ManualsPlus.com

Errata

Title & Document Type: 8656A Signal Generator Operating & Service Manual

Manual Part Number: 08656-90107

Revision Date: May 1981

HP References in this Manual

This manual may contain references to HP or Hewlett-Packard. Please note that Hewlett-Packard's former test and measurement, semiconductor products and chemical analysis businesses are now part of Agilent Technologies. We have made no changes to this manual copy. The HP XXXX referred to in this document is now the Agilent XXXX. For example, model number HP8648A is now model number Agilent 8648A.

About this Manual

We've added this manual to the Agilent website in an effort to help you support your product. This manual provides the best information we could find. It may be incomplete or contain dated information, and the scan quality may not be ideal. If we find a better copy in the future, we will add it to the Agilent website.

Support for Your Product

Agilent no longer sells or supports this product. You will find any other available product information on the Agilent Test & Measurement website:

www.tm.agilent.com

Search for the model number of this product, and the resulting product page will guide you to any available information. Our service centers may be able to perform calibration if no repair parts are needed, but no other support from Agilent is available.

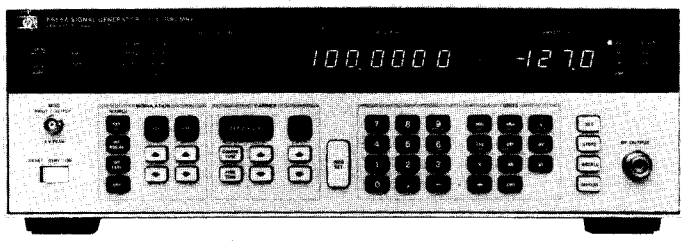
Agilent Technologies

ManualsPlus.com

8656A

SIGNAL GENERATOR

0.1—990 MHz



HEWLETT PACKARD

ManualsPlus.com

OPERATING AND SERVICE MANUAL

8656A
SIGNAL GENERATOR
0.1 — 990 MHz
(Including Options 001 and 002)

SERIAL NUMBERS

This manual applies directly to instruments with serial numbers prefixed 2035A.

With changes described in Section VII, this manual also applies to instruments with serial numbers prefixed 2032A, 2027A, 2026A, 2025A, 2024A, 2023A, 2022A, 2018A, 2014A, and 2009A.

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

HEWLETT PACKARD

© Copyright HEWLETT-PACKARD COMPANY 1980, 1981
1501 PAGE MILL ROAD, PALO ALTO, CALIFORNIA, U.S.A.

OPERATING AND SERVICE MANUAL PART NUMBER 08656-90107
Operating Manual Part No. 08656-90108
Microfiche Operating and Service Manual Part No. 08656-90109

Printed: May 1981

ManualsPlus.com

CONTENTS

Page

Section I
GENERAL INFORMATION

Introduction 1-1
Specifications 1-1
Safety Considerations 1-1
Instruments Covered by this Manual 1-1
Description 1-2
  Carrier Frequency 1-2
  Output Amplitude 1-2
  Modulation Capabilities 1-2
Options 1-2
  Electrical Options 1-3
  Mechanical Options 1-3
    Rear Panel Inputs and Outputs Option 002 1-3
    Front Handle Kit Option 907 1-3
    Rack Flange Kit Option 908 1-3
    Rack Flange and Front Handle Combination Kit Option 909 1-3
Hewlett-Packard Interface Bus 1-3
  Compatibility 1-3
  Selecting the HP-IB Address 1-3
Accessories Supplied 1-3
Recommended Test Equipment 1-3

Section II
INSTALLATION

Introduction 2-1
Initial Inspection 2-1
Preparation for Use 2-1
  Power Requirements 2-1
  Line Voltage and Fuse Selection 2-1
  Power Cables 2-2
  Time Base Selection 2-2
  HP-IB Address Selection 2-3
  Interconnection 2-4
  Mating Connectors 2-4
    Coaxial Connectors 2-4
    Interface Connector 2-4
  Operating Environment 2-4
  Bench Operation 2-4
  Rack Mounting 2-4
Storage and Shipment 2-7
  Environment 2-7
  Packaging 2-7
    Original Packaging 2-7
    Other Packaging 2-7

Section III
OPERATION

Introduction 3-1
  Operating Characteristics 3-1

Page

  Local Operation 3-1
    Simplified Front Panel Features 3-1
    Simplified Operation 3-1
    General Operating Instructions 3-1
    Detailed Panel Features 3-1
    Detailed Operating Instructions 3-1
  Remote Operation 3-1
  Operator's Checks 3-1
    Basic Functional Checks 3-1
    HP-IB Functional Checks 3-1
  Operator's Maintenance 3-1
General Operating Instructions 3-1
  Power-On Procedure 3-1
  Power-On Sequence 3-1
  Keystroke Sequences 3-1
    Carrier Keystroke Sequence 3-1
    Modulation Keystroke Sequence 3-4
    Store-Recall-Display Keystroke Sequence 3-4
  Time Base Selection 3-4
Operator's Maintenance 3-4
Detailed Panel Features 3-4
Operator's Checks 3-13
  Basic Functional Checks 3-13
  HP-IB Functional Checks 3-17
Remote Operation, Hewlett-Packard Interface Bus 3-23
  HP-IB Compatibility 3-23
  Remote Operation 3-23
    Remote Capability 3-23
    Local-to-Remote Change 3-23
  Local Operation 3-23
    Local Capability 3-23
    Remote-to-Local Change 3-23
    Local Lockout 3-23
  Addressing 3-25
  Data Messages 3-25
  Receiving the Data Message 3-25
    Data Message Input Format 3-25
    Keyboard-to-Program Code Correlation 3-26
    Value-Selectable Parameters 3-26
    Data 3-26
  Sending the Data Message 3-27
  Receiving the Trigger Message 3-27
  Receiving the Clear Message 3-27
  Receiving the Remote Message 3-27
  Receiving the Local Message 3-27
  Receiving the Local Lockout Message 3-27
  Receiving the Clear Lockout/Set Local Message 3-28
  Receiving the Pass Control Message 3-28
  Sending the Require Service Message 3-28
  Sending the Status Byte Message 3-28

ManualsPlus.com

CONTENTS (Cont'd)

Page

Sending the Status Bit Message 3-28
Receiving the Abort Message 3-28
Switching Characteristics 3-28
Frequency Switching 3-29
Amplitude Switching 3-31
Modulation Switching 3-31
Detailed Operating Instructions 3-32
Amplitude 3-32
Amplitude Conversion 3-34
Amplitude, Up/Down 3-36
Display 3-37
Display Sequence 3-38
Frequency 3-39
Frequency, Coarse and Fine Tune 3-41
Frequency, Up/Down 3-43
HP-IB Address Display 3-44
Increment Value Change 3-46
Increment Value Display 3-48
Modulation, AM 3-49
Modulation, AM Up/Down 3-50
Modulation, External Source 3-51
Modulation, FM 3-52
Modulation, FM Up/Down 3-54
Modulation, Mixed 3-55
Modulation, OFF 3-59
Recall 3-61
Sequence 3-62
Store 3-63

Section IV
PERFORMANCE TESTS

Introduction 4-1
Equipment Required 4-1
Performance Test Record 4-1
Calibration Cycle 4-1
Abbreviated Performance Testing 4-1
Test Procedures 4-1
Spectral Purity Tests 4-3
High Level Accuracy and Flatness Tests 4-8
Low Level Accuracy Tests 4-11
Modulation Tests 4-13
Output Leakage Tests 4-21

Section V
ADJUSTMENTS

Introduction 5-1
Safety Considerations 5-1
Equipment Required 5-1
Factory-Selected Components 5-1
Post-Repair Adjustments 5-2
Related Adjustments 5-2
Power Supply Voltage Adjustment 5-3

Page

Reference Voltage Adjustment 5-4
Audio Oscillator Level Adjustment 5-5
AM Offset Adjustment 5-6
715 MHz Sideband Adjustment 5-7
Notch Filter Adjustments 5-8
High Frequency Loop Offset Adjustment 5-11
50 MHz Reference Oscillator Frequency Adjustment 5-13
50 MHz Reference Oscillator Level Adjustment 5-14
60 to 110 MHz Oscillator Flatness Adjustment 5-15
690 to 740 MHz IF Compensation Adjustment 5-16
400 MHz Bandpass Filter Adjustment 5-17
Level and ALC Loop Detector Adjustments 5-18
Heterodyne Band Accuracy and Flatness Adjustments 5-20
AM% and ALC Loop AM Adjustment 5-22
FM Deviation Adjustment 5-24
FM Frequency Response Adjustment 5-25
Attenuator Adjustments 5-26
Option 001 10 MHz Reference Oscillator Frequency Adjustment 5-29

Section VI
REPLACEABLE PARTS

Introduction 6-1
Abbreviations 6-1
Replaceable Parts List 6-1
Factory Selected Parts (*) 6-1
Parts List Backdating (†) 6-1
Parts List Updating (Change Sheet) 6-1
Illustrated Parts Breakdowns 6-1
Ordering Information 6-1
Recommended Spares List 6-2

Section VII
MANUAL CHANGES

Introduction 7-1
Manual Changes 7-1
Manual Change Instructions 7-3
Instrument Improvement Modifications 7-10
Improving Power Supply Reliability 7-10
Decreasing Spurious Signal Output 7-10
Improving Low Level Accuracy 7-10
Improving RF Frequency Response 7-11
Loss of Signal Generator Control by the Keyboard 7-11

Section VIII
SERVICE

Introduction 8-1

ManualsPlus.com

CONTENTS (Cont'd)

Page

Service Sheets 8-1
Block Diagrams 8-1
Circuit Schematic Diagrams 8-1
Safety Considerations 8-1
Before Applying Power 8-1
Warnings and Cautions 8-1
Recommended Test Equipment and Accessories 8-2
Service Tools, Aids and Information 8-2
Service Tools 8-2
Pozidriv Screwdrivers 8-2
Tuning Tools 8-2
Heat Staking Tool 8-2
Assembly Locations 8-3
Parts and Cable Locations 8-3
Test Points and Adjustment Locations 8-3
Service Aids on Printed Circuit Boards 8-3
Other Service Documents 8-3
Troubleshooting 8-3
General 8-3
Operator Error 8-3
Instrument Out of Specification 8-4
Catastrophic Failures 8-4
Strategy 8-4
Overall Troubleshooting (Service Sheet BD1) 8-4
Functional Section Troubleshooting (Service Sheets BD2-BD4) 8-4
Circuit Troubleshooting (Service Sheets 1-22) 8-4
Signature Analysis 8-4
Additional Information 8-5
Repair 8-5
Disassembly Procedures 8-5
Front Panel Removal 8-5
A1 Keyboard and A2 Display Assembly Removal 8-5
Cover Removal, Top and Bottom (Levels 1 and 4 Access) 8-5
A3 Assembly Service Position 8-6
Level 2 Access 8-6
A10/A11 Assemblies Service Position 8-7
Level 3 Access 8-7
Rear Panel Removal 8-7

Page

Fan Shroud Removal 8-8
Replacement of Key Cap and Pushbutton Switches 8-8
Key Cap Replacement 8-8
Switch Replacement 8-8
Factory-Selected Components(*) 8-10
Manual Backdating (†) 8-10
Manual Updating (Manual Changes Supplement) 8-10
Etched Circuits (Printed Circuit Boards) 8-10
MOS and CMOS Integrated Circuit Replacement 8-10
Retrofitting Option 001 8-10
Schematic Symbology and Operating Principles 8-10
Schematic Diagram Notes 8-10
Basic Logic Symbology 8-10
Gates and Qualifiers 8-11
Indicator Symbols 8-11
Contiguous Blocks 8-11
Dependency Notation 8-11
Common Control Block 8-15
Complex Device Symbology 8-16
Shift Register 8-16
AND-OR Selector 8-16
Up/Down Counter 8-16
Quad D-Type Latch 8-16
Complex Logic Symbology and Operating Principles 8-17
Microprocessor 8-17
Random Access Memory 8-17
Read Only Memory 8-17
Multiple Bus Transceivers 8-18
General Purpose Interface Adapter (GPIA) 8-18
Successive Approximation Register (SAR) 8-19
Digital-to-Analog Converter (DAC) 8-19
Programmable Interval Timer 8-20
BCD-to-Seven-Segment Latch/Decoder/Driver 8-20
Linear Device Operating Principles 8-21
Operational Amplifiers 8-21
Comparators 8-22

ManualsPlus.com

LIST OF ILLUSTRATIONS

Figure Page

1-1. HP Model 8656A Signal Generator with Option 001 and Accessories Supplied 1-0

2-1. Line Voltage and Fuse Selection 2-2
2-2. Power Cable and Mains Plug Part Numbers .. 2-3
2-3. Time Base Jumper Location 2-5
2-4. HP-IB Address Switch Location and Settings 2-5
2-5. Hewlett-Packard Interface Bus Connections 2-6

3-1. Simplified Front Panel Features 3-2
3-2. Display and Remote Features 3-5
3-3. Carrier Features 3-7
3-4. Modulation Features 3-8
3-5. Data and Units Entry Features 3-9
3-6. Miscellaneous Features 3-10
3-7. Rear Panel Features 3-12
3-8. Test Setup for Basic Functional Checks 3-13
3-9. FM Functional Check Waveform 3-16
3-10. Data Message Examples 3-26
3-11. Frequency Switching Characteristics 3-31

4-1. Spurious Signals Test Setup 4-4
4-2. Modulation Analyzer Residual AM Verification Test Setup 4-5
4-3. Residual AM Test Setup 4-6
4-4. Residual FM Test Setup 4-7
4-5. High Level Accuracy and Flatness Test Setup 4-8
4-6. Low Level Accuracy Test Setup 4-12
4-7. Modulation Test Setup 4-14
4-8. Modulation Analyzer Incidental AM Verification Test Setup 4-19
4-9. Output Leakage Test Setup 4-21

5-1. +5.4 Vdc Power Supply Adjustment Setup 5-3
5-2. +2 Vdc Reference Adjustment Setup 5-4
5-3. Audio Oscillator Level Adjustment Setup 5-5
5-4. AM Offset Adjustment Setup 5-6
5-5. 715 MHz Sideband Adjustment Setup 5-7
5-6. Notch Filters Adjustment Setup 5-8
5-7. High Frequency Loop Offset Adjustment Setup 5-11
5-8. Tune Voltage Waveform 5-12
5-9. 50 MHz Reference Oscillator Frequency Adjustment Setup 5-13
5-10. 50 MHz Reference Oscillator Level Adjustment Setup 5-14
5-11. 60 to 110 MHz Oscillator Flatness Adjustment Setup 5-15
5-12. 690 to 740 MHz IF Compensation Adjustment Setup 5-16
5-13. 400 MHz Bandpass Filter Adjustment Setup 5-17

Figure Page

5-14. Level and ALC Loop Detector Adjustment Setup 5-18
5-15. Heterodyne Band Accuracy and Flatness Adjustment Setup 5-20
5-16. AM% and ALC Loop AM Adjustments Setup 5-22
5-17. FM Deviation Adjustment Setup 5-24
5-18. FM Frequency Response Setup 5-25
5-19. Attenuator Adjustment Setup 5-26
5-20. Attenuator Adjustment Locations 5-28
5-21. 10 MHz Reference Oscillator Frequency Adjustment Setup 5-29

6-1. Cabinet, Parts Identification 6-35
6-2. Front Panel, Parts Identification 6-36
6-3. Rear Panel, Parts Identification 6-37
6-4. Top Internal View; Top Cover Removal 6-38
6-5. Top Internal View; A3 Assembly in Service Position 6-39
6-6. Bottom Internal View; A10/A11 Assemblies in Service Position 6-40
6-7. Bottom Internal View; Bottom Cover Removed 6-41
6-8. Low Frequency Loop Assembly — A3, Parts Identification 6-42
6-9. Attenuator Assembly — A9, Parts Identification 6-43

7-1. Address Buffering and Decoding, Serial I/O and Control Schematic Diagram (P/O Change C) 7-5

8-1. Recommended Position for Maintenance and Servicing 8-2
8-2. Rear-Panel and Fan Shroud Removal 8-7
8-3. Front-Panel Pushbutton Switch Assembly 8-8
8-4. Pushbutton Switch Support Anvil 8-9
8-5. Heat Staking Tip 8-9
8-6. Typical Assembly for Heat Staking Operation 8-9
8-7. Basic Logic Symbols and Qualifiers 8-12
8-8. Indicator Symbols 8-13
8-9. Contiguous Blocks 8-14
8-10. AND Dependency Notation 8-14
8-11. Address Dependency Notation: Coder Example Using Alpha Characters (Letters) 8-15
8-12. OR and Free Dependency Notation 8-15
8-13. Common Control Block 8-15
8-14. Quad D-Type Latch (Individual) 8-15
8-15. Quad D-Type Latch (Combined) 8-16

ManualsPlus.com

LIST OF ILLUSTRATIONS (Cont'd)

Figure Page

8-16. Shift Register 8-16
8-17. AND-OR Selector 8-16
8-18. Up/Down Counter 8-17
8-19. Quad D-Type Latch 8-17
8-20. Random Access Memory 8-17
8-21. Read Only Memory 8-18
8-22. Multiple Bus Transceiver With 3-State Output 8-18
8-23. General Purpose Interface Adapter (GPIA) 8-19
8-24. Successive Approximation Register (SAR) 8-20
8-25. Digital-to-Analog Converter (8-bit) 8-20
8-26. Programmable Interval Timer 8-21
8-27. BCD-to-Seven-Segment Latch/Decoder/Driver 8-21
8-28. Non-Inverting Amplifer (Gain = 1) 8-22
8-29. Non-Inverting Amplifier (Gain = $1 + R_1/R_2$) 8-22
8-30. Inverting Amplifier (Gain = $-R_1/R_2$) 8-22
8-31. Non-Inverting Comparator 8-22
8-32. Inverting Comparator 8-22
8-33. Overall Block Diagram 8-35
8-34. High Frequency and Output Section Block Diagram 8-37
8-35. Low Frequency and FM Section Block Diagram 8-39
8-36. Microprocessor, Keyboard & Display Section Block Diagram 8-41
8-37. High Frequency Oscillator Component Locations 8-44
8-38. IF Section (A4 Assembly) Component Locations 8-45
8-39. High Frequency Oscillator and IF Section Block Diagrams 8-47
8-40. High Frequency Oscillator and IF Section Schematic Diagram 8-47
8-41. High Frequency Loop Amplifier and Control Component Locations 8-49
8-42. High Frequency Loop Amplifier and Control Block Diagrams 8-51
8-43. High Frequency Loop Amplifier and Control Schematic Diagram 8-51
8-44. Frequency Multiplier Component Locations 8-52
8-45. Frequency Multiplier Block Diagrams 8-53
8-46. Frequency Multiplier Schematic Diagrams 8-53
8-47. Output Section (A7 Assembly) Component Locations 8-55
8-48. Output Section (A6 Assembly) Component Locations 8-56
8-49. Output Section Block Diagrams 8-57

Figure Page

8-50. Output Section Schematic Diagram 8-57
8-51. Heterodyne and Output Control (A7 Assembly) Component Locations 8-58
8-52. Heterodyne and Output Control (A6 Assembly) Component Locations 8-59
8-53. Heterodyne and Output Control Block Diagrams 8-61
8-54. Heterodyne and Output Control Schematic Diagrams 8-61
8-55. Modulation and RF Amplitude Control Component Locations 8-65
8-56. Modulation and RF Amplitude Control Block Diagrams 8-67
8-57. Modulation and RF Amplitude Control Schematic Diagram 8-67
8-58. Attenuator Component Locations (Top View) 8-68
8-59. Attenuator Component Locations (Bottom View) 8-68
8-60. Attenuator Control Component Locations 8-69
8-61. Reverse Power Protection Component Locations 8-70
8-62. Attenuator, Attenuator Control and Reverse Power Protection Block Diagrams 8-71
8-63. Attenuator, Attenuator Control and Reverse Power Protection Schematic Diagram 8-71
8-64. LF Loop VCO Component Locations 8-72
8-65. LF Loop VCO Block Diagrams 8-73
8-66. LF Loop VCO Schematic Diagrams 8-73
8-67. LF Loop Data and Timing Control Component Locations 8-81
8-68. LF Loop Data and Timing Control Block Diagrams 8-83
8-69. LF Loop Data and Timing Control Schematic Diagrams 8-83
8-70. LF Loop Phase Lock Circuit Component Locations 8-86
8-71. LF Loop Phase Lock Circuit Block Diagrams 8-87
8-72. LF Loop Phase Lock Circuit Schematic Diagram 8-87
8-73. LF Loop FM Calibrator Component Locations 8-91
8-74. LF Loop FM Calibrator Block Diagrams 8-93
8-75. LF Loop FM Calibrator Schematic Diagrams 8-93
8-76. LF Loop FM System Control Component Locations 8-95
8-77. LF Loop FM System Control and Calibrator Component Locations 8-96

ManualsPlus.com

LIST OF ILLUSTRATIONS (Cont'd)

Figure Page

8-78. LF Loop FM System Control and Calibrator Block Diagrams 8-97
8-79. LF Loop FM System Control and Calibrator Schematic Diagram 8-97
8-80. Reference Oscillator and Phase Lock Loop Component Locations 8-98
8-81. Reference Oscillator and Phase Lock Loop Block Diagrams 8-99
8-82. Reference Oscillator and Phase Lock Loop Schematic Diagram 8-99
8-83. A7 Assembly Interrupt Input Component Locations 8-102
8-84. Microprocessor, Interrupt Processing and Restart Component Locations 8-103
8-85. Microprocessor, Interrupt Processing and Restart Block Diagrams 8-105
8-86. Microprocessor, Interrupt Processing and Restart Schematic Diagram 8-105
8-87. Address Buffering and Decoding, Serial I/O and Control Component Locations 8-106
8-88. Address Buffering and Decoding, Serial I/O and Control Block Diagrams 8-107
8-89. Address Buffering and Decoding, Serial I/O and Control Schematic Diagram 8-107
8-90. Memory Component Locations 8-110
8-91. Memory Block Diagrams 8-111
8-92. Memory Schematic Diagram 8-111
8-93. HP-IB Connector Component Locations ... 8-112

Figure Page

8-94. HP-IB Interface Component Locations ... 8-112
8-95. HP-IB Interface Block Diagrams 8-113
8-96. HP-IB Interface Schematic Diagram 8-113
8-97. Keyboard Component Locations 8-114
8-98. Keyboard Encoder Component Locations 8-114
8-99. Keyboard and Encoder Block Diagrams ... 8-115
8-100. Keyboard and Encoder Schematic Diagram 8-115
8-101. Display Control Component Locations 8-117
8-102. Display Control Block Diagrams 8-119
8-103. Display Control Schematic Diagram 8-119
8-104. Frequency Displays Component Locations 8-120
8-105. Frequency Displays Block Diagrams 8-121
8-106. Frequency Displays Schematic Diagram ... 8-121
8-107. Amplitude, Modulation and Annunciator Displays Component Locations 8-123
8-108. Amplitude, Modulation and Annunciator Displays Block Diagrams 8-125
8-109. Amplitude, Modulation and Annunciator Displays Schematic Diagram 8-125
8-110. Voltage Regulator Component Locations 8-126
8-111. Filter Bank Component Locations 8-126
8-112. Power Supply (A10 Assembly) Component Locations 8-127
8-113. Power Supply Schematic Diagram 8-127

TABLES

Table Page

1-1. Specifications 1-4
1-2. Supplemental Characteristics 1-7
1-3. Recommended Test Equipment 1-8
1-4. Alternate Test Equipment 1-10

2-1. Line Fuse Ratings and Part Numbers 2-2
2-2. Allowable HP-IB Address Codes 2-4

3-1. Initialized Conditions 3-1
3-2. Operating Characteristics 3-1
3-3. Index of Detailed Operating Instructions 3-3
3-4. HP-IB Message Reference Table 3-24
3-5. Valid Decimal Values vs. Equivalent ASCII Characters 3-25
3-6. Input Data Restrictions 3-26
3-7. Response to Clear Message 3-27
3-8. HP-IB Program Codes (Alphabetical Order) 3-28
3-9. HP-IB Program Codes (Functional Order) 3-29
3-10. Commonly Used Code Conversions 3-30

Table Page

4-1. Abbreviated Performance Tests 4-2
4-2. Performance Test Record 4-23

5-1. Factory Selected Components 5-1
5-2. Post-Repair Adjustments 5-2
5-3. Attenuator Pad Adjustment Information 5-27

6-1. Reference Designations 6-3
6-2. Abbreviations 6-3
6-3. Replaceable Parts 6-5
6-4. Code List of Manufacturers 6-34

7-1. Manual Changes by Serial Number 7-1
7-2. Summary of Changes by Component 7-2

8-1. Assembly Access Information 8-6
8-2. Etched Circuit Soldering Equipment 8-11
8-3. Schematic Diagram Notes 8-23

ManualsPlus.com

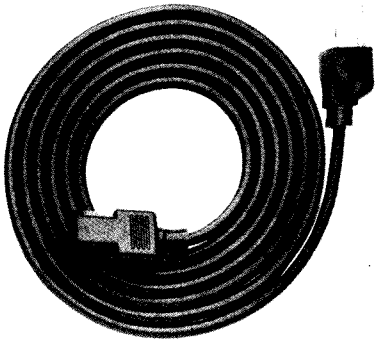
SERVICE SHEETS

Section or Assembly	Schematic	Block Diagram
Overall Troubleshooting	—	BD1
High Frequency and Output Section	—	BD2
Low Frequency and FM Section	—	BD3
Microprocessor, Keyboard, and Display Section	—	BD4
A1 Keyboard Assembly	18	BD4
A2 Display Assembly		
Keyboard and Encoding	18	BD4
Display Control	19	BD4
Frequency Display	20	BD4
Amplitude, Modulation, and Annunciator Displays	21	BD4
A3 Low Frequency Loop Assembly		
Voltage Controlled Oscillator (VCO)	8	BD3
Data and Timing Control	9	BD3
Phase Locked Circuits	10	BD3
Frequency Modulation Calibrator	11	BD3
Frequency Modulation System	12	BD3
50 MHz Reference Oscillator and Phase Lock Loop	13	BD3
A4 High Frequency Loop Assembly		
IF Section	1	BD2
HF Loop Amplifier and Control	2	BD2
A5 High Frequency Oscillator Assembly	1	BD2
A6 Output Assembly		
Output Section	4	BD2
Heterodyne and Output Control	5	BD2
Reverse Power Protection	7	BD2
A7 RFI Assembly	4, 5, 14	—
A8 Frequency Multiplier Assembly	3	BD2
A9 Attenuator Assembly	7	BD2
A10 Audio/Power Supply Assembly		
Modulation and RF Amplitude Control	6	BD2
Attenuator Control	7	BD2
Frequency Modulation Control	12	BD3
Power Supply	22	BD1
A11 Microprocessor/Memory/ HP-IB Assembly		
Microprocessor, Interrupt Processing and Restart	14	BD4
Address Buffering and Decoding, Serial I/O and Control	15	BD4
Memory	16	BD4
HP-IB Interface	17	BD4
A12 Voltage Regulator Assembly	22	BD1
A13 HP-IB Connector Assembly	17	BD4
A14 Filter Bank Assembly	14, 22	—
A15 Line Power Module	22	BD1
A16 10 MHz Reference Oscillator Assembly (Option 001)	13, 22	BD3
A17 Front Feedthrough Assembly	6,18 19, 22	—

ManualsPlus.com

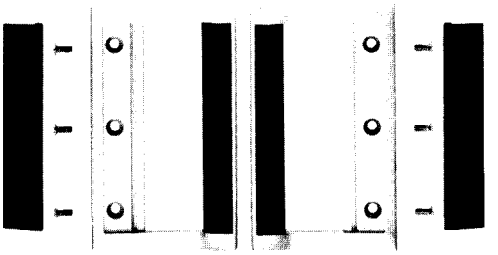


MODEL 8656A

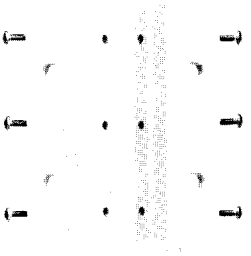


LINE POWER CABLE

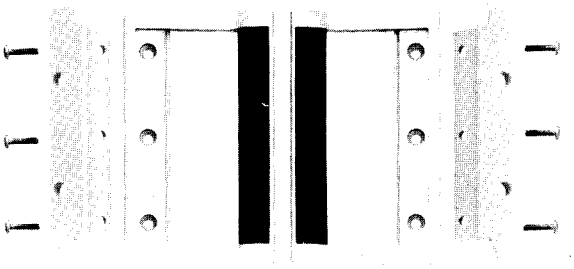
OPTION 001
TIME BASE CABLE



OPTION 907
FRONT HANDLE KIT



OPTION 908
RACK FLANGE KIT



OPTION 909
RACK FLANGE AND FRONT HANDLE
COMBINATION KIT

NOTE: Refer to ACCESSORIES SUPPLIED for more details.

Figure 1-1. HP Model 8656A Signal Generator with Option 001 and Accessories Supplied

ManualsPlus.com

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION

This manual contains information required to install, operate, test, adjust, and service the Hewlett-Packard Model 8656A Signal Generator. The Model 8656A will generally be referred to as the Signal Generator throughout this manual. Figure 1-1 shows the Signal Generator with all of its externally supplied accessories. This manual also documents Signal Generators supplied with the high stability time base, Option 001 and rear panel connectors, Option 002.

This section of the manual describes the instruments documented by this manual and covers instrument description, options, accessories, specifications, and other basic information. The other sections contain the following information:

Section II, Installation: provides information about initial inspection, preparation for use (including time base selection and HP-IB address selection for remote operation), and storage and shipment.

Section III, Operation: provides information about panel features and includes operator's checks, operating instructions for both local and remote operation, and operator's maintenance information.

Section IV, Performance Tests: provides the information required to check performance of the instrument against the critical specifications listed in Table 1-1.

Section V, Adjustments: provides the information required to properly adjust the instrument.

Section VI, Replaceable Parts: provides ordering information for all replaceable parts and assemblies.

Section VII, Manual Changes: with the backdating information, this manual applies to all instruments as indicated on the title page.

Section VIII, Service: provides the information required to repair the instrument.

Two copies of the operating information are supplied with the Signal Generator. One copy is in the form of an Operating Manual. The Operating Manual is simply a copy of the first three sections of the Operating and Service Manual. The Operating Manual should stay with the instrument for use by the operator. Additional copies of the Operating Manual may be ordered separately through your nearest Hewlett-Packard office. Its part number is listed on the title page of this manual.

Also listed on the title page of this manual, below the manual part number, is a "Microfiche" part number. This number may be used to order 100 x 150 millimetre (4- x 6-inch) microfilm transparencies of this manual. Each microfiche contains up to 96 photo-duplicates of the manual's pages. The microfiche package also includes the latest MANUAL CHANGES supplement, as well as all pertinent Service Notes.

1-2. SPECIFICATIONS

Instrument specifications are listed in Table 1-1. These specifications are the performance standards or limits against which the instrument may be tested. Supplemental characteristics are listed in Table 1-2. Supplemental characteristics are not warranted specifications, but are typical characteristics included as additional information for the user.

1-3. SAFETY CONSIDERATIONS

This product is a Safety Class I instrument, that is, one provided with a protective earth terminal. The Signal Generator and all related documentation must be reviewed for familiarization with safety markings and instructions before operation. Refer to the Safety Considerations page found at the beginning of this manual for a summary of the safety information. Safety information pertinent to the task at hand, that is, installation, operation, performance testing, adjustment, or service is found throughout this manual.

1-4. INSTRUMENTS COVERED BY THIS MANUAL

This instrument has a two-part serial number in the form 0000A00000 which is stamped on the serial number plate attached to the rear of the instrument. The first four digits and the letter con-

ManualsPlus.com

INSTRUMENTS COVERED BY THIS MANUAL (Cont'd)

stitute the serial number prefix and the last five digits form 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 directly to instruments having the same serial number prefix(es) as listed under SERIAL NUMBERS on the title page.

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 that the instrument is different from those documented 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.

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 print date and part number, both of which appear on the manual title page. Complimentary copies of the supplement are available from Hewlett-Packard

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 office.

1-5. DESCRIPTION

The Hewlett-Packard Model 8656A is a synthesized signal generator with a carrier frequency range of 100 kHz to 990 MHz. Its output amplitude is leveled and calibrated from +13 to −127 dBm. AM and/or FM functions can be individually selected. The carrier frequency, output amplitude, and modulation functions can be remotely programmed via the Hewlett-Packard Interface Bus. The unique modular design and incorporated service features permit rapid and easy calibration and service.

1-6. Carrier Frequency

The Signal Generator covers a carrier frequency range of 100 kHz to 990 MHz (10 kHz to 990 MHz with underrange) which can be extended to 1.8 GHz with an external doubler. Frequency resolution is 100 Hz or 250 Hz depending on the carrier frequency selected. An 8-digit LED display of the carrier frequency in MHz is provided. Pushbutton keys permit coarse tuning, fine tuning, and incrementing of the carrier frequency.

Frequency accuracy and stability are dependent on the reference source being used, either the internal 50 MHz reference oscillator or an external source that operates at 1, 5, or 10 MHz. An optional 10 MHz crystal reference is available for increased accuracy and stability.

1-7. Output Amplitude

The Signal Generator has precise power levels from +13 to −127 dBm (+1.00V to +0.100 μV) with overrange at decreased accuracy. The output amplitude from +13 to −127 dBm is accurate to less than or equal to ±1.5 dB from 100 kHz to 990 MHz. Level flatness is less than or equal to ±1.0 dB with an output amplitude setting of 0.0 dBm. Output amplitude resolution is 0.1 dB. A 3-1/2-digit LED display of output amplitude is provided with 7 LED annunciators used to display unit information. Easy conversion of units between dBm, μV, EMF, and so forth is possible.

1-8. Modulation Capabilities

The Signal Generator features a versatile internal and external modulation capability for AM and FM. This includes internal 400 Hz or 1 kHz tones; mixed modulation, such as AM/FM, AM/AM, or FM/FM; and the capability to accept low frequency digital unsquelching signals. A 2-digit display of AM depth or FM peak deviation frequencies is provided with 10 LED annunciators used to display internal or external modulation source information. Simple keyboard entries of AM depth up to 99% with a resolution of 1% and FM peak deviation frequencies up to 99 kHz with resolutions of 100 Hz (for deviations less than 10 kHz) or 1 kHz (for deviations greater than or equal to 10 kHz) are possible.

1-9. OPTIONS

The following options are available and may have been ordered and received with the Signal Generator. If they were not received with the original shipment and are now desired, except for option

ManualsPlus.com

OPTIONS (Cont'd)
002, they may be ordered from your nearest Hewlett-Packard office using the part number included in each of the following paragraphs.

1-10. Electrical Options

Option 001 provides a 10 MHz crystal reference for increased frequency accuracy and stability. Order HP part number 08656-60079.

1-11. Mechanical Options

The mechanical options except Option 002 are shown in Figure 1-1.

Rear Panel Inputs and Outputs Option 002. RF Output and Modulation Input/Output Connectors are located on the rear panel. The SEQ (sequencing) input is eliminated.

Front Handle Kit Option 907. Ease of handling is increased with the front panel handles. Order HP part number 5061-0089.

Rack Flange Kit Option 908. This kit contains all necessary hardware and installation instructions for mounting the Signal Generator in a rack with 482.5 millimeter (standard 19-inch) spacing. Order HP part number 5061-0077.

Rack Flange and Front Handle Combination Kit Option 909. This kit is not simply a front handle kit and rack flange kit packaged together. The combination is made up of unique parts which include both functions. Order HP part number 5061-0083.

1-12. HEWLETT-PACKARD INTERFACE BUS*

1-13. Compatibility

The Signal Generator has an HP-IB interface and can be used with any HP-IB computing controller or computer for automatic system applications. The Signal Generator is fully programmable via the HP Interface Bus. The Signal Generator's complete compatibility with HP-IB is defined by the following list of interface functions: SH0, AH1, T0, L2, SR0, RL1, PP0, DC1, DT0, and C0. The Signal Generator interfaces with the bus via open-collector TTL circuitry. An explanation of the compatibility codes can be found in the IEEE Standard 488 and the identical ANSI Standard MC1.1.

For more detailed information relating to programmable control of the Signal Generator, refer to Remote Operation, Hewlett-Packard Interface Bus in Section III of this manual.

1-14 Selecting the HP-IB Address

Five miniature HP-IB address switches are located inside the Signal Generator. These switches represent a five-bit binary number (00 through 31 in decimal). HP-IB addresses greater than 30 (decimal) are invalid. When the instrument is shipped from the factory, the HP-IB address is preset to 07 (decimal). To determine the Signal Generator's HP-IB address, refer to HP-IB Address Display in Section III of this manual. To change the HP-IB address, refer to paragraph 2-8, HP-IB Address Selection.

1-15. ACCESSORIES SUPPLIED

The accessories supplied with the Signal Generator are shown in Figure 1-1. The power cable and fuse supplied are selected at the factory according to the Mains voltage available in the country of destination. For the part numbers of the power cables and Mains plugs available, refer to paragraph 2-6, Power Cables. For the part numbers and ratings of the fuses available, refer to paragraph 2-5, Line Voltage and Fuse Selection. If the Signal Generator is equipped with Option 001, a coaxial time base cable is supplied. This cable must be connected between the rear panel TIME BASE HIGH STABILITY OPTION connector and the TIME BASE INPUT connector.

1-16 RECOMMENDED TEST EQUIPMENT

Table 1-3 lists the test equipment required for testing, adjusting, and servicing the Signal Generator. The Critical Specifications column describes the essential requirements for each piece of test equipment. Other equipment can be substituted if it meets or exceeds these critical specifications.

The Recommended Model column may suggest more than one model. The first model listed is usually the least expensive, single-purpose model. Alternate models are suggested for additional features that would make them a better choice in some applications. For example, reasons for recommending an alternate model might be:

- HP-IB programmablility
  — or —
- Multi-function capability (that is, one model can replace two or more single-purpose models)

Table 1-4 presents the advantages of the alternate suggestions.

*Not just IEEE-488, but the hardware, documentation and support that delivers the shortest path to a measurement system.

ManualsPlus.com

Table 1-1. Specifications (1 of 3)

Electrical Characteristics	Performance Limits	Conditions
FREQUENCY		
Range	100 kHz to 990 MHz	
Resolution	100 Hz 250 Hz	
SPECTRAL PURITY		
Spurious Signals:		
Harmonics	<–30 dBc	≤+7 dBm output levels
Non-harmonics	<–60 dBc	>5 kHz from carrier in CW mode
Sub-harmonics	None	
Residual Modulation		
CW Mode:		
AM (0.05 to 15 kHz Post Detection Noise Bandwidth)	<–70 dBc	0.1 to 990 MHz
FM (0.3 to 3 kHz Post Detection Noise Bandwidth)	<15 Hz rms <3 Hz rms <6 Hz rms <15 Hz rms	0.1 to 123.5 MHz 123.5 to 247 MHz 247 to 494 MHz 494 to 990 MHz
FM (0.05 to 15 kHz Post Detection Noise Bandwidth)	<30 Hz <8 Hz <16 Hz <30 Hz	0.1 to 123.5 MHz 123.5 to 247 MHz 247 to 494 MHz 494 to 990 MHz
OUTPUT		
Level Range	+13 dBm to –127 dBm	Into 50 ohms
Resolution	0.1 dB	
Absolute Level Accuracy[1]	≤±1.5 dB	Output levels of +13 dBm to –127 dBm; frequencies from 100 kHz to 990 MHz
Level Flatness	≤±1.0 dB	Output level setting of 0.0 dBm; frequencies from 100 kHz to 990 MHz
AMPLITUDE MODULATION		
Depth[2]	0 to 99%	Output levels of +7 dBm and below; frequencies from 100 kHz to 990 MHz
	0 to 30%	Output levels of +10 dBm and below; frequencies from 100 kHz to 990 MHz
Resolution	1%	
Incidental Phase Modulation	<0.3 radian peak	30% AM depth and internal rates

[1]Absolute level accuracy includes allowances for detector linearity, temperature, flatness, attenuator accuracy, and measurement error.
[2]AM depth is further limited by the Indicator Accuracy specification.

ManualsPlus.com

Table 1-1. Specifications (2 of 3)

Electrical Characteristics	Performance Limits	Conditions
AMPLITUDE MODULATION (Cont'd)		
Indicator Accuracy[2]	±2% (±4% of reading)	Depths <90% and internal rates
AM Rates:		
Internal	400 and 1 kHz, ±3%	
External	25 Hz to 25 kHz	1 dB bandwidth, ac coupled
AM Distortion (internal rates)	<1.5% <3% <5%	0 to 30% AM 31 to 70% AM 71 to 90% AM
FM MODULATION		
Maximum Peak Deviation (Δfpk):[3]		
Rates ≥60 Hz	99 kHz 25 kHz 50 kHz 99 kHz	0.1 to 123.5 MHz (fc) 123.5 to 247 MHz (fc) 247 to 494 MHz (fc) 494 to 990 MHz (fc)
Rates <60 Hz	1600 x Rate 400 x Rate 800 x Rate 1600 x Rate	0.1 to 123.5 MHz (fc) 123.5 to 247 MHz (fc) 247 to 494 MHz (fc) 494 to 990 MHz (fc) (FM not specified for fc — Δfpk <100 kHz)
Resolution	0.1 kHz 1 kHz	Deviations <10 kHz Deviations ≥10 kHz
Incidental AM	<0.1%	<20 kHz peak deviation and internal rates and carrier frequency ≥500 kHz.
Indicator Accuracy[3]	±5% of reading	At internal rates. Add ±5%, if 250 Hz frequency increments are used.
FM Distortion (Total Harmonic Distortion)	<0.5%	100 Hz to 99 kHz peak deviations and internal rates.
FM Rates:		
Internal	400 and 1 kHz, ±3%	
External	25 Hz to 25 kHz	1 dB bandwidth, ac coupled
GENERAL		
Operating Temperature Range	0 to 55°C	
Power Requirements		
Line Voltage	100, 120, 220, or 240 Vac, +5%, −10%	

[2]AM depth is further limited by the Indicator Accuracy specification.
[3]FM deviation is further limited by the Indicator Accuracy specification.

ManualsPlus.com

Table 1-1. Specifications (3 of 3)

Electrical Characteristics	Performance Limits	Conditions
GENERAL (Cont'd)		
Line Frequency	48 to 66 Hz	
Power Dissipation	125VA maximum	
Conducted and Radiated Electromagnetic Interference	MIL STD 461A, VDE 0871	Conducted and radiated interference is within the requirements of methods CE03 and RE02 of MIL STD 461A, VDE 0871, and CISPR Publication 11.
	<1.0 μV	Induced in a two-turn 2.5 cm (1 inch) diameter loop held 2.5 cm (1 inch) away from the front surface.
Net Weight	18.1 kg (40 lb)	
Dimensions (Full Envelope):		
Height Width Depth	133 mm (5.25 in.) nominal 425 mm (16.75 in.) nominal 520 mm (20.5 in.) nominal.	NOTE: For ordering cabinet accessories, the module sizes are 5-1/4H, 1MW, 17D.
Electrical Characteristics	**Features**	
REMOTE OPERATION		
HP-IB (IEEE 488) Capability:		
Interface	Hewlett-Packard Interface Bus (HP-IB). HP-IB is Hewlett-Packard's implementation of IEEE Standard 488 (and the identical ANSI Standard MC1.1). The Signal Generator's compatibility with HP-IB is defined by the following list of interface functions: SH0, AH1, T0, L2, SR0, RL1, PP0, DC1, DT0, and C0.	
Functions Controlled	All functions controlled from the front panel with the exception of DISPLAY, DISPLAY in conjunction with SEQ, Backspace, COARSE TUNE, FINE TUNE, and display HP-IB ADRS are programmable with the same accuracy and resolution as in local operation.	

ManualsPlus.com

Table 1-2. Supplemental Characteristics

Supplemental characteristics are intended to provide information useful in applying the instrument by giving typical, but non-warranted performance parameters.

FREQUENCY

Accuracy and Stability: same as internal time base.

Time Base Characteristics:

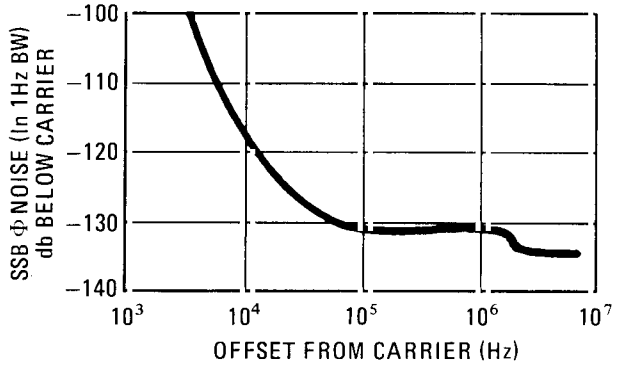
Characteristic	Standard Time Base	Option 001 Time Base
Aging Rate	±2 ppm/year	1×10^{-9}/day
Temperature	±10 ppm (0—55°C)	7×10^{-9} (0—55°C)
Line Voltage	—	2×10^{-9} (+5 to −10%)
Frequency	50 MHz	10 MHz
Time Base Reference Signal (Rear Panel)	Available at a level of >0.15 Vrms into 50 ohms (output of 10, 5 or 1 MHz is selectable via internal jumper). If the Option 001 or another external reference is used, only that reference frequency is available as an output.	
External Reference Input (Rear Panel)	Accepts any 10, 5 or 1 MHz (±0.002%) frequency standard at a level >0.15 Vrms into 50 ohms.	

Frequency Switching Speed: <2 seconds to be within 100 Hz of selected frequency.

SPECTRAL PURITY

SSB ϕ Noise (CW only):

Offset from Carrier	0.1 to 123.5 MHz (dBc/Hz)	123.5 to 247 MHz (dBc/Hz)	247 to 494 MHz (dBc/Hz)	494 to 990 MHz (dBc/Hz)
20 kHz	<−115	<−127	<−121	<−115
500 kHz	<−125	<−135	<−131	<−125



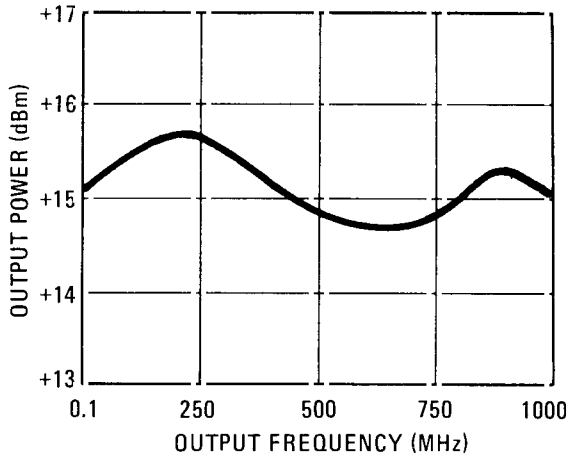
Typical SSB ϕ Noise, f_c = 450 MHz.

OUTPUT

SWR: <2, 0.1 to 990 MHz and <+13 dBm; < 1.5, 1.0 to 990 MHz and <−5 dBm.

Impedance: 50 ohms nominal.

Reverse Power Protection: protects Signal Generator from application of up to 50 watts of RF power to 990 MHz into RF OUTPUT connector; dc voltage cannot exceed 25V.



Typical maximum power output versus frequency (output set to +17 dBm).

MODULATION

(Amplitude and Frequency Modulation)

External Sensitivity: 1V peak for indicated accuracy. Front-panel annunciators indicate application of 1V peak signal ±5%.

External Modulation Input: front-panel BNC; ac-coupled, 600 ohms.

Modulating Signal Output: internal modulating signal is provided at the front-panel BNC connector at 1V peak, ±5% into 600-ohm resistive load.

Digital FM Modulation: will accept digital unsquelching signals. Sag of resultant demodulated signal is less than 8% at 1 kHz deviation for a 10 Hz square-wave modulating signal.

Simultaneous Modulation: internal and external AM and FM. Internal/external AM/FM, FM/AM, AM/AM, and FM/FM.

AM Incidental to FM: <1% for 200 kHz $\leq f_c <$ 500 kHz and <5% for 100 kHz $\leq f_c <$ 200 kHz.

ManualsPlus.com

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

Instrument	Critical Specifications	Recommended Model	Use[1]
AM/FM Test Source (required for modulation analyzer verification)	Range: 10 to 400 MHz Residual AM[2] FM Flatness: ±1% (dc to 250 kHz) Peak Deviation: to 100 kHz)	HP 11715A	P
Attenuator, Fixed	Attenuation: 20 dB Frequency Range: 10 MHz to 990 MHz SWR: <1.2	HP 8491A Option 020	A
Attenuator, Fixed	Attenuation: 60 dB Frequency Range: 100 kHz to 990 MHz Accuracy: ±2 dB ±0.16 dB at Standards Calibration Lab, Frequencies of 10, 100, 201, 801, 901, and 990 MHz. SWR: <1.3	HP 8491A Option H56	P
Controller, HP-IB	HP-IB compatibility as defined by IEEE Standard 488 and the identical ANSI Standard MC1.1: SH0, AH1, T4, TE0, L0, LE0, SR0, RL0, PP0, DC0 DT0, and C1, 2, 3, 28.	HP 9825A/98034A/ 98213A or HP 9835A/ 98332A/98034A (see Table 1-4)	A, T
Digital Multimeter	Accuracy: 4-1/2 digit, ±0.02% of reading ±1 digit Ranges: 20 mV to 30 Vdc and 2 Vac Sensitivity: 100 μV	HP 3465A or HP 3455A (see Table 1-4)	P, A, T
Distortion Analyzer	Distortion Range: <0.1% Range: 25 Hz to 25 kHz	HP 339A or HP 8903A (see Table 1-4)	P, T
Frequency Counter	Range: 10 MHz Resolution: 1 Hz	HP 5328A Option 031 or HP 5328A Options 001 and 031 (see Table 1-4)	A
Frequency Counter	Range: 990 MHz Resolution: 10 Hz	HP 5328A Option 031	T
Loop Antenna 2.5 cm (1 in.)	To ensure measurement accuracy, no substitution is possible. Fabrication depends upon machining and assembling to close tolerances.	HP 008640-60501	P
Modulation Analyzer	Frequency Range: 150 kHz to 990 MHz Input Level: −20 to +13 dBm Amplitude Modulation: Rates[3]: 25 Hz to 25 kHz Depth: to 99% Accuracy: ±2% at 1 kHz Flatness: ±0.5% Demodulated Output Distortion: (0.3% for 50% depth; <0.6% for 90% depth Incidental ΦM: <0.05 radians for 50% depth at 1 kHz rate (50 Hz to 3 kHz bandwidth) Residual AM[2]	HP 8901A	P, A

ManualsPlus.com

Table 1-3. Recommended Test Equipment (2 of 3)

Instrument	Critical Specifications	Recommended Model	Use[1]
Modulation Analyzer (Cont'd)	Frequency Modulation: Rates: 25 Hz to 25 kHz Deviation: to 99 kHz Accuracy: ±2% at 1 kHz Demodulated Output Distortion: <0.3% Incidental AM[3]: Residual FM: <8 Hz rms at 1300 decreasing linearly with frequency to <1 Hz rms for 100 MHz and below (50 Hz to 3 kHz bandwidth).		
Oscilloscope	Vertical Sensitivity: 10 mV/div Bandwidth: 50 MHz	HP 1222A or HP 1801A/1820C/181A (see Table 1-4)	A, T
Power Meter and Sensor	Frequency Range: 100 kHz to 990 MHz Power Range: +17 to −25 dBm with HP 8482A Frequency Range: 10 to 990 MHz Power Range: −20 to −60 dBm with HP 8484A Accuracy: ±0.2 dB	HP 436A or HP 436A Option 022 with HP 8484A and HP 8484A (see Table 1-4)	P, A, T
Signal Source	Frequency: 50 to 300 MHz Level: −20 dBm	HP 8640B	A, T
Signature Analyzer	Provides perferred method for troubleshooting digital circuitry.	HP 5004A	T
Spectrum Analyzer, RF	Frequency Range: 0.1 to 990 MHz Resolution Bandwidth: <1 kHz to 3 kHz	HP 8568A or HP 8558B/P/181T or (see Table 1-4)	P, A, T
Spectrum Analyzer, RF	Frequency: 10 to 990 MHz Resolution Bandwidth: <100 kHz Video Average: 25 Sweeps	Model 8568A	P, A, T
Test Oscillator	Level: 0.0 to 1 Vpk into 50 and 600 ohms Frequency: 25 Hz to 25 MHz	HP 651B	P, T
Wideband Amplifier	Gain: 20 or greater Frequency Range: 10 MHz to 990 MHz Impedance: 50 ohms Connector: Type N	HP 8447D Option 010	P

Adapter	Qty.	Type	Recommended Model	Use[1]
Coaxial	1	BNC(f) to BNC(f)	HP 1250-0080	A, T
Coaxial	1	N(f) to BNC(m)	HP 1250-0077	A
Coaxial	3	N(m) to BNC(f)	HP 1250-0780	P, A, T
Probe	2	SMC(f) to RF Test Point	HP 1250-1598	A, T

ManualsPlus.com

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

Cable	Qty.	Type	Recommended Model	Use[1]
RF	2	BNC(f) to BNC(f)	HP 08662-60080	P
RF	1	Connector: UG-210/U Type N(m)	HP 11500A	P, A, T
RF	2	Connector: UG-210/U Type N(m)	HP 11500B	P, A, T

[1]A = Adjustments; P = Performance Tests; T = Troubleshooting.

[2]The residual AM specification of both the HP 8901A Modulation Analyzer and HP 11715A AM/FM Test Source are stated in a 50 Hz to 3 kHz bandwidth. In order to assure the validity of the residual AM measurement in the bandwidths stated for the HP 8656A Signal Generator (namely, 50 Hz to 15 kHz) the combined performance of both the HP 8901A and HP 11715A must be verified to be better than 0.022% rms for the 50 Hz to 15 kHz bandwidth. See paragraph 4-7, step 4, for the verification procedure.

[3]The incidental AM specification of the Signal Generator is not equivalent to the published specification of the Model 8901A Modulation Analyzer. In order to assure the validity of the incidental AM measurement, the incidental AM of the modulation analyzer must be verified to be less than 0.02% for the 300 Hz to 3 kHz bandwidth and 20 kHz peak deviation at internal rates. Refer to paragraph 4-10, step 18, for the verification procedures.

Table 1-4. Alternate Test Equipment

Instrument	Recommended Model	Suggested Alternative	Advantages of Alternative
Controller, HP-IB	HP 9825A/98213A/ 98034A	HP 9835A/98332A/ 98034A	CRT Display HP Enhanced BASIC Larger Memory
Digital Voltmeter (DVM)	HP 3465A	HP 3455A	HP-IB* Compatible
Distortion Analyzer	HP 339A	HP 8903A	HP-IB* Compatible
Frequency Counter	HP 5328A Option 031	HP 5328A Options 001 and 031	HP-IB* Compatible
Power Meter	HP 436A	HP 436A Option 022	HP-IB* Compatible
Oscilloscope	HP 1222A	HP 1801A/1820C/ 181A	Satisfies all requirements for testing the Signal Generator. Also has increased vertical sensitivity (0.05 mV/ div) and a Persistance Display that makes it possible to troubleshoot the Low Frequency Loop circuits.
Spectrum Analyzer, RF	HP 8568A	HP 8558B/P/181T or HP 8554B/8552B/ 141T	Satisfies most of the requirements for testing the Signal Generator. The exception is the Low Level Accuracy test. In this case, the spectrum analyzer's noise level is high enough that the measurements are meaningless.

*HP-IB is Hewlett-Packard's implementation of IEEE Standard 488 and the identical ANSI Standard MC1.1.

ManualsPlus.com

SECTION II
INSTALLATION

2-1. INTRODUCTION

This section provides the information needed to install the Signal Generator. Included is information pertinent to initial inspection, power requirements, line voltage and fuse selection, power cables, time base selection, HP-IB address selection, interconnection, mating connectors, operating environment, instrument mounting, storage, and shipment.

2-2. INITIAL INSPECTION

WARNING

To avoid hazardous electrical shock, do not perform electrical tests when there are signs of shipping damage to any portion of the outer enclosure (covers and panels).

Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically. The contents of the shipment should be as shown in Figure 1-1. Procedures for checking electrical performance are given in Section IV. If the contents are incomplete, if there is mechanical damage or defect, or if the instrument does not pass the electrical performance test, notify the nearest Hewlett-Packard office. If the shipping container is damaged, or the cushioning material shows signs of stress, notify the carrier as well as the Hewlett-Packard office. Keep the shipping materials for the carrier's inspection.

2-3. PREPARATION FOR USE

2-4. Power Requirements

WARNING

To avoid the possibility of hazardous electrical shock, do not operate this instrument at line voltages greater than 126.5 Vac with line frequencies greater than 66 Hz. Leakage currents at these settings may exceed 3.5 mA.

The Signal Generator requires a power source of 115 (90 to 126) Vac or 230 (198 to 252) Vac, 48 to 66 Hz single phase. Power consumption is 125 VA maximum.

WARNINGS

This is a Safety Class I product (i.e., provided with a protective earth terminal). An uninterruptible safety earth ground must be provided from the Mains power source to the product input wiring terminals, power cord, or supplied power cord set. Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

If this instrument is to be energized via an external autotransformer for voltage reduction, make sure that the common terminal is connected to the earthed pole of the power source.

2-5. Line Voltage and Fuse Selection

CAUTION

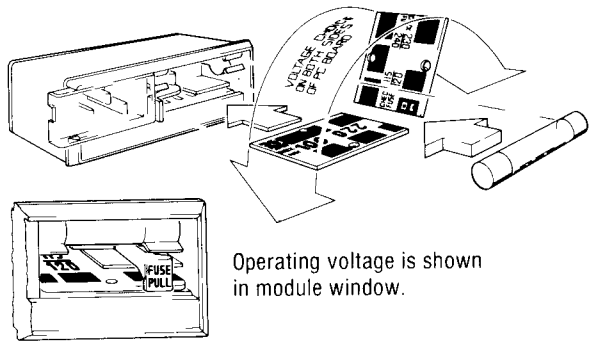
BEFORE PLUGGING THIS INSTRUMENT into the Mains (line) voltage, be sure the correct voltage and fuse have been selected.

A rear panel, line power module permits operation from 100, 120, 220, or 240 Vac. The number visible in the window (located on the module) indicates the nominal line voltage to which the instrument must be connected. Verify that the line voltage selection card and the fuse are matched to the power source. Refer to Figure 2-1, Line Voltage and Fuse Selection. Table 2-1 lists the ratings and HP part numbers for the replaceable fuses.

WARNING

For protection against fire hazard, the line fuse should only be a 250V slow blow fuse with the correct current rating.

ManualsPlus.com



Operating voltage is shown in module window.

SELECTION OF OPERATING VOLTAGE

1. Open cover door, pull the FUSE PULL lever and rotate to left. Remove the fuse.
2. Remove the Line Voltage Selection Card. Position the card so the line voltage appears at top-left corner. Push the card firmly into the slot.
3. Rotate the FUSE PULL lever to its normal position. Insert a fuse of the correct value in the holder. Close the cover door.

WARNING

To avoid the possibility of hazardous electrical shock, do not operate this instrument at line voltages greater than 126.5 Vac with line frequencies greater than 66 Hz (leakage currents at these line settings may exceed 3.5 mA).

Figure 2-1. Line Voltage and Fuse Selection

Table 2-1. Line Fuse Ratings and Part Numbers

Line Voltage	Rating	Part Number
100/120V	1.25A, 250V, SLO-BLO	HP 2110-0305
220/240V	0.6A, 250V, SLO-BLO	HP 2110-0016

2-6. Power Cables

WARNING

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

This instrument is equipped with a three-wire power cable. When connected to an appropriate ac power receptacle, this cable 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 numbers of the power cables and Mains plugs available.

2-7. Time Base Selection

One of three time base output signals (1, 5, or 10 MHz at a level greater than 0.15 Vrms into 50 ohms) is accessible at the rear panel TIME BASE OUTPUT connector. This output signal is derived from the internal reference oscillator frequency and is jumper-selectable through an inductor located inside the Signal Generator on the Low Frequency Loop Assembly — A3. When the instrument is shipped from the factory, the inductive-jumper is hard-wired to provide a 10 MHz time base output signal. If the Option 001 or another external 10 MHz reference is applied to the rear panel TIME BASE INPUT connector, only that reference frequency will be available as an output signal. Also, if either a 1 or 5 MHz output signal is desired, the internal inductive-jumper will have to be repositioned. Similarly, if an external 1 or 5 MHz reference input is to be applied to the rear panel TIME BASE INPUT connector, the inductive-jumper will have to be repositioned to the position that corresponds to the frequency of the external reference input. The top cover of the Signal Generator will have to be removed to gain access to the time base jumper. The following procedure describes how to change the location of the inductive-jumper.

a. Remove the top cover from the Signal Generator by first removing the two screws used to secure the strap handle to each side of the instrument. Next, remove the front and rear caps, slide the side cover in the direction of the arrow, then lift the side cover away from the frame. Finally, lift the top cover away from the frame.

b. Locate the time base jumper on the Low Frequency Loop Assembly — A3 (see Figure 2-3).

c. Unsolder one end of the inductive-jumper and resolder it in the position that corresponds to the desired time base output or to the external reference input.

ManualsPlus.com

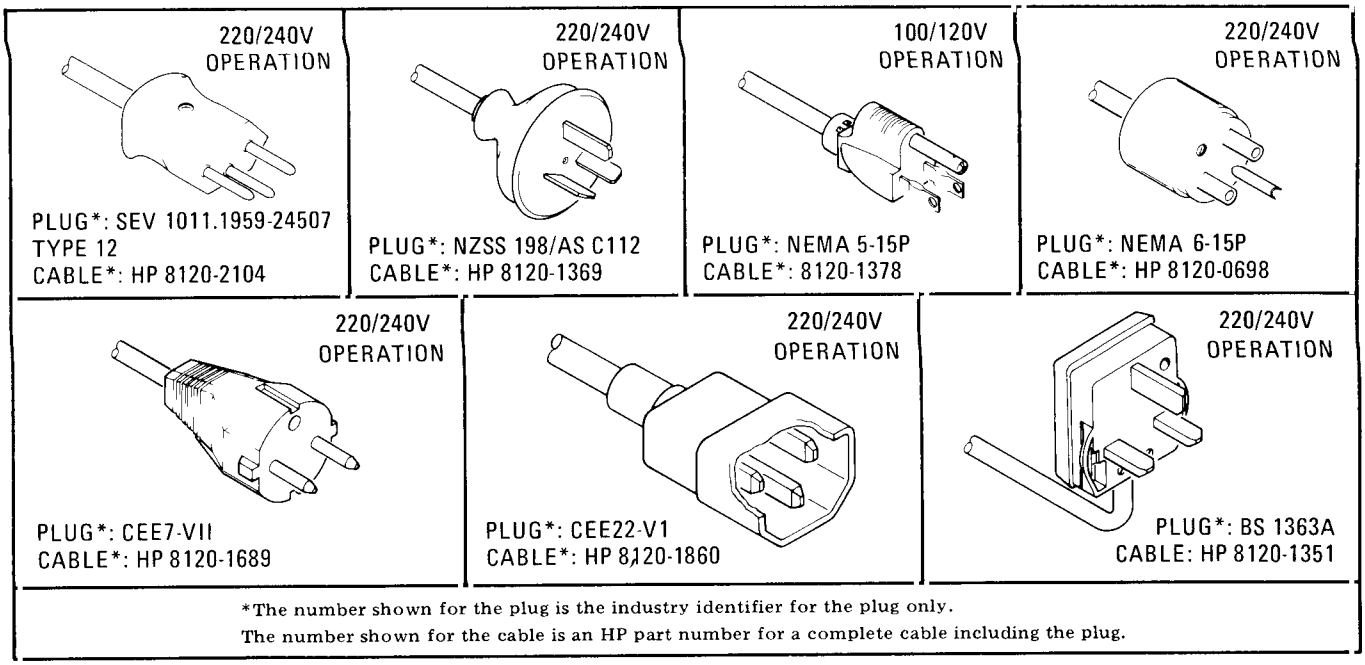


Figure 2-2. Power Cable and Mains Plug Part Numbers

Time Base Selection (Cont'd)

d. Reinstall the top cover by reversing the procedure given in step a.

e. If the Signal Generator is equipped with Option 001, ensure that the coaxial time base cable (A16W2) is connected between the rear panel TIME BASE HIGH STABILITY OPTION connector and the TIME BASE INPUT connector.

2-8. HP-IB Address Selection

The Signal Generator is strictly a listener, never a talker, and therefore only its HP-IB (listen) address can be selected. This HP-IB address is switch-selectable through five miniature rocker-switches located inside the Signal Generator on the Microprocessor/Memory/HP-IB Assembly — A11. These switches provide the means to select one of 31 valid HP-IB addresses (00 through 30). HP-IB addresses greater than 30 (decimal) are invalid. Refer to Table 2-2 for the allowable HP-IB address codes. Listed are the valid address switch settings and the equivalent ASCII character and decimal value. When the instrument is shipped from the factory, the HP-IB address is preset to 07 (decimal). (In binary, this is 00111; the ASCII equivalent character is an apostrophe.) This preset address is shown shaded in Table 2-2. The bottom cover of the Signal Generator will have to be removed to gain access to the HP-IB switches.

The following procedure describes how to change the settings of the HP-IB address switches.

NOTE

The HP-IB address stored in memory will only change when the instrument is powered up or reset. Therefore, the instrument must be unplugged or reset once the settings of the HP-IB address switches have been changed, otherwise, the stored HP-IB address will remain unchanged.

a. Remove the bottom cover from the Signal Generator by first removing the two screws used to secure the strap handle to each side of the instrument. Next, remove the front and rear caps, slide the cover in the direction of the arrow, then lift the side cover away from the frame. Finally, lift the bottom cover away from the frame.

b. Locate the HP-IB address switches S3 and S4 on the Microprocessor/Memory/ HP-IB Assembly — A11 (see Figure 2-4).

c. Use a pencil to set the switches to the desired HP-IB address in binary (see Figure 2-4). The five switches are labeled A1 through A5, where A1 is the least significant address bit and A5 is the most

ManualsPlus.com

Table 2-2. Allowable HP-IB Address Codes

Address Switch					Equivalent ASCII Character (LISTEN)	Equivalent Decimal Value (LISTEN)
A5	A4	A3	A2	A1		
0	0	0	0	0	SP	00
0	0	0	0	1	!	01
0	0	0	1	0	"	02
0	0	0	1	1	#	03
0	0	1	0	0	$	04
0	0	1	0	1	%	05
0	0	1	1	0	&	06
0	0	1	1	1	'	07
0	1	0	0	0	(	08
0	1	0	0	1	)	09
0	1	0	1	0	*	10
0	1	0	1	1	+	11
0	1	1	0	0	,	12
0	1	1	0	1	-	13
0	1	1	1	0	.	14
0	1	1	1	1	/	15
1	0	0	0	0	0	16
1	0	0	0	1	1	17
1	0	0	1	0	2	18
1	0	0	1	1	3	19
1	0	1	0	0	4	20
1	0	1	0	1	5	21
1	0	1	1	0	6	22
1	0	1	1	1	7	23
1	1	0	0	0	8	24
1	1	0	0	1	9	25
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

Indicates factory-set address.

HP-IB Address Selection (Cont'd)

significant address bit. Pressing the right-hand side of the switch (as viewed from the front of the instrument) "sets" the corresponding address bit (bit=1), while pressing the left-hand side "clears" the bit (bit=0). Setting all of the address bits to "1" will result in an invalid HP-IB address (31 decimal). In this case, an HP-IB address of 30 (decimal) will be stored in memory once the instrument is powered up or reset.

d. Reinstall the bottom cover by reversing the procedure given in step a.

e. To confirm the HP-IB address, simply press and hold the front panel HP-IB ADRS key. The internally-set, decimal HP-IB address will be displayed in the MODULATION Display as long as the HP-IB ADRS key remains pressed.

2-9. Interconnection

Interconnection data for the Hewlett-Packard Interface Bus is provided in Figure 2-5.

2-10. Mating Connectors

Coaxial Connectors. Coaxial mating connectors used with the Signal Generator should be either 50-ohm BNC male connectors or 50-ohm Type N male connectors that are compatible with those specified in US MIL-C-39012.

Interface Connector. HP-IB mating connector is shown in Figure 2-5. Note that the two securing screws are metric.

2-11. Operating Environment

The operating environment should be within the following limitations:

Temperature ..... 0°C to +55°C
Humidity ..... <95% relative at 40°C
Altitude ..... <4570 metres (15 000 feet)

2-12. Bench Operation

The instrument cabinet has plastic feet and fold-away tilt stands for convenience in bench operation. (The plastic feet are shaped to ensure self-alignment of instruments when they are stacked.) The tilt stands raise the front of the Signal Generator for easier viewing of the front panel.

2-13. Rack Mounting

WARNING

The Signal Generator weighs 18.1 kg (40 lb); therefore, care must be exercised when lifting to avoid personal injury. Use equipment slides when rack mounting.

ManualsPlus.com

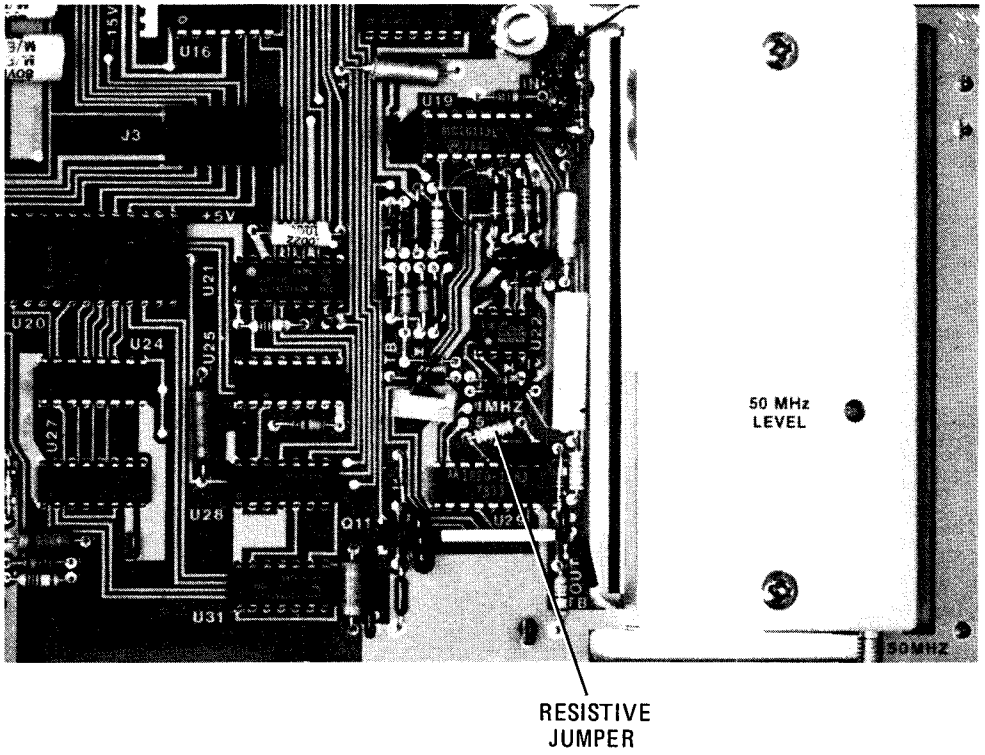


Figure 2-3. Time Base Jumper Location

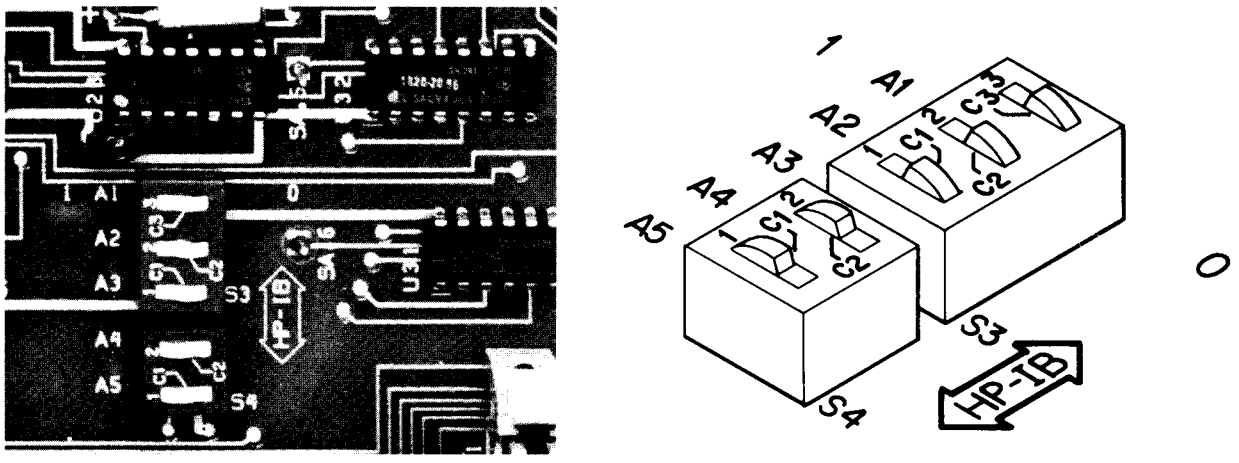
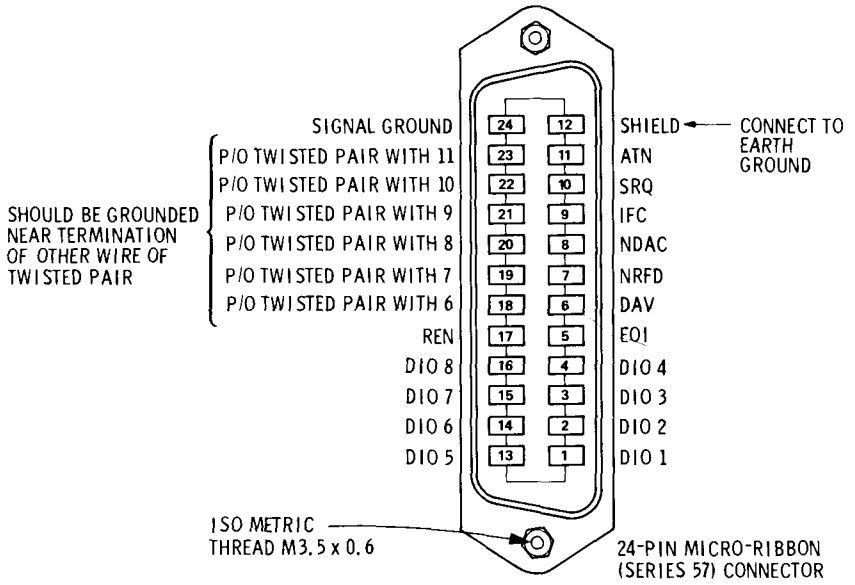


Figure 2-4. HP-IB Address Switch Location and Settings

ManualsPlus.com



Logic Levels

The Hewlett-Packard Interface Bus Logic Levels are TTL compatible, i.e., the true (1) state is 0.0 Vdc to +0.4 Vdc and the false (0) state is +2.5 Vdc to +5.0 Vdc.

Programming and Output Data Format

Refer to Section III, Operation.

Mating Connector

HP 1251-0293; Amphenol 57-30240.

Mating Cables Available

HP 10833A, 1 metre (3.3 ft), HP 10833B, 2 metres (6.6 ft)
HP 10833C 4 metres (13.2 ft), HP 10833D, 0.5 metres (1.6 ft)

Cabling Restrictions

1. A Hewlett-Packard Interface Bus system may contain no more than 2 metres (6.6 ft) of connecting cable per instrument.

2. The maximum accumulative length of connecting cable for any Hewlett-Packard Interface Bus system is 20.0 metres (65.6 ft).

Figure 2-5. Hewlett-Packard Interface Bus Connections

ManualsPlus.com

Rack Mounting (Cont'd)

Rack mounting information is provided with the rack mounting kits. If a kit was not ordered with the Signal Generator as an option, it may be ordered through the nearest Hewlett-Packard office. Slide rack mount kits are discussed in the following paragraphs; refer to paragraph 1-11, Mechanical Options, in Section I for information and part numbers pertaining to other rack mount kits.

Slide rack mount kits allow the convenience of rack mounting with the flexibility of easy access. The slide kits for the Signal Generator are listed below.

Standard Slide Kit for HP rack enclosures ..... HP 1494-0018
Standard Tilt Slide Kit for HP rack enclosures ..... HP 1494-0025
Slide Adapter Bracket Kit for Standard Slides (for non HP rack enclosures) .... HP 1494-0023

2-14. STORAGE AND SHIPMENT

2-15. Environment

The instrument should be stored in a clean, dry environment. The following environmental limitations apply to both storage and shipment.

Temperature .....–55°C to +75°C
Humidity .....<95% relative
Altitude..... 15 300 metres (50 000 feet)

2-16. Packaging

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 assure careful handling. In any correspondence, refer to the instrument by model number and full serial number.

Other Packaging. The following general instructions should be used for repackaging 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, return address, model number, and full serial number).

b. Use a strong shipping container. A double-wall carton made of 2.4 MPa (350 psi) test material is adequate.

c. Use enough shock-absorbing material (75 to 100 millimetre layer; 3 to 4 inches) around all sides of the instrument to provide a firm cushion and to prevent movement in the container. Protect the front panel with cardboard.

d. Seal the shipping container securely.

e. Mark the shipping container FRAGILE to assure careful handling.

ManualsPlus.com

SECTION III
OPERATION

3-1. INTRODUCTION

This section provides complete operating information for the Signal Generator. Included are both general and detailed operating instructions; detailed descriptions of each front and rear panel key, connector, switch, and display; information on remote operation; operator's checks; and operator's maintenance procedures.

3-2. Operating Characteristics

Table 3-2 briefly summarizes the major operating characteristics of the Signal Generator. This table is not intended to be an in-depth listing of all characteristics. For more detailed information on the Signal Generator's characteristics, refer to Table 1-1, Specifications and Table 1-2, Supplemental Characteristics. For information on the instrument's HP-IB capabilities, refer to the summary contained in Table 3-4, HP-IB Message Reference Table.

3-3. Local Operation

Information covering front panel operation of the Signal Generator is presented in five areas of this section, namely Simplified Front Panel Features, Simplified Operation, General Operating Instructions, Detailed Panel Features, and Detailed Operating Instructions.

Simplified Front Panel Features. Figure 3-1 on the backside of this foldout illustrates the front panel of the Signal Generator and provides simplified descriptions of each key, connector, switch, and display. In addition, references are provided to the more detailed descriptions.

Simplified Operation. The instructions on the backside of this foldout provide a quick introduction to front panel operation of the Signal Generator. These instructions are designed to rapidly acquaint the novice user with the basic operation of the instrument. Included are instructions for setting carrier functions, setting modulation functions, and changing parameter values. This is a good starting point for the first-time user. Table 3-3 provides an index (in functional order) to the detailed operating instructions. This index is intended to direct the user to the more complete operating instructions which are arranged alphabetically at the end of this section.

General Operating Instructions. Instructions relating to the Signal Generator's power-on procedure, power-on sequence, various keystroke sequences, and time base selection are presented to acquaint the user with the general operation of the instrument.

Detailed Panel Features. Front and rear panel features are described in detail in Figures 3-2 through 3-7.

Detailed Operating Instructions. The detailed operating instructions present the most comprehensive information about all of the Signal Generator's functions. These instructions are arranged alphabetically by subject and are included at the end of this section for easy reference. They are indexed in functional order in Table 3-3.

3-4. Remote Operation

The Signal Generator is capable of remote operation via the Hewlett-Packard Interface Bus. Knowledge of local operation is essential for HP-IB programming since most of the data messages contain the same keystroke-like sequences. HP-IB information is presented in the following areas of this section:

a. General HP-IB information begins with paragraph 3-17.

b. A summary of HP-IB capabilities is provided in Table 3-4.

c. A summary of program codes is provided in Tables 3-8 and 3-9.

d. Detailed information relating to the Signal Generator's HP-IB programmable features together with tables and examples of associated program codes are presented in the detailed operating instructions which are arranged alphabetically at the end of this section.

3-5. Operator's Checks

Operator's checks are simple procedures designed to verify that the main functions of the Signal

ManualsPlus.com

Generator operate properly. Two procedures are provided, one for basic (front panel) functional checks and the other for HP-IB functional checks.

Basic Functional Checks. This procedure requires only a frequency counter, a spectrum analyzer, and the interconnecting cables and adapters. It provides assurance that most of the front panel controlled functions are being properly executed by the Signal Generator.

HP-IB Functional Checks. This series of procedures requires only an HP-IB compatible computing controller and an HP-IB interface with its interconnecting cable. These procedures assume that front panel operation has been previously verified, that is, that the basic functional checks have been previously performed. The procedures check all of the applicable bus messages summarized in Table 3-4.

3-6. Operator's Maintenance

The only maintenance that the operator should normally perform is the replacement of the primary power fuse. All other maintenance should be referred to qualified service personnel.

3-7. GENERAL OPERATING INSTRUCTIONS

WARNINGS

Before the Signal Generator is switched on, all protective earth terminals, extension cords, autotransformers, and devices connected to it should be connected to a protective earth grounded socket. Any interruption of the protective earth grounding will cause a potential shock hazard that could result in personal injury.

For continued protection against fire hazard, replace the line fuse, with only a 250V slo-blo fuse of the same rating. Do not use repaired fuses or short circuited fuseholders.

CAUTIONS

Before the Signal Generator is switched on, it must be set to the same line voltage as the power source or damage to the instrument may result.

The Signal Generator is protected against reverse power applications up to 50 watts; however, for greatest protection of expensive internal components be careful not to apply any reverse power to the RF OUTPUT connector.

3-8. Power-On Procedure

The Signal Generator has a standby state and an on state. Whenever the power cable is plugged in, the internal power supply is activated. If the instrument is equipped with the high stability reference (Option 001), the oven will be energized to keep the reference oscillator stable. If the Signal Generator is already plugged in, set the RESET/STBY/ON switch to ON. If the power cable is not plugged in, follow these instructions:

ManualsPlus.com

1. Check that the line voltage setting matches the power source. Refer to paragraph 2-5.

2. Check that the fuse rating is appropriate for the line voltage being used. Refer to paragraph 2-5.

3. Plug in the power cable.

4. Set the RESET/STBY/ON switch to ON.

3-9. Power-On Sequence

When the RESET/STBY/ON switch is set to ON after the instrument is first connected to Mains power or after it is reset, an internal memory check is initiated. This check tests for a failure in ROM (read-only memory) and in RAM (read-write memory). During this check, all front panel indicators will light for approximately 1.5 seconds to provide a quick visual inspection of each front panel annunciator and display segment. If a memory failure is detected, all front panel annunciators and display segments will remain lit until any front panel key is pressed. If the memory check was successful, the front panel indicators will display a carrier frequency of 100.0000 MHz, an output amplitude of −127.0 dBm, and no modulation. All annunciators (except dBm) will remain off. Table 3-1 lists the conditions of the Signal Generator as a result of a successful initialization sequence.

Table 3-1. Initialized Conditions

Parameter	Initialized Condition
Carrier Frequency	100.0000 MHz
Output Amplitude	−127.0 dBm
AM Depth	0%
FM Peak Deviation Frequency	0.0 kHz
Carrier Frequency Increment	10.0000 MHz
Output Amplitude Increment	10.0 dB
AM Depth Increment	1%
FM Peak Deviation Frequency Increment	1.0 kHz
Coarse and Fine Tune Pointer	10.0000 MHz
Sequence Counter	0
All 10 Internal Storage Registers	100.0000 MHz and −127.0 dBm with no modulation

3-10. Keystroke Sequences

The Signal Generator's functions can be selected in any order; however, each function selection requires a prescribed sequence of keystrokes. A keystroke sequence might contain only a single keystroke, such as, to read the internally-set, decimal HP-IB address or to return to local operation. More often though, the sequence will contain several keystrokes which must be entered in a specific order. This is true whenever one of the four main functions (Frequency, Amplitude, AM, or FM) is selected. Once one of these functions has been selected, the instrument will remain in that function until one of the following events occurs:

a. One of the three remaining functions is selected.

b. One of the STORE-RECALL-DISPLAY keys is pressed.

c. The instrument is reset or unplugged.

ManualsPlus.com

As long as a function remains in effect, it is not necessary to re-select that function before entering new data. The following paragraphs discuss multiple-entry keystroke sequences.

Carrier Keystroke Sequence. The parameters used to set the carrier's frequency and amplitude are entered in a Function-Data-Units format. Data entered following a function selection will be interpreted for that function. Data previously entered remains unaffected until the new data entry is terminated by pressing a valid unit key. If any other function key is pressed before the data entry is terminated, that entry will be rejected and the last valid display will be restored so that it agrees with the actual output of the Signal Generator.

Table 3-2. Operating Characteristics

Frequency

Range: 100 kHz to 990 MHz

Resolution: 100 Hz
250 Hz

Amplitude

Range: +13 dBm to −127 dBm (+1.00V to +.100 μV)

Resolution: 0.1 dB

Absolute Level Accuracy: ≤±1.5 dB

Level Flatness: ≤±1.0 dB (100 kHz to 990 MHz with output level setting of 0.0 dBm)

Modulation

AM

Depth: 0% to 99% to +7 dBm
0% to 30% to +10 dBm

Resolution: 1%

FM

Peak Deviation:

Carrier Frequency (MHz)	Maximum Peak Deviation	
	Rates ≥60 Hz	Rates <60 Hz
0.1 — 123.5	99 kHz	1600 × Rate
123.5 — 247	25 kHz	400 × Rate
247 — 494	50 kHz	800 × Rate
494 — 990	99 kHz	1600 × Rate

Resolution: 0.1 kHz (deviations <10 kHz)
1 kHz (deviations ≥10 kHz)

Rates: 400 Hz or 1 kHz ±3%, internal
25 Hz to 25 kHz, external (ac coupled, 1 dB bandwidth)

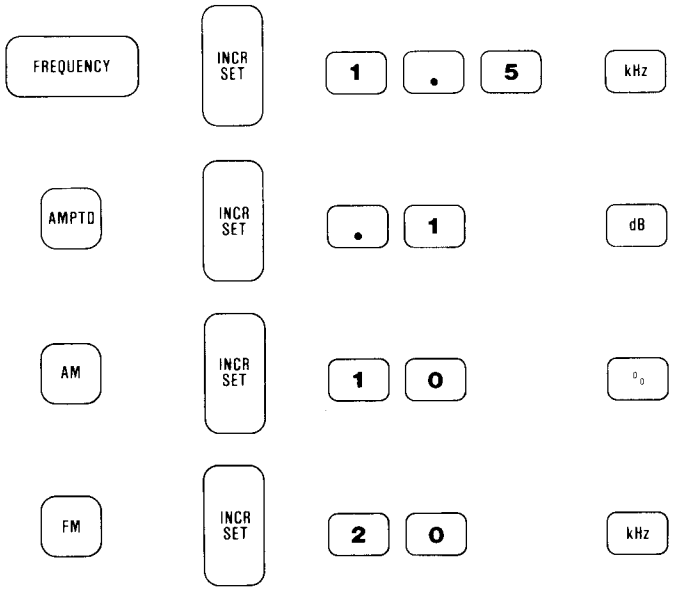
External Modulation Source: 600 ohms nominal, ac coupled

Mixed Modulation: Any combination of internal AM, internal FM, external AM, or external FM is possible.

ManualsPlus.com

CHANGING PARAMETERS VALUES (Cont'd)

The increment value for the four main functions can be modified as follows:



The maximum allowable increment value for each of the four main functions is as follows:

Carrier Frequency	≤989.99 MHz
Output Amplitude	≤144 dB
AM Depth	≤99%
FM Peak Deviation Frequency	≤99 kHz

NOTE

The carrier frequency increment is rejected if it is not a multiple of 100 Hz or 250 Hz.



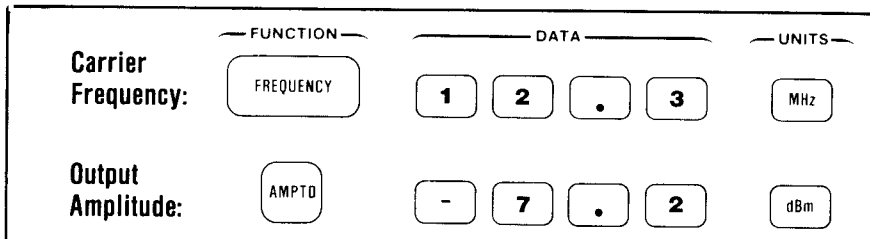
In addition, value-selectable carrier frequency parameters can be changed using the COARSE TUNE or FINE TUNE keys in conjunction with the step up or step down keys associated with the carrier frequency function. The COARSE TUNE key causes the carrier frequency tuning value to be increased by a factor of 10 each time it is pressed, while the FINE TUNE key causes the carrier frequency tuning value to be decreased by a factor of 10. Pressing the INCR SET key disables the affect of these keys and enables the original carrier frequency increment value.

STORE-RECALL-DISPLAY-SEQUENCE

Up to ten complete front panel settings (exclusive of increment values) can be stored for either selectable or sequential recall at a later time. The output of the Signal Generator will be changed so that it agrees with the recalled parameter values. Stored front panel settings can also be displayed without actually changing the output signal.

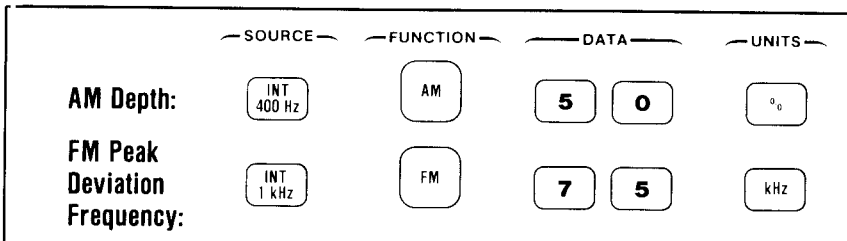
ManualsPlus.com

SETTING CARRIER FUNCTIONS



Both of the Signal Generator's carrier functions have value-selectable parameters. These parameters are selected in the Function-Data-Units format as shown in the examples above.

SETTING MODULATION FUNCTIONS

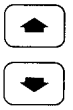


Internal, external, or mixed AM or FM functions can be selected. Modulation parameters are selected in the Source-Function-Data-Units format as shown in the examples above. One of the two internal modulation sources (400 Hz or 1 kHz) and/or a signal from an external modulation source (ac coupled through the front panel connector) may be used to modulate the carrier.

CHANGING PARAMETERS VALUES

Value-selectable parameters can be changed by making new Function-Data-Units entries, or by using the step up or down keys associated with each of the four main functions. These keys are used in conjunction with the INCR SET key.

Step Up and Down Keys



The step up and down keys are always enabled to change the value of the associated main function. The initialized value of each increment is listed as follows:

Carrier Frequency	10 MHz
Output Amplitude	10 dB
AM Depth	1%
FM Peak Deviation Frequency	1 kHz



The value of each increment can be displayed or modified by using the INCR SET key. The stored increment value will be displayed as long as the INCR SET key remains pressed.

ManualsPlus.com

MODULATION Display

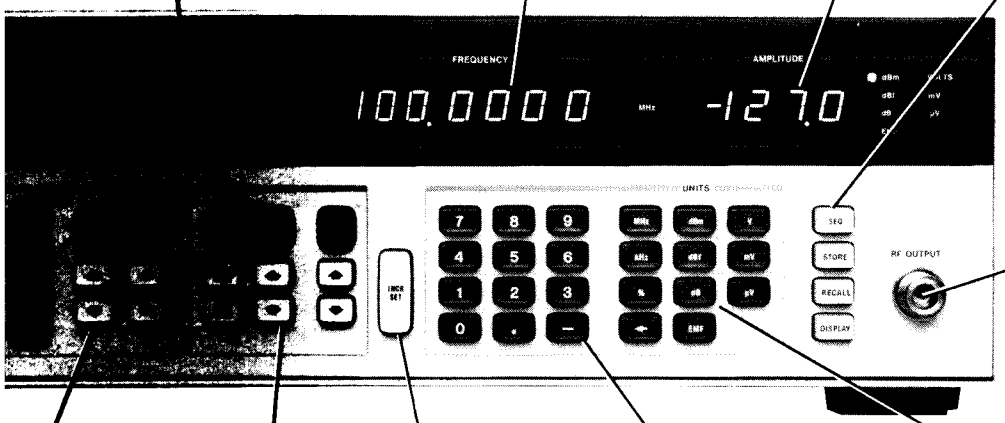
it display of AM depth, FM peak deviafrequency, or modulation increment. ED annunciators display internal and rnal modulation source information. used to display the internally-set, mal HP-IB address (see Figure 3-2).

AMPLITUDE Display

3-1/2 digit display of RF output level or amplitude increment. 7 LED annunciators display unit information. Also used to display the current contents of the internal sequence counter and to indicate that a reverse power condition has been detected (see Figure 3-2).

FREQUENCY Display

8 digit display of frequency or frequency increment in megahertz (see Figure 3-2).



STORE-RECALL-DISPLAY-SEQUENCE Keys

Stores up to ten complete front panel settings for selectable recall or display at a later time. The SEQ key permits a sequential recall of stored front panel settings or a display of the internal sequence counter contents when it is used in conjunction with the DISPLAY key (see Figure 3-6).

RF OUTPUT Connector

Provides an AC-coupled, reverse-power protected RF output signal with a frequency range of 100 kHz to 990 MHz and a leveled output of +13 dBm to –127 dBm (see Figure 3-3).

UNITS Entry Keys

Terminates a data entry for any one of the four main functions. The backspace key (←) clears the last digit or decimal point visible in a display to permit the entry to be corrected (see Figure 3-5).

Data Entry Keys

Ten numeric entry keys, a decimal point key, and a minus sign key used for frequency, amplitude, AM, FM, or increment value data entry. Numeric entry keys are also used in conjunction with the STORE, RECALL, or DISPLAY keys to select one of the ten internal storage registers (see Figure 3-5).

CARRIER Keys

Selects and permits tuning of the basic carrier functions (see Figure 3-3).

ys

nal, or mixed
ure 3-4).

INCR SET Key

Selects the value of the frequency, amplitude, AM, or FM increment. Also used to display the stored increment value for each of the four main functions (see Figure 3-6).

Figure 3-1. Simplified Front Panel Features

ManualsPlus.com

SIMPLIFIED FRONT PANEL FEATURES AND OPERATION

MODULATION Display

2 digit display of AM depth, FM peak deviation frequency, or modulation increment. 10 LED annunciators display internal and external modulation source information. Also used to display the internally-set, decimal HP-IB address (see Figure 3-2).

Remote Annunciators

2 LED annunciators used to indicate remote operation status (see Figure 3-2).

LOCAL Key

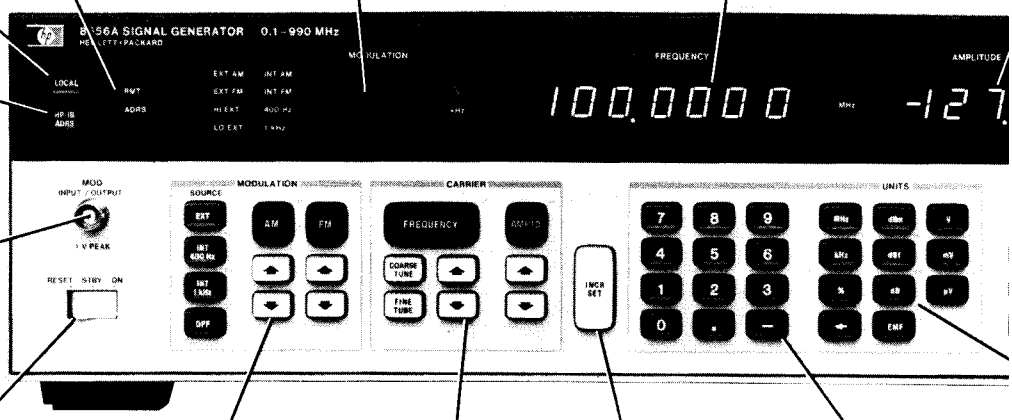
Returns the Signal Generator to local operation, provided that it is not in local lockout (see Figure 3-2).

FREQUENCY Display

8 digit display of frequency or frequency increment in megahertz (see Figure 3-2).

HP-IB ADRS Key

Causes the internally-set, decimal HP-IB address to be displayed in the MODULATION Display (see Figure 3-2).



MOD INPUT/OUTPUT Connector

AC-coupled input for an external modulation source or DC-coupled output for the internal modulation source (see Figure 3-4).

RESET/STBY/ON Switch

Controls the operating state of the internal microprocessor. The internal power supply (and optional reference oscillator) remain energized as long as the power cable is connected to Mains power (see Figure 3-6).

CARRIER Keys

Selects and permits tuning of the basic carrier functions (see Figure 3-3).

Data Entry Key

Ten numeric entry keys, a key, and a minus sign key quency, amplitude, AM, FM value data entry. Numeric also used in conjunction w RECALL, or DISPLAY keys t the ten internal storage regi ure 3-5).

MODULATION Keys

Selects either internal, external, or mixed AM or FM functions (see Figure 3-4).

INCR SET Key

Selects the value of the frequency, amplitude, AM, or FM increment. Also used to display the stored increment value for each of the four main functions (see Figure 3-6).

Figure 3-1. Simplified Front Panel Features

ManualsPlus.com

Table 3-3. Index of Detailed Operating Instructions

Instruction	Page
Frequency	3-39
Frequency, Coarse and Fine Tune	3-41
Frequency, Up/Down	3-43
Amplitude	3-32
Amplitude Conversion	3-34
Amplitude, Up/Down	3-36
Modulation, AM	3-49
Modulation, AM Up/Down	3-50
Modulation, External Source	3-51
Modulation, FM	3-52
Modulation, FM Up/Down	3-54
Modulation, Mixed	3-55
Modulation, Off	3-59
Increment Value Change	3-46
Increment Value Display	3-48
Display	3-37
Display Sequence	3-38
Recall	3-61
Sequence	3-62
Store	3-63
HP-IB Address Display	3-44

The actual detailed operating instructions are arranged in alphabetical order at the end of this section.

ManualsPlus.com

Modulation Keystroke Sequence. Internal, external, or mixed AM or FM functions can be selected. Modulation parameters are selected in a Source-Function-Data-Units format. The modulation source, either one of the two internal modulation signals (400 Hz or 1 kHz) and/or a signal from an external modulation source (ac coupled through the front panel connector), may be selected before or after the AM depth or FM peak deviation frequency parameters are selected. The internal 400 Hz or 1 kHz modulation source will be common to both AM and FM functions whenever they are simultaneously selected.

Store-Recall-Display Keystroke Sequence. Up to ten complete front panel settings (exclusive of increment values) can be stored for either selectable or sequential recall at a later time. Stored front panel settings can also be displayed without actually changing the output signal. A two keystroke sequence is necessary to store, recall, or display front panel settings. First, the desired function is entered followed by a numeric entry (0—9). This numeric entry represents the location of the internal storage register.

3-11. Time Base Selection

The Signal Generator is shipped from the factory with an inductive-jumper hard-wired to provide a 10 MHz time base output signal at the rear panel TIME BASE OUTPUT connector. If either a 1 or 5 MHz output signal is desired, this internal inductive-jumper will have to be repositioned. Also, if an external 1 or 5 MHz reference input is to be applied at the rear panel TIME BASE INPUT connector, this internal inductive-jumper will have to be repositioned. In either case, this internal inductive-jumper has to be installed in the position that corresponds to the frequency of the time base input or output signal being used. Refer to paragraph 2-7 for the time base selection procedure.

3-12. OPERATOR'S MAINTENANCE

WARNING

For continued protection against fire hazard, replace the line fuse with only a 250V slo-blo fuse of the same rating. Do not use repaired fuses or short circuited fuseholders.

The only maintenance that the operator should normally perform is the replacement of the primary power fuse located within the Line Power Module — A15. For instructions on how to change the fuse, see Figure 2-1, steps 1 and 3.

Fuses may be ordered under HP Part Numbers 2110-0305 (1.25A, 250V, slo-blo) for 100/120 Vac operation and 2110-0016 (0.6A, 250V, slo-blo) for 220/240 Vac operation.

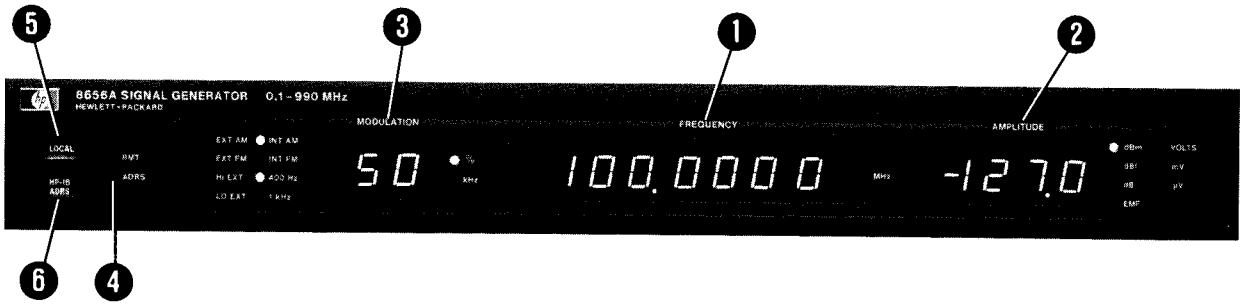
3-13. DETAILED PANEL FEATURES

The Signal Generator is designed to be simple and easy to operate through the front panel. The front panel primarily consists of 48 pushbutton keys, three digital displays, and 19 LED annunciators. Each key has a single purpose and only one key should ever be pressed at any given time. In most cases, keys are pressed, then released, with the action occurring as the key is pressed. In some cases, a key must be pressed and held for the action to occur. The four main functions of the Signal Generator are selected by the four dark gray colored keys labeled FREQUENCY, AMPTD, AM, and FM. The 27 medium gray colored keys are used to control the modulation source, enter numeric data, and select the unit(s) which terminates the data entry. The 15 light gray colored keys are used to set an increment value for each of the four main functions, change main function parameters by the set increment values, and store up to ten complete front panel settings (exclusive of increment values) for either selectable or sequential recall or display at a later time. The two remaining dark gray colored keys (located in the upper left-hand corner of the front panel) select local operation and display the internally-set, decimal HP-IB address.

The three digital displays show the frequency of the carrier in megahertz (the least significant or eighth digit will either be blanked or a numeral 5 depending on the frequency selected), the output amplitude of the carrier in one of fourteen possible units, and the percentage of AM depth or frequency of FM peak deviation used to modulate the carrier. In addition, the FREQUENCY Display can show the value of the carrier frequency increment; the AMPLITUDE Display can show the value of the output amplitude increment or current contents of the internal sequence counter; and the MODULATION Display can show the value of the modulation increment or internally-set, decimal HP-IB address.

The 19 LED annunciators are used to indicate remote operation status, internal or external modulation source and unit information, and amplitude unit information. All of the front and rear panel features are described in detail in Figures 3-2 through 3-7.

ManualsPlus.com



1 FREQUENCY Display

The FREQUENCY Display provides an 8 digit display of carrier frequency from 10 kHz to 990 MHz with a resolution of 100 Hz or 250 Hz. Carrier frequencies are always displayed in megahertz. Any selected frequency between 10 kHz and 100 kHz will result in an uncalibrated output amplitude. When the selected carrier frequency is a multiple of 100 Hz, the resolution will be 100 Hz and the least significant (eighth) digit will be blanked. In cases where the selected carrier frequency is a multiple of 250 Hz, the resolution will be 250 Hz and the least significant digit will be a 5. Digits selected beyond the specified resolution will be truncated and leading zeros will be blanked.

The FREQUENCY Display is also used to display the value stored in the internal carrier frequency increment register. This stored value is used in conjunction with the step up and step down keys associated with the frequency function to change the carrier frequency.

2 AMPLITUDE Display

The AMPLITUDE Display provides a 3-1/2 digit display of output amplitude from +17 to −127 dBm with a resolution of 0.1 dB. Amplitude levels are displayed in dBm, dBf, V, mV, and μV, while relative levels are displayed in dB and EMF. Calibrated levels from +13 to −127 dBm are possible with overrange to the maximum available power (amplitude set to +17 dBm). Digits selected beyond the specified resolution will be truncated and leading zeros will be blanked.

The AMPLITUDE Display is also used to display the value stored in the internal output amplitude increment register. This stored value is used in conjunction with the step up and step down keys associated with the amplitude function to change the output amplitude.

Further, the least significant digit of the AMPLITUDE Display is used to display the stored contents of the internal sequence counter.

Also, whenever a reverse power condition is detected, all segments and all seven LED annunciators associated with the AMPLITUDE Display will flash until the source of reverse power is removed and the AMPTD key is pressed.

Seven LED annunciators are used to display output amplitude unit information. Fourteen unit combinations are possible which will cause one or more LED's to light. The valid output amplitude units are listed as follows:

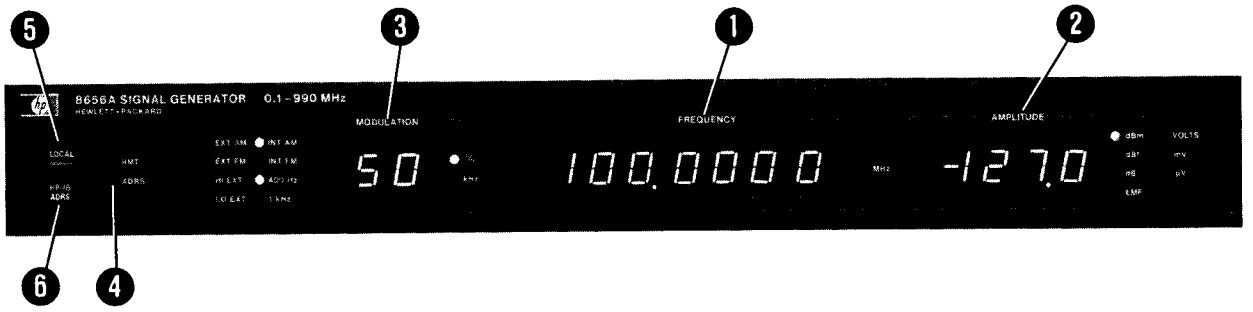
dBm	dB μV	V	EMF mV
dBf	dB EMF V	mV	EMF μV
dB V	dB EMF mV	μV	
dB mV	dB EMF μV	EMF V	

3 MODULATION Display

The MODULATION Display provides a 2 digit display of AM depth from 0 to 99% with a resolution of 1% or FM peak deviation frequency from 0 to 99 kHz with a resolution of 0.1 kHz (for deviations <10 kHz) or 1 kHz (for deviations ≥10 kHz). AM depth is always displayed in percent,

Figure 3-2. Display and Remote Features (1 of 2)

ManualsPlus.com



3 MODULATION Display (Cont'd)

and FM peak deviation frequency is always displayed in kHz. Digits selected beyond the specified resolution will be truncated and leading zeros will be blanked.

If one modulation parameter is being displayed when the other modulation function is selected, the MODULATION Display will be updated to display the newly selected parameter. Selecting the other function will restore the original display.

If a change in carrier frequency causes the FM peak deviation frequency allowed for that frequency band to be exceeded, the MODULATION Display will flash until a carrier frequency within the correct band is selected or the FM, FM step up, or FM step down key is pressed. In this later case, the maximum FM peak deviation frequency permitted for the currently selected carrier frequency will automatically be selected.

The MODULATION Display is also used to display the values stored in the internal AM depth and FM peak deviation frequency increment registers. These stored values are used in conjunction with the step up and step down keys associated with the modulation functions to change the percentage of AM depth or FM peak deviation frequency.

Further, the MODULATION Display is used to display the internally-set, decimal HP-IB address. HP-IB addresses from 0 to 30 (decimal) are valid, all others will be interpreted as 30. (Refer to Section II, Installation when changing the HP-IB address.)

Ten LED annunciators are used to display internal and external modulation source information. The HI EXT and LO EXT annunciators serve as an aid in adjusting the level of the external modulation source. They indicate that the input level is too high or too low for a calibrated display of AM depth or FM peak deviation frequency. The HI EXT annunciator will light if the external modulation signal is greater than 1.02 Vpk (0.721 Vrms), and the LO EXT annunciator light if the signal is less than 0.98 Vpk (0.693 Vrms). Both annunciators will be off when the input level is 1.00 ±0.02 Vpk (0.707 ±0.014 Vrms).

4 Remote Annunciators

Two LED annunciators are used to display remote operation status. The RMT annunciator lights when the instrument is in remote operation. The ADRS annunciator lights when the instrument has been addressed to listen via the bus (regardless of whether or not the instrument is in remote operation).

5 LOCAL Key

The LOCAL key returns the instrument to local operation (full front panel control) from remote operation provided that it is not in Local Lockout.

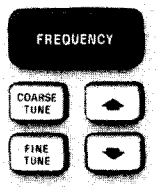
6 HP-IB ADRS Key

The HP-IB ADRS key is used to display the internally-set, decimal HP-IB address in the MODULATION Display.

Figure 3-2. Display and Remote Features (2 of 2)

ManualsPlus.com

CARRIER Keys



The FREQUENCY key is one of the four main function keys. It is used in conjunction with the numeric entry keys, decimal point key, and UNITS entry keys to enter carrier frequency parameters. In addition, it is used in conjunction with the INCR SET key to enter carrier frequency increment values.

The step up and step down keys associated with the frequency function permit the carrier frequency to be changed by the value stored in the internal carrier frequency increment register. The value of the carrier frequency increment initially stored is 10.0000 MHz. Its minimum value is 100 Hz, and its maximum value is ≤989.99 MHz. The carrier frequency will be changed once for each keystroke or repeatedly if either key remains pressed.

The COARSE TUNE and FINE TUNE keys are used in conjunction with the frequency step up and step down keys to tune the carrier frequency. They are used to increase (COARSE TUNE) or decrease (FINE TUNE) the carrier frequency tuning value by a factor of 10. The affect of these keys is disabled and the original carrier frequency increment value is enabled when the INCR SET key is pressed.

If a change in carrier frequency causes the FM peak deviation frequency allowed for that frequency band to be exceeded, the MODULATION Display will flash until a carrier frequency within the correct band is selected or the FM, FM step up , or FM step down key is pressed. In this later case, the maximum FM peak deviation frequency permitted for the currently selected carrier frequency will automatically be selected.



The AMPTD key is one of the four main function keys. It is used in conjunction with all of the Data and UNITS entry keys to enter output amplitude parameters. In addition, it is used in conjunction with the INCR SET key to enter output amplitude increment values. Further, it is used to reset the internal reverse power protection feature once the source of reverse power has been removed.

The step up and step down keys associated with the amplitude function permit the output amplitude to be changed by the value stored in the internal output amplitude increment register. The value of the output amplitude increment initially stored is 10.0 dB. Its minimum value is 0.1 dB (0.001 μV or 0.001 EMF V), and its maximum value is ≤144.0 dB (≤1.57V or ≤ 3.15 EMF V). The output amplitude will be changed once for each keystroke or repeatedly if either key remains pressed.

RF OUTPUT Connector



Female type-N connector (J2) provides access to the RF output signal. Specified output levels are +13 to −127 dBm (+1.00V to +.100 μV) with a minimum resolution of 0.1 dBm. Nominal impedance is 50 ohms. Reverse power protection is provided up to 50W and 25 Vdc. Pressing the AMPTD key restores RF output signal once the source of reverse power has been removed.

Figure 3-3. Carrier Features

ManualsPlus.com

MODULATION Keys



The AM key is one of the four main function keys. It is used in conjunction with the SOURCE keys, numeric entry keys, and UNITS entry keys to enter amplitude modulation parameters. In addition, it is used in conjunction with the INCR SET key to enter AM depth increment values. If the FM peak deviation frequency is being displayed when the AM key is pressed, the MODULATION Display will be updated to show the percentage of AM depth. The default modulation source (internal 1 kHz) will automatically be selected when the AM key is pressed, if no other source has been selected.

The step up and step down keys associated with the AM function permit the percentage of AM depth to be changed by the value stored in the internal AM depth increment register. The value of the AM depth increment initially stored is 1%. This is its minimum value. Its maximum value is ≤99%. The percentage of AM depth will be changed once for each keystroke or repeatedly if either key remains pressed.



The FM key is one of the four main function keys. It is used in conjunction with the SOURCE keys, numeric entry keys, and UNITS entry keys to enter frequency modulation parameters. In addition, it is used in conjunction with the INCR SET key to enter FM peak deviation frequency increment values. If the percentage of AM depth is being displayed when the FM key is pressed, the MODULATION Display will be updated to show the FM peak deviation frequency. The default modulation source (internal 1 kHz) will automatically be selected when the FM key is pressed, if no other source has been selected.

The step up and step down keys associated with the FM function permit the FM peak deviation frequency to be changed by the value stored in the internal FM peak deviation frequency increment register. The value of the FM peak deviation frequency increment initially stored is 1.0 kHz. Its minimum value is 0.1 kHz, and its maximum value is ≤99 kHz. The FM peak deviation frequency will be changed once for each keystroke or repeatedly if either key remains pressed.

If an out of range condition exists (MODULATION Display flashing), pressing either the step up, step down, or FM key will automatically select the maximum FM peak deviation frequency permitted for the currently selected carrier frequency.

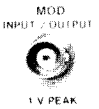
SOURCE Keys



The INT 400 Hz, INT 1 kHz, EXT, and OFF keys are used to select the internal 400 Hz or 1 kHz modulation source, enable an external source to be applied through the front panel MOD INPUT/OUTPUT connector, or disable one or all selected modulation sources.

The internal modulation signal is available at the MOD INPUT/OUTPUT connector when either the 400 Hz or 1 kHz modulation source is selected and the external source is not selected.

MOD INPUT/OUTPUT Connector

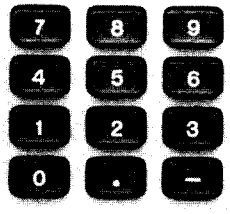


Female BNC connector (J1) accepts either an external modulation signal or a digital unsquelching signal. In addition, it provides access to the 400 Hz or 1 kHz modulation signal from the internal audio oscillator. Source selection is provided by the four MODULATION SOURCE keys. Nominal input impedance is 600 ohms. External input rates are ac coupled with 1 dB of bandwidth. The input signal should be 25 Hz to 25 kHz at 1 Vpk (0.707 Vrms) ±5% minimum into a 600 ohm resistive load to produce calibrated AM depths or FM peak deviations. The HI EXT and LO EXT annunciators provide an indication of the input level available for calibrated modulation. If greater accuracy is required, the signal level should be measured externally.

Figure 3-4. Modulation Features

ManualsPlus.com

Data Entry Keys



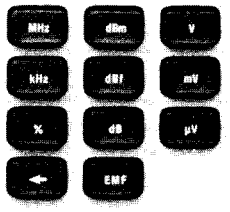
The Data entry keys consist of ten numeric entry keys (0-9), a decimal point key, and a minus sign key.

The ten numeric entry keys are used in conjunction with the four main function keys to enter value-selectable parameters, with the INCR SET key to enter increment values, and with the STORE-RECALL-DISPLAY keys to select one of the ten internal storage registers.

The decimal point key is used to add a decimal point to the numeric entry. A leading zero will be displayed, if the decimal point is added before the numeric entry for carrier frequencies less than 1 MHz and output amplitudes less than ±1 dBm.

The minus sign key is only used when making amplitude Data entries and it can be used at any time before the final UNITS terminator entry is made.

UNITS Entry Keys



The UNITS entry keys consist of ten terminator keys and a backspace (←) key.

The ten terminator keys are used in conjunction with the four main function keys to terminate Data entries. They are also used in conjunction with the INCR SET key to terminate increment value entries.

Frequency entries are always adjusted so that they are displayed in megahertz, even though kHz is a valid terminator.

Fourteen amplitude terminator combinations are possible. They are listed as follows:

dBm
dBf
dB V
dB mV
dB µV
dB EMF V
dB EMF mV
dB EMF µV
V
mV
µV
EMF V
EMF mV
EMF µV

AM entries are always terminated in %, and FM entries are always terminated in kHz.

The backspace key is used to clear the last digit or decimal point visible in a display to permit the entry to be corrected.

Figure 3-5. Data and Units Entry Features

ManualsPlus.com

STORE-RECALL-DISPLAY-SEQUENCE Keys



Four keys used to store up to ten complete front panel setups (exclusive of increment values) for either selectable or sequential recall or display at a later time. When the Signal Generator is powered up or reset, the initialized conditions of the instrument are stored in each of the ten internal storage registers. That is, the parameter values for a carrier frequency of 100 MHz with an output amplitude of −127 dBm and no modulation will be stored in each location.

When the STORE key is used in conjunction with a numeric entry key (a single digit register number 0—9), the current front panel settings (exclusive of increment values) will be stored in an internal storage register.

When the RECALL key is used in conjunction with a numeric entry key (a single digit register number 0—9), the stored contents will be recalled and the output of the Signal Generator will be changed so that it agrees with the recalled parameter values.

When the DISPLAY key is used in conjunction with a numeric entry key (a single digit register number 0—9), the stored contents will be displayed, but the actual output of the Signal Generator will not be affected.

The SEQ key is used to sequence the Signal Generator through each of its ten internal storage registers. As the stored contents are sequentially recalled, the output will be changed so that it agrees with the recalled parameter values.

When the DISPLAY key is used in conjunction with the SEQ key, the stored contents of the internal sequence counter will be displayed in the least significant digit of the AMPLITUDE Display.

INCR SET Key



A single key used in conjunction with any one of the four main function keys to store an increment value for that function. The initialized value of each stored increment is listed as follows:

Carrier Frequency	10.0000 MHz
Output Amplitude	10.0 dB
AM Depth	1%
FM Peak Deviation Frequency	1.0 kHz

The minimum allowable increment value for each of the four main functions is listed as follows:

Carrier Frequency	0.1 kHz
Output Amplitude	0.1 dB
AM Depth	1%
FM Peak Deviation Frequency	0.1 kHz

Figure 3-6. Miscellaneous Features (1 of 2)

ManualsPlus.com

INCR SET Key (Cont'd)

The maximum allowable increment value for each of the four main functions is listed as follows:

Carrier Frequency	≤ 989.99 MHz
Output Amplitude	≤ 144.0 dB
AM Depth	≤ 99%
FM Peak Deviation Frequency	≤ 99 kHz

The stored value of the increment will be displayed in the display associated with the selected function as long as the INCR SET key remains pressed.

The frequency coarse tune and fine tune feature will be disabled and the original carrier frequency increment value will be restored when the INCR SET key is pressed.

RESET/STBY/ON Switch



Three position rocker switch used to control the operating state of the internal microprocessor. The Signal Generator (and its optional reference oscillator) will remain energized and the fan will continue to operate as long as the power cord is connected to Mains power.

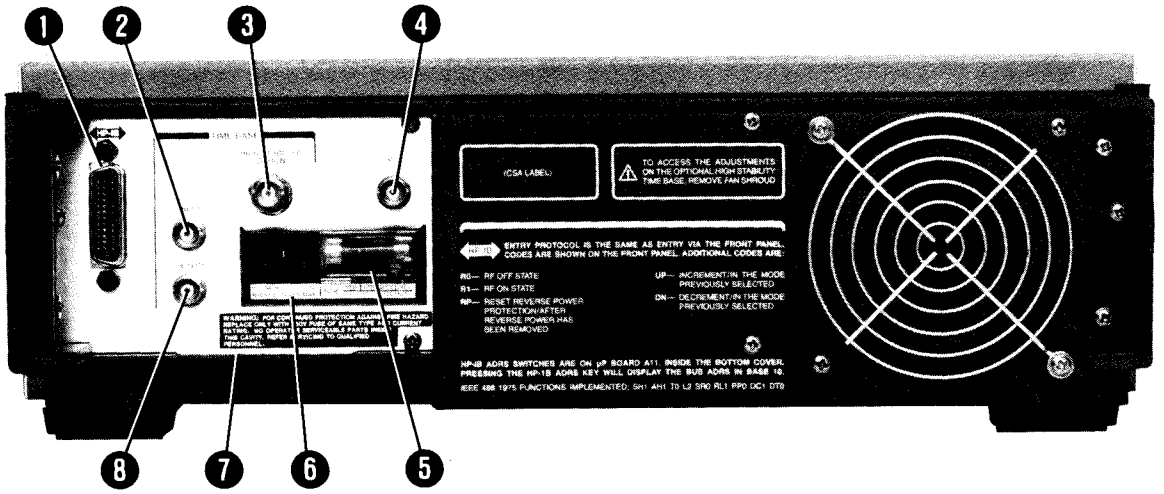
When momentarily set to RESET, the microprocessor will be halted. Upon release, the microprocessor will initiate its restart operation.

When set to STBY, the microprocessor will initiate an RF quieting operation in which all displays are blanked, the high frequency section is turned off, all attenuator sections (120 dB) are switched in, the internal audio oscillator is turned off, and the instrument will not respond to any HP-IB commands.

When set to ON (return from STBY), the operating state of the instrument (prior to entering the standby state) will be restored. Refer to paragraph 3-9 for information regarding the power-on sequence.

Figure 3-6. Miscellaneous Features (2 of 2)

ManualsPlus.com



NOTE

For Option 002 instruments, the RF OUTPUT and MOD INPUT/OUTPUT connectors are located on the rear panel. The RF OUTPUT connector is above **2** *Time Base Input while the MOD INPUT/OUTPUT connector replaces* **4** *SEQ. Refer to Figures 3-3 and 3-4 for detailed information concerning the signals found at these ports.*

1 HP-IB Connector

24-pin female connector used to connect the Signal Generator to the Hewlett-Packard Interface Bus for remote operation. Connection information is presented in Section II, Installation.

2 TIME BASE INPUT

Female BNC connector (J3) accepts an external 1, 5, or 10 MHz (±0.005%) time base reference input at a level of 0.2 to 0.4 Vrms into 50 ohms. Internal jumper must be installed in the position that corresponds to the external time base reference input used (refer to paragraph 2-7).

3 TIME BASE HIGH STABILITY OPTION

Female BNC connector (A16J1) provides access to the optional 10 MHz time base reference output. With Option 001 installed and its output connected to the TIME BASE INPUT connector through the supplied cable (not shown), the frequency accuracy and stability of the Signal Generator will be increased. The optional reference oscillator is kept at operating temperature in the STBY mode as long as the Signal Generator remains connected to Mains power.

4 SEQ

Female BNC connector (J5) accepts external contact closure (from foot pedal, pushbutton switch, etc.) which causes the Signal Generator to sequentially recall the stored contents (exclusive of increment settings) from each of its ten internal storage registers.

5 Fuse

1.25A, 250V, Slo-Blo for 100/120 Vac operation. 0.6A, 250V, Slo-Blo for 220/240 Vac operation. Ordering information is presented in Section II, Installation.

6 Line Power Module

Permits operation from 100, 120, 220, or 240 Vac. The number visible in the window indicates nominal line voltage to which the instrument must be connected (see Figure 2-1). Center conductor is safety earth ground.

7 Serial Number Plate

First four digits and letter constitute the prefix which defines the instrument configuration. The last five digits form a sequential suffix that is unique to each instrument. The plate also indicates any options supplied with the instrument.

8 TIME BASE OUTPUT

Female BNC connector (J4) provides access to an internal 10 MHz time base reference output at a level greater than 0.2 Vrms into 50 ohms which is derived from the internal reference oscillator. An internal jumper may be repositioned to select either a 1 or 5 MHz reference output (refer to paragraph 2-7).

Figure 3-7. Rear Panel Features

ManualsPlus.com

3-14. OPERATOR'S CHECKS

Operator's checks are simple procedures designed to verify that the main functions of the Signal Generator operate properly. Two procedures are provided, one for basic (front panel) functional checks and the other for HP-IB functional checks.

3-15. Basic Functional Checks

DESCRIPTION: This procedure requires only a frequency counter, a spectrum analyzer, and the interconnecting cables and adapters. It provides assurance that most of the front panel controlled functions are being executed by the Signal Generator.

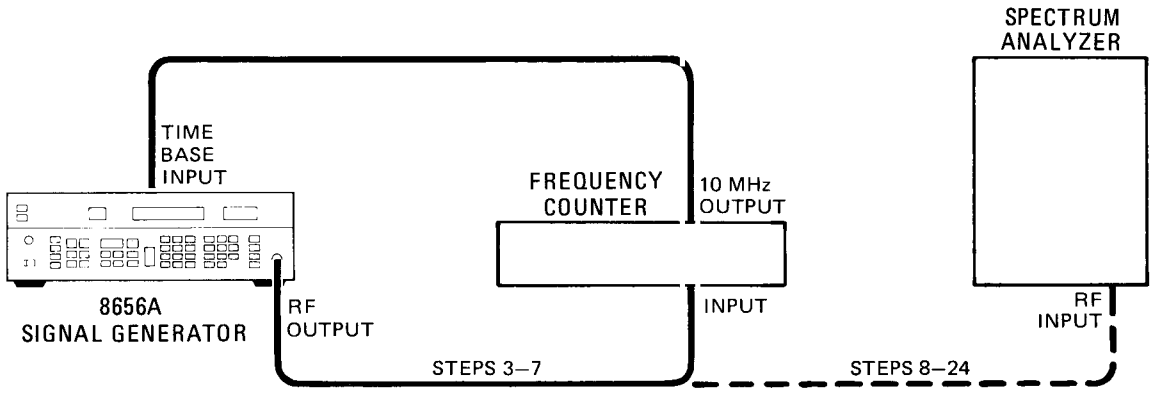


Figure 3-8. Test Setup for Basic Functional Checks

EQUIPMENT: Frequency Counter .....HP 5328A Option 031
Spectrum Analyzer .....HP 8558B/182T

PROCEDURE: **Preliminary Checks**

1. Ensure that the power cable is plugged into a suitable source of Mains power (refer to paragraph 2-4).

2. Momentarily press and release the left-hand side of the RESET/STBY/ON switch to initialize the Signal Generator, then set the switch back to ON.

   An internal memory check will be initiated to test for a failure in ROM (read-only memory) and in RAM (read-write memory). All front panel indicators will light for approximately 1.5 seconds to provide a quick visual inspection of each front panel annunciator and display segment.

   If a memory failure is detected, all front panel annunciators and display segments will remain lit until any front panel key is pressed. If the memory check was successful, the front panel indicators will display a carrier frequency of 100.0000 MHz, an output amplitude of −127.0 dBm, and no modulation. Only the dBm annunciator will be lit, all of the others be off.

3. Connect the RF OUTPUT of the Signal Generator to the input of the frequency counter and the 10 MHz reference output from the frequency counter to the TIME BASE INPUT located at the rear of the Signal Generator as shown in Figure 3-8.

ManualsPlus.com

OPERATOR'S CHECKS

3-15. Basic Functional Checks (Cont'd)

Connecting the 10 MHz reference output of the frequency counter to the TIME BASE INPUT of the Signal Generator will phase lock the two instruments to the same time base reference.

NOTE

If the Signal Generator is equipped with the high stability time base (Option 001), disconnect its cable from the TIME BASE INPUT before performing this step.

Frequency Check

4. Set the output amplitude of the Signal Generator to −10.0 dBm and the carrier frequency to the values listed in the following table:

Carrier Frequency (MHz)
100.0000
140.0000
200.0000
300.0000
400.0000
600.0000
800.0000
990.0000

Verify that the FREQUENCY Display on the Signal Generator agrees with the frequency displayed on the frequency counter (except for the resolution of the frequency counter being used).

5. Set the carrier frequency of the Signal Generator to 111.1111 MHz and the frequency increment value to 111.1111 MHz. Leave the output amplitude set at −10.0 dBm.

Verify that the FREQUENCY Display on the Signal Generator agrees with the frequency displayed on the frequency counter.

6. Quickly press and release the frequency step up key to increase the carrier frequency.

Verify that the FREQUENCY Display on the Signal Generator agrees with the frequency displayed on the frequency counter.

ManualsPlus.com

OPERATOR'S CHECKS

3-15. Basic Functional Checks (Cont'd)

Continue to increase the carrier frequency to the maximum value listed in the following table:

Carrier Frequency (MHz)
111.1111
222.2222
333.3333
444.4444
555.5555
666.6666
777.7777
888.8888

Verify that the FREQUENCY Display on the Signal Generator agrees with the frequency displayed on the frequency counter each time the carrier frequency is increased.

7. Quickly press and release the frequency step down key to decrease the carrier frequency.

   Verify that the FREQUENCY Display on the Signal Generator agrees with the frequency displayed on the frequency counter.

   Continue to decrease the carrier frequency to the minimum value listed in the previous table.

   Verify that the FREQUENCY Display on the Signal Generator agrees with the frequency displayed on the frequency counter each time the carrier frequency is decreased.

Output Level Checks

8. Connect the RF OUTPUT of the Signal Generator to the input of the spectrum analyzer as shown in Figure 3-8.

9. Set the output amplitude of the Signal Generator to 0.0 dBm, carrier frequency to 0.1 MHz, and frequency increment value to 10 MHz.

10. Set the amplitude scale of the spectrum analyzer to display 1 dB/division and make the necessary adjustments to properly display the output signal from the Signal Generator.

NOTE

This check only verifies level flatness, it does not verify absolute level accuracy.

11. Slowly increase the carrier frequency through its entire frequency range (0.1 to 990.0000 MHz) and observe the level displayed on the spectrum analyzer. The level should not vary more than a total of 3 dB (±1.5 dB from 0.0 dBm).

ManualsPlus.com

OPERATOR'S CHECKS

3-15. Basic Functional Checks (Cont'd)

12. Set the carrier frequency of the Signal Generator to 600 MHz, output amplitude to +13 dBm, and output amplitude increment value to 1.0 dB.

13. Adjust the spectrum analyzer as necessary to display the output signal from the Signal Generator. The displayed carrier should be positioned in the center of the graticule with its maximum level positioned near the top of the graticule.

14. Slowly decrease the output amplitude down to −4.0 dBm and observe the level displayed on the spectrum analyzer. The level should decrease in relatively uniform 1 dB steps.

15. Set the output amplitude of the Signal Generator to −10.0 dBm and the output amplitude increment value to 5 dB. Leave the carrier freqeuency set to 600 MHz.

16. Set the amplitude scale of the spectrum analyzer to display 10 dB/division and make the necessary adjustments to properly display the output signal from the Signal Generator. The displayed carrier should be positioned in the center of the graticule with its maximum level positioned near the top of the graticule.

17. Slowly decrease the output amplitude down to −80 dBm and observe the level displayed on the spectrum analyzer. The level should decrease in relatively uniform 5 dB steps.

FM Check

18. Set the output amplitude of the Signal Generator to 0.0 dBm. Leave the carrier frequency set to 600 MHz. Select FM with a peak deviation frequency of 99 kHz using the internal 1 kHz source. Set the FM peak deviation frequency increment value to 1 kHz.

19. Set the spectrum analyzer for a 50 kHz frequency span/division, a resolution bandwidth of 3 kHz, and a reference level of 0 dBm. The waveform displayed should be similar to that shown in Figure 3-9.

20. Slowly decrease the FM peak deviation frequency to zero. The deviation displayed on the spectrum analyzer should decrease in relatively uniform steps.

21. Press FM, then OFF to turn off the FM function.

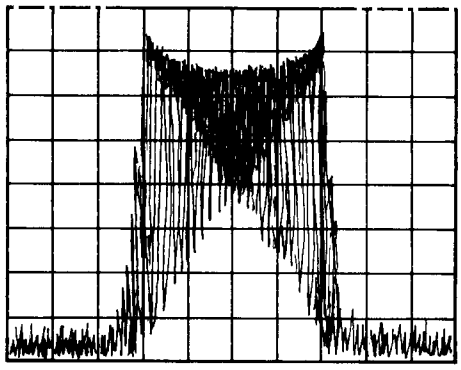


Figure 3-9. FM Functional Check Waveform

ManualsPlus.com

OPERATOR'S CHECKS

3-15. Basic Functional Checks (Cont'd)

AM Check

22. Leave the carrier frequency set to 600 MHz and the output amplitude set to 0.0 dBm. Select AM with a depth of 50% using the internal 400 Hz source.

23. Set the spectrum analyzer to the linear amplitude mode. Set a frequency span/division of zero. Increase the resolution bandwidth, then fine tune for the maximum level of the demodulated signal. The displayed demodulated signal should be a sine wave with a period of 2.5 ms (400 Hz).

24. Press the INT 1 kHz key to change the frequency of the internal modulation source from 400 Hz to 1 kHz. The displayed demodulated signal should be a sine wave with a period of 1 ms (1 kHz).

3-16. HP-IB Functional Checks HP-IB

DESCRIPTION: The following procedures check the Signal Generator's ability to recognize its own HP-IB (listen) address, properly make remote/local transitions, and process all of the applicable HP-IB messages described in Table 3-4. During the process, all of the Signal Generator's HP-IB data input/output bus, control, and handshake lines are checked, except for DIO8 (the most significant data input/output bus line which is not used by the Signal Generator). Only the Signal Generator, a bus controller, and an HP-IB interface with appropriate cabling are required to perform these procedures. These checks are intended to be as independent of one another as possible, since each begins with the instrument being reset to its initialized condition. Nevertheless, it is suggested that the first four checks be performed in order before any other check. Any special initialization steps or requirements for a given check are provided the beginning of the check.

The validity of these checks is based on the following assumptions:

- The Signal Generator performs properly when operated via the front panel keys (that is, in local operation). This can be verified by performing the basic functional checks as outlined in paragraph 3-15.
- The bus controller properly executes HP-IB operations.
- The bus controller's HP-IB interface properly transfers the controller's instructions.
- The select code of the bus controller's interface is set to 7.
- The HP-IB address of the Signal Generator is set to 07 (the factory-set address).
- The select code address combination (that is, 707) is not necessary for these checks to be valid; however, the program lines presented in the following procedures would have to be modified for any other combination.

If the Signal Generator appears to fail any of the remote functional checks, the validity of the preceding assumptions should be confirmed before attempting to service the instrument.

ManualsPlus.com

OPERATOR'S CHECKS

3-16. HP-IB Functional Checks (Cont'd)

If all of these checks are performed successfully, the Signal Generator's HP-IB capability can be considered to be operating properly. These procedures do not check whether or not all of the Signal Generator's program codes are being properly interpreted and executed by the instrument, however, if the front panel operation is confirmed to be working properly and its HP-IB capability operates correctly, then there is a high probability that the Signal Generator will respond properly to all of its program codes.

INITIAL SETUP: The test setup is the same for all of the checks. That is, the Signal Generator is connected to the bus controller through the bus controller's HP-IB interface via the appropriate cable.

EQUIPMENT:

HP-IB Controller ..... HP 9825A/98213A (General and Extended I/O ROM's)
—or—
HP 9835A/98332A (I/O ROM)
—or—
HP 9845A (I/O ROM)

HP-IB Interface ..... HP 98034A (use "revised" version with HP 9835A and HP 9845A)

Address Recognition

NOTE This check determines whether or not the Signal Generator recognizes when it is being addressed and when it is not. It is assumed that the Signal Generator is in local operation and that it can properly handshake on the bus. Before beginning this check, set the RESET/STBY/ON switch to RESET, then back to ON to initialize the instrument.

Description	HP 9825A (HPL)	HP 9835A and HP 9845A (BASIC)
Set the Remote Enable (REN) bus control line false.	lcl 7	LOCAL 7
Send the listen address to the Signal Generator.	wrt 707	OUTPUT 707

OPERATOR'S RESPONSE Verify that the Signal Generator's RMT annunciator remains off and that its ADRS annunciator lights.

Unaddress the Signal Generator by sending a different address.	wrt 715	OUTPUT 715

OPERATOR'S RESPONSE Verify that the Signal Generator's RMT and ADRS annunciators are both off.

ManualsPlus.com

OPERATOR'S CHECKS

3-16. HP-IB Functional Checks (Cont'd)

Remote and Local Messages and the LOCAL Key

NOTE This check determines whether the Signal Generator properly switches from local to remote operation, switches from remote to local operation, and whether the LOCAL key can return the instrument to local operation. It is assumed that the Signal Generator is able to both handshake and recognize its own address. Before beginning this check, set the RESET/STBY/ON switch to RESET, then back to ON to initialize the instrument.

Description	HP 9825A (HPL)	HP 9835A and HP 9845A (BASIC)
Send the Remote message which sets the Remote Enable (REN) bus control line true and addresses the Signal Generator to listen.	rem 707	REMOTE 707

OPERATOR'S RESPONSE Verify that the Signal Generator's RMT and ADRS annunciators both light.

Send the Local message to the Signal Generator.	lcl 707	LOCAL 707

OPERATOR'S RESPONSE Verify that the Signal Generator's RMT annunciator turns off and that its ADRS annunciator remains on.

Send the Remote message to the Signal Generator.	rem 707	REMOTE 707

OPERATOR'S RESPONSE Verify that the Signal Generator's RMT and ADRS annunciators are both on. Press the LOCAL key on the front panel of the Signal Generator and verify that the RMT annunciator turns off and that the ADRS annunciator remains on.

Data Message

NOTE This check determines whether or not the Signal Generator properly receives Data messages. Because the Signal Generator is only a listener, it can only receive Data messages, but never send them. It is assumed that the Signal Generator is able to handshake, recognize its own address, and properly make remote/local transitions. The Data message that is sent will cause the 7 least significant HP-IB data lines to be placed in both their true and false states. Before beginning this check, set the RESET/STBY/ON switch to RESET, then back to ON to initialize the instrument.

ManualsPlus.com

OPERATOR'S CHECKS

3-16. HP-IB Functional Checks (Cont'd)

Description	HP 9825A (HPL)	HP 9835A and HP 9845A (BASIC)
Send the first part of the Remote message (which enables the Signal Generator to remote).	rem 707	REMOTE 707
Address the Signal Generator to listen (which completes the Remote message) and send the Data message (which tunes the Signal Generator to 990 MHz).	wrt 707, "fr990mz"	OUTPUT 707; "FR990MZ"

OPERATOR'S RESPONSE: Verify that the Signal Generator's RMT and ADRS annunciators both light and that the FREQUENCY Display shows a carrier frequency of 990.0000 MHz.

Local Lockout and Clear Lockout/Set Local Messages

NOTE: This check determines whether or not the Signal Generator properly receives the Local Lockout message which disables all of the front panel keys. In addition, this check determines whether or not the Clear Lockout/Set Local message is properly received and executed by the Signal Generator. It is assumed that the Signal Generator is able to handshake, recognize its own address, and properly make remote/local transitions. Before beginning this check, set the RESET/STBY/ON switch to RESET, then back to ON to initialize the instrument.

Description	HP 9825A (HPL)	HP 9835A and HP 9845A (BASIC)
Send the first part of the Remote message (which enables the Signal Generator to remote).	rem 707	REMOTE 707
Send the Local Lockout message.	llo 7	LOCAL LOCKOUT 7
Address the Signal Generator to listen (which completes the Remote message).	wrt 707	OUTPUT 707

OPERATOR'S RESPONSE: Verify that the Signal Generator's RMT and ADRS annunciators both light. Press the LOCAL key on the front panel of the Signal Generator and verify that its RMT and ADRS annunciators both remain on.

Send the Clear Lockout/Set Local message.	lcl 7	LOCAL 7

ManualsPlus.com

OPERATOR'S CHECKS

3-16. HP-IB Functional Checks (Cont'd)

OPERATOR'S RESPONSE: Verify that the Signal Generator's RMT annunciator is turned off and that its ADRS annunciator remains on.

Clear Message

NOTE: This check determines whether or not the Signal Generator properly responds to the Clear message. It is assumed that the Signal Generator is able to handshake, recognize its own address, properly make remote/local transitions, and receive Data messages. Before beginning this check, set the RESET/STBY/ON switch to RESET, then back to ON to initialize the instrument.

Description	HP 9825A (HPL)	HP 9835A and HP 9845A (BASIC)
Send the first part of the Remote message (which enables the Signal Generator to remote).	rem 7	REMOTE 7
Address the Signal Generator to listen (which completes the Remote message) and send the Data message (which sets the output amplitude of the Signal Generator to 3.0 dB mV).	wrt 707, "ap3dbmv"	OUTPUT 707; "AP3DBMV"

OPERATOR'S RESPONSE: Verify that the Signal Generator's RMT, ADRS, dB, and mV annunciators all light and that the AMPLITUDE Display shows an output amplitude of 3.0 dB mV.

Send the Clear message.	clr 707	RESET 707

OPERATOR'S RESPONSE: Verify that the Signal Generator's RMT and ADRS annunciators remain on and that the AMPLITUDE Display now shows the initialized output amplitude of −127.0 dBm. The dB and mV annunciators will now be off and the dBm annunciator will be on.

Abort Message

NOTE: This check determines whether or not the Signal Generator becomes unaddressed when it receives the Abort message. It is assumed that the Signal Generator is able to handshake, recognize its own address, and properly make remote/local transitions. Before beginning this check, set the RESET/STBY/ON switch to RESET, then back to ON to initialize the instrument.

Description	HP 9825A (HPL)	HP 9835A and HP 9845A (BASIC)
Send the complete Remote message.	rem 707	REMOTE 707

ManualsPlus.com

3-16. HP-IB Functional Checks (Cont'd)

OPERATOR'S RESPONSE Verify that the Signal Generator's RMT and ADRS annunciators both light.

Send the Abort message (which unaddresses the Signal Generator to listen).	cli 7	ABORTIO 7

OPERATOR'S RESPONSE Verify that the ADRS annunciator turns off.

NOTE

The remote annunciator may also turn off when using the 9835A or 9845A.

ManualsPlus.com

3-17. REMOTE OPERATION, HEWLETT-PACKARD INTERFACE BUS

The Signal Generator can be operated through the Hewlett-Packard Interface Bus (HP-IB). Bus compatibility, programming, and data formats are described in the following paragraphs.

All front panel functions (except for DISPLAY, DISPLAY in conjunction with SEQ, Backspace, COARSE TUNE, FINE TUNE, and display HP-IB ADRS are programmable through HP-IB.

A quick check of the Signal Generator's HP-IB input/output capability is described in paragraph 3-16, HP-IB Functional Checks. These checks are used to verify that the Signal Generator can respond to each of the applicable HP-IB messages described in Table 3-4.

3-18. HP-IB Compatibility

The Signal Generator has an open-collector, TTL, HP-IB interface which can be used with any HP-IB computing controller or computer for automatic system applications. The Signal Generator is fully programmable via the HP Interface Bus. Its programming capability is described by the twelve HP-IB messages listed in Table 3-4. Foremost among these messages is the Data message. Data messages contain the program codes that control the Signal Generator's output signal. The Signal Generator's complete compatibility with HP-IB is further defined by the following list of interface functions: SH1, AH1, T0, L2, SR0, RL1, PP0, DC1, DT0, and C0. A more detailed explanation of these compatibility codes can be found in the IEEE Standard 488 (and the identical ANSI Standard MC1.1). For more information about HP-IB, refer to the Hewlett-Packard Electronic Instruments and Systems catalog and the booklet titled "Improving Measurements in Engineering and Manufacturing" (HP part number 5952-0058).

3-19. Remote Operation

Remote Capability. In remote operation, the front panel keys are disabled (except for the RESET/STBY/ON switch and the LOCAL key). The Signal Generator can only be addressed to listen. When addressed to listen, the Signal Generator will respond to the following messages: Data, Clear, Remote, Local, Local Lockout, Clear Lockout/Set Local, and Abort. Each is discussed in detail further on in this section.

Local-to-Remote Change. The Signal Generator switches to remote operation upon receipt of the Remote message. The Remote message is comprised of two parts. They are:

- Remote Enable bus control line (REN) set true.
- Device listen address received once (while REN is true).

The Signal Generator's RMT and ADRS annunciators will both light and its output signal and all preselected functions will remain unchanged when the local-to-remote transition occurs.

3-20. Local Operation

Local Capability. In local operation, the Signal Generator's front panel is fully operational and the instrument will respond to the Remote message. Whether addressed or not, the Signal Generator will also respond to the Clear, Local Lockout, Clear Lockout/Set Local, and Abort messages. It will not; however, respond to the Data message unless it has been previously addressed.

Remote-to-Local Change. The Signal Generator returns to local operation upon receipt of the Local message (GTL) or Clear Lockout/Set Local message. The Clear Lockout/Set Local message sets the Remote Enable bus control line (REN) false. The instrument can always be set to local operation by pressing the front panel LOCAL key provided that local lockout is not in effect. The output signal will remain unchanged and all preselected functions will remain unchanged when the remote-to-local transition occurs.

Local Lockout. When a data transmission is interrupted, which can happen by returning the Signal Generator to local operation with the LOCAL key, the data could be lost. This would leave the Signal Generator in an unknown state. To prevent this, a local lockout is recommended. Local lockout disables the LOCAL key and allows return-to-local

ManualsPlus.com

Table 3-4. HP-IB Message Reference Table

HP-IB Message	Applicable	Response	Related Commands Controls*	Interface Functions*
Data	Yes	All front panel functions, except for DISPLAY, DISPLAY in conjunction with SEQ, Backspace, COARSE TUNE, FINE TUNE,and display HP-IB ADRS are programmable. The front panel ADRS annunciator lights when the Signal Generator is addressed to listen.		T0, L2 AH1, SH0
Trigger	No	The Signal Generator does not have a Device Trigger (DT0) capability.	GET	DT0
Clear	Yes	Resets the Signal Generator to a carrier frequency of 100 MHz, an output amplitude of −127 dBm, and no modulation. Responds equally to Device Clear (DCL) and Selected Device Clear (SDC) bus commands.	DCL, SDC	DC1
Remote	Yes	Remote operation is entered when the Remote Enable (REN) bus control line is true and the Signal Generator is first addressed to listen. The front panel RMT and ADRS annunciators will both light when remote operation is entered, all front panel keys will be disabled (except for the LOCAL key and the RESET/STBY/ON switch), and the output signal will remain unchanged.	REN	RL1
Local	Yes	The Signal Generator will return to local operation (full front panel control) when either the Go to Local (GTL) bus command is received or the front panel LOCAL key is pressed. The output signal will remain unchanged.	GTL	RL1
Local Lockout	Yes	Disables the front panel LOCAL key so that only the controller can return the Signal Generator to local operation.	LLO	RL1
Clear Lockout/ Set Local	Yes	The Signal Generator will return to local operation and local lockout will be cleared when the REN bus control line goes false.	REN	RL1
Pass Control/ Take Control	No	The Signal Generator has no control capability.		C0
Require Service	No	The Signal Generator does not have the capability to request service.		SR0
Status Byte	No	The Signal Generator does not have the capability to respond to a serial poll.		T0
Status Bit	No	The Signal Generator does not have the capability to respond to a parallel poll.		PP0
Abort	Yes	The Signal Generator stops listening.	IFC	T0, L2

*Commands, control lines, and interface functions are defined in IEEE Standard 488 (and the identical ANSI Standard MC1.1). Knowledge of these might not be necessary if your controller's manual describes programming in terms of the twelve HP-IB Messages shown in the left-hand column above.

Complete HP-IB compatibility as defined in IEEE Standard 488 (and the identical ANSI Standard MC1.1) is: SH0, AH1, T0, L2, SR0, RL1, PP0, DC1, DT0, and C0.

ManualsPlus.com

Local Operation (Cont'd)

ables the LOCAL key and allows return-to-local only under program control.

NOTE

Return-to-local can also be accomplished by setting the RESET/STBY/ON switch first to RESET, then back to ON. This technique, however, has some potential disadvantages.

- *It defeats the purpose and advantage of local lockout, that is, the system controller will loose control of the Signal Generator.*
- *Some HP-IB conditions are reset to their default state during turn on.*

3-21. Addressing

The Signal Generator interprets the byte of information on its eight data input/output bus lines as either an address or a bus command whenever the bus is in the command entry mode, that is, when the Attention bus control line (ATN) is true and the Interface Clear bus control line (IFC) is false. Whenever the Signal Generator is being addressed (whether in local or remote operation), the front panel ADRS annunciator will light.

The Signal Generator's listen address is established by five miniature rocker switches located inside the instrument. The address selection procedure is described in Section II, Installation. The decimal equivalent of the listen address can be displayed in the MODULATION Display by pressing the HP-IB ADRS key. Refer to Table 3-5 for a list of the valid decimal (listen address) values and their equivalent ASCII characters.

3-22. Data Messages

The Signal Generator communicates on the interface bus with Data messages. Each Data message consists of one or more bytes of information sent over the Signal Generator's eight data input/output bus lines DIO1 through DIO8 during the data entry mode. The data entry mode is established when the Attention bus control line (ATN) is false. Data messages include the program codes listed in Tables 3-8 and 3-9. These program codes contain the necessary information to program virtually all of the instrument functions available in local operation. The only exceptions are DISPLAY, DISPLAY in conjunction with SEQ, Backspace, COARSE TUNE, FINE TUNE, and display HP-IB ADRS.

Table 3-5. Valid Decimal Values vs. Equivalent ASCII Characters

EQUIVALENT DECIMAL VALUE (LISTEN)	EQUIVALENT ASCII CHARACTER (LISTEN)
00	SP
01	!
02	"
03	#
04	$
05	%
06	&
07	'
08	(
09	)
10	*
11	+
12	,
13	-
14	.
15	/
16	0
17	1
18	2
19	3
20	4
21	5
22	6
23	7
24	8
25	9
26	:
27	;
28	<
29	=
30	>

Indicates Factory-set address.

3-23. Receiving the Data Message

The Signal Generator must be in remote operation and addressed to listen before it can respond to Data messages. The instrument will remain addressed to listen until it receives an Abort message or a universal unlisten command from the controller.

The paragraph entitled Switching Characteristics shows how the Signal Generator responds to Data Messages. Timing considerations and other characteristics pertinent to operation are included.

Data Message Input Format. Data messages contain the controller's talk address, the Signal Gen-

ManualsPlus.com

Receiving the Data Message (Cont'd)

erator's listen address, a string of program codes, and an End of String message (EOS). The string of program codes follows the same protocol as a front panel keystroke sequence in local operation. The EOS message can be a Line Feed (LF), a bus END message (EOI and ATN bus control lines both set true), or an internally produced EOS.

The following paragraphs explain other key elements of the program code strings. Figure 3-10 provides some examples of Data messages.

Keyboard-to-Program Code Correlation. There is a program code that corresponds to nearly every front panel key. The exceptions are DISPLAY, DISPLAY in conjunction with SEQ, Backspace, COARSE TUNE, FINE TUNE, and display HP-IB ADRS. In addition, the program code HZ is available for carrier frequency entries, RP is available to reset the reverse power protection circuitry after the source of reverse power has been removed, and R0 and R1 are available to programmatically place the instrument in the STBY and ON states, respectively.

Value-Selectable Parameters. Carrier parameters are set using a Function-Data-Units sequence of program codes, while modulation parameters are set using a Source-Function-Data-Units sequence of program codes. Single-value parameters; such as, INT 400 Hz, INT 1 kHz, and so forth, are set with a single program code sequence.

Data. The term "Data" in each program sequence refers to the numeric value and not to the entire Data message. Data can be any number of arbitrary length in fixed point notation. Digits that exceed the maximum data length for the particular function will be truncated. This maximum limit includes any embedded decimal point. In the case of the Amplitude function, this maximum limit also includes the minus sign. The minus sign is only applicable during Amplitude Data entries. Table 3-6 summarizes these input data restrictions.

Table 3-6. Input Data Restrictions

Function	Maximum Data Length	Decimal Point Allowed	Minus Sign Allowed
Frequency	9 Digits	Yes	No
Amplitude	9 Digits (1)	Yes	Yes
AM	2 Digits	Yes	No
FM	2 Digits	Yes	No
Increment Set	Same as for selected function	Yes	No

NOTES:

1. In the Amplitude function, leading zeros are not counted.
2. Unused or unidentifiable characters are ignored.
3. Either upper or lower case letters can be used in Data messages.
4. Only the following ASCII characters are recognized by the Signal Generator:

   A—Z a—z 0—9 LF — . %

All other characters, including spaces, are ignored.

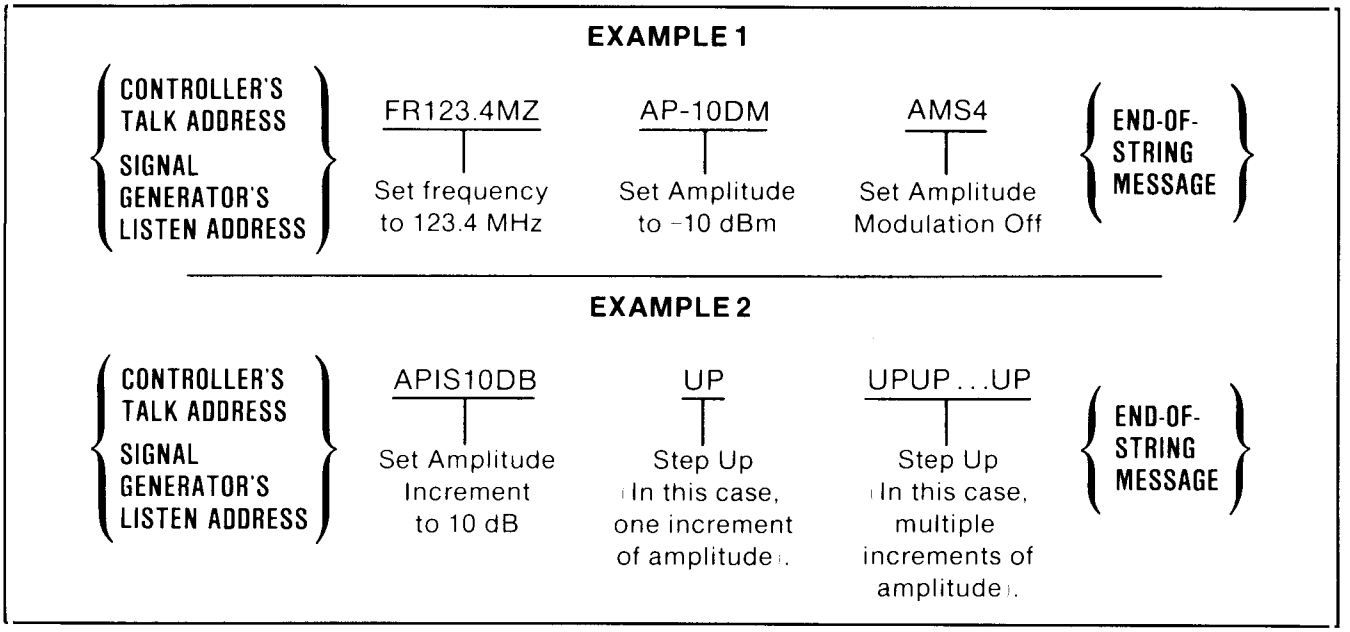


Figure 3-10. Data Message Examples

ManualsPlus.com

Receiving the Data Message (Cont'd)
A complete list of ASCII characters with conversions to binary, octal, decimal, and hexadecimal is provided in Table 3-10.

3-24. Sending the Data Message

The Signal Generator does not have the capability to talk; therefore, it cannot send Data messages.

3-25. Receiving the Trigger Message

The Signal Generator does not have the capability to respond to the trigger message.

3-26. Receiving the Clear Message

The Signal Generator will respond to a Clear message by setting each function parameter to the value listed in Table 3-7. The Signal Generator will respond equally to the Selected Device Clear (SDC) bus command when addressed to listen, and to the Device Clear (DCL) bus command whether addressed or not.

Table 3-7. Response to Clear Message

Parameter	Value
Carrier Frequency	100.0000 MHz
Output Amplitude	−127.0 dBm
AM Depth	0%
FM Peak Deviation Frequency	0.0 kHz
Carrier Frequency Increment	10.0000 MHz
Output Amplitude Increment	10.0 dB
AM Depth Increment	1%
FM Peak Deviation Frequency Increment	1.0 kHz
Coarse and Fine Tune Pointer	10.0000 MHz
Sequence Counter	0
All 10 Internal Storage Registers	Remain unchanged.

3-27. Receiving the Remote Message

The Remote message is comprised of two parts. First, the Remote Enable bus control line (REN) is held true, then the device listen address is sent by the controller. These two actions combine to place the Signal Generator into remote operation. Therefore, the instrument is enabled to go into remote operation when the controller begins the Remote message, but it does not actually make the transition until it is addressed to listen for the first time. All instrument settings remain unchanged when the transition from local-to-remote operation occurs.

The front panel RMT and ADRS annunciators will both light once the Signal Generator has received the Remote message and is addressed to listen.

3-28. Receiving the Local Message

The Local message is the means by which the controller sends the Go to Local (GTL) bus command. If addressed to listen, the Signal Generator will return to local operation (full front panel control) when it receives the Local message. If the instrument is in local lockout when the Local message is received, full front panel control will be returned, but local lockout will remain in effect. Unless the Signal Generator receives the Clear Lockout/Set Local message, it will return to local lockout the next time it receives a Remote message. All instrument settings remain unchanged when the transition from remote-to-local operation occurs.

The front panel RMT annunciator will be turned off when the Signal Generator switches to local operation. However, the front panel ADRS annunciator will remain lit if the Signal Generator is still being addressed to listen (whether in remote or local operation).

The front panel LOCAL key can also be used to return the Signal Generator to local operation. However, pressing the LOCAL key (when the instrument is not in local lockout) might interrupt a Data message being sent to the Signal Generator. This would leave the Signal Generator in a state unknown to the controller. This situation is undesirable and can be avoided by sending the Local Lockout message to disable the LOCAL key.

3-29. Receiving the Local Lockout Message

The Local Lockout message is the means by which the controller sends the Local Lockout (LLO) bus command. If the Signal Generator is in remote operation, it will respond to the Local Lockout message by disabling the front panel LOCAL key. Local lockout prevents the loss of data or system control due to someone accidentally pressing any of the front panel keys. If the Signal Generator is in local operation when it is enabled to remote operation (that is, REN is set true) and it receives the Local Lockout message, it will switch to remote with local lockout operation the first time it is addressed to listen. Once in local lockout, the Signal Generator can only be returned to local operation by the controller or by unplugging or resetting the instrument.

ManualsPlus.com

3-30. Receiving the Clear Lockout/Set Local Message

The Clear Lockout/Set Local message is the means by which the controller sets the Remote Enable bus control line (REN) false. The Signal Generator will return to local operation (full front panel control) when it receives the Clear Lockout/Set Local message. All instrument settings remain unchanged when the transition from remote with lockout to local operation occurs.

The front panel RMT annunciator will be turned off when the Signal Generator switches to local operation.

3-31. Receiving the Pass Control Message

The Signal Generator does not respond to the Pass Control message because it does not have a control capability.

3-32. Sending the Require Service Message

The Signal Generator does not have the capability to require service by setting the Service Request bus control line (SRQ) true.

3-33. Sending the Status Byte Message

The Signal Generator does not have the capability to respond to a Serial Poll Enable (SPE) bus command; therefore, it cannot send the Status Byte message.

3-34. Sending the Status Bit Message

The Signal Generator does not have the capability to respond to a Parallel Poll Enable (PPE) bus command; therefore, it cannot send the Status Bit message.

3-35. Receiving the Abort Message

The Abort message is the means by which the controller sets the Interface Clear bus control line (IFC) true. When the Abort message is received, the Signal Generator becomes unaddressed and stops listening.

3-36. Switching Characteristics

The Signal Generator's switching characteristics are an important consideration in applications involving a computer controller. For most functions, the Signal Generator has the ability to accept new Data Messages before the hardware can settle to the required output. If the timing requirements are not taken into account in the controller's program, it will be impossible in many situations to make meaningful measurements on a device driven by the Signal Generator.

Switching times for frequency, modulation and amplitude have several characteristics in com-

Table 3-8. HP-IB Program Codes (Alphabetical Order)

Program Code[1]	Parameter	Comments
AM	Amplitude Modulation	Function Entry
AP	Amplitude (carrier)	Function Entry
DB	dB	Units Entry
DF	dBf	Units Entry
DM	dBm	Units Entry
DN	Step Down (↓)	Function Feature
EM	EMF	Units Entry
FM	Frequency Modulation	Function Entry
FR	Frequency (carrier)	Function Entry
HZ	Hz	Units Entry
IS	Increment Set	Function Qualifier
KZ	kHz	Units Entry
MV	mV	Units Entry
MZ	MHz	Units Entry
PC	Percent[2]	Units Entry
RC	Recall	Feature
RP	Reverse Power Protection Reset[3]	Feature
R0	Standby[4]	Feature
R1	On[4]	Feature
SQ	Sequence	Feature
ST	Store	Feature
S1	External Modulation Source	Source Qualifier
S2	Internal 400 Hz Modulation Source	Source Qualifier
S3	Internal 1 kHz Modulation Source	Source Qualifier
S4	Modulation Source Off	Source Qualifier
UP	Step Up (↑)	Function Feature
UV	μV	Units Entry
VL	Volts	Units Entry
0—9	Numerals 0 — 9	Data Entries
-	Minus Sign	Data Entry
.	Decimal Point	Data Entry
%	Percent[2]	Units Entry

[1] Program codes can be either upper or lower case.

[2] Either PC or % can be used.

[3] The source of reverse power must be removed.

[4] The RESET/STBY/ON switch must be set to the ON position.

ManualsPlus.com

Switching Characteristics (Cont'd)

mon. In each case a finite amount of time passes from the command (manual or computer generated) until the required output occurs. Software execution time is required for the microprocessor and related digital circuits to process the data. This begins with a valid final terminator (keystroke or data entry) and ends with the execution in the hardware. The software time may vary considerably depending on the function. Examples are internal instructions to more than one hardware location, (may be serial, parallel or both) and differing amounts of control data and calculations.

Hardware execution time will also vary considerably. This depends on the number of circuits affected, the length of time each takes to change and whether the changes occur one at a time or concurrently.

Frequency Switching. The Signal Generator will typically be within 100 Hz of the final frequency within 2 seconds after receiving the valid units data (terminator). Figure 3-11 shows the sequence of events and the typical error frequency relative to time. Area I shows the software execution time. Areas II through IV make up the hardware execution time.

At times certain events in the frequency switching cycle may be bypassed. For example, small frequency changes will often eliminate event II, the fast slew rate mode or event IV, the FM calibration mode. However, the frequency change that allows these events to be bypassed depends on an involved algorithm that is a function of frequency band and the state of the successive approximation register of the Low Frequency Loop. Therefore, it is best to assume that the entire sequence of

Table 3-9. HP-IB Program Codes (Functional Order)

Parameter	Program Code[1]
FREQUENCY	
Frequency (carrier)	FR
AMPLITUDE	
Amplitude (carrier)	AP
MODULATION	
Amplitude Modulation	AM
Frequency Modulation	FM
External Modulation Source	S1
Internal 400 Hz Modulation Source	S2
Internal 1 kHz Modulation Source	S3
Modulation Source Off	S4
DATA	
Numerals 0 — 9	0 — 9
Minus Sign	–
Decimal Point	.
UNITS	
dB	DB
dBf	DF
dBm	DM
EMF	EM
Volts	VL
mV	MV
μV	UV
Hz	HZ
kHz	KZ
MHz	MZ
Percent[2]	PC
Percent[2]	%
OTHER	
Step Up (↑)	UP
Step Down (↓)	DN
Increment Set	IS
Standby[3]	R0
On[3]	R1
Store	ST
Recall	RC
Sequence	SQ
Reverse Power Protection Reset (4)	RP

[1]Program codes can be either upper or lower case.

[2]Either PC or % can be used.

[3]The RESET/STBY/ON switch must be in the ON position.

[4]The source of reverse power must be removed.

ManualsPlus.com

Table 3-10. Commonly Used Code Conversions

ASCII	Binary	Octal	Decimal	Hexa-decimal
NUL	00 000 000	000	0	00
SOH	00 000 001	001	1	01
STX	00 000 010	002	2	02
ETX	00 000 011	003	3	03
EOT	00 000 100	004	4	04
ENQ	00 000 101	005	5	05
ACK	00 000 110	006	6	06
BEL	00 000 111	007	7	07
BS	00 001 000	010	8	08
HT	00 001 001	011	9	09
LF	00 001 010	012	10	0A
VT	00 001 011	013	11	0B
FF	00 001 100	014	12	0C
CR	00 001 101	015	13	0D
SO	00 001 110	016	14	0E
SI	00 001 111	017	15	0F
DLE	00 010 000	020	16	10
DC1	00 010 001	021	17	11
DC2	00 010 010	022	18	12
DC3	00 010 011	023	19	13
DC4	00 010 100	024	20	14
NAK	00 010 101	025	21	15
SYN	00 010 110	026	22	16
ETB	00 010 111	027	23	17
CAN	00 011 000	030	24	18
EM	00 011 001	031	25	19
SUB	00 011 010	032	26	1A
ESC	00 011 011	033	27	1B
FS	00 011 100	034	28	1C
GS	00 011 101	035	29	1D
RS	00 011 110	036	30	1E
US	00 011 111	037	31	1F
SP	00 100 000	040	32	20
!	00 100 001	041	33	21
"	00 100 010	042	34	22
#	00 100 011	043	35	23
$	00 100 100	044	36	24
%	00 100 101	045	37	25
&	00 100 110	046	38	26
'	00 100 111	047	39	27
(	00 101 000	050	40	28
)	00 101 001	051	41	29
*	00 101 010	052	42	2A
+	00 101 011	053	43	2B
,	00 101 100	054	44	2C
—	00 101 101	055	45	2D
.	00 101 110	056	46	2E
/	00 101 111	057	47	2F
0	00 110 000	060	48	30
1	00 110 001	061	49	31
2	00 110 010	062	50	32
3	00 110 011	063	51	33
4	00 110 100	064	52	34
5	00 110 101	065	53	35
6	00 110 110	066	54	36
7	00 110 111	067	55	37
8	00 111 000	070	56	38
9	00 111 001	071	57	39
:	00 111 010	072	58	3A
;	00 111 011	073	59	3B
<	00 111 100	074	60	3C
=	00 111 101	075	61	3D
>	00 111 110	076	62	3E
?	00 111 111	077	63	3F

ASCII	Binary	Octal	Decimal	Hexa-decimal
@	01 000 000	100	64	40
A	01 000 001	101	65	41
B	01 000 010	102	66	42
C	01 000 011	103	67	43
D	01 000 100	104	68	44
E	01 000 101	105	69	45
F	01 000 110	106	70	46
G	01 000 111	107	71	47
H	01 001 000	110	72	48
I	01 001 001	111	73	49
J	01 001 010	112	74	4A
K	01 001 011	113	75	4B
L	01 001 100	114	76	4C
M	01 001 101	115	77	4D
N	01 001 110	116	78	4E
O	01 001 111	117	79	4F
P	01 010 000	120	80	50
Q	01 010 001	121	81	51
R	01 010 010	122	82	52
S	01 010 011	123	83	53
T	01 010 100	124	84	54
U	01 010 101	125	85	55
V	01 010 110	126	86	56
W	01 010 111	127	87	57
X	01 011 000	130	88	58
Y	01 011 001	131	89	59
Z	01 011 010	132	90	5A
[	01 011 011	133	91	5B
\	01 011 100	134	92	5C
]	01 011 101	135	93	5D
^	01 011 110	136	94	5E
_	01 011 111	137	95	5F
`	01 100 000	140	96	60
a	01 100 001	141	97	61
b	01 100 010	142	98	62
c	01 100 011	143	99	63
d	01 100 100	144	100	64
e	01 100 101	145	101	65
f	01 100 110	146	102	66
g	01 100 111	147	103	67
h	01 101 000	150	104	68
i	01 101 001	151	105	69
j	01 101 010	152	106	6A
k	01 101 011	153	107	6B
l	01 101 100	154	108	6C
m	01 101 101	155	109	6D
n	01 101 110	156	110	6E
o	01 101 111	157	111	6F
p	01 110 000	160	112	70
q	01 110 001	161	113	71
r	01 110 010	162	114	72
s	01 110 011	163	115	73
t	01 110 100	164	116	74
u	01 110 101	165	117	75
v	01 110 110	166	118	76
w	01 110 111	167	119	77
x	01 111 000	170	120	78
y	01 111 001	171	121	79
z	01 111 010	172	122	7A
{	01 111 011	173	123	7B
|	01 111 100	174	124	7C
}	01 111 101	175	125	7D
~	01 111 110	176	126	7E
DEL	01 111 111	177	127	7F

ManualsPlus.com

Switching Characteristics (Cont'd)
events shown in Figure 3-11 occurs every time a frequency change is made.

To minimize the effects of frequency hysteresis (especially near the frequency band edges), switch to the desired frequency from the same direction each time, that is, from either above or below the desired frequency. Ideally, the frequency change should be made from the same preset frequency. The main band frequency hysteresis is 100 kHz at the main band edges, that is, 123.5, 247 and 494 MHz.

During a frequency change, all modulation is turned off if the FM mode has been enabled. This applies to FM only or mixed modulation such as FM from two sources or simultaneous AM and FM. After the frequency change and FM calibration is completed, the modulation is turned on.

Amplitude Switching. During an RF amplitude change, the final level is always approached from a lower level. This means that a critical amplitude level will never be exceeded in the course of normal Signal Generator operation.

Software correction of amplitude with respect to frequency may cause the amplitude to be uncalibrated while a frequency change occurs. The software correction is implemented after the final frequency is reached.

Software execution time for an amplitude change varies considerably. The basic unit for amplitude in the Signal Generator is dBm. An input in other units requires calculations. This tends to increase the software execution time considerably. For example, an input in dBm generally will take about 160 ms from the terminator to the end of software execution. A change (increment or decrement) in dB will take a little less time, typically 130 ms. Examples of a change with calculations involved are: a preset level in mV with a change in dB, 200 ms; a level and change in mV, 340 ms; a level in dBm and a change in mV, 460 ms.

A 10 dB change without modulation (narrowband Automatic Level Control—ALC) may take up to 110 ms in the vernier hardware circuits. With modulation (wideband ALC) the switching time is typically 1 to 25 ms. The step attenuator switching time is on the order of 12 ms.

Total time requirements for simple amplitude inputs or changes, that is, minimal software and hardware execution time is 150 ms. A more complex change may take up to 560 ms.

Modulation Switching. There are applications where it is necessary to turn modulation on or off or to change to another modulation level. It takes about 400 ms for the modulation accuracy (AM or FM) to be within tolerance from the time the modulation (audio oscillator) is initially turned on. An FM deviation change typically occurs 60 ms after the final terminator (Units key) triggers the change. Turning the FM off will take about 20 ms. Amplitude modulation normally takes about 120 ms to turn off or to change to a new depth. Software execution time in the modulation mode is insignificant.

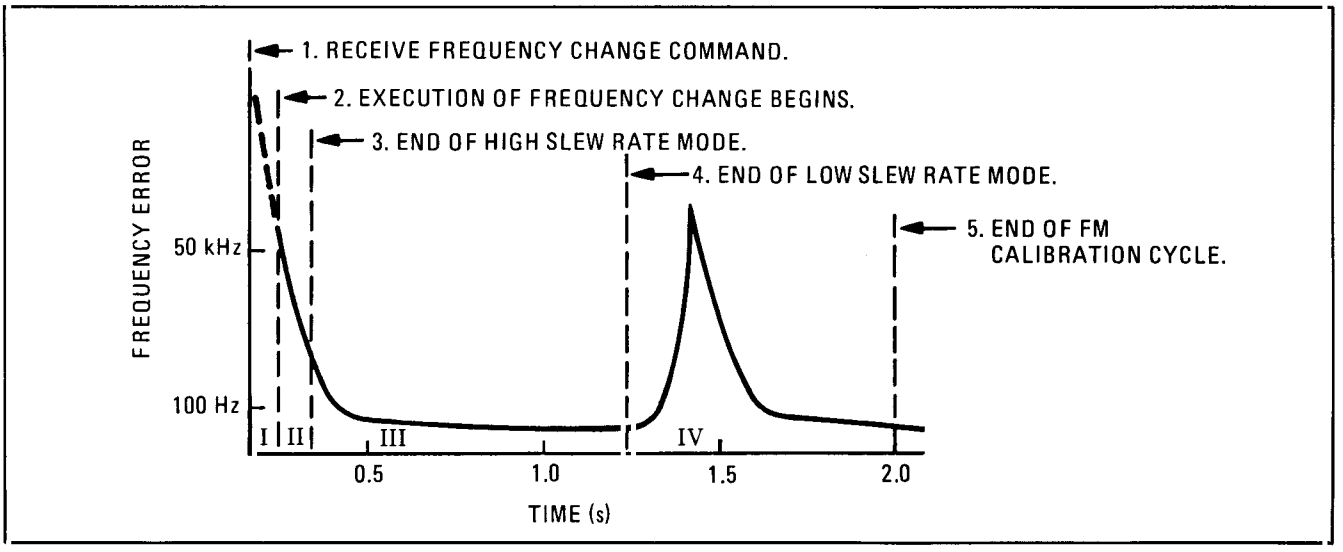


Figure 3-11. Frequency Switching Characteristics

ManualsPlus.com

Amplitude

Description

This instruction details how to set the output amplitude.

Operating Characteristics:
Range: +13 dBm to −127 dBm (+1.00V to +0.100 μV)
Resolution: 0.1 dB

Keystroke Sequence

Press and release the AMPTD Function key, the desired Data keys, and a valid Units key or combination of valid Units keys.

Examples

Set the output amplitude to −12.3 dBm.

LOCAL (keystrokes)	Function: AMPTD — Data: − 1 2 . 3 — Units: dBm
(program codes)	AP−12.3DM (Function: AP; Data: 12.3; Units: DM)

Set the output amplitude to −2.0 dB EMF μV.

LOCAL (keystrokes)	Function: AMPTD — Data: − 2 . 0 — Units: dB EMF μV
(program codes)	AP−2.0DBEMUV (Function: AP; Data: 2.0; Units: DBEMUV)

Keys and Program Codes

Keys	Program Codes
AMPTD	AP
dBm	DM
dBf	DF
dB	DB
EMF	EM
V	VL
mV	MV
μV	UV

Indications

The selected output amplitude (with sign and units) will be displayed in the AMPLITUDE Display.

Comments

Digits selected beyond the specified resolution of the AMPLITUDE Display will be ignored.

ManualsPlus.com

Amplitude (Cont'd)

Comments (Cont'd)

Leading zeros will be blanked.

Calibrated level is from −127 dBm to +13 dBm with overrange to the maximum power of the instrument.

Minus sign may be entered at any time before the final terminator.

Amplitude Data entries that would cause the peak envelope power of the instrument to exceed +17 dBm are rejected.

Amplitude function will remain selected until:

a. One of the three remaining functions is selected.

b. One of the STORE-RECALL-DISPLAY keys is pressed.

c. The instrument is reset or unplugged.

Fourteen valid units entries are possible. They are as follows:

dBm	dB μV	V	EMF mV
dBf	dB EMF V	mV	EMF μV
dB V	dB AMF mV	μV	
dB mV	dB EMF μV	EMF V	

Related Instructions

Amplitude Conversion
Amplitude, Up/Down

ManualsPlus.com

Amplitude Conversion

Description

This instruction details how to change the AMPLITUDE Display from power units in dBm to any one of thirteen other valid unit configurations. This feature does not affect the actual output amplitude of the Signal Generator.

Keystroke Sequence

Press any valid Units key or combination of valid Units keys with the amplitude function selected.

Example

The AMPLITUDE Display shows 10.0 dBm. Change the display to units of dB μV. (The resulting display will be 117.0 dB μV).

LOCAL (keystrokes)	dBm → dB μV [dB] [μV] Prefix Terminator Final Terminator
(program codes)	dBm → dB μV DBUV Prefix Terminator — Final Terminator

Keys and Program Codes

Keys	Program Codes
dBm[1]	DM[1]
dBf[1]	DF[1]
dB[2,3]	DB[2,3]
EMF[2]	EM[2]
V[1]	VL[1]
mV[1]	MV[1]
μV[1]	UV[1]

[1] Final Terminator.
[2] Prefix Terminator.
[3] Final Terminator for Increment Set Mode.

Indications

The AMPLITUDE Display will change to reflect the newly selected units and the corresponding annunciator(s) will light.

Comments

The amplitude function must be selected before the conversion entry or entries are made.

Logarithmic Data entries (dBm or dBf) will be displayed in the AMPLITUDE Display with 0.1 dB resolution.

The dBm or dBf Units terminator overrides a dB or EMF terminator.

If a dB or EMF Units terminator is selected, the AMPLITUDE Display will be blanked, the corresponding annunciator will light, and the Signal Generator will wait for a final terminator to be entered.

ManualsPlus.com

Amplitude Conversion (Cont'd)

Comments (Cont'd)

Linear Data entries (V, mV, or μV) will be displayed in the three most significant digits of the AMPLITUDE Display and the linear terminator will be autoranged (or adjusted) to comply with this condition.

Conversion formulas used are as follows:

dBm	=	dBm
dBf	=	dBm + 120.0
dB V	=	dBm − 13.0
dB mV	=	dBm + 47.0
dB μV	=	dBm + 107.0
dB EMF V	=	dBm − 7.0
dB EMF mV	=	dBm + 53.0
dB EMF μV	=	dBm + 113.0
V	=	$10^{(dBm - 13.0)/20}$
mV	=	$10^{(dBm + 47.0)/20}$
μV	=	$10^{(dBm + 107.0)/20}$
EMF V	=	$10^{(dBm - 7.0)/20}$
EMF mV	=	$10^{(dBm + 53.0)/20}$
EMF μV		$10^{(dBm + 113.0)/20}$

Related Instructions

Amplitude
Amplitude, Up/Down

ManualsPlus.com

Amplitude, Up/Down

Description

This instruction details how to change the output amplitude by the value stored in the internal output amplitude increment register.

Keystroke Sequence

Press and release the step up or step down keys associated with the output amplitude function.

Keys and Program Codes

Keys	Program Codes
AMPTD	AP
▲	UP
▼	DN

NOTE

During remote operation, repeated UP or DN codes can be sent over the bus once the frequency function has been selected.

Indications

The output amplitude shown in the AMPLITUDE Display and the output of the Signal Generator will change by the value stored in the internal output amplitude increment register.

Comments

Step up and step down keys associated with the output amplitude function are used to change the output amplitude by the value stored in the internal output amplitude increment register.

Places the instrument in the Amplitude Data entry mode and clears any previously selected function.

Continues to change the output amplitude by the value stored in the internal output amplitude increment register if either key remains pressed.

Initialized value and limits of the output amplitude increment are as follows:

Initialized Value	Minimum Value	Maximum Value
10.0 dB	0.1 dB	≤144.0 dB
	0.001 μV	≤1.57V
	0.001 EMF μV	≤3.15 EMF V

Related Instructions

Increment Value Change
Increment Value Display

ManualsPlus.com

Display

Description

This instruction details how to selectively display the stored contents of an internal storage register.

Keystroke Sequence

Press and release the DISPLAY key, then press and hold the Data key (a single digit register number 0—9).

Example

Display the stored contents from register 2.	
LOCAL (keystrokes)	Display Contents of Register 2 DISPLAY 2
(program codes)	This feature is not accessible via HP-IB.

Keys and Program Codes

Keys	Program Codes
DISPLAY	None

Indications

The stored contents from the selected register will be displayed as long as the Data key remains pressed.

Comments

Ten internal registers are available (0—9). Each is capable of storing complete front panel setups (exclusive of increment settings).

Does not affect the actual output of the Signal Generator.

Does not change the contents of the internal sequence counter.

Does not affect the current increment settings.

Clears any previously selected function.

Feature is not accessible via HP-IB.

All displays are restored to reflect the actual Signal Generator output when the Data key is released.

Related Instructions

Display Sequence
Recall
Sequence
Store

ManualsPlus.com

Display Sequence

Description This instruction details how to display the contents of the internal sequence counter.

Keystroke Sequence Press and release the DISPLAY key, then press and hold the SEQ key.

Example

Display the contents of the internal sequence counter.	
LOCAL (keystrokes)	Display Sequence Counter Contents: DISPLAY SEQ
(program codes)	This feature is not accessible via HP-IB.

Keys and Program Codes

Keys	Program Codes
DISLPAY	None
SEQ	None

Indications The stored contents from the sequence counter will be displayed in the least significant digit of the AMPLITUDE Display as long as the SEQ key remains pressed.

Comments Does not affect the actual output of the Signal Generator.

Does not change the contents of the internal sequence counter.

Clears any previously selected function.

Feature is not accessible via HP-IB.

The AMPLITUDE Display is restored to reflect the actual Signal Generator output when the SEQ key is released.

Related Instructions Display
Sequence

ManualsPlus.com

Frequency

Description

This instruction details how to set the carrier frequency.

Operating Characteristics:

Range: 100 kHz to 990 MHz (990.0000 MHz)

Resolutions: 100 Hz and 250 Hz, depending on the carrier frequency selected.

Keystroke Sequence

Press and release the FREQUENCY Function key, the desired Data keys, and a valid Units key.

Example

Set the carrier frequency to 123.45 MHz.

	Function	Data						Units
LOCAL (keystrokes)	FREQUENCY	1	2	3	.	4	5	MHz
(program codes)	FR123.45MZ Function — Data — Units							

Keys and Program Codes

Keys	Program Codes
FREQUENCY	FR
MHz	MZ
kHz	KZ
No key	HZ

Indications

The selected carrier frequency will be displayed in megahertz in the FREQUENCY Display.

Comments

Least significant (eighth) digit will be blanked when the selected carrier frequency is a multiple of 100 Hz.

In cases where the selected carrier frequency is a multiple of 250 Hz, the least significant digit will be a 5.

Digits selected beyond the specified resolution of the FREQUENCY Display will be truncated.

Leading zeros will be blanked.

Carrier frequencies below 100 kHz will result in an uncalibrated output amplitude.

The MODULATION Display will flash if a change in carrier frequency would cause the FM peak deviation frequency allowed for that frequency band to be exceeded. Entering a carrier frequency that would set the instrument in the correct band for the selected deviation frequency will clear the error condition, or pressing one of the following keys will automatically adjust the FM peak deviation frequency to the maximum frequency possible for that frequency band.

ManualsPlus.com

Frequency (Cont'd)

Comments (Cont'd)

Band	Carrier Frequency (MHz)
1	0.1 — 123.5
2	123.5 — 247
3	247 — 494
4	494 — 990



The carrier frequency increment is rejected if it is not a multiple of 100 Hz or 250 Hz.

Frequency function will remain selected until:

a. One of the three remaining functions is selected.

b. One of the STORE-RECALL-DISPLAY keys is pressed.

c. The instrument is reset or unplugged.

Related Instructions

Frequency, Coarse and Fine Tune
Frequency, Up/Down

ManualsPlus.com

Frequency, Coarse and Fine Tune

Description

This instruction details how to quickly tune the carrier frequency in decade steps using the step up and step down keys associated with the carrier frequency function.

Keystroke Sequence

This feature is enabled by pressing either the COARSE TUNE or FINE TUNE key.

Pressing either key will increase (COARSE TUNE) or decrease (FINE TUNE) the carrier frequency tuning value by a factor of 10.

Pressing the step up key will then increase the carrier frequency by the newly selected carrier frequency tuning value, while pressing the step down key will decrease the carrier ferquency.

This feature is disabled and the original carrier frequency increment value is enabled by pressing the INCR SET key (with the frequency function selected).

Example

Enable a carrier frequency tuning value of 10 kHz (assuming a starting value of 10 MHz).

LOCAL (keystrokes)	Decrease Tuning Value → FINE TUNE ÷10, FINE TUNE ÷10, FINE TUNE ÷10
(program codes)	This feature is not accessible via HP-IB.

Keys and Program Codes

Keys	Program Codes
FREQUENCY	None
COARSE TUNE	None
FINE TUNE	None
▲	None
▼	None
INCR SET	None

Indications

Whenever the COARSE TUNE or FINE TUNE key is pressed and held, the frequency digit that corresponds to the carrier frequency tuning value will flash.

When the COARSE TUNE key is pressed again, the next digit to the left will flash to indicate the new tuning value.

When the FINE TUNE key is pressed again, the next digit to the right will flash to indicate the new tuning value.

Comments

Feature only applies to the carrier frequency function.

Feature is not accessible via HP-IB.

ManualsPlus.com

Frequency, Coarse and Fine Tune (Cont'd)

Comments (Cont'd)

COARSE TUNE and FINE TUNE keys are always available to change the carrier frequency tuning value by a factor of 10.

Places the instrument into the frequency Data entry mode and clears any previously selected function, once either the step up or step down key is pressed.

Enables the last valid carrier frequency increment value when the INCR SET key is pressed.

Related Instructions

Frequency
Frequency, Up/Down
Increment Value Change

ManualsPlus.com

Frequency, Up/Down

Description

This instruction details how to change the carrier frequency by the value stored in the internal carrier frequency increment register.

Keystroke Sequence

Press and release the step up or step down keys associated with the carrier frequency function.

Keys and Program Codes

Keys	Program Codes
FREQUENCY	FR
▲	UP
▼	DN

NOTE

During remote operation, repeated UP or DN codes can be sent over the bus once the frequency function has been selected.

Indications

The carrier frequency shown in the FREQUENCY Display and the output of the Signal Generator will change by the value stored in the internal carrier frequency increment register.

Comments

Step up and step down keys associated with the carrier frequency function are used to change the carrier frequency by the value stored in the internal carrier frequency increment register.

Places the instrument in the Frequency Data entry mode and clears any previously selected function.

Continues to change the carrier frequency by the value stored in the internal carrier frequency increment register if either key remains pressed.

The MODULATION Display will flash if a change in carrier frequency would cause the FM peak deviation frequency allowed for that frequency band to be exceeded. Entering a carrier frequency that would set the instrument in the correct band for the selected deviation frequency will clear the error condition, or pressing one of the following keys will automatically adjust the FM peak deviation frequency to the maximum frequency possible for that frequency band.

Band	Carrier Frequency (MHz)
1	0.1—123.5
2	123.5—247
3	247—494
4	494—990



Initialized value and limits of the carrier frequency increment are as follows:

Initialized Value	Minimum Value	Maximum Value
10.0000 MHz	0.1 kHz	≤989.99 MHz

Related Instructions

Frequency, Coarse and Fine Tune
Increment Value Change
Increment Value Display

ManualsPlus.com

HP-IB Address Display

Description This instruction details how to display the internally-set, decimal HP-IB address.

Keystroke Sequence Press and hold the HP-IB ADRS key.

Example

Display the internally-set, decimal HP-IB address.	
LOCAL (keystrokes)	Display HP-IB Address HP-IB ADRS
(program codes)	This feature is not accessible via HP-IB.

Keys and Program Codes

Keys	Program Codes
HP-IB ADRS	None

Indications The internally-set, decimal HP-IB address will be displayed in the MODULATION Display as long as the HP-IB ADRS key remains pressed.

Comments HP-IB addresses greater than 30 (decimal) are interpreted as 30.

HP-IB address is factory-set to 07 decimal. (In binary, this is 00111, the equivalent ASCII character is an apostrophe).

HP-IB address is updated only when the instrument is powered up or reset.

To change the HP-IB address, refer to paragraph 2-8, HP-IB Address Selection.

Feature is not accessible via HP-IB.

The MODULATION Display is restored to reflect the actual Signal Generator output when the HP-IB ADRS key is released.

ManualsPlus.com

HP-IB Address Display (Cont'd)

Comments (Cont'd)

Allowable HP-IB Address Codes

ADDRESS SWITCH					EQUIVALENT ASCII CHARACTER (LISTEN)	EQUIVALENT DECIMAL VALUE (LISTEN)
A5	A4	A3	A2	A1		
0	0	0	0	0	SP	00
0	0	0	0	1	!	01
0	0	0	1	0	"	02
0	0	0	1	1	#	03
0	0	1	0	0	$	04
0	0	1	0	1	%	05
0	0	1	1	0	&	06
0	0	1	1	1	'	07
0	1	0	0	0	(	08
0	1	0	0	1	)	09
0	1	0	1	0	*	10
0	1	0	1	1	+	11
0	1	1	0	0	,	12
0	1	1	0	1	-	13
0	1	1	1	0	.	14
0	1	1	1	1	/	15
1	0	0	0	0	0	16
1	0	0	0	1	1	17
1	0	0	1	0	2	18
1	0	0	1	1	3	19
1	0	1	0	0	4	20
1	0	1	0	1	5	21
1	0	1	1	0	6	22
1	0	1	1	1	7	23
1	1	0	0	0	8	24
1	1	0	0	1	9	25
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

Indicates factory-set address.

Related Instructions

None

ManualsPlus.com

Increment Value Change

Description

This instruction details how to change the value of the stored increments which are controlled by the step up and step down keys associated with each of the four main functions. Increment values for the carrier frequency, output amplitude, AM depth, and FM peak deviation frequency can be stored. The initialized value of each stored increment is listed as follows:

Carrier Frequency	10.0000 MHz
Output Amplitude	10.0 dB
AM Depth	1%
FM Peak Deviation Frequency	1.0 kHz

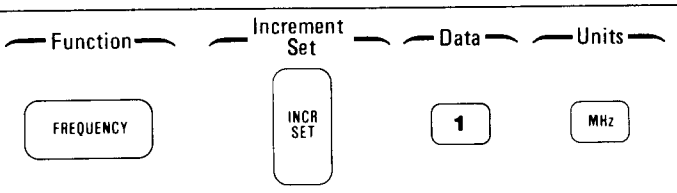
Keystroke Sequence

Press and release a Function key, the INCR SET key, the desired Data keys, and a valid Units key.

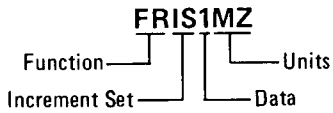
Example

Set a carrier frequency increment of 1 MHz.

LOCAL (keystrokes)



HP-IB (program codes)



Keys and Program Codes

HP-IB

Keys	Program Codes HP-IB	Keys	Program Codes HP-IB
INCR SET	IS	%	PC or %
FREQUENCY	FR	dBm	DM
AMPTD	AP	dBf	DF
AM	AM	dB	DB
FM	FM	EMF	EM
MHz	MZ	V	VL
kHz	KZ	mV	MV
No Key	HZ	μV	UV

Indications

The value of the increment will appear in the display associated with the selected function as the data is entered.

Comments

The frequency increment is rejected if it is not a multiple of 100 Hz or 250 Hz.

FM peak deviation frequency increments must be selected in units of kHz only.

ManualsPlus.com

Increment Value Change (Cont'd)

Comments (Cont'd)

The minimum allowable increment value for each of the four main functions is listed as follows:

Carrier Frequency	0.1 kHz
Output Amplitude	0.1 dB
	0.01 μV
	0.001 EMF μV
AM Depth	1%
FM Peak Deviation Frequency	0.1 kHz

The maximum allowable increment value for each of the four main functions is listed as follows:

Carrier Frequency	≤989.99 MHz
Output Amplitude	≤144.0 dB
	≤1.57V
	≤3.15 EMFV
AM Depth	≤99%
FM Peak Deviation Frequency	≤99 kHz

All displays will be restored to reflect the actual Signal Generator output as soon as a valid increment terminator is selected.

Related Instructions

Amplitude, Up/Down
Frequency, Coarse and Fine Tune
Frequency, Up/Down
Modulation, AM Up/Down
Modulation, FM Up/Down
Increment Value Display

ManualsPlus.com

Increment Value Display

Description

This instruction details how to display the stored value of the increments which are controlled by the step up and step down keys associated with each of the four main functions. Increment values for the carrier frequency, output amplitude, AM depth, and FM peak deviation frequency can be displayed.

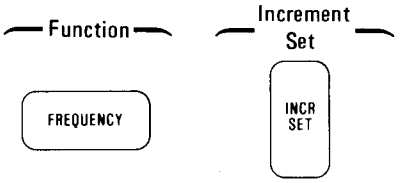
Keystroke Sequence

Press and release a Function key, then press and hold the INCR SET key.

Example

Display the stored carrier frequency increment.

LOCAL (keystrokes)



(program codes)



Keys and Program Codes

Keys	Program Codes
INCR SET	IS
FREQUENCY	FR
AMPTD	AP
AM	AM
FM	FM

Indications

The stored value of the increment will be displayed in the display associated with the selected function as long as the INCR SET key remains pressed.

Comments

The initialized value of each stored increment is listed as follows:

Carrier Frequency	10.0000 MHz
Output Amplitude	10.0 dB
AM Depth	1%
FM Peak Deviation Frequency	1.0 kHz

The display will be restored to reflect the actual Signal Generator output when the INCR SET key is released.

Related Instructions

Increment Value Change

ManualsPlus.com

Modulation, AM

Description

This instruction details how to select amplitude modulation using the internal modulation source.

Operating Characteristics:

Depth: 0 — 99% to +7 dBm
0 — 30% to +10 dBm
Resolution: 1%
Rate (internal): 400 Hz and 1 kHz, ±3%

Keystroke Sequence

Press and release an Internal Source key, the AM Function key, the desired Data keys, and a valid Units key.

Example

Select AM with a depth of 75% using the internal 400 Hz source.

LOCAL (keystrokes)	Source: INT 400 Hz — Function: AM — Data: 7, 5 — Units: %
HP-IB (program codes)	S2AM75PC or % (Source: S2; Function: AM; Data: 75; Units: PC or %)

Keys and Program Codes

Keys	Program Codes (HP-IB)
INT 400 Hz	S2
INT 1 kHz	S3
AM	AM
%	PC or %

Indications

Selected AM depth will be displayed in the MODULATION Display and the source annunciators (INT AM, 400 Hz, and %) will light.

Comments

Digits selected beyond the specified resolution for AM depth will be truncated.

Leading zeros will be blanked.

AM depth Data entries that would cause the peak envelope power of the instrument to exceed +17 dBm are rejected.

AM function will remain selected until:

a. One of the three remaining functions is selected.

b. One of the STORE-RECALL-DISPLAY keys is pressed.

c. The instrument is reset or unplugged.

d. The External Source key may be selected in place of the Internal Source key.

Related Instructions

Modulation, AM Up/Down
Modulation, External Source
Modulation, Mixed
Modulation, Off

ManualsPlus.com

Modulation, AM Up/Down

Description

This instruction details how to change the percentage of AM depth by the value stored in the internal AM depth increment register.

Keystroke Sequence

Press and release the step up or step down keys associated with the amplitude modulation function.

Keys and Program Codes

Keys	Program Codes
AM	AM
▲	UP
▼	DN

NOTE

During remote operation, repeated UP or DN codes can be sent over the bus once the AM function has been selected.

Indications

The percentage of AM depth shown in the MODULATION Display and the output of the Signal Generator will change by the value stored in the internal AM depth increment register.

Comments

Step up and step down keys associated with the amplitude modulation function are used to change the percentage of AM depth by the value stored in the internal AM depth increment register.

Places the instrument in the AM Data entry mode and clears any previously selected function.

Selects default modulation source (internal 1 kHz) if no other source is selected.

Continues to change the percentage of AM depth by the value stored in the internal AM depth increment register if either key remains pressed.

Will automatically stop incrementing when the maximum percentage of AM depth permitted for a selected output amplitude is reached.

Initialized value and limits of the AM depth increment are as follows:

Initialized Value	Minimum Value	Maximum Value
1%	1%	≤99%

Related Instructions

Increment Value Change
Increment Value Display

ManualsPlus.com

Modulation, External Source

Description

This instruction details how to apply an external modulation signal via the front panel MOD INPUT/OUTPUT connector.

Operating Characteristics:

Rate (for AM or FM): 25 Hz to 25 kHz; 1 dB bandwidth; ac coupled
Input Impedance: 600 ohms (resistive)
Input Level: 1 Vpk (0.707 Vrms)

Keystroke Sequence

Press and release the EXT key to enable the front panel MOD INPUT/OUTPUT connector, then set the signal level of the external modulation source to 1 Vpk (0.707 Vrms) for calibrated internal control of the AM depth or FM peak deviation frequency.

Keys and Program Codes

Keys	Program Codes
EXT	S1
AM	AM
%	PC or %
FM	FM
kHz	KZ

Indications

The HI EXT annunciator will light if the external modulation signal is greater than 1.02 Vpk (0.721 Vrms) and the LO EXT annunciator will light if the signal is less than 0.98 Vpk (0.693 Vrms).

NOTE

If greater accuracy is required, use a calibrated voltmeter to measure the external modulation signal.

Comments

In addition to being able to accept an external modulation signal, the MOD INPUT/OUTPUT connector provides access to the internally generated 400 Hz or 1 kHz signal whenever either is selected and the external modulation source is not selected. Its signal level is 1 Vpk (0.707 Vrms) and it cannot be adjusted by the operator.

Related Instructions

Modulation, AM
Modulation, FM
Modulation, Mixed
Modulation, Off

ManualsPlus.com

Modulation, FM

Description

This instruction details how to select frequency modulation using the internal modulation source.

Operating Characteristics:

Peak Deviation:

Carrier Frequency (MHz)	Maximum Peak Deviation	
	Rates ≥60 Hz	Rates <60 Hz
0.1 — 123.5	99 kHz	1600 x Rate
123.5 — 247	25 kHz	400 x Rate
247 — 494	50 kHz	800 x Rate
494 — 990	99 kHz	1600 x Rate

Resolution: 0.1 kHz for peak deviations <10 kHz
1 kHz for peak deviations ≥10 kHz

Rate (internal): 400 Hz or 1 kHz, ±3%

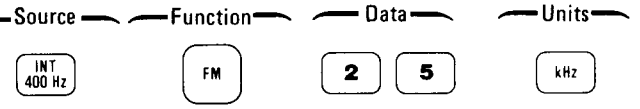
Keystroke Sequence

Press and release an Internal Source key, the FM Function key, the desired Data keys, and a valid Units key.

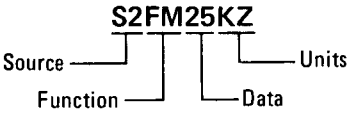
Example

Select FM with a peak deviation frequency of 25 kHz using the internal 400 Hz source.

LOCAL (keystrokes)



(program codes)



Keys and Program Codes

Keys	Program Codes
INT 400 Hz	S2
INT 1 kHz	S3
FM	FM
kHz	KZ

Indications

Selected FM peak deviation frequency will be displayed in the MODULATION Display and the source annunciators (INT FM, 400 Hz, and 1 kHz) will light.

Comments

Digits selected beyond the specified resolution for FM peak deviation will be truncated.

Leading zeros will be blanked.

ManualsPlus.com

Modulation, FM (Cont'd)

Comments (Cont'd)

FM peak deviation Data entries that would be out of range for the selected carrier frequency are rejected.

The MODULATION Display will flash if a change in carrier frequency would cause the FM peak deviation frequency allowed for that frequency band to be exceeded. Entering a carrier frequency that would set the instrument in the correct band for the selected deviation frequency will clear the error condition, or pressing one of the following keys will automatically adjust the FM peak deviation frequency to the maximum frequency possible for that frequency band.

Band	Carrier Frequency MHz
1	0.1 — 123.5
2	123.5 — 247
3	247 — 494
4	494 — 990



FM function will remain selected until:

a. One of the three remaining functions is selected.

b. One of the STORE-RECALL-DISPLAY keys is pressed.

c. The instrument is reset or unplugged.

d. The External Source key may be selected in place of the Internal Source key.

Related Instructions

Modulation, FM Up/Down
Modulation, External Source
Modulation, Mixed
Modulation, Off

ManualsPlus.com

Modulation, FM Up/Down

Description

This instruction details how to change the FM peak deviation frequency by the value stored in the internal FM peak deviation frequency increment register.

Keystroke Sequence

Press and release the step up or step down keys associated with the frequency modulation function.

Keys and Program Codes

Keys	Program Codes
FM	FM
▲	UP
▼	DN

NOTE

During remote operation, repeated UP or DN codes can be sent over the bus once the FM function has been selected.

Indications

The FM peak deviation frequency shown in the MODULATION Display and the output of the Signal Generator will change by the value stored in the internal FM peak deviation frequency increment register.

Comments

Step up and step down keys associated with the frequency modulation function are used to change the FM peak deviation frequency by the value stored in the internal FM peak deviation frequency increment register.

Places the instrument in the FM Data entry mode and clears any previously selected function.

Selects default modulation source (internal 1 kHz) if no other source is selected.

Continues to change the FM peak deviation frequency by the value stored in the internal FM peak deviation frequency increment register if either key remains pressed.

Will automatically stop incrementing when the maximum FM peak deviation frequency permitted for a selected carrier frequency is reached.

If an out of range condition exists (MODULATION Display flashing), pressing either the step up or step down (or FM) key will automatically select the maximum FM peak deviation frequency permitted for the currently selected carrier frequency.

Initialized value and limits of the FM peak deviation frequency are as follows:

Initialized Value	Minimum Value	Maximum Value
1.0 kHz	0.1 kHz	≤99 kHz

Related Instructions

Increment Value Change
Increment Value Display

ManualsPlus.com

Modulation, Mixed

Description

These instructions detail the selection of mixed modulation. Modulation can be selected in one of four ways.

1. Simultaneous AM and FM may be selected using common or separate modulation sources (rate).

2. Simultaneous AM or FM at two rates may be selected by using internal and external modulation sources. Only one AM depth or one FM deviation can be selected.

3. Three simultaneous modulation signals, AM and FM using a common source (rate) and either AM or FM from a separate source, may be selected.

4. Four simultaneous modulation signals, two AM and two FM, may be selected. Each AM/FM pair must have a common modulation source (rate). Only one AM depth and one FM deviation can be selected.

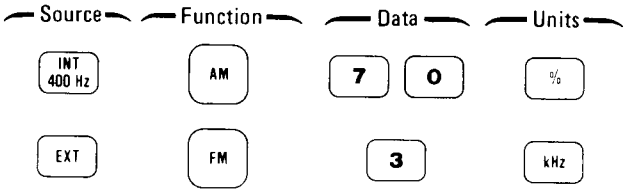
Keystroke Sequence 1

To select simultaneous AM and FM, press and release the Source key to provide the desired AM rate, the AM Function key, the desired Data keys and the % Units key. Then press and release the Source key to provide the desired FM rate, the FM Function key, the desired Data keys and the kHz Units key. (The Source key need not be pressed for FM if the AM and FM rate is the same.)

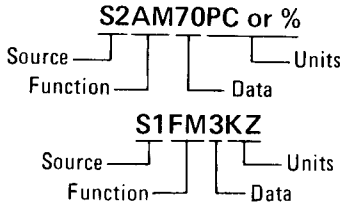
Example 1

Simultaneously select AM with a depth of 70% and FM with a peak deviation frequency of 3 kHz using the internal 400 Hz source, and an external 1 kHz source respectively.

LOCAL (keystrokes)



(program codes)



Keystroke Sequence 2

To select simultaneous AM or FM, press and release the desired Source key, the desired Function key, the desired Data keys and a valid Units key. Then press and release the other Source key and the same Function key that was selected previously.

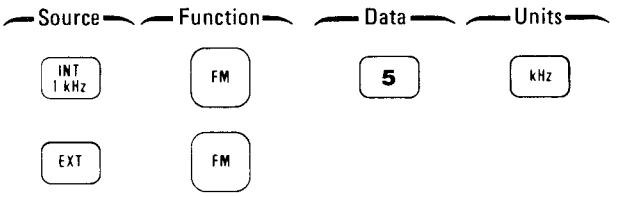
ManualsPlus.com

Modulation, Mixed (Cont'd)

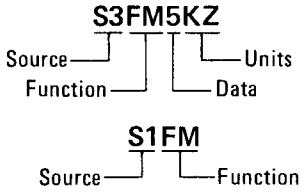
Example 2

Select FM with a peak deviation frequency of 5 kHz using both an internal 1 kHz modulation source and an external 150 Hz modulation source.

LOCAL (keystrokes)



(program codes)



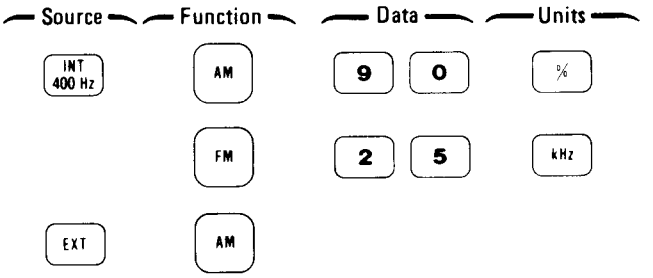
Keystroke Sequence 3

To select three simultaneous modulation signals, AM and FM using a common source (rate) and AM or FM from a separate source, press and release the Source key to provide the common AM and FM rate. Then press a Function key, the desired Data keys and the valid Units key. Press the other Function key, the desired Data keys and the valid Units key. Press and release the other Source key, the appropriate Function key, the desired Data keys and the valid Units key.

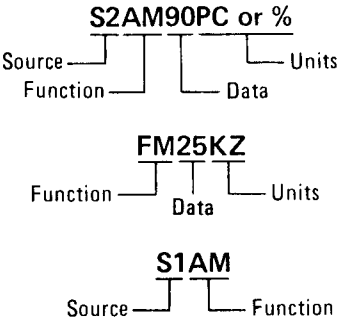
Example 3

Simultaneously select AM with a depth of 90% and FM with a peak deviation frequency of 25 kHz using the internal 400 Hz source, and AM with a depth of 90% using an external 6 kHz modulation source.

LOCAL (keystrokes)



(program codes)



ManualsPlus.com

Modulation, Mixed (Cont'd)

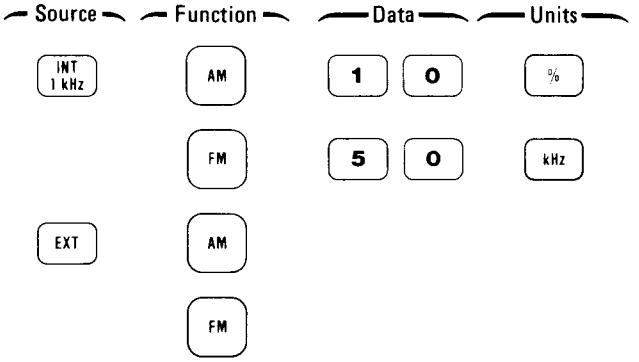
Keystroke Sequence 4

To select four simultaneous modulation signals, press and release the appropriate Source key, a Function key, the desired Data keys and the valid Units key. Press and release the other Function key, the desired Data keys and valid Units key. Press and release the other Source key, and then both Function keys.

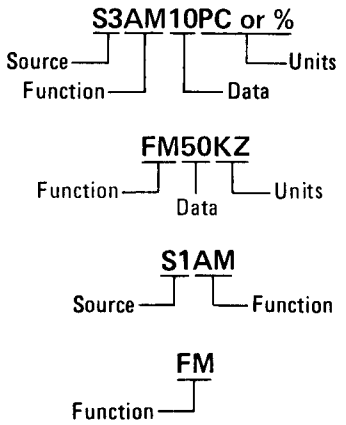
Example 4

Simultaneously select AM with a depth of 10% and FM with a peak deviation of 50 kHz using the internal 1 kHz modulation source. AM and FM with the same depth and deviation as selected previously are also selected using an external 5 kHz source.

LOCAL (keystrokes)



(program codes)



ManualsPlus.com

Modulation, Mixed (Cont'd)

Keys and Program Codes

Keys	Program Codes
AM	AM
FM	FM
EXT	S1
INT 400 Hz	S2
INT 1 kHz	S3

Indications

The last selected AM depth or FM peak deviation frequency will be displayed in the MODULATION Display and the source annunciators will light. In the case where an external modulation source is used, the HI EXT and LO EXT annunciators will also light until the signal level of the external source has been adjusted to 1 Vpk (0.707 Vrms) ±5%.

Comments

Digits selected beyond the specified resolution for AM depth or FM peak deviation will be truncated.

Leading zeros will be blanked.

AM depth Data entries that would cause the peak envelope power of the instrument to exceed +17 dBm are rejected.

FM peak deviation Data entries that would be out of range for the selected carrier frequency are rejected.

The MODULATION Display will flash if a change in carrier frequency would cause the FM peak deviation frequency allowed for that frequency band to be exceeded. Entering a carrier frequency that would set the instrument in the correct band for the selected deviation frequency will clear the error condition, or pressing one of the following keys will automatically adjust the FM peak deviation frequency to the maximum frequency possible for that frequency band.

Band	Carrier Frequency MHz
1	0.1 — 123.5
2	123.5 — 247
3	247 — 494
4	494 — 990



AM or FM function will remain selected until:

a. One of the three remaining functions is selected.

b. One of the STORE-RECALL-DISPLAY keys is pressed.

c. The instrument is reset or unplugged.

Setting the level of the external modulation source is described under Modulation, External Source.

Related Instructions

Modulation, AM
Modulation, AM Up/Down
Modulation, External Source
Modulation, FM
Modulation, FM Up/Down
Modulation, OFF

ManualsPlus.com

Modulation, OFF

Description

This instruction details how to selectively turn off the AM or FM function. In addition, it details how to selectively turn off a modulation source.

Keystroke Sequences

To turn off a modulation function (AM or FM), press and release the associated Function key, then the OFF key.

To turn off a modulation source, press and release the associated Function key, Source key, then the OFF key.

Examples

Selectively turn off AM modulation function with only one modulation source in use.	
LOCAL (keystrokes)	Function: AM; Source: OFF
(program codes)	AMS4 (Function, Source)

Selectively turn off internal 400 Hz source.	
LOCAL (keystrokes)	Function: AM; Source: INT 400 Hz, OFF
(program codes)	AMS2S4 (Function, Source)

Keys and Program Codes

Keys	Program Codes
AM	AM
FM	FM
EXT	S1
INT 400 Hz	S2
INT 1 kHz	S3
OFF	S4

Indications

The current MODULATION Display will be blanked or the modulation source (including its annunciator) will be turned off when the OFF key is pressed.

ManualsPlus.com

Modulation, OFF (Cont'd)

Comments

Currently selected modulation function (AM or FM) will be turned off when the OFF key is pressed provided only one source (internal 400 Hz or 1 kHz or external) has been selected for use.

If more than one source has been selected, then a Source key (INT 400 Hz, INT 1 kHz, or EXT) has to be pressed before the OFF key is pressed. In this case, the currently selected modulation function will remain selected and only the chosen source (including its annunciator) will be turned off.

If both modulation functions are simultaneously selected and share the same source, then only the currently selected modulation function will be turned off when the OFF key is pressed and the MODULATION Display will be restored to show the modulation parameters of the remaining function.

Related Instructions

Modulation, AM Up/Down
Modulation, FM Up/Down
Modulation, External Source
Modulation, Mixed

ManualsPlus.com

Recall

Description

This instruction details how to selectively recall the stored contents from an internal storage register.

Keystroke Sequence

Press and release the RECALL key, then a Data key (a single digit register number 0—9).

Example

Recall the stored contents from register 2.

LOCAL (keystrokes)	Recall Contents from Register 2 RECALL 2
(program codes)	RC2 Recall Contents from Register 2

Keys and Program Codes

Keys	Program Codes
RECALL	RC

Indications

The stored contents from the selected register will be recalled and the output of the Signal Generator will be changed so that it agrees with the recalled parameter values.

Comments

Ten internal registers are available (0—9). Each is capable of storing complete front panel setups (exclusive of increment settings).

Clears any previously selected function.

Updates the contents of the internal sequence counter so that it agrees with the numerical location of the recalled register.

Does not affect the current increment settings.

Related Instructions

Display
Store
Sequence

ManualsPlus.com

Sequence

Description

This instruction details how to sequentially recall the stored contents from each of the internal storage registers.

Keystroke Sequence

Press and release the SEQ key.

Example

Sequentially recall the stored contents from each of the internal storage registers.	
LOCAL (keystrokes)	Recall Contents from Next Sequential Storage Register SEQ
HP-IB (program codes)	SQ Recall Contents from Next Sequential Storage Register

Keys and Program Codes

HP-IB

Keys	Program Codes HP-IB
SEQ	SQ

Indications

The stored contents from each internal storage register will be recalled and the output of the Signal Generator will be changed so that it agrees with the recalled parameter values.

Comments

Ten internal registers are available (0—9). Each is capable of storing complete front panel setups (exclusive of increment settings).

Does not clear any previously selected function.

Updates the contents of the internal sequence counter so that it agrees with the numerical location of the recalled register.

Does not affect the current increment settings.

Remote sequence operation is permitted through an external switch closure connected at the rear panel SEQ connector J5.

Related Instructions

Display
Display Sequence
Recall
Store

ManualsPlus.com

Store

Description

This instruction details how to store complete front panel setups (exclusive of increment settings) for either selectable or sequential recall or display at a later time.

Keystroke Sequence

Press and release the STORE key, then a Data key (a single digit register number 0—9).

Example

Store the current front panel settings in register 2.

LOCAL (keystrokes)	Store Settings in Register 2: STORE, 2
HP-IB (program codes)	ST2 (Store Settings in Register 2)

Keys and Program Codes HP-IB

Keys	Program Codes HP-IB
STORE	ST

Indications

No visible front panel change.

Comments

Ten internal registers are available (0—9). Each is capable of storing complete front panel setups (exclusive of increment settings).

Clears any previously selected function.

Initialized conditions of the Signal Generator are stored in each of the ten internal storage registers when the instrument is powered up or reset.

Related Instructions

Display
Recall
Sequence

ManualsPlus.com

SECTION IV
PERFORMANCE TESTS

4-1. INTRODUCTION

The procedures in this section test the instrument's electrical performance using the specifications of Table 1-1 as the performance standards. All tests can be performed without access to the interior of the instrument. A simpler operational test is included in Section III under Operator's Checks.

NOTES

If the performance tests are to be considered valid, the following conditions must be met:

a. *The Signal Generator must have a 30-minute warmup.*

b. *The line voltage must be within 90—125 Vac or 198—252 Vac; 48—66 Hz. The voltage selector card must be in the proper position. Refer to Figure 2-1.*

c. *The ambient temperature must be 0 to 55°C for the Level Accuracy and Flatness Test.*

4-2. EQUIPMENT REQUIRED

Equipment required for the performance tests is listed in Table 1-3, Recommended Test Equipment. Any equipment that satisfies the critical specifications given in the table may be substituted for the recommended model(s).

4-3. PERFORMANCE TEST RECORD

Results of the performance tests may be tabulated on Table 4-2 which is the Performance Test Record. The Performance Test Record located at the end of this section lists all of the tested specifications and their acceptable limits. The results recorded at incoming inspection can be used for comparison in periodic maintenance and troubleshooting and after repairs or adjustments.

4-4. CALIBRATION CYCLE

This instrument requires periodic verification of performance. Depending on the use and environmental conditions, the instrument should be checked using the following performance tests at least once each year.

4-5. ABBREVIATED PERFORMANCE TESTING

In most cases, it is not necessary to perform all of the tests in this section. Table 4-1 shows which tests are recommended for various situations. The Operator's Checks in Section III should be the first step in all testing situations.

4-6. TEST PROCEDURES

It is assumed that the person performing the following tests understands how to operate the specified test equipment. Equipment settings, other than those for the Signal Generator, are stated in general terms. For example, a test might require that a spectrum analyzer's resolution bandwidth be set to 100 Hz; however, the time per division setting would not be specified and the operator would set that control so that the analyzer operates correctly.

It is also assumed that the person performing the tests will supply whatever cables, connectors, and adapters are necessary.

ManualsPlus.com

Table 4-1. Abbreviated Performance Tests

Testing Situations		Basic Functional Checks Section III	HP-IB Functional Checks Section III	Spectral Purity Para. 4-7	High Level Accuracy & Flatness Para. 4-8	Low Level Accuracy Para. 4-9	Modulation Para. 4-10	Output Leakage Para. 4-11
Incoming Inspection or Overall Performance Verification		x	x	x	x	x	x	x
After Complete Adjustment		x		x	x	x	x	x
After Repairs to an Individual Assembly								
Assembly	Reference Service Sheet No.							
A1	18	x						
A2	18 thru 21	x						
A3	8	x		x				
A3	9	x		x				
A3	10	x		x			FM	
A3	11	x		x			FM	
A3	12	x		x			FM	
A3	13	x		x				
A4	1	x		x				
A4	2	x		x				
A5	1	x						
A6	4	x		x	x		AM	
A6	5	x		x	x			
A6	7	x						
A7	4, 5, and 14	x						
A8	3	x		x				
A9	7	x		x	x	x		x
A10	6	x			x	x	x	
A10	7	x						
A10	12	x					FM	
A10	22	x					x	
A11	14 thru 17	x	x		x		x	
A13	17		x					
A14	14 and 22	x						
A15	22	x						
A16	22	x						
FL1	3	x		x				

ManualsPlus.com

PERFORMANCE TESTS

4-7. SPECTRAL PURITY TESTS

SPECIFICATION:

Electrical Characteristics	Performance Limit	Conditions
SPURIOUS SIGNALS:		
Harmonics	<–30 dBc	≤+7 dBm output levels
Non-harmonics	<–60 dBc	>5 kHz from carrier in CW mode
Sub-harmonics	None	
RESIDUAL MODULATION CW MODE:		
AM (0.05 to 15 kHz Post Detection Noise Bandwidth	<–70 dBc	0.1 to 990 MHz
FM (0.3 to 3 kHz Post Detection Noise Bandwidth)	<15 Hz rms <3 Hz rms <6 Hz rms <15 Hz rms	0.1 to 123.5 MHz 123.5 to 247 MHz 247 to 494 MHz 494 to 990 MHz
FM (0.05 to 15 kHz Post Detection Noise Bandwidth	<30 Hz rms <8 Hz rms <16 Hz rms <30 Hz rms	0.1 to 123.5 MHz 123.5 to 247 MHz 247 to 494 MHz 494 to 990 MHz

DESCRIPTION: Spurious signals are checked using a spectrum analyzer. Residual AM and FM Modulation are checked using a modulation analyzer.

EQUIPMENT:

Spectrum Analyzer ..... HP 8558B
Modulation Analyzer ..... HP 8901A
Digital Multimeter ..... HP 3465A
AM/FM Test Source (required for modulation analyzer verification of residual AM) ..... HP 11715A
Cable (UG-210/U type N connectors) ..... HP 11500B
Cable (UG-88C/U BNC and dual banana plug connectors) ..... HP 11001A

PROCEDURE: *Spurious Signals*

1. Set the spectrum analyzer as follows:

   Frequency Span/Div ..... 200 kHz
   Resolution Bandwidth ..... 3 kHz
   Optimum Input ..... +10 dBm
   Reference Level ..... +10 dBm

ManualsPlus.com

PERFORMANCE TESTS

4-7. SPECTRAL PURITY TESTS (Cont'd)

2. Set the Signal Generator as follows:

   Frequency ..... 100 kHz
   Frequency Increment ..... 100 kHz
   Amplitude ..... +10 dBm
   Modulation ..... Off

3. Connect the RF OUTPUT of the Signal Generator to the input of the spectrum analyzer as shown in Figure 4-1. Verify that all harmonics are <–30 dBc, all non-harmonics 5 kHz from the carrier are <–60 dBc, and that there are no sub-harmonics as the frequency is incremented from 100 kHz to 990 MHz.

NOTES

Adjust the Frequency Span/Div and Resolution Bandwidth controls as required.

Change the frequency increment from 100 kHz to 10 MHz at 10 MHz, if desired.

Spurious Signals	Results	
	Actual	Max.
Harmonics	_____	<–30 dBc
Non-Harmonics (5 kHz from carrier)	_____	<–60 dBc
Sub-Harmonics	_____	None

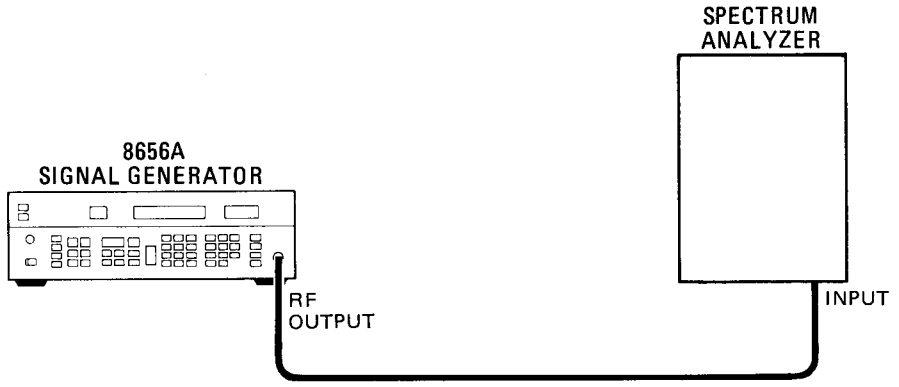


Figure 4-1. Spurious Signals Test Setup

Residual AM

NOTE

The residual AM specification of the Signal Generator is not equivalent to the published specification of the HP 8901A Modulation Analyzer. To make a valid residual AM measurement, the residual AM of the modulation analyzer should be at least 3 dB better than the specification being tested. In order to verify that the residual AM of the modulation analyzer is adequate to measure the Signal Generator's

ManualsPlus.com

4-7. SPECTRAL PURITY TESTS (Cont'd)

NOTE (cont'd)

residual AM specification, the residual AM of the modulation analyzer must be verified to ensure the validity of the measurement. If the Signal Generator's residual AM is measured frequently, it is not necessary to verify the residual AM of the modulation analyzer each time; however, it is recommended that it be verified monthly to ensure an accurate measurement.

4. Verify the residual AM of the modulation analyzer as follows:

a. Connect the modulation output of the modulation analyzer to the input of the digital multimeter and the AM output of the AM/FM test source to the input of the modulation analyzer as shown in Figure 4-2. Nothing should be connected to the audio input of the AM/FM test source.

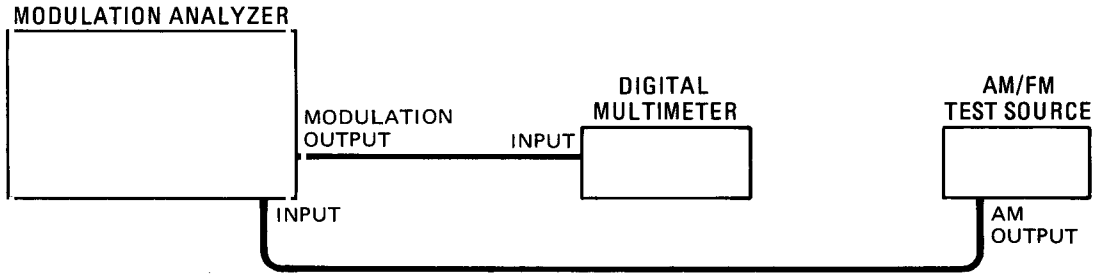


Figure 4-2. Modulation Analyzer Residual AM Verification Test Setup

b. Set the modulation analyzer as follows:

Measurement ..... Frequency

c. Set the AM/FM test source as follows:

Test Mode ..... FM

d. Tune the carrier frequency on the AM/FM test source for a modulation analyzer reading of 12.5 ±0.1 MHz.

e. Set the digital multimeter as follows:

Function ..... Vac
Range ..... 200 mV

f. Set the modulation analyzer as follows:

Measurement ..... AM
HP Filter ..... 50 Hz
LP Filter ..... 15 kHz

g. The digital multimeter should indicate 2.2 mV or less.

ManualsPlus.com

4-7. SPECTRAL PURITY TESTS (Cont'd)

NOTE

To make a valid residual AM measurement, the residual AM of the modulation analyzer should be at least 3 dB better than the specification being tested or <–73 dBc (0.022%). With an output sensitivity of 10%/V, the corresponding output level is 2.2 mV.

5. Set the modulation analyzer as follows:

   Measurement ..... AM
   Detector ..... Peak+
   HP Filter ..... 50 Hz
   LP Filter ..... 15 kHz
   FM De-Emphasis ..... Off

6. Set the Signal Generator as follows:

   Frequency ..... Any
   Amplitude .....0.0 dBm
   Modulation ..... Off

7. Set the digital multimeter as follows:

   Function ..... Vac
   Range ..... 200 mV

8. Connect the RF OUTPUT of the Signal Generator to the input of the modulation analyzer and the output of the modulation analyzer to the input of the digital multimeter as shown in Figure 4-3.

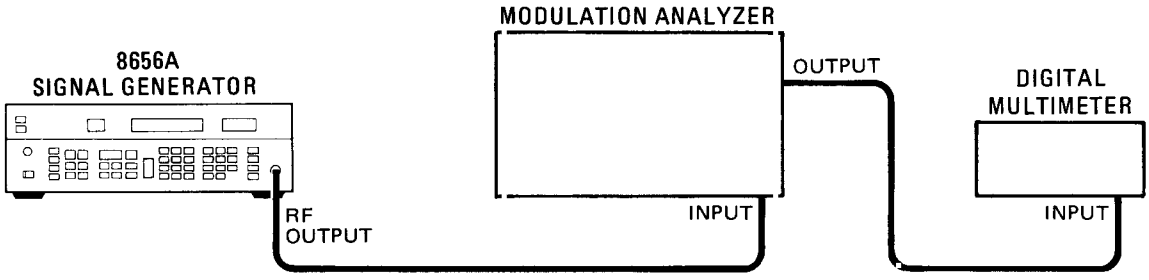


Figure 4-3. Residual AM Test Setup

9. The digital multimeter should indicate <3.16 mVrms.

Actual	Max.
_____	<3.16 mVrms

ManualsPlus.com

PERFORMANCE TESTS

4-7. SPECTRAL PURITY TESTS (Cont'd)

Residual FM

10. Set the modulation analyzer as follows:

    Measurement ..... FM
    Detector .....AVG
    FM De-Emphasis ..... Off
    Automatic Operation .....Selected

11. Set the Signal Generator as follows:

    Frequency ..... Any
    Amplitude .....0.0 dBm
    Modulation ..... Off

12. Connect the RF OUTPUT of the Signal Generator to the input of the modulation analyzer as shown in Figure 4-4.

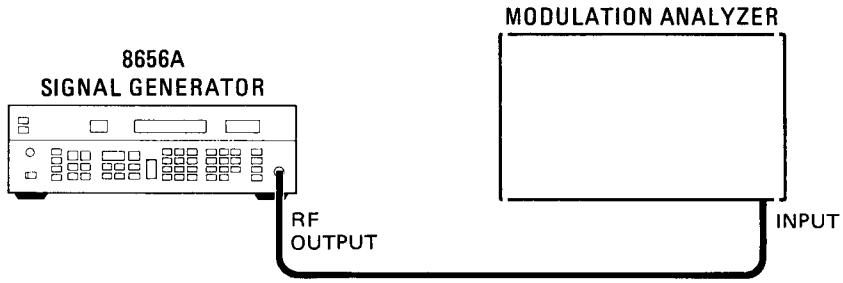


Figure 4-4. Residual FM Test Setup

13. Set the Signal Generator frequency and select the modulation analyzer high-pass and low-pass filters as indicated in the following table. Verify that the measured results do not exceed the limits specified.

Signal Generator Frequency	Modulation Analyzer Filter		Results (Hz rms)	
	High-Pass (Hz)	Low-Pass (kHz)	Actual	Max.
0.1 to 123.5 MHz	300	3	_____	<15
123.5 to 247 MHz	300	3	_____	<3
247 to 494 MHz	300	3	_____	<6
494 to 990 MHz	300	3	_____	<15
0.1 to 123.5 MHz	50	15	_____	<30
123.5 to 247 MHz	50	15	_____	<8
247 to 494 MHz	50	15	_____	<16
494 to 990 MHz	50	15	_____	<30

ManualsPlus.com

PERFORMANCE TESTS

4-8. HIGH LEVEL ACCURACY AND FLATNESS TESTS

SPECIFICATION:

Electrical Characteristics	Performance Limit	Conditions
OUTPUT:		
Level Range	+13 dBm to −127 dBm	Into 50 ohms
Resolution	0.1 dB	
Absolute Level Accuracy[1]	≤±1.5 dB	Output levels of +13 dBm to −127 dBm; frequencies from 100 kHz to 990 MHz
Level Flatness	≤±1.0 dB	Output level setting of 0.0 dBm; frequencies from 100 kHz to 990 MHz

[1]Absolute level accuracy includes allowances for detector linearity, temperature, flatness, attenuator accuracy, and measurement error.

DESCRIPTION: High level accuracy (+13 dBm to −67 dBm) and flatness are verified using a power meter and sensors.

EQUIPMENT:

Power Meter ..... HP 436A
Power Sensor (−25 dBm) ..... HP 8482A
Power Sensor (−60 dBm) ..... HP 8484A

PROCEDURE: *Level Flatness*

1. Connect the −25 dBm power sensor to the power meter. Zero and adjust the power sensor to the power meter.
2. Connect the power sensor to the Signal Generator as shown in Figure 4-5.

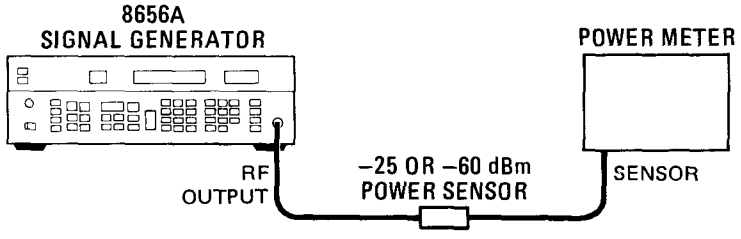


Figure 4-5. High Level Accuracy and Flatness Test Setup

3. Set the Signal Generator as follows:

Frequency ..... 100 kHz
Frequency Increment ..... 100 kHz
Amplitude ..... 0.0 dBm
Modulation ..... Off

ManualsPlus.com

PERFORMANCE TESTS

4-8. HIGH LEVEL ACCURACY AND FLATNESS TESTS (Cont'd)

4. Set power meter mode to dB (Ref).

5. Step the Signal Generator through the frequency range of 100 kHz to 990 MHz (use 10 MHz steps above 10 MHz) and record the highest and lowest readings.

_____ Highest reading _____ Frequency
_____ Lowest reading _____ Frequency

The amplitude variation should not exceed 2.0 dB. Record the maximum variation (highest reading — lowest reading).

_____ ≤±1.0 dB

Absolute Level Accuracy

6. Set the Signal Generator as follows:

Frequency ..... 10 MHz
Amplitude ..... +13 dBm
Amplitude Increment..... 5 dBm
Modulation ..... Off

7. Power meter reading must be +13 ±1.5 dBm. Step the amplitude down to −22 dBm. At each step, the power meter reading must be within ±1.5 dBm of the selected amplitude.

_____ +13 ±1.5 dBm
_____ +8 ±1.5 dBm
_____ +3 ±1.5 dBm
_____ −2 ±1.5 dBm
_____ −7 ±1.5 dBm
_____ −12 ±1.5 dBm
_____ −17 ±1.5 dBm
_____ −22 ±1.5 dBm

8. Replace the −25 dBm power sensor with the −60 dBm power sensor.

NOTE

Let the system warm up, then zero the power meter and adjust the power meter to the power sensor.

9. Connect the −60 dBm power sensor to the RF OUTPUT of the Signal Generator as shown in Figure 4-5.

ManualsPlus.com

PERFORMANCE TESTS

4-8. HIGH LEVEL ACCURACY AND FLATNESS TESTS (Cont'd)

10. Step the amplitude down to –67 dBm. At each step, the power meter reading must be within ±1.5 dB of the selected amplitude.

_____ –27 ±1.5 dBm
_____ –32 ±1.5 dBm
_____ –37 ±1.5 dBm
_____ –42 ±1.5 dBm
_____ –47 ±1.5 dBm
_____ –52 ±1.5 dBm
_____ –57 ±1.5 dBm
_____ –62 ±1.5 dBm
_____ –67 ±1.5 dBm

11. Repeat steps 7 through 10 for frequencies greater than 10 MHz.

ManualsPlus.com

PERFORMANCE TESTS

4-9. LOW LEVEL ACCURACY TESTS

SPECIFICATION:

Electrical Characteristics	Performance Limit	Conditions
OUTPUT:		
Level Range	+13 dBm to −127 dBm	Into 50 ohms
Resolution	0.1 dB	
Absolute Level Accuracy[1]	≤±1.5 dB	Output levels of +13 dBm to −127 dBm; frequencies from 100 kHz to 990 MHz

[1]Absolute level accuracy includes allowances for detector linearity, temperature, flatness, attenuator accuracy, and measurement error.

DESCRIPTION: Low level accuracy (below −67 dBm) is verified by inserting a calibrated attenuator (pad) in series with the Signal Generator output to establish a reference on a spectrum analyzer. The attenuator is then removed and the Signal Generator level is set 60 dBm lower. The Signal Generator output is then compared to the reference level on the spectrum analyzer and the actual level is calculated.

EQUIPMENT:

Power Meter ..... HP 436A
Power Sensor (−25 dBm) ..... HP 8482A
Power Sensor (−60 dBm) ..... HP 8484A
Spectrum Analyzer ..... HP 8568A
Wideband Amplifier (26 dB) ..... HP 8477D Option 010
Fixed 60 dB Attenuator ..... HP 8491A Option H56
Cables (UG-210/U type N connectors) ..... HP 11500B

PROCEDURE:

1. Set the Signal Generator RESET/STBY/ON switch to STBY to zero the power meter.

2. Connect the power sensor to the power meter and to the RF OUTPUT of the Signal Generator as shown in Figure 4-6. Zero the power meter and adjust the power sensor to the power meter.

NOTE

Use the −25 dBm sensor if the level being measured is greater than −20 dBm. For lower levels, use the −60 dBm sensor.

3. Set the Signal Generator as follows:

Frequency ..... 10 MHz
Amplitude ..... 0.0 dBm
Modulation ..... Off
RESET/STBY/ON ..... ON

ManualsPlus.com

PERFORMANCE TESTS

4-9. LOW LEVEL ACCURACY TESTS (Cont'd)

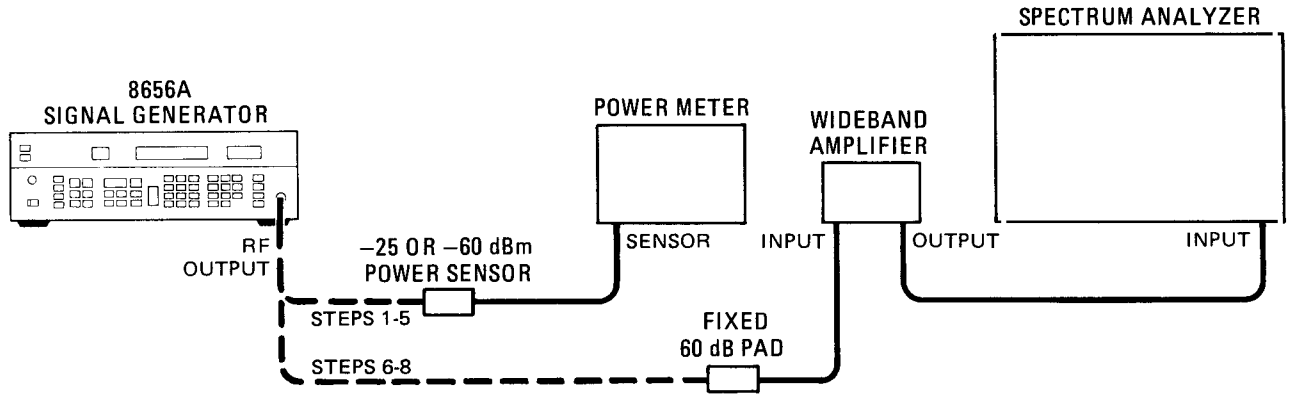


Figure 4-6. Low Level Accuracy Test Setup

4. Set the spectrum analyzer as follows:

   Center Frequency ..... 10 MHz
   Reference Level ..... –60 dBm
   Frequency Span/Div ..... 1 MHz
   Resolution Bandwidth..... 100 kHz
   Video Average ..... 25 times

5. Set the Signal Generator amplitude to 60 dBm above the power level being verified. For example, if it is desired to verify a power level of –80 dBm, set the amplitude to –20 dBm. Measure the output with the power meter and record the reading.

   _____ dBm

6. Connect the 60 dB pad to the RF OUTPUT of the Signal Generator and connect the signal through the wideband amplifier as shown in Figure 4-6. View the signal on the spectrum analyzer and set the reference level of the spectrum analyzer one division above the signal in the 2 dB log amplitude mode. Use well shielded RF cables or leakage will affect the accuracy of the results.

7. Decrease the Signal Generator amplitude by 60 dBm and remove the pad. View the signal on the spectrum analyzer and determine the difference from the signal viewed in step 5. The actual output level is calculated as follows:

   _____ power meter reading in step 5.
   – _____ exact value of pad.
   \+ _____ difference observed in step 7.
   = _____ actual output level

8. Repeat steps 5 through 7 for output amplitudes to –127 dBm.

9. Repeat steps 1 through 8 for frequencies of 100 MHz, 201 MHz, 801 MHz, 901 MHz, and 990 MHz. These are the frequencies for which the pad is calibrated.

ManualsPlus.com

PERFORMANCE TESTS

4-10. MODULATION TESTS

SPECIFICATION:

Electrical Characteristics	Performance Limit	Conditions
AMPLITUDE MODULATION:		
Depth[1]	0 to 99%	Output levels of +7 dBm and below; frequencies from 100 kHz to 990 MHz.
	0 to 30%	Output levels of +10 dBm and below; frequencies from 100 kHz to 990 MHz.
Resolution	1%	
Incidental Phase Modulation	<0.3 radian peak	30% AM depth and internal rates
Indicator Accuracy[1]	±2%, (±4% of reading)	Depths 90% and internal rates
AM Rates:		
Internal	400 and 1 kHz, ±3%	
External	25 Hz to 25 kHz	1 dB bandwidth, ac coupled
AM Distortion (internal rates)	<1.5%	0 to 30% AM
	<3%	31 to 70% AM
	<5%	71 to 90% AM
FREQUENCY MODULATION		
Maximum Peak Deviation (Δfpk)[2]:		
Rates ≥60 Hz	99 kHz	0.1 to 123.5 MHz (fc)
	25 kHz	123.5 to 247 MHz (fc)
	50 kHz	247 to 494 MHz (fc)
	99 kHz	494 to 990 MHz (fc)
Rates <60 Hz	1600 x Rate	0.1 to 123.5 MHz (fc)
	400 x Rate	123.5 to 247 MHz (fc)
	800 x Rate	247 to 494 MHz (fc)
	1600 x Rate	494 to 990 MHz (fc)
		(FM not specified for fc — Δfpk <100 kHz)
Resolution	0.1 kHz	Deviations <10 kHz
	1 kHz	Deviations ≥10 kHz

[1]AM depth is further limited by the Indicator Accuracy specification.

[2]FM deviation is further limited by the Indicator Accuracy specification.

ManualsPlus.com

PERFORMANCE TESTS

4-10. MODULATION TESTS (Cont'd)

SPECIFICATION: (Cont'd)

Electrical Characteristics	Performance Limit	Conditions
FREQUENCY MODULATION (Cont'd):		
Incidental AM	<0.1%	<20 kHz peak deviation, internal rates and carrier frequency ≥500 kHz.
Indicator Accuracy[2]	±5% of reading	At internal rates. Add ±5% if 250 Hz frequency increments are used.
FM Distortion (Total Harmonic Distortion)	<0.5%	100 Hz to 99 kHz peak deviations and internal rates.
FM Rates:		
Internal	400 Hz and 1 kHz, ±3%	
External	25 Hz to 25 kHz	1 dB bandwidth, ac coupled

[2]FM deviation is further limited by the Indicator Accuracy specification.

DESCRIPTION: All modulation specifications are verified by measuring the specified parameters on a modulation analyzer. Distortion is verified by measuring the demodulated output from the modulation analyzer on a distortion analyzer.

EQUIPMENT:

Modulation Analyzer ..... HP 8901A
Distortion Analyzer ..... HP 339A
AM/FM Test Source (required for modulation analyzer verification of incidental AM) ..... HP 11715A
Test Oscillator ..... HP 651B
Cable (UG-210/U type N connectors) ..... HP 11500B
Cable (UG-88C/U BNC and dual banana plug connectors) ..... HP 11001A

PROCEDURE: *AM Indicator Accuracy*

1. Connect the RF OUTPUT of the Signal Generator to the input of the modulation analyzer as shown in Figure 4-7.
2. Connect the modulation output of the modulation analyzer to the input of the distortion analyzer as shown in Figure 4-7.

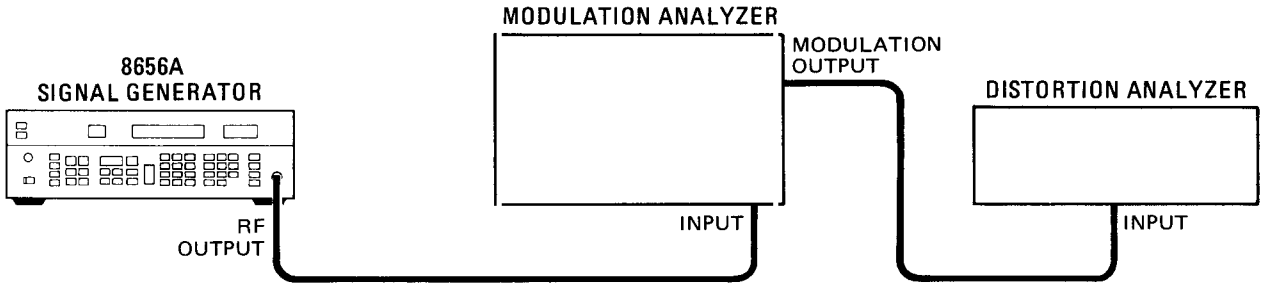


Figure 4-7. Modulation Test Setup

ManualsPlus.com

PERFORMANCE TESTS

4-10. MODULATION TESTS (Cont'd)

3. Set the modulation analyzer as follows:

   Measurement ..... AM
   Detector ..... Peak+
   HP Filter ..... 300 Hz
   LP Filter ..... 15 kHz
   FM De-Emphasis ..... Off
   Automatic Operation ..... Selected

4. Set the Signal Generator as follows:

   Frequency ..... 100 MHz
   Amplitude ..... +7 dBm
   Modulation ..... 1 kHz (Int.) AM 50%

5. Set the AM depth to the values listed in the following table and verify that the measured results are within the limits specified.

AM Depth for 100 MHz	Results		
	Min.	Actual	Max.
10%	7.6%	_____	12.4%
30%	26.8%	_____	33.2%
70%	65.2%	_____	74.8%
90%	84.4%	_____	95.6%

6. Repeat step 5 with the Signal Generator set to frequencies of 240 MHz, 400 MHz, and 990 MHz.

AM Depth for 240 MHz	Results		
	Min.	Actual	Max.
10%	7.6%	_____	12.4%
30%	26.8%	_____	33.2%
70%	65.2%	_____	74.8%
90%	84.4%	_____	95.6%

AM Depth for 400 MHz	Results		
	Min.	Actual	Max.
10%	7.6%	_____	12.4%
30%	26.8%	_____	33.2%
70%	65.2%	_____	74.8%
90%	84.4%	_____	95.6%

ManualsPlus.com

PERFORMANCE TESTS

4-10. MODULATION TESTS (Cont'd)

AM Depth for 990 MHz	Results		
	Min.	Actual	Max.
10%	7.6%	_____	12.4%
30%	26.8%	_____	33.2%
70%	65.2%	_____	74.8%
90%	84.4%	_____	95.6%

7. Select the modulation analyzer's 50 Hz HP filter. Verify the AM accuracy with the Signal Generator frequency at 100 MHz and internal 400 Hz AM modulation.

AM Depth for 100 MHz	Results		
	Min.	Actual	Max.
10%	7.6%	_____	12.4%
30%	26.8%	_____	33.2%
70%	65.2%	_____	74.8%
90%	84.4%	_____	95.6%

Incidental Phase Modulation

8. Set the modulation analyzer as follows:

   Measurement ..... Phase Modulation
   HP Filter ..... 300 Hz
   LP Filter ..... 15 kHz
   Detector ..... Peak+

9. Set the Signal Generator as follows:

   Frequency ..... 100 kHz
   Frequency Increment ..... 100 kHz
   Amplitude ..... +7 dBm
   Modulation ..... 1 kHz (Int.) AM 30%

10. Step the Signal Generator through the frequency range of 100 kHz to 990 MHz (use 10 MHz steps above 10 MHz) and record the highest reading. The highest reading should not exceed the limit specified.

Signal Generator Frequency		Result	
Min.	Max.	Actual	Max.
100 kHz	990 MHz	_____	<0.3 radian peak

ManualsPlus.com

PERFORMANCE TESTS

4-10. MODULATION TESTS (Cont'd)

AM Distortion

11. Set the modulation analyzer as follows:

    Measurement ..... AM
    HP Filter ..... 300 Hz
    LP Filter ..... 15 kHz
    Detector ..... Peak+

12. Set the distortion analzyer as follows:

    Function .....Distortion
    Analyzer Input Select .....Distortion
    Frequency ..... 1 kHz

13. Set the Signal Generator as follows:

    Frequency ..... 10 MHz
    Amplitude ..... +7 dBm
    Modulation ..... 1 kHz (Int.) AM 50%

14. Set the AM depth to the values listed in the following table and verify that the measured results do not exceed the limits specified.

AM Depth for 100 MHz	Results	
	Actual	Max.
30%	_____	<1.5%
70%	_____	<3.0%
90%	_____	<5.0%

15. Repeat step 13 with the Signal Generator set to frequencies of 240 MHz, 400 MHz, and 990 MHz.

AM Depth for 240 MHz	Results	
	Actual	Max.
30%	_____	<1.5%
70%	_____	<3.0%
90%	_____	<5.0%

AM Depth for 400 MHz	Results	
	Actual	Max.
30%	_____	<1.5%
70%	_____	<3.0%
90%	_____	<5.0%

AM Depth for 990 MHz	Results	
	Actual	Max.
30%	_____	<1.5%
70%	_____	<3.0%
90%	_____	<5.0%

ManualsPlus.com

4-10. MODULATION TESTS (Cont'd)

FM Indicator Accuracy

16. Set the modulation analyzer as follows:

    Measurement ..... FM
    Detector ..... Peak+
    HP Filter ..... 300 Hz
    LP Filter ..... 3 kHz

17. Set the Signal Generator as follows:

    Frequency ..... 100 MHz
    Amplitude ..... +7 dBm
    Modulation ..... 1 kHz (Int.) FM 5 kHz

18. Set the FM deviation to the values listed in the following table and verify that the measured results are within the limits specified.

FM Deviation for 100 MHz	Results		
	Min.	Actual	Max.
5.0 kHz	4.75 kHz	_____	5.25 kHz
30.0 kHz	28.50 kHz	_____	31.50 kHz
70.0 kHz	66.50 kHz	_____	73.50 kHz
99.0 kHz	94.05 kHz	_____	103.95 kHz

Incidental AM

NOTE

The incidental AM specification of the Signal Generator is not equivalent to the published specification of the HP 8901A Modulation Analyzer. To make a valid incidental AM measurement, the incidental AM of the modulation analyzer must be four times better than the specification being tested. In order to verify that the incidental AM of the modulation analyzer is adequate to measure the Signal Generator's incidental AM specification, the incidental AM of the modulation analyzer must be verified to ensure the validity of the measurement. If the Signal Generator's incidental AM is measured frequently, it is not necessary to verify the incidental AM of the modulation analyzer each time; however, it is recommended that it be verified monthly to ensure an accurate measurement.

19. Verify the incidental AM of the modulation analyzer as follows:

    a. Connect the FM ÷4 output of the AM/FM test source to the input of the modulation analyzer and the 50Ω output of the test oscillator to the audio input of the AM/FM test source, as shown in Figure 4-8.

    b. Set the modulation analyzer as follows:

       Measurement ..... Frequency

ManualsPlus.com

PERFORMANCE TESTS

4-10. MODULATION TESTS (Cont'd)

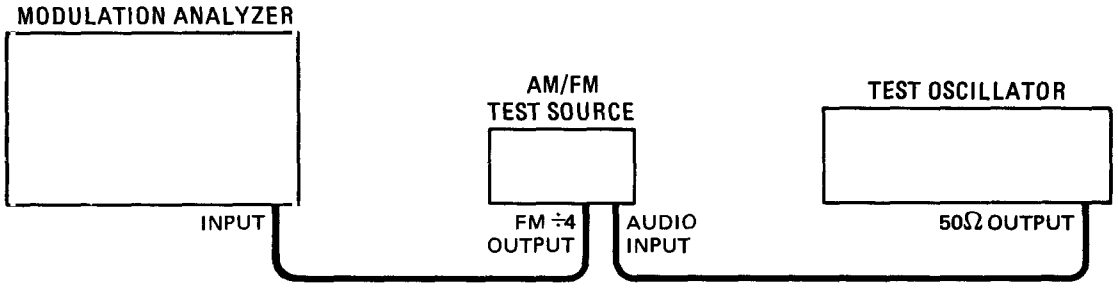


Figure 4-8. Modulation Analyzer Incidental AM Verification Test Setup

c. Set the AM/FM test source as follows:

Test Mode ..... FM

d. Tune the carrier frequency on the AM/FM test source for a modulation analyzer reading of 100 ±0.1 MHz.

e. Set the test oscillator as follows:

Frequency ..... 1 kHz
Output Attenuator ..... −10 dBm
Amplitude Course ..... Fully ccw

f. Set the modulation analyzer as follows:

Measurement ..... FM
Detector ..... Peak+
HP Filter ..... 300 Hz
LP Filter ..... 3 kHz

g. Increase the output of the test oscillator by rotating the Amplitude Coarse control clockwise until the modulation analyzer indicates 20.0 ±0.1 kHz peak deviation.

h. Set the modulation analyzer as follows:

Measurement ..... AM

i. The modulation must be <0.02% AM to test the incidental AM of the Signal Generator.

20. Set the modulation analyzer as follows:

Measurement ..... AM
Detector ..... Peak+
HP Filter ..... 300 Hz
LP Filter ..... 3 kHz

21. Set the Signal Generator as follows:

Amplitude ..... +7 dBm
Modulation ..... 1 kHz (Int.) FM 20 kHz

22. Connect the equipment as shown in Figure 4-7, Modulation Test Setup.

ManualsPlus.com

4-10. MODULATION TESTS (Cont'd)

23. Set the Signal Generator frequency to a value within the range specified in the following table and verify that the measured result does not exceed the limit specified.

Signal Generator		Result	
Min.	Max.	Actual	Max.
500 kHz	990 MHz	_____	<0.1%

FM Distortion

24. Set the modulation analyzer as follows:

Measurement ..... FM
Detector ..... Peak+
HP Filter ..... 300 Hz
LP Filter ..... 3 kHz

25. Set the distortion analyzer as follows:

Function ..... Distortion
Analyzer Input Select ..... Distortion
Frequency ..... 1 kHz

26. Set the Signal Generator as follows:

Frequency ..... 100.0 MHz
Amplitude ..... +7 dBm
Modulation ..... 1 kHz (Int.) FM

27. Connect the equipment as shown in Figure 4-7, Modulation Test Setup.

28. Verify that the measured Total Harmonic Distortion does not exceed 0.5%.

29. Set the Signal Generator FM deviation to a value within the range specified in the following table and verify that the measured result does not exceed the limit specified.

FM Deviation		Result	
Min.	Max.	Actual	Max.
100 Hz	99 kHz	_____	<0.5%

NOTE

At peak deviations less than 3 kHz, residual FM and other types of FM distortion become a greater portion of the distortion reading. If the distortion falls within tolerance at or above 3 kHz, it may be safely assumed that the Signal Generator meets the test requirements.

ManualsPlus.com

PERFORMANCE TESTS

4-11. OUTPUT LEAKAGE TESTS

SPECIFICATION: Leakage: Leakage limits are within those specified in MIL STD 461A, VDE 0871, and CISPR Publication 11. Furthermore, less than 1.0 μV is induced in a two-turn, 2.5 cm (1-inch) diameter loop held 2.5 cm (1 inch) away from the front surface and measured into a 50-ohm receiver.

DESCRIPTION Output leakage is verified by holding a loop antenna 2.5 cm (1 inch) from the front surface of the Signal Generator and measuring the resulting signal with a spectrum analyzer.

The loop antenna is suspended in a molding so that when the molding is in contact with a surface, the loop antenna is one inch from the surface.

NOTE

The use of a screen room may be necessary to reduce external radiated interference.

EQUIPMENT

One-Inch Loop Antenna	HP 08640-60501
26 dB Amplifier	HP 8447D
Spectrum Analyzer	HP 8558A
50-ohm Termination (3 required)	HP 11593A

PROCEDURE:

1. Connect equipment as shown in Figure 4-9.

NOTE

To avoid disturbing the antenna's field and causing measurement error, grasp the antenna at the end that has the BNC connector.

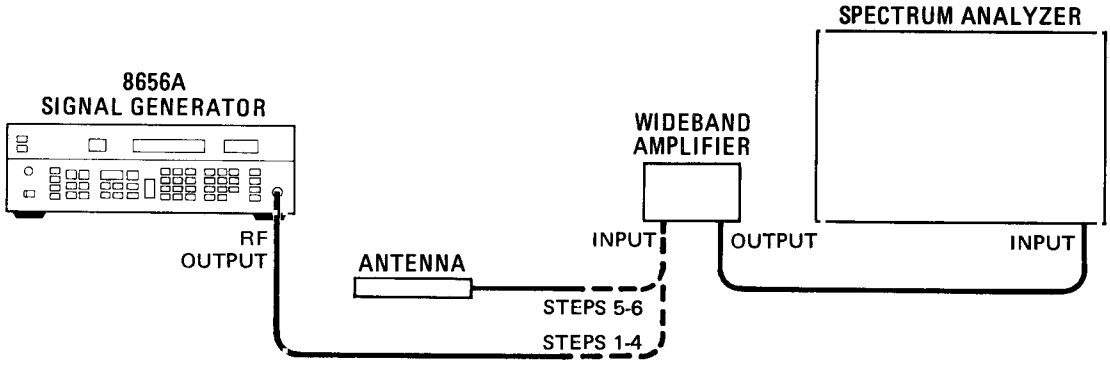


Figure 4-9. Output Leakage Test Setup

2. Set the Signal Generator as follows:

Frequency	100 MHz
Amplitude	−107 dBm
Modulation	Off
RESET/STBY/ON	ON

ManualsPlus.com

4-11. OUTPUT LEAKAGE TESTS (Cont'd)

3. Set the spectrum analyzer as follows:

   Center Frequency . . . . . 100 MHz
   Input Attenuation . . . . . -40 dB
   Reference Level . . . . . -20 dBm
   Frequency Span/Div . . . . . 20 MHz
   Resolution Bandwidth . . . . . 10 kHz

4. View the signal on the spectrum analyzer and adjust the reference level controls of the spectrum analyzer to set the -107 dBm signal from the Signal Generator to a reference graticule line on the spectrum analyzer display. Set the video filter to further separate the signal from the noise. Disconnect the Signal Generator from the spectrum analyzer and connect 50-ohm terminations to the Signal Generator RF OUTPUT connector.

5. Connect the one-inch loop antenna to the analyzer through the 26 dB amplifier as shown in Figure 4-9. Hold the end of the loop antenna cylinder in contact with the front surfaces of the Signal Generator. All signals and noise should be below the reference graticule line (i.e., below -107 dBm).

   _____ <-107 dBm (<1.0 μV) at 100 MHz

6. Repeat step 5 for frequencies of 300, 500, 700, 900, and 990 MHz.

   _____ <-107 dBm (<1.0 μV) at 300 MHz
   _____ <-107 dBm (<1.0 μV) at 500 MHz
   _____ <-107 dBm (<1.0 μV) at 700 MHz
   _____ <-107 dBm (<1.0 μV) at 900 MHz
   _____ <-107 dBm (<1.0 μV) at 990 MHz

ManualsPlus.com

Table 4-2. Performance Test Record (1 of 4)

Hewlett-Packard Company
Model 8656A
Signal Generator
Serial Number _____

Tested by _____

Date _____

Para. No.	Test	Results		
		Min.	Actual	Max.
4-7.	**SPURIOUS SIGNALS:**			
	Harmonics		_____	−30 dBc
	Non-Harmonics (>5 kHz from carrier)		_____	−60 dBc
	Sub-Harmonics		_____	None
	RESIDUAL MODULATION CW MODE:			
	AM			
	(0.05 to 15 kHz Post Detection Noise Bandwidth)			
	0.1 to 990 MHz		_____	3.16 mVrms (−70 dBc)
	FM			
	(0.3 to 3 kHz Post Detection Noise Bandwidth)			
	0.1 to 123.5 MHz		_____	15 Hz rms
	123.5 to 247 MHz		_____	3 Hz rms
	247 to 494 MHz		_____	6 Hz rms
	494 to 990 MHz		_____	15 Hz rms
	FM			
	(0.05 to 15 kHz Post Detection Noise Bandwidth)			
	0.1 to 123.5 MHz		_____	30 Hz rms
	123.5 to 247 MHz		_____	8 Hz rms
	247 to 494 MHz		_____	16 Hz rms
	494 to 990 MHz		_____	30 Hz rms
4-8.	**HIGH LEVEL ACCURACY AND FLATNESS**			
	Absolute Level Accuracy (+13 dBm to −67 dBm;			
	100 kHz to 990 MHz)	+11.5	_____	+14.5 dBm
		+6.5	_____	+9.5 dBm
		+1.5	_____	+4.5 dBm
		−3.5	_____	−0.5 dBm
		−8.5	_____	−5.5 dBm
		−13.5	_____	−10.5 dBm
		−18.5	_____	−15.5 dBm
		−23.5	_____	−20.5 dBm
		−28.5	_____	−25.5 dBm
		−33.5	_____	−30.5 dBm
		−38.5	_____	−35.5 dBm
		−43.5	_____	−40.5 dBm
		−48.5	_____	−45.5 dBm
		−53.5	_____	−50.5 dBm

ManualsPlus.com

Table 4-2. Performance Test Record (2 of 4)

Para. No.	Test	Results		
		Min.	Actual	Max.
4-8. Cont'd	**HIGH LEVEL ACCURACY AND FLATNESS:**			
	Absolute Level Accuracy (+13 to −67 dBm; 100 kHz to 990 MHz)	−58.5	_____	−55.5 dBm
		−63.5	_____	−60.5 dBm
		−68.5	_____	−65.5 dBm
	Level Flatness (0.0 dBm)	−1.0	_____	+1.0 dB
4-9.	**LOW LEVEL ACCURACY**			
	Absolute Level Accuracy (−67 dBm to −127 dBm; 100 kHz to 990 MHz)			
	−67 dBm to −127 dBm 10 MHz	−1.5	_____	+1.5 dB
	100 MHz	−1.5	_____	+1.5 dB
	201 MHz	−1.5	_____	+1.5 dB
	801 MHz	−1.5	_____	+1.5 dB
	901 MHz	−1.5	_____	+1.5 dB
4-10.	**AMPLITUDE MODULATION**			
	Indicator Accuracy (Internal 1 kHz source)			
	100 MHz 10%	7.6	_____	12.4%
	30%	26.8	_____	33.2%
	70%	65.2	_____	74.8%
	90%	84.4	_____	95.6%
	240 MHz 10%	7.6	_____	12.4%
	30%	26.8	_____	33.2%
	70%	65.2	_____	74.8%
	90%	84.4	_____	95.6%
	400 MHz 10%	7.6	_____	12.4%
	30%	26.8	_____	33.2%
	70%	65.2	_____	74.8%
	90%	84.4	_____	95.6%
	990 MHz 10%	7.6	_____	12.4%
	30%	26.8	_____	33.2%
	70%	65.2	_____	74.8%
	90%	84.4	_____	95.6%
	(Internal 400 Hz source)			
	100 MHz 10%	7.6	_____	12.4%
	30%	26.8	_____	33.2%
	70%	65.2	_____	74.8%
	90%	84.4	_____	95.6%
	Incidental Phase Modulation (30% AM Internal Rates) 100 kHz to 990 MHz		_____	0.3 radian peak

ManualsPlus.com

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

Para. No.	Test	Results		
		Min.	Actual	Max.
4-10. Cont'd)	**AMPLITUDE MODULATION:**			
	AM Distortion			
	(Internal 1 kHz Source)			
	100 MHz 30%		_____	1.5%
	70%		_____	3.0%
	90%		_____	5.0%
	240 MHz 30%		_____	1.5%
	70%		_____	3.0%
	90%		_____	5.0%
	400 MHz 30%		_____	1.5%
	70%		_____	3.0%
	90%		_____	5.0%
	990 MHz 30%		_____	1.5%
	70%		_____	3.0%
	90%		_____	5.0%
	FREQUENCY MODULATION			
	Indicator, Accuracy			
	(Internal 1 kHz Source)			
	100 MHz 5.0 kHz	4.75 kHz	_____	5.25 kHz
	30.0 kHz	28.50 kHz	_____	31.50 kHz
	70.0 kHz	66.50 kHz	_____	73.50 kHz
	99.0 kHz	94.05 kHz	_____	103.95 kHz
	Incidental AM			
	(<20 kHz Peak Deviation, Internal Rates and Carrier Frequency 500 kHz to 990 MHz).		_____	0.1%
	FM Distortion			
	(Internal 1 kHz Source)			
	100 Hz to 99 kHz Deviation		_____	0.5%

ManualsPlus.com

Table 4-2. Performance Test Record (4 of 4)

Para. No.	Test	Results		
		Min.	Actual	Max.
4-11.	**OUTPUT LEAKAGE**			
	Leakage (Two-turn 2.5 cm diameter loop held 2.5 cm away from front surface)		_____	−107 dBm (1.0 μV) at 100 mHz
			_____	−107 dBm (1.0 μV) at 300 mHz
			_____	−107 dBm (1.0 μV) at 500 mHz
			_____	−107 dBm (1.0 μV) at 700 mHz
			_____	−107 dBm (1.0 μV) at 900 mHz
			_____	−107 dBm (1.0 μV) at 990 mHz

ManualsPlus.com

SECTION V
ADJUSTMENTS

5-1. INTRODUCTION

This section contains adjustments and checks that assure peak performance of the Signal Generator. The instrument should be readjusted after repair or failure to pass a performance test. Allow a 30-minute warm-up prior to performing the adjustments. Removal of the instrument top and bottom covers is required for most adjustments. Included in this section are test setups and illustrations that show the location of each assembly. Removal and disassembly procedures are given in Section VIII. To determine which performance tests and adjustments to perform after a repair, refer to paragraph 5-5, Post-Repair Adjustments.

5-2. SAFETY CONSIDERATIONS

Refer to the Safety Considerations page found at the beginning of this manual for a summary of the safety information.

5-3. EQUIPMENT REQUIRED

Most adjustment procedures contain a list of required test equipment. The test equipment is also identified by callouts in the test setup diagrams, where included. If substitutions must be made for the specified test equipment, refer to the Recommended Test Equipment table in Section I of this manual for the minimum specifications. It is important that the test equipment meet the critical specifications listed in the table if the Signal Generator is to meet its performance requirements.

5-4. FACTORY-SELECTED COMPONENTS

Factory-selected components are identified on the schematics and parts lists by an asterisk (*) which follows the reference designator. The nominal value or range of the components is shown. Manual change sheets will provide updated information pertaining to selected components. Table 5-1 lists

Table 5-1. Factory Selected Components

Reference Designator	Service Sheet	Range of Values	Basis of Selection
A4R6,10	1	110Ω to 287Ω	Attenuator pad selected for – 8 dBm input to mixer A4U1.
A4R7	1	17.8Ω to 61.9Ω	Measure power level at RF Test Point A4TP3 with A4R6 and A4R7 disconnected. Select pad values for –8 dBm to mixer. Level must be checked whenever the A3, A4, A8, or FL1 assemblies are replaced.
A4C22	1	0 or 1 pF	Removed to eliminate spurs at 690 to 740 MHz.
A6R4	4	75Ω to 147Ω	Selected to bias U1 so noise and harmonics are as low as possible in both the divide-by-2 and divide-by-4 bands. Refer to Specifications and Supplemental Characteristics tables in Section I.

R6, 10	R7	Attenuation (db)
110	61.9	9
121	51.1	8
133	46.4	7
147	38.3	6
178	31.6	5
215	23.7	4
287	17.8	3

ManualsPlus.com

FACTORY-SELECTED COMPONENTS (Cont'd)

the reference designator, the basis used for selecting a particular value, the nominal value range, and the service sheet where the component part is shown.

5-5. POST-REPAIR ADJUSTMENTS

Table 5-2 lists the adjustments related to repairs or replacement of any of the assemblies.

5-6. RELATED ADJUSTMENTS

The procedures in this section can be done in any order; however, it is suggested that the power supply voltage, reference voltage, and audio oscillator adjustments be performed first. Changes in these adjustments can affect other adjustments, especially level and modulation accuracies.

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.

Table 5-2. Post-Repair Adjustments

Assembly Repaired or Replaced	Reference Service Sheet No.	Related Adjustments (Paragraph)
A1	18	None
A2	18 thru 21	None
A3	8	5-16
A3	9	None
A3	10	5-23
A3	11	None
A3	12	5-22
A3	13	5-14, 5-15
A4	1	5-12
A4	2	5-11, 5-13
A5	1	None
A6	4 and 6	5-19, 5-21
A6	5	5-20
A7	14 thru 17	None
A8	1 and 3	5-17, 5-18
A9	7	5-24
A10	6	5-8, 5-9, 5-10, 5-19 and 5-21
A10	12	5-12
A10	22	5-7
A11 thru A15	13 thru 17, and 22	None
A16	22	5-25

ManualsPlus.com

ADJUSTMENTS

5-7. POWER SUPPLY VOLTAGE ADJUSTMENT

REFERENCE: Service Sheets 8 and 22.

DESCRIPTION: The +5.4 Vdc power supply is adjusted for +5.25 Vdc ±0.02 Vdc at Test Point A3TP10 using a digital multimeter.

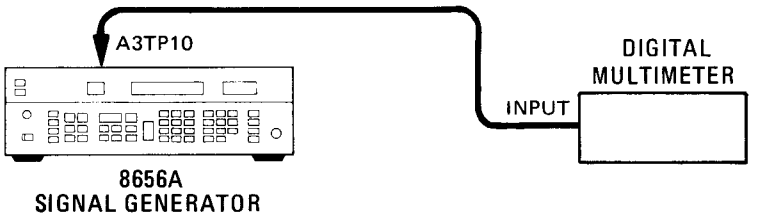


Figure 5-1. +5.4 Vdc Power Supply Adjustment Setup

EQUIPMENT: Digital Multimeter ..... HP 3465A

PROCEDURE:

1. Set the digital multimeter as follows:

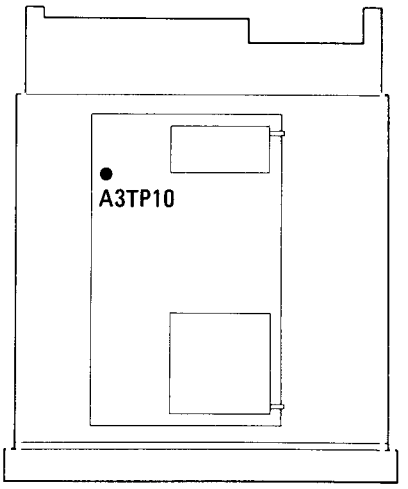
   Function ..... Vdc
   Range 20V

2. Set the Signal Generator as follows:

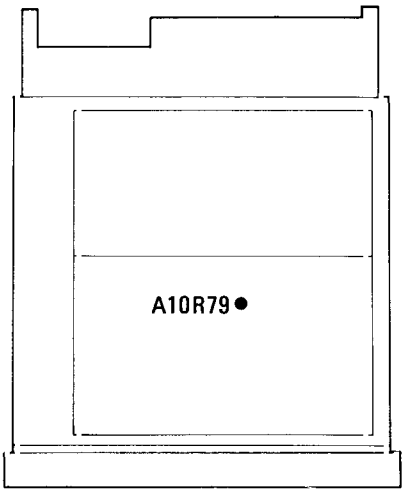
   Frequency ..... 140 MHz
   Amplitude ..... −10 dBm
   Modulation ..... AM 50%

3. Connect the digital multimeter to Test Point A3TP10 (+5V). Adjust A10R79 (+5.4V ADJ) for a reading of +5.25 Vdc ±0.02 Vdc on the digital multimeter.

Top Internal View, Level 1



Bottom Internal View, Level 4



ManualsPlus.com

ADJUSTMENTS

5-8. REFERENCE VOLTAGE ADJUSTMENT

REFERENCE: Service Sheet 6.

DESCRIPTION: The +2 Vdc reference is adjusted for +2.000 Vdc ±0.004 Vdc at Test Point A10J6 pin 4 using a digital multimeter.

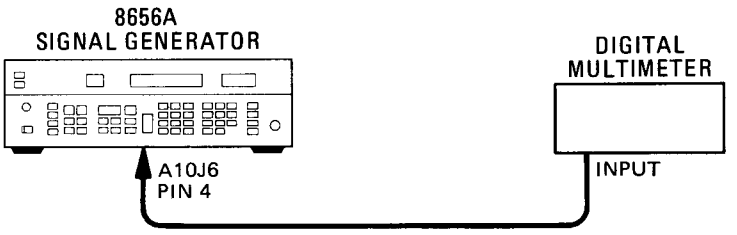


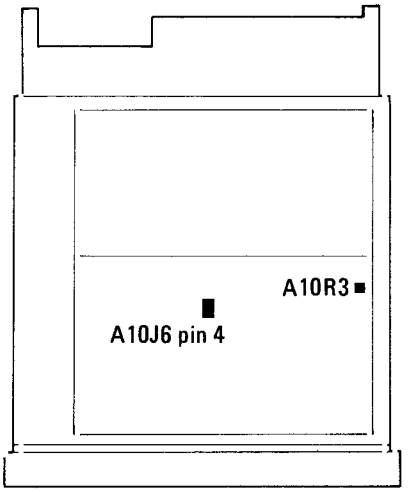
Figure 5-2. +2 Vdc Reference Adjustment Setup

EQUIPMENT: Digital Multimeter ..... HP 3465A

PROCEDURE:

1. Set the digital multimeter as follows:
   Function ..... Vdc
   Range 20V
2. Set the Signal Generator as follows:
   Frequency ..... 140 MHz
   Amplitude ..... −10 dBm
   Modulation ..... AM 50%
3. Connect the digital multimeter to Test Point A10J6 pin 4 (+2V (R)) and adjust A10R3 (+2V REF ADJ) for a reading of 2.000 Vdc ±0.004 Vdc on the digital multimeter.

Bottom Internal View, Level 4



ManualsPlus.com

ADJUSTMENTS

5-9. AUDIO OSCILLATOR LEVEL ADJUSTMENT

REFERENCE: Service Sheet 6.

DESCRIPTION: The internal 1 kHz modulation source is adjusted to 0.707 Vrms ±0.007 Vrms at Test Point A10J6 pin 6. Then, the internal 400 Hz modulation source is checked to ensure that it is within the same limits.

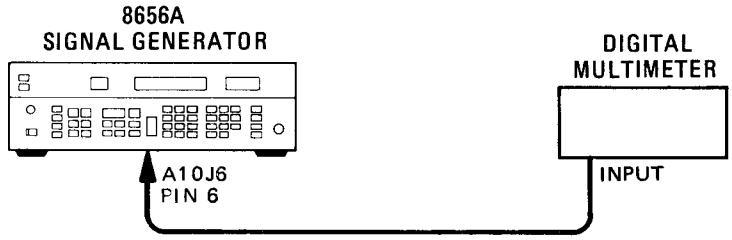


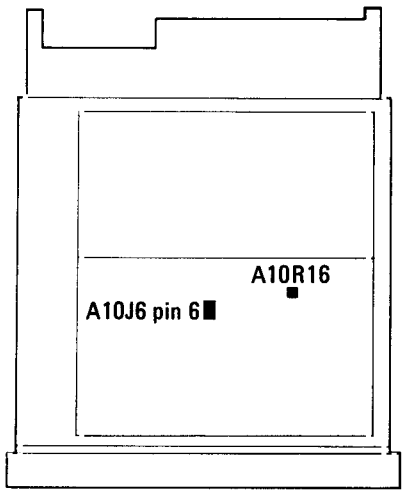
Figure 5-3. Audio Oscillator Level Adjustment Setup

EQUIPMENT: Digital Multimeter ..... HP 3465A

PROCEDURE:

1. Set the digital multimeter as follows:
   Function ..... Vac
   Range 2V
2. Set the Signal Generator as follows:
   Frequency ..... Any
   Amplitude ..... Any
   Modulation ..... 1 kHz AM
3. Connect the digital multimeter to Test Point A10J6 pin 6.
4. Adjust A10R16 (OSC ADJ) for a 0.707 Vrms ±0.007 Vrms reading on the digital multimeter.
5. Select the internal 400 Hz modulation source. Check that the 400 Hz oscillator level is within 0.707 Vrms ±0.007 Vrms. If it is not, repeat step 4 until both readings are within the specified limits.

Bottom Internal View, Level 4



ManualsPlus.com

ADJUSTMENTS

5-10. AM OFFSET ADJUSTMENT

REFERENCE: Service Sheet 6.

DESCRIPTION: The dc offset of the AM Offset Buffer is adjusted for 0.000 Vdc ±0.001 Vdc at Test Point A10J6 pin 12 with the reference inputs to the Level DAC and AM% DAC grounded and the digital input to each programmaticaly set to zero.

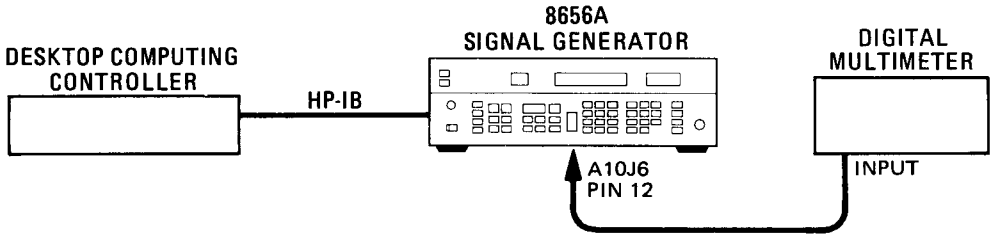


Figure 5-4. AM Offset Adjustment Setup

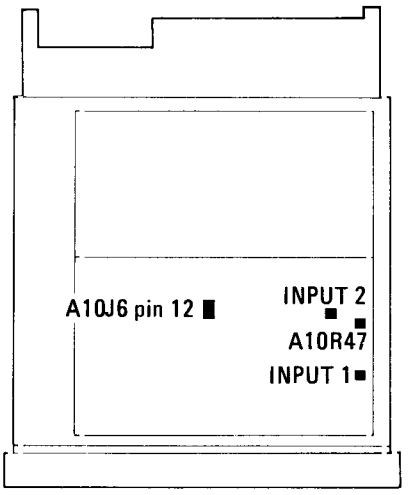
EQUIPMENT:

Digital Multimeter	HP 3465A
Desktop Computing Controller	HP 9825A
General I/O & Extended I/O ROM	HP 98213A
HP-IB Interface	HP 98034A

PROCEDURE:

1. Set the digital multimeter as follows:
   Function ..... Vdc
   Range ..... 200 mV
2. Set the Signal Generator modulation off.
3. Short INPUT 1 and INPUT 2 Test Points to ground.
4. Connect the Desktop Computing Controller using the HP-IB Interface to the HP-IB connector on the rear panel of the Signal Generator.
5. Connect the digital multimeter to A10J6 pin 12.

Bottom Internal View, Level 4



6. Program the Desktop Computing Controller to set the digital inputs to the Level DAC and AM% DAC to zero as follows:
   [Controller talk and Signal Generator listen] "variable name"
   rem 7; wrt 707, "D0"

NOTE

To determine the HP-IB address of the Signal Generator, press the HP-IB ADRS key and read the internally-set, decimal address in the MODULATION Display. The factory set address is 07.

7. Adjust A10R47 (OFFSET ADJ) for 0.000 Vdc ±0.001 Vdc.
8. Remove the two shorts installed in step 3.

ManualsPlus.com

ADJUSTMENTS

5-11. 715 MHz SIDEBAND ADJUSTMENT

REFERENCE: Service Sheet 2.

DESCRIPTION: The 715 MHz Sideband adjustment is made so that both inputs to the Sideband Comparator are equal with the Signal Generator frequency set to 715 MHz. The dc voltage between Test Points A4TP10 and A4TP11 (which are the inputs to the Sideband Comparator) is adjusted to be less than 0.007 Vdc as the frequency is returned to 715 MHz from both 690 and 740 MHz in 5 MHz steps.

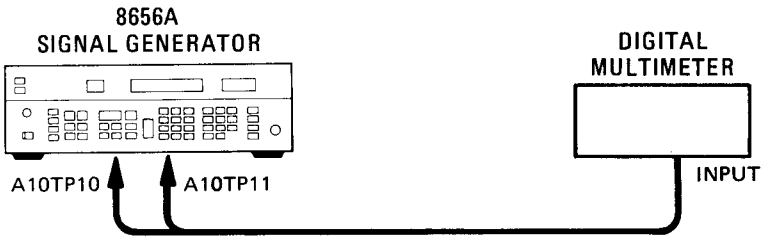


Figure 5-5. 715 MHz Sideband Adjustment Setup

EQUIPMENT: Digital Multimeter ..... HP 3465A

PROCEDURE:

1. Set the digital multimeter as follows:
   Function ..... Vdc
   Range ..... 200 mV

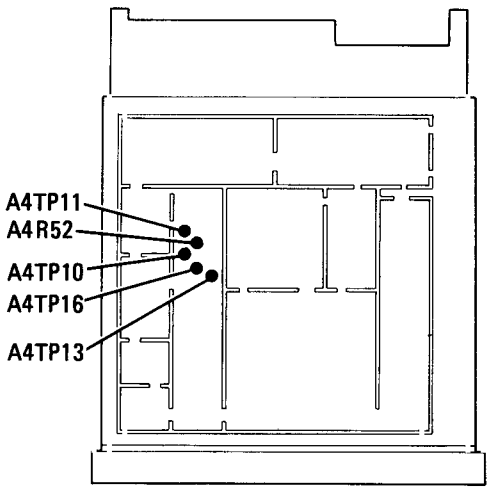
2. Set the Signal Generator as follows:
   Frequency ..... 715 MHz
   Frequency Increment .... 50 MHz
   Amplitude ..... Any
   Modulation ..... Off

   CAUTION

   DO NOT CONNECT TP13 to TP16 when the test points are not grounded.

3. Connect the digital multimeter input between Test Points A4TP10 and A4TP11. Short Test Points A4TP13 and A4TP16 to ground.

Top Internal View, Level 2



4. Increment the frequency up to 765 and back to 715 MHz.

5. Adjust A4R52 (715 MHz ADJ) for 0 Vdc ±0.007 Vdc.

6. Remove the two shorts installed in step 3.

ManualsPlus.com

ADJUSTMENTS

5-12. NOTCH FILTER ADJUSTMENTS

REFERENCE: Service Sheet 1.

DESCRIPTION: Each one of the Notch Filters is adjusted using a signal source set to 50, 100, 150, 200, 250, and 300 MHz. The 50 to 250 MHz Notch Filters are de-selected one at a time to pass that frequency. With each filter de-selected and its output centered on a spectrum analyzer display, the Notch Filter is then re-selected and adjusted for a minimum signal output on the spectrum analyzer.

The two 300 MHz Notch Filters are in the circuit all of the time. A 300 MHz signal source is applied to the input of each filter and its output is connected to a spectrum analyzer. Each filter is then adjusted for a minimum signal output.

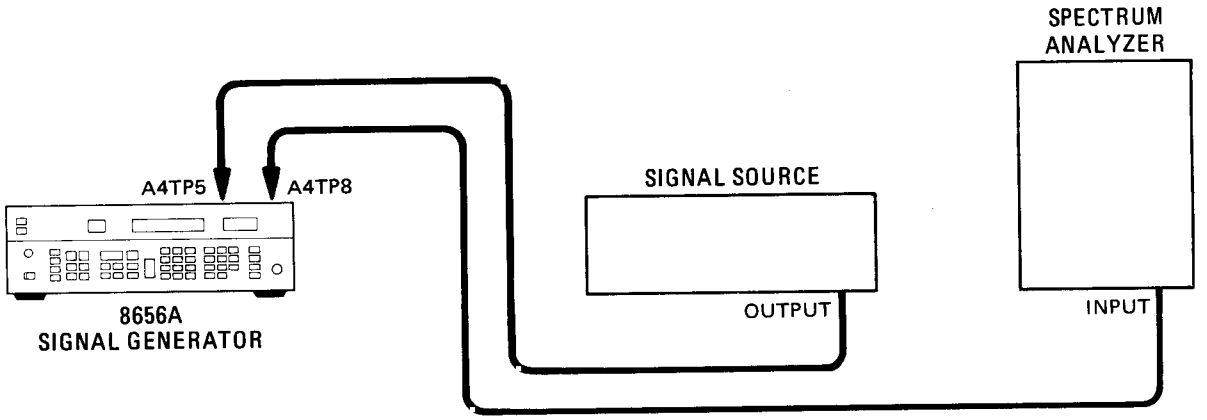


Figure 5-6. Notch Filters Adjustment Setup

EQUIPMENT:

Signal Source	HP 8640B
Spectrum Analyzer	HP 8558B
Adapter Probes (2)	HP 1250-1598
Adapters (2) N(m) to BNC(f)	HP 1250-0780
Cables (2) BNC(m) to SMC(f)	HP 08662-60080

PROCEDURE:

1. Set the signal source as follows:

Frequency	250.000 MHz
Counter Mode	Expand X10
Level	−20 dBm
Modulation	Off

2. Set the spectrum analyzer as follows:

Optimum Input	−10 dBm
Reference Level	0 dBm
Frequency Span/Div	500 kHz
Resolution Bandwidth	30 kHz

3. Set the Signal Generator as follows:

Frequency	950 MHz
Frequency Increment	50 MHz
Amplitude	Any
Modulation	Off

ManualsPlus.com

ADJUSTMENTS

5-12. NOTCH FILTER ADJUSTMENTS (Cont'd)

PROCEDURE: (Cont'd)

4. Connect the signal source to the Signal Generator at RF Test Point A4TP5 using an adapter (HP part no. 1250-1598).

5. Connect the spectrum analyzer to the Signal Generator at RF Test Point A4TP8 using an adapter (HP part no. 1250-1598).

6. Adjust the spectrum analyzer to center the 250 MHz signal on the spectrum analyzer display.

7. Step the frequency down 50 MHz to 900 MHz.

8. Adjust A4C53 (250 MHz IF ADJ) for a minimum signal output on the spectrum analyzer display.

9. Tune the signal source to 200.000 MHz and center the 200 MHz signal on the spectrum analyzer display.

10. Step the frequency down 50 MHz to 850 MHz.

11. Adjust A4L36 (200 MHz IF ADJ) for a minimum signal output on the spectrum analyzer display.

12. Tune the signal source to 150.000 MHz and center the 150 MHz signal on the spectrum analyzer display.

13. Step the frequency down 50 MHz to 800 MHz.

14. Adjust A4L37 (150 MHz IF ADJ) for a minimum signal output on the spectrum analyzer display.

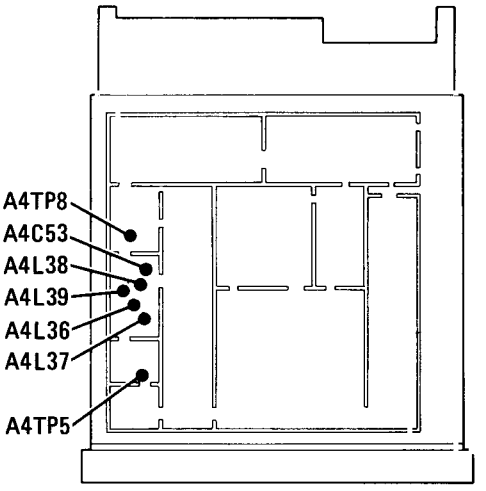
15. Tune the signal source to 100.000 MHz and center the 100 MHz signal on the spectrum analyzer display.

16. Step the frequency down 50 MHz to 750 MHz.

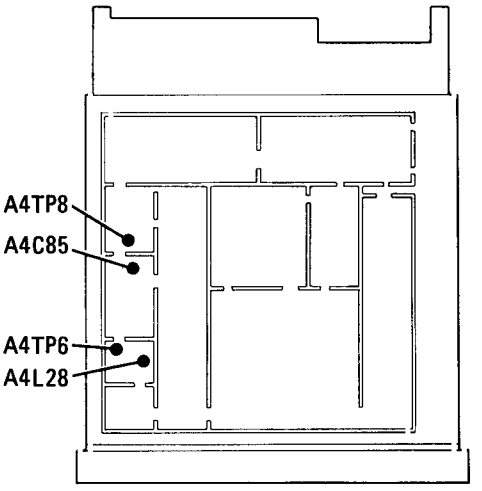
17. Adjust A4L38 (100 MHz IF ADJ) for a minimum signal output on the spectrum analyzer display.

18. Tune the signal source to 50.000 MHz and center the 50 MHz signal on the spectrum analyzer display.

Top Internal Views, Level 2



50 to 250 MHz IF Adjustments (Steps 4—20)



300 MHz IF Adjustments (Steps 21—26)

ManualsPlus.com

5-12. NOTCH FILTER ADJUSTMENTS (Cont'd)

PROCEDURE: (Cont'd)

19. Step the frequency up 50 MHz to 800 MHz.

20. Adjust A4L39 (50 MHz IF ADJ) for a minimum signal output on the spectrum analyzer display.

21. Connect the spectrum analyzer to the Signal Generator at RF Test Point A4TP6 using an adapter (HP part no. 1250-1598).

22. Tune the signal source to 300.000 MHz and center the 300 MHz signal on the spectrum analyzer display.

23. Adjust A4L28 (300 MHz IN IF ADJ) for a minimum signal output on the spectrum analyzer display.

24. Connect the spectrum analyzer to the Signal Generator at RF Test Point A4TP8 using an adapter (HP part no. 1250-1598).

25. Connect the signal source to the Signal Generator at RF Test Point A4TP6 using an adapter (HP part no. 1250-1598) and bypass A4L28 by placing a jumper across it.

26. Adjust A4C85 (300 MHz IF ADJ) for a minimum signal output on the spectrum analyzer display. Remove the jumper across A4L28.

ManualsPlus.com

ADJUSTMENTS

5-13. HIGH FREQUENCY LOOP OFFSET ADJUSTMENT

REFERENCE: Service Sheet 2.

DESCRIPTION: The tune voltage ramp from the Loop Amplifier is disconnected from the High Frequency Oscillator Assembly—A5 and then it is adjusted for a symmetrical ramp using an oscilloscope.

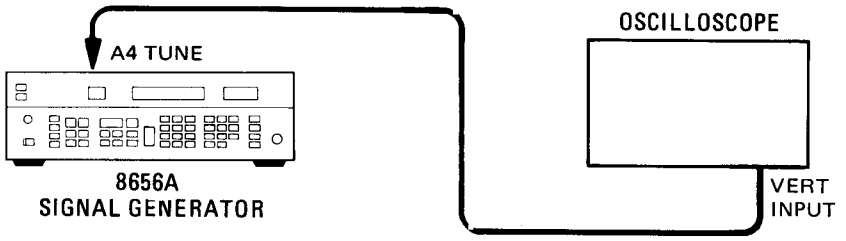


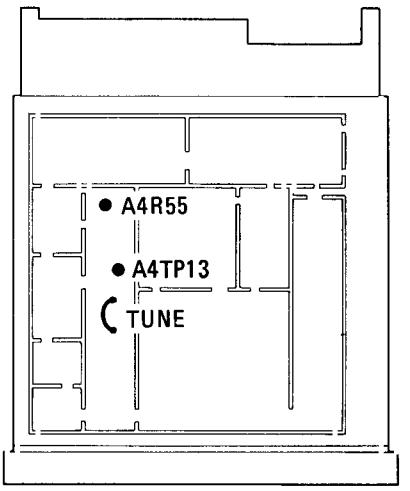
Figure 5-7. High Frequency Loop Offset Adjustment Setup

EQUIPMENT: Oscilloscope ..... HP 1222A

PROCEDURE:

1. Set the oscilloscope as follows:
   Vertical Gain 5V/div
   Sweep Speed ..... 10 ms/div
2. Set the Signal Generator as follows:
   Frequency ..... 140 MHz
   Amplitude ..... -10 dBm
   Modulation ..... 1 kHz (Int.) AM 50%
3. Disconnect the TUNE voltage wire (white-black-orange) from the High Frequency Oscillator Assembly—A5.
4. Connect oscilloscope to TUNE voltage wire (white-black-orange).
5. Short Test Point A4TP13 to ground.

Top Internal View, Level 2



6. Adjust A4R55 (OFFSET ADJ) for the most symmetrical ramp as analyzed on the oscilloscope (equal rise and fall times) as shown in Figure 5-8.
7. Remove the oscilloscope and reconnect the TUNE voltage wire to the High Frequency Oscillator Assembly—A5.
8. Remove the short installed in step 5.

ManualsPlus.com

ADJUSTMENTS

5-13. HIGH FREQUENCY LOOP OFFSET ADJUSTMENT (Cont'd)

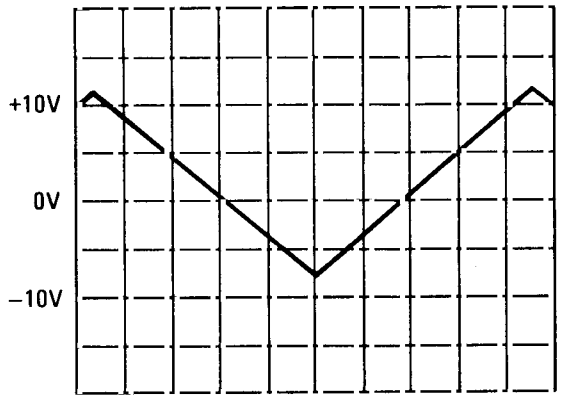


Figure 5-8. Tune Voltage Waveform

ManualsPlus.com

ADJUSTMENTS

5-14. 50 MHz REFERENCE OSCILLATOR FREQUENCY ADJUSTMENT

REFERENCE: Service Sheet 13.

DESCRIPTION: The internal 50 MHz Reference Oscillator frequency is adjusted to 50.0000 MHz ±100 Hz at A3J5 using a frequency counter.

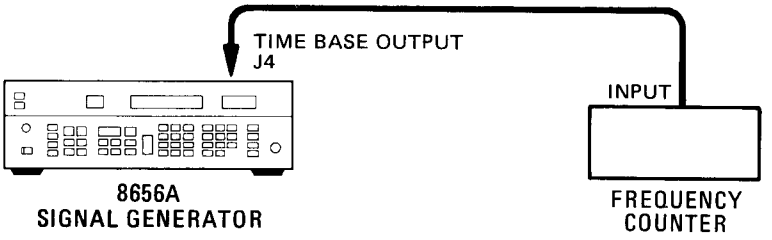


Figure 5-9. 50 MHz Reference Oscillator Frequency Adjustment Setup

EQUIPMENT:

Frequency Counter	HP 5328A
Adapter N(m) to BNC(f)	HP 1250-0780
Cable BNC(m)	HP 10503A

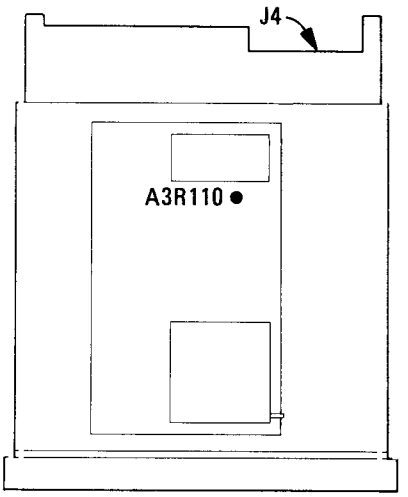
NOTE

If the Signal Generator has Option 001 installed disconnect coaxial cable A16W2 from the rear panel TIME BASE INPUT connector J3.

PROCEDURE:

1. Disconnect coaxial cable W5 from A3J5 (50 MHz Reference Oscillator output). Connect the frequency counter to A3J5 using the appropriate cable and adapters.
2. Adjust A3R110 (TB ADJ) for a frequency counter reading of 10.0000 MHz ±20 Hz.
3. Reconnect A16W2 to J3 if the Signal Generator has Option 001 installed.

Top Internal View, Level 1



ManualsPlus.com

ADJUSTMENTS

5-15. 50 MHz REFERENCE OSCILLATOR LEVEL ADJUSTMENT

REFERENCE: Service Sheet 13.

DESCRIPTION: The output power level of the 50 MHz Reference Oscillator is adjusted for maximum power at A3J5 using a power meter.

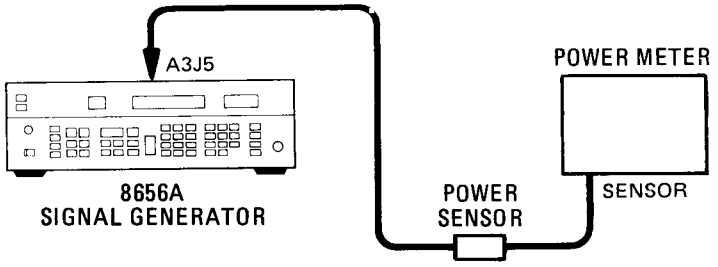


Figure 5-10. 50 MHz Reference Oscillator Level Adjustment Setup

EQUIPMENT:

Power Meter	HP 436A
Power Sensor	HP 8482A
Cable BNC(m) to SMC(f)	HP 08662-60080
Adapter N(f) to BNC(f)	HP 1250-0077
Adapter BNC(f) to BNC(f)	HP 1250-0080

PROCEDURE:

1. Set the power meter with the power meter sensor connected as follows:

   Mode ..... dBm

2. Disconnect coaxial cable W5 from A3J5 (50 MHz Reference Oscillator output). Connect the power sensor to A3J5 using the appropriate cable and adapters.

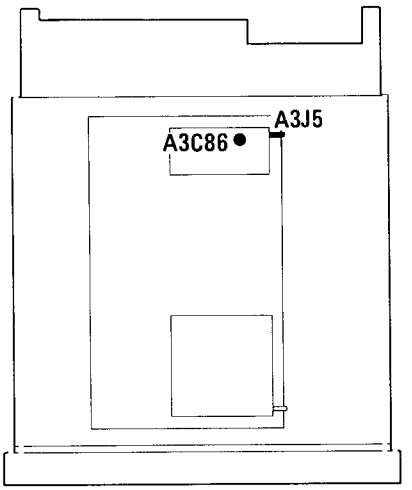
3. Adjust A3C86 (50 MHZ LEVEL ADJ) for a maximum power meter reading. The reading should be +16 dBm or greater.

   NOTE

   Do not remove the 50 MHz Section covers for this adjustment.

4. Disconnect the power meter and reconnect W5 to A3J5.

Top Internal View, Level 1



ManualsPlus.com

ADJUSTMENTS

5-16. 60 TO 110 MHz OSCILLATOR FLATNESS ADJUSTMENT

REFERENCE: Service Sheet 8.

DESCRIPTION: The 60 to 110 MHz Low Frequency Oscillator is adjusted so that its output is ≤0.3 dB at 100 and 110 MHz at A3J4 using a power meter.

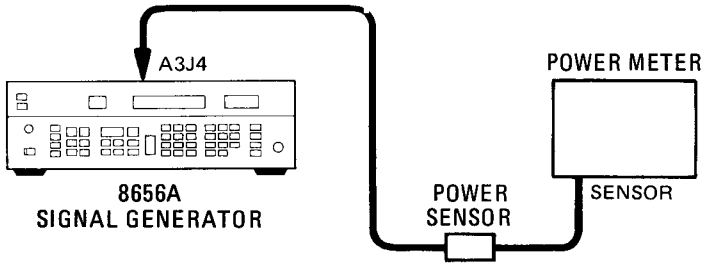


Figure 5-11. 60 to 110 MHz Oscillator Flatness Adjustment Setup

EQUIPMENT:

Power Meter	HP 436A
Power Sensor	HP 8482A
Adapter N(f) to BNC(m)	HP 1250-0077
Adapter BNC(f) to BNC(f)	HP 1250-0080
Cable BNC(m) to SMC(f)	HP 08662-60080

PROCEDURE:

1. Set the power meter with the power sensor connnected as follows:

   Mode ..... dBm

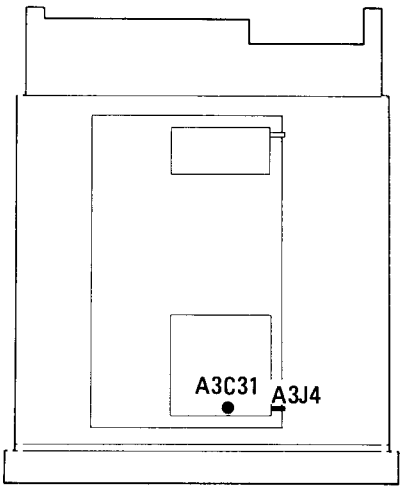
2. Set the Signal Generator as follows:

   Frequency ..... 40 MHz
   Frequency Increment ..... 10 MHz
   Amplitude ..... Any
   Modulation ..... Off

3. Disconnect coaxial cable W3 from A3J4 (60 to 110 MHz Oscillator output). Connect the power sensor to A3J4 using the appropriate cable and adapters.

4. Allow the reading on power meter to stabilize, then set the mode to dB (ref).

Top Internal View, Level 1



5. Adjust A3C31 (60 — 110 MHz FLATNESS ADJ) for a power meter difference of ≤1.3 dB as the frequency is stepped between 40 and 90 MHz in 10 MHz steps. The 60 to 110 MHz oscillator frequency will vary from 60 to 110 MHz.

6. Disconnect the power meter and reconnect W3 to A3J4.

ManualsPlus.com

ADJUSTMENTS

5-17. 690 TO 740 MHz IF COMPENSATION ADJUSTMENT

REFERENCE: Service Sheets 1 and 3

DESCRIPTION: The power levels of the IF frequencies 690 to 740 MHz are measured at RF Test Point A4TP3 and adjusted for flatness within ±1.5 dB using a power meter.

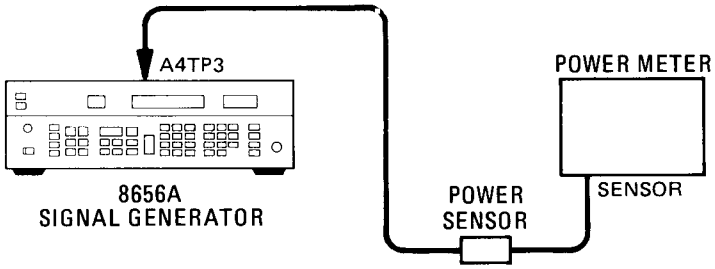


Figure 5-12. 690 to 740 MHz IF Compensation Adjustment Setup

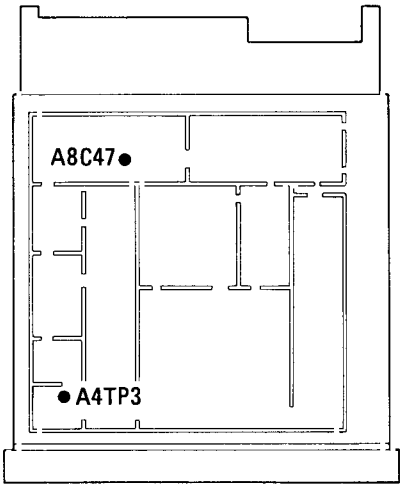
EQUIPMENT:

Power Meter	HP 436A
Power Sensor	HP 8482A
Adapter Probe	HP 1250-1598
Adapter N(f) to BNC(m)	HP 1250-0077
Adapter BNC(f) to BNC(f)	HP 1250-0080
Cable BNC(m) to SMC(f)	HP 08662-60080

PROCEDURE:

1. Set the power meter with the power sensor connected as follows:
   Mode ..... dBm
2. Set the Signal Generator as follows:
   Frequency ..... 40 MHz
   Frequency Increment ..... 10 MHz
   Amplitude ..... Any
   Modulation ..... Off
3. Zero the power meter and wait for zero LED to go out.
4. Connect the power sensor to the Signal Generator at RF Test Point A4TP3 using an adapter (HP part no. 1250-1598).

Top Internal View, Level 2



5. Step the Signal Generator frequency up in 10 MHz steps to 90 MHz recording the power meter reading at each frequency.
6. Step the Signal Generator to the frequency with the lowest reading and select the power meter dB (ref) mode.
7. Step the frequency up and down between 40 and 90 MHz and adjust A8C47 (COMP ADJ) until the maximum and minimum power meter readings are within 3 dB. The 690 to 740 MHz IF will then be flat to within ±1.5 dB.

ManualsPlus.com

ADJUSTMENTS

5-18. 400 MHz BANDPASS FILTER ADJUSTMENT

REFERENCE: Service Sheet 3.

DESCRIPTION: The 400 MHz Bandpass Filter is adjusted for maximum power at RF Test Point A8TP3 using a power meter.

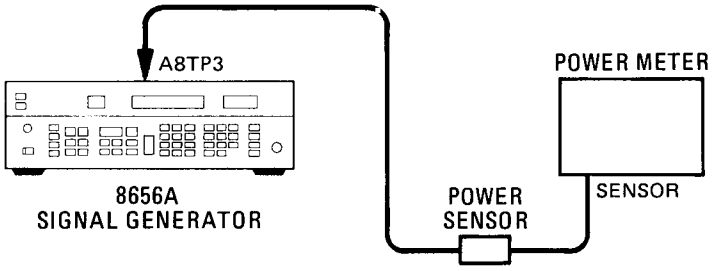


Figure 5-13. 400 MHz Bandpass Filter Adjustment Setup

EQUIPMENT:

Power Meter	HP 436A
Power Sensor	HP 8482A
Adapter Probe	HP 1250-1598
Adapter N(f) to BNC(m)	HP 1250-0077
Cable BNC(m) to SMC(f)	HP 08662-60080

PROCEDURE:

1. Set the power meter with the power sensor connected as follows:

   Mode ..... dBm

2. Set the Signal Generator as follows:

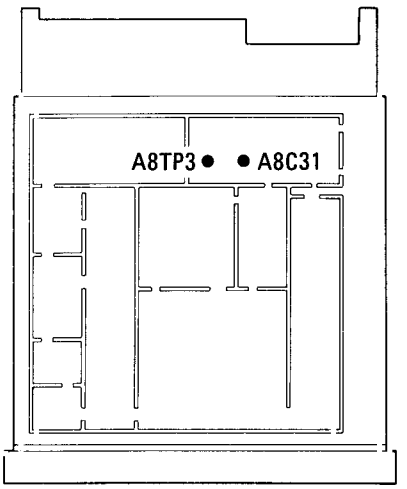
   Frequency ..... Any
   Amplitude ..... −10 dBm
   Modulation ..... Off

3. Zero the power meter and wait for the zero LED to go out.

4. Connect the power sensor to the Signal Generator at RF Test Point A8TP3 using an adapter (HP part no. 1250-1598).

5. Adjust A8C31 (PEAK ADJ) for a maximum power meter reading.

Top Internal View, Level 2



ManualsPlus.com

ADJUSTMENTS

5-19. LEVEL AND ALC LOOP DETECTOR ADJUSTMENTS

REFERENCE: Service Sheets 4 and 6.

DESCRIPTION: First, the reference level to the Level Digital to Analog Converter (DAC) is adjusted to +7.00 dBm ±0.02 dB. Then the detector bias reference level to the ALC Amplifier is adjusted to −4.00 dBm ±0.02 dB.

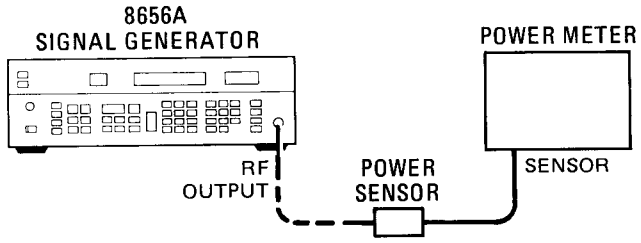


Figure 5-14. Level and ALC Loop Detector Adjustment Setup

EQUIPMENT:
Power Meter ..... HP 436A
Power Sensor ..... HP 8482A

PROCEDURE:

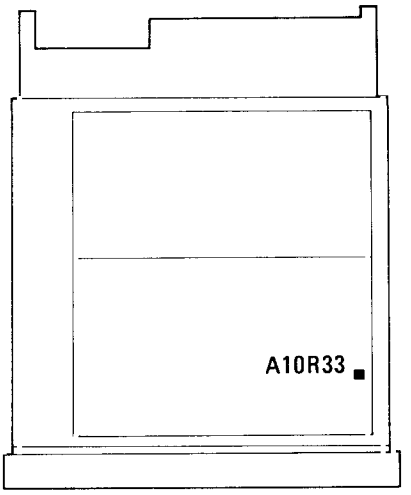
1. Set the power meter with power sensor connected as follows:
   Mode ..... dBm

2. Set the Signal Generator as follows:
   Frequency ..... 800 MHz
   Amplitude ..... +7 dBm
   Modulation ..... Off
   Amplitude Increment ..... 11 dB

NOTE

Before making the adjustment, all internal RF covers must be installed and the instrument must be warmed up for a minimum of 2 hours. (The internal RF top cover is removed to permit access).

Bottom Internal View, Level 4



3. Connect the power sensor to the RF OUTPUT connector on the Signal Generator.

4. Set the Signal Generator RESET/STBY/ON switch to STBY and zero the power meter.

5. Wait for the power meter zero LED to go out, then set the RESET/STBY/ON switch to the ON position.

6. Adjust A10R33 (LEVEL ADJ) for a reading of +7.00 dBm ±0.02 dB on the power meter.

ManualsPlus.com

ADJUSTMENTS

5-19. LEVEL AND ALC LOOP DETECTOR ADJUSTMENTS (Cont'd)

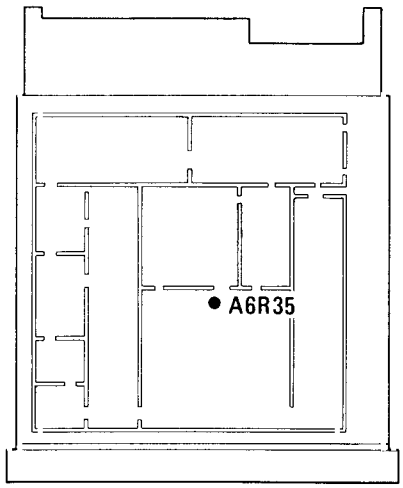
PROCEDURE: (Cont'd)

7. Step the Signal Generator amplitude down to −4 dBm.

8. Adjust A6R35 (DET ADJ) for a reading of −4.00 dBm ±0.02 dB on the power meter.

9. Repeat steps 6, 7 and 8 until both readings are within the required tolerances.

Top Internal View, Level 2



ManualsPlus.com

ADJUSTMENTS

5-20. HETERODYNE BAND ACCURACY AND FLATNESS ADJUSTMENTS

REFERENCE: Service Sheet 5.

DESCRIPTION: The accuracy and flatness of the heterodyne band are adjusted for an equal power difference from 0 dBm at 10 MHz and 123 MHz and power variation not greater than ±0.5 dB for frequencies between 3 MHz and 123 MHz.

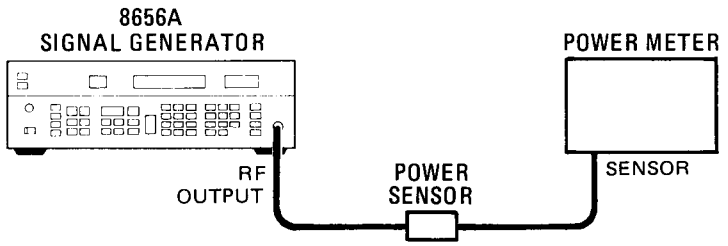


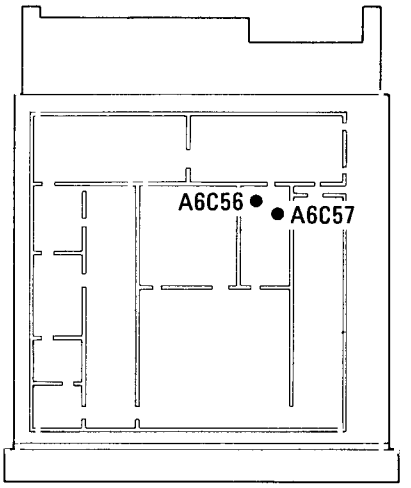
Figure 5-15. Heterodyne Band Accuracy and Flatness Adjustment Setup

EQUIPMENT:
Power Meter ..... HP 436A
Power Sensor ..... HP 8482A

PROCEDURE:

1. Set the power meter with the power sensor connected as follows:
   Mode ..... dBm
2. Set the Signal Generator as follows:
   Frequency ..... 10 MHz
   Frequency Increment ..... 5 MHz
   Amplitude ..... 0 dBm
   Modulation ..... Off
3. Connect the power sensor to RF OUTPUT connector on the Signal Generator.
4. Set the Signal Generator RESET/STBY/ON switch to STBY and zero the power meter.
5. Wait for the power meter zero LED to go out, then set the RESET/STBY/ON switch to the ON position.
6. Adjust A6C56 (ACC ADJ) for a 0 dBm ±0.5 dB reading on the power meter.
7. Change the frequency to 123 MHz and adjust A6C57 (FLAT ADJ) for a 0 dBm ±0.5 dB reading on the power meter.

Top Internal View, Level 2



NOTES

1. If A6C57 does not have the range to adjust the amplitude at 123 MHz to 0.0 dBm ±0.5 dB, repeat step 6 adjusting A6C56 to increase or decrease the amplitude until both adjustments are within the specified limits. A6C56 is used to shift the amplitude level of the heterodyne band.

ManualsPlus.com

ADJUSTMENTS

5-20. HETERODYNE BAND ACCURACY AND FLATNESS ADJUSTMENTS (Cont'd)

PROCEDURE: (Cont'd)

NOTES (Cont'd)

2. This note applies to instruments with serial prefixes 2032A and below. If A6C56 cannot be adjusted so A6C57 (note 1) will meet the specification, change to the capacitor listed in Table 6-3 (2.5—5.5 pF) and repeat this procedure.

8. Step the frequency between 3 MHz and 123 MHz. The amplitude variation from maximum to minimum should not exceed 1 dB. If amplitude variation is greater than 1 dB repeat steps 6 and 7 to compensate the flatness so that amplitude remains within 0.0 dBm ±0.5 dB.

ManualsPlus.com

ADJUSTMENTS

5-21. AM% AND ALC LOOP AM ADJUSTMENTS

REFERENCE: Service Sheets 4 and 6.

DESCRIPTION: The reference level to the AM% Digital to Analog Converter (DAC) is adjusted for an average amplitude modulation of 21.4%. The AM reference to the ALC Amplifier is adjusted for minimum distortion of the modulation.

NOTE

The AM Offset, Level, and Heterodyne Flatness adjustments must be performed before performing these adjustments. Refer to paragraphs 5-10, 5-19 and 5-20.

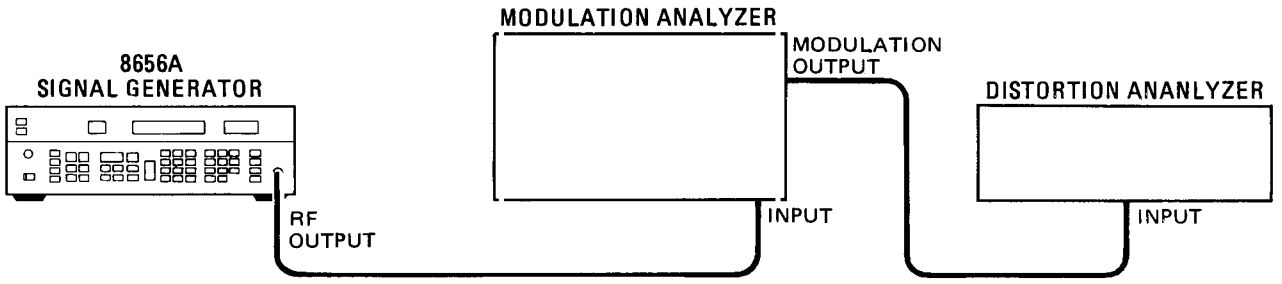


Figure 5-16. AM% and ALC Loop AM Adjustments Setup

EQUIPMENT

Modulation Analyzer	HP 8901A
Distortion Analyzer	HP 339A
AM/FM Test Source (required modulation analyzer verification of incidental AM)	HP 11715A
Test Oscillator	HP 651B
Cable (UG-210/U type N connectors)	HP 11500B
Cable (UG-88C/U BNC and dual banana plug connectors)	HP 11001A

PROCEDURE:

1. Set the modulation analyzer as follows:

Measurement	AM
Detection	AVG
HP Filter	50 Hz
LP Filter	15 kHz

2. Set the Signal Generator as follows:

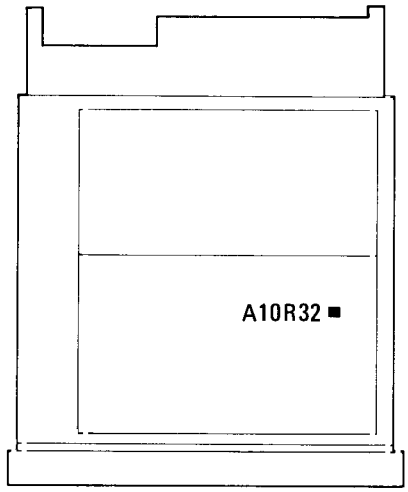
Frequency	200 MHz
Amplitude	+4 dBm
Modulation	1 kHz (Int.) AM 30%
Amplitude Increment	8 dB

3. Adjust A10R32 (AM% ADJ) for a reading of 21.40% on the modulation analyzer.

NOTE

Do not remove any of the internal RF covers for this adjustment.

Bottom Internal View, Level 4



ManualsPlus.com

ADJUSTMENTS

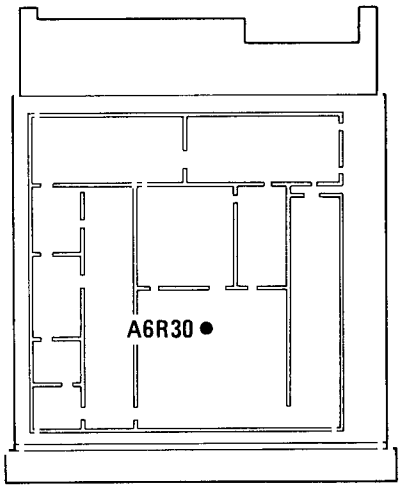
5-21. AM% AND ALC LOOP AM ADJUSTMENTS (Cont'd)

4. Set the Signal Generator as follows:

   Frequency ..... 123 MHz
   Amplitude ..... −4 dBm
   Modulation .....AM 70%

5. Adjust A6R30 (AM ADJ) for a minimum reading on the Distortion Analyzer. Typically the distortion is less than 3%.

Top Internal View, Level 2



ManualsPlus.com

ADJUSTMENTS

5-22. FM DEVIATION ADJUSTMENT

REFERENCE: Service Sheet 12.

DESCRIPTION: The FM deviation is adjusted with a maximum FM peak deviation frequency of 99 kHz entered into the Signal Generator. The carrier frequency is stepped down in 10 MHz steps from 990 to 940 MHz and A10R64 is adjusted for an equal error around 99 kHz deviation.

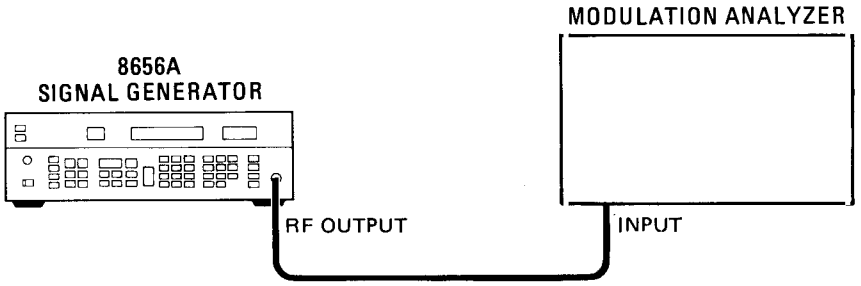


Figure 5-17. FM Deviation Adjustment Setup

EQUIPMENT:
Modulation Analyzer .....HP 8901A
Cable UG-210/U (Type N) .....HP 11500A

PROCEDURE:

1. Set the modulation analyzer as follows:

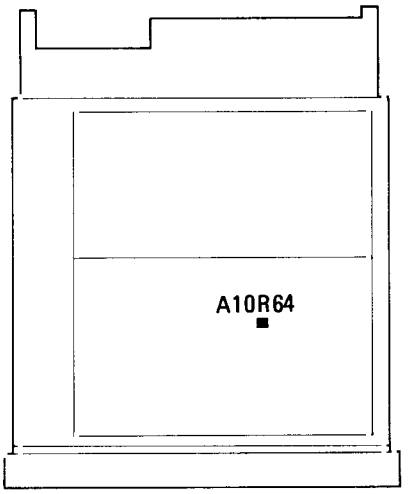
   Measurement ..... FM
   Detector ..... +Peak
   HP Filter ..... 300 Hz
   LP Filter ..... 3 kHz

2. Set the Signal Generator as follows:

   Frequency ..... 990 MHz
   Frequency Increment..... 10 MHz
   Amplitude ..... +4 dBm
   Modulation ..... 1 kHz (Int.) FM 99 kHz

3. Connect the modulation analyzer input to the RF OUTPUT connector on the Signal Generator.

Bottom Internal View, Level 4



4. Adjust A10R64 (FM ADJ) for a 99.0 kHz deviation reading on the modulation analyzer.

5. Step the frequency down from 990 to 940 MHz and record the deviation at each of the 10 MHz steps.

6. Adjust A10R64 for equal error ±2 kHz from 99 kHz at the frequencies of maximum and minimum peak kHz deviation.

ManualsPlus.com

ADJUSTMENTS

5-23. FM FREQUENCY RESPONSE ADJUSTMENT

REFERENCE: Service Sheet 10.

DESCRIPTION: The FM frequency response is adjusted with a peak deviation frequency of 99 kHz as an external modulation source is tuned between 50 Hz and 1 kHz.

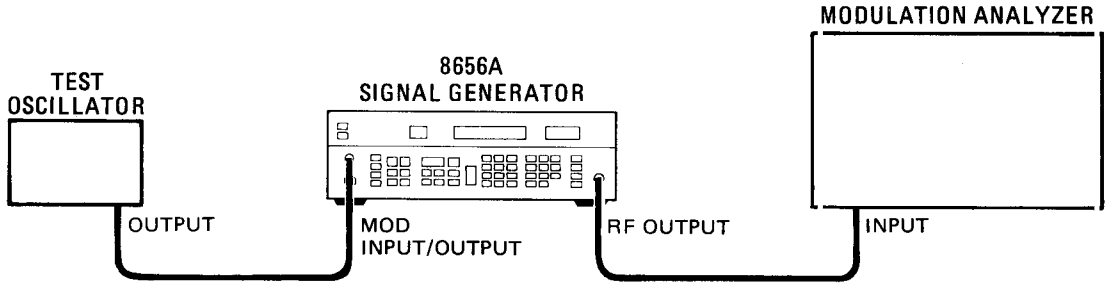


Figure 5-18. FM Frequency Response Setup

EQUIPMENT:
Test Oscillator ..... HP 651B
Modulation Analyzer ..... HP 8901A

PROCEDURE:

1. Set the Signal Generator as follows:

   Frequency ..... 90 MHz
   Ampliutde ..... 0.0 dBm
   Modulation ..... Ext. FM 99 kHz

2. Set the test oscillator as follows:

   Frequency ..... 1 kHz
   Amplitude Coarse ..... CCW

3. Set the modulation analyzer as follows:

   Measurement ..... FM
   Detector ..... Peak+
   LP Filter ..... 15 kHz

4. Connect the equipment as shown in Figure 5-18.

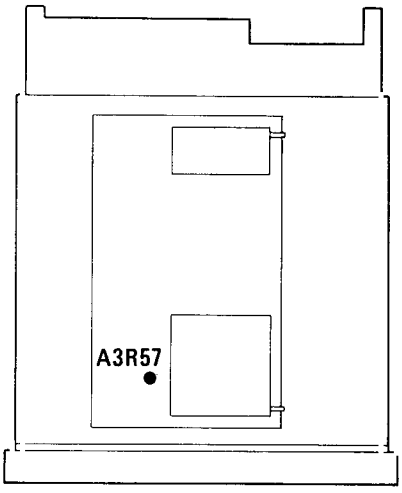
5. Rotate the test oscillator output level CW until the LO EXT LED on the front panel of the Signal Generator goes out. Both the HI EXT and LO EXT LEDs must be out.

6. Record the deviation reading on the modulation analyzer.

7. Tune the test oscillator frequency to 50 Hz.

8. Adjust A3R57 (FM ADJ) for a difference of ±1.0 kHz as the external modulation signal is tuned between 50 Hz and 1 kHz.

Top Internal View, Level 1



ManualsPlus.com

ADJUSTMENTS

5-24. ATTENUATOR ADJUSTMENTS

REFERENCE: Service Sheet 7.

DESCRIPTION: Each of the five attenuator sections is actuated separately via HP-IB using a Desktop Computing Controller so that they can be individually adjusted. The wire adjustment loops form capacitors C1—3, 6 and 8. Each is adjusted in relation to the associated series resistor. A reference power level with all attenuator pads out is taken with the power meter and each attenuator pad is adjusted relative to that reference.

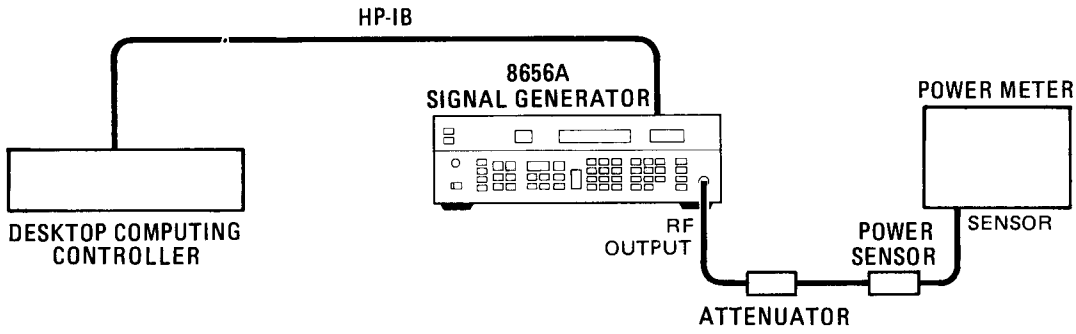


Figure 5-19. Attenuator Adjustment Setup

EQUIPMENT:

Power Meter	HP 436A
Power Sensor	HP 8484A
Attenuator	HP 8491A Option 020
Desktop Computing Controller	HP 9825A
General I/O & Extended I/O ROM	HP 98213A
HP-IB Interface	HP 98034A

PROCEDURE:

1. Set the power meter with the power sensor connected as follows:

   Mode ..... dBm

2. Set the Signal Generator as follows:

   Frequency ..... 990 MHz
   Amplitude ..... 0 dBm
   Modulation ..... Off

3. Connect the Desktop Computing Controller using the HP-IB Interface to the HP-IB connector on the rear panel of the Signal Generator.

4. Connect the power sensor to the attenuator and the attenuator to the RF OUTPUT connector on the Signal Generator.

5. Set the Signal Generator RESET/STBY/ON switch to STBY and zero the Power Meter.

6. Wait for the power meter zero LED to go out, then set the RESET/STBY/ON switch to the ON position.

ManualsPlus.com

ADJUSTMENTS

5-24. ATTENUATOR ADJUSTMENTS (Cont'd)

7. Wait for the power meter reading to stabilize, then select the dB(ref) mode.

8. Program the Desktop Computer to select the desired pad. When the HP 9825A Desktop Computing Controller is used as the controller, the pad is selected by entering the statement shown in Table 5-3.

   (Controller talk and Signal Generator listen) "variable name"

NOTE

To determine the address of the Signal Generator, press the HPIB ADRS key and read the decimal equivalent of the address in the MODULATION display. The factory set address is 07.

9. Only remove the internal RF cover from the pad being adjusted. See Figure 5-20.

10. Adjust the wire loop capacitor for the power meter reading specified for the pad being adjusted. See Table 5-3.

NOTE

Cover must be tight.

11. Replace the internal RF cover and observe the power meter reading. If it has changed, remove the cover and readjust the wire loop to give the correct power meter reading with the cover in place.

12. Place the power meter in dBm mode, select 0 dBm by entering the statement shown in Table 5-3 and repeat steps 5, 6, 7, 8, 10, and 11 until the limits in step 10 are met without further adjustment of the wire loop capacitors.

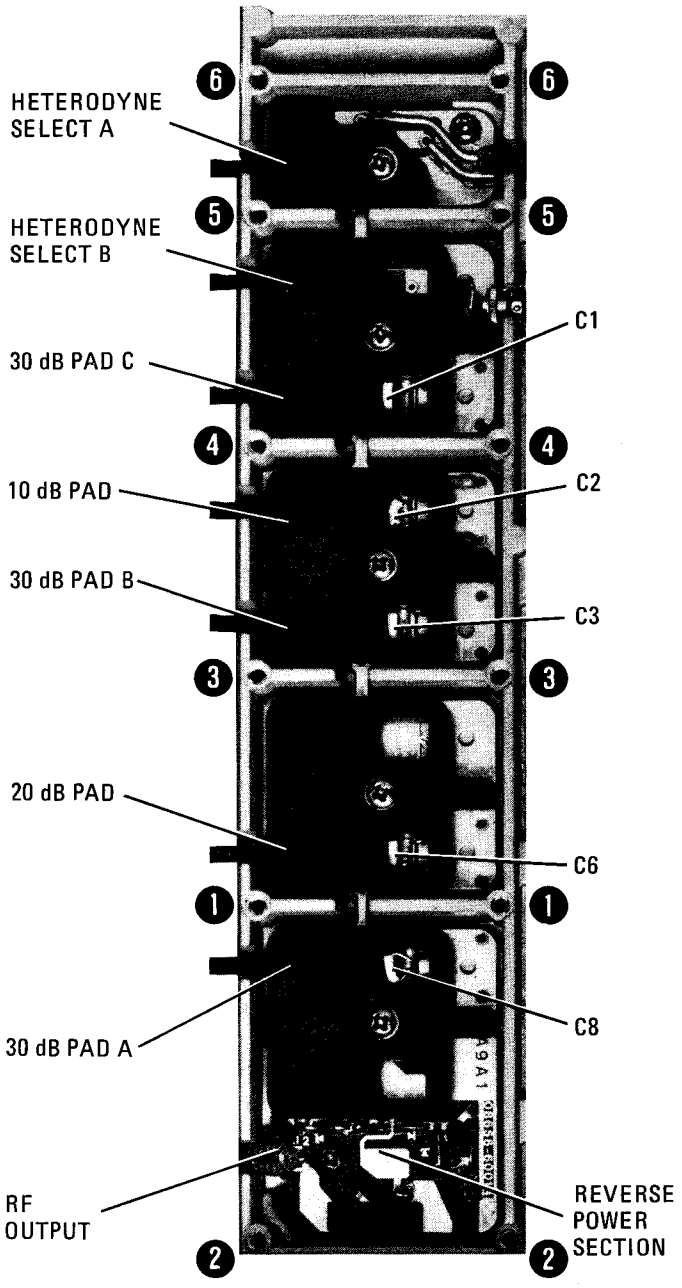
13. Repeat steps 5 through 12 to adjust the other attenuator pads.

14. After the adjustments have been completed, replace the internal RF bottom cover, then place the attenuator plate clamp into position and press down to firmly position the cover flush with the casting. Activate each pad and verify that the power meter reading is still within the specified limits. Readjust the wire loop capacitor, if necessary.

Table 5-3. Attenuator Pad Adjustment Information

Wire Loop Capacitor	Pad	Power Meter Reading	Statement to Select Pad with 9825A Controller
C2	10 dB	10 ± 0.1 dB	rem 7; wrt 707, "A4"
C6	20 dB	20 ± 0.1 dB	rem 7; wrt 707, "A2"
C8	30 dB A	30 ± 0.05 dB	rem 7; wrt 707, "A5"
C3	30 dB B	30 ± 0.05 dB	rem 7; wrt 707, "A3"
C1	30 dB C	30 ± 0.05 dB	rem 7; wrt 707, "A1"
None	None	0 ± 0.5 dB	rem 7; wrt 707, "A0"

ManualsPlus.com



NOTE:

SCREWS SECURING THE ATTENUATOR PLATE CLAMP MUST BE TIGHTENED IN THE 1 TO 6 ORDER SHOWN'

Figure 5-20. Attenuator Adjustment Locations

ManualsPlus.com

ADJUSTMENTS

5-25. OPTION 001 10 MHz REFERENCE OSCILLATOR FREQUENCY ADJUSTMENT

REFERENCE: Service Sheet 22.

DESCRIPTION: The Option 001 10 MHz Reference Oscillator frequency is adjusted to 10.000 MHz ±10.0 Hz using a frequency counter.

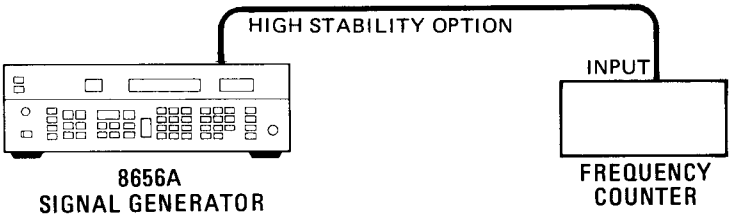


Figure 5-21. 10 MHz Reference Oscillator Frequency Adjustment Setup

EQUIPMENT: Frequency Counter .....HP 5328A

PROCEDURE:

WARNING

To avoid the possibility of hazardous electrical shock, disconnect the power cable from Main power before disconnecting the fan. Electrical power is connected to the fan whenever the power cable is connected to Mains power.

CAUTION

Use caution when removing the fan shroud from the casting. A ground wire is connected between the fan and the casting.

1. Remove the fan shroud from the rear of instrument. (Refer to Disassembly Procedures in Section VIII.)
2. Remove the COARSE and FINE screw-on adjustment covers.
3. Connect the frequency counter to the TIME BASE HIGH STABILITY OPTION connector (A16J1) on the rear panel of the Signal Generator.
4. Adjust the COARSE and FINE adjustments for a reading of 10.000 MHz ±10.0 Hz on the frequency counter.
5. Replace adjustment covers, fan shroud and series regulator cover.

ManualsPlus.com

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION

This section contains information for ordering parts. Table 6-2 lists abbreviations used in the parts list and throughout the manual. Table 6-3 lists all replaceable parts in reference designator order. Table 6-4 contains the names and addresses that correspond to the manufacturer's code numbers.

6-2. ABBREVIATIONS

Table 6-2 lists abbreviations used in the parts list, schematics, and throughout the manual. In some cases, two forms of the abbreviation are used, one all in capitals letters, and one partial or no capitals. This occurs because the abbreviations in the parts list are always all capitals. However, in the schematics and other parts of the manual, other abbreviation forms are used with both lower case and upper case letters.

6-3. REPLACEABLE PARTS LIST

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

a. Electrical assemblies and their components in alphanumeric order by reference designation.

b. Chassis-mounted parts in alphanumeric order by reference designation.

c. Mechanical parts.

The information given for each part consists of the following:

a. The Hewlett-Packard part number.

b. Part number check digit (CD).

c. The total quantity (Qty) for the entire instrument except for option assemblies.

d. The description of the part.

e. A typical manufacturer of the part in a five-digit code.

f. The manufacturer's number for the part.

NOTE

The total quantity for each part is given only once, that is, at the first occurrence of the part number in the list. The total quantities for optional assemblies are totalled by assembly and not integrated into the standard list.

6-4. FACTORY SELECTED PARTS (*)

Parts marked with an asterisk (*) are factory selected parts. The value listed in the parts list is the nominal value. Refer to Sections V and VIII of this manual for information on determining what value to use for replacement.

6-5. PARTS LIST BACKDATING (†)

Parts marked with a dagger (†) are different in Signal Generators with serial number prefixes lower than the one that this manual applies to directly. Table 7-1 lists the backdating changes by serial number prefix. Table 7-2 lists components affected by each change.

6-6. PARTS LIST UPDATING (Change Sheet)

Production changes to Signal Generators made after the publication date of this manual are accompanied by a change in the serial number prefix. Changes to the parts list are recorded by serial number prefix on a MANUAL CHANGES supplement. Also, parts list errors are noted in the ERRATA portion of the MANUAL CHANGES supplement.

6-7. ILLUSTRATED PARTS BREAKDOWNS

Most mechanical parts are identified in Figures 6-1 through 6-9. These figures are located at the end of the replaceable parts table.

6-8. ORDERING INFORMATION

To order a part listed in the replaceable parts table, include the Hewlett-Packard part number (with the check digit) and the quantity required. Address the order to the nearest Hewlett-Packard office. The check digit will ensure accurate and timely processing of your order.

To order a part that is not listed in the replaceable parts table, include the instrument model number,

ManualsPlus.com

ORDERING INFORMATION (Cont'd)
instrument serial number, description and function of the part, and the quantity of parts required. Address the order to the nearest Hewlett-Packard office.

NOTE

Within the USA, it is better to order directly from the HP Parts Center in Mountain View, California. Ask your nearest HP office for information and forms for the "Direct Mail Order System".

6-9. RECOMMENDED SPARES LIST

Stocking spare parts for an instrument is often done to ensure quick return to service after a malfunction occurs. Hewlett-Packard has prepared a "Recommended Spares" list for this instrument. The contents of the list are based on failure reports and repair data. Quantities given are for one year of parts support. A complimentary copy of the "Recommended Spares" list may be requested from your nearest Hewlett-Packard office.

When stocking parts to support more than one Signal Generator or to support a variety of Hewlett-Packard instruments, it may be more economical to work from one consolidated list rather than simply adding together stocking quantities from the individual instrument lists. Hewlett-Packard will prepare consolidated "Recommended Spares" lists for any number or combination of instruments. Contact your nearest Hewlett-Packard office for details.

ManualsPlus.com

Table 6-1. Reference Designations

REFERENCE DESIGNATIONS

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

Table 6-2. Abbreviations (1 of 2)

ABBREVIATIONS

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

NOTE

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

ManualsPlus.com

Table 6-2. Abbreviations (2 of 2)

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

NOTE

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

MULTIPLIERS

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

ManualsPlus.com

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1	08656-60065	7	1	KEYBOARD ASSEMBLY	28480	08656-60065
A1J1	1251-5923	0	1	CONNECTOR 14-PIN M POST TYPE	28480	1251-5923
A1S1	5060-9436	7	48	PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1805	8	1	KEY CAP, HALF 'V'	28480	5041-1805
A1S2	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1793	3	1	KEY CAP, HALF 'SEQ'	28480	5041-1793
A1S3	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1806	9	1	KEY CAP, HALF 'MV'	28480	5041-1806
A1S4	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1789	7	1	KEY CAP, HALF 'STORE'	28480	5041-1789
A1S5	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1807	0	1	KEY CAP, HALF 'UV'	28480	5041-1807
A1S6	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1790	0	1	KEY CAP, HALF 'RECALL'	28480	5041-1790
A1S7	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1792	2	1	KEY CAP, HALF 'LOCAL'	28480	5041-1792
A1S8	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1791	1	1	KEY CAP, HALF 'DISPLAY'	28480	5041-1791
A1S9	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1796	6	1	KEY CAP, HALF 'MHZ'	28480	5041-1796
A1S10	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1802	5	1	KEY CAP, HALF 'DBM'	28480	5041-1802
A1S11	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1795	5	1	KEY CAP, HALF 'KHZ'	28480	5041-1795
A1S12	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1803	6	1	KEY CAP, HALF 'DBF'	28480	5041-1803
A1S13	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1800	3	1	KEY CAP, HALF '%'	28480	5041-1800
A1S14	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1801	4	1	KEY CAP, HALF 'DB'	28480	5041-1801
A1S15	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1813	8	1	KEY CAP, HALF 'BACKSPACE'	28480	5041-1813
A1S16	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1804	7	1	KEY CAP, HALF 'EMF'	28480	5041-1804
A1S17	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1786	4	1	KEY CAP, HALF 'NUMBER 8'	28480	5041-1786
A1S18	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1784	2	2	KEY CAP, HALF 'NUMBER 9'	28480	5041-1784
A1S19	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1783	1	1	KEY CAP, HALF 'NUMBER 5'	28480	5041-1783
A1S20	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1784	2		KEY CAP, HALF 'NUMBER 6'	28480	5041-1784
A1S21	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1780	8	1	KEY CAP, HALF 'NUMBER 2'	28480	5041-1780
A1S22	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1781	9	1	KEY CAP, HALF 'NUMBER 3'	28480	5041-1781
A1S23	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1787	5	1	KEY CAP, HALF 'DECIMAL POINT'	28480	5041-1787
A1S24	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1788	6	1	KEY CAP, HALF 'MINUS'	28480	5041-1788
A1S25	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1814	9	1	KEY CAP, FULL 'AMPTD'	28480	5041-1814
A1S26	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1785	3	1	KEY CAP, HALF 'NUMBER 7'	28480	5041-1785
A1S27	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1799	9	8	KEY CAP, HALF 'INCREMENT AMPTD'	28480	5041-1799
A1S28	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1782	0	1	KEY CAP, HALF 'NUMBER 4'	28480	5041-1782
A1S29	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1799	9		KEY CAP, HALF 'DECREMENT AMPTD'	28480	5041-1799
A1S30	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1779	5	1	KEY CAP, HALF 'NUMBER 1'	28480	5041-1779
A1S31	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1815	0	1	KEY CAP,SMALL DOUBLE FULL 'INCR SET'	28480	5041-1815
A1S32	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1778	4	1	KEY CAP, HALF 'NUMBER 0'	28480	5041-1778
A1S33	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1627	2	1	KEY CAP, FULL 'FM'	28480	5041-1627
A1S34	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1630	7	1	KEY CAP, DOUBLE FULL 'FREQUENCY'	28480	5041-1630
A1S35	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1799	9		KEY CAP, HALF 'INCREMENT FM'	28480	5041-1799
A1S36	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1808	1	1	KEY CAP, HALF 'COARSE TUNE'	28480	5041-1808

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

ManualsPlus.com

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1S37	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1799	9		KEY CAP, HALF 'INCREMENT FREQ'	28480	5041-1799
A1S38	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1799	9		KEY CAP, HALF 'DECREMENT FREQ'	28480	5041-1799
A1S39	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1809	2	1	KEY CAP, HALF 'FINE TUNE'	28480	5041-1809
A1S40	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1799	9		KEY CAP, HALF 'DECREMENT FM'	28480	5041-1799
A1S41	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1794	4	1	KEY CAP, HALF 'EXT'	28480	5041-1794
A1S42	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1628	3	1	KEY CAP, FULL 'AM'	28480	5041-1628
A1S43	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1810	5	1	KEY CAP, HALF 'INT 400 HZ'	28480	5041-1810
A1S44	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1799	9		KEY CAP, HALF 'INCREMENT AM'	28480	5041-1799
A1S45	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1811	6	1	KEY CAP, HALF 'INT 1 KHZ'	28480	5041-1811
A1S46	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1812	7	1	KEY CAP, HALF 'HP-IB ADRS'	28480	5041-1812
A1S47	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1797	7	1	KEY CAP, HALF 'OFF'	28480	5041-1797
A1S48	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1799	9		KEY CAP, HALF 'DECREMENT AM'	28480	5041-1799
A1S49	3101-2382	4	1	SWITCH, TOGGLE SPDT	28480	3101-2382
	0520-0155	0	2	SCREW-MACH 2-56 .125-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2190-0890	1	2	WASHER-LK HLCL NO. 2 .088-IN-ID	28480	2190-0890
	2420-0001	5	2	NUT-HEX-W/LKWR 6-32-THD .109-IN-THK	00000	ORDER BY DESCRIPTION
	08656-20025	5	2	STANDOFF-SWITCH	28480	08656-20025
A2	08656-60009	9	1	DISPLAY ASSEMBLY	28480	08656-60009
A2C1	0180-0100	3	5	CAPACITOR-FXD 4.7UF+-10% 35VDC TA	56289	150D475X9035B2
A2C2	0160-3879	7	20	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2C3	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2C4	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2C5	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2C6	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2C7	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2C8	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2C9	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2C10	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2C11	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2C12	0160-0573	2	1	CAPACITOR-FXD 4700PF +-20% 100VDC CER	28480	0160-0573
A2C13	0160-3878	6	82	CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A2DS1	1990-0486	6	19	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4684
	1400-1008	1	19	STANDOFF-LED	28480	1400-1008
A2DS2	1990-0486	6		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4684
	1400-1008	1		STANDOFF-LED	28480	1400-1008
A2DS3	1990-0486	6		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4684
	1400-1008	1		STANDOFF-LED	28480	1400-1008
A2DS4	1990-0486	6		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4684
	1400-1008	1		STANDOFF-LED	28480	1400-1008
A2DS5	1990-0486	6		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4684
	1400-1008	1		STANDOFF-LED	28480	1400-1008
A2DS6	1990-0486	6		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4684
	1400-1008	1		STANDOFF-LED	28480	1400-1008
A2DS7	1990-0486	6		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4684
	1400-1008	1		STANDOFF-LED	28480	1400-1008
A2DS8	1990-0486	6		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4684
	1400-1008	1		STANDOFF-LED	28480	1400-1008
A2DS9	1990-0486	6		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4684
	1400-1008	1		STANDOFF-LED	28480	1400-1008
A2DS10	1990-0486	6		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4684
	1400-1008	1		STANDOFF-LED	28480	1400-1008
A2DS11	1990-0486	6		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4684
	1400-1008	1		STANDOFF-LED	28480	1400-1008
A2DS12	1990-0486	6		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4684
	1400-1008	1		STANDOFF-LED	28480	1400-1008
A2DS13	1990-0486	6		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4684
	1400-1008	1		STANDOFF-LED	28480	1400-1008
A2DS14	1990-0486	6		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4684
	1400-1008	1		STANDOFF-LED	28480	1400-1008
A2DS15	1990-0486	6		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4684
	1400-1008	1		STANDOFF-LED	28480	1400-1008
A2DS16	1990-0486	6		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4684
	1400-1008	1		STANDOFF-LED	28480	1400-1008
A2DS17	1990-0486	6		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4684
	1400-1008	1		STANDOFF-LED	28480	1400-1008
A2DS18	1990-0486	6		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4684
	1400-1008	1		STANDOFF-LED	28480	1400-1008

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

ManualsPlus.com

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2DS19	1990-0486	6		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4684
	1400-1008	1		STANDOFF-LED	28480	1400-1008
A2J1	1251-5343	8	1	CONNECTOR 12-PIN M POST TYPE	28480	1251-5343
A2J2	1251-5922	9	1	CONNECTOR 14-PIN M POST TYPE	28480	1251-5922
A2MP1	08656-00008	2	4	FRONT PANEL, REAR BRACKET	28480	08656-00008
	2360-0113	2	29	SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A2R1	1810-0275	1	1	NETWORK, RES 1K 10-PIN-SIP .1-PIN-SPCG	01121	210A102
A2R2	1810-0206	8	1	NETWORK, RES 10K 8-PIN-SIP .1PIN-SPCG	01121	208A103
A2R3	0757-0279	0	5	RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A2R4	0698-3161	9	2	RESISTOR 38.3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3832-F
A2R5	0757-0443	0	1	RESISTOR 11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1102-F
A2R6	1810-0402	6	12	NETWORK, RES 330 16-PIN-DIP .1-PIN-SPCG	01121	316B331
A2R7	1810-0402	6		NETWORK, RES 330 16-PIN-DIP .1-PIN-SPCG	01121	316B331
A2R8	1810-0402	6		NETWORK, RES 330 16-PIN-DIP .1-PIN-SPCG	01121	316B331
A2R9	1810-0402	6		NETWORK, RES 330 16-PIN-DIP .1-PIN-SPCG	01121	316B331
A2R10	1810-0402	6		NETWORK, RES 330 16-PIN-DIP .1-PIN-SPCG	01121	316B331
A2R11	1810-0402	6		NETWORK, RES 330 16-PIN-DIP .1-PIN-SPCG	01121	316B331
A2R12	1810-0402	6		NETWORK, RES 330 16-PIN-DIP .1-PIN-SPCG	01121	316B331
A2R13	0757-0797	7	1	RESISTOR 90.9 1% .5W F TC=0+-100	28480	0757-0797
A2R14	1810-0402	6		NETWORK, RES 330 16-PIN-DIP .1-PIN-SPCG	01121	316B331
A2R15	1810-0403	7	2	NETWORK-RESISTOR R1-R15: 330 OHM+-2%	01121	316A331
A2R16	1810-0402	6		NETWORK, RES 330 16-PIN-DIP .1-PIN-SPCG	01121	316B331
A2R17	1810-0402	6		NETWORK, RES 330 16-PIN-DIP .1-PIN-SPCG	01121	316B331
A2R18	1810-0402	6		NETWORK, RES 330 16-PIN-DIP .1-PIN-SPCG	01121	316B331
A2R19	0698-3446	3	5	RESISTOR 383 1% .125W F TC=0+-100	24546	C4-1/8-T0-383R-F
A2R20	0698-3441	8	12	RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A2R21	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A2R22	1810-0403	7		NETWORK-RESISTOR R1-R15: 330 OHM+-2%	01121	316A331
A2R23	1810-0402	6		NETWORK, RES 330 16-PIN-DIP .1-PIN-SPCG	01121	316B331
A2R24	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A2R25	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2TP1	0360-0077	5	9	TERMINAL-STUD SGL-TUR SWGFRM-MTG	28480	0360-0077
A2TP2	0360-0077	5		TERMINAL-STUD SGL-TUR SWGFRM-MTG	28480	0360-0077
A2TP3	0360-0077	5		TERMINAL-STUD SGL-TUR SWGFRM-MTG	28480	0360-0077
A2TP4	0360-0077	5		TERMINAL-STUD SGL-TUR SWGFRM-MTG	28480	0360-0077
A2TP5	0360-0077	5		TERMINAL-STUD SGL-TUR SWGFRM-MTG	28480	0360-0077
A2TP6	0360-0077	5		TERMINAL-STUD SGL-TUR SWGFRM-MTG	28480	0360-0077
A2TP7	1251-0600	0	53	CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2TP8	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2TP9	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2TP10	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2TP11	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2TP12	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2TP13	0360-0077	5		TERMINAL-STUD SGL-TUR SWGFRM-MTG	28480	0360-0077
A2TP14	0360-0077	5		TERMINAL-STUD SGL-TUR SWGFRM-MTG	28480	0360-0077
A2TP15	0360-0077	5		TERMINAL-STUD SGL-TUR SWGFRM-MTG	28480	0360-0077
A2U1	1820-2056	1	4	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS378N
A2U2	1820-1858	9	2	IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A2U3	1820-1560	0	2	IC SHF-RGTR CMOS D-TYPE SERIAL-IN	27014	MM74C165N
A2U4	1990-0592	5	13	DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7653
	1200-0859	4	14	SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-0859
A2U5	1990-0592	5		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7653
	1200-0859	4		SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-0859
A2U6	1990-0592	5		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7653
	1200-0859	4		SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-0859
A2U7	1990-0592	5		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7653
	1200-0859	4		SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-0859
A2U8	1990-0592	5		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7653
	1200-0859	4		SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-0859
A2U9	1990-0592	5		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7653
	1200-0859	4		SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-0859
A2U10	1990-0592	5		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7653
	1200-0859	4		SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-0859
A2U11	1990-0592	5		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7653
	1200-0859	4		SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-0859
A2U12	1990-0592	5		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7653
	1200-0859	4		SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-0859
A2U13	1990-0592	5		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7653
	1200-0859	4		SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-0859
A2U14	1990-0681	3	1	DISPLAY-AN-SEG 1-CHAR .408-H RED	28480	5082-7656
	1200-0859	4		SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-0859
A2U15	1990-0592	5		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7653
	1200-0859	4		SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-0859
A2U16	1990-0592	5		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7653
	1200-0859	4		SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-0859

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

ManualsPlus.com

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2U17	1990-0592	5		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7653
	1200-0859	4		SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-0859
A2U18	1820-1560	0		IC SHF-RGTR CMOS D-TYPE SERIAL-IN	27014	MM74C165N
A2U19	1820-1316	4	1	IC GATE CMOS 8-INP	0192B	CD4048AE
A2U20	1820-0618	7	3	IC BFR TTL NON-INV HEX	01295	SN7417N
A2U21	1820-2186	8	2	IC DRVR TTL LED DRVR 7-INP	01295	SN75497N
A2U22	1820-2186	8		IC DRVR TTL LED DRVR 7-INP	01295	SN75497N
A2U23	1820-1433	6	2	IC SHF-RGTR TTL LS R-S SERIAL-IN PRL-OUT	01295	SN74LS164N
A2U24	1820-1433	6		IC SHF-RGTR TTL LS R-S SERIAL-IN PRL-OUT	01295	SN74LS164N
A2U25	1820-1216	3	4	IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A2U26	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A2U27	1820-1413	2	12	IC DCDR CMOS BCD-TO-7-SEG 4-TO-7-LINE	0192B	CD4511BE
A2U28	1820-1423	4	6	IC MV TTL LS MONOSTBL RETRIG DUAL	01295	SN74LS123N
A2U29	1820-1413	2		IC DCDR CMOS BCD-TO-7-SEG 4-TO-7-LINE	0192B	CD4511BE
A2U30	1820-2056	1		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS378N
A2U31	1820-1413	2		IC DCDR CMOS BCD-TO-7-SEG 4-TO-7-LINE	0192B	CD4511BE
A2U32	1820-1413	2		IC DCDR CMOS BCD-TO-7-SEG 4-TO-7-LINE	0192B	CD4511BE
A2U33	1820-1413	2		IC DCDR CMOS BCD-TO-7-SEG 4-TO-7-LINE	0192B	CD4511BE
A2U34	1820-1413	2		IC DCDR CMOS BCD-TO-7-SEG 4-TO-7-LINE	0192B	CD4511BE
A2U35	1820-1413	2		IC DCDR CMOS BCD-TO-7-SEG 4-TO-7-LINE	0192B	CD4511BE
A2U36	1820-1413	2		IC DCDR CMOS BCD-TO-7-SEG 4-TO-7-LINE	0192B	CD4511BE
A2U37	1820-1413	2		IC DCDR CMOS BCD-TO-7-SEG 4-TO-7-LINE	0192B	CD4511BE
A2U38	1820-2056	1		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS378N
A2U39	1820-1413	2		IC DCDR CMOS BCD-TO-7-SEG 4-TO-7-LINE	0192B	CD4511BE
A2U40	1820-1413	2		IC DCDR CMOS BCD-TO-7-SEG 4-TO-7-LINE	0192B	CD4511BE
A2U41	1820-1413	2		IC DCDR CMOS BCD-TO-7-SEG 4-TO-7-LINE	0192B	CD4511BE
A2U42	1820-1858	9		IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A3	08656-60003	3	1	LOW FREQUENCY LOOP ASSEMBLY	28480	08656-60003
A3C1	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3C2	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3C3	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3C4	0160-0575	4	24	CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A3C5	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A3C6	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A3C7	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A3C8	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3C9	0160-2055	9	25	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3C10	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A3C11	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3C12	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3C13	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A3C14	0160-4082	6	3	CAPACITOR-FDTHRU 1000PF 20% 200V CER (INCLUDES MOUNTING HARDWARE)	28480	0160-4082
A3C15	0160-2437	1	1	CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A3C16	0160-4370	5	1	CAPACITOR-FXD 1000PF +-5% 200VDC CER	51642	200-200-NP0-102J
A3C17	0160-4350	1	1	CAPACITOR-FXD 68PF +-5% 200VDC CER 0+-30	28480	0160-4350
A3C18	0160-4386	3	2	CAPACITOR-FXD 33PF +-5% 200VDC CER 0+-30	51642	200-200-NP0-330J
A3C19	0160-0434	4	2	CAPACITOR-FXD 10PF +-.1PF 500VDC CER	28480	0160-0434
A3C20	0160-0700	7	1	CAPACITOR-FXD 150PF +-10% 100VDC CER	28480	0160-0700
A3C21	0160-0375	2	4	CAPACITOR-FXD 2.2PF +-.1PF 300VDC CER	28480	0160-0375
A3C22	0160-0434	4		CAPACITOR-FXD 10PF +-.1PF 500VDC CER	28480	0160-0434
A3C23	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A3C24	0160-3022	2	1	CAPACITOR-FXD 16PF +-1% 500VDC CER 0+-30	28480	0160-3022
A3C25	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3C26	0160-0375	2		CAPACITOR-FXD 2.2PF +-.1PF 300VDC CER	28480	0160-0375
A3C27	0160-4521	8	1	CAPACITOR-FXD 12PF +-5% 200VDC CER 0+-30	51642	200-200-NP0-120J
A3C28	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A3C29	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A3C30	0160-3873	1		CAPACITOR-FXD 4.7PF +-.5PF 200VDC CER	28480	0160-3873
A3C31	0121-0448	8		CAPACITOR-V TRMR-CER 2.5-5PF 63V PC-MTG	28480	0121-0448
A3C32	0160-2236	8	1	CAPACITOR-FXD 1PF +-.25PF 500VDC CER	28480	0160-2236
A3C33	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3C34	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3C35	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A3C36	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A3C37	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3C38	0160-0154	5	3	CAPACITOR-FXD 2200PF +-10% 200VDC POLYE	28480	0160-0154
A3C39	0160-0161	4	2	CAPACITOR-FXD .01UF +-10% 200VDC POLYE	28480	0160-0161
A3C40	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A3C41	0160-4764	1	2	CAPACITOR-FXD 150PF +-5% 100VDC CER	28480	0160-4764
A3C42	0160-0300	3	1	CAPACITOR-FXD 2700PF +-10% 200VDC POLYE	28480	0160-0300
A3C43	0170-0040	9	2	CAPACITOR-FXD .047UF +-10% 200VDC POLYE	56289	292P47392
A3C44	0160-0154	5		CAPACITOR-FXD 2200PF +-10% 200VDC POLYE	28480	0160-0154

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

ManualsPlus.com

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	CD	Qty	Description	Mfr Code	Mfr Part Number
A3C45	0160-0194	3	1	CAPACITOR-FXD .015UF +-10% 200VDC POLYE	28480	0160-0194
A3C46	0160-0161	4		CAPACITOR-FXD .01UF +-10% 200VDC POLYE	28480	0160-0161
A3C47	0180-0100	3		CAPACITOR-FXD 4.7UF+-10% 35VDC TA	56289	150D475X9035B2
A3C48	0180-0100	3		CAPACITOR-FXD 4.7UF+-10% 35VDC TA	56289	150D475X9035B2
A3C49	0160-4231	7	1	CAPACITOR-FXD 4700PF +-5% 50VDC	28480	0160-4231
A3C50	0160-0153	4	2	CAPACITOR-FXD 1000PF +-10% 200VDC POLYE	28480	0160-0153
A3C51	0160-3072	2	5	CAPACITOR-FXD 1UF +-10% 100VDC MET-POLYE	28480	0160-3072
A3C52	0160-3072	2		CAPACITOR-FXD 1UF +-10% 100VDC MET-POLYE	28480	0160-3072
A3C53	0160-3072	2		CAPACITOR-FXD 1UF +-10% 100VDC MET-POLYE	28480	0160-3072
A3C54	0160-4929	0	1	CAPACITOR-FXD .022UF +-2% 100VDC CER	56289	5CC0G223X2100C5
A3C55	0160-3916	3	1	CAPACITOR-FXD 220PF +-2% 100VDC CER	51642	200-100-NP0-221G
A3C56	0180-2104	1	1	CAPACITOR-FXD 40UF+-20% 30VDC TA	06001	69F2143G7
A3C57	0180-0228	6	1	CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A3C58	0180-1746	5	5	CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A3C59	0160-0154	5		CAPACITOR-FXD 2200PF +-10% 200VDC POLYE	28480	0160-0154
A3C60	0180-0229	7	3	CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A3C61	0160-2453	1	2	CAPACITOR-FXD .22UF +-10% 80VDC POLYE	28480	0160-2453
A3C62	0160-2453	1		CAPACITOR-FXD .22UF +-10% 80VDC POLYE	28480	0160-2453
A3C63	0180-0291	3	10	CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A3C64	0160-2208	4	1	CAPACITOR-FXD 330PF +-5% 300VDC MICA	28480	0160-2208
A3C65	0180-2216	6	1	CAPACITOR-FXD 350UF+75-10% 16VDC AL	56289	30D357G016DH2
A3C66	0160-2307	4	1	CAPACITOR-FXD 47PF +-5% 300VDC MICA	28480	0160-2307
A3C67	0160-4653	7	1	CAPACITOR-FXD .1UF +-5% 100VDC MET-POLYP	28480	0160-4653
A3C68	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A3C69	0160-3072	2		CAPACITOR-FXD 1UF +-10% 100VDC MET-POLYE	28480	0160-3072
A3C70	0160-3661	5	1	CAPACITOR-FXD .1UF +-5% 50VDC MET-POLYC	28480	0160-3661
A3C71	0160-0153	4		CAPACITOR-FXD 1000PF +-10% 200VDC POLYE	28480	0160-0153
A3C72	0160-0162	5	1	CAPACITOR-FXD .022UF +-10% 200VDC POLYE	28480	0160-0162
A3C73	0170-0040	9		CAPACITOR-FXD .047UF +-10% 200VDC POLYE	56289	292P47392
A3C74	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A3C75	0180-2206	4	1	CAPACITOR-FXD 60UF+-10% 6VDC TA	56289	150D606X9006B2
A3C76	0140-0196	3	2	CAPACITOR-FXD 150PF +-5% 300VDC MICA	72136	DM15F151J0300WV1CR
A3C77	0160-2259	5	1	CAPACITOR-FXD 12PF +-5% 500VDC CER 0+-30	28480	0160-2259
A3C78	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A3C79	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A3C80	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A3C81	0160-3072	2		CAPACITOR-FXD 1UF +-10% 100VDC MET-POLYE	28480	0160-3072
A3C82	0160-0570	9	2	CAPACITOR-FXD 220PF +-20% 100VDC CER	20932	5024EM100RD221M
A3C83	0180-0094	4	2	CAPACITOR-FXD 100UF+75-10% 25VDC AL	56289	30D107G025DD2
A3C84	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A3C85	0140-0196	3		CAPACITOR-FXD 150PF +-5% 300VDC MICA	72136	DM15F151J0300WV1CR
A3C86	0121-0061	1	1	CAPACITOR-V TRMR-CER 5.5-18PF 350V	52763	304322 5.5/18PF NPO
A3C87	0160-0574	3	3	CAPACITOR-FXD .022UF +-20% 100VDC CER	28480	0160-0574
A3C88	0140-0205	5	1	CAPACITOR-FXD 62PF +-5% 300VDC MICA	72136	DM15E620J0300WV1CR
A3C89	0160-4387	4	1	CAPACITOR-FXD 47PF +-5% 200VDC CER 0+-30	28480	0160-4387
A3C90	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A3C91	0180-0094	4		CAPACITOR-FXD 100UF+75-10% 25VDC AL	56289	30D107G025DD2
A3C92	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A3C93	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A3C94	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A3C95	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A3C96	0160-4385	2	1	CAPACITOR-FXD 15PF +-5% 200VDC CER 0+-30	51642	200-200-NP0-150J
A3C97	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3CR1	0122-0065	7	6	DIODE-VVC 29PF 3%	28480	0122-0065
A3CR2	1901-0179	7	6	DIODE-SWITCHING 15V 50MA 750PS DO-7	28480	1901-0179
A3CR3	1901-0179	7		DIODE-SWITCHING 15V 50MA 750PS DO-7	28480	1901-0179
A3CR4	1901-0050	3	56	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A3CR5	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A3CR6	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A3CR7	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A3CR8	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A3CR9	1901-0586	0	3	DIODE-GEN PRP 30V 25MA TO-72	28480	1901-0586
A3CR10	1901-0586	0		DIODE-GEN PRP 30V 25MA TO-72	28480	1901-0586
A3CR11	1901-0586	0		DIODE-GEN PRP 30V 25MA TO-72	28480	1901-0586
A3CR12	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A3CR13	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A3CR14	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A3CR15	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A3CR16	1901-0527	9	1	DIODE-CUR RGLTR 75V DO-7	28480	1901-0527
A3CR17	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A3CR18	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A3CR19	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A3CR20	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A3CR21	1901-0539	3	2	DIODE-SM SIG SCHOTTKY	28480	1901-0539
A3CR22	1901-0539	3		DIODE-SM SIG SCHOTTKY	28480	1901-0539
A3CR23	1901-0535	9	4	DIODE-SM SIG SCHOTTKY	28480	1901-0535
A3CR24	1901-0535	9		DIODE-SM SIG SCHOTTKY	28480	1901-0535
A3CR25	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050

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

ManualsPlus.com

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3CR26	1901-0535	9		DIODE-SM SIG SCHOTTKY	28480	1901-0535
A3CR27	1901-0535	9		DIODE-SM SIG SCHOTTKY	28480	1901-0535
A3CR28	1901-0376	6	3	DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A3CR29	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A3CR30	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A3CR31	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A3CR32	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A3CR33	0122-0065	7		DIODE-VVC 29PF 3%	28480	0122-0065
A3CR34	1901-0179	7		DIODE-SWITCHING 15V 50MA 750PS DO-7	28480	1901-0179
A3CR35	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A3E1	9170-0847	3	1	CORE-SHIELDING BEAD	02114	56-590-65/3B PARYLENE COATED
A3E2	9170-0029	3	1	CORE-SHIELDING BEAD	28480	9170-0029
A3J1	1251-5568	9	2	CONNECTOR 8-PIN M POST TYPE	28480	1251-5568
A3J2	1200-0507	9	11	SOCKET-IC 16-CONT DIP-SLDR	28480	1200-0507
A3J3	1200-0507	9		SOCKET-IC 16-CONT DIP-SLDR	28480	1200-0507
A3J4	1250-1626	0	4	CONNECTOR-RF SMC M PC 50-OHM	28480	1250-1626
	3050-0079	3	2	WASHER-FL NM NO. 2 .094-IN-ID .188-IN-OD	28480	3050-0079
A3J5	1250-1626	0		CONNECTOR-RF SMC M PC 50-OHM	28480	1250-1626
	3050-0079	3		WASHER-FL NM NO. 2 .094-IN-ID .188-IN-OD	28480	3050-0079
A3L1	9100-1618	1	8	INDUCTOR RF-CH-MLD 5.6UH 10%	28480	9100-1618
A3L2	9100-1618	1		INDUCTOR RF-CH-MLD 5.6UH 10%	28480	9100-1618
A3L3	9100-1618	1		INDUCTOR RF-CH-MLD 5.6UH 10%	28480	9100-1618
A3L4	9140-0144	0	5	INDUCTOR RF-CH-MLD 4.7UH 10% .105DX.26LG	28480	9140-0144
A3L5				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A3L6				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A3L7				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A3L8				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A3L9				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A3L10				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A3L11				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A3L12				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A3L13				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A3L14				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A3L15	9135-0073	3	5	INDUCTOR RF-CH-MLD 51NH 6% .102DX.26LG	28480	9135-0073
A3L16	9135-0071	1	2	INDUCTOR RF-CH-MLD 62NH 5% .102DX.26LG	28480	9135-0071
A3L17	9100-3368	2	1	INDUCTOR RF-CH-MLD 600NH 5% .2DX.385LG	28480	9100-3368
A3L18	9140-0112	2	2	INDUCTOR RF-CH-MLD 4.7UH 10%	28480	9140-0112
A3L19	9100-2247	4	20	INDUCTOR RF-CH-MLD 100NH 10% .105DX.26LG	28480	9100-2247
A3L20	9140-0112	2		INDUCTOR RF-CH-MLD 4.7UH 10%	28480	9140-0112
A3L21	9140-0144	0		INDUCTOR RF-CH-MLD 4.7UH 10% .105DX.26LG	28480	9140-0144
A3L22	9140-0141	7	4	INDUCTOR RF-CH-MLD 680NH 10% .105DX.26LG	28480	9140-0141
A3L23†				NOT ASSIGNED		
A3L24				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A3L25	9140-0141	7		INDUCTOR RF-CH-MLD 680NH 10% .105DX.26LG	28480	9140-0141
A3MP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3MP2	1400-0966	8	17	CLIP-HINGE	91506	6015-13AT
A3MP3	2190-0087	8	3	WASHER-LK HLCL NO. 8 .168-IN-ID	28480	2190-0087
A3MP4	2360-0113	2		SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A3MP5	2580-0002	4	1	NUT-HEX-DBL-CHAM 8-32-THD .085-IN-THK	00000	ORDER BY DESCRIPTION
A3MP6	3050-0063	5	2	WASHER-FL MTLC NO. 8 .172-IN-ID	28480	3050-0063
A3MP7	3050-0121	6	1	WASHER-FL MTLC NO. 6 .144-IN-ID	28480	3050-0121
A3MP8	4208-0277	9	1	FOAM, BOTTOM, 60/110MHZ SECTION	28480	4208-0277
A3MP9	9220-3065	0	1	FOAM, TOP, 60/110MHZ SECTION	28480	9220-3065
A3MP10	7120-8855	2	1	LABEL, INFO (50MHZ LEVEL)	28480	7120-8855
A3MP11	7120-8856	3	1	LABEL, INFO (60-110MHZ FLATNESS)	28480	7120-8856
A3MP12	08656-00029	7	1	BOTTOM COVER, 60/110MHZ SECTION	28480	08656-00029
A3MP13	08656-00030	0	1	TOP COVER, 60/110MHZ SECTION	28480	08656-00030
A3MP14	08656-00031	1	1	BOTTOM COVER, 50MHZ SECTION	28480	08656-00031
A3MP15	08656-00032	2	1	TOP COVER, 50MHZ SECTION	28480	08656-00032
A3MP16	08656-00041	3	2	CLIP-CAPACITOR GROUND	28480	08656-00041
A3MP17	08656-00044	6	1	SHIELD, FENCE	28480	08656-00044
A3Q1	1855-0280	2	1	TRANSISTOR J-FET N-CHAN D-MODE TO-92 SI	17856	E107
A3Q2	1855-0414	4	2	TRANSISTOR J-FET 2N4393 N-CHAN D-MODE	04713	2N4393
A3Q3	1854-0071	7	4	TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A3Q4	1855-0288	0	1	TRANSISTOR J-FET 2N5556 N-CHAN D-MODE	17856	2N5556
A3Q5	1854-0610	0	1	TRANSISTOR NPN SI TO-46 FT=800MHZ	28480	1854-0610
A3Q6	1854-0345	8	2	TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3Q7	1854-0696	2	6	TRANSISTOR NPN SI TO-72 PD=200MW	28480	1854-0696
A3Q8	1854-0696	2		TRANSISTOR NPN SI TO-72 PD=200MW	28480	1854-0696
A3Q9	1854-0247	9	3	TRANSISTOR NPN SI TO-39 PD=1W FT=800MHZ	28480	1854-0247
A3Q10	1853-0018	0	1	TRANSISTOR PNP SI TO-72 PD=200MW FT=1GHZ	28480	1853-0018
A3Q11	1853-0015	7	1	TRANSISTOR PNP SI PD=200MW FT=500MHZ	28480	1853-0015
A3Q12	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3Q13	1855-0414	4		TRANSISTOR J-FET 2N4393 N-CHAN D-MODE	04713	2N4393

See introduction to this section for ordering information
*Indicates factory selected value
† FOR BACKDATING INFORMATION REFER TO SECTION VII

ManualsPlus.com

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3R1	0698-3151	7	5	RESISTOR 2.87K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2871-F
A3R2	0698-3444	1	12	RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A3R3	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A3R4	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A3R5	0698-3431	6	1	RESISTOR 23.7 1% .125W F TC=0+-100	03888	PME55-1/8-T0-23R7-F
A3R6	0698-3156	2	14	RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A3R7	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A3R8	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A3R9	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A3R10	0698-3151	7		RESISTOR 2.87K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2871-F
A3R11	0757-0441	8	3	RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A3R12	0757-0416	7	5	RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3R13	0757-0180	2	2	RESISTOR 31.6 1% .125W F TC=0+-100	28480	0757-0180
A3R14	0757-0405	4	5	RESISTOR 162 1% .125W F TC=0+-100	24546	C4-1/8-T0-162R-F
A3R15	0698-7199	1	5	RESISTOR 28.7 1% .05W F TC=0+-100	24546	C3-1/8-T00-28R7-G
A3R16	0698-7199	1		RESISTOR 28.7 1% .05W F TC=0+-100	24546	C3-1/8-T00-28R7-G
A3R17	0698-3443	0	2	RESISTOR 287 1% .125W F TC=0+-100	24546	C4-1/8-T0-287R-F
A3R18	0698-7199	1		RESISTOR 28.7 1% .05W F TC=0+-100	24546	C3-1/8-T00-28R7-G
A3R19	0698-7199	1		RESISTOR 28.7 1% .05W F TC=0+-100	24546	C3-1/8-T00-28R7-G
A3R20	0757-0418	9	6	RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-T0-619R-F
A3R21	0757-0400	9		RESISTOR 90.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-90R9-F
A3R22	0757-0159	5	1	RESISTOR 1K 1% .5W F TC=0+-100	28480	0757-0159
A3R23	1810-0203	5	2	NETWORK-RES 8-SIP470.0 OHM X 7	01121	208A471
A3R24	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A3R25	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R26	1810-0215	9	2	NETWORK-RES 8-SIP75.0K OHM X 7	01121	208A753
A3R27	0757-0418	9		RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-T0-619R-F
A3R28	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R29	0757-0405	4		RESISTOR 162 1% .125W F TC=0+-100	24546	C4-1/8-T0-162R-F
A3R30	0757-0422	5	2	RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A3R31	0757-0402	1	6	RESISTOR 110 1% .125W F TC=0+-100	24546	C4-1/8-T0-111-F
A3R32	0757-0418	9		RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-T0-619R-F
A3R33	0698-8789	7	1	RESISTOR 866 .25% .125W F TC=0+-50	28480	0698-8789
A3R34	0757-0418	9		RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-T0-619R-F
A3R35	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A3R36	0757-1094	9	7	RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A3R37	0757-0461	2	7	RESISTOR 68.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6812-F
A3R38	0757-1094	9		RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A3R39	0757-0418	9		RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-T0-619R-F
A3R40	1810-0215	9		NETWORK-RES 8-SIP75.0K OHM X 7	01121	208A753
A3R41	0757-0382	6	3	RESISTOR 16.2 1% .125W F TC=0+-100	19701	MF4C1/8-T0-16R2-F
A3R42	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A3R43	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A3R44	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A3R45	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A3R46	0698-3155	1	8	RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A3R47	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A3R48	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A3R49	0683-1865	5	2	RESISTOR 18M 5% .25W FC TC=-900/+1200	01121	CB1865
A3R50	0698-3160	8	3	RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A3R51	0757-0461	2		RESISTOR 68.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6812-F
A3R52	0683-1865	5		RESISTOR 18M 5% .25W FC TC=-900/+1200	01121	CB1865
A3R53	0757-0402	1		RESISTOR 110 1% .125W F TC=0+-100	24546	C4-1/8-T0-111-F
A3R54	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A3R55	0757-0402	1		RESISTOR 110 1% .125W F TC=0+-100	24546	C4-1/8-T0-111-F
A3R56	0699-0264	9	1	RESISTOR-MATCHED SET 5.0M & 50K OHMS	28480	0699-0264
A3R57	2100-0569	2	1	RESISTOR-TRMR 1M 20% C TOP-ADJ 1-TRN	28480	2100-0569
A3R58	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A3R59	0699-0264	9		PART OF R56 (5.0M)	28480	0699-0264
A3R60	0757-0382	6		RESISTOR 16.2 1% .125W F TC=0+-100	19701	MF4C1/8-T0-16R2-F
A3R61	0757-0424	7	9	RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A3R62	0757-0439	4	2	RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A3R63	0698-7188	8	2	RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T00-10R-G
A3R64	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A3R65	0757-0382	6		RESISTOR 16.2 1% .125W F TC=0+-100	19701	MF4C1/8-T0-16R2-F
A3R66	0757-0461	2		RESISTOR 68.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6812-F
A3R67	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R68	0757-1094	9		RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A3R69	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R70	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R71	0757-0461	2		RESISTOR 68.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6812-F
A3R72	0757-1094	9		RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A3R73	0698-3153	9	10	RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A3R74	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A3R75	0698-3151	7		RESISTOR 2.87K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2871-F

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

ManualsPlus.com

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3R76	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A3R77	0757-0290	5	2	RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A3R78	0757-0397	3		RESISTOR 68.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-68R1-F
A3R79	0687-5661	5	1	RESISTOR 56M 10% .5W CC TC=0+1059	01121	EB5661
A3R80	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A3R81	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A3R82	0757-0458	7	2	RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A3R83	0757-0461	2		RESISTOR 68.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6812-F
A3R84	0683-5655	9	2	RESISTOR 5.6M 5% .25W FC TC=-900/+1100	01121	CB5655
A3R85	0698-3157	3	5	RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A3R86	0698-6866	7	1	RESISTOR 2.182K .25% .125W F TC=0+-50	28480	0698-6866
A3R87	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A3R88	0698-3150	6	1	RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A3R89	0698-0084	9	8	RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A3R90	0757-0418	9		RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-T0-619R-F
A3R91	0757-0123	3	1	RESISTOR 34.8K 1% .125W F TC=0+-100	28480	0757-0123
A3R92	0683-5655	9		RESISTOR 5.6M 5% .25W FC TC=-900/+1100	01121	CB5655
A3R93	0683-2265	1	1	RESISTOR 22M 5% .25W FC TC=-900/+1200	01121	CB2265
A3R94	0757-0398	4	5	RESISTOR 75 1% .125W F TC=0+-100	24546	C4-1/8-T0-75R0-F
A3R95	0757-0402	1		RESISTOR 110 1% .125W F TC=0+-100	24546	C4-1/8-T0-111-F
A3R96	0757-0402	1		RESISTOR 110 1% .125W F TC=0+-100	24546	C4-1/8-T0-111-F
A3R97	0757-0402	1		RESISTOR 110 1% .125W F TC=0+-100	24546	C4-1/8-T0-111-F
A3R98	0698-3429	2	1	RESISTOR 19.6 1% .125W F TC=0+-100	03888	PME55-1/8-T0-19R6-F
A3R99	1810-0203	5		NETWORK-RES 8-SIP470.0 OHM X 7	01121	208A471
A3R100	0698-3457	6	6	RESISTOR 316K 1% .125W F TC=0+-100	28480	0698-3457
A3R101	0698-3457	6		RESISTOR 316K 1% .125W F TC=0+-100	28480	0698-3457
A3R102	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A3R103	0757-1094	9		RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A3R104	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A3R105	0698-3437	2	1	RESISTOR 133 1% .125W F TC=0+-100	24546	C4-1/8-T0-133R-F
A3R106	0698-3457	6		RESISTOR 316K 1% .125W F TC=0+-100	28480	0698-3457
A3R107	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A3R108	0698-3457	6		RESISTOR 316K 1% .125W F TC=0+-100	28480	0698-3457
A3R109	0757-0465	6	9	RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A3R110	2100-3659	7	1	RESISTOR-TRMR 20K 10% C TOP-ADJ 17-TRN	32997	3292W-1-203
A3R111	0698-7199	1		RESISTOR 28.7 1% .05W F TC=0+-100	24546	C3-1/8-T00-28R7-G
A3R112	0698-3445	2	4	RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A3R113	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A3R114	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A3R115	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A3R116	0757-0405	4		RESISTOR 162 1% .125W F TC=0+-100	24546	C4-1/8-T0-162R-F
A3R117	0698-0082	7	4	RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A3R118†	0757-0397	3	3	RESISTOR 68.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-68R1-F
A3R119	0757-0441	2		RESISTOR 68.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6812-F
A3TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3TP3	1251-1556	7	56	CONNECTOR-SGL CONT SKT .018-IN-BSC-SZ	28480	1251-1556
A3TP4	1251-1556	7		CONNECTOR-SGL CONT SKT .018-IN-BSC-SZ	28480	1251-1556
A3TP5	1251-1556	7		CONNECTOR-SGL CONT SKT .018-IN-BSC-SZ	28480	1251-1556
A3TP6	1251-1556	7		CONNECTOR-SGL CONT SKT .018-IN-BSC-SZ	28480	1251-1556
A3TP7	1251-1556	7		CONNECTOR-SGL CONT SKT .018-IN-BSC-SZ	28480	1251-1556
A3TP8	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3TP9	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3TP10	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3U1	1826-0188	8	1	IC CONV 8-B-D/A 16-DIP-C PKG	04713	MC1408L-8
A3U2	1820-1722	6	1	IC RGTR CMOS 8-BIT	04713	MC14559BCP
A3U3	1858-0066	8	3	TRANSISTOR ARRAY 16-PIN CER DIP	32293	IH401A
A3U4	1820-1272	1	1	IC BFR TTL LS NOR QUAD 2-INP	01295	SN74LS33N
A3U5	1820-1212	9	1	IC FF TTL LS J-K NEG-EDGE-TRIG	01295	SN74LS112AN
A3U6	1826-0522	4	3	IC OP AMP QUAD 14-DIP-P PKG	01295	TL074CN
A3U7	1858-0066	8		TRANSISTOR ARRAY 16-PIN CER DIP	32293	IH401A
A3U8	1826-0522	4		IC OP AMP QUAD 14-DIP-P PKG	01295	TL074CN
A3U9	1826-0174	2	2	IC COMPARATOR GP QUAD 14-DIP-P PKG	28480	1826-0174
A3U10	1820-1144	6	1	IC GATE TTL LS NOR QUAD 2-INP	01295	SN74LS02N
A3U11	1820-1423	4		IC MV TTL LS MONOSTBL RETRIG DUAL	01295	SN74LS123N
A3U12	1826-0522	4		IC OP AMP QUAD 14-DIP-P PKG	01295	TL074CN
A3U13	1820-1211	8	2	IC GATE TTL LS EXCL-OR QUAD 2-INP	01295	SN74LS86N
A3U14	1820-0681	4	1	IC GATE TTL S NAND QUAD 2-INP	01295	SN74S00N
A3U15	1820-1423	4		IC MV TTL LS MONOSTBL RETRIG DUAL	01295	SN74LS123N
A3U16	1826-0174	2		IC COMPARATOR GP QUAD 14-DIP-P PKG	28480	1826-0174
A3U17	1820-1112	8	4	IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A3U18	1858-0066	8		TRANSISTOR ARRAY 16-PIN CER DIP	32293	IH401A
A3U19	1820-1882	9	1	IC GATE ECL EXCL-OR QUAD	04713	MC10113L
A3U20	1820-2005	0	1	IC TIMER NMOS	0003J	UPD8253D

See introduction to this section for ordering information
*Indicates factory selected value
† FOR BACKDATING INFORMATION REFER TO SECTION VII

ManualsPlus.com

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3U21	1820-1423	4		IC MV TTL LS MONOSTBL RETRIG DUAL	01295	SN74LS123N
A3U22	1826-0547	3	1	IC OP AMP DUAL 8-DIP-P PKG	01295	TL072ACP
A3U23	1820-1788	4	1	IC CNTR ECL BIN SYNCHRO POS-EDGE-TRIG	07263	F10016DC
A3U24	1820-2008	3	2	IC SHF-RGTR CMOS D-M/S SERIAL-IN PRL-OUT	04713	MC14015BCP
A3U25	1820-2008	3		IC SHF-RGTR CMOS D-M/S SERIAL-IN PRL-OUT	04713	MC14015BCP
A3U26	1820-1225	4	1	IC FF ECL D-M/S DUAL	04713	MC10231P
A3U27	1820-1430	3	1	IC CNTR TTL LS BIN SYNCHRO POS-EDGE-TRIG	01295	SN74LS161AN
A3U28	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A3U29	1820-1383	5	2	IC CNTR ECL BCD POS-EDGE-TRIG	04713	MC10138L
A3U30	1820-0802	1	1	IC GATE ECL NOR QUAD 2-INP	04713	MC10102P
A3U31	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A3U32	1820-1383	5		IC CNTR ECL BCD POS-EDGE-TRIG	04713	MC10138L
A3VR1	1902-3002	3	1	DIODE-ZNR 2.37V 5% DO-7 PD=.4W TC=-.074%	28480	1902-3002
A3VR2	1902-0033	4	1	DIODE-ZNR 1N823 6.2V 5% DO-7 PD=.4W	24046	1N823
A3VR3	1902-0064	1	2	DIODE-ZNR 7.5V 5% DO-35 PD=.4W TC=+.05%	28480	1902-0064
A3VR4	1902-3139	7	4	DIODE-ZNR 8.25V 5% DO-35 PD=.4W	28480	1902-3139
A3VR5	1902-3139	7		DIODE-ZNR 8.25V 5% DO-35 PD=.4W	28480	1902-3139
A3VR6	1902-0041	4	1	DIODE-ZNR 5.11V 5% DO-35 PD=.4W	28480	1902-0041
A3VR7	1902-3139	7		DIODE-ZNR 8.25V 5% DO-35 PD=.4W	28480	1902-3139
A3Y1	0410-1130	0	1	CRYSTAL	28480	0410-1130
	1200-0758	2	1	SOCKET-XTAL 2-CONT HC-25/U DIP-SLDR	28480	1200-0758
A4	08656-60001	1	1	HIGH FREQUENCY LOOP ASSEMBLY	28480	08656-60001
A4C1	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A4C2	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4C3	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A4C4	0160-4389	6	6	CAPACITOR-FXD 100PF +-5PF 200VDC CER	51642	200-200-NP0-101J
A4C5	0160-4082	6		CAPACITOR-FDTHRU 1000PF 20% 200V CER	28480	0160-4082
A4C6	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A4C7	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A4C8	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A4C9	0160-3568	1	6	CAPACITOR-FXD 2.7PF +-5% 200VDC CER	51642	100-100-NP0-279J
A4C10	0160-3568	1		CAPACITOR-FXD 2.7PF +-5% 200VDC CER	51642	100-100-NP0-279J
A4C11	0160-3568	1		CAPACITOR-FXD 2.7PF +-5% 200VDC CER	51642	100-100-NP0-279J
A4C12	0160-4764	1		CAPACITOR-FXD 150PF +-5% 100VDC CER	28480	0160-4764
A4C13	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A4C14	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A4C15	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4C16	0160-3456	6	5	CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A4C17	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A4C18	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A4C19	0160-4389	6		CAPACITOR-FXD 100PF +-5PF 200VDC CER	51642	200-200-NP0-101J
A4C20	0160-4103	2	1	CAPACITOR-FXD 220PF +-5% 100VDC CER	72982	8121-M100-COG-221J
A4C21	0160-4498	8	4	CAPACITOR-FXD 5.6PF +-.5PF 200VDC CER	51642	200-200-NP0-569D
A4C22*	0160-3873	1	7	CAPACITOR-FXD 4.7PF +-.5PF 200VDC CER	28480	0160-3873
A4C23	0160-4498	8		CAPACITOR-FXD 5.6PF +-.5PF 200VDC CER	51642	200-200-NP0-569D
A4C24	0160-4518	3	3	CAPACITOR-FXD 3.9PF +-.5PF 200VDC CER	51642	200-200-NP0-399D
A4C25	0160-4389	6		CAPACITOR-FXD 100PF +-5PF 200VDC CER	51642	200-200-NP0-101J
A4C26	0160-4389	6		CAPACITOR-FXD 100PF +-5PF 200VDC CER	51642	200-200-NP0-101J
A4C27				NOT ASSIGNED		
A4C28	0160-3875	3	4	CAPACITOR-FXD 22PF +-5% 200VDC CER 0+-30	28480	0160-3875
A4C29	0160-3873	1		CAPACITOR-FXD 4.7PF +-.5PF 200VDC CER	28480	0160-3873
A4C30	0160-3568	1		CAPACITOR-FXD 2.7PF +-5% 200VDC CER	51642	100-100-NP0-279J
A4C31	0160-3876	4	4	CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
A4C32	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4C33	0160-3029	9	3	CAPACITOR-FXD 7.5PF +-.5PF 100VDC CER	28480	0160-3029
A4C34†	0180-0197	8	9	CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A4C35	0160-3029	9		CAPACITOR-FXD 7.5PF +-.5PF 100VDC CER	28480	0160-3029
A4C36	0160-4383	0	3	CAPACITOR-FXD 6.8PF +-.5PF 200VDC CER	20932	5024E0200RD689D
A4C37	0160-3029	9		CAPACITOR-FXD 7.5PF +-.5PF 100VDC CER	28480	0160-3029
A4C38	0160-4491	1	3	CAPACITOR-FXD 8.2PF +-5% 200VDC CER	51642	200-200-NP0-829J
A4C39	0160-2257	3	1	CAPACITOR-FXD 10PF +-5% 500VDC CER 0+-60	28480	0160-2257
A4C40				NOT ASSIGNED		
A4C41	0160-4491	1		CAPACITOR-FXD 8.2PF +-5% 200VDC CER	51642	200-200-NP0-829J
A4C42	0160-3875	3		CAPACITOR-FXD 22PF +-5% 200VDC CER 0+-30	28480	0160-3875
A4C43	0160-3873	1		CAPACITOR-FXD 4.7PF +-.5PF 200VDC CER	28480	0160-3873
A4C44	0160-3926	5	1	CAPACITOR-FDTHRU 100PF 20% 200V CER	28480	0160-3926
A4C45	0160-3875	3		CAPACITOR-FXD 22PF +-5% 200VDC CER 0+-30	28480	0160-3875
A4C46				NOT ASSIGNED		
A4C47	0160-3454	4	1	CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A4C48	0160-3459	9	1	CAPACITOR-FXD .02UF +-20% 100VDC CER	28480	0160-3459
A4C49	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A4C50	0160-4494	4	2	CAPACITOR-FXD 39PF +-5% 200VDC CER 0+-30	51642	200-200-NP0-390J

See introduction to this section for ordering information
*Indicates factory selected value
† FOR BACKDATING INFORMATION REFER TO SECTION VII

ManualsPlus.com

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A4C51	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4C52				NOT ASSIGNED		
A4C53	0121-0449	9	3	CAPACITOR-V TRMR-CER 3.5-10PF 63V PC-MTG	28480	0121-0449
A4C54				NOT ASSIGNED		
A4C55				NOT ASSIGNED		
A4C56				NOT ASSIGNED		
A4C57				NOT ASSIGNED		
A4C58				NOT ASSIGNED		
A4C59	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A4C60	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A4C61	0160-3875	3		CAPACITOR-FXD 22PF +-5% 200VDC CER 0+-30	28480	0160-3875
A4C62	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A4C63	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A4C64	0160-4767	4	1	CAPACITOR-FXD 20PF +-5% 200VDC CER 0+-30	28480	0160-4767
A4C65	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A4C66	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A4C67	0160-4497	7	1	CAPACITOR-FXD 82PF +-5% 200VDC CER 0+-30	28480	0160-4497
A4C68	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4C69	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A4C70	0160-2204	0	1	CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A4C71	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4C72	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A4C73†	0160-0155	6	1	CAPACITOR-FXD 3300PF +-10% 200VDC POLYE	28480	0160-0155
A4C74	0160-3453	3	3	CAPACITOR-FXD .05UF +80-20% 100VDC CER	28480	0160-3453
A4C75	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4C76	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4C77†	0160-2218	6	1	CAPACITOR-FXD 1000PF +-5% 300VDC MICA	28480	0160-2218
A4C78	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4C79	0160-3876	4		CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
A4C80	0160-3874	2	2	CAPACITOR-FXD 10PF +-.5PF 200VDC CER	28480	0160-3874
A4C81	0160-4382	9		CAPACITOR-FXD 3.3PF +-.25PF 200VDC CER	51642	200-200-NP0-339C
A4C82				NOT ASSIGNED		
A4C83	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A4C84	0160-3874	2		CAPACITOR-FXD 10PF +-.5PF 200VDC CER	28480	0160-3874
A4C85	0121-0449	9		CAPACITOR-V TRMR-CER 3.5-10PF 63V PC-MTG	28480	0121-0449
A4C86	0160-3568	1		CAPACITOR-FXD 2.7PF +-5% 200VDC CER	51642	100-100-NP0-279J
A4CR1	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A4CR2	1901-0189	9	1	DIODE-STEP RECOVERY	28480	1901-0189
A4CR3	1906-0098	9	4	DIODE-MATCHED 1V	28480	1906-0098
A4CR4	1906-0098	9		DIODE-MATCHED 1V	28480	1906-0098
A4CR5	1906-0098	9		DIODE-MATCHED 1V	28480	1906-0098
A4CR6	1906-0098	9		DIODE-MATCHED 1V	28480	1906-0098
A4CR7	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A4CR8	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A4CR9	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A4CR10	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A4CR11	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A4CR12	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A4CR13	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A4CR14				NOT ASSIGNED		
A4CR15				NOT ASSIGNED		
A4CR16	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A4CR17	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A4CR18	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A4CR19	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A4J1	1251-6731	0	1	CONNECTOR	28480	1251-6731
A4L1	9100-1627	2	4	INDUCTOR RF-CH-MLD 39UH 5% .166DX.385LG	28480	9100-1627
A4L2	9100-1627	2		INDUCTOR RF-CH-MLD 39UH 5% .166DX.385LG	28480	9100-1627
A4L3	9100-1627	2		INDUCTOR RF-CH-MLD 39UH 5% .166DX.385LG	28480	9100-1627
A4L4	9100-1627	2		INDUCTOR RF-CH-MLD 39UH 5% .166DX.385LG	28480	9100-1627
A4L5	9100-2247	4		INDUCTOR RF-CH-MLD 100NH 10% .105DX.26LG	28480	9100-2247
A4L6				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A4L7				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A4L8				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A4L9				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A4L10	9100-2247	4		INDUCTOR RF-CH-MLD 100NH 10% .105DX.26LG	28480	9100-2247
A4L11	9135-0071	1		INDUCTOR RF-CH-MLD 62NH 5% .102DX.26LG	28480	9135-0071
A4L12				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A4L13	9100-2247	4		INDUCTOR RF-CH-MLD 100NH 10% .105DX.26LG	28480	9100-2247
A4L14				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A4L15	9135-0073	3		INDUCTOR RF-CH-MLD 51NH 6% .102DX.26LG	28480	9135-0073
A4L16	9135-0073	3		INDUCTOR RF-CH-MLD 51NH 6% .102DX.26LG	28480	9135-0073
A4L17				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A4L18				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A4L19	9135-0076	6	2	INDUCTOR RF-CH-MLD 39NH 6% .102DX.26LG	28480	9135-0076
A4L20	9135-0074	4	1	INDUCTOR RF-CH-MLD 47NH 4% .102DX.26LG	28480	9135-0074

See introduction to this section for ordering information
*Indicates factory selected value
† FOR BACKDATING INFORMATION REFER TO SECTION VII

ManualsPlus.com

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A4L21	9135-0081	3	3	INDUCTOR RF-CH-MLD 68NH 5% .102DX.26LG	28480	9135-0081
A4L22	9135-0081	3		INDUCTOR RF-CH-MLD 68NH 5% .102DX.26LG	28480	9135-0081
A4L23	9140-0158	6	20	INDUCTOR RF-CH-MLD 1UH 10% .105DX.26LG	28480	9140-0158
A4L24	9140-0158	6		INDUCTOR RF-CH-MLD 1UH 10% .105DX.26LG	28480	9140-0158
A4L25				NOT ASSIGNED		
A4L26	9135-0081	3		INDUCTOR RF-CH-MLD 68NH 5% .102DX.26LG	28480	9135-0081
A4L27	9135-0076	6		INDUCTOR RF-CH-MLD 39NH 6% .102DX.26LG	28480	9135-0076
A4L28	9100-3512	8	2	INDUCTOR-50NH .285D X .4LG	28480	9100-3512
A4L29				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A4L30	9100-2248	5	2	INDUCTOR RF-CH-MLD 120NH 10% .105DX.26LG	28480	9100-2248
A4L31	9140-0141	7		INDUCTOR RF-CH-MLD 680NH 10% .105DX.26LG	28480	9140-0141
A4L32				NOT ASSIGNED		
A4L33	9100-2249	6	2	INDUCTOR RF-CH-MLD 150NH 10% .105DX.26LG	28480	9100-2249
A4L34	9100-1641	0	1	INDUCTOR RF-CH-MLD 240UH 5% .166DX.385LG	28480	9100-1641
A4L35	9135-0068	6	2	INDUCTOR RF-CH-MLD 33NH 6% .102DX.26LG	28480	9135-0068
A4L36	9100-3514	0	2	INDUCTOR-30NH .285D X .4LG	28480	9100-3514
A4L37	9100-3512	8		INDUCTOR-50NH .285D X .4LG	28480	9100-3512
A4L38	9100-3514	0		INDUCTOR-30NH .285D X .4LG	28480	9100-3514
A4L39	9100-3513	9	1	INDUCTOR-75NH .285D X .4LG	28480	9100-3513
A4L40	9135-0068	6		INDUCTOR RF-CH-MLD 33NH 6% .102DX.26LG	28480	9135-0068
A4L41	9100-2249	6		INDUCTOR RF-CH-MLD 150NH 10% .105DX.26LG	28480	9100-2249
A4MP1	0362-0227	1	1	CONNECTOR-SGL CONT SKT 1.14-MM-BSC-SZ	28480	0362-0227
A4MP2	1251-1556	7		CONNECTOR-SGL CONT SKT .018-IN-BSC-SZ	28480	1251-1556
A4MP3	8150-0468	1		WIRE 24AWG W/BK/O 300V PVC 7X32 80C	28480	8150-0468
A4MP4	08656-00033	3	35	GROUND CLIP-SEMI-RIGID	28480	08656-00033
A4MP5†	08656-00089	9	1	BRACKET-HF LOOP FEEDTHRU	28480	08656-00089
A4MP6	08656-00074	2	1	PLATE-HF LOOP BRACKET	28480	08656-00074
A4MP7†				NOT ASSIGNED		
A4MP8	2420-0026	4	2	NUT	00000	ORDER BY DESCRIPTION
A4MP9	2190-0630	7	2	WASHER-LOCK	28480	2190-0630
A4MP10	8150-0449	8	1	WIRE-AWG,RED	28480	8150-0449
A4MP11	8150-0460	3		WIRE-AWG,WHITE ORANGE	28480	8150-0460
A4MP12†	08656-00090	2	1	GROUNDING SPRING	28480	08656-00090
A4Q1	1853-0020	4	4	TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A4Q2	1854-0632	6	8	TRANSISTOR NPN SI PD=180MW FT=4GHZ	25403	BFR-91
A4Q3	1854-0696	2		TRANSISTOR NPN SI TO-72 PD=200MW	28480	1854-0696
A4Q4	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A4Q5	1854-0477	7	2	TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A4Q6	1855-0235	7	1	TRANSISTOR J-FET N-CHAN D-MODE TO-52 SI	28480	1855-0235
A4Q7	1853-0007	7	8	TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A4Q8	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A4Q9	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A4Q10	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A4R1	0698-7227	6	4	RESISTOR 422 1% .05W F TC=0+-100	24546	C3-1/8-T0-422R-G
A4R2	0698-7189	9	2	RESISTOR 11 1% .05W F TC=0+-100	24546	C3-1/8-T00-11R0-G
A4R3	0698-7227	6		RESISTOR 422 1% .05W F TC=0+-100	24546	C3-1/8-T0-422R-G
A4R4	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A4R5	0757-0440	7	2	RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A4R6*	0698-7218	5	2	RESISTOR 178 1% .05W F TC=0+-100	24546	C3-1/8-T0-178R-G
A4R7*	0698-7200	5	1	RESISTOR 31.6 1% .05W F TC=0+-100	24546	C3-1/8-T00-31R6-G
A4R8	0698-3438	3	5	RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-147R-F
A4R9	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A4R10*	0698-7218	5		RESISTOR 178 1% .05W F TC=0+-100	24546	C3-1/8-T0-178R-G
A4R11	0698-3440	7	7	RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A4R12	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A4R13	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A4R14	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A4R15	0757-0179	9	1	RESISTOR 196 1% .25W F TC=0+-100	24546	C5-1/4-T0-196R-F
A4R16	0698-7220	9	1	RESISTOR 215 1% .05W F TC=0+-100	24546	C3-1/8-T0-215R-G
A4R17	0698-7198	0	4	RESISTOR 26.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-26R1-G
A4R18	0698-7198	0		RESISTOR 26.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-26R1-G
A4R19	0698-7205	0	6	RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-51R1-G
A4R20	0698-7236	7	2	RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A4R21†	0757-0280	3	28	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A4R22	0698-3438	3		RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-147R-F
A4R23	0698-7205	0		RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-51R1-G
A4R24	0757-0394	0	3	RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A4R25	0757-0346	2	5	RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A4R26	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A4R27	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A4R28	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A4R29	0698-3132	4	3	RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A4R30	0698-3447	4	3	RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F

See introduction to this section for ordering information
*Indicates factory selected value
† FOR BACKDATING INFORMATION REFER TO SECTION VII

ManualsPlus.com

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A4R31	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A4R32	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A4R33	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A4R34				NOT ASSIGNED		
A4R35	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A4R36	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A4R37	0698-3447	4		RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A4R38	0698-7188	8		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T00-10R-G
A4R39	0698-8816	1	1	RESISTOR 2.15 1% .125W F TC=0+-100	28480	0698-8816
A4R40	0698-7221	0	5	RESISTOR 237 1% .05W F TC=0+-100	24546	C3-1/8-T0-237R-G
A4R41	0698-7221	0		RESISTOR 237 1% .05W F TC=0+-100	24546	C3-1/8-T0-237R-G
A4R42	0698-7221	0		RESISTOR 237 1% .05W F TC=0+-100	24546	C3-1/8-T0-237R-G
A4R43	0698-7221	0		RESISTOR 237 1% .05W F TC=0+-100	24546	C3-1/8-T0-237R-G
A4R44	0698-7221	0		RESISTOR 237 1% .05W F TC=0+-100	24546	C3-1/8-T0-237R-G
A4R45	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A4R46	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A4R47	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A4R48	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A4R49	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A4R50	1810-0269	3	1	NETWORK-RES 9-SIP10.0K OHM X 8	28480	1810-0269
A4R51	0698-3158	4	2	RESISTOR 23.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2372-F
A4R52	2100-2216	0	1	RESISTOR-TRMR 5K 10% C TOP-ADJ 1-TRN	73138	82PR5K
A4R53	0698-3158	4		RESISTOR 23.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2372-F
A4R54	0757-0438	3	3	RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A4R55	2100-2030	6	1	RESISTOR-TRMR 20K 10% C TOP-ADJ 1-TRN	73138	82PR20K
A4R56	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A4R57	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A4R58	0698-3454	3	4	RESISTOR 215K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2153-F
A4R59	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A4R60	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A4R61				NOT ASSIGNED		
A4R62	0698-3457	6		RESISTOR 316K 1% .125W F TC=0+-100	28480	0698-3457
A4R63	0698-3154	0	4	RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A4R64	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A4R65	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A4R66	0698-3266	5	1	RESISTOR 237K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2373-F
A4R67	0698-3438	3		RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-147R-F
A4R68	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A4R69	0698-3454	3		RESISTOR 215K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2153-F
A4R70	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A4R71†	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A4R72	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A4R73	0698-3452	1	2	RESISTOR 147K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1473-F
A4R74	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A4R75	0698-3452	1		RESISTOR 147K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1473-F
A4T1	08552-6024	9	1	TRANSFORMER-RF, YELLOW	28480	08552-6024
A4TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A4TP2	1251-1556	7		CONNECTOR-SGL CONT SKT .018-IN-BSC-SZ	28480	1251-1556
A4TP3	1251-1556	7		CONNECTOR-SGL CONT SKT .018-IN-BSC-SZ	28480	1251-1556
A4TP4	1251-1556	7		CONNECTOR-SGL CONT SKT .018-IN-BSC-SZ	28480	1251-1556
A4TP5	1251-1556	7		CONNECTOR-SGL CONT SKT .018-IN-BSC-SZ	28480	1251-1556
A4TP6	1251-1556	7		CONNECTOR-SGL CONT SKT .018-IN-BSC-SZ	28480	1251-1556
A4TP7	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A4TP8	1251-1556	7		CONNECTOR-SGL CONT SKT .018-IN-BSC-SZ	28480	1251-1556
A4TP9	1251-1556	7		CONNECTOR-SGL CONT SKT .018-IN-BSC-SZ	28480	1251-1556
A4TP10	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A4TP11	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A4TP12	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A4TP13	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A4TP14	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A4TP15	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A4TP16	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A4U1	0955-0146	0	1	MIXER-DOUBLE BALANCED, 1000 MHZ	28480	0955-0146
	8090-0714	2		SOLDER WIRE 354-DEG-F 2.4%-RMA	28480	8090-0714
A4U2	1820-1976	2	2	IC BFR CMOS NON-INV HEX	0192B	CD4050BE
A4U3	1820-0618	7		IC BFR TTL NON-INV HEX	01295	SN7417N
A4U4	1820-1662	3	2	IC SHF-RGTR CMOS SERIAL-IN PRL-OUT 8-BIT	0192B	CD4094BE
A4U5	1826-0323	3	2	IC OP AMP GP QUAD 14-DIP-C PKG	28480	1826-0323
A4U6	1820-1211	8		IC GATE TTL LS EXCL-OR QUAD 2-INP	01295	SN74LS86N
A5	08656-60013	5	1	HIGH FREQUENCY OSCILLATOR ASSEMBLY	28480	08656-60013
A5C1	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A5C2	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A5C3	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A5C4	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A5C5	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878

See introduction to this section for ordering information
*Indicates factory selected value
† FOR BACKDATING INFORMATION REFER TO SECTION VII

ManualsPlus.com

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	CD	Qty	Description	Mfr Code	Mfr Part Number
A5C6	0160-4389	6		CAPACITOR-FXD 100PF +-5PF 200VDC CER	51642	200-200-NP0-101J
A5C7	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A5C8	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A5C9	0160-3568	1		CAPACITOR-FXD 2.7PF +-5% 200VDC CER	51642	100-100-NP0-279J
A5C10	0160-4389	6		CAPACITOR-FXD 100PF +-5PF 200VDC CER	51642	200-200-NP0-101J
A5C11	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A5C12	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A5C13	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A5C14	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A5C15	0160-4386	3		CAPACITOR-FXD 33PF +-5% 200VDC CER 0+-30	51642	200-200-NP0-330J
A5C16	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A5C17	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A5C18	0160-4494	4		CAPACITOR-FXD 39PF +-5% 200VDC CER 0+-30	51642	200-200-NP0-390J
A5C19	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A5C20	0160-4498	8		CAPACITOR-FXD 5.6PF +-.5PF 200VDC CER	51642	200-200-NP0-569D
A5C21	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A5C22*	0160-0690	4	2	CAPACITOR-FXD 1PF +-.5PF 100VDC CER	28480	0160-0690
A5CR1	0122-0072	6	2	DIODE-VVC 2.2PF 5% C3/C25-MIN=4.5	04713	BB105B
A5CR2	0122-0072	6		DIODE-VVC 2.2PF 5% C3/C25-MIN=4.5	04713	BB105B
A5L1				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A5L2				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A5L3	9100-2247	4		INDUCTOR RF-CH-MLD 100NH 10% .105DX.26LG	28480	9100-2247
A5L4				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A5L5	9140-0158	6		INDUCTOR RF-CH-MLD 1UH 10% .105DX.26LG	28480	9140-0158
A5L6	9100-2247	4		INDUCTOR RF-CH-MLD 100NH 10% .105DX.26LG	28480	9100-2247
A5L7	9140-0144	0		INDUCTOR RF-CH-MLD 4.7UH 10% .105DX.26LG	28480	9140-0144
A5L8				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A5L9	9100-2247	4		INDUCTOR RF-CH-MLD 100NH 10% .105DX.26LG	28480	9100-2247
A5L10	9100-2247	4		INDUCTOR RF-CH-MLD 100NH 10% .105DX.26LG	28480	9100-2247
A5L11				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A5L12	9100-2247	4		INDUCTOR RF-CH-MLD 100NH 10% .105DX.26LG	28480	9100-2247
A5MP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A5MP2	8151-0014	5		WIRE 24AWG 1X24	28480	8151-0014
A5Q1	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A5Q2	1854-0632	6		TRANSISTOR NPN SI PD=180MW FT=4GHZ	25403	BFR-91
A5Q3	1854-0632	6		TRANSISTOR NPN SI PD=180MW FT=4GHZ	25403	BFR-91
A5R1	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A5R2	0698-7222	1	1	RESISTOR 261 1% .05W F TC=0+-100	24546	C3-1/8-T0-261R-G
A5R3	0698-7225	4	1	RESISTOR 348 1% .05W F TC=0+-100	24546	C3-1/8-T0-348R-G
A5R4	0698-7202	7	2	RESISTOR 38.3 1% .05W F TC=0+-100	24546	C3-1/8-T00-38R3-G
A5R5	0698-7216	3	3	RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-G
A5R6	0757-0405	4		RESISTOR 162 1% .125W F TC=0+-100	24546	C4-1/8-T0-162R-F
A5R7	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A5R8	0698-3438	3		RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-147R-F
A5R9	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A5R10	0698-7198	0		RESISTOR 26.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-26R1-G
A5R11	0698-7198	0		RESISTOR 26.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-26R1-G
A5R12	0698-7227	6		RESISTOR 422 1% .05W F TC=0+-100	24546	C3-1/8-T0-422R-G
A5R13	0698-7189	9		RESISTOR 11 1% .05W F TC=0+-100	24546	C3-1/8-T00-11R0-G
A5R14	0698-7227	6		RESISTOR 422 1% .05W F TC=0+-100	24546	C3-1/8-T0-422R-G
A5R15	0698-7212	9	1	RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-G
A5R16	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-G
A5R17	0698-7202	7		RESISTOR 38.3 1% .05W F TC=0+-100	24546	C3-1/8-T00-38R3-G
A5R18	0757-0442	9	15	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A5R19	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-G
A5R20	0698-3447	4		RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A5R21	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A5R22	0698-7205	0		RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-51R1-G
A5R23	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A5TP1	1251-1556	7		CONNECTOR-SGL CONT SKT .018-IN-BSC-SZ	28480	1251-1556
A5TP2	1251-1556	7		CONNECTOR-SGL CONT SKT .018-IN-BSC-SZ	28480	1251-1556
A5TP3	1251-1556	7		CONNECTOR-SGL CONT SKT .018-IN-BSC-SZ	28480	1251-1556
A5TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A5TP5	1251-1556	7		CONNECTOR-SGL CONT SKT .018-IN-BSC-SZ	28480	1251-1556
A6	08656-60002	2	1	OUTPUT ASSEMBLY	28480	08656-60002
A6C1	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A6C2	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A6C3	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A6C4	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A6C5	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2

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

ManualsPlus.com

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A6C6	0180-1746	5	2	CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A6C7	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A6C8	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A6C9	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A6C10	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A6C11	0160-3878	6	5	CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A6C12	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A6C13	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A6C14	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A6C15	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A6C16	0180-0291	3	1	CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A6C17	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A6C18†	0160-4519	4		CAPACITOR-FXD 9.1PF +-.5PF 200VDC CER	51642	200-200-NP0-919D
A6C19	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A6C20	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A6C21	0160-3878	6	2	CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A6C22	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A6C23	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A6C24	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A6C25	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A6C26	0140-0210	2	2	CAPACITOR-FXD 270PF +-5% 300VDC MICA	72136	DM15F271J0300WV1CR
A6C27	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A6C28	0160-0690	4		CAPACITOR-FXD 1PF +-.5PF 100VDC CER	28480	0160-0690
A6C29	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A6C30	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A6C31	0160-4490	0		CAPACITOR-FXD 1.8PF +-.25PF 200VDC CER	28480	0160-4490
A6C32				NOT ASSIGNED		
A6C33	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A6C34	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A6C35	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A6C36	0160-3876	4		CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
A6C37	0160-3876	4		CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
A6C38	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A6C39	0160-4498	8		CAPACITOR-FXD 5.6PF +-.5PF 200VDC CER	51642	200-200-NP0-569D
A6C40	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A6C41	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A6C42	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A6C43	0160-4381	8	1	CAPACITOR-FXD 1.5PF +-.25PF 200VDC CER	51642	150-200-NP0-159C
A6C44	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A6C45	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A6C46	0160-0375	2	2	CAPACITOR-FXD 2.2PF +-.1PF 300VDC CER	28480	0160-0375
A6C47	0160-4535	4		CAPACITOR-FXD 1UF +-10% 50VDC CER	28480	0160-4535
A6C48	0160-0375	2		CAPACITOR-FXD 2.2PF +-.1PF 300VDC CER	28480	0160-0375
A6C49	0160-0570	9	7	CAPACITOR-FXD 220PF +-20% 100VDC CER	20932	5024EM100RD221M
A6C50	0160-4493	3		CAPACITOR-FXD 27PF +-5% 200VDC CER 0+-30	51642	200-200-NP0-270J
A6C51	0160-4493	3	5	CAPACITOR-FXD 27PF +-5% 200VDC CER 0+-30	51642	200-200-NP0-270J
A6C52†	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A6C53	0160-3873	1		CAPACITOR-FXD 4.7PF +-.5PF 200VDC CER	28480	0160-3873
A6C54	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A6C55	0160-4535	4		CAPACITOR-FXD 1UF +-10% 50VDC CER	28480	0160-4535
A6C56†	0121-0448	8	3	CAPACITOR-V TRMR-CER 2.5-5PF 63V PC-MTG	28480	0121-0448
A6C57	0121-0449	9		CAPACITOR-V TRMR-CER 3.5-10PF 63V PC-MTG	28480	0121-0449
A6C58	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A6C59†	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A6C60				NOT ASSIGNED		
A6C61	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A6C62	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A6C63	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A6C64	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A6CR1	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR2	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR3	1901-0179	7		DIODE-SWITCHING 15V 50MA 750PS DO-7	28480	1901-0179
A6CR4	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR5†	1901-0844	3	4	DIODE-PIN	04713	MPN3401
A6CR6	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR7†	1901-0844	3		DIODE-PIN	04713	MPN3401
A6CR8	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR9	1901-0179	7		DIODE-SWITCHING 15V 50MA 750PS DO-7	28480	1901-0179
A6CR10	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR11	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR12	1901-0179	7		DIODE-SWITCHING 15V 50MA 750PS DO-7	28480	1901-0179
A6CR13	1901-1096	9	3	DIODE-PIN	28480	1901-1096
A6CR14	1901-1096	9		DIODE-PIN	28480	1901-1096
A6CR15	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050

See introduction to this section for ordering information
*Indicates factory selected value
† FOR BACKDATING INFORMATION REFER TO SECTION VII

ManualsPlus.com

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A6CR16	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR17	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR18	1901-1096	9		DIODE-PIN	28480	1901-1096
A6CR19	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR20	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR21	1901-0844	3		DIODE-PIN	04713	MPN3401
A6CR22	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR23	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR24	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR25†	0122-0329	6	2	DIODE-VVC 2.2PF 5% C3/C25-MIN=4.5	28480	0122-0329
A6CR26	0122-0065	7		DIODE-VVC 29PF 3%	28480	0122-0065
A6CR27	0122-0065	7		DIODE-VVC 29PF 3%	28480	0122-0065
A6CR28†	0122-0329	6		DIODE-VVC 2.2PF 5% C3/C25-MIN=4.5	28480	0122-0329
A6CR29	0122-0065	7		DIODE-VVC 29PF 3%	28480	0122-0065
A6CR30	0122-0065	7		DIODE-VVC 29PF 3%	28480	0122-0065
A6CR31	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR32	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR33	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR34	1901-0844	3		DIODE-PIN	04713	MPN3401
A6CR35	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR36	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR37	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR38	1906-0245	8	1	DIODE-MATCHED PAIR	28480	1906-0245
A6CR39	1906-0245	8		PART OF A6CR38	28480	1906-0245
A6CR40	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR41	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR42	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6J1	1251-5568	9		CONNECTOR 8-PIN M POST TYPE	28480	1251-5568
A6J2	1200-0507	9		SOCKET-IC 16-CONT DIP-SLDR	28480	1200-0507
A6J3	1200-0507	9		SOCKET-IC 16-CONT DIP-SLDR	28480	1200-0507
A6J4	1251-4051	3	1	CONNECTOR 10-PIN M POST TYPE	28480	1251-4051
A6K1	0490-1171	7	1	RELAY-REED 2A 500MA 200VAC 5VDC-COIL	28480	0490-1171
A6L1	9140-0158	6		INDUCTOR RF-CH-MLD 1UH 10% .105DX.26LG	28480	9140-0158
A6L2	9140-0158	6		INDUCTOR RF-CH-MLD 1UH 10% .105DX.26LG	28480	9140-0158
A6L3	9100-1618	1		INDUCTOR RF-CH-MLD 5.6UH 10%	28480	9100-1618
A6L4	9100-1618	1		INDUCTOR RF-CH-MLD 5.6UH 10%	28480	9100-1618
A6L5	9100-1618	1		INDUCTOR RF-CH-MLD 5.6UH 10%	28480	9100-1618
A6L6	9140-0158	6		INDUCTOR RF-CH-MLD 1UH 10% .105DX.26LG	28480	9140-0158
A6L7	9140-0158	6		INDUCTOR RF-CH-MLD 1UH 10% .105DX.26LG	28480	9140-0158
A6L8	9140-0158	6		INDUCTOR RF-CH-MLD 1UH 10% .105DX.26LG	28480	9140-0158
A6L9	9140-0158	6		INDUCTOR RF-CH-MLD 1UH 10% .105DX.26LG	28480	9140-0158
A6L10	9140-0158	6		INDUCTOR RF-CH-MLD 1UH 10% .105DX.26LG	28480	9140-0158
A6L11	9100-1618	1		INDUCTOR RF-CH-MLD 5.6UH 10%	28480	9100-1618
A6L12	9140-0158	6		INDUCTOR RF-CH-MLD 1UH 10% .105DX.26LG	28480	9140-0158
A6L13	9100-2258	7	1	INDUCTOR RF-CH-MLD 1.2UH 10% .105DX.26LG	28480	9100-2258
A6L14	9140-0158	6		INDUCTOR RF-CH-MLD 1UH 10% .105DX.26LG	28480	9140-0158
A6L15	9140-0158	6		INDUCTOR RF-CH-MLD 1UH 10% .105DX.26LG	28480	9140-0158
A6L16	9140-0158	6		INDUCTOR RF-CH-MLD 1UH 10% .105DX.26LG	28480	9140-0158
A6L17	9100-2247	4		INDUCTOR RF-CH-MLD 100NH 10% .105DX.26LG	28480	9100-2247
A6L18	9100-2247	4		INDUCTOR RF-CH-MLD 100NH 10% .105DX.26LG	28480	9100-2247
A6L19				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A6L20				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A6L21	9100-2247	4		INDUCTOR RF-CH-MLD 100NH 10% .105DX.26LG	28480	9100-2247
A6L22	9140-0158	6		INDUCTOR RF-CH-MLD 1UH 10% .105DX.26LG	28480	9140-0158
A6L23	9140-0158	6		INDUCTOR RF-CH-MLD 1UH 10% .105DX.26LG	28480	9140-0158
A6L24	9140-0158	6		INDUCTOR RF-CH-MLD 1UH 10% .105DX.26LG	28480	9140-0158
A6L25				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A6L26				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A6L27	9100-2248	5		INDUCTOR RF-CH-MLD 120NH 10% .105DX.26LG	28480	9100-2248
A6L28				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A6L29				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A6L30	9100-2247	4		INDUCTOR RF-CH-MLD 100NH 10% .105DX.26LG	28480	9100-2247
A6L31				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A6L32				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A6L33	9100-3922	4	5	CHOKE, TOROIDAL 1.0UH	28480	9100-3922
A6L34	9140-0158	6		INDUCTOR RF-CH-MLD 1UH 10% .105DX.26LG	28480	9140-0158
A6L35				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A6L36	9100-3922	4		INDUCTOR-FIXED 120-1300 HZ	28480	9100-3922
A6L37	9140-0158	6		INDUCTOR RF-CH-MLD 1UH 10% .105DX.26LG	28480	9140-0158
A6L38				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A6L39				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A6L40				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A6L41				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A6L42				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A6L43				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A6L44				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A6L45				PART IS ETCHED TRACE ON CIRCUIT BOARD		

See introduction to this section for ordering information
*Indicates factory selected value
† FOR BACKDATING INFORMATION REFER TO SECTION VII

ManualsPlus.com

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A6L46				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A6L47	9135-0073	3		INDUCTOR, 51NH	28480	9135-0073
A6L48	9135-0078	8	1	INDUCTOR 82NH	28480	9135-0078
A6L49	9135-0073	3		INDUCTOR, 51NH	28480	9135-0073
A6L50	9100-2255	4	1	INDUCTOR RF-CH-MLD 470NH 10% .105DX.26LG	28480	9100-2255
A6L51	9140-0158	6		INDUCTOR RF-CH-MLD 1UH 10% .105DX.26LG	28480	9140-0158
A6L52	9100-2252	1	1	INDUCTOR RF-CH-MLD 270NH 10% .105DX.26LG	28480	9100-2252
A6L53	9100-1648	7	1	INDUCTOR RF-CH-MLD 560UH 5% .2DX.45LG	28480	9100-1648
A6L54	9135-0075	5	2	INDUCTOR, 43NH	28480	9135-0075
A6MP1	1251-1556	7		CONNECTOR-SGL CONT SKT .018-IN-BSC-SZ	28480	1251-1556
A6MP2	08656-00033	3		GROUND CLIP, SEMI-RIGID	28480	08656-00033
A6Q1	1854-0696	2		TRANSISTOR NPN SI TO-72 PD=200MW	28480	1854-0696
	1200-0172	4	2	INSULATOR-XSTR DAP-GL	28480	1200-0172
A6Q2	1854-0632	6		TRANSISTOR NPN SI PD=180MW FT=4GHZ	25403	BFR-91
A6Q3	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A6Q4	1853-0281	9	1	TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A6Q5	1853-0012	4	1	TRANSISTOR PNP 2N2904A SI TO-39 PD=600MW	01295	2N2904A
A6Q6	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A6Q7	1854-0720	3	1	TRANSISTOR NPN SI PD=500MW FT=4GHZ	28480	1854-0720
A6Q8	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A6Q9	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A6Q10	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A6Q11	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A6Q12	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A6Q13	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A6Q14	1854-0696	2		TRANSISTOR NPN SI TO-72 PD=200MW	28480	1854-0696
	1200-0172	4		INSULATOR-XSTR DAP-GL	28480	1200-0172
A6Q15	1854-0721	4	1	TRANSISTOR NPN SI TO-39 PD=1.5W	25403	BFR 95
	1200-0173	5	3	INSULATOR-XSTR DAP-GL	28480	1200-0173
	1205-0011	0	1	HEAT SINK TO-5/TO-39-CS	28480	1205-0011
A6R1	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A6R2	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A6R3	0698-7194	6	1	RESISTOR 17.8 1% .05W F TC=0+-100	24546	C3-1/8-T00-17R8-G
A6R4*	0757-0400	9	2	RESISTOR 90.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-90R9-F
A6R5	0698-7223	2	3	RESISTOR 287 1% .05W F TC=0+-100	24546	C3-1/8-T0-287R-G
A6R6	0698-7223	2		RESISTOR 287 1% .05W F TC=0+-100	24546	C3-1/8-T0-287R-G
A6R7	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A6R8	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A6R9	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A6R10	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A6R11	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A6R12	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A6R13	0757-0439	4		RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A6R14	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A6R15	0698-3439	4	4	RESISTOR 178 1% .125W F TC=0+-100	24546	C4-1/8-T0-178R-F
A6R16	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A6R17	0698-0085	0	1	RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A6R18	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A6R19	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A6R20	0698-3161	9		RESISTOR 38.3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3832-F
A6R21	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A6R22	0757-0401	0	8	RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A6R23	0757-0420	3	2	RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A6R24	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6R25	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6R26	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6R27	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A6R28	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A6R29	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A6R30	2100-2031	7	1	RESISTOR-TRMR 50K 10% C TOP-ADJ 1-TRN	73138	82PR50K
A6R31	0757-0199	3	1	RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A6R32	0698-3162	0	7	RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A6R33	0757-0424	7		RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A6R34	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A6R35	2100-2061	3	1	RESISTOR-TRMR 200 10% C TOP-ADJ 1-TRN	73138	82PR200
A6R36	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A6R37	0698-3438	3		RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-147R-F
A6R38	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A6R39	0698-7209	4	4	RESISTOR 75 1% .05W F TC=0+-100	24546	C3-1/8-T00-75R0-G
A6R40	0757-0200	7	2	RESISTOR 5.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5621-F
A6R41	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A6R42	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6R43	0698-7209	4		RESISTOR 75 1% .05W F TC=0+-100	24546	C3-1/8-T00-75R0-G
A6R44	0698-7209	4		RESISTOR 75 1% .05W F TC=0+-100	24546	C3-1/8-T00-75R0-G
A6R45	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F

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

ManualsPlus.com

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A6R46	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A6R47	0698-7209	4		RESISTOR 75 1% .05W F TC=0+-100	24546	C3-1/8-T00-75R0-G
A6R48†	0757-0395	1	1	RESISTOR 56.2 1% .125W F TC=0+-100	24546	C4-1/8-T0-56R2-F
A6R49	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A6R50	0699-0584	6	1	RESISTOR 90.9 1% .05W F TC=0+-100	28480	0699-0584
A6R51	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A6R52	0757-0397	3		RESISTOR 68.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-68R1-F
A6R53	0699-0583	5	1	RESISTOR 34.8 1% .05W F TC=0+-100	28480	0699-0583
A6R54	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6R55	0698-7206	1	2	RESISTOR 56.2 1% .05W F TC=0+-100	24546	C3-1/8-T00-56R2-G
A6R56	0698-7205	0		RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-51R1-G
A6R57	0698-7223	2		RESISTOR 287 1% .05W F TC=0+-100	24546	C3-1/8-T0-287R-G
A6R58	0698-7206	1		RESISTOR 56.2 1% .05W F TC=0+-100	24546	C3-1/8-T00-56R2-G
A6R59	0698-7205	0		RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-51R1-G
A6R60	0757-0421	4	5	RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A6R61	0698-7205	0		RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-51R1-G
A6R62	0698-3446	3		RESISTOR 383 1% .125W F TC=0+-100	24546	C4-1/8-T0-383R-F
A6R63	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A6R64	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A6R65	0698-3446	3		RESISTOR 383 1% .125W F TC=0+-100	24546	C4-1/8-T0-383R-F
A6R66	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A6R67	0698-7192	4	6	RESISTOR 14.7 1% .05W F TC=0+-100	24546	C3-1/8-T00-14R7-G
A6R68	0757-0405	4		RESISTOR 162 1% .125W F TC=0+-100	24546	C4-1/8-T0-162R-F
A6R69	0698-3446	3		RESISTOR 383 1% .125W F TC=0+-100	24546	C4-1/8-T0-383R-F
A6R70	0698-7192	4		RESISTOR 14.7 1% .05W F TC=0+-100	24546	C3-1/8-T00-14R7-G
A6R71	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6R72	0698-7192	4		RESISTOR 14.7 1% .05W F TC=0+-100	24546	C3-1/8-T00-14R7-G
A6R73	0698-3449	6	1	RESISTOR 28.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2872-F
A6R74	0698-3446	3		RESISTOR 383 1% .125W F TC=0+-100	24546	C4-1/8-T0-383R-F
A6R75	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6R76	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6R77	0698-7192	4		RESISTOR 14.7 1% .05W F TC=0+-100	24546	C3-1/8-T00-14R7-G
A6R78	0757-0796	6	1	RESISTOR 82.5 1% .5W F TC=0+-100	28480	0757-0796
A6R79	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A6R80	0698-0083	8	5	RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A6R81	0698-7192	4		RESISTOR 14.7 1% .05W F TC=0+-100	24546	C3-1/8-T00-14R7-G
A6R82	0698-7192	4		RESISTOR 14.7 1% .05W F TC=0+-100	24546	C3-1/8-T00-14R7-G
A6R83	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6R84	0698-3398	4	1	RESISTOR 46.4 1% .5W F TC=0+-100	28480	0698-3398
A6R85	0698-8819	4	1	RESISTOR 3.83 1% .125W F TC=0+-100	28480	0698-8819
A6R86	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A6R87	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A6R88	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A6R89	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A6R90	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A6R91	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A6R92	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A6R93	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A6R94	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6R95	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A6R96	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A6R97	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A6R98	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A6S1	3101-1162	6	1	SWITCH-SL SPDT MINTR .5A 125VAC/DC PC	28480	3101-1162
A6TP1	1251-1556	7		CONNECTOR-SGL CONT SKT .018-IN-BSC-SZ	28480	1251-1556
A6TP2	1251-1556	7		CONNECTOR-SGL CONT SKT .018-IN-BSC-SZ	28480	1251-1556
A6TP3	1251-1556	7		CONNECTOR-SGL CONT SKT .018-IN-BSC-SZ	28480	1251-1556
A6TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A6TP5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A6TP6	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A6U1	1820-1811	4	1	IC-DIGITAL	28480	1820-1811
	0340-0834	0	1	INSULATOR-XSTR POLYI	28480	0340-0834
A6U2	1820-2106	2	1	IC FF ECL D-M/S POS-EDGE-TRIG	07263	F11C06DC
A6U3	1826-0013	8	2	IC OP AMP LOW-NOISE TO-99 PKG	06665	SSS741CJ
A6U4	1820-1976	2		IC BFR CMOS NON-INV HEX	0192B	CD4050BE
A6U5	1820-0618	7		IC BFR TTL NON-INV HEX	01295	SN7417N
A6U6	1826-0488	1	1	IC OP AMP WB TO-99 PKG	27014	LM218H
A6U7	1820-1662	3		IC SHF-RGTR CMOS SERIAL-IN PRL-OUT 8-BIT	0192B	CD4094BE
A6U8	1820-1422	3	2	IC MV TTL LS MONOSTBL RETRIG	01295	SN74LS122N
A6U9	1820-0304	8	1	IC FF TTL J-K M/S PULSE PRESET/CLEAR	01295	SN7472N
A6U10	1826-0013	8		IC OP AMP LOW-NOISE TO-99 PKG	06665	SSS741CJ
A6U11	0955-0145	9		MIXER, DOUBLE BALANCED 1000MHZ	28480	0955-0145

See introduction to this section for ordering information
*Indicates factory selected value
† FOR BACKDATING INFORMATION REFER TO SECTION VII

ManualsPlus.com

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A7	08656-60063	5	1	RFI ASSEMBLY	28480	08656-60063
A7C1	0160-0571	0	7	CAPACITOR-FXD 470PF +-20% 100VDC CER	28480	0160-0571
A7C2	0160-0571	0		CAPACITOR-FXD 470PF +-20% 100VDC CER	28480	0160-0571
A7C3	0160-0571	0		CAPACITOR-FXD 470PF +-20% 100VDC CER	28480	0160-0571
A7C4	0160-0571	0		CAPACITOR-FXD 470PF +-20% 100VDC CER	28480	0160-0571
A7C5	0160-0571	0		CAPACITOR-FXD 470PF +-20% 100VDC CER	28480	0160-0571
A7C6	0160-0571	0		CAPACITOR-FXD 470PF +-20% 100VDC CER	28480	0160-0571
A7C7	0160-0571	0		CAPACITOR-FXD 470PF +-20% 100VDC CER	28480	0160-0571
A7J1				PART OF ETCHED TRACE ON CIRCUIT BOARD		
A7J2				PART OF ETCHED TRACE ON CIRCUIT BOARD		
A7L1	9100-2247	4		INDUCTOR RF-CH-MLD 100NH 10% .105DX.26LG	28480	9100-2247
A7L2	9100-2247	4		INDUCTOR RF-CH-MLD 100NH 10% .105DX.26LG	28480	9100-2247
A7L3	9100-2247	4		INDUCTOR RF-CH-MLD 100NH 10% .105DX.26LG	28480	9100-2247
A7L4	9100-2247	4		INDUCTOR RF-CH-MLD 100NH 10% .105DX.26LG	28480	9100-2247
A7L5	9100-2247	4		INDUCTOR RF-CH-MLD 100NH 10% .105DX.26LG	28480	9100-2247
A7L6	9100-2247	4		INDUCTOR RF-CH-MLD 100NH 10% .105DX.26LG	28480	9100-2247
A7L7	9100-2247	4		INDUCTOR RF-CH-MLD 100NH 10% .105DX.26LG	28480	9100-2247
A8	08656-60004	4	1	FREQUENCY MULTIPLIER ASSEMBLY	28480	08656-60004
A8C1	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A8C2	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A8C3	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A8C4	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A8C5	0160-4527	4	4	CAPACITOR-FXD 56PF +-5% 200VDC CER 0+-30	51642	200-200-NP0-560J
A8C6	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A8C7	0160-2249	3	1	CAPACITOR-FXD 4.7PF +-.25PF 500VDC CER	28480	0160-2249
	4330-0145	9	8	INSULATOR-BEAD GLASS	28480	4330-0145
A8C8	0160-4527	4		CAPACITOR-FXD 56PF +-5% 200VDC CER 0+-30	51642	200-200-NP0-560J
A8C9	0160-4527	4		CAPACITOR-FXD 56PF +-5% 200VDC CER 0+-30	51642	200-200-NP0-560J
A8C10	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A8C11	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A8C12	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A8C13	0160-4383	0		CAPACITOR-FXD 6.8PF +-.5PF 200VDC CER	20932	5024E0200RD689D
A8C14	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A8C15	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A8C16	0160-4493	3		CAPACITOR-FXD 27PF +-5% 200VDC CER 0+-30	51642	200-200-NP0-270J
A8C17	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A8C18	0160-2243	7	1	CAPACITOR-FXD 2.7PF +-.25PF 500VDC CER	28480	0160-2243
	4330-0145	9		INSULATOR-BEAD GLASS	28480	4330-0145
A8C19	0160-4493	3		CAPACITOR-FXD 27PF +-5% 200VDC CER 0+-30	51642	200-200-NP0-270J
A8C20	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A8C21	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A8C22	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A8C23	0160-4493	3		CAPACITOR-FXD 27PF +-5% 200VDC CER 0+-30	51642	200-200-NP0-270J
A8C24	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A8C25	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A8C26	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A8C27	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A8C28	0160-3873	1		CAPACITOR-FXD 4.7PF +-.5PF 200VDC CER	28480	0160-3873
A8C29	0160-3873	1		CAPACITOR-FXD 4.7PF +-.5PF 200VDC CER	28480	0160-3873
A8C30	0160-2237	9	1	CAPACITOR-FXD 1.2PF +-.25PF 500VDC CER	28480	0160-2237
	4330-0145	9		INSULATOR-BEAD GLASS	28480	4330-0145
A8C31	0121-0448	8		CAPACITOR-V TRMR-CER 2.5-5PF 63V PC-MTG	28480	0121-0448
A8C32	0160-4491	1		CAPACITOR-FXD 8.2PF +-5% 200VDC CER	51642	200-200-NP0-829J
A8C33	0160-4518	3		CAPACITOR-FXD 3.9PF +-.5PF 200VDC CER	51642	200-200-NP0-399D
A8C34	0160-4527	4		CAPACITOR-FXD 56PF +-5% 200VDC CER 0+-30	51642	200-200-NP0-560J
A8C35†	0160-4382	9	3	CAPACITOR-FXD 3.3PF +-.25PF 200VDC CER	51642	200-200-NP0-339C
A8C36	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A8C37	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A8C38	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A8C39	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A8C40	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A8C41	0160-4383	0		CAPACITOR-FXD 6.8PF +-.5PF 200VDC CER	20932	5024E0200RD689D
A8C42	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A8C43	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A8C44	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A8C45	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A8C46	0160-2234	6	1	CAPACITOR-FXD .51PF +-.25PF 500VDC CER	28480	0160-2234
	4330-0145	9		INSULATOR-BEAD GLASS	28480	4330-0145
A8C47	0121-0452	4	1	CAPACITOR-V TRMR-AIR 1.3-5.4PF 175V	74970	187-0103-028
A8C48	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A8C49				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A8C50	0160-4518	3		CAPACITOR-FXD 3.9PF +-.5PF 200VDC CER	51642	200-200-NP0-399D
A8C51				PART IS ETCHED TRACE ON CIRCUIT BOARD		

See introduction to this section for ordering information
*Indicates factory selected value
† FOR BACKDATING INFORMATION REFER TO SECTION VII

ManualsPlus.com

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A8C52	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A8C53				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A8C54	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A8C55	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A8C56	0160-4382	9		CAPACITOR-FXD 3.3PF +-.25PF 200VDC CER	51642	200-200-NP0-339C
A8C57†	0160-4490	0	2	CAPACITOR-FXD 1.8PF +-.25PF 200VDC CER	28480	0160-4490
A8J1	1200-0507	9		SOCKET-IC 16-CONT DIP-SLDR	28480	1200-0507
A8J2	1200-0507	9		SOCKET-IC 16-CONT DIP-SLDR	28480	1200-0507
A8J3	1250-1626	0		CONNECTOR-RF SMC M PC 50-OHM	28480	1250-1626
	2190-0124	4	4	WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0124
	2950-0078	9	2	NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A8J4	1250-1626	0		CONNECTOR-RF SMC M PC 50-OHM	28480	1250-1626
	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0124
	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A8L1	9100-1618	1		INDUCTOR RF-CH-MLD 5.6UH 10%	28480	9100-1618
A8L2	9140-0141	7		INDUCTOR RF-CH-MLD 680NH 10% .105DX.26LG	28480	9140-0141
A8L3				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A8L4				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A8L5				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A8L6				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A8L7	9100-3922	4		INDUCTOR-FIXED 120-1300 HZ	28480	9100-3922
A8L8				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A8L9				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A8L10				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A8L11	9100-2251	0	3	INDUCTOR RF-CH-MLD 220NH 10% .105DX.26LG	28480	9100-2251
A8L12				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A8L13				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A8L14				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A8L15				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A8L16	9100-3922	4		INDUCTOR-FIXED 120-1300 HZ	28480	9100-3922
A8L17				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A8L18				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A8L19				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A8L20				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A8L21				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A8L22				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A8L23				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A8L24	9100-2251	0		INDUCTOR RF-CH-MLD 220NH 10% .105DX.26LG	28480	9100-2251
A8L25				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A8L26				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A8L27	9100-3922	4		INDUCTOR-FIXED 120-1300 HZ	28480	9100-3922
A8L28				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A8L29				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A8L30				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A8L31				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A8L32				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A8L33				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A8L34				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A8L35				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A8L36				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A8L37				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A8L38				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A8L39				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A8L40	9100-2251	0		INDUCTOR RF-CH-MLD 220NH 10% .105DX.26LG	28480	9100-2251
A8L41				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A8L42				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A8L43				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A8MP1	1251-1556	7		CONNECTOR-SGL CONT SKT .018-IN-BSC-SZ	28480	1251-1556
A8MP2	1251-2194	1	2	CONNECTOR-SGL CONT SKT .021-IN-BSC-SZ	28480	1251-2194
A8MP3	8150-0459	0		WIRE 24AWG W/R 300V PVC 7X32 80C	28480	8150-0459
A8MP4	08656-00033	3		GROUND CLIP-SEMIRIGID	28480	08656-00033
A8Q1	1854-0632	6		TRANSISTOR NPN SI PD=180MW FT=4GHZ	25403	BFR-91
A8Q2	1854-0632	6		TRANSISTOR NPN SI PD=180MW FT=4GHZ	25403	BFR-91
A8Q3	1854-0632	6		TRANSISTOR NPN SI PD=180MW FT=4GHZ	25403	BFR-91
A8Q4	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A8Q5	1854-0632	6		TRANSISTOR NPN SI PD=180MW FT=4GHZ	25403	BFR-91
A8Q6	1854-0696	2		TRANSISTOR NPN SI TO-72 PD=200MW	28480	1854-0696
A8Q7	1854-0247	9		TRANSISTOR NPN SI TO-39 PD=1W FT=800MHZ	28480	1854-0247
	1200-0173	5		INSULATOR-XSTR DAP-GL	28480	1200-0173
A8Q8	1854-0247	9		TRANSISTOR NPN SI TO-39 PD=1W FT=800MHZ	28480	1854-0247
	1200-0173	5		INSULATOR-XSTR DAP-GL	28480	1200-0173
A8R1	0757-0294	9	1	RESISTOR 17.8 1% .125W F TC=0+-100	19701	MF4C1/8-T0-17R8-F
A8R2	0757-0403	2	1	RESISTOR 121 1% .125W F TC=0+-100	24546	C4-1/8-T0-121R-F
A8R3	0698-3439	4		RESISTOR 178 1% .125W F TC=0+-100	24546	C4-1/8-T0-178R-F
A8R4	0698-3443	0		RESISTOR 287 1% .125W F TC=0+-100	24546	C4-1/8-T0-287R-F
A8R5	0757-0424	7		RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F

See introduction to this section for ordering information
*Indicates factory selected value
†FOR BACKDATING INFORMATION REFER TO SECTION VII

ManualsPlus.com

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A8R6	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A8R7	0757-0398	4		RESISTOR 75 1% .125W F TC=0+-100	24546	C4-1/8-T0-75R0-F
A8R8	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A8R9	0757-0424	7		RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A8R10	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A8R11†	0698-3442	9	7	RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A8R12	0757-0278	9	2	RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1781-F
A8R13	0757-0398	4		RESISTOR 75 1% .125W F TC=0+-100	24546	C4-1/8-T0-75R0-F
A8R14	0757-0278	9		RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1781-F
A8R15	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A8R16	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A8R17	0757-0424	7		RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A8R18	0698-4037	0	1	RESISTOR 46.4 1% .125W F TC=0+-100	24546	C4-1/8-T0-46R4-F
A8R19	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A8R20	0757-0424	7		RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A8R21	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A8R22	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A8R23	0757-0398	4		RESISTOR 75 1% .125W F TC=0+-100	24546	C4-1/8-T0-75R0-F
A8R24	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A8R25	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A8R26	0757-0424	7		RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A8R27	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A8R28	0757-0424	7		RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A8R29	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A8R30	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A8R31	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A8R32	0757-0398	4		RESISTOR 75 1% .125W F TC=0+-100	24546	C4-1/8-T0-75R0-F
A8R33	0757-0180	2		RESISTOR 31.6 1% .125W F TC=0+-100	28480	0757-0180
A8R34	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A8R35	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A8R36	0757-0424	7		RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A8R37	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A8R38	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A8TP1	1251-1556	7		CONNECTOR-SGL CONT SKT .018-IN-BSC-SZ	28480	1251-1556
A8TP2	1251-1556	7		CONNECTOR-SGL CONT SKT .018-IN-BSC-SZ	28480	1251-1556
A8TP3	1251-1556	7		CONNECTOR-SGL CONT SKT .018-IN-BSC-SZ	28480	1251-1556
A8U1†	0955-0145	9	2	MIXER, DOUBLE BALANCED, 1000MHZ	28480	0955-0145
A8W1	08656-20018	6	1	CABLE, COAX SEMI-RIGID #2	28480	08656-20018
A9	08656-60018	0	1	ATTENUATOR ASSEMBLY	28480	08656-60018
A9L1	0491-0106	8	1	SOLENOID BANK ASSEMBLY	28480	0491-0106
A9MP1	0400-0126	1	7	GROMMET-RND .125-IN-ID .188-IN-GRV-OD	28480	0400-0126
A9MP2	08656-00013	9	21	CONTACT, SWITCH ATTENUATOR	28480	08656-00013
A9MP3	08656-40002	0	7	CAM, ATTENUATOR	28480	08656-40002
A9MP4	08656-40003	1	4	CAM GUIDE, DUAL	28480	08656-40003
A9MP5	08656-40004	2	1	CAM GUIDE, SINGLE	28480	08656-40004
A9S1				PART IS COMPRISED OF MP1,MP2, & MP3		
A9A1	08656-60014	6	1	HETERODYNE/PAD/REVERSE POWER ASSEMBLY	28480	08656-60014
A9A1C1	8151-0013	4		WIRE 22AWG 1X22	28480	8151-0013
A9A1C2	8151-0013	4		WIRE 22AWG 1X22	28480	8151-0013
A9A1C3	8151-0013	4		WIRE 22AWG 1X22	28480	8151-0013
A9A1C4	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A9A1C5	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A9A1C6	8151-0013	4		WIRE 22AWG 1X22	28480	8151-0013
A9A1C7	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A9A1C8	8151-0013	4		WIRE 22AWG 1X22	28480	8151-0013
A9A1CR1	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A9A1CR2	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A9A1J1	1200-0507	9		SOCKET-IC 16-CONT DIP-SLDR	28480	1200-0507
A9A1J2	1250-1627	1	1	CONNECTOR-RF SMC M PC 50-OHM	28480	1250-1627
A9A1K1	0490-1073	8	1	RELAY-REED 1A 250MA 120VAC 4.5VDC-COIL	28480	0490-1073
A9A1L1	9135-0075	5		INDUCTOR RF-CH-MLD 43NH 8% .102DX.26LG	28480	9135-0075
A9A1MP1	1251-1556	7		CONNECTOR-SGL CONT SKT .018-IN-BSC-SZ	28480	1251-1556
A9A1MP2	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0124
A9A1MP3	2740-0010	4	2	NUT-HEX-DBL-CHAM 10-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
A9A1MP4	08656-00033	3		GROUND CLIP-SEMI-RIGID	28480	08656-00033
A9A1MP5	08656-00057	1	1	BRACKET-ATTENUATOR WALL	28480	08656-00057

See introduction to this section for ordering information
*Indicates factory selected value
† FOR BACKDATING INFORMATION REFER TO SECTION VII

ManualsPlus.com

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A9A1R1	0699-0089	6	6	RESISTOR 53.27 .1% .25W F TC=0+-50	28480	0699-0089
A9A1R2	0699-0094	3	3	RESISTOR 790 .1% .25W F TC=0+-50	28480	0699-0094
A9A1R3	0699-0089	6		RESISTOR 53.27 .1% .25W F TC=0+-50	28480	0699-0089
A9A1R4	0699-0092	1	2	RESISTOR 96.25 .1% .25W F TC=0+-50	28480	0699-0092
A9A1R5	0699-0091	0	1	RESISTOR 71.15 .1% .25W F TC=0+-50	28480	0699-0091
A9A1R6	0699-0092	1		RESISTOR 96.25 .1% .25W F TC=0+-50	28480	0699-0092
A9A1R7	0699-0089	6		RESISTOR 53.27 .1% .25W F TC=0+-50	28480	0699-0089
A9A1R8	0699-0094	3		RESISTOR 790 .1% .25W F TC=0+-50	28480	0699-0094
A9A1R9	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A9A1R10	0699-0089	6		RESISTOR 53.27 .1% .25W F TC=0+-50	28480	0699-0089
A9A1R11	0699-0090	9	2	RESISTOR 61.11 .1% .25W F TC=0+-50	28480	0699-0090
A9A1R12	0699-0093	2	1	RESISTOR 247.5 .1% .25W F TC=0+-50	28480	0699-0093
A9A1R13	0699-0090	9		RESISTOR 61.11 .1% .25W F TC=0+-50	28480	0699-0090
A9A1R14	0699-0089	6		RESISTOR 53.27 .1% .25W F TC=0+-50	28480	0699-0089
A9A1R15	0699-0094	3		RESISTOR 790 .1% .25W F TC=0+-50	28480	0699-0094
A9A1R16	0699-0089	6		RESISTOR 53.27 .1% .25W F TC=0+-50	28480	0699-0089
A9A1VR1	1902-0579	3	2	DIODE-ZNR 5.11V 5% DO-15 PD=1W TC=-.009%	28480	1902-0579
A9A1VR2	1902-0579	3		DIODE-ZNR 5.11V 5% DO-15 PD=1W TC=-.009%	28480	1902-0579
A10	08656-60006	6	1	AUDIO/POWER SUPPLY ASSEMBLY	28480	08656-60006
A10C1	0160-5035	1	1	CAPACITOR, FXD .051UF 2%	28480	0160-5035
A10C2	0160-5036	2	1	CAPACITOR, FXD .27UF 2%	28480	0160-5036
A10C3	0180-1835	3	1	CAPACITOR-FXD 68UF+-20% 15VDC TA	56289	150D686X0015R2
A10C4	0160-2225	5	1	CAPACITOR-FXD 2000PF +-5% 300VDC MICA	28480	0160-2225
A10C5	0160-0336	5	1	CAPACITOR-FXD 100PF +-1% 300VDC MICA	28480	0160-0336
A10C6	0160-3490	8	1	CAPACITOR-FXD 1UF +-20% 50VDC CER	28480	0160-3490
A10C7	0160-0127	2	2	CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A10C8	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A10C9	0180-0100	3		CAPACITOR-FXD 4.7UF+-10% 35VDC TA	56289	150D475X9035B2
A10C10	0180-0100	3		CAPACITOR-FXD 4.7UF+-10% 35VDC TA	56289	150D475X9035B2
A10C11	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A10C12	0140-0210	2		CAPACITOR-FXD 270PF +-5% 300VDC MICA	72136	DM15F271J0300WV1CR
A10C13	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A10C14	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A10C15	0160-3453	3		CAPACITOR-FXD .05UF +80-20% 100VDC CER	28480	0160-3453
A10C16	0160-3453	3		CAPACITOR-FXD .05UF +80-20% 100VDC CER	28480	0160-3453
A10C17	0180-2874	2	3	CAPACITOR-FXD 3200UF+75-10% 40VDC AL	28480	0180-2874
A10C18	0180-2911	8	1	CAPACITOR-FXD .013F+75-10% 25VDC AL	28480	0180-2911
A10C19	0180-2874	2		CAPACITOR-FXD 3200UF+75-10% 40VDC AL	28480	0180-2874
A10C20	0180-2874	2		CAPACITOR-FXD 3200UF+75-10% 40VDC AL	28480	0180-2874
A10C21	0180-2141	6	1	CAPACITOR-FXD 3.3UF+-10% 50VDC TA	56289	150D335X9050B2
A10C22	0180-0558	5	1	CAPACITOR-FXD 470UF+-20% 10VDC TA	56289	150D477X0010S2
A10C23	0180-2144	9	2	CAPACITOR-FXD 200UF+75-10% 25VDC AL	56289	30D207G025DH9
A10C24	0180-1780	7	1	CAPACITOR-FXD 500UF+75-10% 10VDC AL	28480	0180-1780
A10C25	0180-2144	9		CAPACITOR-FXD 200UF+75-10% 25VDC AL	56289	30D207G025DH9
A10C26	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A10C27	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A10C28	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A10CR1	1901-0040	1	4	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A10CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A10CR3	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A10CR4	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A10CR5	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A10CR6	1901-0328	8	8	DIODE-PWR RECT 400V 1A 6US	03508	A14D
A10CR7	1901-0328	8		DIODE-PWR RECT 400V 1A 6US	03508	A14D
A10CR8	1901-0200	5	4	DIODE-PWR RECT 100V 1.5A	28480	1901-0200
A10CR9	1901-0200	5		DIODE-PWR RECT 100V 1.5A	28480	1901-0200
A10CR10	1901-0200	5		DIODE-PWR RECT 100V 1.5A	28480	1901-0200
A10CR11	1901-0200	5		DIODE-PWR RECT 100V 1.5A	28480	1901-0200
A10CR12	1901-0328	8		DIODE-PWR RECT 400V 1A 6US	03508	A14D
A10CR13	1901-0328	8		DIODE-PWR RECT 400V 1A 6US	03508	A14D
A10CR14	1901-0328	8		DIODE-PWR RECT 400V 1A 6US	03508	A14D
A10CR15	1901-0328	8		DIODE-PWR RECT 400V 1A 6US	03508	A14D
A10CR16	1901-0328	8		DIODE-PWR RECT 400V 1A 6US	03508	A14D
A10CR17	1901-0328	8		DIODE-PWR RECT 400V 1A 6US	03508	A14D
A10DS1	1990-0523	2	3	LED-LAMP LUM-INT=1MCD IF=50MA-MAX BVR=5V	28480	5082-4950
A10DS2	1990-0523	2		LED-LAMP LUM-INT=1MCD IF=50MA-MAX BVR=5V	28480	5082-4950
A10DS3	1990-0523	2		LED-LAMP LUM-INT=1MCD IF=50MA-MAX BVR=5V	28480	5082-4950
A10F1†	2110-0519	3	1	FUSE 4A 125V NTD .348X.25	75915	273004
	1251-1998	1	8	CONNECTOR-SGL CONT SKT .025-IN-BSC-SZ	28480	1251-1998
A10F2	2110-0516	0	2	FUSE 1A 125V NTD .348X.25	75915	273001
	1251-1998	1		CONNECTOR-SGL CONT SKT .025-IN-BSC-SZ	28480	1251-1998
A10F3	2110-0516	0		FUSE 1A 125V NTD .348X.25	75915	273001
	1251-1998	1		CONNECTOR-SGL CONT SKT .025-IN-BSC-SZ	28480	1251-1998

See introduction to this section for ordering information
*Indicates factory selected value
† FOR BACKDATING INFORMATION REFER TO SECTION VII

ManualsPlus.com

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A10F4	2110-0520	6	1	FUSE 5A 125V NTD .348X.25	75915	273005
	1251-1998	1		CONNECTOR-SGL CONT SKT .025-IN-BSC-SZ	28480	1251-1998
A10J1	1251-5571	4	2	CONNECTOR 17-PIN M POST TYPE	28480	1251-5571
A10J2	1251-5569	0	2	CONNECTOR 7-PIN M POST TYPE	28480	1251-5569
A10J3	1200-0507	9		SOCKET-IC 16-CONT DIP-SLDR	28480	1200-0507
A10J4	1251-5569	0		CONNECTOR 7-PIN M POST TYPE	28480	1251-5569
A10J5	1251-5611	3	1	CONNECTOR 5-PIN M POST TYPE	28480	1251-5611
A10J6	1200-0507	9		SOCKET-IC 16-CONT DIP-SLDR	28480	1200-0507
A10L1	9140-0144	0		INDUCTOR RF-CH-MLD 4.7UH 10% .105DX.26LG	28480	9140-0144
A10L2	9140-0142	8	1	INDUCTOR RF-CH-MLD 2.2UH 10% .105DX.26LG	28480	9140-0142
A10L3	9140-0144	0		INDUCTOR RF-CH-MLD 4.7UH 10% .105DX.26LG	28480	9140-0144
A10L4	9100-1635	2	1	INDUCTOR RF-CH-MLD 91UH 5% .166DX.385LG	28480	9100-1635
A10MP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A10MP2	1400-0482	3	6	CABLE TIE .062-3-DIA .14-WD NYL	28480	1400-0482
A10MP3	1400-0966	8		CLIP-HINGE	91506	6015-13AT
A10Q1	1884-0012	9	2	THYRISTOR-SCR 2N3528 TO-8 VRRM=200	0192B	2N3528
A10Q2	1854-0810	2	2	TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A10Q3	1884-0012	9		THYRISTOR-SCR 2N3528 TO-8 VRRM=200	0192B	2N3528
A10Q4	1855-0253	9	2	TRANSISTOR J-FET N-CHAN D-MODE TO-92 SI	28480	1855-0253
A10Q5				NOT ASSIGNED		
A10Q6	1855-0020	8	5	TRANSISTOR J-FET N-CHAN D-MODE TO-18 SI	28480	1855-0020
A10Q7	1855-0020	8		TRANSISTOR J-FET N-CHAN D-MODE TO-18 SI	28480	1855-0020
A10Q8	1855-0020	8		TRANSISTOR J-FET N-CHAN D-MODE TO-18 SI	28480	1855-0020
A10Q9	1855-0020	8		TRANSISTOR J-FET N-CHAN D-MODE TO-18 SI	28480	1855-0020
A10Q10	1855-0020	8		TRANSISTOR J-FET N-CHAN D-MODE TO-18 SI	28480	1855-0020
A10Q11	1855-0253	9		TRANSISTOR J-FET N-CHAN D-MODE TO-92 SI	28480	1855-0253
A10Q12	1884-0018	5	1	THYRISTOR-SCR 2N4186 VRRM=200	04713	2N4186
A10R1	0757-0814	9	1	RESISTOR 511 1% .5W F TC=0+-100	28480	0757-0814
A10R2	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A10R3	2100-0568	1	2	RESISTOR-TRMR 100 10% C TOP-ADJ 1-TRN	28480	2100-0568
A10R4	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A10R5	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A10R6	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A10R7	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A10R8	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A10R9	0757-0462	3	1	RESISTOR 75K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7502-F
A10R10	0757-0461	2		RESISTOR 68.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6812-F
A10R11	0698-3457	6		RESISTOR 316K 1% .125W F TC=0+-100	28480	0698-3457
A10R12	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A10R13	0757-0288	1	2	RESISTOR 9.09K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-9091-F
A10R14	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A10R15	0698-5405	8	1	RESISTOR 600 1% .25W F TC=0+-100	24546	C5-1/4-T0-600R-F
A10R16	2100-0568	1		RESISTOR-TRMR 100 10% C TOP-ADJ 1-TRN	28480	2100-0568
A10R17	0698-8827	4	3	RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-8827
A10R18	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A10R19	0698-8827	4		RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-8827
A10R20	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A10R21	0683-1065	7	1	RESISTOR 10M 5% .25W CC TC=-900/+1100	01121	CB1065
A10R22	0698-6983	9	4	RESISTOR 20.4K .1% .125W F TC=0+-25	19701	MF4C1/8-T9-2042-B
A10R23	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A10R24	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A10R25	0698-6983	9		RESISTOR 20.4K .1% .125W F TC=0+-25	19701	MF4C1/8-T9-2042-B
A10R26	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A10R27	0698-6320	8	2	RESISTOR 5K .1% .125W F TC=0+-25	03888	PME55-1/8-T9-5001-B
A10R28	0698-8863	8	2	RESISTOR 5.2K .1% .125W F TC=0+-25	28480	0698-8863
A10R29	0757-0288	1		RESISTOR 9.09K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-9091-F
A10R30	0698-8863	8		RESISTOR 5.2K .1% .125W F TC=0+-25	28480	0698-8863
A10R31	0698-6320	8		RESISTOR 5K .1% .125W F TC=0+-25	03888	PME55-1/8-T9-5001-B
A10R32	2100-0567	0	2	RESISTOR-TRMR 2K 10% C TOP-ADJ 1-TRN	28480	2100-0567
A10R33	2100-3212	8	1	RESISTOR-TRMR 200 10% C TOP-ADJ 1-TRN	28480	2100-3212
A10R34	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A10R35	0698-3151	7		RESISTOR 2.87K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2871-F
A10R36	0698-3151	7		RESISTOR 2.87K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2871-F
A10R37	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A10R38	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A10R39	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A10R40	0698-4424	9	1	RESISTOR 1.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1401-F
A10R41	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A10R42	0698-3454	3		RESISTOR 215K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2153-F
A10R43	0698-3454	3		RESISTOR 215K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2153-F
A10R44	0757-1094	9		RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A10R45	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F

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

ManualsPlus.com

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A10R46	0698-3459	8	1	RESISTOR 383K 1% .125W F TC=0+-100	28480	0698-3459
A10R47	2100-0558	9	1	RESISTOR-TRMR 20K 10% C TOP-ADJ 1-TRN	28480	2100-0558
A10R48	0698-8827	4		RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-8827
A10R49	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A10R50	0698-6347	9	1	RESISTOR 1.5K .1% .125W F TC=0+-25	28480	0698-6347
A10R51	0698-7394	8	1	RESISTOR 698 .1% .125W F TC=0+-25	19701	MF4C1/8-T9-698R-R
A10R52	0698-3451	0	2	RESISTOR 133K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1333-F
A10R53	0698-3451	0		RESISTOR 133K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1333-F
A10R54	0698-6983	9		RESISTOR 20.4K .1% .125W F TC=0+-25	19701	MF4C1/8-T9-2042-B
A10R55	0698-6983	9		RESISTOR 20.4K .1% .125W F TC=0+-25	19701	MF4C1/8-T9-2042-B
A10R56	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A10R57	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A10R58	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A10R59	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A10R60	0757-0290	5		RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A10R61	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A10R62	0757-0200	7		RESISTOR 5.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5621-F
A10R63	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A10R64	2100-0567	0		RESISTOR-TRMR 2K 10% C TOP-ADJ 1-TRN	28480	2100-0567
A10R65	0698-3405	4	1	RESISTOR 422 1% .5W F TC=0+-100	28480	0698-3405
A10R66	0698-3407	6	3	RESISTOR 1.96K 1% .5W F TC=0+-100	28480	0698-3407
A10R67	0757-0816	1	1	RESISTOR 681 1% .5W F TC=0+-100	28480	0757-0816
A10R68	0698-3407	6		RESISTOR 1.96K 1% .5W F TC=0+-100	28480	0698-3407
A10R69	0698-3407	6		RESISTOR 1.96K 1% .5W F TC=0+-100	28480	0698-3407
A10R70	0757-0198	2	1	RESISTOR 100 1% .5W F TC=0+-100	28480	0757-0198
A10R71	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A10R72	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A10R73	0698-6942	0	1	RESISTOR 25K .1% .125W F TC=0+-50	28480	0698-6942
A10R74	0698-8284	7	1	RESISTOR 118.37K .1% .125W F TC=0+-50	19701	MF4C1/8-T2-118371-B
A10R75	0818-0056	1	1	RESISTOR 1 3% 10W PW TC=0+-50	91637	CW10-1-11W-T2-1R0-H
A10R76	0698-7861	4	1	RESISTOR 25.42K .1% .125W F TC=0+-50	19701	MF4C1/8-T2-25421-B
A10R77	0698-6722	4	1	RESISTOR 124K .1% .125W F TC=0+-50	28480	0698-6722
A10R78	0757-1000	7	1	RESISTOR 51.1 1% .5W F TC=0+-100	28480	0757-1000
A10R79	2100-1768	5	1	RESISTOR-TRMR 20 5% WW TOP-ADJ 1-TRN	28480	2100-1768
A10R80	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A10R81	0698-3439	4		RESISTOR 178 1% .125W F TC=0+-100	24546	C4-1/8-T0-178R-F
A10R82	0757-0158	4	2	RESISTOR 619 1% .5W F TC=0+-100	28480	0757-0158
A10R83	0698-3439	4		RESISTOR 178 1% .125W F TC=0+-100	24546	C4-1/8-T0-178R-F
A10R84	0757-0158	4		RESISTOR 619 1% .5W F TC=0+-100	28480	0757-0158
A10TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A10TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A10U1	1820-1423	4		IC MV TTL LS MONOSTBL RETRIG DUAL	01295	SN74LS123N
A10U2	1826-0412	1	1	IC COMPARATOR PRCN DUAL 8-DIP-P PKG	27014	LM393N
A10U3	1820-1423	4		IC MV TTL LS MONOSTBL RETRIG DUAL	01295	SN74LS123N
A10U4	1826-0462	1	3	IC CONV 10-B-D/A 16-DIP-C PKG	04713	MC3410CL
A10U5	1820-1730	6	7	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A10U6	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A10U7	1820-2111	9	3	IC DRVR TTL INV	01295	SN75468N
A10U8	1826-0462	1		IC CONV 10-B-D/A 16-DIP-C PKG	04713	MC3410CL
A10U9	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A10U10	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A10U11	1820-2111	9		IC DRVR TTL INV	01295	SN75468N
A10U12	1820-2111	9		IC DRVR TTL INV	01295	SN75468N
A10U13	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A10U14	1826-0462	1		IC CONV 10-B-D/A 16-DIP-C PKG	04713	MC3410CL
A10U15	1826-0371	1	2	IC OP AMP LOW-BIAS-H-IMPD TO-99 PKG	27014	LF256H
A10U16	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A10U17	1826-0521	3	2	IC OP AMP DUAL 8-DIP-P PKG	01295	TL072CP
A10U18	1826-0323	3		IC OP AMP GP QUAD 14-DIP-C PKG	28480	1826-0323
A10U19	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A10U20	1826-0521	3		IC OP AMP DUAL 8-DIP-P PKG	01295	TL072CP
A10U21	1826-0138	8	2	IC COMPARATOR GP QUAD 14-DIP-P PKG	01295	LM339N
A10U22	1826-0138	8		IC COMPARATOR GP QUAD 14-DIP-P PKG	01295	LM339N
A10U23	1826-0371	1		IC OP AMP LOW-BIAS-H-IMPD TO-99 PKG	27014	LF256H
A10VR1	1902-1299	6	2	DIODE-ZNR 3.3V 10% DO-15 PD=1W TC=-.061%	28480	1902-1299
A10VR2	1902-1299	6		DIODE-ZNR 3.3V 10% DO-15 PD=1W TC=-.061%	28480	1902-1299
A10VR3	1902-0777	3	1	DIODE-ZNR 1N825 6.2V 5% DO-7 PD=.4W	04713	1N825
A10VR4	1902-0064	1		DIODE-ZNR 7.5V 5% DO-35 PD=.4W TC=+.05%	28480	1902-0064
A10VR5	1902-3381	1	1	DIODE-ZNR 68.1V 5% DO-7 PD=.4W TC=+.079%	28480	1902-3381
A10VR6	1902-3139	7		DIODE-ZNR 8.25V 5% DO-35 PD=.4W	28480	1902-3139
A11	08656-60007	7	1	MICROPROCESSOR/MEMORY/HP-IB ASSEMBLY	28480	08656-60007

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

ManualsPlus.com

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A11C1	0180-2207	5	1	CAPACITOR-FXD 100UF+-10% 10VDC TA	56289	150D107X9010R2
A11C2	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A11C3	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A11C4	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A11C5	0180-0116	1	4	CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A11C6	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A11C7	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A11C8	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A11C9	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A11C10	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A11C11	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A11C12	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A11C13	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A11C14	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A11C15	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A11C16	0160-4493	3		CAPACITOR-FXD 27PF +-5% 200VDC CER 0+-30	51642	200-200-NP0-270J
A11C17	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A11C18	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A11C19	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A11C20	0160-0574	3		CAPACITOR-FXD .022UF +-20% 100VDC CER	28480	0160-0574
A11C21	0160-0574	3		CAPACITOR-FXD .022UF +-20% 100VDC CER	28480	0160-0574
A11C22	0160-4493	3		CAPACITOR-FXD 27PF +-5% 200VDC CER 0+-30	51642	200-200-NP0-270J
A11CR1	1901-0518	8	1	DIODE-SM SIG SCHOTTKY	28480	1901-0518
A11J1	1251-5571	4		CONNECTOR 17-PIN M POST TYPE	28480	1251-5571
	1251-5595	2	1	KEY, POLARIZING	28480	1251-5595
A11J2	1200-0507	9		SOCKET-IC 16-CONT DIP-SLDR	28480	1200-0507
A11J3	1251-5835	3	1	CONNECTOR 6-PIN M POST TYPE	28480	1251-5835
A11J4	1200-0507	9		SOCKET-IC 16-CONT DIP-SLDR	28480	1200-0507
A11J5	1251-5855	7	1	CONNECTOR 16-PIN M POST TYPE	28480	1251-5855
A11J6	1251-5671	5	1	CONNECTOR 20-PIN M POST TYPE	28480	1251-5671
A11MP1	1400-0966	8		CLIP-HINGE	91506	6015-13AT
A11Q1	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A11R1	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A11R2	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A11R3	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A11R4	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A11R5	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A11R6	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A11R7	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A11R8	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A11R9	1810-0278	4	1	NETWORK-RES 10-SIP3.3K OHM X 9	01121	210A332
A11R10	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A11R11	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A11R12	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A11R13	0757-1094	9		RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A11R14	1810-0205	7	1	NETWORK, RES 4.7K 8-PIN-SIP .1-PIN-SPCG	01121	208A472
A11R15	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A11R16	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A11S1	3101-2172	0	2	SWITCH-TGL DIP-RKR-ASSY SPDT .05A 30VDC	28480	3101-2172
A11S2	3101-2172	0		SWITCH-TGL DIP-RKR-ASSY SPDT .05A 30VDC	28480	3101-2172
A11S3	3101-2335	7	1	SWITCH-RKR DIP-RKR-ASSY 3PDT .05A 30VDC	28480	3101-2335
A11S4	3101-2135	5	1	SWITCH-RKR DIP-RKR-ASSY DPDT .05A 30VDC	28480	3101-2135
A11TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A11TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A11TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A11TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A11TP5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A11TP6	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A11TP7	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A11TP8	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A11TP9	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A11TP10	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A11TP11	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A11TP12	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A11TP13	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A11TP14	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A11TP15	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A11TP16	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A11TP17	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A11TP18	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600

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

ManualsPlus.com

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A11U1	1820-1240	3	3	IC DCDR TTL S 3-TO-8-LINE 3-INP	01295	SN74S138N
A11U2†	1818-1365	8	1	ROM #1	18324	N2616N MASKED
A11U3	1818-0701	4	2	IC NMOS 1024 (1K) RAM STAT 360-NS 3-S	04713	MCM68A10P
A11U4	1818-0701	4		IC NMOS 1024 (1K) RAM STAT 360-NS 3-S	04713	MCM68A10P
A11U5†	1818-1362	5	1	ROM #6	18324	N2616N MASKED
A11U6†	1818-1361	4	1	ROM #5	18324	N2616N MASKED
A11U7†	1818-1360	3	1	ROM #4	18324	N2616N MASKED
A11U8†	1818-1359	0	1	ROM #3	18324	N2616N MASKED
A11U9†	1818-1358	9	1	ROM #2	18324	N2616N MASKED
A11U10	1820-2102	8	1	IC LCH TTL LS D-TYPE OCTL	01295	SN74LS373N
A11U11	1820-1240	3		IC DCDR TTL S 3-TO-8-LINE 3-INP	01295	SN74S138N
A11U12	1820-1759	9	4	IC BFR TTL LS NON-INV OCTL	27014	DM81LS97N
A11U13	1820-2099	2	1	IC MICPROC NMOS 8-BIT	04713	MC6802P
A11U14	1820-2075	4	2	IC MISC TTL LS	01295	SN74LS245N
A11U15	1820-2075	4		IC MISC TTL LS	01295	SN74LS245N
A11U16	1820-1491	6	1	IC BFR TTL LS NON-INV HEX 1-INP	01295	SN74LS367AN
A11U17	1820-1759	9		IC BFR TTL LS NON-INV OCTL	27014	DM81LS97N
A11U18	1820-1759	9		IC BFR TTL LS NON-INV OCTL	27014	DM81LS97N
A11U19	1820-2219	8	1	IC MICPROC-ACCESS NMOS 8-BIT	04713	MC68488P
A11U20	1820-1759	9		IC BFR TTL LS NON-INV OCTL	27014	DM81LS97N
A11U21	1820-1200	5	1	IC INV TTL LS HEX	01295	SN74LS05N
A11U22	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A11U23	1820-1689	4	4	IC UART TTL QUAD	01295	MC3446P
A11U24	1820-1240	3		IC DCDR TTL S 3-TO-8-LINE 3-INP	01295	SN74S138N
A11U25	1820-1201	6	1	IC GATE TTL LS AND QUAD 2-INP	01295	SN74LS08N
A11U26	1820-1689	4		IC UART TTL QUAD	01295	MC3446P
A11U27	1820-1689	4		IC UART TTL QUAD	01295	MC3446P
A11U28	1820-1422	3		IC MV TTL LS MONOSTBL RETRIG	01295	SN74LS122N
A11U29	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A11U30	1820-1689	4		IC UART TTL QUAD	01295	MC3446P
A11U31	1820-1568	8	1	IC BFR TTL LS BUS QUAD	01295	SN74LS125AN
A11U32	1820-2056	1		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS378N
A11U33	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A11VR1	1902-3070	5	1	DIODE-ZNR 4.22V 5% DO-35 PD=.4W	28480	1902-3070
A11Y1	0410-0465	2	1	CRYSTAL-QUARTZ 4.00000 MHZ HC-6/U-HLDR	28480	0410-0465
A12	08656-60016	8	1	VOLTAGE REGULATOR ASSEMBLY	28480	08656-60016
A12C1	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A12C2	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A12C3	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A12C4	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A12C5	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A12C6	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A12J1	1251-5810	4	1	CONNECTOR 10-PIN M POST TYPE	28480	1251-5810
A13	08656-60064	6	1	HP-IB CONNECTOR ASSEMBLY	28480	08656-60064
A13J1				PART IS ETCHED TRACE ON CIRCUIT BOARD		
A13J2	1251-3283	1	1	CONNECTOR 24-PIN F MICRORIBBON	28480	1251-3283
A13MP1	0380-0644	4	2	STANDOFF-HEX .327-IN-LG 6-32THD	00000	ORDER BY DESCRIPTION
A13MP2	1530-1098	4	2	CLEVIS 0.070-IN W SLT: 0.454-IN PIN CTR	00000	ORDER BY DESCRIPTION
A13MP3	2190-0034	5		WASHER-LK HLCL NO. 10 .194-IN-ID	28480	2190-0034
A13MP4	2200-0109	8	2	SCREW-MACH 4-40 .438-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A13MP5	2260-0009	3	4	NUT-HEX-W/LKWR 4-40-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
A14	08656-60078	2	1	FILTER BANK ASSEMBLY	28480	08656-60078
A14J1	1251-5880	8	1	CONNECTOR 15-PIN M D SUBMINIATURE	28480	1251-5880
A14J2	1251-4966	9	2	CONNECTOR 8-PIN M POST TYPE	28480	1251-4966
A14J3	1251-4966	9		CONNECTOR 8-PIN M POST TYPE	28480	1251-4966
A14MP1	0460-1439	7		TAPE, INDUSTRIAL (1 INCH)	28480	0460-1439
A14MP2	2200-0103	2		SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A14MP3	2260-0009	3		NUT-HEX-W/LKWR 4-40-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
A14MP4	08656-00047	9	1	CORNER BRACKET, REAR PANEL	28480	08656-00047
A14MP5	08656-00048	0	1	GASKET, CORNER BRACKET	28480	08656-00048
A15	0960-0443	1	1	LINE POWER MODULE	28480	0960-0443
	0360-0001	5	3	TERMINAL-SLDR LUG LK-MTG FOR-#6-SCR	28480	0360-0001
	0890-0983	5		TUBING-HS .125-D/.062-RCVD .02-WALL	28480	0890-0983
	8150-2919	1		WIRE 18AWG G/Y 600V PVC 19X30 105C	28480	8150-2919
	8151-0013	4	5	WIRE 22AWG 1X22	28480	8151-0013
	7120-8986	0	1	LABEL	28480	7120-8986

See introduction to this section for ordering information
*Indicates factory selected value
† FOR BACKDATING INFORMATION REFER TO SECTION VII

ManualsPlus.com

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A16	0950-0411	2	1	10 MHZ REFERENCE OSCILLATOR ASSEMBLY	28480	0950-0411
	8150-2890	7	1	WIRE 18AWG BK 600V PVC 19X30 105C	28480	8150-2890
	8150-0447	6	1	WIRE 24AWG BK 300V PVC 7X32 80C	28480	8150-0447
	2200-0103	2	20	SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2360-0113	2		SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	0360-0001	5		TERMINAL-SLDR LUG LK-MTG FOR-#6-SCR	28480	0360-0001
	0360-0053	7	2	TERMINAL-SLDR LUG LK-MTG FOR-#10-SCR	28480	0360-0053
	0590-1245	8	5	NUT-SHMET-U-TP 6-32-THD .017-IN-THK	00000	ORDER BY DESCRIPTION
	3050-0066	8	6	WASHER-FL MTLC NO. 6 .147-IN-ID	28480	3050-0066
	08656-80005	7	1	FINGER GUARD-INTERNAL	28480	08656-80005
	2360-0199	4	3	SCREW-MACH 6-32 .438-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A16W1	08656-60066	8	1	CABLE-COAXIAL, REF. OSC./A16J1	28480	08656-60066
A16W2	8120-2682	2	1	CABLE-COAXIAL, A16J1/J3	28480	8120-2682
A17†	08656-60081	7	1	FRONT FEEDTHRU ASSEMBLY	28480	08656-60081

See introduction to this section for ordering information
*Indicates factory selected value
†FOR BACKDATING INFORMATION REFER TO SECTION VII

ManualsPlus.com

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				CHASSIS PARTS		
B1	3160-0346	0	1	FAN-TBAX 36-CFM 115V 50/60-HZ 1.5KV-DIEL	28480	3160-0346
	0590-1245	8		NUT-SHMET-U-TP 6-32-THD .017-IN-THK	00000	ORDER BY DESCRIPTION
	2360-0205	3	2	SCREW-MACH 6-32 .75-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2360-0199	4		SCREW-MACH 6-32 .438-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
C1	0160-4900	7	19	CAPACITOR-FDTHRU 1000PF +80 -20% 200V	72982	2425-011-X5U0-102-M
C2	0160-4900	7		CAPACITOR-FDTHRU 1000PF +80 -20% 200V	72982	2425-011-X5U0-102-M
C3	0160-4900	7		CAPACITOR-FDTHRU 1000PF +80 -20% 200V	72982	2425-011-X5U0-102-M
C4	0160-4900	7		CAPACITOR-FDTHRU 1000PF +80 -20% 200V	72982	2425-011-X5U0-102-M
C5	0160-4900	7		CAPACITOR-FDTHRU 1000PF +80 -20% 200V	72982	2425-011-X5U0-102-M
C6	0160-4900	7		CAPACITOR-FDTHRU 1000PF +80 -20% 200V	72982	2425-011-X5U0-102-M
C7	0160-4900	7		CAPACITOR-FDTHRU 1000PF +80 -20% 200V	72982	2425-011-X5U0-102-M
C8	0160-4900	7		CAPACITOR-FDTHRU 1000PF +80 -20% 200V	72982	2425-011-X5U0-102-M
C9	0160-4900	7		CAPACITOR-FDTHRU 1000PF +80 -20% 200V	72982	2425-011-X5U0-102-M
C10	0160-4082	6		CAPACITOR-FDTHRU 1000PF 20% 200V CER (INCLUDES MOUNTING HARDWARE)	28480	0160-4082
C11	0160-4900	7		CAPACITOR-FDTHRU 1000PF +80 -20% 200V	72982	2425-011-X5U0-102-M
C12	0160-4900	7		CAPACITOR-FDTHRU 1000PF +80 -20% 200V	72982	2425-011-X5U0-102-M
C13	0160-4900	7		CAPACITOR-FDTHRU 1000PF +80 -20% 200V	72982	2425-011-X5U0-102-M
C14	0160-4900	7		CAPACITOR-FDTHRU 1000PF +80 -20% 200V	72982	2425-011-X5U0-102-M
C15	0160-4900	7		CAPACITOR-FDTHRU 1000PF +80 -20% 200V	72982	2425-011-X5U0-102-M
C16	0160-4900	7		CAPACITOR-FDTHRU 1000PF +80 -20% 200V	72982	2425-011-X5U0-102-M
C17	0160-4900	7		CAPACITOR-FDTHRU 1000PF +80 -20% 200V	72982	2425-011-X5U0-102-M
C18	0160-4900	7		CAPACITOR-FDTHRU 1000PF +80 -20% 200V	72982	2425-011-X5U0-102-M
C19	0160-4900	7		CAPACITOR-FDTHRU 1000PF +80 -20% 200V	72982	2425-011-X5U0-102-M
C20	0160-4900	7		CAPACITOR-FDTHRU 1000PF +80 -20% 200V	72982	2425-011-X5U0-102-M
C21	0160-4898	2	2	CAPACITOR-FDTHRU 100PF +80 -20% 200V CER	72982	2425-011-X5U0-101-M
C22	0160-4898	2		CAPACITOR-FDTHRU 100PF +80 -20% 200V CER	72982	2425-011-X5U0-101-M
C23	0160-4071	3	1	CAPACITOR-FDTHRU 20PF 20% 200V CER	28480	0160-4071
	08656-00071	9	1	MOUNTING FLANGE	28480	08656-00071
	08656-20079	9	1	NUT-FLANGE	28480	08656-20079
F1	2110-0016	5	1	FUSE .6A 250V TD 1.25X.25 UL (FOR 220/240V OPERATION)	75915	313.600
F1	2110-0305	5	1	FUSE 1.25A 250V TD 1.25X.25 UL (FOR 100/120V OPERATION)	75915	3131.25
FL1	08656-60005	5	1	FILTER, BANDPASS	28480	08656-60005
	8151-0013	4		WIRE 22AWG 1X22	28480	8151-0013
	8159-0005	0		WIRE 22AWG W PVC 1X22 80C	28480	8159-0005
FL2	9135-0099	3	2	FILTER, LOW-PASS	28480	9135-0099
FL3	9135-0099	3		FILTER, LOW-PASS	28480	9135-0099
J1	1250-0118	3	5	CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM (MOD INPUT/OUTPUT;EXCEPT OPT 002)	28480	1250-0118
	2190-0016	3	5	WASHER-LK INTL T 3/8 IN .377-IN-ID	28480	2190-0016
	2950-0001	8	5	NUT-HEX-DBL-CHAM 3/8-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
	8150-0464	7		WIRE 24AWG W/V 300V PVC 7X32 80C	28480	8150-0464
J2				CONNECTOR, NSR P/O W11 (RF OUTPUT)		
J3	1250-0118	3		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM (TIME BASE INPUT)	28480	1250-0118
	0360-1190	5	2	TERMINAL-SLDR LUG PL-MTG FOR-#3/8-SCR	28480	0360-1190
	0890-0050	7		TUBING-HS .405-D/.29-RCVD .02-WALL PVC	28480	0890-0050
	0890-0983	5		TUBING-HS .125-D/.062-RCVD .02-WALL	28480	0890-0983
	2190-0016	3		WASHER-LK INTL T 3/8 IN .377-IN-ID	28480	2190-0016
	2950-0001	8		NUT-HEX-DBL-CHAM 3/8-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
	8150-0462	5	1	WIRE 24AWG W/G 300V PVC 7X32 80C	28480	8150-0462
J4	1250-0118	3		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM (TIME BASE OUTPUT)	28480	1250-0118
	0360-1190	5		TERMINAL-SLDR LUG PL-MTG FOR-#3/8-SCR	28480	0360-1190
	0890-0983	5		TUBING-HS .125-D/.062-RCVD .02-WALL	28480	0890-0983
	2190-0016	3		WASHER-LK INTL T 3/8 IN .377-IN-ID	28480	2190-0016
	2950-0001	8		NUT-HEX-DBL-CHAM 3/8-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
	8150-0460	3	2	WIRE 24AWG W/O 300V PVC 7X32 80C	28480	8150-0460
J5	1250-0118	3		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM (SEQ; EXCEPT OPT. 002)	28480	1250-0118
	2190-0016	3		WASHER-LK INTL T 3/8 IN .377-IN-ID	28480	2190-0016
	2950-0001	8		NUT-HEX-DBL-CHAM 3/8-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
J6	1250-0118	3		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM (MOD INPUT/OUTPUT;OPT 002 ONLY)	28480	1250-0118
	2190-0016	3		WASHER-LK INTL T 3/8 IN .377-IN-ID	28480	2190-0016
	2950-0001	8		NUT-HEX-DBL-CHAM 3/8-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
	8150-0404	5	1	WIRE 18AWG 0 300V PVC 19X30 80C	28480	8150-0404
L1†	9100-2257	6	2	INDUCTOR RF-CH-MLD 820NH 10% .105DX.26LG	28480	9100-2257
L2†	9100-2257	6		INDUCTOR RF-CH-MLD 820NH 10% .105DX.26LG	28480	9100-2257

See introduction to this section for ordering information
*Indicates factory selected value
† FOR BACKDATING INFORMATION REFER TO SECTION VII

ManualsPlus.com

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
MP1	08656-20100	7	1	FRAME-MACHINED	28480	08656-20100
MP2	08656-00004	8	1	COVER-INSTRUMENT-TOP	28480	08656-00004
MP3	08656-40001	9	2	COVER-INSTRUMENT-SIDE	28480	08656-40001
MP4	5060-9803	2	2	HANDLE-STRAP	28480	5060-9803
MP5	08656-20102	9	2	CAP-FRONT	28480	08656-20102
MP6	2680-0118	5	4	SCREW-MACH 10-32 .5-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
MP7	08656-20103	0	2	CAP-REAR	28480	08656-20103
MP8	5040-7202	9	1	TRIM-TOP	28480	5040-7202
MP9	5001-0439	8	2	TRIM-SIDE	28480	5001-0439
MP10†	08656-00076	4	1	COVER-INTERNAL RF-TOP	28480	08656-00076
MP11	08656-00034	4	1	HINGE-TOP	28480	08656-00034
MP12	1460-1761	9	4	HINGE-SPRING	28480	1460-1761
MP13	08656-00069	5		HINGE LOCK	28480	08656-00069
MP14	2360-0111	0	4	SCREW-MACH 6-32 .188-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP15	08656-00059	3	1	HINGE-BOTTOM	28480	08656-00059
MP16†	08656-00069	5	3	HINGE LOCK	28480	08656-00069
MP17	08656-20083	5	1	CLAMP-ATTENUATOR PLATE	28480	08656-20083
MP18	2360-0203	1	17	SCREW-MACH 6-32 .625-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP19	2190-0006	1	25	WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0006
MP20†	08656-00078	6	2	GASKET-ATTENUATOR	28480	08656-00078
MP21	08656-00045	7	2	INSULATOR-ATTENUATOR	28480	08656-00045
MP22	08656-00068	4	1	INSULATOR-ATTENUATOR	28480	08656-00068
MP23†	08656-00075	3	1	COVER-INTERNAL RF-BOTTOM	28480	08656-00075
MP24	2360-0113	2		SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP25	08656-00005	9	1	COVER-BOTTOM	28480	08656-00005
MP26	08656-20101	8	2	FOOT-FRONT	28480	08656-20101
MP27	5040-7201	8	2	FOOT-REAR	28480	5040-7201
MP28	1460-1345	5	2	TILT STAND SST	28480	1460-1345
MP29†	08656-00079	7	4	COVER-INTERNAL RF #1	28480	08656-00079
MP30†	08656-00080	0	2	COVER-INTERNAL RF #2	28480	08656-00080
MP31†	08656-00081	1	2	COVER-INTERNAL RF #3	28480	08656-00081
MP32†	08656-00082	2	2	COVER-INTERNAL RF #4	28480	08656-00082
MP33†	08656-00083	3	2	COVER-INTERNAL RF #5	28480	08656-00083
MP34†	08656-00084	4	2	COVER-INTERNAL RF #6	28480	08656-00084
MP35†	08656-00085	5	1	COVER-INTERNAL RF #7	28480	08656-00085
MP36†	08656-00086	6	7	COVER-INTERNAL RF #8	28480	08656-00086
MP37†	08656-00087	7	3	COVER-INTERNAL RF #9	28480	08656-00087
MP38	08656-00027	5	2	SHIELD-PIN MODULATOR	28480	08656-00027
MP39	0590-1285	6	62	NUT-SELF THREADING .375 IN A/F; .116 IN	00000	ORDER BY DESCRIPTION
MP40	0360-1665	9	1	TERMINAL STRIP 3-TERM PHEN 1.13-IN-L	28480	0360-1665
MP41	2510-0133	5	5	SCREW-MACH 8-32 .188-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP42	2190-0010	7	1	WASHER-LK EXT T NO. 8 .168-IN-ID	28480	2190-0010
MP43	08656-00037	7	1	SR WALL CLIP	28480	08656-00037
MP44	08656-00039	9	1	CLIP-FEED THRU	28480	08656-00039
MP45	1400-0249	0	14	CABLE TIE .062-.625-DIA .091-WD NYL	06383	PLT1M-8
MP46	1400-0510	8		CLAMP-CABLE .15-DIA .62-WD NYL	28480	1400-0510
MP47	2740-0003	5	29	NUT-HEX-W/LKWR 10-32-THD .125-IN-THK	00000	ORDER BY DESCRIPTION
MP48	08656-20082	4	1	GASKET-ATTENUATOR PLATE CLAMP	28480	08656-20082
MP49	7120-8726	6	1	LABEL 'AM ADJ/DET ADJ'	28480	7120-8726
MP50	7120-8130	6	1	LABEL 'CAUTION DO NOT REMOVE'	28480	7120-8130
MP51	7120-8346	6	1	LABEL 'FRONT'	28480	7120-8346
MP52	2360-0135	8	1	SCREW-MACH 6-32 1.5-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP53†	8160-0350	1	1	GASKET-RFI BEAD	28480	8160-0350
MP54†	8160-0351	2	4	GASKET-RFI BEAD	28480	8160-0351
MP55	3050-0002	2	1	WASHER-FL MTLC NO. 10 .203-IN-ID	28480	3050-0002
MP56	2360-0121	2	1	SCREW-MACH 6-32 .5-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP57	3050-0227	3	1	WASHER-FL MTLC NO. 6 .149-IN-ID	28480	3050-0227
MP58	2190-0007	2	1	WASHER-LK INTL T NO. 6 .141-IN-ID	28480	2190-0007
MP59-MP99				NOT ASSIGNED		
MP100	08656-00046	8	1	PANEL-FRONT(EXCEPT OPT 002)	28480	08656-00046
MP100	08656-00094	6	1	PANEL-FRONT(OPT 002 ONLY)	28480	08656-00094
MP101	2360-0185	8	4	SCREW-MACH 6-32 .5-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
MP102	08656-20066	4	1	WINDOW-FRONT PANEL-RIGHT	28480	08656-20066
MP103	08656-20067	5	1	WINDOW-FRONT PANEL-LEFT	28480	08656-20067
MP104	08656-20068	6	1	WINDOW-FRONT PANEL-CENTER	28480	08656-20068
MP105†	08731-210	2	1	NUT-LOCK	28480	08731-210
MP106	7120-1254	1	1	NAMEPLATE .312-IN-WD .54-IN-LG AL	28480	7120-1254
MP107	2200-0103	2		SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP108				NOT ASSIGNED		
MP109				NOT ASSIGNED		
MP110	08656-00063	9	1	SHROUD-FAN	28480	08656-00063
MP111	2360-0302	1	3	SCREW-MACH 6-32 1.625-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP112	2190-0087	8		WASHER-LK HLCL NO. 8 .168-IN-ID	28480	2190-0087
MP113	08656-40009	7	1	FOOT-LEFT REAR	28480	08656-40009

See introduction to this section for ordering information
*Indicates factory selected value
† FOR BACKDATING INFORMATION REFER TO SECTION VII

ManualsPlus.com

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
MP114	2510-0124	4	2	SCREW-MACH 8-32 .625-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
MP115	2190-0017	4	4	WASHER-LK HLCL NO. 8 .168-IN-ID	28480	2190-0017
MP116	3050-0139	6	2	WASHER-FL MTLC NO. 8 .172-IN-ID	28480	3050-0139
MP117	2580-0004	6	2	NUT-HEX-DBL-CHAM 8-32-THD .125-IN-THK	00000	ORDER BY DESCRIPTION
MP118†	08656-40013	3	1	SERIES REGULATOR COVER	28480	08656-40013
MP119	0361-1098	4	1	RIVET-PRESS ON	28480	0361-1098
MP120	08656-00007	1	1	PANEL-LEFT REAR(EXCEPT OPT 002)	28480	08656-00007
MP120	08656-00095	7	1	PANEL-LEFT REAR(OPT 002 ONLY)	28480	08656-00095
MP121	08656-00049	1	1	GASKET-LEFT REAR PANEL (EXCEPT OPT. 002)	28480	08656-00049
MP121	08656-00096	8	1	GASKET-LEFT REAR PANEL (OPT 002 ONLY)	28480	08656-00096
MP122	2360-0195	0	5	SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP123	08656-00064	0	1	BRACKET-CRYSTAL	28480	08656-00064
MP124	2360-0115	4	1	SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP125	08656-40010	0	1	FOOT-RIGHT REAR	28480	08656-40010
MP126	3050-0066	8		WASHER-FL MTLC NO. 6 .147-IN-ID	28480	3050-0066
MP127	08656-40011	1	1	GROMMET-LARGE HOLE	28480	08656-40011
MP128	7120-4295	6	2	LABEL-'HAZARDOUS VOLTAGE'	28480	7120-4295
MP129	7120-5911	5	1	LABEL-'METRIC THREADED FASTENERS'	28480	7120-5911
MP130	1251-6539	6	1	CONNECTOR-MIN. F RECP	28480	1251-6539
MP131	1251-6540	9	1	CONNECTOR-MIN-M PLUG	28480	1251-6540
MP132	1251-6541	0	2	HOOD-MINIATURE	28480	1251-6541
MP133	6960-0002	4	1	PLUG-HOLE DOME-HD FOR .5-D-HOLE STL	28480	6960-0002
MP134	3160-0300	6	1	GUARD-FINGER-EXTERNAL	28480	3160-0300
MP135†				NOT ASSIGNED		
MP136	1400-0510	8		CLAMP-CABLE .15-DIA .62-WD NYL (OPT. 002 ONLY)	28480	1400-0510
MP137	6960-0009	1	1	PLUG-HOLE FL-HD FOR .438-D-HOLE BRS (OPT. 002 ONLY)	28480	6960-0009
T1	9100-5000	3	1	TRANSFORMER	28480	9100-5000
	0360-0053	7		TERMINAL-SLDR LUG LK-MTG FOR-#10-SCR	28480	0360-0053
	2190-0034	5	7	WASHER-LK HLCL NO. 10 .194-IN-ID	28480	2190-0034
	1251-3252	4	2	CONTACT-CONN U/W-SUBMIN-D FEM CRP	28480	1251-3252
	1251-4283	3	2	CONTACT-CONN U/W-POST-TYPE FEM CRP	28480	1251-4283
	2680-0073	1	4	SCREW-MACH 10-32 2-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
U1†	1826-0819	2	1	IC-VOLTAGE REGULATOR TO-3	28480	1826-0819
	2200-0111	2	1	SCREW-MACH 4-40 .5-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2200-0113	4	8	SCREW-MACH 4-40 .625-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
U2	1826-0513	3	1	IC V RGLTR TO-3	80103	LAS-1905
U2†	1200-0043	8	1	INSULATOR-XSTR ALUMINUM	28480	1200-0043
	2200-0113	4		SCREW-MACH 4-40 .625-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	08660-40002	6	3	INSULATOR	28480	08660-40002
U3†	1826-0820	5	1	IC-VOLTAGE REGULATOR TO-3	28480	1826-0820
	0340-0875	9	2	INSULATOR-XSTR THRM-CNDCT	28480	0340-0875
	2200-0113	4		SCREW-MACH 4-40 .625-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	08660-40002	6		INSULATOR	28480	08660-40002
U4	1906-0231	2	1	DIODE-CT-RECT 200V 15A	28480	1906-0231
	0340-0875	9		INSULATOR-XSTR THRM-CNDCT	28480	0340-0875
	2200-0113	4		SCREW-MACH 4-40 .625-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	08660-40002	6		INSULATOR	28480	08660-40002
W1	08656-60045	3	1	WIRING HARNESS, A1J1 TO A2J2	28480	08656-60045
	7120-8725	5	1	LABEL 'A1-J1'	28480	7120-8725
W2	08656-60037	3	1	WIRING HARNESS, A2J1 TO C1-8	28480	08656-60037
W3	08656-60020	4	1	CABLE, COAX,60-110MHZ A3J4 TO A8J4	28480	08656-60020
W4	08656-60039	5	1	WIRING HARNESS, A3J1 TO A7J1/C11-13 TO C15-17, 19	28480	08656-60039
W5	08656-60019	1	1	CABLE, COAX, 50MHZ, A3J5 TO A8J3	28480	08656-60019
W6	08656-60028	2	1	WIRING HARNESS, A6J1 TO A4J1	28480	08656-60028
W7	08656-60027	1	1	WIRING HARNESS, A7J2 TO A6J4/FL2, 3	28480	08656-60027
	1400-0510	8	13	CLAMP-CABLE .15-DIA .62-WD NYL	28480	1400-0510
W8	08656-20022	2	1	CABLE, SEMI-RIGID, 690-740MHZ, FL1 TO A4	28480	08656-20022
W9	08656-20019	7	1	CABLE, SEMI-RIGID, 690-740MHZ, A8 TO A4	28480	08656-20019
W10	08656-20023	3	1	CABLE, SEMI-RIGID, 800MHZ, A8 TO A6	28480	08656-20023
W11	8120-2896	0	1	CABLE, SEMI-RIGID,.1-990MHZ,A9A1J2/J2 (EXCEPT OPT. 002) INCL J2	28480	8120-2896
W11	08656-20117	6	1	CABLE-SEMI-RIGID,REAR 0.1-990MHZ W12 TO J2 (OPT. 002 ONLY;INCL J2)	28480	08656-20117
W12	08656-20116	5	1	CABLE-SEMI-RIGID,FRONT 0.1-990MHZ A9A1J2 TO W11(OPT. 002 ONLY)	28480	08656-20116
W13	08656-20021	1	1	CABLE,SEMI-RIGID,800.1-923.5MHZ,A6/A9A1	28480	08656-20021
W14	08656-20017	5	1	CABLE,SEMI-RIGID,123.5-990MHZ,A6 TO A9A1	28480	08656-20017
W15	08656-60033	9	1	WIRING HARNESS, A11J1 TO A10J1	28480	08656-60033
	7120-8724	4	1	LABEL 'A10-J1'	28480	7120-8724

See introduction to this section for ordering information
*Indicates factory selected value
† FOR BACKDATING INFORMATION REFER TO SECTION VII

ManualsPlus.com

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
W16	08656-60029	3	1	WIRING HARNESS, MAIN (EXCEPT OPT 002)	28480	08656-60029
W16	08656-60084	0	1	WIRING HARNESS,MAIN (OPT 002 ONLY)	28480	08656-60084
W17	8120-2993	8	1	CABLE, RIBBON, A10J3 TO A9A1J1	28480	8120-2993
W18	8120-2946	1	1	CABLE, RIBBON, A11J6 TO A13J1	28480	8120-2946
W19	08656-60072	6	1	WIRING HARNESS, A12J1 TO A14J1	28480	08656-60072
W20	8120-1378	1	1	CABLE, MAINS POWER	28480	8120-1378

Table 6-4. Code List of Manufacturers

Mfr Code	Manufacturer Name	Address		Zip Code
00000	ANY SATISFACTORY SUPPLIER			
0003J	NIPPON ELECTRIC CO			
01121	ALLEN-BRADLEY CO	MILWAUKEE	WI	53204
01295	TEXAS INSTR INC SEMICOND CMPNT DIV	DALLAS	TX	75222
0192B	RCA CORP SOLID STATE DIV	SOMERVILLE	NJ	08876
02114	FERROXCUBE CORP	SAUGERTIES	NY	12477
03508	GE CO SEMICONDUCTOR PROD DEPT	SYRACUSE	NY	13201
03888	KDI PYROFILM CORP	WHIPPANY	NJ	07981
04713	MOTOROLA SEMICONDUCTOR PRODUCTS	PHOENIX	AZ	85062
06001	GE CO ELEK CAP & BAT PROD DEPT	IRMO	SC	29063
06383	PANDUIT CORP	TINLEY PARK	IL	60477
06665	PRECISION MONOLITHICS INC	SANTA CLARA	CA	95050
07263	FAIRCHILD SEMICONDUCTOR DIV	MOUNTAIN VIEW	CA	94042
17856	SILICONIX INC	SANTA CLARA	CA	95054
18324	SIGNETICS CORP	SUNNYVALE	CA	94086
19701	MEPCO/ELECTRA CORP	MINERAL WELLS	TX	76067
20932	EMCON DIV ITW	SAN DIEGO	CA	92129
24046	TRANSITRON ELECTRONIC CORP	WAKEFIELD	MA	01880
24546	CORNING GLASS WORKS (BRADFORD)	BRADFORD	PA	16701
25403	AMPEREX ELEK CORP SEMICON & MC DIV	SLATERSVILLE	RI	02876
27014	NATIONAL SEMICONDUCTOR CORP	SANTA CLARA	CA	95051
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO	CA	94304
32293	INTERSIL INC	CUPERTINO	CA	95014
32997	BOURNS INC TRIMPOT PROD DIV	RIVERSIDE	CA	92507
51642	CENTRE ENGINEERING INC	STATE COLLEGE	PA	16801
52763	STETTNER-TRUSH INC	CAZENOVIA	NY	13035
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
73138	BECKMAN INSTRUMENTS INC HELIPOT DIV	FULLERTON	CA	92634
74970	JOHNSON E F CO	WASECA	MN	56093
75915	LITTELFUSE INC	DES PLAINES	IL	60016
80103	LAMBDA ELECTRONICS CORP	MELVILLE	NY	11746
91506	AUGAT INC	ATTLEBORO	MA	02703
91637	DALE ELECTRONICS INC	COLUMBUS	NE	68601

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

ManualsPlus.com

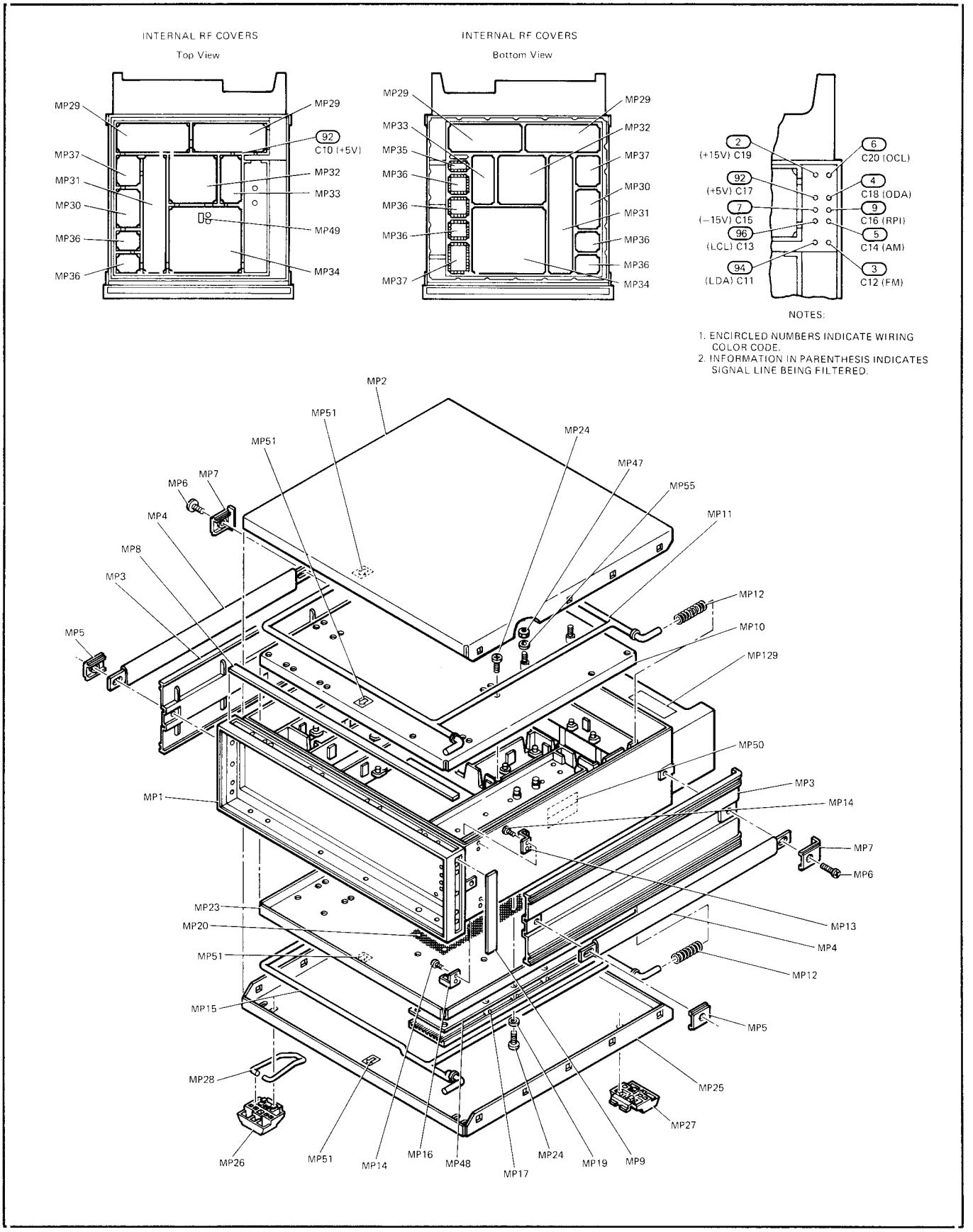


Figure 6-1. Cabinet, Parts Identification

ManualsPlus.com

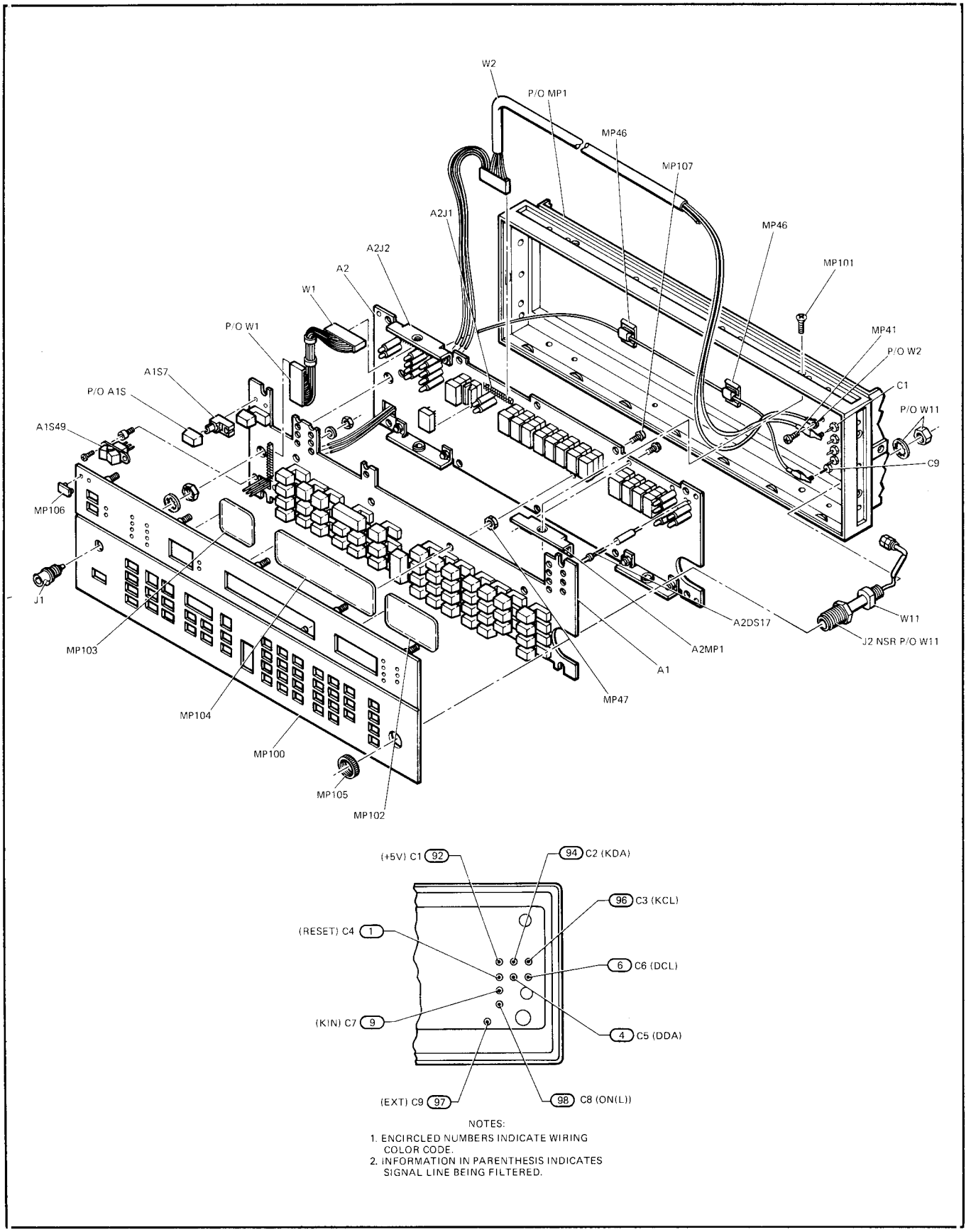


Figure 6-2. Front Panel, Parts Identification

ManualsPlus.com

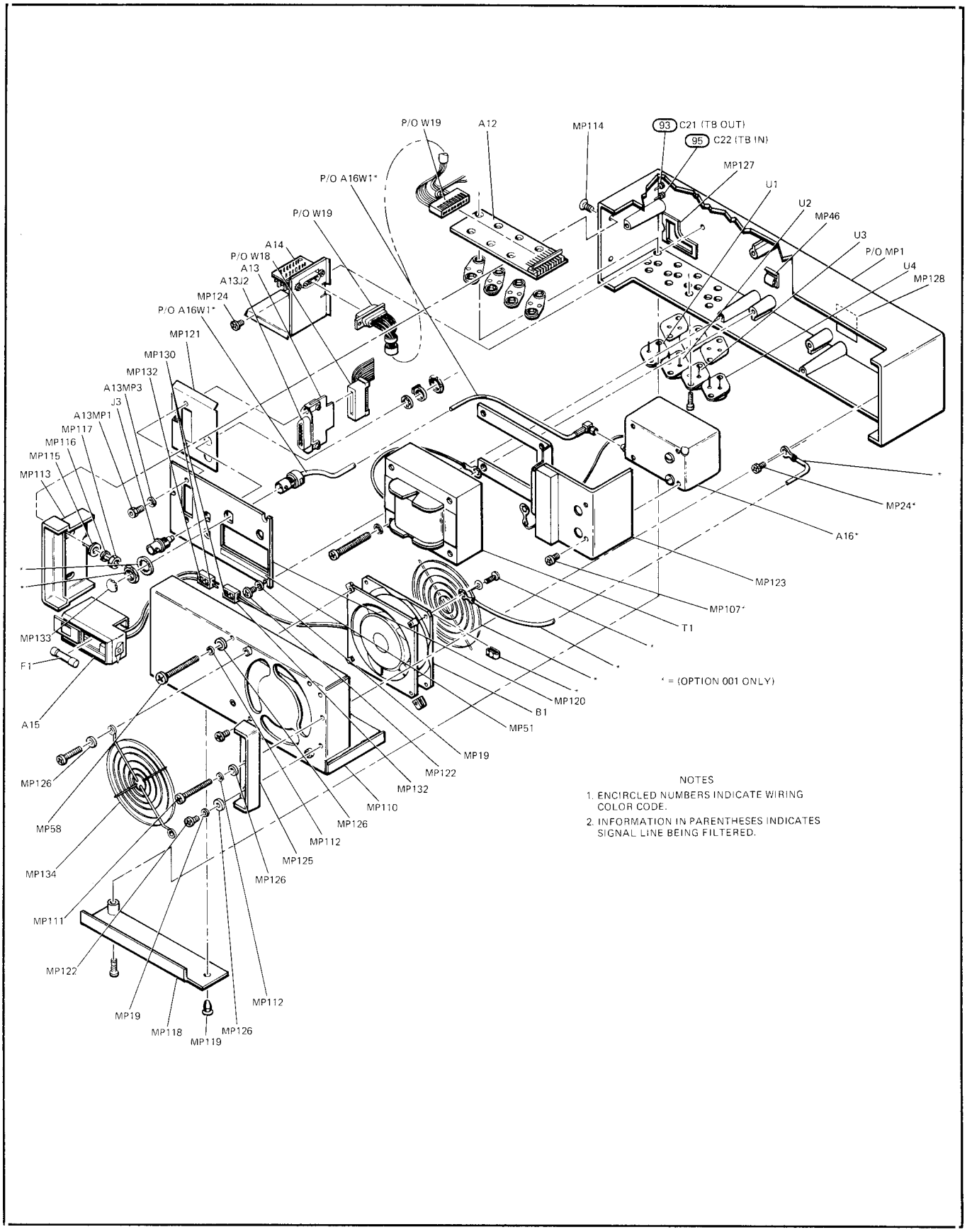


Figure 6-3. Rear Panel, Parts Identification

ManualsPlus.com

TOP INTERNAL VIEW
LEVEL I

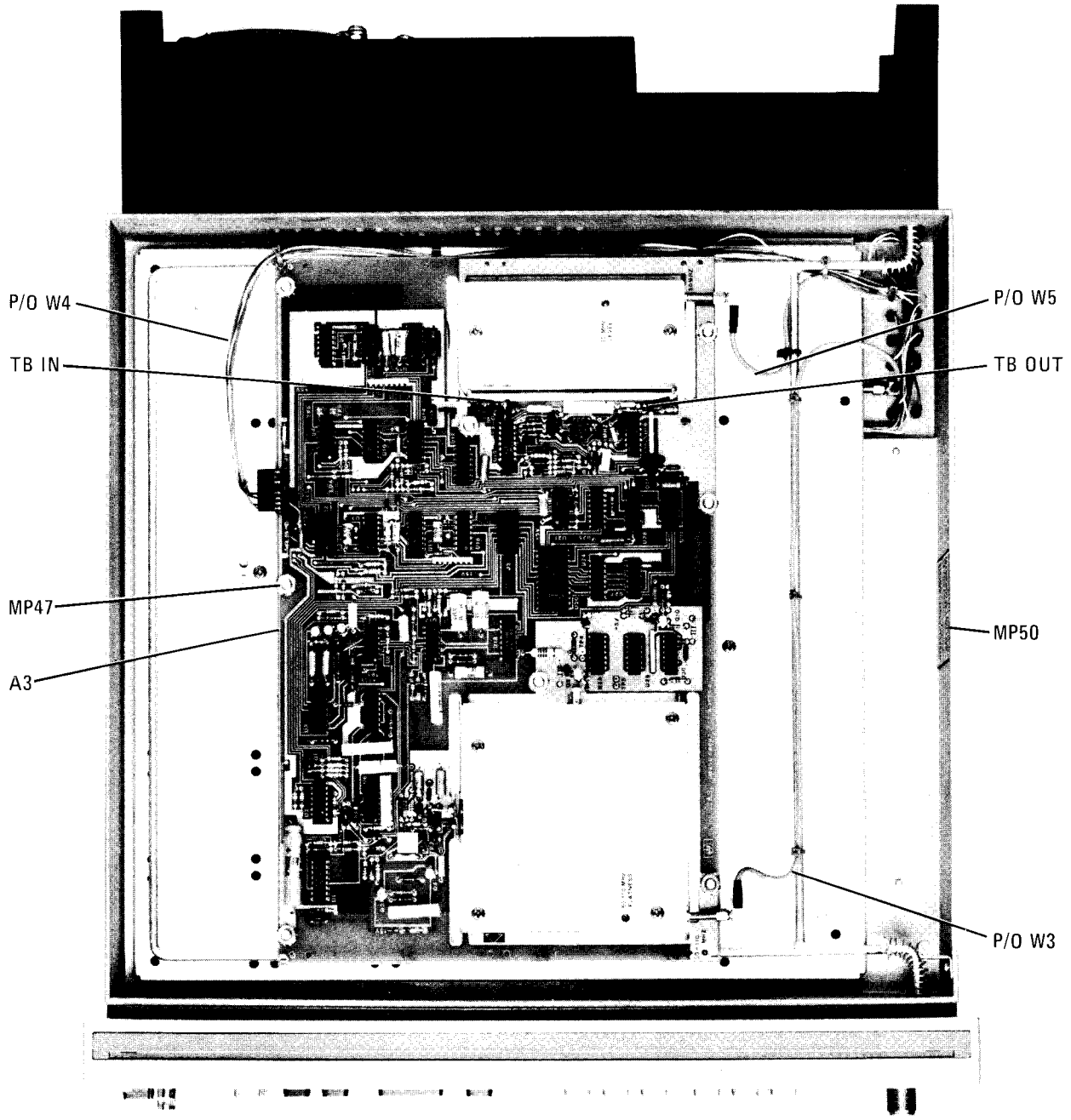


Figure 6-4. Top Internal View; Top Cover Removed

ManualsPlus.com

TOP INTERNAL VIEW
LEVEL 2

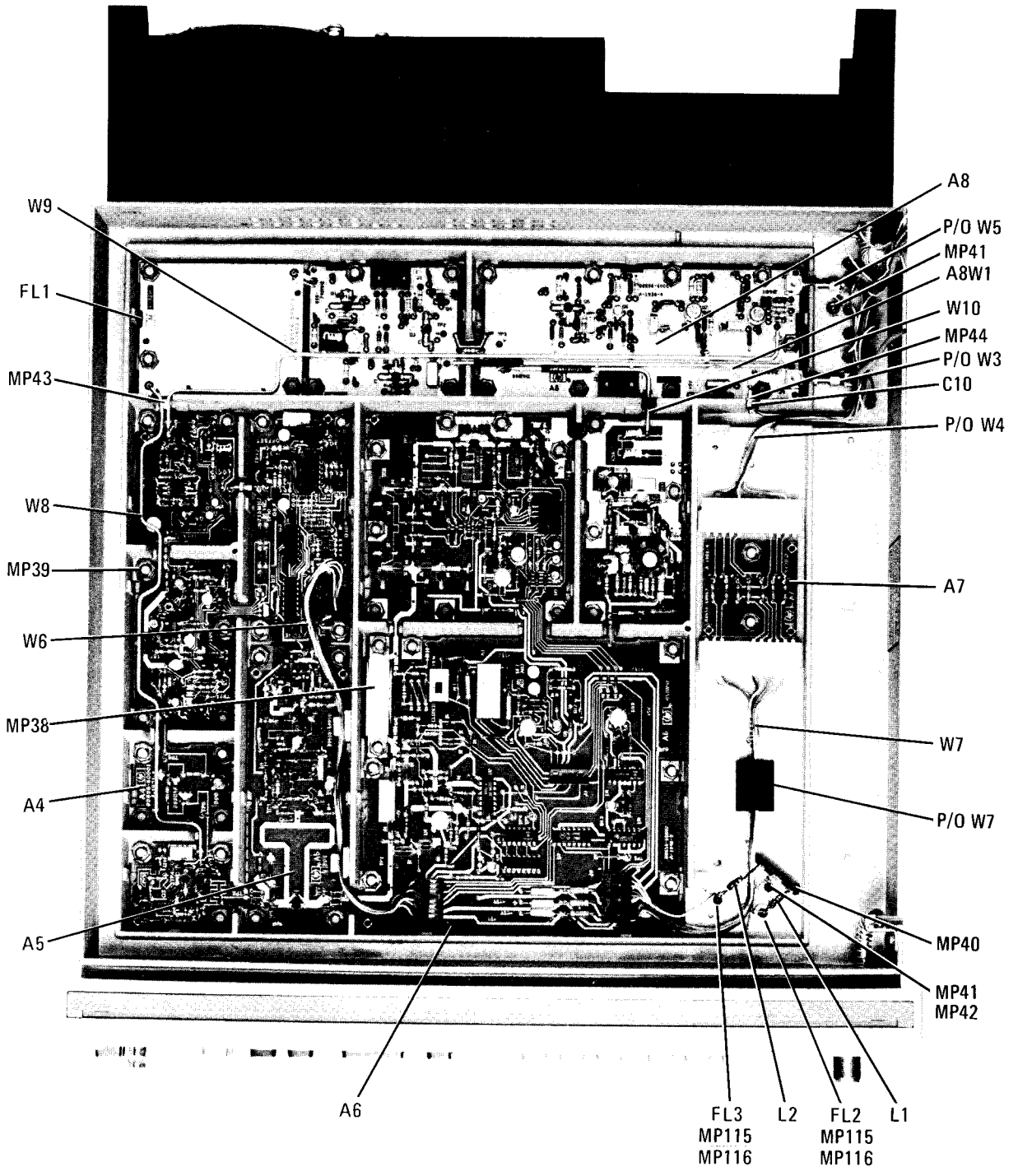


Figure 6-5. Top Internal View; A3 Assembly in Service Position

ManualsPlus.com

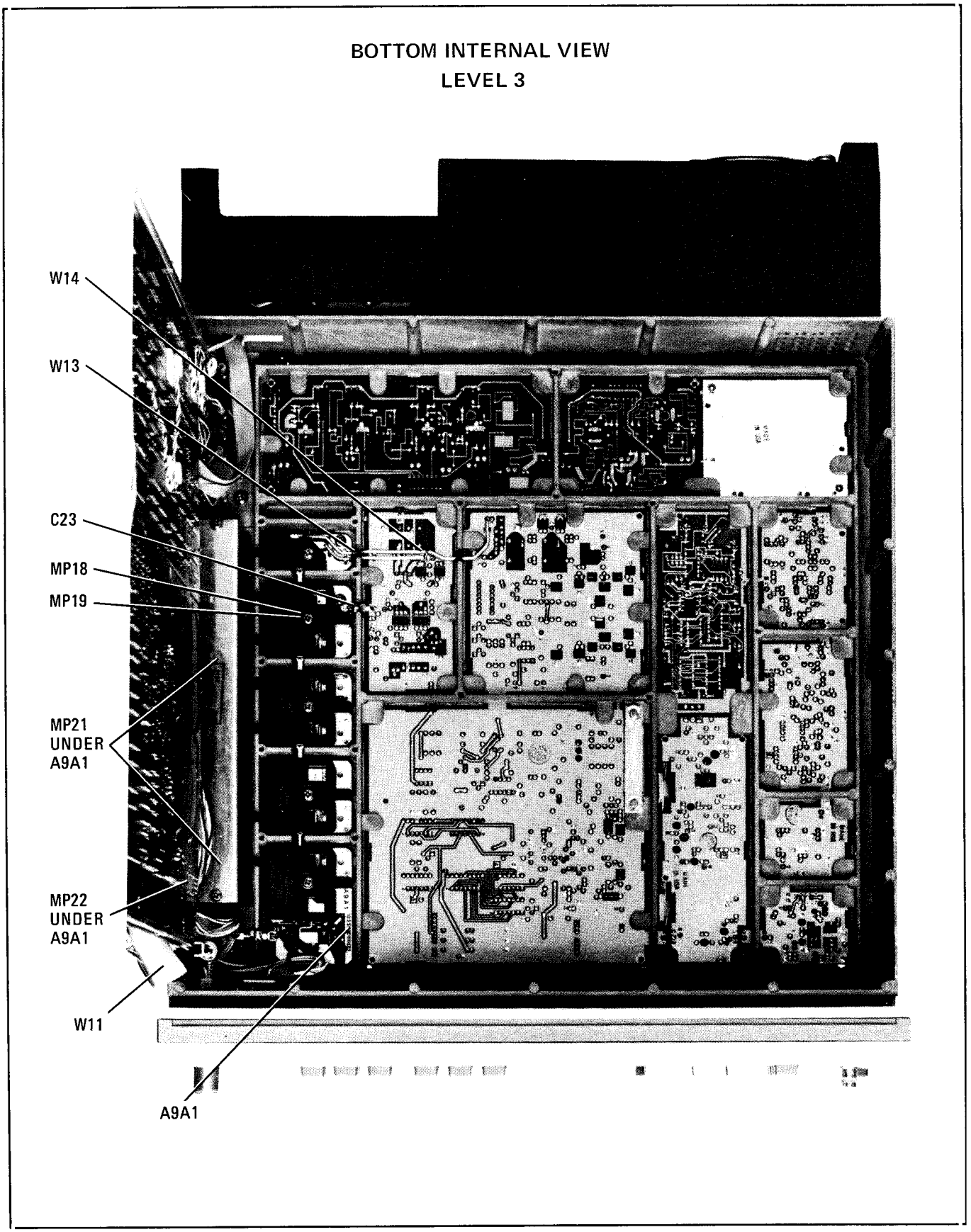


Figure 6-6. Bottom Internal View; A10/A11 Assemblies in Service Position

ManualsPlus.com

BOTTOM INTERNAL VIEW
LEVEL 4

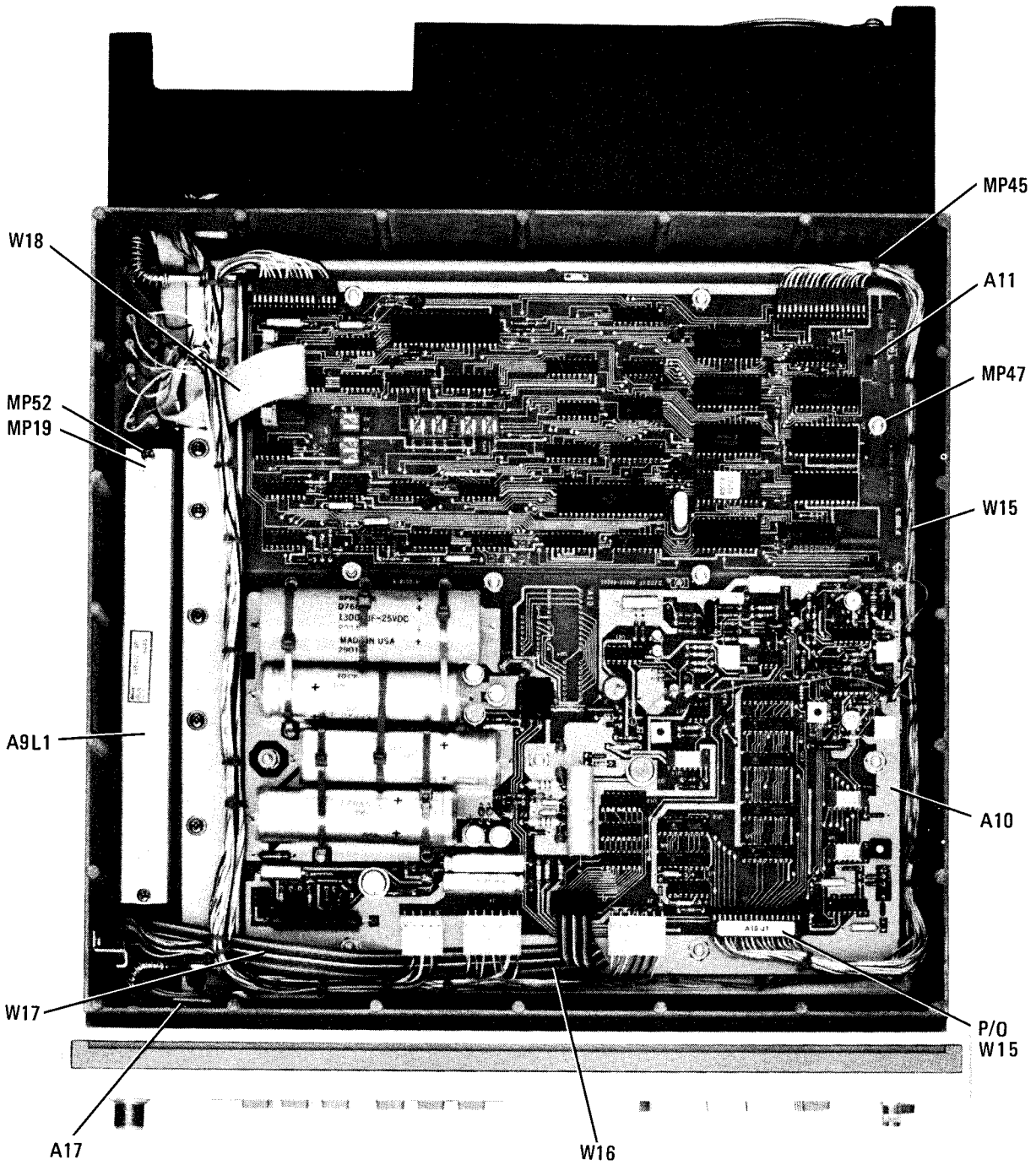


Figure 6-7. Bottom Internal View; Bottom Cover Removed

ManualsPlus.com

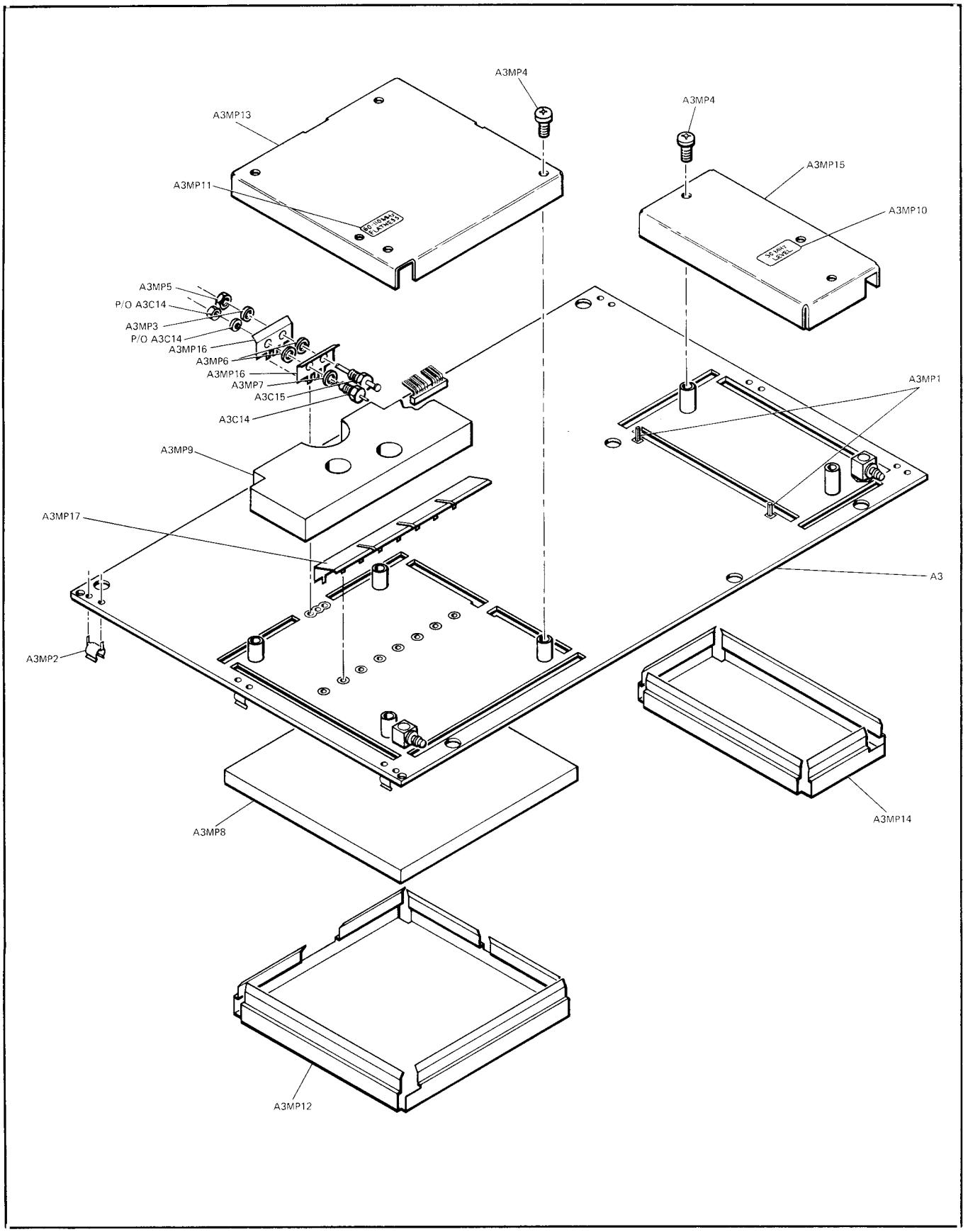


Figure 6-8. Low Frequency Loop Assembly – A3, Parts Identification

ManualsPlus.com

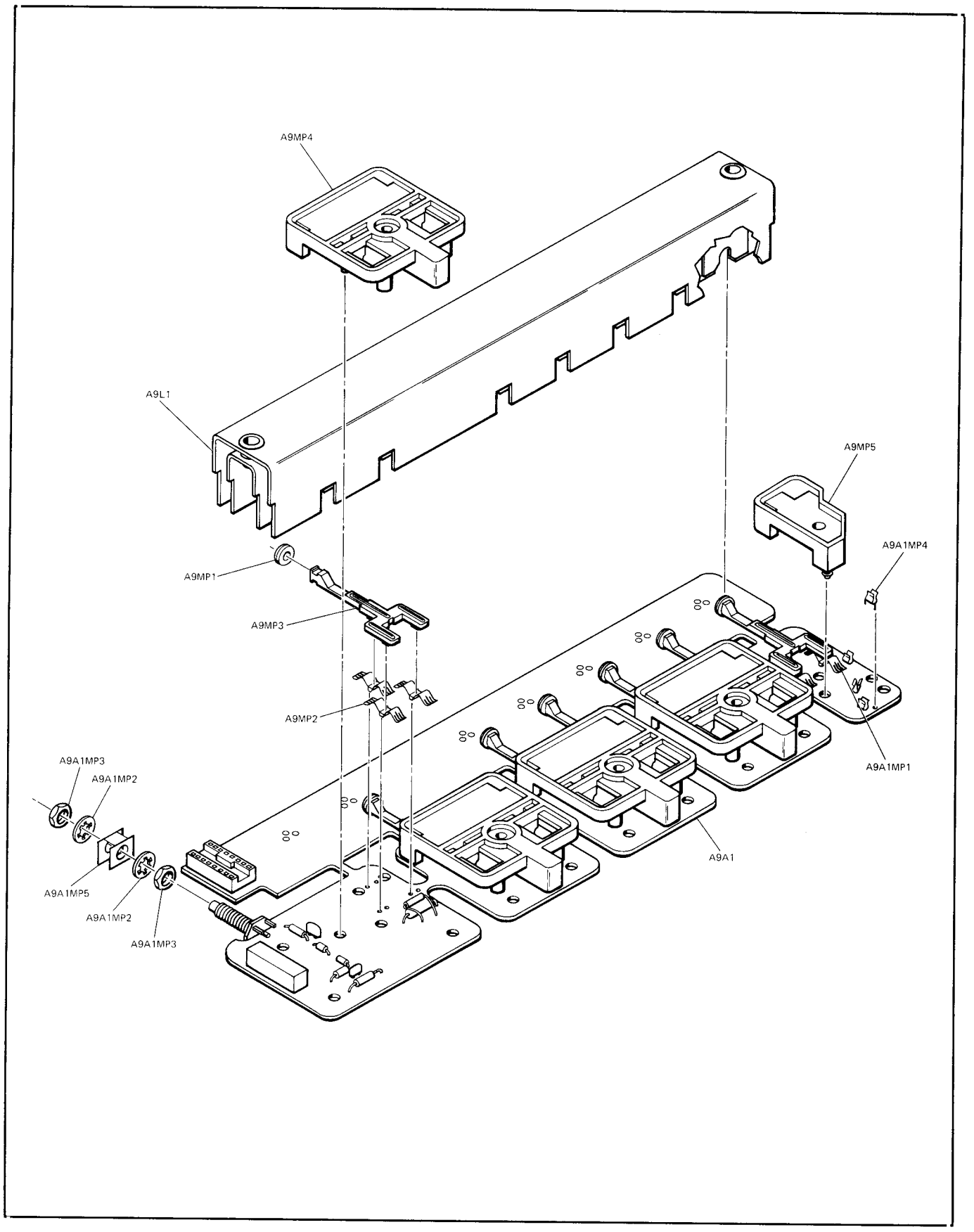


Figure 6-9. Attenuator Assembly – A9, Parts Identification

ManualsPlus.com

SECTION VII
MANUAL CHANGES

7-1. INTRODUCTION

This section contains manual change instructions for backdating this manual for HP Model 8656A Signal Generators that have serial number prefixes that are lower than 2035A. This section also contains instrument modification suggestions and procedures that are recommended to improve the performance and reliability of your instrument.

7-2. MANUAL CHANGES

To adapt this manual to your instrument, refer to Table 7-1 and make all of the manual changes listed opposite your instrument's serial number or prefix. The manual changes are listed in serial number sequence and should be made in the sequence listed. For example, Change A should be made after Change B; Change B should be made after Change C; etc. Table 7-2 is a summary of changes by component.

If your instrument's serial number or prefix is not listed on the title page of this manual or in Table 7-1, it may be documented in a MANUAL CHANGES supplement. For additional important information about serial number coverage, refer to INSTRUMENTS COVERED BY MANUAL in Section I of this manual.

Table 7-1. Manual Changes by Serial Number

Serial Prefix or Number	Make Manual Changes	Serial Prefix or Number	Make Manual Changes
2009A	J,I,H,G,F,E,D,C,B,A	2024A	J,I,H,G
2014A	J,I,H,G,F,E,D,C,B	2025A	J,I,H,F
2018A	J,I,H,G,F,E,D,C	2026A	J,H,F
2022A	J,I,H,G,F,E,D	2027A	J,I
2023A	J,I,H,G,F,E	2032A	J

ManualsPlus.com

Table 7-2. Summary of Changes by Component

Manual Change	Assemblies								
	A2	A3	A4	A6	A8	A10	A11	A17	Chassis
A				C18	C57, U1				MP23
B					C35			(*)	MP16, MP105
C							U2, U5, U6, U7, U8, U9, (**)		P/O U2, MP135
D			MP5, MP12						
E			MP7						MP29-37
F									MP10, MP23
G				C52, C59, CR5, CR7, R48					
H	(**)			CR25, CR28					
I			C34, C73, C77, R71		R11	F1			
J		L23, R118		C56					L1, L2, MP20, MP118, U1, U3

*New Assembly
**Circuit Change

ManualsPlus.com

MANUAL CHANGES

7-3. MANUAL CHANGE INSTRUCTIONS

CHANGE A

Table 6-3:

The components affected by this change are:

A6C18, 0160-3873, 4.7 pF
A8C57, 0160-3568, 2.7 pF
A8U1, 0955-0146, Mixer—Double Balanced
MP23, 08656-00003, Cover—Internal RF Bottom.

In each case the new part listed in Table 6-3 is the recommended replacement. Therefore no manual change is recommended. These parts may be replaced independently of the others listed in this change.

Service Sheet 3 schematic:

A8C57 originally was 2.7 pF. The part shown on the schematic is the recommended replacement. Therefore, no manual change is recommended. This part may be replaced independently of the others listed in this change.

Service Sheet 4 schematic:

A6C18 originally was 4.7 pF. The part shown on the schematic is the recommended replacement. Therefore, no manual change is recommended. This part may be replaced independently of the others listed in this change.

CHANGE B

Table 6-3:

The components affected by this change are:

A8C35, 0160-4382, 3.9 pF
A17, 08656-60087, Front Feedthru Assembly
MP16, 08656-00070, Hinge Lock-Bottom
MP105, 0590-0505, Nut-Knurled

The new parts listed in Table 6-3 for A8C35, MP16 and MP105 are the recommended replacements. For these parts no manual change is recommended. These parts may be replaced independently of the others listed in this change. Delete A17 from Table 6-3.

Service Sheet 3 schematic:

A8C35 originally was 2.7 pF. The part shown on the schematic is the recommended replacement. Therefore, no manual change is recommended. This part may be replaced independently of the others listed in this change.

Service Sheet 6 schematic:

At the MOD INPUT/OUTPUT connector J1, eliminate the A17 assembly and show the white/violet wire P/O W16 connected to C9.

Service Sheet 18 schematic:

At the KEYBOARD CLOCK input, eliminate the A17 assembly and show the white/blue wire P/O W16 connected to C3.

At the outputs on the right side of the schematic, eliminate the A17 assembly and show the wires on the right connected as follows:

1) white/yellow to C2
2) white to C7
3) white/gray to C8
4) brown to C4.

ManualsPlus.com

MANUAL CHANGES

MANUAL CHANGE INSTRUCTIONS (Cont'd)

CHANGE B (Cont'd)

Service Sheet 19 schematic:
At the inputs on the left side of the schematic, eliminate the A17 assembly and show the wires on the left connected as follows:

1) blue to C6
2) yellow to C5

Service Sheet 22 schematic:
At the +5V output on the right side of the schematic, eliminate the A17 assembly and show the white/red wire on the left connected to C1.

CHANGE C

Table 6-3:
The components affected by this change are:
Under U2, 1200-0043, Insulator-Thermal Conductive Transistor
A11U2, 08656-80006, ROM #1 Alternate
A11U5, 08656-80011, ROM #6 Alternate
A11U6, 08656-80010, ROM #5 Alternate
A11U7, 08656-80009, ROM #4 Alternate
A11U8, 08656-80008, ROM #3 Alternate
A11U9, 08656-80007, ROM #2 Alternate
MP135, 3150-0376, Foam Filter

In each case the new part listed in Table 6-3 is the recommended replacement. Therefore, no manual change is recommended. These parts may be replaced independently of the other parts listed in this change.

NOTES

Refer to paragraph 7-5 for information about a recommended modification to the Signal Generator involving the thermal conductive transistor insulator listed under U2.

MP135 has been deleted from Table 6-3. See paragraph 7-5 for important information concerning this part.

Service Sheet 2, Troubleshooting Using Signature Analysis:
Delete.

Service Sheet 5, Troubleshooting Using Signature Analysis:
Delete.

Service Sheet 9, Troubleshooting Using Signature Analysis:
Delete.

ManualsPlus.com

MANUAL CHANGES

MANUAL CHANGE INSTRUCTIONS (Cont'd)

CHANGE C (Cont'd)

Service Sheet 15 schematic:
Replace appropriate portion of schematic with the following partial schematic:

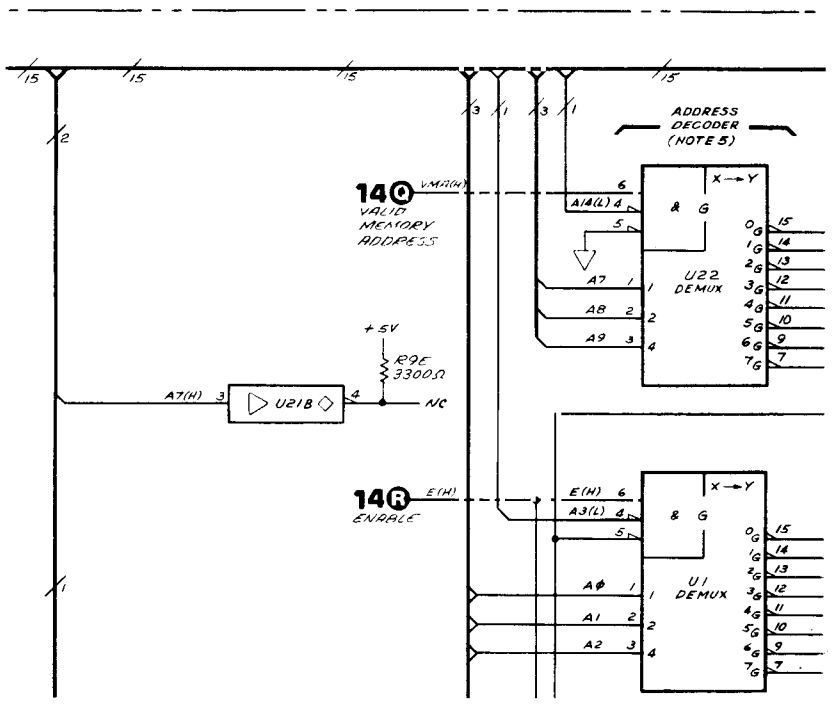


Figure 7-1. Address Buffering and Decoding, Serial I/O and Control Schematic Diagram (P/O Change C)

Service Sheet 16 schematic:
The components affected by this change are:

A11U2, 08656-80006, ROM #1 Alternate
A11U5, 08656-80011, ROM #6 Alternate
A11U6, 08656-80010, ROM #5 Alternate
A11U7, 08656-80009, ROM #4 Alternate
A11U8, 08656-80008, ROM #3 Alternate
A11U9, 08656-80007, ROM #2 Alternate

In each case the new part shown on the schematic is the recommended replacement. Therefore, no manual change is recommended. These parts may be replaced independently of the others listed in this change.

Service Sheet 18, Troubleshooting Using Signature Analysis:
Delete

Service Sheet 19, Troubleshooting Using Signature Analysis:
Delete

ManualsPlus.com

MANUAL CHANGES

MANUAL CHANGE INSTRUCTIONS (Cont'd)

CHANGE C (Cont'd)

Service Sheet 20, Troubleshooting Using Signature Analysis:
Delete.

Service Sheet 21, Troubleshooting Using Signature Analysis:
Delete.

CHANGE D

Table 6-2:
The components affected by this change are:
A4MP5, 08656-00073 and A4MP12. The new part listed for A4MP5 is the recommended replacement. Therefore, no manual change is recommended. This part may be replaced independently of A4MP12.
Delete A4MP12 from Table 6-3.

NOTE

Refer to paragraph 7-6 for information about a recommended modification for the Signal Generator involving the High Frequency Loop Feedthrough Bracket, A4MP5.

CHANGE E

Table 6-3:
A4MP7 and MP29 through MP37 are the parts affected by this change. These parts are listed below.

A4MP7, 0624-0208, Screw-Self Tapping 6-32.

Internal RF Covers

Reference Designation	HP Part Number	Qty
MP29	08656-00018	4
MP30	08656-00019	2
MP31	08656-00020	2
MP32	08656-00021	2
MP33	08656-00022	2
MP34	08656-00023	2
MP35	08656-00024	1
MP36	08656-00025	7
MP37	08656-00026	3

In each case the new part listed in Table 6-3 is the recommended replacement. Therefore no manual change is recommended. These parts may be replaced independently of the others listed in this change. However, if one or more of MP29 through MP37 is replaced, it is recommended that MP29 through MP37 all be replaced to take full advantage of this change. Add A4MP37 to Table 6-3.

NOTE

Refer to paragraph 7-7 for information about a recommended modification for this Signal Generator involving the Internal RF Covers, MP29 through MP37.

ManualsPlus.com

MANUAL CHANGES

MANUAL CHANGE INSTRUCTIONS (Cont'd)

CHANGE F

Table 6-3:

MP10 and MP23 are the parts affected by this change. These parts are listed in the table below.

Signal Generator Covers

Reference Designation	HP Part Number	Qty
MP10	08656-00002	1
MP23	08656-00072	1

In each case the new part number listed in Table 6-3 is the recommended replacement. Therefore, no manual change is recommended. Each part may be replaced independently of the other. However, if one is replaced it is recommended that the other be replaced to take full advantage of the change.

NOTE

Refer to paragraph 7-7 for information about a recommended modification for this Signal Generator involving MP10 and MP23.

CHANGE G

Table 6-3:

The components affected by this change are:

A6C52 and C59, 0160-4535, 1 μF
A6CR5 and CR7, 1901-0050, Switching Diode
A6R48, 0757-0395, 61.9Ω.

In each case the new part listed in Table 6-3 is the recommended replacement. Therefore, no manual change is necessary. If either A6C52 or A6C59 as listed above is changed to the value shown in Table 6-3, replace both. If either A6CR5 or A6CR7 as listed above is changed to the value shown in Table 6-3, replace both. A6R48 may be replaced independently of the other parts listed in this change.

Service Sheet 4 schematic:

A6CR5 and CR7 were originally PIN diodes. A6R48 was originally 61.9Ω.

The new parts shown on the schematic are the recommended replacements. Therefore, no change to the manual is recommended. If either A6CR5 or A6CR7 (PIN diode) is replaced with the parts listed in Table 6-3 (switching diode), replace both. A6R48 may be replaced independently of the other components listed in this change.

Service Sheet 5 schematic:

The original values of A6C52 and C59 were 1 μF. Because the new parts are the recommended replacements, no change to the manual is recommended. If either of these parts is replaced by the value shown in Table 6-3, replace both.

ManualsPlus.com

MANUAL CHANGES

MANUAL CHANGE INSTRUCTIONS (Cont'd)

CHANGE H

Table 6-3:
The following parts are affected by this change:

A6CR25 and CR28, 0122-0072, DIODE-VVC 2.2 pF 5%

In each case the new part listed in Table 6-3 is the recommended replacement. Therefore no manual change is recommended. If either of these parts is replaced by the value shown in Table 6-3, replace both. This change is independent of the accompanying circuit change.

NOTE

Refer to paragraph 7-8 for information about a recommended modification for this Signal Generator involving A6CR25 and CR28.

Service Sheet 18 schematic:
The original circuit had no connection from +5V to U18-pin 10. The circuit shown on the schematic is the recommended configuration. Therefore no manual change is recommended. This circuit change is independent of the accompanying diode change.

NOTE

Refer to paragraph 7-9 for an explanation of the recommended circuit modification and how it can be done.

CHANGE I

Table 6-3:
The components originally affected by this change are:

A4C34, 0180-0291, 1.0 μF
A4C73, 0160-0155, 0.15 μF
A4C77, 0160-2230, 3300 pF
A4R71, 0757-0442, 10kΩ
A8R11, 0698-3439, 178Ω
A10F1, 2110-0518, Fuse 3A, 125V.

In each case the new part listed in Table 6-3 is the recommended replacement. Therefore, no manual change is recommended.

NOTES

1. If A4C34, A4C73, A4C77 and A4R71 are the values shown above, and if one or more parts are changed to the value shown in Table 6-3, they should all be changed to the values shown in Table 6-3.

2. A8R11 and A10F1 may be replaced independently of the others listed in this change.

Service Sheet 1 schematic:
A4C34 was originally 2.2 μF. The part shown on the schematic is the recommended replacement. Therefore no manual change is recommended. Refer to Note 1 above.

ManualsPlus.com

MANUAL CHANGES

MANUAL CHANGE INSTRUCTIONS (Cont'd)

CHANGE I (Cont'd)

Service Sheet 2 schematic:

The components affected by this change are:

A4C73, 0.15 μF
A4C77, 3300 pF
A4R71, 10 kΩ.

In each case the part shown on the schematic is the recommended replacement. Therefore no manual change is recommended. Refer to Note 1 above.

Service Sheet 3 schematic:

A8R11 was originally 178Ω. The part shown on the schematic is the recommended replacement. Therefore no manual change is recommended. Refer to Note 2 above.

Service Sheet 22 schematic:

A10F1 was originally 3A. The part shown on the schematic is the recommended replacement. Therefore no manual change is recommended. Refer to Note 2 above.

CHANGE J

Table 6-3:

The components affected by this change are:

A3L23, 9140-0141, 680 nH (A3R118 shown in Table 6-3 is the direct replacement for A3L23.)
A6C56, 0121-0449, CAPACITOR-V TRMR-CER 3.5-10 pF
L1 and L2, 9100-2258, 1.2 μH
MP20, 08656-00058, Attenuator Gasket
MP118, 08656-40008, Series Regulator Cover
U1, 1826-0203, IC V RGLTR
U3, 1826-0169, IC V RGLTR.

In each case the new part listed in Table 6-3 is the recommended replacement. Therefore no manual change is necessary.

NOTES

Refer to the Heterodyne Band Accuracy and Flatness Adjustment in Section V. It may be necessary to change A6C56 to the value listed in Table 6-3 in order to make the adjustment.

If either L1 or L2 is changed from the value shown above to the value listed in Table 6-3, change the other to the value listed in Table 6-3.

MP20, MP118, U1 and U3 may be replaced independently of the other parts listed in this change. However, if U1 or U3 is changed to the value listed in Table 6-3, it is recommended that both be changed to take full advantage of the change.

Service Sheet 5 schematic:

A6C56 was originally 3.5-10 pF. The part shown on the schematic is the recommended replacement. Therefore no manual change is recommended. Refer to Note 1 above.

Service Sheet 7 schematic:

L1 and L2 were originally 1.2 μH. The parts shown on the schematic are the recommended replacement. Therefore no manual change is recommended. Refer to Note 2 above.

ManualsPlus.com

MANUAL CHANGES

MANUAL CHANGE INSTRUCTIONS (Cont'd)

CHANGE J (Cont'd)

Service Sheet 13 schematic:

R118 68.1Ω is the part used in place of the original L23 680 nH. Because R118 is the recommended replacement and is shown on the schematic, no manual change is recommended.

Service Sheet 22 schematic:

The original part number of U1 was 1826-0203. U3 was 1826-0875. The new part numbers shown on the schematic are the recommended replacements. Therefore no manual change is recommended. Refer to Note 3 above.

INSTRUMENT MODIFICATIONS

7-4. INSTRUMENT IMPROVEMENT MODIFICATIONS

7-5. Improving Power Supply Reliability

On instruments with serial prefixes 2018A and below, it is recommended that the thermal insulator, P/O U2, be replaced to increase reliability. Also, the Foam Filter MP135 should be removed and discarded. It may slip into the fan and stop the blade rotation.

Remove the Series Regulator Cover MP118. Refer to Figure 6-3. Remove the No. 1 Pozidriv screws that hold U2 in place. Remove U2. Replace the thermal insulator with an HP 1200-0043 (check digit 8) aluminum transistor insulator. Reinstall U2 and the Series Regulator Cover.

Loosen the screws on the External Finger Guard MP134. Refer to Figure 6-3. Pull the Foam Filter from behind the External Finger Guard. Discard the filter; tighten the screws.

7-6. Decreasing Spurious Signal Output

For an instrument that has a spurious signal at 500.5 MHz with serial prefix 2022A or below, it is recommended that a new High Frequency Loop Feedthrough Bracket A4MP5, HP 08656-00089 be installed in place of the old bracket. Refer to the paragraph entitled Disassembly Procedure in Section VIII for instructions used to gain access to the A4 Assembly. Refer to the component location diagram for the A4 Assembly (refer to Service Sheets 1 and 2) for the location of A4MP5. Unsolder A4C5, C44 and MP5 from the circuit board. Extract the bracket assembly from the circuit board casting. Insert the capacitors into the new bracket in the same relative positions. Insert the assembly into the casting and resolder the capacitors and mounting bracket. Clean the circuit board. Reassemble the instrument in the reverse order of the way it was taken apart.

7-7. Improving Low Level Accuracy

For instruments with low level RF accuracy problems, improvement may be gained by following these suggestions.

On instruments with serial prefixes 2023A and below, replace the old internal covers with those listed in the table.

Internal RF Covers

Reference Designation	HP Part Number	C D	Qty
MP29	08656-00079	4	4
MP30	08656-00080	5	2
MP31	08656-00081	8	2
MP32	08656-00082	9	2
MP33	08656-00083	0	2
MP34	08656-00084	1	2
MP35	08656-00085	2	1
MP36	08656-00086	3	7
MP37	08656-00087	4	3

ManualsPlus.com

INSTRUMENT MODIFICATIONS

Improving Low Level Accuracy (Cont'd)

Refer to the paragraph entitled Disassembly Procedures in Section VIII and Figure 6-1 for information about gaining access to the covers.

On instruments with serial prefixes 2023A and below, 2025A and 2026A, replace the old internal covers with those listed in the table.

Signal Generator Covers

Reference Designation	HP Part Number	C D	Qty
MP10	08656-00076	6	1
MP23	08656-00075	0	1

On instruments with serial prefixes 2032A and below, replace L1 and L2 with 9100-2257, 0.82 μH inductors, check digit 6. These parts are mounted near FL2 and FL3. Refer to the Disassembly procedures in Section VIII.

7-8. Improving RF Frequency Response

If the RF output level rolls off near 990 MHz on instruments with serial prefixes 2026A and below, it is recommended that diodes A6CR25 and CR28 be replaced by varactor diodes (HP 0122-0329). Refer to the Disassembly Procedures and A6 Assembly component location diagram (part of Service Sheet 4) for instructions about gaining access to these components.

7-9. Loss of Signal Generator Control by the Keyboard

Intermittent control of Signal Generator operation by the keyboard may occur on instruments with serial prefixes of 2026A and below. Furthermore, certain keys may be more prone to problems than others if this condition exists.

For instruments experiencing this problem, it is recommended that the +5V supply be connected to A2U18-pin 10. Refer to the Disassembly Procedures in Section VIII for instructions about removing the A2 Assembly.

When the A2 assembly is removed, connect a red 26 AWG wire from +5V U18 pin 16 to U18-pin 10.

ManualsPlus.com

SECTION VIII
SERVICE

8-1. INTRODUCTION

This section contains information for troubleshooting and repairing the Signal Generator. Included are block and circuit diagrams, principles of operation, troubleshooting tests, and repair procedures.

8-2. SERVICE SHEETS

The foldout pages in the last part of this section are the service sheets. They consist of block diagrams, circuit schematic diagrams, supplemental diagrams and associated information. For more information, refer to the paragraphs under the general heading of Troubleshooting in this section.

8-3. Block Diagrams

The block diagrams and related information are found on Service Sheets BD1 through BD4. BD1 is the overall block diagram that shows the major functional sections. BD1 serves as an index to the troubleshooting blocks and as a starting point for troubleshooting.

The troubleshooting block diagrams and related information are found on Service Sheets BD2 through BD4. Each troubleshooting block diagram shows the major circuits in their functional groupings. These blocks serve as indexes to the circuit schematic diagrams. The High Frequency Loop and Output Section is shown on BD2, the Low Frequency Loop on BD3 and the digital (control) circuits are on BD4.

8-4. Circuit Schematic Diagrams

The circuit schematic diagrams and their associated information are part of Service Sheets 1 through 22. These diagrams, in functional groupings, are aids for understanding operation and for troubleshooting the Signal Generator. Refer to the paragraphs entitled Troubleshooting for more information.

8-5. SAFETY CONSIDERATIONS

8-6. Before Applying Power

Verify that the instrument is set to match the available line voltage and that the correct fuse is installed. An uninterrupted safety earth ground must be provided from the main power source to the instrument input wiring terminals, power cord, or supplied power cord set.

8-7. Warnings and Cautions

Pay attention to WARNINGS and CAUTIONS. They must be followed for your protection and to avoid damage to the equipment.

WARNINGS

Maintenance described herein is performed with power supplied to the instrument and with the 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 supplied, the power should be removed.

Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnection of the protective earth terminal will create a potential shock hazard that could result in personal injury. Grounding one conductor of a two conductor outlet is not sufficient. Whenever it is likely that the protection has been impaired, the instrument must be made inoperative (i.e., secured against unintended operation).

If this instrument is to be energized via an autotransformer, make sure that the autotransformer's common terminal is connected to the earth terminal of the power source.

Capacitors inside the instrument can still be charged even if the instrument is disconnected from its source of supply.

Make sure that only 250 volt fuses with the required rated current and of the specified type (normal blow, time delay, etc.) are used for replacement. Do not use repaired fuses or short-circuited fuseholders. To do so could create a shock or fire hazard.

ManualsPlus.com

Warnings and Cautions (Cont'd)

CAUTIONS

Do not disconnect or remove any boards in the Signal Generator unless the instrument is unplugged. Some boards contain devices which can be damaged if the board is removed when the power is on. Use conductive foam when removing MOS devices from sockets. Use care when unplugging ICs from high-grip sockets.

8-8. RECOMMENDED TEST EQUIPMENT AND ACCESSORIES

Test equipment and test accessories required to maintain the Signal Generator are listed in the table of Recommended Test Equipment in Section I. Equipment other than that listed may be used if it meets the listed critical specifications.

8-9. SERVICE TOOLS, AIDS AND INFORMATION

8-10. Service Tools

There are unique tools available that will make servicing of this instrument easier. Service aids are provided in the instrument. Service information is provided in this manual. Information provided in the paragraph entitled Repair (found in this section) shows how the instrument is accessed for repair purposes. Refer also to Figure 8-1.

Pozidriv Screwdrivers. Many screws in the Signal Generator appear to be Phillips type, but are not. To avoid damage to the screw slots, Pozidriv screwdrivers should be used. HP 8710-0899 is the No. 1 Pozidriv. HP 8710-0900 is the No. 2 Pozidriv.

Tuning Tools. For adjustments requiring nonmetallic tuning tools, use the HP 8710-0033 blade tuning tool or the HP 8710-1010 (JFD Model No. 5284) hex tuning tool. For other adjustments an ordinary small screwdriver or suitable tool is sufficient. No matter which tool is used, never force any adjustment control. This is especially critical when adjusting variable inductors or capacitors.

Heat Staking Tool. The front panel pushbutton switches have small plastic pins protruding from the back. These tabs fit through holes in the keyboard printed circuit board and are melted down to hold the switch in place. This process is known as heat staking. the heat stasking tool is a standard

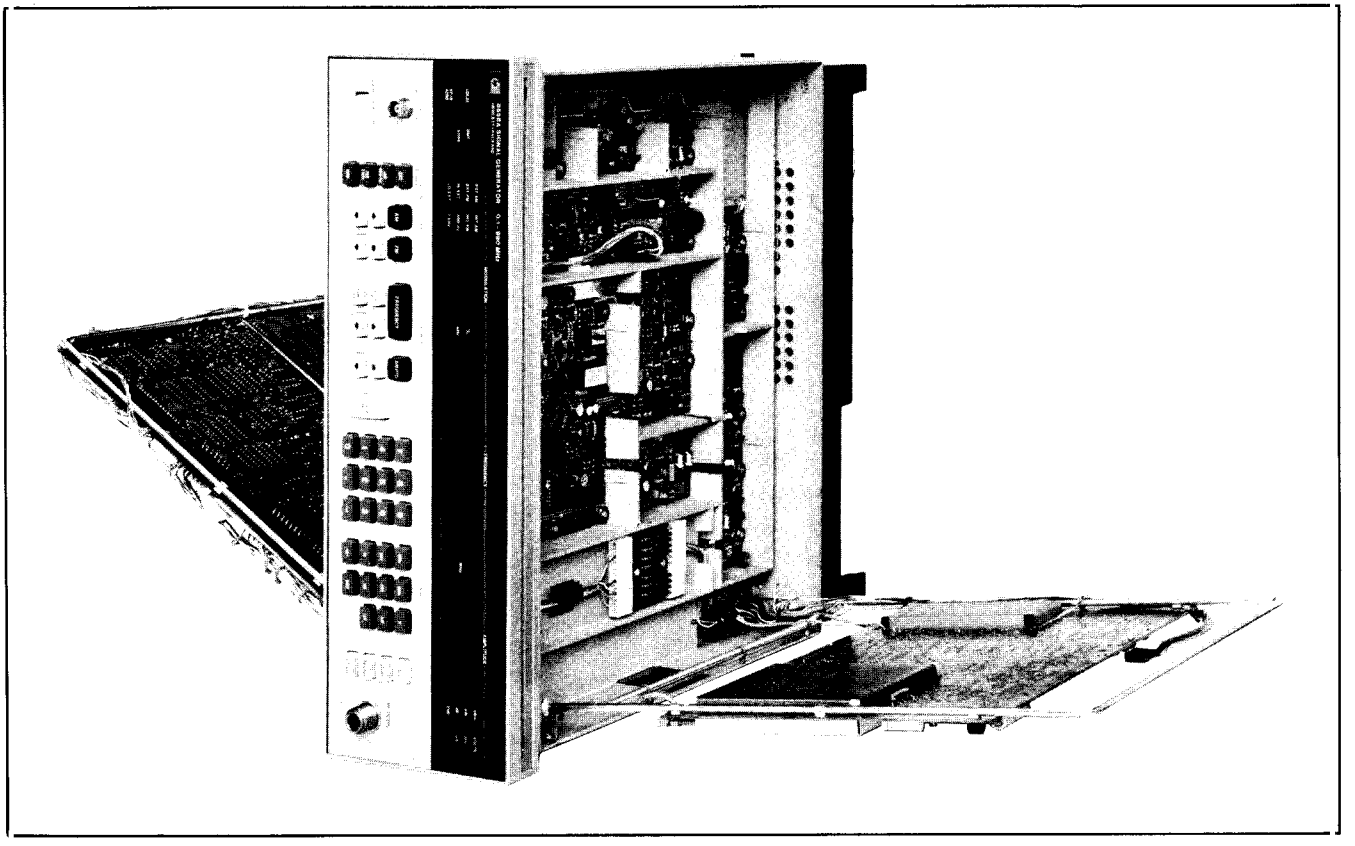


Figure 8-1. Recommended Position for Maintenance and Servicing

ManualsPlus.com

Service Tools (Cont'd)
soldering iron with a special tip attached (refer to Figure 8-5, under paragraphs entitled Replacement of Key Cap and Pushbutton Switches).

Refer to the paragraphs entitled Replacement of Key Cap and Pushbutton Switches under REPAIR in Section VIII for the heat staking procedure.

8-11. Assembly Locations

Assemblies in the Signal Generator are numbered sequentially, front to back, left to right, top to bottom. For example, A1 and A2 are part of the front panel assembly of the instrument.

8-12. Parts and Cable Locations

The locations of individual components mounted on printed circuit boards or other assemblies are shown adjacent to the schematic diagram on the appropriate Service Sheet. The part reference designator is the assembly designator plus the part designator. For example, A6R9 is R9 on the A6 assembly. For specific component descriptions and ordering information, refer to Table 6-3, Replaceable Parts, in Section VI. Chassis and frame parts, as well as mechanical parts and cables, are identified on Figures 6-1 through 6-5.

Major mechanical parts have reference designations that begin with the letters MP. Other mechanical parts, such as screws, are listed in the replaceable parts list below the part to which they fasten. To find the part number and description of a mechanical part, find the part in one of the figures in Section VI or Section VIII. The part in the figure will be labelled with its reference designator. Look up that reference designator in the Table of Replaceable Parts. If the part is a fastener, such as a screw, nut, or washer, look to the figure for the part to which it fastens. Then, look up the fastened part in the parts list. Just below it you will see the part numbers and description of the desired hardware.

Illustrated parts breakdowns of chassis and frame parts, as well as assemblies and mechanical parts and cables, can be identified on Figues 6-1 through 6-9. Parts breakdowns of the front and rear panels are located on Figures 6-2 and 6-3.

8-13. Test Points and Adjustment Locations

Most test points and adjustments are indicated on individual circuit board assemblies. Test points and adjustments can also be found on the component locator photograph adjacent to the assembly's schematic diagram.

8-14. Service Aids on Printed Circuit Boards

Service aids on printed circuit boards include test points, indicator lights, transistor and integrated circuit and relay designations, adjustment names, and assembly part numbers. Of particular importance are the three test LEDs on the A10 Audio/Power Supply Assembly.

8-15. Other Service Documents

Service Notes, Manual Change Supplements, and other service literature are available through Hewlett-Packard. For further information, contact your nearest Hewlett-Packard office.

8-16. TROUBLESHOOTING

8-17. General

Instrument problems usually fall into three general categories: operator errors, operation out of specification and catastrophic failures. The troubleshooting strategy is different for each category. For more information refer to the table of Specifications in Section I and the detailed operating instructions found in Section III.

Operator Error. Apparent failures sometimes result from operator errors. These may take one of several forms. The operator may allow external influences which affect instrument operation. At times he may attempt to operate the instrument in an "out of specification" mode. Under certain circumstances the Signal Generator allows the out of specification operation. Under other conditions it doesn't.

A reverse power level of greater than 0.2 watts (3 volts) coupled to the front panel RF connector will cause an apparent failure. There is no output signal and the Amplitude display flashes. This, however, is normal operation under the circumstances. The instrument has temporarily disconnected itself from the high power level that could do damage to internal circuits. To bring the instrument back to its normal operating mode, remove the high reverse power at the RF output connector and enter a new output power level at the front panel.

NOTE
The Reverse Power Protection provided by this circuit is adequate up to 50 watts (50 volts).

The Signal Generator does allow out of specification operation at frequencies below 0.1 MHz. The

ManualsPlus.com

TROUBLESHOOTING (Cont'd)

frequency is accurate but other specifications, such as RF output power level may be incorrect.

Not-allowed operation is generally indicated by displays that flash or default to the last valid entry. An example of the former is a flashing FM display that occurs when the frequency is changed to a range that will not allow wide deviation. To stop the flashing display, press the FM mode select button. This will change the FM deviation to a level that is acceptable.

Examples of not-allowed operation where the Signal Generator defaults to the last valid entry are: selecting an RF output level that is too high or selecting an AM depth that causes the maximum total RF output power level to be too high.

Instrument Out of Specification. If it is suspected that the instrument's operating parameters are out of tolerance, the Abbreviated Performance Tests table in Section IV tells which test may be performed to verify proper operation. This table may also be used to determine which assembly requires adjusting and on what service sheet the adjustable components are located. The Post-Repair Adjustments table in Section V tells which adjustments are related and may also require adjustment. After adjustments are complete, perform the performance test(s) in Section IV. If the performance is still out of tolerance, refer to the troubleshooting information. Although the problem may be solved very quickly by going to the service sheet where the adjustment is located, it is good practice to begin with the overall troubleshooting information found on Service Sheet BD1.

Catastrophic Failures. When a catastrophic failure occurs, begin troubleshooting on Service Sheet BD1. The information there is used to quickly isolate the problem to one of the three major sections of the instrument.

8-18. Strategy

Troubleshooting for the Signal Generator is organized into three levels. The overall troubleshooting level is where problems are isolated to the power supply or one of the functional sections. The functional section level of troubleshooting isolates the malfunction to the circuit level. At the circuit level, the problem is isolated to a stage within the circuits shown on the schematic. It is expected that further troubleshooting, to the component level, depends on the skill and experience of the troubleshooter.

8-19. Overall Troubleshooting (Service Sheet BD1)

Overall troubleshooting begins with verifying that the power-on sequence occurs properly. At this point, power supply problems become evident. The effect of inputs from the keyboard and an external computer are compared. It is possible to separate a digital or analog problem at this level. Digital problems are usually referred to Service Sheet BD4. Further troubleshooting determines which analog (phase lock) loop is defective. Problems here are referred to Service Sheet BD2 or BD3. If none of the sections or circuits above are defective, further troubleshooting isolates a malfunction in the special circuits.

8-20. Functional Section Troubleshooting (Service Sheets BD2-BD4)

Troubleshooting of the loop sections (Service Sheets BD2 and BD3) is done primarily from an analog viewpoint with the intent of isolating a malfunction to the circuit level. The digital section (Service Sheet BD4) continues with troubleshooting from Service Sheet BD1 but with the intent of isolating the problem to the circuit level.

8-21. Circuit Troubleshooting (Service Sheets 1-22)

The goal of troubleshooting at the previous service sheet level is to be confident that the problem is within the circuits shown by the schematic. Because of the interaction of circuits in the Signal Generator, it may be necessary to refer to other service sheets to completely isolate a problem. Some of the circuits that are mostly analog have digital control circuits. In these cases, troubleshooting the digital circuits first is offered as an alternative.

When the problem is isolated to a stage, the ability of the one doing the troubleshooting is utilized to isolate the defective component.

8-22. Signature Analysis

Signature analysis is a simple method of verifying the operation of digital circuitry. When properly used, signature analysis can detect extremely subtle hardware faults. Signatures must identically match those given in the signature tables located opposite the schematics. If everything is working correctly, signatures will all match exactly. If they don't match, by even one digit, something is wrong.

With the Generator's internal signature analysis routine, the signature analyzer's test probe is used

ManualsPlus.com

Signature Analysis (Cont'd)

to check nodes in the circuit under test. The signature analyzer converts the signals at the node into a four digit "signature", which it displays. The signature is then compared to the signature in the troubleshooting checks adjacent to the appropriate schematic. These two signatures must be identical.

Signature analysis can be speeded up if the following considerations are kept in mind:

1. Make sure that every step is performed as described in the set-up procedure. That is, make sure that the clock, start, and stop connections and triggering are correct.
2. Double-check that the signatures are being taken at the correct node.
3. Make sure that the signature analyzer probe is making good contact with the pin being checked. Oxidation on pins can cause invalid signatures due to poor contacts.
4. When you think that you have found a bad signature, double check to make sure.
5. When checking a node, check that the unstable-signature indicator is not blinking.

8-23. Additional Information

Additional troubleshooting information may be found in various locations in the manual. Reference is made to the information in the appropriate troubleshooting procedure. Examples of this information are the Power-On Sequence, the Basic Functional Checks and the HP-IB Functional Checks which are all found in Section III.

8-24. REPAIR

8-25. Disassembly Procedures

For the most part, disassembling the Signal Generator is quite straightforward. Most of the procedures simply indicate the size, number, type and general location of the mounting hardware. Where it is necessary, the procedures are more detailed. Table 8-1 indicates which procedure will give access to a particular assembly and which figure shows the location of a particular assembly. Reference to the appropriate exploded view in Section VI is included. If a circuit board within the main casting is to be removed from the Signal Generator, seek access to its component (top) side. To reassemble the Signal Generator, follow the procedures in the reverse order.

WARNING

Before beginning any disassembly procedure, be sure that the line (Mains) voltage is disconnected.

CAUTION

DO NOT REMOVE the circuit boards mounted on the casting unless absolutely necessary. With repeated reassembly, the Pal nut cuts new threads in the boss. It then becomes impossible to tighten the Pal nut to provide an effective ground.

Front Panel Removal. Remove the knurled nut MP105 from the RF Output connector with a pair of soft jawed pliers (HP part number 8710-0986). Remove the top trim MP8 and four No 2 Pozidriv screws MP101 from the top and bottom edge of the front panel casting. Pull the front panel forward with the BNC connector until it is free of the casting.

A1 Keyboard and A2 Display Assembly Removal. The front panel has already been removed. Place the front panel face down. To free the A2 Assembly, remove fourteen 4-40 machine screws MP107 from the back of the circuit board with a No 2 Pozidriv screwdriver. Unsolder the front panel switch and BNC connector wires and remove them from the cable clamp MP46 on the casting wall. Remove the cable connectors at A2J1 and A2J2.

CAUTION

During reassembly, be sure that you reconnect A2J1 and J2 correctly. It is possible to reverse the connectors. For reference, the second pins of both connectors are connected to yellow wires while the fourth pins are connected to blue wires. The pin numbers are etched on the circuit board.

Remove the A1 assembly by first removing the eleven 10-32 hex nuts MP47 which hold the assembly in place. Lift the assembly from the mounting lugs.

Cover Removal, Top and Bottom (Levels 1 and 4 Access). Set the Signal Generator in its normal operating position. Free the handles and side covers by removing four No. 2 Posidriv screws MP6.

ManualsPlus.com

Table 8-1. Assembly Access Information

To Gain Access to an Assembly or Module	Perform Procedure(s)	For Disassembly Information Refer to Figure(s)
A1 and A2	Front Panel Removal and, if required, A1 Keyboard and A2 Display Assembly Removal	6-2
A3 (top)	Cover Removal, Top (Level 1 Access)	6-1, 6-4, 6-8
A3 (top and bottom)	Cover Removal, Top (Level 1 Access) A3 Assembly Service Position	6-1, 6-4, 6-8, 8-1
A4, A5, A6, A7, A8 (top), A9A1 (bottom) and FL1, FL2, FL3, L1, L2	Cover Removal, Top (Level 1 Access) A3 Assembly Service Position Level 2 Access	6-1, 6-4, 6-5, 8-1 (A9 Only) 6-9
A4, A5, A6, A8 (bottom) A9A1 (top) and A9L1	Cover Removal, Bottom (Level 4 Access) A10/A11 Assemblies Service Position Level 3 Access	6-1, 6-6, 6-7, 8-1
A10 and A11 (top) A17	Cover Removal, Bottom (Level 4 Access)	6-1, 6-7
A10 and A11 (top and bottom)	Cover Removal, Bottom (Level 4 Access) A10/A11 Assemblies Service Position	6-1, 6-7, 8-1
A12, A13, A14, A15	Rear Panel Removal	6-3, 8-2
A16, B1, T1	Fan Shroud Removal	6-3, 8-2

Disassembly Procedures (Cont'd)

Remove the front and rear handle caps (MP5 and MP7) and the handles MP4. Push the side covers toward the Signal Generator's rear panel to release the angled tabs that fit into the holes in the top and bottom covers. Remove the side covers. The top cover may now be lifted off for Level 1 Access or the instrument may be turned over and the bottom cover lifted off for Level 4 Access.

A3 Assembly Service Position. The top cover has been removed. Remove eight 10-32 inch nuts and washers (MP47 and MP55) from the top of the circuit board. Rotate the circuit board and the hinged carrier MP11 up and to the right. To lock the carrier in place, press the spring loaded hinge toward the rear of the instrument until it slides around the hinge lock MP13.

Level 2 Access. Remove two No 2 Pozidriv screws MP24 from the top internal cover. Lift the cover up and out by the cover handles. Place a standard blade screwdriver under the corner of the small internal RF cover which covers the individual board. Lift the cover from the casting.

NOTES

Insert all shield braid removed during disassembly into the appropriate space(s) in the casting wall before the small internal RF covers are reinstalled.

ManualsPlus.com

Disassembly Procedures (Cont'd)

NOTES (Cont'd)

DO NOT PRESS the small internal RF covers all the way into the casting during reassembly. Make sure the top of the cover is the same level as the top of the casting.

A10/A11 Assemblies Service Position. The bottom cover has been removed. Remove eleven 10-32 nuts and associated washers (MP47 and MP55) from the top of the circuit board. Raise the circuit board and hinged carrier MP15 up and to the left. To lock the carrier in place, press the spring loaded hinge toward the rear of the Signal Generator until it slides around the hinge lock MP13.

Level 3 Access. A10/A11 Assemblies have been locked into the service position. Remove seven No 2 Pozidriv screws MP24 from the bottom internal cover. Remove twelve sets of No 2 Pozidriv screws and washers (MP56 and MP57) from the attenuator cover. Lift the attenuator cover off the bottom internal cover. Lift the bottom internal cover up and out by the cover handles. Access to individual boards is achieved by raising the corners of the small internal RF covers with a standard blade screwdriver.

NOTE

DO NOT PRESS the small internal RF covers all the way in. Make sure the top of the cover is the same level as the top of the casting.

Rear Panel Removal. Position the instrument so you are facing the rear panel as shown in Figure 8-2.

1. Free the left rear foot (item 1) by removing two sets of No 2 Pozidriv screws, washers, lockwashers and nuts (items 2).

2. Free the Rear Panel (item 4) by removing three sets of No 2 Pozidriv screws and lockwashers (items 3).

3. Pull the rear panel toward yourself. Be careful not to pinch the black wire.

4. Remove the flat ribbon cable connector from the HP-IB Connector Assembly—A13.

CAUTION

While reinstalling the rear panel, be sure the thin wall metal gasket MP121 is not twisted or bent against the top, bottom or side of the machined frame (casting) MP1.

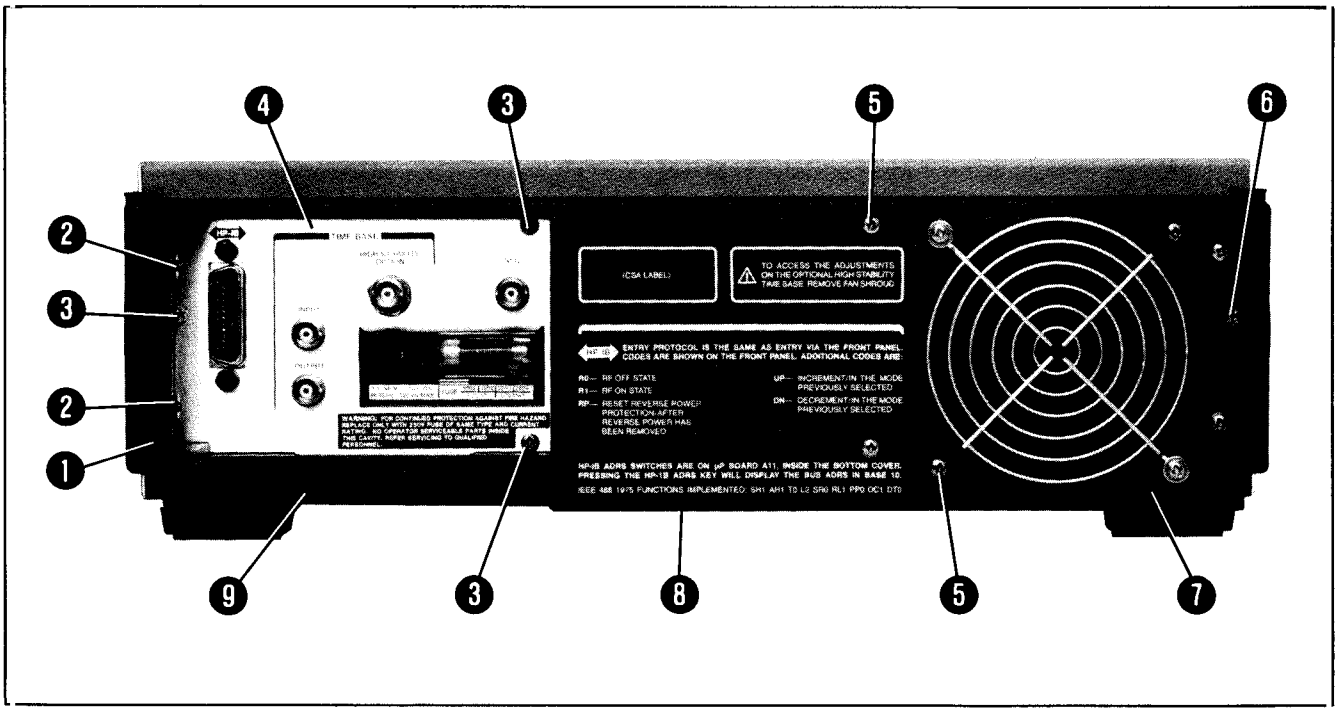


Figure 8-2. Rear-Panel and Fan Shroud Removal

ManualsPlus.com

Disassembly Procedures (Cont'd)

5. While reinstalling the rear panel, reverse the steps of the preceding procedure.

Fan Shroud Removal. Position the instrument on either side.

1. Remove the plastic pin (item 8) that attaches the series regulator cover (item 9) to the Fan Shroud (item 7). (Refer to Figure 6-3).

2. Position the instrument so you are facing the rear panel as shown in Figure 8-2.

3. Free the fan shroud (item 7) by removing three sets of attaching hardware. Two sets are No 2 Pozidriv screws, lockwashers and flatwashers (item 5). The other set is a No 2 Pozidriv screw, lockwasher and flatwasher (item 6).

NOTE

Removing the transformer will free the bracket holding the Option 001 10 MHz Reference Oscillator if it has been installed.

CAUTION

Be sure that none of the wires within this assembly are crushed between the casting and the transformer while reinstalling the transformer. With Option 001 installed, it may be necessary to remove the rear panel to ensure that no damage occurs.

8-26. Replacement of Key Cap and Pushbutton Switches

Key Cap Replacement. Removing a front-panel key cap may be easily done in one of two ways. If the front panel has been removed (refer to the Front Panel Removal procedure), use a small flat blade screwdriver to press on the switch side of the key cap while working it from side-to-side with your fingers. Removing the key cap without opening the instrument is done as follows. Grasp the key cap firmly with pliers. Work it from side-to-side while pulling away from the panel.

NOTE

The pliers may damage the key cap unless the jaws are covered with a protective material.

Be sure the key cap is aligned properly before snapping into place. Note that the key cap has 8 possible positions. Refer to Figure 8-3.

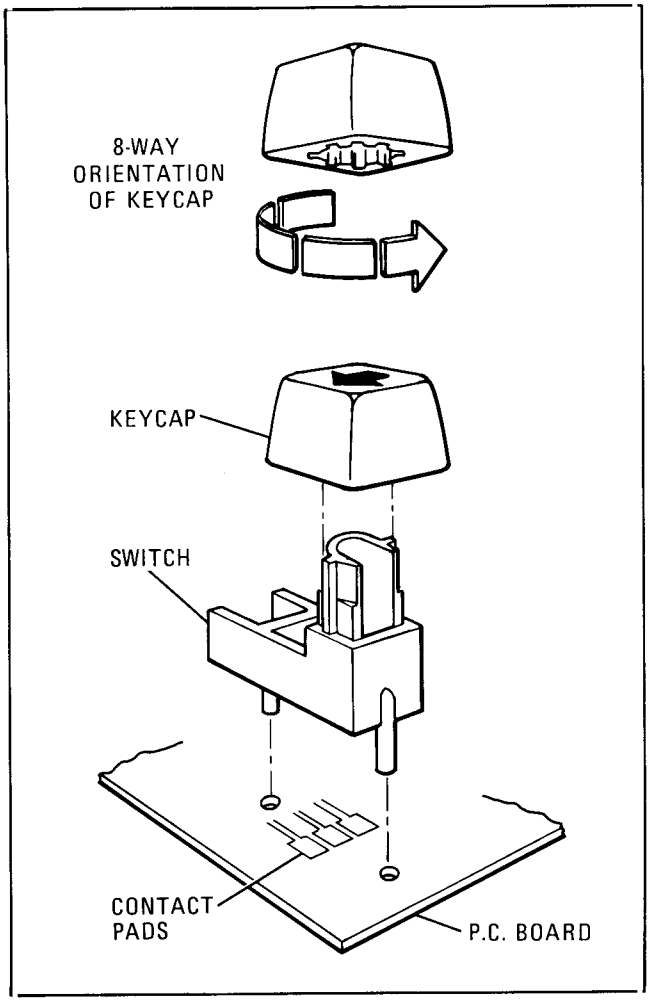


Figure 8-3. Front-Panel Pushbutton Switch Assembly

Switch Replacement. The front-panel switches have a very high cycle life. However, if one becomes faulty and needs replacement, follow the procedure outlined below:

1. Remove the front panel (refer to the Front Panel Removal Procedure).

2. Remove the key cap as indicated above.

3. Remove the switch by chipping away the melted plastic tabs at the circuit of the keyboard which hold the switch in place.

4. To assure long life and reliable electrical performance, the circuit board contact traces (which are found underneath the switch) should

ManualsPlus.com

Disassembly Procedures (Cont'd)

be clean and free of surface imperfections. Clean the switch contact pads before installing a new switch.

5. For reliable operation, any method of assembly must assure that the switch is mounted tightly against the pc board. To facilitate the heat staking operation, specially molded support anvils (HP 5040-6881) can be ordered. Refer to Figure 8-4.

NOTE

The following operation should be done in a well ventilated area. If the heat staking tip is too hot, the plastic will vaporize and emit fumes. These fumes, however, are non-toxic.

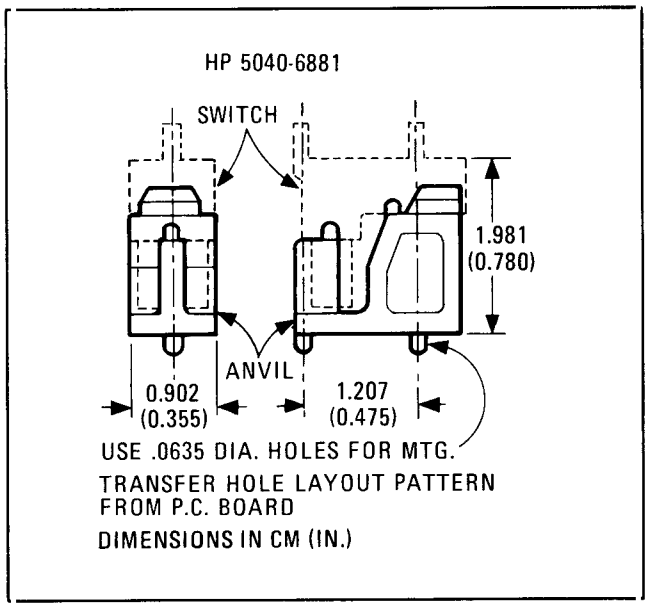


Figure 8-4. Pushbutton Switch Support Anvil

6. To assure proper switch assembly, verify that the switch is pushed firmly against the circuit board and, with the hot (440C or 825°F) staking tip (refer to Figure 8-5) push down on each of the posts (2) of the switch. Each post should take about one second to stake. With the proper cycle, the post should turn a darker color and, in about ten seconds, return to its original bright red color. The correctly staked post should have a smooth round "rivet" like top. Refer to Figure 8-6.

CAUTIONS

Do not disturb the assembly for at least 10 seconds after heat staking.

If not enough heat is applied, the plastic will tend to stick to the tip of the iron.

If too much heat is applied, the plastic will fume profusely, the "rivet" will be irregularly shaped, and the plastic will be permanently discolored.

If the staking tool is worn or flaked, it will cause a misshaped rivet and/or a contamination deposit on the surface.

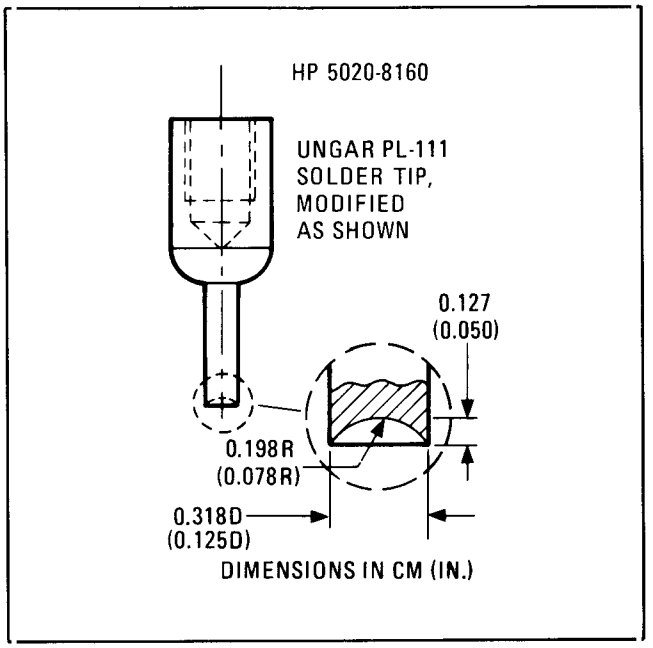


Figure 8-5. Heat Staking Tip

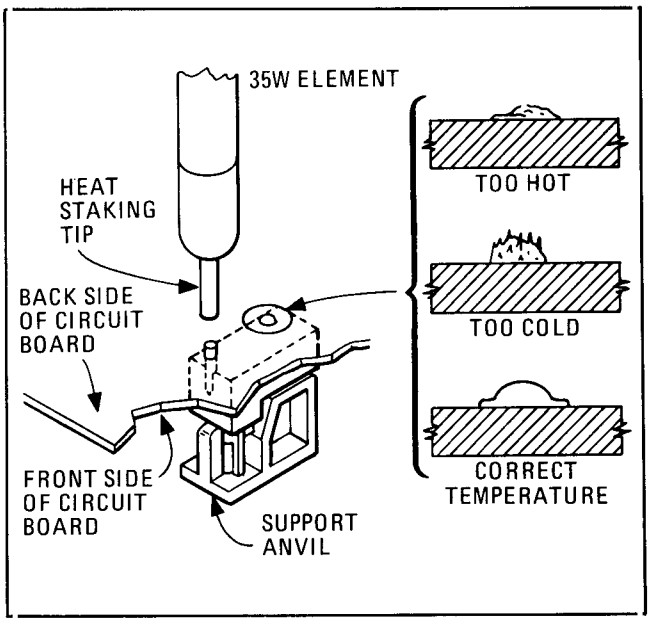


Figure 8-6. Typical Assembly for Heat Staking Operation

ManualsPlus.com

8-27. Factory-Selected Components (*)

Some component values are selected at the time of final checkout at the factory (see Table 5-1). These values are selected to provide optimum compatibility with associated components. These components are identified on individual schematics and the parts list by an asterisk (*).

8-28. Manual Backdating (†)

A dagger (†) by an item of service information means that information is different for Signal Generators with serial number prefixes lower than the one to which this manual applies directly. Table 7-1 lists the backdating changes by serial number prefix. The backdating changes are contained in Section VII. Recommended modifications are also contained in Section VII.

8-29. Manual Updating (Manual Changes Supplement)

Production changes to Signal Generators made after the publication date of this manual are indicated by a change in the serial number prefix. Changes to this manual's information are recorded by a serial number prefix on the Manual Changes supplement. Errors are also noted in the ERRATA portion of the Manual Changes supplement.

Keep this manual up to date by periodically requesting the latest, complimentary supplement from your Hewlett-Packard office.

8-30. Etched Circuits (Printed Circuit Boards)

The etched circuit boards in the Signal Generator have plated-through holes which make a solderable path through to both sides of the insulating material. Soldering can be done from either side of the board with equally good results. When soldering to any circuit board, keep in mind the following recommendations:

1. Avoid unnecessary component substitution. Substitution can result in damage to the circuit board and/or adjacent components.
2. Do not use a high-power soldering iron on etched circuit boards. Excessive heat may lift a conductor or damage the board.
3. Use a suction device or wooden toothpick to remove solder from component mounting holes. DO NOT USE A SHARP METAL OBJECT SUCH AS AN AWL OR TWIST DRILL FOR THIS PURPOSE. SHARP OBJECTS MAY DAMAGE THE PLATED-THROUGH CONDUCTOR. Refer to Table 8-2 for information on available tools for working on etched circuit boards.

8-31. MOS and CMOS Integrated Circuit Replacement

MOS and CMOS integrated circuits are used in this instrument. They are prone to damage from both static and transients and must be handled carefully. When working on the Signal Generator, keep in mind the following recommendations to avoid damaging these sensitive components.

1. Do not remove any board unless the Signal Generator has been unplugged.
2. When removing a socketed MOS or CMOS device from an assembly, be careful not to damage it. Avoid removing devices from these sockets with pullers. Instead, use a small screwdriver to pry the device up from one end, slowly pulling it up one pair of pins at a time.
3. Once a MOS or CMOS device has been removed from an assembly, immediately stick it into a pad of conductive foam or other suitable holding medium.
4. When replacing a MOS or CMOS device, ground the foam on which it resides to the instrument before removing it. If a device requires soldering, make sure that the assembly is lying on a sheet of conductive foam, and that the foam and soldering iron tip are grounded to the assembly. Apply as little heat as possible.
5. Before turning the instrument off, remove any large ac sources which may be driving MOS switches.

8-32. RETROFITTING OPTION 001

Option 001 may be retrofitted to the Signal Generator after taking delivery. Refer to Section I for the descripton and part numbers under the paragraphs entitled Options.

8-33. SCHEMATIC SYMBOLOGY AND OPERATING PRINCIPLES

8-34. Schematic Diagram Notes

Table 8-3, which just precedes the foldouts, summarizes the symbology used for presenting the devices used in the Signal Generator.

8-35. Basic Logic Symbology

The logic symbols used in this manual are based on the American National Standards Institute (ANSI)

ManualsPlus.com

Table 8-2. Etched Circuit Soldering Equipment

Item	Use	Specification	Item Recommended	HP Part No.
Soldering Tool	Soldering, Heat Staking	Wattage: 35W Tip Temp.: 390—440°C (735—825°F)	Ungar No. 135 Ungar Division Eldon Ind. Corp. Compton, CA 90220	8690-0167
Soldering Tip	Soldering, Unsoldering	*Shape: Chisel	*Ungar PL113	8690-0007
Soldering Tip	Heat Staking	Shape: Cupped	HP 5020-8160 or modified Ungar PL111 (see Figure 8-2)	5020-8160
De-Soldering Aid	To remove molten solder from connection	Suction Device	Soldapullt by Edsyn Co., Van Nuys, CA 91406	8690-0060
Rosin (flux) Solvent	To remove excess flux from soldered area before application of protective coating	Must not dissolve etched circuit base board	Freon	8500-0232
Solder	Component replacement; Circuit Board repair wiring	Rosin (flux) core, high tin content (63/37 tin/lead), 18 gauge (SWG) 0.048 in. diameter preferred.		8090-0607

*For working on circuit boards; for general purpose work, use No. 555 Handle (8690-0261) and No. 4037 Heating Unit 47-1/2—56-1/2 W (HP 8690-0006); tip temperature of 850—900°F, and Ungar No. PL113 1/8" chisel tip.

Basic Logic Symbology (Cont'd)

Y32.14-1973, "Graphic Symbols for Logic Diagrams (Two State Devices)". A summary of this symbology is provided to aid in interpreting these symbols.

Gates and Qualifiers. This section includes a brief description of the basic logic symbols used on the service sheets (see Figure 8-7), a summary of indicator symbols (see Figure 8-8), a discussion of contiguous blocks, control blocks, and dependency notation, and a summary of symbology for some of the more complex devices.

Qualifiers are that portion of a device symbol that denotes the logic function. For example, "&" denotes the AND function. See Figure 8-7 for a summary of the basic logic symbols and their qualifiers.

Power supply and ground connections are not shown on the symbols. This information is tabulated on the right margins of the service sheets.

Indicator Symbols. Indicator symbols identify the active state of a device's input or output, as shown in Figure 8-8.

Contiguous Blocks. Two symbols may share a common boundary parallel or perpendicular to the direction of the signal flow. Note that in the examples shown in Figure 8-9, there is generally no logic connection across a horizontal line, but there is always an implied logic connection across a vertical line. Notable exceptions to this rule are the horizontal lines beneath control blocks and between sections of shift registers and counters (dividers).

Dependency Notation. Dependency Notation simplifies symbols for complex integrated circuit ele-

ManualsPlus.com

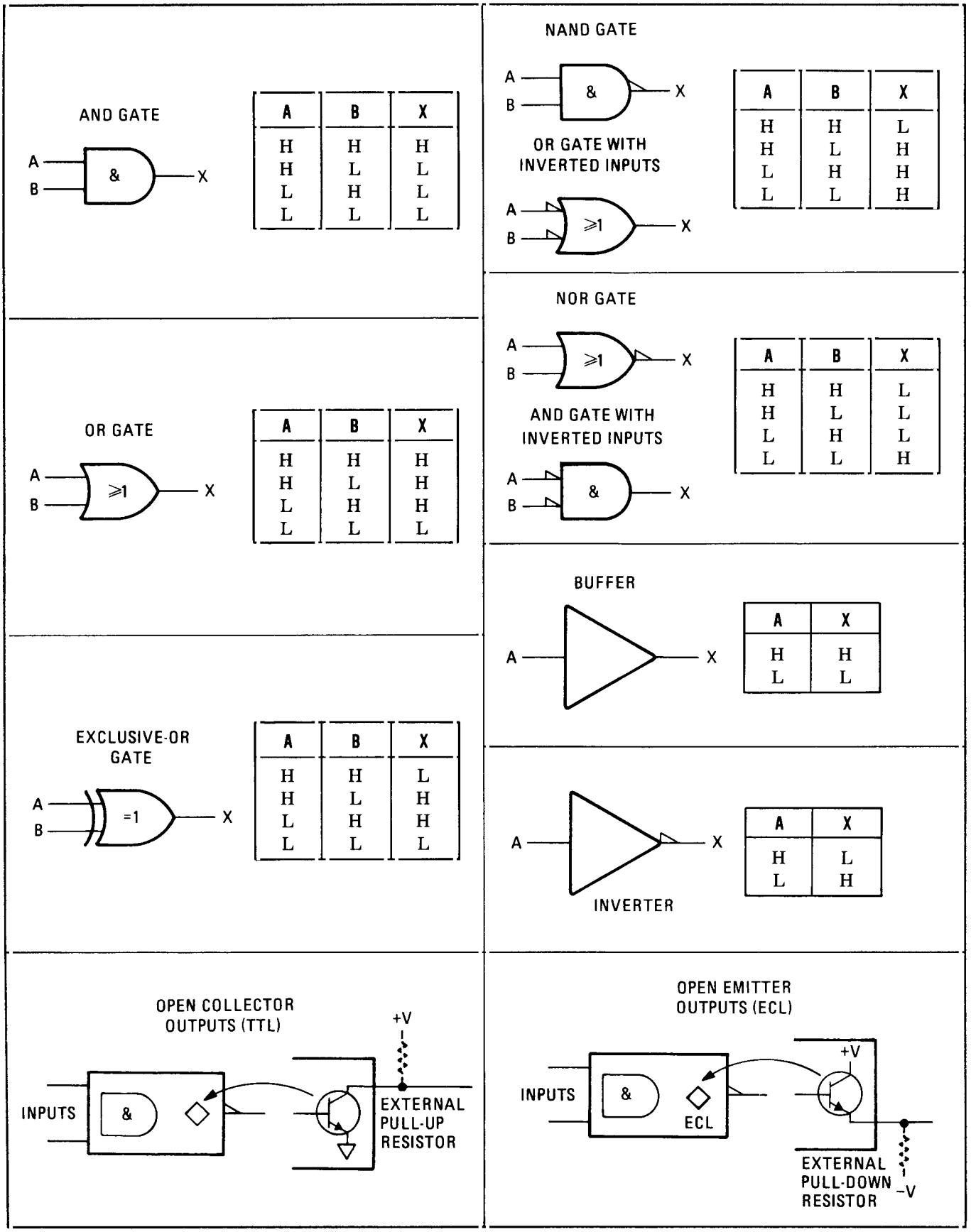


Figure 8-7. Basic Logic Symbols and Qualifiers

ManualsPlus.com

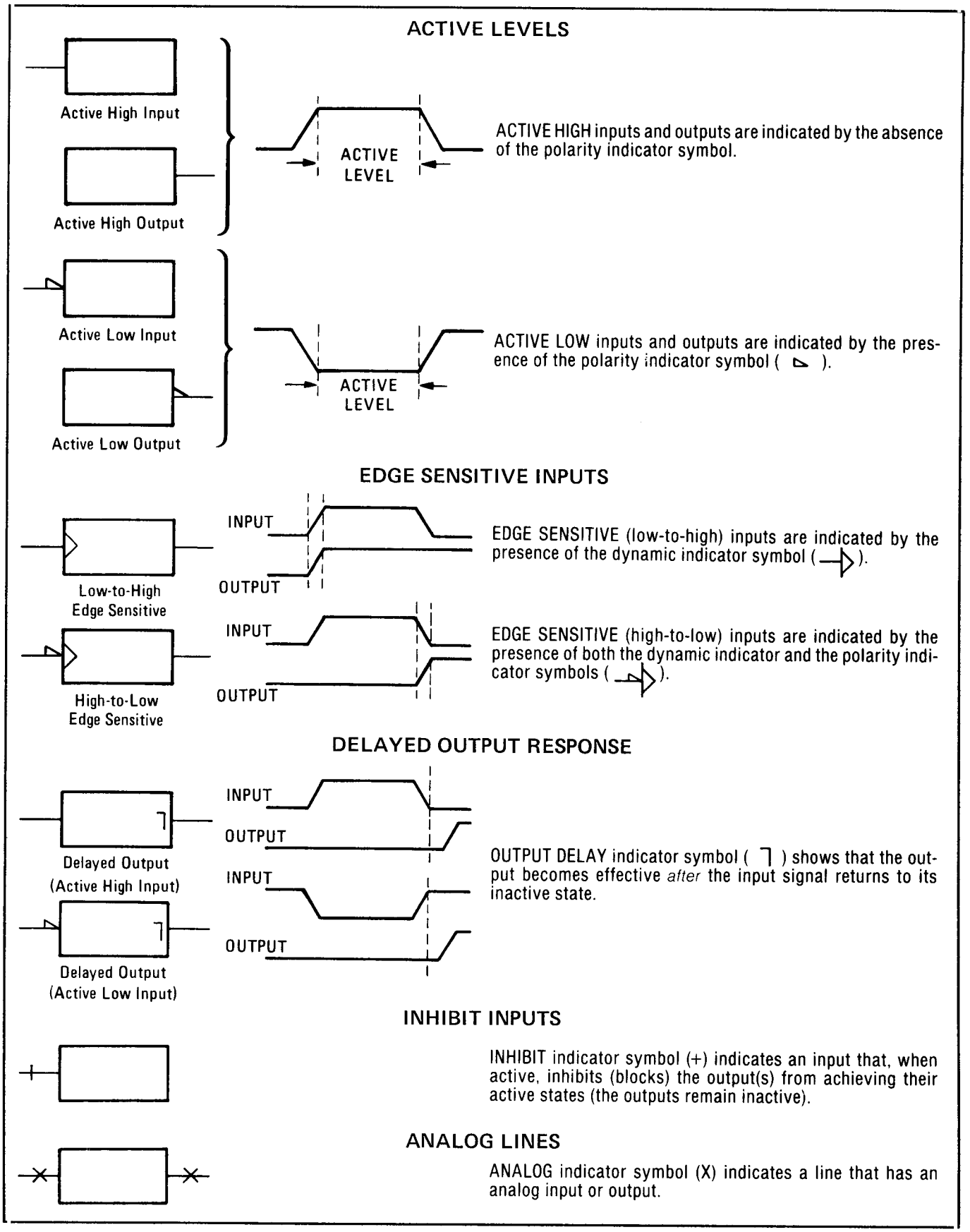


Figure 8-8. Indicator Symbols

ManualsPlus.com

Basic Logic Symbology (Cont'd)

ments by defining the interdependencies of inputs or outputs without actually showing all the elements and interconnections involved (see Figures 8-10 through 8-12). The following examples use the letter A for address, C for control, G for AND, V for OR, and F for free dependencies. The dependent input or output is labeled with a number that is either prefixed (e.g. 1X) or subscripted (e.g. X_1). They both mean the same thing. Note that many times a controlled line may already be labeled with a number that indicates input or output weighting (for example, in a coder). In this case, the controlling or gating input will be labeled with a letter (see Figure 8-11).

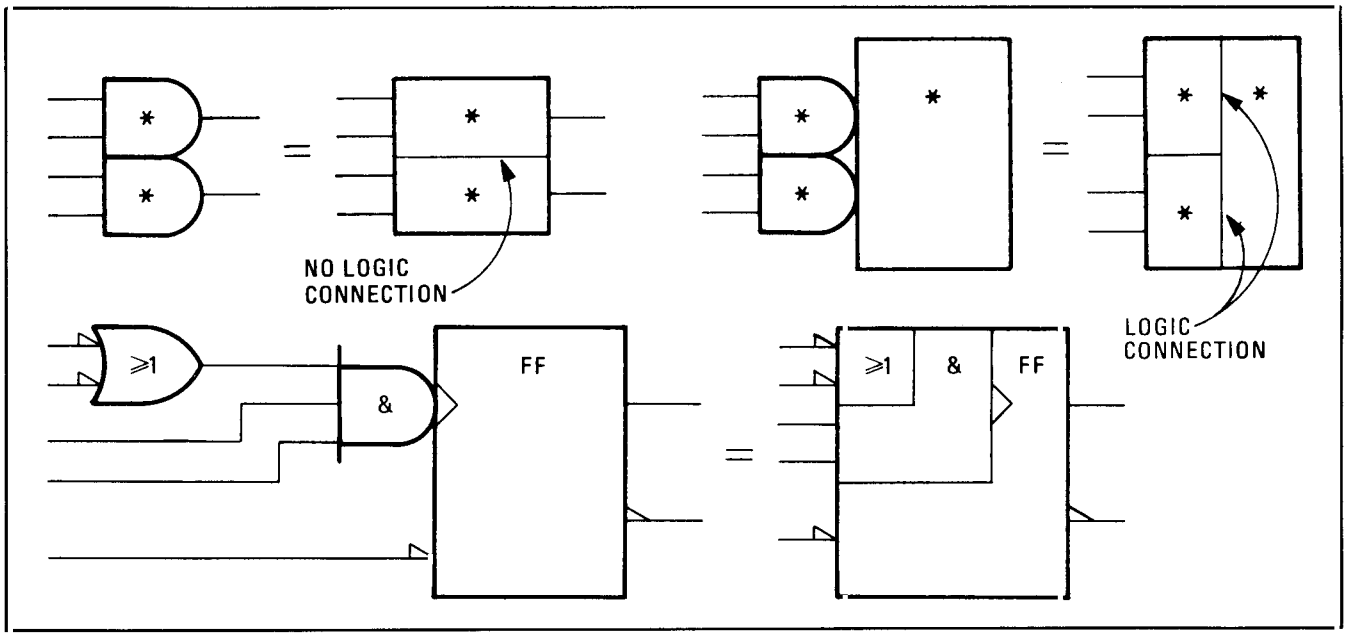


Figure 8-9. Contiguous Blocks

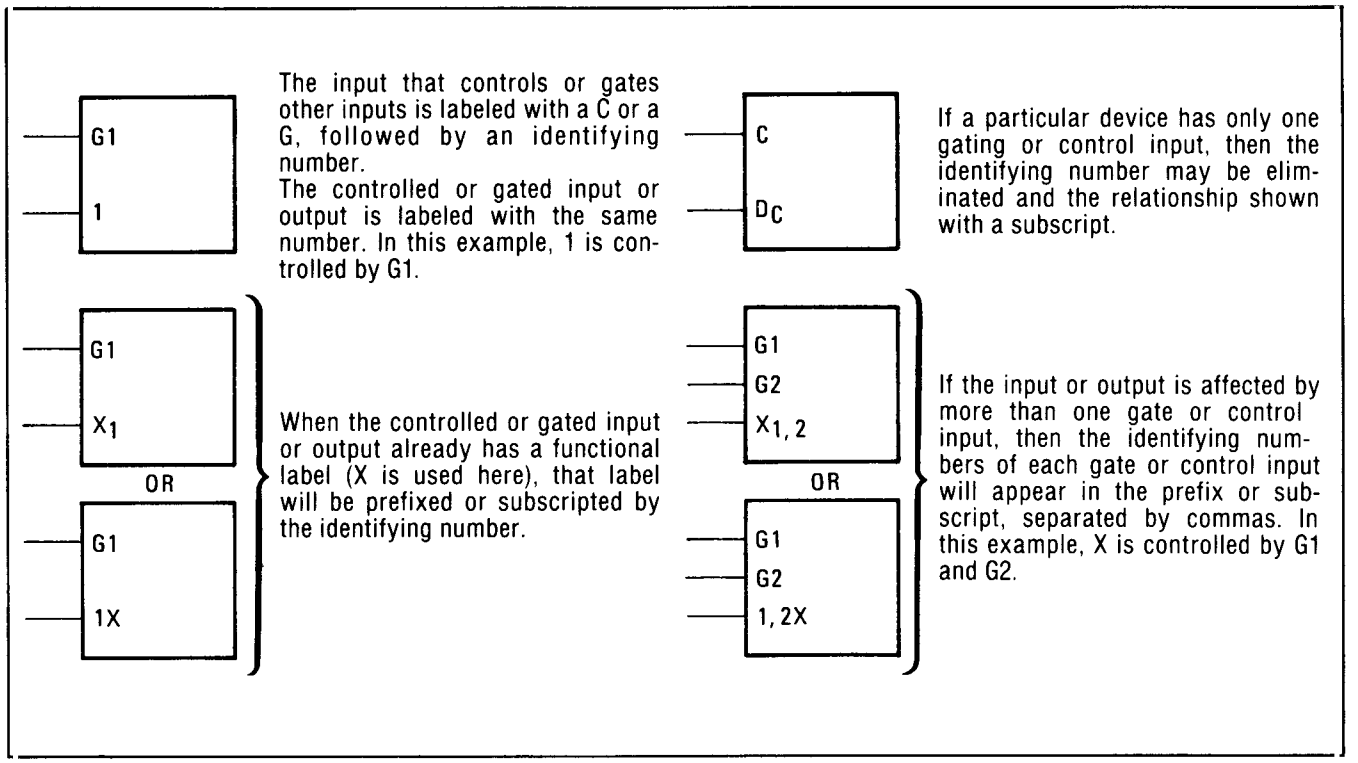


Figure 8-10. AND Dependency Notation

ManualsPlus.com

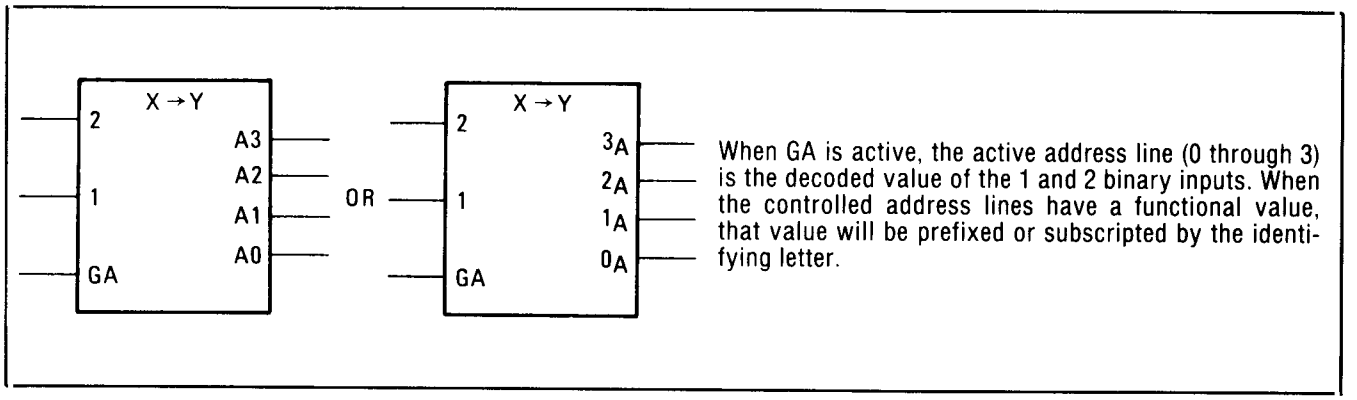


Figure 8-11. Address Dependency Notation: Coder Example Using Alpha Characters (Letters)

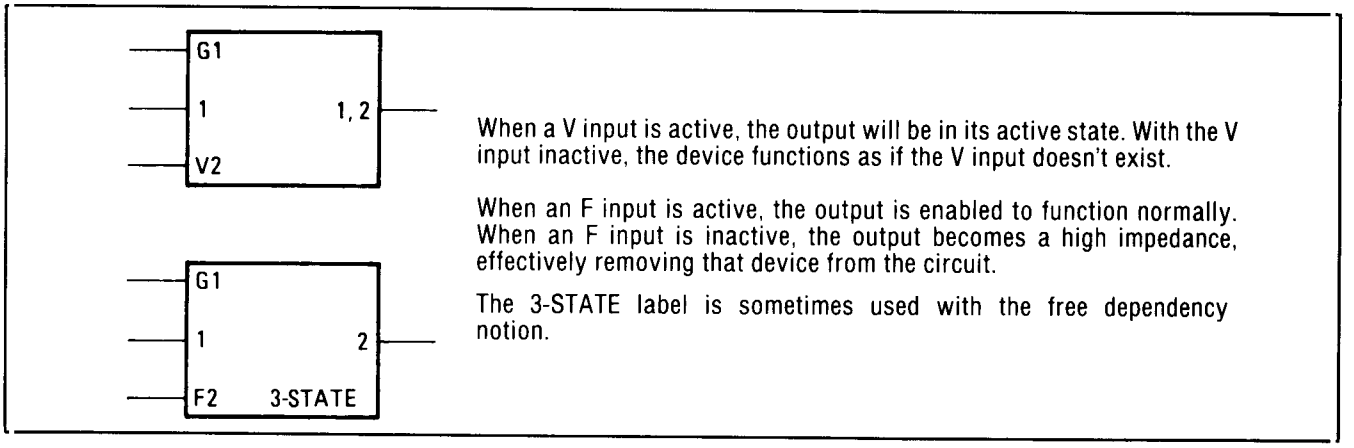


Figure 8-12. OR and Free Dependency Notation

Common Control Block. The Control block is used in conjunction with an array of related symbols in order to group common logic lines. Figure 8-13 shows how the Control block is usually represented. Figure 8-14 shows a quad D-type flip-flop with reset. This can be redrawn as shown in Figure 8-15. Note that the more complex representation shown in Figure 8-14 can be used when the flip-flops are functionally scattered around the schematic (i.e., not used as a quad unit).

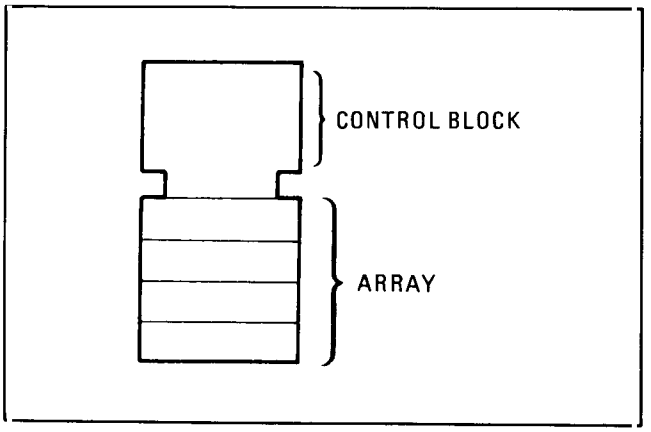


Figure 8-13. Common Control Block

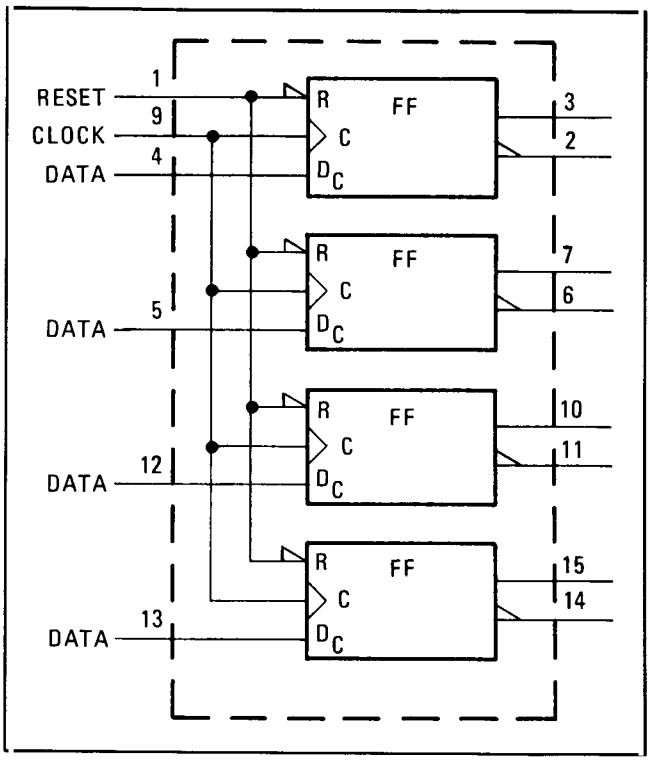


Figure 8-14. Quad D-Type Latch (Individual)

ManualsPlus.com

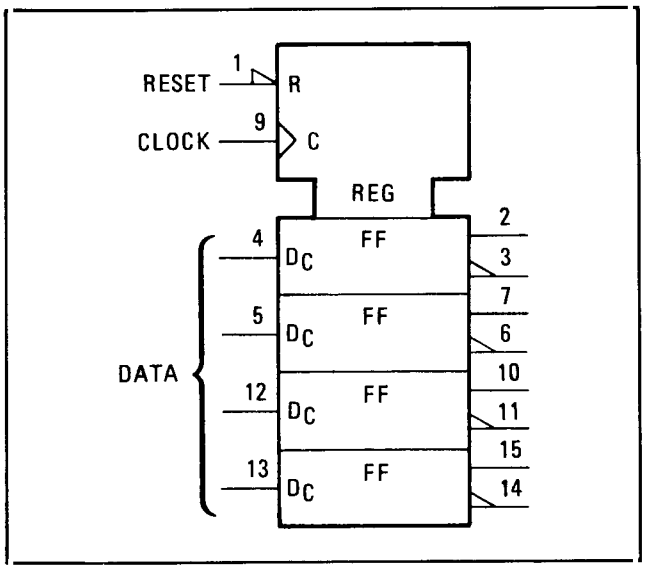


Figure 8-15. Quad D-Type Latch (Combined)

Complex Device Symbology. Figures 8-16 through 8-19 show how the basic symbols can be combined to illustrate behavior of fairly complex devices.

Shift Register. The Shift Register Control Block is used to show common inputs to a bidirectional shift register. Notice that "→ m" means shift the contents to the right or down by "m" units. And "← m" means shift the contents to the left or up by "m" units. Note: If m = 1, it may be omitted. Inputs "a" and "b" are each single IC pins that have two functions. Input "a" enables one of the inputs to the top

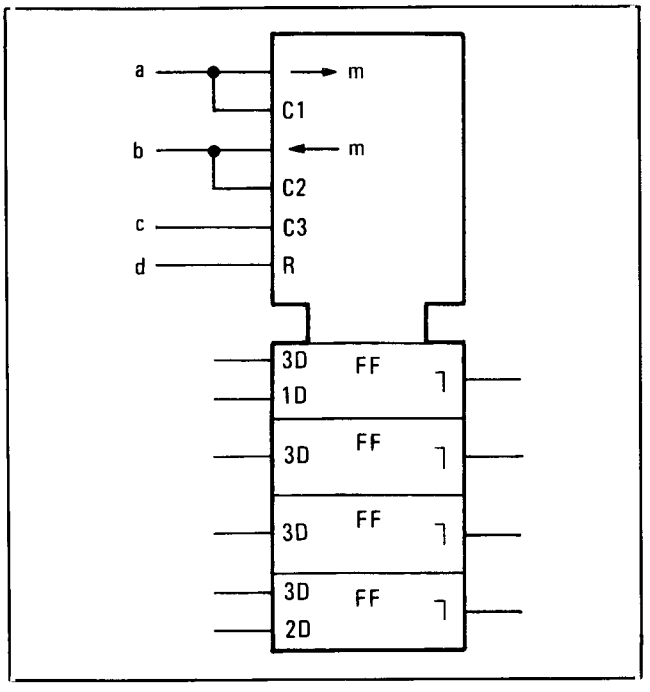


Figure 8-16. Shift Register

D-type flip-flop (1D) and also shifts the register contents down "m" units. Input "b" enables one of the inputs to the bottom flip-flop (2D), and also shifts the register contents up "m" units. Input "c" loads all four flip-flops in parallel (3D). Input "d" is a common reset. The output delay indicator is used because these are master-slave flip-flops.

AND-OR Selector. The Selector Control Block is used to simplify the AND portion of a quad AND-OR select gate. When G1 is high, the data presented at the "1" inputs will be gated through. When G2 is high, the data presented at the "2" inputs will be gated through.

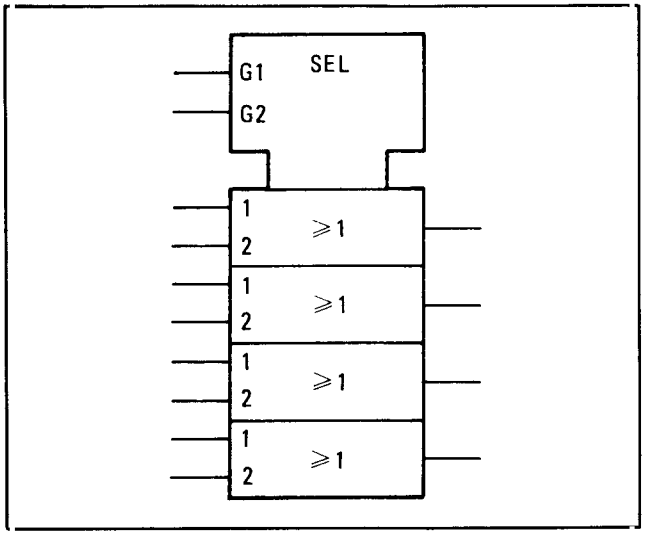


Figure 8-17. AND-OR Selector

Up/Down Counter. The Counter Control Block is used to show common inputs to a Presettable Decade UP/Down Counter. Notice that "+m" means count up (increment the count) by "m"; "–m" means count down by "m". Note: if m = 1, it may be omitted. Since the D-type flip-flops are master-slave, the output delay indicator is used. The "=9, +1" and "=0, –1" notation defines when the carry and borrow outputs are generated. They also define it as a decade counter; a binary counter would have the carry indicated with "=15, +1". Flip-flop weighting is indicated in parentheses. Input "C1" allows all four "D1" flip-flops to be preset in parallel.

Quad D-Type Latch. The Register control block is used to illustrate a quad D-type latch. There is a common active-low reset (R), and a common edge-triggered control input (C). Since there is only one dependency relationship, the controlling input is not numbered and the controlled functions (D) are subscripted with a C.

ManualsPlus.com

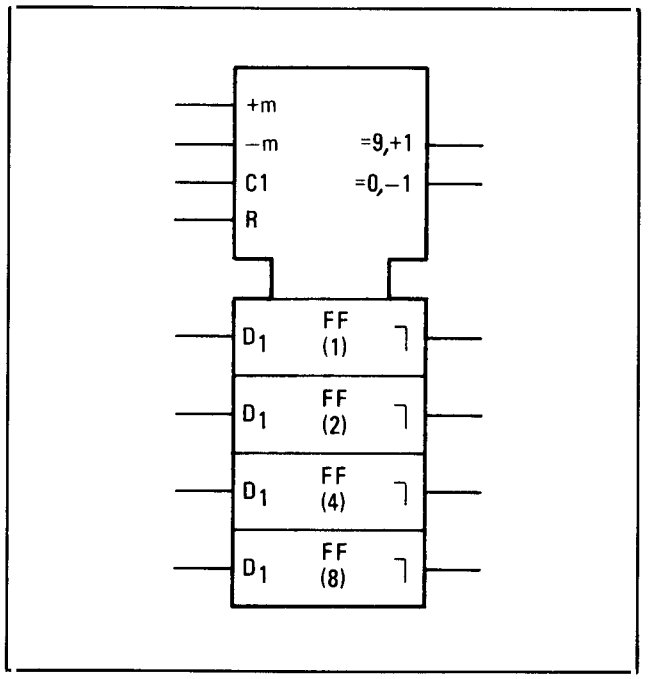


Figure 8-18. Up/Down Counter

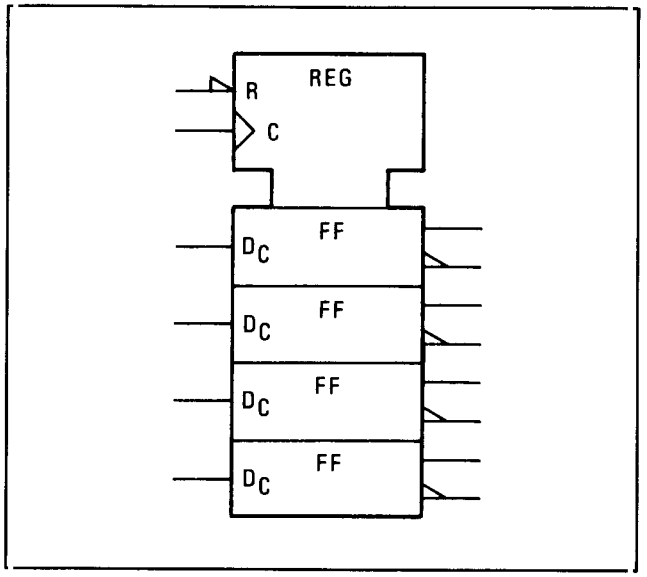


Figure 8-19. Quad D-Type Latch

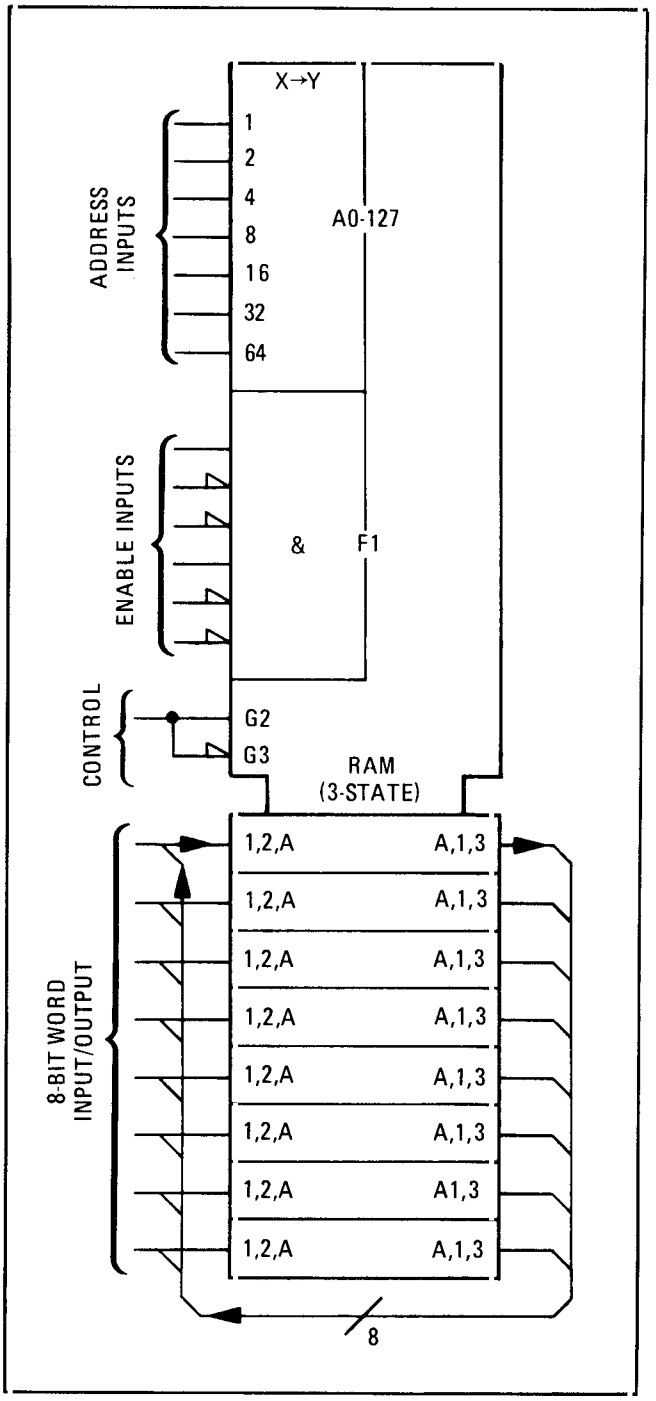


Figure 8-20. Random Access Memory

8-36. Complex Logic Symbology and Operating Principles

Microprocessor. For information regarding this device, refer to the principles of operation on Service Sheet 14.

Random Access Memory. Refer to Figure 8-20. This device provides temporary storage for up to 128 eight-bit words. Memory words are addressed on the address bus. When G2 is high, data is written into memory; when G3 is low, data is read from memory. G2 and G3 are connected internally. The device is active only when the six F1 inputs are active. Note that the input and output lines for each data bit are the same.

Read Only Memory. Refer to Figure 8-21. This device provides permanent storage for up to 2048 eight-bit words. Memory words are addressed by the address bus. When all control inputs are

ManualsPlus.com

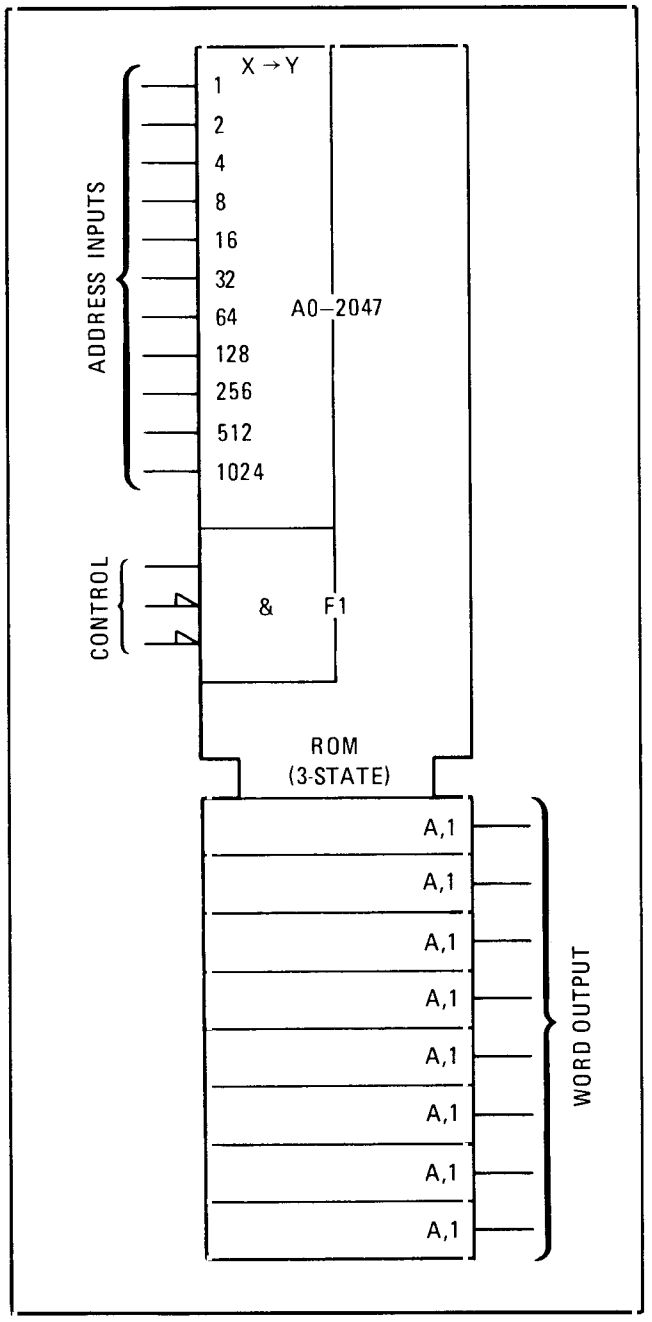


Figure 8-21. Read Only Memory

Complex Logic Symbology and Operating Principles (Cont'd)

active, the output of the ROM is enabled. When any one of the F1 inputs are inactive, the output is forced into an inactive (high-impedance) state.

Multiple Bus Transceivers. Refer to Figure 8-22. This device is used as an interface between the Signal Generator's interface adapter and data bus. If the G2 input is high, the device will allow data to pass from the left-hand inputs to the right-hand outputs. If the G1 input is low, the device passes data from the right inputs to the left outputs. If F3 is high, no data can be passed (all inputs and outputs are driven to a high impedance state). When F3 is low, the device is enabled. Due to the Schmitt trigger type configuration, the propagation delay, switching voltage, and hysteresis voltage will vary slightly from bit to bit as they pass through this device.

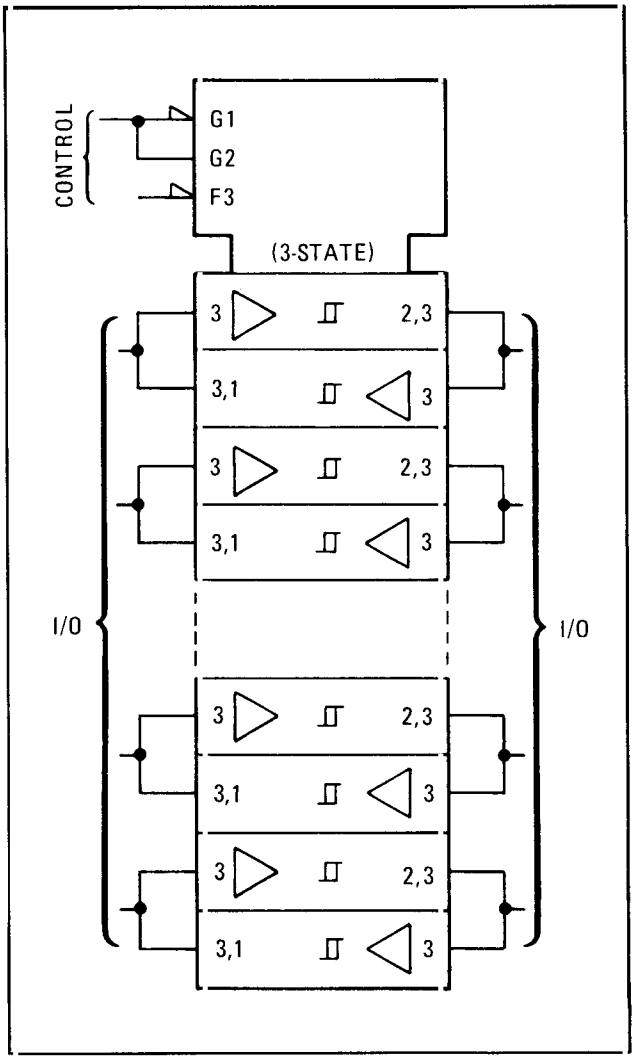


Figure 8-22. Multiple Bus Transceiver With 3-State Output

General Purpose Interface Adapter (GPIA). Refer to Figure 8-23. The GPIA interfaces a microprocessor through the instrument interface and a computer controller through the HP-IB interface. Data flow between the Signal Generator's microprocessor circuits and the interface bus occurs via the D0—D7 data bus lines and the IB0—IB7 signal lines. Each allows bi-directional data transfer. The signal lines pass ASCII data (7 bits).

ManualsPlus.com

Complex Logic Symbology and Operating Principles (Cont'd)

The HP-IB mode is selected by placing a low on chip select CS. The read/write and address (register select) lines RS0, RS1 and RS2 select data and control information flow to and from the microprocessor circuits. The clock is derived from the microprocessor's system clock. The interrupt request IRQ is set low to interrupt microprocessor operation for data or control inputs. ASE address select enables the address output to the data lines. RESET initializes the chip. For this Signal Generator, DMA REQUEST is not used. DMA GRANT must be grounded to enable the chip.

The handshake control lines DAV, RFD and DAC are explained in more detail on Service Sheet 17. The bus management lines ATN attention, SRQ service request, REN remote enable, IFC interface clear and EOI end of information or identify are used to control information to and from the Signal Generator. Refer to Section III, HP-IB Functional Checks for information relating to these lines under various control configurations. In this unit TRIG, T1, T2, R1 and R2 are not used.

Successive Approximation Register (SAR). Refer to Figure 8-24. Successive approximation as used in this instrument is a digital approach to negative feedback. The output signal is converted to digital form and is clocked into the SAR at the DATA input. The SAR output is tied to a Digital-to-Analog Converter (DAC). The DAC acts as an attenuator, thereby controlling the output amplitude directly. Several steps (approximations) are required to bring the output amplitude to the required level. At the end of the conversion cycle, the END OF CONVERSION output inhibits the clock input. This halts the data flow. The data output is maintained at the output just prior to the end of conversion. Start Conversion must be set high to begin the conversion cycle. Feed Forward allows the conversion to be halted before the cycle is complete.

Digital-to-Analog Converter (DAC). Refer to Figure 8-25. The analog output of this Digital-to-Analog Converter is a current flow that is proportional to the maximum current available and to the binary value of the digital input. The voltage output in the formulas is shown in its simplest form and with a minimum of external components. Be aware that other components will affect the actual voltage.

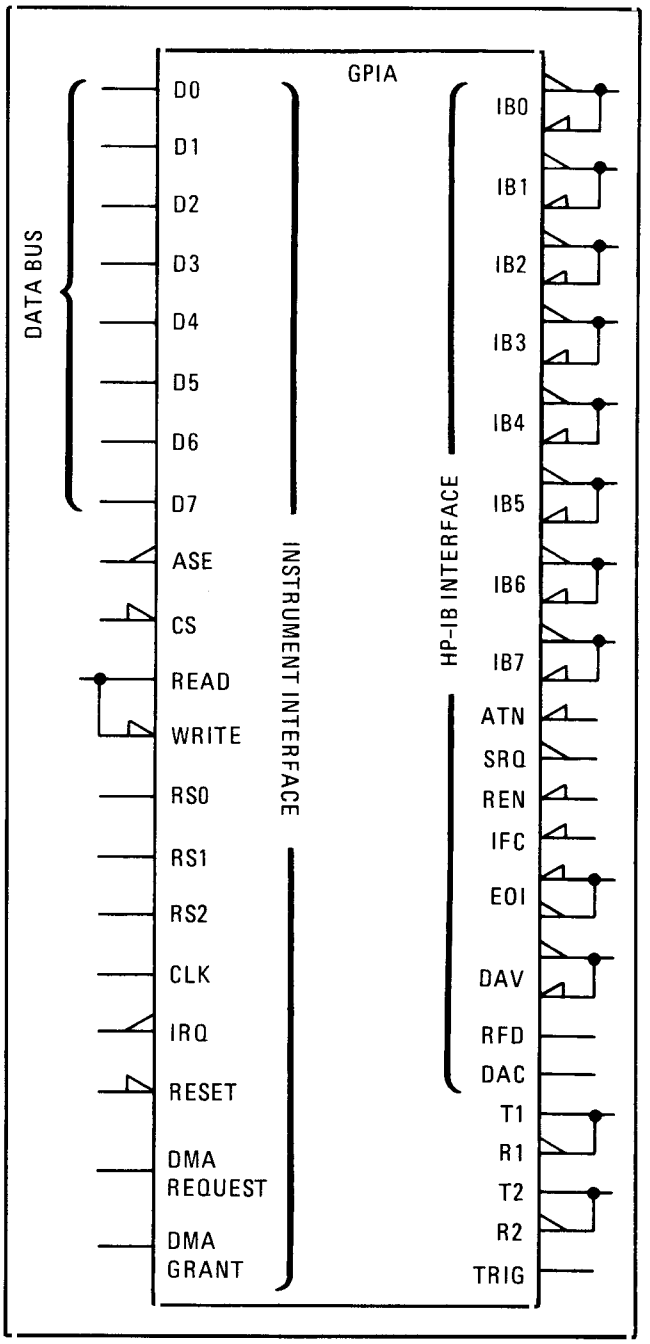


Figure 8-23. General Purpose Interface Adapter (GPIA)

The DAC output for dc voltages is:

$$V_o = V_{MAX}\ (Y/256) + V_{EE}$$

because $V_{MAX} = I_{MAX}\ (R_1)$

and $I_{MAX} = (V_1 - V_{REF(+)})/R_{EXT}$

The DAC output for ac voltages is:

$$V_o = V_i\ (Y/256)$$

Where V_o =output voltage

V_{MAX} =maximum dc output voltage

ManualsPlus.com

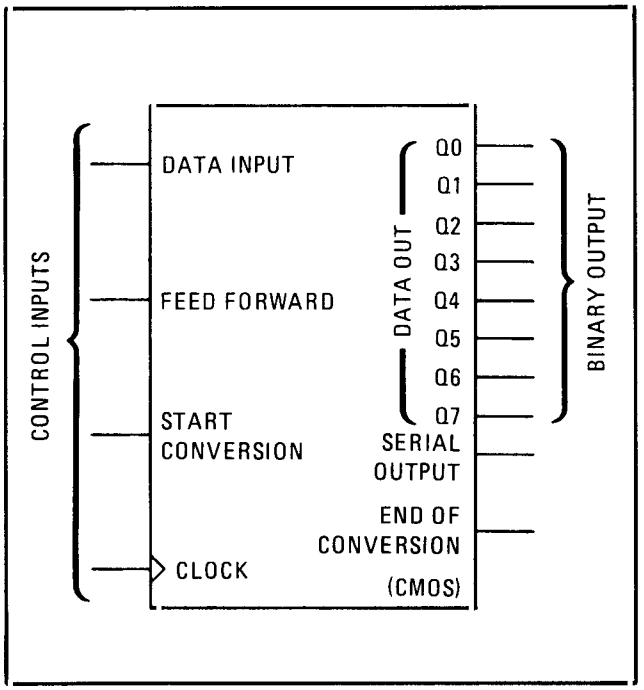


Figure 8-24. Successive Approximation Register (SAR)

Complex Logic Symbology and Operating Principles (Cont'd)

Where V_o = output voltage

V_{MAX} = maximum dc output voltage

V_{EE} = DAC negative bias voltage. (Note: the formulas assume R1 is connected to V_{EE})

V_1 = DAC input dc voltage applied to $V_{REF(+)}$ through R_{EXT}

$V_{REF(+)}$ = DAC positive dc reference

V_i = ac input voltage

I_{MAX} = maximum dc current

R_1 = output resistance

R_{EXT} = resistor that sets maximum current

Y = summation of binary inputs (X) from 1 to 255 in steps of 1

Programmable Interval Timer. Refer to Figure 8-26. This device contains three independent 16-bit down counters which can operate in either binary or BCD count sequences. Each counter is gated and clocked via its own input port. The Data Input pins of the device are bi-directional; data is input to or output from the internal buffer following read or write instructions. Functions of the internal data bus buffers include: programming the modes of the internal counters, pre-setting the count registers, and reading intermediate count values. An active low on the Write line allows the internal counters

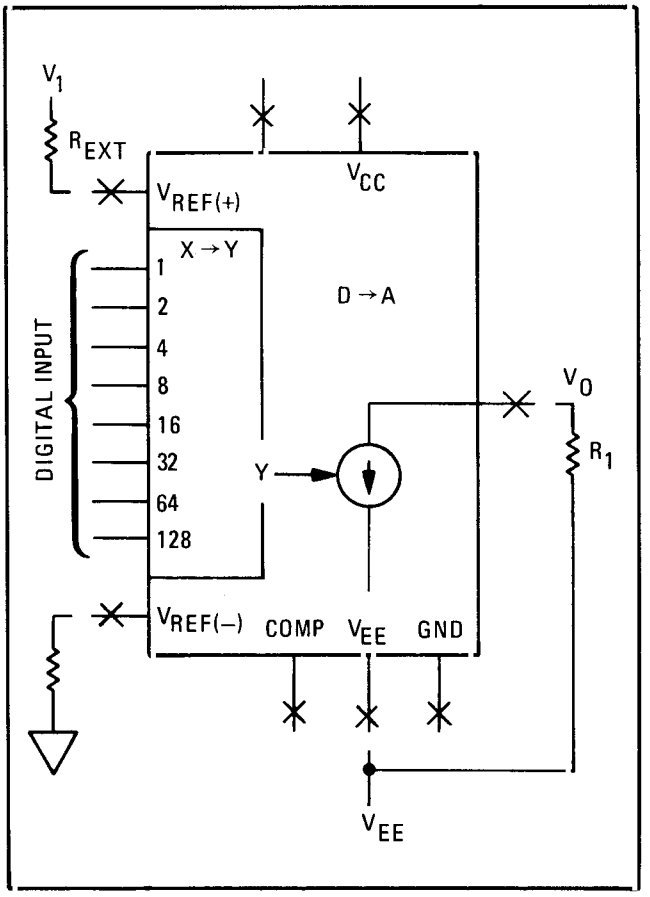


Figure 8-25. Digital-to-Analog Converter (8-bit)

and mode registers to be loaded; an active low on the Read line allows any one of the counter's immediate count values to be read. The Read/Write inputs are enabled by a low at the Select input which has no effect on any count operation. The A0 and A1 address inputs serve to select one of the three counters and to address the internal control word register for mode selection. A "00" at the A0 and A1 inputs selects counter 0, "01" selects counter 1, "10" selects counter 2, and "11" selects the control word register. Each counter's input, gate, and output functions are controlled through the selection of modes via the data bus. Mode selection is stored in the control word register. The six modes of counter operation are interrupt on terminal count, one-shot operation, rate generation, square wave generation, software triggered strobing and hardware triggered strobing.

BCD-to-Seven-Segment Latch/Decoder/Divider. Refer to Figure 8-27. This device latches and decodes BCD data to drive the individual segments of a 7-segment common cathode display. The BCD code is latched into the four flip-flops when C2 goes low. The BCD data is converted to a decimal code and then to the seven-segment code.

ManualsPlus.com

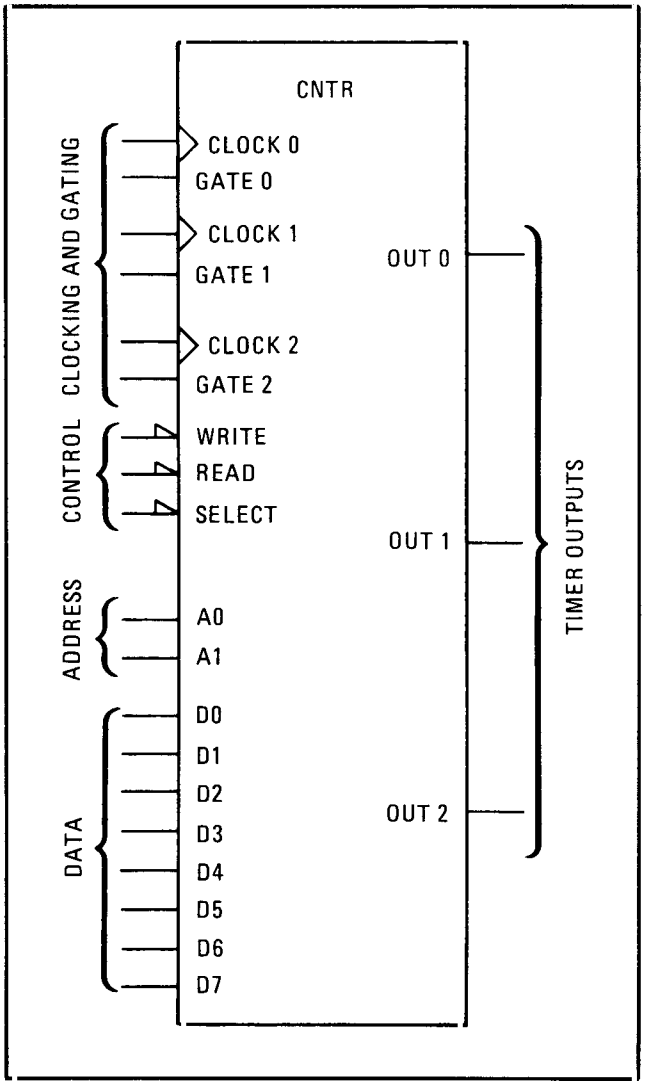


Figure 8-26. Programmable Interval Timer

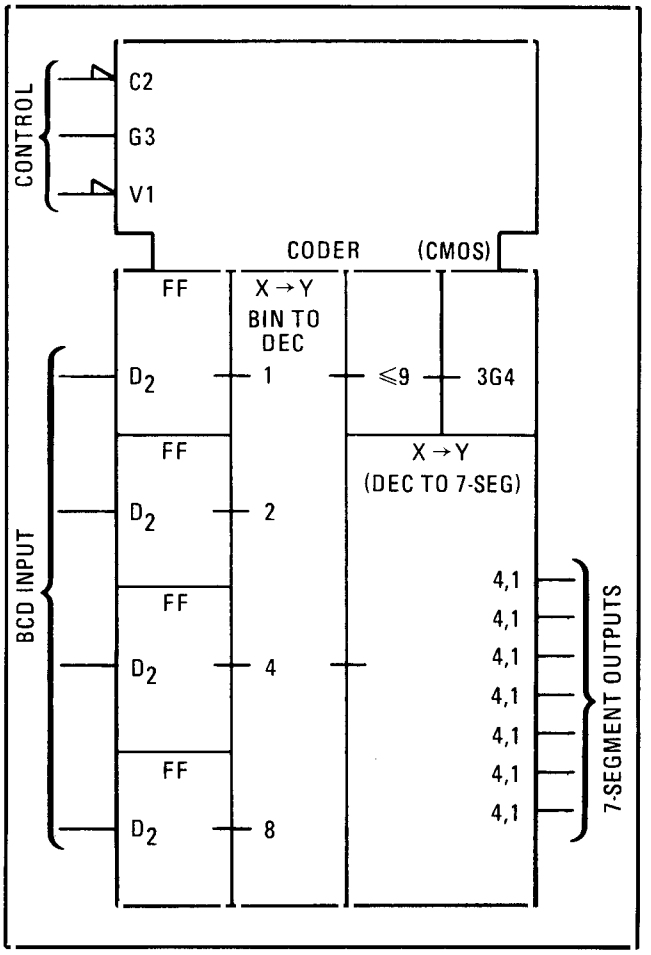


Figure 8-27. BCD-to-Seven-Segment Latch/Decoder/Driver

Complex Logic Symbology and Operating Principles (Cont'd)

The seven-segment output is enabled by an active G4 and an active V1. G4 is active when two conditions exist together: 1) when the binary data is equivalent to decimal 0—9 and 2) when G3 is high. When G3 is low, the outputs are disabled and the display is blanked. When V1 is active (low) all seven output lines will be high to test all segments of the display.

8-37. Linear Device Operating Principles

Operational Amplifiers. The source of gain in an operational amplifier can be characterized as an ideal differential voltage amplifier having low output impedance, high input impedance, and very high differential gain. The output of an operational amplifier is proportional to the difference in the voltages applied to the two input terminals. In use, the amplifier output drives the input voltage difference close to zero through a feedback path.

When troubleshooting an operational amplifier circuit, measure the voltages at the two inputs; the difference between these voltages should be less than 10 mV. (Note: This troubleshooting procedure will not work for operational amplifiers which are configured as comparators.) A difference voltage much greater than 10 mV indicates trouble in the amplifier or its external circuitry. Usually, this difference will be several volts and one of the inputs will be very close to one of the supply voltages (e.g., +15V or −15V).

Next, check the amplifier's output voltage. It will probably also be close to one of the supply voltages (e.g., ground, +15V, or −15V). Check to see that the output conforms to the inputs. For example, if the inverting input is more positive than the non-inverting input, the output should be negative; if the non-inverting input is more positive than the inverting input, the output should be positive. If the

ManualsPlus.com

Linear Device Operating Principles (Cont'd)

output conforms to the inputs, check the amplifier's external circuitry. If the amplifier's output does not conform to its inputs, it is probably defective.

Figures 8-28, 8-29 and 8-30 show typical operational amplifier configurations. Figure 8-28 shows a non-inverting buffer amplifier with a gain of 1. Figure 8-29 is a non-inverting amplifier with gain determined by R1 and R2. Figure 8-30 is an inverting amplifier with a gain determined by R1 and R2.

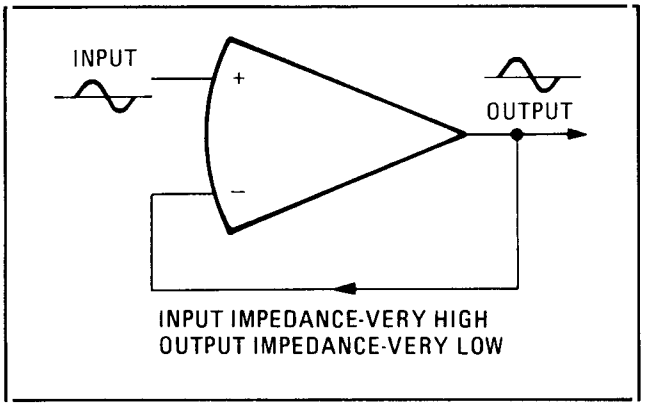


Figure 8-28. Non-Inverting Amplifier (Gain = 1)

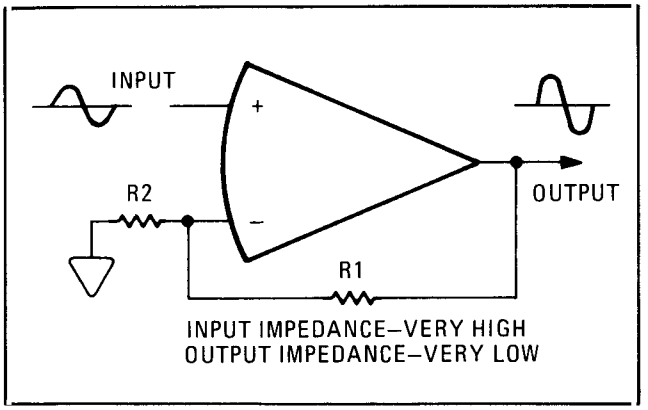


Figure 8-29. Non-Inverting Amplifier (Gain = 1 + R_1/R_2)

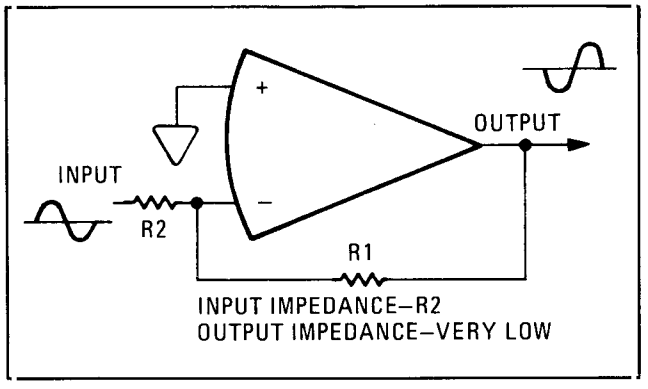


Figure 8-30. Inverting Amplifier (Gain = $-R_1/R_2$)

Comparators. Comparators are used as level sense amplifiers, switch drivers, pulse height discriminators, and voltage comparators. A voltage reference is connected to one of the amplifier's inputs as shown in Figures 8-31 and 8-32. When the other input signal voltage crosses the reference, the output is switched to the opposite polarity; the output remains at this polarity until the input signal re-crosses the reference.

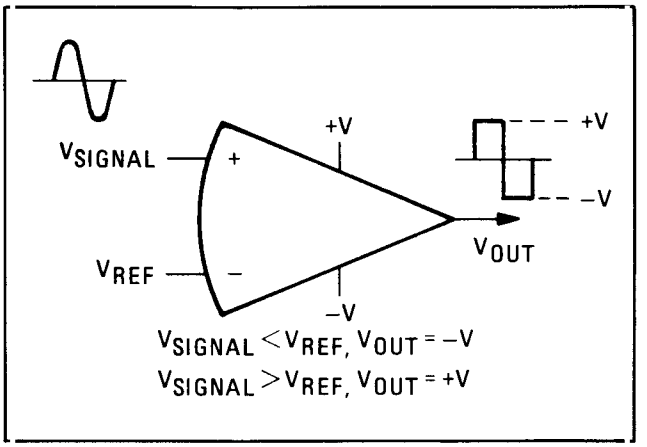


Figure 8-31. Non-Inverting Comparator

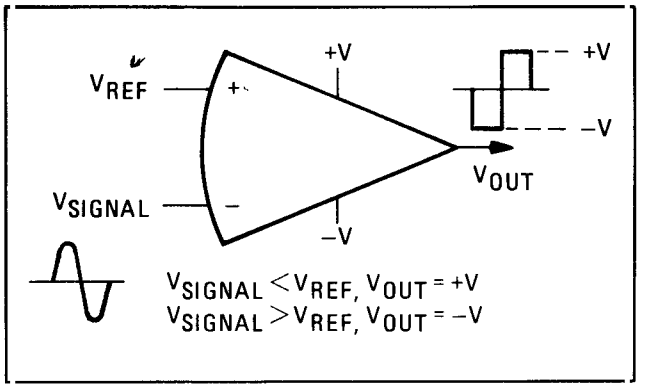
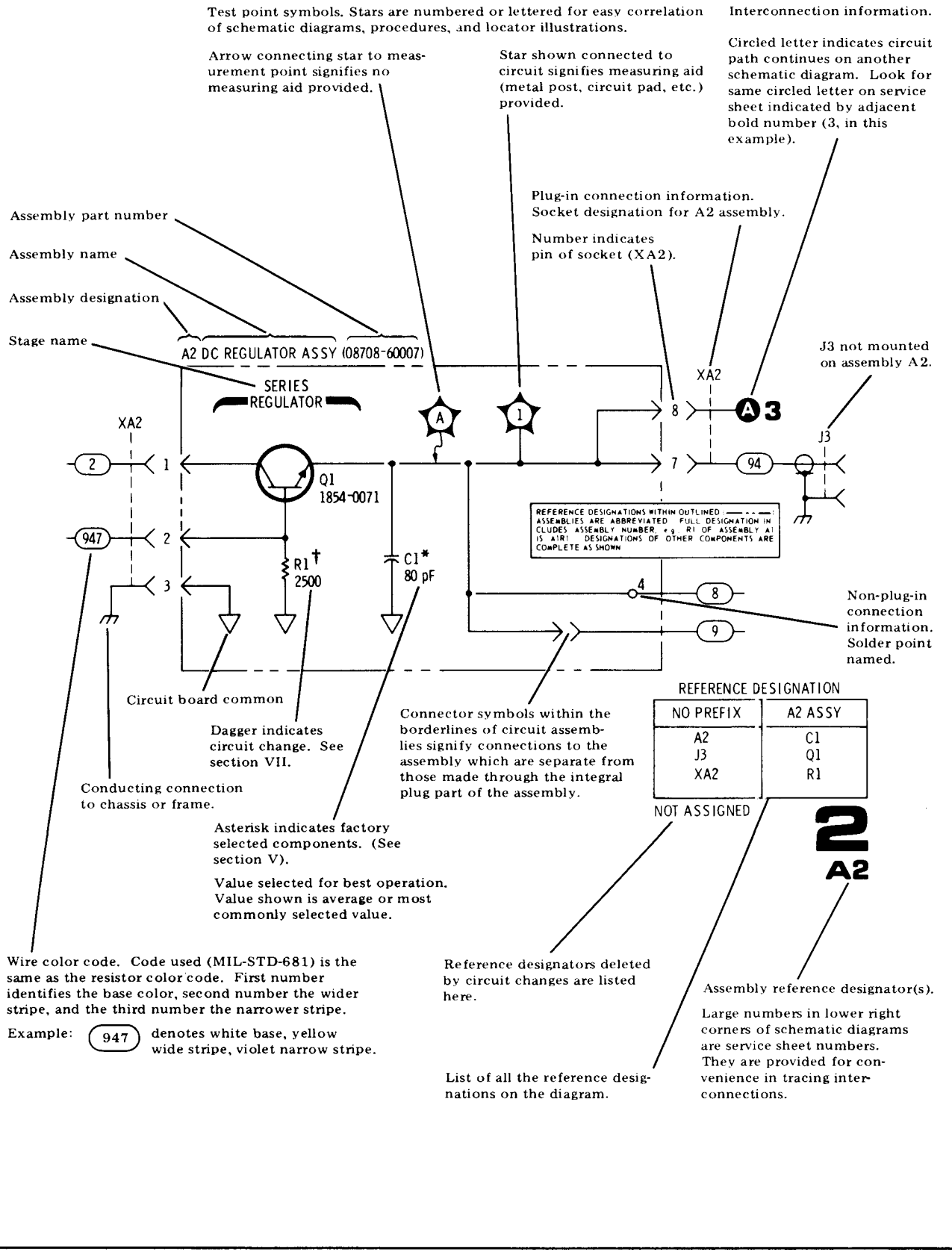


Figure 8-32. Inverting Comparator

ManualsPlus.com

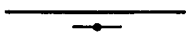
Table 8-3. Schematic Diagram Notes (1 of 8)



ManualsPlus.com

Table 8-3. Schematic Diagram Notes (2 of 8)

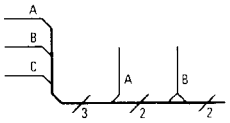
SCHEMATIC DIAGRAM NOTES

*	Asterisk denotes a factory-selected value. Value shown is typical. See Section V.
†	Dagger indicates circuit change. See Section VII.
	Tool-aided adjustment.  Manual control.
	Encloses front-panel designation.
	Encloses rear-panel designation.
	Circuit assembly borderline.
	Other assembly borderline.
	Heavy line with arrows indicates path and direction of main signal.
	Heavy dashed line with arrows indicates path and direction of main feedback.
	Indicates stripline (i.e., RF transmission line above ground).
	Wiper moves toward cw with clockwise rotation of control (as viewed from shaft or knob).
	Numbered Test Point measurement aid provided.
	Encloses wire or cable color code. Code used is the same as the resistor color code. First number identifies the base color, second number identifies the wider stripe, and the third number identifies the narrower stripe, e.g., (947) denotes white base, yellow wide stripe, violet narrow stripe.
	A direct conducting connection to earth, or a conducting connection to a structure that has a similar function (e.g., the frame of an air, sea, or land vehicle).
	A conducting connection to a chassis or frame.
	Common connections. All like-designation points are connected.
	Letter = off-page connection, e.g., A . Number = Service Sheet number for off-page connection, e.g., **12**.
	Number (only) = on-page connection.

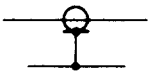
ManualsPlus.com

Table 8-3. Schematic Diagram Notes (3 of 8)

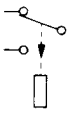
SCHEMATIC DIAGRAM NOTES



Indicates multiple paths represented by only one line. Letters or names identify individual paths. Numbers indicate number of paths represented by the line.



Coaxial or shielded cable.



Relay. Contact moves in direction of arrow when energized.



Indicates a pushbutton switch with a momentary (ON) position.



Indicates a PIN diode.



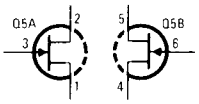
Indicates a current regulation diode.



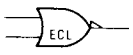
Indicates a voltage regulation diode.



Indicates a Schottky (hot-carrier) diode.



Multiple transistors in a single package—physical location of the pins is shown in package outline on schematic.



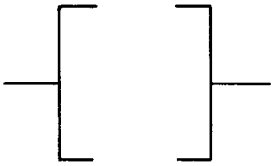
Identification of logic families as shown (in this case, ECL).

ManualsPlus.com

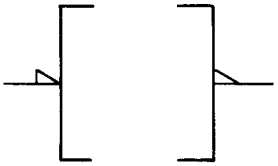
Table 8-3. Schematic Diagram Notes (4 of 8)

DIGITAL SYMBOLOGY REFERENCE INFORMATION

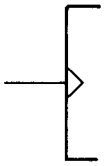
Input and Output Indicators



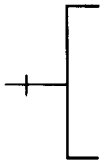
Implied Indicator—Absence of polarity indicator (see below) implies that the active state is a relative high voltage level. Absence of negation indicator (see below) implies that the active state is a relative high voltage level at the input or output.



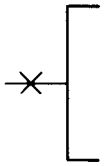
Polarity Indicator—The active state is a relatively low voltage level.



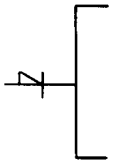
Dynamic Indicator—The active state is a transition from a relative low to a relative high voltage level.



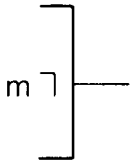
Inhibit Input—Input that, when active, inhibits (blocks) the active state outputs of a digital device.



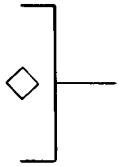
Analog Input—Input that is a continuous signal function (e.g., a sine wave).



Polarity Indicator used with Inhibit Indicator—Indicates that the relatively low level signal inhibits (blocks) the active state outputs of a digital device.



Output Delay—Binary output changes state only after the referenced input (m) returns to its inactive state (m should be replaced by appropriate dependency or function symbols).



Open Collector or Open Emitter Output.

ManualsPlus.com

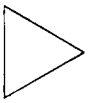
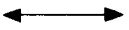
Table 8-3. Schematic Diagram Notes (5 of 8)

DIGITAL SYMBOLOGY REFERENCE INFORMATION

Input and Output Indicators (Cont'd)

3-STATE	Three-state Output—Indicates outputs that can have a high impedance (disconnect) state in addition to the normal binary logic states.

Combinational Logic Symbols and Functions

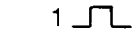
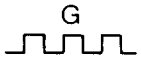
&	AND—All inputs must be active for the output to be active.
≥1	OR—One or more inputs being active will cause the output to be active.
≥m	Logic Threshold—m or more inputs being active will cause the output to be active (replace m with a number).
=1	EXCLUSIVE OR—Output will be active when one (and only one) input is active.
=m	m and only m—Output will be active when m (and only m) inputs are active (replace m with a number).
=	Logic Identity—Output will be active only when all or none of the inputs are active (i.e., when all inputs are identical, output will be active).
	Amplifier—The output will be active only when the input is active (can be used with polarity or logic indicator at input or output to signify inversion).
X/Y	Signal Level Converter—Input level(s) are different than output level(s).
	Bilateral Switch—Binary controlled switch which acts as an on/off switch to analog or binary signals flowing in both directions. Dependency notation should be used to indicate affecting/affected inputs and outputs. Note: amplifier symbol (with dependency notation) should be read to indicate unilateral switching.
X→Y	Coder—Input code (X) is converted to output code (Y) per weighted values or a table.
(Functional Labels)	The following labels are to be used as necessary to ensure rapid identification of device function.
MUX	Multiplexer—The output is dependent only on the selected input.
DEMUX	Demultiplexer—Only the selected output is a function of the input.
CPU	Central Processing Unit

ManualsPlus.com

Table 8-3. Schematic Diagram Notes (6 of 8)

DIGITAL SYMBOLOGY REFERENCE INFORMATION

Sequential Logic Functions

1 	Monostable—Single shot multivibrator. Output becomes active when the input becomes active. Output remains active (even if the input becomes inactive) for a period of time that is characteristic of the device and/or circuit.
G 	Oscillator—The output is a uniform repetitive signal which alternates between the high and low state values. If an input is shown, then the output will be active if and only if the input is in the active state.
FF	Flip-Flop—Binary element with two stable states, set and reset. When the flip-flop is set, its outputs will be in their active states. When the flip-flop is reset, its outputs will be in their inactive states.
T	Toggle Input—When active, causes the flip-flop to change states.
S	Set Input—When active, causes the flip-flop to set.
R	Reset Input—When active, causes the flip-flop to reset.
J	J Input—Analogous to set input.
K	K Input—Analogous to reset input.
D	Data Input—Always enabled by another input (generally a C input—see Dependency Notation). When the D input is dependency-enabled, a high level at D will set the flip-flop; a low level will reset the flip-flop. Note: strictly speaking, D inputs have no active or inactive states—they are just enabled or disabled.
+m	Count-Up Input—When active, increments the contents (count) of a counter by "m" counts (m is replaced with a number).
−m	Count-Down Input—When active, decrements the contents (count) of a counter by "m" counts (m is replaced with a number).
→m	Shift Right (Down) Input—When active, causes the contents of a shift register to shift to the right or down "m" places (m is replaced with a number).
←m	Shift Left (Up) Input—When active, causes the contents of a shift register to shift to the left or up "m" places (m is replaced with a number).

NOTE

For the four functions shown above, if m is one, it is omitted.

(Functional Labels)	The following functional labels are to be used as necessary in symbol build-ups to ensure rapid identification of device function.
mCNTR	Counter—Array of flip-flops connected to form a counter with modules m (m is replaced with a number that indicates the number of states: 5 CNTR, 10 CNTR, etc.).

ManualsPlus.com

Table 8-3. Schematic Diagram Notes (7 of 8)

DIGITAL SYMBOLOGY REFERENCE INFORMATION

Sequential Logic Functions (Cont'd)

REG	Register—Array of unconnected flip-flops that form a simple register or latch.
SREG	Shift Register—Array of flip-flops that form a register with internal connections that permit shifting the contents from flip-flop to flip-flop.
ROM	Read Only Memory—Addressable memory with read-out capability only.
RAM	Random Access Memory—Addressable memory with read-in and read-out capability.

Dependency Notation

mAm	Address Dependency—Binary affecting inputs of affected outputs. The m prefix is replaced with a number that differentiates between several address inputs, indicates dependency, or indicates demultiplexing and multiplexing of address inputs and outputs. The m suffix indicates the number of cells that can be addressed.
Gm	Gate (AND) Dependency—Binary affecting input with an AND relationship to those inputs or outputs labeled with the same identifier. The m is replaced with a number or letter (the identifier).
Cm	Control Dependency—Binary affecting input used where more than a simple AND relationship exists between the C input and the affected inputs and outputs (used only with D-type flip-flops).
Vm	OR Dependency—Binary affecting input with an OR relationship to those inputs or outputs labeled with the same identifier. The m is replaced with a number or the letter (the identifier).
Fm	Free Dependency—Binary affecting input acting as a connect switch when active and a disconnect when inactive. Used to control the 3-state behavior of a 3-state device.

NOTE

The identifier (m) is omitted if it is one—that is, when there is only one dependency relationship of that kind in a particular device. When this is done, the dependency indicator itself (G, C, F, or V) is used to prefix or suffix the affected (dependent) input or output.

Miscellaneous

	Schmitt Trigger—Input characterized by hysterisis; one threshold for positive going signals and a second threshold for negative going signals.

ManualsPlus.com

Table 8-3. Schematic Diagram Notes (8 of 8)

DIGITAL SYMBOLOGY REFERENCE INFORMATION

Miscellaneous (Cont'd)

Active	Active State—A binary physical or logical state that corresponds to the true state of an input, an output, or a function. The opposite of the inactive state.
Enable	Enabled Condition—A logical state that occurs when dependency conditions are satisfied. Although not explicitly stated in the definitions listed above, functions are assumed to be enabled when their behavior is described. A convenient way to think of it is as follows: A function becomes active when: • it is enabled (dependency conditions—if any—are satisfied) • and its external stimulus (e.g., voltage level) enters the active state.

ManualsPlus.com

SERVICE SHEET BD1 (Cont'd)

tuned by a voltage derived from the high frequency VCO's tune voltage. The filters therefore track the oscillator's frequency and are biased on only when that band is selected. This selection of filters provides better isolation and filtering of the out-of-band spurious and harmonic frequencies.

Output level is stepped in 10 dB steps by an electromechanical step attenuator. Output level changes less than 10 dB are controlled by the input to the Automatic Level Control (ALC) Amplifier from the Level Digital-to-Analog Converter (DAC). The ALC Amplifier has two inputs. One is the detected output voltage to level the output. The other is the sum of the amplitude modulation voltage and the level voltage (for level changes less than 10 dB and level correction for frequency response). The output of the ALC Amplifier controls the current through the PIN diode Modulator which controls the fine level attenuation and amplitude modulation of the output.

When triggered, the reverse power protection circuit opens a relay in series with the output. Limiting diodes sense reverse power and provide the voltage to open the relay and protect the output circuits during the time delay until the relay opens.

Internal modulation signals of 400 Hz or 1000 Hz for amplitude and frequency modulation from the Audio Oscillator can be used, or external amplitude and frequency modulation can be selected at the front panel. The internal and external modulation signals are converted to the proper drive levels by the AM% DAC and the FM Dev DAC. The Signal Generator's output can be simultaneously amplitude and frequency modulated by either the 400 Hz or 1000 Hz internal signals and an external signal or any combination thereof. However, only one amplitude modulation and one frequency modulation level can be used. The carrier frequency modulation is generated in the low frequency loop which allows for RF output FM deviation up to 99 kHz for output frequencies that are not divided. These frequencies are the heterodyne band (100 kHz to 123.5 MHz) and the basic band (494 to 990 MHz). The amplitude modulation signal is applied to the ALC Amplifier.

Low Frequency and FM Section. The 50 MHz Reference Oscillator is a crystal oscillator. Its output phase locks the VCOs and is also divided down to provide the 1 MHz time base. The rear panel TIME BASE OUTPUT is a jumper-selectable frequency of 1, 5, or 10 MHz that is divided from the 50 MHz Reference Oscillator and can be used as a stable reference for other instruments.

For Option 001, a 10 MHz temperature-stabilized crystal oscillator is used. The 50 MHz Reference Oscillator is phase locked to the crystal oscillator for greater accuracy and stability. An external reference of 1, 5, or 10 MHz may also be used to phase lock the 50 MHz Reference Oscillator. However, the jumper-selected frequency of 1, 5, or 10 MHz must be the same as the external frequency. With Option 001 instruments, the jumper selection must be 10 MHz. The 50 MHz reference signal is distributed and translated by frequency doublers and mixers to provide reference signals at other frequencies.

The 60 to 110 MHz low frequency VCO is tracked by the high frequency basic band oscillator's frequency. The low frequency VCO is tuned to the correct frequency by the Microprocessor and is locked to the 50 MHz Reference Oscillator. Depending upon the frequency, the Reference Oscillator and the low frequency VCO signals are both divided down to 100 or 250 Hz. This output is used to phase lock the VCO and for the output frequency resolution of 100 Hz or 250 Hz. Any phase difference between the two signals is converted to a voltage, sampled, and applied to the VCO to correct its frequency. The low frequency loop has a narrow bandwidth which enables the VCO to be frequency modulated outside the loop bandwidth. The VCO is tuned over its 50 MHz range in 100 Hz or 250 Hz steps. It therefore steps the 690 to 740 MHz signal, generated by mixing the 60 to 110 MHz with the 800 MHz in the Frequency Multiplier Mixer, in 100 Hz or 250 Hz steps.

Microprocessor, Keyboard, and Display Section. The Microprocessor controls the information on the address bus and data bus, thereby controlling all digital data throughout the instrument. The Microprocessor with its associated Read Only Memory (ROM), Random Access Memory (RAM), Input/Output (I/O), and decoder circuits processes the front panel keyboard inputs, the Hewlett-Packard Interface Bus (HP-IB) inputs, and all displayed information.

Digital data sent to the High Frequency and Output Section performs the following functions:

a. Controls the Voltage Controlled Oscillator (VCO) lock point.

ManualsPlus.com

SERVICE SHEET BD1 (Cont'd)

b. Turns off the correct IF notch filter to pass the specified IF frequency and lock the VCO at the correct frequency.

c. Corrects the output level for frequency response.

d. Changes attenuation in 0.1 dB increments.

e. Controls the amplitude modulation of the carrier.

f. Selects the heterodyne frequencies, and the divide by one, two, or four band as required.

g. Sets attenuation in 10 dB steps.

h. Resets the Reverse Power Relay.

Digital data sent to the Low Frequency and FM Section determines the frequency modulation of the carrier and the frequency resolution of the output (100 or 250 Hz).

Two high frequency data words and eight low frequency data words are serially sent to the High Frequency and Output Section and the Low Frequency and FM Section. The serial data is strobed into the correct registers by decoding the address bus bits. Parallel data is also sent to the High Frequency and Output Section to select AM, FM, and level control; to select the frequency bands; and to select the amount of attenuation in the step attenuator.

TROUBLESHOOTING

The troubleshooting checks on this service sheet are used to isolate a malfunction to one of the three major functional assemblies. The checks are easy to perform and provide much key information. In most instances the checks isolate a failure to either a hardware or a software (controller) problem. The comments associated with each procedure summarize the information known as a result of passing or failing the check. The checks should be done in order.

√1 Line Check

Procedure. Remove the Signal Generator's bottom cover. Refer to the Disassembly Procedures under Repair in Section VIII. After the bottom cover is removed, connect the line voltage.

Normal Indications.

1. The fan runs indicating line voltage or Mains (ac) power is present on the power transformer primary.

2. The three green Light Emitting Diodes (LEDs) on the A10 Audio Power Supply Assembly are lighted indicating that the regulated supplies are operating. This does not mean that the supply voltages are within the required tolerance.

3. Set the RESET/STBY/ON Switch to ON. The amplitude is −127 dBm and the increment is 10 dB. Press the amplitude increment key (up arrow). The clicks can be heard as the attenuator solenoid switches are opened and closed. The attenuator latches receive power from the +24 volt unregulated supply.

Abnormal Indications. If an abnormal indication occurs:

1. Check rear-panel line fuse and line voltage selector.

2. Measure individual regulated supplies and unregulated supply. If necessary, go to Service Sheet 22.

√2 Power-Up Check

Procedure. Switch RESET-STBY-ON switch to RESET and back to ON. Check the front panel annunciators (LEDs) and display segments.

Normal Indication. All front panel indicators are lighted for approximately 1.5 seconds to provide a visual inspection of each front panel annunciator and display segment.

1. All the display segments will display the number eight except the least significant FREQUENCY digit will be a five and the most significant AMPLITUDE digit will be a one.

2. When the power up subroutine is completed, the modulation display will be off, frequency set to 100 MHz and amplitude to −127 dBm.

Abnormal Indication. If an abnormal indication occurs, that is:

1. The LEDs stay lighted and display segments remain eights, five and one, go to Service Sheet BD4.

ManualsPlus.com

SERVICE SHEET BD1 (Cont'd)

2. The LEDs stay lighted and numerical displays are all zeros except the least significant FREQUENCY digit.

a) Check for a noisy +5 Vdc power supply. If necessary, go to Service Sheet 22.

b) Check the Microprocessor clock. Go to Service Sheet 14.

3. An LED or display segment does not show the correct output. Check the display's associated components and drive circuits. Go to Service Sheets 19 or 20 (FREQUENCY display problem) or Service Sheet 19 or 21 (MODULATION or AMPLITUDE display problem).

√3 Frequency and Amplitude

Procedure. Set the amplitude to 0.0 dBm and check the RF OUTPUT frequency and amplitude.

Normal Indication.

1. The RF output is phase locked at 100 MHz; the amplitude is 0.0 dBm ±1.0 dB.

2. The FREQUENCY display is 100 MHz; the AMPLITUDE display is 0.0 dBm.

Abnormal Indication. If an abnormal indication occurs, that is:

1. The AMPLITUDE or FREQUENCY display is not 0.0 dBm or 100 MHz respectively, go to Service Sheet BD4.

2. The output frequency is not phase locked, go to Service Sheets BD2 or BD3.

3. The output frequency is incorrect, go to Service Sheet BD2.

4. The output amplitude is incorrect, go to Service Sheet BD2.

√4 Modulation

Procedure. Set the modulation to INT 1 kHz, AM 50% and FM 50 kHz.

Normal Indications.

1. MODULATION display 1 kHz, INT AM, INT FM, and 50% or 50 kHz (depending on last input).

2. Modulated RF output of 50% AM and 50 kHz FM deviation at 1 kHz rate.

Abnormal Indication. If abnormal indication occurs, that is:

1. The MODULATION display is incorrect, go to Service Sheet BD4.

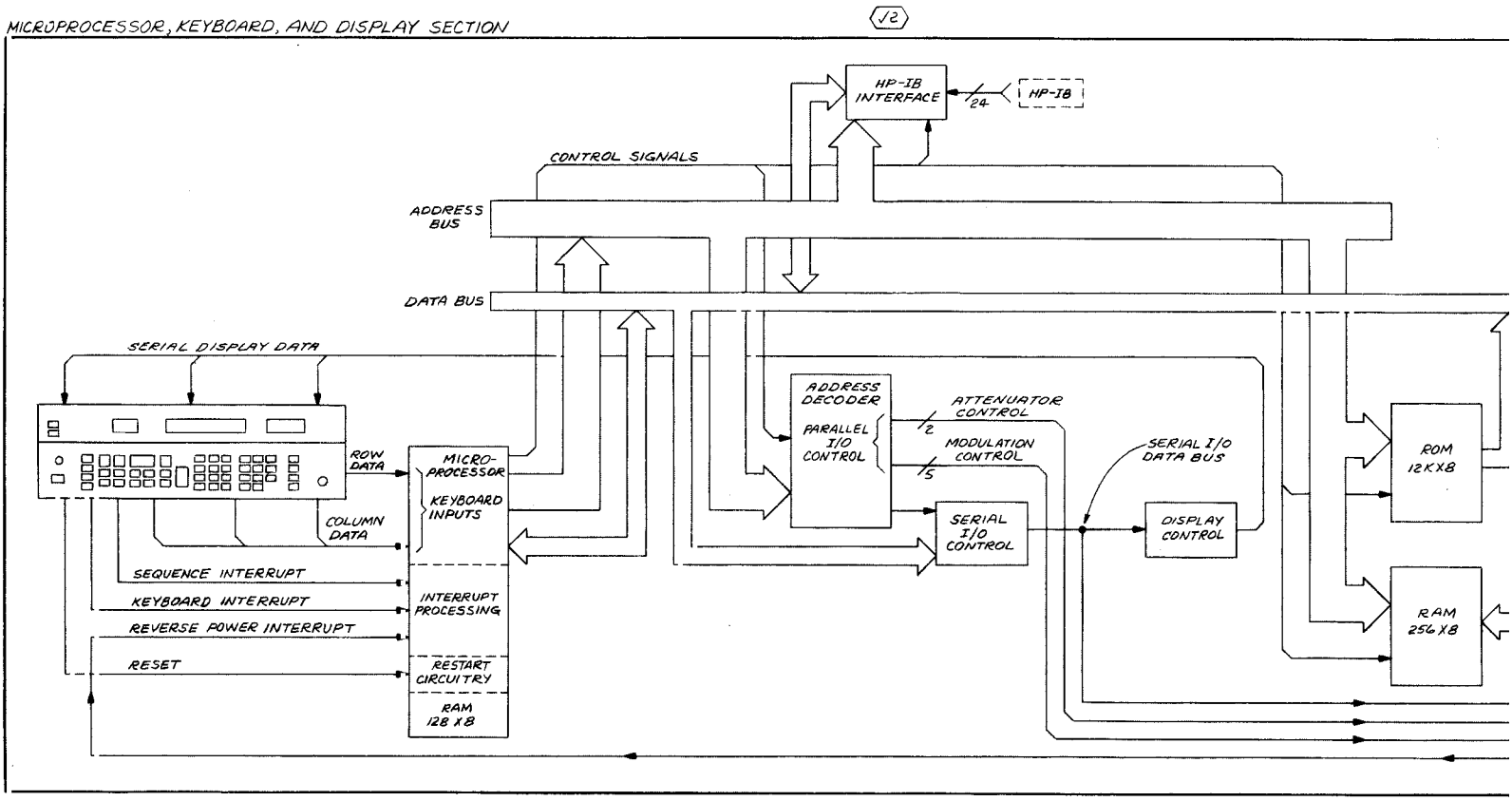
2. Amplitude modulation level is incorrect, go to Service Sheet BD2.

3. Frequency modulation level is incorrect, go to Service Sheet BD3.

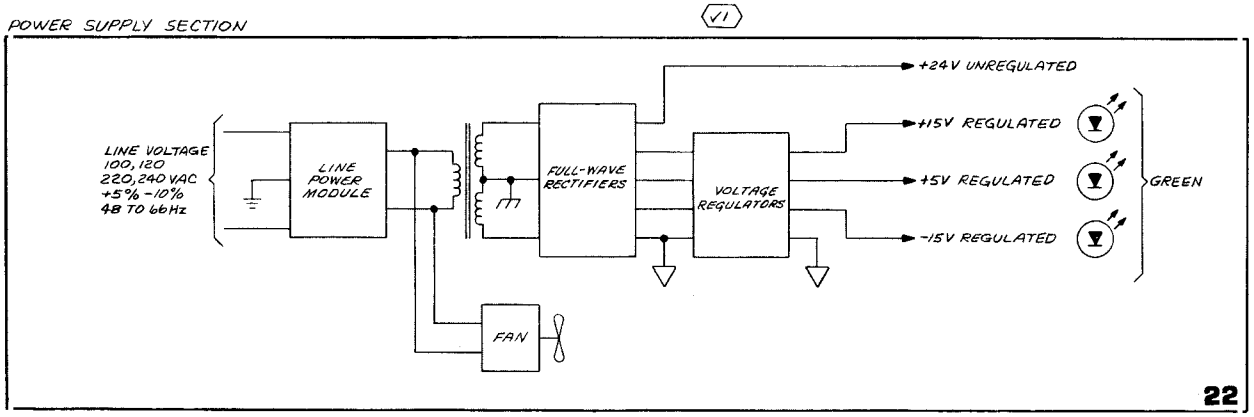
4. Modulation rate is incorrect, go to Service Sheet 6.

ManualsPlus.com

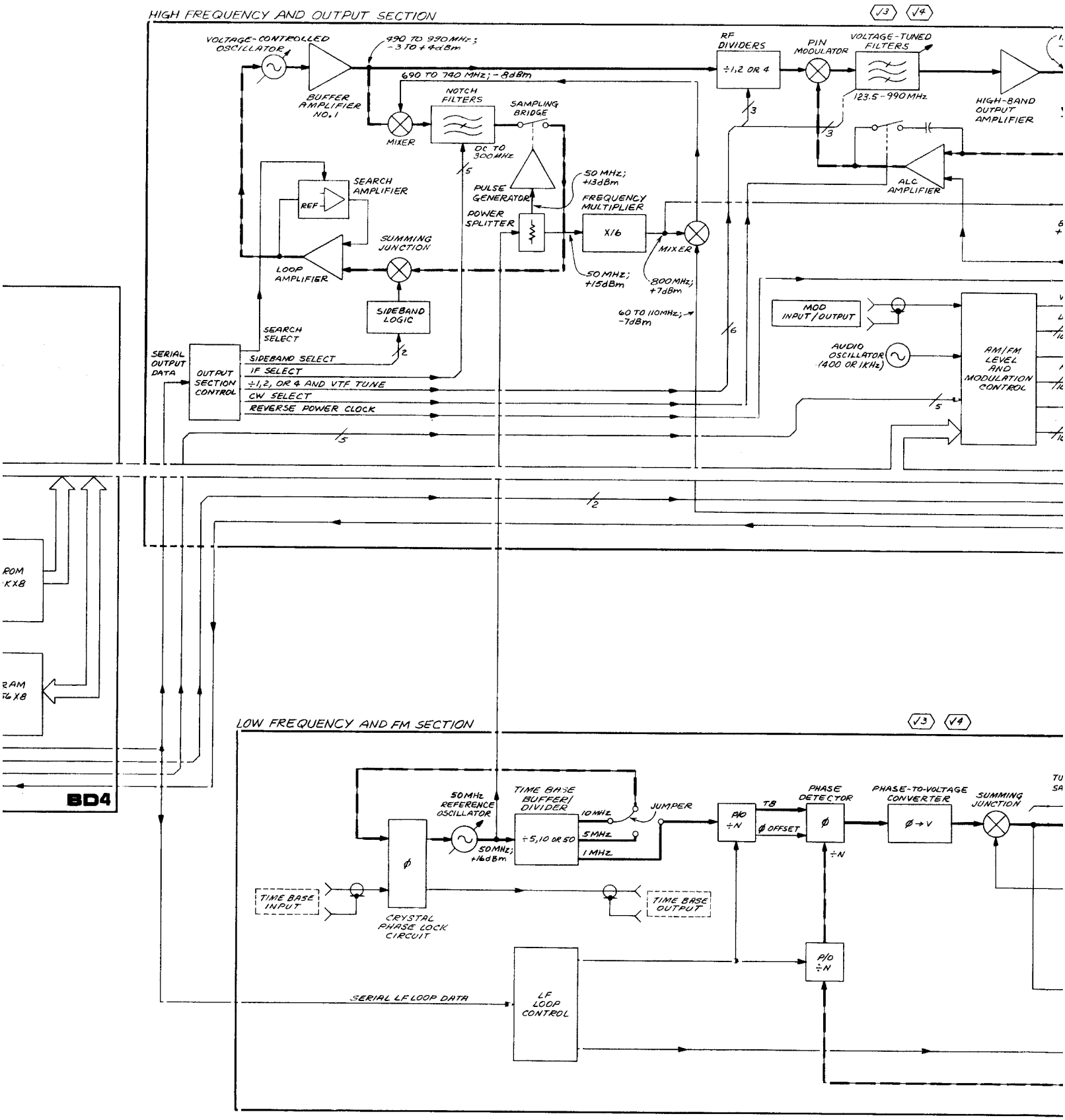
MICROPROCESSOR, KEYBOARD, AND DISPLAY SECTION



POWER SUPPLY SECTION



ManualsPlus.com



ManualsPlus.com

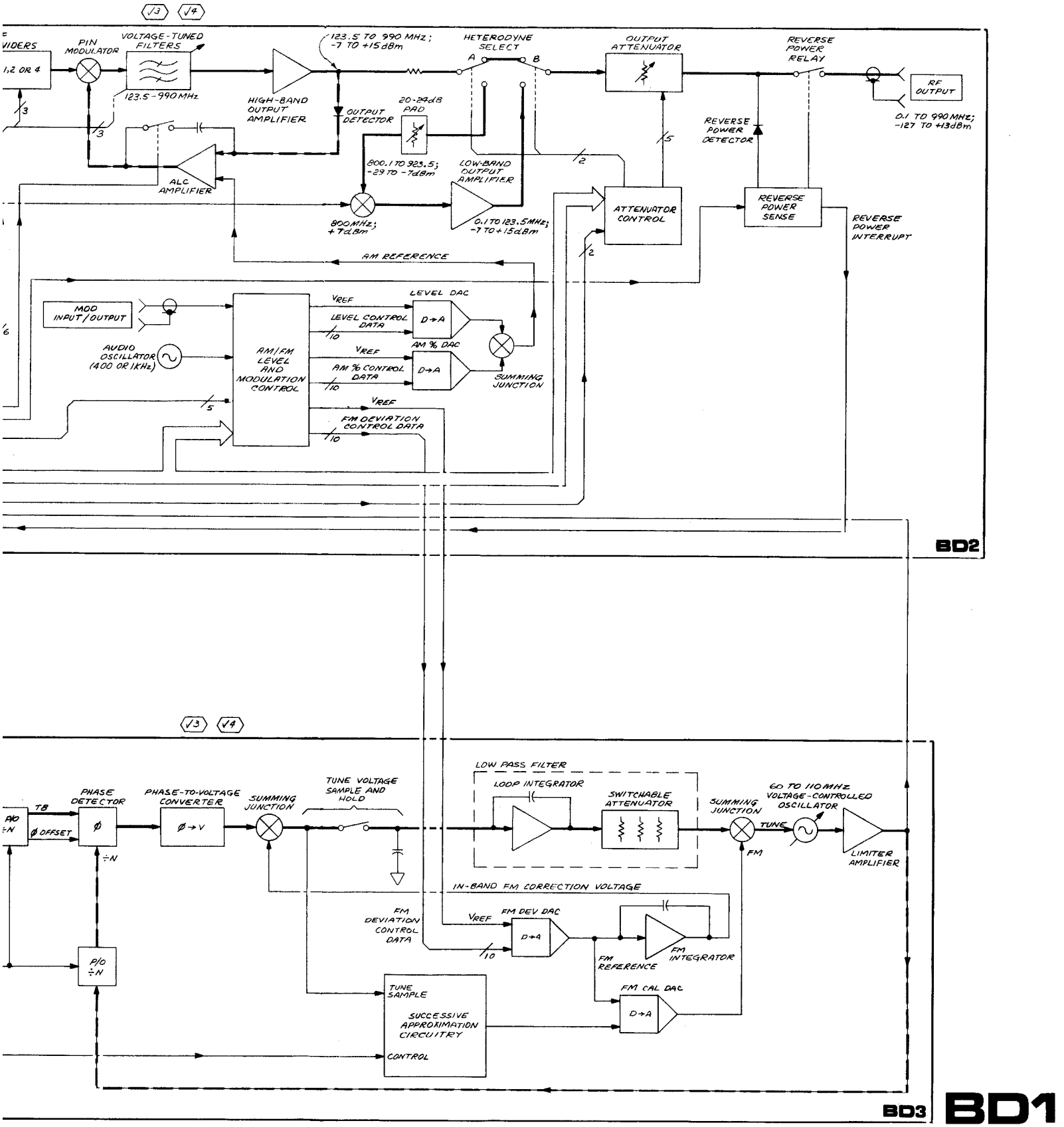


Figure 8-33. Overall Block Diagram

ManualsPlus.com

SERVICE SHEET BD2
HIGH FREQUENCY AND OUTPUT SECTION
TROUBLESHOOTING HELP

Service Sheet BD1
Table 4-1. Abbreviated Performance Tests
Table 5-2. Post-Repair Adjustments

PRINCIPLES OF OPERATION

A8 Frequency Multiplier Assembly. The Frequency Multiplier Assembly multiplies the 50 MHz reference signal by 16 to obtain an 800 MHz signal. The reference signal is doubled four times for frequencies of 100, 200, 400, and 800 MHz. The output of each multiplier is passed through a bandpass filter for the output frequency of that stage to filter out the harmonics and subharmonics generated by the multiplier.

The 800 MHz signal is applied to the A6 Output Assembly and mixed with specific basic band frequencies (800.1 to 923.5 MHz) when output frequencies in the heterodyne band (100 kHz to 123.5 MHz) are selected. It is also applied to the Frequency Multiplier Buffer Amplifier No.1. The signal is amplified and then mixed with the 60 to 110 MHz output from the A3 Low Frequency Loop Assembly (see BD3). The output from the Mixer is a frequency between 690 and 740 MHz that is used to phase lock the high frequency loop. Before a frequency between 690 and 740 MHz is sent to the A4 High Frequency Loop Assembly, it is amplified by two Buffer Amplifiers and filtered by the Bandpass Filter. The 690 to 740 MHz Bandpass Filter filters out the 800 MHz and the Mixer products of 860 to 910 MHz. The Compensation Network is adjusted for a flat frequency response of ±1.5 dB at the input of the A4 High Frequency Loop Assembly.

A4 High Frequency Loop Assembly. The High Frequency Loop Assembly phase locks the 494 to 990 MHz basic band Voltage Controlled Oscillator (VCO) on the A5 High Frequency Oscillator Assembly. The output from this oscillator passes through the 1100 MHz Low-Pass Filter, Buffer Amplifier No.2, and the 450 MHz High-Pass Filter before being mixed with a frequency between 690 and 740 MHz from the A8 Frequency Multiplier Assembly. Both the upper and lower sidebands from the Mixer are used to obtain IF phase lock signals in 50 MHz steps from 0 to 250 MHz. The IF phase lock signal passes throuh the 260 MHz IF Input Filter and is amplified by the IF Buffer Amplifier. The notch filter for the specific IF is not selected which allows that IF signal to pass through the Notch Filters. The IF signal is then sampled at a 50 MHz rate by a pulse from the Pulse Generator that is driven by the 50 MHz Reference Oscillator signal. The output of the Sampling Bridge is a correction voltage proportional to the phase difference of the IF and 50 MHz reference signals. The correction voltage is amplified by the Sampler Amplifier, filtered by the 13 MHz Low-Pass Filter and applied to the Loop Amplifier. It is then fed back to correct the frequency of the VCO on A5.

The dc notch is not selected when the high frequency VCO output is 690 to 740 MHz. The Mixer then functions as a phase detector with both inputs at the same frequency. The Mixer's output is now a

ManualsPlus.com

voltage proportional to the phase difference of the two inputs. All other circuits function as previously described in the high frequency loop.

The eight bit data word used to control the high frequency loop is clocked serially into the HF Loop Data Storage/Drivers circuit. Five bits control the dc, 50, 100, 150, 200 and 250 MHz notch filters. Of these, the 150 and 200 MHz bits also control the Gain Compensation to compensate for the nonlinearity of the VCO frequency change with voltage. Another bit selects the Search Amplifier reference so the Loop Amplifier ramp will be in the direction required to sweep the VCO and phase lock the loop without sweeping the VCO to one end and then back to the lock frequency. The last two bits are for the Sideband Logic that prevents the VCO from locking at the wrong frequency. This is necessary because both the upper and lower sidebands from the Mixer are used for the IF frequencies of 50, 100, 150, 200 and 250 MHz to phase lock the 494 to 990 MHz VCO frequencies.

A5 High Frequency Oscillator Assembly. The High Frequency Oscillator generates the instrument's 494 to 990 MHz basic band frequencies. The VCO is tuned and locked by the A4 High Frequency Loop Assembly. The output of the VCO is amplified by Buffer Amplifier No. 1 and then applied through a 6 dB Pad to the High Frequency Loop Assembly to phase lock the VCO. It is also applied directly to the A6 Output Assembly.

A6 Output Assembly. The Output Assembly translates the 494 to 990 MHz basic band frequencies by dividing (123.5 to 990 MHz) or heterodyning (100 kHz to 123.5 MHz) the basic band frequencies. Each of the divide by 1, 2, and 4 bands is one octave. The output of the dividers passes through the PIN diode Modulator to the Voltage-Tuned Filters. Each filter's bandwidth is also one octave and tuned by the VCO tune voltage. The filters therefore track the VCO frequency and are biased on only when that band is selected. This selection of filters provides better isolation and filtering of the out-of-band spurious and harmonic frequencies.

The eight-bit data word is clocked serially into the Output Section Data Storage/Drivers circuit. Three bits control the dividers and three bits control the Voltage-Tuned Filters. The other two bits are used to select the CW mode and to clock the Reverse Power Sense circuit.

The output from the Voltage-Tuned Filters is amplified by the High-Band Output Amplifier and applied to the Output Detector and the A9 Attenuator Assembly. Output amplitude changes within the 10 dB range set by the step attenuator are controlled by the input to the Automatic Level Control (ALC) Amplifier from the Digital-to-Analog Converter (DAC) on the A10 Audio/Power Supply Assembly. The ALC amplifier has two inputs. One is the detected output voltage used to level the output. The other is the sum of the amplitude modulation voltage (ac) and the leveling voltage (dc) for amplitude changes within the 10 dB range set by the step attenuator and level

ManualsPlus.com

correction for frequency response. The output of the ALC amplifier controls the current through the PIN diodes of the PIN Modulator which controls amplitude modulation and RF level into the output attenuator (−4 to +13 dBm).

When output frequencies from 100 kHz to 123.5 MHz are selected, the first switch (A) of the A9 Attenuator Assembly switches the output back to the A6 Output Assembly where the output frequencies of 800.1 to 923.5 MHz are mixed (heterodyned) with the 800 MHz from the A8 Frequency Multiplier Assembly. The difference frequency of 100 kHz to 123.5 MHz is filtered by a low-pass Diplex Filter, amplified by the Low-Band Output Amplifier, and returned to the A9 Attenuator Assembly through the second switch (B).

A9 Attenuator Assembly. The Attenuator Assembly is an electromechanical step attenuator that steps the output 120 dB in 10 dB steps. The output circuits are reverse power protected for inputs up to 50 watts. A voltage level of 3 volts will trigger the circuit and open the Reverse Power Relay. When a reverse power condition is detected by the Reverse Power Sense circuit, the RPI bit is generated to interrupt the Microprocessor. The AMPLITUDE Display will flash to indicate that a reverse power condition has been detected. The Reverse Power Relay will remain open until the source of reverse power is removed and the AMPTD key is pressed. At that time, the RCL bit, from the Output Data Storage/Drivers circuit on A6, resets the relay.

Ten of the fourteen data bits from the Attenuator Control circuits on the A10 Audio/Power Supply Assembly control the attenuator pads to attenuate the output signal by the amount selected. The remaining four bits control the heterodyne select sections of the Attenuator Assembly.

A10 Audio/Power Supply Assembly. The amplitude modulation and level circuits portion of the Audio/Power Supply Assembly are shown on BD2. The external modulation signal level must be set at the source and the output of the External Modulation Buffer is monitored by the Over and Under Modulation Comparators which control the HI EXT and LOW EXT LEDs (not shown) on the front panel to indicate when the input is too high or low.

The modulation signals are applied to the FM Deviation Summing Amplifier (shown on BD3) and to the AM% Summing Amplifier. The output of the AM% Summing Amplifier is used as a reference voltage by the AM% DAC. The digitally controlled output of the AM% DAC is summed with the dc level voltage from the Level DAC and applied to the input of the AM Reference Summing Amplifier. The AM reference is applied to the ALC Amplifier on A6. The +2 Vdc level is applied to the Level Buffer to produce a reference voltage which is used by the Level DAC before it is summed with the amplitude modulation signal.

Five 8-bit data words are strobed into the Modulation Control Latches each time a front panel or HP-IB modulation entry is made. These data words are used to control all modulation functions, the level of

ManualsPlus.com

the modulation signals, and the reference level voltage applied to the ALC loop.

TROUBLESHOOTING

General

Procedures for checking the High Frequency and Output Sections of the instrument are given below. The blocks or points to check are marked on the block diagram by a hexagon with a check mark and a number inside, e.g., ⟨√2⟩.

Test Equipment

Spectrum Analyzer .....HP 8558B/181T
Modulation Analyzer .....HP 8901A
Oscilloscope .....HP 1222A

⟨√1⟩ RF Output and Attenuator Check

1. Set the Signal Generator's frequency to 500 MHz and amplitude to 0.0 dBm. Connect the RF OUTPUT to the spectrum analyzer's input.

2. Center the signal on the spectrum analyzer's display. Verify that the signal is locked at 500 MHz with an amplitude of 0.0 dBm.

   a) If signal is unlocked perform ⟨√3⟩.

   b) If no output, perform ⟨√2⟩.

   c) If amplitude is not 0.0 dBm ±3.0 dB, continue with ⟨√1⟩ step 3.

3. Reduce the Signal Generator's amplitude in 10 dB steps to –50 dBm. The amplitude should change 10 dB for each step.

   a) If the amplitude does not change in 10 dB steps, go to Service Sheet 7.

   b) If the amplitude changes in 10 dB steps perform ⟨√2⟩.

4. Set the Signal Generator's frequency to 100 MHz. If there is no output or the output is low, go to Service Sheet 5.

⟨√2⟩ Output Assembly Check

1. Set the Signal Generator's frequency to 50 MHz.

2. Measure the amplitude and frequency at the assembly input A6TP1 and output A6W14 with the spectrum analyzer.

   a) If the input is correct (500 MHz and –3 to +4 dBm), if the output level is low (less than –7 dBm) or if the frequency is incorrect, go to Service Sheet 4.

   b) If the input is low, go to Service Sheet 1.

ManualsPlus.com

SERVICE SHEET BD2 (Cont'd)

3. Set the Signal Generator's frequency to 300 MHz and then 150 MHz. Measure the output of the assembly with the spectrum analyzer. If the output level is low or the frequency is not 300 or 150 MHz, go to Service Sheet 5.

√3 Frequency Multiplier

1. Set the Signal Generator's frequency to 500 MHz.

2. Measure the 50 MHz input directly from W5 with the spectrum analyzer. If either level (+15 to +13 dBm) or frequency (50 MHz) is incorrect, go to Service Sheet 13.

3. Measure the 60—110 MHz input (100 MHz) directly from W3 with the spectrum analyzer. If the level (−7 to −9 dBm) is incorrect or frequency (100 MHz) is incorrect or unlocked, go to Service Sheet BD3.

4. Measure the output (690 to 740 MHz) of the FL1 Bandpass Filter. If either level (−1.5 to −9.5 dBm) or frequency (700 MHz) is incorrect, go to Service Sheet 3. If level and frequency are correct, go to Service Sheet 1 or Service Sheet 2.

√4 Audio/Power Supply

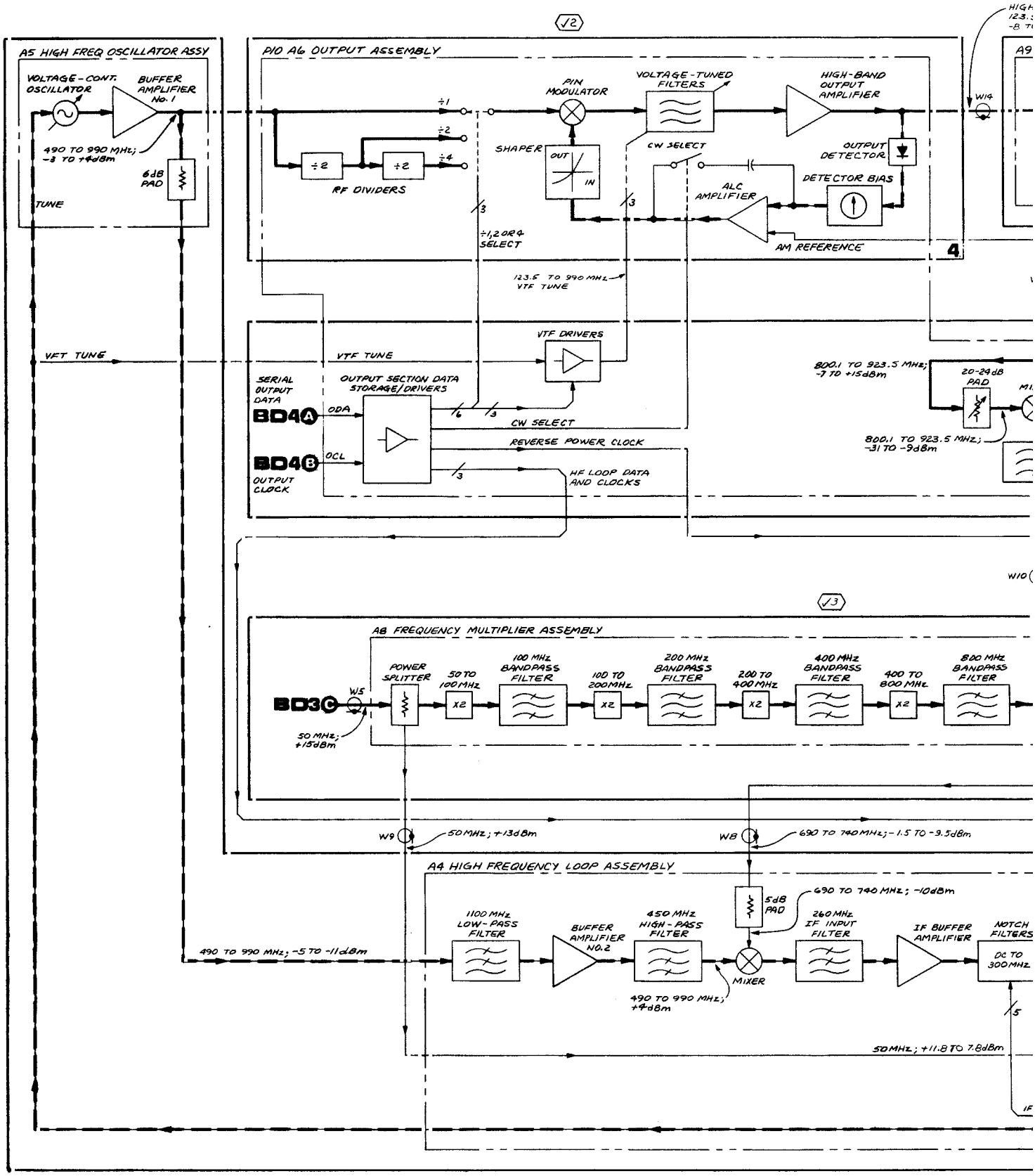
1. Set the Signal Generator's frequency to 500 MHz, amplitude 0.0 dBm, modulation INT 1 kHz, and AM 50%. Connect the RF OUTPUT to the modulation analyzer's input. Connect the modulation analyzer's modulation output to the oscilloscope's input.

2. Measure the amplitude modulation. It should be 50 ±5%. If the modulation level is incorrect, go to Service Sheet 6 (logic control circuits) or Service Sheet 4 (ALC PIN modulator).

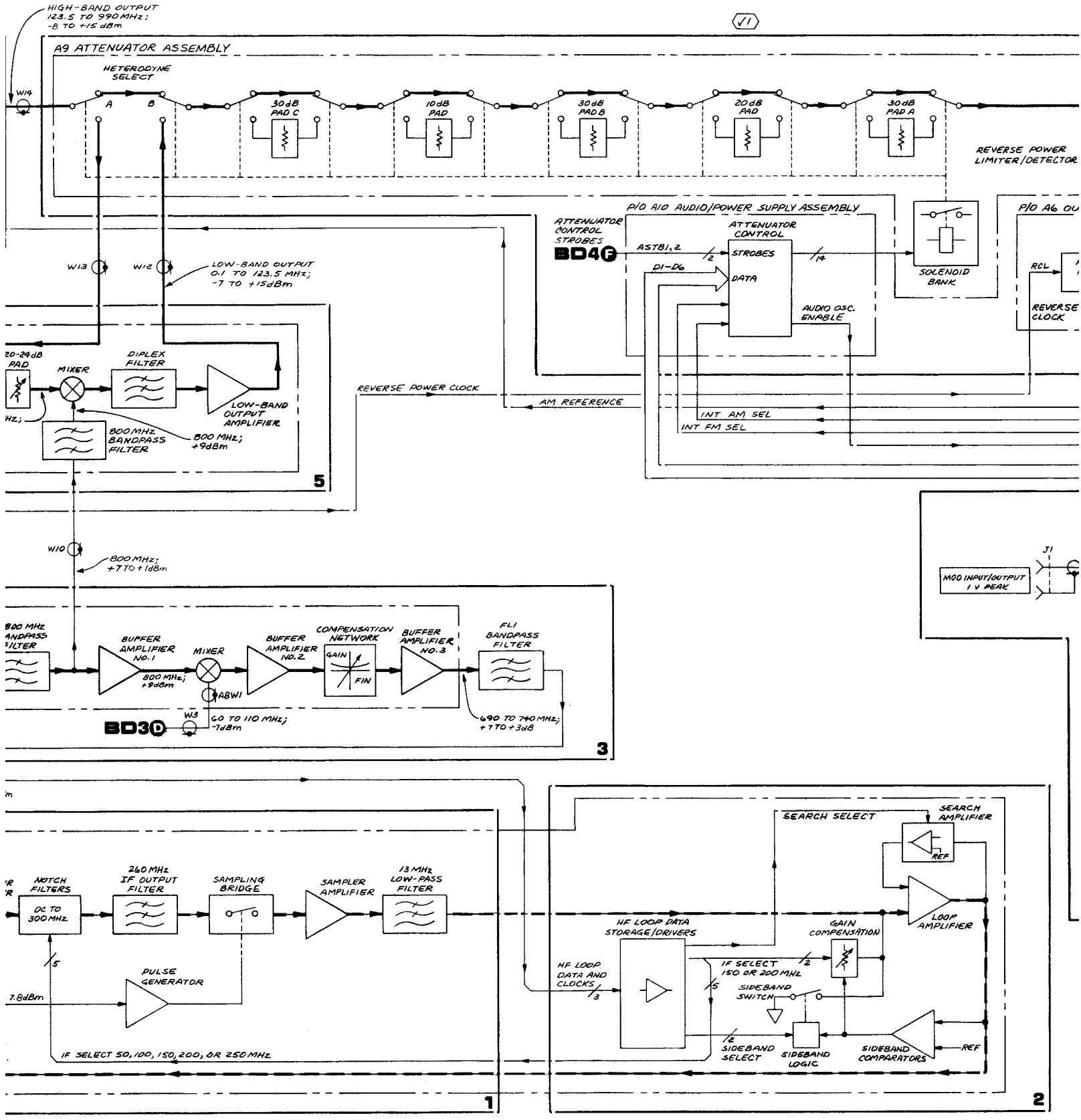
3. Set the AM to off and select INT 1 kHz, FM 50 kHz.

4. Measure the frequency modulation. It should be 50 ±2.5 kHz. If the modulation level is incorrect, go to Service Sheet 6 (logic control circuits) or Service Sheet BD3.

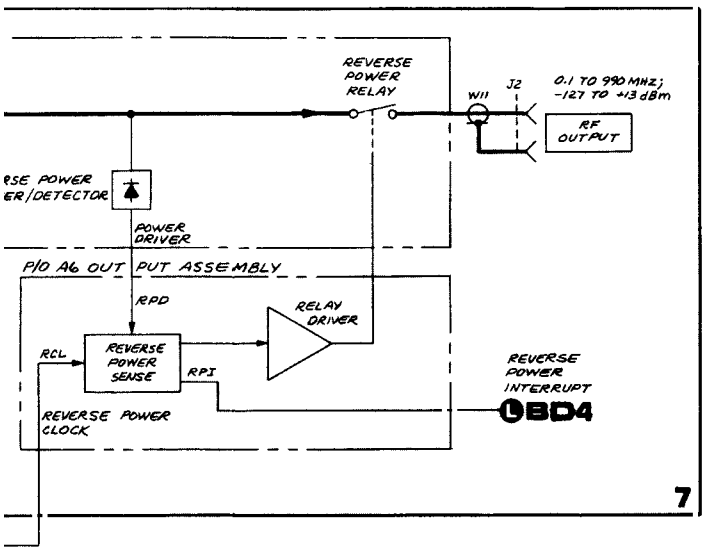
ManualsPlus.com



ManualsPlus.com



ManualsPlus.com



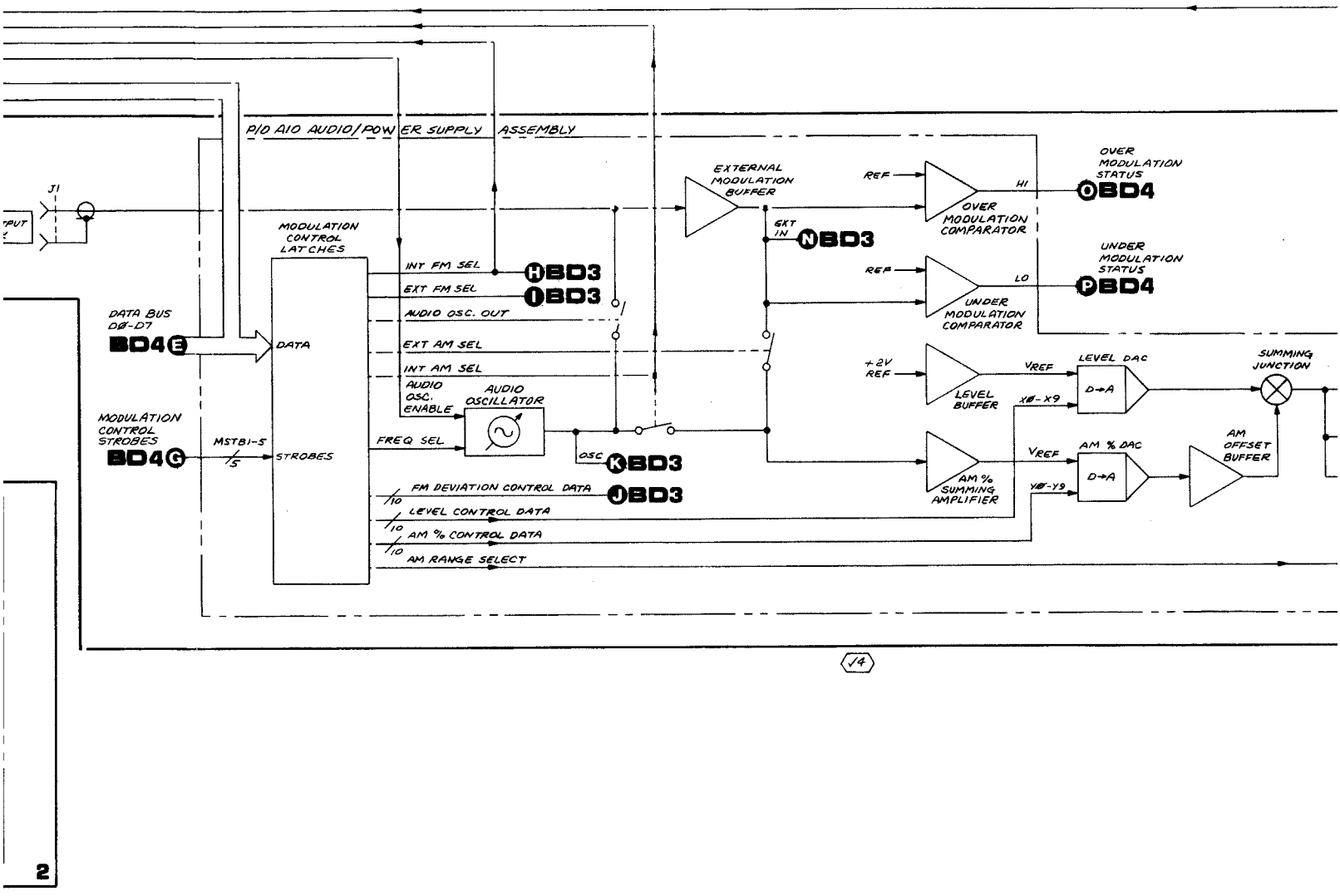
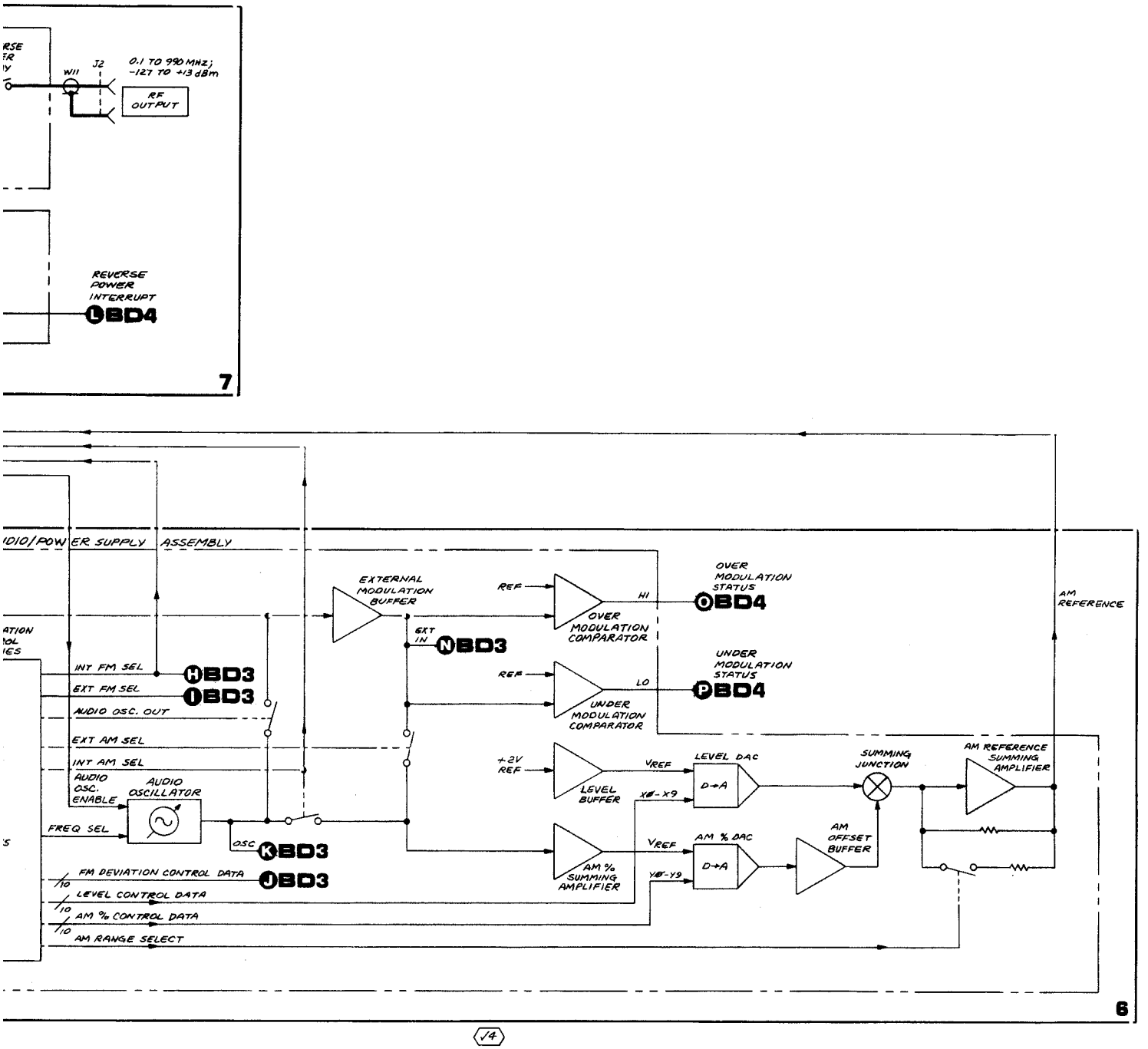


Figure 8-34. High Fr

ManualsPlus.com



BD2

Figure 8-34. High Frequency and Output Section Block Diagram

ManualsPlus.com

SERVICE SHEET BD3
LOW FREQUENCY AND FM SECTION
TROUBLESHOOTING HELP

Service Sheet BD1
Table 4-1. Abbreviated Performance Tests
Table 5-2. Post-Repair Adjustments

PRINCIPLES OF OPERATION

A3 Low Frequency Loop Assembly. The 50 MHz Reference Oscillator is a crystal oscillator that is used to phase lock the Voltage Controlled Oscillators (VCOs). Its output is also divided down to provide the 1 MHz time base. The rear panel TIME BASE OUTPUT signal is a jumper selectable frequency of 1, 5, or 10 MHz divided from the 50 MHz Reference Oscillator and coupled through the Crystal Phase Lock Circuit. For Option 001, a 10 MHz temperature-stabilized crystal oscillator is installed in the Signal Generator. The Option 001 oscillator output is available at the rear panel TIME BASE HIGH STABILITY OPTION connector (not shown). When connected to the TIME BASE INPUT connector, a phase lock is established between the high stability oscillator and the 50 MHz Reference Oscillator. The 1 MHz (divided from the 50 MHz Reference) is the clock 1 and 2 signal for counter 1 and 2 of the Triple Programmable Counter. These two counters supply the Time Base (TB) and ϕ Offset signals to phase lock the low frequency (60 to 110 MHz) VCO to the reference.

Digital data is written to the LF Loop Shift Registers almost every time the frequency is changed. The data sets the frequency of the 60 to 110 MHz low frequency VCO. Data is written into Counter No. 1 (100 Hz resolution; divide-by-1 mode) and Counter No. 2 (1600 Hz resolution; divide-by-1 mode). Data is written into the Triple Programmable Counter when the VCO frequency crosses a 25.6 kHz band edge (Counter 0) or when the frequency resolution changes (Counters 1 and 2). Data is written to all counters when the instrument goes through the power-up routine. This occurs when the Signal Generator is connected to line voltage or reset with the front panel switch.

The Tune Sample Monostable circuit in the low frequency loop sets the LF Loop Ready line low. This line is connected to the Serial LF Loop Data input from the Microprocessor and signals the Microprocessor that the low frequency loop is ready to receive data. The Microprocessor will write the data words serially into the LF Loop Shift Registers and then parallel load the data into the applicable counters to correctly configure the instrument.

Counters No. 1 and No. 2 are up counters and the Triple Programmable Counter's counter 0 is a down counter. Counter No.1 is clocked by the signal from the low frequency VCO. The output of each counter then clocks the next counter dividing the low frequency VCO frequency down to 100 or 250 Hz at the Triple Programmable Counter's counter 0 (Out 0). The Out 0 signal is applied to the Terminal Count Flip-Flop to set a 100 Hz or 250 Hz window on the AND gate. One pulse from Counter No. 2 is gated to the terminal count ÷N output during the window duration. The divide-by-

ManualsPlus.com

N signal is applied to the Phase-to-Voltage Converter to phase lock the low frequency loop.

The other clock to the Triple Programmable Counter (Clocks 1 and 2) is the 1 MHz derived from the 50 MHz Reference Oscillator. The output of counter 1 (Out 1) is 100 or 250 Hz, depending upon the Signal Generator frequency selected. This is the time base reference (TB) input to the Phase-to-Voltage Converter. The phase of the divide-by-N input is compared to the TB input to lock the low frequency VCO to the 50 MHz Reference Oscillator. The other input to the Phase-to-Voltage Converter is the 20 μs ϕ Offset pulse from the Triple Programmable Counter.

If a phase or frequency difference exists between the TB and divide-by-N inputs, the Phase-to-Voltage Converter generates a voltage that is proportional to the difference. This voltage is the correction voltage to the low frequency VCO and is applied to the Summing Junction. The Summing Junction output is applied to the Loop Summing Amplifier and then stored on the Tune Voltage Sample and Hold capacitor. The stored voltage is applied to the Loop Integrator. The Loop Integrator output is attenuated, buffered, and summed with the FM signal to tune and frequency modulate the VCO. The VCO's 60 to 110 MHz output is amplified by the Limiter Amplifier before being applied through the VCO Buffer to Counter No.1 and to the 110 MHz Low Pass Filter. The output of the filter is mixed with the 800 MHz on the A6 Frequency Multiplier Assembly (see BD2) to generate the 690 to 740 MHz signal that phase locks the high frequency loop.

On the A10 Audio/Power Supply Assembly, the internal and external frequency modulation signals from BD2 are applied to the FM Deviation Summing Amplifier, converted by the FM Deviation Digital-to-Analog Converter (DAC) programmed by the FM Deviation Control Data from the Microprocessor and amplified by the FM Deviation Amplifier. The FM Deviation Amplifier output is applied to the A3 Low Frequency Loop Assembly Summing Junction and then to the FM Reference Summing Amplifier whose output is the FM Reference input to the FM Cal DAC. The FM Cal DAC output is determined by the data inputs from the Successive Approximation Register (SAR). The output of the SAR is changed when FM Calibration takes place following each frequency change that causes data to be written to Counters 0, 1 or 2 of the Triple Programmable Counter. The calibrated output of the FM Cal DAC is applied to the Current-to-Voltage Converter and then to the DAC Offset Sample and Hold Buffer. This output is then summed with the Tune Voltage in the Summing Junction. The output from the Summing Junction is used to tune and frequency modulate the VCO.

Also included in the low frequency loop is the FM deviation calibration circuitry consisting of the FM Calibration Signal Generator and the Successive Approximation Register and Control Circuitry. Calibration is necessary to ensure that the FM deviation does not vary with oscillator frequency. Calibration is performed by setting

ManualsPlus.com

the Successive Approximation Register using the Tune Voltage Sample output from the Loop Summing Amplifier as an input to the Successive Approximation Control Circuitry. A binary search sequence varies the frequency modulation drive signal level until the phase detected deviation of the FM loop signal is nulled by the signal from the FM Integrator.

During calibration the phase lock loop is opened. The frequency of the Voltage Controlled Oscillator (VCO) is fixed by the Tune Voltage Sample and Hold and the VCO is frequency modulated by the FM Calibration Signal Generator signal. The voltage from the phase-to-voltage converter is the detected frequency modulation from the VCO. This voltage is summed with (subtracted from) the In-Band FM Correction Voltage (the FM calibration reference signal) at the first Summing Junction. The resultant voltage is applied to the Loop Summing Amplifier whose output sets the SAR. The Tune Voltage Sample output from the Loop Summing Amplifier is equivalent to phase error. Calibration is complete when this voltage to the SAR is reduced to zero.

TROUBLESHOOTING

General

Procedures for checking the Low Frequency and FM Sections of the instrument are given below. The blocks or points to check are marked on the block diagram by a hexagon with a check mark and a number inside, e.g.,  .

Test Equipment

Digital Multimeter .....HP 3465A
Frequency Counter .....HP 5328A
Power Meter and Sensor .....HP 436A/8482A
Oscilloscope .....HP 1222A

 50 MHz Reference Oscillator Checks

1. Set the Signal Generator's frequency to 500 MHz, amplitude to 0.0 dBm and modulation off.

2. Connect the TIME BASE INPUT on the rear panel to the frequency counter's OUTPUT. With the jumper in the 10 MHz position check that the frequency is 10 MHz. If frequency is not correct, go to Service Sheet 13.

3. Connect the power meter to the 50 MHz reference output by removing W5. The power level should be +16 to +14 dBm. If the level is not correct, go to Service Sheet 13.

 Divider Circuit (Counter) Checks

1. Connect the frequency counter to test point A3J3 pin 5. The frequency should be 1 MHz divided from the 50 MHz reference. If the frequency is not correct, go to Service Sheet 13.

ManualsPlus.com

SERVICE SHEET BD3 (Cont'd)

2. Connect the frequency counter to A3TP4, the buffered output of the LF Loop VCO. With the frequency set to 500 MHz, the VCO frequency should be 100 MHz. If the frequency is incorrect, go to Service Sheet 8.

3. Connect the oscilloscope to test points A3J3 pins 4, 6 and 7. The waveforms at pins 4 and 7 should be a 100 Hz squarewave; at pin 6 a 20 μs pulse at a 100 Hz rate. If any or all of the waveforms are not correct, go to Service Sheet 9.

√3 VCO Tune Voltage and FM Checks

1. Connect the multimeter to A3TP2 and measure the dc voltage. It should be 0.6 ±0.3 Vdc with the frequency set to 500 MHz (LF VCO frequency should be 100 MHz). If voltage is not correct, go to Service Sheet 10.

2. Increment the frequency up and down 5 MHz from 500 MHz. Voltage should change approximately 1.2 volts for each step. Return to 500 MHz. If the voltage change is incorrect, go to Service Sheet 10.

3. Connect the multimeter to feedthrough capacitor C15 (the +13 Vdc power supply for the LF Loop VCO). The voltage should be +13 ±2 Vdc with the noise less than 0.03 Vp-p. If the voltage or noise is incorrect, go to Service Sheet 10 or Service Sheet 22 (+15V power supply).

4. Connect the oscilloscope to A3TP2 and set the Signal Generator's modulation to 1 kHz INT, FM, 99 kHz deviation. The waveform should be a 1 kHz modulation signal at approximately 0.05 Vp-p. If incorrect, go to Service Sheet 11.

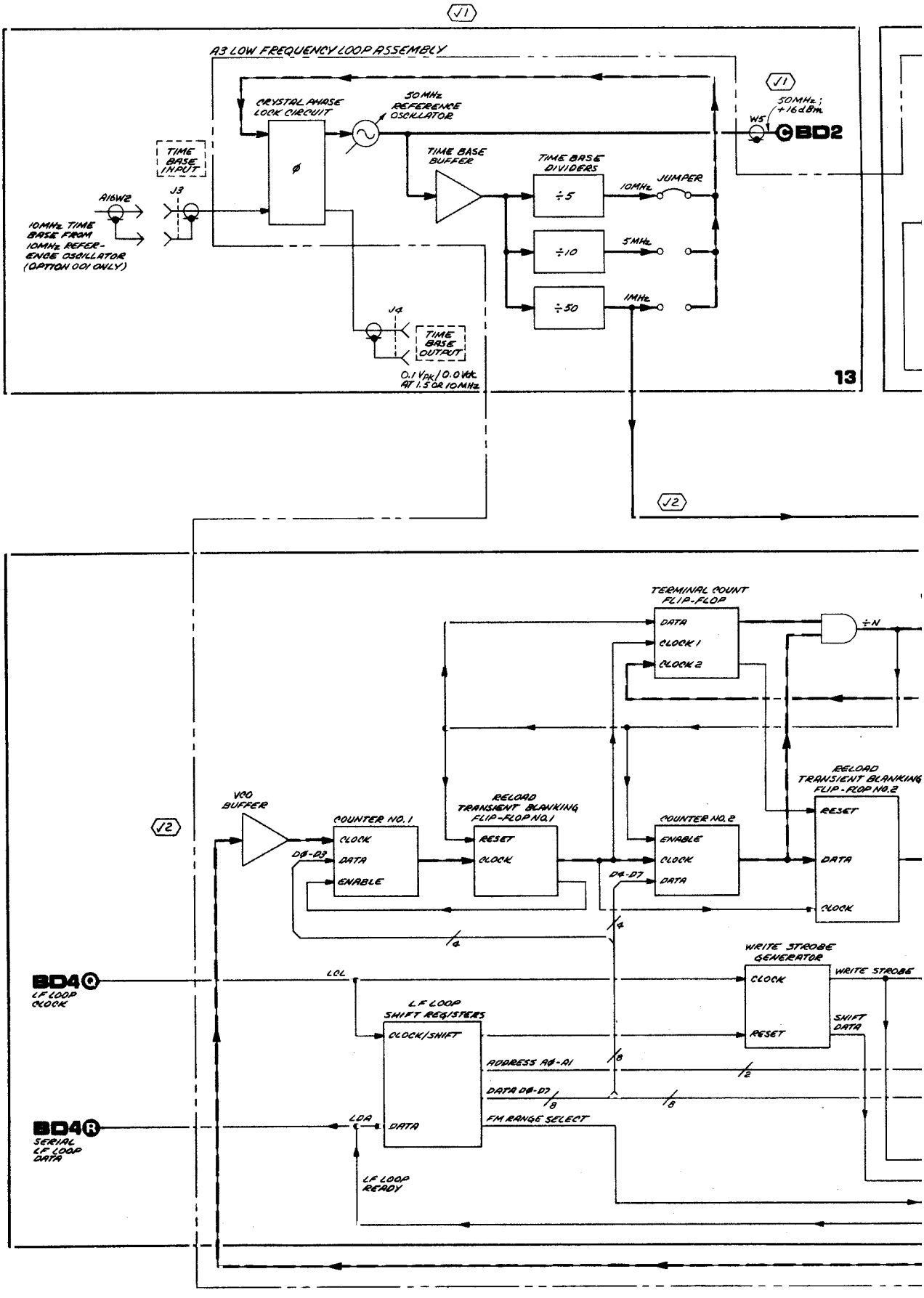
√4 Frequency Modulation Checks

1. Set the Signal Generator's frequency to 500 MHz, modulation to 1 kHz INT FM at 99 kHz deviation.

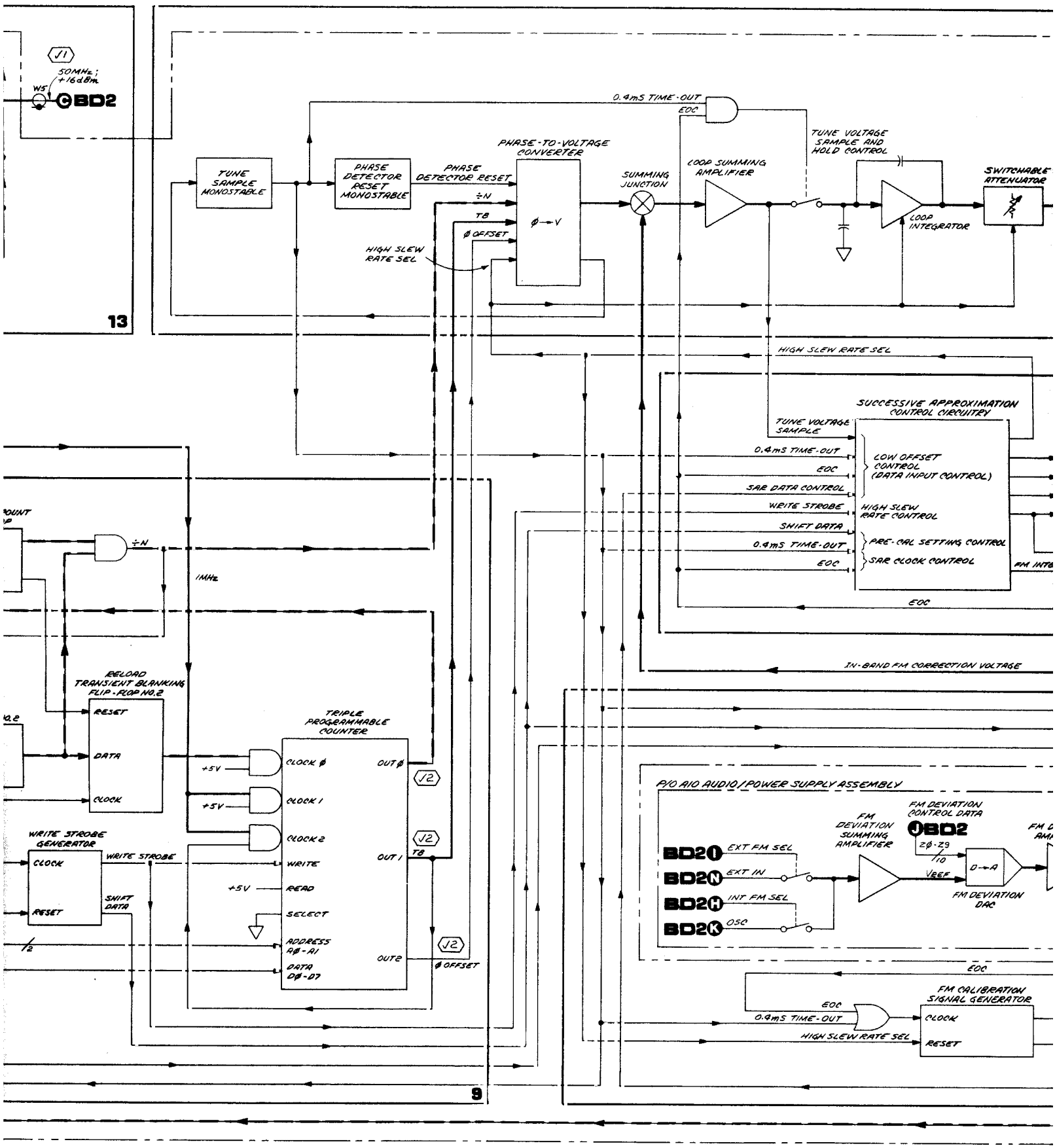
2. Connect the oscilloscope to A3J1 pin 7. The waveform should be 1 kHz at approximately 6.5 Vp-p. If incorrect, go to Service Sheet 6.

3. Connect the oscilloscope to test point A3J2 pin 13. The waveform should be a 1 kHz modulation signal of about 7.5 Vp-p. If incorrect, go to Service Sheet 12.

ManualsPlus.com



ManualsPlus.com



ManualsPlus.com

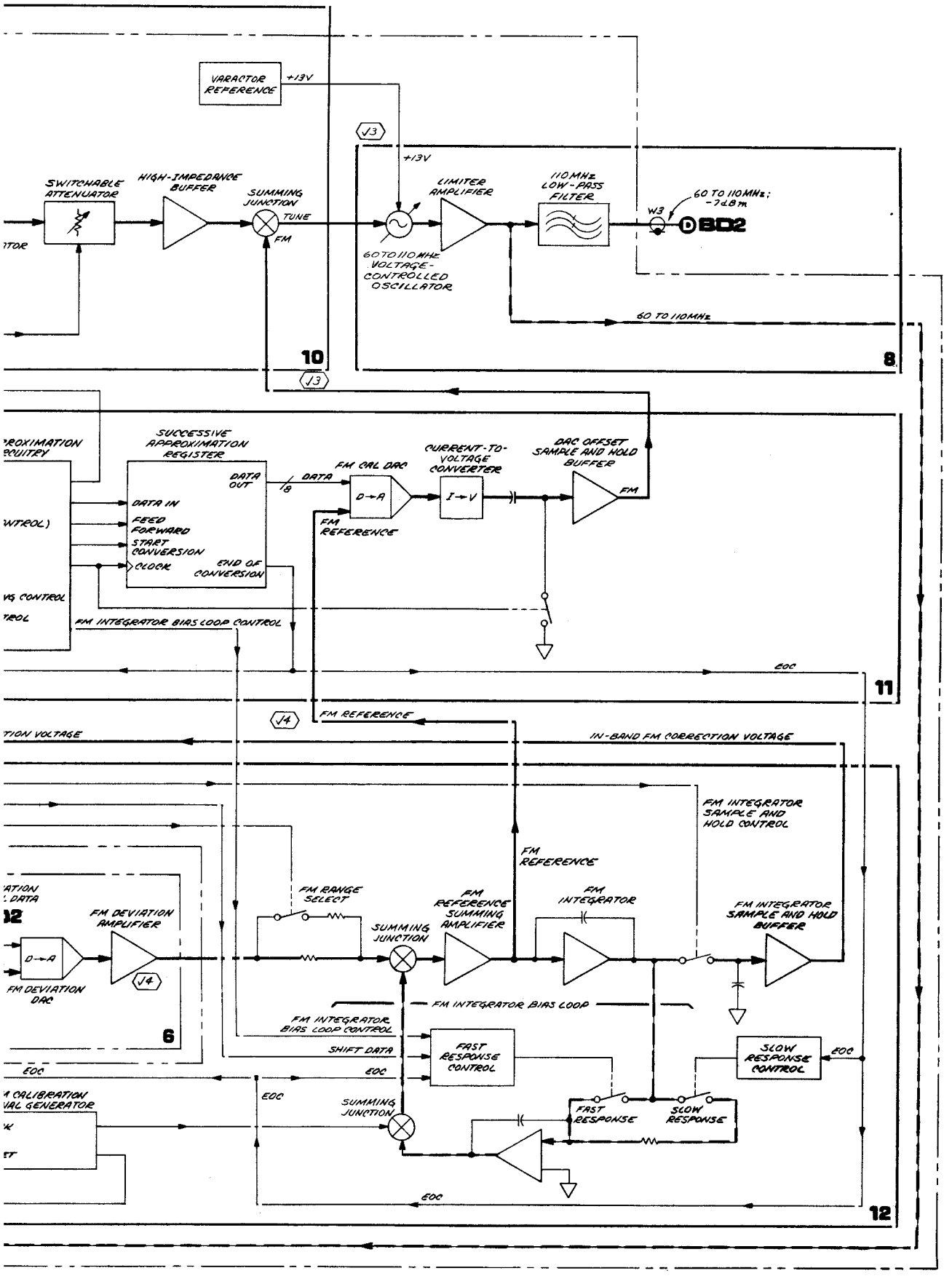


Figure 8-35. Low Frequency and FM Section Block Diagram

ManualsPlus.com

SERVICE SHEET BD4

KEYBOARD, DISPLAY AND MICROPROCESSOR SECTIONS

TROUBLESHOOTING HELP

Service Sheet BD1
Table 4-1. Abbreviated Performance Tests
Table 5-2. Post-Repair Adjustments

PRINCIPLES OF OPERATION

A1 Keyboard Assembly. The Keyboard Assembly consists of forty-eight pushbuttons or keys hard-wired in an eight-row by six-column matrix. Whenever a key is pressed, a row line is connected to a column line. This causes a keyboard interrupt to be issued to the Microprocessor. When the Microprocessor is interrupted, the row and column data is strobed into the Keyboard Data Latch/Shift Register and then serially shifted over the data bus to the Microprocessor.

A11 Microprocessor, Memory, and HP-IB Assembly. The data bus (D0 through D7) consists of eight bidirectional lines which are used to transfer 8-bit, positive-true data to and from the Microprocessor. The Microprocessor reads data from memory, the keyboard, and the HP-IB interface. Information on the data bus is buffered as it enters or leaves the Microprocessor. The Read/Write signal (R/W) from the Microprocessor is used to control the direction of data transfer on the data bus. This signal is buffered by one of the Microprocessor Control Line Buffers.

The address bus (A0 through A15) consists of sixteen unidirectional lines which are used to transfer the 16-bit, positive-true address from the Microprocessor. These address bits are buffered and then used to enable the ROM Select Decoder and address the Read Only Memory (ROM) and Random Access Memory (RAM) locations. In addition, the buffered address bits are decoded to produce modulation, attenuator, and serial Input/Output (I/O) control strobes. The serial I/O control changes the eight bits of parallel data to serial data and clocks this data to the high frequency loop and output section (see BD2), the low frequency loop (see BD3), and the display. It also clocks serial input data from the keyboard to the Microprocessor.

The Halt input to the Microprocessor halts program execution and the Reset input starts the Microprocessor from a power down condition. This signal sequence is used during initial start up of the instrument, after a power failure has occurred, or after the RESET/STBY/ON switch is momentarily set to the RESET position. When the Microprocessor is reset, it will enter its power-up subroutine to initialize the instrument.

The Maskable Interrupt Request (IRQ) input to the Microprocessor is used to interrupt program execution. Maskable interrupts occur whenever a key on the keyboard is pressed, a reverse power condition is detected, or an active low is on the rear panel connector J5 (SEQ). The three maskable interrupts plus the five status conditions (i.e., ON, Overmodulation, Undermodulation, HP-IB interrupt, and

ManualsPlus.com

LF Loop Ready) all provide status inputs to the Interrupt Processing circuit which puts the instrument status information on the data bus.

The Signal Generator memory consists of 348 bytes of RAM (128 internal to the Microprocessor and 12K bytes of ROM. The program used to control the operation of the Signal Generator is stored in the ROM.

All HP-IB data input/output, control, and handshake signals are buffered before being applied to the HP-IB General Purpose Interface Adapter.

A2 Display Assembly. Sixteen bits of serial display data (DDA) are sent from the Microprocessor to the Display Address and Data Shift Registers. Six of the bits are decoded to produce the eleven display strobes and two keyboard strobes. The keyboard strobes are used to strobe column and row data from the keyboard while the display strobes are used to strobe modulation, frequency, and amplitude display data into their respective control drivers and latches. The display data is decoded and latched to drive the applicable 7-segment display or LED annunciator.

TROUBLESHOOTING

General

Procedures for checking the Keyboard, Display and Microprocessor sections of the instrument are given below. The blocks or points to check are marked on the block diagram by a hexagon with a check mark and a number inside, e.g. ⟨√3⟩.

Test Equipment

HP-IB Controller .....HP 9825A/98034A/98213A
Modulation Analyzer .....HP 8901A

⟨√1⟩ Power-On or Reset Sequence

1. Switch the RESET-STBY-ON switch to RESET and back to ON to initiate the internal memory check. This check tests for a failure in ROM (Read Only Memory) and in RAM (Random Access Memory). During this check, all front panel indicators will light for approximately 1.5 seconds to provide a quick visual inspection of each front panel annunciator and display segment. All the display segments will display the number eight except the least significant FREQUENCY digit will be five and the AMPLITUDE most significant digit will be a one. If a memory failure is detected, all front panel annunciators and display segments will remain lit until any front panel key is pressed. If the memory check was successful, the front panel indicators will display a carrier frequency of 100.0000 MHz, an output amplitude of −127.0 dBm, and no modulation. All annuciators (except dBm) will remain off. Table 1 lists the conditions of the Signal Generator as a result of a successful initialization sequence.

ManualsPlus.com

SERVICE SHEET BD4 (Cont'd)

Table 1. Initialized Conditions

Parameter	Initialized Condition
Carrier Frequency	100.0000 MHz
Output Amplitude	−127.0 dBm
AM Depth	0%
FM Peak Deviation Frequency	0.0 kHz
Carrier Frequency Increment	10.0000 MHz
Output Amplitude Increment	10.0 dB
AM Depth Increment	1%
FM Peak Deviation Frequency Increment	1.0 kHz
Coarse and Fine Tune Pointer	10.0000 MHz
Sequence Counter	0
All 10 Internal Storage Registers	100.0000 MHz and −127.0 dBm with no modulation

If the reset sequence is not completed successfully, see Service Sheets 14 and 16. Perform the signature checks for the two Service Sheets.

√2 Keyboard and HP-IB Checks

1. Connect the Signal Generator's RF Output to the modulation analyzer's input.

2. Connect the HP-IB controller to the Signal Generator's HP-IB input connector.

3. Enter modulation, frequency and amplitude data from the keyboard and the controller.

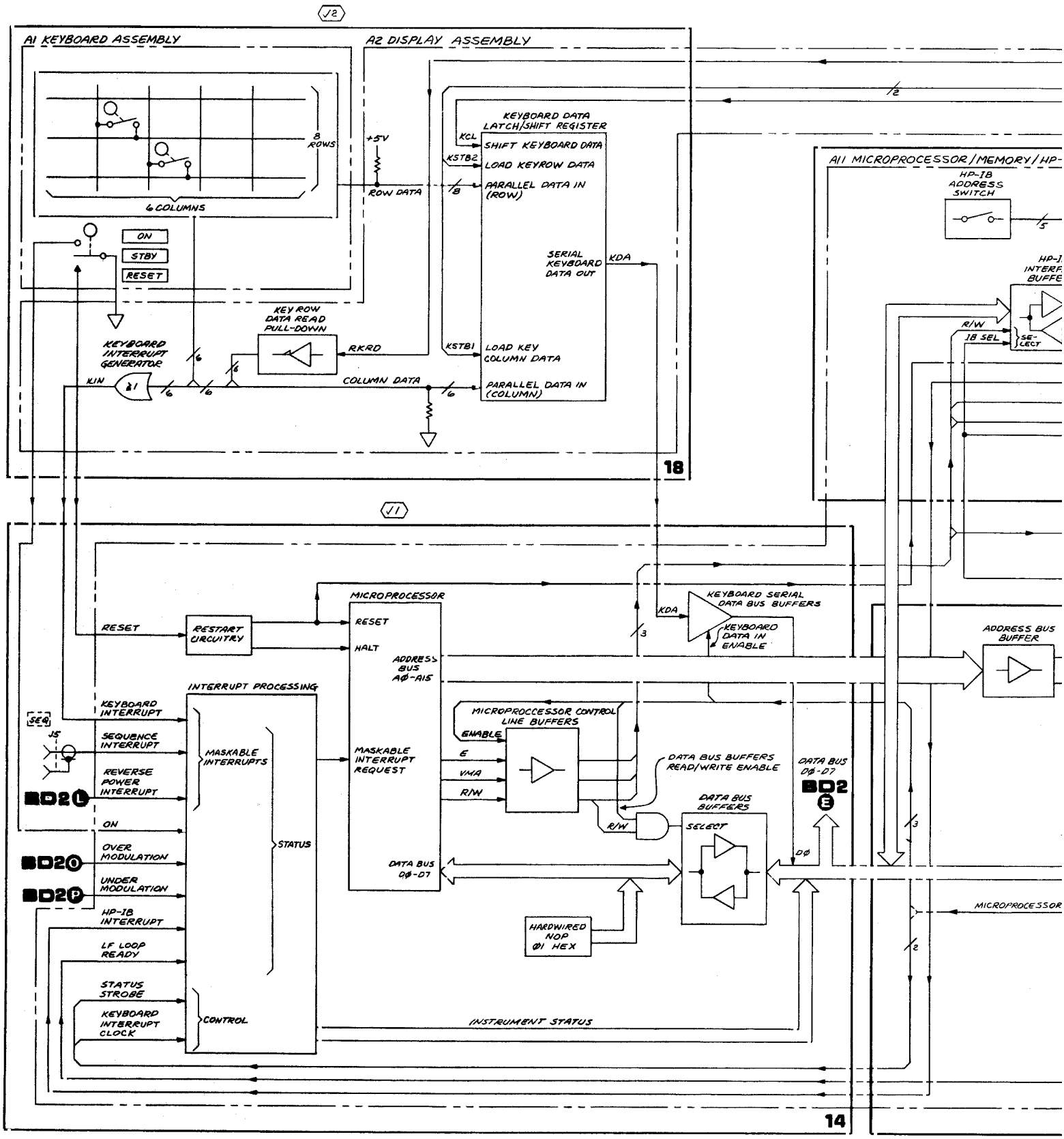
   a) If the RF output modes follow the data entered, but one or more of the displays do not, go to Service Sheets 19 and 20 or 21. Troubleshoot the appropriate strobes, latches, drivers and displays.

   b) If the displays follow the data entered but one or more of the RF output modes do not, go to Service Sheets BD2, BD3, or 15.

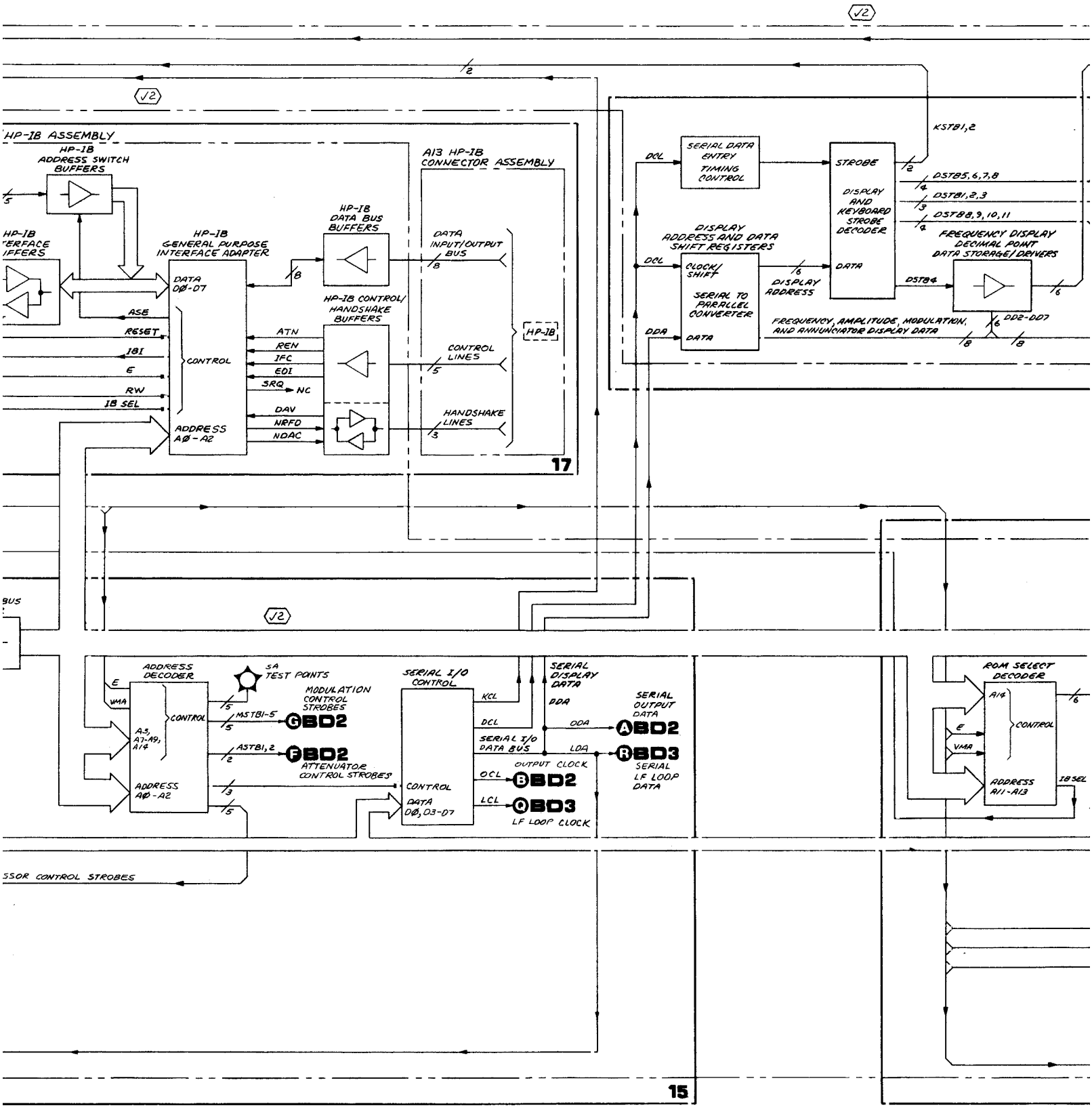
   c) If the output modes and displays follow data entered from the keyboard but not the HP-IB controller, go to Service Sheet 17.

   d) If the output and displays follow data entered from the HP-IB controller but not the keyboard, go to Service Sheet 18.

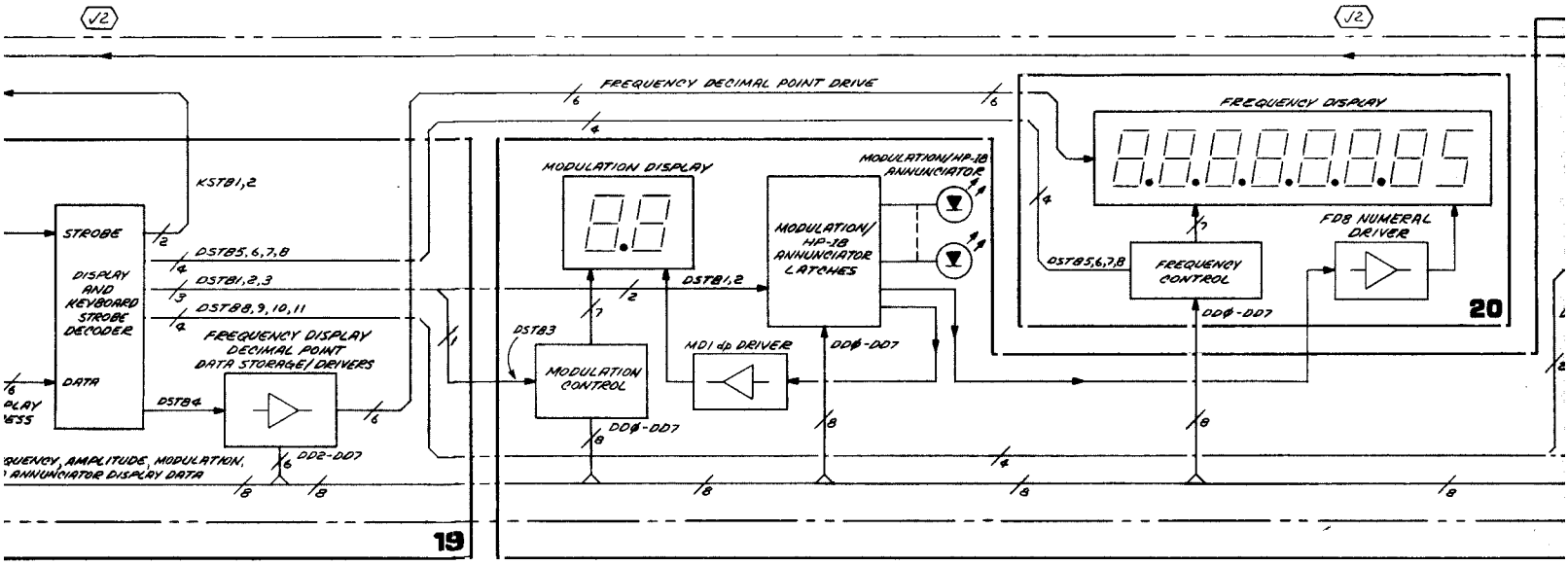
ManualsPlus.com

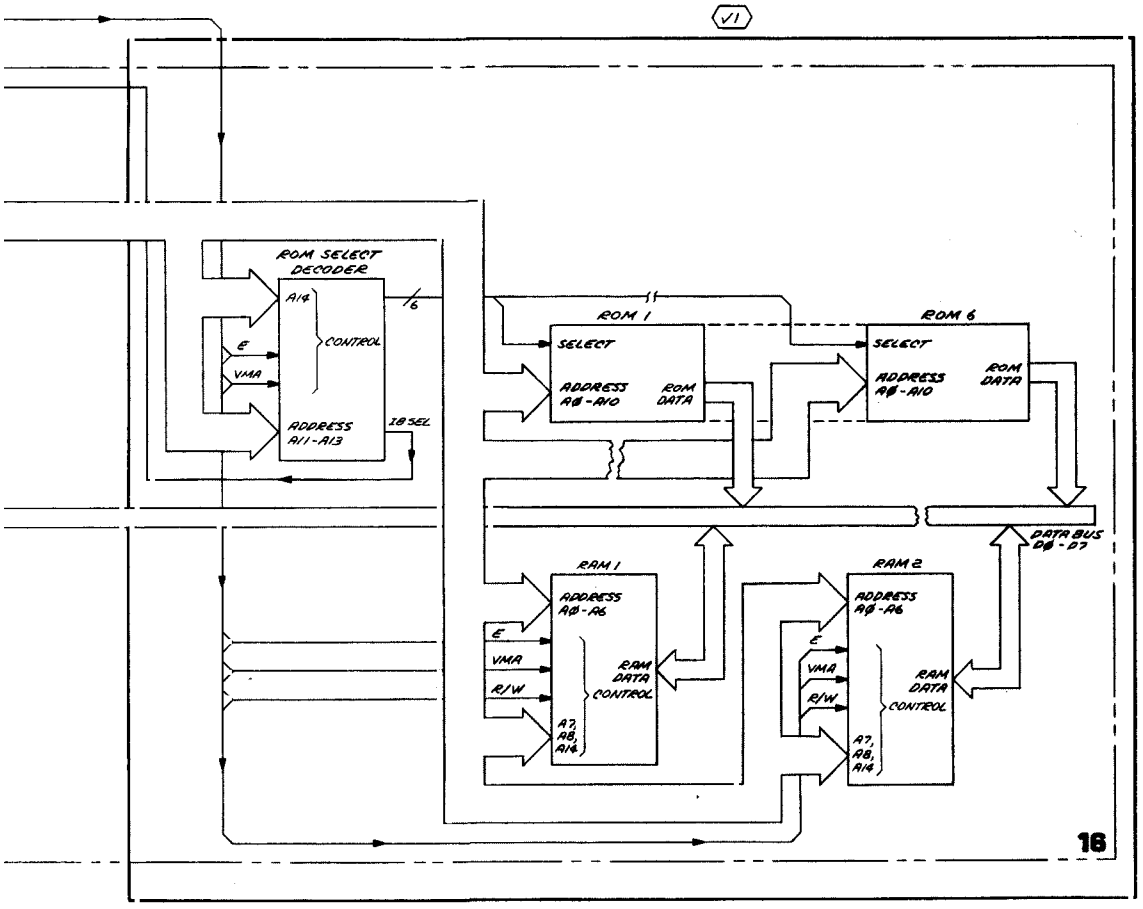


ManualsPlus.com

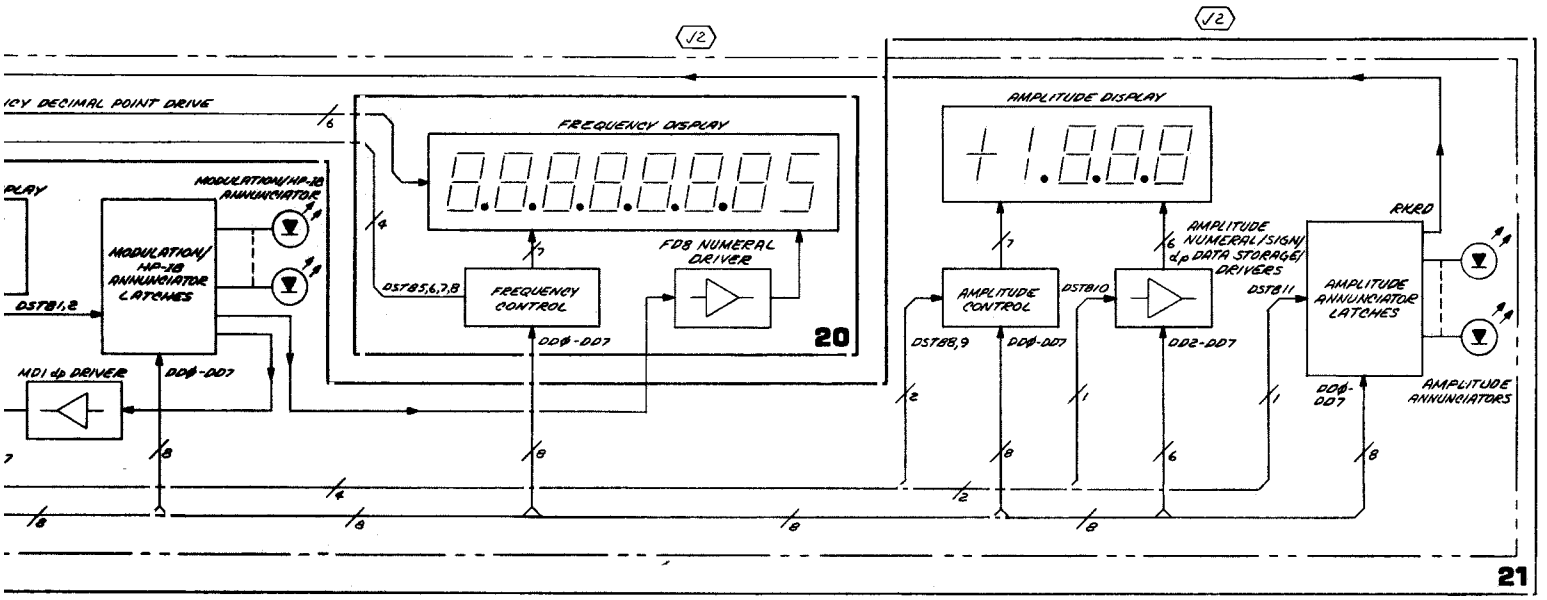


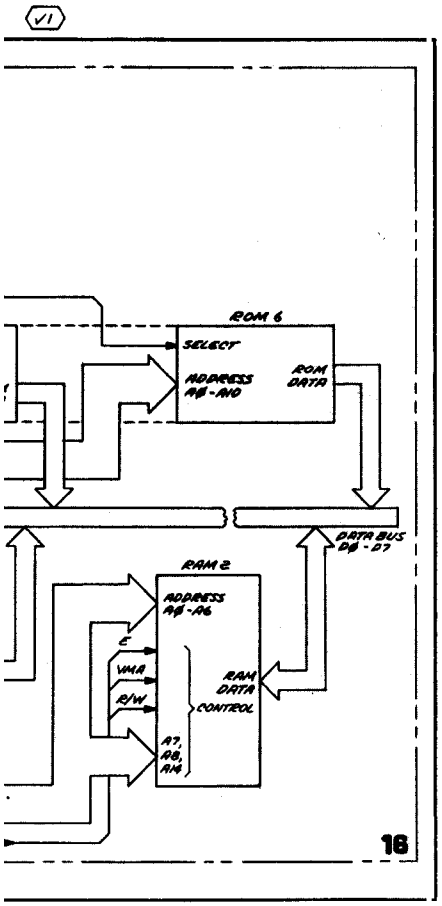
ManualsPlus.com





ManualsPlus.com





BD4

Figure 8-36. Microprocessor, Keyboard and Display Section Block Diagram

ManualsPlus.com

SERVICE SHEET 1
P/O A4 HIGH FREQUENCY LOOP ASSEMBLY
A5 HIGH FREQUENCY OSCILLATOR ASSEMBLY

TROUBLESHOOTING HELP

Service Sheet BD2
Table 4-1. Abbreviated Performance Tests
Table 5-2. Post-Repair Adjustments

PRINCIPLES OF OPERATION

General

The Voltage Controlled Oscillator (VCO) oscillates over a range of 494 to 990 MHz. It is tuned over this range by a −7.5 to +12 volt triangular wave signal. The output signal passes through a power splitter and is coupled to the RF Dividers (on the way to the RF Output) and to the High Frequency Loop Assembly.

Within the High Frequency Loop, the VCO signal is mixed with the phase locked signal (690-740 MHz). As the VCO is searching for its lock point, the mixer generated sidebands pass through a bank of selectable notch filters. The appropriate filter is turned off thus allowing the selected IF sideband to pass. The sampling bridge phase-compares the sideband (a multiple of 50 MHz) with a 50 MHz reference signal. When the correct sideband appears at the sampling bridge, the output to the loop with the amplifier (which up to now has been a continuously changing voltage) becomes a dc voltage. This voltage sets the High Frequency Loop Phase lock point. For more information, refer to the Loop and Search Amplifiers in Service Sheet 2.

Voltage Controlled Oscillator

The tune voltage ramp and the phase lock voltage are supplied to the varicaps CR1 and CR2 by the Loop Amplifier in conjunction with the Search Amplifier. This voltage is coupled into the VCO by the Low Pass Filter composed of L5, L6 and C10. The LPF also isolates the VCO. Varicaps CR1 and CR2 tune the tank circuit which includes inductor L8. Capacitors C11, C13 and C14 provide RF ground for the tank circuit. Varicap bias voltage of approximately −7.5 Vdc is obtained from voltage divider R20, R21 and the −15V (F2) supply. The output of the tank circuit is coupled into the VCO transistor Q3 by capacitor C15. Transistor Q3 is dc biased by R20, R21, L10 and R23. Inductor L11 causes a negative resistance to appear at the emitter of Q3 while C18 removes the negative resistance effect of L11 at low frequencies. Resistor R22 and capacitor C20 moderate the negative resistance effect looking into the emitter and reduce the Q of L11. Capacitors C19 and C21 bypass RF frequencies and power supply noise to ground. Power supply noise or other noise will frequency modulate the oscillator output.

Buffer Amplifier No. 1

Output of the VCO is coupled to the base of Q2 through capacitors C1 and C5 and the 6 dB isolation pad R3, R4, and R5. The collector current of Q3 flows through R1 and R2 to dc bias the base of Q1. Since the emitter of Q1 is also connected to the +15V (F4) supply by R6, the emitter voltage will be approximately 0.6 Vdc more positive than the base. The current in resistor R6 is determined by the voltage difference between the +15 volt supply and the voltage at the emitter of Q1. The current through R6 takes two paths. One path for the current is into the emitter of Q1 and out at its collector. This current is multiplied by the common-base current gain of Q1 which is approximately one. This is the base current for Q2. The other path for the current from R6 flows through R8 and L3 and is the collector current for Q2. The actual base and collector currents depend on the DC current gain of Q2. Therefore, the total current from R6 is

ManualsPlus.com

the sum of the base current and collector current of Q2. This is equal to the emitter current of Q2. The result is that the bias circuit gives accurate and stable control of the emitter current of Q2. Inductor L4 is used to match the collector to the output. Inductor L2, resistor R9, and capacitor C7 are for collector-to-base feedback. Capacitor C9 is a frequency compensation capacitor for Q2 emitter resistors R10 and R11. Capacitors C2, C3, C4, and C6 are filter capacitors.

Power Splitter

Output of Q2 is coupled to the Power Splitter by capacitor C8 and a 2 dB pad which consists of R12, R13, and R14. One output of the Power Splitter goes to the RF Dividers which are located on the A6 Assembly. The other output of Power Divider goes through the 6 dB pad which consists of R16, R17, R19, and C17 to Buffer Amplifier #2 which is located on the A4 Assembly. This output is used to phase lock the VCO. Coupling capacitor C17 passes the RF signal and blocks the +15V(F5) from inductor L12 which also acts to block the RF signal. The RF signal and +15V (F5) are both connected to Buffer Amplifier #2 by the same wire. The Power Splitter also serves to isolate the RF output path from the 690-740 MHz input to Mixer U1.

Buffer Amplifier No. 2

Output of the A5 Assembly is ac coupled to the base of Q2 through 1100 MHz Low Pass Filter composed of L6, L7, L8, L9, C9, C10, and C11. Capacitor C14 blocks the +15 Vdc from the A5 Assembly. Resistors R4 and R5 form the voltage divider to dc bias the base of Q1. The current in resistor R8 is determined by the voltage difference between the +15 Vdc supply and the voltage at the emitter of Q1. The current through R8 takes two paths. One path is into the emitter of Q1 and out at its collector. This current is multiplied by the common-base current gain of Q1 which is approximately one. This is the base current for Q2. The other path for the current from R8 flows through R15 and L3 and is the collector current for Q2. The actual base and collector current depends on the dc current gain of Q2. Therefore, the total current from R8 is the sum of the base current and collector current to Q2. This is equal to the emitter current of Q2. The result is that the bias circuit gives accurate and stable control of the emitter current of Q2. Inductor L14 is used to match the collector to the output. Inductor L12, resistor R16 and capacitor C18 are for collector to base feedback. Capacitor C13 and C15 are filter capacitors. Buffer Amplifier #2 amplifies the VCO's 494-990 MHz signal to about +5 dBm. The signal is then ac coupled through the 450 MHz high-pass filter C21, C22, C23, L17 and L18 to one input of Mixer U1. The other input to Mixer U1 is a 690 to 740 MHz signal of approximately –2 dBm from the Frequency Multiplier Assembly A8. The factory selected pad, that consists of resistors R6, R7, and R10 reduces this signal to –7 dBm. The difference frequencies from Mixer U1 are passed through the IF Input Filter which consists of inductors L19, L21, L26 and capacitors C33, C26, C38, and C41. The output of Mixer U1 is terminated by C30 and R23. C43 and L28 form a notch filter which is tuned to 300 MHz.

ManualsPlus.com

SERVICE SHEET 1 (Cont'd)

IF Buffer Amplifier

One of the IF sideband frequencies from Mixer U1 are phase-compared to the 50 MHz Reference to phase-lock the High Frequency Loop. Refer to Table 1 for a listing of these signals. Table 2 can be used with Table 1 to find the sideband for any frequency selected. At the 0 MHz (dc) frequency, the Mixer acts as a phase dectector. The IF Buffer Amplifier transistors Q3 and Q4 are biased off until one of the Notch Filters is selected (turned off). When a notch filter control line is pulled low by the output of the IF Drivers (See Service Sheet 2), the selected notch filter is turned off by biasing on one of the diodes CR7, CR8, CR9, CR10, or CR11 which shorts out the series capacitor of the notch filter C53, C61, C64, C67, or C70. The notch filter that is turned off then becomes a parallel tuned circuit. It now is a bandpass filter for the selected IF frequency. When the selected diode is biased on, current is drawn from the +15 Vdc supply through resistor R29 which biases on transistor Q4. Transistor Q4 will bias transistors Q3 and Q5 on. Q3 will amplify the IF signal by approximately 6 dB and Q5 will ground any dc voltage from Mixer U1. Resistor R31 provides collector to base feedback in the IF Buffer Amplifier and resistor R39 and capacitor C50 increase the gain at the high IF frequencies to compensate for the increased losses in the input and output filters.

The DC Notch Filter Q5 is used when the VCO's frequency to Mixer U1 is from 690 to 740 MHz (the same as the input from the Frequency Multiplier Assembly A8). The two frequencies will track and the mixer will function as a phase detector. The mixer's dc output voltage is proportional to the phase difference of the two inputs. The output of Mixer U1 looks into a high impedance and not into 50 ohms since the DC Notch Filter and the IF Buffer Amplifier are turned off. Consequently, the voltage level is 6 dB higher in the dc notch range. Since transistors Q3, Q4 and Q5 are all off, Q5 does not ground the dc voltage from Mixer U1. The dc voltage is sampled and fed back to keep the VCO locked.

Sampling Bridge and Pulse Generator

The output of the IF Buffer Amplifier or the DC Notch Filter is the input to be sampled by the Sampling Bridge. The 50, 100, 150, 200 or 250 MHz IF frequency is filtered by the 300 MHz Notch Filter (C85, C86 and L40) and the IF Output Filter (L20, L22, L27, C35, C37, C80, and C81). Resistor R24 and capacitor C79 provide a 50Ω impedance looking into the Sampling Bridge. The 50 MHz Reference Oscillator drives the Sampling Bridge. The 50 MHz, +13 dBm reference signal is applied to transformer T1. Resistors R1, R2 and R3 form a 2 dB pad and inductor L11 and capacitor C12 are used for impedance matching. T1 is the input to the Pulse Generator where 50 MHz pulses are generated by biasing the step recovery diode CR2 on and off. The IF input to the Sampling Bridge is sampled every 20 ns for 1.5 ns. When CR2 is biased off, inductors L15 and L16 will turn the Sampling Bridge on for 1.5 ns. The sampled output is stored in capacitors C28 and C29 and the dc voltage is applied to the 13 MHz Low Pass Filter through R27. When the level of the voltage from the

ManualsPlus.com

SERVICE SHEET 1 (Cont'd)

Table 1. Loop and IF Sideband Frequencies

High Frequency VCO Output (MHz)	Difference Frequencies from Mixing LF Loop Output and 800 MHz (MHz)	'Not Selected' IF Sideband (MHz)
494-540	694-740	-200
540-590	690-740	-150
590-640	690-740	-100
640-690	690-740	-50
690-740	690-740	DC
740-790	690-740	+50
790-840	690-740	+100
840-890	690-740	+150
890-940	690-740	+200
940-990	690-740	+250

Table 2. RF OUTPUT versus HF Loop Output

Output Divider Mode	Output Frequency (MHz)		Bandwidth (MHz)			
			Total		IF Sideband	
	RF	HF Loop	RF	HF Loop	RF	HF Loop
÷1/ Heterodyne	0.1-123.5	800.1-923.5	123.4	123.4	50	50
÷4	123.5-247	494-988	123.5	494	12.5	50
÷2	247-494	494-988	247	494	25	50
÷1	494-990	494-990	496	496	50	50

sampler is changing at a rate greater than 80 Hz, the voltage is coupled through C29 and C34 to the 13 MHz Low Pass Filter. FET Q6 provides a high impedance for the sampling bridge to drive and transistor Q7 provides a low impedance output to drive the 13 MHz Low Pass Filter. The Sampler Amplifier, which consists of Q6 and Q7, is a voltage follower feedback amplifier which functions to increase the bandwidth of the sampler. Transistor Q7 and FET Q6 are always turned on. Approximately 5 mA flows through R22 and Q6 providing 0.6 Vdc between the base and emitter to bias Q7 on. The sampled voltage is stored in capacitor C29 and C28 which is connected to the gate of Q6. For a small voltage change on the gate of Q6 more current must go through R26 to produce the voltage change at the collector-source junction of Q6 and Q7. A portion of the current is supplied by Q6 and the remainder is collector current from Q7. This voltage change is also coupled through C16 to increase the sampler bandwidth.

TROUBLESHOOTING

Procedures for checking circuits of the A5 High Frequency Oscillator Assembly and P/O A4 High Frequency Loop Assembly are given

ManualsPlus.com

below. The areas or points to check are marked on the schematic by a hexagon with a checkmark and a number inside, e.g., ⟨√1⟩. Fixed voltages are shown on the schematic inside a hexagon, e.g. ⟨2V±0.2V⟩. Transistor bias voltages are shown without tolerances.

Test Equipment

Power Meter .....HP 436A
Power Sensor.....HP 8482A
Digital Multimeter.....HP 3465A
Frequency Counter .....HP 5328A
Adapter Probe.....HP 1250-1598
Adapter, Type-N male to
BNC female .....HP 1250-0780
Cable-BNC male to SMC female .....HP 08662-60080

⟨√1⟩ Voltage Tuned Oscillator Check

1. Check the bias voltage on Q3.

2. Connect counter to TP5 using the cable and adapters.

3. Connect counter time base to the Signal Generator's TIME BASE INPUT.

4. Set the Signal Generator's output level to −10 dBm without modulation.

5. Verify that the oscillator frequency is within ±1000 Hz of the center frequency, and that the tune voltage is within tolerance for each frequency shown in Table 3.

Table 3. VCO Frequency versus Tune Voltage

Oscillator Frequency (MHz)	Typical Tune* Voltage (Vdc)	Tune Voltage* Tolerance (Vdc)
500.0000	−6.715	−6.9 to −6.0
510.0000	−6.528	−6.7 to −5.8
520.0000	−6.327	−6.5 to −5.6
530.0000	−6.112	−6.3 to −5.4
540.0000	−5.888	−6.1 to −5.6
550.0000	−5.650	−5.9 to −5.4
715.0000	−0.905	−3.0 to +2.5
990.0000	+8.945	+2.5 to +12

*Voltage measured at TUNE signal location (white/black/orange wire.)

⟨√2⟩ Buffer Amplifier No. 1

1. Check the bias voltages on transistor A5Q1 and Q2.

2. Set the Signal Generator to −10 dBm at 500 MHz without modulation.

ManualsPlus.com

SERVICE SHEET 1 (Cont'd)

3. Measure the power at the test points shown in Table 4. Connect the power sensor to the test points using the cable and adapters.

√3 Buffer Amplifier No. 2

1. Check the bias voltages on A6Q1 and Q2.

2. Set the Signal Generator to −10 dBm at 500 MHz without modulation.

3. Measure the power at the test points shown in Table 5. Connect the power sensor to the test points using the cables and adapters.

√4 IF Input Filter

1. Set the Signal Generator to −10 dBm at 500 MHz without modulation.

2. Connect power sensor to test points indicated in Table 6 using cable and adapters. Verify that the power levels are correct.

√5 IF Buffer Amplifier

1. Set the Signal Generator to −10 dBm at 500 MHz without modulation.

2. Measure and verify the voltages shown in Table 7.

3. Disconnect the TUNE voltage to the A5 High Frequency Oscillator Assembly. Measure the voltage at TP8. It should be 0.000 ±0.005 Vdc.

√6 Notch Filters

1. Set the Signal Generator to −10 dBm at 500 MHz without modulation.

2. Connect counter to TP8 using cable and adapters.

3. Measure and verify the IF Filter select voltages in Table 8.

√7 Pulse Generator, Sampling Bridge

1. Set the Signal Generator to −10 dBm at 500 MHz without modulation.

2. Connect power sensor to the test points indicated in Table 9 using cable and adapters. Measure and verify the power levels.

3. Ground TP13 and disconnect the TUNE voltage to the High Frequency Oscillator Assembly A5. Remove the wire to the feedthrough capacitor C44. Verify that the voltage at TP12 is 0.000±0.010 Vdc.

Table 4. Buffer Amplifier No. 1 Power Levels

Test Point	Power Level (dBm)		Circuit Opened By
	Closed Circuit	Open Circuit*	
A5TP1	−4.00 to −10.00	+2.00 to −4.00	Remove jumper to A4
A5TP2	+6.45 to +0.45	+8.00 to +2.00	Remove jumper to A6
A5TP3	+4.45 to −1.55	+7.15 to +1.15	Remove jumper to A4
A5TP5	+3.65 to −2.35	+4.50 to −1.50	Unsolder base of Q2

*To make the open circuit measurements, disconnect the white/black/orange wire. Ground the TUNE input to the Voltage Controlled Oscillator on A5.

Table 5. Buffer Amplifier No. 2 Power Levels

Test Point	Power Level (dBm)		Circuit Opened By
	Closed Circuit	Open Circuit*	
A4TP2	−5.0 to −11.0	−2.0	remove R6 and R7
A4TP3	−1.5 to −9.5		
A4TP4	+5.5 to −0.5		

*To make the open circuit measurements, disconnect the white/black/orange wire. Ground the TUNE input to the Voltage Controlled Oscillator on A5.

ManualsPlus.com

SERVICE SHEET 1 (Cont'd)

Table 6. IF Input Filter Power Levels

Test Point	Power Level (dBm)		Circuit Opened By
	Closed Circuit	Open Circuit*	
A4TP5	−15.5 to −19.5	−11.5 to −15.5	Disconnect C30, L19
A4TP6	−18.0 to −22.0	−14.0 to −18.0	Disconnect C47, L30

*To make the open circuit measurements, disconnect the white/black/orange wire. Ground the TUNE input to the Voltage Controlled Oscillator on A5.

Table 7. IF Buffer Amplifiers Biasing

Signal Generator Frequency	Bias Q3 (Vdc)			Bias Q4 (Vdc)			Bias Q5 (Vdc)		
	E	B	C	E	B	C	E	B	C
500 MHz	+0.14	+0.89	+4.82	+10.47	+9.79	+2.27	0.00	+0.74	grd
700 MHz	0.00	0.00	+14.06	+14.06	+14.06	0.00	0.00	0.00	grd

Table 8. IF Filter Select Voltages

Signal Generator Frequency (MHz)	IF Filter Select Voltage* (Vdc) at IF SEL Inputs					Frequency at TP8 (MHz)
	250	200	150	100	50	
500	14.0	0.9	14.0	14.0	14.0	200
550	14.0	14.0	0.9	14.0	14.0	150
600	14.0	14.0	14.0	0.9	14.0	100
650	14.0	14.0	14.0	14.0	0.9	50
940	0.9	14.0	14.0	14.0	14.0	250
700	14.0	14.0	14.0	14.0	14.0	DC

*IF Filter 'not selected' when voltage is 0.9 Vdc.

Table 9. Pulse Generator and Sampling Bridge Power Levels

Test Point	Power Level (dBm)		Circuit Opened By
	Closed Circuit	Open Circuit*	
A4TP8	−9.0 to −13.0		
A4TP9	+11.8 to +7.8	+15.0 to +11.0	Disconnect R1, R2

*To make the open circuit measurements, disconnect and ground the TUNE voltage input to the A5 Voltage Controlled Oscillator.

ManualsPlus.com

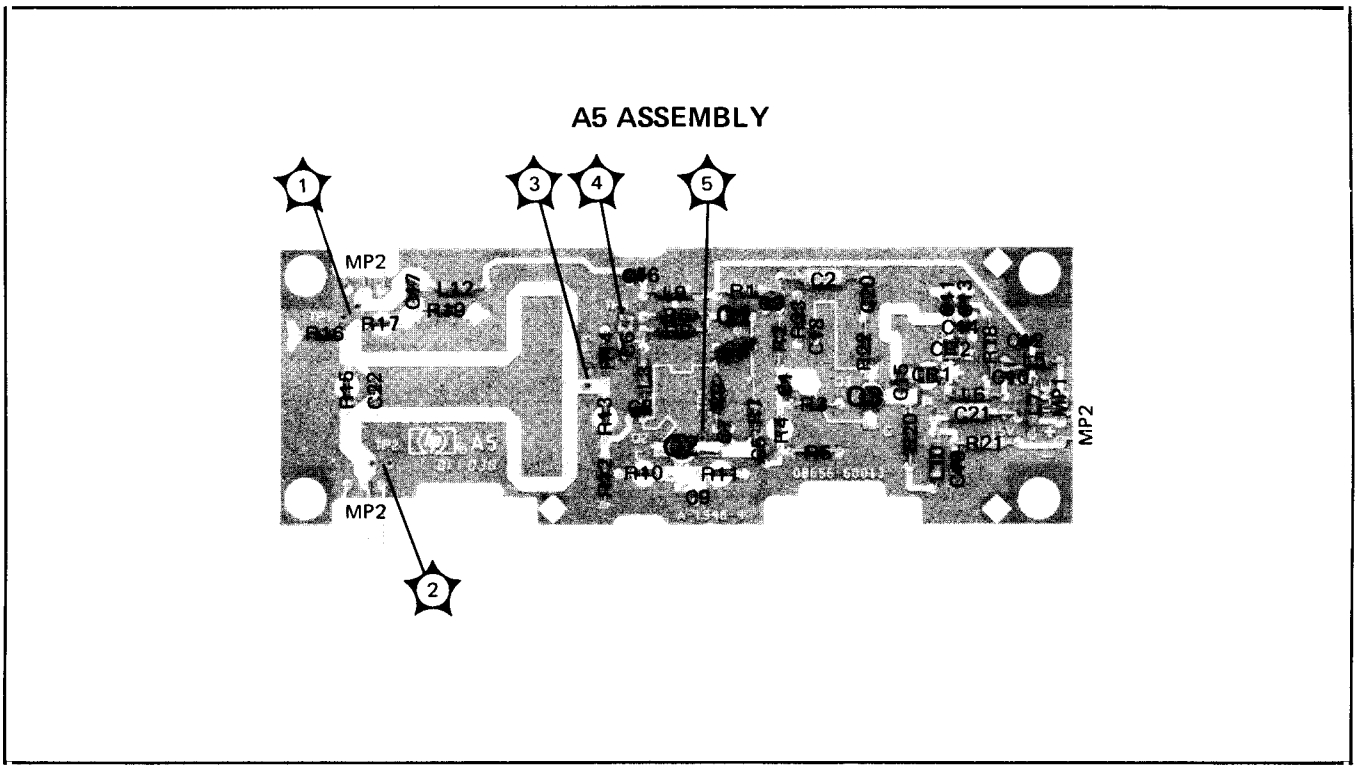


Figure 8-37. High Frequency Oscillator Component Locations

ManualsPlus.com

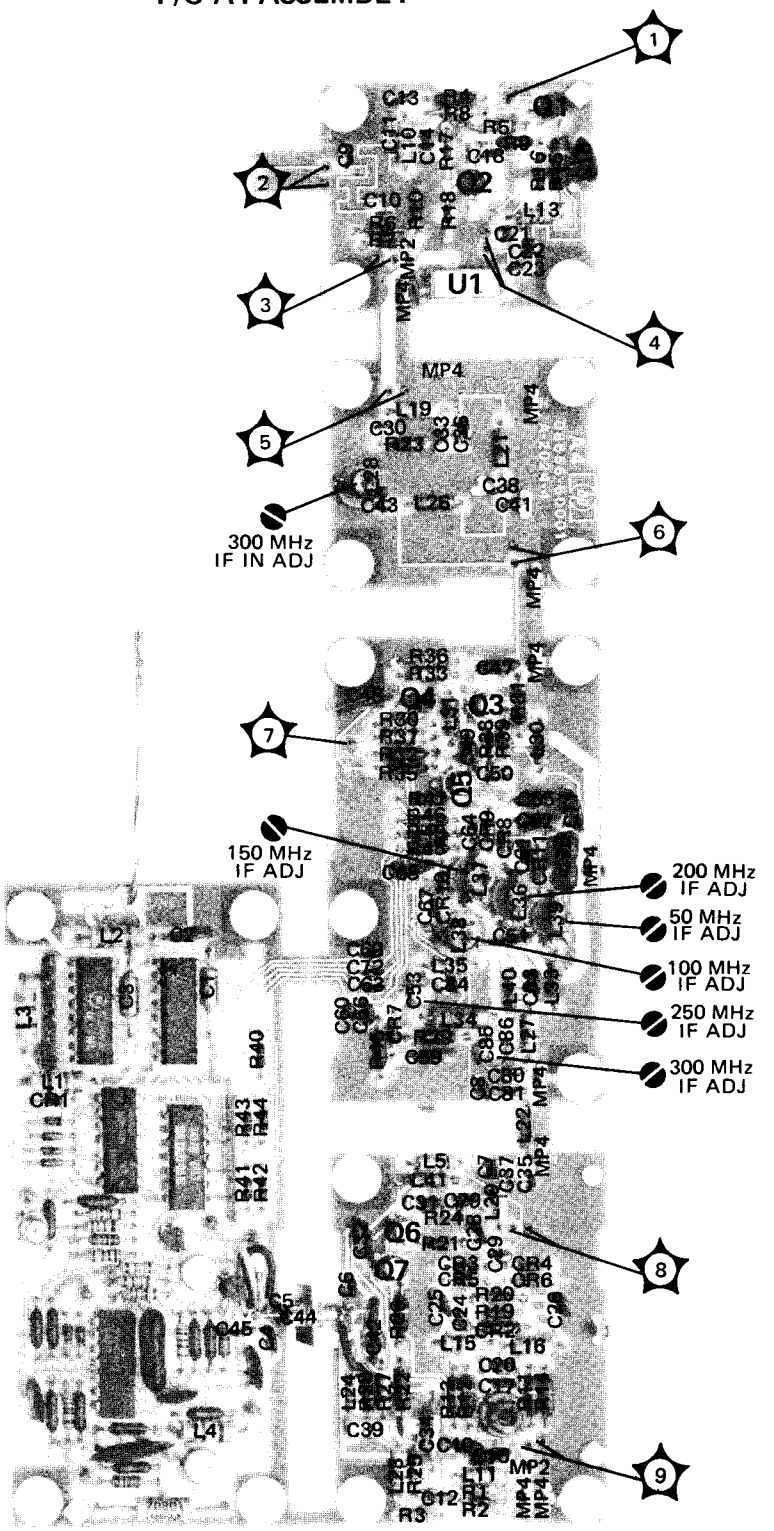


Figure 8-38. IF Section (A4 Assembly) Component Locations

ManualsPlus.com

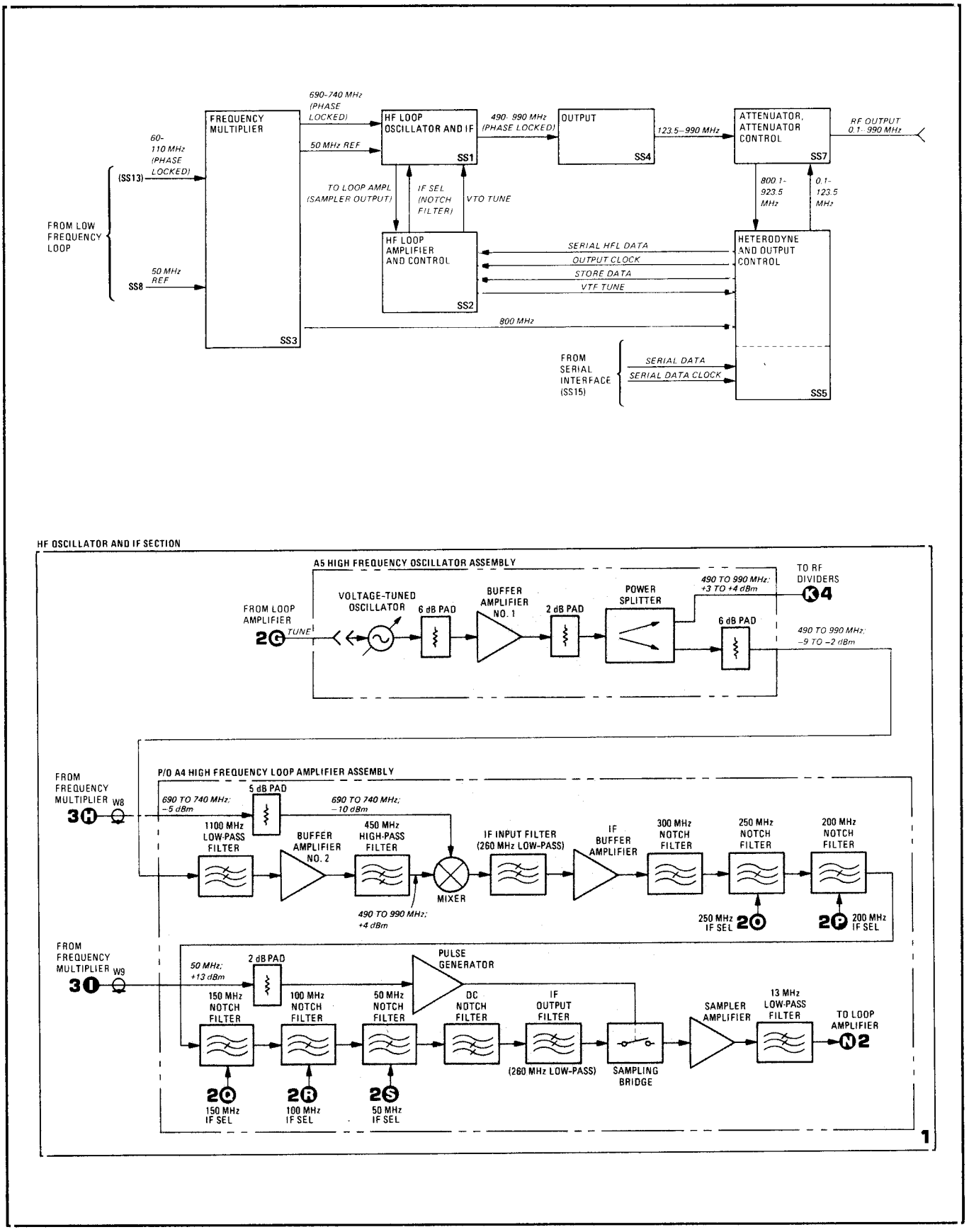
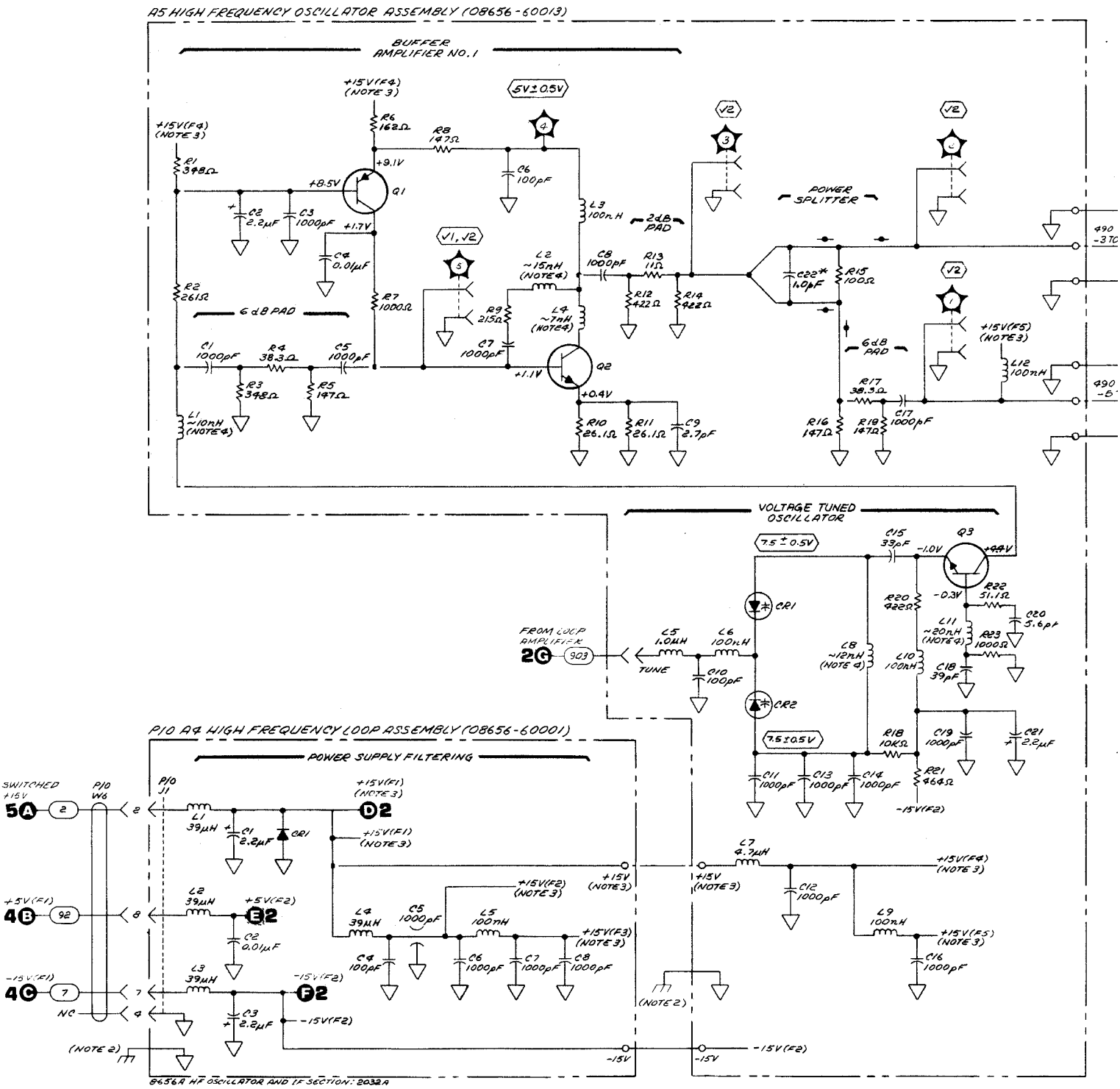
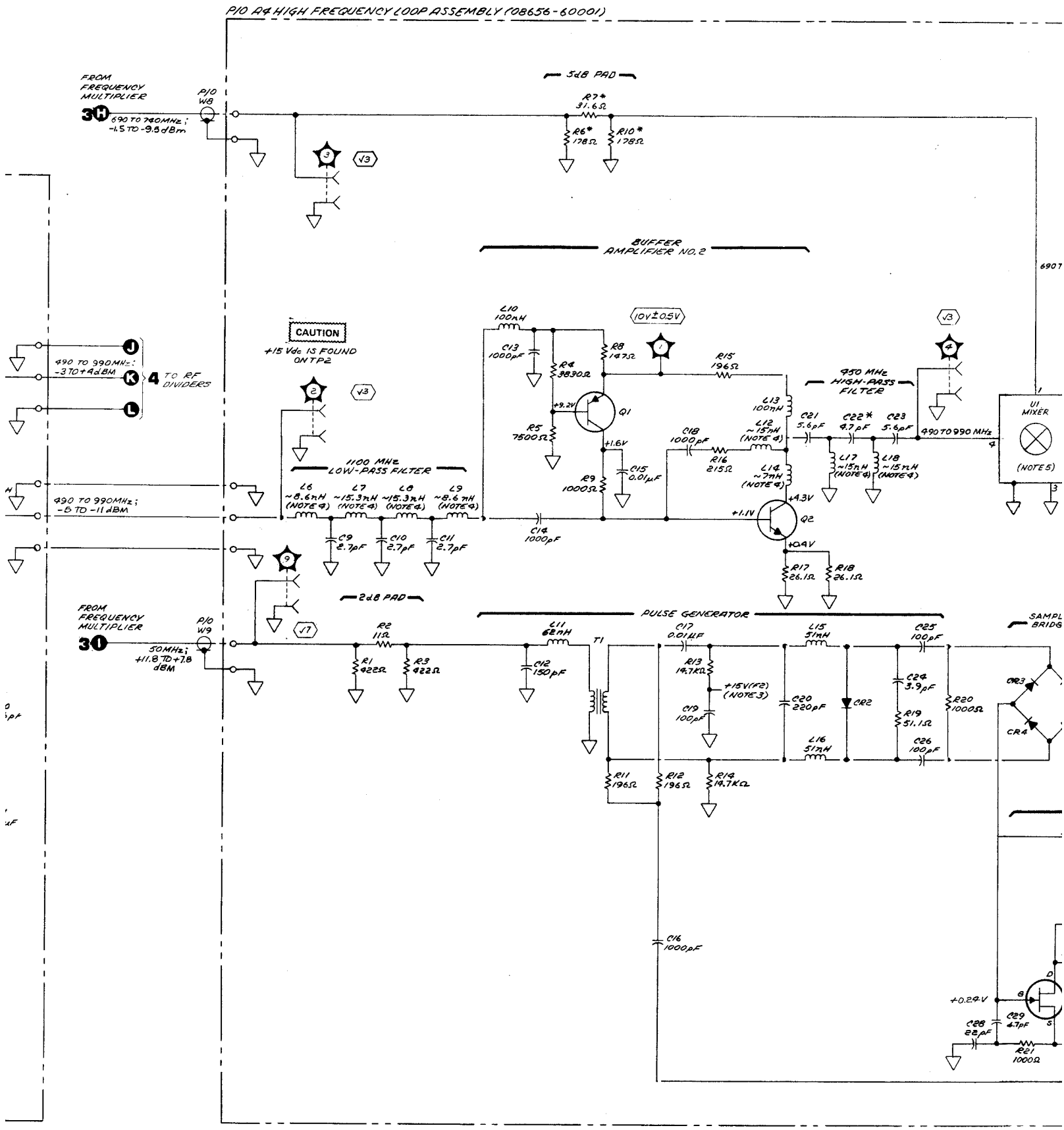


Figure 8-39. High Frequency Oscillator and IF Section Block Diagrams

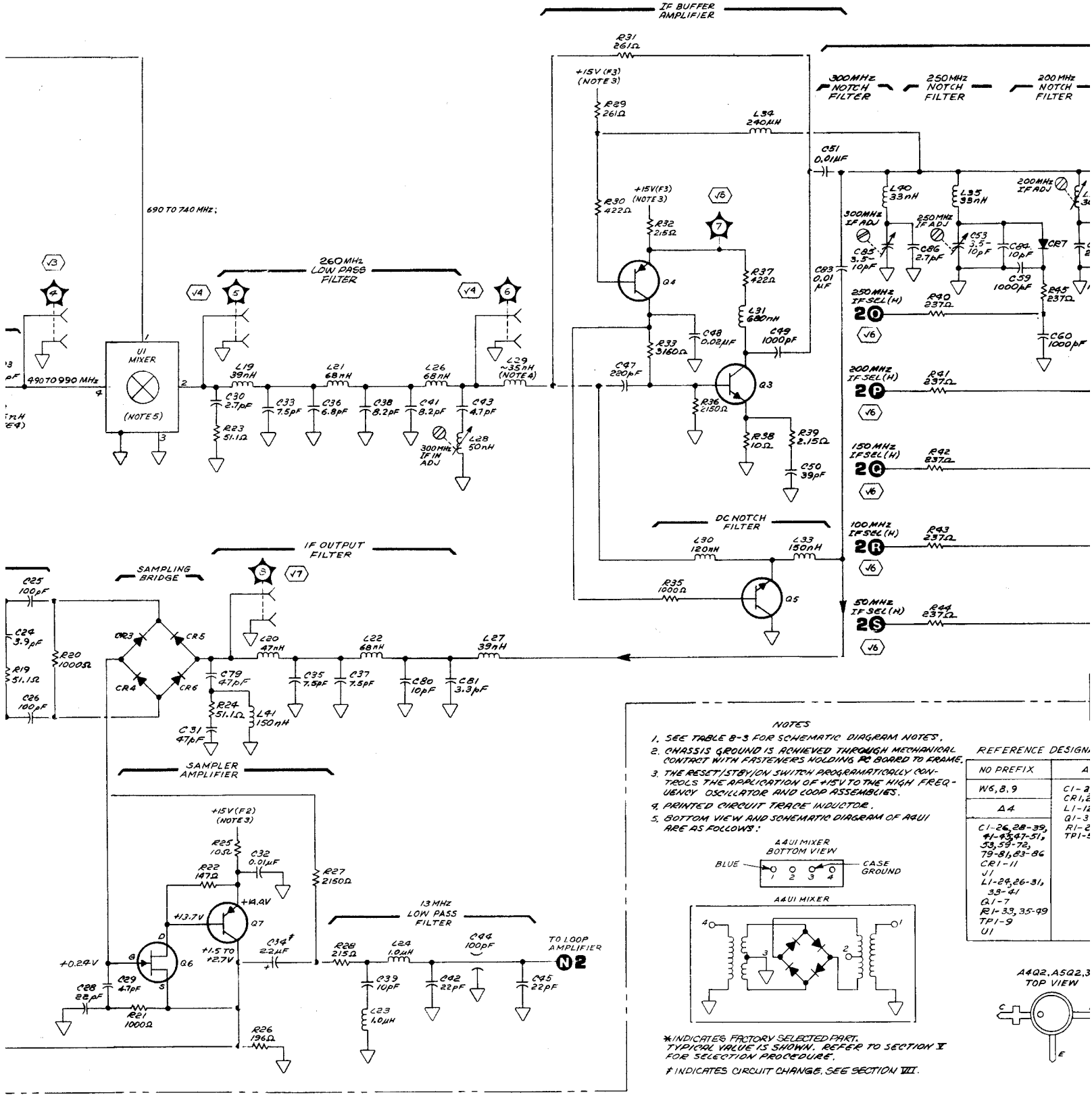
ManualsPlus.com



ManualsPlus.com



ManualsPlus.com



NOTES

1. SEE TABLE 8-3 FOR SCHEMATIC DIAGRAM NOTES.
2. CHASSIS GROUND IS ACHIEVED THROUGH MECHANICAL CONTACT WITH FASTENERS HOLDING A2 BOARD TO FRAME.
3. THE RESET/STBY/ON SWITCH PROGRAMATICALLY CONTROLS THE APPLICATION OF +15V TO THE HIGH FREQUENCY OSCILLATOR AND LOOP ASSEMBLIES.
4. PRINTED CIRCUIT TRACE INDUCTOR.
5. BOTTOM VIEW AND SCHEMATIC DIAGRAM OF A4U1 ARE AS FOLLOWS:

A4U1 MIXER BOTTOM VIEW

A4U1 MIXER

*INDICATES FACTORY SELECTED PART. TYPICAL VALUE IS SHOWN. REFER TO SECTION V FOR SELECTION PROCEDURE.

† INDICATES CIRCUIT CHANGE. SEE SECTION VII.

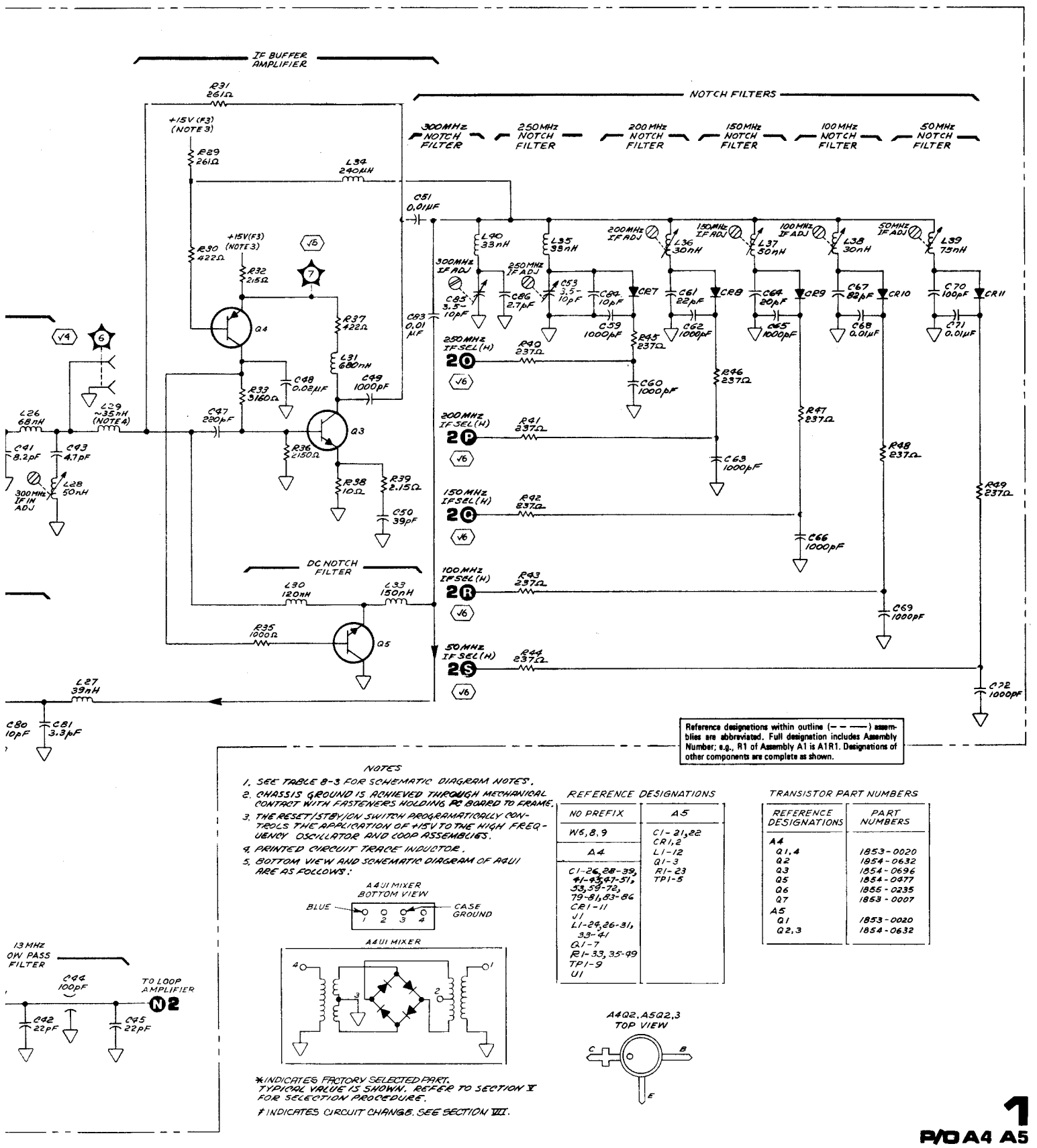
REFERENCE DESIGN

NO PREFIX	A
W6, 8, 9	C1-2 CR1,2 L1-12 Q1-3 R1-2 TP1-5
A4	
C1-26, 28-39, 41-43, 47-51, 53, 59-72, 79-81, 83-86 CR1-11 J1 L1-24, 26-31, 33-41 Q1-7 R1-33, 35-99 TP1-9 U1	

A4Q2, A5Q2, 3 TOP VIEW

Figur

ManualsPlus.com



Reference designations within outline (— — —) assemblies are abbreviated. Full designation includes Assembly Number; e.g., R1 of Assembly A1 is A1R1. Designations of other components are complete as shown.

NOTES

1. SEE TABLE 8-3 FOR SCHEMATIC DIAGRAM NOTES.
2. CHASSIS GROUND IS ACHIEVED THROUGH MECHANICAL CONTACT WITH FASTENERS HOLDING PC BOARD TO FRAME.
3. THE RESET/STBY/ON SWITCH PROGRAMMATICALLY CONTROLS THE APPLICATION OF +15V TO THE HIGH FREQUENCY OSCILLATOR AND LOOP ASSEMBLIES.
4. PRINTED CIRCUIT TRACE INDUCTOR.
5. BOTTOM VIEW AND SCHEMATIC DIAGRAM OF A4U1 ARE AS FOLLOWS:

REFERENCE DESIGNATIONS

NO PREFIX	A5
W5, 8, 9	C1-21, 22 CR1, 2 L1-12 Q1-3 R1-23 TP1-5
A4	
C1-26, 28-39, 41-43, 47-51, 53, 59-72, 79-81, 83-86 CR1-11 J1 L1-24, 26-31, 33-41 Q1-7 R1-33, 35-99 TP1-9 U1	

TRANSISTOR PART NUMBERS

REFERENCE DESIGNATIONS	PART NUMBERS
A4	
Q1, 4	1853-0020
Q2	1854-0632
Q3	1854-0696
Q5	1854-0477
Q6	1855-0235
Q7	1853-0007
A5	
Q1	1853-0020
Q2, 3	1854-0632

* INDICATES FACTORY SELECTED PART. TYPICAL VALUE IS SHOWN. REFER TO SECTION V FOR SELECTION PROCEDURE.

‡ INDICATES CIRCUIT CHANGE. SEE SECTION VII.

P/O A4 A5

Figure 8-40. High Frequency Oscillator and IF Section Schematic Diagram

ManualsPlus.com

SERVICE SHEET 2
P/O A4 HIGH FREQUENCY LOOP ASSEMBLY

TROUBLESHOOTING HELP

Service Sheet BD2
Table 4-1. Abbreviated Performance Tests
Table 5-2. Post-Repair Adjustments

PRINCIPLES OF OPERATION

General

The Loop Amplifier, U5A, functions as an integrator within the loop bandwidth (less than 50 kHz). U5B is a comparator. When the search mode is entered, the input from the sampler (positive input to U5A) begins to change. The comparator input U5B-pin 3 follows the output of U5A. When the reference level (−3.75 Vdc) is reached, the comparator output switches to the opposite polarity which places a voltage differential across C73. C73 begins to discharge and the voltage again approaches the comparator's reference level. This continued action of the comparator and integrator produces a linear triangle waveform. It is used to sweep the voltage controlled oscillator across its frequency range while searching for the loop lock point. When phase lock occurs, the input voltage from the sampler becomes a dc level. The input to the comparator no longer changes, the switching action of U5B stops, and the sweeping output of U5A (the VCO's tune voltage) stops. The VCO output frequency is now essentially fixed and phase locked.

Loop and Search Amplifiers

The Loop Amplifier U5A is a non-inverting unity gain amplifier for frequencies greater than 50 kHz and an integrator for frequencies less than 50 kHz. The phase lock loop does not require additional gain above 50 kHz for phase lock operation. The input signal level from the sampler is at a higher level than necessary for the Voltage Controlled Oscillator's sensitivity. Resistor R72 and capacitor C78 reduce this level by 6 dB. Since the Loop Amplifier does not have any dc feedback the dc gain is open loop. AC feedback is by capacitor C73. The higher frequencies are coupled directly to the VCO tune bus through capacitor C77. The VCO Tune bus applies the TUNE voltage to the Voltage Controlled Oscillator across R70, R71 and R54 and to the positive input of Search Amplifier U5B through resistor R69.

Search Amplifier U5B functions as a comparator. The negative input of U5B is fixed at approximately −3.75 Vdc by resistor R73 and R74. The voltage at pin 1 will be near either− 14 Vdc or +14 Vdc. This change in voltage of U5B will be integrated by U5A to generate both a negative and positive "ramp" VCO Tune Voltage to sweep the Voltage Controlled Oscillator. Therefore, U5A and U5B form a triangle wave generator with an output from U5A that will sweep from approximately −7.5V to +12V.

Refer to the waveforms in Figure 1. The loop is unlocked and the positive input to U5B is more positive than −3.75 Vdc. The output of U5B is switched to +12 Vdc. The VCO is swept across its frequency range (990 to 494 MHz). At time T1 the comparator U5B has just changed state. CR16 is biased on and CR17 is biased off. At time T2 the positive input to U5B becomes more negative then the negative input and the output switches to −14V, CR16 is biased off, CR17 is on and the positive input to U5B is pulled to −8.7V. During this time the instrument would normally have locked. At time T3 the positive input to U5B becomes more positive than the negative input and the output changes to +14V, CR16 is biased on, CR17 is biased off and the positive input of U5B is pulled to +6 volts. This cycle is repeated until a locked voltage is received from the sampler.

ManualsPlus.com

Under normal circumstances, the maximum lock time is one ramp or 1.5 ms. When the lock point is reached the output voltage of the Sampling Bridge and Sampling Amplifier will be a dc voltage to lock the loop and fix the VCO frequency. The Loop and Search Amplifiers stop functioning as a triangle wave generator. The voltage on the VCO bus is fixed except for small changes. The positive input to U5B is fixed and the output will stay at −14 or +14 Vdc and the negative input to U5B has an offset voltage of 20 mVdc from the current flow through R62, R59, R58, and R55. The offset voltage prevents the loop from locking at invalid lock points.

The SEARCH SELECT logic control from the Microprocessor is connected to the negative input of U5B. This reference input sets the output of Search Amplifier to either +14 or −14 volts. Thus the Loop Amplifier integrator "ramp" will be in the right direction for phase lock in the minimum time (1.5 ms maximum). For example, the VCO frequency is 500 MHz and is changed to 600 MHz. The sweep should go up in frequency from 500 MHz to 600 MHz. The logic level of SEARCH SEL will be high which sets the output of U5B to −14 volts and causes the tune voltage to sweep the VCO up in frequency.

Sideband Comparators

Sideband comparator U5D and exclusive-OR gates U6 determine if the instrument will lock at a frequency above or below 715 MHz. The 715 MHz adjustment sets the reference voltage equal to the positive input of U5D with the instrument set to 715 MHz. Lets look at an example where an input frequency of 900 MHz is selected. The Low Frequency Loop oscillator is tuned to 100 MHz. The 200 MHz Notch Filter is 'not selected'. This action passes only the 200 MHz IF sideband. All the other sidebands are 'selected' which effectively filters them out. The input frequency to the mixer A4U1 (refer to Service Sheet 1) will be 700 MHz. The VCO frequency is being swept since the loop is not locked. At the previous frequency, the VCO was tuned to 494 MHz. As the VCO sweeps through 500 MHz, the IF is 200 MHz and the loop wants to lock. SIDEBAND C SEL is set to logic level one, which passes the sideband above 715 MHz. This prevents the loop from locking below 715 MHz. As the VCO sweeps up to 900 MHz, the 700 MHz input is subtracted from the VCO frequency to yield the 200 MHz intermediate frequency and the loop locks.

Under the preceding conditions, both inputs to Nor gate U6D will be high so the output is low. Both inputs to U6A will be low so the output is low. Both inputs to U6B will then be low (output of U6A and U6D) so the output will be low. CR18 will be on and TP16 is approximately +0.6 Volts so CR19 will be off. The VCO sweep voltage will be in a positive direction so the negative input to sideband comparator U5D is also swept in the positive direction. The 715 MHz adjustment is adjusted so at 715 MHz both inputs to U5D are equal. Therefore, with CR19 off, the positive input to U5D is fixed by divider R51, R52, R53 between +15 and −15 volts. So below 715 MHz the positive input will be more positive than negative input of U5D. Output of U5D will be approximately +12 volts and the corresponding input to nor gate

ManualsPlus.com

U6C will be high. The output will be high which turns on Q10 and grounds the phase detector output. The VCO can not lock at 500 MHz. As the VCO sweeps through 715 MHz, the output of comparator U5D switches, the output of Nor gate U6C goes low and Q10 is turned off allowing the loop to lock.

Gain Compensation

Frequency change of the VCO is not linear with respect to voltage. Transistors Q8 and Q9 are used to compensate for this non-linear relationship. The collector of Q9 is low (0 volts dc) when the 200 MHz IF Notch Filter is 'not selected'; the collector of Q8 is low when the 150 MHz IF Notch Filter is 'not selected'. Both the base-emitter junctions of Q8 and Q9 will be forward biased when the VCO frequency is below 715 MHz; the output of U5D will be +12 Vdc. Resistors R56 and R57 are a voltage divider for the dc bias voltage to the base of Q8 and Q9. When the VCO frequency is 500 MHz, Q9 is biased on and resistor R67 and C75 increase the attenuation of the VCO tune voltage. When the VCO frequency is 550 MHz, Q8 is biased on and resistor R68 and capacitor C76 increase the attenuation of the VCO tune voltage.

TROUBLESHOOTING

Procedures for checking part of the circuits of the A4 High Frequency Loop Assembly are given below. The area or points to check are marked on the schematic by a hexagon with a check mark and a number inside, e.g. ⟨√1⟩. Fixed voltages are shown on the schematic inside a hexagon, e.g. ⟨2V±0.2V⟩. Transistor bias voltages are shown without tolerances.

Test Equipment

Digital Multimeter .....HP 3465A
Oscilloscope .....HP 1222A

⟨√1⟩ HF Loop Data Storage/Drivers

1. Set the Signal Generator to −10 dBm at 100 kHz without modulation.

2. Enter frequencies in the order listed in Table 1 beginning with 500 MHz.

3. Check the voltages at the Outputs of U2, U3 and U4 as indicated.

⟨√2⟩ Exclusive-Or Gate A4U6

1. Set the Signal Generator to −10 dBm at 500 MHz without modulation.

2. Check the voltages listed in Table 2.

ManualsPlus.com

SERVICE SHEET 2 (Cont'd)

Table 1. IF Filter Notch Filter Select*

Signal Generator Frequency (MHz)	Digital Level**							
	SEARCH SEL(H)	IF SEL(H) Notch Filters					SIDEBAND	
		250	200	150	100	50	C SEL	B SEL
500	L	H	L	H	H	H	L	H
550	H	H	H	L	H	H	L	H
600	H	H	H	H	L	H	L	H
650	H	H	H	H	H	L	L	H
700	H	H	H	H	H	H	L	L
900	H	H	L	H	H	H	H	L
950	H	L	H	H	H	H	H	L
800	L	H	H	H	L	H	H	L

*A notch filter that is selected "filters out" that IF sideband. Therefore, the required IF sideband filter is 'not selected' in order to pass the required frequency.

**Digital Levels are as follows: A4U4 H>+2 Vdc L<+0.5 Vdc, A4U2 H>+3.5 Vdc L<+1.5 Vdc and A4U3 H>+13 Vdc L<+0.5 Vdc.

Table 2. A4U6 Digital Voltage Levels

Signal Generator Frequency (MHz)	U6A-Pin			U6B-Pin			U6C-Pin			U6D-Pin		
	1	2	3	4	5	6	8	9	10	11	12	13
500	H	L	H	H	H	L	L	H	H	H	L	H
900	L	L	L	L	L	L	L	L	L	L	H	H
715	L	L	L	L	H	H	L	H	H	H	L	H

√3 Search Amplifier, Loop Amplifier, Sideband Comparator, and Sideband Switch

1. Set the Signal Generator to −10 dBm at 500 MHz without modulation.

2. Disconnect the TUNE voltage to the VCO.

3. Verify that the waveforms of Figure 1 are correct.

TROUBLESHOOTING USING SIGNATURE ANALYSIS

This is an alternate method of troubleshooting Service Sheet 2 circuits. Service Sheet BD4 and Service Sheet 5 (which both refer to this service sheet) are used primarily to troubleshoot from the digital (control) standpoint. Note that digital information from the Microprocessor and related circuits must pass through the circuits shown on Service Sheet 5 before they get to circuits on Service Sheet 2. Be sure that the Service

ManualsPlus.com

SERVICE SHEET 2 (Cont'd)

Sheet 5 signatures are correct before trying to isolate an incorrect signature in these circuits. If the signatures on these circuits are correct, the problem may be in the controlled circuits. In this case continue with the troubleshooting information preceding this paragragh or refer to the troubleshooting information found on Service Sheet BD2.

Purpose. Verify correct data transfer from the Microprocessor to the High Frequency Loop.

NOTE

Signatures are not valid for Signal Generators with serial number prefixes 2009A through 2018A.

Setup. Connect the signature analyzer as follows:

1) GND to GND A11TP2
2) CLK to SA4 A11TP7
3) START to SA5 A11TP9
4) STOP to SA5 A11TP9.

Set the controls as follows:

1) START-IN
2) STOP-OUT
3) CLK-IN.

Set up the Signal Generator as follows:

1) Set the LOGIC/RAM switch P/O A11S1 to LOGIC.
2) On the A6 Output Assembly board, short TP5 to TP4 (GND); short TP6 to TP4 (refer to Service Sheet 5).

Initialize. Briefly short A11TP3 NMI to ground.

NOTE

With careless probing it is possible to get the Microprocessor into a program sequence other than that portion intended for signature analysis. If the +5V signature is incorrect, this has probably happened. Restart the test by setting the RST/RUN switch to RST and then RUN. Briefly touch the NMI test point to ground.

ManualsPlus.com

SERVICE SHEET 2

Probe. Connect the probe to the node indicated in Table 3. Verify that each signature is correct and stable.

Disconnect the jumpers between the test points and between the test point and ground. Reset the LOGIC/RAM switch to RAM. Reset the Signal Generator with the front panel RESET-STBY-ON switch.

Table 3. High Frequency Loop Signatures

Node	Correct Signature	Comments
+5V	F84P	
* U4 #3	F84P	SIPO CLK
U4 #2	744F	HF DATA
U4#4 U2#2	HA4C	SRCH SEL
U4#5 U2#4	PH25	250 MHZ
U4#6 U2#6	U692	200 MHZ
U4#7 U2#10	UC49	150 MHZ
U4#14 U2#15	UHA4	100 MHZ
U4#13 U2#12	7PH2	50 MHZ
U4 #11	13C0	SIDEBAND B
U4 #12	CU69	SIDEBAND C

*This signature is the same as the +5V signature; the probe should blink.

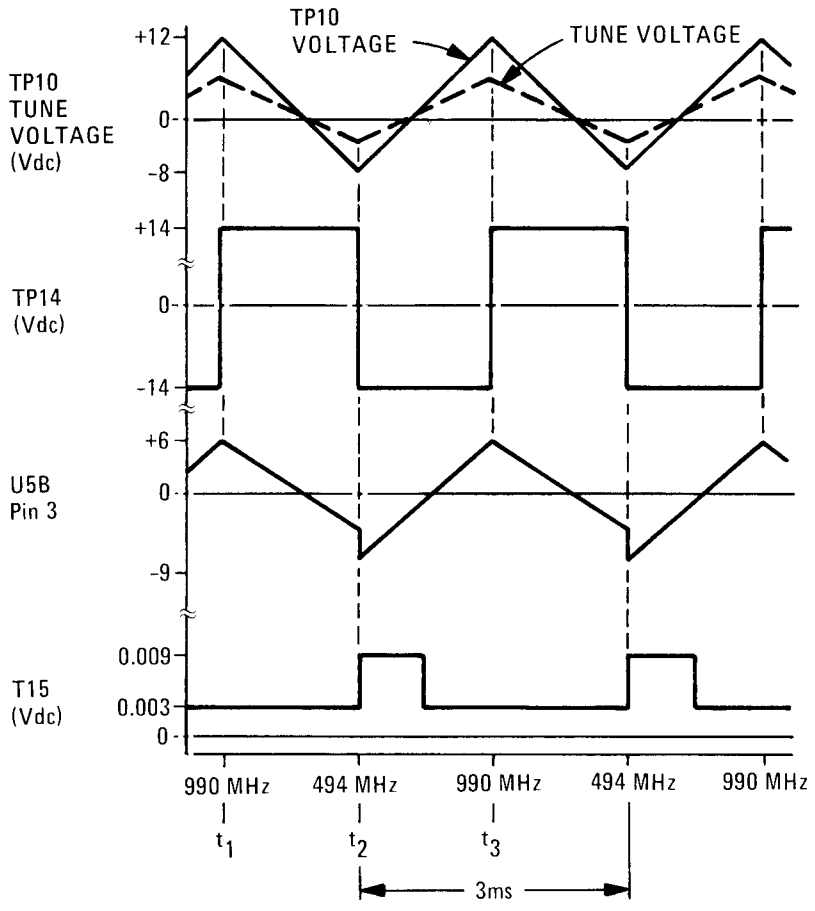


Figure 1. Unlocked High Frequency Loop Waveforms

ManualsPlus.com

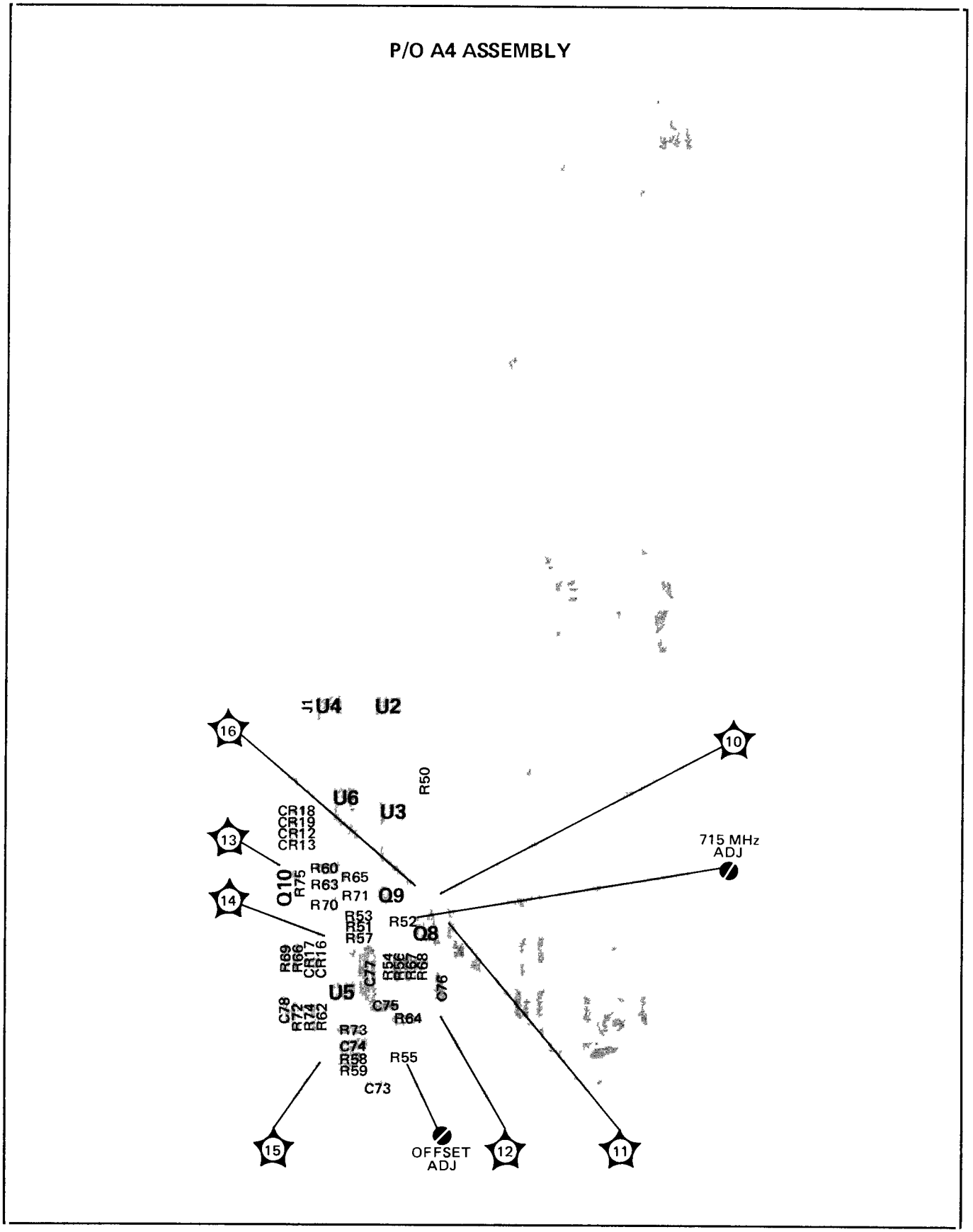
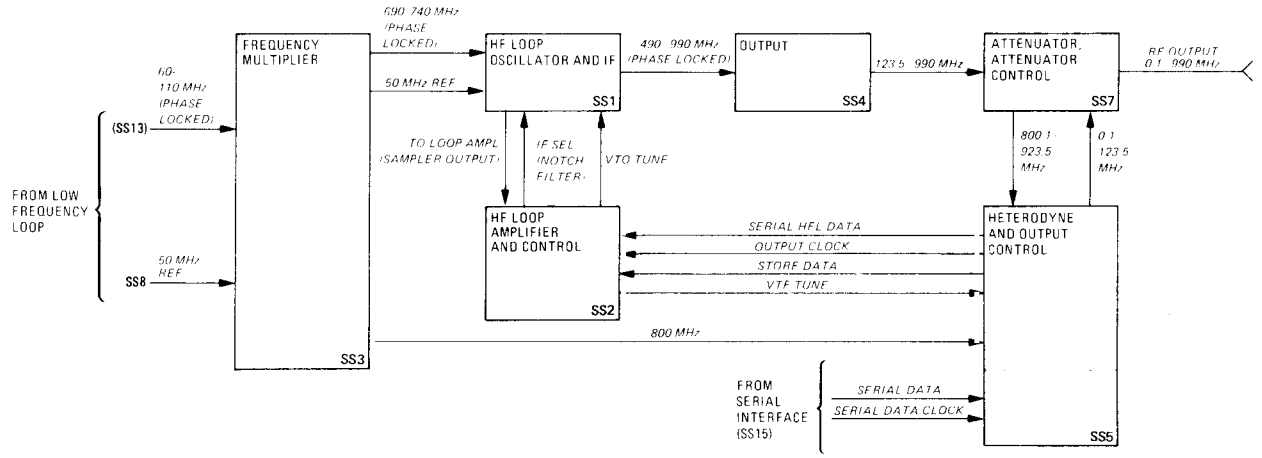


Figure 8-41. High Frequency Loop Amplifier and Control Component Locations

ManualsPlus.com



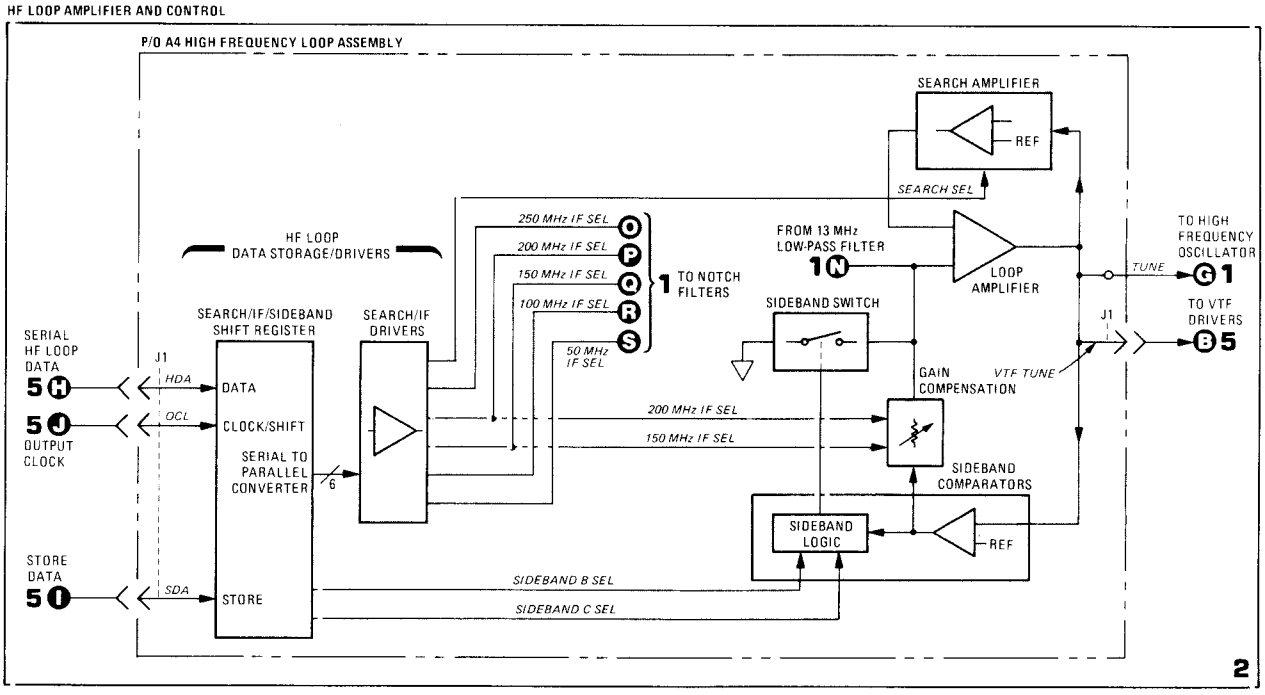
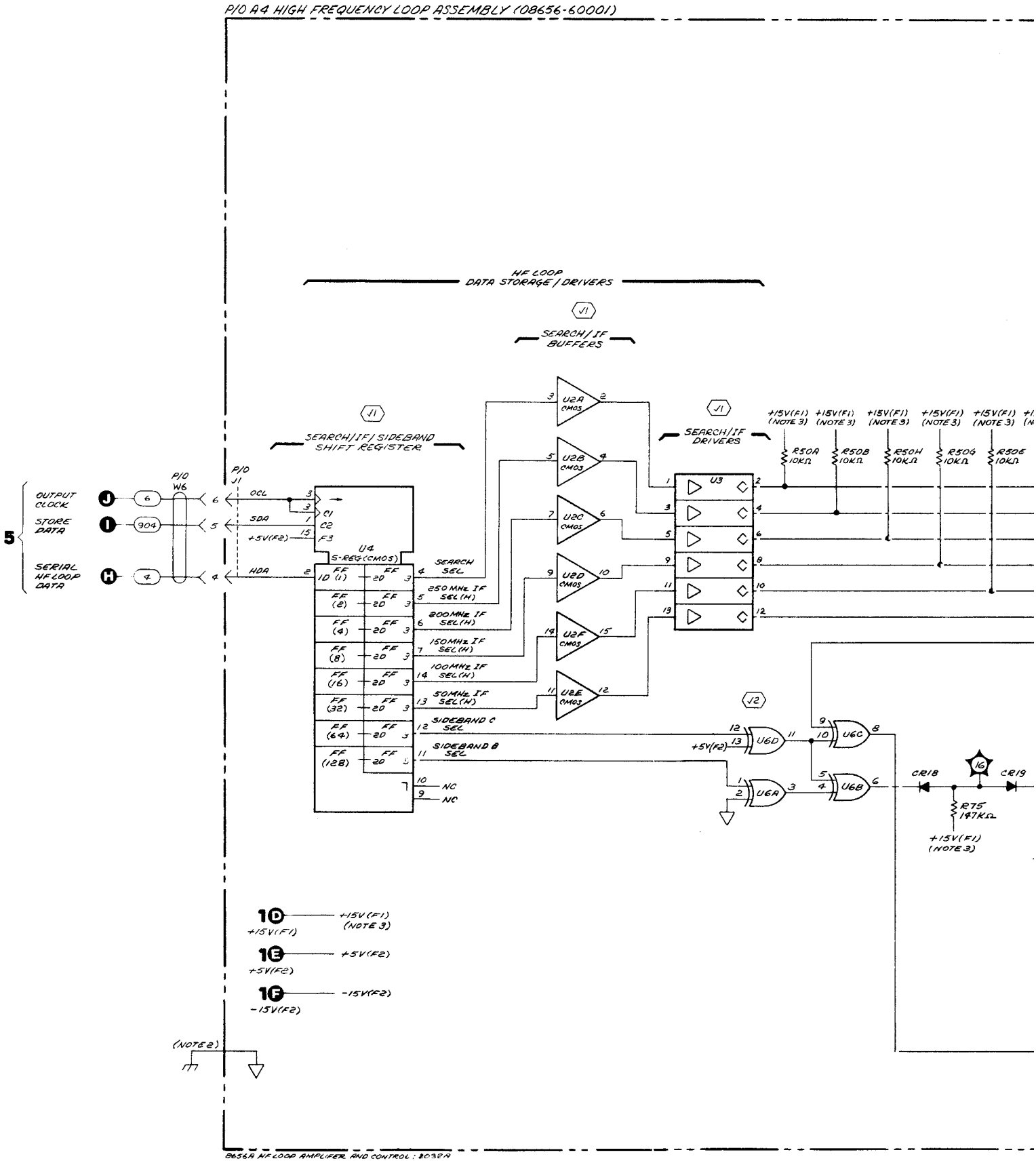
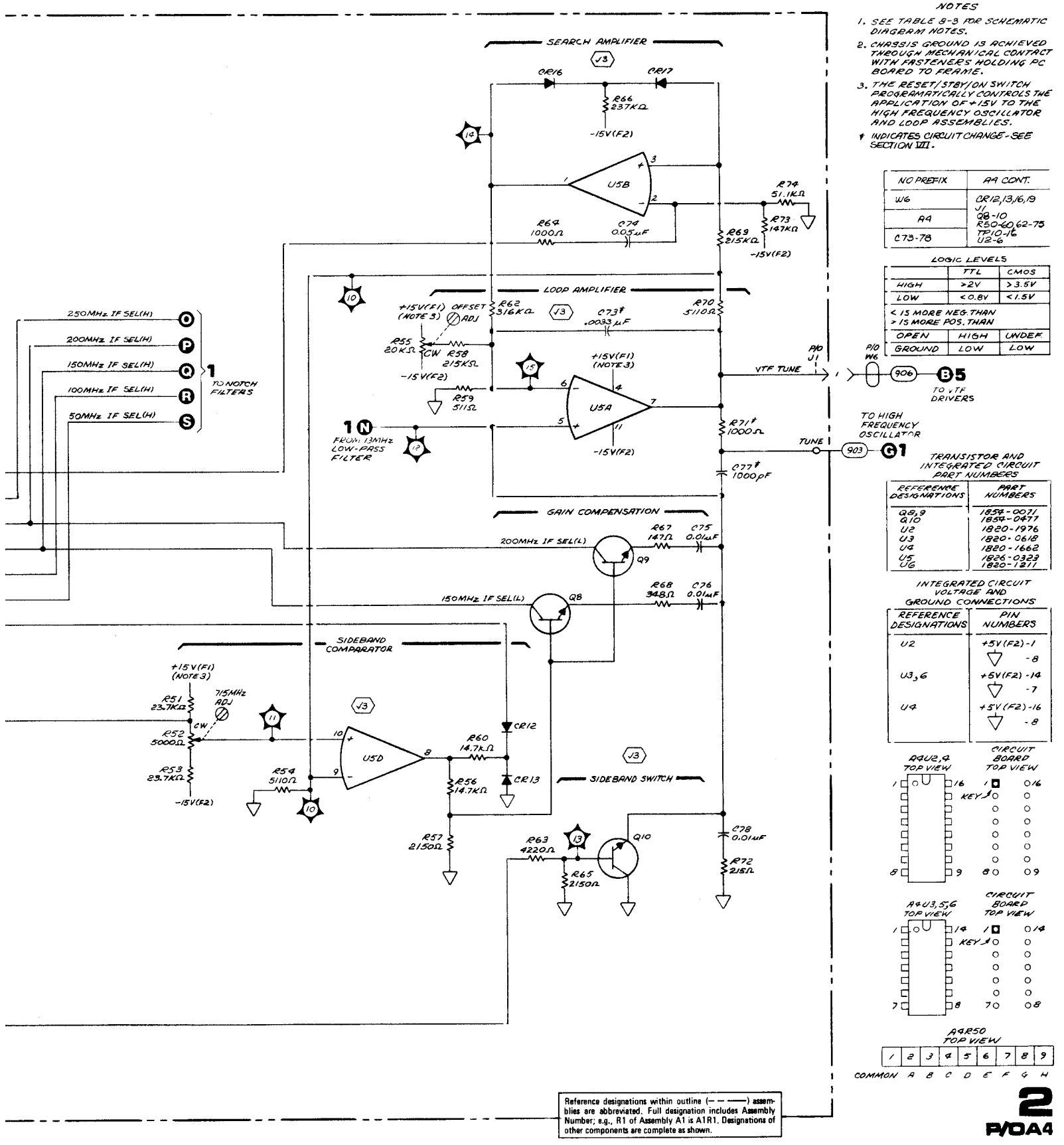


Figure 8-42. High Frequency Loop Amplifer and Control Block Diagrams

ManualsPlus.com



ManualsPlus.com



NO PREFIX	A4 CONT.
W6	CR12,13,16,19 J1
A4	Q8-10 R50-60,62-75 TP10-16 U2-6
C73-78	

LOGIC LEVELS

	TTL	CMOS
HIGH	>2V	>3.5V
LOW	<0.8V	<1.5V
< IS MORE NEG. THAN > IS MORE POS. THAN		
OPEN	HIGH	UNDEF
GROUND	LOW	LOW

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATIONS	PART NUMBERS
Q8,9	1854-0071
Q10	1854-0477
U2	1820-1976
U3	1820-0618
U4	1820-1662
U5	1826-0323
U6	1820-1211

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATIONS	PIN NUMBERS
U2	+5V(F2)-1
	-8
U3,6	+5V(F2)-14
	-7
U4	+5V(F2)-16
	-8

A4U2,4 TOP VIEW — CIRCUIT BOARD TOP VIEW

A4U3,5,6 TOP VIEW — CIRCUIT BOARD TOP VIEW

A4R50 TOP VIEW

1	2	3	4	5	6	7	8	9
COMMON	A	B	C	D	E	F	G	H

Figure 8-43. High Frequency Loop Amplifier and Control Schematic Diagram

ManualsPlus.com

SERVICE SHEET 3
A8 FREQUENCY MULTIPLIER ASSEMBLY

TROUBLESHOOTING HELP

Service Sheet BD2
Table 4-1. Abbreviated Performance Tests
Table 5-2. Post-Repair Adjustments

PRINCIPLES OF OPERATION

General

The 50 MHz reference is multiplied by 16 to 800 MHz. It is mixed with the phase locked 60 to 110 MHz signal from the Low Frequency Loop Assembly. The Mixer's output is amplified and applied to a Bandpass Filter that passes the difference frequency 690 to 740 MHz. The input frequencies to the Mixer are phase locked to the 50 MHz reference. Therefore, the Mixer's output serves as a reference to lock the High Frequency Loop. The 800 MHz output is also applied to the Output Assembly (refer to Service Sheet 5).

Frequency Multiplier

The 50 MHz +15 dBm input from the Reference Oscillator is applied to the Power Splitter consisting of R1, R2, R3, and R4. One output of the Power Splitter goes to the Sampler of the High Frequency Loop (shown on Service Sheet 1). The other output is ac coupled by C2 to Q8, the first multiplier stage. Here, the 50 MHz is doubled four times to a frequency of 800 MHz.

Each of the four multiplier stages (Q8, 7, 6, and 5) is dc biased so the transistor operates in its non-linear region thus generating harmonics. The output of each stage is filtered by a bandpass filter at 100, 200, 400, or 800 MHz. This passes the doubled frequency and filters out the input frequency and other harmonics. Since the stages are electrically equivalent, only the first stage will be discussed in detail. Note, however, that the 800 MHz filter ultilizes printed circuit trace capacitors instead of discrete capacitors.

Resistors R5 and R6 divide the +5 Vdc supply voltage to dc bias the base of Q8 at approximately +1.0 Volts dc without the 50 MHz signal connected. Resistor R7 is the emitter bias resistor. Capacitor C6 bypasses the ac emitter signal to ground. Inductor L2 is an RF choke, capacitor C3 is an RF bypass and C4 ac couples the output to the 100 MHz Bandpass Filter. The 800 MHz output of the last multiplier stage Q5 is applied to the 800 MHz Bandpass Filter on the output Assembly A6 (shown on Service Sheet 5) and to Buffer Amplifier No. 1.

Buffer Amplifier No. 1/Mixer U1

The 800 MHz signal is coupled to the base of Q3 through resistor R11, the circuit board transmission line and capacitor C13. The transmission line serves to isolate Q3 from the input. DC current flows through resistors R14 and 15 to dc bias the base of Q4. Since the emitter of Q4 is also connected to the +5V(F) supply by resistor R18, the emitter voltage will be approximately 0.6 Vdc more positive than the base. The current through resistor R18 is determined by the voltage difference between the +5 Vdc supply and the voltage at the emitter of Q4. The current through R18 takes two paths. One path is into the emitter of Q4 and out at its collector. This current minus the base current of Q4 is the base current of Q3. The other path for the current from R18 flows through L12 and into the collector of Q3. The base to collector current ratio

ManualsPlus.com

depends on the dc current gain of Q3. Therefore, the total current from R18 is equal to the emitter current of Q3. Inductor L11 is an RF choke while L12 serves as a matching element. Capacitors C15, C20, and C21 are RF by-pass capacitors. Capacitor C24 ac couples the output of the Buffer Amplifier to Mixer U1. The other input to Mixer U1 is the 60 to 110 MHz from the Voltage Controlled Oscillator (refer to Service Sheet 8). The difference output of 690 to 740 MHz is ac coupled to Buffer Amplifier No. 2.

Buffer Amplifiers No. 2 and 3

The dc current flowing through resistors R25 and R26 dc bias the base of Q2 at approximately 2.0 Vdc. Resistor R27 is the emitter bias resistor and capacitors C36 and C37 are the emitter resistor bypass to ground. Inductor L24 is an RF choke while capacitors C38 and C39 are RF bypass capacitors. L23, L25 and C41 all serve as matching elements. The output of Buffer Amplifier No. 2 is ac coupled to the Compensation Network by capacitor C41. The Compensation Network is adjusted to keep the 690 to 740 MHz flatness within ±1.5 dB. The signal is ac coupled to Buffer Amplifier No. 3 which functions the same as Buffer Amplifier No. 2. The output of the buffer amplifier passes through Bandpass Filter FL1 which passes the difference frequencies (between 690 and 740 MHz) from the Mixer and filters and eliminates all the other frequencies. A frequency between 690 and 740 MHz goes to the Mixer in the High Frequency Loop (refer to Service Sheet 1) to serve as a phase locked reference for the High Frequency Voltage Controlled Oscillator.

TROUBLESHOOTING

Procedures for checking circuits of the A8 Frequency Multiplier Assembly are given below. The areas or points to check are marked on the schematic by a hexagon with a check mark and a number inside, e.g. ⟨√3⟩. Fixed voltages are shown on the schematic inside a hexagon, e.g. ⟨2V±0.2V⟩ Transistor bias voltages are shown without tolerances.

Test Equipment

Power Meter	HP 436A
Power Sensor	HP 8482A
Digital Multimeter	HP 3456A
Frequency Counter	HP 5328A
Adapter-Probe	HP 1250-1598
Adapter-Type N(male) to BNC (female)	HP 1250-0780
Cable-BNC(male) to SMC(female)	HP 08662-60080

⟨√1⟩ Multiplier Stages Bias Voltages

1. Set the Signal Generator to any frequency.

2. Measure and verify the bias voltages as indicated in Table 1.

⟨√2⟩ RF Levels

1. Set the Signal Generator to any frequency.

2. Check 50 MHz Reference Oscillator input to Frequency Multiplier Assembly at W5 with W5 disconnected. The level should be +15 dBm ±4.0 dB.

ManualsPlus.com

Table 1. Multiplier Stages Bias Voltages

Transistor	50 MHz Input Signal (Vdc)	
	Connected	Not Connected
Q8-E (J2-Pin 2) Q8-B Q8-C	+0.8 +1.0 +5.0	+0.23 to 0.47 +1.0 +5.0
Q7-E (J2-Pin 4) Q7-B Q7-C	+0.35 +1.0 +5.0	+0.23 to 0.47 +1.0 +5.0
Q6-E (J2-Pin 6) Q6B	+0.8 +1.0	+0.23 to 0.47 +1.0
Q5-E (J2-Pin 8) Q5-B Q5-C	+0.8 +1.0 +5.0	+0.23 to 0.47 +1.0 +5.0

3. Reconnect W5.

4. Check 60 to 110 MHz Low Frequency Loop input to Frequency Multiplier Assembly at W3 with W3 disconnected. The level should be −7 dBm ±2.0 dB

5. Reconnect W3.

6. Table 2 shows power levels at various points and the conditions for measurement. Verify that each level is within the required range.

Table 2. RF Power Levels

Conditions	RF Power Levels (dBm) at Measurement Locations				
	W10	TP3	TP2	TP1	Filter Output
All Cables Connected	+7 to +1	+8 to +2	+8 to +2	−20 to −14	+8 to +2
W10 Not Connected	+9 to +5	+9 to +5	+9 to +5	–	–
Jumper Removed		–	–	−14 to −10	–
Filter Not Connected	–	–	–	–	+7 to +3

ManualsPlus.com

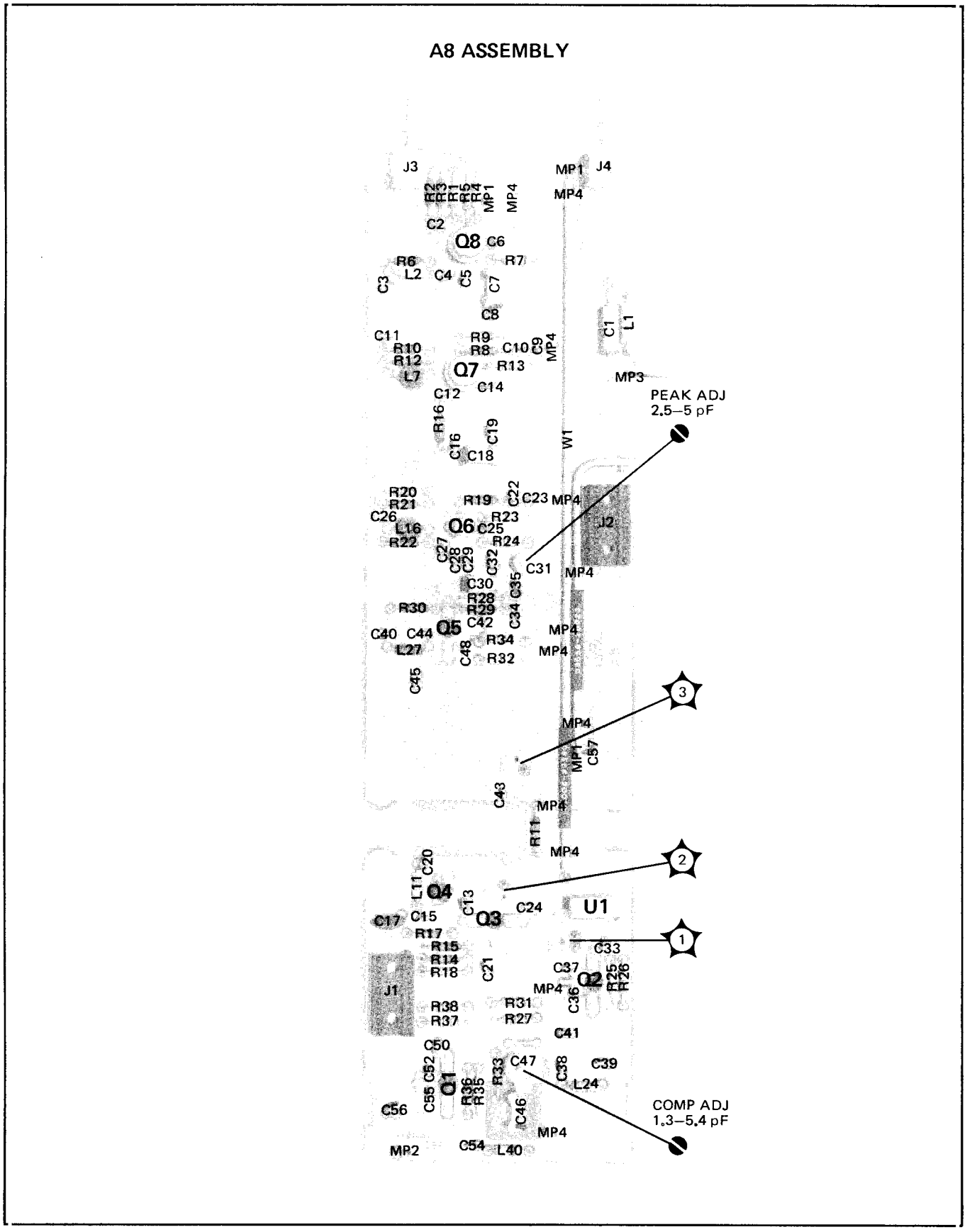
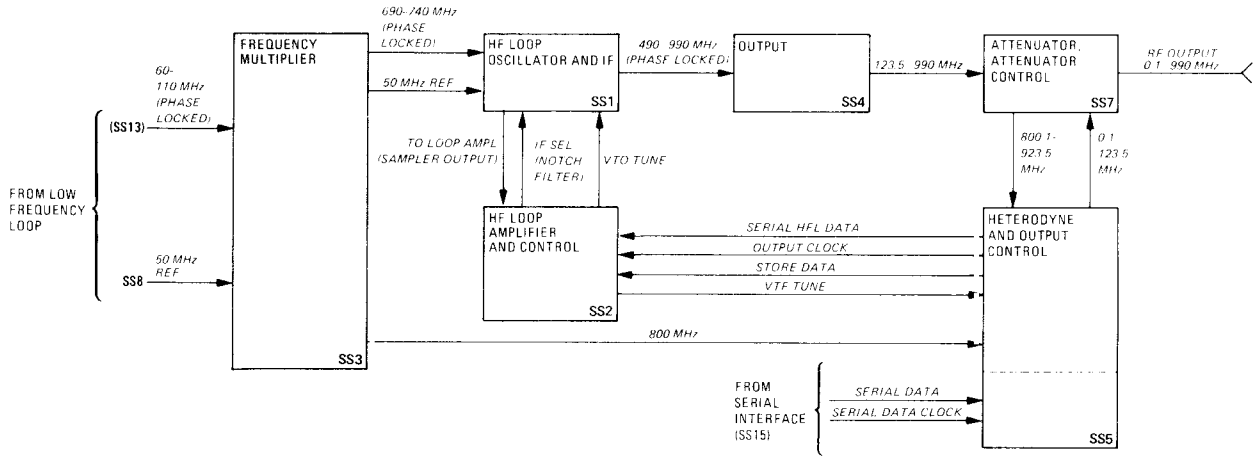


Figure 8-44. Frequency Multiplier Component Locations

ManualsPlus.com



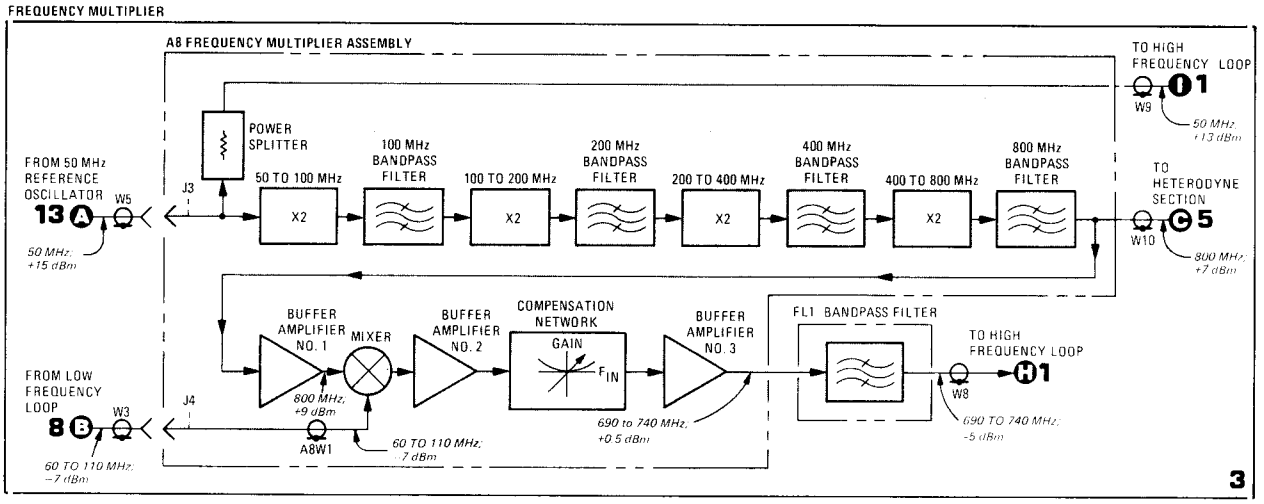
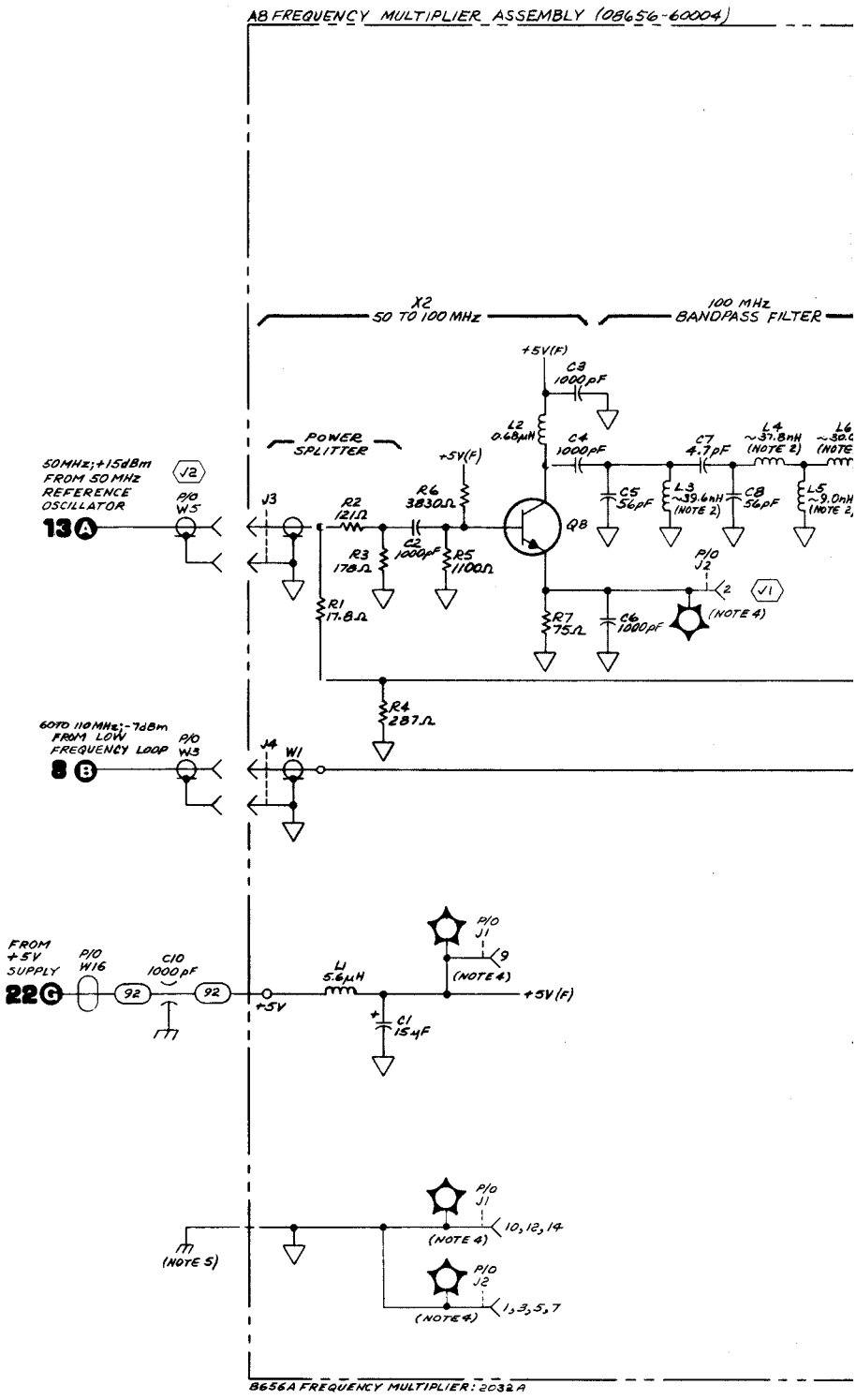


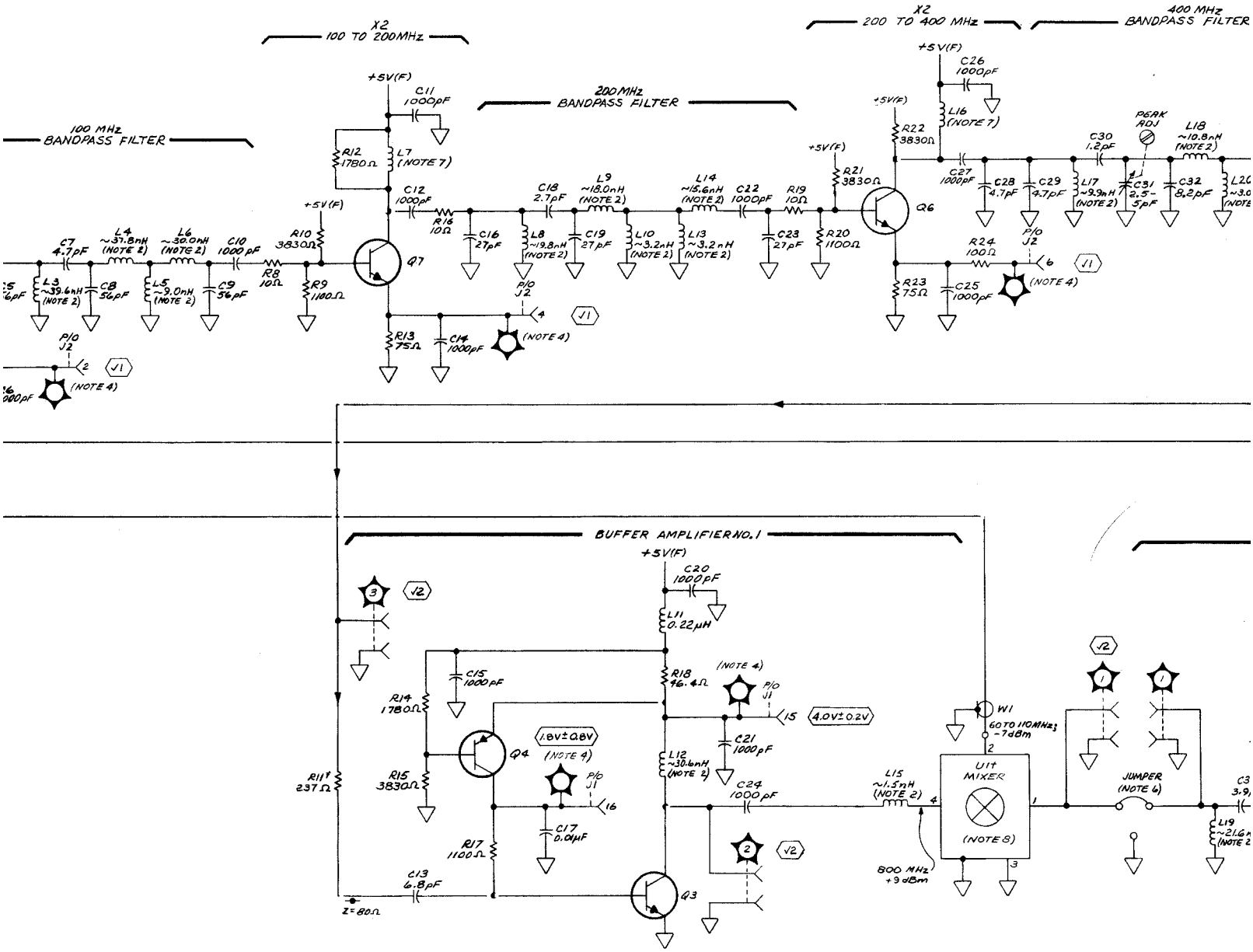
Figure 8-45. Frequency Multiplier Block Diagrams

ManualsPlus.com

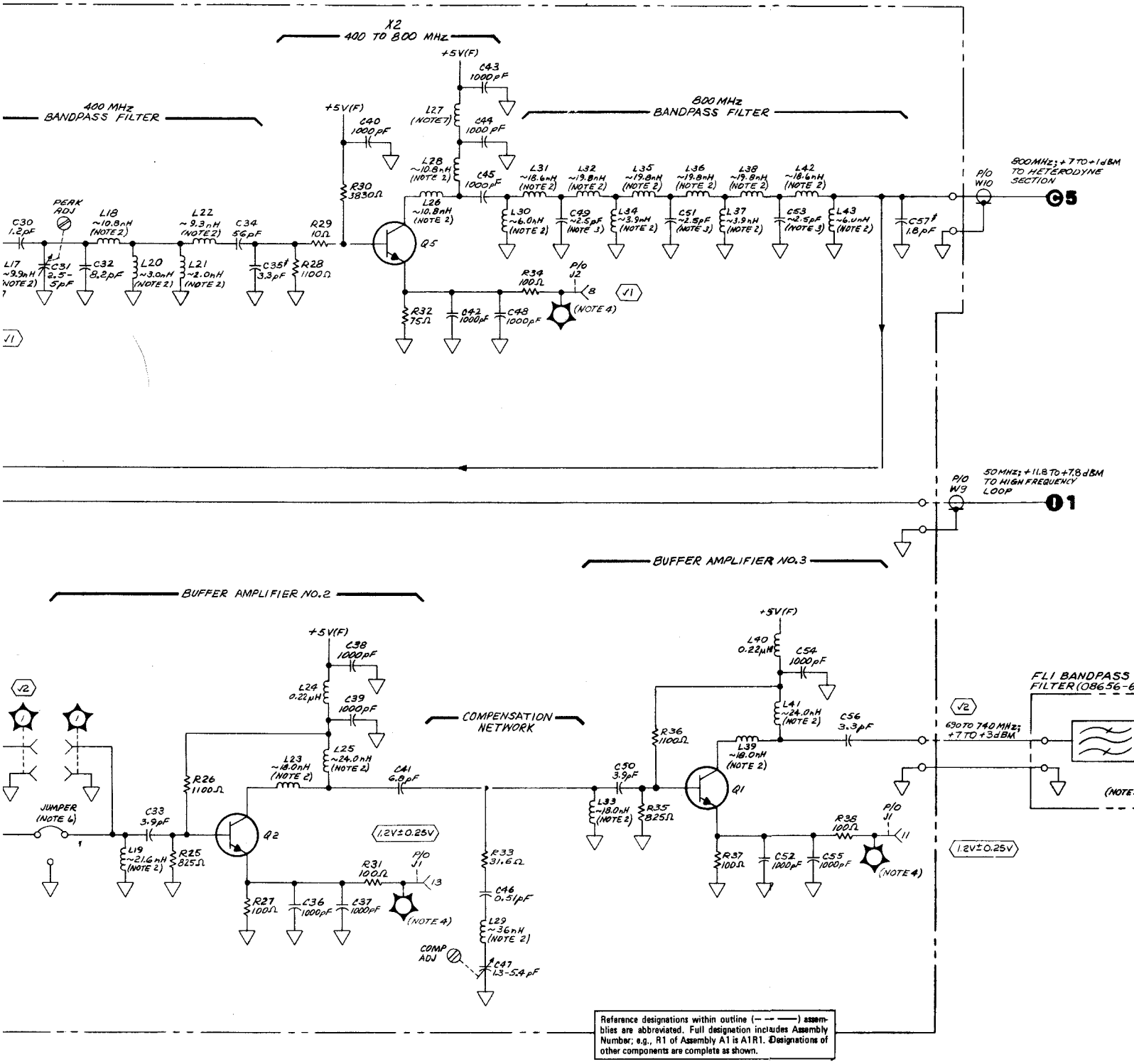


ManualsPlus.com

656-60004)



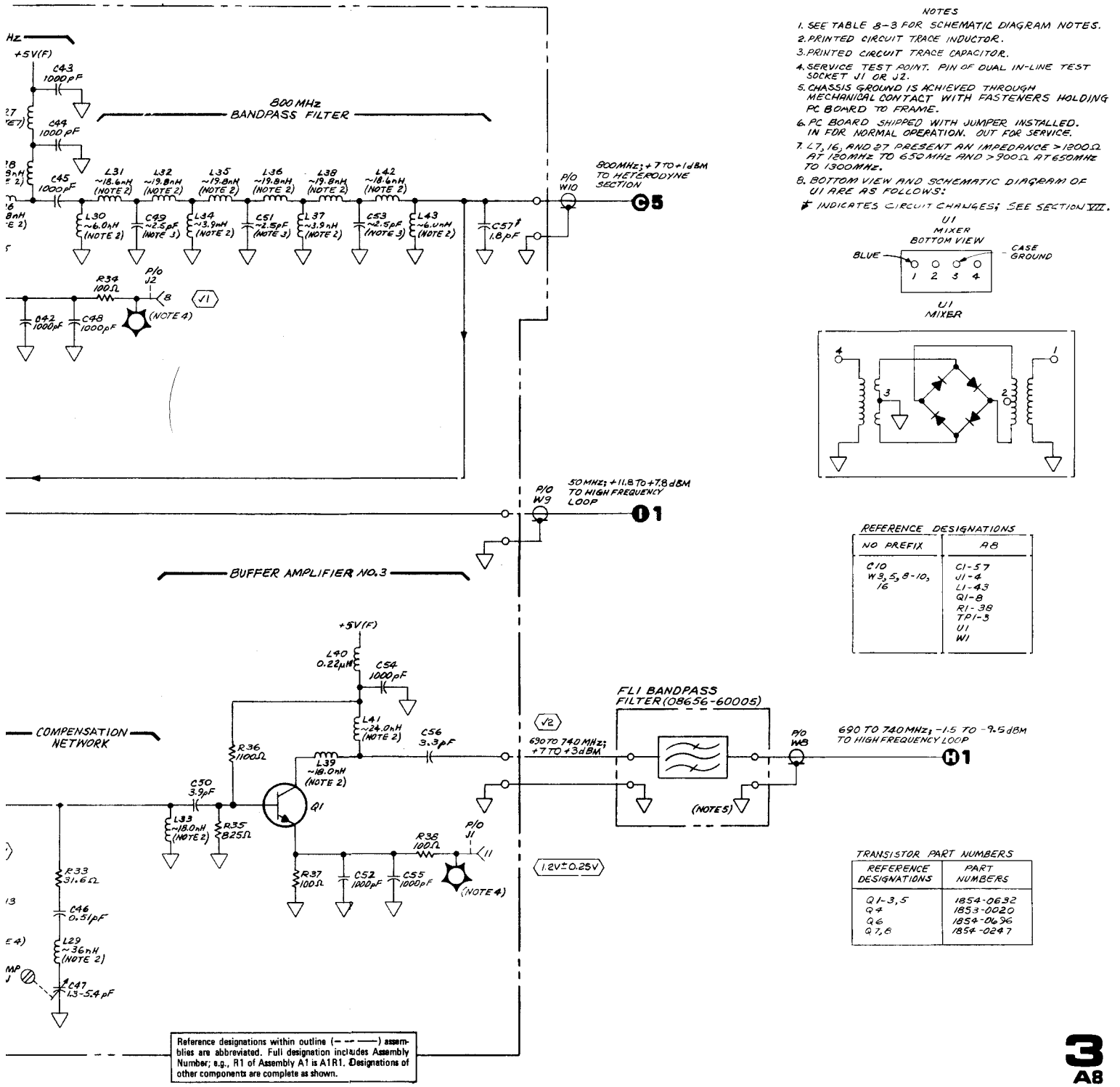
ManualsPlus.com



Reference designations within outline (— — —) assemblies are abbreviated. Full designation includes Assembly Number; e.g., R1 of Assembly A1 is A1R1. Designations of other components are complete as shown.

Figure

ManualsPlus.com



NOTES

1. SEE TABLE 8-3 FOR SCHEMATIC DIAGRAM NOTES.
2. PRINTED CIRCUIT TRACE INDUCTOR.
3. PRINTED CIRCUIT TRACE CAPACITOR.
4. SERVICE TEST POINT. PIN OF DUAL IN-LINE TEST SOCKET J1 OR J2.
5. CHASSIS GROUND IS ACHIEVED THROUGH MECHANICAL CONTACT WITH FASTENERS HOLDING PC BOARD TO FRAME.
6. PC BOARD SHIPPED WITH JUMPER INSTALLED. IN FOR NORMAL OPERATION. OUT FOR SERVICE.
7. L7, 16, AND 27 PRESENT AN IMPEDANCE >1200Ω AT 120MHz TO 650 MHz AND >900Ω AT 650MHz TO 1300MHz.
8. BOTTOM VIEW AND SCHEMATIC DIAGRAM OF U1 ARE AS FOLLOWS:

* INDICATES CIRCUIT CHANGES; SEE SECTION VIII.

REFERENCE DESIGNATIONS

NO PREFIX	A8
C10 W3, 5, 8-10, 16	C1-57 U1-4 L1-43 Q1-8 R1-38 TP1-3 U1 W1

TRANSISTOR PART NUMBERS

REFERENCE DESIGNATIONS	PART NUMBERS
Q1-3, 5	1854-0632
Q4	1853-0020
Q6	1854-0636
Q7, 8	1854-0247

3 A8

Figure 8-46. Frequency Multiplier Schematic Diagram

ManualsPlus.com

SERVICE SHEET 4 (Cont'd)

Table 2. RF Divider Chip Inputs

Signal Generator Frequency (MHz)	Voltages (Vdc) on	
	U1-pin 3	U2-pin 9
500	+4.0	+5.0
300	+3.3	+5.0
200	+3.3	+1.0

√2 Voltage-Tuned Filter

1. Set the Signal Generator to −10 dBm without modulation.

2. Check the voltages in Table 3 for each front panel frequency setting. If loop is not locked, the signal will be a triangular wave.

3. Set the Signal Generator to −10 dBm without modulation.

4. Connect a power meter to test point 2 and check the levels listed in Table 4.

5. Set switch S1 to open position and measure the dc voltage at TP2. It should be −2.0 ±0.5 Vdc.

√3 High Band Output Amplifier

1. Check bias voltages on transistors Q2, Q3, Q6, and Q7.

2. Set the Signal Generator to −10 dBm at 500 MHz without modulation.

3. Check the power level at W14 using the adaptor probe. The power level should be −3.5 dBm ±3.0 dB.

4. Change the RF amplitude to +13 dBm.

5. Check the power level at W14. The power level should be +9.0 dBm ±3.0 dB.

6. Verify that the frequency at W14 is 500.000 MHz ±2 kHz.

√4 ALC Amplifier

1. Set the Signal Generator to 500 MHz without modulation.

Table 3. Voltage Tuned Filter Control Voltages

Signal Generator Frequency (MHz)	VTF TUNE Voltage (Vdc)		
	123.5 to 247 MHz	247 to 494	494 to 990 MHz
900	−0.5	−0.5	+14.0
600	−0.5	−0.5	+8.5
350	−0.5	+12.9	−0.5
300	−0.5	+8.5	−0.5
200	+14.2	−0.5	−0.5
150	+8.5	−0.5	−0.5

Table 4. ALC Loop Level Measurements

Test Point	ALC Loop Switch S1	Circuit Opened By*	Power Level (dBm)	
			Closed	Opened
TP2	Closed	Disconnect C24	−11 to −21	−14 to −18
TP2	Open	Disconnect C24	−5 to −10	−6 to −10
TP3	Closed	Disconnect C33,R34	−21 to −31	+1 to −1
TP3	Open	Disconnect C33,R34	−11 to −21	−7 to −11

*The circuit is opened by unsoldering one end of the component(s) and lifting the unsoldered end from the printed circuit board.

ManualsPlus.com

SERVICE SHEET 4 (Cont'd)

TROUBLESHOOTING

Procedures for checking part of the circuits of the A6 Output Assembly are given below. The area or points to check are marked on the schematic by a hexagon with a checkmark and a number inside, e.g. ⟨√3⟩. Fixed voltages are shown on the schematic inside a hexagon, e.g. ⟨2V±0.2V⟩. Transistor bias voltages are shown without tolerances.

Test Equipment

Digital Multimeter .....HP 3465A
Oscilloscope .....HP 1222A
Power Meter .....HP 436A
Power Sensor .....HP 8482A
Frequency Counter .....HP 5328A
Adapter Probe .....HP 1250-1598
Adapter-Type N(male) to
BNC(female) .....HP 1250-0780
Cable BNC(male) to SMC(female) ...HP 08662-60080

⟨√1⟩ RF Dividers

1. Set the Signal Generator to −10 dBm without modulation.

2. Check the voltages and levels as shown in Tables 1 and 2 for each front panel frequency setting.

Table 1. RF Divider Voltages

Signal Generator Freq. (MHz)	Divider Voltages (Vdc)			Voltages at Q1 (Vdc)			Signal at TP1	
	÷1 SEL	÷2 SEL	÷4 SEL	E	B	C	Level (dBm)	Freq (MHz)
500	+0.2	+4.8	+4.8	+4.4	+5.1	+8.6	+3.0 to −3.0	500
300	+8.0	+0.2	+8.0	+4.4	+5.1	+8.6	+3.0 to −3.0	600
200	+14	+14	+0.2	+4.4	+5.1	+8.5	+3.0 to −3.0	800

ManualsPlus.com

capacitor C40. The total voltage gain of the Output Amplifier is approximately 24 dB from the input of Q2 to the collector of Q7.

The Output Amplifier is ac coupled by C42 to the attenuator (through R53) and to the Detector of the ALC Loop. Resistor R53 approximates a 50 ohm output impedance. The 34.8Ω of the resistor and 5Ω of loss in associated circuitry account for an output impedance of 40 ohms which is not enough of a mismatch to cause a standing wave problem. This will reduce the power loss of the signal applied to the attenuator or to the heterodyne mixer for output frequencies from 100 kHz to 123.5 MHz. The power level of −7 to +15 dBm from the Output Amplifier is measured on the output side of R53.

ALC Loop

The Output Detector of the ALC Loop detects the RF voltage at the output of the High Band Output Amplifier. The level of the detected voltage is forced by the gain of the ALC Loop to be identical to the loop's reference voltage. Therefore, the Output Amplifier must be an RF voltage source and have zero ohms impedance. Resistor R50 provides a small amount of isolation between the detector diode CR39 and the Output Amplifier and rolls off the detector output by about 2 dB over the frequency range 123.5 to 990 MHz. The gain of the Output Amplifier increases about 2 dB and the attenuator losses increase about 2 dB over this range. This helps to keep the output flat without correction. Capacitor C37 couples the RF to detector diode CR39 and stores the dc charge. Inductor L33 and capacitor C36 filter out the RF present on the dc voltage.

Detector Bias. Transistors Q8 and Q12 bias on diodes CR38 and CR39. The transistors are biased on by the resistor divider network of R40, R41 and R42. Q8 biases on CR38 and is the current source for CR38. Q12 biases on CR39 and sinks the current from both CR38 and CR39 to the −15 Vdc supply. The Detector Adjustment (Det Adj) R35 is adjusted for identical currents flowing through CR38 and CR39. When the Detector Adjustment is adjusted correctly there is a voltage difference of approximately 54 mV between the cathodes of the two diodes. This is the ideal offset voltage for the diode detector when the detector is operating linearly. Diode CR38 also temperature compensates the detector.

ALC Amplifier. The dc voltage at the collector of Q8 is equal to the peak voltage of the RF output of the Output Amplifier except for the roll off of R50 and C37. This dc voltage is the positive input to the ALC Amplifier, U6. The voltage to the negative input is the dc level correction voltage and the amplitude modulation voltage when AM modulation is selected from the Audio/Power Supply, A10. The negative input voltage is shaped by resistors R27, R30, R31 and diodes CR31 and CR37. For very low levels, the input voltage characteristic should approximate the square law region of the detector. (The square law region is the non-linear portion of the detector's current-versus-voltage curve. In this region the change in current is proportional to the square of the change in voltage.) If the voltages to the inputs are the same, there is very little distortion.

ManualsPlus.com

problem if the filter selected is tuned to its highest frequency before the Voltage Controlled Oscillator reaches its highest frequency.

The VTF Drivers turn on the selected input and output diodes of the VTF. These are CR20 and CR36, CR19 and CR35 or CR21 and CR34. The current that biases on the input and output diodes is returned to the −15 volt supply by the VTF input resistors R21 and R98 and output resistor R29.

When a Voltage-Tuned Filter is not selected, the varactor diodes and parallel diodes at the input and output are forward biased by the current through R24, R25 or R26. This tends to increase the isolation of the unused filters. Note that the input and output diodes are biased off. Inductors L22, L23 and L24 are RF chokes.

The tune voltage of +3 to +15 volts will vary the capacitance of the varactors approximately 7 to 32 pF in the divide-by-2 and divide-by-4 filters and approximately 3.5 to 8 pF in the divide-by-1 filter.

Output Amplifier

The output of the Voltage Tuned Filters is ac coupled to the two stage Output Amplifier by capacitors C30 and C33. Capacitors C28 and 31 are distributed along the connecting transmission line to match the output of the Voltage Tuned Filters to the input of the Output Amplifier. The amplifier's input resistor R34 and inductor L31 give an input impedance of approximately 50 ohms at the low frequencies. At the high frequencies feedback in the Output Amplifier provides a 50 ohm input impedance.

The Output Amplifier is a two stage amplifier consisting of transistors Q2 and 7. Transistor Q3 provides active bias for Q2 and Q6 does the same for Q7. Transistor Q3 is biased on by +10.6 Vdc (+15 Vdc divided by resistors R10 and R11). The emitter voltage is then approximately +11.2 Vdc and current flow through Q2 will influence this emitter voltage. A current flow increase through Q2 decreases the emitter voltage. This reduces the current through Q3 thus reducing the bias voltage at the base of Q2. Therefore the current through Q2 is reduced. The net effect is that Q3 and Q6 provide negative feedback to Q2 and Q7 respectively. The emitter of Q2 has four resistors R39, R43, R44 and R47 in parallel and a bypass capacitor C39. All are used to reduce the inductance at the emitter. Resistor R45, inductor L32 and capacitor C34 provide an RF shunt feedback path from the collector to the base of Q2. At low frequencies, (100 to 500 MHz) the input impedance of Q7 is zero ohms and there is no RF voltage at the collector of Q2 and no shunt feedback. At the higher frequencies the input impedance of Q7 increases above zero ohms and there is an RF voltage feedback from collector to base of Q2. This feedback helps keep the input impedance of Q2 at approximately 50 ohms as the reactance of L31 masks the 50Ω resistor R34. Masking the 50 ohm input resistor increases the input to Q2 by approximately 3 dB and therefore the amplifier's output increases the same amount. The last amplifier Q7 is a grounded emitter shunt feedback amplifier. RF feedback is by resistor R51, inductor L35 and

ManualsPlus.com

U1 is applied to Q1 which can no longer function as an emitter follower with CR9 turned off. The output is coupled from the collector of Q1 to the input of the second divider U2 by C11. Divider U2 is activated when CR11 is turned on so U2 pin 9 is pulled low. RF Divider U2 is always biased at the right voltage by R12 and R13 (+3.6 Vdc). U2 is temperature compensated by CR8 and CR10. The output of U2 is coupled by C21 and C22 to the PIN Modulator.

Inductors L14, L15 and L16 are RF chokes and resistor R15 biases the output of divider U2. Resistor R1 and inductor L1 supply dc bias voltage from CR3, CR5 and CR7 and block the RF signal.

PIN Modulator

The PIN Modulator consists of three series PIN diodes CR13, CR14 and CR18. There is a 20Ω transmission line between CR13 and CR14 and between CR14 and CR18. PIN diodes function as current controlled RF resistors where the RF resistance is inversely proportional to the current through the diodes. Approximately 50 mA current through the diodes will cause them to appear as shorts and the 20Ω transmission lines will cause a small mismatch resulting in an insertion loss of about 2 dB between the modulator's input and output.

With less than 50 mA, the diodes appear as resistors of several hundred ohms. The transmission line appears as a large capacitance. In this condition the frequency response would roll off at 6 dB/octave for a total of 18 dB for the three octaves. The input inductor L17 and resistor R16, the output inductor L18, resistor R19 and capacitor C23 function to compensate the frequency response by increasing the input and output impedance at the higher frequencies. At the lower frequencies the impedance is a few hundred ohms with a small reactance in series which decreases the gain at the lower frequencies. The modulator flatness over the three octaves is reduced to approximately ±3 dB.

The PIN Modulator is enclosed in a waveguide-beyond-cutoff filter that isolates the input from the output and provides 70 dB of dynamic range.

Voltage-Tuned Filters

Three voltage-tuned low pass filters pass the 123.5 to 990 MHz output of the PIN Modulator to remove the harmonics generated by the dividers and oscillator. Each filter covers one octave of the frequency range; therefore the harmonics are not passed to the Output Amplifier. The tune voltages for all the filter's are derived from the VTF TUNE line of the A4 Assembly's Loop Amplifier (refer to Service Sheet 2). This tune voltage is dependent on the frequency selected and is offset, amplified, and applied to the correct VTF by the VTF Drivers (part of the A6 Assembly; refer to Service Sheet 5). The +3 to +15 volts that tunes each Voltage Tuned Filter, tracks the tune voltage for the VCO as the oscillator is tuned from 494 to 990 MHz. Since the Voltage Tuned Filters are low pass filters, it is not a

ManualsPlus.com

SERVICE SHEET 4
P/O A6 OUTPUT ASSEMBLY
P/O A7 RFI ASSEMBLY

TROUBLESHOOTING HELP

Service Sheet BD2
Table 4-1. Abbreviated Performance Tests
Table 5-2. Post-Repair Adjustment Procedures

PRINCIPLES OF OPERATION

General

The 494 to 990 MHz signal from the High Frequency Oscillator is input to the RF Dividers. The signal is divided by one, two or four depending on the frequency selected at the front panel. The signal passes through the PIN Diode Modulator to the inputs to the Voltage-Tuned Filters. The signal is passed through one of the three filters as determined by the selected frequency. The filter output is amplified and coupled to the output attenuator and the Automatic Level Control (ALC) Loop.

In the ALC loop, the RF signal level is detected and compared to the dc component of the AM Ref Level input. The difference is amplified and coupled back to the PIN Modulator which acts as a current controlled attenuator. The loop serves to hold the output at a constant level.

RF Dividers

The 494 to 990 MHz oscillator output signal from the High Frequency Loop Amplifier (−3 to +4 dBm) is applied to the Output Assembly. The signal is ac coupled by C1 into the RF Dividers where they are divided by one, two or four depending on the Output Frequency selected at the front panel. The RF Dividers divide-by-one when an output frequency from 494 to 990 MHz, or less than 123.5 MHz is selected. The RF Divider divides-by-two when an output frequency from 247 to 494 MHz is selected. It divides-by-four when an output frequency from 123.5 to 247 MHz is selected.

When the RF Divider is configured to divide-by-one, the logic output of the Band Select Dividers for divide-by-one is set low by the third bit of RF Word 2, (refer to Service Sheet 5). With the divide-by-one control line low, diodes CR5 and CR7 are turned on and the signal is coupled by C13 to the PIN Modulator.

In the divide-by-two configuration, the second bit of RF Word 2 sets the divide-by-two control line low and diodes CR2, CR3 and CR9 are turned on. With diode CR3 turned on, C2 couples the input signal to U1 where it is divided by two. The output of U1 is dc coupled to Q1 which functions as an emitter-follower. The output of Q1 is coupled to the PIN (diode) Modulator by C12. Inductor L7 supplies bias voltage for U1.

Diodes CR4 and CR6 along with either CR1 or CR2 (depending on which is selected) provide voltage offsets from +5 Vdc and ground to the bias resistors R2 and R4. The result is a bias voltage of about +2.7 Vdc at the input to U1. This ensures proper triggering on the RF signal in the divide-by-two or divide-by-four modes. Diodes CR4 and CR6 are also used for temperature compensation. Inductors L2, L6 and L7 are RF chokes that pass the dc control voltages and block the RF voltages.

In the divide-by-four configuration, the first bit of RF Word 2 sets the divide-by-four control line low and diodes CR1, CR3, CR11 and CR12 are turned on. The input signal is applied to U1 which functions the same as in the divide-by-two mode. The output of

ManualsPlus.com

SERVICE SHEET 4 (Cont'd)

2. Check the voltages at the stated locations and for the various output amplitudes listed in Table 5.

3. Set the Signal Generator to −10 dBm at 500 MHz with 50% AM depth and an Internal 1 kHz rate.

4. Check the waveforms and the Logic Level as indicated in Figure 1.

Table 5. ALC Amplifier Voltage Levels

Amplitude (dBm)	Test Point Measurement (Vdc)		
	J3-pin 3	J3-pin 15 and J3-pin 16	J3-pin 4*
+13	−1.4 to −6.4	+1.97 to +1.87	L
+10	−1.1 to −4.1	+1.45 to +1.35	L
+5	−1.5 to −4.0	+0.85 to +0.75	L
0	−1.2 to −3.7	+0.49 to +0.39	L
−4	−1.1 to −3.6	+0.33 to +0.23	L
−5	−1.5 to −4.0	+0.84 to +0.74	L

*Signal Generator must be in CW mode. Low is <+0.8 Vdc; K1 is closed.

Test Point	Waveform
J3 Pin 15 and J3 Pin 16	+1.1Vdc +0.7Vdc +0.3Vdc
J3 Pin 3	−1.76Vdc −2.0Vdc −2.24Vdc
J3 Pin 4	Logic level high >2.0 Vdc, K1 should be open

Figure 1. ALC Amplifier Waveforms and Logic Level

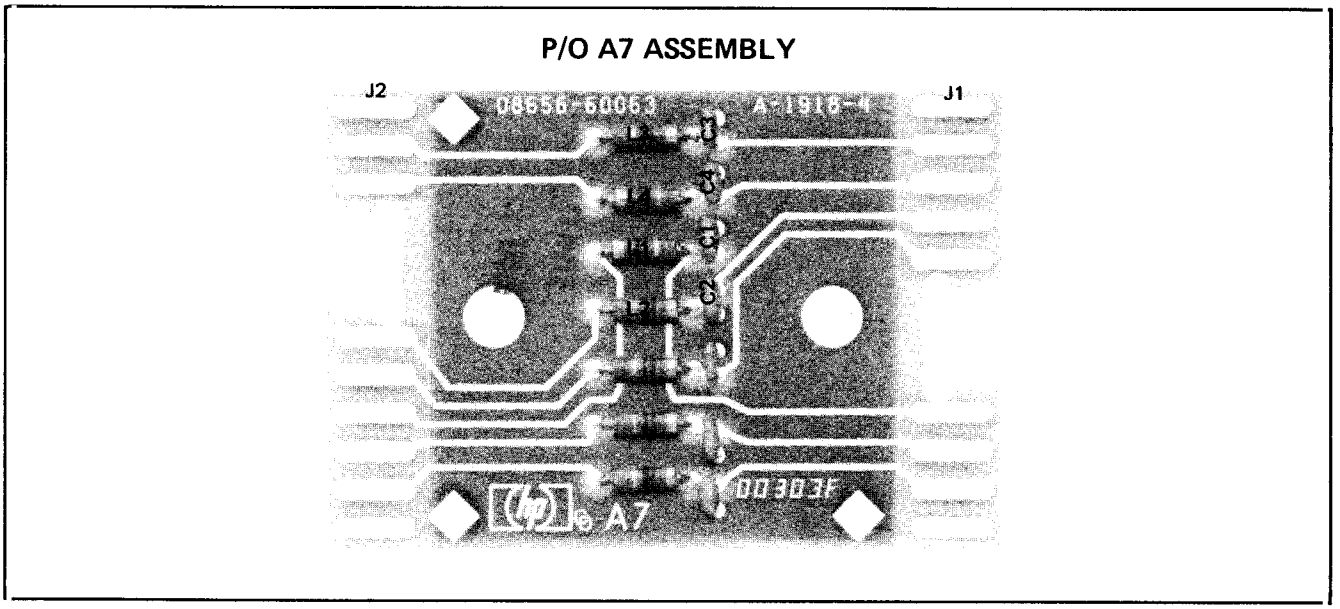


Figure 8-47. Output Section (A7 Assembly) Component Locations

ManualsPlus.com

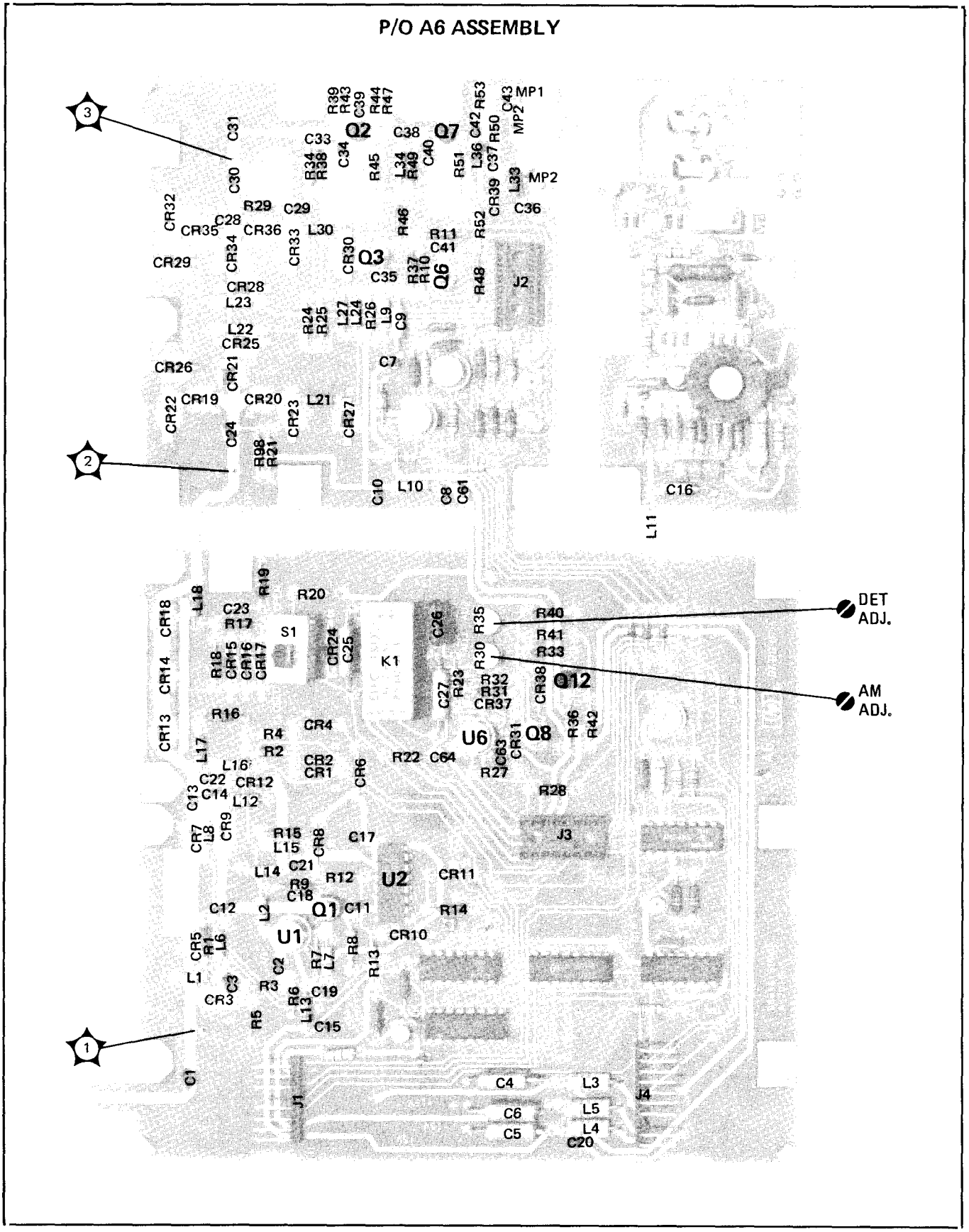
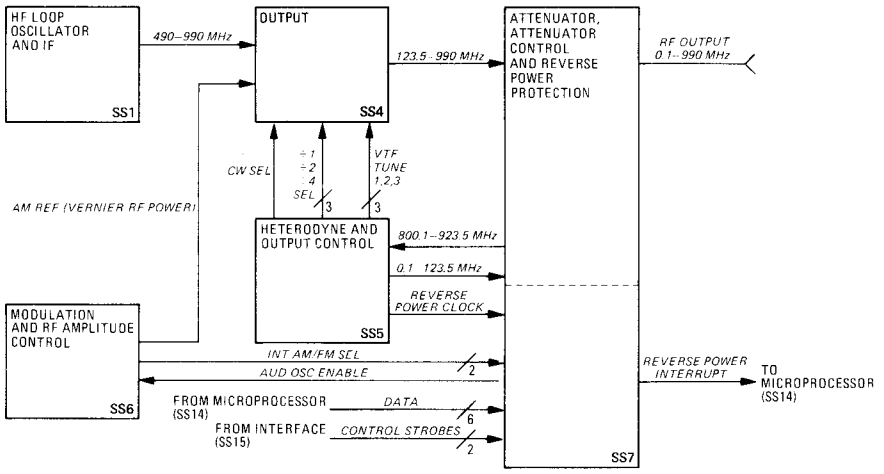


Figure 8-48. Output Section (A6 Assembly) Component Locations

ManualsPlus.com



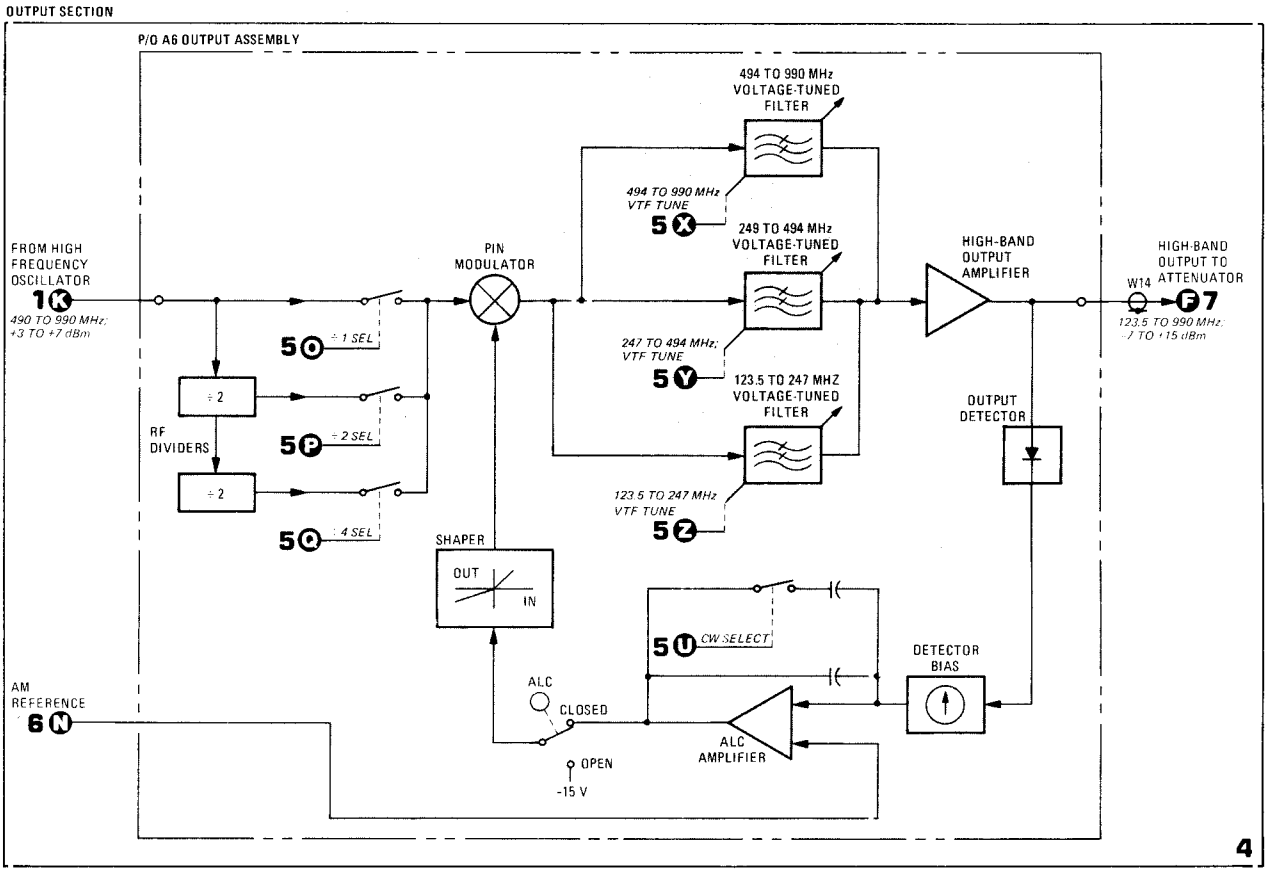
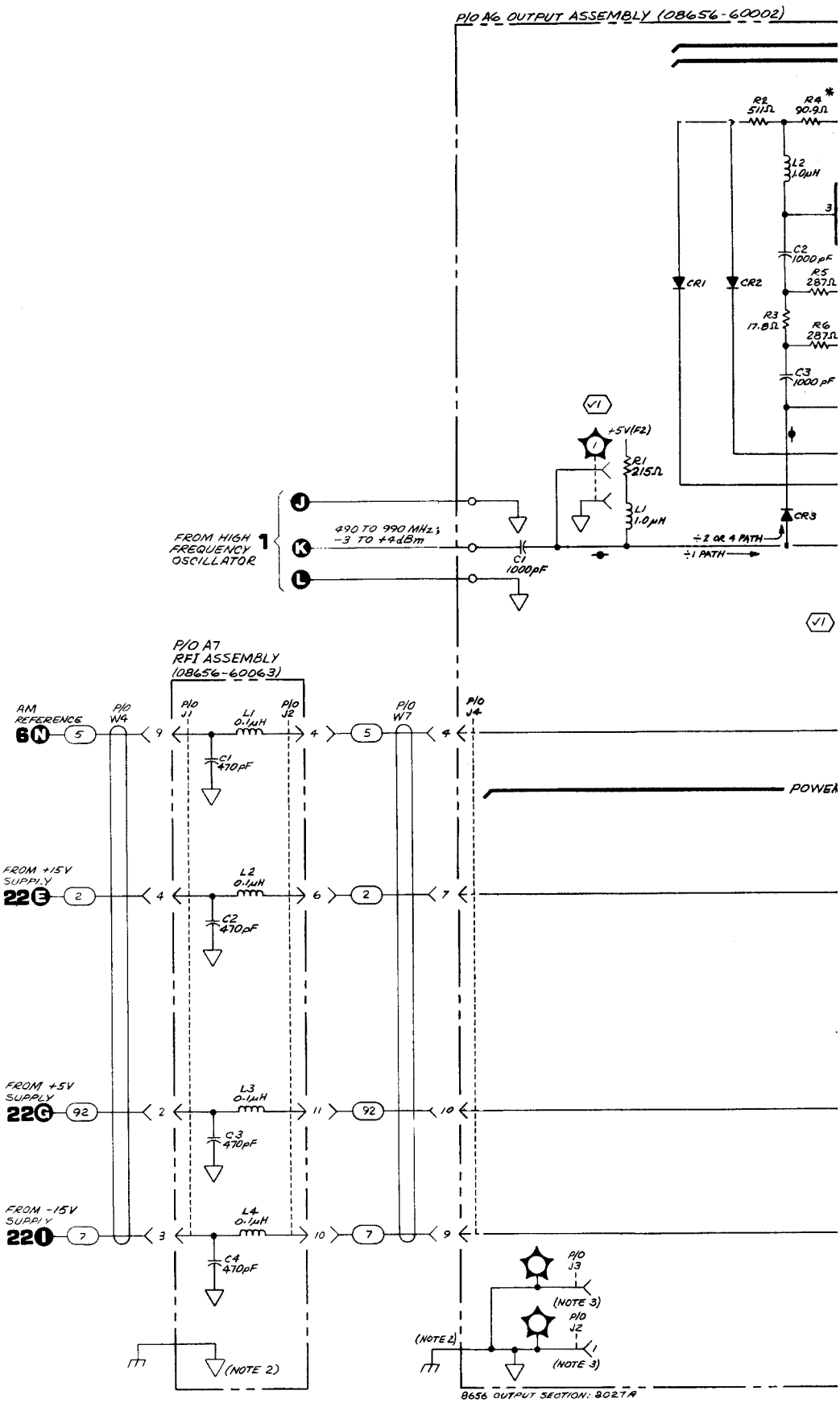
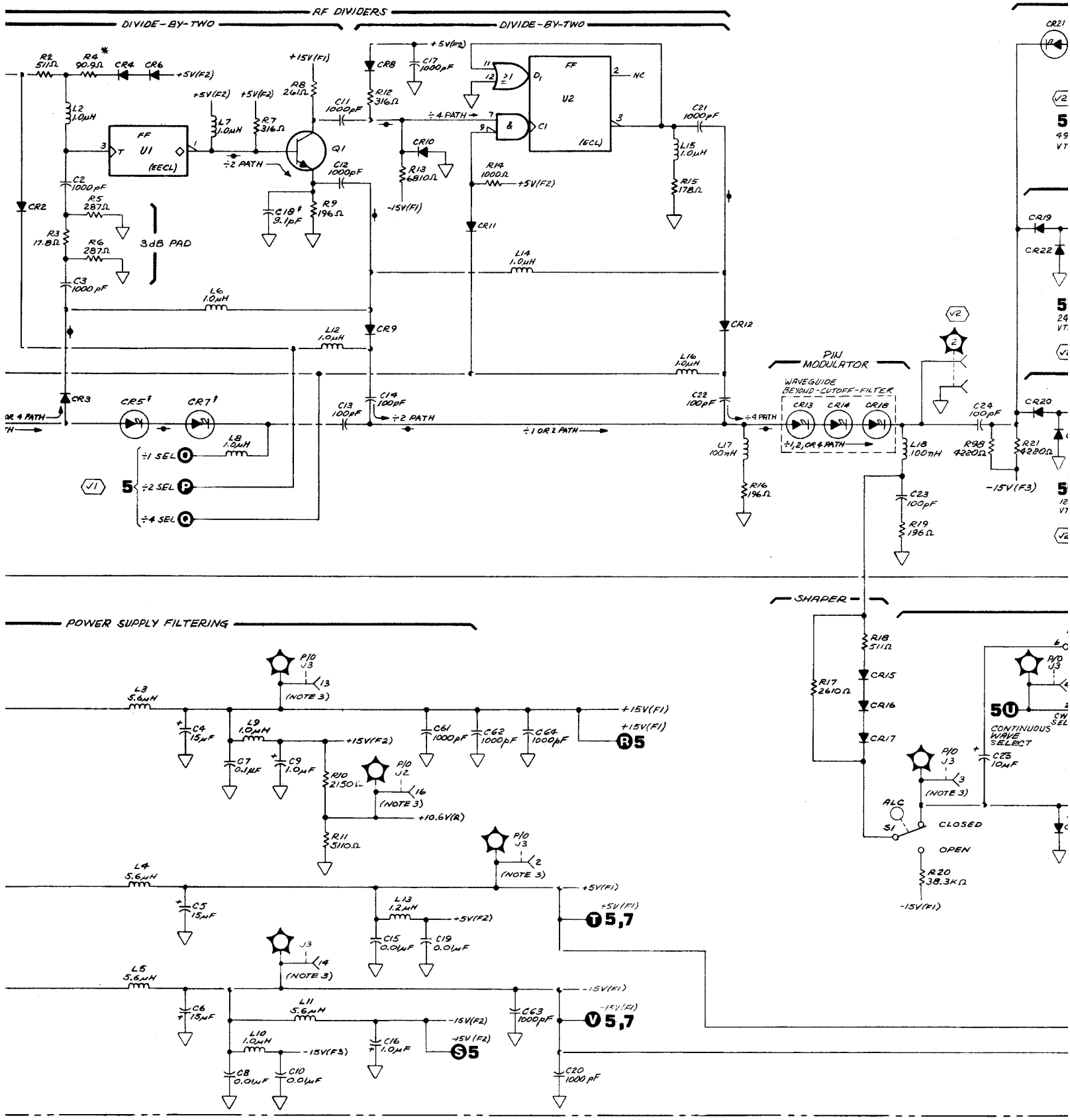


Figure 8-49. Output Section Block Diagrams

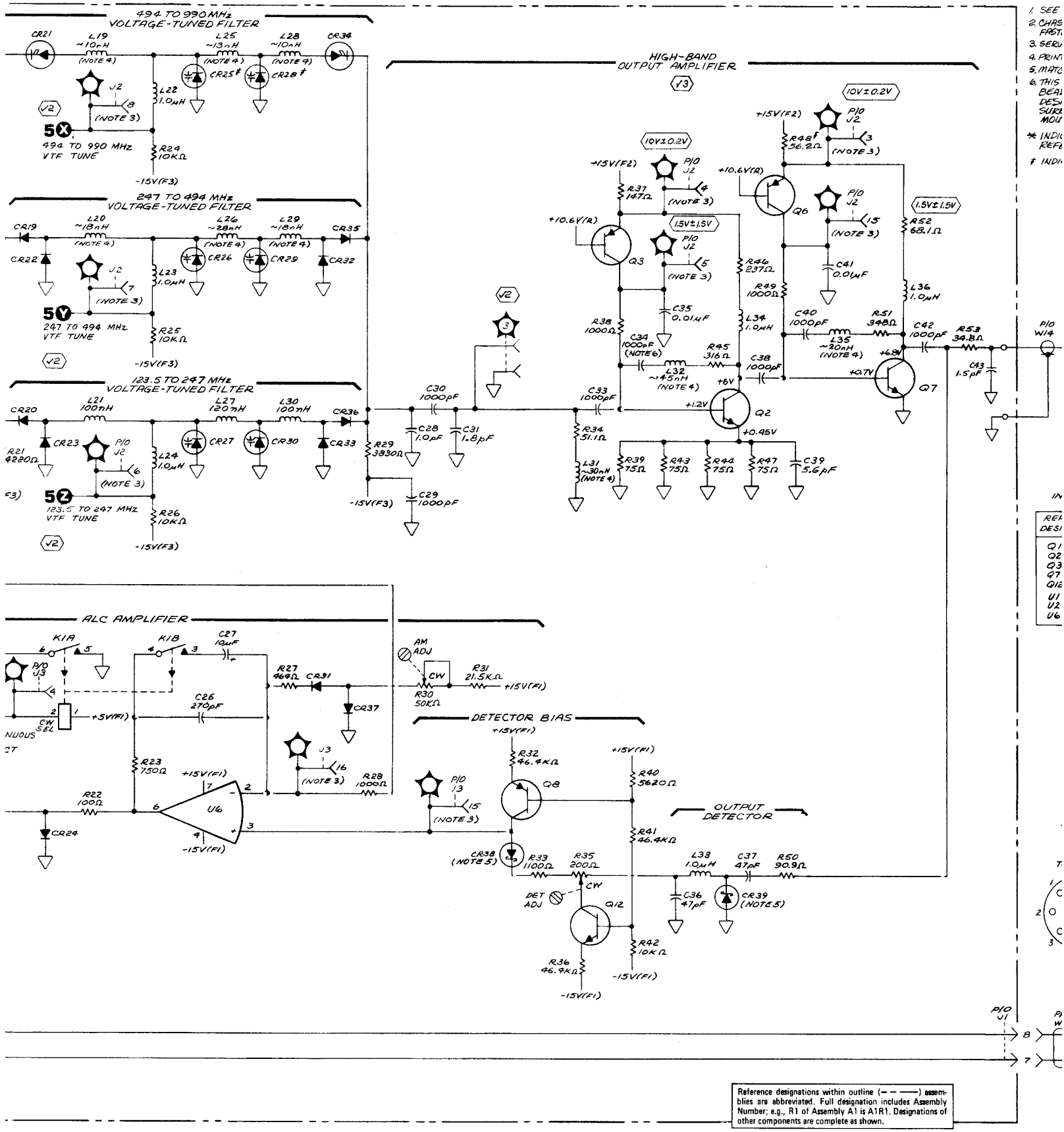
ManualsPlus.com



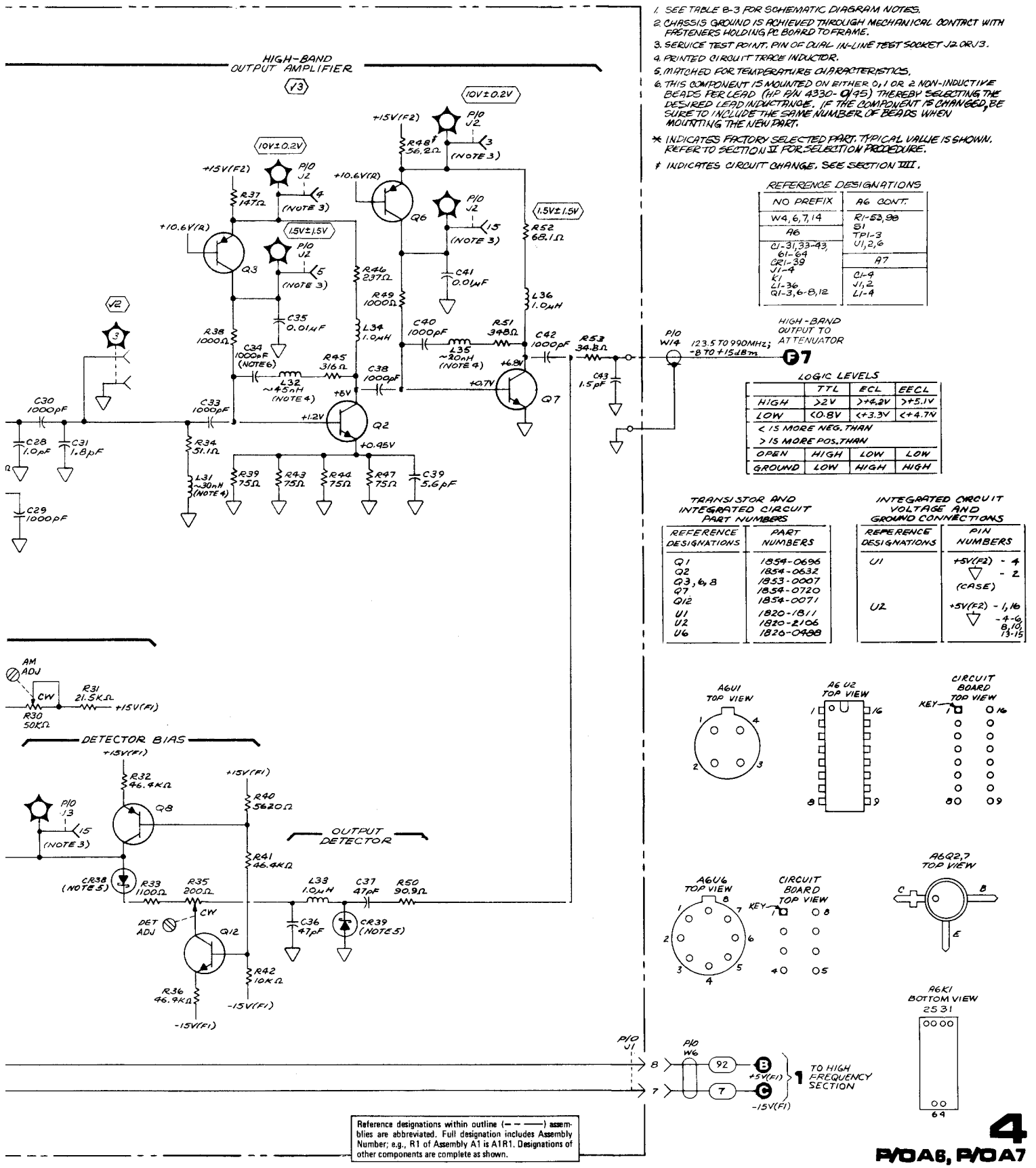
ManualsPlus.com



ManualsPlus.com



ManualsPlus.com



1. SEE TABLE 8-3 FOR SCHEMATIC DIAGRAM NOTES.
2. CHASSIS GROUND IS ACHIEVED THROUGH MECHANICAL CONTACT WITH FASTENERS HOLDING PC BOARD TO FRAME.
3. SERVICE TEST POINT. PIN OF DUAL IN-LINE TEST SOCKET J2 OR J3.
4. PRINTED CIRCUIT TRACE INDUCTOR.
5. MATCHED FOR TEMPERATURE CHARACTERISTICS.
6. THIS COMPONENT IS MOUNTED ON EITHER 0, 1 OR 2 NON-INDUCTIVE BEADS. PER LEAD (HP P/N 4330-0795) THEREBY SELECTING THE DESIRED LEAD INDUCTANCE. IF THE COMPONENT IS CHANGED, BE SURE TO INCLUDE THE SAME NUMBER OF BEADS WHEN MOUNTING THE NEW PART.

* INDICATES FACTORY SELECTED PART. TYPICAL VALUE IS SHOWN. REFER TO SECTION VI FOR SELECTION PROCEDURE.

# INDICATES CIRCUIT CHANGE. SEE SECTION III.

REFERENCE DESIGNATIONS

NO PREFIX	A6 CONT.
W4, 6, 7, 14	R1-53, 90
A6	S1
C1-31, 33-43, 61-64	TP1-3
CR1-39	U1, 2, 6
J1-4	A7
K1	C1-9
L1-36	J1, 2
Q1-3, 6-8, 12	L1-4

LOGIC LEVELS

	TTL	ECL	EECL
HIGH	>2V	>+4.2V	>+5.1V
LOW	<0.8V	<+3.3V	<+4.7V
< IS MORE NEG. THAN			
> IS MORE POS. THAN			
OPEN	HIGH	LOW	LOW
GROUND	LOW	HIGH	HIGH

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATIONS	PART NUMBERS
Q1	1854-0696
Q2	1854-0632
Q3, 6, 8	1853-0007
Q7	1854-0720
Q12	1854-0071
U1	1820-1811
U2	1820-2106
U6	1826-0488

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATIONS	PIN NUMBERS
U1	+5V(F2) - 4
	▽ - 2
	(CASE)
U2	+5V(F2) - 1, 16
	▽ - 4-6, 8, 10, 13-15

A6U1 TOP VIEW

A6 U2 TOP VIEW

CIRCUIT BOARD TOP VIEW

A6U6 TOP VIEW

CIRCUIT BOARD TOP VIEW

A6Q2,7 TOP VIEW

A6K1 BOTTOM VIEW

Reference designations within outline (— — —) assemblies are abbreviated. Full designation includes Assembly Number; e.g., R1 of Assembly A1 is A1R1. Designations of other components are complete as shown.

4

P/O A6, P/O A7

Figure 8-50. Output Section Schematic Diagram

ManualsPlus.com

P/O A7 ASSEMBLY

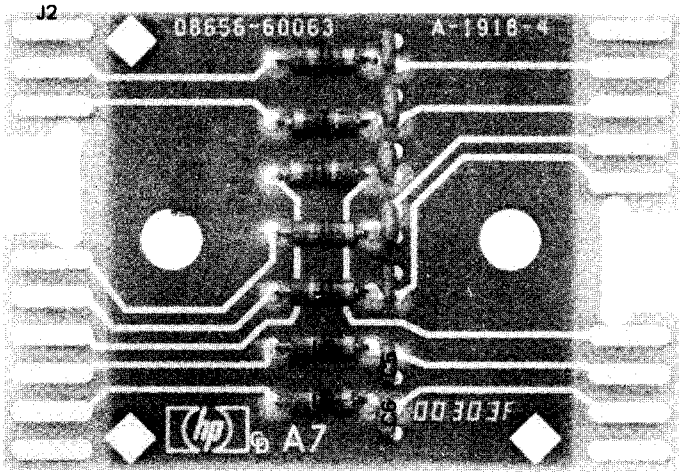


Figure 8-51. Heterodyne and Output Control (A7 Assembly) Component Locations

ManualsPlus.com

SERVICE SHEET 5 (Cont'd)

Purpose. Verify correct data transfer from the Microprocessor to the Output Assembly.

Setup. Connect the signature analyzer as follows:

1) GND to GND A11TP2
2) CLK to SA4 A11TP7
3) START to SA5 A11TP9
4) STOP to SA5 A11TP9

Set the signature analyzer controls as follows:

1) START-IN
2) STOP-OUT
3) CLK-IN

Set up the Signal Generator as follows:

1) On the A6 Output Assembly board, short TP5 and TP6 to TP4 (ground).
2) Set the LOGIC/RAM switch P/O A11S1 to LOGIC.

Initialize. Briefly short A11TP3 NMI to ground.

NOTE

With careless probing it is possible to get the Microprocessor into a program sequence other than that portion intended for signature analysis. If the +5V signature is incorrect, this has probably happened. Restart the test by setting the RST/RUN switch to RST and then RUN. Briefly touch the NMI test point to ground.

Probe. Connect the probe to the node indicated in Table 4. Verify that the signature at each node is correct and stable.

Table 4. Band Select Shift Register Signatures

Node	Correct Signature	Comments
+5V	F84P	
*U7#3	F84P	SIPO CLK
U7#2	6UPP	DATA IN
U7#4/U4#2	P9C5	÷4 BND
U7#5/U4#4	74HA	÷2 BND
U7#6/U4#6	3A6H	÷1 BND
U7#7/U4#15	9H36	CW BIT
U7#14/U4#12	029U	RF OFF

*This signature is the same as the +5V signature but the signature analyzer's probe should blink.

Remove the jumpers between ground, TP5 and TP6. Reset the LOGIC/RAM switch to the RAM position. Set the front panel RESET-STBY-ON switch to STBY and back to ON.

ManualsPlus.com

Table 3. Voltage Tuned Filter TUNE Voltages

Front Panel Frequency (MHz)	VTF TUNE (Vdc)			J2-Pin 13 (Vdc)
	123.5 to 247 MHz	247 to 494 MHz	494 to 990 MHz	
900	–0.5	–0.5	+14.3	+14.4
600	–0.5	–0.5	+ 8.5	+ 8.6
494	–0.5	–0.5	+ 4.9	+ 5.0
350	–0.5	+12.9	–0.5	+13.0
300	–0.5	+ 8.5	–0.5	+ 8.6
200	+14.3	–0.5	–0.5	+14.4
150	+ 8.6	–0.5	–0.5	+ 8.6

3. Remove the tune voltage to the A5 Assembly. The loop is unlocked. The waveforms shown in Figure 1 should occur on the stated connector and pin.

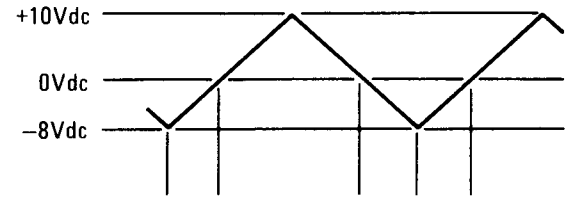
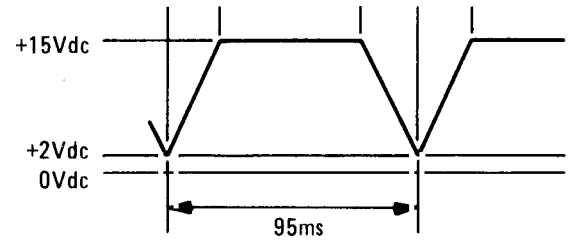
Test Point	Waveform
J2-pin 9	
J2-pin 13	

Figure 1. Waveforms with HF Loop Unlocked

TROUBLESHOOTING USING SIGNATURE ANALYSIS

This is an alternate method of troubleshooting the Service Sheet 5 (and Service Sheet 2) circuits. If the signatures for these circuits are correct, the problem may be in the controlled (analog) circuits. In this case, continue with the preceding troubleshooting information. Remember that a malfunction could be on the control (digital) circuits of Service Sheet 2. If the problem is definitely in the Output or High Frequency Loop circuits, you may wish to refer to BD2.

NOTE

The signatures are not valid for Signal Generators with serial number prefixes of 2018A and below.

ManualsPlus.com

SERVICE SHEET 5 (Cont'd)

Test Equipment (Cont'd)

Adapter, Type N male to
BNC female .....HP 1250-0780
Cable, BNC (male) to SMC (female) ....HP 08662-60080

√1 Heterodyne Section

1. Set the Signal Generator to −10 dBm at 100 MHz without modulation.

2. Measure power level and frequency as shown in Table 1 using the adapter probe.

Table 1. Heterodyne Section Power Levels

Test Point	Power Level (dBm)	Frequency (MHz)
W10	+6.5 to +3.5	800.00
W13	−2.5 to −4.5	900.00
C59	−3.0 to −4.0	100.00

√2 Output Section Data Storage/Driver

1. Set the Signal Generator to −10 dBm at 500 MHz without modulation (cw mode).

2. Check CW SEL at J3-pin 4. It should be +0.2 Vdc (low).

3. Set the Signal Generator to 50% AM at the internal 1 kHz rate.

4. Check CW SEL at J3-pin 4. It should be +5.0 Vdc (high).

5. Check voltages on the J3 test points at the front panel Frequency settings as indicated in Table 2.

Table 2. Band Select Shift Register and Driver Voltages

Front Panel Frequency (MHz)	Voltage Measured at J3 (Vdc)		
	÷1 SEL at Pin 8	÷2 SEL at Pin 5	÷4 SEL at Pin 7
500	+0.2	+4.8	+4.8
300	+8.4	+0.2	+8.4
200	+14.0	+14.0	+0.2

6. Check J3-Pin 12. It should measure less than or equal to +0.2 Vdc with the Signal Generator set to ON and +15.0 Vdc in the STBY mode.

√3 VTF Drivers

1. Set the Signal Generator to −10 dBm without modulation.

2. Check the voltages shown in Table 3 for the front panel frequency indicated. If the High Frequency Loop is not locked the voltage will be a triangular wave.

ManualsPlus.com

SERVICE SHEET 5 (Cont'd)

The output of Q14 is dc coupled to the base of Q15. Resistors R69 and R84 provide dc voltage for the collector of Q15. Inductors L52 and L53 are RF chokes. The emitter circuit components R77, R78, R81, R82, and C47 have the same function as those components of Q14. Resistor R85 and capacitor C49 are a low Q series resonant circuit used to increase the gain of Q15 at the higher frequencies.

The output of Q15 is ac coupled to the Attenuator Assembly by capacitor C59. The 383Ω resistor, R65, lowers the Q of the Diplexed Filter. The Low Band Output Amplifier provides 30 dB of gain ±0.5 dB to restore the RF signal to the same level as input but at the lower frequency.

VTF Drivers and Band Select

The VTF TUNE voltage from the A4 Assembly's Loop Amplifier is applied through voltage divider R71 and R73 to the negative input of U3. This variable tune voltage, −7.5 to +12 volts, is dependent on the frequency selected. The resistors, which act as a voltage divider, offset the input voltage. Operational amplifier U3, transistor Q5 and their associated components, further offset the input voltage. The resulting VTF TUNE voltages vary between +3 and +15 volts. The voltage at the negative input of U3 (the collector voltage of Q5 divided by resistors R75 and R76) is compared to the positive input of U3. Transistor Q5 is a power amplifier that increases the current capability, providing enough current to turn on the input and output diodes of the VTF selected.

Resistors R90 and R91, R86 and R87, and R79 and R80 provide dc bias for transistors Q9, Q10 and Q11 respectively. Transistors Q9, Q10, and Q11 are biased on by bits 5,6, and 7 of High Frequency Word 2. This control signal is received from the Microprocessor by the Band Select Shift Register and Drivers. When the fifth, sixth or seventh bit of the frequency word selects 0 Vdc, diodes CR42, CR41, or CR40 will be forward biased. This turns on transistor Q9, Q10, or Q11, selects the VTF and supplies the tune voltage. These three bits also select one of the three Voltage Tuned Filters on Service Sheet 4, thereby determining the RF Divider mode.

TROUBLESHOOTING

Procedures for checking the circuits of the A6 Output Assembly are given below. The area or points to check are marked on the schematic by a hexagon with a checkmark and a number inside, e.g. ⟨√3⟩. Fixed voltages are shown on the schematic inside a hexagon, e.g. ⟨2V ±0.2V⟩. Transistor bias voltages are shown without tolerances.

Test Equipment

Digital Multimeter	HP 3465A
Oscilloscope	HP 1222A
Power Meter	HP 436A
Power Sensor	HP 8482A
Frequency Counter	HP 5328A
Adapter Probe	HP 1250-1598

ManualsPlus.com

SERVICE SHEET 5
P/O A6 OUTPUT ASSEMBLY
P/O A7 RFI ASSEMBLY

TROUBLESHOOTING HELP

Service Sheet BD2
Table 4-1. Abbreviated Performance Tests
Table 5-2. Post-Repair Adjustment Procedures

PRINCIPLES OF OPERATION

General

When the RF OUTPUT frequency is between 0.1 and 123.5 MHz, the Divide-by-1/Heterodyne mode is selected. The High Frequency Loop's oscillator frequency, in this case between 800.1 and 923.5 MHz, is mixed with the 800 MHz reference signal. The difference frequencies from the Mixer are those that fall within the required RF output frequency band.

The VTF TUNE input is translated by the VTF Drivers to voltages that will tune each of the three VTF filters. The filter selected determines the RF divider mode.

Serial Output Data is clocked into the Band Select Shift Register and on to the register found among the circuits shown on Service Sheet 2. The output of U7 enables the appropriate VTF and the cw mode of operation.

Heterodyne Section

A Frequency input between 0.1 and 123.5 MHz selects the Divide-by-1/Heterodyne mode. The RF signal from the Output Assembly to the A9 Attenuator Assembly (between 800.1 and 923.5 MHz) is switched to the Output Assembly. Switching occurs at front panel frequencies of 123.5999 MHz when incrementing up and 123.4000 MHz when incrementing down. After mixing with the 800 MHz reference, the Diplexed Filter passes the difference frequencies while attenuating the other mixing products. The 0.1 to 123.5 MHz signal is applied to the step attenuator in the A9 Assembly before being coupled to the front panel RF OUTPUT connector.

A frequency from 800.1 MHz to 923.5 MHz at a level from +15 to −7 dBm, vernier dependent, is switched to the Output Assembly and applied to the Mixer A6U10 through an adjustable pad. The pad, consisting of resistors R55, R56, R57, R58 and C56, is adjustable from 20 to 24 dB. The pad reduces the signal into the mixer to a maximum of −7 dBm which prevents spurious signal generation. The LO input to the Mixer is a fixed frequency of 800 MHz at +6 dBm. The 800 MHz enters the Output Assembly through an 800 MHz Bandpass Filter where it is coupled to the Mixer. The difference output frequencies (0.1 to 123.5 MHz) are passed by the Diplexed Filter to the Low Band Output Amplifier. The input of the filter is diplexed by C57 and R59 to give a good match at all frequencies and to reduce spurious signals, primarily the summed mixing product. The output of the filter is ac coupled to the Low Band Output Amplifier by capacitor C52. The value of C52 provides the best signal coupling while preventing amplifier transistors Q14 and Q15 from being reverse biased when the instrument is turned on.

Resistors R64, R62, and R60 form a voltage divider used to dc bias Q14. The voltage divider also contains RF choke L50. Resistors R67, R70, and R72 in the emitter of Q14 provide series feedback. By using these three resistors, the inductance in the emitter current path is reduced. Resistor R68 completes the emitter's dc return and capacitor C55 is the ac path to ground.

ManualsPlus.com

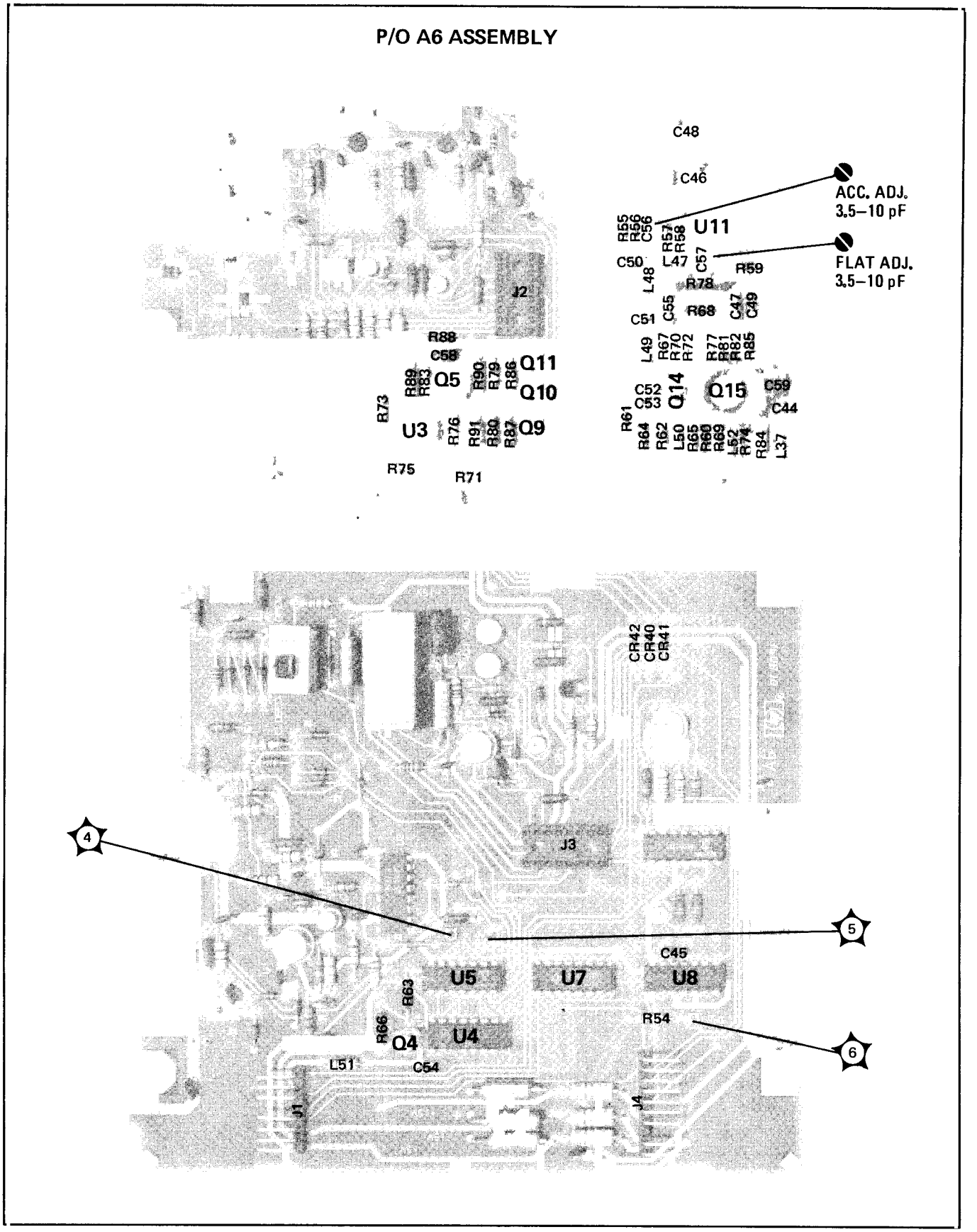
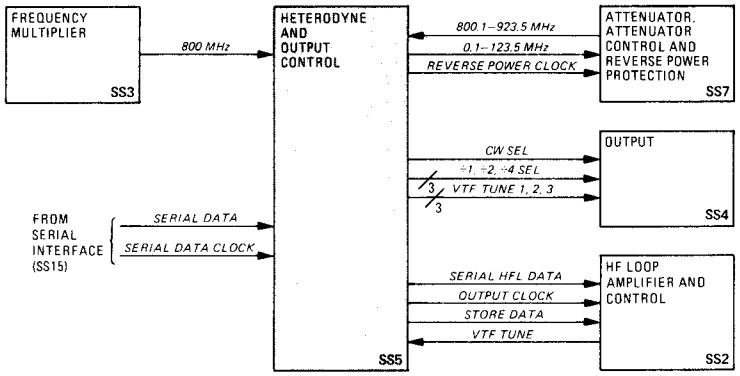


Figure 8-52. Heterodyne and Output Control (A6 Assembly) Component Locations

ManualsPlus.com



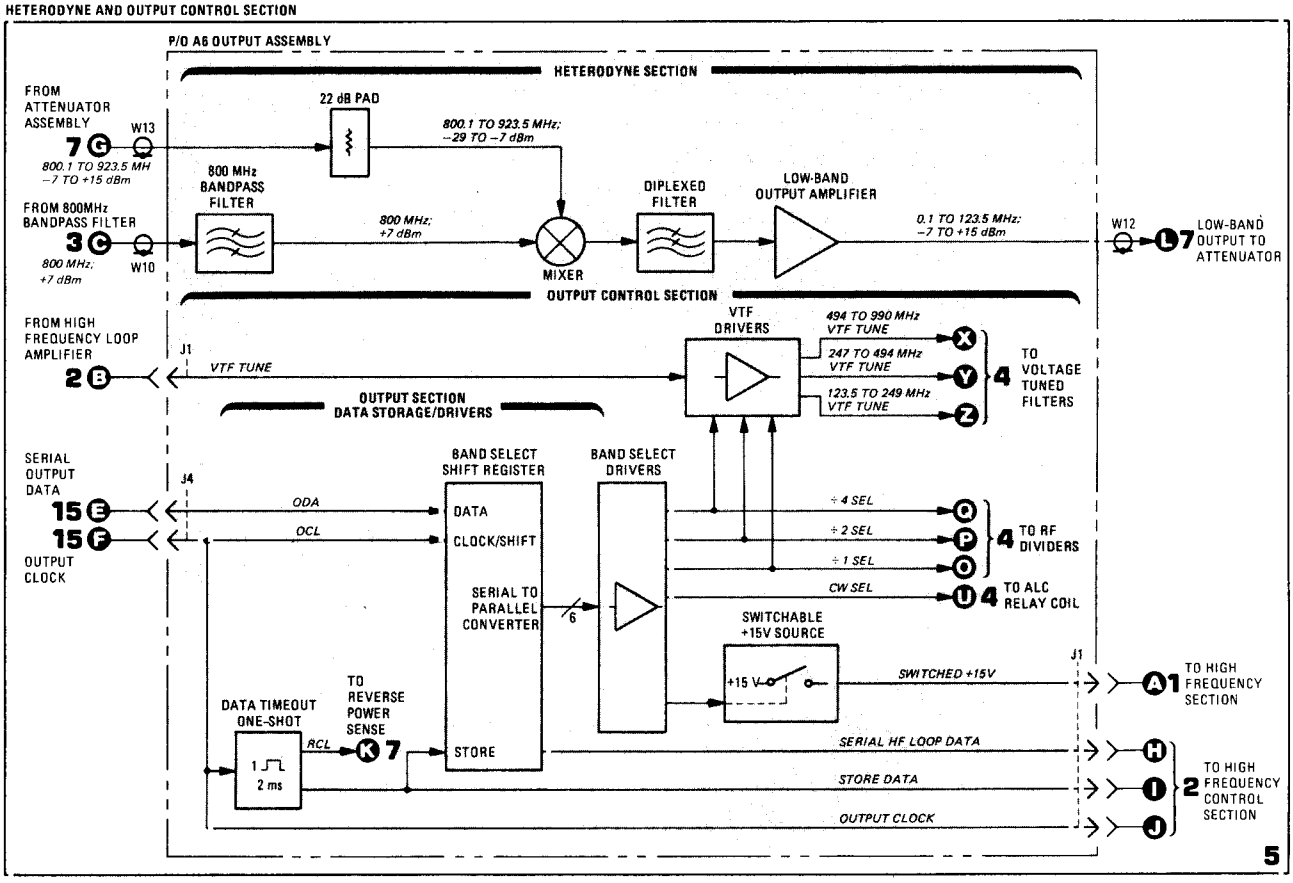
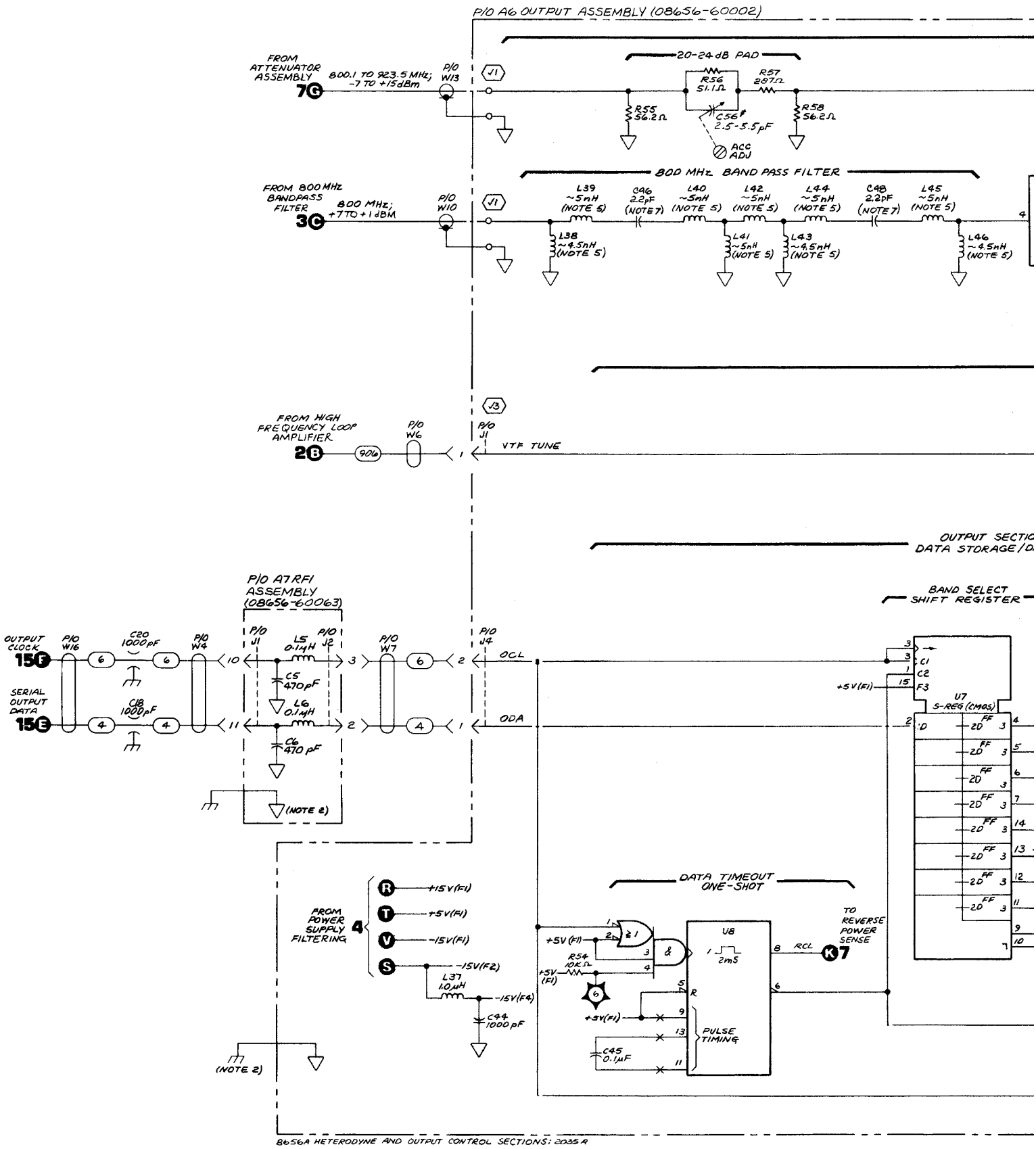
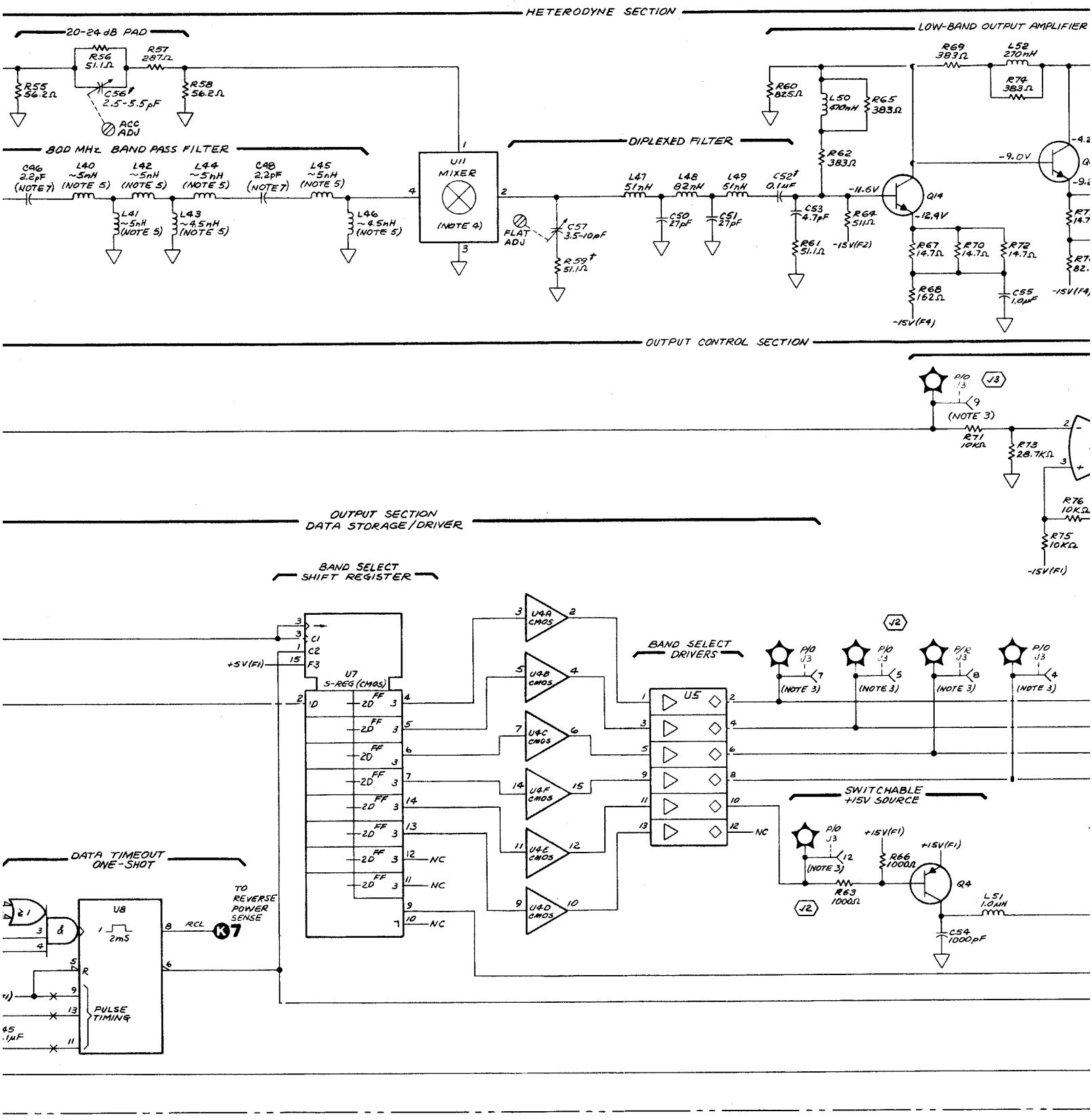


Figure 8-53. Heterodyne and Output Control Block Diagrams

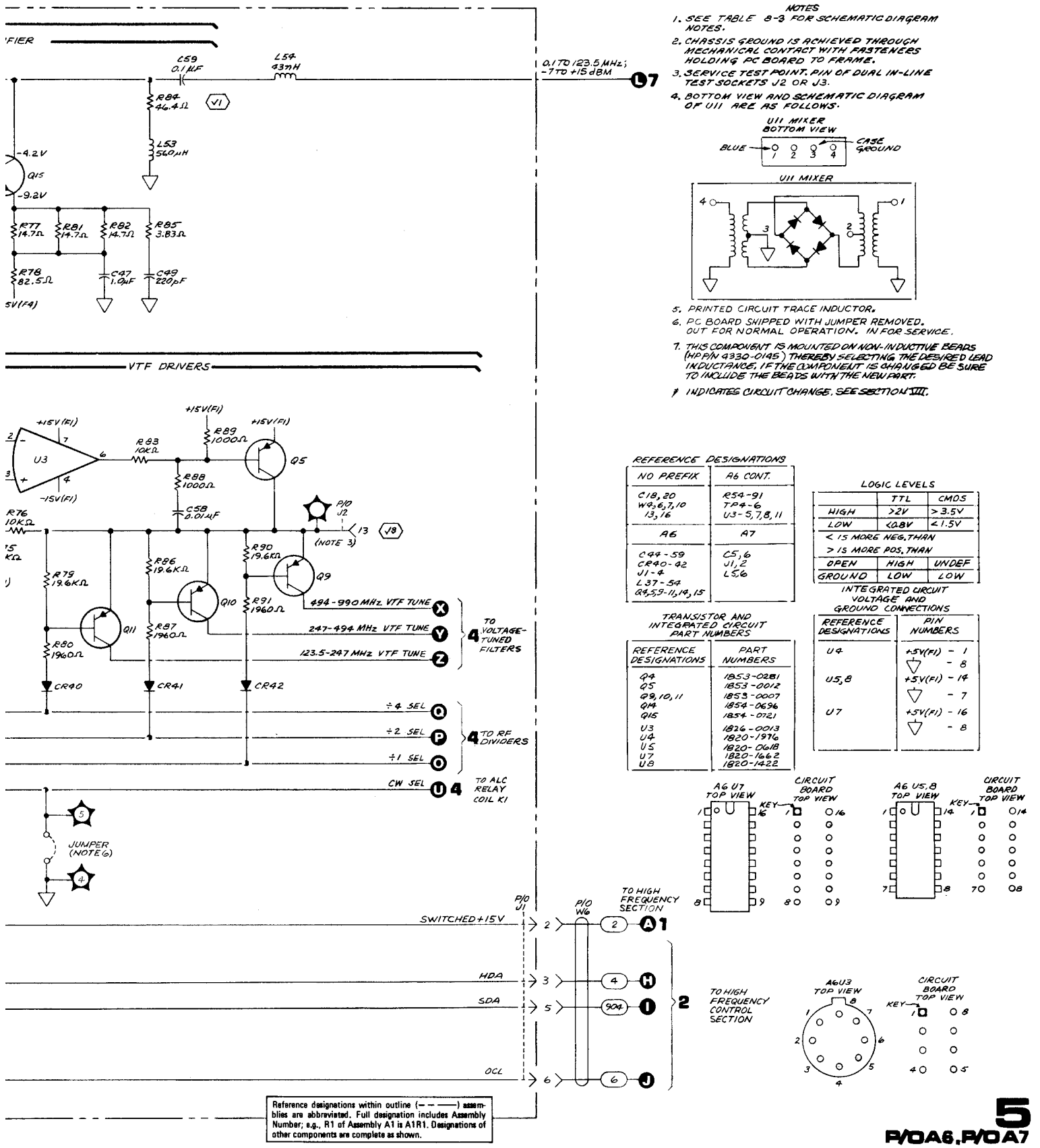
ManualsPlus.com



ManualsPlus.com



ManualsPlus.com



5

P/O A6, P/O A7

Figure 8-54. Heterodyne and Output Control Schematic Diagram

ManualsPlus.com

SERVICE SHEET 6 (Cont'd)

⟨√3⟩ P/O Modulation Control Latches, FM Deviation DAC

1. Set the Signal Generator to −10 dBm at 500 MHz with a 1 kHz source in FM mode.

2. Set FM kHz as indicated in Table 5 and make the indicated voltage checks.

⟨√4⟩ P/O Modulation Control Latches, Comparators, and FET switches

1. Set the Signal Generator to −10 dBm at 500 MHz without modulation.

2. Set the function as indicated in Table 6 and make the indicated voltage checks.

TROUBLESHOOTING USING SIGNATURE ANALYSIS

This is an alternate method of troubleshooting the circuits of Service Sheet 6. If these signatures are incorrect, recall that the data strobes are decoded on the circuitry of Service Sheet 15 and the data is output from the Microprocessor which is on Service Sheet 14. If these signatures are correct, and the problem does not seem to be related to modulation, return to Service Sheet BD4 for further digital troubleshooting. If the problem seems to be related to a modulation problem, continue troubleshooting on this service sheet or refer to Service Sheet BD2.

Test Equipment

Signature Analyzer .....HP 5004A

Purpose. To verify correct transfer of encoded data and strobe information from the Microprocessor to the modulation control latches.

Setup. Connect the signature analyzer as follows:

1) GND as close to the circuitry being probed as possible. (Bad grounding can cause unstable signatures.)
2) CLK to 'E' A11TP11
3) START to 'SA1' A11TP6
4) STOP to 'SA2' A11TP6

Set the signature analyzer controls as follows:

1) START-OUT
2) STOP-IN
3) CLK-IN

Set up the Signal Generator as follows:

1) Disconnect the attenuator cable W17 from the power supply board to the attenuator.
2) Set the LOGIC/RAM switch P/O A11S1 to LOGIC.

NOTE

If the Signal Generator's address switch has been set to other than 07, the signatures taken in this test will be incorrect. In this case, reset the address switches to A1=1, A2=1, A3=1, A4=0 and A5=0. Then set the front panel RESET-STBY-ON switch to RESET and back to ON.

Table 5. FM Deviation Control Voltage Levels

Front Panel FM (kHz)	Measure the voltage* as Indicated at										
	U13				U16						Test Point J6-pin 8 (Vrms)
	12	15	16	19	2	5	6	9	12	15	
1	L	L	L	L	H	H	H	H	L	H	0.2407
5	L	H	L	L	H	H	L	L	H	L	1.205
10	H	L	L	H	H	L	L	H	L	H	2.423
20	L	L	L	H	H	H	H	L	H	H	0.485
50	L	H	L	L	H	H	L	L	H	L	1.209
80	L	H	H	H	H	L	H	L	H	L	1.935
99	H	L	L	H	L	H	H	H	H	H	2.400

*Low ≤0.8Vdc; High ≥2.0Vdc.

ManualsPlus.com

Table 2. Level Control Voltage Levels versus Frequency

Front Panel Frequency (MHz)	Measure the Voltage* as indicated at										
	U5								U9		Test Point J6-pin 12 (Vdc)
	2	5	6	9	12	15	16	19	2	5	
0.100	L	H	L	H	L	L	H	H	L	H	0.387
100	L	H	L	L	H	H	H	L	H	L	0.365
200	L	H	H	L	L	H	H	H	H	L	0.481
300	L	H	H	L	L	H	L	H	L	L	0.470
400	L	H	H	L	L	L	H	L	H	H	0.459
800	L	H	L	H	H	L	L	L	L	L	0.409
990	L	H	L	H	L	L	L	L	L	H	0.373

* Low is <+0.8 Vdc; High is >+2.0 Vdc

Table 3. Level Control Voltage Levels versus Front Panel Amplitude

Front Panel Amplitude (dBm)	Measure the Voltage* as Indicated at										
	U5								U9		Test Point J6-Pin 12 (Vdc)
	2	5	6	9	12	15	16	19	2	5	
0.0	L	H	L	H	H	H	H	H	H	L	0.444
+5.0	H	L	H	L	H	L	L	H	H	H	0.790
+10.0	L	H	H	L	L	L	L	L	L	L	1.396
+13.0	H	L	L	L	L	H	H	H	H	L	1.974

*Low is ≤0.8 Vdc; High is ≥2.0 Vdc.

Table 4. AM% Control Voltage Levels

Front Panel AM%	Measure the voltage* as indicated at										
	U9						U13				Test Point J6-Pin 12 (Vdc)
	6	9	12	15	16	19	2	5	6	9	
1	L	L	L	L	L	L	L	H	L	L	0.0033
5	L	L	L	L	L	H	L	L	H	H	0.015
10	L	L	L	L	H	L	L	H	H	L	0.031
20	L	L	L	H	L	L	H	H	L	L	0.063
50	L	L	H	L	H	H	H	H	H	H	0.162
70	L	H	L	L	L	L	H	L	H	H	0.228
99	L	H	L	H	H	H	H	L	H	L	0.323

* Low <+0.8 Vdc; High >+2.0 Vdc

ManualsPlus.com

External Modulation. The amplitude at the external MOD INPUT connector must be set at the Source and is monitored by the Over/Under Modulation Comparators U22C and D. When the modulation input signal is too high, comparator U22C switches its output from −15 Vdc to 0.0 Vdc and the monostable multivibrator U1A is enabled. The active-high output, pin 13 goes high for 0.45 s. As long as the input is enabled by the modulation signal, the multivibrator will continue to output the pulse.

The pulse from the multivibrator is applied to the Status Register A11U10 (refer to Service Sheet 14). The Microprocessor receives this status bit over the data bus when the inputs to the Status Register are clocked in by the status strobe (the HI EXT LED is turned on). When the output is too low, neither of the comparators are switched (outputs are low) and neither monostable is enabled. The active-high output of U1A is low and the active-low output of U1B is high. The high level is applied to the Status Register and the LO EXT LED is turned on. When the input is one volt peak, comparator U22D's output is switched high which sets U1B (that is, the active-low output returns low). The LO EXT LED is turned off. If the level goes too high, U1A is set which outputs a high on HI(H). As long as the level is high enough, the comparator(s) will switch at the modulation rate.

TROUBLESHOOTING

Procedures for checking the circuits of the A10 Audio/Power Supply Assembly are given below. The areas or points to check are marked on the schematic by a hexagon with a checkmark and a number inside, e.g., ⟨√1⟩. Fixed voltages are shown on the schematic inside a hexagon, e.g. ⟨2V ±0.2V⟩. Transistor bias voltages are shown without tolerances.

Test Equipment

Digital Multimeter .....HP 3465A

⟨√1⟩ P/O Modulation Control Latches, Level DAC

1. Set the Signal Generator to −10 dBm without modulation.

2. Set the frequency as shown in Table 2 and check the levels at U5 and U9.

3. Set the Signal Generator to 500 MHz without modulation.

4. Set the RF output level as shown in Table 3 and check the following levels at U5 and U9.

⟨√2⟩ P/O Modulation Control Latches, AM% DAC

1. Set the Signal Generator to −10 dBm at 500 MHz with a 1 kHz source in the AM mode.

2. Set AM% as indicated in Table 4. Make the indicated voltage checks.

ManualsPlus.com

SERVICE SHEET 6 (Cont'd)

Internal FM Select. Internal FM is selected when the data bit latched into pin 6 of U19 is high. The high output switches the output of Internal FM select comparator U21D to approximately 0.0 Vdc and FET switch Q7 is turned on. Both U21D and Q7 are shown on Service Sheet 12.

Internal Modulation. When internal modulation only is selected, the data bits latched into pin 2 of U19 Audio Osc Out is high. The high output switches the output of Audio Oscillator Out comparator U22B to 0.0 Vdc. FET switch Q10 is turned on and the 400 Hz or 1 kHz Internal Audio Oscillator output of buffer amplifier U20B is applied to MOD INPUT/OUTPUT connector on the front panel.

The internal Audio Oscillator is enabled by a high at either the INT AM SEL or INT FM SEL data bits. These two bits are each applied to A10U7 one of the control drivers shown on Service Sheet 7. The output of U7 enables the Internal Audio Oscillator U20A on this service sheet.

The internal Audio Oscillator's frequency of 400 Hz or 1 kHz is selected by the data bit latched into pin 8 of U19, FREQ SEL. For 1 kHz FREQ SEL is low; for 400 Hz it is high. The high output switches the output of Audio Frequency select comparator U22A to approximately 0.0 Vdc. FET switch Q11 is turned on and capacitor C1 is bypassed. This increased capacitance switches the Audio Oscillator's frequency to 400 Hz. If 1 kHz is selected, Q11 is open and C1 is left in the oscillator's feedback circuit. The peak output of the Audio Oscillator is approximately 7.5 volts as determined by VR1, CR2 and 3. These components form the feedback path for the positive input of U20A.

External AM Select. External AM is selected when the data bit latched into pin 16 EXT AM SEL of U19 is high. The high output switches the output of External AM select comparator U21A to approximately 0.0 Vdc to switch FET Q8 on. The external modulation signal from the External Modulation Buffer U23 is applied to the AM% Summing Amplifier through R25, a 20.4 kΩ resistor.

External FM Select. External FM is selected when the data bit latched into pin 18 EXT FM SEL of U19 is high. The high output switches the output of External FM Select comparator U21C to approximately 0.0 Vdc. FET switch Q6 is turned on and the external modulation signal from the External Modulation Buffer U23 is applied to the FM Deviation Summing Amplifier U17A. (U21C, Q6 and U17A are all shown on Service Sheet 12.)

Modulation Calibration. Internal and external modulation is calibrated only if the modulation signal from the internal Audio Oscillator or external MOD INPUT is equal to 1.00±0.05 Vpeak. The amplitude from the internal Audio Oscillator is adjusted by R16 Osc Adj.

ManualsPlus.com

Table 1. RF Amplitude Ranges

Over-Range	Amplitude Range		Vernier Output Level (dBm)	10 dB Step Attenuator Pads in Use
	Normal	Extended		
Yes	+17.0 to −3.5	+17.0 to −4.0	+17.0 to −4.0	None
No	−3.6 to −13.5	−3.0 to −14.0	+7.0 to −4.0	10
No	−13.6 to −23.5	−13.0 to −24.0	+7.0 to −4.0	20
No	−23.6 to −33.5	−23.0 to −34.0	+7.0 to −4.0	30A
No	−33.6 to −43.5	−33.0 to −44.0	+7.0 to −4.0	30A,10
No	−43.6 to −54.5	−43.0 to −54.0	+7.0 to −4.0	30A,20
No	−54.6 to −64.5	−53.0 to −64.0	+7.0 to −4.0	30A,30B
No	−64.6 to −74.5	−63.0 to −74.0	+7.0 to −4.0	30A,30B,10
No	−74.6 to −84.5	−73.0 to −84.0	+7.0 to −4.0	30A,30B,20
No	−84.6 to −94.5	−83.0 to −94.0	+7.0 to −4.0	30A,30B,30C
No	−93.6 to −103.5	−93.0 to −104.0	+7.0 to −4.0	30A,30B,30C,10
No	−103.6 to −113.5	−103.0 to −114.0	+7.0 to −4.0	30A,30B,30C,20
Yes	−113.6 to −123.5	−113.0 to −127.0	+7.0 to −7.0	30A, 30B,30C,20,10

AM Control. The ten data bits, Y0-Y9, are clocked into Modulation Control Latches U9 and U13 by MSTB2 and MSTB3 strobes from Address Decoder U1 (refer to Service Sheet 15). These ten bits are applied to the AM% DAC U8. The digitally controlled output level of the AM% DAC adjusts the input modulation signal from the AM% Summing Amplifier U18C to the level that will modulate the RF signal to the depth selected. The output signal is ac coupled by C11 to Unity Gain AM Offset Buffer U15. The Offset Adjustment nulls any dc offset of the modulation signal. The amplitude modulation signal is then summed with the level voltage at U18A as discussed above.

FM Control. The ten data bits, Z0-Z9, are clocked into Modulation Control Latches U13 and U16 by MSTB3 and MSTB4 strobes from the Address Decoder U1 (refer to Service Sheet 15). These ten bits are applied to the FM Deviation DAC U14 (refer to Service Sheet 12). The digitally controlled output level of the FM Deviation DAC adjusts the input modulation signal from the FM Deviation Summing Amplifier U17A (refer to Service Sheet 12) for the amplitude level that frequency modulates the RF output to the deviation level selected.

Internal AM Select. Internal AM is selected when the data bit latched into pin 5 of Modulation Control Latch U19 is high . The high output to the positive input of Internal AM Select comparator U21B, being more positive than the +2 volts at the negative input, switches its output to 0.0 Vdc. FET switch Q9 is turned on. When Q9 is on, the output of U20A is ac coupled by C7 through the 20.4 kΩ resistor R22 to the AM% Summing Amplifier.

ManualsPlus.com

SERVICE SHEET 6
P/O A10 AUDIO/POWER SUPPLY ASSEMBLY

TROUBLESHOOTING HELP

Service Sheet BD2
Table 4-1. Abbreviated Performance Tests
Table 5-2. Post-Repair Adjustment Procedures

PRINCIPLES OF OPERATION

General

Encoded data output from the Microprocessor is input to Modulation Control Latches. This data is used to control the RF amplitude level fine steps and RF amplitude level versus frequency correction. The data also controls the amplitude and frequency modulation signals.

Amplitude Control

Output data from the Microprocessor controls 1) the 0.1 dB steps of output amplitude level across 10 dB (the range selected by each step of the 10 dB Step Attenuator) with an extended range of 11 dB, 2) the overrange of about +10 dB added to the highest range and the overrange of −3 dB added to the lowest range and 3) the level correction for frequency. The latter uses the extended 11 dB range. This means that the amplitude range (attenuator step of 10 dB) is never changed for level correction. Refer to Table 1.

When an output amplitude level is selected, the Microprocessor controls the change so the final level is always approached from a lower level. For example, if the vernier level is at its minimum and the output level is decreased by 1 dB, the 10 dB Step Attenuator will increase attenuation by 10 dB. The vernier level then increases the level input to the attenuator by 9 dB. The 9 dB increase will never occur first. For the same reason, a 1 dB increase with the vernier set to maximum causes a 9 dB decrease in level followed by a 10 dB decrease in attenuation in the step attenuator. After the amplitude is changed, the correction for frequency is made.

The ten bits of Microprocessor data, X0-X9, are strobed into Modulation Control Latches U5 and U9 by MSTB1 and MSTB2 from Address Decoder U2 (refer to Service Sheet 15). These ten data bits are applied to the Level Digital-to-Analog Converter (DAC) U4. The digitally controlled output of the Level DAC adjusts the reference voltage input from the unity gain Level Buffer U18B. This dc voltage controls the Vernier Output Level. The output voltage is applied to the AM Reference Summing Amplifier U18A.

When amplitude modulation is selected, the amplitude level voltage is summed with modulation voltage, and applied to U6 of the Automatic Level Control (ALC) Amplifier (refer to Service Sheet 4).

The Microprocessor determines when the Vernier Output Level is greater than +7.0 dBm. At this time the Level Range Sel bit is set high and the output of U18D goes to approximately −15 Vdc. FET switch Q4 opens thereby increasing the gain of Summing Amplifier U18A. This allows the higher output levels. At −127 dBm the amplitude level vernier's range is extended to −7 dB.

Modulation Control

Data from the Microprocessor selects AM, FM or both, internal modulation sources of 400 or 1000 Hz, and/or external modulation. The data also controls the AM depth and FM deviation levels.

ManualsPlus.com

SERVICE SHEET 6 (Cont'd)

Initialize. Briefly short A11TP3 NMI to ground.

NOTE

With careless probing it is possible to get the Microprocessor into a program sequence other than that portion intended for signature analysis. If the +5V signature is incorrect, this has probably happened. Restart the test by setting the RST/RUN switch to RST and then RUN. Briefly touch the NMI test point to ground.

Probe. Connect the probe to each node indicated in Tables 7 through 11. Verify that the signature is correct and stable.

NOTES

Disconnect any external modulation from the BNC jack.

In case of unstable or incorrect signatures, ground the data probe as close as possible to the node being tested.

Table 6. Function Control Voltage Levels

Function Selected	Control Latch	Pin No.	Logic* State	Comparator	Comparator Output (Vdc)	FET Switch	Open/ Closed
Int 1 kHz AM	U19	5	H	U21B	0.0	Q9	Closed
Int 400 Hz	U19	9	H	U22A	+1.0	Q11	Closed
Int Mod	U19	2	H	U22B	+5.0	Q10	Closed
Int FM	U19	6	H	U21D (SS12)	0.0	Q7 (SS12)	Closed
Ext AM	U19	16	H	U21A	0.0	Q8	Closed
Ext FM	U19	19	H	U21C (SS12)	0.0	Q6	Closed
Amplitude +10 dBm	U16	19	H	U18D	−13	Q4	Open
Ext AM No Input	—	—	—	U22D	−14	J6 Pin 4 J6 Pin 15	L H
Ext AM 1V-pk Input	—	—	—	U22D	−14	J6 Pin 14 J6 Pin 15	H L

* Low <+0.8 Vdc; High >+2.0 Vdc

ManualsPlus.com

SERVICE SHEET 6 (Cont'd)

Table 7. AM/Level Control Signatures

Node	Correct Signature	Comments
+5V	H6H5	
U5 #2	5713	Lev DAC
U5 #5	3UA1	
U5 #6	PF25	
U5 #9	8953	
U5 #12	U314	
U5 #15	28HU	
U5 #16	1PCP	
U5 #19	P5H2	
U9 #2	C33C	
U9 #5	UCUU	

Table 8. AM% Control Signatures

Node	Correct Signature	Comments
U9 #6	48U0	AM DAC
U9 #9	H934	
U9 #12	5449	
U9 #15	H3CA	
U9 #16	6U7U	
U9 #19	37P1	
U13 #2	5869	
U13 #5	05A7	
U13 #6	PU57	
U13 #9	P580	
U16 #19	7H7C	AM Range Select

Table 9. FM Deviation Control Signatures

Node	Correct Signature	Comments
+5V	H6H5	
U13 #12	50P3	FM DAC
U13 #15	3P3A	
U13 #16	681U	
U13 #19	6U79	
U16 #2	15A4	
U16 #5	0AU5	
U16 #6	5599	
U16 #9	F65U	
U16 #12	9467	
U16 #15	U761	

Table 10. Audio Oscillator Control Signatures

Node	Correct Signature	Comments
+5V	H6H5	
U19 #2	1821	OSC OUT
U19 #5	52HC	INT AM
U19 #6	7P3H	INT FM
U19 #9	3CU7	OSC FRQ
U19 #16	7FCP	EXT AM
U19 #19	4HFF	EXT FM

Incorrect signatures could be due to:

1) data to latch problem (data bus)
2) strobe to latch problem
3) latch problem
4) test point 'TO2' A2TP13 shorted to "GND" on the display board.

Table 11. Modulation Strobe Signatures

Node	Correct Signature	Comments
+5V	H6H5	
U5 #11	58AP	U5 Strobe
U9 #11	57F4	U9 Strobe
U13 #11	97CC	U13 Strobe
U16 #11	A5FP	U16 Strobe
U19 #11	P1H1	U19 Strobe

ManualsPlus.com

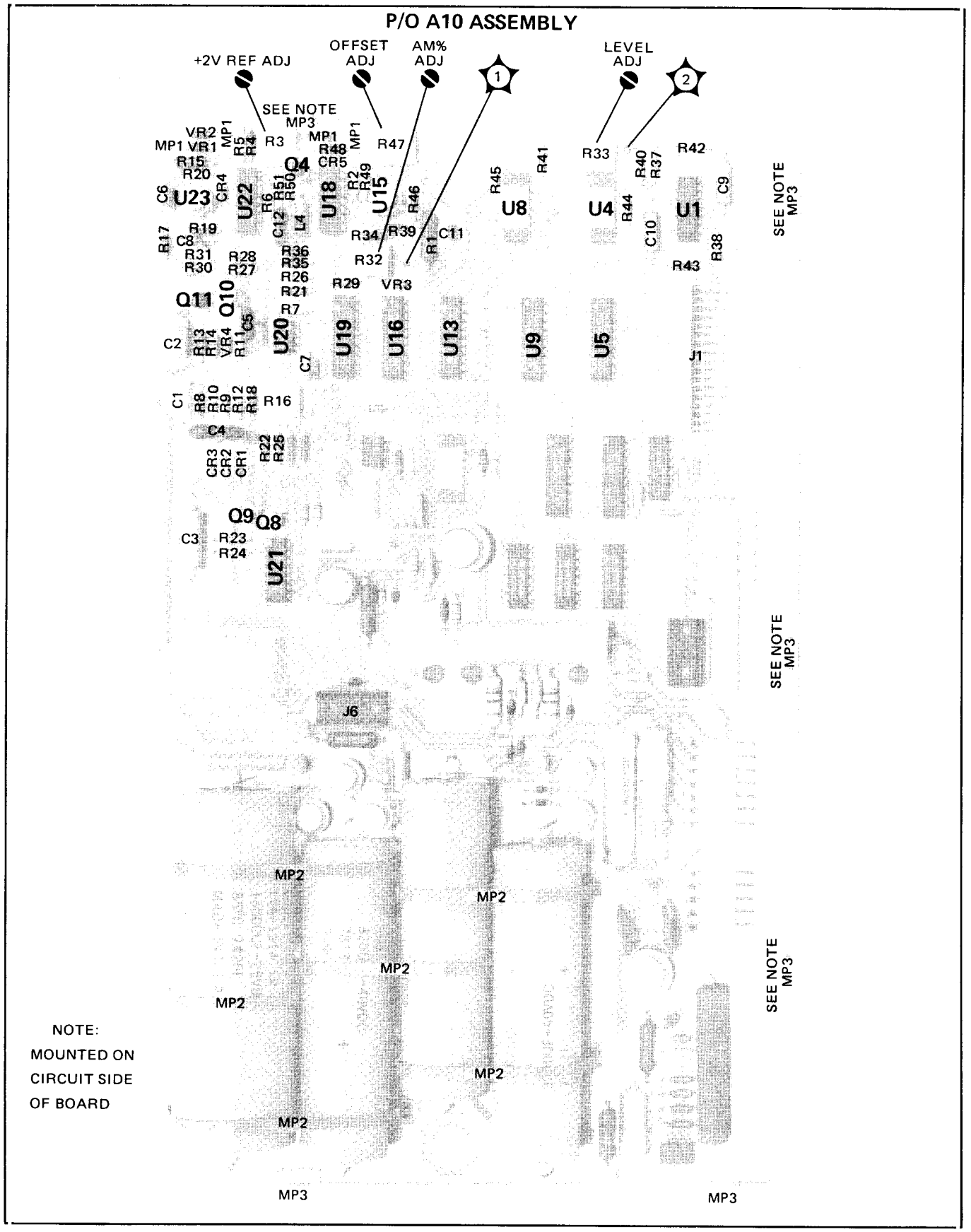
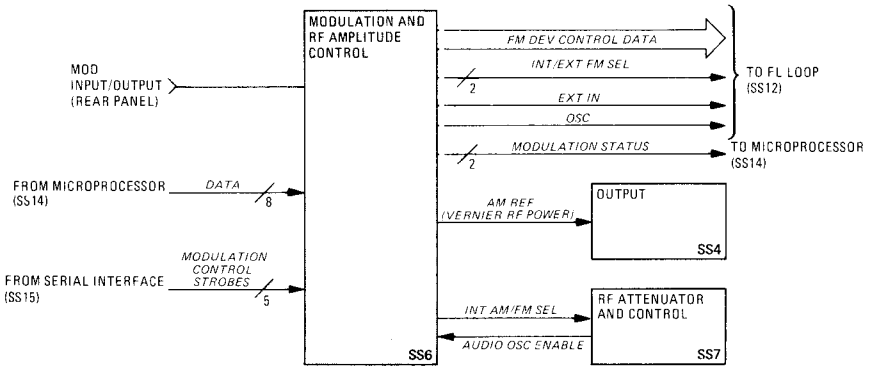


Figure 8-55. Modulation and RF Amplitude Control Component Locations

ManualsPlus.com



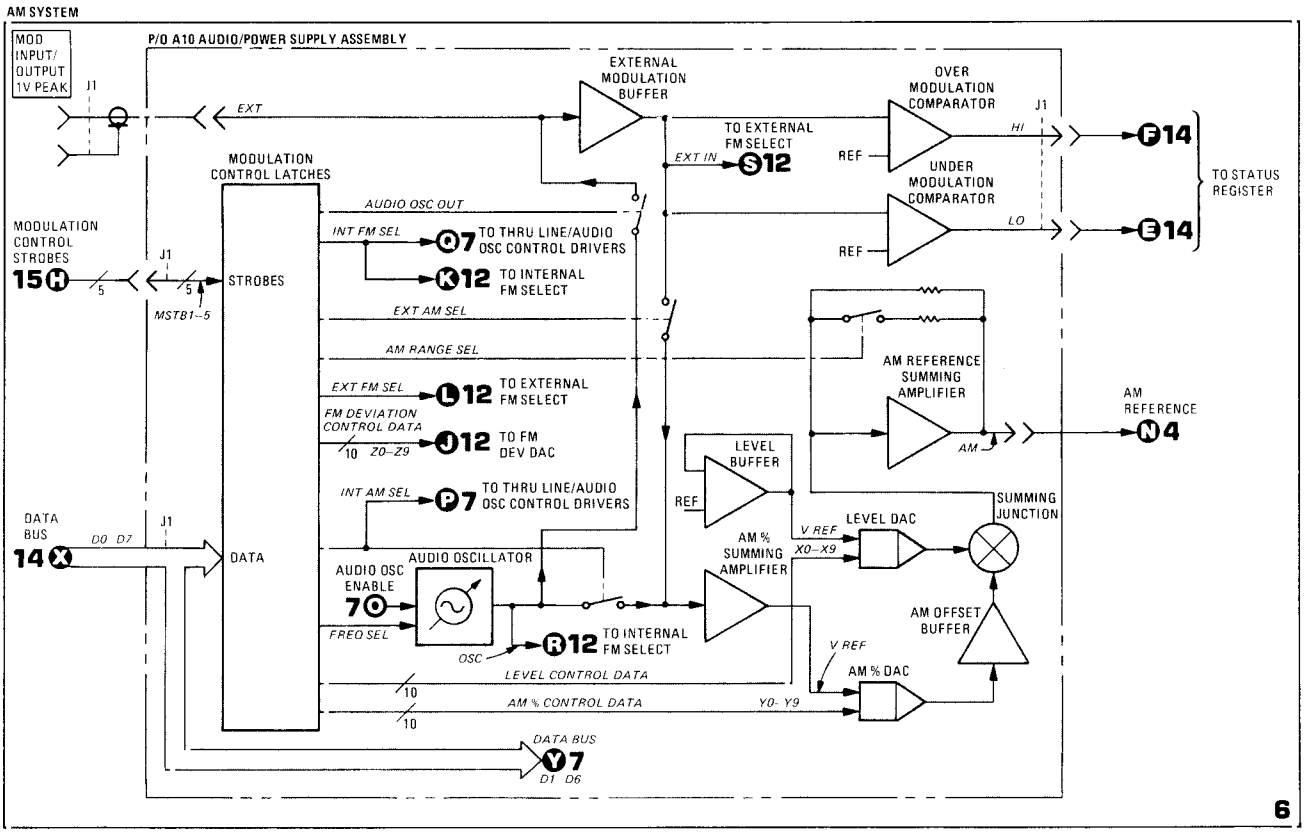
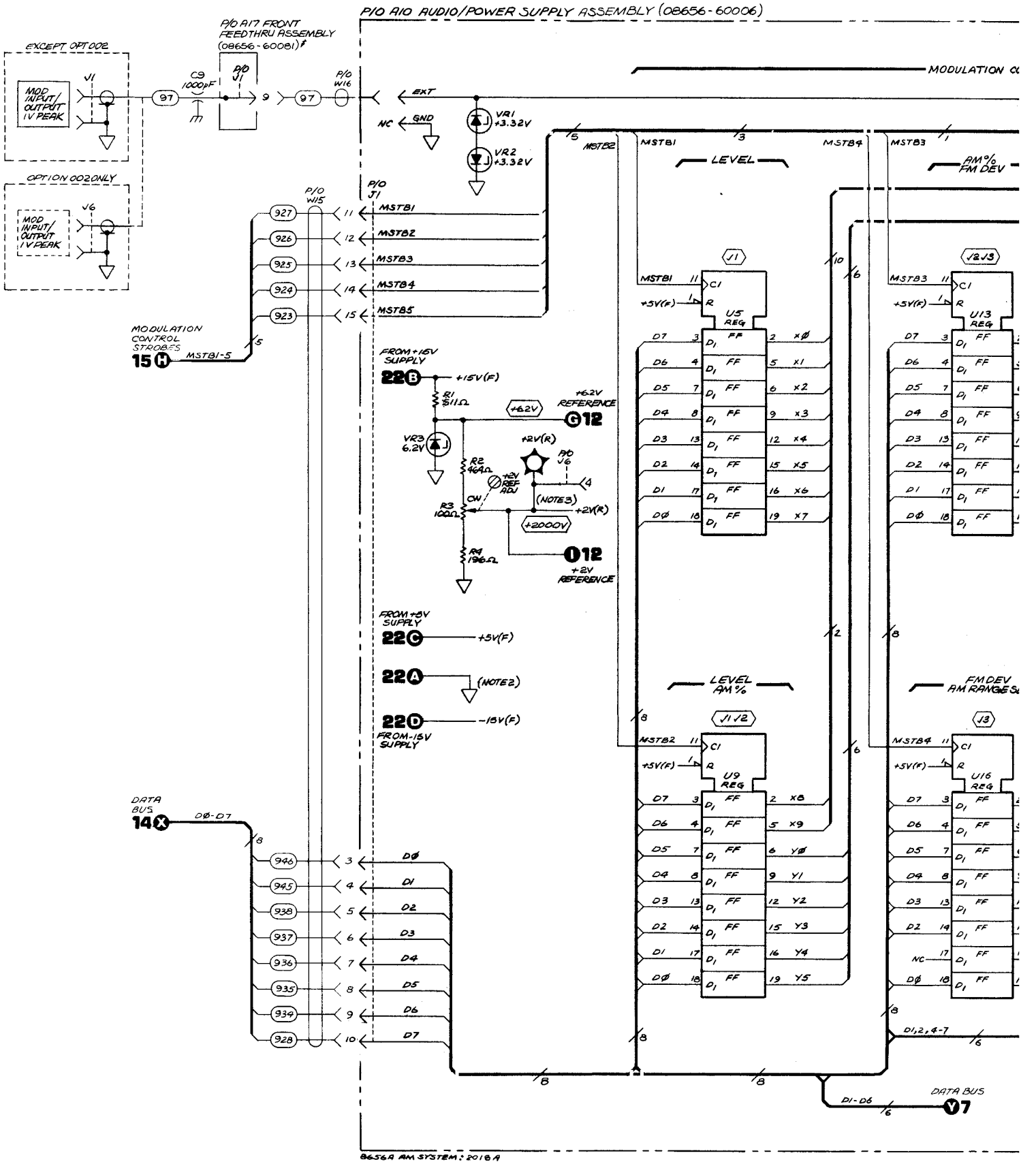
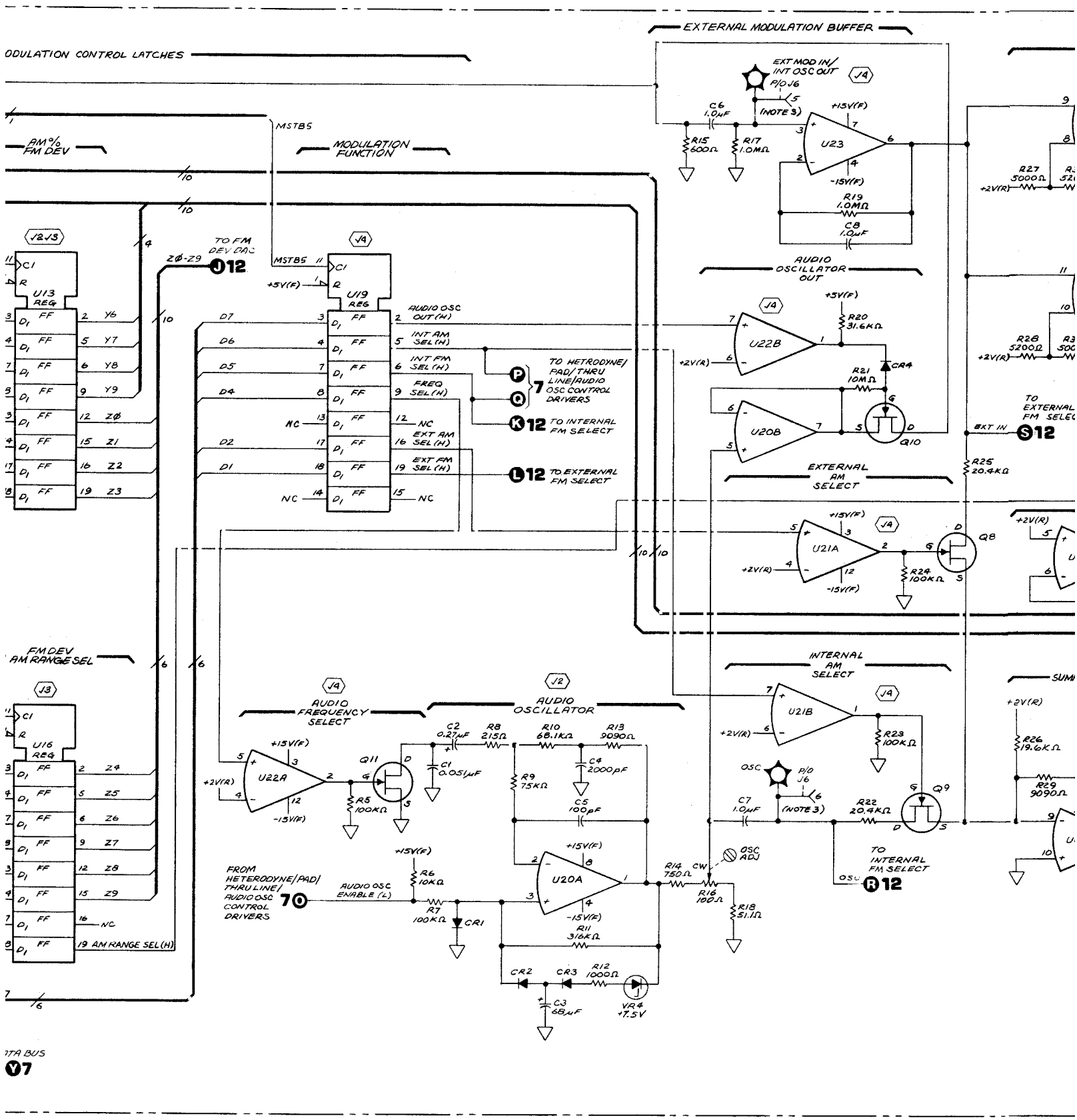


Figure 8-56. Modulation and RF Amplitude Control Block Diagrams

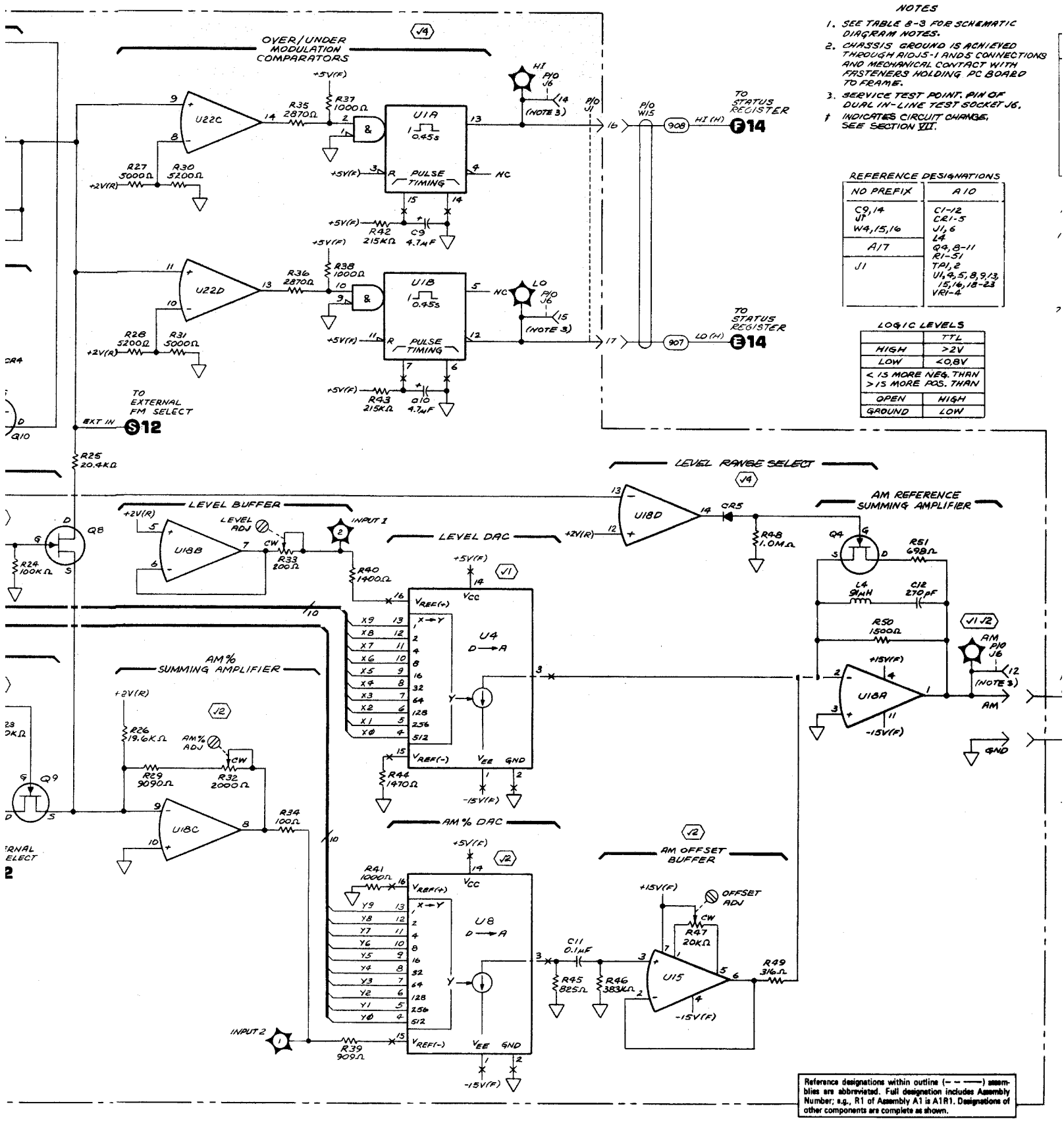
ManualsPlus.com



ManualsPlus.com



ManualsPlus.com



Fig

ManualsPlus.com

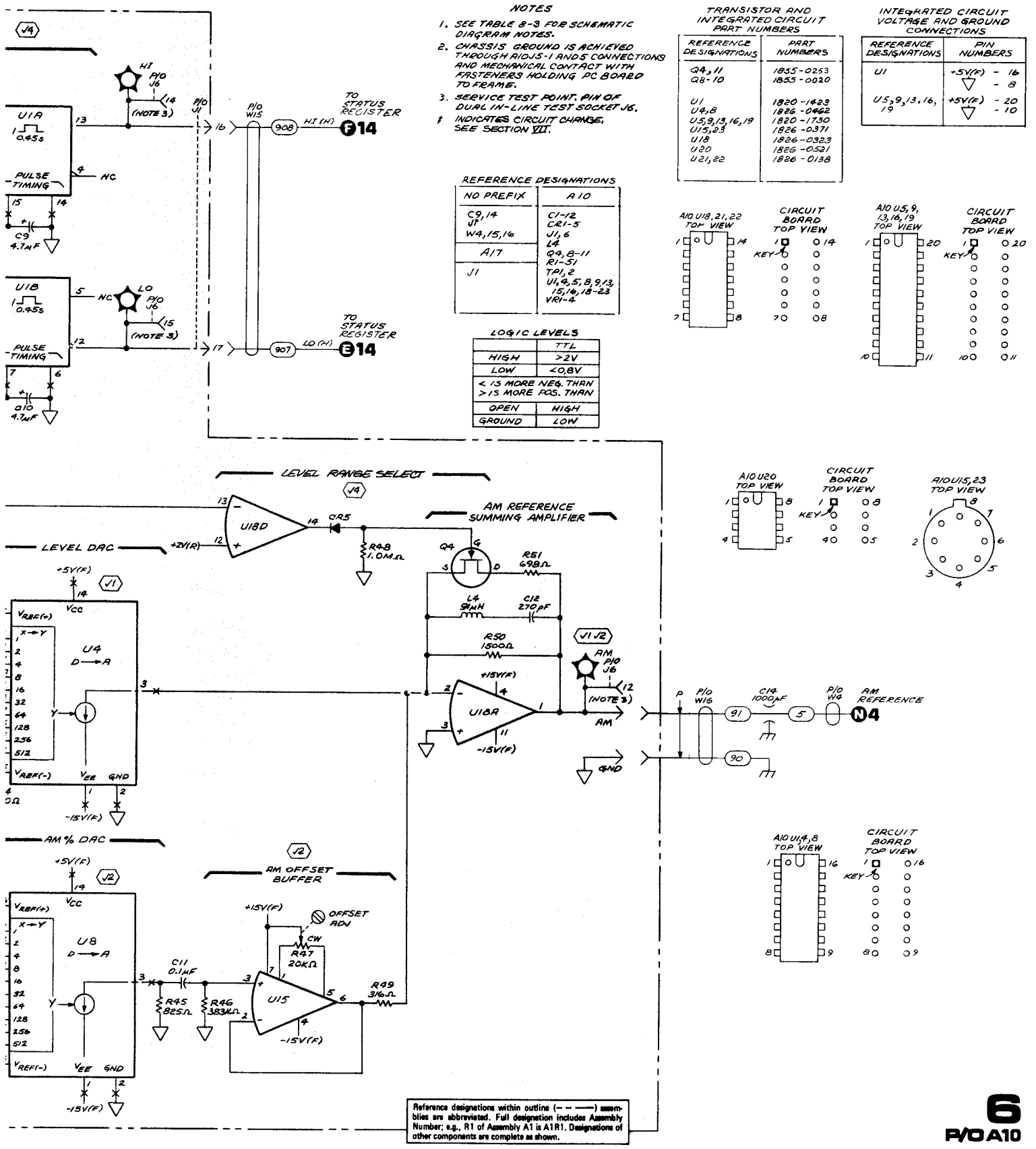


Figure 8-57. Modulation and RF Amplitude Control Schematic Diagram

ManualsPlus.com

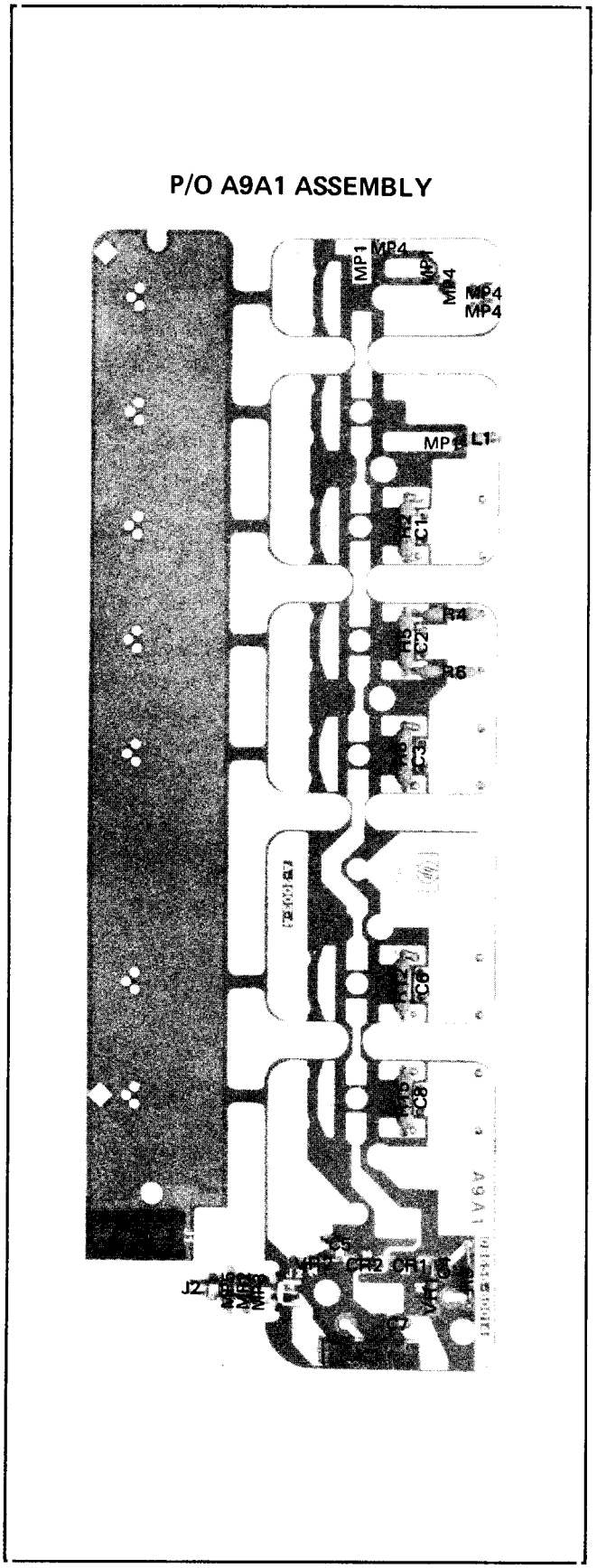


Figure 8-58. Attenuator Component Locations (Top View)

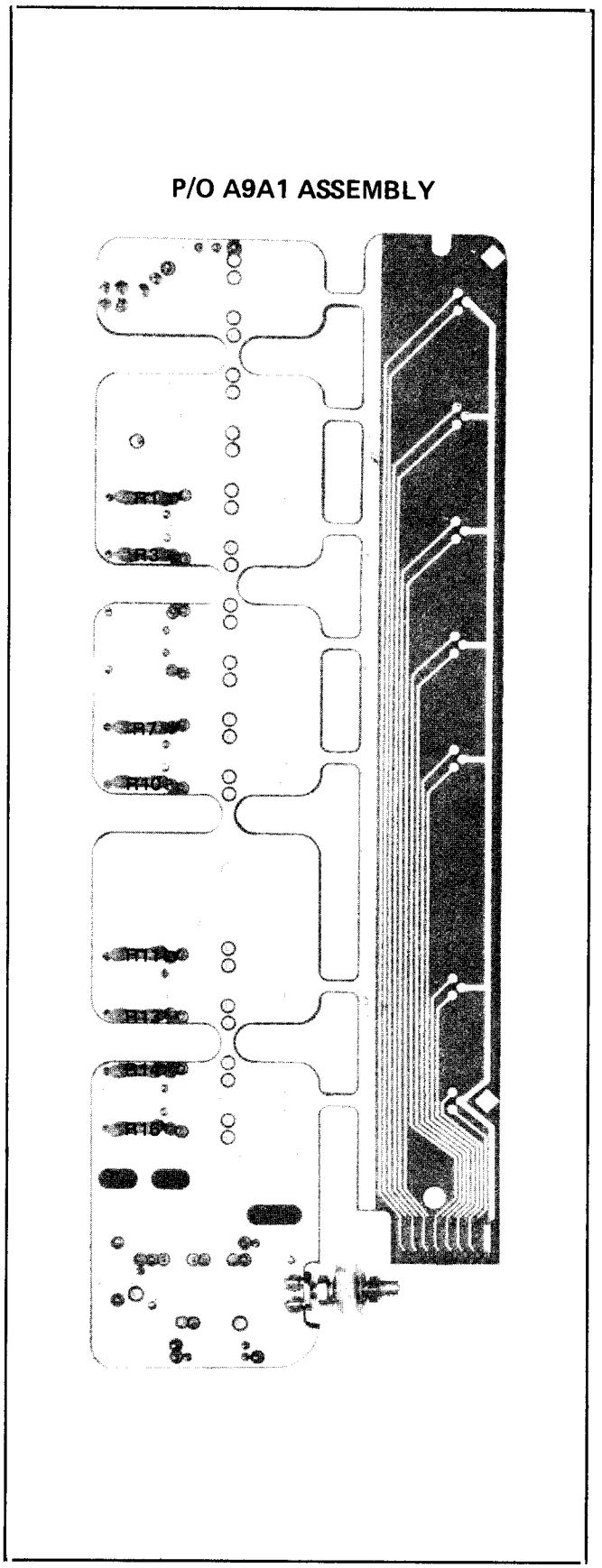


Figure 8-59. Attenuator Component Locations (Bottom View)

ManualsPlus.com

SERVICE SHEET 7 (Cont'd)

Probe. Connect the probe to each node in Tables 4 and 5. Verify a correct and stable signature at each node.

NOTE

In case of unstable or incorrect signatures, ground the data probe as close as possible to the node being tested.

Table 4. Heterodyne/Pad and Thru Line Control Signatures

Node	Correct Signature	Comments
+5V	H6H5	
U10 #2	FP66	HET/PAD
U10 #5	U274	Control
U10 #6	PCH2	Latch
U10 #9	7A42	
U10 #12	8301	
U10 #15	8FFP	
+5V	H6H5	
U6 #2	0P73	THRU LINE
U6 #5	3793	Control
U6 #6	U75P	Latch
U6 #9	63H2	
U6 #12	7418	
U6 #15	4F66	

An incorrect signature could be due to:

1) data to latch problem (data bus)
2) strobe to latch problem
3) latch problem
4) TO2 A2TP13 shorted to GND on the display board.

Table 5. Heterodyne/Pad and Thruline Strobe Signatures

Node	Correct Signature	Comments
+5V	H6H5	
U10 #11	8685	U10 STROB
U6 #11	CF57	U6 STROB

Reset the LOGIC/RAM switch to the RAM position. Reconnect the attenuator cable W17.

ManualsPlus.com

SERVICE SHEET 7 (Cont'd)

Reverse Power Clock toggles the J-K Flip-Flop biasing Q13 and closing the Reverse Power Relay.

TROUBLESHOOTING USING SIGNATURE ANALYSIS

This is an alternate method of troubleshooting the circuits of Service Sheet 7. If these signatures are incorrect, recall that the data strobes are decoded on the circuitry of Service Sheet 15 and the data comes from the Microprocessor on Service Sheet 14. If these signatures are correct and the problem does not seem to be related to 10 dB step attenuation or a 0.1 to 123.5 MHz RF output signal, you may want to return to Service Sheet BD4 for further digital troubleshooting. If the previously mentioned problems require further investigation, continue to troubleshoot on this service sheet or refer to Service Sheet BD2.

Purpose. To verify correct transfer of encoded data and strobe information from the Microprocessor to the attenuator control latches.

Setup. Connect the signature analyzer as follows:

1) GND as close to circuitry being probed as possible. (Bad grounding can cause unstable signatures.)
2) CLK to E A11TP11
3) START SA1 A11TP5
4) STOP to SA2 A11TP6

Set the signature analyzer's controls as follows:

1) START-OUT
2) STOP-IN
3) CLK-IN

Set up the Signal Generator as follows:

1) Disconnect the attenuator cable from the power supply board to the attenuator.
2) Set the LOGIC/RAM switch P/O A11S1 to LOGIC.

NOTE

If the Signal Generator's address switch has been set to other than 07, the signatures taken in this test will be incorrect. In this case, reset the address switches to A1=1, A2=1, A3=1, A4=0 and A5=0. Then set the front panel RESET-STBY-ON switch to RESET and back to ON. Refer to Service Sheet 17 for the location of the address switches.

Initialize. Briefly short A11TP3 NMI to ground.

NOTE

With careless probing it is possible to get the Microprocessor into a program sequence other than that portion intended for signature analysis. If the +5V signature is incorrect, this has probably happened. Restart the test by setting the RST/RUN switch to RST and then RUN. Briefly touch the NMI test point to ground.

ManualsPlus.com

SERVICE SHEET 7 (Cont'd)

√1 Attenuator Control

1. The data word is latched into A10U10 by ASTB1 and A10U6 by ASTB2. The outputs of the latches are applied to the Control Drivers where the active-low outputs are connected to the attenuator solenoids.

2. High data bits to control latch U10 will select the attenuator pad; high data bits to control latch U6 will remove the attenuator pad.

3. The high data bits at the control latches and active low outputs of the drivers must be checked using an oscilloscope. They will appear as pulses.

4. The pulses will be approximately 60 ms controlled by monostables U3A and B. Each monostable is triggered by the strobes and resets the control latch after 60 ms when the active high output goes low.

5. The attenuator pads are selected as shown in Table 2.

Table 2. Step Attenuator Switching

Amplitude Entered at Front Panel	Attenuator Pads Selected
−5 dBm	10 dB
−15 dBm	20 dB
−25 dBm	30 dB (A)
−55 dBm	30 dB (A) and (B)
−85 dBm	30 dB (A), (B) and (C)

√2 Reverse Power Limiter/Detector, Reverse Power Sense

1. Set the Signal Generator to −10 dBm at 500 MHz without modulation.

2. Check the voltages shown in Table 3.

Table 3. Reverse Power Protection Operating Voltages

Reverse Power Relay	U10 Pin 6	Test Point J3 Pin 11	Test Point J3 Pin 10	Q1 (Vdc)		
				E	B	C
Closed	+4.5Vdc	+4.5Vdc	+0.2Vdc	+5.0	+4.3	+5.0
Open	+4.5Vdc*	+4.5Vdc*	+5.0Vdc	+5.0	+5.0	+0.0

*The output of comparator U10A-pin 6 will be low only for the time required to open Reverse Power Relay K1.

3. After reverse power has been removed, enter an amplitude at the front panel and check for the Reverse Power Clock at U9 pin 12. The

ManualsPlus.com

SERVICE SHEET 7 (Cont'd)

Reverse Power Protection

The Reverse Power Limiter/Detector prevents reverse power levels from damaging the Attenuator or Output Amplifiers. The two zener diodes VR1 and VR2 limit the maximum voltage on the transmission line to ±5Vpk. Diodes CR1 and CR2 detect the positive and negative voltage on the transmission line and store the detected voltage on C4 and C5. The voltage stored on C4 is coupled to the negative input of A6U10A in the Reverse Power Sense circuits by resistor divider A9A1R9 and A6R92. U10A functions as a voltage comparator where the positive input reference voltage is about +2.5 volts dc. Resistors A6R93 and 94 divide the +5V(F) supply voltage for the reference voltage. When the negative input to comparator A6U10A becomes more positive than the +2.5 volt reference, which is a detected voltage greater than +2.75V, the output of A6U10A switches to approximately −15 Vdc. The current through A6R95 fixes the voltage at J-K Flip-Flop A6U9 at approximately 0 volts which resets the flip-flop. The active low output of A6U9 is high and biases transistor A6Q13 off and removes the current through A9K1. This opens the relay contacts in the transmission line removing the external overvoltage level. When the output of A6U9 opens relay A9K1, the active high output of A6U9 provides a reverse power interrupt, RP1, to the Microprocessor. The Microprocessor services the interrupt causing the Amplitude display to flash. The keyboard is locked up except for the Amplitude controls thus alerting the operator of a Reverse Power condition. Relay A9K1 will remain open until a new output level is entered. The output clock from the Microprocessor clocks the Data Time Out One-Shot A6U7 generating a 2 ms Reverse Power Clock, RPCL, which toggles (sets) A6U9. The active high output removes the Reverse Power Interrupt and the active low output turns on A6Q13 energizing relay A9K1. If the reverse power condition was not removed, the detector will detect the condition as before, re-opening the relay.

Table 1. A6U9 Operation

Set	Reset	CLK (RPCL) To J-K	Outputs	
			Active High	Active Low
H	L	X	L	H
H	H	↑	Toggle	Toggle

TROUBLESHOOTING

Procedures for checking the circuits of the A6 Output Assembly, A9 Attenuator Assembly and A10 Audio/Power Supply Assembly are given below. The areas or points to check are marked on the schematic by a hexagon with a checkmark and a number inside, e.g., ⟨√1⟩. Fixed voltages are shown on the schematic inside a hexagon, e.g. ⟨2V±0.2V⟩. Transistor bias voltages are shown without tolerances.

Test Equipment

Digital Multimeter .....HP 3465A
Oscilloscope .....HP 1222A

ManualsPlus.com

SERVICE SHEET 7
P/O A6 OUTPUT ASSEMBLY
A9 ATTENUATOR ASSEMBLY
P/O A10 AUDIO/POWER SUPPLY ASSEMBLY

TROUBLESHOOTING HELP

Service Sheet BD2
Table 4-1. Abbreviated Performance Tests
Table 5-2. Post-Repair Adjustments

PRINCIPLES OF OPERATION

General

Encoded data from the Microprocessor is clocked into the Heterodyne/Pad Control and Thru Line Control Latches. The data is held in the latches for approximately 60 ms after the last clock pulse. At this time, U3A or U3B resets which clears the latches. The control signals enable the heterodyne mode (at frequencies from 0.1 to 123.5 MHz) and add or remove attenuation from the RF signal depending on the front panel setting of RF amplitude.

If excessive power from an external source is connected to the RF Output connector, the Reverse Power protection circuits cause a relay in series with the output to open.

Attenuator Control

Frequencies of 123.5 to 990 MHz and levels of −7 to +15 dBm from the Output Assembly, A6 are applied to the Attenuator Assembly, A9. The first two relays switch the input signal out to the Output Assembly and return the signal to the attenuator in the Heterodyne mode when output frequencies of 0.1 to 123.5 MHz are selected. The attenuator has five attenuator pads, one each of 10 and 20 dB and three each of 30 dB for a total of 120 dB. The correct attenuator pads are selected by the Data Word from the Microprocessor. The Data word is latched into A10U10 or A10U6 by strobes ASTB1 or ASTB2 respectively. The strobes trigger the Heterodyne/Pad Data Timeout One-shot U3B and the Thru Line Data Timeout One-shot U3A. The monostable multivibrator outputs are set high. At timeout, about 60 ms, the multivibrator is reset low which resets the control latch. During the 60 ms interval, the attenuator relay pads or heterodyne relays are selected and latched. The outputs of the latches are applied to the control drivers where the active low outputs are connected to the attenuator's relay solenoids.

The center of each solenoid is connected to +24 Vdc. In the case of the attenuator relays, each low output of the drivers will switch the relay so the output will either pass through an attenuator pad or be connected directly to the next section. If the connection is through a pad, a ground is connected to that section of the stripline bypassed. This greatly increases the isolation between the input and the output . The heterodyne mode and any combination of attenuator pads can be selected by the data from the Microprocessor which is dependent on the frequency and output level selected at the front panel.

Capacitors A9A1C1, C2, C3, C6 and C8 represent the capacitance between the adjustment wire loop and the associated resistors A9A1R2, R5, R8, R12 and R15. Each one is adjusted by coupling 990 MHz at +10 dBm into the attenuator. Each pad is individually adjusted to the preset power meter reference level minus the attenuation of the selected pad. The output of the last attenuator section passes through a five section printed circuit board filter that matches the attenuator to the Reverse Power Limiter and Detector.

ManualsPlus.com

P/O A10 ASSEMBLY

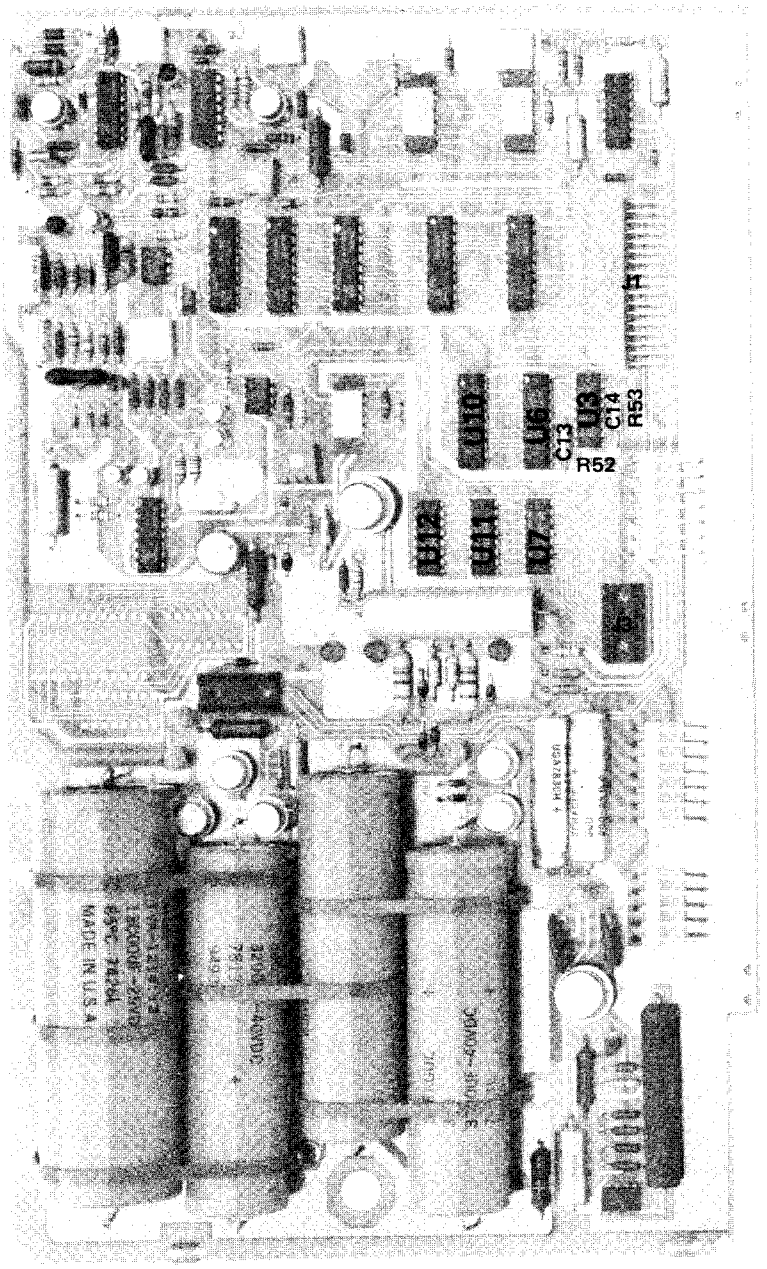


Figure 8-60. Attenuator Control Component Locations

ManualsPlus.com

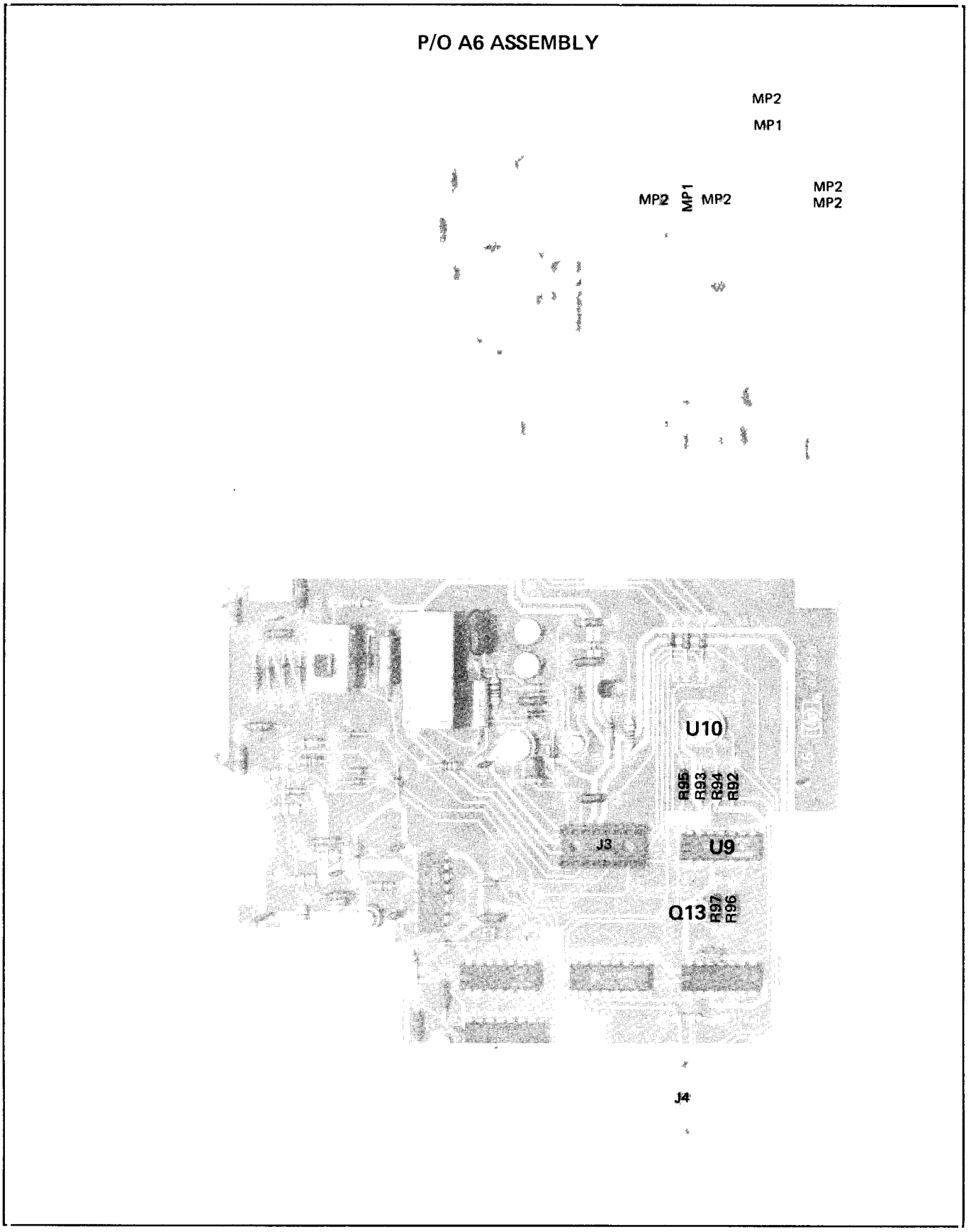


Figure 8-61. Reverse Power Protection Component Locations

ManualsPlus.com

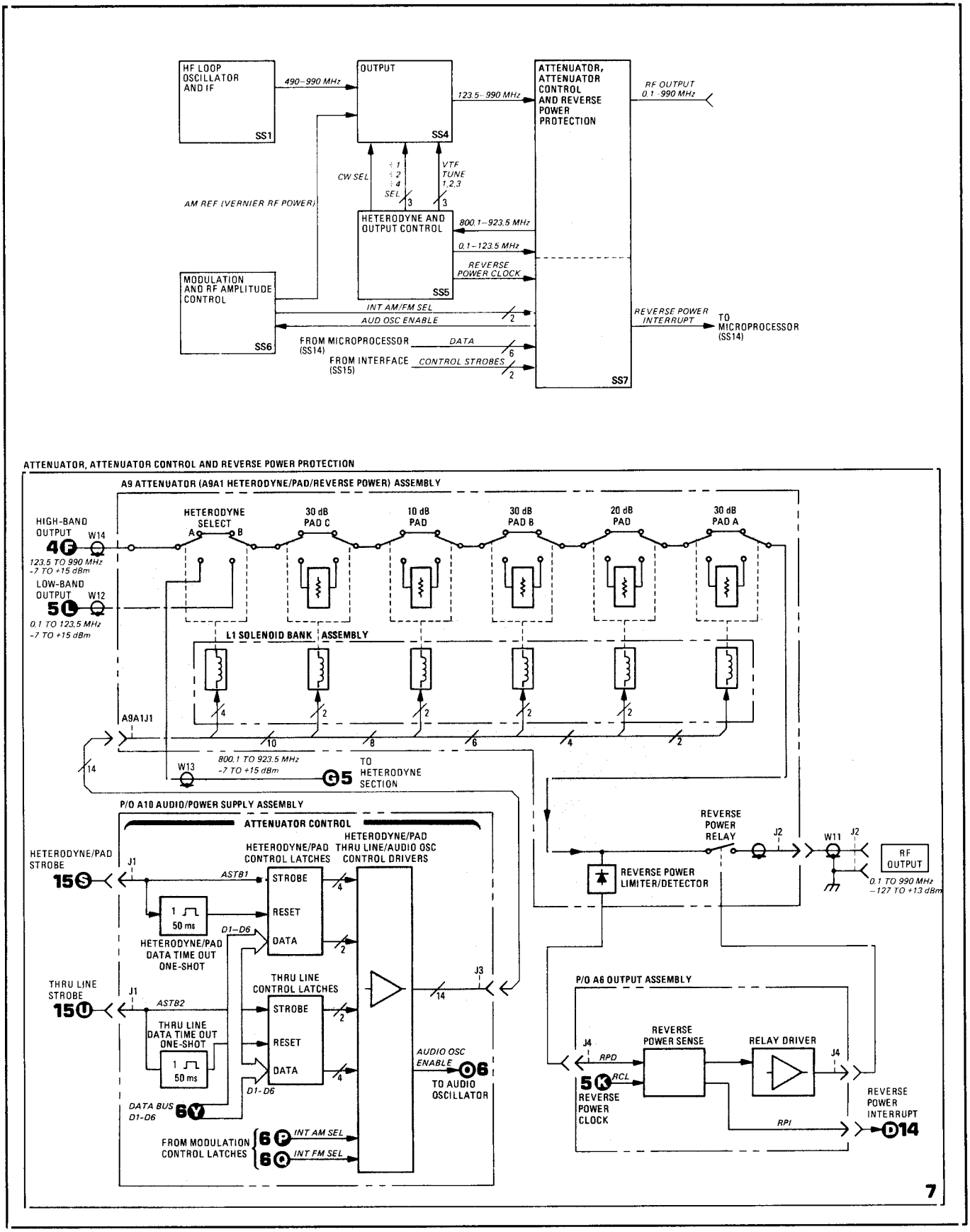
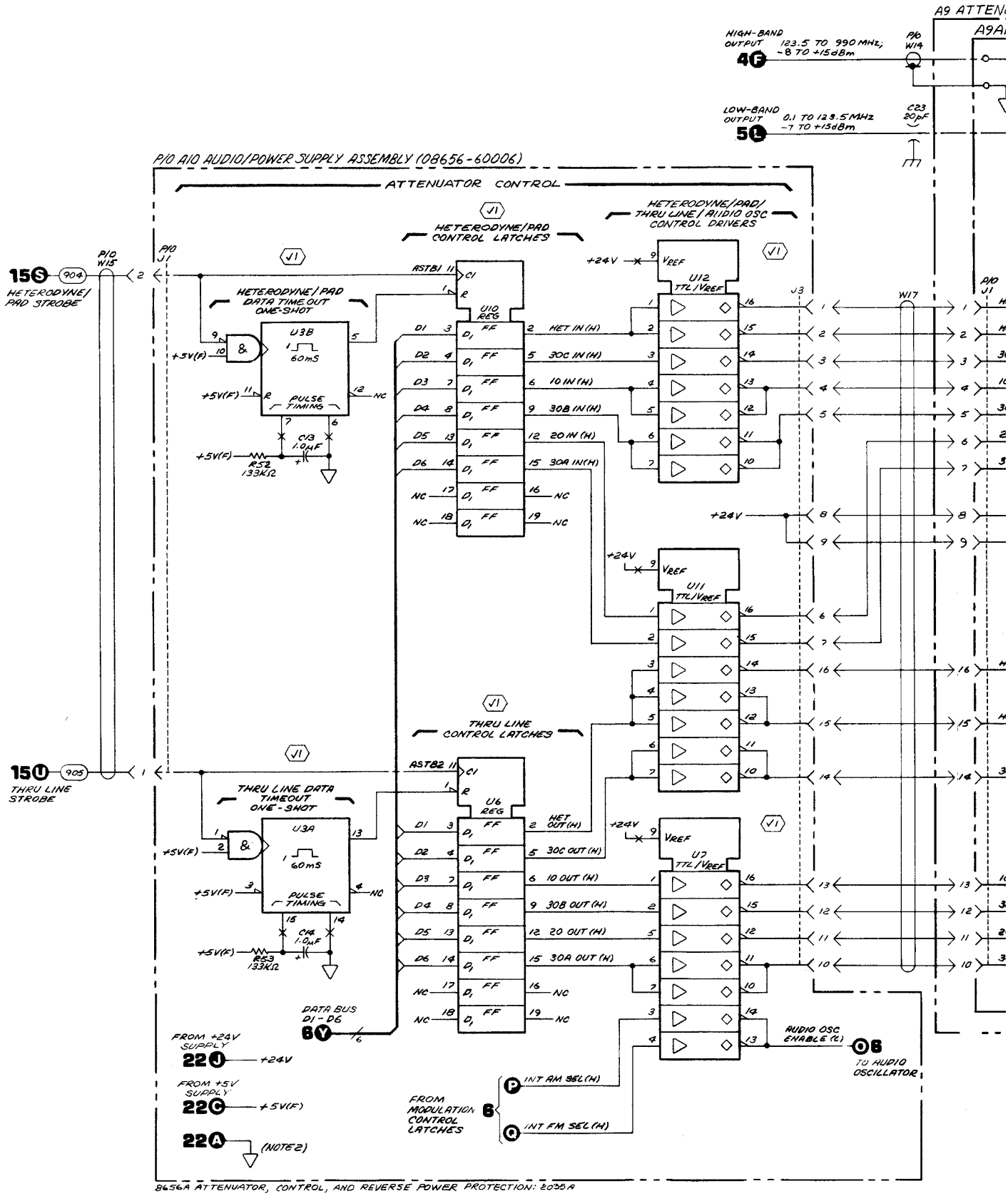


Figure 8-62. Attenuator, Attenuator Control and Reverse Power Protection Block Diagrams

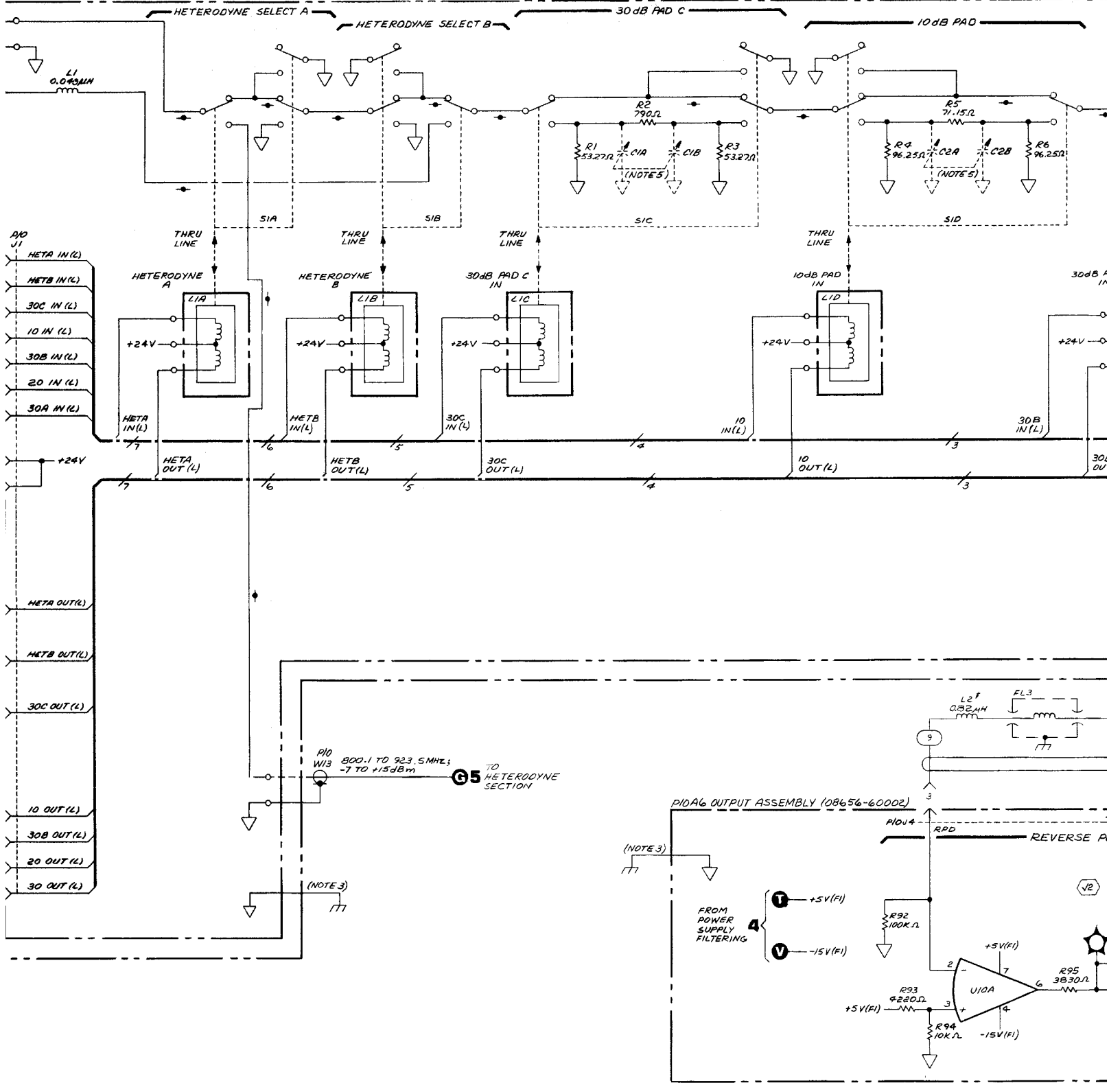
ManualsPlus.com



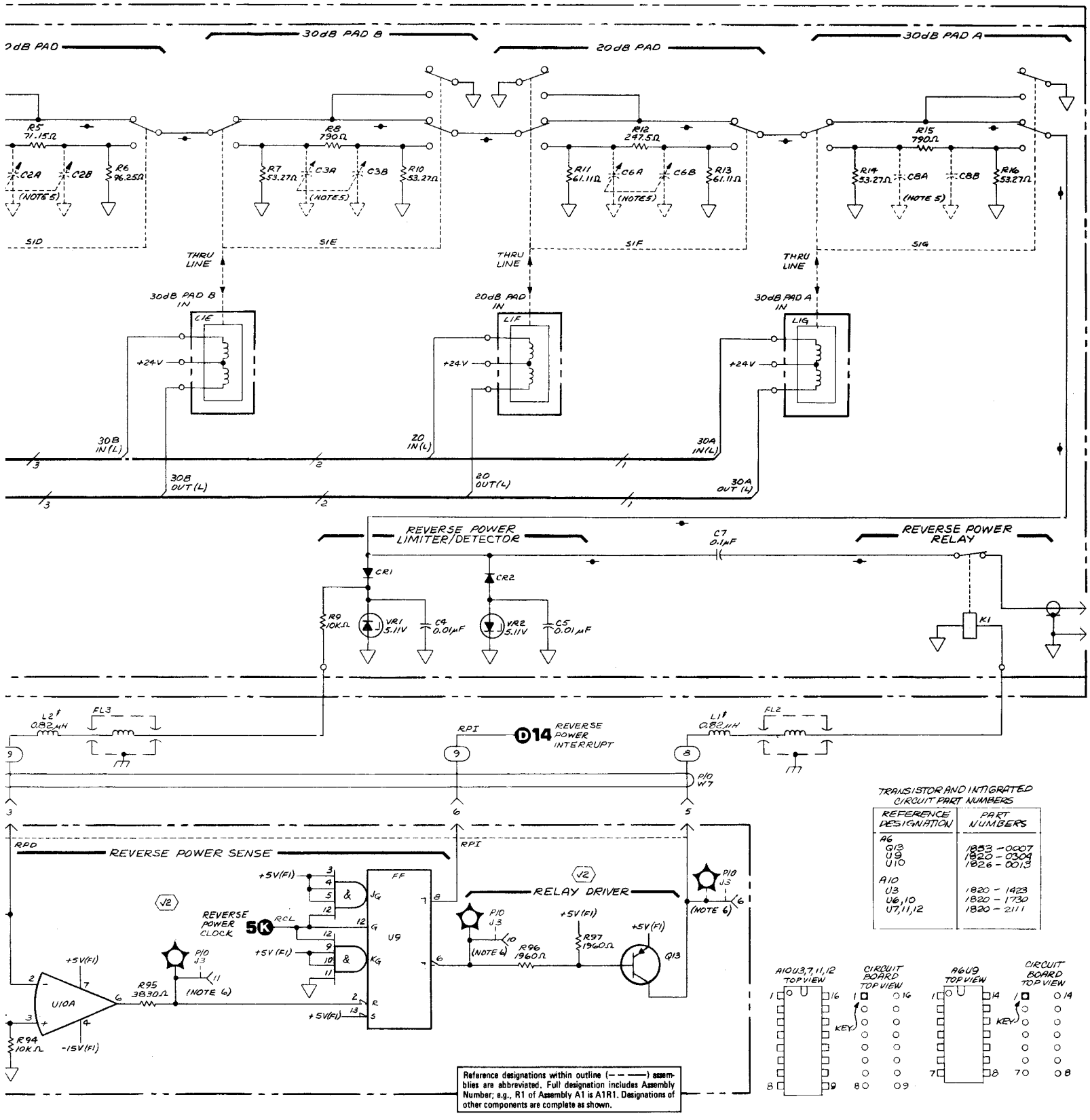
ManualsPlus.com

TENUATOR ASSEMBLY (08656-60018)

A9A1 HETERODYNE/PAD/REVERSE POWER ASSEMBLY (08656-60014)



ManualsPlus.com



TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATION	PART NUMBERS
A6	
Q13	1853 - 0007
U9	1820 - 0304
U10	1826 - 0013
A10	
U3	1820 - 1423
U6,10	1820 - 1730
U7,11,12	1820 - 2111

Figure 8-63. Attenu

ManualsPlus.com

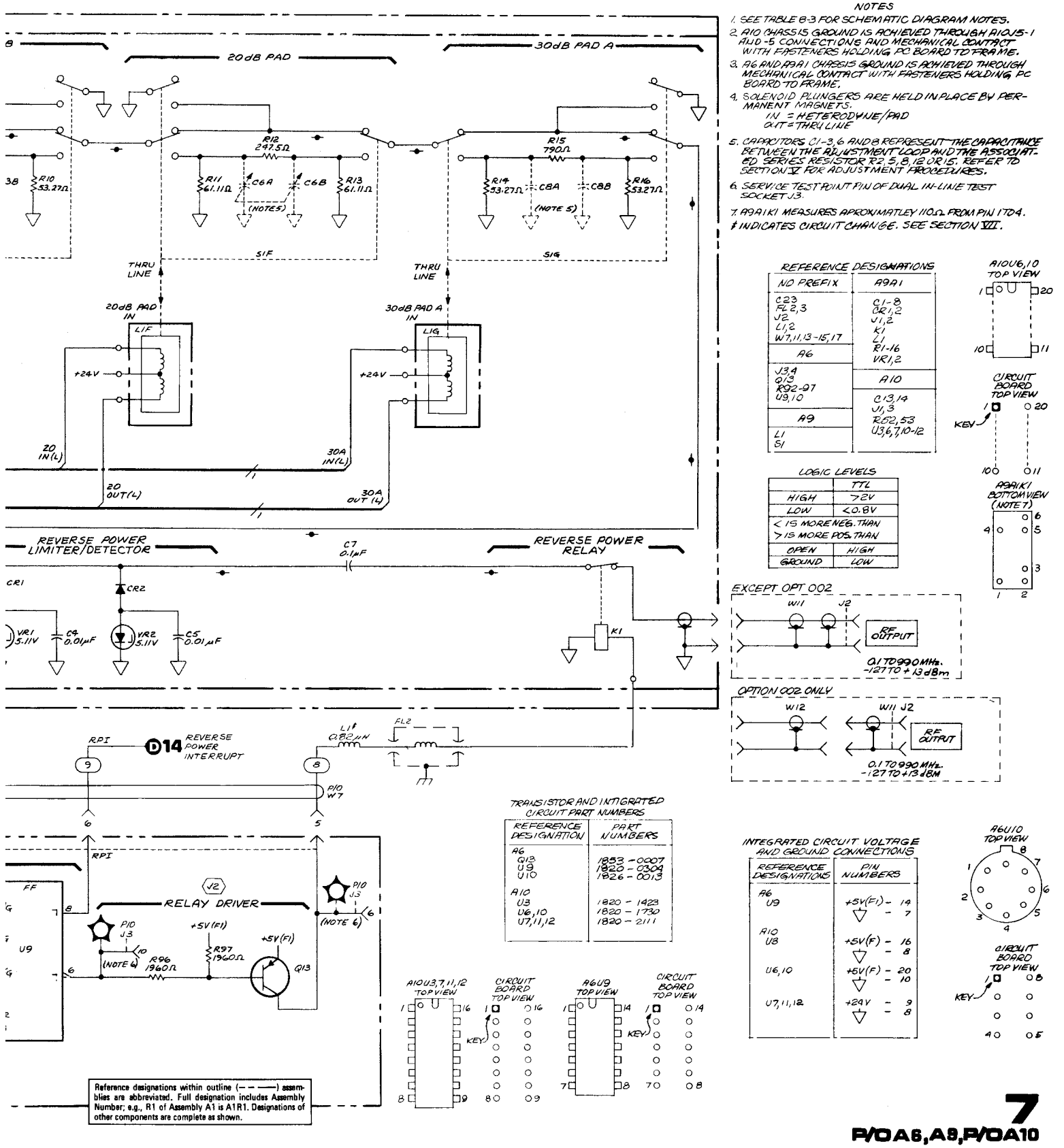


Figure 8-63. Attenuator, Attenuator Control and Reverse Power Protection Schematic Diagram

ManualsPlus.com

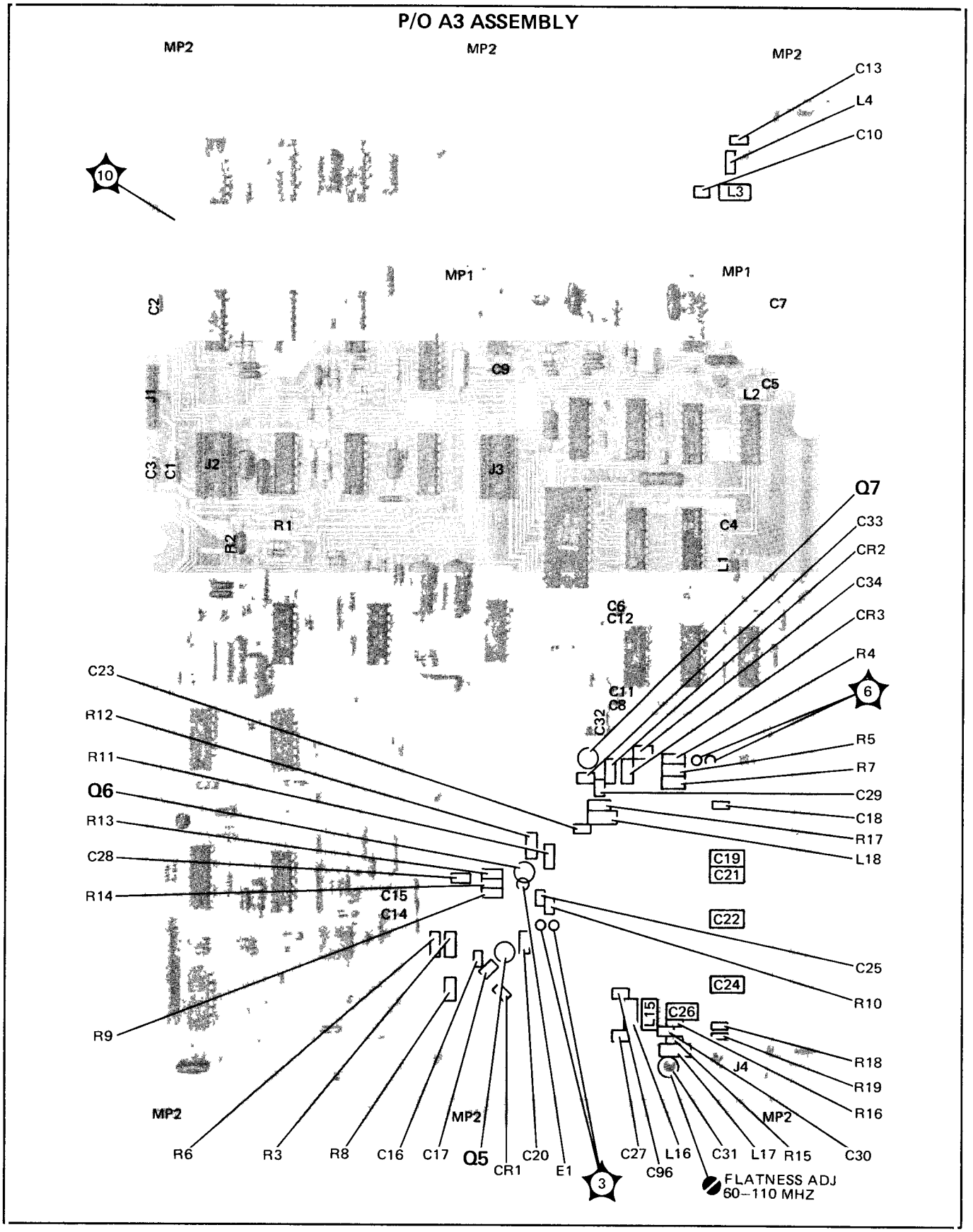


Figure 8-64. LF Loop VCO Component Locations

ManualsPlus.com

s of the A3 Low Frequency Loop
reas or points to check are marked
with a checkmark and a number
re shown on the schematic inside a
ıtor bias voltages are shown with-

.....HP 3465A
.....HP 436A
.....HP 8482A
.....HP 5328A
.....HP 1250-1598
to BNC male ...HP 1250-0077
BNC female ...HP 1250-0080
.....HP 08662-60080

SERVICE SHEET 8 (Cont'd)

√1 Voltaged Controlled Oscillator, Limiter Amplifier and 110 MHz Low-Pass Filter

1. Set the Signal Generator to −10 dBm at 80 MHz with no modulation.

2. Change the frequency to 90 MHz. This ensures the frequency of the Low Frequency Loop VCO will be 60 MHz.

3. Check the following levels at the frequencies indicated in Table 1.

NOTES

When probing the oscillator with the covers removed, a frequency shift may be introduced.

Covers for the oscillator must be installed so that the lip on the bottom cover makes a good contact with the ground plane on the printed circuit board.

Table 1. VCO Frequency, Power Output and TUNE Voltage

tput '6)	VCO Tune Voltage (Vdc)	Power Level (dBm)	
		at TP6	at J4
)	+11.0 to +9.0	+6.8 to +4.8	−7.7 to −9.7
)	+10.0 to +8.0	+7.0 to +5.0	−7.5 to −9.5
)	+9.0 to +7.0	+7.0 to +5.0	−7.3 to −9.3
)	+9.0 to +5.0	+7.2 to +5.2	−7.3 to −9.3
)	+8.0 to +4.0	+6.5 to +4.5	−7.1 to −9.1
)	+7.0 to +3.0	+6.2 to +4.2	−7.0 to −9.0
)	+6.0 to +2.0	+5.9 to +3.9	−7.0 to −9.0
)	+6.0 to 0.0	+5.7 to +3.7	−7.2 to −9.2
)	+5.0 to −1.0	+6.0 to +4.0	−7.8 to −9.8
)	+4.0 to −2.0	+6.2 to +4.2	−8.0 to −10.0
)	+2.5 to −3.5	+5.8 to +3.8	−8.4 to −10.4

ManualsPlus.com

SERVICE SHEET 8
P/O A3 LOW FREQUENCY LOOP ASSEMBLY

TROUBLESHOOTING HELP

Service Sheet BD3
Table 4-1. Abbreviated Performance Tests
Table 5-2. Post-Repair Adjustments

PRINCIPLES OF OPERATION

General

The Low Frequency Voltage Controlled Oscillator (VCO) and Limiter Amplifier generate, amplify and limit the 60 to 110 MHz signal that is mixed with 800 MHz on the Multiplier Assembly. The TUNE voltage to the VCO is controlled by data from the Microprocessor. The VCO is phase locked to the reference oscillator.

Voltage Controlled Oscillator

The VCO, Q5, is a Hartley Oscillator. The amount of positive feedback from the collector to the emitter is predetermined by the taps on the inductors. The inductors are spiral printed circuit board traces. The +13 Vdc is a clean stable voltage to bias the VCO and Limiter Amplifier circuits.

The base of Q5 is biased by resistor R6 and R8, and the emitter by resistor R9. Inductor L8 suppresses any high frequency oscillations and capacitors C16 and C20 ac couple the signal to the base and emitter of Q5. Capacitors C16 and C23 are by-pass capacitors.

The 60 to 110 MHz output is dependent on the TUNE voltage. The output is ac coupled by C25 to Linear Amplifier Q6.

Linear Amplifier

The base of Q6 is biased by resistors R10 and R11, and the emitter by R13 and R14. R13 supplies some negative feedback but R14 does not since it is by-passed by C28. The inductive bead E1 reduces gain at high frequencies.

The output of Q6 is dc coupled to buffer amplifier limiter Q7. The bias voltages of Q7 are set by Q6. Feedback from the collector to base of Q7 is by diodes CR2 and 3 and capacitor C29. The diodes limit the feedback and restrict the collector voltage swing to ±0.6V to provide a constant output level.

The output of the Limiter Amplifier is ac coupled by capacitor C32 to the VCO Buffer Q8 shown on Service Sheet 9 and by capacitor C34 to the 110 MHz Low-Pass Filter. Resistors R4, R5 and R7 form a 2 dB pad whichs isolates the amplifier from the 110 MHz Low-Pass Filter. This makes the filter impedance nearer 50Ω at all VCO frequencies.

110 MHz Low-Pass Filter

Capacitor C31 and inductor L17 form a series resonant circuit. At resonance, R15 and R16 reduce the series impedance for increased output. This is tuned to vary the output level at 110 MHz (flatness). The filter passes 60 to 110 MHz and rejects 120 MHz and above.

SERVICE SHEET 8 (C

TROUBLESHOOTING

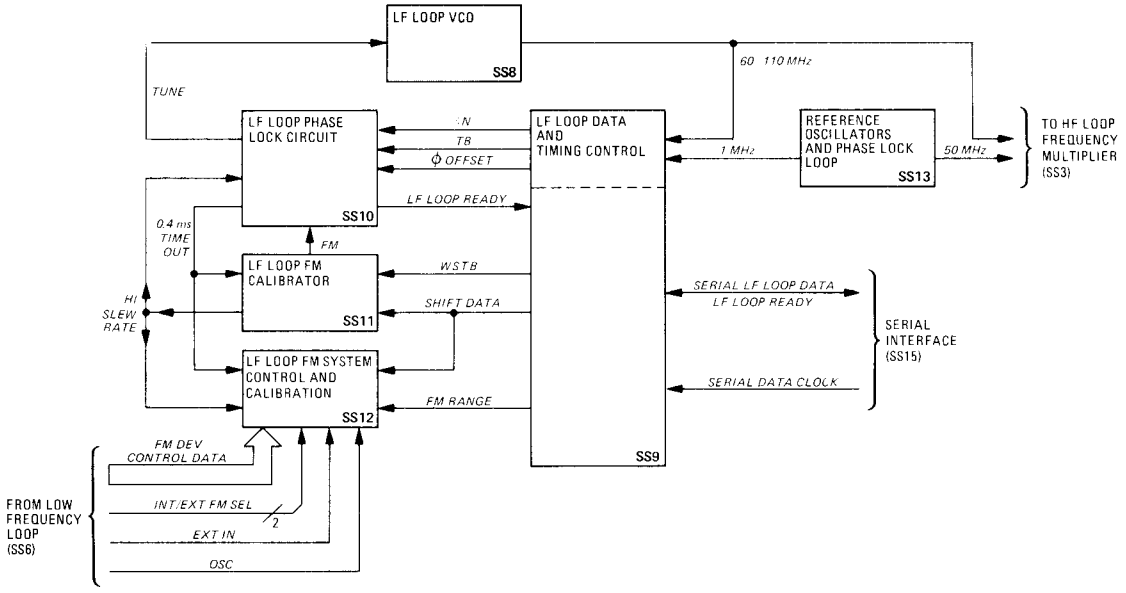
Procedures for checkin
Assembly are given belo
on the schematic by a
inside, e.g. ⟨√1⟩. Fixed v
hexagon e.g. ⟨2V±0.2V⟩
out tolerances.

Test Equipment

Digital Multimeter ....
Power Meter .....
Power Sensor .....
Frequency Counter ....
Adapter Probe .....
Adapter, Coaxial Type-
Adapter, Coaxial BNC f
Cable, BNC male to SM

Frequ
Front Pane Setting
90
85
80
75
70
65
60
55
50
45
40

ManualsPlus.com



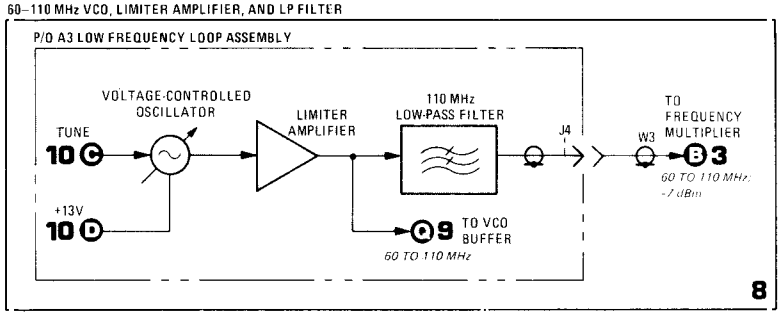
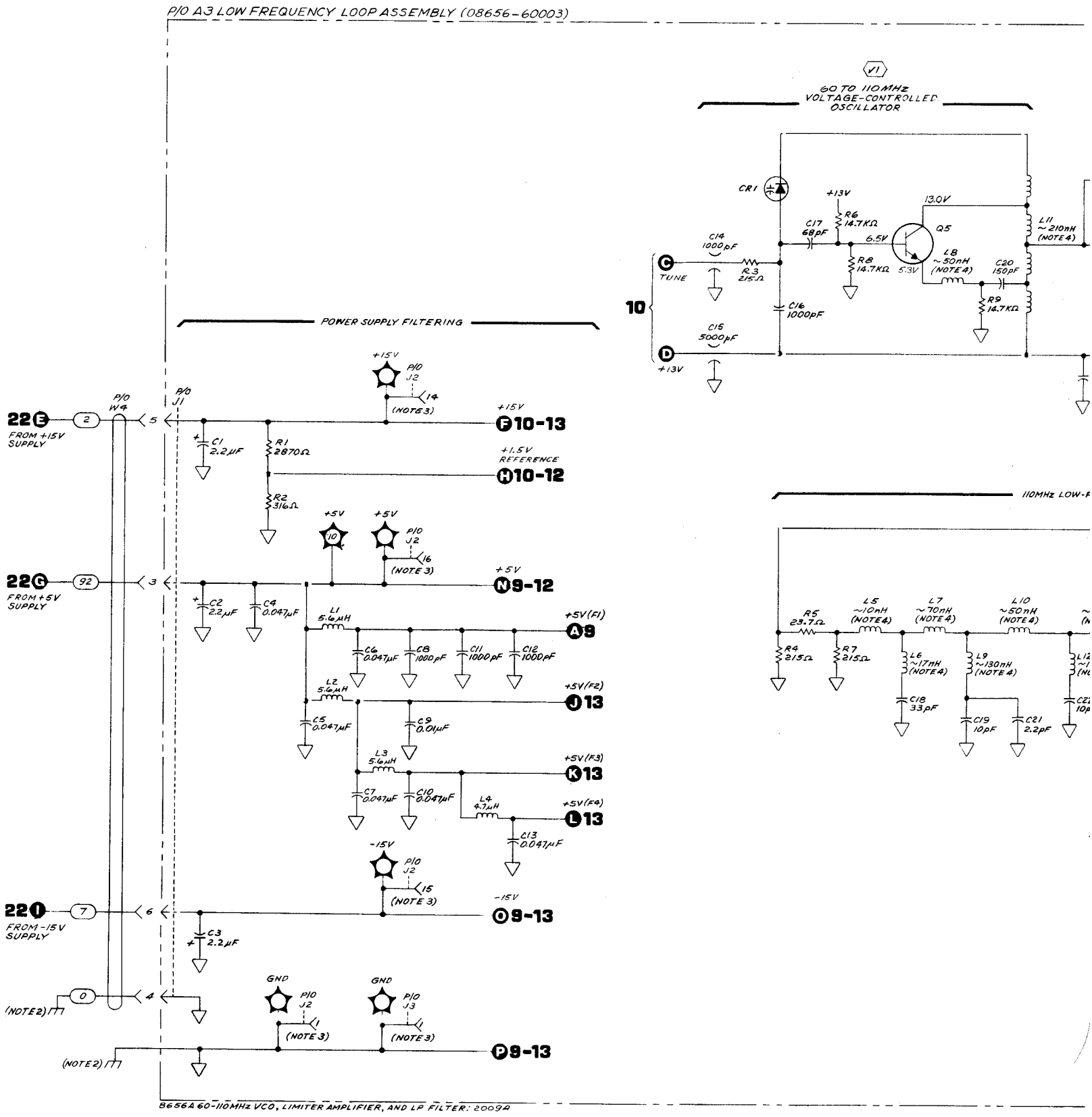
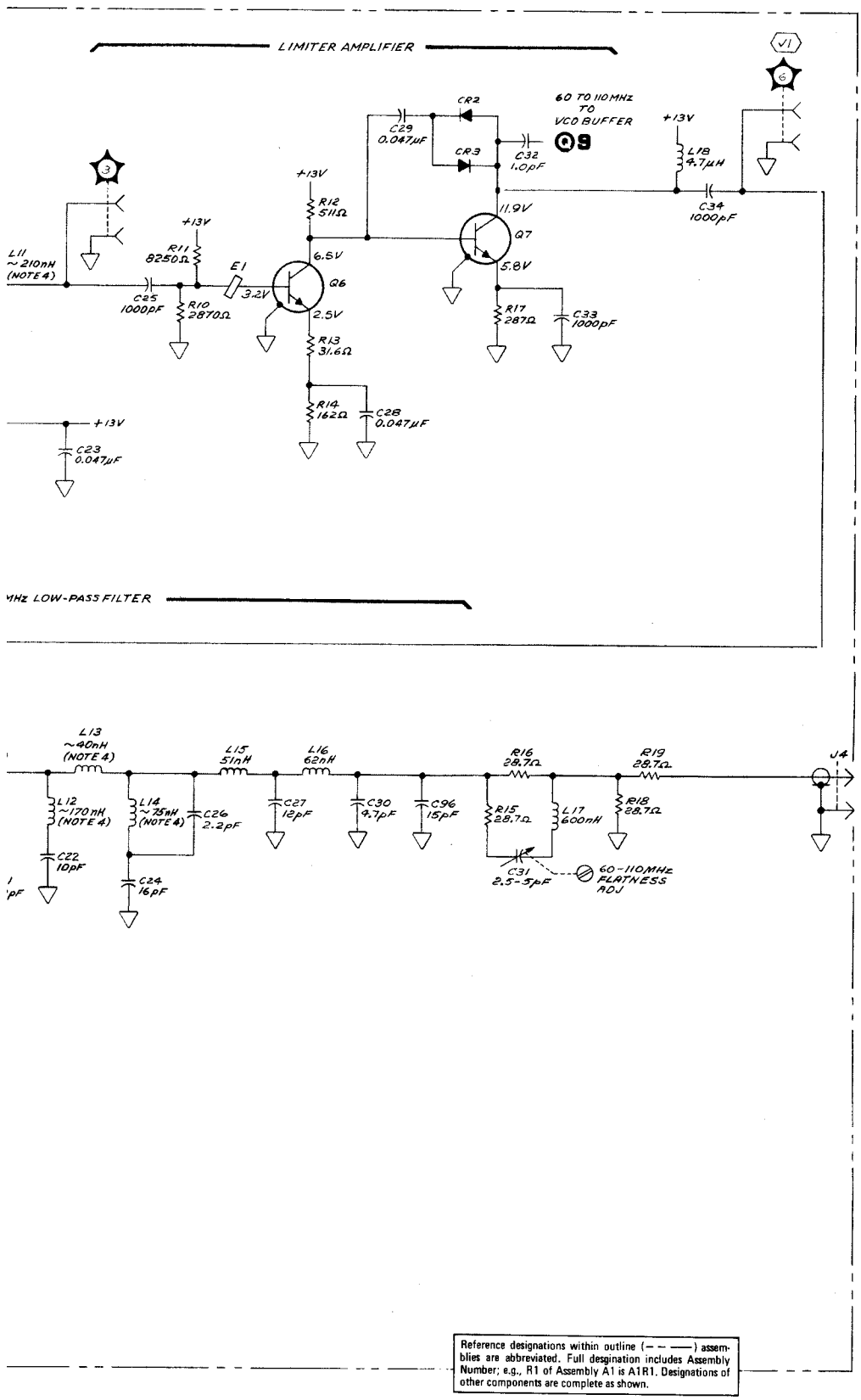


Figure 8-65. LF Loop VCO Block Diagrams

ManualsPlus.com



ManualsPlus.com



NOTES

1. SEE TABLE 8-3 FOR SCHEMATIC DIAGRAM NOTES.
2. CHASSIS GROUND IS ACHIEVED THROUGH A3J1-4 CONNECTION AND MECHANICAL CONTACT WITH FASTENERS HOLDING PC BOARD TO FRAME.
3. SERVICE TEST POINT. PIN OF DUAL IN-LINE TEST SOCKET J2 OR J3.
4. PRINTED CIRCUIT TRACE INDUCTOR.

REFERENCE DESIGNATIONS

NO PREFIX	A3 CONT.
W3, 4	L1-18
A3	Q5-7
C1-34, 96	R1-19
CR1-3	TP3, 6, 10
E1	
J1-4	

TRANSISTOR PART NUMBERS

REFERENCE DESIGNATIONS	PART NUMBERS
Q5	1854-0610
Q6	1854-0345
Q7	1854-0696

Reference designations within outline (— — —) assemblies are abbreviated. Full designation includes Assembly Number; e.g., R1 of Assembly A1 is A1R1. Designations of other components are complete as shown.

8
P/O A3

Figure 8-66. LF Loop VCO Schematic Diagram

ManualsPlus.com

SERVICE SHEET 9 (Cont'd)

by-16 cycle. One input to U30D is high when bit eight of Counter No. 1 goes high. The other input is set low since a low-to-high transition input to U26A sets the active-high output low. The active-high output will remain low until U26A is set by the ÷N terminal count. With one input to U30D high, the output at pin 15 is low and at pin 9 is high. The inputs are coupled to the base and emitter of ECL-to-TTL Translator Q10. The emitter of Q10 will be at approximately +4.2 Vdc, an ECL high, and the anode of CR4 will be at approximately +3.3 Vdc. CR4 will be biased on and the base of Q10 will be at approximately +2.7 Vdc, also on. With Ql0 turned on heavily, its collector voltage will approximately equal the emitter voltage. When the output of Counter No. 1 goes low, the input to pin 13 of U30D goes low and its outputs change to +3.3 Vdc at pin 9 and +4.2 Vdc at pin 15. Therefore, the anode of CR4 will be approximately +4.2 Vdc (biased on) and the base of Q10 will be +3.6 Vdc. The emitter of Q10 will be at approximately +3.3 Vdc and Q10 is biased off. (With Q10 biased off the collector will go to approximately 0 Vdc.) The ECL 3.3 Vdc low and 4.2 Vdc high has been changed to a TTL level (+0.8 Vdc low and +2.0 Vdc high). The signal at J3 pin 2 is a poorly shaped square wave whose frequency is the VCO frequency divided-by-16.

Counter No. 2. ECL-to-TTL Translator output is the clock for Counter No. 2, for Reload Blanking Flip-Flop No. 2, and for Terminal Count Reset Flip-Flop U28A. Refer to Tables 8 and 9 for operation of Counter No. 2 and the Reload Transient Blanking Flip-Flop No. 2.

Table 8. U27 Counter No. 2 Operation

R	Enable P	Enable T	Load	Clk	Counter Mode
H	H	H	H	↑	Count
H	H	H	L	↑	Load Data

Counter No. 2 is a synchronous programmable binary counter. When pin 9 is low data is loaded. When it is high the counter is counted up on each clock pulse low-to-high transition. The counter output at pin 15, the ripple carry output, goes high at binary 15. Therefore, when pin 9 is low the four most significant bits latched into U24B are clocked into Counter No. 2. On each successive low to high transition of the clock the counter counts up by one.

The ripple carry output is pulsed high for approximately 20 μs when the counter reaches 15. Therefore, the counter divides-by-16 except on the first count cycle after the input data has been loaded. Data is loaded every 10 or 4 ms. The output pulses from the counter are clocked through the Reload Transient Blanking Flip Flop No. 2.

Table 9. U31A Reload Transient Blanking Flip-Flop No. 2 Operation

R	S	D1	C	Pin 5	Pin 6
L	H	X	X	L	H
H	H	L	↑	L	H
H	H	H	↑	H	L

Counter 0. The output pulses of U31A clock the Triple Programmable Counter's Counter 0 on the low-to-high transition (positive going edge of pulse). The output of this counter triggers the Terminal Count Flip-Flop at a 100 Hz or 250 Hz rate. This sets a window for the ÷N pulse from Counter No. 2. The ÷N signal is compared with the TB 100 Hz or 250 Hz output of Triple Programmable Counter's Counter 1. TB is 1 MHz divided from the 50 MHz reference oscillator shown on Service Sheet 13.

With the reset input high, the 100 Hz or 250 Hz clock from Counter 0 clocks U31B on the low-to-high transition setting the active-high output high and the active-low output low. Refer to Table 10. The active-low output resets the Reload Transient Blanking Flip-Flop No. 2 and prevents it from being clocked. The active-high output high enables U14A every 10 or 4 ms which allows the output of Counter No. 2 to be gated to the ÷N output. This pulse is applied to U17B of the Phase to Charge Converter shown on Service Sheet 10 where it is compared to TB. The pulse is also coupled to the D input of U28A. The D input low is clocked to the active-high output by the output of Q10 which is equivalent to the output of Counter No. 1. When the active-high output of U28A is set low it resets U31B. The active-low output of U31B being high enables U31A to be clocked again. During this time the low output of U14A sets U27-Pin 9 Counter No. 2 low and it is reloaded on the same clock pulse that clocked U28A. The low output of Ul4A is coupled to the TTL-to-ECL Translator of VRl, CR7, R28 and R29 changing the input to U30B and C to a ECL high (greater than +4.2 Vdc). This changes the set input to U26A to a high

ManualsPlus.com

the outputs are never changed. The LF Loop will not enter the High Slew Rate mode since it is also dependent on the active-low output, that is WSTR(L), being low.

Divide-By-N Circuits

Counter No. 1. The 60 to 110 MHz signal from the VCO is applied to VCO Buffer Q8 to isolate the VCO from Reset Enable Reclock Flip-Flop U26B (refer to Table 5) and Counter No. 1 U23. The wired OR to the D2 input U26B pin 10 are traces on the PC board. Any high from the active-low output of U26A, B or terminal count output U23 pin 4 will provide a high to the D2 input of U26B. Therefore, when U26B is clocked by the VCO input, the active-high output goes high and the active-low output low. The active-high output's high to Counter No. 1 pin 5 enables the counter to count. Counter No. 1 (refer to Table 6) is a binary counter and divides the VCO clock frequency by 16. The terminal count at pin 4 goes low when the counter has counted to binary 15 (HHHH). The divide-by-16 output from Counter No. 1 is applied to the Reload Transient Blanking Flip-Flop No. 1 U26A (refer to Table 7) and to Counter No. 2 (refer to Table 8) through the level translator U30D and Q10.

Table 5. U26B Reset Enable Reclock Flip-Flop Operation

R	S	C2	Cc	D2	Pin 15	Pin 14
L	L	↑	L	L	L	H
L	L	↑	L	H	H	L

Table 6. U23 Counter No. 1 Operation

CE	PE	MR	CP	Remarks
L	L	L	↑	Load Parallel
L	H	L	↑	Count

Table 7. U26A Reload Transient Blanking Flip-Flop No. 1

R	S	C1	Cc	D1	Pin 2	Pin 3
L	L	↑	L	L	L	H
L	H	X	L	L	H	L

On the VCO clock pulse to Counter No. 1 that clocks the binary 15 Count, the terminal count at pin 4 goes low. The active-low output of U26B is also low but the active-low output of U26A is high so the D2 input of U26B remains high. The active-high output remains high and disables the parallel load of U23 of the data bits in Shift Register U24A. At this point, the divide-by-16 cycle starts over. When the output of Counter No. 1 goes high, it will be high for half the divide-

ManualsPlus.com

9 and 10, A0 and A1. The high at U28B's active-high output is coupled back to U21A-Pin 1. The pulse passes through the differentiator C37 and R25. This shortens the pulse to about 1 μs. At this time (between LF Data Words) U21A-Pin 2 is high. This means that U21A is set immediately. 75 μs later U21A returns to the reset condition which again clocks and resets U28B. This action ends the Triple Programmable Counter load enable and WSTR(L) signal. This process is repeated for each data word that is written to the Triple Programmable Counter.

Table 4. U28B Operation

R	S	C	D	Pin 9	Pin 8	Remarks
H	H	↑	H	H	L	Frequency change passes 25.6 kHz band edge.
H	H	↑	L	L	H	
L	H	X	X	L	H	Frequency change does not pass 25.6 kHz band edge

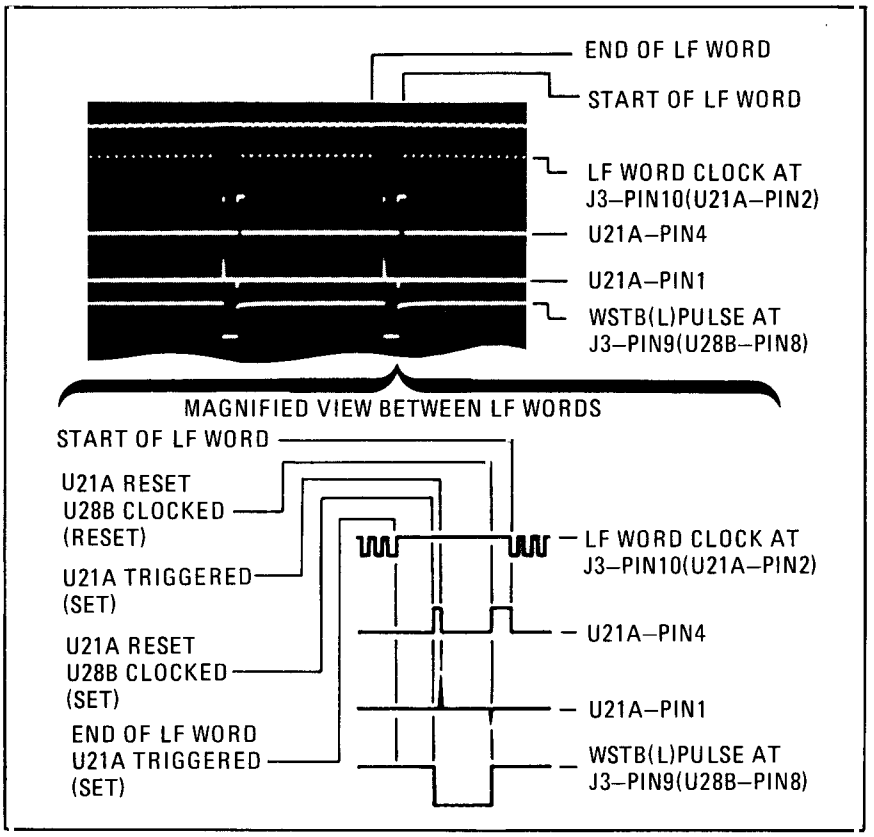


Figure 1. Write Strobe Generator Timing

If data is not to be written to the Triple Programmable Counter, U20, data bit 11 is not set high and the reset input of U28B is held low and

ManualsPlus.com

Table 2. Low Frequency Loop Data and Control Words

LF Word	Function	Written to Counter(s)
1	Time Base Control	U20 Counter 1
2	Time Base Data	U20 Counter 1
3	Phase Offset Control	U20 Counter 2
4	Phase Offset Data	U20 Counter 2
5	Divide-by-N Control	U20 Counter 0
6	Divide-by-N Data	U20 Counter 0
7	Divide-by-N Data	U20 Counter 0
8	Divide-by-N Data	Counters No.1 and 2

Counter and triggers the High Slew Rate Monostable U2lB shown on Service Sheet 11. Bits 9 and 10, A0 and A1, select which counter of U20 receives the data.

Write Strobe Generator

The Write Strobe Generator U21A and U28B is used to enable the Triple Programmable Counter when data is to be written to one of the counters and to enable the LF Loop circuits for the coming frequency change. The Generator is triggered if a LF Loop frequency change is greater that 25.6 kHz, if the LF Loop frequency crosses into another 25.6 kHz band and when the Signal Generator is reset or first connected to line power. Refer to Tables 3 and 4 and Figure 1.

The LF Loop Clock clocks in each of the 16 bit serial data words and triggers the Write Strobe Generator monostable U21A with the active-high output going high and the active-low output going low. About 75 μs after the last clock pulse of each word, U21A returns to its inactive state, active-high low and active-low high.

Table 3. U21A Operation

Pin 3	Pin 1	Pin 2	Pin 13	Pin 4
H	L	↑		
H	↓	H		

The inactive state of the U28B is active-high output low and active-low high which places a high on the D-input. Thus U28B is ready to be clocked high as soon as the low on the Reset input pin-13 is removed. Whenever data is to be written to the Triple Programmable Counter U20 (the Signal Generator is RESET, frequency resolution changes or the LF Loop frequency crosses a 25.6 kHz bandedge), data bit 11 from register U25A is high and the reset input to U28B is removed. When U21A returns to its inactive state, 75 μs after the data word ends, the U21A active-low output's low to high transition clocks U28B with the active-high output going high and the active-low output going low. The active-low output enables the LF Word data stored in the registers to be written to the Triple Programmable Counter. Which counter receives the data is determined by data bits

ManualsPlus.com

holds the input high. When the terminal count of Counter No. 1 is reached, the low at U26B-Pin l0 is transferred to U26B-Pin 15 which reloads Counter No. 1. The ÷N terminal count pulse is cut short when the low at the D input to the Terminal Count Reset Flip-Flop U28-Pin 2 is clocked through to reset the Terminal Count Flip-Flop U31B. The output of Counter No. 2 is switched back to the input of Counter 0.

The high used to set U26A is removed when the ÷N terminal count pulse ends. This enables the clock to Counter No. 2. When Counter No. 1 was reloaded, the output at pin 4 goes high replacing a high at U26B-Pin 10. The active-high output of U26B goes high on the first clock pulse which allows Counter No. 1 to begin counting on the second pulse. The counters again count up to the ÷N terminal count and the cycle repeats.

LF Loop Shift Registers

The serial LF Loop Data bus is pulsed low for approximately 0.5 ms every 10 ms or 4 ms (depending on the frequency resolution, l00 Hz or 250 Hz). This tells the Microprocessor that the Low Frequency Loop is ready to receive data. If the Microprocessor has data to write to the LF Loop Assembly, 9.5 ms is the time allowed in the 100 Hz frequency resolution mode and 3.5 ms in the 250 Hz frequency resolution mode starting at the termination of the LF Loop Ready pulse.

Serial LF Loop Data written to the LF Loop consists of control and data words for the Triple Programmable Counter U20 and data words for Counters No. 1 and No. 2, U23 and U27. Refer to Table 2. There are eight sixteen bit control and data words that are written to the Low Frequency Loop Assembly. They are clocked into U24A, B and U25A by the LF Loop Clock. Only the last twelve bits of each sixteen bit words are used. Each word consists of 4 blank, 4 control and 8 data bits. All eight words are written to the LF Loop when the instrument is RESET or when line power voltage is connected to the Signal Generator and it goes through the power up routine. In all other cases, control words 1, 3, and 5 are not written to the LF Loop Assembly. Data words 2 and 4 are written whenever the frequency resolution is changed from 100 Hz to 250 Hz or 250 Hz to l00 Hz. Data words 6 and 7 are written when the LF VCO frequency goes beyond the 25.6 kHz band edge. LF Loop data word 8 is left latched into shift registers U24A, B and U25A. The four most significant data bits (from U24B) are loaded into U27 Counter No. 2 and the four least significant bits (from U24A) are loaded into U23 Counter No. 1. Counters No. 1 and No. 2 and Counter 0 of the Triple Programmable Counter are all part of the ÷N Counter. These circuits are used to divide the LF Loop VCO to provide an output with 100 and 250 Hz resolution. This output is phase compared with the time base TB signal to phase lock the Low Frequency Loop.

Control bits 9 through 12 are clocked into U25A. These select special functions and the counter within the Triple Programmable Counter that is to receive data. Bit 12 of LFWRD 8 selects the FM range of 0 to 10 kHz or 11 to 99 kHz. Bit 11 resets D Flip Flop U28B whose active-low output, when low, lets data be written into the Triple Programmable

ManualsPlus.com

SERVICE SHEET 9
P/O A3 LOW FREQUENCY LOOP ASSEMBLY

TROUBLESHOOTING HELP

Service Sheet BD3
Table 4-1. Abbreviated Performance Tests
Table 5-2. Post-Repair Adjustments

PRINCIPLES OF OPERATION

General

Inputs to the divider circuits shown on Service Sheet 9 are from the Low Frequency Loop Voltage Controlled Oscillator (VCO) output and the 1 MHz reference signal (divided from 50 MHz). The 60 to 110 MHz VCO signal is divided-by-N to 100 or 250 Hz. The 1 MHz signal is divided to 100 or 250 Hz in Counter 1 of the Triple Programmable Counter. These signals, ÷N and TB, are phase compared in circuits shown on Service Sheet 10.

Counter No. 1 divides the 60 to 110 MHz VCO signal by 16. For each 100 Hz change in the LF Loop output frequency, the data bits to U23 change by 1. Counter No. 2 divides the output of Counter No. 1 by 16. For each 1600 Hz change in the LF Loop output frequency, the data bits to U27 change by 1. Changes in steps of 25.6 kHz (16 x 16 x 100 Hz) do not affect Counters No. 1 and 2. For a 25.6 kHz frequency step, data is written to Counter 0 (P/O U20) only. Because of the RF divider circuits in the Output Section (refer to Service Sheet 4), the RF output frequencies do not seem to correlate with the output of the Low Frequency Loop. Refer to Table 1 for more information.

Table 1. RF Output Versus LF Loop Output Frequencies

Output Divider Mode	RF Frequencies					LF Loop Frequencies					
	Output (MHz)	LF Loop Band (MHz)	High Slew Rate Band kHz)	Counter Resolution #1 (kHz)	Counter Resolution #2 (kHz)	Output (MHz)	LF Loop Band (MHz)	High Slew Rate Band (kHz)	Counter Resolution #1 (kHz)	Counter Resolution #2 (kHz)	Counter Data Change
÷1/Heterodyne	0.1-123.5	50	25.6	0.1	1.6	60-110	50	25.6	0.1	1.6	1
÷4	123.5-247	12.5	6.65	0.1	1.6	60-110	50	25.6	0.4	6.4	4
÷2	247-494	25	13.3	0.1	1.6	60-110	50	25.6	0.2	3.2	2
÷1	494-990	50	25.6	0.1	1.6	60-110	50	25.6	0.1	1.6	1

At the end of the ÷N count cycle, a pulse is output from Counter 0. This pulse clocks the Terminal Count Flip-Flop. The resulting output enables the terminal count gate Ul4A with a high at pin 2 and resets U31A with a low at pin 1. This allows the next clock transition from Counter No. 2 to be gated to the ÷N output instead of the input to Counter 0. Therefore, a 0.5 ms window is opened every 10 ms (100 Hz) or 4 ms (250 Hz) which allows Counter No. 2's terminal count to become the terminal count of the entire ÷N Counter.

The ÷N pulse is used to load Counter No. 2 U27 directly. It also passes through level translator U30B and C to set the Reload Transient Blocking Flip-Flop No. 1 U26A which halts the clock pulse to Counter No. 2. The effect of setting U26A tries to place a low at U26B-Pin 10. The terminal count output of Counter No. 1 U23-Pin 4 overrides this and

ManualsPlus.com

SERVICE SHEET 9 (Cont'd)

which changes the active-high output to a high and the active-low output to a low. This enables the D input to U26B so that when the carry output of Counter No. 1 goes low, Counter No. 1 is reloaded with the data stored in shift register U24A on the next VCO clock pulse.

Table 10. U31B Terminal Count Flip-Flop Operation

R	S	D	C	Pin 9	Pin 8
L	H	X	X	L	H
H	H	H	↑	H	L

Triple Programmable Counter's Counter 2 is clocked by the same 1 MHz as the Counter 1 and supplies a 20 μs pulse every 10 ms or 4 ms to U13D of the Phase to Charge Converter (refer to Service Sheet 10).

TROUBLESHOOTING

Procedures for checking the circuits of the A3 Low Frequency Loop Assembly are given below. The areas or points to check are marked on the schematic by a hexagon with a checkmark and a number inside, e.g., ⟨√1⟩. Fixed voltages are shown on the schematic inside a hexagon, e.g., ⟨2V±0.2V⟩. Transistor bias voltages are shown without tolerances.

Test Equipment

Digital Multimeter .....HP 3465A
Frequency Counter .....HP 5328A
Oscilloscope
- Storage Mainframe .....HP 181A
- Vertical Amplifier .....HP 1801A
- Time Base .....HP 1820C

⟨√1⟩ Reset Enable Reclock Flip-Flop, Counter No. 1

1. Set the Signal Generators frequency to 80 MHz.

2. Set the Signal Generator to −10 dBm at 90 MHz without modulation.

NOTE

It is necessary to include step 1 so that the Low Frequency Loop frequency will be set to 60 MHz.

3. Check the frequencies and voltage levels shown in Table 11.

4. Check the waveforms for TP4, TP5 and J3-pin 2. Refer to Figures 2, 3 and 4. The frequency of the Signal Generator is 90 MHz and the VCO frequency is 60 MHz. Measurements are made using a 1:1 probe.

Table 11. Counter No. 1 Signals versus LF Loop Frequency

Frequency (MHz)			TTL Level at U23-Pins			
Signal Generator Output	LF Loop VCO Output at A3TP4	Output of Counter No. 1 at A3TP5 or J3-Pin 2	11	10	9	7
90.0000	60.0000	3.7500	L	L	L	H
80.0000	70.0000	4.3750	L	L	L	H
60.0000	90.0000	5.6250	L	L	L	H
50.0000	100.0000	6.2500	L	L	L	H
49.5000	100.5000	6.2813	H	L	L	H
49.0000	101.0000	6.3125	L	L	L	H
46.5555	103.4445	6.4653	L	H	L	L
46.5000	103.5000	6.4688	H	L	L	H
46.0555	103.9445	6.4966	H	H	L	L
46.0055	103.9945	6.4997	H	L	L	L
46.0050	103.9950	6.4997	L	L	H	H

ManualsPlus.com

SERVICE SHEET 9 (Cont'd)

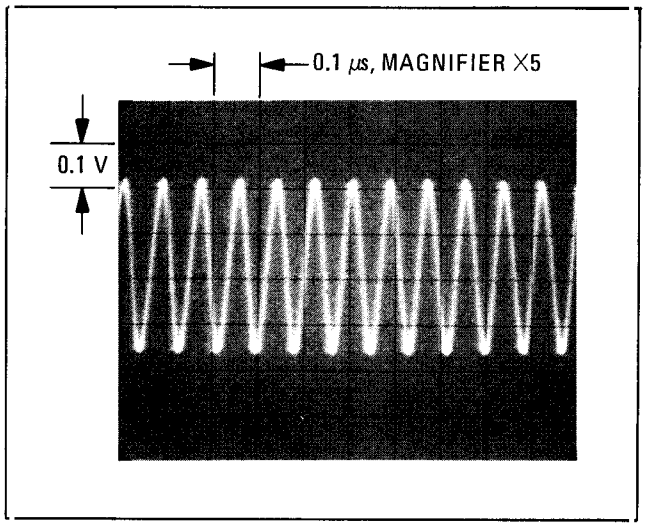


Figure 2. Oscilloscope Display of LF Loop VCO Output at TP4 (with ac coupling and internal triggering)

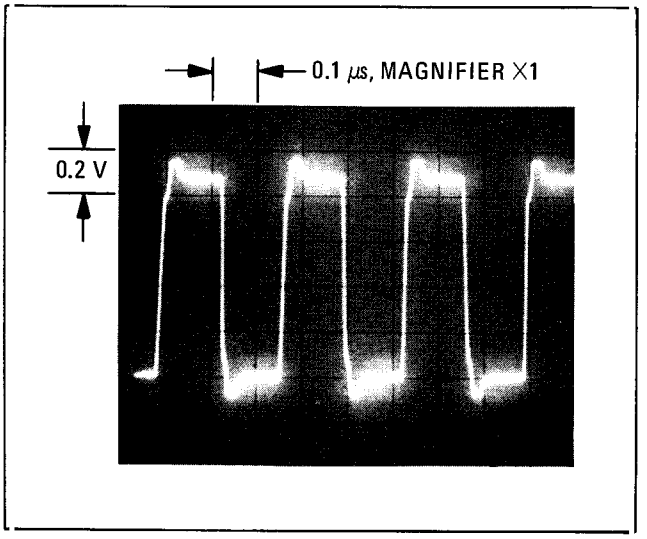


Figure 3. Oscilloscope Display of Counter No. 1 Output at TP5 (with ac coupling and internal triggering)

√2 Counter No. 2, Reload Transient Blanking Flip-Flop No. 2, P/O Triple Programmable Counter and Terminal Count Flip-Flop

1. Set the Signal Generator's frequency to 80 MHz. This allows 90 MHz to be set from a lower frequency.

2. Set the Signal Generator to –10 dB at 90 MHz without modulation.

3. Check the frequencies and voltage levels shown on Table 12. The frequency at J3-Pin 3 may be hard to count due to pulse width. If it is, measure the time of the period and calculate the frequency.

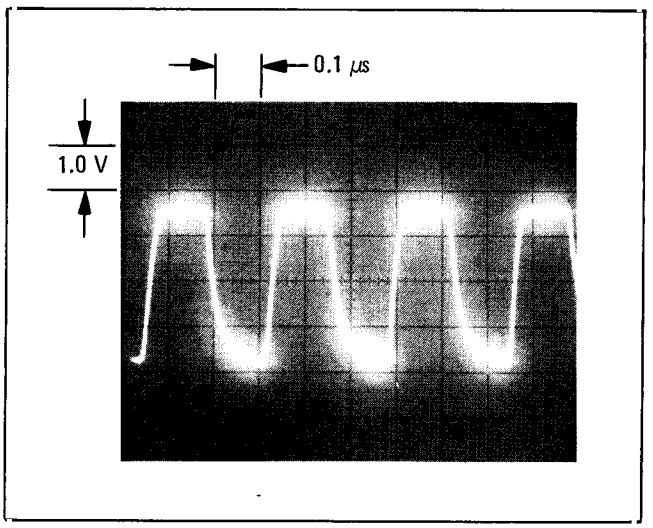


Figure 4. Oscilloscope Display of Counter No. 2 Input at J3-pin 2 (with ac coupling and internal triggering)

Table 12. Counter No. 2 Signals versus Signal Generator Frequency

FREQUENCY (MHz)		Level at U27-Pin no.			
Signal Generator Output	Counter 0 Input at J3-Pin 3	6	5	4	3
90.0000	234.4	L	H	L	H
80.0000	273.5	H	L	H	H
60.0000	351.5	L	H	H	H
50.0000	390.5	H	H	L	H
49.5000	392.6	L	H	L	L
49.0000	394.5	H	H	L	L
46.5555	404.0	L	L	L	H
46.5000	404.3	L	L	L	H
46.0555	406.0	L	L	L	H
46.0055	406.2	L	L	L	L
46.0050	406.2	L	H	H	L

4. Check the waveform for J3-Pin 3 as shown in Figure 5. The frequency of the Signal Generator is 90 MHz. Measurement is made using a 1:1 probe.

5. The Counter 0 output, Out 0, measured at test point J3-Pin 4 of Triple Programmable Counter U20 is a 100 Hz square wave for a Signal Generator frequency of 90 MHz (refer to Figure 6) and a 250 Hz square wave for a Signal Generator frequency of 90.00025 MHz.

ManualsPlus.com

SERVICE SHEET 9 (Cont'd)

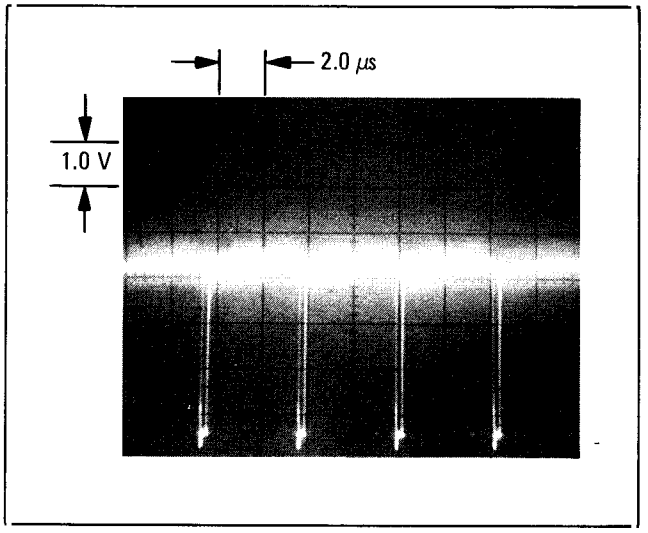


Figure 5. Oscilloscope Display of Counter 0 Input at J3-Pin3 (with ac coupling and internal triggering)

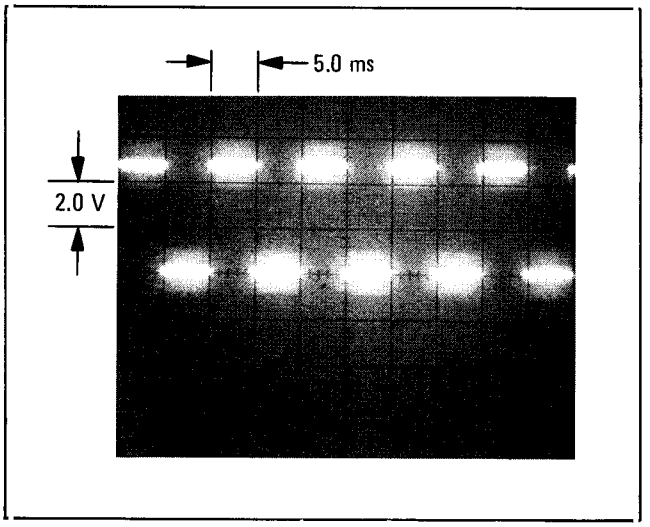


Figure 6. Oscilloscope Display of Counter 0 Output at J3-Pin 4 (with dc coupling and internal triggering)

6. The 100 or 250 Hz output of U20 clocks the Terminal Count Flip-Flop U31B to provide a time interval so the output of Counter No. 2 is gated to the ÷N line. Refer to Figure 7 for a display of the ÷N Terminal Count.

√3 P/O Triple Programmable Counter

1. The TB (Time Base) output at J3-Pin 7 of Triple Programmable Counter U20 is a 100 Hz square wave for a Signal Generator output frequency of 90 MHz and a 250 Hz squarewave for an output of 90.00025 MHz.

2. The square wave display at J3-Pin 7 will be the same as J3-Pin 4.

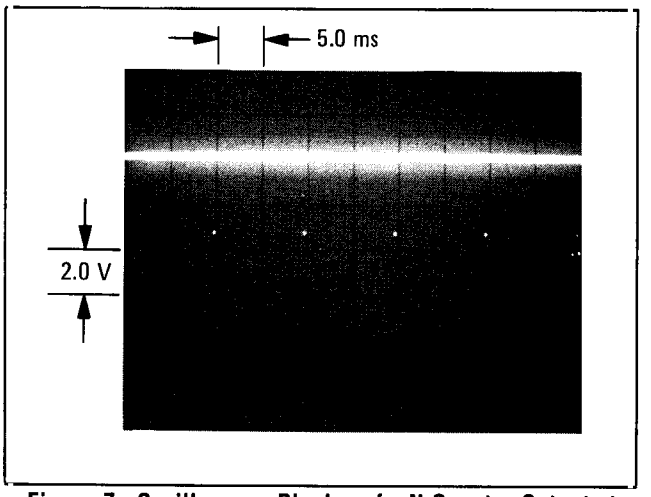


Figure 7. Oscilloscope Display of ÷N Counter Output at U14 Pin 3 (with dc coupling, internal triggering and a persistance display)

3. View the ϕ Offset waveform at J3-Pin 6 of Triple Programmable Counter U20 (refer to Figure 8). It is a 20 μs pulse at a 100 Hz rate for a Signal Generator output frequency of 90 MHz and a 20 μs pulse at a 250 Hz rate for a frequency of 90.00025 MHz.

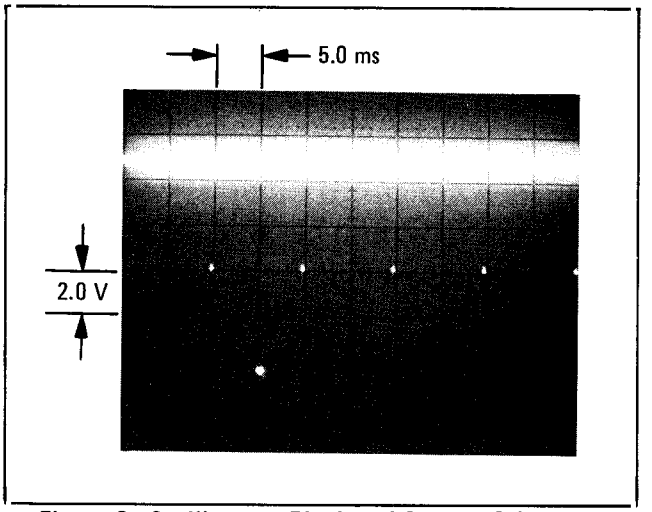


Figure 8. Oscilloscope Display of Counter 2 Output at J3-Pin 6 (with dc coupling and internal triggering)

4. Check the 1 MHz clock inputs for Counters 1 and 2 of Triple Programmable Counter. The clock is a 0 to 5 volt 200 ms pulse at the 1 MHz rate and can be checked at J3 pin 5.

√4 LF Loop Shift Registers, Write Strobe Generator

1. Check the waveform of Figures 9, 10 and 11 when all eight of the low frequency words are writ-

ManualsPlus.com

SERVICE SHEET 9 (Cont'd)

ten to the Low Frequency Loop (at power up or when the instrument is reset at the front panel).

NOTE

This action triggers the high slew rate and lets all seven data words be written to the Triple Programmable Counter. The remaining word is held in the shift registers.

2. Set the Signal Generator's output frequency to 500 MHz. Increment the frequency up 10 MHz. Three words are written to the LF Loop. Figure 12 shows that 16 bits are written for each word (only 12 bits are used). Figure 13 shows the write strobe signal WSTB(L).

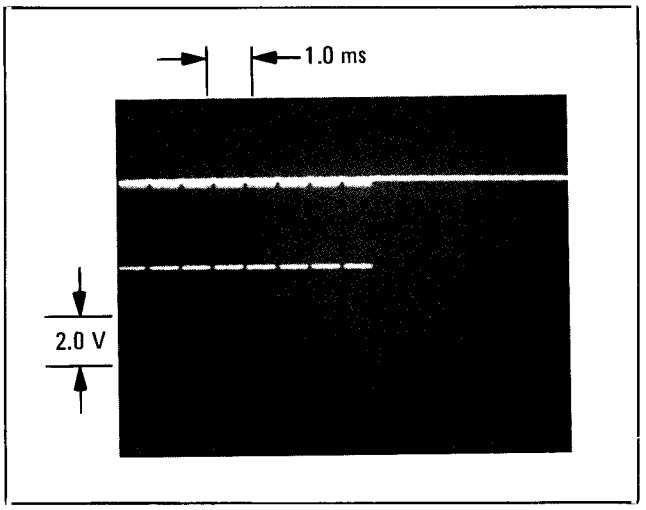


Figure 9. Oscilloscope Display of LF Loop Clock at J3-Pin 10 (with dc coupling and external triggering at J3-Pin 10)

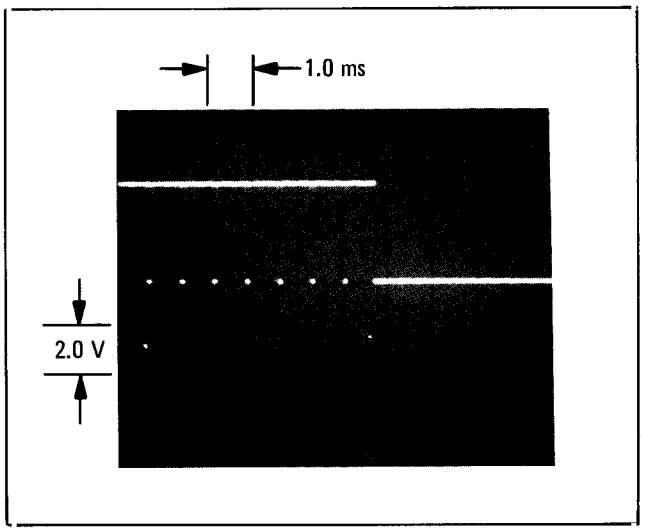


Figure 10. Oscilloscope Display of Shift Data Pulse at U21-Pin 13 (with dc coupling; external triggering from U21-Pin 13)

NOTE

The high slew rate is triggered which lets two data words be written to the Triple Programmable Counter. The third word is held in the shift registers.

3. Set the Signal Generator's frequency to 500 MHz. Increment the frequency up 1.00025 MHz to select 250 Hz resolution (TB and ÷N are 250 Hz). Four words are written to the LF Loop. Refer to Figures 14 and 15.

NOTE

High slew rate is triggered which lets three data words be written to the Triple Programmable Counter. The fourth word is held in the shift registers.

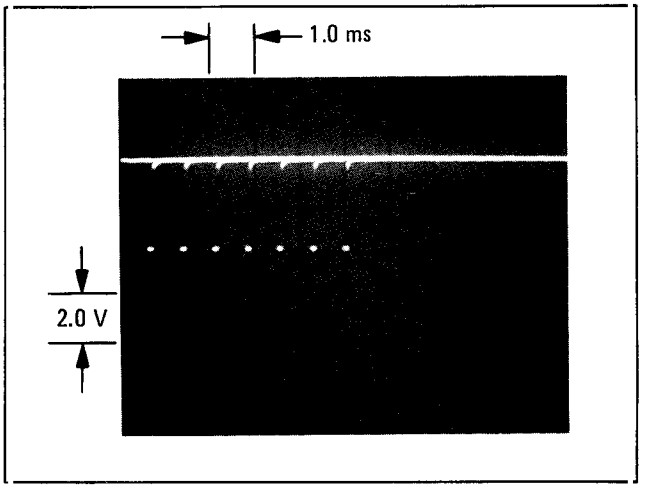


Figure 11. Oscilloscope Display of WSTB (L) at J3-Pin 9 (with dc coupling; external triggering from U21-Pin 13)

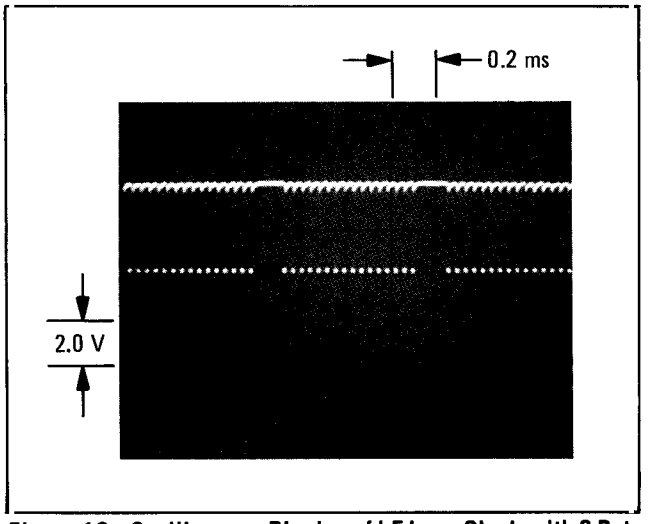


Figure 12. Oscilloscope Display of LF Loop Clock with 3 Data Words and a 10 MHz change at J3-Pin 10 (coupling is dc; triggering is external from J3-Pin 10)

ManualsPlus.com

SERVICE SHEET 9 (Cont'd)

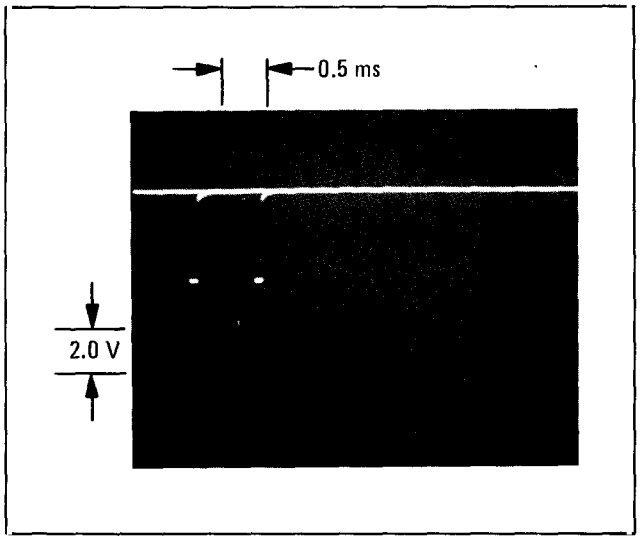


Figure 13. Oscilloscope Display of WSTB (L) at J3-Pin 9 (with dc coupling; external triggering from U21-Pin 13)

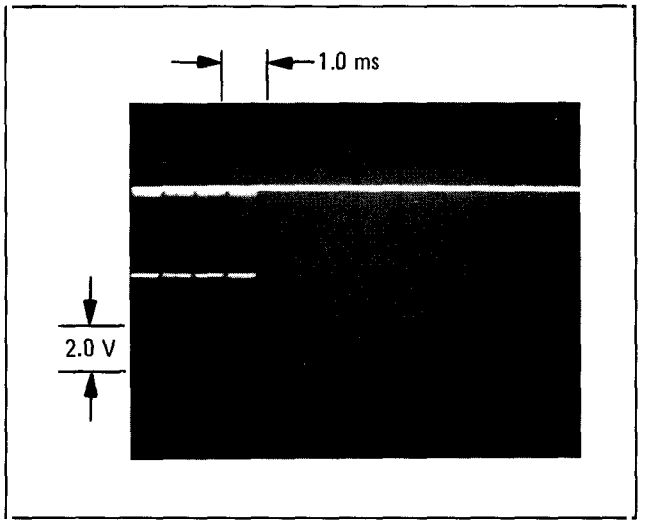


Figure 14. Oscilloscope Display of LF Loop Clock for 4 Data Words at J3-Pin 10 (with dc coupling; external triggering is from J3-Pin 10)

4. Set the Signal Generator to 250 MHz. Increment the frequency up 25 MHz. The LF Loop does not change frequency because U28B does not change state and no new data is stored in the shift registers for Counter Nos. 1 and 2. Only U21A changes state and then returns to its inactive state.

TROUBLESHOOTING USING SIGNATURE ANALYSIS

This information provides an alternate method of troubleshooting Service Sheet 9 circuits. Service Sheet BD4 which leads to this information is used to troubleshoot from the digital (control) standpoint. If the signatures on these circuits are correct, the problem is probably in the controlled circuits. In this case, continue with the preceeding troubleshooting information on this page. You may also refer to Service Sheet BD3. If the signatures are incorrect, recall that the digital signals pass through the circuits of Service Sheet 15 before arriving here.

NOTE

Signatures are not valid for Signal Generators with serial number prefixes of 2018A and below.

Purpose. Verify correct data transfer from the Microprocessor to the Low Frequency Loop.

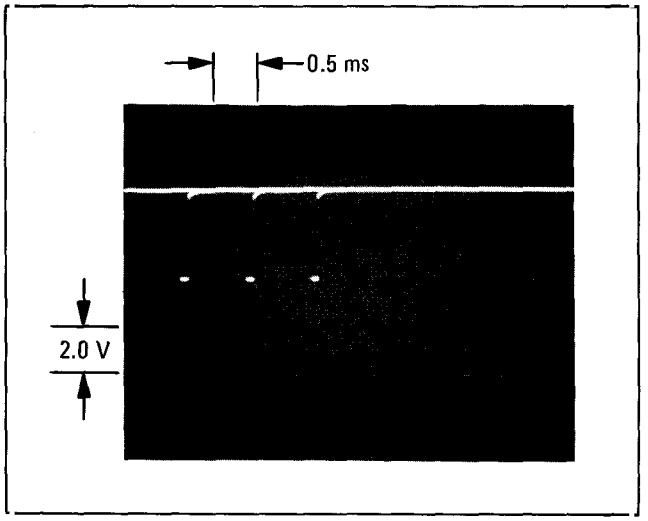


Figure 15. Oscilloscope Display of WSTB (L) at J3-Pin 9 (with dc coupling; external triggering is from U21-Pin 13)

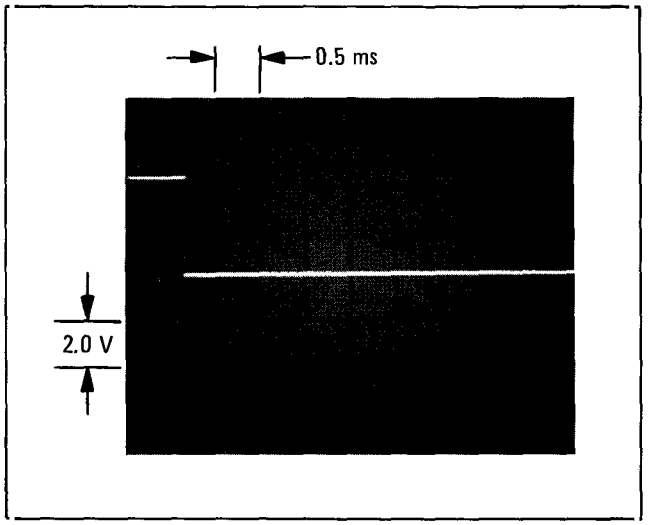


Figure 16. Oscilloscope Display of Shift Data (H) pulse (with dc coupling; external triggering from U21-Pin 13)

ManualsPlus.com

SERVICE SHEET 9 (Cont'd)

Setup. Set up the signature analyzer as follows:

1) GND to GND (close to the circuits being measured).
2) CLK to SA4 A11TP7
3) START to SA5 A11TP9
4) STOP to SA5 A11TP9

Set the signature analyzer controls as follows:

1) START IN
2) STOP OUT
3) CLK IN

Set up the Signal Generator as follows:

1) Set the LOGIC/RAM switch A11S1 to the LOGIC position.
2) Connect A3TP8 to A3TP9.

Initialize. Briefly short A11TP3 NMI to ground.

NOTE

With careless probing it is possible to get the Microprocessor into a program sequence other than that portion intended for signature analysis. If the +5V signature is incorrect this has probably happened. Restart the test by setting the RST/RUN switch to RST and then RUN. Briefly touch the NMI test point to ground.

Probe. Connect to the node indicated in Table 13. Verify that each signature is correct and stable.

Table 13. LF Loop Shift Register Signatures

Node	Correct Signature	Comments
+5V	F84P	
U24-Pin 7	FUC5	SIPO DATA
U24-Pin 9	F84P *	LF CLK
U24-Pin 5	081F	LF D0
U24-Pin 4	040P	LF D1
U24-Pin 3	0207	LF D2
U24-Pin 10	F6AA	LF D3
U24-Pin 13	0895	LF D4
U24-Pin 12	044A	LF D5
U24-Pin 11	0225	LF D6
U24-Pin 2	0112	LF D7
U25-Pin 5	0089	LF A0
U25-Pin 4	0044	LF A1
U25-Pin 3	0022	WRT STROB
U25-Pin 10	F7C8	FM RANGE

*Signature is same as +5V but probe tip should blink.

Remove the jumper between A3TP8 and A3TP9. Reset the LOGIC/RAM switch to the RAM position. Reset the Signal Generator by setting the front panel RESET-STBY-ON switch to RESET and back to ON.

ManualsPlus.com

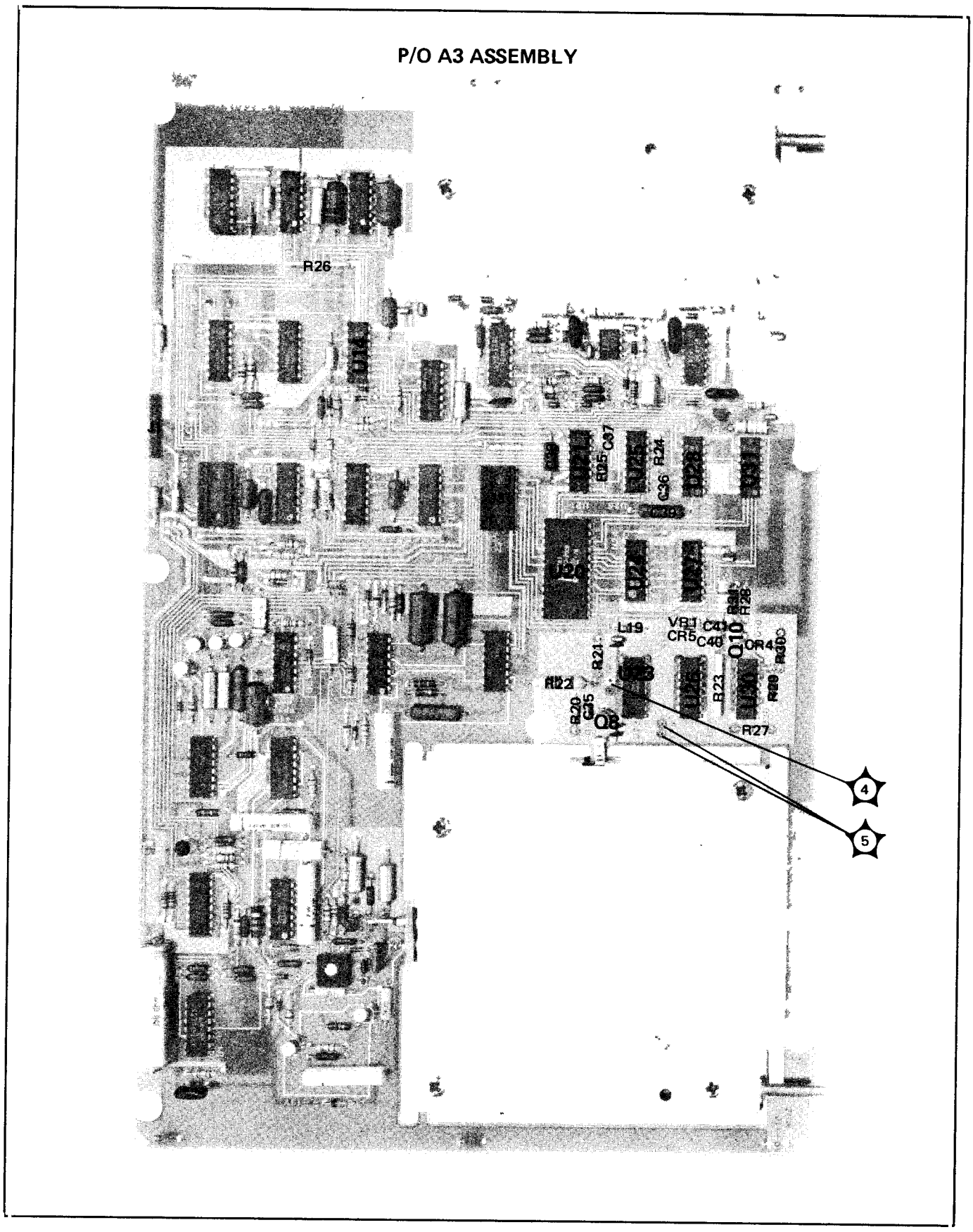


Figure 8-67. LF Loop Data and Timing Control Component Locations

ManualsPlus.com

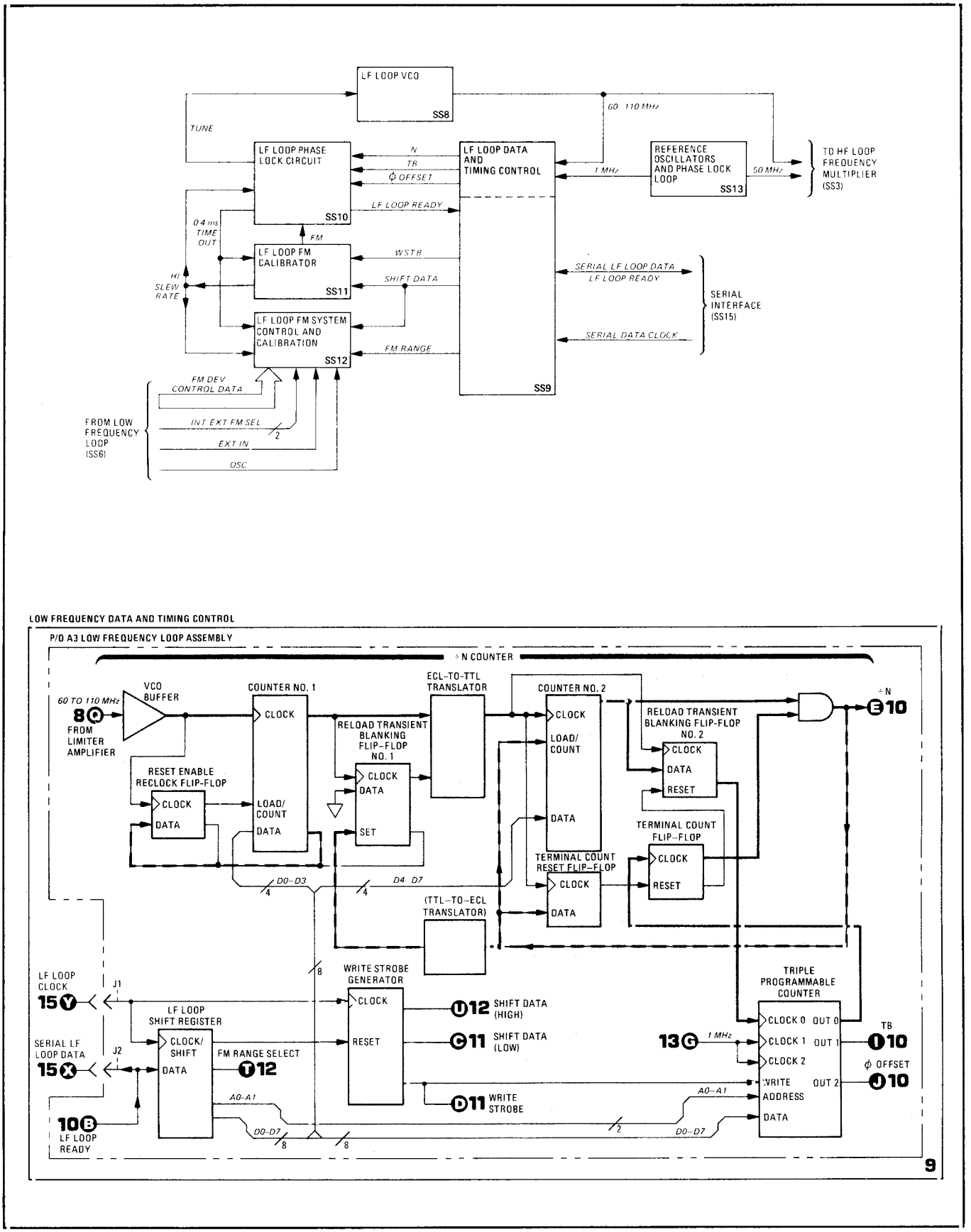
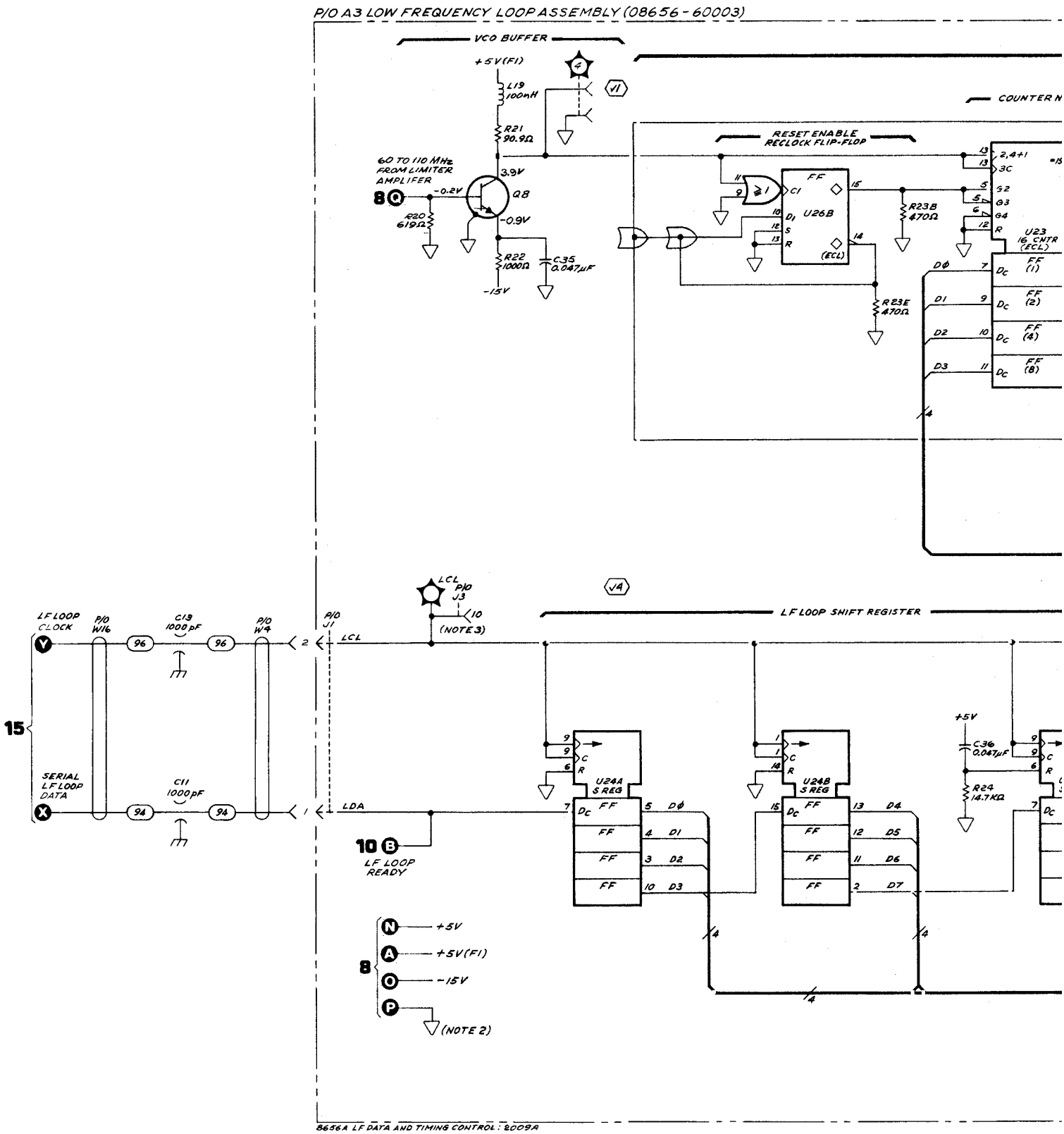
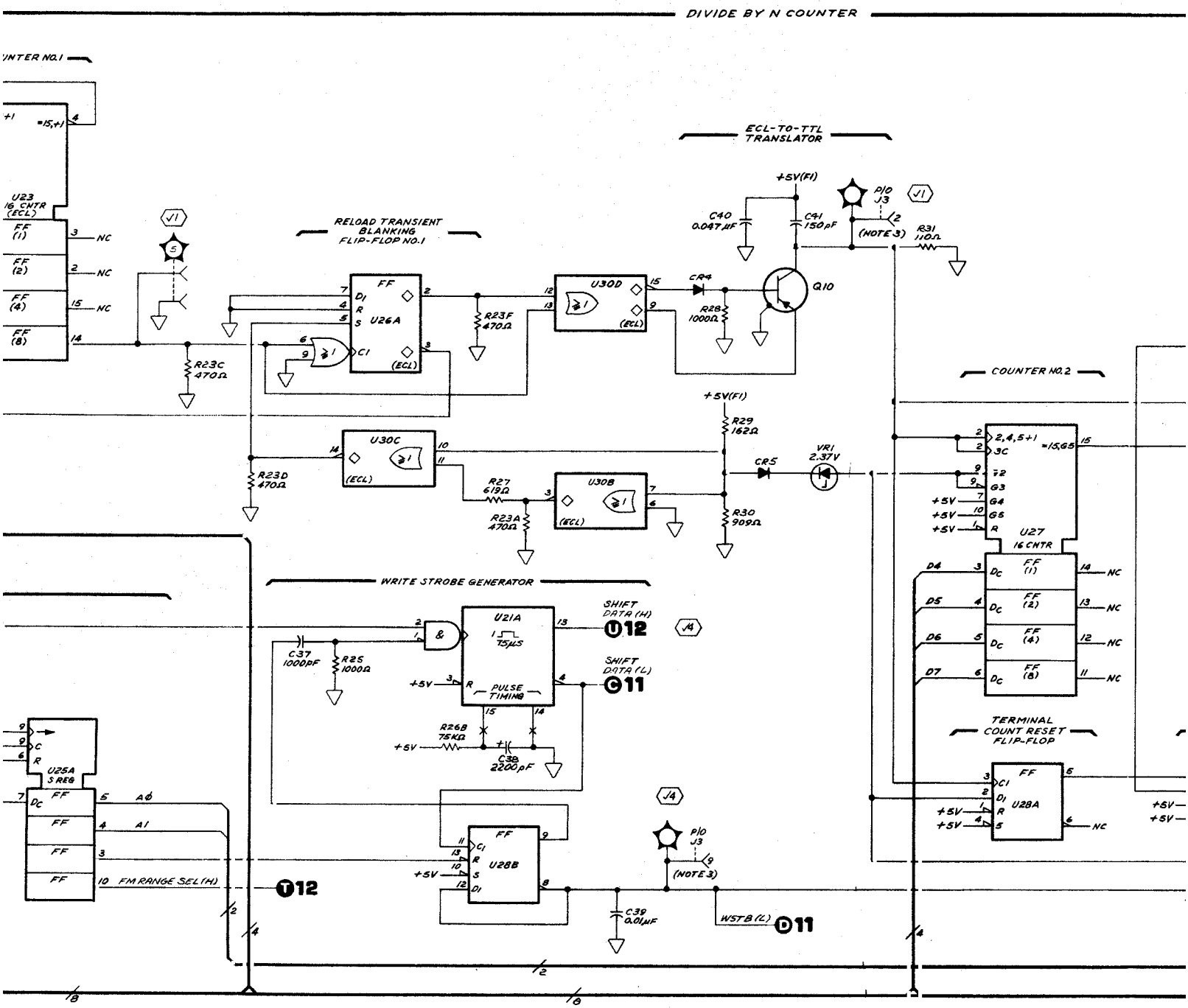


Figure 8-68. LF Loop Data and Timing Control Block Diagrams

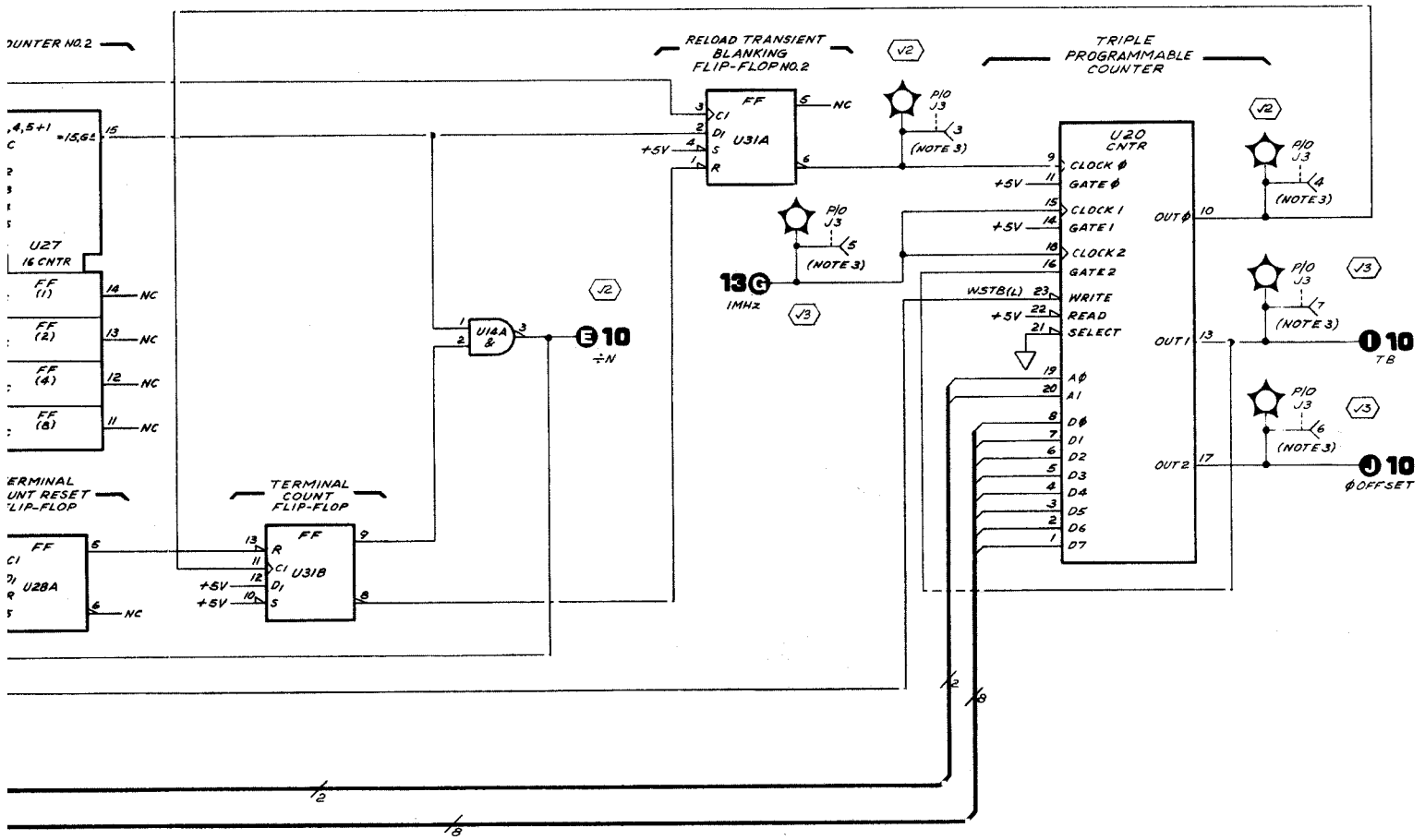
ManualsPlus.com



ManualsPlus.com

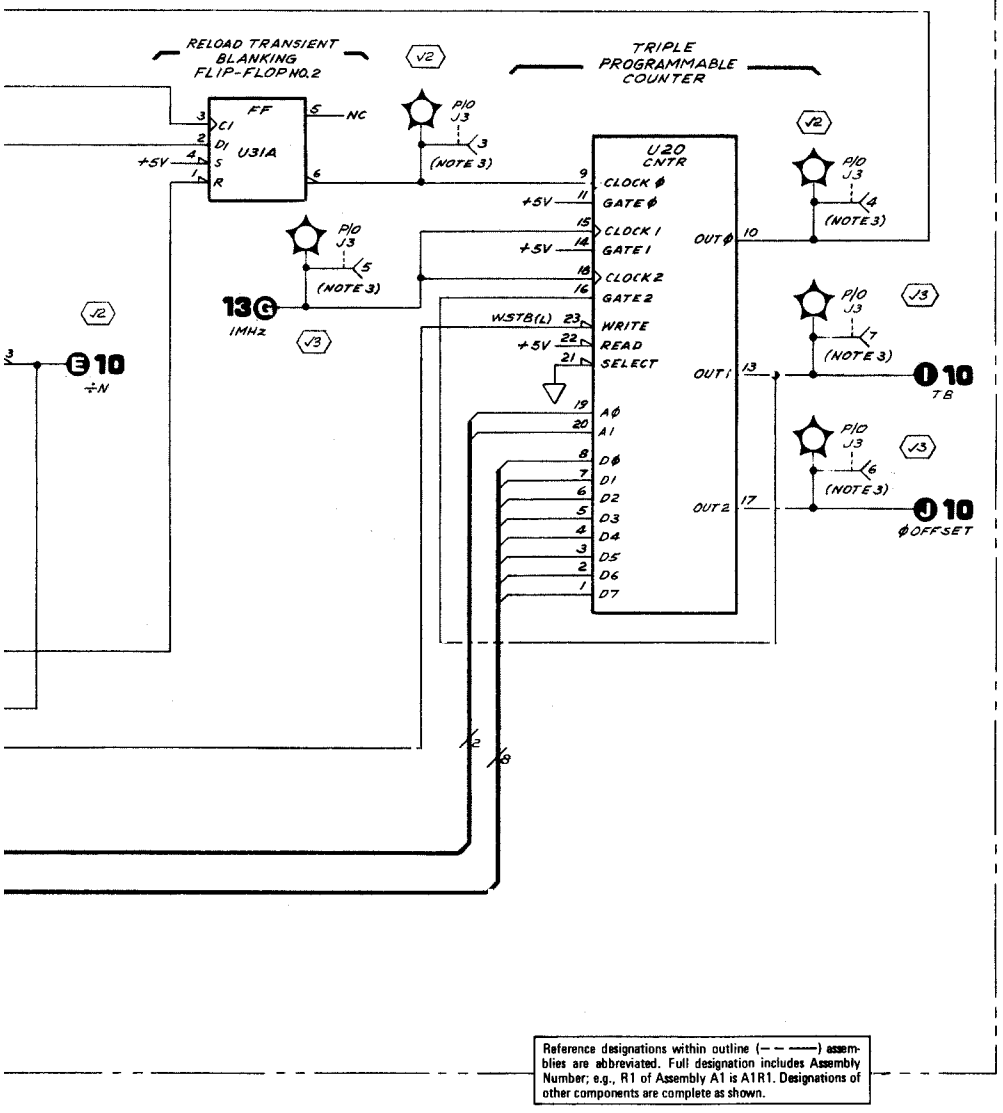


ManualsPlus.com



Reference designations within outline (– – ——) assemblies are abbreviated. Full designation includes Assembly Number; e.g., R1 of Assembly A1 is A1R1. Designations of other components are complete as shown.

ManualsPlus.com



Reference designations within outline (— — —) assemblies are abbreviated. Full designation includes Assembly Number; e.g., R1 of Assembly A1 is A1R1. Designations of other components are complete as shown.

NOTES

1. SEE TABLE 8-3 FOR SCHEMATIC DIAGRAM NOTES.
2. CHASSIS GROUND IS ACHIEVED THROUGH A3J1-4 CONNECTION AND MECHANICAL CONTACT WITH FASTENERS HOLDING PC BOARD TO FRAME.
3. SERVICE TEST POINT. PIN OF DUAL IN-LINE TEST SOCKET J3.

REFERENCE DESIGNATIONS

NO PREFIX	A3 CONT.
C11, 13 W4, 16	L19 Q8, 10 R20-31 TP4, 5 U14, 20, 21, 23-28, 30, 31 VR1
A3	
C35-41 CR4, 5 V1, 3	

LOGIC LEVELS

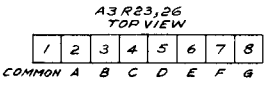
	TTL	ECL
HIGH	>2V	>+4.2V
LOW	<0.8V	<+3.3V
< IS MORE NEG. THAN > IS MORE POS. THAN		
OPEN	HIGH	LOW
GROUND	LOW	HIGH

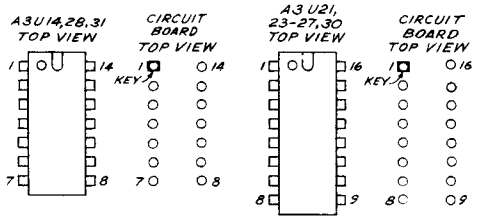
TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

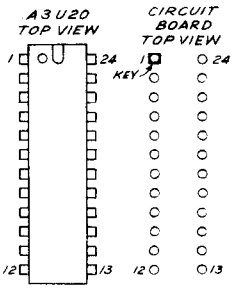
REFERENCE DESIGNATIONS	PART NUMBERS
Q8 Q10	1854-0696 1853-0018
U14 U20 U21 U23 U24, 25 U26 U27 U28, 31 U30	1820-0681 1820-2005 1820-1423 1820-1788 1820-2008 1820-1225 1820-1430 1820-1112 1820-0802

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATIONS	PIN NUMBERS
U14, 28, 31	+5V - 14 - 7
U20	+5V - 24 - 12
U21, 24, 25, 27	+5V - 16 - 8
U23, 26, 30	+5V(F1)-1, 16 - 8







9
P/O A3

Figure 8-69. LF Loop Data and Timing Control Schematic Diagram

ManualsPlus.com

SERVICE SHEET 10 (Cont'd)

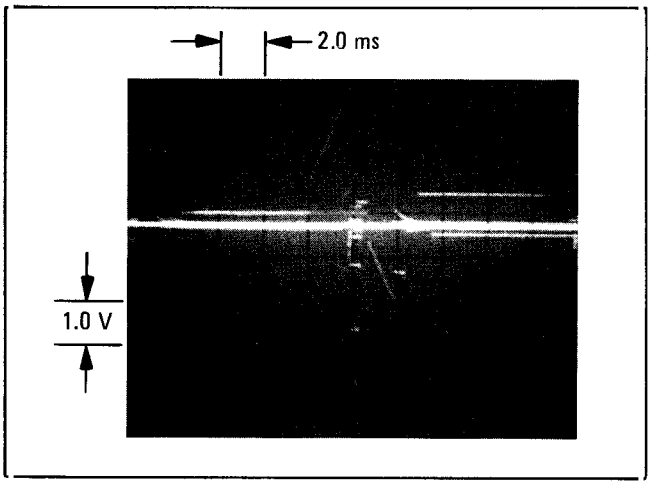


Figure 4. Display of J3-Pin 12 Signal with the LF Loop Locking (with dc coupling; external triggering from J3-Pin 4)

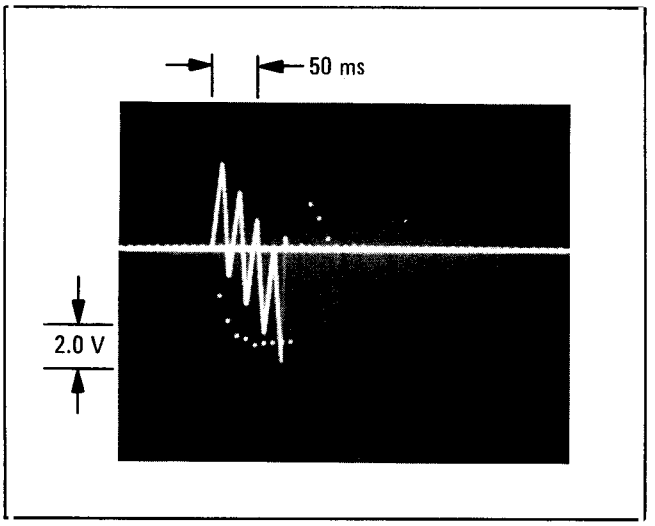


Figure 5. Display of J3-Pin 11 Signal during FM Calibration With LF Loop Locking (with dc coupling; external triggering from U2-Pin 7 SAR CLK)

√2 Tune Sample Monostable, Tune Voltage Sample Control, Phase Detector Reset Monostable, Phase Detector Reset Control

1. Set the Signal Generator to 500 MHz (÷N will be 100 Hz).

2. The Tune Sample Monostable will be triggered at the 100 Hz rate to store the correction voltage on the Tuning Voltage Sample and Hold Capacitor C51.

3. When the output pulse of the Tune Sample Monostable is completed, the active-high output goes low which triggers the Phase Detector Reset Monostable.

4. Verify that the signals are the same as those of Figures 6 and 7.

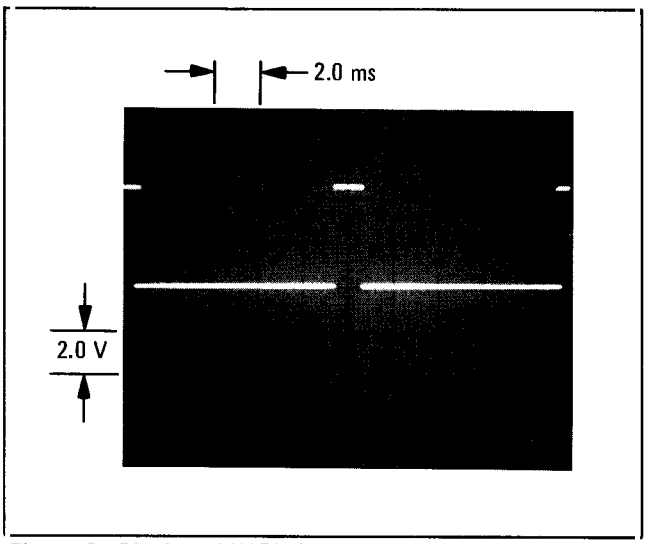


Figure 6. Display of U15B Output Pulse (with dc coupling to J2-Pin 8; external triggering from J3-Pin 4)

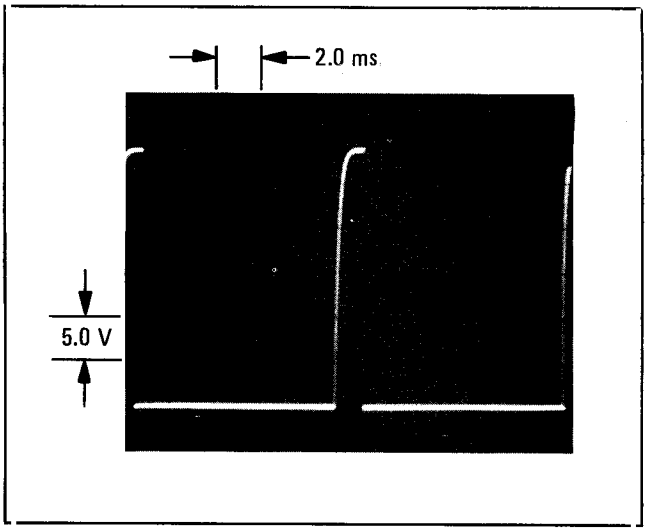


Figure 7. Display of Comparator Output Used To Close FET Switch U3B (dc coupling to J2-Pin 4; external triggering from J3-Pin 4)

√3 Slew Rate Control

1. Set the Signal Generator to 500 MHz.
2. Increment the frequency 10 MHz.
3. Verify that the output of comparator U16C Pin 13 is pulsed from −15 Vdc to +15 Vdc closing FET switches Q13, U7A and Q2.

√4 Loop Integrator, Switchable Attenuator, High Impedance Buffer

1. Set the Signal Generator to 500 MHz.

ManualsPlus.com

SERVICE SHEET 10 (Cont'd)

3. Increment the frequency up 10 MHz and check Figures 2 through 5 as the LF Loop locks.

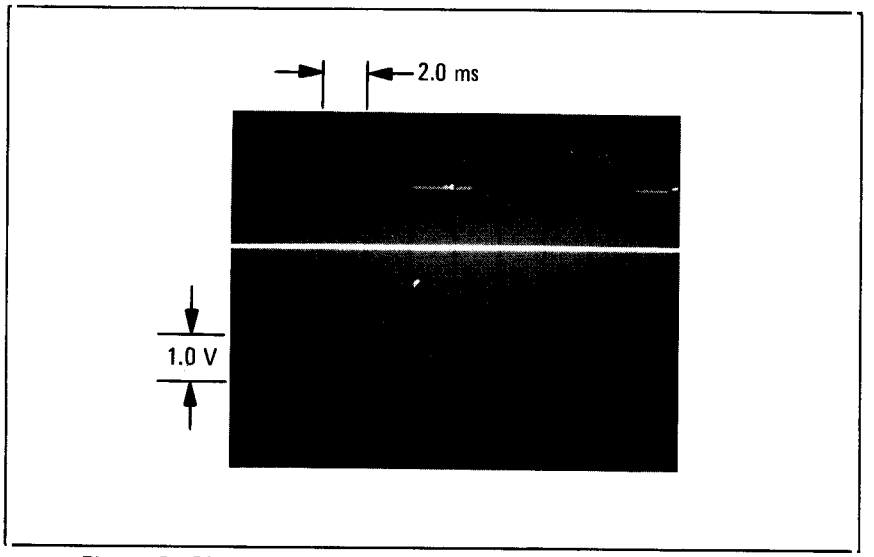


Figure 2. Display of Signal at J2-Pin 12 as the LF Loop is Locking (with dc coupling; external triggering to J3-Pin 4)

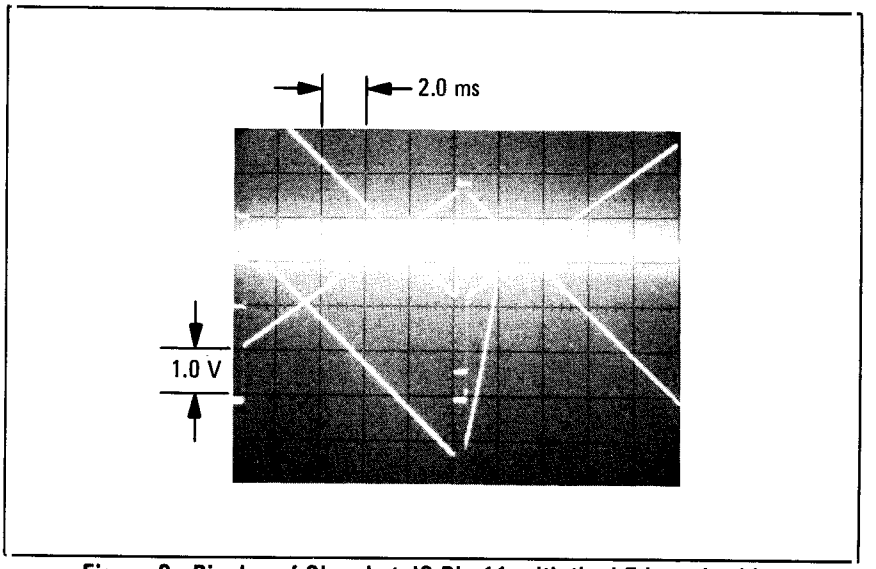


Figure 3. Display of Signal at J2-Pin 11 with the LF Loop Locking (with dc coupling; external triggering from J3-Pin 4)

ManualsPlus.com

TROUBLESHOOTING

Procedures for checking the circuits of the A3 Low Frequency Loop Assembly are given below. The areas or points to check are marked on the schematic by a hexagon with a checkmark and a number inside, e.g. ⟨√3⟩. Fixed voltages are shown on the schematic inside a hexagon, e.g. ⟨2V±0.2V⟩. Transistor bias voltages are shown without tolerances.

Test Equipment

Digital Multimeter .....HP 3465A
Frequency Counter .....HP 5328A
Oscilloscope
  Storage Mainframe .....HP 181A
  Vertical Amplifier .....HP 1801A
  Time Base .....HP 1820C

⟨√1⟩ Phase-to-Charge Converter, Charge-to-Voltage Converter

1. Set the Signal Generator to 500 MHz without modulation.

2. Check the following voltages in Table 4 and the waveforms of Figure 1 with the Low Frequency Loop locked.

Table 4. Phase-To-Charge Converter Voltages

Test Point	Voltage (Vdc)
J2 Pin 11	+2.6 to +3.2
J2 Pin 12	+0.6 to +1.2

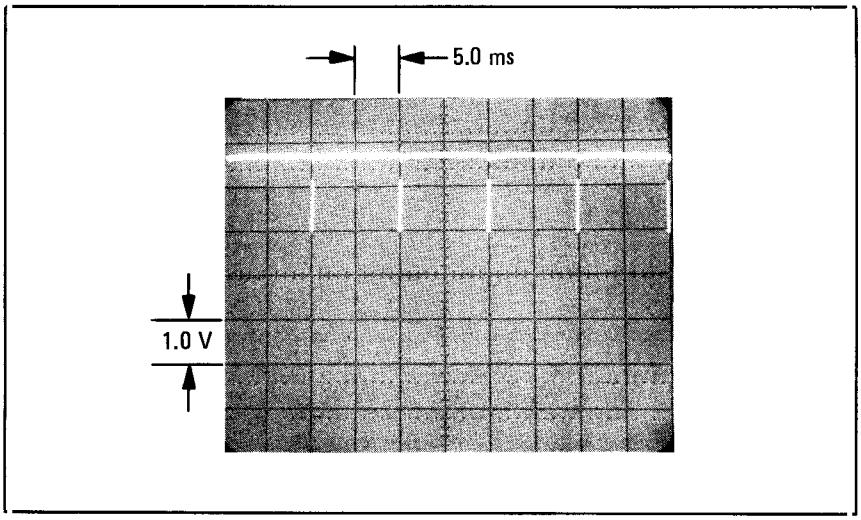


Figure 1. Display of Signal at J3-Pin 12 with LF Loop Locking (with dc coupling; external triggering to J2-pin 8)

ManualsPlus.com

high for 1.5 ms to change the output of the Phase Detector Reset Control comparator U9C from −15 to +15 Vdc. Capacitor C44 introduces a small delay of the voltage charge. This change in voltage turns on FET switch U3B to discharge the integrator capacitor C49.

Table 3. U15B Operation

Pin-11	Pin-9	Pin-10	Pin-5	Pin-12	Pulse Duration
H	↓	H			1.5 ms

Slew Rate Control

The other control of Charge-to-Voltage Converter U8C is FET switch Q13. Q13 is closed when the Low Frequency Loop is in the High Slew Rate Mode and is activated by Slew Rate Control Comparator U16C. The comparator turns the FET switch on when the frequency of the Low Frequency Loop VCO passes the 25.6 kHz band edge. The output of High Slew Rate Monostable U21B (refer to Service Sheet 11) controls this operation. The High Slew Rate Mode lasts for approximately 500 ms. During this time the loop response is quicker than normal in order to reduce the time required for a large frequency change. This is accomplished by decreasing the gain of U8C and U6B while decreasing the attenuation of the signal into Q4. Q13 is turned on which places additional capacitance in parallel with C49 thereby reducing the gain. U7A is turned on which places additional resistance across R49, thus reducing the gain of U6B. Q2 is also turned on which places a low resistance in parallel with R52 to reduce the attenuation of the signal into Q4. The total reduction in gain equals the reduction in attenuation.

Summary

Every 10 or 4 ms (100 or 250 Hz resolution), any phase change between the ÷N and TB signals is sampled and held on CS1 to correct the VCO frequency. This voltage is applied to Loop Integrator U8B where the voltage is changed in the direction to correct the VCO's frequency (or to achieve lock if a frequency change has occurred). This action corrects for the VCO's frequency drift. The output of the Loop Integrator is applied to the Switchable Attenuator and then to the High Impedance Buffer Q4. FET switches Q3, U7A and Q2 are controlled by the Slew Rate Control Comparator U16C and are closed the same as Q13 when the VCO frequency change passes the 25.6 kHz band edge. When U7A is closed, R50, 31.6 kΩ is in parallel with R49, 18 MΩ, increasing the slew rate of the tune voltage. This moves the VCO to the correct frequency quicker. When FET switch Q2 is closed, the attenuation to the High Impedance Buffer Q4 is decreased to 1/500 of its previous value by paralleling R54 with R52. The reduced attenuation of the switchable attenuator compensates for the lower gain of integrator U8C (1/500th normal) during high slew rate. This keeps the overall gain of the loop constant. CR13, VR4, CR15, VR5 prevent the output from going too negative.

ManualsPlus.com

output to take the form of a linear "ramp" voltage. If the ÷N pulse had clocked U17B the output going low turns off CR8 which turns on CR10, thus drawing current from C49 and the output of U8C is a "ramp" in the positive direction. When U17B is reset, its active-high output goes high and CR10 is reversed biased.

When both U17A and B are clocked simultaneously, there is no voltage change on C49. The other current source for integrator U8C is the ϕ Offset which is a low pulse for 20 μs. When the ϕ Offset is pulsed low, Exclusive-Or gate U13D's output is low for the 20 μs duration of the pulse. With U13D's output low and with 0.6 Vdc across CR12, CR11 is turned on and the integrator voltage is a positive "ramp". This small offset in voltage prevents the phase detector from operating in the non-linear zero region. The output of U8C is applied to the unity gain Loop Summing Amplifier and applied to the Tuning Voltage Sample and Hold Capacitor C51 by FET switch U7B.

Tune Sample Control

The output of gate U14B resets U17A and B and triggers the Tune Sample Monostable U15A on the high to low transition. Refer to Table 2.

Table 2. U15A Tune Sample Monostable Operation

Pin-3	Pin-1	Pin-2	Pin-13	Pin-4	Pulse Duration
H	↓	H	H	L	0.4 ms

The active-high output is set high for 0.4 ms. The low active-low output is gated at U10B with the End of Conversion EOC(L) from the Successive Approximation Register (refer to Service Sheet 11). The EOC(L) is low unless the loop is calibrating the FM sensitivity of the VCO. During calibration it is high thus preventing the tune voltage from being sampled. With both inputs to U10B low, the output goes high. This allows the Tune Voltage Sample Control Comparator U9A to switch its output for 0.4 ms to +15 Vdc. This turns on FET switch U7B. Capacitor C50 introduces a small delay of the voltage charge. When U7B is on, the tune voltage is sampled for 0.4 ms.

The active-high output of U15A is inverted by U4A. This output is Øapplied to the serial data input from the Microprocessor to signal the Microprocessor when the Low Frequency Loop is ready to have data written to it.

Phase Detector Reset Control

The active-high output from U15A is coupled to U15B Phase Detector Reset Monostable. It triggers U15B on the high-to-low transition of the pulse. Refer to Table 3. The active-high output of U15B goes

ManualsPlus.com

SERVICE SHEET 10
P/O A3 LOW FREQUENCY LOOP ASSEMBLY

TROUBLESHOOTING HELP

Service Sheet BD3
Table 4-1. Abbreviated Performance Tests
Table 5-2. Post-Repair Adjustments

PRINCIPLES OF OPERATION

General

The difference in phase between the ÷N and the TB signals is detected by the Phase-to-Charge Converter. The charge on C46 is converted to a voltage by U8C which is summed with the In-Band FM Correction Voltage by U12C. The Tune Voltage Output is sampled periodically and stored to tune the Low Frequency Loop VCO. If there is no change in phase, the sampled voltage remains constant and the VCO frequency does not change. The Tune Sample Monostable sets the tune sample duration of 0.4 ms. The rate is controlled by the signals that are phase compared, TB and ÷N. The Phase Detector Reset resets U8C, that is, the charge across C49 set by the Phase-to-Charge Converter output is discharged. A frequency change that passes the 25.6 kHz band edge enables the High Slew Rate mode. The HIGH SLEW RATE SEL signal to U16C controls a reduction in the gain of U8C and U6B that matches the reduction in attenuation into Q4. The effect of the attenuation decrease allows quicker response of the Tune Voltage change while the gain remains constant through the amplifier chain.

Phase-to-Charge Converter

The two D-type Flip-Flops U17A and B are clocked by the 100 Hz or 250 Hz time base pulse TB and the ÷N input respectively. The set and D inputs of U17A and B are tied high (+5 volts), therefore U17A and B are controlled by the reset and clock inputs. When reset is low it overrides the clock input. With the reset high, a low-to-high clock pulse clocks the active-high output high and the active-low output low (D1 is high). Depending on which pulse arrives first, either U17A or B is clocked first. After the second clock arrives both active-high outputs will be high and gate U14B output will go low resetting U17A and B. (Refer to Table 1.) Any phase difference between the TB and ÷N inputs will result in a correction voltage being applied to the VCO via the TUNE output. When the TB pulse arrives first, it clocks U17A active-high output high. This biases CR6 off. Current flows through CR9 to the input of the Charge-to-Voltage Converters.

Table 1. U17A and B operation

Set	Reset	D	Clock	Pins-5/9	Pins-6/8
+5V(H)	L	+5V(H)	X	L	H
+5V(H)	H	+5V(H)	↑	H	L

Charge-To-Voltage Converter

The current from CR9 is applied to the negative input of integrator U8C. This causes the output to change in the negative direction. The effect of charging C49 causes the

ManualsPlus.com

SERVICE SHEET 10 (Cont'd)

2. Verify that the voltages and VCO output frequencies shown in Table 5 are correct.

3. Increment the frequency from 500 MHz in 10 MHz steps. Verify that the waveforms of Figures 8 and 9 are correct.

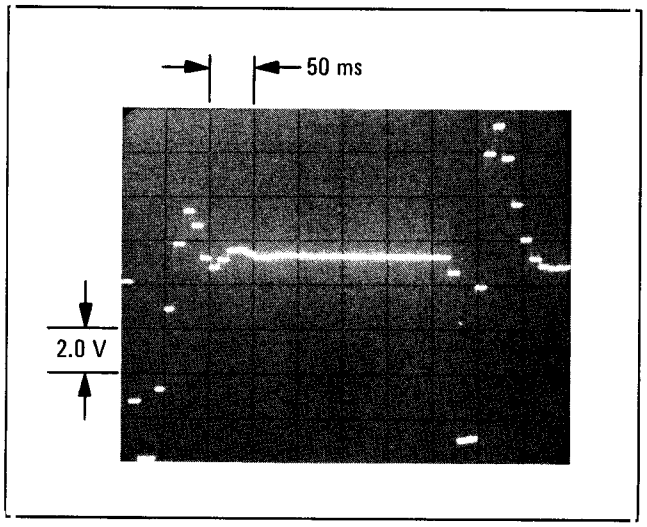


Figure 8. Display of Signal at U6B-Pin 6 (with dc coupling; external triggering from J2-Pin 7)

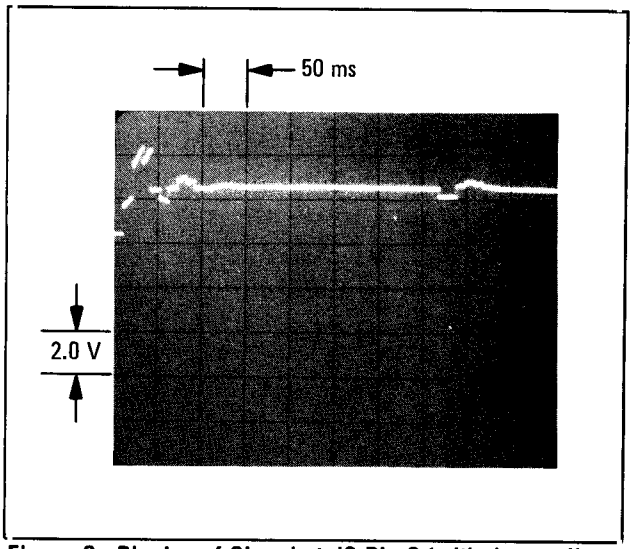


Figure 9. Display of Signal at J3-Pin 9 (with dc coupling; external triggering from J2-Pin 7)

Table 5. Loop Integrator and VCO Tune Voltage and Frequency Output

Frequency (MHz)		Check Voltage (Vdc) at	
Front Panel Setting	LF Loop VCO Output	J3 pin 14	TP2
500	100	0.0 to + 0.4	+0.4 to + 0.8
510	90	+2.3 to + 2.7	+2.6 to + 3.0
520	80	+5.0 to + 5.4	+5.0 to + 5.4
530	70	+7.3 to + 7.7	+7.5 to + 7.9
540	60	+9.8 to +10.2	+9.8 to +10.2
550	100	+0.0 to + 0.4	+0.4 to + 0.8

ManualsPlus.com

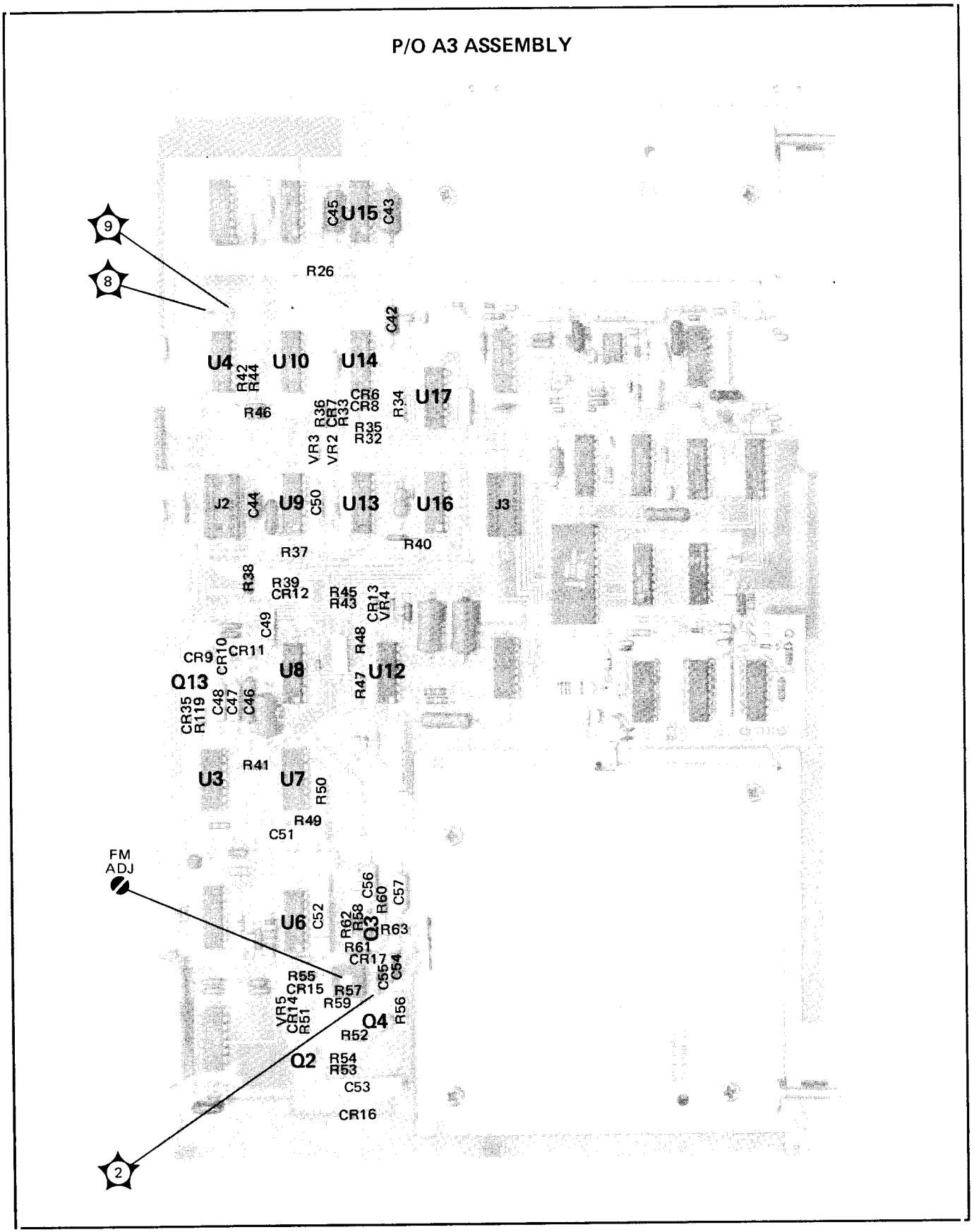
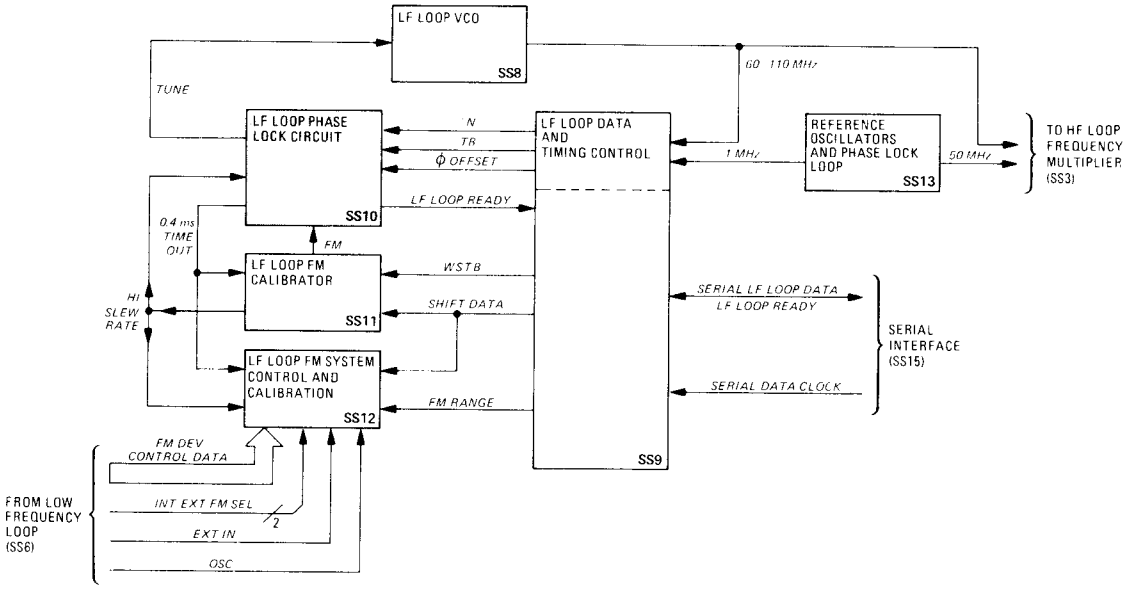


Figure 8-70. LF Loop Phase Lock Circuit Component Locations

ManualsPlus.com



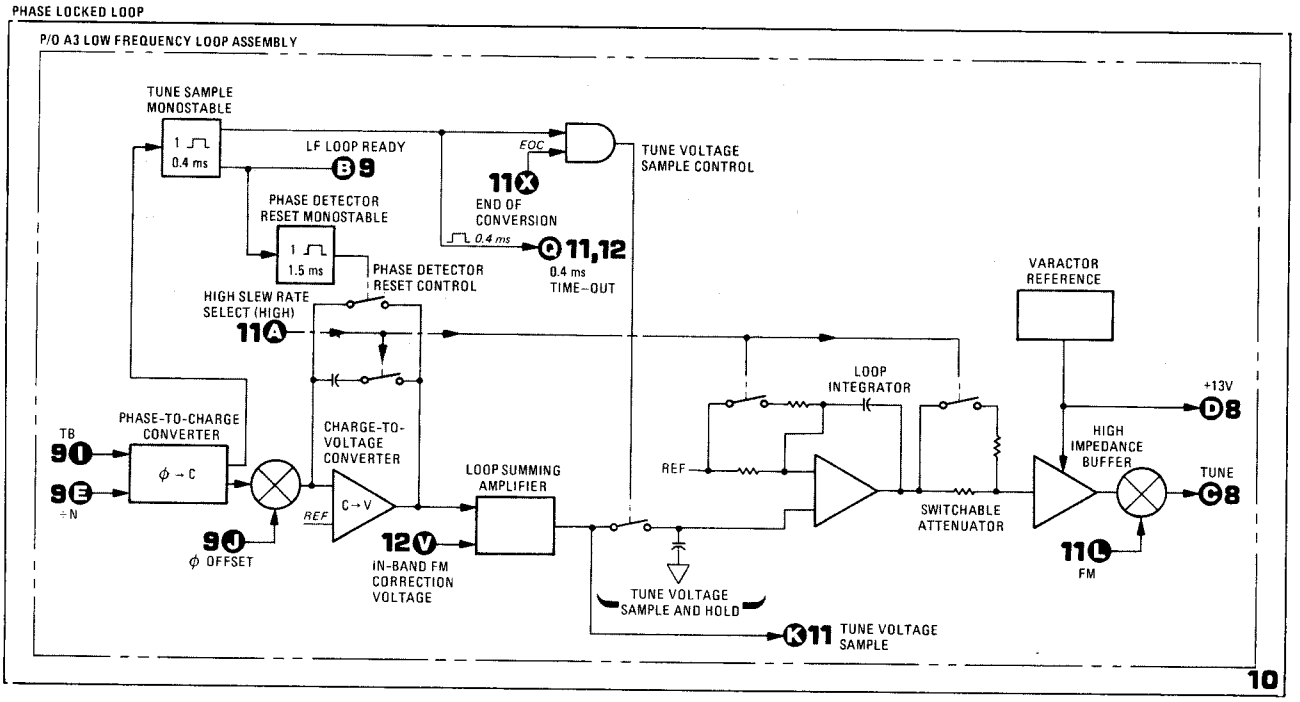
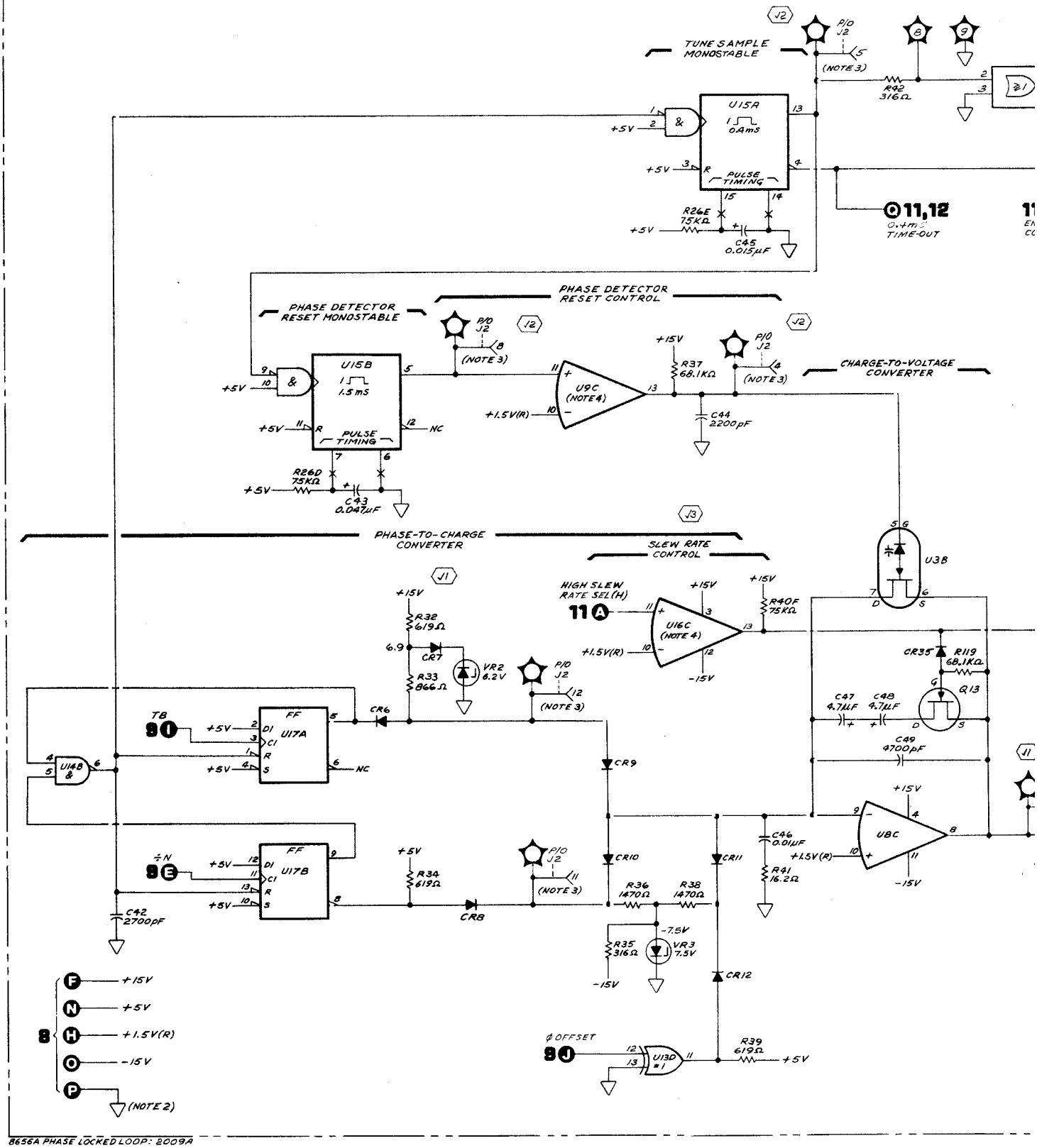


Figure 8-71. LF Loop Phase Lock Circuits Block Diagrams

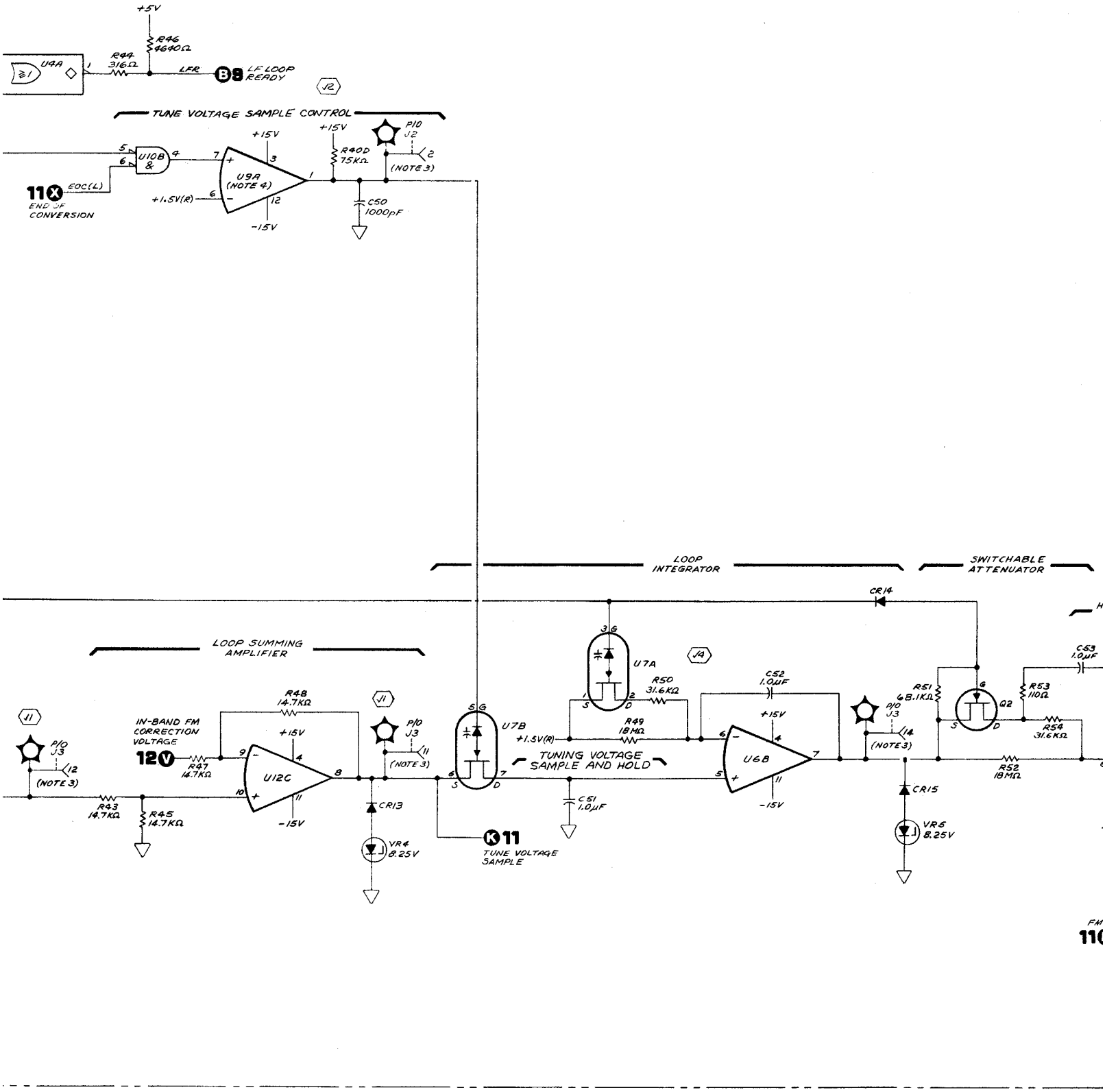
ManualsPlus.com

P/O A3 LOW FREQUENCY LOOP ASSEMBLY (08656-60003)



8656A PHASE LOCKED LOOP: 2009A

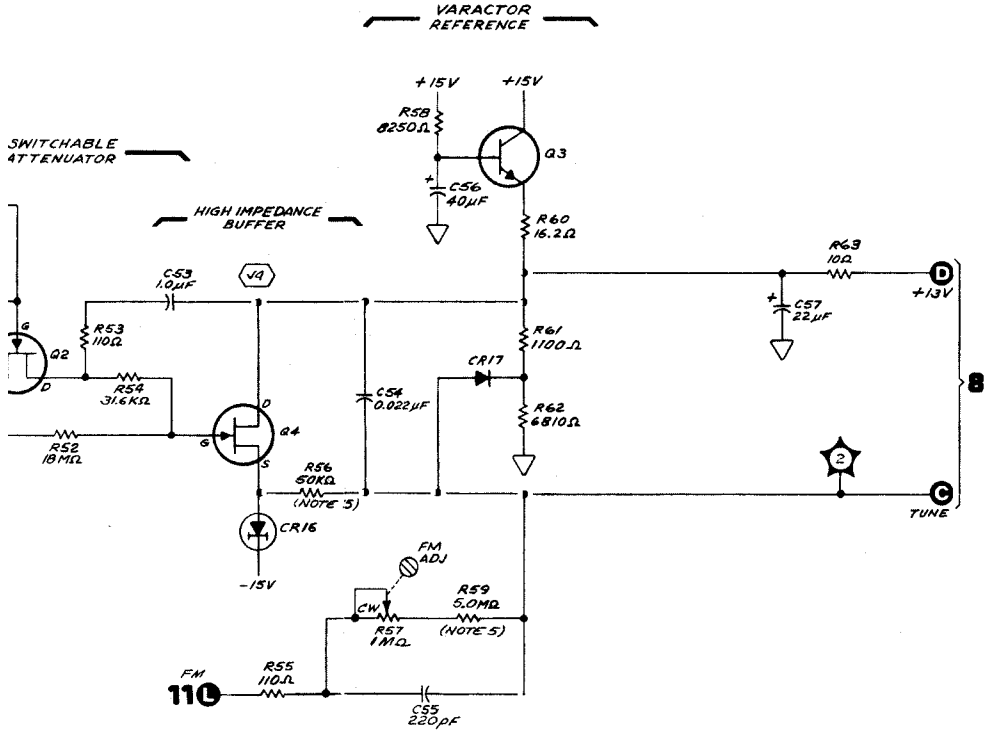
ManualsPlus.com



ManualsPlus.com

NOTES

1. SEE TABLE 8-3 FOR SCHEMATIC DIAGRAM NOTES.
2. CHASSIS GROUND IS ACHIEVED THROUGH A3J1-4 CONNECTION AND MECHANICAL CONTACT WITH FASTENERS HOLDING PC BOARD TO FRAME.
3. SERVICE TEST POINT. PIN OF DUAL IN-LINE TEST SOCKET J2 OR J3.
4. OPEN COLLECTOR DEVICE.
5. MATCHED FOR TEMPERATURE CHARACTERISTICS.



Reference designations within outline (— — —) assemblies are abbreviated. Full designation includes Assembly Number; e.g., R1 of Assembly A1 is A1R1. Designations of other components are complete as shown.

REFERENCE DESIGNATIONS

A3
C42-57 CR6-17,35 J2,3 Q2-4,13 R26,32-63,119 TP2,8,9 U3,4,6-10,12-17 VR2-5

LOGIC LEVELS

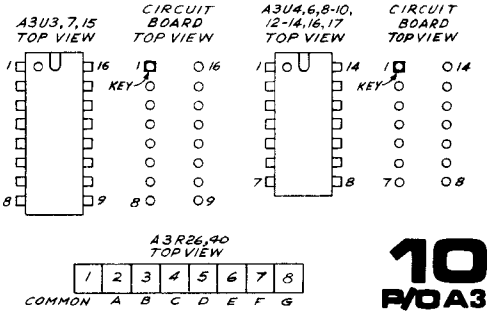
	TTL
HIGH	> 2 V
LOW	< 0.8 V
< 1.5 MORE NEG. THAN > 1.5 MORE POS. THAN	
OPEN	HIGH
GROUND	LOW

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATIONS	PART NUMBERS
Q2, 13	1855-0414
Q3	1854-0071
Q4	1855-0288
U3,7	1858-0066
U4	1820-1272
U6,8,12	1826-0522
U9,16	1826-0174
U10	1820-1144
U13	1820-1211
U14	1820-0681
U15	1820-1423
U17	1820-1112

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATIONS	PIN NUMBERS
U4,10,13,14,17	+5V - 14 ▽ - 7
U15	+5V - 16 ▽ - 8



10 P/O A3

Figure 8-72. LF Loop Phase Lock Circuits Schematic Diagram

ManualsPlus.com

SERVICE SHEET 11 (Cont'd)

During FM calibration the two FET switches are closed and the gate goes to near +15 Vdc when the SAR receives a clock pulse to input data. This effectively grounds the input to U6C during the time data is input to the SAR. The new SAR bit settings are loaded into the FM CAL DAC and then the FET switches are opened to let the adjusted FM cal signal be applied to the VCO thereby adjusting the VCO's FM sensitivity.

TROUBLESHOOTING

Procedures for checking circuits of part of A3 Low Frequency Loop Assembly are given below. The areas or points to check are marked on the schematic by a hexagon with a checkmark and a number inside, e.g., ⟨√3⟩. Fixed voltages are shown on the schematic inside a hexagon, e.g. ⟨2V±0.2V⟩. Transistor bias voltages are shown without tolerances.

Test Equipment

Digital Multimeter .....HP 3465A
Oscilloscope
  Storage Mainframe .....HP 181A
  Vertical Amplifier .....HP 1801A
  Time Base .....HP 1820C

⟨√1⟩ High Slew Rate Monostable, Pre-Cal Settling Monostable, Start Conversion Monostable

1. Set the Signal Generator's frequency to 500 MHz without modulation.

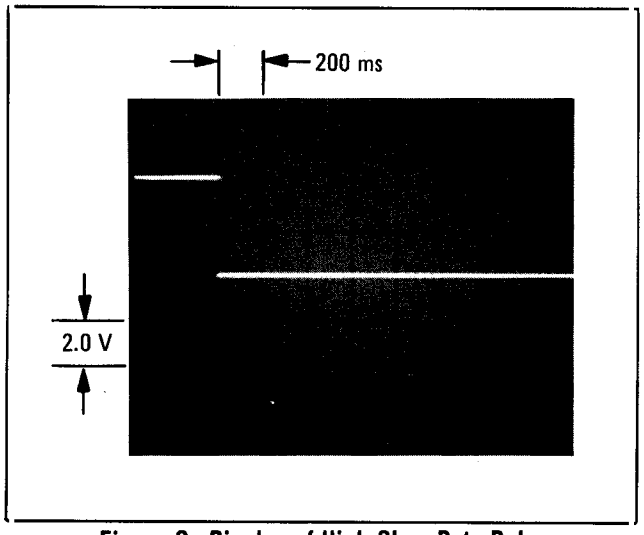


Figure 2. Display of High Slew Rate Pulse (coupling is dc toJ2-Pin 7; external trigger is from U21B-Pin 9)

2. Increase the frequency in 10 MHz steps. Verify that the waveforms are the same as those of Figures 2, 3 and 4. The loop is being phase locked.

NOTE

When the frequency change of the LF Loop passes a 25.6 kHz band edge, the high slew rate mode is triggered.

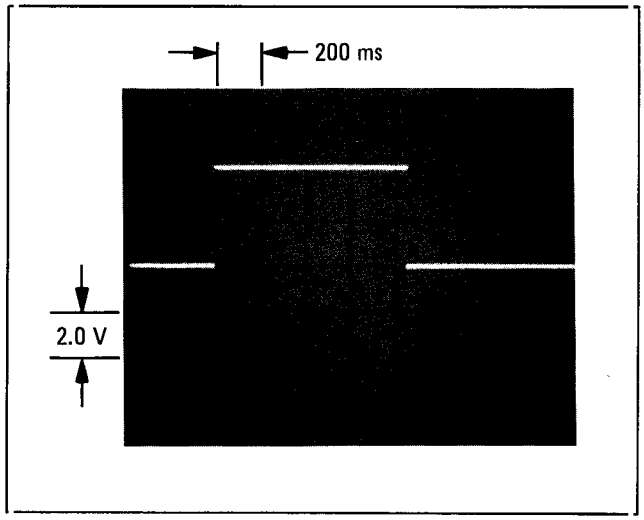


Figure 3. Display of Pre-Cal Settling Pulse (coupling is dc to J2-Pin 9; external trigger is from U21B-Pin 9)

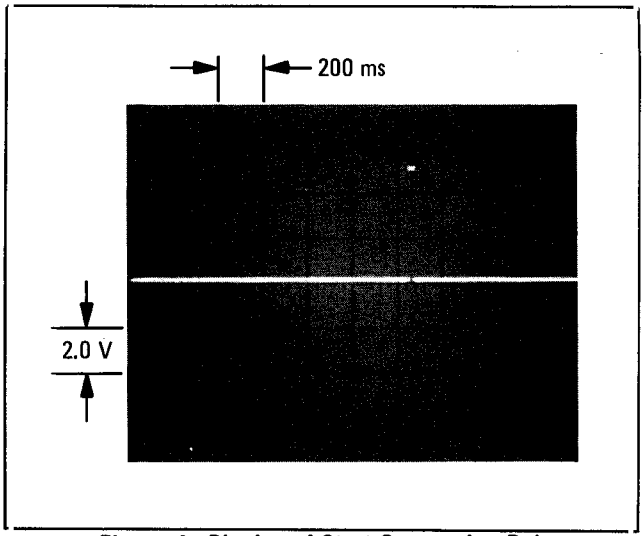


Figure 4. Display of Start Conversion Pulse (coupling is dc to J2-Pin 10; external trigger is from U21B-Pin 9)

NOTES

Pin 10 of the Successive Approximation Register U2 will be high until the active-high output pulse of the Pre-Cal Settling Monostable goes low.

ManualsPlus.com

The EOC(L) input to U14D is low except during the FM calibration period. The 0.4 ms Time Out is high and pulses low for 0.4 ms every 4 or 10 ms. With the EOC(L) input high, the output is high for 0.4 ms. The high input to the positive input of comparator U16D means the output is near +15 volts. The +15 volts controls the gate of FET switches U18B and C causes them to be closed. The positive input to the Low Offset Comparator is connected to ground. U12B becomes a unity gain amplifier because U18B shorts the output to the negative input and removes any offset voltage stored on C68. At this point, assume the frequency of the LF VCO is changed by selecting a new output frequency. Assume also that the VCO's frequency passes a 25.6 kHz band edge. The LF Loop will go into high slew rate mode for 500 ms moving the VCO frequency close to the correct frequency. The loop then enters the Pre-Cal Settling mode for 1.1 s to complete locking the LF VCO at the correct frequency. Then the LF Loop enters the FM Calibration mode for 80 ms. It is in this mode that the SAR is set. This, in turn, sets the FM Cal DAC to calibrate the FM modulation drive of the VCO. When FM calibration is started, the EOC(L) goes high until all bits of the SAR have been set. The EOC(L) input to U14D is high and the 0.4 ms Time Out is high except for the 0.4 ms pulses every 10 ms. Therefore, the output of U14D will be pulsed low. With the output low, comparator U16D's output is near −15 Vdc opening FET switches U18B and C. During this time the Tune Voltage to the LF VCO is fixed and the VCO frequency does not change. The VCO is frequency modulated by the FM Calibration Generator signal which is a function of the SAR Data Control. Any Tune Voltage Sample input to Low Offset Comparator U12B which is not ac grounded is applied to the positive input. Now the Tune Voltage Sample from the Loop Summing Amplifier U12C will control the Low Offset Comparator U12B. The output of the comparator and the SAR Data Control from J-K Flip-Flop U5B, part of FM Calibration Signal Generator, are the inputs to Exclusive-Or gate U13A. The output of U13A is the data input to the SAR which calibrates the FM sensitivity of the VCO by nulling the input to comparator U12B.

The output of the Low Offset Comparator is switched from near +15 to 0 Vdc and is connected through R68 to U13A. The output of U13A is the data input to the SAR whose output sets the FM CAL DAC. The SAR bits are set to control the DAC (which acts as a variable attenuator) to achieve a null on the Tune Voltage Sampler input during the FM calibration cycle.

FM Cal DAC, Converter, and Sample and Hold Buffer

The FM Reference input to the FM CAL DAC is the signal to FM the VCO using internal or external modulation signals or the FM calibration signal during the FM calibration cycle. The FM input signal is attenuated for VCO sensitivity and applied to the current to voltage converter U6A. The signal then is applied to the DAC Offset Sample and Hold Buffer U6C. The ac voltage from U6C is applied to the VCO Tune Voltage bus shown on Service Sheet 10. FET switches U7C and D are open (biased off) except during FM calibration.

ManualsPlus.com

cally. The data input to the SAR is the calibration input and sets the SAR's output. The SAR's output is used to set the FM CAL DAC U1. The FM CAL DAC is set to compensate for the FM sensitivity of the VCO. The End of Conversion EOC(H) output-Pin 11 of the SAR U2 goes high when the conversion is complete. The EOC(H) is normally high and is set low during the 80 ms calibration cycle. The EOC(L) from Nor gate U10C is normally low and is high during the calibration cycle. When EOC(L) goes low, the high-to-low transition clocks J-K Flip-Flop U5A which outputs a high at the active-low output. The clock gate U10D is inhibited which disables the SAR clock generator.

Low Slew Rate Mode

If the frequency of the VCO is changed so that the 25.6 kHz band edge is not reached, the Signal Generator does not enter the high slew rate mode. (High Slew Rate Monostable U21B does not get triggered). The Shift Data Output (low) of the Write Strobe Generator Monostable U21A (refer to Service Sheet 9) is set low for 75 μs. This input is applied to U4B. U4B stays low because the other input (from the active-low output of U5A) stays high. Therefore, the LF Loop stays in the low slew rate mode and FM calibration does not take place.

Data Entry During FM Calibration

If new frequency data is entered into the LF Loop while the LF Loop is in the FM calibration phase, the FM calibration is terminated. The shift Data Low output of Write Strobe Generator Monostable (shown on service sheet 9) is gated by Nor gate U4B. The active-low output of U5A is low during the FM Calibration of the LF Loop which enables U4B. When Shift Data (L) goes low for 75 μs, the output will go high for 75 μs. The high-to-low transition of U4B's output triggers the Pre Cal Settling Monostable U11B setting the active-high output high and the active-low output low. The active-high output of U11B to NOR gate U13B sets its output high since the other input is low. The high output of U13B to Feed Forward input of Successive Approximation Register U2 terminates and prevents conversion from taking place. This terminates the FM Calibration of the LF Loop until the active-high output of U11A Start Conversion Monostable goes low 35 ms after the Pre Cal Settling Monostable U11B goes low.

Low Offset Comparator Circuits

The Low Offset Comparator is enabled by the Low Offset Comparator Control during the Low Frequency Loop's FM Calibration Cycle. The Low Offset Comparator converts the difference between the VCO phase deviation and the integrated FM modulation drive signal (In-band FM Correction Voltage) to a digital input to the SAR. U13A controls the timing of the data input to the SAR based on the input from the FM Calibration Signal Generator. U5B, U9D of the SAR clock Generator and U16D of the Low Offset Comparator Control are all triggered by the 0.4 ms Time Out from the active-low output of Tune Sample Monostable U15A. The output is pulsed low for 0.4 ms every 4 or 10 ms.

ManualsPlus.com

Table 3. U11B Pre-Cal Settling Monostable Operation

Pin-9	Pin-10	Pin-11	Pin-5	Pin-12	Pulse Duration
L	↑	+5V			1.1s
↓	H	+5V			1.1s

Calibration Cycle

At the end of the Pre-Cal Settling cycle, the active-high output of U11B goes low. The active-high output of U11B is applied to U13B and U11A. The output from U13B goes low which enables the Feed Forward input of U2. The Start Conversion Monostable U11A is triggered by the high-to-low transition of the output of U11B. With a high at the Start Conversion Monostable's output, the Successive Approximation Register's conversion cycle is started.

Table 4. U11A Start Conversion Monostable Operation

Pin-1	Pin-2	Pin-3	Pin-13	Pin-4	Pulse Duration
↓	+5V	+5V			25 ms

The active-low output of Pre-Cal Settling Monostable is low for 1.1s. This is connected to the K input of the J-K Flip-Flop that is part of the SAR Clock Generator U5A. U5A's active-low output is set lowby the low active-low output of U21B during the high slew rate mode. The set input returns high after 500 ms at the end of high slew rate mode.

Table 5. U5A (P/O SAR Clock Generator) Operation

S	R	G	J	K	Pin-5	Pin-6
L	H	X	X	X	H	L
H	H	↓	L	H	L	H
H	H	↓	L	L	T	T

T-Toggles to next state.

At the end of the 1.1s Pre-Cal Settling time, U11B changes state making the K input to U5A high. U5A's active-low output will remain low forcing the input to U10D low. Every 10 or 4 ms, U10D-Pin 11 is pulsed low for 0.4 ms by the active-low output of Tune Sample Monostable U15A (shown on service sheet 10). The positive input to comparator U9D-Pin 9 will be pulsed high for 0.4 ms every 10 or 4 ms, and the output of U9D-Pin 14 switches from approximately −15 to +15 volts clocking the Successive Approximation Register on the positive edge of each pulse after the start conversion pulse is received from U11A. The calibration data to the SAR is clocked for eight successive clock pulses (about 80 ms). Calibration of the SAR takes place each time the frequency is changed if the 25.6 kHz band edge is passed. Since the FM sensitivity of the VCO is not precisely predictable with frequency it must be calibrated electroni-

ManualsPlus.com

EOC output from the SAR goes low. Serial data is input at U2-pin 6 and converted to the parallel data that drives the DAC.

High Slew Rate Mode

When the Low Frequency Loop VCO's frequency is changed so that the 25.6 kHz band edge is passed, the Microprocessor word written to the LF Loop Shift Register (refer to Service Sheet 9) contains a high bit at register U25A-Pin 3. This allows the Write Strobe Generator D Flip-Flop U28B to be set when it is clocked by monostable U21A's active-low output low-to-high transition. (Refer to Table 1). The low output of U28B then triggers the High Slew Rate Monostable U21B placing the instrument in the high slew rate mode for approximately 500 ms. Refer to Table 2.

Table 1. U28B (P/O Write Strobe Generator) Operation (refer to Service Sheet 9)

S	R	C	D	Pin-9	Pin-8	Remarks
H	L	X	X	L	H	
H	H	↑	H	H	L	Change passes 25.6 kHz band edge.
H	H	↑	L	L	H	

Table 2. U21B High Slew Rate Monostable Operation

Pin-9	Pin-10	Pin-11	Pin-5	Pin-12	Pulse Duration
↑	+5V	+5V	⎍	⎍	500 ms

The 500 ms pulse duration is determined by R26C 75 kΩ and C58 15 μF. The active-high output pulse is applied to the Slew Rate Control comparator U16C(shown on Service Sheet 10) to close the High Slew Rate FET switches. The active-high output is also applied to Exclusive-Or gate U13B whose output goes high since the other input is low. The high input to the Successive Approximation Register's Feed Forward input stops a conversion which may have been started or prevents a conversion from taking place.

Pre-Cal Settling Monostable

The active-low output (low) of U21B is applied to Pre-Cal Settling Monostable U11B-pin 10. U11B is triggered on the low-to-high transition of the 500 ms pulse. The active-high output goes high and the active-low output low for 1.1s. Refer to Table 3. It is during this time that the LF Loop finishes locking in the low slew rate mode. The active-high output of U11B is the second input to Exclusive-Or gate U13B. The first input (from the High Slew Rate Monostable) has just gone low. Therefore, U11B's active-high output being high keeps U13B's output high. The high input to the Feed Forward input of the Successive Approximation Register terminates and/or prevents conversion as noted.

ManualsPlus.com

SERVICE SHEET 11
P/O A3 LOW FREQUENCY LOOP ASSEMBLY

TROUBLESHOOTING HELP

Service Sheet BD3
Table 4-1. Abbreviated Performance Tests
Table 5-2. Post-Repair Adjustments

PRINCIPLES OF OPERATION

General

The voltage-to-frequency sensitivity of the Signal Generator's VCO is non-linear. To guarantee calibrated frequency modulation, the gain of the audio modulation drive signal is varied by the FM Calibration circuits. Refer to Figure 1 for a simplified diagram of the calibration circuits. The FM Calibration Signal Generator (found on Service Sheet 12) provides the FM reference signal and the VCO modulation signal required to calibrate the modulation drive level. Passing the FM calibration signal through an integrator U12D (found on Service Sheet 12) provides the same signal as passing the frequency modulated VCO signal through the phase detector (found on Service Sheet 10). These signals are input to the Loop Summing (difference) Amplifier (of Service Sheet 10). This difference signal is input to the Low Offset Comparator. The output tells the SAR whether the DAC should increase or decrease in attenuation to cancel the signal from the Loop Summing Amplifier. In successive steps the signal is reduced until after 8 steps the DAC attenuation is calibrated with the data being held in the SAR, U2.

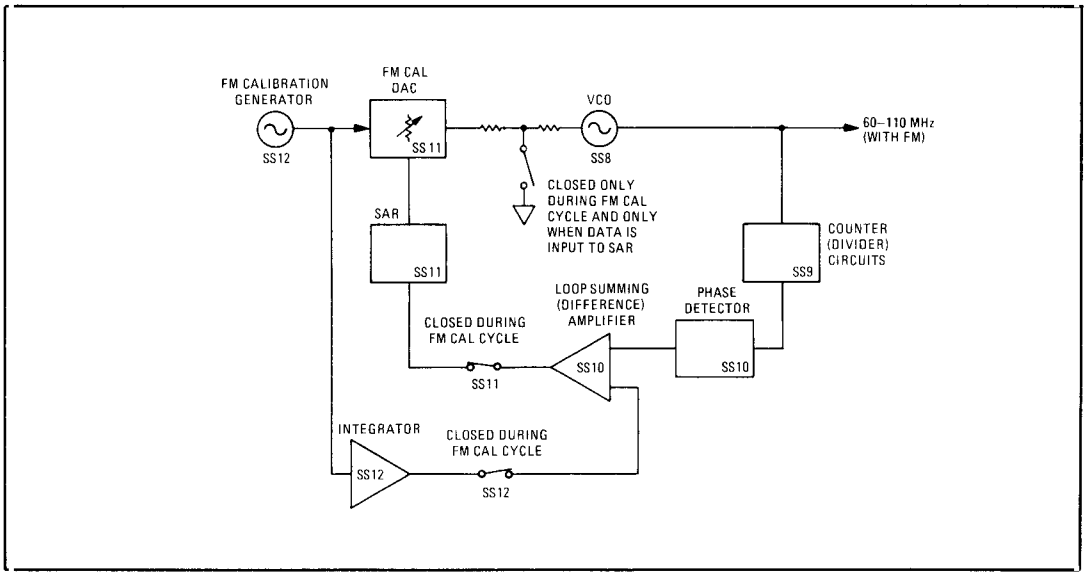


Figure 1. FM Calibration Simplified Block Diagram

If the Signal Generator's frequency is changed so the 25.6 kHz band edge is passed, WSTB(L) triggers the High Slew Rate Monostable U21B. The outputs of U21B inhibit the FM calibration circuits and enable the SAR Clock Generator by causing U5A to be set. At the end of the high slew rate mode, the Pre-Cal Settling Monostable is triggered. During the Pre-Cal Settling time the LF Loop is phase locked. When the settling time ends, the SAR Clock Generator's K input to U5A is set high and the Successive Approximation Register is enabled. The two lows to U13B cause a low to be output to the SAR's Feed Forward Input. The Start Conversion Monostable is triggered which couples a high to the Start Conversion input. The Conversion Cycle begins and the

ManualsPlus.com

SERVICE SHEET 11 (Cont'd)

NOTES (Cont'd)

The Successive Approximation Register's conversion cycle is started when the active-high output pulse of the Start Conversion Monostable is terminated, high to low.

√2 SAR Clock Generator, Successive Approximation Register

NOTES

The Successive Approximation Register's conversion cycle is started when the active-low output of J-K Flip-Flop U5A is low. A 0.5 ms clock pulse is generated every 10 or 4 ms by the Tune Sample Monostable's active-low output pulse.

On each clock pulse to the SAR, the SAR's outputs are set high or low depending on the Data in. As each of the bits are set, the FM Cal DAC gets set.

A total of eight clock pulses are required to set the Output of the SAR (to calibrate the system). Total time is approximately 80 ms.

Clock pulses are generated from the time the High Slew Rate Monostable's active-low output sets the active-low output of the J-K Flip-Flop U5A low.

1. Set the Signal Generator to 500 MHz without modulation.

2. Increment the frequency up 10 MHz and compare the displayed waveforms to those shown in Figures 5 and 6. Refer to √3 to verify SAR Data input during the FM calibration cycle.

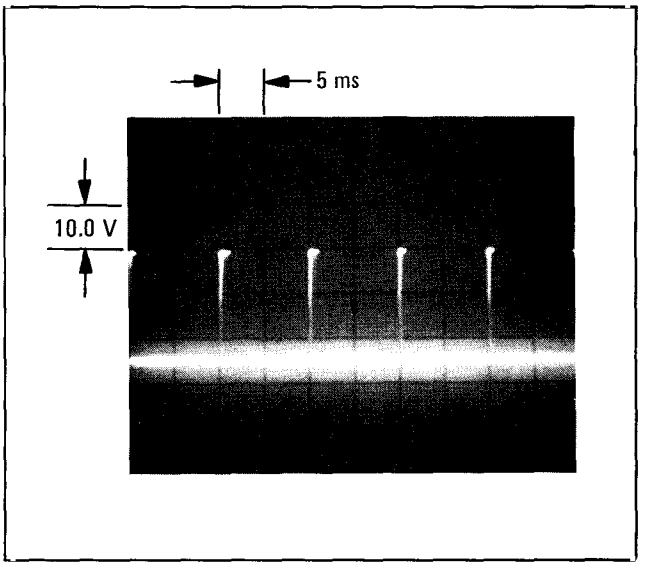


Figure 5. Display of SAR Clock Generator Pulse (coupling is dc to U9D-Pin 14; external trigger from J2-Pin 10)

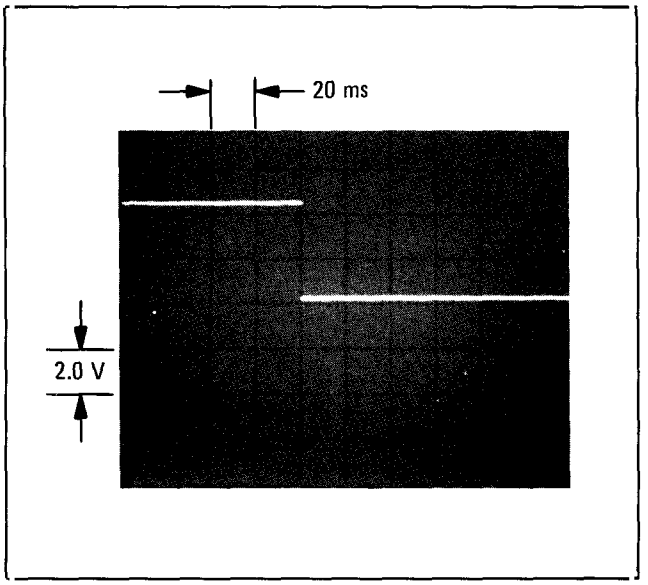


Figure 6. Display of SAR End of Conversion EOC(L) Level (coupling is dc to J2-Pin 6; external trigger from J2-Pin 10)

ManualsPlus.com

SERVICE SHEET 11 (Cont'd)

√3 Low Offset Comparator Control, Low Offset Comparator

NOTES

The correction Tune Voltage Sample input to the Low Offset Comparator will control the comparator's output.

The comparator's output is Exclusive-Or'ed with the integrated FM calibration signal to set the SAR bits high or low.

1. Increment the frequency up 10 MHz and check the oscilloscope displays, Figures 7 and 8 for typical FM calibration data.

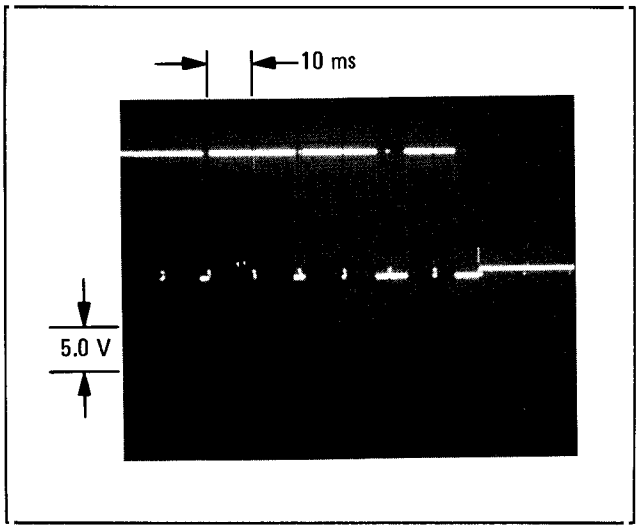


Figure 7. Display of Offset Comparator Output during FM Calibration Cycle (coupling is dc to J3-Pin 16 with external trigger from J2-Pin 10)

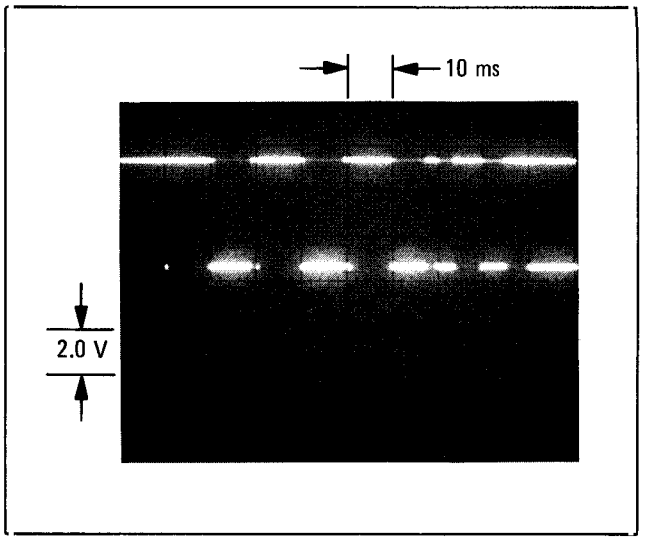


Figure 8. Display of SAR Data Input during FM Calibration Cycle (coupling is dc to U13A-Pin 3; external trigger from J2-Pin 10)

√4 FM Cal DAC, Current-to-Voltage Converter, DAC Offset Sample and Hold Buffer

1. Set the Signal Generator frequency to 500 MHz, modulation source Internal 1 kHz, FM mode and 50 kHz deviation.
2. Check the following.

   a. J2-Pin 13, FM Reference, for a 1 kHz signal approximately 4.0 Vp-p.

   b. U6A-Pin 1 for a 1 kHz signal approximately 2.5 Vp-p.

   c. J3-pin 13 for a 1 kHz signal approximately 2.5 Vp-p.

ManualsPlus.com

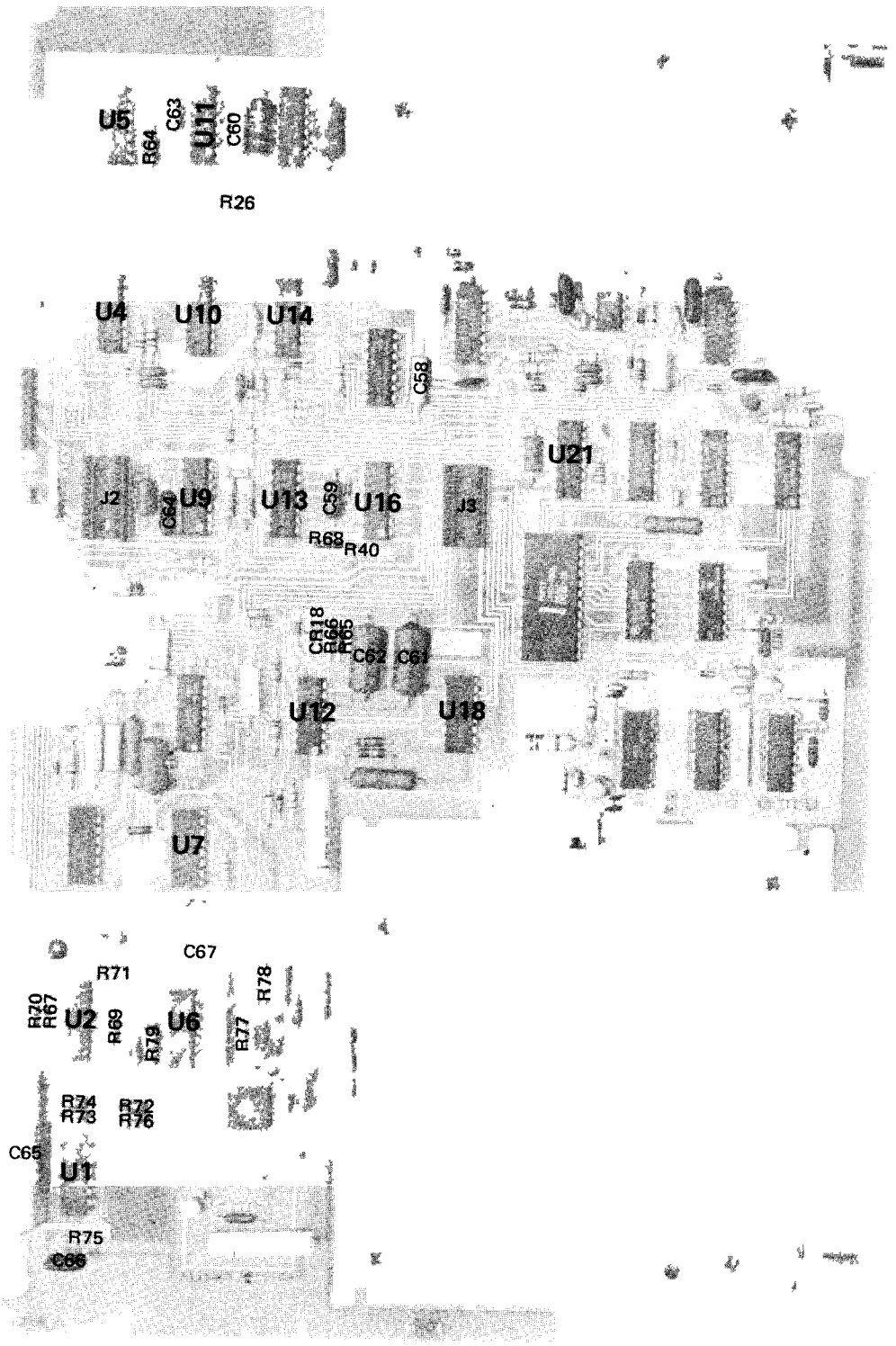
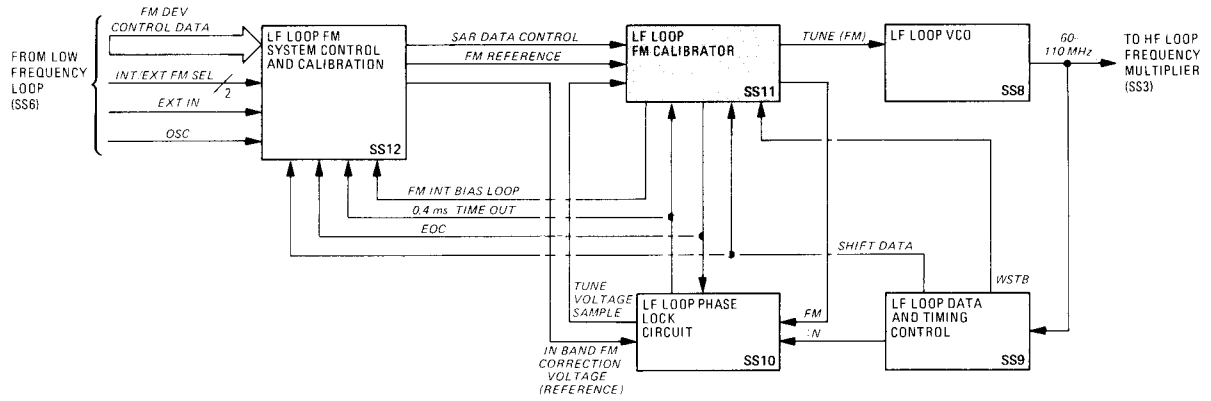


Figure 8-73. LF Loop FM System Calibrator Component Locations

ManualsPlus.com



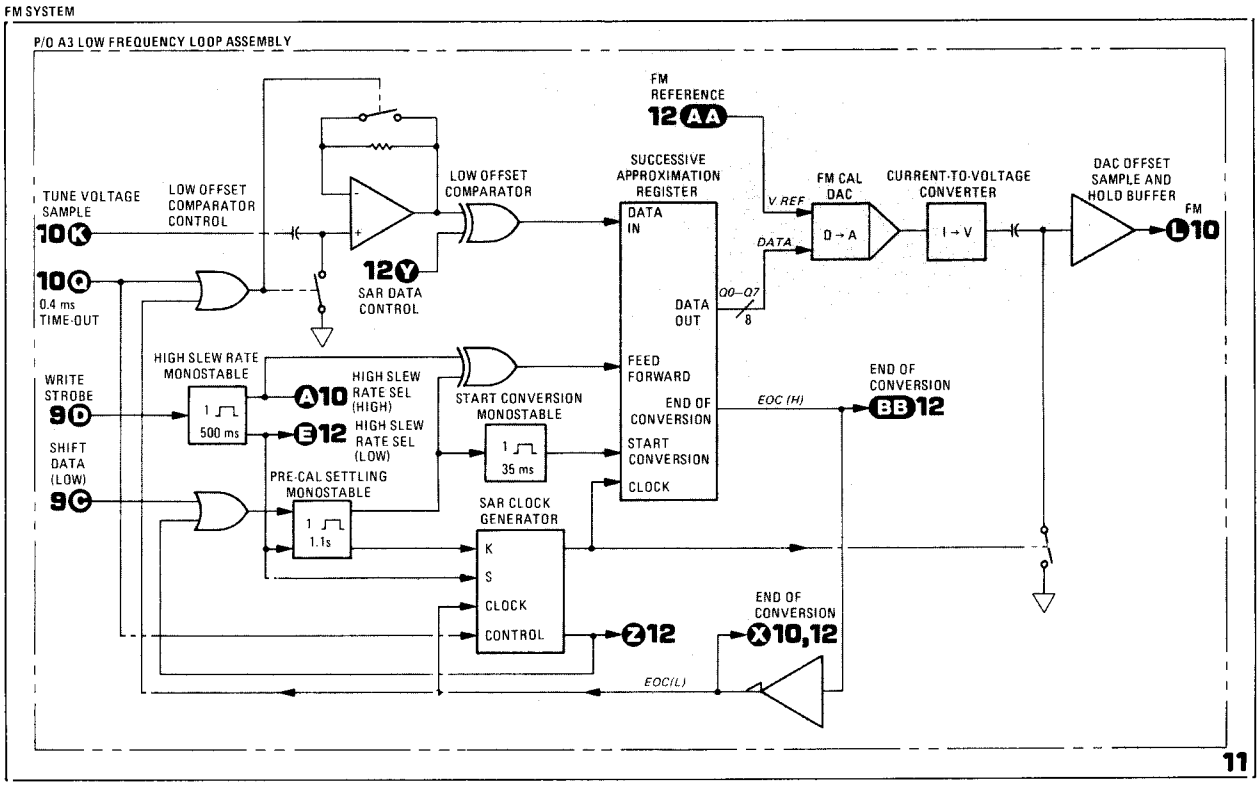
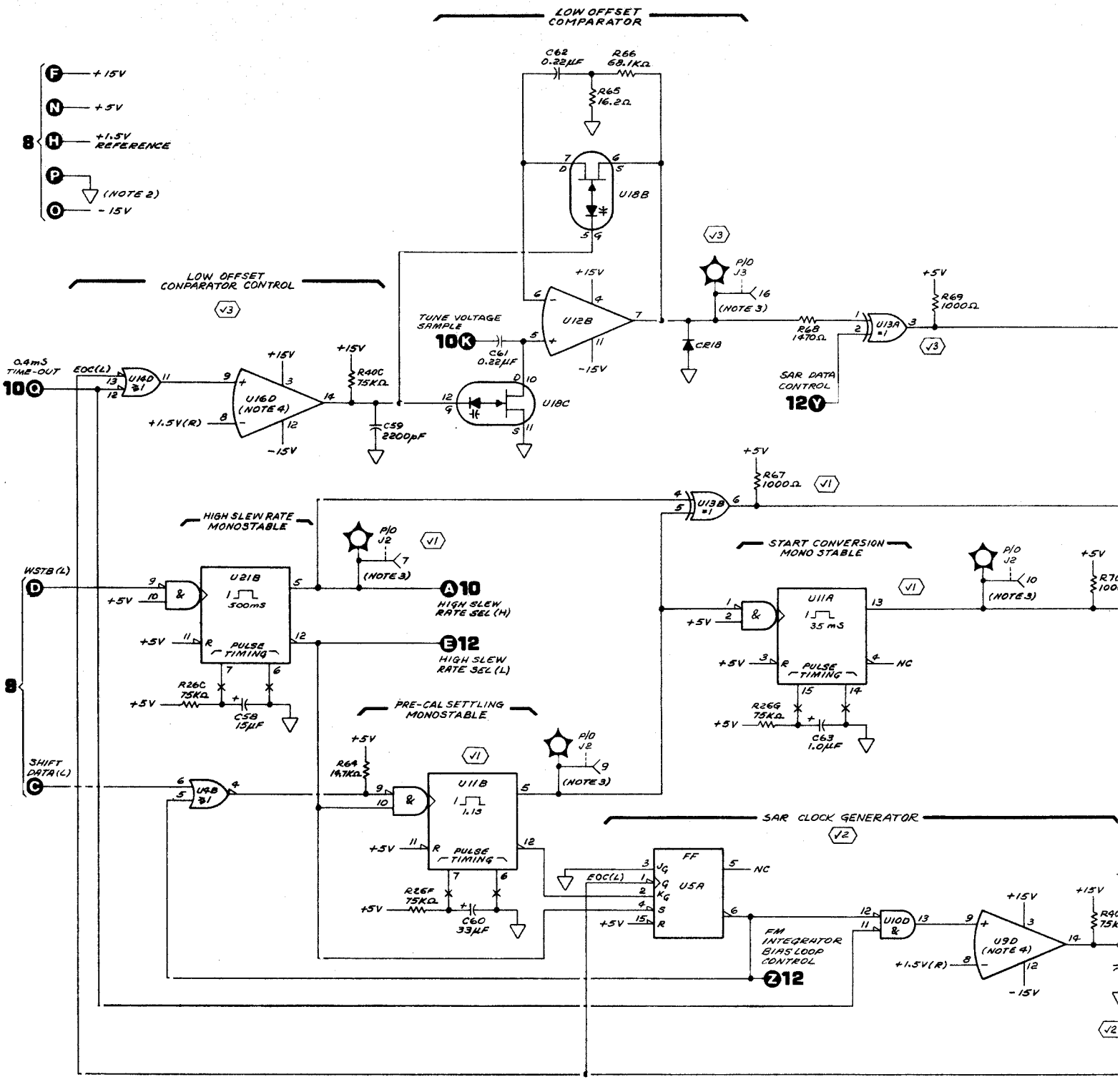


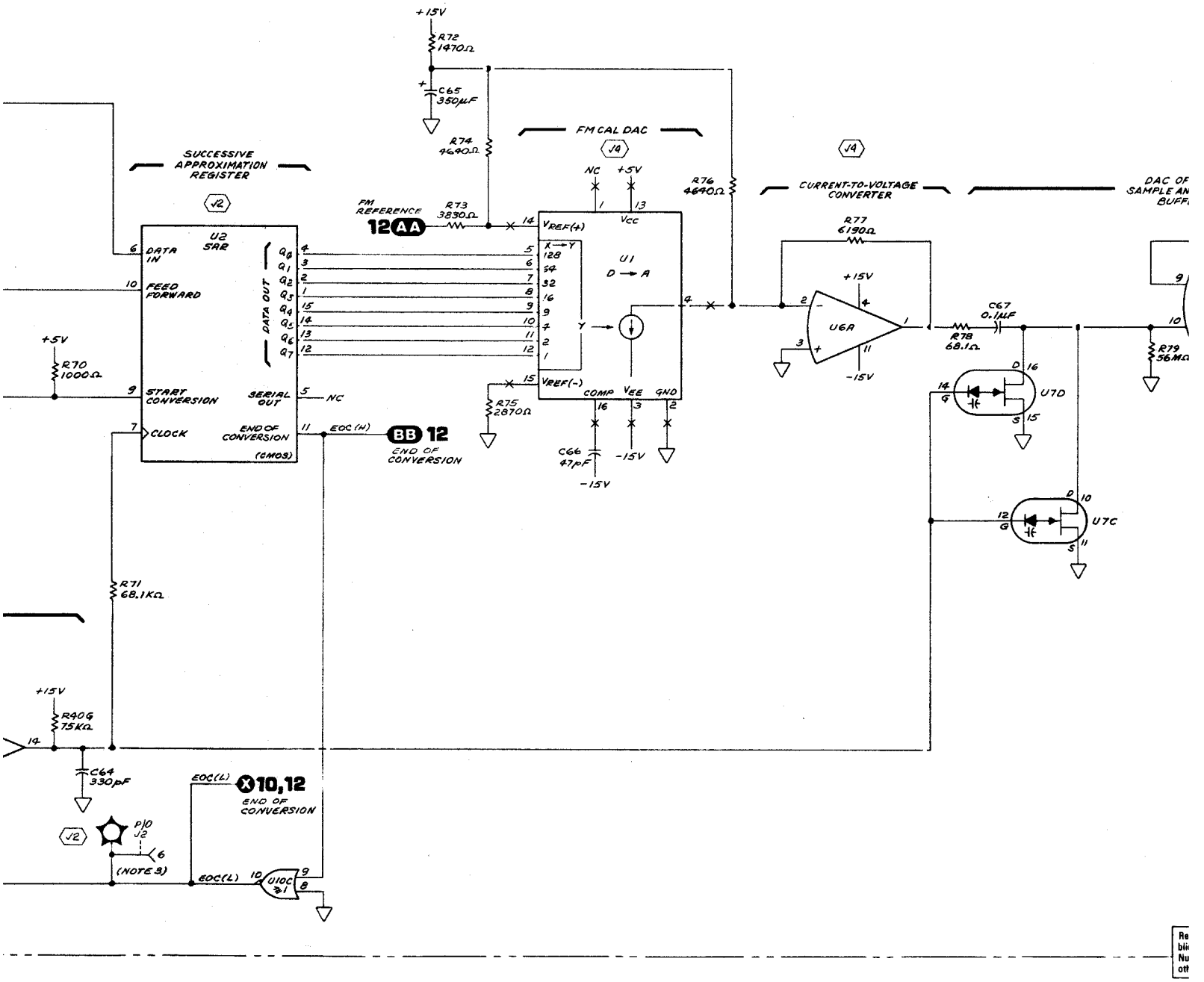
Figure 8-74. LF Loop FM System Calibrator Block Diagrams

ManualsPlus.com

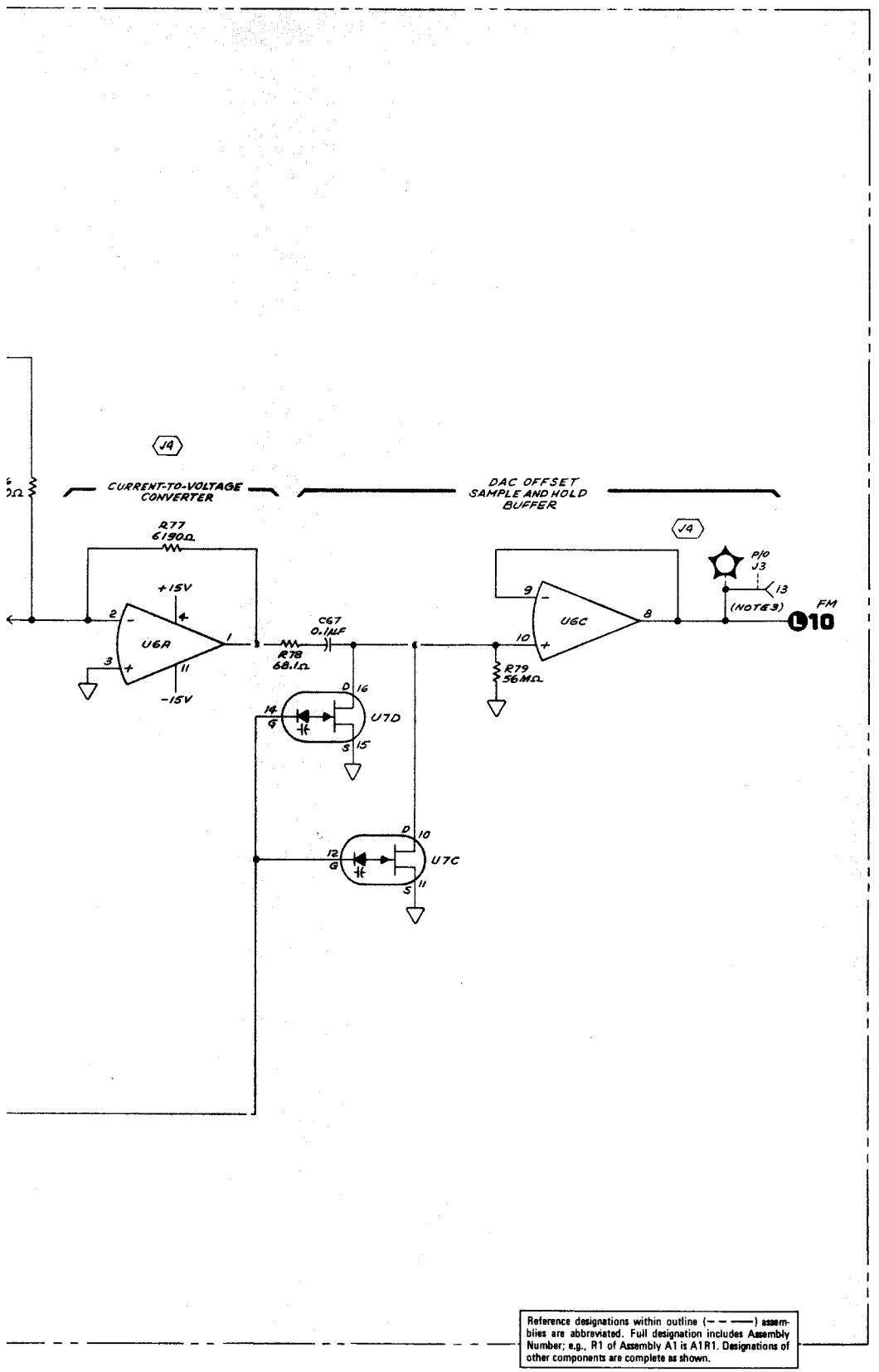
P/O A3 LOW FREQUENCY LOOP ASSEMBLY (08656-60003)



ManualsPlus.com



ManualsPlus.com



Reference designations within outline (— — —) assemblies are abbreviated. Full designation includes Assembly Number; e.g., R1 of Assembly A1 is A1R1. Designations of other components are complete as shown.

NOTES

1. SEE TABLE 8-3 FOR SCHEMATIC DIAGRAM NOTES.
2. CHASSIS GROUND IS ACHIEVED THROUGH A3J1-4 CONNECTION AND MECHANICAL CONTACT WITH FASTENERS HOLDING PC BOARD TO FRAME.
3. SERVICE TEST POINT. PIN OF DUAL IN-LINE TEST SOCKET J2 OR J3.
4. OPEN COLLECTOR DEVICE.

REFERENCE DESIGNATIONS

A3
C58-67 CR18 J2,3 R26,40,64-79 U1,2,4-7,9-14,16,18,21

LOGIC LEVELS

	TTL	CMOS
HIGH	> 2 V	>3.5V
LOW	< 0.8V	<1.5V
< IS MORE NEG. THAN > IS MORE POS. THAN		
OPEN	HIGH	UNDEF.
GROUND	LOW	LOW

INTEGRATED CIRCUIT PART NUMBERS

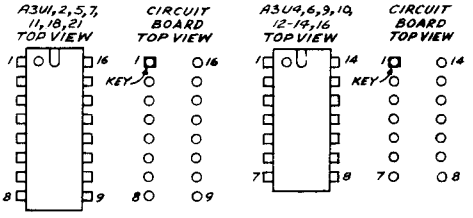
REFERENCE DESIGNATIONS	PART NUMBERS
U1	1826-0188
U2	1820-1722
U4	1820-1272
U5	1820-1212
U6,12	1826-0522
U7,18	1858-0066
U9,16	1826-0174
U10	1820-1144
U11,21	1820-1423
U13	1820-1211
U14	1820-0681

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATIONS	PIN NUMBERS
U2,5,11,21	+5V - 16 ▽ - 8
U4,10,13,14	+5V - 14 ▽ - 7

A3R26,40 TOP VIEW





11 P/O A3

Figure 8-75. LF Loop FM Calibrator Schematic Diagram

ManualsPlus.com

SERVICE SHEET 12 (Cont'd)

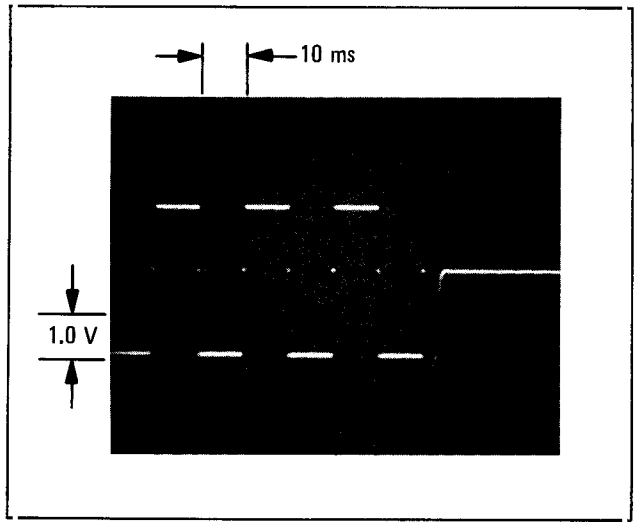


Figure 3. Oscilloscope Display at J2-Pin 13 during FM Calibration (dc coupling to J2-Pin 13; external triggering is from U5-Pin 7)

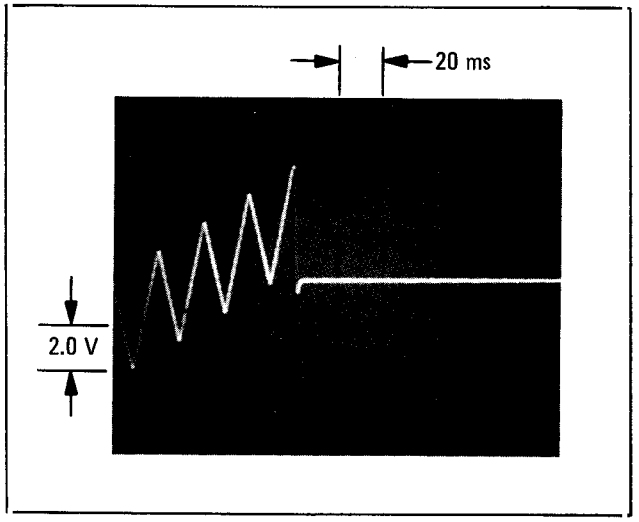


Figure 4. Oscilloscope Display of J3-Pin 15 during FM Calibration (dc coupling to J3-Pin 15; external triggering from U5-Pin 7)

√5 FM Integrator Bias Loop

1. Set the Signal Generator to 500 MHz without modulation.

2. Check the output at U16B-Pin 2, the Slow Response Control comparator. It should be approximately +15 Vdc. FET switch U18A is closed.

3. Check the output of the Fast Response Control comparator U16A-Pin 1. It should be approximately– 15 volts dc. FET switch U18D is open.

4. Increment the frequency up 10 MHz and check that U16B-Pin 2 goes to –15 Vdc during FM calibration approximately 80 ms. Check that U16A-Pin 1 goes to approximately +15 Vdc approximately 50 ms after FM calibration is terminated. Externally trigger the oscilloscope at U5-Pin 7. 50 ms is the time it takes to change the voltage at U16A from –4 to +0.6 Vdc.

ManualsPlus.com

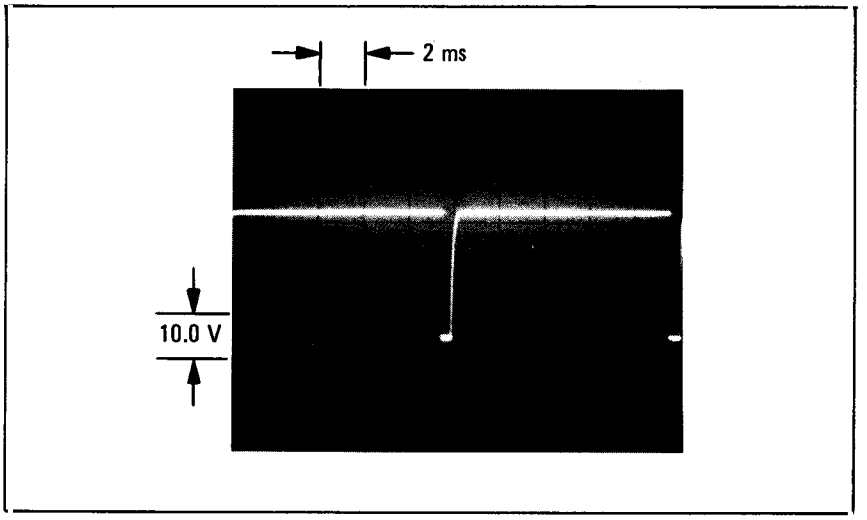


Figure 1. Oscilloscope Display of FM Integrator Sample and Hold Control (dc coupled to J2-Pin 3; internally triggered)

√4 FM Calibration, FM Integrator Sample and Hold Buffer

1. Set the Signal Generator to 500 MHz in the CW mode.

2. Increment the frequency up 10 MHz. Figures 2, 3 and 4 show the correct signals for FM Calibration of the LF Loop's VCO.

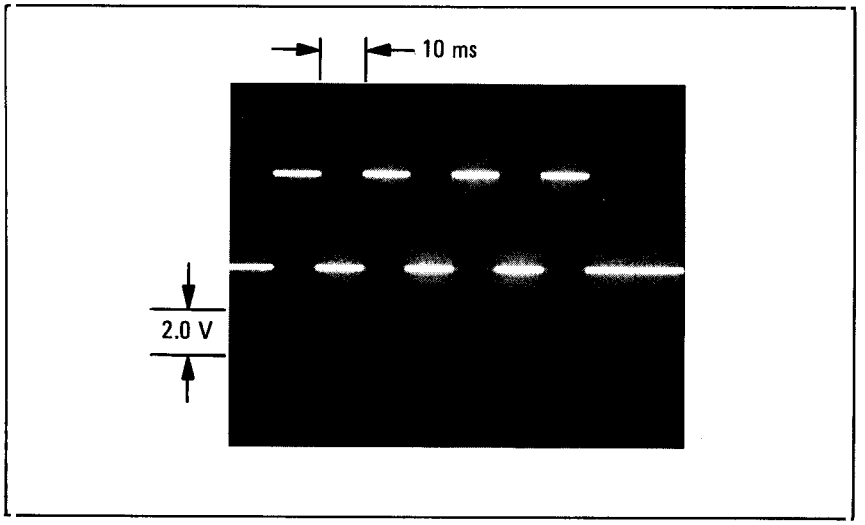


Figure 2. Oscilloscope Display of SAR Data Control Generated during FM Calibration (dc coupling to U5-Pin 7; external triggering from U5-Pin 13)

ManualsPlus.com

SERVICE SHEET 12 (Cont'd)
TROUBLESHOOTING

Procedures for checking circuits of the A10 Audio Power Supply Assembly and the A3 Low Frequency Loop Assembly are given below. The areas or points to check are marked on the schematic by a hexagon with a checkmark and a number inside, e.g., ⟨√1⟩ . Fixed voltages are shown on the schematic inside a hexagon, e.g. ⟨2V±0.2V⟩. Transistor bias voltages are shown without tolerances.

Test Equipment

Digital Multimeter .....HP 3465A
Oscilloscope
  Storage Mainframe.....HP 181A
  Vertical Amplifier .....HP 1801A
  Time Base .....HP 1820C

⟨√1⟩ FM Deviation Amplifier

1. Set the Signal Generator to 500 MHz, modulation source to 1 kHz Internal, FM mode and 50 kHz deviation.

2. Check A10J6-Pin 8 for a 1 kHz signal of approximately 3.0 Vp-p.

⟨√2⟩ FM Range Select, FM Reference Summing Amplifier

1. Set the Signal Generator to 500 MHz, modulation source 1 kHz Internal, FM mode and 50 kHz deviation.

2. Check A3J2-Pin 13 for a 1 kHz signal at approximately 3.2 Vp-p.

3. Change the FM deviation to 5 kHz.

4. Check J2-Pin 13 for a 1 kHz signal approximately 0.32 Vp-p.

⟨√3⟩ FM Integrator, FM Integrator Sample and Hold Control, FM Integrator Sample and Hold Buffer

1. Set the Signal Generator's frequency to 500 MHz, modulation source 1 kHz internal, FM mode and 50 kHz deviation.

2. Verify that the waveform shown in Figure 1 is correct.

NOTE

The FET Switch is opened for 0.4 ms every 10 ms. This stores the FM Integrator's output on capacitor C73.

3. The FM Integrator Sample and Hold Buffer's output, checked at J3-Pin 15, should be approximately 0.1 Vp-p. The cosine of the FM Integrator input is seen at J2-Pin 13. Externally trigger the oscilloscope at J2-Pin 13 to see the phase difference.

4. External trigger the oscilloscope on the FM Integrator Sample and Hold Control (J2-Pin 3) to lock the sample and hold pulse for 0.4 ms every 10 ms.

ManualsPlus.com

the FM calibration cycle is completed. For approximately 1.60 s both inputs to U10A will be low and the output high. This is from the time data is written until the FM calibration cycle begins. At this time the EOC(L) goes high and remains high until the FM Calibration is complete. The high-to-low transition of the EOC(L) clocks the active-low output of J-K Flip-Flop U5A high. Therefore, when data is written to the LF Loop (during the time both inputs to U10A are low and its output is high) FET switch U18D will be closed which enables the fast response mode. When the FM calibration is started the EOC(L) goes high for approximately 80 ms setting the output of U10A low. The Shift Data (H) input to Exclusive-Or gate U13C is low and the EOC(L) is now high. The high output of U13C drives the negative input of comparator U16A to approximately +15.0 Vdc. This keeps the fast response loop open. The slow response FET switch U18A is open when the EOC(H) input is low during the FM calibration time.

The FM Calibration Signal Generator is activated only during FM calibration of the LF Loop. The High Slew Rate Sel (L) from the High Slew Rate Monostable (refer to Service Sheet 11) is low for approximately 500 ms while the instrument is in the high slew rate mode. The low resets the J-K Flip-Flop U5B active-high output low and the active-low output high. One input to gate U4D will be high so the output is low. One input to gate U4C will be low and the other from U14C will be high so its output is low. J-K Flip-Flop U5B will not change until High Slew Rate Monostable U21B's active-low output goes high releasing the Reset input. U5B can not be gated until the EOC(L) goes high when the FM Calibration cycle is started. The outputs of the J-K Flip-Flop are controlled by the output of U14C. The EOC(L) being high will enable the output of U14C to be controlled by the 0.4 ms high-to-low transition of the output of Tune Sample Monostable U15A shown on Service Sheet 10. The monostable's active-low output is pulsed low for 0.4 ms every 10 or 4 ms. On the high-to-low transition at the gate, the output of U5B is set with the active-high output going high and the active-low output going low. Refer to Table 1. The J input is low and the K input is high. Therefore, the Flip-Flop will toggle when the gate goes high and repeat the cycle on each of the 0.4 ms pulses during the FM calibration. The common inputs to U4C and U4D enable the gates each time U5B is toggled (every 10 or 4 ms). The phase relationship between the pulses output from U5B to the remaining inputs to U4D and U4C is 180°. The pulse outputs of U4C and U4D are input to amplifier U8C. The output of U8C will be +15V or −15V and is used for the FM Calibration Cycle.

Table 1. U5B Operation

S	R	G	J	K	Pin-9	Pin-7
H	L	X	X	X	L	H
H	H	↓	H	L	H	L
H	H	H	L	H	T	T

T-Toggles to next state.

ManualsPlus.com

SERVICE SHEET 12 (Cont'd)

U3A opened every 10 or 4 ms for 0.4 ms by the Tune Sample Monostable active-low output to comparator U0B.

The FM Integrator Bias Loop Fast and Slow response are to zero the dc offset to the FM Integrator. The bias circuit looks at the output of the FM Integrator U12D to adjust out the dc drift and therefore keeps the negative input and output at 0.0 Vdc, the same as the positive input. The bias loop takes the output of the integrator and feeds it back to the input of U6D. Although the input of the integrator is held at 0.0 Vdc, there can still be a dc current at the input and voltage at the output. This is accomplished in the slow response mode by limiting the bandwidth to less than 1.0 Hz. The output of the integrator U12D is applied to the negative input of amplifier U12A through filter R92, 93 and C72. FET switch U18A is biased on by comparator U16B in the slow response mode. The End-of-Conversion EOC(L) from the SAR (shown on Service Sheet 11) is high (approximately +5.0 Vdc) setting the output to approximately +15.0 Vdc which turns the FET switch on. FET switch U18D is biased on or off by Fast Response Control comparator U16A. In the fast response mode, the output of integrator U12D is not filtered but connected directly to the input of amplifier U12A. Under both fast and slow response U12A will try to keep the negative input, pin 2, at 0.0 Vdc, the same as the positive grounded input pin 3. This will keep the output of U12D at 0.0 Vdc, the same as the input to U12A. The circuit would do the same for the audio modulation signals except that the narrow loop bandwidth will not let the circuit respond fast enough.

The fast response state is entered when the instrument's frequency is changed. For any change in frequency, the dc voltage from the FM Deviation DAC will change which forces a change at the output of the integrator U12D. The need to remove this voltage quickly from the integrator results in the use of the wider bandwidth of the fast response mode.

The negative input of Fast Response Comparator U16A is normally fixed at approximately 0.6 Vdc by diode CR19. The end-of-conversion, EOC(L), from U10C SAR (Service Sheet 11) is low except during the FM calibration of the LF Loop. The Shift Data (H) output of Write Strobe Generator U21A (Service Sheet 9) is low except when serial data is being written to the LF Loop. The FM Integrator Bias Loop Control active-low output of SAR clock generator J-K Flip-Flop U5A (Service Sheet 11) is high except during the FM calibration of the LF loop. When data is written to the Low Frequency Loop, Shift Data (H) goes high and the negative input to comparator U16A is driven to approximately −4.0 Vdc. The output of the comparator changes to approximately +15.0 Vdc and FET switch U18D is closed. During this time both FET switches U18A and D are closed. 75 μs after the last data bit has been written to the LF Loop, the Shift Data (H) goes low. If the high slew rate mode has been activated, the low active-low output of High Slew Rate Monostable U21B sets the J-K Flip-Flop U5A's active-low output low (refer to Service Sheet 11). This output from U5A will remain low for approximately 1.85s until

ManualsPlus.com

SERVICE SHEET 12
P/O A3 LOW FREQUENCY LOOP ASSEMBLY
P/O A10 AUDIO/POWER SUPPLY ASSEMBLY

TROUBLESHOOTING HELP

Service Sheet BD3
Table 4-1. Abbreviated Performance Tests
Table 5-2. Post-Repair Adjustments

PRINCIPLES OF OPERATION

General

The FM drive signals from internal or external sources are input to the FM Deviation Summing Amplifier. The signal level applied to the VCO may be varied in output level as it passes through the FM Deviation Digital-to-Analog Convertor (DAC). This allows setting the FM deviation of the RF output signal.

Some of the circuitry on the A3 assembly forms part of the FM Calibration circuits. Refer to Service Sheet 11 for a general discussion of these circuits. More specific information is included in the following paragraphs.

FM Deviation Circuits

The Internal 400 or 1000 Hz modulation signal and the External modulation signal are switched to the negative input of FM Deviation Summing Amplifier A10U17A by FET switches A10Q7 and Q6. The FET switches are biased off or on by comparators U21C and D. The comparators are controlled by data bits from the Microprocessor input to the Modulation Control Latches (refer to Service Sheet 6). The FM drive signal output of the FM Deviation Summing Amplifier is the positive Reference input to the FM Deviation DAC A10U14. This audio frequency modulation signal is attenuated by the DAC to the level required to frequency modulate the output signal to the deviation selected at the front panel. The FM Deviation DAC resistance ladder is set by the Microprocessor bits stored by the Modulation Control Latches (refer to Service Sheet 6). The output from the DAC is amplified by the FM Deviation Amplifier A10U17B. Any dc or ac output of the amplifier is connected to the FM Reference Summing Amplifier U6D. The gain of amplifier U6D is either 10 or 1 as determined by the FET switch Q1. The amplifier has a gain of one for the FM deviation range 0 to 9.9 kHz and 10 for the range 10 to 99 kHz. The FET switch is biased on or off by comparator U8A. U8A is controlled by a data bit from the Microprocessor latched in LF Loop Shift Register U25A (refer to Service Sheet 9).

The output of the FM Reference Summing Amplifier U6D is applied to the FM Cal DAC U1 shown on Service Sheet 11. This signal is the FM signal for modulation or the FM signal for calibration of the Low Frequency Oscillator's FM sensitivity. The other output of the amplifier is coupled to FM Integrator U12D. U12D integrates the FM signal to provide a reference for comparing with the detected FM VCO signal during the FM Calibration Cycle. The LF Loop has a narrow bandwidth, therefore, the Low Frequency Loop VCO must be modulated within the loop bandwidth. The output of the integrator is sampled by unity gain FM Integrator Sample and Hold Buffer U8D and C73. The output of the buffer is summed with the output of the Phase-to-Charge Converter shown on Service Sheet 10. The two voltages are out of phase and cancel the In-band FM Correction Voltage to the VCO. During FM Calibration, this voltage is summed with the phase-to-charge voltage and the difference is made equal to 0 by setting SAR bits (refer to Service Sheet 11). The sampling is controlled by FET switch

ManualsPlus.com

P/O A10 ASSEMBLY

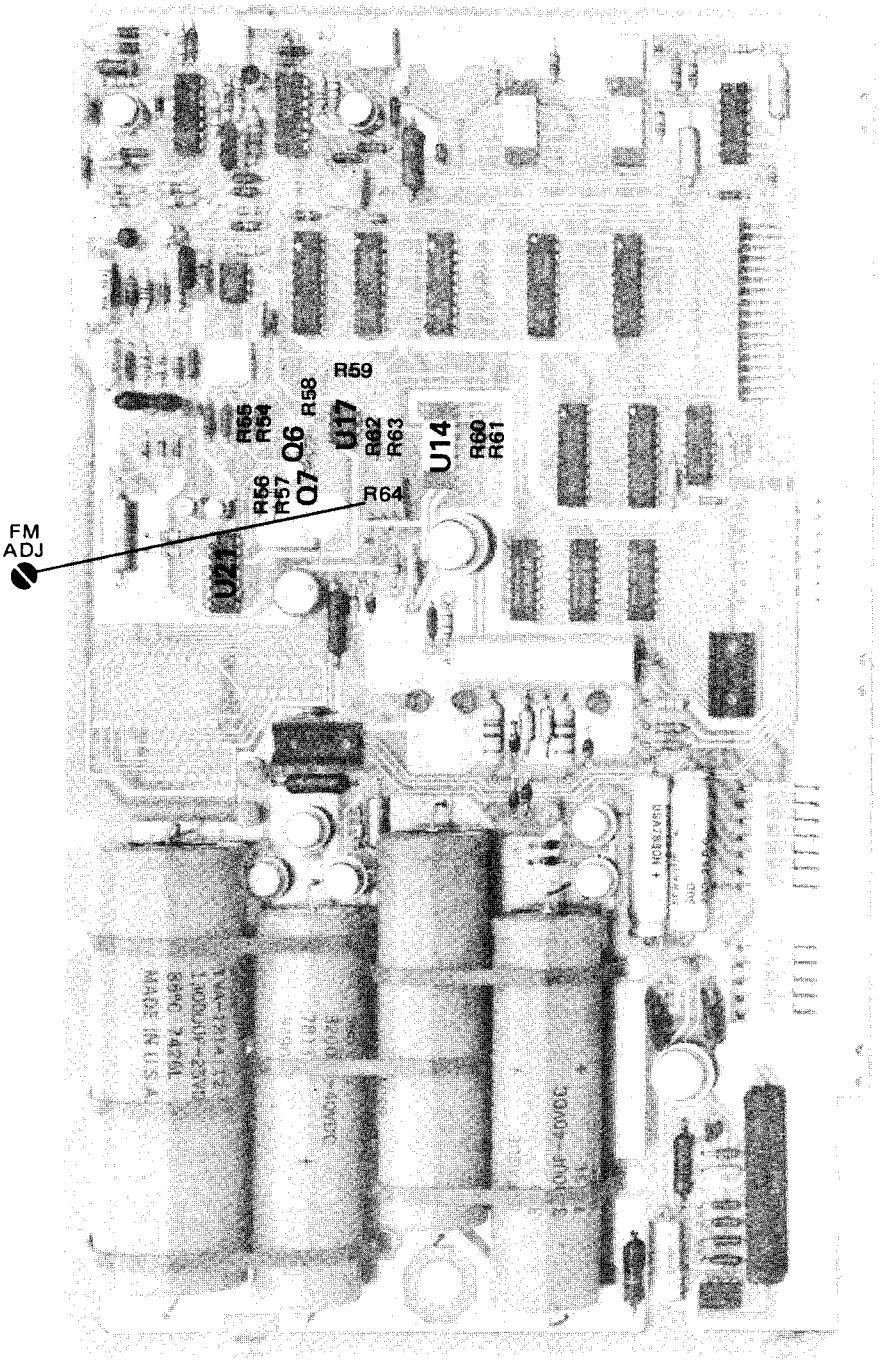


Figure 8-76. LF Loop FM System Control Component Locations

ManualsPlus.com

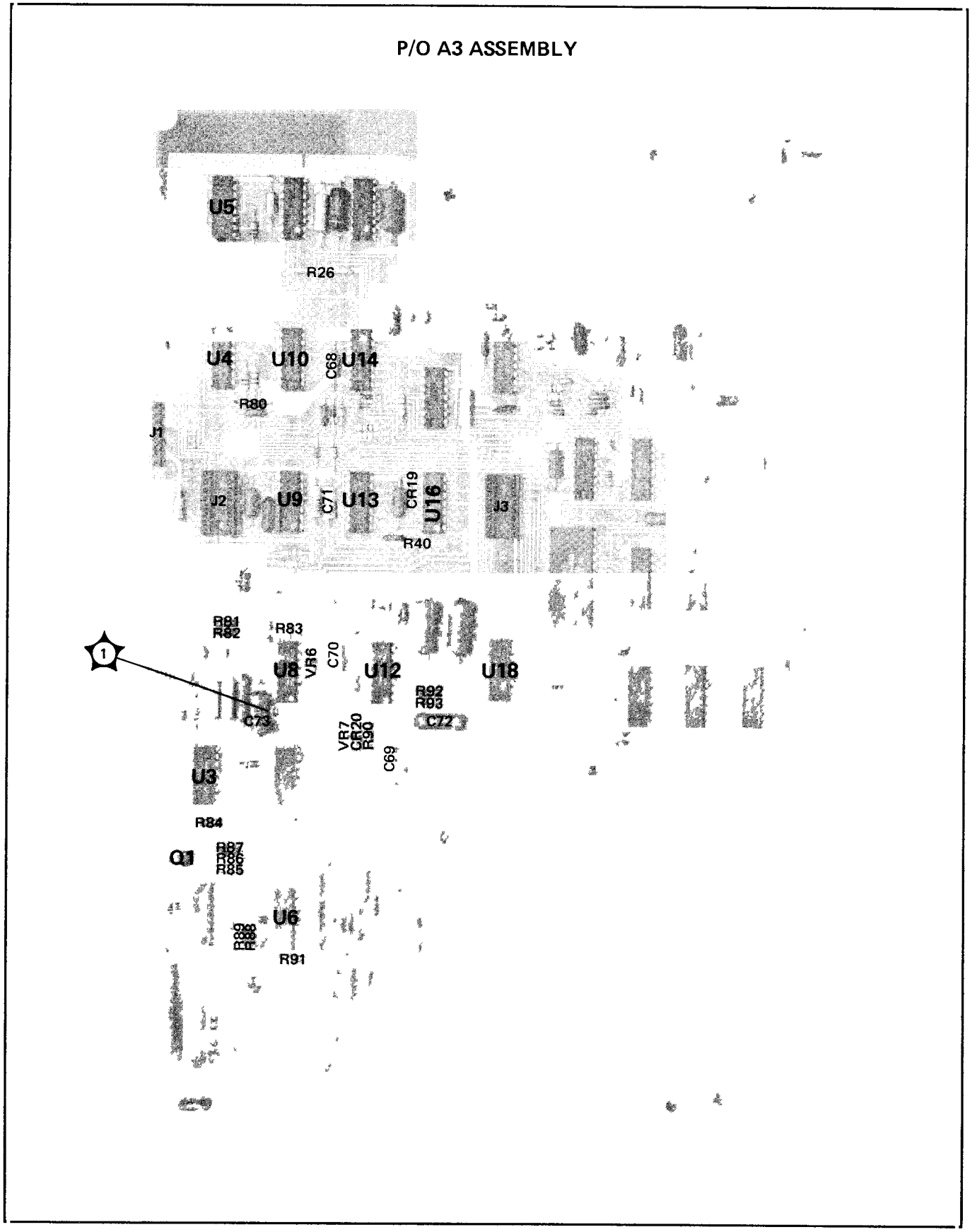


Figure 8-77. LF Loop FM System and Calibrator Component Locations

ManualsPlus.com

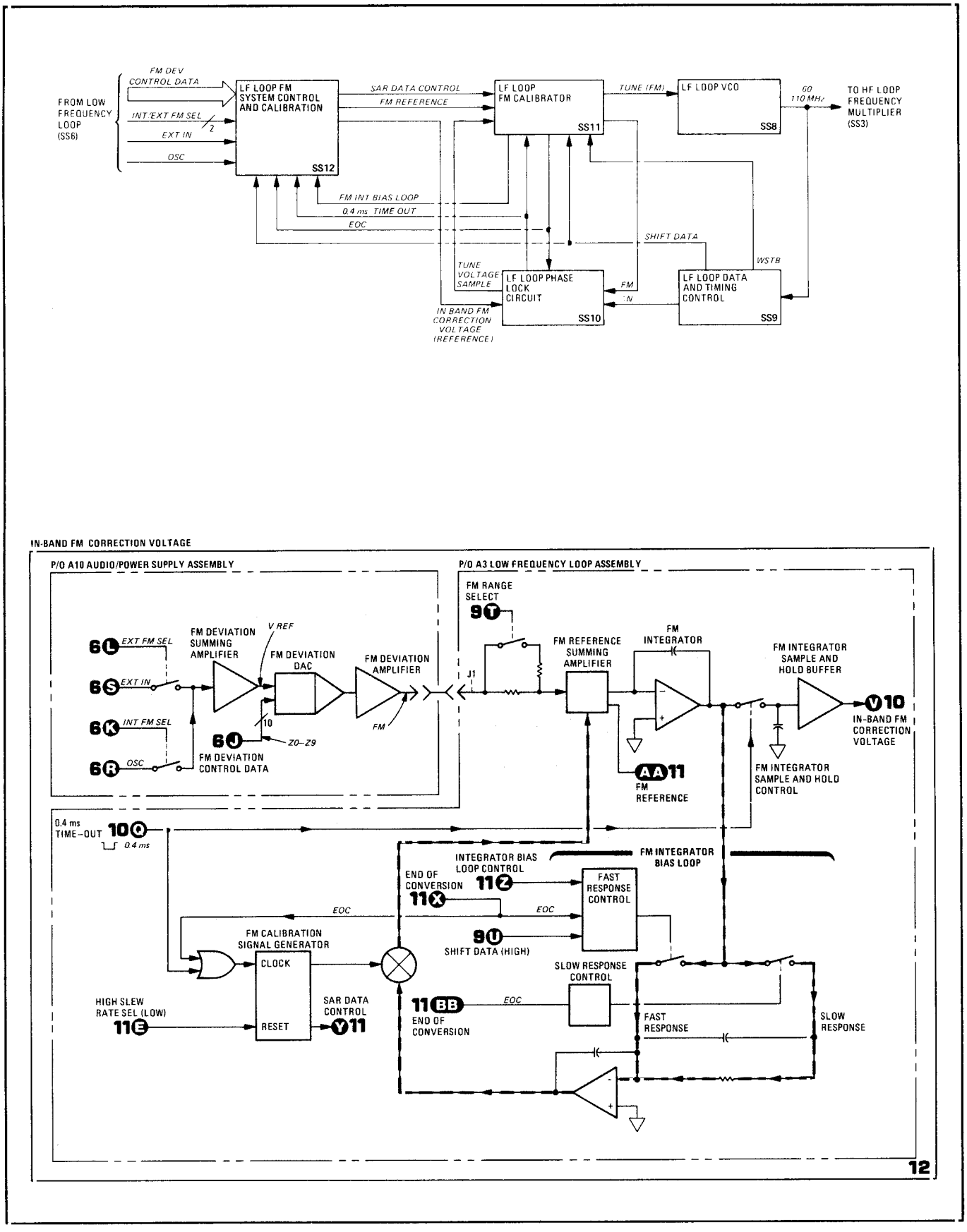
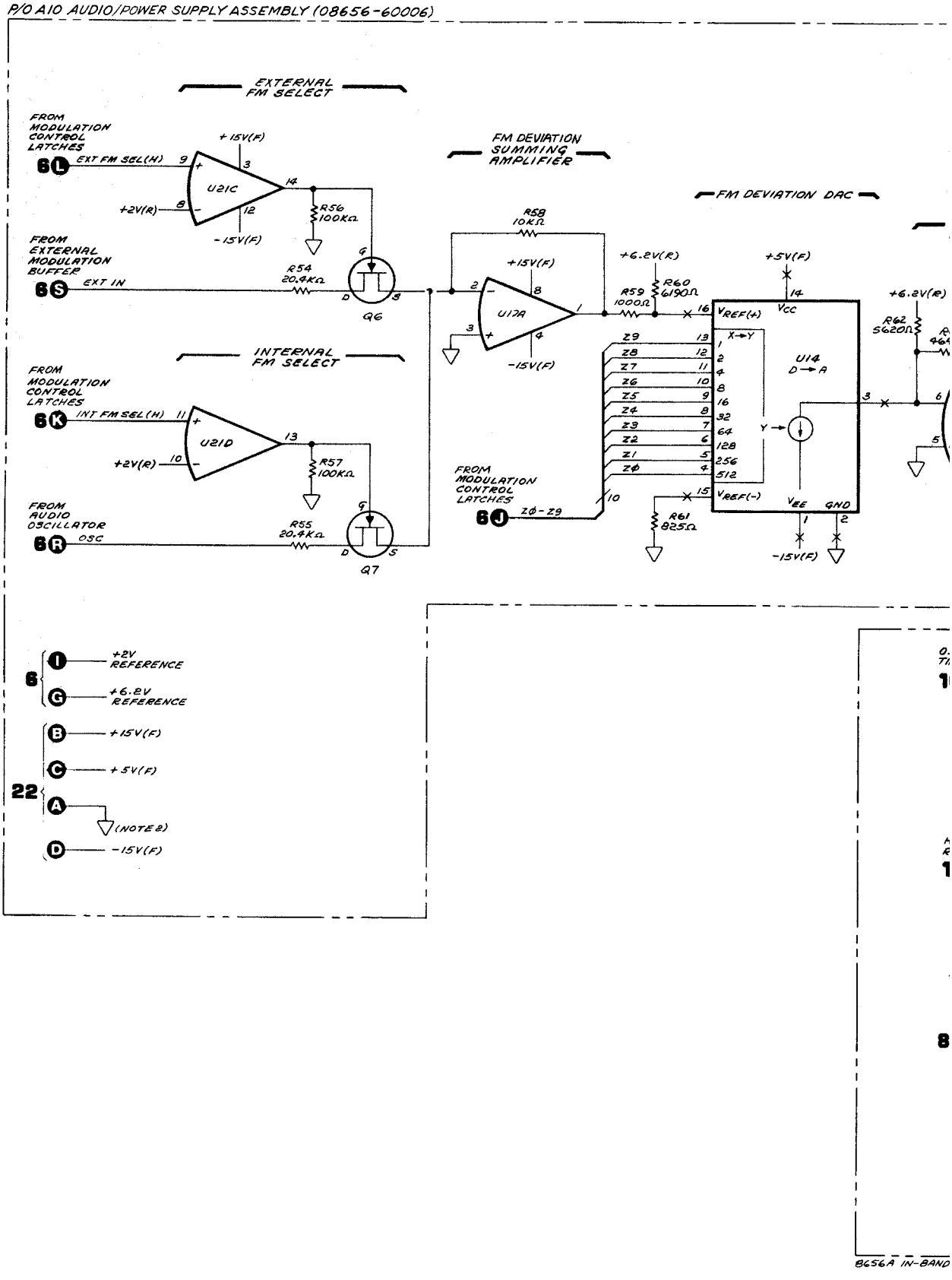


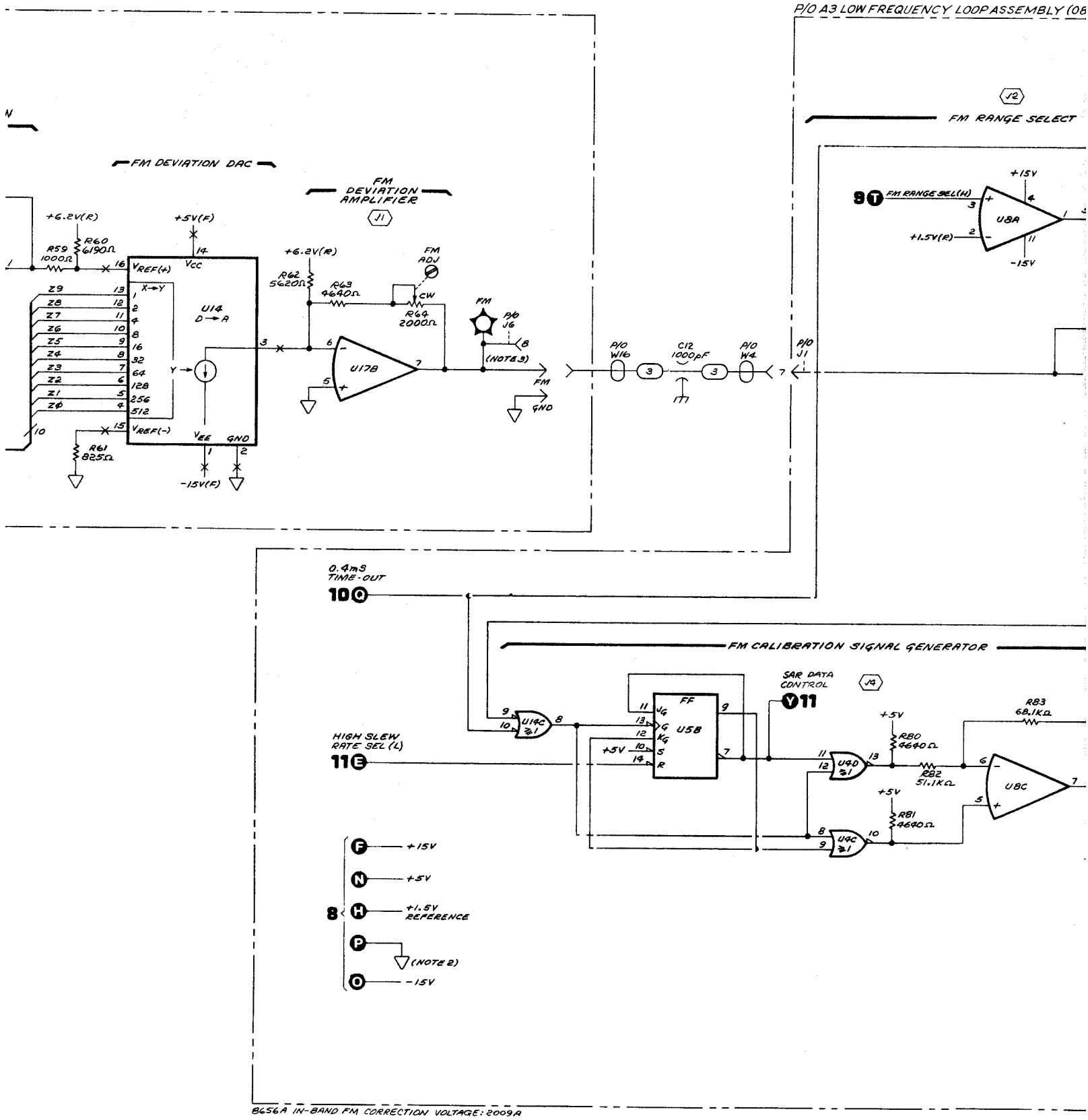
Figure 8-78. LF Loop FM System Control and Calibrator Block Diagrams

ManualsPlus.com

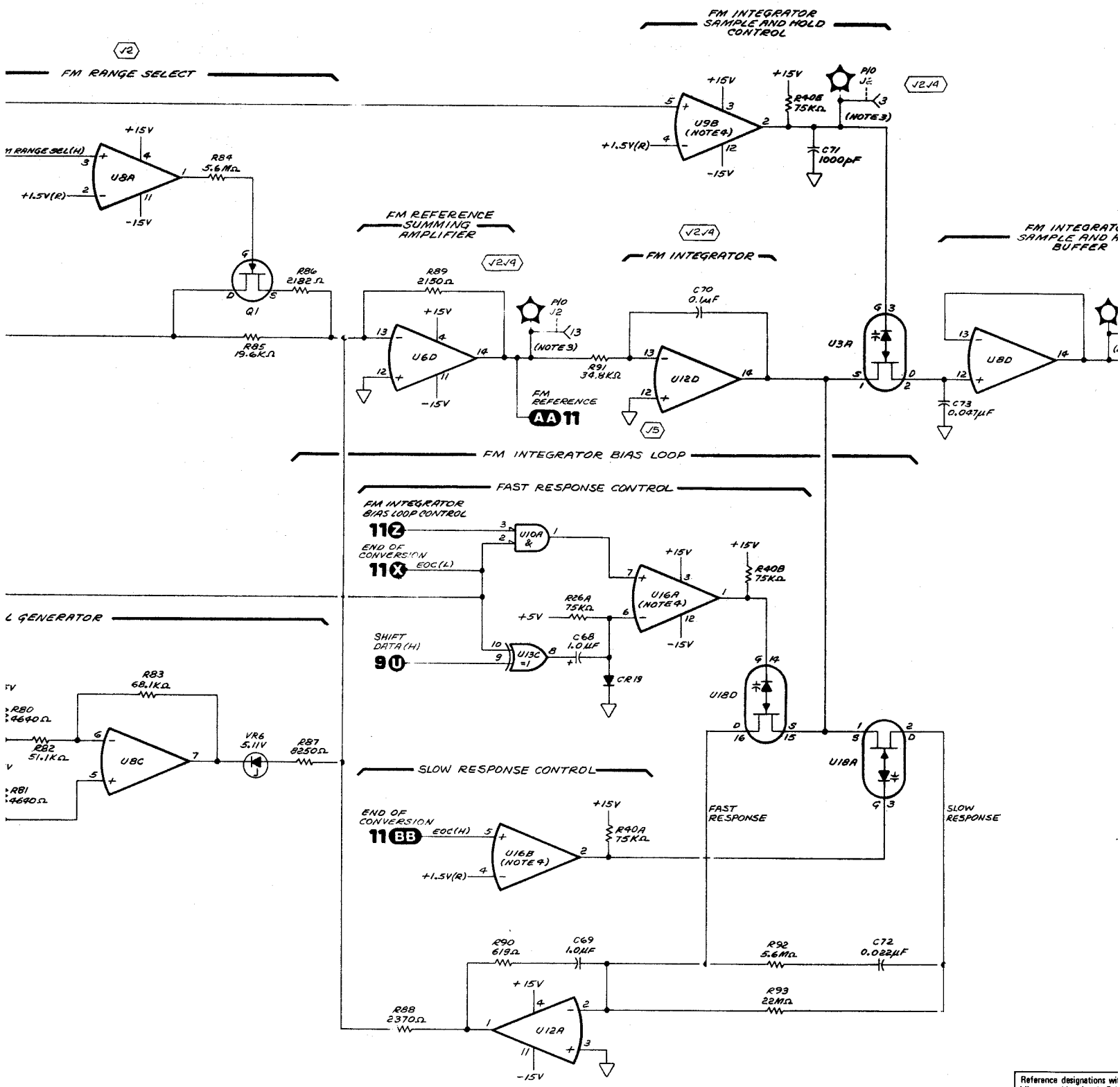
P/O A10 AUDIO/POWER SUPPLY ASSEMBLY (08656-60006)



ManualsPlus.com

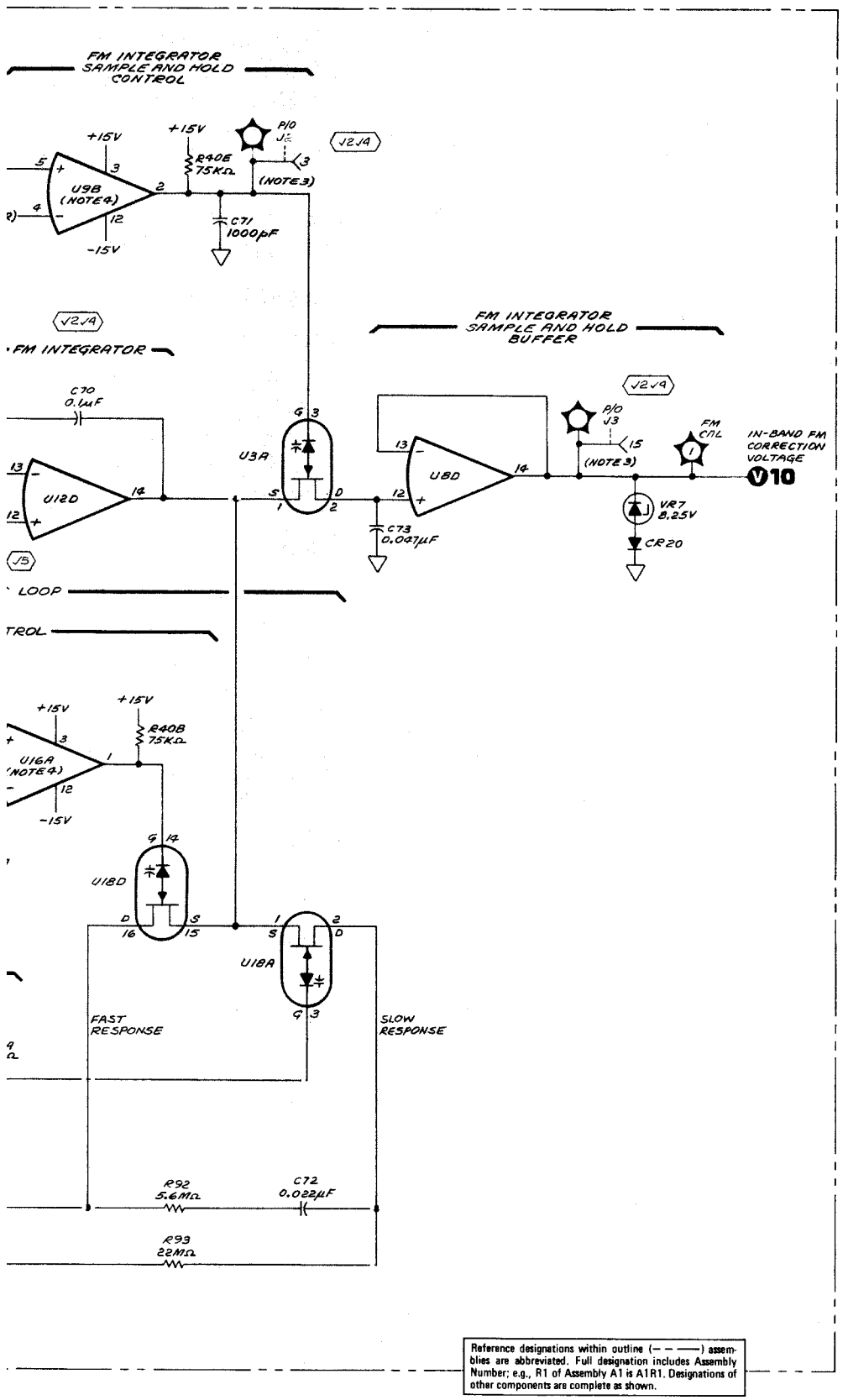


ManualsPlus.com



Reference designations wi
blies are abbreviated. Ful
Number; e.g., R1 of Assem
other components are com

ManualsPlus.com



Reference designations within outline (— — —) assemblies are abbreviated. Full designation includes Assembly Number; e.g., R1 of Assembly A1 is A1R1. Designations of other components are complete as shown.

NOTES

1. SEE TABLE 8-3 FOR SCHEMATIC DIAGRAM NOTES.
2. CHASSIS GROUND IS ACHIEVED THROUGH A3J1-4 CONNECTION AND MECHANICAL CONTACT WITH FASTENERS HOLDING PC BOARD TO FRAME.
3. SERVICE TEST POINT. PIN OF DUAL IN-LINE TEST SOCKET J2 OR J3.
4. OPEN COLLECTOR DEVICE.

REFERENCE DESIGNATIONS

NO PREFIX	A10
C12 W4,16	J6 Q6,7 R54-64 U14,17,21
A3	
C68-73 CR19,20 J1-3 Q1 R26,40, 80-93 TP1 U3-6,8-10, 12-14,16,18 VR6,7	

LOGIC LEVELS

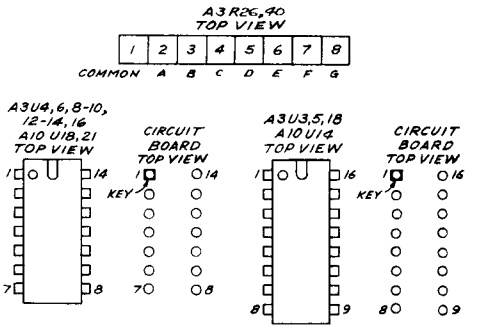
	TTL
HIGH	> 2V
LOW	< 0.8V
< IS MORE NEG. THAN > IS MORE POS. THAN	
OPEN	HIGH
GROUND	LOW

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATIONS	PART NUMBERS
A3	
Q1	1855-0280
U3,18	1858-0066
U4	1820-1272
U5	1820-1212
U6,8,12	1826-0522
U9,16	1826-0174
U10	1820-1144
U13	1820-1211
U14	1826-0462
A10	
Q6,7	1855-0020
U14	1826-0462
U17	1826-0521
U21	1826-0138

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATIONS	PIN NUMBERS
A3	
U4,10,13,14	+5V - 14 ▽ - 7
U5	+5V - 16 ▽ - 8



12
P/O A3, P/O A10

Figure 8-79. LF Loop FM System Control and Calibrator Schematic Diagram

ManualsPlus.com

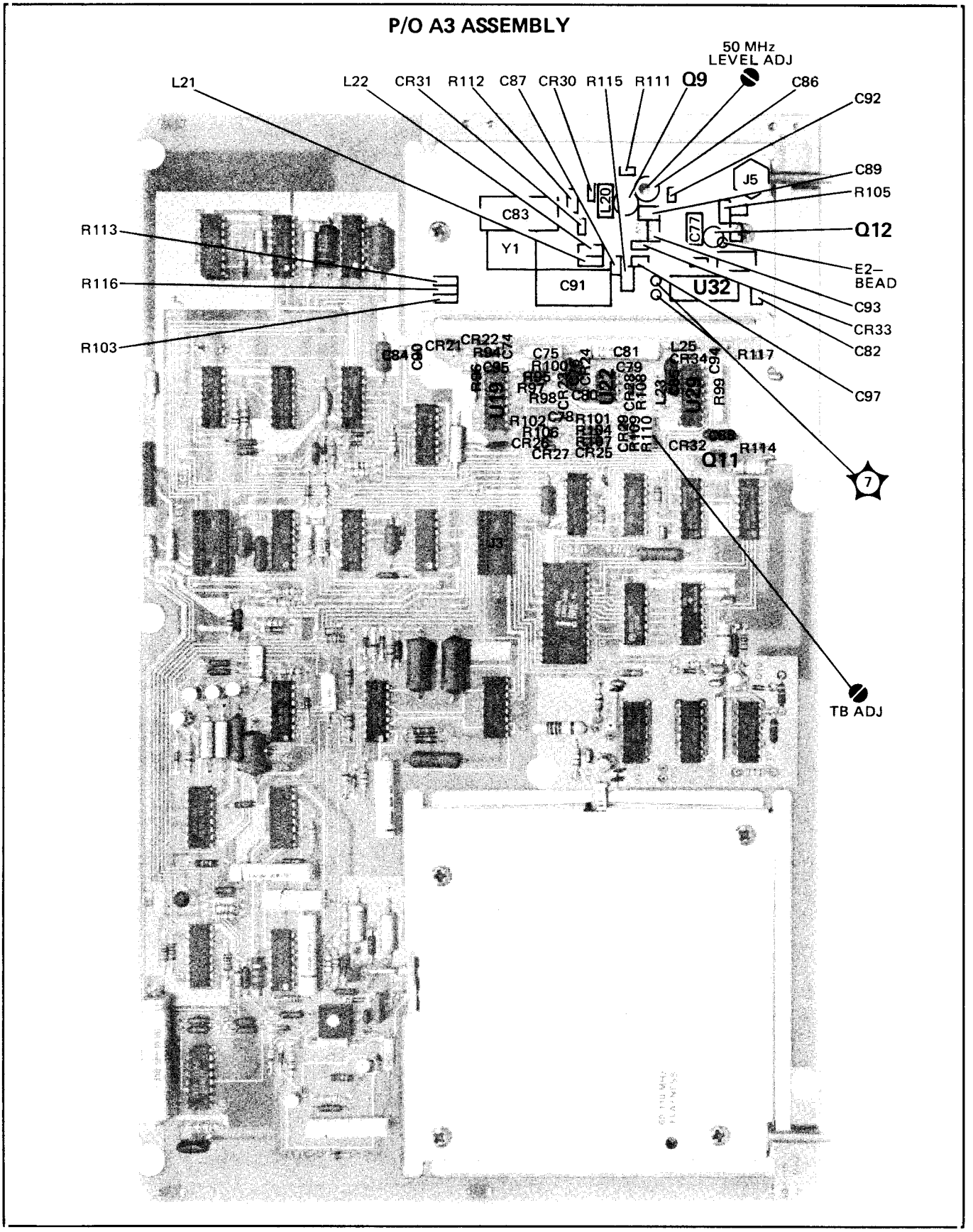


Figure 8-80. Reference Oscillator and Phase Lock Loop Component Locations

ManualsPlus.com

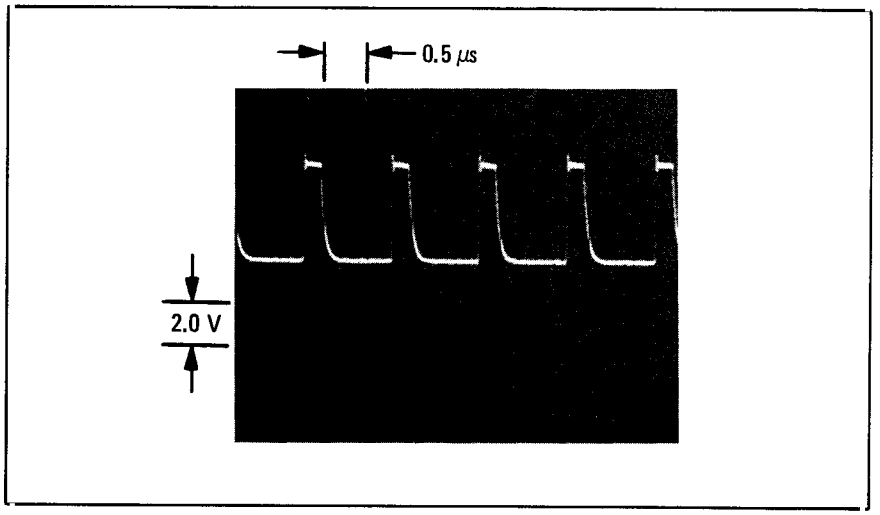


Figure 1. Display of 1 MHz Reference Signal (dc coupling to J3-Pin 5; internal triggering)

NOTE

A residual FM problem at the RF output may be due to residual FM from the 50 MHz Reference Oscillator. Measuring residual FM of the Reference Oscillator using the test setup found in Section IV may be inconclusive. The residual FM of the measuring instrument (HP 8901A Modulation Analyzer) is normally greater than that of a Reference Oscillator that is operating properly. Therefore the measurement would be meaningless.

ManualsPlus.com

SERVICE SHEET 13 (Cont'd)

√1 Crystal Phase Lock Circuit

Measure the voltage shown in Table 1. With an external reference oscillator connected to the Time Base Input or with the internal reference oscillator installed, the 50 MHz oscillator should be phase locked.

Table 1. Crystal Phase Lock Circuit Voltages

Operating Mode		Voltages (dc and ac) on									
		U19-Pin				U22B-Pin			U22A-Pin		
		7	5	2	3	5	6	7	3	2	1
Phase Locked	Vdc	+3.8	+3.8	+3.8	+4.0	+4.0	+3.7	+13	+4	+4	−10
	Vpk	0.4	0.4	0.4	0.4	0.01	0.01	0.01	0.08	0	0.02
Not Phase Locked	Vdc	+3.8	+3.8	+3.8	+3.8	+3.5	+3.7	−13	+4	+3	+14
	Vpk	0.02	0.4	0.2	0.05	0.01	0.01	0.005	0.02	0	0.008

√2 50 MHz Reference Oscillator

1. Verify that Q9's bias voltages are correct.
2. Measure the oscillator output at TP7.

√3 Divided Time Base Signals

1. Measure the signals at J3-Pin 8 and J4.
2. Verify that the waveform shown in Figure 1 is correct.

ManualsPlus.com

SERVICE SHEET 13 (Cont'd)

The time base output is applied to pin 11 of Exclusive-or gate U19. Its other input is tied to +5 Vdc. The output from pin 14 is the input phase shifted 180 degrees. The signal is then detected by diode CR34 and ac coupled to the Time Base Output J4.

Crystal Phase Lock Circuit

The Time Base Input signal is ac coupled by C95 to resistor R94 and the positive and negative peak limiting diodes of CR21 and 22. The input is then ac coupled by capacitor C74 to pin 7 of Exclusive-Or gate U19. The input goes to ac ground by resistors R95 and 96 and capacitor C75. The output of the gate is connected to the input to bias on the ECL gate. The output is also connected through the resistor R98 to resistor R99D and diode CR23. CR23 detects the Time Base Input signal and applies the voltage to the positive input of comparator U22B. The positive input is increased so it is more positive than the negative input and the output of U22B switches to +15 Vdc, detecting the presence of a Time Base Input. When the output of U22B switches to +15 Vdc the phase lock operational amplifier U22A is activated by turning off diode CR25 and turning on diode CR29. The inputs of comparator U22B are connected to U19-Pin 3 the Exclusive-Or gate output. Diode CR24 temperature compensates CR23.

The Time Base Input signal from U19-Pin 3 is connected to U19-Pin 4. The other input, pin 5, is the divided output of the 50 MHz Reference Oscillator. The signal is divided to 10, 5 or 1 MHz depending on the Time Base Input frequency and the subsequent jumper placement. This Exclusive-or gate serves as a phase detector with its change in output voltage being proportional to the phase difference of the two inputs. The output is coupled to the 50 MHz Reference Oscillator which serves to phase lock the oscillator to the Time Base Input signal. The correction voltage to U22A is amplified and applied to the oscillator tank circuit through diode CR28. CR28 is turned on when comparator U22B turns CR25 off and the negative input of U22B changes to approximately +3 Vdc. The positive input is fixed and the output goes from +15 Vdc to approximately −7 Vdc. CR28 is turned on as are diodes CR26 and 27 when the phase difference is large enough. Resistor R106 is bypassed which moves the reference oscillator to the correct frequency.

TROUBLESHOOTING

Procedures for checking the circuits shown on Service Sheet 13 are given below. The area or points to check are marked on the schematic by a hexagon with a check mark and a number inside, e.g. ⟨√3⟩. Fixed voltages are shown on the schematic inside a hexagon, e.g. ⟨2V±0.2V⟩. Transistor bias voltages are shown without tolerances.

Test Equipment

Digital Miltimeter .....HP 3465A
Oscilloscope .....HP 1222A

ManualsPlus.com

SERVICE SHEET 13
P/O A3 Low Frequency Loop Assembly
P/O A16 10 MHz Reference Oscillator

TROUBLESHOOTING HELP

Service Sheet BD3
Table 4-1. Abbreviated Performance Tests
Table 5-2. Post-Repair Adjustments

PRINCIPLES OF OPERATION

General

50 MHz Reference Oscillator

The 50 MHz Reference Oscillator, Q9, is a common base crystal controlled oscillator. The amount of positive feedback is predetermined by the taps on the inductors. The inductors are spiral printed circuit board traces.

The base of Q9 is biased by resistor R111 at approximately 0 Vdc. The emitter is biased by resistors R112 and 113. Resistor R113 is connected to the −15 Vdc supply which biases on diodes CR30 and 31. This closes the dc current path for the emitter current of Q9 and also closes the tank circuit. The tank circuit consists of the crystal Y1, varactor diode CR33, the printed circuit board inductors and C86 and C89. The output frequency can be adjusted by the TB Adj R110 which controls the voltage across the varactor diode thereby changing the capacitance of the tank circuit. This tune voltage is applied through resistors R109, 115 and RF chokes L21 and 22. The output level is peaked by the 50 MHz Level Adj capacitor C86. Capacitors 83, 84, 90, 91, 92 and 97 are bypass capacitors.

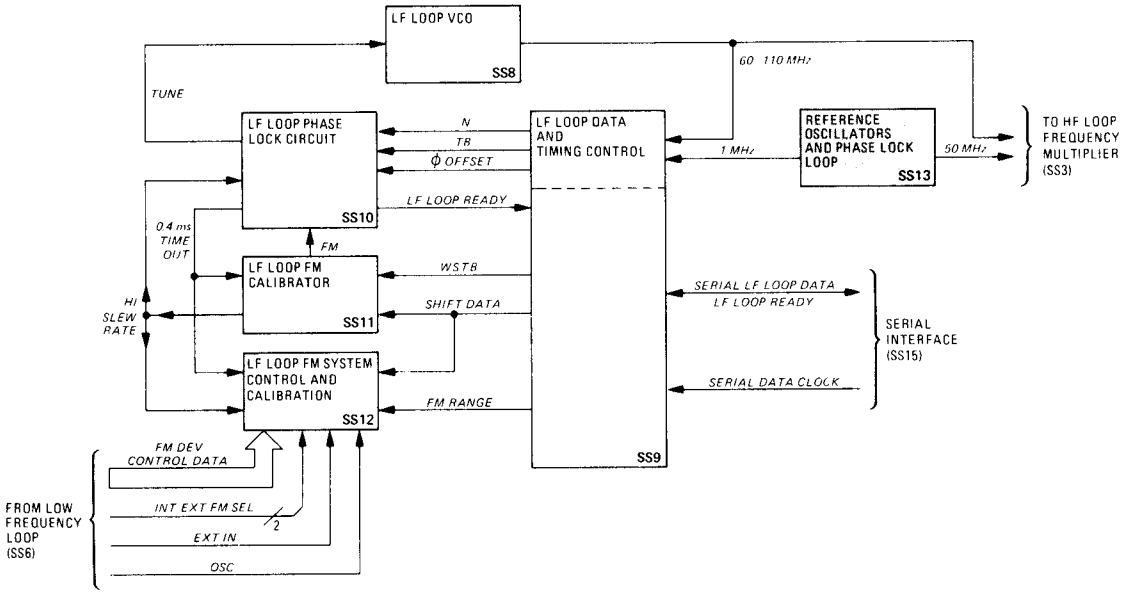
Time Base Divider

The output of the Reference Oscillator is ac coupled by C93 to the Frequency Multiplier Assembly shown on Service Sheet 3. The output is also ac coupled by capacitor C77 to common base Time Base Buffer Q12. The output of Q12 clocks the Divide-by-5 circuit U32A. Note that the set and reset inputs are all tied low. The output, 10 MHz at pin 4, is taken from bit 2. This provides two outputs for every ten clock pulse inputs.

The output of U32A clocks the Divide-by-ten circuit U29B. This divider is made up of a divide-by-2 and a divide-by-5 circuit. Like U32, the set and reset inputs are tied to ground. The outputs are 5 MHz at pin 15 and 1 MHz at pin 4.

One of the three divided output frequencies, 10, 5, or 1 MHz may be selected to phase lock the reference oscillator to an internal (Option 001) or external time base. The resistor jumper is shipped in the 10 MHz position and must be moved to the 5 or 1 MHz position depending on the frequency of the external time base. The Time Base Output follows the frequency selected by the jumper.

ManualsPlus.com



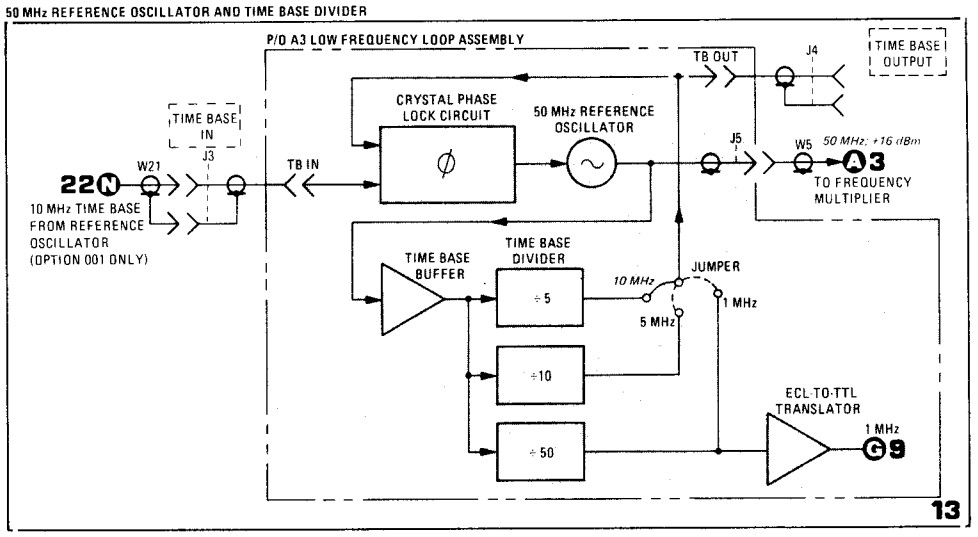
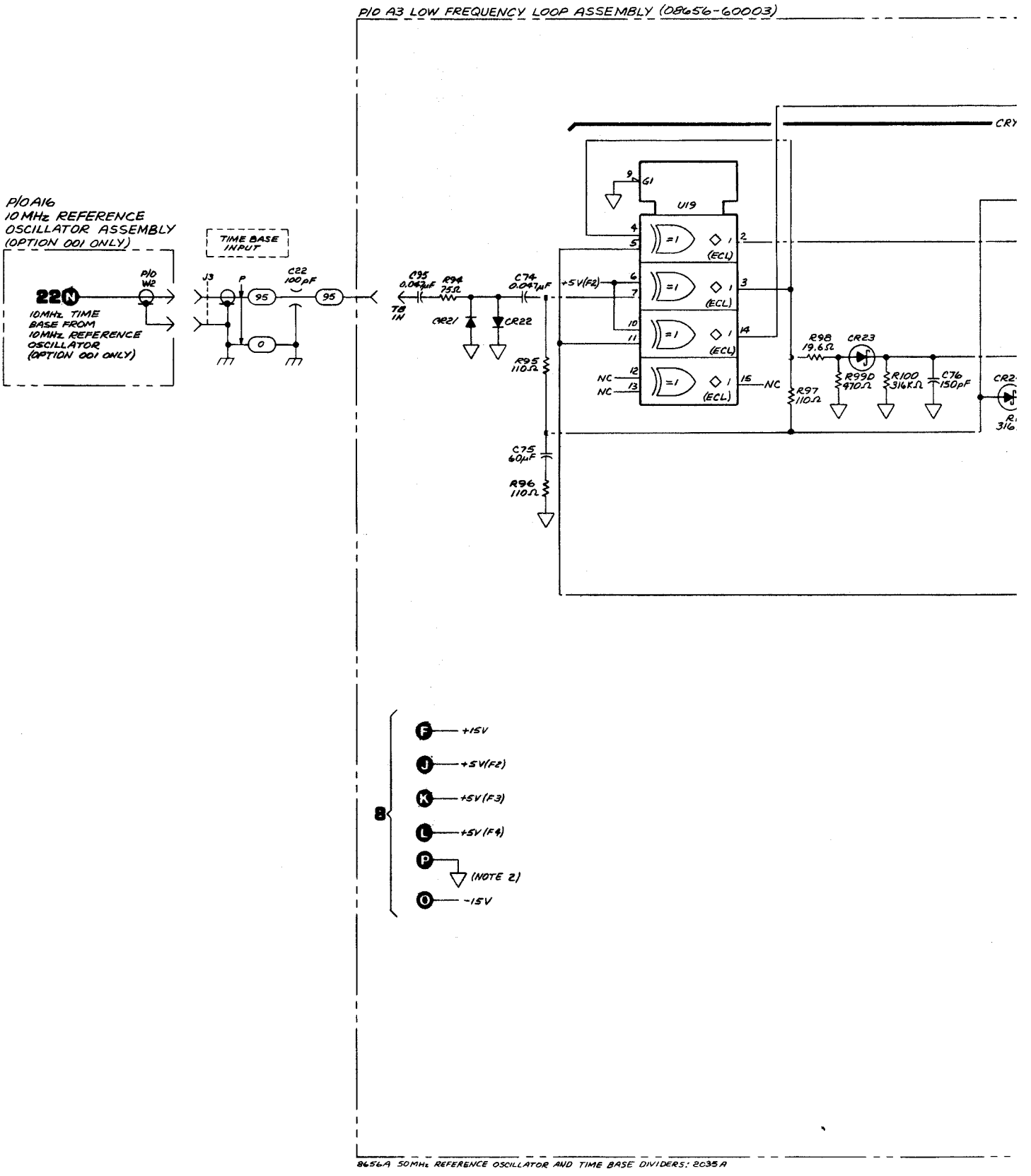
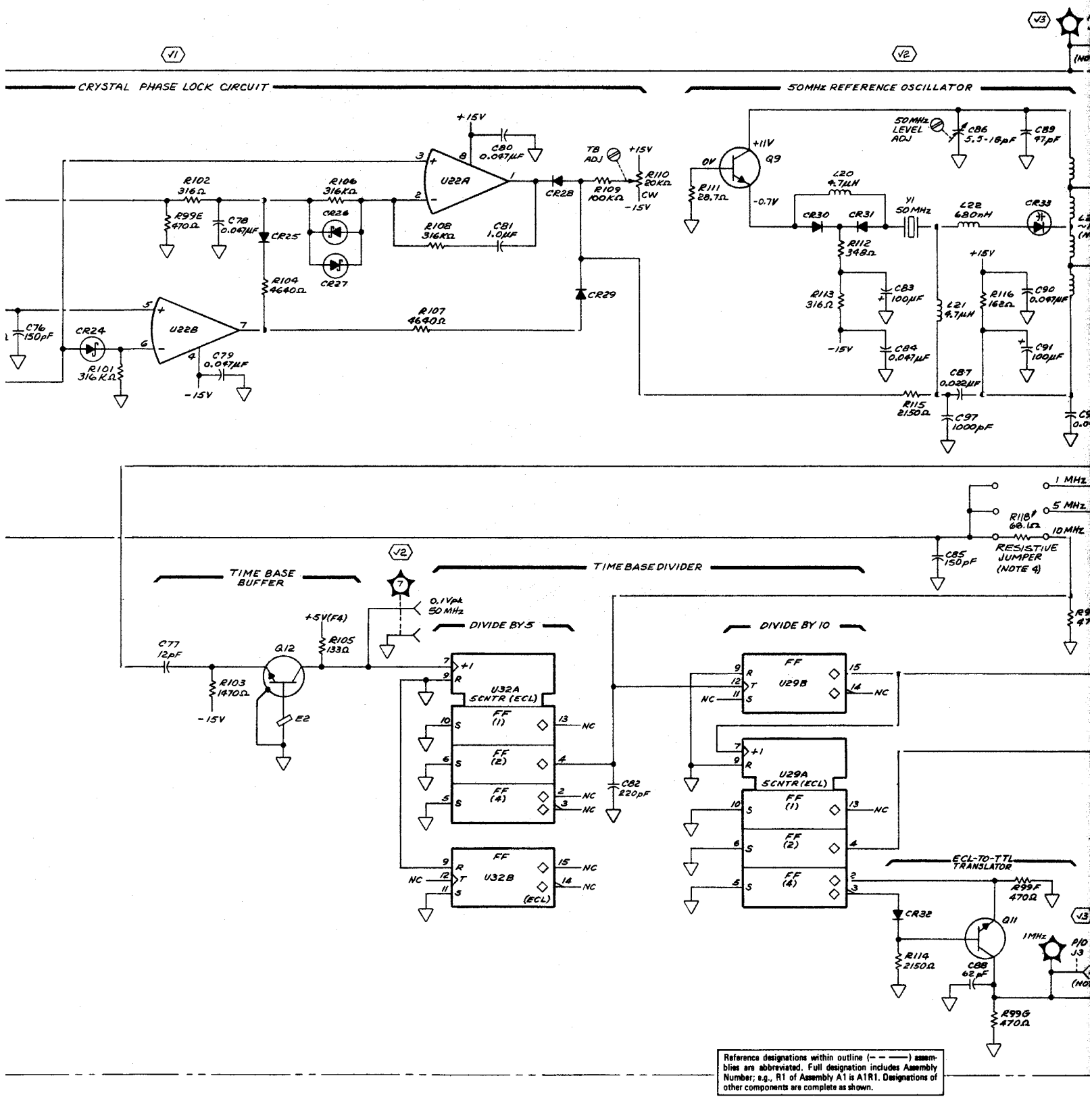


Figure 8-81. Reference Oscillator and Phase Lock Loop Block Diagrams

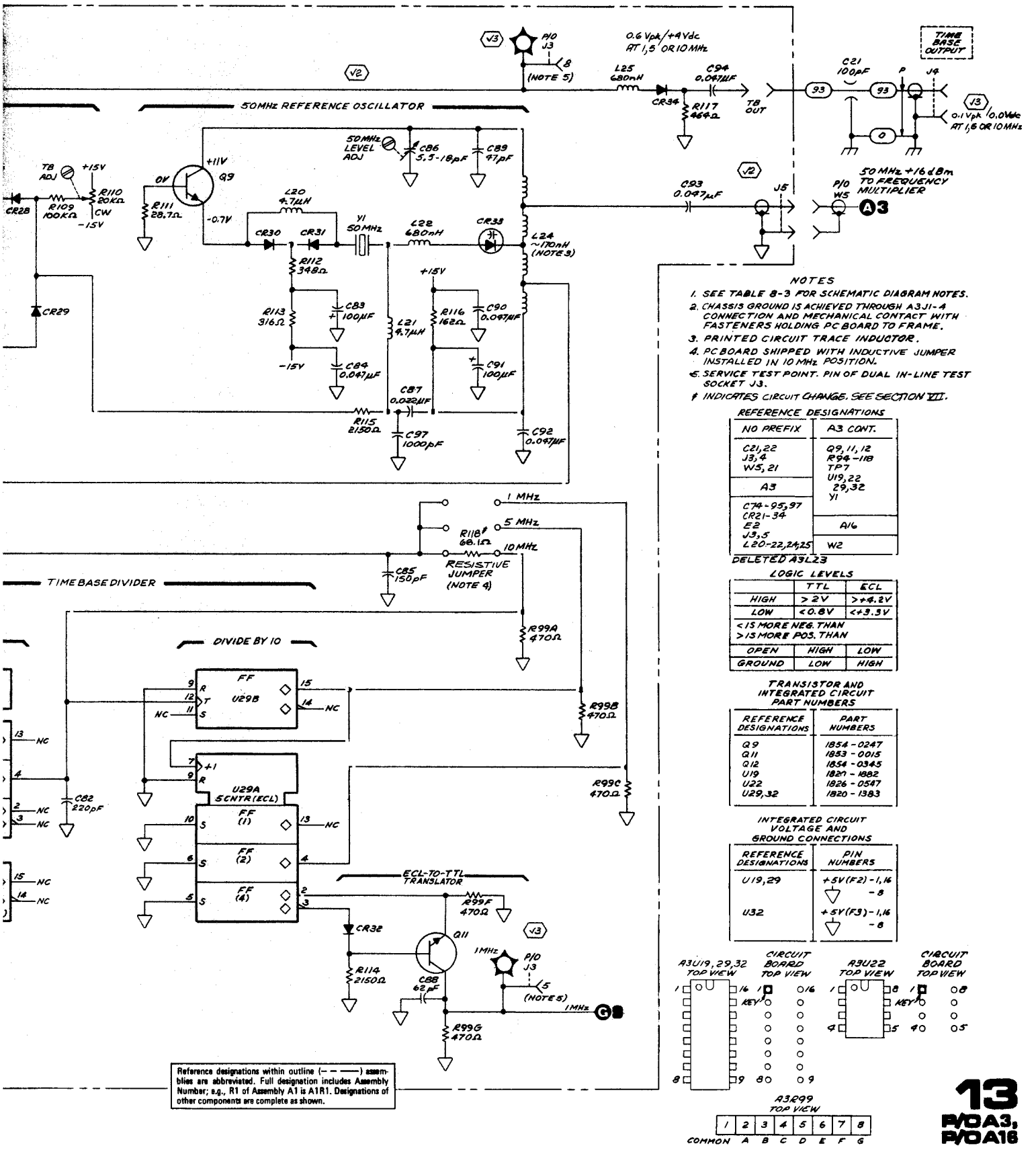
ManualsPlus.com



ManualsPlus.com



ManualsPlus.com



NOTES

1. SEE TABLE 8-3 FOR SCHEMATIC DIAGRAM NOTES.
2. CHASSIS GROUND IS ACHIEVED THROUGH A3J1-4 CONNECTION AND MECHANICAL CONTACT WITH FASTENERS HOLDING PC BOARD TO FRAME.
3. PRINTED CIRCUIT TRACE INDUCTOR.
4. PC BOARD SHIPPED WITH INDUCTIVE JUMPER INSTALLED IN 10 MHz POSITION.
5. SERVICE TEST POINT. PIN OF DUAL IN-LINE TEST SOCKET J3.

# INDICATES CIRCUIT CHANGE. SEE SECTION VII.

REFERENCE DESIGNATIONS

NO PREFIX	A3 CONT.
C21,22 J3,4 W5,21	Q9,11,12 R94-118 TP7 U19,22 29,32 Y1
A3	
C74-95,97 CR21-34 E2 J3,5 L20-22,24,25	A16 W2

DELETED A3L23

LOGIC LEVELS

	TTL	ECL
HIGH	> 2V	> +4.2V
LOW	< 0.8V	< +3.5V
< IS MORE NEG. THAN > IS MORE POS. THAN		
OPEN	HIGH	LOW
GROUND	LOW	HIGH

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATIONS	PART NUMBERS
Q9	1854-0247
Q11	1853-0015
Q12	1854-0345
U19	1821-1882
U22	1826-0547
U29,32	1820-1383

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATIONS	PIN NUMBERS
U19,29	+5V(F2)-1,16 -8
U32	+5V(F3)-1,16 -8

A3U19,29,32 TOP VIEW — CIRCUIT BOARD TOP VIEW — A3U22 TOP VIEW — CIRCUIT BOARD TOP VIEW

A3R99 TOP VIEW

1	2	3	4	5	6	7	8
COMMON	A	B	C	D	E	F	G

Reference designations within outline (– – ——) assemblies are abbreviated. Full designation includes Assembly Number; e.g., R1 of Assembly A1 is A1R1. Designations of other components are complete as shown.

13
P/O A3, P/O A16

Figure 8-82. Reference Oscillators and Phase Lock Loop Schematic Diagram

ManualsPlus.com

SERVICE SHEET 14 (Cont'd)

(IRQ). U31B is enabled at pin 4 through the open-collector driver U21B as long as rocker switch S1D is set for normal (NRM) operation.

Sequence Interrupt. A sequence interrupt (SQI) occurs when an active low switch closure is applied through the rear panel connector J5 and feedthrough capacitor A14C8 to connector A11J5 pin 3. This interrupt is handled in much the same manner as the keyboard interrupt. Normally with no interrupt present, U25B pin 4 will be pulled high through resistor R5. A 33 ms delay is produced by the RC network of R3 and C4 to debounce the leading edge of SQI. When a sequence interrupt occurs, it is gated through U25B pin 4 to direct-set flip-flop U29A causing the output at pin 6 to go low. This flip-flop latches the occurrence of the sequence interrupt. The latched sequence interrupt is gated through U25C and the enabled, 3-state buffer U31B to generate an interrupt request (IRQ). U31B is enabled at pin 4 through the open-collector driver U21B as long as rocker switch S1D is set for normal (NRM) operation.

When the switch closure is removed, U25B pin 4 will be pulled high as soon as capacitor C4 charges. The delay produced by the RC network of R5 and C4 debounces the trailing edge of SQI. Once the sequence interrupt is processed, the Microprocessor, will issue and decode hexidecimal address 01FB to clock U29A clear. Clearing U29A clears the sequence interrupt.

The Non-Maskable Interrupt signal (NMI) input to the Microprocessor (pin 6) is normally pulled high through resistor R10. During signature analysis troubleshooting, this edge-triggered line is momentarily grounded to abort normal program execution and to direct program execution to the non-maskable interrupt subroutine.

In addition to buffering the three maskable interrupts, the Status (Service Request) Register U10 also buffers five status lines which monitor various instrument conditions. These conditions include the setting of the front panel RESET/STBY/ON switch (refer to Service Sheet 18), the state of the LF Loop Ready (LFR) line (refer to Service Sheet 10) the state of the HI and LO lines from the Over and Under Modulation Comparators (refer to Service Sheet 6), and the state of the HP-IB Interrupt Request (IBI) line (refer to Service Sheet 17). During normal program execution, the Microprocessor issues and decodes hexidecimal address 01FC to strobe the contents of U10 onto the data bus. If one of these five conditions is active when the Microprocessor strobes U10, it will execute the necessary instructions to service that condition.

+5V Supply Filtering

Capacitors C1, C3, C6 through C9, C11 through C15, and C17 through C19 are used to filter the +5V supply to the Microprocessor/Memory/HP-IB - A11 circuitry.

TROUBLESHOOTING USING SIGNATURE ANALYSIS

Troubleshooting is done on the circuits of Service Sheet 14 when a defect seems to be related to the Microprocessor. The only troubleshooting information provided is signature analysis. If nothing definite is discovered in performing these checks, refer to Service Sheet 16 (ROM and RAM test) or consider the other possiblities listed on Service Sheet BD4.

Test Equipment

Signature Analyzer .....HP 5004A

Test 1. Address Check

Purpose. Verify ability of the Microprocessor to run through entire address range.

Setup. Connect the signature analyzer as follows:

1) GND to 'GND' A11TP2
2) CLK to 'E' A11TP11
3) START to 'ADR 15' A11TP4
4) STOP to 'ADR 15' A11TP4

Set the signature analyzer's controls as follows:

1) START-IN
2) STOP-OUT
3) CLK-IN

Set up the Signal Generator as follows:

1) The TEST/NRM switch P/O A11S1 to TEST.
2) The ROM/NRM switch P/O A11S1 to ROM.

Probe. Connect the probe to the node indicated in Table 1. Verify that each signature is correct and stable.

After the signatures are taken, reset the TEST/NRM switch to NRM and the ROM/NRM switch to NRM position.

ManualsPlus.com

Microprocessor will finish executing its current instruction before program execution is directed to the respective interrupt subroutine.

Maskable interrupts occur whenever a key on the keyboard is pressed, a reverse power condition is detected, or an active low switch closure is applied through the rear panel sequence connector J5. Whenever one of these conditions is detected and latched the Interrupt Request signal input to the Microprocessor (IRQ at pin 4) will be forced active (low). The Microprocessor will then issue and decode hexidecimal address 01FC so that it can examine the contents of the Status (Service Request) Register U10 via the data bus to determine which one of the three maskable interrupts has occurred. U10 is hard-wired (pin 11 tied high) to function as a 3-state buffer. During program execution of the maskable interrupt subroutine, the Microprocessor first checks for a reverse power interrupt (D7 active low), then a sequence interrupt (D1 and D2 active low), and finally a keyboard interrupt (D2 active low). The methods used to detect and latch the three maskable interrupts are discussed in the following paragraphs.

Keyboard Interrupt. Whenever one of the keys on the Keyboard Assembly - A1 is pressed, a keyboard interrupt (KIN) is detected by the circuitry on the Display Assembly - A2 and issued to the Microprocessor/Memory/HP-IB Assembly - A11 (refer to Service Sheet 18). This active low interrupt is applied to connector J5 at pin 14. It is gated through U25D and U25B to direct-set flip-flop U29A causing the output at pin 6 to go low. This Flip-Flop debounces the leading edge of KIN and latches the occurrence of the keyboard interrupt. The latched keyboard interrupt is gated through U25C and the enabled, 3-state buffer U31B to generate an interrupt request (IRQ). U31B is enabled at pin 4 through the open-collector driver U21A as long as rocker switch S1D is set for normal (NRM) operation.

When the key is released, KIN will be high and U25D pin 12 will be pulled high by resistor R1. After an approximate 33 ms delay produced by the RC network of R2 and C2, capacitor C2 will charge to pull U25D pin 13 high. This delay debounces the trailing edge of KIN. Once the keyboard interrupt is processed, the Microprocessor will issue and decode hexidecimal address 01FB to clock U29A clear. Clearing U29A clears the keyboard interrupt.

Reverse Power Interrupt. A reverse power interrupt (RPI) occurs when a reverse power condition is detected and latched by the reverse power sense circuitry on the Output Assembly - A6 (refer to Service Sheet 7). This active low interrupt is applied through the LC filter of L7 and C7 on the RFI Assembly - A7 and the feedthrough capacitor C16 to connector A11J5 pin 10. Normally with no interrupt present, U25C pin 10 is pulled high through resistor R8. When a reverse power interrupt occurs, it is gated through U25C and the enabled tri-state buffer U31B to generate an interrupt request

ManualsPlus.com

tion, the two enable inputs of U18 (pins 1 and 19) will be pulled high to disable its outputs. During ROM testing, S1D is set to ROM to enable the outputs of U18 which places the hard-wired NOP instructions on the data bus. U14 is disabled during this time because its enable input (pin 19) is pulled high through resistor R9D and the input to U21A is pulled low. Disabling U14 inhibits the NOP instruction from being transferred to any circuitry but the Microprocessor.

Restart Circuitry

Three methods are employed to reset or halt the Microprocessor. They occur:

1. During power-up initialization.

2. During manual operation via the front panel RESET/STBY/ON switch A1S49.

3. During service via rocker switch S1A.

During normal operation, rocker switch S1A is set to RUN. With S1A in this position, the RC network of R4 and C5 will begin to charge as soon as Mains power is applied and the +5V supply comes up. Zener diode VR1 will begin to conduct as soon as the charge across C5 reaches +4.22V. When VR1 conducts, transistor Q1 will be biased on to pull the input to the monostable U28 (pin 1) low. Resistors R6 and R7 set the bias conditions for Q1. With U28 pin 1 low, the output at pin 6 will go low for 30 ms to reset the Microprocessor. Capacitor C10 is used to set the pulse timing for U28. When the Microprocessor is reset, it will enter its power-up subroutine to initialize the instrument. The Schottky diode CR1 across R4 causes the RC network to quickly discharge in the event of a power supply transient. Once the power supply has recovered, another reset will be issued to initialize the instrument. Similarly, if the +5V supply voltage drops below +4.22V, Q1 will be biased off to halt the Microprocessor through the open-collector inverter U21E.

The Microprocessor can also be manually halted and reset by the front panel RESET/STBY/ON switch A1S49 (refer to Service Sheet 18). When A1S49 is momentarily set to RESET, the base of Q1 will be forced low. This will bias Q1 off to halt the Microprocessor through U21E. When A1S49 is released, Q1 is again biased on to initiate another 30 ms Microprocessor restart operation.

In much the same manner, rocker switch S1A can be manually set to cause the Microprocessor to halt. When S1A is set to the HLT/RST position, Q1 will be biased off to halt the Microprocessor through U21E. When S1A is set to RUN, Q1 will be biased on to initiate another 30 ms Microprocessor reset operation.

Interrupt Processing

As previously mentioned, there are two methods employed to interrupt normal program execution, namely maskable, and non-maskable interrupts. When either type of interrupt is detected, the

ManualsPlus.com

is used for the signature analyzer's signature analysis subroutine. For additional information on how this line is controlled, refer to the discussion on Interrupt Processing.

Maskable Interrupt Request. The Maskable Interrupt Request signal input to the Microprocessor (IRQ at pin 4) is the other signal used to interrupt program execution. When IRQ is active (low) and the interrupt mask bit of the internal condition code register is not set, the Microprocessor will finish executing its current instruction. Then its internal program counter will be loaded with the contents of hexidecimal memory locations FFF8 and FFF9. These contents direct program execution to the maskable interrupt subroutine. For additional information on how this line is controlled, refer to the discussion on Interrupt Processing.

Data Bus Buffering

Data is transferred positive-true to and from the Microprocessor on the bidirectional, 8-bit data bus. Information on the data bus is buffered as it leaves or enters the Microprocessor. The 3-state, bidirectional Data Bus Buffers U14 provides this asynchronous, two-way communication between the data bus and the Microprocessor. During normal operation, rocker switch S1D is set to NRM. With S1D in this position, the enable input of U14 (pin 19) will be pulled low through the open-collector inverter U21A. The enable input of the 3-state buffer U31B is also pulled low through U21A (refer to the discussion on Interrupt Processing).

The direction of data transfer through U14 is controlled by the state of the buffered read/write line from the Microprocessor. When the direction input of U14 (pin 1) is high, information will be transferred from the data bus to the Microprocessor (a "read" operation). When this input is low, information will be transferred from the Microprocessor to the data bus (a "write" operation).

Sixteen bits of serial keyboard data are transferred from the storage registers on the Display Assembly - A2 to the Microprocessor via bit 0 of the data bus (refer to Service Sheet 18). During program execution of the keyboard read subroutine, the Keyboard Serial Data Bus Buffer U31D will be enabled to couple the serial keyboard data to the bit 0 input of U14. Buffer enabling occurs when the Microprocessor issues and decodes hexidecimal address 01FA (refer to Service Sheet 15).

One of the service features of this instrument is the hard-wired NOP (no operation) instruction. This 8-bit instruction is used to step the Microprocessor through its ROM addresses during ROM testing or troubleshooting. When the Microprocessor receives a NOP instruction, its program counter will be advanced once for each clock cycle without affecting any other operations. The eight inputs to the 3-state buffer U18 are hard-wired in a configuration to provide the NOP instruction to the Microprocessor, that is, bit D0 is tied high and bits D1 through D7 are tied low (00000001). During normal operation, rocker switch S1D is set to NRM. With S1D in this posi-

ManualsPlus.com

SERVICE SHEET 14 (Cont'd)

System Clock. An external 4 MHz crystal Y1 is directly connected to the Microprocessor (pins 38 and 39). An internal divide-by-4 circuit is used to develop the 1 MHz system clock E (pin 37). Capacitors C16 and C22 are used to keep the clock frequency stable. This clock signal is buffered by one of the Microprocessor Control Line Buffers U16 to enable the decoding of those addresses that produce the level and modulation, attenuator, and serial I/O control strobes (refer to Service Sheet 15). In addition, this buffered clock signal enables the decoding and selection of ROM and RAM memory locations (refer to Service Sheet 16) and clocks the HP-IB General Purpose Interface Adapter U19 (refer to Service Sheet 17).

Memory Ready. The Memory Ready signal input to the Microprocessor (MR at pin 3) is tied high to enable the 1 MHz system clock rate.

RAM Enable. The RAM Enable signal input to the Microprocessor (RE at pin 36) is directly tied to the +5V supply to power the 128 bytes of internal RAM. These bytes are addressed at hexidecimal memory locations 0000 through 007F.

Standby. The Standby signal input to the Microprocessor (STBY at pin 35) is directly tied to the +5V supply to separately power the first 32 bytes of internal RAM. These bytes are addressed at hexidecimal memory locations 0000 through 001F.

Halt. The Halt signal input to the Microprocessor (HALT at pin 2) is used to halt program execution. When HALT is active (low), the Microprocessor will finish executing its current instruction, the address bus will remain fixed at the address of the next instruction, and all 3-state lines will go to their high impedance state (including the data bus). Program execution will continue when HALT goes inactive (high). For additional information on how this line is controlled, refer to the discussion on Restart Circuitry.

Reset. The Reset signal input to the Microprocessor (RESET at pin 40) is used to start the Microprocessor from a power-down condition. This condition exists during initial start-up of the instrument, after a power failure has occurred and when the front panel switch has been momentarily set to RESET. When RESET is active (low), the Microprocessor becomes inactive. When RESET is inactive (high), the internal program counter will be loaded with the contents of hexidecimal memory locations FFFE and FFFF. These contents direct program execution to the power-up subroutine. For additional information on how this line is controlled, refer to the discussion on Restart Circuitry.

Non-Maskable Interrupt. The Non-Maskable Interrupt signal input to the Microprocessor (NMI at pin 6) is one of two signals used to interrupt program execution. When NMI is active (low), the Microprocessor will finish executing its current instruction, save its current status, and then its internal program counter will be loaded with the contents of hexidecimal memory locations FFFC and FFFD. These contents direct program execution to the non-maskable interrupt subroutine. For this Signal Generator, the non-maskable interrupt

ManualsPlus.com

SERVICE SHEET 14
P/O A11 MICROPROCESSOR/MEMORY/HP-IB ASSEMBLY

TROUBLESHOOTING HELP

Service Sheet BD4
Table 4-1. Abbreviated Performance Tests
Table 5-2. Post-Repair Adjustments

PRINCIPLES OF OPERATION

Microprocessor

Instrument functions are controlled by the Microprocessor U13 as it executes the program instructions stored in ROM (read only memory). The function of the Microprocessor's data bus, address bus, and each of its input/output lines is discussed in the following paragraphs.

Data Bus. The data bus (D0 through D7) consists of eight bidirectional lines which are used to transfer an 8-bit positive-true data byte to and from the Microprocessor (pins 26 through 33). The 3-state lines can be high, low, or at the high impedance state depending on the individual data bit or its buffering conditions. The Microprocessor reads data from memory, the keyboard, its HP-IB interface, and so forth under program control via the data bus. Data is written onto the data bus for the displays, RF and modulation circuitry, and so forth. Information on the data bus is buffered as it enters or leaves the Microprocessor. For additional information, refer to the discussion on Data Bus Buffering.

Read/Write Control. The Read/Write signal from the Microprocessor (R/W at pin 34) is used to control the direction of data transfer on the data bus. When the Microprocessor is halted or available to accept data, this signal will be high indicating that the Microprocessor is in the "read" state. When data is being transferred out onto the data bus, this signal will be low indicating that the Microprocessor is in the "write" state. This signal is buffered by one of the Microprocessor Control Line Buffers U16 to control the direction of data transfer through the Data Bus Buffers U14, to or from RAM (Read/Write) memory (refer to Service Sheet 16), and to or from the HP-IB Interface Buffers U15 (refer to Service Sheet 17).

Address Bus. The address bus (A0 through A15) consists of sixteen unidirectional lines which are used to transfer a 16-bit positive-true address from the Microprocessor (pins 9 through 20 and 22 through 25). Information on the address bus is buffered as it leaves the Microprocessor. These buffered address bits are decoded to produce level and modulation, attenuator, and serial I/O control strobes (refer to Service Sheet 15). In addition, these buffered address bits are decoded to select one of 256 external RAM memory locations, one of 12,288 ROM memory locations (refer to Service Sheet 16), or one of the HP-IB General Purpose Interface Adapter U19 ports (refer to Service Sheet 17).

Valid Memory Address. The Valid Memory Address signal from the Microprocessor (VMA at pin 5) is used to indicate that a valid address is on the address bus. When VMA is active (high), the information on the address bus will be valid. This signal is buffered by one of the Microprocessor Control Line Buffers U16 to enable decoding of those addresses that produce the level and modulation, attenuator, and serial I/O control strobes (refer to Service Sheet 15). In addition, this buffered signal enables the decoding and selection of ROM and RAM memory locations (refer to Service Sheet 16).

ManualsPlus.com

SERVICE SHEET 14 (Cont'd)

Table 1. Microprocessor Address Signatures

Node	Correct Signature	Comments
+5V U13 #35	0001	Address
A0 U13 #9	5555	Lines
A1 U13 #10	CCCC	
A2 U13 #11	7F7F	
A3 U13 #12	5H21	
A4 U13 #13	0AFA	
A5 U13 #14	UPFH	
A6 U13 #15	52F8	
A7 U13 #16	HC89	
A8 U13 #17	2H70	
A9 U13 #18	HPPO	
A10 U13 #19	1293	
A11 U13 #20	HAP7	
A12 U13 #22	3C96	
A13 U13 #23	3827	
A14 U13 #24	755U	
*A15 U13 #25	0000	
+5V	0001	Buffered
A0 J4 #2	5555	Address
A1 J4 #3	CCCC	Lines
A2 J4 #4	7F7F	
A3 J4 #5	5H21	
A4 J4 #6	0AFA	
A5 J4 #7	UPFH	
A6 J4 #8	52F8	
A7 J4 #9	HC89	
A8 J4 #10	2H70	
A9 J4 #11	HPP0	
A10 J4 #12	1293	
A11 J4 #13	HAP7	
A12 J4 #14	3C96	
A13 J4 #15	3827	
A14 J4 #16	755U	
*A15 J2 #5	0000	

*Even though the signature equals zero, the probe tip should blink.

Test 2. Data Bus Verification

Purpose. To test the Microprocessor and circuit board digital logic.

Setup. Connect the signature analyzer as follows:

1) GND as close to circuitry being probed as possible (bad grounding can cause unstable signatures).
2) CLK to 'E' A11TP11
3) START to 'SA1' A11TP5
4) STOP to 'SA2' A11TP6

Set the signature analyzer controls as follows:

1) START-OUT
2) STOP-IN
3) CLK-IN

Set up the Signal Generator as follows:

1) Disconnect the attenuator cable W17 from the power supply board to the attenuator.
2) Set the LOGIC/RAM switch P/O A11S1 to LOGIC.

NOTE

If the Signal Generator's address switch has been set to other than '07', the signatures taken in this test will be incorrect. In this case, reset the address switches to A1=1, A2=1, A3=1, A4=0 and A5=0. Then set the front panel RESET-STBY-ON switch to RESET and back to ON. Refer to Service Sheet 17 for location of the address switches.

Initialize. Briefly short A11TP3 'NMI' to ground.

NOTE

With careless probing it is possible to get the Microprocessor into a program sequence other than that portion intended for signature analysis. If the +5V signature is incorrect, this has probably happened. Restart the test by setting the 'RST/RUN' switch to 'RST' and then 'RUN'. Briefly touch the 'NMI' test point to ground.

Probe. Connect the probe to the node indicated in Table 2. Verify that each signature is correct and stable.

NOTE

If the signatures in the first portion of the following table are incorrect, the signatures for the second portion will also be incorrect.

ManualsPlus.com

SERVICE SHEET 14 (Cont'd)

Table 2. Microprocessor Data Bus Signatures

Node	Correct Signature	Comments
+5V	H6H5	
*D0 U13 #33	75HI	Data Bus
D1 U13 #32	2H55	Signatures
D2 U13 #31	197C	are
D3 U13 #30	0926	subject to
D4 U13 #29	4F62	setting of
D5 U13 #28	52U5	HP-IB
D6 U13 #27	088H	address
D7 U13 #26	3001	switches.
+5V	H6H5	Buffered
*D0 J2 #16	4U4A	Data Bus
D1 J2 #15	A132	Signatures
D2 J2 #14	1A47	are
D3 J2 #13	4989	subject to
D4 J2 #12	5586	setting of
D5 J2 #11	307C	HP-IB
D6 J2 #10	0F11	address
D7 J2 #9	8130	switches.

*This signature may vary from unit-to-unit due to differences in one-shot timing of A2U28B. If SA6 A11TP10 is connected to SA7 A2TP15, the signature should read the same as above.

Reset the LOGIC/RAM switch to the RAM position. Reconnect attenuator cable W17.

NOTE

If the HP-IB address switch was changed, reset the address switch (Service Sheet 17) to the original address. Set the front panel RESET-STBY-ON switch to RESET and back to ON.

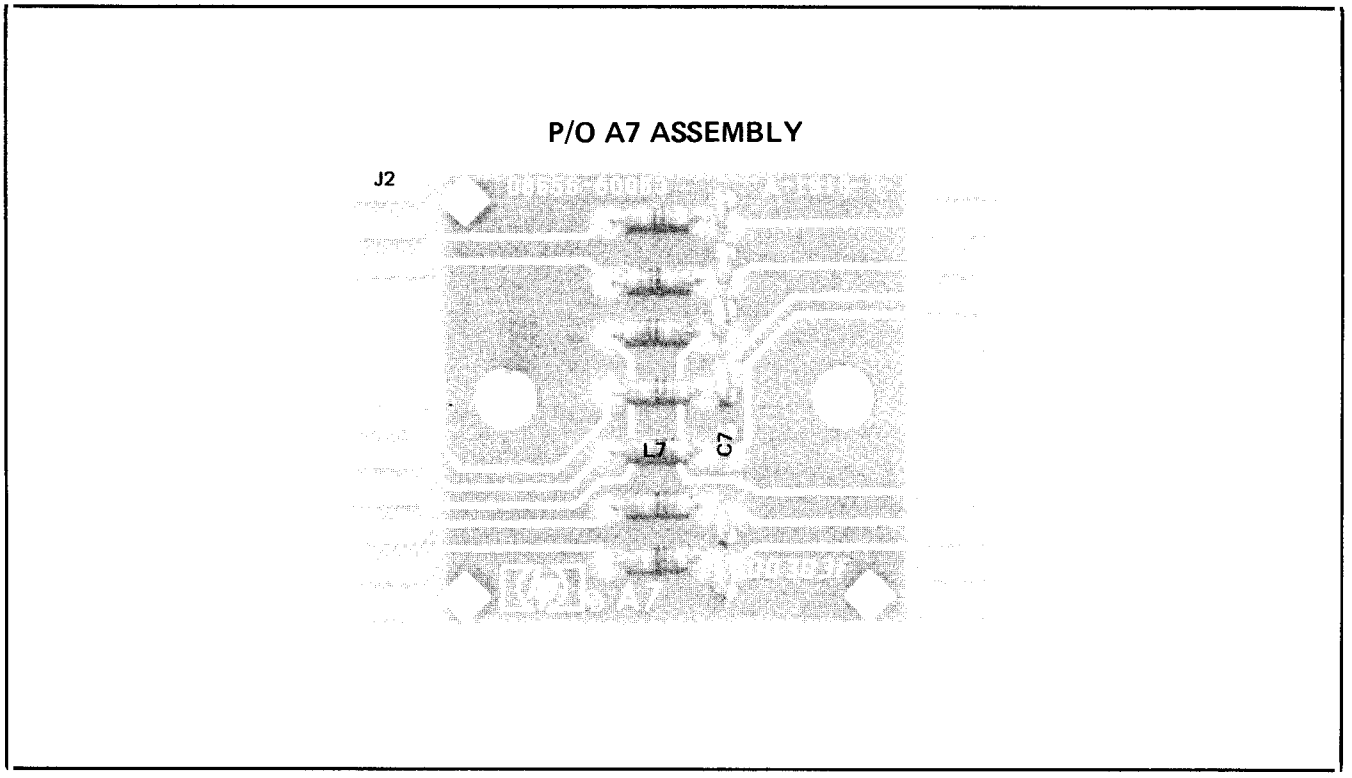


Figure 8-83. A7 Assembly Interrupt Input Component Locations

ManualsPlus.com

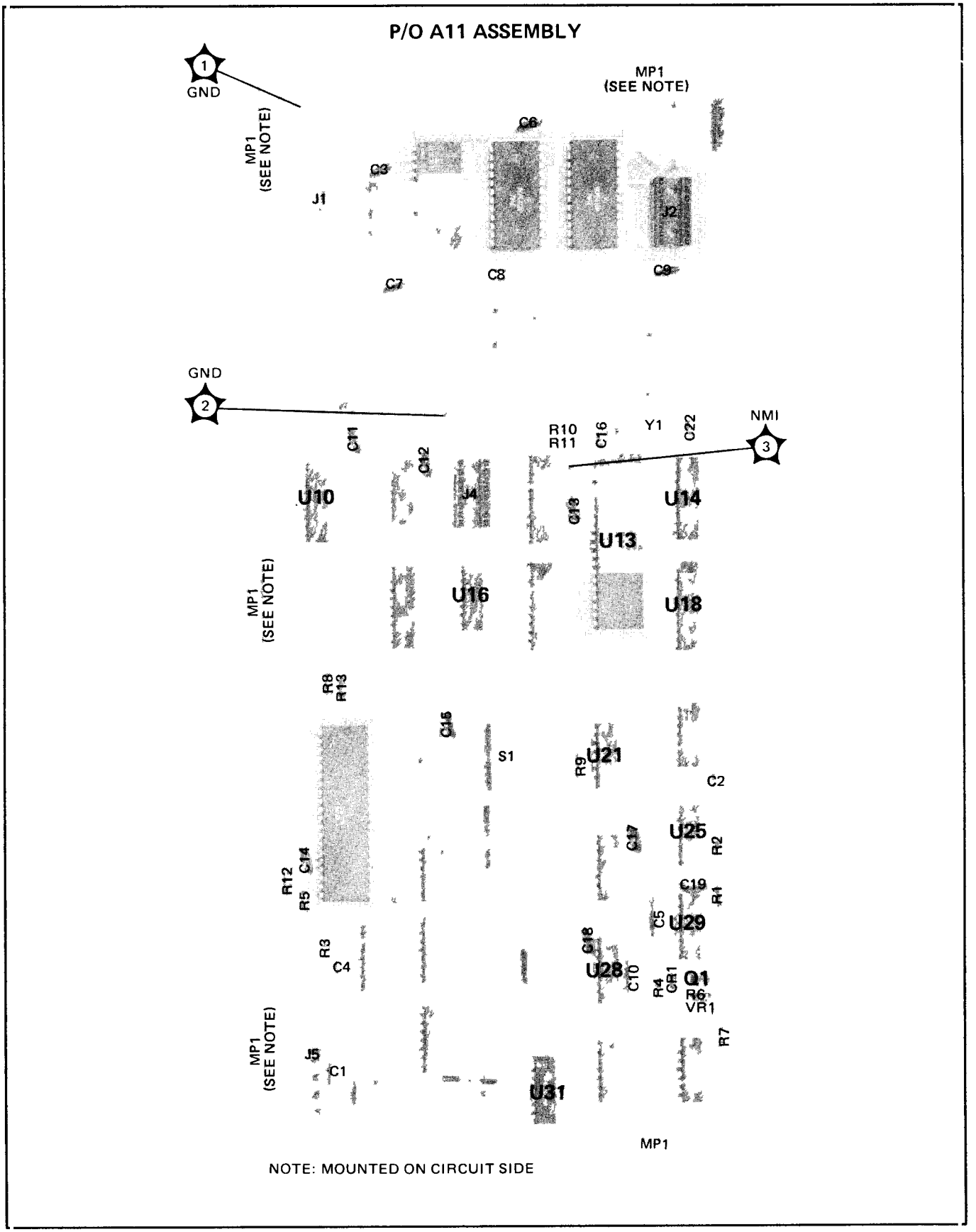
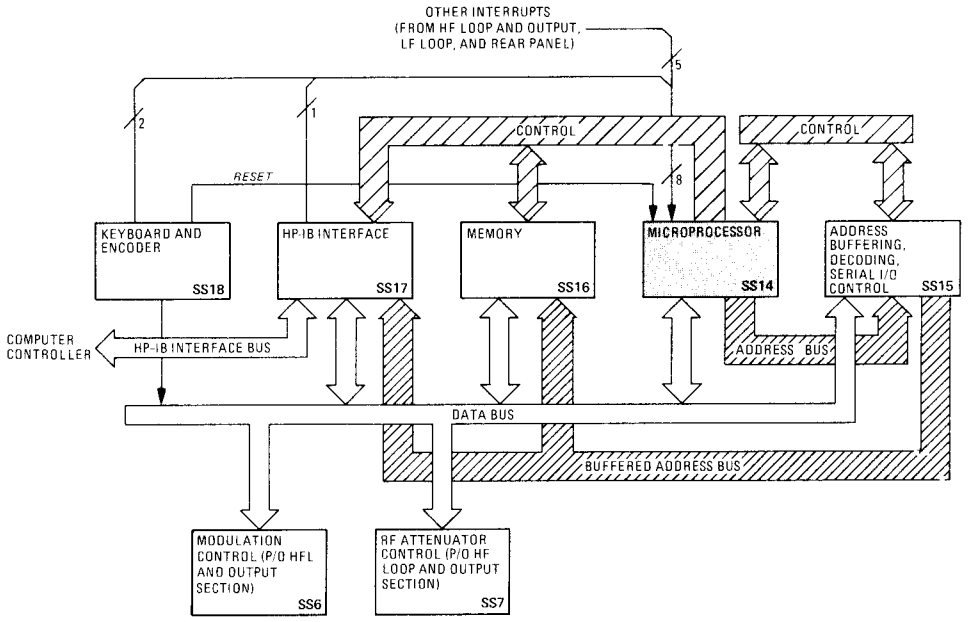


Figure 8-84. Microprocessor, Interrupt Processing and Restart Component Locations

ManualsPlus.com



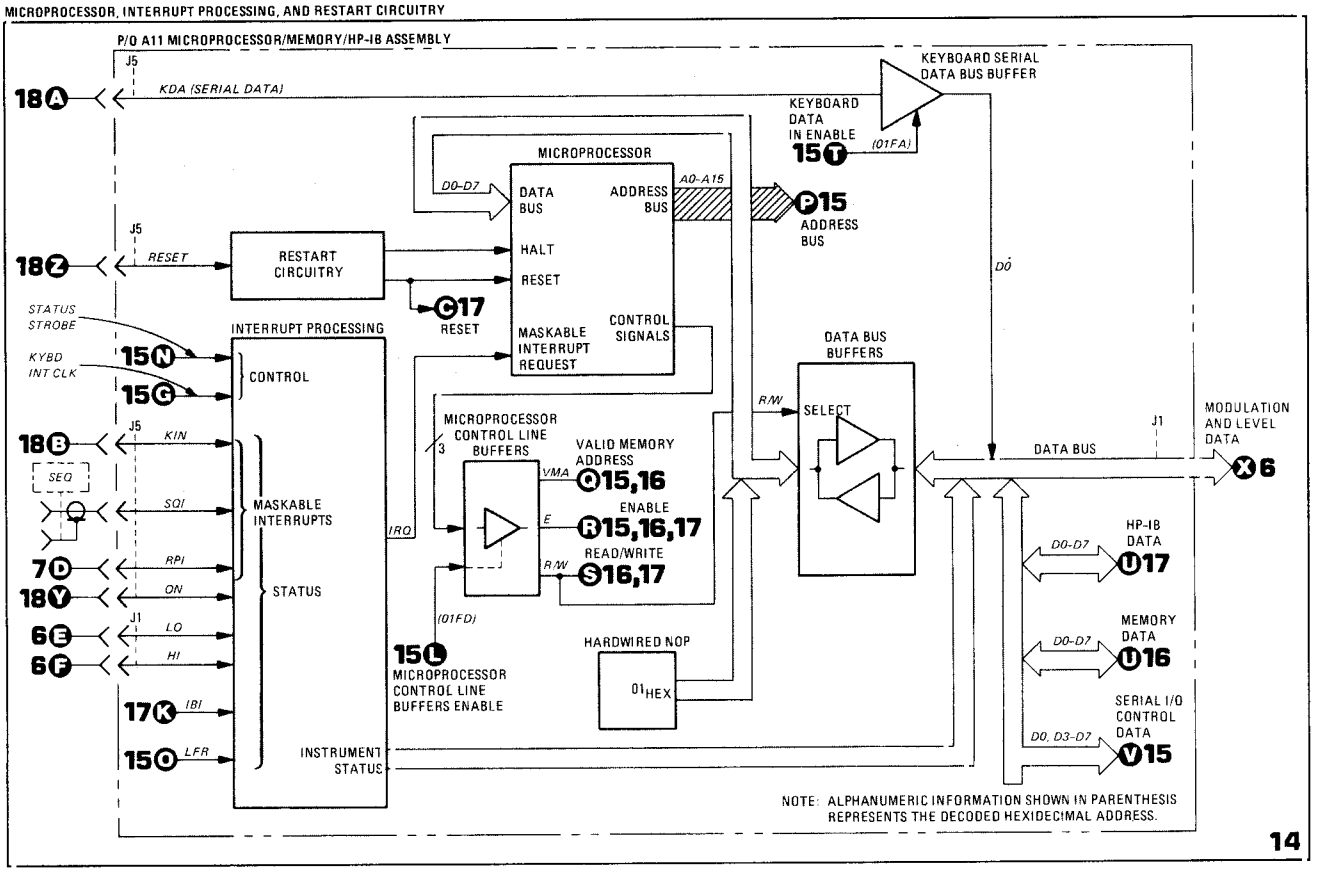
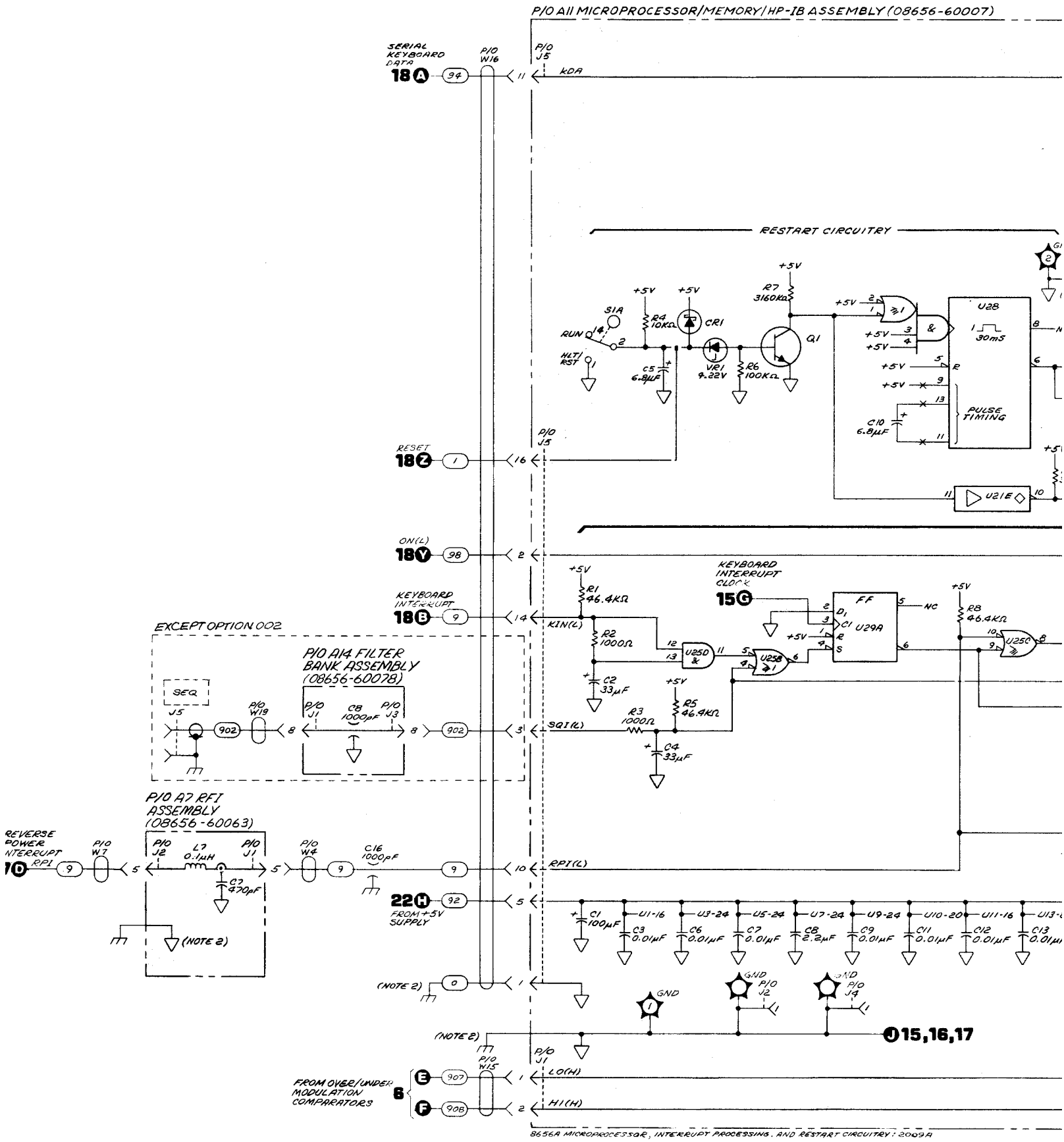
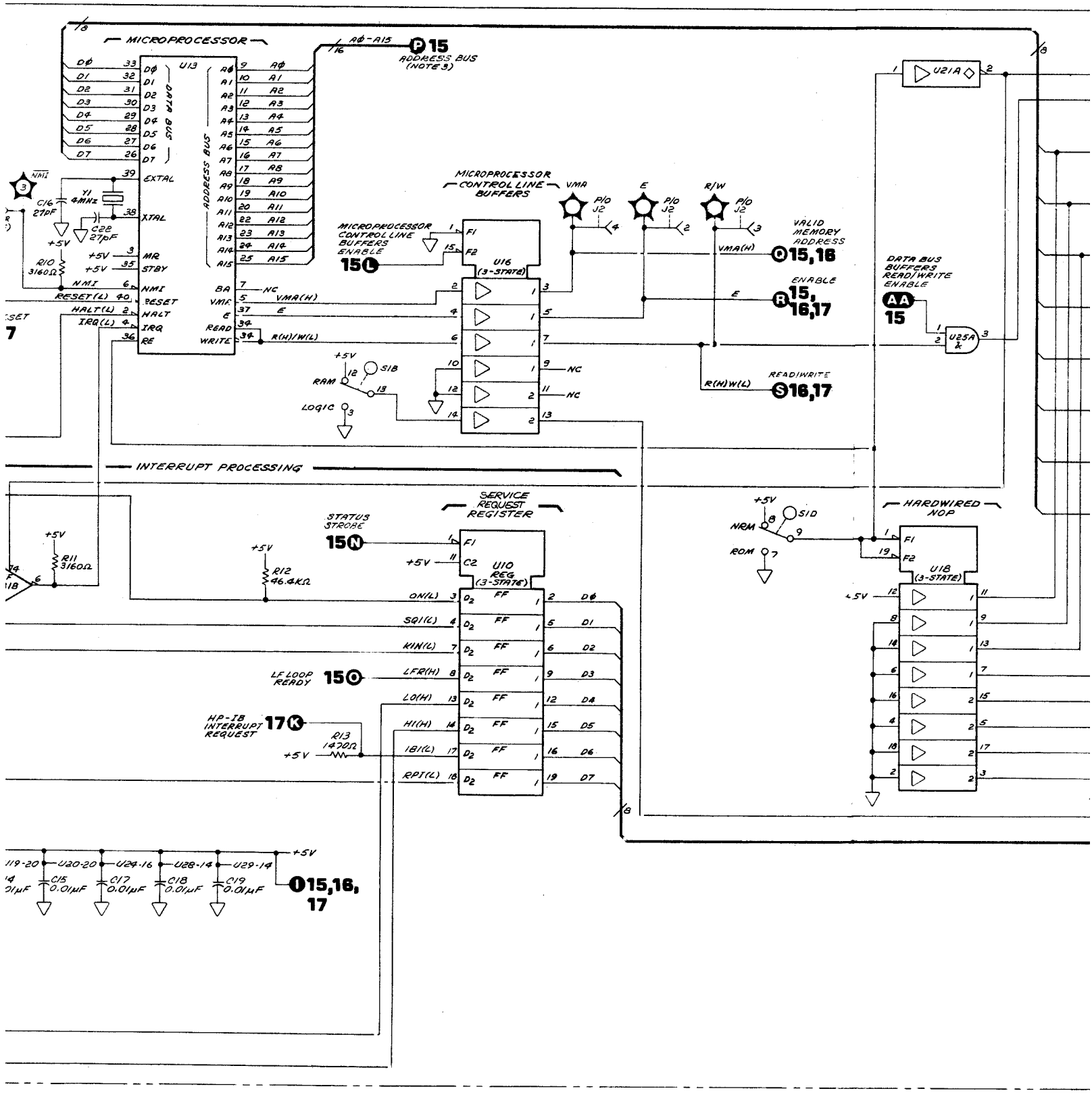


Figure 8-85. Microprocessor, Interrupt Processing and Restart Block Diagrams

ManualsPlus.com



ManualsPlus.com



ManualsPlus.com

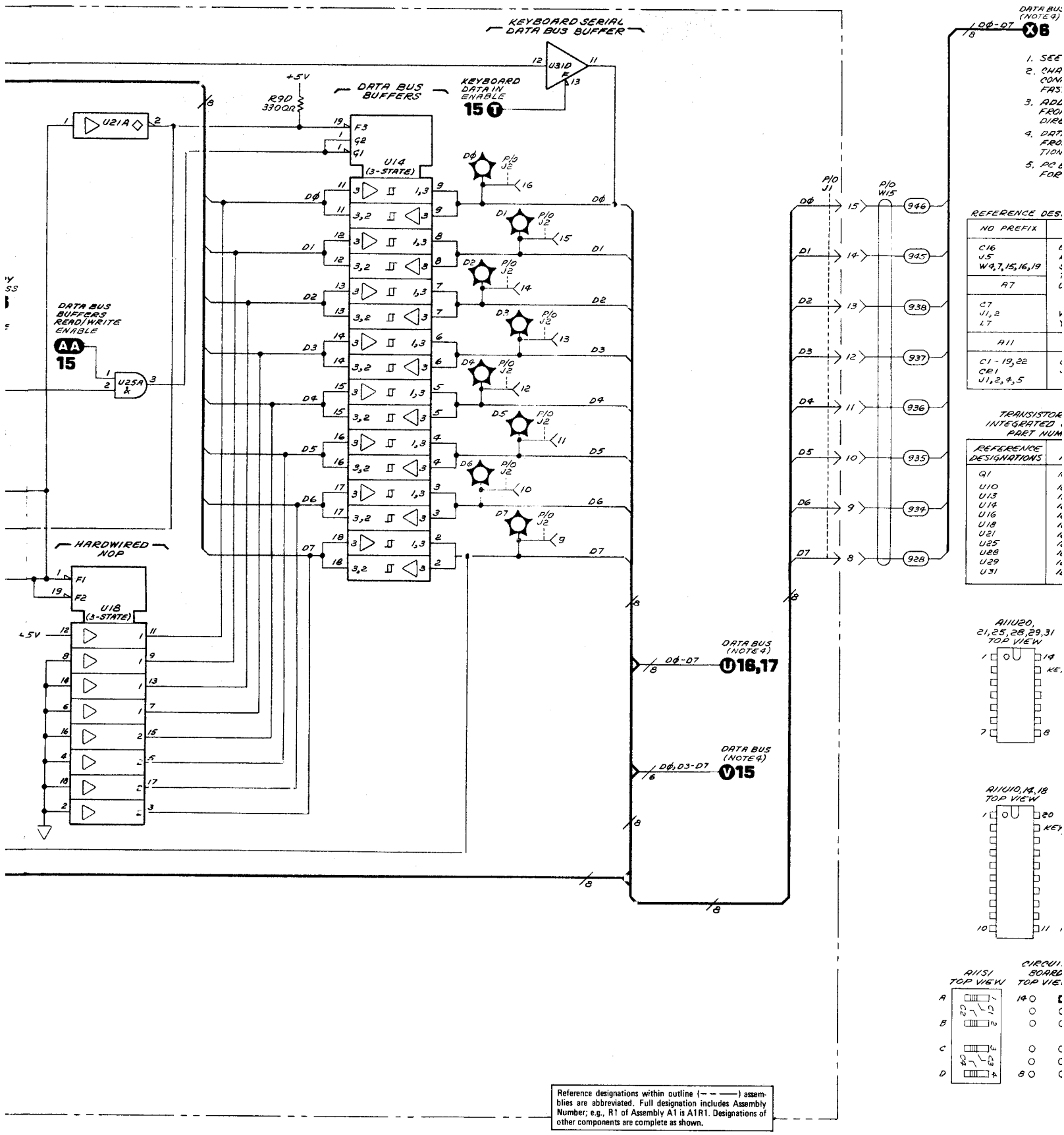
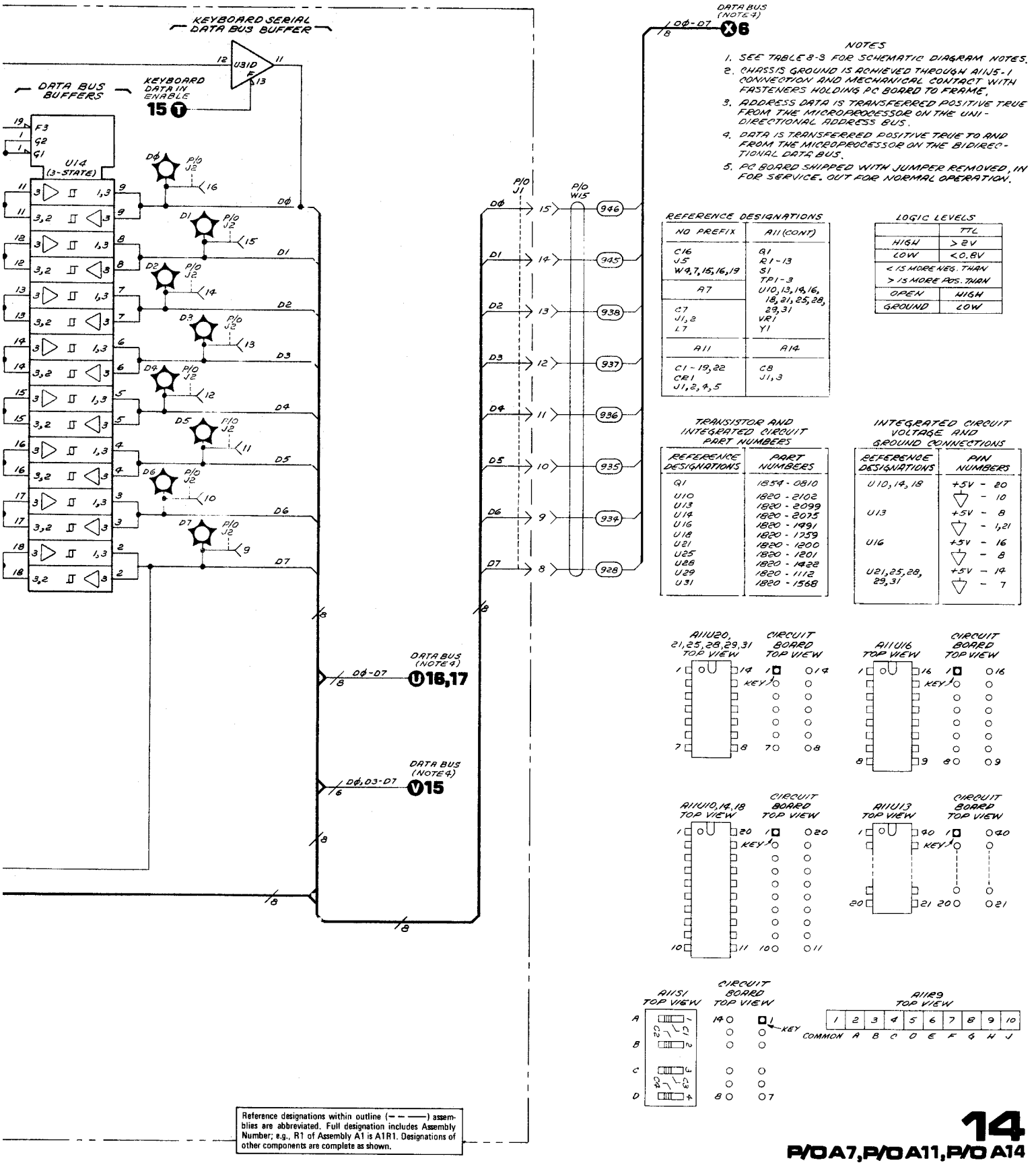


Figure 8-86. Microprocess

ManualsPlus.com



14

P/O A7, P/O A11, P/O A14

Figure 8-86. Microprocessor, Interrupt Processing and Restart Schematic Diagram

ManualsPlus.com

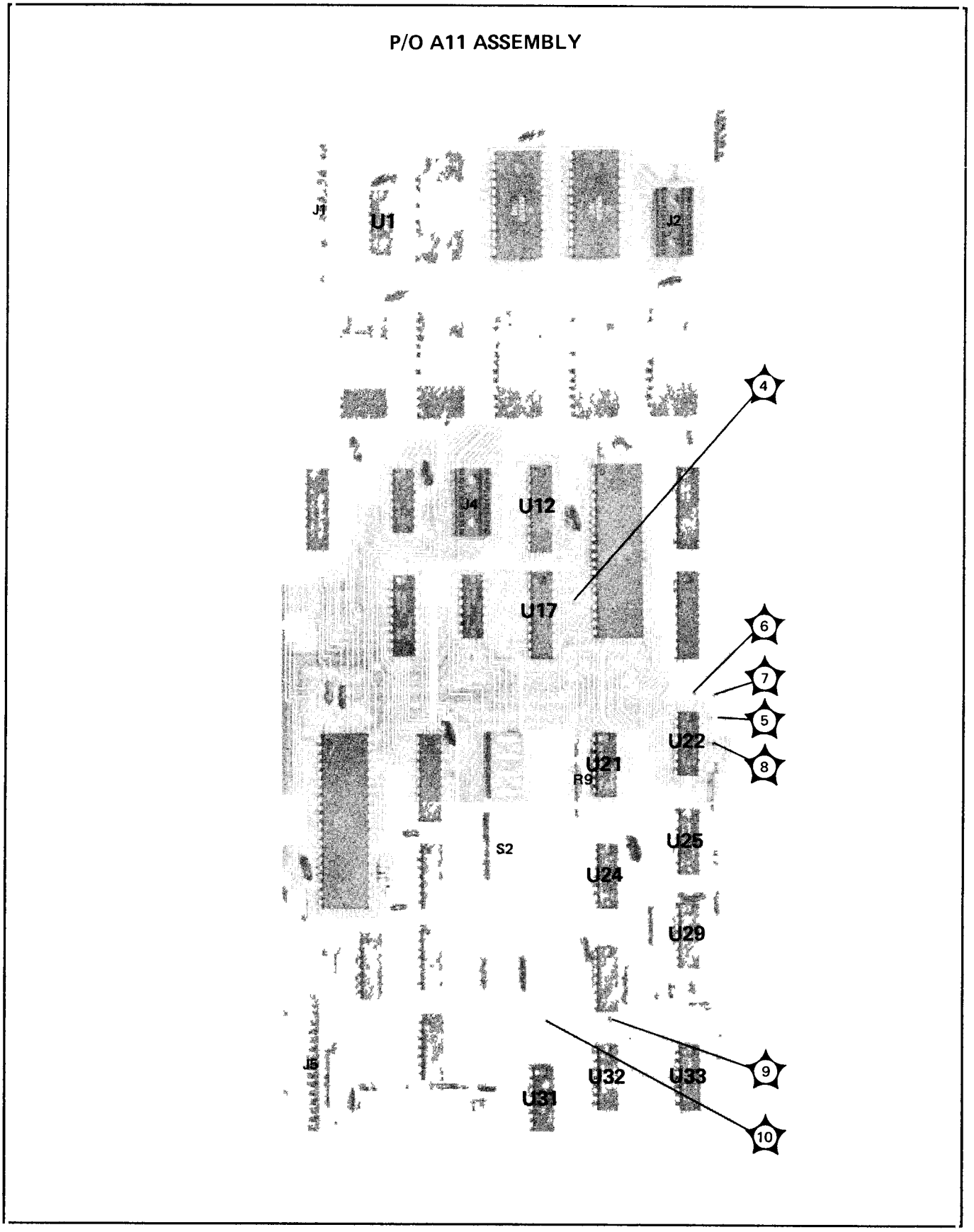


Figure 8-87. Address Buffering and Decoding, Serial I/O and Control Component Locations

ManualsPlus.com

SERVICE SHEET 15 (Cont'd)

Table 1. Interface Signatures

Node	Correct Signature	Comments
+5V	H6H5	
U22 #7	UA17	
*U22 #12	8690	SA CLK(RF)
U24 #7	330C	SER CLK EN
U24 #9	6H08	SER CLK EN
U29 #9	42H7	SER LATCH
U33 #11	6468	
U33 #12	6F77	
+5V	H6H5	
U33 #14	C45F	
U33 #15	2841	
U32 #2	5401	
U32 #5	UC8P	
U32 #7	9PPA	
U32 #10	75UP	
*U32 #15	7064	SA Strobe/ Stop
*U31 #8	FP00	
*U31 #9	FP00	
+5V	H6H5	
U1 #15	58AP	U5 strobe
U1 #14	57F4	U9 strobe
U1 #13	97CC	U13 strobe
U1 #12	A5FP	U16 strobe
U1 #11	P1H1	U19 strobe

*This node is only used to control the signature analyzer during the display and RF interface test.

Reset the LOG/RAM switch to the RAM position. Reconnect attenuator cable W17.

NOTE

If the HP-IB address switch was changed, reset the address switch (service sheet 17) to the original address. Set the front panel RESET-STBY-ON switch to RESET and back to ON.

ManualsPlus.com

SERVICE SHEET 15 (Cont'd)

If the signatures are incorrect, the circuits of Service Sheets 14, 16, 17 or 18 (the Microprocessor, ROM and RAM, the Keyboard or the HP-IB Interface) may be defective. As a last resort, return to Service Sheet BD4 or possibly Service Sheet BD1 and consider the other possiblities shown.

Test Equipment

Signature Analyzer .....HP 5004A

Purpose. To verify transmission of encoded addresses and data from the Microprocessor through the decoders, strobe generators and registers.

Setup. Connect the signature analyzer as follows:

1) GND as close to the circuitry being probed as possible. Bad grounding can cause unstable signatures.
2) CLK to 'E' A11TP11
3) START to 'SA1' A11TP5
4) STOP to 'SA2' A11TP6

Set the signature analyzer's controls as follows:

1) START-OUT
2) STOP-IN
3) CLK-IN

Set up the Signal Generator as follows:

1) Disconnect the attenuator cable W17 from the power supply board to the attenuator.
2) Set the LOGIC/RAM switch P/O A11S1 to the LOGIC position.

NOTE

If the Signal Generator's address switch has been set to other than '07', the signatures taken in this test will be incorrect. In this case, reset the address switches to A1=1, A2=1, A3=1, A4=0 and A5=0. Then set the front panel RESET-STBY-ON switch to RESET and back to ON. Refer to Service Sheet 17 for location of the address switches.

Initialize. Briefly short A11TP3 'NMI' to ground.

NOTE

With careless probing, it is possible to get the Microprocessor into a program sequence other than that intended for signature analysis. If the +5V signature is incorrect, this has probably happened. Restart the test by setting the 'RST/RUN' switch to 'RST' and then 'RUN'. Briefly touch the 'NMI' test point to ground.

Probe. Connect the probe as indicated in Table 1. Verify that the signature is correct and stable as shown.

ManualsPlus.com

SERVICE SHEET 15
P/O A11 MICROPROCESSOR/MEMORY/HP-IB ASSEMBLY

TROUBLESHOOTING HELP

Service Sheet BD4
Table 4-1. Abbreviated Performance Tests
Table 5-2. Post-Repair Adjustments

PRINCIPLES OF OPERATION

General

Control of the major functions of the Signal Generator are contained on the circuits of Service Sheet 15. Direct control is exerted on almost all of the analog functions of the instrument such as frequency, amplitude and modulation. Addresses from the Microprocessor are decoded and the accompanying data (either series or parallel) is manipulated to set various output modes, levels and frequencies. In addition, many purely digital functions such as control of keyboard, display and data bus are decoded here. The Address Bus Buffers U12 and U17 are always enabled during normal operation.

Address Decoders

U22 outputs the Data Bus Buffer Read/Write Enable signal, signature analyzer enable signals and enable signals for U1 and U24. A Valid Memory Address and a low on A14 are required to decode A7, A8 and A9.

U1 outputs strobes that control modulation and attenuation data. Series data contol strobes and Microprocessor related control signals are output by U24. Both U1 and U24 are enabled by the output from U22 and the enable E(H) clock. Address A3 determines which of U1 or U22 is active at a given time. Addresses A0, A1 and A2 are decoded to produce the individual control signals.

Serial I/O Control

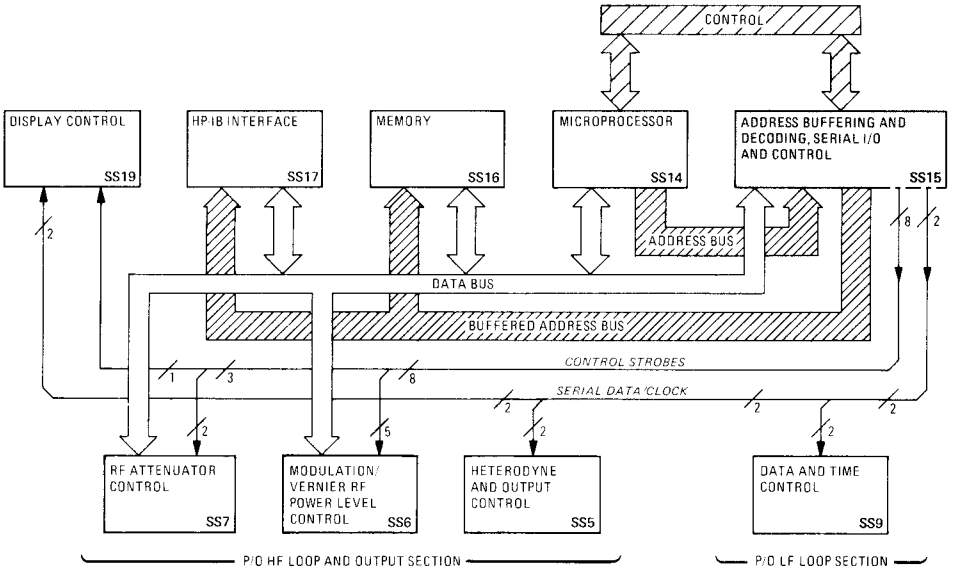
The Serial I/O Control Clock/Strobe Enable Flip-Flop U29B provides an enable signal to the Serial I/O Control Clock/Strobe Generator U33. U33 controls the serial data flow from the keyboard, to the display and to the phase lock loops. Encoded data and strobes are received from the data bus by the Serial I/O Control Register U32. U32 passes the encoded information to the serial data lines and to U33.

TROUBLESHOOTING USING SIGNATURE ANALYSIS

Troubleshooting is done on the circuits of Service Sheet 15 when a defect seems to be related to the Display, Keyboard, or control of the other major sections of the instrument. Examples are the High Frequency Loop, the Output Section and the Low Frequency Loop. If the signatures shown in the tables are correct but the problem is related to another major section of this instrument, refer to:

1) Service Sheet BD2 for Output or High Frequency Loop problems
2) Service Sheet BD3 for Low Frequency Loop problems.

ManualsPlus.com



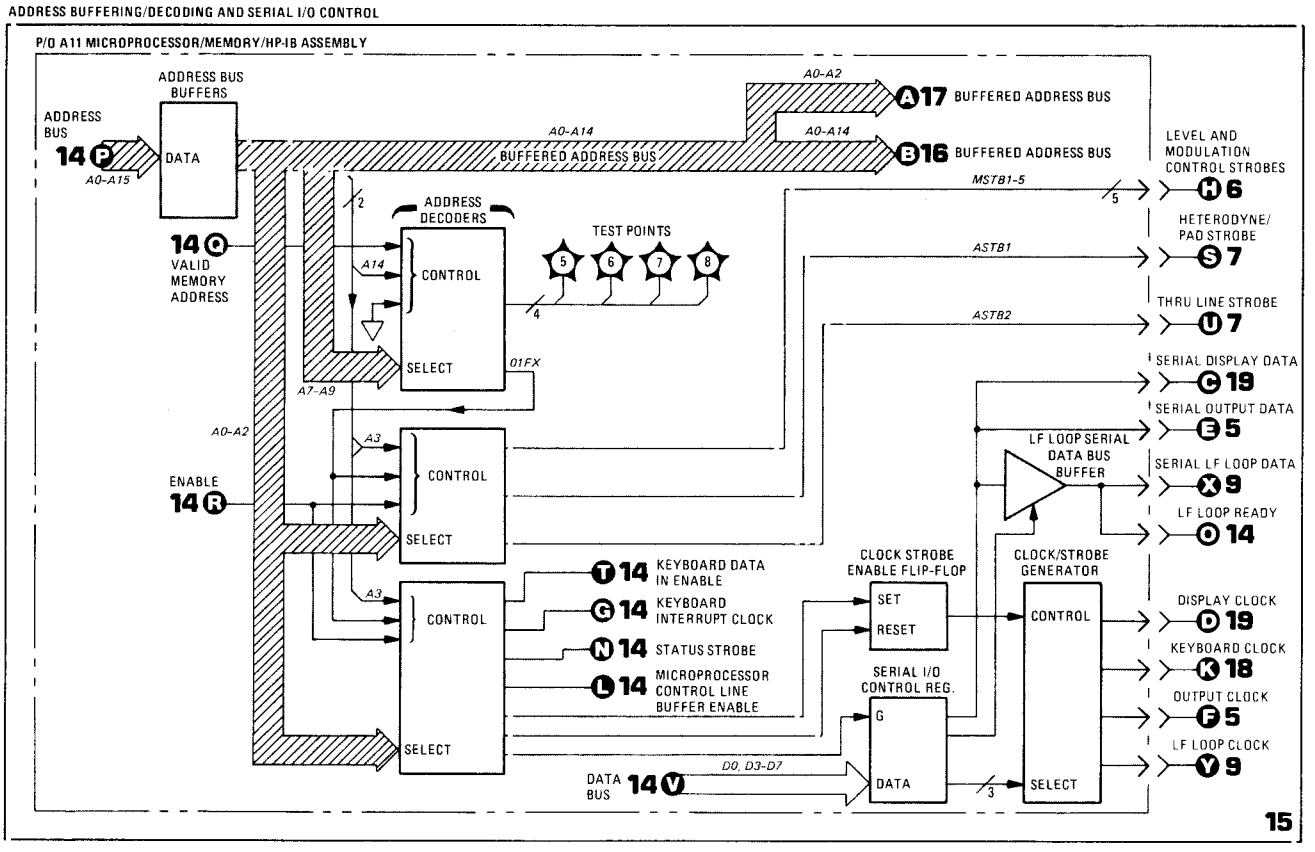
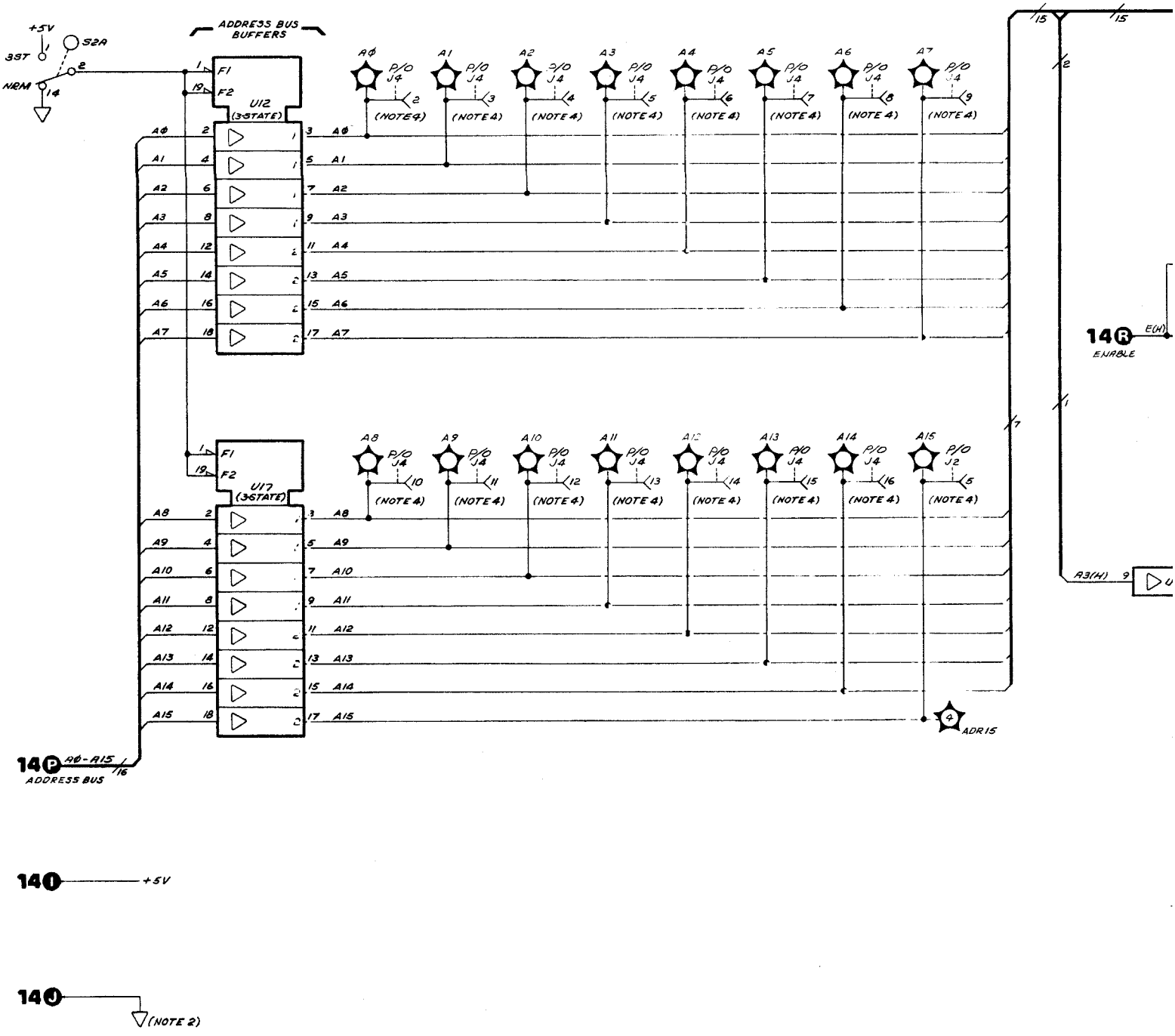
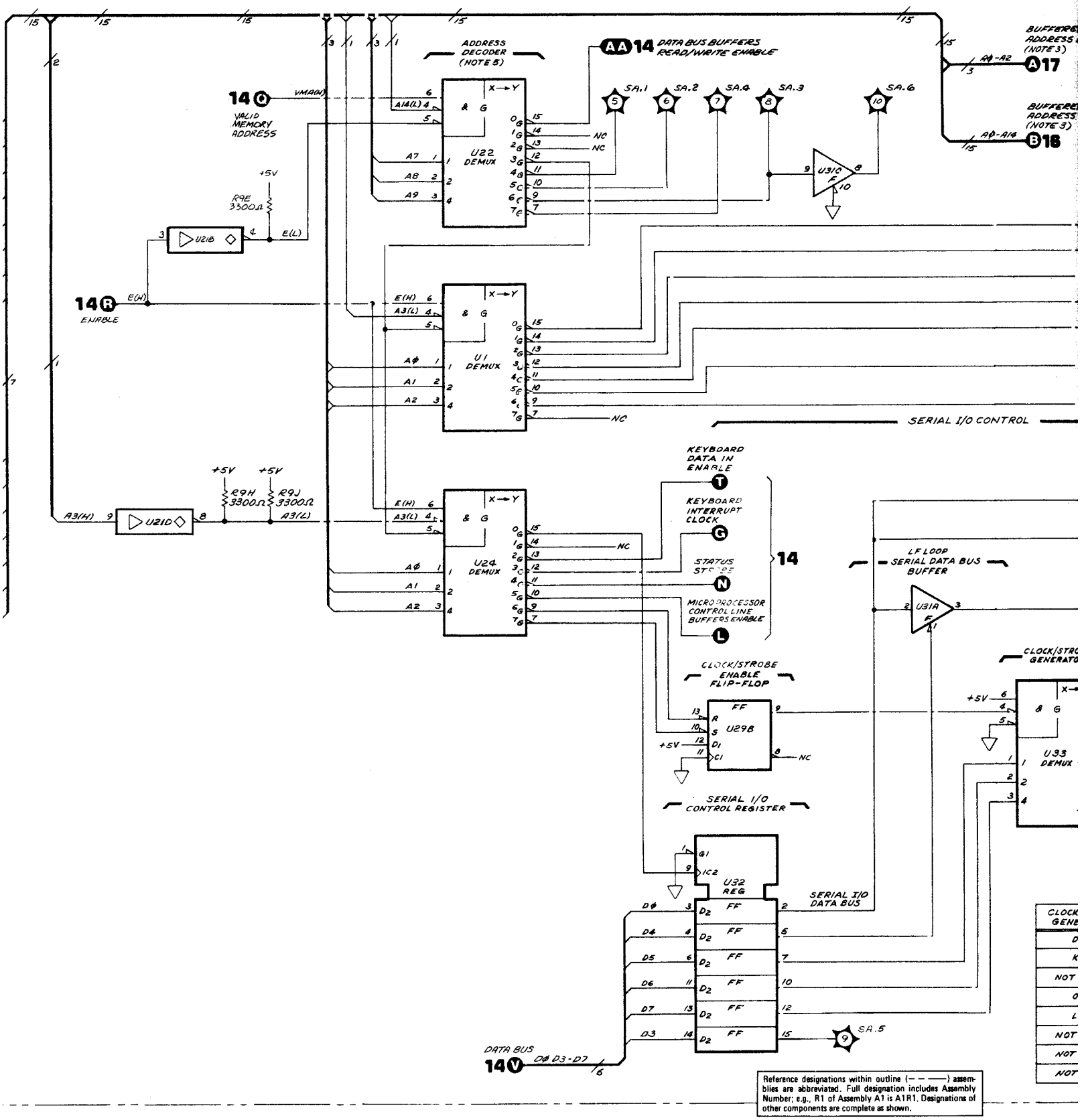


Figure 8-88. Address Buffering and Decoding, Serial I/O and Control Block Diagrams

ManualsPlus.com



ManualsPlus.com

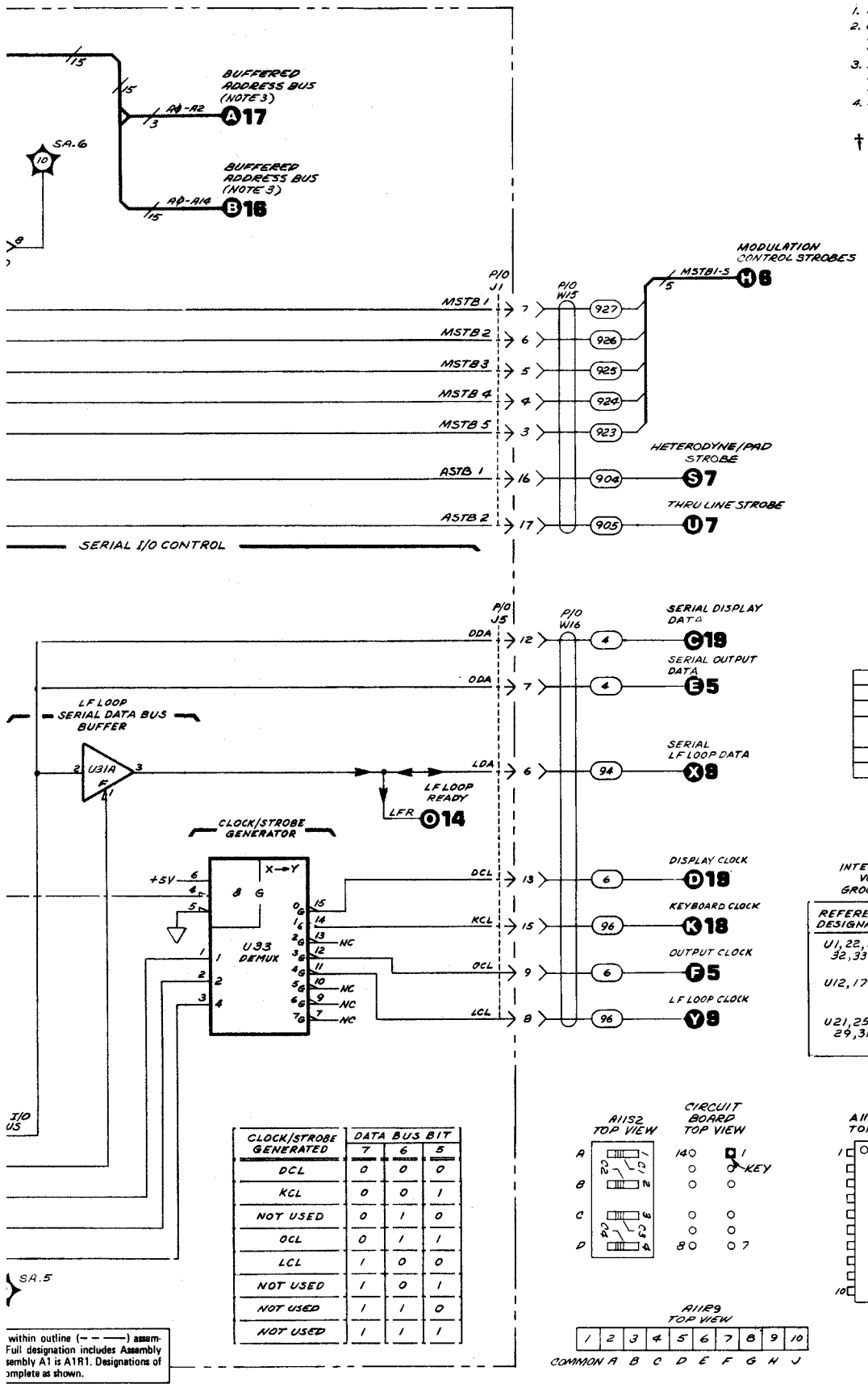


ManualsPlus.com

NOTES

1. SEE TABLE 8-3 FOR SCHEMATIC DIAGRAM NOTES.
2. CHASSIS GROUND IS ACHIEVED THROUGH A11J5-1 CONNECTION AND MECHANICAL CONTACT WITH FASTENERS HOLDING PC BOARD TO FRAME.
3. ADDRESS DATA IS TRANSFERRED POSITIVE TRUE FROM THE MICROPROCESSOR ON THE UNIDIRECTIONAL BUFFERED ADDRESS BUS.
4. SERVICE TEST POINT. PIN OF DUAL IN-LINE TEST SOCKETS J2 OR J4.

† INDICATES CIRCUIT CHANGES. SEE SECTION VII.



CLOCK/STROBE GENERATED	DATA BUS BIT 7	6	5
DCL	0	0	0
KCL	0	0	1
NOT USED	0	1	0
OCL	0	1	1
LCL	1	0	0
NOT USED	1	0	1
NOT USED	1	1	0
NOT USED	1	1	1

within outline (— — —) assembly Full designation includes Assembly sembly A1 is A1R1. Designations of omplete as shown.

REFERENCE DESIGNATIONS

NO PREFIX	A11
W15,16	U1,2,4,5 R9 S2 TP4-10 U1,12,17,21,22,24,25,29,31-33

LOGIC LEVELS

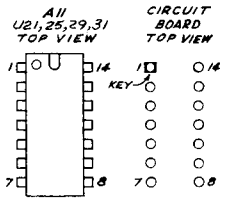
	TTL
HIGH	> 2V
LOW	< 0.8V
< IS MORE NEG. THAN	
> IS MORE POS. THAN	
OPEN	HIGH
GROUND	LOW

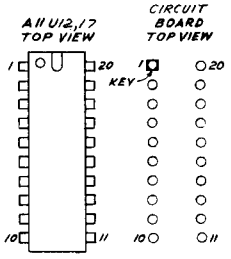
INTEGRATED CIRCUIT PART NUMBERS

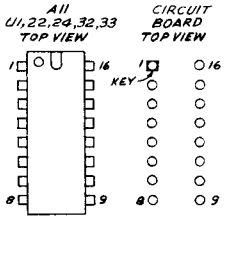
REFERENCE DESIGNATIONS	PART NUMBERS
U1,24	1820-1240
U12,17	1820-1759
U21	1820-1200
U22,33	1820-1216
U25	1820-1201
U29	1820-1112
U31	1820-1568
U32	1820-2056

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATIONS	PIN NUMBERS
U1,22,24,32,33	+5V -16 -8
U12,17	+5V -20 -10
U21,25,29,31	+5V -14 -7







15 P/O A11

Figure 8-89. Address Buffering and Decoding, Serial I/O and Control Schematic Diagram

ManualsPlus.com

SERVICE SHEET 16 (Cont'd)

Setup. Connect the signature analyzer as follows:

1) GND to 'GND' A11TP2
2) CLK to 'E' A11TP7
3) START to 'SA1' A11TP5
4) STOP to 'SA4' A11TP7

Set the signature analyzer's controls as follows:

1) START-OUT
2) STOP-IN
3) CLK-IN

Set up the Signal Generator as follows:

Disconnect the attenuator cable from the power supply to the attenuator.

Initialize. Briefly short the Microprocessor test point 'NMI' to ground.

NOTES

With careless probing it is possible to get the Microprocessor into a program sequence other than that portion intended for signature analysis. If the +5V signature is incorrect this has probably happened. Restart the test by setting the 'RST/RUN' switch to 'RST'; then back to 'RUN'. Briefly touch the 'NMI' test point to ground.

RAM 2 is only used for storing front panel settings. The Signal Generator should work even if RAM 2 is faulty. Only the store and recall related functions will not operate properly.

Probe. Connect the probe to data lines at J2. Verify that the data transfers as indicated by Table 5 are correct.

An incorrect signature may indicate:

1) improper setup
2) RAM program aborting
3) ROM program is incorrect (+5V signature is incorrect).
4) incorrect addressing to RAM
5) defective RAM.

NOTE

Go to Service Sheet 14 to test the addressing.

Table 5. RAM Data Transfer Signatures

Mode	Correct Signature
+5V	C888
D0	3U02
D1	489H
D2	1560
D3	9A3A
D4	58U6
D5	9038
D6	35C7
D7	98HF

1) If the ROM signatures are correct, then the program is correct.
2) If the +5V signature is correct, then the program is running.

Test 5. Microprocessor and Individual RAM Functional Check

Purpose. To test the data transfer of individual RAM.

Setup. Connect the signature analyzer as follows:

1) GND to 'GND' A11TP2
2) CLK to 'E' A11TP7
3) START to test point as indicated in the table
4) STOP to test point as indicated in the table.

Set the signature analyzer controls as follows:

1) START-OUT
2) STOP-IN
3) CLK-IN.

Set up the Signal Generator by disconnecting the attenuator cable W17 from the power supply board to the attenuator.

Initialize. Briefly short A11TP3 'NMI' to ground.

NOTE

With careless probing it is possible to get the Microprocessor into a program sequence other than that portion intended for signature analysis. If the +5V signature is incorrect, this has probably happened. Restart the test by setting the 'RST/RUN' switch to 'RST'; then 'RUN'. Briefly touch the 'NM1' test point to ground.

ManualsPlus.com

SERVICE SHEET 16 (Cont'd)

Table 4. Individual ROM Generated Data Bus Signatures

Node	Correct Signature	Comments
+5V	826P	
D0	HC6U	ROM1
D1	F5FC	U2
D2	FAU1	
D3	C149	
D4	8P66	
D5	P3P4	
D6	17F4	
D7	8FP1	
+5V	826P	
D0	665U	ROM2
D1	8C5H	U9
D2	2763	
D3	3CA7	
D4	38C1	
D5	9AC0	
D6	3487	
D7	84A2	
+5V	826P	
D0	PP18	ROM3
D1	AH74	U8
D2	93H6	
D3	A87F	
D4	P428	
D5	5580	
D6	CHFC	
D7	08H9	
+5V	826P	
D0	1C4C	ROM4
D1	14U5	U7
D2	6389	
D3	7F04	
D4	F1A5	
D5	HAF5	
D6	1F62	
D7	C18U	
+5V	826P	
D0	46C1	ROM5
D1	8831	U6
D2	U30C	
D3	8UCU	
D4	4221	
D5	3AUP	
D6	AA1P	
D7	2559	
+5V	826P	
D0	HP67	ROM6
D1	FO46	U5
D2	323A	
D3	3U32	
D4	15FU	
D5	7FP8	
D6	9A4A	
D7	9F1A	

ManualsPlus.com

The Data Bus Buffer should be in the high impedance state, that is, U14-pin 19 should be high.

If testing is complete, set the TEST/NRM switch to NRM and ROM/NRM to NRM.

Test 3. Microprocessor and Individual ROM Functional Checks

Purpose. Verify the functional operation of the Microprocessor and the data contents of the individual ROM.

Setup. Connect the signature analyzer as follows:

1) GND to 'GND' A11TP2
2) CLK to 'E' A11TP7
3) START to the individual ROM test points (refer to the schematic)
4) STOP to the individual ROM test points (refer to the schematic).

Set the signature analyzer's controls as follows:

1) START-IN
2) STOP-OUT
3) CLK-IN

Set up the Signal Generator as follows:

1) Disconnect the attenuator cable W17 from the power supply board to the attenuator.
2) Set the TEST/NRM switch P/O A11S1 to TEST.
3) Set the ROM/NRM switch P/O A11S1 to ROM.

NOTE

ROM signatures will change as firmware changes. Be sure the part number on ROM corresponds to part number in Table 2.

Probe. Connect the probe to the data bus of the ROM to check data contents. Use connector J2 (refer to Service Sheet 14). Verify that each signature as indicated in Table 4 is correct and stable.

After the signatures are taken, reset the TEST/NRM switch to NRM and the ROM/NRM switch to NRM. Reconnect the attenuator cable W17 if testing is complete.

Test 4. Microprocessor and RAM Functional Check

Purpose. To verify the ability to write and read to the three RAM. (RAM 3 is located in the Microprocessor U13; refer to Service Sheet 14.)

NOTE

An abbreviated RAM check is performed at power up or reset. Memory failute will result in all front panel LEDs staying lit until any key is pressed.

ManualsPlus.com

SERVICE SHEET 16 (Cont'd)

Set up the Signal Generator as follows:

1) Disconnect the attenuator cable from the power supply board to the attenuator.
2) Set the TEST/NRM switch P/O A11S1 to TEST.
3) Set the ROM/NRM switch P/O A11S1 to ROM.

NOTE

ROM signatures will change as firmware changes. Be sure the part number on each ROM corresponds to the part number in Table 2.

Table 2. ROM HP Part Number

ROM Number	HP Part Number
ROM 1	1818-1365
ROM 2	1818-1358
ROM 3	1818-1359
ROM 4	1818-1360
ROM 5	1818-1361
ROM 6	1818-1362

Probe. Connect the probe to the data bus of the ROM to check data contents. Use connector J2 (refer to Service Sheet 14). Verify that each signature is correct and stable as indicated in Table 3.

Table 3. ROM Generated Data Bus Signatures

Node	Correct Signature
+5V	1857
D0	F5F2
D1	1758
D2	2719
D3	F177
D4	7AA2
D5	CA47
D6	U7U2
D7	5F72

An incorrect signature could be due to:

1) improper test setup
2) improper addressing to ROM
3) Bus fight on data bus
4) bad ROM
5) firmware has changed (refer to Table 2).

Recheck the test setup. The D0 to D7 should be set to 1000 0000. If incorrect, be sure the ROM/NRM switch P/O A11S1 is set to ROM (NOP).

ManualsPlus.com

Set the signature analyzer controls as follows:

1) START-IN
2) STOP-OUT
3) CLK-IN

Set up the Signal Generator as follows:

1) TEST/NRM switch P/O A11S1 to TEST.
2) ROM/NRM switch P/O A11S1 to ROM.

Probe. Connect the probe to the node indicated in Table 1. Verify that each signature is correct and stable.

Table 1. ROM Address Select Signatures

Node	Correct Signature	Comments
U21 #12	755P	A14
U11 #7	826U	Chip Sel
U11 #9	603C	
U11 #10	54F5	
U11 #11	A711	
U11 #12	AA6A	
U11 #13	A3UH	

Reset the TEST/NRM switch to NRM and ROM/NRM switch to NRM; reconnect attenuator cable W17 if testing is completed.

Test 2. Microprocessor and ROM Functional Check

Purpose. Verify the functional operation of the Microprocessor and the data contents of the ROM.

NOTE

The ROM checksum test is performed automatically during power up or at front panel RESET. Memory failure will result in all LEDs staying on until any key is hit.

Setup. Connect the signature analyzer as follows:

1) GND to 'GND' A11TP2
2) CLK to 'E' A11TP7
3) START to 'ROM1' A11TP13
4) STOP to 'ROM6' A11TP18

Set the signature analyzer's controls as follows:

1) START-IN
2) STOP-OUT
3) CLK-IN

ManualsPlus.com

SERVICE SHEET 16
P/O A11 MICROPROCESSOR/MEMORY/HP-IB ASSEMBLY

TROUBLESHOOTING HELP

Service Sheet BD4
Table 4-1. Abbreviated Performance Tests
Table 5-2. Post-Repair Adjustments

PRINCIPLES OF OPERATION

General

The memory circuits, except for the Microprocessor's internal RAM (Read/Write Memory) are part of the circuits shown on Service Sheet 16. The individual RAM is selected by direct addressing. The ROM (Read Only Memory) is selected by direct addressing and by means of the ROM Select Decoder U11.

RAM

Valid Memory Address VMA and the enable (clock) E are the inputs that enable the RAM, U3 and U4. Address A14 must be low while A7 and A8 determine which RAM is selected. The Read/Write mode is selected by the control signal placed on pin 16. The memory location in each RAM is selected by addresses A0 through A6. The RAM input/output is connected directly to the data bus D0 through D7.

ROM Select Decoder

The Valid Memory Address VMA and enable (clock) E enable a ROM or the interface bus select IB SEL via the ROM Select Decoder U11. Address A14 (at the Buffered Address Bus) must be high while A11, A12 and A13 are decoded to select one of the six ROM or the interface bus select IB SEL(L).

ROM

Addresses A0 through A10 select the ROM memory location. The outputs of the ROM are connected to the Data Bus D0 through D7.

TROUBLESHOOTING USING SIGNATURE ANALYSIS

Troubleshooting is done to the circuits of Service Sheet 16 when a defect seems to be related to the ROM or RAM circuits. The only troubleshooting information provided is signature analysis. If nothing definite is discovered in performing these checks, refer to Service Sheet 14 or consider the other possibilities listed on Service Sheet BD4.

Test Equipment

Signature Analyzer . . . . . HP 5004A

Test 1. ROM Address Select

Purpose. Verify the ability of the Microprocessor to select the correct ROM/RAM address.

Setup. Connect the signature analyzer as follows:

1) GND to 'GND' A11TP2
2) CLK to 'E' A11TP11
3) START to 'ADR 15' A11TP4
4) STOP to 'ADR 15' A11TP4

ManualsPlus.com

SERVICE SHEET 16 (Cont'd)

Probe. Connect the probe to the data lines at J2. Verify that the individual RAMdata transfers are correct as indicated in Table 6.

Table 6. Individual RAM Data Transfer Signatures

Node	Correct Signature	Comments
+5V	CU45	RAM1 (U2)
D0	30H4	
D1	C372	STRT- SA.2
D2	5P69	STP - SA.3
D3	A585	
D4	5846	
D5	875F	
D6	CCFC	
D7	HPFU	
+5V	A2FP	RAM2 (U3)
D0	4542	
D1	CU9P	STRT- SA.3
D2	1U1H	STP - SA.4
D3	F6P0	
D4	273C	
D5	AAU1	
D6	P5FA	
D7	669F	
+5V	1217	RAM3(U13
D0	66F4	internal)
D1	356C	STRT- SA.1
D2	6F15	STP - SA.2
D3	0H43	
D4	4PC8	
D5	C2F6	
D6	17HU	
D7	C316	

Reconnect the attenuator cable W17. Reset the Signal Generator by setting the front panel RESET-STBY-ON switch to RESET and back to ON.

ManualsPlus.com

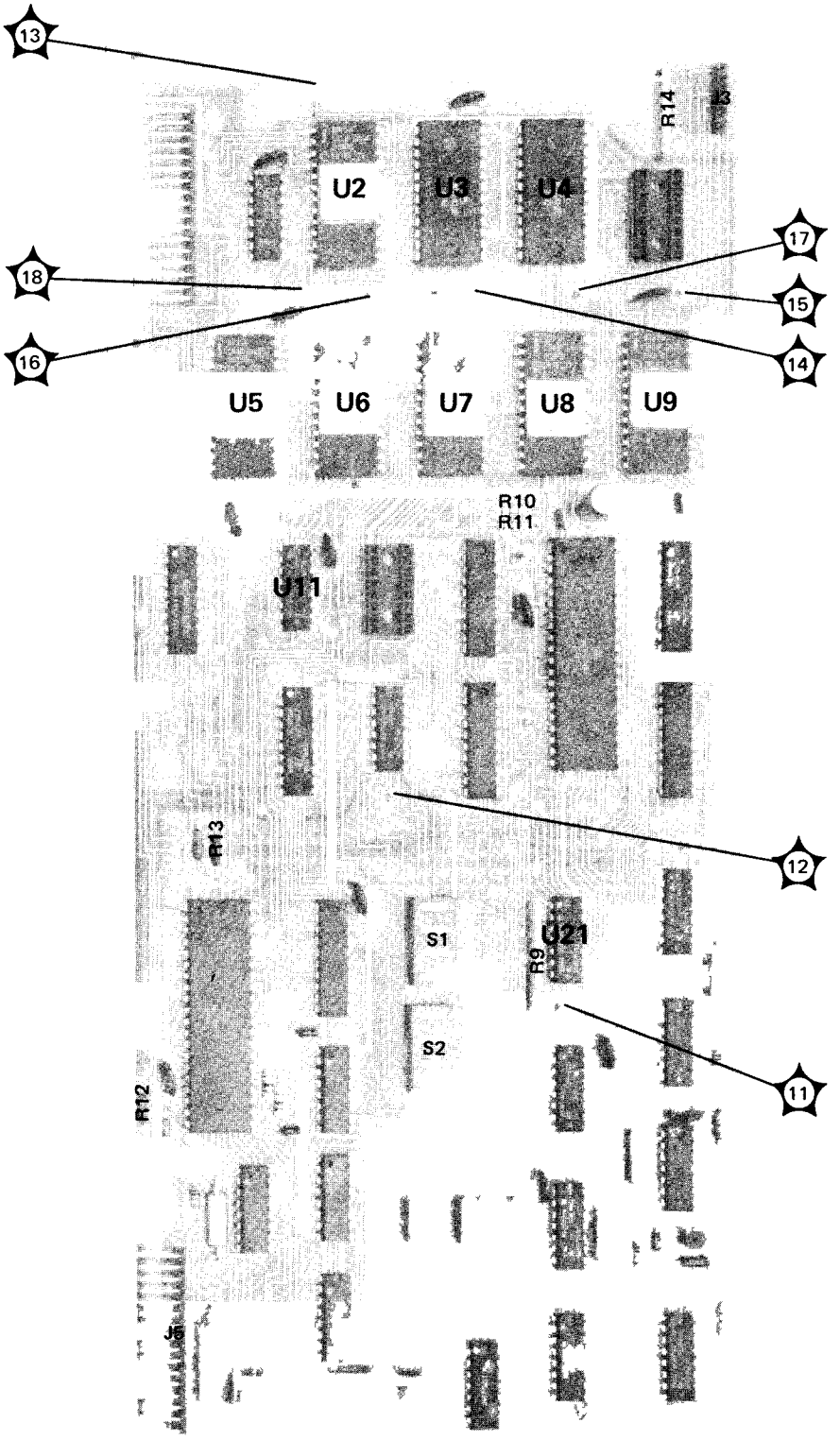
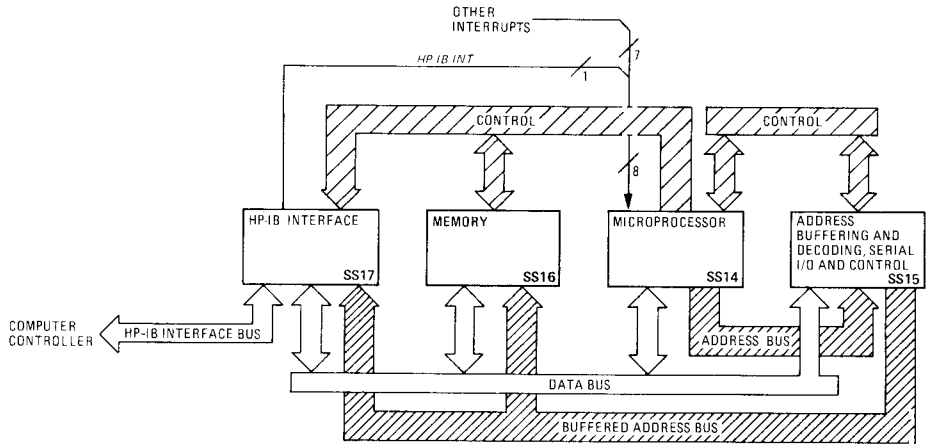


Figure 8-90. Memory Component Locations

ManualsPlus.com



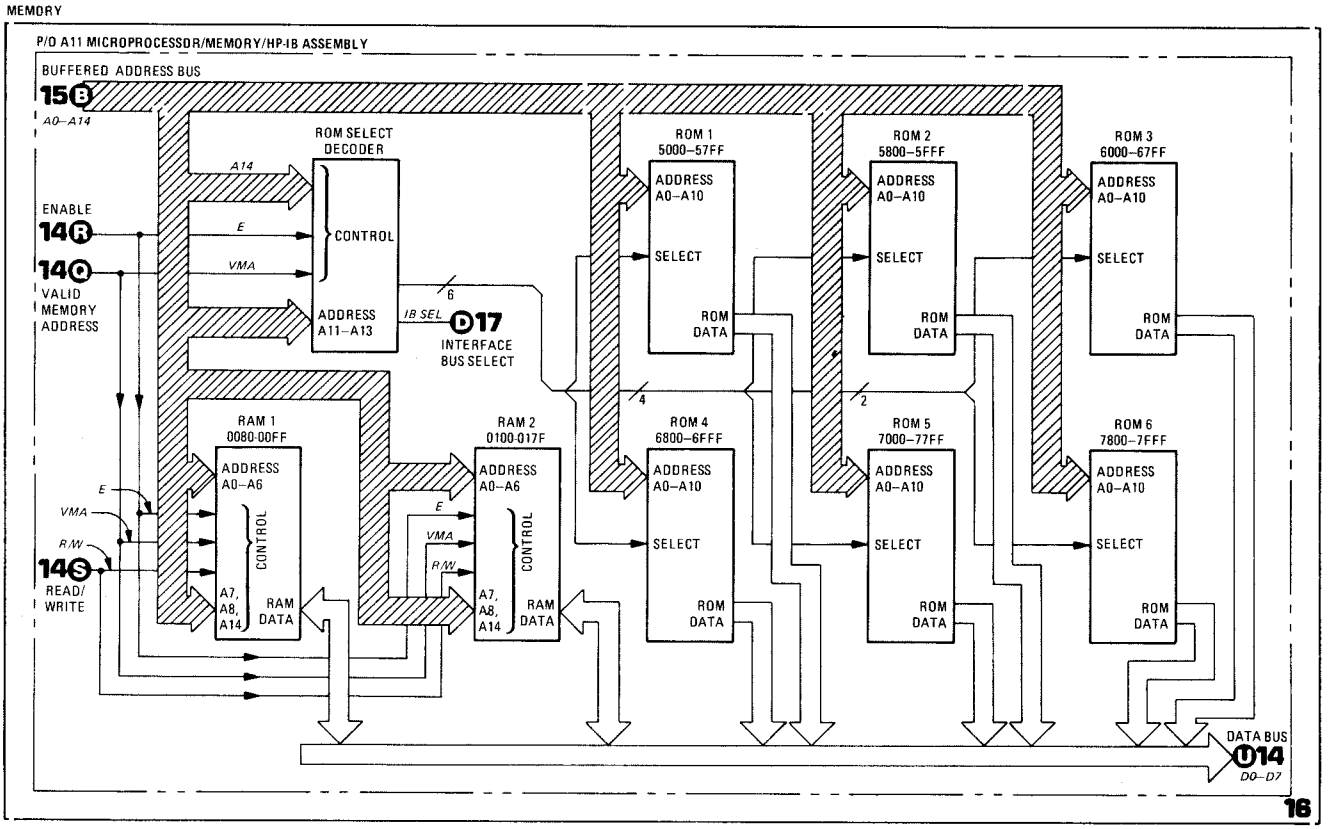
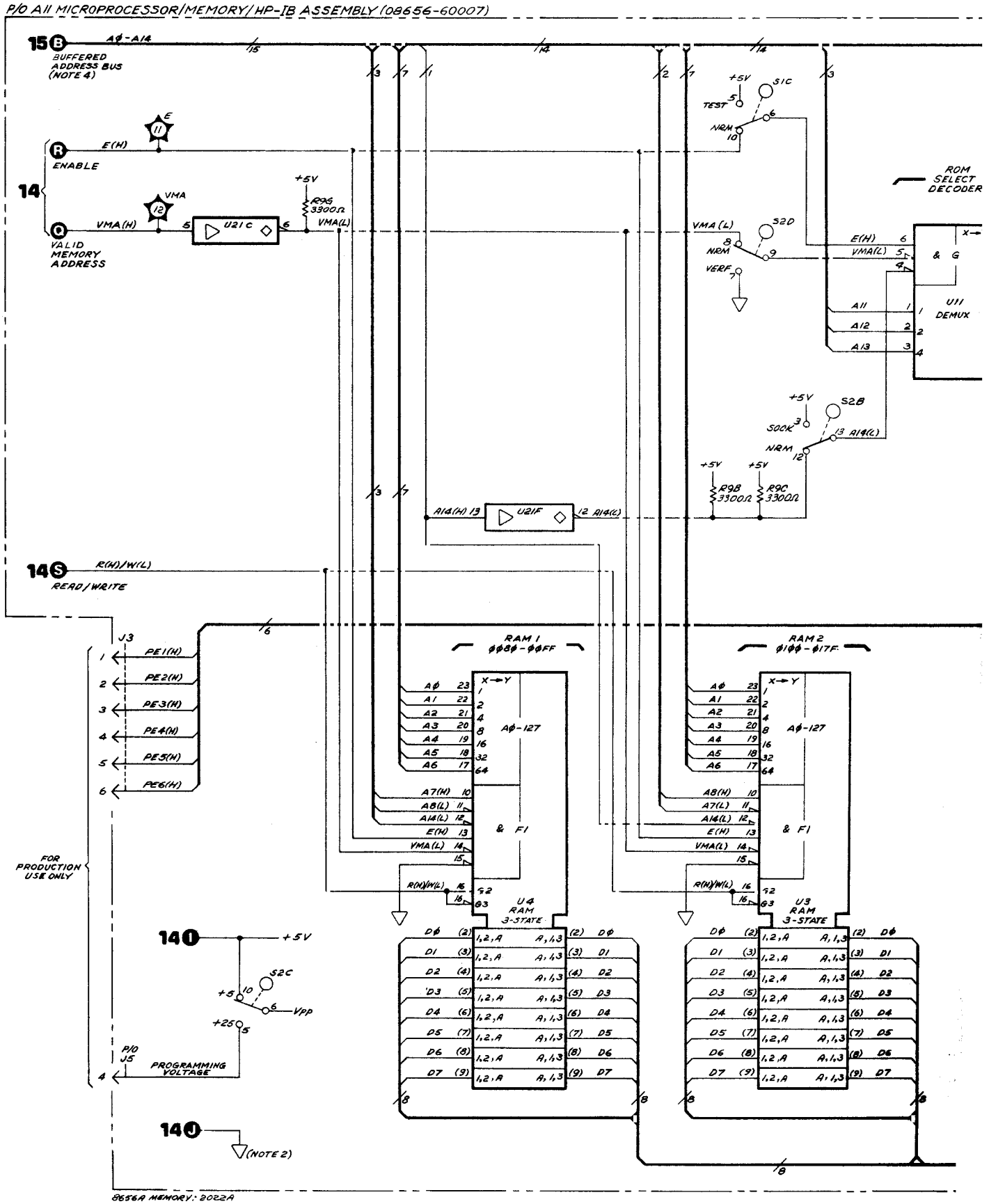
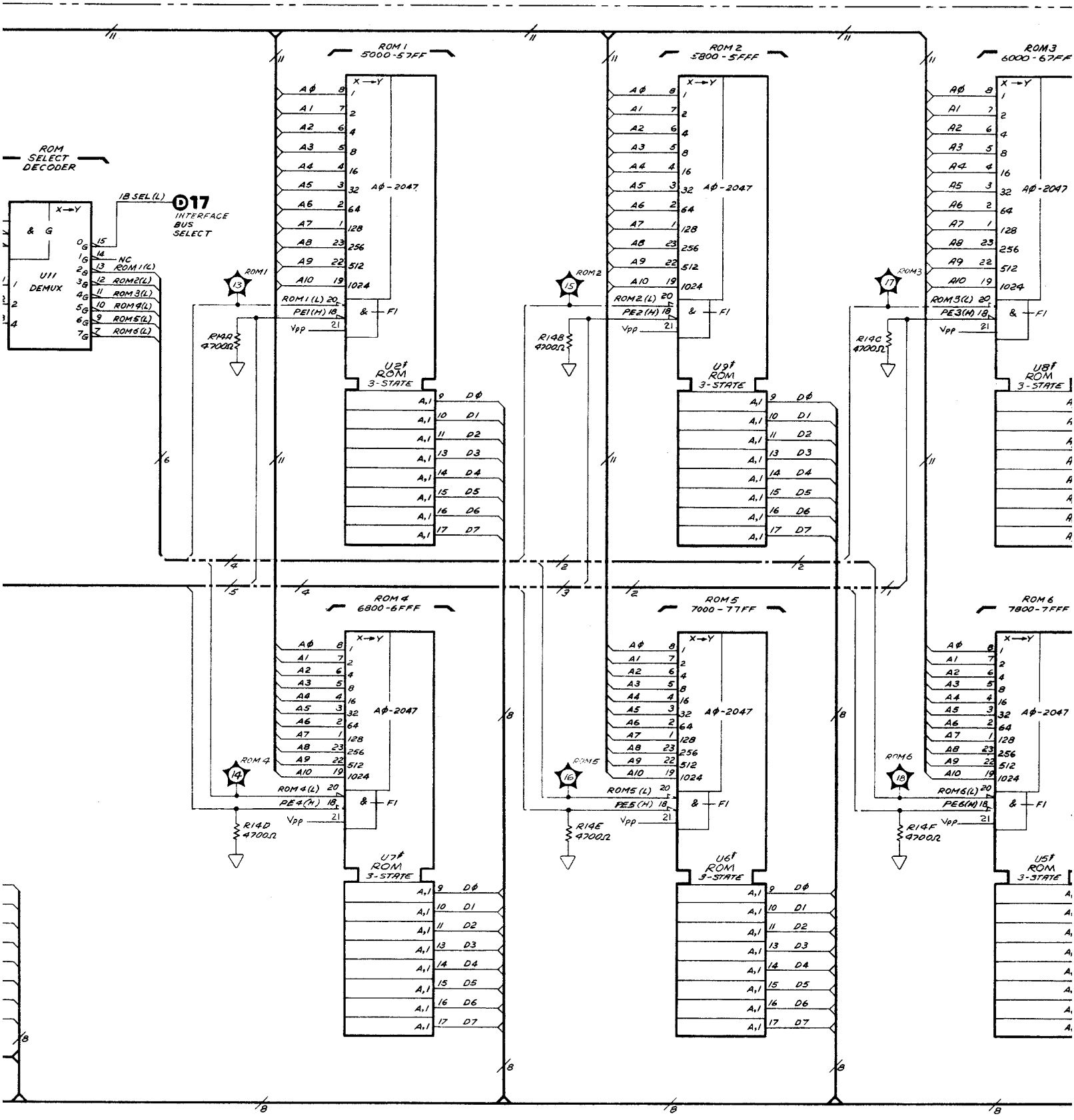


Figure 8-91. Memory Block Diagrams

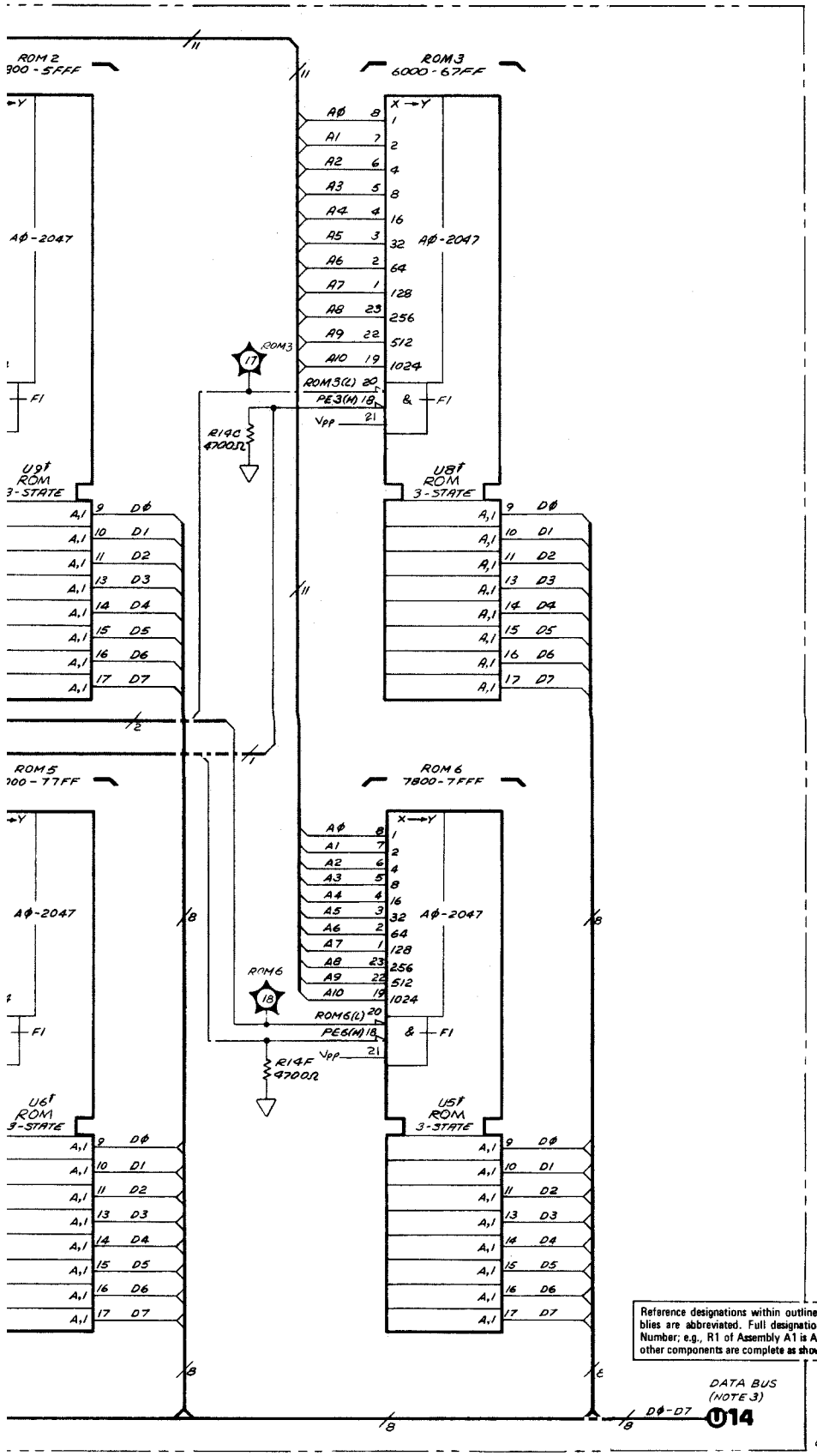
ManualsPlus.com



ManualsPlus.com



ManualsPlus.com



NOTES

1. SEE TABLE 8-3 FOR SCHEMATIC DIAGRAM NOTES.
2. CHASSIS GROUND IS ACHIEVED THROUGH A11J5-1 CONNECTION AND MECHANICAL CONTACT WITH FASTENERS HOLDING PC BOARD TO FRAME.
3. DATA IS TRANSFERRED POSITIVE TRUE FROM ROM OR RAM MEMORY TO THE MICROPROCESSOR ON THE DATA BUS (D0 - D7).
4. ADDRESS DATA IS TRANSFERRED POSITVE TRUE FROM THE MICROPROCESSOR ON THE BUFFERED ADDRESS BUS (A0 - A14).

INDICATES CIRCUIT CHANGE. SEE SECTION VII.

REFERENCE DESIGNATIONS

A11
J3,5 R9,19 S1,2 TP11-18 U2-9,11,21

LOGIC LEVELS

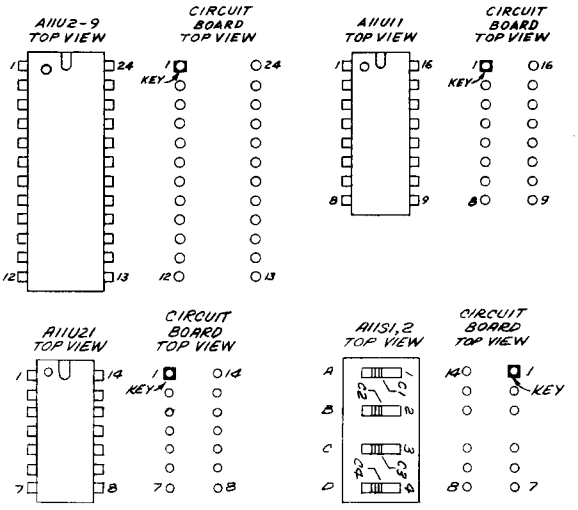
	TTL
HIGH	> 2V
LOW	< 0.8V
< IS MORE NEG. THAN	
> IS MORE POS. THAN	
OPEN	HIGH
GROUND	LOW

INTEGRATED CIRCUIT PART NUMBERS

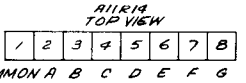
REFERENCE DESIGNATIONS	PART NUMBERS
U2	1818 - 1365
U3,4	1818 - 0701
U5	1818 - 1362
U6	1818 - 1361
U7	1818 - 1360
U8	1818 - 1359
U9	1818 - 1358
U11	1820 - 1240
U21	1820 - 1200

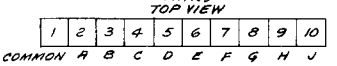
INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATIONS	PIN NUMBERS
U2,5-9	+5V - 24 ▽ - 12
U3,4	+5V - 24 ▽ - 1
U11	+5V - 16 ▽ - 8
U21	+5V - 14 ▽ - 7



Reference designations within outline (— — —) assemblies are abbreviated. Full designation includes Assembly Number; e.g., R1 of Assembly A1 is A1R1. Designations of other components are complete as shown.





16 P/O A11

Figure 8-92. Memory Schematic Diagram

ManualsPlus.com

P/O A11 ASSEMBLY

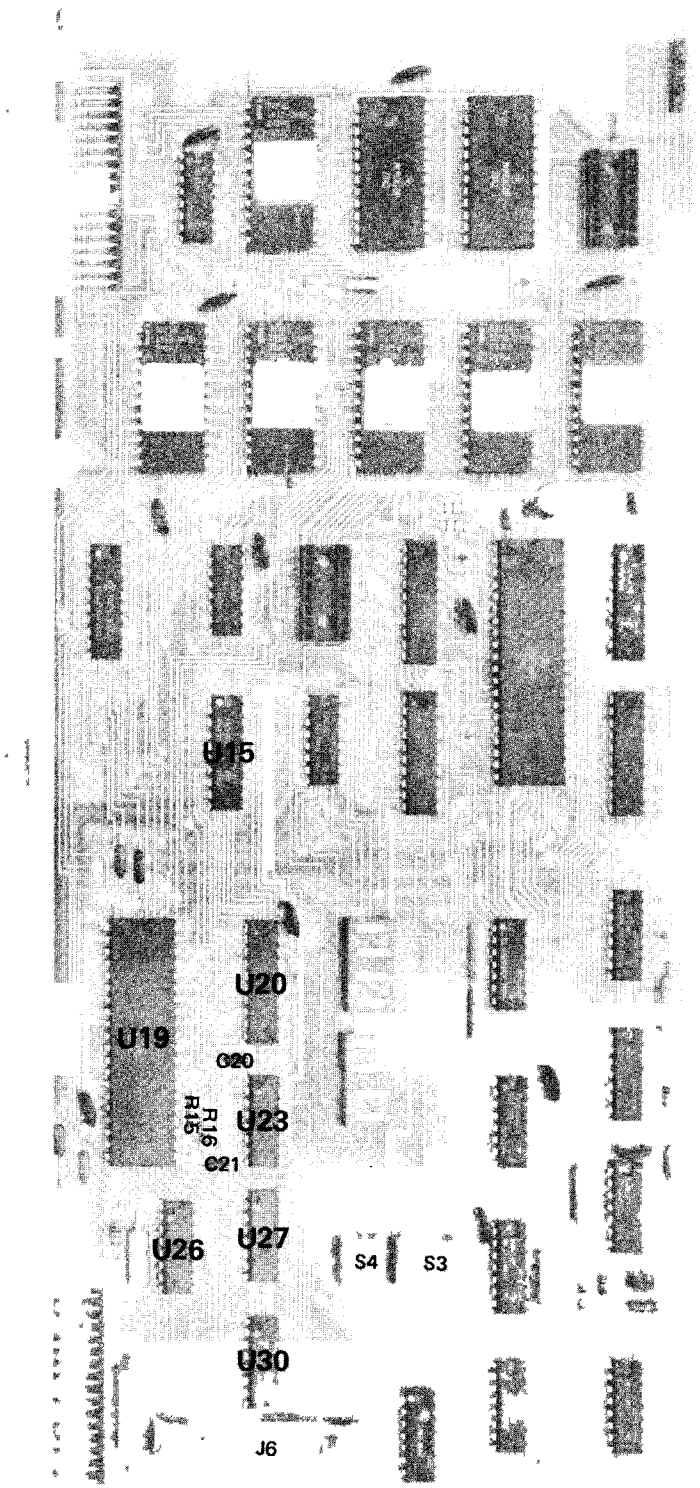


Figure 8-94. HP-IB Interface Component Locations

ManualsPlus.com

Table 1. Interface Signatures

Node	Correct Signature
+5V	H6H5
U15 #19	39A7
U19 #4	6514
U19 #7	69F8
U19 #8	0444
U19 #9	36A9
U19 #10	FF2C
U19 #11	U939
U19 #12	P71U
U19 #13	FH9F
U19 #14	652F

Reconnect attenuator cable W17. Reset the LOGIC/RAM switch to the RAM position.

NOTE

If the HP-IB address switch was changed, reset the address switch to the original address. Set the front panel RESET-STBY-ON switch to RESET and back to ON.

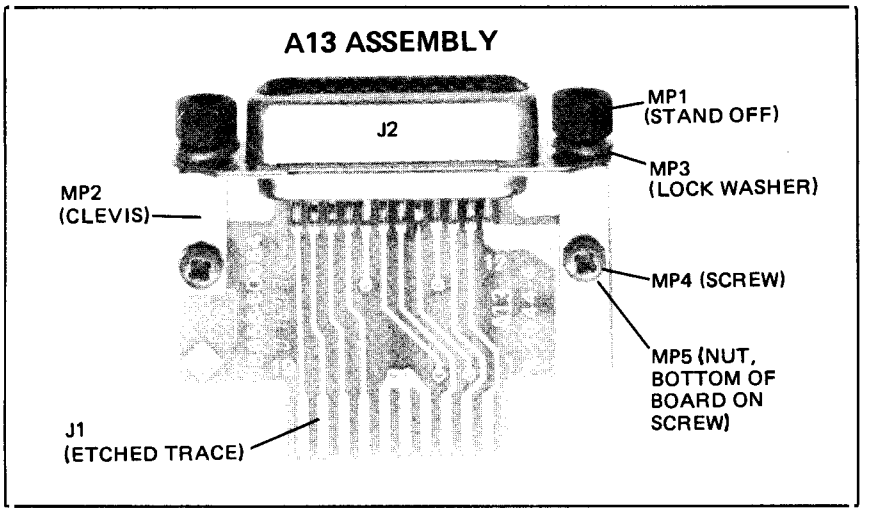


Figure 8-93. HP-IB Connector Component Locations

ManualsPlus.com

SERVICE SHEET 17 (Cont'd)

Checks in Section III to verify proper operation of the HP-IB interface circuits. This includes data, control and handshake connections to the computer controller. Do not overlook the possibility that the HP-IB address switches are set to an address other than what was expected. The address switch setting may be checked by pressing the front panel switch HP-IB ADRS. As a last resort return to Service Sheet BD4 and consider the other possibilities shown.

Purpose. To verify transmission of data from the Microprocessor to the HP-IB General Purpose Interface Adapter A11U19.

Setup. Connect the signature analyzer as follows:

1) GND as close as possible to the circuitry being probed. (Bad grounding can cause unstable signatures.)
2) CLK to 'E' A11TP11
3) START to 'SA1' A11TP5
4) STOP to 'SA2' A11TP6

Set the signature analyzer's controls as follows:

1) START-OUT
2) STOP-IN
3) CLK-IN

Set up the Signal Generator as follows:

1) Disconnect the attenuator cable W17 from the power supply board to the attenuator.
2) Set the LOGIC/RAM switch P/O A11S1 to LOGIC.

NOTE

If the Signal Generator's address switch has been set to other than '07', the signatures taken in this test will be incorrect. In this case, reset the address switches to A1=1, A2=1, A3=1, A4=0 and A5=0. Then set the front panel RESET-STBY-ON switch to RESET and back to ON.

Initialize. Briefly short A11TP3 'NMI' to ground.

NOTE

With careless probing it is possible to get the Microprocessor into a program sequence other than that portion intended for signature analysis. If the +5V signature is incorrect, this has probably happened. Restart the the test by setting the 'RST/RUN' switch to 'RST and then 'RUN'. Briefly touch the 'NMI' test point to ground.

Probe. Connect the probe to the node indicated in Table 1. Verify that each signature is correct and stable.

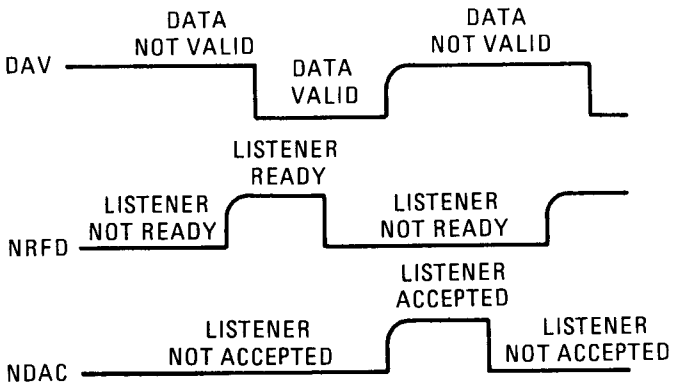
ManualsPlus.com

(U19-pin 23 and U27-pin 15). The only outgoing signals are the handshake control lines NRFD and NDAC. The buffers are permanently enabled by hardwire connections. Refer to Figure 1 for more information about the HP-IB Handshake Control.

HP-IB General Purpose Interface Adapter

The interface adapter U19 provides interfacing between the HP-IB connections to the controller and the Signal Generator's digital circuits. The address select ASE and HP-IB Interrupt Request IBI are generated as a result of inputs from the controller.

The Microprocessor, under the control of the HP-IB subroutines stored in ROM, outputs control and address signals to U19 to control the data input from the controller. IB SEL selects the HP-IB mode. Addressing is input to U19 on A0, A1 and A2. Read/Write determines if data is written onto the data lines D0 through D7 or if the internal address is read by U19. The internal address is compared with that input to the Signal Generator by U19.



Start with the talker waiting for the listener to release NRFD (not ready for data) indicating it is ready.

When the listener is ready, NRFD goes high (false). The talker then places valid data on DIO1 through DIO8 and sets DAV (data valid) low (true).

NRFD then goes low (true) and the talker waits for the listener to indicate it has accepted the data (or ignored it) by releasing the NDAC (not data accepted) to a high (false, i.e., data is accepted).

The talker sets DAV high (false) and again waits for the listener to release NRFD.

(NOTE that if ATN is true, all instruments on the bus must handshake regardless of whether they are talkers, listeners, or bystanders. Being in remote or local has nothing to do with handshaking. If ATN is false, they only handshake if addressed).

Figure 1. Simplified HP-IB Handshake between a Talker (Computer Controller) and One Listener (Signal Generator)

TROUBLESHOOTING

Troubleshooting is done on the circuits of Service Sheet 17 when a defect seems to be related to the HP-IB circuits. If the signatures are all correct, the instrument interface circuits from U19 to the Microprocessor are probably functional. Refer to the HP-IB Functional

ManualsPlus.com

SERVICE SHEET 17
P/O A11 MICROPROCESSOR/MEMORY/HP-IB ASSEMBLY
A13 HP-IB CONNECTOR ASSEMBLY

TROUBLESHOOTING HELP

Service Sheet BD4
Table 4-1. Abbreviated Performance Tests
Table 5-2. Post-Repair Adjustments

PRINCIPLES OF OPERATION

General

This Signal Generator may be connected to an external computer controller via the Hewlett-Packard Interface Bus (HP-IB). Encoded data and control information is passed between the two instruments on the interface bus.

NOTE

The Hewlett-Packard Interface Bus is Hewlett-Packard's implementation of the IEEE Standard 488 "General Purpose Interface Bus".

Inputs to the Signal Generator from the external controller are in the form of encoded control and data information. Control information is input to the Signal Generator via five control lines (four are used in this instrument) and three handshake lines. The control lines allow the controller to gain the Signal Generator's attention and impart other appropriate control information. The handshake lines provide asynchronous control information for data transfer between a talker (computer controller) and the listener (Signal Generator).

In the handshake mode, the Signal Generator first indicates when it is ready to listen (receive data). The controller responds by indicating when the data that appears on the data lines, DI01 through DI08, is valid. The Signal Generator then lets the controller know that the data has been accepted.

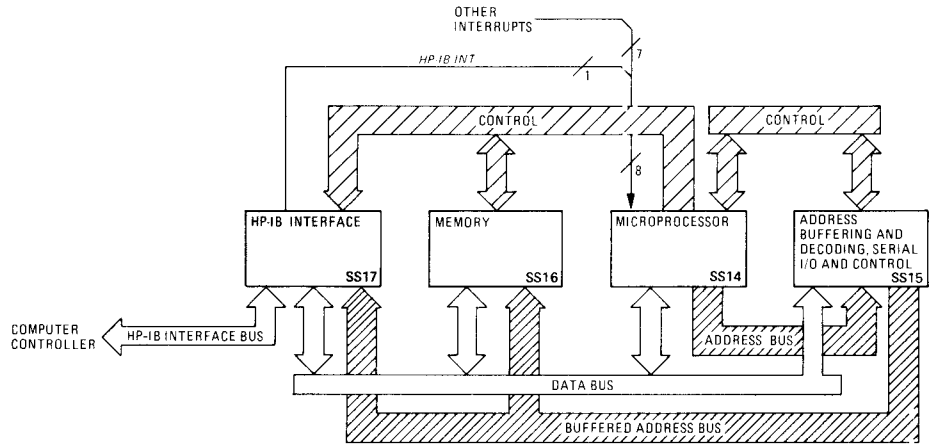
Data that is transferred to the Signal Generator contains all the information required to control each mode of operation. It also contains the level or frequency information for each mode. Examples are 50% AM depth, an RF amplitude of −10 dBm and a frequency of 100 MHz.

The HP-IB Address Switch Buffer U20 places the internally set address on the data lines when addressed by the HP-IB General Interface Adapter. The HP-IB Interface Buffers are enabled by the interface bus select IB SEL. The Read/Write mode determines if data is written onto or read from the Data Bus. Note that the Read/Write lines are tied in parallel to the Hewlett-Packard Interface Bus.

HP-IB Data Bus and Control/Handshake Buffers

The Signal Generator functions as a listener only, therefore there are no input connections to the Data Bus Buffers from the Data Bus. Also, there are no connections to and from the service request line SRQ

ManualsPlus.com



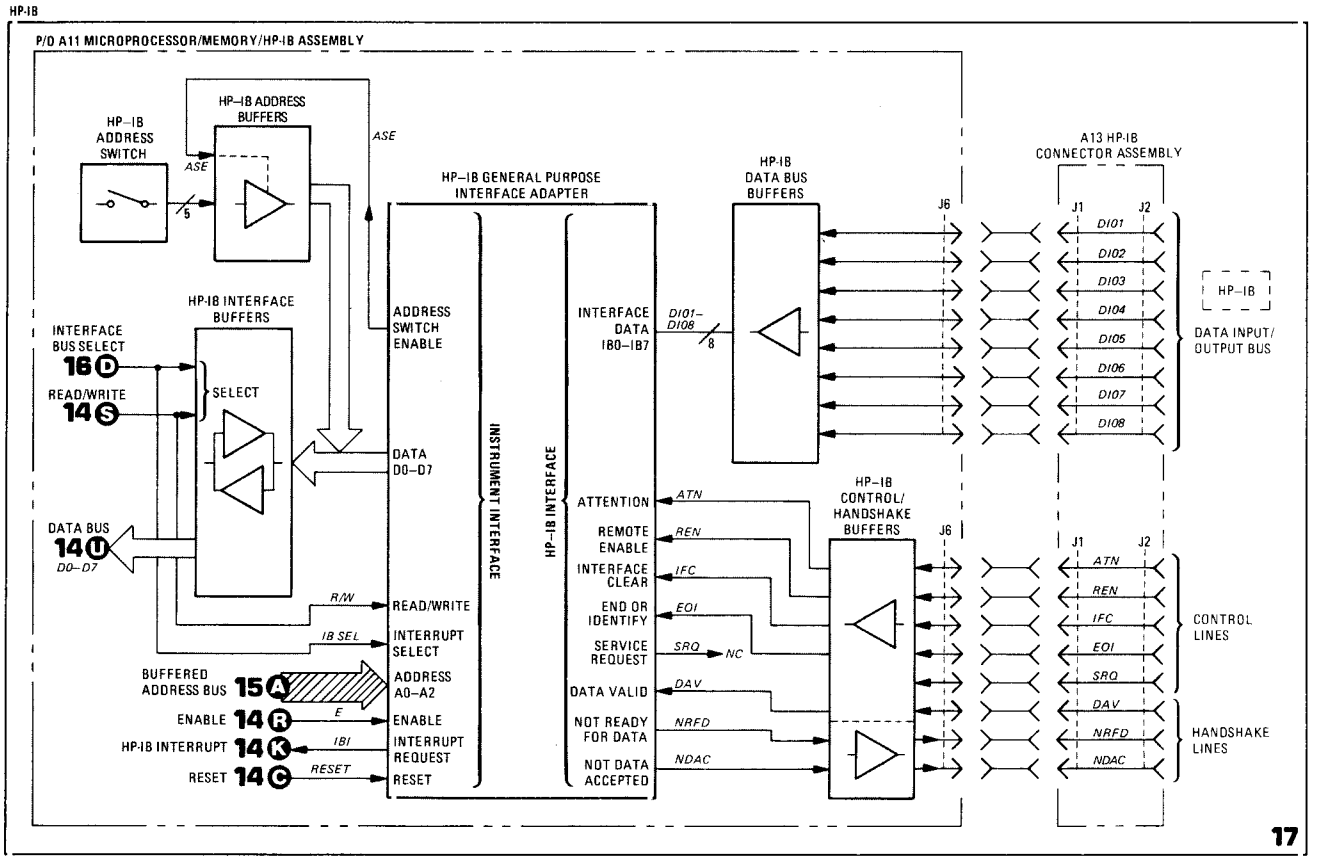
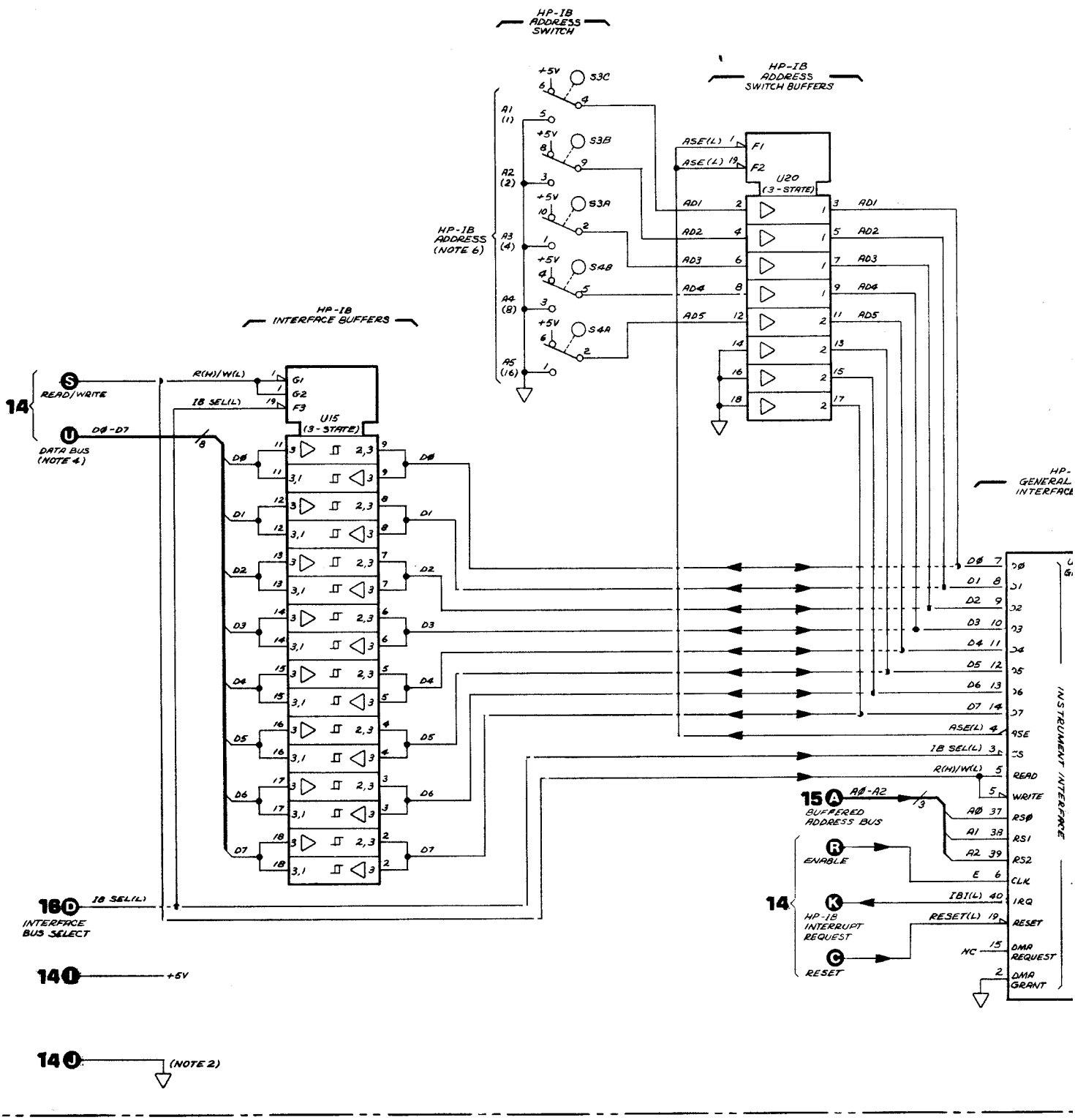
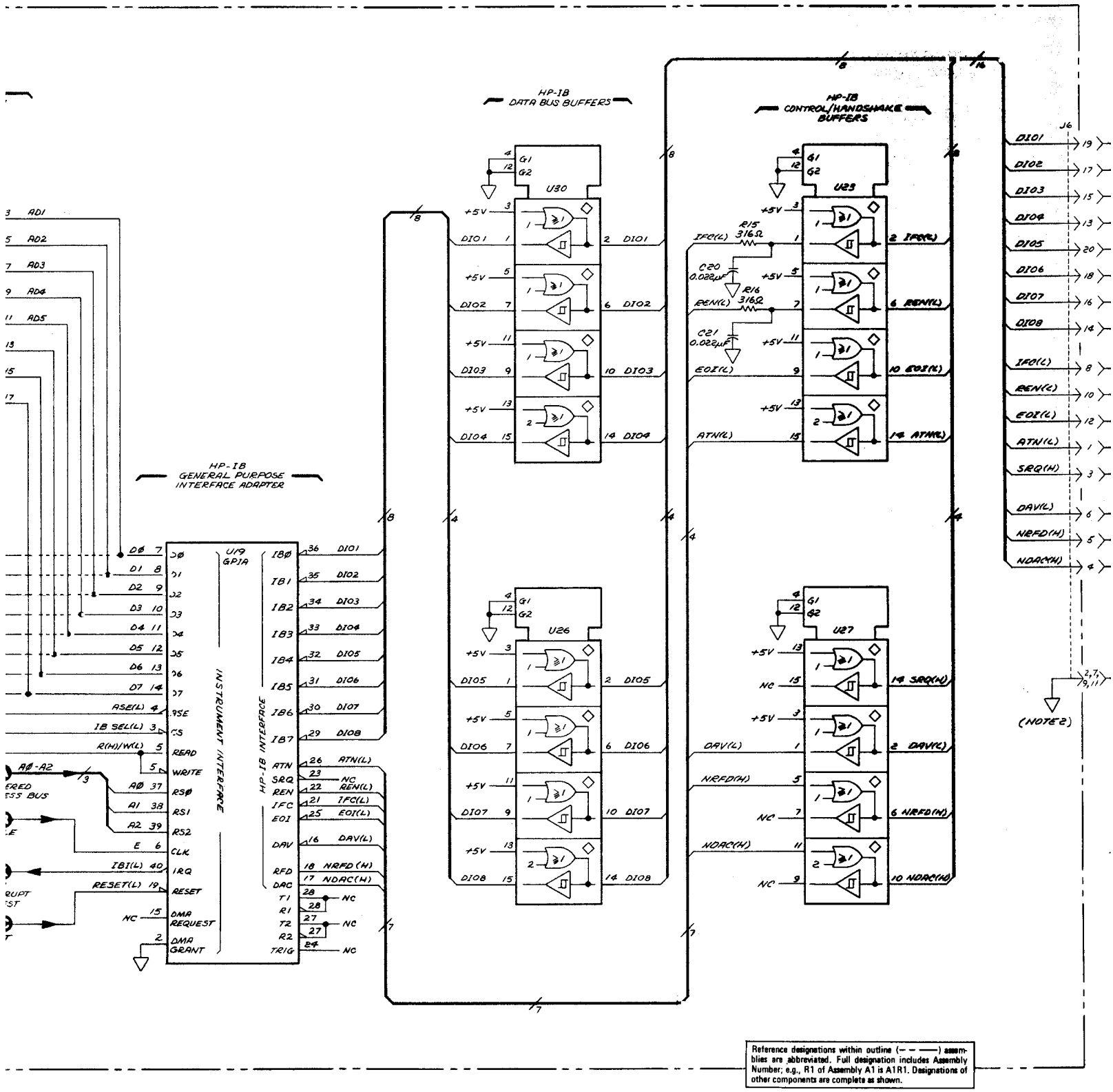


Figure 8-95. HP-IB Interface Block Diagrams

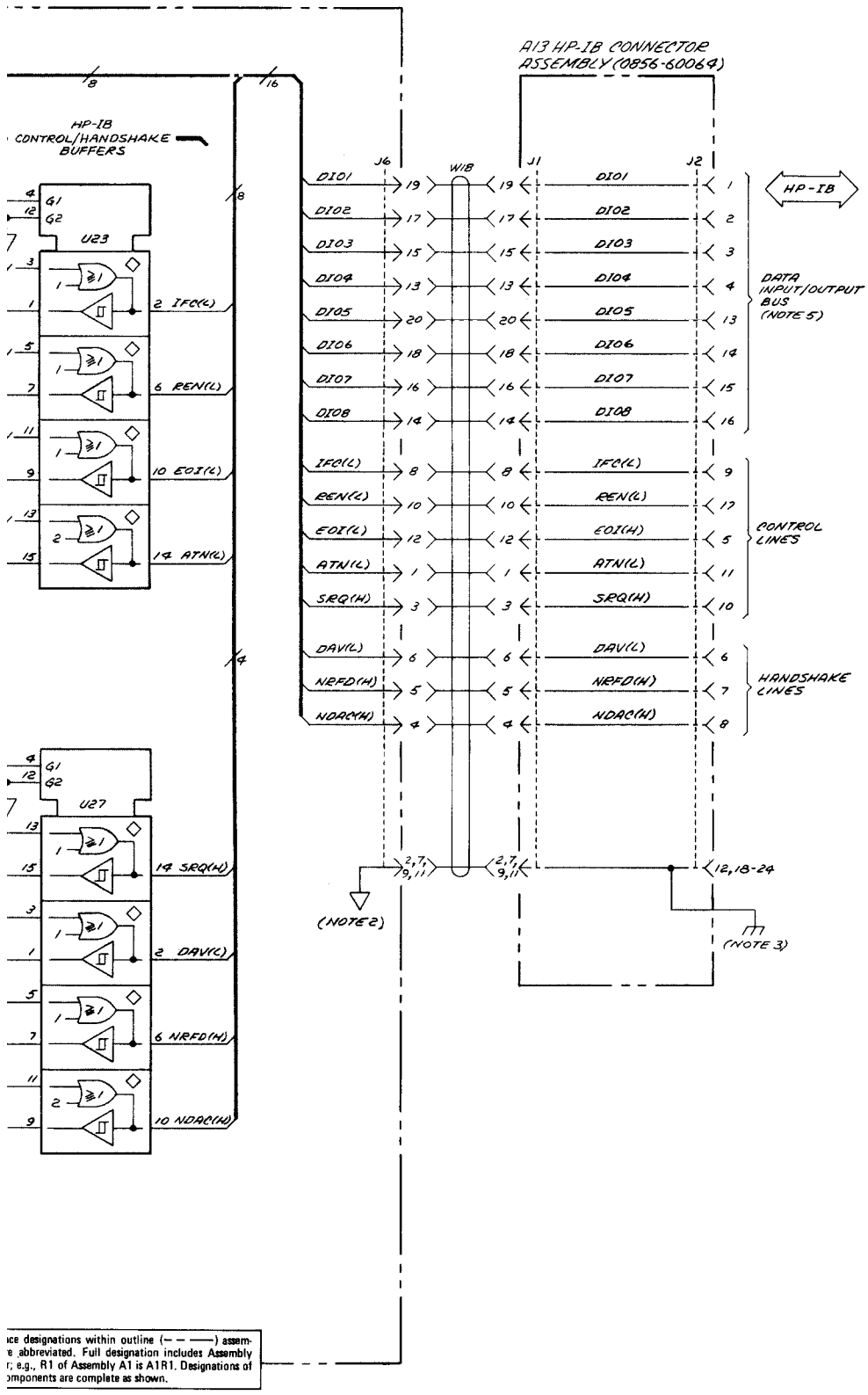
ManualsPlus.com



ManualsPlus.com



ManualsPlus.com



ice designations within outline (— — —) assem-
e abbreviated. Full designation includes Assembly
r; e.g., R1 of Assembly A1 is A1R1. Designations of
omponents are complete as shown.

NOTES

1. SEE TABLE 8-3 FOR SCHEMATIC DIAGRAM NOTES.
2. A11 CHASSIS GROUND IS ACHIEVED THROUGH A11 J5-1 CONNECTION AND MECHANICAL CONTACT WITH FASTENERS HOLDING PC BOARD TO FRAME.
3. A13 CHASSIS GROUND IS ACHIEVED THROUGH A13 J2-12 CONNECTION AND MECHANICAL CONTACT WITH FASTENERS HOLDING PC BOARD TO FRAME.
4. DATA TRANSFERRED ON THE DATA BUS (D0 TO D7) IS POSITIVE TRUE.
5. DATA TRANSFERRED ON THE DATA INPUT/OUTPUT BUS (DIO1 - DIO8) IS NEGATIVE TRUE.
6. HP-IB ADDRESSES GREATER THAN 30 ARE INVALID.

REFERENCE DESIGNATIONS

NO PREFIX	A13
W18	J1, 2
A11	
C20, 21 J6 R15, 16 53, 4 U15, 19, 20, 23, 26, 27, 30	

LOGIC LEVELS

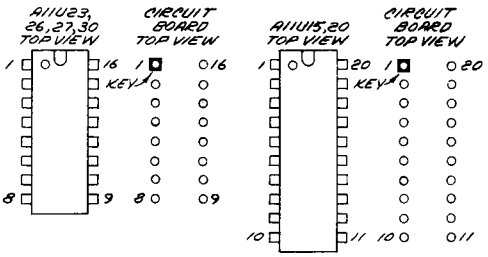
	TTL
HIGH	>2V
LOW	<0.8V
<1S MORE NEG. THAN >1S MORE POS. THAN	
OPEN	HIGH
GROUND	LOW

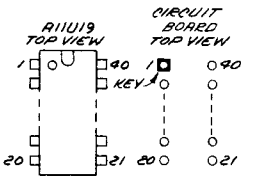
INTEGRATED CIRCUIT PART NUMBERS

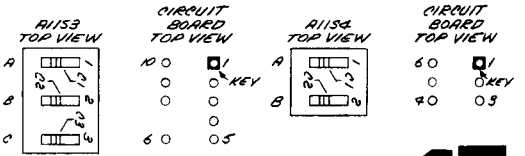
REFERENCE DESIGNATIONS	PIN NUMBERS
A11	
U15,20	+5V - 20 - 10
U19	+5V - 20 - 1
U23,26 27,30	+5V - 16 - 8

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATIONS	PART NUMBERS
A11	
U15	1820-2075
U19	1820-2219
U20	1820-1759
U23,26,27,30	1820-1689







17
P/O A11, A13

Figure 8-96. HP-IB Interface Schematic Diagram

ManualsPlus.com

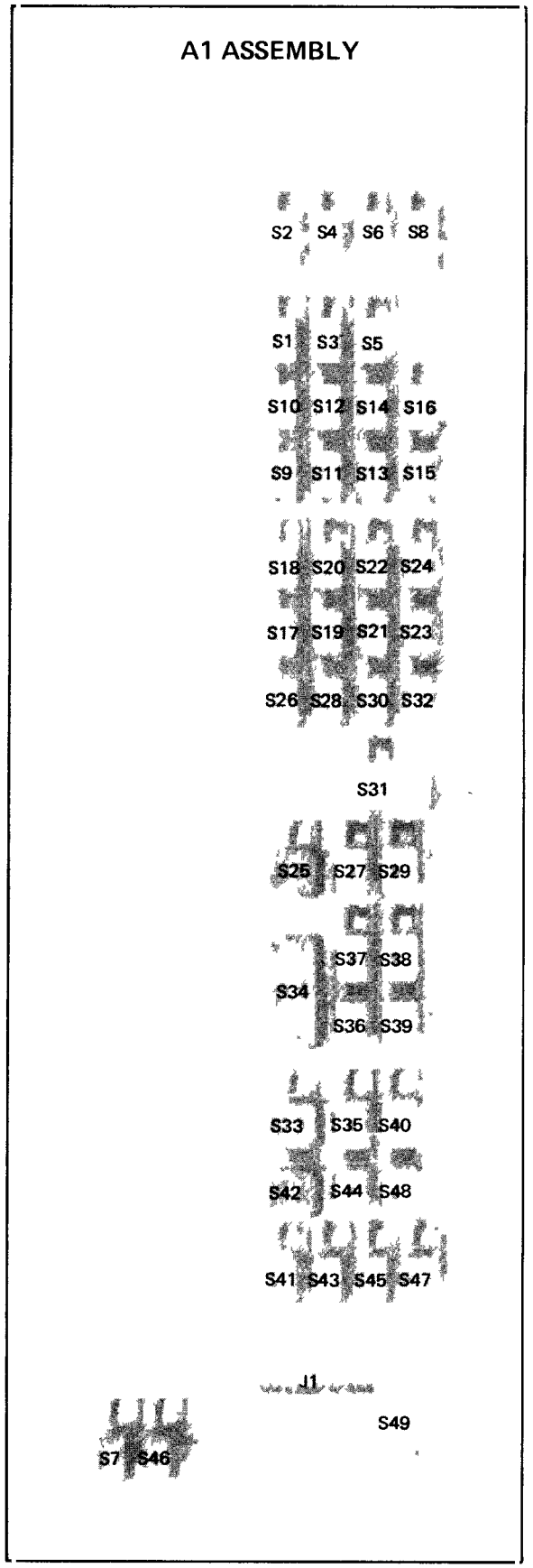


Figure 8-97. Keyboard Component Locations

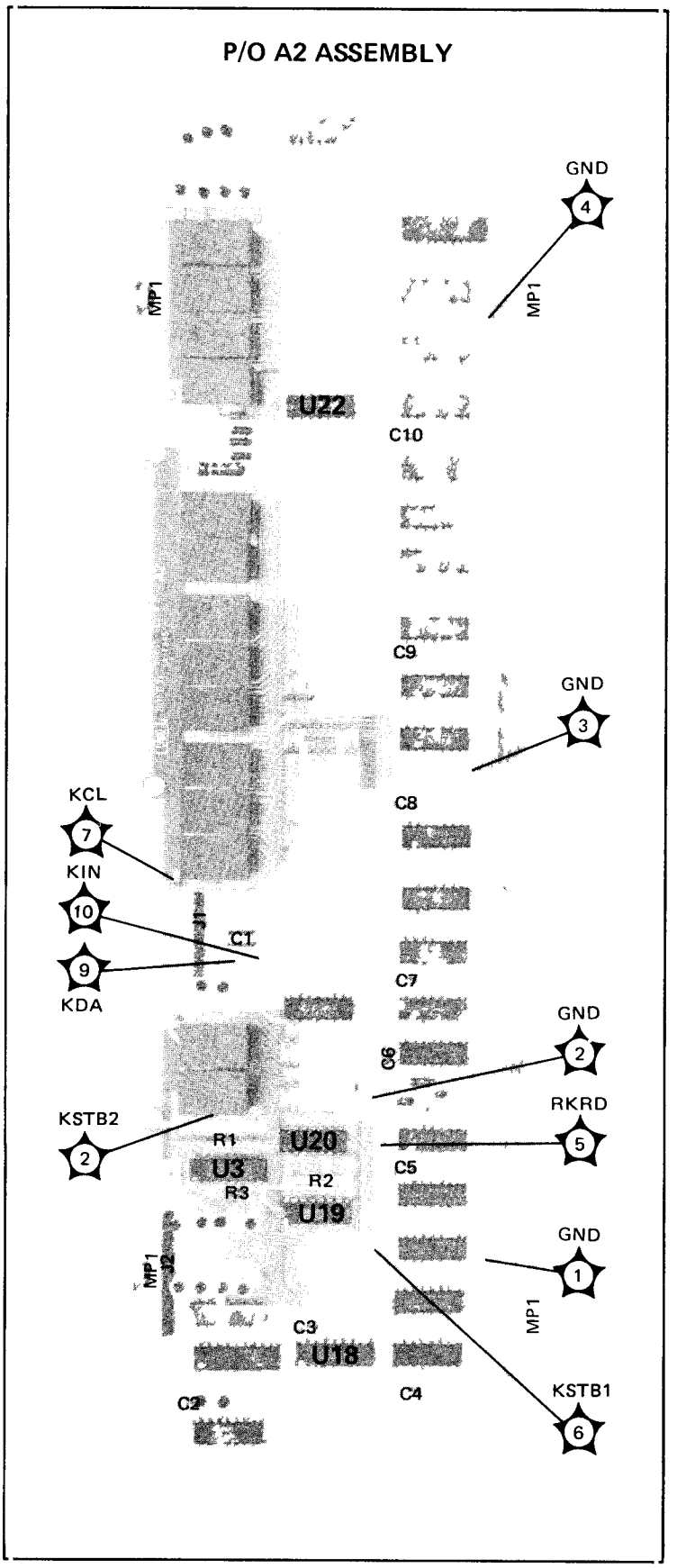


Figure 8-98. Keyboard Encoder Component Locations

ManualsPlus.com

Table 3. Keyboard Signatures (Cont'd)

Key	Correct Signature
FREQ UP	36UA
FREQ DOWN	P914
AMPTD	A91A
AMP UP	PU19
AMP DOWN	U715
INCR SET	9727
7	94P4
4	18P2
1	28UC
0	03A2
8	2AF5
5	6FF6
2	74FA
NO KEY	3FUA
.	14U8
9	173C
6	9C3H
3	AC24
-	807H
MHz	2H7A
KHz	6C79
NO KEY	3FUA
%	7375
←	1347
dBm	1084
dBf	9F82
dB	AF9C
EMF	87F2
V	2205
NO KEY	3FUA
mV	6406
μV	7F0A
SEQ	1UUC
STORE	93UH
RECALL	A3P4
DISPLAY	88CH

Remove the jumpers between A2TP '02' and ground and between A2TP1 'SA7' and A11TP10 'SA6'.

Reset the LOGIC/RAM switch P/O A11S1 to the RAM position.

NOTE

If the HP-IB address switch was changed, reset the address switch (Service Sheet 17) to the original address. Set the front panel RESET-STBY-ON switch to RESET and back to ON.

ManualsPlus.com

2) STOP-OUT
3) CLK-IN

Set up the Signal Generator as follows:

1) Set the LOGIC/RAM switch P/O A11S1 to the LOGIC position.
2) Short A2TP14 'T02' to ground.
3) Connect 'SA6' A11TP10 to 'SA7' A2TP1.

NOTE

If the Signal Generator's address switch has been set to other than '07', the signatures taken in this test will be incorrect. In this case, reset the address switches to A1=1, A2=1, A3=1, A4=0 and A5=0. Then set the front panel RESET/STBY/ON switch to RESET and back to ON.

Initialize. Briefly short A11TP3 'NMI' to ground.

NOTE

With careless probing it is possible to get the Microprocessor into a program sequence other than that portion intended for signature analysis. If the +5V signature is incorrect, this has probably happened. Restart the test by setting 'RST/RUN' switch to 'RST' and then 'RUN'. Briefly touch the 'NMI' test point to ground.

Probe. Connect the probe to 'KDA' A2TP9. Verify that each signature as indicated in Table 3 is correct and stable.

Table 3. Keyboard Signatures

Key	Correct Signature
+5V	F84P
NO KEY	3FUA
LOCAL	1F38
HP-IB ADRS	89P3
EXT	0802
INT 400 Hz	4P01
INT 1 kHz	560H
OFF	363U
AM	35UF
AM UP	C9UA
AM DOWN	A2CA
FM	68U5
FM UP	2PU6
FM DOWN	F24H
FREQUENCY	550C
COARSE TUNE	H90H
FINE TUNE	56F8

ManualsPlus.com

SERVICE SHEET 18 (Cont'd)

3. Verify that keyboard strobes appear on A2TP5, A2TP6 and A2TP8. Note that the signal on A2TP5 comes from the Amplitude Annunciator Latch A2U42 (shown on Service Sheet 21). The strobes for A2U42 as well as the strobes seen on A2TP6 and A2TP8 come from the strobe decoders A2U25 (shown on Service Sheet 19).

√3 Key Column Data Lines

1. Press a front panel key.

2. Verify that the column data line which includes the pressed key is a positive-going pulse. The other column data lines should remain low.

√4 Key Row Data Lines

1. Press a front panel key.

2. Verify that the row data line that includes the pressed key is a negative-going pulse. The other row data lines should remain high.

TROUBLESHOOTING USING SIGNATURE ANALYSIS

Troubleshooting is done on the circuits of Service Sheet 18 when a defect seems to be related to the keyboard. If nothing definite is discovered in performing the signature analysis on this service sheet, consider the other possibilities shown on Service Sheet BD4. Remember that the serial data from the keyboard encoding circuits does pass through the data bus buffers on the way to the Microprocessor (refer to Service Sheet 14). Also, several of the strobes, clocks and control signals are decoded on the circuits of Service Sheet 15. The Load Keyboard Data Strobes are decoded on the circuits of Service Sheet 19. The Read Key Row Data Strobe is latched into A2U42 and is shown on Service Sheet 21.

Purpose. Verify transmission of encoded addresses from Keyboard to Microprocessor.

NOTES

The signatures shown on this service sheet are not valid for instruments with serial prefixes 2018A and below.

Refer to the paragraph entitled REPAIR in this section for front panel keyboard disassembly instructions.

Setup. Connect the signature analyzer as follows:

1) GND to 'GND' A11TP2
2) CLK to 'SA4' A11TP7
3) START to 'SA5' A11TP9
4) STOP to 'SA5' A11TP9

Set the signature anayzer's controls as follows:

1) START-IN

ManualsPlus.com

which the key was pressed. Once the row data is latched, the Microprocessor will clear RKRD.

A parallel-to-serial conversion takes place as the 16 bits of keyboard data are shifted from U3 and U18. As each row bit is shifted out of U3 (pin 9), a column bit is shifted out of U18 (pin 9) into U3 (pin 10). Sixteen keyboard clocks (KCL) later, all 16 bits of keyboard data will have been shifted to the Microprocessor. If the FREQUENCY key had been pressed, the resultant keyboard data sent to the Microprocessor would be as shown in Table 2.

Table 2. Keyboard Data (KDA) With Frequency Key Pressed

Column Data								Row Data							
15*	14*	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	1	0	0	0	0	1	0	1	1	1	1	1	1

* Bits 14 and 15 are tied low.

Capacitors C1 through C10 are used to filter the +5V supply to the Display Assembly circuitry.

TROUBLESHOOTING

Troubleshooting is done on the circuits of Service Sheet 18 when a malfunction seems to have occurred on the keyboard or display. Perform the Troubleshooting Using Signature Analysis on Service Sheets 14, 15, and 16 before attempting to troubleshoot these circuits using this procedure.

NOTE

This troubleshooting information is to be used instead of Troubleshooting Using Signature Analysis for Signal Generators with serial number prefixes 2009A, 2014A and 2018A. If preferred, this information may be used for all Signal Generators regardless of serial number prefix.

Test Equipment

Oscilloscope .....HP 1222A

√1 Keyboard Interrupt and Serial Keyboard Data Output to Microprocessor

1. Press any front panel key.
2. Verify that a negative going pulse of about 5 volts occurs at A2TP10 each time a key is pressed.
3. Verify that at least one pulse train about 16-bits long occurs at A2TP9.

√2 Control Inputs from Microprocessor

1. Press any front panel key.
2. Verify that a series of keyboard clock pulses appear on A2TP7.

ManualsPlus.com

SERVICE SHEET 18
A1 KEYBOARD ASSEMBLY
P/O A2 DISPLAY ASSEMBLY

TROUBLESHOOTING HELP

Service Sheet BD4
Table 4-1. Abbreviated Performance Tests
Table 5-2. Post-Repair Adjustments

PRINCIPLES OF OPERATION

Keyboard Encoding (A1 and A2)

The Keyboard Assembly (A1) is composed of forty-eight pushbuttons or keys. They are hard-wired in an eight row by six column matrix. With none of the keys pressed, the eight row lines will be pulled high (+5V) through a 1 kΩ resistor and the six column lines will be pulled low (0V) through a 10 kΩ resistor. The resultant keyboard data is shown in Table 1.

Table 1. Keyboard Data (KDA) With No Keys Pressed

Column Data								Row Data							
15*	14*	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

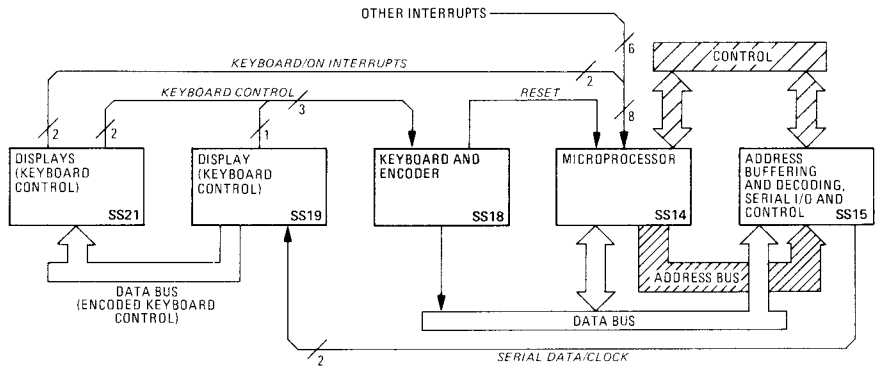
* Bits 14 and 15 are tied low.

Whenever a key is pressed, a row line is connected to a column line through the dividing network of the 1 kΩ and 10 kΩ resistors which are located on the Display Assembly (A2). As long as the key remains pressed, the column line will remain high and the keyboard interrupt will remain issued to the Microprocessor by the Keyboard Interrupt Generator U19. U19 is hard-wired to function as a 6-input NOR gate because its three control lines (pins 11, 12, and 15) are tied low. Also, its output (pin 1) is always enabled because its enable line (pin 2) is tied high. Therefore, whenever a key is pressed, the control line associated with it will be pulled high as previously mentioned. This high will be sensed by U19 which in turn transfers a low to interrupt the Microprocessor (refer to Service Sheet 14).

When the Microprocessor is interrupted, it enters its keyboard read subroutine. A 5 μs keyboard strobe (KSTB1) is decoded (refer to Service Sheet 19) to strobe the column data into the Key Column Data Latch/Shift Register U18. The column data will consist of seven low bits (the two most-significant bits are hard-wired low) and one high bit. The high bit will be in the bit position that is associated with the column position in which the key was pressed.

Once the column data is latched, the Microprocessor issues a Read Key Row Data (RKRD) signal (refer to Service Sheet 21). This signal is inverted by U22G and applied to the six inputs of the Key Row Data Read Pull-Down U20 to force all six column lines low so that the row data can be read. When the column lines are all forced low, the row line associated with the pressed key will also be forced low. Forcing the column lines low will also disable the keyboard interrupt. Next, another 5 μs keyboard strobe (KSTB2) is decoded (refer to Service Sheet 19) to strobe the row data into the Key Row Data Latch/Shift Register U3. The row data will consist of seven high bits and one low bit. The low bit will be in the bit position that is associated with the row position in

ManualsPlus.com



KEYBOARD AND ENCODING

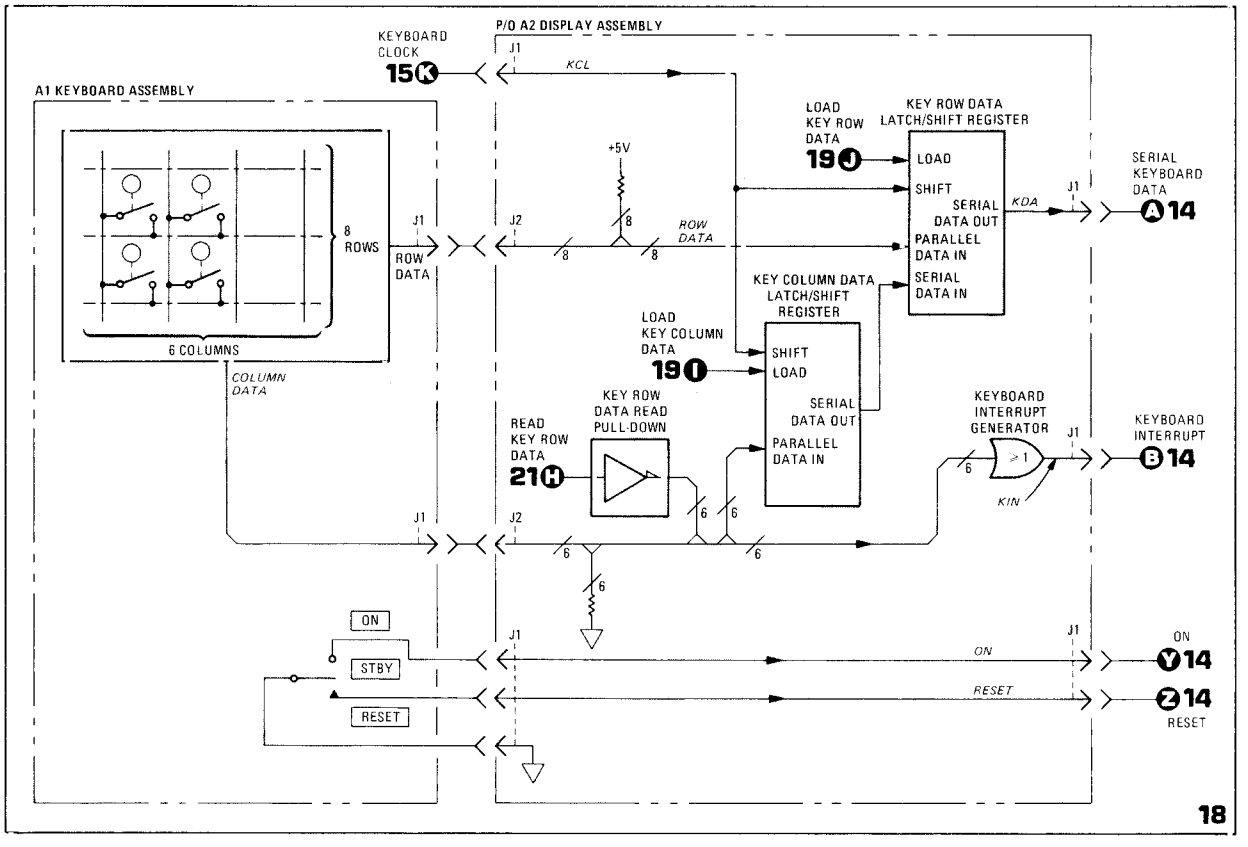
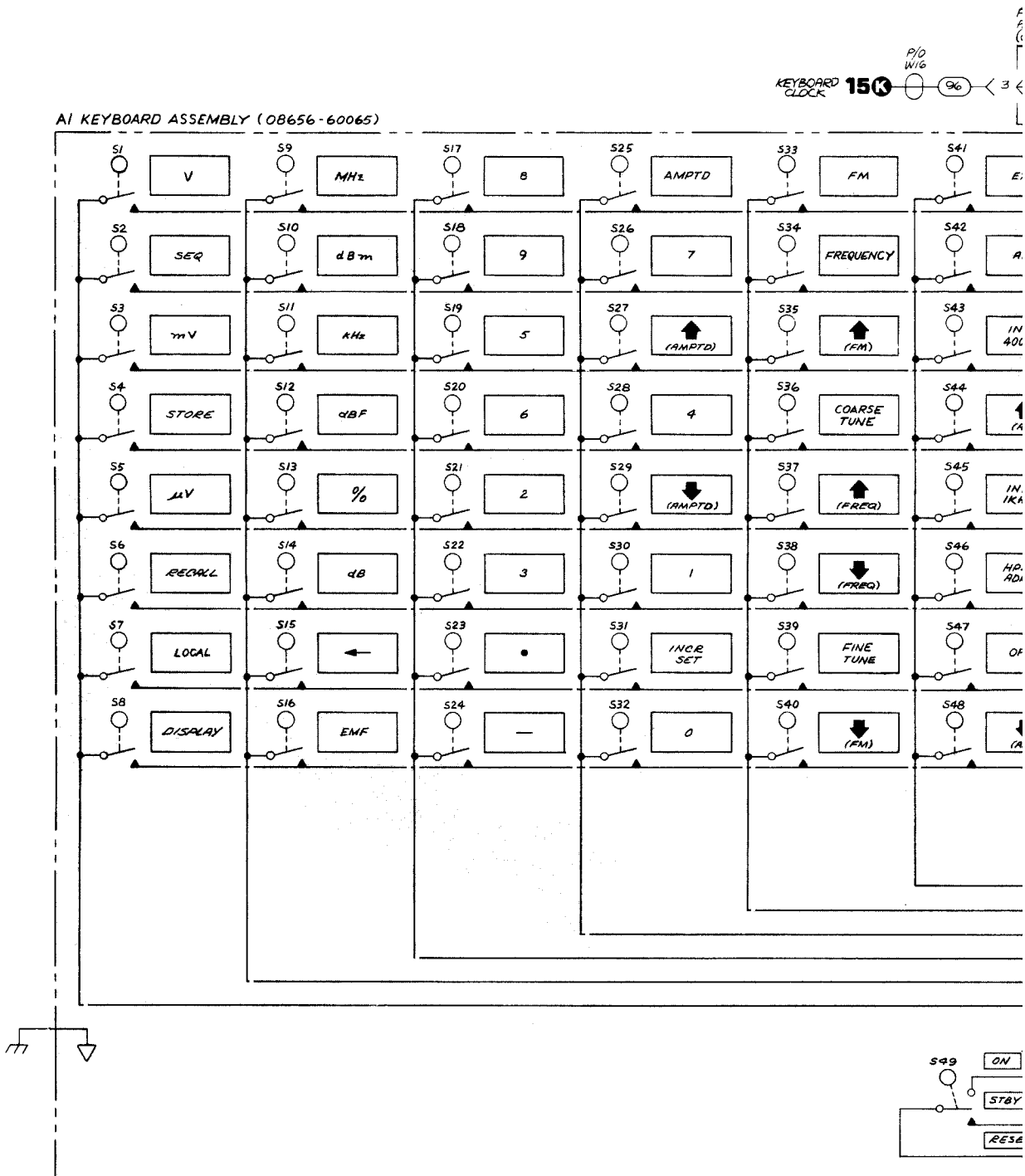
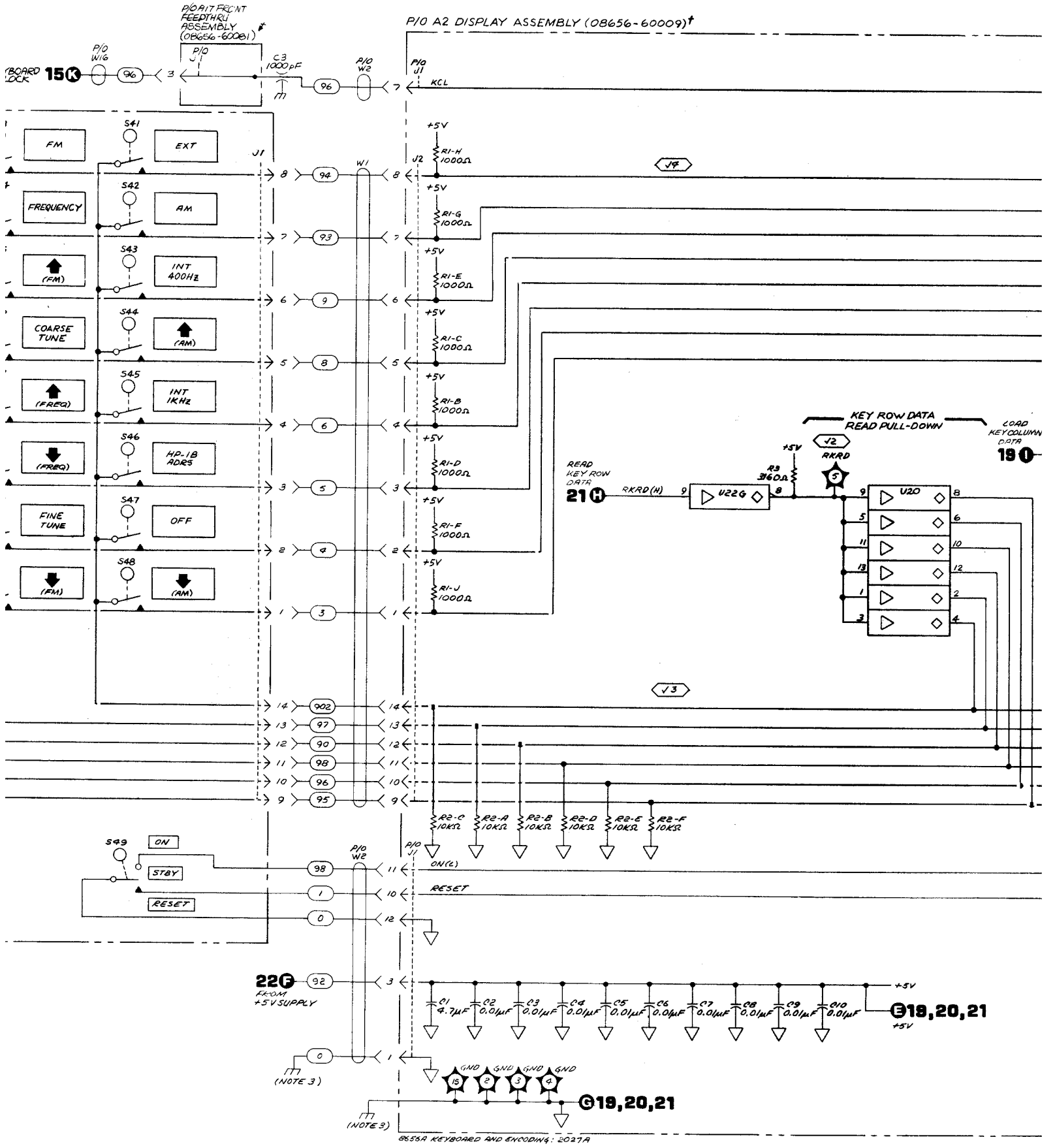


Figure 8-99. Keyboard and Encoder Block Diagrams

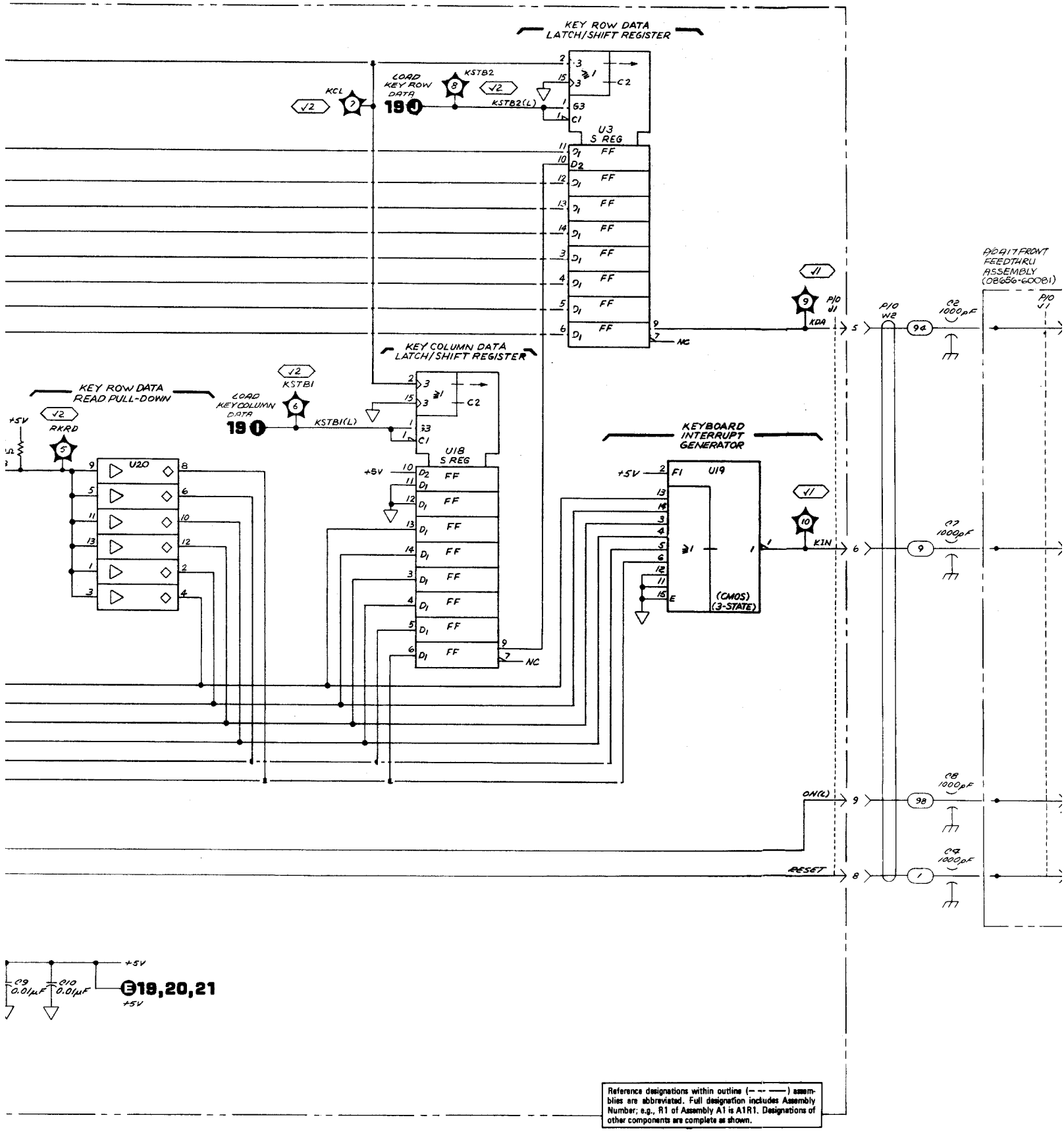
ManualsPlus.com



ManualsPlus.com



ManualsPlus.com



Reference designations within outline (— -- —) assemblies are abbreviated. Full designation includes Assembly Number; e.g., R1 of Assembly A1 is A1R1. Designations of other components are complete as shown.

ManualsPlus.com

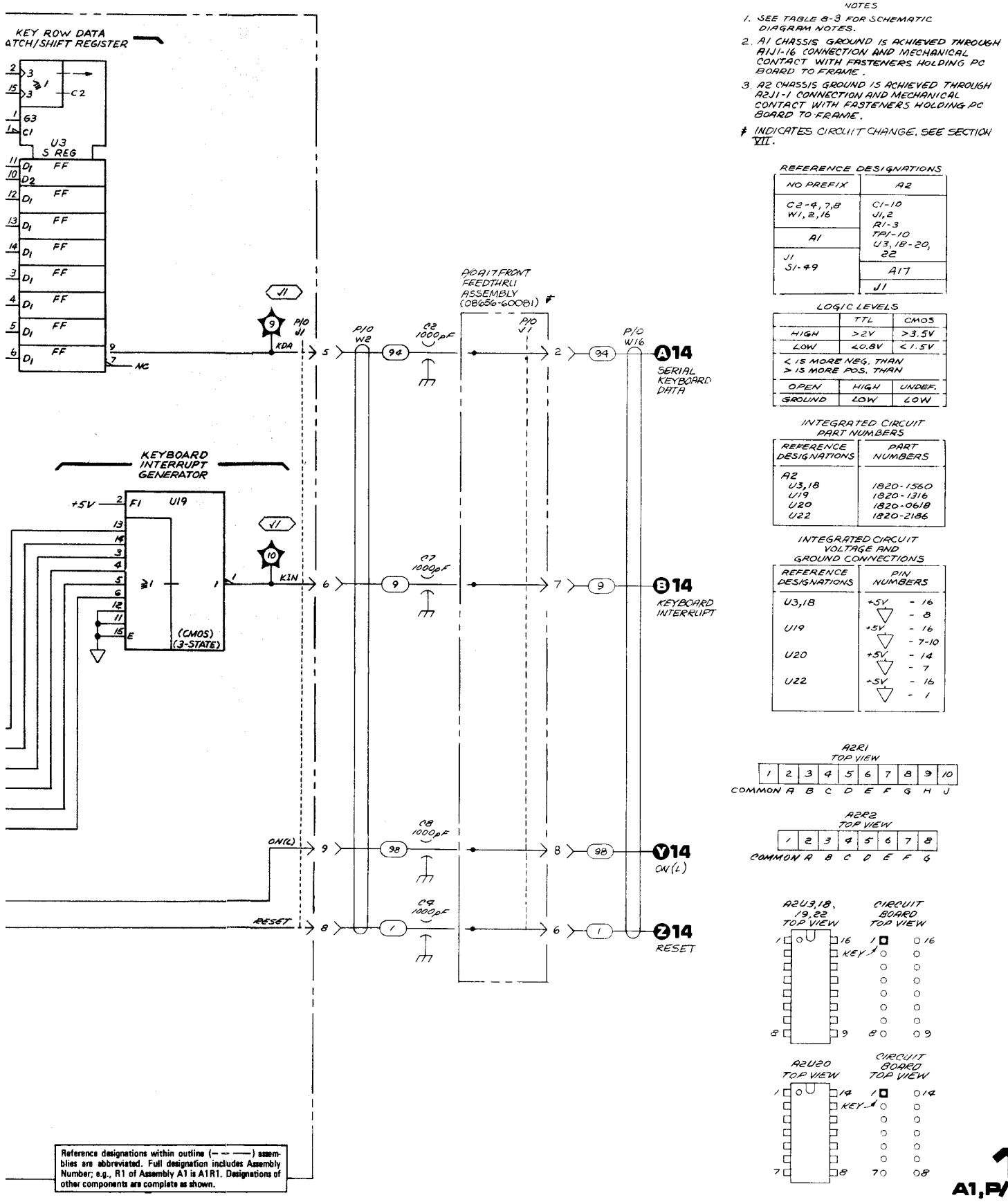


Figure 8-100. Keyboard and Encoder Schematic Diagram

ManualsPlus.com

SERVICE SHEET 19 (Cont'd)

Table 2. Display and Keyboard Strobe Signatures

Node	Correct Signature*	Comments
+5V	H6H5	
U26 #7	C524	
U26 #9	FU10	
U26 #10	66UF	
U26 #11	1F0A	
U26 #12	5A73	
U26 #13	P3HA	
U26 #14	A128	
U26 #4	FP00	
U26 #6	H6H5	no blink
+5V	H6H5	
U25 #9	H161	
U25 #10	CP72	
U25 #11	93AH	
U25 #12	PH45	
U25 #13	FF4P	
U25 #14	8H64	
U25 #4	FP00	
U25 #6	H6H5	no blink

*Probe tip should blink.

Test 3. Decimal Point Data Transmission Check

Purpose. To verify transmission of encoded decimal point data from the Microprocessor to the Frequency Display Decimal Point Latch.

Setup. Connect the signature analyzer controls as follows:

1) GND to 'GND' A11TP2
2) START to SA5 A11TP9
3) STOP to SA5 A11TP9
4) CLK to SA4 A11TP7

Set the signature analyzer's controls as follows:

1) START-IN
2) STOP-OUT
3) CLK-IN

Set up the Signal Generator as follows:

1) Set the LOGIC/RAM switch to the LOGIC position.
2) Connect a jumper between A2TP14 'T02' and ground.
3) Connect a jumper between A11TP10 'SA6' and A2TP15 'SA7'.

NOTE

If the Signal Generator's address switch has been set to other than '07', the signatures taken in this test will be incorrect. In this case, reset the address switches to A1=1, A2=1, A3=1, A4=0 and A5=0. Then set the front panel RESET-STBY-ON switch to RESET and back to ON.

Initialize. Briefly short A11TP3 NMI to ground.

NOTES

With careless probing it is possible to get the Microprocessor into a program sequence other than that portion intended for signature analysis. If the +5V signature is incorrect, this has probably happened. Restart the test by setting the RST/RUN switch to RST and then RUN. Briefly touch the NMI test point to ground.

All LEDs should be cycling on and off rapidly.

Probe. Connect the probe to each node shown in Table 3. Verify that each signature is correct and stable.

Table 3. Decimal Point Signatures

Node	Correct Signature	Comments
+5V	F84P	
U30 #2	F9H9	FR DP 3
U30 #5	8C19	FR DP 2
U30 #7	54PH	FR DP 1
U30 #10	7903	FR DP 4
U30 #12	A44F	FR DP 5
U30 #15	5FC5	FR DP 6

Remove the jumpers between test points and a test point and ground. Reset the LOGIC/RAM switch to the RAM position.

If the HP-IB switch was changed, reset the address switch to the original address. Then set the front panel RESET-STBY-ON switch to RESET and back to ON.

ManualsPlus.com

SERVICE SHEET 19 (Cont'd)

Test 2. Display Strobe Data Transmission and Decoder Check

Purpose. To verify transmission of encoded display strobe data from the Microprocessor through the Display Strobe Decoders.

Setup. Connect the signature analyzer as follows:

1) CLK to 'E' A11TP11
2) START to 'SA1' A11TP5
3) STOP to 'SA2' A11TP6

Set the signature analyzer's controls as follows:

1) START-OUT
2) STOP-IN
3) CLK-IN

Set up the Signal Generator as follows:

1) Set the LOGIC/RAM switch P/O A11S1 to LOGIC.
2) Connect a jumper between A2TP14 T02 and ground.
3) Connect a jumper between A11TP10 SA6 and A2TP1 SA7.

NOTE

If the Signal Generator's address switch has been set to other than '07', the signatures taken in this test will be incorrect. In this case, reset the address switches to A1=1, A2=1, A3=1, A4=0 and A5=0. Then set the front panel RESET-STBY-ON switch to RESET and back to ON.

Initialize. Briefly short A11TP3 NMI to ground.

NOTES

With careless grounding of the test point, it is possible to get the Microprocessor into a program routine other than that portion intended for signature analysis. If the +5V signature is incorrect, this has probably happened. Restart the test by setting the RST/RUN switch to RST and then RUN. Briefly touch the NMI test point to ground.

All LEDs should be cycling on and off rapidly.

Probe. Connect the probe to each node shown in Table 2. Verify that each signature is correct and stable.

If troubleshooting is completed and the signatures are taken,remove the jumpers installed between test points and/or ground. Reset the LOGIC/RAM switch to the RAM position. Also, if the HP-IB switch was changed, reset the address switch (refer to Service Sheet 17) to the original address. Set the front panel RESET-STBY-ON switch to RESET and back to ON.

ManualsPlus.com

SERVICE SHEET 19 (Cont'd)

NOTE

If the Signal Generator's address switch has been set to other than '07', the signatures taken in this test will be incorrect. In this case, reset the address switches to A1=1, A2=1, A3=1, A4=0 and A5=0. Then set the front panel RESET-STBY-ON switch to RESET and back to ON.

Initialize. Briefly short A11TP3 'NMI' to ground.

NOTE

With careless probing it is possible to get the Microprocessor into a program sequence other than that portion intended for signature analysis. If the +5V signature is incorrect, this has probably happened. Restart the test by setting the RST/RUN switch to RST and then RUN. Briefly touch the NMI test point to ground.

Probe. Connect the probe to each node shown in Table 1. Verify that each signature is correct and stable.

Table 1. Display Data Signatures

Node	Correct Signature	Comments
+5V	F84P	
*U24 #8	F84P	DISP CLK
U24 #1	6UPP	DISP DATA
U24 #3	8A0H	
U24 #4	HCH1	
U24 #5	F06F	
U24 #6	F672	
U24 #10	05C8	
U24 #11	2235	
U24 #12	6UH4	
U24 #13	37PA	
U23 #3	2UAU	
U23 #4	7241	
U23 #5	P6U4	
U23 #6	A161	
U23 #10	890U	
U23 #11	FH78	
U23 #12	C382	
U23 #13	7758	

*Probe should blink.

If troubleshooting is completed, remove the jumpers and reset the LOGIC/RAM switch to RAM. Also, if the HP-IB address switch was changed, reset the address switch (Service Sheet 17) to the original address. Then set the front panel RESET-STBY-ON switch to RESET and back to ON.

ManualsPlus.com

SERVICE SHEET 19 (Cont'd)

⟨√2⟩ Serial Data Entry and Timing

1. Verify that U28B-Pin 5 goes high for 5 μs but 72 μs after the last clock pulse ends.

2. Verify that a clock pulse train occurs at A2TP11 for each keystroke.

TROUBLESHOOTING USING SIGNATURE ANALYSIS

Troubleshooting is done on the circuits of Service Sheet 19 when a defect seems to be related to the front panel displays or keyboard operation. The troubleshooting provided is signature analysis although looking at the various displays or realizing that the problem is due to a keyboard malfunction may provide more information about a possible defect. If all the signatures on this service sheet are correct, take another look at the symptoms which brought you to this service sheet. Determine if the problem may be related to circuitry contained on Service Sheets 18, 20 or 21. If any signatures on this service sheet are incorrect, recall that the data and strobes, clocks and other control signals are passed through circuitry of Service Sheet 15 before arriving here. As a last resort, return to Service Sheet BD4 and consider the other possibilities shown.

Test Equipment

Signature Analyzer .....HP 5004A

NOTE

The signatures shown on this service sheet are not valid for Signal Generators with serial numbers prefixed 2018A and below.

Test 1. Display Data Transmission Check

Purpose. To verify transmission of encoded display data from the Microprocessor to the Display Address and Display Data Shift Registers.

Setup. Connect the signature analyzer as follows:

1) GND to 'GND'
2) CLK to 'SA4' A11TP7
3) START to 'SA5' A11TP5
4) STOP to 'SA5' A11TP9

Set the signature analyzer's controls as follows:

1) START-IN
2) STOP-OUT
3) CLK-IN

Set up the Signal Generator as follows:

1) Set the LOGIC/RAM switch P/O A11S1 to LOGIC.
2) Connect a jumper from A2TP14 T02 to ground.
3) Connect a jumper between A11TP10 SA6 and A2TP1 SA7.

ManualsPlus.com

SERVICE SHEET 19 (Cont'd)

Perform the Troubleshooting Using Signature Analysis on Service Sheets 14, 15, and 16 as well as the Troubleshooting on Service Sheet 18 before attempting to troubleshoot these circuits using this procedure.

NOTE

This troubleshooting information is to be used instead of Troubleshooting Using Signature Analysis for Signal Generators with serial number prefixes 2009A, 2014A and 2018A. If preferred, this information may be used for all Signal Generators regardless of serial number prefix.

Test Equipment

Oscilloscope .....HP 1222A

√1 Display Clock

1. Verify that the display changes and/or the correct strobe occurs with each keystroke as shown in Table 1.

Table 1. Active Display Strobe versus Change in Displayed Information

Display Strobe	Change in Displayed Information
DSTB1	HP-IB annunciators REMOTE or ADDRESS Modulation decimal point Modulation annunciators % or kHz Frequency digit 8.
DSTB2	Modulation annunciators: EXT AM, INT AM, EXT FM, INT FM, HI EXT, LO EXT, 400 Hz or 1 kHz.
DSTB3	Modulation digits 1 or 2
DSTB4	Frequency decimal point
DSTB5	Frequency digit 1 or 2
DSTB6	Frequency digit 3 or 4
DSTB7	Frequency digit 5 or 6
DSTB8	Frequency digit 7 or amplitude digit 2
DSTB9	Amplitude digit 3 or 4
DSTB10	Amplitude digit 1, amplitude digit decimal point or the amplitude sign (plus or minus).
DSTB11	Amplitude annunciators: dBm, dBf, dB, EMF, V, mV, or μV or RKRD* (Read Key Row Data).
KSTB1	any key*
KSTB2	any key*

*DSTB11 (due to RKRD), KSTB1 and KSTB2 are strobed each time a key is pressed.

ManualsPlus.com

SERVICE SHEET 19
P/O A2 DISPLAY ASSEMBLY

TROUBLESHOOTING HELP

Service Sheet BD4
Table 4-1. Abbreviated Performance Tests
Table 5-2. Post-Repair Adjustments

PRINCIPLES OF OPERATION

Display Control

Sixteen bits of serial display data (DDA) are sent from the Microprocessor via the Serial I/O control circuits (refer to Service Sheet 15) to Data Shift Registers U24 and U23 respectively. Six of the eight bits stored in U24 are decoded to produce eleven display strobes (DSTB1 through DSTB11) and two keyboard strobes (KSTB1 and KSTB2). DSTB1 through DSTB3 are used to strobe modulation display data (refer to Service Sheet 21), DSTB4 through DSTB8 are used to strobe frequency display data (refer to Service Sheet 20), DSTB8 through DSTB11 are used to strobe amplitude display data (refer to Service Sheet 21), and the two keyboard strobes (KSTB1 and KSTB2) are used to strobe column and row data from the keyboard (refer to Service Sheet 18). Strobe decoding takes place in the Display and Keyboard Strobe Decoders U26 and U25. The decoder outputs remain high until all 16 bits of display data are shifted in and settled.

Display data is shifted into the two shift registers by the display clock (DCL). Each transition of the display clock triggers U28A which forms part of the Serial Data Entry Timing Control circuitry. This circuitry is used to ensure that the data has at least 72 μs to settle after the last clock pulse clocks the sixteenth data bit into U24. When U28A times out, it clocks U28B which goes high for 5 μs to cause the bits stored in U24 to be decoded. During the period that the strobe is active (low), the display data stored in U23 will be decoded and latched to drive the respective 7-segment display or LED annunciator (refer to Service Sheets 20 and 21).

Frequency display decimal point drive is developed when display data bits 2 through 7 are strobed into the Frequency Display Decimal Point Latches U30 by DSTB4. The Microprocessor ensures that only one of these bits is active (low) at any given time (except during the power-up subroutine). When one of these bits is active (low), the associated decimal point control line (U6 through U11-Pin 9) will be pulled high through the associated network resistor (R6A, R7A, R8A, R9A, R10A, and R11A) to light the respective decimal point (refer to Service Sheet 20). When the bits are inactive (high), the stored output will be inverted by the associated Frequency Display Decimal Point Driver U21B through U21G. This will cause the associated decimal point control line (U6 through U11-Pin 9) to be pulled low to inhibit the respective decimal point from being lit.

TROUBLESHOOTING

Troubleshooting is done on the circuits of Service Sheet 19 when a malfunction seems to have occurred in the keyboard or display.

ManualsPlus.com

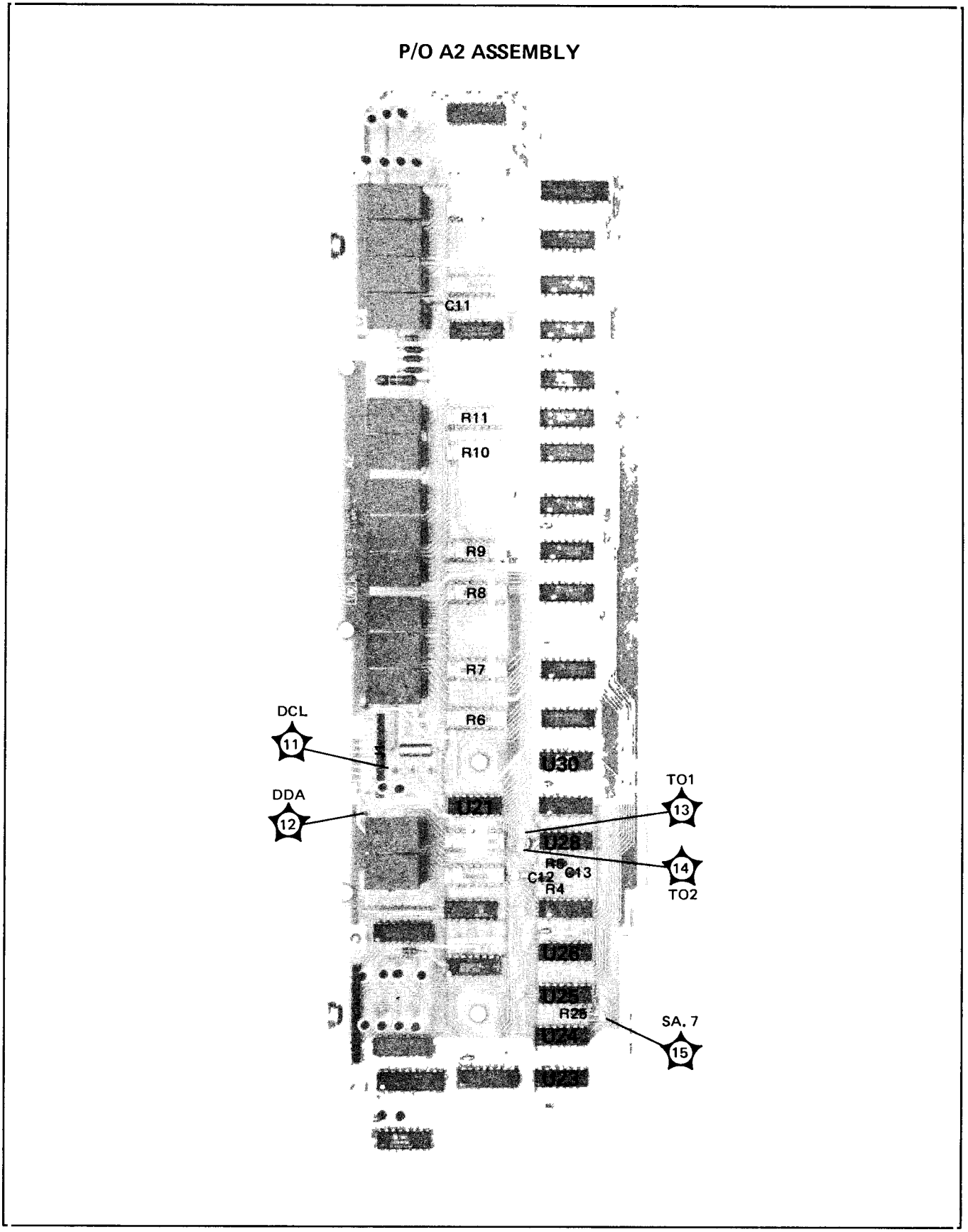
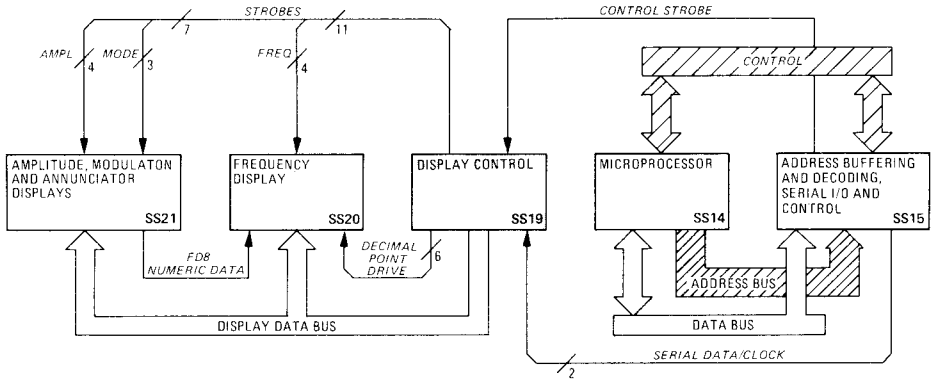


Figure 8-101. Display Control Component Locations

ManualsPlus.com



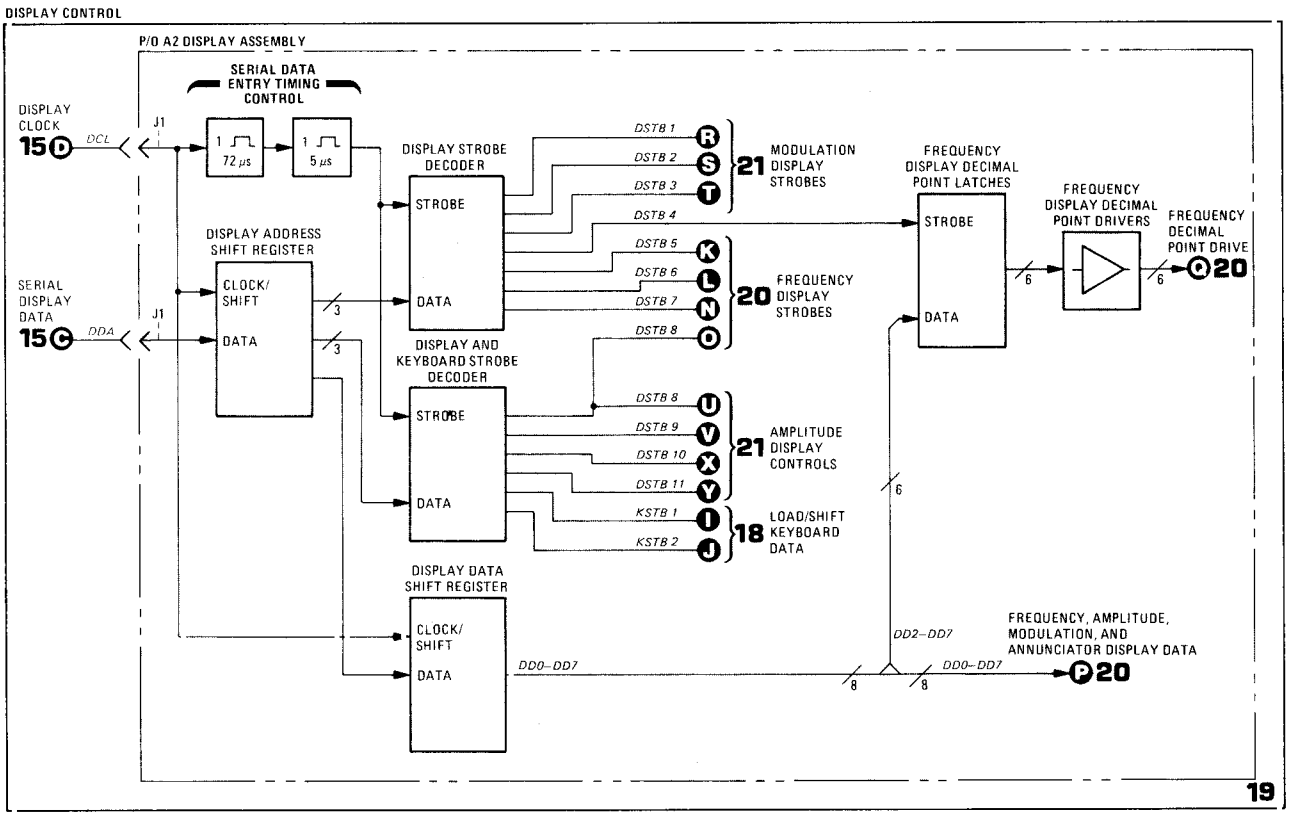
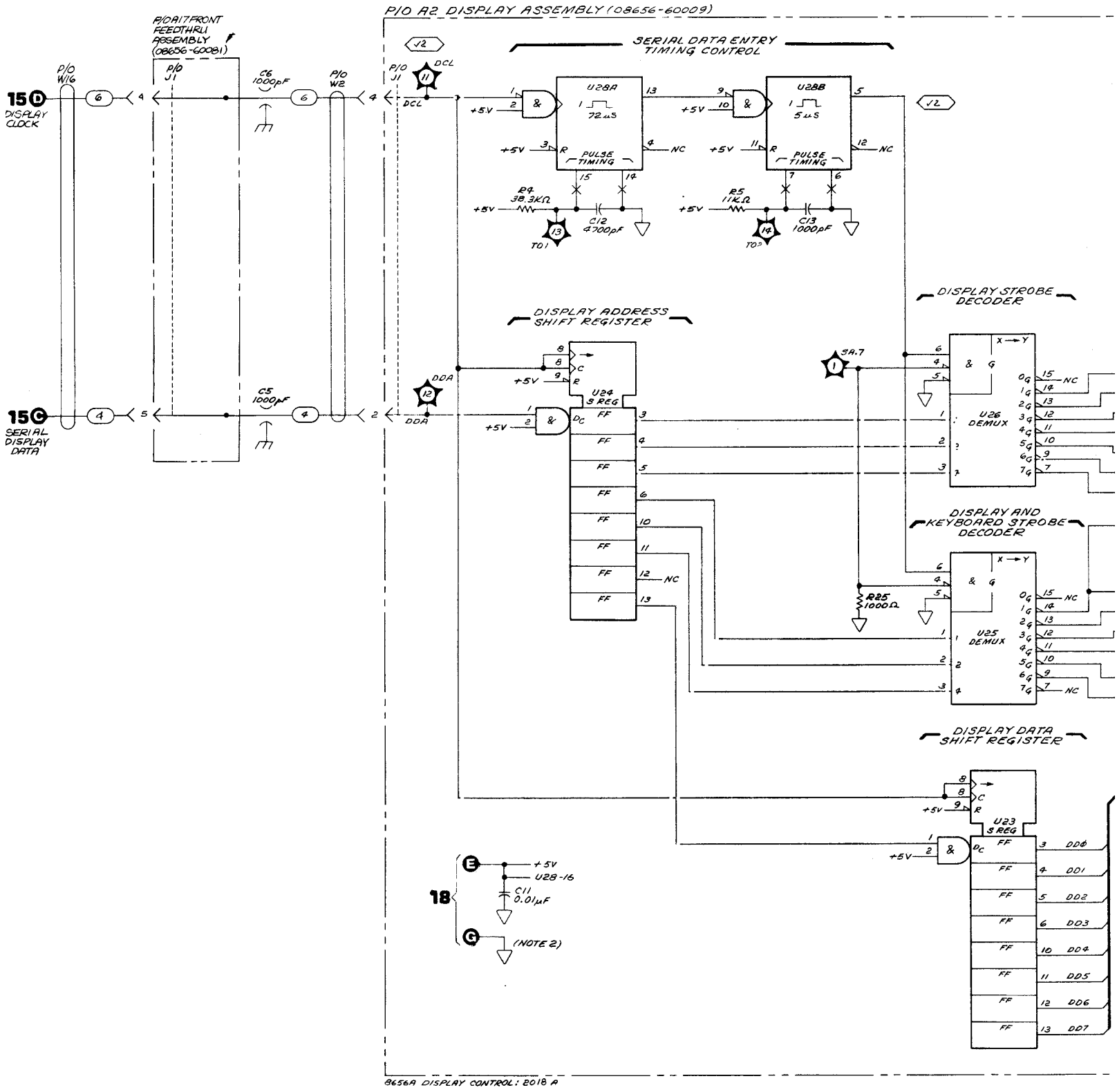
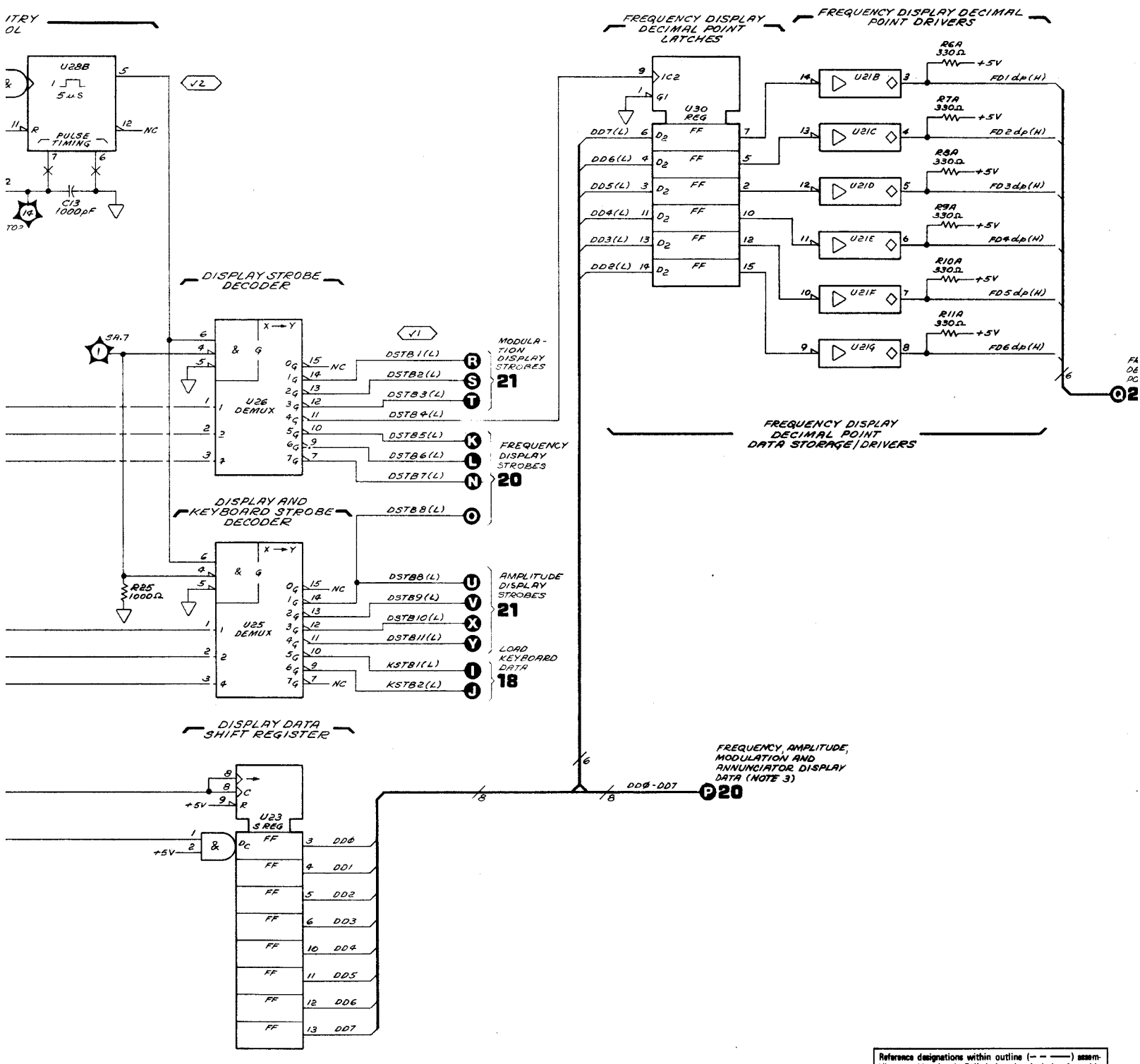


Figure 8-102. Display Control Block Diagrams

ManualsPlus.com

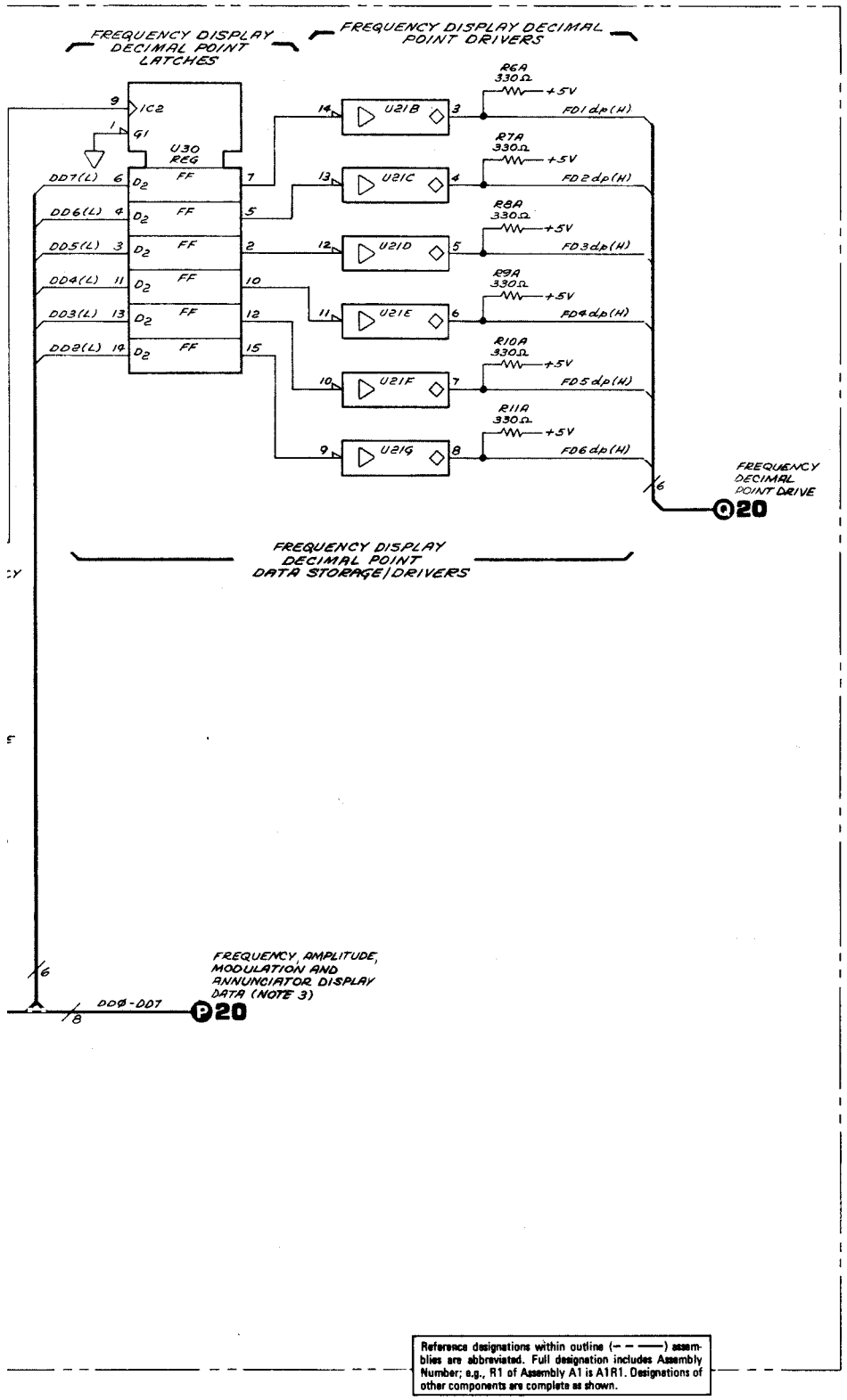


ManualsPlus.com



Reference designations within outline (– – ——) assemblies are abbreviated. Full designation includes Assembly Number; e.g., R1 of Assembly A1 is A1R1. Designations of other components are complete as shown.

ManualsPlus.com



Reference designations within outline (– – ——) assemblies are abbreviated. Full designation includes Assembly Number; e.g., R1 of Assembly A1 is A1R1. Designations of other components are complete as shown.

NOTES

1. SEE TABLE 8-3 FOR SCHEMATIC DIAGRAM NOTES.
2. CHASSIS GROUND IS ACHIEVED THROUGH A2J1-1 CONNECTION AND MECHANICAL CONTACT WITH FASTENERS HOLDING PC BOARD TO FRAME.
3. DISPLAY DATA BUS (DD0-DD7) IS POSITIVE TRUE FOR NUMERIC DATA, EXCEPT FOR FD8.
   DISPLAY DATA BUS (DD0-DD7) IS NEGITIVE TRUE FOR FD8 NUMERIC, DECIMAL POINT, SIGN AND ANNUNCIATOR DATA.

# INDICATES CIRCUIT CHANGE, SEE SECTION VII.

REFERENCE DESIGNATIONS

NO PREFIX	A2
C5,6 W2,16	C11-13 J1 R4-11,25 TP11-15 U21,23-26,28,30
A17	
J1	

LOGIC LEVELS

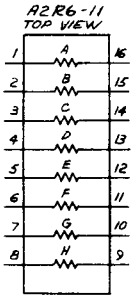
	TTL
HIGH	> 2V
LOW	> 0.8V
< IS MORE NEG. THAN > IS MORE POS. THAN	
OPEN	HIGH
GROUND	LOW

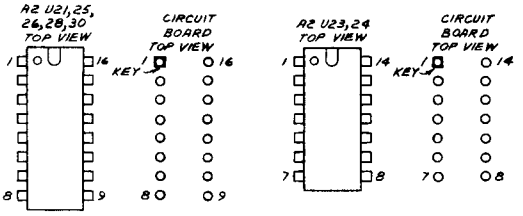
INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATIONS	PART NUMBERS
A2	
U21	1820-2186
U23,24	1820-1433
U25,26	1820-1216
U28	1820-1423
U30	1820-2056

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATIONS	PART NUMBERS
A2	
U21	+5V - 16 ▽ - 1
U23,24	+5V - 14 ▽ - 7
U25,26,28,30	+5V - 16 ▽ - 8





19
P/O A2

Figure 8-103. Display Control Schematic Diagram

ManualsPlus.com

P/O A2 ASSEMBLY

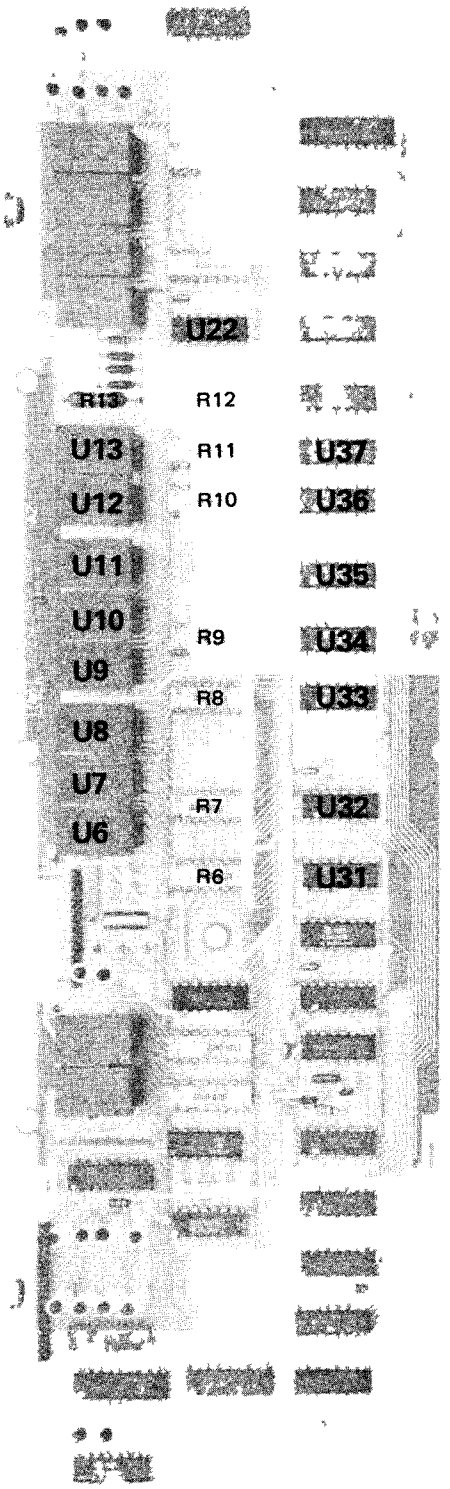


Figure 8-104. Frequency Displays Component Locations

ManualsPlus.com

Table 1. Frequency Display Data Signatures (Cont'd)

Node	Correct Signature	Comments
U36 #12	26HP	FR DIG 6
U36 #13	PHP1	(Cont'd)
U36 #14	1U22	
U36 #15	82C0	
+5V	F84P	
U37 #9	9F11	FR DIG 7
U37 #10	1F17	
U37 #11	8582	
U37 #12	PUHF	
U37 #13	HUU9	
U37 #14	A360	
U37 #15	6847	

Remove the jumpers between test points and between test point and ground. Reset the LOGIC/RAM switch to RAM.

If the HP-IB address switch was changed, reset the address switch (Service Sheet 17) to the original address. Set the front panel RESET-STBY-ON switch to RESET and back to ON.

ManualsPlus.com

SERVICE SHEET 20 (Cont'd)

Table 1. Frequency Display Data Signatures

Node	Correct Signature	Comments
+5V	F84P	FR DIG 1
U31 #9	54A0	
U31 #10	0H80	
U31 #11	09FF	
U31 #12	1HAA	
U31 #13	01H8	
U31 #14	FU58	
U31 #15	3A9C	
+5V	F84P	FR DIG 2
U32 #9	H9PA	
U32 #10	1353	
U32 #11	UA1C	
U32 #12	PFF5	
U32 #13	25F6	
U32 #14	4AH1	
U32 #15	5554	
+5V	F84P	FR DIG 3
U33 #9	7059	
U33 #10	3P0P	
U33 #11	13PC	
U33 #12	C4P5	
U33 #13	6PC6	
U33 #14	133P	
U33 #15	CC02	
+5V	F84P	FR DIG 4
U34 #9	F3A2	
U34 #10	C22P	
U34 #11	P8U9	
U34 #12	U339	
U34 #13	U1H0	
U34 #14	9209	
U34 #15	2659	
+5V	F84P	FR DIG 5
U35 #9	UH23	
U35 #10	7880	
U35 #11	4135	
U35 #12	55PC	
U35 #13	A492	
U35 #14	APi1	
U35 #15	8F6F	
+5V	F84P	FR DIG 6
U36 #9	2C1A	
U36 #10	3168	
U36 #11	UUU9	

ManualsPlus.com

SERVICE SHEET 20 (Cont'd)

Setup. Connect the signature analyzer as follows:

1) GND to ground
2) START to 'SA5' A11TP9
3) STOP to 'SA5' A11TP9
4) CLK to 'SA4' A11TP7

Set the signature analyzer controls as follows:

1) START-IN
2) STOP-OUT
3) CLK-IN

Set up the Signal Generator as follows:

1) Place the LOGIC/RAM switch A11S1B in the LOGIC position.
2) Short A2TP14 'TO2' to 'GND'. This enables data transfer.
3) Connect A11TP10 'SA6' to 'SA7' A2TP15

NOTE

If the Signal Generator's address switch has been set to other than '07', the signatures taken in this test will be incorrect. In this case, reset the address switches to A1=1, A2=1, A3=1, A4=0 and A5=0. Then set the front panel RESET-STBY-ON switch to RESET and back to ON.

Initialize. Briefly short A11TP3 'NMI' to ground.

NOTES

With careless probing it is possible to get the Microprocessor into a program sequence other than that portion intended for signature analysis. If the +5V signature is incorrect, this has probably happened. Restart the test by setting the RST/RUN switch to RST and then RUN. Briefly touch the NMI test point to ground.

All LEDs should be cycling rapidly on and off.

Probe. Connect the probe to each node shown in Table 1. Verify that each signature is correct and stable.

ManualsPlus.com

14, 15 and 16 as well as the Troubleshooting on Service Sheets 18 and 19 is normally performed before troubleshooting these circuits. However, if the problem seems to be related only to the Frequency Display, you may wish to try to isolate the problem quickly by performing the following procedure first.

Determine if the malfunction occurs in single digits, pairs (such as frequency digits 1 and 2, 3 and 4, and 5 and 6, or multiple digits including the amplitude and/or modulation digits. If multiple digit displays are incorrect, be sure to:

1) perform the Troubleshooting Using Signature Analysis on Service Sheets 14, 15 and 16
2) then perform the Troubleshooting on Service Sheets 18 and 19.

If pairs of digits are incorrect, suspect the shift registers shown on Service Sheet 19. If single digits are incorrect, continue troubleshooting on this service sheet for amplitude or modulation display problems.

NOTE

This troubleshooting information is to be used instead of Troubleshooting Using Signature Analysis on Signal Generators with serial number prefixes 2009A, 2014A and 2018A. If preferred, this information may be used for all Signal Generators regardless of serial number prefix.

Test Equipment

Oscilloscope . . . . . HP 1222A

√1 Frequency Display Digital Drive Levels versus Visual LED Outputs

1. Verify that the seven-segment drive levels from the Latch/Decoder/Drivers matches the visual output for the equivalent segment.

2. Verify that the decimal point drive from the latch and drivers (refer to Service Sheet 19) matches the visual decimal point output.

TROUBLESHOOTING USING SIGNATURE ANALYSIS

Troubleshooting is done on the circuits of Service Sheet 20 when a defect seems to be related to the RF frequency display. If nothing definite is discovered in performing these signature analyzer checks, consider the other possibilites shown on Service Sheet BD4. If any of the signatures are incorrect, recall that the data passes through circuitry on Service Sheets 15 and 19 before arriving here.

Test Equipment

Signature Analyzer . . . . . HP 5004A

Purpose. To verify transmission of encoded display data from the Microprocessor to the frequency display drivers.

NOTE

Signatures are not valid for Signal Generators with serial number prefixes of 2018A and below.

ManualsPlus.com

SERVICE SHEET 20
P/O A2 DISPLAY ASSEMBLY

TROUBLESHOOTING HELP

Service Sheet BD4
Table 4-1. Abbreviated Performance Tests
Table 5-2. Post-Repair Adjustments

Frequency Display

Eight 7-segment, common-cathode devices U6 through U13 are used to display the frequency in megahertz. They are also used to display the frequency increment value. The decimal points associated with frequency digits 1 through 6 are the only decimal points that can be lit. The frequency display decimal point drive circuitry has been previously discussed (refer to Service Sheet 19). Frequency Digits 7 and 8 have their decimal point control line (U12 and U13-Pin 9) tied low which inhibits them from being lit.

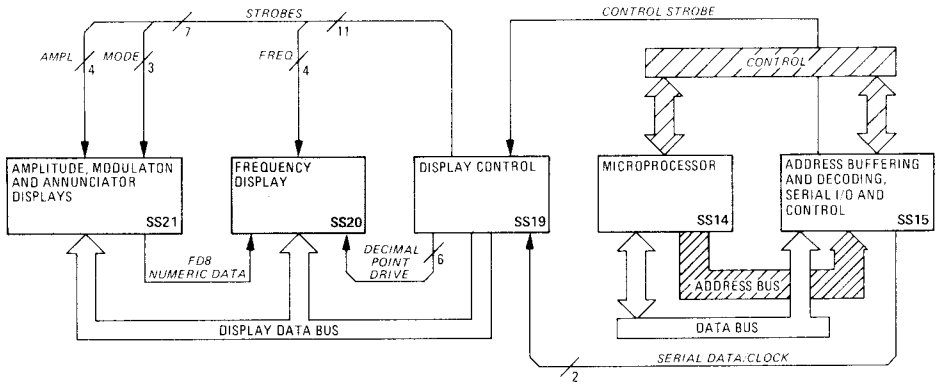
Seven Latch/Decoder/Drivers U31 through U37 decode frequency display data, store the decoded data, and drive the associated frequency display digit. The associated resistor networks R6 through R12 are used to limit the amount of drive current applied to the display digit. As previously mentioned 16 bits of serial display data are sent from the Microprocessor to the display circuitry (refer to Service Sheet 19). After a serial-to-parallel conversion, the eight most-significant bits are stored in the Display Data Shift Register U23 and the eight least-significant bits are stored in the Display Address Shift Register U24. Six of the eight display address bits are decoded to produce eleven display strobes and two keyboard strobes. Display strobes DSTB5 through DSTB8 are used to strobe the frequency display data (DD0 through DD7) into the latch/decoder/drivers. DSTB8 also strobes the display data for Amplitude Digit 2 at the same time it strobes the display data for Frequency Digit 7 (refer to Service Sheet 21). When a strobe is decoded, it will go low for 5 μs to latch a half byte (4 bits) of frequency display data into the associated latch/decoder/driver.

Each latch/decoder/driver is hard-wired to decode and drive the associated digit to display numerals 0 through 9, otherwise the digit will remain blanked. Frequency Digit 8 is hard-wired to display only a numeral 5, otherwise it will remain blanked. Drive for this digit is developed when display data bit 2 (DD2) is strobed into the Modulation/HP-IB Annunciator Latches U1 (refer to Service Sheet 21). When DD2 is active (low), the control lines of frequency digit 8 are pulled high through the series resistor R13 to display a numeral 5. When DD2 is inactive (high), the stored output will be inverted by the FD8 Numeral Driver U22A. This will cause the control lines of Frequency Digit 8 to be pulled low to blank the digit.

TROUBLESHOOTING

Troubleshooting is done on the circuits of Service Sheet 20 when a malfunction seems to be associated with the Frequency Display. The Troubleshooting Using Signature Analysis on Service Sheets

ManualsPlus.com



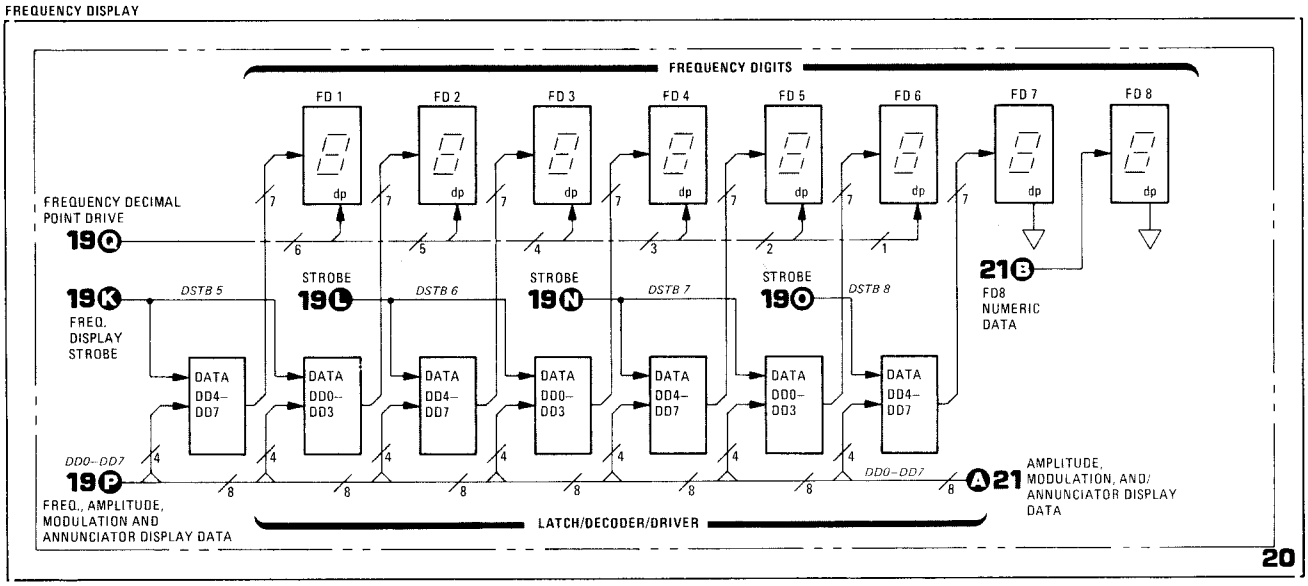
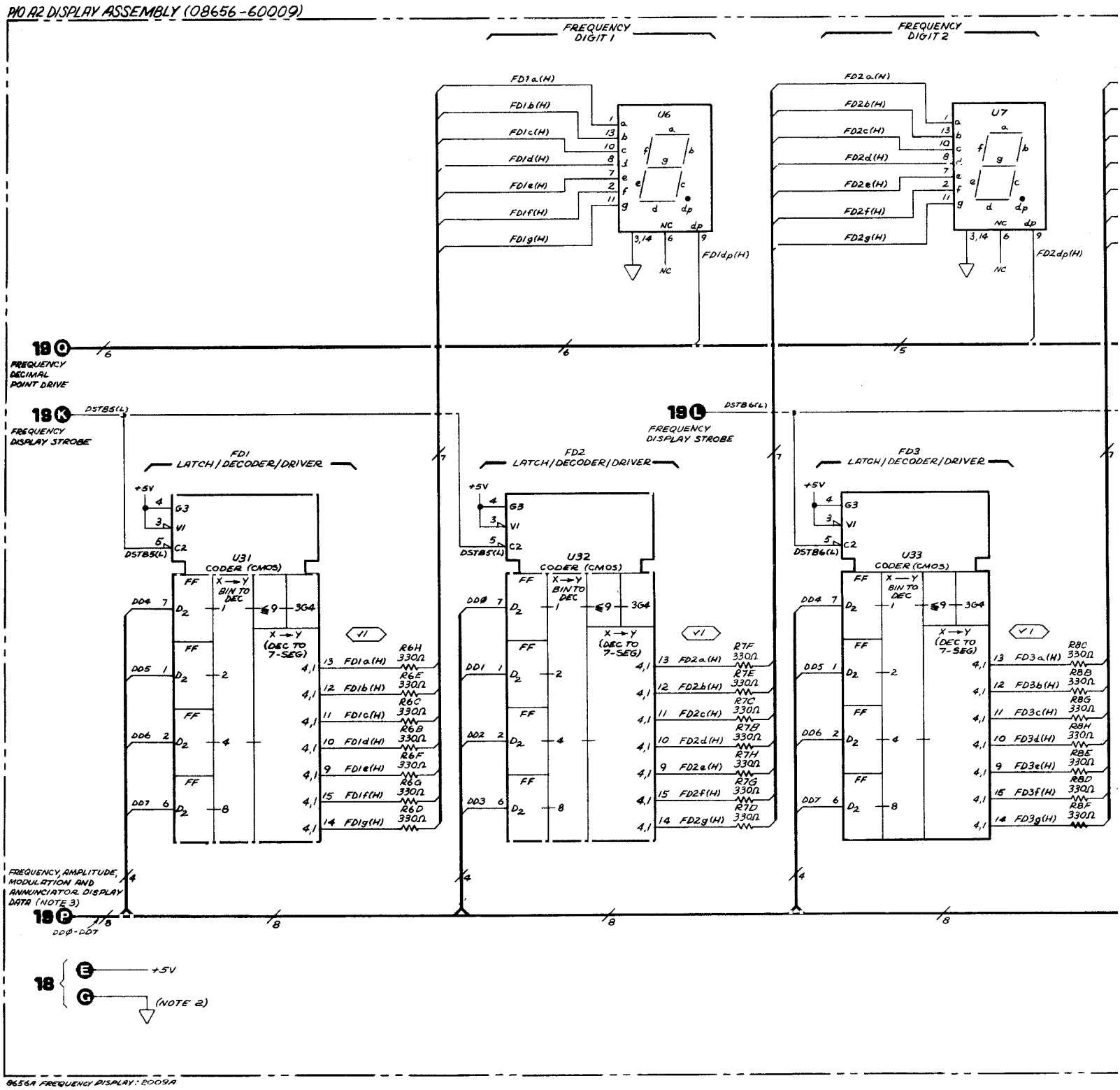


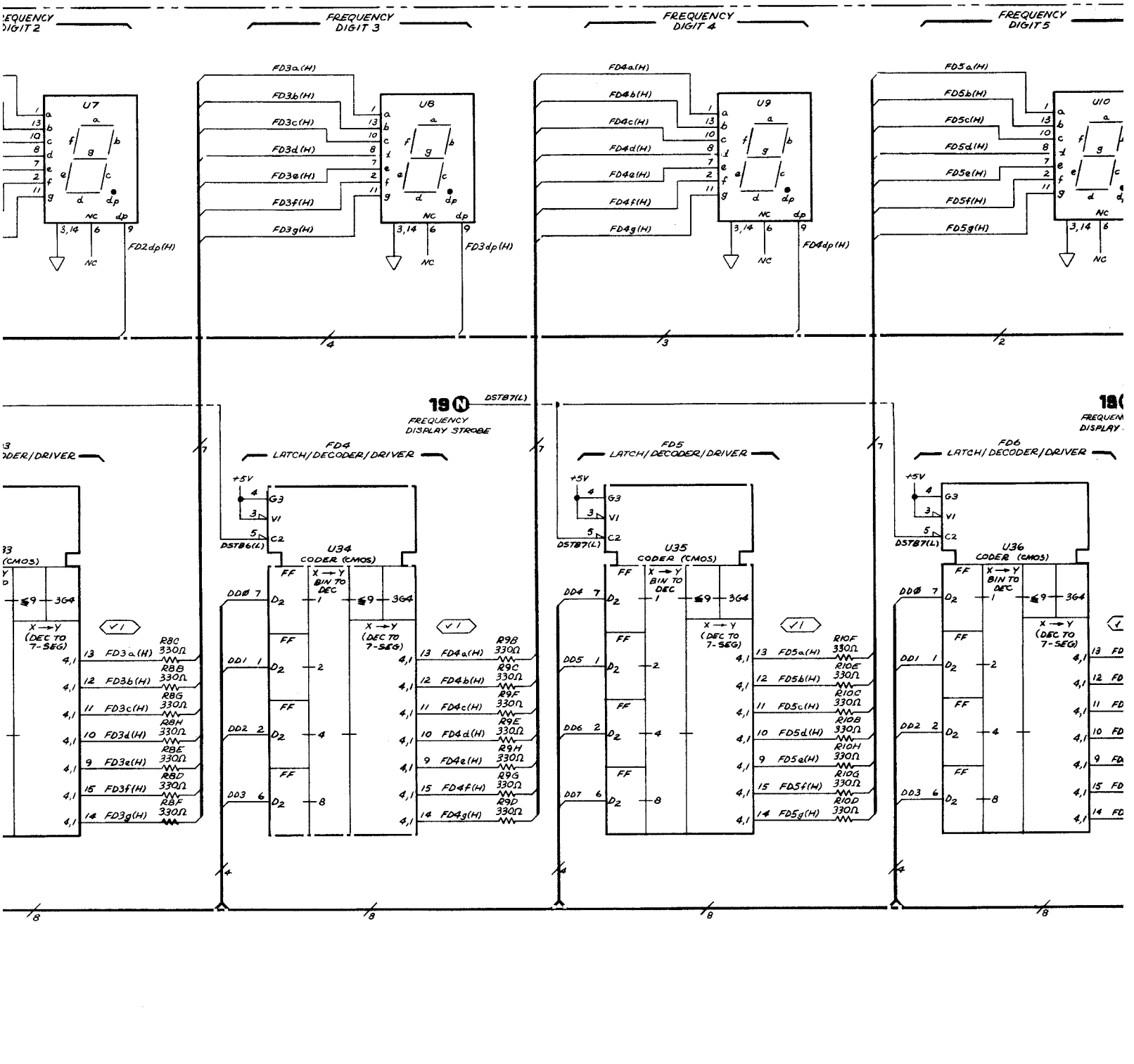
Figure 8-105. Frequency Displays Block Diagrams

ManualsPlus.com

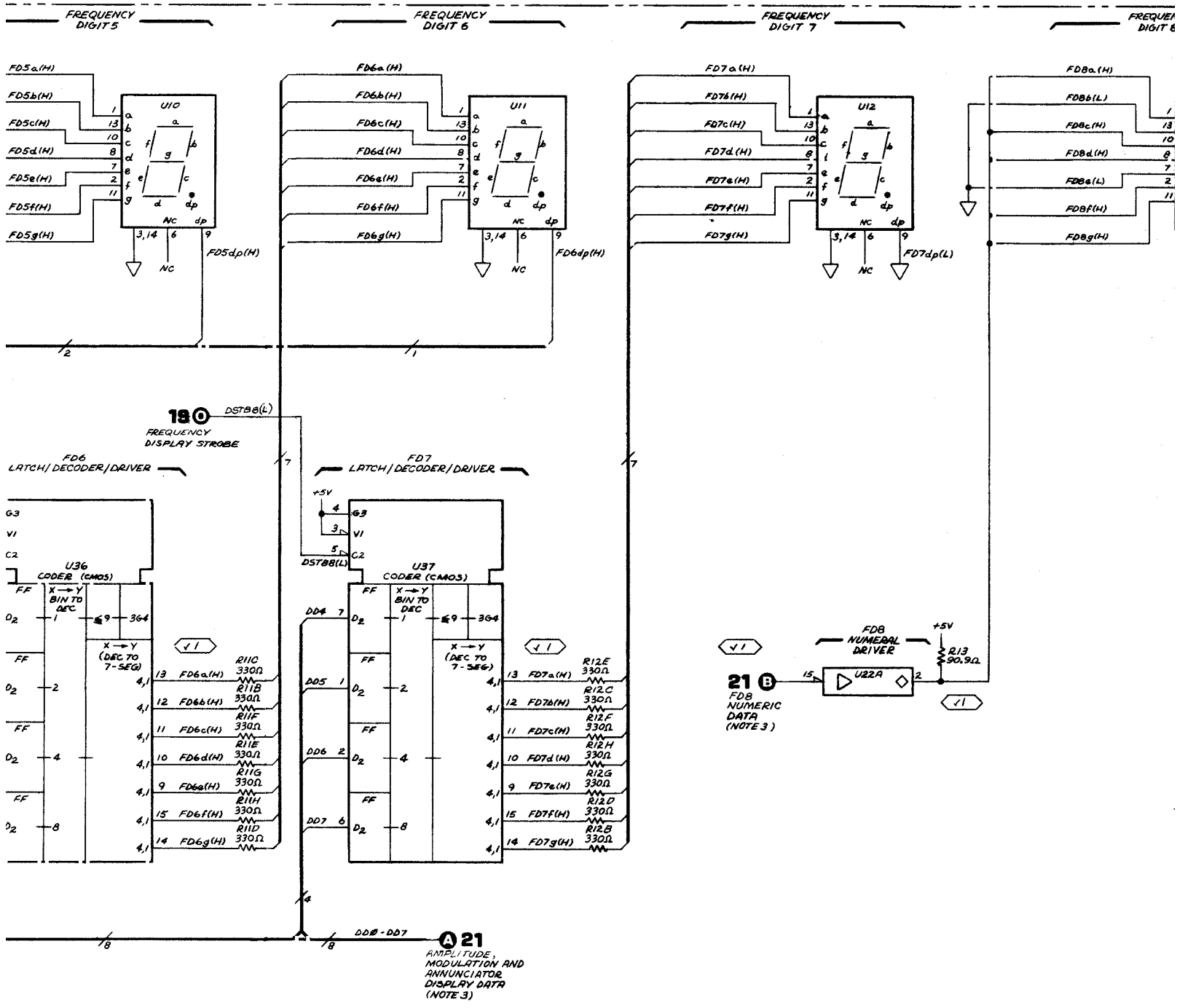
A10 A2 DISPLAY ASSEMBLY (08656-60009)



ManualsPlus.com

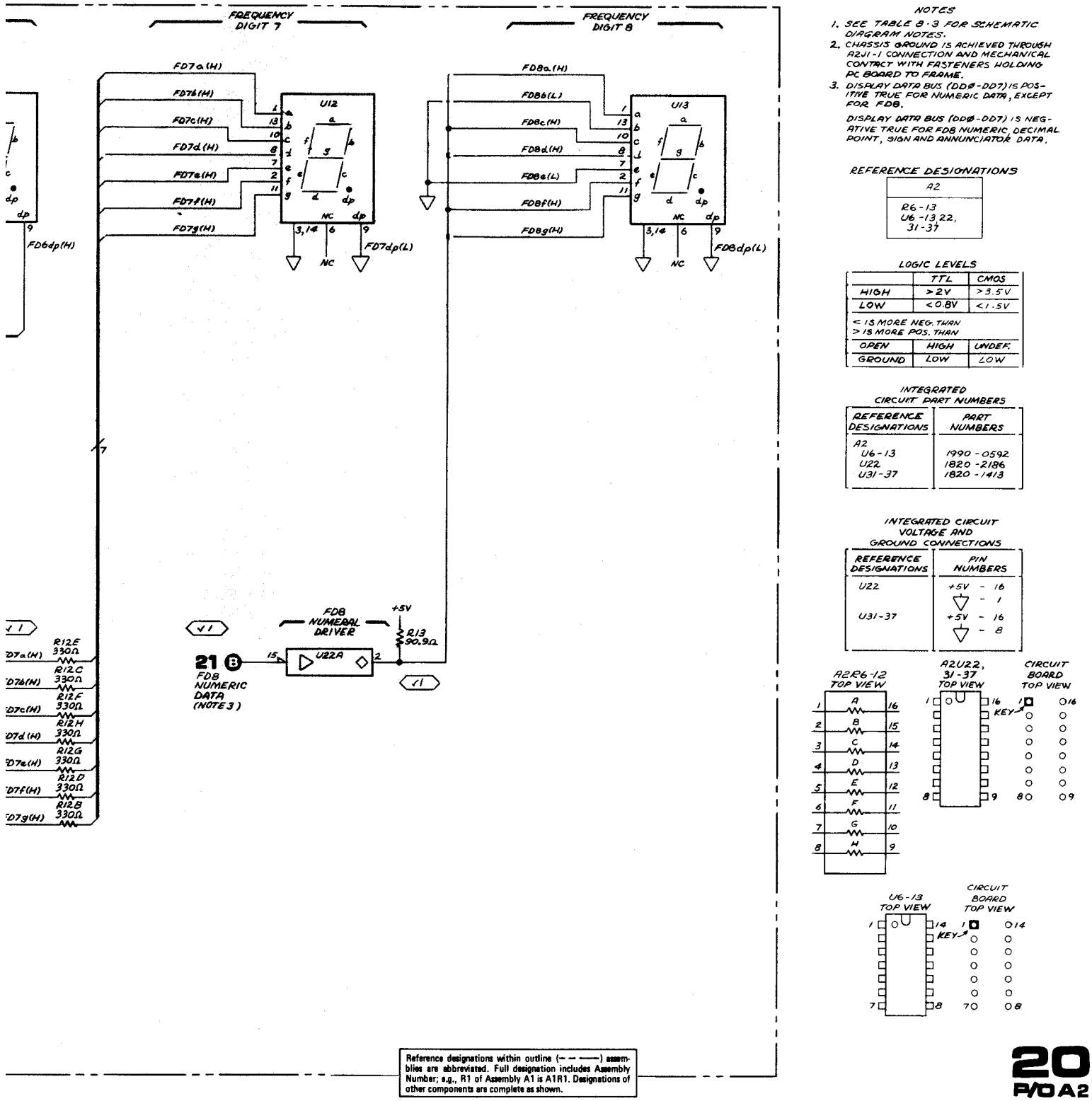


ManualsPlus.com



Reference designations within outline (— — ——) assemblies are abbreviated. Full designation includes Assembly Number; e.g., R1 of Assembly A1 is A1R1. Designations of other components are complete as shown.

ManualsPlus.com



Reference designations within outline (— — —) assemblies are abbreviated. Full designation includes Assembly Number; e.g., R1 of Assembly A1 is A1R1. Designations of other components are complete as shown.

NOTES

1. SEE TABLE 8-3 FOR SCHEMATIC DIAGRAM NOTES.
2. CHASSIS GROUND IS ACHIEVED THROUGH A2J1-1 CONNECTION AND MECHANICAL CONTACT WITH FASTENERS HOLDING PC BOARD TO FRAME.
3. DISPLAY DATA BUS (DD0-DD7) IS POSITIVE TRUE FOR NUMERIC DATA, EXCEPT FOR FD8.

   DISPLAY DATA BUS (DD0-DD7) IS NEGATIVE TRUE FOR FD8 NUMERIC, DECIMAL POINT, SIGN AND ANNUNCIATOR DATA.

REFERENCE DESIGNATIONS

A2
R6-13 U6-13,22, 31-37

LOGIC LEVELS

	TTL	CMOS
HIGH	>2V	>3.5V
LOW	<0.8V	<1.5V

< IS MORE NEG. THAN
> IS MORE POS. THAN

OPEN	HIGH	UNDEF.
GROUND	LOW	LOW

INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATIONS	PART NUMBERS
A2	
U6-13	1990-0592
U22	1820-2186
U31-37	1820-1413

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATIONS	PIN NUMBERS
U22	+5V - 16 ▽ - 1
U31-37	+5V - 16 ▽ - 8

A2R6-12 TOP VIEW

A2U22, 31-37 TOP VIEW

CIRCUIT BOARD TOP VIEW

U6-13 TOP VIEW

CIRCUIT BOARD TOP VIEW

20 P/O A2

Figure 8-106. Frequency Displays Schematic Diagram

ManualsPlus.com

SERVICE SHEET 21 (Cont'd)

Table 1. Decoded Amplitude Signatures

Node	Correct Signature	Comments
+5V	F84P	
U38 #2	P401	AP DIG 1
U38 #5	9CA4	AP ±
U38 #7	2AFA	
U38 #10	620C	AP DP 1
U38 #12	580P	AP DP 2
U38 #15	22FC	AP DP 3
+5V	F84P	
U39 #9	UP60	AP DIG 2
U39 #10	9P35	
U39 #11	4CH5	
U39 #12	PH98	
U39 #13	AA91	
U39 #14	71F0	
U39 #15	0276	
+5V	F84P	
U41 #9	0U7H	AP DIG 4
U41 #10	7P96	
U41 #11	CH03	
U41 #12	8291	
U41 #13	180P	
U41 #14	1732	
U41 #15	19P2	

Table 2. Decoded Annunciator Signatures

Node	Correct Signature	Comments
+5V	F84P	
U1 #2	4PF5	MD DP 1
U1 #5	046A	ADRS
U1 #7	49UH	RMT
U1 #10	27FA	%
U1 #12	C73C	kHz
+5V	F84P	
U2 #2	FP81	HI EXT
U2 #5	34C1	EXT FM
U2 #6	3U35	LO EXT
U2 #9	352H	EXT AM
U2 #12	8405	1K Hz
U2 #15	AFPC	INT AM
U2 #16	UCFP	INT FM
U2 #19	4489	400 Hz
+5V	F84P	
U42 #2	3C63	dB
U42 #5	7HC8	dBf
U42 #6	FU7A	EMF
U42 #9	962P	dBm
U42 #12	P54A	RD KY WRD
U42 #15	UCU0	VOLTS
U42 #16	PHCC	mV
U42 #19	8U6F	μV

Table 3. Frequency Digit 8 Signature

Node	Correct Signature	Comments
+5V	F84P	
U1 #15	L1PO	FR DIG 8

Remove the jumpers between test points and between test point and ground. Reset the LOGIC/RAM switch to RAM.

If the HP-IB address switch was changed, reset the address switch (refer to Service Sheet 17) to the original address. Set the front panel RESET-STBY-ON switch to RESET and back to ON.

ManualsPlus.com

1) GND to ground
2) START to 'SA5' A11TP9
3) STOP to 'SA5' A11TP9
4) CLK to 'SA4' A11TP7

Set the signature analyzer's controls as follows:

1) START-IN
2) STOP-OUT
3) CLK-IN

Set up the Signal Generator as follows:

1) Place the LOGIC/RAM switch A11S1B in the LOGIC postion.
2) Short A2TP14 'TO2' to 'GND'. This enables data transfer.
3) Connect A11TP10 'SA6' to 'SA7' A2TP1.

NOTE

If the Signal Generator's address switch has been set to other than '07', the signatures taken in this test will be incorrect. In this case, reset the address switches to A1=1, A2=1, A3=1, A4=0 and A5=0. Then set the front panel RESET-STBY-ON switch to RESET and back to ON.

Initialize. Briefly short A11TP3 NMI to ground.

NOTES

With careless probing it is possible to get the Microprocessor into a program sequence other than that portion intended for signature analysis. If the +5V signature is incorrect, this has probably happened. Restart the test by setting the RST/RUN switch to RST and then RUN. Briefly touch the NMI test point to ground.

All LEDS should be cycling rapidly on and off.

Probe. Connect the probe to each node shown in Tables 1, 2 and 3. Verify that each signature is correct and stable.

ManualsPlus.com

2. then perform the Troubleshooting on Service Sheets 18 and 19.

If pairs of digits are incorrect, perform the troubleshooting on Service Sheet 19. If single digit displays are incorrect, continue troubleshooting on this service sheet for amplitude or modulation display problems.

NOTE

This troubleshooting information is to be used instead of Troubleshooting Using Signature Analysis on Signal Generators with serial number prefixes 2009A, 2014A and 2018A. If preferred, this information may be used for all Signal Generators regardless of serial number prefix

Test Equipment

Oscilloscope .....HP 1222A

√1 Amplitude and Modulation Display Digital Drive Levels versus Visual LED Output

1. Verify that the seven-segment drive level from the Latch/Decoder/Drivers matches the visual output for the equivalent segment.

2. Verify that the decimal point drive from the latches and drivers matches the visual decimal point output.

√2 Annunciator's Digital Drive Levels versus Visual LED Outputs

If the digital drive level is low, the LED output should be lit.

TROUBLESHOOTING USING SIGNATURE ANALYSIS

Troubleshooting is done on the circuits of Service Sheet 21 when a defect seems to be related to the modulation, amplitude or annunciator displays. If nothing definite is discovered in performing these signature analyzer checks, consider the other possibilites shown on Service Sheet BD4. If any of the signatures are incorrect, recall that the display and strobe data transfer passes through circuitry on Service Sheets 15 and 19 before arriving here.

Test Equipment

Signature Analyzer .....HP 5004A

Purpose. To verify transmission of encoded display data from the Microprocessor to the modulation, amplitude and annunciator display drivers.

NOTE

Signatures are not valid for Signal Generators with serial number prefixes of 2018A and below.

Setup. Connect the signature analyzer as follows:

ManualsPlus.com

vice Sheet 19), 16 bits of serial display data are sent from the Microprocessor to the display circuitry. After a serial-to-parallel conversion, the eight most-significant bits are stored in the Display Data Shift Register U23 and the eight least-significant bits are stored in the Display Address Shift Register U24. Six of the eight display address bits are decoded to produce eleven display strobes and two keyboard strobes. Display strobes DSTB8 and DSTB9 are used to strobe the amplitude display data (DD0 through DD7) into the three latch/decoder/drivers. When a strobe is decoded, it will go low for 5 μs to latch a half byte (4 bits) of amplitude display data into the associated latch/decoder/driver. Each latch/decoder/driver is hard-wired to decode and drive the associated digit to display numerals 0 through 9, otherwise the digit will remain blanked.

Amplitude Annunciators

There are seven LED annunciators associated with the Amplitude Display. These annunciators light to display amplitude units information. As in the case of the other displays, 16 bits of serial display data are sent from the Microprocessor, parallel converted, stored, and decoded. Amplitude annunciator display data bits are always active low. Display strobe DSTB11 is used to strobe amplitude annunciator display data (DD1 through DD7) into the Amplitude Annunciator Latches U42. When the strobe is decoded, it will go low for 5 μs to latch the amplitude annunciator display data. When the stored bit is active (low), the associated LED annunciator DS13 through DS19 will light as current is drawn through the associated network resistor R22.

Display strobe DSTB11 is also used to strobe display data bit 0 (DD0) into the Amplitude Annunciator Latches U42 to force all six keyboard column lines low so that the row data can be read (refer to Service Sheet 18). When DD0 is active (high), a signal to read key row data (RKRD) will be issued to the keyboard encoding circuitry. This signal remains stored until the row data has been latched, then it will be cleared by the Microprocessor.

TROUBLESHOOTING

Troubleshooting is done on the circuits of Service Sheet 21 when a malfunction seems to be associated with the Amplitude or Modulation Displays. The Troubleshooting Using Signature Analysis on Service Sheets 14, 15 and 16 as well as the Troubleshooting on Service Sheets 18 and 19 is normally performed before troubleshooting these circuits. If the problem seems to be related only to the Amplitude or Modulation Displays, you may wish to try to isolate the problem quickly by performing the following procedure.

Determine if the malfunction occurs in single digits, pairs (such as amplitude digits 3 and 4, digit 1 and the decimal point, and so forth; refer to Table 1 on Service Sheet 19), or multiple digits including the amplitude and/or modulation digits. If multiple digit displays are incorrect, be sure to:

1. perform the Troubleshooting Using Signature Analysis on Service Sheets 14, 15 and 16

ManualsPlus.com

Display strobe DSTB1 is also used to strobe display data bit 2 (DD2) into the Modulation/HP-IB Annunciator Latches U1 to control Frequency Digit 8. When DD2 is active (low), the control lines of Frequency Digit 8 will be pulled high through the series resistor R13 to display a numeral 5 (refer to Service Sheet 20). When DD2 is inactive (high), the stored output will be inverted by the FD8 Numeral Driver U22A. This will cause the control lines of Frequency Digit 8 to be pulled low to blank the digit.

Amplitude Display

One 5-segment, universal +1 device U14 and three 7-segment, common-cathode devices U15 through U17 are used to display the RF output level. They are also used to display the amplitude increment value, as well as the current contents of the internal sequence counter. The decimal points associated with Amplitude Digits 1 through 3 are the only decimal points that can be lit. Amplitude Digit 4 has its decimal point control line (U17-Pin 9) tied low which inhibits it from being lit. Decimal point drive is developed when display data bits 2, 3, and 4 are strobed into the Amplitude Display Latches U38 by DSTB10. The Microprocessor ensures that only one of these bits is active (low) at any given time (except during the power-up subroutine). When one of these bits is active (low), the associated decimal point control line (U14-Pin 8, U15-Pin 9, or U16-Pin 9) will be pulled high through the series resistor R12A, R17A, or R18A to light the respective decimal point. When the bits are inactive (high) the stored output will be inverted by the associated decimal point driver U22D, U22E, or U22F. This will cause the associated decimal point control line (U14-Pin 8, U15-Pin 9, or U16-Pin 9) to be pulled low to inhibit the respective decimal point from being lit.

Plus or minus sign drive is produced in much the same manner as that used to light the amplitude display decimal points. The minus sign, which is part of Amplitude Digit 1, lights when display data bit 6 (DD6) is strobed into U38 by DSTB10. When DD6 is active (low), the minus sign control line (pin 4) is pulled low through the series resistor R19 to light the minus sign. The plus sign requires that display data bits 6 and 7 (DD6 and DD7) both be strobed into U38 by DSTB10. Just as in the case of the minus sign when DD6 is active (low), the horizontal segment of the plus sign will light. In addition, when DD7 is active (low), the two vertical segment control lines (pins 2 and 6) will be pulled high through the series resistor R21 to light the two vertical segments of the plus sign display. When DD7 is inactive (high), the stored output will be inverted by the AD1 Sign Driver U22B. This will cause the two vertical segment control lines (pins 2 and 6) to be pulled low to inhibit the two vertical segments of the plus sign display from being lit.

Three latch/decoder/drivers U39 through U41 are used to decode amplitude display data, store the decoded data, and drive the associated amplitude display digit. The associated resistor networks R17, R18, and R23 are used to limit the amount of drive current applied to the display digit. As previously mentioned (refer to Ser-

ManualsPlus.com

SERVICE SHEET 21
P/O A2 DISPLAY ASSEMBLY

TROUBLESHOOTING HELP

Service Sheet BD4
Table 4-1. Abbreviated Performance Tests
Table 5-2. Post-Repair Adjustments

Modulation Display

Two 7-segment, common-cathode devices U4 and U5 are used to display the level of modulation, either the AM depth in percent or the FM peak deviation in kilohertz. They are also used to display the modulation increment value as well as the internally-set decimal HP-IB address. The decimal point associated with Modulation Digit 1 is the only decimal point that can be lit. Modulation Digit 2 has its decimal point control line (U5-Pin 9) tied low which inhibits it from being lit. Decimal point drive is developed when display data bit 5 (DD5) is strobed into the Modulation/HP-IB Annunciator Latches U1 by DSTB1. When DD5 is active (low), the decimal point control line of Modulation Digit 1 (U4-Pin 9) will be pulled high by resistor R14B from the +5V power supply to light the decimal point. When DD5 is inactive (high), the stored output will be inverted by the MD1 dp Driver U21A. This will cause the decimal point control line of Modulation Digit 1 (U4-Pin 9) to be pulled low to inhibit the decimal point from being lit.

Two Latch/Decoder/Drivers U27 and U29 are used to decode modulation display data, store the decoded data, and drive the associated modulation display digit. The associated resistor networks R14 and R16 are used to limit the amount of drive current applied to the display digit. As previously mentioned (refer to Service Sheet 19), 16 bits of serial display data are sent from the Microprocessor to the display circuitry. After a serial-to-parallel conversion, the eight most-significant bits are stored in the Display Data Shift Register U23 and the eight least-significant bits are stored in the Display Address Shift Register U24. Six of the eight display address bits are decoded to produce eleven display strobes and two keyboard strobes. Display strobe DSTB3 is used to strobe the modulation display data (DD0 through DD7) into the two latch/decoder/drivers. When the strobe is decoded, it will go low for 5 μs to latch a half byte (4 bits) of modulation display data into the associated latch/decoder/driver. Each latch/decoder/driver is hard-wired to decode and drive the associated digit to display only numerals 0 through 9 (otherwise the digit will remain blanked).

Modulation/HP-IB Annunciators

There are ten LED annunciators associated with the Modulation Display. These annunciators light to indicate modulation units, source selection, or an external source over or under range condition. In addition, there are two LED annunciators used to indicate remote operation status. As in the case of the other displays, 16 bits of serial display data are sent from the Microprocessor, parallel converted, stored, and decoded. Modulation and HP-IB annunciator display data bits are always active low. Display strobe DSTB1 is used to strobe modulation or HP-IB annunciator display data (DD3 through DD7) into the Modulation/HP-IB Annunciator Latches U1, and DSTB2 is used to strobe modulation annunciator display data (DD0 through DD7) into the Modulation Annunciator Latches U2. When a strobe is decoded, it will go low for 5 μs to latch the modulation or HP-IB annunciator display data. When the stored bit is active (low), the associated LED annunciator DS1 through DS12 will light as current is drawn through the associated network resistor R15.

ManualsPlus.com

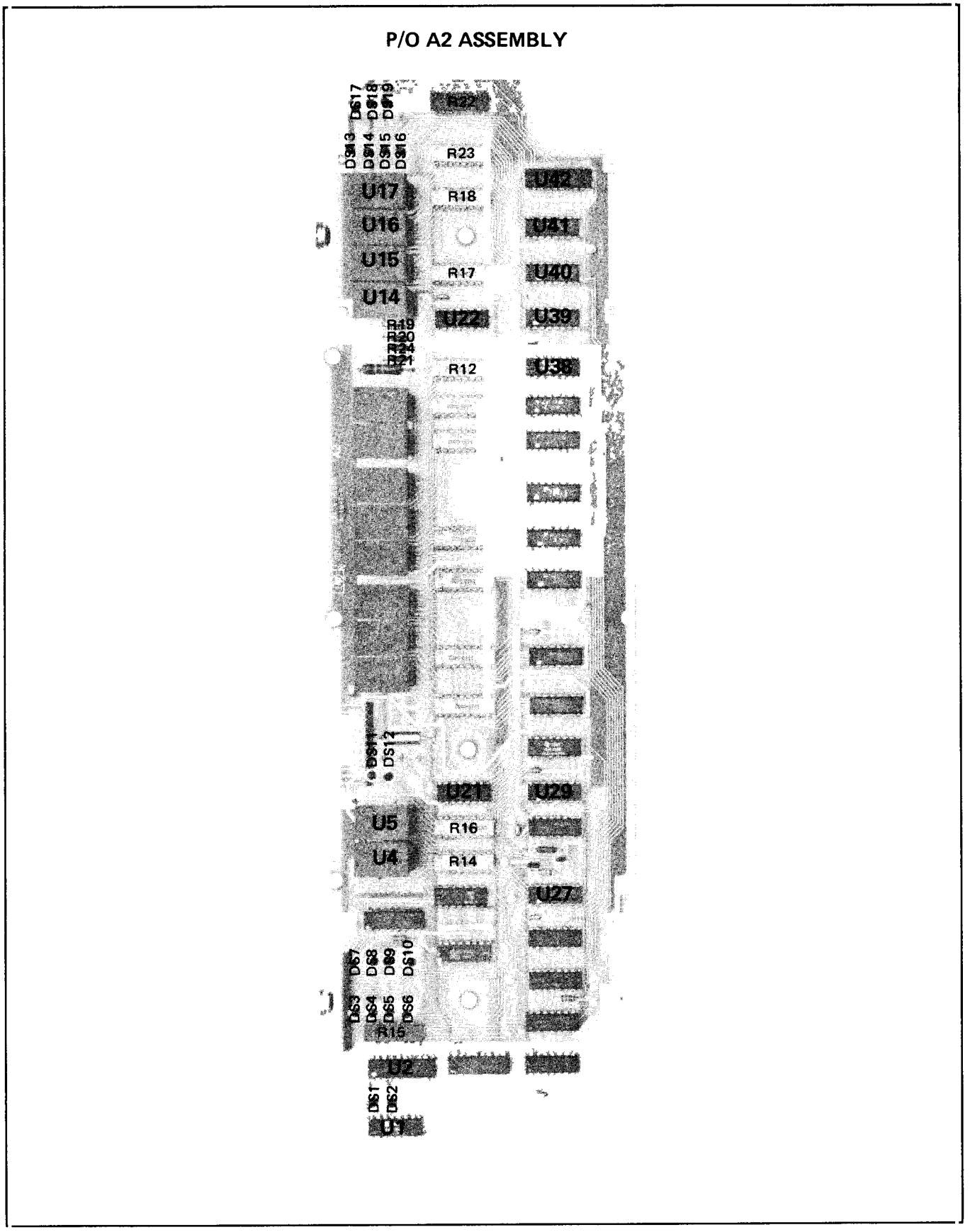
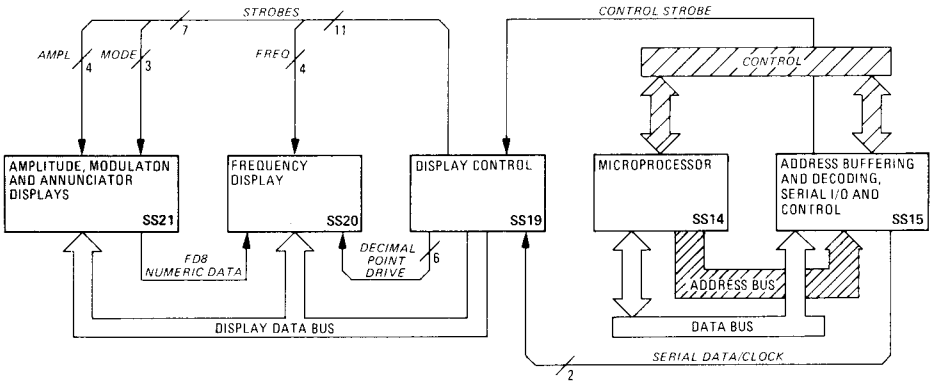


Figure 8-107. Amplitude, Modulation and Annunciator Displays Component Locations

ManualsPlus.com



AMPLITUDE, MODULATION AND ANNUNCIATOR DISPLAYS

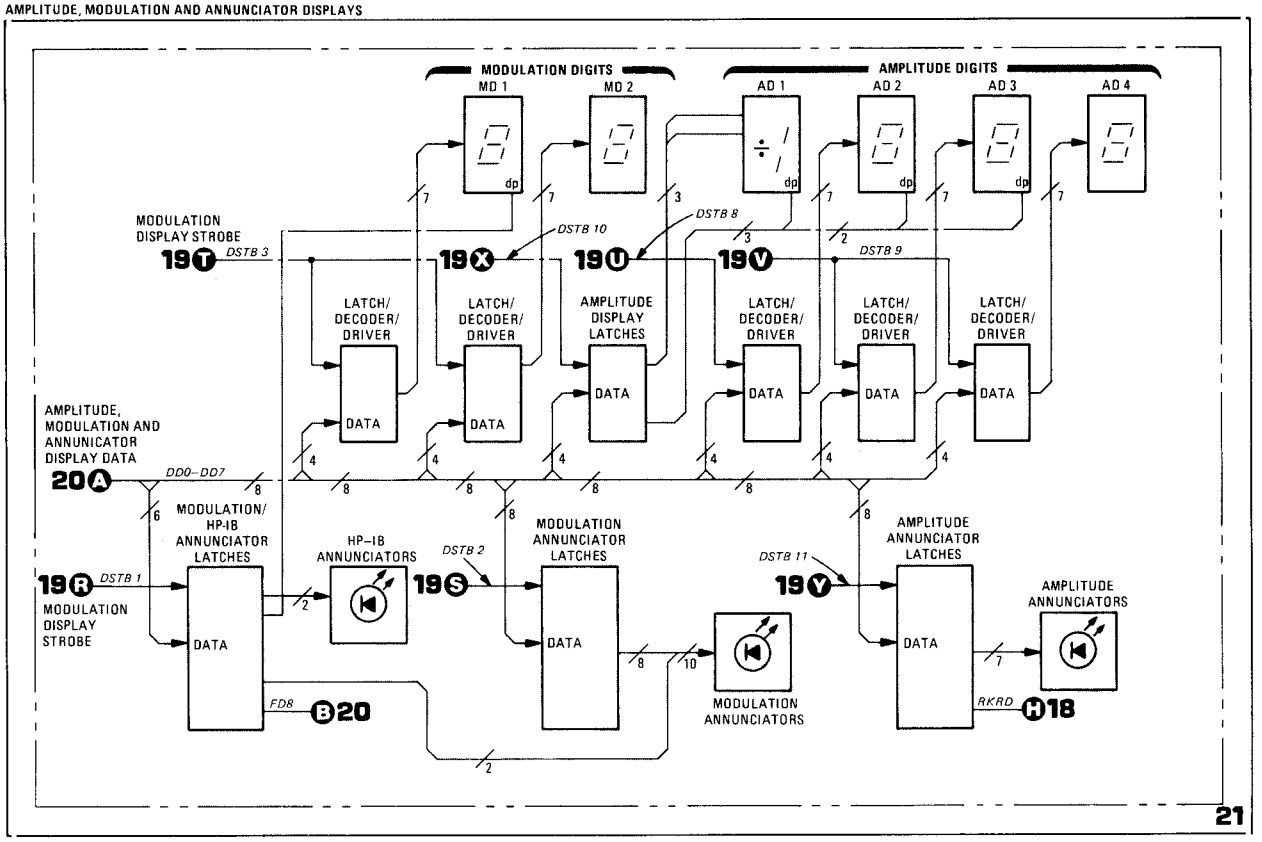
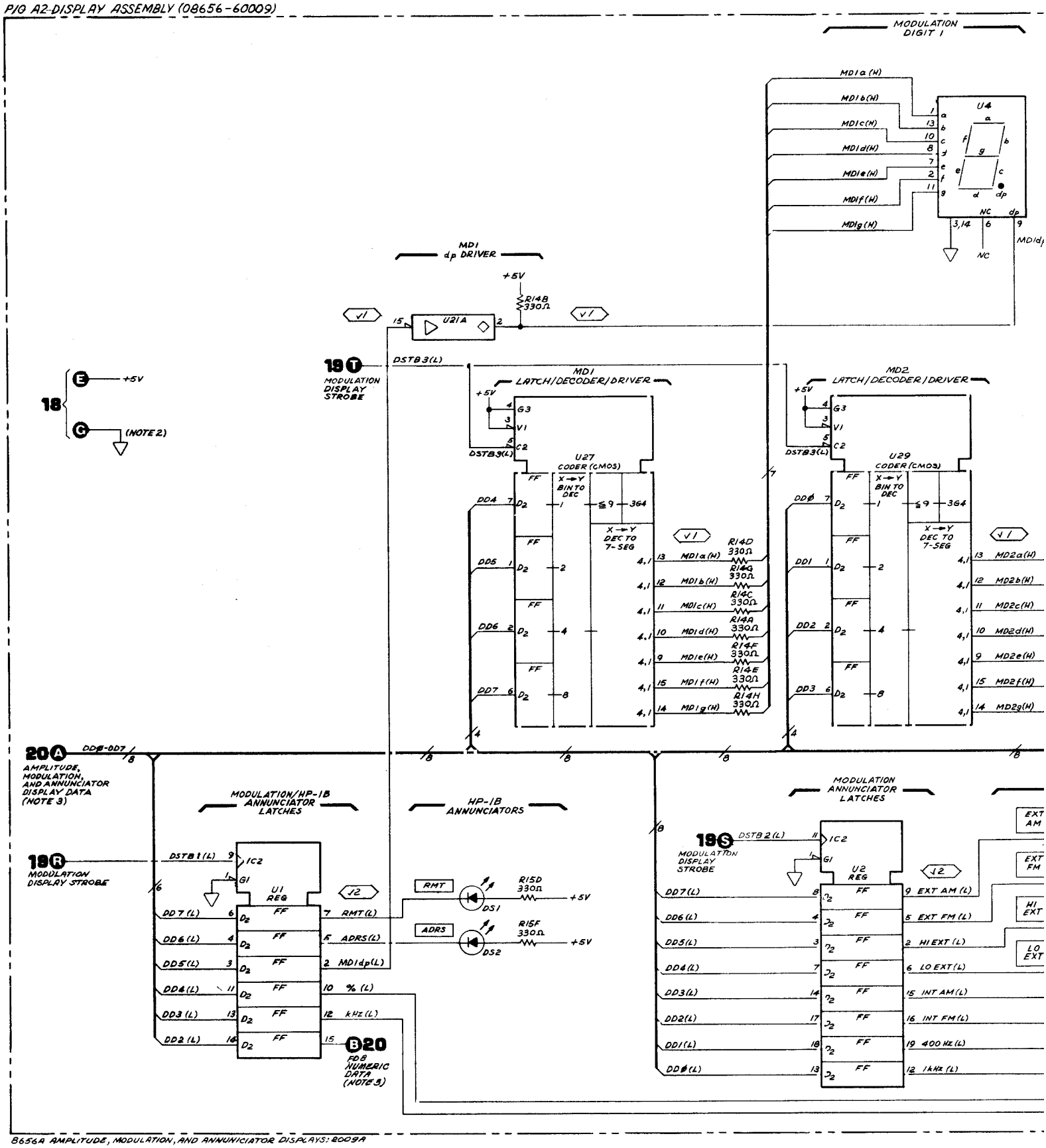
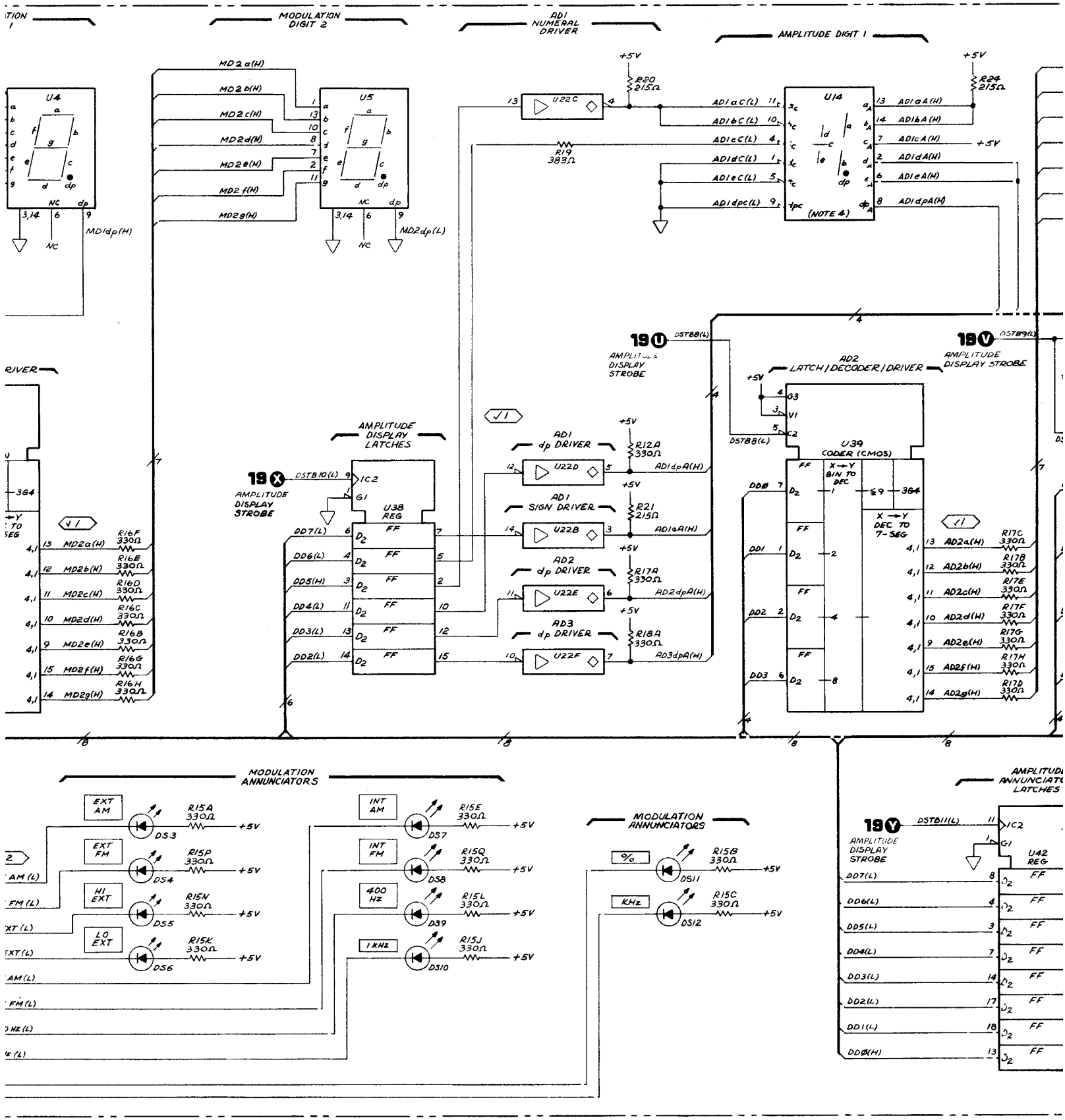


Figure 8-108. Amplitude, Modulation and Annunciator Displays Block Diagrams

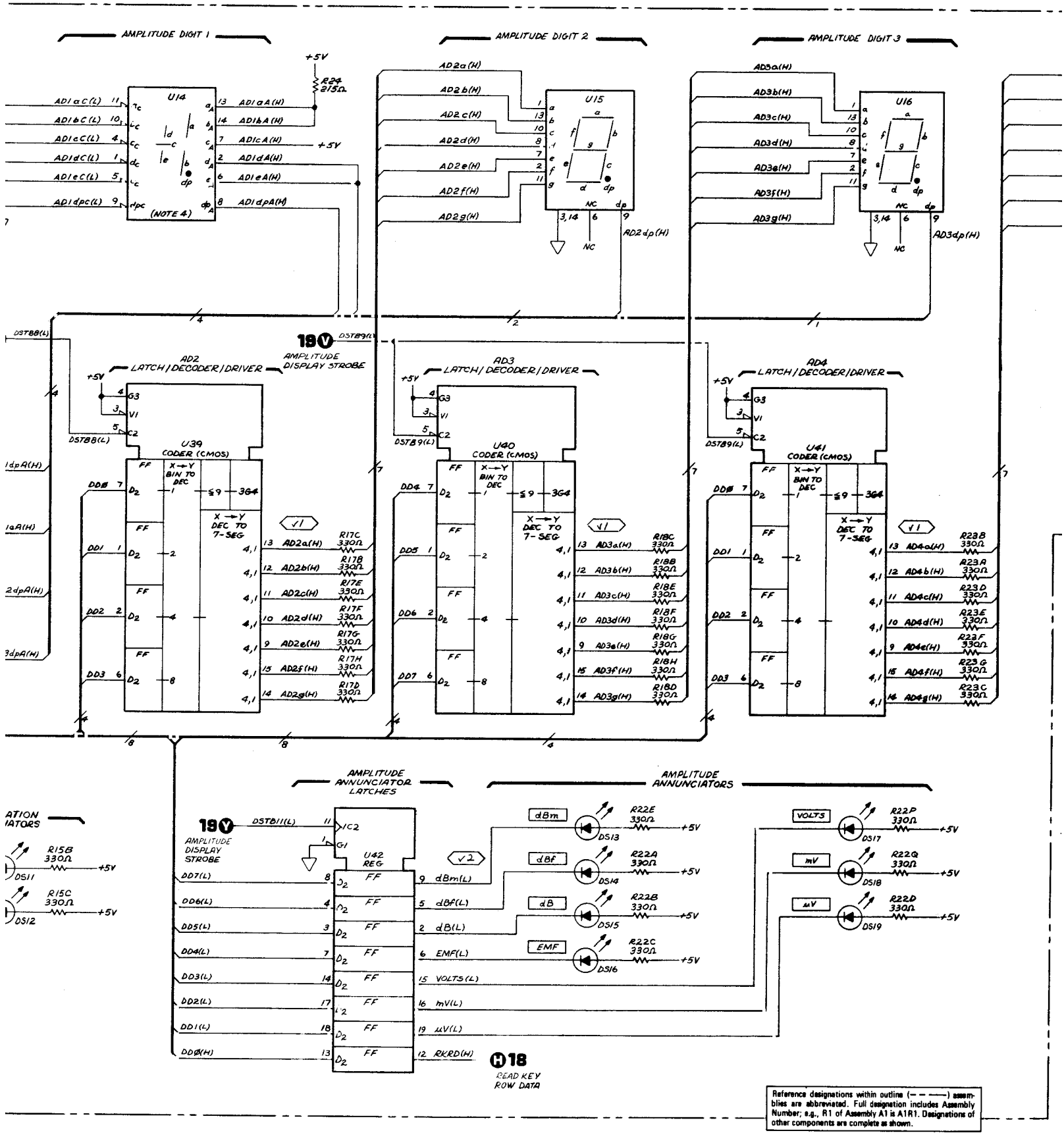
ManualsPlus.com



ManualsPlus.com

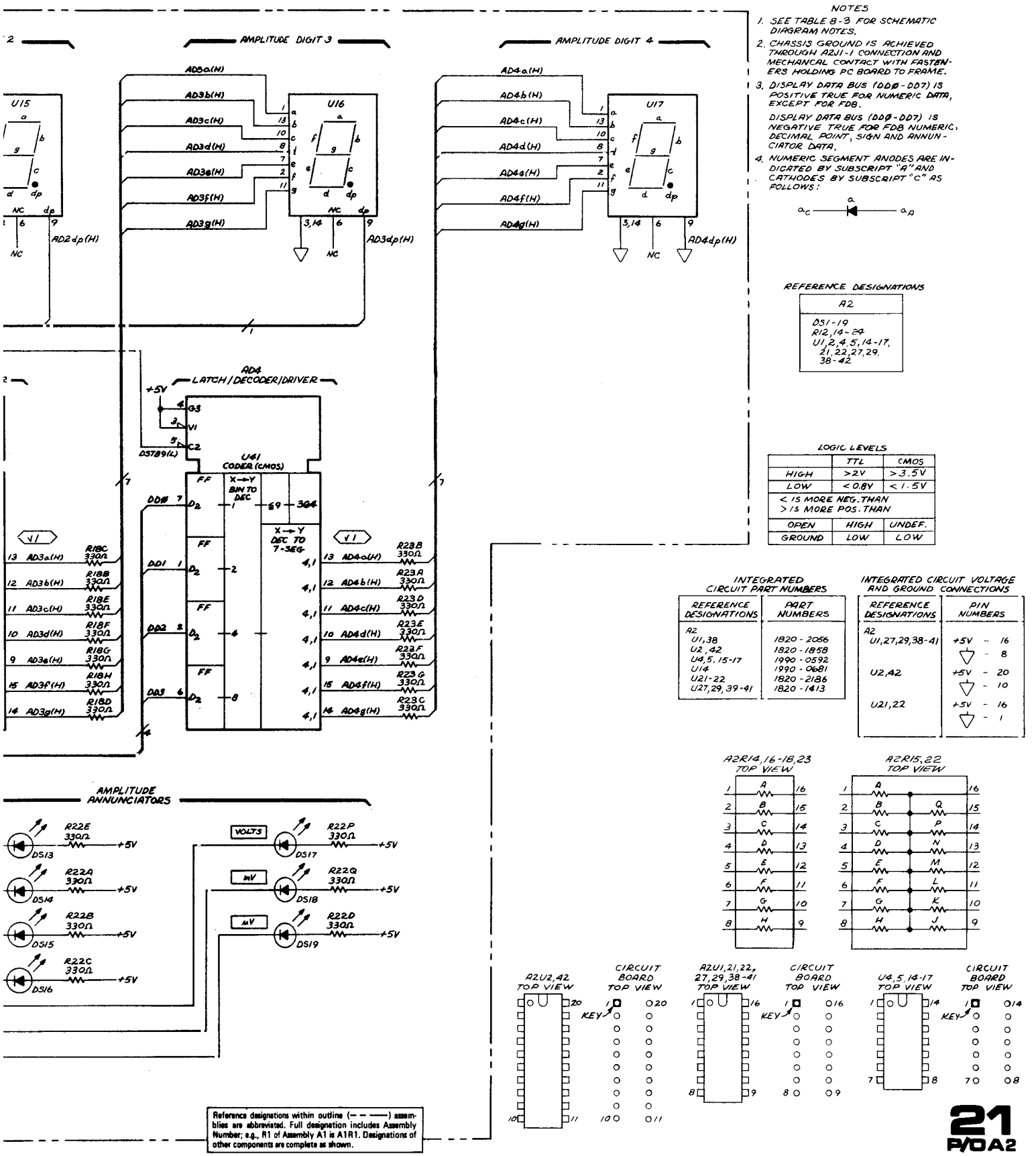


ManualsPlus.com



Reference designations within outline (– – ——) assemblies are abbreviated. Full designation includes Assembly Number; e.g., R1 of Assembly A1 is A1R1. Designations of other components are complete as shown.

ManualsPlus.com



NOTES

1. SEE TABLE 8-3 FOR SCHEMATIC DIAGRAM NOTES.
2. CHASSIS GROUND IS ACHIEVED THROUGH A2J1-1 CONNECTION AND MECHANICAL CONTACT WITH FASTENERS HOLDING PC BOARD TO FRAME.
3. DISPLAY DATA BUS (DD0-DD7) IS POSITIVE TRUE FOR NUMERIC DATA, EXCEPT FOR FDB.

   DISPLAY DATA BUS (DD0-DD7) IS NEGATIVE TRUE FOR FDB NUMERIC, DECIMAL POINT, SIGN AND ANNUNCIATOR DATA.
4. NUMERIC SEGMENT ANODES ARE INDICATED BY SUBSCRIPT "A" AND CATHODES BY SUBSCRIPT "C" AS FOLLOWS:

REFERENCE DESIGNATIONS

A2
DS1-19 R12,14-24 U1,2,4,5,14-17, 21,22,27,29, 38-42

LOGIC LEVELS

	TTL	CMOS
HIGH	>2V	>3.5V
LOW	<0.8V	<1.5V
< IS MORE NEG. THAN > IS MORE POS. THAN		
OPEN	HIGH	UNDEF.
GROUND	LOW	LOW

INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATIONS	PART NUMBERS
A2	
U1,38	1820-2056
U2,42	1820-1858
U4,5,15-17	1990-0592
U14	1990-0681
U21-22	1820-2186
U27,29,39-41	1820-1413

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATIONS	PIN NUMBERS
A2	
U1,27,29,38-41	+5V - 16 ▽ - 8
U2,42	+5V - 20 ▽ - 10
U21,22	+5V - 16 ▽ - 1

21 P/O A2

Figure 8-109. Amplitude, Modulation and Annunciator Displays Schematic Diagram

ManualsPlus.com

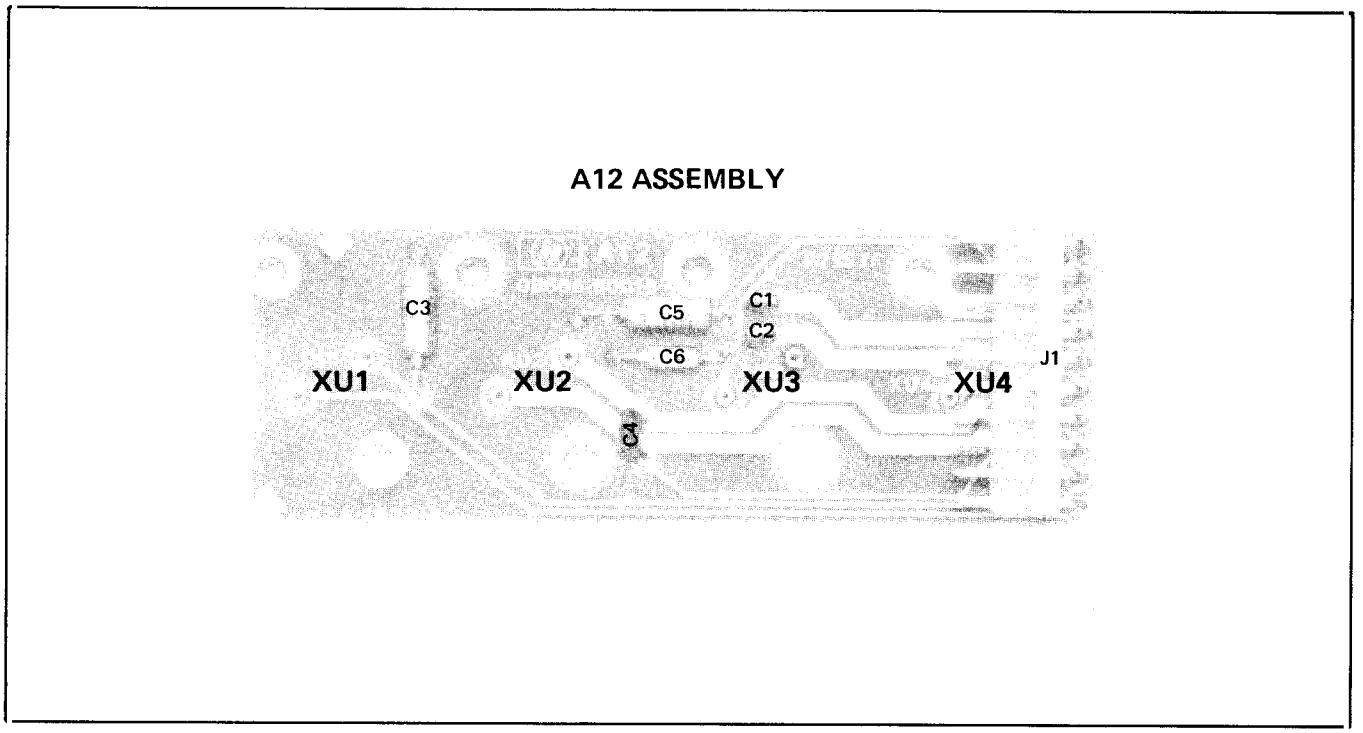


Figure 8-110. Voltage Regulator Component Locations

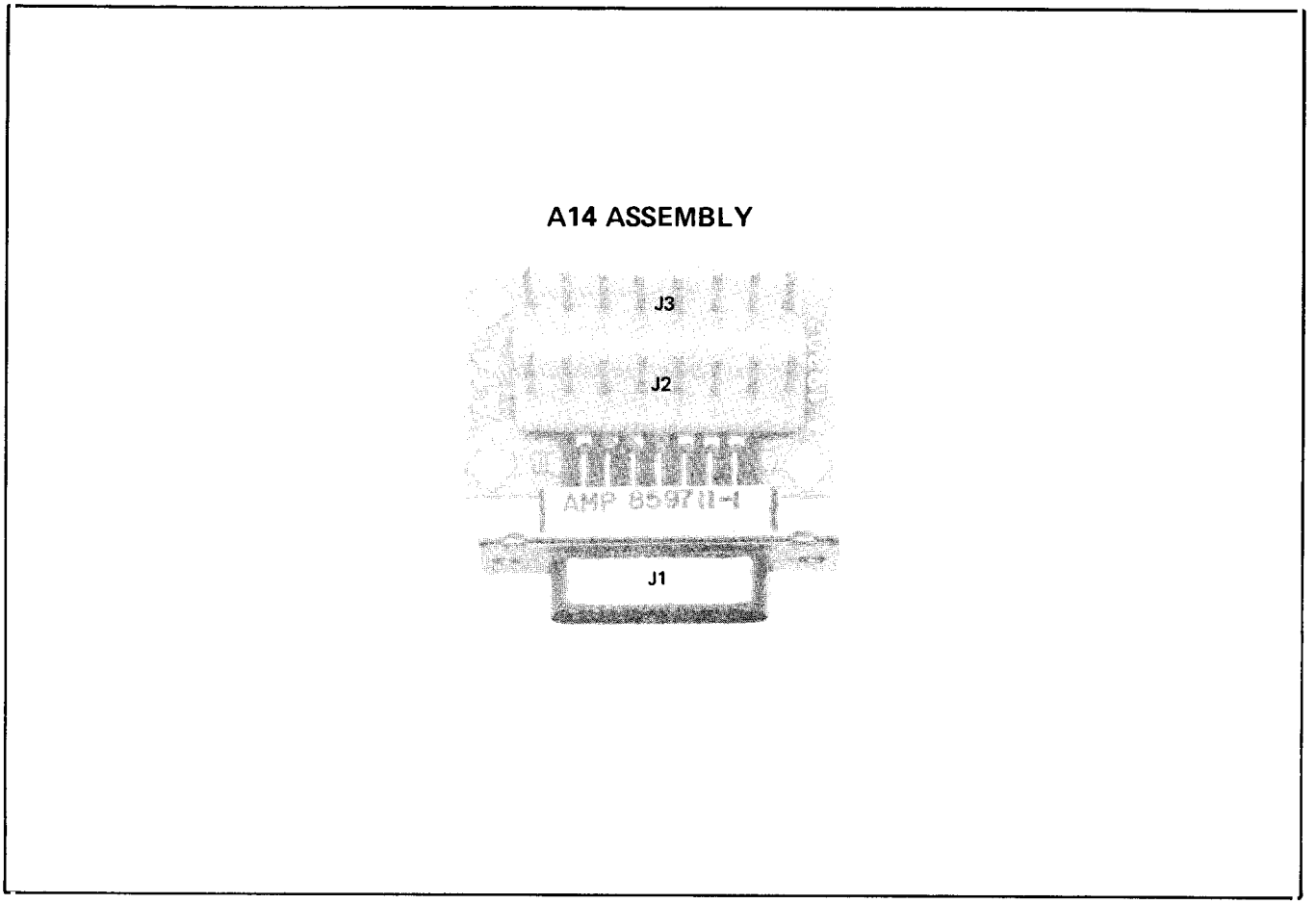


Figure 8-111. Filter Bank Component Locations

ManualsPlus.com

keeps the regulators from being reverse biased if an output is connected to a higher voltage.

The overvoltage protection circuit at the input of the +15 and −15V power supplies (VR5, R65, C21 and Q12) protects the supplies from excess line voltage. The unregulated voltages for the +15 and −15 Vdc supplies are about +25 and −25 Vdc. The 68.1 volt zener diode VR5 and its accompanying components is connected between the two supplies. The normal voltage across the zener diode is approximately 50 Vdc. When the voltage exceeds the threshold of 68.1 volts, the zener will turn on. Current is drawn through R65 which charges C21 until Q12 fires. Then the line fuse blows.

The +5 Vdc supply's crowbar (overvoltage protection) circuit consists of VR6, R80, R81 and Q3. The circuit protects the +5 volt supply if it is shorted to the +15 Vdc supply or other positive voltage greater than the threshold voltage of VR6 (+8.25 volts). In this situation, VR6 will turn on and draw enough current through R80 to fire Q3. This blows the +5 volt supply fuse.

LEDs DS1,2 and 3 are lit when the power supplies are providing an output voltage. Resistors R82, 83 and 84 set the current through the LEDs. Inductors L1, 2 and 3 and capacitors C17, 18, 19, 23, 24, 25, 26, 27 and 28 isolate and filter the associated supplies.

TROUBLESHOOTING

Procedures for checking the circuits shown on Service Sheet 22 are given below. The area or points to check are marked on the schematic by a hexagon with a check mark and a number inside, e.g. ⟨√3⟩. Fixed voltages are shown on the schematic inside a hexagon, e.g. ⟨2V±0.2V⟩. Transistor bias voltages are shown without tolerances.

Test Equipment

Digital Multimeter .....HP 3465A
Oscilloscope .....HP 1222A

⟨√1⟩ Verify that the voltages shown in Table 1 are correct.

Table 1. Power Supply Measurements

Volts	On test point J6-Pin:					
	11	13	9	3	10	2
Vdc Vp-p	+25 1.0	+17 to +13 0.01	+11 1.5	+5.6 to +5.2 0.01	−25 1.0	−13 to −17 0.01

ManualsPlus.com

SERVICE SHEET 22
P/O A10 AUDIO/POWER SUPPLY ASSEMBLY
P/O A12 VOLTAGE REGULATOR ASSEMBLY
P/O A14 FILTER BANK ASSEMBLY
A15 LINE POWER MODULE
P/O A16 10 MHz REFERENCE OSCILLATOR ASSEMBLY

TROUBLESHOOTING HELP

Service Sheet BD1
Table 4-1. Abbreviated Performance Tests
Table 5-2. Post-Repair Adjustments

PRINCIPLES OF OPERATION

General

The four dc power supplies are +24 Vdc unregulated, +15 Vdc regulated, +5 Vdc regulated and −15 Vdc regulated. The Attenuator Current Protection circuit protects against continuing current flow through the A9 Attenuator Assembly's latching relay coils. The switching time is about 60 ms. There are two types of overvoltage protection circuits. The first limits the unregulated voltage input to the ±15 volt supplies. The second type limits the voltage out of the +5 volt supply to the Signal Generator's circuits.

+24V Unregulated Supply and Attenuator Current Protection

The unregulated +24 volts switches the Step Attenuator, the Heterodyne frequency band and supplies current to the crystal oven's heater when the high stability time base, Option 001 is installed. The Attenuator Current Protection circuit will short +24V to ground through Q1 which blows F1. This occurs when attenuator and or heterodyne band switching current is drawn for more than 2.2 seconds.

The comparator, U2's reference voltage is set by the +24 voltage divided by R73 and R74. The step attenuator and heterodyne band switching coils draw current only during the time the switching takes place (about 60 ms). The resulting voltage drop across R75 will cause the voltage at the inverting input to go more negative. This causes the output of U2 to try to switch positive. Capacitor C22 keeps the output from switching immediately. The capacitor charges through R72 which is connected to the +5V supply. When the voltage on C22 nears +1.4 volts, Q2 will conduct enough current to trigger SCR Q1. This shorts the +24 volt supply to ground which blows fuse F1.

Regulated +15, +5, and −15 Volt Supplies

The ac voltages from the secondary of the power transformer are rectified by diodes CR6,7,8 and 9 for the +15 and −15 Vdc unregulated voltages. The +5 volts dc supply's unregulated voltage is from rectifiers located within the rear panel.

Diodes CR12, 13 and 14 protect the series regulators, U1, U2 and U3. If the output voltage of the series regulators goes more positive than the unregulated input voltage the diodes will be turned on. This

ManualsPlus.com

P/O A10 ASSEMBLY

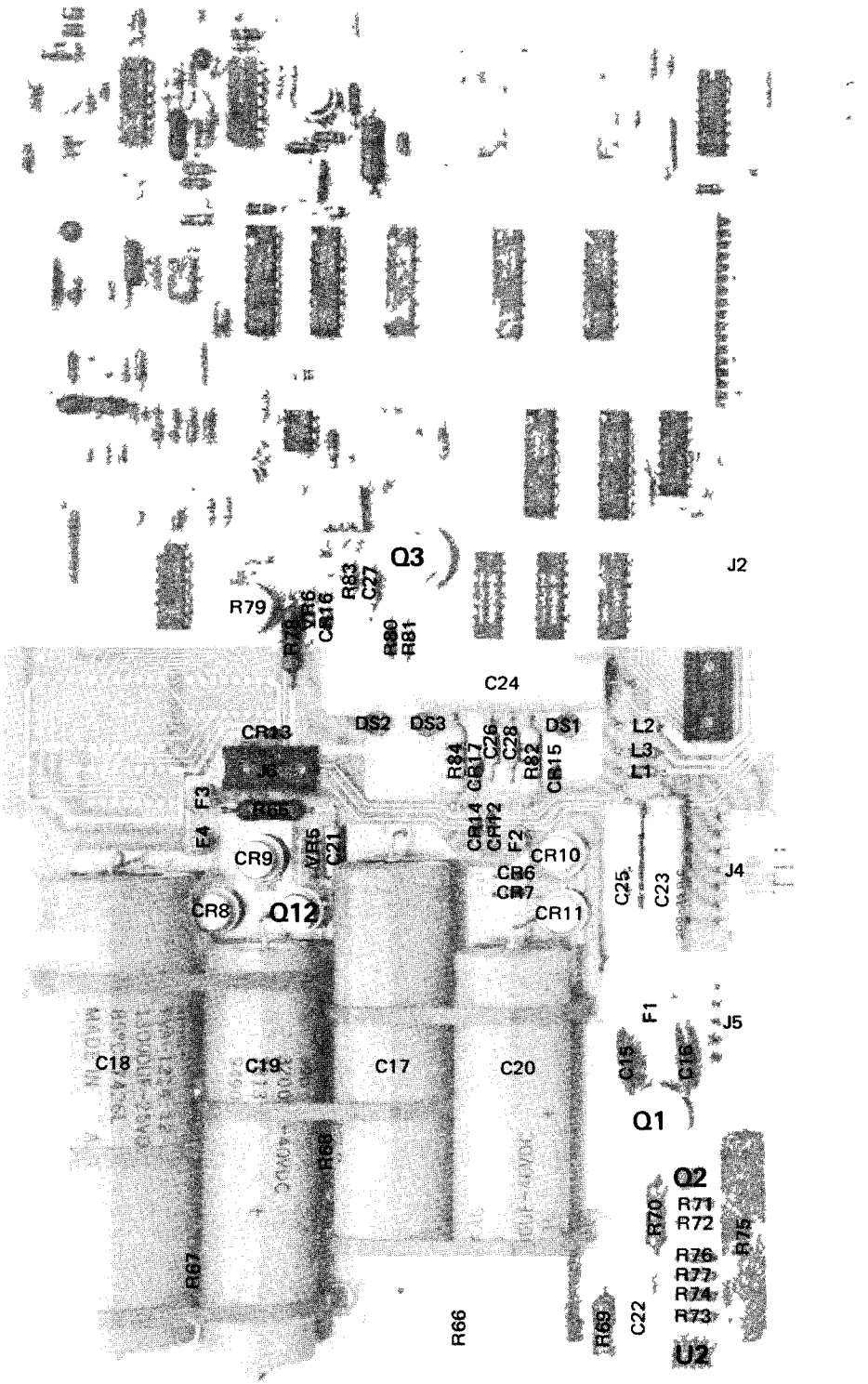
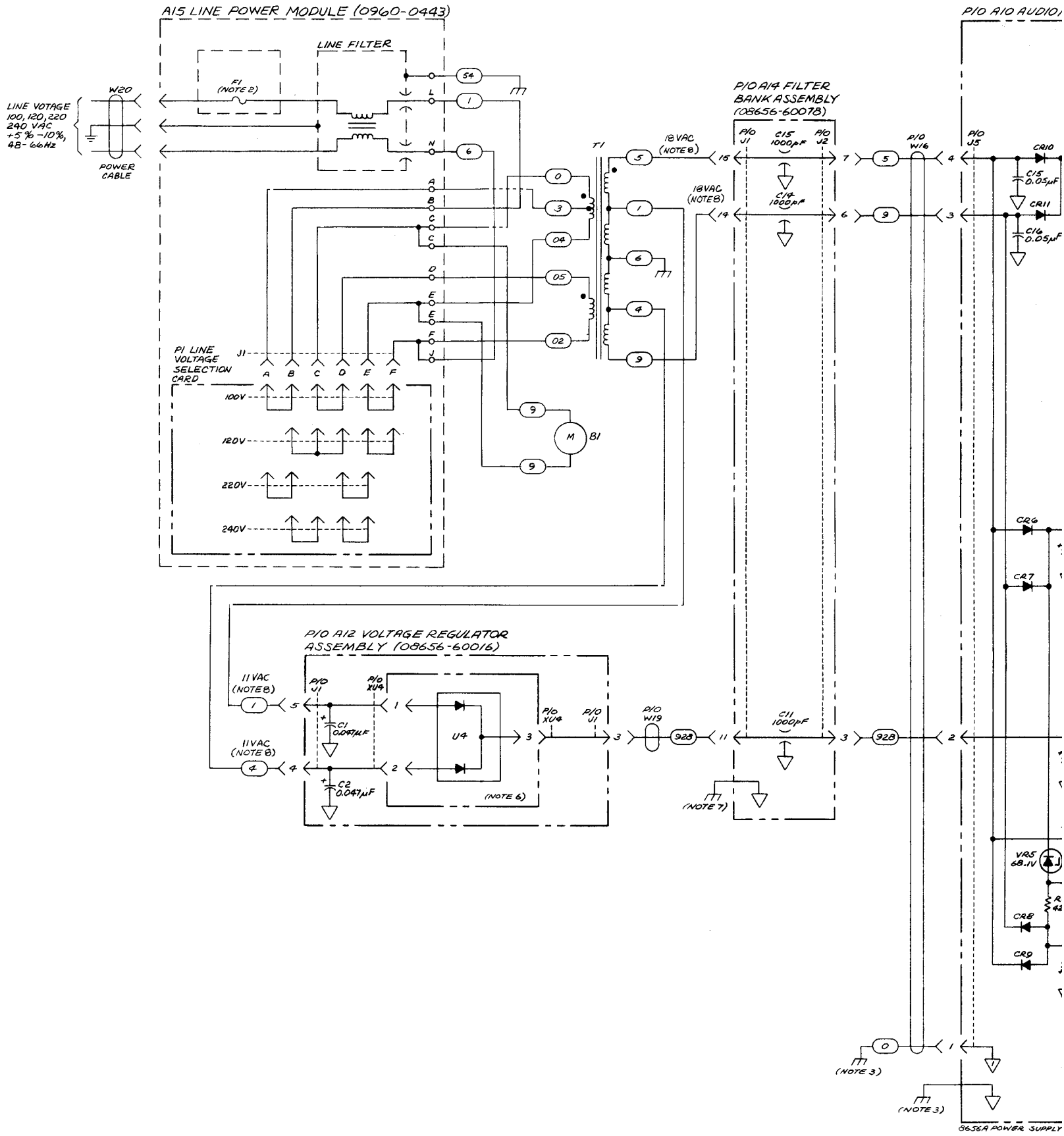
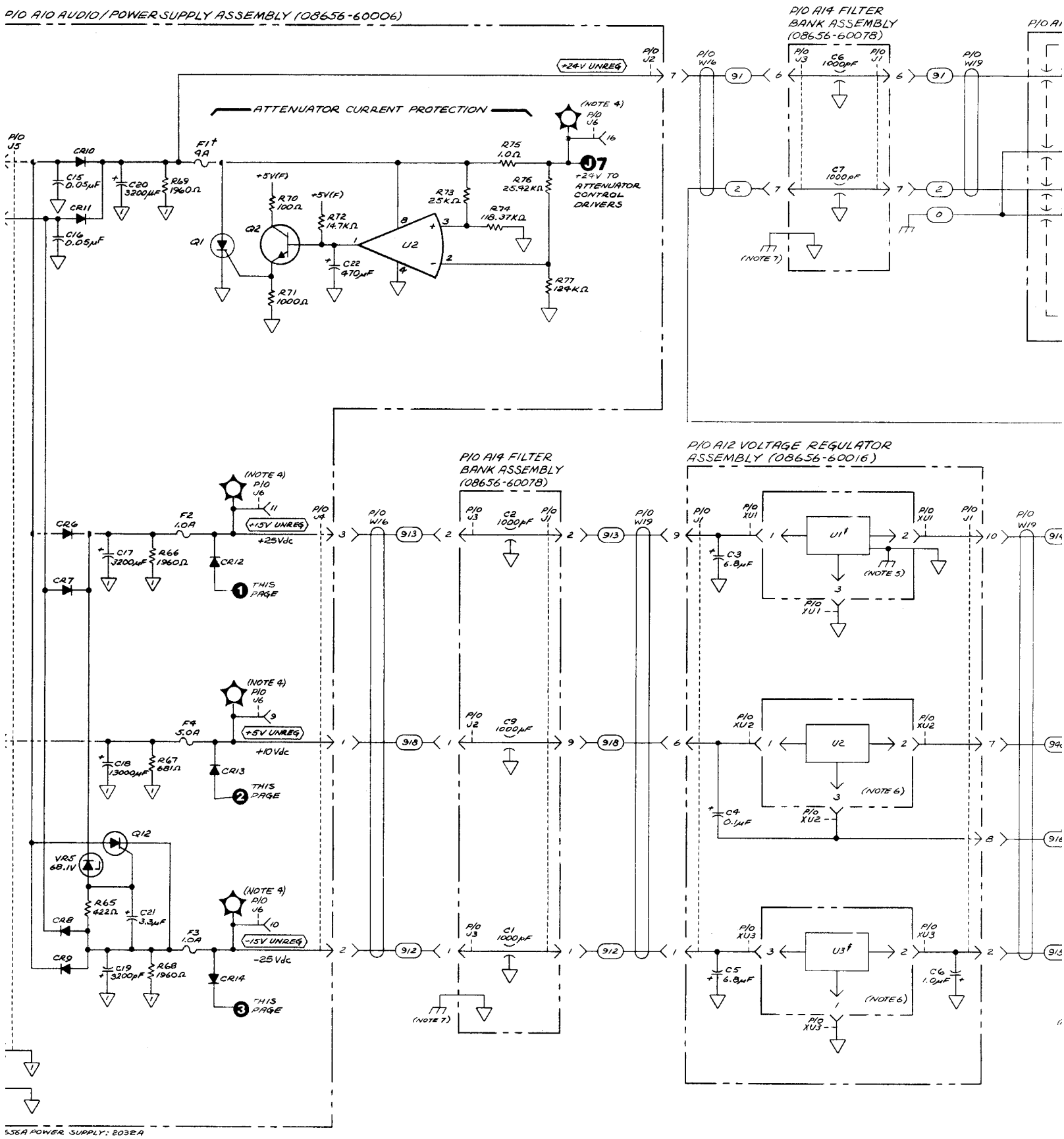


Figure 8-112. Power Supply (A10 Assembly) Component Locations

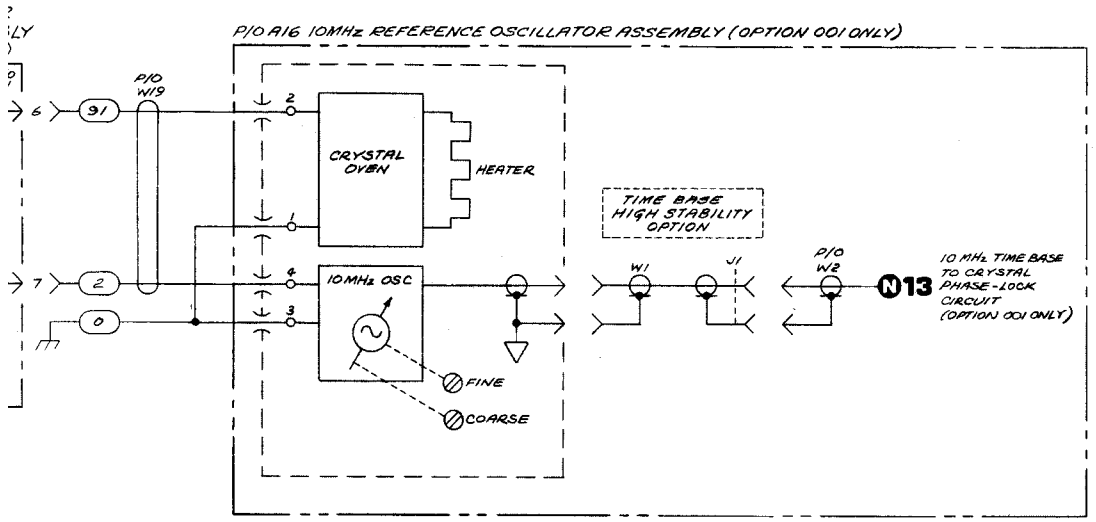
ManualsPlus.com



ManualsPlus.com



ManualsPlus.com



WARNING

THIS INSTRUMENT DOES NOT HAVE A PRIMARY POWER SWITCH. THE FOLLOWING VOLTAGES ARE ALWAYS PRESENT WHENEVER THE INSTRUMENT IS CONNECTED TO AN AC OUTLET:

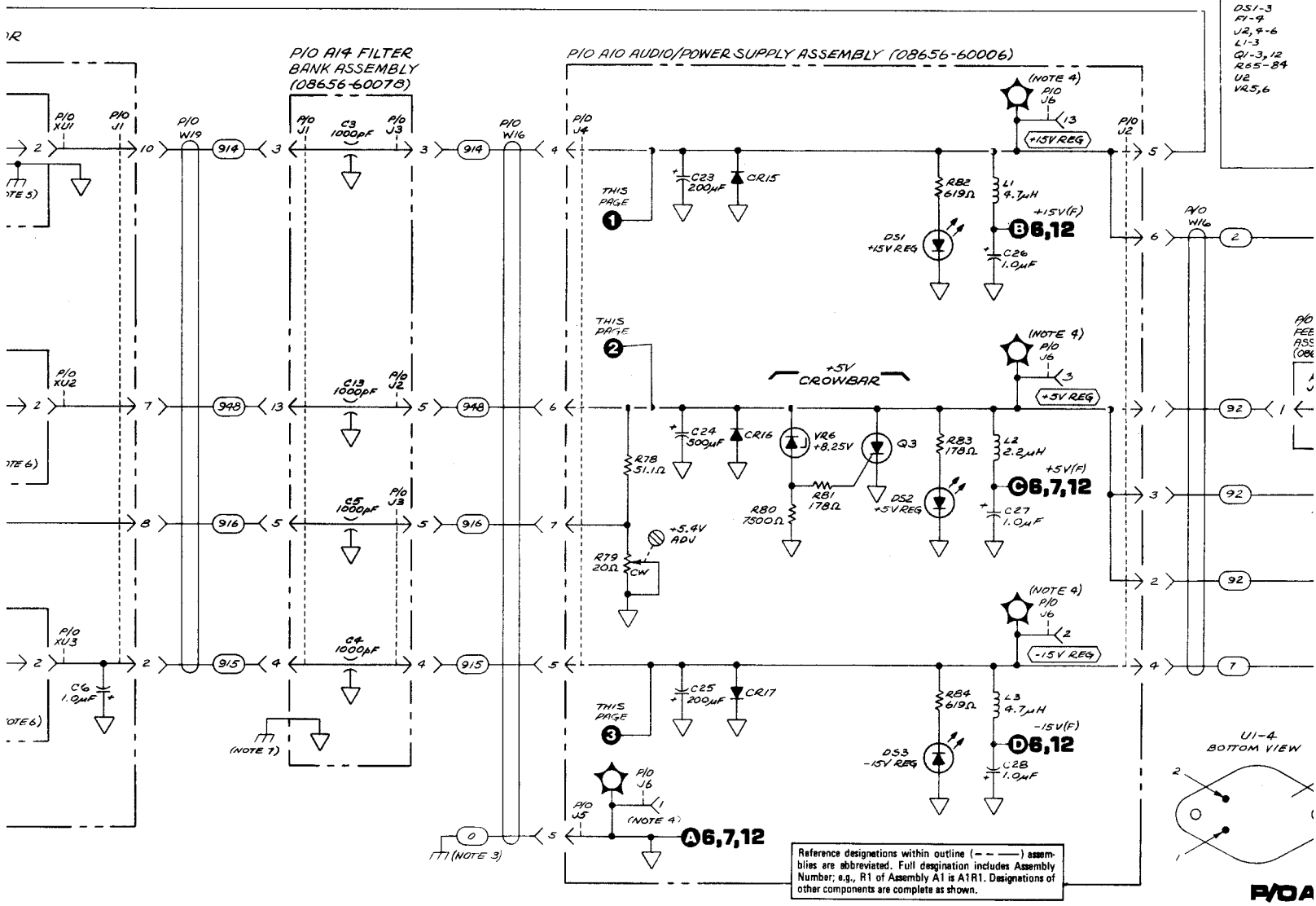
A. LINE VOLTAGE
B. PRIMARY AND SECONDARY AC VOLTAGES
C. UNREGULATED DC VOLTAGES - (+24V, +15V, +5V AND -15V).
D. REGULATED DC VOLTAGES - (+15V, +5V, AND -15V).

CAUTION

DO NOT CONNECT OR DISCONNECT THE AUDIO/POWER SUPPLY BOARD (A10) OR VOLTAGE REGULATOR BOARD (A12) WITH THE AC POWER CORD CONNECTED, OTHERWISE DAMAGE TO THE INSTRUMENT MAY RESULT.

REFERENCE

NO PREFIX
B1 C1,15,17,19 F1 T1 U1-4 W2,4,16,19,20
A10
C15-28 CR6-17 DS1-3 R1-9 U2,4-6 L1-3 Q1-3,12 R65-84 U2 VR5,6



Reference designations within outline (— — —) assemblies are abbreviated. Full designation includes Assembly Number; e.g., R1 of Assembly A1 is A1R1. Designations of other components are complete as shown.

Figu

ManualsPlus.com

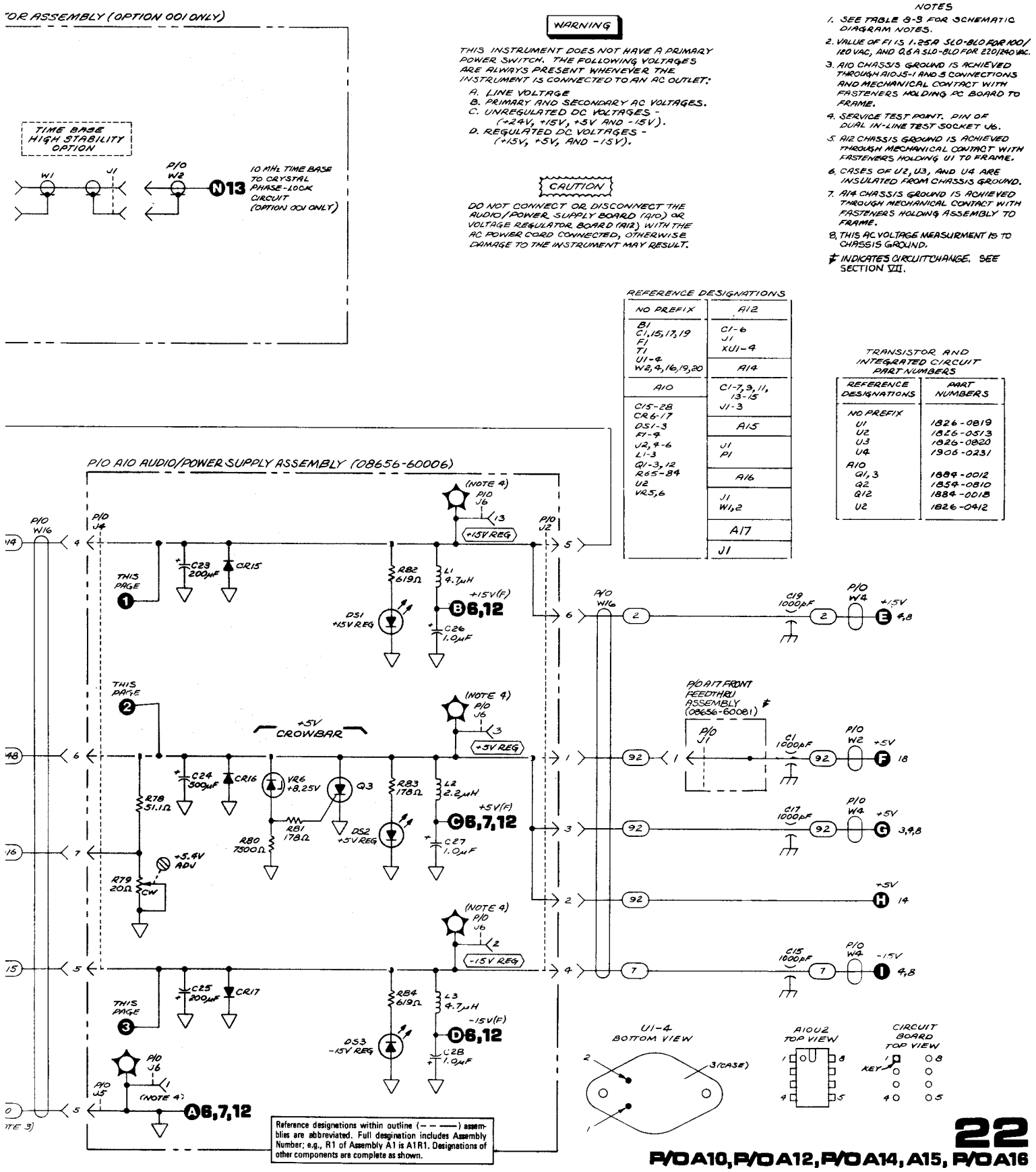


Figure 8-113. Power Supply Schematic Diagram

ManualsPlus.com

ManualsPlus.com

HEWLETT
PACKARD

HP Part No. 08656-90107

Printed in U.S.A.

ManualsPlus.com

MANUAL CHANGES

MANUAL IDENTIFICATION
Model Number: 8656A
Date Printed: May 1981
Part Number: 08656-90108

SIGNAL GENERATOR
OPERATING MANUAL

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

To use this supplement, first, make all ERRATA corrections and then all appropriate serial number related changes indicated in the tables below.

SERIAL PREFIX OR NUMBER	MAKE MANUAL CHANGES
2107A, 2111A	Errata Only
2115A, 2117A	Errata Only
2124A, 2127A	Errata Only
2128A, 2131A	Errata Only
2132A, 2135A	Errata Only
2136A, 2141A	Errata Only
2142A, 2146A	Errata Only
2148A, 2150A	Errata Only
2151A, 2208A	Errata Only
2214A, 2228A	Errata Only
2232A, 2233A	Errata Only
2245A, 2312A	Errata Only
2326A, 2341A	Errata Only
>> 2352A, 2402A	Errata Only

SERIAL PREFIX OR NUMBER	MAKE MANUAL CHANGES

>> NEW ITEM

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

Printed in U.S.A.

HEWLETT PACKARD

20 January 1984
2 Pages Text

ManualsPlus.com

MANUAL CHANGES

MANUAL IDENTIFICATION
Model Number: 8656A
Date Printed: May 1981
Part Number: 08656-90108

SIGNAL GENERATOR
OPERATING MANUAL

plement contains important information for correcting manual errors and for
the manual to instruments containing improvements made after printing the

his supplement, first, make all ERRATA corrections and then all appropriate
umber related changes indicated in the tables below.

X OR NUMBER	MAKE MANUAL CHANGES	SERIAL PREFIX OR NUMBER	MAKE MANUAL CHANGES
'A, 2111A	Errata Only		
iA, 2117A	Errata Only		
IA, 2127A	Errata Only		
3A, 2131A	Errata Only		
'A, 2135A	Errata Only		
iA, 2141A	Errata Only		
'A, 2146A	Errata Only		
3A, 2150A	Errata Only		
A, 2208A	Errata Only		
IA, 2228A	Errata Only		
'A, 2233A	Errata Only		
iA, 2312A	Errata Only		
iA, 2341A	Errata Only		
'A, 2402A	Errata Only.		
)A	Errata Only		

NOTE:
change supplements are revised as often as necessary to keep manuals as
and accurate as possible. Hewlett-Packard recommends that you peri-
y request the latest editron of this supplement. Free copies are avail-
om all HP offices. When requesting copies, quote the manual identifica-
formation from your supplement or the model number and print date from
le page of the manual.

HEWLETT PACKARD

1984
Text

ManualsPlus.com

MANUAL CHANGES

MANUAL IDENTIFICATION
Model Number: 8656A
Date Printed: May 1981
Part Number: 08656-90107

SIGNAL GENERATOR
OEPERATING AND SERVICE MANUAL

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

To use this supplement, first, make all ERRATA corrections and then all appropriate serial number related changes indicated in the tables below.

SERIAL PREFIX OR NUMBER	MAKE MANUAL CHANGES
2107A	1
2111A	1-2
2115A	1-3
2117A	1-4
2124A	1-5
2127A	1-6
2128A	1-6, 11
2131A	1-7
2132A	1-7, 11
2135A	1-8
2136A	1-8, 11
2141A	1-9
2142A	1-9, 11
2146A	1-11
2148A	1-12
2150A	1-13
2151A	1-14
2208A	1-15
2214A	1-16

SERIAL PREFIX OR NUMBER	MAKE MANUAL CHANGES
2228A	1-17
2232A	1-18
2233A	1-19
2245A	1-20
2312A	1-21
2326A	1-22
>> 2341A	1-23
>> 2352A	1-24
>> 2402A	1-25

>> NEW ITEM

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

Printed in U.S.A.

HEWLETT PACKARD

20 January 1984
25 Pages Text
20 Illustrations

ManualsPlus.com

ERRATA

Page 1-4, Table 1-1:
Under SPECTRAL PURITY, change the performance limit for Harmonics to <-25 dBc.

>> Page 1-7, Table 1-2:
In the "**Supplemental Characteristics**" under "**Modulation**" change "**Modulating Signal Output:**" to read:

Internal modulating signal is provided at the front-panel BNC connector: nominally 1V peak into a 600 ohm resistive load.

Page 1-10, Table 1-3:
Change RF Cable, BNC(f) to BNC(f) 08662-60080, to RF Cable, BNC(m) to SMC(f), 08662-60075.

Page 2-1, paragraph 2-4:
In the first sentence following the first WARNING, change "115 (90 to 126) Vac or 230 (198 to 252) Vac" to "100, 120, 220, or 240 Vac, +5%, -10%.

Page 2-2, paragraph 2-7:
In this section any information referring to an inductive-jumper should be changed to read resistive-jumper.

Page 2-7/2-8, Section 2-13 **Rack Mounting (Cont'd):**
Delete: Standard Tilt Slide Kit for HP rack enclosures.....HP 1494-0025
Add: Special Tilt Slide Kit for HP rack enclosures.....HP 08656-82001

Page 3-4, paragraph 3-11:
In this section any information referring to an inductive-jumper should be changed to read resistive-jumper.

>> Page 3-8, Figure 3-4:
Under "**MOD INPUT/OUTPUT Connector**" in the fifth sentence delete "±5% minimum".

Page 3-23, paragraph 3-18:
In the sixth sentence change SH1 to SH0.

Page 4-3, paragraph 4-7:
In the Specification table under SPURIOUS SIGNALS, change the performance limit for Harmonics to <-25 dBc.

Page 4-4, paragraph 4-7:
In step 3 (in the instruction and in the record table) change <-30 dBc to <-25 dBc.

Page 4-20:
In the table under step 23, change "500 kHz" to "10 MHz".

Page 4-23, Table 4-2:
Under SPURIOUS SIGNALS, change the maximum limit for harmonics to -25 dBc.

Page 5-1, Table 5-1:
Replace the table with the attached **Table 5-1. Factory Selected Components (P/O ERRATA).**

Page 5-13:
In the DESCRIPTION, delete "at A3J5". In the PROCEDURE, step 1, delete the first sentence, and change A3J5 to J4 in the second sentence.

Page 5-14:
Under EQUIPMENT: change HP 08662-60080 to HP 08662-60075.

Page 5-15:
Under EQUIPMENT: change HP 08662-60080 to HP 08662-60075.

ManualsPlus.com

ERRATA (cont'd)

Page 6-33, Table 6-3:
Add MP139 08656-00008 (CD2) QTY 4 FRONT PANEL, REAR BRACKET, Mfr. Code 28480, Mfr. Part Number 08656-00008.
Change W2 to 08656-60089 Wiring Harness and Front (F) Feedthru Assembly Service Kit.
>>r Change U1 to 1826-1181 (CD3) IC V RGLTR-FXD-POS 14.7/15.3V TO-3 PKG.
>>r Change U3 to 1826-1157 (CD3) IC V RGLTR-14.7/15.3V TO-3 PKG.
>> Page 6-36, Figure 6-2:
Change MP47 to MP108 and MP109.
Page 8-42, check 7, step 3:
Change the last two sentences to read, "Disconnect the wire from capacitor C44 to U5A pin 5. Verify that the voltage at C44 is 0.00 + 0.010 Vdc. Reconnect the wire."
Page 8-47, Service Sheet 1 (schematic):
A4C22: Delete the asterisk (*). A4C22 is not a factory selected component
A5C15: Add an asterisk (*) to indicate a factory selected component.
Page 8-48, Figure 1:
Replace Figure 1 with the attached **Figure 1. Unlocked High Frequency Loop Waveforms (P/O ERRATA).**
Page 8-53, Figure 8-46, Service Sheet 3 (schematic):
A8C40: Add an asterisk (*) to indicate a factory selected component.
A8C5: Add an asterisk (*) to indicate a factory selected component.
A8C19: Add an asterisk (*) to indicate a factory selected component.
Page 8-56, (component locations):
Add component location identification for C62 which is located directly below (with normal page orientation) silkscreened "A6" and "HP" logo.
>>r Page 8-57, Service Sheet 4:
In the TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS table change U2 to 1820-3485.
Page 8-59/8-60, (component locations):
Add component location identification for L53 which is located directly below (with normal page orientation) L50, R60, R65 and R69.
Page 8-61, Figure 8-61, Service Sheet 5 (schematic):
In the upper left corner of the schematic add an asterisk (*) to R57 to indicate a factory selected value.
Page 8-67, Figure 8-57, Service Sheet 6 (schematic):
Change the schematic as shown in the attached figure, **P/O Figure 8-57. Modulation and RF Amplitude Control Schematic Diagram (P/O ERRATA).**
Page 8-71, Figure 8-63, Service Sheet 7 (schematic):
In instruments with Serial Prefix 2214A and below, the timing for one-shot multivibrators U3A and U3B is 44 ms. In these units, attenuator switching reliability can be improved by changing R52 and R53 to 178k ohms, with 60 ms timing. The two resistors are independent, and either or both can be changed.
In Figure 8-62 the timing shown should be either 44 or 60 ms depending on the resistance values of R52 and R53.
>>r Page 8-83, Service Sheet 9:
In the TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS table change U23 to 1820-3102.

ManualsPlus.com

CHANGE 1

r Page 6-14, Table 6-3:
Change A4C67 to 0160-4389 CD6 CAPACITOR-FXD 100 PF ± 5 PF 200 VDC CER.

r Page 6-17, Table 6-3:
Change A5CR1 and CR2 to 0122-0329 CD6 DIODE VCC 2.2 PF 5%
C3/C25-MIN=4.5 28480 0122-0329.

Page 6-29, Table 6-3:
Under A11U13 and A11U19, add 1200-0654 CD7 SOCKET-IC 40-CONT DIP-SLDR 28480 1200-0654.

Page 8-47, Figure 8-40, Service Sheet 1 (schematic):
Change the value of A4C67 to 100 pF.

CHANGE 2

Page 6-32, Table 6-3:
MP38: If replacement is needed, use the part shown in CHANGE 13, and discard the flat and lock washers.
Change MP39 to 2150-0193 CD7 SCREW-MACH 8-32 .375-IN-LG PAN-HD-POZI 28480 2510-0193.

Page 6-33, Table 6-3:
Add MP138 2515-0017 CD4 SCREW-MACH 8-32 .25 IN-LG PAN-HD-PHL 00000 ORDER BY DESCRIPTION.

CHANGE 3

Page 6-9, Table 6-3:
Delete A3C82.

Page 6-23, Table 6-3:
Add A8C58 0160-3878 CD6 CAPACITOR-FXD 1000 PF ±20% 100 VDC CER 28480 0160-3878.
Add A8MP5 0360-0124 CD3 QTY 2 CONNECTOR-SGL CONT PIN .04-IN-BSC-SZ RND 28480 0360-0124.
Add A8MP6 08656-00099 MULTIPLIER BOARD GROUND TAB 28480 08656-00099.

Page 6-24, Table 6-3:
Add A8R39 0757-0278 CD9 RESISTOR 1.78K 1% .125W F TC=0±100.

Page 8-53, Figure 8-46, Service Sheet 3 (schematic):
In the X2 400 to 800 MHz circuit, add R39 1780 ohms connected in parallel with L27.
In the Buffer Amplifier No.1 circuit, add C58, 1000 pF connected in parallel with C20.

Page 8-99, Figure 8-82, Service Sheet 13 (schematic):
Delete C82 at U32A pin 4.

CHANGE 4

Page 5-1, Table 5-1:
Delete all information pertaining to A6R4.

Page 5-17:
Add the attached RF Divider Bias Adjustment Procedure, 5-18A. RF DIVIDER BIAS ADJUSTMENT (P/O CHANGE 4).

ManualsPlus.com

CHANGE 4 (cont'd)

Page 8-58, Service Sheet 5, Table 2:
Change the table as follows:

500	+0.2	+14.8	+14.8
300	+14.8	+0.2	+14.8
200	+14.8	+14.8	+0.2

Page 8-61, Figure 8-54, Service Sheet 5 (schematic):
Change the A6 circuit board part number to 08656-60118.
In the Low Band Output Amplifier, change C52 and C59 to 1.0 uF.
Change the Output Section Data Storage/Driver as shown in the attached figure, P/O Figure 8-54. **Heterodyne and Output Control Schematic Diagram (P/O CHANGE 4).**

Page 8-62, Service Sheet 6, Tables 2, 3, and 4:
Replace the Tables with the attached tables, **Table 2. Level Control Voltage Levels Versus Frequency (P/O CHANGE 4), Table 3. Level Control Voltage Levels Versus Front Panel Amplitude (P/O CHANGE 4),** and **Table 4. AM% Control Voltage Levels (P/O CHANGE 4).**

Page 8-71, Figure 8-63, Service Sheet 7 (schematic):
Change the A6 circuit board part number to 08656-60118.

Page 8-73, Figure 8-66, Service Sheet 8 (schematic):
Change the value of A3R4 and R7 to 287 ohms.
Change the value of A3R5 to 17.8 ohms.

Page 8-93, Figure 8-75, Service Sheet 11 (schematic):
Change the value of A3C64 to 910 pF.

Page 8-105, Figure 8-86, Service Sheet 14 (schematic):
Change the A11 circuit board part number to 08656-60121.

Page 8-107, Figure 8-89, Service Sheet 15 (schematic):
Change the A11 circuit board part number to 08656-60121.

Page 8-108, Service Sheet 16, Table 2:
Change ROM6 to 08656-80012.

Page 8-108. Service Sheet 16, Tables 3 and 4:
Change the signatures to those in the following tables.

Table 3. ROM Generated Data Bus Signatures (P/O CHANGE 4).

Node	Correct Signature
+5V	1817
D0	93FA
D1	8169
D2	FU1A
D3	9F30
D4	PC89
D5	6P97
D6	U31C
D7	23FP

ManualsPlus.com

CHANGE 7

Page 6-25, Table 6-3:
A10C18: In some instruments this capacitor is HP 0180-3141 (13500 uF). However, if this part fails, replace it with the part shown in CHANGE 16.
Page 6-33, Table 6-3:
Delete MP130, MP131, MP132.
Page 6-37, Figure 6-3:
Delete MP130, MP131, and MP132 between the fan and power module. This is now a direct connection.
Page 8-127/128, Figure 8-113, Service Sheet 22 (schematic):
A10C18: In some instruments this part is a 13500 uF capacitor. However, if this part fails, replace it with the part shown in CHANGE 16.

CHANGE 8

Page 6-18, Table 6-3:
Change A6C26 to 0160-2208 CD4 CAPACITOR-FXD 330 PF ±5% 300 VDC MICA.
Page 6-31, Table 6-3:
Change B1 to 3160-0383 CD5 FAN-TUBAXIAL 36-CFM 115V 50/60 HZ (DOES NOT INCLUDE W21).
Page 6-34, Table 6-3:
Add W21 8120-1478 CD2 CABLE ASSY FAN WITH MIN. CONNECTOR.
Page 6-37, Figure 6-3:
Add W21 in place of existing fan cable and connectors.
Page 8-57, Figure 8-50, Service Sheet 4 (schematic):
Change the value of A6C26 to 330 pF.
Page 8-127/128, Figure 8-113, Service Sheet 22 (schematic):
Add reference designator W21 to wires connecting fan B1 to line power module A15. Change wire color to (0) (black).

CHANGE 9

Page 6-10, Table 6-3:
A3MP6: Change the quantity to 4.
A3MP13: Change to 08656-00091 CD3 same description.
Page 6-18, Table 6-3:
Change A6C16 to 0180-0228 CD6 CAPACITOR-FXD 22UF ±10% 15 VDC TA.
Page 6-19, Table 6-3:
Change A6L11 to 9100-1622 CD7 INDUCTOR RF-CH MLD 24 UH 5% .166D X .385LG.
Page 6-42, Figure 6-8:
A3MP6: Change quantity to 4.

NOTE

The new cover is thicker and therefore 2 additional washers are needed to avoid distorting the grounding contact.

ManualsPlus.com

CHANGE 12 (cont'd)

Page 8-115, Figure 8-100, Service Sheet 18 (schematic):
Replace the upper center portion of the schematic between C3 and P/O W2 (feedthru assembly) with the attached partial schematic, **P/O Figure 8-100. Keyboard and Encoder Schematic Diagram (P/O CHANGE 12).**
Replace the lower center portion of the schematic between A1 Keyboard Assembly and P/O W2 with the attached partial schematic, **P/O Figure 8-100. Keyboard and Encoder Schematic Diagram (P/O CHANGE 12).**
Replace the right side of the schematic between P/O W2 and C2, C7, C8, and C4 with the attached partial schematic, **P/O Figure 8-100. Keyboard and Encoder Schematic Diagram. (P/O CHANGE 12).**

Page 8-119, Figure 8-103, Service Sheet 19 (schematic):
Replace the upper left portion of the schematic between C5 and C6 and P/O W2 with the attached partial schematic, **P/O Figure 8-103. Display Control Schematic Diagram (P/O CHANGE 12).**

CHANGE 13

Page 6-32, Table 6-3:
Change MP38 to 08656-00101 CD6 SHIELD-PIN MODULATOR.

CHANGE 14

Page 6-30, Table 6-3:
Add A19, 08656-60122 CD7 REAR FEEDTHRU ASSEMBLY.

r Page 6-34, Table 6-3:
Change W16 to 08656-60087 CD3 WIRING HARNESS MAIN (EXCEPT OPT 002).
Change W16 to 08656-60091 CD9 WIRING HARNESS MAIN (OPT 002 ONLY).
Add the following replacement parts for W16:

HP Part Number	Check Digit	Quantity	Description
1251-0512	3	1	Connector Body, 5-pin
1251-4968	1	2	Connector Body, 7-pin
1251-3278	4	2	Connector Body, 8-pin
1251-3411	7	6	Pins for above, for 18 ga wire
1251-3966	7	26	Pins for above, for 24 ga wire
1251-4741	8	1	Connector Body, 9-pin
1251-5260	8	1	Connector Body, 14-pin
1251-5207	3	1	Connector Body, 16-pin
1251-4182	1	37	Pins for above
1251-3808	6	1	Polarizing key for 14-pin connector
0362-0227	1	4	Single push-on pins for wires 90, 91, 3, and 97
0890-0983	5	100 mm	Heat-shrink tubing for above
1251-3720	1	2	Single push-on pins for wires 903 and 905
5020-0176	9	2	Insulator for above pins
0890-0312	4	150mm	Heat-shrink tubing for cable to 9-pin connector
0360-0001	5	1	Terminal lug, #6

ManualsPlus.com

CHANGE 16

r Page 6-9, Table 6-3:
Change A3CR1 to 0122-0152 CD3 DIODE VVC 7.5 PF AT 15V.
r Page 6-10, Table 6-3:
Change A3CR33 to 0122-0152 CD3 DIODE VVC 7.5 PF AT 15V.
r Page 6-17, Table 6-3:
Change A5R9 to 0698-7220 CD9 RESISTOR 215 1% .05W F TC=0±100.
r Page 6-19, Table 6-3:
Change A6CR26, 27, 29, and 30 to 0122-0152 CD3 DIODE VVC 7.5 PF AT 15V.
r Page 6-25, Table 6-3:
Change A10C18 to 0180-3209 CD9 CAPACITOR-FXD 24000 UF 20V.
Page 8-127/128,Figure 8-113,Service Sheet 22(schematic):
Change the value of A10C18 to 24000 uF.

CHANGE 17

Page 6-24, Table 6-3:
r Change A9MP3 to 08656-40014 CD4.
Add A9MP6 1410-0226 CD4 QTY 21 BALL-BRG TYPE 0.09375 DIA GRADE-50 SST.
r Page 6-27, Table 6-3:
Change A10R52 and R53 to 0698-3243 CD8 RESISTOR 178K 1% .125W F TC=0+100.
Page 6-43, Figure 6-9:
Replace the appropriate portion of Figure 6-9 with the attached drawing, **P/O Figure 6-9. Attenuator Assembly - A9 Parts Identification (P/O CHANGE 17).**
Page 8-71, Figure 8-63, Service Sheet 7 (schematic):
Change the value of A10R52 and R53 to 178k ohms.

CHANGE 18

r Page 6-10, Table 6-3:
Change A3L21 to 9100-3922 CD4 INDUCTOR-TORRIOD 1uH.
Page 6-16, Table 6-3:
Change A4R63 to 0757-0440 CD7 RESISTOR 7.5K 1% .125W F TC=0+100.
Change A4R65 to 0698-3153 CD9 RESISTOR 3.83K 1% .125W F TC=0±100.
Add A4R76 0757-0280 CD3 RESISTOR 1K 1% .125W F TC=0±100.
Page 8-51, Figure 8-43, Service Sheet 2 (schematic):
Replace the appropriate part of the schematic with the attached partial schematic, **P/O Figure 8-43. High Frequency Loop Amplifier and Control Schematic Diagram. (P/O CHANGE 18).**
Page 8-99, Figure 8-22, Service Sheet 13 (schematic):
Change the value of A3L21 to 1uH.

CHANGE 19

r Page 6-11, Table 6-3:
Change A3R73 to 0698-3152 CD8 RESISTOR 3.48K 1% .125W F TC=0±100.
Page 6-25, Table 6-3:
r Change A10 to 08656-60124 CD9, same description.
Add A10C30, C31, C32 0160-4084 CD8 CAPACITOR-FXD .1 UF +20% 50 VDC CER.
Add A10C33, 0160-0127 (CD2) CAPACITOR-FXD 1 UF +20% 25 VDC.
Add A10C34 0160-3490 CD8 CAPACITOR-FXD 1 UF +20% 50 VDC CER.
Change A10CR6, CR7 to 1901-0200 CD5 DIODE-PWR RECT 100V 1.5A.

ManualsPlus.com

CHANGE 20 (cont'd)

Page 8-51, Figure 8-43, Service Sheet 2 (schematic) [(see note 1)]:
Replace the appropriate part of the schematic with the attached partial schematic, P/O Figure 8-43. High Frequency Loop Amplifier and Control Schematic Diagram **(P/O CHANGE 20)**.
In the TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS table change the part number of Q10 to 1855-0423.

Page 8-67, Figure 8-57, Service Sheet 6 (schematic):
Add L3, 143 uH, in series with J1, MOD INPUT/OUTPUT.
Add L4, 143 uH, in series with J6, MOD INPUT/OUTPUT.

Page 8-127/128, Figure 8-113, Service Sheet 22 (schematic)[(see note 1)]:
In the middle left side of the schematic add safety ground wire, green/yellow (54), to B1(motor) indicating a chassis ground to the fan casing.

NOTE 1:
Instruments with the following serial numbers are not affected by this change:

2245A04132-04150
04152-04157
04159-04161
04164-04168
04171
04175
04177-04178
04180
04198-04199
04201
04203-04204
04226
04239
04244

CHANGE 21

r Page 6-33, Table 6-3:
Change U2 to 1813-0361 (CD2) IC V RGLTR SXD-POS 4.85/5.25V TO3-PKG.

Page 8-127/128, Service Sheet 22 (Figure 8-113):
In Transistor and Integrated Circuit Part Number table change U2 to 1813-0361.

CHANGE 22

r Page 6-26, Table 6-3:
Change A10Q1 and A10Q3 to 1884-0244 (CD5) THYRISTOR-SCR VRRM=400. (Use Heat Sink A10MP4 with A10Q3)

Page 6-26, Table 6-3:
Add A10MP4 1205-0361 (CD3) HEAT SINK SGL TO-5/TO-39-CS.

CHANGE 23

>> Page 6-24, Table 6-3:
Delete A9A1L1 from the table.

ManualsPlus.com

Table 5-1. Factory Selected Components (1 of 2)

Reference Designator	Service Sheet	Range of Values	Basis of Selection
A4R6,7,10	1	See table under "Basis of Selection"	Attenuator pad selected for -8 dBm input to mixer A4U1. Measure power level at RF Test Point A4TP3 with A4R6 and A4R7 disconnected. Select pad values for -8 dBm to mixer. Level must be checked whenever the A3, A4, A8, or FL1 assemblies are replaced.

Attenuation (dB)	R6, R10 (ohms)	HP Part No. (Check Digit)	R7 (ohms)	HP Part No. (Check Digit)
3	287	0698-7223 (2)	17.8	0698-7194 (6)
4	215	0698-7220 (9)	23.7	0698-7197 (9)
5	178	0698-7218 (5)	31.6	0698-7200 (5)
6	147	0698-7216 (3)	38.3	0698-7202 (7)
7	133	0698-7215 (2)	46.4	0698-7204 (9)
8	121	0698-7214 (1)	51.1	0698-7205 (0)
9	110	0698-7213 (0)	61.9	0698-7207 (2)
10	100	0698-7212 (9)	75.0	0698-7209 (4)

Reference Designator	Service Sheet	Range of Values	Basis of Selection
A5C22	1	0 or 1 pF	Selected to eliminate spurious signals at 690 to 740 MHz.
A6R4	4	75 ohms to 147 ohms	Selected to bias U1 so noise and harmonics are as low as possible in both the divide-by-2 and divide-by-4 bands. Refer to Specifications and Supplemental Characteristics tables in Section I.
A8C40	4	0 or 1000 pF	Selected to eliminate a spurious signal at 700 MHz.
A5C15	1	10 to 33 pF	Decrease the value of C15 if the 494-990MHz oscillator fails to oscillate at 494 MHz only. Increase C15's value if spurs are present at 1/2 the fundamental frequency from 494 to 990 MHz.
A6R57	5	237 to 348 ohms	Selected to center the adjustment range of C56 in the heterodyne band (.1 to 123 MHz).

ManualsPlus.com

Table 2. Level Control Voltage Levels Versus Frequency
(P/O CHANGE 4)

Front Panel Frequency (MHz)	Measure the Voltage* as Indicated										
	U5								U9		Test Point J6-pin 12 (VDC)
	2	5	6	9	12	15	16	19	2	5	
0.100	L	H	H	L	L	H	L	H	L	L	0.488
100	L	H	H	L	L	H	L	H	L	L	0.488
200	L	H	H	L	H	L	H	L	L	L	0.513
300	L	H	H	L	H	L	L	L	H	H	0.506
400	L	H	H	L	H	L	H	L	L	L	0.512
800	L	H	H	L	L	H	L	L	L	L	0.483
990	L	H	H	L	L	L	L	L	H	L	0.467

* Low is <+0.8 Vdc; High is >+2.0 Vdc.

Table 3. Level Control Voltage Levels Versus Front Panel Amplitude
(P/O CHANGE 4)

Front Panel Amplitude (MHz)	Measure the Voltage* as Indicated										
	U5								U9		Test Point J6-pin 12 (VDC)
	2	5	6	9	12	15	16	19	2	5	
0.0	L	H	H	L	L	H	H	H	H	L	0.500
+5.0	H	L	H	H	H	L	L	L	L	L	0.890
+10.0	L	H	H	L	H	L	L	L	L	L	1.577
+13.0	H	L	L	H	L	L	H	H	L	L	2.233

* Low is <+0.8 Vdc; High is >+2.0 Vdc.

Table 4. AM% Control Voltage Levels
(P/O CHANGE 4)

Front Panel AM%	Measure the Voltage* as Indicated										
	U9						U13				Test Point J6-pin 12 (Vac)
	6	9	12	15	16	19	2	5	6	9	
1	L	L	L	L	L	L	L	H	L	L	0.0033
5	L	L	L	L	L	H	L	H	L	H	0.018
10	L	L	L	L	H	L	H	L	L	H	0.035
20	L	L	L	H	L	H	L	L	H	H	0.072
50	L	L	H	H	L	L	H	H	H	H	0.180
70	L	H	L	L	H	L	L	L	L	H	0.251
99	L	H	H	L	L	H	H	L	L	H	0.356

* Low is <+0.8 Vdc; HIgh is >+2.0 Vdc.

ManualsPlus.com

ADJUSTMENTS

PROCEDURE (continued)

6. Readjust A6R101 ccw until the correct display just reappears. Measure and record the dc voltage present at U1-pin 3.

_____Vdc

7. Continue to turn A6R101 ccw until the incorrect display as stated in step 5 appears.

8. Turn the adjustment cw until the correct display just reappears. Measure and record the dc voltage present at U1-pin 3.

_____Vdc

9. Adjust A6R101 to the average voltage calculated from the voltages measured in steps 6 and 8.

ManualsPlus.com

ADJUSTMENTS

5-19. LEVEL AND ALC LOOP DETECTOR ADJUSTMENTS (P/O CHANGE 4) (Cont'd)

PROCEDURE: (Cont'd)

5. Wait for the power meter zero LED to go out, then set the RESET/STBY/ON switch to the ON position.

6. Measure the dc voltage between A10J6 pin 12 and ground. Adjust A10R33 (LEVEL ADJ) for a reading of 1.09 Vdc +/-0.001 V.

7. Physically adjust the inductors A6L33 and A6L36 for a vertical position and for parallelism with respect to the right side cavity wall. Physically adjust A6L36 and A6C37 closer together or farther apart in order to set the HP 8656A output power to +7.00 dBm.

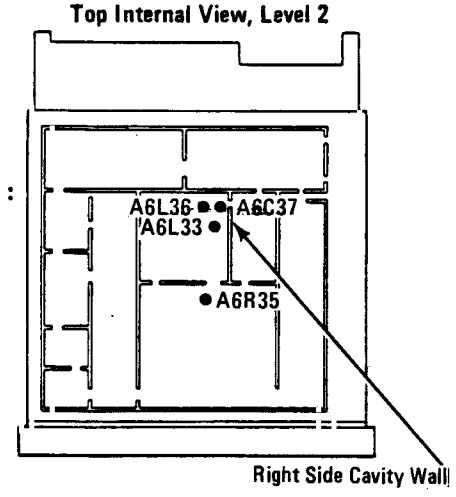
8. Set the Signal Generator frequency to 820 MHz.

9. Adjust A10R33 (LEVEL) for a reading of +7.00 dBm +/-0.02 dB on the power meter.

10. Step the Signal Generator amplitude down to -4 dBm.

11. Adjust A6R35 (DET ADJ) for a reading of -4.00 dBm +/-0.02 dB on the power meter.

12. Repeat steps 9, 10 and 11 until both readings are within the required tolerance.



ManualsPlus.com

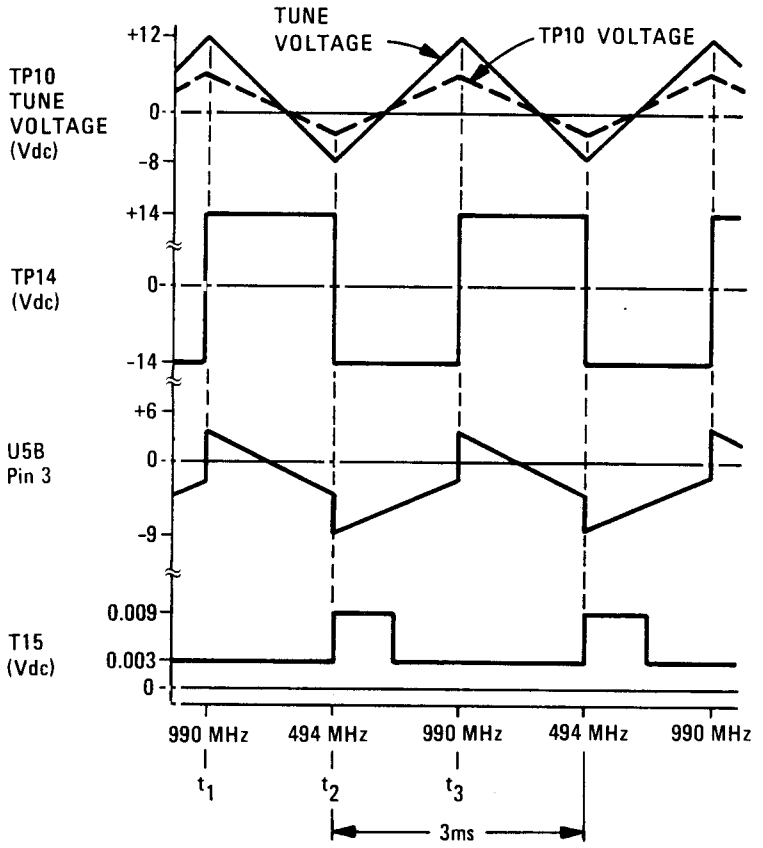
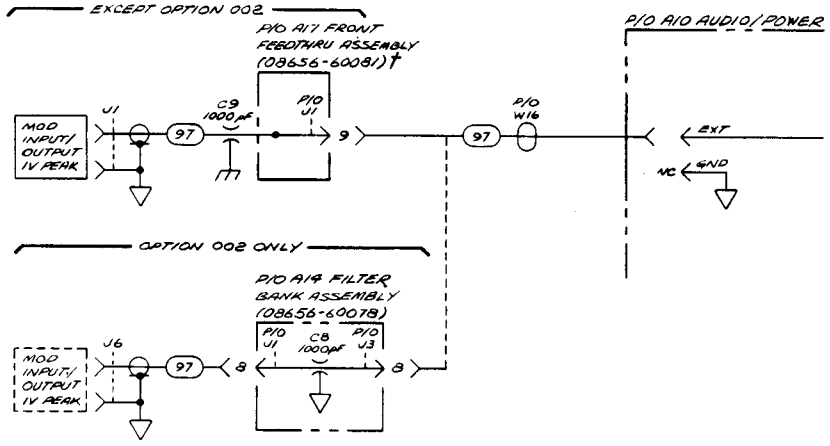
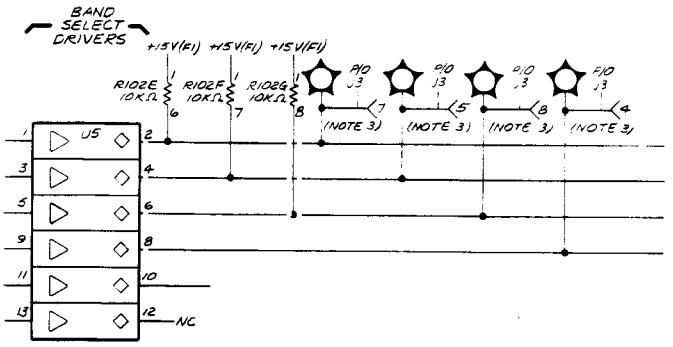


Figure 1. Unlocked High Frequency Loop Waveforms (P/O ERRATA)

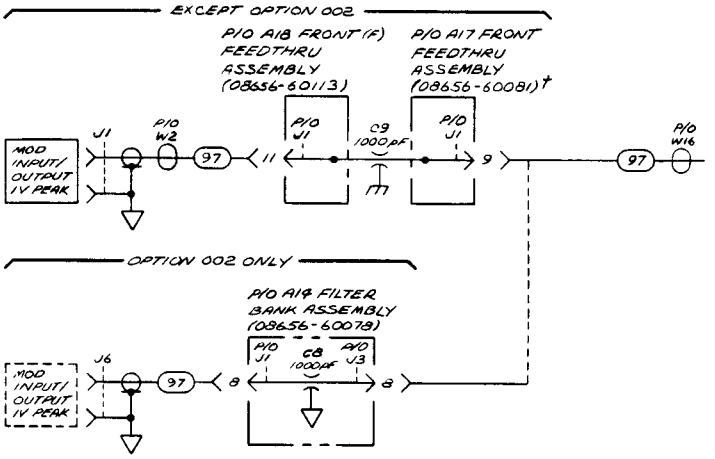


P/O Figure 8-57. Modulation and RF Amplitude Control Schematic Diagram (P/O ERRATA)

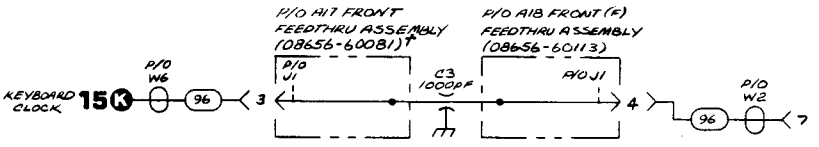
ManualsPlus.com



P/O Figure 8-54. Heterodyne and Output Control Schematic Diagram (P/O CHANGE 4)

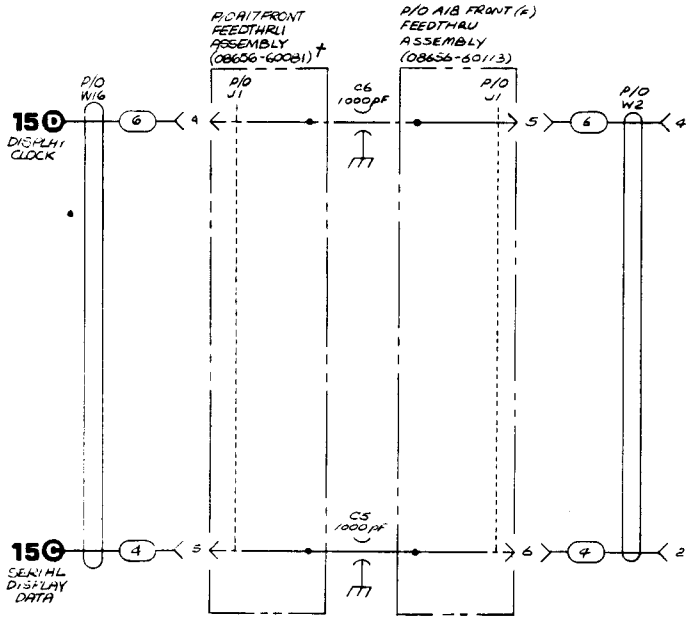


P/O Figure 8-57. Modulation and RF Amplitude Control Shematic Diagram P/O CHANGE 12)

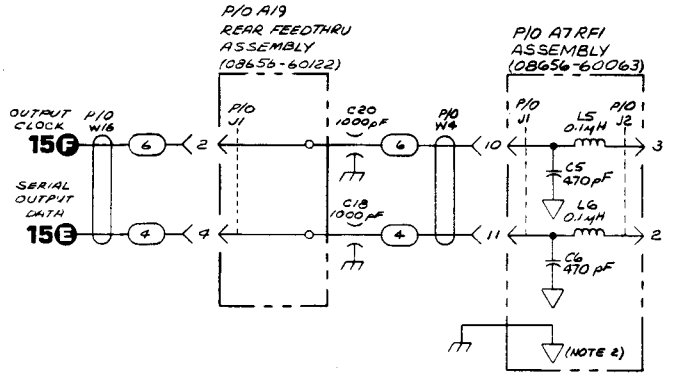


P/O Figure 8-100. Keyboard and Encoder Schematic Diagram (P/O CHANGE 12)

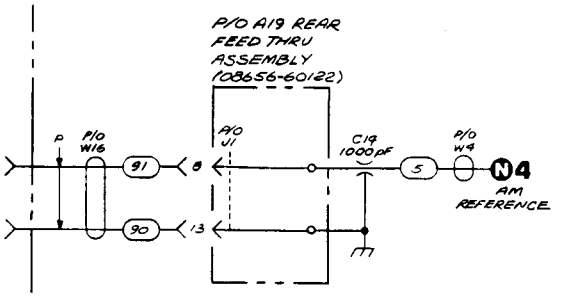
ManualsPlus.com



P/O Figure 8-103. Display Control Schematic Diagram (P/O CHANGE 12)

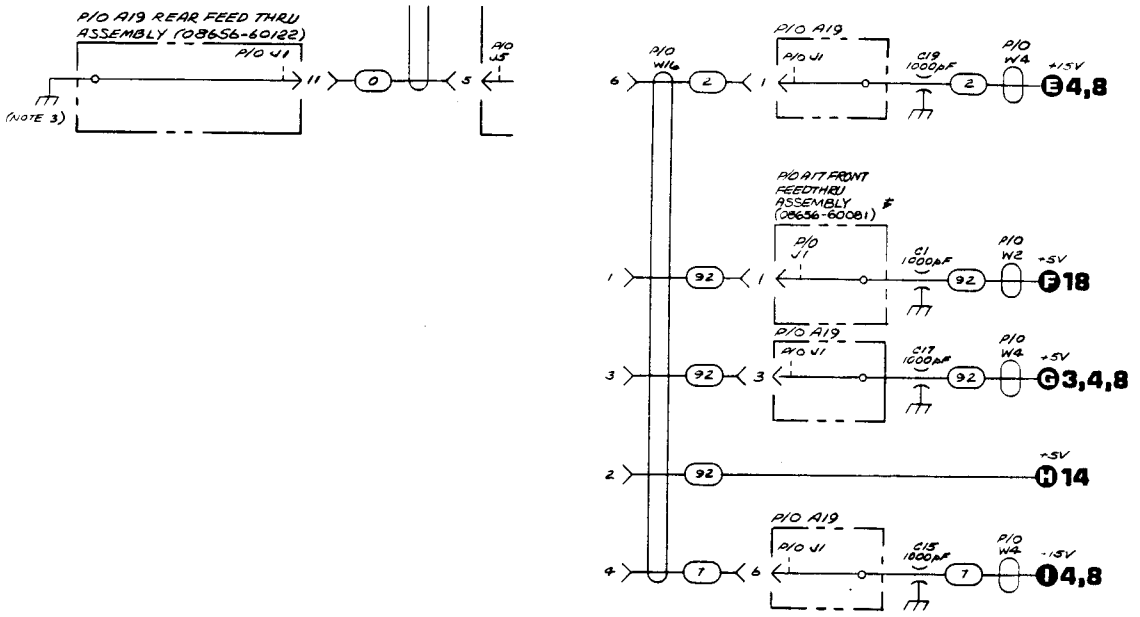


P/O Figure 8-54. Heterodyne and Output Control Schematic Diagram (P/O CHANGE 14)

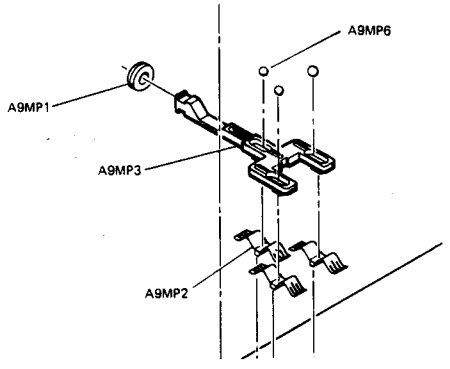


P/O Figure 8-57. Modulation and RF Amplitude Control Schematic Diagram (P/O CHANGE 14)

ManualsPlus.com

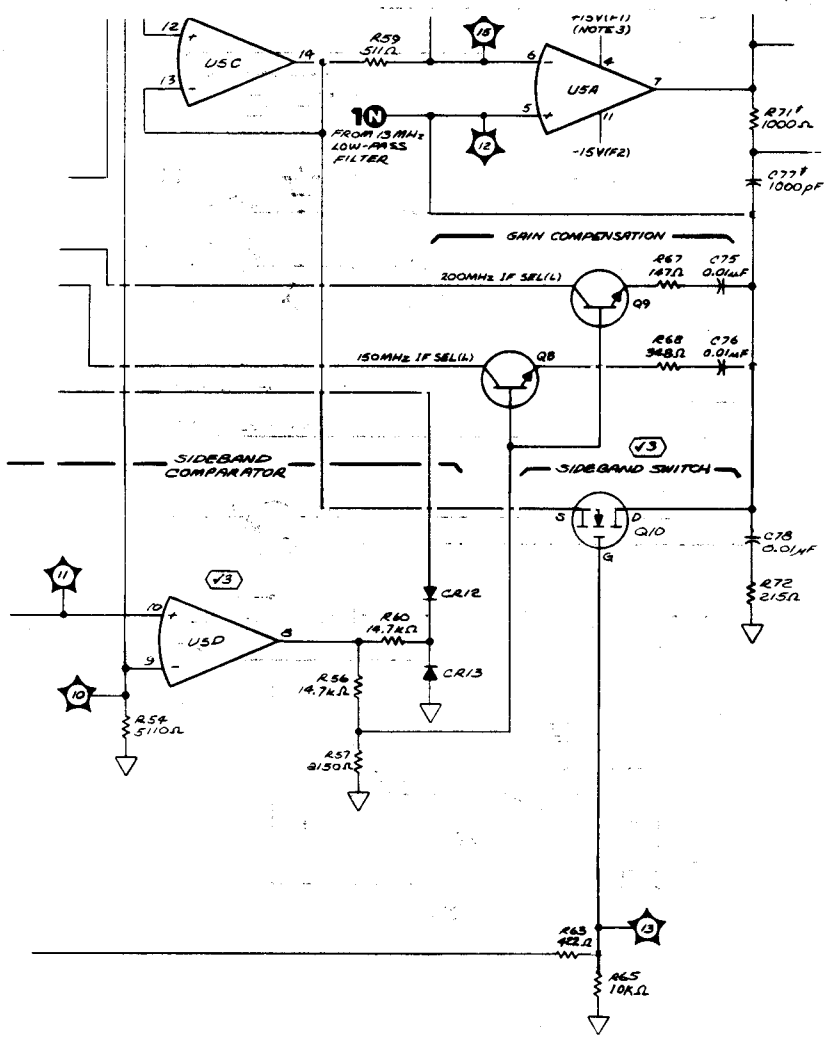


P/O Figure 8-113. Power Supply Schematic Diagram (P/O CHANGE 14)



P/O Figure 6-9. Attenuator Assembly — A9 Parts Identification (P/O CHANGE 17)

ManualsPlus.com



P/O Figure 8-43. High Frequency Loop Amplifier and Control Schematic Diagram (P/O Change 20)

ManualsPlus.com

ERRATA

Page 1-4. Table 1-1:
Under SPECTRAL PURITY, change the performance limit for Harmonics to < -25dBc.

Page 1-7, Table 1-2:
In the "**Supplemental Characteristics**" under "**Modulation**" change "**Modulating Signal Output:**" to read:

> Internal modulating signal is provided at the front-panel BNC connector: nominally 1V peak into a 600 ohm resistive load.

Page 1-10, Table 1-3:
Change RF Cable, BNC(f) to BNC(f), 08662-60080, to RF Cable, BNC(m) to SMC(f), 08662-60075.

Page 2-1, paragraph 2-4:
In the first sentence following the first warning, change "115 (90 to 126) Vac or 230 (198 to 252) Vac" to "100, 120, 220, or 240 Vac, +5%, -10%".

Page 2-2, paragraph 2-7:
In this section any information referring to an inductive-jumper should be changed to read resistive-jumper.

Page 2-7/2-8, Section 2-13 **Rack Mounting (Cont'd):**
Delete: Standard Tilt Slide Kit for HP rack enclosures.....HP 1494-0025
Add: Special Tilt Slide Kit for HP rack enclosures.....HP 08656-82001

Page 3-4, paragraph 3-11:
In this section any information referring to an inductive-jumper should be changed to read resistive-jumper.

Page 3-8, Figure 3-4:
Under "**MOD INPUT/OUTPUT Connector**" in the fifth sentence delete "±5% minimum".

Page 3-23, paragraph 3-18:
In the sixth sentence change SH1 to SH0.

ManualsPlus.com

ERRATA

Page 1-4. Table 1-1:
Under SPECTRAL PURITY, change the performance limit for Harmonics to < -25dBc.

>> Page 1-7, Table 1-2:
In the "**Supplemental Characteristics**" under "**Modulation**" change "**Modulating Signal Output:**" to read:

Internal modulating signal is provided at the front-panel BNC connector: nominally 1V peak into a 600 ohm resistive load.

Page 1-10, Table 1-3:
Change RF Cable, BNC(f) to BNC(f), 08662-60080, to RF Cable, BNC(m) to SMC(f), 08662-60075.

Page 2-1, paragraph 2-4:
In the first sentence following the first warning, change "115 (90 to 126) Vac or 230 (198 to 252) Vac" to "100, 120, 220, or 240 Vac, +5%, -10%".

Page 2-2, paragraph 2-7:
In this section any information referring to an inductive-jumper should be changed to read resistive-jumper.

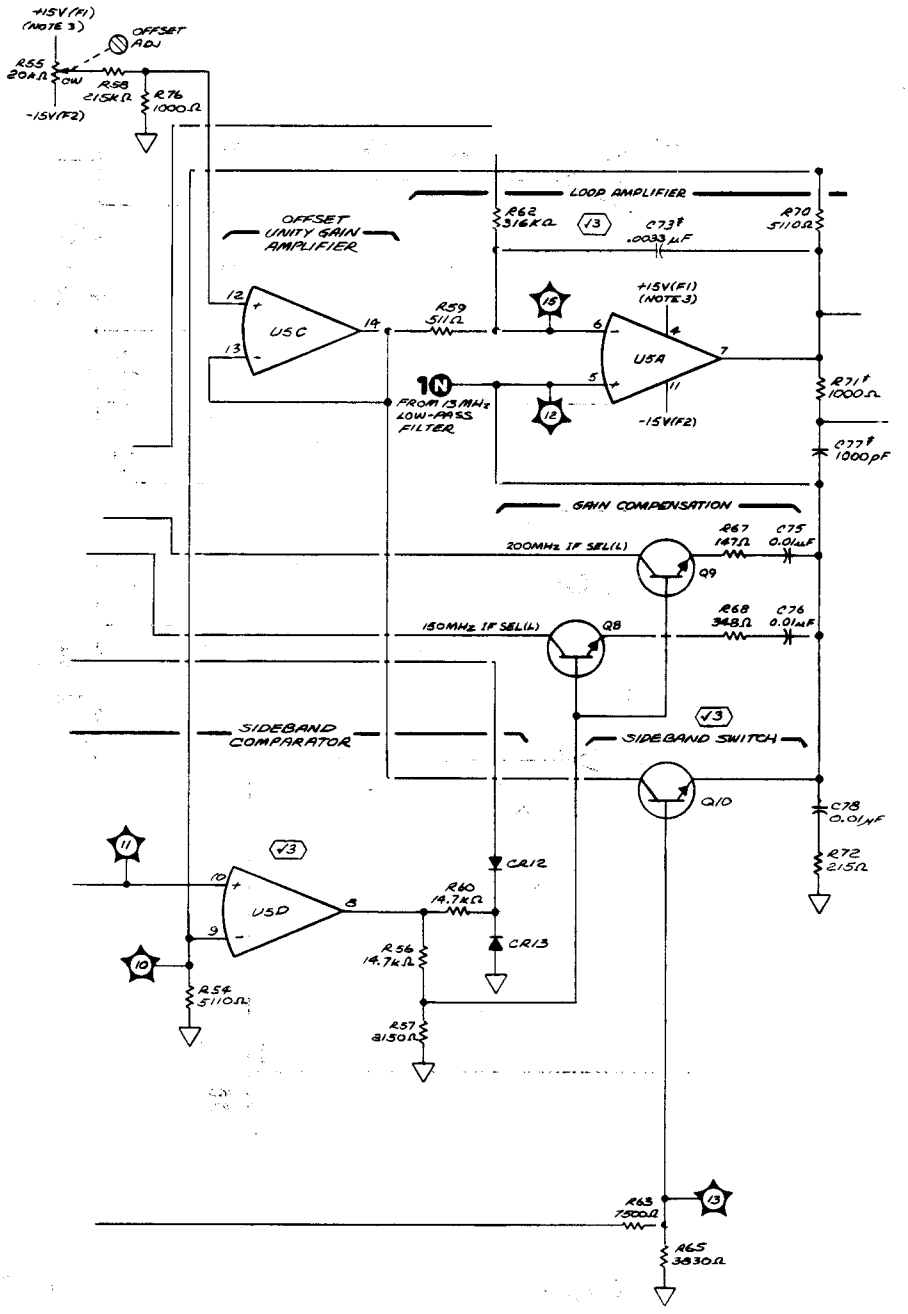
Page 2-7/2-8, Section 2-13 **Rack Mounting (Cont'd):**
Delete: Standard Tilt Slide Kit for HP rack enclosures.....HP 1494-0025
Add: Special Tilt Slide Kit for HP rack enclosures.....HP 08656-82001

Page 3-4, paragraph 3-11:
In this section any information referring to an inductive-jumper should be changed to read resistive-jumper.

>> Page 3-8, Figure 3-4:
Under "**MOD INPUT/OUTPUT Connector**" in the fifth sentence delete "±5% minimum".

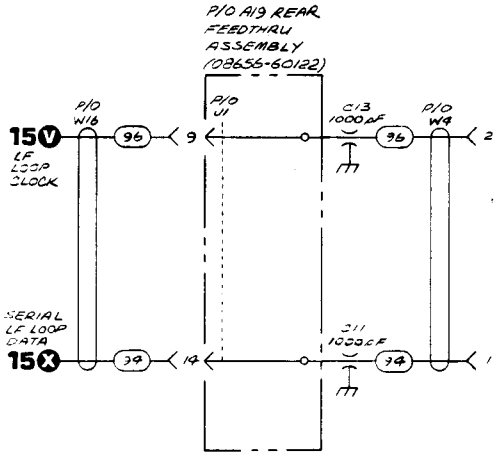
Page 3-23, paragraph 3-18:
In the sixth sentence change SH1 to SH0.

ManualsPlus.com

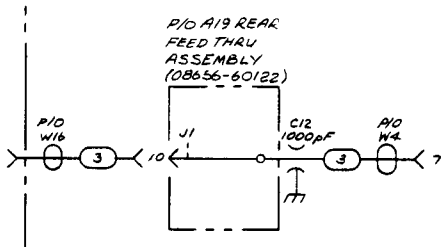


P/O Figure 8-43. High Frequency Loop Amplifier and Control Schematic Diagram (P/O CHANGE 18)

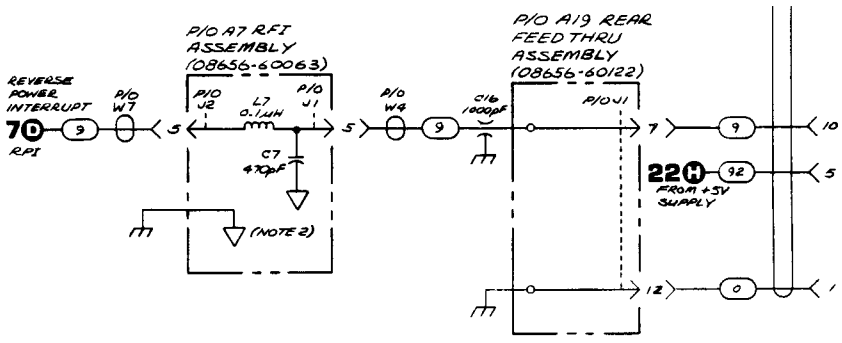
ManualsPlus.com



P/O Figure 8-69. LF Loop Data and Timing Control Schematic Diagram (P/O CHANGE 14)

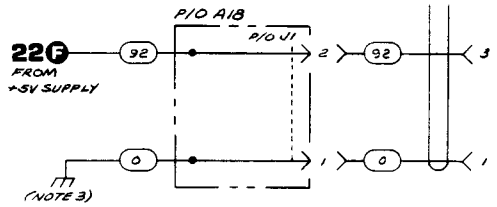


P/O Figure 8-79. LF Loop FM System Control and Calibrater Schematic Diagram (P/O CHANGE 14)

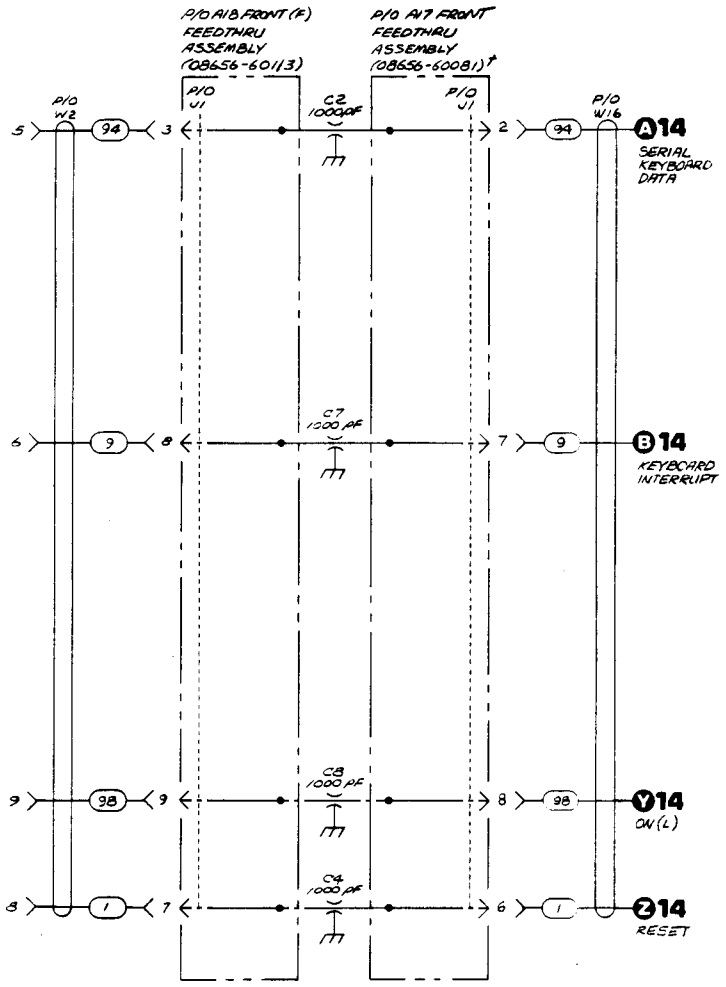


P/O Figure 8-86. Microprocessor, Interrupt Processing and Restart Schematic Diagram (P/O CHANGE 14)

ManualsPlus.com

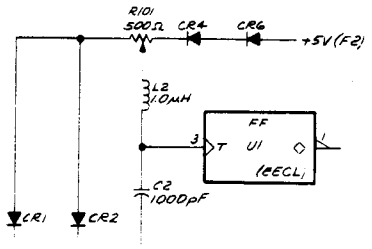


P/O Figure 8-100. Keyboard and Encoder Schematic Diagram (P/O CHANGE 12)

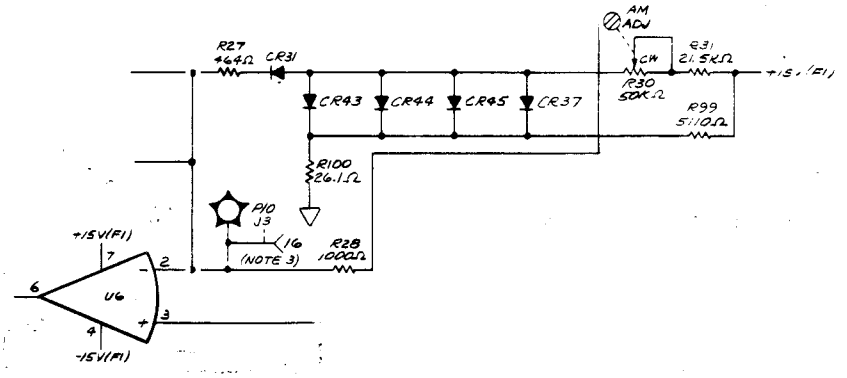


P/O Figure 8-100. Keyboard and Encoder Schematic Diagram (P/O CHANGE 12)

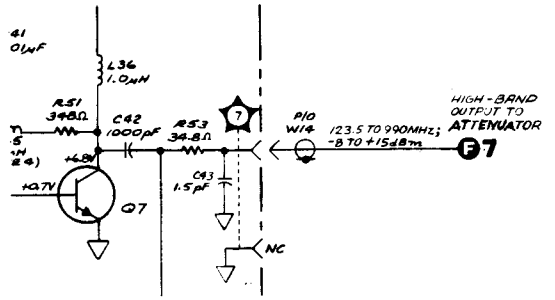
ManualsPlus.com



P/O Figure 8-50. Output Section Schematic Diagram (P/O CHANGE 4)



P/O Figure 8-50. Output Section Schematic Diagram (P/O CHANGE 4)



P/O Figure 8-50. Output Section Schematic Diagram (P/O CHANGE 4)

ManualsPlus.com

ADJUSTMENTS

5-19. LEVEL AND ALC LOOP DETECTOR ADJUSTMENTS (P/O CHANGE 4)

REFERENCE: Service Sheets 4 and 6.

DESCRIPTION: First, the reference level to the Level Digital to Analog Converter (DAC) is adjusted to +7.00 dBm +/-0.02 dB. Then the detector bias reference level to the ALC Amplifier is adjusted to -4.00 dBm +/-0.02 dB.

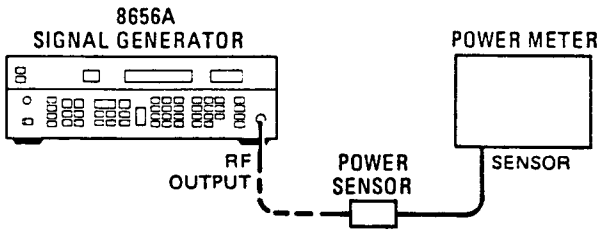


Figure 5-14. Level and ALC Loop Detector Adjustment Setup

EQUIPMENT:

Power Meter ..... HP 436A
Power Sensor ..... HP 8482A

PROCEDURE:

1. Set the power meter with power sensor connected as follows:

   Mode ..... dBm

2. Set the Signal Generator as follows:

   Frequency ..... 990 MHz
   Amplitude ..... +7 dBm
   Modulation ..... Off
   Amplitude Increment ..... 11 dB

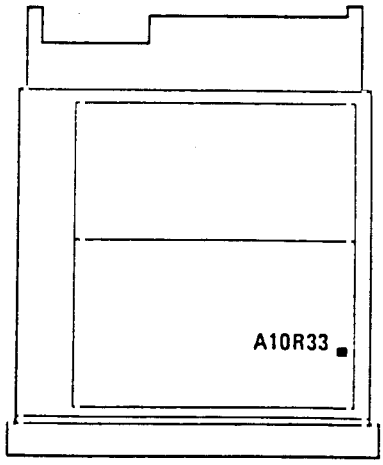
   NOTE

   Before making the adjustment, all internal RF covers must be installed and the instrument must be warmed up for a minimum of 2 hours. (The internal RF top cover is removed to permit access).

3. Connect the power sensor to the RF OUTPUT connector on the Signal Generator.

4. Set the Signal Generator RESET/STBY/ON switch to STBY and zero the power meter.

Bottom Internal View, Level 4



ManualsPlus.com

ADJUSTMENTS

5-18A. RF DIVIDER BIAS ADJUSTMENT (P/O CHANGE 4)

REFERENCE: Service Sheet 4.

DESCRIPTION: The RF Divider Divide-by-2 circuit is adjusted for correct bias at U1-pin 3 using a digital multimeter and spectrum analyzer.

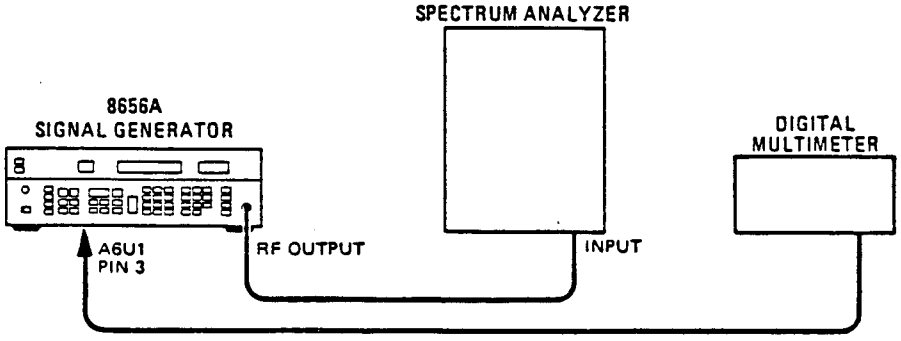


Figure 5-13A. RF Divider Bias Adjustment Setup

EQUIPMENT:
Digital Multimeter ..... HP 3465A
Spectrum Analyzer ..... HP 8558B

PROCEDURE:

1. Set the digital multimeter as follows:

   Function ..... Vdc
   Range 20V

2. Set the spectrum analyzer as follows:

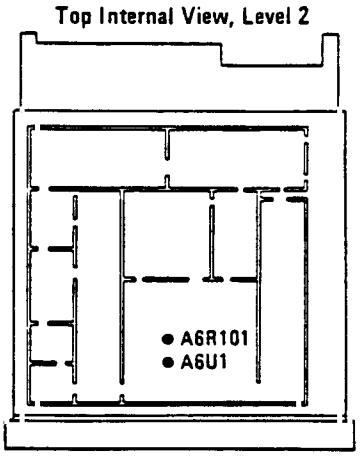
   Reference Level ..... 0 dBm
   Frequency Span/Div ..... 100 MHz

3. Set the Signal Generator as follows:

   Frequency ..... 246 MHz
   Amplitude ..... 0 dBm
   Modulation ..... Off

4. Adjust A6R101 until the output signal is at the correct frequency and the noise floor is flat and at a minimum level.

5. Adjust A6R101 cw until the noise floor just begins to rise, the noise on the carrier skirt begins to increase or the frequency changes.



ManualsPlus.com

Table 5-1. Factory Selected Components (2 of 2)

Reference Designator	Service Sheet	Range of Values	Basis of Selection
A8C5	3	47pf - 82pf	Select A8C5 to maximize DC voltage measured at J2 pin 4.
A8C19	3	20pf - 39pf	Select A8C19 to maximize DC voltage measured at J2 pin 6.

ManualsPlus.com

CHANGE 23 (cont'd)

>>r Page 6-25, Table 6-3:
Add A9A1R17 0689-8816 (CD2) (QTY1) RESISTOR 2.15 1% .12W.
>>r Page 8-71, Service Sheet 7 (schematic):
Delete A9A1L1 and add in its place A9A1R17 2.15 ohms.
In the REFERENCE DESIGNATIONS table, under A9A1, delete L1 and add R17.

CHANGE 24

>>r Page 6-24, Table 6-3:
Change A9MP1 to 0400-0270 (CD6) GROMMET-RND 3.18-MM-ID 6.34-MM-GRV-OD.

CHANGE 25

>> Page 6-24, Table 6-3:
Change A9 to 08656-60164 (CD7).
>> Page 6-32, Table 6-3:
Delete MP20 and MP48.
Change MP17 to 08656-00135 (CD6).
Change MP59 to 08656-00134 (CD5).
>> Page 6-35, Figure 6-1:
Delete MP20 and MP48.

ManualsPlus.com

CHANGE 19 (cont'd)

Page 6-25, Table 6-3 (cont'd):
Change A10F1 to 2110-0055 CD2 FUSE 4A 250V NTD 1.25X .25 UL.
Change A10F2, F3 to 2110-0001 CD8 FUSE 1A 250V NTD 1.25X .25 UL.
Under the entries for F1, F2, F3, Delete 1251-1998 and add 2110-0643 CD4 FUSEHOLDER-CLIP TYPE 15A 240V.

Page 6-26, Table 6-3:
Change A10F4 to 2110-0010 CD9 FUSE 5A 250V NTD 1.25X .25 UL.
Under the entry for F4, delete 1251-1998 and add 2110-0643 CD4 FUSEHOLDER-CLIP TYPE 15A 240V.

Page 6-27, Table 6-3:
Change A10R65 to 0757-0280 CD3 RESISTOR 1K 1% .125W F TC=0±100.
Add A10R85 0698-3405 CD4 RESISTOR 422 1% .125W F TC=0±100.

Page 8-67, Figure 8-57, Service Sheet 6 (schematic):
Change A10 AUDIO/POWER SUPPLY ASSEMBLY (upper left corner) to 08656-60124.
Add A10C30, 0.1 uF, connected from +15V (F) to ground.
Add A10C31, 0.1 uF, connected from +5V (F) to ground.
Add A10C32, 0.1 uF, connected from -15V (F) to ground.

Page 8-71, Figure 8-63, Service Sheet 7 (schematic):
Change A10 AUDIO/POWER SUPPLY ASSEMBLY (upper left corner) to 08656-60124.

Page 8-93, Figure 8-75, Service Sheet 11 (schematic):
Change the value of A3R73 to 3480 ohms.

Page 8-97, Figure 8-79, Service Sheet 12 (schematic):
Change A10 AUDIO/POWER SUPPLY ASSEMBLY (upper left corner) to 08656-60124.

Page 8-127/128,Figure 8-113,Service Sheet 22(schematic):
Change A10 AUDIO/POWER SUPPLY ASSEMBLY (upper left corner) to 08656-60124.
Delete the line connecting the cathode of A10CR7 to the cathode of VR5, and in its place add A10R85, 422 ohms.
Change the value of A10R65 to 1000 ohms.
Add A10C33, 1.0 uF, in parallel with A10R71.
Add A10C34, 1.0 uF, in parallel with A10R69.

CHANGE 20

Page 6-15, Table 6-3, (see note 1):
Change A4Q10 to 1855-0423 (CD5) TRANSISTOR MOSFET N-CHAN E-MODE.

Page 6-16, Table 6-3, (see note 1):
Change A4R65 to 0757-0442 (CD9) RESISTOR 10K 1% .125W F TC=0+-100.
Change A4R63 to 0698-3447 (CD4) RESISTOR 422 1% .125W F TC=0+-100.

r Page 6-17, Table 6-3:
Change A5C9 to 0160-4491 CD1 CAPACITOR-FXD 8.2 PF 200 VDC CER.

Page 6-24, Table 6-3, (see note 1):
Change A9MP6 to 1410-1122 BALL-BRG .0984 DIA.

Page 6-31, Table 6-3:
Add L3, L4 9135-0095 CD9 INDUCTOR RF-CH-MLD 143 UH 5% .102 DX .26 LG.

Page 8-47, Figure 8-40, Service Sheet 1 (schematic):
Change the value of A5C9 to 8.2 pF.

ManualsPlus.com

CHANGE 14 (cont'd)

Page 8-61, Figure 8-54, Service Sheet 5 (schematic):
Replace the appropriate part of the left hand portion of the schematic with the attached partial schematic, **P/O Figure 8-54. Heterodyne and Output Control Schematic Diagram (P/O CHANGE 14).**

Page 8-67, Figure 8-57, Service Sheet 6 (schematic):
Replace the appropriate part of the right hand portion of the schematic with the attached partial schematic, **P/O Figure 8-57. Modulation and RF Amplitude Control Schematic Diagram. (P/O CHANGE 14).**

Page 8-83, Figure 8-69, Service Sheet 9 (schematic):
Replace the appropriate part of the left hand portion of the schematic with the attached partial schematic, **P/O Figure 8-60. LF Loop Data and Timing Control Schematic Diagram (P/O CHANGE 14).**

Page 8-97, Figure 8-79, Service Sheet 12 (schematic):
Replace the appropriate part of the center portion of the schematic with the attached partial schematic, **P/O Figure 8-79. LF Loop FM System Control and Calibrator Schematic Diagram (P/O CHANGE 14).**

Page 8-105, Figure 8-86, Service Sheet 14 (schematic):
Replace the left hand portion of the schematic between C16 and W16 with the attached partial schematic, **P/O Figure 8-86. Microprocessor, Interrupt Processing and Restart Schematic Diagram (P/O CHANGE 14).**

Page 8-127/128,Figure 8-113,Service Sheet 22(schematic):
Replace the lower right portion, and the appropriate part of the right hand portion of the schematic with the attached partial portions of the schematic titled, **P/O Figure 8-113. Power Supply Schematic Diagram (P/O CHANGE 14).**

CHANGE 15

Page 6-24, Table 6-3:
Change A9A1MP5 to 08656-00110 CD7 SHIELD-ATTENUATOR WALL.

Page 6-32, Table 6-3:
Change MP17 to 08656-00107 CD2 ATTENUATOR COVER PLATE.
Change the description for MP20 to "GASKET-ATTENUATOR, SCREEN".
r Change MP23 to 08656-00109 CD4.
Delete MP35.
MP36: Change quantity to 4.
MP37: Change quantity to 2.
Change MP48 to 08656-20123 CD4 GASKET-ATTENUATOR, RUBBER COMPRESSION.
Add MP59 08656-00108 CD3 GASKET-ATTENUATOR, WAFFLE.

Page 6-33, Table 6-3:
Add MP139 2360-0119 CD8 Qty 12 SCREW-MACH 6-32 0.438-IN-LG PAN-HD-POZI.

Page 6-35, Figure 6-1:
Delete MP 17 and MP48. Between MP20, attenuator screen gasket, and MP23, Internal RF Bottom Cover, are the following parts:
MP59 Attenuator Waffle Gasket
MP48 Rubber Compression Gasket
MP17 Attenuator Cover Plate
In the top center portion of the figure, replace the 5 attenuator covers with the above gaskets and cover plate.

r Page 6-43, Figure 6-9:
A9A1MP5 is approximately 50% higher than shown.

ManualsPlus.com

CHANGE 9 (cont'd)

Page 8-57, Figure 8-50, Service Sheet 4 (schematic):
Change the value of A6C16 to 22 uF.
Change the value of A6L11 to 24 uH.

CHANGE 10

r Page 6-16, Table 6-3:
Change A4U5 to 1826-0522 CD4, same description.
r Page 6-27, Table 6-3:
Change A10U18 to 1826-0522 CD4, same description.
r Page 6-32, Table 6-3:
MP13, MP16: Change to 08656-00100 CD5, same description.
MP14: Change to 2360-0113 CD2 .25-IN-LG.
Page 8-51, Figure 8-43, Service Sheet 2 (schematic):
Change A4U5 to 1826-0522.
Page 8-67, Figure 8-57, Service Sheet 6 (schematic):
Change A10U18 to 1826-0522.

CHANGE 11

Page 6-28, Table 6-3:
Delete A11C5.
Change A11C10 to 0180-0229 CD7 CAPACITOR-FXD 33 UF ±10% 10 VDC TA.
Delete A11CR1.
Change A11R4 to 0757-0280 CD3 RESISTOR 1K 1% .125W TC=0±100.
Change A11R6 to 0698-3150 CD6 RESISTOR 2.37K 1% .125W TC=0±100.
Page 6-29, Table 6-3:
Change A11VR1 to 1901-0983 CD3 DIODE-ZNR 1N4621 3.6V 5% DO-14 PD=.25W.
Page 8-105, Figure 8-86, Service Sheet 14 (schematic):
Delete A11C5.
Change the value of A11C10 to 33 uF.
Delete A11CR1.
Change the value of A11R4 to 1000 ohms.
Change the value of A11R6 to 2370 ohms.
Change A11VR1 to 3.6V.

CHANGE 12

Page 6-30, Table 6-3:
Add A18 08656-60113 CD6 Front (F) Feedthru Assembly.
Page 6-33, Table 6-3:
Change W2 to 08656-60085 CD1.
Page 8-67, Figure 8-5, Service Sheet 6 (schematic):
Replace the part of the schematic (upper left) between J1 MOD INPUT/OUTPUT and C9 with the attached partial schematic, **P/O Figure 8-57. Modulation and RF Amplitide Control Schematic Diagram. (P/O CHANGE 12).**

ManualsPlus.com

CHANGE 4 (cont'd)

P/O Table 4. (P/O CHANGE 4)

Node	Correct Signature	Comments
+5V	826F	
D0	886U	ROM6
D1	5677	U5
D2	HA39	
D3	6275	
D4	84P4	
D5	A838	
D6	9PA3	
D7	P3A6	

Page 8-111, Figure 8-92, Service Sheet 16 (schematic):
Change the All circuit board part number to 08656-60121.
In the Integrated Circuit Part Number Table, change U5 to 08656-80012.
Page 8-113, Figure 8-96, Service Sheet 17 (schematic):
Change the All circuit board part number to 08656-60121.

CHANGE 5

Page 6-7, Table 6-3:
Change A2R1 to 1810-0273 CD9 NETWORK-RES 10-SIP 470.0 OHM X9.
Change A2R2 to 1810-0204 CD6 NETWORK-RES 8-SIP 1.0K OHM X7.
Add A2R26 0698-3438 CD3 RESISTOR 147 1% .125W F TC=0±100.
Change A2U3 to 1820-1975 CD1 IC SHF-RGTR TTL LS NEG-EDGE-TRIG PRL-IN.
Page 6-8, Table 6-3:
Change A2U18 to 1820-1975 CD1 IC SHF-RGTR TTL LS NEG-EDGE-TRIG PRL-IN.
Page 8-115, Figure 8-100, Service Sheet 18 (schematic):
Change the value of A2R1B-H and A2R1J to 470 ohms.
Change the value of A2R2A-F to 1000 ohms.
On A2U18, delete +5V at pin 10; then connect pin 10 to pin 11.
Add A2R26, 147 ohms, between A2U3 pin 9 and A2TP9.
In the table of integrated circuit part numbers, change U3 and U18 to 1820-1975.

CHANGE 6

Page 6-25, Table 6-3:
Add A10C29 0160-4386 CD3 CAPACITOR-FXD 33 PF ±5% 200 VDC CER 0±30.
Page 8-97, Figure 8-79, Service Sheet 12 (schematic):
Add a 33 pF capacitor, A10C29, between pins 6 and 7 of A10U17B (that is parallel to A10R63 and R64).

ManualsPlus.com

CHANGE 4 (cont'd)

Page 5-18/19:
Change the Level and ALC Loop Detector Adjustments by replacing it with the attached, "5-19. **LEVEL AND ALC LOOP DETECTOR ADJUSTMENTS (P/O CHANGE 4).**"

r Page 6-9, Table 6-3:
Change A3C64 to 0160-0945 CD2 CAPACITOR-FXD 910 PF ±5% 100 VDC MICA 28480 0160-0945.
Change A3CR2 and CR3 to 1901-0050 CD3 DIODE-SWITCHING 80V 200 MA 2NS DO-35 28480 1901-0050.

Page 6-11, Table 6-3:
Change A3R4 and R7 to 0698-3443 CD4 RESISTOR 287 1% .125W F TC=0±100.
Change A3R5 to 0757-0294 CD9 RESISTOR 17.8 1% .125W F TC=0±100.

Page 6-16, Table 6-3:
Change A4R63 to 0757-0441 CD8 RESISTOR 8.25K 1% .125W F TC=0±100.
Change A4R65 to 0698-3154 CD0 RESISTOR 4.22K 1% .125W F TC=0±100.

Page 6-17, Table 6-3:
Change A6 to 08656-60118.

Page 6-18, Table 6-3:
Change A6C52 and A6C59 to 0160-3490 CD8 CAPACITOR-FXD 1 UF ±20% 50 VDC CER 28480 0160-3490.

Page 6-19, Table 6-3:
Add A6CR43, A6CR44, and A6CR45 1901-0050 CD3 DIODE-SWITCHING 80V 200 MA 2NS DO-35 28480 1901-0050.

Page 6-20, Table 6-3:
Delete A6R3 and A6R4.

Page 6-21, Table 6-3:
Change A6R50 to 0699-0838 CD3 RESISTOR 82.5 1% .05W F TC=0±100 28480 0699-0838.
Add A6R99 0757-0438 CD3 RESISTOR 5.11K 1% .125W F TC=0±100.
Add A6R100 0698-3432 CD7 RESISTOR 26.1 1% .125W F TC=0±100.
Add A6R101 2100-1788 CD9 RESISTOR-TRMR 500 10% C TOP-ADJ 1-TRN.
Add A6R102 1810-0206 CD8 NETWORK-RES 8 SIP 10.0K OHM X7.

Page 6-27, Table 6-3:
Change A11 to 08656-60121.

Page 6-29, Table 6-3:
Change A11U5 to 08656-80012 CD6 ROM #6 28480 08656-80012.

Page 8-51, Figure 8-43, Service Sheet 2 (schematic):
Change the value of A4R63 to 8250 ohms.
Change the value of A4R65 to 4220 ohms.

Page 8-57, Figure 8-50, Service Sheet 4 (schematic):
Change the A6 circuit board part number to 08656-60118.
Change the Divide-by-two Circuit as shown in the attached figure, **P/O Figure 8-50. Output Section Schematic Diagram (P/O CHANGE 4).**
Change the ALC Amplifier circuit as shown in the attached figure, **P/O Figure 8-50. Output Section Schematic Diagram (P/O CHANGE 4).**
Change the High Band Output Amplifier to add TP7 (Qty 2) as shown in the attached figure, **P/O figure 8-50. Output Section Schematic Diagram (P/O CHANGE 4).**
In the Output Detector, change R50 to 82.5 ohms.

ManualsPlus.com

ERRATA (cont'd)

Page 8-99, Figure 8-82, Service Sheet 13 (notes):
Change NOTE 4 to read: 4. PC BOARD SHIPPED WITH RESISTIVE JUMPER INSTALLED IN 10 MHZ POSITION.
In the TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS table change U22 to 1826-0785.

Page 8-102, Service Sheet 14, Table 2:
In the first group of signatures, change 52U5 to 52U2.
In the second group of signatures, change 4U4A to 76F4.
In the footnote, change A2TP15 to A2TP1.

Page 8-105, Figure 8-86, Service Sheet 14, (schematic):
In the upper left hand corner of the schematic change A11R7 to 3160 ohms.
Change the pulse timing width written on U28 to 150ms.

Page 8-106, Service Sheet 15, Principles of Operation:
Under **Address Decoder** the second paragraph, change the fourth sentence to read: Address A3 determines which of U1 or U24 is active at a given time.

Page 8-109, Service Sheet 16, Table 6:
In the comments, change RAM1 (U2) to RAM1 (U4).

Page 8-114, Service Sheet 16, Table 3:
Change the signature for +5V to 1817.

Page 8-120, Service Sheet 20, (Troubleshooting Using Signature Analysis):
In the setup for the Signal Generator, change A2TP15 to A2TP1.

Page 8-122, Service Sheet 21, Table 3:
Change L1PO to 61PO.

Page 8-127/128, Service Sheet 22 (schematic):
Change A10C19 to 3200uf.

>> Page 8-127/128, Service Sheet 22:
In the "TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS" table change U1 to 1826-1181 and U3 to 1826-1157.

ManualsPlus.com

ERRATA (cont'd)

Page 5-16:
Under EQUIPMENT: change HP 08662-60080 to HP 08662-60075.

Page 5-17:
Under EQUIPMENT: change HP 08662-60080 to HP 08662-60075.

Page 5-21, NOTE 2:
Add the following text:
A6R57 can be changed if the adjustment range of A6C56 is not centered in the .1 to 123 MHz band. See Table 5-1 for the correct resistance value range.

Page 6-7, Table 6-3 :
Delete A2MP1 08656-00008 (CD2) (QTY 4) FRONT PANEL, REAR BRACKET.

Page 6-8, Table 6-3:
Change A3C16 to 0160-3878 CD6 CAPACITOR-FXD 1000 PF ±10% 100 VDC CER.

Page 6-13, Table 6-3:
A4C22: Delete the asterisk (*). A4C22 is not a factory selected component.

r Change A3U22 to 1826-0785 (CD1) IC OP AMP LOW-BIAS-H-IMPD DUAL 8-DIP-C.

>>r Change A3U23 to 1820-3102 (CD0) IC CNTR ECL/10KH BIN SYNCHRO 4-BIT.

r Page 6-15, Table 6-3:
Change A4MP4 to 08656-00133 (CD4) (QTY11).

Page 6-16, Table 6-3:
Change A4T1 to 11661-60087 (CD7) Transformer-RF, Yellow.

Page 6-17, Table 6-3:
A5C15: Add an asterisk (*) to A5C15 to indicate a factory selected component.
Change A5R10, R11 to 0699-0983 CD4, same description.

r Page 6-20, Table 6-3:
Change A6MP2 to 08656-00133 (CD4) (QTY7).

Page 6-21, Table 6-3:
A6R57: Add an asterisk (*) to indicate a factory selected component.

>>r Change A6U2 to 1820-3485 (CD2) IC FF ECL B-M/S.

Page 6-22, Table 6-3:
A8C40: Add an asterisk (*) to indicate a factory selected component.
A8C5: Add an asterisk (*) to indicate a factory selected component.
A8C19: Add an asterisk (*) to indicate a factory selected component.

r Page 6-23, Table 6-3:
Change A8MP4 to 08656-00133 (CD4) (QTY13).

Page 6-24, Table 6-3:
Change A9A1C5 to 0160-5217 (CD1) Capacitor-FXD .01uf +-20% 100vDC Cer.

r Change A9A1MP4 to 08656-00133 (CD4) (QTY4).

Page 6-29, Table 6-3:
Add A14C1-15 P/O A14J1, NOT SEPARATELY REPLACEABLE.

Page 6-31, Table 6-3:
B1: If your instrument has Serial Prefix 2131A or below and the fan fails, replace with the fan and cable assembly listed in **CHANGE 8**.

>> Page 6-32, Table 6-3:
Change the quantity of MP47 from 29 to 18.

r Add MP108 2740-0001 (CD1) (QTY11) NUT-HEX-DBL-CHAM 10-32-THD .109-IN-THK.

r Add MP109 2190-0034 (CD5) (QTY15) WASHER-LK HL-CL NO. 10 .194-IN-ID.

ManualsPlus.com

The following table lists all components affected by this Manual Changes supplement.

In the change column:

1. "E" indicates Errata information.
2. Numeric value is the manual change number.
3. "(r)" indicates the change describing the recommended replacement for that component.

SUMMARY OF CHANGES BY COMPONENT

Assy	Component	Change
A1	----	----
A2	A2MP1	E
	A2R1	5
	A2R2	5
	A2R26	5
	A2U3	5
	A2U18	5
A3	A3C16	E
	A3C64	4(r)
	A3C82	3
	A3CR1	16(r)
	A3CR2,3	4
	A3CR33	16(r)
	A3L21	18(r)
	A3MP6	9
	A3MP13	9
	A3R4,7	4
	A3R5	4
	A3R73	19(r)
	A3U22	E(r)
	A3U23	E(r)
A4	A4C22	E
	A4C67	1(r)
	A4MP4	E(r)
	A4Q10	20
	A4R63	4,18,19
	A4R65	4,18,19
	A4R76	18
	A4T1	E
	A4U5	10(r)
A5	A5C9	20(r)
	A5C15	E
	A5CR1,2	1(r)
	A5R9	16(r)
	A5R10,11	E
A6		4
	A6C16	9
	A6C26	8
	A6C52,59	4
	A6C56	E
	A6CR26,27,29,30	16(r)
	A6CR43,44,45	4
	A6L11	9
	A6MP2	E(r)
	A6R3	4
	A6R4	4
	A6R50	4
	A6R99	4
A6	(Cont'd)	
	A6R100	4
	A6R101	4
	A6R102	4
	A6R57	E
	A6U2	E(r)
A7	----	----
A8	A8C5	E
	A8C19	E
	A8C40	E
	A8C58	3
	A8MP4	E(r)
	A8MP5	3
	A8MP6	3
	A8R39	3
A9		25
	A9MP3	17(r)
	A9MP6	20
	A9A1C5	E
	A9A1L1	23
	A9MP1	24(r)
	A9A1MP4	E(r)
	A9A1MP5	15(r)
	A9A1R17	23(r)
A10		19(r)
	A10C18	7,16(r)
	A10C29	6
	A10C30-32	19
	A10C33	19
	A10C34	19
	A10CR6,7	19
	A10F1-4	19
	A10MP4	22
	A10Q1	22(r)
	A10Q5	22(r)
	A10R52,53	17(r)
	A10R65	19
	A10R85	19
	A10U18	10(r)
A11		4
	A11C5	11
	A11C10	11
	A11CR1	11
	A11R4	11
	A11R6	11
	A11 ROM6	4
	A11U5	4
	A11U13,19	1
	A11VR1	11
A12	----	----
A13	----	----
A14	A14C1-15	E
	A14J1	E
A15	----	----
A16	----	----
A17	----	----
A18		12
A19		14
No Prefix	B1	E,8
	L3,4	20
	MP13,14,16	10(r)
	MP17	15,25
	MP20	25
	MP23	15(r)
	MP35	15
	MP36	15
	MP37	15
	MP38	2,13
	MP39	2
	MP48	15,25
	MP59	15,25
	MP108	E(r)
	MP109	E(r)
	MP130-132	7
	MP138	2
	MP139	E,15
	U2	21(r)
	W2	E,12
	W16	14(r)
	W21	8