OPERATING AND SERVICE MANUAL

435A
POWER METER

(Including Options 001, 002, 003, 009, 010, 011, 012, and 013)

SERIAL NUMBERS

This manual applies directly to instruments with serial numbers prefixed 2015A.

With changes described in Section VII, this manual also applies to instruments with serial numbers prefixed 1234A, 1312A, 1415A, 1527A, 1530A, 1548A, 1601A, 1624A, 1629A, 1701A, 1723A, 1733A, 1750A, 1810A, 1921A, and 1949A.

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

1501 PAGE MILL ROAD, PALO ALTO, CALIFORNIA, U.S.A.

OPERATING AND SERVICE MANUAL PART NO. 00435-90032
Operating Manual Part No. 00435-90033
Operating and Service Microfiche Part No. 00435-90034

Printed: NOVEMBER 1980

SALES & SUPPORT OFFICES

Arranged alphabetically by country

UNITED STATES (Cont'd)

Hewlett-Packard Co.
3952 Sand Shell St
FORT WORTH, TX 76137
Tel: (817) 232-9500
A,C,CH,E,M

Hewlett-Packard Co.
10535 Harwin Drive
P.O. Box 42816
HOUSTON, TX 77042
Tel: (713) 776-6400
A,C,CH,CS,E,M,P*

Hewlett-Packard Co.
511 W. John W. Carpenter Fwy.
Royal Tech. Center #100
IRVINE, TX 75062
Tel: (214) 556-1950
C,CH,CS,E

Hewlett-Packard Co.
930 E. Campbell Rd.
P.O. Box 83/1270
RICHARDSON, TX 75083-1270
Tel: (214) 231-6101
A,CH,CM,CS,E,M,P*

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

Utah

Hewlett-Packard Co.
3530 W. 2100 South
P.O. Box 26626
SALT LAKE CITY, UT 84126
Tel: (801) 974-1700
A,CH,CS,E,M

Virginia

Hewlett-Packard Co.
4305 Cox Road
GLEN ALLEN, VA 23060
P.O. Box 9669
RICHMOND, VA 23228
Tel: (804) 747-7750
A,C,CH,CS,E,M,P*

Washington

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

Hewlett-Packard Co.
708 North Argonne Road
P.O. Box 3808
SPOKANE, WA 99220-3808
Tel: (509) 922-7000
CH,CS

West Virginia

Hewlett-Packard Co.
4604 MacCorkle Ave.
CHARLESTON, WV 25304
Tel: (304) 925-0492
A,M

Wisconsin

Hewlett-Packard Co.
275 N. Corporate Dr.
BROOKFIELD, WI 53005
Tel: (414) 784-8800
A,CH,CS,E*,M

URUGUAY

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

Mini Computadores, Ltda.
Avda. del Libertador Brig
Gral Lavalleja 2071
Local 007
MONTEVIDEO
Tel: 29-55-22
Telex: 901 P BOOTH UY
P

Olympia de Uruguay S.A.
Maquines de Oficina
Avda. del Libertador 1997
Casilla de Correos 6644
MONTEVIDEO
Tel: 91-1809, 98.-3807
Telex: 6342 OROU UY
P

VENEZUELA

Hewlett-Packard de Venezuela C.A.
3RA Transversal Los Ruices Norte
Edificio Segre 1, 2 & 3
Apartado 50933
CARACAS 1071
Tel: 239-4133
Telex: 251046 HEWPACK
A,CH,CS,E,M,P

Hewlett-Packard de Venezuela C.A.
Residencias Tia Betty Local 1
Avenida 3 y con calfe 75
MARACAIBO, Estado Zulia
Apartado 2646
Tel: (061) 75801-75805-75806-80304
Telex: 62464 HPMAR
C,E*

Hewlett-Packard de Venezuela C.A.
Urb. Lomas de Este
Torre Trebol — Piso 11
VALENCIA, Estado Carabobo
Apartado 3347
Tel: (041) 222992/223024
CH,CS,P

Albis Venezolana S.R.L.
Av. Las Marias, Ota. Alix,
El Pedregal
Apartado 81025
CARACAS *1080A*
Tel: 747984, 742146
Telex: 24009 ALBIS VC
A

Tecnologica Medica del Caribe, C.A.
Multicentro Empresarial del Este
Ave. Libertador
Edif. Libertador
Nucleo "C" - Oficina 51-52
CARACAS
Tel: 339867/333780
M

CIZUCA
Cientifica Zulia C.A.
Calle 70, Los Olivos
No. 66-86
Apartado 1843
MARACAIBO
Tel: 54-64-37, 54-63-85, 54-64-94
Telex: 62144
A

YUGOSLAVIA

Do Hermes
General Zdanova 4
Telex: YU-11000 ***BEOGRAD***
A,CH,E,P

Hermes
Titova 50
Telex: YU-61000 ***LJUBLJANA***
CH,CS,E,M,P

Elektrotehna
Titova 51
Telex: YU-61000 ***LJUBLJANA***
CM

ZAMBIA

R.J. Tilbury (Zambia) Ltd.
P.O. Box 32792
LUSAKA
Tel: 215590
Telex: 40128
E

ZIMBABWE

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

August 1984

HP distributors are printed in italics.

CONTENTS

UNITED STATES (Cont'd)

Hewlett-Packard Co.
4201 Corporate Dr.
WEST DES MOINES, IA 50265
Tel: (515) 224-1435
A**,CH,M**

Kentucky

Hewlett-Packard Co.
10300 Linn Station Road, #100
LOUISVILLE, KY 40223
Tel: (502) 426-0100
A,CH,CS,M

Louisiana

Hewlett-Packard Co.
160 James Drive East
ST. ROSE, LA 70087
P.O. Box 1449
KENNER, LA 70063
Tel: (504) 467-4100
A,C,CH,E,M,P*

Maryland

Hewlett-Packard Co.
3701 Koppers Street
BALTIMORE, MD 21227
Tel: (301) 644-5800
Telex: 710-862-1943
A,CH,CM,CS,E,M

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

Massachusetts

Hewlett-Packard Co.
1775 Minuteman Road
ANDOVER, MA 01810
Tel: (617) 682-1500
A,C,CH,CS,CM,E,M,P*

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

Michigan

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

Hewlett-Packard Co.
39550 Orchard Hill Place Drive
NOVI, MI 48050
Tel: (313) 349-9200
A,CH,CS,E,M

Hewlett-Packard Co.
1771 W. Big Beaver Road
TROY, MI 48084
Tel: (313) 643-6474
CH,CS

Minnesota

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

Missouri

Hewlett-Packard Co.
1001 E. 101st Terrace
KANSAS CITY, MO 64131
Tel: (816) 941-0411
A,CH,CM,CS,E,M

Hewlett-Packard Co.
13001 Hollenberg Drive
BRIDGETON, MO 63044
Tel: (314) 344-5100
A,CH,CS,E,M

Nebraska

Hewlett-Packard
10824 Old Mill Rd., Suite 3
OMAHA, NE 68154
Tel: (402) 334-1813
CM,M

New Jersey

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

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

New Mexico

Hewlett-Packard Co.
11300 Lomas Blvd.,N.E.
P.O. Box 11634
ALBUQUERQUE, NM 87112
Tel: (505) 292-1330
CH,CS,E,M

New York

Hewlett-Packard Co.
5 Computer Drive South
ALBANY, NY 12205
Tel: (518) 458-1550
A,CH,E,M

Hewlett-Packard Co.
9600 Main Street
P.O. Box AC
CLARENCE, NY 14031
Tel: (716) 759-8621
CH,CS,E

Hewlett-Packard Co.
200 Cross Keys Office Park
FAIRPORT, NY 14450
Tel: (716) 223-9950
A,CH,CM,CS,E,M

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

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

Hewlett-Packard Co.
15 Myers Corner Rd.
WAPPINGER FALLS, NY 12590
CM,E

Hewlett-Packard Co.
250 Westchester Avenue
WHITE PLAINS, NY 10604
Tel: (914) 684-6100
CM,CH,CS,E

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

North Carolina

Hewlett-Packard Co.
305 Gregson Dr.
CARY, NC 27511
Tel: (919) 467-6600
C,CH,CM,CS,E,M,P*

Hewlett-Packard Co.
9600-H Southern Pine Blvd.
CHARLOTTE, NC 28210
Tel: (704) 527-8780
CH*,CS*

Hewlett-Packard Co.
5605 Roanne Way
P.O. Box 26500
GREENSBORO, NC 27420
Tel: (919) 852-1800
A,C,CH,CM,CS,E,M,P*

Ohio

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

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

Hewlett-Packard Co.
980 Springboro Pike
MIAMISBURG, OH 45343
Tel: (513) 859-8202
A,CH,CM,E*,M

Hewlett-Packard Co.
675 Brooksedge Blvd.
WESTERVILLE, OH 43081
Tel: (614) 436-1041
CH,CM,CS,E*

Oklahoma

Hewlett-Packard Co.
304 N. Meridian, Suite A
P.O. Box 75609
OKLAHOMA CITY, OK 73147
Tel: (405) 946-9499
C,CH,CS,E*,M

Hewlett-Packard Co.
3840 S. 103rd E. Ave., #100
P.O. Box 35747
TULSA, OK 74153
Tel: (918) 665-3300
A**,C,CH,CS,M*,E,P*

Oregon

Hewlett-Packard Co.
9255 S. W. Pioneer Court
P.O. Box 328
WILSONVILLE, OR 97070
Tel: (503) 682-8000
A,CH,CS,E*,M

Pennsylvania

Hewlett-Packard Co.
50 Dorchester Rd.
P.O. Box 6080
HARRISBURG, PA 17111
Tel: (717) 657-5900
C

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

Hewlett-Packard Co.
2750 Monroe Boulevard
P.O. Box 713
VALLEY FORGE, PA 19482
Tel: (215) 666-9000
A,CH,CM,CS,E,M

South Carolina

Hewlett-Packard Co.
Brookside Park, Suite 122
1 Harbison Way
P.O. Box 21708
COLUMBIA, SC 29221
Tel: (803) 732-0400
A,C,CH,CS,M

Hewlett-Packard Co.
100 Executive Cntr. Dr.
Koger Executive Center
Chesterfield Bldg., Suite 124
GREENVILLE, SC 29615
Tel: (803) 297-4120
C

Tennessee

Hewlett-Packard Co.
One Energy Centr. #200
Pellissippi Pkwy.
P.O. Box 22490
KNOXVILLE, TN 37933
Tel: (615) 966-4747
A,C,CH,CS,M

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

Hewlett-Packard Co.
220 Great Circle Road, Suite 116
NASHVILLE, TN 37228
Tel: (615) 255-1271
C,M,P*

Texas

Hewlett-Packard Co.
11002-B Metric Boulevard
AUSTIN, TX 78758
Tel: (512) 835-6771
C,CM,E,P*

Hewlett-Packard Co.
5700 Cromo Dr
P.O. Box 12903
EL PASO, TX 79913
Tel: (915) 833-4400
CH,E*,M**

SERVICE SHEETS

ILLUSTRATIONS

SALES & SUPPORT OFFICES
Arranged alphabetically by country

GREAT BRITAIN (Cont'd)

Hewlett-Packard Ltd.
Bridewell House
Bridewell Place
LONDON EC4V 6BS
Tel: 01 583 6565
Telex: 298163
CH,CS,P

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

Hewlett-Packard Ltd.
Pontefract Road
NORMANTON, West Yorkshire WF6 1RN
Tel: 0924 895566
Telex: 557355
CH,CS,P

Hewlett-Packard Ltd.
The Quadrangle
106-118 Station Road
REDHILL, Surrey RH1 1PS
Tel: 0737 68655
Telex: 947234
CH,CS,E,P

Hewlett-Packard Ltd.
Avon House
435 Stratford Road
Shirley, **SOLIHULL**, West Midlands
B90 4BL
Tel: 021 745 8800
Telex: 339105
CH,CS,E,P

Hewlett-Packard Ltd.
West End House
41 High Street, West End
SOUTHAMPTON
Hampshire S03 3DQ
Tel: 04218 6767
Telex: 477138
CH,CS,P

Hewlett-Packard Ltd.
King Street Lane
Winnersh, **WOKINGHAM**
Berkshire RG11 5AR
Tel: 0734 784774
Telex: 847178
A,CH,CS,E,M,P

Hewlett-Packard Ltd.
Nine Mile Ride
Easthampstead, **WOKINGHAM**
Berkshire, 3RG11 3LL
Tel: 0344 773100
Telex: 848805
CH,CS,E,P

IRELAND

NORTHERN IRELAND

Hewlett-Packard Ltd.
Cardiac Services Building
95A Finaghy Road South
BELFAST BT10 OBY
Tel: 0232 625-566
Telex: 747626
CH,CS

SCOTLAND

Hewlett-Packard Ltd.
SOUTH QUEENSFERRY
West Lothian, EH30 9TG
Tel: 031 331 1188
Telex: 72682
CH,CM,CS,E,M,P

UNITED STATES

Alabama

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

Hewlett-Packard Co.
420 Wynn Drive
P.O. Box 7700
HUNTSVILLE, AL 35807
Tel: (205) 830-2000
C,CH,CM,CS,E,M*

Alaska

Hewlett-Packard Co.
3601 C St., Suite 1234
ANCHORAGE, AK 99503
Tel: (907) 563-8855
CH,CS,E

Arizona

Hewlett-Packard Co.
8080 Pointe Parkway West
PHOENIX, AZ 85044
Tel: (602) 273-8000
A,CH,CM,CS,E,M

Hewlett-Packard Co.
2424 East Aragon Road
TUCSON, AZ 85706
Tel: (602) 573-7400
CH,E,M**

California

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

Hewlett-Packard Co.
P.O. Box 7830 (93747)
5060 E. Clinton Avenue, Suite 102
FRESNO, CA 93727
Tel: (209) 252-9652
CH,CS,M

Hewlett-Packard Co.
1421 S. Manhattan Av.
FULLERTON, CA 92631
Tel: (714) 999-6700
CH,CM,CS,E,M

Hewlett-Packard Co.
320 S. Kellogg, Suite B
GOLETA, CA 93117
Tel: (805) 967-3405
CH

Hewlett-Packard Co.
5400 W. Rosecrans Blvd.
LAWNDALE, CA 90260
P.O. Box 92105
LOS ANGELES, CA 90009
Tel: (213) 643-7500
Telex: 910-325-6608
CH,CM,CS,M

Hewlett-Packard Co.
3155 Porter Drive
PALO ALTO, CA 94304
Tel: (415) 857-8000
CH,CS,E

Hewlett-Packard Co.
4244 So. Market Court, Suite A
P.O. Box 15976
SACRAMENTO, CA 95813
Tel: (916) 929-7222
A*,CH,CS,E,M

Hewlett-Packard Co.
9606 Aero Drive
P.O. Box 23333
SAN DIEGO, CA 92123
Tel: (619) 279-3200
CH,CM,CS,E,M

Hewlett-Packard Co.
2305 Camino Ramon 'C'
SAN RAMON, CA 94583
Tel: (415) 838-5900
CH,CS

Hewlett-Packard Co.
3005 Scott Boulevard
SANTA CLARA, CA 95050
Tel: (408) 988-7000
Telex: 910-338-0586
A,CH,CM,CS,E,M

Hewlett-Packard Co.
5703 Corsa Avenue
WESTLAKE VILLAGE, CA 91362
Tel: (213) 706-6800
E*,CH*,CS*

Colorado

Hewlett-Packard Co.
24 Inverness Place, East
ENGLEWOOD, CO 80112
Tel: (303) 649-5000
A,CH,CM,CS,E,M

Connecticut

Eff. Dec. 1, 1984
Hewlett-Packard Co.
500 Sylvan Av.
BRIDGEPORT, CT 06606
Tel: (203) 371-6454
CH,CS,E

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

Florida

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

Hewlett-Packard Co.
4080 Woodcock Drive, Suite 132
JACKSONVILLE, FL 32207
Tel: (904) 398-0663
C*,CH*,M**

Hewlett-Packard Co.
6177 Lake Ellenor Drive
P.O. Box 13910
ORLANDO, FL 32859
Tel: (305) 859-2900
A,C,CH,CM,CS,E,P*

Hewlett-Packard Co.
4700 Bayoue Blvd.
Building 5
PENSACOLA, FL 32505
Tel: (904) 476-8422
A,C,CH,CM,CS,M

Hewlett-Packard Co.
5550 Idlewild, #150
P.O. Box 15200
TAMPA, FL 33684
Tel: (813) 884-3282
A*,C,CH,CS,E*,M*,P*

Georgia

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

Hawaii

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

Illinois

Hewlett-Packard Co.
304 Eldorado Road
P.O. Box 1607
BLOOMINGTON, IL 61701
Tel: (309) 662-9411
CH,M**

Hewlett-Packard Co.
525 W. Monroe, #1300
CHICAGO, IL 60606
Tel: (312) 930-0010
CH,CS

Hewlett-Packard Co.
1200 Diehl
NAPERVILLE, IL 60566
Tel: (312) 357-8800
CH*,CS

Hewlett-Packard Co.
5201 Tollview Drive
ROLLING MEADOWS, IL 60008
Tel: (312) 255-9800
Telex: 910-687-1066
A,CH,CM,CS,E,M

Indiana

Hewlett-Packard Co.
11911 N. Meridian St.
CARMEL, IN 46032
Tel: (317) 844-4100
A,CH,CM,CS,E,M

Iowa

Hewlett-Packard Co.
4070 22nd Av. SW
CEDAR RAPIDS, IA 52404
Tel: (319) 390-4250
CH,CS,E,M

ILLUSTRATIONS (Cont'd)

TABLES

SOUTH AFRICA (Cont'd)

Hewlett-Packard So Africa (Pty.) Ltd.
Private Bag Wendywood
SANDTON 2144
Tel: 802-5111, 802-5125
Telex: 4-20877
Cable: HEWPACK Johannesburg
A,CH,CM,CS,E,M,P

SPAIN

Hewlett-Packard Española S.A.
Calle Entenza, 321
E-BARCELONA 29
Tel: 322.24.51, 321.73.54
Telex: 52603 hpbee
A,CH,CS,E,M,P

Hewlett-Packard Española S.A.
Calle San Vicente S/No
Edificio Albia II 7B
E-BILBAO 1
Tel: 423.83.06
A,CH,E,M

Hewlett-Packard Española S.A.
Crta. de la Coruña, Km. 16, 400
Las Rozas
E-MADRID
Tel: (1) 637.00.11
Telex: 23515 HPE
CH,CS,M

Hewlett-Packard Española S.A.
Avda. S. Francisco Javier, S/no
Planta 10. Edificio Sevilla 2,
E-SEVILLA 5
Tel: 64.44.54
Telex: 72933
A,CS,M,P

Hewlett-Packard Española S.A.
C/Isabel La Catolica, 8
E-46004 VALENCIA
Tel: 0034/6/351 59 44
CH,P

SWEDEN

Hewlett-Packard Sverige AB
Sunnanvagen 14K
S-22226 **LUND**
Tel: (046) 13-69-79
Telex: (854) 17886 (via Spånga office)
CH

Hewlett-Packard Sverige AB
Östra Tullgatan 3
S-21128 **MALMÖ**
Tel: (040) 70270
Telex: (854) 17886 (via Spånga office)

Hewlett-Packard Sverige AB
Västra Vintergatan 9
S-70344 **ÖREBRO**
Tel: (19) 10-48-80
Telex: (854) 17886 (via Spånga office)
CH

Hewlett-Packard Sverige AB
Skalholtsgatan 9, Kista
Box 19
S-16393 **SPÅNGA**
Tel: (08) 750-2000
Telex: (854) 17886
Telefax: (08) 7527781
A,CH,CM,CS,E,M,P

Hewlett-Packard Sverige AB
Frötallisgatan 30
S-42132 **VÄSTRA-FRÖLUNDA**
Tel: (031) 49-09-50
Telex: (854) 17886 (via Spånga office)
CH,E,P

SWITZERLAND

Hewlett-Packard (Schweiz) AG
Clarastrasse 12
CH-4058 **BASEL**
Tel: (61) 33-59-20
A

Hewlett-Packard (Schweiz) AG
7, rue du Bois-du-Lan
Case Postale 365
CH-1217 **MEYRIN** 2
Tel: (0041) 22-83-11-11
Telex:27333 HPAG CH
CH,CM,CS

Hewlett-Packard (Schweiz) AG
Allmend 2
CH-8967 **WIDEN**
Tel: (0041) 57 31 21 11
Telex: 53933 hpag ch
Cable: HPAG CH
A,CH,CM,CS,E,M,P

SYRIA

General Electronic Inc.
Nuri Basha Ahnaf Ebn Kays Street
P.O. Box 5781
DAMASCUS
Tel: 33-24-87
Telex: 411 215
Cable: ELECTROBOR DAMASCUS
E

Middle East Electronics
P.O.Box 2308
Abu Rumnaneh
DAMASCUS
Tel: 33 45 92
Telex: 411 304
M

TAIWAN

Hewlett-Packard Taiwan
Kaohsiung Office
11/F 456, Chung Hsiao 1st Road
KAOHSIUNG
Tel: (07) 2412318
CH,CS,E

Hewlett-Packard Taiwan
8th Floor Hewlett-Packard Building
337 Fu Hsing North Road
TAIPEI
Tel: (02) 712-0404
Telex: 24439 HEWPACK
Cable:HEWPACK Taipei
A,CH,CM,CS,E,M,P

Ing Lih Trading Co.
3rd Floor, 7 Jen-Ai Road, Sec. 2
TAIPEI 100
Tel: (02) 3948191
Cable: INGLIH TAIPEI
A

THAILAND

Unimesa
30 Patpong Ave., Suriwong
BANGKOK *5*
Tel: 235-5727
Telex: 84439 Simonco TH
Cable: UNIMESA Bangkok
A,CH,CS,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

TOGO

Societe Africaine De
Promotion
B.P. 12271
LOME
Tel: 21-62-88
Telex: 5304
P

TRINIDAD & TOBAGO

Caribbean Telecoms Ltd.
Corner McAllister Street &
Eastern Main Road, Laventille
P.O. Box 732
PORT-OF-SPAIN
Tel: 624-4213
Telex: 22561 CARTEL WG
Cable: CARTEL, PORT OF SPAIN
CM,E,M,P

Computer and Controls Ltd.
P.O. Box 51
66 Independence Square
PORT-OF-SPAIN
Tel: 623-4472
Telex: 3000 POSTLX WG
P

TUNISIA

Tunisie Electronique
31 Avenue de la Liberte
TUNIS
Tel: 280-144
CH,CS,E,P

Corema
1 ter. Av. de Carthage
TUNIS
Tel: 253-821
Telex: 12319 CABAM TN
M

TURKEY

E.M.A
Mediha Eldem Sokak No. 41/6
Yenisehir
ANKARA
Tel: 319175
Telex: 42321 KTX TR
Cable: EMATRADE ANKARA
M

Kurt & Kurt A.S.
Mithatpasa Caddesi No. 75
Kat 4 Kizilay
ANKARA
Tel: 318875/6/7/8
Telex: 42490 MESR TR
A

Saniva Bilgisayar Sistemleri A.S.
Buyukdere Caddesi 103/6
Gayrettepe
ISTANBUL
Tel: 1673180
Telex: 26345 SANI TR
C,P

Teknim Company Ltd.
Iran Caddesi No. 7
Kavaklidere
ANKARA
Tel: 275800
Telex: 42155 TKNM TR
E,CM

UNITED ARAB EMIRATES

Emitac Ltd.
P.O. Box 1641
SHARJAH,
Tel: 591181
Telex: 68136 EMITAC EM
Cable: EMITAC SHARJAH
E,C,M,P,A

Emitac Ltd.
P.O. Box 2711
ABU DHABI,
Tel: 820419-20
Cable: EMITACH ABUDHABI

Emitac Ltd.
P.O. Box 8391
DUBAI,
Tel: 377951

Emitac Ltd.
P.O. Box 473
RAS AL KHAIMAH,
Tel: 28133, 21270

UNITED KINGDOM

GREAT BRITAIN

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

Hewlett-Packard Ltd.
Miller House
The Ring, **BRACKNELL**
Berks RG12 1XN
Tel: 44344 424898
Telex: 848733
E

Hewlett-Packard Ltd.
Elstree House, Elstree Way
BOREHAMWOOD, Herts WD6 1SG
Tel: 01 207 5000
Telex: 8952716
E,CH,CS,P

Hewlett-Packard Ltd.
Oakfield House, Oakfield Grove
Clifton **BRISTOL,** Avon BS8 2BN
Tel: 0272 736806
Telex: 444302
CH,CS,E,P

SAFETY CONSIDERATIONS

GENERAL

This product and related documentation must be reviewed for familiarization with safety markings and instructions before operation.

This product is a Safety Class I instrument (provided with a protective earth terminal).

BEFORE APPLYING POWER

Verify that the product is set to match the available line voltage and the correct fuse is installed.

SAFETY EARTH GROUND

An uninterruptible safety earth ground must be provided from the main power source to the product input wiring terminals, power cord, or supplied power cord set.

SAFETY SYMBOLS

Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual (see Table of contents for page references).

Indicates hazardous voltages.

Indicates earth (ground) terminal.

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

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

WARNINGS

Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnecting the protective earth terminal will cause a potential shock hazard that could result in personal injury. (Grounding one conductor of a two conductor outlet is not sufficient protection).

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

If this instrument is to be energized via an autotransformer (for voltage reduction) make sure the common terminal is connected to the earth terminal of the power source.

Servicing instructions are for use by service-trained personnel only. To avoid dangerous electric shock, do not perform any servicing unless qualified to do so.

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

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

For continued protection against fire hazard, replace the line fuse(s) only with 250V fuse(s) of the same current rating and type (for example, normal blow, time delay, etc.). Do not use repaired fuses or short circuited fuseholders.

6 SALES & SUPPORT OFFICES
Arranged alphabetically by country

NEW ZEALAND
Hewlett-Packard (N.Z.) Ltd.
5 Owens Road
P.O. Box 26-189
Epsom, **AUCKLAND**
Tel: 687-159
Cable: HEWPAK Auckland
CH,CS,CM,E,P*

Hewlett-Packard (N.Z.) Ltd.
4-12 Cruickshank Street
Kilbirnie, **WELLINGTON 3**
P.O. Box 9443
Courtenay Place, **WELLINGTON 3**
Tel: 877-199
Cable: HEWPACK Wellington
CH,CS,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: 488-873
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
See United Kingdom

NORWAY
Hewlett-Packard Norge A/S
Folke Bernadottes vei 50
P.O. Box 3558
N-5033 **FYLLINGSDALEN** (Bergen)
Tel: 0047/5/16 55 40
Telex: 16621 hpnas n
CH,CS,E,M

Hewlett-Packard Norge A/S
UCOsterndalen 16-18
P.O. Box 34
N-1345 **OCUSTERÅS**
Tel: 0047/2/17 11 80
Telex: 16621 hpnas n
A,CH,CM,CS,E,M,P

OMAN
Khimjil Ramdas
P.O. Box 19
MUSCAT
Tel: 722225, 745601
Telex: 3289 BROKER MB MUSCAT
P

Suhail & Saud Bahwan
P.O.Box 169
MUSCAT
Tel: 734 201-3
Telex: 3274 BAHWAN MB
E

Imtac LLC
P.O. Box 8676
MUTRAH
Tel: 601695
Telex: 5741 Tawoos On
A,C,M

PAKISTAN
Mushko & Company Ltd.
House No. 16, Street No. 16
Sector F-6/3
ISLAMABAD
Tel: 824545
Cable: FEMUS Islamabad
*A,E,M,P**

Mushko & Company Ltd.
Oosman Chambers
Abdullah Haroon Road
KARACHI *0302*
Tel: 524131, 524132
Telex: 2894 MUSKO PK
Cable: COOPERATOR Karachi
*A,E,M,P**

PANAMA
ElectrOnico Balboa, S.A.
Calle Samuel Lewis, Ed. Alfa
Apartado 4929
PANAMA *5*
Tel: 63-6613, 63-6748
Telex: 3483 ELECTRON PG
A,CM,E,M,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
CM,E,M,P

SAMS
Rio De La Plata 305
SAN ISIDRO
Tel: 419928
Telex: 394 20450 PELIBERTAD
P

PHILIPPINES
The Online Advanced Systems Corporation
Rico House, Amorsolo Cor. Herrera Street
Legaspi Village, Makati
P.O. Box 1510
Metro **MANILA**
Tel: 815-38-11 (up to 16)
Telex: 63274 Online PN
A,CH,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

PORTUGAL
Mundinter
Intercambio Mundial de ComAErcio S.A.R.L.
P.O. Box 2761
Av. Antonio Augusto de Aguiar 138
*P-***LISBON**
Tel: (19) 53-21-31, 53-21-37
Telex: 16691 munter p
M

Soquimica
Av. da Liberdade, 220-2
1298 **LISBOA** *Codex*
Tel: 56 21 81/2/3
Telex: 13316 SABASA
P

Telectra-Empresa Técnica de Equipmentos Eléctricos S.A.R.L.
Rua Rodrigo da Fonseca 103
P.O. Box 2531
*P-***LISBON** *1*
Tel: (19) 68-60-72
Telex: 12598
CM,E

Rarcentro Ltda
R. Costa Cabral 575
4200 **PORTO**
Tel: 499174/495173
Telex: 26054
CH,CS

PUERTO RICO
Hewlett-Packard Puerto Rico
101 MuANoz Rivera Av
Esu. Calle Ochoa
HATO REY, Puerto Rico 00918
Tel: (809) 754-7800
A,CH,CS,CM,M,E,P

QATAR
Computer Arabia
P.O. Box 2750
DOHA
Tel: 883555
Telex: 4806 CHPARB
P

Nasser Trading & Contracting
P.O.Box 1563
DOHA
Tel: 422170
Telex: 4439 NASSER DH
M

SAUDI ARABIA
Modern Electronic Establishment
Hewlett-Packard Division
P.O. Box 281
Thuobah
AL-KHOBAR
Tel: 895-1760, 895-1764
Telex: 671 106 HPMEEK SJ
Cable: ELECTA AL-KHOBAR
CH,CS,E,M

Modern Electronic Establishment
Hewlett-Packard Division
P.O. Box 1228
Redec Plaza, 6th Floor
JEDDAH
Tel: 644 38 48
Telex: 4027 12 FARNAS SJ
Cable: ELECTA JEDDAH
A,CH,CS,CM,E,M,P

Modern Electronic Establishment
Hewlett-Packard Division
P.O.Box 22015
RIYADH
Tel: 491-97 15, 491-63 87
Telex: 202049 MEERYD SJ
CH,CS,E,M

Abdul Ghani El Ajou
P.O. Box 78
RIYADH
Tel: 40 41 717
Telex: 200 932 EL AJOU
P

SCOTLAND
See United Kingdom

SINGAPORE
Hewlett-Packard Singapore (Sales) Pte. Ltd.
#08-00 Inchcape House
450-2 Alexandra Road
P.O. Box 58 Alexandra Rd. Post Office
SINGAPORE, 9115
Tel: 631788
Telex: HPSGSO RS 34209
Cable: HEWPACK, Singapore
A,CH,CS,E,MS,P

Dynamar International Ltd.
Unit 05-11Block 6
Kolam Ayer Industrial Estate
SINGAPORE *1334*
Tel: 747-6188
Telex: RS 26283
CM

SOUTH AFRICA
Hewlett-Packard So Africa (Pty.) Ltd.
P.O. Box 120
Howard Place **CAPE PROVINCE** 7450
Pine Park Center, Forest Drive, Pinelands
CAPE PROVINCE 7405
Tel: 53-7954
Telex: 57-20006
A,CH,CM,E,M,P

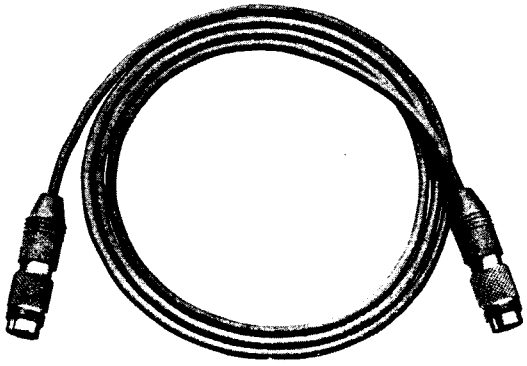
Hewlett-Packard So Africa (Pty.) Ltd.
P.O. Box 37099
Overport Drive 92
DURBAN 4067
Tel: 28-4178
Telex: 6-22954
CH,CM

Hewlett-Packard So Africa (Pty.) Ltd.
6 Linton Arcade
511 Cape Road
Linton Grange
PORT ELIZABETH 600¹
Tel: 041-301201
CH

Hewlett-Packard So Africa (Pty.) Ltd.
Fountain Center
Kalkden Str.
Monument Park
Ext 2
PRETORIA 0105
Tel: 45-5723
Telex: 32163
CH,E

MODEL 435A

POWER SENSOR CABLE



POWER CABLE

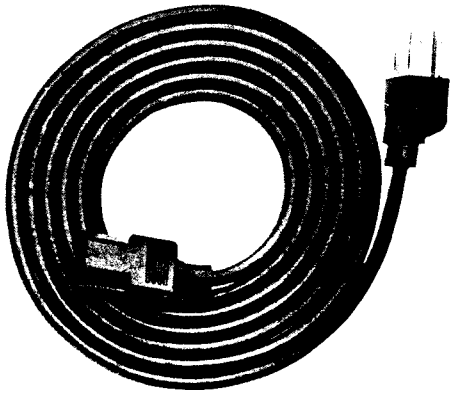


Figure 1-1. HP Model 435A and Accessories Supplied

ITALY (Cont'd)

Hewlett-Packard Italiana S.p.A.
Via di Casellina 57/C
I-50018 **SCANDICCI-FIRENZE**
Tel: (055) 753863
CH,E,M

Hewlett-Packard Italiana S.p.A.
Corso Svizzera, 185
I-10144 **TORINO**
Tel: (011) 74 4044
Telex: 221079
A*,CS,CH,E

JAPAN

Yokogawa-Hewlett-Packard Ltd.
152-1, Onna
ATSUGI, Kanagawa, 243
Tel: (0462) 28-0451
CM,C*,E

Yokogawa-Hewlett-Packard Ltd.
Meiji-Seimei Bldg. 6F
3-1 Hon Chiba-Cho
CHIBA, 280
Tel: 472 25 7701
E,CH,CS

Yokogawa-Hewlett-Packard Ltd.
Yasuda-Seimei Hiroshima Bldg.
6-11, Hon-dori, Naka-ku
HIROSHIMA, 730
Tel: 82-241-0611

Yokogawa-Hewlett-Packard Ltd.
Towa Building
2-3, Kaigan-dori, 2 Chome Chuo-ku
KOBE, 650
Tel: (078) 392-4791
C,E

Yokogawa-Hewlett-Packard Ltd.
Kumagaya Asahi 82 Bldg
3-4 Tsukuba
KUMAGAYA, Saitama 360
Tel: (0485) 24-6563
CH,CM,E

Yokogawa-Hewlett-Packard Ltd.
Asahi Shinbun Daiichi Seimei Bldg.
4-7, Hanabata-cho
KUMAMOTO, 860
Tel: (0963) 54-7311
CH,E

Yokogawa-Hewlett-Packard Ltd.
Shin-Kyoto Center Bldg.
614, Higashi-Shiokoji-cho
Karasuma-Nishiiru
Shiokoji-dori, Shimogyo-ku
KYOTO, 600
Tel: 075-343-0921
CH,E

Yokogawa-Hewlett-Packard Ltd.
Mito Mitsui Bldg
4-73, Sanno-maru, 1 Chome
MITO, Ibaraki 310
Tel: (0292) 25-7470
CH,CM,E

Yokogawa-Hewlett-Packard Ltd.
Meiji-Seimei Kokubun Bldg. 7-8
Kokubun, 1 Chome, Sendai
MIYAGI, 980
Tel: (0222) 25-1011
Telex:
C,E

Yokogawa-Hewlett-Packard Ltd.
Sumitomo Seimei 14-9 Bldg.
Meieki-Minami, 2 Chome
Nakamura-ku
NAGOYA, 450
Tel: (052) 571-5171
CH,CM,CS,E,M

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

Yokogawa-Hewlett-Packard Ltd.
27-15, Yabe, 1 Chome
SAGAMIHARA Kanagawa, 229
Tel: 0427 59-1311

Yokogawa-Hewlett-Packard Ltd.
Daiichi Seimei Bldg.
7-1, Nishi Shinjuku, 2 Chome
Shinjuku-ku,**TOKYO** 160
Tel: 03-348-4611
CH,E

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

Yokogawa-Hewlett-Packard Ltd.
Daiichi Asano Building
2-8, Odori, 5 Chome
UTSUNOMIYA, Tochigi 320
Tel: (0286) 25-7155
CH,CS,E

Yokogawa-Hewlett-Packard Ltd.
Yasuda Seimei Nishiguchi Bldg.
30-4 Tsuruya-cho, 3 Chome
YOKOHAMA 221
Tel: (045) 312-1252
CH,CM,E

JORDAN

Scientific and Medical Supplies Co.
P.O. Box 1387
AMMAN
Tel: 24907, 39907
Telex: 21456 SABCO JO
CH,E,M,P

KENYA

ADCOM Ltd., Inc., Kenya
P.O.Box 30070
NAIROBI
Tel: 331955
Telex: 22639
E,M

KOREA

Samsung Hewlett-Packard Co. Ltd.
12 Fl. Kinam Bldg.
San 75-31, Yeoksam-Dong
Kangnam-Ku
Yeongdong P.O. Box 72
SEOUL
Tel: 555-7555, 555-5447
Telex: K27364 SAMSAN
A,CH,CM,CS,E,M,P

KUWAIT

Al-Khaldiya Trading & Contracting
P.O. Box 830
SAFAT
Tel: 424910, 411726
Telex: 22481 AREEG KT
Cable: VISCOUNT
E,M,A

Photo & Cine Equipment
P.O. Box 270
SAFAT
Tel: 2445111
Telex: 22247 MATIN KT
Cable: MATIN KUWAIT
P

W.J. Towell Computer Services
P.O. Box 75
SAFAT
Tel: 2462640/1
Telex: 30336 TOWELL KT
C

LEBANON

Computer Information Systems
P.O. Box 11-6274
BEIRUT
Tel: 89 40 73
Telex: 42309
C,E,M,P

LUXEMBOURG

Hewlett-Packard Belgium S.A./N.V.
Blvd de la Woluwe, 100
Woluwedal
B-1200 **BRUSSELS**
Tel: (02) 762-32-00
Telex: 23-494 paloben bru
A,CH,CM,CS,E,M,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
P.O.Box 1917
Lot 6624, Section 64
23/4 Pending Road
Kuching, **SARAWAK**
Tel: 36299
Telex: MA 70904 PROMAL
Cable: PROTELENG
A,E,M

MALTA

Philip Toledo Ltd.
Notabile Rd.
MRIEHEL
Tel: 447 47, 455 66
Telex: Media MW 649
E,P,M

MEXICO

Hewlett-Packard Mexicana, S.A.
de C.V.
Av. Periferico Sur No. 6501
Tepepan, Xochimilco
16020 **MEXICO D.F.**
Tel: 6-76-46-00
Telex: 17-74-507 HEWPACK MEX
A,CH,CS,E,M,P

Hewlett-Packard Mexicana, S.A.
de C.V.
Czda. del Valle
409 Ote. 1 °Piso
Colonia del Valle
Municipio de Garza Garcia
66220 **MONTERREY,** Nuevo LeAOn
Tel: 78 42 41
Telex: 038 410
CH

Equipos Cientificos de Occidente, S.A.
Av. Lazaro Cardenas 3540
GUADALAJARA
Tel: 21-66-91
Telex: 0684186 ECOME
A

Infograficas y Sistemas del Noreste, S.A.
Rio Orinoco #171 Oriente
Despacho 2001
Colonia Del Valle
MONTERREY
Tel: 782499, 781259A
A

MOROCCO

Dolbeau
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

Sema-Maroc
Rue Lapebie
CASABLANCA
Tel: 26.09.80
CH,CS,P

NETHERLANDS

Hewlett-Packard Nederland B.V.
Van Heuven Goedhartlaan 121
NL 1181KK **AMSTELVEEN**
P.O. Box 667
NL1180 AR **AMSTELVEEN**
Tel: (020) 47-20-21
Telex: 13 216 HEPA NL
A,CH,CM,CS,E,M,P

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

Hewlett-Packard Nederland B.V.
Pastoor Petersstraat 134-136
NL 5612 LV **EINDHOVEN**
P.O. Box 2342
NL 5600 CH **EINDHOVEN**
Tel: (040) 326911
Telex: 51484 hepae nl
A,CH**,E,M

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION

This manual provides information pertaining to the installation, operation, testing, adjustment and maintenance of the HP Model 435A Power Meter.

Figure 1-1 shows the Power Meter with accessories supplied.

An operating manual is shipped with the instrument. This is simply a copy of the first three sections of this manual. The operating manual should be kept with the instrument for use by the operator. Additional copies of the operating manual may be ordered separately through your nearest Hewlett-Packard office. The part number is listed on the title page of this manual.

On the title page of this manual, below the manual part number, is a "Microfiche" part number. This number may be used to order 100 x 150 mm (4x6-inch) microfilm transparencies of the manaul. The microfiche package also includes the latest Manual Changes supplement as well as all pertinent Service Notes.

Instrument specifications are listed in Table 1-1. These specifications are the performance standards or limits against which the instrument may be tested.

1-2. INSTRUMENTS COVERED BY MANUAL

Options 001, 002, 003, 009, 010, 011, 012 and 013 of the Power Meter are documented in this manual. The differences are noted in the appropriate location such as OPTIONS in Section I, the Replaceable Parts List, and the schematic diagrams.

This instrument has a two-part serial number. The first four digits and the letter comprise the serial number prefix. The last five digits form the sequential suffix that is unique to each instrument. The contents of this manual apply directly to instruments having the same serial number prefix(es) as listed under SERIAL NUMBERS on the title page.

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

In addition to change information, the supplement may contain information for correcting errors in the manual. To keep this manual as current and accurate as possible, Hewlett-Packard recommends that you periodically request the latest Manual Changes supplement. The supplement for this manual is keyed to the manual's print date and part number, both of which appear on the title page. Complimentary copies of the supplement are available from Hewlett-Packard.

For information concerning a serial number prefix not listed on the title page or in the Manual Changes supplement, contact your nearest Hewlett-Packard office.

1-3. DESCRIPTION

The Power Meter and a compatible power sensor are interconnected with the power sensor cable to form a power measurement system. The system power level range, frequency response, and load impedance are dependent on the power sensor.

Accuracy of the power measurement system is ensured by the following Power Meter characteristics:

a. An internal automatic zeroing circuit which removes error due to the ambient temperature output of the power sensor's power sensing device.

b. A calibration factor adjustment which accounts for error due to the frequency response of the power sensing device.

c. An internal calibration reference which has an output of 1 mW ± 0.7% (50Ω).

SALES & SUPPORT OFFICES
Arranged alphabetically by country

GREECE
Hewlett-Packard A.E.
178, Kifissias Avenue
6th Floor
Halandri-**ATHENS**
Greece
Tel: 6471673, 6471543, 6472971
A,CH,CM**,CS**,E,M,P

Kostas Karaynnis S.A.
8 Omirou Street
***ATHENS** 133*
Tel: 32 30 303, 32 37 371
Telex: 215962 RKAR GR
A,CH,CM,CS,E,M,P

PLAISIO S.A.
Eliopoulos Brohers Ltd.
11854
ATHENS
Tel: 34-51-911
Telex: 216286
P

GUATEMALA
IPESA
Avenida Reforma 3-48, Zona 9
GUATEMALA CITY
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 HX
Cable: HEWPACK HONG KONG
E,CH,CS,P

CET Ltd.
10th Floor, Hua Asia
Bldg. Gloucester
64-66 Gloulester Road
HONG KONG
Tel: (5) 200922
Telex: 85148 CET HX
CM

Schmidt & Co. (Hong Kong) Ltd.
18th Floor, Great Eagle Centre
23 Harbour Road, Wanchai
HONG KONG
Tel: 5-8330222
Telex: 74766 SCHMC HX
A,M

ICELAND
Elding Trading Company Inc.
Hafnarnvoli-Tryggvagotu
P.O. Box 895
*IS-***REYKJAVIK**
Tel: 1-58-20, 1-63-03
M

INDIA
Computer products are sold through Blue Star Ltd.All computer repairs and maintenance service is done through Computer Maintenance Corp.

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: 011-71193
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 *600 034*
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 Bolarum 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

Computer Maintenance Corporation Ltd.
115, Sarojini Devi Road
SECUNDERABAD *500 003*
Tel: 310-184, 345-774
Telex: 031-2960
*CH***

INDONESIA
BERCA Indonesia P.T.
P.O.Box 496/Jkt.
Jl. Abdul Muis 62
JAKARTA
Tel: 21-373009
Telex: 46748 BERSAL IA
Cable: BERSAL JAKARTA
P

BERCA Indonesia P.T.
P.O.Box 2497/Jkt
Antara Bldg., 17th Floor
Jl. Medan Merdeka Selatan 17
JAKARTA-PUSAT
Tel: 21-344-181
Telex: BERSAL IA
A,CS,E,M

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

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

IRELAND
Hewlett-Packard Ireland Ltd.
82/83 Lower Leeson Street
DUBLIN 2
Tel: 0001 608800
Telex: 30439
A,CH,CM,CS,E,M,P

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

ISRAEL
Eldan Electronic Instrument Ltd.
P.O.Box 1270
JERUSALEM *91000*
16, Ohaliav St.
JERUSALEM *94467*
Tel: 533 221, 553 242
Telex: 25231 AB/PAKRD IL
A,M

Computation and Measurement
Systems (CMS) Ltd.
11 Masad Street
67060
TEL-AVIV
Tel: 388 388
Telex: 33569 Motil IL
CH,CM,CS,E,P

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

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

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

Hewlett-Packard Italiana S.p.A.
Via G. Di Vittorio 9
I-20063 **CERNUSCO SUL NAVIGLIO**
(Milano)
Tel: (02) 923691
Telex: 334632
A,CH,CM,CS,E,M,P

Hewlett-Packard Italiana S.p.A.
Via C. Colombo 49
I-20090 **TREZZANO SUL NAVIGLIO**
(Milano)
Tel: (02) 4459041
Telex: 322116
CH,CS

Hewlett-Packard Italiana S.p.A.
Via Nuova San Rocco a
Capodimonte, 62/A
I-80131 **NAPOLI**
Tel: (081) 7413544
Telex: 710698
A**,CH,CS,E,M

Hewlett-Packard Italiana S.p.A.
Viale G. Modugno 33
I-16156 **GENOVA PEGLI**
Tel: (010) 68-37-07
Telex: 215238
E,C

Hewlett-Packard Italiana S.p.A.
Via Pelizzo 15
I-35128 **PADOVA**
Tel: (049) 664888
Telex: 430315
A,CH,CS,E,M

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

Table 1-1. Specifications

SPECIFICATIONS

Frequency Range:
100 kHz to 26.5 GHz (depending on power sensor used).

Power Range:
(Meter calibrated in watts and dBm.)
With 8481B or 8482B sensors: 44 dB with 9 full scale ranges of 5, 10, 15, 20, 25, 30, 35, 40 and 45 dBm (1 mW to 25W).
With 8481H or 8482H sensors: 45 dB with 9 full scale ranges of −5, 0, 5, 10, 15, 20, 25, 30 and 35 dBm (30 μW to 3W).
With 8481A, 8482A, 8483A or 8485A sensors: 50 dB with 10 full scale ranges of −25, −20, −15, −10, −5, 0, 5, 10, 15 and 20 dBm (3 μW to 100 mW).
With 8484A sensor: 50 dB with 10 full scale ranges of -65, −60, −55, −50, −45, −40, −35, −30, −25 and −20 dBm (300 pW to 10 μW).

Accuracy:
Instrumentation:[1] ±1% of full scale on all ranges.
Zero: Automatic, operated by front-panel switch.
Zero Set: ±0.5% of full scale on most sensitive range, typical.
Zero Carryover: ±0.5% of full scale when zeroed on the most sensitive range.
Noise (typical, at constant temperature, peak change over any one-minute interval): 20 pW (8484A); 40 nW (8481A, 8482A, 8483A, 8485A); 4 μW (8481H, 8482H); 40 μW (8481B, 8482B).
Drift (1 hour, typical), at constant temperature after 24-hour warm-up); 40 pW (8484A); 15 nW (8481A, 8482A, 8483A, 8485A); 1.5 μW (8481H, 8482H); 15 μW (8481B, 8482B).
Power Reference: Internal 50 MHz oscillator with Type N Female connector on front panel (or rear panel, Option 003 only).
Power output: 1.00 mW.
Factory set to ±0.7% traceable to the National Bureau of Standards.
Accuracy: ±1.2% worst case (±0.9% rss) for one year (0 to 55°C).

Response Time:
(0 to 99% of reading, five time constants.)

Range 1 (most sensitive)	<10.0 seconds.
Range 2	<3.8 seconds.
Range 3	<1.3 seconds.
Ranges 4—10	<500 milliseconds.

Typical, measured at recorder output.)

Cal Factor:
16-position switch normalizes meter reading to account for calibration factor or effective efficiency.
Range 85% to 100% in 1% steps.

Cal Adjustment:
Front panel adjustment provides capability to adjust gain of meter to match power sensor in use.

Recorder Output:
Proportional to indicated power with 1 volt corresponding to full scale; 1 kΩ output impedance; BNC connector.

RF Blanking Output:
Provides a contact closure to ground when autozero mode is engaged.

Power Consumption:
100, 120, 220, or 240V +5%, −10%.
100 and 120 volts, 48 to 66 Hz and 360—440 Hz.
220 and 240 volts, 48 to 66 Hz.
20 V·A maximum.

Weight:
Net, 2.6 kg (5.8 lbs).

Dimensions:
155 mm high (6-3/32 inches).
130 mm wide (5-1/8 inches).
279 mm deep (11 inches).

[1] Includes sensor non-linearity. Add +1.5, −1.0% on top two ranges when using the 8481A, 8482A, 8483A and 8485A power sensors; add ±4.0% on the top two ranges when using the 8481B and 8482B power sensors; add ±5.0% on the top two ranges when using the 8481H and 8482H power sensors.

EGYPT (Cont'd)

INFORMATIC FOR SYSTEMS
22 Talaat Harb Street
CAIRO,
Tel: 759006
Telex: 93697 SAFLM UN
CS

International Engineering Associates
24 Hussein Hegazi Street
Kasr-el-Aini
CAIRO,
Tel: 23829, 21641
Telex: 93830 IEA UN
Cable: INTEGASSO
E

S.S.C. Medical
40 Gezerat El Arab Street
Mohandessin
CAIRO,
Tel: 803844, 805998, 810263
Telex: 20503 SSC UN
*M**

EL SALVADOR

IPESA de El Salvador S.A.
29 Avenida Norte 1216
SAN SALVADOR
Tel: 26-6858, 26-6868
Telex: 20539 IPESASAL
A,CH,CM,CS,E,P

FINLAND

Hewlett-Packard Oy
Piispankalliontie 17
02200 **ESPOO**
Tel: 00358-0-88721
Telex: 121563 HEWPA SF
CH,CM,SS,P

Hewlett-Packard Oy
(Olarinluoma 7)
PL 24
02101 **ESPOO** 10
Tel: (90) 4521022
A,E,M

Hewlett-Packard Oy
Aatoksenkatv 10-C
SF-40720-72 **JYVASKYLA**
Tel: (941) 216318
CH

Hewlett-Packard Oy
Kainvuntie 1-C
SF-90140-14 **OULU**
Tel: (981) 338785
CH

FRANCE

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

Hewlett-Packard France
64, rue Marchand Saillant
F-61000 **ALENCON**
Tel: (33) 29 04 42

Hewlett-Packard France
Boite Postale 503
F-25026 **BESANCON**
28 rue de la Republique
F-25000 **BESANCON**
Tel: (81) 83-16-22
Telex: 361157
CH,M

Hewlett-Packard France
13, Place Napoleon III
F-29000 **BREST**
Tel: (98) 03-38-35

Hewlett-Packard France
Chemin des Mouilles
Boite Postale 162
F-69130 **ECULLY** Cedex (Lyon)
Tel: (78) 833-81-25
Telex: 310617F
A,CH,CS,E,M

Hewlett-Packard France
Parc d'Activite du Bois Briard
.Ave. du Lac
F-91040 **EVRY** Cedex
Tel: 6 077-8383
Telex: 692315F
E

Hewlett-Packard France
5, Avenue Raymond Chanas
F-38320 **EYBENS** (Grenoble)
Tel: (76) 62-67-98
Telex: 980124 HP GRENOB EYBE
CH

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: (1) 865-44-52
Telex: 211032F
CH,CS,E,M

Hewlett-Packard France
Parc d'Activités Cadera
Quartier Jean Mermoz
Avenue du Président JF Kennedy
F-33700 **MERIGNAC** (Bordeaux)
Tel: (56) 34-00-84
Telex: 550105F
CH,E,M

Hewlett-Packard France
Immueble "Les 3 B"
Nouveau Chemin de la Garde
ZAC de Bois Briand
F-44085 **NANTES** Cedex
Tel: (40) 50-32-22
Telex: 711085F
CH**

Hewlett-Packard France
125, rue du Faubourg Bannier
F-45000 **ORLEANS**
Tel: (38) 68 01 63

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

Hewlett-Packard France
Paris Porte-Maillot
15, Avenue de L'Amiral Bruix
F-75782 **PARIS** CEDEX 16
Tel: (1) 502-12-20
Telex: 613663F
CH,M,P

Hewlett-Packard France
124, Boulevard Tourasse
F-64000 **PAU**
Tel: (59) 80 38 02

Hewlett-Packard France
2 AllAEe de la Bourgonnette
F-35100 **RENNES**
Tel: (99) 51-42-44
Telex: 740912F
CH,CM,E,M,P*

Hewlett-Packard France
98 Avenue de Bretagne
F-76100 **ROUEN**
Tel: (35) 63-57-66
Telex: 770035F
CH**,CS

Hewlett-Packard France
4 Rue Thomas Mann
Boite Postale 56
F-67033 **STRASBOURG** Cedex
Tel: (88) 28-56-46
Telex: 890141F
CH,E,M,P*

Hewlett-Packard France
Le PAEripole
20, Chemin du Pigeonnier de la CAEpiGEere
F-31083 **TOULOUSE** Cedex
Tel: (61) 40-11-12
Telex: 531639F
A,CH,CS,E,P*

Hewlett-Packard France
9, rue Baudin
F-26000 **VALENCE**
Tel: (75) 42 76 16

Hewlett-Packard France
Carolor
ZAC de Bois Briand
F-57640 **VIGY** (Metz)
Tel: (8) 771 20 22
CH

Hewlett-Packard France
Immeuble PEricentre
F-59658 **VILLENEUVE D'ASCQ** Cedex
Tel: (20) 91-41-25
Telex: 160124F
CH,E,M,P*

GERMAN FEDERAL REPUBLIC

Hewlett-Packard GmbH
Geschäftsstelle
Keithstrasse 2-4
D-1000 **BERLIN** 30
Tel: (030) 24-90-86
Telex: 018 3405 hpbln d
A,CH,E,M,P

Hewlett-Packard GmbH
Geschäftsstelle
Herrenberger Strasse 130
D-7030 **BÖBLINGEN**
Tel: (7031) 14-0
Telex: 07265739
A,CH,CM,CS,E,M,P

Hewlett-Packard GmbH
Geschäftsstelle
Emanuel-Leutze-Strasse 1
D-4000 **DÜSSELDORF**
Tel: (0211) 5971-1
Telex: 085/86 533 hpdd d
A,CH,CS,E,M,P

Hewlett-Packard GmbH
Geschäftsstelle
Schleefstr. 28a
D-4600 **DORTMUND**-Aplerbeck
Tel: (0231) 45001

Hewlett-Packard GmbH
Vertriebszentrale Frankfurt
Berner Strasse 117
Postfach 560 140
D-6000 **FRANKFURT** 56
Tel: (0611) 50-04-1
Telex: 04 13249 hpffm d
A,CH,CM,CS,E,M,P

Hewlett-Packard GmbH
Geschäftsstelle
Aussenstelle Bad Homburg
Louisenstrasse 115
D-6380 **BAD HOMBURG**
Tel: (06172) 109-0

Hewlett-Packard GmbH
Geschäftsstelle
Kapstadtring 5
D-2000 **HAMBURG** 60
Tel: (040) 63804-1
Telex: 021 63 032 hphh d
A,CH,CS,E,M,P

Hewlett-Packard GmbH
Geschäftsstelle
Heidering 37-39
D-3000 **HANNOVER** 61
Tel: (0511) 5706-0
Telex: 092 3259
A,CH,CM,E,M,P

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

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

Hewlett-Packard GmbH
Geschäftsstelle
Ehhericherstr. 13
D-8500 **NÜRNBERG** 10
Tel: (0911) 5205-0
Telex: 0623 860
CH,CM,E,M,P

Hewlett-Packard GmbH
Geschäftsstelle
Eschenstrasse 5
D-8028 **TAUFKIRCHEN**
Tel: (089) 6117-1
Telex: 0524985
A,CH,CM,E,M,P

GREAT BRITAIN

See United Kingdom

1-4. OPTIONS

1-5. Battery

The Model 435A, Option 001 Power Meter is supplied with a rechargeable battery that provides up to 16 hours continuous operation from a full charge.

If the Power Meter was purchased without the battery option, it may be ordered in kit form under HP part number 00435-60012. The kit includes the battery, the battery clamp, a 6-32 x 1/2-inch pan head machine screw and installation instructions.

1-6. Input-Output Options

Option 002. A rear panel input connector is connected in parallel with the front panel input connector.

Option 003. A rear panel input connector replaces the standard front panel input connector; a rear panel POWER REF OUTPUT connector replaces the standard front panel connector.

1-7. Cable Options

A 1.5 metre (5-foot) power sensor cable is normally supplied. The 1.5 metre cable is omitted with any cable option. The option and cable length are shown in the table.

Option	Cable Length in Metres (Ft.)
009	3.1 (10)
010	6.1 (20)
011	15.2 (50)
012	30.5 (100)
013	61.0 (200)

1-8. ACCESSORIES SUPPLIED

The accessories supplied with the Power Meter are shown in Figure 1-1.

a. The 1.5 metre (5-foot) power sensor cable, HP part number 8120-2263, is used to couple the power sensor to the Power Meter. The 1.5 metre cable is omitted with any cable option.

b. The line power cable may be supplied in several configurations. Refer to the paragraph entitled Power Cables in Section II.

1-9. EQUIPMENT REQUIRED BUT NOT SUPPLIED.

To form a complete RF power measurement system, a power sensor, such as the HP Model 8481A, must be connected to the Power Meter via the power sensor cable.

1-10. EQUIPMENT AVAILABLE

The HP Model 11683A Range Calibrator is recommended for performance testing, adjusting and troubleshooting the Power Meter. The Power Meter's range-to-range accuracy and auto-zero operation can easily be verified with the calibrator. It also has the capability of supplying a full-scale test signal for each range.

An extender board (HP part number 5060-0630) may be used to place the A4 assembly printed circuit board in a position that allows easy access to test points and components.

1-11. RECOMMENDED TEST EQUIPMENT

The test equipment shown in Table 1-2 is recommended for use during performance testing, adjustments and troubleshooting. To ensure optimum performance of the Power Meter, the specifications of a substitute instrument must equal or exceed the critical specifications shown in the table.

1-12. SAFETY CONSIDERATIONS

The Power Meter is a Safety Class I instrument (provided with a protective earth terminal). This instrument has been designed according to international safety standards and has been supplied in safe condition.

2 SALES & SUPPORT OFFICES
Arranged alphabetically by country

BRAZIL (Cont'd)
Hewlett-Packard do Brasil
I.e.C. Ltda.
Avenida Epitacio Pessoa, 4664
22471 **RIO DE JANEIRO-RJ**
Tel: (021) 286.0237
Telex: 021-21905 HPBR-BR
Cable: HEWPACK Rio de Janeiro
A,CH,CM,E,M,P*

Convex/Van Den
Rua Jose Bonifacio
458 Todos Os Santos
CEP 20771
RIO DE JANEIRO, RJ
Tel: 249-7121, 591-4946
Telex: 33487

ANAMED I.C.E.I. Ltda.
Rua Bage, 103
04012 SAO PAULO
Tel: (011) 570-5726
Telex: 021-21905 HPBR-BR
M

CANADA
Alberta
Hewlett-Packard (Canada) Ltd.
3030 3rd Avenue N.E.
CALGARY, Alberta T2A 6T7
Tel: (403) 235-3100
A,CH,CM,E*,M,P*

Hewlett-Packard (Canada) Ltd.
11120-178th Street
EDMONTON, Alberta T5S 1P2
Tel: (403) 486-6666
A,CH,CM,CS,E,M,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*,M,P*

Hewlett-Packard (Canada) Ltd.
121 - 3350 Douglas Street
VICTORIA, British Columbia V8Z 3L1
Tel: (604) 381-6616
CH,CS

Manitoba
Hewlett-Packard (Canada) Ltd.
1825 Inkster Blvd.
WINNIPEG, Manitoba R3H 0Y1
Tel: (204) 786-6701
A,CH,CM,E,M,P*

New Brunswick
Hewlett-Packard (Canada) Ltd.
37 Shediac Road
MONCTON, New Brunswick E1A 2R6
Tel: (506) 855-2841
CH,CS

Nova Scotia
Hewlett-Packard (Canada) Ltd.
Suite 111
900 Windmill Road
DARTMOUTH, Nova Scotia B2Y 3Z6
Tel: (902) 469-7820
CH,CM,CS,E*,M,P*

Ontario
Hewlett-Packard (Canada) Ltd.
3325 N. Service Rd., Unit 6
BURLINGTON, Ontario P3A 2A3
Tel: (416) 335-8644
CS,M*

Hewlett-Packard (Canada) Ltd.
496 Days Road
KINGSTON, Ontario K7M 5R4
Tel: (613) 384-2088
CH,CS

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

Hewlett-Packard (Canada) Ltd.
6877 Goreway Drive
MISSISSAUGA, Ontario L4V 1M8
Tel: (416) 678-9430
A,CH,CM,CS,E,M,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.
1855 Lasalle Boulevard
SUDBURY, Ontario, P3A 2A3
Tel: (705) 560-5450
CH

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
A,CH,CM,CS,E,M,P*

Hewlett-Packard (Canada) Ltd.
1150 Rue Claire Fontaine
QUEBEC CITY, Quebec G1R 5G4
Tel: (418) 648-0726
CH,CS

Hewlett-Packard (Canada) Ltd.
#7-130 Robin Crescent
SASKATOON, Saskatchewan S7L 6M7
Tel: (306) 242-3702
CH,CS

CHILE
ASC Ltda.
Austria 2041
SANTIAGO
Tel: 223-5946, 223-6148
Telex: 340192 ASC CK
P,C

Jorge Calcagni y Cia. Ltda.
Av. Italia 634 Santiago
Casilla 16475
SANTIAGO 9
Tel: 222-0222
Telex: 440283 JCYCL CZ
CM,E,M

Metrolab S.A.
Monjitas 454 of. 206
SANTIAGO
Tel: 395752, 398296
Telex: 340866 METLAB CK
A

Olympia (Chile) Ltda.
Av. Rodrigo de Araya 1045
Casilla 256-V
SANTIAGO 21
Tel: 225-5044
Telex: 340892 OLYMP
Cable: Olympiachile Santiagochile
CH,CS,P

CHINA, People's Republic of
China Hewlett-Packard Co., Ltd.
6th Floor, Sun Hung Kai Centre
30 Harbour Road
HONG KONG
Tel: 5-8323211
Telex: 36678 HEWPA HX
A,C,CH,CS,E,M,P

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
InstrumentaciAOn
H. A. Langebaek & Kier S.A.
Carrera 4A No. 52A-26
Apartado Aereo 6287
BOGOTA 1, D.E.
Tel: 212-1466
Telex: 44400 INST CO
Cable: AARIS Bogota
CM,E,M

Nefromedicas Ltda.
Calle 123 No. 9B-31
Apartado Aereo 100-958
BOGOTA D.E., 10
Tel: 213-5267, 213-1615
Telex: 43415 HEGAS CO
A

Procesa, S.A.
CRA 7 No. 24-89 Piso 25
Torre Colpatria
Apartado Aereo No. 49667
BOGOTA D.E.
Tel: 2344925, 2344958, 2344742
Telex: 43127 COVER CO
C,P

Compumundo
Avenida 15 # 107-80
BOGOTA D.E.
Tel: 214-4458
Telex: 45466 MARICO
P

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

CYPRUS
Telerexa Ltd.
P.O. Box 4809
14C Stassinos Avenue
NICOSIA
Tel: 62698
Telex: 2894 LEVIDO CY
E,M,P

DENMARK
Hewlett-Packard A/S
Datavej 52
DK-3460 **BIRKEROD**
Tel: (02) 81-66-40
Telex: 37409 hpas dk
A,CH,CM,CS,E,M,P

Hewlett-Packard A/S
Rolighedsvej 32
DK-8240 **RISSKOV,** Aarhus
Tel: (06) 17-60-00
Telex: 37409 hpas dk
CH,E

DOMINICAN REPUBLIC
Microprog S.A.
Juan Tomás Mejía y Cotes No. 60
Arroyo Hondo
SANTO DOMINGO
Tel: 565-6268
Telex: 4510 ARENTA DR (RCA)
P

ECUADOR
CYEDE Cia. Ltda.
Avenida Eloy Alfaro 1749
y Belgica
Casilla 6423 CCI
QUITO
Tel: 450-975, 243-052
Telex: 2548 CYEDE ED
CM,E,P

Hospitalar S.A.
Robles 625
Casilla 3590
QUITO
Tel: 545-250, 545-122
Telex: 2485 HOSPTL ED
Cable: HOSPITALAR-Quito
M

QUITO
Tel: 2-238-951
Telex: 2298 ECUAME ED

EGYPT
Egyptian International
Office for Foreign Trade
P.O. Box 2558
42 El-Zahraa Street
Dokki, **CAIRO,**
Tel: 712230
Telex: 93337 EGPOR UN
Cable: EGYPOR
P,A

Table 1-2. Recommended Test Equipment

Instrument Type	Critical Specifications	Suggested Model	Use*
Digital Voltmeter	Function: DC, Resistance Ranges: Resistance: 200 Ω Vdc: 100 mV, 1000 mV, 10V, 100V 10 MΩ input impedance 5 1/2 digit resolution Accuracy: ±0.05% of reading ±0.028% of range	HP 3455A	P, A, T
Frequency Counter	Frequency Range: 200 Hz — 50 MHz Sensitivity: 100 mVrms Accuracy: 0.01%	HP 5314A	A
Oscilloscope	Bandwidth: dc to 50 MHz Vertical sensitivity: 0.2 V/division Horizontal sensitivity: 1 ms/division	HP 1740A	P, A, T
Power Meter	Range: capability to measure 1 mW Transfer Accuracy (input to output): ±0.2%	HP 432A	P, A
Power Sensor	Range: capability to measure 1 mW	HP 8481A/H or HP 8482A/H	P, A
Range Calibrator		HP 11683A	
Thermistor Mount	SWR: 1.05 at 50 MHz Accuracy:** ±0.5% at 50 MHz	HP 478A-H75	P, A

* P = Performance Tests; A = Adjustments; T = Troubleshooting.

** Traceable to NBS.

SALES & SUPPORT OFFICES
Arranged alphabetically by country

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
- **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.

HEADQUARTERS OFFICES

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

AFRICA AND MIDDLE EAST
Hewlett-Packard S.A.
Mediterranean and Middle East Operations
Atrina Centre
32 Kifissias Ave.
Paradissos-Amarousion, **ATHENS**
Greece
Tel: 682 88 11
Telex: 21-6588 HPAT GR
Cable: HEWPACKSA Athens

NORTH/CENTRAL AFRICA
Hewlett-Packard S.A.
7, Rue du Bois-du-Lan
CH-1217 **MEYRIN** 2, Switzerland
Tel: (022) 83 12 12
Telex: 27835 hpse
Cable: HEWPACKSA Geneve

ASIA
Hewlett-Packard Asia Ltd.
47/F, 26 Harbour Rd.,
Wanchai, **HONG KONG**
G.P.O. Box 863, Hong Kong
Tel: 5-8330833
Telex: 76793 HPA HX
Cable: HPASIAL TD

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.
Lieblgasse 1
P.O.Box 72
A-1222 **VIENNA,** Austria
Tel: (222) 2365110
Telex: 1 3 4425 HEPA A

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

SOUTH EAST EUROPE
Hewlett-Packard S.A.
World Trade Center
110 Avenue Louis Carol
1215 Cointrin, **GENEVA,** Switzerland
Tel: (022) 98 96 51
Telex: 27225 hpse.

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.
2000 South Park Place
P.O. Box 105005
ATLANTA, GA 30348
Tel: (404) 955-1500

WESTERN USA
Hewlett-Packard Co.
3939 Lankershim Blvd.
P.O. Box 3919
LOS ANGELES, CA 91604
Tel: (213) 506-3700

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

ANGOLA
Telectra
Empresa TAEcnica de Equipamentos
R. Barbosa Rodrigues, 41-I DT.
Caixa Postal 6487
LUANDA
Tel: 35515,35516
E,P

ARGENTINA
Hewlett-Packard Argentina S.A.
Avenida Santa Fe 2035
Martinez 1640 **BUENOS AIRES**
Tel: 798-5735, 792-1293
Cable: HEWPACKARG
A,E,CH,CS,P

AUSTRALIA

Adelaide, South Australia Office
Hewlett-Packard Australia Ltd.
153 Greenhill Road
PARKSIDE, S.A. 5063
Tel: 272-5911
Telex: 82536
Cable: HEWPARD Adelaide
A*,CH,CM,CS,E,M,P

Brisbane, Queensland Office
Hewlett-Packard Australia Ltd.
10 Payne Road
THE GAP, Queensland 4061
Tel: 30-4133
Telex: 42133
Cable: HEWPARD Brisbane
A,CH,CS,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: HEWPARD Canberra
C,CH,CM,CS,E,P

Melbourne, Victoria Office
Hewlett-Packard Australia Ltd.
31-41 Joseph Street
BLACKBURN, Victoria 3130
Tel: 895-2895
Telex: 31-024
Cable: HEWPARD Melbourne
A,CH,CM,CS,E,M,P

Perth, Western Australia Office
Hewlett-Packard Australia Ltd.
261 Stirling Highway
CLAREMONT, W.A. 6010
Tel: 383-2188
Telex: 93859
Cable: HEWPARD Perth
A,CH,CM,CS,E,M,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: 888-4444
Telex: 21561
Cable: HEWPARD Sydney
A,CH,CM,CS,E,M,P

AUSTRIA
Hewlett-Packard Ges.m.b.h.
Grottenhofstrasse 94
A-8052 **GRAZ**
Tel: (0316) 291 5 66
Telex: 32375
CH,E

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

BAHRAIN
Green Salon
P.O. Box 557
Manama
BAHRAIN
Tel: 255503-255950
Telex: 84419
P

Wael Pharmacy
P.O. Box 648
BAHRAIN
Tel: 256123
Telex: 8550 WAEL BN
E,M

BELGIUM
Hewlett-Packard Belgium S.A./N.V.
Blvd de la Woluwe, 100
Woluwedal
B-1200 **BRUSSELS**
Tel: (02) 762-32-00
Telex: 23-494 paloben bru
A,CH,CM,CS,E,M,P

BERMUDA
Applied Computer Technologies
Atlantic House Building
Par-La-Ville Road
Hamilton 5
Tel: 295-1616
P

BRAZIL
Hewlett-Packard do Brasil
I.e.C. Ltda.
Alameda Rio Negro, 750
Alphaville
06400 **BARUERI SP**
Tel: (011) 421.1311
Telex: (011) 33872 HPBR-BR
Cable: HEWPACK Sao Paulo
A,CH,CM,CS,E,M,P

SECTION II
INSTALLATION

2-1. INTRODUCTION

This section includes information on the initial inspection, preparation for use, and storage and shipment instructions for the Power Meter.

2-2. INITIAL INSPECTION

WARNING

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

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

2-3. PREPARATION FOR USE

2-4. Meter Zeroing

With the LINE switch set to OFF, the meter pointer should be positioned directly over zero. If necessary, insert a screwdriver into the mechanical Meter Zero control (beneath the meter) and align the pointer with zero. Back the adjustment off slightly. The backlash in the control ensures against a meter indication error caused by jarring the instrument.

2-5. Range Switch Scale Selection

The RANGE switch has three scales on 2 removable rings which correspond to the measurement capabilities of compatible power sensors. The range scales are 3W to 0.3 mW (+35 to -5 dBm), 100 mW to 3 μW (+20 to -25 dBm) and 10 μW to 0.3 nW (-20 to -65 dBm). Each scale listed indicates the maximum and minimum full scale meter readings.

To select the correct RANGE switch knob assembly scale (see Figure 2-1):

a. Unscrew the outer (black) knob by turning it counterclockwise. Then, remove the outer knob.

b. Remove the two scale rings.

c. Determine which of the 3 scales is to be used.

d. Place the other scale ring on the knob assembly.

e. Place the selected ring on the knob assembly with the selected scale out.

f. Line up the tabs of the scale rings with the slot in the knob assembly.

g. Hold the scale rings in place with your fingers. Thread the outer knob onto the knob assembly. Lightly tighten the knob.

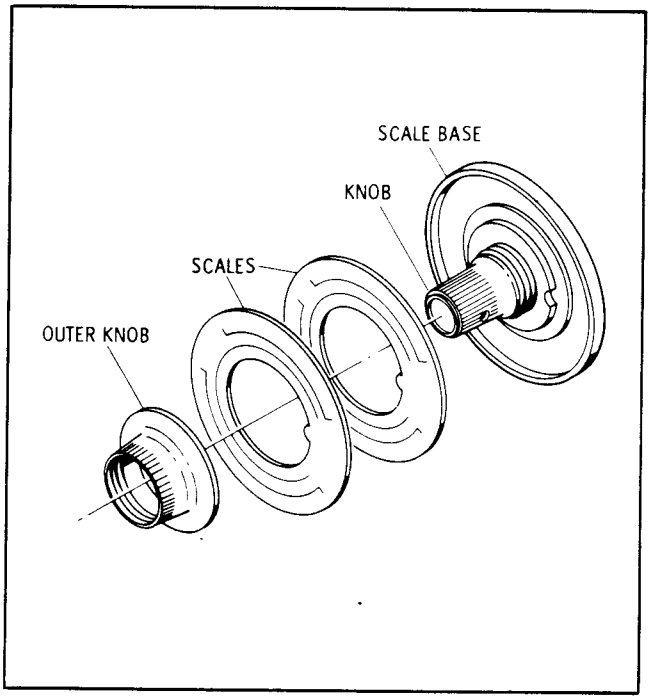


Figure 2-1. Changing Range Switch Scale

ERRATA (Cont'd)

Page 6-4, Table 6-2:

Change A3C6 to 0160-2027, CD5 (same description).
Change A3C7 to 0160-3070, CD0 (same description).
Change A3C11 to 0160-0179, CD4 (same description).

► Page 6-5, Table 6-2:

A4C4, A4C8. The part numbers shown for these two capacitors should have been HP 0160-0164, 0.039 μF (for instruments with prefixes 2030U and below). However, the parts shown in Table 6-2 are the recommended replacements. Therefore, no manual change is suggested.

Page 6-8, Table 6-2:

Under MP2, delete 3050-0699.
► Delete MP4.

► Page 6-10, Table 6-2:

Below W1 place the following parts: 1251-3362 CD7 NUT CONN HEX .
00436-20014 CD0 WASHER MOUNT CONN.
Below W6 place the following parts: 1251-3362 CD7 NUT CONN HEX.
00436-20014 CD0 WASHER MOUNT CONN.

Page 7-1:

Add a second Table 7-1 as follows:

Table 7-1. Manual Changes by Serial Number Prefix

Serial Number Prefix	Manual Change(s)	Serial Number Prefix	Manual Change(s)
1335U, 1321G	L, K, J, I, H, G, F, E, D, C, B	1731U	L, K, J, I(1), G
		1748U, 1734U	L, K, J, I(1)
1528U, 1430U, 1425G	L, K, J, I, H, G, F, E, D, C	1812U	L, K, J, I(1, 2)
1534U	L, K, J, I, H, G, F, E, D	1820U	L, K, J
1541U	L, K, J, I, H, G, F, E	2004U, 1823U	L, K
1551U	L, K, J, I, H, G, F	2030U	L
1626U	L, K, J, I, H, G		

NOTES: 1. Ignore those parts of change I referring to F1.
2. Ignore those parts of change I referring to A4C39 and A4CR13.

Page 7-20, Change H:

Add a note to Change H as follows:

NOTE

The parts shown in Table 6-2 are the recommended replacement parts for all serial numbers, and should be used if replacement is required.

Page 7-21, paragraph 7-5:

Change the paragraph title to: "**Modification of Front Panel** (Serial Prefixes 1629A or 1734U and below)".

2-6. Power Requirements

The Power Meter requires a power source with an output of 100, 120, 220, or 240 Vac +5%, −10% single phase, 100 and 120 volts, 48 to 66 Hz and 360 to 440 Hz, 220 and 240 volts, 48 to 66 Hz. Power consumption is 20 V·A maximum.

WARNING

If this instrument is to be energized via an external autotransformer, make sure the autotransformer common terminal is connected to the earth terminal of the power source.

2-7. Line Voltage Selection

CAUTION

BEFORE SWITCHING ON THIS INSTRUMENT, make sure the instrument is set to the voltage of the power source.

Figure 2-2 provides instructions for line voltage and fuse selection. The line voltage selection card and proper fuse are factory installed for 120 Vac operation.

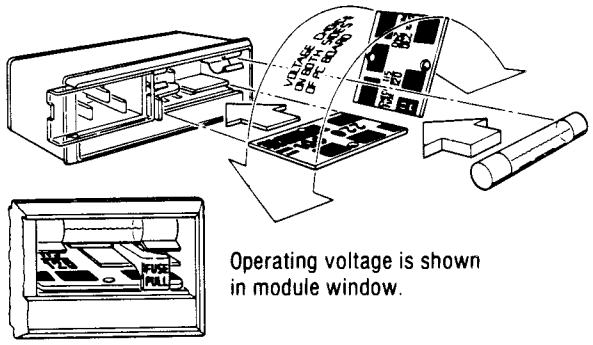
Fuses may be ordered under HP part numbers 2110-0234, 0.1A (250V slow blow) for 100/120 Vac operation and 2110-0040 0.062A (250V slow blow) for 220/240 Vac operation.

2-8. Power Cable

In accordance with international safety standards, this instrument is equipped with a three-wire power cable. When connected to an appropriate ac power receptacle, this cable grounds the instrument cabinet. The type of power cable plug shipped with each instrument depends on the country of destination. Refer to Figure 2-3 for the part numbers of the power cable plugs available.

WARNING

BEFORE SWITCHING ON THIS INSTRUMENT, the protective earth terminals of this instrument must be connected to the protective conductor of the (Mains) power cord. The Mains plug shall only be inserted in a socket outlet provided with a protective earth contact. The protective action must not be negated by the use of an extension cord (power cable) without a protective conductor (grounding).



Operating voltage is shown in module window.

SELECTION OF OPERATING VOLTAGE

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

WARNING

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

Figure 2-2. Line Voltage Selection

2-9. Interconnections

The Power Meter and a power sensor are integral parts of this measurement system. Before measurements can be performed, the Power Meter and sensor must be connected together with the power sensor cable. (The cable is supplied with the Power Meter.)

The power sensor cable couples the dc supply and sampling gate drive from the Power Meter to the power sensor and the 220 Hz ac output signal from the power sensor to the Power Meter.

CAUTION

The maximum voltage which may be safely coupled to the Power Meter input from the power sensor is 18 mVrms.

2-10. Operating Environment

The operating environment should be within the following limitations:

POWER METER

MANUAL IDENTIFICATION
Model Number: 435A
Date Printed: November 1980
Part Number: 00435-90032

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

To use this supplement:

Make all ERRATA corrections

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

Serial Prefix or Number	Make Manual Changes
2101A	Errata Only

Serial Prefix or Number	Make Manual Changes

► NEW ITEM

ERRATA

Title Page:

Under SERIAL NUMBERS, add to the second sentence: 1321G, 1335U, 1425G, 1430U, 1528U, 1534U, 1541U, 1551U, 1626U, 1731U, 1734U, 1748U, 1812U, 1820U, 1823U, 2004U, and 2030U.

Page 1-2, Table 1-1:

In the footnote, change "+1.5, −1.0%" to "+2, −4%".

Pages 3-4, 3-6 and 3-7, Figures 3-2, 3-4 and 3-5:

Change Note 1 (on all three pages) to read: "– – – – prefixes 1527A or 1534U or less – – – – ".

Page 4-6, paragraph 4-7:

In the right RESULTS, Max column, change the last two entries from +1015 to +1010.

Page 4-8, Table 4-1:

Under paragraph 4-7, change the last two entries in the Max Results column from +1015 to +1010.

Page 5-5, paragraph 5-6:

Under MATH ASSUMPTIONS, change two lines as follows:

"Since: $-(V_1-V_0)^2 = -V_1^2 + 2V_1V_0 - V_0^2$, and"

⋮

"the error is: $(-V_1^2 + 2V_1V_0 - V_0^2) - (V_0^2 - V_1^2) = -2V_0^2 + 2V_1V_0 = 2V_0(V_1 - V_0)$".

NOTE

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

25 March 1982
2 Pages

HEWLETT PACKARD

Printed in U.S.A.

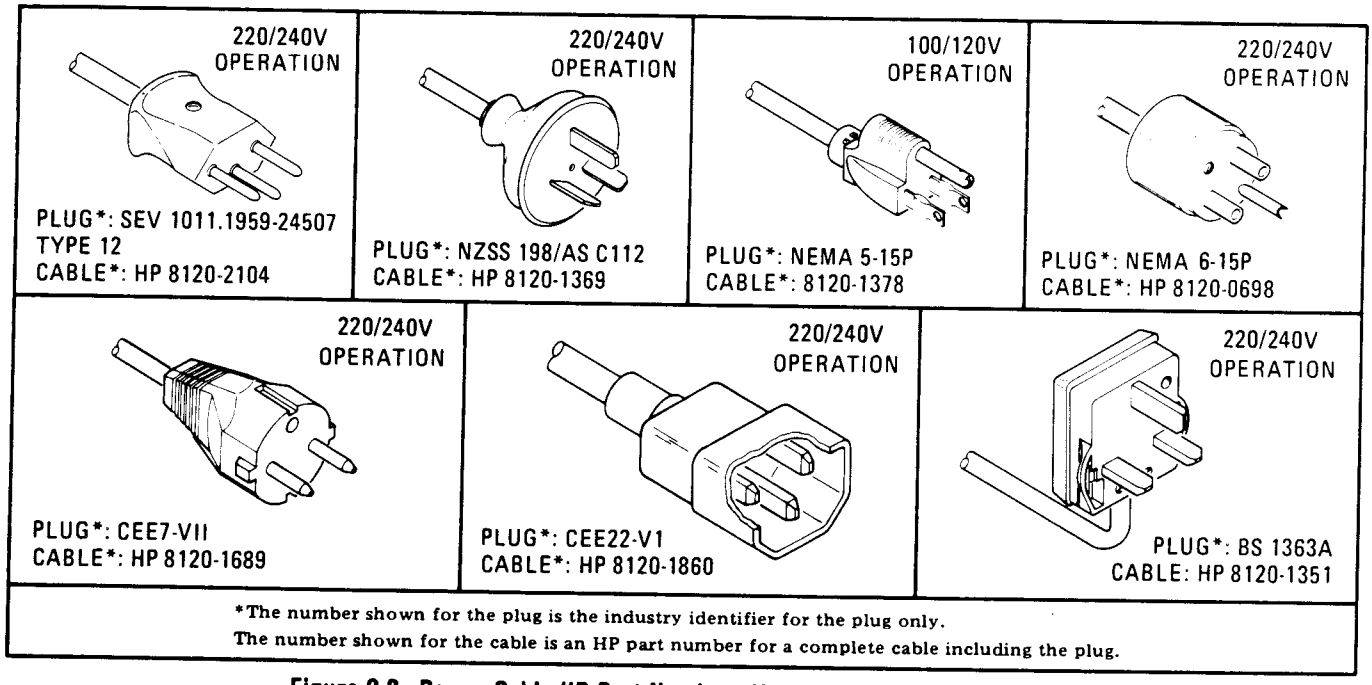


Figure 2-3. Power Cable HP Part Numbers Versus Mains Plugs Available

Operating Environment (cont'd)

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

2-11. Bench Operation

The instrument cabinet has plastic feet and a fold-away tilt stand for convenience in bench operation. (The plastic feet are shaped to ensure self-aligning of the instruments when stacked.) The tilt stand raises the front of the instrument for easier viewing of the control panel.

2-12. Rack Mounting

Instruments that are narrower than full rack-width may be rack-mounted using Hewlett-Packard adapter frames or combining cases.

Adaptor Frames. Hewlett-Packard accessory adaptor frames are an economical means of rack mounting instruments that are narrower than full rack-width. A set of spacer clamps, supplied with each adaptor frame, permits instruments of different dimensions to be combined and rack mounted as a unit. Accessory blank panels are available for filling unused spaces.

Combining Cases. Model 1051A and 1052A Combining Cases are metal enclosures that allow combinations of one-third and one-half rack-width instruments to be assembled for use on a workbench or for mounting in a rack of standard 19-inch spacing. Each case includes a set of partitions for positioning and retaining instruments and a rack mounting kit. No tools are required for installing the partitions. For bench use the cases have the same convenient features as full rack-width instruments, (i.e., fold-away tilt stands and specially designed feet for easier instrument stacking). Accessories available for the combining cases include blank filler panels and snap-on full width control panel covers.

2-13. Battery Operation

To operate the Power Meter on battery power, the battery must be installed and charged, the line power cable must be disconnected, and the LINE switch must be ON.

Battery Installation.

WARNINGS

This task should be performed only by service trained persons who are aware of the potential shock hazard of working on an instrument with protective covers removed.

To avoid hazardous electrical shock, the line (Mains) power cable should be disconnected before attempting to install the battery.

Battery Operation (Cont'd)

WARNINGS (Cont'd)

Do not short the battery terminals. This may result in overheating which can cause burns or increase risk of fire.

Do not incinerate or mutilate the battery. It might burst or release toxic materials causing personal injury.

The battery is installed in the Power Meter as follows (see Figure 2-4):

a. Remove the top cover.

b. Hold the battery above the Power Meter, parallel to printed circuit board A4. The battery terminal lugs must face the circuit board.

c. Loosen the lugs. Move the battery down into place and guide the lugs into the slots on the circuit board. The battery should now rest on the aluminum deck.

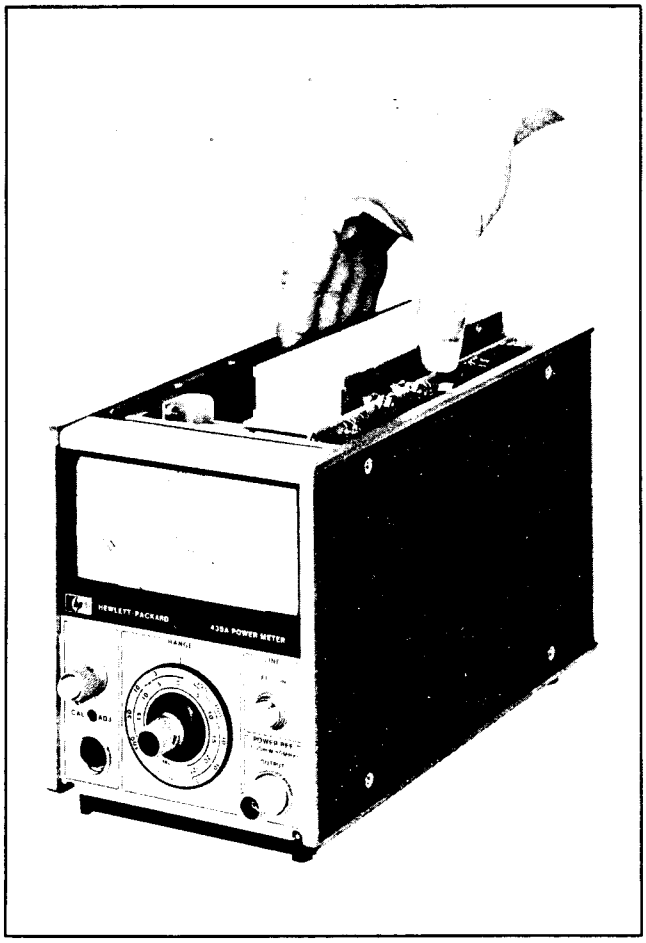


Figure 2-4. Battery Installation

d. Place the battery clamp over the battery and secure it. The two prongs fit into slots on the rear panel and the 6-32 x 1/2-inch pan head machine screw holds the forward end of the clamp in place.

e. Tighten the battery terminal lugs by hand.

Figure 2-5 shows the Power Meter with battery installed.

Battery Charging. The battery is being charged if the battery has been installed, the line power cable is connected to the available line power, and the LINE switch is ON. In the fully charged condition, (24-hour charge time), the battery will supply power for a minimum of 16 hours.

2-14. STORAGE AND SHIPMENT

2-15. Environment

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

Temperature ..... −40 to +75°C
Humidity ..... <95% relative
Altitude ..... <7 630 metres (25 000 feet)

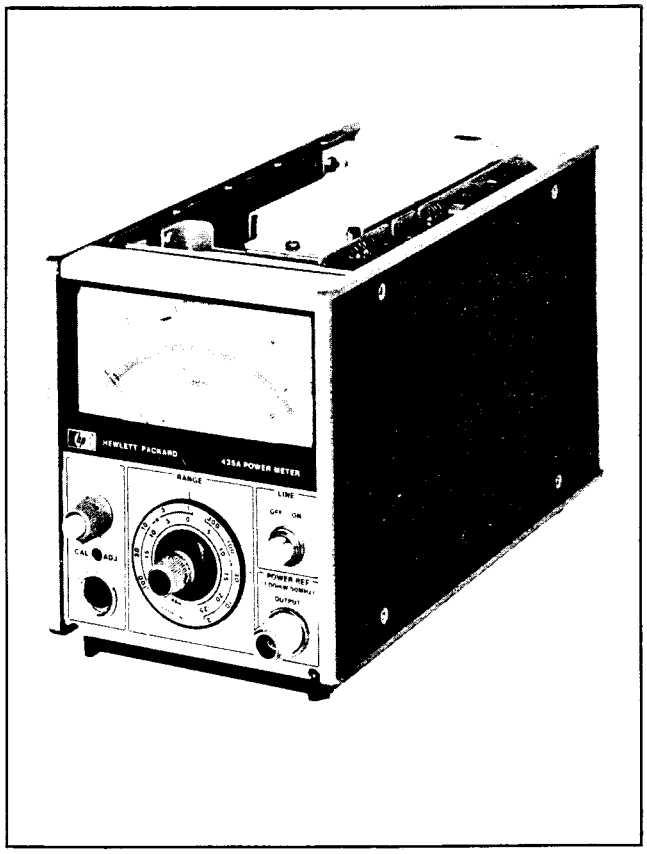


Figure 2-5. Power Meter with Battery Installed

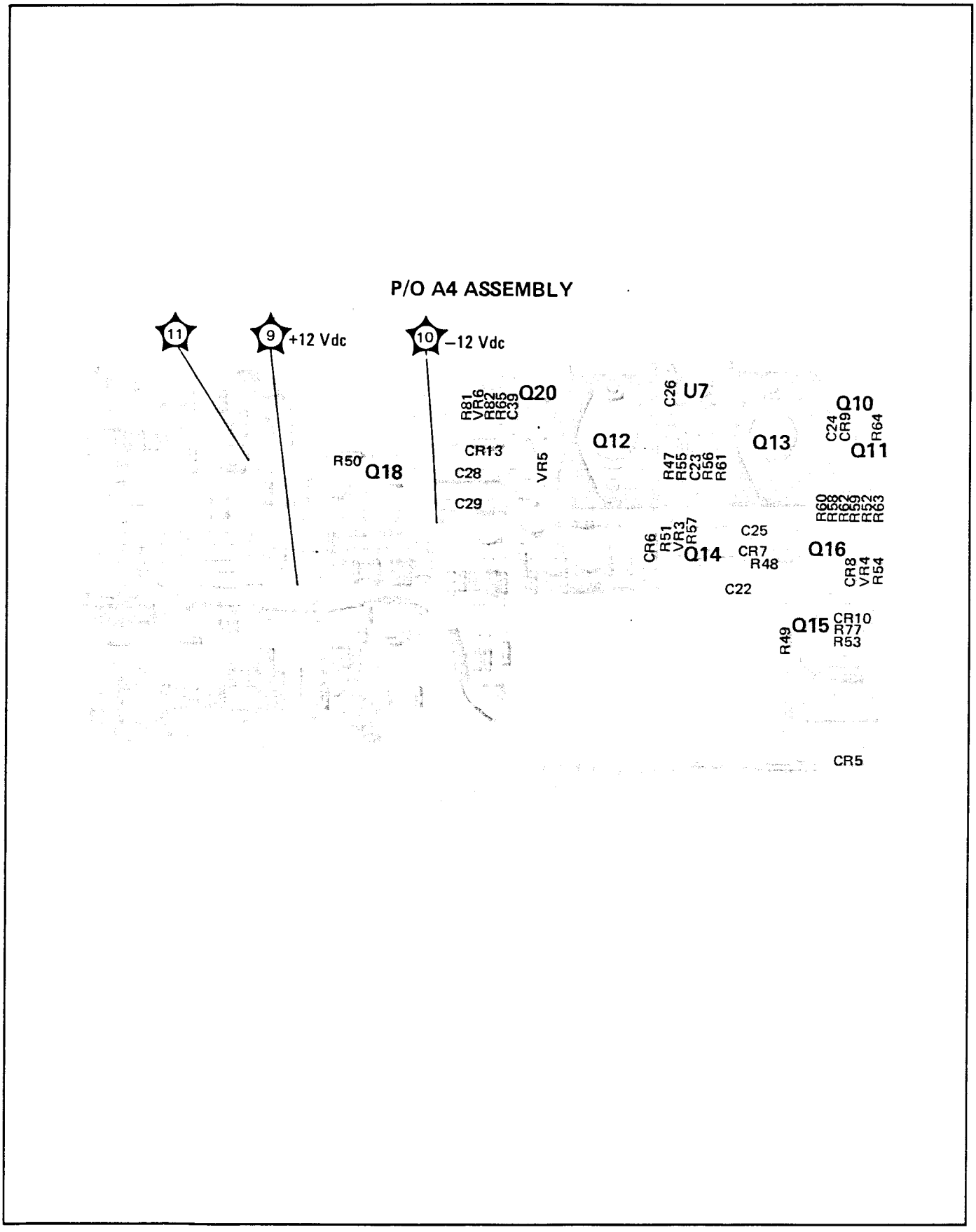


Figure 8-17. P/O A4 Assembly (Power Supply) Component and Test Point Locations

2-16. Packaging

Tagging for Service. If the instrument is being returned to Hewlett-Packard for service, please complete one of the blue repair tags located at the end of this manual and attach it to the instrument.

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

Other Packaging. The following general instructions should be used for re-packaging with commercially available materials:

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

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

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

d. Seal the shipping container securely.

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

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

SERVICE SHEET 5 (cont'd)

begins to turn off. The collector voltage begins to go positive and the change is transmitted through R51 and VR5 to Q18. As Q18 begins to turn off, its collector goes more negative. A negative going ransient is coupled through R55 to the base of Q14 which speeds up the turn-off time. The positive supply voltage is removed from the collecto of Q18 and also the DC Amplifier. As the battery voltage is further reduced, the series regulated output begins to decrease faster than the battery voltage and, eventually, the 3 volt threshold voltage is exceeded. Q14 is then biased on, but because the battery voltage is less than 20 Vdc, the knee voltage of VR5 cannot be reached. Therefore, VR5 does not conduct and Q18 remains biased off.

Battery Charger

If a battery has been placed in the Power Meter as a secondary power source, it is always being charged whenever the line voltage is coupled to the instrument and the LINE switch is ON. With ac line (Mains) power supplying energy, VR3 is turned on which biases Q12 for a charging current of approximately 90 mA. This current is supplied through CR6 to the battery BT1, CR7 is reverse biased while the battery is being charged. When the line voltage is removed, CR7 is forward biased by the current flowing to the Power Meter circuits from the battery. CR6 is turned off and no current flows through the charging circuit.

Current Limiter

If the current flow through the 24V regulator were to suddenly increase to approximately 90 mA, Q15 would turn on and draw the drive current away from Q16. Consequently, the current flow to Q13 would disappear and the regulator output would be reduced.

TROUBLESHOOTING

Set the line switch to off and remove A4P1 (red wire) from A4J1 and A4P2 (blue wire) from A4J2. This disconnects the load from the power supply. If the supply voltages are now correct, the malfunction is not in the power supply.

If, after removing the load, the output voltages measured are less than normal but of equal and opposite polarity, the malfunction is probably in the series regulator circuits.

Voltages shown in parenthesis are for battery operation only.

SECTION III
OPERATION

3-1. INTRODUCTION

This section provides complete operating instructions for the Power Meter. The instructions consist of: panel features, operator's checks, operating instructions, power measurement accuracy and operator's maintenance.

3-2. PANEL FEATURES

Front and rear panel features of the Power Meter are described in Figures 3-2 and 3-3. These figures contain a detailed description of the controls, indicators and connectors.

3-3. OPERATOR'S CHECKS

NOTE

If the instrument does not operate properly and is being returned to Hewlett-Packard for service, please complete one of the blue repair tags located at the end of this manual and attach it to the instrument.

Upon receipt of the instrument, or to check the Power Meter for an indication of normal operation, follow the operational procedure shown in Figure 3-4. These procedures are designed to familiarize the operator with the Power Meter and to provide an understanding of the operating capabilities.

3-4. OPERATING INSTRUCTIONS

General operating instructions are contained in Figure 3-5. The instructions will familiarize the operator with the basic practices used when operating the Power Meter.

WARNING

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

3-5. POWER MEASUREMENT ACCURACY

A power measurement is never free from error or uncertainty. Any RF system has RF losses, mismatch losses, mismatch uncertainty, instrumentation uncertainty and calibration uncertainty. Measurement errors as high as 50% are not only possible, they are highly likely unless the error sources are understood and, as much as possible, eliminated.

3-6. Sources of Error and Measurement Uncertainty

RF Losses. Some of the RF power that enters the power sensor is not dissipated in the power sensing elements. This RF loss is caused by dissipation in the walls of waveguide power sensors, in the center conductor of coaxial power sensors, in the dielectric of capacitors, connections within the sensor and radiation losses.

Mismatch. The result of mismatched impedances between the device under test and the power sensor is that some of the power fed to the sensor is reflected before it is dissipated in the load. Mismatches affect the measurement in two ways. First, the initial reflection is a simple loss and is called mismatch loss. Second, the power reflected from the sensor mismatch travels back up the transmission line until it reaches the source. There, most of it is dissipated in the source impedance, but some of it is re-reflected by the source mismatch. The re-reflected power returns to the power sensor and adds to, or subtracts from, the incident power. For all practical purposes, the effect the re-reflected power has upon the power measurement is unpredictable. This effect is called mismatch uncertainty.

Instrumentation Uncertainty. Instrumentation uncertainty describes the ability of the metering circuits to accurately measure the dc output from the power sensor's power sensing device. In the Power Meter, this error is less than ±1%.[1] It is important to realize, however, that a 1% meter does not automatically give 1% overall measurement accuracy.

Power Reference Uncertainty. The uncertainty of the output level of the power reference oscillator is ±0.7%. This reference is normally used to calibrate the system and is, therefore, a part of the system's total measurement uncertainty.

[1] Refer to Instrument accuracy specification in Section I when using the top two ranges.

Regulating action of the 24V supply is started by CR9, R58, and R60. When the LINE switch is set to ON, current begins to flow through R60 and VR4. As the voltage increases across VR4, current begins to flow through Q11 which biases Q13 and Q16 on. The regulator output begins to increase in a negative direction. The output voltage biases CR9 which, in turn, causes the voltage across VR4 to increase. The resulting rapid increase in voltage on the base of Q11 keeps it ahead of that on the base of Q10. When the Q11 base voltage stabilizes at —12Vdc, the lower voltage on Q10 keeps the output level increasing until it approaches —24Vdc. At this point the base voltages of Q10 and Q11 become equal, the differential amplifiers error output goes to zero, and the output is stabilized at —24V.

C25 and R61 form a low pass filter which reduces the high gain of the circuit at high frequencies thus preventing unwanted oscillations. R59 and C24 form a noise filter for the zener diode.

The input voltage to the 24V regulator may be as high as 70 Vdc from the line voltage or as low as 26 Vdc from the battery.

12V Shunt Regulator

U7 is connected as a voltage follower circuit. Chassis ground is coupled to the inverting input of U7 and the non-inverting input is coupled across half the 24V series regulator output by a voltage divider R63 and R64. If the voltage input to pin 3 tries to shift toward +12 or —12 Vdc, the output from U7 would bring the voltage at U7 pin 3 back to ground potential.

Battery Test

NOTE

The battery test circuit is in operation any time the LINE switch is set to ON, however the only time the meter indication is meaningful is when the battery is supplying power.

When the battery is supplying power for the Power Meter circuits, and the battery is defective or discharged, the battery test circuit removes the positive (+12 Vdc) supply voltage from the DC Amplifier (A4U5). This causes a full downscale meter indication.

The test circuit measures a percentage of the voltage difference between the —12V output and the negative battery terminal. As this voltage difference decreases to approximately 3 Vdc, Q14

Cal Factor Switch Resolution Error. The resolution of the CAL FACTOR switch contributes a significant error to the total measurement because the switch has 1% steps. The maximum error possible in each position is ±0.5%.

3-7. Corrections for Error

Calibration Factor and Effective Efficiency. The two correction factors basic to power meters are calibration factor and effective efficiency. Effective efficiency is the correction factor for RF losses within the power sensor. Calibration factor takes into account the effective efficiency and mismatch losses.

Calibration factor is expressed as a percentage with 100% meaning the power sensor has no losses. Normally the calibration factor will be 100% at 50 MHz, the operating frequency of the internal reference oscillator.

The power sensors used with the Power Meter have individually calibrated calibration factor curves placed on their covers. To correct for RF and mismatch losses, simply find the power sensor's calibration factor at the measurement frequency from the curve or the table that is supplied with the power sensor, and set the CAL FACTOR switch to this value.

The CAL FACTOR switch resolution error of ±0.5% may be reduced by one of the following methods:

1) Set the CAL FACTOR switch to the nearest positions above and below the correction factor given on the table. Interpolating between the power levels measured provides the corrected power level.

2) Leave the CAL FACTOR switch on 100% after calibration. Then, make the measurement and record the reading. Use the reflection coefficient, magnitude and phase angle, if such a table is supplied with the power sensor, to calculate the corrected power level.

3-8. Calculating Worst Case Uncertainty

Worst case uncertainty is the sum of the specified uncertainties and mismatch uncertainty. Uncertainty calculation is outlined in the following two subsections and examples are worked out in Figures 3-6 and 3-7. For a more complete explanation of measurement uncertainty refer to HP application note AN-64-1 "Fundamentals of RF and Microwave Power Measurement".

Specified Uncertainties. The specified uncertainties which account for part of the total power measurement uncertainty are:

a. Instrumentation ±1%[1] or ±0.05 dB.

b. Power reference ±0.7% or ±0.03 dB.

c. CAL FACTOR switch resolution, 0 to ±0.5% (depending on Cal Factor).

d. Zero set, ±0.5% of full scale of lowest range which is 15 nW.

e. Zero Carryover, ±0.5%.

f. Noise and Drift, depends on the range and type of sensor.

g. Calibration factor uncertainty, which depends on sensor type, is listed in the sensor manual.

Figure 3-6 gives an example of specified uncertainty calculation.

Calculating Mismatch Uncertainty. Mismatch uncertainty is the result of the source mismatch interacting with the power sensor mismatch. The magnitude of uncertainty is related to the magnitudes of the source and power sensor reflection coefficients, which can be calculated from SWR. Figure 3-7 shows how the calculations are made and Figure 3-8 illustrates mismatch uncertainty and total calculated uncertainty for two cases. In the first case, the power sensor's SWR = 1.5, and in the second case, the power sensor's SWR = 1.25. In both cases the source has an SWR of 2.0. The example shows the effect on power measurement accuracy a poorly matched power sensor will have as compared to one with low mismatch.

A faster, easier way to find mismatch uncertainty is to use the HP Mismatch Error (uncertainty) Limits/Reflectometer Calculator. The calculator may be obtained, on request, from your nearest Hewlett-Packard office by using HP part number 5952-0948.

The method of calculating measurement uncertainty from the uncertainty in dB is shown by Figure 3-9. This method would be used when the initial uncertainty calculations were made with the Mismatch Error/Reflectometer Calculator.

[1] Refer to Instrument accuracy specification in Section I when using the top two ranges.

SERVICE SHEET 5

PRINCIPLES OF OPERATION

General

Power Sources for the Power Meter are line (Mains) power or the rechargeable battery. If the battery is being used as a power source, it will receive a charging current anytime the line voltage is coupled to the instrument and the LINE switch is set to ON. When the line voltage is disconnected, the battery automatically becomes the power source.

CAUTION

A voltmeter or oscilloscope which is used to measure the 24V output across the +12V terminals must have a floating ground input.

The 12V Shunt Regulator establishes a reference ground at the half voltage point of the 24V Series Regulator output and thus establish the +12 and —12 Vdc outputs with respect to ground.

Over Voltage Protection Circuit

The Over Voltage Protection Circuit consists of capacitor C39, thyristor Q20, resistors R81 and R82, and zener diode VR6. The function of this circuit is to prevent component damage in the power supply due to power line transients, wrong voltages being applied to the Power Module (A5), or the shorting of Q13's collector to ground.

24V Series Regulator

NOTE

The explanation of the 24V Series Regulator is based on the assumption that TP9 is the reference ground and the regulator output is —24Vdc at TP10.

A reference voltage of —12 Vdc is established on the base of Q11 by VR4. Because Q10 and Q11 are a differential amplifier pair a difference in voltage between the base of Q11 and the base of Q10, half the 24V output (refer to the note above), produces an error output on the collector of Q11. This error voltage is coupled to Q16, the regulator driver, and from there to Q13, the series regulator. If, for example, the output voltage suddenly decreased to —23 volts, the current through Q11 would increase and the collector voltage would become less negative. Current flow through Q16 increases and the collector voltage goes more negative. The emitter voltage of Q13 follows the collector voltage of Q16 and approaches —24V. As the output voltage becomes more negative, the Q10 base voltage also becomes more negative until it equals the base voltage of Q11. At this instant, the output voltage is —24 Vdc and the circuit action (voltage change) ceases.

3-9. OPERATOR'S MAINTENANCE

The only maintenance responsibilities the operator should normally perform are primary power fuse replacement, LINE switch lamp replacement and rechargeable battery replacement.

Battery replacement is the only operation that requires tools. A Pozidriv screwdriver is needed to remove the battery clamp.

3-10. Fuses

The primary power fuse is found within the A5 Power Module Assembly on the Power Meter's rear panel. For instructions on how to change the fuse, refer to the paragraph entitled Line Voltage Selection in Section II.

CAUTION

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

3-11. Lamp Replacement

The lamp is contained in the white plastic lens which doubles for a pushbutton on the LINE switch. When the 435A LINE switch is ON and is being operated by the available line power, the lamp should be illuminated. Figure 3-1 illustrates how to remove and install the lamp.

3-12. Battery Replacement

If the meter indicates that the battery is discharged by a full downscale reading, and after charging the battery still will only power the Power Meter for a short period of time, the battery is probably defective. The replacement battery, BT1 (HP part number 1420-0096), may be ordered through the nearest Hewlett-Packard office. Refer to Battery Installation in Section II.

WARNING

This task should be performed only by service trained persons who are aware of the potential shock hazard of working on an instrument with protective covers removed.

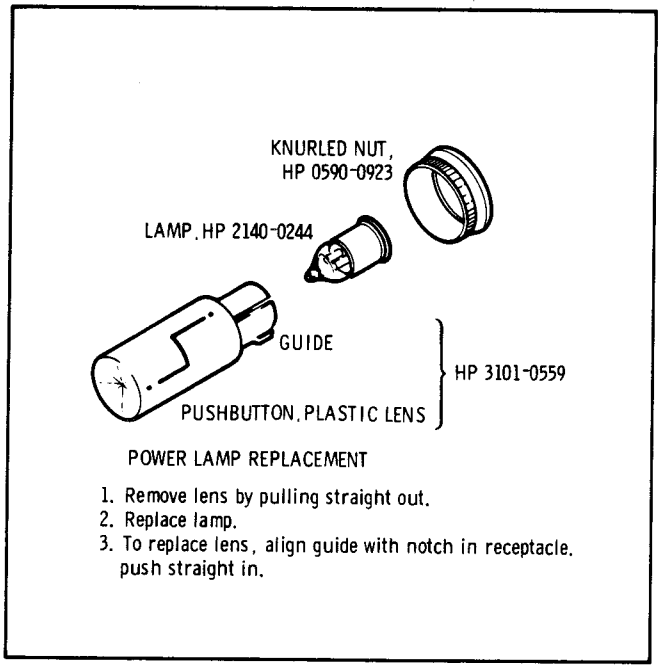
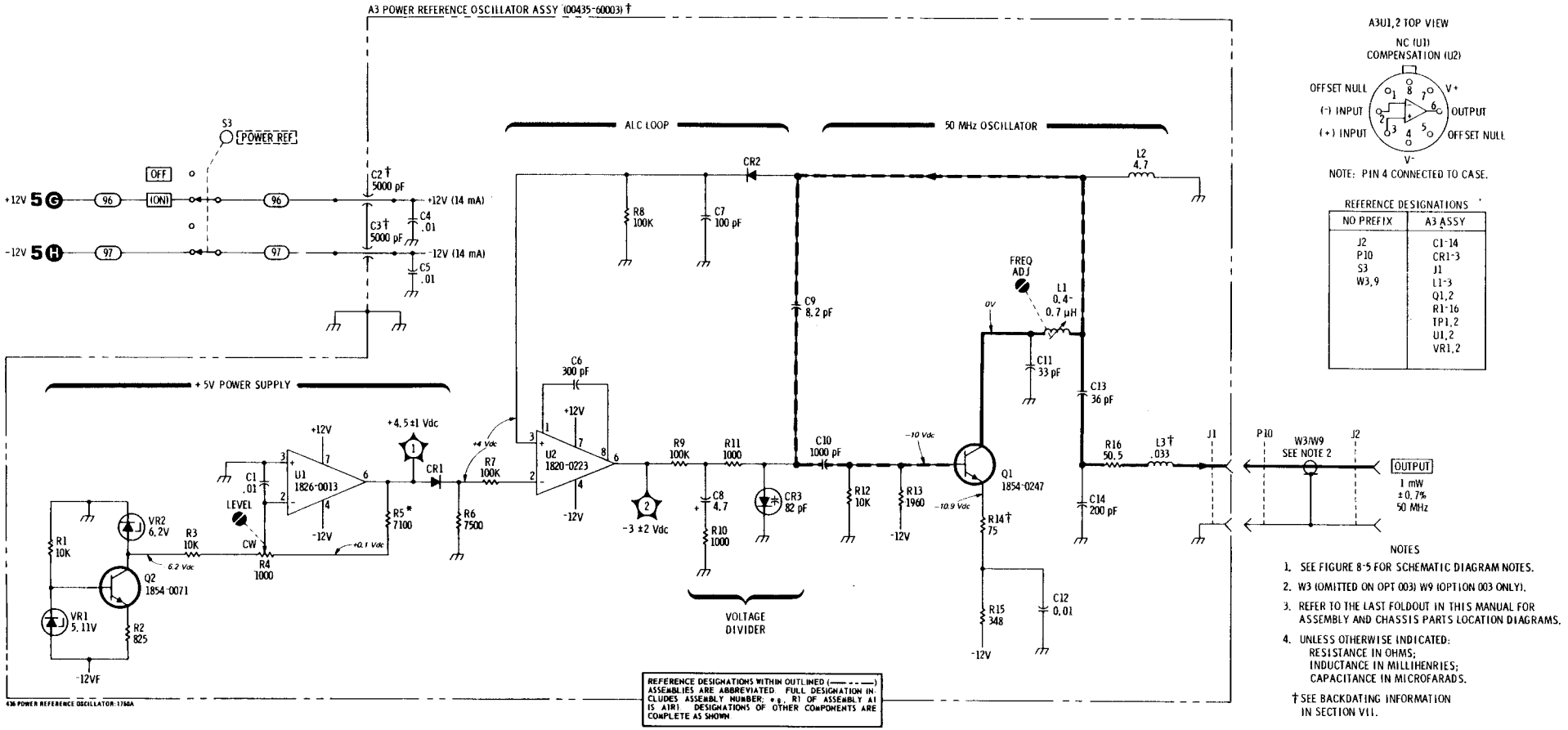


Figure 3-1. Line Switch Lamp Replacement



A3U1,2 TOP VIEW

NOTE: PIN 4 CONNECTED TO CASE.

REFERENCE DESIGNATIONS

NO PREFIX	A3 ASSY
J2	C1-14
P10	CR1-3
S3	J1
W3,9	L1-3
	Q1,2
	R1-16
	TP1,2
	U1,2
	VR1,2

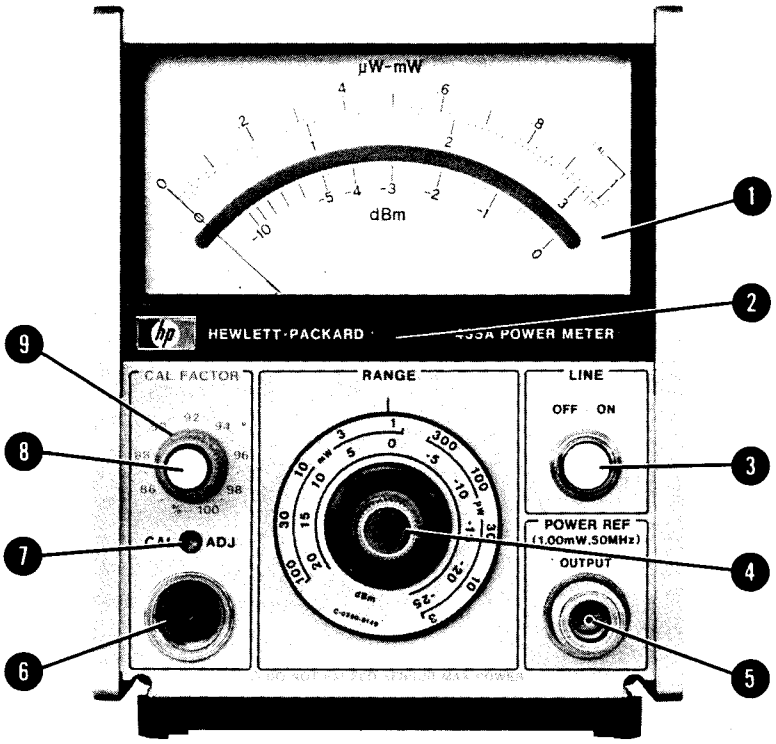
NOTES

1. SEE FIGURE 8-5 FOR SCHEMATIC DIAGRAM NOTES.
2. W3 (OMITTED ON OPT 003) W9 (OPTION 003 ONLY).
3. REFER TO THE LAST FOLDOUT IN THIS MANUAL FOR ASSEMBLY AND CHASSIS PARTS LOCATION DIAGRAMS.
4. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   INDUCTANCE IN MILLIHENRIES;
   CAPACITANCE IN MICROFARADS.

† SEE BACKDATING INFORMATION IN SECTION VII.

Figure 8-16. A3 Power Reference Assembly Schematic Diagram

FRONT PANEL FEATURES



1 Meter. Normally indicates average RF power in dBm or watts. During battery operation the meter continuously indicates battery condition. A normal reading indicates the battery is charged; a full down-scale reading indicates the battery is discharged or is defective.

2 Meter Zero. Mechanical adjustment used to zero the meter when the LINE switch is OFF.

3 LINE Switch. Connects line or battery power to the 435A circuits when the LINE switch is ON. During battery operation, the lamp contained within the LINE switch will not be illuminated when the INSTRUMENT is ON.

4 RANGE Switch.[1] Selects desired power range; keyed to meter full-scale deflection; has three removable scales which are changed to match the range of the power sensor.

5 POWER REF OUTPUT. RF output of 1.00 mW 0.70% into 50Ω at 50 MHz from an internal reference oscillator. Available for system calibration.

6 Input Connector. Input from the Power Sensor via the Power Sensor Cable.

7 CAL ADJ. Screwdriver adjustment for calibrating any Power Sensor and 435A as a system, to a known standard.

8 ZERO Switch. The ZERO switch activates a feedback circuit, which automatically zeros the meter pointer, and a rear panel RF blanking signal.

9 CAL FACTOR Switch. Changes the gain of the 435A amplifier circuits to compensate for mismatch losses and effective efficiency of the Power Sensor.

[1] For instruments with serial number prefix 1527A or less refer to Section VII.

Figure 3-2. Front Panel Controls, Connectors and Indicators

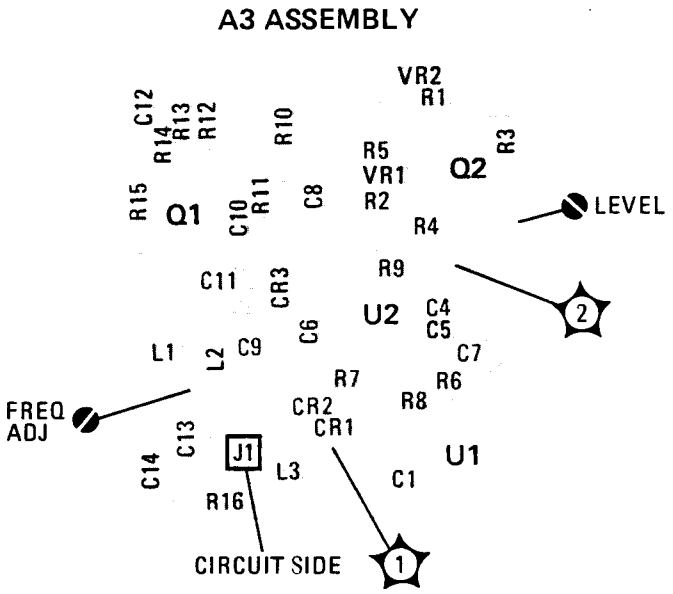
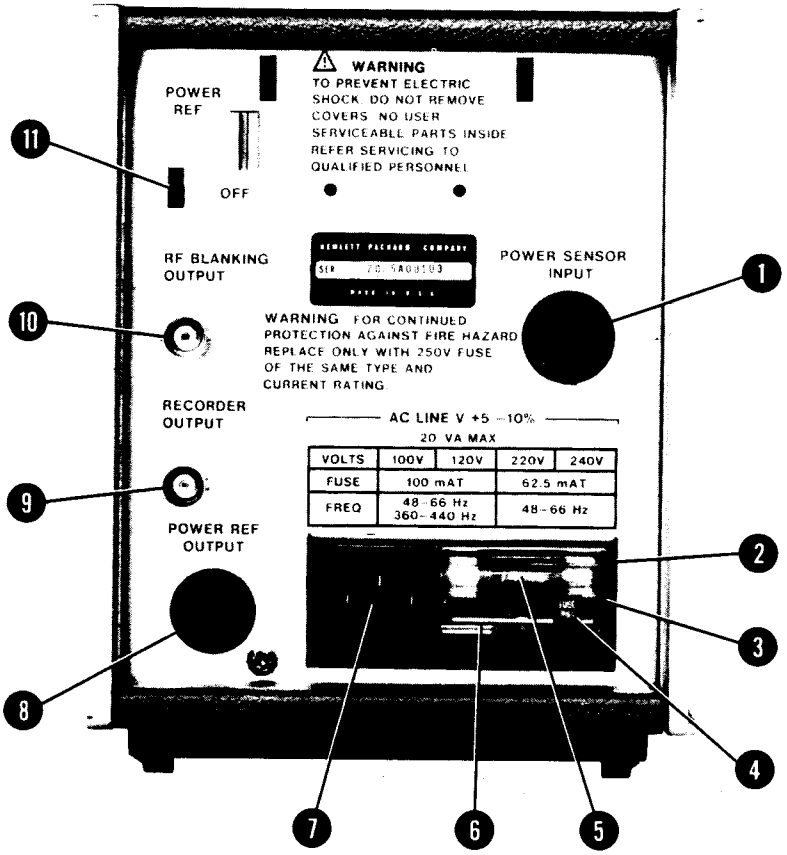


Figure 8-15. A3 Power Reference Assembly Component and Test Point Locations

REAR PANEL FEATURES



1 POWER SENSOR INPUT. Option 002 has a rear panel input connector wired in parallel with the front panel input connector. In Option 003, this connector replaces the input front panel connector.

2 Power Module Assembly.

3 Window. Safety interlock; fuse cannot be removed while power cable is connected to Power Meter.

4 FUSE PULL Handle. Mechanical interlock to guarantee fuse has been removed before Line Voltage Selection Card can be removed.

5 Fuse. Refer to Section II for values.

6 Line Voltage Selection Card. Matches transformer primary to available line voltage.

7 Receptacle. For power cable connection to available line voltage.

8 POWER REF OUTPUT. Takes the place of the front panel POWER REF OUTPUT connector (Option 003 only).

9 RECORDER OUTPUT. Provides a linear output with respect to the input power. +1.00 Vdc corresponds to meter full-scale. The minimum load which may be coupled to the output is 1 MΩ.

10 RF BLANKING OUTPUT. Contact closure to ground when ZERO switch is pressed. May be used to remove RF input signal during automatic zeroing operation.

11 POWER REF Switch. Opens or closes the circuit from the power supply to the power reference oscillator. Reduces current drain during battery operation when OFF.

Figure 3-3. Rear Panel Controls, Connectors and Indicators

OPERATOR'S CHECKS

1. BEFORE SWITCHING ON THIS INSTRUMENT, check that the power transformer primary is matched to the available line voltage, the correct fuse is installed and the safety precautions are taken. See Power Requirements, Line Voltage Selection, Power Cables and associated warnings and cautions in section II.

WARNINGS

BEFORE CONNECTING LINE POWER TO THIS INSTRUMENT, ensure that all devices connected to this instrument are connected to the protective (earth) ground.

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

CAUTION

Do not twist the body of the power sensor when connecting or disconnecting it. This can cause major damage to the power sensor.

2. Set the meter indication to zero with the mechanical meter zero control. Back the control off slightly.

3. Connect the power sensor to the Power Meter with the power sensor cable.

4. Connect the power cable to the power outlet and power module receptacles. Set the LINE switch to ON; the lamp within the switch lens should be illuminated.

5. Change the Power Meter's RANGE switch scale so it corresponds to the range of the power sensor. Refer to the paragraph entitled Range Switch Scale Selection in Section II.[1]

6. Set the Power Meter Controls as follows:

RANGE switch position.....fully ccw
CAL FACTOR switch.....100%
POWER REF switch.....OFF

7. Press the ZERO switch and verify that the meter pointer moves to zero (0) and the RF BLANKING OUTPUT is shorted to ground.

8. Set the RANGE switch to the position indicated in the following table. Then, connect the power sensor (and adapter or attenuator as required) to the POWER REF OUTPUT and set the rear panel POWER REF switch to (ON). Verify that the meter reads approximately the same as indicated in the table.

[1] For instrument serial number prefixes 1527A or less refer to Section VII.

Figure 3-4. Operator's Checks (1 of 2)

SERVICE SHEET 4

PRINCIPLES OF OPERATION

General

The A3 assembly provides a 50 ± 5 MHz output at 1 mW ± 0.7%. The oscillator output is held constant by an ALC loop made up of a peak detector CR2 and comparator U2. The comparator reference input is from a very stable +5V power supply composed of U1, VR1, VR2, Q2, and their associated components. The LEVEL control R4 sets the comparator reference which controls the oscillator feedback level and thereby controls the A3 assembly POWER REFERENCE OUTPUT level.

50 MHz Oscillator

The oscillator circuit is made up of common emitter amplifier Q1 and its associated components. Resistors R10, R11, R12 and R13 bias Q1 for an emitter current of approximately 5 mA. The π-network tuned circuit, C9, L1, C10, and C11 determines the operating frequency. The amplifier ac gain is set by the operating circuit impedance across the tuned circuit and the emitter resistor R15 (which is ac coupled to ground by C12). The positive feedback required to sustain oscillation is satisfied in this circuit. Phase shift of 180° is a characteristic of both common-emitter transistor amplifiers and π-network tuned circuits. This feedback is coupled through C9 and C10, back to the base of Q1.

ALC Loop

At the positive peak of each cycle, current momentarily flows from the feedback loop through peak detector diode CR2 to C7. The resultant stored charge is coupled, as a dc input voltage, to pin 3 of U2. The detector output is compared to a very stable reference input by comparator U2. Any difference between the comparator's input voltages produces an error voltage at the dc output. The comparator output is coupled to a reactance voltage divider, capacitor C9 and varactor CR3. As the error output voltage goes more positive the capacitive reactance of CR3 decreases, which reduces the oscillator feedback. Conversely, a more negative output voltage will increase the feedback. For example, if the oscillator output were to suddenly increase, the detector output would become more positive. The comparator output would become more positive, a lower CR3 reactance would decrease the feedback to Q1 which forces the oscillator output level back to its original level. If the R4 LEVEL control were adjusted for a more positive reference voltage, the comparator output would go more negative, the feedback would increase, allowing the oscillator output to increase. Therefore, the peak detector output would increase until it equals the comparator reference level input, thus establishing a higher leveled-output signal from the oscillator.

A1 CAL FACTOR Switch Assembly
P/O A2 RANGE Switch (Low Pass Filters) Assembly
P/O A4 Assembly (DC Ampl/Auto Zero)
◀ SERVICE SHEET 3

SERVICE SHEET 4 (cont'd)

Frequency shaping components R9, R10, R11, and C8 determine the upper limit of frequency response of the ALC loop which prevents spurious oscillations.

+5V Power Supply

A3VR2 provides a reference voltage of −6.2 Vdc to the power supply reference amplifier A3U1. The gain of the reference amplifier is set by R3, R4, and R5 and is approximately −0.8 with R4 centered. The very stable output is coupled through CR1 as the reference voltage input to comparator U2. Diode CR1 temperature compensates CR2.

TROUBLESHOOTING

General

Before trying to troubleshoot the A3 assembly, verify the presence of +12 Vdc and −12 Vdc on the circuit board.

If a defect in the A3 assembly is isolated and repaired, the correct output level (1 mW ± 0.7%) must be set by a very accurate power measurement system. Hewlett-Packard employs a special system, accurate to ±0.5% and traceable to the National Bureau of Standards. When setting the power level, a transfer error of ±0.2% is introduced making the total error ±0.7%. If a system this accurate is available it may be used to set the proper output level. Otherwise, Hewlett-Packard recommends returning the Power Meter so it can be reset at the factory. Contact your nearest Hewlett-Packard office for more information.

50 MHz Oscillator

Malfunctions of the oscillator circuits will occur as a wrong output frequency or as an abnormal output level. The voltage at TP2 will indicate if the ALC loop is trying to compensate for an incorrect output level.

Modulation of the 50 MHz signal or spurious signals, which are part of the output, may be caused by defects in R9, R10, R11, or C8 in the ALC loop.

ALC Loop and Power Supply

Problems in the ALC Loop and Power Supply circuits may be quickly isolated by measuring dc voltages at the inputs and outputs of the integrated circuits. For added information on troubleshooting integrated circuits, refer to General Service Information in Section VIII.

OPERATOR'S CHECKS

Power Sensor	RANGE Switch Position	Meter Indication
8481B and 8482B (remove attenuator)	3W	1W
8481A, 8482A, 8481H, 8482H	3 mW	1 mW
8485A (HP 1250-1250 Adapter required)	3 mW	1mW
8483A (HP 1250-0597 Mechanical Adapter required)	3 mW	0.96 mW
8484A (HP 11708A Reference Attenuator rrequired)	3 μW	1 μW

9. Step the CAL FACTOR switch through its range noting a small increase in meter reading with each successive step. Reset the CAL FACTOR switch to 100%.

10. Set the RANGE switch to the position indicated in the table below. Then, adjust the CAL ADJ control for a full-scale meter reading for 50Ω power sensors and a 96% of full scale meter reading for 75Ω power sensors.

Power Sensor	RANGE Switch Position
8481B and 8482B (remove attenuator)	1W
8481A, 8482A, 8481H, 8482H	1 mW
8485A (HP 1250-1250 Adapter required)	1 mW
8483A (HP 1250-0597 Mechanical Adapter required)	1 mW
8484A (HP 11708A Reference Attenuator required)	1 μW

11. Check at the rear panel RECORDER OUTPUT jack for an output of ≈ 1 Vdc.

12. To check operation using battery power, disconnect the power cable from the rear panel power module receptacle and set the LINE switch to ON (the lamp within the switch lens will not be illuminated). When a power measurement is made, a normal upscale reading indicates normal operation; a full down-scale reading indicates the battery is discharged.

Figure 3-4. Operator's Checks (2 of 2)

OPERATING INSTRUCTIONS

1. BEFORE SWITCHING ON THIS INSTRUMENT, check that the power transformer primary is matched to the available line voltage, the correct fuse is installed and safety precautions are taken. See Power Requirement, Line Voltage Selection, Power Cables and associated warnings and cautions in Section II.

WARNINGS

BEFORE CONNECTING LINE POWER TO THE INSTRUMENT, ensure that all devices connected to this instrument are connected to the protective (earth) ground.

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

CAUTION

Do not twist the body of the power sensor when connecting or disconnecting it. This can cause major damage to the sensor.

2. Set the meter indication to zero with the mechanical meter zero control. Back the control off slightly.

3. Connect the power sensor to the Power Meter with the power sensor cable.

4. Connect the power cable to the power outlet and power module receptacles. Set the LINE switch to ON; the lamp within the switch lens should be lit.

5. Change the Power Meter's RANGE switch scale so it corresponds to the range of the power sensor. Refer to the paragraph entitled Range Switch Scale Selection in Section II.[1]

6. Set the Power Meter switches as follows:

RANGE position	fully ccw
CAL FACTOR	100%
POWER REF	OFF

7. Press the ZERO switch, allow 5 seconds for the zeroing operation to take place, and release the switch.

8. Set the RANGE switch to the position indicated in the following table. Then, connect the power sensor (and adapter or attenuator as required) to the POWER REF OUTPUT and set the rear panel POWER REF switch to (ON). For 50Ω power sensors, adjust the CAL ADJ control for a full-scale reading; the meter pointer should be aligned with the CAL mark (full-scale reading) on the meter face. For 75Ω power sensors, adjust the CAL ADJ control for a 96% of full scale reading; the meter pointer should be aligned with the 0.96 mark on the meter face.

[1] For instrument serial number prefixes 1527A or less refer to Section VII.

Figure 3-5. Operating Instructions (1 of 2)

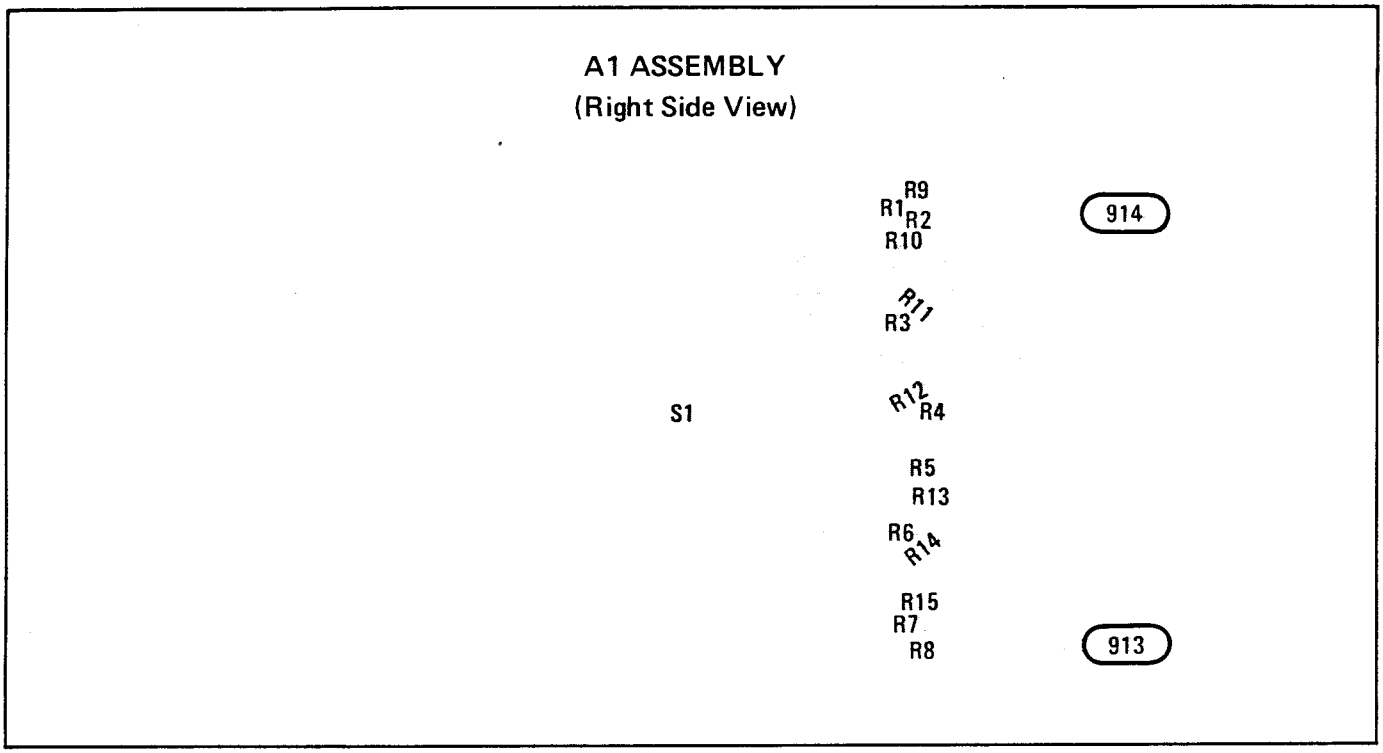


Figure 8-12. A1 Cal Factor Switch Assembly Component Locations

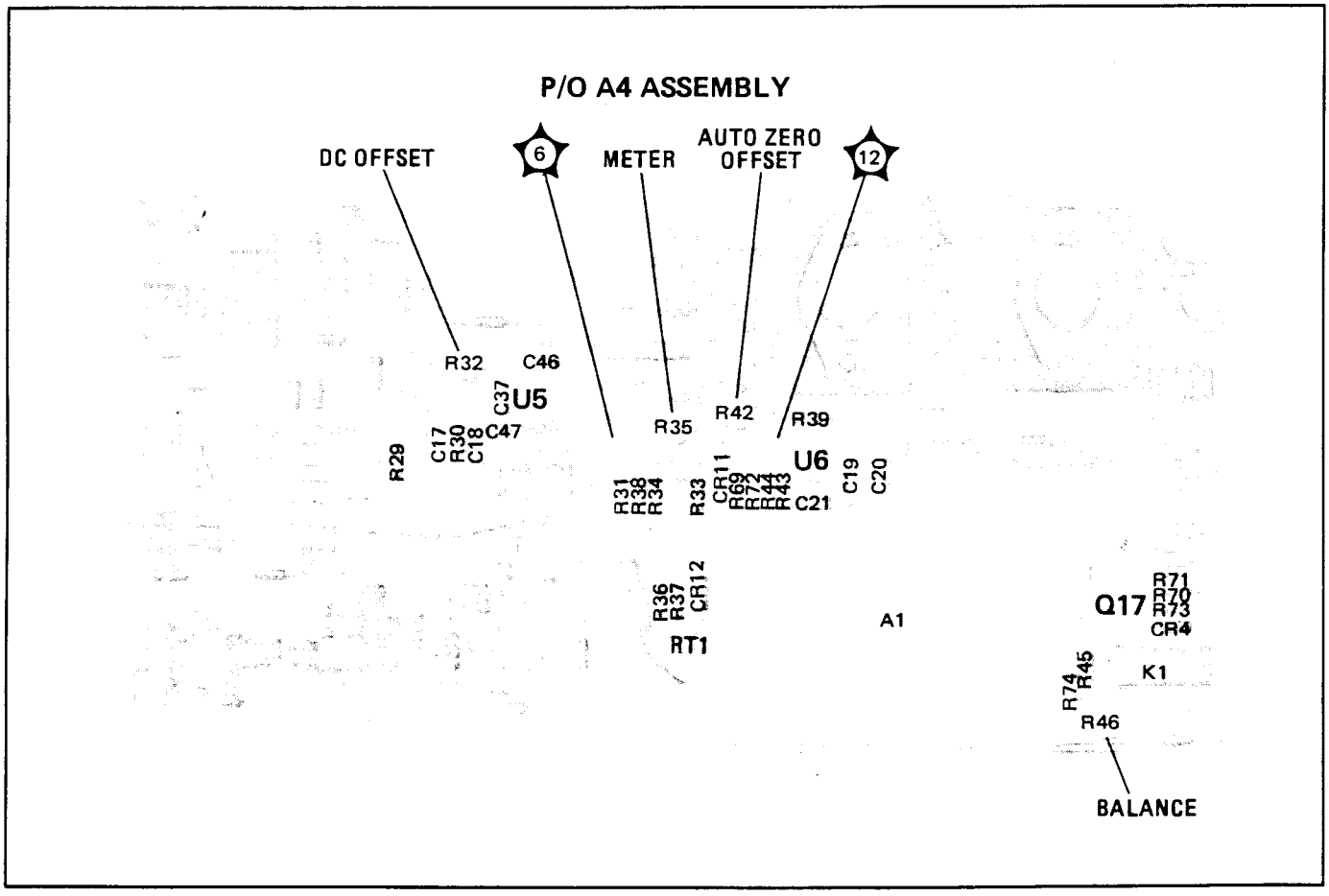


Figure 8-13. P/O A4 Assembly (DC Ampl/Auto Zero) Component and Test Point Locations

OPERATING INSTRUCTIONS

Power Sensor	RANGE Switch Position
8481B and 8482B (remove attenuator)	1W
8481A, 8482A, 8481H, 8482H	1 mW
8485A (HP 1250-1250 Adapter required)	1 mW
8483A (HP 1250-0597 Mechanical Adapter required)	1 mW
8484A (HP 11708A Reference Attenuator required)	1 μW

9. Disconnect the power sensor from the POWER REF OUTPUT and set the POWER REF switch to OFF.

10. Locate the calibration curve on the power sensor cover. Find the CAL FACTOR for the measurement frequency; set the CAL FACTOR switch accordingly.

11. Set the RANGE switch such that full scale is greater than the power level to be measured.

CAUTION

See Operating Precautions in the power sensor Operating and Service Manuals for maximum power levels which may be safely coupled to this system. Levels which exceed the limits may damage the power sensor, Power Meter, or both.

12. Connect the power sensor to the RF source. Read the power level in dBm or Watts on the panel meter.

NOTE

When the battery is being used as the power supply for the Power Meter, an automatic test circuit continually monitors battery condition. When the battery voltage is above a predetermined level, the meter indicates the correct power level. When the voltage drops below the threshold level, the meter reading is full downscale.

Figure 3-5. Operating Instructions (2 of 2)

SPECIFIED UNCERTAINTY CALCULATION

Conditions: Range — 1 mW
Meter Reading — 0.7 mW
Sensor — 8481A
Frequency — 1 GHz
CAL FACTOR — 99.5%

(FS)	Instrumentation Uncertainty	= ±1.0%	= ±0.01 mW	= ±0.06 dB
(R)	Power Reference Uncertainty	= ±0.7%	= ±0.0049 mW	= ±0.03 dB
(R)	CAL FACTOR Switch Resolution Uncertainty	= ±0.5%	= ±0.0035 mW	= ±0.02 dB
(R)	Zero Set Uncertainty	= ±0.002%	= ±0.000015 mW	= ±0.00009 dB
(FS)	Zero Carryover Uncertainty	= ±0.5%	= ±0.005 mW	= ±0.03 dB
(R)	Noise	= ±0.006%	= ±0.00004 mW	= ±0.00025 dB
(R)	Drift	= ±0.002%	= ±0.000015 mW	= ±0.00009 dB
(R)	Cal Factor Uncertainty	= ±2.70%	= ±0.019 mW	= ±0.12 dB
			±0.0425 mW	

$$\text{Total Specified Uncertainties} = \pm 0.0425 \text{ mW} = \frac{0.0425}{0.7} (100) = \pm 6.07\%$$

$$= 10 \log \frac{0.7425}{0.7} = \pm 0.26 \text{ dB}$$

NOTE: FS = % of full scale
R = % of reading

Figure 3-6. Specified Uncertainties

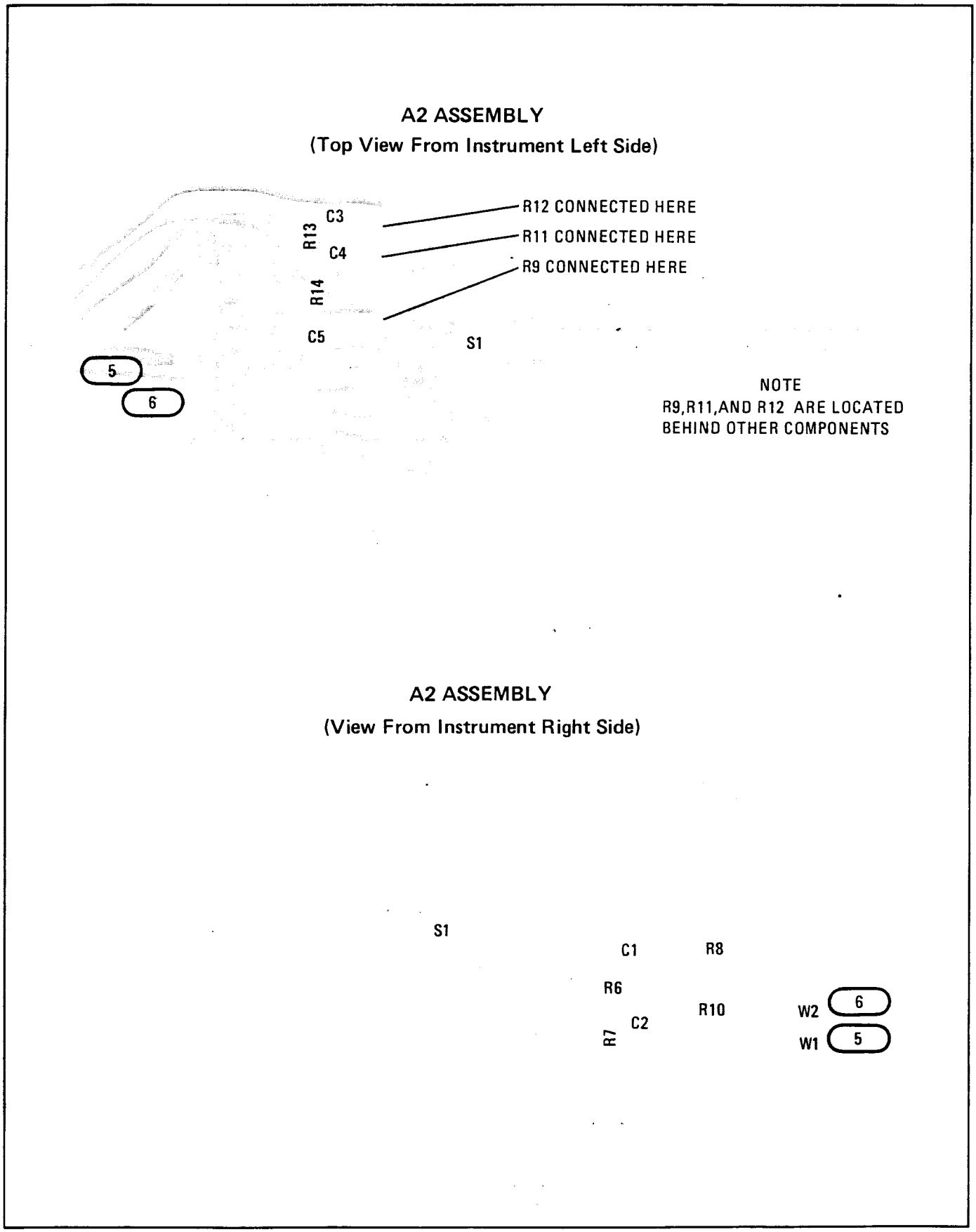


Figure 8-11. A2 RANGE Switch Assembly (Low Pass Filters) Component Locations

CALCULATING MEASUREMENT UNCERTAINTY

1. Calculate the reflection coefficient from the given SWR.

$$\rho = \frac{SWR-1}{SWR+1}$$

Power Sensor #1 SWR = 1.5	Power Sensor #2 SWR = 1.25	Power Source SWR = 2.0
$\rho_1 = \frac{1.5-1}{1.5+1}$	$\rho_2 = \frac{1.25-1}{1.25+1}$	$\rho_S = \frac{2.0-1}{2.0+1}$
$= \frac{0.5}{2.5}$	$= \frac{0.25}{2.25}$	$= \frac{1.0}{3.0}$
$= 0.2$	$= 0.111$	$= 0.333$

2. Calculate the relative power and percentage power mismatch uncertainties from the reflection coefficients. An initial reference level of 1 is assumed.

Relative Power Uncertainty

$$PU = [1 \pm (\rho_n \rho_s)]^2$$

$PU_1 = \{1 \pm [(0.2)(0.333)]\}^2$

$= \{1 \pm 0.067\}^2$

$= \{1.067\}^2$ and $\{0.933\}^2$

$= 1.138$ and 0.871

$PU_2 = \{1 \pm [(0.111)(0.333)]\}^2$

$= \{1 \pm 0.037\}^2$

$= \{1.037\}^2$ and $\{0.963\}^2$

$= 1.075$ and 0.927

Percentage Power Uncertainty

$\%PU = (PU-1)\ 100\%$

$\%PU_1 =$	$(1.138-1)\ 100\%$	and	$(0.871-1)\ 100\%$
$=$	$(0.138)\ 100\%$	and	$(-0.129)\ 100\%$
$=$	13.8%	and	-12.9%
$\%PU_2 =$	$(1.075-1)\ 100\%$	and	$(0.927-1)\ 100\%$
$=$	$(0.075)\ 100\%$	and	$(-0.073)\ 100\%$
$=$	7.5%	and	-7.3%

Figure 3-7. Calculating Measurement Uncertainties (1 of 2)

CALCULATING MEASUREMENT UNCERTAINTY

3. Calculate the Measurement Uncertainty in dB.

$$MU = 10\left[\log_{10}\left(\frac{P_1}{P_0}\right)\right] \text{ dB}$$

$$MU_1 = 10\left[\log\left(\frac{1.138}{1}\right)\right] \quad \text{and} \quad 10\left[\log\left(\frac{0.871}{1}\right)\right]$$

$$= 10\,[0.056] \quad \text{and} \quad 10\,[-0.060]$$

$$= +0.56 \text{ dB} \quad \text{and} \quad -0.60 \text{ dB}$$

$$MU_2 = 10\left[\log\left(\frac{1.075}{1}\right)\right] \quad \text{and} \quad 10\left[\log\left(\frac{0.927}{1}\right)\right]$$

$$= 10\,[0.031] \quad \text{and} \quad 10\,[-0.033]$$

$$= +0.31 \text{ dB} \quad \text{and} \quad -0.33 \text{ dB}$$

Figure 3-7. Calculating Measurement Uncertainties (2 of 2)

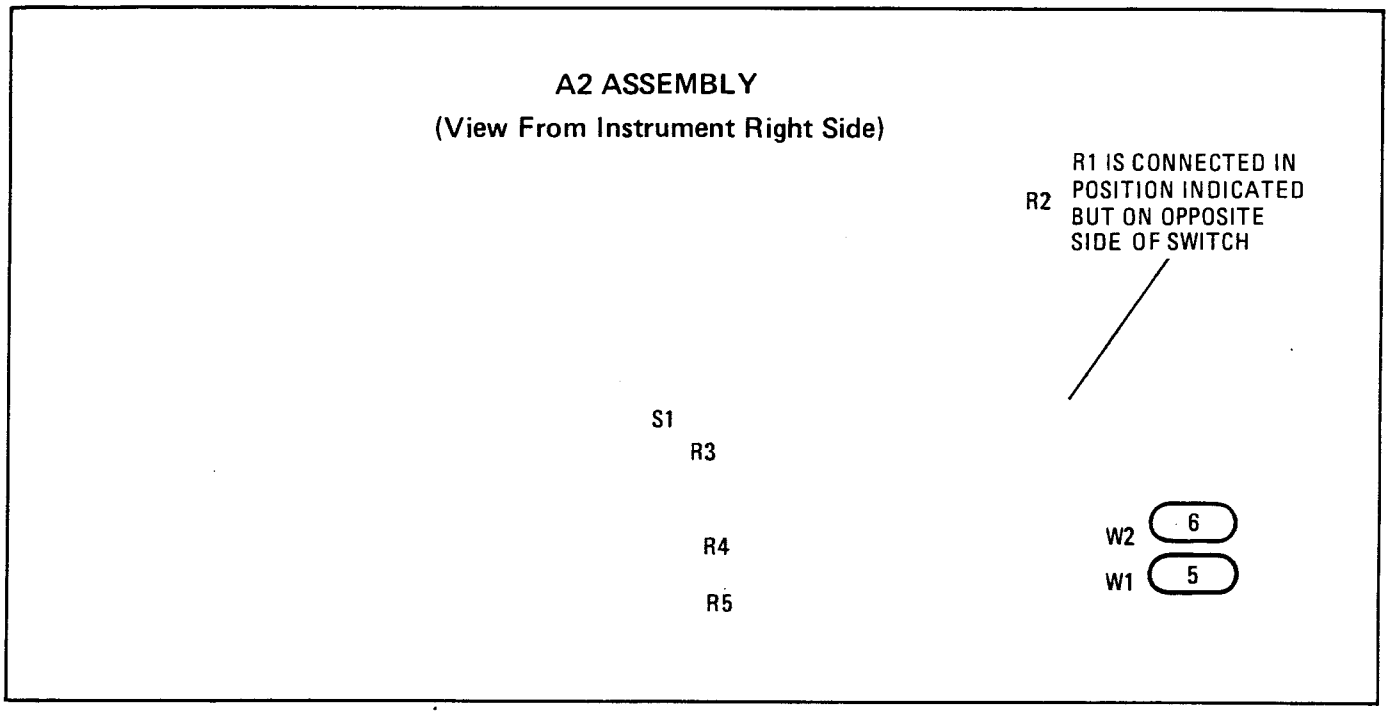


Figure 8-8. P/O A2 Range Switch Assembly (Attenuator) Component Locations

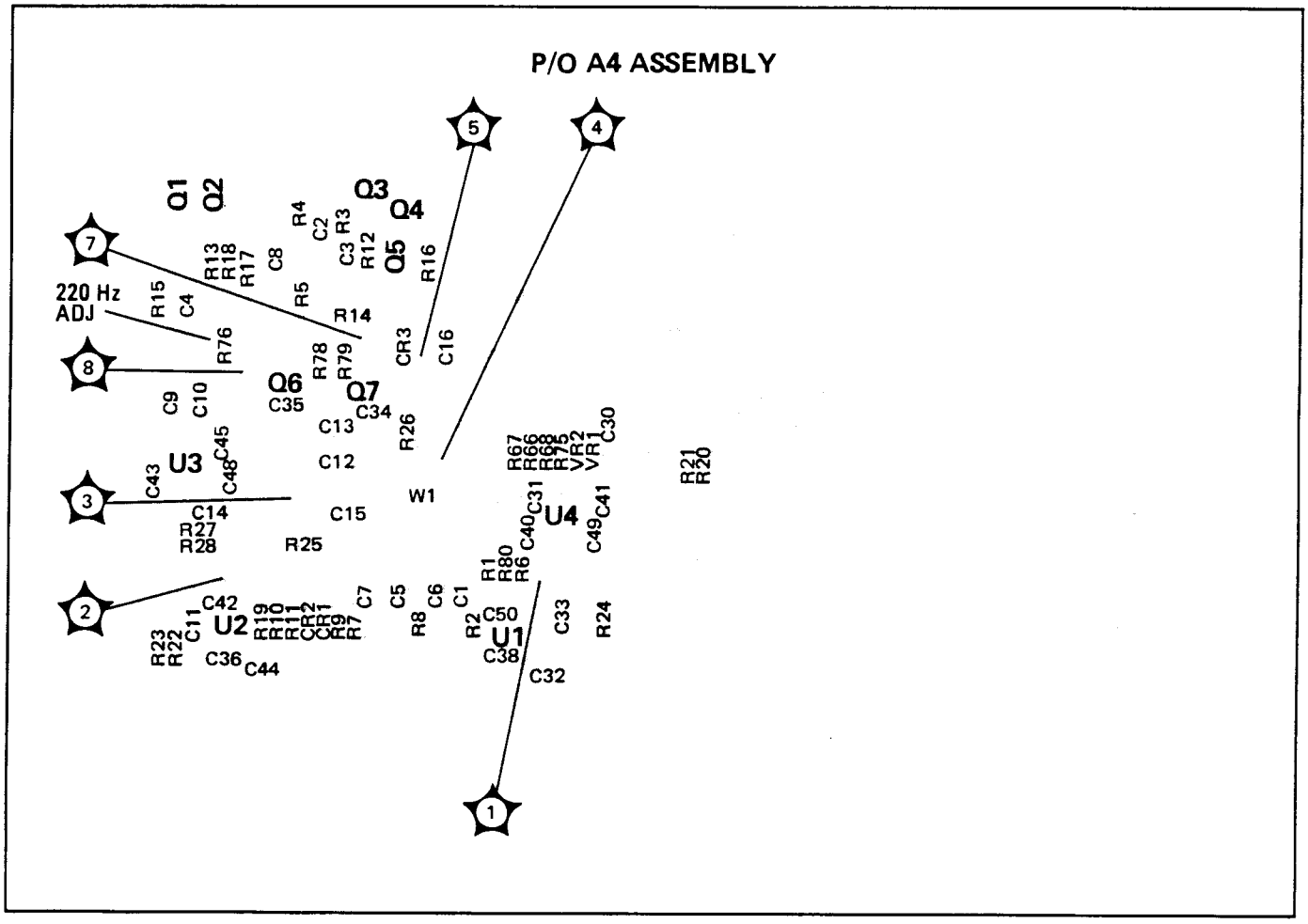


Figure 8-9. P/O A4 Assembly (AC Ampl/Sync Detector) Component and Test Point Locations

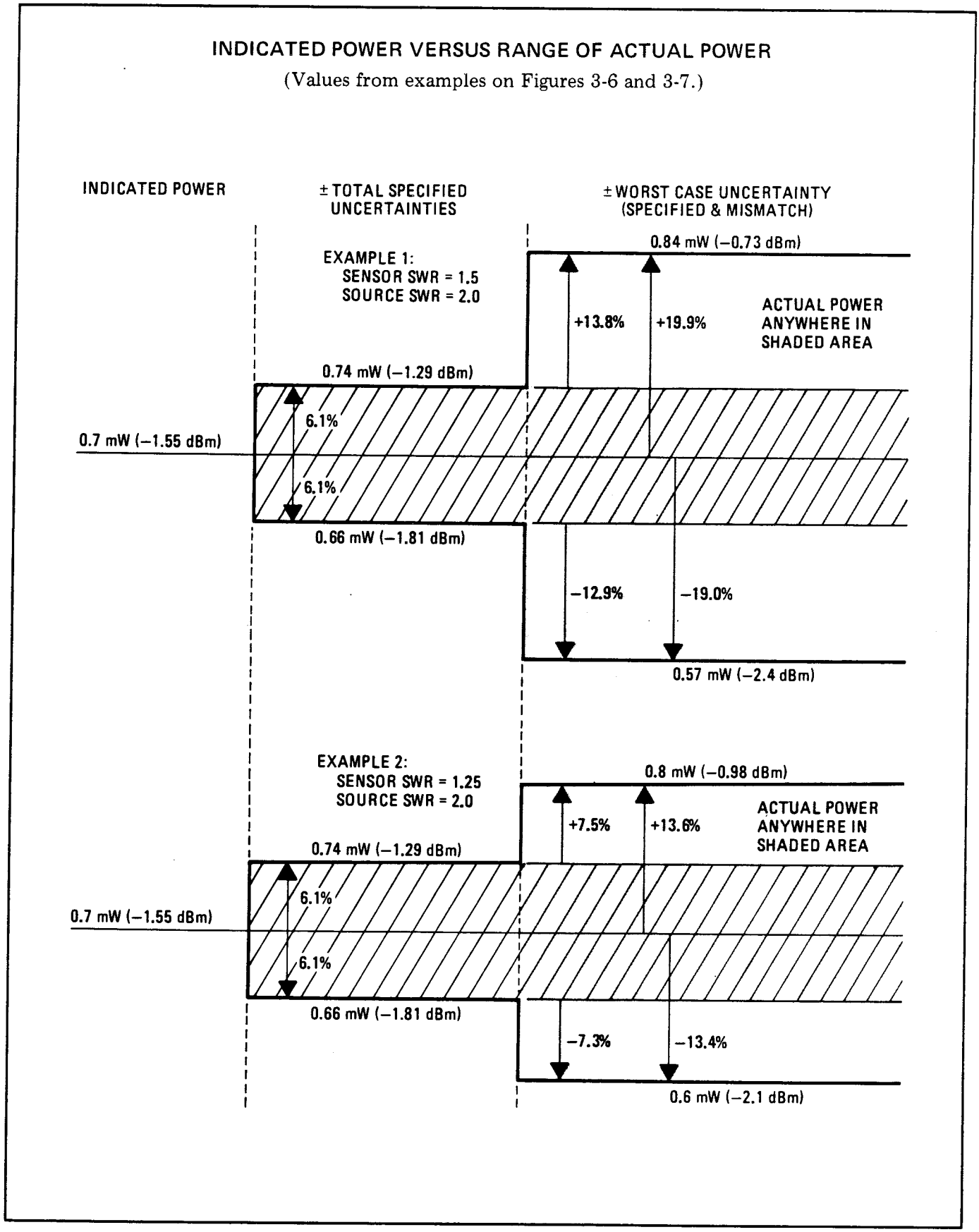


Figure 3-8. Worst Case Effects of Specified and Mismatch Uncertainties

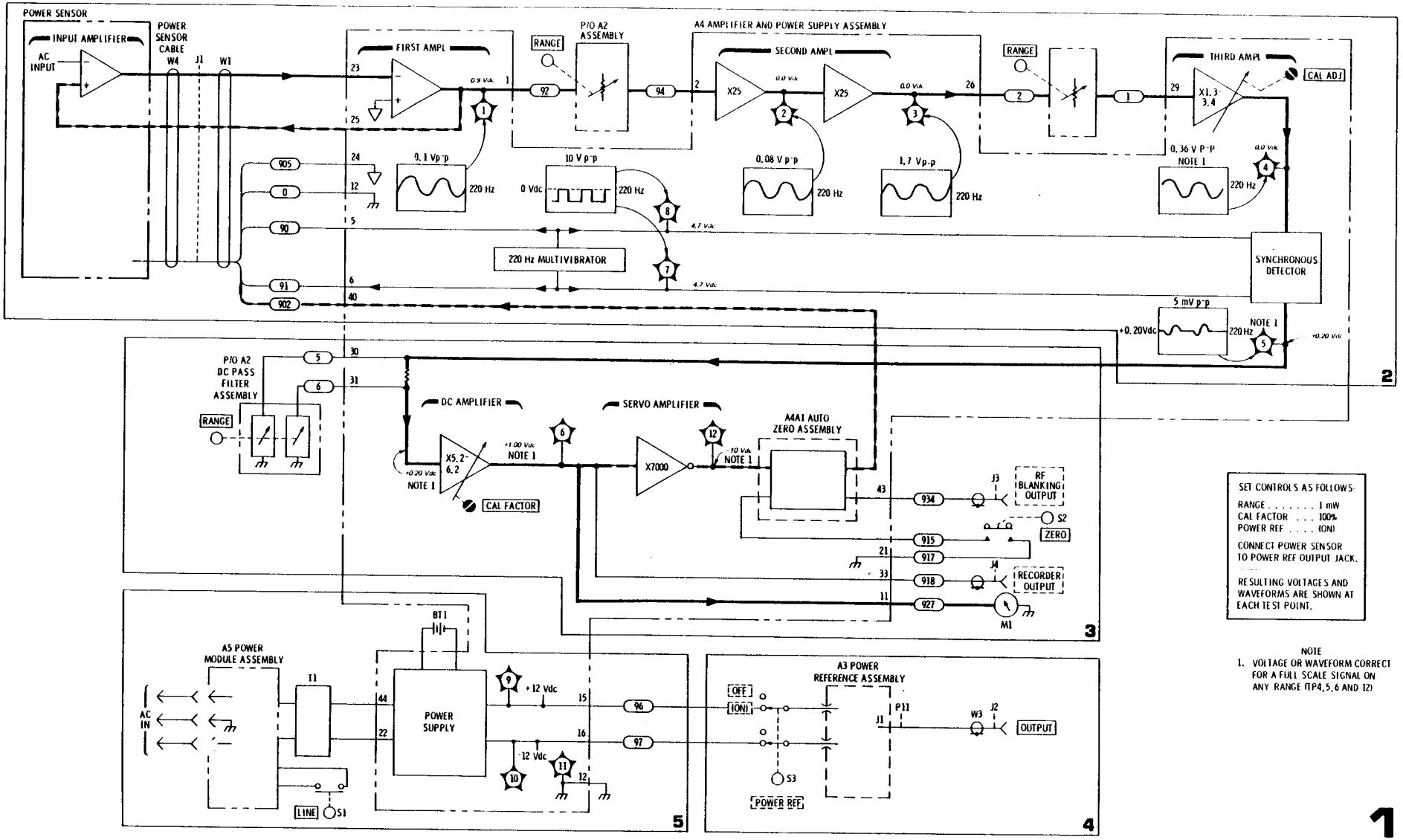


Figure 8-6. Troubleshooting Block Diagram

CALCULATING MEASUREMENT UNCERTAINTY

1. For this example the known values are: source SWR, 2.2 and power sensor SWR, 1.16. From the Mismatch Error Calculator the mismatch uncertainty is found to be +0.24, —0.25 dB.

2. Add the specified uncertainties from Figure 3-6, (±0.26 dB). Our total measurement uncertainty is +0.50, —0.51 dB.

3. Calculate the relative measurement uncertainty from the following formula:

$$dB = 10 \log\left(\frac{P_1}{P_0}\right)$$

$$\frac{dB}{10} = \log\left(\frac{P_1}{P_0}\right)$$

$$\frac{P_1}{P_0} = \log^{-1}\left(\frac{dB}{10}\right)$$

$$MU = P_1 = \log^{-1}\left(\frac{dB}{10}\right)$$

$$= \log^{-1}\left(\frac{0.50}{10}\right) \qquad = \log^{-1}\left(\frac{-0.51}{10}\right)$$

$$= 1.122 \qquad = 0.889$$

4. Calculate the percentage Measurement Uncertainty.

$$\%MU = (P_1 - P_0)\,100$$

$$= (1.122 - 1)\,100 \qquad = (0.889 - 1)\,100$$

$$= +12.2\% \qquad = -11.1\%$$

Figure 3-9. Calculating Measurement Uncertainty (Uncertainty in dB Known)

SERVICE SHEET 1 (Cont'd)

Servo Amplifier/Auto Zero

The Servo Amplifier amplifies the DC Amplifier output. When the front panel ZERO switch is pressed, the Servo Amplifier output is connected to the auto zero circuits completing the automatic zeroing feedback loop. The auto zero dc output voltage (error signal) is added to the ambient temperature output of the Power Sensor's power sensing device. The polarity of the error signal and the feedback loop gain force the DC Amplifier output to ground potential after five seconds. When the zero switch is released, the Auto Zero circuits hold the error signal constant.

Power Reference Assembly

The A3 Power Reference Assembly contains a 50 MHz oscillator with an ALC loop capable of providing an exceptionally stable output level. The calibrated output is 1 mW ± 0.70% at 50 ± 5 MHz.

Power Supply

The Power Supply is a 24V series regulator with a shunt regulator coupled across the output. The shunt regulator places ground potential midway between the 24V potential difference thus providing supply outputs of +12 and −12 Vdc. The battery charging and test circuits are automatically operative with the battery installed.

TROUBLESHOOTING

General

Before beginning to troubleshoot the Power Meter, remove the cover from the right side of the instrument and measure the power supply voltages at TP9 and TP10.

When a malfunctioning component is isolated to an assembly or stage, refer to the appropriate Service Sheet for component level troubleshooting.

Block Diagram Troubleshooting Conditions

The waveforms and voltages shown are normal when operating under the following conditions.

NOTE

To exhibit the correct waveforms in the RANGE positions shown, the Power Sensor (as part of the measurement system) must measure power from −35 to +20 dBm (50Ω).

a. **POWER METER AND SENSOR.** Set the Power Meter's RANGE switch to the 1 mW position, CAL FACTOR switch to 100%, and the rear panel POWER REF switch to (ON). Connect the Power Sensor to the Power Meter's POWER REF OUTPUT jack.

b. **POWER METER AND HP MODEL 11683A RANGE CALIBRATOR.** Set the Power Meter's RANGE switch to the 1 mW position and CAL FACTOR switch to 100%. Set the Range Calibrator's RANGE switch to 1 mW, POLARITY switch to NORMAL, and FUNCTION switch to STANDBY. Connect the Range Calibrator to the Power Meter with the Power Sensor Cable. Set the Range Calibrator FUNCTION switch to CALIBRATE.

AC Amplifiers

If the waveform and/or voltage at TP1 is incorrect, it must be determined if the circuit malfunction is in the Power Meter, Power Sensor, or cable. Substitution will quickly isolate the defective instrument. If a spare cable and Power Sensor or Range Calibrator is not available, refer to the troubleshooting information for the First Amplifier on Service Sheet 2. Also, check the multivibrator output (TP7 and TP8) of the power meter.

Miscellaneous

Voltages at TP4, 5, 6, and 12 are correct as shown for full-scale meter readings on any range.

With a full scale input, on 1 mW range only, pressing the front panel zero switch should produce a meter reading of about 0.96. If the reading is incorrect, refer to Section V and perform the adjustments. If the problem still exists, refer to autozero circuit troubleshooting on Service Sheet 3.

A noise problem evident as meter vibration may be due to defective components illustrated on Service Sheets 2, 3, or 5.

SECTION IV
PERFORMANCE TESTS

4-1. INTRODUCTION

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

4-2. EQUIPMENT REQUIRED

Equipment required for the performance tests is listed in Table 1-2, Recommended Test Equipment. Any equipment that satisfies the critical specifications given in the table may be substituted for the recommended model(s).

4-3. TEST RECORD

Results of the performance tests may be tabulated on the Test Record at the end of the test procedures. The Test Record lists all of the tested specifications and their acceptable limits. Test results recorded at incoming inspection can be used for comparison in periodic maintenance, troubleshooting and after repairs or adjustments.

4-4. PERFORMANCE TESTS

The performance tests given in this section are suitable for incoming inspection, troubleshooting or preventive maintenance. During any performance test, all shields and connecting hardware must be in place. Perform the tests in the order given and record the data on the test card and/or in the data spaces provided at the end of each procedure.

NOTE

The Power Meter must have a half-hour warmup and the line voltage must be within +5%, -10% of nominal if the performance tests are to be considered valid.

Each test is arranged so that the specification is written as it appears in Table 1-1. Next, a description of the test and any special instructions or problem areas are included. Each test that requires test equipment has a setup drawing and a list of the required equipment. The initial steps of each procedure give control settings required for that particular test.

PERFORMANCE TESTS

4-5. POWER REFERENCE LEVEL TEST

SPECIFICATION: Internal 50 MHz oscillator with Type N Female connector on front panel (or rear panel, Option 003 only). Power output: 1.00 mW. Factory set to ±0.7% traceable to the National Bureau of Standards. Accuracy: ±1.2% worst case (±0.9% rss) for one year (0 to 55°C).

DESCRIPTION: The power reference oscillator output is factory adjusted to 1 mW ±0.7%. To achieve this accuracy, Hewlett-Packard employs a special measurement system accurate to 0.5% (traceable to the National Bureau of Standards) and allows for a transfer error of ±0.2% in making the adjustment. If an equivalent measurement system is employed for verification, the power reference oscillator output can be verified to 1 mW ±1.9% (±1.2% accuracy + ±0.5% verification system error + ±0.2% transfer error = 1.9% maximum error). The power reference oscillator can be set to ±0.7% using the same equipment and following the adjustment procedure in Section V. To ensure maximum accuracy in verifying the power reference oscillator output, the following procedure provides step-by-step instructions for using specified Hewlett-Packard test instruments of known capability. If equivalent test instruments are used, signal acquisition criteria may vary and reference should be made to the manufacturer's guidelines for operating the instruments.

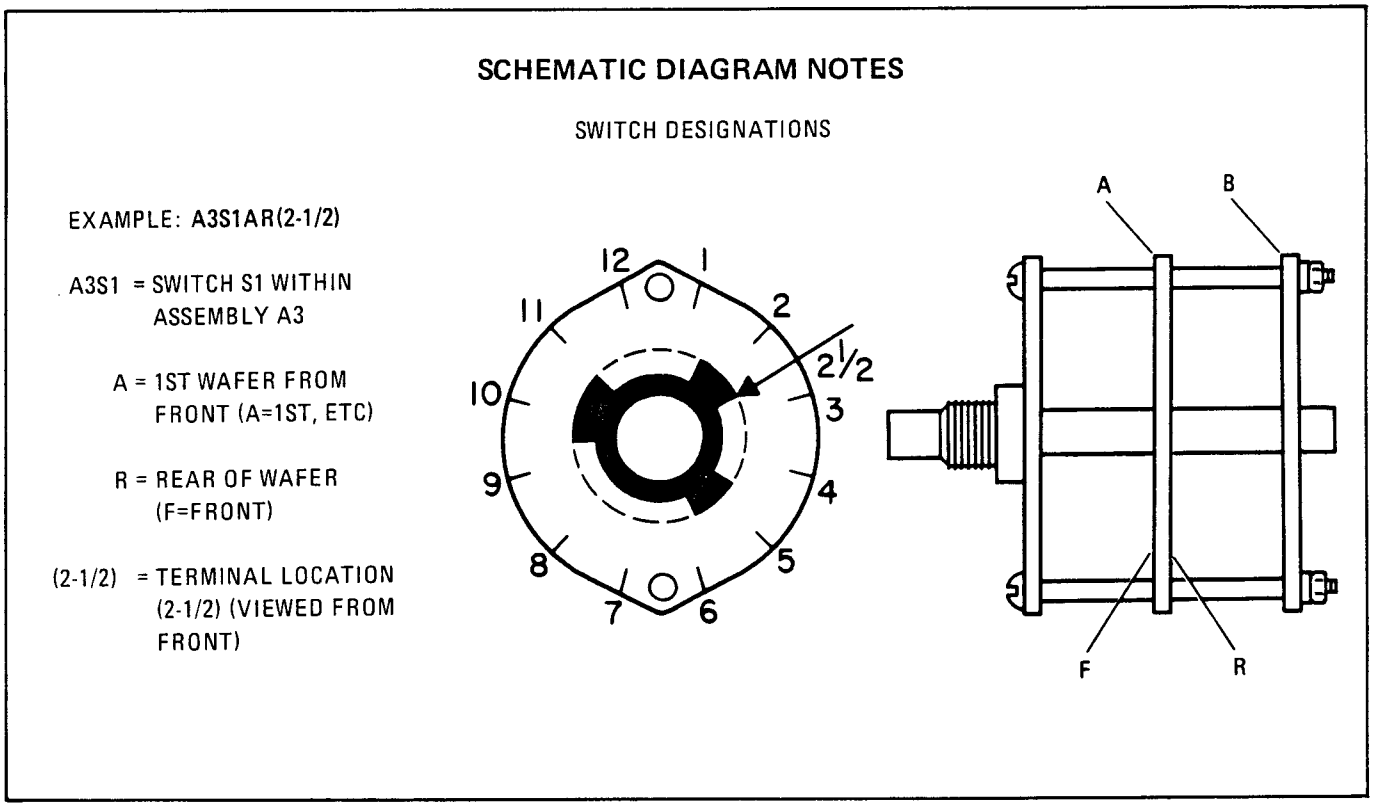


Figure 8-5. Schematic Diagram Notes (3 of 3)

SERVICE SHEET 1

PRINCIPLES OF OPERATION

General

The Power Meter and a compatible Power Sensor are used to measure RF power levels. For example, the power range of the HP Model 8481A is from −35 to +20 dBm (≅0.3 μW to 100 mW) into 50Ω; the frequency range is from 10 MHz to 18 GHz.

Power Sensor

The power sensing device dissipates the input RF energy into 50 ohms and produces a dc voltage proportional to the power level. This dc voltage is sampled creating an ac signal which is coupled to the Input Amplifier for amplification.

AC Amplifiers/A2 Range Switch Assembly

The ac signal is amplified by the Power Sensor's Input Amplifier and the Power Meter's First, Second, and Third Amplifiers. The RANGE switch attenuators which are placed between the First and Second and Second and Third amplifiers are used to set the range-to-range gain of the Power Meter amplifiers.

DC Circuits

The Synchronous Detector converts the ac signal back to dc. The output is coupled to the DC Amplifier via a Low Pass Filter network which is part of the A2 Range Switch Assembly. The DC Amplifier drives the meters, the Servo Amplifier, and possibly an external device through the RECORDER OUTPUT jack.

PERFORMANCE TESTS

4-5. POWER REFERENCE LEVEL TEST (Cont'd)

NOTE

The Power Meter may be returned to the nearest Hewlett-Packard office to have the power reference oscillator checked and/or adjusted. Refer to Section II, PACKAGING.

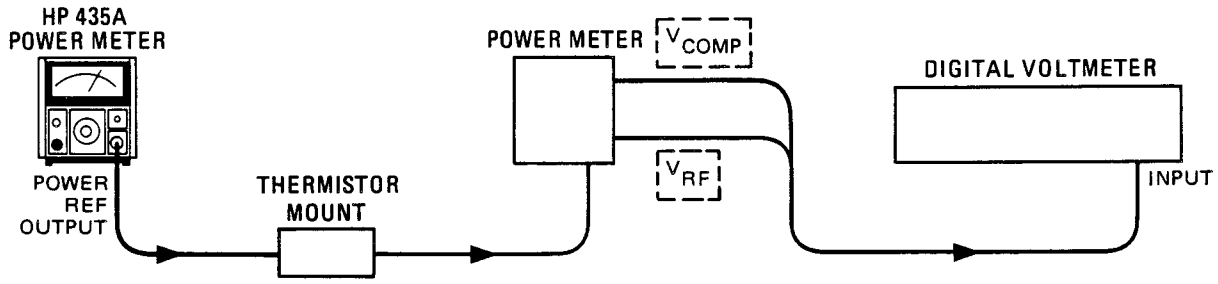


Figure 4-1. Power Reference Level Test Setup

EQUIPMENT:

Power Meter	HP 432A
Thermistor Mount	HP 478A-H75
Digital Voltmeter (DVM)	HP 3455A

PROCEDURE:

1. Set up the DVM to measure resistance. Connect the DVM between the V_{RF} connector on the rear panel of the 432A and pin 1 of the thermistor mount end of the 432A interconnect cable.

2. Round off the DVM indication to two decimal places and record this value as the internal bridge resistance (R) of the 432A (approximately 200 ohms).

3. Connect 432A to the Power Meter as shown in Figure 4-1.

4. Set the Power Meter LINE switch to ON (in) and the POWER REF switch to OFF. Then, wait thirty minutes for the 432A thermistor mount to stabilize before proceeding to the next step.

5. Set the 432A RANGE switch to COARSE ZERO and adjust the front-panel COARSE ZERO control to obtain a zero meter indication.

6. Fine zero the 432A on the most sensitive range, then set the 432A RANGE switch to 1 mW.

NOTE

Check that DVM input leads are isolated from chassis ground when performing the next step.

7. Set up the DVM to measure microvolts and connect the positive and negative input leads, respectively, to the V_{COMP} and V_{RF} connectors on the rear panel of the 432A.

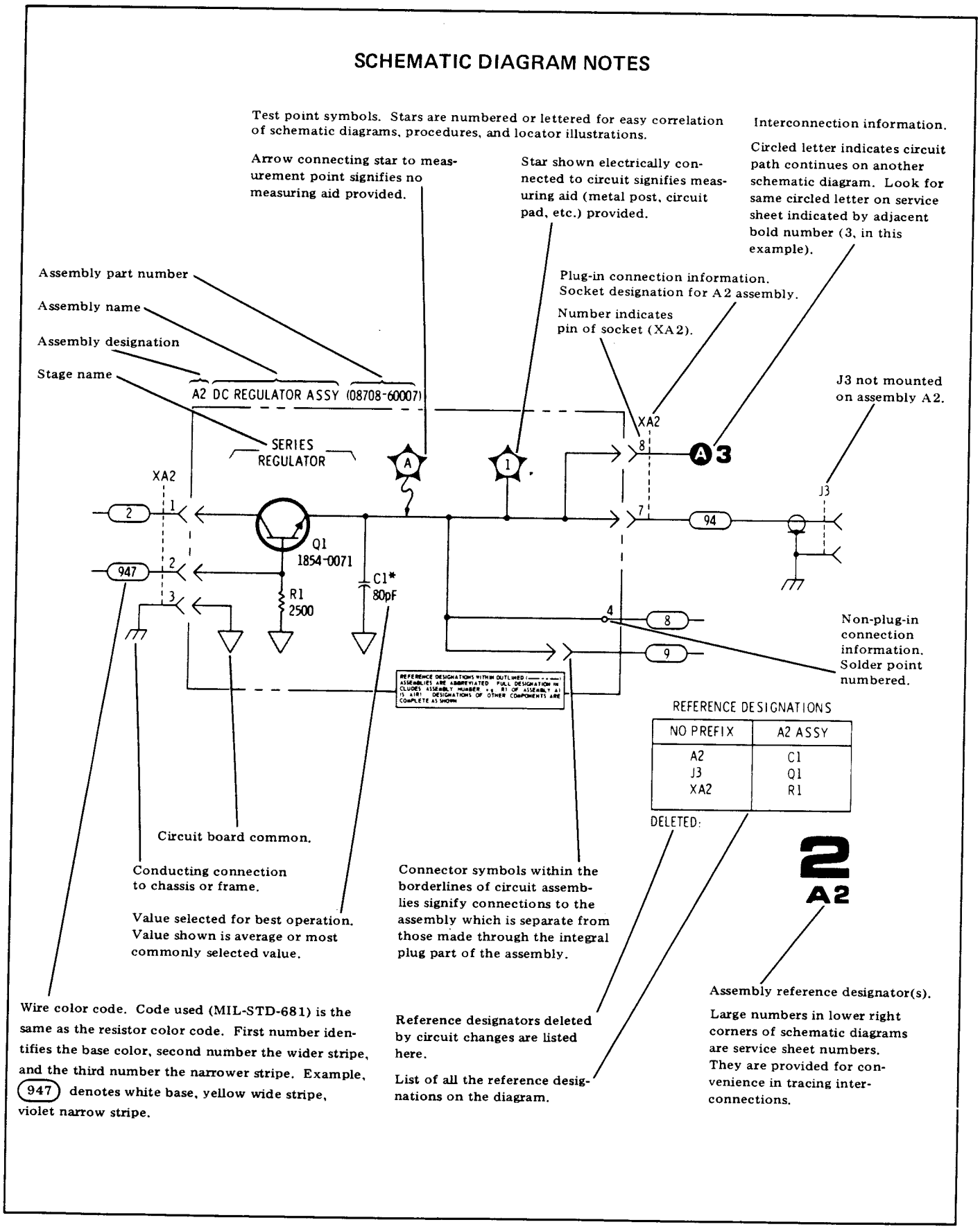


Figure 8-5. Schematic Diagram Notes (2 of 3)

PERFORMANCE TESTS

4-5. POWER REFERENCE LEVEL TEST (Cont'd)

8. Observe the indication on the DVM. If less than 400 microvolts, proceed to the next step. If 400 microvolts or greater, press and hold the 432A FINE ZERO switch and adjust the COARSE ZERO control so that the DVM indicates 200 microvolts or less. Then, release the FINE ZERO switch and proceed to the next step.

9. Round off the DVM indication to the nearest microvolt and record this value as V_0.

10. Set the Power Meter POWER REF switch to ON (in) and record the indications observed on the DVM as V_1.

11. Disconnect the DVM negative input lead from the V_{RF} connector on the 432A and reconnect it to 432A chassis ground. Record the new indication observed on the DVM as V_{COMP}.

12. Calculate the power reference oscillator output level (P_{RF}) from the following formula:

$$P_{RF} = \frac{2V_{COMP}(V_1 - V_0) + V_0^2 - V_1^2}{4R\ (\text{CALIBRATION FACTOR})}$$

Where:

P_{RF} = power reference oscillator output level

V_{COMP} = previously recorded value

V_1 = previously recorded value

V_0 = previously recorded value

R = previously recorded value

CALIBRATION FACTOR = value for thermistor mount at 50 MHz (traceable to the National Bureau of Standards)

13. Verify that the P_{RF} is within the following limits:

Min.	Actual	Max.
0.981 mW	_____	1.019 mW

SCHEMATIC DIAGRAM NOTES

* Asterisk denotes a factory-selected value. Value shown is typical. Part might be omitted.

Tool-aided adjustment. ○ Manual control.

Encloses front-panel designation.

Encloses rear-panel designation.

Circuit assembly borderline.

Other assembly borderline. Also used to indicate mechanical interconnection (ganging).

Heavy line with arrows indicates path and direction of main signal.

Heavy dashed line with arrows indicates path and direction of main feedback.

CW Wiper moves toward CW with clockwise rotation of control (as viewed from shaft or knob).

(1) Numbered Test point. Measurement aid provided.

(A) Lettered Test point. No measurement aid provided.

Encloses wire color code. Code used is the same as the resistor color code. First number identifies the base color, second number identifies the wider stripe, third number identifies the narrower stripe. Eg., (947) denotes white base, yellow wide stripe, violet narrow stripe.

A direct conducting connection to the earth, or a conducting connection to a structure that has a similar function (e.g., the frame of an air, sea or land vehicle).

A conducting connection to a chassis or frame.

Common connections. All like-designated points are connected.

K6 Letter = off-page connection.
Number = Service Sheet number for off-page connection.

Figure 8-5. Schematic Diagram Notes (1 of 3)

PERFORMANCE TESTS

4-6. ZERO CARRYOVER TEST

SPECIFICATION: ±0.5% of full scale when zeroed in the most sensitive range.

DESCRIPTION: After the Power Meter is initially zeroed, the change in the meter reading is monitored at the RECORDER OUTPUT as the instrument is stepped through its ranges. The meter readings take into account noise and drift because zero carryover and the noise drift readings cannot be separated. Refer to Table 5-1 if the results are not within the limits.

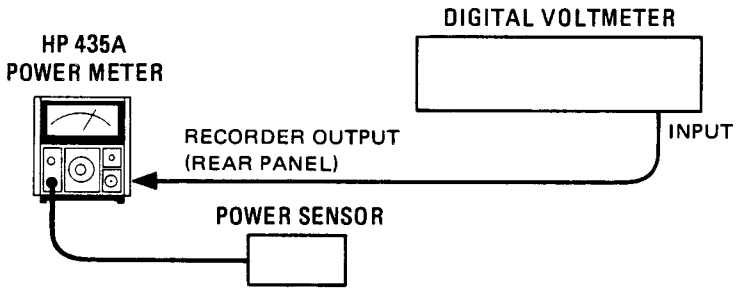


Figure 4-2. Zero Carryover Test Setup

EQUIPMENT:
Digital Voltmeter ..... HP 3455A
Power Sensor ..... HP 8481A/H or 8482A/H

PROCEDURE

1. Set the DVM RANGE control to 100 mVdc.
2. Set the Power Meter Switches as follows:
   CAL FACTOR 100%
   RANGE position ..... fully ccw
   POWER REF (rear panel) ... OFF
3. Connect the equipment shown in Figure 4-2.
4. Press the front panel ZERO switch and wait for the meter indicator's position to stabilize. Verify that the DVM reads 0 ±0.9 mVdc. Release the ZERO switch.
5. Verify that the RECORDER OUTPUT falls within the limits shown on the table for each range. Record the readings.

RANGE Switch Position	Results			RANGE Switch Position	Results		
	Min.	Actual	Max.		Min.	Actual	Max.
	mVdc	mVdc	mVdc		mVdc	mVdc	mVdc
fully ccw	-15	_____	+15	5 steps cw	-5	_____	+5
1 step cw	-17	_____	+17	6 steps cw	-5	_____	+5
2 steps cw	-14	_____	+14	7 steps cw	-5	_____	+5
3 steps cw	-11	_____	+11	8 steps cw	-5	_____	+5
4 steps cw	-8	_____	+8	fully cw	-5	_____	+5

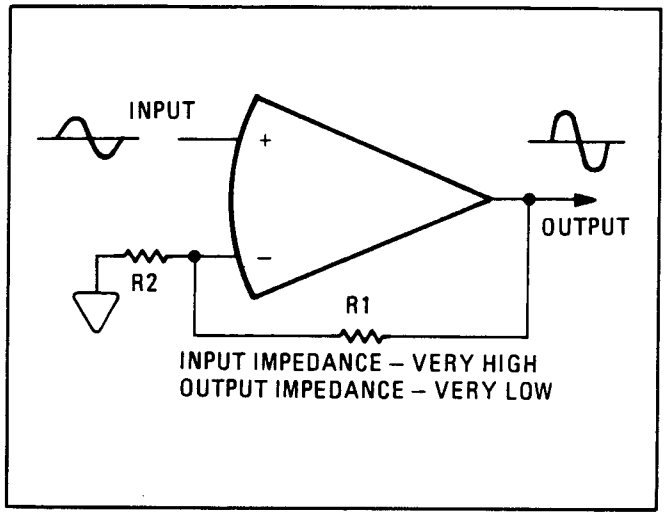


Figure 8-3. Non-Inverting Amplifier (Gain = 1 + R_1/R_2)

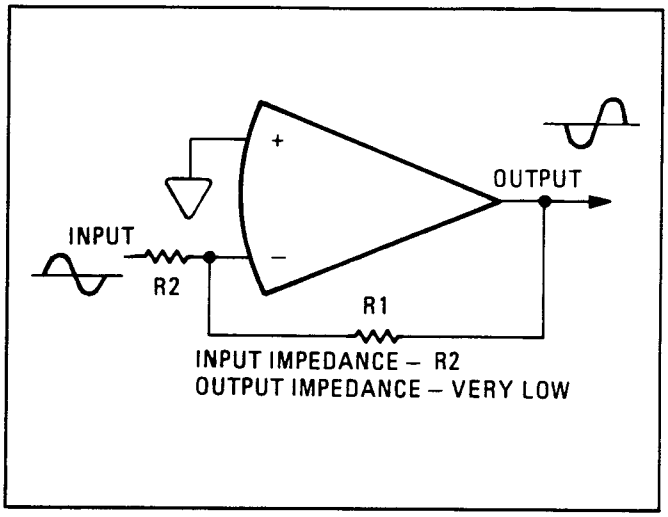


Figure 8-4. Inverting Amplifier (Gain = $-R_1/R_2$)

PERFORMANCE TESTS

4-7. INSTRUMENTATION ACCURACY TEST WITH CALIBRATOR

SPECIFICATION: ±1% of full scale on all ranges.

DESCRIPTION: Instrumentation accuracy is verified by coupling a full-scale reference input from the HP 11683A Calibrator to the Power Meter on each range. Verify that the RECORDER OUTPUT level is within ±1% plus noise and drift.

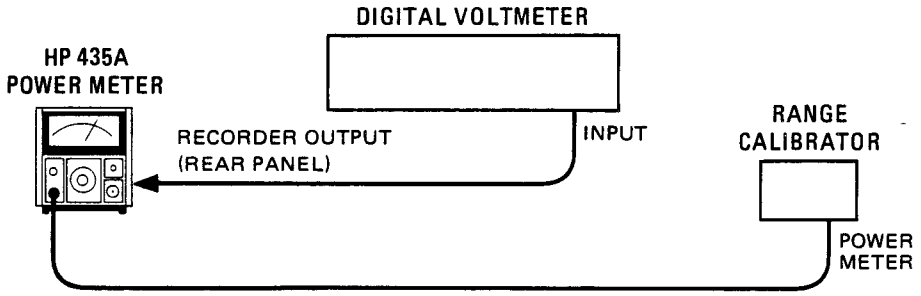


Figure 4-3. Instrumentation Accuracy Test Setup with Calibrator

EQUIPMENT:
Digital Voltmeter ..... HP 3455A
Range Calibrator ..... HP 11683A

PROCEDURE:

1. Set the 11683A RANGE switch to 1 mW, the FUNCTION switch to CALIBRATE and the POLARITY switch to NORMAL.
2. Set the Power Meter RANGE switch 5 steps from the fully ccw position.
3. Set the DVM RANGE switch to 1000 mVdc.
4. Connect the equipment as shown in Figure 4-3.
5. Adjust the front panel CAL ADJ control to provide a reading of 1000 ±2 mVdc.

CAUTION

To avoid damage to the meter, set the Calibrator's FUNCTION control to STANDBY while changing the RANGE control settings on the Power Meter and Calibrator.

Table 8-1. Etched Circuit Soldering Equipment

Item	Use	Specification	Item Recommended
Soldering tool	Soldering Unsoldering	Wattage rating: 47½—56½ Tip Temp: 850—900 degrees	Ungar No. 776 handle with *Ungar No. 4037 Heating Unit
Soldering tip*	Soldering Unsoldering	*Shape: pointed	*Ungar No. PL111
De-soldering Aid	To remove molten solder from connection	Suction device	Soldapult by Edsyn Co. Arleta, California
Resin (flux)	Remove excess flux from soldered area before application of protective coating.	Must not dissolve etched circuit base board material or conductor bonding agent.	Freon, Aceton, Lacquer Thinner, Isopropyl Alcohol (100% dry)
Solder	Component replacement Circuit board repair Wiring	Resin (flux) core, high tin content (60/40 tin/lead), 18 gauge (SWG) preferred	
Protective coating	Contamination, corrosion protection	Good electrical insulation, corrosion-prevention properties	Silicone Resin such as GE DRI-FILM**88

*For working on etched boards; for general purpose work, use Ungar No. 1237 Heating Unit (37.5W, tip temperature of 750—800 degrees) and Ungar No. PL113, 1/8-inch chisel tip.

**General Electric Co., Silicone Products Dept., Waterford, New York, U.S.A.

Operational Amplifiers (Cont'd)

When troubleshooting an operational amplifier circuit, measure the voltages at the two inputs; the difference between these voltages should be less than 10 mV. (Note: This troubleshooting procedure will not work for operational amplifiers which are configured as comparators.) A difference voltage much greater than 10 mV indicates trouble in the amplifier or its external circuitry. Usually, this difference will be several volts and one of the inputs will be very close to one of the supply voltages (e.g., +12V or −12V).

Next, check the amplifier's output voltage. It will probably also be close to one of the supply voltages (e.g., ground, +12V, or −12V). Check to see that the output conforms to the inputs. For example, if the inverting input is more positive than the non-inverting input, the output should be negative; if the non-inverting input is more positive than the inverting input, the output should be positive. If the output conforms to the inputs, check the amplifier's external circuitry. If the amplifier's output does not conform to its inputs, it is probably defective.

Figures 8-2, 8-3, and 8-4 show typical operational amplifier configurations. Figure 8-2 shows a non-inverting buffer amplifier with a gain of 1. Figure 8-3 is a non-inverting amplifier with gain determined by R1 and R2. Figure 8-4 is an inverting amplifier with a gain determined by R1 and R2.

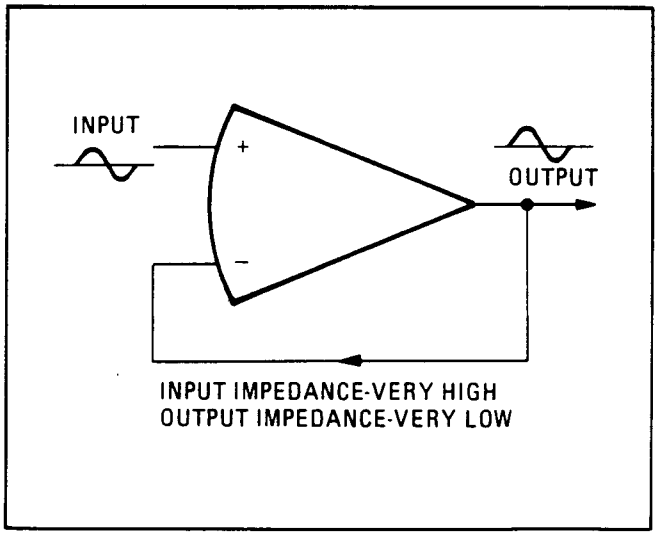


Figure 8-2. Non-Inverting Amplifier (Gain = 1)

PERFORMANCE TESTS

4-7. INSTRUMENTATION ACCURACY TEST WITH CALIBRATOR (Cont'd)

6. Set the Power Meter RANGE switch to each possible position in turn. Set the 11683A RANGE switch to the same position and verify that the DVM reading, which includes noise and drift, is within the limits shown in the table below.

RANGE Switch Position	Results			RANGE Switch Position	Results		
	Min.	Actual	Max.		Min.	Actual	Max.
	mVdc	mVdc	mVdc		mVdc	mVdc	mVdc
fully ccw	+975	_____	+1025	5 steps cw	+998	_____	+1002
1 step cw	+978	_____	+1022	6 steps cw	+990	_____	+1010
2 steps cw	+981	_____	+1019	7 steps cw	+990	_____	+1010
3 steps cw	+984	_____	+1016	8 steps cw	+990	_____	+1015
4 steps cw	+987	_____	+1013	fully cw	+990	_____	+1015

8-6. RECOMMENDED TEST EQUIPMENT

Equipment recommended in Table 1-2 should be used for testing and troubleshooting the Power Meter to ensure that it is operating within the specifications listed in Table 1-1. Test equipment that meets or exceeds the critical specifications listed may be used in place of recommended equipment.

8-7. REPAIR

After repairing any circuitry within the Power Meter, refer to Section V and perform the adjustments.

Perform the tests in Section IV to ensure that the instrument is operating within the specified limits.

NOTE

If the A3 Power Reference Assembly is repaired, see the Power Reference Output test in Section IV for instructions on setting the power output level.

8-8. GENERAL SERVICE INFORMATION

8-9. Etched Circuit Boards

The etched circuit boards used in Hewlett-Packard equipment are the plated-through type consisting of metallic conductors bonded to both sides of an insulating material. The metallic conductors are extended through the component holes or interconnect holes by a plating process. Soldering can be performed on either side of the board with equally good results. Table 8-1 lists recommended tools and materials for use in repairing etched circuit boards. Following are recommendations and precautions pertinent to etched circuit repair work.

a. Avoid unnecessary component substitution; it can result in damage to the circuit board and/or adjacent components.

b. Do not use a high power soldering iron on etched circuit boards. Excessive heat may lift a conductor or damage the board or a component.

CAUTION

Do not use a sharp metal object such as an awl or twist drill to remove solder from component mounting holes. Sharp objects may damage the plated-through conductor.

c. Use a suction device or wooden toothpick to remove solder from component mounting holes.

d. After soldering, remove excess flux from the soldered areas and apply a protective coating to prevent contamination and corrosion.

8-10. Component Replacement

The following procedures are recommended when component replacement is necessary:

a. Remove defective component from board.

b. If component was unsoldered, remove solder from mounting holes with a suction device or a wooden toothpick.

c. Shape leads of replacement component to match mounting hole spacing.

NOTE

Although not recommended when both sides of the circuit board are accessible, axial lead components such as resistors and tubular capacitors, can be replaced without unsoldering. Clip leads near body or defective component, remove component and straighten leads left in board. Wrap leads of replacement component one turn around original leads. Solder wrapped connection and clip off excess lead.

d. Insert component leads into mounting holes and position component as original was positioned. Do not force leads into mounting holes; sharp lead ends may damage the plated-through conductor.

8-11. Operational Amplifiers

The source of gain in an operational amplifier can be characterized as an ideal, differential voltage amplifier having low output impedance, high input impedance, and very high differential gain. The output of an operational amplifier is proportional to the difference in the voltages applied to the two input terminals. In use, the amplifier output drives the input voltage difference close to zero through a feedback path.

PERFORMANCE TESTS

4-8. CALIBRATION FACTOR TEST

SPECIFICATION: 16-position switch normalizes meter reading to account for calibration factor or effective efficiency. Range 85% to 100% in 1% steps.

DESCRIPTION: After the Power Meter is zeroed on the most sensitive range, a 1 mW input level is applied to the Power Meter and the CAL ADJ control is set to obtain a 1.000 mW indication. Then the CAL FACTOR switch is stepped through its 16 positions and the meter is monitored to ensure that the proper indication is obtained for each position.

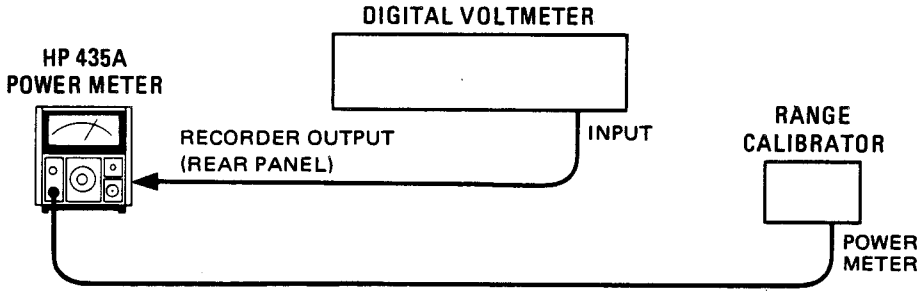


Figure 4-4. Calibration Factor Test Setup

EQUIPMENT:
Digital Voltmeter ..... HP 3455A
Range Calibrator ..... HP 11683A

PROCEDURE:

1. Set the 11683A RANGE switch to 1 mW, the FUNCTION switch to CALIBRATE and the POLARITY switch to NORMAL.
2. Set the Power Meter RANGE switch 5 steps from the fully ccw position.
3. Set the DVM RANGE switch to Vdc.
4. Connect the equipment as shown in Figure 4-4.
5. Set the front panel CAL ADJ control to provide a reading of 1000 ±2 mVdc on the DVM.
6. Set the CAL FACTOR switch to each position and verify that the indications observed at each position are within the limits specified in the following table.

CAL FACTOR Switch Position	Results			CAL FACTOR Switch Position	Results		
	Min.	Actual	Max.		Min.	Actual	Max.
	Vdc	Vdc	Vdc		Vdc	Vdc	Vdc
100	0.994	_____	1.006	92	1.081	_____	1.093
99	1.004	_____	1.016	91	1.093	_____	1.105
98	1.014	_____	1.026	90	1.105	_____	1.117
97	1.025	_____	1.037	89	1.118	_____	1.130
96	1.036	_____	1.048	88	1.130	_____	1.142
95	1.047	_____	1.059	87	1.143	_____	1.155
94	1.058	_____	1.070	86	1.157	_____	1.169
93	1.069	_____	1.081	85	1.170	_____	1.182

Troubleshooting (Cont'd)

On Service Sheet 1, a malfunction is isolated to an assembly or stage. After turning to the appropriate service sheet, troubleshooting continues on a stage and/or component level.

DC voltages and, in some cases, ac voltages and waveforms are included on the schematics. Test points are physically located on printed circuit boards and have assigned reference designators and symbols on the schematics. The waveforms and/or voltages refer to the test points and other important circuit junctions.

A circuit board extender, which provides easy access for troubleshooting, is shown in Figure 8-1. The extender may be ordered through your nearest HP office. Refer to Equipment Available in Section I.

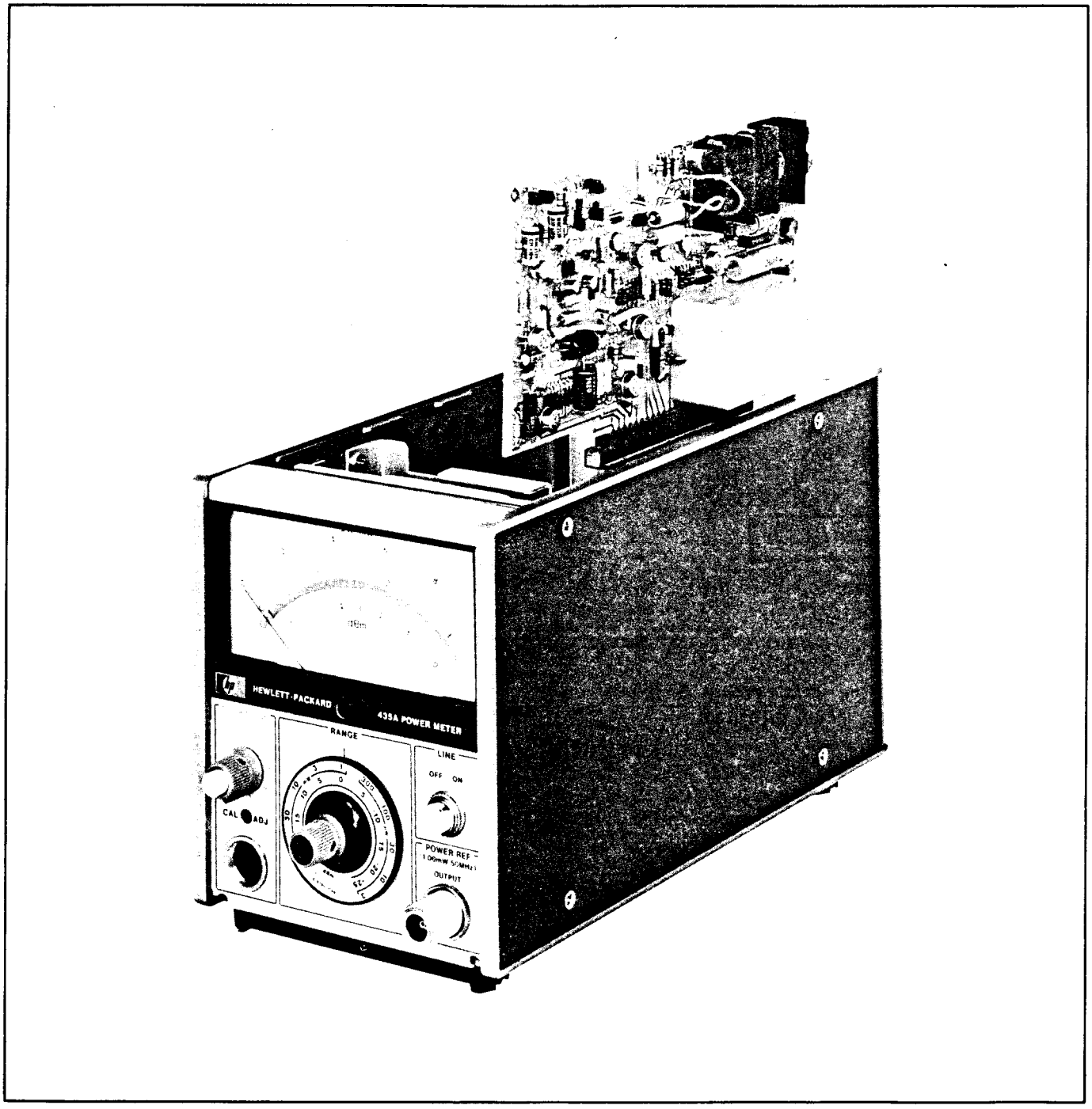


Figure 8-1. A4 Assembly Extended for Service

Table 4-1. Performance Test Record

Hewlett-Packard Company
Model 435A
Power Meter

Tested By _____

Serial Number _____

Date _____

Para No.	Test Description	Results		
		Min.	Actual	Max.
4-5.	Power Reference Accuracy	mW	mW	mW
	1 mW	0.981	_____	1.019
4-6.	Zero Carryover	mVdc	mVdc	mVdc
	fully ccw	-15	_____	+15
	1 step cw	-17	_____	+17
	2 steps cw	-14	_____	+14
	3 steps cw	-11	_____	+11
	4 steps cw	-8	_____	+8
	5 steps cw	-5	_____	+5
	6 steps cw	-5	_____	+5
	7 steps cw	-5	_____	+5
	8 steps cw	-5	_____	+5
	fully cw	-5	_____	+5
4-7.	Instrumentation Accuracy	mVdc	mVdc	mVdc
	fully ccw	+975	_____	+1025
	1 step cw	+978	_____	+1022
	2 steps cw	+981	_____	+1019
	3 steps cw	+984	_____	+1016
	4 steps cw	+987	_____	+1013
	5 steps cw	+998	_____	+1002
	6 steps cw	+990	_____	+1010
	7 steps cw	+990	_____	+1010
	8 steps cw	+990	_____	+1015
	fully cw	+990	_____	+1015
4-8.	Calibration Factor	Vdc	Vdc	Vdc
	100	0.994	_____	1.006
	99	1.004	_____	1.016
	98	1.014	_____	1.026
	97	1.025	_____	1.037
	96	1.036	_____	1.048
	95	1.047	_____	1.059
	94	1.058	_____	1.070
	93	1.069	_____	1.081
	92	1.081	_____	1.093
	91	1.093	_____	1.105
	90	1.105	_____	1.117
	89	1.118	_____	1.130
	88	1.130	_____	1.142
	87	1.143	_____	1.155
	86	1.157	_____	1.169
	85	1.170	_____	1.182

SECTION VIII
SERVICE

8-1. INTRODUCTION

Service information is provided in this section. General service information relates to troubleshooting. Repair information relates to performance testing and adjustments after repairs are made. Each service sheet includes principles of operation and troubleshooting information, a component location diagram and a schematic diagram.

The last foldout in the manual shows the location of each assembly, chassis mounted component and adjustable component.

8-2. SAFETY CONSIDERATIONS

Although this instrument has been designed in accordance with international safety standards, this manual contains information, cautions and warnings which must be followed to avoid personal injury and damage to the instrument (see Sections II, III, and V). Service and adjustments should be performed only by qualified service personnel.

WARNINGS

Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnection of the protective earth terminal is likely to make the instrument dangerous. Intentional interruption is prohibited.

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

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

For continued protection against fire hazard, replace the line fuse only with a 250V fuse of the same current rating and type (for example, slow blow, time delay, etc.). Do not use repaired fuses or short circuited fuseholders.

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

The service information is often used with power supplied and protective covers removed from the instrument. Energy available at many points may, if contacted, result in personal injury.

8-3. SERVICE SHEETS

Each service sheet normally includes principles of operation and troubleshooting information, a component location diagram and a schematic, all of which apply to a specific portion of circuitry within the instrument.

Service Sheet 1 includes an overview of the instrument operation, troubleshooting on an assembly or stage level and a troubleshooting block diagram. The block diagram also serves as an "index" for the other service sheets.

The Schematic Diagram Notes, Figure 8-5, aid in interpreting the schematics.

8-4. Principles of Operation

The operation of the circuitry shown by the schematic diagram is explained in the Principles of Operation. This information is outlined by using assembly and stage names. These names also separate circuit areas on the schematic diagrams.

8-5. Troubleshooting

This information is in the form of hints and suggestions pertaining to problems one may encounter while troubleshooting the Power Meter. The troubleshooting information is located on the left-hand foldout of the service sheet following the Principles of Operation.

SECTION V
ADJUSTMENTS

5-1. INTRODUCTION

This section describes the adjustments which will return the Power Meter to peak operating condition after repairs are completed.

If the adjustments are to be considered valid, the Power Meter must have a half hour warmup and the line voltage must be within +5 to −10% of nominal.

The adjustment procedure entitled "Power Meter Adjustments with 50Ω Power Sensor" is to be performed only when the HP Model 11683A Range Calibrator is not available.

5-2. SAFETY CONSIDERATIONS

Although this instrument has been designed in accordance with international safety standards, this manual contains information, cautions and warnings which must be followed to avoid personal injury and damage to the instrument (see Sections II and III). Service and adjustments should be performed only by qualified service personnel.

WARNINGS

Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnection of the protective earth terminal is likely to make the instrument dangerous. Intentional interruption is prohibited.

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

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

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

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

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

5-3. EQUIPMENT REQUIRED

The test equipment required for the adjustment procedures is listed in Table 1-2, Recommended Test Equipment. The critical specifications of substitute test instruments must meet or exceed the standards listed in the table if the Power Meter is to meet the standards set forth in Table 1-1, Specifications.

5-4. FACTORY SELECTED COMPONENTS

Factory selected components are indicated on the schematic and replaceable parts list with an asterisk (*) immediately following the reference designator. The nominal value of the component is listed. Table 5-1 lists the parts by reference designator and provides an explanation of how the component is selected, the normal value range and a reference to the appropriate service sheet. The Manual Changes supplement will update any changes to factory selected component information.

5-5. ADJUSTMENT LOCATIONS

All the adjustments for the Power Meter are contained on the A4 assembly except the front panel CAL ADJ control and POWER REF OUTPUT level control. The last foldout in this manual contains a table which cross-references all pictorial and schematic locations of the adjustment controls. The accompanying figure shows the locations of the adjustable controls, assemblies and chassis-mounted parts.

ADJUSTMENTS

Table 5-1. Factory Selected Components

Reference Designator	Basis of Selection	Range of Values	Service Sheet
A3R5	A3R5 is selected for a power reference output of 1 mW (into 50Ω) if this value is outside the adjustment range of LEVEL ADJ A3R4.	7.1 to 7.5 kΩ	4
A4C11, C14	See Multivibrator Adjustment (paragraph 5-7).	0.0082 to 0.01 μF	2
A4R12, R16	A4R12 and R16 are selected for correct zero carryover between ranges. See Zero Carryover Test (paragraph 4-6) for the limits for each range.	3.16 to 4.64 kΩ	2
A4R66	A4R66 is selected for a full-scale reading (100 mW) with an accurate 10 mW input after completing Power Meter Adjustments with Calibrator (see paragraph 5-9). Hewlett-Packard recommends using a Model 11683A Calibrator to achieve the needed accuracy for selecting this resistor. The DVM reading at the Power Meter's RECORDER OUTPUT will be 1000 ±3 mVdc with the correct resistor in place.	150 to 250 kΩ	2
A4VR1, VR2	A4VR1 and VR2 are selected to achieve accuracy on the top two ranges when the accuracy on other ranges is within specifications. See Instrumentation Accuracy Test with Calibrator (paragraph 4-7) for the limits for each range.	2.37 to 2.61V	2

INSTRUMENT MODIFICATIONS

7-4. MODIFICATION OF A4 ASSEMBLY (SERIAL PREFIX 1234A)

The Power Meter's A4 assembly must be changed to HP Part Number 00435-60001 Revision B (B-130304) when used with a Power Sensor Cable of length greater than 5 feet. The new board, which may be used without further modification, may be ordered through your nearest Hewlett-Packard office.

NOTE

Perform the adjustments in Section V after installing the new board.

7-5. MODIFICATION OF FRONT PANEL (SERIAL PREFIXES 1629A AND BELOW)

The connector on the Reference Oscillator cable W3 (W9 for Option 003) was changed starting with instruments with serial number prefix 1701A. The new connector has one instead of two flat surfaces. If W3 or W9 must be replaced on instruments with serial number prefixes 1629A or less, the new cable must be ordered and its installation will require a slight modification of the front panel. This modification is accomplished by rounding one of the front panel "flats" with a file.

ADJUSTMENTS

5-6. POWER REFERENCE OSCILLATOR LEVEL ADJUSTMENT

REFERENCE: Service Sheet 4.

DESCRIPTION: The power reference oscillator output is factory-adjusted to 1 mW ±0.7% using a special measurement system accurate to 0.5% (traceable to the National Bureau of Standards) and allowing for a 0.2% transfer error. To ensure maximum accuracy in readjusting the power reference oscillator, the following procedure provides step-by-step instructions for using specified Hewlett-Packard instruments of known capability. If equivalent instruments are used, signal acquisition criteria may vary and reference should be made to the manufacturer's guidelines for operating the equipment.

NOTE

The Power Meter may be returned to the nearest HP office to have the power reference oscillator checked and/or adjusted. Refer to Section II, PACKAGING.

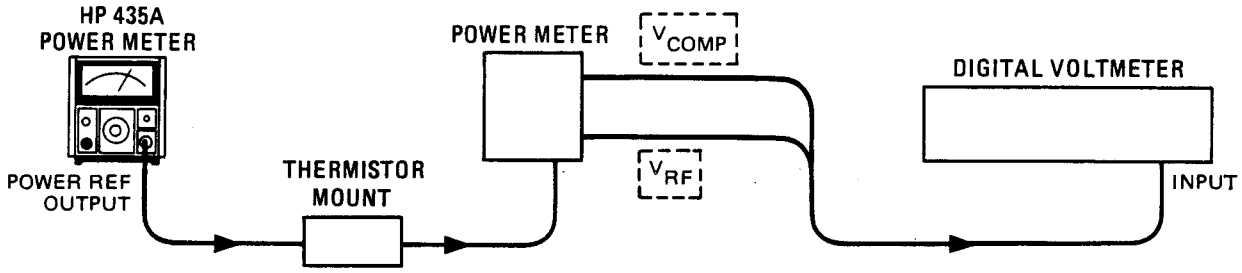


Figure 5-1. Power Reference Oscillator Level Adjustment Setup

EQUIPMENT:

Power Meter	HP 432A
Thermistor Mount	HP 478A-H75
Digital Voltmeter (DVM)	HP 3455A

PROCEDURE:

1. Set up the DVM to measure resistance and connect the DVM between the V_{RF} connector on the rear panel of the 432A and pin 1 on the thermistor mount end of the 432A interconnect cable.

2. Round off the DVM indication to two decimal places and record this value as the internal bridge resistance (R) of the 432A (approximately 200 ohms).

3. Connect the 432A to the Power Meter as shown in Figure 5-1.

4. Set the Power Meter LINE switch to ON (in) and the POWER REF switch to OFF. Then, wait thirty minutes for the 432A thermistor mount to stabilize before proceeding to the next step.

5. Set the 432A RANGE switch to COARSE ZERO and adjust the front-panel COARSE ZERO control to obtain a zero meter indication.

MANUAL CHANGES

CHANGE H

Figure 3-3:
Change the **Fuse** information to:
Fuse: 1/4A for 100/120 Vac; 1/8A for 220/240 Vac.

Table 6-2:
Replace the F1 listing with the following:
F1 2110-0004 (CD1) FUSE .25A 250V FAST-BLO 1.25 X .25 UL IEC (FOR 100, 120 VAC OPERATION).
F1 2110-0027 (CD8) FUSE .125A 250V NORM-BLO 1.25 X .25 UL IEC (FOR 220, 240 VAC OPERATION).

Change MP8 part number to 00435-00003 (CD4).

CHANGE I

Figure 3-3:
Change the **Fuse** information to:
Fuse: 100 mA.

Table 6-2:
Change A3C2 and A3C3 to 0160-3964 (CD1) CAPACITOR-FXD 2000 pF +100 −0% 300 WVDC.
Change A4C39 to 0180-0373 (CD2) CAPACITOR-FXD .68 μF ±10% 35 VDC TA.
Delete A4CR13.
Replace the entry for both fuses (F1) with:
F1 2110-0234 (CD9) FUSE 100 mA SLO-BLO.

Service Sheet 4 (schematic):
Change A3C2 and C3 to 2000 pF.

Service Sheet 5 (schematic):
Change the value of C39 to 0.68 μF.
Delete CR13.

CHANGE J

Table 6-2:
Change A4VR6 to 1902-3404 (CD9) DIODE-ZNR 82.5V 5% DO-7 PD=.4W TC=+.082%.

Service Sheet 5 (schematic):
Change the voltage for VR6 to 82.5V.

CHANGE K

Table 6-2:
Change S3 to 3101-0070 (CD3) SWITCH-SL DPDT-NS MINTR .5A 125 VAC/DC (POWER REF. SWITCH).

CHANGE L

Table 6-2:
Change A4CR1 and A4CR2 to 1901-0518 (CD8) DIODE-SCHOTTKY.

ADJUSTMENTS

5-6. POWER REFERENCE OSCILLATOR LEVEL ADJUSTMENT (Cont'd)

6. Fine zero the 432A on the most sensitive range, then set the 432A RANGE switch to 1 mW.

NOTE

Ensure that the DVM input leads are isolated from chassis ground when performing the next step.

7. Set up the DVM to measure microvolts and connect the positive and negative input leads, respectively, to the V_{COMP} and V_{RF} connectors on the rear panel of the 432A.

8. Observe the indication on the DVM. If less than 400 microvolts, proceed to the next step. If 400 microvolts or greater, press and hold the 432A FINE ZERO switch and adjust the COARSE ZERO control so that the DVM indicates 200 microvolts or less. Then release the FINE ZERO switch and proceed to the next step.

9. Round off the DVM indication to the nearest microvolt and record this value as V_0.

10. Disconnect the DVM negative input lead from the V_{RF} connector on the 432A and reconnect it to chassis ground.

11. Set the Power Meter POWER REF switch to ON and record the indication observed on the DVM as V_{COMP}.

12. Disconnect the DVM negative input lead from chassis ground and reconnect it to the V_{RF} connector on the rear panel of the 432A. The DVM is now set up to measure V_1 which represents the power reference oscillator output level.

13. Calculate the value of V_1 equal to 1 milliwatt from the following equation:

$$V_1 - V_0 = V_{COMP} - \sqrt{(V_{COMP})^2 - (10^{-3})\,(4R)\,(\text{EFFECTIVE EFFICIENCY})}$$

Where:

V_0 = previously recorded value

V_{COMP} = previously recorded value

10^{-3} = 1 milliwatt

R = previously recorded value

EFFECTIVE EFFICIENCY = value for thermistor mount at 50 MHz (traceable to the National Bureau of Standards).

14. Remove the Power Meter top cover and adjust LEVEL ADJ potentiometer A3R4 so that the DVM indicates the calculated value of V_1.

MANUAL CHANGES

CHANGE G (Cont'd)

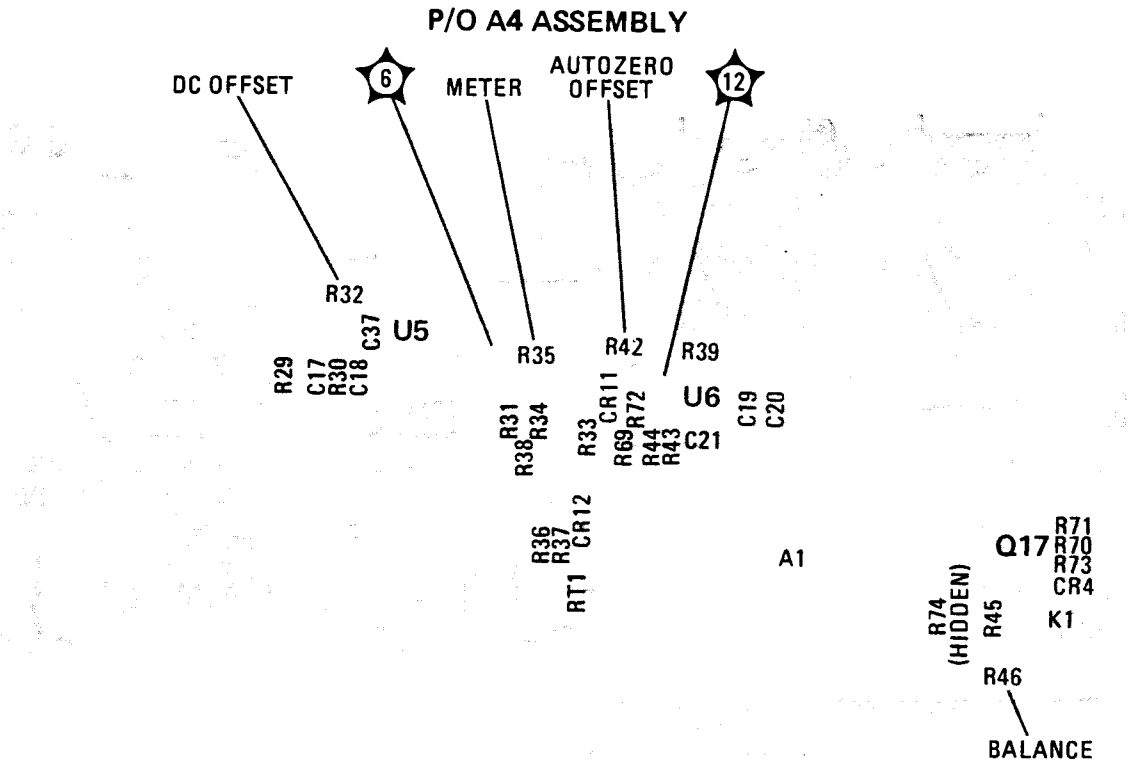


Figure 7-16. P/O A4 Assembly (DC Ampl/Auto Zero) Component and Test Point Locations Backdating (P/O Change G)

ADJUSTMENTS

5-6. POWER REFERENCE OSCILLATOR LEVEL ADJUSTMENT (Cont'd)

TYPICAL CALCULATIONS:

1. ACCURACY

DVM Measurements:	(V_{COMP})	±0.018%
(HP 3455A –90 days, 23°C ±5°C)	($V_1 - V_0$)	±0.023%
	(R)	±0.03%
Math Assumptions:		±0.01%
EFFECTIVE EFFICIENCY CAL (NBS):		±0.5%
MISMATCH UNCERTAINTY:		
(Source & Mount SWR ≤1.05)		±0.1%
		≤±0.7%

2. MATH ASSUMPTIONS:

$$P_{RF} = \frac{2V_{COMP}(V_1 - V_0) + V_0^2 - V_1^2}{(4R)\,(\text{EFFECTIVE EFFICIENCY})}$$

Assume: $V_0^2 - V_1^2 = -(V_1 - V_0)^2$

Since: $-(V_1 - V_0)^2 = -V_1^2 + 2V_1V_0^2$, and

we want: $V_0^2 - V_1^2$, then

the error is: $(-V_1^2 + 2V_1V_0 - V_0)^2 - (V_0^2 - V_1^2) = -2V_0^2 + 2V_1V_0 = 2V_0V_1 - V_0)$

if $2V_0(V_1 - V_0) << 2V_{COMP}(V_1 - V_0)$ i.e., $V_0 << V_{COMP}$, error is negligible

$V_{COMP} \sim 4$ volts. If $V_0 < 400\ \mu V$, error is <0.01%.

(Typically V_0 can be set to <50 μV.)

3. Derivation of Formula for $V_1 - V_0$

$$P_{RF} = \frac{2V_{COMP}(V_1 - V_0) + V_0^2 - V_1^2}{(4R)\,(\text{EFFECTIVE EFFICIENCY})}$$

004

Desired $P_{RF} = 1\ mW = 10^{-3}$

$$\therefore 10^{-3} = \frac{2V_{COMP}(V_1 - V_0) + V_0^2 - V_1^2}{(4R)\,(\text{EFFECTIVE EFFICIENCY})}$$

Let (4R) (EFFECTIVE EFFICIENCY) $(10^{-3}) = K$

Substitute $-(V_1 - V_0)^2$ for $V_0^2 - V_1^2$ (see Match Assemptions under Accuracy)

Then $0 = (V_1 - V_0)^2 - 2V_{COMP}(V_1 - V_0) + K$

or $V_1 - V_0 = V_{COMP} - \sqrt{(V_{COMP})^2 - K}$

MANUAL CHANGES

CHANGE G (Cont'd)

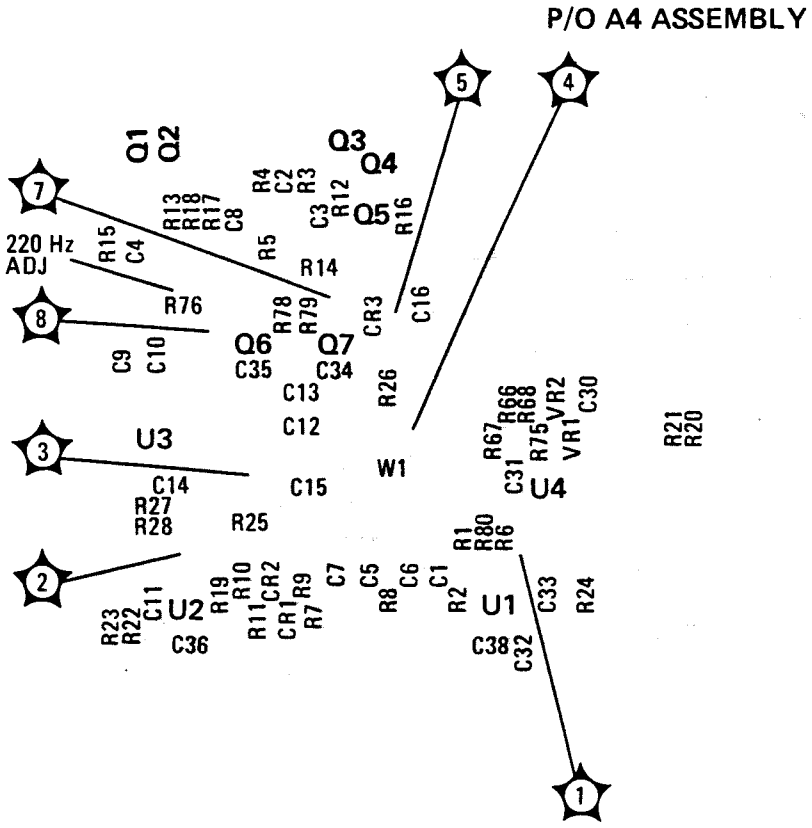


Figure 7-15. P/O A4 Assembly (AC Ampl/Sync Detector) Component and Test Point Locations Backdating (P/O Change G)

ADJUSTMENTS

5-7. MULTIVIBRATOR ADJUSTMENT

REFERENCE: Service Sheet 2.

DESCRIPTION: FREQ potentiometer A4R76 is adjusted to set the reference frequency of the multivibrator which drives the phase detector and the FET power sensor.

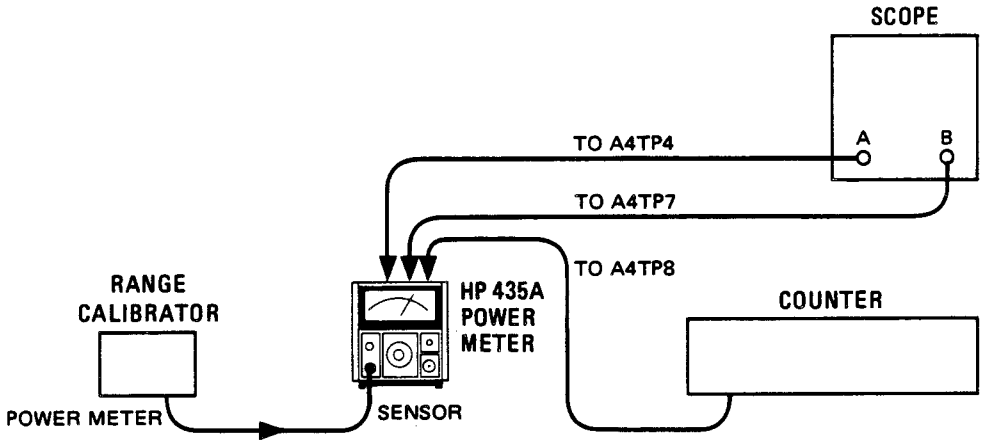


Figure 5-2. Multivibrator Adjustment Setup

EQUIPMENT:

Range Calibrator	HP 11683A
Counter	HP 5314A
Oscilloscope	HP 1740A

PROCEDURE:

1. a. Power Meter switch settings:

CAL FACTOR	100%
POWER REF	OFF
LINE	ON

   b. Range Calibrator switch settings:

FUNCTION	CALIBRATE
POLARITY	NORMAL
LINE	ON

   c. Oscilloscope switch settings:

CH. A	0.05 V/Div. AC coupled
CH. B	0.2 V/Div.
TIME	0.5 ms/Div.
Display	Chopped — Ch. B trigger

2. Connect the equipment as shown in Figure 5-2.

3. Adjust oscilloscope position controls to superimpose waveforms. Establish a horizontal grid line as DC average of the TP4 waveform by turning the 11683A MODE to STANDBY and positioning the Channel A trace on the line. Set the 11683A back to CALIBRATE. Turn the oscilloscope horizontal MAGNIFIER to X10 so that time calibration will be 50 μs/div. See Figure 5-3.

MANUAL CHANGES

CHANGE F (Cont'd)

Service Sheet 5 (schematic):
Change the portion of the schematic as shown below.

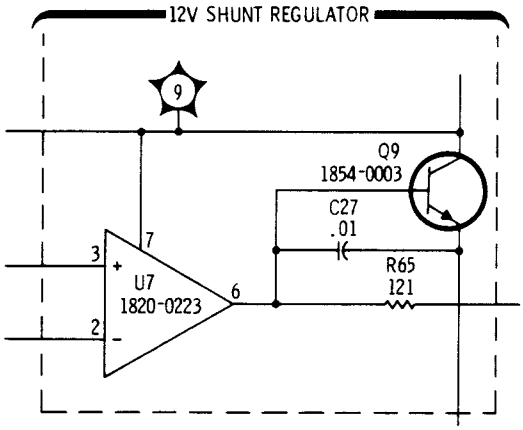


Figure 7-14. P/O A4 Assembly (Power Supply) Schematic Backdating (P/O Change F)

CHANGE G

Table 6-2:
Change A4 to 00435-60029 (CD0) AMPLIFIER/POWER SUPPLY ASSEMBLY.
Delete A4C40—A4C50.

Service Sheet 2 (Component and Test Point Locations):
Replace the figure with Figure 7-15.

Service Sheet 2 (schematic):
Delete the following capacitors and the path between the designated point and the ground indicated:

C40, U4 pin 8 and ⏚B
C41, U4 pin 4 and ⏚B
C42, U2 pin 7 and ⏚C
C43, U3 pin 7 and ⏚C
C44, U2 pin 4 and ⏚C
C45, U3 pin 4 and ⏚C
C50, U1 pin 7 and ⏚B

Change the A4 assembly part number to 00435-60029.
Delete C48 and the path between pins 2 and 3 of U3.
Delete C49 and the path between pins 2 and 3 of U4.

Service Sheet 3 (Component and Test Point Locations):
Replace the figure with Figure 7-16.

Service Sheet 3 (schematic):
Delete C46 and the path between U5 pin 7 and chassis ground.
Delete C47 and the path between U5 pin 4 and chassis ground.
Change the A4 assembly part number to 00435-60029.

Service Sheet 5 (schematic):
Change the A4 assembly part number to 00435-60029.

ADJUSTMENTS

5-7. MULTIVIBRATOR ADJUSTMENT (Cont'd)

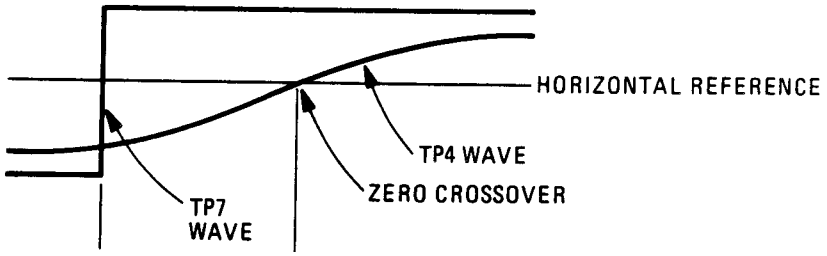


Figure 5-3. 220 Hz Zero Crossover

4. Adjust A4R76 so that the zero crossover lags the square wave by 150 ±10 μs.

5. Check that the counter measures 220 ±12 Hz at TP8. If necessary, adjust A4R76 for a compromise between frequency and phase.

6. If the conditions of steps 4 and 5 cannot be met, change A4C11* or A4C14* as follows:

   a. If the frequency at TP8 is too high, change C14* to 0.01 μF.

   b. If the frequency at TP8 is too low, change C11* to 0.0082 μF.

   c. Repeat steps 4 and 5.

MANUAL CHANGES

CHANGE F (Cont'd)

Service Sheet 3 (schematic):
Delete CR11 and CR12.

Service Sheet 5 (Principles of Operation):
Delete the paragraph titled "Overvoltage Protection Circuit".
Change all references of VR5 to CR8 in the paragraphs under battery test.

Service Sheet 5 (Component and Test Point Locations):
Replace the figure with Figure 7-13 below.

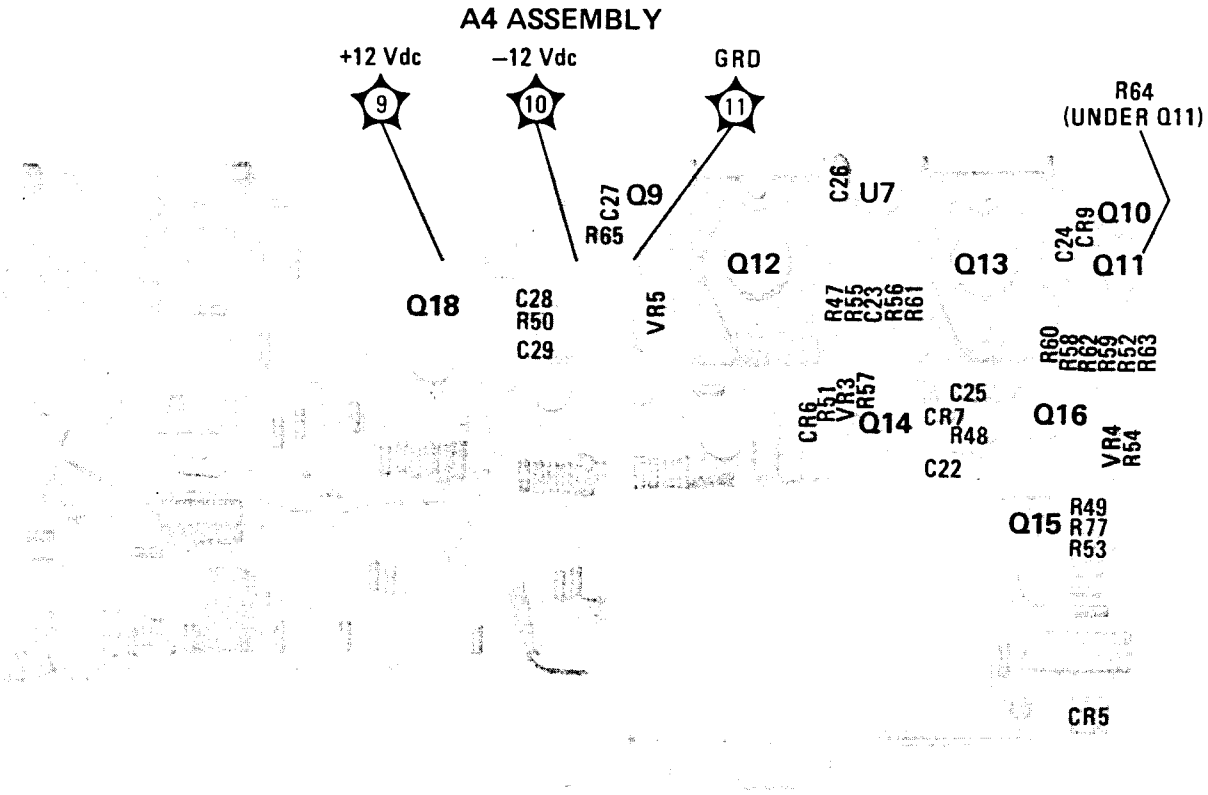


Figure 7-13. P/O A4 Assembly (Power Supply) Component and Test Point Locations Backdating (P/O Change F)

ADJUSTMENTS

5-8. POWER METER ADJUSTMENTS WITH 50Ω POWER SENSOR

NOTES

This adjustment should only be performed when the HP Model 11683A Range Calibrator is not available.

If the adjustments are to be considered valid, the Power Meter must have a half-hour warmup and the line voltage must be within +5 to -10% of nominal.

REFERENCE: Service Sheets 2 and 3.

DESCRIPTION:

1. The Balance control is centered to remove the dc offset introduced by the Auto Zero circuit.
2. The DC Offset control removes any dc voltage introduced by the DC Amplifier.
3. The CAL ADJ control is used to set a level of +1.00 Vdc at the rear panel RECORDER OUTPUT jack with a full scale input.
4. The Meter control sets the meter reading to full scale when the RECORDER OUTPUT level is +1.00 Vdc.
5. The Auto Zero Offset adjustment removes any dc voltage introduced by the Auto Zero circuits when the ZERO switch is pressed.
6. The Balance control centers the Auto Zero circuits output voltage range. The Auto Zero output is forced to its negative extreme and the Balance control sets the RECORDER OUTPUT voltage below center-range (+1.00 Vdc) by one-half the total range.

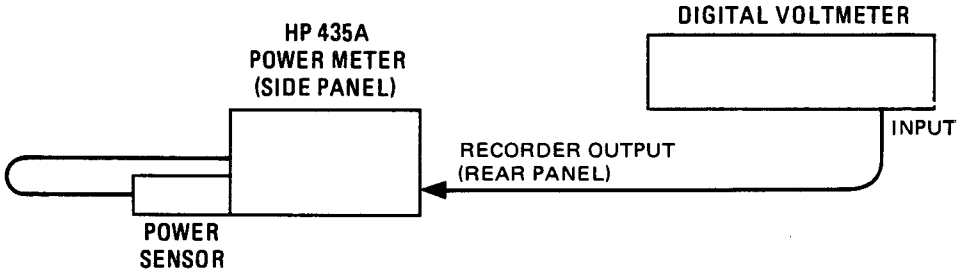


Figure 5-4. Power Meter Adjustment Setup with 50Ω Power Sensor

EQUIPMENT:

Digital Voltmeter	HP 3455A
Power Sensor	HP 8481A/H or 8482A/H

PROCEDURE:

1. Set the LINE switch to OFF, wait a few seconds, and adjust the mechanical meter zero control for a meter reading of zero.
2. Set the DVM RANGE switch to 1 Vdc.
3. Set the Power Meter CAL FACTOR switch to 100%.
4. Remove the right side cover of the Power Meter and connect the equipment as shown in Figure 5-4.

MANUAL CHANGES

CHANGE F

Table 6-2:

Add: A4C27 0160-3879 CAPACITOR-FXD, 0.01 μF ±20% 100 WVDC, 28440, 0160-3879
A4C28 0180-0228 CAPACITOR-FXD, 22 μF ±10% 15 VDC TA SOLID, 56289, 150D226X9015B2,
A4C29 0180-0228 CAPACITOR-FXD, 22 μF ±10% 15 VDC TA SOLID, 56289, 150D226X9015B2
A4CR8 1902-0184 DIODE-ZNR 16.2V 5% DC-7 PD=.4W, 28480, 1902-0184
A4Q9 1854-0003 TRANSISTOR NPN SI TO-39 PD=800 mW, 28480, 1854-0003.

Delete: A4Q20, A4C28, C29, C39, CR8, CR10, CR11, CR12, A4R81, R82, VR5, VR6.

Service Sheet 3 (Principles of Operation):
Delete the last sentence of paragraph 3 under DC amplifier.

Service Sheet 3 (Component and Test Point Locations):
Replace the figure with Figure 7-12 below.

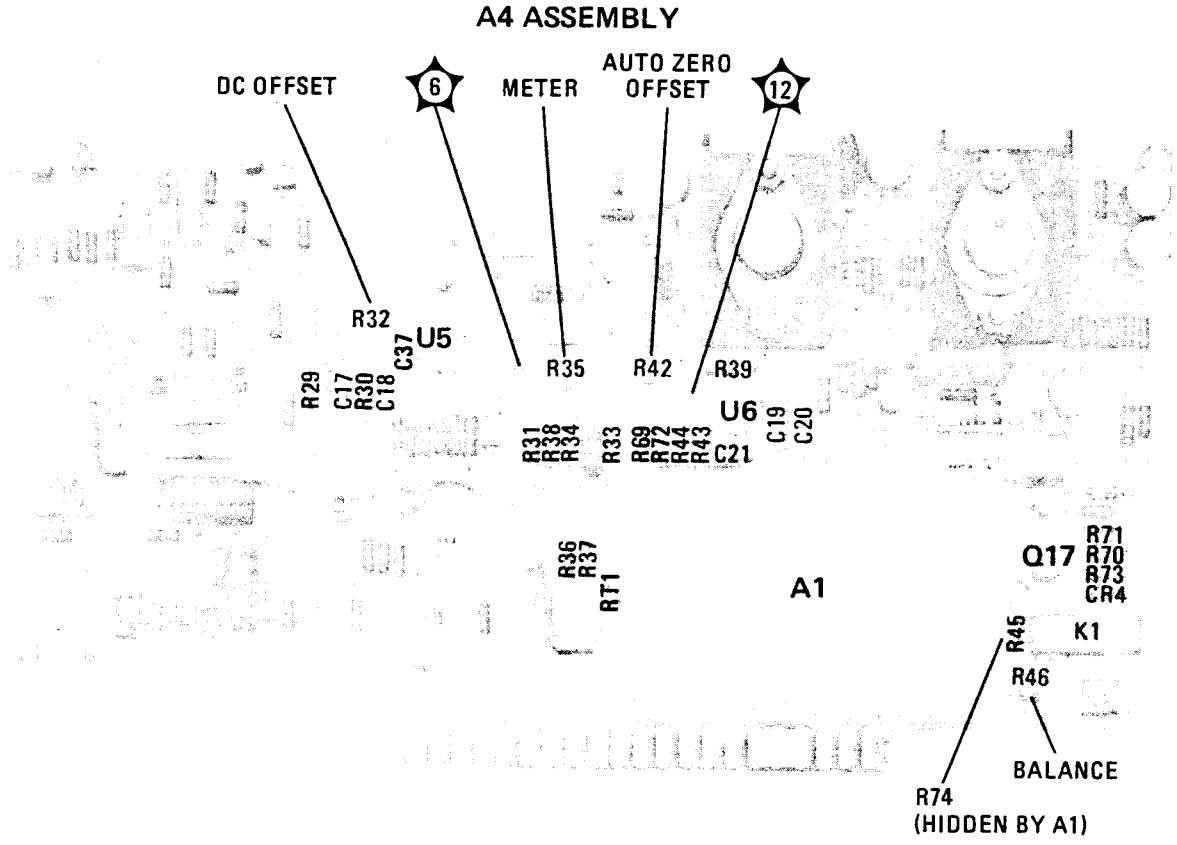


Figure 7-12. P/O A4 Assembly (DC Ampl/Auto Zero) Component and Test Point Locations Backdating (P/O Change F)

ADJUSTMENTS

5-8. POWER METER ADJUSTMENTS WITH 50Ω POWER SENSOR (Cont'd)

5. Set the LINE switch to (ON).

NOTE

Before proceeding with the adjustment, connect the input of a frequency counter (such as the HP 5314A) to TP7 or TP8 and verify that the multivibrator frequency is 220 ±12 Hz. If the frequency is incorrect, perform the Multivibrator Adjustment (5-7).

6. Center the Power Meter Balance Control A4R46.

7. Set the Power Meter RANGE switch fully cw and adjust A4R32, DC Offset control, for a DVM reading of 0 ±0.2 mVdc.

8. Set the RANGE switch to the position indicated in the table below; set the rear panel POWER REF switch to (ON).

Power Sensor	RANGE Switch Position
8481B and 8482B (remove attenuator)	1W
8481A, 8482A, 8481H, 8482H	1 mW
8485A (HP 1250-1250 Adapter required)	1 mW
8484A (HP 11708A Reference Attenuator required)	1 μW

9. Adjust the front panel CAL ADJ control to read 1.000 ±0.001 Vdc on the DVM.

10. Adjust A4R35, Meter control, to give a full-scale meter reading.

11. Set the rear panel POWER REF switch to OFF; set the RANGE switch to the position indicated in the table below.

Power Sensor	RANGE Switch Positon
8481B and 8482B (remove attenuator)	3W
8481A, 8482A, 8481H, 8482H	3 mW
8485A (HP 1250-1250 Adapter required)	3 mW
8484A (HP 11708A Reference Attenuator required)	3 μW

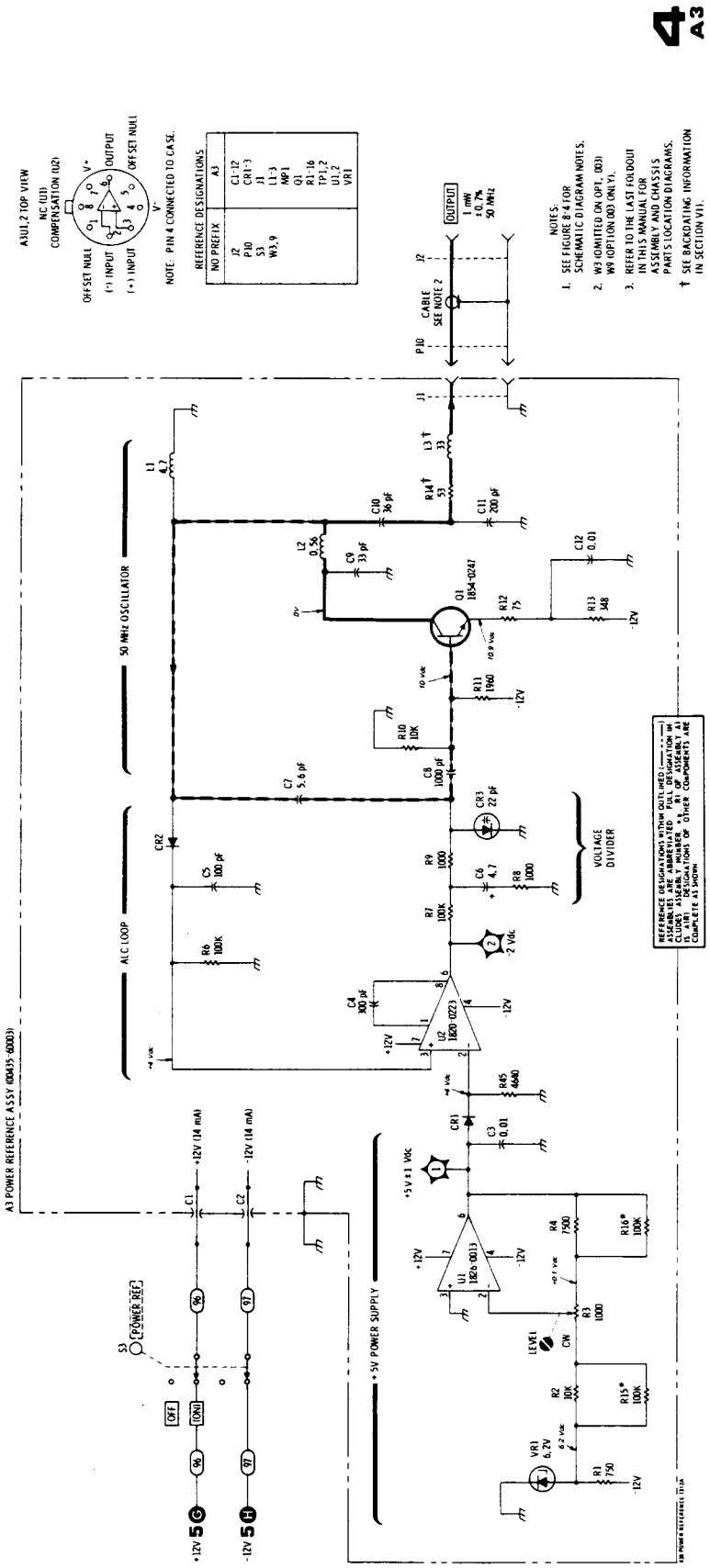


Figure 7-11. A3 Power Reference Assembly Schematic Diagram Backdating (P/O Change E)

ADJUSTMENTS

5-8. POWER METER ADJUSTMENTS WITH 50Ω POWER SENSOR (Cont'd)

12. Press the front panel ZERO switch, hold it in, and adjust the Auto Zero Offset control A4R42 for a DVM reading of 0 ±1 mVdc.

13. Set the RANGE switch to the position indicated in the table below; set the rear panel POWER REF switch to (ON).

Power Sensor	RANGE Switch Position
8481B, 8482B, (remove attenuator)	1W
8481A, 8482A, 8481H, 8482H	1 mW
8485A (HP 1250-1250 Adapter required)	1 mW
8484A (HP 11708A Reference Attenuator required)	1 μW

14. Press the ZERO switch, hold it in, and adjust the Balance Adjustment, A4R46, until the DVM reading is 961 ±1 mVdc.

Table 7-3. Replaceable Parts Backdating (P/O Change E)

Ref. Desig.	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A3	00435-60003	1	POWER REFERENCE ASSY	28480	00435-60003
A3C1	0160-3964	2	CAPACITOR-FXD .002UF +100–0% 300WVDC	28480	0160-3964
A3C2	0160-3964		CAPACITOR-FXD .002UF +100–0% 300WVDC	28480	0160-3964
A3C3	0160-3879	3	CAPACITOR-FXD .01UF +–20% 100WVDC	28480	0160-3879
A3C4	0160-2207	1	CAPACITOR-FXD 300PF +–5% 300WVDC	28480	0160-2207
A3C5	0160-2204	2	CAPACITOR-FXD 100PF +–5% 300WVDC	28480	0160-2204
A3C6	0180-0100	1	CAPACITOR-FXD; 4.7UF +–10% 35VDC TA	56289	150D475X903582
A3C7	0160-2251	1	CAPACITOR-FXD 5.6PF +–.25PF 500WVDC	28480	0160-2251
A3C8	0160-3878	1	CAPACITOR-FXD .001UF +–20% 100WVDC	28480	0160-3878
A3C9	0160-2150	1	CAPACITOR-FXD 33PF +–5% 300WVDC	28480	0160-2150
A3C10	0160-4006	1	CAPACITOR-FXD 36PF +–5% 300WVDC	28480	0160-4006
A3C11	0160-4007	1	CAPACITOR-FXD 200PF +–5% 300WVDC	28480	0160-4007
A3C12	0160-3879		CAPACITOR-FXD .01UF +–20% 100WVDC	28480	0160-3879
A3CR1	1901-0518	4	DIODE-SCHOTTKY	28480	1901-0518
A3CR2	1901-0518		DIODE-SCHOTTKY	28480	1901-0518
A3CR3	0122-0255	1	DIODE-VVC; SI 1N5144	04713	1N5144
A3J1	1250-1220	1	CONNECTOR-COAX; SMC; 50 OHM MALE	98291	50-051-0109
A3L1	9140-0144	1	COIL; FXD: MOLDED RF CHOKE; 4.7UH 10%	24226	10/471
A3L2	9100-2232	1	COIL; FXD: MOLDED RF CHOKE; .56UH 10%	24226	15/560
A3L3	00435-80001	1	INDUCTOR, 33 UH	28480	00435-80001
A3MP1	00435-00010	1	SHIELD, CAN	28480	00435-00010
A3Q1	1854-0247	1	TRANSISTOR NPN SI TO-39 PD=1W FT=800MHZ	28480	1854-0247
A3R1	0757-0420	1	RESISTOR 750 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-751-F
A3R2	0811-3234	1	RESISTOR 10K 1% .05W PWW TUBULAR	20940	140-1/20-1002-F
A3R3	2100-3154	1	RESISTOR; VAR; TRMR; 1KOHM 10% C	32997	3006P-1-102
A3R4	0811-3235	1	RESISTOR 7.5K 1% .05W PWW TUBULAR	20940	140-1/20-7501-F
A3R5	0698-3155	2	RESISTOR 4.64K 1% .125W F TUBULAR	16299	C4-1/8-10-4641-F
A3R6	0757-0465		RESISTOR 100K 1% .125W F TUBULAR	24546	C4-1/8-TO-1003-F
A3R7	0757-0465		RESISTOR 100K 1% .125W F TUBULAR	24546	C4-1/8-TO-1003-F
A3R8	0757-0280		RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-TO-1001-F
A3R9	0757-0280		RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-TO-1001-F
A3R10	0757-0442	10	RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-TO-1002-F
A3R11	0698-0083	2	RESISTOR 1.96K 1% .125W F TUBULAR	16299	C4-1/8-TO-1961-F
A3R12	0757-0398	1	RESISTOR 75 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-75R0-F
A3R13	0698-3445	1	RESISTOR 348 OHM 1% .125W F TUBULAR	16299	C4-1/8-TO-348R-F
A3R14	0698-3566	1	RESISTOR 53 OHM 1% .125W F TUBULAR	03888	PME55-1/8-TO-53R0-F
A3R15*	0757-0465	10	RESISTOR 100K 1% .125W F TUBULAR *FACTORY SELECTED PART	24546	C4-1/8-TO-1003-F
A3R16*	0757-0465		RESISTOR 100K 1% .125W F TUBULAR *FACTORY SELECTED PART	24546	C4-1/8-TO-1003-F
A3TP1	0360-1514	48	TERMINAL; SLDR STUD	28480	0360-1514
A3TP2	0360-1514		TERMINAL; SLDR STUD	28480	0360-1514
A3U1	1826-0013	6	IC; LIN: OPERATIONAL AMPLIFIER	28480	1826-0013
A3U2	1820-0223	2	IC: LIN: OPERATIONAL AMPLIFIER	27014	LM301AH
A3VR1	1902-0033	1	DIODE; ZENER: 6-2V VZ; .25W MAX PD	03877	IN823

ADJUSTMENTS

5-9. POWER METER ADJUSTMENTS WITH CALIBRATOR

NOTE

If the adjustments are to be considered valid, the Power Meter must have a half-hour warmup and the line voltage must be within +5 to −10% of nominal.

REFERENCE: Service Sheets 2 and 3.

DESCRIPTION:

1. The Balance control is centered to remove the dc offset introduced by the Auto Zero circuits.
2. The DC Offset control removes any dc voltage introduced by the DC Amplifier.
3. The CAL ADJ control is used to set a level of +1.00 Vdc at rear panel RECORDER OUTPUT jack with a full scale input from the Model 11683A Range Calibrator.
4. The Meter control sets the meter reading to full scale when the RECORDER OUTPUT level is +1.00 Vdc.
5. The Auto Zero Offset adjustment removes any dc voltage that is introduced by the Auto Zero circuits while the ZERO switch is pressed.
6. The Balance control centers the Auto Zero circuit's output voltage range. The Auto Zero output is forced to its negative extreme. The Balance Control sets the RECORDER OUTPUT voltage below the center (+1.00 Vdc) by one-half the total possible voltage swing.

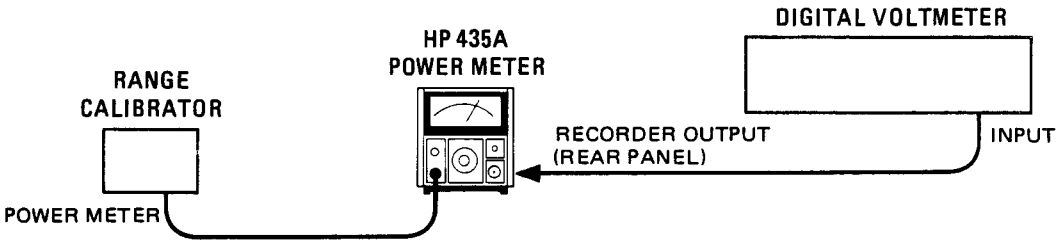


Figure 5-5. Power Meter Adjustment Setup with Calibrator

EQUIPMENT:

Digital Voltmeter	HP 3455A
Range Calibrator	HP 11683A (ONLY)

PROCEDURE:

1. Set the Power Meter LINE switch to OFF and adjust the mechanical Meter Zero control for a meter reading of zero.
2. Set the Power Meter switches as follows:

CAL FACTOR	100%
RANGE position	fully cw
POWER REF	OFF

MANUAL CHANGES

CHANGE E

Table 5-1:
Delete A3R5.
Add the following entries to the table:

Reference Designator	Selected For	Normal Value Range	Service Sheet
A3R15	A POWER REF. output of 1 mW when the LEVEL control is full ccw. Needed if the highest output level possible is <1 mW.	50K to 200K	4
A3R16	A POWER REF. output of 1 mW when the LEVEL control is full ccw. Needed if the highest output level possible is <1 mW.	50K to 200K	4

Table 6-2:
Replace the parts list for the A3 Assembly with the one in this change.

Service Sheet 4 (Component and Test Point Locations):
Replace the figure with Figure 7-10 in this change.

Service Sheet 4 (schematic):
Replace the schematic with Figure 7-11 in this change.

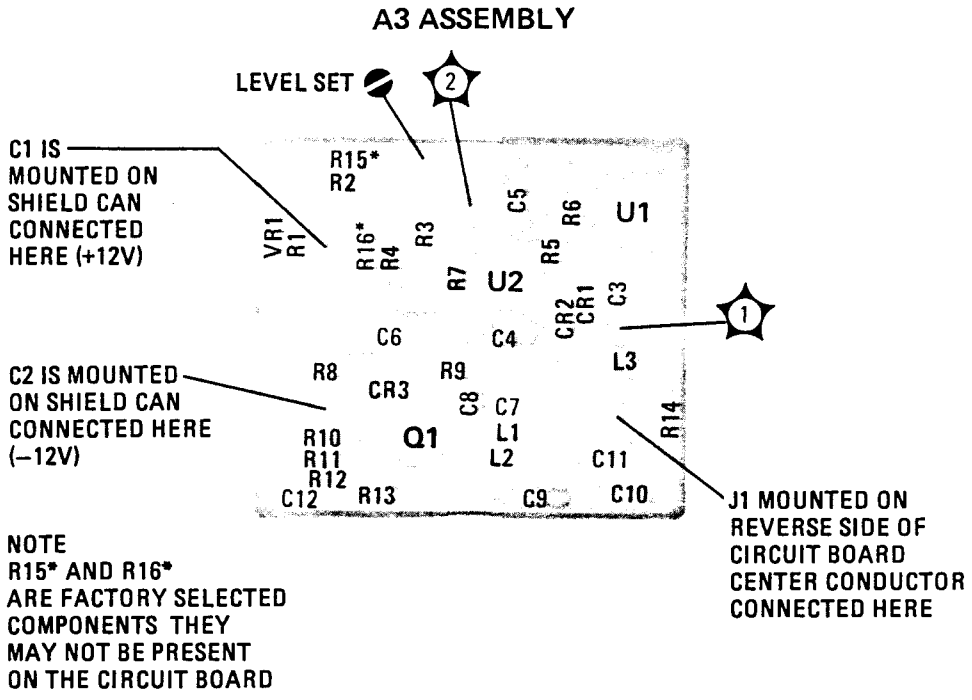


Figure 7-10. A3 Power Reference Assembly Component and Test Point Locations Backdating (P/O Change E)

ADJUSTMENTS

5-9. POWER METER ADJUSTMENTS WITH CALIBRATOR (Cont'd)

3. Set the Range Calibrator RANGE switch to 1 mW, FUNCTION switch to STANDBY, and POLARITY switch to NORMAL.

4. Set the DVM RANGE switch to Vdc.

5. Remove the right side cover of the Power Meter, connect the equipment as shown in Figure 5-5 and set the LINE switch to ON.

NOTE

Before proceeding with the adjustment, connect the input of a frequency counter (such as the HP 5314A) to TP7 or TP8 and verify that the multivibrator frequency is 220 ±12 Hz. If the frequency is incorrect, perform the Multivibrator Adjustment (5-7).

6. Center the Power Meter Balance control, A4R46.

7. Adjust A4R32 DC Offset control for a DVM reading of 0 ±0.2 mVdc.

8. Set the Power Meter RANGE switch 5 turns from the fully ccw position.

9. Set the Range Calibrator FUNCTION switch to CALIBRATE.

10. Adjust the Power Meter front panel CAL ADJ control for a DVM reading of 1000 ±1 mVdc.

11. Adjust the Meter control A4R35 for a full-scale meter reading.

12. Set the Range Calibrator FUNCTION switch to STANDBY.

13. Set the Power Meter RANGE switch fully ccw, press and hold the ZERO switch, and adjust A4R42 Auto Zero Offset control for a DVM reading of 0 ±1 mVdc.

14. Set the Power Meter RANGE switch 5 turns from the fully ccw position; set the Range Calibrator's FUNCTION switch to CALIBRATE.

15. Press and hold the Power Meter ZERO switch and adjust the A4R46 Balance control for a DVM reading of 961 ±3 mVdc.

MANUAL CHANGES

CHANGE D

Section II:
Delete paragraph entitled "Range Switch Scale Selection."

Figure 3-2:
Make a note on the front panel photo that the range switch has one fixed scale.
Change RANGE switch to "Selects desired power range; keyed to meter full scale deflection."

Figures 3-4 and 3-5:
Delete step 5.

Table 6-2:
Change the entire MP2 part number to 0370-2388.

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION

This section contains information for ordering replacement parts for the Power Meter. Table 6-1 lists abbreviations used in the parts list and throughout the manual. Table 6-2 lists all replaceable parts in reference designator order. Table 6-3 contains the names and addresses that correspond to the manufacturer's code number.

6-2. ABBREVIATIONS

Table 6-1 gives a list of abbreviations used in the parts list, schematics and throughout the manual. In some cases, two forms of the abbreviations are given, one all capital letters and one partial or no capitals. This occurs because the abbreviations in the parts list are always all capitals. However, in the schematics and other parts of the manual, other abbreviation forms are used with both lower case and upper case letters.

6-3. REPLACEABLE PARTS LIST

Table 6-2 is the list of replaceable parts and is organized as follows:

a. Electrical assemblies and their components in alpha-numeric order by reference designation.

b. Chassis-mounted parts in alpha-numeric order by reference designation.

c. Miscellaneous parts.

d. Illustrated parts breakdown.

The information given for each part consists of the following:

a. The Hewlett-Packard part number.

b. The part number check digit (CD).

c. The total quantity (Qty) used in the instrument.

d. The description of the part.

e. Typical manufacturer of the part in a five-digit code.

f. The manufacturer's number for the part.

The total quantity for each part is given only once; at the first appearance of the part number in the list.

6-4. FACTORY SELECTED PARTS (*)

Parts marked with an asterisk (*) are factory selected parts. The value listed in the parts list is the nominal value. Refer to Section V for information on determining what value to use for replacement.

6-5. ORDERING INSTRUCTIONS

To order a part listed in the replaceable parts table, quote the Hewlett-Packard part number, indicate quantity required and address the order to the nearest Hewlett-Packard office.

To order a part that is not listed in the replaceable parts table, include the instrument model number, instrument serial number, the description and function of the part, and the number of parts required. Address the order to the nearest Hewlett-Packard office.

NOTE

Within the USA, it is better to order directly from the HP Parts Center in Mt. View, California. Ask your nearest HP office for information and forms for the "Direct Mail Order System"

6-6. PARTS PROVISIONING

Stocking spare parts for an instrument is often done to insure quick return to service after a malfunction occurs. Hewlett-Packard has a "Spare Parts Kit" available for this purpose. The kit consists of selected replaceable assemblies and components for this instrument. The contents of the kit and the "Recommended Spares" list are based on failure reports and repair data, and parts support for one year. A complimentary "Recommended Spares" list for this instrument may be obtained on request, and the "Spare Parts Kit" may be ordered through your nearest Hewlett-Packard office.

MANUAL CHANGES

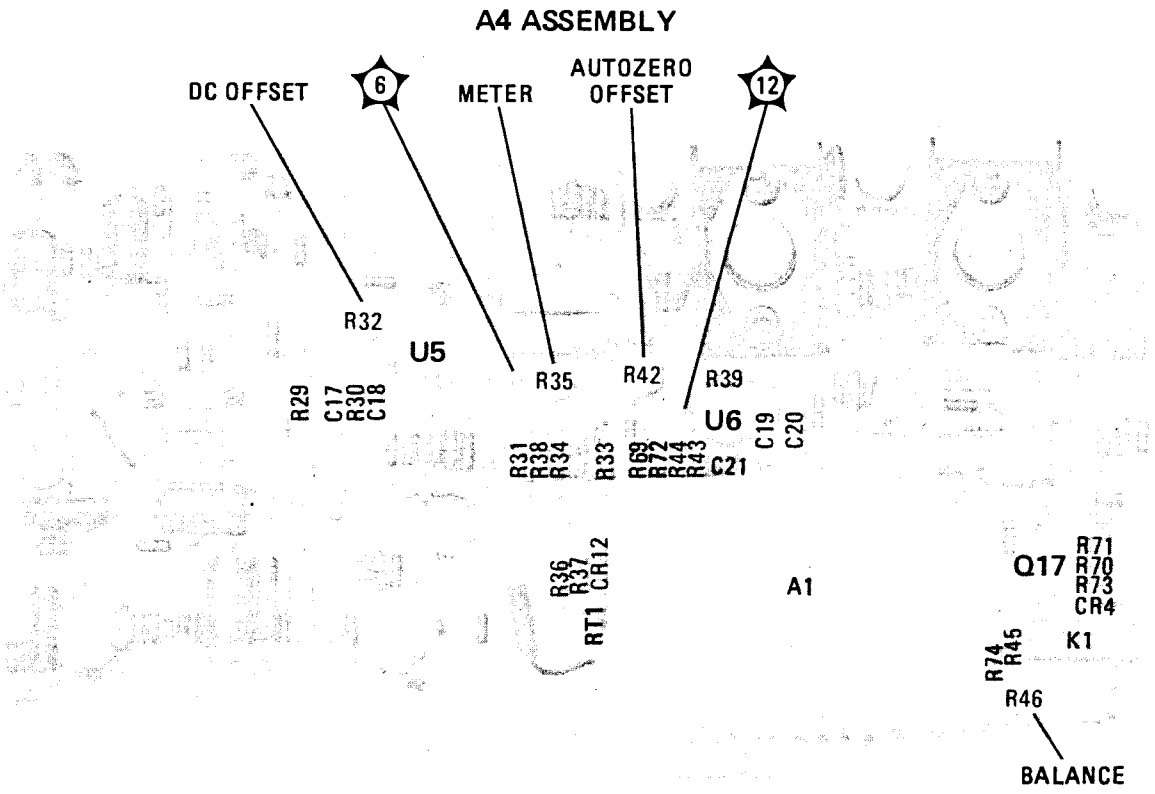


Figure 7-9. P/O A4 Assembly (DC Ampl/Auto Zero Component, Adjustment and Test Point Locations Backdating (P/O Change C)

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

MOD . . . . . modulator
MOM . . . . . momentary
MOS . . . . . metal-oxide semiconductor
ms . . . . . millisecond
MTG . . . . . mounting
MTR . . . meter (indicating device)
mV . . . . . millivolt
mVac . . . . . millivolt, ac
mVdc . . . . . millivolt, dc
mVpk . . . . millivolt, peak
mVp-p . . . millivolt, peak-to-peak
mVrms . . . . millivolt, rms
mW . . . . . milliwatt
MUX . . . . . multiplex
MY . . . . . mylar
μA . . . . . microampere
μF . . . . . microfarad
μH . . . . . microhenry
μmho . . . . . micromho
μs . . . . . microsecond
μV . . . . . microvolt
μVac . . . . . microvolt, ac
μVdc . . . . . microvolt, dc
μVpk . . . microvolt, peak
μVp-p . . . microvolt, peak-to-peak
μVrms . . . microvolt, rms
μW . . . . . microwatt
nA . . . . . nanoampere
NC . . . . . no connection
N/C . . . . normally closed
NE . . . . . neon
NEG . . . . . negative
nF . . . . . nanofarad
NI PL . . . . . nickel plate
N/O . . . . . normally open
NOM . . . . . nominal
NORM . . . . . normal
NPN . . . negative-positive-negative
NPO . . . . negative-positive zero (zero temperature coefficient)
NRFR . . not recommended for field replacement
NSR . . . . . not separately replaceable
ns . . . . . nanosecond
nW . . . . . nanowatt
OBD . . . order by description
OD . . . . . outside diameter
OH . . . . . oval head
OP AMPL . . . operational amplifier
OPT . . . . . option
OSC . . . . . oscillator
OX . . . . . oxide
oz . . . . . ounce
Ω . . . . . ohm
P . . . . peak (used in parts list)
PAM . . . . pulse-amplitude modulation
PC . . . . . printed circuit
PCM . . pulse-code modulation; pulse-count modulation
PDM . . . . . pulse-duration modulation
pF . . . . . picofarad
PH BRZ phosphor bronze
PHL . . . . . Phillips
PIN . . . positive-intrinsic-negative
PIV . . . . . peak inverse voltage
pk . . . . . peak
PL . . . . . phase lock
PLO . . . . . phase lock oscillator
PM . . . . phase modulation
PNP . . . positive-negative-positive
P/O . . . . . part of
POLY . . . . . polystyrene
PORC . . . . . porcelain
POS . . positive; position(s) (used in parts list)
POSN . . . . . position
POT . . . . . potentiometer
p-p . . . . . peak-to-peak
PP . . . peak-to-peak (used in parts list)
PPM . . . . . pulse-position modulation
PREAMPL . . . preamplifier
PRF . . . . pulse-repetition frequency
PRR . . . . pulse repetition rate
ps . . . . . picosecond
PT . . . . . point
PTM . . . . . pulse-time modulation
PWM . . . . . pulse-width modulation
PWV . . . . . peak working voltage
RC . . . . . resistance-capacitance
RECT . . . . . rectifier
REF . . . . . reference
REG . . . . . regulated
REPL . . . . . replaceable
RF . . . . . radio frequency
RFI . . . . radio frequency interference
RH . . . . round head; right hand
RLC . . . . . resistance-inductance-capacitance
RMO . . . rack mount only
rms . . . . root-mean-square
RND . . . . . round
ROM . . read-only memory
R&P . . . . . rack and panel
RWV . . . reverse working voltage
S . . . scattering parameter
s . . . . . second (time)
. . . " . second (plane angle)
S-B . . . . . slow-blow (fuse) (used in parts list)
SCR . . . silicon controlled rectifier; screw
SE . . . . . selenium
SECT . . . . . sections
SEMICON . . . . . semiconductor
SHF . . . . . superhigh frequency
SI . . . . . silicon
SIL . . . . . silver
SL . . . . . slide
SNR . . signal-to-noise ratio
SPDT . . . . . single-pole, double-throw
SPG . . . . . spring
SR . . . . . split ring
SPST . . . . . single-pole, single-throw
SSB . . . . . single sideband
SST . . . . . stainless steel
STL . . . . . steel
SQ . . . . . square
SWR . . standing-wave ratio
SYNC . . . . . synchronize
T . . timed (slow-blow fuse)
TA . . . . . tantalum
TC . . . . . temperature compensating
TD . . . . . time delay
TERM . . . . . terminal
TFT . . thin-film transistor
TGL . . . . . toggle
THD . . . . . thread
THRU . . . . . through
TI . . . . . titanium
TOL . . . . . tolerance
TRIM . . . . . trimmer
TSTR . . . . . transistor
TTL . . transistor-transistor logic
TV . . . . . television
TVI television interference
TWT . . traveling wave tube
U . . . . . micro (10^{-6}) (used in parts list)
UF . . . microfarad (used in parts list)
UHF . . ultrahigh frequency
UNREG . . . . unregulated
V . . . . . volt
VA . . . . . voltampere
Vac . . . . . volts, ac
VAR . . . . . variable
VCO . . . voltage-controlled oscillator
Vdc . . . . . volts, dc
VDCW . . volts, dc, working (used in parts list)
V(F) . . . . . volts, filtered
VFO . . variable-frequency oscillator
VHF . . . . . very-high frequency
Vpk . . . . . volts, peak
Vp-p . . volts, peak-to-peak
Vrms . . . . . volts, rms
VSWR . . . voltage standing wave ratio
VTO . . . . . voltage-tuned oscillator
VTVM . . . . vacuum-tube voltmeter
V(X) . . . . volts, switched
W . . . . . watt
W/ . . . . . with
WIV . . . . working inverse voltage
WW . . . . . wirewound
W/O . . . . . without
YIG . . yttrium-iron-garnet
Z_o . . . . . characteristic impedance

NOTE

All abbreviations in the parts list will be in upper-case.

MULTIPLIERS

Abbreviation	Prefix	Multiple
T	tera	10^{12}
G	giga	10^{9}
M	mega	10^{6}
k	kilo	10^{3}
da	deka	10
d	deci	10^{-1}
c	centi	10^{-2}
m	milli	10^{-3}
μ	micro	10^{-6}
n	nano	10^{-9}
p	pico	10^{-12}
f	femto	10^{-15}
a	atto	10^{-18}

MANUAL CHANGES

CHANGE C

Table 6-2:

Change the A4 part number to 00435-60001.

Delete A4C31—A4C38.

Delete A4R78—A4R80.

Service Sheets 2, 3, and 5 (schematic):

Change the A4 assembly part number to 00435-60001.

Service Sheet 2 (Component and Test Point Locations):

Replace the figure with Figure 7-8 below.

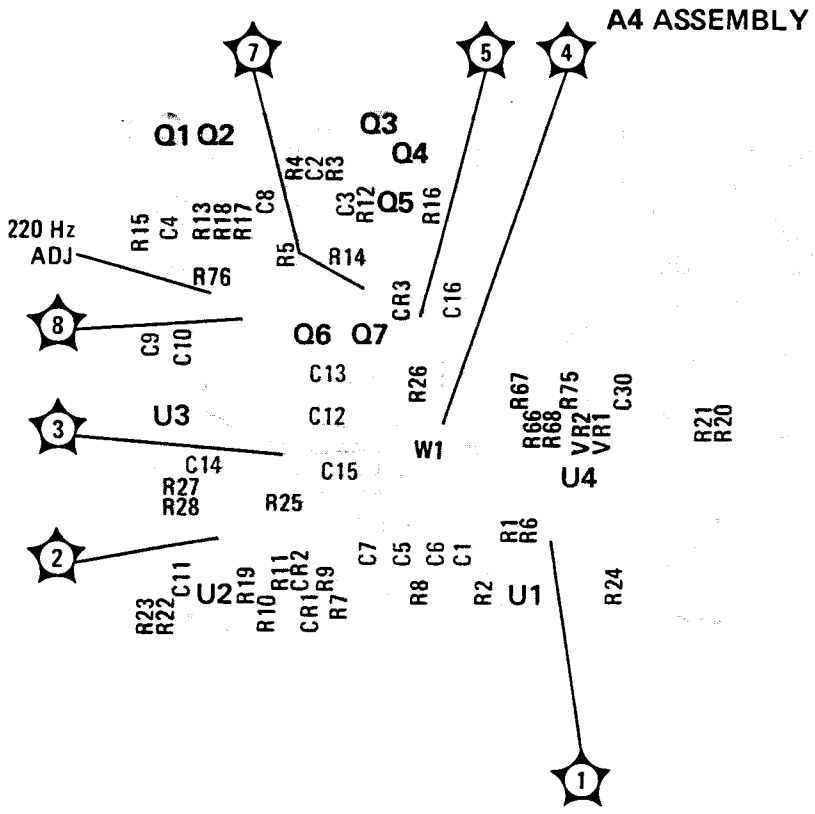


Figure 7-8. P/O A4 Assembly (AC Ampl/Sync Detector) Component and Test Point Locations Backdating (P/O Change C)

Service Sheet 2 (schematic):

Delete A4C36.

Service Sheet 3 (Component and Test Point Locations):

Replace the figure with Figure 7-9.

Service Sheet 3 (schematic):

Delete A4C37.

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

REFERENCE DESIGNATIONS

A . . . . . assembly
AT . . attenuator; isolator; termination
B . . . . . fan; motor
BT . . . . . battery
C . . . . . capacitor
CP . . . . . coupler
CR . . . . . diode; diode thyristor; varactor
DC . . . directional coupler
DL . . . . . delay line
DS . . . . . annunciator; signaling device (audible or visual); lamp; LED
E . . . . . miscellaneous electrical part
F . . . . . fuse
FL . . . . . filter
H . . . . . hardware
HY . . . . . circulator
J . . . electrical connector (stationary portion); jack
K . . . . . relay
L . . . . . coil; inductor
M . . . . . meter
MP . . . . . miscellaneous mechanical part
P . . . electrical connector (movable portion); plug
Q . . . . . transistor; SCR; triode thyristor
R . . . . . resistor
RT . . . . . thermistor
S . . . . . switch
T . . . . . transformer
TB . . . . . terminal board
TC . . . . . thermocouple
TP . . . . . test point
U . . . . . integrated circuit; microcircuit
V . . . . . electron tube
VR . . . . voltage regulator; breakdown diode
W . . . . cable; transmission path; wire
X . . . . . socket
Y . . . . crystal unit (piezoelectric or quartz)
Z . . . . tuned cavity; tuned circuit

ABBREVIATIONS

A . . . . . ampere
ac . . . . alternating current
ACCESS . . . . . accessory
ADJ . . . . . adjustment
A/D . . . . analog-to-digital
AF . . . . . audio frequency
AFC . . . . . automatic frequency control
AGC . . . . . automatic gain control
AL . . . . . aluminum
ALC . . . . . automatic level control
AM . . . amplitude modulation
AMPL . . . . . amplifier
APC . . . . automatic phase control
ASSY . . . . . assembly
AUX . . . . . auxiliary
avg . . . . . average
AWG . . . . American wire gauge
BAL . . . . . balance
BCD . . . . . binary coded decimal
BD . . . . . board
BE CU . . . . . beryllium copper
BFO . . . . . beat frequency oscillator
BH . . . . . binder head
BKDN . . . . . breakdown
BP . . . . . bandpass
BPF . . . . . bandpass filter
BRS . . . . . brass
BWO . . . . . backward-wave oscillator
CAL . . . . . calibrate
ccw . . counter-clockwise
CER . . . . . ceramic
CHAN . . . . . channel
cm . . . . . centimeter
CMO . . cabinet mount only
COAX . . . . . coaxial
COEF . . . . . coefficient
COM . . . . . common
COMP . . . . . composition
COMPL . . . . . complete
CONN . . . . . connector
CP . . . . . cadmium plate
CRT . . . cathode-ray tube
CTL . . . . complementary transistor logic
CW . . . . . continuous wave
cw . . . . . clockwise
cm . . . . . centimeter
D/A . . . . digital-to-analog
dB . . . . . decibel
dBm . . . . decibel referred to 1 mW
dc . . . . . direct current
deg . . degree (temperature interval or difference)
° . . . . . degree (plane angle)
°C . . . . . degree Celsius (centigrade)
°F . . . . degree Fahrenheit
°K . . . . . degree Kelvin
DEPC . . deposited carbon
DET . . . . . detector
diam . . . . . diameter
DIA . . . diameter (used in parts list)
DIFF AMPL . . differential amplifier
div . . . . . division
DPDT . . . . . double-pole, double-throw
DR . . . . . drive
DSB . . . . double sideband
DTL . . . . diode transistor logic
DVM . . . digital voltmeter
ECL . . . . emitter coupled logic
EMF . . electromotive force
EDP . . . . . electronic data processing
ELECT . . . . . electrolytic
ENCAP . . . . encapsulated
EXT . . . . . external
F . . . . . farad
FET . . . . . field-effect transistor
F/F . . . . . flip-flop
FH . . . . . flat head
FIL H . . . . . fillister head
FM . . frequency modulation
FP . . . . . front panel
FREQ . . . . . frequency
FXD . . . . . fixed
g . . . . . gram
GE . . . . . germanium
GHz . . . . . gigahertz
GL . . . . . glass
GRD . . . . . ground(ed)
H . . . . . henry
h . . . . . hour
HET . . . . . heterodyne
HEX . . . . . hexagonal
HD . . . . . head
HDW . . . . . hardware
HF . . . . . high frequency
HG . . . . . mercury
HI . . . . . high
HP . . . . . Hewlett-Packard
HPF . . . . . high pass filter
HR . . . . . hour (used in parts list)
HV . . . . . high voltage
Hz . . . . . Hertz
IC . . . . integrated circuit
ID . . . . . inside diameter
IF . . . . . intermediate frequency
IMPG . . . . . impregnated
in . . . . . inch
INCD . . . . . incandescent
INCL . . . . . include(s)
INP . . . . . input
INS . . . . . insulation
INT . . . . . internal
kg . . . . . kilogram
kHz . . . . . kilohertz
kΩ . . . . . kilohm
kV . . . . . kilovolt
lb . . . . . pound
LC . . . . . inductance-capacitance
LED . . light-emitting diode
LF . . . . . low frequency
LG . . . . . long
LH . . . . . left hand
LIM . . . . . limit
LIN . . . linear taper (used in parts list)
lin . . . . . linear
LK WASH . . . lock washer
LO . . . low; local oscillator
LOG . . . . logarithmic taper (used in parts list)
log . . . . . logrithm(ic)
LPF . . . . . low pass filter
LV . . . . . low voltage
m . . . . . meter (distance)
mA . . . . . milliampere
MAX . . . . . maximum
MΩ . . . . . megohm
MEG . . . . meg (10^6) (used in parts list)
MET FLM . . . . metal film
MET OX . . metallic oxide
MF . . . medium frequency; microfarad (used in parts list)
MFR . . . . . manufacturer
mg . . . . . milligram
MHz . . . . . megahertz
mH . . . . . millihenry
mho . . . . . mho
MIN . . . . . minimum
min . . . . . minute (time)
. . . ' . . . . . minute (plane angle)
MINAT . . . . . miniature
mm . . . . . millimeter

NOTE

All abbreviations in the parts list will be in upper-case.

MANUAL CHANGES

CHANGE B (Cont'd)

Service Sheet 5 (schematic):

Delete A4R77 (replace with a connection between Q15B and the R49—R53 Junction).

Change the schematic as shown in Figure 7-7 below.

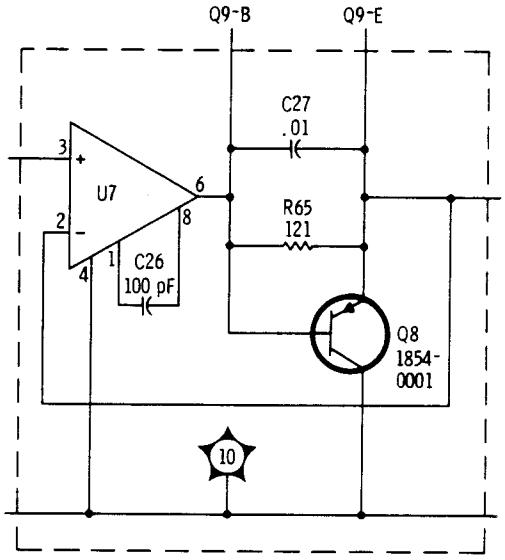


Figure 7-7. P/O A4 Assembly (Power Supply) Schematic Backdating (P/O Change B)

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1	00435-60005	2	1	CAL FACTOR SWITCH ASSY	28480	00435-60005
A1R1	0757-0346	2	15	RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A1R2	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A1R3	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A1R4	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A1R5	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A1R6	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A1R7	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A1R8	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A1R9	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A1R10	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A1R11	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A1R12	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A1R13	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A1R14	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A1R15	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A1S1	3100-3073	0	1	SWITCH-ROTARY 1.562 STRUT CTR SPCG; 16	28480	3100-3073
A2	00435-60009	6	1	RANGE SWITCH ASSY	28480	00435-60009
A2C1	0180-1704	5	1	CAPACITOR-FXD 47UF+-10% 6VDC TA	56289	150D476X9006B2
A2C2	0180-1746	5	1	CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A2C3	0180-0374	3	4	CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A2C4	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A2C5	0180-0229	7	2	CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A2R1	0811-3202	1	1	RESISTOR 30.615K .1% .05W PWW TC=0+-10	14140	1409-1/40-30615R-B
A2R2	0811-3203	2	1	RESISTOR 968 .1% .05W PWW TC=0+-10	14140	1409-1/40-968R-B
A2R3	0811-3204	3	1	RESISTOR 21.616K .1% .05W PWW TC=0+-10	14140	1409-1/40-21616R-B
A2R4	0811-3205	4	1	RESISTOR 6.836K .1% .05W PWW TC=0+-10	14140	1409-1/40-6836R-B
A2R5	0811-3206	5	1	RESISTOR 2.162K .1% .05W PWW TC=0+-10	14140	1409-1/40-2162R-B
A2R6	0757-0279	0	5	RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A2R7	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A2R8	0698-7284	5	4	RESISTOR 100K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1003-G
A2R9	0757-0465	6	7	RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2R10	0698-7284	5		RESISTOR 100K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1003-G
A2R11	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2R12	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2R13	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A2R14	0757-0280	3	5	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2S1	3100-3090	1	1	SWITCH-ROTARY 1.250 STRUT CTR SPCG; 10	28480	3100-3090
A2W1	00435-60014	3	1	CABLE ASSY, GREEN	28480	00435-60014
A2W2	00435-60015	4	1	CABLE ASSY, BLUE	28480	00435-60015
A3†	00435-60003	0	1	POWER REFERENCE OSCILLATOR ASSEMBLY	28480	00435-60003
A3C1	0160-3879	7	16	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C2†	0160-3036	8	2	CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-3036
A3C3 †	0160-3036	8		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-3036
A3C4	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C5	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C6	0160-2207	3	1	CAPACITOR-FXD 300PF +-5% 300VDC MICA	28480	0160-2207
A3C7	0160-2204	0	2	CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A3C8	0180-0100	3	1	CAPACITOR-FXD 4.7UF+-10% 35VDC TA	56289	150D475X9035B2
A3C9	0160-2255	1	1	CAPACITOR-FXD 8.2PF +-.25PF 500VDC CER	28480	0160-2255
A3C10	0160-3878	6	1	CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3C11	0160-2150	5	1	CAPACITOR-FXD 33PF +-5% 300VDC MICA	28480	0160-2150
A3C12	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C13	0160-4006	4	1	CAPACITOR-FXD 36PF +-5% 300VDC GL	28480	0160-4006
A3C14	0160-4007	5	1	CAPACITOR-FXD 200PF +-5% 300VDC GL	28480	0160-4007
A3CR1	1901-0518	8	2	DIODE-SM SIG SCHOTTKY	28480	1901-0518
A3CR2	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A3CR3	0122-0299	9	1	DIODE-VVC 82PF 5% C2/C20-MIN=2 BVR=20V	28480	0122-0299
A3J1	1250-1220	0	1	CONNECTOR-RF SMC M PC 50-OHM	28480	1250-1220
A3L1	00436-80001	1	1	COIL, VARIABLE	28480	00436-80001
A3L2	9140-0144	0	1	INDUCTOR RF-CH-MLD 4.7UH 10% .105DX.26LG	28480	9140-0144
A3L3†	00436-80002	2	1	COIL, 3-1/2 TURNS	28480	00436-80002
A3Q1	1854-0247	9	1	TRANSISTOR NPN SI TO-39 PD=1W FT=800MHZ	28480	1854-0247
A3Q2	1854-0071	7	6	TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071

See introduction to this section for ordering information
*Indicates factory selected value
† FOR BACKDATING INFORMATION SEE SECTION VII

MANUAL CHANGES

CHANGE B (Cont'd)

Service Sheet 5 (Component and Test Point Locations):
Replace the figure with Figure 7-6 below.

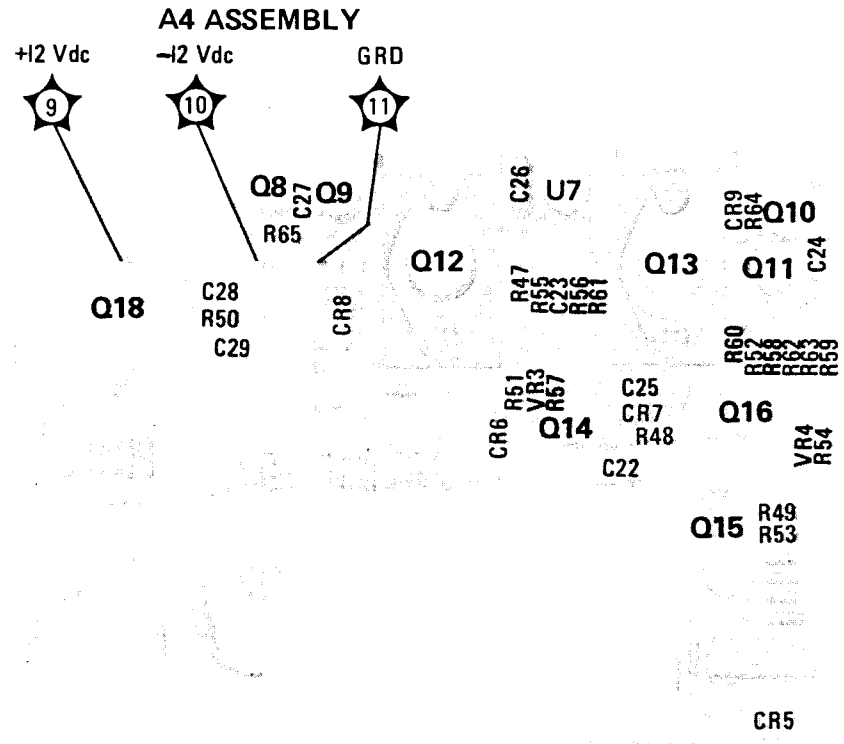


Figure 7-6. P/O A4 Assembly (Power Supply) Component and Test Point Location Backdating (P/O Change B)

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3R1	0757-0442	9	13	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R2	0757-0421	4	1	RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A3R3	0811-3234	9	1	RESISTOR 10K 1% .05W PWW TC=0+-10	20940	140-1/20-1002-F
A3R4	2100-3154	7	1	RESISTOR-TRMR 1K 10% C SIDE-ADJ 17-TRN	02111	43P102
A3R5*	0811-3381	7	1	RESISTOR 7.1K 1% .05W PWW TC=0+-10	28480	0811-3381
A3R6	0757-0440	7	1	RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A3R7	0698-7284	5		RESISTOR 100K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1003-G
A3R8	0698-7284	5		RESISTOR 100K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1003-G
A3R9	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A3R10	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R11	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R12	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R13	0698-0083	8	2	RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A3R14†	0757-0398	4	1	RESISTOR 75 1% .125W F TC=0+-100	24546	C4-1/8-T0-75R0-F
A3R15	0698-3445	2	1	RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A3R16	0698-8581	7	1	RESISTOR 50.5 1% .125W F TC=0+-25	28480	0698-8581
A3TP1	0360-1514	7	25	TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A3TP2	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A3U1	1826-0013	8	6	IC OP AMP LOW-NOISE TO-99 PKG	06665	SSS741CJ
A3U2	1820-0223	0	1	IC OP AMP GP TO-99 PKG	04713	MLM301AG
A3VR1	1902-0041	4	2	DIODE-ZNR 5.11V 5% DO-35 PD=.4W	28480	1902-0041
A3VR2	1902-0680	7	1	DIODE-ZNR 1N827 6.2V 5% DO-7 PD=.4W	24046	1N827
				A3 MISCELLANEOUS		
	2190-0008	3	4	WASHER-LK EXT T NO. 6 .141-IN-ID	28480	2190-0008
	2190-0009	4	5	WASHER-LK INTL T NO. 8 .168-IN-ID	28480	2190-0009
	2190-0124	4	1	WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0124
	2360-0209	7	4	SCREW-MACH 6-32 1-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2580-0002	4	5	NUT-HEX-DBL-CHAM 8-32-THD .085-IN-THK	00000	ORDER BY DESCRIPTION
	2950-0078	9	1	NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
	3050-0079	3	1	WASHER-FL NM NO. 2 .094-IN-ID .188-IN-OD	28480	3050-0079
	7100-1204	9	1	CAN, RECT 2.00"	28480	7100-1204
	7120-6996	8	1	LABEL-REF OSC.	28480	7120-6996
A4†	00435-60033	6	1	AMPLIFIER/POWER SUPPLY ASSY	28480	00435-60033
A4C1	0180-2206	4	2	CAPACITOR-FXD 60UF+-10% 6VDC TA	56289	150D606X9006B2
A4C2	0180-0228	6	1	CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A4C3	0160-2055	9	1	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4C4	0160-3439	5	2	CAPACITOR-FXD .039UF +-5% 200VDC	28480	0160-3439
A4C5	0160-0160	3	2	CAPACITOR-FXD 8200PF +-10% 200VDC POLYE	28480	0160-0160
A4C6	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A4C7	0170-0040	9	2	CAPACITOR-FXD .047UF +-10% 200VDC POLYE	56289	292P47392
A4C8	0160-3439	5		CAPACITOR-FXD .039UF +-5% 200VDC	28480	0160-3439
A4C9	0180-0197	8	4	CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A4C10	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A4C11*	0160-0161	4	1	CAPACITOR-FXD .01UF +-10% 200VDC POLYE	28480	0160-0161
A4C12	0180-0116	1	4	CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A4C13	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A4C14*	0160-0160	3		CAPACITOR-FXD 8200PF +-10% 200VDC POLYE	28480	0160-0160
A4C15	0170-0040	9		CAPACITOR-FXD .047UF +-10% 200VDC POLYE	56289	292P47392
A4C16	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A4C17	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A4C18	0180-0373	2	1	CAPACITOR-FXD .68UF+-10% 35VDC TA	56289	150D684X9035A2
A4C19	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A4C20	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A4C21	0160-3456	6	1	CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A4C22	0180-1997	8	1	CAPACITOR-FXD 20UF+50-10% 150VDC AL	28480	0180-1997
A4C23	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A4C24	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A4C25	0160-2290	4	1	CAPACITOR-FXD .15UF +-10% 80VDC POLYE	28480	0160-2290
A4C26	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A4C27††				NOT ASSIGNED		
A4C28††	0180-1794	3	2	CAPACITOR-FXD 22UF+-10% 35VDC TA	56289	150D226X9035R2
A4C29††	0180-1794	3		CAPACITOR-FXD 22UF+-10% 35VDC TA	56289	150D226X9035R2
A4C30 ††	0180-2206	4		CAPACITOR-FXD 60UF+-10% 6VDC TA	56289	150D606X9006B2
A4C31††	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A4C32††	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A4C33††	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A4C34††	0160-3877	5	6	CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A4C35††	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A4C36††	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A4C37††	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A4C38††	0160-4306	7	1	CAPACITOR-FXD 100PF +-10% 100VDC CER	51959	0805C101K3P
A4C39††	0180-0291	3	1	CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A4C40††	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879

See introduction to this section for ordering information
*Indicates factory selected value
† FOR BACKDATING INFORMATION SEE SECTION VII

MANUAL CHANGES

CHANGE B (Cont'd)

Service Sheet 2 (schematic):
Replace the appropriate portion of the schematic with Figure 7-5 below.

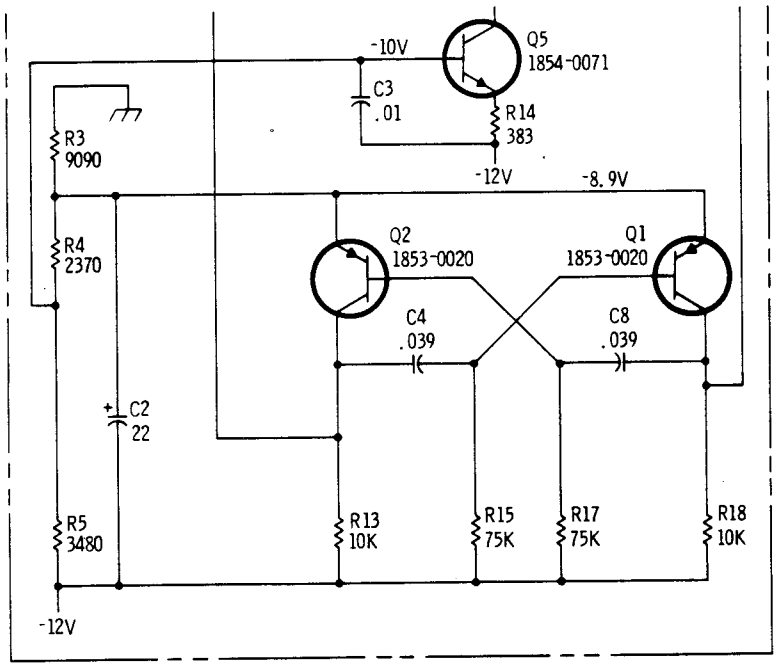


Figure 7-5. P/O A4 Assembly (AC Ampl/Sync Detector) Schematic Backdating (P/O Change B)

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A4C41†	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A4C42†	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A4C43†	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A4C44†	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A4C45†	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A4C46†	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A4C47†	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A4C48†	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A4C49†	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A4C50†	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A4CR1††	1901-0895	4	2	DIODE-SM SIG SCHOTTKY	28480	1901-0895
A4CR2†	1901-0895	4		DIODE-SM SIG SCHOTTKY	28480	1901-0895
A4CR3	1901-0033	2	7	DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A4CR4	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A4CR5	1901-0364	2	1	DIODE-FW BRDG 200V 1A	28480	1901-0364
A4CR6	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A4CR7	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A4CR8†	1901-0328	8	3	DIODE-PWR RECT 400V 1A 6US	03508	A14D
A4CR9	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A4CR10†	1901-0328	8		DIODE-PWR RECT 400V 1A 6US	03508	A14D
A4CR11††	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A4CR12†	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A4CR13†	1901-0328	8		DIODE-PWR RECT 400V 1A 6US	03508	A14D
A4J1	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A4J2	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A4K1	0490-0916	6	1	RELAY-REED 1A 500MA 100VDC 5VDC-COIL	28480	0490-0916
A4MP1	1205-0085	8	2	HEAT SINK TO-66-CS	28480	1205-0085
A4MP2	1205-0085	8		HEAT SINK TO-66-CS	28480	1205-0085
A4P1	0362-0063	3	2	CONNECTOR-SGL CONT QDISC-FEM	28480	0362-0063
A4P2	0362-0063	3		CONNECTOR-SGL CONT QDISC-FEM	28480	0362-0063
A4Q1	1853-0020	4	3	TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A4Q2	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A4Q3	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A4Q4	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A4Q5	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A4Q6	1855-0020	8	2	TRANSISTOR J-FET N-CHAN D-MODE TO-18 SI	28480	1855-0020
A4Q7	1855-0020	8		TRANSISTOR J-FET N-CHAN D-MODE TO-18 SI	28480	1855-0020
A4Q8††				NOT ASSIGNED		
A4Q9†				NOT ASSIGNED		
A4Q10	1853-0012	4	2	TRANSISTOR PNP 2N2904A SI TO-39 PD=600MW	01295	2N2904A
A4Q11	1853-0012	4		TRANSISTOR PNP 2N2904A SI TO-39 PD=600MW	01295	2N2904A
A4Q12	1854-0072	8	1	TRANSISTOR NPN 2N3054 SI TO-66 PD=25W	0192B	2N3054
A4Q13	1853-0052	2	1	TRANSISTOR PNP 2N3740 SI TO-66 PD=25W	04713	2N3740
A4Q14	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A4Q15	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A4Q16	1854-0090	0	1	TRANSISTOR NPN SI TO-39 PD=1W FT=100MHZ	28480	1854-0090
A4Q17	1853-0038	4	1	TRANSISTOR PNP SI TO-39 PD=1W FT=100MHZ	28480	1853-0038
A4Q18	1853-0020	4		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A4Q19				NOT ASSIGNED		
A4Q20†	1884-0073	2	1	THYRISTOR-SCR TO-5 VRRM=100	28480	1884-0073
A4R1	0698-3160	8	3	RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A4R2	0698-3156	2	1	RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A4R3	0757-0288	1	1	RESISTOR 9.09K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-9091-F
A4R4	0698-3438	3	1	RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-147R-F
A4R5	0698-3152	8	1	RESISTOR 3.48K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3481-F
A4R6	0757-0459	8	1	RESISTOR 56.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5622-F
A4R7	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A4R8	0757-0444	1	1	RESISTOR 12.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1212-F
A4R9	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4R10	0698-3159	5	3	RESISTOR 26.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2612-F
A4R11	0698-3159	5		RESISTOR 26.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2612-F
A4R12*	0698-3154	0	3	RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A4R13	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4R14††	0698-3446	3	1	RESISTOR 383 1% .125W F TC=0+-100	24546	C4-1/8-T0-383R-F
A4R15†	0757-0461	2	2	RESISTOR 68.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6812-F
A4R16*†	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A4R17†	0757-0461	2		RESISTOR 68.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6812-F
A4R18	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4R19	0811-3214	5	1	RESISTOR 31.62 .1% .05W PWW TC=0+-10	14140	1409-1/40-31R62-B
A4R20	0811-3218	9	1	RESISTOR 1K .1% .05W PWW TC=0+-10	14140	1409-1/80-1001-B
A4R21	0757-0290	5	1	RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A4R22	0698-3450	9	2	RESISTOR 42.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4222-F
A4R23	0757-0278	9	2	RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1781-F
A4R24	0757-0438	3	1	RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A4R25	0698-3162	0	2	RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F

See introduction to this section for ordering information
*Indicates factory selected value
† FOR BACKDATING INFORMATION SEE SECTION VII

MANUAL CHANGES

CHANGE B

Section V, Power Meter Adjustments with 50Ω Power Sensor and Power Meter Adjustments With Calibrator:

Delete note between steps 5 and 6.

Table 6-2:

Change A4R15 and A4R17 to 0757-0462, RESISTOR 75K, 1% .125W F TUBULAR, 24546, C4-1/8 TO 7502-F

Add A4Q8 1853-0001, TRANSISTOR, PNP SI SHIP TO-39 PD=600 MW, 28480, 1853-0001

Delete A4R76 and A4R77.

Service Sheet 2 (Component and Test Point Locations):

Replace the figure with Figure 7-4 below.

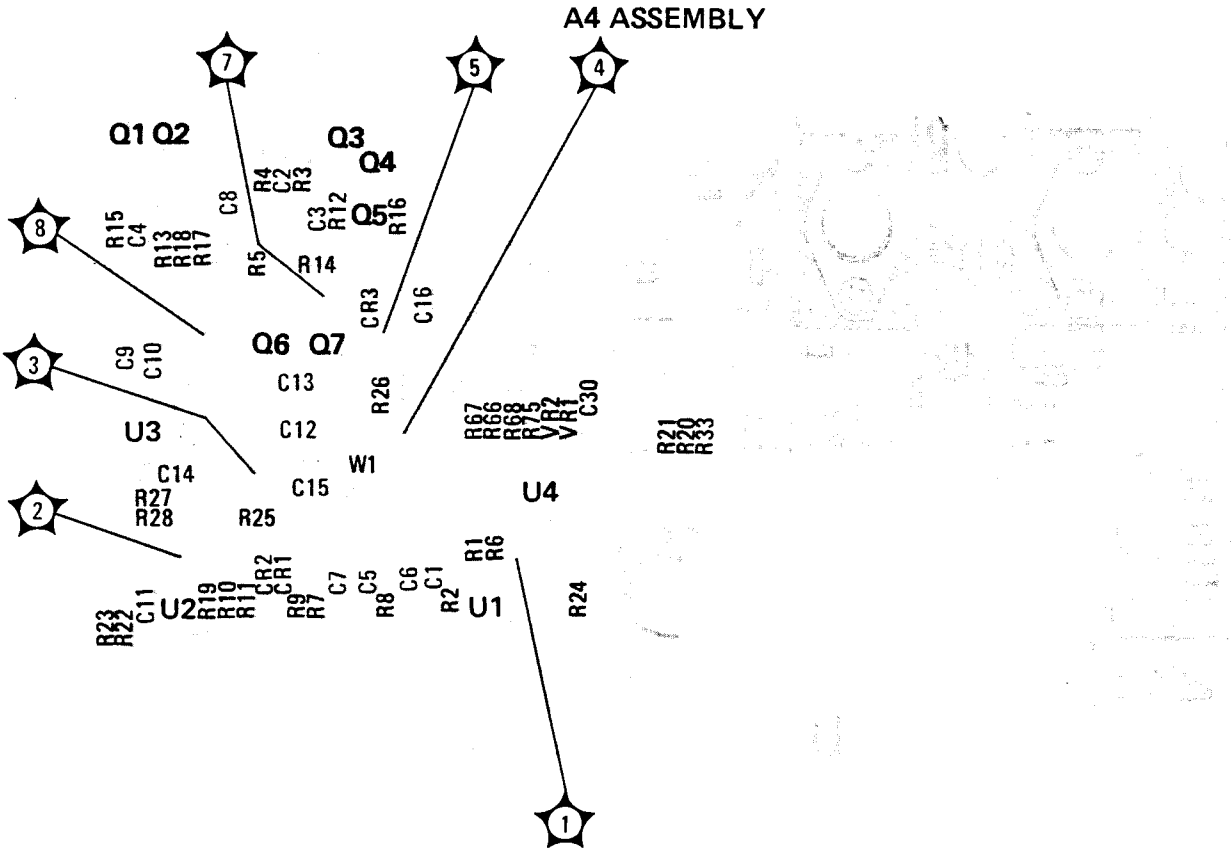


Figure 7-4. P/O A4 Assembly (AC Ampl/Sync Detector) Component and Test Point Locations Backdating (P/O Change B)

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A4R26	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A4R27	0698-3450	9		RESISTOR 42.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4222-F
A4R28	0757-0278	9		RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1781-F
A4R29	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4R30	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4R31	0698-3158	4	2	RESISTOR 23.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2372-F
A4R32	2100-1738	9	3	RESISTOR-TRMR 10K 10% C TOP-ADJ 1-TRN	73138	82PR10K
A4R33	0698-8300	8	1	RESISTOR 840 1% .125W F TC=0+-100	19701	MF4C1/8-T0-840R-F
A4R34	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A4R35	2100-2061	3	1	RESISTOR-TRMR 200 10% C TOP-ADJ 1-TRN	73138	82PR200
A4R36	0757-0419	0	1	RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1/8-T0-681R-F
A4R37	0757-0399	5	1	RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A4R38	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A4R39	0698-3150	6	1	RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A4R40				NOT ASSIGNED		
A4R41				NOT ASSIGNED		
A4R42	2100-1738	9		RESISTOR-TRMR 10K 10% C TOP-ADJ 1-TRN	73138	82PR10K
A4R43	0683-2265	1	1	RESISTOR 22M 5% .25W FC TC=-900/+1200	01121	CB2265
A4R44	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A4R45	0757-0467	8	1	RESISTOR 121K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1213-F
A4R46	2100-2031	7	1	RESISTOR-TRMR 50K 10% C TOP-ADJ 1-TRN	73138	82PR50K
A4R47	0757-0841	2	1	RESISTOR 12.1K 1% .5W F TC=0+-100	28480	0757-0841
A4R48	0757-1000	7	1	RESISTOR 51.1 1% .5W F TC=0+-100	28480	0757-1000
A4R49	0683-0685	5	1	RESISTOR 6.8 5% .25W FC TC=-400/+500	01121	CB68G5
A4R50	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A4R51	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A4R52	0698-3157	3	1	RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A4R53	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A4R54	0698-3159	5		RESISTOR 26.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2612-F
A4R55	0683-1555	0	1	RESISTOR 1.5M 5% .25W FC TC=-900/+1100	01121	CB1555
A4R56	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4R57	0757-0441	8	1	RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A4R58	0757-0428	1	3	RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A4R59	0698-3155	1	1	RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A4R60	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A4R61	0757-1094	9	1	RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A4R62	0698-3449	6	1	RESISTOR 28.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2872-F
A4R63	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4R64	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4R65	0757-0403	2	1	RESISTOR 121 1% .125W F TC=0+-100	24546	C4-1/8-T0-121R-F
A4R66*	0698-3453	2	1	RESISTOR 196K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1963-F
A4R67 †	0698-0084	9	1	RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A4R68†	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A4R69	0683-3355	2	1	RESISTOR 3.3M 5% .25W FC TC=-900/+1100	01121	CB3355
A4R70	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A4R71	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4R72	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A4R73	0757-0274	5	1	RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1211-F
A4R74††	0698-3440	7	1	RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A4R75 †	0698-3158	4		RESISTOR 23.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2372-F
A4R76 ††	2100-1738	9		RESISTOR-TRMR 10K 10% C TOP-ADJ 1-TRN	73138	82PR10K
A4R77 ††	0757-0401	0	1	RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A4R78 ††	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4R79 ††	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4R80 †	0698-3442	9	1	RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A4R81 ††	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A4R82 †	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A4RT1	0839-0011	2	1	THERMISTOR DISC 100-OHM TC=-3.8%/C-DEG	28480	0839-0011
A4TP1	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A4TP2	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A4TP3	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A4TP4	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A4TP5	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A4TP6	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A4TP7	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A4TP8	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A4TP9	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A4TP10	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A4TP11	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A4TP12	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A4U1	1826-0013	8		IC OP AMP LOW-NOISE TO-99 PKG	06665	SSS741CJ
A4U2	1826-0013	8		IC OP AMP LOW-NOISE TO-99 PKG	06665	SSS741CJ
A4U3	1826-0013	8		IC OP AMP LOW-NOISE TO-99 PKG	06665	SSS741CJ
A4U4†	1826-0092	3	1	IC OP AMP GP DUAL TO-99 PKG	28480	1826-0092
A4U5	1826-0013	8		IC OP AMP LOW-NOISE TO-99 PKG	06665	SSS741CJ

See introduction to this section for ordering information
*Indicates factory selected value
† FOR BACKDATING INFORMATION SEE SECTION VII

MANUAL CHANGES

CHANGE A (Cont'd)

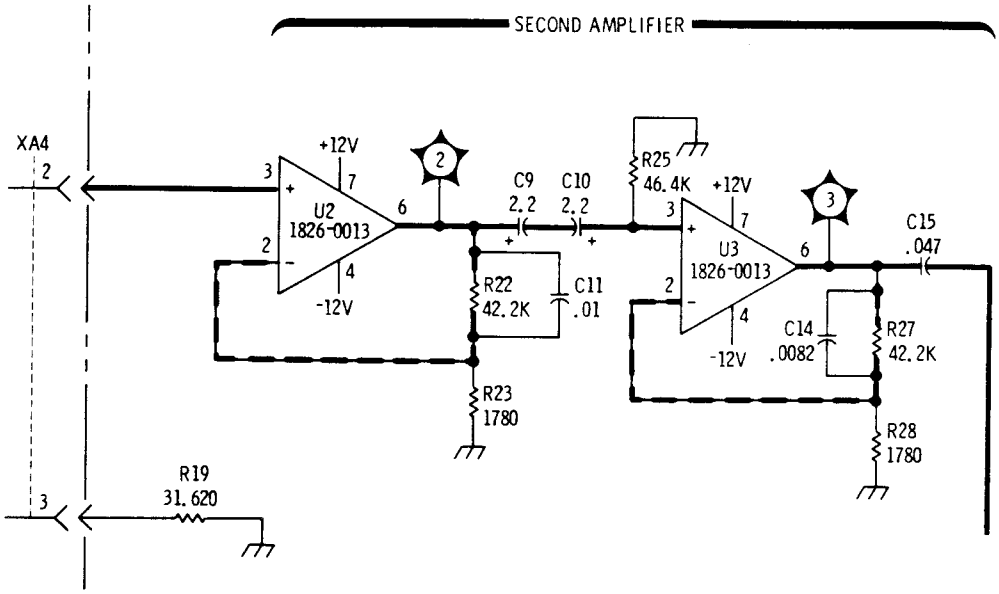


Figure 7-2. P/O A4 Assembly Schematic (Service Sheet 2) (P/O Change A)

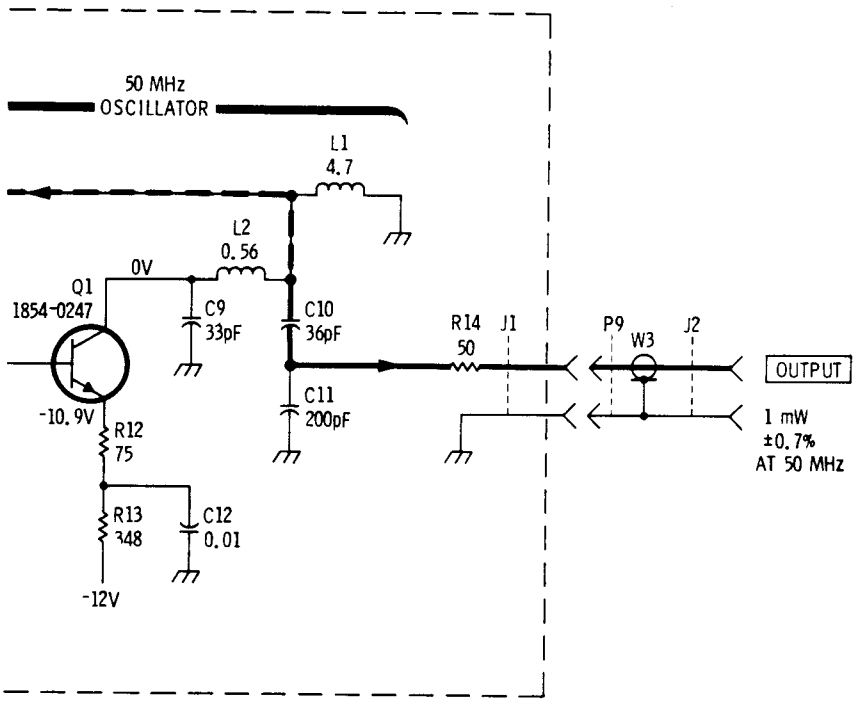


Figure 7-3. P/O A3 Assembly Schematic (Service Sheet 4) (P/O Change A)

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A4U6	1826-0013	8		IC OP AMP LOW-NOISE TO-99 PKG	06665	SSS741CJ
A4U7	1820-0058	9	1	IC OP AMP GP TO-99 PKG	24046	TOA 2709V
A4VR1*	1902-3002	3	2	DIODE-ZNR 2.37V 5% DO-7 PD=.4W TC=-.074%	28480	1902-3002
A4VR2*	1902-3002	3		DIODE-ZNR 2.37V 5% DO-7 PD=.4W TC=-.074%	28480	1902-3002
A4VR3	1902-0041	4		DIODE-ZNR 5.11V 5% DO-35 PD=.4W	28480	1902-0041
A4VR4	1902-3182	0	1	DIODE-ZNR 12.1V 5% DO-35 PD=.4W	28480	1902-3182
A4VR5†	1902-0184	6	1	DIODE-ZNR 16.2V 5% DO-35 PD=.4W	28480	1902-0184
A4VR6†	1902-3416	3	1	DIODE-ZNR 90.9V 5% DO-7 PD=.4W TC=+.082%	28480	1902-3416
A4W1	00435-60013	2	1	CABLE-GRAY SHIELDED, 2-CONDUCTOR	28480	00435-60013
A4A1	00435-60010	9	1	AUTO ZERO ASSEMBLY	28480	00435-60010
A4A1C1				NSR, P/O A4A1 ASSY		
A4A1C2				NSR, P/O A4A1 ASSY		
A4A1C3				NSR, P/O A4A1 ASSY		
A4A1C4				NSR, P/O A4A1 ASSY		
A4A1CR1				NSR, P/O A4A1 ASSY		
A4A1K1				NSR, P/O A4A1 ASSY		
A4A1Q1				NSR, P/O A4A1 ASSY		
A4A1R1				NSR, P/O A4A1 ASSY		
A4A1R2				NSR, P/O A4A1 ASSY		
A4A1R3				NSR, P/O A4A1 ASSY		
A4A1R4				NSR, P/O A4A1 ASSY		
A5	0960-0443	1	1	POWER MODULE ASSEMBLY, JADE GRAY	28480	0960-0443
A5J1	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A5J2	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A5J3	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A5J4	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A5J5	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A5J6	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A5J7	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A5J8	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A5J9	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A5J10				NSR, PART OF A5 ASSY		
				CHASSIS PARTS		
BT1	1420-0096	7	1	BATTERY 28.8V 1.2A-HR NI-CD POST (FOR OPT. 001)	28480	1420-0096
DS1	2140-0244	4	1	LAMP-GLOW A1H 135/105VDC 1.2MA T-2-BULB (PART OF S1)	0046G	A1H
F1†	2110-0234	9	1	FUSE .1A 250V TD 1.25X.25 UL (FOR 100,120 VAC OPERATION)	71400	MDL 1/10,
F1†	2110-0040	5	1	FUSE .062A 250V TD 1.25X.25 UL (FOR 220, 240 VAC OPERATION)	28480	2110-0040
J1	1251-5759	0	2	CONNECTOR 12-PIN F SOCKET (P/O W1, SEE MP4)	28480	1251-5759
J2				NSR, P/O W3 OR W9; SEE MP3 AND MP6.		
J3	1250-0118	3	2	CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0118
J4	1250-0118	3		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0118
J5	1251-5759	0		CONNECTOR 12-PIN F SOCKET	28480	1251-5759
M1	1120-1513	9	1	METER	28480	1120-1513
MP1	0370-2986	0	1	KNOB (CAL FACTOR SWITCH)	28480	0370-2986
MP2†	00435-60030	3	1	KNOB-SKIRTED, JADE GRAY(RANGE SWITCH)	28480	00435-60030
	00435-00013	6	1	KNOB-OUTER, BLACK (THREADED)	28480	00435-00013
	0350-0148	0	1	SCALE-RING (-20 TO -65 DBM)	28480	0350-0148
	0350-0149	1	1	SCALE-RING(+35 TO -5 & +20 TO -25DBM)	28480	0350-0149
	0370-1091	6	1	KNOB-BASE 1/2 JGK .25-IN-ID	28480	0370-1091
	3030-0057	5	1	SCREW-SET 2-56 .094-IN-LG SMALL CUP-PT	00000	ORDER BY DESCRIPTION
	3050-0699	3	1	WASHER-SPR WAVY 1 IN 1.015-IN-ID	28480	3050-0699
	00435-00012	5	1	KNOB-SKIRTED, BLACK	28480	00435-00012
MP3	0590-0011	4	1	NUT-KNRLD-R 5/8-24-THD .125-IN-THK (USED WITH J2)	28480	0590-0011
MP4	1251-3362	7	1	NUT-AUDIO CONN (USED WITH J1 AND J5)	28480	1251-3362
MP5	0590-0923	7	1	NUT-KNRLD-R 1/2-32-THD .125-IN-THK (PART OF S1)	00000	ORDER BY DESCRIPTION
MP6	2950-0079	0	1	NUT-HEX-DBL-CHAM 5/8-24-THD .125-IN-THK (P/O W3 OR W9, USED WITH J2)	28480	2950-0079

See introduction to this section for ordering information
*Indicates factory selected value
† FOR BACKDATING INFORMATION SEE SECTION VII

MANUAL CHANGES

7-3. MANUAL CHANGE INSTRUCTION

CHANGE A

Table 6-2:

Change:

A3R14 to 0698-5068, R: FXD 50 OHM 1% 1/8W F TUBULAR, 30983, MF4C1/8-T9-50R0-F
A4R67 to 0757-0280, RESISTOR, FXD 1K 1% 1/8W F TUBULAR, 24546, C4-1/8-TO-1001-
A4R68 to 0757-0444, RESISTOR, FXD 12.1K 1% 1/8W F TUBULAR, 24546, C4-1/8-to-130
A4U4 to 1826-0013, INTEGRATED CIRCUIT; LINEAR OP AMP, 28480-1826-0013.

Delete A3L3, A4C30, A4R74, and A4R75.

Service Sheet 2 (schematic):

Change the diagram as shown by the partial schematics, Figures 7-1 and 7-2.

Service Sheet 3 (schematic):

Delete A4R74 (the connection is made directly from A4A1 output to XA4 pin 40).

Service Sheet 4 (schematic):

Change the diagram as shown by the partial schematic, Figure 7-3.

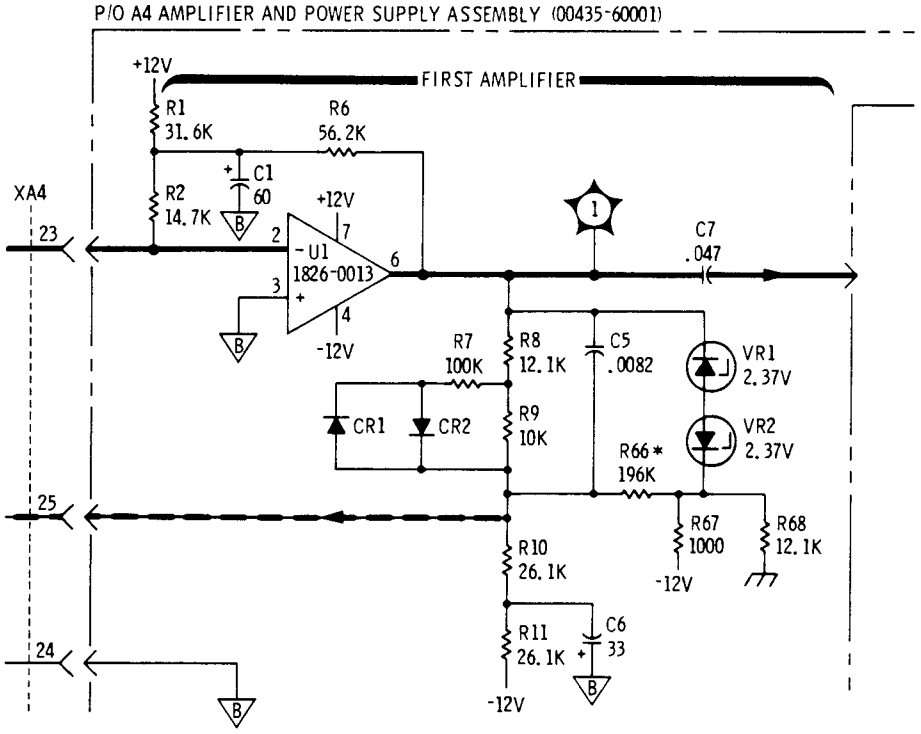


Figure 7-1. P/O A4 Assembly Schematic (Service Sheet 2) (P/O Change A)

Table 6-2. Replaceable Parts

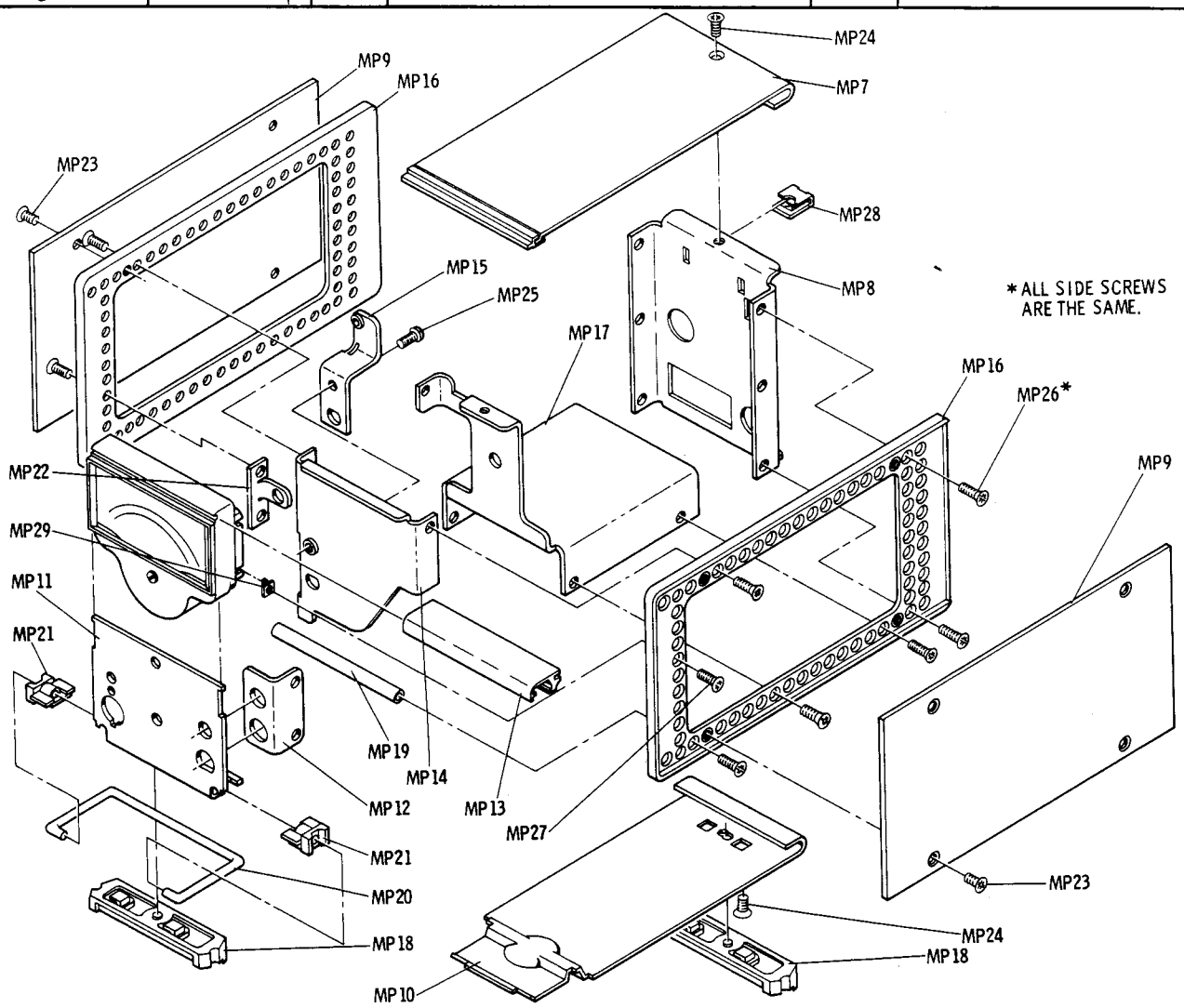


Figure 6-1. Cabinet Parts, Exploded View

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				FIGURE 6-1. CABINET PARTS		
MP7	5060-8555	9	1	COVER ASSY:TOP 5 X 11	28480	5060-8555
MP8†	00435-00017	0	1	PANEL-REAR	28480	00435-00017
MP9	5000-8565	5	2	COVER:SIDE	28480	5000-8565
MP10	5000-8571	3	1	COVER:BOTTOM 5 X 11	28480	5000-8571
MP11	00435-00001	2	1	PANEL-FRONT	28480	00435-00001
MP12	00435-00011	4	1	GUSSET-FRONT PANEL	28480	00435-00011
MP13	5020-7633	8	1	METER TRIM:THIRD MODULE	28480	5020-7633
MP14	00435-00004	5	1	BRACKET-SWITCH	28480	00435-00004
MP15	00435-00005	6	1	BRACKET MOUNTING-MICROSWITCH	28480	00435-00005
MP16	5060-0703	3	2	FRAME ASSY:6 X 11 SM	28480	5060-0703
MP17	00435-00007	8	1	DECK-CHASSIS	28480	00435-00007
MP18	5060-0727	1	2	FOOT ASSY	28480	5060-0727
MP19	5020-0700	6	1	SPACER:CABINET	28480	5020-0700
MP20	1490-0031	7	1	TILT STAND 2.236-IN-W 4.438-IN-OA-LG SST	28480	1490-0031
MP21	5040-0700	8	2	HINGE	28480	5040-0700
MP22	00435-00002	3	1	BRACKET MOUNTING- CAL POT	28480	00435-00002
MP23	2360-0192	7	8	SCREW-MACH 6-32 .25-IN-LG 100 DEG	00000	ORDER BY DESCRIPTION
MP24	2360-0194	9	2	SCREW-MACH 6-32 .312-IN-LG 100 DEG	00000	ORDER BY DESCRIPTION
MP25	0520-0131	2	1	SCREW-MACH 2-56 .438-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP26	2360-0116	5	20	SCREW-MACH 6-32 .312-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
MP27	2360-0120	1	4	SCREW-MACH 6-32 .438-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
MP28	0590-0052	3	2	NUT-SHMET-J-TP 6-32-THD .5-WD STL	28480	0590-0052
MP29	0590-0039	6	4	NUT-SHMET 6-32-THD .28-WD STL	28480	0590-0039

See introduction to this section for ordering information

† FOR BACKDATING INFORMATION SEE SECTION VII

Table 7-2. Summary of Changes by Component (2 of 2)

Assembly / Change	Instrument	A3	A4
F			Change C28, C29, and CR8; delete C39, CR10, CR11, CR12, Q20, R81, R82, VR5, VR6. Add Q9, C27
E		Change A3 board	
D	Change MP2		
C			Delete C31—C38, R78—R80 Change A4
B			Change R15 and R17 Add Q8 Delete R76 and R77
A		Change R14 Delete L3	Change R67, R68 and U4 Delete C30, R74, and R75

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
P1	0362-0063	3	9	CONNECTOR-SGL CONT QDISC-FEM	28480	0362-0063
P2	0362-0063	3		CONNECTOR-SGL CONT QDISC-FEM	28480	0362-0063
P3	0362-0063	3		CONNECTOR-SGL CONT QDISC-FEM	28480	0362-0063
P4	0362-0063	3		CONNECTOR-SGL CONT QDISC-FEM	28480	0362-0063
P5	0362-0063	3		CONNECTOR-SGL CONT QDISC-FEM	28480	0362-0063
P6	0362-0063	3		CONNECTOR-SGL CONT QDISC-FEM	28480	0362-0063
P7	0362-0063	3		CONNECTOR-SGL CONT QDISC-FEM	28480	0362-0063
P8	0362-0063	3		CONNECTOR-SGL CONT QDISC-FEM	28480	0362-0063
P9	0362-0063	3		CONNECTOR-SGL CONT QDISC-FEM	28480	0362-0063
P10	1250-1411	1	1	CONNECTOR-RF SMC FEM UNMTD 50-OHM (P/O W3 OR W9)	28480	1250-1411
R1	2100-3342	5	1	RESISTOR-VAR PREC WW 10-TRN 10K 5%	28480	2100-3342
R2	0757-0459	8	1	RESISTOR 56.2K 1% .125W F TC=0+-100 (P/O W2)	24546	C4-1/8-T0-5622-F
S1	3101-1395	7	1	SWITCH-PB DPDT-DB ALTNG 10.5A 250VAC (P/O W2, INCLUDES DS1 AND MP5)	28480	3101-1395
S2	3102-0006	7	1	SWITCH-SENS SPDT SUBMIN 1A 30VDC (ZERO)	28480	3102-0006
	00435-00006	7	1	SPRING-PUSHBUTTON	28480	00435-00006
	00435-40001	6	1	PUSHBUTTON-MICROSWITCH	28480	00435-40001
	03603-2004	5	1	NUT PLATE-MICROSWITCH	28480	03603-2004
S3†	3101-0415	0	1	SWITCH-SL DPDT MINTR .5A 125VAC/DC (POWER REF. SWITCH)	28480	3101-0415
T1	9100-3391	1	1	TRANSFORMER-POWER 100/120/220/240V	28480	9100-3391
TB1	5020-8122	2	1	LINE VOLTAGE SELECTION CARD	28480	5020-8122
W1	00435-60006	3	1	CABLE-INPUT, GRAY (INCL J1, SEE MP4, OMITTED ON OPT. 003	28480	00435-60006
W2	00435-60007	4	1	CABLE-POWER, PRIMARY (INCLUDES R2 AND S1)	28480	00435-60007
W3	00435-60031	4	1	CABLE-POWER REFERENCE (INCLUDES J2, P10 AND MP6, SEE MP3, OMITTED ON OPT. 003)	28480	00435-60031
W4	8120-2263	5	1	CABLE-POWER SENSOR, 5FT. (STD) (OMIT ON OPT. 009,010,011,012 & 013)	28480	8120-2263
	8120-2264	6	1	CABLE-POWER SENSOR, 10 FT.(OPT. 009 ONLY	28480	8120-2264
	8120-2265	7	1	CABLE-POWER SENSOR, 20 FT(OPT. 010 ONLY)	28480	8120-2265
	8120-2260	2	1	CABLE-POWER SENSOR,50 FT(OPT. 011 ONLY)	28480	8120-2260
	8120-2261	3	1	CABLE-POWER SENSOR,100 FT(OPT. 012 ONLY)	28480	8120-2261
	8120-2262	4	1	CABLE-POWER SENSOR,200 FT(OPT. 013 ONLY)	28480	8120-2262
W5	8120-1378	1	1	CABLE ASSY 18AWG 3-CNDCT JGK-JKT	28480	8120-1378
W6	00435-60027	8	1	CABLE-INPUT, GRAY (INCL J5, SEE MP4, FOR OPT. 002 & 003)	28480	00435-60027
W7	00435-60025	6	1	CABLE-GREEN	28480	00435-60025
W8	00435-60026	7	1	CABLE-BLUE, 2-CONDUCTOR	28480	00435-60026
W9	00435-60032	5	1	CABLE-POWER REFERENCE (INCL J2, P10 & MP6), SEE MP3 OPT.	28480	00435-60032
XA4	1251-0233	5	1	CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-0233
				MISCELLANEOUS PARTS		
	0403-0131	4	2	GUIDE-PC BD GRA POLYC .062-BD-THKNS	28480	0403-0131
	6960-0010	4	1	PLUG-HOLE DOME-HD FOR .625-D-HOLE STL	28480	6960-0010
	6960-0024	0	1	PLUG-HOLE FL-HD FOR .688-D-HOLE NYL	28480	6960-0024
	5040-0345	7	4	INSULATOR:CONNECTOR	28480	5040-0345
	00435-00009	0	1	CLAMP-BATTERY(OPT. 001 ONLY)	28480	00435-00009

See introduction to this section for ordering information
*Indicates factory selected value
† FOR BACKDATING INFORMATION SEE SECTION VII

SECTION VII
MANUAL CHANGES

7-1. INTRODUCTION

This section contains information for adapting this manual to instruments for which the content does not apply directly. In addition, information about recommended modifications for improvements to the instruments is provided.

7-2. MANUAL CHANGES

To adapt this manual to your instrument, refer to Table 7-1 and make all of the manual changes listed opposite your instrument serial number. Perform these changes in the sequence listed.

If your instrument serial number is not listed on the title page of this manual or in Table 7-1 below, it may be documented in a yellow MANUAL CHANGES supplement. For additional important information about serial number coverage refer to INSTRUMENTS COVERED BY MANUAL in Section I. Table 7-2 cross-references changes and affected components.

Table 7-1. Manual Changes by Serial Number Prefix

Serial Number Prefix	Manual Change(s)	Serial Number Prefix	Manual Change(s)
1234A	L, K, J, I, H, G, F, E, D, C, B, A	1624A, 1629A, 1701A	L, K, J, I, H, G
1312A	L, K, J, I, H, G, F, E, D, C, B	1723A	L, K, J, I, H
1415A	L, K, J, I, H, G, F, E, D, C	1733A	L, K, J, I
1527A	L, K, J, I, H, G, F, E, D	1750A	L, K, J
1530A	L, K, J, I, H, G, F, E	1810A	L, K
1548A, 1601A	L, K, J, I, H, G, F	1921A, 1949A	L

Table 7-2. Summary of Changes by Component (1 of 2)

Assembly / Change	Instrument	A3	A4
L			Change CR1 and CR2
K	Change S3 (POWER REF. Switch)		
J			Change VR6
I	Change F1	Change C2 and C3	Change C39; delete CR13
H	Change F1 and MP8		
G			Change A4 board; delete C40—50

Table 6-3. Code List of Manufacturers

Mfr Code	Manufacturer Name	Address		Zip Code
00000	ANY SATISFACTORY SUPPLIER			
0046G	NORELCO NORTH AMER PHILIPS LTG CORP	LOS ANGELES	CA	90021
01121	ALLEN-BRADLEY CO	MILWAUKEE	WI	53204
01295	TEXAS INSTR INC SEMICOND CMPNT DIV	DALLAS	TX	75222
0192B	RCA CORP SOLID STATE DIV	SOMERVILLE	NJ	08876
02111	SPECTROL ELECTRONICS CORP	CITY OF IND	CA	91745
0350B	GE CO SEMICONDUCTOR PROD DEPT	SYRACUSE	NY	13201
04713	MOTOROLA SEMICONDUCTOR PRODUCTS	PHOENIX	AZ	85062
06665	PRECISION MONOLITHICS INC	SANTA CLARA	CA	95050
14140	EDISON ELEK DIV MCGRAW-EDISON	MANCHESTER	NH	03130
19701	MEPCO/ELECTRA CORP	MINERAL WELLS	TX	76067
20940	MICRO-OHM CORP	EL MONTE	CA	91731
24046	TRANSITRON ELECTRONIC CORP	WAKEFIELD	MA	01880
24546	CORNING GLASS WORKS (BRADFORD)	BRADFORD	PA	16701
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO	CA	94304
51959	VICLAN INC	SAN DIEGO	CA	92138
56289	SPRAGUE ELECTRIC CO	NORTH ADAMS	MA	01247
71400	BUSSMAN MFG DIV OF MCGRAW-EDISON CO	ST LOUIS	MO	63107
73138	BECKMAN INSTRUMENTS INC HELIPOT DIV	FULLERTON	CA	92634