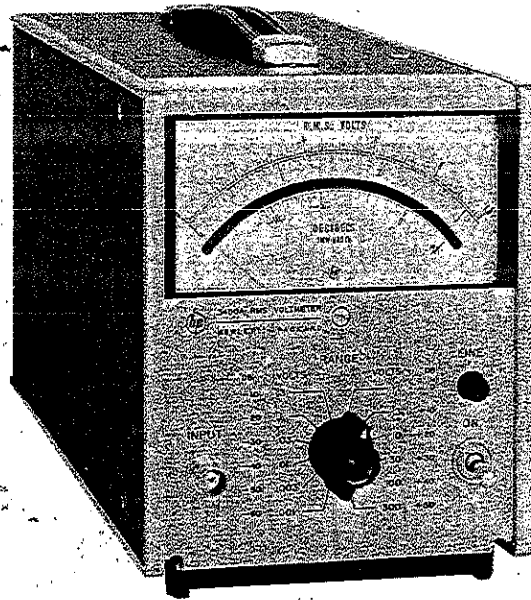


OPERATING AND SERVICE MANUAL

**3400A
RMS VOLTMETER**



 **HEWLETT
PACKARD**

hp-3400A



HEWLETT
PACKARD

OPERATING AND SERVICE MANUAL

MODEL 3400A RMS VOLTMETER

SERIAL NUMBERS

This manual applies directly to instruments with a serial number prefix of 2225.

WARNING

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

Manual Part Number 03400-90012
Microfiche Part Number 03400-90062

© Copyright Hewlett-Packard Company 1965
P.O. Box 301, Loveland, Colorado 80537 U.S.A.

Printed: January 1983



CERTIFICATION

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

WARRANTY

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

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

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

LIMITATION OF WARRANTY

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

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

EXCLUSIVE REMEDIES

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

ASSISTANCE

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

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

TABLE OF CONTENTS

<table border="0" style="width: 100%;"> <thead> <tr> <th style="text-align: left;">Section</th> <th style="text-align: right;">Page</th> </tr> </thead> <tbody> <tr> <td colspan="2">I. GENERAL INFORMATION</td> </tr> <tr> <td>1-1. Introduction.....</td> <td style="text-align: right;">1-1</td> </tr> <tr> <td>1-3. Description and Purpose.....</td> <td style="text-align: right;">1-1</td> </tr> <tr> <td>1-8. Specifications.....</td> <td style="text-align: right;">1-1</td> </tr> <tr> <td>1-10. Instrument and Manual Identification.....</td> <td style="text-align: right;">1-1</td> </tr> <tr> <td>1-12. Equipment Supplied.....</td> <td style="text-align: right;">1-1</td> </tr> <tr> <td>1-14. Accessory Equipment Available.....</td> <td style="text-align: right;">1-3</td> </tr> </tbody> </table> <table border="0" style="width: 100%;"> <thead> <tr> <th style="text-align: left;">Section</th> <th style="text-align: right;">Page</th> </tr> </thead> <tbody> <tr> <td colspan="2">II. INSTALLATION</td> </tr> <tr> <td>2-1. Introduction.....</td> <td style="text-align: right;">2-1</td> </tr> <tr> <td>2-3. Initial Inspection.....</td> <td style="text-align: right;">2-1</td> </tr> <tr> <td>2-5. Power Requirements.....</td> <td style="text-align: right;">2-1</td> </tr> <tr> <td>2-8. Installation.....</td> <td style="text-align: right;">2-1</td> </tr> <tr> <td>2-10. Combining Case (-hp- Models 1051A or 1052A).....</td> <td style="text-align: right;">2-1</td> </tr> <tr> <td>2-12. Adapter Frame (-hp- Part No. 5060-0797).....</td> <td style="text-align: right;">2-2</td> </tr> <tr> <td>2-14. Repackaging for Shipment.....</td> <td style="text-align: right;">2-2</td> </tr> </tbody> </table> <table border="0" style="width: 100%;"> <thead> <tr> <th style="text-align: left;">Section</th> <th style="text-align: right;">Page</th> </tr> </thead> <tbody> <tr> <td colspan="2">III. OPERATING INSTRUCTIONS</td> </tr> <tr> <td>3-1. Introduction.....</td> <td style="text-align: right;">3-1</td> </tr> <tr> <td>3-3. Controls and Indicators.....</td> <td style="text-align: right;">3-1</td> </tr> <tr> <td>3-5. Turn on Procedure.....</td> <td style="text-align: right;">3-1</td> </tr> <tr> <td>3-7. Operating Instruction.....</td> <td style="text-align: right;">3-1</td> </tr> <tr> <td>3-9. Applications.....</td> <td style="text-align: right;">3-2</td> </tr> <tr> <td>3-11. RMS Value of AC Signals with DC Component.....</td> <td style="text-align: right;">3-2</td> </tr> <tr> <td>3-13. RMS Current.....</td> <td style="text-align: right;">3-2</td> </tr> <tr> <td>3-15. RMS AC-to-DC Converter.....</td> <td style="text-align: right;">3-2</td> </tr> </tbody> </table> <table border="0" style="width: 100%;"> <thead> <tr> <th style="text-align: left;">Section</th> <th style="text-align: right;">Page</th> </tr> </thead> <tbody> <tr> <td colspan="2">IV. THEORY OF OPERATION</td> </tr> <tr> <td>4-1. Introduction.....</td> <td style="text-align: right;">4-1</td> </tr> <tr> <td>4-3. General Description.....</td> <td style="text-align: right;">4-1</td> </tr> <tr> <td>4-11. Detailed Description.....</td> <td style="text-align: right;">4-2</td> </tr> <tr> <td>4-12. Input Attenuator Assembly A1.....</td> <td style="text-align: right;">4-2</td> </tr> <tr> <td>4-15. Impedance Converter Assembly A2.....</td> <td style="text-align: right;">4-3</td> </tr> <tr> <td>4-19. Second Attenuator Assembly A3.....</td> <td style="text-align: right;">4-3</td> </tr> <tr> <td>4-22. Video Amplifier Assembly A4.....</td> <td style="text-align: right;">4-3</td> </tr> <tr> <td>4-27. Chopper Op Amp Assembly A6 and Thermocouple Pair (Part of A4).....</td> <td style="text-align: right;">4-4</td> </tr> <tr> <td>4-36. Power Supply Assembly A7.....</td> <td style="text-align: right;">4-5</td> </tr> <tr> <td>4-39. Regulator Operation.....</td> <td style="text-align: right;">4-5</td> </tr> <tr> <td>4-41. +75 Volt Supply.....</td> <td style="text-align: right;">4-5</td> </tr> <tr> <td>4-43. -17.5 Volt Supply.....</td> <td style="text-align: right;">4-5</td> </tr> <tr> <td>4-45. -6.3 Volt Supply.....</td> <td style="text-align: right;">4-5</td> </tr> </tbody> </table>	Section	Page	I. GENERAL INFORMATION		1-1. Introduction.....	1-1	1-3. Description and Purpose.....	1-1	1-8. Specifications.....	1-1	1-10. Instrument and Manual Identification.....	1-1	1-12. Equipment Supplied.....	1-1	1-14. Accessory Equipment Available.....	1-3	Section	Page	II. INSTALLATION		2-1. Introduction.....	2-1	2-3. Initial Inspection.....	2-1	2-5. Power Requirements.....	2-1	2-8. Installation.....	2-1	2-10. Combining Case (-hp- Models 1051A or 1052A).....	2-1	2-12. Adapter Frame (-hp- Part No. 5060-0797).....	2-2	2-14. Repackaging for Shipment.....	2-2	Section	Page	III. OPERATING INSTRUCTIONS		3-1. Introduction.....	3-1	3-3. Controls and Indicators.....	3-1	3-5. Turn on Procedure.....	3-1	3-7. Operating Instruction.....	3-1	3-9. Applications.....	3-2	3-11. RMS Value of AC Signals with DC Component.....	3-2	3-13. RMS Current.....	3-2	3-15. RMS AC-to-DC Converter.....	3-2	Section	Page	IV. THEORY OF OPERATION		4-1. Introduction.....	4-1	4-3. General Description.....	4-1	4-11. Detailed Description.....	4-2	4-12. Input Attenuator Assembly A1.....	4-2	4-15. Impedance Converter Assembly A2.....	4-3	4-19. Second Attenuator Assembly A3.....	4-3	4-22. Video Amplifier Assembly A4.....	4-3	4-27. Chopper Op Amp Assembly A6 and Thermocouple Pair (Part of A4).....	4-4	4-36. Power Supply Assembly A7.....	4-5	4-39. Regulator Operation.....	4-5	4-41. +75 Volt Supply.....	4-5	4-43. -17.5 Volt Supply.....	4-5	4-45. -6.3 Volt Supply.....	4-5		<table border="0" style="width: 100%;"> <thead> <tr> <th style="text-align: left;">Section</th> <th style="text-align: right;">Page</th> </tr> </thead> <tbody> <tr> <td colspan="2">V. MAINTENANCE</td> </tr> <tr> <td>5-1. Introduction.....</td> <td style="text-align: right;">5-1</td> </tr> <tr> <td>5-3. Test Equipment.....</td> <td style="text-align: right;">5-1</td> </tr> <tr> <td>5-5. Performance Checks.....</td> <td style="text-align: right;">5-1</td> </tr> <tr> <td>5-7. Accuracy, Linearity, and DC Output Check.....</td> <td style="text-align: right;">5-1</td> </tr> <tr> <td>5-9. Frequency Response Check.....</td> <td style="text-align: right;">5-4</td> </tr> <tr> <td>5-10. Input Impedance Check.....</td> <td style="text-align: right;">5-5</td> </tr> <tr> <td>5-11. Resistance Check.....</td> <td style="text-align: right;">5-5</td> </tr> <tr> <td>5-12. Capacitance Check.....</td> <td style="text-align: right;">5-5</td> </tr> <tr> <td>5-13. Crest Factor Check.....</td> <td style="text-align: right;">5-6</td> </tr> <tr> <td>5-14. Output Noise Check.....</td> <td style="text-align: right;">5-7</td> </tr> <tr> <td>5-15. Adjustment and Calibration Procedures.....</td> <td style="text-align: right;">5-7</td> </tr> <tr> <td>5-17. Mechanical Meter Zero.....</td> <td style="text-align: right;">5-7</td> </tr> <tr> <td>5-19. Power Supply Checks.....</td> <td style="text-align: right;">5-8</td> </tr> <tr> <td>5-21. Low Frequency Calibration.....</td> <td style="text-align: right;">5-8</td> </tr> <tr> <td>5-22. Amplifier Offset Adjustment.....</td> <td style="text-align: right;">5-8</td> </tr> <tr> <td>5-23. Amplifier Gain Adjustment.....</td> <td style="text-align: right;">5-8</td> </tr> <tr> <td>5-24. 1/10 Scale Adjustment.....</td> <td style="text-align: right;">5-8</td> </tr> <tr> <td>5-25. 1 Volt Adjustment.....</td> <td style="text-align: right;">5-9</td> </tr> <tr> <td>5-26. High Frequency Calibration.....</td> <td style="text-align: right;">5-9</td> </tr> <tr> <td>5-27. Amplifier Gain Adjustment.....</td> <td style="text-align: right;">5-9</td> </tr> <tr> <td>5-28. Input Attenuator Adjustment.....</td> <td style="text-align: right;">5-10</td> </tr> <tr> <td>5-29. Second Attenuator Adjustment.....</td> <td style="text-align: right;">5-11</td> </tr> <tr> <td>5-30. Troubleshooting Procedures.....</td> <td style="text-align: right;">5-11</td> </tr> <tr> <td>5-35. Checking Thermocouples TC410 and TC402.....</td> <td style="text-align: right;">5-12</td> </tr> <tr> <td>5-38. Thermocouple Replacement.....</td> <td style="text-align: right;">5-14</td> </tr> <tr> <td>5-40. Servicing Etched Circuit Boards.....</td> <td style="text-align: right;">5-15</td> </tr> <tr> <td>5-43. A6 Assembly (03400-66512) Retrofit Procedure.....</td> <td style="text-align: right;">5-16</td> </tr> </tbody> </table> <table border="0" style="width: 100%;"> <thead> <tr> <th style="text-align: left;">Section</th> <th style="text-align: right;">Page</th> </tr> </thead> <tbody> <tr> <td colspan="2">VI. CIRCUIT DIAGRAMS</td> </tr> <tr> <td>6-1. Introduction.....</td> <td style="text-align: right;">6-1</td> </tr> <tr> <td>6-3. Schematic Diagrams.....</td> <td style="text-align: right;">6-1</td> </tr> <tr> <td>6-6. Parts Location Diagrams.....</td> <td style="text-align: right;">6-1</td> </tr> </tbody> </table> <table border="0" style="width: 100%;"> <thead> <tr> <th style="text-align: left;">Section</th> <th style="text-align: right;">Page</th> </tr> </thead> <tbody> <tr> <td colspan="2">VII. REPLACEABLE PARTS</td> </tr> <tr> <td>7-1. Introduction.....</td> <td style="text-align: right;">7-1</td> </tr> <tr> <td>7-4. Ordering Information.....</td> <td style="text-align: right;">7-1</td> </tr> <tr> <td>7-6. Non-Listed Parts.....</td> <td style="text-align: right;">7-1</td> </tr> </tbody> </table> <p style="margin-left: 20px;">APPENDIX</p>	Section	Page	V. MAINTENANCE		5-1. Introduction.....	5-1	5-3. Test Equipment.....	5-1	5-5. Performance Checks.....	5-1	5-7. Accuracy, Linearity, and DC Output Check.....	5-1	5-9. Frequency Response Check.....	5-4	5-10. Input Impedance Check.....	5-5	5-11. Resistance Check.....	5-5	5-12. Capacitance Check.....	5-5	5-13. Crest Factor Check.....	5-6	5-14. Output Noise Check.....	5-7	5-15. Adjustment and Calibration Procedures.....	5-7	5-17. Mechanical Meter Zero.....	5-7	5-19. Power Supply Checks.....	5-8	5-21. Low Frequency Calibration.....	5-8	5-22. Amplifier Offset Adjustment.....	5-8	5-23. Amplifier Gain Adjustment.....	5-8	5-24. 1/10 Scale Adjustment.....	5-8	5-25. 1 Volt Adjustment.....	5-9	5-26. High Frequency Calibration.....	5-9	5-27. Amplifier Gain Adjustment.....	5-9	5-28. Input Attenuator Adjustment.....	5-10	5-29. Second Attenuator Adjustment.....	5-11	5-30. Troubleshooting Procedures.....	5-11	5-35. Checking Thermocouples TC410 and TC402.....	5-12	5-38. Thermocouple Replacement.....	5-14	5-40. Servicing Etched Circuit Boards.....	5-15	5-43. A6 Assembly (03400-66512) Retrofit Procedure.....	5-16	Section	Page	VI. CIRCUIT DIAGRAMS		6-1. Introduction.....	6-1	6-3. Schematic Diagrams.....	6-1	6-6. Parts Location Diagrams.....	6-1	Section	Page	VII. REPLACEABLE PARTS		7-1. Introduction.....	7-1	7-4. Ordering Information.....	7-1	7-6. Non-Listed Parts.....	7-1
Section	Page																																																																																																																																																																			
I. GENERAL INFORMATION																																																																																																																																																																				
1-1. Introduction.....	1-1																																																																																																																																																																			
1-3. Description and Purpose.....	1-1																																																																																																																																																																			
1-8. Specifications.....	1-1																																																																																																																																																																			
1-10. Instrument and Manual Identification.....	1-1																																																																																																																																																																			
1-12. Equipment Supplied.....	1-1																																																																																																																																																																			
1-14. Accessory Equipment Available.....	1-3																																																																																																																																																																			
Section	Page																																																																																																																																																																			
II. INSTALLATION																																																																																																																																																																				
2-1. Introduction.....	2-1																																																																																																																																																																			
2-3. Initial Inspection.....	2-1																																																																																																																																																																			
2-5. Power Requirements.....	2-1																																																																																																																																																																			
2-8. Installation.....	2-1																																																																																																																																																																			
2-10. Combining Case (-hp- Models 1051A or 1052A).....	2-1																																																																																																																																																																			
2-12. Adapter Frame (-hp- Part No. 5060-0797).....	2-2																																																																																																																																																																			
2-14. Repackaging for Shipment.....	2-2																																																																																																																																																																			
Section	Page																																																																																																																																																																			
III. OPERATING INSTRUCTIONS																																																																																																																																																																				
3-1. Introduction.....	3-1																																																																																																																																																																			
3-3. Controls and Indicators.....	3-1																																																																																																																																																																			
3-5. Turn on Procedure.....	3-1																																																																																																																																																																			
3-7. Operating Instruction.....	3-1																																																																																																																																																																			
3-9. Applications.....	3-2																																																																																																																																																																			
3-11. RMS Value of AC Signals with DC Component.....	3-2																																																																																																																																																																			
3-13. RMS Current.....	3-2																																																																																																																																																																			
3-15. RMS AC-to-DC Converter.....	3-2																																																																																																																																																																			
Section	Page																																																																																																																																																																			
IV. THEORY OF OPERATION																																																																																																																																																																				
4-1. Introduction.....	4-1																																																																																																																																																																			
4-3. General Description.....	4-1																																																																																																																																																																			
4-11. Detailed Description.....	4-2																																																																																																																																																																			
4-12. Input Attenuator Assembly A1.....	4-2																																																																																																																																																																			
4-15. Impedance Converter Assembly A2.....	4-3																																																																																																																																																																			
4-19. Second Attenuator Assembly A3.....	4-3																																																																																																																																																																			
4-22. Video Amplifier Assembly A4.....	4-3																																																																																																																																																																			
4-27. Chopper Op Amp Assembly A6 and Thermocouple Pair (Part of A4).....	4-4																																																																																																																																																																			
4-36. Power Supply Assembly A7.....	4-5																																																																																																																																																																			
4-39. Regulator Operation.....	4-5																																																																																																																																																																			
4-41. +75 Volt Supply.....	4-5																																																																																																																																																																			
4-43. -17.5 Volt Supply.....	4-5																																																																																																																																																																			
4-45. -6.3 Volt Supply.....	4-5																																																																																																																																																																			
Section	Page																																																																																																																																																																			
V. MAINTENANCE																																																																																																																																																																				
5-1. Introduction.....	5-1																																																																																																																																																																			
5-3. Test Equipment.....	5-1																																																																																																																																																																			
5-5. Performance Checks.....	5-1																																																																																																																																																																			
5-7. Accuracy, Linearity, and DC Output Check.....	5-1																																																																																																																																																																			
5-9. Frequency Response Check.....	5-4																																																																																																																																																																			
5-10. Input Impedance Check.....	5-5																																																																																																																																																																			
5-11. Resistance Check.....	5-5																																																																																																																																																																			
5-12. Capacitance Check.....	5-5																																																																																																																																																																			
5-13. Crest Factor Check.....	5-6																																																																																																																																																																			
5-14. Output Noise Check.....	5-7																																																																																																																																																																			
5-15. Adjustment and Calibration Procedures.....	5-7																																																																																																																																																																			
5-17. Mechanical Meter Zero.....	5-7																																																																																																																																																																			
5-19. Power Supply Checks.....	5-8																																																																																																																																																																			
5-21. Low Frequency Calibration.....	5-8																																																																																																																																																																			
5-22. Amplifier Offset Adjustment.....	5-8																																																																																																																																																																			
5-23. Amplifier Gain Adjustment.....	5-8																																																																																																																																																																			
5-24. 1/10 Scale Adjustment.....	5-8																																																																																																																																																																			
5-25. 1 Volt Adjustment.....	5-9																																																																																																																																																																			
5-26. High Frequency Calibration.....	5-9																																																																																																																																																																			
5-27. Amplifier Gain Adjustment.....	5-9																																																																																																																																																																			
5-28. Input Attenuator Adjustment.....	5-10																																																																																																																																																																			
5-29. Second Attenuator Adjustment.....	5-11																																																																																																																																																																			
5-30. Troubleshooting Procedures.....	5-11																																																																																																																																																																			
5-35. Checking Thermocouples TC410 and TC402.....	5-12																																																																																																																																																																			
5-38. Thermocouple Replacement.....	5-14																																																																																																																																																																			
5-40. Servicing Etched Circuit Boards.....	5-15																																																																																																																																																																			
5-43. A6 Assembly (03400-66512) Retrofit Procedure.....	5-16																																																																																																																																																																			
Section	Page																																																																																																																																																																			
VI. CIRCUIT DIAGRAMS																																																																																																																																																																				
6-1. Introduction.....	6-1																																																																																																																																																																			
6-3. Schematic Diagrams.....	6-1																																																																																																																																																																			
6-6. Parts Location Diagrams.....	6-1																																																																																																																																																																			
Section	Page																																																																																																																																																																			
VII. REPLACEABLE PARTS																																																																																																																																																																				
7-1. Introduction.....	7-1																																																																																																																																																																			
7-4. Ordering Information.....	7-1																																																																																																																																																																			
7-6. Non-Listed Parts.....	7-1																																																																																																																																																																			

LIST OF TABLES

Table	Page
1-1. Model 3400A Specifications.....	1-2
1-2. Equipment Supplied.....	1-3
1-3. Accessory Equipment Available.....	1-3
5-1. Required Test Equipment.....	5-2
5-2. Accuracy, Linearity, and DC Output Check Data.....	5-3
5-3. Frequency Response Check.....	5-4
5-4. Power Supply Checks.....	5-9
5-5. Front Panel Symptoms.....	5-12
5-6. Troubleshooting Procedure.....	5-13
5-7. Factory Selected Components.....	5-15
7-1. List of Abbreviations.....	7-2

LIST OF ILLUSTRATIONS

Figure	Page
1-1. 3400 RMS Voltmeter.....	1-2
3-1. Model 3400A Controls and Indicators.....	3-3
4-1. Block Diagram.....	4-2
5-1. Accuracy, Linearity, and DC Output Test Setup.....	5-3
5-2. Frequency Response Test Setup.....	5-4
5-3. Input Impedance Test Setup.....	5-5
5-4. Crest Factor Test Setup.....	5-6
5-5. Troubleshooting Tree.....	5-13
5-6. Input to Demodulator.....	5-14
6-1. Input Attenuator A1, Impedance Converter A2, and Second Attenuator A3 Schematic and Parts Location Diagram.....	6-3/6-4
6-2. Video Amplifier A4, Schematic and Parts Location Diagram.....	6-5/6-6
6-3. Chopper Amplifier A6 and Thermocouple Pair (Part of A4) Schematic and Parts Location Diagram.....	6-7/6-8
6-4. Power Supply A7, Schematic and Parts Location Diagram.....	6-9/6-10
7-1. Modular Cabinet.....	7-3
7-2. Code List of Manufacturers.....	7-2
A-1. Chopper Amplifier A6 and Thermocouple Pair (Part of A4) Schematic and Parts Location Diagram.....	A-1



SAFETY SUMMARY

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

GROUND THE INSTRUMENT

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

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE

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

KEEP AWAY FROM LIVE CIRCUITS

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

DO NOT SERVICE OR ADJUST ALONE

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

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT

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

DANGEROUS PROCEDURE WARNINGS

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

WARNING

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

SAFETY SYMBOLS

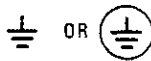
General Definitions of Safety Symbols Used On Equipment or In Manuals.



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



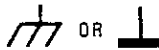
Indicates dangerous voltage (terminals fed from the interior by voltage exceeding 1000 volts must be so marked).



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



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



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



Alternating current (power line).



Direct current (power line).



Alternating or direct current (power line).

WARNING

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

CAUTION

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

NOTE:

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

SECTION I

GENERAL INFORMATION

1-1. INTRODUCTION

1-2. This section contains general information about the Model 3400A RMS Voltmeter (Figure 1-1). Included are: description of instrument, purpose, instrument identification, equipment supplied and accessory equipment available. Also included is a table of instrument specifications.

1-3. DESCRIPTION AND PURPOSE

1-4. The Model 3400A RMS Voltmeter measures the actual root-means-square (RMS) value of ac voltages between 100 microvolts and 300 volts. Frequency range is from 10 Hz to 10 MHz. Full scale measurements of nonsinusoidal waveforms with crest factors (ratio of peak voltage to rms voltage) of 10 can be made.

1-5. Ac voltages are measured with a specified full-scale accuracy of $\pm 1\%$ from 50 Hz to 1 MHz, $\pm 2\%$ from 1 MHz to 2 MHz, $\pm 3\%$ from 2 MHz to 3 MHz, and $\pm 5\%$ from 10 Hz to 50 Hz and 3 MHz to 10 MHz. A single front panel control selects one of 12 voltage or decibel ranges.

1-6. The Model 3400A crest factor rating is 10:1 which enables full scale readings for pulses which have a 1% duty cycle. At 1/10th of full scale, pulse trains with 0.01% duty cycle (100:1 crest factor) can be accurately measured.

1-7. The Model 3400A provides a dc output which is proportional to the front panel meter reading. By using this voltage to drive auxiliary equipment, the Model 3400A functions as an rms ac-to-dc converter.

1-8. SPECIFICATIONS

1-9. Table 1-1 contains the specifications for the Model 3400A.

1-10. INSTRUMENT AND MANUAL IDENTIFICATION

1-11. Hewlett-Packard uses a two-section serial number. If the first section (serial prefix) of the serial number on your instrument does not agree with those on the title page of this manual, change sheets supplied with the manual will define the differences between your instrument and the Model 3400A described in this manual. Some serial numbers may have a letter separating the two sections of the number. This letter indicates the country in which the instrument was manufactured.

1-12. EQUIPMENT SUPPLIED

1-13. The equipment supplied with each Model 3400A is listed and described in Table 1-2.

Table 1-1. Model 3400A Specifications

<p>VOLTAGE RANGE: 1 mV to 300 V full scale, 12 ranges.</p> <p>DB RANGE: -72 to +52 dBm (0 dBm = 1 mW in 600Ω).</p> <p>FREQUENCY RANGE: 10 Hz to 10 MHz.</p> <p>RESPONSE: Responds to rms value (heating value) of input signal.</p> <p>METER ACCURACY:* from 1/10 scale to full scale is % of Full Scale (20°C to 30°C)**</p> <table border="1"> <tr> <td>10Hz</td> <td>50Hz</td> <td>1MHz</td> <td>2MHz</td> <td>3MHz</td> <td>10MHz</td> </tr> <tr> <td>±5%</td> <td>±1%</td> <td>±2%</td> <td>±3%</td> <td>±3%</td> <td>±5%</td> </tr> </table> <p>AC-to-DC CONVERTER ACCURACY: % of Full Scale (20°C to 30°C)*</p> <table border="1"> <tr> <td>10Hz</td> <td>50Hz</td> <td>1MHz</td> <td>2MHz</td> <td>3MHz</td> <td>10MHz</td> </tr> <tr> <td>±5%</td> <td>±0.75%</td> <td>±2%</td> <td>±3%</td> <td>±3%</td> <td>±5%</td> </tr> </table> <p>OUTPUT: Negative 1 V dc into open circuit for full-scale deflection, proportional to meter deflection; 1mA maximum; nominal source impedance 1000Ω.</p> <p>OUTPUT NOISE: < 1 mV RMS.</p>	10Hz	50Hz	1MHz	2MHz	3MHz	10MHz	±5%	±1%	±2%	±3%	±3%	±5%	10Hz	50Hz	1MHz	2MHz	3MHz	10MHz	±5%	±0.75%	±2%	±3%	±3%	±5%	<p>CREST FACTOR: (ratio of peak-to-rms amplitude of input signal): 10:1 at full scale (except where limited by maximum input), inversely proportional to meter deflection (e.g., 20:1 at half-scale, 100:1 at tenth-scale).</p> <p>INPUT IMPEDANCE 0.001 V to 0.3 V range; 10 MΩ shunted by < 50 pF; 1.0 V to 300 V range; 10 MΩ shunted by < 20 pF. AC-coupled input.</p> <p>AC OVERLOAD: 30dB above full scale or 800 V peak, whichever is less, on each range.</p> <p>MAXIMUM DC INPUT: 600 V on any range.</p> <p>RESPONSE TIME: For a step function, < 5 seconds to respond to final value.</p> <p>POWER: 115 or 230 V ± 10%, 48 to 440 Hz. approximately 7 watts.</p> <p>WEIGHT: Net 7 1/4 lbs. (3, 3kg); shipping 10 lbs. (5kg).</p> <p>OVERALL DIMENSIONS: 6 1/2" high; 5 1/8" wide; 11 1/16" deep.</p> <p>STORAGE TEMPERATURE: -10°C to +60°C.</p>
10Hz	50Hz	1MHz	2MHz	3MHz	10MHz																				
±5%	±1%	±2%	±3%	±3%	±5%																				
10Hz	50Hz	1MHz	2MHz	3MHz	10MHz																				
±5%	±0.75%	±2%	±3%	±3%	±5%																				

* The 3400A may show a zero offset with no voltage applied to the input terminals.

** Temperature Coefficient: ±.15%/°C over range of 0°C to 20°C and 30°C to 55°C.

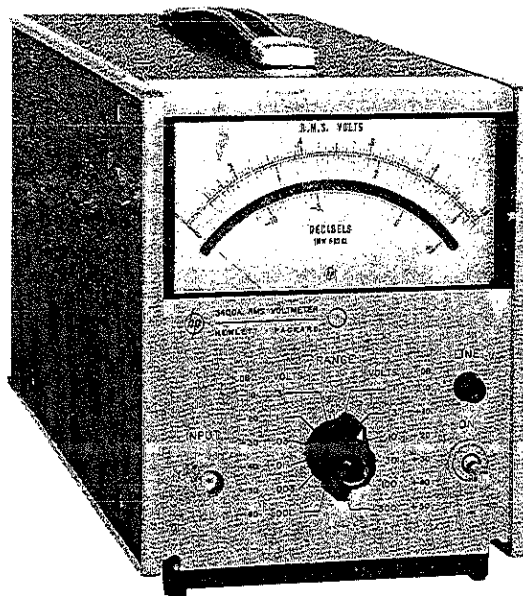


Figure 1-1. 3400 RMS Voltmeter

1-14. ACCESSORY EQUIPMENT AVAILABLE

1-15. The accessory equipment available is listed in Table 1-3. For further information contact your local -hp- Sales and Service Office.

Table 1-2. Equipment Supplied

Identification Number	Quantity	Description
10110B	1	Adapter (BNC to dual banana jack)
8120-1348	1	Power Cord
03400-90011	1	Operating and Service Manual

Table 1-3. Accessory Equipment Available

Identification Number	Description
10503A	Cable (Male BNC to male BNC, 48 inches)
11001A	Cable (Male BNC to dual banana plug, 45 inches)
11002A	Test Lead (dual banana plug to alligator clips, 60 inches)
11003A	Test Lead (dual banana plug to probe and alligator clip, 60 in.)
456A	Current Probe

SECTION II

INSTALLATION

2-1. INTRODUCTION

2-2. This section contains information and instructions necessary for installation and shipping of the -hp- Model 3400A RMS Voltmeter. Included are initial inspection procedures, power requirements, installation information, and instructions for repackaging for shipment.

2-3. INITIAL INSPECTION

2-4. The -hp- Model 3400A RMS Voltmeter received a careful mechanical and electrical inspection before shipment. As soon as the Model 3400A is received, verify that the contents are intact and as ordered. Although the instrument should be free of marks and scratches and in perfect electrical condition, it should be inspected for any physical damage which may have been incurred in transit. Also test the electrical performance of the instrument using the procedures given in paragraph 5-5. If any physical damage or electrical deficiency is found, refer to the warranty on the inside front cover of this manual. Should shipping of the instrument become necessary, refer to paragraph 2-14 for repackaging and shipping instructions.

2-5. POWER REQUIREMENTS

2-6. The Model 3400A can be operated from any ac source of 115- or 230- volts ($\pm 10\%$), at 48 to 440 cycles. With the instrument disconnected from the ac power source, move the slide switch (located on the rear panel) until the desired line voltage value appears. The ac line fuse is a 0.25 amp, fast blow type for 115- or 230-volt operation. Power dissipation is approximately 7 watts.

2-7. The Model 3400A is equipped with a three-prong power cord. To protect operating personnel, it is necessary to preserve the grounding feature of this plug when using a two contact ac outlet. Use a three-prong to two-prong adapter and connect the green pigtail lead on the adapter to ground.

2-8. INSTALLATION

2-9. The Model 3400A is a submodular unit suitable for bench top use. However, when used in combination with other submodular units it can be bench and/or rack mounted. The -hp- combining case and adapter frame are designed for this purpose.

2-10. Combining Case (-hp- Models 1051A or 1052A)

2-11. The combining case is a full-module unit which accepts various combinations of submodular units. Being a full-module unit, it can be bench or rack mounted and is analogous to any full-module instrument.

2-12. Adapter Frame (-hp- Part No. 5060-0797)

2-13. The adapter frame is a rack frame that accepts any combination of submodular units. It can be rack mounted only. For additional information, address inquiries to your -hp- Sales and Service Office.

2-14. REPACKAGING FOR SHIPMENT

2-15. The following paragraphs contain a general guide for repackaging for shipment. Refer to paragraph 2-16 if the original container is to be used; 2-17 if it is not. If you have any questions, contact your local -hp- Sales and Service Office.

NOTE

If the instrument is to be shipped to Hewlett-Packard for service or repair, attach a tag to the instrument identifying the owner and indicate the service or repair to be accomplished; include the model number and full serial number of the instrument. In any correspondence, identify the instrument by model number, serial number, and serial number prefix.

2-16. If original container is to be used, proceed as follows:

a. Place instrument in original container if available. If original container is not available, one can be purchased from your nearest -hp- Sales and Service Office.

b. Ensure that the container is well sealed with strong tape or metal bands.

2-17. If original container is not to be used, proceed as follows:

a. Wrap instrument in heavy paper or plastic before placing in an inner container.

b. Use packing material around all sides of instrument and protect panel face with cardboard strips.

c. Place instrument and inner container in a heavy carton or wooden box and seal with strong tape or metal bands.

d. Mark shipping container with "DELICATE INSTRUMENT," "FRAGILE," etc.

SECTION III

OPERATING INSTRUCTIONS

3-1. INTRODUCTION

3-2. This section consists of instructions and information necessary for the operation of the -hp- Model 3400A RMS Voltmeter. This section contains identification of controls and indicators, turn-on procedures, and operating instructions. Also included is a discussion of the applications for the Model 3400A.

3-3. CONTROLS AND INDICATORS

3-4. Each operating control, connector, and indicator located on the Model 3400A is identified and described in Figure 3-1. The description of each component is keyed to an illustration of that component which is included within the figure.

3-5. TURN ON PROCEDURE

3-6. To turn on the Model 3400A, proceed as follows:

- a. Set 115/230 switch (7, Figure 3-1) to correct position for input line voltage.
- b. Apply ac voltage to Model 3400A by plugging power cord into input power jack (8) ac receptacle.
- c. Operate power switch (4) to ON; ensure that LINE indicator (3) lights.

NOTE

Allow five minutes for the Model 3400A to warm up and stabilize before making a reading.

3-7. OPERATING INSTRUCTION

CAUTION

Do not measure signal above 80 volts with 10 to 1 crest factor. Otherwise, the maximum input rating (800 volts peak) will be exceeded. When measuring signals up to 80 volts RMS with a 10 to 1 crest factor, use the BNC to dual banana jack, accessory 10110A, supplied with the instrument, or other input test leads and connections that will withstand the maximum input of 800 volts peak.

3-8. To operate the Model 3400A as an rms voltmeter proceed as follows:

- a. Attach test lead to INPUT connector (6, Figure 3-1). (See Table 1-3 for a list of test leads available.)

- b. Set RANGE switch (5) to 300 VOLTS position.

CAUTION

When measuring an ac signal superimposed on a DC level, always set the range switch to the 300 volt position. A high voltage transient due to the application of a DC voltage will damage the input circuitry.

- c. Connect test lead to point to be measured.
- d. Rotate RANGE switch counterclockwise until meter (1) indicates on upper two thirds of scale.

3-9. APPLICATIONS

3-10. The Model 3400A can be used in conjunction with other test instruments to measure the rms value of ac signal with a dc component, measure rms current and act as an rms ac-to-dc converter. For additional information on special applications, contact your -hp- Sales and Service Office.

3-11. RMS Value Of AC Signals With DC Component

3-12. Since the 3400A is an ac device it will measure only the rms value of the ac component. If it is necessary to include the rms value of the dc component when measuring a signal use an -hp- Model 3468A Digital Multimeter to measure the dc component. Substitute the reading from the Model 3468A and Model 3400A in the following formula: The ac signal (up to 800V peak) may be superimposed on a dc level of up to 600 V.

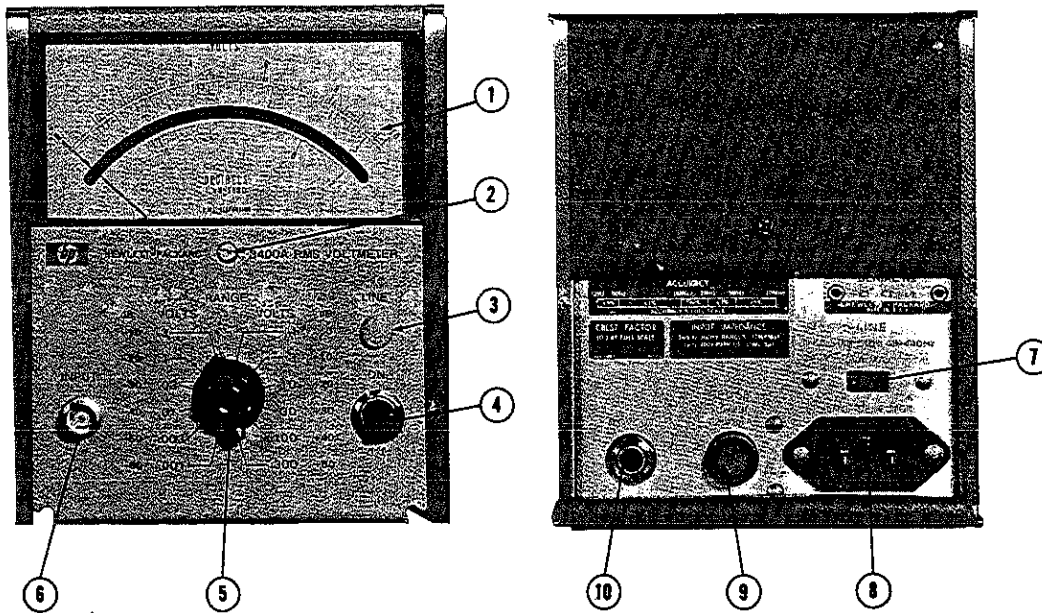
$$e_{rms} = \sqrt{e_{ac}^2 + e_{dc}^2}$$

3-13. RMS Current

3-14. To measure rms current, use an -hp- Model 456A AC Current Probe. This probe clips around the current conductor and provides an output voltage that is proportional to the current being measured. Using this method, rms currents of one milliampere to one ampere can be measured.

3-15. RMS AC-TO-DC Converter

3-16. Since the Model 3400A is provided with a dc output (10, Figure 3-1) which is proportional to the meter deflection, it can be used as a linear rms ac to dc converter. The dc output can be used to drive an -hp- Model 3468A Digital Multimeter for high resolution measurements and/or an -hp- Model 680 Strip Chart Recorder. External loading does not affect the meter accuracy so that both the meter and dc output can be used simultaneously. A plug for DC OUT jack may be purchased under -hp- Part No. 1251-0067.



- ① Direct reading meter: dc meter which indicates rms voltage level of input signal.
 - ② Mechanical zero adjustment: screwdriver adjustment for zero of direct reading meter.
 - ③ LINE ON pilot lamp: neon lamp which indicates when power is applied to instrument and power switch is ON.
 - ④ Power switch: two-position toggle switch which applies 115- or 230-volts ac to instrument.
 - ⑤ RANGE switch: 12-position rotary switch which selects various attenuation ranges available within Model 3400A.
 - ⑥ INPUT connector: BNC jack which enables application of input signal to instruments measuring circuits.
 - ⑦ 115/230-volt switch: two-position slide switch which sets instrument to operate from either a 115- or 230-volt ac source.
 - ⑧ Input power jack: three-prong jack which enables application of line voltage to instruments power supply circuits.
 - ⑨ 115V/230V .25A FUSE: 0.25 ampere fuse which provides protection against line voltage surges.
 - ⑩ DC OUT jack: telephone-type jack which provides negative 1-volt dc out at full scale deflection, output is proportional to meter deflection, output impedance is 1000 ohms.
- A telephone plug for the DC OUT jack may be purchased under -hp- Part No. 1251-0067.

Figure 3-1. Model 3400A Controls and Indicators

SECTION IV

THEORY OF OPERATION

4-1. INTRODUCTION

4-2. This section contains the theory of operation of the Model 3400A RMS Voltmeter. Included is a general and detailed description of the theory of operation.

4-3. GENERAL DESCRIPTION

4-4. The operation circuitry of the Model 3400A consists of two attenuators, an impedance converter, a video amplifier, a chopper op amp, a thermocouple pair, and a direct reading meter.

4-5. A signal being measured with the Model 3400A is applied to input attenuator A1 through the INPUT jack, located on the Model 3400A front panel. The input attenuator has an input impedance of over 10 megohms and provides two ranges of attenuation. The output of the input attenuator is applied to impedance converter A2. The impedance converter is a non-inverting unity voltage gain amplifier. It presents a high impedance to the input signal and provides a low impedance output to drive the second attenuator A3. The second attenuator provides 6 ranges in a 1, 3, 10 sequence. The two attenuators are switched to provide 12 ranges of attenuation.

4-6. The output of the second attenuator is amplified by video amplifier A4. The video amplifier is a wideband, five stage amplifier. The overall gain of the video amplifier is controlled by an ac feedback loop. The ac output of the amplifier is applied to TC401; one of the thermocouples of the thermocouple pair.

4-7. The dc output of TC401 is applied to the chopper op amp (U601) which modulates the voltage. The resultant modulated signal is then amplified and, after the amplification, the signal is demodulated back to dc volts. This voltage is the output of the chopper op amp. The value of the voltage is proportional to the dc input voltage.

4-8. The output of the chopper op amp is applied to a filter and also to TC402, the second thermocouple of the thermocouple pair. The output of the filter is applied to an output amp (A4) which is used to drive the meter (M1).

4-9. The thermocouple pair TC401 and TC402 acts as a summing point for the ac output of the video amplifier (A4) and the dc output of the chopper op amp. The difference in the heating effect of these voltages is the dc input to the chopper op amp. This difference input is amplified and is fed to TC402 and also, after going through the output amplifier (U602), to the meter (M1). This voltage represents the rms value of the ac signal applied to the 3400A's INPUT jack. By using two "matched" thermocouples and measuring the difference, the output of the chopper op amp will be linear. Using two thermocouples also provides temperature stability.

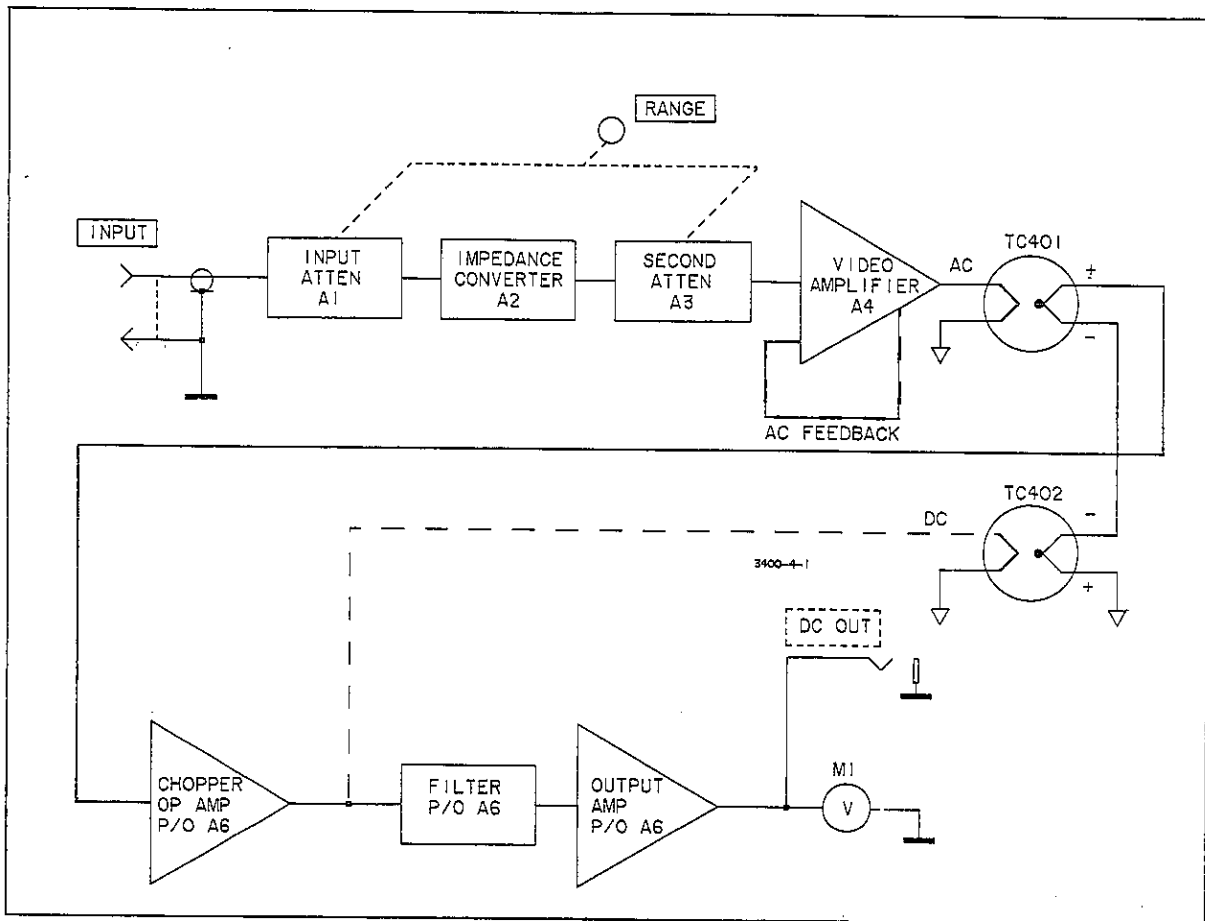


Figure 4-1. Block Diagram

4-10. The dc voltage driving meter M1 is also available at the DC OUT jack, located at the rear of the Model 3400A.

4-11. DETAILED DESCRIPTION

4-12. Input Attenuator Assembly A1

4-13. The input attenuator assembly is a capacitive-compensated attenuator which provides two ranges of attenuation for the 12 positions of the RANGE switch. See input attenuator schematic diagram illustrated on Figure 6-1.

4-14. When the RANGE switch is positioned to one of the six most sensitive ranges (.001 to .3 VOLTS), the attenuator output voltage is equal to the input voltage. When the RANGE switch is positioned to one of six highest ranges (1 to 300 VOLTS), the input signal is attenuated 60 dB (1000: 1 voltage division) by the resistive voltage divider consisting of R101, R103, and R104. Trimmer C102 is adjusted at 100 kHz, and R104 is adjusted at 400 Hz to provide constant attenuation over the input frequency range.

4-15. Impedance Converter Assembly A2

4-16. The impedance converter assembly utilizes a nuvistor tube cathode follower circuit to match the high output impedance of the input attenuator to the low input impedance of the second attenuator. The cathode follower circuit preserves the phase relationship of the input and output signals while maintaining a gain of unity. See impedance converter assembly schematic diagram illustrated on Figure 6-1.

4-17. The ac signal input to the impedance converter is RC coupled to the grid of cathode follower V201 through C201 and R203. The output signal is developed by Q201 which acts as a variable resistance in the cathode circuit of V201. The bootstrap feedback from the cathode of V201 to R203 increases the effective resistance of R203 to the input signal. This prevents R203 from loading the input signal and preserves the high input impedance of the Model 3400A. The gain compensating feedback from the plate of V201 to the base of Q201 compensates for any varying gain in V201 due to age or replacement.

4-18. Breakdown diode CR201 controls the grid bias voltage on V201 thereby establishing the operating point of this stage. CR202 and R211 across the base-emitter junction of Q201 protects Q201 in the event of a failure in the +75 volt power supply. Regulated dc is supplied to V201 filaments to avoid inducing ac hum in the signal path. This also prevents the gain of V201 changing with line voltage variations.

4-19. Second Attenuator Assembly A3

4-20. The second attenuator is a resistive divider which attenuates the ac input signal while maintaining a low impedance output for the following amplification stages. See second attenuator assembly schematic diagram illustrated in Figure 6-1.

4-21. The ac input signal is applied to a precision resistance voltage divider consisting of R302 through R312. These resistors are arranged to give six ranges of attenuation at 10 dB per range. The six ranges of the second attenuator combined with the two ranges of the input attenuator make up the 12 ranges of attenuation (0.001 to 300V). Trimmer capacitor C303 (10MHz 0.3V ADJ) provides an adjustment for frequency response at the higher frequencies.

4-22. Video Amplifier Assembly A4

4-23. The video amplifier functions to provide constant gain to the ac signal being measured over the entire frequency range of Model 3400A. See video amplifier assembly schematic diagram illustrated on Figure 6-2.

4-24. The ac input signal from the second attenuator is coupled through C402 to the base of input amplifier Q401. Q401, a class A amplifier, amplifies and inverts the signal which is then direct coupled to the base of bootstrap amplifier Q402. The output, taken from Q402 emitter is applied to the base of Q403 and fed back to the top of R406 as a bootstrap feedback. This positive ac feedback increases the effective ac resistance of R406 allowing a greater portion of the signal to be felt at the base of Q402. In this manner, the effective ac gain of Q401 is increased for the midband frequencies without disturbing the static operating voltages of Q401.

4-25. Driver amplifier Q403 further amplifies the ac signal and the output at Q403 collector is fed to the base circuit emitter follower Q404. The feedback path from the collector of Q403 to the base of Q402 through C405 (10 MHz ADJ) prevents spurious oscillations at high input frequencies. A dc feedback loop exists from the emitter circuit of Q403, to the base of Q401 through R425. This feedback stabilizes the Q401 bias voltage. Emitter follower Q404 acts as a driver for the output amplifier consisting of Q405 and Q406; a complimentary pair operating as a push-pull amplifier. The video amplifier output is taken from the collectors of the output amplifiers and applied to thermocouples TC401. A gain stabilizing feedback is developed in the emitter circuits of the output amplifiers. This negative feedback is applied to the emitter of input amplifier Q401 and establishes the overall gain of the video amplifier.

4-26. Trimmer capacitor C405 is adjusted at 10 MHz for frequency response of the video amplifier. Diodes CR402 and CR406 are protection diodes which prevent voltage surges from damaging transistors in the video amplifier. CR401, CR407, and CR408 are temperature compensating diodes to maintain the zero signal balance condition in the output amplifier over the operating temperature range. CR403, a breakdown diode, establishes the operating potentials for the output amplifier.

4-27. Chopper Op Amp Assembly A6 And Thermocouple Pair (Part Of A4)

4-28. The chopper op amp and thermocouple pair form a servo loop which functions to position the direct reading meter M1 to the rms value of the ac input signal. The chopper op amp and thermocouple pair schematic diagram is illustrated in Figure 6-3.

4-29. The video amplifier output signal is applied to the heater of thermocouple TC401. This ac voltage causes a dc voltage to be generated in the resistive portion of TC401 which is proportional to the heating effect (rms value) of the ac input. The dc voltage is applied to the chopper op amp.

4-30. The chopper op amp assembly consists of a chopper op amp (U601), filter, oscillator, and output amp (U602). The chopper op amp is a high gain low drift op amp and is used to modulate the applied dc voltage, amplify the voltage, and then demodulate the voltage back to dc (the output voltage of the amplifier). The output of the amplifier is the ac stabilizing and summing feedback for thermocouple TC402, and is also applied to the filter. The ac stabilizing feedback (using R614, R615, and C605) is used to prevent the circuitry from oscillating.

4-31. The oscillator consisting of Q601, Q602, and associated circuitry, is used to reduce the noise of the chopper op amp. It operates at a frequency of approximately 2KHz.

4-32. The output from the chopper op amp (summing feedback) is applied to the heating element of thermocouple TC402. The dc voltage developed in the resistive portion of TC402 is effectively subtracted from the voltage developed by TC401. The input signal to the chopper op amp then becomes the difference in the dc outputs of the two thermocouples. When the difference between the two thermocouples becomes zero, the dc output from the chopper op amp will be equal to the ac from the video amplifier.

4-33. The filter, consisting of R617, R618, R619, C607 and C608, is used to further reduce the noise on the output of the chopper op amp. This is to make the meter reading quiet.

4-34. The output of the filter is connected to the output amp (U602). The purpose of the amplifier is to drive the meter (M1) and to provide a low impedance output for the rear D.C. OUT connector. The output impedance of the amplifier is approximately 1 ohm. Since there

are two 499 ohm resistors (R624 and R631) between the amplifier output and the rear terminal, the output impedance at the terminal is approximately 1000 ohms.

4-35. Other circuits, consisting of C611, R629, and R630, are used to speed up the step response of the 3400A.

4-36. Power Supply Assembly A7

4-37. The power supply assembly provides dc operating voltages for the tube and transistors used in the Model 3400A. See power supply assembly schematic diagram illustrated on Figure 6-4.

4-38. Either 115 or 230 volts ac is connected to the primary of power transformer T1 through fuse F1 and the POWER switch S1. Switch S2 (slide switch on rear panel) connects T1 primary windings in series for 230-volt operation or in parallel for 115-volt operation. Neon lamp DS1 lights to indicate LINE power ON when ac power is applied and S1 is closed.

4-39. Regulator Operation

4-40. The series regulator acts as a dynamic variable resistor in series with the power supply output. A control amplifier senses changes in the output voltage by comparing the output with a fixed reference voltage. The control amplifier then supplies any output voltage changes to the driver transistor, which in turn changes the resistance of the series regulator to oppose the change in output voltage. Diodes CR704, CR713 and CR706 across the base emitter junction of the series regulator provide overload current protection.

4-41. +75 Volt Supply

4-42. The +75 volt supply consists of a full-wave rectifier (CR701 and CR702) whose output is filtered by C1A and C1B and regulated by series regulator Q1. The +75 volt supply provides regulated +75 volts which is used as the plate supply voltage for V201. Voltage variation from the output is felt at Q702 base circuit through C704, R715, and R716. The C703 and R709 network provides phase correction for power supply stability. The regulation circuitry is in the negative leg of the +75 volt supply, and uses the -17.5 volt supply as a reference.

4-43. -17.5 Volt Supply

4-44. The regulated -17.5 volt supply consists of a full-wave rectifier (CR711, and CR712) whose output is filtered by C706 and C707 and regulated by Q2. Breakdown diode CR715 provides reference voltage at the base of Q704. Regulation operation is the same described in Paragraph 4-40.

4-45. -6.3 Volt Supply

4-46. The regulated -6.3 volt supply consists of a full-wave rectifier (CR716 and CR717) whose output is filtered by C2 and regulated by Q3. Emitter follower Q705 is connected to the -17.5 volt supply which provides a reference for the -6.3 volt supply. Series regulator Q3 acts as a dynamic variable resistor in series with the output to oppose changes in output voltage.

WARNING

Maintenance described herein is performed with power supplied to the instrument, and protective covers removed. Such maintenance should be performed only by service-trained personnel who are aware of the hazards involved (for example, fire and electrical shock). Where maintenance can be performed without power applied, the power should be removed.

SECTION V

MAINTENANCE

5-1. INTRODUCTION

5-2. This section contains the information necessary for maintenance of the Model 3400A RMS Voltmeter. Included are performance checks, adjustment and calibration procedures, and troubleshooting procedures.

5-3. TEST EQUIPMENT

5-4. The test equipment required for the maintenance of the Model 3400A is listed in Table 5-1. If the recommended model is not available, use any substitute that meets the required characteristics.

5-5. PERFORMANCE CHECKS

5-6. The Performance Checks are in-cabinet tests that compare the Model 3400A with its given specifications. These checks may be used for incoming inspection, periodic maintenance, and for specification checks after a repair. A Performance Check Test Card is provided at the end of this section for recording the performance of the instrument during the Performance Checks. The card may be removed from the manual and used as a permanent record of the incoming inspection or of a routine performance check. If the instrument fails to meet any of its specifications, perform the Adjustment and Calibration Procedures outlined in Paragraph 5-15.

NOTE

Allow a 30-minute warmup period before making performance checks. During the performance checks, periodically vary the Model 3400A line voltage $\pm 10\%$ with a power line transformer to assure that the instrument operates correctly at various ac line voltages.

5-7. Accuracy, Linearity, And DC Output Check

5-8. The accuracy, linearity, and dc output test set-up is illustrated in Figure 5-1. A Meter Calibrator Fluke Model 760A and a Digital Multimeter -hp- Model 3468A are required for this test.

- a. Connect test setup illustrated in Figure 5-1.
- b. Set Model 3400A RANGE switch to 0.001 position.
- c. Adjust the Meter Calibrator for a 0.001V 400Hz ac volts output; set the Digital Multimeter to measure 1V dc.

d. If Model 3400A does not indicate within values listed under "meter reading" in Table 5-2, perform low frequency calibration procedure, Paragraph 5-21. Record 3400A readings.

e. DC output as indicated on the Digital Multimeter should be within values listed under "3400A DC output" in Table 5-2.

f. Continue to check accuracy, linearity, and dc output using Table 5-2.

Table 5-1. Required Test Equipment

Instrument Type	Required Characteristics	Use	Recommended Model
DC Digital Multimeter	Accuracy: $\pm 0.1\%$ full scale Voltage Range: 10mV to 100V	Performance Checks Adjustment and Calibration	-hp- Model 3468A
Meter Calibrator	Voltage Range: 1mV to 300 V rms Frequency: 400 Hz	Performance Checks Adjustment and Calibration Troubleshooting	Fluke Model 760A
Oscillator	Frequency Range: 10 Hz to 10 MHz Output: 1 mV to 3 V Frequency Response: 0.25% (expand scale)	Performance Checks Adjustment and Calibration Troubleshooting	-hp- Model 652A Test Oscillator
Oscilloscope	Sensitivity: .005V/cm Bandwidth: dc to 20 MHz	Troubleshooting	-hp- Model 1740A
Pulse Generator	Pulse Width: variable to 10 μ sec Pulse Amp: ± 10 volts peak, variable Pulse Rate: 250 to 1000 pps	Performance Checks	-hp- Model 214B
Frequency Counter	Range: 250 to 1000 Hz Accuracy: ± 1 count Time Interval: 1 μ sec	Performance Checks	-hp- Model 5381A
Peak Responding Voltmeter	Voltage Range: 0.5 V to 300 V Accuracy: $\pm 3\%$ full scale	Performance Checks	-hp- Model 410C Voltmeter
Average Responding Voltmeter	Voltage Range: 0.001 to 300 V Accuracy: 1% full scale	Adjustment and Calibration Troubleshooting	-hp- Model 400E/EL Voltmeter
Power Supply	Output Voltage: 5 V dc Output Current: 5 mA	Troubleshooting	-hp- Model 6214A
RMS Responding Voltmeter	Range: 1 m V full scale	Performance Checks	-hp- Model 3400A RMS Voltmeter
Resistor	200 k Ω , metal film, $\frac{1}{4}$ W 1%	Performance Checks	-hp- Part No. 0757-0782
Resistor	499 k Ω , metal film, $\frac{1}{4}$ W 1%	Troubleshooting	-hp- Part No. 0757-0327
Resistor	1k Ω , Carbon, $\frac{1}{4}$ W 10%	Troubleshooting	-hp- Part No. 0684-1021
50 Ω Feedthru Termination	Resistor: fixed comp 50 Ω $\pm 5\%$ $\frac{1}{4}$ W	Performance Checks	-hp- Model 11048B 50 Ω Feedthru
BNC-T-Adapter	--	Performance Checks Adjustment and Calibration	-hp- Part No. 1250-0072
Adapter	410C to Dual Banana	Performance Checks	-hp- Model 11018A
Extender Board	15 pin programmable	Troubleshooting	-hp- Part No. 6038

Table 5-2. Accuracy, Linearity, and DC Output Check Data

Voltmeter Calibrator Output (V)	3400A Voltage Range (V)	3400A Meter Reading (V)	3400A DC Output (V)
0.001	0.001	0.000990 to 0.00101	0.992 to 1.008
0.003	0.003	0.00297 to 0.00303	0.942 to 0.957
0.01	0.01	0.00990 to 0.0101	0.992 to 1.008
0.03	0.03	0.0297 to 0.0303	0.942 to 0.957
0.1	0.1	0.0990 to 0.101	0.992 to 1.008
0.3	0.3	0.297 to 0.303	0.942 to 0.957
1.0	1.0	0.990 to 1.01	0.992 to 1.008
0.9	1.0	0.89 to 0.91	0.892 to 0.908
0.8	1.0	0.79 to 0.81	0.792 to 0.808
0.7	1.0	0.69 to 0.71	0.692 to 0.708
0.6	1.0	0.59 to 0.61	0.592 to 0.608
0.5	1.0	0.49 to 0.51	0.492 to 0.508
0.4	1.0	0.39 to 0.41	0.392 to 0.408
0.3	1.0	0.29 to 0.31	0.292 to 0.308
0.2	1.0	0.19 to 0.21	0.192 to 0.208
0.1	1.0	0.090 to 0.11	0.092 to 0.108
3.0	3.0	2.97 to 3.03	0.942 to 0.957
10.0	10.0	9.90 to 10.10	0.992 to 1.008
30.0	30.0	29.7 to 30.3	0.942 to 0.957
100.0	100.0	99.0 to 101.0	0.992 to 1.008
300.0	300.0	297.0 to 303.0	0.942 to 0.957

use 9313
Rms Voltmeter
to set up proper
voltages

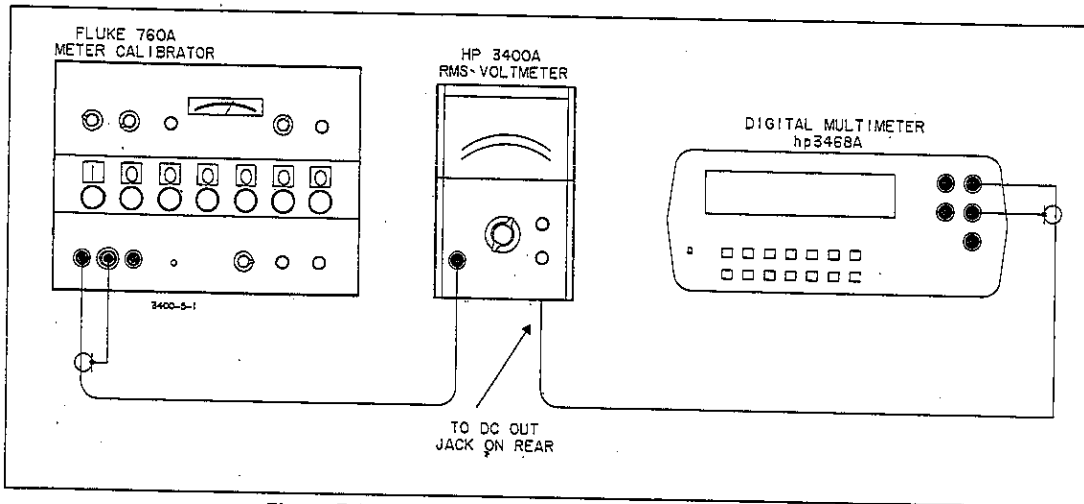


Figure 5-1. Accuracy, Linearity, and DC Output Test Setup

5-9. Frequency Response Check

NOTE

Connect 50 Ω feedthru termination directly to 3400A INPUT to eliminate loss in output cable at high frequency.

- a. Connect test setup illustrated in Figure 5-2.
- b. Set Model 3400A RANGE switch and Test Oscillator output attenuator to 1 volt position.
- c. Set Test Oscillator for 400 Hz output and adjust output amplitude for the reading obtained in Paragraph 5-8 step d on the Model 3400A.
- d. Switch the Test Oscillator monitor switch to expand mode and set a convenient reference level.
- e. Adjust test oscillator output frequency to values listed under "frequency" in Table 5-3; adjust oscillator output voltage to maintain reference level set in step d. If Model 3400A does not indicate within values under "meter reading" in Table 5-3, perform high frequency calibration procedures, Paragraph 5-25.

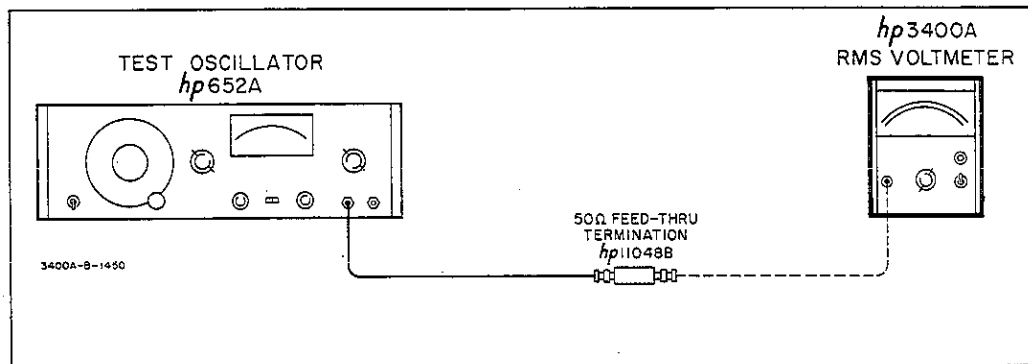


Figure 5-2. Frequency Response Test Setup

Table 5-3. Frequency Response Check

Frequency	Meter Reading
15 Hz	0.95 to 1.05
45 Hz	0.95 to 1.05
100 Hz	0.99 to 1.01
900 kHz	0.99 to 1.01
1.2 MHz	0.98 to 1.02
1.8 MHz	0.98 to 1.02
2.2 MHz	0.97 to 1.03
2.8 MHz	0.97 to 1.03
3.2 MHz	0.95 to 1.05
9.8 MHz	0.95 to 1.05

5-10. Input Impedance Check**5-11. Resistance Check**

- a. Connect the Test Oscillator, 50 ohm feedthru and -hp- Model 3400A to position A in Figure 5-3.
- b. Set 3400A to 1 volt range and Test Oscillator to 400 Hz.
- c. Adjust Test Oscillator output for 1 volt indication on Model 3400A.
- d. Connect Model 3400A to position B, as shown in Figure 5-3. The 3400A meter reading now should change less than or equal to .02 volts (2 minor divisions). 2 minor divisions corresponds to an input impedance of 10 megohms.

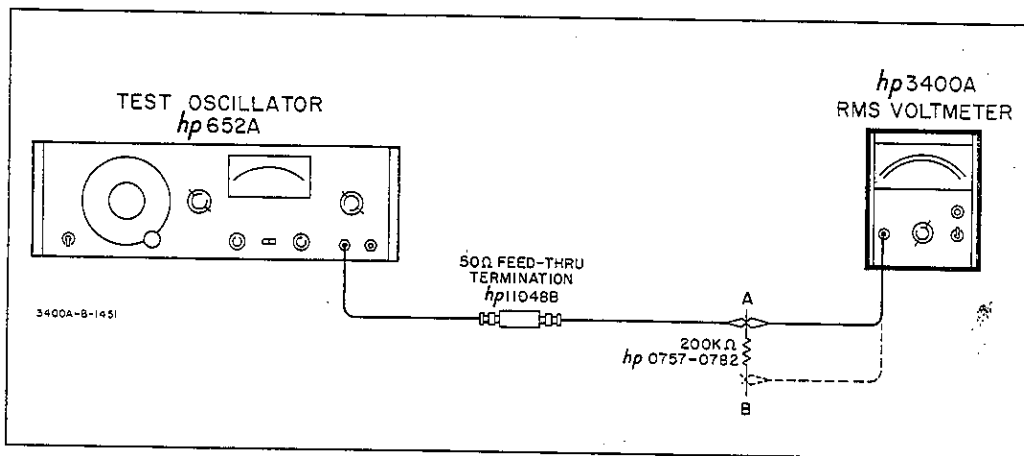


Figure 5-3. Input Impedance Test Setup

5-12. Capacitance Check

- a. Connect Test Oscillator, 50 ohm feedthru and Model 3400A to position B in Figure 5-3. Insert the resistor lead directly into the BNC connector on the 3400A as an adapter adds capacitances to the measurement.
- b. Set 3400A to 0.001 volt range and Test Oscillator to 400 Hz.
- c. Adjust Test Oscillator output for full scale indication on Model 3400A. Switch the Test Oscillator Switch to Expand mode and set a convenient reference level.
- d. Change Test Oscillator frequency to 16 kHz, maintaining the reference level set in step c. The Model 3400A reading should be greater than 0.707mV. This corresponds to an input shunt capacity of less than 50 pF.
- e. Set Model 3400A Range switch to 1 V position and repeat step c.
- f. Change Test Oscillator frequency to 40 kHz, maintaining the reference level set in step c. The Model 3400A reading should be greater than .707V. This corresponds to an input shunt capacity of less than 20 pF.

5-13. Crest Factor Check

- a. Connect test setup as illustrated in Figure 5-4.
- b. Set Model 3400A Range switch to 1 volt position.
- c. Adjust Pulse Generator for pulse output with the following characteristics:

Pulse Rate - 990 pps as indicated on electronic counter.

Pulse Width - 10 μ sec as indicated on electronic counter in time interval mode.

Pulse Amplitude - 7.07 volts as indicated on Model 410C.

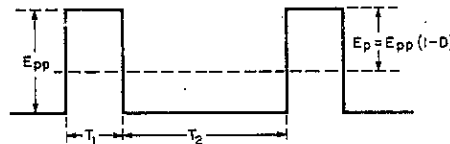
NOTE

The 410C responds to the positive peak above the average of the input waveform. Since the Model 410C is calibrated to read the rms value of a sine wave a correction factor is required to measure pulse amplitude. The correction factor under these conditions is:

$$E_{410C} = \frac{E_{pp}}{\sqrt{2} \left(1 + \frac{T_1}{T_2} \right)}$$

see waveform

$$E_p = \frac{T_2}{T_1 + T_2}$$



$$E_{410C} = \sqrt{2} \left(1 + \frac{T_1}{T_2} \right)$$

$$E_{410C} = 7.07V$$

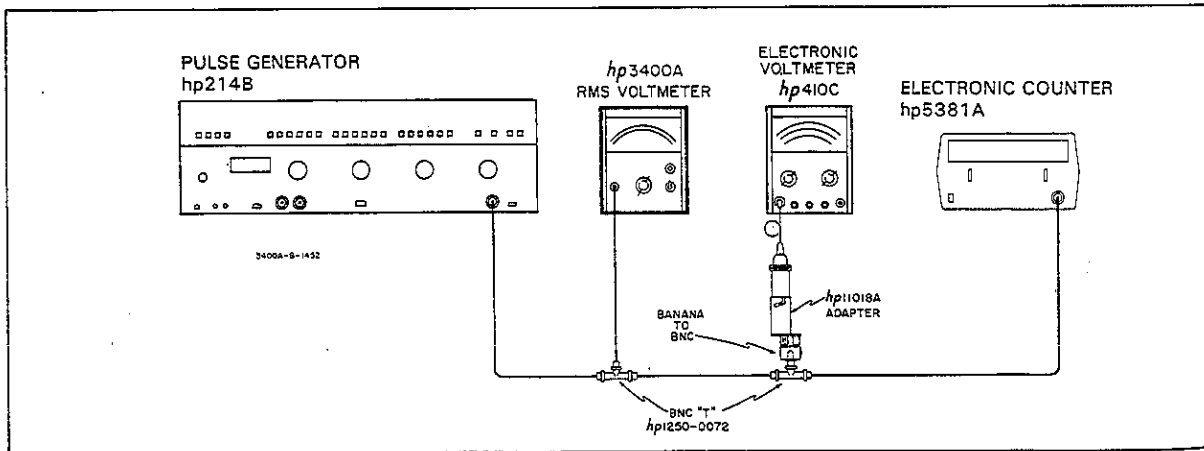


Figure 5-4. Crest Factor Test Setup

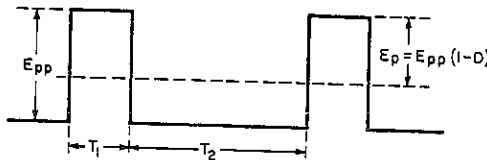
This corresponds to a crest factor of 10 where:

$$E_{rms} = E_{pp} \sqrt{D(1-D)} \text{ where } D = \frac{T_1}{T_1 + T_2}$$

$$C.F. = \frac{E_p}{E_{rms}}$$

$$C.F. = \frac{E_{pp}(1-D)}{E_{pp} \sqrt{D(1-D)}}$$

$$C.F. = \sqrt{\frac{1-D}{D}}$$



- d. The Model 3400A should indicate 1 volt, $\pm 4\%$ (includes the $\pm 3\%$ accuracy of 410C).
- e. Adjust pulse generator pulse rate to 250 pps as indicated on electronic counter. This corresponds to a crest factor of 20.
- f. Model 3400A should indicate 0.5 volt, $\pm 4\%$ (includes the $\pm 3\%$ accuracy of 410C.)

5-14. Output Noise Check

- a. Connect 50 ohm feedthru to 3400A INPUT.
- b. Connect another RMS Voltmeter to DC output.
- c. Set -hp- Model 3400A to 0.001 volt range.
- d. The reading on the RMS Voltmeter should not exceed 1 mV.

5-15. ADJUSTMENT AND CALIBRATION PROCEDURES

5-16. The following is a complete adjustment and calibration procedure for the Model 3400A. These procedures should be conducted only if it has previously been established by Performance Checks, Paragraph 5-5 to 5-14, that the Model 3400A is out of adjustment. Indiscriminate adjustment of the internal controls to refine settings may actually cause more difficulty. If the procedures outlined do not rectify any maladjustments that may exist, and you have carefully rechecked your connections and settings, refer to Paragraph 5-29, Troubleshooting Procedures for possible cause and recommended corrective action.

5-17. Mechanical Meter Zero

5-18. The mechanical meter zero screw is located on the instrument front panel. If the meter pointer does not indicate zero when the instrument power has been off for at least one minute, mechanically zero the meter following the procedure outlined below.

- a. Turn instrument power off; disconnect input signal and any cable connected to J2 (DC OUT) at rear of instrument and allow one minute for meter pointer to stabilize.

b. Rotate zero adjust CW until pointer is to left of zero, moving up scale. Continue until pointer is at zero. If pointer overshoots zero, repeat operation.

c. When the pointer is exactly at zero, rotate the adjusting screw slightly counterclockwise to remove tension on pointer suspension. If the meter pointer moves to the left during this adjustment, repeat steps b and c.

5-19. Power Supply Checks

5-20. Power supply voltage and ac ripple tolerances are listed in Table 5-4. Test points are also indicated in this table. When making ripple voltage measurements, it may be desirable to use a battery powered A.C. Voltmeter (H-P 403B) to avoid any undesirable ground loop currents.

5-21. Low Frequency Calibration

5-22. Amplifier Offset Adjustment

a. Perform the following adjustment only for Revision C A6 assemblies. The adjustment is not required for Revision A assemblies.

b. Remove the 3400A's top cover.

c. Refer to the Chopper Amplifier component locator (see Page 6-7/6-8) and connect TP5 to TP1 (on the A6 assembly).

d. Connect a DC Voltmeter between TP6 and TP1.

e. Adjust A6R629 (on the A6 assembly) for a $\approx 2\text{mV}$ dc reading on the dc voltmeter.

5-23. Amplifier Gain Adjustment

a. Connect test setup illustrated in Figure 5-1.

b. Set Model 3400A RANGE switch to 0.01 volt position.

c. Adjust the Meter Calibrator for a 0.01V 400Hz ac volts output; set the Digital Multimeter to measure 1V dc.

d. Remove the 3400A's top cover; adjust A6R627 (on the A6 assembly) for 1.0V as indicated on the Digital Multimeter.

e. Adjust R6 (FULL-SCALE ADJUST) for Model 3400A full-scale meter indication.

5-24. 1/10 Scale Adjustment

a. Connect test setup illustrated in Figure 5-1; omit the DC Voltmeter.

b. Set Model 3400A RANGE switch to 0.1 volt position and adjust Voltmeter Calibrator for 0.01 volt rms, 400 Hz output.

NOTE

The meter may show a small positive offset when the 3400A's input is shorted. This is normal and the 3400A will be fully accurate from 1/10 scale to full scale.

- c. Adjust the 1/10 scale adjust (A6R626, located on the A6 assembly) until the meter of the 3400A reads exactly 1/10 scale (0.1V).

Table 5-4. Power Supply Checks

Power Supply	Test Equipment And Check Point	DC Voltage Specifications	Regulation (Vary Line Voltage Between 103.5 and 126.5 vac)	Ripple Specifications
- 17.5 Vdc	Connect Digital Multimeter, Oscilloscope between violet lead on video amplifier (A4) board and chassis ground.	- 16.8 to 18.2 Vdc	± 0.5 volt from nominal reading at 115 Vac line.	400 μ V rms or 1.1 mV p-p
+ 75 Vdc	Connect Digital Multimeter, Oscilloscope between red/wht/blue on video amplifier A4 and chassis ground.	70.0 to 78.0 Vdc	± 1 volt from nominal reading at 115 Vac line.	400 μ V rms or 1.1 mV p-p
- 6.3 Vdc	Connect Digital Multimeter, Oscilloscope between Q3 emitter (grey lead) and chassis ground.	- 5.9 to -6.5 Vdc	± 0.1 volt from nominal reading at 115 Vac line.	750 μ V rms or 2.0 mV p-p

5-25. 1 Volt Adjustment

- Connect test setup illustrated in Figure 5-1; omit the DC Voltmeter.
- Set Model 3400A RANGE switch to 1 volt position.
- Adjust voltmeter calibrator for 1.0 volt rms, 400 Hz output.
- Remove right side cover (INPUT side) and adjust R104 (1 V ADJUST) for Model 3400A full-scale meter indication.

5-26. High Frequency Calibration

5-27. Amplifier Gain Adjustment

NOTE

The Test Oscillator used in this procedure should be calibrated at the end of its output cable.

- a. Connect test setup illustrated in Figure 5-2.
- b. Set Model 3400A RANGE switch and Test Oscillator output attenuator to 0.001V position.
- c. Adjust Test Oscillator output frequency for 400 Hz; output voltage for 90% of full scale as indicated on Model 3400A meter.
- d. Switch the Test oscillator monitor switch to expand mode and set a convenient reference level.
- e. Change Test Oscillator frequency to 10 MHz. Adjust Test Oscillator output voltage to maintain reference level set in step d.
- f. Adjust C405 (10 MHz ADJUST) on A4 board for 90% full scale as indicated on the Model 3400A meter. Replace right side cover; readjust C405 if meter reading varies after replacing the cover.
- g. Vary oscillator between 3 and 10 MHz; maintaining reference level set in step d. If the Model 3400A meter reading varies below 85% or above 95% of full scale, repeat step f until optimum response is obtained between 3 and 10 MHz.

5-28. Input Attenuator Adjustment

NOTE

The Test Oscillator used in this procedure should be calibrated at the end of its output cable.

- a. Connect test setup illustrated in Figure 5-2.
- b. Set Model 3400A RANGE switch and Test Oscillator output attenuator to 1 volt position.
- c. Adjust Test Oscillator output frequency for 400 Hz, output voltage for 90% full scale as indicated on Model 3400A meter.
- d. Switch the Test Oscillator monitor switch to expand mode and set a convenient reference level.
- e. Change Test Oscillator frequency to 100 kHz; adjust Test Oscillator output voltage to maintain reference level set in step d.
- f. Remove Model 3400A bottom cover. Adjust C102 (1V, 100 KC ADJ) for 90% full scale as indicated on Model 3400A meter.
- g. Vary oscillator between 100 kHz and 10 MHz; maintain test oscillator output voltage to reference level set in step d. If Model 3400A meter reading varies more than $\pm 1\%$ to 1 MHz, $\pm 2\%$ from 1 MHz to 2 MHz, $\pm 3\%$ from 2 MHz to 3 MHz, or $\pm 5\%$ from 3 MHz to 10 MHz, readjust C102 until optimum response is obtained.

5-29. Second Attenuator Adjustment**NOTE**

The Test Oscillator used in this procedure should be calibrated at the end of its output cable.

- a. Connect test setup illustrated in Figure 5-2.
- b. Set Model 3400A RANGE switch and Test Oscillator output attenuator to a 0.3 volt position.
- c. Adjust Test Oscillator output frequency for 400 Hz; output voltage for 90% full scale as indicated on Model 3400A meter.
- d. Switch the Test Oscillator monitor switch to expand mode and set a convenient reference level.
- e. Change Test Oscillator output frequency to 3 MHz; adjust output voltage to maintain reference level set in step d.
- f. Adjust C303 (10 MC .3V ADJ) for 90% full scale as indicated on Model 3400A meter.
- g. Vary Test Oscillator between 3 MHz and 10 MHz; maintain test oscillator output voltage to reference level set in step d. If Model 3400A meter reading varies below 85% or above 95% of full scale, repeat steps e and f until optimum response is obtained between 3 and 10 MHz.

5-30. TROUBLESHOOTING PROCEDURES

5-31. This section contains procedures designed to assist in the isolation of malfunctions. These operations should be undertaken only after it has been established that the difficulty cannot be eliminated by the Adjustment and Calibration Procedures, Paragraph 5-15. An investigation should also be made to ensure that the trouble is not a result of conditions external to the Model 3400A.

5-32. Conduct a visual check of the Model 3400A for possible burned or loose components, loose connections, or any other condition which might suggest a source of trouble.

5-33. Table 5-5 contains a summary of known problems by front panel symptoms.

5-34. Table 5-6 contains procedures which may be used as a guide in isolating malfunctions. The checks outlined in Table 5-6 are not designed to measure all circuit parameters, rather only to localize the malfunction. Therefore, it is quite possible that additional measurements will be required to completely isolate the problem. Amplifier gain and biasing may vary slightly from instrument to instrument; therefore, it should not be necessary to precisely duplicate waveforms or values described.

NOTE

Do not use an extender board on the Chopper Amplifier Board (A6).

Table 5-5. Front Panel Symptoms

Symptoms	Possible Causes
Reading far out of tolerance, meter pegged out.	Check for a defective oscillator on the A6 assembly.
Excessive offset (> 8%) with input shorted.	A6R626 and/or C405 misadjusted.
400Hz calibration low and frequency response falls off above 50KHz.	Q401 or Q402 shorted.
Switching transients exceeds 5% of full scale with shorted input.	Check collector voltage of Q201 (should not exceed 9.0V)
Instrument has been overloaded.	Check Q201, Q401, Q402, and TC401. See paragraph 5-34 for details on TC401.
Meter jitter.	Noisy chopper op amp (U601).
Full-scale difference from range to range.	Check resistors in second attenuator.
Meter pegs full scale.	Check thermocouples. See paragraph 5-34 for details.
Overshoot, undershoot, or sluggish response on meter.	Replace thermocouples. See paragraph 5-37.
Meter moves rapidly from zero to full-scale and back.	Check ac feedback on the A6 assembly (R614, C605, and R615).

5-35. Checking Thermocouples TC401 and TC402

5-36. The following procedure will allow you to check the thermocouples for proper operation in the -hp- Model 3400A RMS Voltmeter.

NOTE

This check will not yield any information concerning thermocouple operation for either sluggish or overshoot-undershoot response on 3400A meter. If a 3400A has the above symptoms replace thermocouples.

5-37. To perform these checks, supply 5mA of current to the heaters of the thermocouples. This can be accomplished by connecting a 1K ohm resistor (-hp- Part Number: 0684-1021) in series with the output of a 5V dc power supply. Then connect the supply to the heater of thermocouple and measure the output voltage of the thermocouple with the Digital Multimeter. If the thermocouple fails any of the following tests, replace it using the procedure in paragraph 5-37. Do the following:

- a. Turn the 3400A off and remove the A6 assembly.

NOTE

See Figure 6-3 for component locations.

- b. Set the multimeter to the ohms function. Connect the test leads between ground and the junction of C413 and C415 on the A4 assembly (this checks the resistance of the heater

in TC401). Make sure the reading on the multimeter is between 76.5 ohms and 103.5 ohms. If the reading is not within limits, replace the matched set of thermocouples (-hp- Part Number: 0853-0003).

c. Remove the multimeter and, in place of the multimeter, connect the 5V dc power supply between ground and the junction of C413 and C415. Turn the power supply on. Set the multimeter to the dc volts function and connect it as follows:

Negative (low) input to pin 11 on the A6 socket.

Positive (high) input to pin 13 on the A6 socket.

The multimeter should display between +6.5mV and +9mV. Note the reading on the multimeter. If the reading is not within limits, replace the thermocouple pair. If the reading is within the test limits, remove the multimeter and set it to the ohms function. Then disconnect the power supply and turn it off.

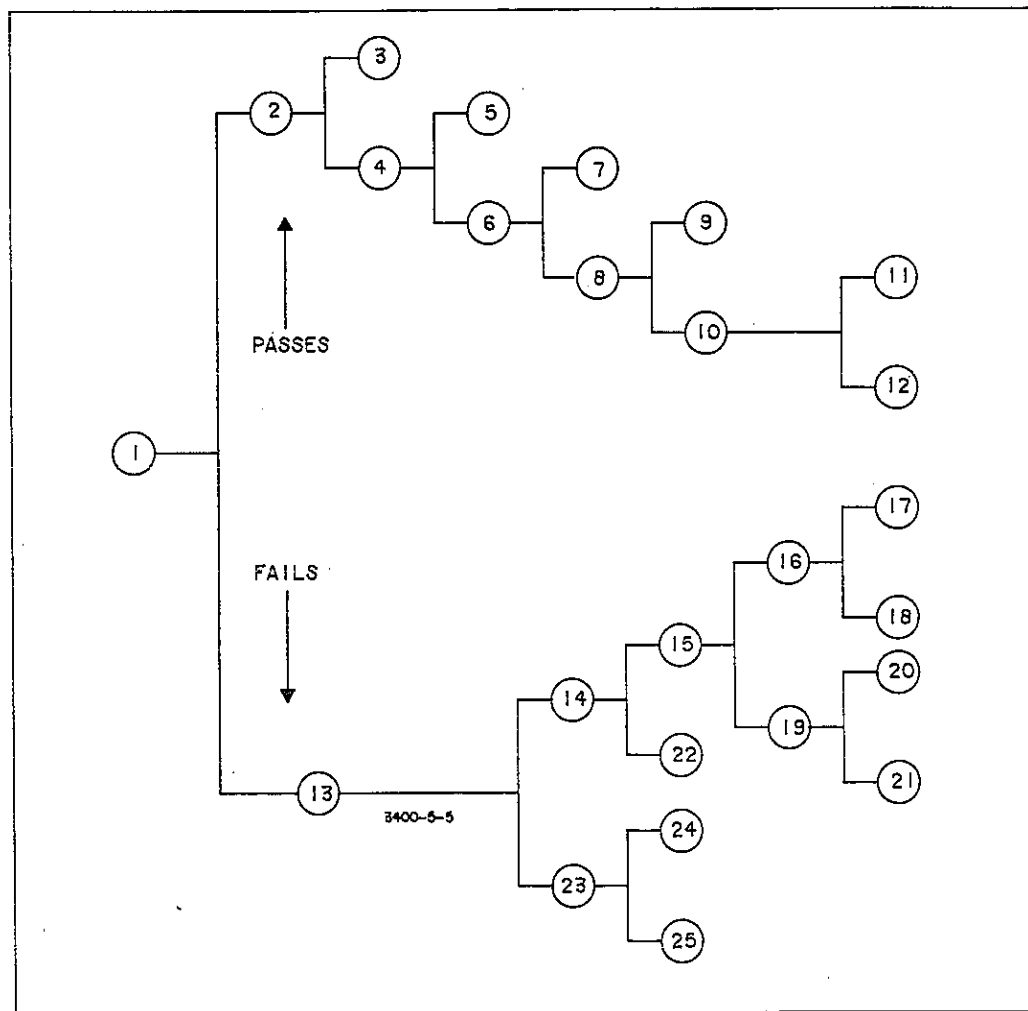


Figure 5-5. Troubleshooting Tree

Table 5-6. Troubleshooting Procedure

Check	Procedure	Action	Check	Procedure	Action
①	Set the 3400A to the 1V range. Apply 1V, 400Hz ac signal to the input terminals. Measure the signal at junction of C413 and 415. The reading should be between 240mV and 280mV RMS.	PASSES: Proceed to ② FAILS: Proceed to ⑬	⑪	Check for a defective U602.	
②	Measure the signal between TP2 and TP1 on the A6 assembly. The signal should look like the one in Figure 5-6.	PASSES: Proceed to ④ FAILS: Proceed to ③	⑫	The A6 assembly is probably working correctly. Make sure the meter assembly M1 and associated circuitry are good.	
③	Troubleshoot and repair oscillator circuitry.		⑬	Measure the ac signal at the output of impedance converter A2 (negative side of C205). The reading should be approximately .96mV RMS.	PASSES: Proceed to ⑭ FAILS: Proceed to ⑰
④	Turn the 3400A off and place the A6 board on an extender board. Unsolder and lift one end of R616 from the board (the dc feedback is now disconnected). Set the instrument to the 1V range and apply a 1V, 400Hz RMS ac signal to the input terminals. Using a Digital Multimeter (like the 3468A), measure the voltage between TP3 and TP1 on the A6 assembly. The voltage should be approximately 2mV to 2.5mV ac.	PASSES: Proceed to ⑧ FAILS: Proceed to ⑤	⑭	Measure the ac signal at the input of the video amplifier A4 (positive side of C402). The reading should be approximately .95mV RMS.	PASSES: Proceed to ⑮ FAILS: Proceed to ⑳
⑤	Check for a defective TC401. TC401 may also be disconnected from the output of the video amplifier via capacitors C413 and C415.		⑮	Measure the ac signal at the base of Q404. The reading should be approximately 155mV RMS.	PASSES: Proceed to ⑯ FAILS: Proceed to ⑰
⑥	Turn the instrument off and replace and resolder R616 on the A6 board. Make sure the 3400A is still on the 1V range and the 1V, 400Hz signal is still applied. Turn the instrument on and measure the voltage between TP4 and TP1 on the A6 board. The voltage should approximately be -4V dc.	PASSES: Proceed to ⑧ FAILS: Proceed to ⑦	⑯	Measure the ac signal at the negative side C427. The reading should be approximately 32mV RMS.	PASSES: Proceed to ⑰ FAILS: Proceed to ⑱
⑦	If the voltage is positive, check for a shorted CR603. If the voltage is negative but other than -4V, U602 or TC401 may be defective.		⑰	Check for a defective C413 and C415.	
⑧	Check the voltage between TP5 and TP1 and make sure it is -.19V.	PASSES: Proceed to ⑩ FAILS: Proceed to ⑨	⑱	Check for defective Q404, Q405, Q406 and associated circuitry. Also check the thermocouples (see paragraph 5-34).	
⑨	Troubleshoot the filter circuitry consisting of R617 through R619, and C606 through C608.		⑳	Measure the ac signal at the emitter of Q402. Reading should be 1.85mV RMS.	PASSES: Proceed to ㉑ FAILS: Proceed to ㉒
⑩	Check the voltage between TP6 and TP1 and make sure it is approximately -1V.	PASSES: Proceed to ⑫ FAILS: Proceed to ⑪	㉑	Check Q401 and Q402 circuitry.	
			㉒	Check Q403 circuitry.	
			㉓	Check second attenuator circuitry A3.	
			㉔	Measure the ac signal at the input to impedance converter, pin 7 on A2 board. The reading should be approximately 1mV RMS.	PASSES: Proceed to ㉕ FAILS: Proceed to ㉖
			㉕	Check the impedance converter or power supply. See Table 5-4 for specifications on power supply.	
			㉖	Check the input attenuator circuitry.	

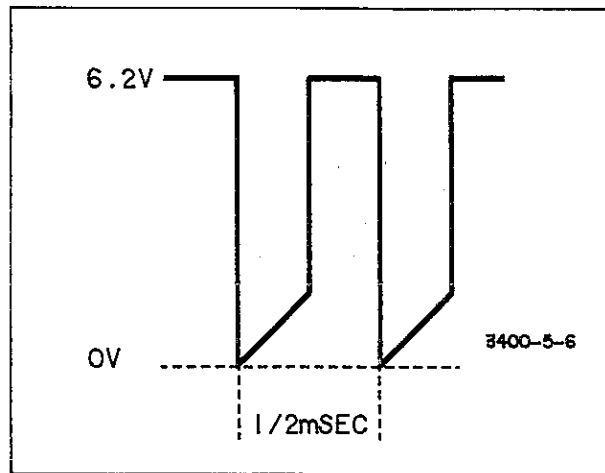


Figure 5-6. Input to Demodulator

d. Connect the multimeter between the silver colored wire on R4 (CAL pot on chassis) and pin 14 on the A6 socket (this step checks the heater of TC402). Make sure the reading is between 76.5 ohms and 103.5 ohms.

e. Remove the multimeter and, in place of the multimeter, connect the 5V dc power supply between the silver wire and pin 14 on the A6 socket (see previous step). Turn the power supply on. Set the multimeter to the dc volts function and connect it to pin 11 and pin 13 on the A6 socket (see step c). Make sure the displayed reading on the multimeter is negative and within 1mV of the reading noted in step c.

f. Disconnect the power supply and the multimeter from the 3400A. Set the multimeter to the ohms function and connect it between pin 11 and pin 14 of the A6 socket (this checks for thermocouples shorted to ground through the cover). Make sure the displayed reading on the multimeter is >200K ohms. If below 200K ohms, look for ground short.

5-38. Thermocouple Replacement

CAUTION

Exercise extreme care when removing or replacing the amplifier printed circuit board assembly and when shaping the thermocouple leads.

5-39. Should a thermocouple be defective, it is necessary to replace both as a matched pair (see Section VII, Table of Replaceable Parts) for part number. To replace thermocouples, perform the following steps:

- a. Turn instrument power off and remove right side (INPUT side) and top covers.
- b. Remove the four lead connection to the A4 amplifier board.
 1. Black coaxial cable (two leads)
 2. Violet lead
 3. White lead/blue lead.

- c. Remove the three mounting screws on the amplifier board.
- d. Gently pull bottom of board out at the same time relieving stress on thermocouple cable until the board will drop down and the top will clear main frame. Carefully fold board down to expose the four nuts holding the thermocouple shield.
- e. Remove four shield nuts; lift shield off. Remove thermocouples, noting orientation.
- f. Leads on new thermocouples must be shaped before inserting into PC board. During the shaping process, hold leads between bending point and glass with long-nose pliers.
- g. Place the red dots on the thermocouples face down on the A4 Video Amplifier Board. If one of the thermocouples has an additional colored dot place it in the TC402 position.
- h. Carefully insert new thermocouple leads and solder.
- i. Reverse steps e, d, c, b. Note: the violet lead goes to the lower of the two top connectors on the A4 board.
- j. After thermocouple replacements perform a complete adjustment and calibration procedure as outlined in Paragraph 5-15.

5-40. SERVICING ETCHED CIRCUIT BOARDS

5-41. The -hp- Model 3400A has five etched circuit boards. Use caution when removing them to avoid damaging mounted components. The assembly and -hp- Part No. are silk screened on the interior of the circuit board to identify it. Refer to Section VII for parts replacement and -hp- part number information.

5-42. The etched circuit boards are plated-through type. The electrical connection between sides of the board is made by a layer of metal plated through the component holes. When working on these boards, observe the following general rules:

- a. Use a low-heat (25 to 50 watts) small-tip soldering iron and a small diameter rosin core solder.

Table 5-7. Factory Selected Components

Designator	Function	Low	Value Normal	High
C205	Adjust low frequency (10 Hz) response.	—	100 μ F (selected)	—
C302	Adjust high frequency (10 MHz) of Second Attenuator on 0.001 V and 1 V ranges.	5 pF	12 pF	15 pF
C304	Adjust high frequency (3 MHz to 10 MHz) of Second Attenuator on 0.3 V and 300 V ranges.	—	24 pF	39 pF
C305	Adjust high frequency (10 MHz) of Second Attenuator on 0.01 V and 10 V ranges.	—	5 pF	12 pF
C427	See NOTE on schematic.	—	200 μ F (selected)	—
R419	Adjust voltage at collector of Q406 (with no signal input) to 1.5V to 2.5V dc.	270	300	—

- b. Circuit components can be removed by replacing the soldering iron on the component lead on either side of the board and pulling upon lead. If a component is obviously damaged, clip leads as close to component as possible and then remove. Excess heat can cause the circuit and board to separate or cause damage to the component.
- c. Component lead hole should be cleaned before inserting new lead.
- d. To replace components, shape new leads and insert them in holes. Reheat with iron and add solder as required to insure a good electrical connection.
- e. Clean excess flux from the connection and adjoining area.

5-43. A6 ASSEMBLY (03400-66512) RETROFIT PROCEDURE

5-44. The following procedure can be used to retrofit older 3400A's which have the old A6 Assembly (-hp- Part Number: 03400-66508) with the presently available A6 Assembly (-hp- Part Number: 03400-66512). To do the procedure, obtain a manual which has the schematic (in Figure 6-3) for the old A6 Assembly (Part Number 03400-66508). A manual with -hp- Part Number 03400-90008 and below is a good choice. Do the following:

- a. Turn the 3400A off and disconnect it from the ac power source.
- b. Refer to Figure 6-3 (of old A6 Assembly schematic) and remove R3, R8, R9 and R10. These parts and the part in the next step are located next to the connector of the A6 Assembly.
- c. Refer to Figure 6-3. Connect and solder both legs of R4 together or connect pin 10 of the A6 Assembly to the CLR line of the thermocouple TC402.
- d. Refer to Figure 6-4 (A10 Assembly schematic; Power Supply) and remove CR719, C711, C712, CR718, R701, R702, R712, R713, and Q706.
- e. Remove the old A6 Assembly (03400-66508) and replace it with the new A6 Assembly (03400-66512).
- f. Connect the 3400A to the ac power source and turn it on. After the recommended warmup, calibrate the instrument using the calibration procedure in paragraph 5-15.
- g. After calibration, the 3400A may display an offset with OV inputs. This is normal and the 3400A will be fully accurate from 1/10 scale to full scale.

PERFORMANCE CHECK TEST CARD

Hewlett-Packard Model 3400A
RMS Voltmeter
Serial No. _____

Tests performed by _____
Date _____

Description	Check																																																																																								
<p>Accuracy, Linearity and DC Output:</p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">Calibrator Output</th> <th style="text-align: center;">3400A Range</th> </tr> </thead> <tbody> <tr><td>0.001</td><td>0.001</td></tr> <tr><td>0.003</td><td>0.003</td></tr> <tr><td>0.01</td><td>0.01</td></tr> <tr><td>0.03</td><td>0.03</td></tr> <tr><td>0.1</td><td>0.1</td></tr> <tr><td>0.3</td><td>0.3</td></tr> <tr><td>1.0</td><td>1.0</td></tr> <tr><td>0.9</td><td>1.0</td></tr> <tr><td>0.8</td><td>1.0</td></tr> <tr><td>0.7</td><td>1.0</td></tr> <tr><td>0.6</td><td>1.0</td></tr> <tr><td>0.5</td><td>1.0</td></tr> <tr><td>0.4</td><td>1.0</td></tr> <tr><td>0.3</td><td>1.0</td></tr> <tr><td>0.2</td><td>1.0</td></tr> <tr><td>0.1</td><td>1.0</td></tr> <tr><td>3.0</td><td>3.0</td></tr> <tr><td>10.0</td><td>10.0</td></tr> <tr><td>30.0</td><td>30.0</td></tr> <tr><td>100.0</td><td>100.0</td></tr> <tr><td>300.0</td><td>300.0</td></tr> </tbody> </table>	Calibrator Output	3400A Range	0.001	0.001	0.003	0.003	0.01	0.01	0.03	0.03	0.1	0.1	0.3	0.3	1.0	1.0	0.9	1.0	0.8	1.0	0.7	1.0	0.6	1.0	0.5	1.0	0.4	1.0	0.3	1.0	0.2	1.0	0.1	1.0	3.0	3.0	10.0	10.0	30.0	30.0	100.0	100.0	300.0	300.0	<table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">Meter Reading</th> <th style="text-align: center;">DC Output</th> </tr> </thead> <tbody> <tr><td>0.000990 _____</td><td>0.00101 _____</td></tr> <tr><td>0.00297 _____</td><td>0.00303 _____</td></tr> <tr><td>0.00990 _____</td><td>0.0101 _____</td></tr> <tr><td>0.0297 _____</td><td>0.0303 _____</td></tr> <tr><td>0.0990 _____</td><td>0.101 _____</td></tr> <tr><td>0.297 _____</td><td>0.303 _____</td></tr> <tr><td>0.990 _____</td><td>1.01 _____</td></tr> <tr><td>0.90 _____</td><td>0.91 _____</td></tr> <tr><td>0.79 _____</td><td>0.81 _____</td></tr> <tr><td>0.69 _____</td><td>0.71 _____</td></tr> <tr><td>0.59 _____</td><td>0.61 _____</td></tr> <tr><td>0.49 _____</td><td>0.51 _____</td></tr> <tr><td>0.39 _____</td><td>0.41 _____</td></tr> <tr><td>0.29 _____</td><td>0.31 _____</td></tr> <tr><td>0.19 _____</td><td>0.21 _____</td></tr> <tr><td>0.090 _____</td><td>0.11 _____</td></tr> <tr><td>2.97 _____</td><td>3.03 _____</td></tr> <tr><td>9.90 _____</td><td>10.10 _____</td></tr> <tr><td>29.7 _____</td><td>30.3 _____</td></tr> <tr><td>99.0 _____</td><td>101.0 _____</td></tr> <tr><td>297.0 _____</td><td>303.0 _____</td></tr> </tbody> </table>	Meter Reading	DC Output	0.000990 _____	0.00101 _____	0.00297 _____	0.00303 _____	0.00990 _____	0.0101 _____	0.0297 _____	0.0303 _____	0.0990 _____	0.101 _____	0.297 _____	0.303 _____	0.990 _____	1.01 _____	0.90 _____	0.91 _____	0.79 _____	0.81 _____	0.69 _____	0.71 _____	0.59 _____	0.61 _____	0.49 _____	0.51 _____	0.39 _____	0.41 _____	0.29 _____	0.31 _____	0.19 _____	0.21 _____	0.090 _____	0.11 _____	2.97 _____	3.03 _____	9.90 _____	10.10 _____	29.7 _____	30.3 _____	99.0 _____	101.0 _____	297.0 _____	303.0 _____
Calibrator Output	3400A Range																																																																																								
0.001	0.001																																																																																								
0.003	0.003																																																																																								
0.01	0.01																																																																																								
0.03	0.03																																																																																								
0.1	0.1																																																																																								
0.3	0.3																																																																																								
1.0	1.0																																																																																								
0.9	1.0																																																																																								
0.8	1.0																																																																																								
0.7	1.0																																																																																								
0.6	1.0																																																																																								
0.5	1.0																																																																																								
0.4	1.0																																																																																								
0.3	1.0																																																																																								
0.2	1.0																																																																																								
0.1	1.0																																																																																								
3.0	3.0																																																																																								
10.0	10.0																																																																																								
30.0	30.0																																																																																								
100.0	100.0																																																																																								
300.0	300.0																																																																																								
Meter Reading	DC Output																																																																																								
0.000990 _____	0.00101 _____																																																																																								
0.00297 _____	0.00303 _____																																																																																								
0.00990 _____	0.0101 _____																																																																																								
0.0297 _____	0.0303 _____																																																																																								
0.0990 _____	0.101 _____																																																																																								
0.297 _____	0.303 _____																																																																																								
0.990 _____	1.01 _____																																																																																								
0.90 _____	0.91 _____																																																																																								
0.79 _____	0.81 _____																																																																																								
0.69 _____	0.71 _____																																																																																								
0.59 _____	0.61 _____																																																																																								
0.49 _____	0.51 _____																																																																																								
0.39 _____	0.41 _____																																																																																								
0.29 _____	0.31 _____																																																																																								
0.19 _____	0.21 _____																																																																																								
0.090 _____	0.11 _____																																																																																								
2.97 _____	3.03 _____																																																																																								
9.90 _____	10.10 _____																																																																																								
29.7 _____	30.3 _____																																																																																								
99.0 _____	101.0 _____																																																																																								
297.0 _____	303.0 _____																																																																																								
<p>Frequency Response Check:</p>	<table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">Frequency</th> <th style="text-align: center;">Meter Reading</th> </tr> </thead> <tbody> <tr><td>15 Hz</td><td>0.95 _____ 1.05</td></tr> <tr><td>45 Hz</td><td>0.95 _____ 1.05</td></tr> <tr><td>100 Hz</td><td>0.99 _____ 1.01</td></tr> <tr><td>900 kHz</td><td>0.99 _____ 1.01</td></tr> <tr><td>1.2 MHz</td><td>0.98 _____ 1.02</td></tr> <tr><td>1.8 MHz</td><td>0.98 _____ 1.02</td></tr> <tr><td>2.2 MHz</td><td>0.97 _____ 1.03</td></tr> <tr><td>2.8 MHz</td><td>0.97 _____ 1.03</td></tr> <tr><td>3.2 MHz</td><td>0.95 _____ 1.05</td></tr> <tr><td>9.8 MHz</td><td>0.95 _____ 1.05</td></tr> </tbody> </table>	Frequency	Meter Reading	15 Hz	0.95 _____ 1.05	45 Hz	0.95 _____ 1.05	100 Hz	0.99 _____ 1.01	900 kHz	0.99 _____ 1.01	1.2 MHz	0.98 _____ 1.02	1.8 MHz	0.98 _____ 1.02	2.2 MHz	0.97 _____ 1.03	2.8 MHz	0.97 _____ 1.03	3.2 MHz	0.95 _____ 1.05	9.8 MHz	0.95 _____ 1.05																																																																		
Frequency	Meter Reading																																																																																								
15 Hz	0.95 _____ 1.05																																																																																								
45 Hz	0.95 _____ 1.05																																																																																								
100 Hz	0.99 _____ 1.01																																																																																								
900 kHz	0.99 _____ 1.01																																																																																								
1.2 MHz	0.98 _____ 1.02																																																																																								
1.8 MHz	0.98 _____ 1.02																																																																																								
2.2 MHz	0.97 _____ 1.03																																																																																								
2.8 MHz	0.97 _____ 1.03																																																																																								
3.2 MHz	0.95 _____ 1.05																																																																																								
9.8 MHz	0.95 _____ 1.05																																																																																								
<p>Input Impedance Check:</p> <p>Resistance Capacitance</p>	<p>_____ 10 MΩ or greater _____ 50 pF or less 0.001 V to 0.3 V _____ 20 pF or less 1 V to 300 V</p>																																																																																								
<p>Crest Factor Check:</p>	<p>_____ 10:1 full scale _____ 20:1 half scale</p>																																																																																								
<p>Output Noise Check:</p>	<p>_____ 1 mV RMS or less</p>																																																																																								

SECTION VI

CIRCUIT DIAGRAMS

6-1. INTRODUCTION

6-2. This section contains the circuit diagrams necessary for the operation and maintenance of the Model 3400A RMS Voltmeter. Included are schematic and parts location diagrams.

6-3. SCHEMATIC DIAGRAMS

6-4. The schematic diagrams depict the circuits contained within each assembly of the 3400A as well as assembly interconnection. Main signal paths and significant feedback paths are identified.













6-5. The schematic diagrams are arranged in ascending order of assembly reference designation.

6-6. PARTS LOCATION DIAGRAMS

6-7. The parts location diagrams show the physical location of parts within an assembly. Parts are identified by reference designation. A parts location diagram is included for each assembly which does not have adequate silk screening of reference designations.

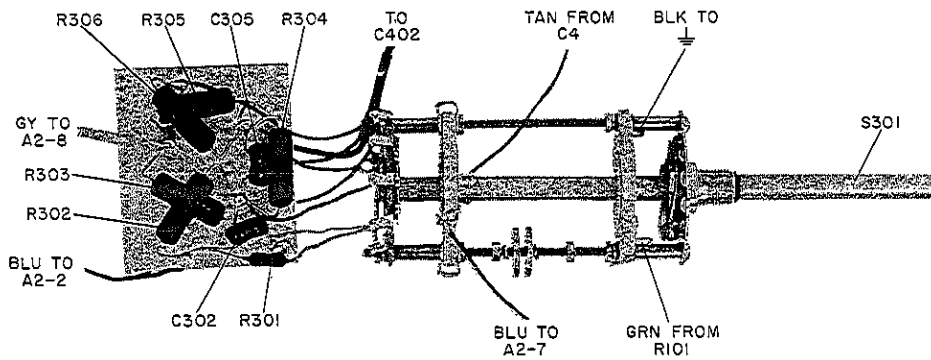
6-8. The parts location diagrams are located on the same figure as the schematic of the assembly.

GENERAL SCHEMATIC NOTES

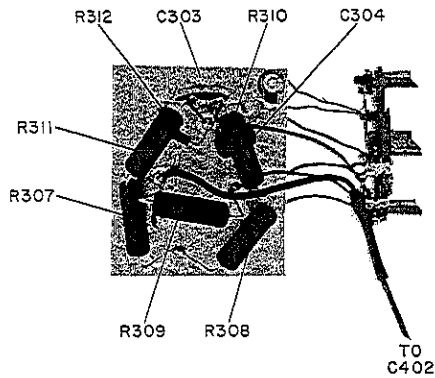
1. COMPLETE REFERENCE DESIGNATIONS ARE SHOWN.
2. COMPONENT VALUES ARE SHOWN AS FOLLOWS UNLESS OTHERWISE NOTED.
RESISTANCE IN OHMS
CAPACITANCE IN MICROFARADS
3.  DENOTES POWER LINE GROUND (VOLTMETER CHASSIS \perp).
 DENOTES CIRCUIT GROUND; ON PRINTED CIRCUIT ASSEMBLY.
4.  DENOTES ASSEMBLY.
 DENOTES MAIN SIGNAL PATH.
 DENOTES DC FEEDBACK PATH.
 DENOTES AC FEEDBACK PATH.
 DENOTES SHIELD.
5.  DENOTES FRONT PANEL MARKING.
 DENOTES REAR PANEL MARKING.
 DENOTES SCREWDRIVER ADJUST.
6.  DENOTES COMPONENTS NOT MOUNTED ON ASSEMBLY.
7. * AVERAGE VALUE SHOWN, OPTIMUM VALUE SELECTED AT FACTORY. SEE TABLE 5-7.
8.  DENOTES SECOND APPEARANCE OF A CONNECTOR PIN.

NOTES

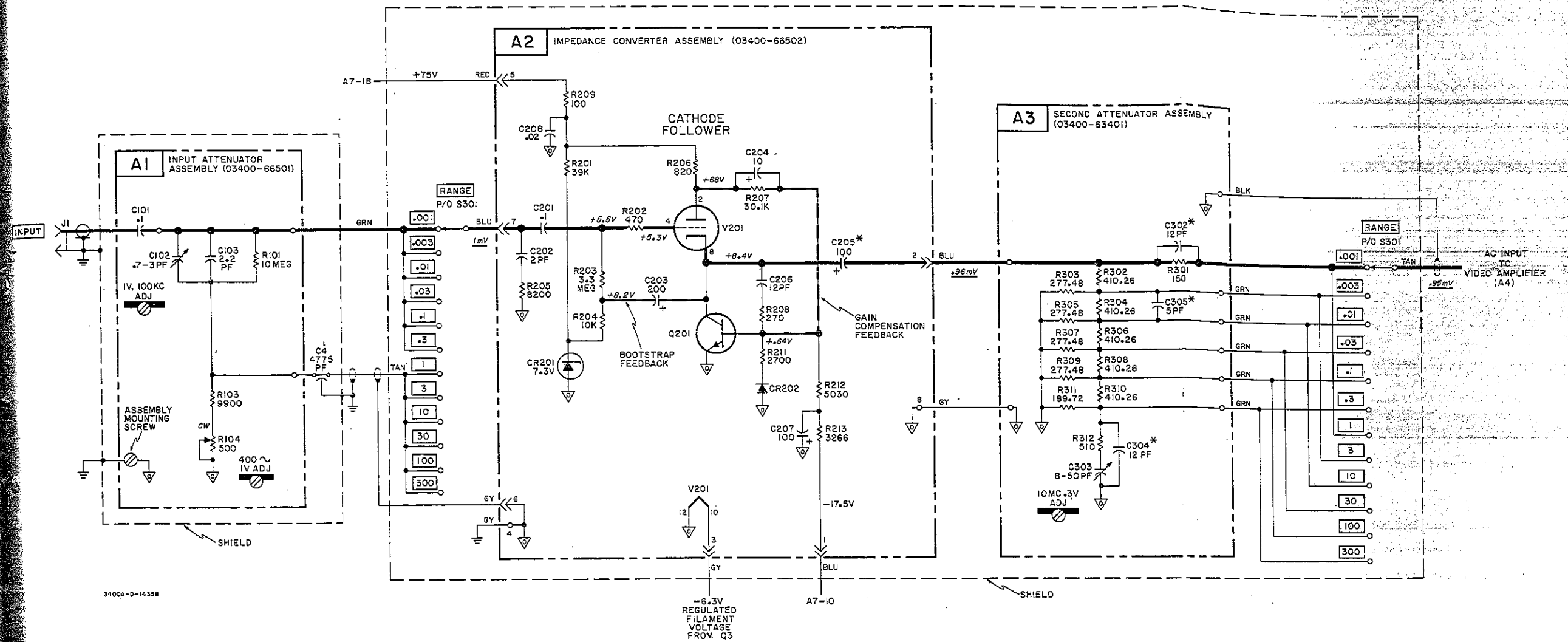
1. ALL DC AND AC VOLTAGE LEVELS SHOWN IN RED ARE WITH 1 MV INPUT (FULL SCALE DEFLECTION). A TOLERANCE OF $\pm 10\%$ SHOULD BE ALLOWED FOR VARIATIONS FROM INSTRUMENT TO INSTRUMENT.
2. ALL AC VOLTAGES ARE UNDERLINED>. ALL DC VOLTAGES HAVE A POLARITY INDICATION.



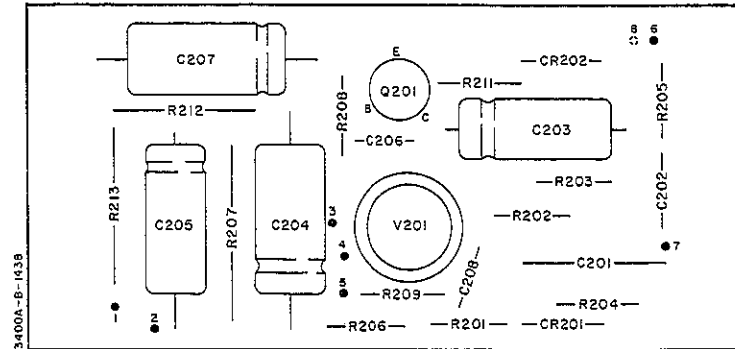
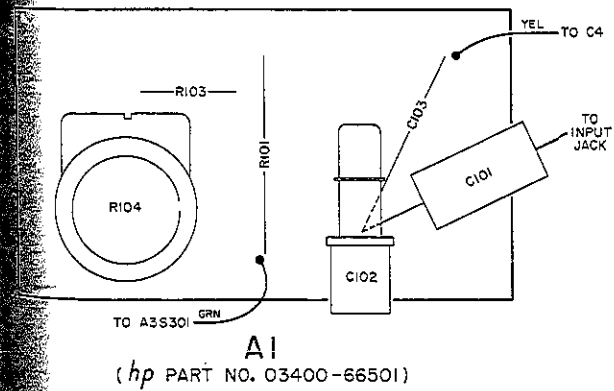
3400A-A-0107



A3
 (hp PART NO. 03400-63401)
 (BOARD ONLY)



3400A-D-1435B

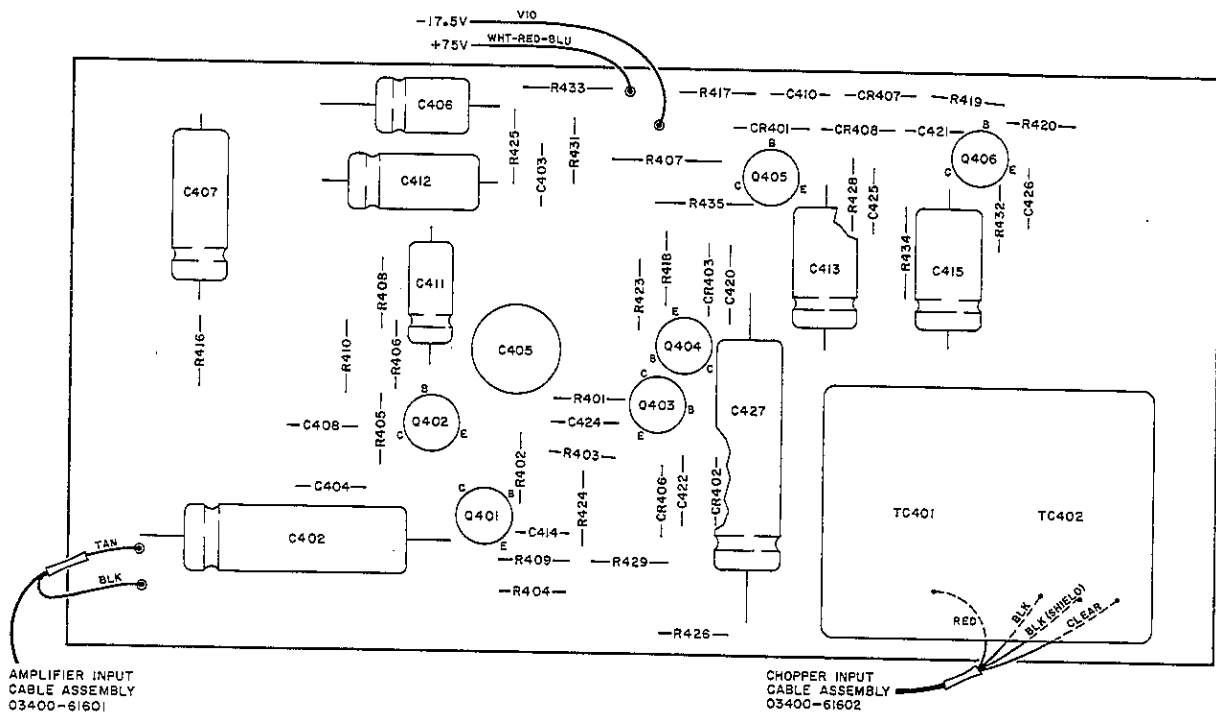


- 1 BLU A7-10
- 2 BLU A3R302
- 3 GY Q3 EMITTER
- 4 GY C2 (⊥)
- 5 RED A7-18
- 6 GY C4 (⊥)
- 7 BLU S301
- 8 GY A3R305 (⊥)

Figure 6-1. Input Attenuator A1, Impedance Converter A2, and Second Attenuator A3 Schematic and Parts Location Diagram
 6-3/6-4

NOTES

1. ALL DC AND AC VOLTAGE LEVELS SHOWN IN RED ARE WITH 1 MV INPUT (FULL SCALE DEFLECTION). A TOLERANCE OF $\pm 10\%$ SHOULD BE ALLOWED FOR VARIATIONS FROM INSTRUMENT TO INSTRUMENT.
2. ALL AC VOLTAGES ARE UNDERLINED. ALL DC VOLTAGES HAVE A POLARITY INDICATION.
3. AC VOLTAGE LEVELS AT Q405 AND Q406 MUST BE OBSERVED WITH 10:1 DIVIDER PROBE.
4. IF C427 IS REPLACED, IT MAY BE NECESSARY TO SELECT THE VALUE OF C427 FOR PROPER FREQUENCY RESPONSE. THIS IS DUE TO CAPACITOR TOLERANCE.



AMPLIFIER INPUT
CABLE ASSEMBLY
03400-61601

CHOPPER INPUT
CABLE ASSEMBLY
03400-61602

A4

(hp PART NO. 03400-66503)

3400A-B-1439

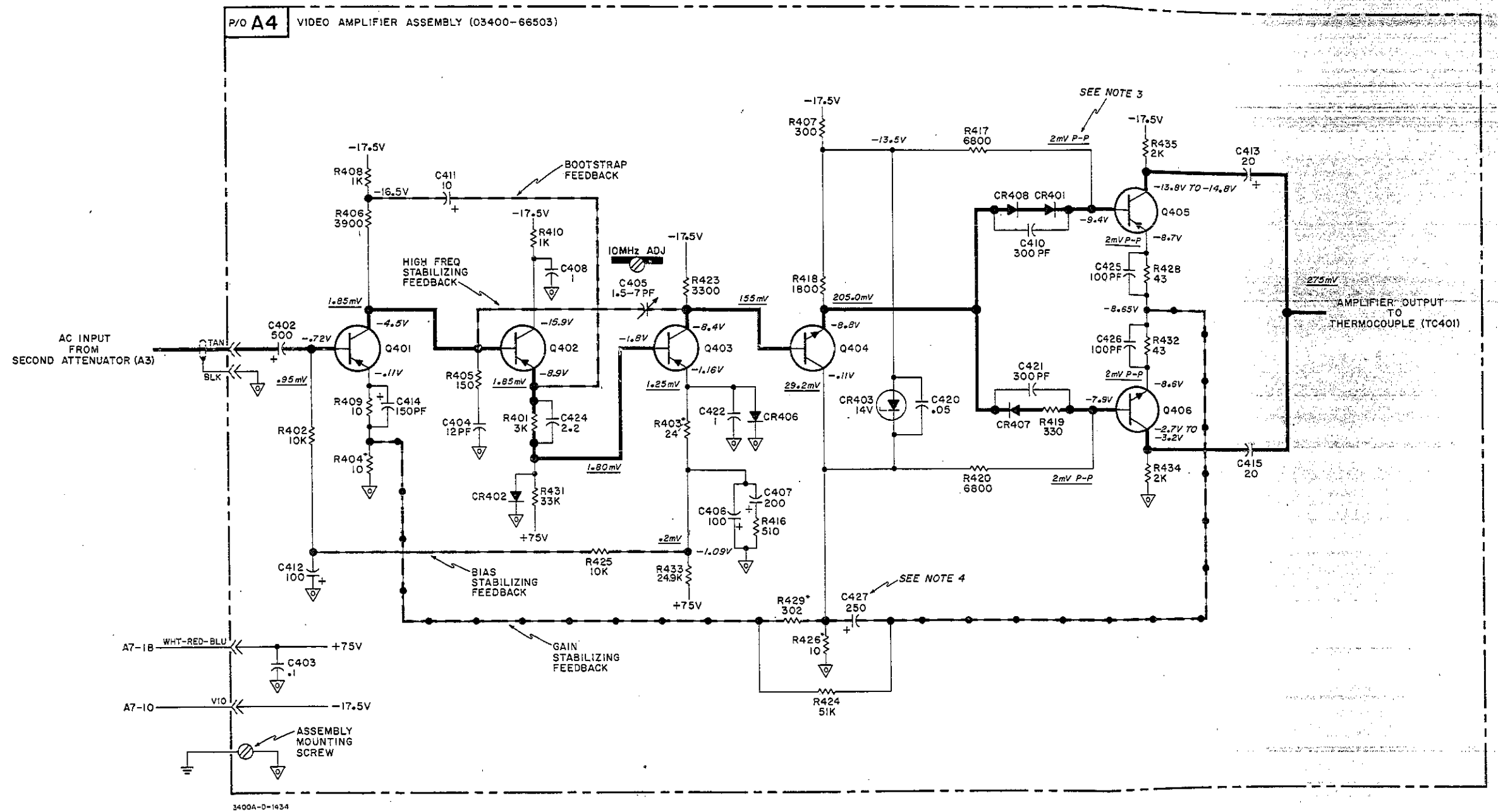
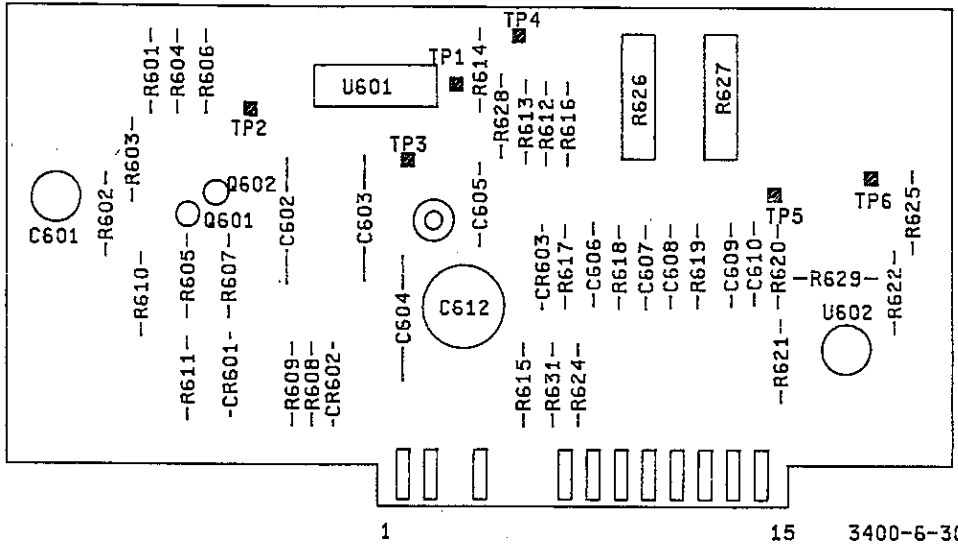
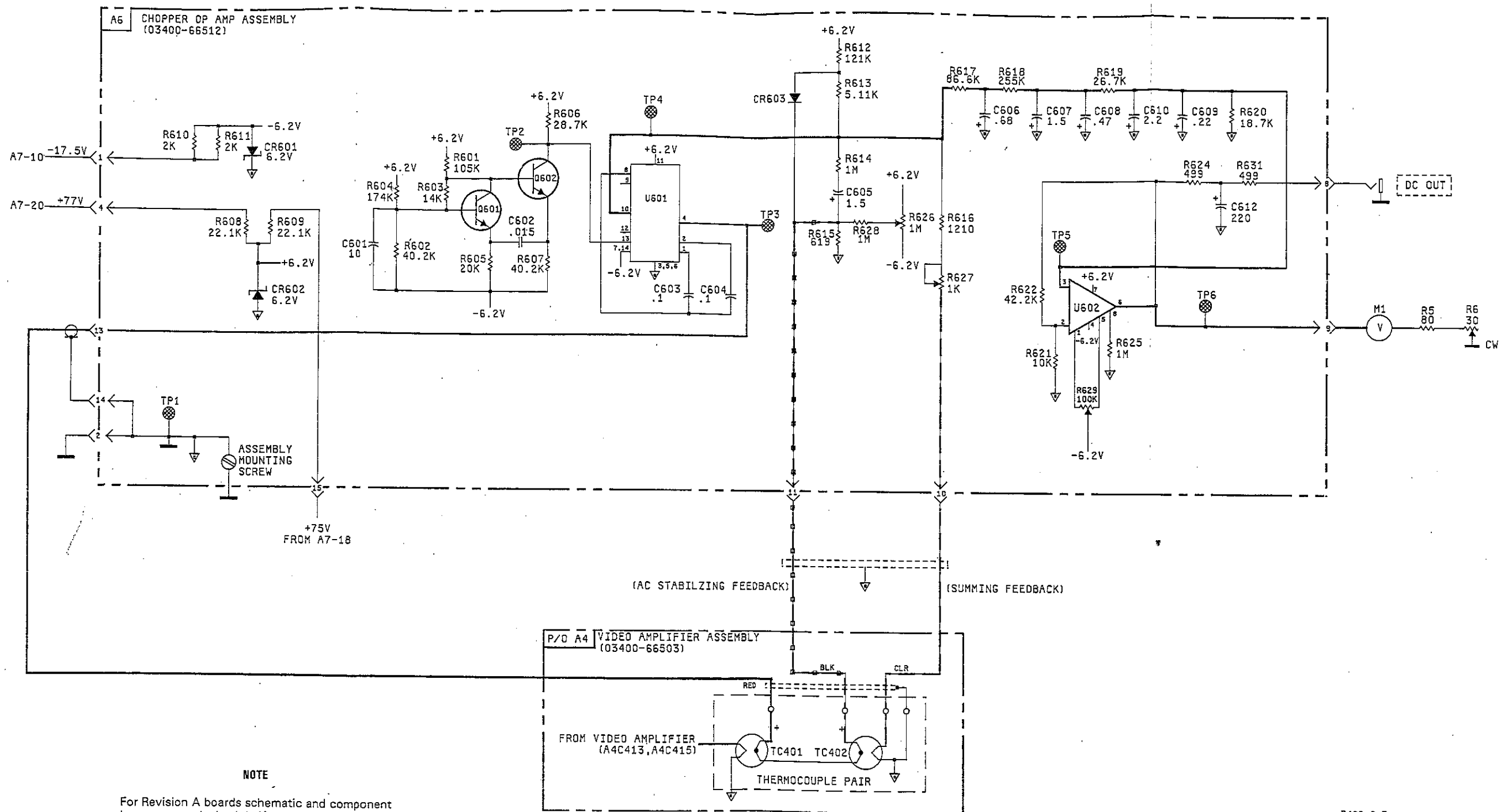


Figure 6-2. Video Amplifier A4 Schematic and Parts Location Diagram
6-5/6-6



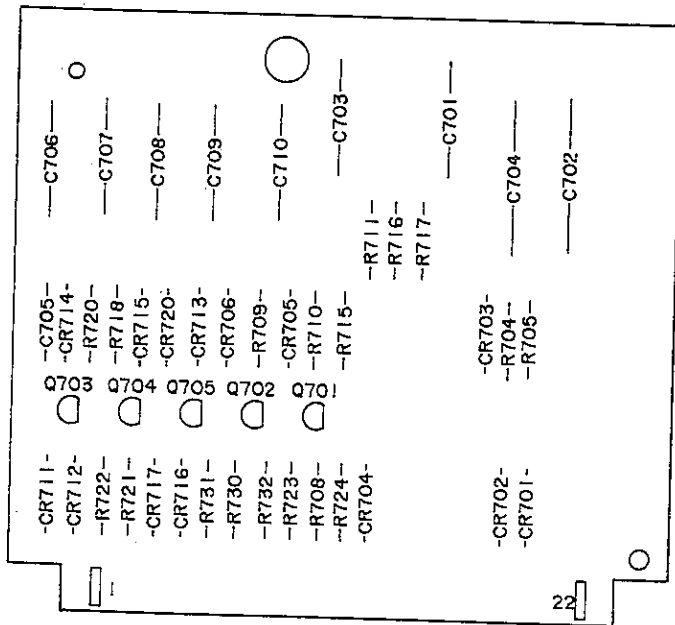
3400-6-3C

A6
 (REV. C)
 (-hp- Part Number 03400-66512)



3400-6-3

Figure 6-3. Chopper Amplifier A6 and Thermouple Pair
 (Part of A4) Schematic and Parts Location Diagram
 6-7/6-8



3400-6-4C

A7
 (REV. A)
 (hp Part Number 03400-66510)

NOTE

Some 3400's have capacitors C3A and C3B connected across the ac line, as shown below. If any capacitor is defective, remove the defective capacitor but do NOT replace it with a good one.

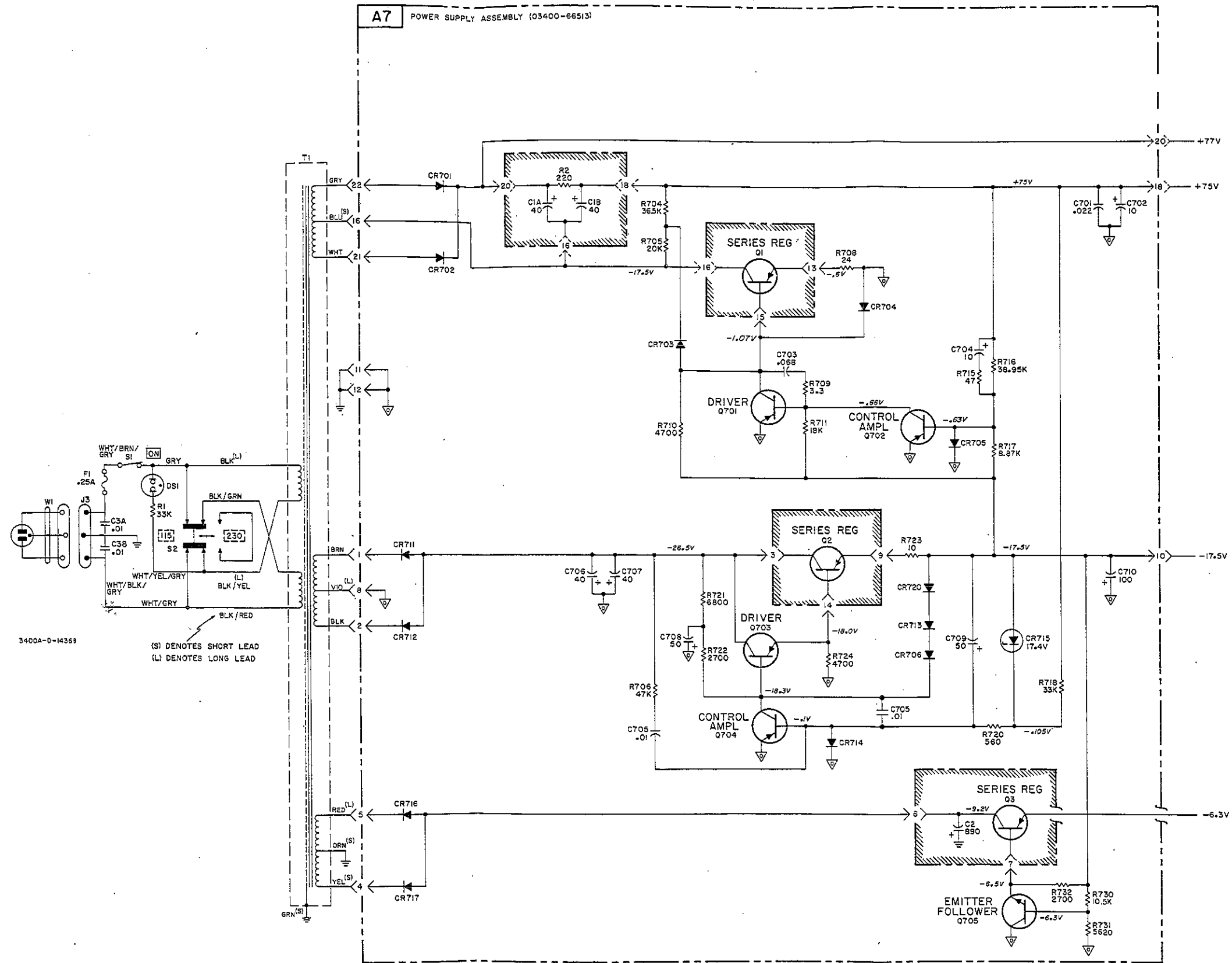


Figure 6-4. Power Supply A7 Schematic and Parts Location
6-9/6-10

SECTION VII

REPLACEABLE PARTS

7-1. INTRODUCTION

7-2. This section contains information for ordering replacement parts. Table 7-1 lists parts in alphameric order of their reference designators and indicates the description, -hp- part number for each part, together with any applicable notes, and provides the following:

- a. Total quantity used in the instrument (TQ column). The total quantity of a part is given the first time the part number appears.
- b. Description of the part. (See list of abbreviations below.)
- c. Typical manufacturer of the part in a five digit code.
- d. Manufacturer's part number.

7-3. Miscellaneous parts are listed at the end of Table 7-1.

7-4. ORDERING INFORMATION

7-5. To obtain replacement parts, address order or inquiry to your local Hewlett-Packard Field Office. Identify parts by their Hewlett-Packard part numbers. Include instrument model and serial numbers.

7-6. NON-LISTED PARTS

7-7. To obtain a part that is not listed, include:

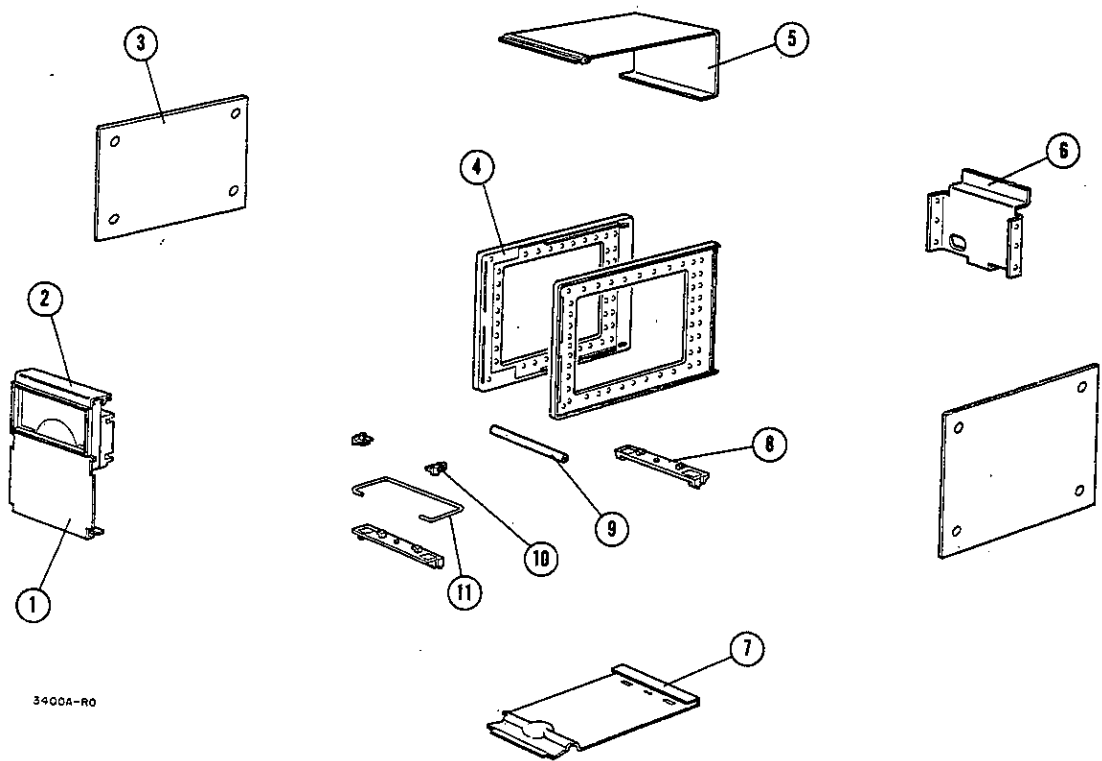
- a. Instrument model number.
- b. Instrument serial number.
- c. Description of the part.
- d. Function and location of the part.

Table 7-1. List of Abbreviations

ABBREVIATIONS			
Ag	silver	Hz	hertz (cycle(s) per second)
Al	aluminum	ID	inside diameter
A _s	ampere(s)	imp	impregnated
Au	gold	incd	incandescent
C	capacitor	ins	insulation(s)
cer	ceramic	kΩ	kiloohm(s) = 10 ⁺³ ohms
coef	coefficient	kHz	kilohertz = 10 ⁺³ hertz
com	common	L	inductor
comp	composition	lin	linear taper
conn	connection	log	logarithmic taper
dep	deposited	mA	milliampere(s) = 10 ⁻³ amperes
DPDT	double-pole double-throw	MHz	megahertz = 10 ⁺⁶ hertz
DPST	double-pole single-throw	MΩ	megaohm(s) = 10 ⁺⁶ ohms
elect.	electrolytic	met film	metal film
encap.	encapsulated	mfr	manufacturer
F	feral(s)	ms	millisecond
FET	field effect transistor	mtg	mounting
fxd	fixed	mV	millivolt(s) = 10 ⁻³ volts
GeAs	gallium arsenide	μF	microfarad(s)
GHz	gigahertz = 10 ⁺⁹ hertz	μs	microsecond(s)
gd	guarded	μV	microvolt(s) = 10 ⁻⁶ volts
Gs	germanium	mv	Mylar
gnd	grounded	nA	nanampere(s) = 10 ⁻⁹ amperes
H	henry(ies)	NC	normally closed
Hg	mercury	Ne	neon
		NO	normally open
		NPO	negative positive zero (zero temperature coefficient)
		ns	nanosecond(s) = 10 ⁻⁹ seconds
		nsr	not separately replaceable
		ohm(s)	ohm(s)
		D	order by description
		OD	outside diameter
		p	peak
		pA	picoampere(s)
		pc	printed circuit
		pF	picofarad(s) 10 ⁻¹² farads
		piv	peak inverse voltage
		pos	part of
		pos	position(s)
		poly	polystyrene
		pot	potentiometer
		p-p	peak-to-peak
		ppm	parts per million
		prec.	precision (temperature coefficient, long term stability and/or tolerance)
		R	resistor
		Rh	rhodium
		rms	root-mean-square
		rot	rotary
		Se	selenium
		sect	section(s)
		Si	silicon
		sl	slide
		SPDT	single-pole double-throw
		SPST	single-pole single-throw
		Ta	tantalum
		TC	temperature coefficient
		TiO ₂	titanium dioxide
		tog	toggle
		tol	tolerance
		trim	trimmer
		TSTR	transistor
		V	volt(s)
		vacw	alternating current working voltage
		var	variable
		vcw	direct current working voltage
		W	watt(s)
		wf	with
		wiv	working inverse voltage
		w/o	without
		ww	wirewound
		*	optimum value selected at factory, average value shown (part may be omitted)
		**	no standard type number assigned selected or special type
			© Dupont de Nemours
DESIGNATORS			
A	assembly	FL	filter
B	motor	HR	heater
BT	battery	IC	integrated circuit
C	capacitor	J	jack
CR	diode or thyristor	K	relay
DL	delay line	L	inductor
DS	lamp	M	meter
E	misc electronic part	MP	mechanical part
F	fuse	P	plug
		Q	transistor
		QCR	transistor-diode
		R(p)	resistor(pack)
		RT	thermistor
		S	switch
		T	transformer
		TB	terminal board
		TC	thermocouple
		TP	test point
		TS	terminal strip
		U	microcircuit
		V	vacuum tube, neon bulb, photocell, etc.
		W	wire
		X	socket
		XDS	lameholder
		XF	fuseholder
		Y	crystal
		Z	network

Table 7-2. Code List of Manufacturers

Mfr. No.	Manufacturer Name	Address
00494	Addressograph Multigraph Corp.	Cleveland, OH 44117
01121	Allen-Bradley Co	Milwaukee, WI 53204
02111	Spectrol Electronics Corp	City of Ind, CA 91745
04713	Motorola Semiconductor Products	Phoenix, AZ 85008
13606	Sprague Elect Co Semiconductor Div	Concord, NH 03301
24546	Corning Glass Works (Bradford)	Bradford, Pa 16701
27014	National Semiconductor Corp	Santa Clara, CA 95051
28480	Hewlett-Packard Co Corporate Hq	Palo Alto, CA 94304
3L585	RCA Corp Solid State Div	Somerville, NJ
56289	Sprague Electric Co	North Adams, MA 01247
72136	Electro Motive Corp	Florence, SC 06226
72982	Erie Technological Products Inc	Erie, PA 16512
91637	Dale Electronics Inc	Columbus, NE 68601
91802	Industrial Devices Inc	Edgewater, NJ 07020



3400A-R0

Index No.	Description	Quantity	-hp- Part No.
1	Front Panel	1	
2	Meter Trim 1/2 module	1	03400-00204
3	Side Cover 6 x 11 sm	1	5020-6852
4	Frame Assembly	2	4000-8565
5	Top Cover (with handle)	2	5060-0703
6	Rear Panel	1	03400-64103
7	Bottom Cover 5 x 11 sm	1	03400-00215
8	Foot Assembly 1/2 module	1	5000-8571
9	Spacer 1/2 module	2	5060-0727
10	Hinge	1	5020-6852
11	Tilt Stand 1/2 module	2	4050-0700
		1	1490-0031

Figure 7-1. Modular Cabinet

Table 7-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1	03400-66501	0	1	ASSEMBLY-INPUT ATTENUATOR BOARD	28480	03400-66501
A2	03400-66502	1	1	ASSEMBLY-IMPEDANCE CONVERTER BOARD	28480	03400-66502
A3	03400-63401	3	1	ASSEMBLY-SECOND ATTENUATOR	28480	03400-63401
A4	03400-66503	2	1	ASSEMBLY-AMPLIFIER BOARD	28480	03400-66503
A6	03400-66512	3	1	ASSEMBLY-CHOPPER OP AMP	28480	03400-66512
A7	03400-66513	4	1	ASSEMBLY-POWER SUPPLY BOARD	28480	03400-66513
C1	0180-0152	5	1	CAPACITOR-FXD 40UF+30-10% 200VDC AL	28480	0180-0152
C2	0180-0148	9	1	CAPACITOR-FXD 890UF+100-10% 15VDC AL	28480	0180-0148
C4	0160-0379	6	1	CAPACITOR-FDTHRU 4775PF 10% 500V MICA	72982	633-010 1801 47750
C101	0170-0022	7	1	CAPACITOR-FXD .1UF +-20% 500VDC POLYE	28480	0170-0022
C102	0132-0003	4	1	CAPACITOR-V TRMR-PTN 7-32PF 350V	28480	0132-0003
C103	0150-0058	7	1	CAPACITOR-FXD 2.2PF +-25PF 500VDC CER	28480	0150-0058
C201	0160-2671	5	1	CAPACITOR-FXD .1UF +-5% 80VDC POLYE	28480	0160-2671
C202	0150-0031	6	1	CAPACITOR-FXD 2PF +-5% 500VDC TI DIOX	28480	0150-0031
C203	0180-0060	4	2	CAPACITOR-FXD 200UF+75-10% 3VDC AL	56289	30D2070013CC2
C204	0180-0059	7	3	CAPACITOR-FXD 100UF+50-10% 150VDC AL	56289	30D106F150DD2
C205*	0180-0039	7	2	CAPACITOR-FXD 100UF+75-10% 12VDC AL	56289	30D1076012CC2
C206	0140-0201	1	2	CAPACITOR-FXD 12PF +-5% 500VDC MICA	72136	DM15C120J0500WV1CR
C207	0180-0061	5	1	CAPACITOR-FXD 100UF+75-10% 16VDC AL	56289	30D1076016DC2
C208	0150-0024	7	1	CAPACITOR-FXD .02UF +-80-20% 100VDC CER	28480	0150-0024
C302*	0160-0987	1	1	CAPACITOR-FXD 12PF+-10% 500VDC MICA	28480	0160-0987
C303	0121-0039	3	1	CAPACITOR-V TRMR-CER 8-50PF 350V PNL-MTG	72982	557-062 58-50
C304*	0160-0987	2	2	CAPACITOR-FXD 12PF +-5% 500VDC MICA	28480	0160-0987
C305*	0160-0987	2	2	CAPACITOR-FXD 12PF +-3% 500VDC MICA	28480	0160-0987
C402	0180-0063	7	1	CAPACITOR-FXD 500UF+75-10% 3VDC AL	56289	30D507003DF2
C403	0160-0269	3	1	CAPACITOR-FXD .1UF +-20% 500VDC CER	28480	0160-0269
C404	0140-0201	1	1	CAPACITOR-FXD 12PF +-5% 500VDC MICA	72136	DM15C120J0500WV1CR
C405	0130-0018	7	1	CAPACITOR-V TRMR-CER 1.5-7PF 350V PC-MTG	28480	0130-0018
C406	0180-0137	6	1	CAPACITOR-FXD 100UF+-20% 10VDC TA	56289	150D107X0010R2
C407	0180-0060	4	2	CAPACITOR-FXD 200UF+75-10% 3VDC AL	56289	30D207003CC2
C408	0160-0127	2	2	CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
C410	0140-0225	9	2	CAPACITOR-FXD 300PF +-1% 300VDC MICA	72136	DM15F301F0300WV1C
C411	0180-0224	2	1	CAPACITOR-FXD 10UF+75-10% 16VDC AL	56289	30D1060165A2
C412	0180-0039	7	2	CAPACITOR-FXD 100UF+75-10% 12VDC AL	56289	30D1076012CC2
C413	0180-0142	3	2	CAPACITOR-FXD 20UF+100-10% 25VDC AL SPOL	28480	0180-0142
C414	0140-0196	3	1	CAPACITOR-FXD 150PF +-5% 300VDC MICA	72136	DM15F151J0300WV1CR
C415	0180-0142	3	3	CAPACITOR-FXD 20UF+100-10% 25VDC AL SPOL	28480	0180-0142
C420	0150-1096	3	1	CAPACITOR-FXD .05UF +-80-20% 100VDC CER	28480	0150-1096
C421	0140-0225	9	2	CAPACITOR-FXD 300PF +-1% 300VDC MICA	72136	DM15F301F0300WV1C
C422	0160-0127	2	2	CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
C424	0160-0128	3	1	CAPACITOR-FXD 2.2UF +-20% 50VDC CER	28480	0160-0128
C425	0140-0176	9	2	CAPACITOR-FXD 100PF +-2% 300VDC MICA	72136	DM15F101G0300WV1CR
C426	0140-0176	9	2	CAPACITOR-FXD 100PF +-2% 300VDC MICA	72136	DM15F101G0300WV1CR
C427*	0180-2428	2	1	CAPACITOR-FXD 250UF+75-10% 25VDC AL	56289	50D2570025EF7
C601	0180-2822	0	1	CAPACITOR-FXD 10UF+50-10% 50VDC TA	28480	0180-2822
C602	0160-0194	3	1	CAPACITOR-FXD .015UF +-10% 200VDC POLYE	28480	0160-0194
C603	0160-0168	1	2	CAPACITOR-FXD .1UF +-10% 200VDC POLYE	28480	0160-0168
C604	0160-0168	1	2	CAPACITOR-FXD .1UF +-10% 200VDC POLYE	28480	0160-0168
C605	0180-1745	4	2	CAPACITOR-FXD 1.5UF+-10% 20VDC TA	56289	150D155X9020A2
C606	0180-0373	2	1	CAPACITOR-FXD .68UF+-10% 35VDC TA	56289	150D684X9035A2
C607	0180-1745	4	4	CAPACITOR-FXD 1.5UF+-10% 20VDC TA	56289	150D155X9020A2
C608	0180-0376	5	1	CAPACITOR-FXD .47UF+-10% 35VDC TA	56289	150D474X9035A2
C609	0180-1735	2	1	CAPACITOR-FXD .22UF+-10% 35VDC TA	56289	150D224X9035A2
C610	0180-0197	8	1	CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
C612	0180-0692	8	1	CAPACITOR-FXD 220UF+50-10% 35VDC AL	01494	35V8L220
C701	0170-0024	9	1	CAPACITOR-FXD .022UF +-20% 200VDC POLYE	28480	0170-0024
C702	0180-0089	9	1	CAPACITOR-FXD 10UF+50-10% 150VDC AL	56289	30D106F150DD2
C703	0160-0166	7	1	CAPACITOR-FXD .068UF +-10% 200VDC POLYE	28480	0160-0166
C704	0180-0089	7	1	CAPACITOR-FXD 10UF+50-10% 150VDC AL	56289	30D106F150DD2
C705	0150-0012	3	1	CAPACITOR-FXD .01UF +-20% 1KVDC CER	56289	C023A1 02J103MS38
C706	0180-0050	2	2	CAPACITOR-FXD 40UF+75-10% 50VDC AL	56289	30D4060C050DD2
C707	0180-0050	2	2	CAPACITOR-FXD 40UF+75-10% 50VDC AL	56289	30D4060C050DD2
C708	0180-0105	8	2	CAPACITOR-FXD 50UF+100-10% 25VDC AL SPOL	28480	0180-0105
C709	0180-0105	8	1	CAPACITOR-FXD 50UF+100-10% 25VDC AL SPOL	28480	0180-0105
C710	0180-0098	8	1	CAPACITOR-FXD 100UF+-20% 20VDC TA	56289	150D107X0020S2
CR201	1902-0045	8	1	DIODE-ZNR 7.32V 2% DO-35 PD=.4W	28480	1912-0045
CR202	1901-0025	1	8	DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
CR401	1901-0025	1	8	DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
CR402	1901-0040	2	2	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
CR403	1902-0040	3	1	DIODE-ZNR 14V 5%	28480	1902-0040

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

Table 7-3. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
CR406	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7		
CR407	1918-0016	0	2	DIODE-GE 60V 60MA 1US DO-7	28480	1901-0025
CR408	1918-0016	0		DIODE-GE 60V 60MA 1US DO-7	28480	1910-0016
CR601	1902-0777	3	2	DIODE-ZNR 1N825 6.2V SZ DO-7 PD=.4W	28480	1910-0016
CR602	1902-0777	3		DIODE-ZNR 1N825 6.2V SZ DO-7 PD=.4W	04713	1N825
CR603	1901-0518	8	1	DIODE-SM SIG SCHOTTKY	04713	1N825
CR701	1901-0028	5	2	DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0518
CR702	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
CR703	1901-0025	5	2	DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0028
CR704	1901-0701	1	2	DIODE-STABISTOR 12V 10MA	28480	1901-0025
CR705	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0701
CR706	1901-0701	1		DIODE-STABISTOR 12V 10MA	28480	1901-0025
CR711	1901-0026	3	2	DIODE-PWR RECT 200V 750MA DO-29	28480	1901-0701
CR712	1901-0026	3		DIODE-PWR RECT 200V 750MA DO-29	28480	1901-0026
CR713	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0026
CR714	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
CR715	1902-3223	0	1	DIODE-ZNR 17.4V 2X DO-35 PD=.4W	28480	1901-0025
CR716	1901-0045	6	2	DIODE-PWR RECT 100V 750MA DO-29	28480	1902-3223
CR717	1901-0045	6		DIODE-PWR RECT 100V 750MA DO-29	28480	1901-0045
CR720	1901-0025	2		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0045
DS1	1450-0566	9	1	LIGHT-IND WHT-TL .4-DIA SLDR-LUC-TERM	28480	1901-0025
F1	2110-0004	1	1	FUSE .25A 250V NTD 1.25X.25 UL	91802	2910S21
J1	1250-0118	3	1	CONNECTOR-RF BNC FEM SCL-HOLE-FR 50-OHM	28480	2110-0004
J2	1251-0205	1	1	CONNECTOR-TEL JACK 2-CKT .25-SHK-DIA	28480	1250-0118
J3	1251-2357	8	1	CONNECTOR-AC PWR HP-9 MALE FLG-MTG	28480	1251-0205
J4	1251-0208	4	1	CONNECTOR-PC EDGE 22-CONT/ROW 1-ROW	28480	1251-2357
J5	1251-0194	7	1	CONNECTOR-PC EDGE 15-CONT/ROW 1-ROW	28480	1251-0208
M1	1120-0320	4	1	METER-3MA	28480	1251-0194
M1	1120-0308	8	1	METER-DB SCALE (OPT. 001 ONLY)	28480	1120-0320
Q1	1853-0063	5	1	TRANSISTOR PNP SI TO-3 PD=150W FT=3MHZ	28480	1120-0308
Q2	1853-0305	8	1	TRANSISTOR PNP SI TO-3 PD=150W	28480	1853-0063
Q3	1853-0511	6	1	TRANSISTOR PNP 2N3792 SI TO-3 PD=150W	04713	2N5875
Q201	1853-0213	1	2	TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3792
Q401	1853-0288	6	4	TRANSISTOR PNP SI TO-18 PD=360MW	04713	2N3904
Q402	1853-0288	6		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0288
Q403	1853-0288	6		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0288
Q404	1854-0354	9	2	TRANSISTOR NPN SI TO-52 PD=360MW	28480	1854-0354
Q405	1853-0288	6		TRANSISTOR NPN SI TO-52 PD=360MW	28480	1853-0288
Q406	1854-0354	9		TRANSISTOR NPN SI TO-52 PD=360MW	28480	1854-0354
Q601	1854-0226	4	2	TRANSISTOR NPN 2N4384 SI TO-18 PD=500MW	13606	2N4384
Q602	1854-0226	4		TRANSISTOR NPN 2N4384 SI TO-18 PD=500MW	13606	2N4384
Q701	1853-0066	8	2	TRANSISTOR PNP SI TO-92 PD=625MW	28480	1853-0066
Q702	1853-0066	8		TRANSISTOR PNP SI TO-92 PD=625MW	28480	1853-0066
Q703	1853-0066	2	2	TRANSISTOR PNP SI PD=310MW FT=40MHZ	27014	2N5087
Q704	1853-0066	2		TRANSISTOR PNP SI PD=310MW FT=40MHZ	27014	2N5087
Q705	1854-0213	1	1	TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
R1	0687-3331	2	1	RESISTOR 33K 10% .5W CC TC=0+765	01121	EB3331
R2	0687-2211	5	1	RESISTOR 220 10% .5W CC TC=0+529	01121	EB2211
R5	0812-0048	9	1	RESISTOR 80 3% .75W PW TC=0+20	91637	RS1/2-T9-80R-H
R6	2100-0721	8	1	RESISTOR-TRMR 30 20% WW SIDE-ADJ 1-TRN	28480	2100-0721
R101	0698-4128	8	1	RESISTOR 10M .25% 1W F TC=0+50	28480	0698-4128
R103	0698-6204	7	1	RESISTOR 9.9K 1% .125W F TC=0+100	24546	C4-1/8-T0-9901-F
R104	2100-0554	5	1	RESISTOR-TRMR 500 10% C TOP-ADJ 1-TRN	28480	2100-0554
R201	0683-3935	4	1	RESISTOR 39K 5% .25W FC TC=-400/+800	01121	C3935
R202	0683-4715	0	1	RESISTOR 470 5% .25W FC TC=-400/+600	01121	C4715
R203	0683-3355	2	1	RESISTOR 3.3M 5% .25W FC TC=-900/+1100	01121	C3355
R204	0683-1035	1	3	RESISTOR 10K 5% .25W FC TC=-400/+700	01121	C81035
R205	0683-8225	5	1	RESISTOR 8.2K 5% .25W FC TC=-400/+700	01121	C8225
R206	0683-8215	3	1	RESISTOR 820 5% .25W FC TC=-400/+600	01121	C8215
R207	0757-0348	9	1	RESISTOR 30.1K .5% .25W FC TC=-400/+600	28480	0757-0348
R208	0683-2715	6	1	RESISTOR 270 5% .25W FC TC=-400/+600	01121	C82715
R209	0683-1015	7	1	RESISTOR 100 5% .25W FC TC=-400/+500	01121	C81015
R211	0683-2725	8	3	RESISTOR 2.7K 5% .25W FC TC=-400/+700	01121	C82725
R212	0727-0136	5	1	RESISTOR 5.03K 1% .5W CF TC=0-500	28480	0727-0136
R213	0737-0126	3	1	RESISTOR 3.266K 1% .5W CF TC=0-500	91637	DCS1/2-3266R-F
R301	0737-0715	9	1	RESISTOR 150 1% .25W F TC=0+100	24546	C5-1/4-T0-151-F
R302	0698-4119	8	5	RESISTOR 410.26 .1% .25W F TC=0+100	28480	0698-4119
R303	0698-4118	9	4	RESISTOR 277.48 .1% .25W F TC=0+100	28480	0698-4118
R304	0698-4119	9		RESISTOR 410.26 .1% .25W F TC=0+100	28480	0698-4119
R305	0698-4118	8		RESISTOR 277.48 .1% .25W F TC=0+100	28480	0698-4118
R306	0698-4119	9		RESISTOR 410.26 .1% .25W F TC=0+100	28480	0698-4119

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

Table 7-3. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
R307	0698-4118	8		RESISTOR 277.48 .1% .25W F TC=0+100	28480	0698-4118
R308	0698-4119	9		RESISTOR 410.25 .1% .25W F TC=0+100	28480	0698-4119
R309	0698-4118	9		RESISTOR 277.48 .1% .25W F TC=0+100	28480	0698-4118
R310	0698-4119	9		RESISTOR 410.25 .1% .25W F TC=0+100	28480	0698-4119
R311	0698-4117	7	1	RESISTOR 189.72 .1% .25W F TC=0+100	28480	0698-4117
R312	0683-5115	6		RESISTOR 510 5% .25W FC TC=-400/+600	01121	CB5115
R401	0683-3025	3	1	RESISTOR 5K 5% .25W FC TC=-400/+700	01121	CB3025
R402	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
R403*	0683-2405	1	2	RESISTOR 24 5% .25W FC TC=-400/+500	01121	CB2405
R404*	0757-0346	2	2	RESISTOR 10 1% .125W F TC=0+100	24546	C4-1/8-T0-10R0-F
R405	0683-1515	2	1	RESISTOR 150 5% .25W FC TC=-400/+600	01121	CB1515
R406	0683-3925	2	1	RESISTOR 3.9K 5% .25W FC TC=-400/+700	01121	CB3925
R407	0727-0065	9	1	RESISTOR 300 1% .5W CF TC=0-500	28480	0727-0065
R408	0683-1025	9	2	RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R409	0683-1005	5	1	RESISTOR 10 5% .25W FC TC=-400/+500	01121	CB1005
R410	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
R416	0683-5115	6		RESISTOR 510 5% .25W FC TC=-400/+600	01121	CB5115
R417	0683-6825	7	3	RESISTOR 6.8K 5% .25W FC TC=-400/+700	01121	CB6825
R418	0683-1825	7	1	RESISTOR 1.8K 5% .25W FC TC=-400/+700	01121	CB1825
R419	0683-3315	4	1	RESISTOR 330 5% .25W FC TC=-400/+600	01121	CB3315
R420	0683-6825	7		RESISTOR 6.8K 5% .25W FC TC=-400/+700	01121	CB6825
R423	0683-3325	6	1	RESISTOR 3.3K 5% .25W FC TC=-400/+700	01121	CB3325
R424	0683-5135	0	1	RESISTOR 51K 5% .25W FC TC=-400/+800	01121	CB5135
R425	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
R426*	0757-0346	2	2	RESISTOR 10 1% .125W F TC=0+100	24546	C4-1/8-T0-10R0-F
R428	0683-4305	4	2	RESISTOR 43 5% .25W FC TC=-400/+500	01121	CB4305
R429*	0757-0346	1	1	RESISTOR 302 1% .125W F TC=0+100	24546	C4-1/8-T0-302R-F
R431	0683-3335	8	2	RESISTOR 33K 5% .25W FC TC=-400/+800	01121	CB3335
R432	0683-4305	4	2	RESISTOR 43 5% .25W FC TC=-400/+500	01121	CB4305
R433	0698-3217	6	1	RESISTOR 24.9K 1% .25W F TC=0+100	24546	C5-1/4-T0-2492-F
R434	0757-0739	7	2	RESISTOR 2K 1% .25W F TC=0+100	24546	C5-1/4-T0-2001-F
R435	0757-0739	7	2	RESISTOR 2K 1% .25W F TC=0+100	24546	C5-1/4-T0-2001-F
R601	0698-4524	0	1	RESISTOR 174K 1% .125W F TC=0+100	24546	C4-1/8-T0-1743-F
R602	0698-3499	6	2	RESISTOR 40.2K 1% .125W F TC=0+100	24546	C4-1/8-T0-4022-F
R603	0698-4479	4	1	RESISTOR 14K 1% .125W F TC=0+100	24546	C4-1/8-T0-1402-F
R604	0698-4514	8	1	RESISTOR 105K 1% .125W F TC=0+100	24546	C4-1/8-T0-1053-F
R605	0757-0449	6	1	RESISTOR 20K 1% .125W F TC=0+100	24546	C4-1/8-T0-2002-F
R606	0698-3449	6	1	RESISTOR 28.7K 1% .125W F TC=0+100	24546	C4-1/8-T0-2872-F
R607	0698-3499	6	2	RESISTOR 40.2K 1% .125W F TC=0+100	24546	C4-1/8-T0-4022-F
R608	0757-0450	9	2	RESISTOR 22.1K 1% .125W F TC=0+100	24546	C4-1/8-T0-2212-F
R609	0757-0450	9		RESISTOR 22.1K 1% .125W F TC=0+100	24546	C4-1/8-T0-2212-F
R610	0683-2025	1	2	RESISTOR 2K 5% .25W FC TC=-400/+700	01121	CB2025
R611	0683-2025	1		RESISTOR 2K 5% .25W FC TC=-400/+700	01121	CB2025
R612	0757-0467	8	1	RESISTOR 121K 1% .125W F TC=0+100	24546	C4-1/8-T0-1213-F
R613	0757-0438	3	1	RESISTOR 5.11K 1% .125W F TC=0+100	24546	C4-1/8-T0-5111-F
R614	0698-7332	4	2	RESISTOR 1M 1% .125W F TC=0+100	28480	0698-7332
R615	0757-0276	7	1	RESISTOR 61.9 1% .125W F TC=0+100	24546	C4-1/8-T0-6192-F
R616	0757-0274	7	1	RESISTOR 1.21K 1% .125W F TC=0+100	24546	C4-1/8-T0-1211-F
R617	0698-4511	5	1	RESISTOR 86.6K 1% .125W F TC=0+100	24546	C4-1/8-T0-8662-F
R618	0698-3149	3	1	RESISTOR 255K 1% .125W F TC=0+100	24546	C4-1/8-T0-2553-F
R619	0698-4488	5	1	RESISTOR 26.7K 1% .125W F TC=0+100	24546	C4-1/8-T0-2672-F
R620	0698-4483	0	1	RESISTOR 18.7K 1% .125W F TC=0+100	24546	C4-1/8-T0-1872-F
R621	0757-0442	9	1	RESISTOR 10K 1% .125W F TC=0+100	24546	C4-1/8-T0-1002-F
R622	0698-3450	9	1	RESISTOR 42.2K 1% .125W F TC=0+100	24546	C4-1/8-T0-4222-F
R624	0698-4123	5	2	RESISTOR 499 1% .125W F TC=0+100	24546	C4-1/8-T0-499R-F
R625	0698-7332	4	1	RESISTOR 1M 1% .125W F TC=0+100	24546	C4-1/8-T0-1004-F
R626	2100-3163	8	1	RESISTOR-TRMR 1M 20% C SIDE-ADJ 17-TRN	02111	43P105
R627	2100-3154	7	1	RESISTOR-TRMR 1K 10% C SIDE-ADJ 17-TRN	02111	43P102
R628	0698-7332	4	1	RESISTOR 1M 1% .125W F TC=0+100	28480	0698-7332
R629	2100-3355	0	1	RESISTOR-TRMR 100K 10%	28480	2100-3355
R631	0698-4123	5	1	RESISTOR 499 1% .125W F TC=0+100	24546	C4-1/8-T0-499R-F
R704	0757-0768	9	1	RESISTOR 36.5K 1% .25W F TC=0+100	24546	C5-1/4-T0-3652-F
R705	0683-2635	3	1	RESISTOR 20K 5% .25W FC TC=-400/+800	01121	CB2035
R708	0683-2405	1		RESISTOR 24 5% .25W FC TC=-400/+500	01121	CB2405
R709	0683-0335	2	1	RESISTOR 3.3 5% .25W FC TC=-400/+500	01121	CB3305
R710	0683-4725	2	2	RESISTOR 4.7K 5% .25W FC TC=-400/+700	01121	CB4725
R711	0687-1831	3	1	RESISTOR 18K 10% .5W CC TC=0+765	01121	EB1831
R715	0683-4705	8	1	RESISTOR 47 5% .25W FC TC=-400/+500	01121	CB4705
R716	0727-0188	7	1	RESISTOR 38.95K .5% .5W CF TC=0-500	91637	DCS1/2-38951-D
R717	0998-4133	6	1	RESISTOR 8.87K 1% .5% CF TC=0-50	28480	0998-4133
R718	0683-3333	8		RESISTOR 33K 5% .25W FC TC=-400/+800	01121	CB3333
R720	0683-5615	1	1	RESISTOR 560 5% .25W FC TC=-400/+600	01121	CB5615
R721	0683-6825	7		RESISTOR 6.8K 5% .25W FC TC=-400/+700	01121	CB6825
R722	0683-2725	8		RESISTOR 2.7K 5% .25W FC TC=-400/+700	01121	CB2725
R723	0684-1001	3	1	RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
R724	0683-4725	2		RESISTOR 4.7K 5% .25W FC TC=-400/+700	01121	CB4725

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

Table 7-3. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
R730	0698-4477	2	1	RESISTOR 10.5K 1% .125W F TC=0+-100	24546	
R731	0737-0200	7	1	RESISTOR 5.62K 1% .125W F TC=0+-100	24546	
R732	0603-2725	8	1	RESISTOR 2.7K 5% .25W FC TC=400/+700	01121	C4-1/8-T0-1052-F C4-1/8-T0-5621-F CB2725
S1	3101-0036	1	1	SWITCH-TGL BASIC SPST 3A 250VAC/DC	28480	3101-0036
S2	3101-1234	3	1	SWITCH-SL DPDT STD 1.5A 250VAC SLDR-LUG	28480	3101-1234
S301	3100-0358	8	1	SWITCH-ROTARY 1.250 STRUT CTR SPCB; 12	28480	3100-0358
T1	9100-4248	9	1	TRANSFORMER-POWER (SEE NOTE BELOW)	28480	9100-4248
TC401	0853-0003	2	2	THERMOCOUPLE-PR.	28480	0853-0003
TC402	0853-0003	2	2	THERMOCOUPLE-PR.	28480	0853-0003
U601	1826-0968	2	1	IC-OPERATIONAL AMPLIFIER	28480	1826-0968
U602	1826-0310	8	1	IC-OPERATIONAL AMPLIFIER	28480	1826-0310
V201	1921-0017	4	1	TUBE-ELECTRON 7586 TRIODE	3LS85	7586
W1	8120-1348	5	1	CABLE ASSY 18AWG 3-CNDCT BLK-JKT	28480	8120-1348
XF1	1400-0084	1	1	FUSEHOLDER-EXTR POST 15A 250 V UL	28480	1400-0084
XV201	1200-0086	9	1	SOCKET-TUBE 5-CONT ES-6S DIP-SLDR	28480	1200-0086
	1200-0044	9	2	SOCKET-XSTR 2-CONT TO-3	28480	1200-0044
				MISCELLANEOUS		
	0370-0077	4	1	KNOB SHRTD BAR:BLK:FOR .250SHFT: .625D	28480	0370-0077
	0340-0580	3	1	INSULATOR-XSTR	28480	0340-0580
	1520-0002	7	1	PLATE-MOUNTING FOR TWIST LOCK TYPE CAP	28480	1520-0002
	1520-0003	8	1	PLATE-MOUNTING FOR TWIST LOCK TYPE CAP	28480	1520-0003
	03400-01202	2	1	CLAMP-CAPACITOR MOUNTING	28480	03400-01202
	03400-01204	4	1	BRACKET-GROUND	28480	03400-01204
	03400-61601	1	1	CABLE ASSEMBLY-AMPLIFIER INPUT	28480	03400-61601
	03400-61602	2	1	CABLE ASSEMBLY-CHOPPER INPUT	28480	03400-61602
	03400-61603	3	1	CABLE ASSEMBLY-INPUT ATTENUATOR	28480	03400-61603
	03400-69501	6	1	SHOCK MOUNT IMPEDANCE CONVERTER	28480	03400-69501
	1200-0044	9	1	SOCKET-XSTR 2-CONT TO-3	28480	1200-0044

NOTE: SOME INSTRUMENTS HAVE POWER TRANSFORMERS (T1) WITH -HP- PART NUMBER 9100-4449. REPLACE WITH NEW PART NUMBER.

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

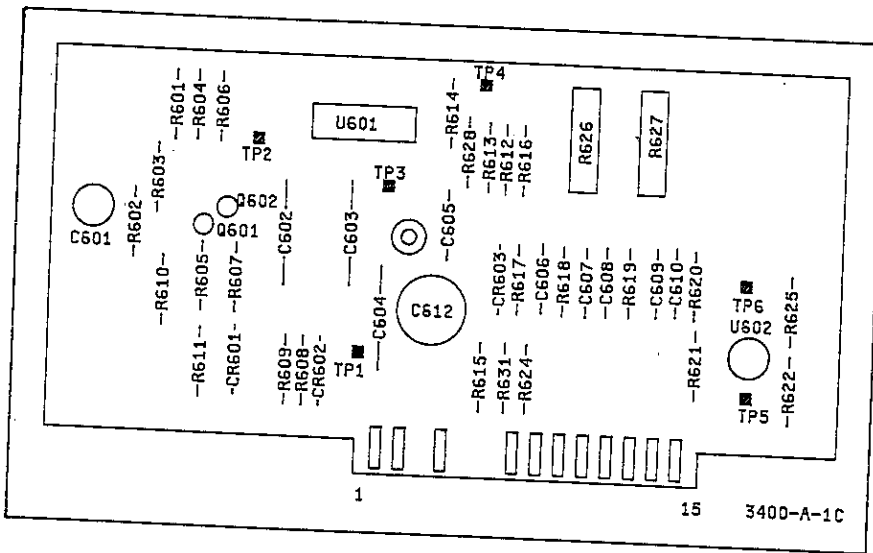
APPENDIX A BACKDATING

A-1. INTRODUCTION

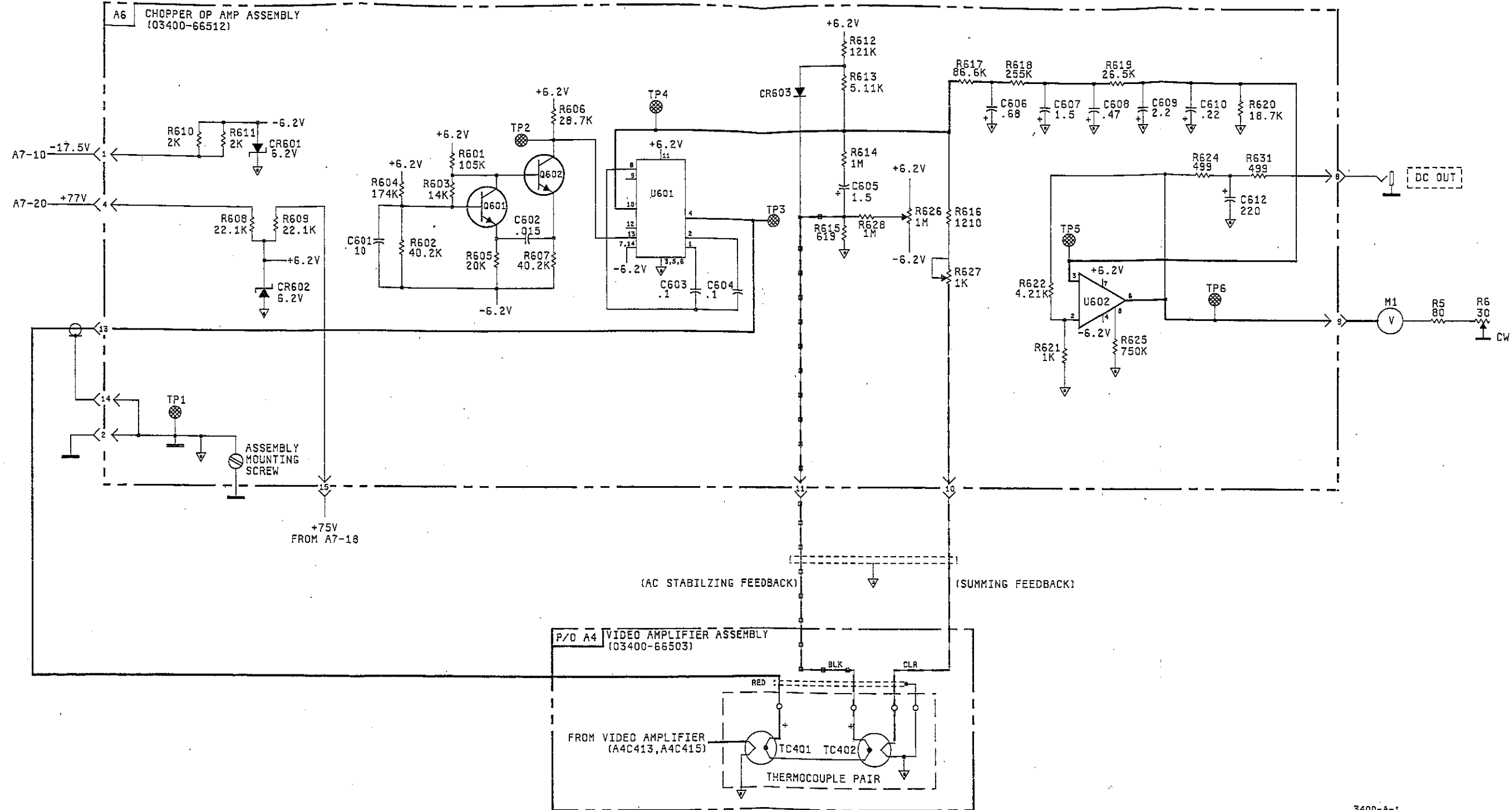
A-2. The following paragraphs have information to adapt this manual to earlier instruments with a serial number prefix of 2225 and above only. If the component values in the instrument are different than the ones on the schematics and parts list and are NOT listed in this appendix, replace with the component values on the schematics and parts list.

Change #1. Use the Schematic and Parts Locator shown in Figure A-1 for all A6 assemblies with Revision A designation. Also, for all Revision A boards, change the following components.

Reference Designator	-hp- Part Number	Description
R621	0757-0280	RESISTOR 1K 1% .125W
R622	0698-3154	RESISTOR 4.22K 1% .125W
R625	0683-7545	RESISTOR 750K 5% .25W



A6
(REV. A)
(-hp- Part Number 03400-66512)



3400-A-1

Figure A-1. Chopper Amplifier A6 and Thermocouple Pair
(Part of A4) Schematic and Parts Location Diagram
A-1

SALES & SUPPORT OFFICES

Arranged alphabetically by country

1



Product Line Sales/Support Key

Key Product Line

- A Analytical
 - CM Components
 - C Computer Systems Sales only
 - CH Computer Systems Hardware Sales and Services
 - CS Computer Systems Software Sales and Services
 - E Electronic Instruments & Measurement Systems
 - M Medical Products
 - MP Medical Products Primary SRO
 - MS Medical Products Secondary SRO
 - P Personal Computation Products
- * Sales only for specific product line
** Support only for specific product line

IMPORTANT: These symbols designate general product line capability. They do not insure sales or support availability for all products within a line, at all locations. Contact your local sales office for information regarding locations where HP support is available for specific products.

HP distributors are printed in italics.

ANGOLA

Telebra
Empresa Técnica de Equipamentos Eléctricos, S.A.R.L.
R. Barbosa Rodrigues, 41-1 DT.
Caixa Postal 6487
LUANDA
Tel: 35515,35516
E,M,P

ARGENTINA

Hewlett-Packard Argentina S.A.
Avenida Santa Fe 2035
Martínez 1640 BUENOS AIRES
Tel: 798-5735, 792-1293
Telex: 17595 BIONAR
Cable: HEWPACKARG
A,E,CH,CS,P

Biotron S.A.c.i.Me.l
Av Paseo Colon 221, 9 Piso
1399 BUENOS AIRES
Tel: 30-4846, 30-1651
Telex: 17595 BIONAR
M

Fate S.A. I.C.I. Electronica
Venezuela 1326
1095 BUENOS AIRES
Tel: 37-9020, 37-9026/9
Telex: 9234 FATEN AR
P

AUSTRALIA

Adelaide, South Australia Office

Hewlett-Packard Australia Ltd.
153 Greenhill Road
PARKSIDE, S.A. 5063
Tel: 272-5911
Telex: 82536
Cable: HEWPAKD Adelaide
A*,CH,CM,E,MS,P

Brisbane, Queensland Office

Hewlett-Packard Australia Ltd.
5th Floor
Teachers Union Building
495-499 Boundary Street
SPRING HILL, Queensland 4000
Tel: 229-1544
Telex: 42133
Cable: HEWPAKD Brisbane
A,CH,CM,E,M,P

Canberra, Australia Capital Territory Office

Hewlett-Packard Australia Ltd.
121 Wollongong Street
FYSHWICK, A.C.T. 2609
Tel: 80 4244
Telex: 62650
Cable: HEWPAKD Canberra
CH,CM,E,P

Melbourne, Victoria Office

Hewlett-Packard Australia Ltd.
31-41 Joseph Street
BLACKBURN, Victoria 3130
Tel: 89-6351
Telex: 31-024
Cable: HEWPAKD Melbourne
A,CH,CM,CS,E,MS,P

Perth, Western Australia Office

Hewlett-Packard Australia Ltd.
261 Slirling Highway
CLAREMONT, W.A. 6010
Tel: 383-2188
Telex: 93859
Cable: HEWPAKD Perth
A,CH,CM,E,MS,P

Sydney, New South Wales Office

Hewlett-Packard Australia Ltd.
17-23 Talavera Road
P.O. Box 308
NORTH RYDE, N.S.W. 2113
Tel: 887-1611
Telex: 21561
Cable: HEWPAKD Sydney
A,CH,CM,CS,E,MS,P

AUSTRIA

Hewlett-Packard Ges.m.b.h.
Grottenhofstrasse 94
Verkaufsburo Graz
A-8052 GRAZ
Tel: 291-5-66
Telex: 32375
CH,CM,E*

Hewlett-Packard Ges.m.b.h.
Stanghofweg 5
A-4020 LINZ
Tel: 0732 51585
CH

Hewlett-Packard Ges.m.b.h.
Liebigasse 1
P.O. Box 72
A-1222 VIENNA
Tel: (0222) 23-65-11-0
Telex: 134425 HEPA A
A,CH,CM,CS,E,MS,P

BAHRAIN

Green Salon
P.O. Box 557
BAHRAIN
Tel: 25503-250950
Telex: 84419
P

Wael Pharmacy
P.O. Box 648
BAHRAIN
Tel: 256123
Telex: 8550 WAEI GJ
M

BELGIUM

Hewlett-Packard Belgium S.A./N.V.
Bvd de Woluwe, 100
Woluwedal
B-1200 BRUSSELS
Tel: (02) 762-32-00
Telex: 23-484 paloben br
A,CH,CM,CS,E,MP,P

BRAZIL

Hewlett-Packard do Brasil i.e.C. Ltda.
Alameda Rio Negro, 750
ALPHAVILLE 06400 Barueri SP
Tel: 421-1311
Telex: 011 33872 HPBR-BR
Cable: HEWPAK Sao Paulo
A,CH,CM,CS,E,MS
Hewlett-Packard do Brasil i.e.C. Ltda.
Avenida Epitacio Pessoa, 4664
22471 RIO DE JANEIRO-RJ
Tel: 286-0237
Telex: 02-21905 HPBR-BR
Cable: HEWPAK Rio de Janeiro
A,CH,CM,E,MS,P*

CANADA

Alberta
Hewlett-Packard (Canada) Ltd.
210, 7220 Fisher Street S.E.
CALGARY, Alberta T2H 2H8
Tel: (403) 253-2713
A,CH,CM,E*,MS,P*

Hewlett-Packard (Canada) Ltd.
11620A-169th Street
EDMONTON, Alberta T5M 3T9
Tel: (403) 452-3670
A,CH,CM,CS,E,MS,P*

British Columbia
Hewlett-Packard (Canada) Ltd.
10691 Shellbridge Way
RICHMOND,
British Columbia V6X 2W7

Tel: (604) 270-2277
Telex: 610-922-5059
A,CH,CM,CS,E*,MS,P*

Manitoba
Hewlett-Packard (Canada) Ltd.
380-550 Century Street
WINNIPEG, Manitoba R3H 0Y1
Tel: (204) 786-6701
A,CH,CM,E,MS,P*

New Brunswick
Hewlett-Packard (Canada) Ltd.
37 Sheadiac Road
MONCTON, New Brunswick E2B 2VQ
Tel: (506) 855-2841
CH**

Nova Scotia
Hewlett-Packard (Canada) Ltd.
P.O. Box 931
900 Windmill Road
DARTMOUTH, Nova Scotia B2Y 3Z6
Tel: (902) 469-7820
Telex: 01931470
CH,CM,CS,E*,MS,P*

Ontario
Hewlett-Packard (Canada) Ltd.
552 Newbold Street
LONDON, Ontario N6E 2S5
Tel: (519) 686-9181
A,CH,CM,E*,MS,P*

Hewlett-Packard (Canada) Ltd.
6877 Goreway Drive
MISSISSAUGA, Ontario L4V 1M8
Tel: (416) 678-9430
Telex: 06983644
A,CH,CM,CS,E,MP,P

Hewlett-Packard (Canada) Ltd.
2670 Queensview Dr.
OTTAWA, Ontario K2B 8K1
Tel: (613) 820-6483
A,CH,CM,CS,E*,MS,P*

Hewlett-Packard (Canada) Ltd.
220 Yorkland Blvd., Unit #11
WILLOWDALE, Ontario M2J 1R5
Tel: (416) 499-9333
CH

Quebec

Hewlett-Packard (Canada) Ltd.
17500 South Service Road
Trans-Canada Highway
KIRKLAND, Quebec H9J 2M5
Tel: (514) 697-4232
Telex: 05821521
A,CH,CM,CS,E,MP,P*

CHILE

Jorge Calcagni y Cia. Ltda.
Arturo Burtie 065
Casilla 16475
SANTIAGO 9
Tel: 222-0222 --
Telex: Public Booth 0001
A,CM,E,M
Olympia (Chile) Ltda.
Av. Rodrigo de Araya 1045
Casilla 256-V
SANTIAGO 21
Tel: 2-25-50-44
Telex: 340 892 OLYMP CK
Cable: Olympiachile Santiagochile
CH,CS,P

CHINA, People's Republic of

China Hewlett-Packard Rep. Office
P.O. Box 418
1A Lane 2, Luchang St.
Beiwei Rd., Xuanwu District
BEIJING
Tel: 33-1947, 33-7426
Telex: 22601 CTSHP CN
Cable: 1920
A,CH,CM,CS,E,P

COLOMBIA

Instrumentación
H. A. Langebaek & Kier S.A.
Carrera 7 No. 48-75
Apartado Aéreo 6287
BOGOTA, 1 D.E.
Tel: 287-8877
Telex: 44400 INST CO
Cable: AARIS Bogota
A,CM,E,M,P

COSTA RICA

Cientifica Costarricense S.A.
Avenida 2, Calle 5
San Pedro de Montes de Oca
Apartado 10159
SAN JOSE
Tel: 24-38-20, 24-08-19
Telex: 2367 GALGUR
CM,E,M

CYPRUS

Telerexa Ltd.
P.O. Box 4809
14C Stassinou Avenue
NICOSIA
Tel: 62698
Telex: 2894 Levidocy
E,M,P

CZECHOSLOVAKIA

Hewlett-Packard
Obchodni Zastupitelstvi v CSSR
Post. schranka 27
CS-118 01 PRAHA 011
Tel: 66-296
Telex: 121353 IHC

DENMARK

Hewlett-Packard A/S
Datavej 52
DK-3460 Birkerød
Tel: (02) 81-66-40
Telex: 37409 hpas dk
A,CH,CM,CS,E,MS,P
Hewlett-Packard A/S
Navervej 1
DK-8600 SILKEBORG
Tel: (06) 82-71-66
Telex: 37409 hpas dk
CH,CM,E

ECUADOR

CYEDE Cia. Ltda.
Avenida Eloy Alfaro 1749
Casilla 6423 CCI
QUITO
Tel: 450-975, 242-052
Telex: 2548 CYEDE ED
A,CM,E,P
Hospitalar S.A.
Robles 625
Casilla 3590
QUITO
Tel: 545-250, 545-122
Telex: 2485 HOSPTEL ED
Cable: HOSPITALAR-Quito
M

EGYPT

International Engineering Associates
24 Hussein Hegazi Street
Kasr-el-Aini
CAIRO
Tel: 23-829
Telex: 93830
CH,CS,E,M
Informatic For Systems
22 Taleat Harb Street
CAIRO
Tel: 759006
Telex: 93938 FRANK UN
CH,CS,P
Egyptian International Office for Foreign Trade
P.O.Box 2558
CAIRO
Tel: 984935
Telex: 93337 EGPOR
P

EL SALVADOR

IPESA de El Salvador S.A.
29 Avenida Norte 1216
SAN SALVADOR
Tel: 26-6858, 26-6868
Telex: Public Booth 20107
A,CH,CM,CS,E,P

FINLAND

Hewlett-Packard Oy
Revontulentie 7
SF-02100 ESPOO 10
Tel: (90) 455-0211
Telex: 121563 hewpa sf
A,CH,CM,CS,E,MS,P
Hewlett-Packard Oy
Aatoksenkatu 10-C
SF-40720-72 JYVASKYLA
Tel: (941) 216318
CH
Hewlett-Packard Oy
Kaimuntie 1-C
SF-90140-14 OULU
Tel: (981) 338785
CH



SALES & SUPPORT OFFICES

Arranged alphabetically by country

FRANCE

Hewlett-Packard France
Z.I. Mercure B
Rue Berthelot
F-13763 Les Milles Cedex
AIX-EN-PROVENCE
Tel: (42) 59-41-02
Telex: 410770F
A,CH,CM,E,MS,P*

Hewlett-Packard France
Boite Postale No. 503
F-25026 BESANCON
28 Rue de la Republique
F-25000 BESANCON
Tel: (81) 83-16-22
CH,M

Hewlett-Packard France
Bureau de Vente de Lyon
Chemin des Mouilles
Boite Postale 162
F-69130 ECULLY Cédex
Tel: (78) 33-81-25
Telex: 310817F
A,CH,CM,CS,E,MP

Hewlett-Packard France
Immeuble France Evry
Tour Lorraine
Boulevard de France
F-91035 EVRY Cédex
Tel: (60) 77-96-60
Telex: 692315F
CM,E

Hewlett-Packard France
5th Avenue Raymond Chanas
F-38320 EYBENS
Tel: (76) 25-81-41
Telex: 980124 HP GRENOB EYBE
CH,CM

Hewlett-Packard France
Centre d'Affaire Paris-Nord
Bâtiment Ampère 5 étage
Rue de la Commune de Paris
Boite Postale 300
F-93153 LE BLANC MESNIL
Tel: (01) 865-44-52
Telex: 211032F
CH,CM,CS,E,MS

Hewlett-Packard France
Le Montesquieu
Avenue du President JF Kennedy
F-33700 MERIGNAC
Tel: (56) 34-00-84
Telex: 550105F
CH,CM,E,MS

Hewlett-Packard France
32 Rue Lothaire
F-57000 METZ
Tel: (87) 65-53-50
CH,CM

Hewlett-Packard France
1 Bis Rue Julien Videment
F-44200 NANTES
Tel: 40-89-33-38
CH**

Hewlett-Packard France
Zone Industrielle de Courtaboeuf
Avenue des Tropiques
F-91947 Les Ulis Cédex ORSAY
Tel: (6) 907-78-25
Telex: 600048F
A,CH,CM,CS,E,MP,P

Hewlett-Packard France
Paris Porte-Maillot
13, 15 25 Bld. De L'Amiral Bruix
F-75782 PARIS Cédex 16
Tel: (01) 502-12-20
Telex: 613663F
CH,CM,MS,P

Hewlett-Packard France
Technisches Büro Bourgonette
F-35100 RENNES
Tel: (99) 51-42-44
Telex: 740912F
CH,CM,E,MS,P*

Hewlett-Packard France
98 Avenue de Bretagne
F-78100 ROUEN
Tel: (35) 63-57-66 CH**_CS

Hewlett-Packard France
4 Rue Thomas Mann
Boite Postale 56
F-67200 STRASBOURG
Tel: (88) 28-56-46
Telex: 890141F
CH,CM,E,MS,P*

Hewlett-Packard France
20 Chemin de la Cèpière
F-31061 TOULOUSE Cédex
Tel: (61) 40-11-12
Telex: 531639F
A,CH,CM,CS,E,P*

Hewlett-Packard France
Immeuble Péricentre
Rue Van Gogh
F-59650 VILLENEUVE D'ASO
Tel: (20) 91-41-25
Telex: 160124F
CH,CM,E,MS,P*

GERMAN FEDERAL REPUBLIC

Hewlett-Packard GmbH
Technisches Büro Berlin
Keihsstrasse 2-4
D-1000 BERLIN 30
Tel: (030) 24-90-86
Telex: 018 3405 hpbln d
A,CH,CM,E,M,P,X

Hewlett-Packard GmbH
Technisches Büro Böblingen
Herrnberger Strasse 110
D-7030 BOBLINGEN
Tel: (07031) 667-1
Telex: bbn or
A,CH,CM,CS,E,MP,P

Hewlett-Packard GmbH
Technisches Büro Dusseldorf
Emanuel-Leutze-Strasse 1
D-4000 DUSSELDORF
Tel: (0211) 5971-1
Telex: 085/86 533 hpdd d
A,CH,CM,CS,E,MS,P

Hewlett-Packard GmbH
Vertriebszentrale Frankfurt
Bernar Strasse 117
Postfach 560 140
D-5000 FRANKFURT 56
Tel: (0511) 50-04-1
Telex: 04 13249 hpffm d
A,CH,CM,CS,E,MP,P

Hewlett-Packard GmbH
Technisches Büro Hamburg
Kapstadtring 5
D-2000 HAMBURG 60
Tel: (040) 63804-1
Telex: 021 63 032 hph d
A,CH,CM,CS,E,MS,P

Hewlett-Packard GmbH
Technisches Büro Hannover
Am Grossmarkt 6
D-3000 HANNOVER 91
Tel: (0511) 46-60-01
Telex: 092 3259
A,CH,CM,E,MS,P

Hewlett-Packard GmbH
Technisches Büro Mannheim
Rosslauer Weg 2-4
D-6800 MANNHEIM
Tel: (0621) 70050
Telex: 0462105
A,C,E

Hewlett-Packard GmbH
Technisches Büro Neu Ulm
Messerschmittstrasse 7
D-7910 NEU ULM
Tel: 0731-70241
Telex: 0712816 HP ULM-D
A,C,E*

Hewlett-Packard GmbH
Technisches Büro Nürnberg
Neumeyerstrasse 90
D-8500 NÜRNBERG
Tel: (0911) 52 20 83-87
Telex: 0623 860
CH,CM,E,MS,P

Hewlett-Packard GmbH
Technisches Büro München
Eschenstrasse 5
D-8028 TAUFKIRCHEN
Tel: (089) 6117-1
Telex: 0524985
A,CH,CM,E,MS,P

GREAT BRITAIN

Hewlett-Packard Ltd.
Trafalgar House
Navigation Road
ALTRINCHAM
Cheshire WA14 1NU
Tel: (061) 928-6422
Telex: 668068
A,CH,CS,E,M

Hewlett-Packard Ltd.
Oakfield House, Oakfield Grove
Clifton
BRISTOL BS8 2BN, Avon
Tel: (027) 38606
Telex: 444302
CH,CM,M,P

Hewlett-Packard Ltd.
14 Wesley Street
CASTLEFORD
Yorkshire WF10 1AE
Tel: (0977) 550016
Telex: 5557355
CH

Hewlett-Packard Ltd.
Nine Mile Ride
EASTHAMPTON
Wokingham
Berkshire, RG11 3LL
Tel: 3446 3100
Telex: 84-88-05
CH,CS,E

Hewlett-Packard Ltd.
Fouier House
257-263 High Street
LONDON COLNEY
Herts., AL2 1HA, St. Albans
Tel: (0727) 24400
Telex: 1-8952716
CH,CS,E

Hewlett-Packard Ltd.
Trax House, St. Mary's Walk
MAIDENHEAD
Berkshire, SL6 1ST
Tel: (0628) 39151
CH,CS,E,P

Hewlett-Packard Ltd.
Quadrangle
106-118 Station Road
REDHILL, Surrey
Tel: (0737) 66655
Telex: 947234 CH,CS,E
Hewlett-Packard Ltd.
Westminster House
190 Stratford Road
SHIRLEY, Solihull
West Midlands B90 3BJ
Tel: (021) 7458800
Telex: 339105
CH

Hewlett-Packard Ltd.
West End House 41
High Street, West End
SOUTHAMPTON
Hampshire SO3 3DO
Tel: (703) 886767
Telex: 477138
CH

Hewlett-Packard Ltd.
King Street Lane
WINNERSH, Wokingham
Berkshire RG11 5AR
Tel: (0734) 784774
Telex: 847178
A,CH,E,M

GREECE

Kostas Karayannis S.A.
8 Omirou Street
ATHENS 133
Tel: 32-30-303, 32-37-371
Telex: 21 59 62 FKAR GR
A,CH,CM,CS,E,M,P

PLAISIO S.A.
G. Gerardos
24 Stourmara Street
ATHENS
Tel: 36-11-160
Telex: 21 9492
P

GUATEMALA

IPESA
Avenida Reforma 3-48, Zona 9
GUATEMALA
Tel: 316627, 314786
Telex: 4192 TELTRO GU
A,CH,CM,CS,E,M,P

HONG KONG

Hewlett-Packard Hong Kong, Ltd.
G.P.O. Box 795
5th Floor, Sun Hung Kai Centre
30 Harbour Road
HONG KONG
Tel: 5-8323211
Telex: 66678 HEWPA HK
Cable: HP ASIA LTD Hong Kong
E,CH,CS,P

CET Ltd.
1402 Tung Way Mansion
199-203 Hennessy Rd.
Wanchia, HONG KONG
Tel: 5-729376
Telex: 85148 CET HX
CM
Schmidt & Co. (Hong Kong) Ltd.
Wing On Centre, 28th Floor
Connaught Road, C.

HONG KONG
Tel: 5-455644
Telex: 74766 SCHMX HX
A,M

ICELAND

Elding Trading Company Inc.
Háinnvöll-Tryggvagatol
P.O. Box 895
IS-REYKJAVIK
Tel: 1-58-20, 1-63-03
M

INDIA

Blue Star Ltd.
Sabri Complex II Floor
24 Residency Rd.
BANGALORE 560 025
Tel: 55660
Telex: 0845-430
Cable: BLUESTAR
A,CH,CM,CS,E

Blue Star Ltd.
Band Box House
Prabhadevi
BOMBAY 400 025
Tel: 422-3101
Telex: 011-3751
Cable: BLUESTAR
A,M

Blue Star Ltd.
Sahas
414/2 Vir Savarkar Marg
Prabhadevi
BOMBAY 400 025
Tel: 422-6155
Telex: 011-4093
Cable: FROSTBLUE
A,CH,CM,CS,E,M

Blue Star Ltd.
Kalyan, 19 Vishwas Colony
Alkapuri, BORODA, 390 005
Tel: 65235
Cable: BLUE STAR
A

Blue Star Ltd.
7 Hare Street
CALCUTTA 700 001
Tel: 12-01-31
Telex: 021-7655
Cable: BLUESTAR
A,M

Blue Star Ltd.
133 Kodambakkam High Road
MADRAS 500 034
Tel: 82057
Telex: 041-379
Cable: BLUESTAR
A,M

Blue Star Ltd.
Bhandari House, 7th/8th Floors
91 Nehru Place
NEW DELHI 110 024
Tel: 682547
Telex: 031-2463
Cable: BLUESTAR
A,CH,CM,CS,E,M

Blue Star Ltd.
15/16-C Wellesley Rd.
PUNE 411 011
Tel: 22775
Cable: BLUE STAR
A

Blue Star Ltd.
2-2-47/1108 Polarum Rd.
SECUNDERABAD 500 003
Tel: 72057
Telex: 0155-459
Cable: BLUEFROST
A,E

Blue Star Ltd.
T.C. 7/603 Poornima
Maruthankuzhi
TRIVANDRUM 695 013
Tel: 65799
Telex: 0884-259
Cable: BLUESTAR
E

INDONESIA

BERCA Indonesia P.T.
P.O.Box 496/JKT.
J. Abdul Muis 62
JAKARTA
Tel: 373009
Telex: 46748 BERSAL IA
Cable: BERSAL JAKARTA
P

SALES & SUPPORT OFFICES

Arranged alphabetically by country



INDONESIA (Con't.)

BERCA Indonesia P.T.
Wisma Antara Bldg., 17th floor
JAKARTA
A,CS,E,M

BERCA Indonesia P.T.
P.O. Box 174/5BY,
Jl. Kutek No. 11
SURABAYA
Tel: 68172
Telex: 31146 BERSAL SB
Cable: BERSAL-SURABAYA
A*,E,M,P

IRAQ

Hewlett-Packard Trading S.A.
Mansoor City 9B/3/7
BAGHDAD
Tel: 551-49-73
Telex: 212-455 HEPARAO IK
CH,CS

IRELAND

Hewlett-Packard Ireland Ltd.
Kestrel House
Clanwilliam Court
Lower Mount Street
DUBLIN 2, Eire
Tel: (1) 60 88 00
Telex: 30439
A,CH,CM,CS,E,M,P

Cardiac Services Ltd.
Kilmore Road
Artane
DUBLIN 5, Eire
Tel: (01) 351820
Telex: 30439
M

ISRAEL

Electronics Engineering Division
Motorola Israel Ltd.
16 Kremnetski Street
P.O. Box 25016
TEL-AVIV 67899
Tel: 3-338973
Telex: 33569 Motil IL
Cable: BASTEL Tel-Aviv
A,CH,CM,CS,E,M,P

ITALY

Hewlett-Packard Italiana S.p.A.
Traversa 99C
Giulio Petroni, 19
I-70124 BARI
Tel: (080) 41-07-44
M

Hewlett-Packard Italiana S.p.A.
Via Martin Luther King, 38/111
I-40132 BOLOGNA
Tel: (051) 402394
Telex: 511630
CH,CM,E,MS

Hewlett-Packard Italiana S.p.A.
Via Principe Nicola 43G/C
I-95126 CATANIA
Tel: (095) 37-10-87
Telex: 970291
C,P

Hewlett-Packard Italiana S.p.A.
Via G. Di Vittorio 9
I-20063 CERNUSCO SUL NAVIGLIO
Tel: (2) 903691
Telex: 334632
A,CH,CM,CS,E,MP,P

Hewlett-Packard Italiana S.p.A.
Via Nuova san Rocco A
Capodimonte, 62/A
I-80131 NAPLES
Tel: (081) 7413544
Telex: 710698
A,CH,CM,E

Hewlett-Packard Italiana S.p.A.
Viale G. Modugno 33
I-16156 GENOVA FEGLI
Tel: (010) 68-37-07
E,C

Hewlett-Packard Italiana S.p.A.
Via Turazza 14
I-35100 PADOVA
Tel: (049) 864888
Telex: 430315
A,CH,CM,E,MS

Hewlett-Packard Italiana S.p.A.
Viale C. Pavese 340
I-00144 ROMA
Tel: (06) 54831
Telex: 610514
A,CH,CM,CS,E,MS,P*

Hewlett-Packard Italiana S.p.A.
Corso Svizzera, 184
I-10149 TORINO
Tel: (011) 74 4044
Telex: 221079
CH,CM,E

JAPAN

Yokogawa-Hewlett-Packard Ltd.
Inoue Building
1-21-8, Asahi-cho
ATSUGI, Kanagawa 243
Tel: (0462) 28-0451
CM,C*,E

Yokogawa-Hewlett-Packard Ltd.
Sannomiya Dai-ichi Seimei Bldg.
69 Kyo-machi, Chuo-ku
KOBE, 650
Tel: (078) 392-4791
C,E

Yokogawa-Hewlett-Packard Ltd.
Kumagaya Asahi Yasoji Bldg 4F
3-4 Chome Tsukuba
KUMAGAYA, Saitama 360
Tel: (0485) 24-6563
CH,CM,E

Yokogawa-Hewlett-Packard Ltd.
Asahi Shinbun Dai-ichi Bldg., 2F
4-7 Hanabata-cho
KUMAMOTO-SHI, 860
Tel: (0963) 54-7311
CH,E

Yokogawa-Hewlett-Packard Ltd.
Shin Kyoto Center Bldg. 5F
614 Sikoji-cho
Nishiruhigashi, Karasuma
Sikoji-don, Shimogyo-ku
KYOTO 600
Tel: 075-343-0921
CH,E

Yokogawa-Hewlett-Packard Ltd.
Mito Mitsui Building
1-4-73, San-no-maru
MITO, Ibaragi 310
Tel: (0292) 25-7470
CH,CM,E

Yokogawa-Hewlett-Packard Ltd.
Sumitomo Seimei Nagoya Bldg.
11-2 Shimo-sasajima-cho
Nakamura-ku
NAGOYA, Aichi 450
Tel: (052) 571-5171
CH,CM,CS,E,MS

Yokogawa-Hewlett-Packard Ltd.
Chuo Bldg., 4th Floor
5-4-20 Nishinakajima
Yodogawa-ku
OSAKA, 532
Tel: (06) 304-6021
Telex: YHPOSA 523-3624
A,CH,CM,CS,E,MP,P*

Yokogawa-Hewlett-Packard Ltd.
27-15, 1-chome
Yabe
SAGAMIHARA-SHI PREF. 229
Tel: 427-591311
Telex: 8912
CH*,E*,P*

Yokogawa-Hewlett-Packard Ltd.
Shinjuku Dai-ichi Seimei 5F
2-7-1, Nishi Shinjuku
Shinjuku-ku, TOKYO 160
Tel: 03-348-4611-5
CH,E

Yokogawa-Hewlett-Packard Ltd.
3-29-21 Takaido-Higashi
Suginami-ku TOKYO 168
Tel: (03) 331-6111
Telex: 232-2024 YHPTOK
A,CH,CM,CS,E,MP,P*

Yokogawa-Hewlett-Packard Ltd.
Yasudaselmei Yokohama
Nishiguchi Bldg.
3-304 Tsunuya-cho
Kanagawa-ku
YOKOHAMA, Kanagawa, 221
Tel: (045) 312-1252
CH,CM,E

JORDAN

Mousher Cousins Company
P.O. Box 1387
AMMAN
Tel: 24907, 39907
Telex: 21456 SABCO JO
CH,E,M,P

KENYA

ADCOM Ltd., Inc.
City House, Wabera Street
P.O. Box 30635
NAIROBI
Tel: 331955
Telex: 22639
E,M

KOREA

Samsung Electronics Computer
Division
76-561 Yeoksam-Dong
Kangnam-ku
C.P.O. Box 2775
SEOUL
Tel: 555-7555, 555-5447
Telex: K27364 SAMSAN
A,CH,CM,CS,E,M,P

KUWAIT

Al-Khalidya Trading & Contracting
P.O. Box 830 Safat
KUWAIT
Tel: 42-4910, 41-1726
Telex: 2481 Areeg K1
CH,E,M

Photo & Cine Equipment
P.O. Box 270 Safat
KUWAIT
Tel: 42-2846, 42-3801
Telex: 2247 Malin
P

LEBANON

G.M. Dolmadjian
Achrifeh
P.O. Box 165.167
BEIRUT
Tel: 290293
MP

LUXEMBOURG

Hewlett-Packard Belgium S.A./N.V.
Blvd de la Woluwe, 100
Woluwedal
B-1200 BRUSSELS
Tel: (02) 762-32-00
Telex: 29-494 paloben bru
A,CH,CM,CS,E,MP,P

MALAYSIA

Hewlett-Packard Sales (Malaysia)
Sdn. Bhd.
1st Floor, Bangunan British
American
Jalan Semantan, Damansara Heights
KUALA LUMPUR 23-03
Tel: 943022
Telex: MA31011
A,CH,E,M,P*

Protel Engineering
Lot 319, Satok Road
P.O. Box 1917
Kuching, SARAWAK
Tel: 53544
Telex: MA 70904 PROMAL
Cable: PROTELENG
A,E,M

MALTA

Philip Toledo Ltd.
Natabile Rd.
MRIEHEL
Tel: 447 47, 455 66
Telex: MW.649
P

MEXICO

Hewlett-Packard Mexicana, S.A. de
C.V.
Av. Periferico Sur No. 6501
Tepepan, Xochimilco 16020
MEXICO CITY
Tel: (905) 676-4600
Telex: 017-74-507
A,CH,CS,E,MS,P

Hewlett-Packard Mexicana, S.A. de
C.V.
Rio Volga 600
Colonia del Valle
MONTERREY, N.L.
Tel: 78-42-93, 78-42-40, 78-42-41
Telex: 038-410
CH

ECISA
Taine 229 10 Pisa
Polanco D.F.
C.P. 11570
Tel: (905) 250-5391
M

MOROCCO

Doibea
81 rue Karatchi
CASABLANCA
Tel: 3041-82, 3068-38
Telex: 23051, 22822
E

Gerep
2 rue d'Agadir
Boite Postale 156
CASABLANCA
Tel: 272093, 272095
Telex: 23 739
P

NETHERLANDS

Hewlett-Packard Nederland B.V.
Van Heuven Goedhartlaan 121
NL 1181KK AMSTELVEEN
P.O. Box 667
NL 1180 AR AMSTELVEEN
Tel: (20) 47-20-21
Telex: 13 216
A,CH,CM,CS,E,MP,P

Hewlett-Packard Nederland B.V.
Bongerd 2
NL 2906VK CAPPELLE, A/D IJssel
P.O. Box 41
NL 2900 AA CAPELLE, IJssel
Tel: (10) 51-64-44
Telex: 21261 HEPAC NL
A,CH,CM,CS

Koning en Hartman Electrotechniek
B.V.

Koperwerf 30
2544 En den Haag
The NETHERLANDS
Tel: 070-210101
Telex: 31528
CM

NEW ZEALAND

Hewlett-Packard (N.Z.) Ltd.
169 Manukau Road
P.O. Box 26-189
Epsom, AUCKLAND
Tel: 687-159
Cable: HEWPACK Auckland
CH,CM,E,P*

Hewlett-Packard (N.Z.) Ltd.
4-12 Crickshank Street
Kilbirnie, WELLINGTON 3
P.O. Box 9443
Courtenay Place, WELLINGTON 3
Tel: 877-199
Cable: HEWPACK Wellington
CH,CM,E,P

Northrop Instruments & Systems
Ltd.

369 Khyber Pass Road
P.O. Box 8602
AUCKLAND
Tel: 794-091
Telex: 60605
A,M

Northrop Instruments & Systems
Ltd.

110 Mandeville St.
P.O. Box 8388
CHRISTCHURCH
Tel: 486-928
Telex: 4203
A,M

Northrop Instruments & Systems
Ltd.

Sturdee House
85-87 Ghuznee Street
P.O. Box 2406
WELLINGTON
Tel: 850-091
Telex: NZ 3380
A,M

NORTHERN IRELAND

Cardiac Services Company
95A Finaghy Road South
BELFAST BT 10 0BY
Tel: (0232) 625-566
Telex: 747626
M

NORWAY

Hewlett-Packard Norge A/S
Folke Bemadotiesvei 50
P.O. Box 3558
N-5033 FYLLINGSDALEN (BERGEN)
Tel: (05) 16-55-40
Telex: 16621 hpnas n
CH,CM,E

Hewlett-Packard Norge A/S
Oestermdalen 18
P.O. Box 34
N-1345 OSTERAS
Tel: (02) 17-11-80
Telex: 16821 hpnas n
A*,CM,E,MS,P

OMAN

Khimji Ramdas
P.O. Box 19
MUSCAT
Tel: 72-22-17, 72-22-25
Telex: 3289 BROKER MB MUSCAT
P

PAKISTAN

Mushko & Company Ltd.
1-B, Street 43
Sector F-8/1
ISLAMABAD
Tel: 26875
Cable: FEMUS Rawalpindi
A,E,M



SALES & SUPPORT OFFICES

Arranged alphabetically by country

PAKISTAN (Con't.)

Musko & Company Ltd.
Cosman Chambers
Abdullah Haroon Road
KARACHI 0302
Tel: 511027, 512927
Telex: 2894 MUSKO FK
Cable: COOPERATOR Karachi
A,E,M,P*

PANAMA

Electrónico Balboa, S.A.
Calle Samuel Lewis, Ed. Alfa
Apartado 4929
PANAMA 5
Tel: 64-2700
Telex: 3438 ELECTRON PG
A,C,M,E,M,P
Foto Internacional, S.A.
Colon Free Zone, Apartado 2068
COLON 3
Tel: 45-2333
Telex: 379 8626, IMPORT PG
P

PERU

Cia Electro Médica S.A.
Los Flamencos 145, San Isidro
Casilla 1030
LIMA 1
Tel: 41-4325, 41-3703
Telex: Pub. Booth 25306
A,C,M,E,M,P

PHILIPPINES

The Online Advanced Systems
Corporation
Rico House, Amorsolo Cor. Herrera
Street
Legaspi Village, Makail
P.O. Box 1510
Metro MANILA
Tel: 85-35-81, 85-34-91, 85-32-21
Telex: 3274 ONLINE
A,C,H,CS,E,M
Electronic Specialists and
Proponents Inc.
690-B Epifanio de los Santos
Avenue
Cubao, QUEZON CITY
P.O. Box 2649 Manila
Tel: 98-96-81, 98-96-82, 98-96-83
Telex: 40018, 42000 ITT GLOBE
MACKAY BOOTH
P

POLAND

Buro Informacji Technicznej
Hewlett-Packard
Ul Slawki 2, 6P
PL00-950 WARSZAWA
Tel: 39-59-62, 39-67-43
Telex: 812453 hepa pl

PORTUGAL

Telectra-Empresa Técnica de
Equipamentos Eléctricos S.a.r.l.
Rua Rodrigo da Fonseca 103
P.O. Box 2531
P-LISBON 1
Tel: (19) 68-60-72
Telex: 12598
CH,CS,E,P
Mundinter
Intercambio Mundial de Comércio
S.a.r.l.
P.O. Box 2761
Avenida Antonio Augusto de Aguiar
138
P-LISBON
Tel: (19) 53-21-31, 53-21-37
Telex: 16691 munter p
M

PUERTO RICO

Hewlett-Packard Puerto Rico
P.O. Box 4407
CAROLINA, Puerto Rico 00630
Calle 272 Edificio 203
Urb. Country Club
RIO PIEDRAS, Puerto Rico 00924
Tel: (809) 762-7255
Telex: 345 0514
A,CH,CS

QATAR

Nasser Trading & Contracting
P.O. Box 1563
DOHA
Tel: 22170
Telex: 4439 NASSER
M
Computerbia
P.O. Box 2570
DOHA
Tel: 329515
Telex: 4806 CHPARB
P

ROMANIA

Hewlett-Packard Reprezentanta
Boulevard Nicolae Balcescu 16
BUCURESTI
Tel: 130725
Telex: 10440

SAUDI ARABIA

Modern Electronic Establishment
P.O. Box 193
AL-KHOBAR
Tel: 864-4678
Telex: 670136
Cable: ELECTA AL-KHOBAR
CH,CS,E,M,P
Modern Electronic Establishment
P.O. Box 1228, Baghdadiah Street
JEDDAH
Tel: 642-0229
Telex: 401035
Cable: ELECTA JEDDAH
CH,CS,E,M,P
Modern Electronic Establishment
P.O. Box 2728
RIYADH
Tel: 491-9715, 491-6387
Telex: 200756
CH,CS,E,M,P

SCOTLAND

Hewlett-Packard Ltd.
Royal Bank Buildings
Swan Street
BRECHIN, Angus, Scotland
Tel: (03562) 3101-2
CH,CM
Hewlett-Packard Ltd.
SOUTH QUEENSFERRY
West Lothian, EH30 9GT
GB-Scotland
Tel: (031) 331188
Telex: 72682
A,CH,CM,CS,E,M

SINGAPORE

Hewlett-Packard Singapore (Pty.)
Ltd.
P.O. Box 58 Alexandra Post Office
SINGAPORE, 9115
6th Floor, Incharge House
450-452 Alexandra Road
SINGAPORE 0511
Tel: 631788
Telex: HPSGSD RS 34209
Cable: HEWPACK, Singapore
A,CH,CS,E,MS,P
Dynamar International Ltd.
Unit 05-11 Block 6
Kolam Ayer Industrial Estate
SINGAPORE 1334
Tel: 747-6188
Telex: RS26283
CM

SOUTH AFRICA

Hewlett-Packard South Africa (Pty.)
Ltd.
P.O. Box 120
Howard Place
Pine Park Center, Forest Drive,
Pinelands
CAPE PROVINCE 7450
Tel: 53-7955, 53-7956, 53-7957
Telex: 57-20006
A,CH,CM,E,MS,P
Hewlett-Packard South Africa (Pty.)
Ltd.
P.O. Box 37099
Overport
DURBAN 4067
Tel: 28-4178, 28-4179, 28-4110
Telex: 6-22954
CH,CM
Hewlett-Packard South Africa (Pty.)
Ltd.
P.O. Box 33345
Glenstantia 0010 TRANSVAAL
1st Floor East
Constantia Park Ridge Shopping
Centre
Constantia Park
PRETORIA
Tel: 982043
Telex: 32163
CH,E
Hewlett-Packard South Africa (Pty.)
Ltd.
Private Bag Wendywood
SANDTON 2144
Tel: 802-5111, 802-5125
Telex: 4-20877
Cable: HEWPACK Johannesburg
A,CH,CM,CS,E,MS,P

SPAIN

Hewlett-Packard Española S.A.
c/Entenza, 321
E-BARCELONA 29
Tel: (3) 322-24-51, 321-73-54
Telex: 52603 hpbee
A,CH,CM,CS,E,MS,P
Hewlett-Packard Española S.A.
c/San Vicente S/N
Edificio Albia II,7 B
E-BILBAO 1
Tel: (4) 23-8306, (4) 23-8206
A,CH,CM,E,MS
Hewlett-Packard Española S.A.
Calle Jerez 3
E-MADRID 16
Tel: (1) 458-2600
Telex: 23515 hpe
A,CM,E
Hewlett-Packard Española S.A.
c/o Costa Brava 13
Colonia Mirasierra
E-MADRID 34
Tel: (1) 734-8061, (1) 734-1162
CH,CS,M
Hewlett-Packard Española S.A.
Av Ramón y Cajal 1-9
Edificio Sevilla 1,
E-SEVILLA 5
Tel: 64-44-54, 64-44-58
Telex: 72933
A,CM,CS,MS,P
Hewlett-Packard Española S.A.
C/Ramón Gordillo, 1 (Entlo.3)
E-VALENCIA 10
Tel: 361-1354, 361-1358
CH,CM,P

SWEDEN

Hewlett-Packard Sverige AB
Sunnanvagen 14K
S-22226 LUND
Tel: (046) 13-69-79
Telex: (854) 10721 (via SPANGA
office)
CH,CM

Hewlett-Packard Sverige AB
Vastra Vingergatan 9
S-70344 ÖREBRO
Tel: (19) 10-48-80
Telex: (854) 10721 (via SPANGA
office)
CH,CM
Hewlett-Packard (Schweiz) AG
Skalholtsgatan 9, Kista
Box 19
S-16393 SPANGA
Tel: (08) 750-2000
Telex: 854-10721
A,CH,CM,CS,E,MS,P
Hewlett-Packard Sverige AB
Fröfallsgratan 30
S-42132 VÄSTRA-FRÖLUNDA
Tel: (031) 49-09-50
Telex: (854) 10721 (via SPANGA
office)
CH,CM,E,P

SWITZERLAND

Hewlett-Packard (Schweiz) AG
Clarastrasse 12
CH-4058 BASLE
Tel: (61) 33-59-20
A,CM
Hewlett-Packard (Schweiz) AG
Bahnhofweg 44
3018 BERN
Tel: (031) 56-24-22
CH,CM
Hewlett-Packard (Schweiz) AG
47 Avenue Blanc
CH-1202 GENEVA
Tel: (022) 32-48-00
CH,CM,CS
Hewlett-Packard (Schweiz) AG
29 Chemin Château Bloc
CH-1219 LE LIGNON-Geneva
Tel: (022) 96-03-22
Telex: 27333 hpag ch
Cable: HEWPACKAG Geneva
A,CM,E,MS,P
Hewlett-Packard (Schweiz) AG
Allmend 2
CH-8967 WIDEN
Tel: (57) 50-111
Telex: 59933 hpag ch
Cable: HPAG CH
A,CH,CM,CS,E,MS,P

SYRIA

General Electronic Inc.
Nuri Basha-Ahmad Ebn Kays Street
P.O. Box 5781
DAMASCUS
Tel: 33-24-87
Telex: 11215 ITIKAL
Cable: ELECTROBOR DAMASCUS
E
Middle East Electronics
Place Azmé
Boite Postale 2308
DAMASCUS
Tel: 334592
Telex: 11304 SATACO SY
M,P

TAIWAN

Hewlett-Packard Far East Ltd.
Kachsiung Office
2/F 68-2, Chung Cheng 3rd Road
KAOHSIUNG
Tel: 241-2318, 261-3253
CH,CS
Hewlett-Packard Far East Ltd.
Taichung Office
#33, Cheng Yi Rd.
10th Floor, Room 5
TAICHUNG
Tel: (042) 289274

Hewlett-Packard Far East Ltd.
Taiwan Branch
5th Floor
205 Tun Hwa North Road
TAIPEI
Tel:(02) 751-0404
Cable:HEWPACK Taipei
A,CH,CM,CS,E,M,P
Ing Lih Trading Co.
3rd Floor 18, Po-Ai Road
TAIPEI 100
Tel: (02) 3111914
Cable: INGLIH TAIPEI
A

THAILAND

Unimesa
30 Paipong Ave., Suriwong
BANGKOK 5
Tel: 234 091, 234 092
Telex: 84439 Simonco TH
Cable: UNIMESA Bangkok
A,C,E,M
Bangkok Business Equipment Ltd.
5/5-6 Dejo Road
BANGKOK
Tel: 234-8670, 234-8671
Telex: 87669-BEQUIPT TH
Cable: BUSIQUIPT Bangkok
P

TRINIDAD & TOBAGO

Caribbean Telecoms Ltd.
50A Jerningham Avenue
P.O. Box 732
PORT-OF-SPAIN
Tel: 62-44213, 62-44214
Telex: 235,272 HUGCO WG
A,CM,E,M,P

TUNISIA

Tunisienne Electronique
31 Avenue de la Liberté
TUNIS
Tel: 280-144
E,P
Corema
1 ter. Av. de Carthage
TUNIS
Tel: 253-821
Telex: 12319 CABAM TN
M

TURKEY

Teknim Company Ltd.
Iran Caddesi No.7
Kavaklıdere, ANKARA
Tel: 275900
Telex: 42155
E
E.M.A.
Medina Eldem Sokak No.41/6
Yüksel Caddesi
ANKARA
Tel: 175 622
M,P

UNITED ARAB EMIRATES

Emilat Ltd.
P.O. Box 1641
SHARJAH
Tel: 354121, 354123
Telex: 68136 Emilat Sh
CH,CS,E,M,P

UNITED KINGDOM

see: GREAT BRITAIN

NORTHERN IRELAND

SCOTLAND

SALES & SUPPORT OFFICES

Arranged alphabetically by country



UNITED STATES

Alabama

Hewlett-Packard Co.
700 Century Park South
Suite 128
BIRMINGHAM, AL 35226
Tel: (205) 822-6802
CH,MP

Hewlett-Packard Co.
P.O. Box 4207
8290 Whitesburg Drive, S.E.
HUNTSVILLE, AL 35802
Tel: (205) 881-4591
CH,CM,CS,E,M*

Alaska

Hewlett-Packard Co.
1577 "C" Street Plaza, Suite 252
ANCHORAGE, AK 99501
Tel: (907) 278-5709
CH*

Arizona

Hewlett-Packard Co.
2336 East Magnolia Street
PHOENIX, AZ 85034
Tel: (602) 273-8000
A,CH,CM,CS,E,MS

Hewlett-Packard Co.
2424 East Aragon Road
TUCSON, AZ 85706
Tel: (602) 889-4631
CH,E,MS**

Arkansas

Hewlett-Packard Co.
P.O. Box 5646
Brady Station
LITTLE ROCK, AR 72215
111 N. Filmore
LITTLE ROCK, AR 72205
Tel: (501) 664-8773, 376-1844
MS

California

Hewlett-Packard Co.
99 South Hill Dr.
BRISBANE, CA 94005
Tel: (415) 330-2500
CH,CS

Hewlett-Packard Co.
7621 Canoga Avenue
CANOGA PARK, CA 91304
Tel: (213) 702-8300
A,CH,CS,E,P

Hewlett-Packard Co.
1579 W. Shaw Avenue
FRESNO, CA 93711
Tel: (209) 221-6821
MS

Hewlett-Packard Co.
1430 East Orangethorpe
FULLERTON, CA 92631
Tel: (714) 870-1000
CH,CM,CS,E,MP

Hewlett-Packard Co.
5400 W. Rosecrans Boulevard
LAWDALE, CA 90260
P.O. Box 92105
LOS ANGELES, CA 90009
Tel: (213) 970-7500
CH,CM,CS,MP

Hewlett-Packard Co.
3939 Lankershim Blvd.
NORTH HOLLYWOOD, CA 91604
Tel: (213) 877-1292
Regional Headquarters

Hewlett-Packard Co.
3200 Hillview Avenue
PALO ALTO, CA 94304
Tel: (415) 857-8000
CH,CS,E

Hewlett-Packard Co.
648 W. North Market Boulevard
SACRAMENTO, CA 95834
Tel: (916) 929-7222
A*,CH,CS,E,MS

Hewlett-Packard Co.
9606 Aero Drive
P.O. Box 23333 SAN DIEGO, CA
92123
Tel: (714) 279-3200
CH,CM,CS,E,MP

Hewlett-Packard Co.
P.O. Box 4230
Fullerton, CA 92631

363 Brookhollow Drive
SANTA ANA, CA 92705
Tel: (714) 641-0977
A,CH,CM,CS,MP

Hewlett-Packard Co.
Suite A
5553 Hollister

SANTA BARBARA, CA 93111
Tel: (805) 964-3390

Hewlett-Packard Co.
3003 Scott Boulevard
SANTA CLARA, CA 95050
Tel: (408) 968-7000
A,CH,CM,CS,E,MP

Colorado

Hewlett-Packard Co.
24 Inverness Place, East
ENGLEWOOD, CO 80112
Tel: (303) 771-3455
A,CH,CM,CS,E,MS

Connecticut

Hewlett-Packard Co.
47 Barnes Industrial Road South
P.O. Box 5007
WALLINGFORD, CT 06492
Tel: (203) 265-7801
A,CH,CM,CS,E,MS

Florida

Hewlett-Packard Co.
P.O. Box 24210
2901 N.W. 62nd Street
FORT LAUDERDALE, FL 33307
Tel: (305) 973-2600
CH,CS,E,MP

Hewlett-Packard Co.
4080 Woodcock Drive, #132
Brownnett Building
JACKSONVILLE, FL 32207
Tel: (904) 398-0663
C*,E*,MS**

Hewlett-Packard Co.
P.O. Box 13910
6177 Lake Eleanor Drive
ORLANDO, FL 32809
Tel: (305) 859-2900
A,CH,CM,CS,E,MS

Hewlett-Packard Co.
6425 N. Pensacola Blvd.
Suite 4, Building 1
PENSACOLA, FL 32505
Tel: (904) 476-8422
A,MS

Hewlett-Packard Co.
5750 North Hoover, Suite 123
TAMPA, FL 33614
Tel: (813) 872-0900
A*,CH,CM,CS,E*,M*

Georgia

Hewlett-Packard Co.
P.O. Box 105005
ATLANTA, GA 30348
2000 South Park Place
ATLANTA, GA 30339
Tel: (404) 955-1500
Telex: 810-766-4890
A,CH,CM,CS,E,MP

Hewlett-Packard Co.
Executive Park Suite 306
AUGUSTA, GA 30907
Tel: (404) 736-0592
MS

Hewlett-Packard Co.
P.O. Box 2103
WARNER ROBINS, GA 31099
1172 N. Davis Drive
WARNER ROBINS, GA 31093
Tel: (912) 923-8831
E

Hawaii

Hewlett-Packard Co.
Kawaiahao Plaza, Suite 190
567 South King Street
HONOLULU, HI 96813
Tel: (808) 526-1555
A,CH,E,MS

Idaho

Hewlett-Packard Co.
250 S. Beechwood
1st Floor, JUB Engineering Bldg.
BOISE, ID 83702
Tel: (208) 376-6000
CH,M*

Illinois

Hewlett-Packard Co.
211 Prospect Road, Suite C
BLOOMINGTON, IL 61701
Tel: (309) 863-0383
CH,MS**

Hewlett-Packard Co.
1100 31st Street
DOWNERS GROVE, IL 60515
Tel: (312) 960-5760
CH,CS

Hewlett-Packard Co.
5201 Tolview Drive
ROLLING MEADOWS, IL 60008
Tel: (312) 255-9800
A,CH,CM,CS,E,MP

Indiana

Hewlett-Packard Co.
P.O. Box 50807
7301 No. Shadeland Avenue
INDIANAPOLIS, IN 46250
Tel: (317) 842-1000
A,CH,CM,CS,E,MS

Iowa

Hewlett-Packard Co.
1776 22nd Street, Suite 1
WEST DES MOINES, IA 50265
Tel: (515) 224-1435
CH,MS**
Hewlett-Packard Co.
2415 Heinz Road
IOWA CITY, IA 52240
Tel: (319) 351-1020, 366-6477
CH,E*,MS

Kansas

Hewlett-Packard Co.
1644 S. Rock Road
WICHITA, KA 67207
Tel: (316) 684-8491
CH

Kentucky

Hewlett-Packard Co.
10170 Linn Station Road
Suite 525
LOUISVILLE, KY 40223
Tel: (502) 426-0100
A,CH,CS,MS

Louisiana

Hewlett-Packard Co.
P.O. Box 1449
KENNER, LA 70062
160 James Drive East
DESTAHH, LA 70047
Tel: (504) 467-4100
A,CH,CS,E,MS

Maryland

Hewlett-Packard Co.
7121 Standard Drive
HANOVER, MD 21076
Tel: (301) 796-7700
A,CH,CM,CS,E,MS

Hewlett-Packard Co.
2 Choke Cherry Road
ROCKVILLE, MD 20850
Tel: (301) 948-6370
Telex: 710-828-9685
A,CH,CM,CS,E,MP

Massachusetts

Hewlett-Packard Co.
32 Hartwell Avenue
LEXINGTON, MA 02173
Tel: (617) 861-8960
A,CH,CM,CS,E,MP

Michigan

Hewlett-Packard Co.
23855 Research Drive
FARMINGTON HILLS, MI 48024
Tel: (313) 476-6400
A,CH,CM,CS,E,MP

Hewlett-Packard Co.
4326 Cascade Road S.E.
GRAND RAPIDS, MI 49506
Tel: (616) 957-1970
CH,CS,MS

Minnesota

Hewlett-Packard Co.
2025 W. Larpenteur Ave.
ST. PAUL, MN 55113
Tel: (612) 644-1100
A,CH,CM,CS,E,MP

Mississippi

Hewlett-Packard Co.
P.O. Box 5028
1675 Lakeland Drive
JACKSON, MS 39216
Tel: (601) 982-9363
MS

Missouri

Hewlett-Packard Co.
11131 Colorado Avenue
KANSAS CITY, MO 64137
Tel: (816) 763-8000
Telex: 910-771-2087
A,CH,CM,CS,E,MS

Hewlett-Packard Co.
1024 Executive Parkway
ST. LOUIS, MO 63141
Tel: (314) 878-0200
A,CH,CS,E,MP

Nebraska

Hewlett-Packard
7101 Mercy Road
Suite 101, IBX Building
OMAHA, NE 68106
Tel: (402) 392-0948
CM,MS

Nevada

Hewlett-Packard Co.
Suite D-130
5030 Paradise Blvd.
LAS VEGAS, NV 89119
Tel: (702) 736-8610
MS**

New Jersey

Hewlett-Packard Co.
Crystal Brook Professional Building
Route 35
EATONTOWN, NJ 07724
Tel: (201) 542-1384
A*,C*,E*,F*

Hewlett-Packard Co.
W120 Century Road
PARAMUS, NJ 07652
Tel: (201) 265-5000
A,CH,CM,CS,E,MP

Hewlett-Packard Co.
60 New England Av. West
PISCATAWAY, NJ 08854
Tel: (201) 981-1199
A,CH,CM,CS,E

New Mexico

Hewlett-Packard Co.
P.O. Box 11634
ALBUQUERQUE, NM 87112
11300 Lomas Blvd., N.E.
ALBUQUERQUE, NM 87123
Tel: (505) 292-1330
Telex: 910-989-1185
CH,CS,E,MS

New York

Hewlett-Packard Co.
5 Computer Drive South
ALBANY, NY 12205
Tel: (518) 458-1550
Telex: 710-444-4691
A,CH,E,MS
Hewlett-Packard Co.
P.O. Box 297
9600 Main Street
CLARENCE, NY 14031
Tel: (716) 759-8621
Telex: 710-523-1893
CH

Hewlett-Packard Co.
200 Cross Keys Office
FAIRPORT, NY 14450
Tel: (716) 223-9950
Telex: 510-253-0092
CH,CM,CS,E,MS

Hewlett-Packard Co.
7641 Henry Clay Blvd.
LIVERPOOL, NY 13088
Tel: (315) 451-1820
A,CH,CM,E,MS

Hewlett-Packard Co.
No. 1 Pennsylvania Plaza
55th Floor
34th Street & 8th Avenue
NEW YORK, NY 10119
Tel: (212) 971-0800
CH,CS,E*,M*

Hewlett-Packard Co.
3 Crossways Park West
WOODBURY, NY 11797
Tel: (516) 921-0300
Telex: 510-221-2183
A,CH,CM,CS,E,MS

North Carolina

Hewlett-Packard Co.
4915 Water's Edge Drive
Suite 160
RALEIGH, NC 27606
Tel: (919) 851-3021
C,M

Hewlett-Packard Co.
P.O. Box 26500
5605 Roanne Way
GREENSBORO, NC 27450
Tel: (919) 852-1800
A,CH,CM,CS,E,MS

Ohio

Hewlett-Packard Co.
9920 Carver Road
CINCINNATI, OH 45242
Tel: (513) 891-9870
CH,CS,MS

Hewlett-Packard Co.
16500 Sprague Road
CLEVELAND, OH 44130
Tel: (216) 243-7300
Telex: 810-423-9430
A,CH,CM,CS,E,MS

Hewlett-Packard Co.
962 Crupper Ave.
COLUMBUS, OH 43229
Tel: (614) 436-1041
CH,CM,CS,E*

SALES & SUPPORT OFFICES

Arranged alphabetically by country

Hewlett-Packard Co.
P.O. Box 280
330 Progress Rd.
DAYTON, OH 45449
Tel: (513) 859-8202
A,CH,CM,E*,MS

Oklahoma
Hewlett-Packard Co.
P.O. Box 32008
Oklahoma City, OK 73123
1503 W. Gore Blvd., Suite #2
LAWTON, OK 73505
Tel: (405) 248-4248
C

Hewlett-Packard Co.
P.O. Box 32008
OKLAHOMA CITY, OK 73123
304 N. Meridian Avenue, Suite A
OKLAHOMA CITY, OK 73107
Tel: (405) 946-9499
A*,CH,E*,MS

Hewlett-Packard Co.
Suite 121
9920 E. 42nd Street
TULSA, OK 74145
Tel: (918) 665-3300
A*,CH,CS,M*

Oregon
Hewlett-Packard Co.
1500 Valley River Drive
Suite 330
EUGENE, OR 97401
Tel: (503) 683-8075
C

Hewlett-Packard Co.
9255 S. W. Pioneer Court
WILSONVILLE, OR 97070
Tel: (503) 682-8000
A,CH,CS,E*,MS

Pennsylvania
Hewlett-Packard Co.
1021.8th Avenue
King of Prussia Industrial Park
KING OF PRUSSIA, PA 19406
Tel: (215) 265-7000
Telex: 510-660-2670
A,CH,CM,CS,E,MP

Hewlett-Packard Co.
111 Zela Drive
PITTSBURGH, PA 15238
Tel: (412) 782-0400
A,CH,CS,E,MP

South Carolina
Hewlett-Packard Co.
P.O. Box 21708
Brookside Park, Suite 122
1 Harbison Way
COLUMBIA, SC 29210
Tel: (803) 732-0400
CH,E,MS

Hewlett-Packard Co.
Koger Executive Center
Chesterfield Bldg., Suite 124
GREENVILLE, SC 29615
Tel: (803) 748-5601
C

Tennessee
Hewlett-Packard Co.
P.O. Box 22490
224 Peters Road
Suite 102
KNOXVILLE, TN 37922
Tel: (615) 691-2371
A*,CH,MS

Hewlett-Packard Co.
3070 Directors Row
MEMPHIS, TN 38131
Tel: (901) 346-8370
A,CH,MS

Hewlett-Packard Co.
230 Great Circle Road
Suite 216
NASHVILLE, TN 32228
Tel: (615) 255-1271
MS**

Texas
Hewlett-Packard Co.
Suite 310W
7800 Shoal Creek Blvd.
AUSTIN, TX 78757
Tel: (512) 459-3143
E

Hewlett-Packard Co.
Suite C-110
4171 North Mesa
EL PASO, TX 79902
Tel: (915) 533-3555, 533-4489
CH,E*,MS**

Hewlett-Packard Co.
5020 Mark IV Parkway
FORT WORTH, TX 76106
Tel: (817) 625-6361
CH,CS*

Hewlett-Packard Co.
P.O. Box 42816
HOUSTON, TX 77042
10535 Harwin Street
HOUSTON, TX 77036
Tel: (713) 776-6400
A,CH,CM,CS,E,MP

Hewlett-Packard Co.
3309 67th Street
Suite 24
LUBBOCK, TX 79413
Tel: (806) 799-4472
M

Hewlett-Packard Co.
P.O. Box 1270
RICHARDSON, TX 75080
930 E. Campbell Rd.
RICHARDSON, TX 75081
Tel: (214) 231-6101
A,CH,CM,CS,E,MP

Hewlett-Packard Co.
P.O. Box 32993
SAN ANTONIO, TX 78216
1020 Central Parkway South
SAN ANTONIO, TX 78232
Tel: (512) 494-9336
CH,CS,E,MS

Utah
Hewlett-Packard Co.
P.O. Box 26626
3530 W. 2100 South
SALT LAKE CITY, UT 84119
Tel: (801) 974-1700
A,CH,CS,E,MS

Virginia
Hewlett-Packard Co.
P.O. Box 9669
2914 Hungary Spring Road
RICHMOND, VA 23228
Tel: (804) 285-3431
A,CH,CS,E,MS

Hewlett-Packard Co.
3106 Peters Creek Road, N.W.
ROANOKE, VA 24019
Tel: (703) 563-2205
CH,E**

Hewlett-Packard Co.
5700 Thurston Avenue
Suite 111
VIRGINIA BEACH, VA 23455
Tel: (804) 460-2471
CH,MS

Washington
Hewlett-Packard Co.
15815 S.E. 37th Street
BELLEVUE, WA 98006
Tel: (206) 643-4000
A,CH,CM,CS,E,MP

Hewlett-Packard Co.
Suite A
708 North Argonne Road
SPOKANE, WA 99208
Tel: (509) 922-7000
CH,CS

West Virginia
Hewlett-Packard Co.
4604 MacCorkle Ave., S.E.
CHARLESTON, WV 25304-4297
Tel: (304) 925-0492
A,MS

Wisconsin
Hewlett-Packard Co.
150 S. Sunny Slope Road
BROOKFIELD, WI 53005
Tel: (414) 784-8600
A,CH,CS,E*,MP

URUGUAY
Pablo Ferrando S.A.C. e.l.
Avenida Italia 2877
Casilla de Correo 370
MONTEVIDEO
Tel: 80-2586
Telex: Public Booth 901
A,CM,E,M

Guillermo Kraft del Uruguay S.A.
Av. Lib. Brig. Gra. Lavalleja 2083
MONTEVIDEO
Tel: 234588, 234808, 208830
Telex: 6245 ACTOUR UY
P

U.S.S.R.
Hewlett-Packard Co.
Representative Office
Pokrovsky Blvd. 4/17 KV12
MOSCOW 101000 Tel: 294-2024
Telex: 7825 HEWPACK SU

VENEZUELA
Hewlett-Packard de Venezuela C.A.
Apartado 50933
3A Transversal Los Ruices Norte
Edificio Segre
CARACAS 1071
Tel: 239-4133
Telex: 25146 HEWPACK
A,CH,CS,E,MS,P
Colimodio S.A.
Apartado 1053
Este 2-Sur 21 No. 148
CARACAS 1010
Tel: 571-35-11
Telex: 21529
M

YUGOSLAVIA
Iskra-Commerce-Representation of
Hewlett-Packard
Sava Centar Delegacija 30
Milentija Popovica 9
11170 BEOGRAD
Tel: 638-762
Telex: 12042, 12322 YU SAV CEN
Iskra-Commerce-Representation of
Hewlett-Packard
Koprska 46
61000 LJUBLJANA
Tel: 321674, 315879
Telex:

ZAIRE
Computer & Industrial Engineering
25 Avenue de la Justice
B.P. 10-976
Kinshasa I/Zaire
GOMBE
Tel: 32063
Telex: 21-457 SGEKIN ZR
CH,CS

ZIMBABWE
Field Technical Sales
45 Kelvin Road, North
P.B. 3458
SALISBURY
Tel: 705 231
Telex: 4-122 RH.
C,E,M,P

If there is no sales office listed for your area, contact one of these headquarters offices.

NORTH/CENTRAL AFRICA
Hewlett-Packard S.A.
7 Rue du Bois-du-Lan
CH-1217 MEYRIN 2, Switzerland
Tel: (022) 98-96-51
Telex: 27835 hpse
Cable: HEWPACKSA Geneve

ASIA
Hewlett-Packard Asia Ltd.
6th Floor, Sun Hung Kai Center
30 Harbor Rd.
G.P.O. Box 795
HONG KONG
Tel: 5-832 3211
Telex: 66678 HEWPA HX
Cable: HP ASIA LTD Hong Kong

CANADA
Hewlett-Packard (Canada) Ltd.
6877 Goreway Drive
MISSISSAUGA, Ontario L4V 1M8
Tel: (416) 678-9430
Telex: 610-492-4246

EASTERN EUROPE
Hewlett-Packard Ges.m.b.h.
Wehlstrasse 29
P.O. Box 7
A-1205 VIENNA
Tel: (222) 35-16-210
Telex: 135823/135066

NORTHERN EUROPE
Hewlett-Packard S.A.
Uilenstede 475
NL-1183 AG AMSTELVEEN
The Netherlands
P.O. Box 999
NL-1180 AZ AMSTELVEEN
The Netherlands
Tel: 20 437771

OTHER EUROPEAN
Hewlett-Packard S.A.
7 Rue du Bois-du-Lan
CH-1217 MEYRIN 2, Switzerland
Tel: (022) 98-96-51
Telex: 27835 hpse
Cable: HEWPACKSA Geneve
(Offices in the World Trade Center)

MEDITERRANEAN AND MIDDLE EAST
Hewlett-Packard S.A.
Mediterranean and Middle East Operations
Atrina Centre
32 Kifissias Ave.
Amaroussion, ATHENS, Greece
Tel: 808-0359 808-0429
Telex: 21-6588
Cable: HEWPACKSA Athens

EASTERN USA
Hewlett-Packard Co.
4 Choke Cherry Road
Rockville, MD 20850
Tel: (301) 258-2000

MIDWESTERN USA
Hewlett-Packard Co.
5201 Tollview Drive
ROLLING MEADOWS, IL 60008
Tel: (312) 255-9800

SOUTHERN USA
Hewlett-Packard Co.
P.O. Box 105005
450 Interstate N. Parkway
ATLANTA, GA 30339
Tel: (404) 955-1500

WESTERN USA
Hewlett-Packard Co.
3939 Lankersim Blvd.
LOS ANGELES, CA 91604
Tel: (213) 877-1282

OTHER INTERNATIONAL AREAS
Hewlett-Packard Co.
Intercontinental Headquarters
3495 Deer Creek Road
PALO ALTO, CA 94304
Tel: (415) 857-1501
Telex: 034-8300
Cable: HEWPACK

14 April 1982 5952-6900