGE
DISCHARGE
0 TO +2V P-P
X AXIS GRAPHICS
RETRACE LOGIC
RETRACE (L) RTRC
RETRACE CURRENT SOURCE
MARKER COMPARATOR
COMP XA9A(W) II
GRAPHICS - ALPHA MUX
(L) ASEL
(L) GSEL
0 TO HV P-P
0 TO 1V
0 TO -1V
X AXIS A13J4(1) L
Y AXIS A13J9(1) L
+5V T
+15V V
SUMMING NODE
X AXIS ALPHA POSITION
X SUMMING AMPL
X REG ADJ
Y ALPHA
X ALPHA
FROM Q201(E) Q A10
+VREF = +10 VDC
MARKER POSITION
BAND COLOR - BLUE -
SHIELD

3582-E-3

K

Figure 8-5-6. A10 Analog Display Driver. REV C
8-5-19/8-5-20

Table 8-5-3. Replaceable Parts.

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A9	03582-66509	7	1	PC ASSEMBLY, DIGITAL DISPLAY DRIVER	28480	03582-66509
C1	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C2	0160-3046	0	1	CAPACITOR-FXD 250PF +-1% 100VDC MICA	28480	0160-3046
C3	0160-2199	2	4	CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
C6	0140-0193	0	1	CAPACITOR-FXD 82PF +-5% 300VDC MICA	72136	DM15E820J0300WV1CR
C7	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C8	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C9	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C10	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C11	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C12	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C13	0180-0374	3	1	CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
CR1	1902-0041	4	1	DIODE-ZNR 5.11V 5% DO-7 PD=.4W TC=-.009%	28480	1902-0041
J1	1200-0458	9		SOCKET-XSTR 3-CONT TO-5 DIP-SLDR	28480	1200-0458
J2	1251-5380	3	5	CONNECTOR 2-PIN M POST TYPE	28480	1251-5380
J3	1251-5202	8		CONNECTOR 5-PIN M POST TYPE	28480	1251-5202
J4	1251-5202	8		CONNECTOR 5-PIN M POST TYPE	28480	1251-5202
J5	1251-5202	8		CONNECTOR 5-PIN M POST TYPE	28480	1251-5202
R1	0683-2025	1	7	RESISTOR 2K 5% .25W FC TC=-400/+700	01121	CB2025
R2	0683-5125	8		RESISTOR 5.1K 5% .25W FC TC=-400/+700	01121	CB5125
R3	0683-5125	8		RESISTOR 5.1K 5% .25W FC TC=-400/+700	01121	CB5125
R8	0683-2025	1		RESISTOR 2K 5% .25W FC TC=-400/+700	01121	CB2025
R10	0683-5125	8		RESISTOR 5.1K 5% .25W FC TC=-400/+700	01121	CB5125
R11	0683-5125	8		RESISTOR 5.1K 5% .25W FC TC=-400/+700	01121	CB5125
RP6	1810-0136	3		NETWORK-RES 10-PIN-SIP .1-PIN-SPCG	28480	1810-0136
RP7	1810-0136	3		NETWORK-RES 10-PIN-SIP .1-PIN-SPCG	28480	1810-0136
S1	3101-0642	5	1	SWITCH-SL DPDT-NS MINTR .5A 115VAC/DC PC	28480	3101-0642
U1	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
U2	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
U3	1820-1212	9	6	IC FF TTL LS J-K NEG-EDGE-TRIG	01295	SN74LS112N
U4	1820-1430	3	13	IC CNTR TTL LS BIN SYNCHRO POS-EDGE-TRIG	01295	SN74LS161N
U5	1820-1430	3		IC CNTR TTL LS BIN SYNCHRO POS-EDGE-TRIG	01295	SN74LS161N
U6	1820-1207	2		IC GATE TTL LS NAND 8-INP	01295	SN74LS30N
U7	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
U8	1820-1759	9		IC BFR TTL LS NON-INV OCTL	27014	DM81LS97N
U9	1820-1196	8	10	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174N
U10	1820-1193	5	3	IC CNTR TTL LS BIN ASYNCHRO	01295	SN74LS197N
U11	1820-1193	5		IC CNTR TTL LS BIN ASYNCHRO	01295	SN74LS197N
U12	1820-1193	5		IC CNTR TTL LS BIN ASYNCHRO	01295	SN74LS197N
U13	1820-1428	9	3	IC MUXR/DATA-SEL TTL LS 2-TO-1-LINE QUAD	01295	SN74LS158N
U14	1820-1428	9		IC MUXR/DATA-SEL TTL LS 2-TO-1-LINE QUAD	01295	SN74LS158N
U15	1820-1428	9		IC MUXR/DATA-SEL TTL LS 2-TO-1-LINE QUAD	01295	SN74LS158N
U16	1818-0511	4	1		28480	1818-0511
U17	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
U18	1816-1170	9	1		28480	1816-1170
U19	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
U20	1820-0640	5	1	IC MUXR/DATA-SEL TTL 16-TO-1-LINE 16-INP	01295	SN74150N
***U21	1816-1169	6	1	IC TTL S 256-BIT ROM 70-NS 3-S	01698	SN74S288N
U22	1816-1168	5	1	IC TTL S 256-BIT ROM 50-NS 3-S	01698	SN74S288N
U23	1820-1440	5	2	IC LCH TTL LS QUAD	01295	SN74LS279N
U24	1820-1422	3	1	IC MV TTL LS MONOSTBL RETRIG	01295	SN74LS122N
U25	1820-1423	4		IC MV TTL LS MONOSTBL RETRIG DUAL	01295	SN74LS123N
U27	1820-1199	1		IC INV TTL LS HEX 1-INP	01295	SN74LS04N
U28	1820-1199	1		IC INV TTL LS HEX 1-INP	01295	SN74LS04N
U29	1820-1201	6		IC GATE TTL LS AND QUAD 2-INP	01295	SN74LS08N
U30	1820-1202	7		IC GATE TTL LS NAND TPL 3-INP	01295	SN74LS10N
U31	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
				MISCELLANEOUS PARTS		
	4040-0748	3		EXTRACTOR-PC BOARD BLK POLYC	28480	4040-0748
	4040-0756	3	1	EXTRACTOR-PC BOARD WHT POLYC	28480	4040-0756
	6960-0080	8		PLUG-HOLE FL-HD FOR .185-D-HOLE TFE	28480	6960-0080

**743288 IS UNPROGRAMMED.

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

Table 8-5-3. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A10	03582-66510	0	1	PC ASSEMBLY, ANALOG DISPLAY DRIVER	28480	03582-66510
C1	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C3	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C4	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C6	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C7	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C8	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C9	0180-0100	3	17	CAPACITOR-FXD 4.7UF+-10% 35VDC TA	56289	150D475X903582
C10	0160-4438	6	1	CAPACITOR-FXD 470PF +-2.5% 160VDC POLYP	28480	0160-4438
C11	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C12	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C13	0160-2264	2	9	CAPACITOR-FXD 20PF +-5% 500VDC CER 0+-30	28480	0160-2264
C14	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C16	0160-4682	2	1	CAPACITOR-FXD 1000PF +-2.5% 160VDC POLYP	28480	0160-4682
C17	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C18	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C19	0160-2264	2		CAPACITOR-FXD 20PF +-5% 500VDC CER 0+-30	28480	0160-2264
C20	0160-3787	6	1	CAPACITOR-FXD 1UF +-10% 50VDC MET-POLYC	28480	0160-3787
C21	0180-0100	3		CAPACITOR-FXD 4.7UF+-10% 35VDC TA	56289	150D475X903582
C22	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C23	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C24	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C25	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C27	0180-0100	3		CAPACITOR-FXD 4.7UF+-10% 35VDC TA	56289	150D475X903582
C28	0160-2264	2		CAPACITOR-FXD 20PF +-5% 500VDC CER 0+-30	28480	0160-2264
C29	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C30	0160-2264	2		CAPACITOR-FXD 20PF +-5% 500VDC CER 0+-30	28480	0160-2264
C31	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C34	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C35	0160-2264	2		CAPACITOR-FXD 20PF +-5% 500VDC CER 0+-30	28480	0160-2264
C36	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C38	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C39	0180-0100	3		CAPACITOR-FXD 4.7UF+-10% 35VDC TA	56289	150D475X903582
C40	0180-0100	3		CAPACITOR-FXD 4.7UF+-10% 35VDC TA	56289	150D475X903582
C41	0180-0100	3		CAPACITOR-FXD 4.7UF+-10% 35VDC TA	56289	150D475X903582
C42	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C43	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C45	0180-0100	3		CAPACITOR-FXD 4.7UF+-10% 35VDC TA	56289	150D475X903582
C46	0140-0191	8	2	CAPACITOR-FXD 56PF +-5% 300VDC MICA	72136	DM15E560J0300WV1CR
C47	0140-0191	8		CAPACITOR-FXD 56PF +-5% 300VDC MICA	72136	DM15E560J0300WV1CR
C48	0160-2199	2		CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
C100	0180-0100	3		CAPACITOR-FXD 4.7UF+-10% 35VDC TA	56289	150D475X903582
C101	0180-0100	3		CAPACITOR-FXD 4.7UF+-10% 35VDC TA	56289	150D475X903582
C102	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C103	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C104	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C105	0180-0100	3		CAPACITOR-FXD 4.7UF+-10% 35VDC TA	56289	150D475X903582
C106	0160-2264	2		CAPACITOR-FXD 20PF +-5% 500VDC CER 0+-30	28480	0160-2264
C107	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C108	0180-0100	3		CAPACITOR-FXD 4.7UF+-10% 35VDC TA	56289	150D475X903582
C109	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C110	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C111	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C112	0180-0100	3		CAPACITOR-FXD 4.7UF+-10% 35VDC TA	56289	150D475X903582
C113	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C114	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C115	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C116	0160-2264	2		CAPACITOR-FXD 20PF +-5% 500VDC CER 0+-30	28480	0160-2264
C117	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C119	0180-0100	3		CAPACITOR-FXD 4.7UF+-10% 35VDC TA	56289	150D475X903582
C120	0180-0100	3		CAPACITOR-FXD 4.7UF+-10% 35VDC TA	56289	150D475X903582
C122	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C123	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C124	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C125	0180-0100	3		CAPACITOR-FXD 4.7UF+-10% 35VDC TA	56289	150D475X903582
C126	0180-0100	3		CAPACITOR-FXD 4.7UF+-10% 35VDC TA	56289	150D475X903582
C127	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C128	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C129	0180-0100	3		CAPACITOR-FXD 4.7UF+-10% 35VDC TA	56289	150D475X903582
C130	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C140	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622

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

Table 8-5-3. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
C141	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C201	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C203	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C205	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C210	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
C211	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
CR1	1902-3030	7	3	DIODE-ZNR 3.01V 5% DO-7 PD=.4W TC=-.067%	28480	1902-3030
CR2	1901-0535	9	4	DIODE-SCHOTTKY	28480	1901-0535
CR3	1901-0535	9		DIODE-SCHOTTKY	28480	1901-0535
CR201	1902-0777	3		DIODE-ZNR 1N825 6.2V 5% DO-7 PD=.4W	04713	1N825
CR202	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
CR203	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
CR204	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
CR205	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
CR206	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
CR207	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
CR208	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
CR209	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
CR210	1901-0535	9		DIODE-SCHOTTKY	28480	1901-0535
CR211	1901-0535	9		DIODE-SCHOTTKY	28480	1901-0535
L1	9100-2556	8	6	COIL-MLD 33UH 10% Q=45 .156DX.375LG-NDM	28480	9100-2556
L2	9100-2556	8		COIL-MLD 33UH 10% Q=45 .156DX.375LG-NDM	28480	9100-2556
L3	9100-2556	8		COIL-MLD 33UH 10% Q=45 .156DX.375LG-NDM	28480	9100-2556
Q1	1854-0475	5	4	TRANSISTOR-DUAL NPN PD=750MW	28480	1854-0475
Q2	1853-0083	9	2	TRANSISTOR-DUAL PNP PD=600MW	28480	1853-0083
Q3	1855-0272	2	1	TRANSISTOR MOSFET N-CHAN TO-72 SI	04713	MFE3004
Q4	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	SPS 3611
Q5	1853-0089	5	6	TRANSISTOR PNP 2N4917 SI PD=200MW	07263	2N4917
Q6	1854-0023	9	1	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0023
Q7	1853-0083	9		TRANSISTOR-DUAL PNP PD=600MW	28480	1853-0083
Q8	1853-0089	5		TRANSISTOR PNP 2N4917 SI PD=200MW	07263	2N4917
Q9	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
Q10	1854-0233	3		TRANSISTOR NPN 2N3866 SI TO-39 PD=1W	0192B	2N3866
Q201	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
Q202	1853-0016	8		TRANSISTOR PNP SI TO-92 PD=300MW	28480	1853-0016
Q203	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
Q204	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
Q205	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
R1	0698-4435	2	5	RESISTOR 2.49K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2491-F
R2	0757-0273	4	7	RESISTOR 3.01K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3011-F
R3	0757-0280	3	24	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
R4	0757-0273	4		RESISTOR 3.01K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3011-F
R5	0698-3279	0	30	RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
R6	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
R7	0683-0515	0	2	RESISTOR 5.1 5% .25W FC TC=-400/+500	01121	CB51G5
R8	0683-0515	0		RESISTOR 5.1 5% .25W FC TC=-400/+500	01121	CB51G5
R9	0757-0273	4		RESISTOR 3.01K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3011-F
R10 **	0683-1525	4		RESISTOR 1.5K 5% .25W FC TC=-400/+700	01121	CB1525
R11	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
R12	0683-2025	1		RESISTOR 2K 5% .25W FC TC=-400/+700	01121	CB2025
R13	0757-0273	4		RESISTOR 3.01K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3011-F
R14	2100-3109	2		RESISTOR-TRMR 2K 10% C SIDE-ADJ 17-TRN	02111	43P202
R15	0757-0436	1	1	RESISTOR 4.32K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4321-F
R16	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
R17	0698-3558	8	5	RESISTOR 4.02K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4021-F
R18	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
R19	2100-3109	2		RESISTOR-TRMR 2K 10% C SIDE-ADJ 17-TRN	02111	43P202
R20	0698-4470	5		RESISTOR 6.98K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6981-F
R21	0698-4467	0	1	RESISTOR 1.05K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1051-F
R22	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
R23	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
R24	0757-0447	4	4	RESISTOR 16.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1622-F
R25	0757-0447	4		RESISTOR 16.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1622-F
R26	0683-8205	1	1	RESISTOR 82 5% .25W FC TC=-400/+500	01121	CB8205
R27	0698-4307	7	2	RESISTOR 14.3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1432-F
R28	0683-2025	1		RESISTOR 2K 5% .25W FC TC=-400/+700	01121	CB2025
R29	0757-0273	4		RESISTOR 3.01K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3011-F
R32	0698-4123	5	9	RESISTOR 499 1% .125W F TC=0+-100	24546	C4-1/8-T0-499R-F
R33	0698-4123	5		RESISTOR 499 1% .125W F TC=0+-100	24546	C4-1/8-T0-499R-F
R35	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
R36	0698-3223	4	3	RESISTOR 1.24K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1241-F
R37	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
R38	0757-0284	7		RESISTOR 150 1% .125W F TC=0+-100	24546	C4-1/8-T0-151-F
**R10 STAR VALUES	0683-7515	4		RESISTOR 750 5% .25W FC TC=-400/+600	01607	CB7515
	0683-1525	4		RESISTOR 1.5K 5% .25W FC TC=-400/+700	01607	CB1525
	0757-0159	5		RESISTOR 1K 1% .5W F TC=0+-100	28480	0757-0159

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

Table 8-5-3. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
R39	0698-4439	6	2	RESISTOR 3.24K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3241-F
R40	0757-0349	5	1	RESISTOR 22.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2262-F
	2100-3354	9	2	RESISTOR-TRMR 50K 10% C SIDE-ADJ 1-TRN	28480	2100-3354
R42	2100-3273	1		RESISTOR-TRMR 2K 10% C SIDE-ADJ 1-TRN	28480	2100-3273
R43	0698-3558	8		RESISTOR 4.02K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4021-F
R44	0698-3223	4		RESISTOR 1.24K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1241-F
R45	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
R46	0698-3548	6	1	RESISTOR 732 1% .125W F TC=0+-100	24546	C4-1/8-T0-732R-F
R53	2100-3357	2	1	RESISTOR-TRMR 500K 10% C SIDE-ADJ 1-TRN	28480	2100-3357
R54	0757-0469	0		RESISTOR 150K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1503-F
R56	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
R57	0698-3223	4		RESISTOR 1.24K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1241-F
R58	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
R60	0698-4435	2		RESISTOR 2.49K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2491-F
R61	0698-4456	7	1	RESISTOR 549 1% .125W F TC=0+-100	24546	C4-1/8-T0-549R-F
R62	0698-3558	8		RESISTOR 4.02K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4021-F
R63	0757-0284	7		RESISTOR 150 1% .125W F TC=0+-100	24546	C4-1/8-T0-151-F
R64	0698-4123	5		RESISTOR 499 1% .125W F TC=0+-100	24546	C4-1/8-T0-499R-F
R66	0698-4430	7	2	RESISTOR 1.91K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1911-F
R67	0683-2025	1		RESISTOR 2K 5% .25W FC TC=-400/+700	01121	CB2025
R68	0698-3558	8		RESISTOR 4.02K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4021-F
R69	0698-4307	7		RESISTOR 14.3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1432-F
R70	0698-4123	5		RESISTOR 499 1% .125W F TC=0+-100	03292	C4-1/8-T0-499R-F
R71	2100-3354	9		RESISTOR-TRMR 50K 10% C SIDE-ADJ 1-TRN	28480	2100-3354
R72	0757-0447	4		RESISTOR 16.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1622-F
R73	0757-0447	4		RESISTOR 16.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1622-F
R74	0757-0284	7		RESISTOR 150 1% .125W F TC=0+-100	24546	C4-1/8-T0-151-F
R100	0683-1005	5		RESISTOR 10 5% .25W FC TC=-400/+500	01121	CB1005
R101	0683-1005	5		RESISTOR 10 5% .25W FC TC=-400/+500	01121	CB1005
R102	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
R104	0698-4435	2		RESISTOR 2.49K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2491-F
R201	0698-0063	4	1	RESISTOR 5.23K 1% .125W F TC=0+-100	91637	CMF-1/8-T1-5231-F
R202	2100-3273	1		RESISTOR-TRMR 2K 10% C SIDE-ADJ 1-TRN	28480	2100-3273
R203	0698-3447	4		RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
R204	0698-3153	9	1	RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
R205	0757-0284	7		RESISTOR 150 1% .125W F TC=0+-100	24546	C4-1/8-T0-151-F
R206	0698-4020	1		RESISTOR 9.53K 1% .125W F TC=0+-100	24546	C4-1/8-T0-9531-F
R207	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
R208	0698-4439	6		RESISTOR 3.24K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3241-F
R209	0757-0284	7		RESISTOR 150 1% .125W F TC=0+-100	24546	C4-1/8-T0-151-F
R210	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
R211	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
R212	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
R213	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
R214	0757-0284	7		RESISTOR 150 1% .125W F TC=0+-100	24546	C4-1/8-T0-151-F
R215	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
R216	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
R220	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
R221	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
RP105	1810-0279	5		NETWORK-RES 10-PIN-8IP .1-PIN-SPCG	11236	750-101-R4.7K
RP106	1810-0279	5		NETWORK-RES 10-PIN-8IP .1-PIN-SPCG	11236	750-101-R4.7K
RP107	1810-0279	5		NETWORK-RES 10-PIN-8IP .1-PIN-SPCG	11236	750-101-R4.7K
U1	1826-0508	6	1	IC CONV 10-B-D/A 16-DIP-C	03285	AD561JD
U2	1826-0413	2	7	IC OP AMP TO-99	34371	HA2-2605-5
U3	1826-0413	2		IC OP AMP TO-99	34371	HA2-2605-5
U4	1826-0021	8	6	IC OP AMP TO-99	27014	LM310H
U5	1826-0302	8	1	IC OP AMP TO-99	04713	MC17418CG
U6	1826-0413	2		IC OP AMP TO-99	34371	HA2-2605-5
U7	1826-0188	8	5	IC 1408 CONV 16-DIP-C	04713	MC1408L-8
U8	1826-0021	8		IC OP AMP TO-99	27014	LM310H
U9	1826-0026	3		IC 311 COMPARATOR TO-99	04713	MLM311G
U10	1826-0188	8		IC 1408 CONV 16-DIP-C	04713	MC1408L-8
U11	1826-0188	8		IC 1408 CONV 16-DIP-C	04713	MC1408L-8
U12	1826-0021	8		IC OP AMP TO-99	27014	LM310H
U13	1826-0188	8		IC 1408 CONV 16-DIP-C	04713	MC1408L-8
U14	1826-0413	2		IC OP AMP TO-99	34371	HA2-2605-5
U15	1820-1941	1	2	IC SW ANALOG	27014	LF13201N
U16	1826-0021	8		IC OP AMP TO-99	27014	LM310H
U17	1820-1941	1		IC SW ANALOG	27014	LF13201N
U18	1826-0021	8		IC OP AMP TO-99	27014	LM310H
U19	1826-0021	8		IC OP AMP TO-99	27014	LM310H
U21	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74L800N
U23	1826-0026	3		IC 311 COMPARATOR TO-99	04713	MLM311G
U201	1826-0557	5	1	IC OP AMP GP QUAD 14-DIP-C	03406	LM348J
U202	1820-1196	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174N
U203	1820-1196	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174N
U204	1820-1196	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174N

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

Table 8-5-3. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
U205	1820-1196	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174N
U206	1826-0356	2	2	IC 7530 CONV 10-B-D/A 16-DIP-C	03285	AD7530JD
U207	1826-0356	2		IC 7530 CONV 10-B-D/A 16-DIP-C	03285	AD7530JD
				(NOTE: 1826-0356 REPLACES 1820-1789)		
				MISCELLANEOUS PARTS		
	4040-0748	3		EXTRACTOR-PC BOARD BLK POLYC	28480	4040-0748
	4040-0749	4		EXTRACTOR-PC BOARD BRN POLYC	28480	4040-0749
	6960-0080	8	3	PLUG-HOLE FL-HD FOR .185-D-HOLE TFE	28480	6960-0080

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

SERVICE GROUP 6
HIGH VOLTAGE SECTION

TABLE OF CONTENTS

Service Group		Page
6.	HIGH VOLTAGE SECTION	8-6-1
	8-6-1. Introduction	8-6-1
	8-6-3. General Information	8-6-1
	8-6-5. High Voltage Section Theory	8-6-1
	8-6-6. The X Axis and Y Axis Amplifiers L (A13)	8-6-1
	8-6-10. The Z Axis Amplifier	8-6-1
	8-6-15. The High Voltage Oscillator and High Voltage Rectifier M(A13,A65)	8-6-2
	8-6-19. The Flood Gun	8-6-3
	8-6-21. The + 100 Regulator	8-6-3
	8-6-24.Troubleshooting The High Voltage Oscillator	8-6-4

LIST OF TABLES

Table		Page
8-6-1.	Replaceable Parts	8-6-11

LIST OF ILLUSTRATIONS

Figure		Page
8-6-1.	HV Oscillator Block Diagram	8-6-2
8-6-2.	+ 100V Regulator	8-6-3
8-6-3.	DC Measurements In The High Voltage Oscillator	8-6-5
8-6-4.	X, Y, and Z Inputs To A13	8-6-6
8-6-5.	A13 XYZ Amplifiers	8-6-7/8-6-8
8-6-6.	Display High Voltage	8-6-9/8-6-10

HIGH VOLTAGE SECTION
SERVICE GROUP 6

8-6-1. INTRODUCTION.

8-6-2. The High Voltage Section contains the necessary circuits to provide all of the CRT drive voltages. While most of the circuits may be found on the A13 board (schematics L and M), the drive voltages of over +150V are supplied by the M(A65) high voltage rectifier circuit, located beneath the rear of the CRT. Inputs to the L(A13) board are low dc levels and TTL blanking signals which are produced in the Display Control section.

8-6-3. GENERAL INFORMATION.

8-6-4. Use extreme caution when performing any type of maintenance or adjustment in this area. Voltages of up to +18KV are present on circuit components, even after the instrument is turned OFF. High voltage measurements are critical and should be made with the equipment suggested in Adjustment (Section V). Incorrect adjustment of CRT voltages may lead to a shortened CRT life.

WARNING

Dangerous voltages (up to +18KV) capable of causing death **are present in circuits even when the instrument is turned OFF.** *Use extreme caution when working in this area.*

8-6-5. HIGH VOLTAGE SECTION THEORY.

8-6-6. The X Axis and Y Axis Amplifiers L (A13).

8-6-7. The X and Y Axis Amplifiers are identical, therefore, only the X Axis Amplifier is explained in the following paragraphs.

8-6-8. The X Axis input signal causes the percentage of current in the Differential Current Amplifier to vary between Q14A and Q14B. The current is supplied by a constant current source Q15. The variable resistor R54 sets the X Axis gain and the variable resistor R60 sets the X Axis position.

8-6-9. The current from the collector of Q14A is converted by the X1 Deflection Amplifier to a voltage between +8Vdc and +90Vdc which is used to drive the X1 deflection plate of the display CRT. R70 and C29 form a feedback network to provide gain stability. Note that each deflection amp has essentially zero input impedance.

8-6-10. The Z Axis Amplifier.

8-6-11. The Z Axis Amplifier controls the intensity of the display by supplying a bias signal to the High Voltage Rectifier A65 which in turn operates the control grid of the display CRT.

8-6-12. The Z Axis input has a voltage proportional to the line length in graphics mode and a fixed dc voltage in the alpha mode each multiplied by the position of the front panel pot. If the gain of U1 is $\frac{R12}{R_F}$ where the value R_F is the resistance of the FET Q1B. Q220,221, and Q1A generate the gate voltage necessary to cause R_F to be proportional to the intensity pot. Q202 is a constant current source.

8-6-13. To produce the character matrix dots in the alpha mode, the H BLANK line is pulsed causing the current Switch (A2 and Q3) to blank the display between dots. The current from the collector of Q3 is applied to the Grid Drive Amplifier which supplies a voltage to the high voltage rectifier.

8-6-14. The CRT control grid voltage is produced in the High Voltage Rectifier by a voltage shifting circuit which references it to the -4000 Vdc cathode voltage. The amount of maximum intensity is determined by the setting of the Intensity Limit control A13R109. The Z Gate input from A13 modulates the dc grid voltage to produce variations in display intensity.

8-6-15. The High Voltage Oscillator and High Voltage Rectifier M(A13,A65).

8-6-16. Transistor A13Q13 and transformer A66T1 together form a class C oscillator stimulating the primary of A66T1 with a 20 to 30kHz signal. The highly stepped up signal from the secondary of A66T1 is rectified by A65CR1 and filtered by the Pi network filter consisting of A65C1, A65C2, and A65R2 providing a -4000 Vdc cathode voltage. This voltage is sampled by the feedback network consisting of A65C3, A65R4, A12R46 and A13R44. This feedback signal is applied to IC regulator A13U2 regulating the dc level of the base winding of A66T1 causing A13Q13 to maintain the cathode voltage at -4000 Vdc (see Figure 8-6-1).

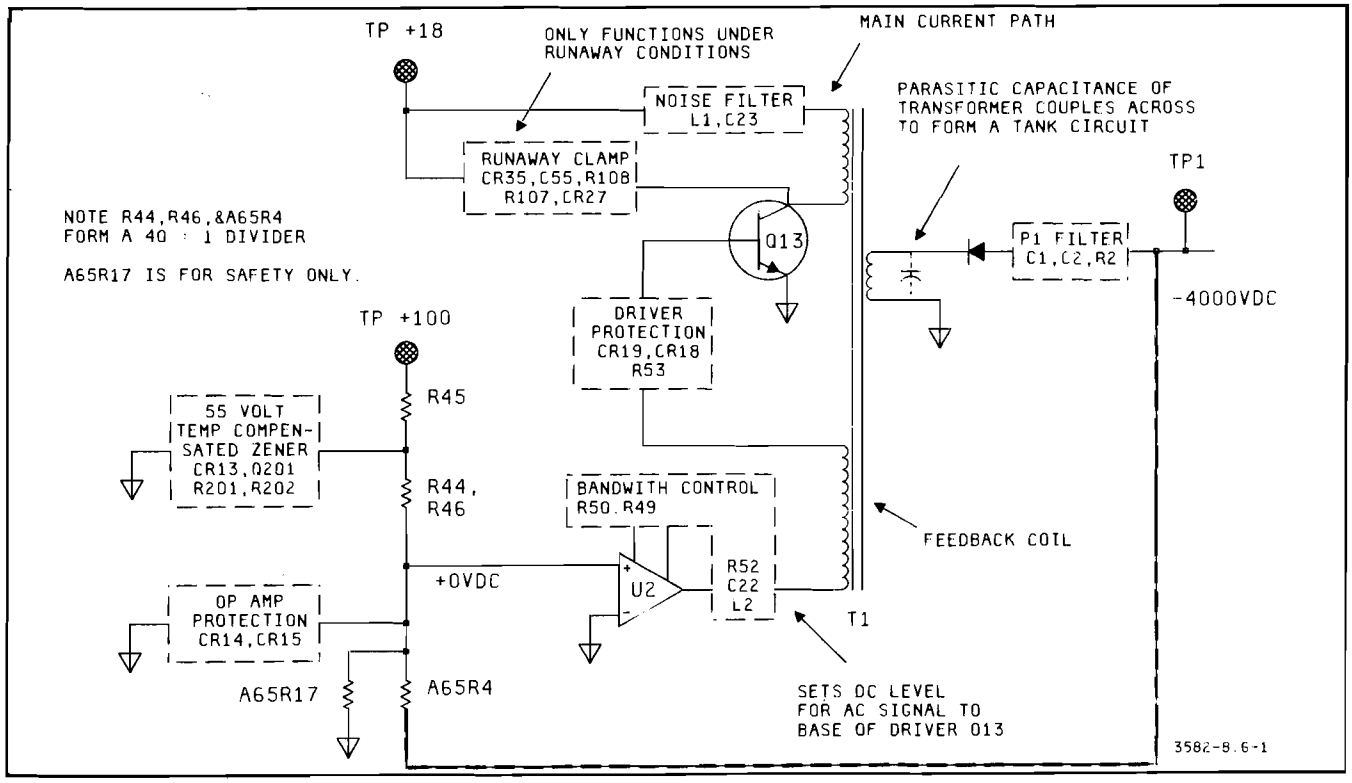


Figure 8-6-1. HV Oscillator Block Diagram.

8-6-17. The focus voltage is determined by a resistor string with two variable resistors. The fine adjustment is varied by the Front Panel Focus control. Gross adjustment is provided by A65R13.

8-6-18. A tap off from the secondary output of A66T1 is applied to a voltage sixtupler which increases the voltage to +18000 Vdc for the post accelerator.

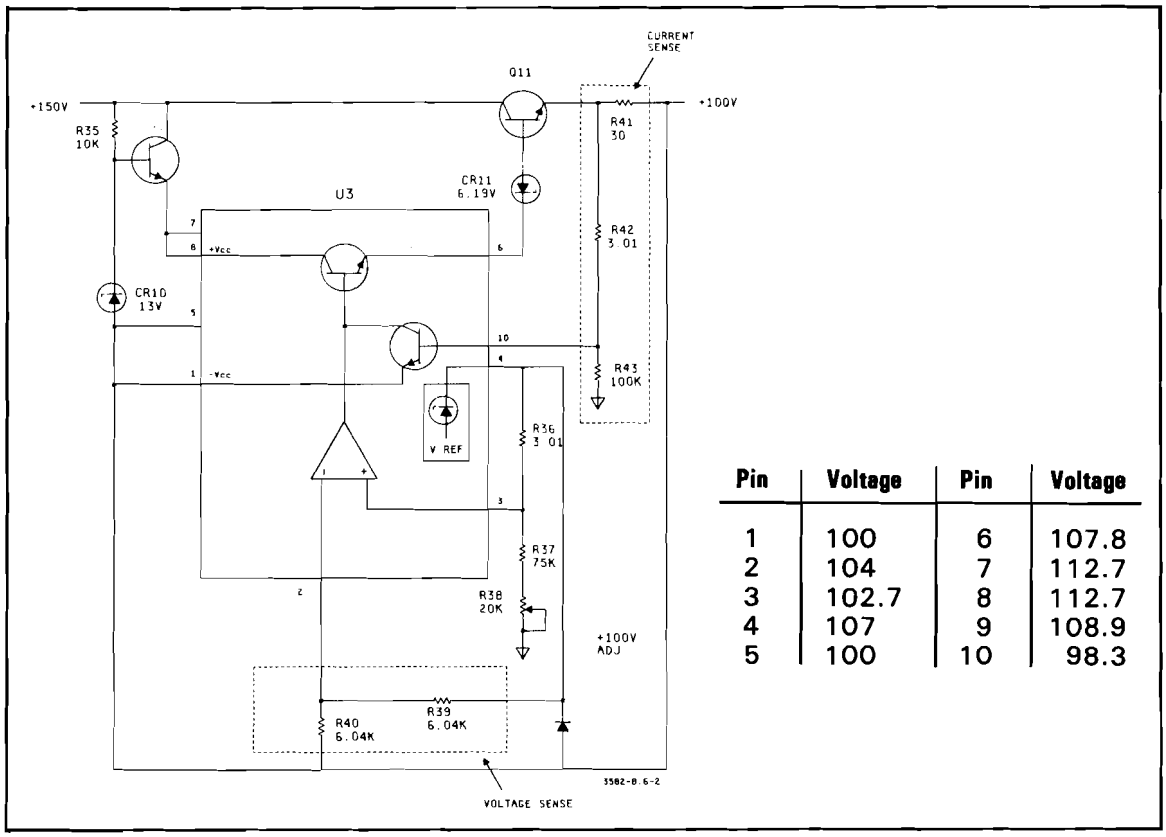
8-6-19. The Flood Gun.

8-6-20. The Flood Gun circuit supplies an additional source of electrons from a second filament in the tube, which cause the phosphor of the CRT to radiate illuminating the graticule. A13R105 adjusts the uniformity of the Flood Gun.

8-6-21. The +100 Regulator.

8-6-22. A reference signal is generated by A13U3 at pin 4 and is applied to the non-inverting input pin 3 through a resistor divider network consiting of A13R36, A13R37, and A13R38. The output of the Regulator is sensed and compared to the reference by resistors A13R40 and A14R39. The result of the comparison is applied to A13U3 pin 2 which drives the pass transistor A13Q11 through zener diode A13CR11. A13R41, A13R42 and A13R43 act as a foldback current sensing network and supply a voltage between pin 10 and 1 which limits the drive to A13Q11 (see Figure 8-6-2).

8-6-23. A13Q12, A13CR10, and A13R35 are connected to provide the 13 V relative positive and negative Vcc inputs to A13U3. See Figure 8-6-2 for a simplified representation. CR30 acts as a clamp for the +100 V output to protect the display from regulator failure.



Pin	Voltage	Pin	Voltage
1	100	6	107.8
2	104	7	112.7
3	102.7	8	112.7
4	107	9	108.9
5	100	10	98.3

Figure 8-6-2. +100V Regulator.

8-6-24. TROUBLESHOOTING THE HIGH VOLTAGE OSCILLATOR.

8-6-25. Because the high voltage oscillator incorporates a closed loop feedback circuit, ac signal levels may vary between instruments due to the differences in high voltage settings for the CRT. One way of breaking the loop, which permits testing under static conditions, is to remove the transistor mounting screws from A13Q13. This opens the circuit at the collector of Q13 which disables the oscillator. Now, characteristic dc levels may be measured at various parts of the circuit, which should aid in determining the malfunction. This technique is useful even if the circuit was operating, but failed to produce the proper high voltage levels. In this case, areas of concern would involve leaky capacitors or zener diodes.

8-6-26. If this procedure does not indicate a malfunctioning component, then the problem area may exist inside the high voltage rectifier box (A65). Troubleshooting in the high voltage recitifier box is not recommended because of the danger from lethal voltages (as high as +18KV) which remain on circuit components even after the instrument is turned off. Therefore, the high voltage rectifier box should be replaced as a unit if any of the components within are suspected or known to be defective.

8-6-27. Perform the following procedure.

a. Set the LINE switch to OFF.

b. Remove the top instrument cover and the plastic shield scovering the A13 board.

c. Remove the two transistor mounting screws from A13Q13.

d. Set the LINE switch to ON.

e. Make dc voltage measurements as indicated in Figure 8-6-3.

f. Set the LINE switch to OFF.

g. If all the voltages given in Figure 8-6-3 are correct, it is still possible that U2 or Q13 is defective.

h. If replacement of all indicated defective parts does not result in an operating oscillator, then replace the High Voltage Rectifier.

i. Once the High Voltage Oscillator is operational, perform the high voltage adjustment given in Section V.

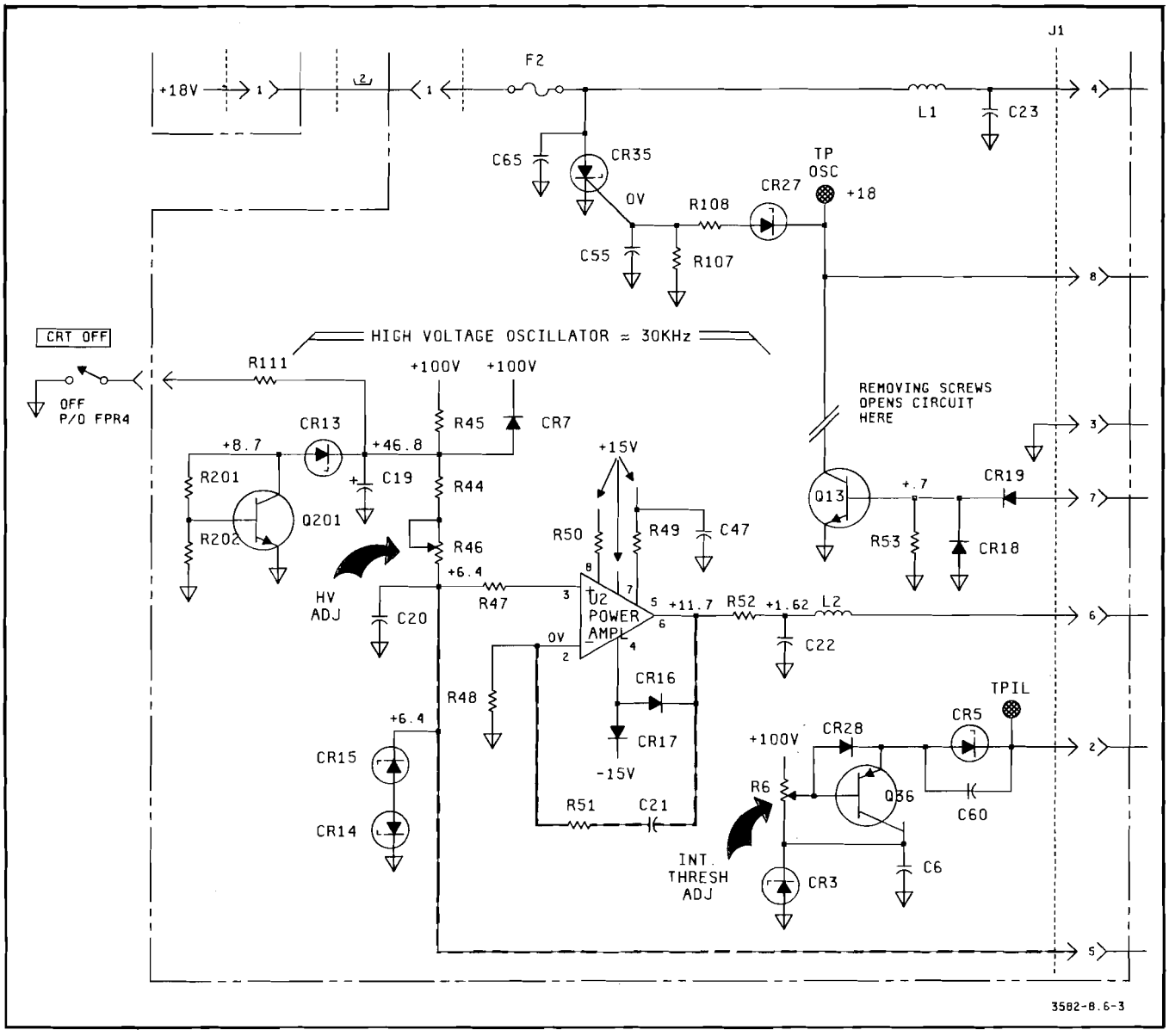
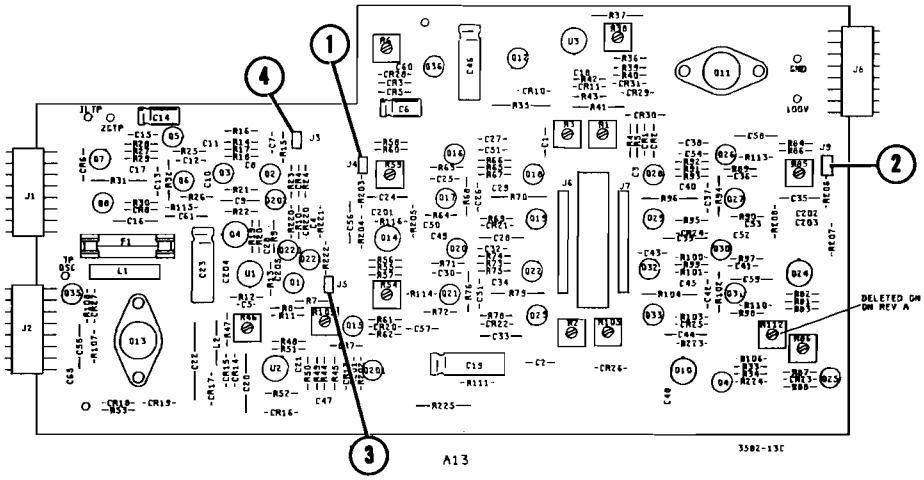


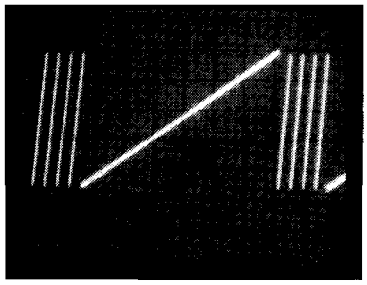
Figure 8-6-3. DC Measurements In The High Voltage Oscillator.

A13 INPUT ANALOG CHECKS

To perform the following analog checks, set the TEST switch on the top of the A9 board to TEST. All of the signal points are accessible through holes provided in the A13 plastic cover.

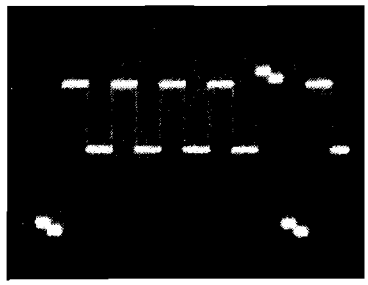


Analog Signal Points



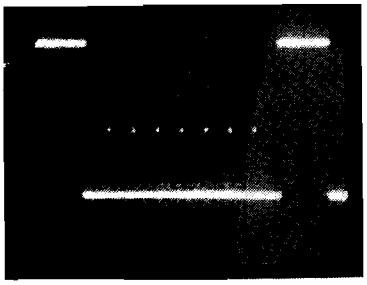
(1) X-axis input to A13

Internal trigger
0.02v/div;X10 probe
0vdc 2.5cm from bottom
2ms/div sweep



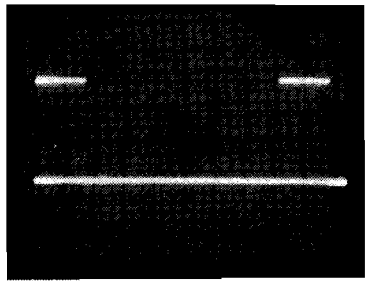
(2) Y-axis input to A13

Internal trigger
0.02v/div;X10 probe
0vdc 2.5cm from bottom
2ms/div sweep



(3) Z-axis input to A13

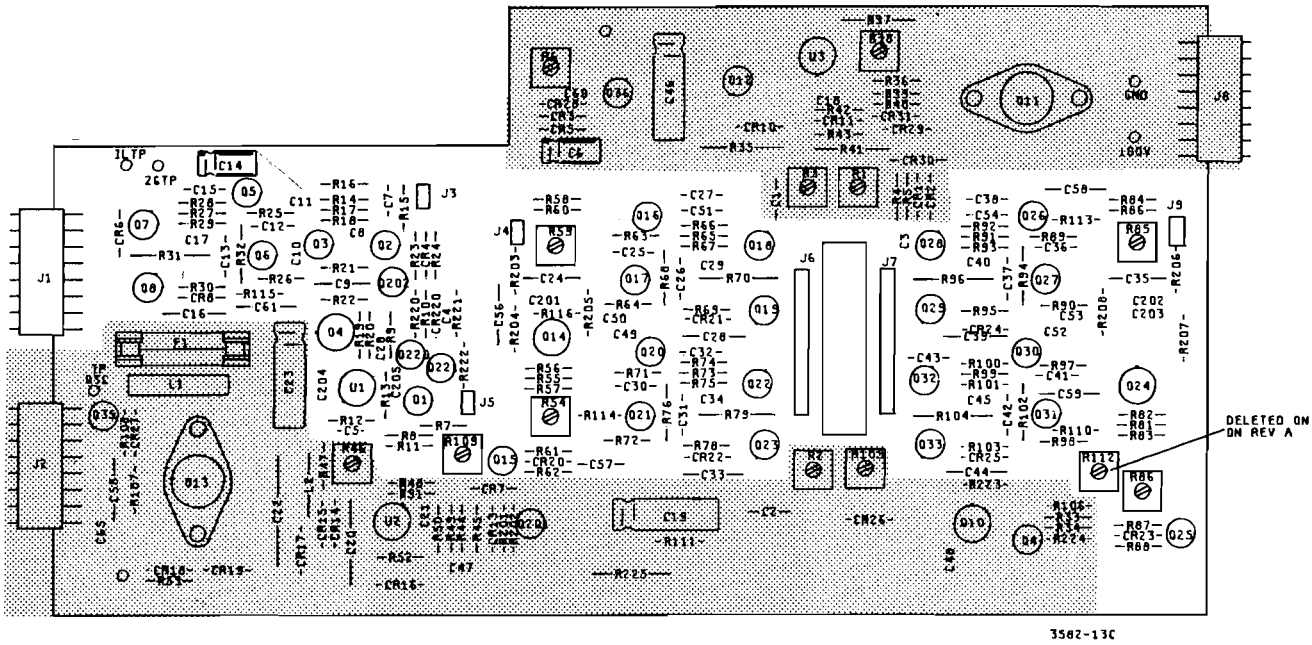
Internal trigger
0.01v/div;X10 probe
0vdc 2cm from bottom
2ms/div sweep



(4) High blank

0.02v/div;X10 probe
0vdc 2.5cm from bottom
2ms/div sweep
int. trigger

Figure 8-6-4. X, Y, and Z Inputs To A13.



A13
03582-66513
REV C

A13 PART I X Y Z AXIS AMPLIFIER 03582-66513

P/O A20 MOTHER BOARD 03582-66520

Z AXIS AMPLIFIER

GRID DRIVE AMPLIFIER

CURRENT SWITCH

DIFFERENTIAL CURRENT AMPL

X AXIS AMPLIFIER

X1 DEFLECTION AMPLIFIER

X2 DEFLECTION AMPLIFIER

DIFFERENTIAL CURRENT AMPLIFIER

H BLANK FROM A9 Part I XA9B(L)

Z AXIS FROM A10 Part I XA10(22,Z)

X AXIS FROM A10 Part I XA10(20,X)

Y-AXIS FROM A10 Part I XA10(21,Y)

INTENSITY

FPR4 2.0K

INT LIMIT ADJ

X GAIN ADJ

X POS ADJ

FROM A13R41

P6 A20 MOTHER BD. 03582-66520

GRID DRIVE AMPLIFIER

+100V R28 1.5K
+100 R27 4.75K R29 10 C14 .1
C12 .01 Q7
R32 43K C13 .01
+100V CR6
R30 10 Q8
C17 1.2 pF CR8 6.19V C16 2.2
R31 20K

X AXIS AMPLIFIER

X1 DEFLECTION AMPLIFIER

+100V R66 1.5K
+15V R63 4.99K C25 .01 +100V R65 4.75K R67 10 Q18 C27 .01
Q16
-15V +15V Q17 R68 43K C26 .01
+7.2V R116 4.99K C56 2.2
R69 10 Q19
R64 4.99K -15V
C29 1.2 pF R70 20K CR21 6.19V C28 2.2

X2 DEFLECTION AMPLIFIER

+100V R74 1.5K
+15V R71 4.99K C30 .01 +100V R73 4.75K R75 10 Q22 C32 .01
Q20
-15V +15V Q21 R76 43K C31 .01
R78 10 Q23
R72 4.99K -15V
C34 1.2 pF R79 20K CR22 6.19V C33 2.2

DIFFERENTIAL CURRENT AMPLIFIER

R203 200 R204 49.9 Q14A Q14B R205 49.9
C201 130 pF
R55 324 R54 200 X GAIN ADJ
+15 R58 17.8K R59 500 X POS ADJ
R56 1K R57 1K C24 2.2 R60 402
-2.5V
Q15
R61 1.62K CR20 6.19V R62 1.13K
-15V -15V

+7.2V R114 4.99K C57 2.2

Y AXIS AMPLIFIER

Y1 DEFLECTION AMPLIFIER

+100V R92 1.5K
+15V R89 4.99K C36 .01 +100V R91 4.75K R93 10 Q28 C38 .01
Q26
-15V +15V Q27 R94 43K C37 .01
+7.2V R113 4.99K C58 2.2
R95 10 Q29
R90 4.99K -15V
C40 1.2 pF R96 20K CR24 6.19V C39 2.2

Y2 DEFLECTION AMPLIFIER

+100V R100 1.5K
+15V R97 4.99K C41 .01 +100V R99 4.75K R101 10 Q32 C43 .01
Q30
-15V +15V Q31 R102 43K C42 .01
R98 4.99K -15V
R103 10 Q33
C45 1.2 pF R104 20K CR25 6.19V C44 2.2

DIFFERENTIAL CURRENT AMPLIFIER

R206 200 R207 49.9 Q24A Q24B R208 49.9
C202 130 pF
R81 499 R80 200 Y GAIN ADJ
R82 1K R83 1K C35 2.2
-3.3V
Q25
R87 1.62K CR23 6.19V R88 1.13K
-15V -15V

-15V R84 17.8K R85 500 Y POS ADJ R86 402

+7.2V R110 4.99K C59 2.2

TP 2G

Z GATE J1 91 TO HIGH VOLTAGE RECTIFIER A65(6) M

X1 J6 6 4 TO CRT M

X2 8 5 TO CRT M

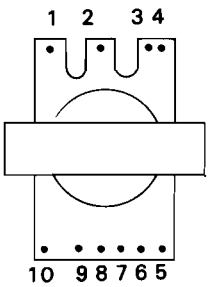
Y1 J7 6 94 TO CRT M

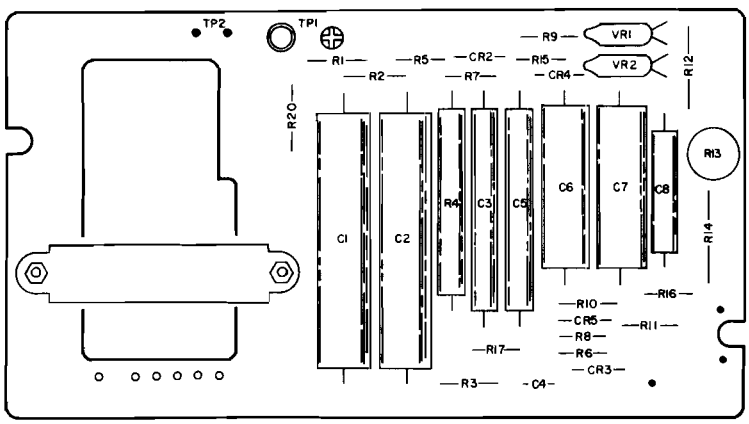
Y2 8 95 TO CRT M

3582-5-4

L

Figure 8-6-5. A13 XYZ Amplifiers. REV A,B,C
8-6-7/8-6-8

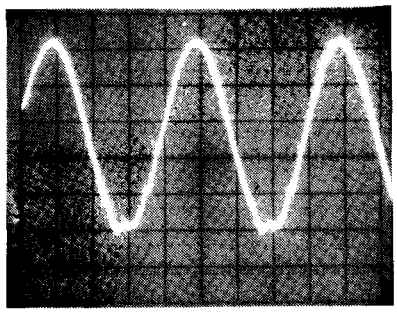




A65
03582-66565

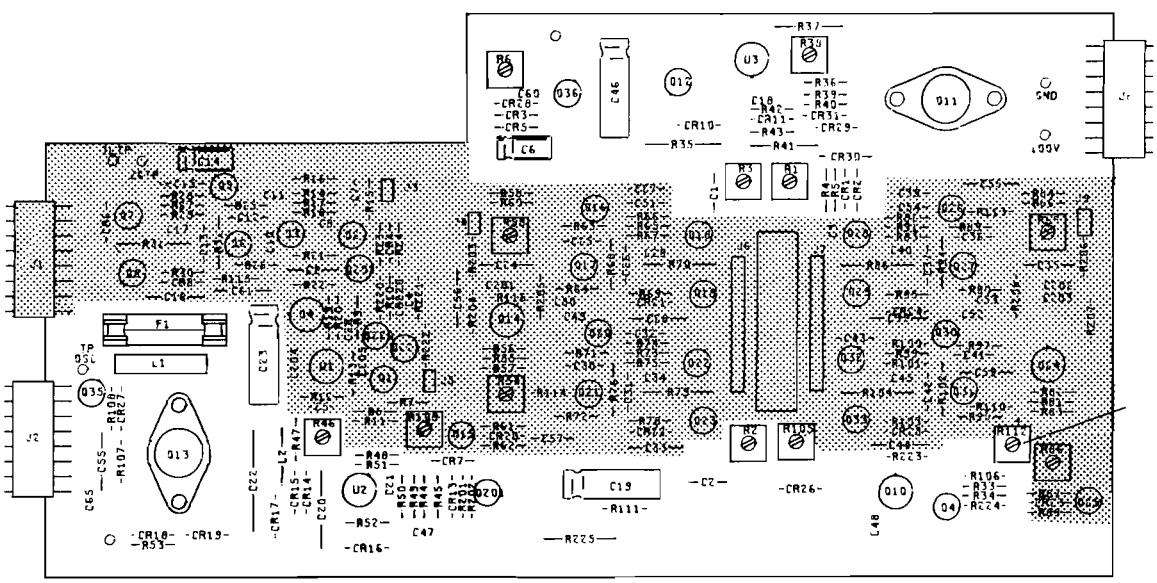
Typical Resistance Measures of XFMR out of CKT.

Pins	OHMS
3 to 4	.01Ω
5 to 6	.08Ω
7 to 8	.07Ω
9 to 1	250Ω
9 to 2	350Ω
9 to 10	27.1Ω



(1) HV Oscillator TP

Internal trigger
0.5v/div
0vdc 1cm from bottom
X10 probe
10usec/div



A13
03582-66513
REV C

A13 PART II DISPLAY HIGH VOLTAGE 03582-66513

P/O A20 MOTHER BD 03582-66520

+100 VOLT REGULATOR

+150V

+18V

+15V

-15V

-30V

GND

+5V

+100V

HV RUN AWAY CLAMP

F2 1A (4A SLO-BLO)

CRT OFF

OFF

P6 FPR4

HIGH VOLTAGE OSCILLATOR ≈ 30 KHz

HV ADJ

+100V ADJ

INT. THRESH ADJ

U2 POWER AMP

U3

Q11

Q12

Q13

Q35

Q36

Q201

CR1 20V

CR2 38V

CR3 38V

CR10 13V

CR11 6.19V

CR13 38V

CR15 6.2V

CR14 6.2V

CR27 34V

CR28 20V

CR30 120V

CR31

CR5 20V

TP OSC

TP IL

TP I

MESH

ACCELERATOR

PATT ADJ

PIN CONNECTIONS OF CRT AS VIEWED FROM REAR

PIN 5

+18000V

PDA

Y AXIS FROM A13 Part I J7(6,8)

X AXIS FROM A13 Part I J6(6,8)

Z GATE FROM A13 Part I J1(1)

A65 H.V. RECTIFIER 03585-66565

A66 H.V. XFMR 03585-66566

4.45V RMS

~ 4 KVDC

HIGH VOLTAGE MULTIPLIER

FOCUS GRID ADJ

SPARK GAP

3582-66513

+100 VOLT REGULATOR

CR29 · Q11 · R41 30 · +100V · CR30 120V · C46 10 · C15,C51 ±C54 .01 · CR11 6.19V · R42 3.01K · R43 100K · U3 · R36 3.01K · R37 75K · R38 20K +100V ADJ · C18 .001 · R39 6.04K · CR31

+100V · R4 51K · R5 2.2K · C3 .1 · CR1 20V · CR2 38V

MESH J7 4 → 8

+100V · PATT ADJ · R3 50K · J6 4 → 906 · C1 .01

ACCELERATOR J7 10 → 96

PIN CONNECTIONS OF CRT AS VIEWED FROM REAR

PAT · H · H · AST · V · V · PA · PIN 5 · ACC · HTR · FG · HTR

+18000V · PDA

MES · PAT · Acc

Y AXIS FROM A13 Part I J7(6,8) → 94, 95 → V, V

X AXIS FROM A13 Part I J6(6,8) → 4, 5 → H, H

FG · HTR · HTR · AST

A13 PART II

+18 VDC · J7 · R105 100K · CR26 30V · R223 330Ω · +15 V · R106 54.5K · Q9 · R34 7.15K · R224 330Ω · R33 12.1K · Q10 · +15V · R1 20K · -15V · X ALIGN · R225 100Ω · R112 50K · +15V · R2 20K · -15V · ORTHO · C2 .01

913 · 2 · 914 W12 · 0 · 91 W13 · 0 · 903

J6 · J8

TO A13 Part I

+100V +15V -15V · 6 7 8 5 3 1 4 · 6, 92, 907, 0, 93, 8, 95 · +100V +15V -15V · W4 TO FRONT PANEL

ASTIGMATISM · +100V · R3 50K · -15V

INTENSITY · R4 20K · +15V

FOCUS

GRATICULE ILLUMINATION · +15V · FP R6 20K

PART NUMBERS IN FRONT PANEL SERVICE GROUP

A65 H.V. RECTIFIER 03585-66565

A66 H.V. XFMR 03585-66566

J1 · L1 40μH · C23 50 · TP OSC · CR27 34V · L2 240μH · C22 .068 · CR28 · CR5 20V · TP1L · +100V · R6 50K · Q36 · C60 · CR3 39V · C6 · Q13 · CR19 · CR18 · R53 1K

4.95 V RMS · ~ 4 KVDC · TP1 · R20 .75 · R1 100K · R2 4.7K · C1 .033 · C2 .033 · R5 1K · CR1 · CR2 · R7 10M · R15 1K · CR4 · R9 11M · C5 .001 · R3 330K · C4 22pF · SPARK GAP · R8 1K · C6 .01 · R10 22K · C7 .01 · CR25 · R6 1K · CR3 · R11 68 · R4 30M · C3 .001 · R17 200K · V1 59V · V2 59V · HIGH VOLTAGE MULTIPLIER · R12 8.25M · FOCUS GRID ADJ · R13 2M · C8 .0047 · R14 13M · R16 5M · R5 5M

P/O H.V. RECTIFIER ASSY

Z GATE FROM A13 Part I J1(1) → 91

917 · 905 · 0 · 96 · 906 · 94 · 91

W3

WARNING

DANGEROUS VOLTAGES CAPABLE OF CAUSING DEATH ARE PRESENT IN THIS INSTRUMENT

Figure 8-6-6. Display High Voltage. REV C
8-6-9/8-6-10

Table 8-6-1. Replaceable Parts.

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A13	03582-66513	3	1	PC ASSEMBLY, X-Y-Z- AMPLIFIER	28480	03582-66513
C1	0150-0012	3	19	CAPACITOR-FXD .01UF +-20% 1KVDC CER	04200	C023A102J103MS38
C2	0150-0012	3		CAPACITOR-FXD .01UF +-20% 1KVDC CER	04200	C023A102J103MS38
C3	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C4	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C5	0160-2241	5	1	CAPACITOR-FXD 2.2PF +-.25PF 500VDC CER	28480	0160-2241
C6	0180-0269	5	2	CAPACITOR-FXD 1UF+50-10% 150VDC AL	56289	30D105G150BA2
C7	0160-2199	2		CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
C8	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C9	0180-0197	8	14	CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
C10	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C11	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C12	0150-0012	3		CAPACITOR-FXD .01UF +-20% 1KVCD CER	04200	C023A102J103MS38
C13	0150-0012	3		CAPACITOR-FXD .01UF +-20% 1KVCD CER	04200	C023A102J103MS38
C14	0180-0269	5		CAPACITOR-FXD 1UF+50-10% 150VDC AL	56289	30D105G150BA2
C15	0150-0012	3		CAPACITOR-FXD .01UF +-20% 1KVCD CER	04200	C023A102J103MS38
C16	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
C17	0160-2237	9	5	CAPACITOR-FXD 1.2PF +-.25PF 500VDC CER	28480	0160-2237
C18	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
C19	0180-0089	7	2	CAPACITOR-FXD 10UF+50-10% 150VDC AL	56289	30D106F150DD2
C20	0160-3468	0	1	CAPACITOR-FXD .12UF +-10% 80VDC POLYE	28480	0160-3468
C21	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C22	0160-0166	9	1	CAPACITOR-FXD .068UF +-10% 200VDC POLYE	28480	0160-0166
C23	0180-0141	2		CAPACITOR-FXD 50UF+75-10% 50VDC AL	56289	30D506G050DD2
C24	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
C25	0150-0012	3		CAPACITOR-FXD .01UF +-20% 1KVDC CER	04200	C023A102J103MS38
C26	0160-4676	4		CAPACITOR-FXD .01UF +-20% 250VDC	28480	0160-4676
C27	0160-4676	4		CAPACITOR-FXD .01UF +-20% 250VDC	28480	0160-4676
C28	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
C29	0160-2237	9		CAPACITOR-FXD 1.2PF +-.25PF 500VDC CER	28480	0160-2237
C30	0150-0012	3		CAPACITOR-FXD .01UF +-20% 1KVDC CER	04200	C023A102J103MS38
C31	0150-0012	3		CAPACITOR-FXD .01UF +-20% 1KVDC CER	04200	C023A102J103MS38
C32	0150-0012			CAPACITOR-FXD .01UF +-20% 1KVDC CER	04200	C023A102J103MS38
C33	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
C34	0160-2237	9		CAPACITOR-FXD 1.2PF +-.25PF 500VDC CER	28480	0160-2237
C35	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
C36	0150-0012	3		CAPACITOR-FXD .01UF +-20% 1KVDC CER	04200	C023A102J103MS38
C37	0150-0012	3		CAPACITOR-FXD .01UF +-20% 1KVDC CER	04200	C023A102J103MS38
C38	0150-0012	3		CAPACITOR-FXD .01UF +-20% 1KVDC CER	04200	C023A102J103MS38
C39	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
C40	0160-2237	9		CAPACITOR-FXD 1.2PF +-.25PF 500VDC CER	28480	0160-2237
C41	0150-0012	3		CAPACITOR-FXD .01UF +-20% 1KVDC CER	04200	C023A102J103MS38
C42	0150-0012	3		CAPACITOR-FXD .01UF +-20% 1KVDC CER	04200	C023A102J103MS38
C43	0150-0012	3		CAPACITOR-FXD .01UF +-20% 1KVDC CER	04200	C023A102J103MS38
C44	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
C45	0160-2237	9		CAPACITOR-FXD 1.2PF +-.25PF 500VDC CER	28480	0160-2237
C46	0180-0089	7		CAPACITOR-FXD 10UF+50-10% 150VDC AL	56289	30D106F150DD2
C47	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C48	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C49	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C50	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C51	0150-0012	3		CAPACITOR-FXD .01UF +-20% 1KVDC CER	04200	C023A102J103MS38
C52	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C53	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C54	0150-0012	3		CAPACITOR-FXD .01UF +-20% 1KVDC CER	04200	C023A102J103MS38
C55	0160-0159	0	1	CAPACITOR-FXD 6800PF +-10% 200VDC POLYE	28480	0160-0159
C56	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
C57	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
C58	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
C59	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
C60	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C61	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
C65	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C201	0140-0195	2		CAPACITOR-FXD 130PF +-5% 300VDC MICA	72136	DM15F131J0300WV1CR
C202	0140-0195	2		CAPACITOR-FXD 130PF +-5% 300VDC MICA	72136	DM15F131J0300WV1CR
C203	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C204	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C205	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
CR1	1902-3237	6	2	DIODE-ZNR 20V 5% DO-7 PD=.4W TC=+.073%	28480	1902-3237
CR2	1902-3311	7	3	DIODE-ZNR 38.3V 5% DO-7 PD=.4W TC=+.081%	28480	1902-3311
CR3	1902-3311	7		DIODE-ZNR 38.3V 5% DO-7 PD=.4W TC=+.081%	28480	1902-3311
CR4	1902-0049	2	13	DIODE-ZNR 6.19V 5% DO-7 PD=.4W TC=+.022%	28480	1902-0049
CR5	1902-3237	6		DIODE-ZNR 20V 5% DO-7 PD=.4W TC=+.073%	28480	1902-3237

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

Table 8-6-1. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
CR6	1901-0096	7	1	DIODE-SWITCHING 120V 50MA 100NS	28480	1901-0096
CR7	1901-0029	6		DIODE-PWR RECT 600V 750MA DO-29	28480	1901-0029
CR8	1902-0049	2		DIODE-ZNR 6.19V 5% DO-7 PD=.4W TC=+.022%	28480	1902-0049
CR10	1902-3193	3	1	DIODE-ZNR 13.3V 5% DO-7 PD=.4W TC=+.059%	28480	1902-3193
CR11	1902-0049	2		DIODE-ZNR 6.19V 5% DO-7 PD=.4W TC=+.022%	28480	1902-0049
CR13	1902-3311	7		DIODE-ZNR 38.3V 5% DO-7 PD=.4W TC=+.081%	28480	1902-3311
CR14	1902-0049	2		DIODE-ZNR 6.19V 5% DO-7 PD=.4W TC=+.022%	28480	1902-0049
CR15	1902-0049	2		DIODE-ZNR 6.19V 5% DO-7 PD=.4W TC=+.022%	28480	1902-0049
CR16	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
CR17	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
CR18	1901-0029	6		DIODE-PWR RECT 600V 750MA DO-29	28480	1901-0029
CR19	1901-0029	6		DIODE-PWR RECT 600V 750MA DO-29	28480	1901-0029
CR20	1902-0049	2		DIODE-ZNR 6.19V 5% DO-7 PD=.4W TC=+.022%	28480	1902-0049
CR21	1902-0049	2		DIODE-ZNR 6.19V 5% DO-7 PD=.4W TC=+.022%	28480	1902-0049
CR22	1902-0049	2		DIODE-ZNR 6.19V 5% DO-7 PD=.4W TC=+.022%	28480	1902-0049
CR23	1902-0049	2		DIODE-ZNR 6.19V 5% DO-7 PD=.4W TC=+.022%	28480	1902-0049
CR24	1902-0049	2		DIODE-ZNR 6.19V 5% DO-7 PD=.4W TC=+.022%	28480	1902-0049
CR25	1902-0049	2		DIODE-ZNR 6.19V 5% DO-7 PD=.4W TC=+.022%	28480	1902-0049
CR26	1902-0244	9	1	DIODE-ZNR 30.1V 5% DO-15 PD=1W TC=+.075%	28480	1902-0244
CR27	1902-3302	6	1	DIODE-ZNR 34.8V 2% DO-7 PD=.4W TC=+.078%	28480	1902-3302
CR28	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
CR29	1901-0029	6		DIODE-PWR RECT 600V 750MA DO-29	28480	1901-0029
CR30	1902-0934	4	1	DIODE-ZNR 1N5380B 120V 5% DO-29 PD=5W	04713	1N5380B
CR31	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
CR220	1901-0518	8		DIODE-SCHOTTKY	28480	1901-0518
FC1A,B	2110-0269	0		FUSEHOLDER-CLIP TYPE,25D-FUSE	28480	2110-0269
F1	2110-0339	5	1	FUSE ,6A 250V SLO-BLO 1.25X.25 UL IEC	28480	2110-0339
L1	9140-0171	3	1	COIL-MLD 40UH 10% Q=20 .296DX.968LG-NOM	28480	9140-0171
L2	9100-1641	0	1	COIL-MLD 240UH 5% Q=65 .155DX.375LG-NOM	28480	9100-1641
Q1	1855-0308	5		TRANSISTOR-JFET DUAL N-CHAN D-MODE SI	28480	1855-0308
Q2	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
Q3	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
Q4	1854-0475	5		TRANSISTOR-DUAL NPN PD=750MW	28480	1854-0475
Q5	1853-0036	2	7	TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
Q6	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
Q7	1853-0232	0	6	TRANSISTOR PNP SI TO-39 PD=1W FT=200MHZ	28480	1853-0232
Q8	1854-0419	7	5	TRANSISTOR NPN SI TO-39 PD=1W FT=200MHZ	28480	1854-0419
Q9	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
Q10	1854-0234	4	2	TRANSISTOR NPN 2N3440 SI TO-5 PD=1W	01928	2N3440
	1205-0011	0	5	HEAT SINK TO-5/TO-39-PKG	28480	1205-0011
Q11	1854-0237	7	1	TRANSISTOR NPN SI TO-66 PD=20W FT=10MHZ	28480	1854-0237
	1205-0347	5	2	HEAT SINK SGL TO-66-PKG	28480	1205-0347
Q12	1854-0234	4		TRANSISTOR NPN 2N3440 SI TO-5 PD=1W	01928	2N3440
	1205-0011	0		HEAT SINK TO-5/TO-39-PKG	28480	1205-0011
Q13	1854-0476	6	1	TRANSISTOR NPN 2N3879 SI TO-66 PD=35W	01928	2N3879
	1205-0347	5		HEAT SINK SGL TO-66-PKG	28480	1205-0347
Q14	1854-0475	5		TRANSISTOR-DUAL NPN PD=750MW	28480	1854-0475
Q15	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
Q16	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
Q17	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
Q18	1853-0232	0		TRANSISTOR PNP SI TO-39 PD=1W FT=200MHZ	28480	1853-0232
Q19	1854-0419	7		TRANSISTOR NPN SI TO-39 PD=1W FT=200MHZ	28480	1854-0419
Q20	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
Q21	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
Q22	1853-0232	0		TRANSISTOR PNP SI TO-39 PD=1W FT=200MHZ	28480	1853-0232
Q23	1854-0419	7		TRANSISTOR NPN SI TO-39 PD=1W FT=200MHZ	28480	1854-0419
Q24	1854-0475	5		TRANSISTOR-DUAL NPN PD=750MW	28480	1854-0475
Q25	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
Q26	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
Q27	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
Q28	1853-0232	0		TRANSISTOR PNP SI TO-39 PD=1W FT=200MHZ	28480	1853-0232
Q29	1854-0419	7		TRANSISTOR NPN SI TO-39 PD=1W FT=200MHZ	28480	1854-0419
Q30	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
Q31	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
Q32	1853-0232	0		TRANSISTOR PNP SI TO-39 PD=1W FT=200MHZ	28480	1853-0232
Q33	1854-0419	7		TRANSISTOR NPN SI TO-39 PD=1W FT=200MHZ	28480	1854-0419
Q35	1884-0073	2	1	THYRISTOR-SCR TO-5 VRRM=100	28480	1884-0073
Q36	1853-0232	0		TRANSISTOR PNP SI TO-39 PD=1W FT=200MHZ	28480	1853-0232
Q201	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
Q202	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
Q220	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
Q221	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
R1	2100-0558	9	4	RESISTOR-TRMR 20K 10% C TOP-ADJ 1-TRN	28480	2100-0558
R2	2100-0558	9		RESISTOR-TRMR 20K 10% C TOP-ADJ 1-TRN	28480	2100-0558
R3	2100-3253	7	4	RESISTOR-TRMR 50K 10% C TOP-ADJ 1-TRN	28480	2100-3253
R4	0683-5135	0	1	RESISTOR 51K 5% .25W FC TC=-400/+800	01121	CB5135
R5	0683-2225	3	2	RESISTOR 2.2K 5% .25W FC TC=-400/+700	01121	CB2225

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

Table 8-6-1. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	CD	Qty	Description	Mfr Code	Mfr Part Number
R6	2100-3253	7		RESISTOR-TRMR 50K 10% C TOP-ADJ 1-TRN	28480	2100-3253
R7	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
R8	0757-0469	0	2	RESISTOR 150K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1503-F
R9	0757-0453	2	1	RESISTOR 30.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3012-F
R10	0757-0451	0	1	RESISTOR 24.3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2432-F
R11	0757-0426	9	2	RESISTOR 1.3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1301-F
R12	0698-3497	4	6	RESISTOR 6.04K 1% .125W F TC=0+-100	24546	C4-1/8-T0-604R-F
R13	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
R14	0683-1135	2	3	RESISTOR 11K 5% .25W FC TC=-400/+800	01121	CB1135
R15	0683-2725	8		RESISTOR 2.7K 5% .25W FC TC=-400/+700	01121	CB2725
R16	0757-0426	9		RESISTOR 1.3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1301-F
R17	0683-1135	2		RESISTOR 11K 5% .25W FC TC=-400/+800	01121	CB1135
R18	0698-3558	8		RESISTOR 4.02K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4021-F
R19	0757-0407	6	4	RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
R20	0757-0407	6		RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
R21	0698-4479	4	3	RESISTOR 14K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1402-F
R22	0757-0420	3	2	RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
R23	0757-0428	1	3	RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
R24	0698-4468	1	5	RESISTOR 1.13K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1131-F
R25	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
R26	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
R27	0757-0437	2	6	RESISTOR 4.75K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4751-F
R28	0683-1525	4		RESISTOR 1.5K 5% .25W FC TC=-400/+700	01121	CB1525
R29	0757-0346	2	11	RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
R30	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
R31	0757-0190	4	5	RESISTOR 20K 1% .5W F TC=0+-100	28480	0757-0190
R32	0686-4335	6	5	RESISTOR 43K 5% .5W CC TC=0+765	01121	EB4335
R33	0698-4479	4		RESISTOR 14K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1402-F
R34	0698-4471	6	1	RESISTOR 7.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7151-F
R35	0764-0005	5	1	RESISTOR 10K 5% 2W MO TC=0+-200	28480	0764-0005
R36	0757-0273	4		RESISTOR 3.01K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3011-F
R37	0686-7535	4	1	RESISTOR 75K 5% .5W CC TC=0+765	01121	EB7535
R38	2100-0558	9		RESISTOR-TRMR 20K 10% C TOP-ADJ 1-TRN	28480	2100-0558
R39	0698-3497	4		RESISTOR 6.04K 1% .125W F TC=0+-100	24546	C4-1/8-T0-604R-F
R40	0698-3497	4		RESISTOR 6.04K 1% .125W F TC=0+-100	24546	C4-1/8-T0-604R-F
R41	0686-3005	5	1	RESISTOR 30 5% .5W CC TC=0+412	01121	EB3005
R42	0757-0273	4		RESISTOR 3.01K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3011-F
R43	0683-1045	3		RESISTOR 100K 5% .25W FC TC=-400/+800	01121	CB1045
R44	0757-0476	9	1	RESISTOR 301K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3013-F
R45	0757-0465	6	3	RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
R46	2100-3214	0	1	RESISTOR-TRMR 100K 10% C TOP-ADJ 1-TRN	28480	2100-3214
R47	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
R48	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
R49	0683-2265	1	1	RESISTOR 22M 5% .25W FC TC=-900/+1200	01121	CB2265
R50	0683-1215	9	1	RESISTOR 120 5% .25W FC TC=-400/+600	01121	CB1215
R51	0757-0479	2	1	RESISTOR 392K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-3923-F
R52	0683-3915	0		RESISTOR 390 5% .25W FC TC=-400/+600	01121	CB3915
R53	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
R54	2100-3212	8	2	RESISTOR-TRMR 200 10% C TOP-ADJ 1-TRN	28480	2100-3212
R55	0698-4450	1	1	RESISTOR 324 1% .125W F TC=0+-100	24546	C4-1/8-T0-324R-F
R56	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
R57	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
R58	0698-3136	8	2	RESISTOR 17.8K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1782-F
R59	2100-0554	5	2	RESISTOR-TRMR 500 10% C TOP-ADJ 1-TRN	28480	2100-0554
R60	0698-4453	4	2	RESISTOR 402 1% .125W F TC=0+-100	24546	C4-1/8-T0-402R-F
R61	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
R62	0698-4468	1		RESISTOR 1.13K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1131-F
R63	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
R64	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
R65	0757-0437	2		RESISTOR 4.75K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4751-F
R66	0683-1525	4		RESISTOR 1.5K 5% .25W FC TC=-400/+700	01121	CB1525
R67	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
R68	0686-4335	6		RESISTOR 43K 5% .5W CC TC=0+765	01121	EB4335
R69	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
R70	0757-0190	4		RESISTOR 20K 1% .5W F TC=0+-100	28480	0757-0190
R71	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
R72	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
R73	0757-0437	2		RESISTOR 4.75K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4751-F
R74	0683-1525	4		RESISTOR 1.5K 5% .25W FC TC=-400/+700	01121	CB1525
R75	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
R76	0686-4335	6		RESISTOR 43K 5% .5W CC TC=0+765	01121	EB4335
R78	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
R79	0757-0190	4		RESISTOR 20K 1% .5W F TC=0+-100	28480	0757-0190
R80	2100-3212	8		RESISTOR-TRMR 200 10% C TOP-ADJ 1-TRN	28480	2100-3212
R81	0698-4123	5		RESISTOR 499 1% .125W F TC=0+-100	24546	C4-1/8-T0-499R-F

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

Table 8-6-1. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
R82	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
R83	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
R84	0698-3136	8		RESISTOR 17.8K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1782-F
R85	2100-0554	5		RESISTOR-TRMR 500 10% C TOP-ADJ 1-TRN	28480	2100-0554
R86	0698-4453	4		RESISTOR 402 1% .125W F TC=0+-100	24546	C4-1/8-T0-402R-F
R87	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
R88	0698-4468	1		RESISTOR 1.13K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1131-F
R89	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
R90	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
R91	0757-0437	2		RESISTOR 4.75K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4751-F
R92	0683-1525	4		RESISTOR 1.5K 5% .25W FC TC=-400/+700	01121	CB1525
R93	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
R94	0686-4335	6		RESISTOR 43K 5% .5W CC TC=0+765	01121	EB4335
R95	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
R96	0757-0190	4		RESISTOR 20K 1% .5W F TC=0+-100	28480	0757-0190
R97	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
R98	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
R99	0757-0437	2		RESISTOR 4.75K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4751-F
R100	0683-1525	4		RESISTOR 1.5K 5% .25W FC TC=-400/+700	01121	CB1525
R101	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
R102	0686-4335	6		RESISTOR 43K 5% .5W CC TC=0+765	01121	EB4335
R103	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
R104	0757-0190	4		RESISTOR 20K 1% .5W F TC=0+-100	28480	0757-0190
R105	2100-3253	7		RESISTOR-TRMR 50K 10% C TOP-ADJ 1-TRN	28480	2100-3253
R106	0698-4510	4	2	RESISTOR 84.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8452-F
R107	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
R108	0698-4123	5		RESISTOR 499 1% .125W F TC=0+-100	24546	C4-1/8-T0-499R-F
R109	2100-3253	7		RESISTOR-TRMR 50K 10% C TOP-ADJ 1-TRN	28480	2100-3253
R110	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
R111	0683-1135	2		RESISTOR 11K 5% .25W FC TC=-400/+800	01121	CB1135
R112	2100-3253	7		RESISTOR-TRMR 50K 10% C TOP-ADJ 1-TRN	28480	2100-3253
R113	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
R114	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
R115	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
R116	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
R201	0698-4510	4		RESISTOR 84.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8452-F
R202	0698-3497	4		RESISTOR 6.04K 1% .125W F TC=0+-100	24546	C4-1/8-T0-604R-F
R203	0757-0407	6		RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
R204	0757-0277	8	4	RESISTOR 49.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-4992-F
R205	0757-0277	8		RESISTOR 49.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-4992-F
R206	0757-0407	6		RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
R207	0757-0277	8		RESISTOR 49.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-4992-F
R208	0757-0277	8		RESISTOR 49.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-4992-F
R220	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
R221	0698-4479	4		RESISTOR 14K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1402-F
R222	0698-4123	5		RESISTOR 499 1% .125 F TC=0+-100	24546	C4-1/8-T0-499R-F
R223	0683-3315	4		RESISTOR 330 5% .25W FC TC=-400/+600	01607	CB3315
R224	0683-3315	4		RESISTOR 330 5% .25W FC TC=-400/+600	01607	CB3315
U1	1826-0089	8	3	IC 2525 OP AMP TO-99	29832	1322
U2	1826-0167	3	1	IC OP AMP TO-99	0192B	CA3094AT
U3	1820-0196	6	1	IC 723 V RGLTR TO-100	04713	MC1723CG
				MISCELLANEOUS PARTS		
J1,2,8	1251-4034	2	3	CONNECTOR 8-PIN M POST TYPE	28480	1251-4034
	1251-4794	1	2	CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-4794
	03582-04106	0	1	CLEAR PLASTIC INSULATOR	28480	03582-04106
J6,7	1251-6652	4		CONNECTOR 13-PIN M POST TYPE	22526	65500-113
	0380-1018	8		STANDOFF-RVT-ON .562-IN-LG 4-40 THD	00000	ORDER BY DESCRIPTION
				PADDING LIST FOR CR1		
	1902-3128	8		DIODE-ZNR 4.32V 5% DO-7 PD=.4W TC=+.035%	28480	1902-3073
	1902-3128	4		DIODE-ZNR 7.32V 5% DO-7 PD=.4W TC=+.048%	28480	1902-3128
	1902-0025	4		DIODE-ZNR 10V 5% DO-7 PD=.4W TC=+.06%	28480	1902-0025

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

Table 8-6-1. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				HIGH VOLTAGE POWER SUPPLY		
A1	03582-64201	2	1	H.V. POWER SUPPLY ASSEMBLY, CONSISTS OF:	28480	03582-64201
A2	03582-25201	0	1	HOUSING, HVPS	28480	03582-25201
A3	03582-61607	6	1	CABLE ASSY, HV MULTIPLIER	28480	03582-61607
A4	03585-61648	8	1	CABLE, HVPS-67	28480	03585-61648
A5	03585-61651	3	1	CABLE 65-CRT-END	28480	03585-61651
A6	03585-66565	8	1	H.V. SECTION (PARTS LIST BELOW)	28480	03585-66565
A7	1400-0908	8	1	CLAMP	06915	KKC-3
A65	03585-66565	8		PC ASSEMBLY, HIGH VOLTAGE	28480	03585-66565
A66	9100-4046	5	1	TRANSFORMER, HIGH VOLTAGE	28480	9100-4046
C1	0160-4148	5	2	CAPACITOR-FXD .033UF +-20% 6KVDC	56289	430P333060
C2	0160-4148	5		CAPACITOR-FXD .033UF +-20% 6KVDC	56289	430P333060
C3	0160-3960	7	2	CAPACITOR-FXD 1000PF +-20% 8KVDC	28480	0160-3960
C4	0160-2265	3	1	CAPACITOR-FXD 22PF +-5% 500VDC CER 0+-30	28480	0160-2265
C5	0160-3960	7		CAPACITOR-FXD 1000PF +-20% 8KVDC	28480	0160-3960
C6	0160-0678	8	2	CAPACITOR-FXD .01UF +-20% 6KVDC	28480	0160-0678
C7	0160-0678	8		CAPACITOR-FXD .01UF +-20% 6KVDC	28480	0160-0678
C8	0160-0543	6	1	CAPACITOR-FXD 4700PF +-20% 4KVDC	28480	0160-0543
CR1	1901-0683	8	1	DIODE-HV RECT 10KV 5MA 250NS	28480	1901-0683
CR2	1901-0029	6	8	DIODE-PWR RECT 600V 750MA DO-29	28480	1901-0029
CR3	1901-0029	6		DIODE-PWR RECT 600V 750MA DO-29	28480	1901-0029
CR4	1901-0029	6		DIODE-PWR RECT 600V 750MA DO-29	28480	1901-0029
CR5	1901-0029	6		DIODE-PWR RECT 600V 750MA DO-29	28480	1901-0029
R1	0683-1045	3	2	RESISTOR 100K 5% .25W FC TC=-400/+800	01121	CB1045
R2	0683-4725	2		RESISTOR 4.7K 5% .25W FC TC=-400/+700	01121	CB4725
R3	0686-3945	2	1	RESISTOR 390K 5% .5W CC TC=0+882	01121	EB3945
R4	0698-8018	5	1	RESISTOR 30M 1% 3W C TC=0+-100	03888	PVC175-3-TO-3004-F
R5	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R6	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R7	0683-1065	7	1	RESISTOR 10M 5% .25W FC TC=-900/+1100	01121	CB1065
R8	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R9	0686-1055	1	1	RESISTOR 1M 5% .5W CC TC=0+1000	01121	EB1055
R10	0686-2225	9	1	RESISTOR 2.2K 5% .5W CC TC=0+647	01121	EB2225
R11	0687-6801	7	1	RESISTOR 68 10% .5W CC TC=0+412	01121	EB6801
R12	0698-5353	5	1	RESISTOR 8.25M 5% 1W CF TC=-2000/+250	28480	0698-5353
R13	2100-3148	9	1	RESISTOR-TRMR 2M 20% MG TOP-ADJ 1-TRN	28480	2100-3148
R14	0698-6442	5	1	RESISTOR 13M 5% 1W CF TC=-3500/+250	28480	0698-6442
R15	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R16	0698-5094	1	1	RESISTOR 5.1M 5% .25W FC TC=-900/+1100	01121	CB5155
R17	0683-2045	5	1	RESISTOR 200K 5% .25W FC TC=-800/+900	01121	CB2045
R20	0811-3050	7	1	RESISTOR .75 5% .5W PW TC=0+-150	75042	BW20-1-3/4-J
V1	2140-0028	2	2	LAMP-GLOW A9A-B 90/59VDC 700UA T-2-BULB	28480	2140-0028
V2	2140-0028	2		LAMP-GLOW A9A-B 90/59VDC 700UA T-2-BULB	28480	2140-0028
				MISCELLANEOUS PARTS		
	5040-0402	7	1	MOUNT, TRANSFORMER	28480	5040-0402
	5040-0430	1	1	MOUNT, TRANSFORMER	28480	5040-0430
	7120-6957	1	1	LABEL, INFO	28480	7120-6957

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

SERVICE GROUP 7
FRONT PANEL SERVICE GROUP

TABLE OF CONTENTS

Service Group — Page

7. FRONT PANEL SERVICE GROUP 8-7-1
   - 8-7-1. Introduction 8-7-1
   - 8-7-3. General Information 8-7-1
   - 8-7-5. Troubleshooting The Front Panel 8-7-1
   - 8-7-6. Removing The Front Panel For Service 8-7-1
   - 8-7-8. Troubleshooting The RPG (Rotary Pulse Generator) 8-7-2

LIST OF TABLES

Table — Page

8-7-1. Replaceable Parts 8-7-7

LIST OF ILLUSTRATIONS

Figure — Page

8-7-1. Detaching The Front Panel 8-7-2
8-7-2. Controls and Connectors 8-7-3/8-7-4
8-7-3. A11,A12 Front Panel Switches 8-7-5/8-7-6

FRONT PANEL SERVICE GROUP
SERVICE GROUP 7

8-7-1. INTRODUCTION.

8-7-2. The Front Panel electronics consist primarily of digital switches in push button or rotary form, latches, and buffers. The signals derived from the different switch positions are latched into buffers and interrogated by the Processor F(A7) over the I/O Bus approximately ten times a second. Analog signals are cabled from each front panel control to its respective board. Some of the analog signals pass through the mother board via a front mounted connector.

8-7-3. GENERAL INFORMATION.

8-7-4. Suspected Front Panel problems should be verified using the Internal Self Tests (Front Panel Test). These tests will check out the digital circuits and the Rotary Pulse Generator (RPG) which is connected to the N(A12) board. Analog controls may be troubleshot from the board end of the cables connected to the controls. Analog control cables connected to the Display High Voltage section (schematics L and M) may be carrying dangerous voltages capable of causing personal injury.

8-7-5. TROUBLESHOOTING THE FRONT PANEL.

8-7-6. Removing The Front Panel For Service.

8-7-7. The Front Panel switch electrical pins are accessible when the Front Panel is folded forward and down. Use the following procedure for removing the Front Panel.

a. Disconnect the power and place the instrument on one side.

b. Remove the four plastic feet and the instruction card holder.

c. Remove the plastic strips on the top and bottom of the front panel casting using a small flat bladed screwdriver (inserted into the slots at the rear of each strip) to pry them out. This will reveal the front panel securing screws.

d. Remove eight screws from the top and three screws from the bottom.

e. Place the instrument in the normal position with a piece of soft material before the Front Panel.

f. Carefully slide the Front Panel forward while swinging it down taking care that connecting cables do not bind (slide the main digital ribbon cable from beneath the plastic guard).

g. With the Front Panel folded down, remove four screws from the A12 board and carefully fold it forward (away from the instrument).

h. The instrument may now be reconnected to a power source and turned on for board level troubelshooting.

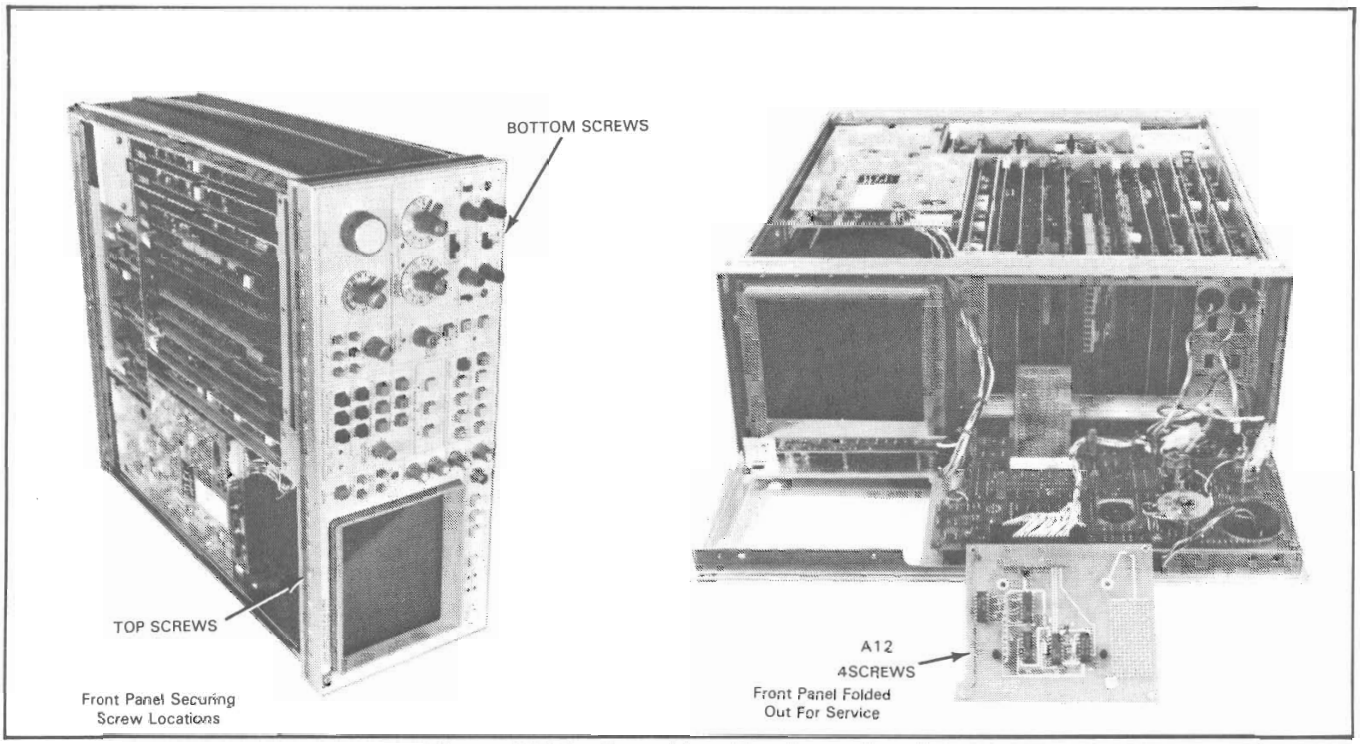


Figure 8-7-1. Detaching The Front Panel.

8-7-8. Troubleshooting The RPG (Rotary Pulse Generator).

8-7-9. The most typical failure mode of the RPG results in an inability to adjust the start or center frequency in the set start or set center modes. To check the entire A12 assembly and RPG, go through front panel self-test zero, described in Paragraph 8-7-10. If this test fails, remove the front panel and turn the instrument on. As the RPG is turned, pulses should appear at pins 1 and 3 (pins 1 and 3 should be complimentary signals). If no pulses appear, check for +5 on pin 4 and gnd on pin 5. If these are OK, the RPG is most likely at fault.

8-7-10. RPG Front Panel Self-Test. Initiate front panel self-test zero by pressing RESET while holding in average RESTART.

8-7-11. Condition codes 6 and 7 show the current RPG count and the most recent RPG increment, respectively. With the FREQUENCY MODE switch in the 0-25 kHz SPAN or 0 START positions these numbers should remain unchanged when the FREQUENCY ADJUST knob is turned. When the FREQUENCY MODE switch is in the SET START or SET CENTER positions, however, condition codes 6 and 7 should respond to the FREQUENCY ADJUST knob.

8-7-12. Condition code 6 RPG count, should count up or down as the FREQUENCY ADJUST knob is turned right or left, with limits on the RPG count of 000000 thru 061777 (octal).

8-7-13. Condition code 7, RPG increment, shows the most recent change in the RPG count, and it should be possible to see the values 000001, 000005, and 000036 while turning the FREQUENCY ADJUST knob right at low, medium, and high velocity, respectively.

Similarly, turning the FREQUENCY ADJUST knob left at low, medium, and high velocities should give RPG increments of 177777, 177773, and 177742, respectively. When the RPG count arrives at either of its limits, the RPG increment may be left with a value different from those listed above; but, otherwise, errors in the RPG increment indicate front panel malfunctions. In particular, negative increments while adjusting right, or positive increments while adjusting down indicate errors.

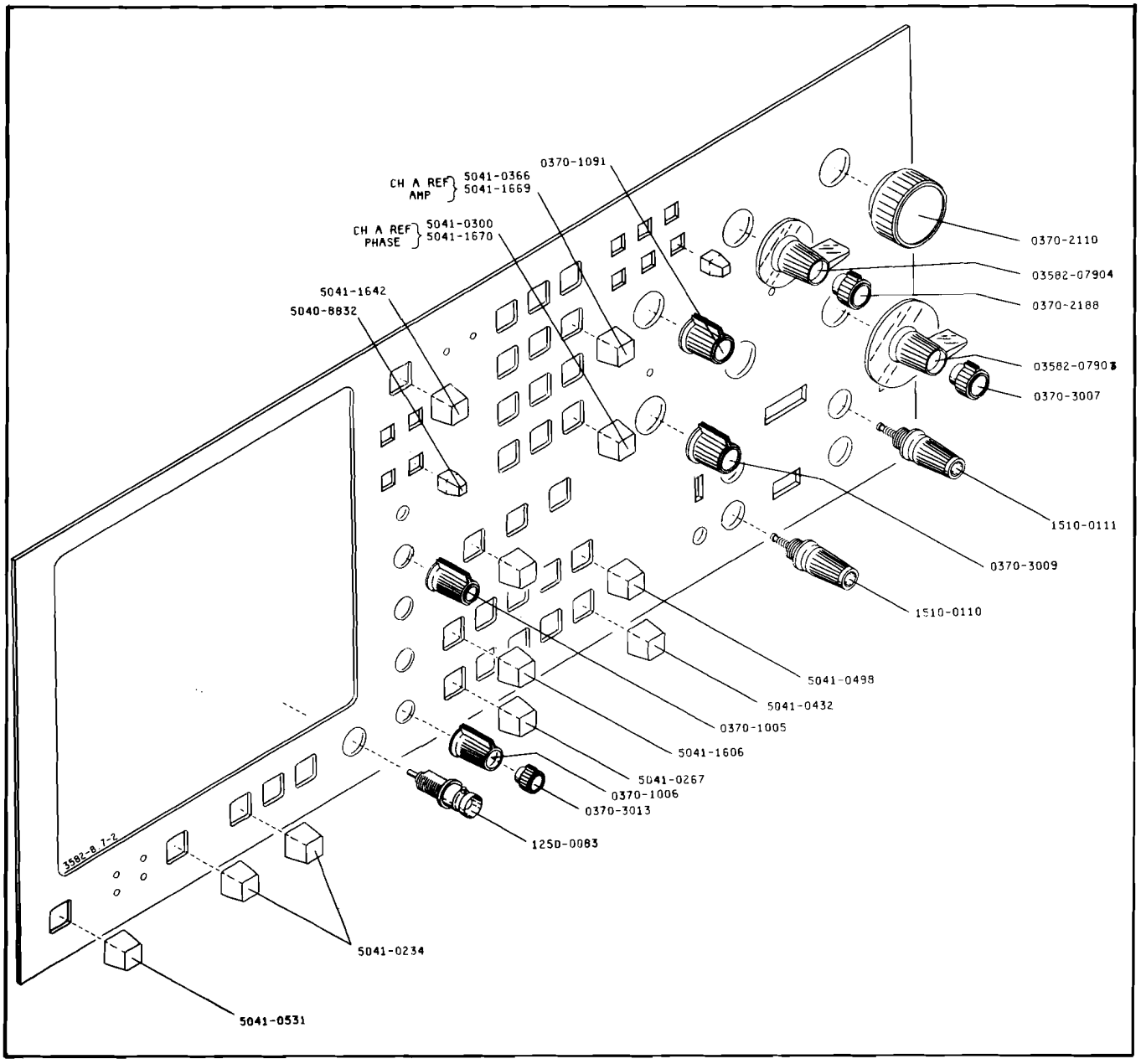
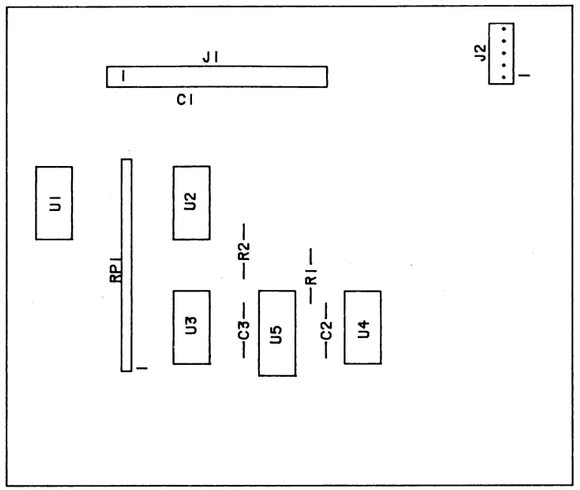
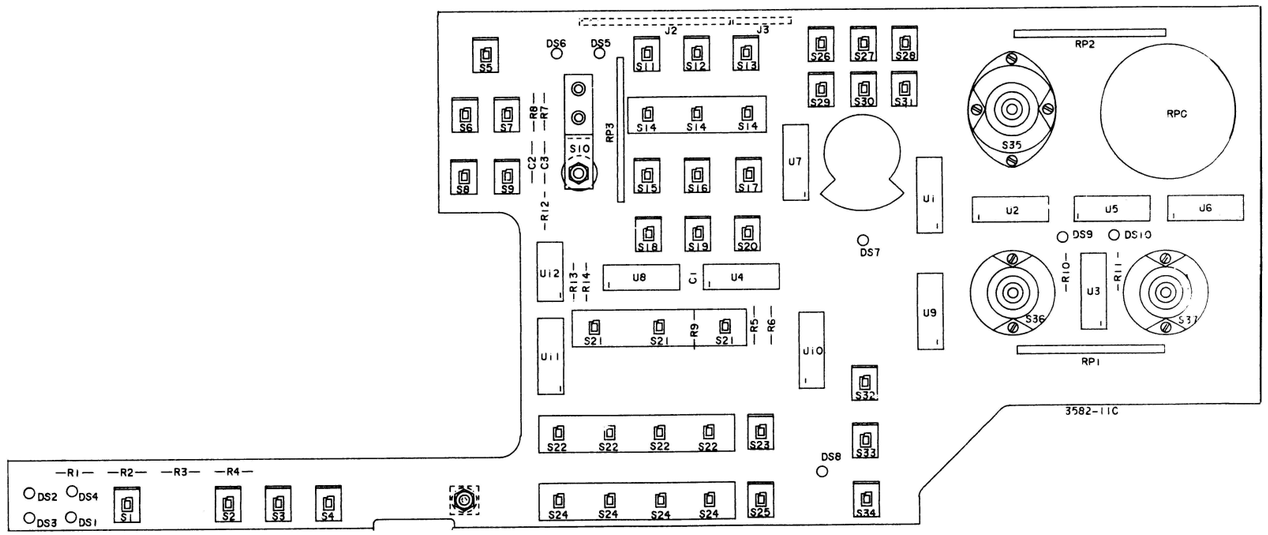


Figure 8-7-2. Controls and Connectors.

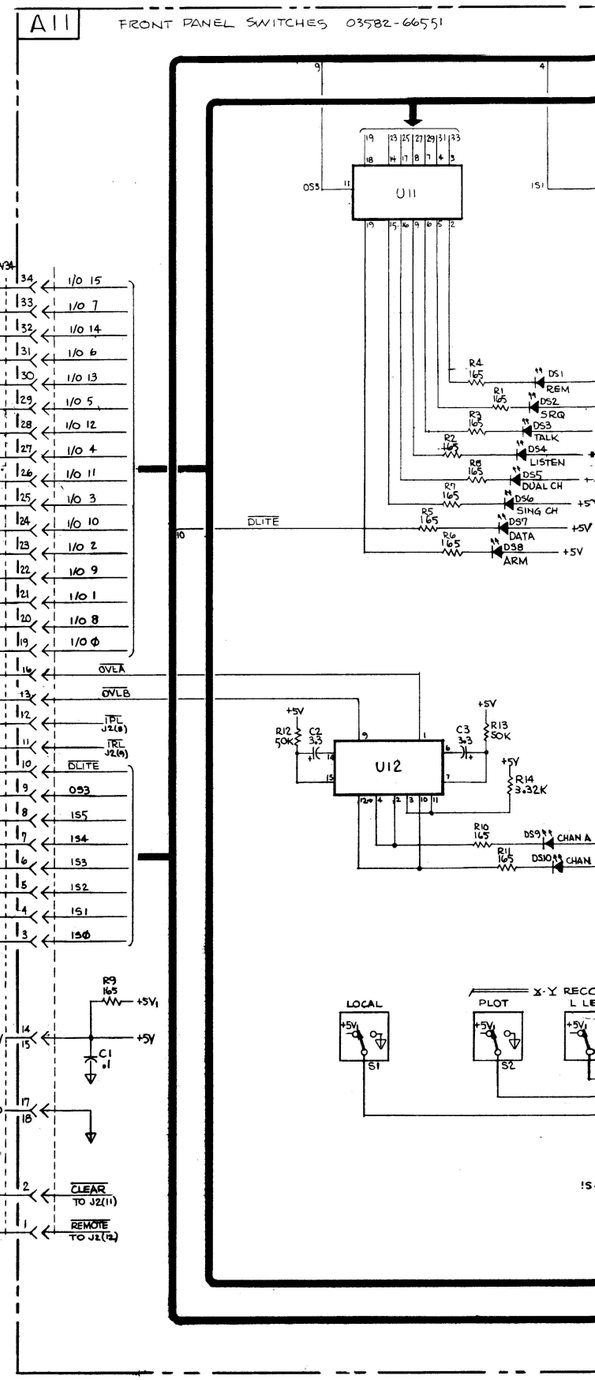


NOTE

—Marker Position Pot is on Schematic K
—Trigger Level Pot is on Schematic A
—Chassis isolate switch is on Schematic A
—DC Balance Pot is on Schematic A
—Noise Source Amplitude Pot is on Schematic P
—Intensity Pot is on Schematic M
—Focus Pot is on Schematic M
—Graticule Illumination Pot is on Schematic M
—Astigmatism Pot is on Schematic M

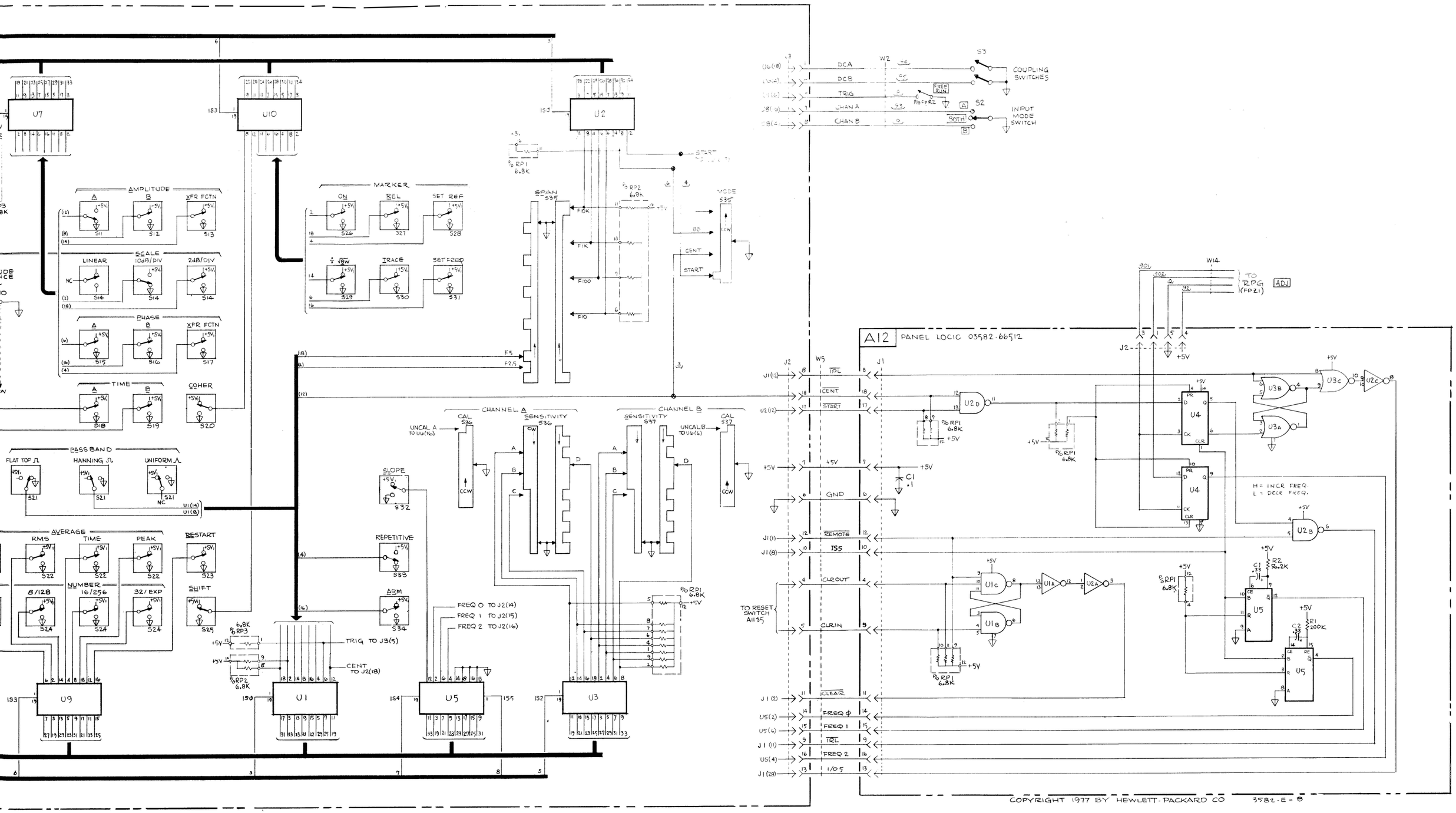


A51
03582-66551



A11 FRONT PANEL SWITCHES 03582-66451

W34
I/O 15
I/O 7
I/O 14
I/O 6
I/O 13
I/O 5
I/O 12
I/O 4
I/O 11
I/O 3
I/O 10
I/O 2
I/O 9
I/O 1
I/O 8
I/O Φ
OVLA
OVLB
TRL J2(8)
TRL J2(9)
BLITE
053
155
154
153
152
151
15Φ
+5V
GND
CLEAR TO J2(11)
REMOTE TO J2(12)
XA5B(2)
XA5B(6)
XA7B(17)
XA7B(T)
XA5B(C)
XA7B(N)
XA7B(5)
XA7A(19)
XA2A(14)
R9 165 +5V1
C1 .1
R12 50K
C2 33
R13 50K
C3 33
R14 3.32K
R10 165
R11 165
DS9 CHAN A OVLD
DS10 CHAN B OVLD
U12
U11
U8
U4
U7
U10
U2
U6
U9
U1
U5
U3
RP2 6.8K
CHAN B FROM J3(6)
CHAN A FROM J3(7)
RP3 6.8K
R4 165 DS1 REM
R1 165 DS2 SRQ
R3 165 DS3 TALK
R2 165 DS4 LISTEN
R5 165 DS5 DUAL CH
R7 165 DS6 SING CH
R8 165 DS7 DATA
R6 165 DS8 ARM
RESET
CURIN TO J2(1)
CUROUT TO J2(4)
S5
TRACE 1
STORE S6
RECALL S7
TRACE 2
STORE S8
RECALL S9
AMPLITUDE REFERENCE LEVEL
S10
CW
AMPLITUDE
A S11
B S12
XFR FCTN S13
SCALE
LINEAR S14
10dB/DIV S14
2dB/DIV S14
PHASE
A S15
B S16
XFR FCTN S17
TIME
A S18
B S19
COHER S20
PASS BAND
FLAT TOP S21
HANNING S21
UNIFORM S21
U1(14)
U1(8)
MARKER
ON S26
REL S27
SET REF S28
÷√8W S29
TRACE S30
SET FREQ S31
SPAN S35
MODE S35
FIK
F100
F10
F5
F2.5
START
CENT
BB
CCW
CHANNEL A
CAL S36
SENSITIVITY S36
UNCAL A TO U6(16)
CHANNEL B
SENSITIVITY S37
CAL S37
UNCAL B TO U6(6)
SLOPE S32
REPETITIVE S33
ARM S34
FREQ 0 TO J2(14)
FREQ 1 TO J2(15)
FREQ 2 TO J2(16)
TRIG TO J3(5)
CENT TO J2(18)
LOCAL S1
X-Y RECORDER
PLOT S2
L LEFT S3
U RIGHT S4
UNCAL B FROM CAL B SWITCH
UNCAL A FROM CAL A SWITCH
DCB TO J3(4)
DCA TO J3(1)
AVERAGE
OFF S22
RMS S22
TIME S22
PEAK S22
RESTART S23
4/64 S24
8/128 S24
NUMBER 16/256 S24
32/EXP S24
SHIFT S25
U6(18)
U6(4)
U1(6)
U8(16)
U8(4)
TO RESET SWITCH A11S5
J1(12)
U2(12)
J1(1)
J1(8)
J1(2)
U5(2)
U5(4)
J1(1)
U5(4)
J1(29)



N

Figure 8-7-3. A11,A12 Front Panel Switches.

Table 8-7-1. Replaceable Parts.

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
***A11	03582-66551	9	1	PC ASSEMBLY, FRONT PANEL	28480	03582-66551
C1	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C2	0180-0210	6		CAPACITOR-FXD 3.3UF+-20% 15VDC TA	56289	150D335X0015A2
C3	0180-0210	6		CAPACITOR-FXD 3.3UF+-20% 15VDC TA	56289	150D335X0015A2
DS1	1990-0487	7	8	LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	5082-4584
DS2	1990-0487	7		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	5082-4584
DS3	1990-0487	7		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	5082-4584
DS4	1990-0487	7		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	5082-4584
DS5	1990-0487	7		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	5082-4584
DS6	1990-0487	7		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	5082-4584
DS7	1990-0487	7		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	5082-4584
DS8	1990-0487	7		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	5082-4584
DS9	1990-0486	6		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	5082-4684
DS10	1990-0486	6		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	5082-4684
J1	A120-2622	0	1	CABLE-SHLD 18AWG 5-CNDCT JGK-JKT	28480	8120-2622
J2	1251-5039	9	1	CONNECTOR 18-PIN M PDST TYPE	22526	65500-118
J3	1251-4170	7	1	CONNECTOR 7-PIN M POST TYPE	28480	1251-4170
R1	0698-4415	8	11	RESISTOR 165 1% .125W F TC=0+-100	24546	C4-1/8-T0-165R-F
R2	0698-4415	8		RESISTOR 165 1% .125W F TC=0+-100	24546	C4-1/8-T0-165R-F
R3	0698-4415	8		RESISTOR 165 1% .125W F TC=0+-100	24546	C4-1/8-T0-165R-F
R4	0698-4415	8		RESISTOR 165 1% .125W F TC=0+-100	24546	C4-1/8-T0-165R-F
R5	0698-4415	8		RESISTOR 165 1% .125W F TC=0+-100	24546	C4-1/8-T0-165R-F
R6	0698-4415	8		RESISTOR 165 1% .125W F TC=0+-100	24546	C4-1/8-T0-165R-F
R7	0698-4415	8		RESISTOR 165 1% .125W F TC=0+-100	24546	C4-1/8-T0-165R-F
R8	0698-4415	8		RESISTOR 165 1% .125W F TC=0+-100	24546	C4-1/8-T0-165R-F
R9	0698-4415	8		RESISTOR 165 1% .125W F TC=0+-100	24546	C4-1/8-T0-165R-F
R10	0698-4415	8		RESISTOR 165 1% .125W F TC=0+-100	24546	C4-1/8-T0-165R-F
R11	0698-4415	8		RESISTOR 165 1% .125W F TC=0+-100	24546	C4-1/8-T0-165R-F
R12	0698-3228	9		RESISTOR 49.9K 1% .125W F TC=0+-100	28480	0698-3228
R13	0698-3228	9		RESISTOR 49.9K 1% .125W F TC=0+-100	28480	0698-3228
R14	0757-0433	8	2	RESISTOR 3.32K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3321-F
R15	2100-3685	9	2	RESISTOR-VAR W/SW 5K 10% LIN SPST-NO	28480	2100-3685
R16	2100-3685	9		RESISTOR-VAR W/SW 5K 10% LIN SPST-NO	28480	2100-3685
R17	2100-3737	2	1	RESISTOR-VARIABLE W/SW 5K OHM; +-10%	28480	2100-3737
RP1	1810-0049	7		NETWORK-RES 12-PIN-SIP .15-PIN-SPCG	28480	1810-0049
RP2	1810-0049	7		NETWORK-RES 12-PIN-SIP .15-PIN-SPCG	28480	1810-0049
RP3	1810-0049	7		NETWORK-RES 12-PIN-SIP .15-PIN-SPCG	28480	1810-0049
S1	3101-2272	1	12	SWITCH-PB SPDT MOM .25A 115VAC	28480	3101-2272
S2	3101-2272	1		SWITCH-PB SPDT MOM .25A 115VAC	28480	3101-2272
S3	3101-2272	1		SWITCH-PB SPDT MOM .25A 115VAC	28480	3101-2272
S4	3101-2272	1		SWITCH-PB SPDT MOM .25A 115VAC	28480	3101-2272
S5	3101-2189	9	1	SWITCH-PB DPDT MOM .125A 115VAC	28480	3101-2189
S6	3101-2272	1		SWITCH-PB SPDT MOM .25A 115VAC	28480	3101-2272
S7	3101-2124	2	16	SWITCH-PB DPDT ALTNG .25A 115VAC	28480	3101-2124
S8	3101-2272	1		SWITCH-PB SPDT MOM .25A 115VAC	28480	3101-2272
S9	3101-2124	2		SWITCH-PB DPDT ALTNG .25A 115VAC	28480	3101-2124
S10	3100-3433	6	1	SWITCH-RTRY SP9T-SS .562-DIA IDX-ANG=30	28480	3100-3433
S11	3101-2124	2		SWITCH-PB DPDT ALTNG .25A 115VAC	28480	3101-2124
S12	3101-2124	2		SWITCH-PB DPDT ALTNG .25A 115VAC	28480	3101-2124
S13	3101-2124	2		SWITCH-PB DPDT ALTNG .25A 115VAC	28480	3101-2124
S14	3101-2275	4	1	SWITCH-PB 3-STATION 15MM C-C SPACING	28480	3101-2275
S15	3101-2124	2		SWITCH-PB DPDT ALTNG .25A 115VAC	28480	3101-2124
S16	3101-2124	2		SWITCH-PB DPDT ALTNG .25A 115VAC	28480	3101-2124
S17	3101-2124	2		SWITCH-PB DPDT ALTNG .25A 115VAC	28480	3101-2124
S18	3101-2272	1		SWITCH-PB SPDT MOM .25A 115VAC	28480	3101-2272
S19	3101-2272	1		SWITCH-PB SPDT MOM .25A 115VAC	28480	3101-2272
S20	3101-2124	2		SWITCH-PB DPDT ALTNG .25A 115VAC	28480	3101-2124
S21	3101-2274	3	1	SWITCH-PB 3-STATION 20MM C-C SPACING	28480	3101-2274
S22	3101-2273	2	2	SWITCH-PB 4-STATION 15MM C-C SPACING	28480	3101-2273
S23	3101-2272	1		SWITCH-PB SPDT MOM .25A 115VAC	28480	3101-2272
S24	3101-2273	2		SWITCH-PB 4-STATION 15MM C-C SPACING	28480	3101-2273
S25	3101-2124	2		SWITCH-PB DPDT ALTNG .25A 115VAC	28480	3101-2124
S26	3101-2124	2		SWITCH-PB DPDT ALTNG .25A 115VAC	28480	3101-2124
S27	3101-2124	2		SWITCH-PB DPDT ALTNG .25A 115VAC	28480	3101-2124
S28	3101-2272	1		SWITCH-PB SPDT MOM .25A 115VAC	28480	3101-2272
S29	3101-2124	2		SWITCH-PB DPDT ALTNG .25A 115VAC	28480	3101-2124
S30	3101-2124	2		SWITCH-PB DPDT ALTNG .25A 115VAC	28480	3101-2124
S31	3101-2272	1		SWITCH-PB SPDT MOM .25A 115VAC	28480	3101-2272
S32	3101-2124	2		SWITCH-PB DPDT ALTNG .25A 115VAC	28480	3101-2124
S33	3101-2124	2		SWITCH-PB DPDT ALTNG .25A 115VAC	28480	3101-2124
S34	3101-2272	1		SWITCH-PB SPDT MOM .25A 115VAC	28480	3101-2272
S35	3100-3437	0	1	SWITCH-ROTARY 1,250 STRUT CTR SPCG; 14	28480	3100-3437
				***ON INSTRUMENTS PREFIXED 1747A - REMOVE NOISE LEVEL POT 2100-2588 FOR REV A.		

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

Table 8-7-1. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	CD	Qty	Description	Mfr Code	Mfr Part Number
S36	3100-3438	1	2	SWITCH-ROTARY 0.812 STRUT CTR SPCG; 10	28480	3100-3438
S37	3100-3438	1		SWITCH-ROTARY 0.812 STRUT CTR SPCG; 10	28480	3100-3438
U1	1820-1759	9	13	IC BFR TTL LS NON-INV OCTL	27014	DM81LS97N
U2	1820-1759	9		IC BFR TTL LS NON-INV OCTL	27014	DM81LS97N
U3	1820-1759	9		IC BFR TTL LS NON-INV OCTL	27014	DM81LS97N
U4	1820-1759	9		IC BFR TTL LS NON-INV OCTL	27014	DM81LS97N
U5	1820-1759	9		IC BFR TTL LS NON-INV OCTL	27014	DM81LS97N
U6	1820-1759	9		IC BFR TTL LS NON-INV OCTL	27014	DM81LS97N
U7	1820-1759	9		IC BFR TTL LS NON-INV OCTL	27014	DM81LS97N
U8	1820-1759	9		IC BFR TTL LS NON-INV OCTL	27014	DM81LS97N
U9	1820-1759	9		IC BFR TTL LS NON-INV OCTL	27014	DM81LS97N
U10	1820-1759	9		IC BFR TTL LS NON-INV OCTL	27014	DM81LS97N
U11	1820-1997	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG PRL-IN	34335	SN74LS374PC
U12	1820-0579	9	1	IC MV TTL MONOSTBL RETRIG DUAL	01295	SN74123N
U34	1820-2621			CABLE ASSY: PINK RIBBON	28480	1820-2621
				MISCELLANEOUS PARTS		
	03582-01213	4	1	BRACKET, SWITCH	28480	03582-01213
	03582-61628	1	2	CABLE ASSEMBLY, VERNIA	28480	03582-61628
	03582-61636	1	1	CABLE ASSEMBLY, NOISE SWITCH	28480	03582-61636
	5040-8832	3	10	PUSHBUTTON, SQUARE(MARKER 7 TRACE STORE)	28480	5040-8832
	5041-0234	5	4	KEY CAP, S1-S4	28480	5041-0234
	5041-0267	4	12	KEY CAP, PEARL GRAY	28480	5041-0267
	5041-0300	6	5	PUSHBUTTON, 1/4, PTY GRAY (S15, 16, 18-20)	28480	5041-0300
	5041-0366	4	5	KEY CAP, 1/4, SMOKE GRAY (S11, 12, 14)	28480	5041-0366
	5041-0432	5	1	KEY CAP, SEA BLUE (SHIFT)	28480	5041-0432
	5041-0498	3	1	KEY CAP, GREEN (RESTART)	28480	5041-0498
	5041-0531	5	1	KEY CAP, POWER SWITCH	28480	5041-0531
	5041-1606	7	2	KEY CAP, PEARL GRAY (FRAMED)	28480	5041-1606
	5041-1642	1	1	KEY CAP, SWITCH POT, (RESET)	28480	5041-1642
	5041-1669	2	1	KEY CAP, SMOKE GRAY (CH A REF AMP)	28480	5041-1669
	5041-1670	5	1	KEY CAP, PTY GRAY (CH A REF PHASE)	28480	5041-1670

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

Table 8-7-1. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				KNOBS:		
	0370-1005	2	1	KNOB, AMPLITUDE REF LEVEL	28480	0370-1005
	0370-1006	3	1	KNOB, PERIODIC/RANDOM	28480	0370-1006
	0370-3013	6	1	KNOB, NOISE SOURCE LEVEL (FOR S/N PREFIX 1747A, ORDER P/N 1005)	28480	0370-3013
	0370-3009	0	1	KNOB, TRIG LEVEL	28480	0370-3009
	0370-2188	4	1	KNOB, FREQUENCY MODE	28480	0370-2188
	0370-1091	6	1	KNOB, MARKER POSITION	28480	0370-1091
	0370-3007	8	2	KNOB, AMPLITUDE VERNIER	28480	0370-3007
	0370-2110	2	1	KNOB, ADJUST	28480	0370-2110
	03582-07904	2	1	KNOB, FREQUENCY SPAN	28480	03582-07904
	03582-07903	1	2	KNOB, INPUT SENSITIVITY	28480	03582-07903
	0370-2383	1		KNOB-BASE-PTR 3/8 JGK .125-IN-ID (INTENSITY, FOCUS, GRAT. ILLUM)	28480	0370-2383

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

Table 8-7-1. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
	03582-61620	3	3	ROTARY PULSE GENERATOR W/CABLE	28480	03582-61620
A12	03582-66512	2	1	PC ASSEMBLY, RPG	28480	03582-66512
C1	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C2	0180-0195	6	2	CAPACITOR-FXD .33UF+-20% 35VDC TA	56289	150D334X0035A2
C3	0180-0195	6		CAPACITOR-FXD .33UF+-20% 35VDC TA	56289	150D334X0035A2
J1	1251-5254	0	1	CONNECTOR 18-PIN M POST TYPE	28480	1251-5254
J2	1251-5253	9	1	CONNECTOR 5-PIN M POST TYPE	28480	1251-5253
R1	0757-0472	5	1	RESISTOR 200K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2003-F
R2	0757-0459	8	2	RESISTOR 56.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5622-F
RP1	1810-0049	7	4	NETWORK-RES 12-PIN-SIP .15-PIN-SPCG	28480	1810-0049
U1	1820-1202	7	2	IC GATE TTL LS NAND TPL 3-INP	01295	SN74LS10N
U2	1820-1198	0		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS03N
U3	1820-1144	6	7	IC GATE TTL LS NOR QUAD 2-INP	01295	SN74LS02N
U4	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74N
U5	1820-1423	4	3	IC MV TTL LS MONOSTBL RETRIG DUAL	01295	SN74LS123N
				MISCELLANEOUS PARTS		
	0380-1229	3		STANDOFF-HEX 1-IN-LG 6-32 THD	14480	ORDER BY DESCRIPTION
	**0380-1122	5	2	SPACER-SNAP-IN .250 LG; FOR .156 DIA	28480	0380-1122
	03582-01217	8	1	PLASTIC CABLE CLAMP	28480	03582-01217
	0380-1228	2		STANDOFF-HEX .562-IN-LG 6-32 THD	14480	ORDER BY DESCRIPTION
	0380-1229	3		STANDOFF-HEX 1-IN-LG 6-32 THD	14480	ORDER BY DESCRIPTION
				**SPACER 0380-1122 HOLDS PLASTIC CABLE CLAMP 03582-01217 TO A12 BOARD.		

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

Table 8-7-1. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				FRONT PANEL MOUNTED COMPONENTS		
FPC1	0160-3622	8	2	CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
FPR1	2100-2862	2	1	RESISTOR-VAR PREC WW 10-TRN 10K 5% (POS POT)	28480	2100-2862
FPR2	2100-2924	7	1	RESISTOR-VAR W/SW 10K 20% LIN SPST-NO (TRIGGER)	28480	2100-2924
FPR3	2100-3687	1	1	RESISTOR-VAR CONTROL CCP 50K 20% LIN (ASTIG)	28480	2100-3687
FPR4	2100-3716	7	1	RESISTOR-VAR W/SW 20K 10% LIN SPST-NC (INTEN)	28480	2100-3716
FPR5	03582-61608	7	2	RESISTOR, VAR 5MEGOHM,FOCUS W/CABLE	28480	03582-61608
FPR6	2100-2083	9	1	RESISTOR-VAR CONTROL CCP 20K 20% LIN (GRAT ILLUM)	28480	2100-2083
FPR7	2100-3848	6	2	RESISTOR-VAR CONTROL CCP 500 20% LIN (DC BAL)	11237	VA305
***FPR8	2100-2588	9		RESISTOR-VAR W/SW 10% 10CW SPST NO (NOISE LVL)	28480	2100-2588
FPS1	3101-1235	4	1	SWITCH-SL DPDT-NS STD 1.5A 125VAC (ISOL/CHAS)	28480	3101-1235
FPS2	3101-0106	6	1	SWITCH-SL DPST-NS STD .5A 125VAC/DC (INPUT MODE)	28480	3101-0106
FPS3	3101-0199	7	2	SWITCH-SL DPDT-NS MINTR .5A 125VAC/DC (COUPLING A)	28480	3101-0199
FPZ1	03582-61620	3	1	ROTARY PULSE GENERATOR (INCLUDES CABLE) NOTE: FPZ1 NOT INCLUDED WITH A12 ASSY	28480	03582-61620
				FRONT PANEL MOUNTED COMPONENTS		
MP1	03582-00212	1	1	PANEL, FRONT-SUB	28480	03582-00212
**MP11	03582-00222	3	2	PANEL, FRONT	28480	03582-00222
	7120-1254	1		NAMEPLATE .312-IN-WD .54-IN-LG AL	28480	7120-1254

***FOR SERIAL NO PREFIXED 1747A-ONLY. FOR LATER INSTRUMENTS POT IS PART OF A11(03582-66551) ASSY.

**ORIGINAL PANEL ON INSTRUMENTS PREFIXED 1747A- ARE NOT AVAILABLE. USE PART NO. 03582-00221.

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

Table 8-7-1. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				FRONT PANEL, MISCELLANEOUS		
	03580-24707	7	3	SPACER, POT	28480	03580-24707
	5040-8104	2	10	LIGHT PIPE	28480	5040-8104
	1510-0110	7	2	BINDING POST ASSY SGL SGL-TUR JGK BLK	28480	1510-0110
	2950-0144	0	2	NUT-HEX-DBL-CHAM 3/8-32-THD .188-IN-THK	28480	2950-0144
	1510-0111	8	2	BINDING POST ASSY SGL SGL-TUR JGK RED	28480	1510-0111
	03582-20601	4	4	SHIELD, NUT (MP12)	28480	03582-20601
	1250-0083	1		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0083
	1410-0069	3	4	BUSHING-PNL .128-ID .343-LG 1/4-32-THD	28480	1410-0069

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

SERVICE GROUP 8

HP-IB

TABLE OF CONTENTS

Service Group — Page

8. HP-IB 8-8-1
   - 8-8-1. Introduction 8-8-1
   - 8-8-3. General Information 8-8-1
   - 8-8-5. Troubleshooting The HP-IB Board 8-8-1
   - 8-8-6. Installation of HP-IB Board 8-8-1
   - 8-8-7. Troubleshooting Procedures 8-8-1
   - 8-8-10. Blinking Light Test 8-8-2

LIST OF TABLES

Table — Page

8-8-1. SA Test 1 Overall Test With Program Branching 8-8-3
8-8-2. SA Test 2 General SA Test 8-8-4
8-8-3. SA Test 3 8-8-6
8-8-4. SA Test 4 8-8-7
8-8-5. SA Test 5 - Read Switch Test 8-8-8
8-8-6. SA Test 6 Interrupt Test 8-8-8
8-8-7. Front Panel I/O Bus Test 8-8-9
8-8-8. HP-IB Interconnections 8-8-9
8-8-9. Mnemonic Dictionary 8-8-10
8-8-10. Line Functions 8-8-10
8-8-11. HP-IB Troubleshooting Hints ... 8-8-11/8-8-12
8-8-12. Replaceable Parts 8-8-15

LIST OF ILLUSTRATIONS

Figure — Page

8-8-1. HP-IB Block Diagram 8-8-13/8-8-14

HP-IB
SERVICE GROUP 8

8-8-1. INTRODUCTION.

8-8-2. The HP-IB board provides an isolated link between the Processor and the HP-IB connector. Bus protocol is handled by a nanoprocessor which also sequences the operation of devices and circuits on the board through the data/instruction bus, device select, and direct control outputs. The HP-IB board communicates with the Processor using an interrupt scheme. The Processor F(A7) controls the HP-IB board by entering commands through the command register.

8-8-3. GENERAL INFORMATION.

8-8-4. The HP-IB board is the only board which may be removed from the instrument allowing full manual control to continue. Thus, if processor problems are suspected, try removing the HP-IB board from the instrument. This will help to eliminate I/O Bus problems where one or more lines may be held low, possibly resulting in an inability to enter a Front Panel Self-Test. Operation of the board is dependent on a clock signal from the Timing board C(A3). The HP-IB board has its own internal self-test loops in addition to Signature Analysis (SA).

8-8-5. TROUBLESHOOTING THE HP-IB BOARD.

8-8-6. Installation of HP-IB Board.

a. Install the board and check the following:

1. + 12 V at XA2A(18)
2. − 18 V at XA2B(18)
3. + 5 V at XA2A(17)
4. 4 MHz clock at XA2B(N)

b. Adjust V_{BG} at TP3 with the pot to the voltage marked on U16 (± .2 V).

8-8-7. Troubleshooting Procedures.

8-8-8. The first thing to do if there are problems associated with remote operation is to run the Blinking Light Test. If the A2 board passes this test, the board is OK and the problem is probably with the processor. Check that the FLG and STS lines to the processor aren't being held low and use the front panel I/O bus test to check the bus lines from the processor (details are given on the last page of this section).

8-8-9. If the board fails the Blinking Light Test, go to SA Test 1. This test runs through the test program until an error is detected and then branches to the end. This is in order to retain a signature characteristic of the error. If it passes this test, check the LED. If it fails, go to Test 2. This is the same as Test 1 except that it doesn't branch to the end on an error, allow-

ing SA troubleshooting. There are SA flow charts following this test that follow data flows. If the board fails the initial check of Test 2, the test program is wrong and the following tests check out the processor and instruction ROM.

NOTE

For each test, the board is preset by momentarily shorting TP1 to ground. If you get a wrong signature, preset the board again and recheck.

NOTE

Be sure NO HP-IB cable is connected to the rear panel.

8-8-10. Blinking Light Test.

a. Set the HP-IB address to 101_8. (1000001)
b. Preset the board by momentarily shorting TP1 to ground.
c. A blinking light indicates the board is OK. If the light doesn't blink, go to SA Test 1.

Table 8-8-1. SA Test 1 Overall Test With Program Branching.

Address switch = 101_8

SA Test Jack J1

Clock J1(3)

Start J1(4)

Stop J1(5)

Preset board by momentarily shorting TP1 to ground and *disconnect the HP-IB cable.*

Check the SA signature at +5 V. Should be 9C81. A correct signature at this point indicates the test ROM is generating the right test program which should make the light blink. If it is not blinking, check the LED itself. If the SA signature checks bad, check J1(4) and J1(5). If the lines are static go to SA Test #3 otherwise go to the SA Test 1 Trouble Table and attempt to localize the trouble. Then continue with SA Test 2 to pinpoint the trouble.

SA Test 1 Trouble Table

Code	Possible Trouble
9515	U16(37) signal.
5159	U16(37) signal.
159A	U16(32) signal.
59A4	U16(32) signal.
6929	U16(33) signal.
29F3	U16(36), U16(35), U16(31) signals.
70FC	U16(36) shorted to ground.
32HF	U16(35) shorted to ground.
29F3	U16(31) shorted to ground.
70HA	U16(36), U16(35), U16(31) signals.
3696	U16(36), U16(35), U16(31) signals.
ASC1	U9(6), U1(8), U1(3), to Data Bus or Device Select to U24(13), U3(1).
H6PC	Received wrong data thru Bus; Data Latch U5, U6.
6PCP	Received wrong data thru Bus Control Latch U23, U8, U9, U38, U39, U21, U22, U26, U27.
PCP5	Received wrong data thru BPC - Data Latch U30.
UP64	Error in EOI line.
593A	Error in ATN line.
4PC7	Error in REN line.
H5H8	Same as H6PC; U35.
5H82	Same as PCP5; U30.
OAU9	Error in REMOTE line; not necessarily in "REN".
U9H5	Same as 6PCP.
C45H	Error in IMD not floating bus lines.
66PO	Same as H6PC.
PFHF	No ATN interrupt.

Table 8-8-2. SA Test 2 General SA Test

(Same as Test 1 without branching)

Address switch = 104_8

SA Test Jack J1

Clock J1(3) ⌐¯

Start J1(4) ⌐¯

Stop J1(5) ¯⌐

Preset board by momentarily shorting TP1 to ground.

Check the SA signatures at +5 V and at U16(1). These should be UHC8 and FUU5 respectively.

If either signature checks bad, a wrong test program is being generated. Continue with SA Test 3 in this case.

If both signatures check OK, pinpoint the trouble by using the SA signatures given as follows:

Flow Chart 1: Bus Buffers → Isolation Circuits → Processor

(Test Jack J1)

U36(14)	CU99	U36(13)	CU99	U35(2)	4221	U35(3)	187A	U16(1)	FUU5
10	9592	11	9592	5	682A	4	810A	2	5A86
6	P3U9	5	P3U9	6	1P41	7	14HH	3	33P6
2	65A0	3	65A0	9	9819	8	P3C1	4	1U6H
U37(14)	A5F7	U37(13)	A5F7	12	587U	13	UU63	5	4HU6
10	P850	11	P850	15	15P8	14	POU1	6	F615
6	OU57	5	OU57	16	U2PU	17	6HP4	7	4470
2	372H	→ 3	372H	→ 19	FAC5	18	A4PC	8	0000
U38(14)	FF06	U38(13)	FF06	U21(3)	1A00	→ U27(7)	980F	→ 9	4FU4
10	0369	11	3UUH	6	F377	9	7UUC	26	AC6A
6	HU6C	5	P3UU	11	CUP2	11	F7UU	31	980F
2	2694	3	1A00	14	C306	U28(10)	7UPO	32	7UPO
U39(14)	F377	U39(13)	F377	U27(1)	FF06	U21(4)	UU63	33	UHC8
10	CUP2	11	CUP2	14	3UUH	5	POU1	34	UHC8
6	C306	5	C306	13	P3UU	12	187A	35	F7UU
2	UHC8	3	UHC8	2	1A00	13	6HP4	36	7UUC
U40(15)	3F94	U40(13)	F377					37	38CU
		14	F12F						

Table 8-8-2. SA Test 2 General SA Test (Cont'd).

Flow Chart 2: I/O Bus ← I/O Buffers ← Processor

(Test Jack J1)

U32(3)	UHUC	U32(2)	0884	U33(3)	187A
5	799C	4	AOAA	4	810A
7	C771	6	7905	7	14HH
9	458C	8	6060	8	P3C1
17	A192	18	61UF	18	UU63
15	424H	16	57A1	17	POU1
13	8CO6	14	FCCH	14	6HP4
11	U8HA	12	C113	13	A4PC

Flow Chart 3: Device Select

(Test Jack J1)

U4(15)	P6A8			U4(1)	H47U
14	44AF			2	1C5H
13	7C13			3	CC95
12	9U3A			4	8AHU
11	H519			5	0000
10	91U8			U16(16)	7039
U23(12)	7F68	U23(3,5)	14FP		
9	POC5	10,14	6165		
7	3H61				
4	H417				

Flow Chart 4: Incomming Buffer and Isolation Circuits

Address switch = 104_8

This test writes out through U35 and back through the buffers and isolation circuits, allowing SA testing.

Clk: U16(16) ⎍

Start: U16(9) ⎍

Stop: U16(9) ⎏

Preset Board + 5 Signature 3395

U5(2)	H966	U36(15)	H966	U25(10)	PAU3
3	F8FU	9	8PFC	8	CH5P
5	8PFC	7	043P	6	37AC
6	919A	1	C560	4	86U5
		U37(15)	434C		
11	043P			U26(10)	70HP
		9	3H8P		
10	4823			8	OP1C
		7	3256		
14	C560			6	01F3
		1	33A9		
13	3395	U38(7)	F8FU	4	003F
U6(2)	434C	9	919A	U27(11)	F8FF
3	97H6	15	4823	9	9199
5	3H8P	1	P910	7	4823
		U39(15)	97H6		
6	99FH			5	P913
		9	733P		
11	3256			U28(10)	0003
		7	980P		
10	980P				
		1	3395		
14	33A9				
13	P910				

Table 8-8-3. SA Test 3.

Remove U34

Verify that U16(29) is high; a low level at this pin means that the nanoprocessor is constantly being interrupted due to a DC level problem. Check the interrupt circuitry to determine what holds U16(29) low.

Check for a clock signal at J2(4); the absence of a signal indicates a nanoprocessor problem.

Address = 100_8

SA Test Jack J2

Clock J2(3) ⊓

Start J2(4) ⊓

Stop J2(5) ⊔

+5 Signature 7A70

Check for following signatures:

U16 pin	1	C21A
pin	2	HA07
pin	3	HOAA
pin	4	P030
pin	5	4442
pin	6	4U2A
pin	7	0772
pin	8	9635
pin	9	1734
pin	10	8P54
pin	11	0000
+5V		7A70

U16 pins 17,26,28,30,33,38 all zero

U16 pins 12-40 except above, all ones (7A70)

U15 pin	9	COC8
pin	10	3UP7
pin	11	9507
pin	13	CC96
pin	14	24HC
pin	15	5H44
pin	16	429F
pin	17	6PUA

Change addess to 000_8. (0000000)

Check for following signatures:

U15 pin	9	UAU6
pin	10	HOPU
pin	11	U255
pin	13	4AF2
pin	14	UAU7
pin	15	7412
pin	16	PUPP
pin	17	U6A5

If any of the signatures are bad, the problem is either the ROM or the nanoprocessor.

If all signatures are OK, continue with SA Test 4.

Insert U34

Table 8-8-4. SA Test 4.

Address = 177_8 (1111111)

SA Test Jack J3

Clock J3(3) ⌐¯
Start J3(4) ⌐¯
Stop J3(5) ¯⌐

Check that U16(29) is high
Preset board

Check for the following correct signatures:

+5 V----------UP73

U16	pin	1	55H2	U16	pin	10	UP73
	pin	2	334H		pin	11	0
	pin	3	OU16		pin	18	UP73
	pin	4	OOUP		pin	19	UP73
	pin	5	0		pin	20	UP73
	pin	6	UP73		pin	21	UP73
	pin	7	UP73		pin	22	UP73
	pin	8	0		pin	23	UP73
	pin	9	UP73		pin	24	UP73
					pin	25	UP73
					pin	34	UP70

SA Test Jack J1

Clock J1(3) ⌐¯
Start J1(4) ⌐¯
Stop J1(5) ¯⌐

Preset board

Check for the following correct signatures:

+5 V----------P545

U16	pin	29	P545				
U4	pin	1	3H3C	U4	pin	9	U1P7
	pin	2	5077		pin	10	C7FF
	pin	3	F203		pin	11	AU61
	pin	4	FC24		pin	12	FHH7
	pin	5	0		pin	13	470P
	pin	6	P545		pin	14	6F69
	pin	7	PO6H		pin	15	F1U6
	pin	8	0		pin	16	P545
U23	pin	1	4PP7	U23	pin	9	U1PU
	pin	2	P545		pin	10	U1P7
	pin	3	PO6H		pin	11	P545
	pin	4	PO6U		pin	12	P54H
	pin	5	PO6H		pin	13	P545
	pin	6	P545		pin	14	U1P7
	pin	7	P547		pin	15	0
	pin	8	0		pin	16	P545

If all signatures checked OK, continue with DSA Test 5.

Table 8-8-5. SA Test 5 - Read Switch Test

Address = 100_8 (1000000)
Preset board - light should go off
Check that U16(29) is high
Check that U16(34) is pulsing

SA Test Jack J1

Clock J1(3) ⎍⎾
Start J1(4) ⎍⎾
Stop J1(5) ⏋⎽

Preset board again and check signature at +5V which should be 03U9.

If this is OK, continue with SA Test 6.

If bad, check address switch and U22.

Table 8-8-6. SA Test 6 Interrupt Test.

Address = 102_8 (1000010)

SA Test Jack J1

Clock J1(3) ⎍⎾
Start J1(4) ⎍⎾
Stop J1(5) ⏋⎽

Check Signature at + 5V which should be 9FA8.

If bad, check interrupt hardware U10, U12, U8, U9.

If signature is OK, repeat SA Test 2.

If SA Test 2 fails to find problem, the board cannot be fixed by SA testing.

Table 8-8-7. Front Panel I/O Bus Test.

This test checks the I/O bus lines from the processor. Do this test only if the board passes the Blinking Light Test and you are having bus problems that aren't external.

Put HP-IB address to 013_8

Select I/O Bus Test #6

(Front panel self-test, Ave #256, *then* short A7 J4 and push RESTART).

Clk: 036 [U8(13)] ⌐¬ 0000

Start/Stop: I/O #7 [U32(11)] ¬⌐ 01UF

+5 Signature: UFP6

I/O 7	U30(13)	01UF	U30(12)	026C
6	14	03U9	15	0369
5	17	07U3	16	016F
4	18	OUP7	19	0566
3	8	1UFP	9	OH72
2	7	3U9F	6	1H5C
1	4	7U39	5	3H09
0	3	UP73	2	7HAF

Table 8-8-8. HP-IB Interconnections.

Function	XA2B	A20 (cable conn)	Wire Color	HP-IB Conn Pin
Data				
DIO1	3	X9(4)	90	1
DIO2	C	X9(1)	91	2
DIO3	B	X9(10)	92	3
DIO4	2	X9(3)	93	4
DIO5	5	X9(7)	903	13
DIO6	E	X9(9)	904	14
DIO7	D	X9(5)	905	15
DIO8	4	X9(6)	906	16
Handshake				
DAV	H	X8(5)	95	6
NRFD	7	X8(10)	96	7
NDAC	6	X8(8)	97	8
Management				
EOI	F	X9(8)	94	5
IFC	J	X8(3)	98	9
SRQ	K	X8(1)	901	10
ATN	9	X8(12)	902	11
REN	8	X9(11)	907	17
Grounds				
**	1,A	X8(2,4,6,7,9,11)	0	18-23
SHIELD	17,U	X9(12)	0	12
SIGNAL GROUND	1,A	X9(2)	0	24

**NOTE - Unused lines of twisted pairs are grounded.

Table 8-8-9. Mnemonic Dictionary.

Code	Definition
ATN	Attention
DAV	Data Valid
DØ-D7	Data I/O
DCØ-DC6	Direct Control
DSØ-DS3	Device Select
ENA	Interrupt Enable
EOI	End or Identify
IFC	Interface Clear
IMD	Interface Multiplex Data
INT ACK	Interrupt Acknowledge
PG	Program Gate
PAØ-PA10	Program Rom Address
PDAC	Peripheral Data Accepted
PDAV	Peripheral Data Valid
PFLG	Peripheral Flag
PREN	Peripheral Remote Enable
PRFD	Peripheral Ready For Data
PSTS	Peripheral Status
PWRCL	Power Up Clear
PWRINT	Power Up Interrupt
R/W	Read/Write Select
REN	Remote Enable
REQ	Interrupt Request
RFD	Ready For Data
RCCR	Read Computer Command Register
RCOD	Read Computer Output Data
RIBA	Read Interface Binary Address
RIBC	Read Interface Binary Control
RIBD	Read Interface Binary Data
SCID	Send Computer Interface Data
SIBC	Send Interface Binary Control
SIBD	Send Interface Binary Data
TSTSTB	Tri-state, Tri-state to Buffer
Vbg	Back Gate Voltage Bias
WCCR	Write Computer Command Register
WIRR	Write Interface Remote Register

Table 8-8-10. Line Functions.

Line	Definition
STATUS	Tells the computer the peripheral is OK and running.
FLG	Tells the computer the peripheral is busy processing data or is ready for a data transfer.
IOB15	Tells computer when remote is initiated.
IOB9	Tells computer when the HP-IB board is in place.
CLEAR	Causes the computer to initiate a power up turn on sequence.
PFLG	Tells the Nanoprocessor that a data transfer is complete
D1	Tells Nanoprocessor whether computer is reading or writing.
D2-D3	Tells Nanoprocessor the type of Data coming down the I/O Bus.

Table 8-8-11. HP-IB Troubleshooting Hints.

1. Always check power supply voltages and back gate bias (Vbg) voltage on nanoprocessor.

   a. A misadjusted Vbg can cause:

      (1) Failure after warm-up (too high).

      (2) Relays on A1 board to clatter and processor to run erratically (too low).

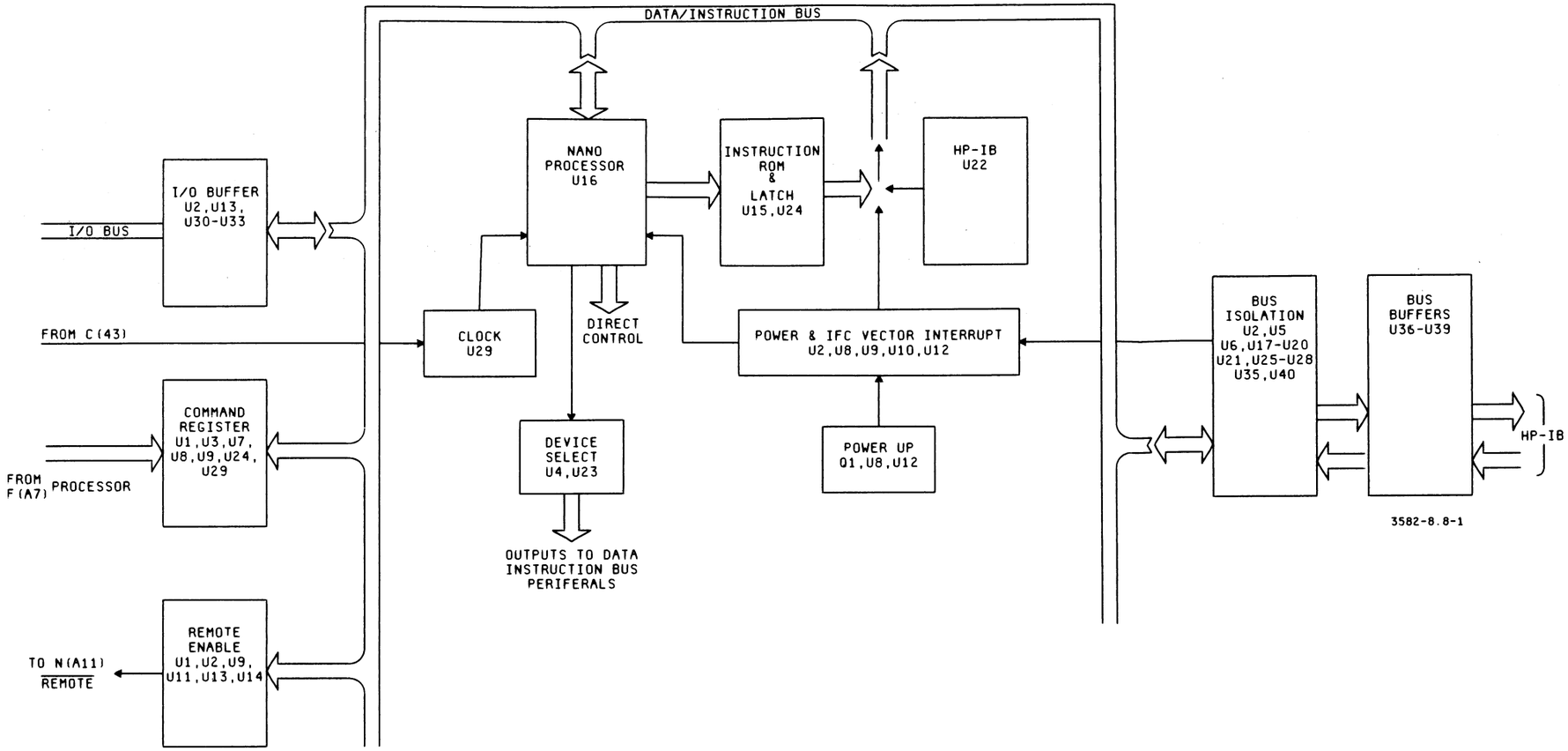
   b. An inability to adjust Vbg (usually less than .6V) may indicate a bad nanoprocessor.

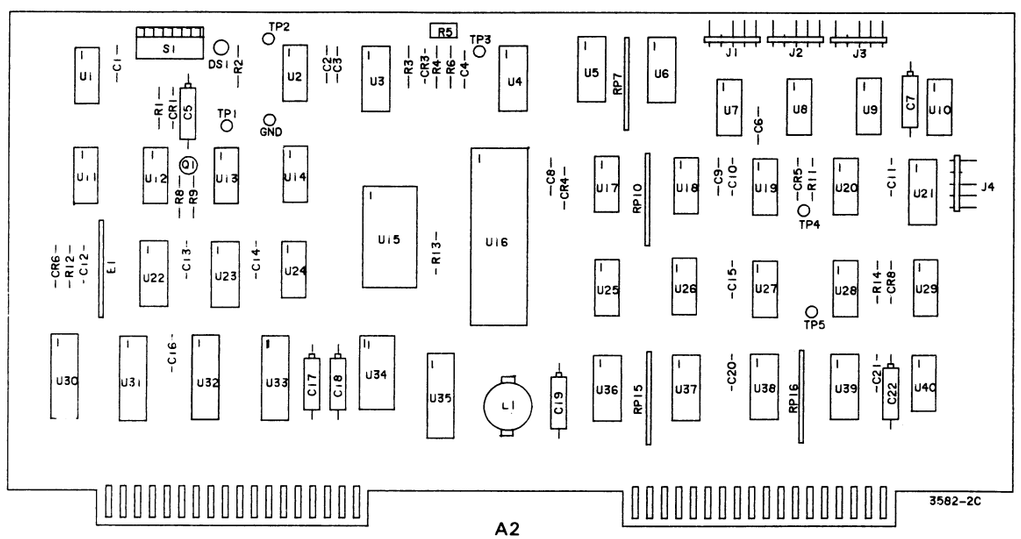
2. Some resistor packs were installed and soldered into the board and appear to be bent over. These resistor packs may function correctly; however, do not straighten them up as broken traces may result.

3. If the blinking light test passes, but bus problems persist, check inverter U2D.

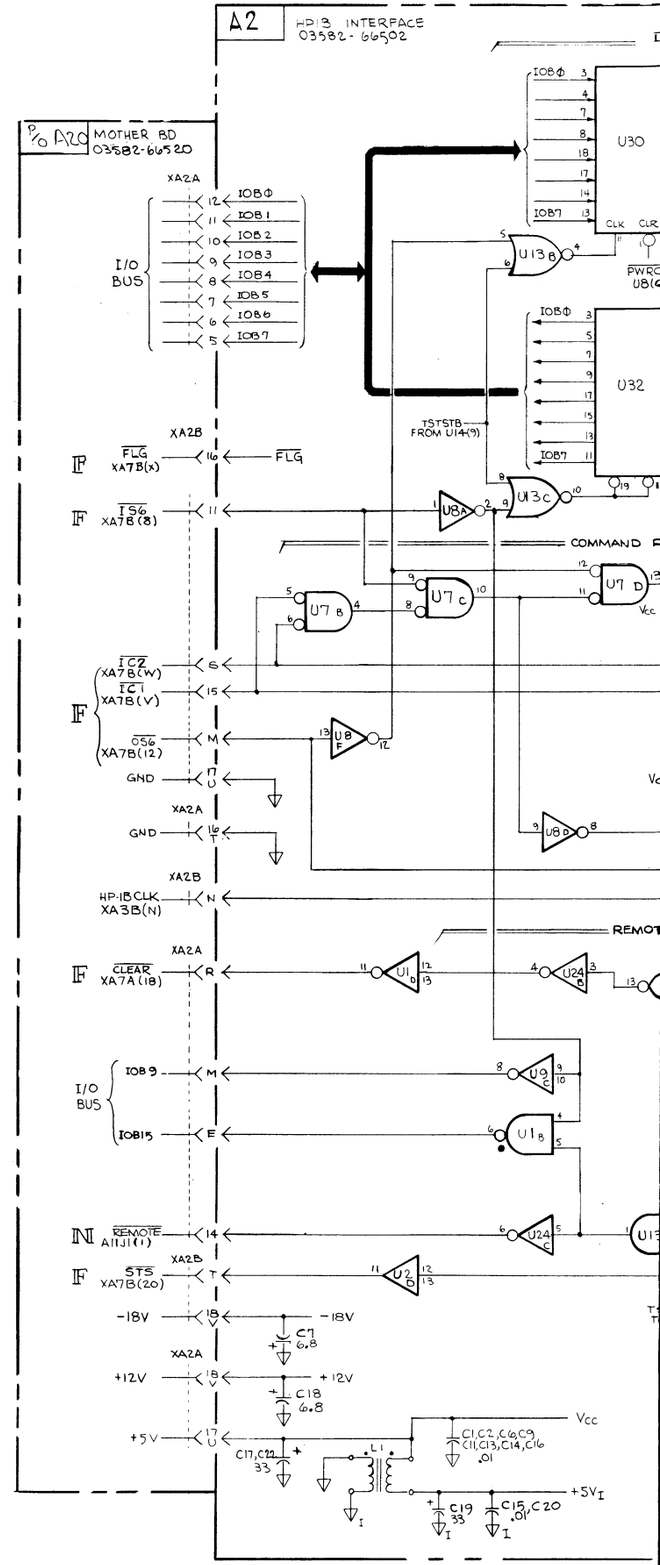
4. If preliminary DSA tests fail, check HP-IB address switches for continuity when closed. Also check outputs on U22 for low true signal when the gate on pins 1 and 15 is activated.

5. Be sure that the HP-IB cable is disconnected before performing the SA tests.





A2
03582-66502
Rev A



A2 HPIB INTERFACE 03582-66502

P/O A20 MOTHER BD 03582-66520

I/O BUFFERS

DATA / INSTRUCTION BUS

U16 NANO PROCESSOR

INSTRUCTION ROM

HPIB ADDRESS SWITCH

FACTORY SETTING

COMMAND REGISTER

REMOTE ENABLE

PROCESSOR CLOCK

DEVICE SELECT

POWER & IFC VECTOR INTERRUPT

POWER-UP

SET VOLTAGE AT TP3 TO VALUE MARKED ON U16

TO DEVICE SELECT BUS

DIRECT CONTROL BUS

DEVICE SELECT BUS

DATA / INSTRUCTION BUS

INSTRUCTION ROM

U16
NANO PROCESSOR

U15

U34

U22

HPIB ADDRESS SWITCH

S1

FACTORY SETTING
1 1 0 1 0 0 0 0
MLA = 4
MTA = K

OPEN FOR BOARD SERVICE

TEST/RUN U13(12)

TO DEVICE SELECT BUS

U5

U6

SELECT

BUS INPUT ISOLATION CIRCUITS

U17

U18

U19

U20

TEST JACKS SA SERVICE

J1 CLK
J2 PSTS
J3 PA10
J4 PA9 PSTS

FROM PROCESSOR

BUS BUFFERS

U36

U37

U38

U39

P6 A20 MOTHER BD 03582-66520

XA2B

(L) DIO1
(L) DIO2
(L) DIO3
(L) DIO4
(L) DIO5
(L) DIO6
(L) DIO7
(L) DIO8
(L) DAV
RFD
DAC
(L) EOI
(L) ATN
(L) SRQ
(L) REN
(L) IFC
GND

HPIB BUS

SEE TABLE FOR CABLE CONNECTIONS

POWER & IFC VECTOR INTERRUPT

U12

U10

U9

INT ACK

PWRINT

POWER-UP

PWRCLR
U1, U11, U12
U14, U30

SET VOLTAGE AT TP3 TO VALUE MARKED ON U16

U4

U23

DEVICE SELECT

BUS OUTPUT ISOLATION CIRCUIT

U35

U25

U26

U27

U21

U28

U40

FROM U40(13)

TO U40(4)

DIRECT CONTROL BUS

DEVICE SELECT BUS

Figure 8-8-1. HP-IB Block Diagram.
8-8-13/8-8-14

Table 8-8-12. Replaceable Parts.

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2	03582-66502	0	1	PC ASSEMBLY, HP-IB INTERFACE	28480	03582-66502
C1	0160-3847	9	53	CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C2	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C3	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C4	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C5	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X901582
C6	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C7	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
C8	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C9	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C10	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C11	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C12	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C13	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C14	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C15	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C16	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C17	0180-0229	7	5	CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
C18	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
C19	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
C20	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C21	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
C22	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
CR1	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
CR3	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
CR4	1902-3030	7		DIODE-ZNR 3.01V 5% DO-7 PD=.4W TC=-.067%	28480	1902-3030
CR5	1902-3054	5	2	DIODE-ZNR 3.65V 5% DO-7 PD=.4W TC=-.055%	28480	1902-3054
CR6	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
CR8	1902-3054	5		DIODE-ZNR 3.65V 5% DO-7 PD=.4W TC=-.055%	28480	1902-3054
DS1	1990-0486	6		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	5082-4684
E1	1810-0326	3	1	NETWORK-RD 10 PIN SIP, 0.1 IN SPACING	28480	1810-0326
J1	1251-5202	8		CONNECTOR 5-PIN M POST TYPE	28480	1251-5202
J2	1251-5202	8		CONNECTOR 5-PIN M POST TYPE	28480	1251-5202
J3	1251-5202	8		CONNECTOR 5-PIN M POST TYPE	28480	1251-5202
L1	9100-4031	8	1	TRANSFORMER IND: 225 MAY -10%, +50%,DC	28480	9100-4031
Q1	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
R1	0683-1335	4	4	RESISTOR 13K 5% .25W FC TC=-400/+800	01121	CB1335
R2	0683-2715	6	5	RESISTOR 270 5% .25W FC TC=-400/+600	01121	CB2715
R3	0683-1525	4		RESISTOR 1.5K 5% .25W FC TC=-400/+700	01121	CB1525
R4	0683-2715	6		RESISTOR 270 5% .25W FC TC=-400/+600	01121	CB2715
R5	2100-3273	1		RESISTOR-TRMR 2K 10% C SIDE-ADJ 1-TRN	28480	2100-3273
R6	0683-3625	9	1	RESISTOR 3.6K 5% .25W FC TC=-400/+700	01121	CB3625
R8	0683-5135	0		RESISTOR 51K 5% .25W FC TC=-400/+800	01121	CB5135
R9	0683-1335	4		RESISTOR 13K 5% .25W FC TC=-400/+800	01121	CB1335
R11	0683-7505	2	2	RESISTOR 75 5% .25W FC TC=-400/+500	01121	CB7505
R12	0683-2715	6		RESISTOR 270 5% .25W FC TC=-400/+600	01121	CB2715
R13	0683-3925	2	1	RESISTOR 3.9K 5% .25W FC TC=-400/+700	01121	CB3925
R14	0683-7505	2		RESISTOR 75 5% .25W FC TC=-400/+500	01121	CB7505
RP7	1810-0329	6	4	NETWORK-RES 10-PIN-SIP .1-PIN-SPCG	91637	CSP10E-01-752G
RP10	1810-0329	6		NETWORK-RES 10-PIN-SIP .1-PIN-SPCG	91637	CSP10E-01-752G
RP15	1810-0329	6		NETWORK-RES 10-PIN-SIP .1-PIN-SPCG	91637	CSP10E-01-752G
RP16	1810-0329	6		NETWORK-RES 10-PIN-SIP .1-PIN-SPCG	91637	CSP10E-01-752G
S1	3101-2215	2	1	SWITCH-RKR DIP-RKR-ASSY 7-1A .05A 30VDC	28480	3101-2215
U1	1820-1198	0	4	IC GATE TTL LS NAND QUAD 2-INP	01295	SN74L803N
U2	1820-1201	6	6	IC GATE TTL LS AND QUAD 2-INP	01295	SN74L808N
U3	1820-1195	7	3	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74L8175N
U4	1820-1216	3	2	IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74L8138N
U5	1820-1439	2	2	IC MUXR/DATA-SEL TTL LS 2-TO-1-LINE	01295	SN74LS258N
U6	1820-1439	2		IC MUXR/DATA-SEL TTL LS 2-TO-1-LINE	01295	SN74LS258N
U7	1820-1144	6		IC GATE TTL LS NOR QUAD 2-INP	01295	SN74L802N
U8	1820-1199	1		IC INV TTL LS HEX 1-INP	01295	SN74L804N
U9	1820-1198	0		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74L803N
U10	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74L874N
U11	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74L874N
U12	1820-1425	6	1	IC SCHMITT-TRIG TTL LS NAND QUAD 2-INP	01295	SN74L8132N
U13	1820-1144	6		IC GATE TTL LS NOR QUAD 2-INP	01295	SN74L802N
U14	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74L874N
U15	1816-1200	6	1		28480	1816-1200

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

Table 8-8-12. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
U16	1820-1691	8	1	IC MICPROC MOS	28480	1820-1691
	1200-0659	2	5	SOCKET-IC 40-CONT DIP-SLDR	28480	1200-0659
U17	1826-0138	8		IC 339 COMPARATOR 14-DIP-P	04713	MLM339P
U18	1826-0138	8		IC 339 COMPARATOR 14-DIP-P	04713	MLM339P
U19	1826-0138	8		IC 339 COMPARATOR 14-DIP-P	04713	MLM339P
U20	1826-0138	8		IC 339 COMPARATOR 14-DIP-P	04713	MLM339P
U21	1820-1195	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS175N
U22	1820-1491	6	3	IC BFR TTL LS NON-INV HEX 1-INP	01295	SN74LS367N
U23	1820-1438	1	1	IC MUXR/DATA-SEL TTL LS 2-TO-1-LINE QUAD	01295	SN74LS257N
U24	1820-1199	1		IC INV TTL LS HEX 1-INP	01295	SN74LS04N
U25	1826-0138	8		IC 339 COMPARATOR 14-DIP-P	04713	MLM339P
U26	1826-0138	8		IC 339 COMPARATOR 14-DIP-P	04713	MLM339P
U27	1826-0138	8		IC 339 COMPARATOR 14-DIP-P	04713	MLM339P
U28	1826-0138	8		IC 339 COMPARATOR 14-DIP-P	04713	MLM339P
U29	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74N
U30	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
U31	1820-1873	8		IC BFR TTL LS INV OCTL 2-INP	27014	DM81LS98N
U32	1820-1873	8		IC BFR TTL LS INV OCTL 2-INP	27014	DM81LS98N
U33	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
U34	1810-0307	0	1	NETWORK-CNDCT MODULE DIP; 16 PINS; 0.100	28480	1810-0307
	1200-0473	8	1	SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0473
U35	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
U36	1820-1689	4	4	IC MISC QUAD	04713	MC3446P
U37	1820-1689	4		IC MISC QUAD	04713	MC3446P
U38	1820-1689	4		IC MISC QUAD	04713	MC3446P
U39	1820-1689	4		IC MISC QUAD	04713	MC3446P
U40	1820-1144	6		IC GATE TTL LS NOR QUAD 2-INP	01295	SN74LS02N
				MISCELLANEOUS PARTS		
	4040-0748	3		EXTRACTOR-PC BOARD BLK POLYC	28480	4040-0748
	4040-0750	7	1	EXTRACTOR-PC BOARD RED POLYC	28480	4040-0750
MP3B	03582-61613		1	HP-IB CONNECTOR W/CABLE	28480	03582-61613
MP3C	1251-3283	1	1	CONNECTOR 24-PIN F MICRORIBBON	28480	1251-3283

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

SERVICE GROUP 9
PSEUDO RANDOM NOISE

TABLE OF CONTENTS

Service Group	Page
9. PSEUDO RANDOM NOISE	8-9-1
8-9-1. Introduction	8-9-1
8-9-3. General Information	8-9-1

LIST OF TABLES

Table	Page
8-9-1. Troubleshooting Hints	8-9-1
8-9-2. PRN Signatures	8-9-2

LIST OF ILLUSTRATIONS

Figure	Page
8-9-1. P/O A4 Pseudo Random Noise Generator	8-9-3/8-9-4

PSEUDO RANDOM NOISE
SERVICE GROUP 9

8-9-1. INTRODUCTION.

8-9-2. The Pseudo Random Noise (PRN) generator is essentially a pseudo random binary generator that has its output processed by a digital filter (similar to a current output DAC). This signal is then band translated by a four quadrant multiplier, low pass filtered, and buffered before being presented at the front panel BNC connector (NOISE SOURCE OUTPUT). A switch on the NOISE SOURCE LEVEL control selects either a PERIODIC or RANDOM noise source. Random noise is extended periodic noise that is unsyncronized with the data collection time which makes it appear like a white noise source to the device under test and the 3582A.

8-9-3. GENERAL INFORMATION.

8-9-4. The PRN requires a clock signal and a sync signal from the Timing board C(A3) and also a cosine word from the Digital Local Oscillator portion of the A4 board (schematic E). Signature Analysis (SA) is the primary troubleshooting tool for the digital circuits. For the analog circuits, use a two channel oscilloscope to check the inputs and outputs of the various operational amplifiers.

Table 8-9-1. Troubleshooting Hints.

1. It is a good idea to check the following things first:
   a. U17 pin 6 should be at + 5 VDC. This can be adjusted with R33. An incorrect DC level will cause a "spike" at the center of the display in band analysis modes.
   b. Set the center frequency to 1kHz, move J5 to "test" and check TP5 (L.O. test point) for a 3 Vp-p sin wave centered around zero.
   c. Move J5 back to "run".
2. Use the oscilliscope photos to check the analog circuits (current summer, mixer, low pass filter and buffer).
3. Use signature analysis to check the digital circuits. If a signature analyzer is not available, check for 5V levels at the shift register outputs.

Table 8-9-2. PRN Signatures.

a. Move the test jumper (PRN J4) to Test.

b. Preset the board by momentarily shorting TP6 and 7.

c. Check U1-4, pins 3-6 and 10-13 for good 5V square waves.

d. Set up the 5004A as follows:

GND: J5(1)

Clock: J5(3) ⎍⎍

Start/stop: J5(4,5) ⎍⎍

3582A: Single channel; 0-25kHz +5 signature 3951

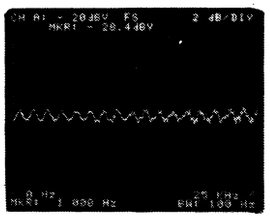
e. Troubleshoot using the following signatures:

U1 & 3 pin	3	P391	U2 & 4 pin	3	00C2
	4	U1F8		4	A5A0
	5	78P4		5	U729
	6	3F72		6	HP6H
	10	9P39		10	FAFU
	11	FU1F		11	F09P
	12	P78P		12	F5C6
	13	73F7		13	F722
U5 pin	8	3551			
U5 pin	3	FU1F			
U7 pin	6	3UCO			

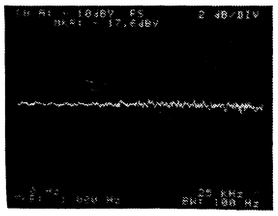
Single Channel Baseband		Dual Channel Baseband Single Channel Zoom	Dual Channel Zoom
U9 pin	1 low	low	high
U10 pin	1 high	low	low
U9 pin	4 FAFU	HP6H	U729
	7 HP6H	HP6H	00C2
	9 U729	U729	low
U10 pin	4 FAFU	A5A0	A5A0
	7 FAFU	HP6H	HP6H
	9 HP6H	low	low
U8 pin	8 P74F	9FC1	9FC1
	6 980A	C15P	P3U7
	12 8FA0	980A	C15P
U12 pin	12 HP1H	A5P0	A5P0
	6 A15C	88OU	HAA6
	4 8A49	FF72	4004
	2 C5U1	A15C	88OU
U7 pin	11 14A2	7CFH	A512
	3 2C12	447H	9AA2
U6 pin	6 06P9	5478	U15A
	11 C318	U523	7955

NOTE

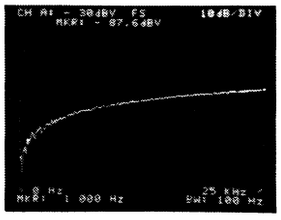
The Parts List for Service Group 9 is located in Service Group 3.



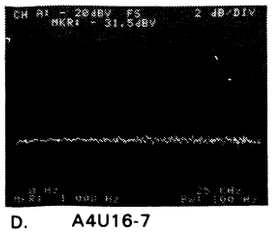
A. A4U3-3



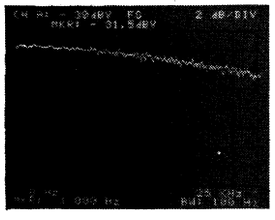
B. A4U17-7.
Amplitude Reference Level.



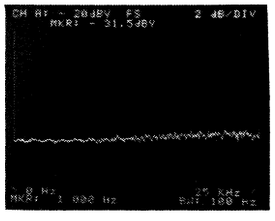
C. A4U14-1
Scale: 10dB/DIV
Sensitivity: -20dB
Amplitude Reference Level



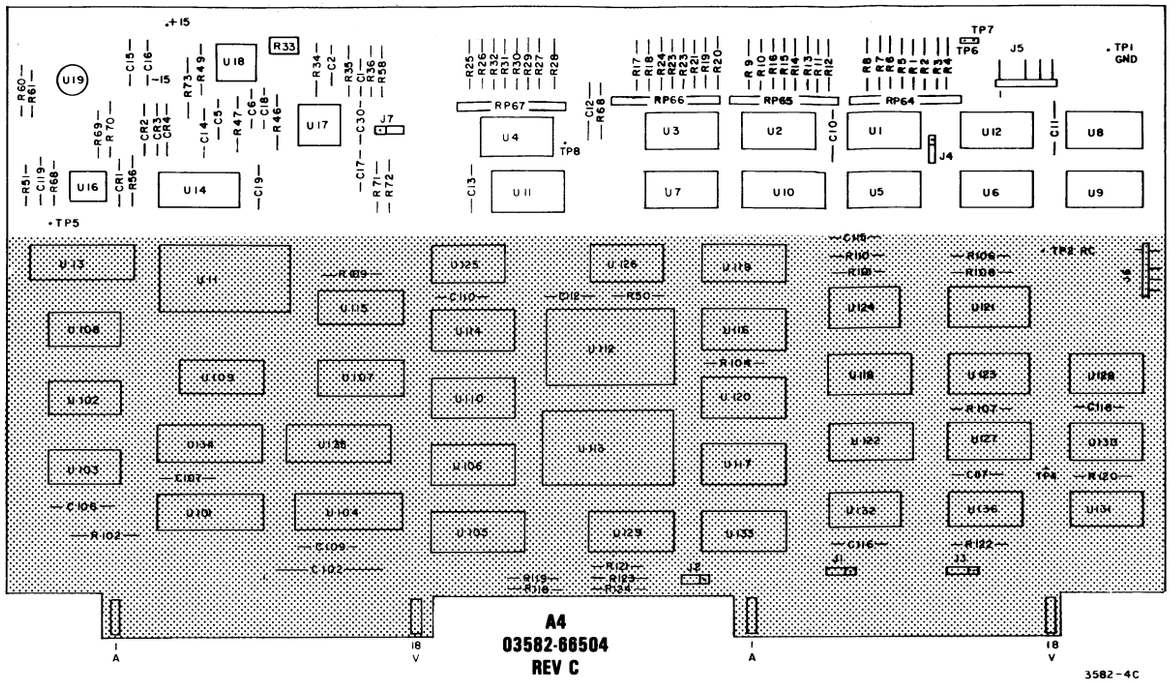
D. A4U16-7
Scale: 2dB/DIV
Sensitivity: +10dB
Amplitude Reference Level

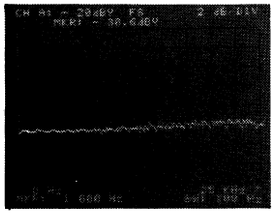


E. A4U16-1
Amplitude Reference Level

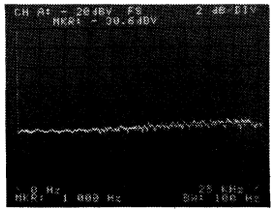


F. A4U18-1
Amplitude Reference Level

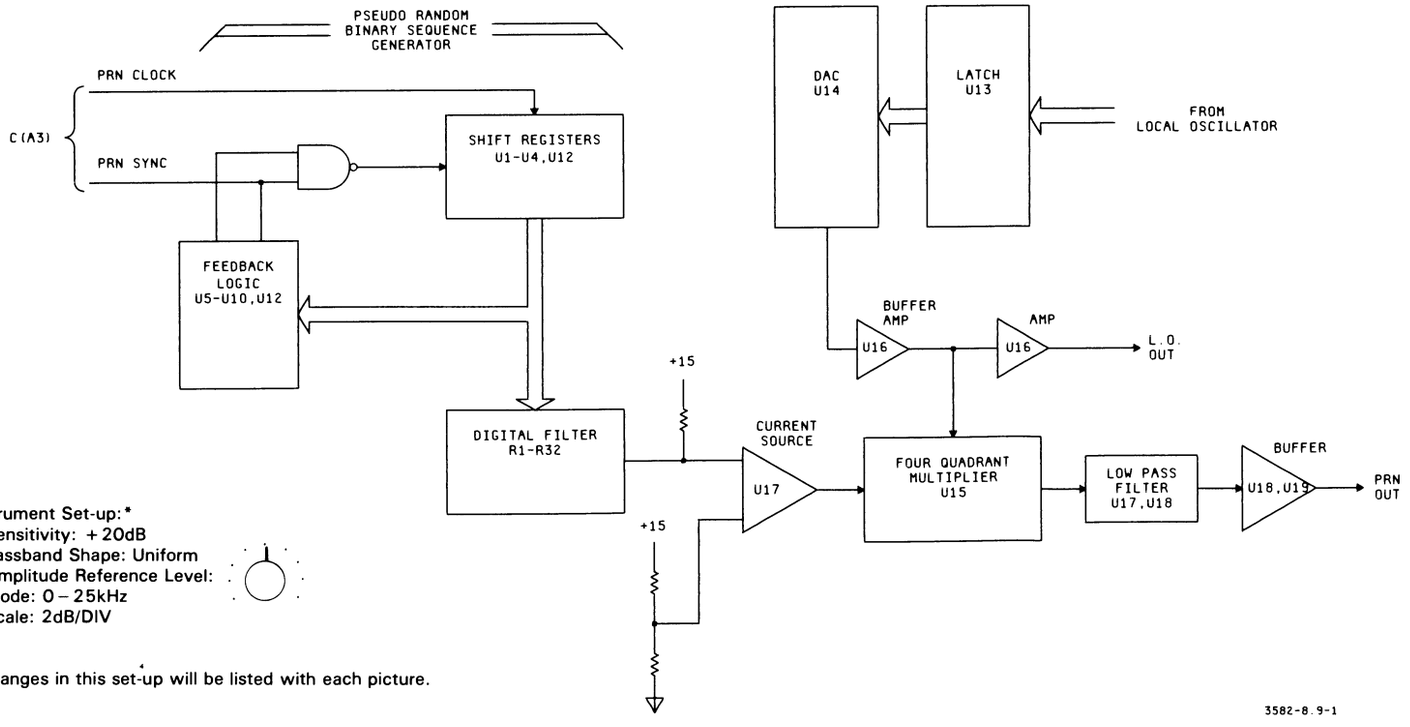




G. A4U18-7



H. A4U19-4



Instrument Set-up:*
Sensitivity: +20dB
Passband Shape: Uniform
Amplitude Reference Level:
Mode: 0 – 25kHz
Scale: 2dB/DIV

*Changes in this set-up will be listed with each picture.

P/O A4 PSEUDO RANDOM NOISE GENERATOR 03582-66504

P/O A20 MOTHER BD 03582-66520

XA4B

PRN CLK XA3B(5)

PRN SYNC XA3B(E)

+5V R68 1K

J5

CLR TP6

TP7

D/A CONVERTE

*4 JUMPER

U1 SHIFT REGISTER

U2 SHIFT REGISTER

U3 SHIFT REGISTER

U4 SHIFT REGISTER

R50 1K

FROM XA4B(3)

U6 U12 U11D U11A U11C U11B U12D U12E U6B U8A U7A U7D U7B U12C U8B U6A U5 U7C U12F U8C

RP64 4.7K

RP65 4.7K

RP66 4.7K

RP67 4.7K

FEEDBACK QUALIFIER

U9

U10

FROM U129(12) DIGITAL LO SCHEM. E

FROM U129(5) DIGITAL LO SCHEM. E

R1 1M R2 316K R3 187K R4 115K R5 86.6K R6 76.8K R7 82.5K R8 143K R9 340K R10 549K R11 267K R12 165K R13 111.8K R14 9530 R15 8250 R16 7680 R17 7680 R18 8250 R19 9530 R20 11.8K R21 16.5K R22 26.7K R23 34.9K R24 340K R25 143K R26 82.5K R27 76.8K R28 86.6K R29 115K R30 187K R31 316K R32 1M

DIGITAL FILTER

U14 MDAC

R56 2.49K CR1 U16A R69 5K

R70 5K CR2 U17

-15V R71 2.80K J7 R72 200K CURRENT SUMMER

DC ADJ R33 200 R34 2.21K C2 220 pF R35 3.42

R36 2K R58 1K C1 .1

P/O A20 MOTHER BOARD 03582-66520

P/O A11

J5

TP7

CLR TP6

U2 SHIFT REGISTER

U3 SHIFT REGISTER

U4 SHIFT REGISTER

U12D

U12E

U7C

RP65 4.7K

RP66 4.7K

RP67 4.7K

R8 143K

R10 549K

R12 165K

R14 953Ω

R16 7680

R9 340K

R11 267K

R13 118K

R15 8250

R17 7680

R18 8250

R19 953Ω

R20 11.8K

R21 165K

R22 267K

R23 549K

R24 340K

R25 143K

R26 82.5K

R27 76.8K

R28 86.6K

R29 115K

R30 187K

R31 316K

R32 1M

DIGITAL FILTER

D/A CONVERTER

U14 MDAC

U13

TO U133(7) E SYNC

FROM U125 DIGITAL LO E

MSB

LSB

U6C

U16A

U16B

R56 2.49K

R74 12.1K

C18 500pf

R69 5K

R51 604

LO TP5

LOW PASS FILTER

R70 5K

U17

CR2

R71 2.80K

R72 200K

CURRENT SUMMER

DC ADJ

R33 200

R34 2.21K

C2 220pf

R35 5.42

R36 2K

R58 1K

C1 .1

R37 1.5K

U11(12)

XA4B

XA4A

LO OUT XA7(6)

X2

PERIODIC

SWITCH IS PART OF R17

RANDOM

BUFFER

C5 2000pF

R47 6810

C6 260pF

U18

R46 6810

R49 422Ω

R33 510

U19

R60 22.1

R61 22.1

CR3

CR4

R17 5K

W28

W23

XA4A

+5V TP

+15V W

-15V W

C14 .1

C10-13 .01

C15,17,18 .1

C16,19,20 .1

TP1

P

Figure 8-9-1. P/O A4 Pseudo Random Noise Generator. REV C

SERVICE GROUP 10

X-Y RECORDER

TABLE OF CONTENTS

Service Group		Page
10.	X-Y RECORDER	8-10-1/8-10-2
	8-10-1. Introduction	8-10-1/8-10-2
	8-10.4. General Information	8-10-1/8-10-2
	8-10-6. Recorder Output Test (000005) Ave #128	8-10-1/8-10-2
	8-10-7. Function	8-10-1/8-10-2
	8-10-10. Status Code	8-10-1/8-10-2
	8-10-12. Condition Code	8-10-1/8-10-2

LIST OF ILLUSTRATIONS

Figure		Page
8-10-1.	P.O A10 X-Y Recorder	8-10-3/8-10-4

X-Y RECORDER
SERVICE GROUP 10

8-10-1. INTRODUCTION.

8-10-2. The X-Y Recorder outputs are managed entirely by the Processor F(A7). The Processor latches binary data directly into the Y and X latches from the I/O Bus. The data is converted by DACS to a DC signal which is applied to a buffer driver circuit whose outputs result in the recorder drive signals at the rear panel. The Processor latches data at time intervals which approximate a constant slew rate for the recorder helping to eliminate curved line segments between data points.

8-10-3. A DAC voltage reference source is also located on this portion of the A10 board. Its outputs are also used by the Analog Display Driver DACS (schematic K).

8-10-4. GENERAL INFORMATION.

8-10-5. An internal self test is available for checking the DAC output voltages. The test causes the Processor to latch a known bit pattern into the DACS. The outputs can then be checked using a DC voltmeter (see Self-Tests).

8-10-6. RECORDER OUTPUT TEST (000005) AVE #128.

8-10-7. Function.

8-10-8. To test the X-Y recorder DAC's and the pen-lift relay, the X-Y recorder output registers are loaded with a word containing a single 1 bit and all the rest zeroes. Both the X and Y registers are loaded with the same number, and the 1 bit is shifted each time this test is re-selected with the AVERAGE NUMBER and AVERAGE RESTART keys. Thus, a voltmeter can be used to check each bit of the DAC outputs.

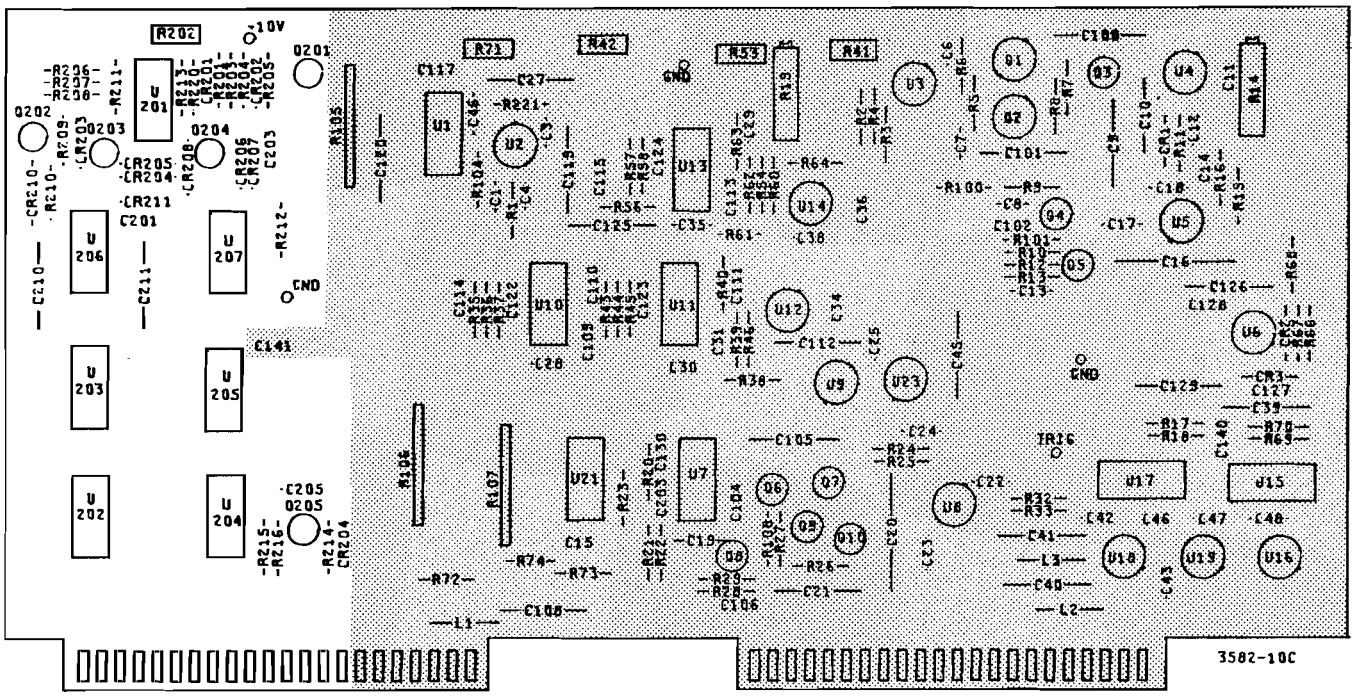
8-10-9. For the X-Y output registers, bits 0-9 are X-Y output bits, while bit 10 controls the pen-up relay. When the X-Y output word (see "condition code" paragraph 8-10-12) is octal 002000, the pen-up relay should close, and the X-Y outputs should be zero.

8-10-10. Status Code.

8-10-11. CY only. Performs no internal checks for errors.

8-10-12. Condition Code.

8-10-13. Condition code 8 displays the octal number loaded into the X-Y output registers.



A10
H-P PART NO. 03582-66510
REV A.B.C

P/O A10 PART II X-Y PLOTTER 03582-66510

P/O A20 MOTHER BOARD 03582-66520

DAC VOLTAGE REF SOURCE

OUTPUTS

+15V R220 10K

+15V R205 150

U201D

Q201

R201 5.23K

R202 2K +10V REF ADJ

R204 3.83K

R203 422

CR202

CR201 6.2V

+VREF (10V)

-VREF (-5.2V)

R206 9.53K

R207 4.99K

U201A

Q202

R208 3.24K

-15V

R209 150

-15V

I/O BUS BUFFERS X-POSITION LATCHES

X-POSITION DAC

MSB

U202

U204

U206

+5V

+5V

I/O BUS

XA10A

XA10B

XA78(P)

-VREF

BUFFER-DRIVER

U201B

Q203

CR210

C210 15μF

R211 10K

CR205

CR203

CR204

R210 1K

+15V

-15V

P/O A20 MOTHER BD 03582-66520

X7

X AXIS

PEN LIFT DRIVER

CR209

R214 150

Q205

R215 4.99K

R216 4.99K

RPC1

RPC2

PEN LIFT

K1

Y-POSITION LATCHES

Y-POSITION DAC

U203

U205

U207

BUFFER DRIVER

U201C

Q204

CR211

C211 15μF

R213 10K

CR208

CR206

CR207

R212 1K

Y AXIS

+5V L1 C141 .1 +5V

+15V L2 C203 C205 .1 +15V

-15V L3 C201 .1 -15V

3582-E-16

Figure 8-10-1. P/O A10 X-Y Recorder. REV A,B,C

NOTE

The Parts List for Service Group 10 is located in Service Group 5.

SERVICE GROUP 11
POWER SUPPLY

TABLE OF CONTENTS

Service Group — Page

11. POWER SUPPLY 8-11-1
    - 8-11-1. Introduction 8-11-1
    - 8-11-3. Theory (Switching Supplies) 8-11-2
    - 8-11-6. Troubleshooting The Power Supply Section 8-11-2
    - 8-11-8. Determining Which Board Is Causing A Supply To Malfunction 8-11-2
    - 8-11-10. Switching Supply Troubleshooting 8-11-3
    - 8-11-14. Power Supply A18 8-11-5
    - 8-11-17. Power Supply Control A17 8-11-6
    - 8-11-20. Fan Retrofit Kits 8-11-7/8-11-8

LIST OF TABLES

Table — Page

8-11-1. Table of Power Supply Use 8-11-1
8-11-2. Replaceable Parts 8-11-19

LIST OF ILLUSTRATIONS

Figure — Page

8-11-1. Initial Power Supply Test Setup 8-11-3
8-11-2. Control Pulses For Positive Supply 8-11-4
8-11-3. Voltage Effects On Control Pulses 8-11-4
8-11-4. Setup For Current Limit Check 8-11-5
8-11-5. −18 Volt Power Supply 8-11-9/8-11-10
8-11-6. +18, +12, +7 Volt Power Supply 8-11-11/8-11-12
8-11-7. +5 Volt Power Supply 8-11-13/8-11-14
8-11-8. Power Supply Control 8-11-15/8-11-16
8-11-9. Linear Power Supply 8-11-17/8-11-18

POWER SUPPLY
SERVICE GROUP 11

8-11-1. INTRODUCTION.

8-11-2. The Power Supply Service Group contains information for troubleshooting the power supply control A17 board; the switching supplies A14, A15 and A16 boards; the linear supplies A18 board; the transformer, and the rectifier circuits. The linear supplies are used for low current circuits while the switching supplies power the remainder of the instrument. The power supply control A17 board generates the clock signal and reference voltages used by the switching supplies in addition to a raw +150V for the display section.

Table 8-11-1. Table of Power Supply Use.

Volts	Source	Schematic	Use
+5	A16	T	A1 A2 A3 A4 A5 A6 A7 A8 A9 A10 A11 A12 A13
+7	A15A	S	A5 A7
+12	A15B	S	A2 A3 A4 A5 A6 A7 A8 A9
+18	A15C	S	A4 A5 A13
+5 Raw	A18	V	A1
+15	A18	V	A4 A10 A13
-15	A18	V	A4 A10 A13
+15 Isol	A18	V	A1
-15 Isol	A18	V	A1
+150 Raw	A17	V	A13
+5 Ref	A17	U	A14 A15 A16
- 5 Ref	A17	U	A14 A15 A16
+18 Ref	A17	U	A15 A16
-18 Ref	A17	U	A14
+24 Ref	A17	U	A14 A15 A16
-24 Ref	A17	U	A14 A15 A16

8-11-3. THEORY (Switching Supplies).

8-11-4. The switching power supply provides a very efficient means for regulating the voltage associated with high current demand. The principal component involved is the switching regulator which, when provided with the proper drive signal, switches between two states. When the switching regulator is turned on, the resistance between the input and output is very low. This low resistance dissipates very little power, even with high current flow. When the switching regulator is turned off, the resistance between the input and output is very high. This results in complete current cutoff and no power is dissipated by the device. With this criteria in mind, it can be easily realized that any prolonged delay in switching between the two states will result in high power dissipation and failure of the device. Therefore, the switching drive current and voltages must be of the proper magnitude to assure complete state change of the switching regulator. The drive signals to the switching regulator are developed from a 27kHz clock signal modified by the current and voltage sense circuits.

8-11-5. The output from the switching regulator consists of pulses of high voltage and current. These pulses are filtered by a low pass network formed by a series inductor and a parallel capacitor. The voltage output is monitored by the voltage sense circuit which compares the monitored voltage to a known reference. If voltage output is low, the drive pulse remains on for a greater period of time. The current output is monitored across a low resistance series resistor located between the inductor and capacitor. The voltage drop across the resistor signals the current sense detector which turns off the switching hybrid. If the current demand is too great such as in the case of a short circuit, the current detector will signal the current sense latch causing an indicator red (current limit LED) to light and the output current to fold back.

8-11-6. TROUBLESHOOTING THE POWER SUPPLY SECTION.

NOTE

Because damage may occur, boards should **not** *be inserted into or removed from the chassis with power ON.*

8-11-7. If supplies are down, remove all load by removing A1 through A10 boards and disconnecting A13J2. This will also eliminate damage to components on these boards. At this point go to the paragraph applying to the appropriate supply.

8-11-8. Determining Which Board Is Causing A Supply To Malfunction.

8-11-9. Because the supplies will operate without a load, use the following procedure to identify a malfunctioning supply or board.

a. Install the boards A1 through A10 and A13J2 one at a time until the problem board is found. Use information given in the Table of Power Supply Use.

b. When the affected board is found, the first thing to check is the decoupling capacitors for a short.

c. When all supplies are again working, reinstall A1 through A10 and A13J2.

8-11-10. Switching Supply Troubleshooting.

8-11-11. The switching power supplies are somewhat similar in design and operation. The series switching regulator responds to control pulses that vary in width according to output voltage and current variations which are sensed by the associated control circuitry.

8-11-12. If a power supply fails, it usually requires replacement of the switching regulator. This leads to the problem of trying to determine if the switching regulator was at fault or the associated control circuitry. Therefore before replacing the switching regulator, the control circuitry should be checked, otherwise, the new regulator may be immediately damaged upon application of line power to the instrument.

8-11-13. The proper operation of the control circuitry may be determined through the use of the following procedure.

a. Remove circuit boards A1 through A10 and unplug the connector on A13J2 to unload the supplies.

b. Remove the damaged power supply board from the instrument. Then plug an extender board (03582-66533) back into the slot for further troubleshooting use. Measure the output pin to ground to determine if the over voltage protection diode is shorted (see schematic).

c. Remove the two screws which hold down the switching regulator. Then, gently pry the regulator from its socket using a small flat bladed screwdriver.

d. Connect a 1Kohm resistor (-hp- 0683-1025) between the (+ or −) 50V input to the switching regulator and the control input to the switching regulator (use Figure 8-11-1 and the proper schematic as a guide).

e. Place the power supply board on the extender in the 3582A.

f. Turn the LINE switch to ON and check the inputs to the power supply board (use the schematic for voltage references).

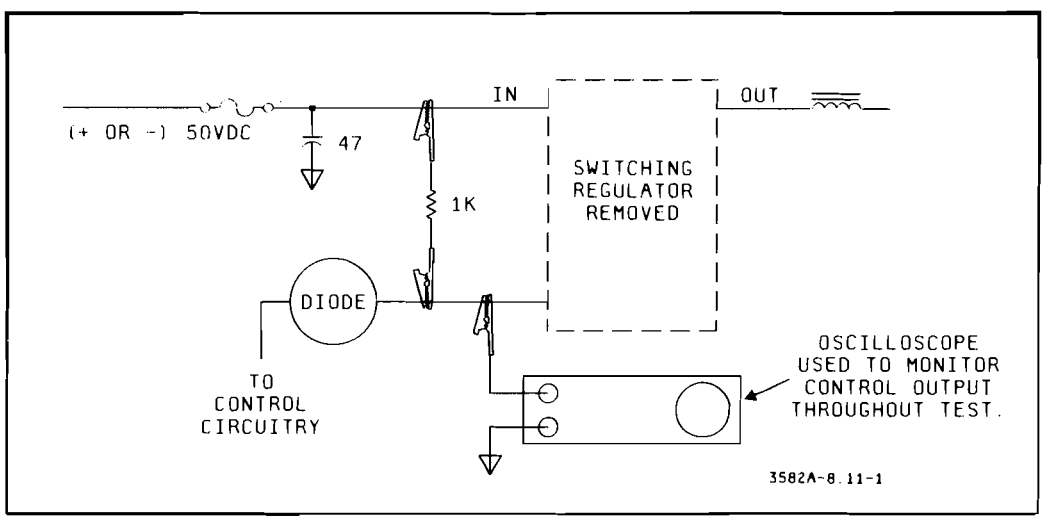


Figure 8-11-1. Initial Power Supply Test Setup.

g. Set up an oscilloscope for reading ± 80VDC and set the sweep for 10usec. Connect the oscilloscope to the control input line of the switching regulator (see Figure 8-11-1).

h. If the power supply is positive, observe that pulses appear on the oscilloscope display and are similar to the ones shown in Figure 8-11-2. If the power supply is negative, the pulses will be inverted and positioned in the negative portion of the oscilloscope display (actual voltage levels may vary between instruments). If no pulses appear, troubleshoot the output transistors of the control circuitry; also check the clock signal for TTL levels. These pulses indicate maximum power output for the switching regulator.

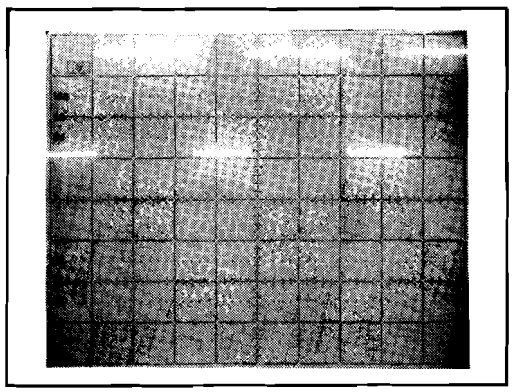
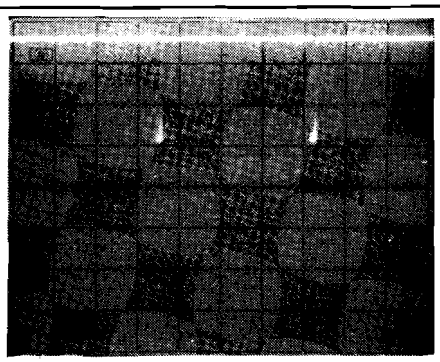


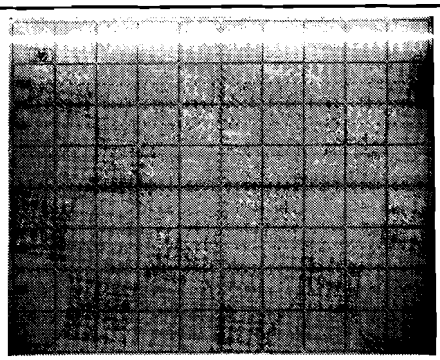
Figure 8-11-2. Control Pulses For Positive Supply.

i. To check for voltage regulation, connect an external power supply with the same polarity between the voltage output test point and ground (for a positive supply, connect the positive output to the VO test point).

j. Increase the voltage on the external power supply until the PC board green LED indicator is on and the pulses on the oscilloscope display start to become narrower. This is the approximate output voltage of the supply under test. Further increase in voltage will cause the pulses to decrease in width, then disappear leaving a DC level (see Figure 8-11-3). If problems occur here, check the voltage sense amplifier. When finished with this portion of the check, disconnect the external power supply, but leave the oscilloscope connected for further checks.



As voltage goes up, pulses become narrower.



Finally, pulses disappear shutting off switching regulator.

Figure 8-11-3. Voltage Effects On Control Pulses.

k. The current limiting control circuit senses the voltage drop across a low resistance in the output line of the supply. On the +5 volt supply, this is actually a trace on the circuit

board. When the voltage drop exceeds the value associated with an overcurrent condition, the current sense circuit clears a flip-flop. This latches the pulse control circuits in a steady state, removing control pulses from the switching regulator, thereby causing it to shut down. The switching regulator will remain shut down as long as the overcurrent condition exists.

1. To simulate an overcurrent condition requires the use of an external power supply. Before connecting the supply, verify that the output voltage is set to zero. If the power supply under test is a positive supply, connect the negative output of the external supply to the voltage output test point. For negative supplies, connect the positive output from the external supply. Connect the other output from the external supply through a 1Kohm resistor to the input of the current sense amplifier which as the opposite polarity to the supply under test. For example, if the supply under test is a positive supply, connect the positive output from the external supply to the negative input of the current sense amplifier using a 1Kohm resistor (see Figure 8-11-4).

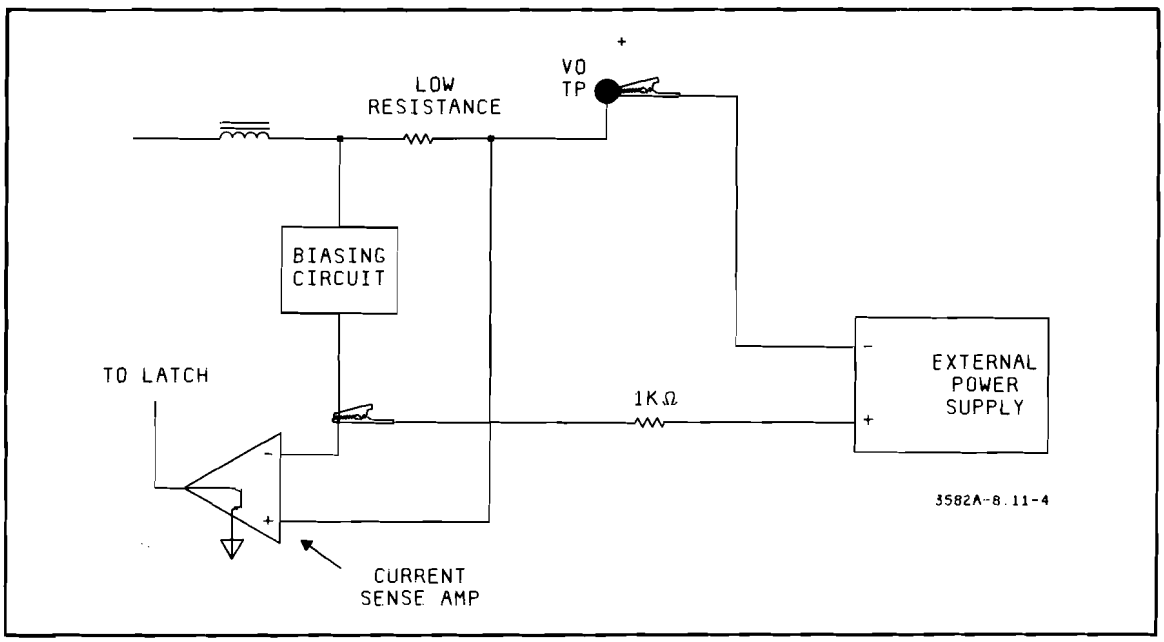


Figure 8-11-4. Setup For Current Limit Check.

m. Slowly increase the voltage on the external power supply until the PC board red LED lights, indicating that an overcurrent condition exists. Also notice that the pulses on the oscilloscope display have again returned to a DC level indicating that the switching regulator is turned off. For problems in this area, check devices for TTL logic levels and the current sense amplifier for turn on when both inputs are of equal voltage.

8-11-14. Power Supply A18.

8-11-15. For adjustment of −15 Volt isolated supply see Adjustment Procedure. The A18 board has the following supplies:

+15 volt
−15 volt
+15 volt isolated
−15 volt isolated
+5 volt raw (for +5 volt isolated see A1 board A)

8-11-16. When all supplies are working, replace A1 through A10 and A13J2.

8-11-17. Power Supply Control A17.

8-11-18. If a problem seems to afflict more than one power supply, a good place to start troubleshooting is the A17 Power Supply Control board. Perform the following steps:

a. Remove all power supply boards.

b. Turn on the 3582A and verify the following voltages on connector XA17.

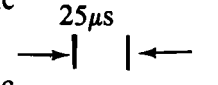
Pin	Voltage
A	+50 Vdc
C	−50 Vdc
12,N,14,R	114 Vac
J	9.2 Vac
L	8.5 Vac

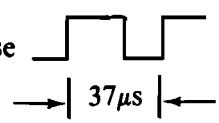
c. If these voltages are incorrect, troubleshoot the transformer and rectifier circuits as indicated by the problem.

d. If these voltages appear to be good, turn the instrument OFF and plug in the A17 Power Supply Control board using an (03582-66533) extender board.

e. Turn ON the 3582A and measure the following voltages on the output pins.

Pin	Voltage
15	+150 Vdc RAW (200 Vdc unloaded)
4	+ 24 Vdc
3	− 24 Vdc
7	+ 18 Vdc
8	− 18 Vdc
6	+ 5 Vdc
5	− 5 Vdc
1	TTL Pulse (27kHz)





f. Refer to Adjustments Section V if the ± 18V or 27kHz signals are not correct.

g. Reinstall all power supply boards after the reference voltages are restored.

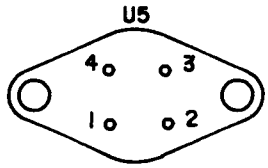
8-11-19. When all supplies are working, replace A1 through A10 and A13J2.

8-11-20. Fan Retrofit Kits.

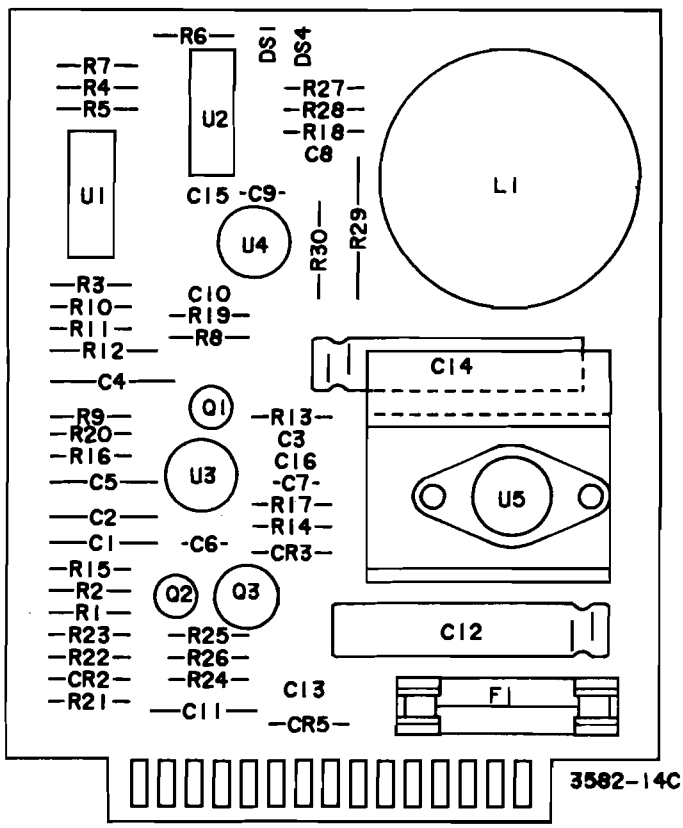
8-11-21. Two retrofit kits have been set up to change the fan in the -hp- 3582A.

a. The LO VOL FAN KIT (PN 03582-68702) contains a quieter fan. This fan is recommended for applications where noise is objectionable.

b. The HI VOL FAN KIT (PN 03582-68703) contains a noisier fan. This fan cools the 3582A better and therefore increases its reliability and is recommended for applications where reliability is important.



BOTTOM VIEW



A14
03582-66514
Rev A - C

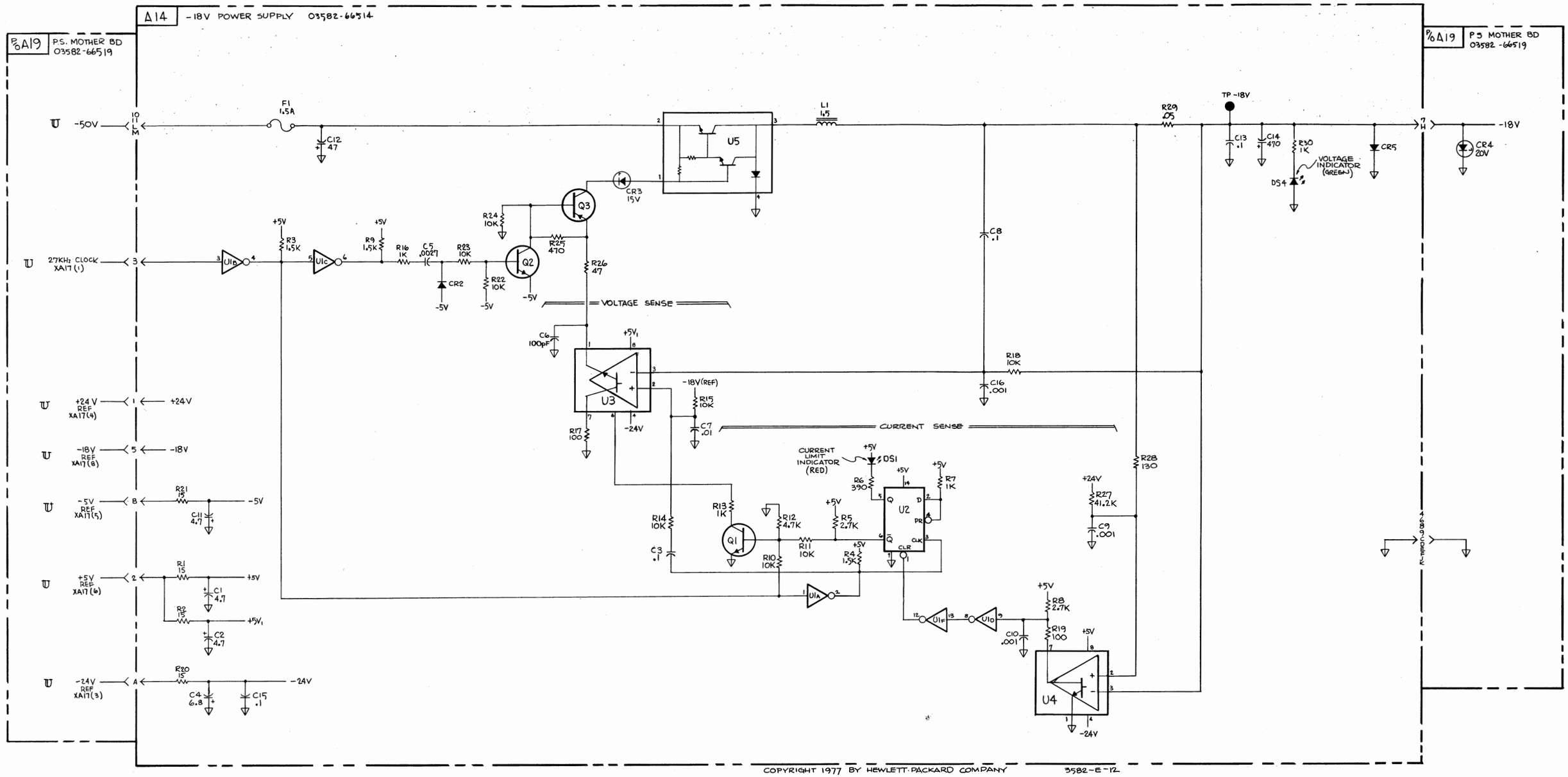
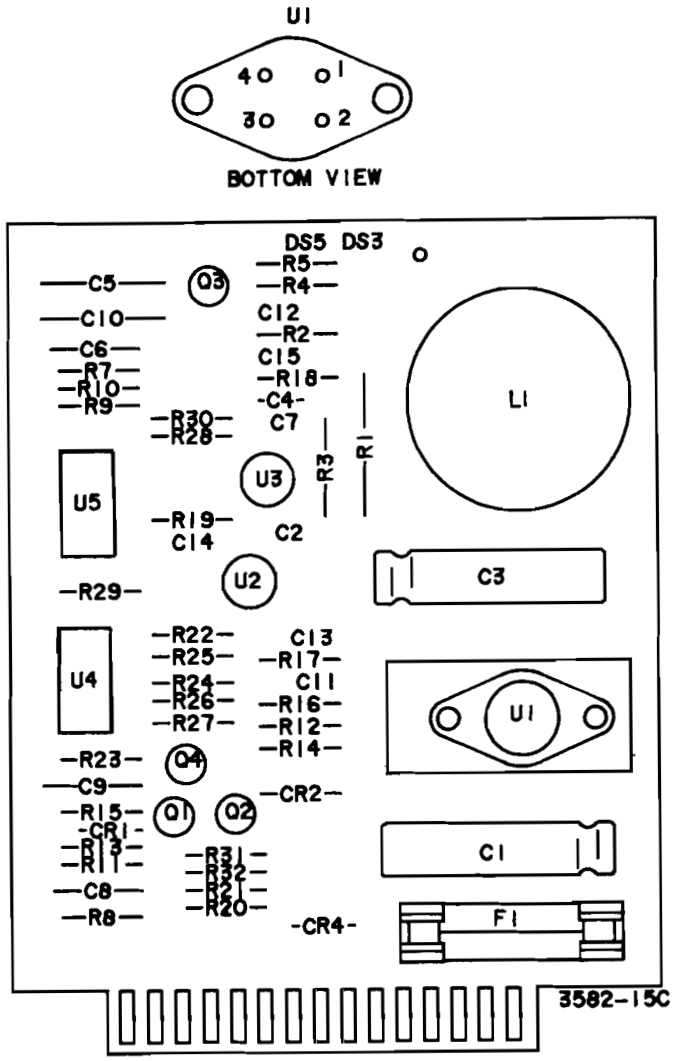


Figure 8-11-5. —18 Volt Power Supply.



A15
03582-66515
Rev A & B

A15 a- +7 VOLT POWER SUPPLY 03582-66515
b- +12 VOLT POWER SUPPLY
c- +18 VOLT POWER SUPPLY

P/A19 POWER SUPPLY MOTHER BOARD 03582-66519

P/A19 POWER SUPPLY MOTHER BOARD 03582-66519

+50V FROM XA17(10) — F1 1.5A — C1 47 — L1 — R1 .05 — TP VO — C2 .1 — C3 470 — DS3 VOLTAGE INDICATOR (GREEN) — CR4 — J7 H — +Eo = 18V or 12V or 7V — CR (SEE TABLE)

Eo	CR Value	CR №	
+18V	20V	CR2	A15C
+12V	15V	CR5	A15B
+7V		CR3	A15A

27KHz (CLOCK) FROM XA17(1) — ON OFF — 0 25 µsec 37 — U4F — U4E — U4D — R23 1.5K — R11 1K — CR1 — C9 .0027 — R15 10K — R13 10K — Q1 — Q2 — CR2 15V — U1 — R12 1K — R14 10K — R16 150 — C15 .1

+24V FROM XA17(4) — R9 15 — C10 6.8 — +24V1 — R10 15 — C5 6.8 — +24V2

VOLTAGE SENSE — U2 — REF. V — R31 4.7K — C11 .01 — C12 .001 — R18 10K

18V REF. FROM XA17(7) — R20 24.9K — R21 15.8K — R32 52.3K — REF.V

PIN "5" IS GROUNDED FOR +7V

PIN "D" IS GROUNDED FOR +12V

XC-11-4

-24V FROM XA17(3) — -24V

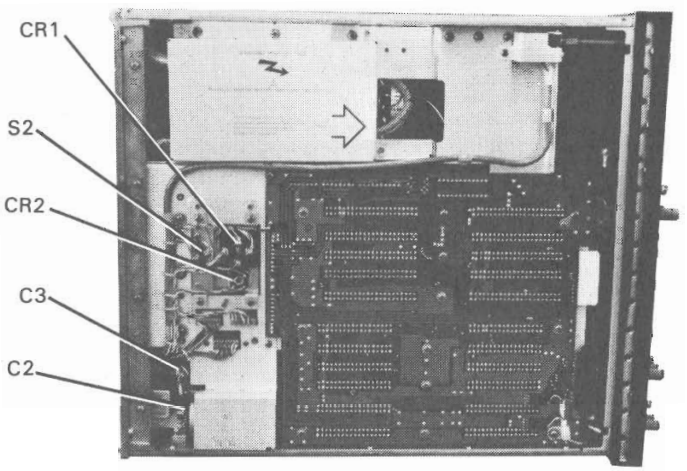
+5V FROM XA17(6) — R8 15 — C8 4.7 — +5V

-5V FROM XA17(5) — R7 15 — C6 4.7 — C7 .1 — -5V

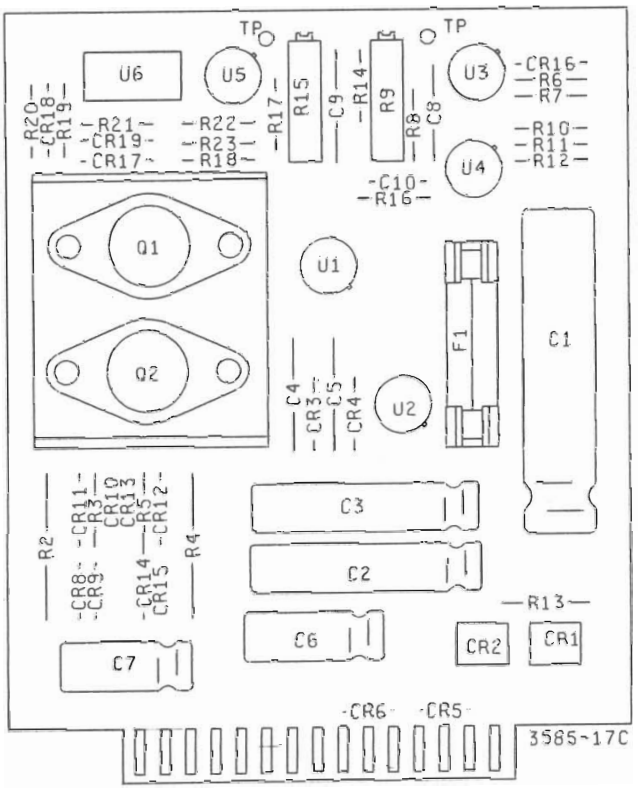
CURRENT SENSE — CURRENT LIMIT INDICATOR (RED) — DS5 — R28 390 — R29 1K — U5 — R22 6.8K — R24 4.7K — R27 2.7K — R26 10K — R25 10K — Q4 — R17 10K — C13 .1 — U4A — R2 150 — C4 .001 — Q3 — R4 1K — R5 20K — -24V

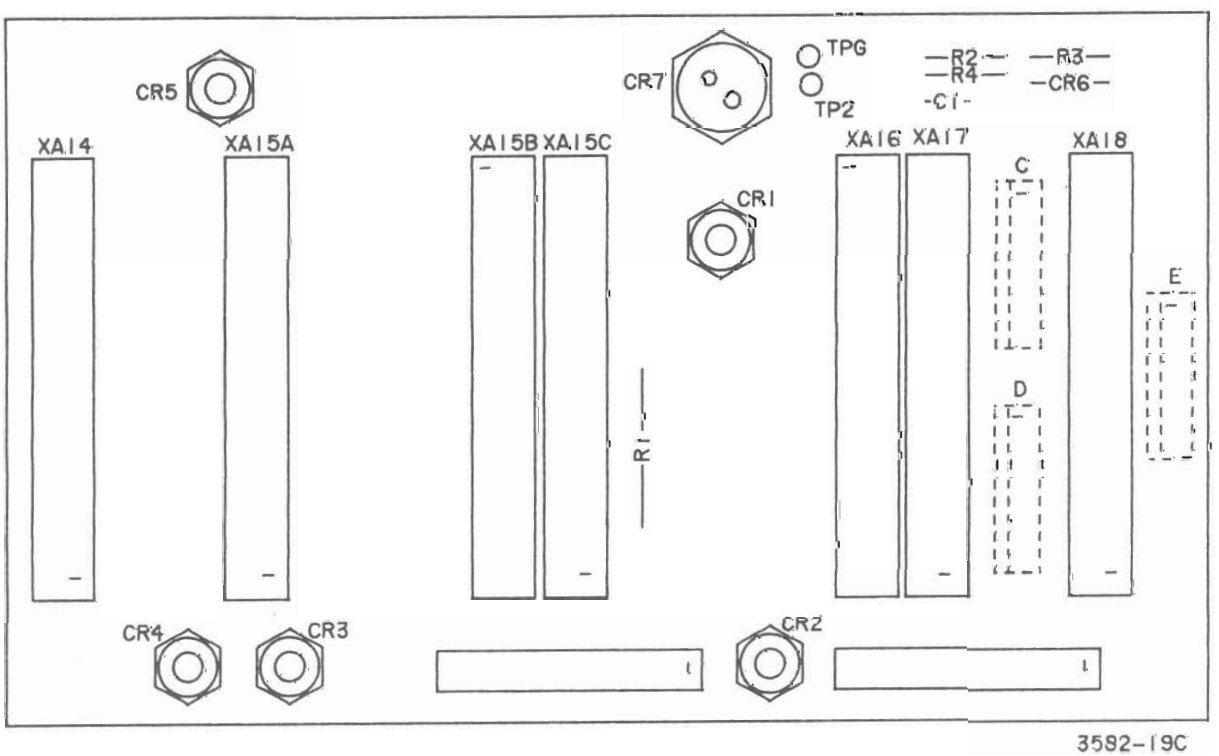
U4C — U4B — R30 2.7K — R19 100 — C14 .001 — +24V2 — U3 — -5V

Figure 8-11-6. +18, ± 12, +7 Volt Power Supply.



CHASSIS MOUNTED COMPONENTS





A16 +5V POWER SUPPLY 03582-66516

P/A19 P.S. Mother Bd 03582-66519

P/A19 Power Supl Mother Bd 03582-66519

THIS RESISTANCE A P.C. BOARD TRACE

+50V

F1 1Amp

C1 47

+5V1

R29 1K

CR5

R27 10K

Q5

Q3

CR1 15V

R9 1K

R34 10K

R10 68

R28 10K

C4 .0022

U5

L1 150uH

R3 .008

TP

C2 .1

C3 1000

DS3 VOLTAGE INDICATOR

R4 160

CR4

+5V

CR1 6.2V

25 KHz (CLOCK) FROM XA17(1)

U3F

U3A

U3B

VOLTAGE SENSE

+24V (REF) XA17(4)

R11 15

C8 6.8

+24V1

R21 15

C13 6.8

+24V2

+24V1

+18V(REF)

R30 24.9K

+5V ADJ

R31 5K

R32 9.09K

R12 10K

C9 .01

-5V

C11 .1

R15 100

CURRENT SENSE

+18 V XA17(7)

+18V(REF)

-24V XA17(3)

-24V(REF)

CURRENT LIMIT INDICATOR

DB6

R5 390

U4

R24 1K

R35 33K

R33 200

R19 2K

CURRENT LIMIT ADJ

C4 .001

R20 56.2K

-24V

R14 6.8K

Q4

R18 4.7K

R25 2.7K

R17 10K

R16 10K

R13 10K

C10 .1

R26 1.5K

+5V XA17(6)

+5V(REF)

R6 15

C5 4.7

R8 15

+5V1

C7 4.7

U3C

U3D

U3E

R23 4.7K

R22 100

+24V2

C14 .001

U2

-5V XA17(5)

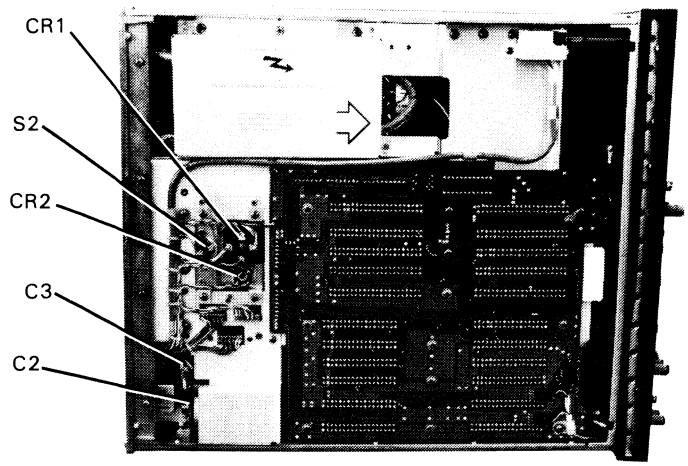
-5V(REF)

R7 15

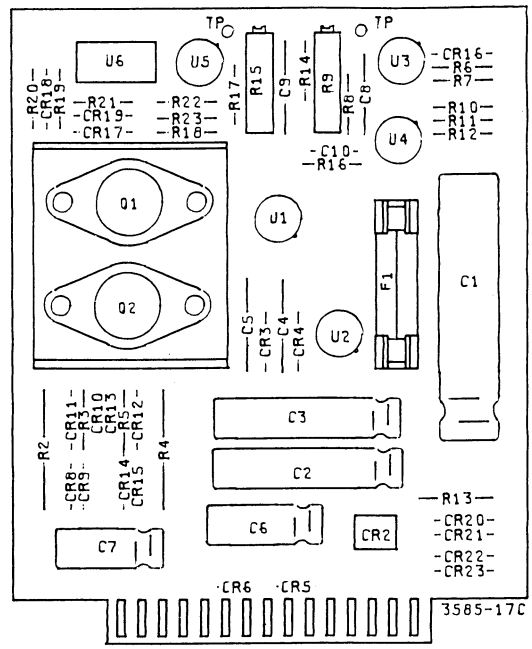
C6 4.7

3582-E-11

Figure 8-11-7. +5 Volt Power Supply.



CHASSIS MOUNTED
COMPONENTS



A17
03582-66517
REV C

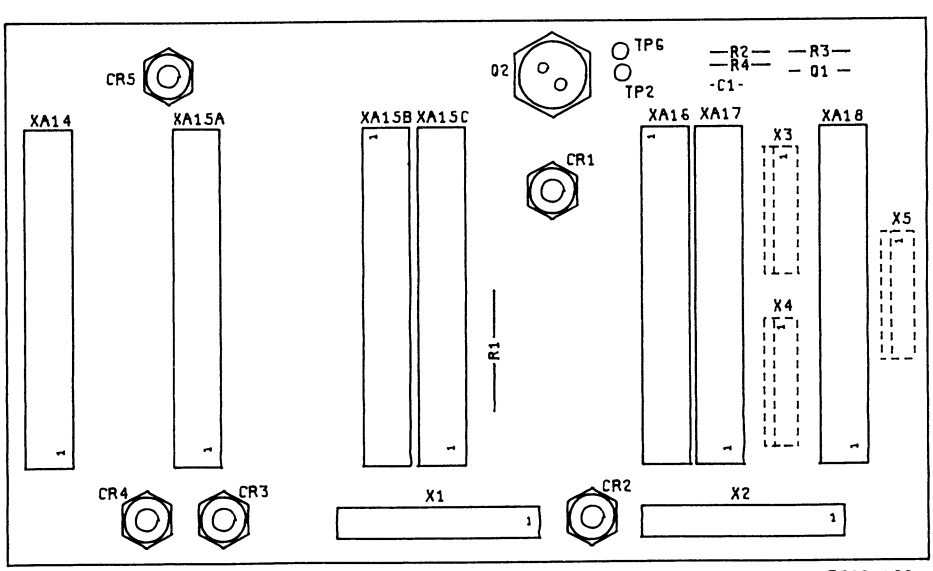
OHMS Readings of Secondary, T1*

Pins	OHMS
5 to 4	29.3
1 to 3	4.8
1 to 2	2.4
3 to 2	2.4
15 to 16	0.5
7 to 8	0.3
9 to 11	2.6
9 to 10	1.3
10 to 11	1.3
14 to 13	2.7
6 to all	Open
12 to all	Open

OHMS Readings of Primary, T1*

Power plug @ 240v	7.9Ω
Power plug @ 220v	7.1Ω
Power plug @ 120v	2.3Ω
Power plug @ 100v	2.2Ω
0 to 40	3.8Ω
0 to 3	0.8Ω
50 to 20	4.0Ω

*Measured with -hp-3455, 4 wire kΩ.



P/O A19 MOTHER BD 03582-66519

A17 POWER SUPPLY CONTROL 03582-66517

P/O A19 03582-66519

P/O A20 MOTHER BOARD

T1

X3

114Vac

114 Vac

9.2Vac

8.5 Vac

CR20 CR21 CR23 CR22

F1 .25A

R13 82K

C1 45

+150V TO A13

U2

C3 350

C5 22

CR4

-5V REF

CR2

C2 350

U1

C4 22

CR3

+5V

R14 10

+5V1

C9 22

+5V REF

U1 & U2 BOTTOM VIEW

OVER VOLTAGE CLAMP

X4

R4 33.2K

C1

R3 33.2K

Q1

Q2

R2 49.9K

CR1

C2 2600

R2 5.6K

+50V

W10

+50V A15 & A16 II

+50V

Q1

R3 10

CR8 CR9 CR10

CR5

R2 2.2K

CR11 24.3V

C6 50

+24V

+24V REF

CR2

C3 900

R3 5.6K

R1 10K

-50V TO A14 TP

-30V to A13

Q2

R5 10

CR13

CR14 CR15

CR6

R4 2.2K

CR12 24.3V

C7 50

-24V

-24V REF

X5

TO A18 IV

(14,R)

(15,S)

(10,L)

(1,A)

(11,M)

W15

W16

SHIELD

FAN

W18 W17

CR16 6.2V

+24V

R7 604

TP +18V

U3

R6 1580

R10 4990

R9 2K

R8 11K

C8 1

+18V REF. ADJ

R11 15K

R12 15K

U4

+5V

-24V

+18V REF

-18V REF

R19 90.9K

R20 20K

R18 36.5K

U5

R16 12.4K

C10 4700pF

R15 5K

27KHz ADJ

+5V1

R17 1K

U6C

U6B

U6A

CR17 15V

R23 10K

R22 1K

CR18

CR19

R21 1K

TP 27KHz

25 μsec

-> 2.5V

- 0V

37 μsec

27 KHz CLK

TO POWER SUPPLY

S1 S3 S4

F1 1.5A

R1 90.9 1W

HIGH LOW

220V 110V

GND

W11

03582-E-9

Figure 8-11-8. Power Supply C
8-11-15/

P/O A19 MOTHER BD 03582-66519 | A17 POWER SUPPLY CONTROL 03582-66517 | P/O A19 03582-66519

P/O A20 MOTHER BOARD

T1

114Vac

114 Vac

9.2Vac

8.5 Vac

CR20 CR21 CR23 CR22 CR2

F1 .25A

R13 82K

C1 45

+150V RAW TO A13 BOARD

U2 U1

U1 & U2 BOTTOM VIEW

C3 350

C2 350

C5 22

C4 22

CR4

CR3

-5V REF

+5V REF.

+5V

R14 10

C9 22

+5V1

OVER VOLTAGE CLAMP

R4 39.2K

C1 .1

R3 332K

R2 49.9K

Q1 Q2

CR1

C1 1

C2 2600

R2 5.6K

+50V

+50V A15 A16

-50V TO A14

-30V to A13

C3 900

R3 5.6K

R1 10K

CR2

R1 90.9 1%

S3 HIGH LOW

S4 220V 110V

FAN

W18 W17 W16 W15 W10

X3 X4 X5

TO A18

SHIELD

Q1 Q2

R3 10

R2 2.2K

CR11 24.3V

CR8 CR9 CR10

C6 50

CR5

R5 10

R4 2.2K

CR12 24.3V

CR13 CR14 CR15

C7 50

CR6

+24V

-24V

+24V REF

-24V REF.

CR16 6.2V

R6 1580

U3

R7 604

R10 4990

R9 2K

R8 11K

C8 1

+18V REF. ADJ

TP +18V

+18V REF.

R11 15K

R12 15K

U4

-18V REF.

R19 90.9K

R20 20K

R18 36.5K

U5

R16 12.4K

R15 5K

C10 4700pF

27KHz ADJ

R17 1K

U6C

U6B

U6A

CR17 15V

R23 10K

R22 1K

CR18 CR19

R21 1K

TP 27KHz

25.4μsec

-> 2.5V

- 0V

37μsec

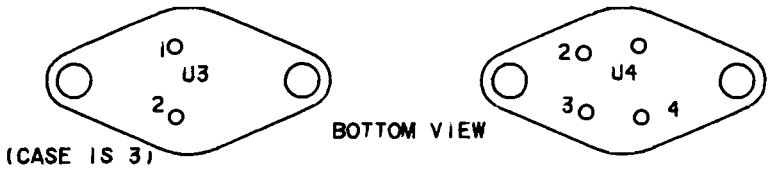
27 KHz CLK

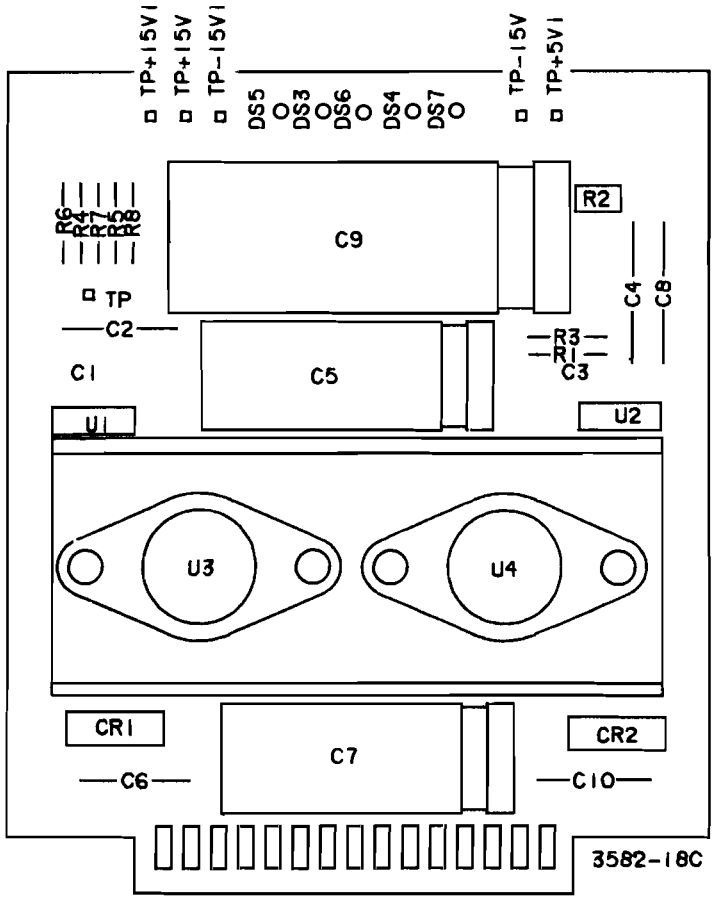
TO POWER SUPPLY BOARDS

03582-E-9

U

Figure 8-11-8. Power Supply Control.





A18
03582-66558
REV A & B

A18 LINEAR POWER SUPPLY 03582-66558

P/O A19 P.S. MOTHER BD 03582-66519

P/O A19 POWER SUP'Y MOTHER BD 03582-66519

U FROM T1

(7) E1 — XA18 4 R

(5) E2 — 15 S

CR2

C9 1700

C10 2.2

+5V TP

DS7

R8 820

XA18 3 C — +5V RAW (+10 to +12V) XA1A (15,5) A

+18V S XA15(7) — 7 H

U1

C1 .1

C2 2.2

TP +15V

DS3

R4 1300

8 J — +15V TO A20 MOTHER BD.

-18V R XA14(8) — 12 N

U2

C3 .1

C4 2.2

TP-15V

DS4

R5 1300

13 P — -15V

(11) E3 — 11 M

CR1

C5 300

U3

C6 2.2

TP +15VI

DS5

R6 1300

4 D — +15VI XA1A(17,U) A

(9) E4 — 10 L

A — ISOLATED GND XA1A(8,Y) XA1B(1,A) A

(10) E6 — 2 B

6 F

C7 300

U4

C8 2.2

TP-15VI

DS6

R7 1300

R3 11.8K

R2 2K -15V ADJ

R1 2.2K

5 E — -15VI XA1A(16,T) A

3582-E-17

ADJ Vout 1 2 BOTTOM VIEW

INPUT U4 OUTPUT CASE

R3 121

R2 200 -15V ADJ

R1 1.21K

REV C CONFIGURATION

V

Figure 8-11-9. Linear Power Supply.

Table 8-11-2. Replaceable Parts.

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A14	03582-66514	4	1	PC ASSEMBLY, -18V POWER SUPPLY	28480	03582-66514
C1	0180-0309	4	18	CAPACITOR-FXD 4.7UF+-20% 10VDC TA	56289	150D475X0010A2
C2	0180-0309	4		CAPACITOR-FXD 4.7UF+-20% 10VDC TA	56289	150D475X0010A2
C3	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C4	0180-0116	1	24	CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
C5	0160-0300	3	2	CAPACITOR-FXD 2700PF +-10% 200VDC POLYE	28480	0160-0300
C6	0160-2204	0	3	CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
C7	0160-2055	9	4	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
C8	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C9	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
C10	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
C11	0180-0309	4		CAPACITOR-FXD 4.7UF+-20% 10VDC TA	56289	150D475X0010A2
C12	0180-2687	5		CAPACITOR-FXD 47UF+100-10% 100VDC AL	28480	0180-2687
C13	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C14	0180-2686	4		CAPACITOR-FXD 470UF+100-10% 25VDC AL	28480	0180-2686
C15	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C16	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
CR3	1902-0202	9		DIODE-ZNR 15V 5% DO-15 PD=1W TC=+.057%	28480	1902-0202
CR5	1901-0026	3		DIODE-PWR RECT 200V 750MA DO-29	28480	1901-0026
DS1	1990-0486	6	6	LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX-RED	28480	5082-4684
DS4	1990-0485	5		LED-VISIBLE LUM-INT=800UCD IF=30MA-MAX-GRN	28480	5082-4984
F1	2110-0043	8	3	FUSE 1.5A 250V FAST-BLO 1.25X.25 UL IEC	28480	2110-0043
	2110-0269	0	9	FUSEHOLDER-CLIP TYPE.25D-FUSE	28480	2110-0269
L1	9140-0244	1		INDUCTOR 1MH	28480	9140-0244
Q1	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	SPS 3611
Q2	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	SPS 3611
Q3	1853-0210	4	1	TRANSISTOR PNP SI TO-39 PD=1W FT=50MHZ	28480	1853-0210
R1	0683-1505	0	13	RESISTOR 15 5% .25W FC TC=-400/+500	01121	CB1505
R2	0683-1505	0		RESISTOR 15 5% .25W FC TC=-400/+500	01121	CB1505
R3	0683-1525	4	15	RESISTOR 1.5K 5% .25W FC TC=-400/+700	01121	CB1525
R4	0683-1525	4		RESISTOR 1.5K 5% .25W FC TC=-400/+700	01121	CB1525
R5	0683-2725	8	7	RESISTOR 2.7K 5% .25W FC TC=-400/+700	01121	CB2725
R6	0683-3915	0		RESISTOR 390 5% .25W FC TC=-400/+600	01121	CB3915
R7	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R8	0683-2725	8		RESISTOR 2.7K 5% .25W FC TC=-400/+700	01121	CB2725
R9	0683-1525	4		RESISTOR 1.5K 5% .25W FC TC=-400/+700	01121	CB1525
R10	0683-1035	1	23	RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
R11	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
R12	0683-4725	2		RESISTOR 4.7K 5% .25W FC TC=-400/+700	01121	CB4725
R13	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R14	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
R15	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
R16	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R17	0683-1015	7		RESISTOR 100 5% .25W FC TC=-400/+500	01121	CB1015
R18	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
R19	0683-1015	7		RESISTOR 100 5% .25W FC TC=-400/+500	01121	CB1015
R20	0683-1505	0		RESISTOR 15 5% .25W FC TC=-400/+500	01121	CB1505
R21	0683-1505	0		RESISTOR 15 5% .25W FC TC=-400/+500	01121	CB1505
R22	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
R23	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
R24	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
R25	0683-4715	0		RESISTOR 470 5% .25W FC TC=-400/+600	01121	CB4715
R26	0683-4705	8		RESISTOR 47 5% .25W FC TC=-400/+500	01121	CB4705
R27	0698-3582	8	1	RESISTOR 41.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4122-F
R28	0757-0404	3	1	RESISTOR 130 1% .125W F TC=0+-100	24546	C4-1/8-T0-131-F
R29	0811-1826	1		RESISTOR .05 10% 3W PW TC=0+-200	28480	0811-1826
R30	0687-1021	3		RESISTOR 1K 10% .5W CC TC=0+647	01121	EB1021
U1	1820-1199	1	13	IC INV TTL LS HEX 1-INP	01295	SN74LS04N
U2	1820-1112	8	20	IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74N
U3	1826-0026	3		IC 311 COMPARATOR TO-99	04713	MLM311G
U4	1826-0026	3		IC 311 COMPARATOR TO-99	04713	MLM311G
U5	1813-0084	6	1	IC TO-66 SW-REG	12969	PIC611
	1205-0247	4		HEAT SINK TO-66-PKG	28480	1205-0247
	03582-01103	1	1	HEAT SINK	28480	03582-01103
				MISCELLANEOUS PARTS		
	4040-0749	4	7	EXTRACTOR-PC BOARD BRN POLYC	28480	4040-0749
	4040-0752	9		EXTRACTOR-PC BOARD YEL POLYC	28480	4040-0752
				NOTE: THE SOLDER BUCKET 1251-2551 IS NO LONGER USED ON THE SWITCHING REGULATOR, U1.		

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

Table 8-11-2. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A15	03582-66515	5	1	PC ASSEMBLY, +7, +12, +18V POWER SUPPLY	28480	03582-66515
C1	0180-2687	5	3	CAPACITOR-FXD 47UF+100-10% 100VDC AL	28480	0180-2687
C2	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C3	0180-2686	4	2	CAPACITOR-FXD 470UF+100-10% 25VDC AL	28480	0180-2686
C4	0160-3456	6	9	CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
C5	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
C6	0180-0309	4		CAPACITOR-FXD 4.7UF+-20% 10VDC TA	56289	150D475X0010A2
C7	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C8	0180-0309	4		CAPACITOR-FXD 4.7UF+-20% 10VDC TA	56289	150D475X0010A2
C9	0160-0300	3		CAPACITOR-FXD 2700PF +-10% 200VDC POLYE	28480	0160-0300
C10	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
C11	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
C12	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
C13	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C14	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
C16	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
CR1	1901-0040	1	19	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
CR2	1902-0202	9		DIODE-ZNR 15V 5% DO-15 PD=1W TC=+.057%	28480	1902-0202
CR4	1901-0026	3		DIODE-PWR RECT 200V 750MA DO-29	28480	1901-0026
D33	1990-0485	5	8	LED-VISIBLE LUM-INT=800UCD IF=30MA-MAX-GRN	28480	5082-4984
D35	1990-0486	6		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX-RED	28480	5082-4684
F1	2110-0043	8		FUSE 1.5A 250V FAST-BLO 1.25X.25 UL IEC	28480	2110-0043
	2110-0269	0		FUSEHOLDER-CLIP TYPE,250-FUSE	28480	2110-0269
L1	9140-0244	1	2	INDUCTOR 1MH	28480	9140-0244
Q1	1853-0086	2	2	TRANSISTOR PNP SI PD=310MW FT=40MHZ	28480	1853-0086
Q2	1854-0022	8	2	TRANSISTOR NPN SI TO-39 PD=700MW	07263	817843
Q3	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	SPS 3611
Q4	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	SPS 3611
R1	0811-1826	1	2	RESISTOR .05 10% 3W PW TC=0+-200	28480	0811-1826
R2	0757-0284	7	7	RESISTOR 150 1% .125W F TC=0+-100	24546	C4-1/8-T0-151-F
R3	0687-1021	3	2	RESISTOR 1K 10% .5W CC TC=0+647	01121	EB1021
R4	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R5	0757-0449	6	2	RESISTOR 20K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2002-F
R7	0683-1505	0		RESISTOR 15 5% .25W FC TC=-400/+500	01121	CB1505
R8	0683-1505	0		RESISTOR 15 5% .25W FC TC=-400/+500	01121	CB1505
R9	0683-1505	0		RESISTOR 15 5% .25W FC TC=-400/+500	01121	CB1505
R10	0683-1505	0		RESISTOR 15 5% .25W FC TC=-400/+500	01121	CB1505
R11	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R12	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R13	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
R14	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
R15	0757-0442	9	10	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
R16	0683-1515	2	2	RESISTOR 150 5% .25W FC TC=-400/+600	01121	CB1515
R17	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
R18	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
R19	0683-1015	7		RESISTOR 100 5% .25W FC TC=-400/+500	01121	CB1015
R20	0698-6704	2	1	RESISTOR 24.9K .25% .125W F TC=0+-100	28480	0698-6704
R21	0698-4480	7	2	RESISTOR 15.8K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1582-F
R22	0683-6825	7		RESISTOR 6.8K 5% .25W FC TC=-400/+700	01121	CB6825
R23	0683-1525	4		RESISTOR 1.5K 5% .25W FC TC=-400/+700	01121	CB1525
R24	0683-4725	2		RESISTOR 4.7K 5% .25W FC TC=-400/+700	01121	CB4725
R25	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
R26	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
R27	0683-2725	8		RESISTOR 2.7K 5% .25W FC TC=-400/+700	01121	CB2725
R28	0683-3915	0		RESISTOR 390 5% .25W FC TC=-400/+600	01121	CB3915
R29	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R30	0683-2725	8		RESISTOR 2.7K 5% .25W FC TC=-400/+700	01121	CB2725
R31	0683-4725	2		RESISTOR 4.7K 5% .25W FC TC=-400/+700	01121	CB4725
R32	0757-0272	3	1	RESISTOR 52.3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5232-F
U1	1813-0083	5	1	IC TO-66	12969	PIC601
	1205-0247	4	2	HEAT SINK TO-66-PKG	28480	1205-0247
	03582-01103			HEAT SINK	28480	03482-01103
U2	1826-0026	3		IC 311 COMPARATOR TO-99	04713	MLM311G
U3	1826-0026	3		IC 311 COMPARATOR TO-99	04713	MLM311G
U4	1820-1199	1		IC INV TTL LS HEX 1-INP	01295	SN74LS04N
U5	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74N
				MISCELLANEOUS PARTS		
				NOTE: THE 1251-2551 SOLDER BUCKET IS NO LONGER USED ON THE SWITCHING REGULATOR, U1.		

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

Table 8-11-2. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
	4040-0749 4040-0753	4 0	3	EXTRACTOR-PC BOARD BRN POLYC EXTRACTOR-PC BOARD GRN POLYC	28480 28480	4040-0749 4040-0753

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

Table 8-11-2. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A16	03582-66516	6	1	PC ASSEMBLY, +5V POWER SUPPLY	28480	03582-66516
C1	0180-2687	5		CAPACITOR-FXD 47UF+100-10% 100VDC AL	28480	0180-2687
C2	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C3	0180-2695	5	1	CAPACITOR-FXD 1000UF+100-10% 12VDC AL	28480	0180-2695
C4	0160-0154	5	1	CAPACITOR-FXD 2200PF +-10% 200VDC POLYE	28480	0160-0154
C5	0180-0309	4		CAPACITOR-FXD 4.7UF+-20% 10VDC TA	56289	150D475X0010A2
C6	0180-0309	4		CAPACITOR-FXD 4.7UF+-20% 10VDC TA	56289	150D475X0010A2
C7	0180-0309	4		CAPACITOR-FXD 4.7UF+-20% 10VDC TA	56289	150D475X0010A2
C8	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
C9	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
C10	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C11	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C12	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
C13	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
C14	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
CR1	1902-0202	9	3	DIODE-ZNR 15V 5% DO-15 PD=1W TC=+.057%	28480	1902-0202
CR4	1901-0662	3	1	DIODE-PWR RECT 100V 6A	04713	MR751
CR5	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
DS3	1990-0485	5		LED-VISIBLE LUM-INT=800UCD IF=30MA-MAX-GRN	28480	5082-4984
DS6	1990-0486	6		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX-RED	28480	5082-4684
F1	2110-0043	8		FUSE 1.5A 250V FAST-BLO 1.25X.25 UL IEC	28480	2110-0043
	2110-0269	0		FUSEHOLDER-CLIP TYPE,25D-FUSE	28480	2110-0269
L1	9140-0243	0	1	INDUCTOR 150μH	28480	9140-0243
Q3	1854-0022	8		TRANSISTOR NPN SI TO-39 PD=700MW	07263	S17843
Q4	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	SPS 3611
Q5	1853-0086	2		TRANSISTOR PNP SI PD=310MW FT=40MHZ	28480	1853-0086
R4	0683-1615	3	1	RESISTOR 160 5% .25W FC TC=-400/+600	01121	CB1615
R5	0683-3915	0	10	RESISTOR 390 5% .25W FC TC=-400/+600	01121	CB3915
R6	0683-1505	0		RESISTOR 15 5% .25W FC TC=-400/+500	01121	CB1505
R7	0683-1505	0		RESISTOR 15 5% .25W FC TC=-400/+500	01121	CB1505
R8	0683-1505	0		RESISTOR 15 5% .25W FC TC=-400/+500	01121	CB1505
R9	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R10	0683-6805	3	1	RESISTOR 68 5% .25W FC TC=-400/+500	01121	CB6805
R11	0683-1505	0		RESISTOR 15 5% .25W FC TC=-400/+500	01121	CB1505
R12	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
R13	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
R14	0683-6825	7	2	RESISTOR 6.8K 5% .25W FC TC=-400/+700	01121	CB6825
R15	0683-1015	7		RESISTOR 100 5% .25W FC TC=-400/+500	01121	CB1015
R16	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
R17	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
R18	0683-4725	2		RESISTOR 4.7K 5% .25W FC TC=-400/+700	01121	CB4725
R19	2100-3273	1		RESISTOR-TRMR 2K 10% C SIDE-ADJ 1-TRN	28480	2100-3273
R20	0757-0459	8		RESISTOR 56.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5622-F
R21	0683-1505	0		RESISTOR 15 5% .25W FC TC=-400/+500	01121	CB1505
R22	0683-1015	7		RESISTOR 100 5% .25W FC TC=-400/+500	01121	CB1015
R23	0683-2725	8		RESISTOR 2.7K 5% .25W FC TC=-400/+700	01121	CB2725
R24	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R25	0683-2725	8		RESISTOR 2.7K 5% .25W FC TC=-400/+700	01121	CB2725
R26	0683-1525	4		RESISTOR 1.5K 5% .25W FC TC=-400/+700	01121	CB1525
R27	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
R28	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
R29	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R30	0698-4480	7		RESISTOR 15.8K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1582-F
R31	2100-3207	1	1	RESISTOR-TRMR 5K 10% C SIDE-ADJ 1-TRN	28480	2100-3207
R32	0698-4470	5		RESISTOR 6.98K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6981-F
R33	0812-0031	0	1	RESISTOR 200 5% .25W PWW TC=+4000+-400	54294	PC312-1/4-201-J
R34	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
R35	0683-3335	8	1	RESISTOR 33K 5% .25W FC TC=-400/+800	01121	CB3335
U1	1826-0026	3	9	IC 311 COMPARATOR TO-99	04713	MLM311G
U2	1826-0026	3		IC 311 COMPARATOR TO-99	04713	MLM311G
U3	1820-1199	1		IC INV TTL LS HEX 1-INP	01295	SN74LS04N
U4	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74N
U5	1813-0082	4	1	IC TO-3 SW-REG	12969	PIC646
	1251-1636	4	3	CONNECTOR-SGL CONT SKT .04-IN-BSC-BZ RND	28480	1251-1636
	03582-01101	9	1	HEAT SINK	28480	03582-01101
				MISCELLANEOUS PARTS		
	4040-0749	4		EXTRACTOR-PC BOARD BRN POLYC	28480	4040-0749
	4040-0754	1	2	EXTRACTOR-PC BOARD BLU POLYC	28480	4040-0754

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

Table 8-11-2. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	CD	Qty	Description	Mfr Code	Mfr Part Number
A17	03582-66517	7	1	PC ASSEMBLY, POWER SUPPLY CONTROL	28480	03582-66517
C1	0180-1748	7	1	CAPACITOR-FXD 45UF+50-10% 250VDC AL	56289	39D456F250FL4
C2	0180-2216	6	2	CAPACITOR-FXD 350UF+75-10% 16VDC AL	56289	30D357G016DH2
C3	0180-2216	6		CAPACITOR-FXD 350UF+75-10% 16VDC AL	56289	30D357G016DH2
C4	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
C5	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
C6	0180-0141	2	3	CAPACITOR-FXD 50UF+75-10% 50VDC AL	56289	30D506G050DD2
C7	0180-0141	2		CAPACITOR-FXD 50UF+75-10% 50VDC AL	56289	30D506G050DD2
C8	0180-0291	3	1	CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
C9	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
C10	0160-2373	4	1	CAPACITOR-FXD 4700PF +-2% 300VDC MICA	28480	0160-2373
CR2	1906-0069	4		DIODE-FW BRDG 400V 1A	28480	1906-0069
CR3	1901-0026	3	6	DIODE-PWR RECT 200V 750MA DO-29	28480	1901-0026
CR4	1901-0026	3		DIODE-PWR RECT 200V 750MA DO-29	28480	1901-0026
CR5	1901-0026	3		DIODE-PWR RECT 200V 750MA DO-29	28480	1901-0026
CR6	1901-0026	3		DIODE-PWR RECT 200V 750MA DO-29	28480	1901-0026
CR8	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
CR9	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
CR10	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
CR11	1902-0557	7	2	DIODE-ZNR 24.3V 5% DO-15 PD=1W TC=+.078%	28480	1902-0557
CR12	1902-0557	7		DIODE-ZNR 24.3V 5% DO-15 PD=1W TC=+.078%	28480	1902-0557
CR13	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
CR14	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
CR15	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
CR16	1902-0777	3		DIODE-ZNR 1N825 6.2V 5% DO-7 PD=.4W	04713	1N825
CR17	1902-3205	8	1	DIODE-ZNR 15V 5% DO-7 PD=.4W TC=+.057%	28480	1902-3205
CR18	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
CR19	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
CR20-23	1901-0924	0		DIODE-HV RECT 1N4005 600V 1A DO-41	04713	1N4005
F1	2110-0201	0	1	FUSE .25A 250V SLO-BLO 1.25X.25 UL IEC	75915	313.250
FC1,2	2110-0269	0		FUSEHOLDER-CLIP TYPE,250-FUSE	28480	2110-0269
Q1	1854-0216	2	1	TRANSISTOR NPN 2N3441 SI TO-66 PD=25W	01928	2N3441
Q2	1853-0323	0	1	TRANSISTOR PNP 2N4900 SI TO-66 PD=25W	07263	2N4900
	0340-0566	5	2	INSULATOR-XSTR RUBBER RED	28480	0340-0566
	03582-01104	2	1	HEAT SINK	28480	03582-01104
	1251-2551	4	10	CONNECTOR-SGL CONT SKT .033-IN-BSC-SZ	28480	1251-2551
R2	0764-0042	0	2	RESISTOR 2.2K 5% 2W MO TC=0+-200	28480	0764-0042
R3	0683-1005	5	11	RESISTOR 10 5% .25W FC TC=-400/+500	01121	CB1005
R4	0764-0042	0		RESISTOR 2.2K 5% 2W MO TC=0+-200	28480	0764-0042
R5	0683-1005	5		RESISTOR 10 5% .25W FC TC=-400/+500	01121	CB1005
R6	0698-4426	1	1	RESISTOR 1.58K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1581-F
R7	0757-0161	9	6	RESISTOR 604 1% .125W F TC=0+-100	24546	C4-1/8-T0-604R-F
R8	0757-0443	0	1	RESISTOR 11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1102-F
R9	2100-3109	2	3	RESISTOR-TRMR 2K 10% C SIDE-ADJ 17-TRN	02111	43P202
R10	0698-3279	0		RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
R11	0698-6678	9	2	RESISTOR 15K .5% .125W F TC=0+-50	28480	0698-6678
R12	0698-6678	9		RESISTOR 15K .5% .125W F TC=0+-50	28480	0698-6678
R13	0687-8231	1	1	RESISTOR 82K 10% .5W CC TC=0+765	01121	EB8231
R14	0683-1005	5		RESISTOR 10 5% .25W FC TC=-400/+500	01121	CB1005
R15	2100-3056	8	1	RESISTOR-TRMR 5K 10% C SIDE-ADJ 17-TRN	02111	43P502
R16	0698-3519	1	2	RESISTOR 12.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1242-F
R17	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R18	0757-0455	4	1	RESISTOR 36.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3652-F
R19	0757-0464	5	1	RESISTOR 90.9K 1% .125W F TC=0+-100	24546	C4-1/8-T0-9092-F
R20	0757-0449	6		RESISTOR 20K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2002-F
R21	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R22	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R23	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
U1	1820-0429	8	1	IC V RGLTR TO-39	18324	LM309H
	1205-0011	0		HEAT SINK TO-5/TO-39-PKG	28480	1205-0011
U2	1826-0220	9	3	IC V RGLTR TO-39	27014	LM320H-05
U3	1820-0203	6		IC 741 DP AMP TO-99	01928	CA741CT
U4	1820-0203	6		IC 741 DP AMP TO-99	01928	CA741CT
U5	1826-0026	3		IC 311 COMPARATOR TO-99	04713	MLM311G
U6	1820-1201	6		IC GATE TTL LS AND QUAD 2-INP	01295	SN74LS08N
				MISCELLANEOUS PARTS		
	4040-0749	4		EXTRACTOR-PC BOARD BRN POLYC	28480	4040-0749
	4040-0755	2	3	EXTRACTOR-PC BOARD VIO POLYC	28480	4040-0755

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

Table 8-11-2. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	CD	Qty	Description	Mfr Code	Mfr Part Number
A18	03582-66518	8	1	PC ASSEMBLY, LINEAR POWER SUPPLY	28480	03582-66518
C1	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C2	0180-1846	6		CAPACITOR-FXD 2.2UF+-10% 35VDC TA	56289	150D225X9035B2
C3	0160-3622	8		CAPACITOR-FXD .1UF +80-20% 100VDC CER	28480	0160-3622
C4	0180-1846	6		CAPACITOR-FXD 2.2UF+-10% 35VDC TA	56289	150D225X9035B2
C5	0180-2503	4	2	CAPACITOR-FXD 300UF+75-10% 40VDC AL	56289	39D307G040FJ4
C6	0180-1846	6		CAPACITOR-FXD 2.2UF+-10% 35VDC TA	56289	150D225X9035B2
C7	0180-2503	4		CAPACITOR-FXD 300UF+75-10% 40VDC AL	56289	39D307G040FJ4
C8	0180-1846	6		CAPACITOR-FXD 2.2UF+-10% 35VDC TA	56289	150D225X9035B2
C9	0180-2730	9	1	CAPACITOR-FXD 1700UF+75-10% 30VDC AL	28480	0180-2730
C10	0180-1846	6		CAPACITOR-FXD 2.2UF+-10% 35VDC TA	56289	150D225X9035B2
CR1	1906-0096	7	2	DIODE-FW BRDG 200V 2A	04713	MDA202
CR2	1906-0096	7		DIODE-FW BRDG 200V 2A	04713	MDA202
DS3	1990-0485	5		LED-VISIBLE LUM-INT=800UCD IF=30MA-MAX-GRN	28480	5082-4984
DS4	1990-0485	5		LED-VISIBLE LUM-INT=800UCD IF=30MA-MAX-GRN	28480	5082-4984
DS5	1990-0485	5		LED-VISIBLE LUM-INT=800UCD IF=30MA-MAX-GRN	28480	5082-4984
DS6	1990-0485	5		LED-VISIBLE LUM-INT=800UCD IF=30MA-MAX-GRN	28480	5082-4984
DS7	1990-0485	5		LED-VISIBLE LUM-INT=800UCD IF=30MA-MAX-GRN	28480	5082-4984
R1	0757-0430	5	1	RESISTOR 2.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2211-F
R2	2100-3273	1	5	RESISTOR-TRMR 2K 10% C SIDE-ADJ 1-TRN	28480	2100-3273
R3	0698-3264	3	3	RESISTOR 11.8K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1182-F
R4	0683-1325	2	4	RESISTOR 1.3K 5% .25W FC TC=-400/+700	01121	CB1325
R5	0683-1325	2		RESISTOR 1.3K 5% .25W FC TC=-400/+700	01121	CB1325
R6	0683-1325	2		RESISTOR 1.3K 5% .25W FC TC=-400/+700	01121	CB1325
R7	0683-1325	2		RESISTOR 1.3K 5% .25W FC TC=-400/+700	01121	CB1325
R8	0683-8215	3	2	RESISTOR 820 5% .25W FC TC=-400/+600	01121	CB8215
U1	1826-0396	0	1	IC 7815 V RGLTR TO-220	07263	7815UC
U2	1826-0277	6	1	IC V RGLTR TO-220	27014	LM320T-15
	0340-0564	3	2	INSULATOR-XSTR RUBBER RED	28480	0340-0564
U3	1826-0203	8	1	IC 7815 V RGLTR TO-3	07263	7815KC
U4	1826-0444	9	1	IC V RGLTR TO-3	07263	UA79GKC
	0340-0656	4	1	INSULATOR-XSTR THRM-CNDCT	28480	0340-0656
	03582-01112	2	1	HEAT SINK	28480	03582-01112
				MISCELLANEOUS PARTS		
	4040-0747	2	2	EXTRACTOR-PC BOARD GRA POLYC	28480	4040-0747
	4040-0749	4		EXTRACTOR-PC BOARD BRN POLYC	28480	4040-0749

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

Table 8-11-2. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A19	03582-66519	9	1	PC ASSEMBLY, POWER SUPPLY MOTHER BOARD	28480	03582-66519
C1	0160-3879	7	1	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
CR1	1902-1217	8	1	DIODE-ZNR 6.2V 5% DO-4 PD=10W TC=+.035%	28480	1902-1217
CR2	1902-1204	3	1	DIODE-ZNR 1N2984B 20V 5% DO-4 PD=10W	12954	1N2984B
CR3	1902-0909	3	1	DIODE-ZNR 1N2972A 8.2V 10% DO-4 PD=10W	04713	1N2972A
CR4	1902-0910	6	1	DIODE-ZNR 1N2984RB 20V 5% DO-4 PD=10W	04713	1N2984RB
CR5	1902-0643	2	1	DIODE-ZNR 1N2979B 15V 5% DO-4 PD=10W	28480	1902-0643
Q1	1884-0272	3	1	THYRISTOR-DIAC TRIG IPK=2A MAX; PD=300MW	01928	D3202Y
Q2	1884-0270	1	1	THYRISTOR-TRIAC 2N5569	01928	2N5569
R1	0687-1031	5	1	RESISTOR 10K 10% .5W CC TC=0+765	01121	EB1031
R2	0698-3228	9	3	RESISTOR 49.9K 1% .125W F TC=0+-100	28480	0698-3228
R3	0757-0454	3	2	RESISTOR 33.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3322-F
R4	0757-0454	3		RESISTOR 33.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3322-F
				MISCELLANEOUS PARTS		
	1251-1115	4		POLARIZING KEY-PC EDGE CONN	28480	1251-1115
	1251-2035	9	7	CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
X1,2	1251-3361	6	2	CONNECTOR 10-PIN F POST TYPE	28480	1251-3361
X3,4,5	1251-3638	0	3	CONNECTOR 6-PIN M POST TYPE	28480	1251-3638

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

Table 8-11-2. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				REAR PANEL MOUNTED COMPONENTS		
B1	3160-0097	8	1	FAN-TBAX 120-CFM 115B 50/60-HZ	28480	3160-0097
MP2	03582-00210	9	1	PANEL, POWER SUPPLY	28480	03582-00210
MP2A	9100-3910	0	1	FILTER-LINE	28480	9100-3910
MP2B	3101-2042	3	2	SWITCH, SLIDE, LINE VOLTAGE	28480	3101-2042
MP2C	2110-0564	8	1	FUSEHOLDER BODY 12A MAX FOR UL	06328	031,1657
MP2D	2110-0565	9	1	FUSEHOLDER CAP 12A MAX FOR UL	28480	2110-0565
MP2E	2110-0569	3		FUSEHOLDER-NUT-THREAD-M 12.7 X 1.5 DBL	H9027	583.0016
MP3	03582-00213	2	1	PANEL, CONNECTOR	28480	03582-00213
MP3A	3101-0199	7	2	SWITCH-SL DPDT-NS MINTR .5A 125VAC/DC	28480	3101-0199
MP3B	03582-61613	4	2	HP-IB CONNECTOR W/CABLE	28480	03582-61613
MP3C	1251-3283	1	1	HP-IB CONNECTOR	28480	1251-3283
MP3D	0380-0643	3	1	STANDOFF-METRIC LONG STUD MOUNT FOR CONN	28480	0380-0643
MP3E	1250-0083	1	2	CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0083
MP3F	1510-0090	2	2	BINDING POST ASSY SGL SGL-TUR JGK	28480	1510-0090
MP5	03582-04104	8	2	GUARD, FAN	28480	03582-04104
MP6	03582-00214	3	1	PANEL, FAN	28480	03582-00214
MP7A	0590-0167	1	4	NUT-THUMB 6-32-THD BRS	28480	0590-0167
MP7	3150-0218	4	1	FILTER-AIR 32 STD MESH MET SCREEN	28480	3150-0218
MP8	03582-00209	6	1	PANEL, REAR	28480	03582-00209
RPC1	0150-0012	3	2	CAPACITOR-FXD .01UF +-20% 1KVDC CER	56289	C023A102J103M838
RPC2	0150-0012	3		CAPACITOR-FXD .01UF +-20% 1KVDC CER	56289	C023A102J103M838
	7120-0270	9		LABEL	28480	7120-0270
	7120-3810	9		LABEL-WARNING .1-IN-WD 2.6-IN-LG MYLAR	28480	7120-3810
	7120-3811	0		LABEL-WARNING .1-IN-WD 2.6-IN-LG MYLAR	28480	7120-3811
	7120-6957	1		LABEL-INFORMATION .5-IN-WD 1.75-IN-LG	28480	7120-6957

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

Table 8-11-2. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				CHASSIS MOUNTED COMPONENTS		
C1	0160-4603	7	1	CAPACITOR-FXD 1UF +-20% 200VDC MET-POLYP	28480	0160-4603
C2	0180-0696	2	1	CAPACITOR-FXD 2600UF+50-10% 75VDC AL	00853	1012627075882A
C3	0180-2316	7	1	CAPACITOR-FXD 900UF+50-10% 100VDC AL	56289	36D901F100A82A
CR1	1906-0212	9	1	DIODE-FW BRDG 400V 35A	04713	MDA3504
CR2	1901-0526	8	1	DIODE-FW BRDG 100V 5A	14099	8CAJ1
R1	03582-27901	1	1	RESISTOR, FXD 90.9 OHM, 5W	28480	03582-27901
R2	0764-0020	4	2	RESISTOR 5.6K 5% 2W MO TC=0+-200	28480	0764-0020
R3	0764-0020	4		RESISTOR 5.6K 5% 2W MO TC=0+-200	28480	0764-0020
S1	3101-2216	3	2	SWITCH-PB DPDT ALTNG 4A 250VAC	28480	3101-2216
S2	3103-0020	7	1	SWITCH-THRM FXD +100C 15A DPN-ON-RISE	28480	3103-0020
S3	3101-2024	1	2	SWITCH-TGL BASIC SPDT 1A 250VAC SLDR-LUG	28480	3101-2024
S4	3101-2024	1		SWITCH-TGL BASIC SPDT 1A 250VAC SLDR-LUG	28480	3101-2024
T1	9100-4063	6	1	TRANSFORMER-POWER 115V 50-60 HZ, 1	28480	9100-4063

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

SERVICE GROUP 12
CHASSIS MOUNTED COMPONENTS

TABLE OF CONTENTS

Service Group — Page

12. CHASSIS MOUNTED COMPONENTS . . 8-12-1
    - 8-12-1. Introduction 8-12-1
    - 8-12-3. Chassis Mounted Components Cross Reference 8-12-1
    - 8-12-5. Replacing The CRT 8-12-1
    - 8-12-6. General Information 8-12-1

LIST OF TABLES

Table — Page

8-12-1. Replaceable Parts 8-12-9

LIST OF ILLUSTRATIONS

Figure — Page

8-12-1. Mother Board (Bottom Side) 8-12-3/8-12-4
8-12-2. Chassis Exploded View 8-12-5/8-12-6
8-12-3. CRT Assy Exploded View 8-12-7/8-12-8

CHASSIS MOUNTED COMPONENTS
SERVICE GROUP 12

8-12-1. INTRODUCTION.

8-12-2. This service group contains information concerning the replacement of the CRT, Mother board diagram, and chassis mounted components not covered in other service groups.

8-12-3. CHASSIS MOUNTED COMPONENTS CROSS REFERENCE.

8-12-4. Use the following cross reference to determine the service group which contains the part numbers for a particular part grouping.

Part Group	Service Group
Cables	12
CRT	12
Fan	11
Frame Parts	12
Front Panel	7
Power Supply	11
Miscellaneous Parts	12
Rear Panel	11

8-12-5. REPLACING THE CRT.

CAUTION

The CRT and associated circuits may retain lethal voltages (up to 18 kV) even when the instrument power is off.

8-12-6. General Information.

8-12-7. Before removing CRT, be sure that instrument power is off and allow sufficient time for circuits to discharge. Handle the CRT with care!

8-12-8. Perform the following steps:

a. Remove the top and bottom instrument covers.

b. From the bottom of the instrument, remove the screw retaining the CRT shield ground lug.

c. Unplug the post accelerator cable (red) and ground the CRT end to the chassis. Then connect clip lead between the HV lead and ground. Be careful of the high voltage hazards!

d. Remove the plastic shield over the A13 board.

e. Unplug the two Molex connectors in the center of the A13 board (that have wires leading to the pin connectors).

f. Remove the remaining screws (standoffs) holding the A13 board to the chassis. The A13 board may be swung up leaving other cables attached.

g. Using a flat-bladed screwdriver, carefully pry off the connector at the rear of the CRT.

h. Remove the retaining band that clamps the CRT shield to the chassis.

i. With the A13 board swung aside, the CRT may be pulled upward and backward away from the instrument chassis.

j. To remove the CRT from the shield, perform the following steps:

   1. Disconnect the wires at the pin connectors at the side of the CRT.

   2. Loosen the screws of the alignment coils (2 each).

   3. Place the CRT face on a soft surface. Then while holding the shield with both hands, press on the rear of the tube with the thumbs forcing the tube forward and out of the shield.

   4. Remove the foam ring from the rear of the CRT shield.

k. Reinstall the CRT using the general procedure for removal in reverse order. Be careful that the following points are observed.

   1. Slide the CRT into the shield so that the neck and connectors line up with the slots.

   2. Press forward on the alignment coils screws (at the side) to secure the coil against the CRT neck before tightening.

   3. Replace the foam ring at the rear of the CRT shield, sliding it just far enough on the CRT neck so that there is no interferrence to the rear connector.

l. Perform high voltage section adjustment and alignment.

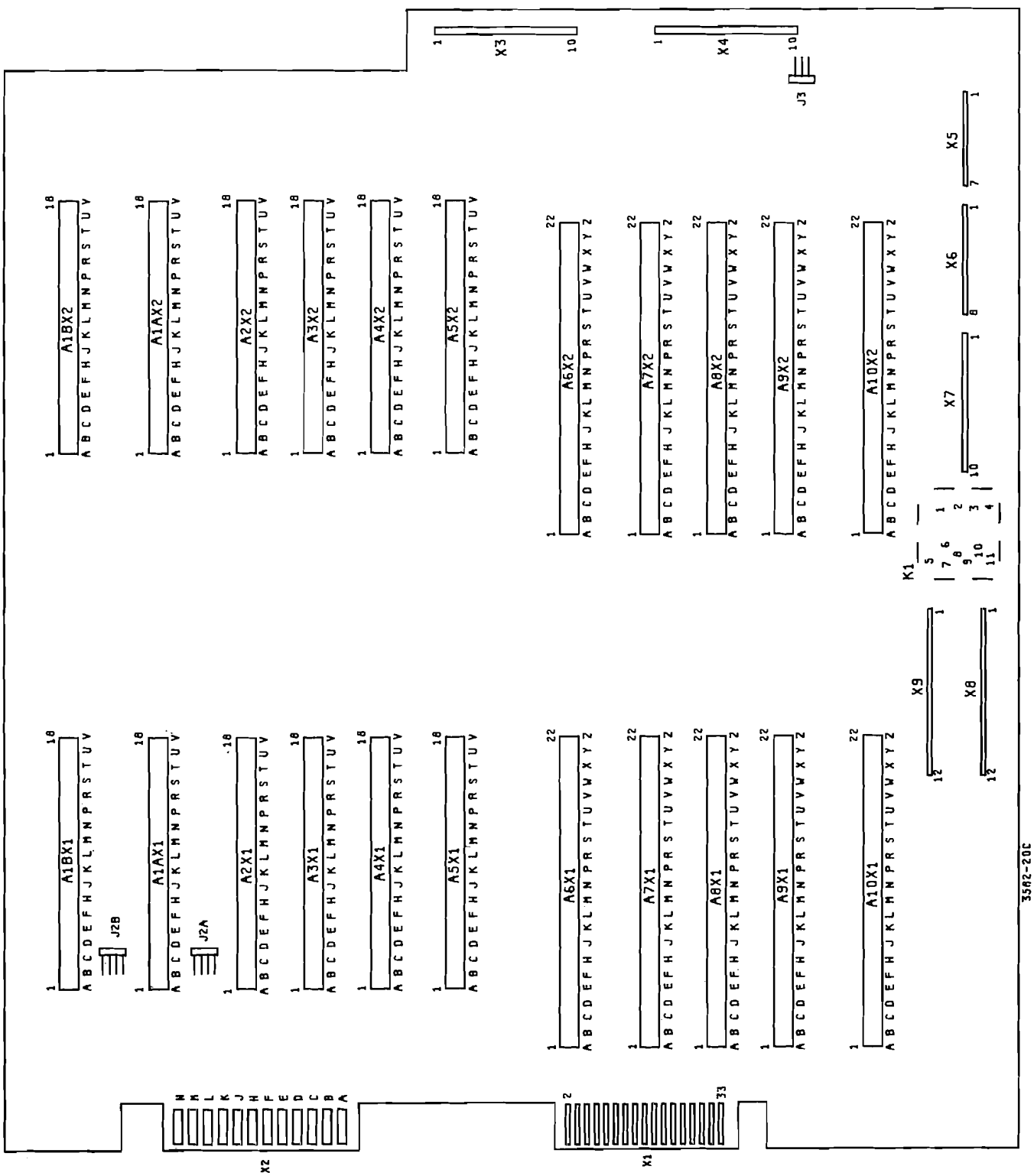


Figure 8-12-1. Mother Board (Bottom Side).

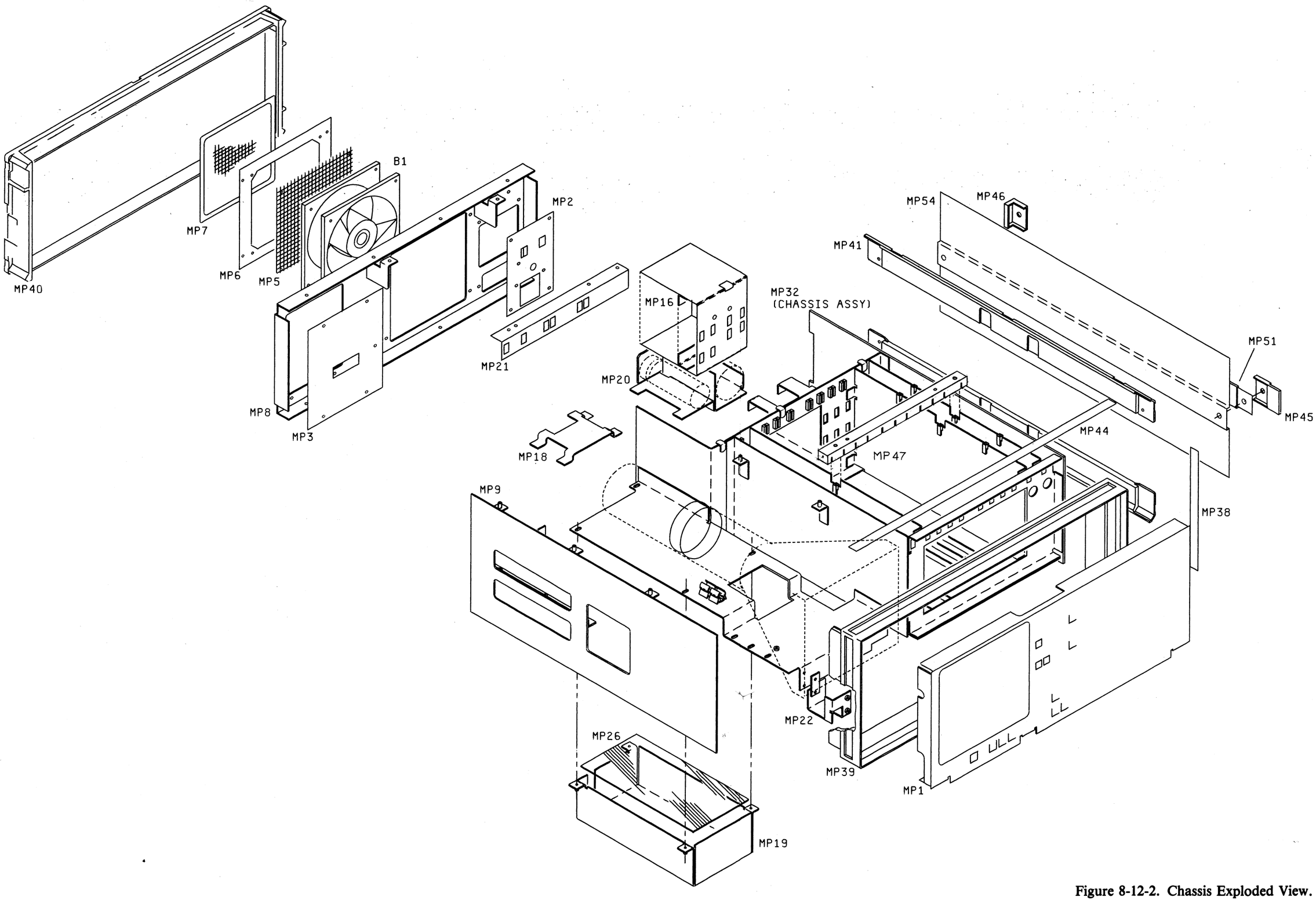


Figure 8-12-2. Chassis Exploded View.

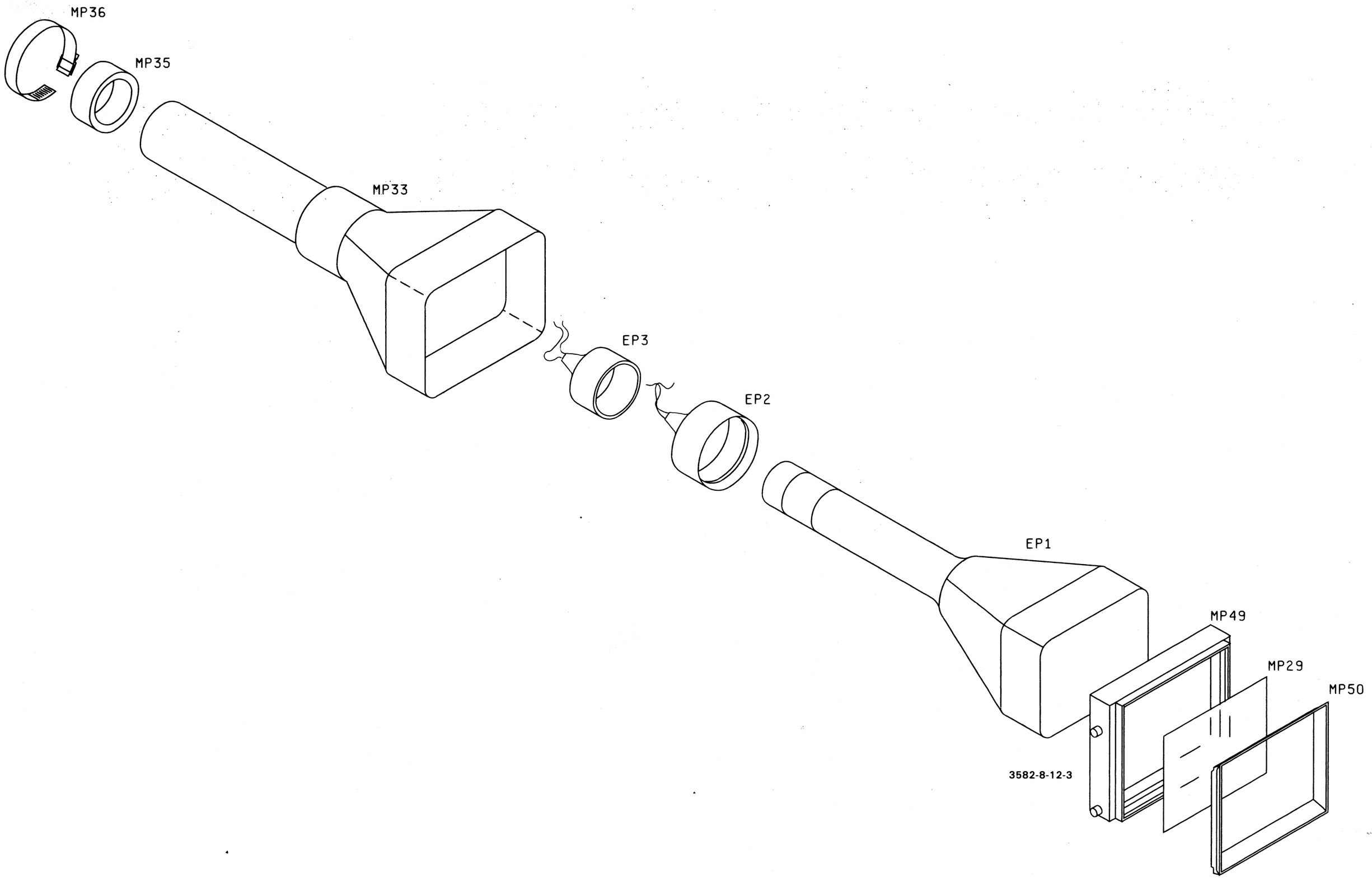


Figure 8-12-3. CRT Assy Exploded View.
8-12-7/8-12-8

CATHODE-RAY TUBE FAILURE REPORT

(This form must accompany all warranty claims and MFR/HEART credit claims.)

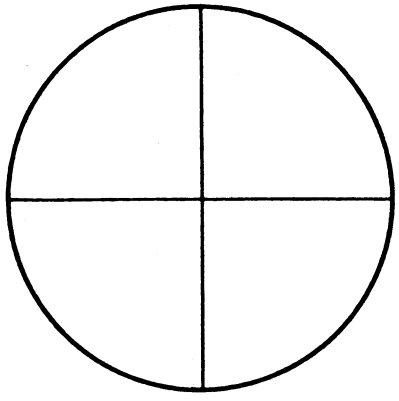
Date_____

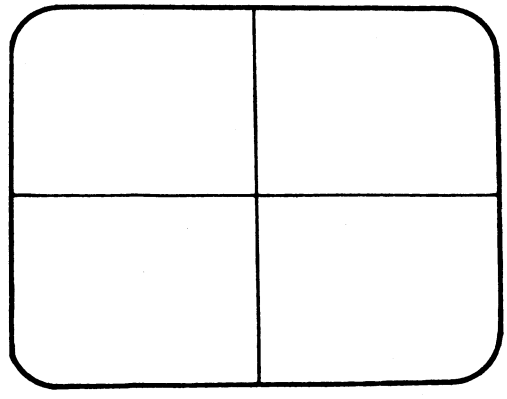
Submitted By (Name)_____

Name of Company_____

Address_____

1. Hewlett-Packard Instrument Model No._____
2. Hewlett-Packard Instrument Serial No._____
3. Defective CRT Serial No._____ Part No._____
4. Replacement (New) CRT Serial No._____
5. Please describe the failure and, if possible, show the trouble on the appropriate CRT face below.





6. Is a warranty claim being made?_____
7. Hewlett-Packard Sales/Service Office_____
8. MFR, HEART or Customer Service Order Number_____

Table 8-12-1. Replaceable Parts.

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A20	03582-66520	2	1	PC ASSEMBLY, MOTHER	28480	03582-66520
J2A, 2B	1251-5291	5	1	CONNECTOR 4-PIN M POST TYPE	28480	1251-5291
J3	1251-5501	0	1	CONNECTOR 3-PIN M POST TYPE	28480	1251-5501
K1	0490-0563	9	1	RELAY	28480	0490-0563
	0490-0568	4	1	SOCKET-RLY 11-CONT DIP-SLDR	28480	0490-0568
				MISCELLANEOUS PARTS		
	1251-1115	4	58	POLARIZING KEY-PC EDGE CONN	28480	1251-1115
	1251-1365	6	10	CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
	1251-2026	8	12	CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
X7	1251-3750	7	1	CONNECTOR 10-PIN M POST TYPE	28480	1251-3750
X6	1251-3751	8	1	CONNECTOR 8-PIN M POST TYPE	28480	1251-3751
X8, 9	1251-3902	1	2	CONNECTOR 12-PIN M POST TYPE	28480	1251-3902
X5	1251-4882	8	1	CONNECTOR 7-PIN M POST TYPE	28480	1251-4882
X3, 4	1251-5096	8	2	CONNECTOR 10-PIN M POST TYPE	28480	1251-5096

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

Table 8-12-1. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				CHASSIS MOUNTED COMPONENTS		
**EP1	5083-5788	2	1	CRT	28480	5083-5788
EP2	01332-66001	8	1	COIL, ORTHO	28480	01332-66001
EP3	01701-66001	5	1	COIL, X-AXIS	28480	01701-66001
MP5	03582-04104	8		GUARD, FAN SWITCH	28480	03582-04104
MP9	03582-00201	8	1	PANEL, LEFT	28480	03582-00201
MP10	03582-00215	4	1	PLATE, CUTOUT	28480	03582-00215
MP11	03582-00222	3		PANEL, FRONT	28480	03582-00222
MP12	03582-20601	4		SHIELD, TERM	28480	03582-20601
MP13	03582-00601	2	2	SHIELD, INPUT	28480	03582-00601
MP14	03582-00602	3	1	SHIELD, DISPLAY	28480	03582-00602
MP15	03582-00603	4	1	COVER, CARD NEST	28480	03582-00603
MP16	03582-00605	6	1	SHIELD, TRANSFORMER	28480	03582-00605
MP17	03582-01201	0	1	BRACKET, TRANSFORMER	28480	03582-01201
MP18	03582-01202	1	1	BRACKET, RECT.	28480	03582-01202
MP19	03582-01209	8	1	BRACKET, H.V.P.S.	28480	03582-01209
MP20	03582-01210	1	1	BRACKET, CAP.	28480	03582-01210
MP21	03582-01211	2	1	CARD GUIDE, REAR	28480	03582-01211
MP22	03582-01216	7	1	BRACKET, LINE SWITCH	28480	03582-01216
MP23	03582-01219	0	1	BRACKET, CARD NEST	28480	03582-01219
MP24	03582-01225	8	1	BRACKET, TRANSFORMER SHIELD	28480	03582-01225
MP25	03582-04101	5	1	INSULATOR, CAP	28480	03582-04101
MP26	03582-04103	7	1	INSULATOR, H.V.P.S.	28480	03582-04103
MP27	03582-04105	9	1	INSULATOR, POWER SUPPLY	28480	03582-04105
MP28	03582-04106	0		INSULATOR, AMPLIFIER BOARD	28480	03582-04106
MP29	03582-22701	9	1	FILTER, GRAY	28480	03582-22701
MP30	03582-24702	4	3	SPACER, AMPLIFIER BOARD A13 ASSY	28480	03582-24702
MP31	03582-24703	5	3	SPACER, CUTOUT A13 ASSY	28480	03582-24703
MP32	03582-60101	3	1	CHASSIS ASSEMBLY	28480	03582-60101
MP33	03582-60103	5	1	SHIELD, CRT	28480	03582-60103
MP34	03582-60201	4	1	SHIELD ASSEMBLY	28480	03582-60201
MP35	0905-0573	2	1	GASKET, ROUND, NPRN	28480	0905-0573
MP36	1400-0906	6	1	CLAMP-HOSE 2.062-3-DIA .5-WD SST	08484	Q8200-M40M
MP37	1460-1345	5	2	TILT STAND SST	28480	1460-1345
MP38	5001-0440	1	2	TRIM, SIDE	28480	5001-0440
MP39	5020-8805	8	1	FRAME: FRONT	28480	5020-8805
MP40	5020-8806	9	1	FRAME: REAR	28480	5020-8806
MP41	5020-8837	6	4	STRUT: CORNER	28480	5020-8837
MP42	5040-7023	2	1	PUSHROD	28480	5040-7023
MP43	5040-7201	8	4	FOOT(STANDARD)	28480	5040-7201
MP44	5040-7202	9	1	TRIM, TOP	28480	5040-7202
MP45	5040-7219	8	2	STRAP, HANDLE, CAP-FRONT	28480	5040-7219
MP46	5040-7220	1	2	STRAP, HANDLE, CAP-REAR	28480	5040-7220
MP47	5040-8393	1	1	SUPPORT, CARD	28480	5040-8393
MP48	5040-8394	2	1	CARD GUIDE, FRONT	28480	5040-8394
MP49	5040-8399	7	1	BEZEL, CRT	28480	5040-8399
MP50	5060-7474	9	1	BEZEL, FRAME	28480	5060-7474
MP51	5060-9804	3	2	STRAP HANDLE, 18 IN.	28480	5060-9804
MP52	5060-9835	0	1	TOP COVER	28480	5060-9835
MP53	5060-9847	4	1	BOTTOM COVER	28480	5060-9847
MP54	5060-9942	0	2	SIDE COVER	28480	5060-9942
MP55	5061-2009	8	1	KIT, REAR FEET	28480	5061-2009
MP56	5061-2033	8	1	CARD HOLDER	28480	5061-2033
MP57	9320-3885	4	1	INSTRUCTION CARD	28480	9320-3885
MP58	9320-3886	5	1	MP-IB INSTRUCTION CARD	28480	9320-3886
MP59	4324-0094	4	8	ISOLATOR CRT	28480	4324-0094
MP60	4320-0325	6	2	FOAM, POWER SUPPLY SUPPORT	28480	4320-0325
MP61	4324-0095	5	2	FOAM, CARD NEST SUPPORT	28480	4324-0095
MP62	03582-00204	1		FRONT CARD NEST SUPPORT	28480	03582-00204
S2	3101-2216	3		SWITCH-PB DPDT ALTNG 4A 250VAC LINE SW	28480	3101-2216
T1	9100-4063	6	1	TRANSFORMER, LINE	28480	9100-4063
W23	8120-1521	6	1	CABLE ASSY 18AWG 3-CNDCT JGK-JKT (AC PWR CRD)	28480	8120-1521

**FOR INSTRUMENTS WITH CRT SERIAL NUMBER 5083-5788, THIS IS A DIRECT REPLACEMENT TUBE AND DOES NOT REQUIRE CIRCUIT MODIFICATION.

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

Table 8-12-1. Replaceable Parts (Cont'd).

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				CABLE ASSEMBLIES		
W1	03582-61604	3	1	CABLE ASSEMBLY, INPUT	28480	03582-61604
W2	03582-61606	5	1	CABLE ASSEMBLY, FRONT PANEL A11	28480	03582-61606
W3	03582-61608	7		CABLE ASSEMBLY, FOCUS POT	28480	03582-61608
W4	03582-61609	8	1	CABLE ASSEMBLY, FP-A13	28480	03582-61609
W5	03582-61610	1	1	CABLE ASSEMBLY, A11-A12	28480	03582-61610
W6	03582-61611	2	1	CABLE ASSEMBLY, A13-A20	28480	03582-61611
W7	03582-61612	3	1	CABLE ASSEMBLY, A13-POWER	28480	03582-61612
W8	03582-61613	4		CABLE ASSEMBLY, HP-IB	28480	03582-61613
W9	03582-61614	5	1	CABLE ASSEMBLY, RP-A20	28480	03582-61614
W10	03582-61615	6	1	CABLE ASSEMBLY, RECT.-A19X4	28480	03582-61615
W11	03582-61616	7	1	CABLE ASSEMBLY, LINE SWITCH	28480	03582-61616
W12	03582-61617	8	1	CABLE ASSEMBLY, NECK PINS-X-ALIGN	28480	03582-61617
W13	03582-61618	9	1	CABLE ASSEMBLY, NECK PINS, ORTHO	28480	03582-61618
W14	03582-61620	3		CABLE ASSEMBLY, RPG-A12	28480	03582-61620
W15	03582-61621	4	1	CABLE ASSEMBLY, POWER-A19X3	28480	03582-61621
W16	03582-61622	5	1	CABLE ASSEMBLY, POWER, A19X5	28480	03582-61622
W17	03582-61623	6	1	CABLE ASSEMBLY, FAN, MALE	28480	03582-61623
W18	03582-61624	7	1	CABLE ASSEMBLY, FAN, FEMALE	28480	03582-61624
W19	03582-61625	8	1	CABLE ASSEMBLY, CAL A (RED)	28480	03582-61625
W20	03582-61626	9	1	CABLE ASSEMBLY, CAL B (WHITE)	28480	03582-61626
W21	03582-61629	2	1	CABLE ASSEMBLY, THERMAL CUTOUT	28480	03582-61629
W22	03582-61635	0	1	CABLE ASSEMBLY, FP-A20	28480	03582-61635
W23	03582-61637	2	1	CABLE ASSEMBLY, PRN OUT	28480	03582-61637
W24	03582-61638	3	1	CABLE ASSEMBLY, MARKER POSITION	28480	03582-61638
W25	03582-61639	4	1	CABLE ASSEMBLY, CH A BAL	28480	03582-61639
W26	03582-61640	7	1	CABLE ASSEMBLY, CH A TRIG LEVEL	28480	03582-61640
W27	03582-61641	8	1	CABLE ASSEMBLY, CH B BAL	28480	03582-61641
W28	03582-61642	9	1	CABLE ASSEMBLY, PRN LEVEL	28480	03582-61642
W29	03582-61643	0	1	CABLE ASSEMBLY, Z-AXIS	28480	03582-61643
W30	03582-61644	1	1	CABLE ASSEMBLY, Y-AXIS	28480	03582-61644
W31	03582-61645	2	1	CABLE ASSEMBLY, X-AXIS	28480	03582-61645
W32	03582-61646	3	1	CABLE ASSEMBLY, H-BLANK	28480	03582-61646
W33	03582-61647	4	1	CABLE ASSEMBLY, IMPULSE	28480	03582-61647
W34	8120-2621	9	1	CABLE ASSY 28AWG, 34-CNDCT UL-2480 (PINK RIBBON)	28480	8120-2621

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

CATHODE-RAY TUBE FAILURE REPORT

(This form must accompany all warranty claims and MFR/HEART credit claims.)

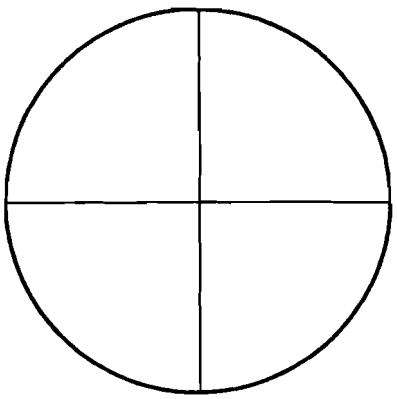
Date_____

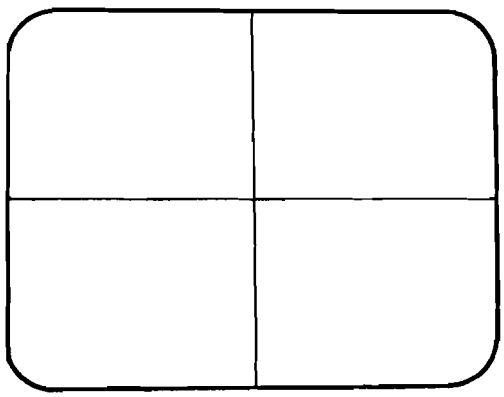
Submitted By (Name)_____

Name of Company_____

Address_____

1. Hewlett-Packard Instrument Model No._____
2. Hewlett-Packard Instrument Serial No._____
3. Defective CRT Serial No._____ Part No._____
4. Replacement (New) CRT Serial No._____
5. Please describe the failure and, if possible, show the trouble on the appropriate CRT face below.





6. Is a warranty claim being made?_____
7. Hewlett-Packard Sales/Service Office_____
8. MFR, HEART or Customer Service Order Number_____

MANUAL CHANGES

-hp- MODEL 3582A

SPECTRUM ANALYZER

Manual Part Number 03582-90004

All New Items

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:

1. Make all Manual ERRATA changes.
2. Make all additional changes that pertain to your instrument serial number only.

ERRATA

Page 7-A-5/7-A-6, Figure 7-A-2. Change the Figure number to 8-1-12. Change the page number to 8-1-15/8-1-16. Add REV F to the Figure title. Add the component locator in Figure 1. Move the page to section 8-1.

Page 8-1-15/8-1-16, Figure 8-1-12. Change the Figure number to 7-A-2. Change the page number to 7-A-5/7-A-6. Move the page to section 7-A.

CHANGE NUMBER 1 for all Serial Numbers.

Pages 8-1-3/8-1-4, 8-1-5/8-1-6, 8-1-7/8-1-8, and 8-1-13/8-1-14. Update the component locator according to Figure 1.

Page 8-3-20, Table 8-3-2. Change the part number and description of U16 and U18 to 1826-0111 OPAMPL MC1458G. Change the part number of U17 to 1826-0866.

Page 8-6-15/8-6-16, Table 8-6-1. Change the part number and description of A3 to 0960-0491 MULT HI VOLT.

Page 8-7-3/8-7-4, Figure 8-7-2. Add SEE NOTE to part numbers 0370-1006 and 0370-3013. Add the following note:

NOTE

For instruments with Serial Numbers through 1809A03324, if the potientometer is replaced with part number 2100-3737, replace knob 0370-1006 with 0370-3048 and 0370-3013 with 0370-3049.

For instruments with Serial Numbers 1809A03325 and greater, use part number 0370-3048 instead of 0370-1006 and 0370-3049 instead of 0370-3013.

Page 8-7-7, Table 8-7-1. Change the part number for R17 to 2100-3983. Change R17 to ***R17. Add ***For instruments with Serial Numbers through 1809A03324, if the potientometer is replaced with part number 2100-3737, replace knob 0370-1006 with 0370-3048 and 0370-3013 with 0370-3049.

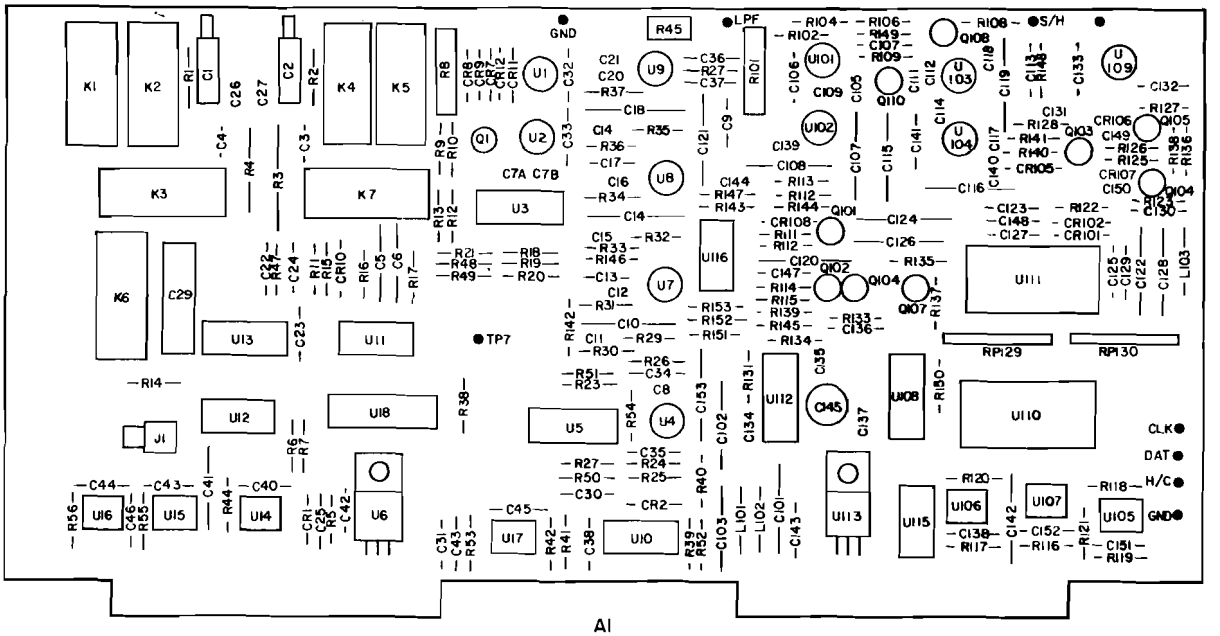


Figure 1.

Page 8-7-9, Table 8-7-1. Add SEE NOTE to part numbers 0370-1006 and 0370-3013. Add the following note:

NOTE

For instruments with Serial Numbers through 1809A03324, if the potientometer is replaced with part number 2100-3737, replace knob 0370-1006 with 0370-3048 and 0370-3013 with 0370-3049.

For instruments with Serial Numbers 1809A03325 and greater, use part number 0370-3048 instead of 0370-1006 and 0370-3049 instead of 0370-3013.

Page 8-7-10, Table 8-7-1. Add 1460-1581 HOLD DOWN SPRING.

Page 8-11-15/8-11-16, Figure 8-11-8. At the left end of the A17 schematic, change the voltage value of A17CR11 and A17CR12 to 24V.

Page 8-12-9, Table 8-7-1. Add 1460-1581 HOLD DOWN SPRING.

Page 8-12-10, Table 8-12-1. Change the following part numbers and descriptions:

MP30 0380-1228 SPACER-AMPL
MP31 0380-1227 SPACER-CUTOUT

Add 0380-1229 SPACER RPG BD to the parts list.

CHANGE NUMBER 2 for Serial Numbers 1809A02186 and greater.

Page 8-4-26, Table 8-4-3. Add R43 0683-1335 RESISTOR FXD 13K 5% .25 W to the parts list. Change the part number and description of R16 to 0683-5625 RESISTOR FXD 5.6K 5%.

CHANGE NUMBER 3 for Serial Numbers 1809A02336 and greater.

Page 8-5-24, Table 8-5-3. Change the part number of U15 and U17 to 1826-0582.

Page 8-8-15, Table 8-8-12. Change the part number and description of C5 to 0180-0374 CAPACITOR FXD 10 UF 20V.

CHANGE NUMBER 4 for Serial Numbers 1809A02406 and greater.

Page 8-8-13/8-8-14, Figure 8-8-1. In the lower left corner of the schematic, add a resistor (R17, value 10) in parallel with the coil of L1 that is connected to ground.

Page 8-8-15, Table 8-8-12. Add R17 0683-1005 RESISTOR 10 5%.

CHANGE NUMBER 5 for Serial Numbers 1809A02436 and greater.

Page 8-3-19, Table 8-3-2. Delete C7, C8, and C9.
Change the following parts:

C2 0160-0134 CAPACITOR FXD 220PF 300V
R33 2100-3350 RESISTOR VAR 200
R34 0757-0430 RESISTOR FXD 2210
R35 0698-3152 RESISTOR FXD 3480 1%

Add the following parts:

CR1, CR2 1901-0518 DIODE - SI
CR3, CR4 1091-0025 DIODE - HOT CARRIER

Page 8-3-20, Table 8-3-2.
Delete R37 through R45, R52 through R55, R57, R59,R62, R63, and U15.

Change the following parts:

U14 1826-0356 CNVTR AD 7530AD
R56 0698-4435 RESISTOR FXD 2490 1%

Add the following parts:

R69, R70 0699-0059 RESISTOR FXD 5K
R71 0698-4436 RESISTOR FXD 2800 1%
R72 0757-0283 RESISTOR FXD 2000 1%
R73 0688-5115 RESISTOR FXD 510 5%

CHANGE NUMBER 6 for Serial Numbers 1809A02465 and greater.

Page 8-5-19/8-5-20, Figure 8-5-6. In the center top portion of the schematic, change the values of R12 to 1.24K, R13 to 1.91K, and R10 to 1K.

Page 8-5-23, Table 8-5-3. Change the part numbers and descriptions of the following parts:

Q4 1854-0094 TRANSISTOR - 2N3646
R12 0698-3223 RESISTOR 1.24K 1% .125W
R13 0698-4430 RESISTOR 1.91K 1% .125W

Delete the entries for R10** and add R10 0683-1025 RESISTOR 1000 5% .125W.

CHANGE NUMBER 7 for Serial Numbers 1809A02976 and greater.

Page 7-H-1/7-H-2. Change "REV A&B" TO "REV A&B 3582-66508."
CHANGE "Rev C board" to 3582-66508 Rev C board."
Add

REV C 3582-66508
Schematic
Use the schematic provided in this section.

Troubleshooting
Use the trouble shooting procedures provided in this section.

Page 8-4-17, Paragraph 8-4-34. Change the heading to "TROUBLESHOOTING THE 03582-66508 RAM ASSEMBLY."

Pages 8-4-17 through 8-4-24. Renumber the pages to 7-H-3 through 7-H-11. Renumber Figure 8-4-5 to 7-H-1. Resequence the paragraph numbers starting with 7-H-1. Move these pages to section 7-H. Insert the attached pages 8-4-17 through 8-4-24 into section 8-4.

Page 8-4-29/8-4-30, Table 8-4-3. Add the following Table:

A8	1	03582-66528	PC ASSEMBLY, RAM
C1-4, C6-10	9	0160-4571	CAPACITOR-FXD .1 UF .20
C12-C14	3	0180-0228	CAPACITOR-FXD 22 UF 15V
R1	1	0683-1025	RESISTOR-FXD 1000 5%
R2	1	0683-5125	RESISTOR-FXD 5100 5%
U1, U3, U5	3	1820-1445	TTL-74LS375
U2, U4, U6	3	1820-1470	IC-SN74LS157N
U17, U10	4	1818-1611	IC MEMORY
U11, U14	2	1820-1794	TTL-BUF 81LS95N
U12, 15-17	4	1820-1872	TTL-BUF 81LS96N
U13, U19	2	1820-1199	IC SN74LS04N
U18	1	1820-1430	IC SN74LS161AN
U20	1	1820-1491	IC SN74LS367N
U21, U22	2	1820-1197	IC SN74LS00N

MISC. PARTS

4040-0747	EXTR-GREY PC BD
4040-0748	EXTR-BLACK PC BD

CHANGE NUMBER 8 for Serial Numbers 1809A03066 and greater.

Page 8-5-19/8-5-20, Figure 8-5-6. At the top center of the schematic, delete A10C13.

Page 8-5-22, Table 8-5-3. Delete C13.

CHANGE NUMBER 9 for Serial Numbers 1809A03091 and greater.

Page 8-11-9/8-11-10, Figure 8-11-5. In the top right corner of the schematic, add R31 (value 470) between R30 and the horizontal line. Change the values of A14C3, A14C8, A14C13, and A14C15 to 1UF. Change the value of A14R30 to 470. Replace the component locater with the attached Figure 2.

Page 8-11-19, Table 8-11-2. Add R31 0683-4715 RESISTOR FXD 470 5%. Change the following components:

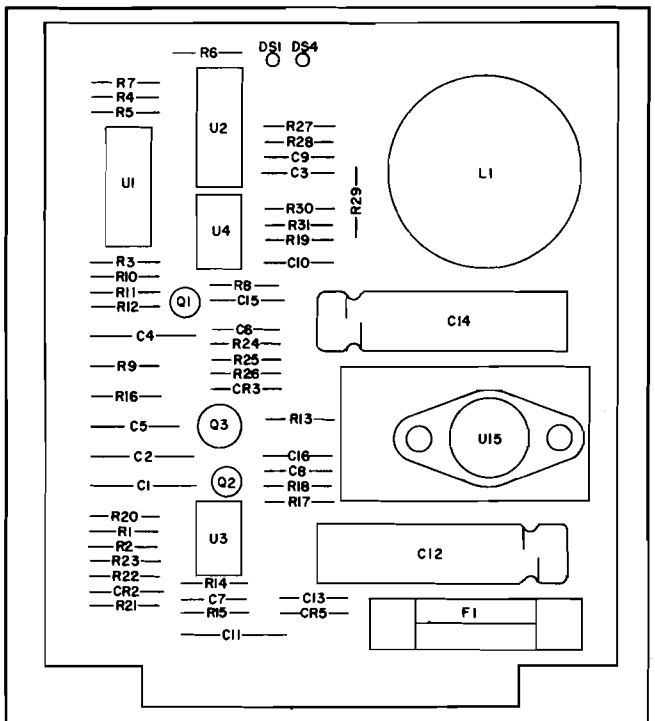
C3, C8, C13, C15	0160-4577	CAPACITOR-FXD 1UF 50V
C6	0160-4801	CAPACITOR-FXD 100PF
C7	0160-4832	CAPACITOR-FXD .01UF
C9, C10, C16	0160-4822	CAPACITOR-FXD 1000 PF
R30	0683-4715	RESISTOR-FXD 470 5%

CHANGE NUMBER 10 for Serial Numbers 1809A03161 and greater.

Page 8-11-11/8-11-12, Figure 8-11-6. Replace the component locator with the attached Figure 3. In the top right corner of the schematic, delete R3 and add R33 (470 OHM) and R34 (470 OHM) in series with DS3 on the anode side of DS3. Change the A15U4 designators and pins according to the following table:

OLD REF DESIGNATOR	NEW REF DESIGNATOR	INPUT PIN	OUTPUT PIN
U4F	U4B	3	4
U4E	U4C	5	6
U4D	U4E	11	10
U4C	U4F	13	12
U4B	U4D	9	8

Page 8-11-20, Table 8-11-2. Delete C16 and R3. Add C15 0160-4571 CAPACITOR-FXD .1 UF 50V and R33, R34 0683-4715

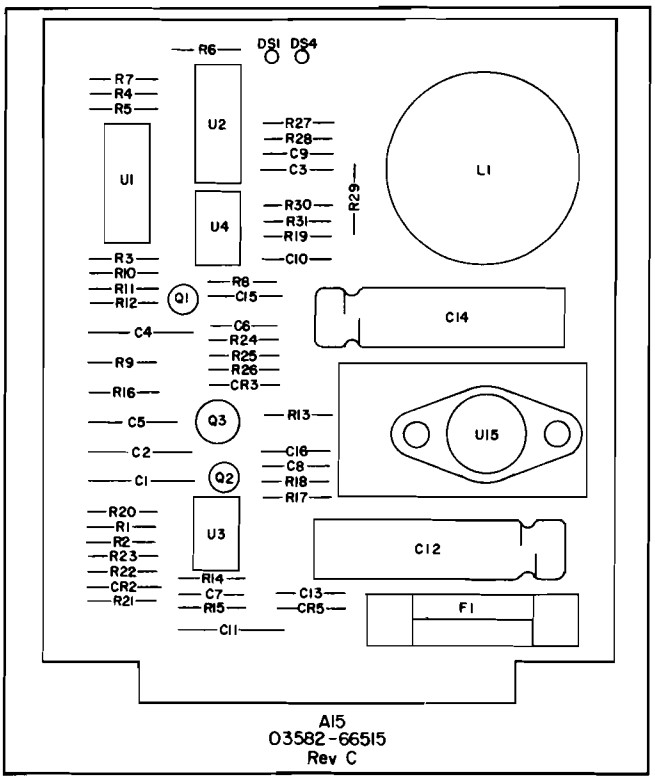


A14
03582-66514
Rev D

Figure 2.

RESISTOR 470 5%. Change the part number and description of the following parts:

C2, C7, C13	0160-4571	CAPACITOR-FXD .1UF 50V
C4, C12, C14	0160-4822	CAPACITOR-FXD 1000 PF
C11	0160-4832	CAPACITOR-FXD .01 UF



A15
03582-66515
Rev C

Figure 3.

CHANGE NUMBER 11 for Serial Numbers 1809A03266 and greater.

Page 8-11-26, Table 8-11-2. Delete MP5. Change B1 to 3160-0394 FAN-TUBEAXIEL. Add 03582-24704 SPACER FAN and 3160-0092 FINGER GUARD.

Page 8-12-10, Table 8-12-1. Delete MP5.

CHANGE NUMBER 12 for Serial Numbes 1809A03306 and greater.

Page 8-9-3/8-9-4, Figure 8-9-1. In the right center portion of the schematic, change the value of A4R74 to 13.3K.

Page 8-3-20, Table 8-3-2. Add R74 0757-0289 RESISTOR-FXD 13.3K 1%.

CHANGE NUMBER 13 for Serial Numbers 1809A03401 and greater.

Page 8-1-7/8-1-8. Figure 8-1-4. Change the EXTERNAL TRIGGER CIRCUIT as illustrated in Figure 4.

Page 8-1-18, Table 8-1-4. Add the following parts:
0690-1211 RESISTOR 120 10%
1902-0579 DIODE BKDN 5.11%

CHANGE NUMBER 14 for Serial Numbers 1809A03421 and greater.

Page 1-3, Table 1-1. Delete option 001.

Page 1-7, Table 1-5. Delete the specifications for TRANSFER FUNCTION ACCURACY (STANDARD). Change TRANSFER FUNCTION ACCURACY (OPTION 001): to TRANSFER FUNCTION ACCURACY:.

Page 4-11, Paragraph 4-63. In step d., delete "(+ – 2 degrees, Option 001), and change + – 5 degrees to + – 2 degrees.

CHANGE NUMBER 15 for Serial Numbers 1809A03516 and greater.

Page 8-11-15/8-11-16, Figure 8-11-8. Change the value of A19R13 to 29.4K.

Page 8-11-25, Table 8-11-2. Change the part number and description of Q1 to 1884-0306 SIL BILATERAL and R3 to 0698-4490 RESISTOR 29.4K 1%.

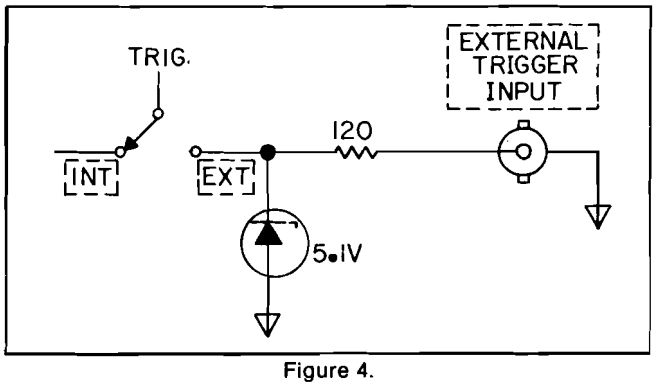


Figure 4.

CHANGE NUMBER 16 for Serial Numbers 1809A03791 and greater.

Page 8-1-7/8-1-8, Figure 8-1-4. Change A1R12 near the left center of the schematic to *R12 and change the value of A1R11 to 422.

Page 8-1-18, Table 8-1-4. Change the part number and description of R11 to 0698-3447 RESISTOR 422 1%. Change R12 to *R12. Add the following components for *R12:

0698-3516 RESISTOR 6340 1%
0698-3226 RESISTOR 6490 1%
0698-3486 RESISTOR 6650 1%
0757-3439 RESISTOR 6810 1%
0698-4471 RESISTOR 7.15K 1%
0698-3518 RESISTOR 7320 1%
0757-0440 RESISTOR 7.5K 1%
0698-4472 RESISTOR 6780 1%

Page 8-7-11, Table 8-7-1. Change the part number of FPR7 to 2100-3686.

CHANGE NUMBER 17 for Serial Numbers 1809A03816 and greater.

Page 8-5-15/8-5-16, Figure 8-5-4. Change the page number to 7-I-1/7-I-2. Change the figure number to 7-I-1. Add

I(A9) DIGITAL DISPLAY CONTROLLER BACKDATING

REVISION A, B, C, AND D

Schematic

Use backdating schematic I(A9) for Revision A, B, C, and D.

Component Locator

Use component locator on backdating Schematic I (A9)

Parts List

Use the current parts list except for the following parts:

C2	0160-3046	CAPACITOR-FXD 250 PF + – 1% 100VDC MICA
C3	0160-2199	CAPACITOR-FXD 30 PF + – 5% 300VDC MICA
C6	0140-0193	CAPACITOR-FXD 82 PF + – .5% 300VDC MICA
J1	1200-0458	SOCKET-XSTR 3-CONT TO-5 DIP-SLDR
R2, R3, R10, R11	0683-5125	RESISTOR 5.1K 5% .25W TC = 400/ + 700
—	6960-0080	HOLE PLUG
DELETE		
C14	0160-3847	CAPACITOR-FXD .01UF 50V
JR1	1258-0141	JUMPER-REMOVABLE
U32-U35	1820-1208	IC DIG SN74LS32N

Move page to section 7-I. Insert attached page 8-5-15/8-5-16.

Page 8-5-17/8-5-18, Figure 8-5-5. Change the page number to 7-J-3/7-J-4. Change the figure title to "Figure 7-J-1. P/O A9 Digital Display Driver. REV C, D." Add

J(A9) DIGITAL DISPLAY CONTROLLER BACKDATING

REVISION C AND D

Schematic

Use backdating schematic J(A9) for Revision C and D.

Component Locator

Use component locator on backdating Schematic J(A9) Revision C and D.

Parts List

Use the current parts list for J(A9).

Move page to section 7-J. Insert attached page 8-5-17/8-5-18.

Page 8-5-21, Table 8-5-3. Change the following components:

C2	0160-4811	CAPACITOR-FXD 270 PF
C3	0160-4807	CAPACITOR-FXD 33 PF 110V
C6	0160-4802	CAPACITOR-FXD 82 PF .5 100V
J1	1251-5501	CONNECTOR
R2, R3 R10, R11	0698-3155	RESISTOR-FXD 4640 1% .125W
ADD		
C14	0160-3847	CAPACITOR-FXD .01UF 50V
JR1	1258-0141	JUMPER-REMOVABLE
U32-U35	1820-1208	IC DIG SN74LS32N
DELETE:	6960-0080	HOLE PLUG

CHANGE NUMBER 18 for Serial Numbers 1809A03826 and greater.

Page 8-11-19, Table 8-11-2. Change the part number and description of L1 to 9140-0649 INDUCTOR-FXD.

Page 8-11-20, Table 8-11-2. Change the part number and description of L1 to 9140-0649 INDUCTOR-FXD.

CHANGE NUMBER 19 for Serial Numbers 1809A03936 and greater.

Page 8-11-13/8-11-14, Figure 8-11-7. Replace the component locator in the upper right corner with the attached Figure 5.

Page 8-11-22, Table 8-11-2. Change the fuse holder part number and description to FH1 2110-0643 FUHLR-CL 15A. Change the following component part numbers and descriptions:

C2, C10, C11	0160-4835	CAPACITOR-FXD .1UF 50V
C9	0160-3847	CAPACITOR-FXD .01 UF
C12, C14	0160-4822	CAPACITOR-FXD 1000 PF

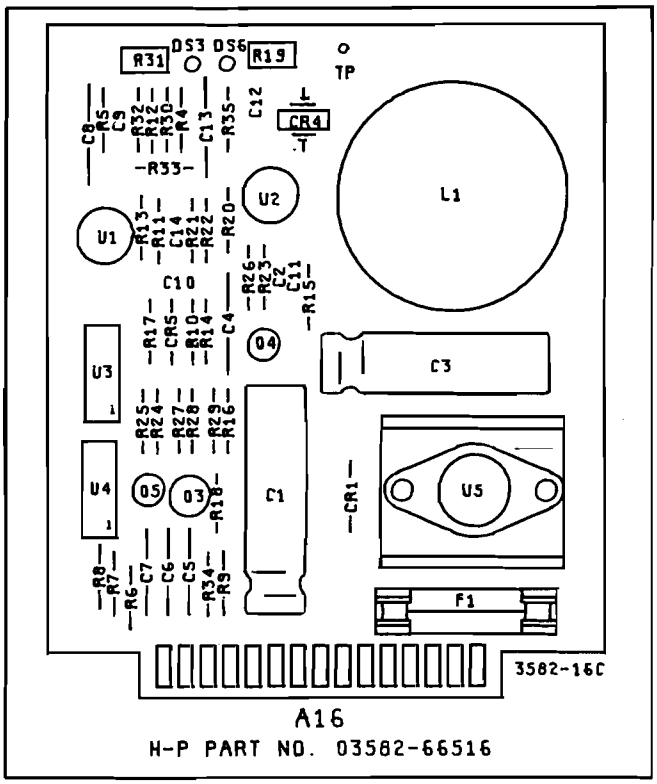


Figure 5.