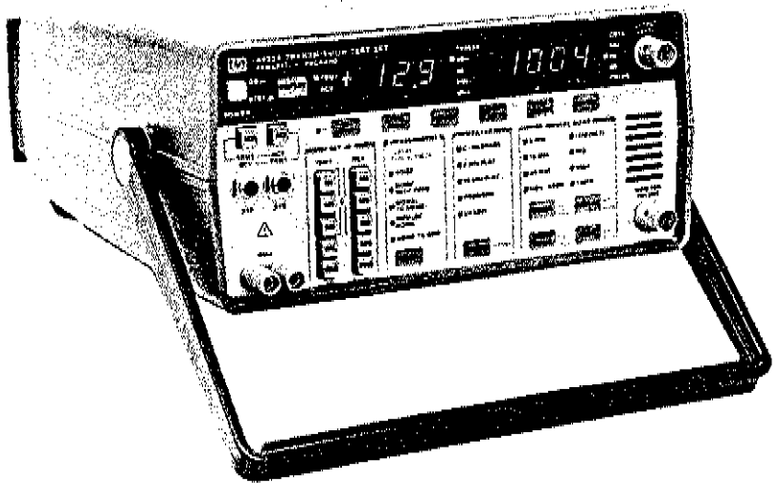
OPERATING AND SERVICE MANUAL

HEWLETT-PACKARD

4935A

TRANSMISSION IMPAIRMENT MEASURING SET



1842 EEG. NETET
C9604 PH.# 3700

HEWLETT PACKARD

COPYRIGHT AND DISCLAIMER NOTICE

OPERATING AND SERVICE MANUAL

4935A
Transmission Impairment Measuring Set

SERIAL NUMBERS

This manual applies directly to instruments with serial numbers prefixed **2512A.**

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

WARNING

Power switch does not turn off AC power and some DC power circuits.

MANUAL PART NO. 04935-90023
MICROFICHE PART NO. 04935-90024

Printed JAN 1986
Revised MAY 1986
PRINTED IN U.S.A.

PERFORMANCE TESTS

4-22. HOLD CIRCUIT TEST

SET UP:

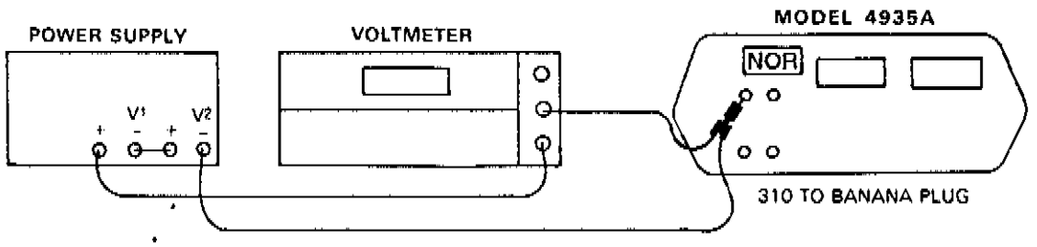


Figure 4-10. Hold Circuit Test

EQUIPMENT:

HP 6218A Power Supply
HP 3455A AC-DC Voltmeter
~~HP 3466A Milliammeter~~ 8010A FLUKE

1. Connect equipment as shown in Figure 4-10.

2. Check the power supply output with the DC Voltmeter. Adjust the output to 6.9V ±.2 vDC.

3. On 4935A select:

   DISPLAY - TRMT
   NOR - press in
   SET UP - press in TRMT HOLD
   press in RCV HOLD

4. The DC current on the milliammeter should be 24.0mA ±.5mA.

5. On the 4935A press in the REV button.

6. Reverse the power supply leads. The DC current readings should be 24.0 mA ±.5mA in both the TRMT and RCV HOLD circuits. Return the power supply leads to the normal polarity.

7. Set the monitoring Voltmeter to a voltage range of 50V or greater and adjust the power supply for 50 VDC. The DC current reading should be less than 26 mA.

8. Press in NOR button. The DC current should be less than 26 mA.

Operating and Service Manual

HP 4935A
Transmission Impairment Measuring Set

Serial Numbers

This manual applies to instruments with serial numbers prefixed:

2846A

Manual Part No: 04935-90029
Microfiche Part No: 04935-98804

Printed Nov. 1988
Printed in U.S.A.

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION

1-2. This Operating and Service manual contains information to install, operate, maintain, and service the HP Model 4935A Transmission Impairment Measuring Set (TIMS). Figure 1-1 shows the HP Model 4935A with cover and power cord. The manual is divided into eight major sections which provide the following information:

SECTION I. GENERAL INFORMATION. Provides identification, specifications, related manuals, and user-repair information.

SECTION II. INSTALLATION. Contains unpacking and inspection information, power requirements, packaging, and storage instructions.

SECTION III. OPERATION. Includes an explanation of controls, connectors, indicators, and an automatic self check procedure. Describes measurement principles and front panel instructions for making each measurement.

SECTION IV. PERFORMANCE TESTS. Gives test procedures required to verify that the instrument's performance is in accordance with the specifications.

SECTION V. ADJUSTMENTS. Provides adjustment and calibration procedures.

SECTION VI. REPLACEABLE PARTS. Lists and identifies the instrument assemblies and replaceable parts.

★ SECTION VII. MANUAL CHANGES. Contains information to backdate the manual for instruments with earlier serial numbers.

SECTION VIII. SERVICE. Includes theory of operation, troubleshooting procedures, flowcharts, component locators, and schematic diagrams.

1-3. GENERAL DESCRIPTION

1-4. HP Model 4935A is a Transmission Impairment Measuring Set (TIMS) which measures wideband data and voice impairments. The frequency range over which measurements are made is 20 Hz to 110 kHz, in steps of 1, 10, 100, 1000, or 10,000 Hz. There are four permanently stored, fixed frequencies –404, 1004, 2804, and 2713 Hz. Any other four frequencies may be temporarily assigned and stored by the user.

1-5. INSTRUMENT IDENTIFICATION

1-6. A 10 character serial number (0000A00000) is inscribed on the rear panel. The first four digits and the letter are the serial prefix. The serial prefix will change only if changes are made to the instrument; a Manual Change Sheet will be included with the manuals of any instruments affected. The last five numbers form the serial suffix which is unique to each instrument.

1-7. SPECIFICATIONS

1-8. Instrument specifications are listed in Table 1-1.

SECTION VII
MANUAL CHANGES

7-1. INTRODUCTION

7-2. This section contains information to backdate this manual for instreuments with serial prefix numbers lower than the serial prefix listed on the title page.

7-3. MANUAL CHANGES

7-4. Using the information provided, this manual can be corrected so that it applies to any version or configuration of the 4935A. To adapt this manual to an earlier instrument, refer to Table 7-1 and make all of the manual backdating changes listed opposite your instrument serial prefix number. Changes are listed in serial prefix order.

7-5. If your instrument's serial number or prefix number is not listed on the title page of this manual or in Table 7-1, it may be documented in a yellow MANUAL CHANGE SHEET supplement.

Table 7-1. Manual Changes

Instrument Changes		Assembly Changes			
Instrument Serial No.	Make Changes	Assy. Design.	Description	Instrument Serial No.	Make Changes
2215A	1-15	A2	Switchboard	2203A	2,1
2204A	2-15	A5	Battery Charger	2203A	2,1
2206A	4-15	A4	Transmitter	2204A	4,3,2,1
2207A	5-15	A3	Receiver	2207A	6,5,4,3,2,1
2208A	6-15				
2233A	7-15				
2247A	8,10-15				
2248A	10-15				
2305A	9-15				
2310A	11-15				
2314A	11-15				
2351A	12-15				
2414A	13-154				
2437A	14,15				
* 2512A	15				

7-6. MANUAL CHANGE INSTRUCTIONS

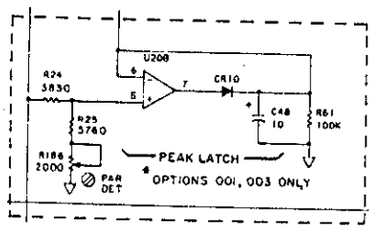
CHANGE 1

Page 6-9, Table 6-3. Replaceable Parts (A2 Switchboard).
Add: A2J5, HP Part No. 1251-5063, CONNECTOR.
Change: A2 to HP Part No. 04935-60002, SWITCH BOARD (all units), Mfr Code 28480, Mfr Part No. 04935-60002.
Change: A2J2 to HP Part No. 1251-5063, CONNECTOR PIN
Page 6-10, Table 6-3. Replaceable Parts (A2 Switchboard).
Change: A2TP3 to HP Part 0360-0124, TEST PIN.
Change: A2TP4 to HP Part 0360-0124, TEST PIN.

Model 4935A

Page 8-69, Figure 8-29. A3 Receiver Board Schematic (A13)
Ground the case of A13C1, located in the upper left corner of the schematic.

Page 8-71, Figure 8-30. A3 Receiver Board Schematic (Page 2 of 2)
Change PAR (A13) section of schematic to the following:



CHANGE 14

Page 6-17, Table 6-3. Replaceable Parts
Change A4CR7 to 1902-3214 DIODE-ZNR 16.2V, 2%, .4W, CD=6, MFG CODE 28480, MFG P/N 1902-3214

Page 6-18, Table 6-3. Replaceable Parts
Change A4CR15 to 1902-3214 DIODE-ZNR 16.2V 2%, .4W, CD=6. MFG CODE 28480, MFG P/N 1902-3214

Change A4CR23 to 1902-3214 DIODE-ZNR 16.2V, 2%, .4W, CD=6. MFG CODE 28480, MFG P/N 1902-3214

Change A4CR25 to 1902-3105 DIODE-ZNR 5.62V, 2%, .4W, CD=4 MFG CODE 28480, MFG P/N 1902-3105

Page 6-32, Table 6-3. Replaceable Parts
Change A14CR7 to 1902-3214 DIODE-ZNR 16.2V, 2%, .4W, CD=6, MFG CODE 28480, MFG P/N 1902-3214

Change A14CR15 to 1902-3214 DIODE-ZNR 16.2V, 2%, .4W, CD=6, MFG CODE 28480, MFG P/N 1902-3214

Change A14CR23 to 1902-3214 DIODE-ZNR 16.2V, 2%, .4W, CD=6, MFG CODE 28480, MFG P/N 1902-3214

Change A14CR25 to 1902-3105 DIODE-ZNR 5.62V, 2%, .4W, CD=4 MFG CODE 28480, MFG P/N 1902-3105

Page 6-35/36(blank). Table 6-3. Replaceable Parts
Change F1 to 2110-0065 FUSE FOR 100/120V INSTRUMENTS, .375A, CD=4, MFG CODE 04492, MFG P/N 2110-0065

Change F1 to 2110-0296 FUSE FOR 220/240V INSTRUMENTS, .20A, CD=3, MFG CODE 28480, MFG P/N 2110-0296

Page 8-75, Figure 8-34. A4 Transmitter Board Schematic Diagram (sheet 2 of 2)
Change the following diode values:

CR15 change to 16.2V
CR25 change to 5.62V
CR23 change to 16.2V
CR7 change to 16.2V

* Change 15 has been deleted from the most current edition of the ~~commercial~~ ~~data~~ commercial data.

PERFORMANCE TESTS

4-25. Noise To Ground (Standard and Option 001)

SETUP:

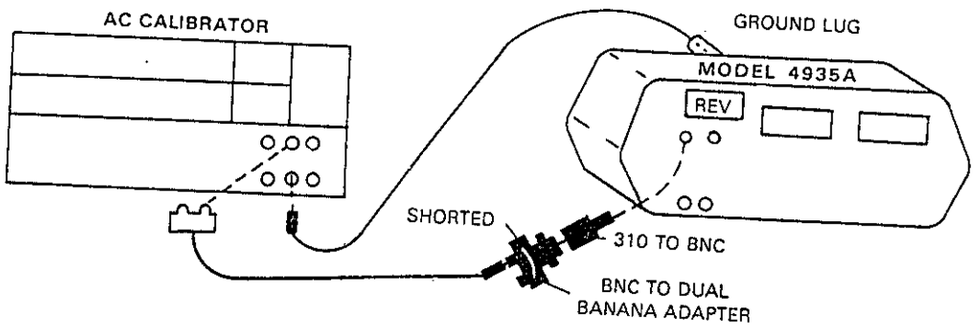


Figure 4-15. Noise to Ground Test

EQUIPMENT:

Fluke 5200A AC Calibrator 1 shorting strap
310 to BNC adapter 2 banana cables
1 banana to BNC connector (female)

1. Connect equipment as shown in Figure 4-15. On 4935A select:

   POWER ..... ON
   DISPLAY ..... RCV
   MEASUREMENT ..... NOISE TO GROUND
   SETUP ..... press in both 600 buttons
   BRG in

2. Connect AC Calibrator low to ground lug on 4935A rear panel.

3. Short 4935A input (tip and ring) and connect to the AC Calibrator HIGH.

4. Set AC Calibrator output to .7746 Vrms at 1000 Hz. 4935A display should typically read 90dBrn + 2dBrn.

ABBREVIATED NOISE TO GROUND TEST

There is no Abbreviated Noise to Ground Test.

OPERATING AND SERVICE MANUAL

4935A
Transmission Impairment
Measuring Set

SERIAL NUMBERS

This manual applies directly to instruments with serial numbers prefixed **2314A.**

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

WARNING

Power switch does not turn off AC power and some DC power circuits.

MANUAL PART NO. 04935-90013
MICROFICHE PART NO. 04935-90014

Printed APR 1983
PRINTED IN U.S.A.

04935-90023 New Manual

WARNING

SAFETY

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

BEFORE SWITCHING ON THIS INSTRUMENT, the protective earth terminals of this 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 use of an extension cord (power cable) without a protective conductor (grounding).

Make sure that only fuses with the required rated current and of the specified type (normal blow, time delay, etc.) are used for replacement. The use of repaired fuses and the short-circuiting of fuse holders must be avoided.

Whenever it is likely that the protection offered by fuses has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

GROUNDING

Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnecting the protective earth terminal can make this instrument dangerous. Intentional interruption is prohibited.

HIGH VOLTAGE

Any adjustment, maintenance, and repair of the opened instrument under voltage should be avoided as much as possible and, when inevitable, should be carried out only by a skilled person who is aware of the hazard involved.

Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

Adjustments and service described herein are performed with power supplied to the instrument while protective covers are removed. Energy available at many points, if contacted, result in personal injury.

CAUTION

LINE VOLTAGE

BEFORE SWITCHING ON THIS INSTRUMENT, make sure instrument requirements match the voltage of the power source.

GROUNDING

BEFORE SWITCHING ON THIS INSTRUMENT, ensure that all devices connected to this instrument are connected to the protective (earth) ground.

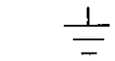
BEFORE SWITCHING ON THIS INSTRUMENT, ensure that the line power (mains) plug is connected to a three-conductor line power outlet that has a protective (earth) ground. (Grounding one conductor of a two-conductor outlet is not sufficient.)

IEC SYMBOLS

The following is a list of key IEC symbols used by Hewlett-Packard. All symbols are normally applied adjacent to the device requiring the symbol. They shall not be placed on removable parts likely to be detached or lost.

Instruction Manual symbol: If necessary, to preserve the apparatus from damage it is necessary for the user to refer to the instruction manual, then shall the apparatus be marked with this symbol (IEC 348;16a).

Terminal devices fed from the interior by live voltages that may be dangerous when connecting to or disconnecting from those devices shall be marked with the flash shown when the voltage exceeds 1 KV: The flash shall be red (IEC 348;18c).

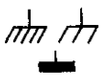


Earth Terminals. If the use of this symbol for the protective earth terminal is not permitted by National Standards, it may be modified, for example, by being placed inside a circle (IEC 348;18a).

AC current (IEC 117-1, symbol No. 3).

DC current (IEC 117-1, symbol No. 2).

AC or DC current (IEC 117-1, symbol No. 8).



Frame or chassis connection. The hatching may be completely or partly omitted if there is no ambiguity. If the hatching is omitted, the line representing the frame or chassis shall be thicker (IEC 117-1, symbol No. 87).

A Ampere (IEC 117-4, symbol No. 356).

V Volt (IEC 117-4, symbol No. 357).

VA Voltampere (IEC 117-4, symbol No. 358).

W Watt (IEC 117-4, symbol No. 360).

Wh Watthour (IEC 117-4, symbol No. 361).

VAh Voltamperehour (IEC 117-4, symbol No. 362).

Hz Hertz (IEC 117-4, symbol No. 365).

Contactor, normally closed. In order to avoid confusion with the symbol for a capacitor, the distance between the horizontal (as drawn here) lines should be at least equal to the length of those lines (IEC 117-3, symbol No. 215.2).

In addition the following describes the use of Warnings, Cautions and Notes used in HP Automatic Test System Manuals.

Warnings, cautions and notes. (All) Warnings and cautions shall precede the text to which each applies but notes may precede or follow applicable text depending on the material to be highlighted. Warnings, cautions, and notes shall not contain procedural steps nor shall they be numbered. When a warning, caution, or note consists of two or more paragraphs, the heading WARNING, CAUTION, NOTE, shall not be repeated above each paragraph. If it is ever necessary to precede a paragraph by both a warning and a note, or a caution and a note, etc, they shall appear in the sequence as noted, namely, warnings, cautions, notes. Such inserts in the text shall be short and concise and be used to emphasize important and critical instructions.

WARNING

An operating procedure, practice, etc, which, if not correctly followed, could result in personal injury or loss of life.

CAUTION

An operating procedure, practice, etc. which, if not strictly observed, could result in damage to, or destruction of, equipment.

NOTE: An operating procedure, condition, etc. which it is essential to highlight.

Health hazards precaution data. (All) When hazardous chemicals or adverse health factors, in the environment or use of the equipment cannot be eliminated, appropriate precautionary requirements shall be included.

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont'd)

TABLE OF CONTENTS (Cont'd)

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS (Cont'd)

LIST OF TABLES

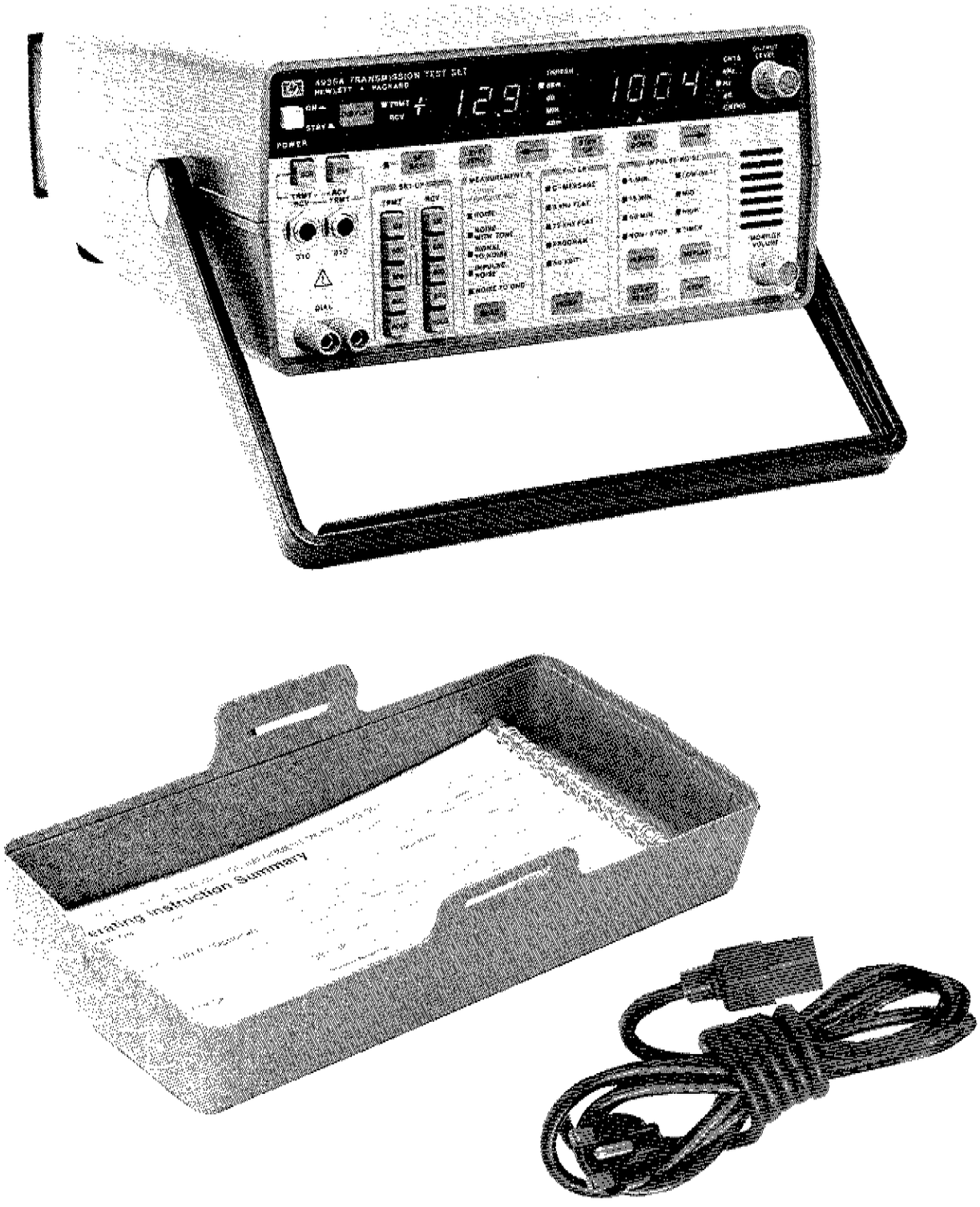


Figure 1-1. Model 4935A Transmission Impairment Measuring Set

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION

1-2. This Operating and Service manual contains information to install, operate, maintain, and service the HP Model 4935A Transmission Impairment Measuring Set (TIMS). Figure 1-1 shows the HP Model 4935A with cover and power cord. The manual is divided into eight major sections which provide the following information:

SECTION I. GENERAL INFORMATION. Provides identification, specifications, related manuals, and user-repair information.

SECTION II. INSTALLATION. Contains unpacking and inspection information, power requirements, packaging, and storage instructions.

SECTION III. OPERATION. Includes an explanation of controls, connectors, indicators, and an automatic self check procedure. Describes measurement principles and front panel instructions for making each measurement.

SECTION IV. PERFORMANCE TESTS. Gives test procedures required to verify that the instrument's performance is in accordance with the specifications.

SECTION V. ADJUSTMENTS. Provides adjustment and calibration procedures.

SECTION VI. REPLACEABLE PARTS. Lists and identifies the instrument assemblies and replaceable parts.

SECTION VII. MANUAL CHANGES. Contains information to backdate the manual for instruments with earlier serial numbers.

SECTION VIII. SERVICE. Includes theory of operation, troubleshooting procedures, flowcharts, component locators, and schematic diagrams.

1-3. GENERAL DESCRIPTION

1-4. HP Model 4935A is a Transmission Impairment Measuring Set (TIMS) which measures wideband data and voice impairments. The frequency range over which measurements are made is 20 Hz to 110 kHz, in steps of 1, 10, 100, 1000, or 10,000 Hz. There are four permanently stored, fixed frequencies –404, 1004, 2804, and 2713 Hz. Any other four frequencies may be temporarily assigned and stored by the user.

1-5. INSTRUMENT IDENTIFICATION

1-6. A 10 character serial number (0000A00000) is inscribed on the rear panel. The first four digits and the letter are the serial prefix. The serial prefix will change only if changes are made to the instrument; a Manual Change Sheet will be included with the manuals of any instruments affected. The last five numbers form the serial suffix which is unique to each instrument.

1-7. SPECIFICATIONS

1-8. Instrument specifications are listed in Table 1-1.

Table 1-1. Specifications

TRANSMITTER

Frequency

Frequency Range ..... 20 Hz to 110 kHz

	Resolution	Accuracy
20–99,999 Hz	1 Hz	± .005% of output frequency
100–110 kHz	10 Hz	± .012% of output frequency

Store and Recall Functions

SK Skip ... At power up skips a band from 2450–2750 Hz

Frequencies ..... At power up F1 is 404 Hz
F2 is 1004 Hz
F3 is 2804 Hz
F4 is 2713 Hz

Level

Range ..... –40 to +13 dBm
Resolution ..... 0.1 dB
Flatness ..... (in dB)

FREQUENCY, Hz

Output Level (dBm)	20	200	15k	60k	85k	110k
+13 to +10	+0, –3.0	±0.2	±0.5	±0.7	±1.5	
0 to –40	+1.0	±0.2	±0.5	±0.5	±1.5	

Distortion: (in dB from fundamental)
(Includes harmonics, spurious and background noise within a filter with a 3 dB bandwidth of 4 kHz or 4 f_0, whichever is greater.)

FREQUENCY (Hz)

Output Level (dBm)	30 Hz	100 Hz	4k	110k
+13 to +10	–20	–45	–45	
0	–30	–55	–50	
–40	–40	–50	–40	

At 1004 Hz, 0 dBm, THD using a 4 kHz filter is more than 65 dB down from the fundamental.

Message Circuit Noise

Transmitter is quiet terminated

RECEIVER

Frequency

Frequency Range ..... 20 Hz to 110 kHz

	Resolution	Accuracy
20–9,999 Hz	1 Hz	±0.5 Hz
10–110 kHz	10 Hz	±5 Hz

Level

Range ..... –60 to +13 dBm
Resolution ..... 0.1 dB
Accuracy ..... (in dB)

FREQUENCY (Hz)

Input Level (dBm)	20	50	200	15k	60k	85k	110k
+13 to –40	+1.0	±0.5	±0.2	±0.5	±0.5	±2.0	
–40 to –60	±1.0	±0.6	±0.4	±0.8	±1.0	±2.0	

Receiver accuracy not specified below 500 Hz when using 135Ω termination.

At 1004 kHz accuracy is ±0.1 dB from –20 to +13 dBm.

Cross talk: >78 dB isolation @ 4 kHz, decreasing 6 dB per octave above 4 kHz.

Message Circuit Noise

Range (@ 600Ω and 900Ω) ..... 0 to 100 dBrn
@ 135Ω lower limit is 7 dB higher
Resolution ..... 1 dB
Accuracy ..... ± 1 dB from 10 to 100 dBrn
±2 dB from 0 to 10 dBrn
Filters ..... C-Message, 3 kHz Flat, 15 kHz Flat, Program, 50 kBit

Specifications describe the instrument's warranted performance. Supplemental characteristics shown in shaded areas or in italics are intended to provide information useful in applying the instrument by giving typical, but non-warranted performance parameters.

Table 1-1. Specifications (Continued)

TRANSMITTER

Noise with Tone
Frequency ..... 1004 Hz fixed tone
(For other specifications, see Level and Frequency)

Signal-to-Noise Ratio
Frequency ..... 1004 Hz fixed tone
(For other specifications, see Level and Frequency)

3-Level Impulse Noise
Frequency .....1004 Hz fixed tone or quiet terminated depending on filter selection
(For other specifications, see Level and Frequency)

Noise-to-Ground
Transmitter is quiet terminated

P/AR (Optional)
Frequency .... Signal spectrum is a complex pulse train of 16 frequencies between 140 Hz and 3890 Hz.
Level Range .....–40 to 0 dBm
Resolution .....1 dB

RECEIVER

Noise with Tone
Notch Filter ..... >50 dB rejection from 995 to 1025 Hz
Range (@ 600Ω and 900Ω) ..... 10–100 dBrn
Accuracy ..... ±1 dB from 20 to 100 dBrn
±2 dB from 10 to 20 dBrn
(For other specifications, refer to Message Circuit Noise)

Signal-to-Noise Ratio
Signal Level Range .....–40 to +13 dBm
Ratio Range ..... 10 to 45 dB
Resolution .....1 dB

3-Level Impulse Noise
Level Range .....–40 to +13 dBm
Notch Filter .....See Noise with Tone
Threshold Ranges (@ 600Ω)
Low .....30 to 109 dBrn
Mid ..... 4 dB above Low to a maximum of 109 dBrn
High ..... 8 dB above Low to a maximum of 109 dBrn
Loss of Holding Tone Indication ..... Minus sign
Threshold Accuracy (above 40 dBrn) ..... ±1 dB
Count Timer ..... 5, 15, 60 min. or non-stop
Count Range ..... 0–9999 for each threshold
Count Rate ..... 8 per sec.

Noise-to-Ground
Range (@ 600Ω and 900Ω) .....50 to 130 dBrn
Resolution .....1 dB
Accuracy ..... ±1.5 dB

P/AR (Optional)
P/AR Range .....0 to 120 P/AR units
Resolution ..... 1 P/AR unit
Accuracy (from 30 to 110 P/AR units) ... ±2 P/AR units
Level Range .....–40 to +3 dBm
Resolution .....1 dB

GENERAL

Maximum D.C. Blocking 200V

Impedances ... 135Ω, 600Ω, 900Ω with TRMT and RCV independent

Bridging Loss to 20 kHz ..... <0.2 dB

Receiver Return Loss } >30 dB from 50 Hz to 4 kHz at 600Ω, 900Ω
>30 dB from 800 Hz to 16 kHz at 135Ω

Longitudinal Balance ..... >80 dB at 60 Hz
>70 dB at 540 Hz
>60 dB up to 4 kHz decreasing 6 dB per octave to 20 kHz.

Hold Circuits .....2, each drawing 23 milliamps

AC Line .....100V, 120V, 220V, 240VAC +5%, –10%, 45-66 Hz

Battery Supply (optional): .....Typically >3.0 hours of continuous operation at 25°C. Complete recharge in 14 hours.

Temperature Range:
Operating ..... 0°C to 50°C (32°F to 122°F)
with batteries 0°C to 40°C (32°F to 104°F)
Storage ..... –20°C to 75°C (–4°F to 167°F)
with batteries –20°C to 45°C (–4°F to 113°F)
Warm up time @ 20°C for stated accuracy .....5 min.

Dimensions .11.2 x 25.9 x 28.6 cm (4.4 x 10.2 x 11.25 in.)
Weight .....5.0 kg (11 lbs.), 6.5 kg (14 lbs.) with battery

OPTIONS
001 ..... Adds rechargeable battery pack
002 Adds P/AR measurement in place of Noise-to-Ground
003 ..... Adds both battery pack and P/AR
Deletes Noise-to-Ground

ACCESSORIES:
15513A ..... Test cord w/310 male at both ends
18132A ..... 19" rack mount adapter
18134A ..... Soft pack carrying case
18161A ..... Ladder bracket

1-9. SAFETY CONSIDERATIONS

CAUTION

Before applying power, make sure that the rear power input module is set to the line voltage in use and that the correct fuse is installed.

1-10. Whenever internal circuits are exposed, caution must be used. Observe all warnings and cautions marked on the instrument or listed in the procedures.

1-11. When using AC power for test equipment, the chassis must be connected to earth ground. When the power button is on STBY (standby), AC and DC voltages are present in the instrument. To completely power down, disconnect the AC power cord from the 4935A. The batteries in options 001 and 003 provide continuous power to 4935A circuits; follow the disassembly procedures in Section VIII, Service to access the instrument.

WARNING

Power switch does not turn off AC power and some DC circuits.

1-12. RELATED MANUALS

1-13. Operating information is summarized on a card in the instrument cover.

1-14. USER REPAIR

1-15. Internal repairs to the instrument should be done by authorized repair shops only. For assistance, contact the nearest Hewlett-Packard Sales and Service Office listed at the rear of this manual.

1-16. OPTIONS AND ACCESSORIES

1-17. Options available are:

Option 001: Adds a rechargeable battery pack.

Option 002: Adds P/AR (Peak/Average Ratio) measurement in place of Noise-to-Ground.

Option 003: Adds P/AR (Peak/Average Ratio) measurement in place of Noise-to-Ground and a rechargeable battery pack.

1-18. Accessories available are:

15513A	Test cord w/310 male at both ends
18132A	19" Rack Mount Adapter
18134A	Soft-pack Carrying case
18161A	Ladder Bracket
04935-60014	Diagnostic Service Kit

1-19. WARRANTY

1-20. Instrument warranty is as listed on the inside of the front cover.

Battery warranty is 1 year.

1-21. RECOMMENDED TEST EQUIPMENT

1-22. Recommended test equipment is listed in Table 1-2. Equipment with equivalent characteristics may be used.

Table 1-2. Recommended Test Equipment

INSTRUMENT	CRITICAL SPECIFICATIONS	RECOMMENDED MODEL	USE*
AC CALIBRATOR	OUTPUT LEVEL 1mV TO 10V FREQUENCY: 20 Hz TO 110 kHz ACCURACY 0.1% @ ≥7mV	FLUKE 5200A OR EQUIVALENT	P,T
OSCILLOSCOPE	>15 MHz BANDWIDTH A VS B CAPABILITY	HP 1741A	P,A
MULTIMETER	AC AND DC FUNCTIONS AC VOLTS: 1V MIN. TO 1000V DC VOLTS: .1 TO 1000V BALANCED INPUT	HP 3455A	P,A,T
DIGITAL MULTIMETER	DC CURRENT: 1AMP MAX	HP 3468A	P,A,T
DUAL OUTPUT POWER SUPPLY	+12 AND -12V @ 0 TO 0.2A	HP 6234A	P
DUAL RANGE DC POWER SUPPLY	0-50 Vdc @ 0 TO .2A	HP 6218A	P,T
AUDIO ANALYZER	INPUT VOLTAGE RANGE 50mV-300V BANDWIDTH 500 kHz FILTER 30 kHz	HP 8903A	P
COUNTER	RANGE: AC COUPLED 30 Hz TO 100 MHz SENSITIVITY: 10 mV TO 100 MHz	HP 5315A	P

*P = PERFORMANCE TESTS A = ADJUSTMENTS T = TROUBLESHOOTING

Table 1-3. List of Parts Used for Performance Tests

PART NUMBER (IF APPLICABLE)	DESCRIPTION
1698-3447	135Ω 1% RESISTOR
0698-8240	398Ω 1% RESISTOR
0698-7408	600Ω .1% RESISTOR
0698-6344	900Ω .1% RESISTOR
HP 11095A	TERMINATION, 600Ω BNC-TO-BNC
1250-0781	BNC-TEE FEMALE
1251-3757	BNC TO TYPE 310 POMONA NO. 2798 OR EQUIVALENT BNC TO DUAL BANANA JACK POMONA NO. 1296 DUAL BANANA COMPONENT CARRIER POMONA NO. 1330-ST
04935-60014	DIAGNOSTIC SERVICE KIT

1-23. BATTERY OPERATION (Options 001 and 003)

1-24. Nickel-Cadmium batteries enable the 4935A to be used in areas removed from AC power. Typical operating time is 3 hrs when fully charged. The batteries are trickle-charged whenever the instrument is connected to an AC source and the POWER switch is in STBY.

1-25. Regular discharge-charge cycles are recommended to maintain battery capacity. The instrument should be operated until batteries are discharged (instrument stops working) then recharged, at least every 30 days. Normal recharge time is about 14 hours. Typical battery life under normal operating conditions should be at least 100 charge-discharge cycles.

NOTE

Batteries do not charge when 4935A is operating from an AC source.

1-26. Charging the Batteries

1-27. The internal battery pack consists of three rechargeable battery packs (+6V, +15.6V and -15.6V). These provide typically three hours of continuous use without recharging. To recharge the battery packs, connect the 4935A to an AC power source and press power switch to STBY (the batteries will not charge with the POWER switch in ON). Normal recharge time is about 14 hours.

1-28. The batteries may be charged at temperatures between 5°C and 40°C (41°F and 104°F), but have greater charge capacity if charged between 5°C and 25°C (41°F and 77°F). At temperatures above 25°C the charge acceptance falls off as shown in Figure 1-2. For example, a cell charged at 45°C accepts about 60-70% of its rated capacity. Temperatures below 5°C cause pressure to build up within the cell as it is charged, which could result in venting of the cell. This results in a permanent degradation of the battery capacity due to loss of electrolyte.

1-29. Operating Temperature

1-30. Normal operating temperature of the 4935A with batteries (options 001 and 003) should be between -20°C and +40°C. However, there will be a loss of capacity when operating at the extremes. At low temperatures, the batteries cannot fully discharge even if they were fully charged at room temperature. At high temperatures, this same effect takes place to a lesser degree, in addition to the problem of charge acceptance previously mentioned. Figure 1-3 illustrates this effect.

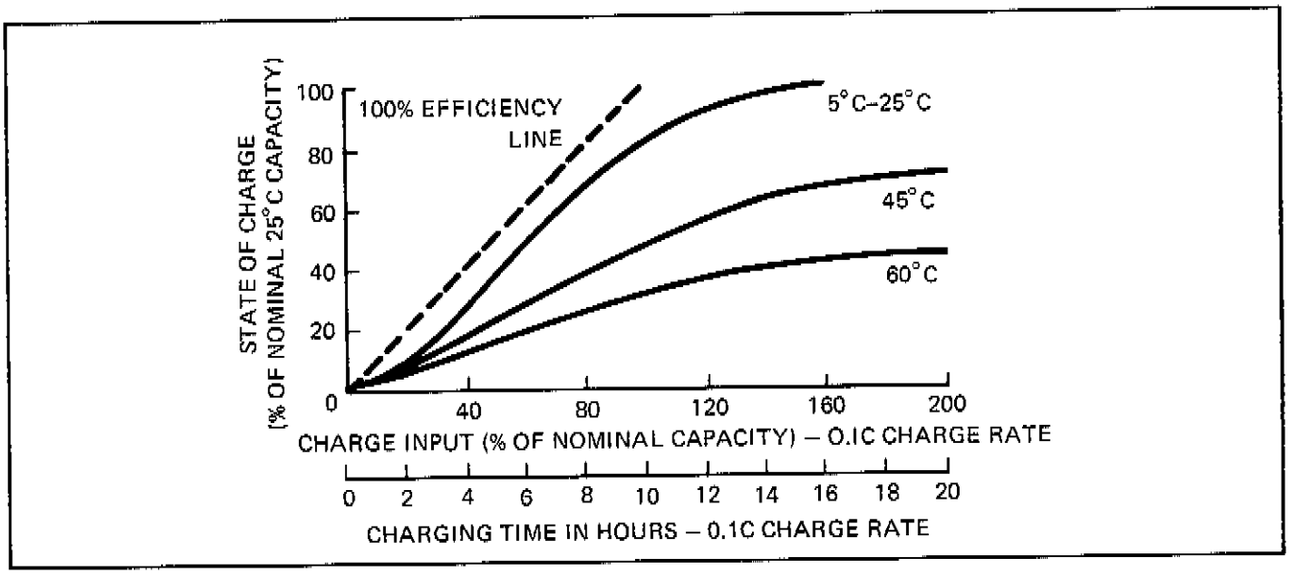


Figure 1-2. Charge Acceptance at Various Temperatures

SECTION II
INSTALLATION

2-1. INTRODUCTION

2-2. This section contains information on initial inspection, preparation for use, power requirements and storage and shipment. Table 2-1 shows all power cords available.

2-3. INITIAL INSPECTION

2-4. Inspect the shipping container for damage. If the container or cushioning material is damaged, keep it. Check the contents of the shipment for completeness, then check the unit mechanically and electrically. Refer to Section IV for electrical checks.

2-5. If the unit is mechanically damaged or fails electrical tests, notify the carrier and the nearest HP office (listed at the rear of this manual). Hewlett-Packard will arrange for repair or replacement of the instrument without waiting for claim settlement.

2-6. PREPARATION FOR USE

CAUTION

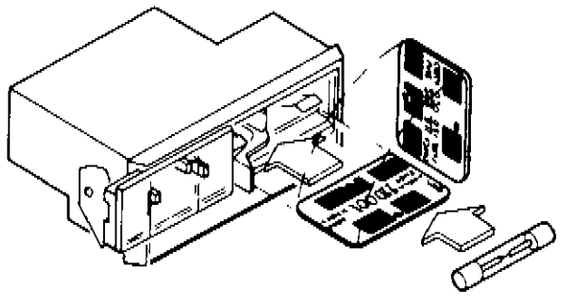
Before connecting this instrument to an AC power source, be sure that the rear panel line module is set to the same voltage as the AC source and that the correct fuse for that AC voltage is installed (.375 Amp for 120 Vac, .200 Amp for 220 Vac).

2-7. POWER REQUIREMENTS

2-8. This instrument requires a power source of 100, 120, 220, or 240 Vac. +5%-10%, 48 to 66 Hz single phase. Power consumption is no more than 25 Vac.

2-9. LINE VOLTAGE SELECTION

2-10. Figure 2-1 provides instructions for line voltage selection. Card and fuse are factory installed for 120 Vac operation.



Operating voltage is shown in module window.

PROCEDURE

1. Slide cover door to left (the line power cord must be disconnected).
2. Rotate FUSE PULL to left. Remove the fuse.
3. Remove the PC board by pulling it out. Select operating voltage by positioning PC board to show the desired voltage on top-left side.
4. Reinsert the PC board.
5. Rotate FUSE-PULL back into normal position and reinsert fuse. Use caution to select correct fuse value.

Figure 2-1. Line Voltage Selection

2-11. POWER CABLE

WARNING

Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnecting the protective earth terminal can make this instrument dangerous. Intentional interruption is prohibited.

2-12. This instrument is supplied with a three-wire power cable. When connected to an appropriate three-wire ac power receptacle, the cable grounds the instrument chassis.

2-13. OPERATING ENVIRONMENT

2-14. TEMPERATURE. The instrument may be operated in temperatures from 0° to 50°C (32°F to +122°F). Temperature for battery unit operation is 0° to 40°C (32°F to 103°F).

2-15. HUMIDITY. The instrument may be operated in environments with humidity from 5% to 95% R.H. @ 40°C. However, the instrument should be protected from temperature extremes which cause condensation within the instrument.

2-16. STORAGE AND SHIPMENT

2-17. ENVIRONMENT

2-18. The 4935A (all options) may be stored and shipped within the following environmental limits:

Temperature:	–20°C to +45°C (–4°F to +113°F)	Do not store or ship where temperature extremes will cause condensation within the instrument.
Humidity:	90% R.H. @ 65°C	

2-19. INSTRUMENT PACKAGING

2-20. ORIGINAL PACKAGING. Containers and packing material used in factory packaging can be obtained through Hewlett-Packard sales and service offices listed at the rear of this manual. If the instrument is returned to HP for repair, attach a tag listing the type of service or repair needed. Include return address, model number, option number (if applicable) and complete serial number. Also, mark the container "FRAGILE" to ensure careful handling. In any letters, refer to the instrument by model number, option number (if applicable) and complete serial number.

2-21. OTHER PACKAGING. Use these general instructions for packaging with commercially available materials:

a. Wrap the instrument in heavy paper or plastic. If shipping to an HP Sales or Service Office, include a tag listing type of service needed, return address, model number, option number (if applicable) and complete serial number.

b. Use a strong shipping container such as a double-wall carton with 275 lbs. burst test.

c. Use a layer of shock absorbing material, 70–100 mm (3–4 in.) thick. This provides a firm cushion and prevents movement inside the container. Protect the front panel with cardboard or the front cover.

d. Seal the carton securely and mark it "FRAGILE" to ensure careful handling.

2-22. TAGGING FOR SERVICE. If the instrument is being returned to Hewlett-Packard for service, please complete one of the blue tags located at the back of this manual and attach it to the instrument.

Table 2-1. HP Plug Styles

Plug Type	Cable HP Part Number	CD	Plug Description	Cable Length (inches)	Cable Color	For Use In Country
250V 	8120-1351 8120-1703	0 6	Straight*BS1363A 90°	90 90	Mint Gray Mint Gray	United Kingdom, Cyprus, Nigeria, Rhodesia, Singapore
250V 	8120-1369 8120-0696	0 4	Straight*NZSS198/ASC112 90°	79 87	Gray Gray	Australia, New Zealand
250V 	8120-1689 8120-1692	7 2	Straight*CEE7-Y11 90°	79 79	Mint Gray Mint Gray	East and West Europe, Saudi Arabia, Egypt, So. Africa, India (unpolarized in many nations)
125V 	8120-1348 8120-1398 8120-1754 8120-1378 8120-1521 8120-1676	5 5 7 1 6 2	Straight*NEMA5-15P 90° Straight*NEMA5-15P Straight*NEMA5-15P 90° Straight*NEMA5-15P	80 80 36 80 80 36	Black Black Black Jade Gray Jade Gray Jade Gray	United States, Canada, Japan (100V or 200V), Mexico, Philippines, Taiwan
250V 	8120-2104	3	Straight*SEV1011 1959-24507 Type 12	79	Gray	Switzerland
250V 	8120-0698	6	Straight*NEMA6-15P			United States, Canada
220V 	8120-1957 8120-2956	2 3	Straight*DHCK 107 90°	79 79	Gray Gray	Denmark
250V 	8120-1860	6	Straight*CEE22-VI (Systems Cabinet use)			

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

SECTION III
OPERATION

3-1. INTRODUCTION

3-2. This section contains information on front and rear panel features, self check procedures, and error codes (Err-codes). Also covered are the principles of operation for all measurements. If any of the automatic self check procedures fail acceptable limits as specified in the checks, then adjustment or repair may be necessary.

3-3. SELF CHECK

3-4. The self check procedures are performed automatically at power-up by the instrument. Most of the major circuits are checked and any problems are identified. Self check does not verify performance specifications. Performance checks verify that the instrument meets published specifications. Failure of the instrument to pass any self check procedure indicates a malfunction that can possibly affect other measurements.

3-5. ERROR MESSAGES

3-6. When the 4935A is powered up, the instrument automatically transmits a signal into its receiver through the filters. The signal is checked after each filter, to verify that it is within acceptable limits. Errors 0 through 6 indicate there are problems during self check. Errors 7 and 8 highlight problems during a particular measurement. Other indications of errors during measurement are described by the particular measurement. After startup self-check, the instrument automatically goes into Transmit Mode, LEVEL FREQUENCY. Even if error messages occur, the instrument continues to operate correctly except for those measurements affected by the displayed errors. Errors 0 through 5 (Err 0-Err 5) followed by Error 6 (Err 6) is indicative of a system level failure more than a filter failure.

Displayed Errors are:

Err 0 — Test signal cannot be measured through C-Message filter.

Err 1 — Test signal cannot be measured through 3 kHz flat filter.

Err 2 — Test signal cannot be measured through 15 kHz flat filter.

Err 3 — Test signal cannot be measured through Program filter.

Err 4 — Test signal cannot be measured through 50 kBit filter.

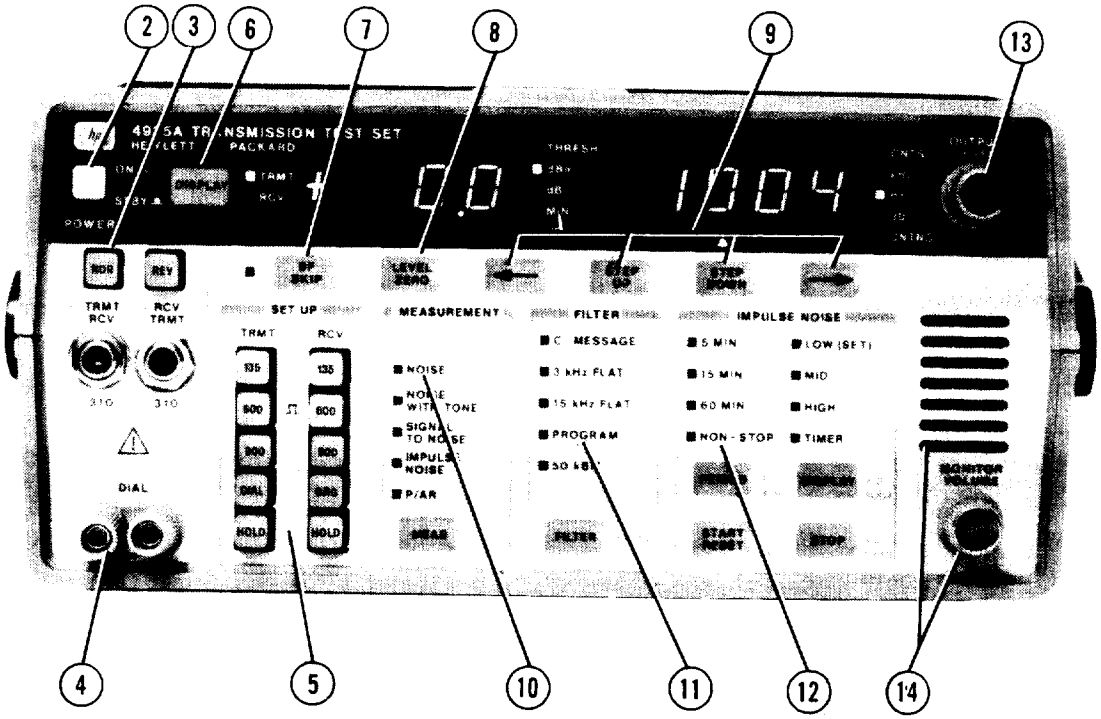
Err 5 — Test signal cannot be measured through P/AR filter. If not a P/AR unit refer to Err 0.

Err 6 — Error in LEVEL FREQUENCY signal path.

Err 7 — Received 1004 Hz tone is below −46 dBm or above +13 dBm in NOISE WITH TONE or SIGNAL TO NOISE.

Err 8 — IMPULSE NOISE threshold is set too high. The upper limit varies with the receive impedance as follows:

RCV Ω:	135Ω	116 dBrn Upper Limit
	600Ω	109 dBrn
	900Ω	107 dBrn



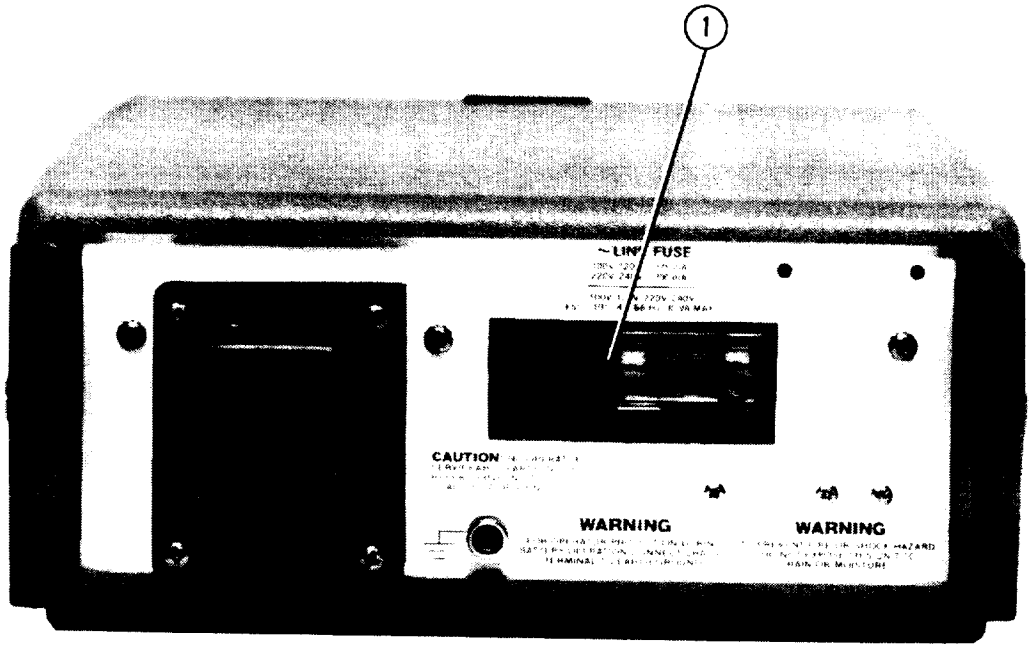


Figure 3-1. Front and Rear Panel Controls/Connectors/Indicators

CONTROLS, CONNECTORS AND INDICATORS

1. **Power Cord Module.** Accepts power cord supplied with instrument. Contains line fuse and PC board for selecting line voltage (see Section II, paragraph 2-9 for procedure to select line voltage).

WARNING

Always connect power cord to a properly grounded 3-wire power outlet.

⚠ **Do not connect more than 200VDC signal to terminals.**

2. **POWER button.** Switches power to front panel when in ON position. In STBY position power is still applied to some circuits. If unit has battery option there will still be power available to some internal circuits even in STBY position.

3. **NOR and REV switches.** NOR switch depressed connects the left 310 jack to the transmitter and the right 310 jack to the receiver. REV switch depressed connects the left 310 jack to the receiver and the right 310 jack to the transmitter. Both switches out simultaneously or depressed simultaneously internally loops the transmitter to the receiver.

4. **DIAL Binding Posts.** Handset can be connected to binding posts to dial-up a line through the 310 jacks.

5. **SET UP Switches.**

TRMT.
135Ω, 600Ω, 900Ω: Provides terminating impedance to match the lines' characteristic impedance.

DIAL: Disconnects TRMT-RCV 310 jack from the transmitter and connects the TRMT-RCV 310 jack to the DIAL binding posts.

HOLD: Connects the hold circuits to the TRMT-RCV 310 jacks to hold dial-up lines.

RCV.
135Ω, 600Ω, 900Ω: Provides terminating impedance to match the lines' characteristic impedance.

BRG: Connects the RCV-TRMT 310 jack through high impedance when the 4935A bridges the circuit under test instead of terminating the line.

HOLD: Connects the receive-hold-circuits to the RCV-TRMT 310 jack to hold the dial-up lines.

6. DISPLAY Key. TRMT-RCV. Selects either the transmitted or the received signal to be displayed. Corresponding LED will light.

7. SF SKIP Key. Prevents the transmitter from transmitting within ±150 Hz (300 Hz band) of a designated frequency. This feature eliminates accidental disconnection by SF signaling units on dial-up lines. Operates only in LEVEL FREQUENCY. LED will light when key is pressed.

8. LEVEL ZERO Key. Sets a 0 dB reference in RCV LEVEL FREQUENCY mode. All subsequent measurements will be made in dB relative to this reference. DB LED in center of front panel will light. A "–" (minus) dB reading indicates levels higher than the reference level per the telephone industry convention.

9. **STEP UP, STEP DOWN, ← and → Keys.** In TRMT Mode (right display) and LEVEL FREQUENCY: ← or → selects the position of digit to be increased or decreased. Lighted cursor indicates one-of-five digit positions. Digit value is incremented by pressing STEP UP and decremented by pressing STEP DOWN. Holding the STEP UP or STEP DOWN key depressed causes the actions to repeat.

Figure 3-1. Front and Rear Panel Controls/Connectors/Indicators (Continued)

In RCV Mode (left display) and IMPULSE NOISE; ← or → selects the position of the threshold digit to be increased or decreased. Lighted cursor indicates one-of-two digit positions. Digit value is incremented by pressing STEP UP and decremented by pressing STEP DOWN. THRESH LED, dBrn and LOW(SET) LED will be on.

10. MEASUREMENT Section.

MEAS Key. Selects measurement to be made. Lighted LED indicates selected measurement. For detailed measurement information of each mode see Figure 3-3. Measurement modes are:

LEVEL FREQUENCY (Blue)

NOISE

NOISE WITH TONE

SIGNAL TO NOISE

IMPULSE NOISE

NOISE TO GROUND (Standard units and option 001)

P/AR (Options 002, 003)

11. FILTER Section.

FILTER/STORE Key. Selects desired weighting filter for Noise Measurements. Selected weighting-filter LED will light. In LEVEL FREQUENCY the STORE function enables frequencies on right display to be stored for recall using the F1, F2, F3, or F4 keys. The STORE function is also used to change the SF SKIP Frequency.

12. IMPULSE NOISE Section.

Impulse-Noise controls are used in RCV and in conjunction with the MEASUREMENT section IMPULSE NOISE mode. Four keys control this section:

PERIOD/F1-404

DISPLAY/F2-1004

START RESET/F3-2804

STOP/F4-2713

PERIOD: Sets the instrument timer for the impulse noise test (5 MIN, 15 MIN, 60 MIN or NON-STOP). Also provides the F1-404 Hz preprogrammed frequency for LEVEL FREQUENCY Mode.

DISPLAY: Changes the display through each of the threshold values and their impulse noise counts then displays the TIMER setting selected by the PERIOD key. Also provides the F2-1004 Hz preprogrammed frequency for LEVEL FREQUENCY Mode.

START RESET: Starts the impulse noise test and resets the count to zero for every threshold. Also provides the F3-2804 Hz preprogrammed frequency for LEVEL FREQUENCY Mode.

STOP: Stops the impulse noise test but retains the displayed count values. Also provides the F4-2713 Hz preprogrammed frequency for LEVEL FREQUENCY Mode.

Figure 3-1. Front and Rear Panel Controls/Connectors/Indicators (Continued)

13. **OUTPUT LEVEL Control**

Adjusts the transmitter output level continuously from -40 dBm to +13 dBm. Output level is displayed on left display.

14. **MONITOR VOLUME Control and Speaker.**

Permits adjustable volume for listening to the circuit under test or to the Test Set Transmitter.

Figure 3-1. Front and Rear Panel Controls/Connectors/Indicators (Continued)

3-7. OPERATING INSTRUCTIONS

3-8. Figure 3-2 lists the various measurement modes available. A brief Power On and Set Up procedure precedes the detailed explanation. Each measurement mode is explained with a drawing and accompanying text.

POWER ON and SET UP

A.C. POWER

1. Connect power cord to the rear line module on which the correct line voltage has been selected. See paragraph 2-9 of Installation section for procedure to select line voltages.

WARNING

Always connect power cord to a properly grounded 3-wire power outlet.

2. Press POWER button ON. The 4935A will automatically do a self check of the transmitter, the filters, and the LEDs.

BATTERY POWER (Optional)

WARNING

For operator protection during battery operation, connect the chassis terminal on the rear panel to earth ground.

1. Press POWER button ON with no power cord connected. When switching between battery and A C power cycle the POWER button from STBY to ON again.

NOTE: Proper care in charging and discharging NiCad batteries can dramatically improve their lives. Consult Section I of this manual for recommended procedures.

SET UP

⚠ Connect circuit to 310 jacks. Do not connect more than 200VDC or 10 Vrms at 60 Hz to these jacks.

NOR-REV

1. Press in the NOR button to connect the left 310 jack to the transmitter and the right 310 jack to the receiver.

2. To reverse the direction of the test press the REV button IN.

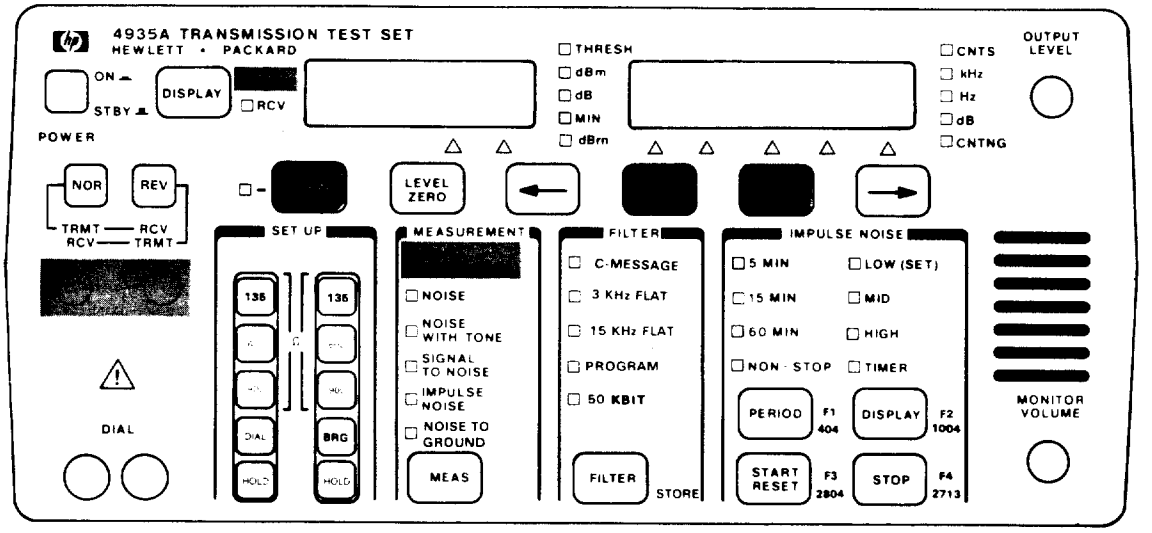
Impedance

1. Press the TRMT impedance button Ω that matches the impedance of the circuit on the TRMT side.

2. Press the RCV impedance button Ω that matches the impedance of the circuit on the RCV side. If the test set is to be used in the bridged mode press the BRG button also. This means that in the bridged mode two RCV Setup buttons will be pressed in — the correct circuit impedance and the BRG button. Note: Do not leave the BRG button IN while the instrument is actually terminating the circuit as it will cause a 6 dB error.

Figure 3-2. Measurements

3-9. MEASUREMENTS



LEVEL AND FREQUENCY—TRANSMITTER

a. Use MEAS key to select LEVEL FREQUENCY.

b. Press DISPLAY-TRMT key to display the transmitted signal. TRMT light is ON. Level can be read in the left display and frequency in the right.

c. If SF signalling units are used on the circuit under test, press SF SKIP key to turn on SF SKIP. When the light is on the transmitter is blanked from 2450 Hz to 2750 Hz or ±150 Hz around a stored SF SKIP frequency.

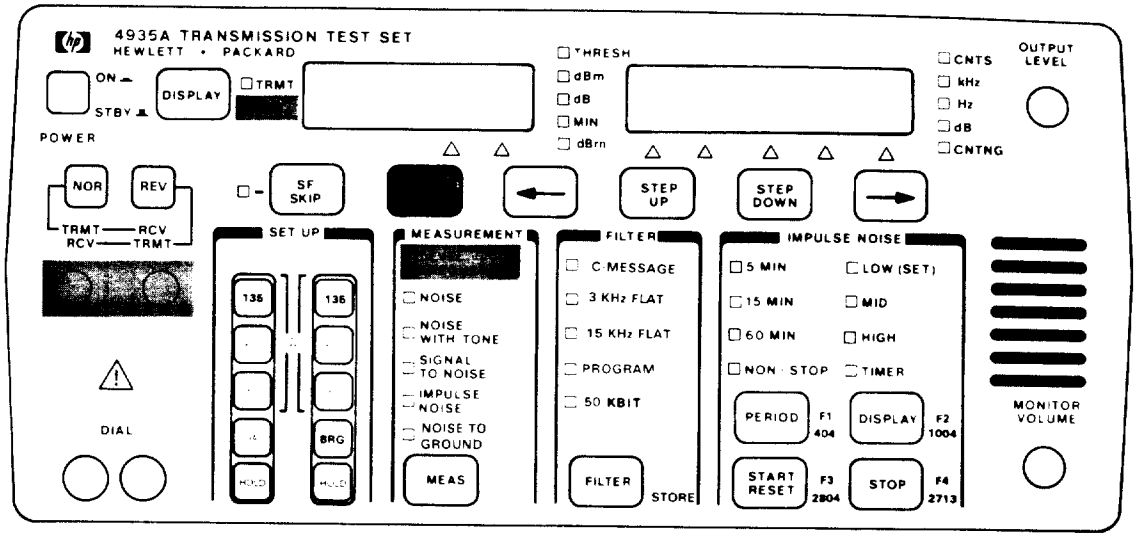
SF SKIP frequency is preset at 2600 Hz (Skip will be 2600 Hz ± 150 Hz). The SF SKIP center frequency can be changed by putting the desired skip frequency into the transmitted frequency display. Then press the STORE key and the SF SKIP key. Be sure to disconnect the transmit side of the line from the test set first to avoid dropping the circuit during the storage procedure.

d. Turn OUTPUT LEVEL knob to adjust the level of the transmitted signal to DATA LEVEL. DATA LEVEL is usually 13 dB below the transmission level point (TLP). A + sign indicates the level is > +13 dBm. A - sign indicates the level is < -40 dBm.

e. Use the STEP UP and STEP DOWN keys to set the desired frequency or press F1, F2, F3 or F4 to recall any stored frequency. Holding a finger on either the STEP UP or STEP DOWN keys causes the transmitter to sweep.

STORE and RECALL Frequencies. There are 4 frequencies stored in locations F1, F2, F3 and F4 when the 4935A is turned on. F1 is 404 Hz, F2 is 1004 Hz, F3 is 2804 Hz and F4 is 2713 Hz. To store other frequencies set the desired frequency in the transmitted frequency display, press the STORE key and press whichever location key, F1, F2, F3, or F4 that is desired as the storage location.

Figure 3-2. Measurements (Continued)



LEVEL AND FREQUENCY—RECEIVER

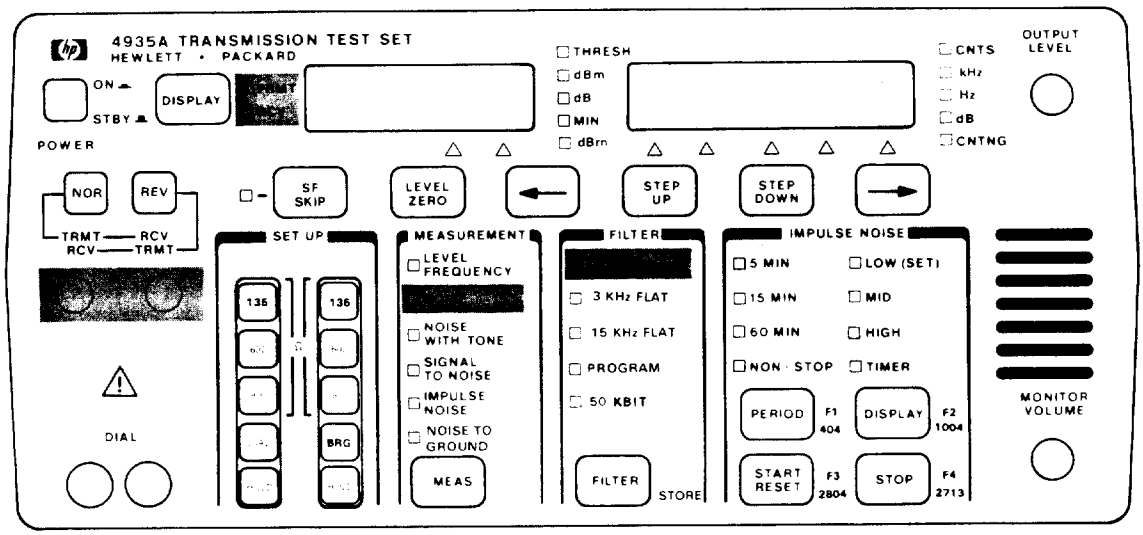
a. Use MEAS key to select LEVEL FREQUENCY.

b. Press DISPLAY key to display the received signal. The RCV light will come ON.

c. Read the RCV level in the left display. A + sign indicates the received signal is > +13 dBm. A - sign indicates received level is < -78 dBm.

d. LEVEL ZERO — For attenuation distortion measurements press LEVEL ZERO key to set the received level at 0 dB. All subsequent level measurements will be made relative to this point. Pressing the LEVEL ZERO key a second time reverts the level to absolute units (dBm) instead of relative units (dB). A negative reading indicates levels higher than the reference level per the telephone industry convention.

Figure 3-2. Measurements (Continued)



NOISE – TRANSMITTER

a. Press DISPLAY TRMT-RCV key to display the transmitted signal. TRMT light will be on.

b. Press MEAS key to select NOISE.

There will be no values displayed because in this configuration the transmitter is turned off and a quiet termination is supplied to the TRMT jack.

NOISE – RECEIVER

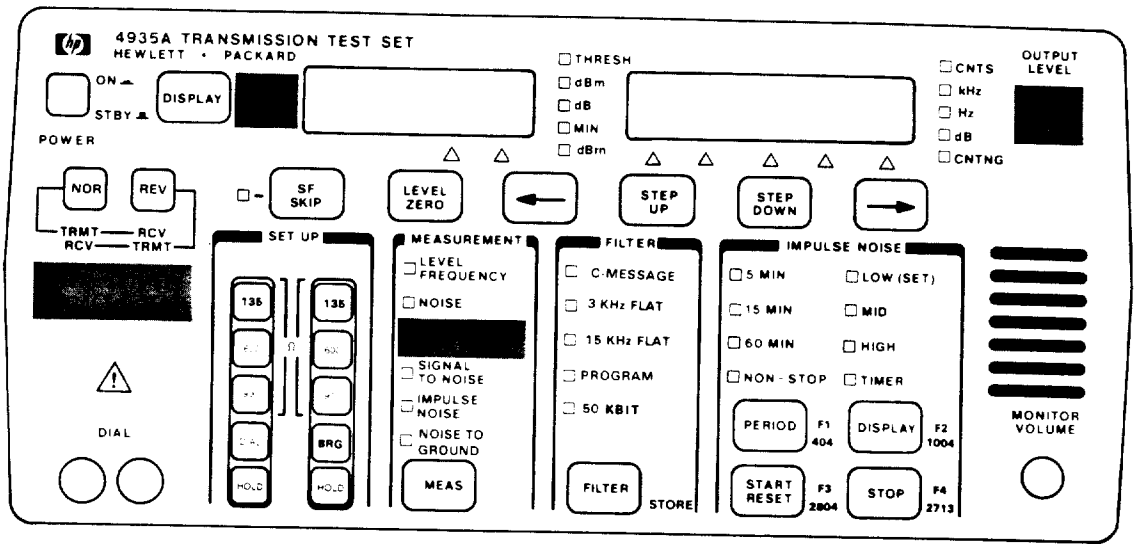
a. Press DISPLAY TRMT-RCV key to display the received signal. RCV light will be on.

b. Press MEAS key to select NOISE.

c. Press FILTER key to select the desired filter.

d. Read the dBrn noise level in the left display. A "–" in the left display indicates underrange (<0 dBrn).

Figure 3-2. Measurements (Continued)



NOISE WITH TONE — TRANSMITTER

a. Press MEAS key to select NOISE WITH TONE.

b. Press DISPLAY TRMT-RCV key to display the transmitted signal. TRMT light will be on and 1004 Hz should be in right display.

c. Turn OUTPUT LEVEL knob to adjust 1004 Hz signal to data level in left display (usually 13 dB below the transmission level point).

NOISE WITH TONE – RECEIVER

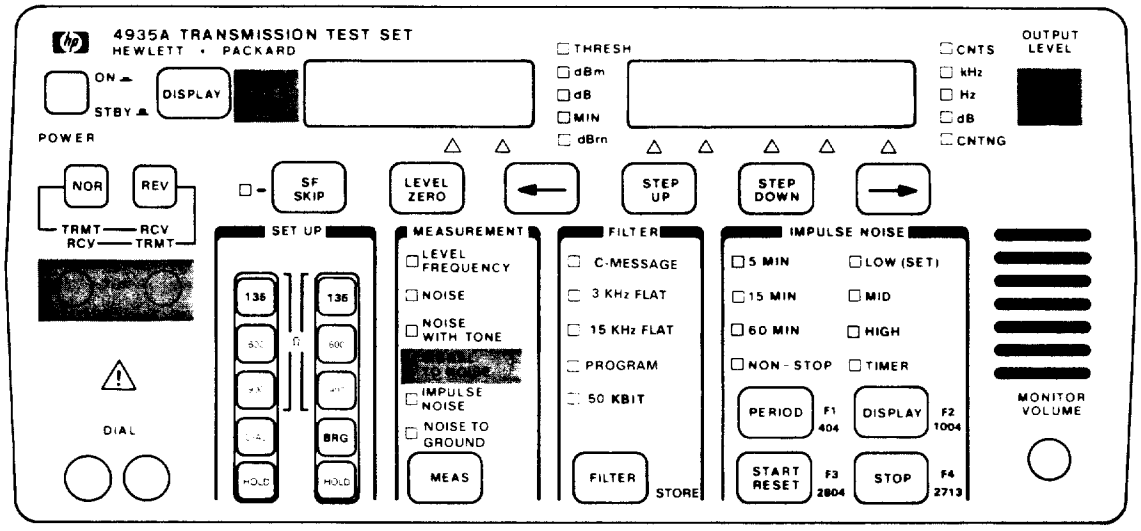
a. Press MEAS key to select NOISE WITH TONE.

b. Press DISPLAY TRMT-RCV key to display the received signal. RCV light will be on.

c. Read dBrn in left display.

Note: Err 7 in the right display indicates the received 1004 Hz tone has dropped below –46 dBm or exceeded +13 dBm.

Figure 3-2. Measurements (Continued)



SIGNAL TO NOISE — TRANSMITTER

a. Press MEAS key to select SIGNAL TO NOISE.

b. Press DISPLAY TRMT-RCV key to display the transmitted signal. TRMT light will be on.

c. Turn OUTPUT LEVEL knob to adjust 1004 Hz signal to data level (usually 13 dB below the transmission level point).

SIGNAL TO NOISE — RECEIVER

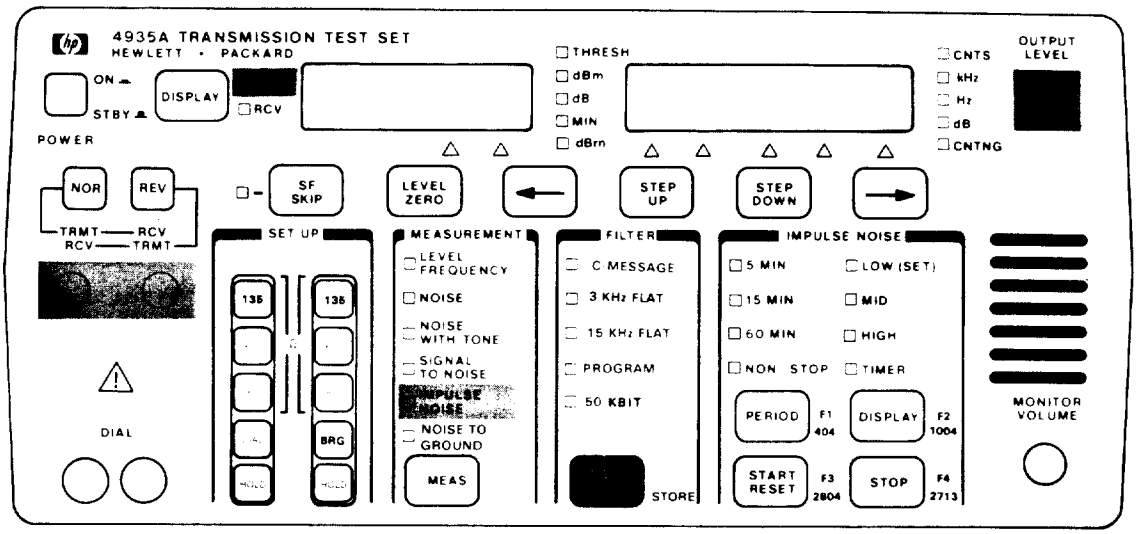
a. Press MEAS key to select SIGNAL TO NOISE.

b. Press DISPLAY TRMT-RCV key to display the received signal. RCV light will be on.

c. Read the Signal to Noise ratio as dB in the right display. The received level is displayed in the left display.

Note: Err 7 indicates the received 1004 Hz tone has dropped below –46 dBm or exceeded +13 dBm.

Figure 3-2. Measurements (Continued)



IMPULSE NOISE – TRANSMITTER

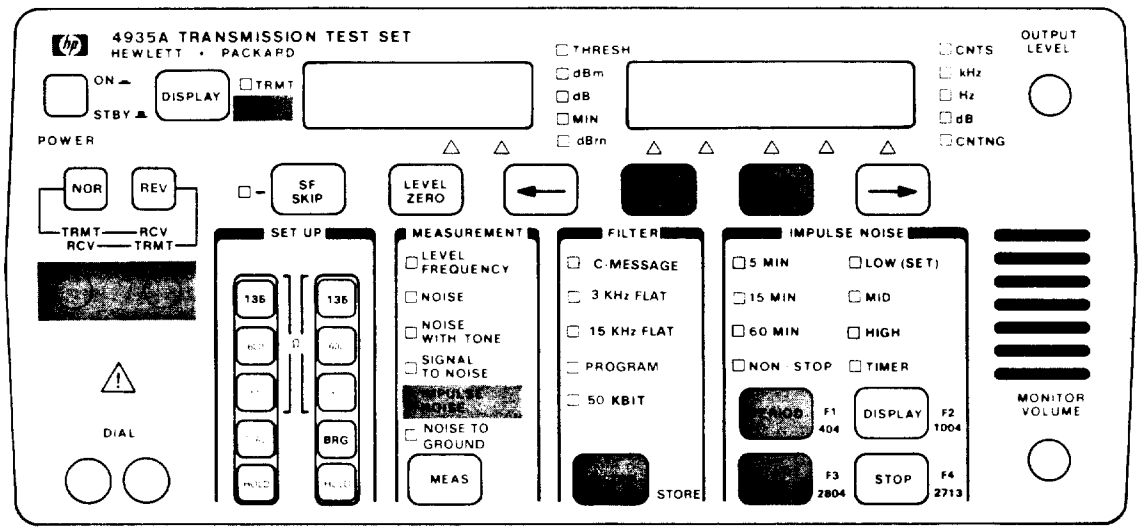
a. Press MEAS key to select IMPULSE NOISE.

b. Press DISPLAY TRMT-RCV key to display the transmitted signal. TRMT light will be on.

c. Press FILTER key to select the same filter as the receiver will use. Although the transmitted signal is not affected by the filter, selecting either the 15 kHz FLAT, PROGRAM or 50 kBit filter will quiet terminate the transmitter instead of sending a hold tone.

d. Turn OUTPUT LEVEL knob to adjust the level to data level (usually 13 dB below transmission level point).

Figure 3-2. Measurements (Continued)



IMPULSE NOISE — RECEIVER

a. Press MEAS key to select IMPULSE NOISE.

b. Press DISPLAY TRMT-RCV key to display the received signal. RCV light will be on.

c. Press FILTER key to select the appropriate filter.

d. Use STEP UP, STEP DOWN and ← → keys to adjust the level of the LOW threshold shown in the left display. The LOW threshold may be set at any value between 30 and 109 dBrn @ 600Ω.

Note: Err 8 indicates the threshold is set out of limits. See paragraph 3-6 for limits.

e. Press PERIOD key to set the time of the test to 5 MIN, 15 MIN, 60 MIN or NON-STOP.

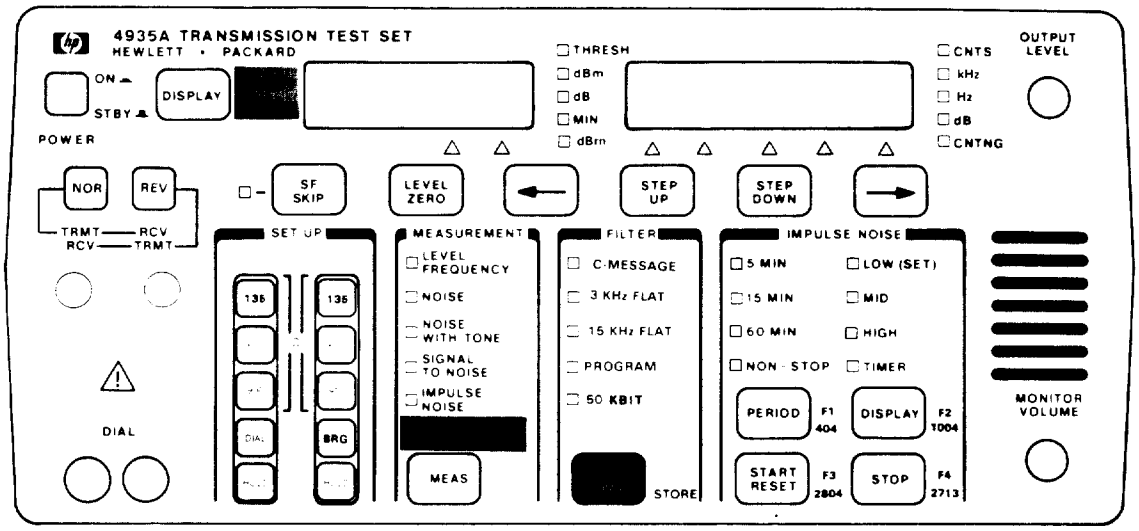
f. Press START-RESET key to start the test. The CNTNG LED by the right display will go on to indicate that the test is in progress. Note that you can see how many counts have been accumulated at each threshold by pressing DISPLAY key. When NON-STOP is selected, STOP must be pressed to stop counting.

g. The left display shows threshold or minutes; the right display shows the number of counts for the threshold selected.

Note: The 1010 Hz notch filter is automatically used when the C Message or 3 kHz flat filter is selected. it is not used for the other filters.

Note: A minus sign in the counts display indicates that the tone has dropped below −46 dBm for more than 1 sec during the test. Tone dropout could cause invalid count totals.

Figure 3-2. Measurements (Continued)



NOISE TO GROUND — TRANSMITTER (STANDARD UNIT and Option 001)

a. Press DISPLAY TRMT-RCV key to display the transmitted signal. TRMT light will be on.

b. Press MEAS key to select NOISE-TO-GROUND which provides a quiet termination to the TRMT jack.

NOISE TO GROUND — RECEIVER (STANDARD UNIT and Option 001)

For valid NOISE-TO-GROUND measurements the test set must be properly grounded. Connect the rear panel chassis ground post to a known good ground.

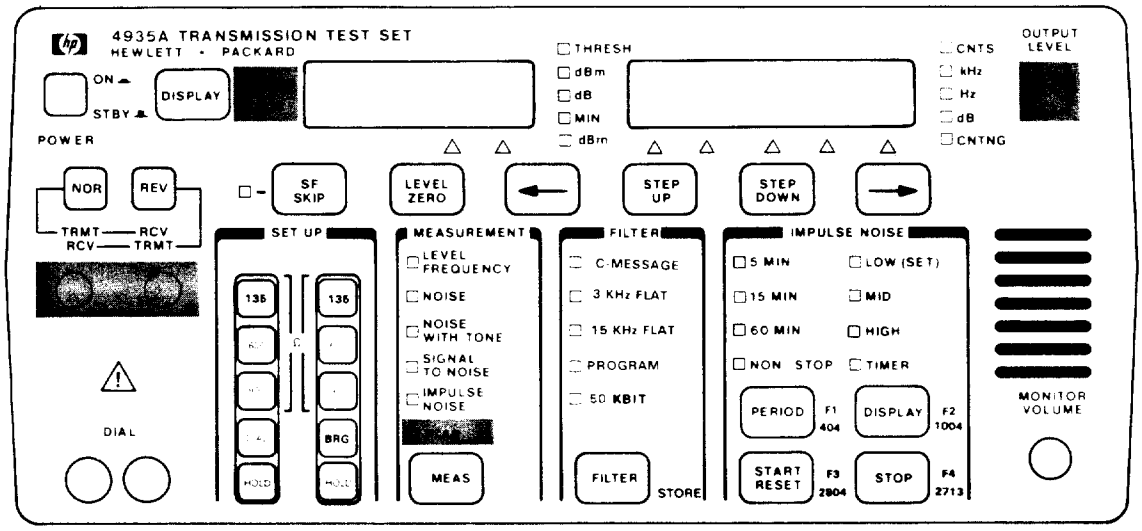
a. Press DISPLAY TRMT-RCV KEY to display the received signal. RCV light will be on.

b. Press MEAS key to select NOISE-TO-GROUND.

c. Use FILTER key to select the desired filter.

d. Read dBrn noise level in the left display.

Figure 3-2. Measurements (Continued)



P/AR — TRANSMITTER (Option 002 and 003)

a. Press DISPLAY TRMT-RCV key to display the transmitted signal. TRMT light will be on.

b. Press MEAS key to select P/AR.

c. Use OUTPUT LEVEL knob to adjust signal level to data level. Maximum output for P/AR is +3 dBm.

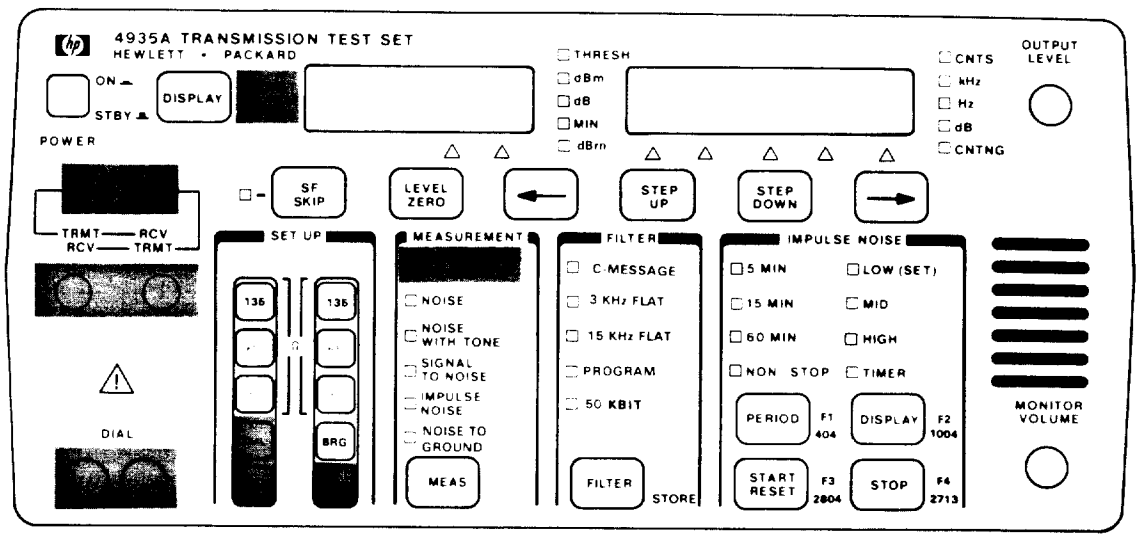
P/AR — RECEIVER (Option 002 and 003)

a. Press DISPLAY TRMT-RCV key to display the received signal. RCV light will be on.

b. Press MEAS key to select P/AR.

c. Read P/AR units in right display.

Figure 3-2. Measurements (Continued)



DIAL and HOLD (WET DIAL-UP and 2 two-wire circuits)

DIAL AND HOLD PROCEDURES

The 4935A has the capability to hold wet dial-up lines (lines where the central office provides battery. For example: DDD; Direct Distance Dialing network). Dialing can be accomplished with a butt-in. The procedure is as follows:

1. Connect circuit to left 310 jack.
2. Push NOR switch to connect TRMT side to left jack.
3. Connect the butt-in handset to the DIAL binding posts.
4. Push TRMT DIAL switch. Use the butt-in to dial the remote end of the circuit.
5. After the circuit is answered, push the TRMT HOLD switch to hold the circuit.
6. Push the TRMT DIAL switch again to release it. This disengages the dial circuitry and allows testing.
7. If the 4935A is designated the receive set, press RCV HOLD switch and then push REV switch to connect RCV side to left 310 jack.

For 2 two-wire circuits, follow preceding steps 1 through 6 for the first side, then:

1. Push RCV HOLD switch.
2. Push REV switch to transfer the transmit side.
3. Push TRMT DIAL switch. Use the butt-in to dial-up the other end.
4. After the circuit is answered, push the TRMT HOLD switch to hold this circuit.
5. Release TRMT DIAL switch by pushing it again.

Figure 3-2. Measurements (Continued)

3-10. MEASUREMENT PRINCIPLES

3-11. The principles for making measurements with the 4935A are described in the following paragraphs. Included are explanations of the measurements and the effects of certain parameters on data transmission.

3-12. INPUT-OUTPUT SWITCHING

3-13. The TRMT and RCV 310 jacks provide connection between the 4935A and the circuit under test. Pressing in the NOR button selects the transmit function for the left 310 jack. The right 310 jack simultaneously performs the receive function. If the REV button is pressed in, the opposite is true as illustrated by Figure 3-3.

3-14. Pressing the two HOLD buttons allows the 4935A to simultaneously hold two DDD (Direct Distance Dialing) circuits. Used with the NOR and REV buttons this permits changing the direction of the test signal without physically changing the test cables and potentially dropping the circuits.

3-15. The input and output impedances are the standard values of 135, 600, or 900 ohms. The 4935A impedance selected must match the impedance of the circuit under test, or erroneous measurements will be obtained.

3-16. The receive input may be internally terminated or bridged across the circuit under test. The 4935A internal termination provides a resistive load which matches the impedance of the line under test. If the line is terminated externally, the internal termination is switched out of the circuit by pressing in the BRG button. The bridged mode provides a high impedance receive input (greater than 50 kohms).

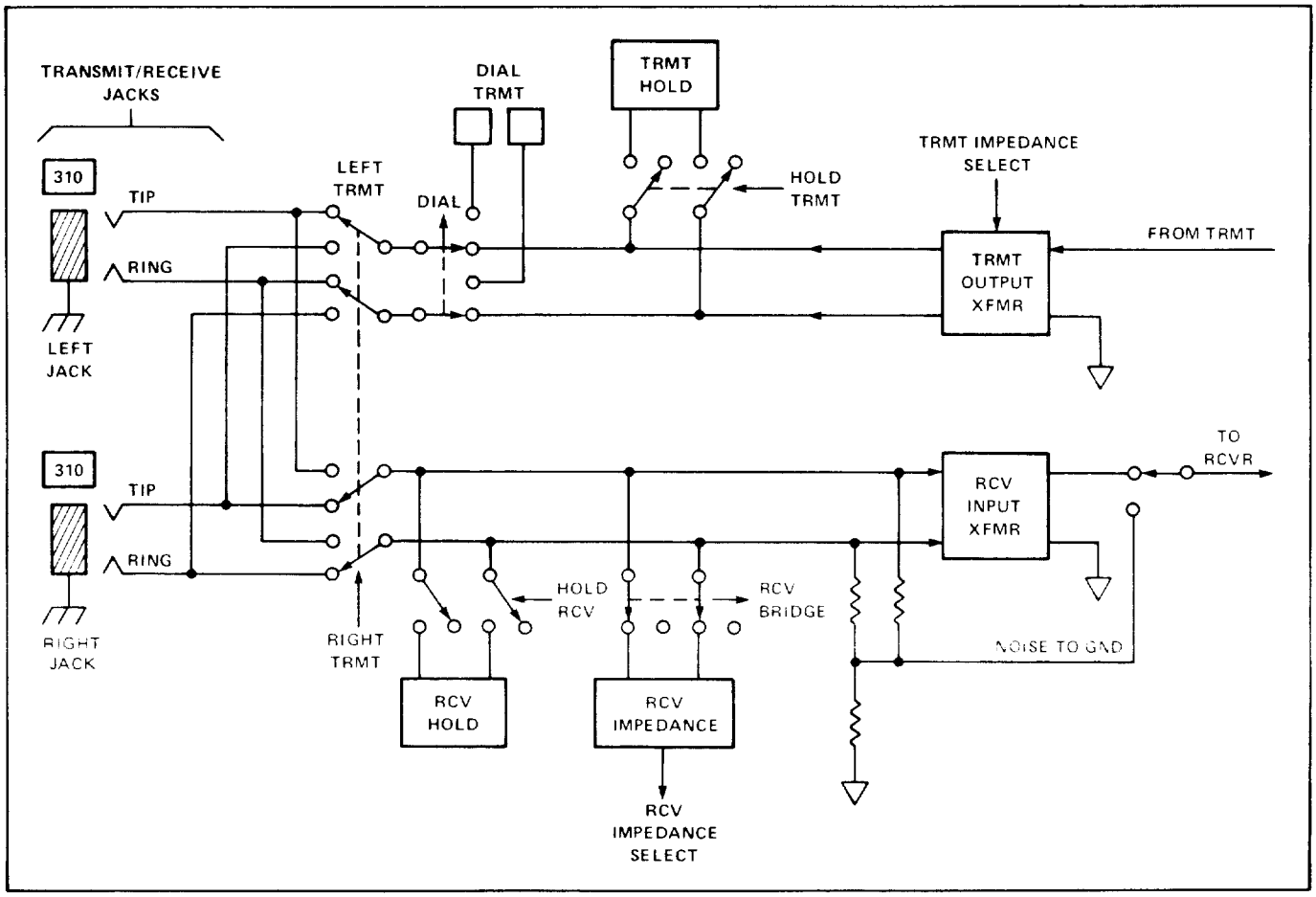


Figure 3-3. Input-Output Switching

3-17. The 4935A input and output circuits are balanced to match standard voice channel lines. A balanced line is electrically symmetrical; the two sides of the line have equal series resistance, series inductance, shunt capacitance, and leakage-to-ground.

3-18. To allow dialing, talking, and listening on the circuit under test, the lineman may plug his handset into the handset terminals (binding posts).

3-19. LEVEL AND FREQUENCY MEASUREMENTS

3-20. The LEVEL FREQUENCY measurement identifies the amplitude versus frequency response of a voice channel, 1000 Hz loss, frequency shifts, and attenuation distortion. The setup as shown in Figure 3-4 is used for all of these functions.

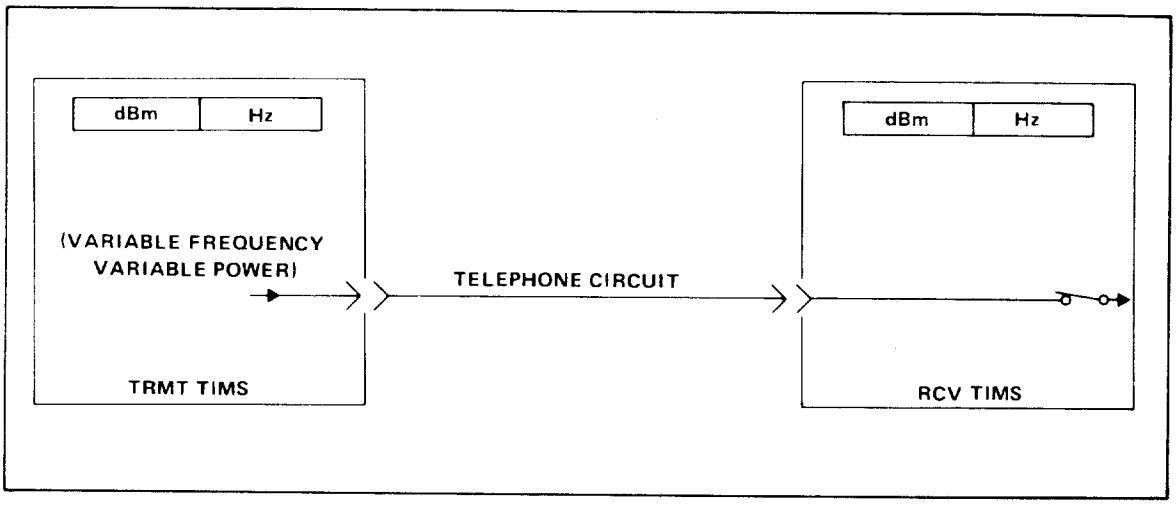


Figure 3-4. Level and Frequency Measurements

3-21. 1000 Hz LOSS

3-22. The 1000 Hz loss measurement determines the point-to-point loss (or gain) of a 1000 Hz test tone transmitted over a voice channel. To make this measurement, a 1004 Hz test frequency is transmitted at the data level. At the receiving 4935A, the received loss or gain is measured (in dBm).

3-23. The wakeup transmit frequency is actually 1004 Hz (not 1000 Hz), to prevent errors over certain circuits. This 4 Hz offset avoids measurement errors caused by test frequencies which are submultiples of the 8 kHz "T-carrier" sampling rate. The other preset frequencies F_1, F_3, and F_4 are offset for the same reason.

3-24. FREQUENCY SHIFT

3-25. The frequency shift measurement checks for any difference in the received frequency with reference to the transmitted frequency (frequency translation) as caused by carrier facilities. To make this measurement, a test tone of known frequency is transmitted. At the receiving end, the received frequency is observed and compared with the transmitted frequency. Any difference between transmitted and received frequencies indicates a frequency shift in the test signal. This measurement is not valid when measured on looped-around carrier facilities, since the frequency shift in one direction (near-end to far-end) may be cancelled by the frequency shift in the other direction (far-end to near-end).

3-26. ATTENUATION DISTORTION

3-27. The attenuation distortion measurement checks the amplitude-versus-frequency characteristics of a circuit using a single frequency measurement technique and defines the circuit's usable bandwidth. To make the measurement, a 1004 Hz test frequency is transmitted at the data level. At the receiving 4935A the power is recorded as the reference level at 1004 Hz. Frequencies between 20 Hz and 110 Hz can be transmitted. The different power readings may be compared to the 1004 Hz reference to obtain the frequency attenuation characteristics of the voice channel in dBm.

3-28. To obtain loss deviations relative to 1004 Hz, the LEVEL ZERO button is pressed during reception of the 1004 Hz reference signal. The received power level is stored (in dBm) and simultaneously displayed as 0 dB. Level readings taken at other frequencies are compared to the 1004 Hz reference and displayed in dB. The 1004 Hz reference level will not have to be subtracted from levels at other frequencies to obtain dB readings.

3-29. According to telephone industry convention, attenuation is defined as a change in loss of a telephone circuit, compared to the loss of a nominal 1000 Hz signal on that circuit. For example, a circuit with 6 dB more loss at 2800 Hz would have an attenuation distortion of +6 dB.

3-30. SF SKIP

3-31. SF Skip (single frequency skip) automatically prevents the 4935A from transmitting frequencies in the 2450 Hz to 2750 Hz range. This feature is used when transmitting over a dial-up network with single frequency signaling units. Any skipped frequency can be programmed using the STORE capability of the 4935A (see Figure 3-1).

3-32. MESSAGE CIRCUIT NOISE MEASUREMENTS

3-33. The message circuit noise measurements determine the effects of background noise and tones. Figure 3-5 illustrates the basic setup for these measurements.

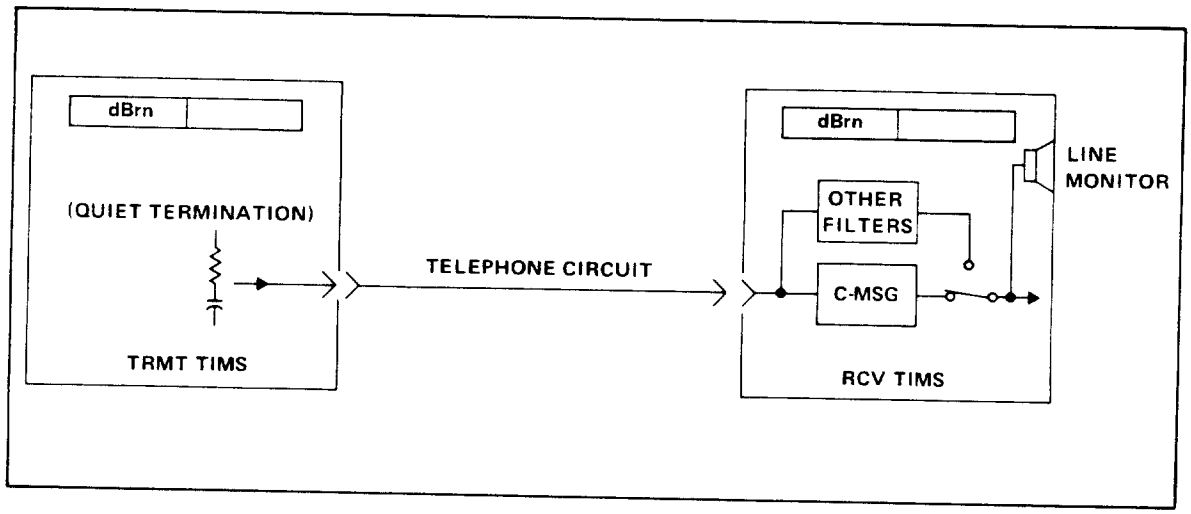


Figure 3-5. Message Circuit Noise Measurements

3-34. The message circuit measurement is obtained by measuring the noise present on a line with a quiet termination on one end (supplied by the transmitting 4935A) and a weighted measuring device on the other end (receiving 4935A).

3-35. The C-message filter measures noise signals that annoy the typical telephone service subscriber. C-message weighting is also used to evaluate the effects of noise on voice-grade data circuits. C-weighting is valid for data transmission since the response characteristic is relatively flat over most of the frequency range for data transmission (600 to 3000 Hz, see Figure 3-6).

3-36. The 3 kHz flat filter has a response that provides much less attenuation to the low frequencies (60 Hz to 500 Hz) than the C-message filter. By comparing a 3 kHz flat noise measurement to a C-message noise measurement, the relative influence of low frequency noise (60 Hz commercial power, 20 Hz ringing, etc.) can be determined (see Figure 3-7).

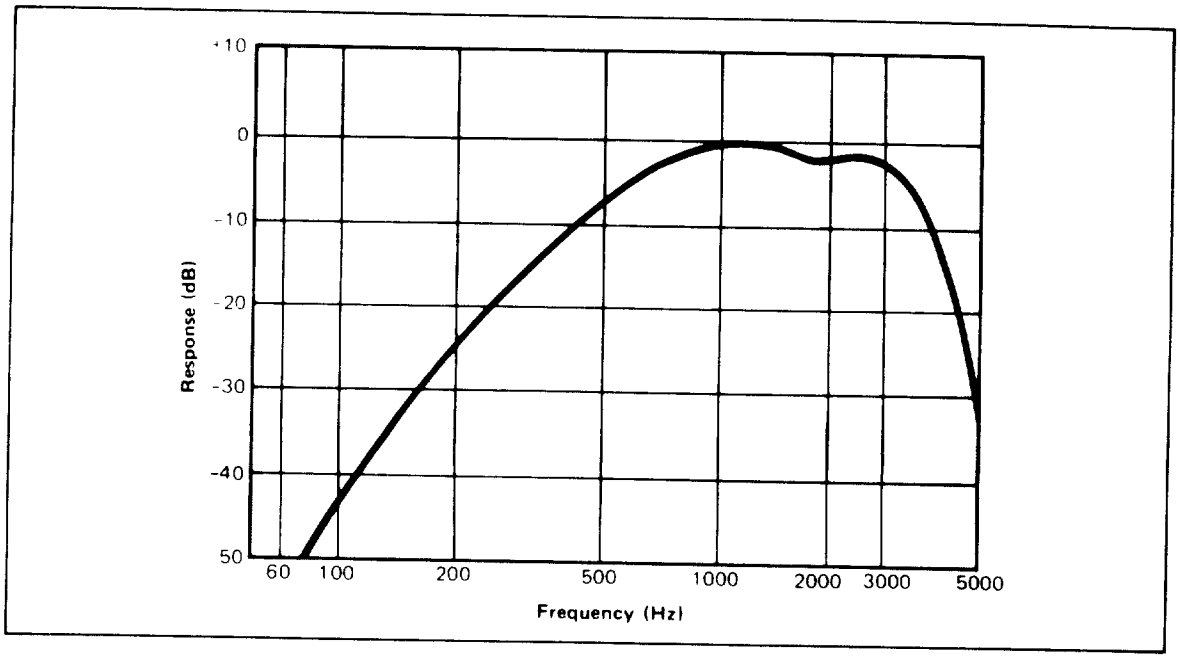


Figure 3-6. C-Message Weighting Characteristic

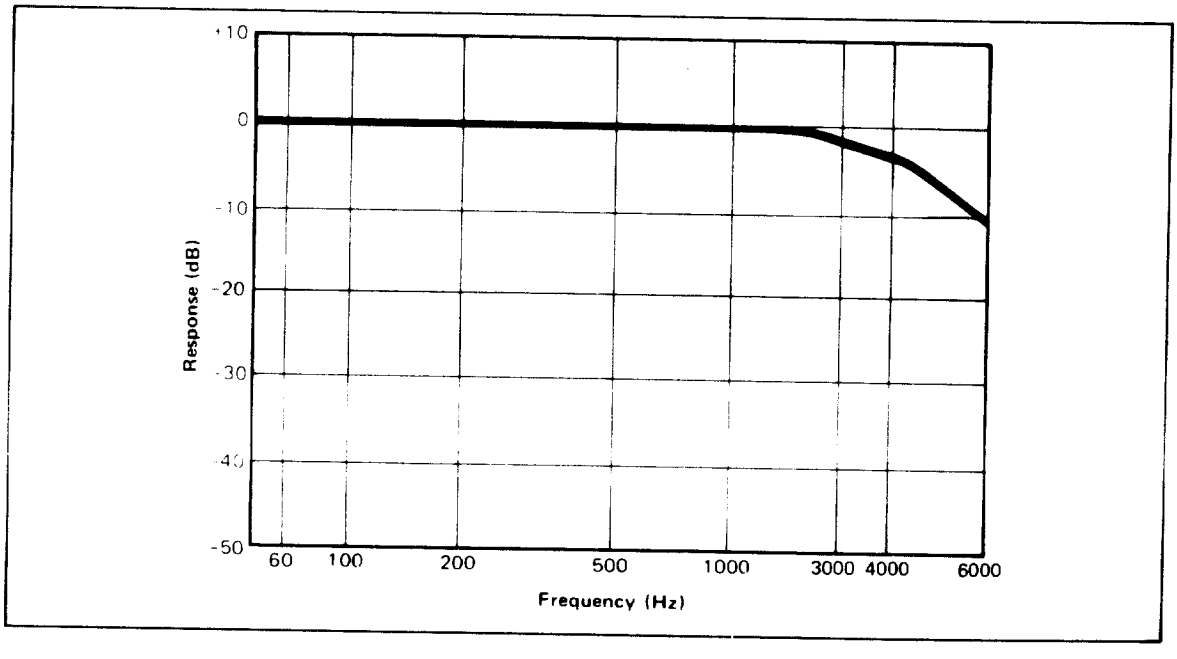


Figure 3-7. 3 kHz Flat Weighting Characteristic

3-37. The program weighted filter is designed for weighted noise measurements on program channels used primarily by the broadcast industry to communicate between studio and transmitter site (see Figure 3-8).

3-38. The 15 kHz flat filter is also designed for measurements on program channels. Like the 3 kHz flat filter, it includes low frequency noise in the measurement (see Figure 3-9).

3-39. The 50 kBit filter is designed to measure weighted noise on wide-band data circuits (see Figure 3-10).

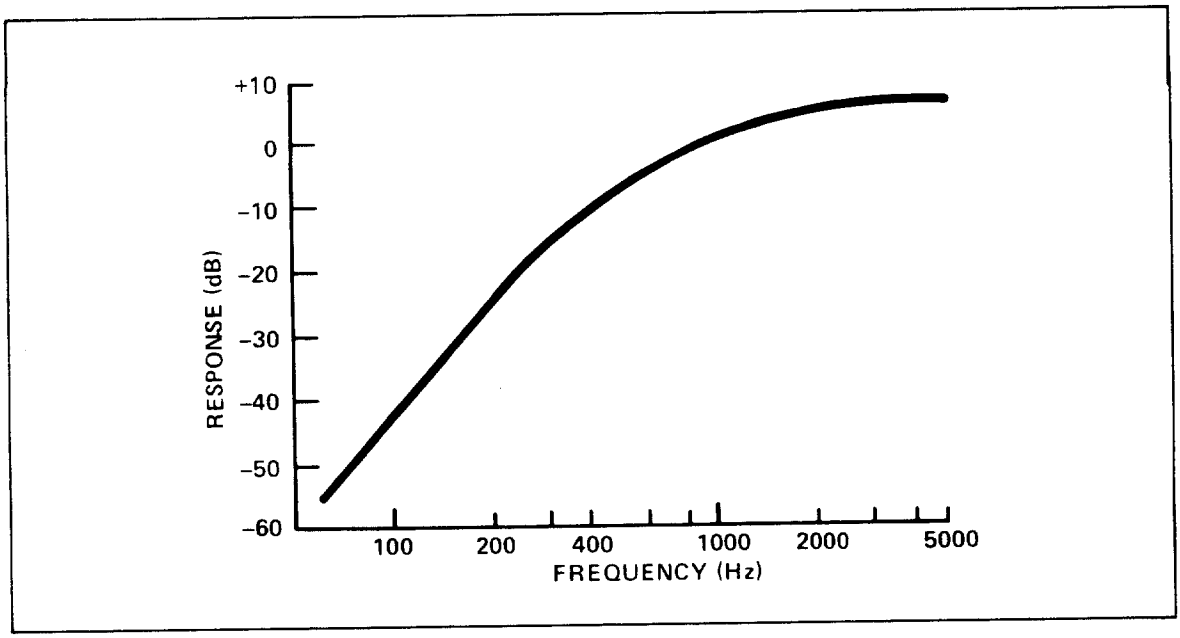


Figure 3-8. Program Weighted Filter

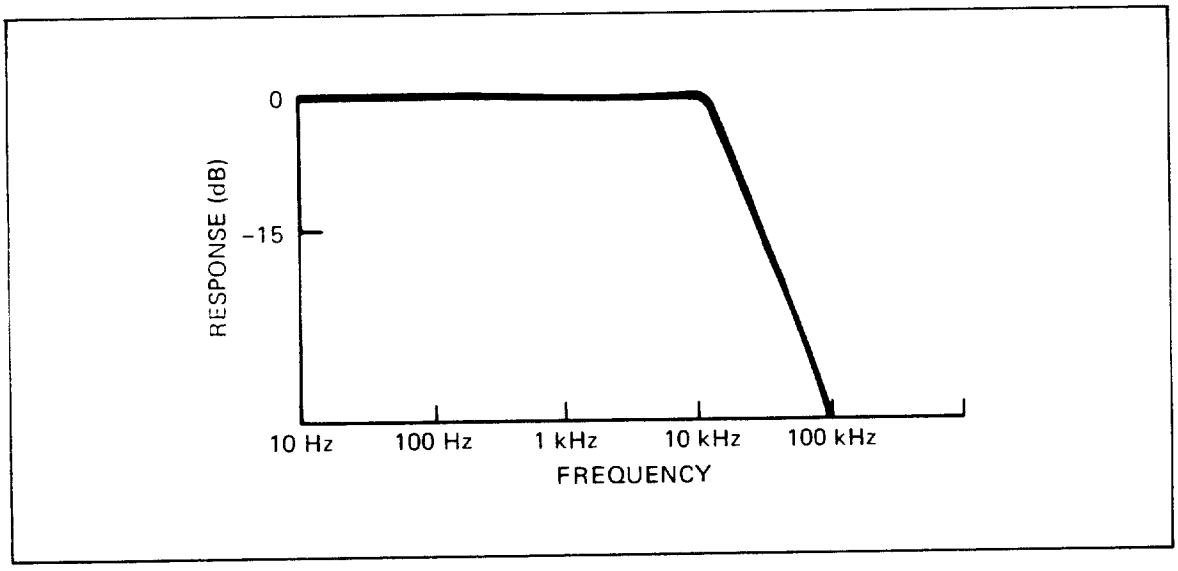


Figure 3-9. 15 kHz Flat Filter

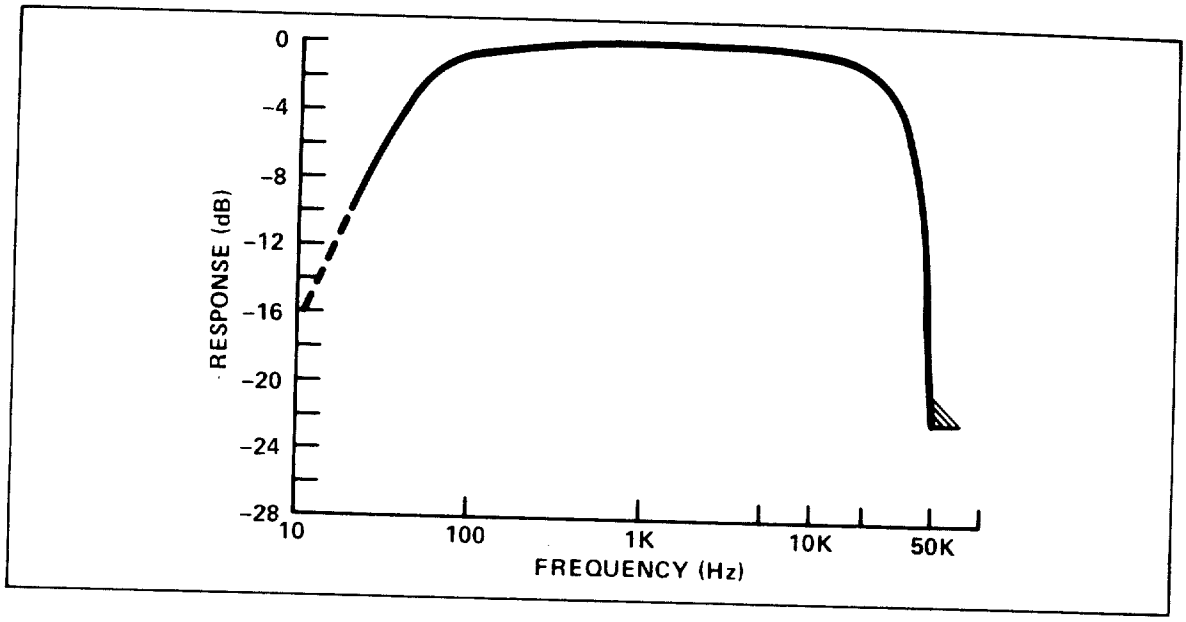


Figure 3-10. 50 kBit Filter

3-40. NOISE MEASUREMENTS

3-41. Received noise levels are displayed in units of dBrn, or dB with respect to reference noise (1000 Hz tone at -90 dBm). For example, a noise reading of 20 dBrn has an RMS power of -70 dBm (20 - 90 = -70). When the C-message filter is selected, readings are displayed in units of dBrn C and the noise level with a C-message weighted measuring device is displayed in dBm.

3-42. NOISE-WITH-TONE (Notched Noise)

3-43. The noise-with-tone measurement technique is used to condition compandors and/or quantizers in the transmission system to their normal operating levels for continuous data signals. Therefore, noise levels are received which duplicate levels present under operating conditions.

3-44. To make this measurement, a 1004 Hz test frequency (holding tone) is transmitted at a data level. At the receiving 4935A, the 1004 Hz holding tone is selectively attenuated by 50 dB using a notch filter (all frequencies between 995 Hz and 1025 Hz are attenuated by 50 dB). The remaining received signal (noise) is passed through a filter for measurement. The received noise level is displayed in units of dBrn. Figure 3-11 illustrates the combination of the C-message weighting and notch filter characteristics. The 4935A combines the notch with any of the five filters.

3-45. SIGNAL-TO-NOISE MEASUREMENT

3-46. The signal-to-noise mode allows measurement of the ratio of received signal-plus-noise power to noise power (S + N N).

3-47. To make this measurement, a 1004 Hz test frequency is transmitted over the line. At the receiving 4935A, the 1004 Hz signal is selectively attenuated by 50 dB in the notch filter, usually C-message weighted. The remaining received signal (noise) is then compared with the original signal-plus-noise signal. The computed signal-to-noise ratio is displayed in units of dB. Figure 3-12 illustrates this measurement. This is one of the most important parameters for determining the quality of a line.

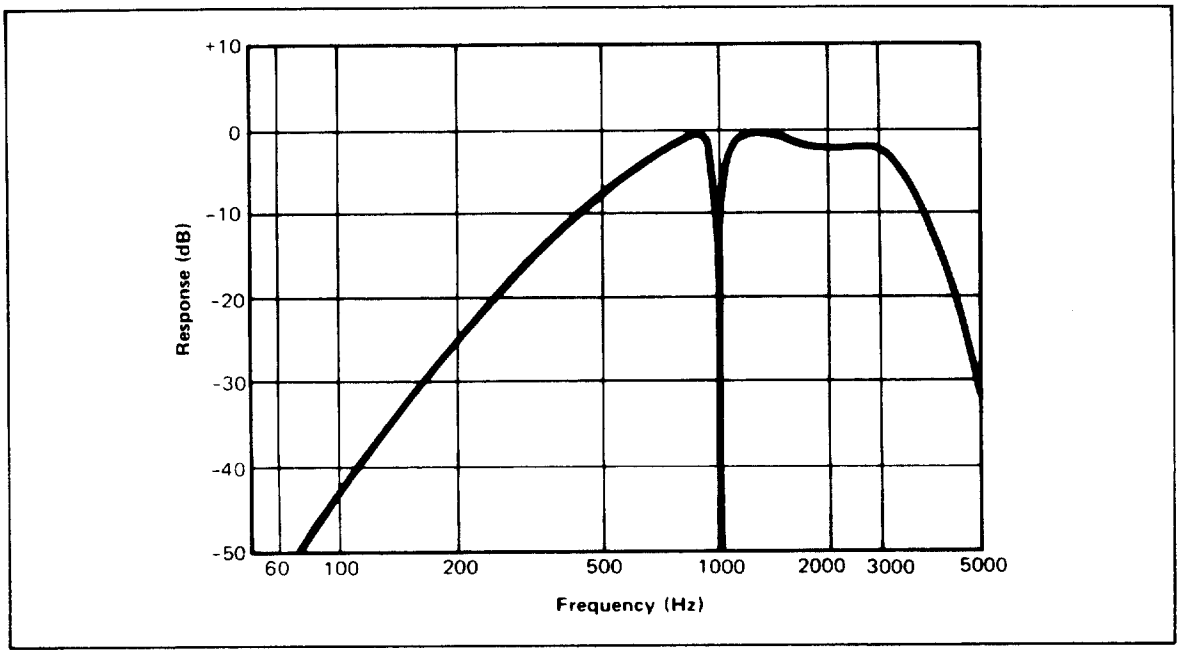


Figure 3-11. C-Message Weighting with Notch Characteristic

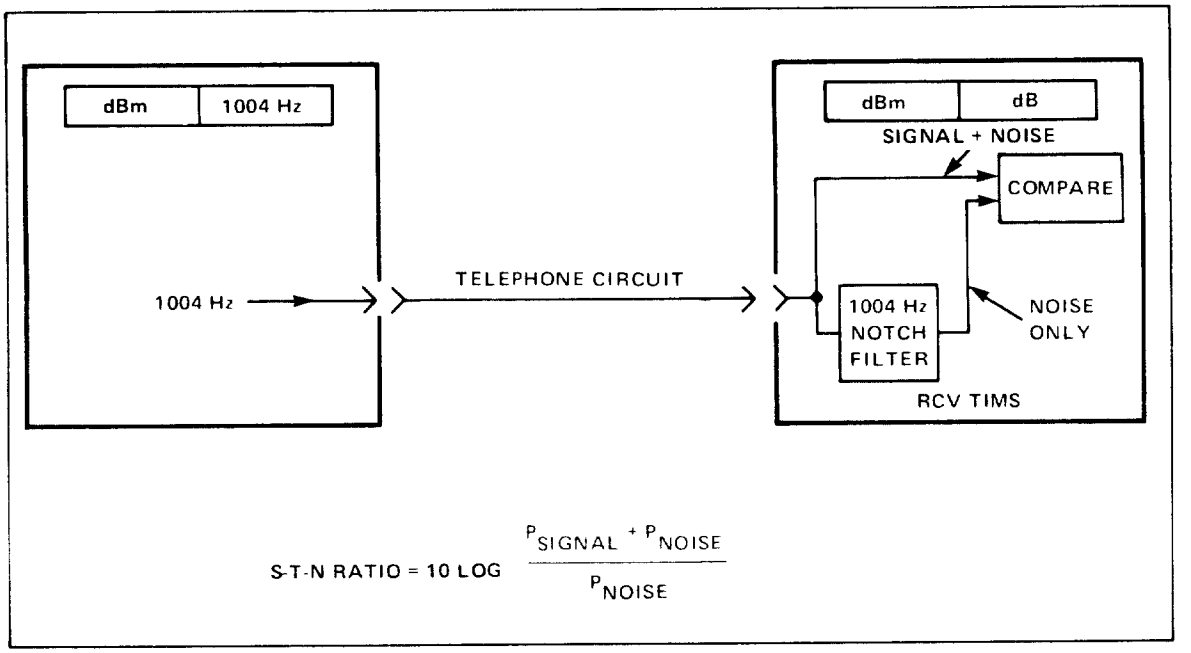


Figure 3-12. Signal-to-Noise Measurement

3-48 SINGLE FREQUENCY INTERFERENCE

3-49. Single frequency interference refers to unwanted steady tones which may appear in lines. Occasional bursts of low level tones which may occur from crosstalk of multifrequency signalling, for example, do not fall in this category. Single frequency tones may interfere with certain data signals, particularly narrowband signals which are multiplexed onto a voiceband channel.

3-50. A simple audio monitoring arrangement will usually detect this interference, since tones exceeding acceptable levels are easily heard if the C-message noise is within limits. The single frequency interference check is made with the setup shown in Figure 3-5. After the received noise signal passes through the C-message filter, the resultant signal is applied to the line monitor speaker. The 4935A operator listens for any predominant tone, which may indicate a single frequency interference problem.

3-51. If a single frequency tone (or tones) of long duration is heard, single frequency interference may be present and should be measured. To determine the frequency and level of the interfering tone, a frequency selective voltmeter or spectrum analyzer must be used. Single frequency interference during a C-message filter measurement occurs if the signal is 3 dB or less below the C-message noise limits.

3-52. IMPULSE NOISE

3-53. The 3-level Impulse Noise Mode measures one of the most important transient phenomena. Transient phenomena can cause data transmission errors and/or interruptions to datacom systems.

3-54. Impulse noise is that component of the received noise signal which is much greater in amplitude than the normal peaks of the message circuit noise. It occurs as short duration spikes and/or bursts of energy. Studies by Bell Telephone laboratories have shown that impulse noise spikes have a duration of less than one millisecond, and that all significant effects of the noise spike disappear within four milliseconds. Waveform (b) in Figure 3-13 illustrates a received holding tone (or test signal) that includes interfering impulse noise spikes. The impulse noise measurement counts the number of noise spikes above a selected threshold level during a specified time period.

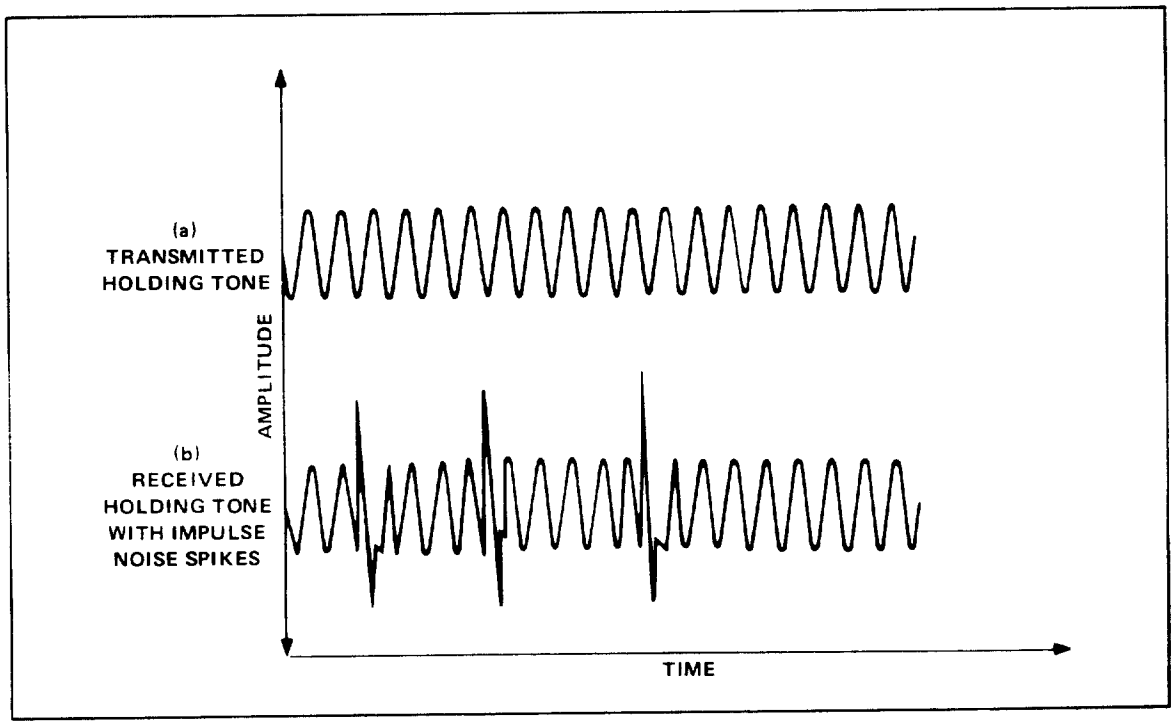


Figure 3-13. Impulse Noise Waveform Representation

3-55. NOISE-TO-GROUND MEASUREMENT

3-56. The 4935A uses noise-to-ground to measure the longitudinal noise present on a telephone circuit, with reference to ground. The transmitting 4935A provides a quiet termination at one end of the voice channel, and the receiving 4935A provides a frequency weighted filter and detector at the other end. The basic measurement technique used for the noise-to-ground measurement is very similar to the message circuit noise measurement; the main difference lies in the use of a ground reference. Figure 3-14 illustrates this difference.

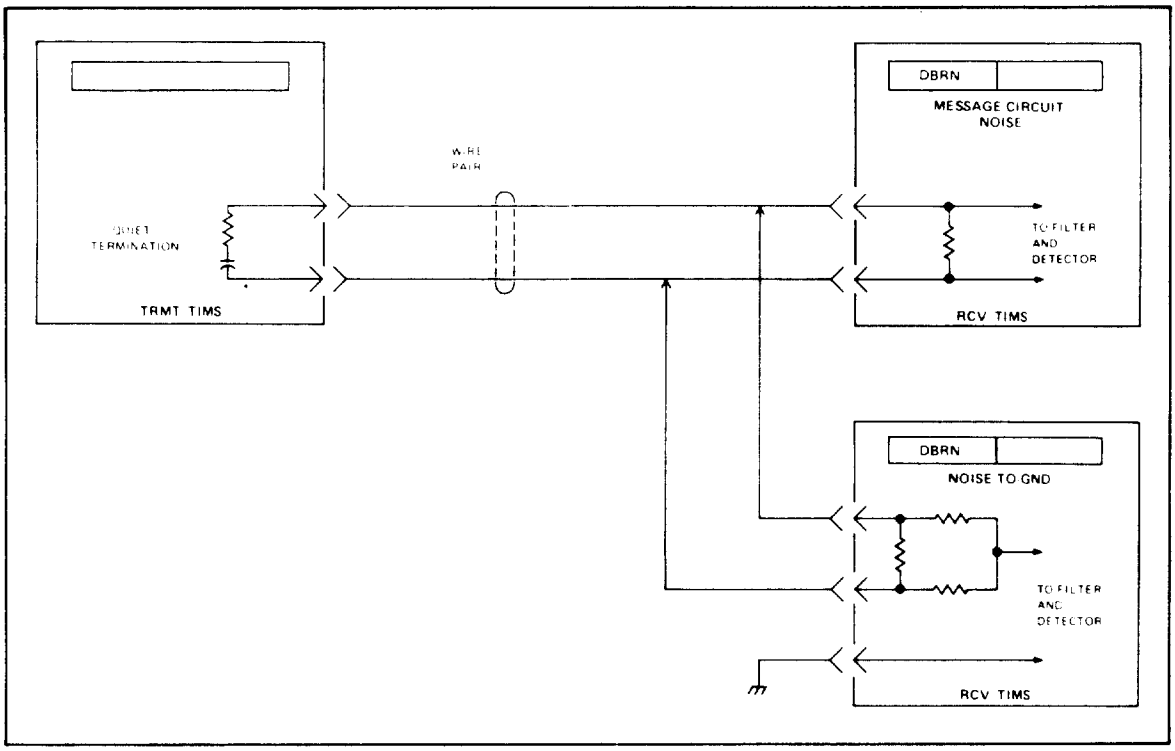


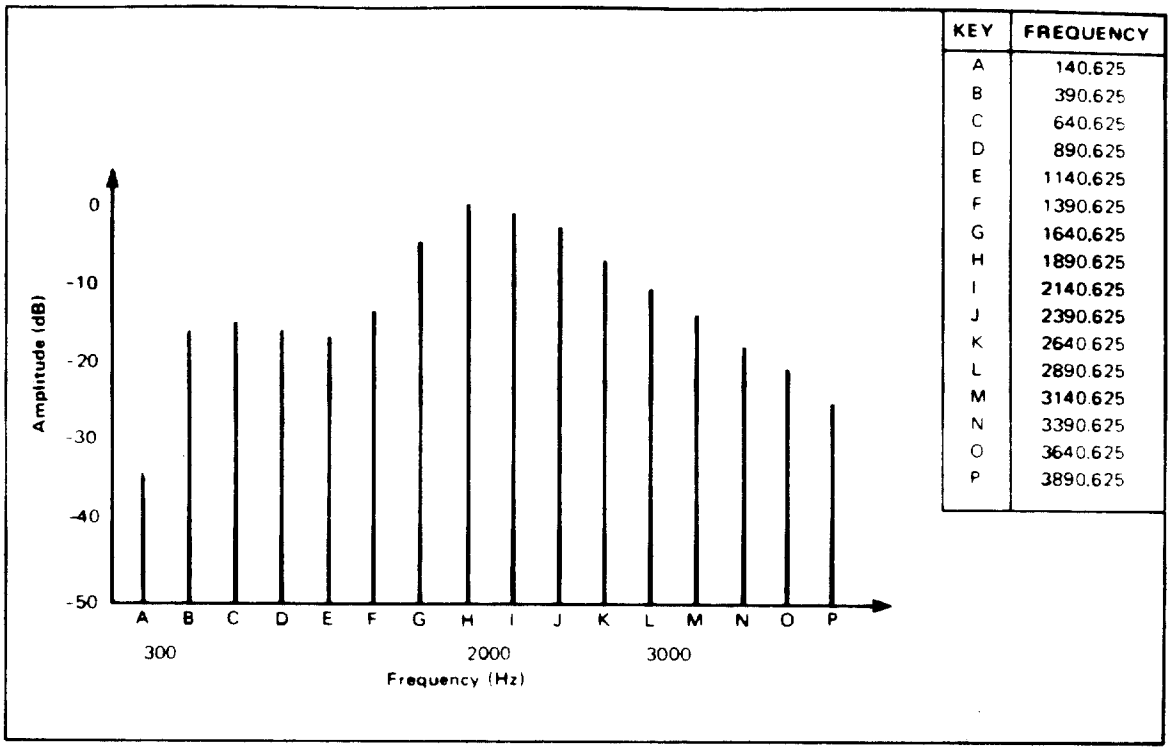
Figure 3-14. Noise-to-Ground Related to Message Circuit Noise

3-57. Noise-to-ground measurements are usually made for troubleshooting purposes; to measure the magnitude of longitudinal signals, which may indicate the susceptibility of a cable pair to electrical coupling from external sources. These measurements are also made to coordinate new installations with power companies, to minimize power line coupling.

3-58. The relative line balance of an end loop can be calculated by subtracting the measured noise-to-ground (N_g) value from the measured message circuit noise (N_m) value. This calculation is only valid if the measurements are made on a twisted pair and it is assumed that the message circuit noise is caused by longitudinal noise converted to message circuit noise by line imbalance. It is recommended that both message circuit noise and noise-to-ground be measured with the 3 kHz flat weighted filter to include the effects of power line related noise.

3-59. PEAK-TO-AVERAGE RATIO MEASUREMENT

3-60. The 4935A uses the peak-to-average ratio (P/AR) to measure the channel dispersion (spreading in time of signal amplitude) due to transmission imperfections. As the P/AR signal traverses a dispersive medium, the peak-to-average ratio will deteriorate. Then by measuring the peak-to-average ratio at the receiving end, a simple measure of dispersion is obtained. P/AR is measured as the ratio of the peak to full-wave rectified average values of a specially processed test signal transmitted over a line. The test signal has a peak-to-average ratio and a spectral content that approximates a data signal. Figure 3-15 illustrates the frequency spectrum of the transmitted P/AR test signal, and Figure 3-16 illustrates the signal envelope.



KEY	FREQUENCY
A	140.625
B	390.625
C	640.625
D	890.625
E	1140.625
F	1390.625
G	1640.625
H	1890.625
I	2140.625
J	2390.625
K	2640.625
L	2890.625
M	3140.625
N	3390.625
O	3640.625
P	3890.625

Figure 3-15. P/AR Transmit Signal Frequency Spectrum

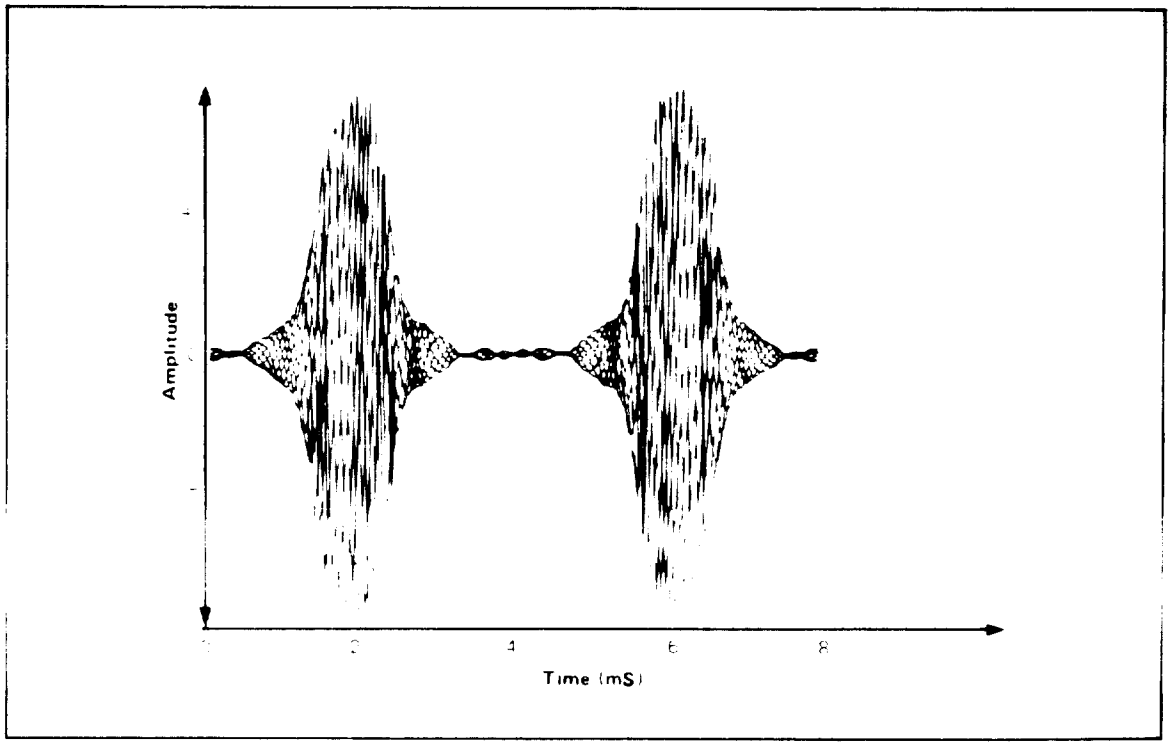


Figure 3-16. P/AR Transmit Signal Envelope

3-61. The P/AR measurement is a single number rating of the fidelity of a voiceband channel and is a weighted measure of the total attenuation, phase distortion, and noise. The P/AR rating is derived by comparing the P/AR of an ideal signal with the P/AR of the output signal of the system under test. The P/AR measurement is most sensitive to envelope delay distortion and is also affected by noise, bandwidth reduction, gain ripples, nonlinearities such as compression and clipping, and other impairments. P/AR is simpler to understand than envelope delay because it is only one number instead of a curve. Also P/AR can be measured in loop-around mode with only one instrument, unlike envelope delay. If the P/AR signal were received entirely undistorted, the P/AR rating would be 100, while a circuit that causes a 10% reduction in the peak-to-average ratio has a P/AR rating of 80.

3-62. The P/AR measurement provides little information about the nature of the fault condition in any particular case. However, since P/AR is a figure of merit for the channel, it can be used as a benchmark for future reference. After other measurements are made and a channel is considered acceptable, the P/AR rating can be recorded for future reference. In case of a suspected trouble on the channel, P/AR may be measured first and be compared to the benchmark P/AR value. Deviations in excess of ±4 P/AR units from an initial P/AR value provides sufficient reason to suspect that some channel characteristic has changed significantly.

SECTION IV
PERFORMANCE TESTS

4-1. INTRODUCTION

4-2. Tests in this section verify instrument specifications. These tests may be used as part of incoming inspection and can be done without accessing the instrument's internal circuits. If the instrument fails the tests, refer to the Service Section.

4-3. EQUIPMENT REQUIRED

4-4. Equipment required for the performance tests is listed in Table 1-2. Test equipment with similar characteristics may be substituted.

4-5. TEST RECORD

4-6. Test results may be recorded on the test record located at the end of this section. Results of tests recorded during incoming inspection can be used for comparison in maintenance, troubleshooting, and following repairs and/or adjustments.

4-7. SELF CHECK

4-8. Self check is automatically done each time the instrument is powered up. Some circuits and filters are tested in addition to all the front panel leds and seven segment displays.

4-9. PERFORMANCE VERIFICATION

4-10. This instrument requires periodic performance verification. Depending on use and operating environment, the instrument should be checked every six months using the performance tests. Performance tests should also be made following repair or when internal adjustments are required.

4-11. To shorten testing time, the abbreviated Performance Tests may be used. The test results do not totally confirm that the instrument meets the published specifications. Perform the full test to verify that instrument's performance completely meets the specifications.

PERFORMANCE TESTS

4-12. PERFORMANCE TESTS

4-13. Transmitter Flatness at +10 dBm

SETUP:

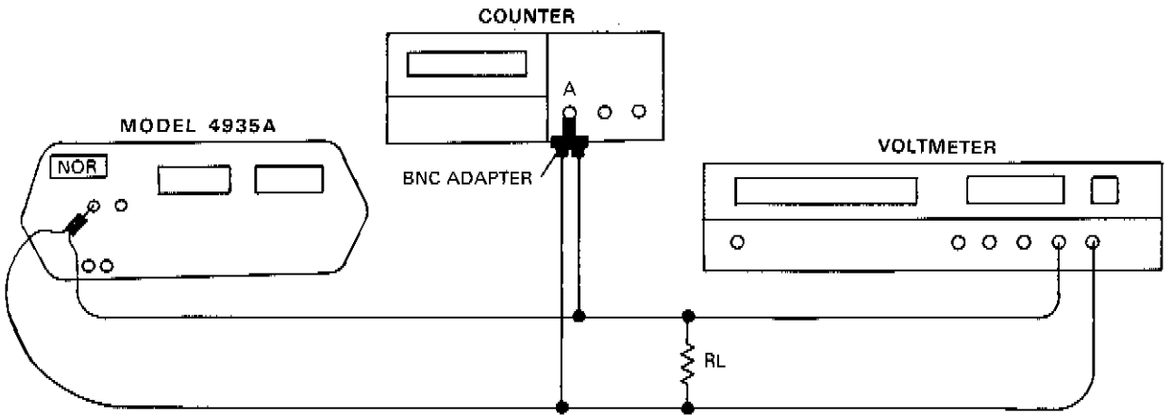


Figure 4-1. Transmitter Flatness Test at +10 dBm

EQUIPMENT:

Fluke 5200A AC Calibrator	BNC to 310 adapter
HP 5315 Counter	2 BNC cables
HP 3490A Multimeter	BNC "T" connectors
20 dB Amp (circuit shown in Figure 4-13)	600 ohm termination
	1 BNC to banana cable

1. Connect Voltmeter to the 4935A TRMT jack as shown in Figure 4-1.

2. On 4935A select:

   POWER ..... ON
   DISPLAY ..... TRMT
   SET UP ..... press in TRMT 600Ω
   MEASUREMENT ..... LEVEL FREQUENCY

3. Set the 4935A to 1004 Hz.

4. Adjust 4935A OUTPUT LEVEL until 2.435 Vrms (9.95 dBm into 600 ohms) appears on the Voltmeter (note: 4935A must be terminated as shown above.

5. Check the 4935A transmitter at the frequencies listed in Table 4-1.

6. At 85 kHz verify that the 4935A frequency when measured with the counter is between 84.996 kHz and 85.004 kHz.

PERFORMANCE TESTS

Table 4-1. Transmitter Flatness at +10 dBm

FREQUENCY	ACCEPTABLE VOLTAGE RANGE
20 Hz	2.17 to 2.73 Vrms
200 Hz	2.38 to 2.49 Vrms
5 kHz	2.38 to 2.49 Vrms
15 kHz	2.38 to 2.49 Vrms
30 kHz	2.30 to 2.58 Vrms
60 kHz	2.30 to 2.58 Vrms
85 kHz	2.25 to 2.64 Vrms

ABBREVIATED TRANSMITTER FLATNESS AT +10 dBm TEST
See the Abbreviated Transmitter Flatness Test.

PERFORMANCE TESTS

4-14. Transmitter Flatness at –40 dBm

SETUP:

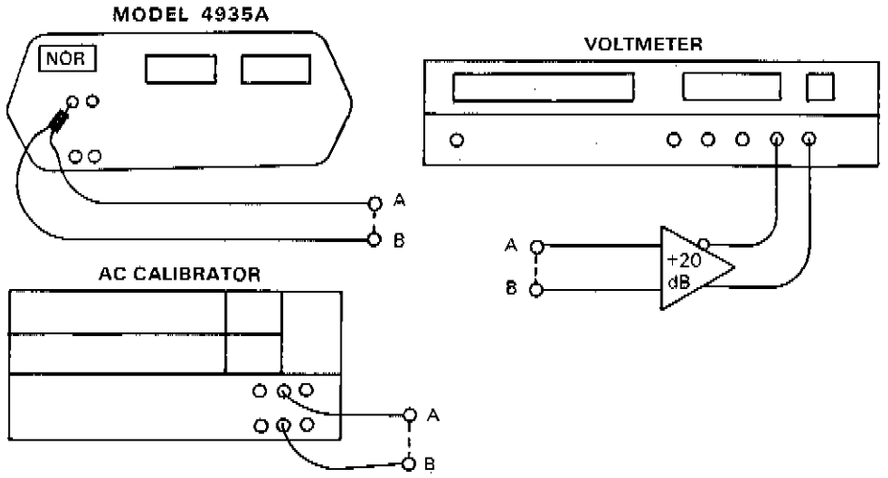


Figure 4-2. Transmitter Flatness Test at –40 dBm

EQUIPMENT:

Fluke 5200A AC Calibrator	310 to banana adapter
+20 dB amplifier (see figure 4-13)	2 banana plug test cables
HP 6234A Dual Output Power Supply	HP 3490A Multimeter

1. Set up the 4935A as follows:

POWER	ON
DISPLAY	TRMT
NOR	press in
SET UP	press in TRMT 600Ω
	BRG out
	DIAL out
	both HOLDs out
MEASUREMENT	LEVEL FREQUENCY
IMPULSE NOISE	press DISPLAY (1004 Hz)

2. Adjust the Power Supply to provide ±12 V to the +20 dB Amplifier

3. Set the AC Calibrator and the 4935A to exactly –40 dBm as follows.
   a. Set the AC Calibrator to 7.746 mV (–40 dBm into 600 ohms) at 1004 Hz with the output floating.

   b. Connect the AC Calibrator to the +20 dB amplifier input. Record the amplifier output voltage.

   c. Connect the +20 dB amplifier input to the 4935A TRMT 310 jack. Monitor the +20 amplifier output with the voltmeter.

   d. Adjust the 4935A OUTPUT LEVEL control until the voltmeter reading is the same as the +20 dB amplifier output voltage in step b. The AC Calibrator and the 4935A are both set to exactly –40 dBm.
   NOTE: A 600 ohm termination is provided by the +20 dB amplifier in the Diagnostic Service Kit and must be added if a high impedance amplifier is used.

PERFORMANCE TESTS

4. Do not change –40 dBm setting on the AC Calibrator or the 4935A OUTPUT LEVEL settings during the rest of this test.

5. Connect the AC Calibrator to the +20 dB amplifier input.

   a. Set the AC Calibrator to 20 Hz.

   b. Record the voltage.

   c. From Table 4-2 locate the horizontal voltage line closest to the recorded voltage reading. Use this voltage line (see example).
   EXAMPLE: If the Voltmeter reading is 71.0 mV, locate the 71.0 mV line from the V_{out} column of Table 4-2. Locate the 20 Hz frequency column. The allowable voltage reading, when the AC Calibrator is substituted by the 4935A transmitter, is 79.7 mV to 63.3 mV.

6. Substitute the 4935A TRMT output in place of the AC Calibrator. Use the STEP UP or STEP DOWN buttons in conjunction with the – or – buttons to set the 4935A TRMT frequency to 20 Hz (do not adjust the OUTPUT LEVEL).

7. From Table 4-2, locate the voltage line identified in Step 3. In the vertical frequency column (frequency under test) identify the allowable voltage range. Verify that the +20 dB amplifier output is in this range.

8. Repeat Steps 3 to 5 for each frequency column of Table 4-2 (20 Hz through 85 kHz).

Table 4-2. Transmitter Flatness at –40 dBm

Vout (in mV)	±1.0 dB 20 Hz	±0.5 dB 50 Hz	±0.2 dB 200 Hz & ±0.2 dB 15 kHz	±0.5 dB 60 kHz	±0.5 dB 85 kHz
65.0	72.9 to 57.9	68.9 to 61.4	66.5 to 63.5	68.9 to 61.4	68.9 to 61.4
65.4	73.4 to 58.3	69.3 to 61.7	66.9 to 63.9	69.3 to 61.7	69.3 to 61.7
65.8	73.8 to 58.6	69.7 to 62.1	67.3 to 64.3	69.7 to 62.1	69.7 to 62.1
66.2	74.3 to 59.0	70.1 to 62.5	67.7 to 64.7	70.1 to 62.5	70.1 to 62.5
66.6	74.7 to 59.4	70.5 to 62.9	68.2 to 65.1	70.5 to 62.9	70.5 to 62.9
67.0	75.2 to 59.7	71.0 to 63.3	68.6 to 65.5	71.0 to 63.3	71.0 to 63.3
67.4	75.6 to 60.1	71.4 to 63.6	69.0 to 65.9	71.4 to 63.6	71.4 to 63.6
67.8	76.1 to 60.4	71.8 to 64.0	69.4 to 66.3	71.8 to 64.0	71.8 to 64.0
68.2	76.5 to 60.8	72.2 to 64.4	69.8 to 66.6	72.2 to 64.4	72.2 to 64.4
68.6	77.0 to 61.1	72.7 to 64.8	70.2 to 67.0	72.7 to 64.8	72.7 to 64.8
69.0	77.4 to 61.5	73.1 to 65.1	70.6 to 67.4	73.1 to 65.1	73.1 to 65.1
69.4	77.9 to 61.9	73.5 to 65.5	71.0 to 67.8	73.5 to 65.5	73.5 to 65.5
69.8	78.3 to 62.2	73.9 to 65.9	71.4 to 68.2	73.9 to 65.9	73.9 to 65.9
70.2	78.8 to 62.6	74.4 to 66.3	71.8 to 68.6	74.4 to 66.3	74.4 to 66.3
70.6	79.2 to 62.9	74.8 to 66.7	72.2 to 69.0	74.8 to 66.7	74.8 to 66.7
71.0	79.7 to 63.3	75.2 to 67.0	72.7 to 69.4	75.2 to 67.0	75.2 to 67.0
71.4	80.1 to 63.6	75.6 to 67.4	73.1 to 69.8	75.6 to 67.4	75.6 to 67.4
71.8	80.6 to 64.0	76.1 to 67.8	73.5 to 70.2	76.1 to 67.8	76.1 to 67.8
72.2	81.0 to 64.3	76.5 to 68.2	73.9 to 70.6	76.5 to 68.2	76.5 to 68.2
72.6	81.5 to 64.7	76.9 to 68.5	74.3 to 70.9	76.9 to 68.5	76.9 to 68.5
73.0	81.9 to 65.1	77.3 to 68.9	74.7 to 71.3	77.3 to 68.9	77.3 to 68.9
73.4	82.4 to 65.4	77.7 to 69.3	75.1 to 71.7	77.7 to 69.3	77.7 to 69.3
73.8	82.8 to 65.8	78.2 to 69.7	75.5 to 72.1	78.2 to 69.7	78.2 to 69.7
74.2	83.3 to 66.1	78.6 to 70.0	75.9 to 72.5	78.6 to 70.0	78.6 to 70.0
74.6	83.7 to 66.5	79.0 to 70.4	76.3 to 72.9	79.0 to 70.4	79.0 to 70.4

PERFORMANCE TESTS

Table 4-2. Transmitter Flatness at −40 dBm (Cont'd)

Vout (in mV)	±1.0 dB 20 Hz	±0.5 dB 50 Hz	±0.2 dB 200 Hz & ±0.2 dB 15 kHz	±0.5 dB 60 kHz	±0.5 dB 85 kHz
75.0	84.2 to 66.8	79.4 to 70.8	76.7 to 73.3	79.4 to 70.8	79.4 to 70.8
75.4	84.6 to 67.2	79.9 to 71.2	77.2 to 73.7	79.9 to 71.2	79.9 to 71.2
75.8	85.0 to 67.6	80.3 to 71.6	77.6 to 74.1	80.3 to 71.6	80.3 to 71.6
76.2	85.5 to 67.9	80.7 to 71.9	78.0 to 74.5	80.7 to 71.9	80.7 to 71.9
76.6	85.9 to 68.3	81.1 to 72.3	78.4 to 74.9	81.1 to 72.3	81.1 to 72.3
77.0	86.4 to 68.6	81.6 to 72.7	78.8 to 75.2	81.6 to 72.7	81.6 to 72.7
77.4	86.8 to 69.0	82.0 to 73.1	79.2 to 75.6	82.0 to 73.1	82.0 to 73.1
77.8	87.3 to 69.3	82.4 to 73.4	79.6 to 76.0	82.4 to 73.4	82.4 to 73.4
78.2	87.7 to 69.7	82.8 to 73.8	80.0 to 76.4	82.8 to 73.8	82.8 to 73.8
78.6	88.2 to 70.1	83.3 to 74.2	80.4 to 76.8	83.3 to 74.2	83.3 to 74.2
79.0	88.6 to 70.4	83.7 to 74.6	80.8 to 77.2	83.7 to 74.6	83.7 to 74.6
79.4	89.1 to 70.8	84.1 to 75.0	81.2 to 77.6	84.1 to 75.0	84.1 to 75.0
79.8	89.5 to 71.1	84.5 to 75.3	81.7 to 78.0	84.5 to 75.3	84.5 to 75.3
80.2	90.0 to 71.5	85.0 to 75.7	82.1 to 78.4	85.0 to 75.7	85.0 to 75.7
80.6	90.4 to 71.8	85.4 to 76.1	82.5 to 78.8	85.4 to 76.1	85.4 to 76.1
81.0	90.9 to 72.2	86.8 to 76.5	82.9 to 79.2	85.8 to 76.5	85.8 to 76.5
81.4	91.3 to 72.5	86.2 to 76.8	83.3 to 79.5	86.2 to 76.8	86.2 to 76.8
81.8	91.8 to 72.9	86.6 to 77.2	83.7 to 79.9	86.6 to 77.2	86.6 to 77.2
82.2	92.2 to 73.3	87.1 to 77.6	84.1 to 80.3	87.1 to 77.6	87.1 to 77.6
82.6	92.7 to 73.6	87.5 to 78.0	84.5 to 80.7	87.5 to 78.0	87.5 to 78.0
83.0	93.1 to 74.0	87.9 to 78.4	84.9 to 81.1	87.9 to 78.4	87.9 to 78.4
83.4	93.6 to 74.3	88.3 to 78.7	85.3 to 81.5	88.3 to 78.7	88.3 to 78.7
83.8	94.0 to 74.7	88.8 to 79.1	85.8 to 81.9	88.8 to 79.1	88.8 to 79.1
84.2	94.5 to 75.0	89.2 to 79.5	86.2 to 82.3	89.2 to 79.5	89.2 to 79.5
84.6	94.9 to 75.4	89.6 to 79.9	86.6 to 82.7	89.6 to 79.9	89.6 to 79.9
85.0	95.4 to 75.8	90.0 to 80.2	87.0 to 83.1	90.0 to 80.2	90.0 to 80.2
85.4	95.8 to 76.1	90.5 to 80.6	87.4 to 83.5	90.5 to 80.6	90.5 to 80.6
85.8	96.3 to 76.5	90.9 to 81.0	87.8 to 83.8	90.9 to 81.0	90.9 to 81.0
86.2	96.7 to 76.8	91.3 to 81.4	88.2 to 84.2	91.3 to 81.4	91.3 to 81.4
86.6	97.2 to 77.2	91.7 to 81.8	88.6 to 84.6	91.7 to 81.8	91.7 to 81.8
87.0	97.6 to 77.5	92.2 to 82.1	89.0 to 85.0	92.2 to 82.1	92.2 to 82.1
87.4	98.1 to 77.9	92.6 to 82.5	89.4 to 85.4	92.6 to 82.5	92.6 to 82.5
87.8	98.5 to 78.3	93.0 to 82.9	89.8 to 85.8	93.0 to 82.9	93.0 to 82.9
88.2	99.0 to 78.6	93.4 to 83.3	90.3 to 86.2	93.4 to 83.3	93.4 to 83.3
88.6	99.4 to 79.0	93.8 to 83.6	90.7 to 86.6	93.8 to 83.6	93.8 to 83.6
89.0	99.9 to 79.3	94.3 to 84.0	91.1 to 87.0	94.3 to 84.0	94.3 to 84.0
89.4	100.3 to 79.7	94.7 to 84.4	91.5 to 87.4	94.7 to 84.4	94.7 to 84.4
89.8	100.8 to 80.0	95.1 to 84.8	91.9 to 87.8	95.1 to 84.8	95.1 to 84.8
90.2	101.2 to 80.4	95.5 to 85.2	92.3 to 88.1	95.5 to 85.2	95.5 to 85.2
90.6	101.7 to 80.7	96.0 to 85.5	92.7 to 88.5	96.0 to 85.5	96.0 to 85.5
91.0	102.1 to 81.1	96.4 to 85.9	93.1 to 88.9	96.4 to 85.9	96.4 to 85.9
FACTOR	1.12202 to .89125	1.05925 to .94406	1.02329 to .97724	1.05925 to .94406	1.05925 to .94406

PERFORMANCE TESTS

ABBREVIATED TRANSMITTER FLATNESS TEST

1. Use test setup shown in Figure 4-2.

2. Set up the 4935A as follows:

POWER ..... ON
DISPLAY ..... TRMT
NOR ..... press in
SET UP ..... press in TRMT 600Ω
BRG out
DIAL out
both HOLDs out
MEASUREMENT ..... LEVEL FREQUENCY
IMPULSE NOISE ..... press DISPLAY (1004 Hz)

3. Adjust the 4935A OUTPUT LEVEL until 0.775 V (0 dBm) appears on the Voltmeter.

4. Check the 4935A transmitter at the frequencies given in Table 4-3.

Table 4-3. Abbreviated Transmitter Flatness

FREQUENCY	VOLTAGES (VRMS)	
	MIN	MAX
20 Hz	.690	.869
200 Hz	.757	.793
15 kHz	.757	.793
85 kHz	.731	.820
110 kHz	.652	.920

PERFORMANCE TESTS

4-15. RECEIVER ACCURACY at +11 dBm and –40 dBm

SETUP:

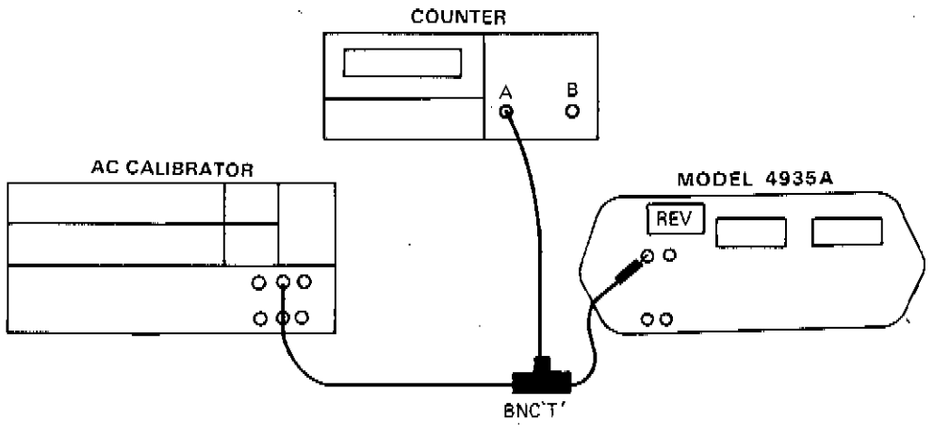


Figure 4-3. Receiver Test at +11 dBm and –40 dBm

EQUIPMENT:

Fluke 5200A AC Calibrator	3 BNC cables
HP 5313B Frequency Counter	2 BNC to banana cables
310 to BNC adapter	1 banana plug cable
BNC "T"	

1. Connect the AC Calibrator to the 4935A RCV jack as shown in Figure 4-4.

2. Setup the 4935A as follows:

POWER	ON
DISPLAY	RCV
REV	press in
SET UP	press in RCV 600Ω
	press in BRG
MEASUREMENT	LEVEL FREQUENCY

RECEIVER ACCURACY AT +11 dBm

1. Set AC Calibrator output to 2.733 V (+10.95 dBm into 600 ohms; the 0.05 dB offset checks for round off errors in the 4935A).

2. The 4935A level and frequency displays should be within the limits shown in Table 4-3.

RECEIVER ACCURACY AT –40 dBm

1. Set the AC Calibrator output to 7.702 mV (–40.05 dBm into 600 ohms).

2. The 4935A level display should be within the limits shown in Table 4-4.

PERFORMANCE TESTS

Table 4-4. Receiver Accuracy Test Table

FREQUENCY (MONITOR AT COUNTER)	+11 DBM	−40 DBM	FREQUENCY TOLERENCE
20 Hz	10.0 to 11.9	−41.0 to −39.1	±1 Hz
50 Hz	10.5 to 11.4	−40.5 to −39.6	±1 Hz
200 Hz	10.8 to 11.1	−40.2 to −39.9	±1 Hz
500 Hz	10.8 to 11.1	−40.2 to −39.9	±1 Hz
1000 Hz	10.9 to 11.0	−40.2 to −39.9	±1 Hz
5000 Hz	10.8 to 11.1	−40.2 to −39.9	±1 Hz
15000 Hz	10.8 to 11.1	−40.2 to −39.9	±1 Hz
30000 Hz	10.5 to 11.4	−40.5 to −39.6	±.01 kHz
50000 Hz	10.5 to 11.4	−40.5 to −39.6	±.01 kHz
85000 Hz	10.5 to 11.4	−40.5 to −39.6	±.01 kHz
110000 Hz	9.0 to 12.9	−42.0 to −38.1*	±.01 kHz

ABBREVIATED RECEIVER ACCURACY TEST

1. Use the test setup shown in Figure 4-3.
2. Set the AC Calibrator to .7791 V (−0.05 dBm into 600 ohms).
3. Test the 4935A at each frequency given in Table 4-5.

Table 4-5. Abbreviated Receiver Accuracy Test Table

FREQUENCY	LEVEL (0.7791 V)	FREQUENCY TOLERANCE
20 Hz	−1.0 to +0.9 dBm	±1 Hz
50 Hz	−0.5 to +0.4 dBm	±1 Hz
200 Hz	−0.2 to +0.1 dBm	±1 Hz
15 kHz	−0.2 to +0.1 dBm	±.01 kHz
85 kHz	−0.5 to +0.5 dBm	±.01 kHz
110 kHz	−2.0 to +1.9 dBm*	±.01 kHz

*For instruments with serial prefix 2207A and below refer to Section VII Manual Changes backdating information.

PERFORMANCE TESTS

4-16. Autorange Test

SETUP:

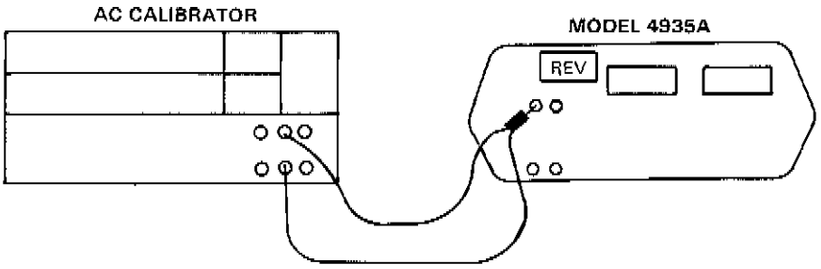


Figure 4-4. Autorange Test

EQUIPMENT:

Fluke 5200A AC Calibrator
1 banana plug test cable
1 BNC to banana adapter

1. Connect equipment as shown in Figure 4-4. On 4935A select:

   POWER ..... ON
   DISPLAY ..... RCV
   SET UP ..... press RCV 600Ω
   MEASUREMENT ..... LEVEL FREQUENCY

2. Set the AC Calibrator to 1000 Hz.

3. For each voltage and range in Table 4-6 check that the display is within acceptable limits.

Table 4-6. Autorange Test

AC CALIBRATOR VOLTAGE	DISPLAY
.86911 V	0.9 to 1.1
.086911 V	−19.1 to −18.9
.0086911 V	−39.2 to −38.8
.00086911 V	−59.4 to −58.6
2.7484 V	+10.9 to +11.1
0.27484 V	− 9.1 to − 8.9
0.027484 V	−29.2 to −28.8
0.0027484 V	−49.4 to −48.6

ABBREVIATED AUTORANGE TEST

There is no abbreviated Autorange Test.

PERFORMANCE TESTS

4-17. Filter Tests

SETUP:

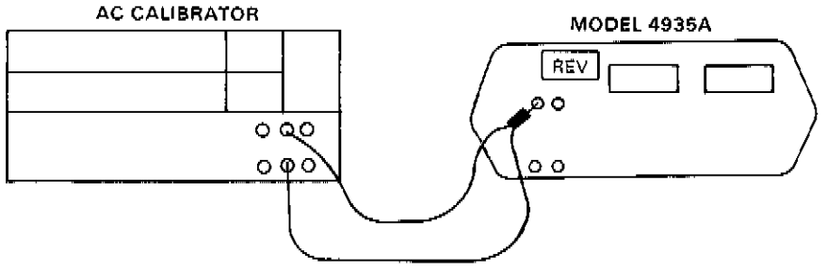


Figure 4-5. Filter Tests

EQUIPMENT:

Fluke 5200A AC Calibrator
1 BNC to dual banana test cable
1 BNC to 310 adapter

GENERAL PROCEDURE

1. Connect equipment as shown in Figure 4-5.

2. Set AC Calibrator to .775 V (0.0 dBm across 600 ohms).

3. On 4935A select:

POWER ..... ON
DISPLAY ..... RCV
SETUP ..... RCV 600Ω
MEASUREMENT ..... NOISE
FILTER ..... select according to test

C-MESSAGE FILTER

1. Select the C-MESSAGE filter on 4935A.

2. Check the response at each frequency in Table 4-7. The 4935A should be within the range given.

Table 4-7. C-Message Filter Test

FREQUENCY (in Hz)	RECEIVED LEVEL (dBrn) ACCEPTABLE READINGS
300	73-74
900	89-90
1000	90
2500	88-89
3000	87-88
4500	66-71

PERFORMANCE TESTS

3 kHZ FLAT FILTER TEST

1. Select the 3 kHz FLAT Filter on the 4935A.

2. Check the response at each frequency in Table 4-8. The 4935A display should be within the range given.

Table 4-8. 3 kHz Flat Filter Test

FREQUENCY (in Hz)	RECEIVED LEVEL (dBrn) ACCEPTABLE READINGS
1000	90
3000	86-88
6000	75-80

15 kHZ FLAT FILTER TEST

1. Select the 15 kHz FLAT Filter on the 4935A.

2. Check the response at each frequency in Table 4-9. The 4935A display should be within the range given.

Table 4-9. 15 kHz Flat Filter Test

FREQUENCY (in Hz)	RECEIVED LEVEL (dBrn) ACCEPTABLE READINGS
1000	90
15000	86-88
30000	75-80

PROGRAM FILTER TEST

1. Select the PROGRAM filter on the 4935A.

2. Check the response at each frequency in Table 4-10. The 4935A display should be within the range given.

Table 4-10. Program Filter Test

FREQUENCY (in Hz)	RECEIVED LEVEL (dBrn) ACCEPTABLE READINGS
100	62-65
500	83-84
1000	90
2000	94-95
5000	95-98
10000	78-85

PERFORMANCE TESTS

50 kBIT FILTER TEST

1. Select the 50 kBIT filter on the 4935A.

2. Check the response at each frequency in Table 4-11. The 4935A display should be within the range given.

NOTE

Test must be performed in sequence given.

Table 4-11. 50 kBIT Filter Test

FREQUENCY (in Hz)	RECEIVED LEVEL (dBrn) ACCEPTABLE READINGS
1000	90
15000	89-90
25000	87-88
35000	84-86
50000	62-67

NOTCH FILTER TEST

1. Select the 15 kHz filter and NOISE WITH TONE measurement on the 4935A.

2. Check the response at each frequency in Table 4-12. The 4935A display should be within the range given.

Table 4-12. Notch Filter Test

FREQUENCY (in Hz)	RECEIVED LEVEL (dBrn) ACCEPTABLE READINGS
400	90
862	≥88
1000	<40
1020	<40
1182	≥88
1700	90

ABBREVIATED FILTER TEST

There is no abbreviated Filter Test.

PERFORMANCE TESTS

4-18. IMPULSE NOISE DAC TEST

SETUP:

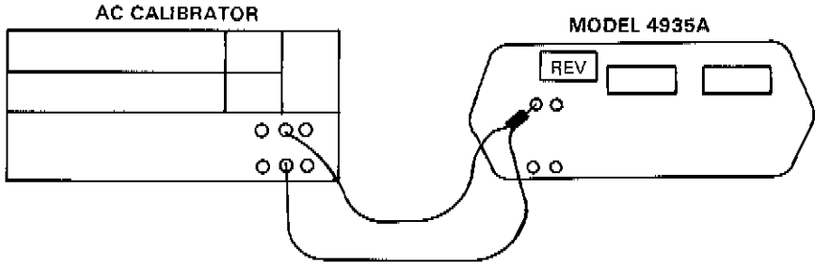


Figure 4-6. Impulse Noise DAC Test

EQUIPMENT:

Fluke 5200A AC Calibrator
1 BNC to dual banana test cable
1 310 to BNC adapter

1. Connect equipment as shown in Figure 4-6.

2. On 4935A select:

POWER	ON
DISPLAY	RCV
SET UP	press both 600Ω buttons
MEASUREMENT	IMPULSE NOISE
FILTER	15 kHz FLAT Filter
IMPULSE NOISE	press PERIOD to select NON-STOP press DISPLAY to select LOW(SET) press START/RESET
Left display	adjust threshold to 90 dBrn

3. Set AC Calibrator signal source to 2 kHz at the levels given in Table 4-13 (start with 0.580 V).

4. The 4935A should start counting.

5. Raise the 4935A LOW THRESHOLD BY 1 dBrn.

6. The 4935A display should stop counting.

7. Repeat steps 3 through 6 for each level shown in Source in Volts Table 4-13.

8. Set the LOW(SET) threshold to 90 dBrn (0 dBm).

9. Press DISPLAY in IMPULSE NOISE to select MID threshold.

10. Set the AC Calibrator to 0.820 V; the 4935A display should not count.

11. Set the AC Calibrator to 0.920 V; the 4935A display should count.

12. Press DISPLAY in IMPULSE NOISE to select HIGH threshold.

13. Set the AC Calibrator to 1.299 V; the 4935A display should not count.

14. Set the AC Calibrator to 1.457 V; the 4935A display should count.

PERFORMANCE TESTS

Table 4-13. Impulse Noise DAC Test

AC CALIBRATOR VOLTAGE	PEAK SIGNAL IN dBm	COUNTING THRESHOLD	NOT COUNTING THRESHOLD
0.580	0.5	90	91
0.651	1.5	91	92
0.730	2.5	92	93
0.820	3.5	93	94
0.920	4.5	94	95
1.032	5.5	95	96
1.158	6.5	96	97
1.299	7.5	97	98
1.457	8.5	98	99
1.635	9.5	99	100

ABBREVIATED IMPULSE NOISE DAC TEST

There is no abbreviated Impulse Noise DAC Test.

PERFORMANCE TESTS

4-19. Count Limit Test

SETUP:

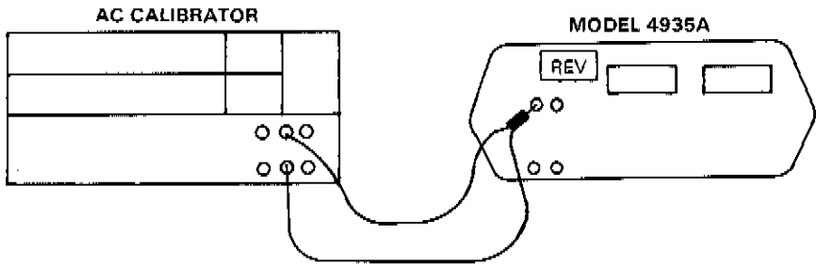


Figure 4-7. Count Limit Test

EQUIPMENT:

Fluke 5200A AC Calibrator
1 banana plug test cable
1 310 to banana adapter

1. Connect equipment as shown in Figure 4-7.

2. On 4935A select:

POWER	ON
DISPLAY	RCV
MEASUREMENT	IMPULSE NOISE
FILTER	3 kHz FLAT
IMPULSE NOISE	LOW(SET)

3. Set AC Calibrator to 2000 Hz, .775 V (0.0 dBm into 600 ohms).

4. Adjust the 4935A threshold to 75 dBrn.

5. Press the START/RESET button.

6. Wait 60 seconds and press STOP. The 4935A right display should indicate 480 ±48 counts.

8. Press Impulse Noise DISPLAY button to select MID threshold.

9. The 4935A display should indicate 480 ±48 counts.

10. Press DISPLAY button in IMPULSE NOISE to select HIGH threshold.

11. The 4935A display should indicate 480 ±48 counts.

ABBREVIATED COUNT LIMIT TEST

There is no abbreviated Count Limit Test.

PERFORMANCE TESTS

4-20. Termination Impedance Test

SETUP:

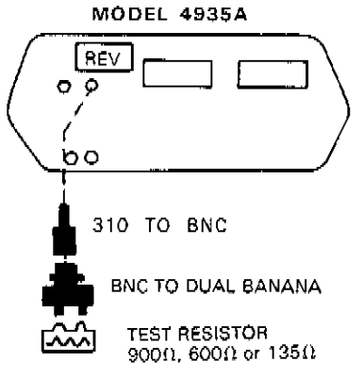


Figure 4-8. Termination Impedance Test

EQUIPMENT:

HP 3490A Multimeter
1 310 to BNC adapter
1 BNC to dual banana adaptor
Resistors — 900Ω, 600Ω, 135Ω

1. Disconnnect 4935A from AC power.

2. Connect equipment as shown in Figure 4-8.

3. On 4935A select:

POWER	STBY
NOR, REV	press in simultaneously
SET UP	BRG out
	DIAL out
	Both HOLDs out
	press in RCV 900Ω
	press in TRMT 900Ω

4. Measure the resistance across the transmitter and receiver jacks. Both should be greater than 1M ohm.

   a. As the DC blocking capacitors charge, the measured resistance may slowly rise. Set the Multimeter to the lowest resistance and increase the resistance as the meter overranges.

5. Set up 4935A as follows:

POWER	ON
DISPLAY	RCV
MEASUREMENT	LEVEL FREQUENCY
OUTPUT LEVEL	adjust to 0.0 dBm

PERFORMANCE TESTS

6. Repeat the following test three times. The procedure and the expected result remain the same. The termination impedances selected and the value of the resistor placed across the RCV jack will change. First use a 900Ω resistor, second a 600Ω, and finally a 135Ω resistor.

   a. Select equal TRMT and RCV termination impedances (900Ω, 600Ω, or 135Ω).

   b. The display should read 0.0 dBm.

   c. Press in the BRG button.

   d. The display should read 6.1 dBm ±.1 dBm.

   e. Connect the first resistor externally across the right jack. If the TRMT and RCV resistance buttons pressed are 900Ω, the resistor chosen should be 900Ω.

   f. The display should read 0.0 dBm ±.1 dBm.

   g. Release the BRG button and remove the resistor.

   h. Return to step a and select the next resistor.

ABBREVIATED TERMINATION IMPEDANCE TEST

1. Setup the 4935A as follows:

   POWER ..... ON
   DISPLAY ..... RCV
   NOR } ..... press in simultaneously
   REV }
   SET UP ..... press in both 600Ω buttons
   MEASUREMENT ..... LEVEL FREQUENCY
   OUTPUT LEVEL ..... adjust to 0.0 dBm

2. Press in the BRG button. The display should read 6.1 dBm ±.1 dBm.

3. Release the BRG button.

4. Press in both 135Ω impedance buttons. The display should read 0.0 dBm ±0.1 dBm.

5. Press in both 900Ω impedance buttons. The display should read 0.0 dBm ±0.1 dBm.

PERFORMANCE TESTS

4-21. Hold Tone Dropout Detector Test

SETUP:

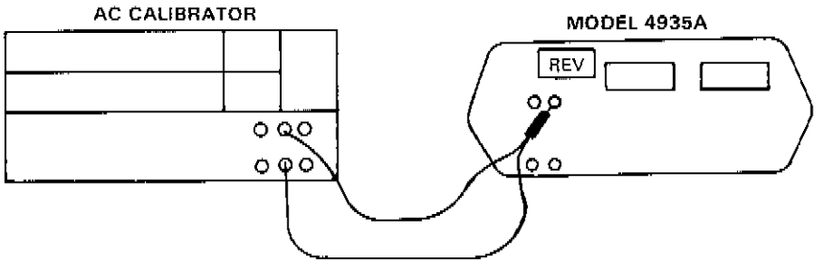


Figure 4-9. Hold Tone Dropout Detector Test

EQUIPMENT:

Fluke 5200A AC Calibrator
1 BNC to dual banana test cable
1 310 to BNC adapter

1. Connect equipment as shown in Figure 4-9.

2. On 4935A select:

POWER	ON
DISPLAY	RCV
REV	press in
SET UP	press in RCV 600Ω
MEASUREMENT	NOISE WITH TONE
FILTER	C-MESSAGE

3. Set AC Calibrator to 10mV at 1004 Hz.

4. Lower the AC Calibrator level until Err 7 appears on the 4935A (between 3-4 mVrms).

5. On 4935A select LEVEL FREQUENCY and read the signal level from the display. It should be −46 dBm ±2 dBm.

ABBREVIATED HOLD TONE DROPOUT DETECTOR TEST

There is no abbreviated Hold Tone Dropout Detector Test.

PERFORMANCE TESTS

4-22. Hold Circuit Test

SETUP:

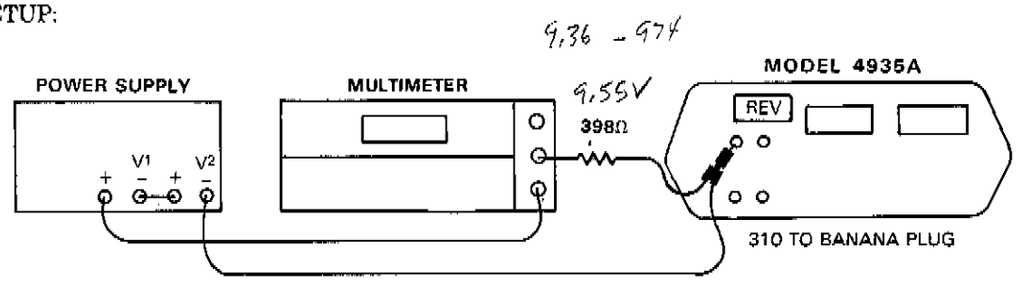


Figure 4-10. Hold Circuit Test

EQUIPMENT:

HP 6218A Power Supply
HP 3465 Multimeter
4 ea banana plug cables
1 310 to banana adapter (female)

1. Connect equipment as shown in Figure 4-10.

2. On 4935A select:

NOR/REV	both out
POWER	ON
DISPLAY	RCV
SET UP	DIAL out
	BRG in
	both HOLDs out
	press in TRMT and RCV 600Ω
MEASUREMENT	LEVEL FREQUENCY
OUTPUT LEVEL	adjust to –40 dBm

3. Set the 4935A to 1004 Hz.

4. Adjust the power supply to 16.5 Volts.

5. Press in the RCV HOLD button, the current on the multimeter (milliammeter funtion) should be 24.0 ±.5 mA.

< 10.35 ✓

6. Adjust the power supply to 50 volts. Current on multimeter should be less than 26 mA.

7. Release the RCV HOLD button, the display should not change.

8. Repeat steps 3 through 7 with TRMT HOLD instead of RCV HOLD.

ABBREVIATED HOLD CIRCUIT TEST

There is no abbreviated Hold Circuit Test.

PERFORMANCE TESTS

4-23. Distortion Test

SETUP:

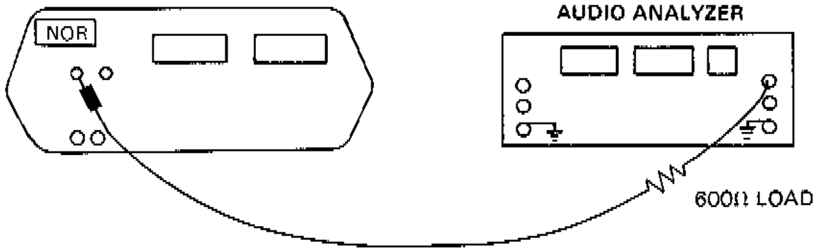


Figure 4-11. Distortion Test

EQUIPMENT:

- HP 6234A Dual Output Power Supply
- HP 8903A Audio Analyzer
- 4 kHz Low Pass Filter (included in Diagnostic Service Kit)*
- 20 dB amplifier (included in Diagnostic Service Kit)*
- 2 310 to BNC adapter
- 2 BNC to BNC test cables
- 600Ω load

1. Connect equipment as shown in Figure 4-11.

2. On 4935A select:

   POWER .... ON
   DISPLAY .... TRMT
   NOR .... press in
   SET UP .... press in TRMT 600Ω
   MEASUREMENT .... LEVEL FREQUENCY

3. Set the Audio Analyzer to measure distortion in dB. The input should be floating.

4. Enable the 30 kHz low pass filter on the Audio Analyzer.

5. Measure distortion at the following points.

FREQUENCY	OUTPUT LEVEL	DISTORTION
100 Hz	a) +10 dBm b) 0 dBm	≤55 dB
4000 Hz	a) +10 dBm b) 0 dBm	≤55 dB

*see figure 4-13 for circuits

PERFORMANCE TESTS

6. Turn off the 30 kHz low pass filter on the Audio Analyzer.

7. Measure distortion at the following points.

FREQUENCY	OUTPUT LEVEL	DISTORTION
110 kHz	a) + 9 dBm b) 0 dBm c) −20 dBm	≤50 dB

8. Connect an amplifier with +20 dB gain in the signal path as shown in Figure 4-12. The Power Supply should supply ±12 V to the +20 dB Amplifier and 4 kHz Low Pass Filter Board. See Figure 4-13 for the circuit and Table 4-14 for the Parts List.

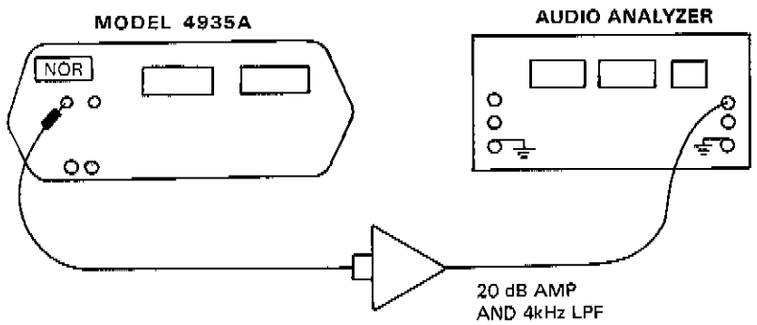


Figure 4-12. −40 dBm Distortion Test

9. Enable the 30 kHz low pass filter on the Audio Analyzer.

10. Measure distortion at the following points. The 4 kHz low pass filter should not be used in the measurement.

FREQUENCY	OUTPUT LEVEL	DISTORTION
a) 100 Hz b) 4000 Hz	−40 dBm −40 dBm	≤50 dBm ≤50 dBm

11. Change the +20 dB amplifier to unity gain and switch in the 4 kHz low pass filter.

12. Measure distortion at the following point.

FREQUENCY	OUTPUT LEVEL	DISTORTION
1004 Hz	0 dBm	≤65 dB

PERFORMANCE TESTS

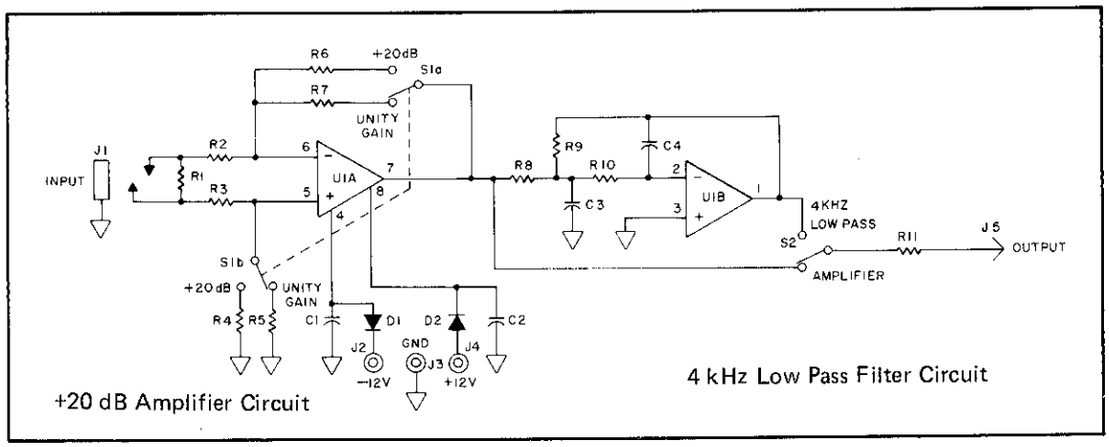


Figure 4-13. Filter Circuits*

Table 4-14. Filter Circuit Parts List

REFERENCE DESIGNATOR	HP PART NO.	DESCRIPTION
C1	0160-3468	0.12 μf ±5%
C2	0160-3468	0.12 μf ±5%
C3	0160-3548	10K pf ±1%
C4	0160-2387	1K pf ±1%
D1	1901-0040	Diode
D2	1901-0040	Diode
R1	0698-7408	600Ω ±0.1%
R2	0757-0442	10KΩ ±1%
R3	0757-0442	10KΩ ±1%
R4	0757-0465	100KΩ ±1%
R5	0757-9442	10KΩ ±1%
R6	0757-0465	100KΩ ±1%
R7	0757-0442	10KΩ ±1%
R8	0698-3450	42.2KΩ ±1%
R9	0698-3450	42.2KΩ ±1%
R10	0698-3151	2.87KΩ ±1%
R11	0698-7408	600Ω
U1	1826-0712	IC OP Amp
S1	3101-0973	DPDT Switch
S2	3101-0973	DPDT Switch
J1	1251-3677	310 Jack
J2	1510-0076	Binding Post
J3	1510-0076	Binding Post
J4	1510-0076	Binding Post
J5	1251-1780	BNC Connector

* The Diagnostic Service Kit (HP 04935-60014) contains a test board with this circuit.

PERFORMANCE TESTS

ABBREVIATED DISTORTION TEST

1. Disconnect all cables from the 4935A input.

2. On 4935A select:

POWER ..... ON
DISPLAY ..... RCV
SETUP ..... press in both NOR and REV buttons
MEASUREMENT ..... SIGNAL TO NOISE
OUTPUT LEVEL ..... adjust to 0.0 dBm.

3. For each filter in Table 4-15 the displayed level should be within the given range. If either level is out of tolerence, perform the complete Distortion Test before troubleshooting.

Table 4-15. Abbreviated Distortion Test

FILTER	DISPLAY
C-Message	73 dB ±2
50 kBit	58 dB ±1

PERFORMANCE TESTS

4-24. P/AR Test

SETUP:

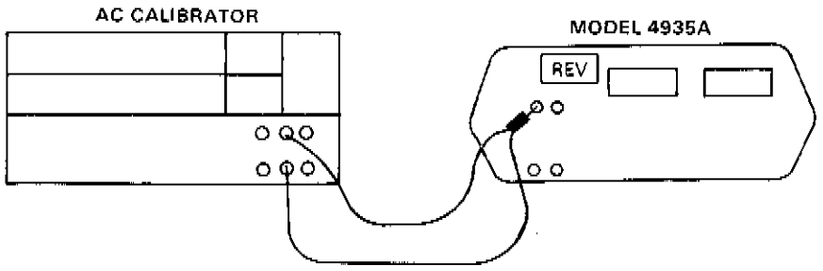


Figure 4-14. P/AR Test

EQUIPMENT:

Fluke 5200A AC Calibrator
1 BNC to dual banana test cable
1 310 to BNC adapter

1. Connect equipment as shown in Figure 4-14. On 4935A select:

POWER	ON
DISPLAY	RCV
REV	press in
SETUP	press in both 600Ω buttons BRG out
MEASUREMENT	P/AR

2. Set the AC Calibrator for a 300 Hz sinewave at 0.495 Vrms (–3.9 dBm).

3. For each frequency in Table 4-16 check that the right display is within the acceptable limits.

Table 4-16. P/AR Filter Responses

FREQUENCY	ACCEPTABLE LEVEL
300 Hz	–30 dBm
1000 Hz	0 dBm
2300 Hz	–10 dBm

4. Press DISPLAY to change the 4935A to TRMT mode. The right display should read 100 ±1.

5. Vary the OUTPUT LEVEL to obtain a left display reading between –12 dBm and –1 dBm. The P/AR reading in the right display should not change by more than 1 P/AR unit.

ABBREVIATED P/AR TEST

1. Perform only steps 4 and 5 of the P/AR Test.

PERFORMANCE TESTS

4-25. Noise To Ground (Standard and Option 001)

SETUP:

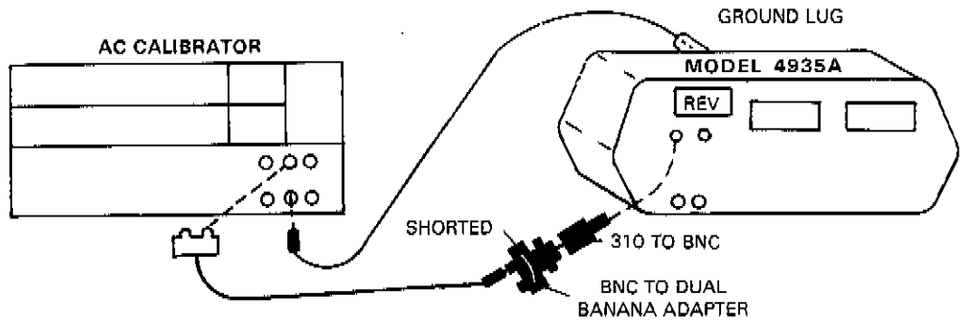


Figure 4-15. Noise to Ground Test

EQUIPMENT:

Fluke 5200A AC Calibrator 1 shorting strap
310 to BNC adapter 2 banana cables
1 banana to BNC connector (female)

1. Connect equipment as shown in Figure 4-15. On 4935A select:

   POWER ..... ON
   DISPLAY ..... RCV
   MEASUREMENT ..... NOISE TO GROUND

2. Connect AC Calibrator low to ground lug on 4935A rear panel.

3. Short 4935A input (tip and ring) and connect to the AC Calibrator HIGH.

4. Set AC Calibrator output to .7746 Vrms at 1000 Hz. 4935A display should read 90 dBrn.

ABBREVIATED NOISE TO GROUND TEST

There is no Abbreviated Noise to Ground Test.

Performance Test Record

4935A

SN _____ DATE _____

DESCRIPTION	RESULTS PASS	FAIL
Self Check		
Transmitter Flatness at +10 dBm		
Transmitter Flatness at −40 dBm		
Receiver Accuracy at +12 dBm and −40 dBm		
Autorange Test		
Filter Tests		
Impulse Noise DAC Test		
Count Limit Test		
Termination Impedance Test		
Hold-Tone Dropout Detector Test		
Hold Circuit Test		
P/AR Test (Options 002 and 003 only)		
Noise-To-Ground Test (Standard Unit Only)		
Distortion Test		

SECTION V
ADJUSTMENT/CALIBRATION

5-1. INTRODUCTION

5-2. This section contains adjustment and calibration information for the HP Model 4935A Transmission Test Set. Verify all adjustments and calibrations with the tests in Section IV, Performance Tests.

5-3. SAFETY CONSIDERATIONS

5-4. Listed warnings and cautions must be followed for your protection and to avoid damage to the equipment. Whenever internal instrument circuits are exposed, caution must be exercised. When using AC powered test equipment, the test equipment chassis should be connected to earth ground. With the 4935A in STBY (standby) AC power is still applied to the instrument and some DC voltages are still present. To completely power down the instrument, disconnect it from the AC power source. For instruments with the batteries (Options 002 and 003), disconnect the three batteries and the AC power source.

WARNING

Power switch does not turn off AC power and some DC power circuits.

5-5. EQUIPMENT REQUIRED

5-6. Test equipment needed for adjustments is listed in Table 1-2. Test equipment with equivalent specifications may be substituted.

5-7. Instrument Access (see warning of paragraph 5-4)

5-8. The instrument's internal circuits and assemblies are accessed by removing the case top. The case top is secured by four screws located on the bottom of the instrument. For the complete procedure refer to the Mechanical Disassembly Procedure in Section VIII, Service Section.

CAUTION

When the 4935A is in STBY, AC power is still present in the instrument as well as some DC voltages. Disconnect AC power from the instrument before opening the case or removing any assemblies.

5-9. ADJUSTMENT LOCATIONS

5-10. Adjustment locations are shown on the component locaters at the end of Section VIII.

5-11. ADJUSTMENTS

5-12. Adjustments should be done in the sequence given. Power Supply Adjustments should be done prior to making any internal adjustments. Access instrument circuits as described in paragraph 5-7.

There are seven adjustment procedures for the 4935A.

a. Power Supply Adjustments

b. Receiver Gain Adjustments

c. Detector Adjustments

d. Notch Filter Adjustments

e. A13 P/AR Filter and Latch Adjustments

f. Output Level and Transmit Monitor Loop Adjustments

g. Hold Circuit Adjustments

ADJUSTMENTS

5-13. +5 V, +14 V, and -14 V Power Supply Adjustments

REFERENCE:

A4 Transmitter Assembly

EQUIPMENT:

DC Voltmeter	HP 3490A
Oscilloscope	HP 1740A

PROCEDURE:

1. Press power button ON.
2. Connect the Voltmeter to A4JU+5.
3. Voltmeter should read +5VDC ±20 mV. If not, adjust A4R42 (+5 V ADJ).
4. Remove the Voltmeter and connect the Oscilloscope to A4JU+5. Ripple should not exceed 100 mVAC.
5. Connect the Voltmeter to A4JU+14.
6. The Voltmeter should read +14 VDC ±20 mV. If not adjust A4R31 (+14V ADJ).
7. Remove the Voltmeter and connect the Oscilloscope to A4JU+14. Ripple should not exceed 100 mVAC.
8. Connect the Voltmeter to A4JU-14.
9. The Voltmeter should read -14 VDC ±25 mV and is not adjustable. If the reading is incorrect the power supply is defective and should be repaired.
10. Remove the Voltmeter and connect the Oscilloscope to A4JU-14. Ripple should not exceed 100 mVAC.

ADJUSTMENTS

5-14. A3 Receiver Gain Adjustments

REFERENCE:

A3 Receiver Assembly

EQUIPMENT:

AC-DC Voltmeter ..... HP 3490A

PROCEDURE:

1. Externally loop the RCV and TRMT 310 jacks.

2. On 4935A select:

POWER	ON
DISPLAY	RCV
MEASUREMENT	LEVEL FREQUENCY
SET UP	press both 600Ω buttons

3. Measure the voltage at the looped jacks. Adjust the OUTPUT LEVEL control until the Voltmeter reads about 1 VRMS. Record the exact voltage.

4. Connect the Voltmeter to A3TP13.

5. Adjust A3R77 (RCV GAIN) until the voltage at A3TP13 and the voltage measured in step 3 are equal.

ADJUSTMENTS

5-15. Detector Adjustments

REFERENCE:

A3 Receiver Assembly
EQUIPMENT:

Voltmeter	HP 3490A
AC Calibrator	Fluke 5200A

PROCEDURE:

1. On 4935A select:

POWER	ON
DISPLAY	TRMT
MEASUREMENT	NOISE

2. Detector Offset Adjustment:

   a. Short TP10 to TP21.
   Short TP22 to TP23.

   b. Measure the voltage at TP24. Adjust A3R33 (OFFSET ADJ) if voltage is not within 0 ±.3 mV DC.

   c. Remove the shorts placed in Step 2a.

3. Detector Adjustment:

   a. Set AC Calibrator to .7700V (–.0517 dBm), frequency to 1004 Hz. Do not connect the AC Calibrator output to the 4935A until Step 3c.

   b. On 4935A select:

DISPLAY	RCV
NOR button	press in
SET UP	press in RCV 600Ω
	BRG out
	DIAL out
	both HOLDs out
MEASUREMENT	LEVEL FREQUENCY

   c. Connect AC Calibrator to the RCV jack.

   d. Adjust R23 (Ave Det) for a displayed level of 0.0 dBm then reduce the displayed level until it changes to –0.1 dBm.

   e. Change AC Calibrator outputs to .7795 V (.0548 dBm). The 4935A displayed level should be +0.1 dBm. If the displayed level is not +0.1 dBm, change the AC Calibrator to .7700 V and repeat Step d. Failure of Steps d and e indicate an instrument failure or that the receiver gain is out of adjustment. Go to paragraph 5-15 or the Service Section.

   f. On 4935A change:

   LEVEL FREQUENCY change to NOISE
   FILTER select 15 kHz FLAT

   g. Change the AC Calibrator output to .7270V (–0.55 dBm or 89.45 dBrn).

ADJUSTMENTS

h. Adjust A3R65 (QRMS DET) for a displayed level of 90 dBrn, then reduce the displayed level until it barely changes to a stable 89 dBrn.

i. Change the AC Calibrator to .8260 V.

j. 4935A display should read 91 dBrn. If not repeat step g and h. If the display still does not read 91 dBrn the instrument has failed, go to the Service Section.

5-16. There are problems that could go undetected using only a Voltmeter. The following test is intended as quick check to verify that the instrument basically works.

a. Attach a scope probe to TP23 (full wave rectified output).

b. On 4935A select:

DISPLAY ..... TRMT
MEASUREMENT ..... LEVEL FREQUENCY

c. Vary the OUTPUT LEVEL from 0 dBm to +12.9 dBm, start at 0 and finish at +12.9. The waveform at TP23 should be a full wave rectified sinewave with the peaks within 50 mV of each other.

d. On 4935A press DISPLAY to change from TRMT to RCV.

e. Adjust the AC Calibrator to 2.45 Vrms (+10 dBm) at 1 kHz. A rectified sinewave should appear.

f. On 4935A change LEVEL FREQUENCY to NOISE.

g. Try each filter and verify in each case that a rectified sinewave appears at TP23 with no visual distortion.

h. Check the notch filter capacitors (A3C92, A3C100, and A3C141); they must lean away from the switch board (they pick up noise when too close). Bend the capacitors away from the switch board if necessary.

ADJUSTMENTS

5-17. Notch Filter Adjustments

REFERENCE:

A3 Receiver Assembly

EQUIPMENT:

Oscilloscope ..... HP 1741A

PROCEDURE:

1. Externally loop the TRMT jack to the RCV jack.
2. On 4935A select:

   DISPLAY ..... TRMT
   MEASUREMENT ..... LEVEL FREQUENCY
3. Set the displayed frequency on the right display to 995 Hz. Adjust the OUTPUT LEVEL until the left display reads approximately 0.0 dBm.
4. Press DISPLAY to select RCV mode.
5. Move the JU5 shorting bars to the right (short pin 5 to 12, 6 to 11, 7 to 10, and 8 to 9).
6. Connect an Oscilloscope to JU5 pin 1.
7. Adjust R102 (995 Hz) for minimum AC signal on the Oscilloscope.
8. Change the frequency to 1010 Hz using STEP UP button.
9. Connect Oscilloscope to JU5 pin 4.
10. Adjust A3R132 (1010 Hz) for minimum AC signal on the Oscilloscope.
11. Change 4935A frequency to 1025 Hz using STEP UP button.
12. Connect oscilloscope probe to TP7.
13. Adjust A3R180 (1025 Hz) for minimum AC signal on the Oscilloscope.
14. Move JU5 shorting bars to original positions (shorting pins 1 to 16, 2 to 15, 3 to 14, and 4 to 13).

ADJUSTMENTS

5-18. A13 P/AR Filter and Latch Adjustments (Options 002 and 003)

REFERENCE

A13 Receiver Assembly

EQUIPMENT

Oscilloscope ..... HP 1741A with 1:1 probes

PROCEDURE:

1. On the Oscilloscope select A vs B operation and connect the probes to the normal input jack.
   a. For HP model 180 series oscilloscopes, feed one input to channel A and the other to the external horizontal input — not the external trigger input.
   b. This setup will display lissajous pattens which are used to adjust the P/AR filter.
   c. If an adjustment is needed, a rising slope oval waveshape is produced.
   d. When adjusted, a single diagonal line will appear.
2. Externally loop the 4935A TRMT and RCV 310 jacks.
3. Select LEVEL FREQUENCY measurement mode.
4. Set the 4935A frequency to 1300 Hz.
5. Adjust the OUTPUT LEVEL for a left display of 0.0 dBm.
6. Set the Oscilloscope to 0.2 volts per division. Connect channel A to TP15 pin 2 and channel B to TP15 pin 7.
7. Adjust A13R153 (PAR PHASE 1) to obtain a 0 degree phase (close the waveshape loop).
8. Move Oscilloscope channel A probe to TP15 pin 8.
9. Adjust A13R175 (PAR PHASE 2) to obtain a 0 degree phase difference.
10. Select P/AR measurement mode on the 4935A.
11. Adjust A13R186 (PAR DET) until the display reads 100.

ADJUSTMENTS

5-19. Output Level and Transmit Monitor Loop Adjustments

REFERENCE

A4 Transmitter Assembly

PROCEDURE:

1. Externally loop the 4935A TRMT and RCV jacks.

2. On 4935A select:

DISPLAY	RCV
MEASUREMENT	LEVEL FREQUENCY
SET UP	press in TRMT 600Ω
	press in RCV 600Ω
	BRG out
	DIAL out
	both HOLDs out
OUTPUT LEVEL	turn full clockwise

3. Adjust A4R74 (output Adj) until +12.9 dBm is displayed on the 4935A.

4. Adjust the OUTPUT LEVEL until the display flashes a reading between 0.0 dBm and +0.1 dBm.

5. Press DISPLAY to select TRMT.

6. Adjust A4R72 (Loop Adj) until the display flashes a reading between 0.0 dBm and +0.1 dBm.

ADJUSTMENTS

5-20. Hold Circuit Adjustments

REFERENCE:

A2 Switch Board Assembly

SETUP:

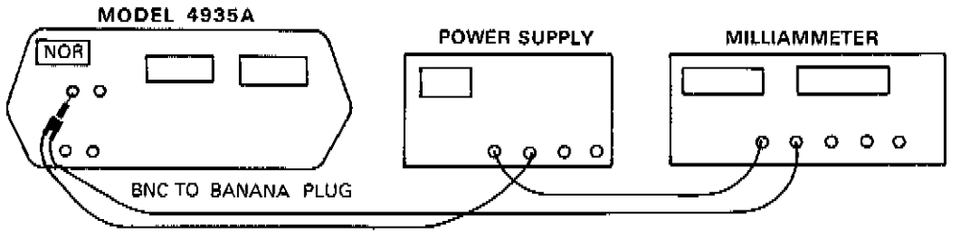


Figure 5-1. Hold Circuit Adjustment

EQUIPMENT:

AC-DC Voltmeter	HP 3490A
Milliammeter	HP 3465A
Power Supply	HP 6218A

PROCEDURE:

1. Connect equipment as shown in Figure 5-1.

2. Check the power supply output with the DC Voltmeter. Adjust the output to 6.9 V ±.2 VDC.

3. On 4935A select:

DISPLAY	TRMT
NOR	press in
SET UP	press in TRMT HOLD press in RCV HOLD

4. Adjust A2R53, the TRMT Hold adjustment to a DC current reading of 24.0mA ±.1 mA.

5. Reverse the power supply leads. The DC current reading should be 24.0 mA ±.1 mA. Return the power supply leads to normal polarity.

6. On 4935A press in the REV button.

7. Adjust A2R73 (RCV hold adjustment) to a DC current reading of 24.0 mA ±.1mA.

8. Reverse the power supply leads. The DC current reading should be 24.0 mA ±.1mA. Return the power supply leads to normal polarity.

9. Set the monitoring Voltmeter to a voltage range of 50 V or greater and adjust Power Supply for 50 VDC. DC current reading should be less than 26 mA.

10. Press in the NOR button, the DC current should be less than 26 mA.

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION

6-2. This section contains information for ordering replacement parts. Table 6-1 lists abbreviations, Table 6-2 is the Manufacturer's Code List, and Table 6-3 lists replaceable parts. Figures 6-1, 6-2, and 6-3 are exploded views of the instrument.

6-3. REPLACEABLE PARTS LIST

6-4. Table 6-3 is the list of replaceable parts with parts listed in alphanumerical order. Included is the description, quantity (total used in the instrument), HP Part Number and manufacturers' part number. Chassis and mechanical parts are also listed in Table 6-3 and Figures 6-1, 6-2 and 6-3.

6-5. ORDERING INFORMATION

6-6. To order a listed part, quote the HP Part Number, indicate the quantity needed and address the order to the nearest Hewlett-Packard Office. When ordering a non-listed part include the instrument model number, serial number and a description and function of the part. Address the order to the nearest Hewlett-Packard Office.

Table 6-1. Reference Designations and Abbreviations (1 of 2)

REFERENCE DESIGNATIONS

A = assembly	JU = jumper	U = integrated circuit, non-repairable assembly
B = motor, synchro, fan	K = relay	V = vacuum tube, photocell, etc.
BP = binding post	L = inductor	VR = voltage regulator
BT = battery	M = meter	W = jumper wire, cable assembly
C = capacitor	OE = optical encoder	X = socket
CB = circuit breaker	P = plug connector	Y = crystal
CR = diode	Q = transistor	Z = tuned cavity, network
DL = delay line	R = resistor	
DS = indicator, display	RT = thermistor	
E = Misc electrical parts	S = switch	
F = fuse	T = transformer	
FL = filter	TB = terminal board	
J = receptacle connector, jack	TP = test point	

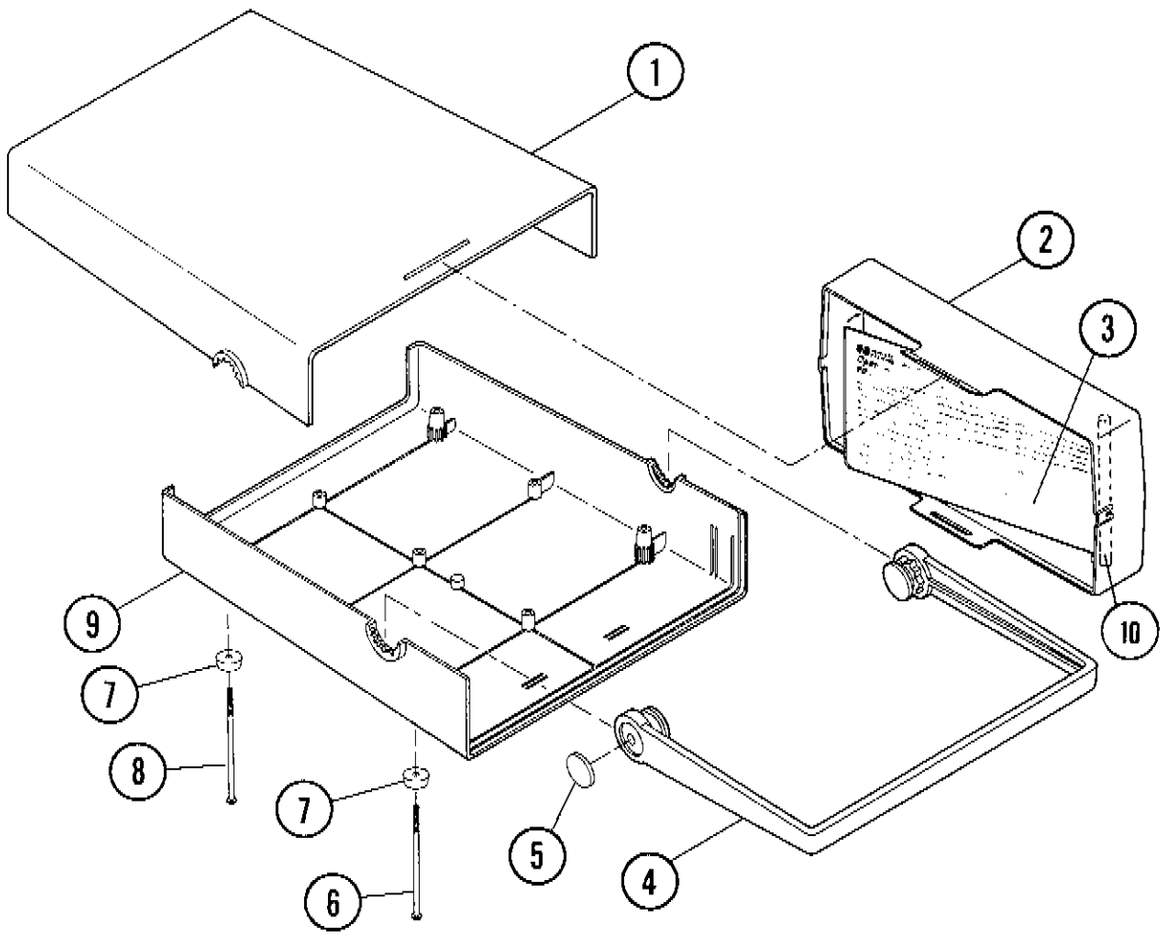
ABBREVIATIONS

A = amperes	DIA = diameter	K = kilo (10^3), kilohm
AC = alternating current	DIP = dual in-line package	
ADD = address	DPDT = double-pole, double-throw	LED = light emitting diode
ADJ = adjust, adjustment	DPST = double-pole, single-throw	LFT = left
AL = aluminum	DR = drive	LG = long
AR = as required	DRVR = driver	LH = left hand
ASM = algorithmic state machine	DSPL = display	LKWR = lockwasher
ASSY = assembly	DTL = diode-transistor logic	LP = low pass
		LS = low power Schottky
B = base	E = emitter	LSB = least significant bit
BCD = binary coded decimal	ECL = emitter-coupled logic	
BeCu = beryllium copper	ELECT = electrolytic	M = milli (10^{-3}), male, mega (10^6), megohm
BIN = binary	ENCAP = encapsulated	MET FLM = metal film
BLK = black	EXT = external	MET OX. = metal oxide
BLU = blue	EXTR = extractor	MHZ = megahertz
BP = band pass		MFR = manufacturer
BRN = brown	F = female, farads	MINTR = miniature
BRS = brass	FF = flip-flop	MISC = miscellaneous
BTU = British thermal unit	FLM = film	MOM = momentary
	FRNT = front	MOS = metal oxide semiconductor
C = collector	FXD = fixed	MSB = most significant bit
CATH = cathode		MTCHD = matched
CCW = counterclockwise	G = giga (10^9)	MTG = mounting
CD PL = cadmium plate	GE = germanium	MTLC = metallic
CER = ceramic	GL = glass	
CERMET = ceramic met flm	GND = ground(ed)	N = nano (10^{-9})
CKTS = circuits	GP = General Purpose	N.C. = normally closed, no connection
C FLM = carbon film	GRA = gray	
CLK = clock	GRN = green	NE = neon
CLR = clear		NO. = number
CMOS = complementary metal oxide semiconductor logic	H = henries	N.O. = normally open
	HDW = hardware	NP = No Polarity
COM = common	HEX = hexagon, hexagonal, six	NPN = negative-positive-negative
COML = commercial	HP = high pass	NPO = negative-positive zero (zero temperature coefficient)
COMP = composition	HR = hour(s)	
COMPL = complete	HZ = Hertz	NRFR = not recommended for field replacement
COND = conductor		
CONN = connector	IC = integrated circuit	NS = normally shorting, nanosecond
CONT = contact	ID = inside diameter	
CPRSN = compression	IF = intermediate frequency	NSR = not separately replaceable
CTL = complementary-transistor logic	IN. = inch, inches	NYL = nylon
	INCAND = incandescent	
CW = clockwise	INCL = include(s)	OBD = order by description
	INSUL = insulation, insulated	OD = outside diameter
D = diameter	INT = internal	ORN = orange
DC = direct current	INTL = internal	
DEPC = deposited carbon		

Table 6-1. Reference Designations and Abbreviations (2 of 2)

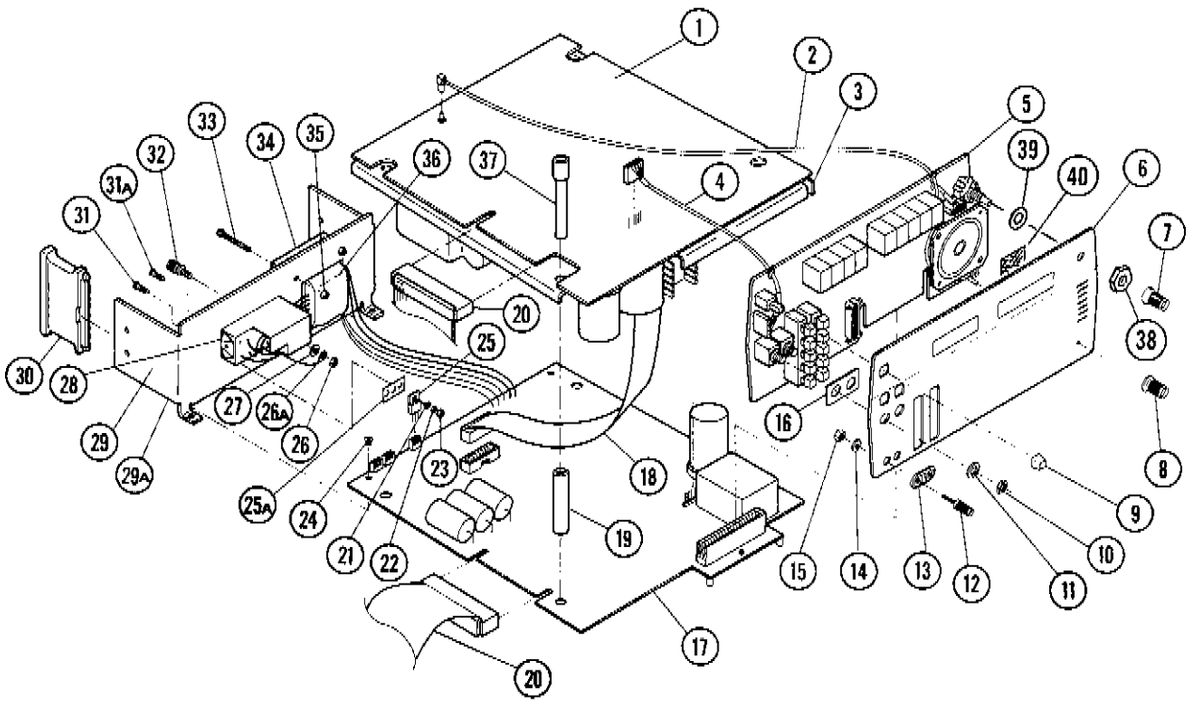
ABBREVIATIONS

P = pico (10^{-12})	RVT = rivet	TRN = turn
PC = printed circuit	RWV = reverse working voltage	TTL = transistor-transistor logic
PCA = printed-circuit assembly		TYP = typical
PF = picofarad	S = second	
PIV = Peak Inverse Voltage	SB = slow blow	U (μ) = micro (10^{-6})
PK = peak	SCR = silicon controlled rectifier	UF = microfarad
PNL = panel	SE = selenium	US = microseconds
PNP = positive-negative-positive	SGL = single	
P-P = peak-to-peak	SI = silicon	V = volt(s)
PPM = parts per million	SHK = shank	VAR = variable
POLYC = polycarbonate	SIP = single in-line package	VCO = voltage controlled oscillator
POLYE = polyethylene	SKT = socket	VDCW = direct current working volts
POLYSTY = polystyrene	SLDR = solder	VIO = violet
PORC = porcelain	SPCG = spacing	VNP = no polarity voltage
POSN = position(s)	SPDT = single-pole, double-throw	
POZI = pozidrive	SPST = single-pole, single-throw	W = watts
PRV = peak reverse voltage	SST = stainless-steel	WT = weight
PWV = peak working voltage	STL = steel	WW = wirewound
P/O = part of	SZ = size	WHT = white
		WIP = wiper
R = ring	T = tip	WIV = working inverse voltage
RAM = random access memory	TA = tantalum	WSHR = washer
ROM = read only memory	TEL = telephone	
RECT = rectifier	T.C. = Temp. Compensated, temp. coefficient	X = times, multiple
RF = radio frequency		YEL = yellow
RH = right hand	THKNS = thickness	
RMS = root-mean-square	TI = titanium	ZNR = zener
RND = round	TGL = toggle	
RT = right hand	THD = thread	ϕ = phi, phase
RTL = resistor-transistor logic	THK = thick	
RTNT = retainer	TOL = tolerance	
RTRY = rotary	TRMR = trimmer	



ITEM	DESCRIPTION	HP PART NO.	QUANTITY
1	Case; top half	4040-1703	1
2	Front Cover	5040-4469	1
3	Instruction Card	04935-90002	1
4	Handle — Case	5040-4470	1
5	Cap — Handle	7120-4184	2
6	Screw; Machine	2510-0296	2
7	Foot, Bumper	0403-0414	4
8	Screw; Machine	2510-0296	2
9	Case; Bottom Half	4040-1704	1
10	Metal Rod	7205-0356	1

Figure 6-1. Exploded View Case and Covers

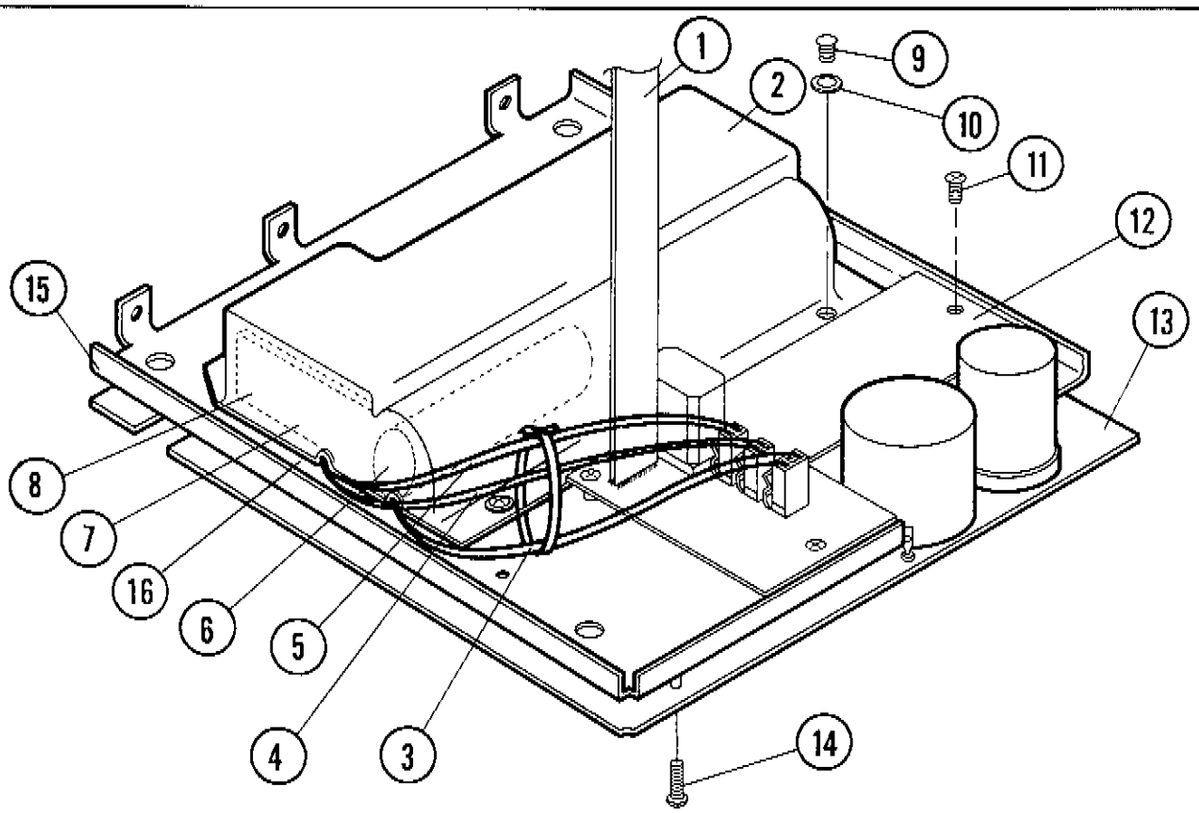


ITEM	DESCRIPTION	HP PART NO.	QUANTITY
1	Receiver Assy (Std)	04935-60004	1
	Receiver Assy (P/AR)	04935-60006	1
2	Coax Cable	04935-60009	1
3	Shield; Metal Mounting	04935-00002	1
4	Shielded Cable	04935-60010	1
5	Switch Board Assy	04935-60102	1
6	Front Panel Assy (Std)	0950-0498	1
	Front Panel Assy (P/AR)	0950-0496	1
7	Knob, Output Lever	0370-1091	1
8	Knob, Monitor Volume	0370-1089	1
9	Key Cap White	5041-0201	1
10	Nut, Hex	2950-0087	1
11	Washer 5/16 x .375	3050-0067	1
12	Binding Posts (Dial Jacks)	1510-0076	2
13	Insulator	04936-40001	1
14	Washer No. 6; 147 ID	3050-0100	1
15	Nut No. 6	2420-0015	1
16	Shim, 310 Jacks	04935-00004	1
17	Transmitter Assy (Std)	04935-60203	1
	Transmitter Assy (P/AR)	04935-60207	1

Figure 6-2. Exploded View Assemblies and Cables

ITEM	DESCRIPTION	HP PART NO.	QUANTITY
18	Cable, (Battery Opt. Interconnect)	8120-3181	1
19	Standoff, Plastic	5040-4467	4
20	Cable, Rec./Tran. Interconnect	8120-3126	1
21	Shouldered Fiber Washer	3050-1021	3
22	Washer, Lock	2260-0012	3
23	Nut, Hex No. 4, Transistor MTG	2260-0012	3
24	Screw No. 4, MTG	2200-0103	2
25	Transistor Power (P/O Item 17)	1853-0363	3
25A	Transistor Insulator	0340-0963	3
26	Nut Hex	2950-0006	1
26A	Solder Terminal	0360-1251	1
27	Lock Washer	2190-0027	1
28	Line Filter Module	0960-0443	1
29	Rear Panel Assy (Loaded) Consists of Items: 26, 26A, 27, 28, 29, 32, 33, 34, 35, 36 for Repair Replacement only.	04935-60108	1
29A	Rear Panel (Unloaded)	04935-00001	1
30	Foot Rear	5040-4471	2
31	Screw No. 6	2360-0197	2
31A	Screw No. 4	2200-0107	3
32	Binding Post, Ground	1510-0038	1
33	Screw Transformer MTG	2360-0242	4
34	Cover Transformer	7100-0389	1
35	Nut, Transformer MTG	2420-0014	4
36	Transformer T1	9100-4205	1
37	Standoff, Plastic	5040-4468	4
38	Nut, Hex	2950-0043	1
39	Nylon Washer	3050-1114	1
40	Screen Mesh	7154-0394	1

Figure 6-2. Exploded View Assemblies and Cables (Continued)



ITEM	DESCRIPTION	HP PART NO.	QUANTITY
	Battery Assy consists of the following listed items:	04935-60011	1
1	Cable: P/O Battery Charger Board	8120-3181	See A5 Parts List
2	Battery Holder	1400-1076	1
3	Wire] Included With		
4	Wire] Replacement	—	—
5	Wire] Batteries		
6	6 Vdc Battery	1420-0285	1
7	15.6 Vdc Battery	1420-0284	2
8	Foam	0460-1601	3″
9	Screw	04935-00002	
10	Washer	2510-0103	4
11	Screw	3050-0001	4
12	Battery Charger Board	2360-0117	3
13	Receiver Assy (Std) Receiver Assy (P/AR)	04935-60005 04935-60004	1 1
14	Screw	04935-60006	1
15	Shield; Metal Mounting	2360-0117	5
16	Insulator	04935-00007	1

Figure 6-3. Exploded View Battery Option

Table 6-2. Manufacturer Code List

MFR NO.	MANUFACTURER NAME	ADDRESS		ZIP CODE
00000	ANY SATISFACTORY SUPPLIER			
01121	ALLEN-BRADLEY CO	MILWAUKEE	WI	53204
01295	TEXAS INSTR INC SEMICOND CMPNT DIV	DALLAS	TX	75222
01928	RCA CORP SOLID STATE DIV	SOMERVILLE	NJ	08876
02111	SPECTROL ELECTRONICS CORP	CITY OF IND	CA	91745
03508	GE CO SEMICONDUCTOR PROD DEPT	SYRACUSE	NY	13201
03888	KDI PYROFILM CORP	WHIPPANY	NJ	07981
04713	MOTOROLA SEMICONDUCTOR PRODUCTS	PHOENIX	AZ	85062
05245	CORCOM INC	CHICAGO	IL	60657
06383	PANDUIT CORP	TINLEY PARK	IL	60477
0656A	ASHLAND PRODUCTS CO	CHICAGO	IL	60628
11236	CTS OF BERNE INC	BERNE	IN	46711
17856	SILICONIX INC	SANTA CLARA	CA	95054
18324	SIGNETICS CORP	SUNNYVALE	CA	94086
19701	MEPCO/ELECTRA CORP	MINERAL WELLS	TX	76067
24355	ANALOG DEVICES INC	NORWOOD	MA	02062
24546	CORNING GLASS WORKS (BRADFORD)	BRADFORD	PA	16701
25088	SIEMENS CORP	ISELIN	NJ	08830
27014	NATIONAL SEMICONDUCTOR CORP	SANTA CLARA	CA	95051
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO	CA	94304
32293	INTERSIL INC	CUPERTIND	CA	95014
34371	HARRIS SEMICON DIV HARRIS-INTERTYPE	MELBOURNE	FL	32901
55576	SYNERTEK	SANTA CLARA	CA	95051
56289	SPRAGUE ELECTRIC CO	NORTH ADAMS	MA	01247
72136	ELECTRO MOTIVE CORP SUB IEC	WILLIMANTIC	CT	06226
75042	TRW INC PHILADELPHIA DIV	PHILADELPHIA	PA	19108
75915	LITTELFUSE INC	DES PLAINES	IL	60016
8E175	BURR BROWN CO	HUNTSVILLE	AL	35801

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1	0950-0496	3	1	FRONT PANEL W/PAR (OPT. 002, 003 ONLY)	28480	0950-0496
A1	0950-0498	9	1	FRONT PANEL W/NTG (STD. UNIT ONLY)	28480	0950-0498
A1DS1-DS40	1990-0810	3	40	LED (SERVICE ONLY)	28480	5082-4160
A2	04935-60102	2	1	SWITCH BOARD (ALL UNITS)	28480	04935-60102
A2C2	0160-0576	5	13	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A2C3	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A2C4	0160-0302	5	1	CAPACITOR-FXD .018UF +-10% 200VDC POLYE	28480	0160-0302
A2C5	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A2C7	0180-0291	3	1	CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A2C10	0180-0104	7	1	CAPACITOR-FXD 200UF+75-10% 16VDC AL	56289	30D207G016DF2
A2C11	0180-2206	4	2	CAPACITOR-FXD 60UF+-10% 6VDC TA	56289	150D606X9006B2
A2C12	0180-2206	4		CAPACITOR-FXD 60UF+-10% 6VDC TA	56289	150D606X9006B2
A2C13	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A2C14	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A2C15	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A2C16	0160-3878	6	1	CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A2C17	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A2C52	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A2C53	0180-0373	2	2	CAPACITOR-FXD .68UF+-10% 35VDC TA	56289	150D684X9035A2
A2C54	0160-3879	7	4	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2C56	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2C57	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A2C58	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A2C72	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A2C73	0180-0373	2		CAPACITOR-FXD .68UF+-10% 35VDC TA	56289	150D684X9035A2
A2C74	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2C76	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2C77	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A2C78	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A2CR8	1906-0069	4	2	DIODE-FW BRDG 400V 1A	28480	1906-0069
A2CR9	1906-0069	4		DIODE-FW BRDG 400V 1A	28480	1906-0069
A2CR51	1826-0585	9	2	V REF TO-92	27014	LM329DZ
A2CR71	1826-0585	9		V REF TO-92	27014	LM329DZ
A2DS1	1990-0681	3	1	DISPLAY-AN-SEG 1-CHAR .408-H RED	28480	5082-7656
A2DS2	1990-0540	3	8	DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7650
A2DS3	1990-0540	3		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7650
A2DS4	1990-0540	3		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7650
A2DS5	1990-0540	3		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7650
A2DS6	1990-0540	3		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7650
A2DS7	1990-0540	3		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7650
A2DS8	1990-0540	3		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7650
A2DS9	1990-0540	3		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7650
A2J2	1251-6947	0	2	CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A2J3	1251-3677	7	2	CONNECTOR-TEL JACK 2-CKT .25-SHK-DIA	28480	1251-3677
A2J4	1251-3677	7		CONNECTOR-TEL JACK 2-CKT .25-SHK-DIA	28480	1251-3677
A2J5	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A2J6	1251-6537	4	2	CONNECTOR 13-PIN F POST TYPE	28480	1251-6537
A2J7	1251-6537	4		CONNECTOR 13-PIN F POST TYPE	28480	1251-6537
A2J8	1250-0257	1	1	CONNECTOR-RF SMB M PC 50-OHM	28480	1250-0257
A2Q4	1854-0643	9	2	TRANSISTOR NPN 2N3585 SI TO-66 PD=35W	01928	2N3585
A2Q8	1854-0643	9		TRANSISTOR NPN 2N3585 SI TO-66 PD=35W	01928	2N3585
A2Q51	1854-0575	6	6	TRANSISTOR NPN SI PD=625MW FT=50MHZ	04713	MPS-A42
A2Q52	1854-0071	7	2	TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A2Q53	1854-0575	6		TRANSISTOR NPN SI PD=625MW FT=50MHZ	04713	MPS-A42
A2Q55	1854-0575	6		TRANSISTOR NPN SI PD=625MW FT=50MHZ	04713	MPS-A42
A2Q71	1854-0575	6		TRANSISTOR NPN SI PD=625MW FT=50MHZ	04713	MPS-A42
A2Q72	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A2Q73	1854-0575	6		TRANSISTOR NPN SI PD=625MW FT=50MHZ	04713	MPS-A42
A2Q75	1854-0575	6		TRANSISTOR NPN SI PD=625MW FT=50MHZ	04713	MPS-A42
A2R5	0757-0461	2	2	RESISTOR 68.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6812-F
A2R6	0757-0288	1	1	RESISTOR 9.09K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-9091-F
A2R15	0757-0458	7	1	RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A2R18	0757-0461	2		RESISTOR 68.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6812-F
A2R19	0698-3132	4	1	RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A2R20	0757-0442	9	3	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R21	0698-8558	8	2	RESISTOR 67.3 .25% .5W F TC=0+-50	28480	0698-8558
A2R22	0698-8558	8		RESISTOR 67.3 .25% .5W F TC=0+-50	28480	0698-8558
A2R23	0699-0657	4	2	RESISTOR 300 .25% .5W F TC=0+-50	28480	0699-0657
A2R24	0699-0657	4		RESISTOR 300 .25% .5W F TC=0+-50	28480	0699-0657

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

Table 6-3. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2R25	0699-0658	5	2	RESISTOR 450 .25% .5W F TC=0+-50	28480	0699-0658
A2R26	0699-0658	5		RESISTOR 450 .25% .5W F TC=0+-50	28480	0699-0658
A2R27	0757-0346	2	1	RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A2R28	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R29	0757-0447	4	1	RESISTOR 16.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1622-F
A2R30	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R35	2100-3857	7	1	RESISTOR-VARIABLE 10K +-20%; SPECIAL	28480	2100-3857
A2R36	2100-3858	8	1	RESISTOR-VAR CONTROL CP 50K 20% 10CW	28480	2100-3858
A2R51	0698-8827	4	2	RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-8827
A2R52	0757-0199	3	2	RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2R53	2100-3164	9	2	RESISTOR-TRMR 10 20% C SIDE-ADJ 17-TRN	02111	43P100
A2R54	0698-3429	2	2	RESISTOR 19.6 1% .125W F TC=0+-100	03888	PME55-1/8-T0-19R6-F
A2R56	0757-0401	0	8	RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A2R57	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A2R58	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A2R60	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A2R71	0698-8827	4		RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-8827
A2R72	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2R73	2100-3164	9		RESISTOR-TRMR 10 20% C SIDE-ADJ 17-TRN	02111	43P100
A2R74	0698-3429	2		RESISTOR 19.6 1% .125W F TC=0+-100	03888	PME55-1/8-T0-19R6-F
A2R76	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A2R77	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A2R78	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A2R80	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A2S1	3101-2124	2	1	SWITCH-PB DPDT ALTNG .25A 115VAC	28480	3101-2124
A2S2	3101-2391	5	2	SWITCH-PB 2-STATION 15MM C-C SPACING	28480	3101-2391
A2S3	3101-2391	5		SWITCH-PB 2-STATION 15MM C-C SPACING	28480	3101-2391
A2S4	3101-0499	0	10	SWITCH-PB 5-STATION 10MM C-C SPACING	28480	3101-0499
A2S5	3101-0499	0		SWITCH-PB 5-STATION 10MM C-C SPACING	28480	3101-0499
A2S6	3101-0499	0		SWITCH-PB 5-STATION 10MM C-C SPACING	28480	3101-0499
A2S7	3101-0499	0		SWITCH-PB 5-STATION 10MM C-C SPACING	28480	3101-0499
A2S8	3101-0499	0		SWITCH-PB 5-STATION 10MM C-C SPACING	28480	3101-0499
A2S9	3101-0499	0		SWITCH-PB 5-STATION 10MM C-C SPACING	28480	3101-0499
A2S10	3101-0499	0		SWITCH-PB 5-STATION 10MM C-C SPACING	28480	3101-0499
A2S11	3101-0499	0		SWITCH-PB 5-STATION 10MM C-C SPACING	28480	3101-0499
A2S12	3101-0499	0		SWITCH-PB 5-STATION 10MM C-C SPACING	28480	3101-0499
A2S13	3101-0499	0		SWITCH-PB 5-STATION 10MM C-C SPACING	28480	3101-0499
A2SG1	1970-0078	0	2	TUBE-ELECTRON SURGE V PTCTR	25088	B1-A350/15
A2SG2	1970-0078	0		TUBE-ELECTRON SURGE V PTCTR	25088	B1-A350/15
A2SP1	9160-0273	8	1	LOUD SPEAKER	28480	9160-0273
A2TP3	1251-6947	0	2	CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A2TP4	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A2U2	1820-2132	4	2	IC DRVR CMOS LED DRVR	32293	ICM7218A
A2U3	1820-2132	4		IC DRVR CMOS LED DRVR	32293	ICM7218A
A2U4	1826-0205	0	1	IC TIMER TTL	18324	NE556A
A2U6	1826-0682	7	1	IC AUDIO AMPL PWR 8-DIP-P PKG	27014	LM386N-1
A2U7	1826-0712	4	1	IC OP AMP LOW-BIAS-H-IMPD DUAL 8-DIP-P	27014	LF353N
A2XDS1	1200-0915	3	9	SOCKET-DSPL 14-CONT DIP DIP-SLDR	28480	1200-0915
A2XDS2	1200-0915	3		SOCKET-DSPL 14-CONT DIP DIP-SLDR	28480	1200-0915
A2XDS3	1200-0915	3		SOCKET-DSPL 14-CONT DIP DIP-SLDR	28480	1200-0915
A2XDS4	1200-0915	3		SOCKET-DSPL 14-CONT DIP DIP-SLDR	28480	1200-0915
A2XDS5	1200-0915	3		SOCKET-DSPL 14-CONT DIP DIP-SLDR	28480	1200-0915
A2XDS6	1200-0915	3		SOCKET-DSPL 14-CONT DIP DIP-SLDR	28480	1200-0915
A2XDS7	1200-0915	3		SOCKET-DSPL 14-CONT DIP DIP-SLDR	28480	1200-0915
A2XDS8	1200-0915	3		SOCKET-DSPL 14-CONT DIP DIP-SLDR	28480	1200-0915
A2XDS9	1200-0915	3		SOCKET-DSPL 14-CONT DIP DIP-SLDR	28480	1200-0915
	0340-0992	1	2	INSULATOR TRANSISTOR	28480	0340-0992
	0380-1013	3	2	SPACER-RND .688-IN-LG .115-IN-ID	00000	ORDER BY DESCRIPTION
	2200-0173	6	2	SCREW-MACH 4-40 1-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
	2260-0012	8	2	NUT-HEX-W/LKWR 4-40-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
	2360-0197	2	4	SCREW-MACH 6-32 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2420-0015	1	4	NUT-HEX-W/LKWR 6-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
	5041-0201	6	1	KEY CAP-WHITE (POWER SWITCH)	28480	5041-0201
	5041-1931	1	1	KEY CAP-NOR (REV-TRMT)	28480	5041-1931
	5041-1932	2	1	KEY CAP-REV (REV-TRMT)	28480	5041-1932
	5041-1933	3	1	KEY CAP-DIAL (SETUP-TRMT)	28480	5041-1933
	5041-1934	4	1	KEY CAP-HOLD (SETUP-TRMT-REV)	28480	5041-1934
	5041-1935	5	1	KEY CAP-BRDG (SETUP-REV)	28480	5041-1935
	5041-1936	6	1	KEY CAP-135 (SETUP-TRMT-REV)	28480	5041-1936
	5041-1938	8	1	KEY CAP-600 (SETUP-TRMT-REV)	28480	5041-1938
	5041-1939	**9**	**1**	**KEY CAP-900 (SETUP-TRMT-REV)**	**28480**	**5041-1939**

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

Table 6-3. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3	04935-60004	4	1	RECEIVER BOARD ASSY (STD. UNIT ONLY)	28480	04935-60004
A3C1	0180-3124	8	1	CAPACITOR-FXD 75UF+100-20% 300VDC AL	28480	0180-3124
A3C2	0180-1746	5	3	CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A3C3	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A3C4	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A3C5	0160-0576	5	73	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C6	0160-2213	1	1	CAPACITOR-FXD 620PF +-5% 300VDC MICA	28480	0160-2213
A3C7	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C8	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C9	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C10	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C11	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C12	0160-2225	5	1	CAPACITOR-FXD 2000PF +-5% 300VDC MICA	28480	0160-2225
A3C13	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C14	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C15	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C16	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C17	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C18	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C19	0160-3548	7	10	CAPACITOR-FXD .01UF +-1% 100VDC MICA	28480	0160-3548
A3C21	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C22	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C23	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C24	0140-0190	7	2	CAPACITOR-FXD 39PF +-5% 300VDC MICA	72136	DM15E390J0300WV1CR
A3C25	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C26	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C27	0160-3548	7		CAPACITOR-FXD .01UF +-1% 100VDC MICA	28480	0160-3548
A3C28	0180-0374	3	13	CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A3C29	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A3C31	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C32	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C33	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C34	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A3C35	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A3C36	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A3C37	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C38	0140-0190	7		CAPACITOR-FXD 39PF +-5% 300VDC MICA	72136	DM15E390J0300WV1CR
A3C39	0160-0167	0	2	CAPACITOR-FXD .082UF +-10% 200VDC POLYE	28480	0160-0167
A3C40	0160-0167	0		CAPACITOR-FXD .082UF +-10% 200VDC POLYE	28480	0160-0167
A3C41	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C42	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C43	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C44	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A3C45	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C46	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A3C47	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A3C49	0160-0340	1	1	CAPACITOR-FXD 600PF +-1% 300VDC MICA	28480	0160-0340
A3C50	0160-3291	7	6	CAPACITOR-FXD 1200PF +-1% 100VDC MICA	28480	0160-3291
A3C51	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C52	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C53	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C54	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C55	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C56	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C57*	0160-2222	2	1	CAPACITOR-FXD 1500PF +-5% 300VDC MICA	28480	0160-2222
				(FACT SELECT)		
A3C58	0160-3024	4	10	CAPACITOR-FXD 1700PF +-1% 100VDC MICA	28480	0160-3024
A3C59	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A3C60	0160-5257	7		CAPACITOR-FXD 1100PF +-1% 100VDC MICA	28480	0160-5267
A3C61	0160-3024	4		CAPACITOR-FXD 1700PF +-1% 100VDC MICA	28480	0160-3024
A3C62	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C63	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C64	0180-0197	8	4	CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3C65	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3C66	0160-3024	4		CAPACITOR-FXD 1700PF +-1% 100VDC MICA	28480	0160-3024
A3C67	0160-3024	4		CAPACITOR-FXD 1700PF +-1% 100VDC MICA	28480	0160-3024
A3C68	0160-3024	4		CAPACITOR-FXD 1700PF +-1% 100VDC MICA	28480	0160-3024
A3C69	0160-2387	0	2	CAPACITOR-FXD 1000PF +-1% 500VDC MICA	28480	0160-2387
A3C70	0140-0163	4	3	CAPACITOR-FXD 4751PF +-1% 300VDC MICA	72136	DM20F4751F0300WV1CR
A3C71	0160-2387	0		CAPACITOR-FXD 1000PF +-1% 500VDC MICA	28480	0160-2387
A3C72	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C73	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C74	0160-0839	3	1	CAPACITOR-FXD 110PF +-1% 300VDC MICA	28480	0160-0839
A3C75	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C76	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C77	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C78	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576

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

Table 6-3. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3C79	0140-0163	4		CAPACITOR-FXD 4751PF +-1% 300VDC MICA	72136	DM20F4751F0300WV1CR
A3C80	0160-2534	9	1	CAPACITOR-FXD 30PF +-1% 300VDC MICA	28480	0160-2534
A3C81	0160-0218	2	5	CAPACITOR-FXD 2400PF +-1% 300VDC MICA	28480	0160-0218
A3C82	0160-3291	7		CAPACITOR-FXD 1200PF +-1% 100VDC MICA	28480	0160-3291
A3C83	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C84	0160-0218	2		CAPACITOR-FXD 2400PF +-1% 300VDC MICA	28480	0160-0218
A3C85	0160-3024	4		CAPACITOR-FXD 1700PF +-1% 100VDC MICA	28480	0160-3024
A3C87	0160-3024	4		CAPACITOR-FXD 1700PF +-1% 100VDC MICA	28480	0160-3024
A3C88	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C89	0160-3548	7		CAPACITOR-FXD .01UF +-1% 100VDC MICA	28480	0160-3548
A3C90	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C91	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C92	0160-3548	7		CAPACITOR-FXD .01UF +-1% 100VDC MICA	28480	0160-3548
A3C93	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C94	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C95	0140-0177	0	1	CAPACITOR-FXD 400PF +-1% 300VDC MICA	72136	DM15F401F0300WV1CR
A3C97	0140-0163	4		CAPACITOR-FXD 4751PF +-1% 300VDC MICA	72136	DM20F4751F0300WV1CR
A3C98	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C99	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A3C100	0160-3548	7		CAPACITOR-FXD .01UF +-1% 100VDC MICA	28480	0160-3548
A3C101	0160-3548	7		CAPACITOR-FXD .01UF +-1% 100VDC MICA	28480	0160-3548
A3C102	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C103	0160-3291	7		CAPACITOR-FXD 1200PF +-1% 100VDC MICA	28480	0160-3291
A3C104	0160-0218	2		CAPACITOR-FXD 2400PF +-1% 300VDC MICA	28480	0160-0218
A3C105	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C106	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C107	0160-3291	7		CAPACITOR-FXD 1200PF +-1% 100VDC MICA	28480	0160-3291
A3C108	0160-0218	2		CAPACITOR-FXD 2400PF +-1% 300VDC MICA	28480	0160-0218
A3C109	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C110	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C111	0140-0235	1	1	CAPACITOR-FXD 2250PF +-1% 300VDC MICA	72136	DM20F2250RF0300WV1C
A3C112	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C113	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C114	0160-2537	2	1	CAPACITOR-FXD 360PF +-1% 300VDC MICA	28480	0160-2537
A3C115	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C116	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C117	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C118	0160-3548	7		CAPACITOR-FXD .01UF +-1% 100VDC MICA	28480	0160-3548
A3C119	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C120	0160-3548	7		CAPACITOR-FXD .01UF +-1% 100VDC MICA	28480	0160-3548
A3C121	0160-3024	4		CAPACITOR-FXD 1700PF +-1% 100VDC MICA	28480	0160-3024
A3C122	0160-2219	7	1	CAPACITOR-FXD 1100PF +-5% 300VDC MICA	28480	0160-2219
A3C123	0160-3291	7		CAPACITOR-FXD 1200PF +-1% 100VDC MICA	28480	0160-3291
A3C124	0160-0218	2		CAPACITOR-FXD 2400PF +-1% 300VDC MICA	28480	0160-0218
A3C125	0160-3024	4		CAPACITOR-FXD 1700PF +-1% 100VDC MICA	28480	0160-3024
A3C127	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C131	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C132	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C133	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A3C137	0160-3024	4		CAPACITOR-FXD 1700PF +-1% 100VDC MICA	28480	0160-3024
A3C139	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C140	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C141	0160-3548	7		CAPACITOR-FXD .01UF +-1% 100VDC MICA	28480	0160-3548
A3C142	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C143	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C144	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C145	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C146	0160-3548	7		CAPACITOR-FXD .01UF +-1% 100VDC MICA	28480	0160-3548
A3C147	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C152	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C153	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C154	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C155	0160-2215	3	1	CAPACITOR-FXD 750PF +-5% 300VDC MICA	28480	0160-2215
A3C156	0160-2209	5	1	CAPACITOR-FXD 360PF +-5% 300VDC MICA	28480	0160-2209
A3C157	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3C158	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3C159	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C160				CAPACITOR, HAND SELECTED ONLY IF NEEDED		
A3C201	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C202				CAPACITOR, HAND SELECTED ONLY IF NEEDED		
A3CR1	1901-1068	5	1	DIODE-SM SIG SCHOTTKY	28480	1901-1068
A3CR3	1901-0040	1	2	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR4	5020-5252	3	1	WIRE 2-1/2 IN.(REPL FOR CR4)	28480	5020-5252
A3CR5	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR6	1901-0376	6	15	DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376

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

Table 6-3. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3CR7	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A3CR8	1901-0518	2	6	DIODE-SCHOTTKY	02062	5082-5509
A3CR9	1901-0518	2		DIODE-SCHOTTKY	02062	5082-5509
A3CR10	1901-0376			DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A3CR11	1901-0518	2		DIODE-SCHOTTKY	02062	5082-5509
A3CR12	1901-0518	2		DIODE-SCHOTTKY	02062	5082-5509
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	1901-0518	2		DIODE-SCHOTTKY	02062	5082-5509
A3CR16	1901-0518	2		DIODE-SCHOTTKY	02062	5082-5509
A3CR26	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A3CR27	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A3J1	1250-0257	1	3	CONNECTOR-RF SMB M PC 50-OHM	28480	1250-0257
A3J4	1251-5063	9	1	CONNECTOR 6-PIN M POST TYPE	28480	1251-5063
	1251-6947	0	34	CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A3JU1	1200-0473	8	8	SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0473
	1251-4398	1	2	SHUNT, 4-POSITION	28480	1251-4398
A3JU2	1200-0473	8		SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0473
A3JU3	1200-0473	8		SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0473
A3JU4	1200-0473	8		SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0473
A3JU5	1200-0473	8		SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0473
	1251-4398	1	2	SHUNT, 4-POSITION	28480	1251-4398
A3JU7	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A3R1	0757-0442	9	12	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R2	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R3	0698-4465	8	1	RESISTOR 931 1% .125W F TC=0+-100	24546	C4-1/8-T0-931R-F
A3R4	0698-6393	5	1	RESISTOR 585 1% .125W F TC=0+-25	28480	0698-6393
A3R5	0757-0280	3	6	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R6	0757-0290	5	5	RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A3R7	0757-0290	5		RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A3R8	0757-0290	5		RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A3R9	0698-0084	9	4	RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A3R10	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A3R11	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A3R12	0757-0453	2	1	RESISTOR 30.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3012-F
A3R15	1810-0281	9	2	NETWORK-RES 10-SIP100.0K OHM X 9	01121	210A104
A3R16	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R17	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R18	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R19	0698-3457	6	1	RESISTOR 316K 1% .125W F TC=0+-100	28480	0698-3457
A3R20	1810-0281	9		NETWORK-RES 10-SIP100.0K OHM X 9	01121	210A104
A3R21	1810-0369	4	1	NETWORK-RES 6-SIP100.0K OHM X 5	11236	750-61-R100K
A3R22	0698-6360	6	20	RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A3R23	2100-3882	8	2	RESISTOR-TRMR 2K 10% C TOP-ADJ 17-TRN	28480	2100-3882
A3R26	0698-3152	8	1	RESISTOR 3.48K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3481-F
A3R27	0698-3153	9	1	RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A3R28	0757-6360	6		RESISTOR 10K .1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R29	0698-6320	8	1	RESISTOR 5K .1% .125W F TC=0+-100	24546	C4-1/8-T0-5001-F
A3R30	0757-0416	7	4	RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3R32	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3R33	2100-3883	9	4	RESISTOR-TRMR 5K 10% C TOP-ADJ 17-TRN	28480	2100-3883
A3R34	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R35	0757-0420	9		RESISTOR 10K 1% .125W	24546	CA-1/8-TO-1002-F
A3R36	0698-4480	7	4	RESISTOR 15.8K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1582-F
A3R37	0698-4480	7		RESISTOR 15.8K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1582-F
A3R38	0757-0424	7	1	RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A3R39	0698-3150	6	1	RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A3R40	0757-6360	6		RESISTOR 10K .1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R42	0757-6360	6		RESISTOR 10K .1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R43	0757-0420	9		RESISTOR 10K 1% .125W	24546	CA-1/8-TO-1002-F
A3R44	0698-4480	7		RESISTOR 15.8K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1582-F
A3R45	0698-4480	7		RESISTOR 15.8K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1582-F
A3R46	0698-3155	1	2	RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A3R47	0698-4475	0	1	RESISTOR 9.76K 1% .125W F TC=0+-100	03888	PME55-1/8-T0-9761-F
A3R48	0698-7847	6	3	RESISTOR 1.111K .1% .125W F TC=0+-25	19701	MF4C1/8-T9-111R-B
A3R49	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A3R50	0698-3409	2	1	RESISTOR 2.37K 1% .125W	24546	CA-1/8-TO-2371-F
A3R51	0698-0083	8		RESISTOR 1.96K 1% .125W	24546	CA-1/8-TO-1961-F

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

Table 6-3. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3R52	0757-0864	9	2	RESISTOR 301K 1% .5W F TC=0+-100	28480	0757-0864
A3R53	0757-0864	9		RESISTOR 301K 1% .5W F TC=0+-100	28480	0757-0864
A3R54	0698-3453	2	1	RESISTOR 196K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1963-F
A3R55	0757-0401	0	4	RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3R56	0757-0438	3	1	RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3R57	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A3R58	0757-0199	3	2	RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A3R59	0698-3156	2	1	RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A3R60	0698-6360	6		RESISTOR 10K .1% .125W F TC=0±25	28480	0698-6360
A3R62	0757-0317	6		RESISTOR 1.33K 1% .125W	24546	CA-1/8-TO-131-F
A3R63	0757-0317	6		RESISTOR 1.33K 1% .125W	24546	CA-1/8-TO-131-F
A3R64	0757-0442	7		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R65	2100-3882	8		RESISTOR-TRMR 2K 10% C TOP-ADJ 17-TRN	28480	2100-3882
A3R66	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R67	0698-3157	3	2	RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A3R68	0757-0444	1	1	RESISTOR 12.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1212-F
A3R69	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A3R70	0757-0420	3	2	RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A3R71	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A3R72	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A3R72A	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1001-F
A3R73	0698-3150	2		RESISTOR 2.37K 1% .125W	24546	CA-1/8-TO-2371-F
A3R74	0698-3150			RESISTOR 2.37K 1% .125W	24546	CA-1/8-TO-2371-F
A3R75	0757-0274	5	1	RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1211-F
A3R76	0698-6084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A3R77	2100-3881	7	1	RESISTOR-TRMR 500 10% C TOP-ADJ 17-TRN	28480	2100-3881
A3R78	0757-0465	6	2	RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A3R79	0698-4530	8	1	RESISTOR 232K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2323-F
A3R80	0699-0595	9	1	RESISTOR 365K .1% .125W F TC=0+-25	28480	0699-0595
A3R81	0699-1078	5	1	RESISTOR 134K .1% .125W F TC=0+-25	28480	0699-1078
A3R82	0698-4516	0	1	RESISTOR 113K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1133-F
A3R83	0698-4158	6	2	RESISTOR 100K .1% .125W F TC=0+-50	28480	0698-4158
A3R84	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A3R85	0698-4158	6		RESISTOR 100K .1% .125W F TC=0+-50	28480	0698-4158
A3R86	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A3R87	0698-4490	9	2	RESISTOR 29.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2942-F
A3R88	0698-4490	9		RESISTOR 29.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2942-F
A3R89	0699-0566	4	4	RESISTOR 25.5K .1% .125W F TC=0+-25	28480	0699-0566
A3R90	0699-0566	4		RESISTOR 25.5K .1% .125W F TC=0+-25	28480	0699-0566
A3R91	0757-0280	3		RESISTOR 1K 1% 125W F TC=0+-100	24546	C4-1/8-TO-1001-F
A3R92	0698-7847	6	2	RESISTOR 1.111K .1% .125W F TC=0+-25	19701	MF4C1/8-T9-1111R-B
A3R93	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A3R94	0698-8638	5		RESISTOR 3.16K .1% .125W F TC=0+-25	28480	0698-8638
A3R95	0698-6445	8		RESISTOR 6.838K .1% .125W F TC=0+-25	28480	0698-6445
A3R96	0699-0586	8	1	RESISTOR 186.365K .1% .125W F TC=0+-25	28480	0699-0586
A3R97	0699-0585	7	1	RESISTOR 240.738K .1% .125W F TC=0+-25	28480	0699-0585
A3R98	0698-6467	4	3	RESISTOR 16.9K 1% .125W F TC=0+-50	28480	0698-6467
A3R99	0699-0587	9	1	RESISTOR 12.918K .1% .125W F TC=0+-25	28480	0699-0587
A3R100	0699-0588	0	2	RESISTOR 18.171K .1% .125W F TC=0+-25	28480	0699-0588
A3R102	2100-3883	9		RESISTOR-TRMR 5K 10% C TOP-ADJ 17-TRN	28480	2100-3883
A3R103	0698-7413	2	2	RESISTOR 17.4K .25% .125W F TC=0+-100	19701	MF4C1/8-T0-1742-C
A3R104	0698-6423	2	2	RESISTOR 31.25K .1% .125W F TC=0+-25	28480	0698-6423
A3R105	0698-7413	2		RESISTOR 17.4K .25% .125W F TC=0+-100	19701	MF4C1/8-T0-1742-C
A3R106	0698-8858	1	3	RESISTOR 12.4K .1% .125W F TC=0+-25	28480	0698-8858
A3R107	0698-8858	1		RESISTOR 12.4K .1% .125W F TC=0+-25	28480	0698-8858
A3R108	0698-7929	5	2	RESISTOR 9.09K .1% .125W F TC=0+-50	19701	MF4C1/8-T2-9091-B
A3R109	0698-7929	5		RESISTOR 9.09K .1% .125W F TC=0+-50	19701	MF4C1/8-T2-9091-B
A3R110	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A3R111	0698-6467	4		RESISTOR 16.9K 1% .125W F TC=0+-50	28480	0698-6467
A3R112	0699-0566	4		RESISTOR 25.5K .1% .125W F TC=0+-25	28480	0699-0566
A3R113	0699-0566	4		RESISTOR 25.5K .1% .125W F TC=0+-25	28480	0699-0566
A3R114	0698-6445	8		RESISTOR 6.838K .1% .125W F TC=0+-25	28480	0698-6445
A3R115	0698-8638	5		RESISTOR 3.16K .1% .125W F TC=0+-25	28480	0698-8638
A3R116	0757-0289	2	1	RESISTOR 13.3K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-1332-F
A3R117	0699-0589	1	2	RESISTOR 34.334K .1% .125W F TC=0+-25	28480	0699-0589
A3R118	0699-0589	1		RESISTOR 34.334K .1% .125W F TC=0+-25	28480	0699-0589
A3R119	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A3R120	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A3R121	0699-0588	0		RESISTOR 18.171K .1% .125W F TC=0+-25	28480	0699-0588
A3R122	0698-8858	5	1	RESISTOR 12.4K .1% .125W F TC=0+-25	28480	0698-8858
A3R123	0699-0164	8	1	RESISTOR 738.5 .1% .125W F TC=0+-25	24546	NE55
A3R124	0757-0290	5		RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A3R125	0757-0290	5		RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A3R126	0698-6423	2		RESISTOR 31.25K .1% .125W F TC=0+-25	28480	0698-6423
A3R127	0698-6754	2	1	RESISTOR 44.2K .5% .125W F TC=0+-50	24546	NC4-1/8-T2-4422-D
A3R128	0698-4537	5	1	RESISTOR 357K 1% .125W F TC=0+-100	28480	0698-4537

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

Table 6-3. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3R129	0698-7585	9	1	RESISTOR 316.2 1% .125W F TC=0+-25	28480	0698-7585
A3R132	2100-3883	9		RESISTOR-TRMR 5K 10% C TOP-ADJ 17-TRN	28480	2100-3883
A3R134	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A3R135	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A3R136	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A3R137	0699-0590	4	2	RESISTOR 15.758K .1% .125W F TC=0+-25	28480	0699-0590
A3R138	0698-3456	5	1	RESISTOR 287K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2873-F
A3R139	0699-0596	0	2	RESISTOR 4.12K .1% .125W F TC=0+-25	28480	0699-0596
A3R140	0699-0596	0		RESISTOR 4.12K .1% .125W F TC=0+-25	28480	0699-0596
A3R141	0699-0594	8	2	RESISTOR 2.21K .1% .125W F TC=0+-25	28480	0699-0594
A3R142	0699-0594	8		RESISTOR 2.21K .1% .125W F TC=0+-25	28480	0699-0594
A3R143	0698-8337	1	1	RESISTOR 10.7K .1% .125W F TC=0+-50	19701	MF4C1/8-T2-1072-B
A3R144	0698-8068	5	1	RESISTOR 4.99K .25% .125W F TC=0+-25	19701	MF4C1/8-T9-4991-C
A3R145	0699-0597	1	3	RESISTOR 2.26K .1% .125W F TC=0+-25	28480	0699-0597
A3R146	0698-6447	0	1	RESISTOR 683.8 1% .125W F TC=0+-25	28480	0698-6447
A3R147	0698-6446	9	1	RESISTOR 2.162K 1% .125W F TC=0+-25	28480	0698-6446
A3R148	0699-0592	6	1	RESISTOR 7.741K .1% .125W F TC=0+-25	28480	0699-0592
A3R149	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A3R150	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A3R151	0699-0590	4		RESISTOR 15.758K .1% .125W F TC=0+-25	28480	0699-0590
A3R158	0699-0597	1		RESISTOR 2.26K .1% .125W F TC=0+-25	28480	0699-0597
A3R159	0699-0597	1		RESISTOR 2.26K .1% .125W F TC=0+-25	28480	0699-0597
A3R160	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A3R161	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A3R162	0698-8799	9	1	RESISTOR 21.5K .1% .125W F TC=0+-25	28480	0698-8799
A3R163	0699-0593	7	2	RESISTOR 13.665K .1% .125W F TC=0+-25	28480	0699-0593
A3R164	0699-0593	7		RESISTOR 13.665K .1% .125W F TC=0+-25	28480	0699-0593
A3R165	0699-0600	7	1	RESISTOR 108.502K .1% .125W F TC=0+-25	28480	0699-0600
A3R166	0699-0591	5	1	RESISTOR 140.158K .1% .125W F TC=0+-25	28480	0699-0591
A3R167	0757-0443	0	1	RESISTOR 11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1102-F
A3R176	0698-8638	5		RESISTOR 3.16K .1% .125W F TC=0+-25	28480	0698-8638
A3R177	0698-6445	8		RESISTOR 6.838K .1% .125W F TC=0+-25	28480	0698-6445
A3R178	0698-7847	6		RESISTOR 1.111K .1% .125W F TC=0+-25	19701	MF4C1/8-T9-1111R-B
A3R179	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A3R180	2100-3883	9		RESISTOR-TRMR 5K 10% C TOP-ADJ 17-TRN	28480	2100-3883
A3R181	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R182	0757-0421	4	1	RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A3R183	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R184	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A3R185	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3R187	0698-6467	4		RESISTOR 16.9K 1% .125W F TC=0+-50	28480	0698-6467
A3R201	0757-0458	7	2	RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A3R202	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3R203	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A3R204	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3R205	0698-4002	1		RESISTOR 5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5001-F
A3R206	1810-0369	4		NETWORK-RES 6-SIP 100.0K OHM X5	11236	750-61-R100K
A3R207	0698-6445	8		RESISTOR 6.838K 1% .125W F TC=0+-25	28480	0698-6445
A3R208	5020-5252			WIRE 1/2 IN.	28480	5020-5252
A3T1	9100-3498	3	1	TRANSFORMER-POWER 100/120/220/240V	28480	9100-3498
A3TP2	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A3TP3	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A3TP4	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A3TP5	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A3TP6	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A3TP7	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A3TP9	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A3TP10	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A3TP11	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A3TP12	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A3TP13	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A3TP14	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A3TP15	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A3TP21	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A3TP22	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A3TP23	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A3TP24	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A3TP25	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A3U1	1826-0712	4	4	IC OP AMP LOW-BIAS-H-IMPD DUAL 8-DIP-P	27014	LF353N
A3U2	1826-0138	8	1	IC COMPARATOR CP QUAD 14-DIP-P PKG	01295	LM339N
A3U3	1826-0624	7	1	IC CONV V/FREQ 14-DIP-P PKG	8E175	VFC32KP
A3U4	1826-0686	1	1	IC OP AMP LOW-BIAS-H-IMPD TO-99 PKG	27014	LF351AH
A3U5	1826-0742	0	1	IC PRECISION 10V REFERENCE, AD581J	28480	1826-0742

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

Table 6-3. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3U6	1826-0639	4	1	IC CONV 8-B-D/A 16-DIP-P PKG	24355	AD7524JN
A3U7	1820-1956	8		IC LCH CMOS COM CLOCK QUAD	01928	CD4042BE
A3U8	1820-1956	8	4	IC LCH CMOS COM CLOCK QUAD	01928	CD4042BE
A3U11	1820-1956	8		IC LCH CMOS COM CLOCK QUAD	01928	CD4042BE
A3U12	1820-2326	3	1	IC XLTR CMOS TTL-TO-MOS HEX	04713	MC14504BCP
A3U13	1820-1315	3	1	IC MULTIPLXR 8-CHAN-ANLG 16-DIP-P PKG	01928	CD4051BE
A3U14	1826-0208	8	7	IC OP AMP GP 8-DIP-P PKG	27014	LM310N
A3U15	1826-0667	4	5	IC OP AMP LOW-BIAS-H-IMPD 8-DIP-P PKG	27014	LF351N
A3U16	1826-0712	8		IC OP AMP LOW-BIAS-H-IMPD DUAL 8-DIP-P	27014	LF353N
A3U17	1820-1956	9		IC LCH CMOS COM CLOCK QUAD	01928	CD4042BE
A3U20	1826-0741		1	IC OP AMP LOW-BIAS-H-IMPD DUAL TO-99 PKG	04713	MC34002AG
A3U21	1826-0735	1	8	IC OP AMP H-SLEW-RATE 8-DIP-P PKG	34371	HA3-2507-5
A3U22	1826-0735	1		IC OP AMP H-SLEW-RATE 8-DIP-P PKG	34371	HA3-2507-5
A3U23	1826-0735	1		IC OP AMP H-SLEW-RATE 8-DIP-P PKG	34371	HA3-2507-5
A3U24	1826-0735	1		IC OP AMP H-SLEW-RATE 8-DIP-P PKG	34371	HA3-2507-5
A3U25	1826-0735	1		IC OP AMP H-SLEW-RATE 8-DIP-P PKG	34371	HA3-2507-5
A3U26	1826-0208	3		IC OP AMP GP 8-DIP-P PKG	27014	LM310N
A3U27	1826-0740	8	4	IC SWITCH ANLG DUAL 16-DIP-C PKG	32293	IH5043CDE
A3U28	1826-0208	3		IC OP AMP GP 8-DIP-P PKG	27014	LM310N
A3U29	1826-0208	3		IC OP AMP GP 8-DIP-P PKG	27014	LM310N
A3U30	1826-0735	1		IC OP AMP H-SLEW-RATE 8-DIP-P PKG	34371	HA3-2507-5
A3U31	1826-0665	6	4	IC OP AMP LOW-BIAS-H-IMPD QUAD 14-DIP-P	27014	LF347BN
A3U32	1826-0712	4		IC OP AMP LOW-BIAS-H-IMPD DUAL 8-DIP-P	27014	LF353N
A3U33	1826-0208	3		IC OP AMP GP 8-DIP-P PKG	27014	LM310N
A3U34	1826-0740	8		IC SWITCH ANLG DUAL 16-DIP-C PKG	32293	IH5043CDE
A3U35	1826-0740	8		IC SWITCH ANLG DUAL 16-DIP-C PKG	32293	IH5043CDE
A3U36	1826-0665	6		IC OP AMP LOW-BIAS-H-IMPD QUAD 14-DIP-P	27014	LF347BN
A3U37	1820-1725	9	2	IC MULTIPLXR ANLG 16-DIP-P PKG	17856	DG508CJ
A3U38	1826-0735	1		IC OP AMP H-SLEW-RATE 8-DIP-P PKG	34371	HA3-2507-5
A3U39	1820-1725	9		IC MULTIPLXR ANLG 16-DIP-P PKG	17856	DG508CJ
A3U40	1826-0665	6		IC OP AMP LOW-BIAS-H-IMPD QUAD 14-DIP-P	27014	LF347BN
A3U42	1826-0736	2	1	IC OP AMP WB 8-DIP-P PKG	34371	HA3-2627-5
A3U43	1826-0667	8		IC OP AMP LOW-BIAS-H-IMPD 8-DIP-P PKG	27014	LF351N
A3U44	1826-0667	8		IC OP AMP LOW-BIAS-H-IMPD 8-DIP-P PKG	27014	LF351N
A3U45	1826-0667	8		IC OP AMP LOW-BIAS-H-IMPD 8-DIP-P PKG	27014	LF351N
A3U46	1826-0712	4		IC OP AMP LOW-BIAS-H-IMPD DUAL 8-DIP-P	27014	LF353N
A3U47	1826-0532	6	1	IC OP AMP GP QUAD 14-DIP-C PKG	34371	HA1-4605-5
A3U48	1826-0208	3		IC OP AMP GP 8-DIP-P PKG	27014	LM310N
A3U50	1826-0740	8		IC SWITCH ANLG DUAL 16-DIP-C PKG	32293	IH5043CDE
A3U51	1826-0665	6		IC OP AMP LOW-BIAS-H-IMPD QUAD 14-DIP-P	27014	LF347BN
A3U52	1826-0208	3		IC OP AMP GP 8-DIP-P PKG	27014	LM310N
A3U55	1826-0735	1		IC OP AMP H-SLEW-RATE 8-DIP-P PKG	34371	HA3-2507-5
A3U56	1826-0667	8		IC OP AMP LOW-BIAS-H-IMPD 8-DIP-P PKG	27014	LF351N
A3UX7	1200-0473	8		SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0473
A3UX8	1200-0473	8		SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0473
A3UX17	1200-0473	8		SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0473
				A3 MISCELLANEOUS PARTS		
	2260-0002	6	2	NUT-HEX-DBL-CHAM 4-40-THD .062-IN-THK	00000	ORDER BY DESCRIPTION
	2260-0012	8	2	NUT-HEX-W/LKWR 4-40-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
	8150-0456	7	1	WIRE 24AWG W 300V PVC 7X32 80C	28480	8150-0456
	0380-1157	6	1	SNAP IN SPACER	00509	TCBS-4N

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

Table 6-3. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A4	04935-60303			TRANSMITTER BOARD (STD UNIT ONLY)	28480	04935-60303
A4C1	0160-3963	0	3	CAPACITOR-FXD 15UF +-5% 50VDC MET-POLYC	28480	0160-3963
A4C2	0160-3963	0		CAPACITOR-FXD 15UF +-5% 50VDC MET-POLYC	28480	0160-3963
A4C3	0160-3963	0		CAPACITOR-FXD 15UF +-5% 50VDC MET-POLYC	28480	0160-3963
A4C4	0160-0576	5	39	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A4C5	0180-3045	1	2	CAPACITOR-FXD 2200UF+50-10% 25VDC AL	28480	0180-3045
A4C6	0180-2945	8	2	CAPACITOR-FXD 100UF+50-10% 35VDC AL	28480	0180-2945
A4C7	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A4C8	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A4C9	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A4C10	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A4C11	0180-3045	1		CAPACITOR-FXD 2200UF+50-10% 25VDC AL	28480	0180-3045
A4C12	0180-2945	8		CAPACITOR-FXD 100UF+50-10% 35VDC AL	28480	0180-2945
A4C13	0160-3456	9	2	CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A4C14	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A4C15	0180-3044	0	1	CAPACITOR-FXD 3300UF+50-10% 16VDC AL	28480	0180-3044
A4C16	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A4C17	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A4C20	0160-3456	9		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A4C21	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A4C22	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A4C23	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A4C24	0160-2257	3	1	CAPACITOR-FXD 10PF +-5% 500VDC CER 0+-60	28480	0160-2257
A4C26	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A4C28	0160-0576	5		CAPACITOR-FXD .10UF +-20% 50VDC CER	28480	0160-0576
A4C29	0160-0576	5		CAPACITOR-FXD .10UF +-20% 50VDC CER	28480	0160-0576
A4C30	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A4C31	0180-3050	8		CAPACITOR-FXD 330UF +50-10% 16VDC AL	28480	0180-3050
A4C32	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A4C33	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A4C34	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A4C35	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A4C36	0180-0058	0	1	CAPACITOR-FXD 50UF+75-10% 25VDC AL	56289	30D506G025CC2
A4C37	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A4C38	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A4C39	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A4C40	0160-3094	2	3	CAPACITOR-FXD 1UF +-10% 25VDC CER	28480	0160-3094
A4C41	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A4C42	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A4C43	0160-3291	7	2	CAPACITOR-FXD 1200PF +-1% 100VDC MICA	28480	0160-3291
A4C44	0160-3291	7		CAPACITOR-FXD 1200PF +-1% 100VDC MICA	28480	0160-3291
A4C45	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A4C46	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A4C47	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A4C48	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A4C49	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A4C50	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A4C51	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A4C52	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A4C53	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A4C54	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A4C55	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A4C56	0180-3124	7	1	CAPACITOR-75 300 N.P.	28480	0180-T02710
A4C62	0180-0197	8	2	CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A4C63	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A4C64	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A4C65	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A4C67	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A4C68	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A4C69	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A4C70	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A4C71	0180-0374	3	1	CAPACITOR-FXD 10UF +-10% 20VDC TA	56289	150D106X9020B2
A3C72	0180-1746	5	1	CAPACITOR-FXD 15UF +-10% 20VDC TAR	56289	150D156X9020B2-DYS
A4C73	0160-4833	5	1	CAPACITOR-FXD 022UF +-20% 100VDC CER	28480	0160-4833
A4C74	0160-4835	7	1	CAPACITOR-FXD 1UF +-10% 50VDC CER	28480	0160-4835
A4C75	0180-0291	3	1	CAPACITOR-FXD 1UF +-10% 35VDC CER	28480	0180-0291
A4CP1	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A4CR1	1902-0041	4	2	DIODE-ZNR 5.11V 5% DO-35 PD=.4W	28480	1902-0041
A4CR4	1901-0033	2	7	DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A4CR6	1901-0731	7	9	DIODE-PWR RECT 400V 1A	28480	1901-0731
A4CR7	1902-3214	6	3	DIODE-ZNR 16.2V 2% DO-35 PD=.4W	28480	1902-3214
A4CR9	1901-0731	7		DIODE-PWR RECT 400V 1A	28480	1901-0731
A4CR10	1901-0731	7		DIODE-PWR RECT 400V 1A	28480	1901-0731
A4CR11	1901-0731	7		DIODE-PWR RECT 400V 1A	28480	1901-0731
A4CR12	1901-0731	7		DIODE-PWR RECT 400V 1A	28480	1901-0731
A4CR13	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A4CR14	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033

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

Table 6-3. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A4CR15	1902-3214	6		DIODE-ZNR 16.2V 2% DO-35 PD=.4W	28480	1902-3214
A4CR16	1901-0731	7		DIODE-PWR RECT 400V 1A	28480	1901-0731
A4CR17	1901-0731	9	4	DIODE-PWR RECT 400V 1A	28480	1901-0731
A4CR18	1901-0731	9		DIODE-PWR RECT 400V 1A	28480	1901-0731
A4CR19	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A4CR20	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A4CR23	1902-3214	6		DIODE-ZNR 16.2V 2% DO-35 PD=.4W	28480	1902-3214
A4CR24	1884-0250	7	1	THYRISTOR-TRIAC TO-220AB	01928	T2500B
A4CR25	1902-3105	4		DIODE-ZNR 5.62V 5% DO-35 PD=.4W	28480	1902-3105
A4CR26	1901-0731	7		DIODE-PWR RECT 400V 1A	28480	1901-0731
A4CR27	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A4CR28	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A4CR29	1902-0202	9	2	DIODE-ZNR 15V 5% DO-15 PD=1W TC=+.057%	28480	1902-0202
A4CR30	1902-0202	9		DIODE-ZNR 15V 5% DO-15 PD=1W TC=+.057%	28480	1902-0202
A4CSA1	1251-6947	0	30	CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A4CSA2	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A4J2	1251-6856	0	1	CONNECTOR 18-PIN M POST TYPE	28480	1251-6856
A4J3	1251-4573	4	1	CONNECTOR-PC EDGE 25-CONT/ROW 2-ROWS	28480	1251-4573
A4JU1	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A4JU2	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
	1258-0141	5	5	JUMPER-REMOVABLE FOR 0.025 IN SQ PINS	28480	1258-0141
A4JU5	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
	1258-0141	5		JUMPER-REMOVABLE FOR 0.025 IN SQ PINS	28480	1258-0141
A4JU6	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
	1258-0141	5		JUMPER-REMOVABLE FOR 0.025 IN SQ PINS	28480	1258-0141
A4JU14	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
	1258-0141	5		JUMPER-REMOVABLE FOR 0.025 IN SQ PINS	28480	1258-0141
A4JU-14	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
	1258-0141	5		JUMPER-REMOVABLE FOR 0.025 IN SQ PINS	28480	1258-0141
A4JW1	5020-5252	3	3	WIRE-2-1/2 IN	28480	5020-5252
A4JW2	5020-5252	3		WIRE-2-1/2 IN	28480	5020-5252
A4JW3	5020-5252	3		WIRE-2-1/2 IN.	28480	5020-5252
A4JW4	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A4Q1	1853-0512	9	3	TRANSISTOR PNP PD=50W FT= 20MHZ	28480	1853-0512
A4Q2	1854-0575	6	1	TRANSISTOR NPN SI PD=625MW FT= 50MHZ	04713	MPS-A42
A4Q3	1853-0512	9		TRANSISTOR PNP PD=50W FT= 20MHZ	28480	1853-0512
A4Q4	1853-0512	9		TRANSISTOR PNP PD=50W FT= 20MHZ	28480	1853-0512
A4Q5	1853-0012	4	1	TRANSISTOR PNP 2N2904A SI TO-39 PD=600MW	01295	2N2904A
A4Q6	1854-0053	5	1	TRANSISTOR NPN 2N2218 SI TO-5 PD=800MW	04713	2N2218
A4Q7	1853-0036	2	1	TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A4R1	0757-0465	6	6	RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A4R2	0698-6360	6	2	RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A4R3	0757-0819	4	1	RESISTOR 909 1% .5W F TC=0+-100	28480	0757-0819
A4R4	0757-0442	9	19	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4R5	0698-8827	4	4	RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-8827
A4R6	0698-8826	3	3	RESISTOR 825K 1% .125W F TC=0+-100	28480	0698-8826
A4R7	0698-8826	3		RESISTOR 825K 1% .125W F TC=0+-100	28480	0698-8826
A4R8	0698-8827	4		RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-8827
A4R9	0698-8827	4		RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-8827
A4R10	0698-8826	3		RESISTOR 825K 1% .125W F TC=0+-100	28480	0698-8826
A4R11	0698-8824	1	1	RESISTOR 562K 1% .125W F TC=0+-100	28480	0698-8824
A4R12	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4R13	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A4R14	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A4R16	0698-3440	7	1	RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A4R17	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A4R19	0757-0280	3	4	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A4R20	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4R21	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4R22	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4R23	0757-0288	1	1	RESISTOR 9.09K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-9091-F
A4R24	0757-0420	3	7	RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A4R25	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A4R27	0698-0083	8	2	RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A4R28	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A4R29	1810-0207	9	1	NETWORK-RES 8-SIP22.0K OHM X 7	01121	208A223
A4R30	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A4R31	2100-3882	8	2	RESISTOR-TRMR 2K 10% C TOP-ADJ 17-TRN	28480	2100-3882
A4R33	0757-0416	7	1	RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A4R34	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F

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

Table 6-3. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A4R35	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4R36	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CA-1/8-TO-1002-1F
A4R37	0757-0317	7	1	RESISTOR 1.33K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1331-F
A4R38	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A4R39	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A4R40	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A4R41	0757-0280	3	3	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A4R42	2100-3881	7	2	RESISTOR-TRMR 500 10% C TOP-ADJ 17-TRN	28480	2100-3881
A4R43	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A4R44	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A4R45	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4R46	0757-0458	7	3	RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A4R47	0698-3156	2	1	RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A4R48	0698-3152	8	1	RESISTOR 3.48K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3481-F
A4R49	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A4R52	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4R53	0698-3160	8	5	RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A4R54	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4R55	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A4R56	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A4R57	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A4R58	0698-3451	0	1	RESISTOR 133K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1333-F
A4R59	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4R60	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A4R60	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4R61	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A4R62	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A4R63	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4R64	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A4R65	0757-0421	4	2	RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A4R66	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4R67	0757-0443	0	1	RESISTOR 11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1102-F
A4R68	0757-0441	8	1	RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A4R69	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A4R70	0757-0421	3		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-TO-825R
A4R71	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4R72	2100-3881	7		RESISTOR-TRMR 500 10% C TOP-ADJ 17-TRN	28480	2100-3881
A4R73	0757-0279	0	2	RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A4R74	2100-3882	7		RESISTOR-TRMR 2K 10% C TOP-ADJ 17-TRN	28480	2100-3882
A4R75	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4R76	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4R77	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4R78	0757-0180	2	2	RESISTOR 31.6 1% .125W F TC=0+-100	28480	0757-0180
A4R79	0757-0180	2		RESISTOR 31.6 1% .125W F TC=0+-100	28480	0757-0180
A4R80	0757-0428	1		RESISTOR 1.62K 1% .125W	02995	MF4C-1
A4R81	0757-0431	6	1	RESISTOR 2.43K 1% .125W	02995	MF4C-1
A4R82	0698-0084	9	1	RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A4R83	0698-7498	5	1	RESISTOR 600 .1% .125W F TC=0+-50	19701	MF4C1/8-T2-600R-B
A4R92	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A4R93	0698-8827	4		RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-8827
A4R94	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4R95	0757-0394	0	1	RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A4R96	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4R97	0698-3150	0		RESISTOR 2.37K 1% .125W	02995	MF4C-1
A4R98	0757-0280	3		RESISTOR 1K 1% .125W	02273	CEA-993
A4R99	0698-3157	0		RESISTOR 19.6K 1% .125W	02273	CEA-993
A4R100	0757-0428	1		RESISTOR 1.62K 1% .125W	02995	MF4C-1
A4S/S	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A4T1	9100-2647	8	1	TRANSFORMER, AUDIO	28480	9100-2647
A4TP1	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A4TP2	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A4TP3	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A4TP4	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A4TP5	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A4TP6	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A4TP7	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A4TP8	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A4TP9	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A4TP10	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A4TP11	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A4U1	1826-0679	2	1	IC OP AMP LOW-BIAS-H-IMPD TO-99 PKG	01928	CA3140AT
A4U2	1820-1932	0	2	IC MV CMOS MONOSTBL RETRIG/RESET DUAL	04713	MC14538BCP
A4U3	1820-1932	0		IC MV CMOS MONOSTBL RETRIG/RESET DUAL	04713	MC14538BCP
A4U4	1820-0939	5	3	IC FF CMOS D-TYPE POS-EDGE-TRIG DUAL	01928	CD4013AF
A4U5	1820-0939	5		IC FF CMOS D-TYPE POS-EDGE-TRIG DUAL	01928	CD4013AF

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

Table 6-3. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A4U6	1820-2472	5	1	MICROPROCESSOR MK3872	28480	1820-2472
A4U7	1820-1827	2	1	IC DCDR CMOS 4-TO-16-LINE	27014	MM74C154N
A4U8	1826-0728	2	2	IC PRECISION GEN. PURPOSE VOLT REG.	28480	SG1532J
A4U9	1826-0411	0	2	IC TIMER CMOS	04713	MC14536BCP
A4U10	1826-0411	0		IC TIMER CMOS	04713	MC14536BCP
A4U11	1820-1956	8	7	IC LCH CMOS COM CLOCK QUAD	0192B	CD4042BE
A4U12	1820-1956	8		IC LCH CMOS COM CLOCK QUAD	0192B	CD4042BE
A4U13	1820-2566	8	1	IC BFR CMOS LINE DRVR QUAD	27014	MM74C240N
A4U14	1826-0728	2		IC PRECISION GEN. PURPOSE VOLT. REG.	28480	SG1532J
A4U15	1820-1745	3	1	IC GATE CMOS NOR QUAD 2-INP	04713	MC14001BCP
A4U16	1820-2576	0	3	IC GATE CMOS NAND QUAD 2-INP	04713	MC14011BCL
A4U17	1820-2576	0		IC GATE CMOS NAND QUAD 2-INP	04713	MC14011BCL
A4U18	1820-0939	5		IC FF CMOS D-TYPE POS-EDGE-TRIG DUAL	0192B	CD4013AF
A4U19	1820-2576	0		IC GATE CMOS NAND QUAD 2-INP	04713	MC14011BCL
A4U20	1820-1960	4	1	IC GATE CMOS NAND DUAL 4-INP	04713	MC14012BCP
A4U21	1826-0667	8	1	IC OP AMP LOW-BIAS-H-IMPD 8-DIP-P PKG	27014	LF351N
A4U23	1820-1977	3	1	IC OSC ECL	04713	MC12061P
A4U24	1826-0712	4	1	IC OP AMP LOW-BIAS-H-IMPD DUAL 8-DIP-P	27014	LF353N
A4U25	1826-0138	8	1	IC COMPARATOR GP QUAD 14-DIP-P PKG	01295	LM339N
A4U26	1820-1956	8		IC LCH CMOS COM CLOCK QUAD	0192B	CD4042BE
A4U27	1820-1956	8		IC LCH CMOS COM CLOCK QUAD	0192B	CD4042BE
A4U28	1820-1956	8		IC LCH CMOS COM CLOCK QUAD	0192B	CD4042BE
A4U29	1820-1956	8		IC LCH CMOS COM CLOCK QUAD	0192B	CD4042BE
A4U30	1820-1956	8		IC LCH CMOS COM CLOCK QUAD	0192B	CD4042BE
A4U32	1820-1478	0	1	IC CNTR ASYNCHRO	01698	SN57246N
A4U33	**1826-0508**	6	1	IC CONV 10-B-D/A 16-DIP-C PKG	24355	AD561JD
A4U34	1820-1441	6	5	IC ADDR TTL LS BIN FULL ADDR 4-BIT	01295	SN74LS283N
A4U35	1820-1441	6		IC ADDR TTL LS BIN FULL ADDR 4-BIT	01295	SN74LS283N
A4U36	1820-1441	6		IC ADDR TTL LS BIN FULL ADDR 4-BIT	01295	SN74LS283N
A4U37	1820-1441	6		IC ADDR TTL LS BIN FULL ADDR 4-BIT	01295	SN74LS283N
A4U38	1820-1441	6		IC ADDR TTL LS BIN FULL ADDR 4-BIT	01295	SN74LS283N
A4U40	1826-0779	3	1	IC MULTIPLXR 4-CHAN-ANLG DUAL 16-DIP-P	24355	AD7502JN
A4U41	1826-0735	1	4	IC OP AMP H-SLEW-RATE 8-DIP-P PKG	34371	HA3-2507-5
A4U42	1826-0686	1		IC OP AMP LOW-BIAS-H-IMPD TO-99 PKG	27014	1826-0686
A4U43	1818-1574	1	1	IC NMOS 32768 (32K) ROM 450-NS 3-S	55576	SYP2332 MASKED
A4U44	1820-1730	6	3	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A4U45	1820-1195	7	1	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS175N
A4U46	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A4U47	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A4U48	1820-1112	8	2	IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A4U49	1820-1199	1	1	IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A4U50	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A4U52	1826-0735	1		IC OP AMP H-SLEW-RATE 8-DIP-P PKG	34371	HA3-2507-5
A14U53	1826-0735	1		IC OP AMP H-SLEW-RATE 8-DIP-P PKG	34371	HA3-2507-5
A4XU6	1200-0654	4	1	SOCKET-IC 40-CONT DIP-SLDR	28480	1200-0654
A4XU32	1200-0638		1	SOCKET-IC 14 PIN	28480	1200-0638
A4Y1	0410-1180	0	1	CRYSTAL-4.000MHZ	28480	0410-1180
A4Y2	0410-1220	9	1	CRYSTAL-4.1984304MHZ	28480	0410-1220
				A4 MISCELLANEOUS PARTS		
	0360-0124	3	13	CONNECTOR-SGL CONT PIN .04-IN-BSC-SZ RND	28480	0360-0124
	1200-0666	1	3	SOCKET-XSTR 3-CONT POWER DIP-SLDR	28480	1200-0666
	1251-4259	3	5	CONNECTOR-SGL CONT PIN .031-IN-BSC-SZ	28480	1251-4259
	1251-5063	9	1	CONNECTOR 6-PIN M POST TYPE	28480	1251-5063

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

Table 6-3. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A5	04935-60005	5	1	BATTERY CHARGER BOARD(OPT'S 001 & 003)	28480	04935-60005
A5C1	0180-0291	3	1	CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A5C2	0180-1746	5	1	CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A5C3	0180-0097	7	1	CAPACITOR-FXD 47UF+-10% 35VDC TA	56289	150D476X9035B2
A5C4	0160-0576	5	5	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A5C5	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A5C6	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A5C7	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A5C8	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A5CR1	1901-0050	3	20	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A5CR2	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A5CR3	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A5CR4	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A5CR5	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A5CR6	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A5CR10	1901-1091	4	3	DIODE-PWR RECT 50V 5A 200NS	03508	A115F
A5CR12	1902-0041	4	1	DIODE-ZNR 5.11V 5% DO-35 PD=.4W	28480	1902-0041
A5CR14	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A5CR15	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A5CR16	1902-0554	4	1	DIODE-ZNR 10V 5% DO-15 PD=1W TC=+.06%	28480	1902-0554
A5CR17	1902-0184	6	2	DIODE-ZNR 16.2V 5% DO-35 PD=.4W	28480	1902-0184
A5CR18	1902-0184	6		DIODE-ZNR 16.2V 5% DO-35 PD=.4W	28480	1902-0184
A5CR19	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A5CR20	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A5CR21	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A5CR22	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A5CR23	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A5CR24	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A5CR25	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A5CR26	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A5CR27	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A5CR28	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A5CR29	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A5CR30	1901-1091	4		DIODE-PWR RECT 50V 5A 200NS	03508	A115F
A5CR31	1901-1091	4		DIODE-PWR RECT 50V 5A 200NS	03508	A115F
A5F1	2110-0568	2	3	FUSE 4A 125V .281X.093	75915	276004
A5F2	2110-0568	2		FUSE 4A 125V .281X.093	75915	276004
A5F3	2110-0568	2		FUSE 4A 125V .281X.093	75915	276004
A5J2	1251-4245	7	2	CONNECTOR 2-PIN M POST TYPE	28480	1251-4245
A5J3	1251-4245	7		CONNECTOR 2-PIN M POST TYPE	28480	1251-4245
A5J4	1251-4246	8	1	CONNECTOR 3-PIN M POST TYPE	28480	1251-4246
A5K1	0490-0569	5	1	RELAY 4C 24VDC-COIL 2A 115VAC	28480	0490-0569
A5Q1	1853-0406	0	2	TRANSISTOR PNP 2N6476 SI TO-220AB PD=40W	01928	2N6476
A5Q2	1854-0575	6	1	TRANSISTOR NPN SI PD=625MW FT=50MHZ	04713	MPS-A42
A5Q3	1853-0036	2	5	TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A5Q4	1854-0215	1	4	TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A5Q5	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A5Q8	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A5Q9	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A5Q10	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A5Q11	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A5Q12	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A5Q13	1854-0727	0	1	TRANSISTOR NPN 2N6474 SI TO-220AB PD=40W	01928	2N6474
A5Q14	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A5Q15	1853-0406	0		TRANSISTOR PNP 2N6476 SI TO-220AB PD=40W	01928	2N6476
A5R1	0757-0418	9	2	RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-T0-619R-F
A5R2	0757-0465	6	3	RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A5R3	0757-0458	7	1	RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A5R4	0757-0442	9	5	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A5R5	0757-0280	3	4	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A5R7	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A5R8	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A5R9	0699-0653	0	3	RESISTOR 121.78K .1% .125W F TC=0+-25	28480	0699-0653
A5R10	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A5R11	0699-0591	5	2	RESISTOR 140.158K .1% .125W F TC=0+-25	28480	0699-0591
A5R13	0698-6358	2	1	RESISTOR 100K .1% .125W F TC=0+-25	28480	0698-6358
A5R14	0699-0653	0		RESISTOR 121.78K .1% .125W F TC=0+-25	28480	0699-0653
A5R16	0699-0653	0		RESISTOR 121.78K .1% .125W F TC=0+-25	28480	0699-0653
A5R17	0699-0591	5		RESISTOR 140.158K .1% .125W F TC=0+-25	28480	0699-0591
A5R19	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F

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

Table 6-3. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A5R20	0757-0984	4	2	RESISTOR 10 1% .5W F TC=0+-100	28480	0757-0984
A5R21	0698-3409	8	4	RESISTOR 2.37K 1% .5W F TC=0+-100	28480	0698-3409
A5R22	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A5R23	0698-3409	8		RESISTOR 2.37K 1% .5W F TC=0+-100	28480	0698-3409
A5R24	0698-3409	8		RESISTOR 2.37K 1% .5W F TC=0+-100	28480	0698-3409
A5R25	0698-3150	6	1	RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A5R27	0698-6360	6	4	RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A5R28	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A5R29	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A5R30	0698-0083	8	1	RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A5R31	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A5R32	0757-0418	9		RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-T0-619R-F
A5R33	0757-0984	4		RESISTOR 10 1% .5W F TC=0+-100	28480	0757-0984
A5R34	0811-1673	6	1	RESISTOR 3.9 5% 2W PW TC=0+-400	75042	BWH2-3R9-J
A5R35	0698-3409	8		RESISTOR 2.37K 1% .5W F TC=0+-100	28480	0698-3409
A5R36	0698-3404	3	1	RESISTOR 383 1% .5W F TC=0+-100	28480	0698-3404
A5R37	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A5R38	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A5R39	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A5R40	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A5TP1	0360-0124	3	2	CONNECTOR-SGL CONT PIN .04-IN-BSC-SZ RND	28480	0360-0124
A5TP2	0360-0124	3		CONNECTOR-SGL CONT PIN .04-IN-BSC-SZ RND	28480	0360-0124
A5U1	1826-0138	8	1	IC COMPARATOR GP QUAD 14-DIP-P PKG	01295	LM339N
A5U2	1826-0712	4	1	IC OP AMP LOW-BIAS-H-IMPD DUAL 8-DIP-P	27014	LF353N
	0490-0570	8	1	SOCKET-RLY 6-CONT CRADLE PC	28480	0490-0570
	0490-0628	7	1	STRAP-RELAY HOLD DOWN FOR PC SOCKETS	28480	0490-0628
	1205-0512	9	3	HEAT SINK SGL TO-220-CS	28480	1205-0512
	1251-6859	3	1	CONNECTOR 18-PIN F POST TYPE	28480	1251-6859
	8120-3181	8	2	CABLE ASSY-FLEX COND	28480	8120-3181

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

Table 6-3. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A6	04935-60108	8	1	REAR PANEL ASSEMBLY	28480	04935-60108
A6LF1	0960-0443	1	1	LINE MODULE-FILTER	28480	0960-0443
A6T1	9100-4205	8	1	TRANSFORMER-AC POWER	28480	9100-4205
	0360-1251	9	1	TERMINAL-SLDR LUG PL-MTG FOR-#12-SCR	28480	0360-1251
	0890-0271	4		TUBING-HS .187-D/.093-RCVD .025-WALL PVC	00000	ORDER BY DESCRIPTION
	0890-0100	9	1	TUBING-HS .093-D/.046-RCVD .02-WALL	28480	0890-0100
	1400-0249	0	6	CABLE TIE .062-.625-DIA .091-WD NYL	06383	PLT1M-8
	1400-1077	4	2	CLIP-MOUNTING ASSEMBLY FOR MOUNTING LFI	05245	45-1676
	1510-0038	8	1	BINDING POST ASSY SGL THD-STUD	28480	1510-0038
	2190-0023	2	1	WASHER-LK HLCL 1/4 IN .255-IN-ID	28480	2190-0023
	2360-0242	8	4	SCREW-MACH 6-32 1.25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2420-0015	1	4	NUT-HEX-W/LKWR 6-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
	2950-0006	3	1	NUT-HEX-DBL-CHAM 1/4-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
	8150-2846	3		WIRE 18AWG G/Y 300V PVC 19X30 105C	28480	8150-2846
	04935-00001	5	1	REAR PANEL (BLANK)	28480	04935-00001

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

Table 6-3. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A13	04935-60006	6	1	RECEIVER BOARD WITH PAR	28480	04935-60006
A13C1	0180-3124	7	1	CAPACITOR-FXD 750UF+100-20% 300VDC AL	28480	0180-3124
A13C2	0180-1746	5	3	CAPACITOR-FXD 150UF+-10% 20VDC TA	56289	150D156X9020B2
A13C3	0180-1746	5		CAPACITOR-FXD 150UF+-10% 20VDC TA	56289	150D156X9020B2
A13C4	0180-1746	5		CAPACITOR-FXD 150UF+-10% 20VDC TA	56289	150D156X9020B2
A13C5	0160-0576	5	76	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C6	0160-2213	1	1	CAPACITOR-FXD 620PF +-5% 300VDC MICA	28480	0160-2213
A13C7	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C8	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C9	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C10	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C11	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C12	0160-2225	5	1	CAPACITOR-FXD 2000PF +-5% 300VDC MICA	28480	0160-2225
A13C13	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C14	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C15	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C16	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C17	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C18	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C19	0160-3548	7	10	CAPACITOR-FXD .01UF +-1% 100VDC MICA	28480	0160-3548
A13C21	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C22	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C23	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C24	0140-0190	7	2	CAPACITOR-FXD 39PF +-5% 300VDC MICA	72136	DM15E390J0300WV1CR
A13C25	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C26	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C27	0160-3548	7		CAPACITOR-FXD .01UF +-1% 100VDC MICA	28480	0160-3548
A13C28	0180-0374	3	14	CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A13C29	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A13C31	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C32	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C33	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C34	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A13C35	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A13C36	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A13C37	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C38	0140-0190	7		CAPACITOR-FXD 39PF +-5% 300VDC MICA	72136	DM15E390J0300WV1CR
A13C41	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C42	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C43	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C44	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A13C45	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C46	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A13C47	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A13C48	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A13C49	0160-0340	1	1	CAPACITOR-FXD 600PF +-1% 300VDC MICA	28480	0160-0340
A13C50	0160-3291	7	6	CAPACITOR-FXD 1200PF +-1% 100VDC MICA	28480	0160-3291
A13C51	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C52	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C56	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C57	0160-2222	2	1	CAPACITOR-FXD 1500PF +-5% 300VDC MICA	28480	0160-2222
A13C58	0160-3024	4	14	CAPACITOR-FXD 1700PF +-1% 100VDC MICA	28480	0160-3024
A13C59	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A13C60	0160-5257	9		CAPACITOR-FXD 1100PF +-1% 100VDC MICA	28480	0160-5257
A13C61	0160-3024	4		CAPACITOR-FXD 1700PF +-1% 100VDC MICA	28480	0160-3024
A13C62	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C63	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C64	0180-0197	8	4	CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A13C65	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A13C66	0160-3024	4		CAPACITOR-FXD 1700PF +-1% 100VDC MICA	28480	0160-3024
A13C67	0160-3024	4		CAPACITOR-FXD 1700PF +-1% 100VDC MICA	28480	0160-3024
A13C68	0160-3024	4		CAPACITOR-FXD 1700PF +-1% 100VDC MICA	28480	0160-3024
A13C69	0160-2387	0	1	CAPACITOR-FXD 1000PF +-1% 500VDC MICA	28480	0160-2387
A13C70	0140-0163	4	3	CAPACITOR-FXD 4751PF +-1% 300VDC MICA	72136	DM20F4751F0300WV1CR
A13C71	0160-2387	9	1	CAPACITOR-FXD 1000PF +-1% 500VDC MICA	28480	0160-2387
A13C72	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C73	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C74	0160-0839	3	1	CAPACITOR-FXD 110PF +-1% 300VDC MICA	28480	0160-0839
A13C75	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C76	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576

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

Table 6-3. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A13C77	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C78	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C79	0140-0163	4		CAPACITOR-FXD 4751PF +-1% 300VDC MICA	72136	DM20F4751F0300WV1CR
A13C80	0160-2534	9	1	CAPACITOR-FXD 300PF +-1% 300VDC MICA	28480	0160-2534
A13C81	0160-0218	2	5	CAPACITOR-FXD 2400PF +-1% 300VDC MICA	28480	0160-0218
A13C82	0160-3291	7		CAPACITOR-FXD 1200PF +-1% 100VDC MICA	28480	0160-3291
A13C83	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C84	0160-0218	2		CAPACITOR-FXD 2400PF +-1% 300VDC MICA	28480	0160-0218
A13C85	0160-3024	4		CAPACITOR-FXD 1700PF +-1% 100VDC MICA	28480	0160-3024
A13C87	0160-3024	4		CAPACITOR-FXD 1700PF +-1% 100VDC MICA	28480	0160-3024
A13C88	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C89	0160-3548	7		CAPACITOR-FXD .01UF +-1% 100VDC MICA	28480	0160-3548
A13C90	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C91	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C92	0160-3548	7		CAPACITOR-FXD .01UF +-1% 100VDC MICA	28480	0160-3548
A13C93	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C94	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C95	0140-0177	0	1	CAPACITOR-FXD 400PF +-1% 300VDC MICA	72136	DM15F401F0300WV1CR
A13C97	0140-0163	4		CAPACITOR-FXD 4751PF +-1% 300VDC MICA	72136	DM20F4751F0300WV1CR
A13C98	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C99	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A13C100	0160-3548	7		CAPACITOR-FXD .01UF +-1% 100VDC MICA	28480	0160-3548
A13C101	0160-3548	7		CAPACITOR-FXD .01UF +-1% 100VDC MICA	28480	0160-3548
A13C102	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C103	0160-3291	7		CAPACITOR-FXD 1200PF +-1% 100VDC MICA	28480	0160-3291
A13C104	0160-0218	2		CAPACITOR-FXD 2400PF +-1% 300VDC MICA	28480	0160-0218
A13C105	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C106	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C107	0160-3291	7		CAPACITOR-FXD 1200PF +-1% 100VDC MICA	28480	0160-3291
A13C108	0160-0218	2		CAPACITOR-FXD 2400PF +-1% 300VDC MICA	28480	0160-0218
A13C109	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C110	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C111	0140-0235	1	1	CAPACITOR-FXD 2250PF +-1% 300VDC MICA	72136	DM20F2250RF0300WV1C
A13C112	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C113	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C114	0160-2537	2	1	CAPACITOR-FXD 360PF +-1% 300VDC MICA	28480	0160-2537
A13C115	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C116	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C117	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C118	0160-3548	7		CAPACITOR-FXD .01UF +-1% 100VDC MICA	28480	0160-3548
A13C119	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C120	0160-3548	7		CAPACITOR-FXD .01UF +-1% 100VDC MICA	28480	0160-3548
A13C121	0160-3024	4		CAPACITOR-FXD 1700PF +-1% 100VDC MICA	28480	0160-3024
A13C122	0160-2219	7	1	CAPACITOR-FXD 1100PF +-5% 300VDC MICA	28480	0160-2219
A13C123	0160-3291	7		CAPACITOR-FXD 1200PF +-1% 100VDC MICA	28480	0160-3291
A13C124	0160-0218	2		CAPACITOR-FXD 2400PF +-1% 300VDC MICA	28480	0160-0218
A13C125	0160-3024	4		CAPACITOR-FXD 1700PF +-1% 100VDC MICA	28480	0160-3024
A13C126	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C127	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C131	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C132	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C133	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A13C134	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C135	0160-3024	4		CAPACITOR-FXD 1700PF +-1% 100VDC MICA	28480	0160-3024
A13C136	0160-3024	4		CAPACITOR-FXD 1700PF +-1% 100VDC MICA	28480	0160-3024
A13C137	0160-3024	4		CAPACITOR-FXD 1700PF +-1% 100VDC MICA	28480	0160-3024
A13C139	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C140	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C141	0160-3548	7		CAPACITOR-FXD .01UF +-1% 100VDC MICA	28480	0160-3548
A13C142	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C143	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C144	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C145	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C146	0160-3548	7		CAPACITOR-FXD .01UF +-1% 100VDC MICA	28480	0160-3548
A13C147	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C148	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C149	0160-3024	4		CAPACITOR-FXD 1700PF +-1% 100VDC MICA	28480	0160-3024
A13C150	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C151	0160-3024	4		CAPACITOR-FXD 1700PF +-1% 100VDC MICA	28480	0160-3024
A13C152	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576

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

Table 6-3. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A13C153	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C154	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C155	0160-2215	3	1	CAPACITOR-FXD 750PF +-5% 300VDC MICA	28480	0160-2215
A13C156	0160-2209	5	1	CAPACITOR-FXD 360PF +-5% 300VDC MICA	28480	0160-2209
A13C157	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A13C158	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A13C159	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C160				CAPACITOR HAND SELECTED ONLY IF NEEDED	28480	
A13C201	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A13C202				CAPACITOR HAND SELECTED ONLY IF NEEDED		
A13CR1	1901-1068	5	1	DIODE-SM SIG SCHOTTKY	28480	1901-1068
A13CR3	1901-0040	1	3	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A13CR4	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A13CR5	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A13CR6	1901-0376	6	15	DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A13CR7	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A13CR8	1901-0518	2	6	DIODE-SCHOTTKY	02062	5082-5509
A13CR9	1901-0518	2		DIODE-SCHOTTKY	02062	5082-5509
A13CR10	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A13CR11	1901-0518	2		DIODE-SCHOTTKY	02062	5082-5509
A13CR12	1901-0518	2		DIODE-SCHOTTKY	02062	5082-5509
A13CR15	1901-0518	2		DIODE-SCHOTTKY	02062	5082-5509
A13CR16	1901-0518	2		DIODE-SCHOTTKY	02062	5082-5509
A13CR26	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A13CR27	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A13J1	1250-0257	1	3	CONNECTOR-RF SMB M PC 50-OHM	28480	1250-0257
A13J4	1251-5063	9	1	CONNECTOR 6-PIN M POST TYPE	28480	1251-5063
A13J4	1251-6947	0	1	CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A13JU1	1200-0473	8	7	SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0473
A13JU1	1251-4398	1	2	SHUNT,4-POSITION	28480	1251-4398
A13JU2	1200-0473	8		SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0473
A13JU3	1200-0473	8		SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0473
A13JU4	1200-0473	8		SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0473
A13JU5	1200-0473	8		SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0473
A13JU5	1251-4398	1		SHUNT,4-POSITION	28480	1251-4398
A13JU6	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A13JU7	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A13JW2	5020-5252	3	1	WIRE-2-1/2 IN.	28480	5020-5252
A13R1	0757-0442	9	9	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A13R2	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A13R3	0698-4465	8	1	RESISTOR 931 1% .125W F TC=0+-100	24546	C4-1/8-T0-931R-F
A13R4	0698-6393	5	1	RESISTOR 585 1% .125W F TC=0+-25	28480	0698-6393
A13R5	0757-0280	3	2	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A13R6	0757-0290	5	5	RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A13R7	0757-0290	5		RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A13R8	0757-0290	5		RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A13R9	0698-0084	9	4	RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A13R10	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A13R11	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A13R12	0757-0453	2	1	RESISTOR 30.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3012-F
A13R15	1810-0281	9	2	NETWORK-RES 10-SIP100.0K OHM X 9	01121	210A104
A13R16	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A13R17	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A13R18	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A13R19	0698-3457	6	1	RESISTOR 316K 1% .125W F TC=0+-100	28480	0698-3457
A13R20	1810-0281	9		NETWORK-RES 10-SIP100.0K OHM X 9	01121	210A104
A13R21	1810-0369	4	1	NETWORK-RES 6-SIP100.0K OHM X 5	11236	750-61-R100K
A13R22	0698-6360	6	23	RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A13R23	2100-3882	8	3	RESISTOR-TRMR 2K 10% C TOP-ADJ 17-TRN	28480	2100-3882
A13R24	0698-3153	9	2	RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A13R25	0698-4445	4	1	RESISTOR 5.76K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5761-F
A13R26	0698-3152	8	1	RESISTOR 3.48K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3481-F
A13R27	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A13R28	0757-6360	6		RESISTOR 10K.1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A13R29	0698-6320	8	2	RESISTOR 5K.1% .125W F TC=0+-100	24546	C4-1/8-T0-5001-F
A13R30	0757-0416	7	5	RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A13R31	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A13R32	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F

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

Table 6-3. Replaceable Parts (Continued)

Reference Designation	HP Part Number	CD	Qty	Description	Mfr Code	Mfr Part Number
A13R33	2100-3883	9	4	RESISTOR-TRMR 5K 10% C TOP-ADJ 17-TRN	28480	2100-3883
A13R34	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A13R35	0757-0420	9		RESISTOR 10K 1% .125W	24546	CA-1/8-T0-1002-F
A13R36	0698-4480	7	4	RESISTOR 15.8K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1582-F
A13R37	0698-4480	7		RESISTOR 15.8K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1582-F
A13R38	0757-0424	7	1	RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A13R39	0698-3150	6	1	RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A13R40	0757-6360	2		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A13R42	0757-6360	2		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A13R43	0757-0420	9		RESISTOR 10K 1% .125W	24546	CA-1/8-T0-1002-F
A13R44	0698-4480	7		RESISTOR 15.8K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1582-F
A13R45	0698-4480	7		RESISTOR 15.8K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1582-F
A13R46	0698-3155	1	2	RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A13R47	0698-4475	0	1	RESISTOR 9.76K 1% .125W F TC=0+-100	03888	PME55-1/8-T0-9761-F
A13R48	0698-7847	6	4	RESISTOR 1.111K .1% .125W F TC=0+-25	19701	MF4C1/8-T9-1111R-B
A13R49	0698-6360	6	5	RESISTOR 10K 1% .125W F TC=0+-25	28480	0698-6360
A13R50	0698-3409	2		RESISTOR 2.37K 1% .125W	24546	CA-1/8-T0-2371-F
A13R51	0698-0083	8		RESISTOR 1.96K 1% .125W	24546	CA-1/8-T0-1961-F
A13R54	0698-3453	2	1	RESISTOR 196K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1963-F
A13R55	0757-0401	0	4	RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A13R56	0757-0438	3	1	RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A13R57	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A13R58	0757-0199	3	2	RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A13R60	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A13R61	0757-0465	6	3	RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A13R62	0757-0317	6		RESISTOR 1.33K 1% .125W	24546	CA-1/8-T0-1331-F
A13R63	0757-0317	6		RESISTOR 1.33K 1% .125W	24546	CA-1/8-T0-1331-F
A13R64	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A13R65	2100-3882	8		RESISTOR-TRMR 2K 10% C TOP-ADJ 17-TRN	28480	2100-3882
A13R66	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A13R67	0698-3157	3	2	RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A13R68	0757-0444	1	1	RESISTOR 12.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1212-F
A13R69	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A13R70	0757-0420	3	2	RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A13R71	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A13R72	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A13R72A	0757-0280	3	2	RESISTOR 1K 1% 125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A13R73	0698-3150	2		RESISTOR 2.37K 1% .125W	24546	CA-1/8-T0-2371-F
A13R74	0698-3150			RESISTOR 2.37K 1% .125W	24546	CA-1/8-T0-2371-F
A13R75	0757-0274	5	1	RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1211-F
A13R76	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A13R77	2100-3881	7	1	RESISTOR-TRMR 500 10% C TOP-ADJ 17-TRN	28480	2100-3881
A13R78	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A13R79	0698-4530	8	1	RESISTOR 232K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2323-F
A13R80	0699-0595	9	1	RESISTOR 365K .1% .125W F TC=0+-25	28480	0699-0595
A13R81	0699-1078	3	1	RESISTOR 134K .1% .125W F TC=0+-25	28480	0699-1078
A13R82	0698-4516	0	1	RESISTOR 113K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1133-F
A13R83	0698-4158	6	2	RESISTOR 100K .1% .125W F TC=0+-50	28480	0698-4158
A13R84	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A13R85	0698-4158	6		RESISTOR 100K .1% .125W F TC=0+-50	28480	0698-4158
A13R86	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A13R87	0698-4490	9	2	RESISTOR 29.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2942-F
A13R88	0698-4490	9		RESISTOR 29.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2942-F
A13R89	0699-0566	4	4	RESISTOR 25.5K .1% .125W F TC=0+-25	28480	0699-0566
A13R90	0699-0566	4		RESISTOR 25.5K .1% .125W F TC=0+-25	28480	0699-0566
A13R91	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A13R92	0698-7847	6	2	RESISTOR 1.111K .1% .125W F TC=0+-25	19701	MF4C1/8-T9-1111R-B
A13R93	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A13R94	0698-8638	5		RESISTOR 3.16K .1% .125W F TC=0+-25	28480	0698-8638
A13R95	0698-6445	8		RESISTOR 6.838K .1% .125W F TC=0+-25	28480	0698-6445
A13R96	0699-0586	8	1	RESISTOR 186.365K .1% .125W F TC=0+-25	28480	0699-0586
A13R97	0699-0585	7	1	RESISTOR 240.738K .1% .125W F TC=0+-25	28480	0699-0585
A13R98	0698-6467	4	3	RESISTOR 16.9K 1% .125W F TC=0+-50	28480	0698-6467
A13R99	0699-0587	9	1	RESISTOR 12.918K .1% .125W F TC=0+-25	28480	0699-0587
A13R100	0699-0588	0	2	RESISTOR 18.171K .1% .125W F TC=0+-25	28480	0699-0588
A13R102	2100-3883	9		RESISTOR-TRMR 5K 10% C TOP-ADJ 17-TRN	28480	2100-3883
A13R103	0698-7413	2	2	RESISTOR 17.4K .25% .125W F TC=0+-100	19701	MF4C1/8-T0-1742-C
A13R104	0698-6423	2	2	RESISTOR 31.25K .1% .125W F TC=0+-25	28480	0698-6423
A13R105	0698-7413	2		RESISTOR 17.4K .25% .125W F TC=0+-100	19701	MF4C1/8-T0-1742-C
A13R106	0698-8858	1	2	RESISTOR 12.4K .1% .125W F TC=0+-25	28480	0698-8858
A13R107	0698-8858	1		RESISTOR 12.4K .1% .125W F TC=0+-25	28480	0698-8858
A13R108	0698-7929	5	2	RESISTOR 9.09K .1% .125W F TC=0+-50	19701	MF4C1/8-T2-9091-B
A13R109	0698-7929	5		RESISTOR 9.09K .1% .125W F TC=0+-50	19701	MF4C1/8-T2-9091-B
A13R110	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A13R111	0698-6467	4		RESISTOR 16.9K 1% .125W F TC=0+-50	28480	0698-6467

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

Table 6-3. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A13R112	0699-0566	4		RESISTOR 25.5K .1% .125W F TC=0+-25	28480	0699-0566
A13R113	0699-0566	4		RESISTOR 25.5K .1% .125W F TC=0+-25	28480	0699-0566
A13R114	0698-6445	8		RESISTOR 6.836K .1% .125W F TC=0+-25	28480	0698-6445
A13R115	0698-8638	5		RESISTOR 3.16K .1% .125W F TC=0+-25	28480	0698-8638
A13R116	0757-0289	2	1	RESISTOR 13.3K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-1332-F
A13R117	0699-0589	1	2	RESISTOR 34.334K .1% .125W F TC=0+-25	28480	0699-0589
A13R118	0699-0589	1		RESISTOR 34.334K .1% .125W F TC=0+-25	28480	0699-0589
A13R119	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A13R120	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A13R121	0699-0588	0		RESISTOR 18.171K .1% .125W F TC=0+-25	28480	0699-0588
A13R122	0698-8858	5	1	RESISTOR 12.4K 1% .125W F TC=0+-25	28480	0698-8858
A13R123	0699-0164	8	1	RESISTOR 738.5 1% .125W F TC=0+-25	28480	0699-0164
A13R124	0757-0290	3		RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A13R125	0757-0290	5		RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A13R126	0698-6423	2		RESISTOR 31.25K .1% .125W F TC=0+-25	28480	0698-6423
A13R127	0698-6754	2	1	RESISTOR 44.2K .5% .125W F TC=0+-50	24546	NC4-1/8-T2-4422-D
A13R128	0698-4537	5	1	RESISTOR 357K 1% .125W F TC=0+-100	28480	0698-4537
A13R129	0698-7585	9	1	RESISTOR 316.2 1% .125W F TC=0+-25	28480	0698-7585
A13R132	2100-3883	9		RESISTOR-TRMR 5K 10% C TOP-ADJ 17-TRN	28480	2100-3883
A13R134	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A13R135	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A13R136	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A13R137	0699-0590	4	2	RESISTOR 15.758K .1% .125W F TC=0+-25	28480	0699-0590
A13R138	0698-3456	5	1	RESISTOR 287K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2873-F
A13R139	0699-0596	0	2	RESISTOR 4.12K .1% .125W F TC=0+-25	28480	0699-0596
A13R140	0699-0596	0		RESISTOR 4.12K .1% .125W F TC=0+-25	28480	0699-0596
A13R141	0699-0594	8	2	RESISTOR 2.21K .1% .125W F TC=0+-25	28480	0699-0594
A13R142	0699-0594	8		RESISTOR 2.21K .1% .125W F TC=0+-25	28480	0699-0594
A13R143	0698-8337	1	1	RESISTOR 10.7K .1% .125W F TC=0+-50	19701	MF4C1/8-T2-1072-B
A13R144	0698-8068	5	1	RESISTOR 4.99K .25% .125W F TC=0+-25	19701	MF4C1/8-T9-4991-C
A13R145	0699-0597	1	3	RESISTOR 2.26K .1% .125W F TC=0+-25	28480	0699-0597
A13R146	0698-6447	0	1	RESISTOR 683.8 1% .125W F TC=0+-25	28480	0698-6447
A13R147	0698-6446	9		RESISTOR 2.162K 1% .125W F TC=0+-25	28480	0698-6446
A13R148	0699-0592	6	1	RESISTOR 7.741K .1% .125W F TC=0+-25	28480	0699-0592
A13R149	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A13R150	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A13R151	0699-0590	4		RESISTOR 15.758K .1% .125W F TC=0+-25	28480	0699-0590
A13R152	0757-0462	3	1	RESISTOR 75K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7502-F
A13R153	2100-3884	0	2	RESISTOR-TRMR 10K 10% C TOP-ADJ 17-TRN	28480	2100-3884
A13R154	0698-4520	6	2	RESISTOR 143K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1433-F
A13R155	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A13R156	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A13R157	0698-4505	7	2	RESISTOR 71.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7152-F
A13R158	0699-0597	1		RESISTOR 2.26K .1% .125W F TC=0+-25	28480	0699-0597
A13R159	0699-0597	1		RESISTOR 2.26K .1% .125W F TC=0+-25	28480	0699-0597
A13R160	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A13R161	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A13R162	0698-8799	9	1	RESISTOR 21.5K .1% .125W F TC=0+-25	28480	0698-8799
A13R163	0699-0593	7	2	RESISTOR 13.665K .1% .125W F TC=0+-25	28480	0699-0593
A13R164	0699-0593	7		RESISTOR 13.665K .1% .125W F TC=0+-25	28480	0699-0593
A13R165	0699-0600	7	1	RESISTOR 108.502K .1% .125W F TC=0+-25	28480	0699-0600
A13R166	0699-0591	5	1	RESISTOR 140.156K .1% .125W F TC=0+-25	28480	0699-0591
A13R167	0757-0443	0	1	RESISTOR 11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1102-F
A13R168	0698-4520	6		RESISTOR 143K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1433-F
A13R169	0757-0461	2	2	RESISTOR 68.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6812-F
A13R170	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A13R171	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A13R172	0698-4505	7		RESISTOR 71.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7152-F
A13R173	0757-0463	4	1	RESISTOR 82.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8252-F
A13R174	0757-0461	2		RESISTOR 68.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6812-F
A13R175	2100-3884	0		RESISTOR-TRMR 10K 10% C TOP-ADJ 17-TRN	28480	2100-3884
A13R178	0698-7847	6		RESISTOR 1.111K .1% .125W F TC=0+-25	19701	MF4C1/8-T9-1111R-B
A13R179	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A13R180	2100-3883	9		RESISTOR-TRMR 5K 10% C TOP-ADJ 17-TRN	28480	2100-3883
A13R182	0757-0421	4	1	RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A13R183	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A13R184	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A13R185	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A13R186	2100-3882	8		RESISTOR-TRMR 2K 10% C TOP-ADJ 17-TRN	28480	2100-3882
A13R187	0698-6467	4		RESISTOR 16.9K 1% .125W F TC=0+-50	28480	0698-6467
A13R201	0757-0458	7	2	RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A13R202	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F

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

Table 6-3. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A13R203	0757-0448	7		RESISTOR 51.1K .1% .125W F TC=0+-100	24546	C4-1/8-TO-5112-F
A13R204	0757-0401	0		RESISTOR 100 .1% .125W F TC=0+-100	24546	C4-1/8-TO-101-F
A13R205	0698-4002	9		RESISTOR 5K .1% .125W F TC=0+-100	24546	C4-1/8-TO-5001-F
A13R206	1810-0369	4		NETWORK-RES 6-SIP 100.0K OHM X5	11236	750-61-R100K
A13R207	0698-6445	8		RESISTOR 6.838K .1% .125W F TC=0+-25	28480	0698-6445
A13R208	5020-5252			WIRE, 1/2 IN.	28480	5020-5252
A3T1	9100-3498	9		TRANSFORMER-POWER 100/120/220/240V	28480	9100-3498
A13TP2	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A13TP3	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A13TP4	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A13TP5	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A13TP6	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A13TP7	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A13TP9	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A13TP10	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A13TP11	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A13TP12	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A13TP13	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A13TP14	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A13TP15	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A13TP21	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A13TP22	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A13TP23	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A13TP24	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A13TP25	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A13U1	1826-0712	4	5	IC OP AMP LOW-BIAS-H-IMPD DUAL 8-DIP-P	27014	LF353N
A13U2	1826-0138	8	1	IC COMPARATOR GP QUAD 14-DIP-P PKG	01295	LM339N
A13U3	1826-0624	7	1	IC CONV V/FREQ 14-DIP-P PKG	9E175	VFC32KP
A13U4	1826-0686	1	1	IC OP AMP LOW-BIAS-H-IMPD TO-99 PKG	27014	LF351AH
A13U5	1826-0742	0	1	IC PRECISION 10V RET AD581J	28480	1826-0742
A13U6	1826-0639	4	1	IC CONV 8-B-D/A 16-DIP-P PKG	24355	AD7524JN
A13U7	1820-1956	8	4	IC LCH CMOS COM CLOCK QUAD	0192B	CD4042BE
A13U7	1200-0473	8		SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0473
A13U8	1820-1956	8		IC LCH CMOS COM CLOCK QUAD	0192B	CD4042BE
A13U11	1820-1956	8		IC LCH CMOS COM CLOCK QUAD	0192B	CD4042BE
A13U12	1820-2326	8	1	IC XLTR CMOS TTL-TO-MOS HEX	04713	MC14504BCP
A13U13	1820-1315	3	1	IC MULTIPLXR 8-CHAN-ANLG 16-DIP-P PKG	0192B	CD4051BE
A13U14	1826-0208	3	7	IC OP AMP GP 8-DIP-P PKG	27014	LM310N
A13U15	1826-0667	8	5	IC OP AMP LOW-BIAS-H-IMPD 8-DIP-P PKG	27014	LF351N
A13U16	1826-0712	4		IC OP AMP LOW-BIAS-H-IMPD DUAL 8-DIP-P	27014	LF353N
A13U17	1820-1956	8		IC LCH CMOS COM CLOCK QUAD	0192B	CD4042BE
A13U17	1200-0473	8		SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0473
A13U20	1826-0741	9	1	IC OP AMP LOW-BIAS-H-IMPD DUAL TO-99 PKG	04713	MC34002AG
A13U21	1826-0735	1	9	IC OP AMP H-SLEW-RATE 8-DIP-P PKG	34371	HA3-2507-5
A13U22	1826-0735	1		IC OP AMP H-SLEW-RATE 8-DIP-P PKG	34371	HA3-2507-5
A13U23	1826-0735	1		IC OP AMP H-SLEW-RATE 8-DIP-P PKG	34371	HA3-2507-5
A13U24	1826-0735	1		IC OP AMP H-SLEW-RATE 8-DIP-P PKG	34371	HA3-2507-5
A13U25	1826-0735	1		IC OP AMP H-SLEW-RATE 8-DIP-P PKG	34371	HA3-2507-5
A13U26	1826-0208	3		IC OP AMP GP 8-DIP-P PKG	27014	LM310N
A13U28	1826-0208	3		IC OP AMP GP 8-DIP-P PKG	27014	LM310N
A13U29	1826-0208	3		IC OP AMP GP 8-DIP-P PKG	27014	LM310N
A13U30	1826-0735	1		IC OP AMP H-SLEW-RATE 8-DIP-P PKG	34371	HA3-2507-5
A13U31	1826-0665	6	5	IC OP AMP LOW-BIAS-H-IMPD QUAD 14-DIP-P	27014	LF347BN
A13U32	1826-0712	4		IC OP AMP LOW-BIAS-H-IMPD DUAL 8-DIP-P	27014	LF353N
A13U33	1826-0208	3		IC OP AMP GP 8-DIP-P PKG	27014	LM310N
A13U34	1826-0740	8	3	IC SWITCH ANLG DUAL 16-DIP-C PKG	32293	IH5043CDE
A13U35	1826-0740	8		IC SWITCH ANLG DUAL 16-DIP-C PKG	32293	IH5043CDE
A13U36	1826-0665	6		IC OP AMP LOW-BIAS-H-IMPD QUAD 14-DIP-P	27014	LF347BN
A13U37	1820-1725	9	2	IC MULTIPLXR ANLG 16-DIP-P PKG	17856	DG508CJ
A13U38	1826-0735	1		IC OP AMP H-SLEW-RATE 8-DIP-P PKG	34371	HA3-2507-5
A13U39	1820-1725	9		IC MULTIPLXR ANLG 16-DIP-P PKG	17856	DG508CJ
A13U40	1826-0665	6		IC OP AMP LOW-BIAS-H-IMPD QUAD 14-DIP-P	27014	LF347BN
A13U42	1826-0736	2	1	IC OP AMP WB 8-DIP-P PKG	34371	HA3-2627-5
A13U43	1826-0667	8		IC OP AMP LOW-BIAS-H-IMPD 8-DIP-P PKG	27014	LF351N
A13U44	1826-0667	8		IC OP AMP LOW-BIAS-H-IMPD 8-DIP-P PKG	27014	LF351N
A13U45	1826-0667	8		IC OP AMP LOW-BIAS-H-IMPD 8-DIP-P PKG	27014	LF351N
A13U46	1826-0712	4		IC OP AMP LOW-BIAS-H-IMPD DUAL 8-DIP-P	27014	LF353N
A13U47	1826-0532	6	1	IC OP AMP GP QUAD 14-DIP-C PKG	34371	HA1-4605-5
A13U48	1826-0208	3		IC OP AMP GP 8-DIP-P PKG	27014	LM310N
A13U50	1826-0740	8		IC SWITCH ANLG DUAL 16-DIP-C PKG	32293	IH5043CDE
A13U51	1826-0665	6		IC OP AMP LOW-BIAS-H-IMPD QUAD 14-DIP-P	27014	LF347BN
A13U52	1826-0208	3		IC OP AMP GP 8-DIP-P PKG	27014	LM310N
A13U53	1826-0665	6		IC OP AMP LOW-BIAS-H-IMPD QUAD 14-DIP-P	27014	LF347BN
A13U54	1826-0712	4		IC OP AMP LOW-BIAS-H-IMPD DUAL 8-DIP-P	27014	LF353N
A13U55	1826-0735	1		IC OP AMP H-SLEW-RATE 8-DIP-P PKG	34371	HA3-2507-5
A13U56	1826-0667	8		IC OP AMP LOW-BIAS-H-IMPD 8-DIP-P PKG	27014	LF351N

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

Table 6-3. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A13UX7	1200-0473	8		SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0473
A13UX8	1200-0473	8		SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0473
A13UX17	1200-0473	8		SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0473
				A13 MISCELLANEOUS PARTS		
	2260-0002	6	2	NUT-HEX-DBL-CHAM 4-40-THD .062-IN-THK	00000	ORDER BY DESCRIPTION
	2260-0012	8	2	NUT-HEX-W/LKWR 4-40-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
	8150-0456	7	1	WIRE 24AWG W 300V PVC 7X32 80C	28480	8150-0456
	0380-1157	6	1	SNAP IN SPACER	00509	TCBS-4N

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

Table 6-3. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A14	04935-60307	7	1	TRANSMITTER BOARD WITH PAR	28480	04935-60307
A14C1	0160-3963	0	3	CAPACITOR-FXD .15UF +-5% 50VDC MET-POLYC	28480	0160-3963
A14C2	0160-3963	0		CAPACITOR-FXD .15UF +-5% 50VDC MET-POLYC	28480	0160-3963
A14C3	0160-3963	0		CAPACITOR-FXD .15UF +-5% 50VDC MET-POLYC	28480	0160-3963
A14C4	0160-0576	5	44	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A14C5	0180-3045	1	2	CAPACITOR-FXD 2200UF+50-10% 25VDC AL	28480	0180-3045
A14C6	0180-2945	8	2	CAPACITOR-FXD 100UF+50-10% 35VDC AL	28480	0180-2945
A14C7	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A14C8	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A14C9	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A14C10	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A14C11	0180-3045	1		CAPACITOR-FXD 2200UF+50-10% 25VDC AL	28480	0180-3045
A14C12	0180-2945	8		CAPACITOR-FXD 100UF+50-10% 35VDC AL	28480	0180-2945
A14C13	0160-3456	9	2	CAPACITOR-FXD 1000PF 10 % 1KVDC CER	28480	0160-3456
A14C14	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A14C15	0180-3044	0	1	CAPACITOR-FXD 3300UF+50-10% 16VDC AL	28480	0180-3044
A14C16	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A14C17	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A14C20	0160-3456	9		CAPACITOR-FXD 1000PF 10% 1KVDC CER	28480	0160-3456
A14C21	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A14C22	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A14C23	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A14C24	0160-2257	3	1	CAPACITOR-FXD 10PF +-5% 500VDC CER 0+-60	28480	0160-2257
A14C25	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A14C26	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A14C27	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A14C28	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A14C29	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A14C30	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A14C31	0180-3050	8	1	CAPACITOR-FXD 330UF+50-10% 16VDC AL	28480	0180-3050
A14C32	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A14C33	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A14C34	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A14C35	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A14C36	0180-0058	0	1	CAPACITOR-FXD 50UF+75-10% 25VDC AL	56289	30D506G025CC2
A14C37	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A14C38	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A14C39	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A14C40	0160-3094	2	3	CAPACITOR-FXD .1UF +-10% 25VDC CER	28480	0160-3094
A14C41	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A14C42	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A14C43	0160-3291	7	2	CAPACITOR-FXD 1200PF +-1% 100VDC MICA	28480	0160-3291
A14C44	0160-3291	7		CAPACITOR-FXD 1200PF +-1% 100VDC MICA	28480	0160-3291
A14C45	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A14C46	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A14C47	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A14C48	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A14C49	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A14C50	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A14C51	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A14C52	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A14C53	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A14C54	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A14C55	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A14C56	0180-3124	7	1	CAPACITOR- 75 300 N.P.	28480	0180-T02710
A14C57	0160-4135	0	3	CAPACITOR-FXD 4700PF +-1% 300VDC MICA	28480	0160-4135
A14C58	0160-4135	0		CAPACITOR-FXD 4700PF +-1% 300VDC MICA	28480	0160-4135
A14C59	0160-4135	0		CAPACITOR-FXD 4700PF +-1% 300VDC MICA	28480	0160-4135
A14C60	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A14C61	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A14C62	0180-0197	8	2	CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A14C63	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A14C64	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A14C66	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A14C67	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A14C68	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A14C69	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A14C70	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A14C71	0180-0374	3	1	CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A14C72	0180-1746	5		CAPACITOR-FXD 15UF +-10% 20VDC TA	28480	0180-1746
A14C73	0160-4833	5		CAPACITOR-FXD .022UF +-10% 100VDC CER	28480	0160-4833
A14C74	0160-4835	7		CAPACITOR-FXD 1UF +-10% 50VDC CER	28480	0160-4835
A14C75	0180-0291	3		CAPACITOR-FXD 1UF +-10% 35VDC CER	28480	0180-0291

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

Table 6-3. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A14CR1	1902-0041	4	2	DIODE-ZNR 5.11V 5% DO-35 PD=.4W	28480	1902-0041
A14CR4	1901-0033	2	7	DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A14CR6	1901-0731	7	7	DIODE-PWR RECT 400V 1A	28480	1901-0731
A14CR7	1902-3214	6	3	DIODE-ZNR 16.2V 5% DO-35 PD=.4W	28480	1902-3214
A14CR9	1901-0731	7		DIODE-PWR RECT 400V 1A	28480	1901-0731
A14CR10	1901-0731	7		DIODE-PWR RECT 400V 1A	28480	1901-0731
A14CR11	1901-0731	7		DIODE-PWR RECT 400V 1A	28480	1901-0731
A14CR12	1901-0731	7		DIODE-PWR RECT 400V 1A	28480	1901-0731
A14CR13	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A14CR14	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A14CR15	1902-3214	6		DIODE-ZNR 16.2V 2% DO-35 PD=.4W	28480	1902-3214
A14CR16	1901-0731	7		DIODE-PWR RECT 400V 1A	28480	1901-0731
A14CR17	1901-0731	9	4	DIODE-PWR RECT -100V 1A	28480	1901-0731
A14CR18	1901-0731	9		DIODE-PWR RECT -100V 1A	28480	1901-0731
A14CR19	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A14CR20	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A14CR23	1902-3214	6		DIODE-ZNR 16.2V 2% DO-35 PD=.4W	28480	1902-3214
A14CR24	1884-0250	7	1	THYRISTOR-TRIAC TO-220AB	0192B	T2500B
A14CR25	1902-3105	7		DIODE-ZNR 5.62V 5% DO-35 PD=.4W	28480	1902-3105
A14CR26	1901-0731	7		DIODE-PWR RECT 400V 1A	28480	1901-0731
A14CR27	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A14CR28	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A14CR29	1902-0202	9	2	DIODE-ZNR 15V 5% DO-15 PD=1W TC=+.057%	28480	1902-0202
A14CR30	1902-0202	9		DIODE-ZNR 15V DO-15 PD=1W TC=+.057%	28480	1902-0202
A14CSA1	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A14CSA2	1251-6947	0		CONNECTOR-SGL CON + PIN .025-IN-BSC-525A	28480	1251-6947
A14J2	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A14J3	1251-4573	4	1	CONNECTOR-PC EDGE 25-CONT/ROW 2-ROWS	28480	1251-4573
A14JU1	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A14JU2	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
	1258-0141	5	5	JUMPER-REMOVABLE FOR 0.025 IN SQ PINS	28480	1258-0141
A14JU5	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
	1258-0141	5	5	JUMPER-REMOVABLE FOR 0.025 IN SQ PINS	28480	1258-0141
A14JU6	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
	1258-0141	5	5	JUMPER-REMOVABLE FOR 0.025 IN SQ PINS	28480	1258-0141
A14JU14	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
	1258-0141	5	5	JUMPER-REMOVABLE FOR 0.025 IN SQ PINS	28480	1258-0141
A14JU-14	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
	1258-0141	5	5	JUMPER-REMOVABLE FOR 0.025 IN SQ PINS	28480	1258-0141
A14JW2	5020-5252	3	2	WIRE-2-1/2 IN.	28480	5020-5252
A14JW3	5020-5252	3	2	WIRE-2-1/2 IN.	28480	5020-5252
A14P1	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A14Q1	1853-0363	8	3	TRANSISTOR PNP SI PD=50W FT=20MHZ	03508	X45H281
A14Q2	1854-0575	6	1	TRANSISTOR NPN SI PD=625MW FT=50MHZ	04713	MPS-A42
A14Q3	1853-0363	8		TRANSISTOR PNP SI PD=50W FT=20MHZ	03508	X45H281
A14Q4	1853-0363	8		TRANSISTOR PNP SI PD=50W FT=20MHZ	03508	X45H281
A14Q5	1853-0012	4	1	TRANSISTOR PNP 2N2904A SI TO-39 PD=600MW	01295	2N2904A
A14Q6	1854-0053	5	1	TRANSISTOR NPN 2N2218 SI TO-5 PD=800MW	04713	2N2218
A14Q7	1853-0036	2	1	TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A14R1	0757-0465	6	6	RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A14R2	0698-6360	6	4	RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A14R3	0757-0819	4	1	RESISTOR 909 1% .5W F TC=0+-100	28480	0757-0819
A14R4	0757-0442	9	21	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R5	0698-8827	4	4	RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-8827
A14R6	0698-8826	3	3	RESISTOR 825K 1% .125W F TC=0+-100	28480	0698-8826
A14R7	0698-8826	3		RESISTOR 825K 1% .125W F TC=0+-100	28480	0698-8826
A14R8	0698-8827	4		RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-8827
A14R9	0698-8827	4		RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-8827
A14R10	0698-8826	3		RESISTOR 825K 1% .125W F TC=0+-100	28480	0698-8826
A14R11	0698-8824	1	1	RESISTOR 562K 1% .125W F TC=0+-100	28480	0698-8824
A14R12	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R13	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A14R14	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A14R16	0698-3440	7	1	RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A14R17	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A14R19	0757-0280	3	4	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A14R20	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R21	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R22	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F

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

Table 6-3. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A14R23	0757-0288	1	1	RESISTOR 9.09K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-9091-F
A14R24	0757-0420	3	7	RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A14R25	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A14R27	0698-0083	8	2	RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A14R28	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A14R29	1810-0207	9	1	NETWORK-RES 8-SIP22.0K OHM X 7	01121	208A223
A14R30	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A14R31	2100-3882	8	1	RESISTOR-TRMR 2K 10% C TOP-ADJ 17-TRN	28480	2100-3882
A14R33	0757-0416	7	1	RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A14R34	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A14R35	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R36	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A14R37	0757-0317	7	1	RESISTOR 1.33K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1331-F
A14R38	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A14R39	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A14R40	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A14R41	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A14R42	2100-3881	7	3	RESISTOR-TRMR 500 10% C TOP-ADJ 17-TRN	28480	2100-3881
A14R43	0757-0438	3	2	RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A14R44	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A14R45	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R46	0757-0458	7	3	RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A14R47	0698-3156	2	1	RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A14R48	0698-3152	8	1	RESISTOR 3.48K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3481-F
A14R49	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A14R52	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R53	0698-3160	8	5	RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A14R54	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R55	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A14R56	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A14R57	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A14R58	0698-3451	0	1	RESISTOR 133K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1333-F
A14R59	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R60	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R61	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A14R62	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A14R63	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R64	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A14R65	0757-0421	4	1	RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A14R66	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R67	0757-0443	0	1	RESISTOR 11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1102-F
A14R68	0757-0441	8	1	RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A14R69	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A14R70	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A14R71	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R72	2100-3881	7		RESISTOR-TRMR 500 10% C TOP-ADJ 17-TRN	28480	2100-3881
A14R73	0757-0279	0	2	RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A14R74	2100-3882	8		RESISTOR-TRMR 2K 10% C TOP-ADJ 17-TRN	28480	2100-3882
A14R75	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R76	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R77	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R78	0757-0180	2	2	RESISTOR 31.6 1% .125W F TC=0+-100	28480	0757-0180
A14R79	0757-0180	2		RESISTOR 31.6 1% .125W F TC=0+-100	28480	0757-0180
A14R80	0757-0428	1		RESISTOR 1.62K 1% .125W	02995	MF4C-1
A14R81	0757-0431	6		RESISTOR 2.43K 1% .125W	02995	MF4C-1
A14R82	0698-0084	9	1	RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A14R83	0698-7408	5	1	RESISTOR 600 .1% .125W F TC=0+-50	19701	MF4C1/8-T2-600R-B
A14R85	0699-0763	3	1	RESISTOR 10.6K 1% .125W F TC=0+-100	28480	0699-0763
A14R86	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R87	0698-4437	4	1	RESISTOR 2.94K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2941-F
A14R88	0698-6360	6		RESISTOR 10K .1% .125W FTC=0+-25	28480	0698-6360
A14R89	0698-6360	6		RESISTOR 10K .1% .125W FTC=0+-25	28480	0698-6360
A14R90	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R91	0757-0289	2	1	RESISTOR 13.3K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-1332-F
A14R92	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A14R93	0698-8827	4		RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-8827
A14R94	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R95	0757-0394	0	1	RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A14R96	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R97	0698-3150	0		RESISTOR 2.37K 1% .125W	02995	MF4C-1
A14R98	0757-0280	3		RESISTOR 1K 1% .125W	02273	CEA-993
A14R99	0698-3157	0		RESISTOR 19.6K 1% .125W	02273	CEA-993
A14R100	0757-0428	1		RESISTOR 1.62K 1% .125W	02995	MF4C-1
A14T1	9100-2647	8	1	TRANSFORMER: AUDIO	28480	9100-2647
A14TP1	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A14TP2	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A14TP3	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A14TP4	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A14TP5	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947

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

Table 6-3. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A14TP6	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A14TP7	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A14TP9	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A14TP10	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A14TP11	1251-6947	0		CONNECTOR-SGL CONT PIN .025-IN-BSC-SZ SQ	28480	1251-6947
A14TPS/S	1251-6947	0		CONNECTOR SGL CONT PIN	28480	1251-6947
A14U1	1826-0679	2	1	IC OP AMP LOW-BIAS-H-IMPD TO-99 PKG	0192B	CA3140AT
A14U2	1820-1932	0	2	IC MV CMOS MONOSTBL RETRIG/RESET DUAL	04713	MC14538BCP
A14U3	1820-1932	0		IC MV CMOS MONOSTBL RETRIG/RESET DUAL	04713	MC14538BCP
A14U4	1820-0939	5	3	IC FF CMOS D-TYPE POS-EDGE-TRIG DUAL	0192B	CD4013AF
A14U5	1820-0939	5		IC FF CMOS D-TYPE POS-EDGE-TRIG DUAL	0192B	CD4013AF
A14U6	1820-2472	5	1	MICROPROCESSOR MK3872	28480	1820-2472
A14U7	1820-1827	2	1	IC DCDR CMOS 4-TO-16-LINE	27014	MM74C154N
A14U8	1826-0728	2	2	IC: PRECISION GEN. PURPOSE REG.	28480	SG1532J
A14U9	1826-0411	0	2	IC TIMER CMOS	04713	MC14536BCP
A14U10	1826-0411	0		IC TIMER CMOS	04713	MC14536BCP
A14U11	1820-1956	8	7	IC LCH CMOS COM CLOCK QUAD	0192B	CD4042BE
A14U12	1820-1956	8		IC LCH CMOS COM CLOCK QUAD	0192B	CD4042BE
A14U13	1820-2566	8	1	IC BFR CMOS LINE DRVR QUAD	27014	MM74C240N
A14U14	1826-0728	2		IC PRECISION GEN. PURPOSE REG.	28480	SG1532J
A14U15	1820-1745	3	1	IC GATE CMOS NOR QUAD 2-INP	04713	MC14001BCP
A14U16	1820-2576	0	3	IC GATE CMOS NAND QUAD 2-INP	04713	MC14011BCL
A14U17	1826-0686	0		IC GATE CMOS NAND QUAD 2-INP	04713	MC14011BCL
A14U18	1820-0939	5		IC FF CMOS D-TYPE POS-EDGE-TRIG DUAL	0192B	CD4013AF
A14U19	1820-2576	0		IC GATE CMOS NAND QUAD 2-INP	04713	MC14011BCL
A14U20	1820-1960	4	1	IC GATE CMOS NAND DUAL 4-INP	04713	MC14012BCP
A14U21	1826-0667	8	1	IC OP AMP LOW-BIAS-H-IMPD 8-DIP-P PKG	27014	LF351N
A14U22	1820-1977	3	2	IC OSC ECL	04713	MC12061P
A14U23	1820-1977	3		IC OSC ECL	04713	MC12061P
A14U24	1826-0712	4	2	IC OP AMP LOW-BIAS-H-IMPD DUAL 8-DIP-P	27014	LF353N
A14U25	1826-0138	8	1	IC COMPARATOR OP QUAD 14-DIP-P PKG	01295	LM339N
A14U26	1820-1956	8		IC LCH CMOS COM CLOCK QUAD	0192B	CD4042BE
A14U27	1820-1956	8		IC LCH CMOS COM CLOCK QUAD	0192B	CD4042BE
A14U28	1820-1956	8		IC LCH CMOS COM CLOCK QUAD	0192B	CD4042BE
A14U29	1820-1956	8		IC LCH CMOS COM CLOCK QUAD	0192B	CD4042BE
A14U30	1820-1956	8		IC LCH CMOS COM CLOCK QUAD	0192B	CD4042BE
A14U31	1820-1420	1	1	IC CNTR TTL LS DIV-X-12 ASYNCHRO	01295	SN74LS92N
A14U32	1820-1478	9	1	IC CNTR TTL LS BIN ASYNCHRO	01295	SN74LS93N
A14U33	1826-0508	6	1	IC CONV 10-B-D/A 16-DIP-C PKG	24355	AD561JD
A14U34	1820-1441	6	5	IC ADDR TTL LS BIN FULL ADDR 4-BIT	01295	SN74LS283N
A14U35	1820-1441	6		IC ADDR TTL LS BIN FULL ADDR 4-BIT	01295	SN74LS283N
A14U36	1820-1441	6		IC ADDR TTL LS BIN FULL ADDR 4-BIT	01295	SN74LS283N
A14U37	1820-1441	6		IC ADDR TTL LS BIN FULL ADDR 4-BIT	01295	SN74LS283N
A14U38	1820-1441	6		IC ADDR TTL LS BIN FULL ADDR 4-BIT	01295	SN74LS283N
A14U39	1820-1197	9	1	IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A14U40	1826-0779	3	1	IC MULTIPLXR 4-CHAN-ANLG DUAL 16-DIP-P	24355	AD7502JN
A14U41	1826-0735	1	3	IC OP AMP H-SLEW-RATE 8-DIP-P PKG	34371	HA3-2507-5
A14U42	1826-0688	1		IC OP AMP LOW-BIAS-H-IMPD TO-99 PKG	27014	LF351AH
A14U43	1818-1574	1	1	IC NMOS 32768 (32K) ROM 450-NS 3-S	55576	SYP2332 MASKED
A14U44	1820-1730	6	3	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A14U45	1820-1195	7	1	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS175N
A14U46	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A14U47	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A14U48	1820-1112	8	2	IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A14U49	1820-1199	1	1	IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A14U50	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A14U51	1826-0712	4		IC OP AMP LOW-BIAS-H-IMPD DUAL 8-DIP-P	27014	LF353N
A14U52	1826-0735	1		IC OP AMP H-SLEW-RATE 8-DIP-P PKG	34371	HA3-2507-5
A14U53	1826-0735	1		IC OP AMP H-SLEW RATE 8-DIP-P PKG	34371	HA3-2507-5
A14XU6	1200-0654	6	1	SOCKET-IC 40-CONT	28480	1200-0654
A14XU32	1200-0638	5		SOCKET-IC 14 PIN	28480	1200-0638
A14Y1	0410-1180	0	1	CRYSTAL-4.000 MHZ	28480	0410-1180
A14Y2	0410-1220	9	1	CRYSTAL-4.194304 MHZ	28480	0410-1220
A14Y3	0410-0800	9	1	CRYSTAL-6.144 MHZ	28480	0410-0800
				A14 MISCELLANEOUS PART		
	1200-0666	9	3	SOCKET-XSTR 3-CONT POWER DIP-SLDR	28480	1200-0666
	1251-6856	0	1	CONNECTOR 18-PIN M POST TYPE	28480	1251-6856

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

Table 6-3. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				MISC. AND CHASSIS PARTS		
F1	2110-0065	4	1	FUSE .375A 250V NTD 1.25X.25 UL (120 VAC OPERATION)	28480	2110-0065
F1	2110-0296	3	1	FUSE .2A 250V NTD 1.25X.25 UL (220 VAC OPERATION)	28480	2110-0296
W2	8120-3126	5	1	CABLE-REC-TRAN INTERCONNECT	28480	8120-3126
W3	04935-60019	2	2	CABLE SHIELDED	28480	04935-60019
W5	04935-60009	9	1	CABLE ASSEMBLY-COAX	28480	04935-60009
	0340-0949	2	1	INSULATOR-XSTR THRM-CNDCT	28480	0340-0949
	0370-1089	2	1	KNOB-BASE 1/2 JGK .125-IN-ID	28480	0370-1089
	0370-1091	6	1	KNOB-BASE 1/2 JGK .25-IN-ID	28480	0370-1091
	0380-1283	9	2	SPACER	28480	0380-1283
	0403-0414	6	4	FOOT-BUMPER	0656A	9026-P
	1258-0141	8	6	JUMPER-REMOVABLE(OPT 001 & 003)	28480	1258-0141
	1400-0510	8	1	CLAMP-CABLE(OPT 001 & 003)	28480	1400-0510
	1510-0076	4	2	BINDING POST SGL SGL-TUR JGK	28480	1510-0076
	2200-0103	2	2	SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2200-0704	9	3	SCREW-MACH 4-40 .375 NYL	00000	ORDER BY DESCRIPTION
	2260-0012	8	3	NUT-HEX-W/LKWR 4-40-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
	2360-0113	2	3	SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2360-0117	6	8	SCREW-MACH 6-32 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2420-0015	1	2	NUT-HEX-W/LKWR 6-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
	2510-0103	9	4	SCREW-MACH 8-32 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2510-0296	1	4	SCREW-MACH 8-32 4-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2950-0087	0	2	NUT-HEX-DBL-CHAM 3/8-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
	3050-0001	1	4	WASHER-FL MTLC NO. 8 .172-IN-ID	28480	3050-0001
	3050-0067	9	2	WASHER-FL MTLC 5/16 IN .375-IN-ID	28480	3050-0067
	3050-0100	1	2	WASHER-FL MTLC NO. 6 .147-IN-ID	28480	3050-0100
	0590-0810	1	3	NUT-HEX 4-40 NYL	28480	0590-0810
	5040-4475	2	1	CASE-TOP HALF	28480	5040-4475
	5040-4476	3	1	CASE-BOTTOM HALF	28480	5040-4476
	7120-1155	1	1	LABEL-WARNING	28480	7120-1155
	7120-2388	4	1	PLATE-IDENT	28480	7120-2388
	7120-4184	2	1	LABEL-CAP, COVER	28480	7120-4184
	7120-5370	0	2	LABEL-INFO, HANDLE	28480	7120-5370
	7154-0394	9	1	WIRE MESH	28480	7154-0394
	7205-0356	2	1	SUPPORT-ROD	28480	7205-0356
	8120-1521	6	1	CABLE ASSY 18AWG 3-CNDCT JGK-JKT	28480	8120-1521
	8120-3126	1	1	JUMPER-CABLE ASSY	28480	8120-3126
	5040-4467	2	4	SPACER-SHORT, PLASTIC	28480	5040-4467
	5040-4468	3	4	SPACER-LONG, PLASTIC	28480	5040-4468
	5040-4469	4	1	COVER-FRONT	28480	5040-4469
	5040-4470	7	1	HANDLE-CASE	28480	5040-4470
	5040-4471	8	2	FOOT-REAR	28480	5040-4471
	5060-7159	7	1	PWR CORD STRAP ASSY	28480	5060-7159
	04936-40001	0	1	INSULATOR	28480	04936-40001
	04935-00002	6	1	SHIELD-ALUM.	28480	04935-00002
	04935-00004	8	1	SHIM-310 JACKS	28480	04935-00004
	04935-90002	5	1	INSTRUCTION SUMMARY CARD	28480	04935-90002
	04935-90003	6	1	OPERATING & SERVICE MANUAL	28480	04935-90003
	04935-00007	1	1	BATTERY-INSULATOR	28480	04935-00007
	04935-60011	3	1	BATTERY ASSEMBLY- (OPT. 001 & 003, CONSISTS OF	28480	04935-60011
	0460-0880	0	2	TAPE-INDUSTRIAL .25-IN FOLLOWING)	28480	0460-0880
	0460-1601	5	2	TAPE-INDUSTRIAL (FOAM)	28480	0460-1601
	1400-1076	3	2	BATTERY HOLDER	28480	1400-1076
BT1 ┐ OPTIONS	1420-0284	5	2	BATTERY 15.6V .8A-HR NI-CD CONN	28480	1420-0284
BT2 ├ 001 & 003	1420-0284	5		BATTERY 15.6V .8A-HR NI-CD CONN	28480	1420-0284
BT3 ┘	1420-0285	6	1	BATTERY 6V 2.2A-HR NI-CD CONN	28480	1420-0285
	2950-0043	7	1	NUT HEX 3/8-32	28480	2950-0043
	3050-1114	3	1	NYLON WASHER	28480	3050-1114
	1540-0835	6	1	CARRYING CASE	28480	1540-0835

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

SECTION VII
MANUAL CHANGES

7-1. INTRODUCTION

7-2. This section contains information to backdate this manual for instruments with serial prefix numbers lower than the serial prefix listed on the title page.

7-3. MANUAL CHANGES

7-4. Using the information provided, this manual can be corrected so that it applies to any version or configuration of the 4935A. To adapt this manual to an earlier instrument, refer to Table 7-1 and make all of the manual backdating changes listed opposite your instrument serial prefix number. Changes are listed in serial prefix order.

7-5. If your instrument's serial number or prefix number is not listed on the title page of this manual or in Table 7-1, it may be documented in a yellow MANUAL CHANGE SHEET supplement.

Table 7-1. Manual Changes

Instrument Changes		Assembly Changes			
Instrument Serial No.	Make Changes	Assy Design.	Desc	Serial Number/ Date Code	Make Changes
2215A	11,10,9,8,7,6,5,4,3,2,1	A2	Switchboard	2203A	2,1
2204A	11,10,9,8,7,6,5,4,3,2	A5	Battery Charger	2203A	2,1
2206A	11,10,9,8,7,6,5,4	A4	Transmitter	2204A	4,3,2,1
2207A	11,10,9,8,7,6,5	A3	Receiver	2207A	6,5,4,2,1
2208A	11,10,9,8,7,6				
2233A	11,10,9,8,7				
2247A	11,10,8				
2248A	11,10				
2305A	11,10,9				
2310A	11				

7-6. MANUAL CHANGE INSTRUCTIONS

CHANGE 1

Page 6-9, Table 6-3. Replaceable Parts (A2 Switch Board).
Add: A2J5, HP Part No. 1251-5063, CONNECTOR.
Change: A2 to HP Part No. 04935-60002, SWITCH BOARD (all units), Mfr Code 28480, Mfr Part No. 04935-60002.
Change: A2J2 to HP Part No. 1251-5063, CONNECTOR PIN.
Page 6-10, Table 6-3. Replaceable Parts (A2 Switch Board).
Change: A2TP3 to HP Part No. 0360-0124, TEST PIN.
Change: A2TP4 to HP Part No. 0360-0124, TEST PIN.

CHANGE 1. (Cont'd)

Page 6-20, Table 6-3. Replaceable Parts (A14 Transmitter Board).
Add: HP Part No. 1251-5063, CONNECTOR.
Page 6-21, Table 6-3. Replaceable Parts (A5 Charger Board).
Add: A5CR13, HP Part No. 1901-0050, DIODE-SWITCHING.
Delete: A5Q8, HP Part No. 1853-0036, TRANSISTOR-PNP.
Delete: A5R40, HP Part No. 0757-0280, RESISTOR 1K.
Page 6-34, Table 6-3. Replaceable Parts (A14 Transmitter Board).
Add: HP Part No. 1251-5063, CONNECTOR.
Page 6-35, Table 6-3. Replaceable Parts (A14 Transmitter Board).
Add: A14W4, HP Part No. 04935-60010, SHIELDED CABLE.
Change: A14W3 to HP Part No. 04935-60010, WIRE.
Page 8-76, A2, Switchboard Component Locator.
Replace with Figure 7-1.
Page 8-86, A5, Battery Charger Board Component Locator.
Replace with Figure 7-2.
Page 8-87, A5 Battery Charger Board Schematic
Replace with partial schematic shown in Figure 7-3.

CHANGE 2

Page 6-18, Table 6-3. Replaceable Parts (A4 Transmitter Board).
Add: A4JW5, HP Part No. 5020-5252, WIRE.
Add: A4JW6, HP Part No. 5020-5252, WIRE.
Page 6-32, Table 6-3. Replaceable Parts (A14 Transmitter Board).
Add: A14JW5, HP Part No. 5020-5252, WIRE.
Add: A14JW6, HP Part No. 5020-5252, WIRE.
Page 8-82/83, A14 and A4 Transmitter Board Component Locators.
Replace with Figure 7-4.
Page 8-84, A14 and A4 Transmitter Board Assembly Schematics.
Modify as shown in Figure 7-5.

CHANGE 3

Page 6-17, Table 6-3. Replaceable Parts List (A4 Transmitter Board).
Delete: A4C72, HP Part No. 0180-1746 CAPACITOR, 15 μF 20V.
Change: A4, TRANSMITTER BOARD, to HP Part No. 04935-60003.
Page 6-19, Table 6-3. Replaceable Parts List (A4 Transmitter Board).
Change: A4R70 to HP Part No. 0757-0421, RESISTOR 823 OHM 1%.
Page 6-20, Table 6-3. Replaceable Parts List (A14 Transmitter Board).
Delete: HP Part No. 1251-6947, CONNECTOR-SNGL CONT PIN.
Add: HP Part No. 1251-6857, CONNECTOR-2 PIN POST TYPE.
Add: HP Part No. 1251-4259, TEST PIN.
Add: HP Part No. 1200-0564, SOCKET, 8 PIN.
Change: A4U42 to HP Part No. 1826-0735, IC OP AMP.
Page 6-31, Table 6-3. Replaceable Parts List (A14 Transmitter Board).
Delete: A14C72, HP Part No. 0180-1746, CAPACITOR 15 μF 20V.
Change: A14 board number to HP Part No. 04935-60007.
Page 6-33, Table 6-3. Replaceable Parts List (A14 Transmitter Board).
Change: A14R70 to HP Part No. 0757-0420, RESISTOR 750 OHM 1%.
Page 6-34, Table 6-3. Replaceable Parts List (A14 Transmitter Board).
Delete: HP Part No. 1251-6947, CONNECTOR-SNGL CONT PIN.
Add: HP Part No. 1251-6857, CONNECTOR-2 PIN POST TYPE.
Add: HP Part No. 1251-4259, TEST PIN.
Add: HP Part No. 1200-0564, SOCKET, 8 PIN.
Change: U42 to HP Part No. 1826-0735, IC OP AMP.
Pages 8-82/85, A14 and A4 Transmitter Boards.
Add: PC board number 04935-60003.
Add: PC board number 04935-60007.
Delete: PC board number 04935-60103.
Delete: PC board number 04935-60107.

CHANGE 4

Page 6-13, Table 6-3. Replaceable Parts.
Change: A3R50 to HP Part No. 0757-0159, RESISTOR 1K 1%.
Page 6-17, Table 6-3. Replaceable Parts.
Delete: A4C73, HP Part No. 0160-4833, CAPACITOR .022 μF ±10%.
Delete: A4C74, HP Part No. 0160-4835, CAPACITOR .1 μF ±10%.
Delete: A4C75, HP Part No. 0180-0291, CAPACITOR 1 μF ±10%.
Page 6-18, Table 6-3. Replaceable Parts.
Change: A4R36 to HP Part No. 0757-0280, RESISTOR 1K 1%.
Page 6-31, Table 6-3. Replaceable Parts.
Delete: A14C73, HP Part No. 0160-4833, CAPACITOR .022 μF ±10%.
Delete: A14C74, HP Part No. 0160-4835, CAPACITOR .1μF ±10%.
Delete: A14C75, HP Part No. 0180-0291, CAPACITOR 1 μF ±10%.
Page 6-32, Table 6-3. Replaceable Parts.
Change: A14R36 to HP Part No. 0757-0416, RESISTOR 511 OHM 1%.
Page 8-82, A14 Transmitter Board Component Locator.
Replace with Figure 7-6.
Page 8-83, A4 Transmitter Board Component Locator.
Replace with Figure 7-7.
Page 8-83, A4 Transmitter Board Assembly sheet 1 of 2.
Delete: A4C75, the 1μF CAPACITOR, on the trace between U6 pin 39 and R12.
Page 8-85, A4 Transmitter Board Assembly (sheet 2 of 2).
Modify as shown in Figure 7-8.

CHANGE 5

Paragraph 4-15, Table 4-3. Receiver Accuracy Test Table.
For instruments with serial prefix 2207A and earlier, the level tolerance at +11 dBm is 11.6 to 7.0 dBm. At –40 dBm, the level tolerance is –39.1 to –44.0 dBm.
Paragraph 4-15, Table 4-4. Abbreviated Receiver Accuracy Test Table.
For instruments with serial prefix 2207A and earlier, the level tolerance is –4.0 to +0.6 dBm.
Page 6-11, Table 6-3. Replacement Parts (A3 Receiver Board).
Change: A3C60 to HP Part No. 0160-3291, CAPACITOR 1200 pF 1%.
Change: A3C71 to HP Part No. 0160-5257, CAPACITOR 1100 pF 1%.
Page 6-12, Table 6-3. Replacement Parts (A3 Receiver Board).
Add: A3C128, HP Part No. 0160-0576, CAPACITOR .1 μF.
Add: A3C129, HP Part No. 0180-0374, CAPACITOR 10 μF.
Add: A3C130, HP Part No. 0180-0374, CAPACITOR 10 μF.
Add: A3C138, HP Part No. 0160-0576, CAPACITOR .1 μF.
Delete: A3C160, hand selected capacitor.
Page 6-13, Table 6-3. Replacement Parts (A3 Receiver Board).
Add: A3CR18, HP Part No. 1901-0376, DIODE-GEN.
Add: A3CR19, HP Part No. 1901-0376, DIODE-GEN.
Add: A3CR20, HP Part No. 1901-0376, DIODE-GEN.
Add: A3CR21, HP Part No. 1901-0376, DIODE-GEN.
Add: A3CR22, HP Part No. 1901-0376, DIODE-GEN.
Add: A3CR23, HP Part No. 1901-0376, DIODE-GEN.
Add: A3CR24, HP Part No. 1901-0376, DIODE-GEN.
Add: A3CR25, HP Part No. 1901-0376, DIODE-GEN.
Add: A3J2, HP Part No. 1250-0257, CONNECTOR.
Add: A3J3, HP Part No. 1250-0257, CONNECTOR.
Change: A3JU7 to HP Part No. 1200-0473, CONNECTOR.
Add: A3R48 to HP Part No. 0698-8638, RESISTOR 3.16K 1%.
Add: A3R49 to HP Part No. 0698-6445, RESISTOR 6.838K 1%.
Page 6-14, Table 6-3. Replacement Parts (A3 Receiver Board).
Change: A3R62 to HP Part No. 0699-0666, RESISTOR 1.705K 1%.
Change: A3R63 to HP Part No. 0699-0666, RESISTOR 1.705K 1%.
Change: A3R72A to HP Part No. 0699-0665, RESISTOR 1.248K .1%.
Change: A3R73 to HP Part No. 0699-0669, RESISTOR 3.288K .1%.

CHANGE 5 (Cont'd)

Change: A3R74 to HP Part No. 0699-0669, RESISTOR 3.288K 1%.
Change: A3R91 to HP Part No. 0699-0665, RESISTOR 1.248K .1%.
Change: A3R122 to HP Part No. 0698-3268, RESISTOR 11.5K .1%.
Change: A3R123 to HP Part No. 0757-0419, RESISTOR 681 OHM 1%.

Page 6-15, Table 6-3. Replacement Parts (A3 Receiver Board).
Delete: A3TP21-25, HP Part No. 1251-6947, TEST PIN.
Delete: A3R206, HP Part No. 1810-0369, RESISTOR, NETWORK 100K x 5.
Delete: A3R207, HP Part No. 0698-6445, RESISTOR 6.838K .1%.
Add: A3R130, HP Part No. 0757-0442, RESISTOR 10K 1%.
Add: A3R176, HP Part No. 0698-8638, RESISTOR 3.16K .1%.
Add: A3R177, HP Part No. 0698-6445, RESISTOR 6.838K .1%.
Change: A3R129 to HP Part No. 0698-6362, RESISTOR 1K .1%.
Change: A3R146 to HP Part No. 0698-6446, RESISTOR 2.162K .1%.
Change: A3R147 to HP Part No. 0698-6445, RESISTOR 6.838K .1%.
Change: A3TP2-7 to HP Part No. 0360-0124, TEST PIN.
Change: A3TP9-15 to HP Part No. 0360-0124, TEST PIN.

Page 6-16, Table 6-3. Replacement Parts (A3 Receiver Board).
Add: A3U49, HP Part No. 1826-0735, IC HA 2507-5.

Page 6-24, Table 6-3. Replacement Parts (A3 Receiver Board).
Change: A13C60 to HP Part No. 0160-3291, CAPACITOR 1200 pF 1%.
Change: A13C71 to HP Part No. 0160-5257, CAPACITOR 1100 pF 1%.

Page 6-25, Table 6-3. Replacement Parts (A13 Receiver Board).
Add: A13C128, HP Part No. 0160-0576, CAPACITOR .1 μF 10%.
Add: A13C129, HP Part No. 0180-0374, CAPACITOR 10 μF 10%.
Add: A13C130, HP Part No. 0180-0374, CAPACITOR 10 μF 10%.
Add: A13C138, HP Part No. 0160-0576, CAPACITOR .1 μF 10%.
Delete: A13C160, hand selected capacitor.

Page 6-26, Table 6-3. Replacement Parts (A13 Receiver Board).
Add: A13CR18, HP Part No. 1901-0376, DIODE-GEN.
Add: A13CR19, HP Part No. 1901-0376, DIODE-GEN.
Add: A13CR20, HP Part No. 1901-0376, DIODE-GEN.
Add: A13CR21, HP Part No. 1901-0376, DIODE-GEN.
Add: A13CR22, HP Part No. 1901-0376, DIODE-GEN.
Add: A13CR23, HP Part No. 1901-0376, DIODE-GEN.
Add: A13CR24, HP Part No. 1901-0376, DIODE-GEN.
Add: A13CR25, HP Part No. 1901-0376, DIODE-GEN.
Add: A13J2, HP Part No. 1250-0257, CONNECTOR.
Add: A13J3, HP Part No. 1250-0257, CONNECTOR.
Change: A13JU7 to HP Part No. 1251-0473, CONNECTOR.

Page 6-27, Table 6-3. Replacement Parts (A13 Receiver Board).
Change: A13R48 to HP Part No. 0698-8638, RESISTOR 3.16K .1%.
Change: A13R49 to HP Part No. 0698-6445, RESISTOR 6.838K 1%.
Change: A13R62 to HP Part No. 0699-0666, RESISTOR 1.705K 1%.
Change: A13R63 to HP Part No. 0690-0666, RESISTOR 1.705K 1%.
Change: A13R72A to HP Part No. 0699-0665, RESISTOR 1.248K .1%.
Change: A13R73 to HP Part No. 0699-0669, RESISTOR 3.288K 1%.
Change: A13R74 to HP Part No. 0699-0669, RESISTOR 3.288K 1%.
Change: A13R91 to HP Part No. 0699-0665, RESISTOR 1.248K .1%.

Page 6-28, Table 6-3. Replacement Parts (A13 Receiver Board).
Add: A13R130, HP Part No. 0757-0442, RESISTOR 10K 1%.
Add: A13R176, HP Part No. 0698-8638, RESISTOR 3.16K .1%.
Add: A13R177, HP Part No. 0698-6445, RESISTOR 6.838K .1%.
Change: A13R129 to HP Part No. 0698-6362, RESISTOR 1K .1%.
Change: A13R122 to HP Part No. 0698-3268, RESISTOR 11.5K .1%.
Change: A13R123 to HP Part No. 0757-0419, RESISTOR 681.1 OHM .1%.
Change: A13R146 to HP Part No. 0698-6446, RESISTOR 2.162K .1%.
Change: A13R147 to HP Part No. 0698-6445, RESISTOR 6.838K .1%.

Page 6-29, Table 6-3. Replacement Parts (A13 Receiver Board).
Delete: A13TP21-25, HP Part No. 1251-6947, TEST PIN.

CHANGE 5 (Cont'd)

Delete: A13R206, HP Part No. 1810-0369, RESISTOR, NETWORK 100K x 5.
Delete: A13R207, HP Part No. 0698-6445 RESISTOR 6.838K .1%.
Add: A13U49, HP Part No. 1826-0735, IC HA 2507-5.
Change: A13TP-7 to HP Part No. 0360-0124, TEST PIN.
Change: A13TP9-15 to HP Part No. 0360-0124, TEST PIN.

Page 6-33, Table 6-3. Replacement Parts (A13 Receiver Board).
Change: A14R88 to HP Part No. 0698-8824, RESISTOR 10K .1%.
Change: A14R89 to HP Part No. 0698-8824, RESISTOR 10K .1%.

Page 8-78, A13 PAR Receiver Component Locator.
Replace with Figure 7-9.

Page 8-79, A3 Reciever Component Locator.
Replace with Figure 7-10.

Page 8-79, A3 Receiver Board Assembly, Sheet 1 of 2.
Replace with Figure 7-11.

Page 8-81, A3 Receiver Board Assembly, Sheet 2 of 2.
Replace with Figure 7-12.

CHANGE 6

Page 6-17, Table 6-3. Replaceable Parts.
Replace A4 with 04935-60103 Transmitter Board, MFG CODE 28480, MFG P/N 04935-60103

Page 6-18, Table 6-3. Replaceable Parts.
Replace A4CR17 with 1901-0731 Diode-pwr rect 400V 1A, CD=4, MFG CODE 03508, MFG P/N A15F.
Replace A4CR18 with 1901-0731 Diode-pwr rect 400V 1A, CD=4, MFG CODE 03508, MFG P/N A15F.
Add A4CR21 1901-0754 Diode-pwr rect 50V 5A, CD=4, MFG CODE 03508, MFG P/N A15F.
Add A4CR22 1901-0754 Diode-pwr rect 50V 5A, CD=4, MFG CODE 03508, MFG P/N A15F.

Page 6-31, Table 6-3. Replaceable Parts.
Replace A14 with 04935-60107 Transmitter Board, MFG CODE 28480, MFG P/N 04935-60107.

Page 6-32, Table 6-3. Replaceable Parts.
Replace A14CR17 with 1901-0731 Diode-pwr rect 400V 1A, CD=4, MFG CODE 03508, MFG P/N A15F.
Replace A14CR18 with 1901-0731 Diode-pwr rect 400V 1A, CD=4, MFG CODE 03508, MFG P/N A15F.
Add A14CR21 1901-0754 Diode-pwr rect 50V 5A, CD=4, MFG CODE 03508, MFG P/N A15F.
Add A14CR22 1901-0754 Diode-pwr rect 50V 5A, CD=4, MFG CODE 03508, MFG P/N A15F.

CHANGE 7

Page 6-6, Figure 6-2. Exploded View Assemblies and Cables (Cont'd)
Replace Item 29 with Rear Panel Assy (loaded) 04935-60008.

Page 6-12, Table 6-3. Replaceable Parts.
Delete A3C202 Hand Selected Capacitor.

Page 6-13, Table 6-3. Replaceable Parts.
Replace A3CR8 with 1901-0376 Diode-Gen prp, CD=6, MFG CODE 28480, MFG P/N 1901-0376.
Replace A3CR9 with 1901-0376 Diode-Gen prp, CD=6, MFG CODE 28480, MFG P/N 1901-0376.
Replace A3CR11 with 1901-0376 Diode-Gen prp, CD=6, MFG CODE 28480, MFG P/N 1901-0376.
Replace A3CR12 with 1901-0376 Diode-Gen prp, CD=6, MFG CODE 28480, MFG P/N 1901-0376.
Replace A3CR15 with 1901-0376 Diode-Gen prp, CD=6, MFG CODE 28480, MFG P/N 1901-0376.
Replace A3CR16 with 1901-0376 Diode-Gen prp, CD=6, MFG CODE 28480, MFG P/N 1901-0376.

CHANGE 7 (Cont'd)

Replace A3R50 with 0757-0159 Resistor 1K 1% .5 W, CD=5, MFG CODE 28480, MFG P/N 0757-0159.
Replace A3R51 with 0757-0280 Resistor 1K 1% .125 W, CD=3, MFG CODE 24546, MFG P/N C4-1/8-TO-1001-F.

Page 6-14, Table 6-3. Replaceable Parts.
Add A3R59 0698-3156 Resistor 14.7K 1% .125 W, CD=2, MFG CODE 24546, MFG P/N C4-1/8-TO-1472-F.
Replace A3R62 with 0698-3223 Resistor 1.24K 1% .125 W, CD=4, MFG CODE 24546, MFG P/N C4-1/8-TO-1241-F.
Replace A3R63 with 0698-3223 Resistor 1.24K 1% .125 W, CD=4, MFG CODE 24546, MFG P/N C4-1/8-TO-1241-F.
Replace A3R73 with 0757-0431 Resistor 2.43K 1% .125 W, CD=6, MFG CODE 24546, MFG P/N C4-1/8-TO-2431-F.
Replace A3R74 with 0698-3223 Resistor 1.24K 1% .125 W, CD=, MFG CODE 24546, MFG P/N C4-1/8-TO-2431-F.

Page 6-15, Table 6-3. Replaceable Parts.
Delete A3R208 5020-5252 Wire 1/2 in, CD=3, MFG CODE 28480, MFG P/N 5020-5252.

Page 6-23, Table 6-3. Replaceable Parts.
Replace A6 with 04935-60008 Rear Panel Assembly, CD=8, MFG CODE 28480, MFG P/N 04935-60008.
Replace A6T1 with 9100-2676 Transformer-AC pwr, CD=3, MFG CODE 28480, MFG P/N 9100-2676.
Add 7100-0389 Transformer Cover 62-DP, CD=9, MFG CODE 28480, MFG P/N 7100-0389.

Page 6-26, Table 6-3. Replaceable Parts.
Delete A13C202 Hand Selected Capacitor.
Replace A13CR8 with 1901-0376 Diode-Gen prp, CD=6, MFG CODE 28480, MFG P/N 1901-0376.
Replace A13CR9 with 1901-0376 Diode-Gen prp, CD=6, MFG CODE 28480, MFG P/N 1901-0376.
Replace A13CR10 with 1901-0376 Diode-Gen prp, CD=6, MFG CODE 28480, MFG P/N 1901-0376.
Replace A13CR12 with 1901-0376 Diode-Gen prp, CD=6, MFG CODE 28480, MFG P/N 1901-0376.
Replace A13CR15 with 1901-0376 Diode-Gen prp, CD=6, MFG CODE 28480, MFG P/N 1901-0376.
Replace A13CR16 with 1901-0376 Diode-Gen prp, CD=6, MFG CODE 28480, MFG P/N 1901-0376.

Page 6-27, Table 6-3. Replaceable Parts.
Replace A13R50 with 0757-0159 Resistor 1K 1% .5 W, CD=5, MFG CODE 28480, MFG P/N 0757-0159.
Replace A13R51 with 0757-0280 Resistor 1K 1% .125 W, CD=3, MFG CODE 24546, MFG P/N C4-1/8-TO-1001-F.

Page 6-14, Table 6-3. Replaceable Parts.
Add A13R59 0698-3156 Resistor 14.7K 1% .125 W, CD=2, MFG CODE 24546, MFG P/N C4-1/8-TO-1472-F.
Replace A13R62 with 0698-3223 Resistor 1.24K 1% .125 W, CD=4, MFG CODE 24546, MFG P/N C4-1/8-TO-1241-F.
Replace A13R63 with 0698-3223 Resistor 1.24K 1% .125 W, CD=4, MFG CODE 24546, MFG P/N C4-1/8-TO-1241-F.
Replace A13R73 with 0757-0431 Resistor 2.43K 1% .125 W, CD=6, MFG CODE 24546, MFG P/N C4-1/8-TO-2431-F.
Replace A13R74 with 0698-3223 Resistor 1.24K 1% .125 W, CD=6, MFG CODE 24546, MFG P/N C4-1/8-TO-2431-F.

Page 6-29, Table 6-3. Replaceable Parts.
Delete A13R208 5020-5252 Wire 1/2 in, CD=3, MFG CODE 28480, MFG P/N 5020-5252.
Page 6-34, Table 6-3. Replaceable Parts.
Replace A14U17 with 1826-0686 IC Gate CMOS NAND quad, CD=0, MFG CODE 04713, MFG P/N MC14011BCL.

CHANGE 7 (Cont'd)

Page 8-69, Figure 8-28. A13 Receiver Board Component Locator.
Delete C202, R208, and add R59 as shown in Figure 7-13.

Page 8-68, Figure 8-27. A3 Receiver Board Component Locator.
Delete C202, R208, and add R59 as shown in Figure 7-14.

Page 8-69, Figure 8-29. A13 Receiver Board Schematic Diagram (1 of 2).
Replace with partial schematic shown in Figure 7-15.

CHANGE 8

Page 6-14, Table 6-3. Replaceable Parts (Continued),
Change A3R81 to 0699-0567, RESISTOR 137K .1% .125W, CD=5, Mfr Code 28480, Mfr P/N 0699-0567.

Page 6-17, Table 6-3. Replaceable Parts (Continued),
Change A4 to 04935-60203, TRANSMITTER BOARD (std unit only), Mfr Code 28480, Mfr P/N 04935-60203.

Page 6-19, Table 6-3. Replaceable Parts (Continued),
Delete A4R97, 0757-0442, RESISTOR 10K 1% .125W, CD=9, Mfr Code 24546, Mfr P/N C4-1/4-TO-1002-F.
Delete A4R98, 0757-0278, RESISTOR 1.78K 1% .125W, CD=9, Mfr Code 02273, Mfr P/N CEA-993.
Delete A4R99, 0698-3157, RESISTOR 19.6K 1% .125W, CD=0, Mfr P/N CEA-993.
Delete A4R100, 0757-0428, RESISTOR 1.62K 1% .125W, CD=7, Mfr Code 02995, Mfr P/N MF4C-1.
Change A4R80 to 0757-0420, RESISTOR 750K 1% .125W, CD=3, Mfr Code 24546, Mfr P/N C4-1/8-TO-751-F.
Change A4R81 to 0757-0290, RESISTOR 6.19K 1% .125W, CD=5, Mfr Code 19701, Mfr P/N MF4C1/8-TO-6191-F.

Page 6-20, Table 6-3. Replaceable Parts (Continued),
Delete A4U53, 1826-0735, IC OP AMP H-SLEW-RATE 8-DIP PKG, CD=1, Mfr Code 34371, Mfr P/N HA3-2507-5.

Page 6-22, Table 6-3. Replaceable Parts (Continued),
Change 1205-0512 to 1205-0309, HEAT SINK SGL TO-220-CS, CD=9, Mfr Code 28480, Mfr P/N 1205-0309.

Page 6-31, Table 6-3. Replaceable Parts (Continued),
Change A14 to 04935-60207, TRANSMITTER BOARD WITH PAR, CD=7, Mfr Code 28480, Mfr P/N 04935-60207.

Page 6-33, Table 6-3. Replaceable Parts (Continued),
Delete A14R97, 0757-0442, RESISTOR 10K 1% .125W, CD=9, Mfr Code 24546, Mfr P/N C4-1/4-TO-1002-F.
Delete A14R98, 0757-0278, RESISTOR 1.78K 1% .125W, CD=9, Mfr Code 02273, Mfr P/N CEA-993.
Delete A14R99, 0698-3157, RESISTOR 19.6K 1% .125W, CD=0, Mfr Code 02273, Mfr P/N CEA-993.
Delete A14R100, 0757-0428, RESISTOR 1.62K 1% .125W, CD=7, Mfr Code 02995, Mfr P/N MF4C-1.
Change A14R80 to 0757-0420, RESISTOR 7509K 1% .125W, CD=3, Mfr Code 24546, Mfr P/N C4-1/8-TO-751-F.
Change A14R81 to 0757-0290, RESISTOR 6.19K 1% .125W, CD=5, Mfr Code 19701, Mfr P/N MF4C-1/8-TO-1626-F.

CHANGE 8 (Cont'd)

Page 6-34, Table 6-3. Replaceable Parts (Continued),
Delete A14U53, 1826-0735, IC OP AMP H-SLEW-RATE 8-DIP-P PKG, CD=1, Mfr Code 34371, Mfr P/N HA3-2507-5.

Page 6-35, Table 6-3. Replaceable Parts (Continued),
Change 2200-0704 to 2200-0107, SCREW MACH 4-40 .375IN LG PAN HD POZI, CD=6, Mfr Code 0000, Mfr P/N order by description.

Page 8-72, Figure 8-31. A4 Transmitter Board Component Locator,
Replace with component locator shown in Figure 7-16.

Page 8-73, Figure 8-32. A14 Transmitter Board Component Locator,
Replace with component locator shown in Figure 7-17.

Page 8-75, Figure 8-34. A4 Transmitter Board Schematic Diagram (Sheet 2 of 2).
Replace with partial schematics shown in Figures 7-18 and 7-19.

CHANGE 9

With the exception of the Receiver Boards, all instruments with Serial Prefix 2305A follow the Component Locator and Schematics in the 4935A Operating and Service Manual with the Print Date OCT 1982 and the modifications defined in Change 8 of this Manual Change Section. The Receiver Boards for both standard (04935-60004) and Option 001 (04935-60006) units are the same as Receiver Boards with the 2208A Serial Prefix.

CHANGE 10

NOTE

See Service Note 4935A-9 prior to replacing any of the parts below.

Page 6-19, Table 6-3. Replaceable Parts,
Change A4R80 to 0757-0428, RESISTOR 1.62K 1% .125W, CD=1, Mfr Code 02995, Mfr P/N MF4C-1.
Change A4R81 to 0757-0431, RESISTOR 2.43K 1% .125W, CD=6, Mfr Code 02995, Mfr P/N MF4C-1.
Change A4R97 to 0698-3150, RESISTOR 2.37K 1% .125W, CD=0, Mfr Code 02995, Mfr P/N MF4C-1.
Change A4R98 to 0757-0280, RESISTOR 1K 1% .125W, CD=3, Mfr Code 02273, Mfr P/N CEA-993.

Page 6-33, Table 6-3. Replaceable Parts,
Change A14R80 to 0757-0428, RESISTOR 1.62K 1% .125W, CD=1, Mfr Code 02995, Mfr P/N MF4C-1.
Change A14R81 to 0757-0431, RESISTOR 2.43K 1% .125W, CD=6, Mfr Code 02995, Mfr P/N MF4C-1.
Change A14R97 to 0698-3150, RESISTOR 2.37K 1% .125W, CD=0, Mfr Code 02995, Mfr P/N MF4C-1.
Change A14R98 to 0757-0280, RESISTOR 1K 1% .125W, CD=3, Mfr Code 02273, Mfr P/N CEA-993.

Page 8-75, Figure 8-34. A4 Transmitter Board Schematic Diagram (Sheet 2 of 2),
Change the values of the following resistors located in the Output Select MUX and Power Amplifier sections of the schematic.
Change R80 to 1.62K
Change R81 to 2.43K
Change R97 to 2.37K
Change R98 to 1K

CHANGE 11

Page 6-5, Figure 6-2. Exploded View Assembly and Cables,
Change Item 13 to Insulator, binding posts, HP 03770-50004.

Page 6-35/(6-36 blank), Table 6-3. Replaceable Parts (Continued),
Change 04936-40001 to 03770-50004, INSULATOR, BINDING POSTS, CD=2, Mfr Code 28480, Mfr P/N 03770-50004.

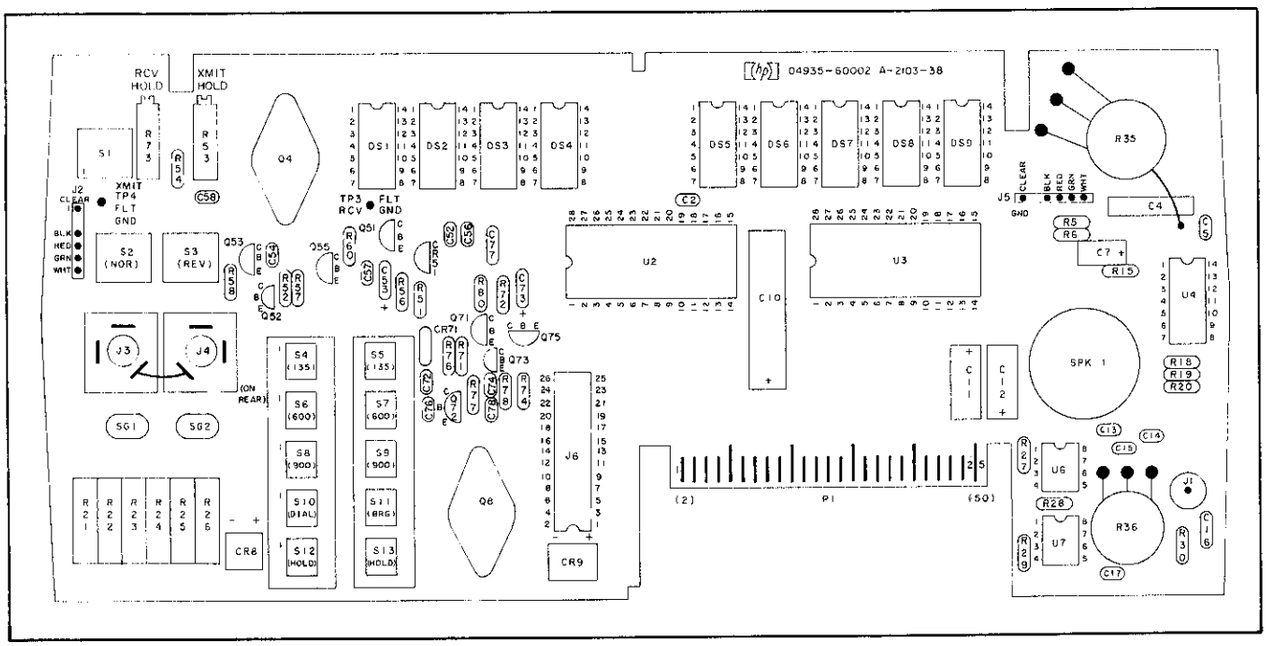


Figure 7-1. A2 Switch Board Component Locator

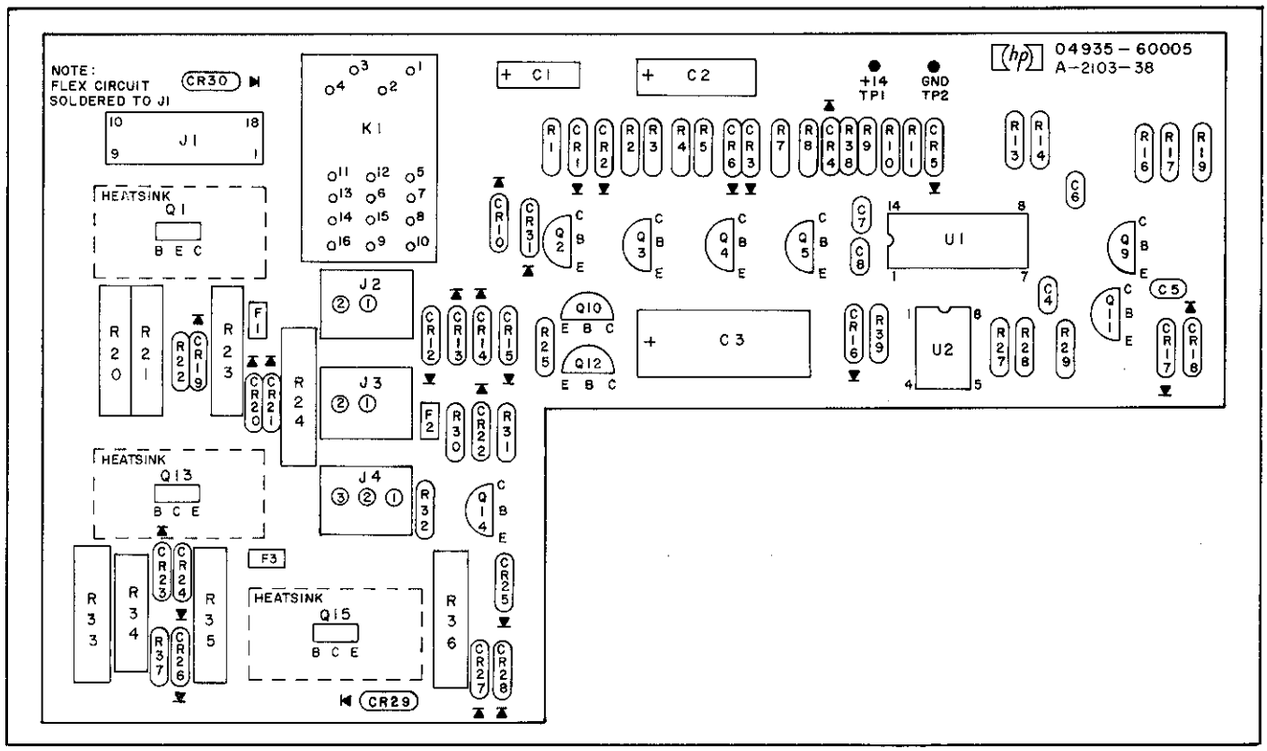


Figure 7-2. A5 Charger Board Component Locator

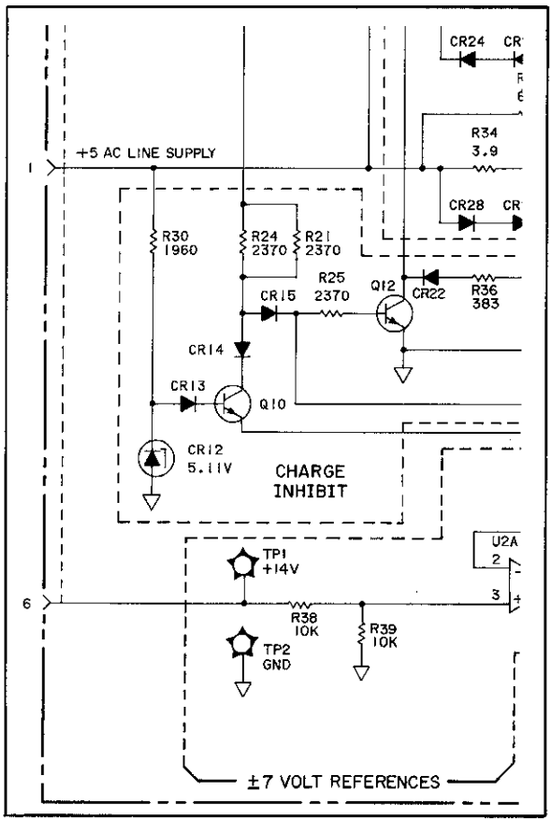


Figure 7-3. Partial A5 Charger Board Schematic

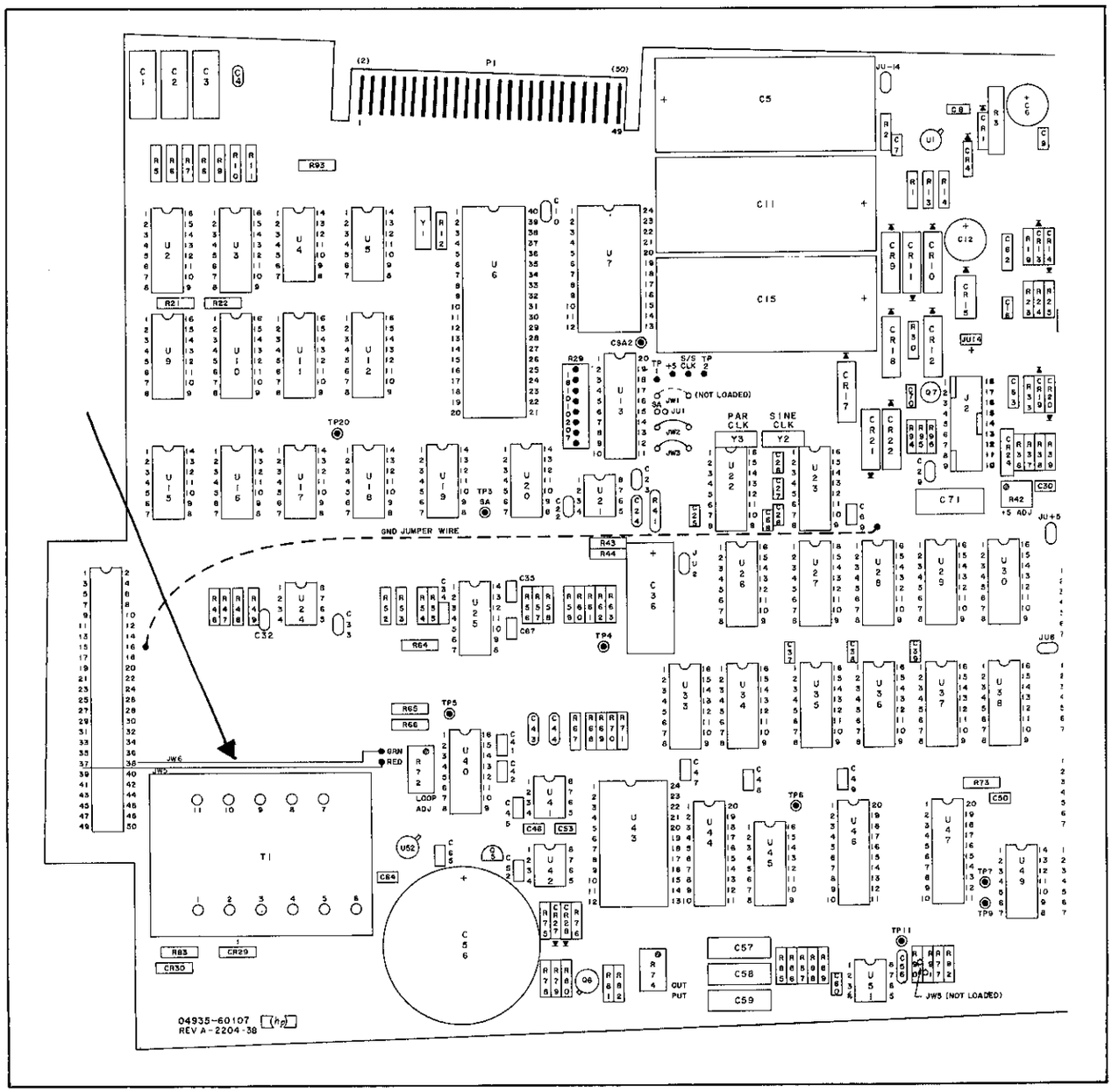


Figure 7-4. A14 Transmitter Board Component Locator

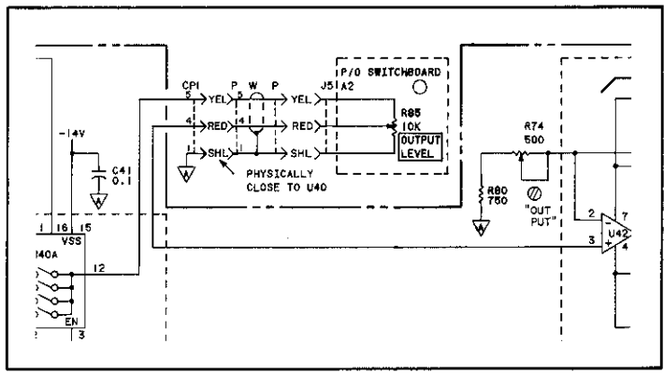


Figure 7-5. A4/A14 Partial Schematic

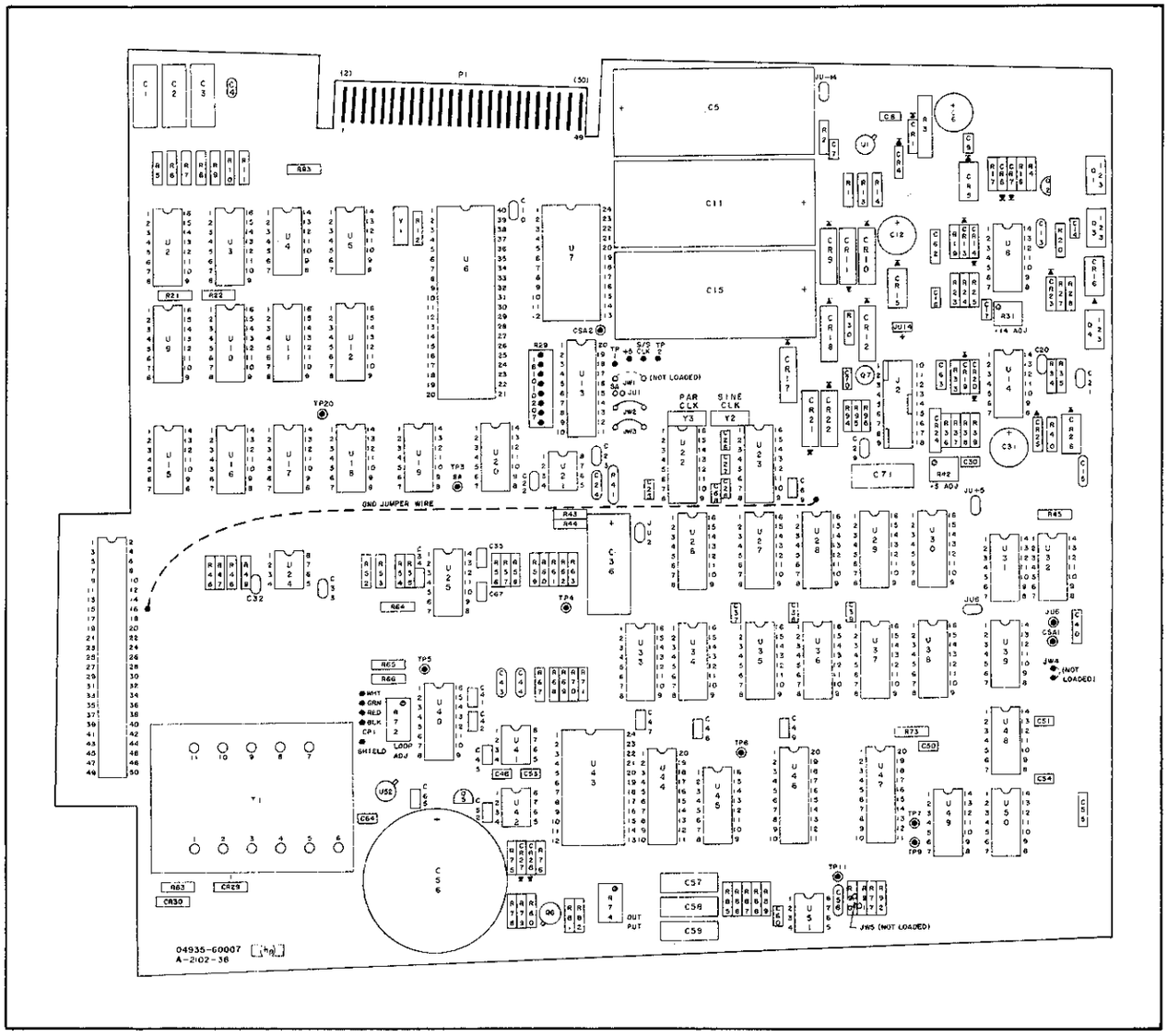


Figure 7-6. A14 P/AR Transmitter Board Component Locator

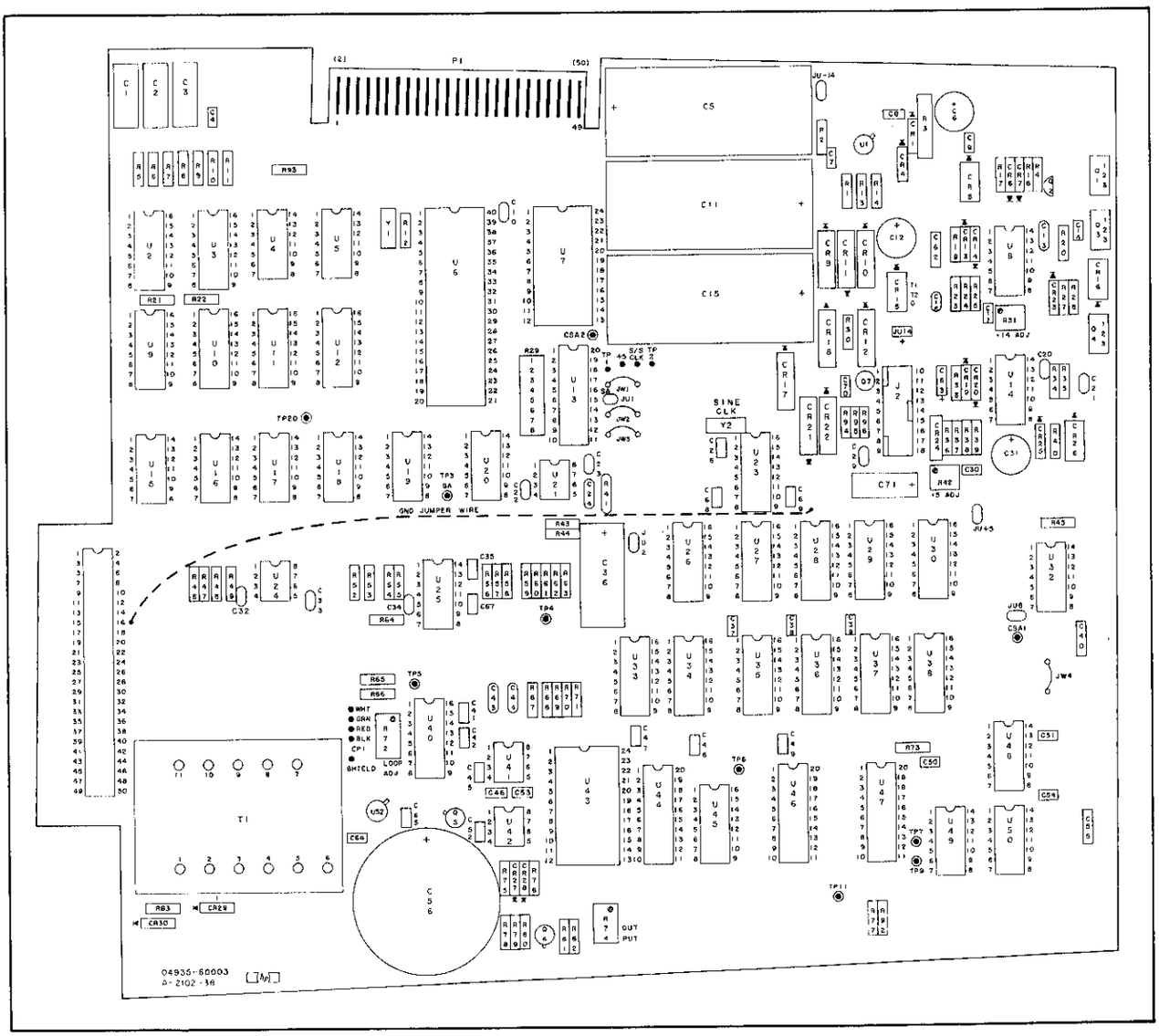


Figure 7-7. A4 Transmitter Board Component Locator

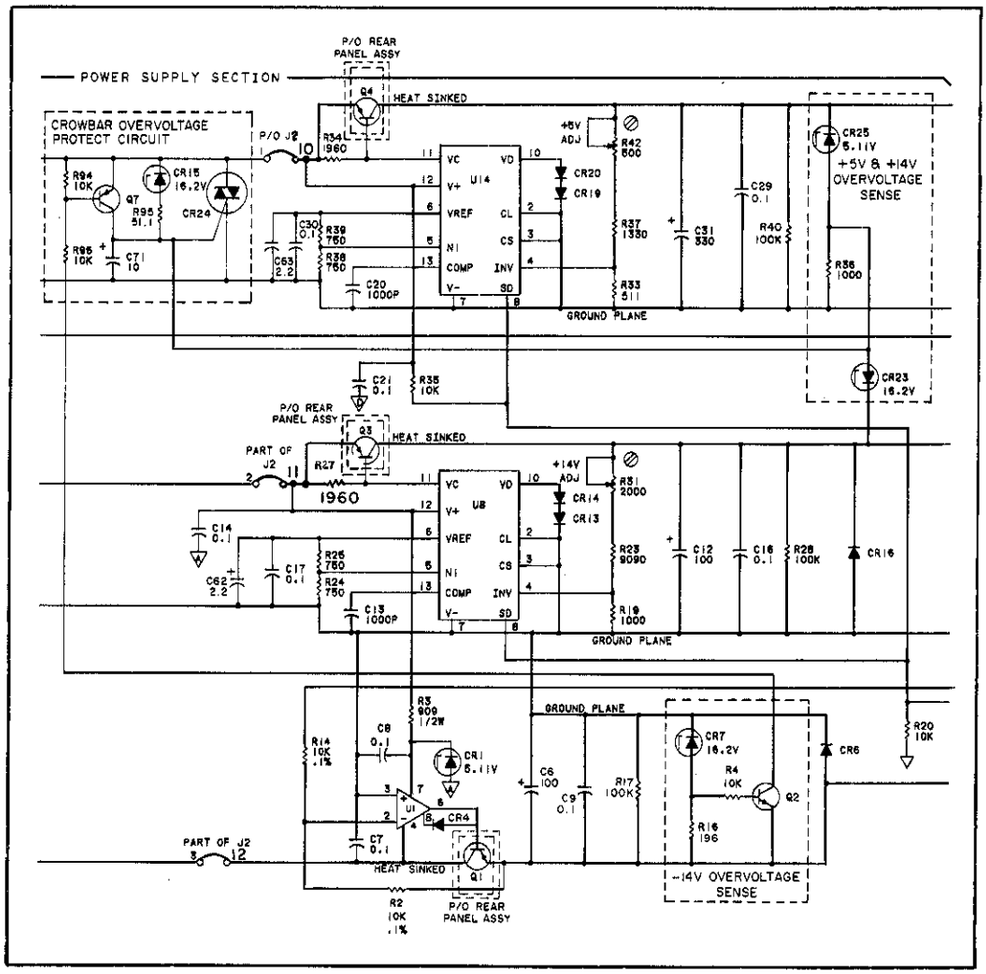


Figure 7-8. Partial Power Supply Schematic

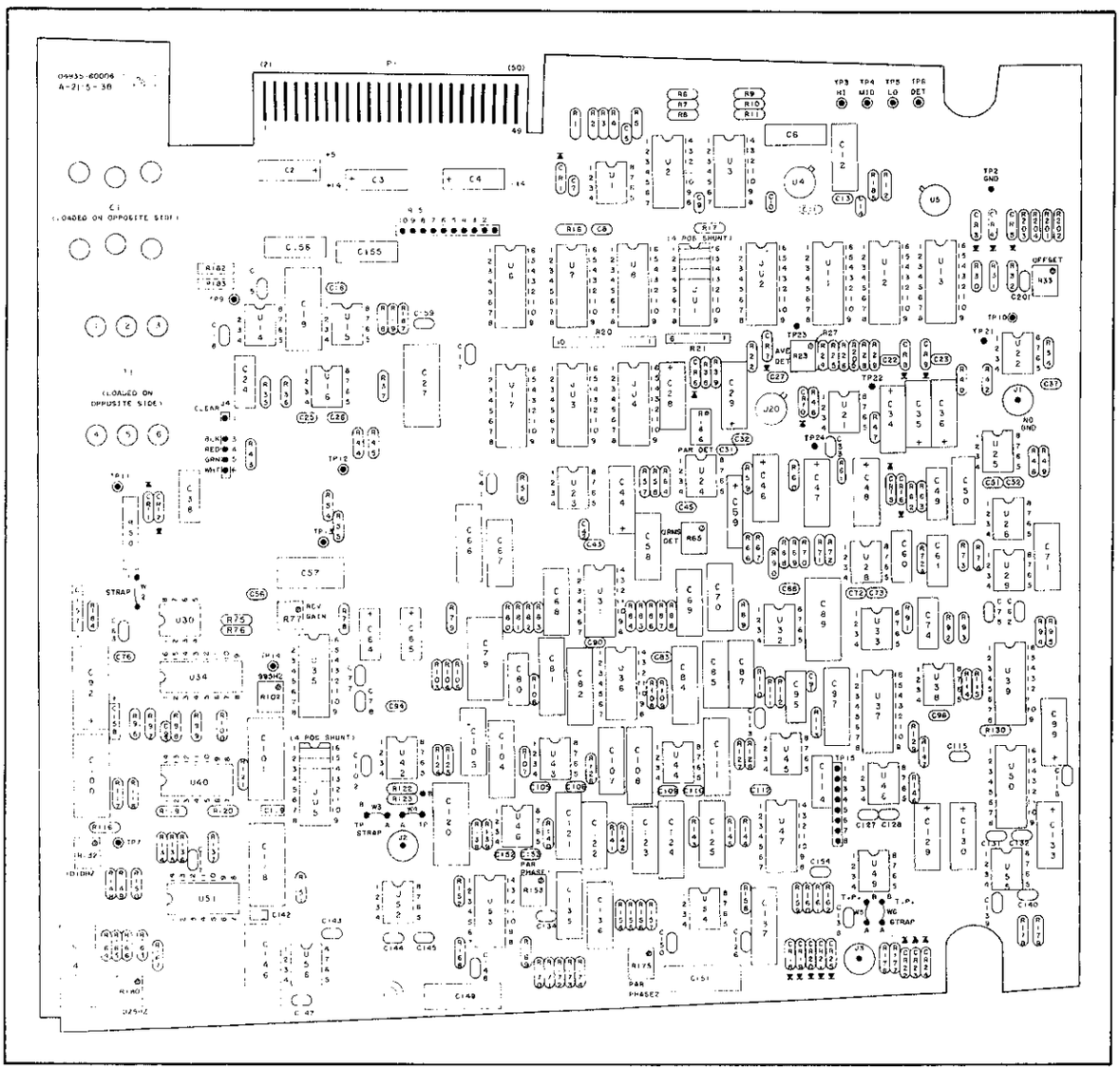


Figure 7-9. A13 P/AR Receiver Board Component Locator

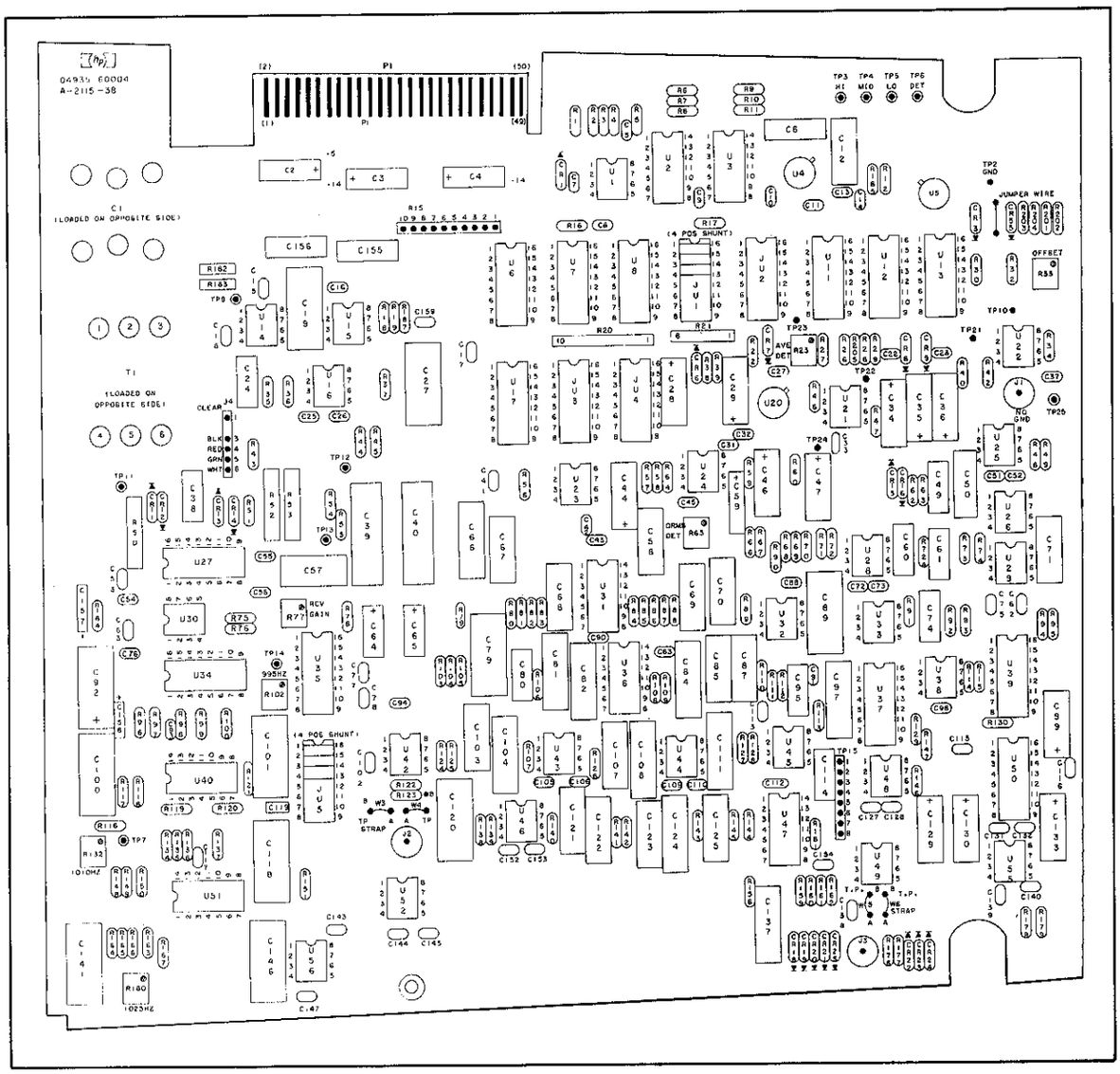


Figure 7-10. A3 Receiver Board Component Locator

Fig 7-11 Sht 1 of 3

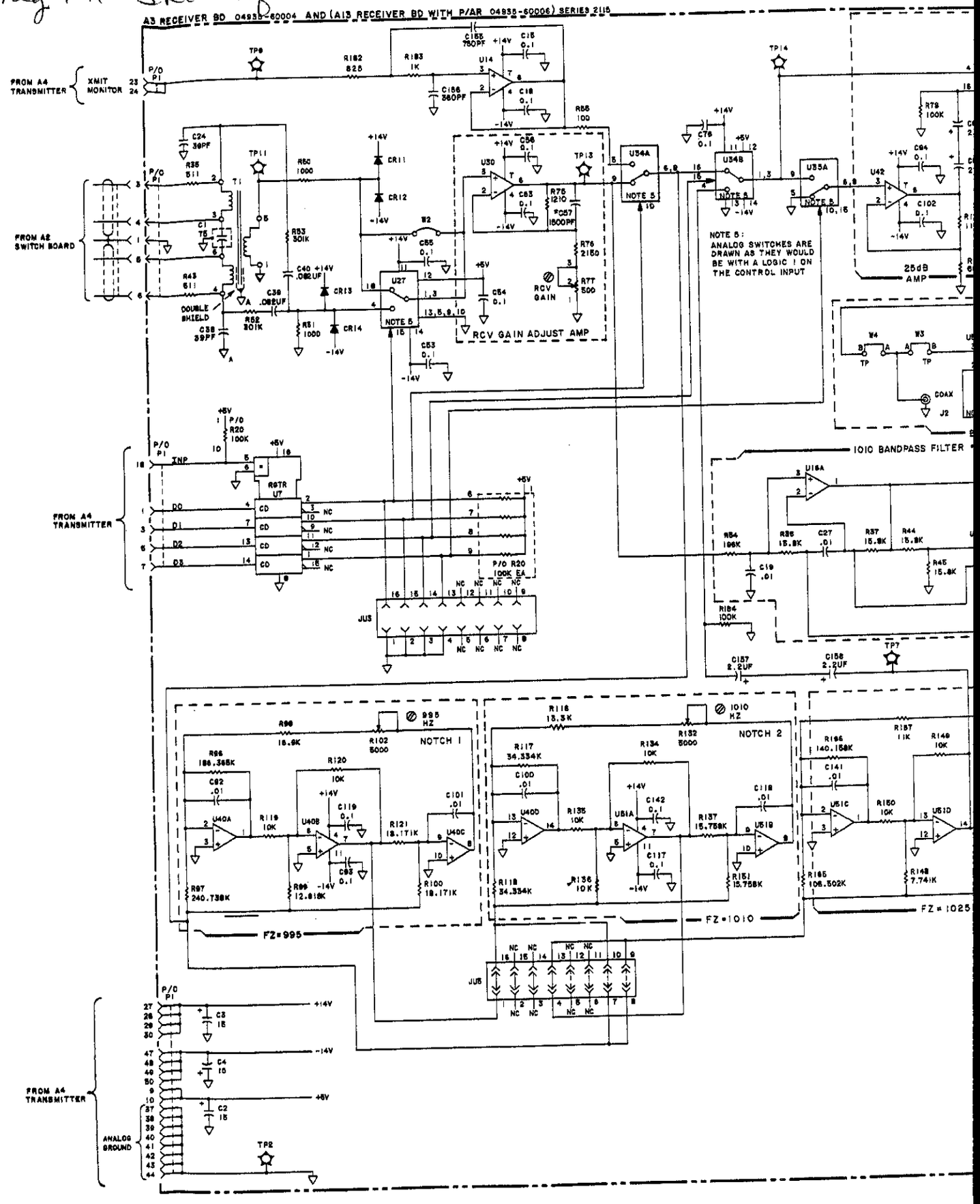
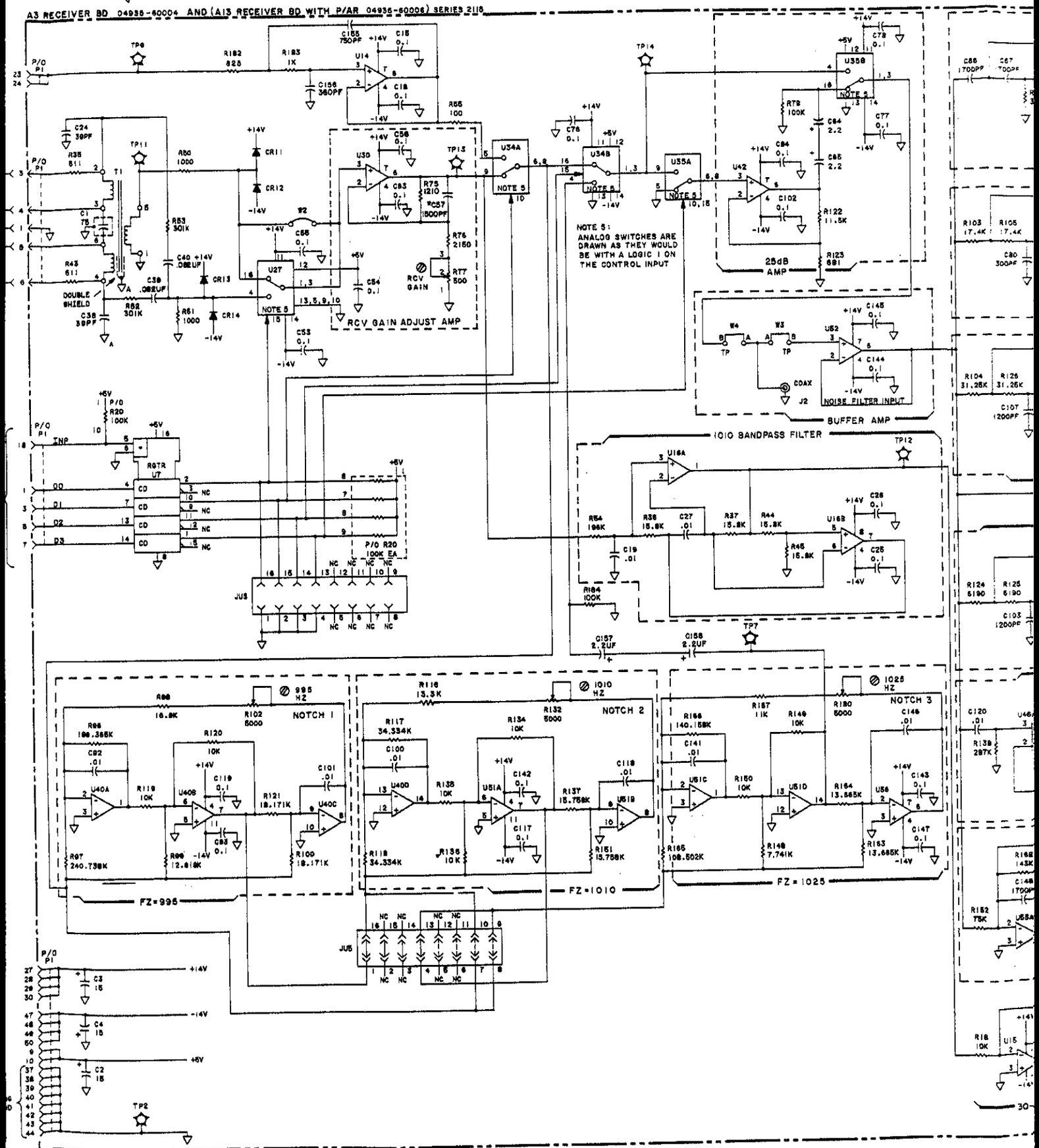


Fig 7-11 sht 2 of 3



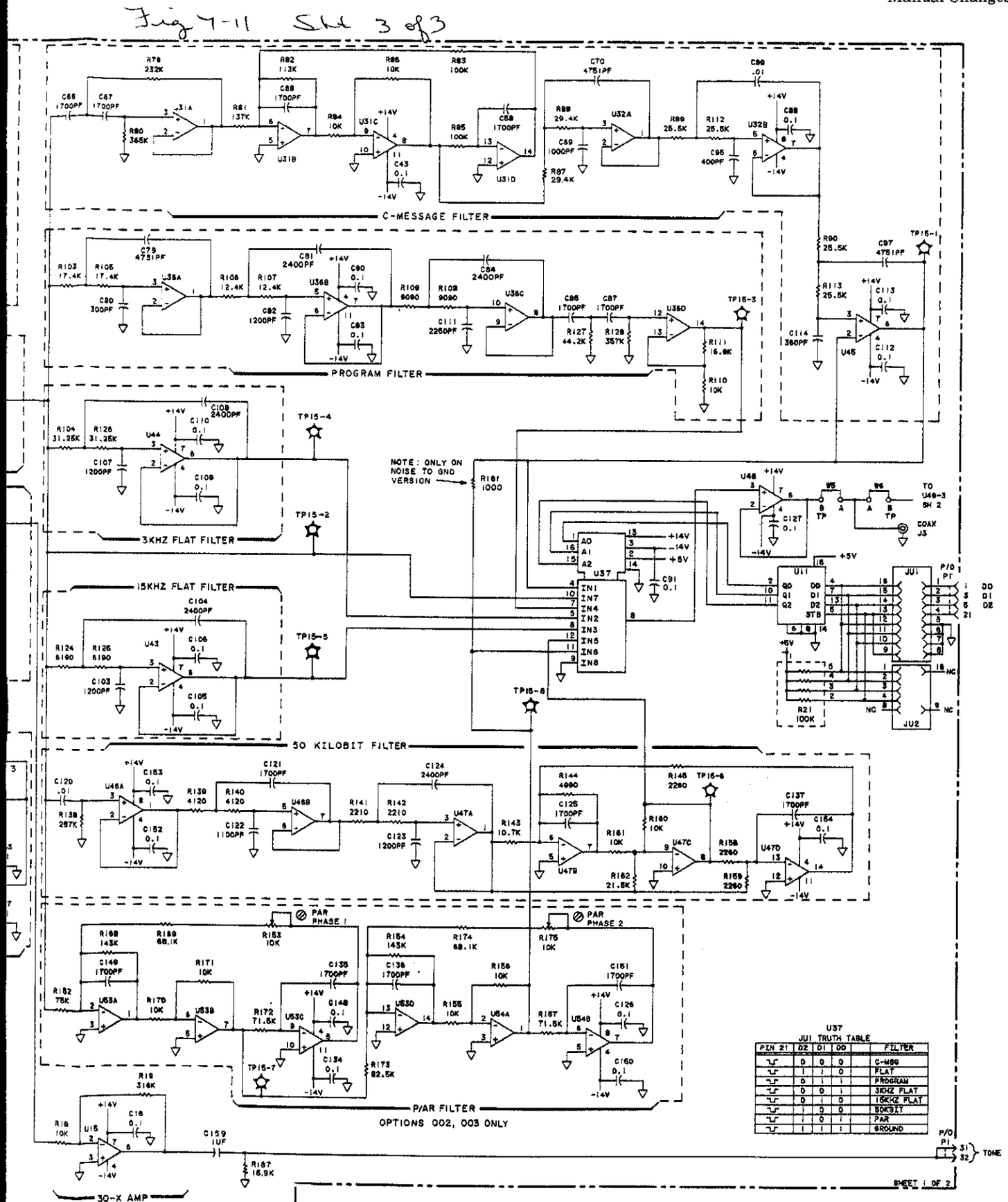


Figure 7-11.
A3/13 Receiver Board Schematic (1 of 2)
7-17/(7-18 blank)

Fig 7-12 Sht 1 of 3

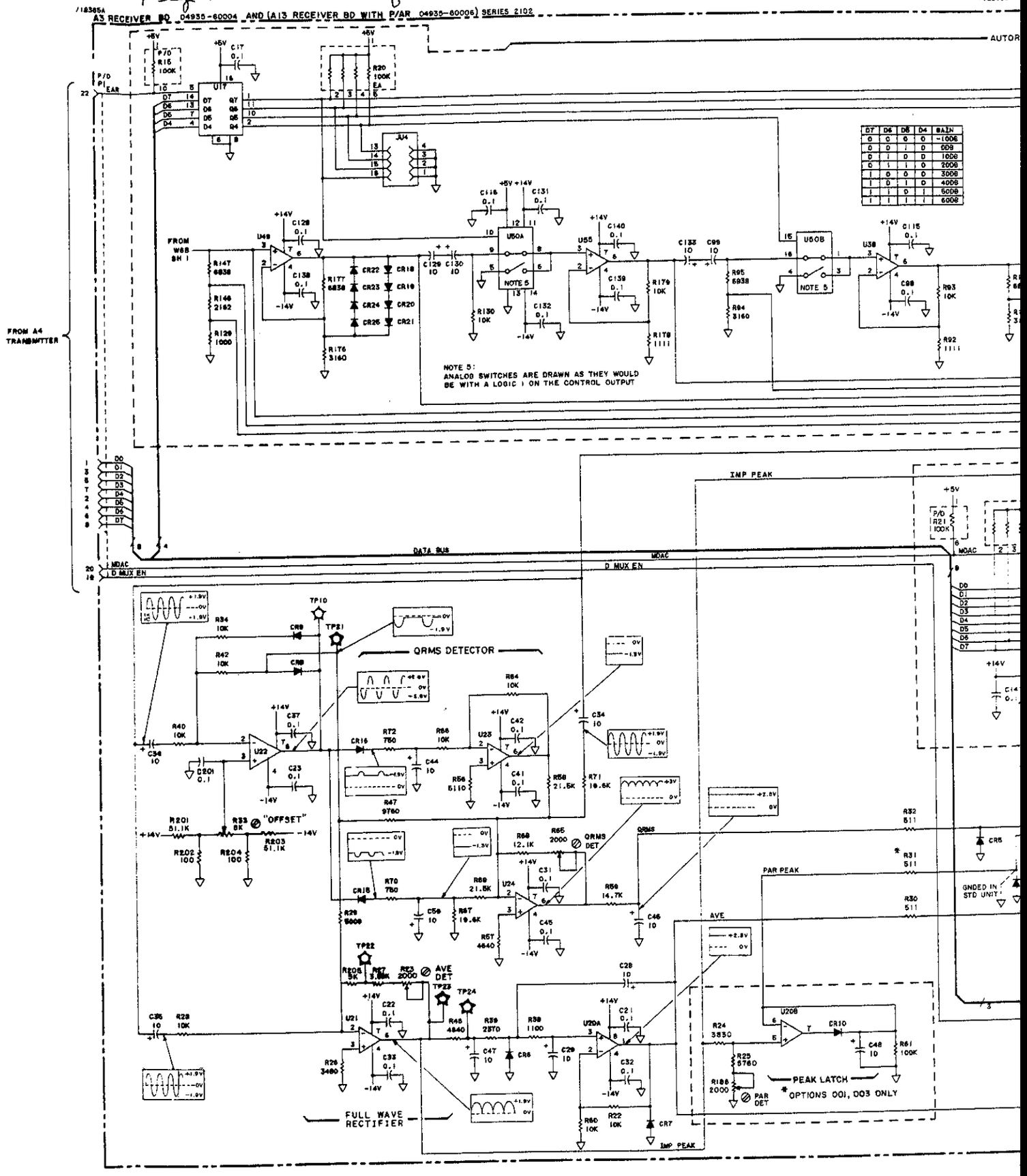


Fig 7-12 Sht 2 of 3

A3 RECEIVER BD 04935-60004 AND (A13 RECEIVER BD WITH P/AR 04935-60006) SERIES 2102

AUTORANGE BLOCK

D7	D6	D5	D4	GAIN
0	0	0	0	-100dB
0	0	1	0	0dB
0	1	0	0	10dB
0	1	1	0	20dB
1	0	0	0	30dB
1	0	1	0	40dB
1	1	0	1	50dB
1	1	1	1	60dB

NOTE 5:
ANALOG SWITCHES ARE DRAWN AS THEY WOULD BE WITH A LOGIC 1 ON THE CONTROL OUTPUT

QRMS DETECTOR

FULL WAVE RECTIFIER

PEAK LATCH

*OPTIONS 001, 003 ONLY

Fig 7-12 Sht 3 of 3

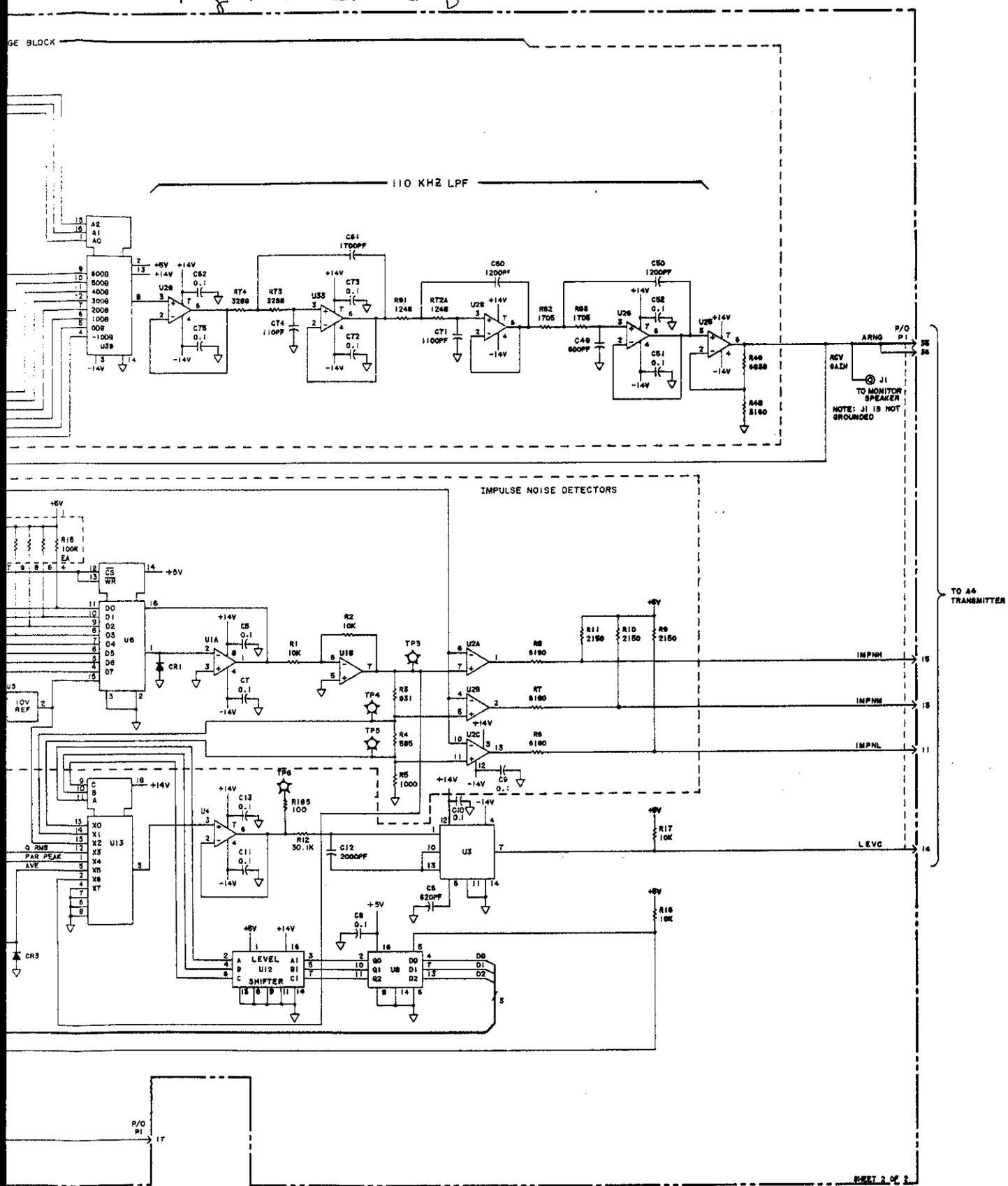
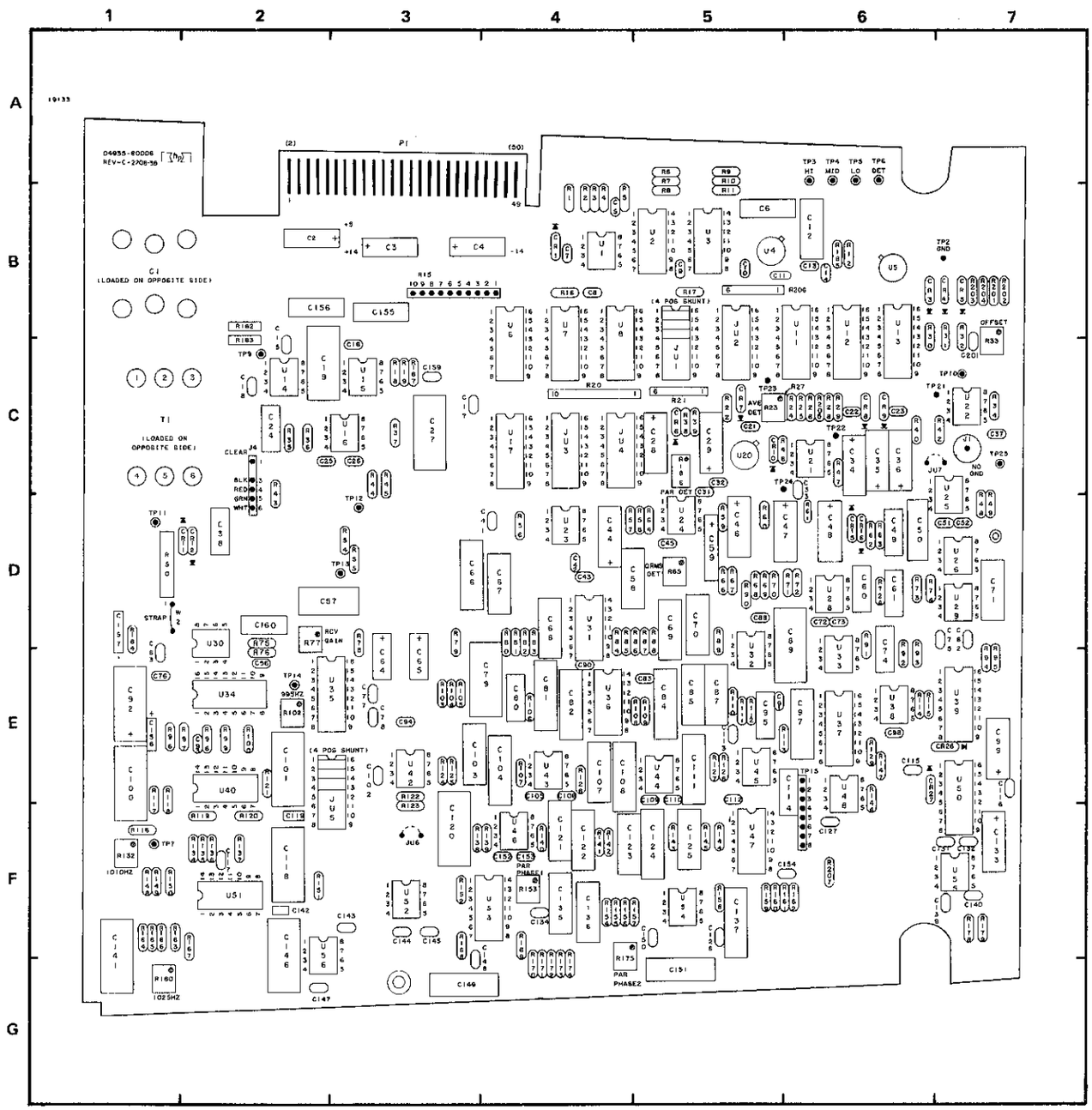
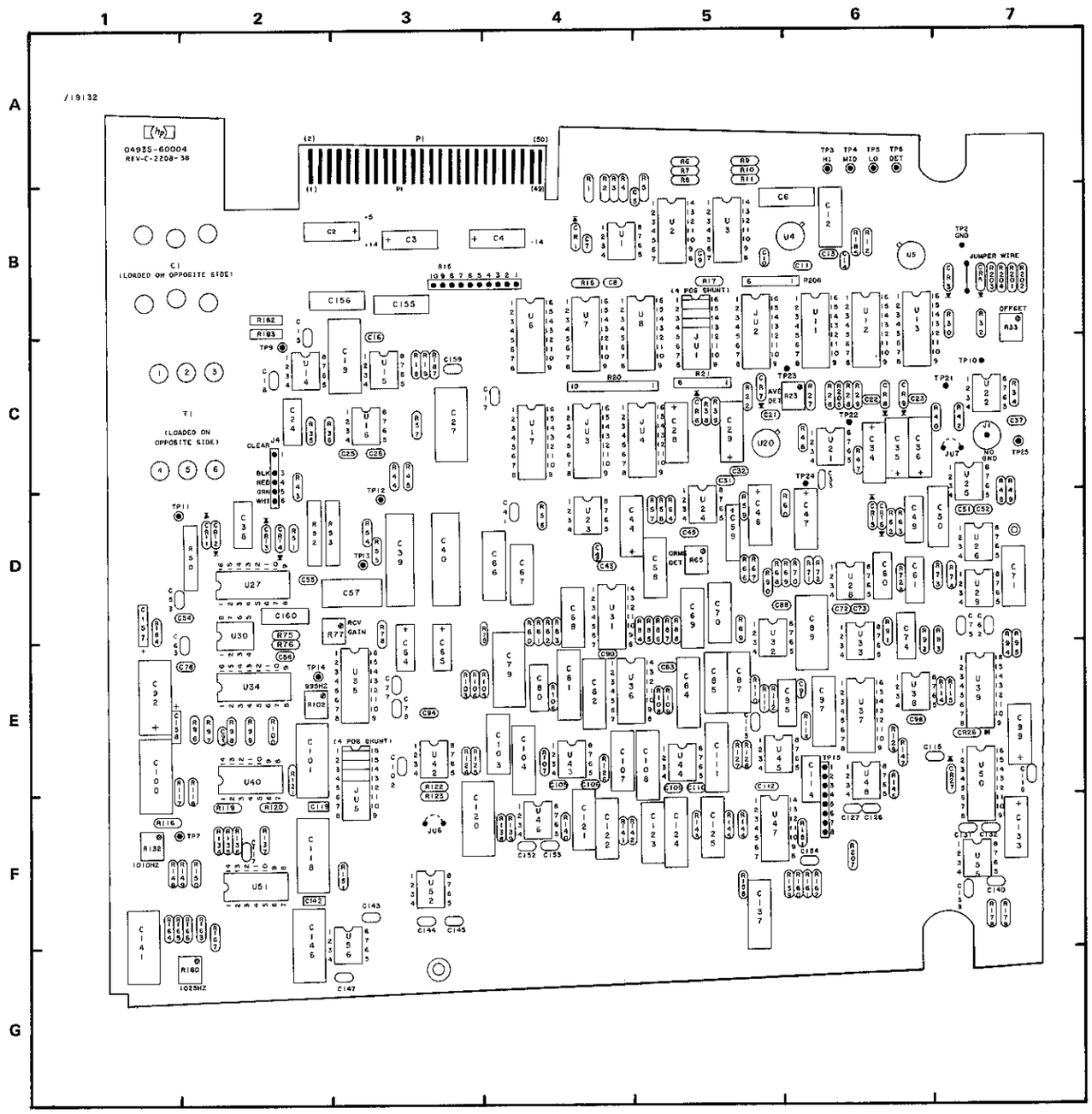


Figure 7-12.
A3/13 Receiver Board Schematic (2 of 2)
7-19/(7-20 blank)



LOCATOR GRID KEY			LOCATOR GRID KEY		
Test Points	**Jacks/Plugs**	**Non-Sequenced Components**	**Test Points**	**Jacks/Plugs**	**Non-Sequenced Componnets**
TP1 = NONE TP2 = B7 TP3 = A6 TP4 = A6 TP5 = A6 TP6 = A6 TP7 = F1 TP8 = NONE TP9 = B2 TP10 = C7	TP15 CONN = EF 6 P1 = A2–4 JU1 = B/C 5 JU2 = B/C 5 JU3 = C4 JU4 = C 4/5 JU4 = E/F 2/3 J1 = C7 J2 = F3 J3 = F/G 6		TP11 = D1 TP12 = C3 TP13 = D3 TP14 = E2 TP15 = E/F6 TP16–20 = NONE TP21 = C7 TP22 = C6 TP23 = C 5/6 TP24 = C6	J4 = C2	

Figure 7-13. A13 Receiver Board Component Locator



LOCATOR GRID KEY			LOCATOR GRID KEY		
Test Points	**Jacks/Plugs**	**Non-Sequenced Components**	**Test Points**	**Jacks/Plugs**	**Non-Sequenced Components**
TP1 = NONE	W3–W4 = F3	C156 = B2	TP14 = E2		
TP2 = B7	W5–W6 = F6	C155 = B3	TP15 = NONE		
TP3 = A6		R205 = C6	TP16 = NONE		
TP4 = A6	J1 = C7	R90 = D5	TP17 = NONE		
TP5 = A6	J2 = F2	C159 = C3	TP18 = NONE		
TP7 = F1	J3 = G6		TP19 = NONE		
TP8 = NONE	J4 = C/D 2		TP20 = NONE		
TP9 = B2	TP15 = E/F 6		TP21 = C6/7		
TP10 = C7	P1 = A2,3,4		TP22 = C6		
TP11 = D1			TP23 = C5		
TP12 = D3			TP24 = C6		
TP13 = D2/3			TP25 = C7		

Figure 7-14. A3 Receiver Board Component Locator

Fig 7-15 Sht 1 of 1

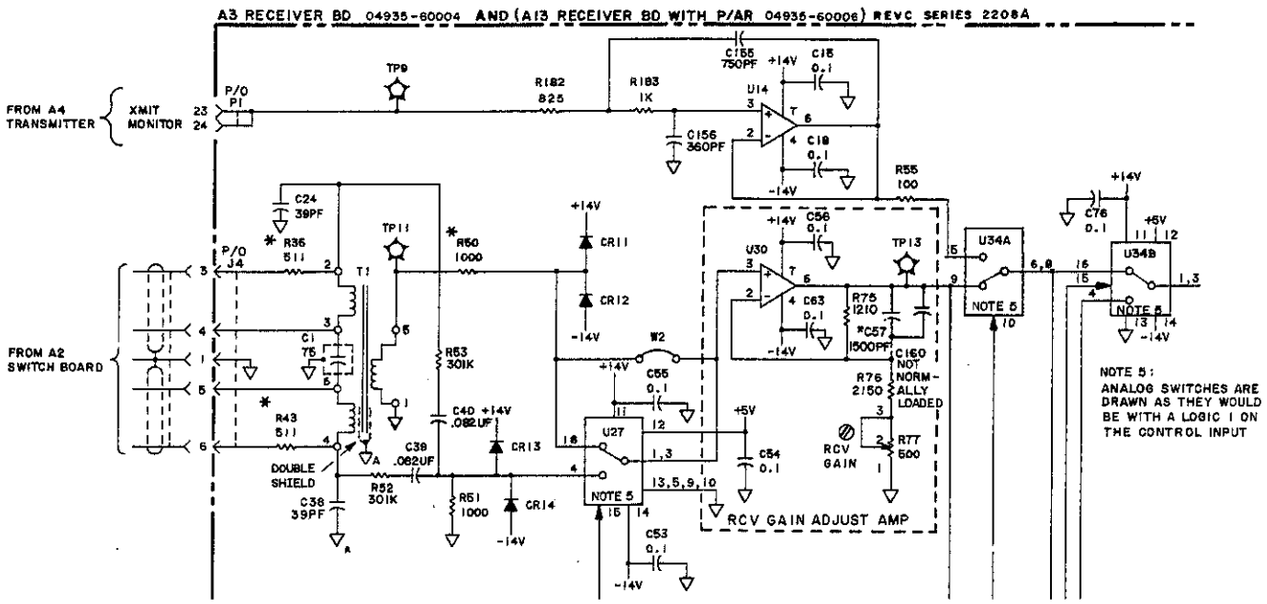


Figure 7-15. A13 Receiver Board Schematic Diagram (Partial)

Fig 7-16
Sht 1 of 2

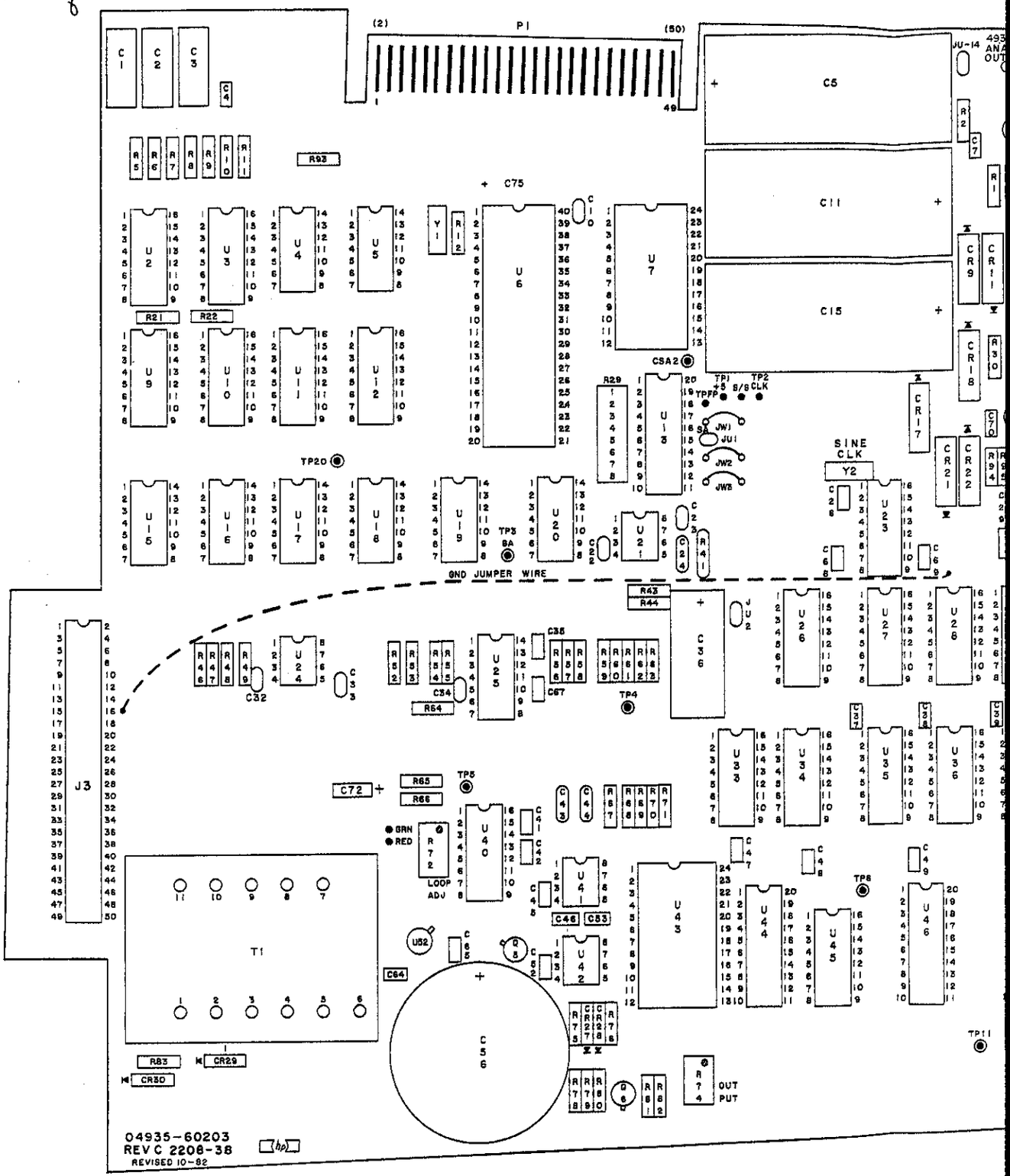


Figure 7-16. A4 Transmitter Board Component Locator

Fig 7-16
Sht 2 of 2

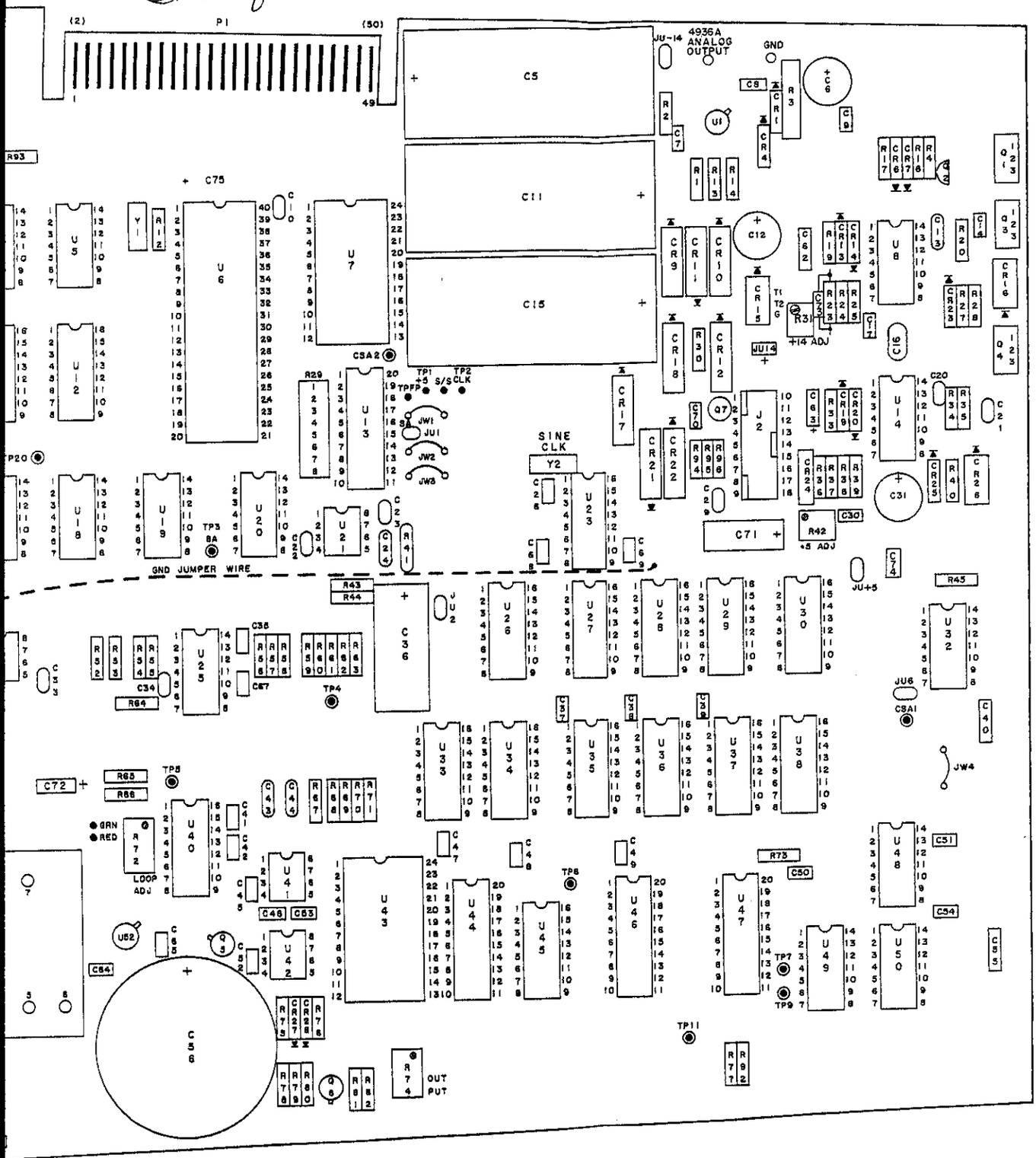


Figure 7-16. A4 Transmitter Board Component Locator

Fig 7-17
Sht 1 of 2

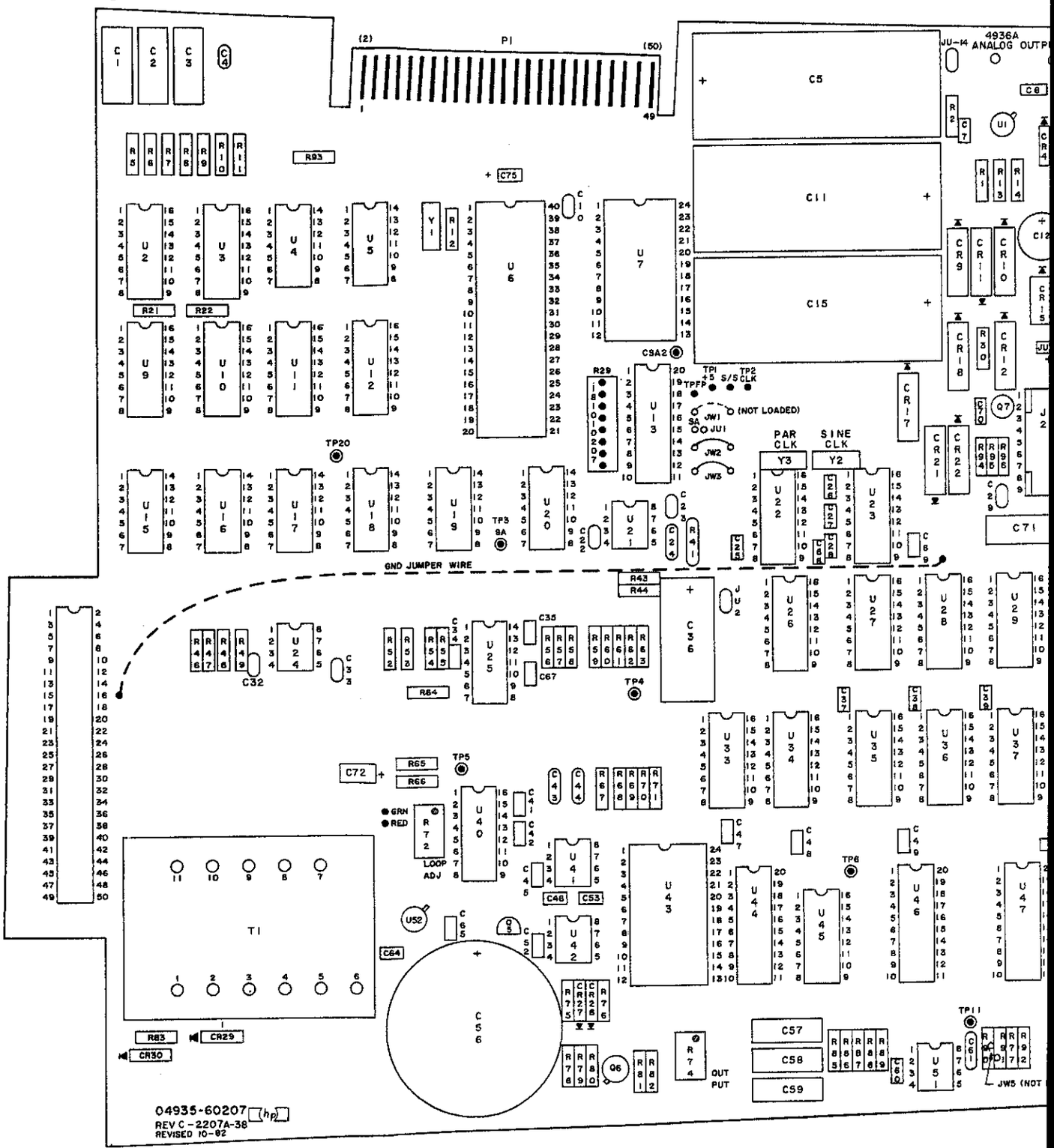


Figure 7-17. A14 Transmitter Board Co

Fig 7-17
Sht 2 of 2

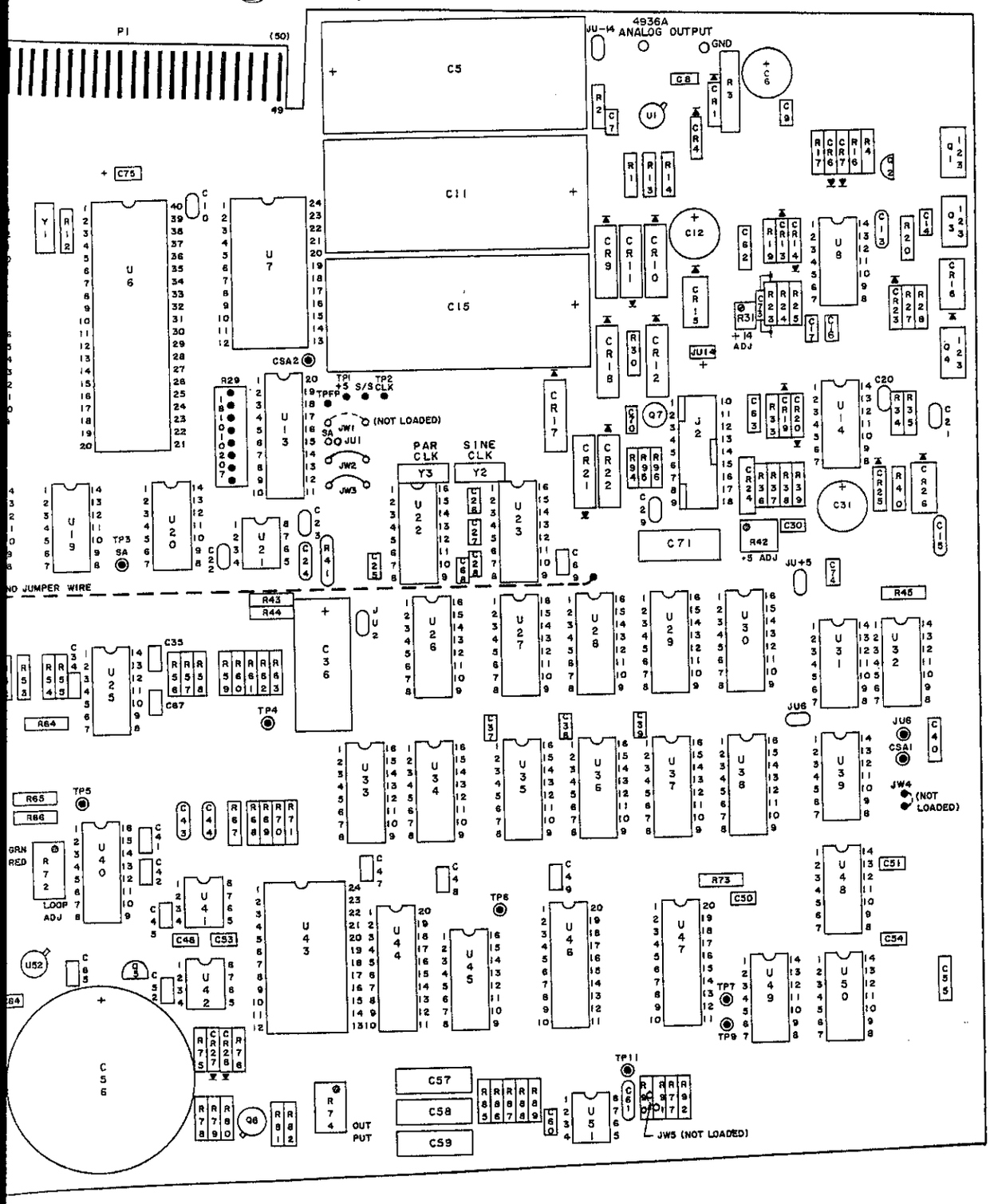
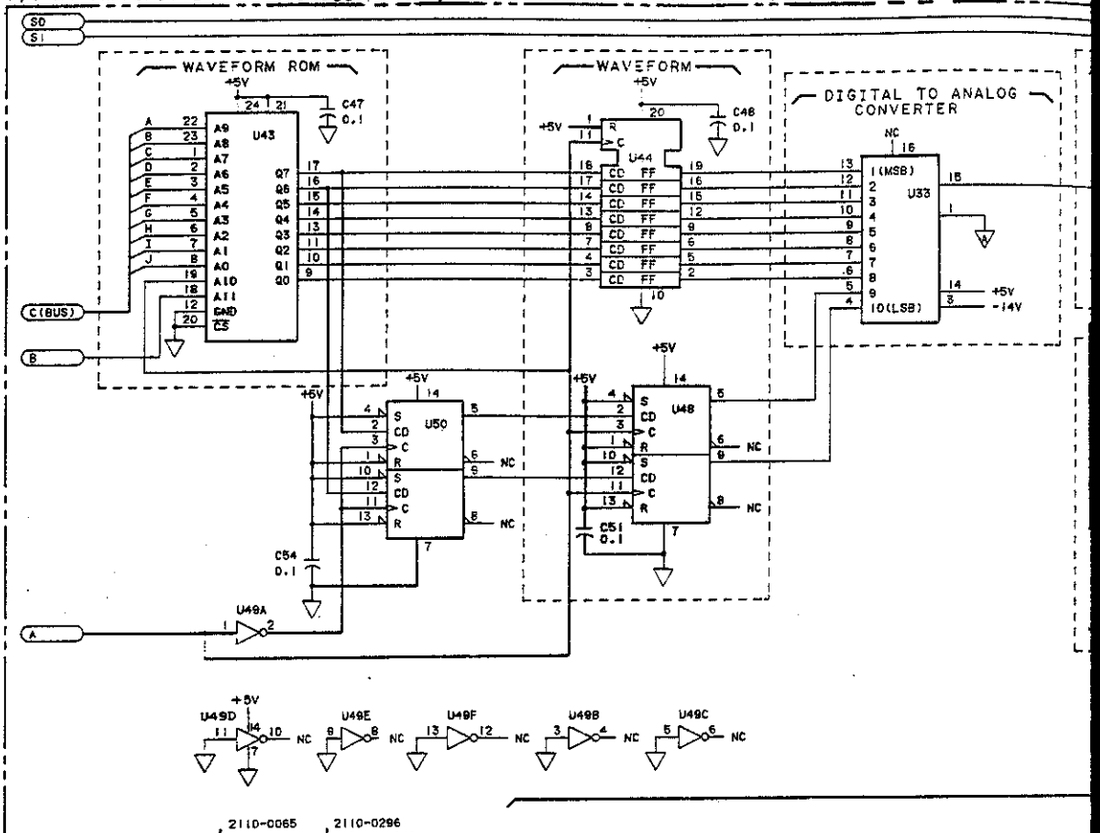


Figure 7-17. A14 Transmitter Board Component Locator

Fig 7-18
Sht 1 of 3

P/O A4 TRANSMITTER BOARD 04935-60203, (A14 TRANSMITTER ASSY WITH P/AR 04935-60207 REVC-2208A



AC LINE VOLT	2110-0065 100	120	2110-0296 220	240
FUSE	375MA	375MA	200MA	200MA

NOTE: FUSES ARE NON TIME DELAY TYPES

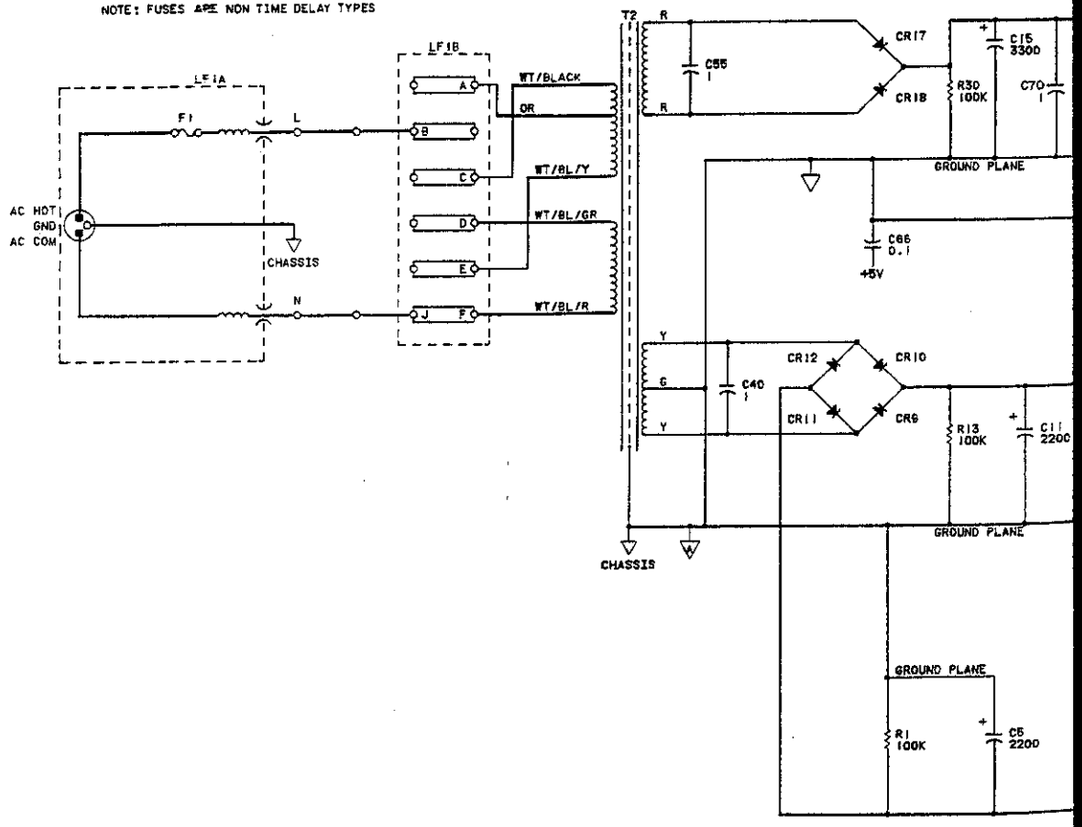
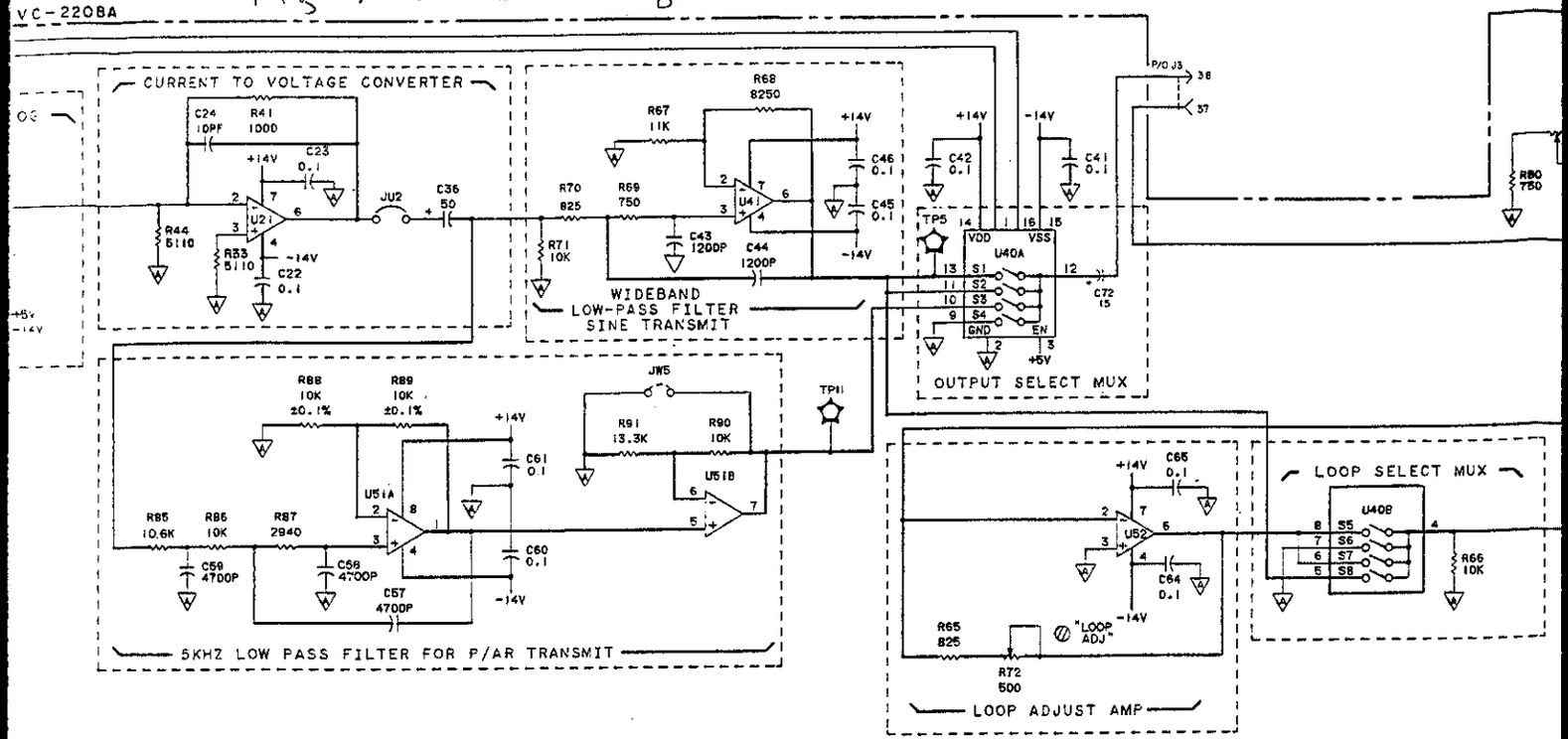


Fig 7-18 Sht 2 of 3

VC-2208A



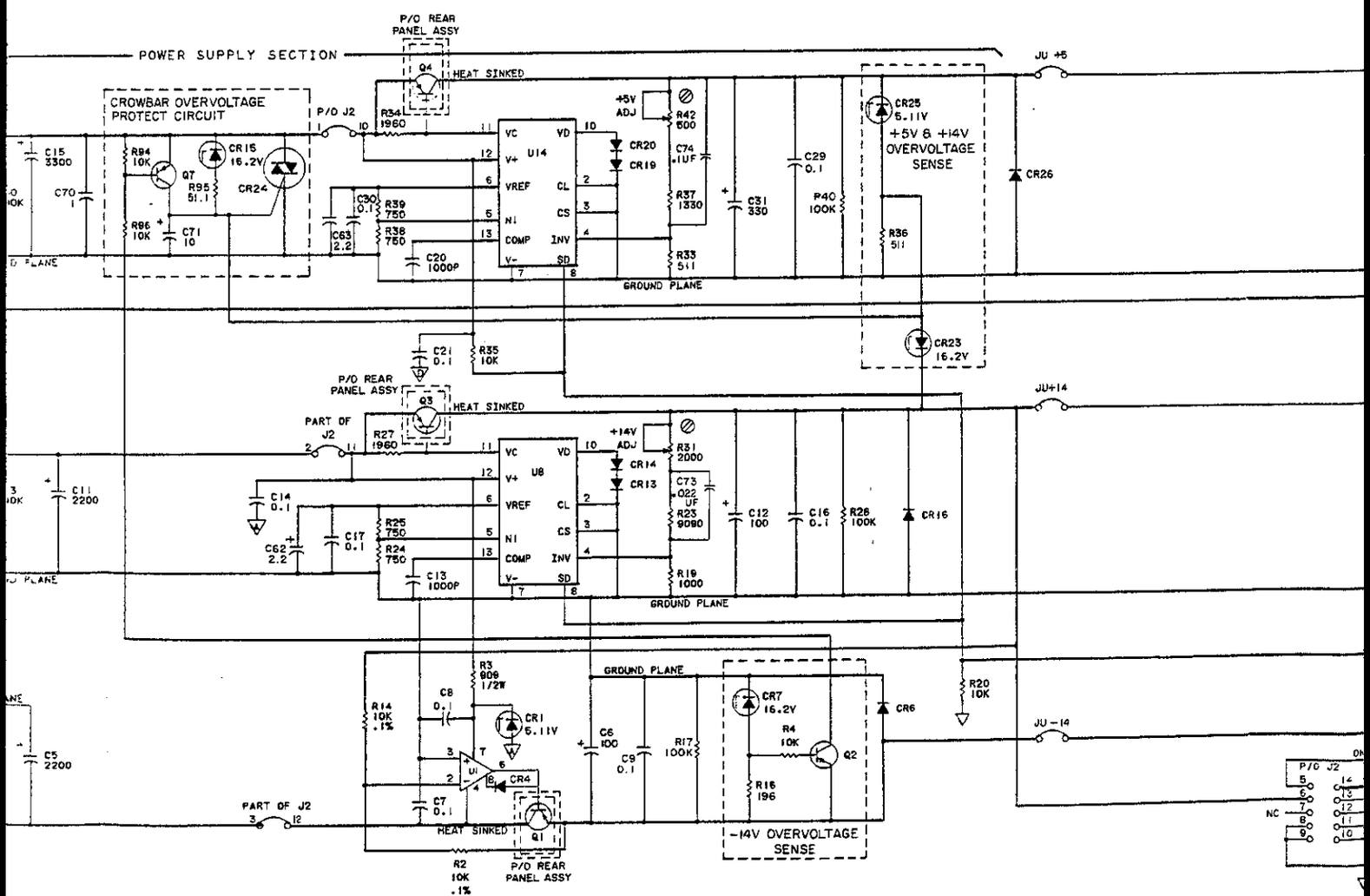
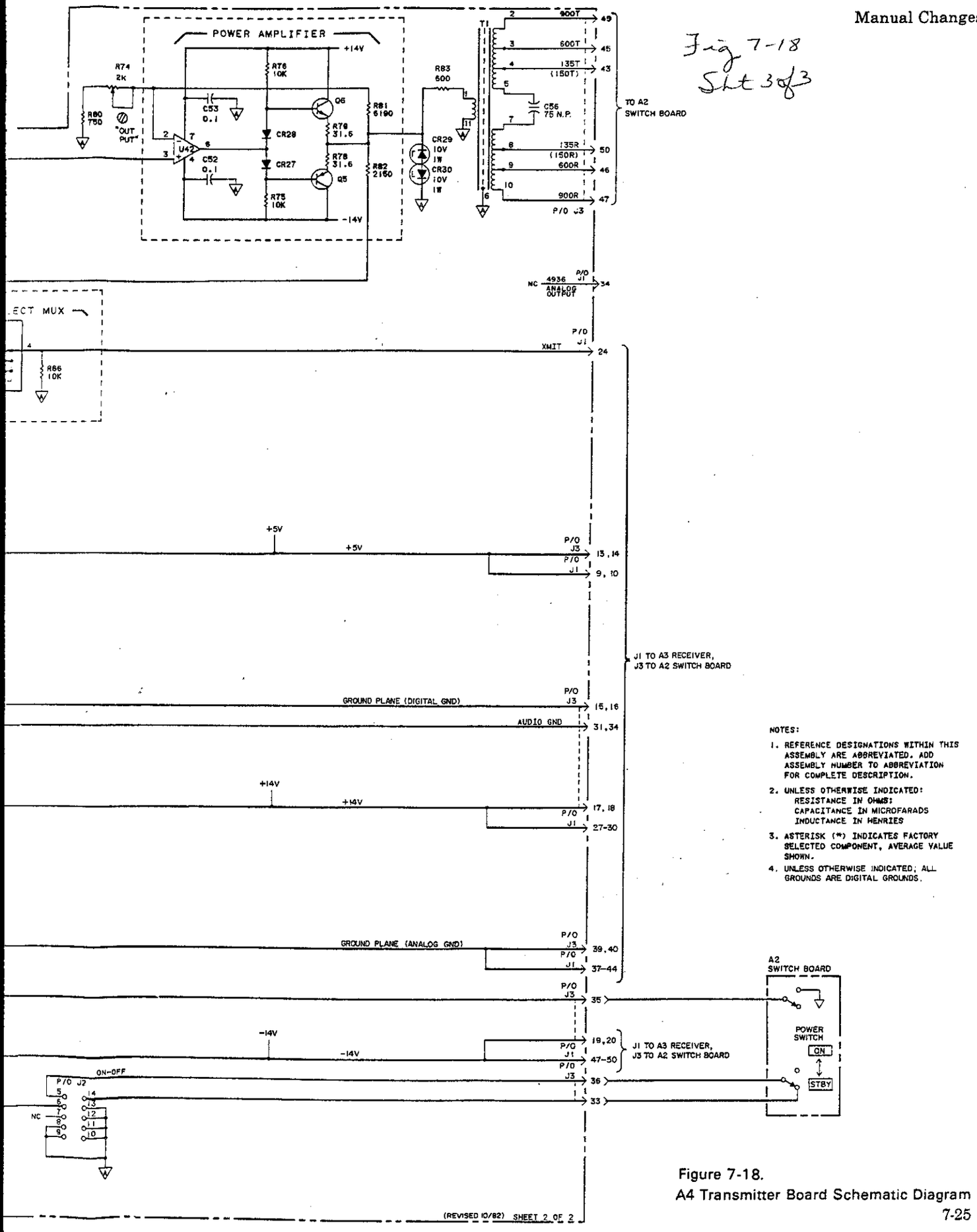


Fig 7-18
Sht 3 of 3



NOTES:

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS:
   CAPACITANCE IN MICROFARADS
   INDUCTANCE IN HENRIES
3. ASTERISK (*) INDICATES FACTORY SELECTED COMPONENT, AVERAGE VALUE SHOWN.
4. UNLESS OTHERWISE INDICATED; ALL GROUNDS ARE DIGITAL GROUNDS.

Figure 7-18.
A4 Transmitter Board Schematic Diagram

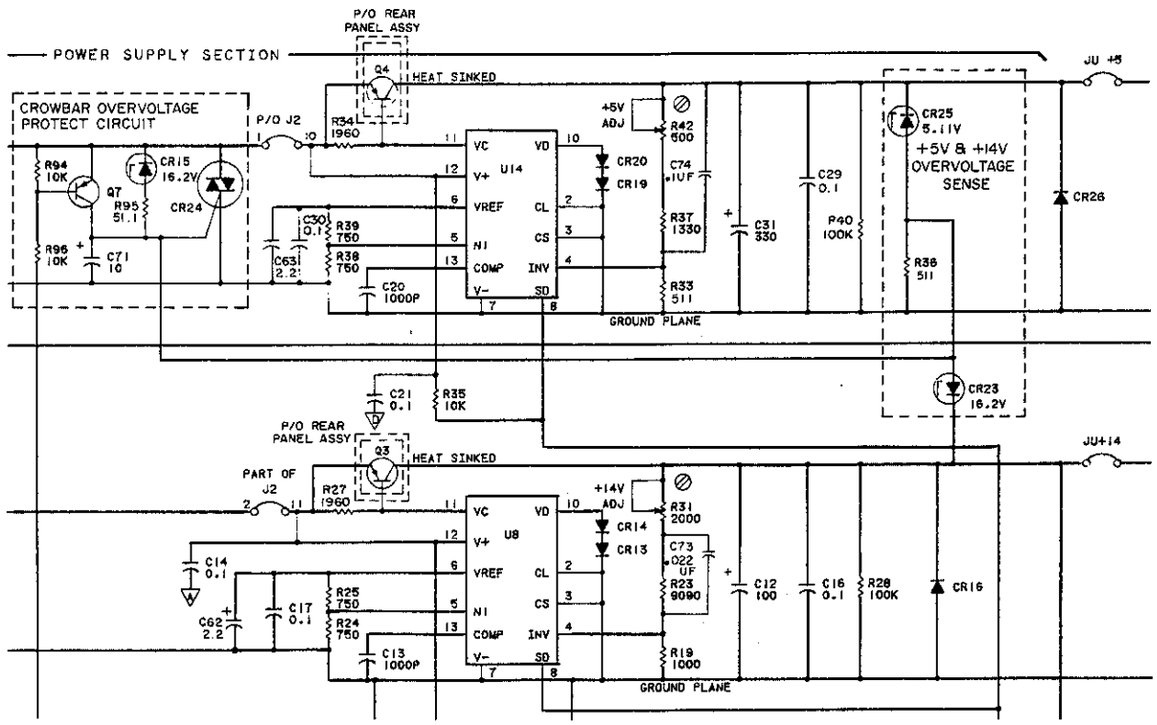


Figure 7-18. A14 Transmitter Board Schematic Diagram (partial)

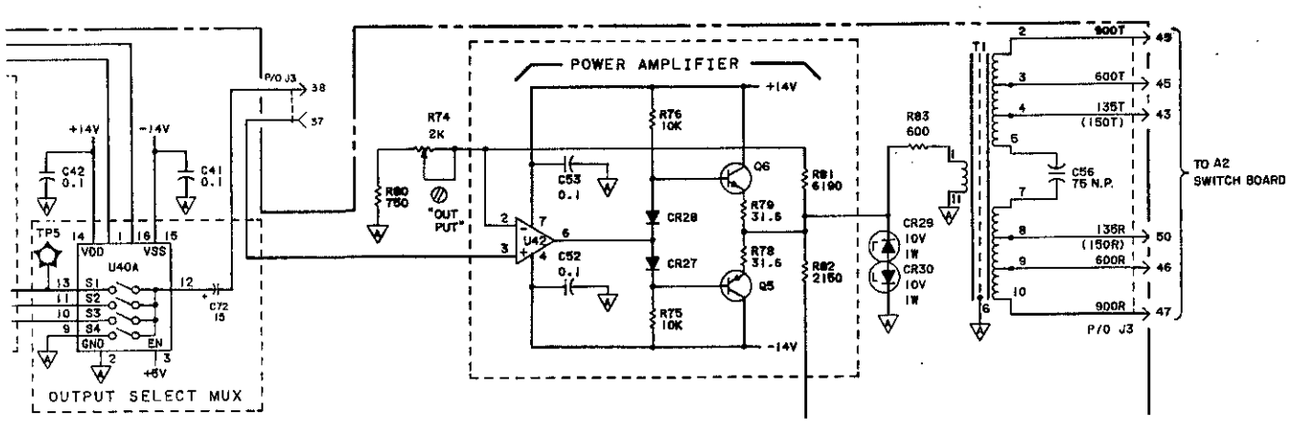


Figure 7-19. A14 Transmitter Board Schematic Diagram (partial)

SECTION VIII
SERVICE

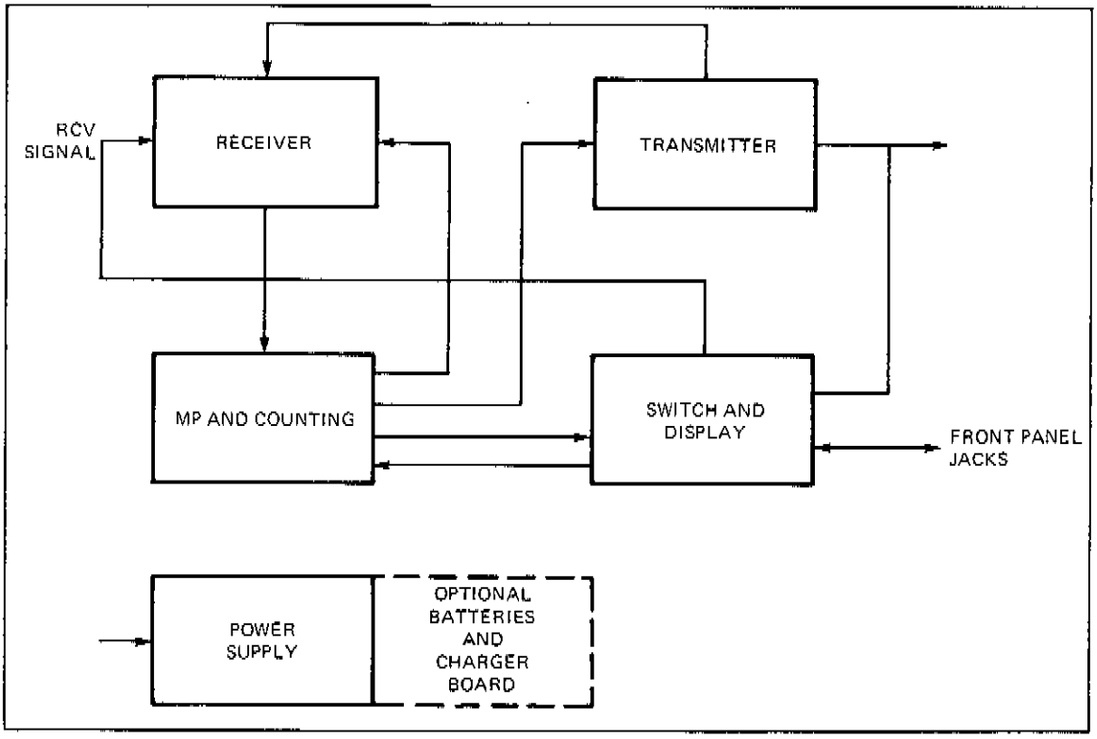


Figure 8-1. 4935A Main Block Diagram

8-1. GENERAL INFORMATION

8-2. The 4935A is a Transmission Impairment Measurement Set which provides both the test signals and measurement capabilities required for testing the transmission characteristics of communications lines. Functionally the 4935A consists of six parts:

The microprocessor/controller processes data from the receiver and controls counting functions and general operation of the instrument.

The receiver collects and processes test signals.

The transmitter generates test signals for making measurements.

The switchboard/display interfaces with communication lines and the operator.

The power supply provides power for the 4935A.

The charger controls battery operation.

8-3. The microprocessor and counting section is the heart of the 4935A. The microprocessor provides control and sequencing functions for all measurements. The counting circuitry provides impulse noise detector processing, frequency measurement, and drop-out detection.

8-4. The receiver processes signals, monitors frequency levels, and provides signals to the microprocessor and counting circuits. Ac input from the switch board or transmitter board is filtered and autoranged by the receiver. It detects full wave average or quasi-rms level of the signal. Then a pulse stream with the frequency proportional to the level detected is sent to the microprocessor and counters. It also sends information to the microprocessor if the incoming signal exceeds preset thresholds.

8-5. The transmitter receives frequency and signal information from the microprocessor, synthesizes the appropriate waveform, and sends it out through the switch board which provides a transmit monitor signal to the receiver board. In several measurement modes the transmitter has no output signal but is quiet terminated.

8-6. The switch and display circuits have four major functions. First to provide data storage and drive for the segment display and the annunciator LEDs. Second connect the front panel membrane switches to the microprocessor and counting circuits. Third, provide an audio amplifier and speaker, to monitor the received signal and beep generating circuit signal when a touch button is pressed. Fourth, connect the front panel jacks to the transmitter and receiver after selection of the proper impedances. Also provides dial connections and hold currents as required, receiver termination selections are routed to the microprocessor and control circuits.

8-7. The power supply provides +5 V at 600 mA and ±14 V at 200 mA. Options 001 and 003 add batteries and a battery charger board to the power supply.

8-8. HOW MEASUREMENTS ARE MADE

8-9. This section describes how the 4935A makes measurements and conditions that can be expected during normal operation. Table 8-1 summarizes some of this information.

Table 8-1. Measurements Summary

MEASUREMENT	INPUT SOURCE SELECTED	A3JU3 PIN		NOTCH FILTER A3JU3		DETECTORS USED	A3U8			TRANSMIT FILTER	XMIT MONITOR SOURCE	S1 A4 U40 (1)	S0 A4 U40 (16)
		16	15	IN/ OUT	PIN 14		Q2 PIN 11	Q1 PIN 10	Q0 PIN 2				
Level and Frequency													
TRMT Display	Xmit Monitor	1	0	Out	1	AVG	1	0	T	Wideband LPF	Power Amp Output	0	0
RCV Display	Input Transformer	1	1	Out	1	AVG	1	0	T	Wideband LPF	Gnd	0	1
Noise													
TRMT Display	Xmit Monitor	1	0	Out	1	AVG	1	0	T	Gnd	Wideband LPF	1	1
RCV Display	Input Transformer	1	1	Out	1	QRMS	0	1	T	Gnd	Wideband LPF	1	1
Noise w/Tone													
TRMT Display	Xmit Monitor	1	0	Out	1	Avg	1	0	T	Wideband LPF	Power Amp Output	0	0
RCV Display	Input Transformer	1	1	In	0	QRMS	0	1	T	Wideband LPF	Gnd	0	1
Signal to Noise													
TRMT Display	Xmit Monitor	1	0	Out	1	Avg	1	0	T	Wideband LPF	Power Amp Output	0	0
RCV Display Signal	Input Transformer	1	1	In	0	Avg	Toggling at ≈ 1 Hz			Wideband LPF	Gnd	0	1
Noise	Input Transformer	1	1	Out	1	QRMS				Wideband LPF	Gnd	0	1
Impulse Noise													
TRMT Display	Xmit Monitor	1	0	Out	1	Avg	1	0	1	Wideband LPF	Power Amp Output	0	0
RCV Display	Input Transformer	1	1	In	0	Avg	1	0	1	Wideband LPF	Gnd	0	1
Noise to Ground													
TRMT	Xmit Monitor	1	0	Out	1	Avg	1	0	T	Gnd	Wideband LPF	1	1
RCV	Signal to Gnd	0	1	Out	1	QRMS	0	1	T	Gnd	Wideband LPF	1	1
P/AR													
TRMT Display	Xmit Monitor	1	0	Out	1	Avg	1	0	T	Wideband LPF	Power Amp Output	1	0
RCV Display	Input Transformer	1	1	Out	1	Avg QRMS P/AR Peak	Toggling at ≈ 1 Hz			5 kHz LPF	Power Amp Output	1	0

T = toggling

8-10. Level And Frequency

8-11. Once the frequency is selected on the front panel and the level adjusted (use the OUTPUT LEVEL knob), the transmitter generates the appropriate sinewave. The level measurement is made in the loop-around path on the receiver board. The loop-around path selects the wideband low pass filter and the transmitter output to make its measurement. When monitoring the transmit signal, no frequency measurement is made. If the input frequency and the output frequency are different, the transmitter circuit should be repaired.

8-12. DISPLAY RCV: The receiver measures the level and frequency of a balanced input signal from the front panel RCV 310 jack. The receiver signal path is as follows:

Balanced input through input transformer

Notch filter out

25 dB amp switched in when input signal is less than .5 mVRMS

Autorange switched in

Average detector selected

Loop-around path grounded

8-13. Noise

8-14. DISPLAY TRMT: The transmitter provides a quiet termination for the line. The input to the power amp is grounded (no output current through the transmit transformer). The synthesis of the output waveform is stopped since the phase-step latches are set to zero.

8-15. DISPLAY RCV: The receiver measures the level (not frequency) of the input to the front panel RCV jacks. The receiver signal path is as follows:

Balanced input through input transformer

Notch filter out

25 dB amp switched in when input signal is less than .5 mVRMS

Autorange switched in

Noise filter selected and displayed on front panel

QRMS detector selected

8-16. Noise With Tone

8-17. DISPLAY TRMT: The transmitter synthesizes a 1004 Hz signal set by the OUTPUT LEVEL control. The wideband low pass filter is selected and the loop-around path monitors the output of the power amplifier.

8-18. DISPLAY RCV: The receiver measures the level and frequency signal from the front panel RCV jack. The level is measured with the 1004 Hz signal notched out. Frequency measurements occur only when the 4935A is setup with DISPLAY-RCV, NOISE WITH TONE, and LEVEL FREQUENCY modes. The signal path is as follows:

Balanced input through the input transformer

Notch filter in

25 dB amp switched in when input signal is less than .5 mVRMS

Autorange switch in

Noise filter selected on front panel

QRMS detector selected

8-19. Signal To Noise

8-20. DISPLAY TRMT: Transmitter synthesizes a 1004 Hz sinewave whose level is set by the front panel OUTPUT LEVEL control. The wideband low pass filter is selected and the loop-around path monitors the power amplifier output.

8-21. DISPLAY RCV: The 4935A measures the signal-to-noise ratio of the signal input to the front panel RCV (1004 Hz is assumed). The level of the entire input signal (1004 Hz plus noise) is measured through the average detector. Second, the 1004 Hz signal is notched out and the remaining noise measured with the QRMS detector through the noise filter selected. Finally, the microprocessor calculates the signal-to-noise ratio on the right display. The receiver path is as follows:

Balanced input through input transformer

Notch filter in

25 dB amp switched in when input signal is less than .5 mVRMS

Autorange switched in

Noise filter selected and displayed on front panel

QRMS or AVG detector selected as needed

QRMS for noise measurements

AVG for hold tone to measure signal level

Microprocessor computes level

8-22. Impulse Noise

8-23. DISPLAY TRMT: The transmitter synthesizes a 1004 Hz sinewave. For the C-message and 3 kHz flat filters, the output level is set by adjusting the OUTPUT LEVEL control. The wideband low pass filter is switched in. For measurements using the other filters, the loop-around signal path is connected to ground.

8-24. DISPLAY RCV: The receiver monitors the level of the input signal through the selected noise filter. The 1004 Hz component of the signal is notched out and the residual noise routed through the selected noise filter. The noise is amplified by the autorange circuit which is set according to the 10's digit of the low threshold level selected. This enables the user to set the autorange to a desired state while troubleshooting the receiver.

Table 8-2. Noise Amplification

10's DIGIT OF LOW THRESHOLD	AUTORANGE AMPLIFICATION
3×	60 dB
4×	50 dB
5×	40 dB
6×	30 dB
7×	20 dB
8×	10 dB
9×	0 dB
10×	−10 dB

8-25. After being autoranged, the noise is full-wave rectified and sent to the impulse noise comparators where it is compared to three preset thresholds. These thresholds are set by the microprocessor through the receiver board D-to-A converter and associated circuitry. Outputs of the comparators go to the microprocessor and counting circuit where they are processed to limit the repetition rate to about 8 per second and counted by the microprocessor. The processor keeps a running total of the number of counts from each comparator and also keeps track of the test time interval. Receiver signal path is as follows:

Balanced input through input transformer.

Notch filter in.

25 dB amp out.

Noise filter selected from and displayed on the front panel.

Autorange set by 10's digit of Low Threshold.

An average detector is selected but not used. The threshold detector circuitry is used instead of the detector-select-MUX and voltage-to-frequency converter.

Loop-around path input grounded (RCV display).

Loop-around path input monitors transmitter output (TRMT display).

8-26. Noise-To-Ground (Standard and Option 001)

8-27. DISPLAY TRMT: The transmitter provides a quiet termination for the line. Input to the power amp is grounded.

8-28. DISPLAY RCV: The receiver measures the common mode (to ground) input signal from the front panel RCV 310 jacks. The receiver input (in RCV display) is from the noise-to-ground input source. With the exception of the input source selected, noise-to-ground mode works in the same way as the noise measurement mode.

8-29. Peak-To-Average Ratio: P/AR (Options 002 and 003)

8-30. DISPLAY TRMT: The transmitter synthesizes the P/AR signal defined in Bell Publication 41009.

8-31. DISPLAY RCV: The receiver measures the signal input to the 4935A front panel jacks. It measures the total signal level through the QRMS detector to ensure that the received signal is within the proper level range. The signal level is measured by the average detector and peak latch. The comparison of these two measurements gives the peak-to-average ratio (P/AR).

The receiver signal path is as follows:

Balanced input through input transformer in DISPLAY RCV

Notch Filter out

25 dB amp out

Detector selected varies

Loop-around path input is from power amp output in DISPLAY TRMT

Loop-around path input is from output in DISPLAY RCV

8-32. FREQUENCY MEASUREMENT

8-33. Two counters are used to measure level and frequency. These counters are enabled by Port 5 bit 3 of the microprocessor and count pulses present for each counter. To select frequency, the microprocessor writes a 1 latch U12. Following the procedure given in the timing diagram found in paragraph 8-4, steps 1 through 11, the microprocessor has enough information to calculate frequency. The counters are read by addressing and serially reading successive bits from the two counters. Counter no. 2 contains the number of 262 kHz clock transitions detected during the gating or "Open" interval. Counter no. 1 contains a count of the frequency cycles which occurred during this same interval. Frequency is the number of complete cycles in a unit time interval, i.e. 10 cycles in 60 msec would be 10/.06 sec = 167 Hz. The time interval is calculated from the number of counts in counter no. 2 by calculating N/262,144 which is the amount of time it takes to

accumulate "N" counts of 262,144 Hz square wave. Let "Events" be the number of frequency cycles, and "Counts" the number of 262,144 Hz cycles, the frequency is calculated by the microprocessor using the formula:

$$\text{Frequency} = \frac{\text{Counts}}{\text{Events}/262{,}144} \text{ Hz}$$

$$= \frac{\text{Counts}}{\text{Events}} \times 262{,}144 \text{ Hz}$$

The microprocessor will detect an error and blank the frequency display if:

1. The 262 kHz signal fails to fill Counter no. 2 to the 1/4th full condition in approximately 63 milliseconds. This is an indication that the 262 kHz clock, NAND gate U17, or Counter no. 2 is not operating properly.

2. If the "Not Open" signal fails to toggle within 50 milliseconds, then this indicates that the frequency is not present or is less than 20 Hz.

8-34. LEVEL MEASUREMENT

8-35. Level measurement is "gated" by an internal timed loop in the microprocessor. The interval is accurately controlled by the microprocessor using the "Inhibit" command to counter no. 1 as shown in Figure 8-4 items 12 through 16.

8-36. There is no need to calculate the voltage-to-frequency converter output from the gated count since the ratio of counts is equal to the ratio of frequencies. The microprocessor reads the level counts. 10 v counts for the same 70 msec interval have been accumulated during calibration and have been stored in RAM for later recall. There are 4 inputs:

1. 10 Volt Reference
2. QRMS
3. AVE
4. PEAK detector signals

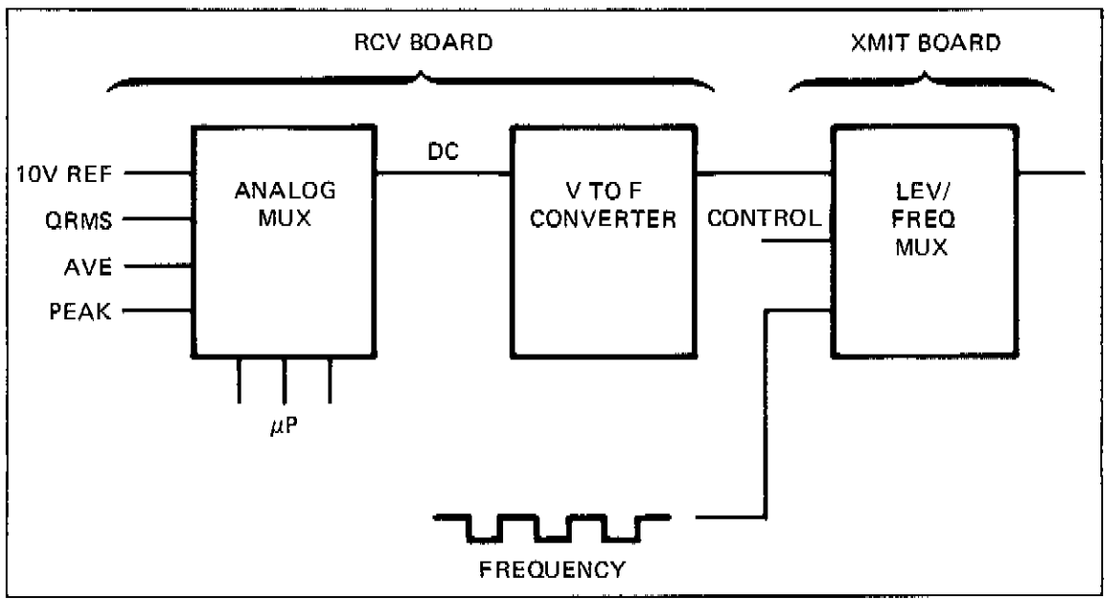


Figure 8-2. Voltage-To-Frequency Conversion Characteristics

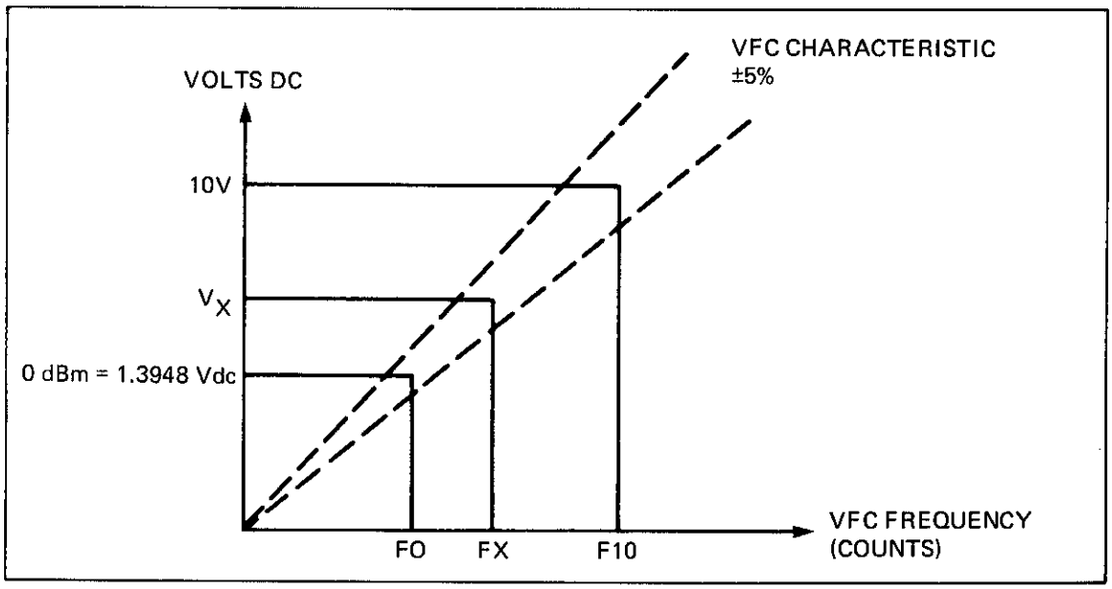


Figure 8-3. Voltage-to-Frequency Conversion Output

8-37. These dc signals are selected and routed to the voltage-to-frequency converter. The voltage-to-frequency converter is linear and the 10 volt reference signal is very accurate. The 10 volt signal is used to recalibrate the V-To-F converter whenever a new measurement is selected. The 10 volt frequency is approximately equal to 60 kHz. Assume that the 10 volt frequency is exactly 60 kHz. Then if detector output is 3 volts, the V-To-F frequency will be exactly $3/10 \times 60$ kHz = 18000 Hz. The number of 3 volt-counts in 70 milliseconds will be $1800 \times .070 = 1260$ counts.

8-38. HOW TO COMPUTE FREQUENCY AND LEVEL MEASUREMENT

8-39. Level Calculation Example

8-40. The 10 volt reference level in dBm is:

$$20 \log \frac{10 \text{ volts}}{1.3948 \text{ volts}} = 17.1 \text{ dBm}$$

Also,

$$\frac{10 \text{ volts}}{v_x} = \frac{f10 \text{ volts}}{f_x} = \frac{10 \text{ volt counts}}{v_x \text{ counts}}$$

The level in dBm is calculated by the microprocessor as follows:

$$v_x(\text{dBm}) = 17 - 20\log_{10} \frac{10 \text{ volt counts}}{v_x \text{ counts}}$$

For a detector voltage of 3 volts the counts in a .070 sec interval would be 1260 counts. Similarly, the 10 volt signal would result in a count of $60{,}000 \times .070$ sec or 4200 counts.

$$17.1 - 20\log_{10} \frac{4200}{1260} = 6.65 \text{ dBm}$$

If the microprocessor has added twenty dB of gain to get the signal within the 1 volt to 5 volt level "window," the microprocessor will subtract 20 dB from the 6.65 dBm signal and display.

$$6.65 - 20 = -13.3 \text{ dBm}$$

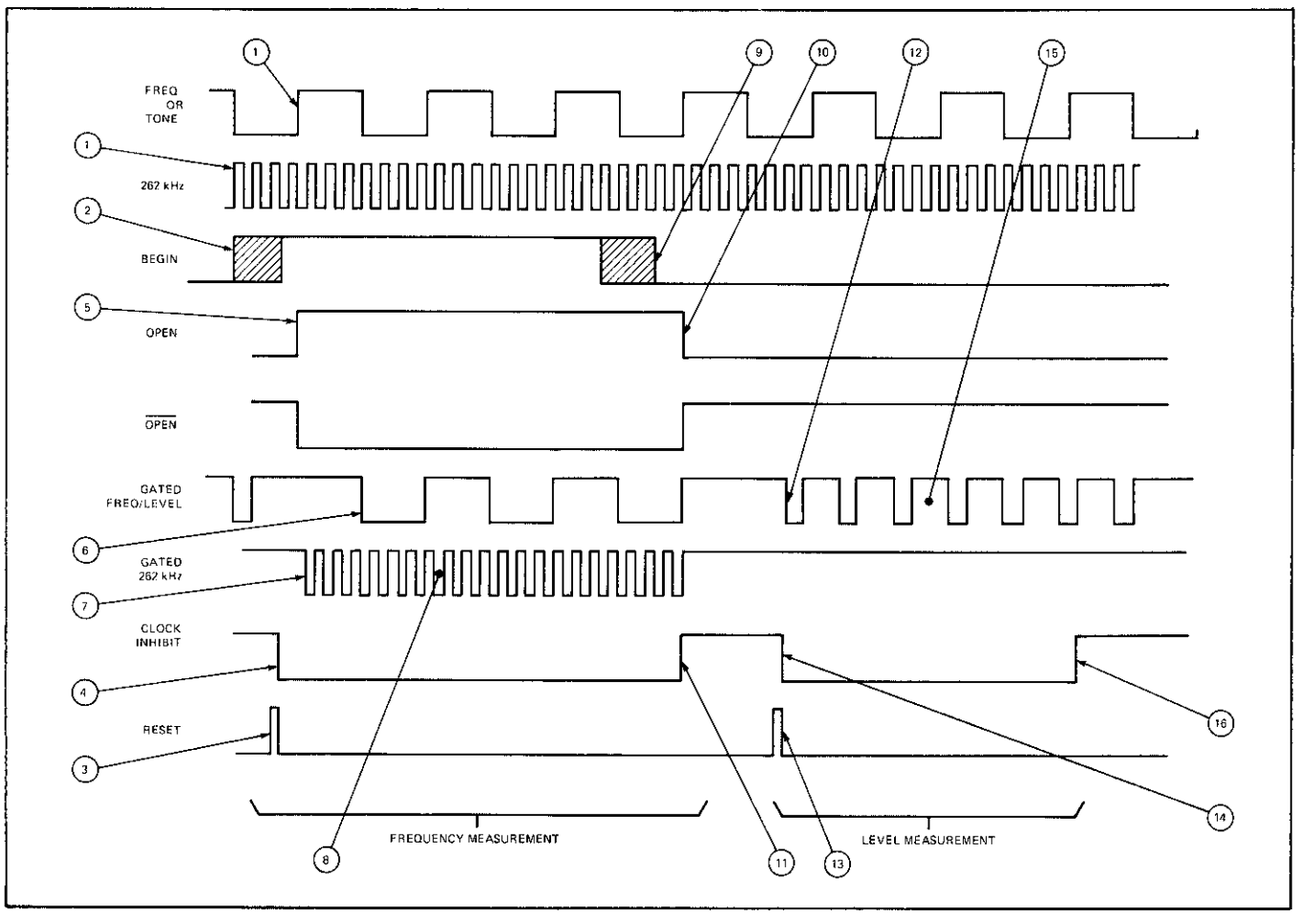


Figure 8-4. Frequency and Level Measurement Timing

8-41. To measure level and frequency, the microprocessor autoranges the signal until it is within a 13 dB window (approximately 6 to 30 kHz from the V-to-F converter in the detector circuit). The following is a description of the level and frequency measurement.

1. Schmitt triggers U25A and U25B square the autoranged sinewave. If a tone frequency is to be measured, for example, 1000 Hz in noise-with-tone measurement, the microprocessor selects it by writing a "0" to Q3 of latch U11. This signal must be intercepted prior to the notch filter for measurement.

2. The start command is generated by writing a "one" to Q1 of latch U11.

3. The microprocessor U6 pin 29 resets counters 1 and 2.

4. The microprocessor U6 pin 30 enables counters 1 and 2 to begin counting.

5. The "Open" signal is clocked out of RS flip-flop U18 on the next rising edge of the frequency waveform. This signal is generated to ensure that counting takes place for exactly an integer number of frequency cycles.

6. The "Open" signal is used to gate the frequency signal through NAND gate U16B and into pin 3 of counter no. 1.

7. The "Open" signal also gates the 262 kHz clock through NAND gate U17C and into pin 3 of counter no. 2.

8. The microprocessor monitors the output of the 2nd most significant bit of counter no. 2 until it senses that this counter is 1/4th full of transitions of the 262 kHz clock (approximately 60 msec). It monitors the 15th bit of the counter by writing "1110" to the counter inputs ABCD and detects the change from "0" to "1" by reading the counter output.

9. After the microprocessor senses the "1/4th full" condition, it clears the "Begin" command.

10. The next positive transition of the frquency waveform clears the "Open" line and stops the waveform from being gated to the counters.

11. The microprocessor monitors the "not open" signal through pin 2 of tri-state buffer U13. When it detects that the "Open" line has cleared, it inhibits the counters by writing a "1" to Port 5, Bit 3.

12. "LEVEL" counts are routed to the counter by writing a "0" to Q3 of register U12. The microprocessor stores the number of counts from counter no. 1 and the number of 262 kHz pulses from counter no. 2 for later use in computing the frequency of the input signal. The microprocessor next measures the level of the input signal by measuring the frequency of the V-to-F converter from the detector circuit as follows:

13. The counters are reset by microprocessor.

14. The inhibit command to the counters starts counter no. 1 counting pulses.

15. Counters accumulate frequency counts at a rate proportional to the input level.

16. After an interval 70 msec., the microprocessor stops the counting by writing a 1 to the inhibit line of counter no. 1. This count is proportional to the level of the input signal.

8-42. CONTROL THEORY OF OPERATION

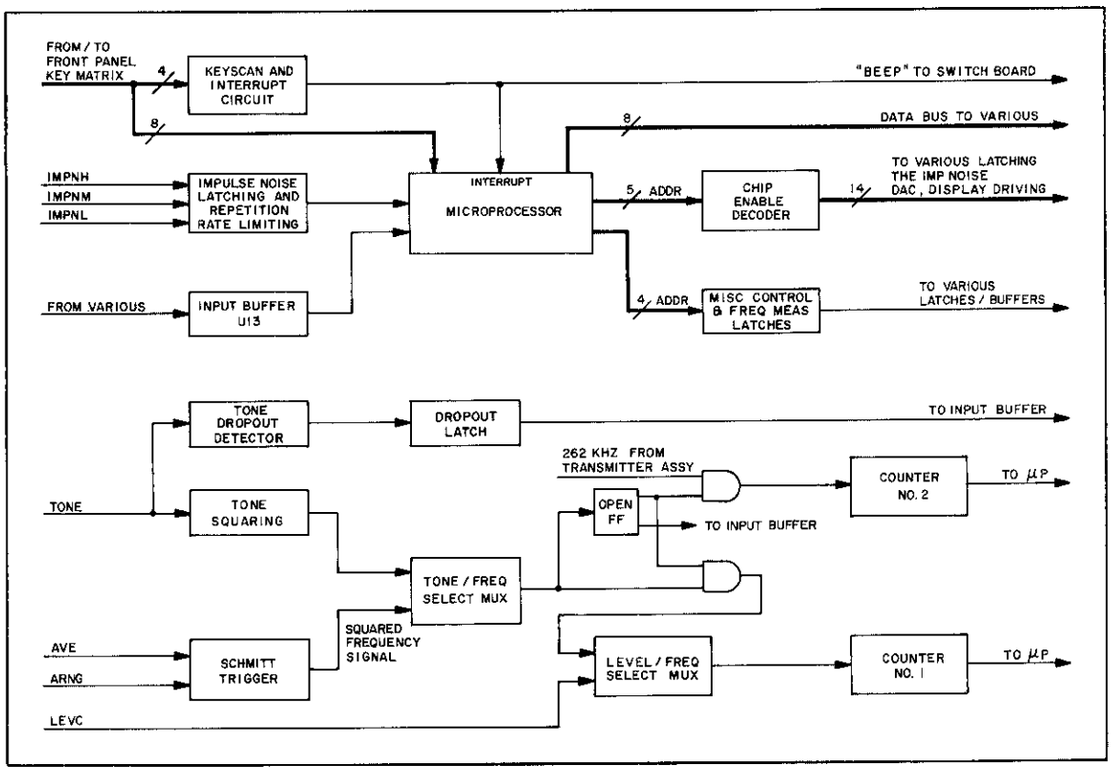


Figure 8-5. Control Circuitry Block Diagram

8-43. The center of the control circuitry is the microprocessor. It has 4K bytes of onboard ROM, 128 bytes of RAM, a built in clock circuit, four 8 bit bidirectional I/O ports, and interrupt and timer functions. There are six major flows of information between the operator, the microprocessor, and the rest of the instrument.

8-44. MICROPROCESSOR TO INSTRUMENT

8-45. System Latches

8-46 The microprocessor controls the 4935A through system latches. System latch data comes on the data bus from the processor I/O. The latch strobes are activated by the chip enable decoder via I/O port 4. Strobes for the latches are provided by the chip enable decoder A4U7 from inputs supplied by the microprocessor through output port 4. There are six system latches.

1. The phase-step latches (A4U26-A4U30) control the transmitter output frequency. They provide select lines for the output waveform and transmit monitor multiplexers.

2. The input select latch (A3U7) controls the set up of the input circuitry through analog switches. It selects the input source (balanced input, noise-to-ground, or transmit monitor), determines switching in or out of notch filter, and selects switching in or out of 25 dB amp.

3. The filter select latch (A3U11) controls the filter select MUX which determines which filter is selected.

4. The autorange latch (A3U17) sets the autorange circuit gain through the autorange multiplexer (A3U39) and analog switch (U50).

5. The detector select latch (A3U8) selects which detector to use for level measurements. It is also used by the diagnostic processor to check the impulse noise detector's digital-to-analog converter.

6. The impulse noise DAC latch (A3U6) sets the comparison thresholds for impulse noise measurements.

8-47. There are two additional latches used in the level and frequency measurement process. They are the miscellaneous control latch (A4U12) and the frequency measurement control latch A4U11. How these latches work is described in paragraph 8-38, How to Compute Level and Frequency.

8-48. INSTRUMENT TO MICROPROCESSOR

8-49. The microprocessor receives inputs from many parts of the 4935A.

1. The option and miscellaneous sense latch provides the microprocessor with the following information:

   a. D0 reads the state of the open line during frequency measurement.

   b. D1 reads the state of the tone dropout latch.

   c. D3 and D4 read the receiver impedance setting from the front panel.

   d. D4, D5, and D6 read the instrument option number.

   e. D7 is used with the diagnostic processor from the Diagnostic Service kit to enable the signature analysis routines.

2. The level and frequency measurement counters, see paragraph 8-38, How to Compute Level and Frequency, for an explanation.

3. The impulse noise latches, see paragraph 8-69 for an explanation.

8-50. The microprocessor has internal circuitry which senses power up and causes a reset. Reset can also be caused by grounding the processor reset line.

8-51. OPERATOR TO MICROPROCESSOR

8-52. Keyboard Interrupt

8-53. The microprocessor senses operator commands through I/O port 0, its own interrupt line, and the keyscan interrupt circuitry. The eight lines of microprocessor I/O port 0 form a four by four key matrix on the front panel. The four least significant bits of this port feed into NAND gate U20. When a hex "OF" is written into the keys, a key closure causes an interrupt via external interrupt of the microprocessor. A 50 millisecond one-shot and a D type flip-flop form the switch debounce circuitry. Bit 2 of I/O Port 5 is programmed by the microprocessor to reset the interrupt latch after the key has been read.

8-54. Receiver Impedance Switches

8-55. The receiver impedance selected on the front panel setup switches is sensed through the option and miscellaneous sense latch. The microprocessor uses the receiver impedance to compute the power level of the input signal.

8-56. When the 4935A is in BRG receive impedance mode, the receiver has a high impedance input. However, the received level is still computed from the input voltage per the receive impedance selected on the setup switches. For correct level measurement the proper receive impedance MUST BE SELECTED.

8-57. MICROPROCESSOR TO OPERATOR

8-58. Displays

8-59. The microprocessor sends information to the operator through the front panel numeric displays and annunciators. The displays and annunciators are driven by two display decoder/drivers on the switch board which provide all multiplexing and drive requirements. The display or the annunciator decoder/drivers are selected by the chip enable decoder outputs DISP (CE0) or ANNUN (CE1) A0 of I/O port 4. If control or data is input to the display chips through the system data bus from I/O port 1 of the microprocessor. The microprocessor writes to the display system chips by sending a control word to the chip (A0 = logic 0 and CE1 or CE2 pulsing).

8-60. INSTRUMENT TO OPERATOR

8-61. There are two lines of communication from the instrument to the operator, note that neither is microprocessor controlled.

8-62. Monitor Amp

8-63. An audio amplifier and speaker are provided to monitor the test signal being measured by the 4935A receiver. The monitor amplifier takes its input from the output of the receiver autorange circuit. The monitor amplifier, monitor volume control and speaker are located on the switch board.

8-64. Beep Generator

8-65. The beep circuit located on the switch board provides audio feedback to alert the operator when a membrane switch closure has been sensed. Whenever a front panel membrane switch is pressed the keyboard interrupt circuitry provides both an interrupt for the microprocessor and a pulse causing an audible beep from the monitor amplifier and speaker.

8-66. OPERATOR TO INSTRUMENT

8-67. There are several operator commands which cannot be sensed by the microprocessor including the input NOR and REV buttons, the set up buttons (excluding RCV impedance select), the OUTPUT LEVEL control, and the MONITOR VOLUME control.

8-68. MISCELLANEOUS CIRCUITRY

8-69. IMPULSE NOISE DETECTORS: The impulse noise latches perform two functions for each of 3 threshold signals from the receiver. Non-retriggerable monostable one-shots limit the count rate to 8 per second. Edge triggered latches hold the count for the microprocessor. The microprocessor reads and resets the latches through I/O port 5.

8-70. MISCELLANEOUS ANALOG: The Schmitt trigger circuit squares the incoming signal during frequency measurements. Schmitt trigger hysteresis is required for good noise rejection. The amount of hysteresis is proportional to the average detector output to provide wider hysteresis for larger signals.

8-71. TONE SQUARING AND TONE DROPOUT: The 1004 Hz tone dropout and squaring circuitry measures the 1004 Hz frequency tone in noise-with-tone, signal-to-noise, or impulse noise measurements, and detects drops in the tone signal below −46 dB. The notch filter removes the 1004 Hz tone before autoranging, the tone signal is intercepted before the notch filter and amplified through a bandpass filter before being routed to the transmitter board.

8-72. To measure the hold tone of 1004 Hz in noise-with-tone, a squared 1004 Hz waveform is selected by the microprocessor. The microprocessor determines if the hold tone is present and above −46 ±2 dBm as follows:

1. The microprocessor sets the dropout latch through the frequency measurement and control latch.

2. The microprocessor waits for a short time.

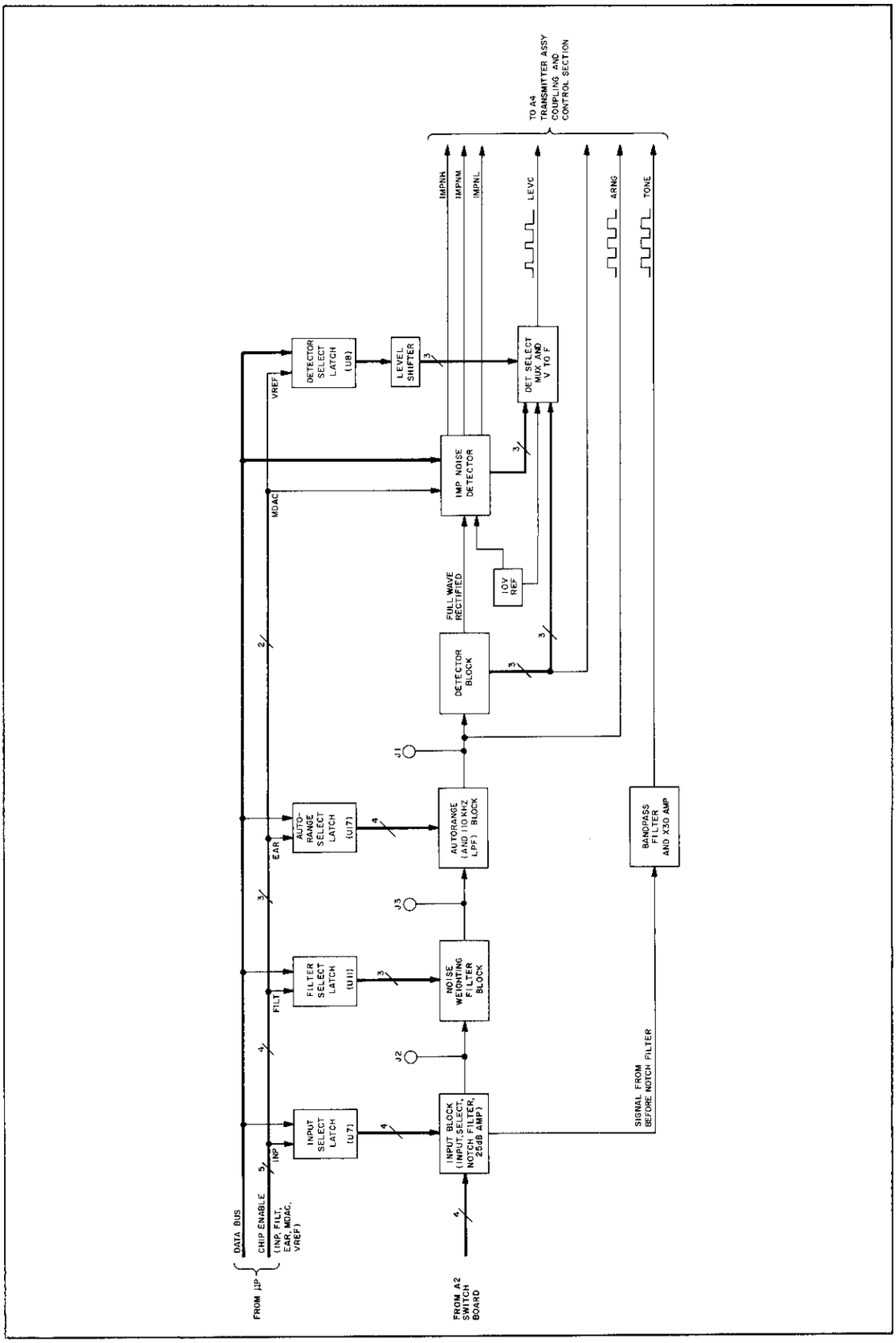


Figure 8-6. Receiver Block Diagram

3. If a tone signal is present and above -46 dBm then the tone dropout detector will reset the tone dropout latch.

4. The microprocessor reads the tone dropout latch through the option and miscellaneous sense latches to determine if the tone dropout latch was reset.

5. If the tone dropout latch was not reset, the microprocessor writes ERR 7 to the right-hand display.

8-73. RECEIVER THEORY OF OPERATION

8-74. The A3 receiver assembly contains all the circuits to do level measurements, background noise measurements and impulse noise measurements. All measurements are done by amplification, filtering and detection of the received signal.

8-75. The 4935A receiver can be divided into the following major circuits:

a. I/O Switching/hold circuit/termination

b. Input Select/notch filter/25 dB amp

c. Noise filter

d. Autorange amplifier

e. Level detectors

f. Impulse noise detectors

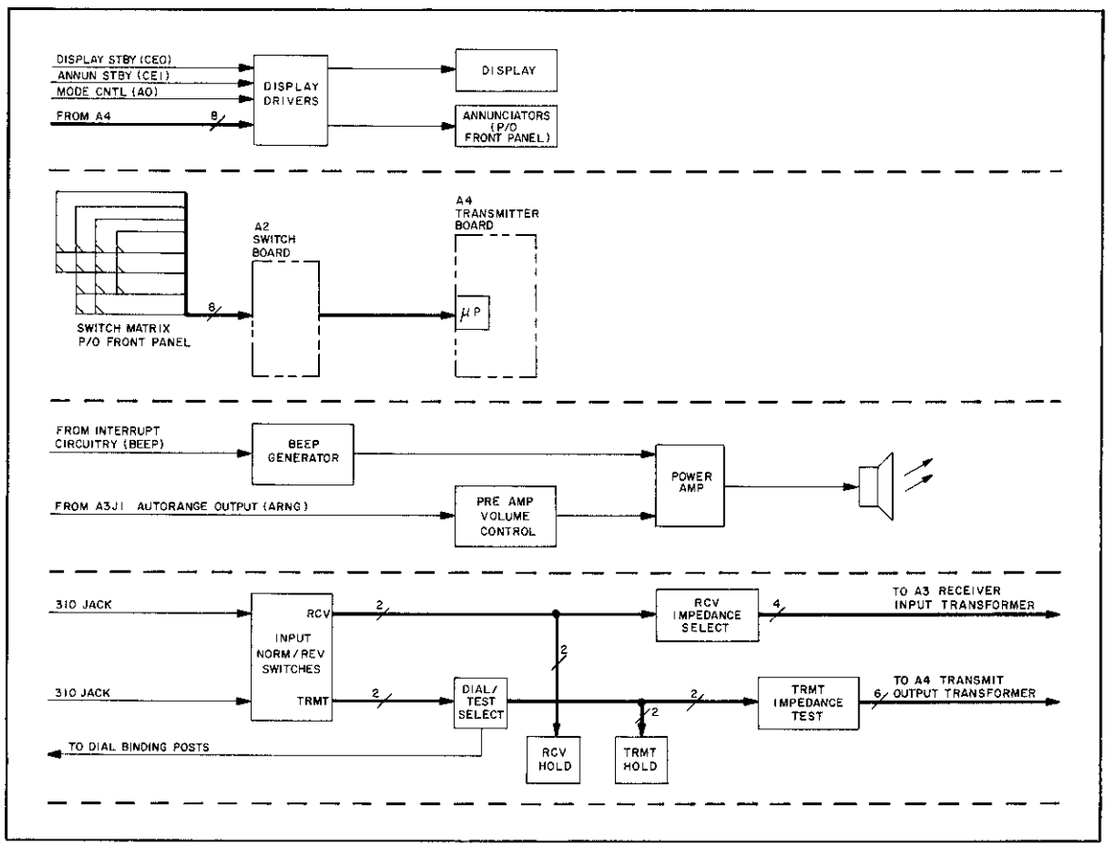


Figure 8-7. Switchboard Block Diagram

8-76. I/O Switching/Hold Circuits/Termination

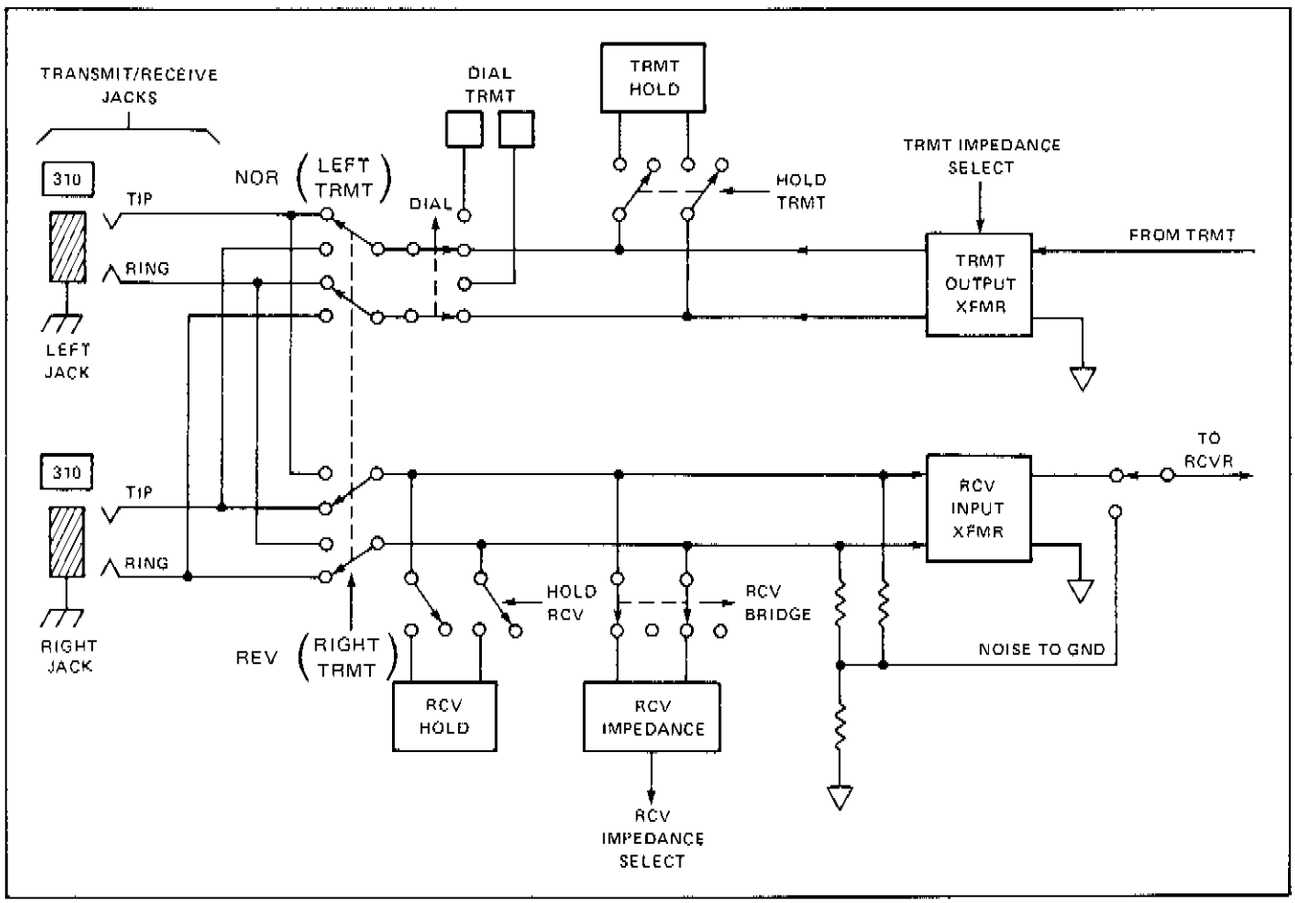


Figure 8-8. Input-Output Switching

8-77. INPUT-OUTPUT SWITCHING: The 4935A and telephone line to be tested are connected through the RCV/TRMT 310 jacks as shown in Figure 8-8. The NOR and REV buttons select switches select either the transmit or the receive function for the left 310 connectors, and the other function for the right 310 jack. In normal operation, only one of these ganged switches is in use at any one time. Engaging or disengaging both switches simultaneously creates a non-standard situation resulting in the transmitter being connected internally to the receiver (only at reversing switches, not through transmit monitor path).

8-78. DIAL AND TEST WITH HOLD: The 4935A has two hold coil circuits and a dial connector made up of two binding posts. The hold coil circuits sink 23 mA between tip and ring of a "wet" (dial-up) line to hold or "latch" the line during testing. Failure to engage the hold coil circuit on a "wet" line indicates an "on-hook condition" causing the telephone switching equipment to drop the line under test. The dial terminals are accessed by engaging the TRMT DIAL button in the setup section. Engaging TRMT DIAL connects the DIAL posts directly to the tip and ring of the transmit 310 jack and to the circuit under test. After dialing the number for the circuit to be tested and engaging the TRMT HOLD switch, the dialed line is connected to the 4935A by disengaging the TRMT DIAL switch. The line can be transferred to the receive input by depressing the RCV HOLD switch and transferring the line using the NOR and REV switches.

8-79. HOLD CIRCUIT: The hold circuit sinks a constant current of 23 mA or greater under dc bias voltages of either polarity. This current is maintained with 46 volts into 1700 ohms and draws less than 40 mA with 53 volts into 400 ohms.

8-80. Input Select/Notch Filter/25 dB Amp

8-81. INPUT/FILTER: The 4935A receiver can select any of 3 inputs:

1. A balanced input through the receiver input transformer,
2. The noise-to-ground input which senses common mode noise on the input,
3. The transmit monitor path which allows the receiver to measure the transmitted signal. Transient protection is provided.

8-82. An analog switch enables selection of either receiver signal or transmitter signal. Each signal can be routed through or by the notch filter. The 25 dB amplifier is dependent on the amplitude of the received signal, and may be bypassed by the microprocessor. A buffer amplifier delivers the signal to the weighting filters.

8-83. NOTCH FILTER: The notch filter consists of three, second order biquad notch filters. The first has the zero located at 995 Hz. The second has the zero at 1010 Hz. The third has the zero at 1025 Hz.

8-84. TONE MONITOR/1010 BANDPASS FILTER: The tone monitor path detects the holding tone loss in measurements. The signal is bandpass filtered, amplified and sent to the transmitter assembly.

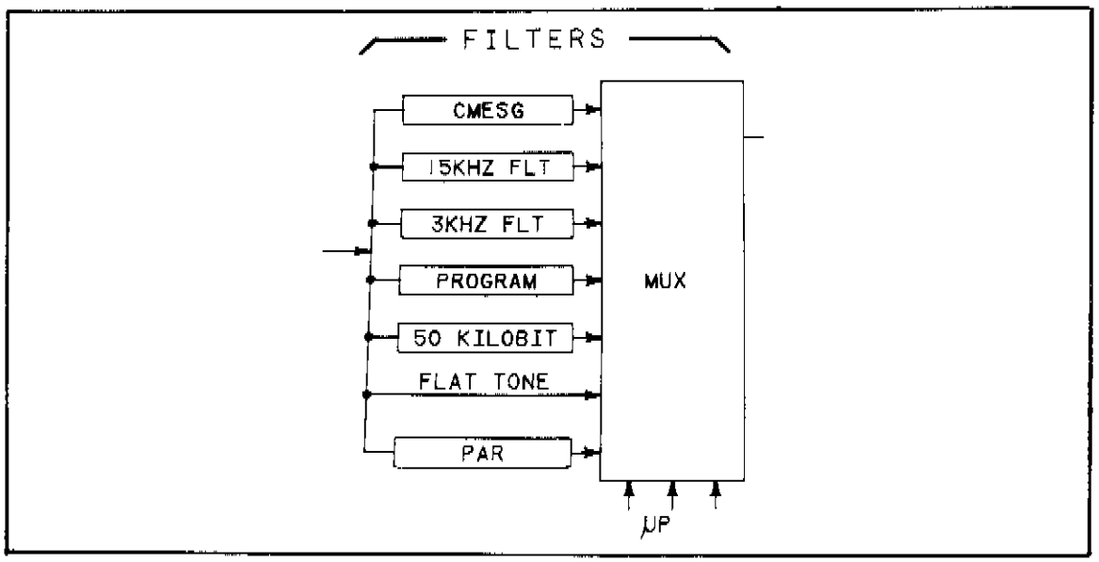


Figure 8-9. Filter Block Diagram

8-85. NOISE FILTER CIRCUITRY

8-86. FILTERS: There are 6 noise weighting filters.

a. C-Message Filter
b. Program Filter
c. 3 kHz Flat Filter
d. 15 kHz Flat Filter
e. 50 K Bit Filter
f. PAR Filter (Options 002 and 003 only)

8-87. C-MESSAGE FILTER: The C-Message filter consists of five second order networks. The first section is a high-pass network, the second is a band-pass, and the third, fourth and fifth are low-pass networks. Filter gain at 1 kHz is 0 dB.

8-88. PROGRAM FILTER: This filter has three second order low pass cascaded sections and one, second order high pass.

8-89. 3kHz FILTER: This is a second order Butterworth low pass filter. The 3 dB frequency is 3 kHz.

8-90. 15 kHz FILTER: This is a second order Butterworth low pass filter. The 3 dB frequency is 15 kHz.

8-91. 50 kBit FILTER: This filter consists of a high pass network, two low pass networks and a low pass network with a notch. It has a 3.3 dB attenuation at 30 kHz.

8-92. PAR FILTER (OPTION 002 and 003): The PAR filter consists of two band pass filters connected in series. The pole and zero frequencies are identical in both stages. The gain, at 1300 Hz in the first section, is 5.61 dB. In the second stage the gain is 4.78 dB.

8-93. The microprocessor controls the filter multiplexer's selection of the desired signal from the different filter outputs and routes it through a buffer amplifier to the autorange circuit.

8-94. AUTORANGE

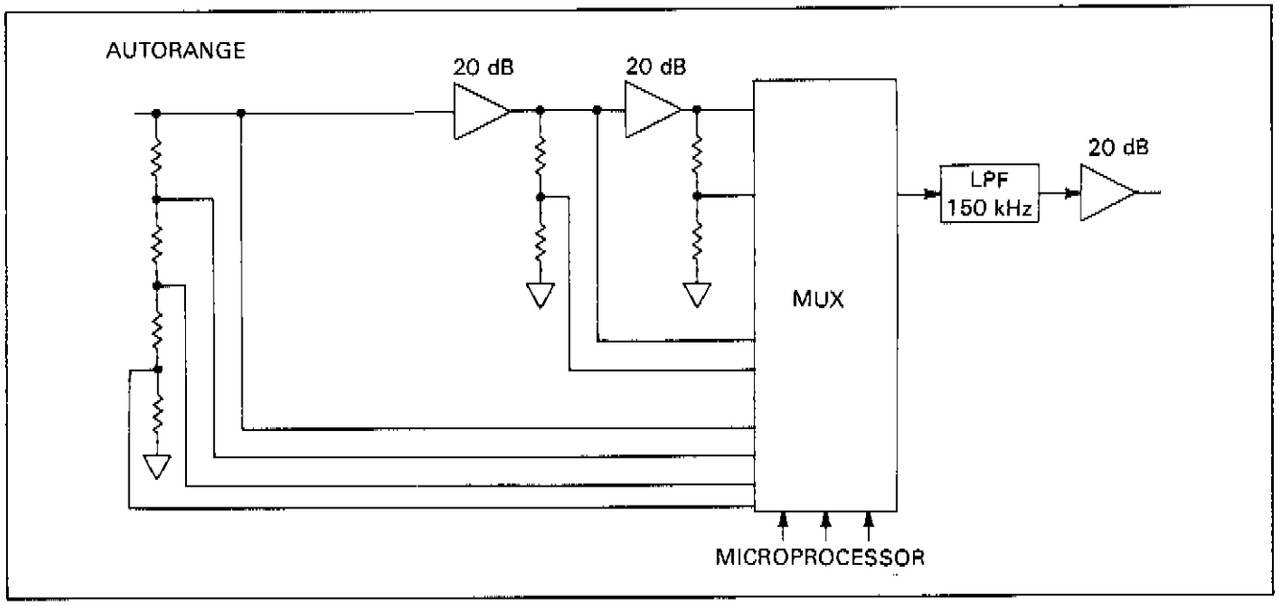


Figure 8-10. Autorange Block Diagram

8-95. The autorange circuit amplifies signals up to 60 dB in 10 dB steps, or attenuates them by 10 dB. The various gain states are software controlled. Determination of the correct state is determined by measuring the detector output voltage and changing the gain in 10 dB steps until the detector output falls within the dynamic range of the detector.

8-96. 110 kHz LOW PASS FILTER: The properly amplified signal is routed through the 100 kHz filter (3 dB). This filter is a sixth order Butterworth low pass filter. It is comprised of three second order stages connected in series.

8-97. Level Detectors

8-98. DETECTOR CIRCUIT: The detector circuits convert ac inputs to dc output levels proportional to the input signal level. The 4935A uses three different detectors: Fullwave average, QRMS, and a Peak Detector. All of the detectors require a full wave rectified signal.

8-99. 1. The full wave rectifier combines the input ac signal with a halfwave rectified signal of twice the peak amplitude to produce a full wave rectified signal. The average detector takes the full wave rectified signal and low pass filters it to produce a dc level output.

2. The QRMS detector sums the peak and the average voltage signals. Different scaling factors are used for the peak and average levels, making the output of the Quasi-RMS detector approximately equal to the RMS value of the input waveform.

3. The P/AR peak detector uses the fullwave rectifier, a non-inverting buffer and a peak detector to produce a dc level equal to the peak input voltage. The time constant of this detector is approximately one second. An analog multiplexer selects the desired detector signal and sends it to the voltage-to-frequency converter. At this stage the dc level is converted into a frequency measured by the control circuitry associated with the microprocessor. The displayed signal level is computed by the microprocessor according to the receiver impedance selected on the front panel. Although the voltage-to-frequency converter possesses excellent linearity, it lacks absolute accuracy. By measuring the voltage-to-frequency characteristics of the accurate 10 volt reference the required accuracy is obtained.

8-100. Impulse Noise Detectors

8-101. The impulse noise detectors compare the full wave rectified signal from the detector circuitry with the preset high mid and low thresholds. When the full wave rectified signal exceeds any preset threshold, that threshold comparator sends a signal to the control and counting section impulse noise latches. The preset thresholds are set as follows:

1. The tens digit of all thresholds is set by scaling the input voltage by setting the proper autorange state.

2. The ones digit of the low threshold is set by the impulse noise digital to analog convertor and the 10 volt reference.

3. The mid and high thresholds are automatically set at +4 and +8 dB higher than the low threshold by a voltage divider.

Open collector comparators do the comparisons and send individual signals for high, mid, and low thresholds to the receiver board.

8-102. TRANSMITTER

8-103. The transmitter circuit is responsible for digitally synthesizing the 4935A output signal. It takes inputs from the microprocessor through the data bus I/O port 1 which determines the frequency and type of output waveform. The transmitter circuit supplies outputs through a transformer to the switch board for the output 310 jacks and to the receiver circuit to internally monitor the transmitted signal through the transmitter monitor loop-around path.

8-104. Test Signal Generation Method

8-105. SINEWAVES: If the instantaneous voltage of a sinewave is sampled at many points in time along the wave, a series of numbers representing the wave is obtained. Each number represents the voltage of the sinewave at a single point in time. This series of numbers can be saved in ROM and later recalled by stepping through or scanning the ROM. Convert this series of numbers back to a series of voltage levels and the result is a stair step approximation of the original sinewave.

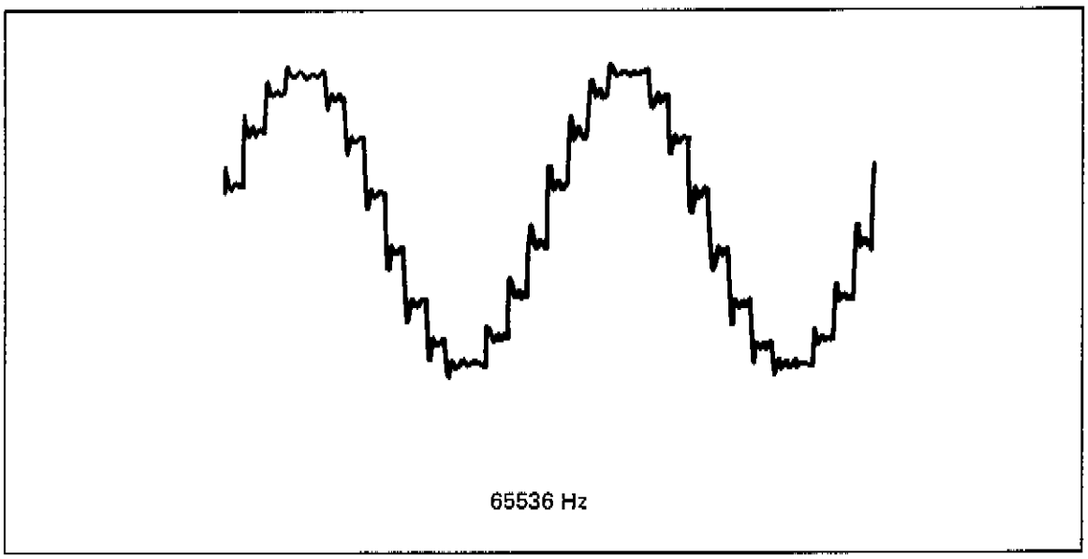


Figure 8-11. Stair Step Sinewave

8-106. A difference between the original sinewave and the stair-step approximation occurs only at frequencies higher than the original sinewave frequency. These high frequency distortion components can be eliminated with a filter, leaving a very good approximation of the original sinewave.

8-107. This is the principle used in the 4935A. A series of binary numbers in ROM represents a sinewave (or P/AR waveform when P/AR measurement is selected). The instrument scans the ROM and converts the numbers to voltage levels, filters out the high frequency distortion components, and amplifies the resulting waveform to provide the desired test signal.

8-108. FREQUENCY: The frequency of the sinewave depends on the rate at which the voltage numbers are changed and the number of steps needed to complete the waveform. In the 4935A the rate at which the voltages are changed the transmit clock frequency is constant at 2^{20} or 1048576 times per second. The frequency of the waveform is varied by changing the size of the steps through the ROM.

8-109. Assume that the ROM has 2^{20} or 1048576 locations. The address counter used to scan the ROM has 20 stages and can count to 2^{20}. By incrementing the address counter by one at each clock cycle, it will take 2^{20} to scan through the ROM and to produce a single cycle of sinewave. Since the voltage change rate (the transmit clock rate) is 2^{20} times per second, a 1 Hz sinewave is produced. The address counter is incremented by 2 each transmit clock cycle. In one second the ROM is scanned twice producing a 2 Hz sinewave. Increment the address counter by some number N each transmit clock cycle. In one second the ROM is scanned N times producing an N Hz sinewave.

8-110. The 4935A ROM has 2^{10} or 1024 locations. The 10 most significant bits of the address counter are used for the ROM. ROMs generally have 8 bit words available. The 4935A needs 10 bits of binary voltage value to keep waveform distortion to an acceptable level. The 8 most significant bits of the voltage value are saved in the first 1024 places in the ROM and the 2 least significant bits (ignoring extra bits) in the next 1024 locations in the ROM. The ROM is accessed twice for each voltage value. The 2 least significant bits are saved in an intermediate latch until the 8 most significant bits are available and the whole 10 bit number can be latched and presented together to the digital-to-analog conversion circuit which changes the binary number to a voltage value.

8-111. The 11th address bit is used to select whether the 8 most significant or 2 least significant bits are accessed. The 11th ROM address bit is driven by the transmit clock. When the clock is high, the 2 least significant bits are accessed and latched into the intermediate latch on the falling edge of the clock. When the clock goes low the 8 MSB's are accessed and latched (on rising clock edge) into the final latch where they are presented to the D-to-A converter. The D-to-A converter output is the stepped approximation of the desired wave in current form. The output of the current-to-voltage converter changes the current waveform to a voltage waveform.

8-112. The 4935A ROM contains 2 full waveforms: 1024 ten bit points of sinewave in 2048 locations and 1024 ten bit points of P/AR waveform in an additional 2048 locations. The desired waveform is selected by switching the 12th ROM address bit with the sine/P/AR select signal (clock select).

8-113. Circuit Description

8-114. There are seven circuits in the transmit signal generator.

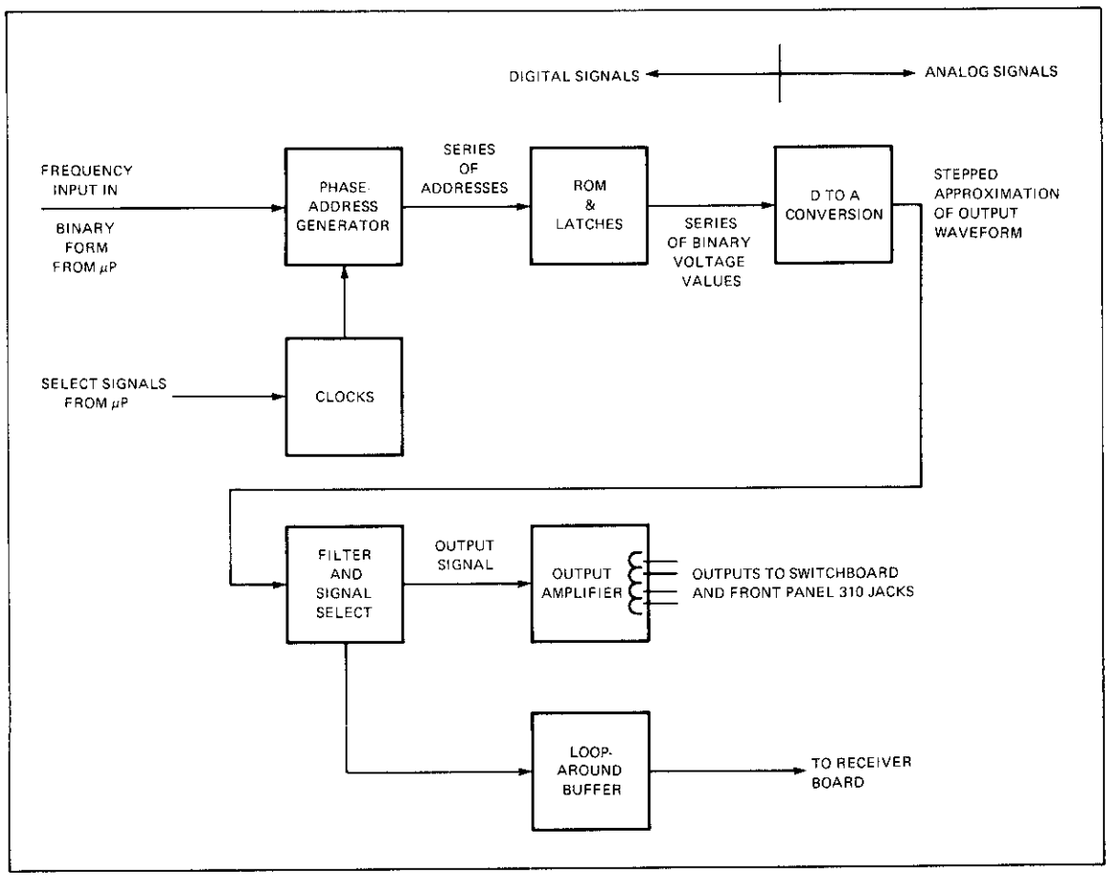


Figure 8-12. Transmitter Block Diagram

8-115. TRANSMIT CLOCK GENERATOR: The transmit clock generator provides the proper clock frequency to the phase address generator, waveform ROM and ROM latches. It also provides a 262 kHz signal to the microprocessor and counting circuit where it is used when measuring frequency. In the standard model, only the sine clock circuitry is provided.

8-116. In P/AR models (options 002 and 003) sine and P/AR clocks are provided as well as a multiplexer (U30). The P/AR sine select signal from U26 pin 1 (low = sine clock selected) determines which clock is enabled.

8-117. PHASE ADDRESS GENERATOR: The phase-step latches hold the binary value of the frequency. This value changes only if the frequency is changed. The adders add the phase-step size (the binary frequency value) to the old phase address to get a new phase address. The new phase address is latched into the phase address latch on the positive going transition of the clock line. The output of the phase address generator is a series of ROM addresses.

8-118. ROM AND LATCHES: The ROM and latches convert the series of addresses from the phase address generator and into a series of binary voltage values which represent the output waveform. These values are held in the voltage value latches. This section unpacks the 8 most significant bits and the 2 least significant bits of voltage data so that the D-to-A converter can get the entire 10 bits at one time.

8-119. DIGITAL TO ANALOG CONVERSION: The digital-to-analog conversion circuit takes the binary voltages from the voltage value latches and converts them to a series of step voltages approximating the output waveform. Both the D-to-A converter and current-to-voltage converter are in this circuit. The current to voltage converter converts the output of the D-to-A converter to a series of voltage, not current values.

8-120. FILTER AND SIGNAL SELECT: The output of the digital to analog conversion circuit is an approximation of the desired output. Unwanted high frequency components introduced by the step nature of the waveform must be filtered. The P/AR waveform is filtered by the 5 kHz low pass filter. The output select multiplexer selects the appropriate filter (or a ground input for "quiet termination") as the input to the power amplifier.

8-121. LOOP-AROUND CIRCUIT: The loop-around circuit provides the signal path used by the 4935A receiver to monitor the transmitted signal in the display transmit mode. The circuit has two signal paths. The first is from the power amplifier output stage, through the loop adjust amp, and the loop select MUX to the receiver board. The second comes from the wideband low pass filter and goes directly through the MUX to J1 and the receiver board. This path is used when the output is quiet terminated and the 4935A monitoring the fixed level sinewave being generated.

8-122. To suppress the loop-around signal, the transmit line is grounded through the loop select MUX. The loop select lines are the same as the output select MUX address lines. With quiet termination, the noise should be below 20 mv.

8-123. OUTPUT AMPLIFIER CIRCUIT: The output power amplifier is an op amp driven complementary-symmetry output stage which provides the amplification necessary for a +13 dBm output level. The OUTPUT LEVEL control provides a full dynamic range of -40 dBm to +13 dBm. The display blanks to a "+" sign to indicate the signal level is too high (overrange). When generating a P/AR waveform, the P/AR signal crest factor causes the output to overrange at +3 dBm.

8-124. TRANSMIT IMPEDANCE/HOLD/DIAL/OUTPUT ROUTING: The output amplifier circuit drives a transformer with balanced outputs at each of the 3 impedances. The proper transmitter impedance is set from the front panel TRMT impedance set up switches.

8-125. If selected, a transmit hold circuit is connected across the transmit output lines. This hold circuit is similar to the receiver hold circuit, for an explanation of the hold circuit and the dial terminals see the receiver theory of operation. Transmit dial and hold circuits are selected by the front panel TRMT set up switches. Finally, the transmitter signal is routed to whichever front panel 310 jack is selected by the front panel NOR and REV switches.

8-126. POWER SUPPLY THEORY

8-127. The 4935A power supply is powered by ac lines or rechargeable batteries (Option 001 or 003). The power supplies provide +5 v at ±600 mA and ±14 v at ±200 mA to the rest of the instrument.

There are 3 major functional sections of the power supply

1. The ac power line supplies.
2. The regulator sections.
3. The overvoltage protection circuitry

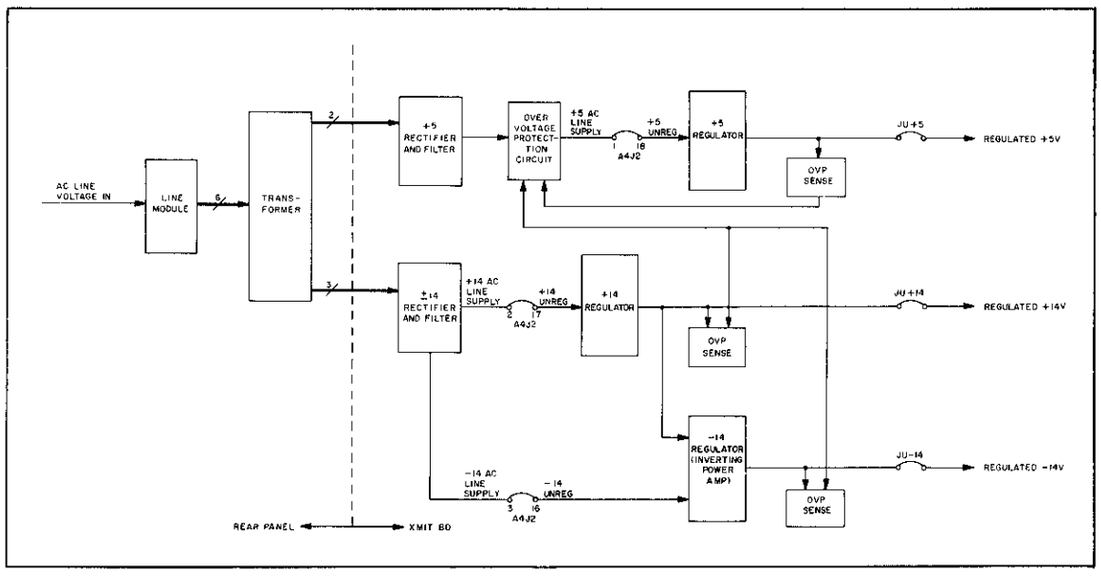


Figure 8-13. Power Supply Block Diagram

8-128. AC Line Supplies

8-129. The line module filters noise, has protective fuses, and sets the line voltage as ac line power is brought into the power supply. From the line module ac power goes to the transformer which provides 10 vac (9-11) for the +5 v supply and 35 (33-39) vac center tapped for positive and negative 14 volt supplies.

8-130. The 9-11 vac secondary is full wave bridge rectified and is capacitively filtered to provide 10-14 vdc unregulated to the +5 volt regulator. The 35 v C-T is full wave rectified and capacitively filtered to provide both ±19 to 27 vdc unregulated for the ±14 vdc supplies.

WARNING

Voltages are present at the back panel and power supply whenever the units are plugged in whether the power switches are in ON or STBY.

8-131. Regulators

8-132. Separate regulator circuits are provided for +5 v and ±14 v supplies. The +5 v and +14 v regulators are similar in form. The −14 v regulator tracks the +14 v supply; it resembles a power amplifier with a gain of −1 with input from the +14 regulated supply.

8-133. +5 REGULATOR: The +5 v supply is series regulated with a pass transister mounted on the rear panel. A regulator chip provides the reference voltage, an error amplifier, shut down circuitry, and base drive for the pass transistor. When the error amplifier senses that the output voltage is low it sinks current through the base of the pass transistor turning it on until the output voltage rises to an acceptable level.

8-134. +14 V REGULATOR: The +14 v regulator has a +14 v output voltage but otherwise is the same as the +5 v regulator circuit.

8-135. −14 V REGULATOR: The −14 v regulator resembles a unity gain inverting amplifier with drive in only the negative direction. Input comes from the +14 v supply, so any malfunction in the +14 v regulator supply will affect in the −14 v regulated supply.

8-136. There are 2 unusual features in this supply. First, a (local) zener voltage regulator provides the +Vcc supply for the op amp to avoid excessive supply voltage since the ±14 vac line supplies provide more than 36 v between them. Second, a diode helps the op amp output to swing as close to the negative Vcc supply rail as possible.

8-137. OVERVOLTAGE PROTECTION CIRCUIT: The overvoltage protection circuit checks the voltage at 4 points in the power supply and shorts the +5 vac line supply if any of these voltages exceed normal levels. The +5 v regulated output, the +14 v regulated output and the unregulated +5 vac line supply voltages are checked with simple zener diode-series resistor sense circuits. The −14 v regulated output sense circuit is more complex although it performs the same function. When any abnormally high voltage is sensed a triac shorts the +5 vac line supply and the inline fuse blows shutting the instrument down.

8-138. JUMPERS: There are two sets of jumpers in the power supply. One set (JU+5, JU+14, and JU−14) isolates the regulated supply outputs from the rest of the instrument. This allows troubleshooting the power supply, under no load conditions, without endangering the rest of the instrument. The other set of jumpers goes into the first 3 pins of J2, they isolate the ac line supplies from the regulators to allow troubleshooting the ac line supplies and the OVP circuit. In battery units J2 connects the batteries and charger board to the ac line supplies and the regulators.

8-139. CHARGER BOARD THEORY OF OPERATION

8-140. The Charger Board has three primary functions.

1. It supplies charging current to the batteries. To charge, plug in the instrument and turn the power switch to STBY.

2. As the power switch is cycled on and off, the charger board switches the batteries in and out of the unregulated side of the power supply. The instrument must be unplugged to operate from the batteries.

3. If any battery voltage goes too low or if the ac cord is plugged in, the batteries are disconnected from the unregulated side of the power supply and the ac line supplies are switched in.

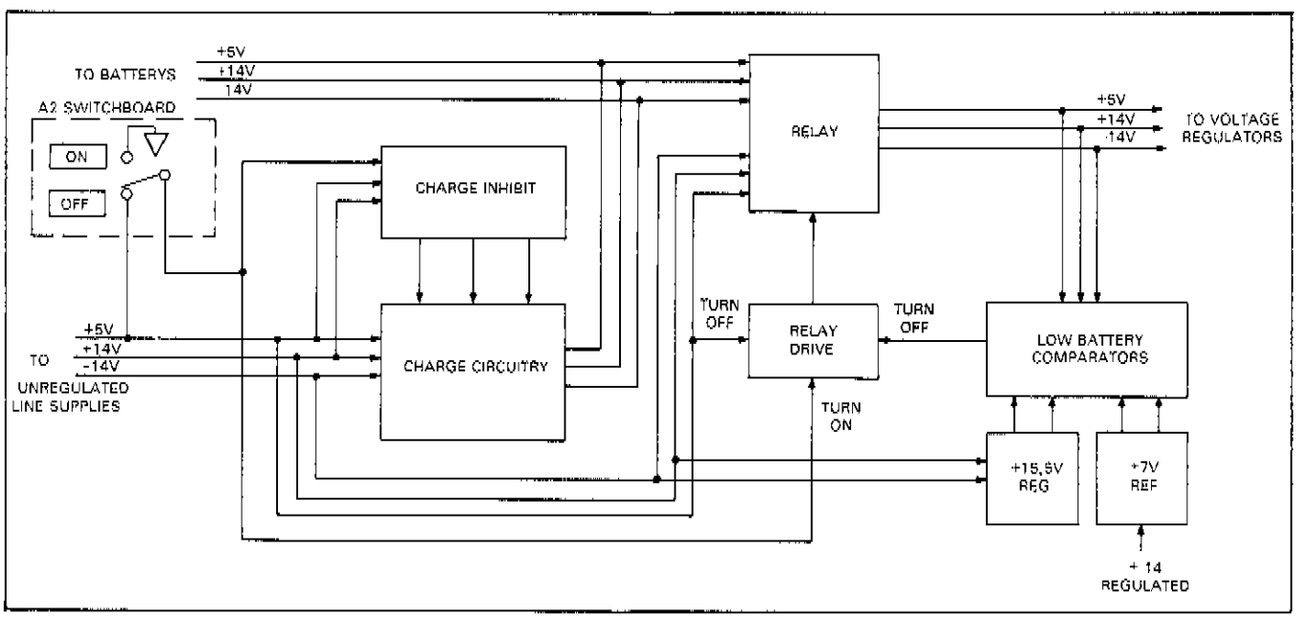


Figure 8-14. Charger Board Block Diagram

8-141. Battery Charging

8-142. There are three battery packs to charge. The ac line supply provides the necessary current to charge the batteries when the unit is plugged in and turned to STBY. Each battery is regulated at approximately the C/10 rate for each battery so overcharge poses no problem. When the power switch is turned on, the charge current is reduced to a trickle charge. Thus, full charging of the batteries takes place only in STBY.

8-143. The +14 v current source circuit in Figure 8-15 is an example of the instrument charging circuits. The full charge current is supplied by Q1 through R20. CR21 and CR20 holds the voltage across R20 nearly constant which keeps the charge current nearly constant. When the instrument is on, no base current flows through R23 so Q1 is off, so R22 provides a trickle charge.

8-144. Power Source Selection

8-145. Battery power or ac line power to the unregulated power supplies is selected through a relay. The battery supplies are selected by the relay whenever the batteries are charged, the power switch is on, and the instrument is unplugged. STBY mode switches the power to the ac line power which sits at zero volts. If the battery voltages drop below ±15 v and/or ±5.75 v, the relay selects ac line power, effectively shutting the instrument off. Plugging in the instrument automatically selects the ac line power independent of the power switch setting.

8-146. Relay Drive Circuitry

8-147. The relay drive/shut-down circuitry controls driving the relay or shutting it off. Figure 8-16 is a simplified schematic. Q2 drives the relay through the ±15 volt batteries when battery operation is selected. In this state Q3, R2, CR2 and R4 form a feedback loop keeping Q2 latched. The power switch input provides a transient to latch Q2 (R5, C1). This transient is the transition switch between +5 battery and ground. When the power switch is on, the latch latches. Turn the power switch off, the feedback loop is broken, and Q2 turned off. The only input to the drive circuit is the inhibit signal (through Q4) that turns Q2 off and then turns on transient.

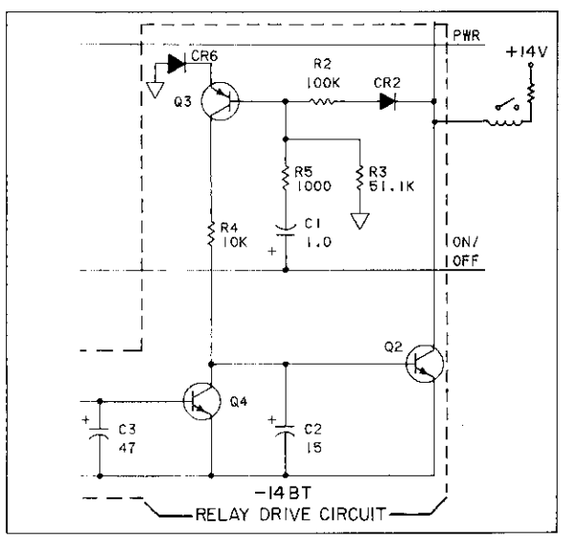


Figure 8-15. Inhibit Circuit

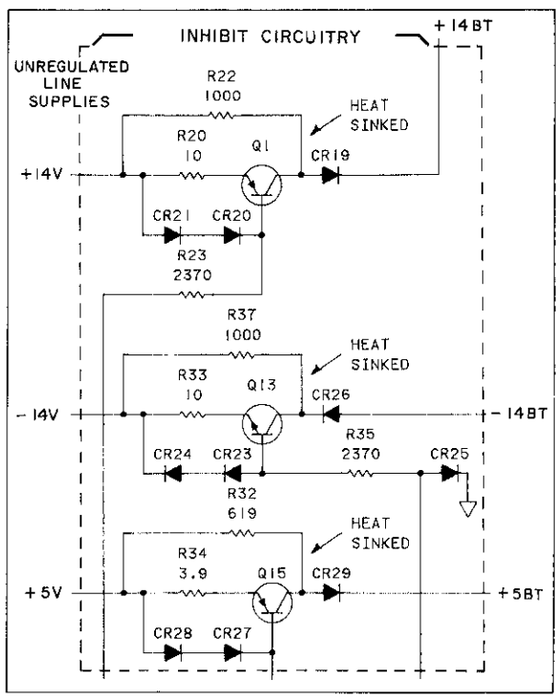


Figure 8-16. Relay Drive Circuit

8-148. Inhibit Circuit

8-149. When the instrument is plugged in, if −15 ac line voltage is present or any battery voltage drops too low, the inhibit signal is activated.

8-150. To check the battery voltages, the 3 unregulated voltages are compared to reference voltages with open collector comparators. In battery mode these unregulated voltages will be battery voltages. The reference voltages are generated from the +14 v regulated supply.

8-151. Any of the comparators tripping will turn on inhibit transistor Q5. Note that if the −15 ac line voltage is present, Q5 will be turned on through CR3 (thus, CR3 and CR5 effectively form an OR function). Note that the Low Battery Sense Circuit has a regulator for the power supplies formed by Q11 and Q9 because of the wide range of voltages seen at the ±14 volt unregulated supplies.

8-152. When the power switch is turned on, Q12 turns off. Current flow to R23 stops and the charging current turns off. Q12 is turned on by R21 and R24 in the STBY mode. In the on mode Q10 turns Q12 off. Q14 inverts the base current enabling the −14 v battery to turn off.

8-153. MAINTENANCE

8-154. Maintenance consists of periodic type and failure type maintenance.

8-155. Periodic Maintenance

8-156. Periodic maintenance should be done at least once per year. It consists of preventive maintenance and Adjustment/Calibration. Preventive maintenance consists of incorporating any modifications to the instrument and cleaning of all assemblies to minimize leakage paths, etc. Following any preventive maintenance, do the Performance Tests of Section IV. As part of the Periodic Maintenance cycle, do the Adjustment/Calibration procedures of Section V.

8-157. Failure Maintenance

8-158. This type of maintenance identifies the failure and troubleshoots the instrument to locate the defective part. See the troubleshooting procedures of subsequent paragraphs.

8-159. Component Replacement

8-160. Failed components can be replaced by any of three methods:

8-161. CLIP-OUT: Clip failed components from the board and the desolder and remove lead remains.

8-162. VACUUM DEVICE: A vacuum device, such as the Soldapullt®[1] Model DS-017, is used with a soldering iron to remove melted solder from the terminals.

8-163. DESOLDERING BRAID: A copper braided-wire, such as Solder Wick®[2] no. 2 size, is used with the soldering iron, to absorb the melted solder.

8-164. Soldering

8-165. Integrated circuit or the printed-circuit boards can be damaged by excess heat. ICs can also be damaged by static charges (from handling or from the soldering iron) when installing them. The recommended soldering iron to use is the "Ungar, 3-wire" type with a 35-watt maximum heat element and the "Ungar, Micro-Spade" tip. The recommended solder is "Kester Rosin-Core 60/40" with a diameter of .032 inches. This diameter works very well with IC pins and leaves minimum residue.

8-166. Cleaning

8-167. Cleaning the board and components after soldering is important. Use a cleaning solution such as Reliasolv No. 563®[3]. Apply the solution with a small, stiff-bristle brush and scrub the area previously soldered. No residue should remain after the solution dries.

NOTE

Do not use chlorothene, freon or kenco 192 to clean electrolytic capacitors as these cleaners may damage them.

[1]Edsyn Company.
[2]Solder Removal Company.
[3]Alpha Metals, Inc.

8-168. DISASSEMBLY

8-169. Remove Case

8-170.

1. Place instrument bottom up on bench and remove the 4 screws holding the feet on.
2. Hold the two halves of the case together and turn the instrument upright.
3. Remove the top half of the case by lifting it upward. The case top should separate from the rest of the instrument without pulling other parts with it. Slip the handle out of the lower case half.
4. Remove the 4 black plastic posts from their holes in the receiver board (top PC board).
5. Disconnect W5 (monitor amp cable).
6. Remove 3 screws securing the shield plate to the rear panel.
7. a. The receiver board with shield plate will now fold up and over and will lay on the bench beside the rest of the instrument when access is required.

   b. If you have the Diagnostic Service Kit (P/N 04935-60014):

      1) Lift the receiver board.

      2) Remove the 2 left hand black plastic parts (spacers between transmitter and receiver board).

      3) Slip service kit support posts in place of posts removed in step 6 above.

      4) Slip the receiver shield plate into the service kit support posts to support receiver board in a vertical position.

      5) Connect the monitor amp cable to J1 using the extension cable provided with the service kit.

8-171. RECEIVER BOARD/SHIELD PLATE/BATTERY CHARGER BOARD DISASSEMBLY

8-172.

1. Disconnect W3 (the cable between the switch board and the receiver board) at receiver board.
2. Disconnect W5 (cable from monitor amp) at receiver board.
3. Disconnect W2 (cable from the transmitter to receiver board) at receiver board.
4. Remove 6 screws holding receiver board to receiver board shield plate.
5. Lift receiver board and set it aside.
6. Lift receiver board shield with battery pack and charger board attached.
7. Disconnect W6 (if battery option) and set shield/battery pack charger board aside.
8. To remove battery pack:

   a. Disconnect cables W7, W8, W9 from charger board.

   b. Remove 4 screws holding battery pack to shield board. Batteries will lift off shield board.

9. To remove charger board:

   a. Remove 3 screws holding board to shield. Board will lift off.

8-173. SWITCH BOARD/FRONT PANEL REMOVAL

8-174. 1. Disconnect W3 (the cable running from the receiver board to the switch board) at the receiver board.

2. Disconnect W5 (the monitor amp cable from the receiver board).

3. Disconnect W4 (the cable from transmitter board to switch board) at the transmitter board.

4. Press down gently on the transmitter output transformer (on the transmitter board near the switch board connector) and pull up on the switch board/front panel assembly. Assembly should slide up and out at its retaining grooves.

5. To remove the front panel from switch board remove output level and monitor volume knobs and the hex nuts from the TRMT and RCV 310 jacks. Carefully pull the front panel directly away from switch board.

CAUTION

If the switch board and front panel do not remain parallel while being separated, then the monitor volume potentiometer shaft can bind in its hole in the front panel and break the potentiometer case or bend the shaft.

8-175. TRANSMITTER BOARD REMOVAL

8-176. 1. Open case.

2. Remove receiver board/shield/battery pack/charge board assembly.

3. Remove switch board/front panel assembly.

4. Remove all spacer parts.

5. Gently lift transmitter board and back panel assembly from lower case as a unit.

6. To remove back panel assembly:

   a. Remove hardware holding 3 power supply transistors to back panel.

   b. Desolder leads from power transformer to transmitter board.

   c. Remove 2 screws holding transmitter board to back panel.

   d. Back panel will come off.

8-177. REASSEMBLY

8-178. Seating the case top on some early 4935A instruments is difficult. The laminated front panel chips or peels at the edges and corners if the case top is forced onto the instrument. Follow the procedure below for correct reassembly.

1. Reassemble the transmitter board and back panel if necessary.

2. Reconnect W2 to edge connector.

3. Replace transmitter board and back panel in lower half of case.

4. Align and press together switch board and front panel.

NOTE

Before attaching the switch board to front panel, put plastic shim (HP 04935-00004) on the 310 jack.

5. Slide switch board and front panel back into retaining grooves. (To avoid damaging the front panel it should be eased carefully into place.)

6. Insert the four large plastic standoffs.

7. Replace receiver board and shield plate.

   a. On battery options reconnect A5W1 before replacing battery charger board shield plate.

8. Route W5 towards the front panel then onto the transmitter board and reconnect. Keep the cable away from the handle mounting notches in the case to avoid pinching the cable and locking the handle into a fixed position.

9. Place W4 flat across receiver board and reconnect.

10. Reconnect W2 and W3 and insert the four small plastic standoffs.

11. Gently put on case top.

CAUTION

To avoid damage to the front panel when replacing the case top, remove 3 screws fastening the shield plate to the back panel and slide, do not force the case top into the guides.

12. Replace 3 screws on rear panel.

13. Replace 4 screws on case bottom.

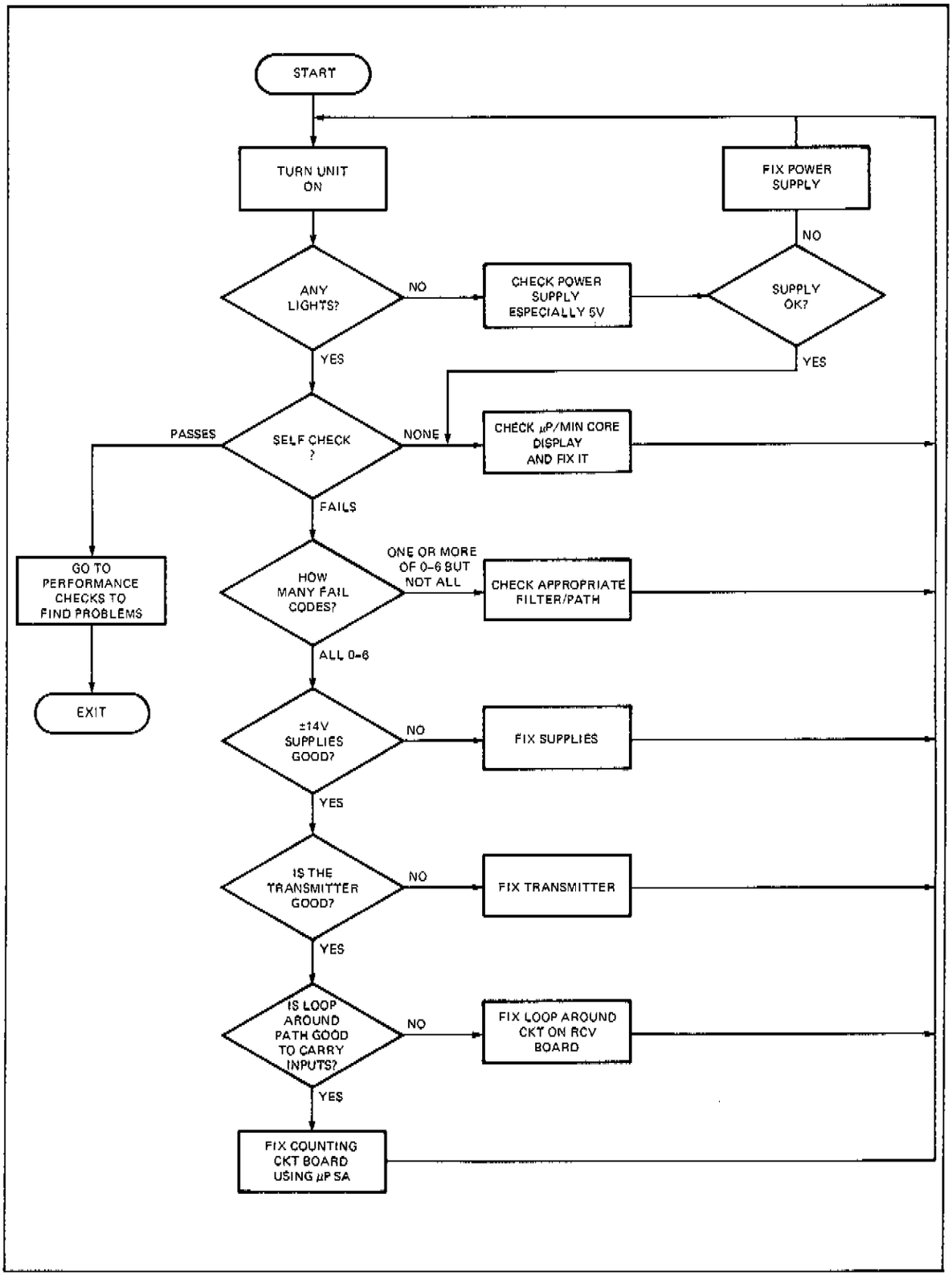


Figure 8-17. Instrument Troubleshooting

8-179. POWER SUPPLY TROUBLESHOOTING

8-180. 1. Isolate the ac line supplies from the regulators by removing the 3 jumpers from A4J2 in non-battery units. Disconnect the cable from the charger board to the transmitter board in battery units.

2. Disconnect the power supply from the rest of the unit removing the +5, +14, and −14 jumpers.

WARNING

Ac voltages are present whenever the unit is plugged in whether the power switch is in ON or STBY.

3. Plug in the unit. Check the power supply voltages.

C15 = +12.0 to +14.0 v
C11 = +23.5 to 29.5 v
C5 = −23.5 to −29.5 v

If all voltages are out of range, check the ac line module and the transformer. If only 1 or 2 voltages are out of range, check the appropriate rectifiers and filters. If the fuse blows as the unit is plugged in, disable the Over Voltage Protection circuit (OVP).

To disable the OVP, desolder and remove triac CR24.

CAUTION

Always isolate the power supply from the instrument whenever the overvoltage protection is disabled. Isolate by pulling JU+5, JU+14, and JU−14 jumpers.

NOTE

Tripping the OVP shorts only the +5 vac line supply. Avoid shorting regulated outputs (brief shorts cause no damage).

4. Once the voltages are correct, check the over voltage protection circuitry. Jumper A4J2 pin 1 to 10 to enable the +5 v regulator.

a. If the fuse blows, check the +5 v overvoltage sense circuit (CR25 for 5 v supply or CR23 for +14 v supply).

b. Check A4JU+5 for +5 v ±20 mv. If correct go to Step 5. If the voltage is incorrect try to adjust the supply. One or two tweaks of the appropriate pot should bring the supply within range. If not then there are problems which must be found before troubleshooting any other parts of the 4935A.

1) If the voltage is ~0, check for a shutdown signal from the front panel.

2) If U14 pin 8 reads ground then the regulator is enabled (less than 1 volt gives shutdown signal).

3) If the voltage at JU+5 is wrong or has too much ripple:

a) Check that the reference voltage at U14 pin 6 is approximately 2.5 v for +5 v supply (also 2.5 v for +14 v supply). If not, replace U14.

b) Check the +5 voltage sense divider R33, R37, and R42 (R19, R23, and R31 for the +14 v regulator).

c) Remove the pass transistor Q4 for the +5 v supply (Q3 for the +14 v supply) and check U14 for the following voltages:

U14 pin no.	Voltage
7	GND
10	~1.6
11	~pin 10 + .6 v
12	+8 to 14 v

NOTE

Removing Q4 or Q3 may require pressing on the line module retaining springs and sliding the line module out of its hole. When reinstalling pass transistors Q3, Q4, or Q1 remember to install the insulating shoulder washer.

d) If pin 10 is greater than 2.0 v or less than 1.2 v, check CR19, CR20. If pin 12 is incorrect check ac supply and A4J2 jumpers. Replace U14 if the other voltages are wrong.

5. Jumper A4J2 pins 2 and 11 to enable the +14 v regulator. Check A4JU+14 for +14 v ±20 mv, if correct go to Step 6. If incorrect, troubleshoot as in Step 3 above, referring to U8 INSTEAD OF U14. Pin 12 of U8 should be +21 v to +25 v.

6. Jumper A4J2 pins 3 and 12 to power the −14 v regulator. Note that the −14 v OVP is more complex than the +5 v and +14 v OVP.

a. If the fuse blows, check the overvoltage protection circuitry CR7, R4, R16, R94, R95, R96, Q2 and Q7.

b. Any ripple on the +14 v supply will appear on the −14 v supply, even though the −14 v supply is operating properly. When troubleshooting this regulator think of it as an *OP AMP DRIVEN DC POWER AMPLIFIER* (with drive only in the negative direction) which uses the +14 v supply as its input.

NOTE

CR4 helps U1 provide sufficient drive for Q1. When replacing U1 check CR4 and also replace if needed. R3 and CR1 insure that U1 has a power supply range of less than 35 volt Vcc+ to Vcc−.

8-181. MINIMUM CORE TROUBLESHOOTING

8-182. The power supply and a minimum core of the instrument must function to test or troubleshoot. Components which must be working for the core to function are:

a. microprocessor (A4U6),

b. chip-enable Decoder (A4U7),

c. display Driver chips A2U2, A2U3,

d. data bus from the microprocessor D0-D7 of I/O 1 of the microprocessor,

e. microprocessor to chip enable decoder lines, A4-A7 of I/O 4 of the microprocessor,

f. mode control line A0 of I/O 4 of the microprocessor,

g. DISP and ANNUN STROBES from Chip Enable Decoder (A4U7) to the Display Driver chips (A2U2 and A2U3).

NOTE

The lines in d, f, and g above run through the edge connector between the transmitter and display boards.

8-183. Procedure

8-184. 1. Remove the microprocessor from its socket, power up the 4935A and check for the appropriate voltages on the following pins:

a. Socket pins 1 through 20 must be at ground (<.1 volt).

b. Socket pins 38, 39, 40 must be at +5 v ±.1 v.

c. No pin should be above 5 v ±1 v.

CAUTION

When checking the microprocessor socket pin use a small probe to avoid spreading the socket pins. Microprocessor socket pins are connected to *STATIC SENSITIVE* devices which can be easily damaged. Ground yourself.

2. If any of the above conditions are not met, troubleshoot and fix, otherwise power down the 4935A, and replace the microprocessor (A4U6) and power back up.

3. Check the following pins on the microprocessor (A4U6).

a. Pin 40 must be +5 v ±.1 v (this is Vcc for U6).

b. Pin 39 must be +5 v ±.1 v (if it is grounded, the microprocessor resets).

c. Pin 38 should be logic high and pulse low when the PERIOD key is pressed (this is the microprocessor interrupt line).

d. Pin 20 must be ground.

e. Pins 7 through 15, 22 through 30, and 33 through 37 should be toggling (check with a logic probe).

f. After the self check is completed pins 3 through 6 should be logic high and pins 16 through 21 should be logic low.

NOTE

Signal lines are generally checked at the IC pin but a defective socket may stop the signal from getting to its destination.

g. If pin 38 does not work (see paragraph 8-192), troubleshoot the Key Scan Circuitry and the front panel key matrix.

4. If any other pins are not as described above, try inserting another microprocessor (A4U6).

8-185. If the preceding conditions are met and the display still does not respond, check the control latches to see if the microprocessor is configuring the instrument correctly. Use Table 8-2 and the How Measurements are Made part of the Theory of Operation. Additionally if needed, troubleshoot the display.

8-186. DISPLAY TROUBLESHOOTING

8-187. 1. Power down the instrument and remove the front panel.

2. Reinstall the switch board and power up. Note that standard ribbon cable extenders do not work, they reverse the pins.

3. Check for the following pin conditions on both A2U2 and A2U3.

a. Voltage at power supply pins should be; pin 19 = +5 v ±.1; pin 28 = ground. If not, repair power supply or power distribution.

b. Both the mode input pin 9 and the write input pin 8 should be toggling; use a logic probe to test.

c. The data bus should also be toggling, pins 5, 6, 7 and 11 through 14.

8-188. If these conditions are met and the display is frozen (to check, change the output level) or shows meaningless numbers, the display drive chips have probably failed.

8-189. CONTROL TROUBLESHOOTING

8-190. Troubleshoot Keyscan/Interrupt Circuitry

8-191. 1. Look at I/O port 0 (U6 pins 3-6 and pins 16-19) for a proper setup word. If U6 (3, 4, 5, 6) = high and U6 (16, 17, 18, 19) = low then go to paragraph 8-192 below, otherwise:

a. Remove the front panel and try again,

b. try another processor, and

c. if only a single pin of U6 (3, 4, 5, 6) is low then replace U20.

2. Check U20 pin 1 with a logic probe. It should be low if no membrane switch is pressed. It should go high and stay high when any membrane switch is pressed. If not check the inputs. At least one input (U20 pin 2, 3, 4, or 5) should go low when any membrane switch is pressed. If not, replace U20. If none of the inputs go low, then the front panel key matrix and/or wiring is suspect.

3. Check U3 pin 9 with a logic probe. It should pulse low, but not stay low, when any membrane switch is pressed. Replace U3 if not.

4. Check U5 pin 12 with a logic probe. It should pulse low, but not stay low when any membrane switch is pressed.

5. Check U5 pin 10 with a logic probe. When any membrane switch is pressed, it should be normally low and pulse high, but not stay high. If not then the microprocessor (U6) is suspect.

6. The line monitor circuit should beep whenever U5 pin 12 pulses low which should happen when any membrane switch is pressed.

8-192. CONTROL AND COUNTING SECTION TROUBLESHOOTING

8-193. Use the Diagnostic Service Kit signature analysis procedure to troubleshoot the control and counting section. Most of the microprocessor and counting section is located on the transmitter board.

NOTE

This procedure requires the 4935A Diagnostic Service Kit, HP 04935-60014.

8-194. TRANSMITTER TROUBLESHOOTING

8-195. To troubleshoot the transmitter section of the 4935A, refer to the Diagnostic Service Kit (HP 04935-60014) for most of the troubleshooting procedures.

8-196. Transmit Clock Generator

8-197. The transmit clock generator provides the proper clock frequency to the phase address generator, waveform ROM, and ROM latches. It also provides 262 kHz signal to the microprocessor and counting block where it is used internally when measuring frequency. In the standard 4935A, only the sine clock circuitry is provided so wire jumper JW4 shoud be installed.

CAUTION

JW4 should not be installed if U39 is loaded. If U39 were loaded two outputs (U23 pin 10, U39 pin 11) would drive the same line.

8-198. In the P/AR model (options 002 and 003) sine and P/AR clocks are provided. Multiplexer U39 selects the proper clock according to the state of the P/AR/SINE select signal from U26 pin 1 (high = sine clock selected). When the sine clock is selected the following frequencies should appear:

CHIP	PIN	FREQUENCY
U39	4	Low
U23	10	4.194 Hz
U32	9	1.049 MHz
U32	11	262.1 kHz

8-199. When the P/AR clock is selected the following IC pins should toggle at the frequencies indicated.

CHIP	PIN	FREQUENCY
U39	4	High
U32	10	6.144 MHz
U31	8	512 kHz
U32	9	128 kHz
U32	11	32 kHz

8-200. TRANSMITTER SIGNATURE ANALYSIS PROCEDURE

8-201. The transmit signature analysis procedure is used to check the digital components in the transmit section from the adders (phase address generator) to the digital inputs to the digital to analog converter (U33). The procedure is as follows:

1. Put the 4935A in level and frequency mode. The frequency = 128 Hz.
2. Set up the 5004 signature analyzer;
   a. Connect the start and stop with the inputs of the 5004 connected to TP6. Start and stop on the positive transition (both buttons out).
   b. Connect the clock input of the 5004 to TP7 and-clock on the negative transition (pushbutton in).
   c. Connect ground to TP 9 (or any clean digital gnd).
3. The reference signature for +5 v = P254 (remember to push the reset button). The following IC pins can be checked:

Table 8-3. Reference Signatures

U34 pin	1.	55CU	U35 pin	1.	7CU5	U37 pin	1.	FC75
	2.	AAHU		2.	3HUA		2.	65CA
	3.	0000		3.	0000		3.	0000
	4.	3PCH		4.	9422		4.	8HC7
	5.	0000		5.	0000		5.	0000
	6.	1U5P		6.	FA11		6.	46HC
	7.	21P3		7.	5P33		7.	FC6F
	8.	0000		8.	0000		8.	0000
	9.	86C3		9.	FC6F		9.	21P3
	10.	P688		10.	6U4A		10.	2482
	11.	603A		11.	C7A5		11.	9241
	12.	0000		12.	0000		12.	0000
	13.	PFFA		13.	25P1		13.	15U7
	14.	0000		14.	0000		14.	0000
	15.	U665		15.	12U0		15.	8AUC
	16.	P254 (+5 v)		16.	P254 (+5 v)		16.	P254 (+5 v)
U45 pin	1.	P254 (+5 v)	U46 pin	1.	P254	U43 pin	1.	AAHU
	2.	1U5P		2.	FA11		2.	1U5P
	3.	UHOA		3.	9422		3.	9241
	4.	3PCH		4.	7CU5		4.	8AUC
	5.	55CU		5.	3HUA		5.	65CA
	6.	488C		6.	12U0		6.	46HC
	7.	AAHU		7.	25P1		7.	C7A5
	8.	0000		8.	6U4A		8.	12U0
	9.	P254		9.	C7A5		9.	619H
	10.	U665		10.	0000		10.	4P69
	11.	1431		11.	P254		11.	9C3U
	12.	PFFA		12.	46HC		12.	0000
	13.	P688		13.	8HC7		13.	2350
	14.	826P		14.	FC75		14.	H679
	15.	603A		15.	65CA		15.	803A
	16.	P254 (+5 v)		16.	8AUC		16.	63H5
				17.	15U7		17.	42PQ
				18.	2482		18.	0000
				19.	9241		19.	P254
				20.	P254 (+5 v)		20.	0000
							21.	P254 (+5 v)
							22.	603A
							23.	U665
							25.	P254 (+5 v)

Table 8-3. Reference Signatures (Continued)

U44 pin 1. P254 (+5 v) 2. UC56 3. 619H 4. 4P69 5. 25CP 6. 5919 7. 9C3U 8. 2350 9. 7P6P 10. 0000 11. P254 12. 34FH 13. H679 14. 803A 15. 38F3 16. AA85 17. 63H5 18. 42PO 19. 2C12 20. P254 (+5 v)	U48 pin 1. P254 (+5 v) 2. 320P 3. P254 4. P254 (+5 v) 5. 320P 6. HO5A 7. 0000 8. 40F0 9. A294 10. P254 (+5 v) 11. P254 12. A294 13. P254 (+5 v) 14. P254 (+5 v)	U33 pin 1. 0000 2. P254 (+5 v) 3. 0000 4. A294 5. 320P 6. UC56 7. 25CP 8. 5919 9. 7P6P 10. 34FH 11. 38F3 12. AA85 13. 2C12 14. P254 (+5 v) 15. 0000 16. 0000

8-202. Digital To Analog Conversion

8-203. To check the D-to-A conversion circuitry set the transmit frequency to 65,536 Hz. Figure 8-18 shows the waveform at JU2. If this waveform is not present, check U21 pin 2 of the current to voltage converter. It should have 0 v ±20 mv. If not, U21 (the current-to-voltage converter) is probably defective. Otherwise the D-to-A converter chip U33 is suspect or the phase address generator is not working.

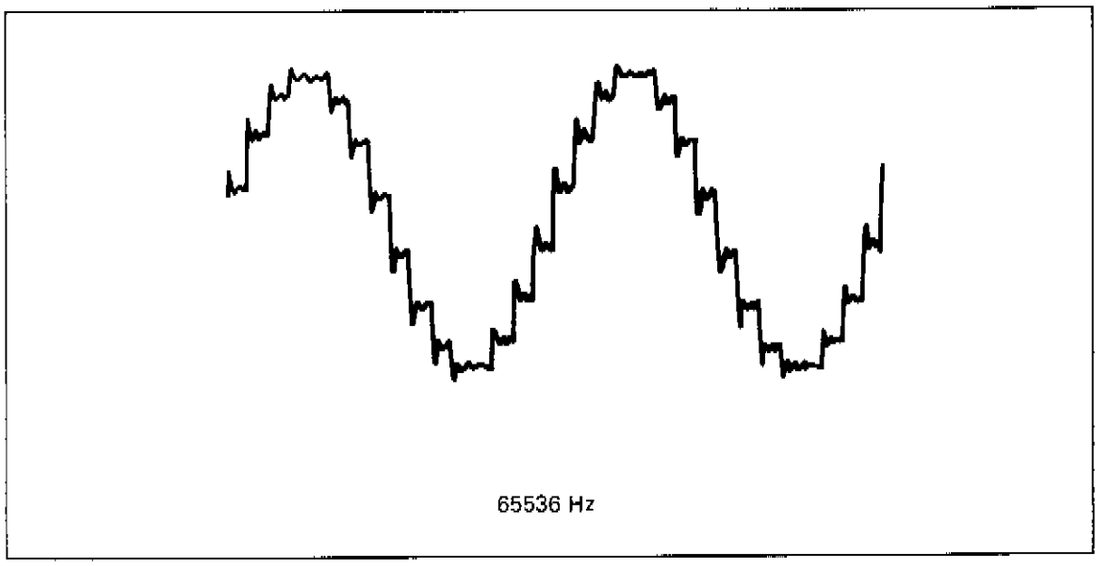


Figure 8-18. Stair Step Sinewave

8-204. FILTER AND SIGNAL SELECT CIRCUITRY

8-205. The transmit filter and signal select circuit filters the output of the D to A circuit. The wideband low pass filter is used when generating a sinewave. When generating the P/AR waveform the filtering is done by the 5 kHz low pass filter. The S0 and S1 lines from the output select multiplexer (U26) selects the appropriate filter (or a ground input for quiet termination) as the input to the power amplifier.

NOTE

JW5 puts a grounded input in place of the 5 kHz filter when noise to ground measurement is selected in the standard and option 001 instruments.

8-206. To troubleshoot the transmit filters:

1. Remove A4JU2.
2. Feed a 2 v P-P sinewave to the negative end of A4C36.
3. Monitor the output of the wideband low pass filter at TP5.
4. For each frequency in Table 8-4, check for the appropriate output.

Table 8-4. Wideband Filter Response
2 V P-P = 0.7 VRMS Input at A4C36

FREQUENCY IN HZ	VOLTAGE AT TP5 (P-P)
10000	3.5
40000	3.5
80000	3.6
120000	3.5
160000	3.1
200000	2.4

5. Monitor the output of the 5 kHz LPF at A4 TP11.
6. For each frequency in Table 8-5 check for the appropriate output.

Table 8-5. 5 kHz Low Pass Filter Response

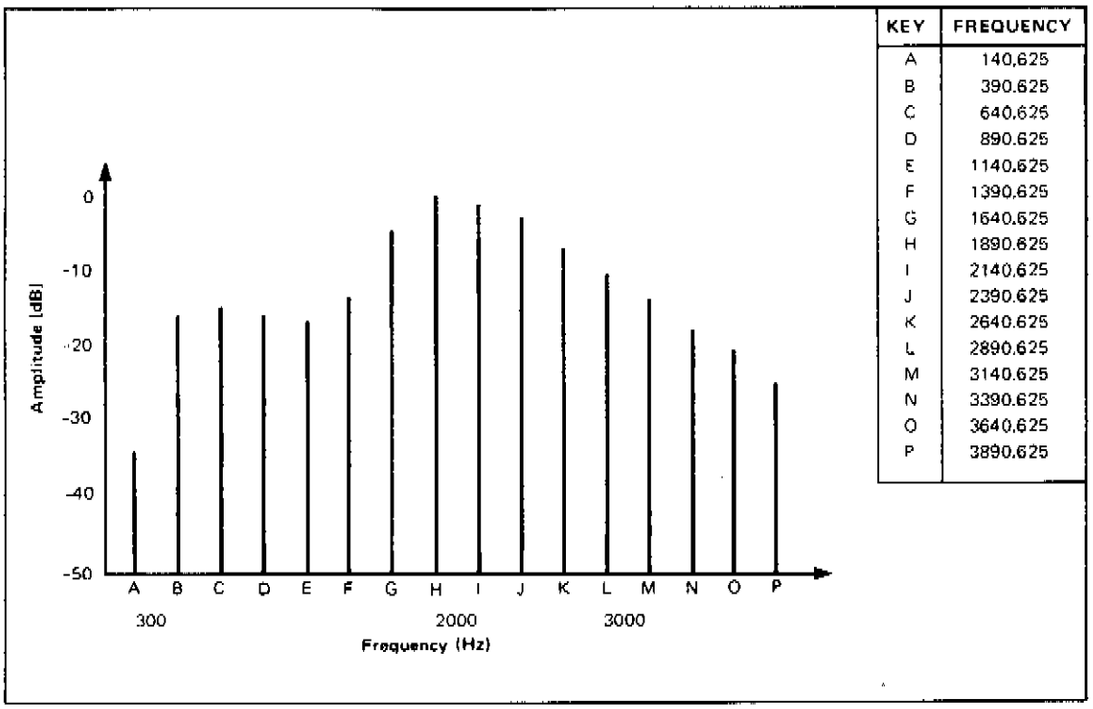
FREQUENCY IN Hz	VOLTAGE AT TP11 (P-P)
500	7.0
1000	7.0
7500	2.0
10000	0.9

7. Check the output select MUX by selecting measurement and display modes according to Table 8-6. Check for the indicated waveform at the transmitter output or level control (amplitudes may vary).

Table 8-6. Output Select MUX

MEASUREMENT	WAVEFORM	NOTES
Level and Frequency Display TRMT	Sinewave 1004 Hz	Set to 1004 Hz if necessary
Level and Frequency Display RCV	Sinewave 1004 Hz	
Noise Display RCV	DC level approx 0 v	
P/AR (opt 2 and 3) Display RCV	Characteristic P/AR Waveform	See Figure 8-18

The characteristic P/AR waveform can be checked with a spectrum analyzer using Figure 8-19 or with an oscilloscope using Figure 8-20.



KEY	FREQUENCY
A	140.625
B	390.625
C	640.625
D	890.625
E	1140.625
F	1390.625
G	1640.625
H	1890.625
I	2140.625
J	2390.625
K	2640.625
L	2890.625
M	3140.625
N	3390.625
O	3640.625
P	3890.625

Figure 8-19. P/AR Transmit Signal Frequency Spectrum

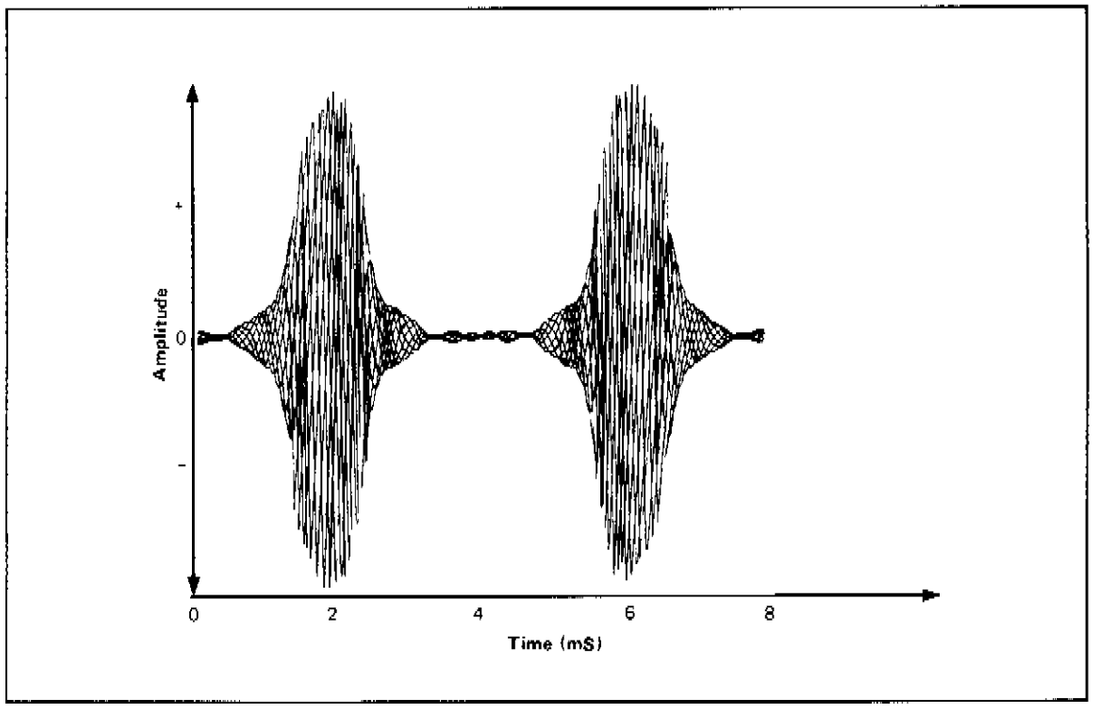


Figure 8-20. P/AR Transmit Signal Envelope

8-207. OUTPUT AMPLIFIER

8-208. The output power amplifier provides the amplification necessary for a +13 dBm output level. The OUTPUT LEVEL control provides a full dynamic range of -40 dBm to +13 dBm. To test, adjust the transmit level to approximately 0 dBm. The output waveform appears on the lowest LEVEL CONTROL terminal as an approximate 3 volt P-P signal, a .8 v P-P signal at the wiper terminal, and 4 to 5 v P-P signal at the juncture of R81, R82, and R83. Simple signal tracing should isolate problems to the component level.

NOTE

The P/AR signal crest-factor prevents valid signals greater than +3 dBm. When the signal level is too high the display blanks out. At this point the instrument is overranged (positive state condition).

8-209. At low frequencies and high output levels the 4935A TRMT output has considerable distortion introduced in the output transformer, see Figure 8-19. All signals to the TRMT output transformer should be clean sinewaves except in P/AR mode or quiet termination. In P/AR mode the characteristic P/AR signal should be present, see Figure 8-21.

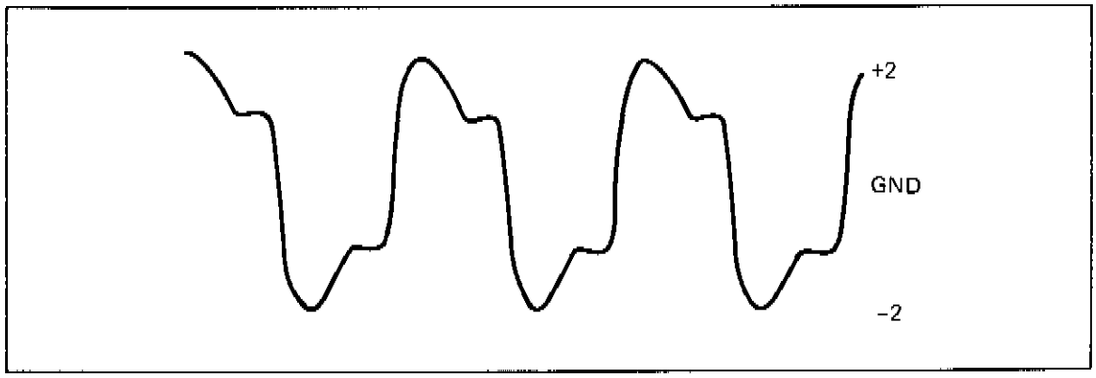


Figure 8-21. 20 Hz Waveform

8-210. TRANSMIT MONITOR

8-211. The transmit monitor circuitry provides a signal path used by the 4935A receiver circuitry when monitoring the 4935A transmit signal in the display transmit mode. Troubleshoot the transmit monitor circuit by monitoring the signal at A3TP9 (on receiver board). Select the measurement modes in the following table and check for the indicated waveforms.

Table 8-7. Transmit Monitor Test

MEASUREMENT MODE	WAVEFORM	NOTES
Level and frequency Display TRMT	Sinewave 1004 Hz	Set to 1004 Hz if necessary
Level and frequency Display RCV	dc level approx 0 v	
Noise Display RCV	dc level approx 0 v	
P/AR (opt 2 and 3) Display RCV	Characteristic P/AR waveform	See Figure 8-18.

8-212. RECEIVER TROUBLESHOOTING

8-213. This section contains troubleshooting procedures for the A3 receiver board. Discussed first is troubleshooting the signal path used by the 4935A to monitor its own transmit signal; this is the XMIT monitor path referred to in the main troubleshooting tree. The following parts of the receiver are checked in the second part of this section: input circuitry to A3U34A pin 9, tone bandpass and buffer circuitry the notch filter, any noise filters, autorange circuitry from A3U49 to the autorange select MUX, impulse noise detectors and the QRMS detector P/AR peak latch.

8-214. The procedure is as follows: The transmit monitor path is checked as an entire section. If this test passes, proceed to paragraphs 8-217 through 8-226 to complete the inputs from front panel through and notch filter receiver testing. If it fails, check for a transmitter signal at the receiver transmit input TP9. If no input is present, fix the transmitter.

NOTE

The transmitter section must be working for the receiver loop-around path test to work. The output must be a clean sinewave of about 1000 Hz and the loop-around select MUX must function.

8-215. If the transmitter circuitry sends the proper signal to the receiver path, then trace that signal through successive circuits. When a circuit output fails to have the proper signal, step through it backwards, stage by stage, until the problem is isolated. After the problem is fixed, continue the XMIT monitor test until the proper output from the voltage-to-frequency converter is established.

8-216. While tracing ac signals it is important to check not only the amplitude and frequency of the signal but also to check for dc offsets in the signal. Acceptable offsets depend on both the type of amplifier and the circuit type. As an estimate for amplifier circuits, multiply the maximum specified input offset voltage (from the op amp specification sheet) by the gain of the amplifier. Example: HP Part No. 1826-0735 a 2507 in a 20 dB amplifier configuration. Offset voltage = voltage amplification × offset spec. = 10 × 8 mv = 80 mv. The offset can be easily checked by switching the oscilloscope used to look at the signal from ac to dc input and looking for a jump in the position of the waveform. Any noticeable jump indicates a failure.

8-217. Set Up

8-218. Set the 4935A to LEVEL FREQUENCY measurement and DISPLAY-TRMT display mode. Press in both 600 ohm impedance buttons. Set the output frequency to 1004 Hz and adjust the output level to +5 dBm (+5 dBm = 1.78 vrms = 3.90 v P-P signal).

NOTE

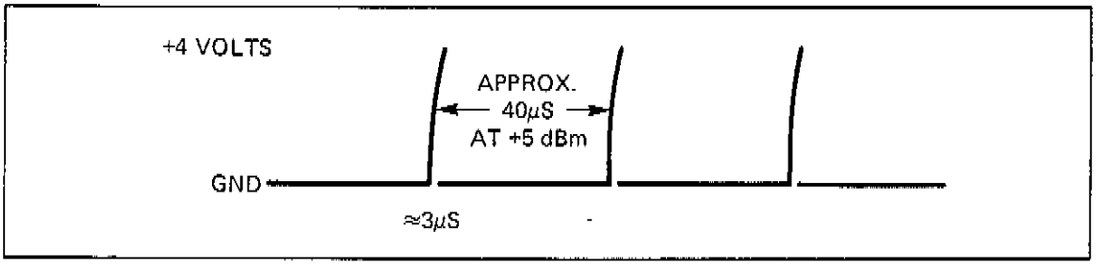
When measuring voltage at front panel jacks the voltmeter must be terminated with 600 ohms. If no termination is used, the voltage will be 7.8 v P-P.

8-219. Overall Transmit Monitor Test

8-220. If everything is working properly, the receiver board will present pulsed signals, approximately 15 kHz 4 v P-P to the microprocessor and counting section on the transmitter board through the LEVC line. Check A3U3 pin 7 for this signal. If it is present, vary the transmit level with the OUTPUT LEVEL control. As the output level rises, the LEVC (A3U3 pin 7) signal frequency should increase and vise versa.

8-221. If this signal is present, varies with output level, and the right hand display indicates approximately 5.0 dBm, then go to the inputs from the FRONT PANEL/NOTCH FILTER/25 dB AMP/TONE DROPOUT SIGNAL PATH section, paragraph 8-232.

Figure 8-22. Transmit Monitor Test Output



8-222. Transmit Monitor Signal

8-223. Check for a 3.9 v P-P signal at TP9. This signal should be a clean 1004 Hz sinewave. If this signal is not present, fix the transmitter circuit.

8-224. INPUT

1. Check for a signal at U52 pin 3 (approximately 3.9 v P-P, 1004 Hz). If the signal is present, go to paragraph 8-225.

2. Check JU3 for proper latch contents:

   pin 15 = logic 0
   pin 14 = logic 1
   pin 13 = logic 0

   If not latch, microprocessor, or data bus problems are probable. After fixing return to step 1.

3. Check for signal at TP14 (3.9 v P-P 1004 Hz). If signal is present, A3U35 has failed.

4. Check for signal at A3U34 pin 5. If signal is present, A3U34 has failed. Fix it and return to step 1.

   a. If no signal is present at A3U34 pin 5, then the low pass filter using A3U14 has failed. Fix it and return to step 1.

8-225. Noise Filter

8-226. 1. Check for a signal at U48 pin 6 (3.9 v P-P 1004 Hz). If signal is present, the flat filter path and MUX are working, go to paragraph 8-227. If not, continue to step 2.

2. Check MUX select address A3U11:

   pin 5 = logic 0
   pin 10 = logic 1
   pin 11 = logic 1

   If select address 110 is not present, there is a microprocessor, latch (A3U11), chip enable, bus problem, or the jumper in JU1 is missing.

3. Check for signal at TP 15-2 (3.9 v P-P 1004 Hz). If the signal is present, A3U37 or buffer A3U48 have failed.

4. If no signal is present at TP15 pin 2, then buffer U52 has failed.

8-227. Simplified Autorange Check

8-228. 1. Check Section VII, Manual Backdating before troubleshooting the autorange or the 150 kHz low pass filter.

2. Check for a signal (3.9 v P-P, 1004 Hz) at J1 or A3U25 pin 6. If the signal is present, go to paragraph 8-229. If not, continue.

NOTE

The housing of J1 is not connected to ground and another signal ground must be provided.

3. Check the MUX select address at JU4.
   pin 16 = logic 0
   pin 15 = logic 0
   pin 14 = logic 1
   pin 13 = logic 0

   If these addresses are not present, there is a latch (A3U17), chip enable line, microprocessor or data bus problem or the latch is being loaded down. Fix it and return to step 1.

4. Check for a signal at A3U26 pin 6 (0.39 v P-P, 1004 Hz). If the signal is present, buffer A3U25 has failed.

   a. Signal at A3U26 is 1.2 v for serial prefix 2207A and earlier.

5. Check for a signal at A3U28 pin 6 (0.39 v P-P 1004 Hz). If signal is present, A3U26 LPF has failed.

6. Check for a signal at A3U33 pin 6 (0.39 v P-P 1004 Hz). If signal is present, A3U28 LPF section has failed.

7. Check for a signal at A3U29 pin 6 (0.39 v P-P 1004 Hz). If signal is present, A3U33 LPF has failed.

8. Check for a signal at A3U39 pin 8 (0.39 v P-P 1004 Hz). If signal is present, A3U29 LPF section has failed.

9. Check for a signal at A3U39 pin 5 (0.39 v P-P 1004 Hz). If signal is present, A3U39 autorange MUX has failed.

10. If none of the above brings the correct signal then there is a jumper or trace problem; or bad resistors (R129, 146, 147). Trace backwards, from A3U39 P6 to J1.

8-229. Detector Select

8-230. 1. Check for 10 v ±30 mv at A3U13 pin 15. If this level is not present, A3U5 has failed or is being loaded down.

2. Check TP6 for an approximate 2.5 vdc level. If a signal is present, the voltage-to-frequency converter A3U3 has failed or the supporting resistors and capacitors are defective. See the overall transmit monitor test paragraph 8-219 for a description of the proper A3U3 output signal. If signal is not present, continue.

NOTE

If a dc level is present, (1.0 v to 4.5 v) but is not the proper value and the level changes with small input signal changes, then it only needs adjustment. Also, check the signal at TP23 (the full wave rectifier output) for a greater than 5% difference in alternate peak heights.

3. Check A3U13 pin 3 for approximate 2.5 vdc level. If dc level is present, A3U4 or R185 has failed.

4. Check detector select MUX address 101 at A3U13.

   pin 11 = +14 v
   pin 10 = 0 v
   pin 9 = +14 v

   If this address is not present, there is a level problem (A3U12), a latch (A3U8), chip enable, microprocessor or data bus problem.

5. Check the input of A3U13 pin 5 for 2.5 vdc level. If dc level is present, MUX A3U13 has failed.

6. Detectors have failed. Go to the Detector Troubleshooting Section, paragraph 8-250.

8-231. The above tests complete the transmit monitor tests. All transmit monitor tests must pass before going on to the tests below.

8-232. INPUTS FROM FRONT PANEL/NOTCH FILTER/25dB amp/TONE DROPOUT SIGNAL PATH

8-233. Set Up

8-234. 4935A in LEVEL FREQUENCY mode, transmit signal to 1004 Hz at +5 dBm, and DISPLAY-RCV mode. Set both impedances to 600 ohms (Impedances in); all other SETUP buttons out. U7 removed and DIP switch (HP 3101-2059) in JU3 as per service selection of input circuits, paragraph 8-267.

1. Loop 4935A output signal externally and select DISPLAY RCV.

2. Refer to A3 Schematic; set DIP switch to:

   1-16 = open
   2-15 = open
   3-14 = closed
   4-13 = closed

3. The DIP switch provides a balanced input to the receiver with the notch filter out and the 25 dB amp out.

8-235. Input Transformer

8-236. Look for a signal at the transformer output TP11. If signal is good, go to paragraph 8-239. If no signal is present, remove the receiver input cable and feed transmitter output directly into the input transformer through pins 3 and 6 of A3J4. If TP11 now has a signal, the problem is on the switchboard input and impedance selection sections. If no signal appears at TP11, the input transformer and associated circuiting (including noise to ground circuitry) is suspect. Replace the cable.

8-237. Noise To Ground Input Path (Noise-To-Ground Units Only)

8-238. Remove the receiver input cable (W3). Jumper pins 3 and 6 together and feed an input signal to pin 3 vs ground (pin 1 is ground, pin 2 is missing). Monitor TP13 with an oscilloscope, check U27 for signal. Close the DIP switch between JU3 pins 1 and 16. The signal should appear at TP13 (if not check U30 and U27).

NOTE

If U27 is not installed, W2 must be installed. Replace receiver input cable (W3). Open the DIP switch between pins 1-16 of JU3.

8-239. Tone Dropout Signal Path

8-240. Adjust input signal to 2004 Hz approximately +5 dBm (TP13 approx. 3.9 v P-P). The signal at TP12 should be about .42 v P-P. Check the signal at A3U15 pin 6, it should be approximately 12.6 v P-P 2004 Hz (31 times whatever signal is at TP12, the 12.6 v P-P assumes .4 v at TP12); if not, check A3U15 and associated circuitry.

8-241. Change input signal to 1004 Hz. Voltage at TP12 should be approximately 7.8 v P-P. (If not, check U16 bandpass filter.) Signal at both sides of C159 should be roughly on 1004 Hz squarewave 25 v P-P; if not, check U15.

8-242. Notch Filter

8-243. At TP14 the input signal of 1004 Hz is approximately +5 dBm. Open the DIP switch between pins 3 and 14 of JU3 (1-16 = open, 2-15 = open, 3-14 = open, 4-13 = closed). The signal at TP14 should drop to 1/300th or less than at its original level. If not, U34 or the notch filter has failed. For a more complete test of notch filter see the Performance Checks in Section IV. Close the DIP switch between pins 3 and 14 at JU3.

8-244. Check the 25 dB amp. Reduce the input signal until signal at TP14 is about .2 v P-P. Open DIP Switch pins 4-13 at JU3 (1-16 = open, 2-15 = open, 3-14 = closed, 4-13 = open). Signal at A3W4B should be approx. 3.5 v P-P. If not, 25 dB amp is bad. Close DIP switch pins 4-13 of JU3.

8-245. When finished, remove the jumpers on the DIP switch leaving all pins open.

8-246. NOISE FILTERS

8-247. If any noise filter responses are incorrect, go to paragraph 8-280 and troubleshoot each filter stage.

8-248. Autorange

8-249. 1. Loop the 4935A TRMT 310 jack to the RCV 310 jack through an attenuator (HP 4436A). Set the attenuation to 0 dB.

2. Adjust signal level to approx. +5.0 dBm (3.9 v P-P).

3. Monitor autorange output at J1.

NOTE

J1 case is not grounded so some other signal ground must be used.

4. Leave the attenuator inputs and outputs floating and ground the attenuator case to the 4935A. Step the attenuator from 0 to 60 dB attenuation in steps of 10 dB. With each step the autorange output will drop and then stabilize at its original amplitude. As greater attenuation is switched in the noise on the signal will rise.

5. If a failure is found, check the latch outputs vs the values shown in the MUX Table on A3, schematic sheet 2 of 2. If the select address is correct, check amplifiers, voltage dividers and input grounding analog switch A3U50.

6. To avoid crosstalk in A3U39 do input grounding as follows: U55 input is grounded –10 to +20 dB gain. U38 input is grounded –10 to +40 dB gain.

8-250. Detector Troubleshooting

8-251. 1. Check the positive side of C34, C35, or C36. There should be a 3.9 v P-P 1004 Hz transmit monitor signal. If not, adjust the looped transmit level.

2. Waveform diagrams are provided on the schematic to ease troubleshooting the detector section. The following hints may prove useful.

a. The output of U22 must be correct for any of the rest of the circuit to work. Both TP10 and TP21 signals must be correct.

b. In addition to U22, only U21, U20A and associated circuitry must function for the average detector to work.

c. U22, U23, U24B, and associated circuitry must function for the Qrms detector to work.

8-252. IMPULSE NOISE CIRCUITRY

8-253. 1. Check for 10 v reference voltage at A3U13 pin 15. If not, the reference voltage has failed or is being loaded down.

2. Check the impulse noise DAC as follows:

   a. Select IMPULSE NOISE and DISPLAY-RCV on the front panel.

   b. Select LOW (SET) threshold to 0 dBrn (the 10's digit is irrelevant).

   c. The following dc voltages should appear on TP3 through TP5.

3. Check inverter A3U1B. Voltages at A3U1 pin 1 and pin 7 should be equal but of opposite sign (±20 mv, if not, replace A3U1).

Table 8-8. A3U1B Voltages

TP	ACCEPTABLE RANGE
5(LO)	0.762 - 0.794
4(MID)	1.207 - 1.257
3(HI)	1.914 - 1.992

The following table indicates the DC voltage on TP2 (HI) for each dB of low-threshold setting.

Table 8-9. TP3 Voltages

THRESHOLD (dB)	NOMINAL VOLTAGE	ACCEPTABLE RANGE
X1	2.188	2.144 - 2.232
X2	2.461	2.412 - 2.510
X3	2.734	2.679 - 2.789
X4	3.086	3.024 - 3.148
X5	3.477	3.407 - 3.547
X6	3.867	3.790 - 3.944
X7	4.336	4.249 - 4.423
X8	4.883	4.785 - 4.981
X9	5.469	5.360 - 5.578

4. Check comparators.

   a. Set the IMPULSE NOISE LOW threshold to 90 dBrn. Select the 15 kHz filter. Adjust the input signal to 2.0 v at 1 kHz.

   b. Monitor the output of the impulse noise comparators (A3U2 pins 1, 2, and 13). Each output should be a squarewave with a voltage swing from +5 v to −14 v.

8-254. CHARGER BOARD TROUBLESHOOTING

8-255. Procedure

8-256. Check ac supply at the A5 charger board. To set up connect the 4935A to an ac power source, cycle power switch from ON to STBY and check for the following voltages on A51J1.

pin 1 = 11 to 13 vdc
pin 2 = 21 to 24 dc
pin 3 = −24 to −21 vdc

If these voltgaes are not present check ac power supply and cable.

8-257. Charge Circuitry/Charge Inhibit Circuitry

8-258. 1. Disconnect the batteries from charger board. Remove the battery cables from A5J2, J3, and J4. Place a 900-1000Ω load in parallel with a voltmeter. Put the power switch in STBY.

2. Check the voltage at the battery jacks (one terminal of each battery jack is ground).

J2 = +9 ±2 v
J3 = −9 ±2 v
J4 = +6 ±2 v

a. For GROUND voltage readings, check F1, F2, F3 and diodes CR10, CR30, CR31.

b. If there is no change in voltage between ON and STBY for all jacks, check front panel power switch and the charger inhibit circuitry.

c. For incorrect voltages or no change in voltage between ON and STBY, on only one or two jacks, check the charge circuit associated with that jack.

3. Turn power switch ON and check voltage at the following points on A5 charger board.

J2 = +9 ±2 v
J3 = −9 ±2 v
J4 = +6 ±2 v

a. For GROUND voltage readings, check F1, F2, F3 and diodes CR10, CR30, CR31.

b. If there is no change in voltage between ON and STBY for all jacks, check front panel power switch and the charger inhibit circuitry.

c. For incorrect voltages or no change in voltage between ON and STBY, on only one or two jacks, check the charge circuit associated with that jack.

4. Reconnect battery cables to A5J2, A5J3, A5J4 and remove the load from the voltmeter (cabling to J2 and J3 can be interchanged).

5. Check battery voltages at A5J2, A5J3, and A5J4.

a. At A5J4 the +5 v supply should be greater than 6. The low voltage shutdown is 5.75 vdc.

b. A5J2 and A5J3 the ±14 v supply voltages should be greater than 16 v (absolute value). The low voltage shutdown is 15.06 v.

c. If the battery voltages are low, charge the batteries by connecting the 4935A to an ac power source. Turn the power switch to STBY and let the unit charge overnight.

d. If battery voltages do not reach acceptable values after overnight charging and the unit passes tests 1-4 above, replace the batteries and repeat the charger board troubleshooting tests to verify fix.

8-259. Relay Drive Circuitry, Low Voltage Inhibit Circuitry

NOTE

Batteries must be functional and fully charged for this test to work, see paragraph 8-258.

8-260.
1. Disconnect 4935A from ac power.
2. Cycle the power switch from STBY to ON. If 4935A comes on, go to paragraph 8-261, if not continue.
3. Short A5C3 to disable ac and low voltage inhibit circuitry.
4. Cycle power switch from STBY to ON. If unit does not start, see paragraph 8-263 below and troubleshoot relay drive circuitry before continuing.

8-261. Inhibit Circuitry AC And Low Voltage

NOTE

Batteries must be functional and fully charged for this test to work, see paragraph 8-258.

8-262.
1. Turn unit on under battery power. Check +14 v supply. Shut down by momentarily grounding (~2 sec) A5U1 pin 5. The unit should shut down.
2. Wait 2 seconds and cycle the power switch to turn unit on under battery power. Check -14 v supply low voltage shutdown by momentarily (~2 sec) grounding A5U1 pin 6. Unit should shut down.
3. Wait 2 seconds and cycle power switch to turn unit ON under battery power. Check +5 v supply low voltage shutdown by momentarily (~2 sec) shorting A5U1 pins 7 and 9.
4. Wait 2 seconds and cycle power switches to turn unit on under battery power.
5. The instrument self-check check has been completed, connect the unit to an ac power source and the 4935A will usually reset (do a self check).
6. Wait 2 seconds and disconnect ac power source. 4935A should shut down.
7. If any of these tests fail, go to paragraph 8-265. If the unit has passed all tests to this point, the charger board is functioning properly and the following tests are not necessary to perform.

8-263. Delay And Relay Drive Circuitry

NOTE

Batteries must be fully charged for this test to be applicable, see paragraph 8-258.

8-264.
1. Short A5C3 with a jumper to disable ac and low voltage inhibit circuitry.
2. Disconnect 4935A from ac power and turn the power switch to ON.
3. Short the collector and emitter of Q2. The relay should click and unit turn on. If not check K1, R1, F1, F3, CR1, CR10, CR31, CR3, or ±14 v batteries.
4. Remove the jumper, cycle power from ON to STBY, to shut the unit down.

5. Plug unit into the ac power source.

6. Momentarily ground the collector of Q3, the 4935A should turn on and stay on.

   a. If it does not turn on, R4, Q4, C2, and Q2 are suspect.

   b. It is comes on but does not stay on CR2, R2, Q3, CR6, R5, R3 and C1 are suspect.

   c. If it turns on and stays on but will not turn on from the power switch, then C1, F2, R5 and the power switch and wiring are suspect.

8-265. Ac And Low Voltage Inhibit Troubleshooting

8-266. 1. Connect 4935A to ac power source and turn on.

NOTE

When the 4935A is operated on ac power the low voltage and ac inhibit sense circuits take power and sense inputs from the A4 transmitter board. The circuits are not affected by the battery or charge circuitry.

2. Check the +15.5 v regulated supply. U1 pin 3 and U2 pin 8 should be between +14 v and +16.5 v. If not, check Q11, CR17, R29.

3. Check the −15.5 v regulated supply. U1 pin 3 and U2 pin 8 should be between −14 v and − 16.5 v. If not, check Q9, CR18, and R19 (the ±15.5 v regulated supplies are used only for U1 and U2 on the charger board).

4. U2 takes its input from the +14 v regulated supply on the A5 charger board and establishes ±7 volt references.

   a. U2 pin 3 should be +7.0 ±0.1 v. If not, check R38, R39 and the +14 v regulated ac supply on the A4 transmitter board. The unit should be ON.

   b. U2 pins 1 and 2 should be +7.0 v ±20 mv. If not replace U2, U1.

   c. U2 pin 7 should be −7.0 v, equal to U2 pin 1 ±100 mv. If not replace U2, U1, R14, or R28 as necessary.

5. Check the inputs to the comparators.

   a. References

      U1 p4 = +7 v
      U1 p7 = −7 v
      U1 p8 = GND

   b. Scaled supply voltages

      U1 p5 > +7 v (more positive)
      U1 p6 > −7 v (more negative)
      U1 p9 > 0 v (any positive voltage)

   If not, check the ac supplies and the voltage dividers (R9 & R11, R13 & R14, R16, and R17) replace U1 if necessary.

6. Check U1. With the inputs at levels given in Step 5, the voltage at pins 1, 2, and 14 should be ~0 volts (open collector outputs). If not replace U1 and/or CR5.

7. Check the ac inhibit sense. The voltage at the junction of CR3, CR5 and R10 should be more negative than -17 v (-16 v at the low line voltage limit, -21 v at high limit). If not check the -17 vac supply and CR3.

8. Check the inhibit circuitry common to both ac and low voltage inhibit functions.

   a. Measure each side of C3, then subtract to get the voltage across C3.

CAUTION

Do not ground either side of C3.

   b. Under ac opertion it should be about .7 volts.

   c. Remove ac power. Turn the cycle power switch from ON to STBY to ON and wait 10 seconds. The voltage across C3 should be approximately 0 volts, no more than +.5 volts.

   d. If either of these tests fail, check Q4, Q5, CR4, CR1, R7, R8, R10, and C3. If necessary, go to the relay drive troubleshooting paragraph 8-263.

9. If all tests pass, then the ac and low voltage inhibit circuitry is working.

8-267. SERVICE AIDS

8-268. SERVICE SELECTION OF INPUT/NOTCH FILTER/25 dB AMP

8-269. The input source selects (balanced input transformer vs loop-around from transmitter vs noise to ground), whether the notch filter is selected, or whether the 25 dB amp is selected can be set by hand for servicing.

8-270. Procedure

CAUTION

U7 is static sensitive.

8-271. 1. Remove U7 from its socket and place it in protective carbon foam.

2. Install DIP switch in JU3.

3. Select desired conditions using following tables:

D0 — Balanced input/noise-to-ground select.
Switch open = logic 1 = Balanced input from transformer.
Switch closed = logic 0 = noise-to-ground input.

D1 — Front panel input/transmit monitor loop-around switch
Switch open = logic 1 = front panel. Input (balanced input or noise to ground input).
Switch closed = logic 0 transmit monitor loop around.

D2 — notch filter in/out select.
Switch open = logic 1 = notch filter in.
Switch closed = logic 0 = Notch filter out.

D3 — 25 dB Amplifier in/out.
Switch open = logic 1 = Amp in.
Switch closed = logic 0 = Amp out.

4. Remove DIP switch.

5. Replace U7 in its socket (observe CAUTION of Step 1).

8-272. SERVICE SELECTION OF NOISE FILTERS BY HAND

8-273. The noise filter select MUX can be hand programmed to a desired filter with a DIP switch inserted in JU1 in place of the shorting bar.

8-274. Procedure

8-275. 1. Remove shorting bar from JU1.

2. Insert DIP switch with all switches open.

3. Close the switch between pins 8 and 9. This is the strobe for latch U11, with switch closed, latch outputs follow latch inputs.

4. Use the switches between pins 5-12, 6-11 and 7-10 to select filter according to Table 8-10.

Table 8-10. Hand Selection of Noise Filters

FILTER	ADDRESS D2	D1	D0	SWITCH SETTINGS S7-PINS 7 & 10	S6-PINS 6 & 11	S5-PINS 5 & 12
C-Message	0	0	0	Closed	Closed	Closed
3 kHz Flat	0	0	1	Closed	Closed	Open
15 kHz Flat	0	1	0	Closed	Open	Closed
Program	0	1	1	Closed	Open	Open
50 kBit	1	0	0	Open	Closed	Closed
P/AR Filter	1	0	1	Open	Closed	Open
Flat (No Filter)	1	1	0	Open	Open	Closed
Ground	1	1	1	Open	Open	Open

5. When you are finished, replace the shorting bar in JU1 pins 1-16, 2-15, 3-14, 4-13.

8-276. SERVICE SELECTION OF AUTORANGE GAIN FOR SERVICE

8-277. The autorange circuit can be forced to a desired gain, manually, for servicing.

8-278. Procedure

CAUTION

U17 is static sensitive.

1. Remove U17 from its socket and insert into protective foam.

2. Place a DIP switch in JU4.

3. Select the desired autorange state according to Table 8-11.

Table 8-11. Autorange States

GAIN WANTED	SWITCH SETTINGS S1-PINS 1–16	S2-PINS 2–15	S3-PINS 3–14	S4-PINS 4–13	D7	D6	D5	D4
–10 dB	Closed	Closed	Closed	Closed	0	0	0	0
0 dB	Closed	Closed	Open	Closed	0	0	1	0
10 dB	Closed	Open	Closed	Closed	0	1	0	0
20 dB	Closed	Open	Open	Closed	0	1	1	0
30 dB	Open	Closed	Closed	Closed	1	0	0	0
40 dB	Open	Closed	Open	Closed	1	0	1	0
50 dB	Open	Open	Closed	Open	1	1	0	1
60 dB	Open	Open	Open	Open	1	1	1	1

4. When you are finished, remove the DIP switch and replace U7.

8-279. HAND SELECTION OF A3C57 AND A3C160 (A13, C57 AND A3C160 FOR P/AR UNITS) FOR DESIRED FREQUENCY RESPONSE

8-280. Three things affect the frequency response of the 4935A receiver in LEVEL FREQUENCY if everything is functioning correctly:

1. The input transformer.
2. The buffer amp at the input (U30).
3. The 150 kHz low pass filter (LPF) at the autorange output.

8-281. If an instrument fails to meet the frequency response specification ±.5 dB at the frequencies listed in the frequency response table below, first check for an instrument failure. This might include op-amps that distort the signal, losses or gains through switches (CMOS switches), tip or ring on the input terminal being grounded either through a direct short or a finite resistance, etc.

Second, the 150 kHz LPF should be rechecked. Use the table in the receiver test procedure.

Third, the U30 buffer amplifier should be checked. In particular, check for incorrect or out of tolerance components among U30, R75, R76, and C57. (R75 and C57 especially!)

If all looks correct, C57 and C160 need to be hand selected.

8-282. Hand Selection Of C57 And C160

Step 1: Measure the frequency response of the receiver at the frequencies noted in Table 8-12 and record them in dB.

Table 8-12. Hand Selection of C57 and C160

CAPACITOR	FREQUENCY RESPONSE						
	30 kHz	40 kHz	50 kHz	60 kHz	70 kHz	80 kHz	85 kHz
Ⓐ 1500 pF	(measured)						
Ⓑ (circle) (one)							
1200 pF	+.09	+.14	+.20	+.25	+.30	+.33	+.35
1300 pF	+.06	+.10	+.14	+.17	+.20	+.22	+.23
1400 pF	+.03	+.05	+.07	+.08	+.10	+.11	+.11
1500 pF	0 (ref)	0 (ref)	0 (ref)	0 (ref)	0 (ref)	0 (ref)	0 (ref)
1600 pF	−.03	−.05	−.07	−.08	−.10	−.11	−.11
1700 pF	−.07	−.10	−.14	−.17	−.19	−.21	−.21
1800 pF	−.10	−.16	−.21	−.25	−.28	−.30	−.31
Others: (approximately)	N.03 per 100 pF	.05 / 100 pF	.07 / 100 pF	.08 / 100 pF	.10 / 100 pF	.11 / 100 pF	.11 / 100 pF
Net Response (Add Ⓐ + Ⓑ)							

Step 2: Look in the table and pick a capacitor to make the overall frequency response be within specification. The specification should be ±.4 dB at all frequencies. Some judgment should be used to make the overall frequency response as flat as possible. Select a capacitor that makes the highest error = +.3 dB (if we were too high at 85 kHz). Note that the maximum may occur anywhere between 60 to 85 kHz typically. Probability of being too low in the 40 kHz region is minimal.

After picking this new capacitor, calculate the new theoretical frequency response (by adding A and B for the new capacitor value chosen), if it looks good continue to Step 3.

Step 3: Get a capacitor of the value chosen, it can be any mica capacitor of any tolerance and 50 vac or greater working voltage (you might measure its value to be sure). Put this capacitor in the circuit and recheck the frequency response at all frequencies (math errors aside, it should pass with a high degree of confidence).

8-283. FILTERS: RESPONSE OF EACH STAGE

8-284. The following are the nominal design responses to each filter in 4935A.

Table 8-13. 4935A C-Message Filter

Filter Input = 1.000 volts (output in mv)					
FREQUENCY	U31-1 STAGE 1	U31-8 STAGE 2	U32-1 STAGE 3	U32-7 STAGE 4	TP15-1 STAGE 5
300	583	145	146	147	148
900	960	789	848	917	946
1000	968	790	863	952	988
2500	995	295	320	665	852
3000	997	241	201	512	734
4500	999	156	55	45	85

Table 8-14. 4935A 3 kHz Filter

Filter Input = 1.000 volts (output in mv)					
FREQUENCY	UP154				
1K	994				
3K HZ	707				
6K HZ	243				

Table 8-15. 4935A 15 kHz Filter

Filter Input = 1.000 volts (output in mv)					
FREQUENCY	TP15-5				
1K	1000				
15K	714				
30K	247				

Table 8-16. 4935A Program Filter

Filter Input = 1.000 volts (output in mv)					
FREQUENCY	U36-1 STAGE 1	U36-7 STAGE 2	U36-8 STAGE 3	TP15-3 STAGE 4	
100	1000	1000	1000	40.2	
500	1004	1004	1000	490.0	
1000	1015	1015	1000	1007.0	
2000	1063	1060	998	1712.0	
5000	1512	1386	989	2398.0	
10000	1040	516	193	504.0	

Table 8-17. 4935A 50 kBit Filter

Filter Input = 1.000 volts (output in mv)					
FREQUENCY	U46-1 STAGE 1	U46-7 STAGE 2	U47-1 STAGE 3	TP15-6 STAGE 4	
1000	999	998	998	998.0	
15K	1000	896	889	944.0	
25K	1000	694	656	787.0	
35K	1000	485	401	560.0	
50K	1000	281	164	74.3	

Table 8-18. 4935A Notch Filter

Filter Input = 1.000 volts (output in mv)					
FREQUENCY	U40-7 STAGE 1	U51-7 STAGE 2	U51-14 STAGE 3		
400	1058	1034	993		
862	2476	1411	901		
1182	493	280	894		
1700	691	637	979		

Table 8-19. 4935A PAR Filter

Filter Input = 1.000 volts (output in mv)					
FREQUENCY	TP15-7 STAGE 1	TP15-8 STAGE 2			
300	232	49.1			
1000	1312	1566.0			
2300	736	492.0			

Table 8-20. 4935A 150 kHz Low Pass Filter

Filter Input = 0.20 volts (output in mv)					
FREQUENCY	U33 PIN 6 STAGE 1	U28 PIN 6 STAGE 2	U26 PIN 6 STAGE 3		
1	200	200	200		
60 K	231	204	201		
85 K	269	212	203		
100 K	305	221	203		
110 K	333	228	202		
135 K	402	235	184		

Table 8-21. 4935A 110 kHz Low Pass Filter

Filter Input = 0.50 volts (output in mv)					
FREQUENCY	U33 PIN 6 STAGE 1	U28 PIN 6 STAGE 2	U26 PIN 6 STAGE 3		
1 K	500	500	500		
60 K	656	523	501		
85 K	873	580	492		
100 K	1005	580	467		
110 K	998	526	372		

8-285. In order to check the filters accurately, the 4935A can be used as a measuring device. To measure, use a synthesizer as the input and set 4935A on LEVEL, FREQUENCY and RCV. Next, remove the shorting bar on JU1 and replace it with a DIP switch. Using the table for the filter MUX (U37) given on the schematic, one can manually control which filter is switched in and can read the display to check the filter response.

Table 8-22. Bell 41009 C-Message Filter

Filter Input = 0.0 dBm		
FREQUENCY	ACCEPTABLE minimum	OUTPUT LEVEL maximum
60	−57.7	−53.7
100	−44.5	−40.5
200	−27.0	−23.0
300	−17.5	−15.5
400	−12.4	−10.4
500	− 8.5	− 6.5
600	− 5.7	− 3.7
700	− 3.7	− 1.7
800	− 2.5	− .5
900	− 1.6	+ .4
1000	− .2	+ .2
1200	− 1.2	+ .8
1300	− 1.5	+ .5
1500	− 2.0	0.0
1800	− 2.3	− .3
2000	− 2.3	− .3
2500	− 2.4	− .4
2800	− 2.9	− .9
3000	− 3.5	− 1.5
3300	− 7.2	− 3.2
3500	− 9.6	− 5.6
4000	−17.5	−11.5
4500	−24.5	−18.5
5000	−31.5	−25.5

Table 8-23. Bell 41009 3 kHz Flat Filter

Filter Input = 0.0 dBm		
FREQUENCY	ACCEPTABLE minimum	OUTPUT LEVEL maximum
30	- 2.5	+ 2.5
60	- 1.7	+ 1.7
400	- .5	+ .5
1000	- .2	+ .2
2000	- 1.8	+ .2
3000	- 4.8	- 1.2
6000	-15.3	- 9.3

Table 8-24. Bell 41009 15 kHz Flat Filter

Filter Input = 0.0 dBm at given frequencies		
FREQUENCY	ACCEPTABLE minimum	OUTPUT LEVEL maximum
30	- 2.5	+ 2.5
60	- 1.7	+ 1.7
400	- .5	+ .5
1000	- .2	+ .2
10K	- 1.8	+ .2
15K	- 4.8	- 1.2
30K	-15.3	- 9.3

Table 8-25. Bell 41009 Program Filter

Filter Input = 0.0 dBm		
FREQUENCY	ACCEPTABLE minimum	OUTPUT LEVEL maximum
100	-28.3	-24.3
200	-19.3	-15.3
300	-14.3	-10.3
400	-11.0	- 7.0
500	- 7.6	- 5.6
600	- 5.7	- 3.7
700	- 4.2	- 2.2
800	- 3.0	- 1.0
900	- 1.8	+ .2
1000	- .2	+ .2
1500	+ 2.2	+ 4.2
2000	+ 3.8	+ 5.8
2500	+ 3.6	+ 7.6
3000	+ 4.0	+ 8.0
4000	+ 4.5	+ 8.5
5000	+ 4.5	8.5
6000	+ 3.4	+ 9.4
7000	+ 2.8	+ 8.8
8000	+ 1.0	+ 7.0
9000	- 5.5	+ 2.5
1000	-12.5	- 4.5

Table 8-26. Bell 41009 50 kBit Filter

Filter Input = 0.0 dBm		
FREQUENCY	ACCEPTABLE minimum	OUTPUT LEVEL maximum
20	-13.0	- 7.0
50	- 4.2	- 1.2
200	- .7	+ .3
1k	- .2	+ .2
5k	- .6	+ .4
10k	- .8	+ .2
15k	- 1.7	+ .3
20k	- 2.3	- .3
25k	- 3.1	- 1.1
30k	- 4.8	- 1.8
35k	- 6.7	- 3.3
40k	- 9.8	- 5.8
45k	-17.0	-11.0
50k		<-22.0
55k		<-30.0

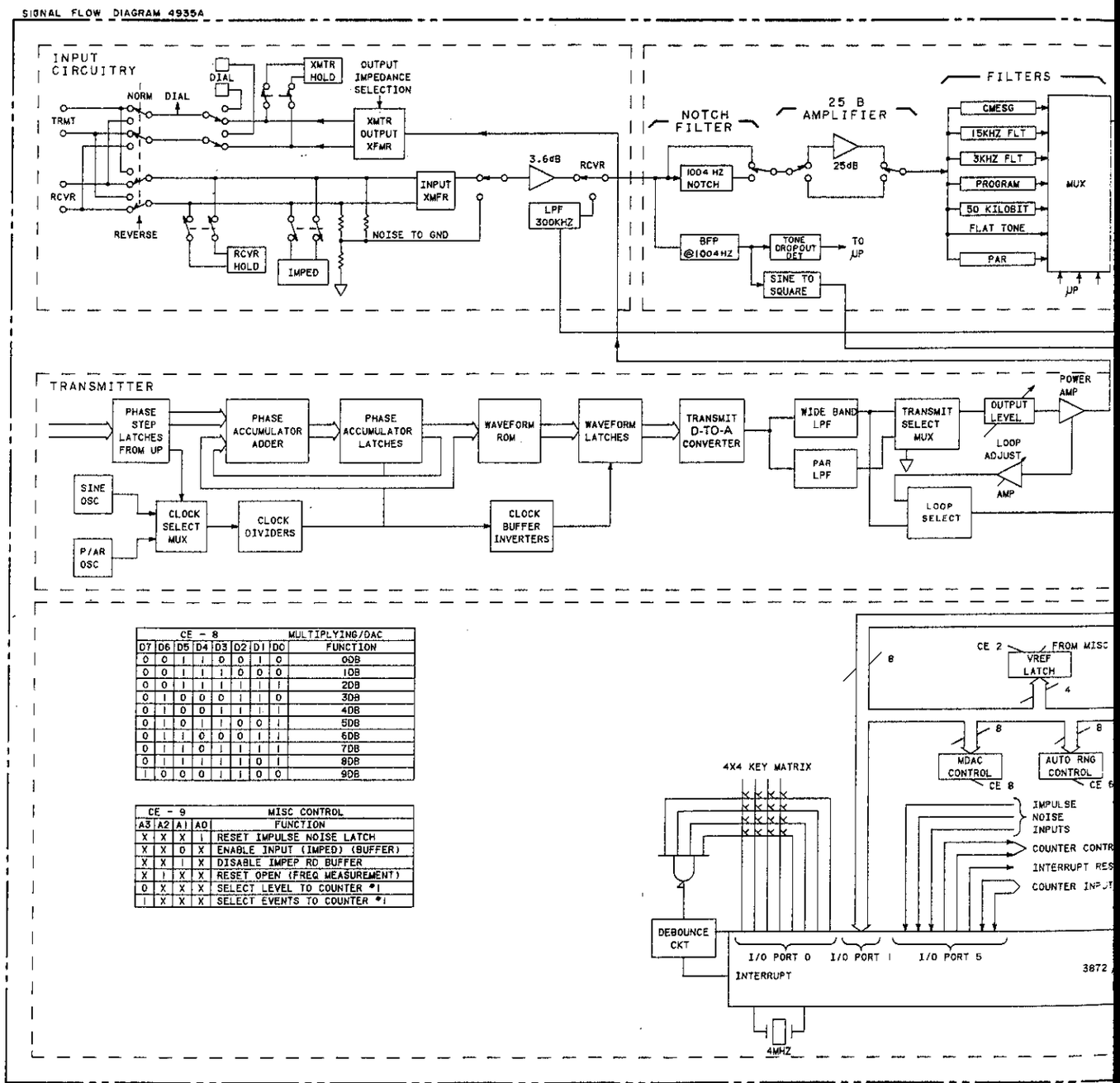
Table 8-27. Bell 41009 PAR Filter

FREQUENCY	NOMINAL LOSS	NOMINAL PHASE RESPONSE (Degrees)
140.625	-50.5	173.7
390.625	-31.5	161.2
640.625	-20.4	144.0
890.625	-10.6	114.3
1140.625	- 2.1	55.4
1390.625	- .6	30.2
1640.625	- 5.5	- 86.4
1890.625	-10.5	-113.8
2140.625	-14.5	-128.6
2390.625	-17.7	-137.8
2640.625	-20.4	-144.0
2890.625	-22.7	-148.5
3140.625	-24.6	-152.0
3390.625	-26.4	-154.7
3640.625	-27.9	-156.9
3890.625	-29.3	-158.7

Table 8-28. Bell 41009 Notch Filter

Filter Input = 0.0 dBm (with 15 kHz flat)		
FREQUENCY	ACCEPTABLE minimum	OUTPUT LEVEL maximum
=< 400 Hz	- .5	+ .5
400 <f=< 862 Hz	-3.0	+ .5
862 <f=< 995		<+ .5
995=<f=<1025		<-50.0
1025 <f< 1182		<+ .5
1182=<f< 1700	-3.0	+ .5
1700=<f	- .5	+ .5

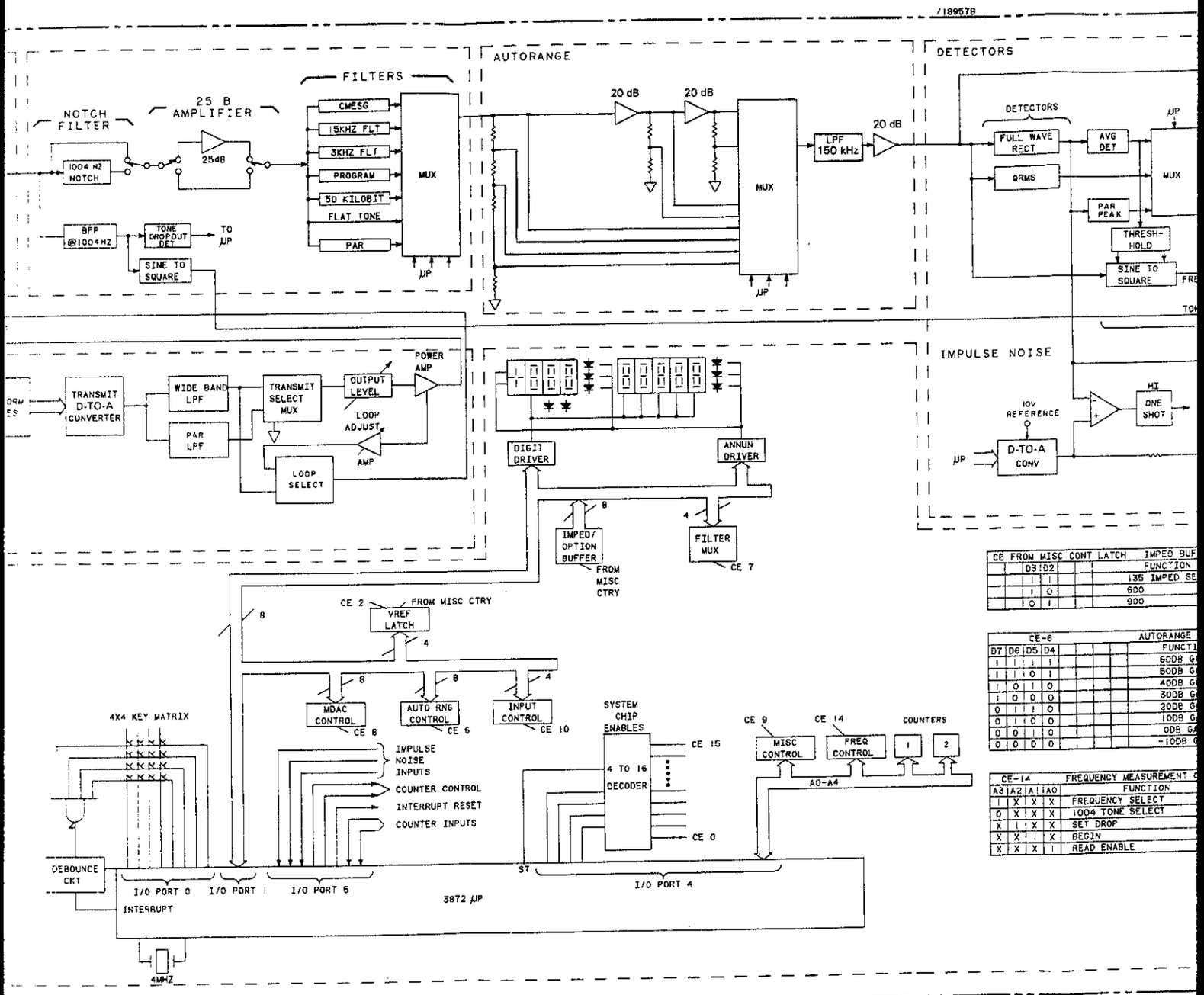
Fig 8-23
Sht 1 of 3



CE - 8								MULTIPLYING/DAC
D7	D6	D5	D4	D3	D2	D1	D0	FUNCTION
0	0	1	1	0	0	1	0	0DB
0	0	1	1	1	0	0	0	1DB
0	0	1	1	1	1	1	1	2DB
0	1	0	0	0	1	1	0	3DB
0	1	0	0	1	1	1	1	4DB
0	1	0	1	1	0	0	1	5DB
0	1	1	0	0	0	1	1	6DB
0	1	1	0	1	1	1	1	7DB
0	1	1	1	1	1	0	1	8DB
1	0	0	0	1	1	0	0	9DB

CE - 9				MISC CONTROL
A3	A2	A1	A0	FUNCTION
X	X	X	1	RESET IMPULSE NOISE LATCH
X	X	0	X	ENABLE INPUT (IMPED) (BUFFER)
X	X	1	X	DISABLE IMPED RD BUFFER
X	1	X	X	RESET OPEN (FREQ MEASUREMENT)
0	X	X	X	SELECT LEVEL TO COUNTER #1
1	X	X	X	SELECT EVENTS TO COUNTER #1

Fig 8-23
Sht 2 of 3

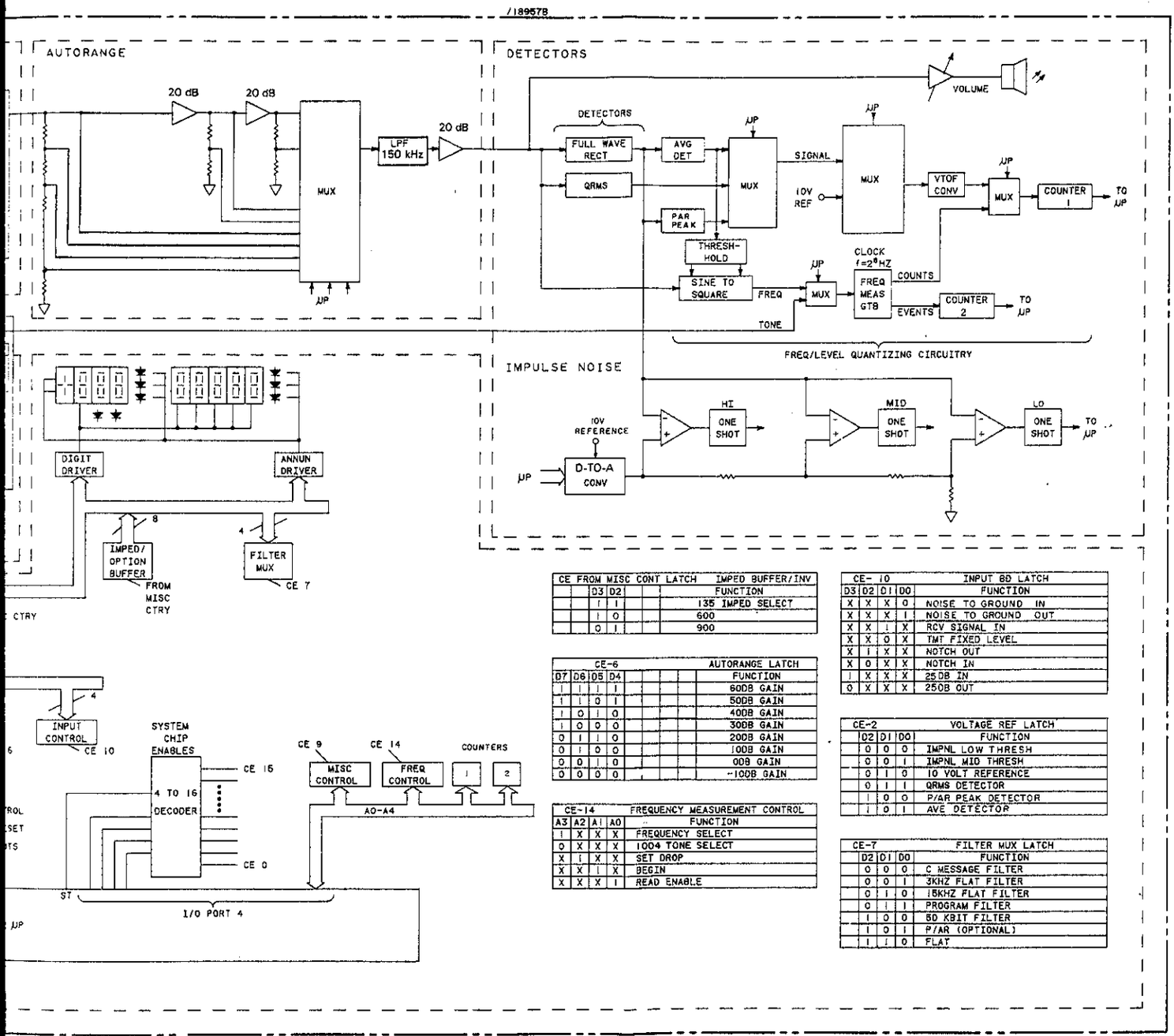


CE FROM MISC CONT LATCH	IMPED BUF
D3 D2	FUNCTION
1 1	135 IMPED SE
1 0	600
0 1	900

CE-6				AUTORANGE
D7	D6	D5	D4	FUNCTI
1	1	1	1	60DB G
1	1	1	0	50DB G
1	1	0	1	40DB G
1	0	1	0	30DB G
1	0	0	1	20DB G
0	1	1	1	10DB G
0	1	1	0	0DB G
0	0	1	0	-10DB
0	0	0	0	

CE-14				FREQUENCY MEASUREMENT C
A3	A2	A1	A0	FUNCTION
1	X	X	X	FREQUENCY SELECT
0	X	X	X	1004 TONE SELECT
X	1	X	X	SET DROP
X	X	1	X	BEGIN
X	X	X	1	READ ENABLE

Fig 8-23
Sht 3 of 3



CE FROM MISC CONT LATCH				IMPED BUFFER/INV
	D3	D2		FUNCTION
	1	1		135 IMPED SELECT
	1	0		600
	0	1		900

CE-6				AUTORANGE LATCH
D7	D6	D5	D4	FUNCTION
1	1	1	1	60DB GAIN
1	1	0	1	50DB GAIN
1	0	1	0	40DB GAIN
1	0	0	0	30DB GAIN
0	1	1	0	20DB GAIN
0	1	0	0	10DB GAIN
0	0	1	0	0DB GAIN
0	0	0	0	-10DB GAIN

CE-14				FREQUENCY MEASUREMENT CONTROL
A3	A2	A1	A0	FUNCTION
1	X	X	X	FREQUENCY SELECT
0	X	X	X	1004 TONE SELECT
X	1	X	X	SET DROP
X	X	1	X	BEGIN
X	X	X	1	READ ENABLE

CE- 10				INPUT 8D LATCH
D3	D2	D1	D0	FUNCTION
X	X	X	0	NOISE TO GROUND IN
X	X	X	1	NOISE TO GROUND OUT
X	X	1	X	RCV SIGNAL IN
X	X	0	X	TMT FIXED LEVEL
X	1	X	X	NOTCH OUT
X	0	X	X	NOTCH IN
1	X	X	X	25DB IN
0	X	X	X	250B OUT

CE-2				VOLTAGE REF LATCH
	D2	D1	D0	FUNCTION
	0	0	0	IMPNL LOW THRESH
	0	0	1	IMPNL MID THRESH
	0	1	0	10 VOLT REFERENCE
	0	1	1	QRMS DETECTOR
	1	0	0	P/AR PEAK DETECTOR
	1	0	1	AVE DETECTOR

CE-7			FILTER MUX LATCH
D2	D1	D0	FUNCTION
0	0	0	C MESSAGE FILTER
0	0	1	3KHZ FLAT FILTER
0	1	0	15KHZ FLAT FILTER
0	1	1	PROGRAM FILTER
1	0	0	50 KBIT FILTER
1	0	1	P/AR (OPTIONAL)
1	1	0	FLAT

Figure 8-23.
Signal Flow Diagram
8-63/(8-64 blank)

Fig 8-24 Sht 1 of 2

A1 FRONT PANEL WITH P/AR SHOWN (0950-0496 PAR)(0950-0498 STD)

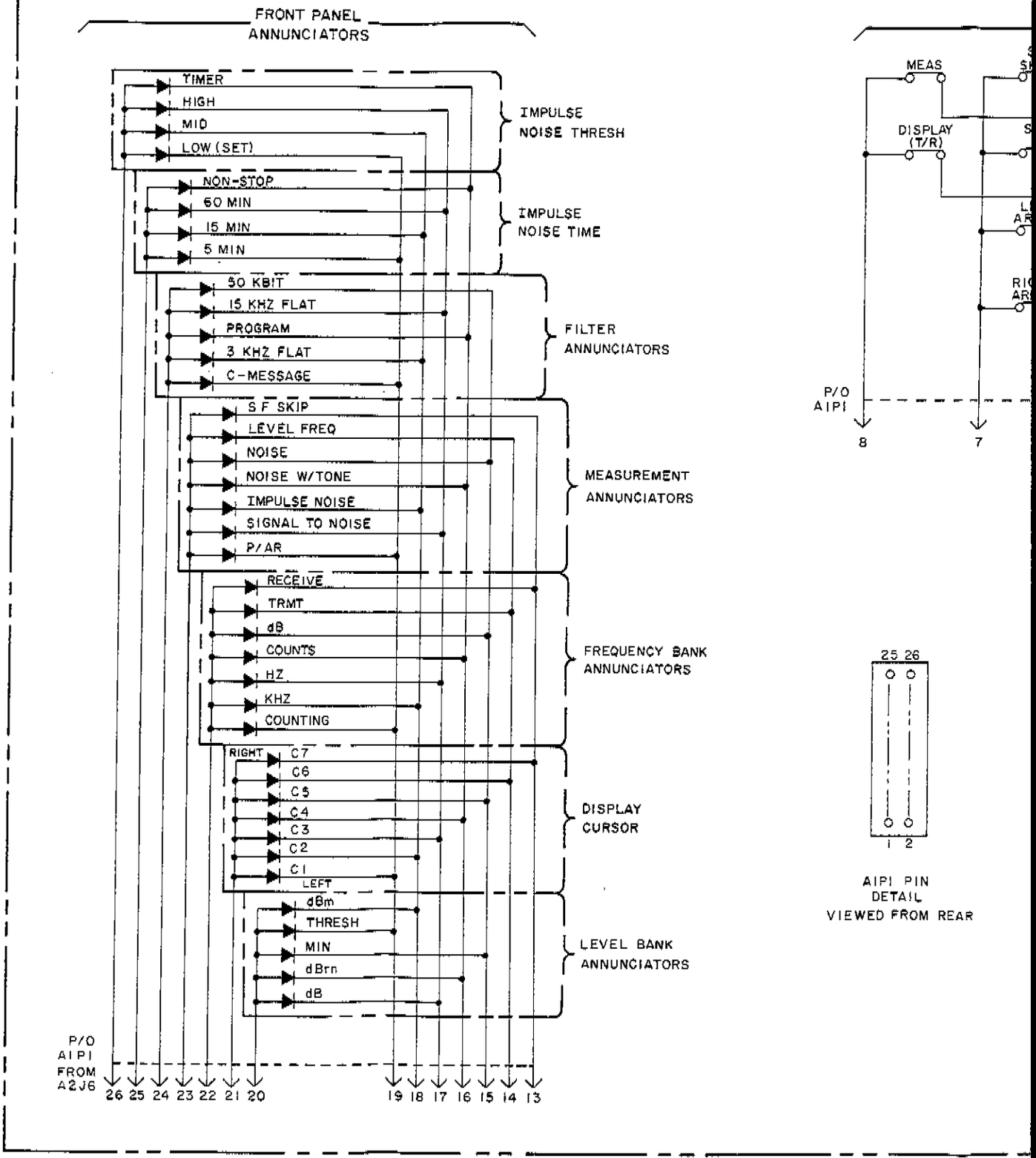


Fig 8-24 sht 2 of 2

-0496 PAR)(0950-0498 STD)

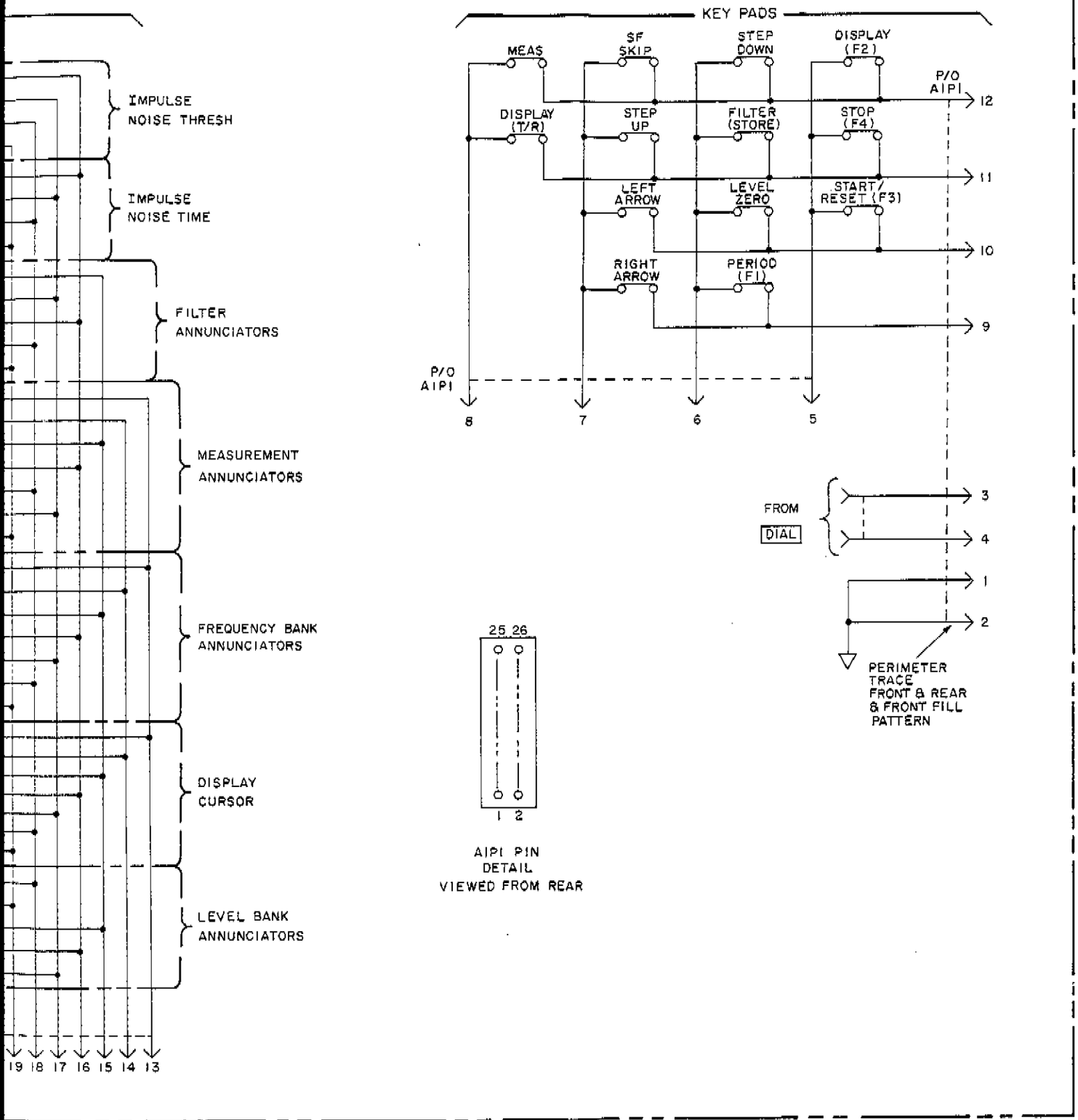
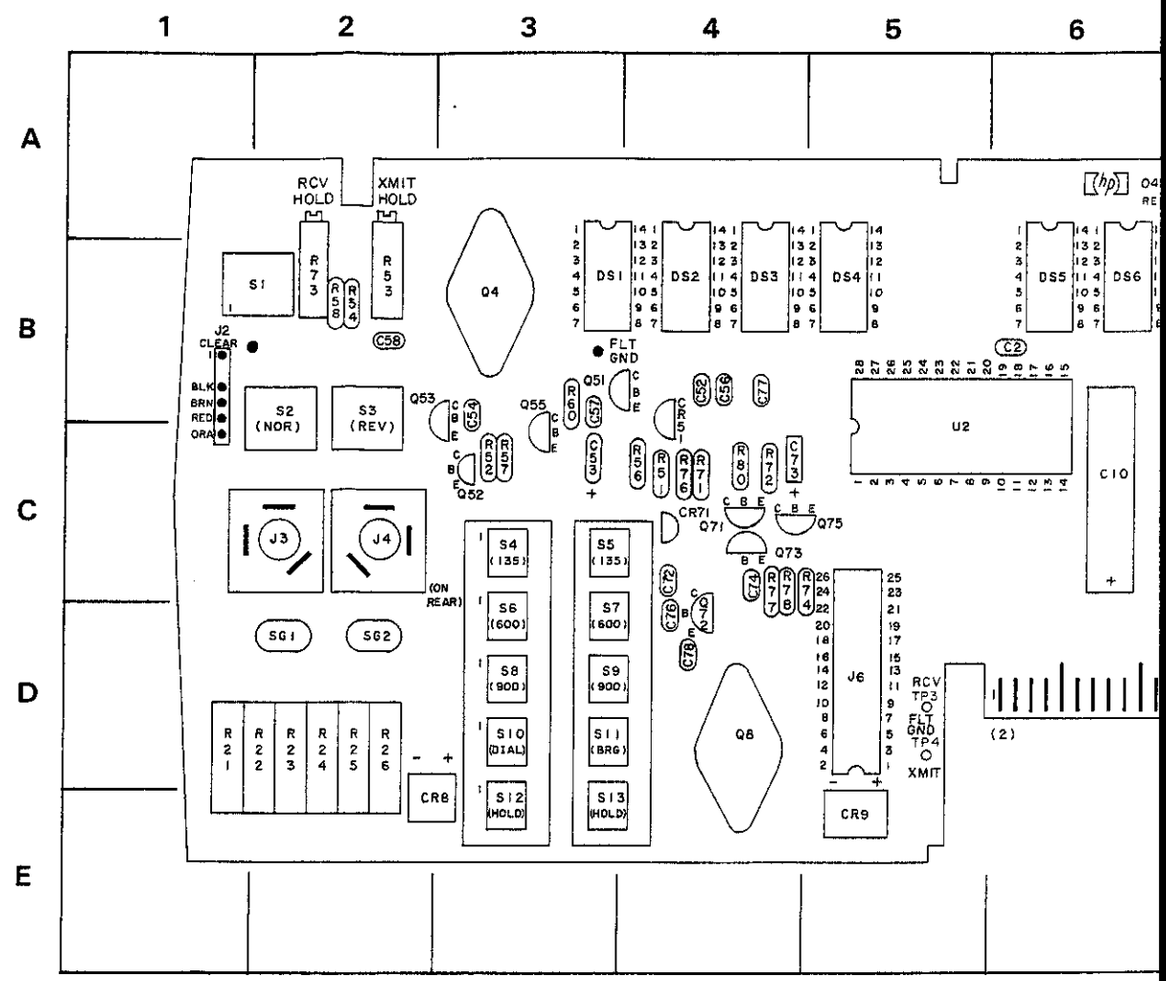


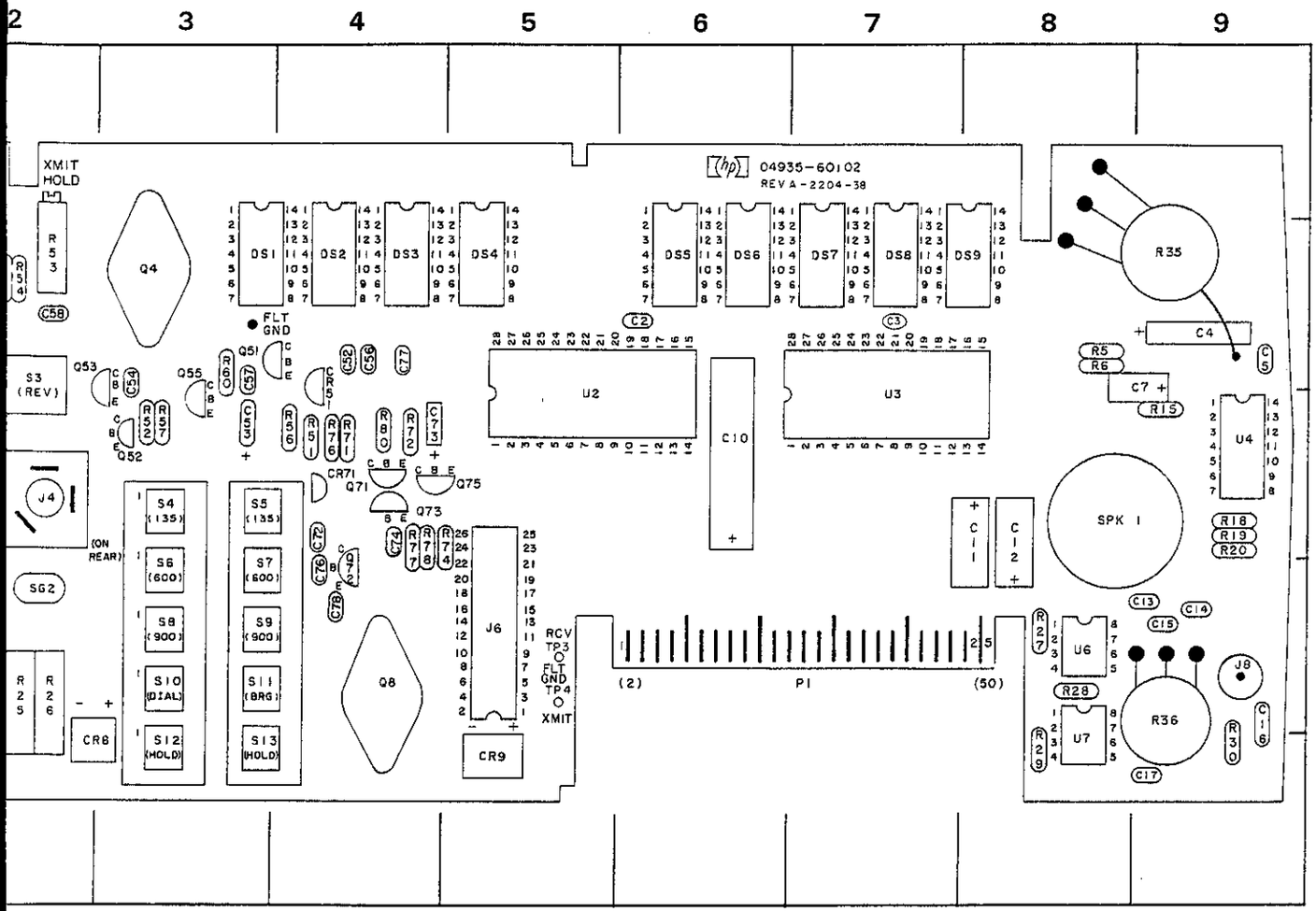
Figure 8-24.
A1 Front Panel Schematic Diagram

Fig 8-25
Sht 1 of 2



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG
C2	B-6	C53	C-3	CR71	C-4	J8	D-9	R18
C3	B-7	C54	C-3	DS1	B-3	Q4	B-3	R19
C4	B-9	C56	C-4	DS2	B-4	Q8	D-4	R20
C5	B-9	C57	C-3	DS2	B-4	Q51	C-4	R21
C7	C-9	C58	B-2	DS4	B-5	Q52	C-3	R22
C10	C-5	C72	D-4	DS5	B-6	Q53	C-3	R23
C11	D-8	C73	C-4	DS6	B-6	Q55	C-3	R24
C12	D-8	C74	D-4	DS8	B-7	Q71	C-4	R25
C13	D-9	C76	D-4	DS9	B-8	Q72	D-4	R26
C14	D-9	C77	C-4	J2	B-1	Q73	C-4	R27
C15	D-9	C78	D-4	J3	C-2	Q75	C-5	R28
C16	E-8	CR8	E-3	J4	C-2	R5	B-8	R29
C17	E-8	CR9	E-9	J6	D-5	R6	B-8	R30
C52	C-4	CR51	C-4	J7	D-5	R15	C-9	R35

Figure 8-25. A2 Switchboard Cor



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C2	B-6	C53	C-3	CR71	C-4	J8	D-9	R18	C-9	R36	E-8	R76	C-4	S11	D-3
C3	B-7	C54	C-3	DS1	B-3	Q4	B-3	R19	D-9	R51	C-4	R77	D-4	S12	E-3
C4	B-9	C56	C-4	DS2	B-4	Q8	D-4	R20	D-9	R52	C-3	R78	D-4	S13	E-3
C5	B-9	C57	C-3	DS2	B-4	Q51	C-4	R21	D-1	R53	B-2	R80	C-4	SG1	D-2
C7	C-9	C58	B-2	DS4	B-5	Q52	C-3	R22	D-2	R54	B-2	S2	C-2	SG2	D-2
C10	C-5	C72	D-4	DS5	B-6	Q53	C-3	R23	D-2	R56	C-4	S3	C-2	SPK1	C-8
C11	D-8	C73	C-4	DS6	B-6	Q55	C-3	R24	D-2	R57	C-3	S4	C-3	TP3	D-5
C12	D-8	C74	D-4	DS8	B-7	Q71	C-4	R25	D-2	R58	B-2	S5	C-3	TP4	D-5
C13	D-9	C76	D-4	DS9	B-8	Q72	D-4	R26	D-2	R60	C-3	S6	D-3	U2	C-5
C14	D-9	C77	C-4	J2	B-1	Q73	C-4	R27	D-8	R71	C-4	S7	D-3	U3	C-7
C15	D-9	C78	D-4	J3	C-2	Q75	C-5	R28	D-8	R72	C-4	S8	D-3	U4	C-9
C16	E-8	CR8	E-3	J4	C-2	R5	B-8	R29	E-8	R73	B-2	S9	D-3	U6	D-8
C17	E-8	CR9	E-9	J6	D-5	R6	B-8	R30	E-8	R74	D-5	S10	D-3	U7	E-8
C52	C-4	CR51	C-4	J7	D-5	R15	C-9	R35	B-9						

Figure 8-25. A2 Switchboard Component Locator

Fig 8-26 Sht 1 of 2

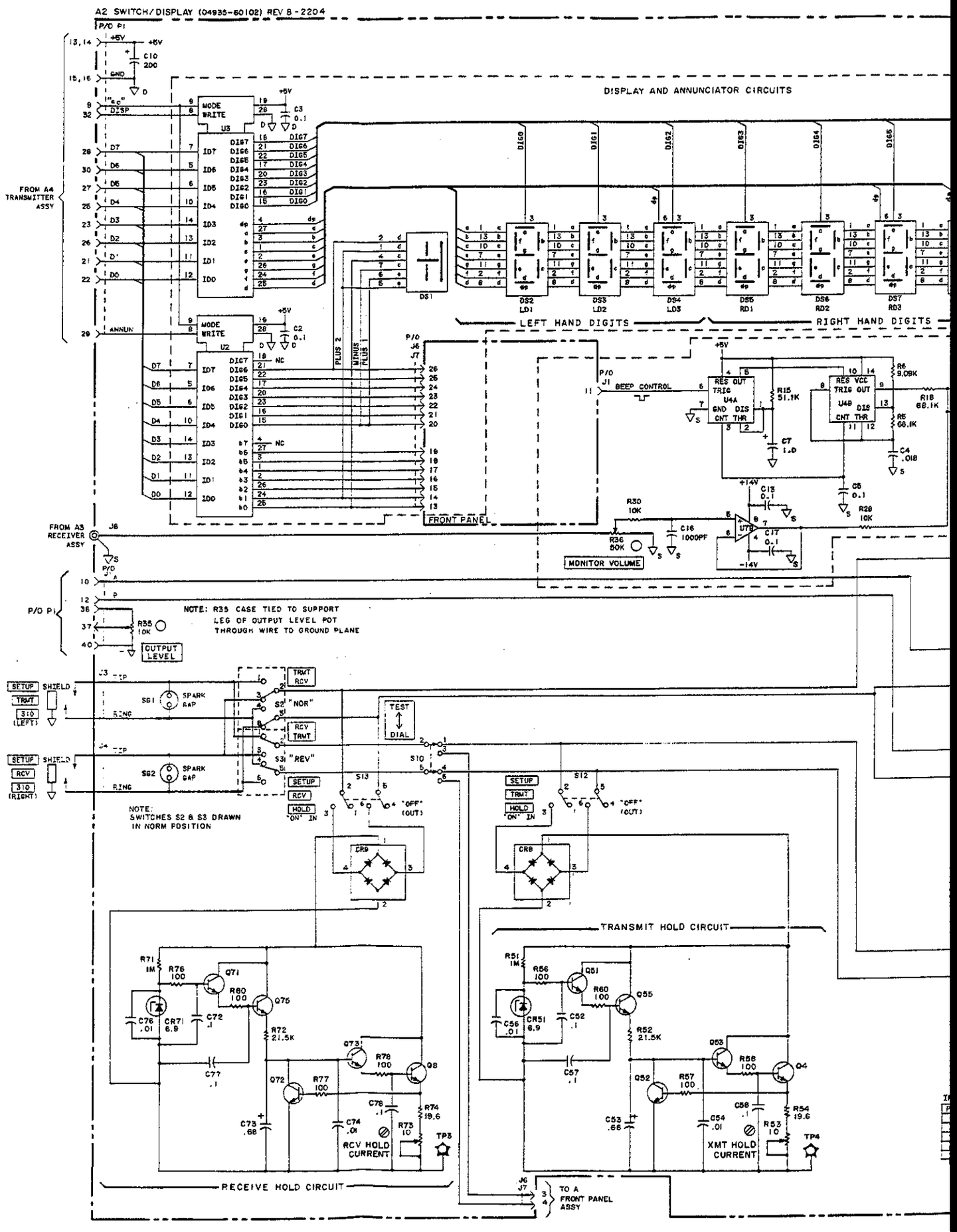


Fig 8-26 Sht 2 of 2

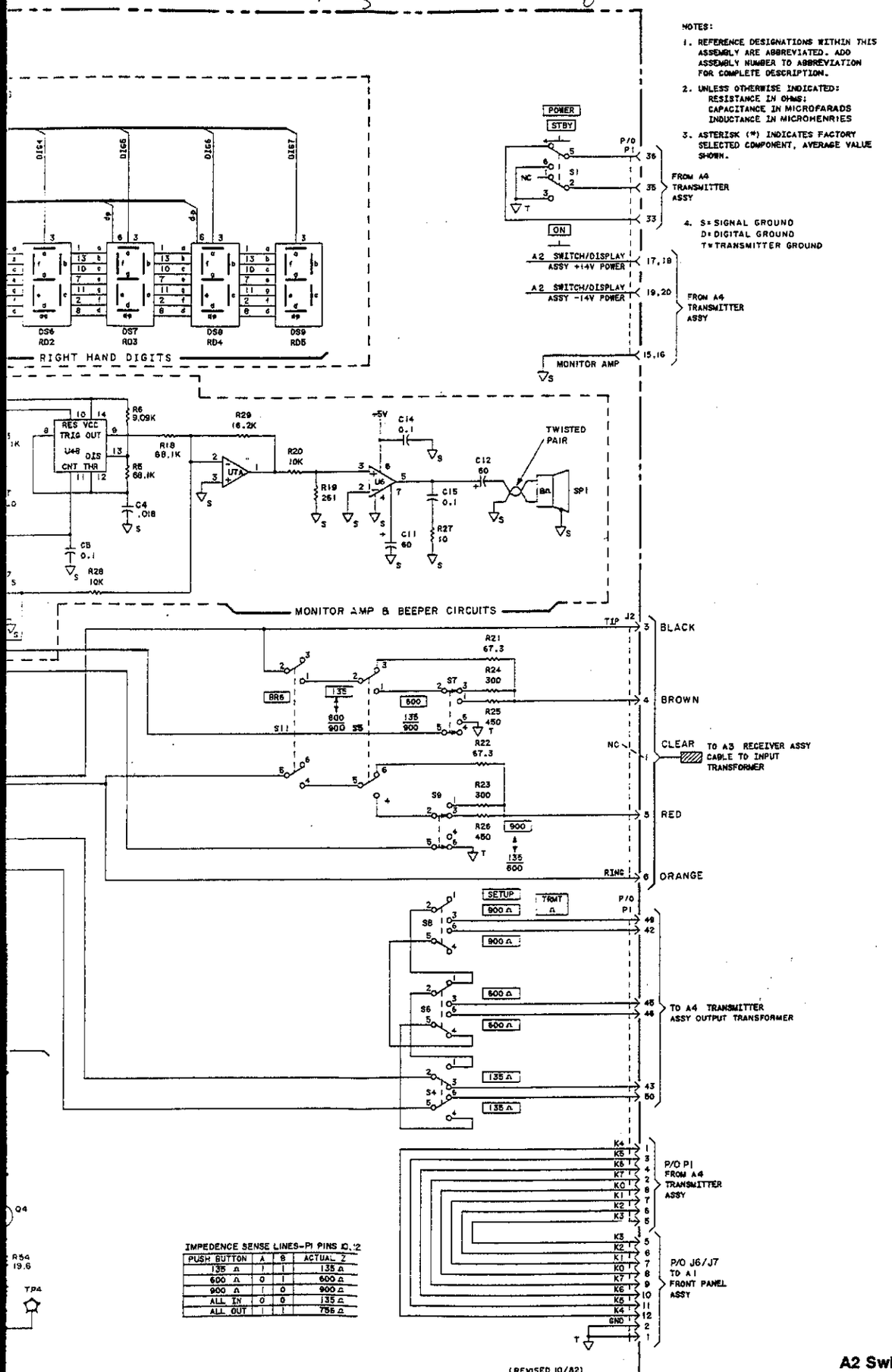


Figure 8-26.
A2 Switchboard Schematic Diagram

Fig 8-27
Sht 1 of 3

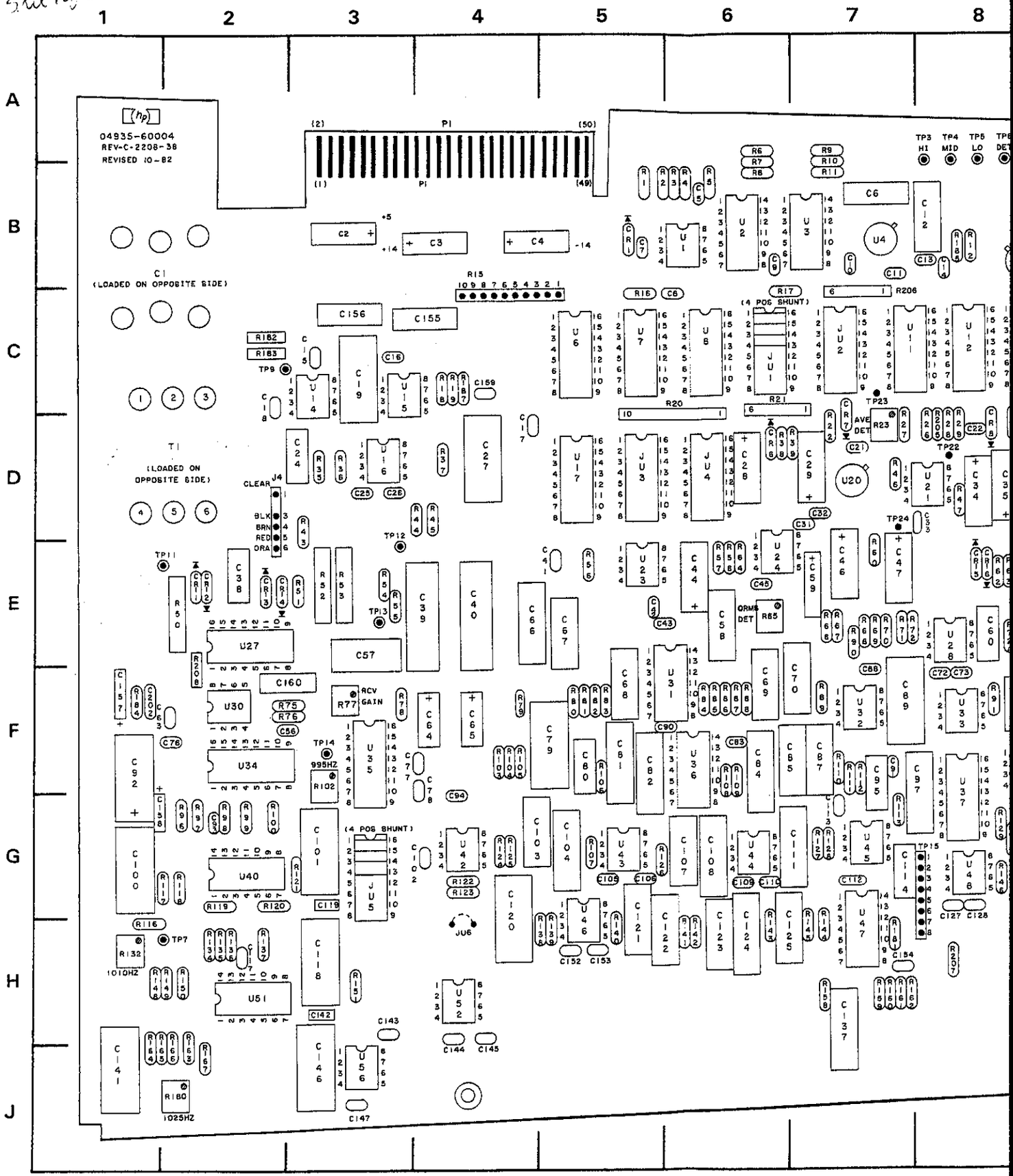
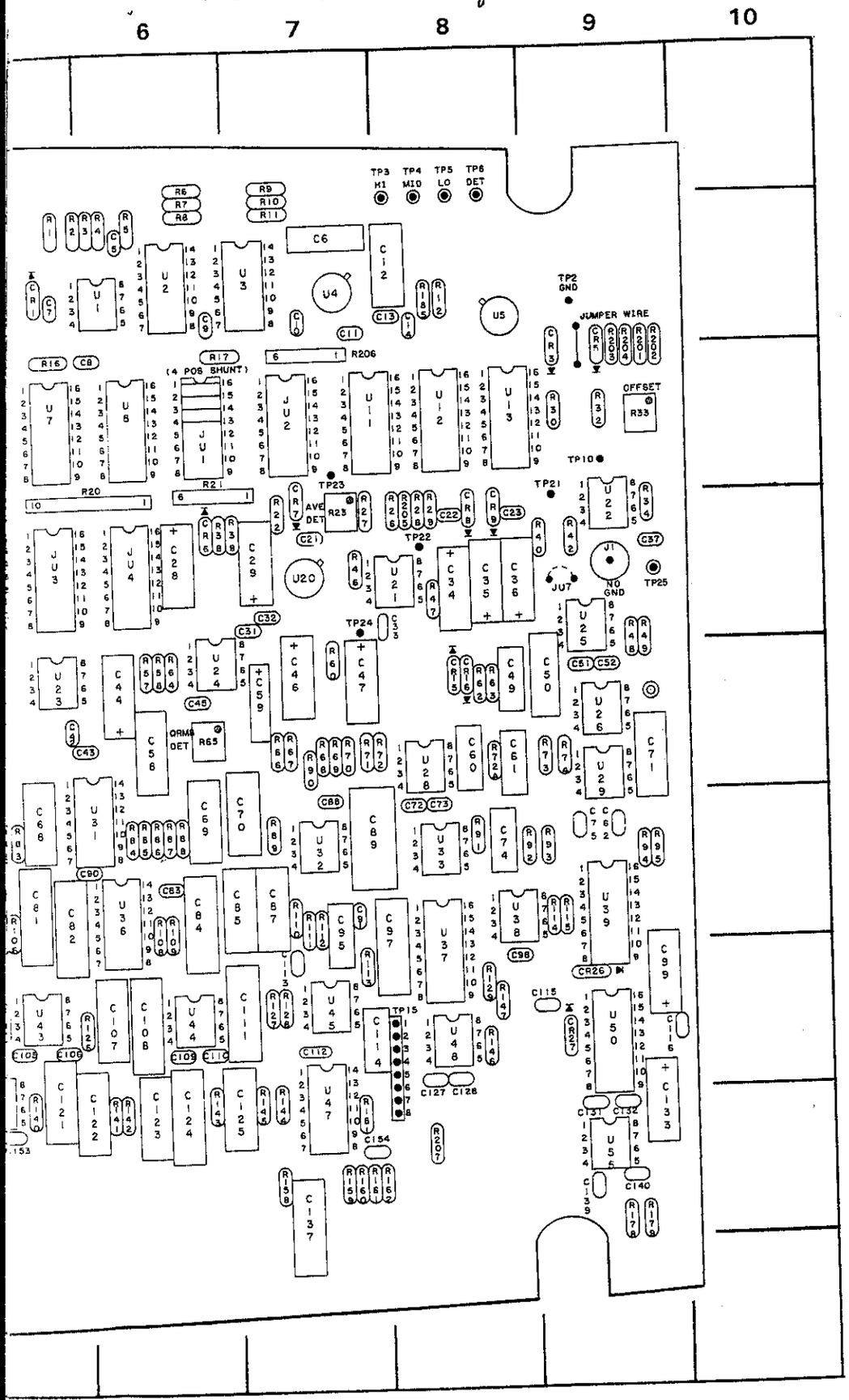


Figure 8-27. A3 Receiver Board Component Locator

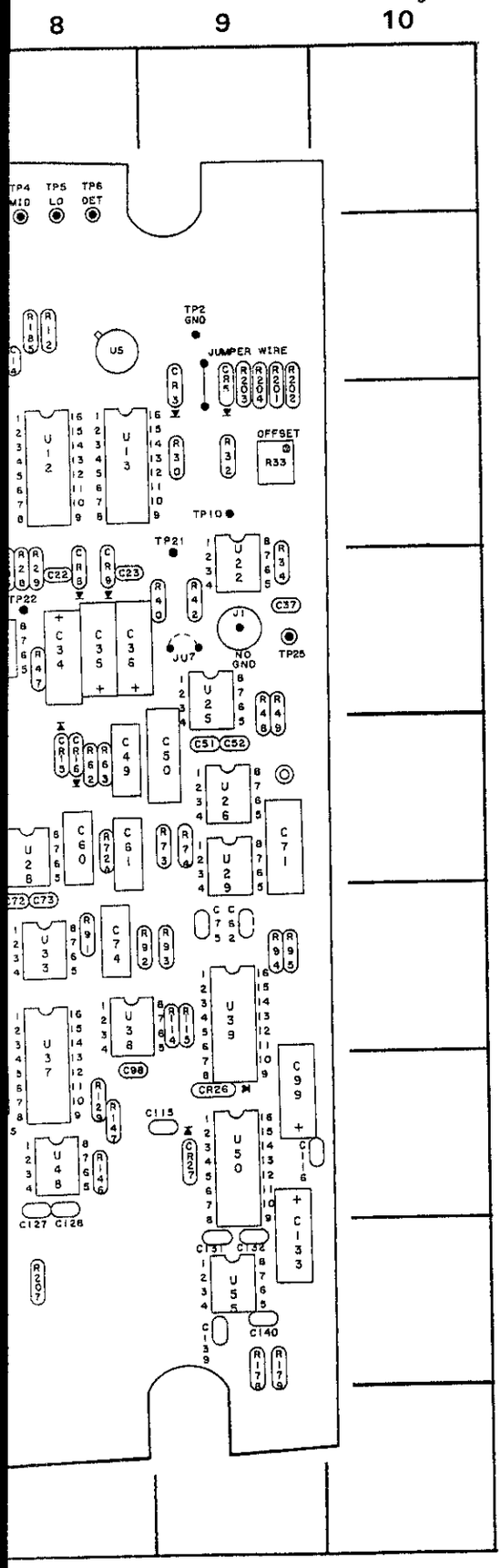
FIG 8-27 Sht 2 of 3



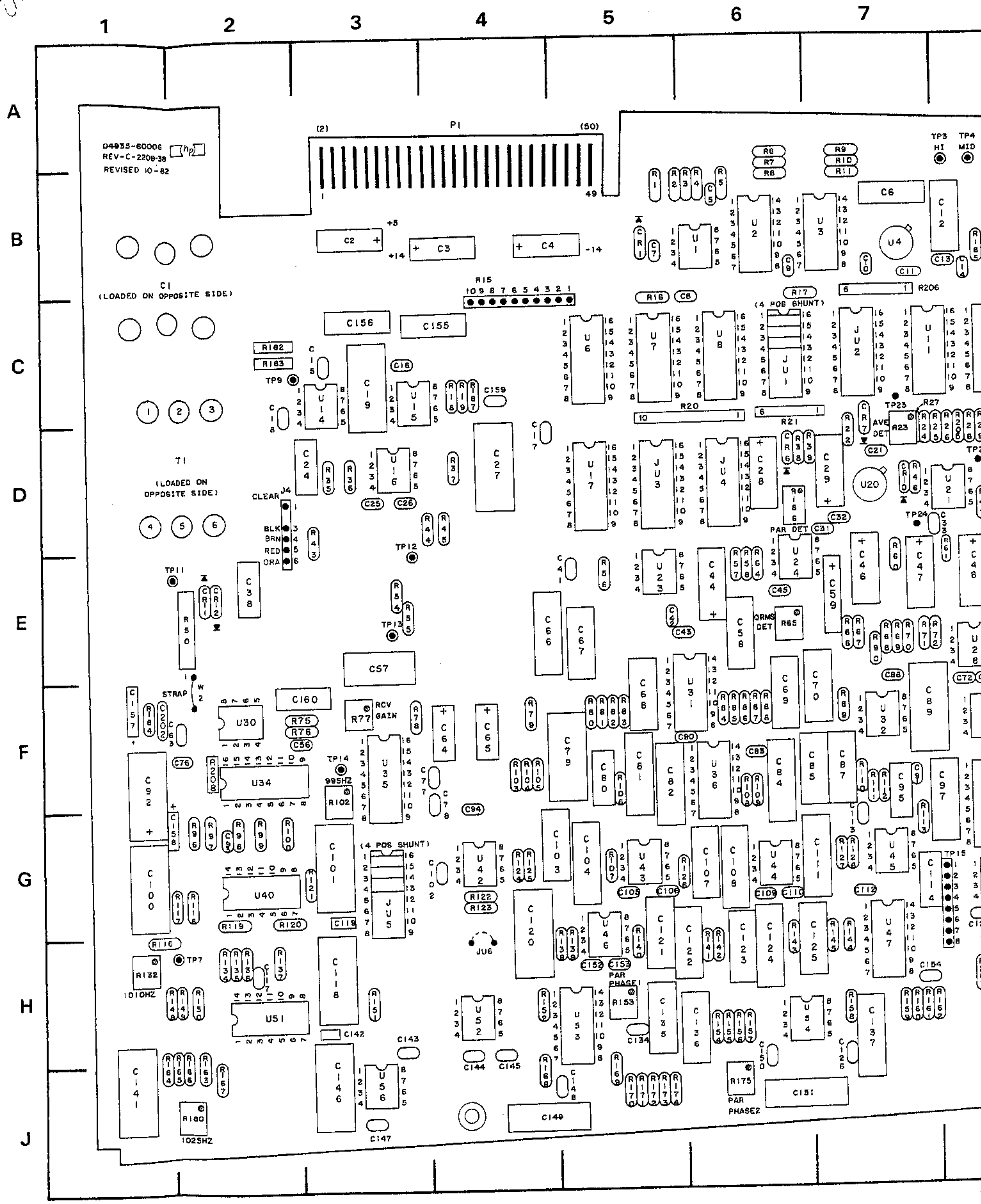
REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	B-1	C89	F-7	JU5	G-3
C2	B-3	C90	F-6	JU6	H-4
C3	B-4	C91	F-7	JU7	D-9
C4	B-4	C92	F-1	R1	B-5
C5	B-6	C93	G-2	R2	B-5
C6	B-7	C94	G-4	R3	B-6
C7	B-5	C95	F-7	R4	B-6
C8	C-6	C97	G-8	R5	B-6
C9	B-6	C99	G-9	R6	A-6
C10	B-7	C100	G-1	R7	B-6
C12	B-8	C101	G-3	R8	B-6
C13	B-8	C102	G-4	R9	A-7
C14	B-8	C103	G-4	R10	B-7
C15	C-3	C104	G-5	R11	B-7
C16	C-3	C105	G-5	R12	B-8
C17	D-4	C106	G-5	R15	B-4
C18	C-2	C107	G-6	R16	C-6
C19	C-3	C108	G-6	R17	C-7
C21	D-7	C109	G-6	R18	C-4
C22	D-8	C110	G-6	R19	C-4
C23	D-8	C111	G-7	R20	C-6
C24	D-3	C112	G-7	R21	C-7
C25	D-3	C113	G-7	R22	D-7
C26	D-3	C114	G-8	R23	D-7
C27	D-4	C115	G-9	R26	D-8
C28	D-6	C116	G-9	R27	D-8
C29	D-7	C117	H-2	R28	D-8
C31	D-7	C118	H-3	R29	D-8
C32	D-7	C119	G-3	R30	C-9
C33	D-8	C120	G-4	R32	C-9
C34	D-8	C122	H-6	R33	C-9
C35	D-8	C123	H-6	R34	D-9
C36	D-8	C124	H-6	R35	D-3
C37	D-9	C125	H-7	R36	D-3
C38	E-2	C127	G-8	R37	D-4
C39	E-4	C128	G-8	R38	D-6
C40	E-4	C131	H-9	R39	D-7
C41	E-5	C132	H-9	R40	D-9
C42	E-5	C133	H-9	R42	D-9
C43	E-5	C137	H-7	R43	D-3
C44	E-5	C139	H-9	R44	D-4
C45	E-5	C140	H-9	R45	D-4
C46	E-7	C141	J-1	R46	D-7
C47	E-7	C142	H-3	R47	D-8
C49	E-8	C143	H-3	R48	D-9
C50	E-9	C144	H-4	R49	D-9
C51	E-9	C145	H-4	R50	E-2
C52	E-9	C146	J-3	R51	E-3
C56	F-2	C147	J-3	R52	E-3
C57	E-3	C152	H-5	R53	E-3
C58	E-6	C153	H-5	R54	E-3
C59	E-7	C154	H-7	R55	E-3
C60	E-8	C155	C-4	R56	E-5
C61	E-9	C156	C-3	R57	E-6
C62	F-9	C157	F-1	R58	E-6
C63	F-2	C158	G-2	R60	E-7
C64	F-4	C159	C-4	R62	E-8
C65	F-4	C160	F-2	R63	E-8
C67	E-5	CR1	B-5	R64	E-6
C68	F-5	CR3	C-9	R65	E-7
C69	F-6	CR5	C-9	R66	E-7
C70	F-7	CR6	D-6	R67	E-7
C71	E-9	CR7	D-7	R68	E-7
C72	F-8	CR8	D-8	R69	E-7
C73	F-8	CR9	D-9	R70	E-7
C74	F-8	CR11	E-2	R71	E-7
C75	F-9	CR12	E-2	R72	E-7
C76	F-2	CR13	E-2	R72A	E-8
C77	F-4	CR14	E-2	R73	E-9
C78	F-4	CR15	E-8	R74	E-9
C79	F-5	CR16	E-8	R75	F-2
C80	F-5	CR26	G-9	R76	F-2
C81	F-5	CR27	G-9	R77	F-3
C82	F-5	J1	D-9	R78	F-3
C83	F-6	J4	D-2	R79	F-4
C84	F-6	JU1	C-6	R80	F-5
C85	F-7	JU2	C-7	R81	F-5
C87	F-7	JU3	D-5	R82	F-5
C88	F-7	JU4	D-6	R83	F-5

Receiver Board Component Locator

FIG. 8-27
Sht 3 of 3

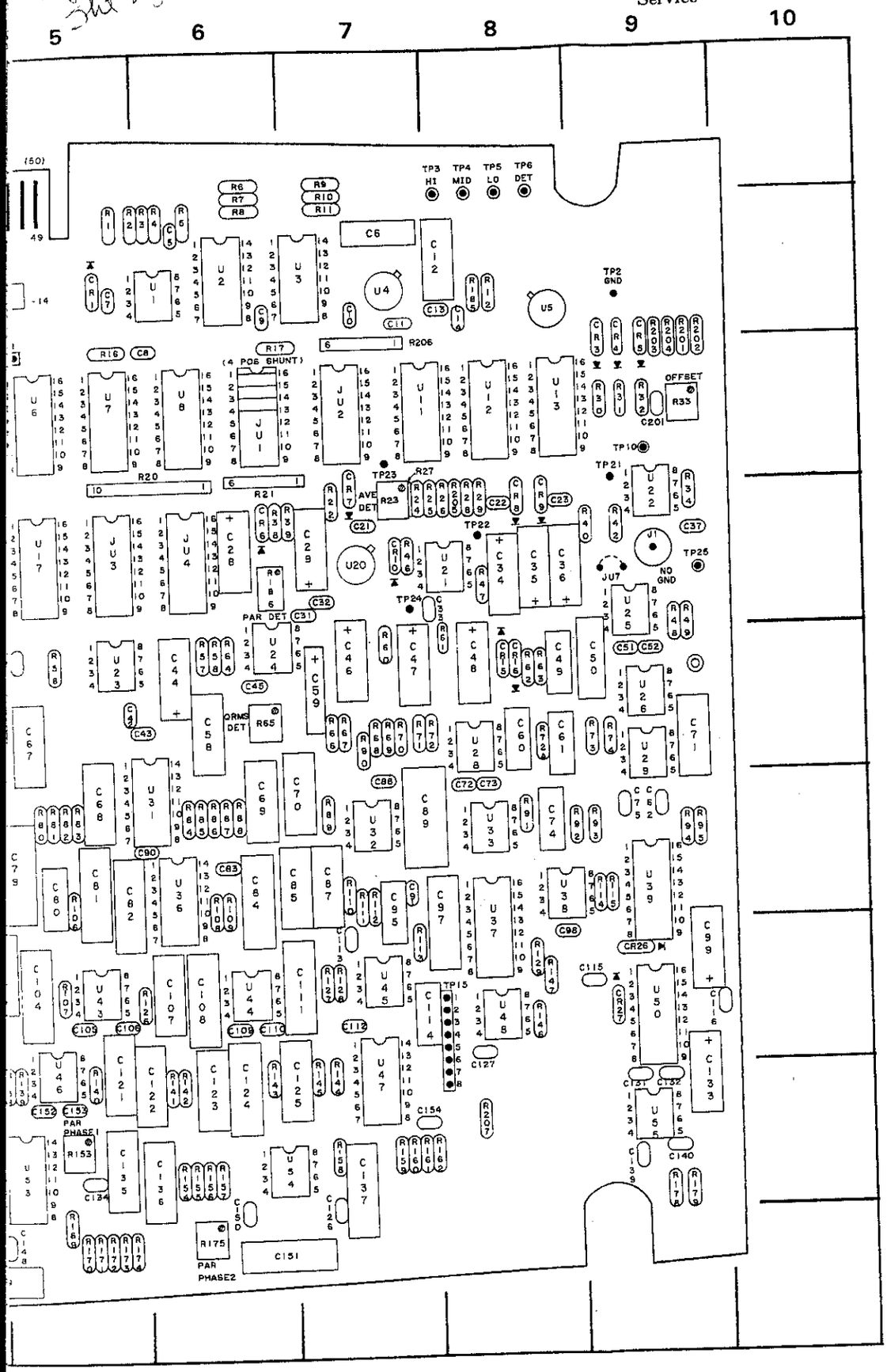


REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	B-1	C89	F-7	JU5	G-3	R84	F-6	R187	C-4
C2	B-3	C90	F-6	JU6	H-4	R85	F-6	R201	C-10
C3	B-4	C91	F-7	JU7	D-9	R86	F-6	R202	C-10
C4	B-4	C92	F-1	R1	B-5	R87	F-6	R203	C-9
C5	B-6	C93	G-2	R2	B-5	R88	F-6	R204	C-9
C6	B-7	C94	G-4	R3	B-6	R89	F-7	R205	D-8
C7	B-5	C95	F-7	R4	B-6	R90	E-7	R206	C-7
C8	C-6	C97	G-8	R5	B-6	R91	F-8	R207	H-8
C9	B-6	C99	G-9	R6	A-6	R92	F-9	T1	D-2
C10	B-7	C100	G-1	R7	B-6	R93	F-9	TP2	B-9
C12	B-8	C101	G-3	R8	B-6	R94	F-9	TP3	A-8
C13	B-8	C102	G-4	R9	A-7	R95	F-9	TP4	A-8
C14	B-8	C103	G-4	R10	B-7	R96	G-2	TP5	A-8
C15	C-3	C104	G-5	R11	B-7	R97	G-2	TP6	A-8
C16	C-3	C105	G-5	R12	B-8	R98	G-2	TP7	H-2
C17	D-4	C106	G-5	R15	B-4	R99	G-2	TP9	C-3
C18	C-2	C107	G-6	R16	C-6	R100	G-2	TP10	C-9
C19	C-3	C108	G-6	R17	C-7	R102	F-3	TP11	E-2
C21	D-7	C109	G-6	R18	C-4	R103	F-4	TP12	E-4
C22	D-8	C110	G-6	R19	C-4	R104	F-4	TP13	E-3
C23	D-8	C111	G-7	R20	C-6	R105	F-4	TP14	F-3
C24	D-3	C112	G-7	R21	C-7	R106	F-5	TP15	G-8
C25	D-3	C113	G-7	R22	D-7	R107	G-5	TP21	C-9
C26	D-3	C114	G-8	R23	D-7	R108	F-6	TP22	D-8
C27	D-4	C115	G-9	R26	D-8	R109	F-6	TP23	C-7
C28	D-6	C116	G-9	R27	D-8	R110	F-7	TP24	D-8
C29	D-7	C117	H-2	R28	D-8	R111	F-7	TP25	D-10
C31	D-7	C118	H-3	R29	D-8	R112	F-7	U1	B-6
C32	D-7	C119	G-3	R30	C-9	R113	G-8	U2	B-6
C33	D-8	C120	G-4	R32	C-9	R114	F-9	U3	B-7
C34	D-8	C122	H-6	R33	C-9	R115	F-9	U4	B-7
C35	D-8	C123	H-6	R34	D-9	R116	H-1	U5	B-9
C36	D-8	C124	H-6	R35	D-3	R117	G-2	U6	C-5
C37	D-9	C125	H-7	R36	D-3	R118	G-2	U7	C-6
C38	E-2	C127	G-8	R37	D-4	R119	G-2	U11	C-8
C39	E-4	C128	G-8	R38	D-6	R120	G-2	U12	C-8
C40	E-4	C131	H-9	R39	D-7	R121	G-3	U13	C-9
C41	E-5	C132	H-9	R40	D-9	R122	G-4	U14	C-3
C42	E-5	C133	H-9	R42	D-9	R123	G-4	U15	C-4
C43	E-5	C137	H-7	R43	D-3	R124	G-4	U16	D-3
C44	E-5	C139	H-9	R44	D-4	R125	G-4	U17	D-5
C45	E-5	C140	H-9	R45	D-4	R126	G-5	U20	D-7
C46	E-7	C141	J-1	R46	D-7	R127	G-7	U21	D-8
C47	E-7	C142	H-3	R47	D-8	R128	G-7	U22	D-9
C49	E-8	C143	H-3	R48	D-9	R129	G-8	U23	E-6
C50	E-9	C144	H-4	R49	D-9	R132	H-1	U24	E-7
C51	E-9	C145	H-4	R50	E-2	R134	H-2	U25	D-9
C52	E-9	C146	J-3	R51	E-3	R135	H-2	U26	E-9
C56	F-2	C147	J-3	R52	E-3	R136	H-2	U27	E-2
C57	E-3	C152	H-5	R53	E-3	R140	H-5	U28	E-8
C58	E-6	C153	H-5	R54	E-3	R141	H-6	U29	E-9
C59	E-7	C154	H-7	R55	E-3	R142	H-6	U30	F-2
C60	E-8	C155	C-4	R56	E-5	R143	H-7	U31	F-6
C61	E-9	C156	C-3	R57	E-6	R144	H-7	U32	F-7
C62	F-9	C157	F-1	R58	E-6	R145	H-7	U33	F-8
C63	F-2	C158	G-2	R60	E-7	R146	G-8	U34	F-2
C64	F-4	C159	C-4	R62	E-8	R147	G-8	U35	F-3
C65	F-4	C160	F-2	R63	E-8	R148	H-1	U36	F-6
C67	E-5	CR1	B-5	R64	E-6	R149	H-2	U37	G-8
C68	F-5	CR3	C-9	R65	E-7	R150	H-2	U38	F-9
C69	F-6	CR5	C-9	R66	E-7	R151	H-3	U39	F-9
C70	F-7	CR6	D-6	R67	E-7	R158	H-7	U40	G-2
C71	E-9	CR7	D-7	R68	E-7	R159	H-7	U42	G-4
C72	F-8	CR8	D-8	R69	E-7	R160	H-7	U43	G-5
C73	F-8	CR9	D-9	R70	E-7	R161	H-8	U44	G-6
C74	F-8	CR11	E-2	R71	E-7	R162	H-7	U45	G-7
C75	F-9	CR12	E-2	R72	E-7	R163	J-2	U46	H-5
C76	F-2	CR13	E-2	R72A	E-8	R164	J-2	U47	H-7
C77	F-4	CR14	E-2	R73	E-9	R165	J-2	U48	G-8
C78	F-4	CR15	E-8	R74	E-9	R166	J-2	U50	G-9
C79	F-5	CR16	E-8	R75	F-2	R167	J-2	U51	H-1
C80	F-5	CR26	G-9	R76	F-2	R178	J-9	U52	H-4
C81	F-5	CR27	G-9	R77	F-3	R179	J-9	U55	H-8
C82	F-5	J1	D-9	R78	F-3	R180	J-2	U56	J-3
C83	F-6	J4	D-2	R79	F-4	R181	H-8		
C84	F-6	JU1	C-6	R80	F-5	R182	C-2		
C85	F-7	JU2	C-7	R81	F-5	R183	C-2		
C87	F-7	JU3	D-5	R82	F-5	R184	F-1		
C88	F-7	JU4	D-6	R83	F-5	R185	B-8		



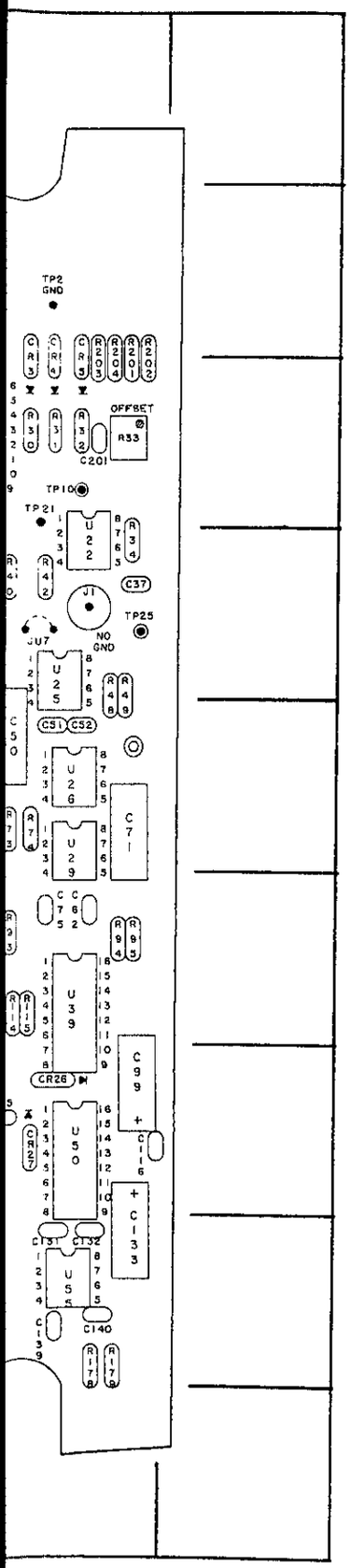
04935-60006
REV-C-2208-38
REVISED 10-82
P1
C1
(LOADED ON OPPOSITE SIDE)
T1
(LOADED ON OPPOSITE SIDE)
CLEAR
STRAP
RCV GAIN
995HZ
1010HZ
1025HZ
PAR DET
QRMS DET
AVE DET
PAR PHASE1
PAR PHASE2
(4 POS SHUNT)

Fig 8-28 Sht 2 of 3



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG
C1	B-2	C88	F-7	CR10
C2	B-3	C89	F-7	CR11
C3	B-4	C90	F-6	CR12
C4	B-5	C91	F-8	CR15
C5	B-6	C92	F-1	CR16
C6	B-7	C93	G-2	CR26
C7	B-5	C94	G-4	CR27
C8	C-6	C95	F-7	J1
C9	B-6	C97	G-8	J4
C10	B-7	C98	G-8	JU1
C11	B-7	C99	G-9	JU2
C12	B-8	C100	G-1	JU3
C13	B-8	C101	G-3	JU4
C14	C-8	C102	G-4	JU5
C15	C-3	C103	G-4	JU6
C16	C-3	C104	G-5	JU7
C17	D-4	C105	G-5	R1
C18	C-2	C106	G-5	R2
C19	C-3	C107	G-6	R3
C21	D-7	C108	G-6	R4
C22	D-8	C109	G-6	R5
C23	D-8	C110	G-6	R6
C24	D-3	C111	G-7	R7
C25	D-3	C112	G-7	R8
C26	D-3	C113	G-7	R9
C27	D-4	C114	G-7	R10
C28	D-6	C115	G-9	R11
C29	D-7	C116	G-9	R12
C31	D-7	C117	H-2	R15
C32	D-7	C118	H-3	R16
C33	D-8	C119	G-3	R17
C34	D-8	C120	H-4	R18
C35	D-8	C121	H-5	R19
C36	D-8	C122	H-6	R20
C37	D-9	C123	H-6	R21
C38	E-2	C124	H-6	R22
C41	E-5	C125	H-7	R23
C42	E-5	C126	H-7	R24
C43	E-6	C127	H-8	R25
C44	E-5	C128	H-8	R26
C45	E-6	C131	H-9	R27
C46	E-7	C132	H-9	R28
C47	E-7	C133	H-9	R29
C48	E-8	C134	H-5	R30
C49	E-8	C135	H-5	R31
C50	E-9	C136	H-6	R32
C51	E-9	C137	H-7	R33
C52	E-9	C139	H-9	R34
C56	F-3	C140	H-9	R35
C57	E-3	C141	J-1	R36
C58	E-6	C142	H-3	R37
C59	E-7	C143	H-3	R38
C60	E-8	C144	H-4	R39
C61	E-8	C145	H-4	R40
C62	F-9	C146	J-3	R42
C63	F-2	C147	J-3	R43
C64	F-4	C148	J-5	R44
C65	F-4	C149	J-5	R45
C66	E-4	C150	J-6	R46
C67	E-5	C151	J-7	R47
C68	F-5	C152	H-5	R48
C69	F-6	C153	H-5	R49
C70	F-7	C154	H-7	R50
C71	E-9	C155	C-4	R54
C72	F-8	C156	C-3	R55
C73	F-8	C157	F-1	R56
C74	F-8	C158	G-2	R57
C75	F-9	C159	C-4	R58
C76	F-2	C160	F-3	R60
C77	F-4	C201	C-9	R61
C78	F-4	C202	F-1	R62
C79	F-5	CR1	B-5	R63
C80	F-5	CR3	C-9	R64
C81	F-5	CR4	C-9	R65
C82	F-5	CR5	C-9	R66
C83	F-6	CR6	D-6	R67
C84	F-6	CR7	D-7	R68
C85	F-6	CR8	D-8	R69
C87	F-7	CR9	D-8	R70

Figure 8-28. A13 Receiver Board C



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	B-2	C88	F-7	CR10	D-7	R71	E-7	R152	H-4	U23	E-5
C2	B-3	C89	F-7	CR11	E-2	R72	E-7	R153	H-5	U24	E-6
C3	B-4	C90	F-6	CR12	E-2	R72A	E-8	R154	H-6	U25	D-9
C4	B-5	C91	F-8	CR15	E-8	R73	E-9	R155	H-6	U26	E-9
C5	B-6	C92	F-1	CR16	E-8	R74	E-9	R156	H-6	U28	E-8
C6	B-7	C93	G-2	CR26	G-9	R75	F-3	R157	H-6	U29	E-9
C7	B-5	C94	G-4	CR27	G-9	R76	F-3	R158	H-7	U30	F-2
C8	C-6	C95	F-7	J1	D-9	R77	F-3	R159	H-7	U31	F-6
C9	B-6	C97	G-8	J4	D-3	R78	F-3	R160	H-7	U32	F-7
C10	B-7	C98	G-8	JU1	C-6	R79	F-4	R161	H-7	U33	F-8
C11	B-7	C99	G-9	JU2	C-7	R80	F-5	R162	H-7	U34	F-2
C12	B-8	C100	G-1	JU3	D-5	R81	F-5	R163	J-2	U35	F-3
C13	B-8	C101	G-3	JU4	D-6	R82	F-5	R164	J-1	U36	F-6
C14	C-8	C102	G-4	JU5	G-3	R83	F-5	R165	J-2	U37	G-8
C15	C-3	C103	G-4	JU6	H-4	R84	F-6	R166	J-2	U38	F-8
C16	C-3	C104	G-5	JU7	D-9	R85	F-6	R167	J-2	U39	F-9
C17	D-4	C105	G-5	R1	B-5	R86	F-6	R168	J-4	U40	G-2
C18	C-2	C106	G-5	R2	B-6	R87	F-6	R169	J-5	U42	G-4
C19	C-3	C107	G-6	R3	B-6	R88	F-6	R170	J-5	U43	G-5
C21	D-7	C108	G-6	R4	B-6	R89	F-7	R171	J-5	U44	G-6
C22	D-8	C109	G-6	R5	B-6	R90	E-7	R172	J-5	U45	G-7
C23	D-8	C110	G-6	R6	A-6	R91	F-8	R173	J-5	U46	H-5
C24	D-3	C111	G-7	R7	B-6	R92	F-9	R174	J-5	U47	H-7
C25	D-3	C112	G-7	R8	B-6	R93	F-8	R175	J-6	U48	G-8
C26	D-3	C113	G-7	R9	A-7	R94	F-9	R178	H-9	U50	G-9
C27	D-4	C114	G-7	R10	A-7	R95	F-9	R179	H-9	U51	H-2
C28	D-6	C115	G-9	R11	B-7	R96	G-2	R180	J-2	U52	H-4
C29	D-7	C116	G-9	R12	B-8	R97	G-2	R181	H-8	U53	H-5
C31	D-7	C117	H-2	R15	B-4	R98	G-2	R182	C-2	U54	H-7
C32	D-7	C118	H-3	R16	C-5	R99	G-2	R183	C-2	U55	H-9
C33	D-8	C119	G-3	R17	C-7	R100	G-2	R184	F-1	U56	J-3
C34	D-8	C120	H-4	R18	C-4	R102	F-3	R185	B-8		
C35	D-8	C121	H-5	R19	C-4	R103	F-4	R186	D-7		
C36	D-8	C122	H-6	R20	C-6	R104	F-4	R187	C-4		
C37	D-9	C123	H-6	R21	C-7	R105	F-4	R201	C-9		
C38	E-2	C124	H-6	R22	D-7	R106	F-5	R202	C-9		
C41	E-5	C125	H-7	R23	D-7	R107	G-5	R203	C-9		
C42	E-5	C126	H-7	R24	D-7	R108	F-6	R204	C-9		
C43	E-6	C127	H-8	R25	D-7	R109	F-6	R205	D-8		
C44	E-5	C128	H-8	R26	D-8	R110	F-7	R206	C-7		
C45	E-6	C131	H-9	R27	D-7	R111	F-7	R207	H-8		
C46	E-7	C132	H-9	R28	D-8	R112	F-7	R208	F-2		
C47	E-7	C133	H-9	R29	D-8	R113	G-7	T1	D-2		
C48	E-8	C134	H-5	R30	C-9	R114	F-8	TP2	B-9		
C49	E-8	C135	H-5	R31	C-9	R115	F-9	TP3	B-8		
C50	E-9	C136	H-6	R32	C-9	R116	H-1	TP4	B-8		
C51	E-9	C137	H-7	R33	C-9	R117	G-2	TP5	B-8		
C52	E-9	C139	H-9	R34	D-9	R118	G-2	TP6	B-8		
C56	F-3	C140	H-9	R35	D-3	R119	G-2	TP7	H-2		
C57	E-3	C141	J-1	R36	D-3	R120	G-2	TP9	C-3		
C58	E-6	C142	H-3	R37	D-4	R121	G-3	TP10	C-9		
C59	E-7	C143	H-3	R38	D-6	R122	G-4	TP11	E-2		
C60	E-8	C144	H-4	R39	D-7	R123	G-4	TP12	E-3		
C61	E-8	C145	H-4	R40	D-9	R124	G-4	TP13	E-3		
C62	F-9	C146	J-3	R42	D-9	R125	G-4	TP14	F-3		
C63	F-2	C147	J-3	R43	D-3	R126	G-5	TP15	G-8		
C64	F-4	C148	J-5	R44	D-4	R127	G-7	TP21	C-9		
C65	F-4	C149	J-5	R45	D-4	R128	G-7	TP22	D-8		
C66	E-4	C150	J-6	R46	D-7	R129	G-8	TP23	C-7		
C67	E-5	C151	J-7	R47	D-8	R132	H-1	TP24	D-8		
C68	F-5	C152	H-5	R48	D-9	R133	H-9	TP25	D-9		
C69	F-6	C153	H-5	R49	D-9	R134	H-2	U1	B-6		
C70	F-7	C154	H-7	R50	E-2	R135	H-2	U2	B-6		
C71	E-9	C155	C-4	R54	E-3	R136	H-2	U3	B-7		
C72	F-8	C156	C-3	R55	E-3	R137	H-2	U4	B-7		
C73	F-8	C157	F-1	R56	E-5	R138	H-5	U5	B-8		
C74	F-8	C158	G-2	R57	E-6	R139	H-5	U6	C-5		
C75	F-9	C159	C-4	R58	E-6	R140	H-6	U7	C-5		
C76	F-2	C160	F-3	R60	E-7	R141	H-6	U8	C-6		
C77	F-4	C201	C-9	R61	E-8	R142	H-6	U11	C-8		
C78	F-4	C202	F-1	R62	E-8	R143	H-6	U12	C-8		
C79	F-5	CR1	B-5	R63	E-8	R144	H-7	U13	C-9		
C80	F-5	CR3	C-9	R64	E-6	R145	H-7	U14	C-3		
C81	F-5	CR4	C-9	R65	E-6	R146	G-8	U15	C-3		
C82	F-5	CR5	C-9	R66	E-7	R147	G-8	U16	D-3		
C83	F-6	CR6	D-6	R67	E-7	R148	H-1	U17	D-5		
C84	F-6	CR7	D-7	R68	E-7	R149	H-2	U20	D-7		
C85	F-6	CR8	D-8	R69	E-7	R150	H-2	U21	D-8		
C87	F-7	CR9	D-8	R70	E-7	R151	H-3	U22	D-9		

Figure 8-28. A13 Receiver Board Component Locator

Fig 8-29 Sht 1 of 3

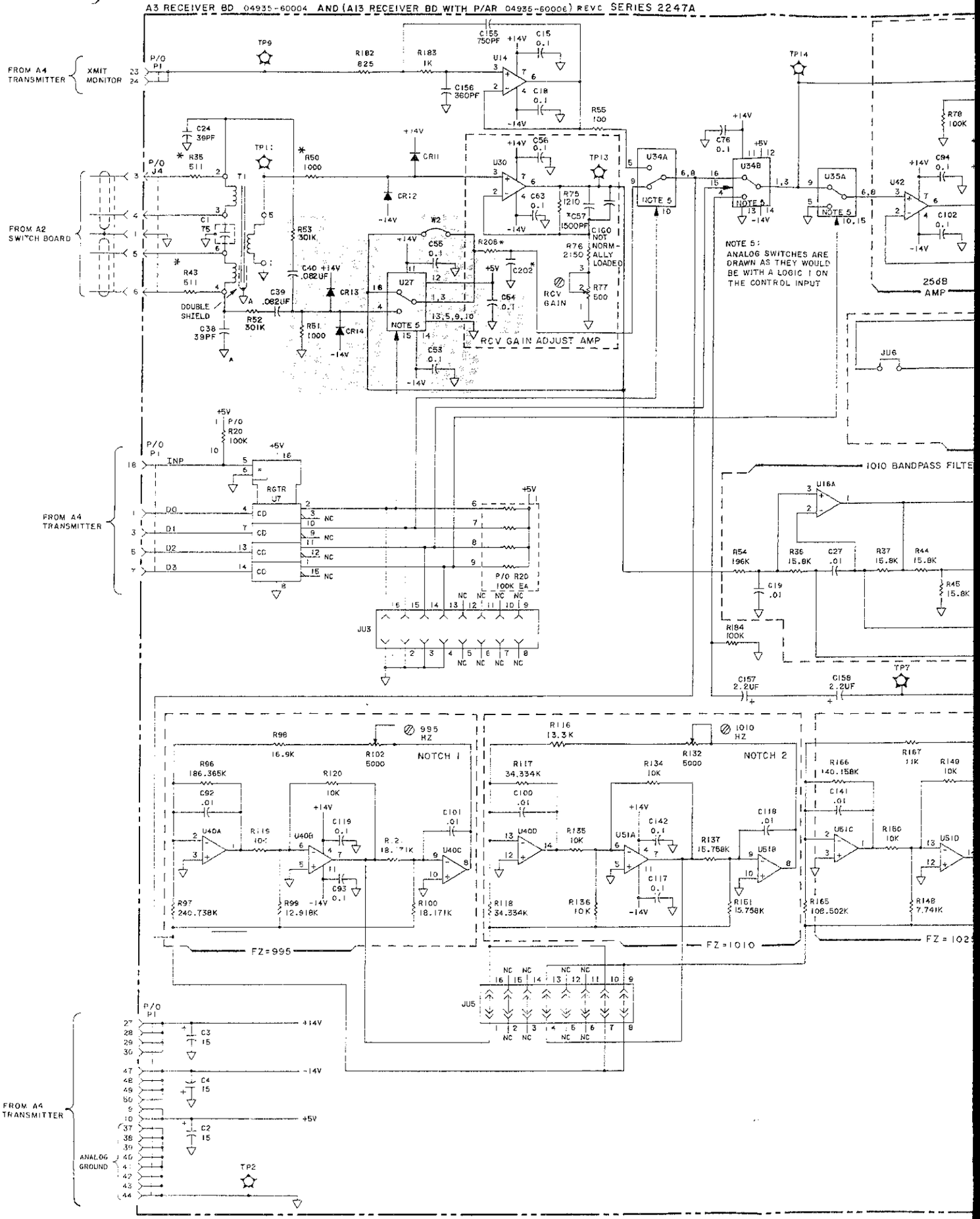


Fig 8-29 Sht 2 of 3

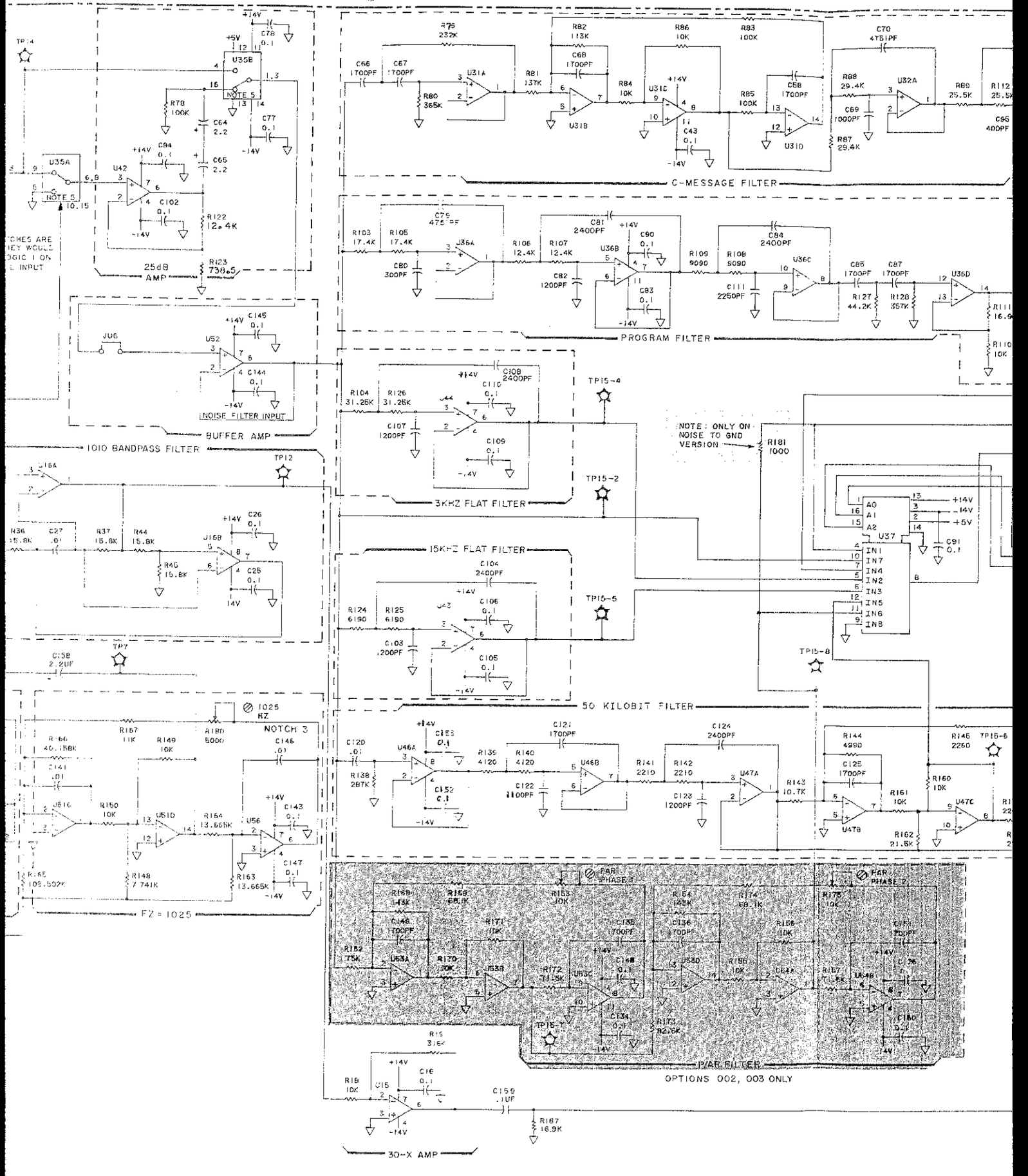
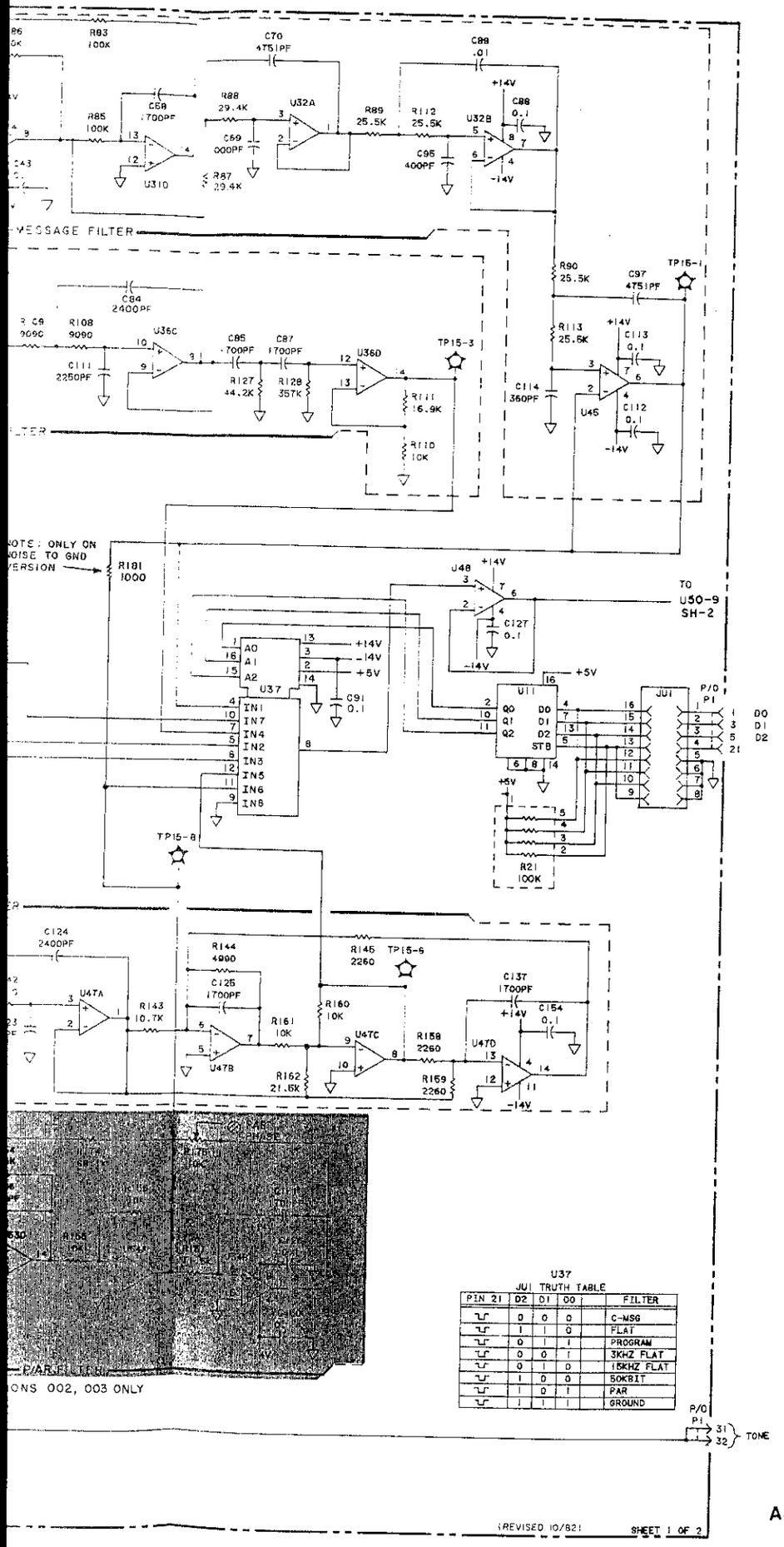


Fig 8-29
Sht 3 of 3

CIRCUIT APPLIES TO STANDARD UNITS ONLY

CIRCUIT APPLIES TO P/AR UNITS ONLY



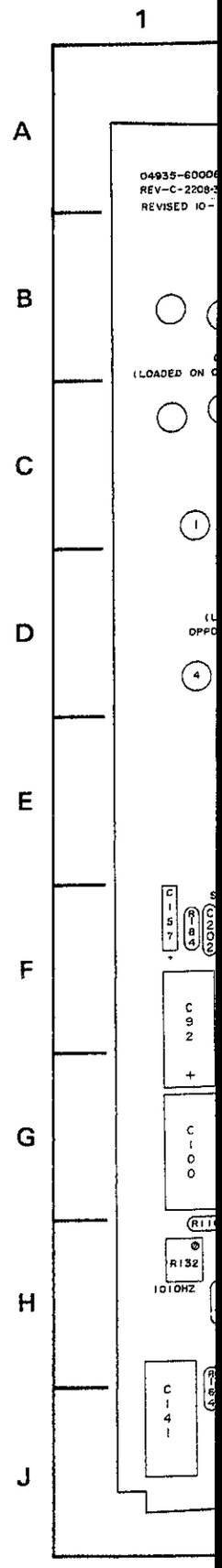
U37
J01 TRUTH TABLE

PIN 21	D2	D1	D0	FILTER
⊓	0	0	0	C-MSG
⊓	1	1	0	FLAT
⊓	0	1	1	PROGRAM
⊓	0	0	1	3KHZ FLAT
⊓	0	1	0	15KHZ FLAT
⊓	1	0	0	50KBIT
⊓	1	0	1	PAR
⊓	1	1	1	GROUND

Figure 8-29.
A3 Receiver Board Schematic Diagram (Sheet 1 of 2)

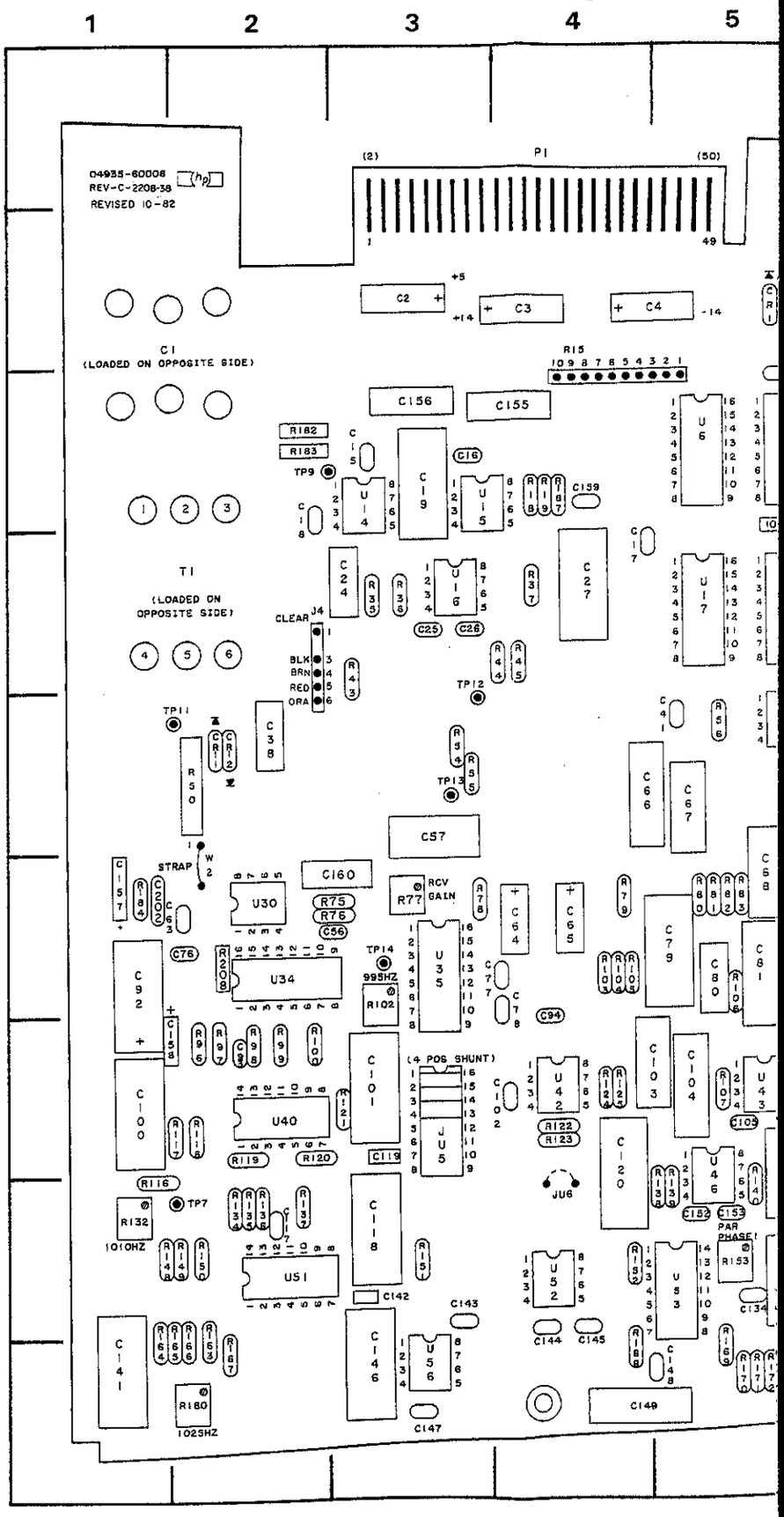
A13 Sht 1 of 3

REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	B-2	C87	F-7	CR8	D-8	R68	E-7	R148	H-1	U16	D-3
C2	B-3	C88	F-7	CR9	D-8	R69	E-7	R149	H-2	U17	D-5
C3	B-4	C89	F-7	CR10	D-7	R70	E-7	R150	H-2	U20	D-7
C4	B-5	C90	F-6	CR11	E-2	R71	E-7	R151	H-3	U21	D-8
C5	B-6	C91	F-8	CR12	E-2	R72	E-7	R152	H-4	U22	D-9
C6	B-7	C92	F-1	CR15	E-8	R72A	E-8	R153	H-5	U23	E-5
C7	B-5	C93	G-2	CR16	E-8	R73	E-9	R154	H-6	U24	E-6
C8	C-6	C94	G-4	CR26	G-9	R74	E-9	R155	H-6	U25	D-9
C9	B-6	C95	F-7	CR27	G-9	R75	F-3	R156	H-6	U26	E-9
C10	B-7	C97	G-8	J1	D-9	R76	F-3	R157	H-6	U28	E-8
C11	B-7	C98	G-8	J4	D-3	R77	F-3	R158	H-7	U29	E-9
C12	B-8	C99	G-9	JU1	C-6	R78	F-3	R159	H-7	U30	F-2
C13	B-8	C100	G-1	JU2	C-7	R79	F-4	R160	H-7	U31	F-6
C14	C-8	C101	G-3	JU3	D-5	R80	F-5	R161	H-7	U32	F-7
C15	C-3	C102	G-4	JU4	D-6	R81	F-5	R162	H-7	U33	F-8
C16	C-3	C103	G-4	JU5	G-3	R82	F-5	R163	J-2	U34	F-2
C17	D-4	C104	G-5	JU6	H-4	R83	F-5	R164	J-1	U35	F-3
C18	C-2	C105	G-5	JU7	D-9	R84	F-6	R165	J-2	U36	F-6
C19	C-3	C106	G-5	R1	B-5	R85	F-6	R166	J-2	U37	G-8
C21	D-7	C107	G-6	R2	B-6	R86	F-6	R167	J-2	U38	F-8
C22	D-8	C108	G-6	R3	B-6	R87	F-6	R168	J-4	U39	F-9
C23	D-8	C109	G-6	R4	B-6	R88	F-6	R169	J-5	U40	G-2
C24	D-3	C110	G-6	R5	B-6	R89	F-7	R170	J-5	U42	G-4
C25	D-3	C111	G-7	R6	A-6	R90	E-7	R171	J-5	U43	G-5
C26	D-3	C112	G-7	R7	B-6	R91	F-8	R172	J-5	U44	G-6
C27	D-4	C113	G-7	R8	B-6	R92	F-9	R173	J-5	U45	G-7
C28	D-6	C114	G-7	R9	A-7	R93	F-8	R174	J-5	U46	H-5
C29	D-7	C115	G-9	R10	A-7	R94	F-9	R175	J-6	U47	H-7
C31	D-7	C116	G-9	R11	B-7	R95	F-9	R178	H-9	U48	G-8
C32	D-7	C117	H-2	R12	B-8	R96	G-2	R179	H-9	U50	G-9
C33	D-8	C118	H-3	R15	B-4	R97	G-2	R180	J-2	U51	H-2
C34	D-8	C119	G-3	R16	C-5	R98	G-2	R181	H-8	U52	H-4
C35	D-8	C120	H-4	R17	C-7	R99	G-2	R182	C-2	U53	H-5
C36	D-8	C121	H-5	R18	C-4	R100	G-2	R183	C-2	U54	H-7
C37	D-9	C122	H-6	R19	C-4	R102	F-3	R184	F-1	U55	H-9
C38	E-2	C123	H-6	R20	C-6	R103	F-4	R185	B-8	U56	J-3
C41	E-5	C124	H-6	R21	C-7	R104	F-4	R186	D-7		
C42	E-5	C125	H-7	R22	D-7	R105	F-4	R187	C-4		
C43	E-6	C126	H-7	R23	D-7	R106	F-5	R201	C-9		
C44	E-5	C127	H-8	R24	D-7	R107	G-5	R202	C-9		
C45	E-6	C128	H-8	R25	D-7	R108	F-6	R203	C-9		
C46	E-7	C131	H-9	R26	D-8	R109	F-6	R204	C-9		
C47	E-7	C132	H-9	R27	D-7	R110	F-7	R205	D-8		
C48	E-8	C133	H-9	R28	D-8	R111	F-7	R206	C-7		
C49	E-8	C134	H-5	R29	D-8	R112	F-7	R207	H-8		
C50	E-9	C135	H-5	R30	C-9	R113	G-7	R208	F-2		
C51	E-9	C136	H-6	R31	C-9	R114	F-8	T1	D-2		
C52	E-9	C137	H-7	R32	C-9	R115	F-9	TP2	B-9		
C56	F-3	C139	H-9	R33	C-9	R116	H-1	TP3	B-8		
C57	E-3	C140	H-9	R34	D-9	R117	G-2	TP4	B-8		
C58	E-6	C141	J-1	R35	D-3	R118	G-2	TP5	B-8		
C59	E-7	C142	H-3	R36	D-3	R119	G-2	TP6	B-8		
C60	E-8	C143	H-3	R37	D-4	R120	G-2	TP7	H-2		
C61	E-8	C144	H-4	R38	D-6	R121	G-3	TP9	C-3		
C62	F-9	C145	H-4	R39	D-7	R122	G-4	TP10	C-9		
C63	F-2	C146	J-3	R40	D-9	R123	G-4	TP11	E-2		
C64	F-4	C147	J-3	R42	D-9	R124	G-4	TP12	E-3		
C65	F-4	C148	J-5	R43	D-3	R125	G-4	TP13	E-3		
C66	E-4	C149	J-5	R44	D-4	R126	G-5	TP14	F-3		
C67	E-5	C150	J-6	R45	D-4	R127	G-7	TP15	G-8		
C68	F-5	C151	J-7	R46	D-7	R128	G-7	TP21	C-9		
C69	F-6	C152	H-5	R47	D-8	R129	G-8	TP22	D-8		
C70	F-7	C153	H-5	R48	D-9	R132	H-1	TP23	C-7		
C71	E-9	C154	H-7	R49	D-9	R133	H-9	TP24	D-8		
C72	F-8	C155	C-4	R50	E-2	R134	H-2	TP25	D-9		
C73	F-8	C156	C-3	R54	E-3	R135	H-2	U1	B-6		
C74	F-8	C157	F-1	R55	E-3	R136	H-2	U2	B-6		
C75	F-9	C158	G-2	R56	E-5	R137	H-2	U3	B-7		
C76	F-2	C159	C-4	R57	E-6	R138	H-5	U4	B-7		
C77	F-4	C160	F-3	R58	E-6	R139	H-5	U5	B-8		
C78	F-4	C201	C-9	R60	E-7	R140	H-6	U6	C-5		
C79	F-5	C202	F-1	R61	E-8	R141	H-6	U7	C-5		
C80	F-5	CR1	B-5	R62	E-8	R142	H-6	U8	C-6		
C81	F-5	CR3	C-9	R63	E-8	R143	H-6	U11	C-8		
C82	F-5	CR4	C-9	R64	E-6	R144	H-7	U12	C-8		
C83	F-6	CR5	C-9	R65	E-6	R145	H-7	U13	C-9		
C84	F-6	CR6	D-6	R66	E-7	R146	G-8	U14	C-3		
C85	F-6	CR7	D-7	R67	E-7	R147	G-8	U15	C-3		



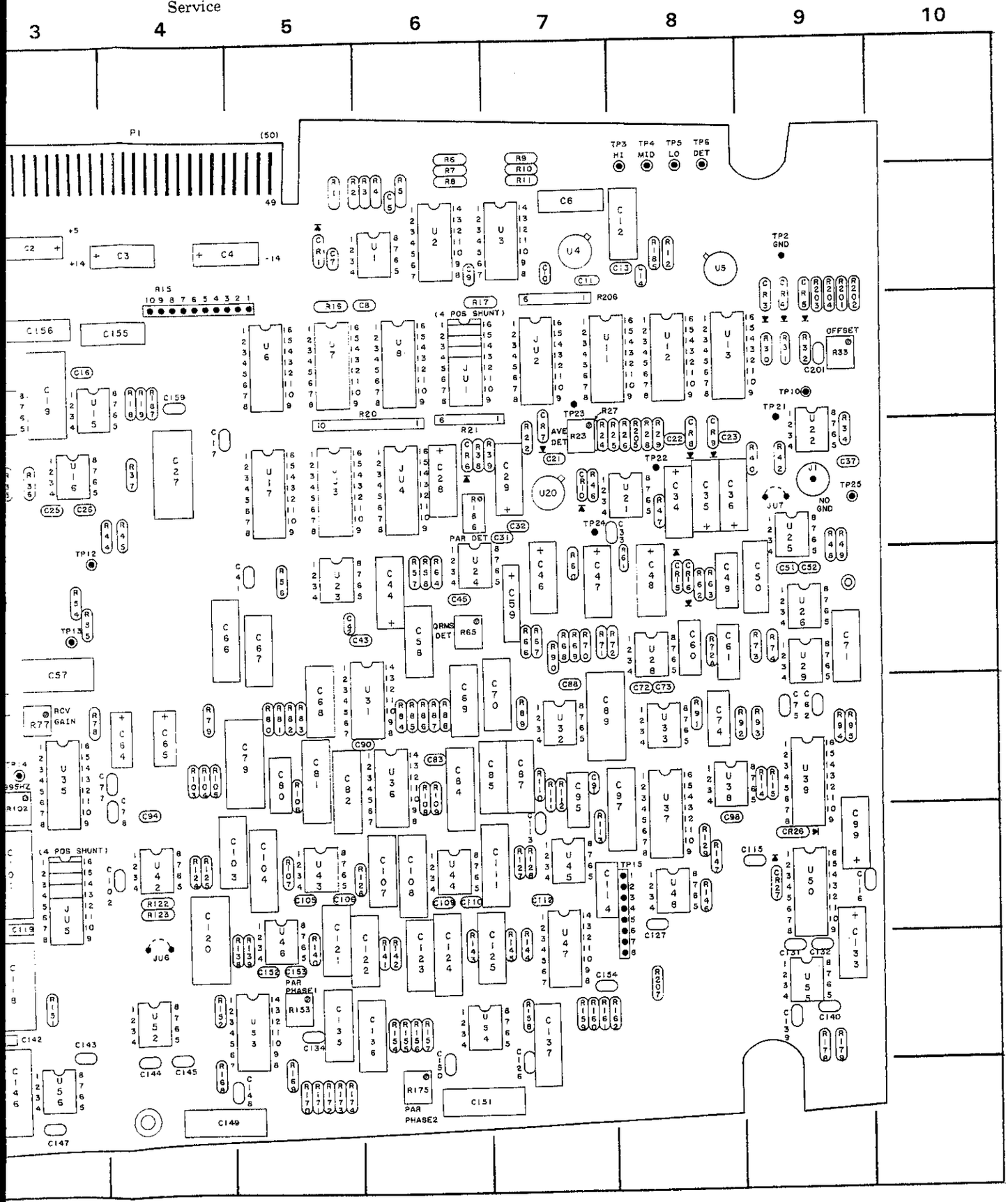
A13 Sht 2 of 3

GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
-8	R68	E-7	R148	H-1	U16	D-3
-8	R69	E-7	R149	H-2	U17	D-5
-7	R70	E-7	R150	H-2	U20	D-7
-2	R71	E-7	R151	H-3	U21	D-8
-2	R72	E-7	R152	H-4	U22	D-9
-8	R72A	E-8	R153	H-5	U23	E-5
-8	R73	E-9	R154	H-6	U24	E-6
-9	R74	E-9	R155	H-6	U25	D-9
-9	R75	F-3	R156	H-6	U26	E-9
-9	R76	F-3	R157	H-6	U28	E-8
-3	R77	F-3	R158	H-7	U29	E-9
-6	R78	F-3	R159	H-7	U30	F-2
-7	R79	F-4	R160	H-7	U31	F-6
-5	R80	F-5	R161	H-7	U32	F-7
-6	R81	F-5	R162	H-7	U33	F-8
-3	R82	F-5	R163	J-2	U34	F-2
-4	R83	F-5	R164	J-1	U35	F-3
-9	R84	F-6	R165	J-2	U36	F-6
-5	R85	F-6	R166	J-2	U37	G-8
-6	R86	F-6	R167	J-2	U38	F-8
-6	R87	F-6	R168	J-4	U39	F-9
-6	R88	F-6	R169	J-5	U40	G-2
-6	R89	F-7	R170	J-5	U42	G-4
-6	R90	E-7	R171	J-5	U43	G-5
-6	R91	F-8	R172	J-5	U44	G-6
-6	R92	F-9	R173	J-5	U45	G-7
-7	R93	F-8	R174	J-5	U46	H-5
-7	R94	F-9	R175	J-6	U47	H-7
-7	R95	F-9	R178	H-9	U48	G-8
-8	R96	G-2	R179	H-9	U50	G-9
-4	R97	G-2	R180	J-2	U51	H-2
-5	R98	G-2	R181	H-8	U52	H-4
-7	R99	G-2	R182	C-2	U53	H-5
-4	R100	G-2	R183	C-2	U54	H-7
-4	R102	F-3	R184	F-1	U55	H-9
-6	R103	F-4	R185	B-8	U56	J-3
-7	R104	F-4	R186	D-7		
-7	R105	F-4	R187	C-4		
-7	R106	F-5	R201	C-9		
-7	R107	G-5	R202	C-9		
-7	R108	F-6	R203	C-9		
-8	R109	F-6	R204	C-9		
-7	R110	F-7	R205	D-8		
-8	R111	F-7	R206	C-7		
-9	R112	F-7	R207	H-8		
-9	R113	G-7	R208	F-2		
-9	R114	F-8	T1	D-2		
-9	R115	F-9	TP2	B-9		
-9	R116	H-1	TP3	B-8		
-9	R117	G-2	TP4	B-8		
-3	R118	G-2	TP5	B-8		
-3	R119	G-2	TP6	B-8		
-4	R120	G-2	TP7	H-2		
-6	R121	G-3	TP9	C-3		
-7	R122	G-4	TP10	C-9		
-9	R123	G-4	TP11	E-2		
-9	R124	G-4	TP12	E-3		
-3	R125	G-4	TP13	E-3		
-4	R126	G-5	TP14	F-3		
-4	R127	G-7	TP15	G-8		
-7	R128	G-7	TP21	C-9		
-8	R129	G-8	TP22	D-8		
-9	R132	H-1	TP23	C-7		
-9	R133	H-9	TP24	D-8		
-2	R134	H-2	TP25	D-9		
-3	R135	H-2	U1	B-6		
-3	R136	H-2	U2	B-6		
-5	R137	H-2	U3	B-7		
-6	R138	H-5	U4	B-7		
-6	R139	H-5	U5	B-8		
-7	R140	H-6	U6	C-5		
-8	R141	H-6	U7	C-5		
-8	R142	H-6	U8	C-6		
-8	R143	H-6	U11	C-8		
-6	R144	H-7	U12	C-8		
-6	R145	H-7	U13	C-9		
-7	R146	G-8	U14	C-3		
-7	R147	G-8	U15	C-3		



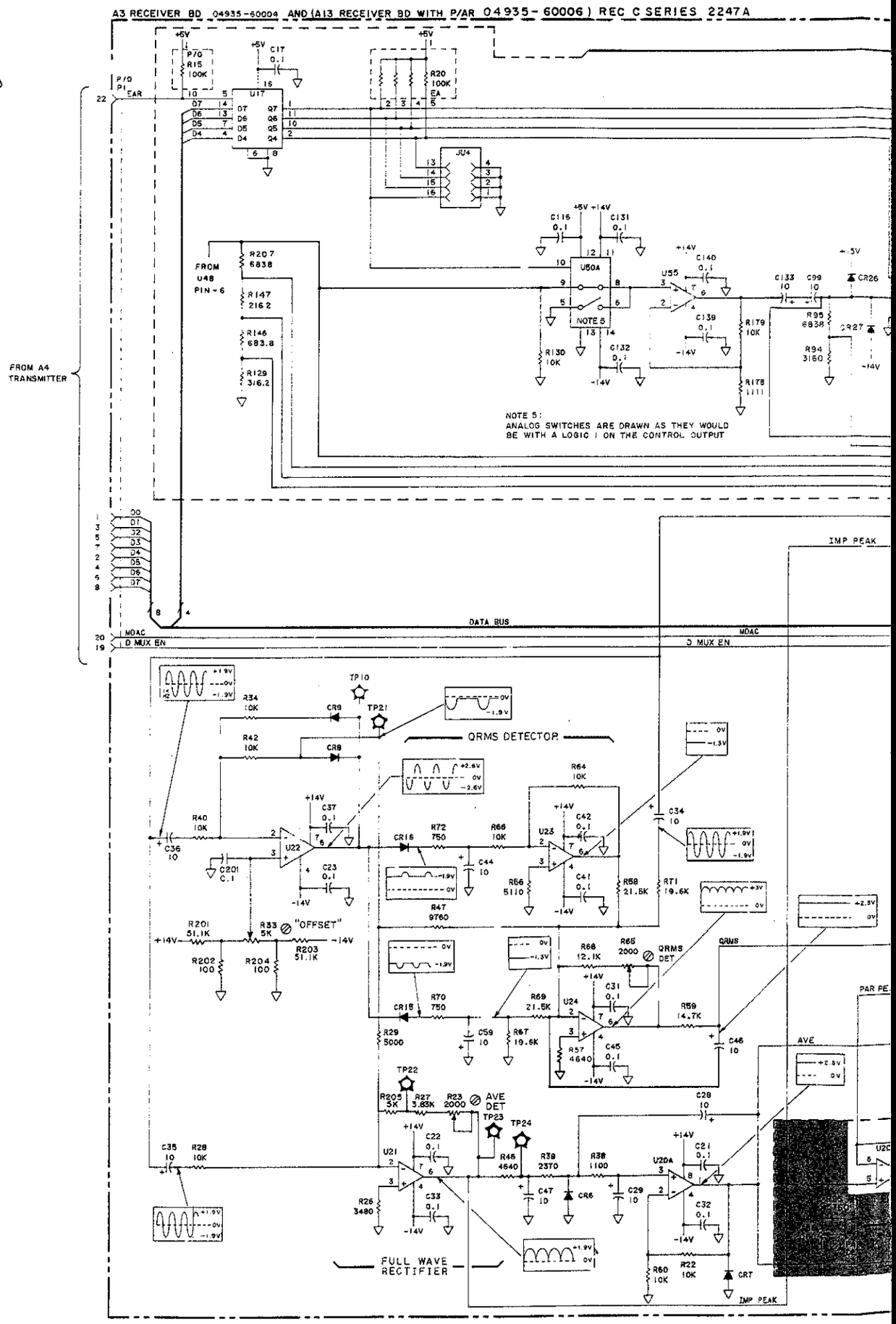
A13 Sht 3 of 3

Service



A13 Receiver Board Component Locator

Fig 8-30
Sht 1 of 3



ES 2247A

Fig 8-30 sht 2 of 3

AUTORANGE BLOCK

D7	D6	D5	D4	GAIN
0	0	0	0	-100DB
0	0	:	0	0DB
0	:	0	0	10DB
0	:	:	0	20DB
1	0	0	0	30DB
:	0	:	0	40DB
:	0	:	1	50DB
1	:	:	1	60DB

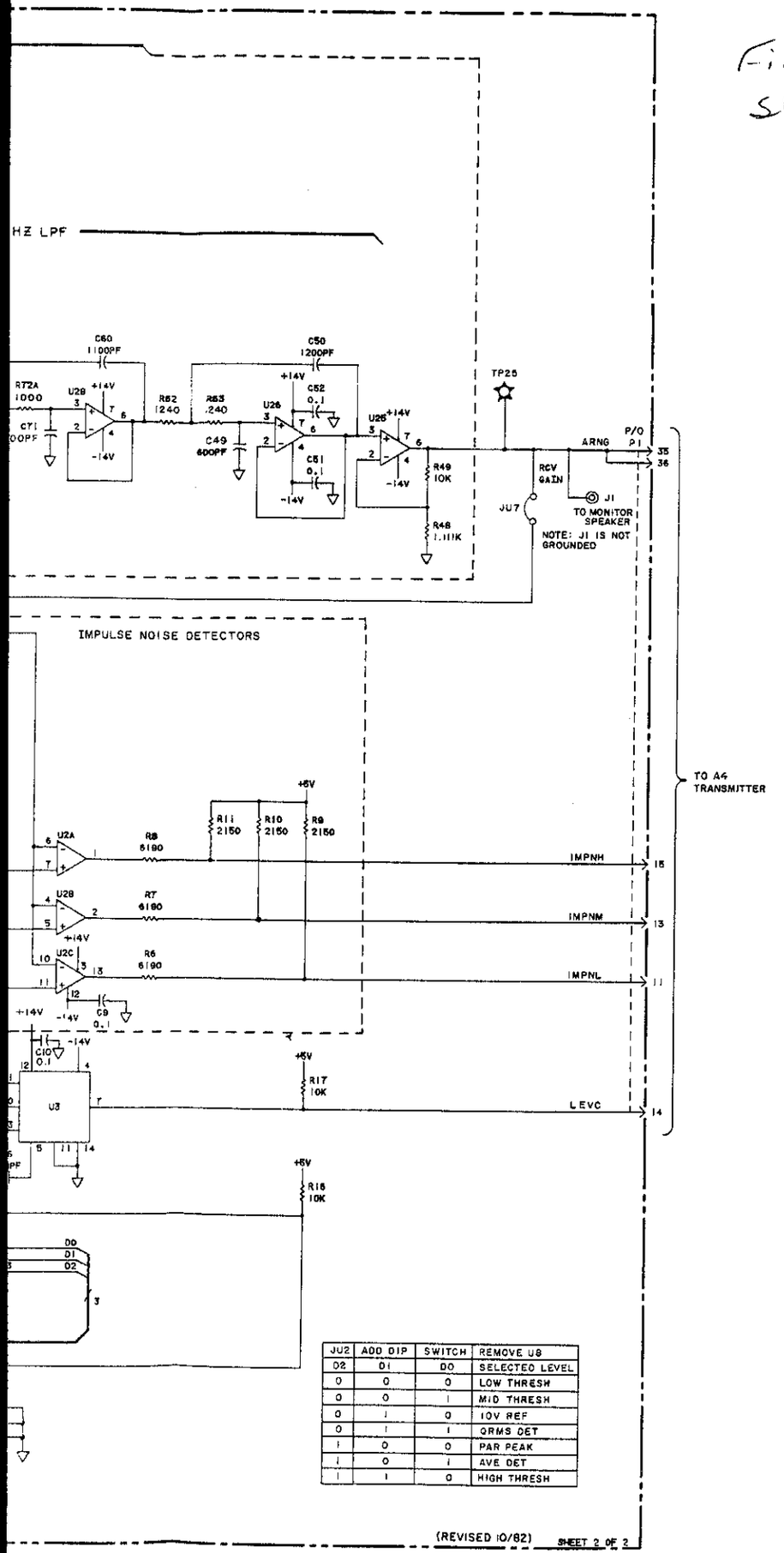
150 KHZ LPF

IMP PEAK

IMPULSE NOISE DET

PEAK LATCH
(OPTIONS 001, 003 ONLY)

Fig 8-30
Sht 3 of 3



JU2	ADD DIP	SWITCH	REMOVE U8
D2	D1	D0	SELECTED LEVEL
0	0	0	LOW THRESH
0	0	1	MID THRESH
0	1	0	10V REF
0	1	1	QRMS DET
1	0	0	PAR PEAK
1	0	1	AVE DET
1	1	0	HIGH THRESH

(REVISED 10/82) SHEET 2 OF 2

CIRCUIT APPLIES TO STANDARD UNITS ONLY

CIRCUIT APPLIES TO P/AR UNITS ONLY

Figure 8-30.
A3 Receiver Board Schematic Diagram (Sheet 2 of 2)

Fig 8-31 sht 1 of 3

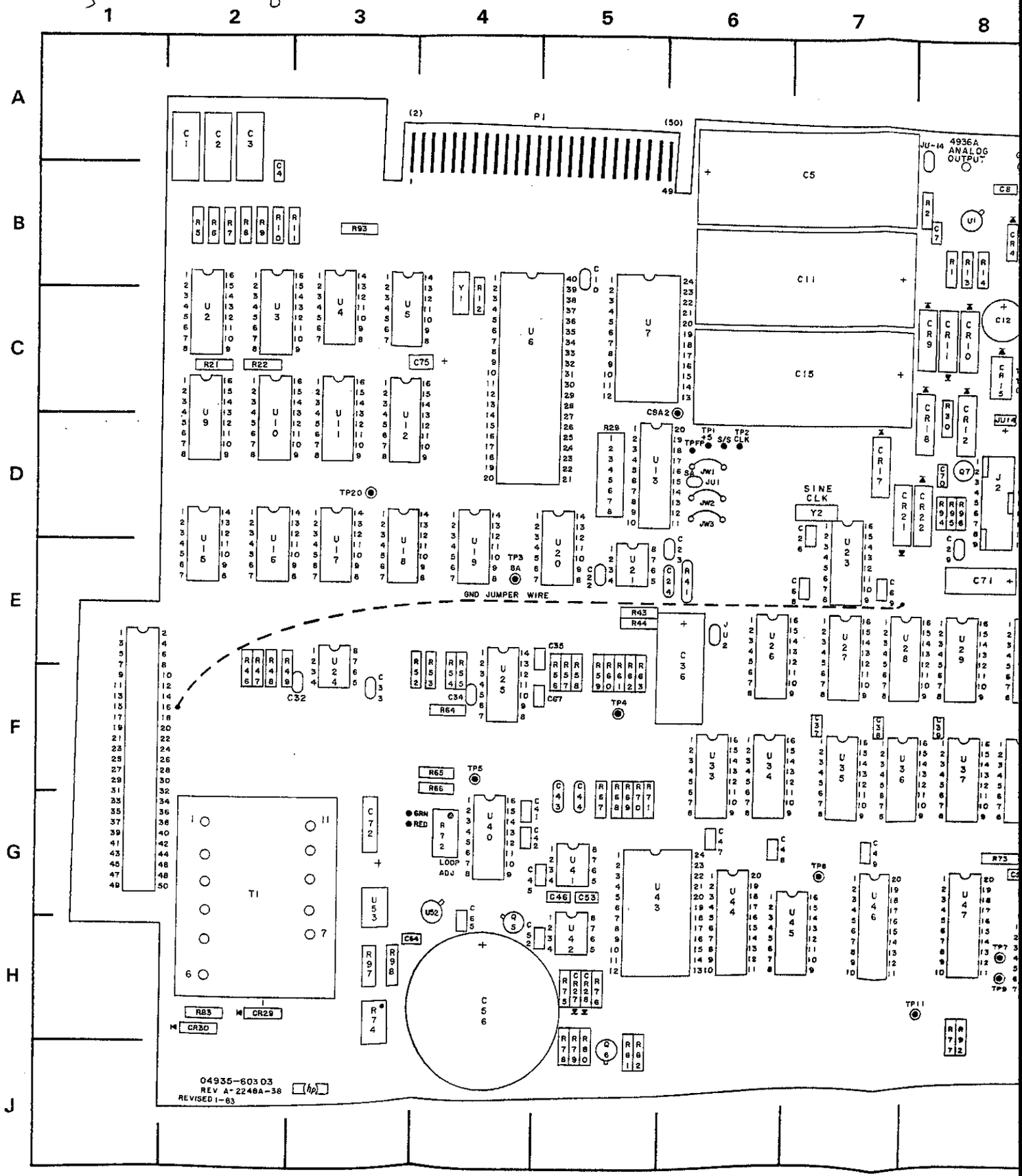
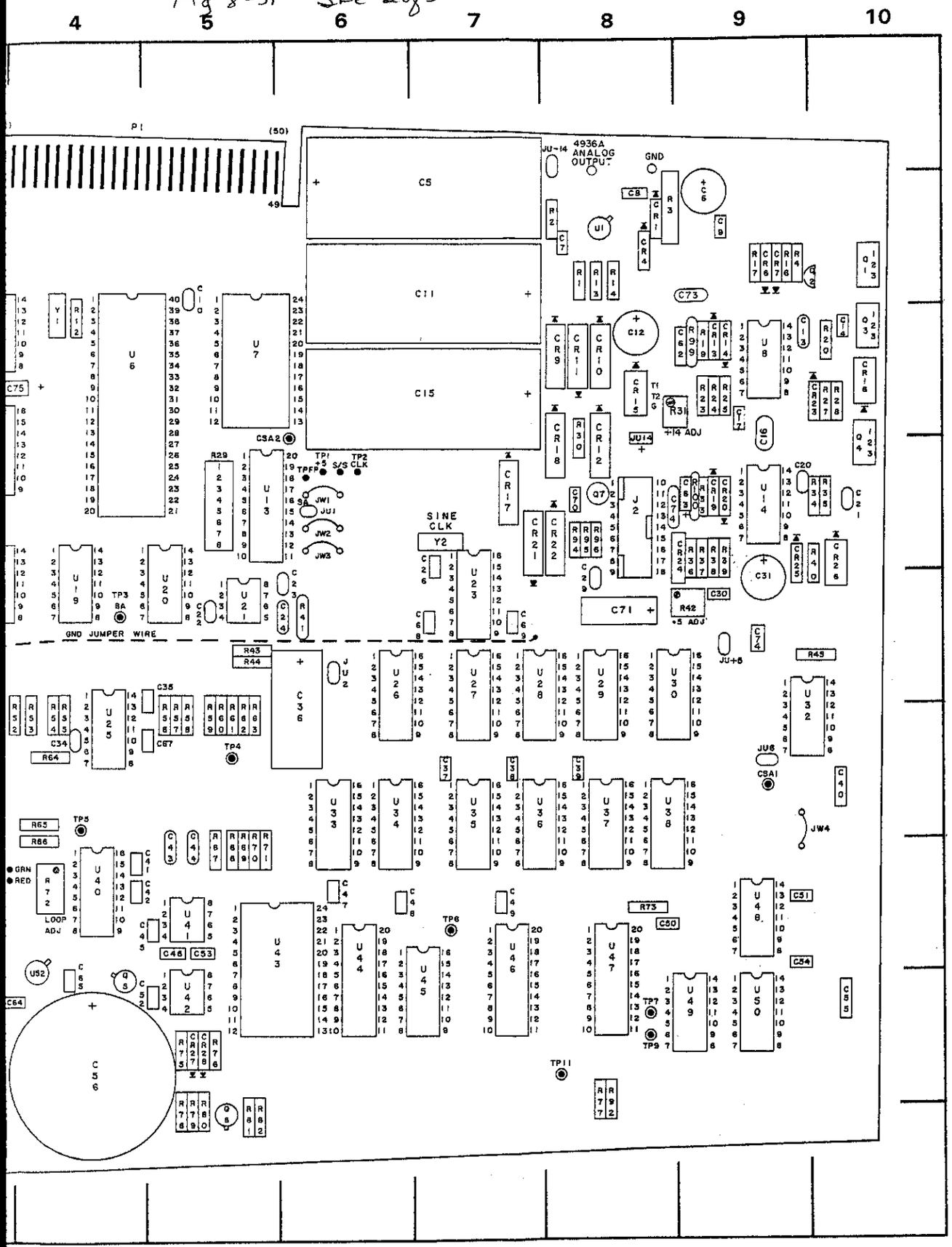


Figure 8-31. A4 Transmitter Board Component Locator

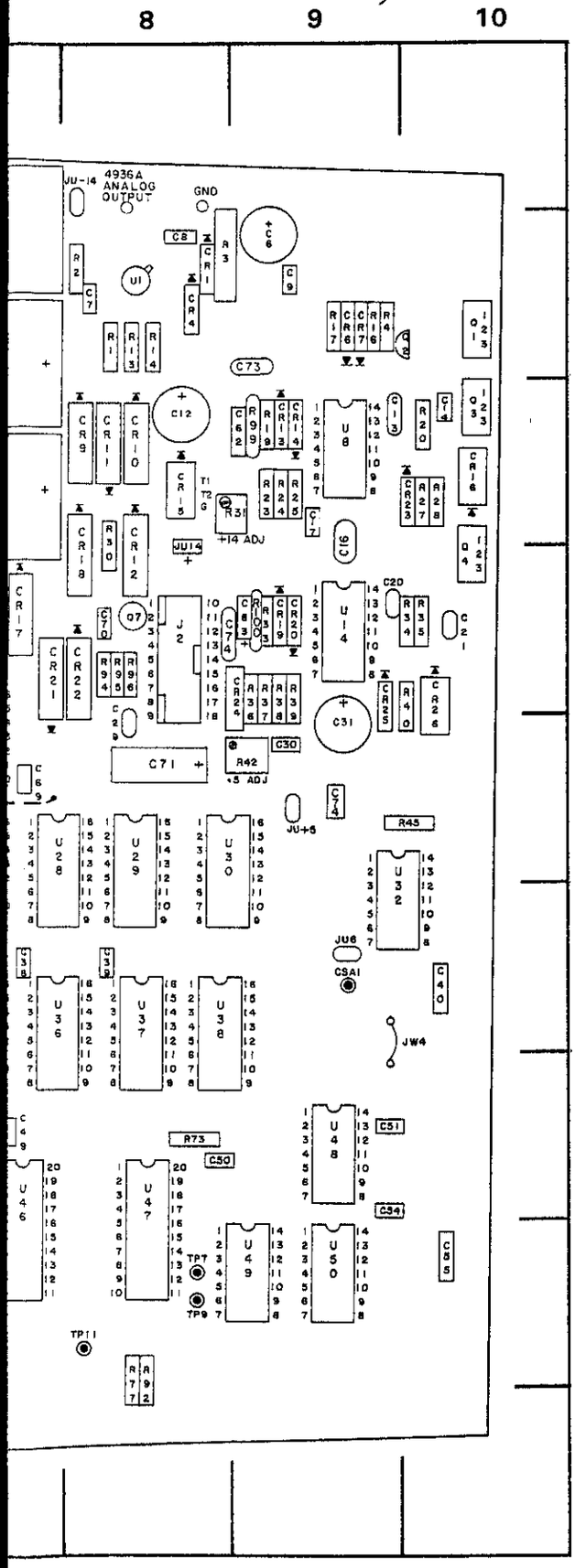
Fig 8-31 Sht 2 of 3



REF DESIG	GRID LOC	REF DESIG
C1	A-2	CR12
C2	A-2	CR13
C3	A-2	CR14
C4	A-2	CR15
C5	A-7	CR16
C6	B-9	CR17
C7	B-8	CR18
C8	A-8	CR19
C9	B-9	CR20
C10	B-5	CR23
C11	B-7	CR24
C12	C-8	CR25
C13	C-10	CR26
C14	C-10	CR27
C15	C-7	CR28
C16	C-9	CR29
C17	C-9	CR30
C20	D-10	CSA1
C21	D-10	CSA2
C22	E-5	J2
C23	D-6	J3
C24	E-6	JU1
C25	E-6	JU2
C26	D-7	JU+5
C28	E-7	JU6
C29	D-8	JU14
C30	E-9	JU-14
C31	D-9	JW2
C32	F-3	JW3
C33	F-3	JW4
C34	F-4	P1
C35	E-5	Q1
C36	E-6	Q2
C37	F-7	Q3
C38	F-7	Q4
C39	F-8	Q5
C40	F-10	Q6
C41	G-5	Q7
C42	G-5	R1
C43	G-5	R2
C44	G-5	R3
C45	G-5	R4
C46	G-5	R5
C47	G-6	R6
C48	G-7	R7
C49	G-7	R8
C50	G-9	R9
C51	G-10	R10
C52	H-5	R11
C53	G-5	R12
C54	G-10	R13
C55	H-10	R14
C56	H-4	R16
C61	J-8	R17
C62	C-9	R19
C63	D-9	R20
C64	H-4	R21
C65	H-4	R22
C67	F-5	R23
C68	E-7	R24
C69	E-7	R25
C70	D-8	R27
C71	E-8	R28
C72	F-3	R29
C73	C-9	R30
C74	E-9	R31
C75	B-5	R33
CR1	B-9	R34
CR4	B-8	R35
CR6	B-9	R36
CR7	B-9	R37
CR9	C-8	R38
CR10	C-8	R39
CR11	C-8	R40

Figure 8-31. A4 Transmitter Board Component Locator

Fig 8-31 Sht 3 of 3



A4 and A14 Transmitter Boards

REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	A-2	CR12	C-8	R41	E-6	U11	C-3
C2	A-2	CR13	C-9	R42	E-9	U12	C-3
C3	A-2	CR14	C-9	R43	E-5	U13	D-6
C4	A-2	CR15	C-8	R44	E-5	U14	D-9
C5	A-7	CR16	C-10	R45	E-10	U15	D-2
C6	B-9	CR17	D-7	R46	F-2	U16	D-2
C7	B-8	CR18	C-8	R47	F-2	U17	D-3
C8	A-8	CR19	D-9	R48	F-2	U18	D-3
C9	B-9	CR20	D-9	R49	F-2	U19	D-4
C10	B-5	CR23	C-10	R52	F-4	U20	D-5
C11	B-7	CR24	D-9	R53	F-4	U21	E-5
C12	C-8	CR25	D-10	R55	F-4	U23	D-7
C13	C-10	CR26	D-10	R56	F-5	U24	E-3
C14	C-10	CR27	H-5	F57	F-5	U25	F-4
C15	C-7	CR28	H-5	R58	F-5	U26	E-7
C16	C-9	CR29	H-2	R59	F-5	U27	E-7
C17	C-9	CR30	H-2	R60	F-5	U28	E-8
C20	D-10	CSA1	F-10	R61	F-5	U29	E-8
C21	D-10	CSA2	C-6	R62	F-5	U30	E-9
C22	E-5	J2	D-8	R63	F-5	U31	E-9
C23	D-6	J3	F-1	R64	F-4	U32	E-10
C24	E-6	JU1	D-6	R65	F-4	U33	F-6
C25	E-6	JU2	E-6	R66	F-4	U34	F-7
C26	D-7	JU+5	E-9	R67	F-5	U35	F-7
C28	E-7	JU6	F-9	R68	F-5	U36	F-8
C29	D-8	JU14	C-8	R69	F-5	U37	F-8
C30	E-9	JU-14	A-8	R70	F-5	U38	F-9
C31	D-9	JW2	D-6	R71	G-6	U39	F-9
C32	F-3	JW3	D-6	R72	G-4	U40	G-4
C33	F-3	JW4	F-10	R73	G-8	U41	G-4
C34	F-4	P1	A-4	R74	H-6	U42	H-5
C35	E-5	Q1	B-10	R75	H-5	U43	G-6
C36	E-6	Q2	B-10	R76	H-5	U44	G-6
C37	F-7	Q3	C-10	R77	J-8	U45	G-7
C38	F-7	Q4	C-10	R78	J-5	U46	G-7
C39	F-8	Q5	H-4	R79	J-5	U47	G-8
C40	F-10	Q6	J-5	R80	J-5	U48	G-9
C41	G-5	Q7	D-8	R81	J-5	U49	H-9
C42	G-5	R1	B-8	R82	J-5	U50	H-9
C43	G-5	R2	B-8	R83	H-2	U51	J-8
C44	G-5	R3	B-9	R85	H-7	U52	H-4
C45	G-5	R4	B-10	R86	H-7	Y1	B-4
C46	G-5	R5	B-2	R87	H-7	Y2	D-7
C47	G-6	R6	B-2	R88	H-7	Y3	D-7
C48	G-7	R7	B-2	R89	H-7		
C49	G-7	R8	B-2	R90	H-8		
C50	G-9	R9	B-2	R91	H-8		
C51	G-10	R10	B-2	R92	H-8		
C52	H-5	R11	B-3	R93	B-3		
C53	G-5	R12	B-4	R94	D-8		
C54	G-10	R13	B-8	R95	D-8	**A14 BOARD ONLY**	
C55	H-10	R14	B-8	R96	D-8		
C56	H-4	R16	B-9	S/S	D-6		
C61	J-8	R17	B-9	T1	H-3		
C62	C-9	R19	C-9	TP1	D-6		
C63	D-9	R20	C-10	TP2CLK	D-6		
C64	H-4	R21	C-2	TP3	E-4	C27	E-7
C65	H-4	R22	C-2	TP4	F-5	C57	H-7
C67	F-5	R23	C-9	TP5	F-4	C58	J-7
C68	E-7	R24	C-9	TP6	G-7	C59	J-7
C69	E-7	R25	C-9	TP7	H-8	C60	J-7
C70	D-8	R27	C-10	TP9	H-8	R85	J-7
C71	E-8	R28	C-10	TP11	H-8	R86	J-7
C72	F-3	R29	D-5	TP20	D-3	R87	J-7
C73	C-9	R30	C-8	U1	B-8	R88	J-7
C74	E-9	R31	C-9	U2	C-2	R89	J-7
C75	B-5	R33	D-9	U3	C-2	R90	J-8
CR1	B-9	R34	D-10	U4	C-3	R91	J-8
CR4	B-8	R35	D-10	U5	C-3	TP11	H-8
CR6	B-9	R36	D-9	U6	C-4	U22	D-6
CR7	B-9	R37	D-9	U7	C-5	U31	F-9
CR9	C-8	R38	D-9	U8	C-9	U39	F-9
CR10	C-8	R39	D-9	U9	C-2	U51	J-8
CR11	C-8	R40	D-10	U10	C-2	Y3	D-7

Fig 8-32
Sht 1 of 2

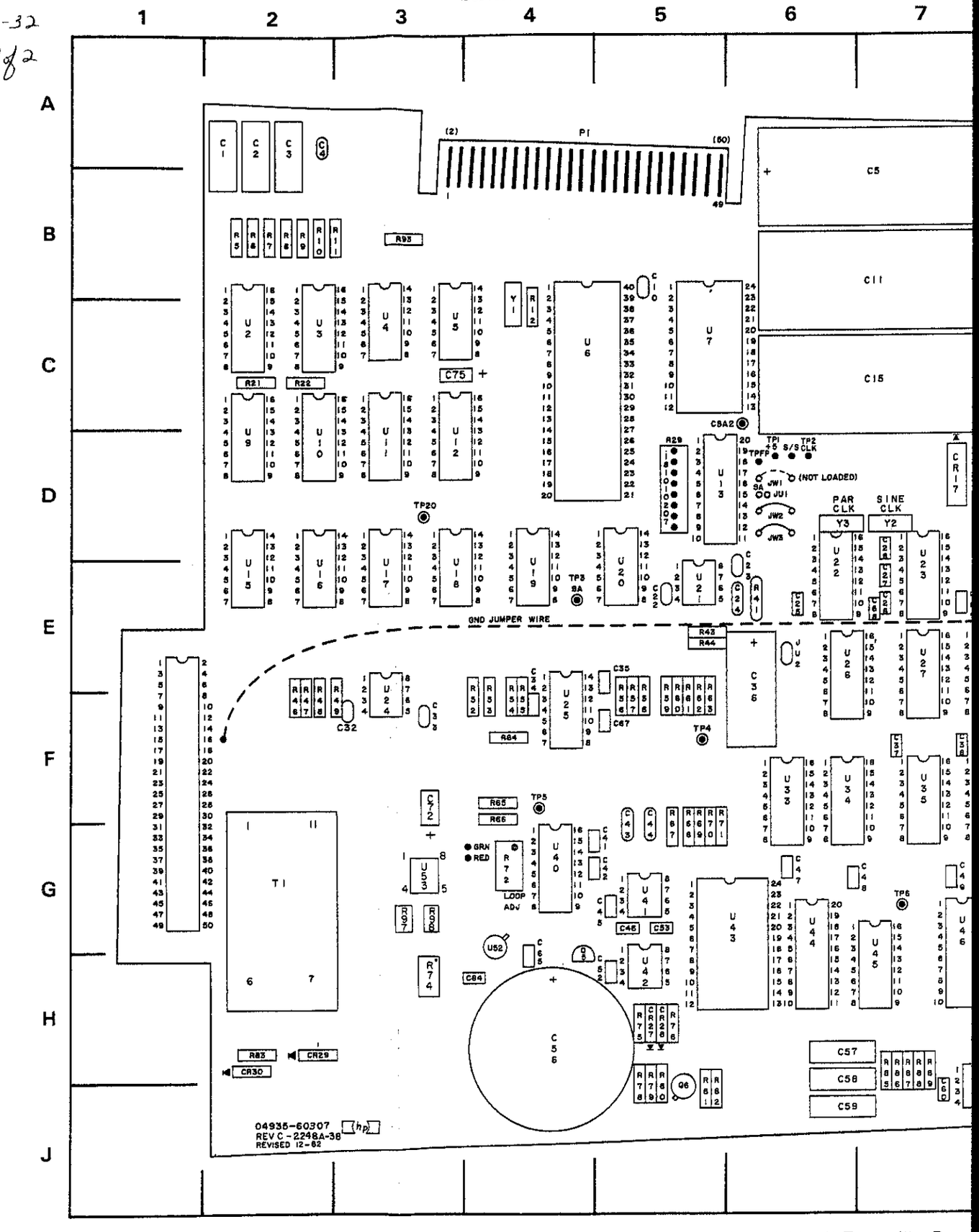


Figure 8-32. A14 Transmitter Board

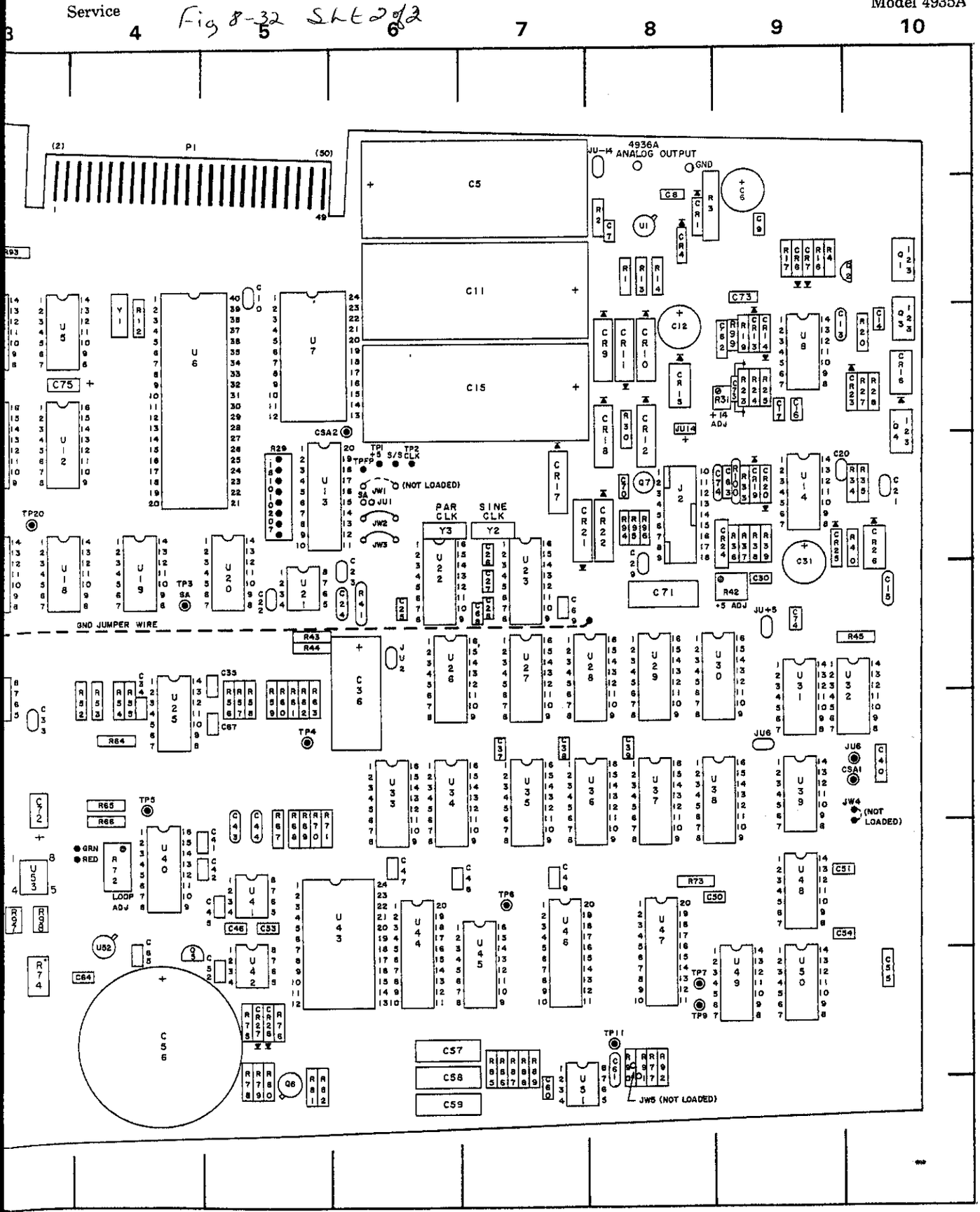


Figure 8-32. A14 Transmitter Board Component Locator

/10956A

Fig 8-33
Sht 1 of 3

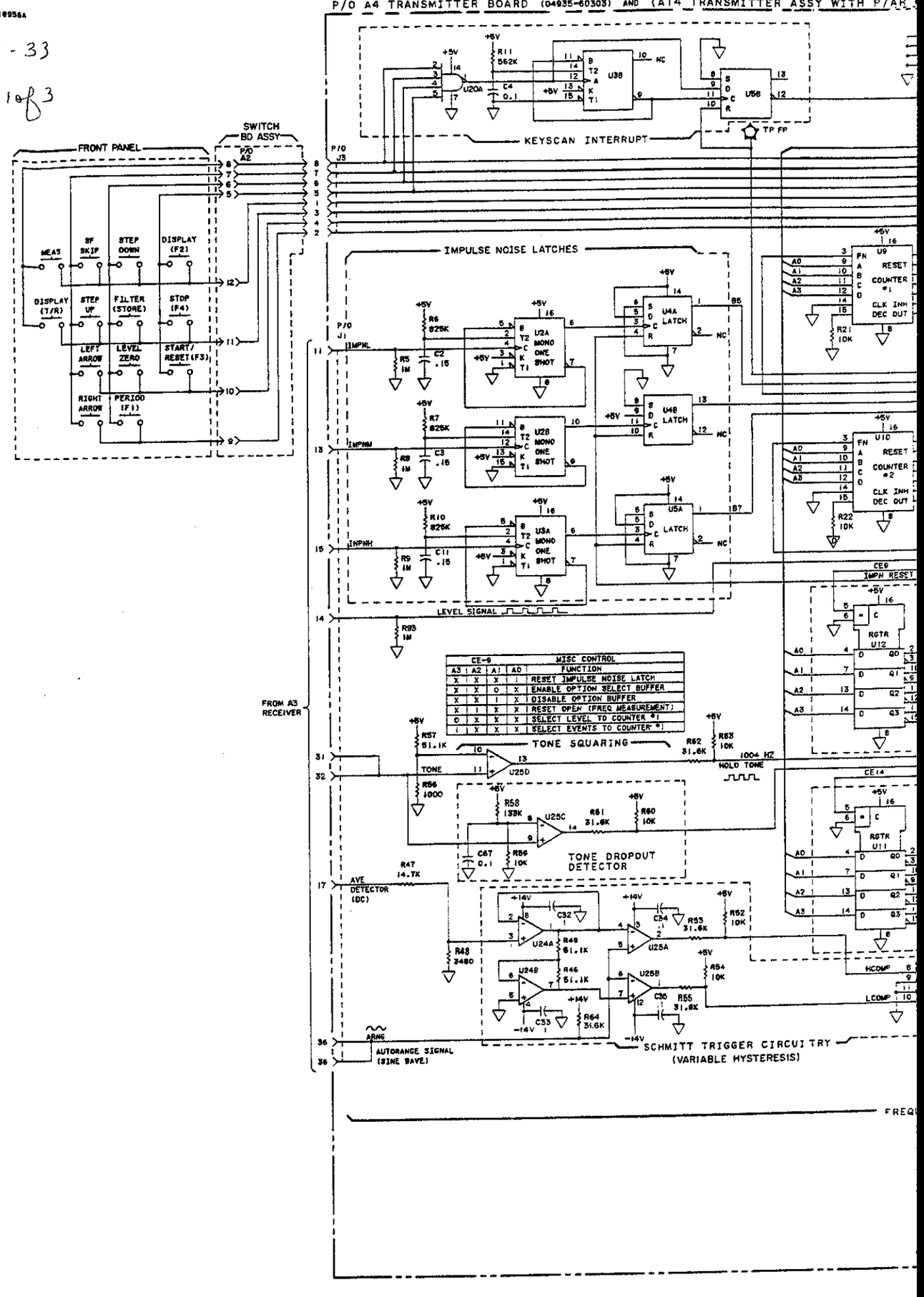
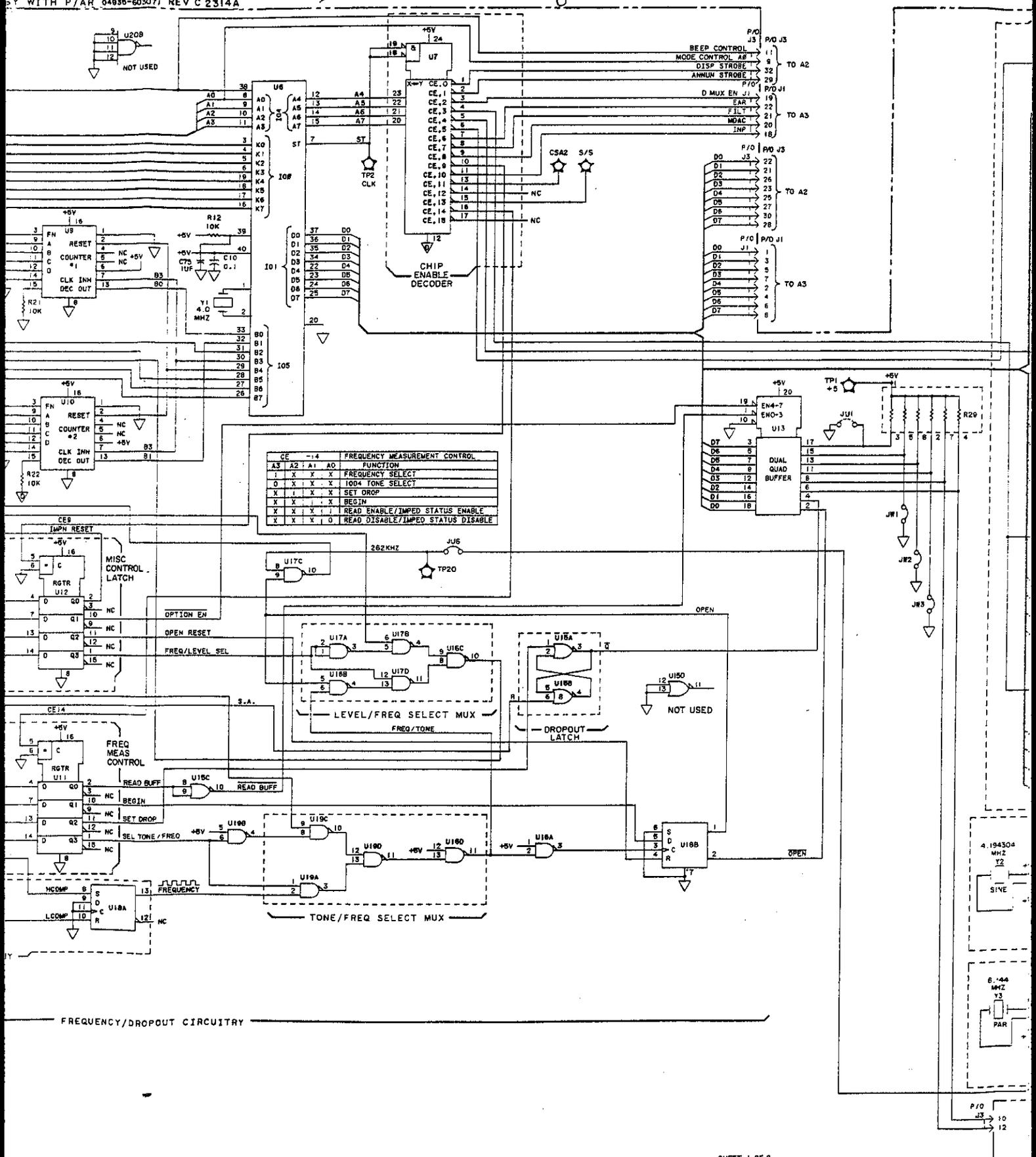


Fig 8-33 Sht 2 of 3

SY WITH P/AR 04936-60307) REV C 2314A



CE				FREQUENCY MEASUREMENT CONTROL
A3	A2	A1	A0	FUNCTION
1	X	X	X	FREQUENCY SELECT
0	X	X	X	1004 TONE SELECT
X	1	X	X	SET DROP
X	X	1	X	BEGIN
X	X	X	1	READ ENABLE/IMPED STATUS ENABLE
X	X	X	0	READ DISABLE/IMPED STATUS DISABLE

Fig 8-33
Sht 3 of 3

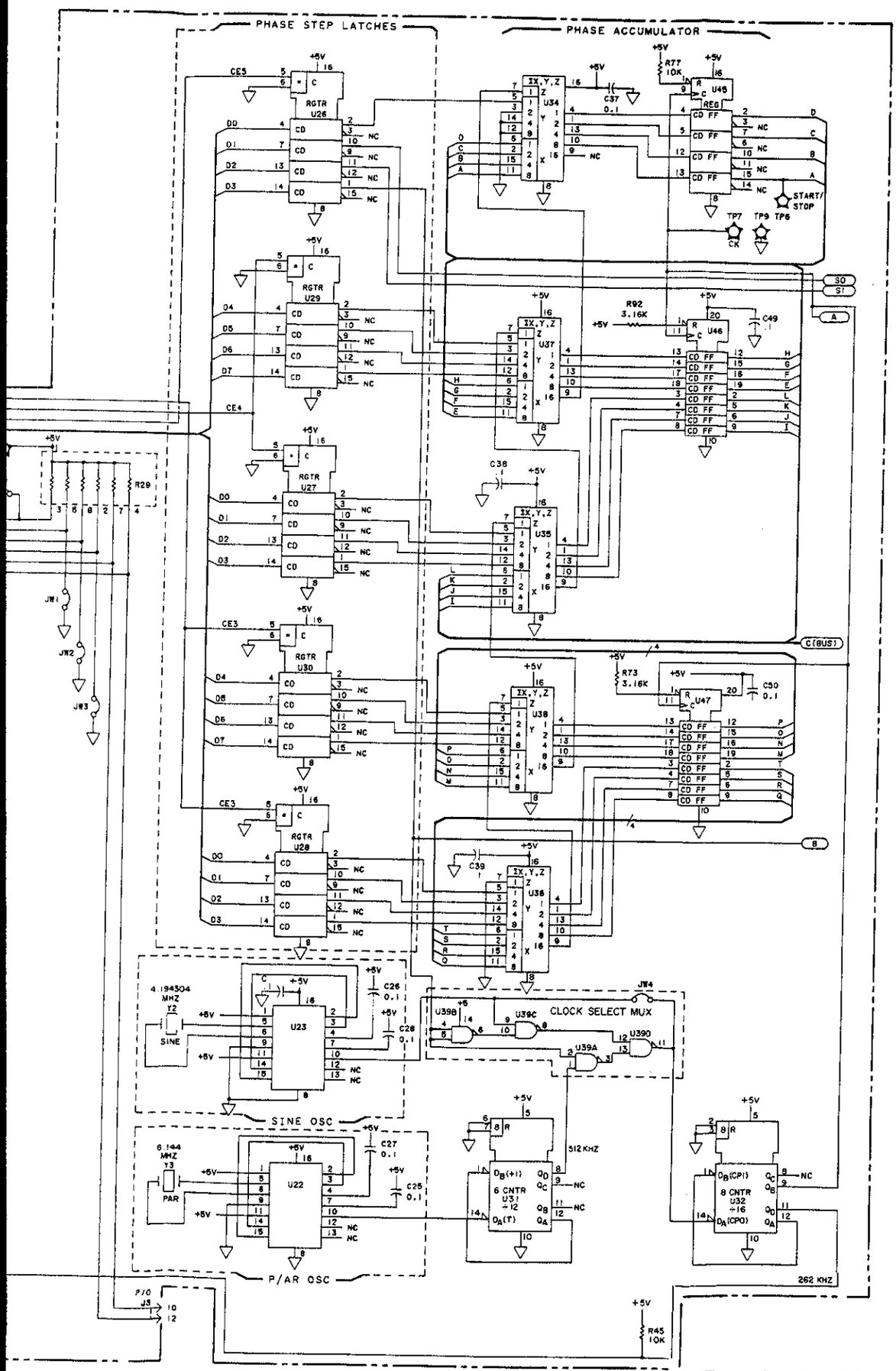


Figure 8-33.
A4 Transmitter Board Schematic Diagram (Sheet 1 of 2)

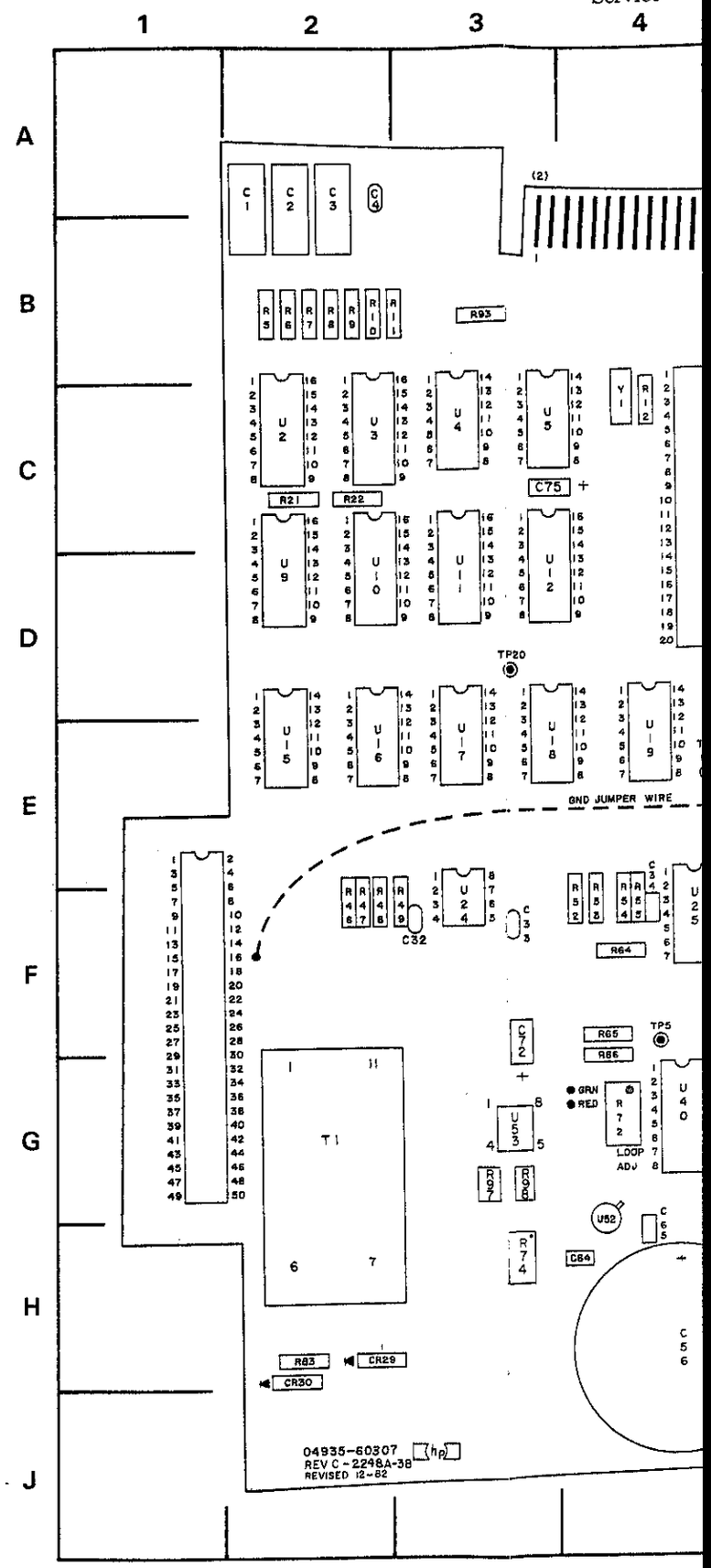
A14 Sht 1 of 2

A4 and A14 Transmitter Boards

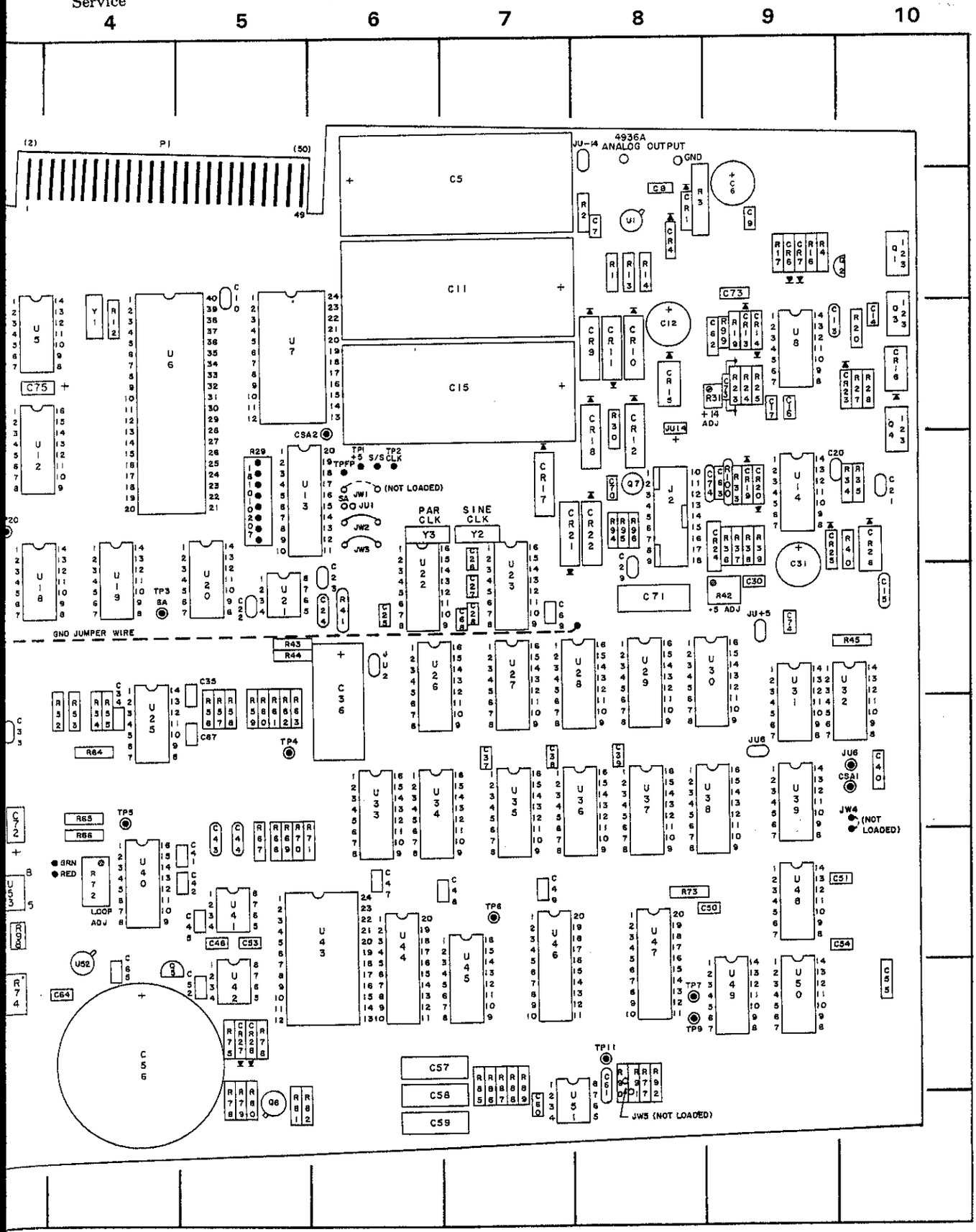
REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	A-2	CR12	C-8	R41	E-6	U11	C-3
C2	A-2	CR13	C-9	R42	E-9	U12	C-3
C3	A-2	CR14	C-9	R43	E-5	U13	D-6
C4	A-2	CR15	C-8	R44	E-5	U14	D-9
C5	A-7	CR16	C-10	R45	E-10	U15	D-2
C6	B-9	CR17	D-7	R46	F-2	U16	D-2
C7	B-8	CR18	C-8	R47	F-2	U17	D-3
C8	A-8	CR19	D-9	R48	F-2	U18	D-3
C9	B-9	CR20	D-9	R49	F-2	U19	D-4
C10	B-5	CR23	C-10	R52	F-4	U20	D-5
C11	B-7	CR24	D-9	R53	F-4	U21	E-5
C12	C-8	CR25	D-10	R55	F-4	U23	D-7
C13	C-10	CR26	D-10	R56	F-5	U24	E-3
C14	C-10	CR27	H-5	F57	F-5	U25	F-4
C15	C-7	CR28	H-5	R58	F-5	U26	E-7
C16	C-9	CR29	H-2	R59	F-5	U27	E-7
C17	C-9	CR30	H-2	R60	F-5	U28	E-8
C20	D-10	CSA1	F-10	R61	F-5	U29	E-8
C21	D-10	CSA2	C-6	R62	F-5	U30	E-9
C22	E-5	J2	D-8	R63	F-5	U31	E-9
C23	D-6	J3	F-1	R64	F-4	U32	E-10
C24	E-6	JU1	D-6	R65	F-4	U33	F-6
C25	E-6	JU2	E-6	R66	F-4	U34	F-7
C26	D-7	JU+5	E-9	R67	F-5	U35	F-7
C28	E-7	JU6	F-9	R68	F-5	U36	F-8
C29	D-8	JU14	C-8	R69	F-5	U37	F-8
C30	E-9	JU-14	A-8	R70	F-5	U38	F-9
C31	D-9	JW2	D-6	R71	G-6	U39	F-9
C32	F-3	JW3	D-6	R72	G-4	U40	G-4
C33	F-3	JW4	F-10	R73	G-8	U41	G-4
C34	F-4	P1	A-4	R74	H-6	U42	H-5
C35	E-5	Q1	B-10	R75	H-5	U43	G-6
C36	E-6	Q2	B-10	R76	H-5	U44	G-6
C37	F-7	Q3	C-10	R77	J-8	U45	G-7
C38	F-7	Q4	C-10	R78	J-5	U46	G-7
C39	F-8	Q5	H-4	R79	J-5	U47	G-8
C40	F-10	Q6	J-5	R80	J-5	U48	G-9
C41	G-5	Q7	D-8	R81	J-5	U49	H-9
C42	G-5	R1	B-8	R82	J-5	U50	H-9
C43	G-5	R2	B-8	R83	H-2	U51	J-8
C44	G-5	R3	B-9	R85	H-7	U52	H-4
C45	G-5	R4	B-10	R86	H-7	Y1	B-4
C46	G-5	R5	B-2	R87	H-7	Y2	D-7
C47	G-6	R6	B-2	R88	H-7	Y3	D-7
C48	G-7	R7	B-2	R89	H-7		
C49	G-7	R8	B-2	R90	H-8		
C50	G-9	R9	B-2	R91	H-8		
C51	G-10	R10	B-2	R92	H-8		
C52	H-5	R11	B-3	R93	B-3		
C53	G-5	R12	B-4	R94	D-8		
C54	G-10	R13	B-8	R95	D-8		
C55	H-10	R14	B-8	R96	D-8		
C56	H-4	R16	B-9	S/S	D-6		
C61	J-8	R17	B-9	T1	H-3		
C62	C-9	R19	C-9	TP1	D-6		
C63	D-9	R20	C-10	TP2CLK	D-6		
C64	H-4	R21	C-2	TP3	E-4		
C65	H-4	R22	C-2	TP4	F-5		
C67	F-5	R23	C-9	TP5	F-4		
C68	E-7	R24	C-9	TP6	G-7		
C69	E-7	R25	C-9	TP7	H-8		
C70	D-8	R27	C-10	TP9	H-8		
C71	E-8	R28	C-10	TP11	H-8		
C72	F-3	R29	D-5	TP20	D-3		
C73	C-9	R30	C-8	U1	B-8		
C74	E-9	R31	C-9	U2	C-2		
C75	B-5	R33	D-9	U3	C-2		
CR1	B-9	R34	D-10	U4	C-3		
CR4	B-8	R35	D-10	U5	C-3		
CR6	B-9	R36	D-9	U6	C-4		
CR7	B-9	R37	D-9	U7	C-5		
CR9	C-8	R38	D-9	U8	C-9		
CR10	C-8	R39	D-9	U9	C-2		
CR11	C-8	R40	D-10	U10	C-2		

A14 BOARD ONLY

C27	E-7
C57	H-7
C58	J-7
C59	J-7
C60	J-7
R85	J-7
R86	J-7
R87	J-7
R88	J-7
R89	J-7
R90	J-8
R91	J-8
TP11	H-8
U22	D-6
U31	F-9
U39	F-9
U51	J-8
Y3	D-7



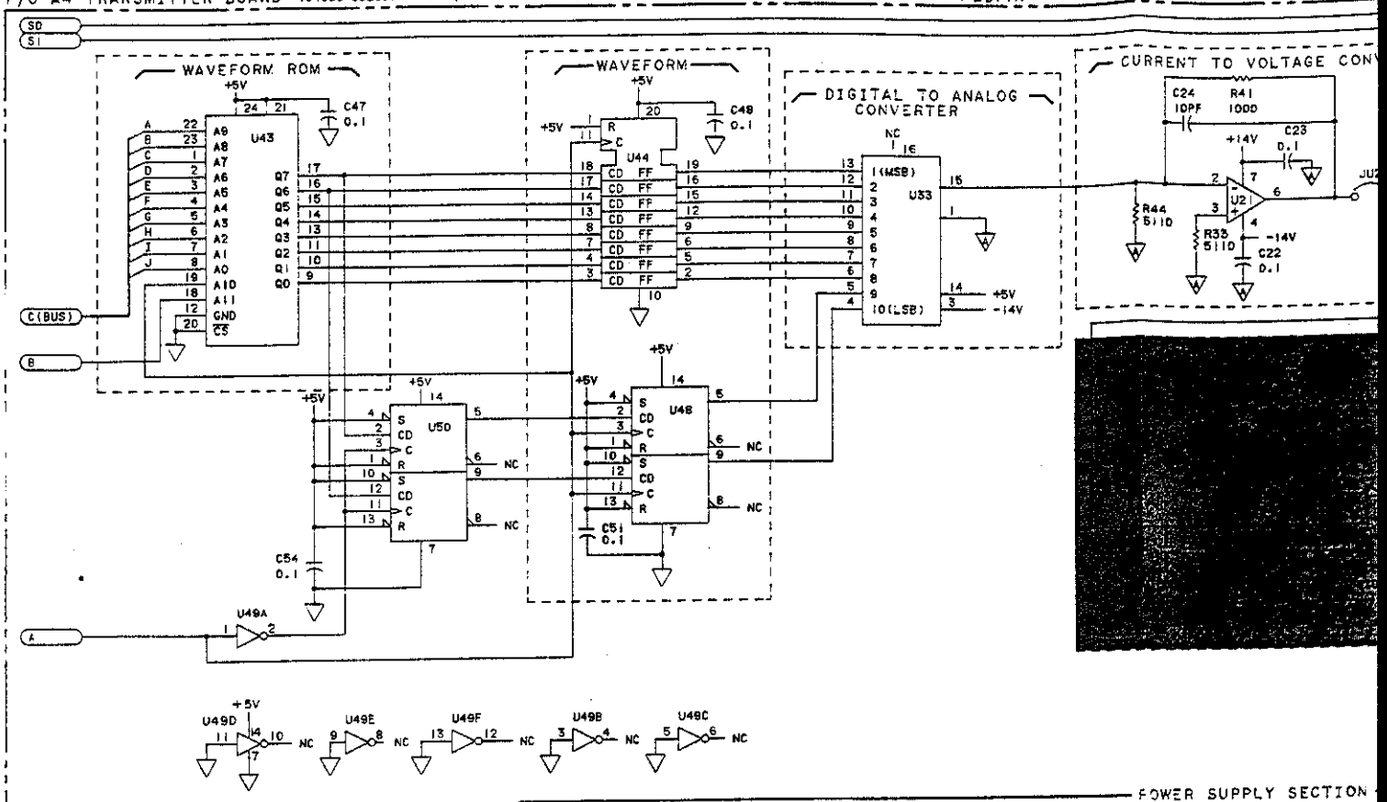
A14 Sht 2 of 2



A14 Transmitter Board Component Locator

Fig 8-34 Sht 1 of 3

/10338A P/O A4 TRANSMITTER BOARD (04935-60303) AND (A14 TRANSMITTER ASSY WITH P/AR 04935-60307) REV C 2314A



POWER SUPPLY SECTION

AC LINE VOLT	100	120	220	240
2110-0065 FUSE	375MA	375MA		
2110-0296 FUSE			200MA	200MA

NOTE: FUSES ARE NON TIME DELAY TYPES

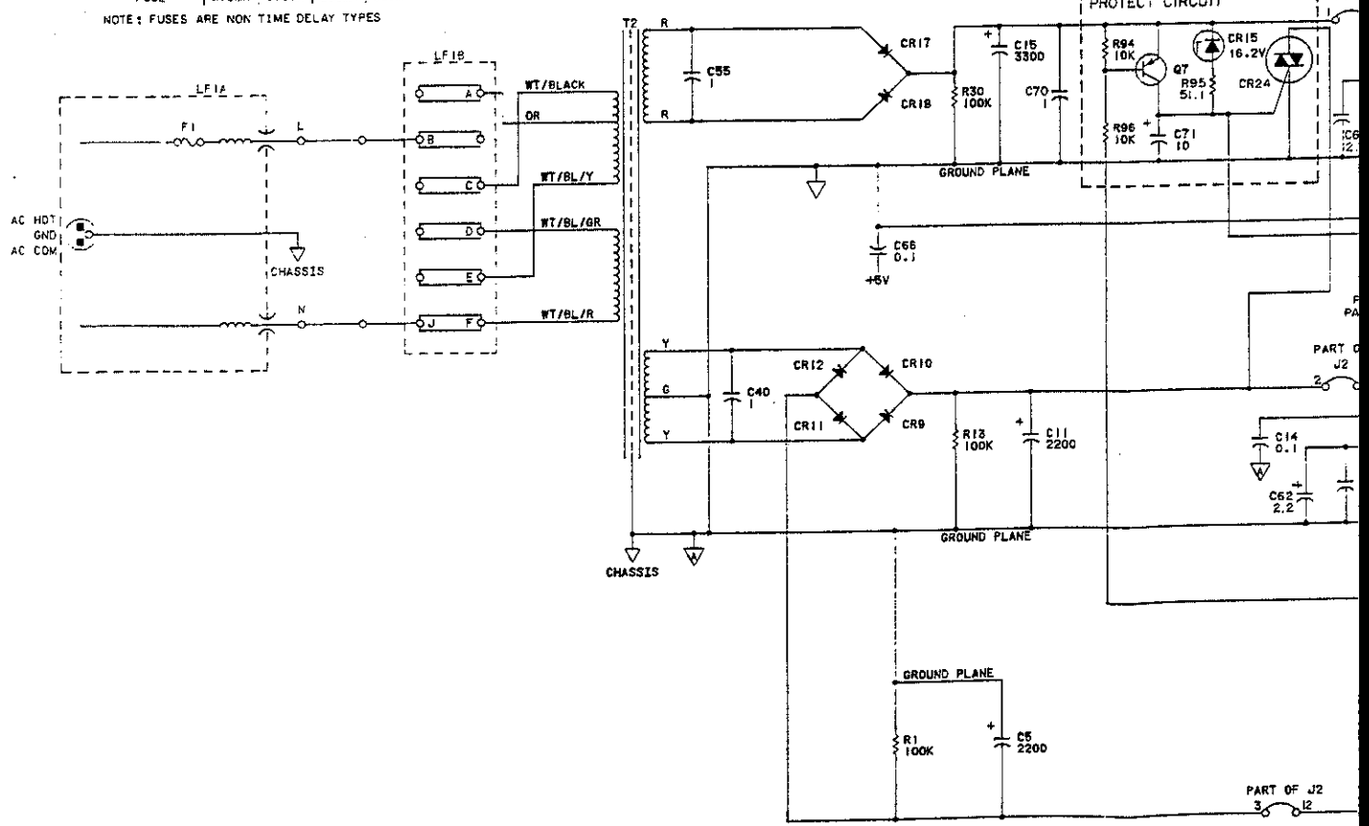
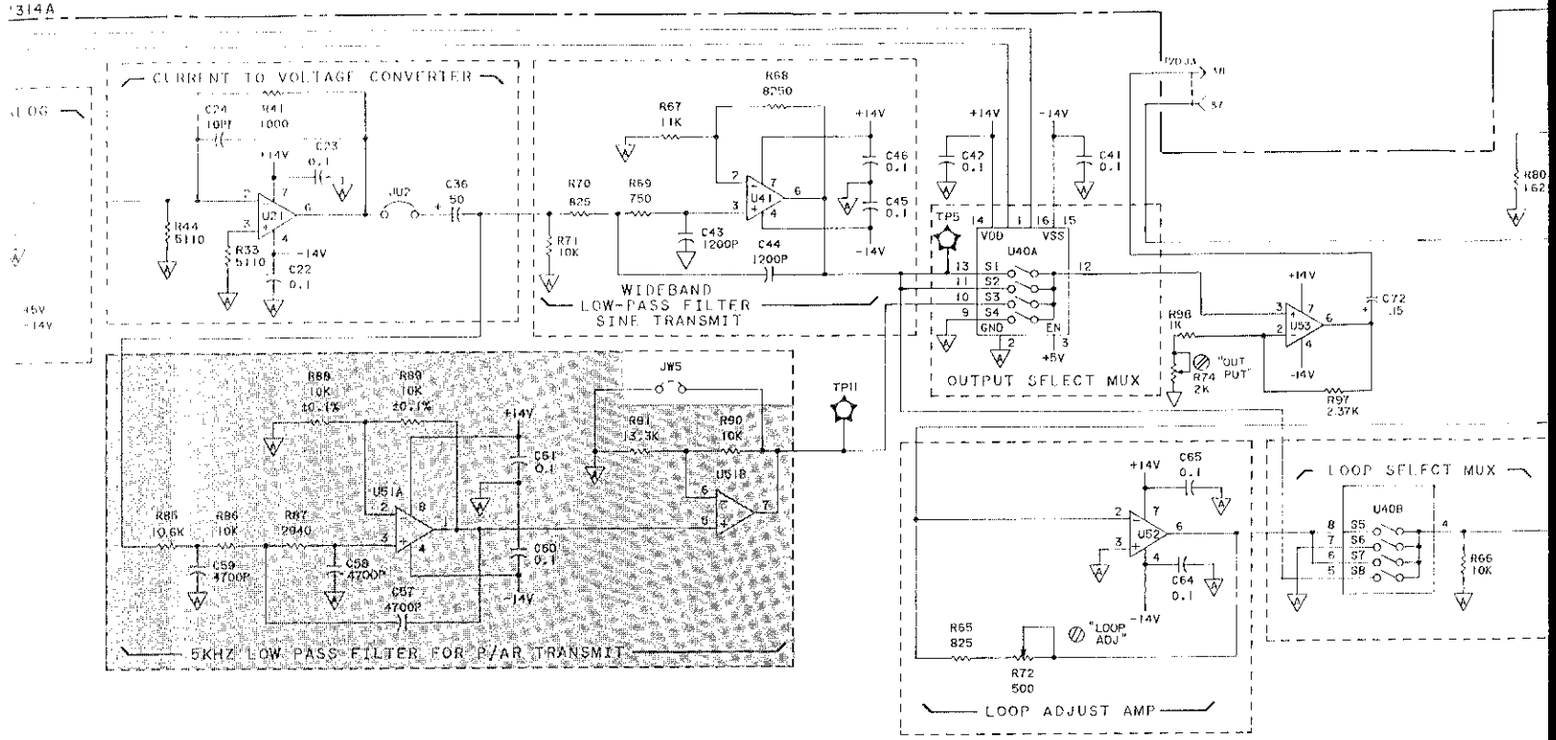


Fig 8-34 Sht 2 of 3



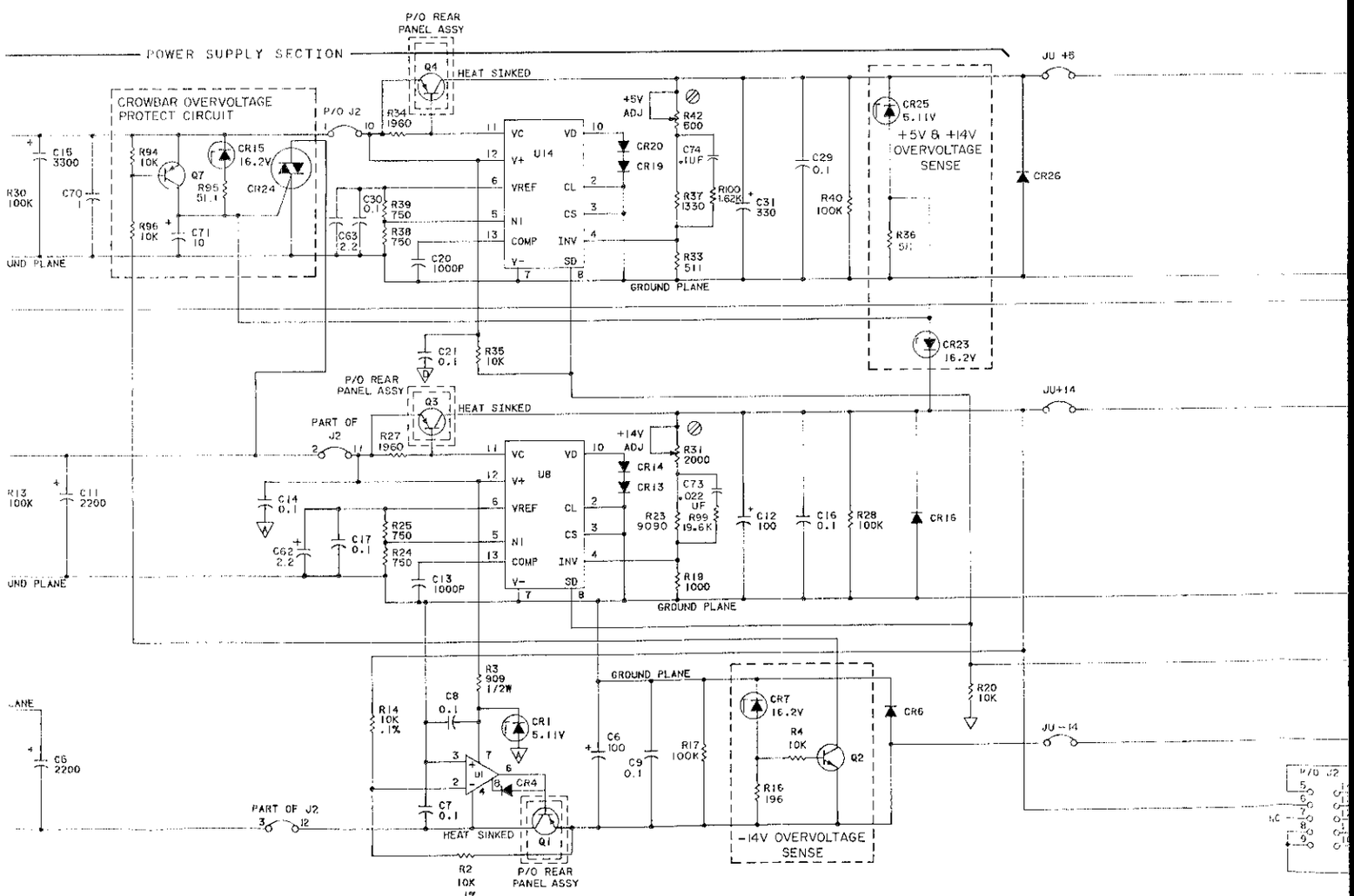
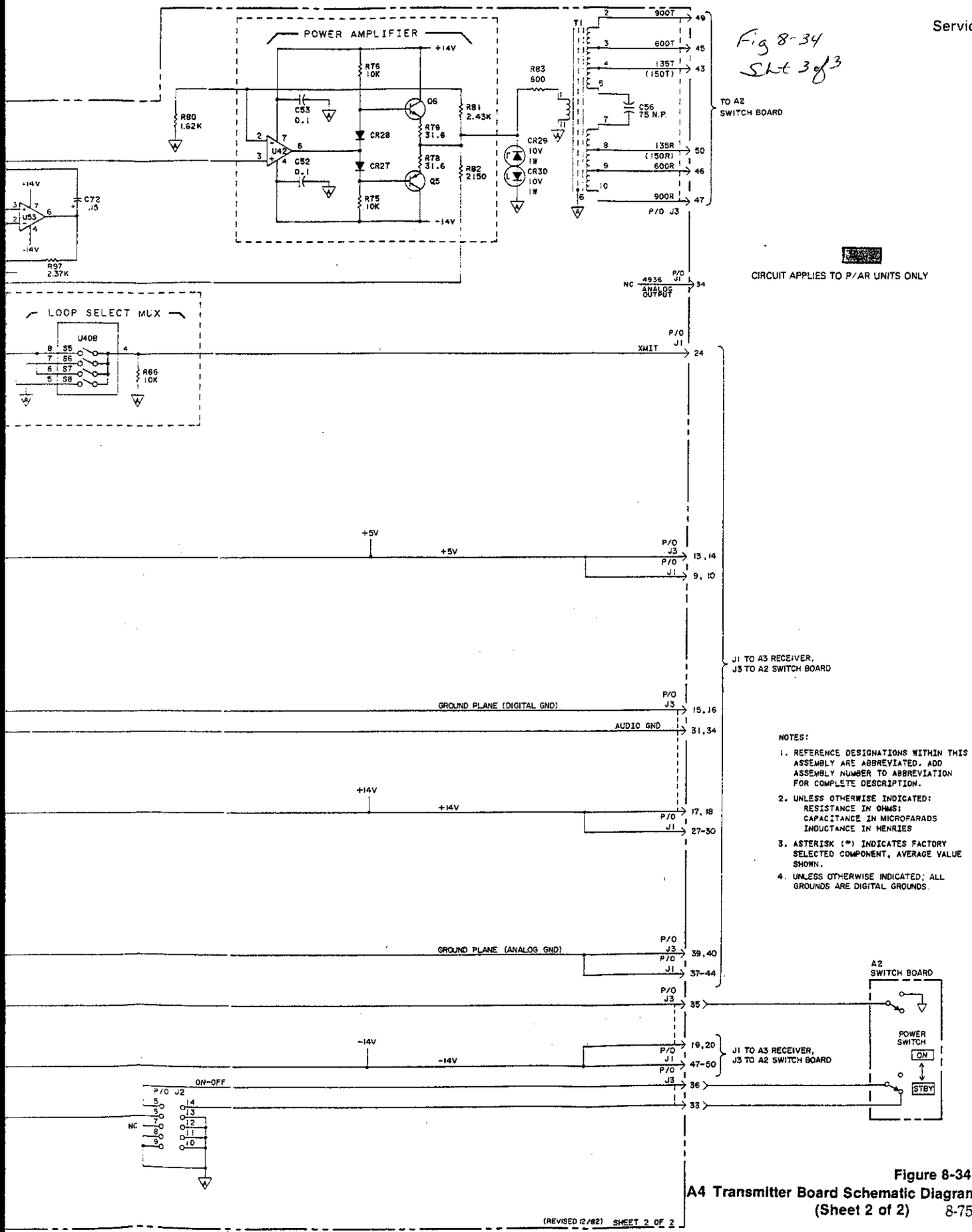


Fig 8-34
Sht 3 of 3

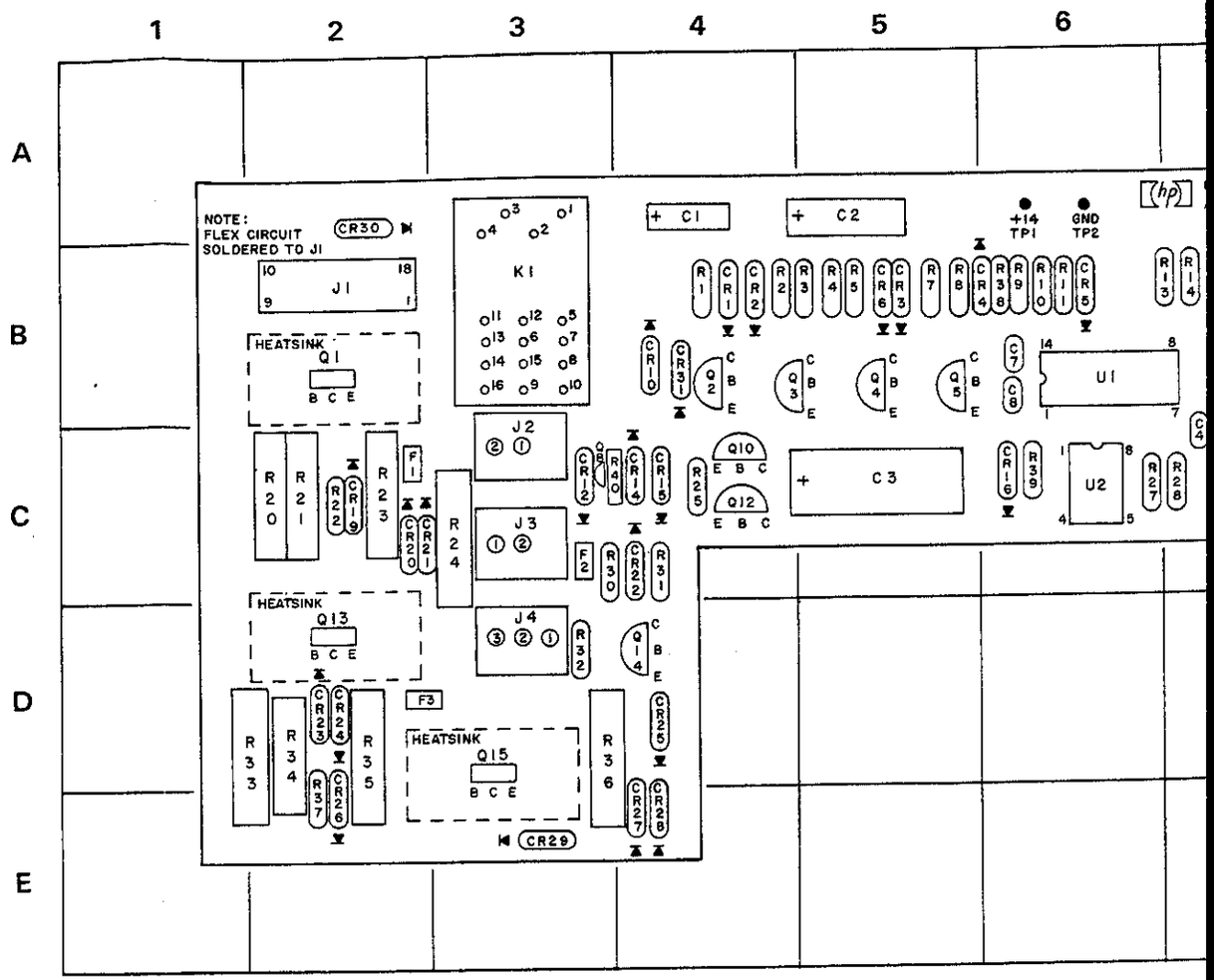


NOTES:

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN MICROFARADS
   INDUCTANCE IN HENRIES
3. ASTERISK (*) INDICATES FACTORY SELECTED COMPONENT, AVERAGE VALUE SHOWN.
4. UNLESS OTHERWISE INDICATED; ALL GROUNDS ARE DIGITAL GROUNDS.

Figure 8-34.
A4 Transmitter Board Schematic Diagram
(Sheet 2 of 2)

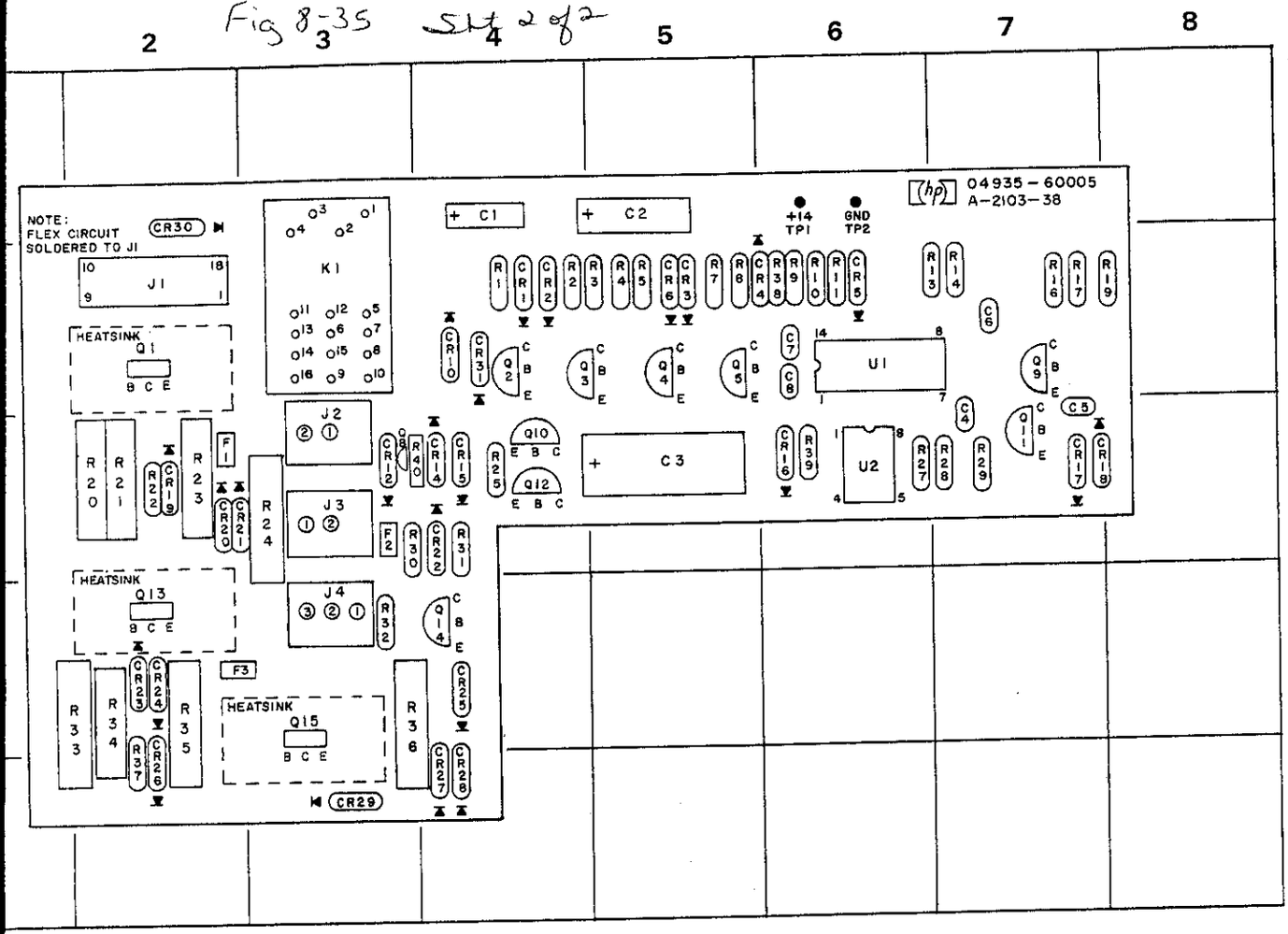
Fig 8-35
Sht 1 of 2



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	A-4	CR5	B-6	CR22	C-4	J1	B-2	Q10	C-4	R7	B-5
C2	A-5	CR6	B-5	CR23	D-2	J2	C-3	Q11	C-7	R8	B-5
C3	C-5	CR10	B-4	CR24	D-2	J3	C-3	Q12	C-4	R9	B-6
C4	C-7	CR12	C-3	CR26	E-2	J4	D-3	Q13	D-2	R10	B-6
C5	C-7	CR14	C-4	CR27	E-4	K1	B-3	Q14	D-4	R11	B-6
C6	B-7	CR15	C-4	CR28	E-4	Q1	B-2	Q15	D-3	R13	B-7
C7	B-6	CR16	C-6	CR29	E-3	Q2	B-4	R1	B-4	R14	B-7
C8	B-6	CR17	C-7	CR30	A-2	Q3	B-4	R2	B-4	R16	B-7
CR1	B-4	CR18	C-7	CR31	B-4	Q4	B-5	R3	B-5	R17	B-7
CR2	B-4	CR19	C-2	F1	C-2	Q5	B-5	R4	B-5	R19	B-8
CR3	B-5	CR20	C-2	F2	C-3	Q8	C-3	R5	B-5	R20	C-2
CR4	B-6	CR21	C-2	F3	D-2	Q9	B-7				

Figure 8-35. A5 Charger Board Component Locator

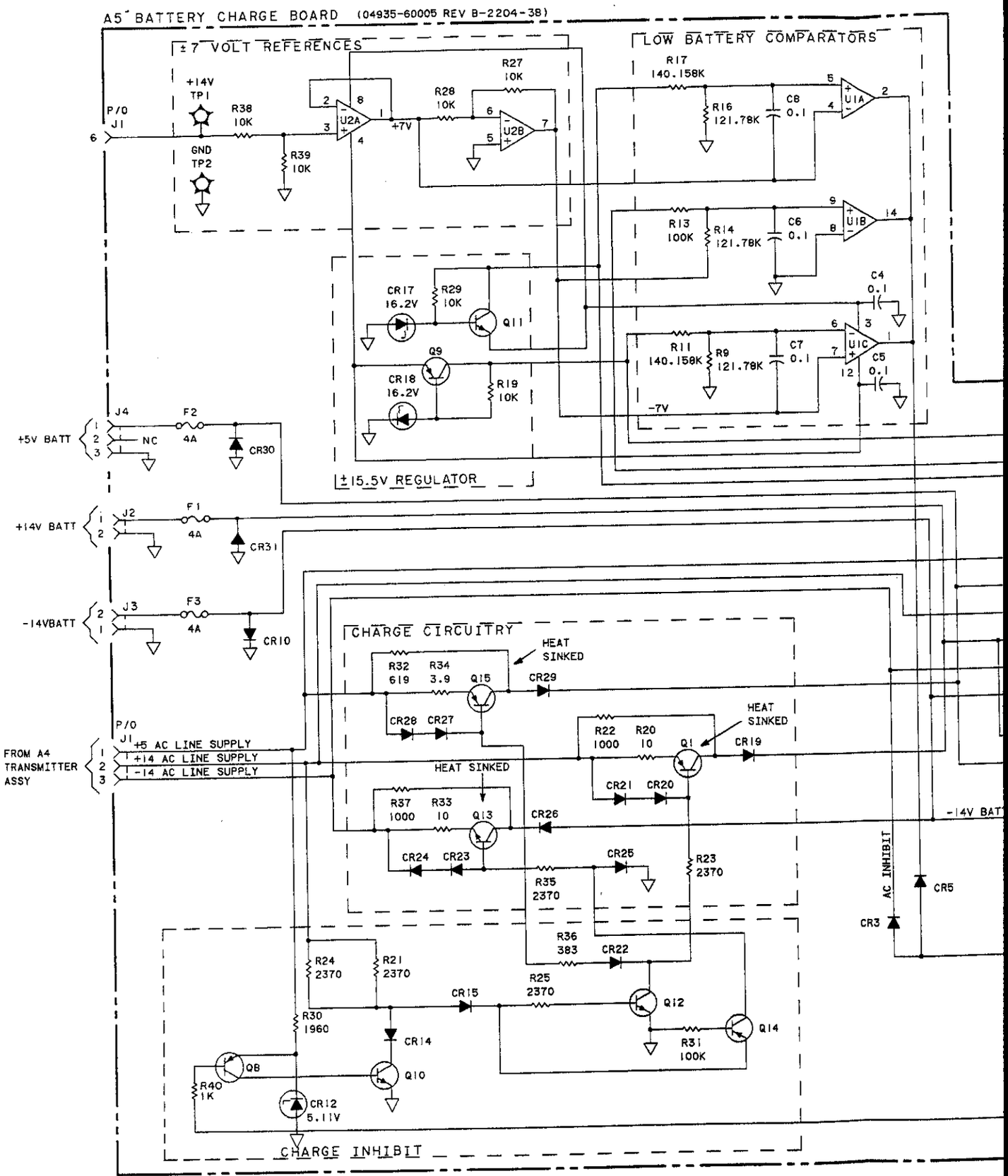
Fig 8-35 Sht 2 of 2



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	A-4	CR5	B-6	CR22	C-4	J1	B-2	Q10	C-4	R7	B-5	R21	C-2	R34	D-2
C2	A-5	CR6	B-5	CR23	D-2	J2	C-3	Q11	C-7	R8	B-5	R22	C-2	R35	D-2
C3	C-5	CR10	B-4	CR24	D-2	J3	C-3	Q12	C-4	R9	B-6	R23	C-2	R36	D-3
C4	C-7	CR12	C-3	CR26	E-2	J4	D-3	Q13	D-2	R10	B-6	R24	C-3	R37	E-2
C5	C-7	CR14	C-4	CR27	E-4	K1	B-3	Q14	D-4	R11	B-6	R25	C-4	R38	B-6
C6	B-7	CR15	C-4	CR28	E-4	Q1	B-2	Q15	D-3	R13	B-7	R27	C-6	R39	C-6
C7	B-6	CR16	C-6	CR29	E-3	Q2	B-4	R1	B-4	R14	B-7	R28	C-7	R40	C-3
C8	B-6	CR17	C-7	CR30	A-2	Q3	B-4	R2	B-4	R16	B-7	R29	C-7	TP1	A-6
CR1	B-4	CR18	C-7	CR31	B-4	Q4	B-5	R3	B-5	R17	B-7	R31	C-4	TP2	A-6
CR2	B-4	CR19	C-2	F1	C-2	Q5	B-5	R4	B-5	R19	B-8	R32	D-3	U1	B-6
CR3	B-5	CR20	C-2	F2	C-3	Q8	C-3	R5	B-5	R20	C-2	R33	D-1	U2	C-6
CR4	B-6	CR21	C-2	F3	D-2	Q9	B-7								

Figure 8-35. A5 Charger Board Component Locator

Fig 8-36 Sht 1 of 2



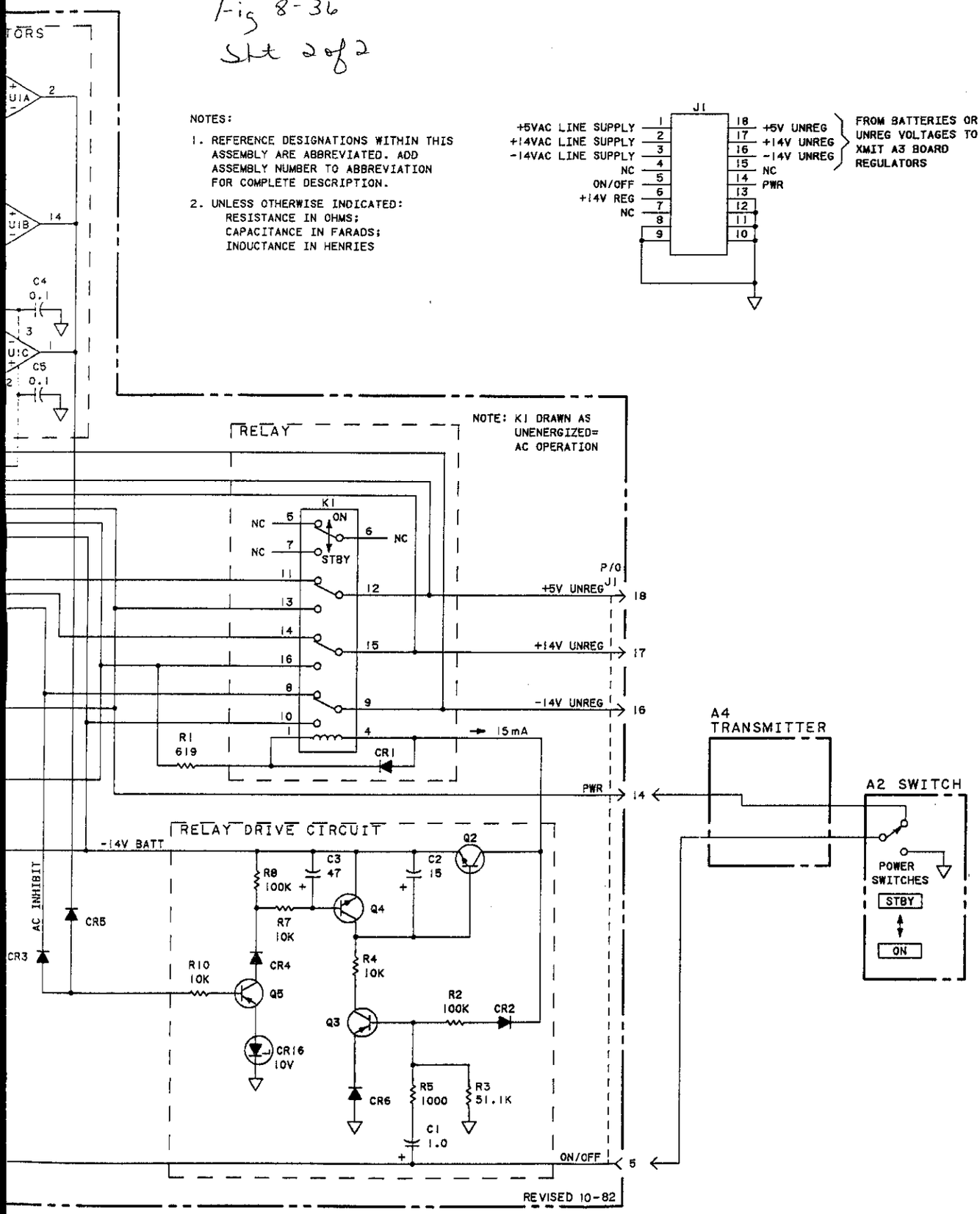


Figure 8-36.
A5 Charger Board Schematic Diagram
8-77/(8-78 blank)