HP 8935 CDMA Cellular/PCS Base Station
Test Set

Assembly Level Repair
Firmware Version A.01.00 and above

HP Part Number E6380-90015
CD Rom Part Number E6380-90027

Revision A
Printed in U.S.A.

January 1998
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1 General Information

This chapter contains generic information about the product, safety, warranty, sales and service offices, power-cables, and other information.
Manufacturer's Declaration

This statement is provided to comply with the requirements of the German Sound Emission Directive, from 18 January 1991.

This product has the following sound pressure emission specification:

- sound pressure $L_p < 70 \text{ dB(A)}$
- at the operator position
- under normal operation
- according to ISO 7779:1988/EN 27779:1991 (Type Test).

Herstellerbescheinigung


- Schalldruckpegel $L_p < 70 \text{ dB(A)}$.
- Am Arbeitsplatz.
- Normaler Betrieb.
GENERAL

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

This product has been designed and tested in accordance with IEC Publication 1010, "Safety Requirements for Electronic Measuring Apparatus," and has been supplied in a safe condition. This instruction documentation contains information and warnings which must be followed by the user to ensure safe operation and to maintain the product in a safe condition.

SAFETY EARTH GROUND

A 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.

CHASSIS GROUND TERMINAL

To prevent a potential shock hazard, always connect the rear-panel chassis ground terminal to earth ground when operating this instrument from a dc power source.

SAFETY SYMBOLS

⚠ Indicates instrument damage can occur if indicated operating limits are exceeded. Refer to the instructions in this guide.

⚡ Indicates hazardous voltages.

-ground Indicates earth (ground) terminal

**WARNING**

A WARNING note 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**

A CAUTION note denotes a hazard. It calls attention to an operation 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 an CAUTION note until the indicated conditions are fully understood and met.
Safety Considerations for this Instrument

**WARNING**

This product is a Safety Class I instrument (provided with a protective earthing ground incorporated in the power cord). The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. Any interruption of the protective conductor inside or outside of the product is likely to make the product dangerous. Intentional interruption is prohibited.

Do not expose to or operate this instrument in outdoor atmospheric conditions such as direct rain, hail, sleet, snow, icing, sunshine or wind. Operate this instrument only within its specified temperature humidity conditions.

This instrument is equipped with internal ground fault circuit interrupter class A.

- This device does not protect against electrical shock due to contact with both circuit conductors or a fault in supply wiring to product.

- Do not use extension cord to connect this product to power receptacle. Attention-ne pas utiliser de rallonge pour raccorder le detecteur-disjoncteur a la prise de courant.

- Replace cordset only with HP 8120 series. Attention - Remplacer uniquement par un cordon amovible numero 8120.

- Do not use in wet location. Ne pas utiliser dans un emplacement mouille.
WARNING

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.

If this product is not used as specified, the protection provided by the equipment could be impaired. This product must be used in a normal condition (in which all means for protection are intact) only.

No operator serviceable parts in this product. Refer servicing to qualified personnel. To prevent electrical shock, do not remove covers.

Servicing instructions are for use by qualified personnel only. To avoid electrical shock, do not perform any servicing unless you are qualified to do so.

The opening of covers or removal of parts is likely to expose dangerous voltages. Disconnect the product from all voltage sources while it is being opened.

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.

The power cord is connected to internal capacitors that may remain live for 5 seconds after disconnecting the plug from its power supply.

For continued protection against fire hazard, replace the line fuse(s) only with 250 V fuse(s) or the same current rating and type (for example, normal blow or time delay). Do not use repaired fuses or short circuit fuseholders. FUSE: T 5.0A.
CAUTION  Always use the three-prong ac power cord supplied with this product. Failure to ensure adequate earth grounding by not using this cord may cause personal injury and/or product damage.

This product is designed for use in Installation Category II and Pollution Degree 2 per IEC 1010 and IEC 664 respectively. For indoor use only.

This product has autoranging line voltage input, be sure the supply voltage is within the specified range.

Ventilation Requirements: When installing the product in a cabinet, the convection into and out of the product must not be restricted. The ambient temperature (outside the cabinet) must be less than the maximum operating temperature of the product by 4° C for every 100 watts dissipated in the cabinet. If the total power dissipated in the cabinet is greater than 800 watts, then forced convection must be used.

To prevent electrical shock, disconnect instrument from mains (line) before cleaning. Use a dry cloth or one slightly dampened with water to clean the external case parts. Do not attempt to clean internally.

Product Markings  CE - the CE mark is a registered trademark of the European Community. A CE mark accompanied by a year indicated the year the design was proven.

CSA - the CSA mark is a registered trademark of the Canadian Standards Association.
CERTIFICATION  
Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Institute of Standards and Technology, to the extent allowed by the Institute's calibration facility, and to the calibration facilities of other International Standards Organization members.

WARRANTY  
This Hewlett-Packard instrument product is warranted against defects in material and workmanship for a period of one year from date of shipment. During the warranty period, Hewlett-Packard Company will at its option, either repair or replace products which prove to be defective.

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

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

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

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

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

ASSISTANCE  
Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products. For any assistance, contact your nearest Hewlett-Packard Sales and Service Office.

Regional Sales and Service Offices
# General Information

<table>
<thead>
<tr>
<th>Country</th>
<th>Address</th>
<th>Telephone</th>
<th>Fax</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States of America</td>
<td>U.S. Instrument Support Center&lt;br&gt;For Test &amp; Measurement Equipment Repair &amp; Calibration.&lt;br&gt;Englewood, Colorado 80112&lt;br&gt;Telephone: (800) 403-0801&lt;br&gt;Fax: (888) 857-8161</td>
<td>United States of America&lt;br&gt;Customer Information Center&lt;br&gt;Hewlett-Packard Company&lt;br&gt;Tel: (800) 752-0900&lt;br&gt;6:00 am to 5:00 pm Pacific Time&lt;br&gt;Parts Direct: 1-800-227-8164</td>
<td>United Kingdom&lt;br&gt;Sales and Service&lt;br&gt;Hewlett-Packard Ltd.&lt;br&gt;Cain Road&lt;br&gt;Amen Corner&lt;br&gt;Bracknell, Berkshire&lt;br&gt;RG12 1HN&lt;br&gt;United Kingdom&lt;br&gt;Telephone: 44 344 360000&lt;br&gt;Fax: 44 344 363344</td>
</tr>
<tr>
<td>South Eastern Europe</td>
<td>Sales and Service&lt;br&gt;Hewlett-Packard Ges. m.b.h.&lt;br&gt;Liebigasse 1&lt;br&gt;P.O. Box 72&lt;br&gt;A-1222 Vienna, Austria&lt;br&gt;Telephone: 43 222 2500 0&lt;br&gt;Telex: 13 4425</td>
<td>European Multicountry Region&lt;br&gt;Sales and Service&lt;br&gt;Hewlett-Packard S.A.&lt;br&gt;P.O. Box 95&lt;br&gt;150, Route du Nant_dL AVRIL&lt;br&gt;CH-1217 Meyrin 2&lt;br&gt;Geneva, Switzerland&lt;br&gt;Telephone: (41/22) 780-8111&lt;br&gt;Fax: (41/22) 780-8542</td>
<td>Northern Europe&lt;br&gt;Sales and Service&lt;br&gt;Hewlett-Packard Nederland B.V.&lt;br&gt;Startbaan 16&lt;br&gt;1187 XR&lt;br&gt;Amstelveen, The Netherlands&lt;br&gt;P.O. Box 667&lt;br&gt;Telephone: 31/20 5476911 X&lt;br&gt;Fax: 31-20-6471825NL</td>
</tr>
<tr>
<td>Asia</td>
<td>Sales and Service&lt;br&gt;Hewlett-Packard Asia Ltd.&lt;br&gt;22-30/F Peregrine Tower&lt;br&gt;Lippo Center&lt;br&gt;89 Queensway, Central&lt;br&gt;Hong Kong&lt;br&gt;G.P.O. Box 863 Hong Kong&lt;br&gt;Telephone: 852-848-7777&lt;br&gt;Fax: 852-868-4997</td>
<td>Japan&lt;br&gt;Sales and Service&lt;br&gt;Yokogawa-Hewlett-Packard Ltd.&lt;br&gt;3-29-21, Takaido-Higashi&lt;br&gt;Suginami-Ku, Tokyo 168&lt;br&gt;Telephone: 81 3 3331-6111&lt;br&gt;Fax: 81 3 3331-6631</td>
<td>International Sales Branch&lt;br&gt;Headquarters&lt;br&gt;Sales and Service&lt;br&gt;Hewlett-Packard S.A.&lt;br&gt;39 Rue Veyrot&lt;br&gt;P.O. Box 365&lt;br&gt;1217 Meyrin 1&lt;br&gt;Geneva, Switzerland&lt;br&gt;Telephone: 41-22-780-4111&lt;br&gt;Fax: 41-22-780-4770</td>
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<tr>
<td>Australia, New Zealand</td>
<td>Sales and Service&lt;br&gt;Hewlett-Packard Ltd.&lt;br&gt;P.O. Box 221&lt;br&gt;31-41 Joseph Street&lt;br&gt;Blackburn, Victoria 3130&lt;br&gt;Telephone: (61/3) 895-2895&lt;br&gt;Fax: (61/3) 898-9257</td>
<td>Canada&lt;br&gt;Sales and Service&lt;br&gt;Hewlett-Packard (Canada) Ltd.&lt;br&gt;5150 Spectrum Way&lt;br&gt;Mississauga, Ontario L4W 5G1&lt;br&gt;Canada&lt;br&gt;Telephone: (416) 206-4725&lt;br&gt;Fax: (416) 206-4739</td>
<td>Canada&lt;br&gt;Service Center&lt;br&gt;Hewlett-Packard Company&lt;br&gt;17500 Transcanada Highway&lt;br&gt;S. Serv Road&lt;br&gt;Kirkland, Quebec H9J 2X8&lt;br&gt;Canada&lt;br&gt;Telephone: (416) 206-3295</td>
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<tr>
<td>Country</td>
<td>Address</td>
<td>Telephone</td>
<td>Fax</td>
</tr>
<tr>
<td>-----------</td>
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<td>-------------</td>
<td>--------------</td>
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<tr>
<td>Canada</td>
<td>Hewlett-Packard Ltd. 11120 178 Street</td>
<td>(403) 486-6666</td>
<td>(403) 489-8764</td>
</tr>
<tr>
<td></td>
<td>Edmonton, Alberta T5S 1P2 Canada</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Latin America</td>
<td>Hewlett-Packard Company LAHQ Mexico City</td>
<td>(52/5) 326-4000</td>
<td>(52/5) 202 7718</td>
</tr>
<tr>
<td></td>
<td>Col. Lomas de Virreyes 11000 Mexico D.F.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mexico</td>
<td></td>
<td></td>
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</table>
### Table 1-1  Power Cables

<table>
<thead>
<tr>
<th>Plug Type</th>
<th>Plug Descriptions male/female</th>
<th>HP Part # (cable &amp; plug)</th>
<th>Cable Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Straight/Straight</td>
<td>8120-1689</td>
<td>79 inches, mint gray</td>
</tr>
<tr>
<td></td>
<td>Straight/90°</td>
<td>8120-1692</td>
<td>79 inches, mint gray</td>
</tr>
</tbody>
</table>

Used in the following locations

Afghanistan, Albania, Algeria, Angola, Armenia, Austria, Azerbaijan, Azores
Bangladesh, Belgium, Benin, Bolivia, Boznia-Herzegovina, Bulgaria, Burkina Faso, Burma, Burundi, Byelarus
Cameroon, Canary Islands, Central African Republic, Chad, Chile, Comoros, Congo, Croatia, Czech Republic, Czechoslovakia
Denmark, Djibouti
East Germany, Egypt, Estonia, Ethiopia
Finland, France, French Guiana, French Indian Ocean Areas
Gabon, Gaza Strip, Georgia, Germany, Gozo, Greece
Hungary
Iceland, Indonesia, Iran, Iraq, Israel, Italy, Ivory Coast
Jordan
Kazakhstan, Korea, Kyrgyzstan
Latvia, Lebanon, Libya, Lithuania, Luxembourg
Macedonia, Madeira Islands, Malagasy Republic, Mali, Malta, Mauritania, Miquelon, Moldova, Mongolia, Morocco, Mozambique
Nepal, Netherlands, Netherlands Antilles, Niger, Norway
Oman
Pakistan, Paraguay, Poland, Portugal
Rep. South Africa, Romania, Russia, Rwanda
Saudi Arabia (220V), Senegal, Slovak Republic, Slovenia, Somalia, Spain, Spanish Africa, Sri Lanka, St.Pierce Islands
Sweden, Syria
Tajikistan, Thailand, Togo, Tunisia, Turkey, Turkmenistan
### Table 1-2

<table>
<thead>
<tr>
<th>Plug Type</th>
<th>Plug Descriptions male/female</th>
<th>HP Part # (cable &amp; plug)</th>
<th>Cable Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Straight/Straight</td>
<td>8120-1689 8120-1692</td>
<td>79 inches, mint gray 79 inches, mint gray</td>
</tr>
</tbody>
</table>

**USSR, Ukraine, Uzbekistan**

**Western Africa, Western Sahara**

**Yugoslavia**

**Zaire**

**Power Cables**

**Table 1-2**

<table>
<thead>
<tr>
<th>Plug Type</th>
<th>Plug Descriptions male/female</th>
<th>HP Part # (cable &amp; plug)</th>
<th>Cable Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Straight/Straight</td>
<td>8120-0698</td>
<td>90 inches, black</td>
</tr>
</tbody>
</table>

**Used in the following locations**

**Peru**

**Table 1-3**

<table>
<thead>
<tr>
<th>Plug Type</th>
<th>Plug Descriptions male/female</th>
<th>HP Part # (cable &amp; plug)</th>
<th>Cable Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Straight/Straight</td>
<td>8120-2104 8120-2296</td>
<td>79 inches, gray 79 inches, gray</td>
</tr>
</tbody>
</table>

**Used in the following locations**

**Switzerland**
## General Information

### Table 1-4

<table>
<thead>
<tr>
<th>Plug Type</th>
<th>Plug Descriptions male/female</th>
<th>HP Part # (cable &amp; plug)</th>
<th>Cable Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>125V</td>
<td>Straight/Straight Straight/Straight/90 Straight/Straight</td>
<td>8120-1378 8120-1521 8120-1751</td>
<td>90 inches, jade gray 90 inches, jade gray 90 inches, jade gray</td>
</tr>
</tbody>
</table>

Used in the following locations

- American Samoa
- Bahamas, Barbados, Belize, Bermuda, Brazil, Caicos, Cambodia, Canada, Cayman Islands, Columbia, Costa Rica, Cuba
- Dominican Republic
- Ecuador, El Salvador
- French West Indies
- Guam, Guatemala, Guyana
- Haiti, Honduras
- Jamaica
- Korea
- Laos, Leeward and Windward Is., Liberia
- Mexico, Midway Islands
- Nicaragua
- Other Pacific Islands
- Panama, Philippines, Puerto Rico
- Saudi Arabia (115V, 127V), Suriname
- Taiwan, Tobago, Trinidad, Trust Territories of Pacific Islands
- Turks Island
- United States
- Venezuela, Vietnam, Virgin Islands of the US
- Wake Island
### Table 1-5

<table>
<thead>
<tr>
<th>Plug Type</th>
<th>Plug Descriptions male/female</th>
<th>HP Part # (cable &amp; plug)</th>
<th>Cable Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>JIS C 8303, 100 V</td>
<td>Straight/Straight</td>
<td>8120-4753</td>
<td>90 inches, dark gray</td>
</tr>
<tr>
<td></td>
<td>Straight/90°</td>
<td>8120-4754</td>
<td>90 inches, dark gray</td>
</tr>
</tbody>
</table>

Used in the following locations

Japan

### Table 1-6

<table>
<thead>
<tr>
<th>Plug Type</th>
<th>Plug Descriptions male/female</th>
<th>HP Part # (cable &amp; plug)</th>
<th>Cable Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>90°/Straight</td>
<td>8120-2956</td>
<td>79 inches, gray</td>
</tr>
<tr>
<td></td>
<td>90°/90°</td>
<td>8120-2957</td>
<td>79 inches, gray</td>
</tr>
<tr>
<td></td>
<td>Straight/Straight</td>
<td>8120-3997</td>
<td>79 inches, gray</td>
</tr>
</tbody>
</table>

Used in the following locations

Denmark

Greenland

### Table 1-7

<table>
<thead>
<tr>
<th>Plug Type</th>
<th>Plug Descriptions male/female</th>
<th>HP Part # (cable &amp; plug)</th>
<th>Cable Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Straight/Straight</td>
<td>8120-4211</td>
<td>79 inches, mint gray</td>
</tr>
<tr>
<td></td>
<td>Straight/90°</td>
<td>8120-4600</td>
<td>79 inches, mint gray</td>
</tr>
</tbody>
</table>

Used in the following locations

Botswana

India

Lesotho
## General Information

<table>
<thead>
<tr>
<th>Plug Type</th>
<th>Plug Description</th>
<th>HP Part # (cable &amp; plug)</th>
<th>Cable Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malawi</td>
<td>Male/female</td>
<td>8120-1351</td>
<td>90 inches, mint gray</td>
</tr>
<tr>
<td>South-West Africa (Namibia), Swaziland</td>
<td>Male/female</td>
<td>8120-1703</td>
<td>90 inches, mint gray</td>
</tr>
<tr>
<td>Zambia, Zimbabwe</td>
<td>Male/female</td>
<td>Earth, Ground, Line, Neutral</td>
<td>90°/Straight, 90°/90°</td>
</tr>
</tbody>
</table>

### Table 1-8

<table>
<thead>
<tr>
<th>Plug Type (Male)</th>
<th>Plug Description</th>
<th>HP Part # (cable &amp; plug)</th>
<th>Cable Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earth, Ground, Line, Neutral</td>
<td>90°/Straight, 90°/90°</td>
<td>8120-1351, 8120-1703</td>
<td>90 inches, mint gray</td>
</tr>
</tbody>
</table>

Used in the following locations:

- Bahrain, British Indian Ocean Terr., Brunei
- Canton, Cyprus
- Enderbury Island, Equatorial Guinea
- Falkland Islands, French Pacific Islands
- Gambia, Ghana, Gibraltar, Guinea
- Hong Kong
- Ireland
- Kenya, Kuwait
- Macao, Malaysia, Mauritius
- Nigeria
- Qatar
- Seychelles, Sierra Leone, Singapore, Southern Asia, Southern Pacific Islands, St. Helena, Sudan
- Tanzania
- Uganda, United Arab Emirates, United Kingdom
- Yeman (Aden & Sana)
### Table 1-9

<table>
<thead>
<tr>
<th>Plug Type</th>
<th>Plug Descriptions male/female</th>
<th>HP Part # (cable &amp; plug)</th>
<th>Cable Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Straight/Straight</td>
<td>Straight/90°</td>
<td>8120-1369 8120-0696</td>
<td>79 inches, gray 80 inches, gray</td>
</tr>
</tbody>
</table>

Used in the following locations
- Argentina, Australia
- China (People’s Republic)
- New Zealand
- Papua New Guinea
- Uruguay
- Western Samoa

### Table 1-10

<table>
<thead>
<tr>
<th>Plug Type</th>
<th>Plug Descriptions male/female</th>
<th>HP Part # (cable &amp; plug)</th>
<th>Cable Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Straight/Straight</td>
<td>Straight/90°</td>
<td>8120-1860 8120-1575 8120-2191 8120-4379</td>
<td>60 inches, jade gray 30 inches, jade gray 60 inches, jade gray 15.5 inches, jade gray</td>
</tr>
</tbody>
</table>

Used in the following locations
- System Cabinets
ATTENTION
Static Sensitive Devices

This instrument was constructed in an ESD (electro-static discharge) protected environment. This is because most of the semiconductor devices used in this instrument are susceptible to damage by static discharge.

Depending on the magnitude of the charge, device substrates can be punctured or destroyed by contact or mere proximity of a static charge. The result can cause degradation of device performance, early failure, or immediate destruction.

These charges are generated in numerous ways such as simple contact, separation of materials, and normal motions of persons working with static sensitive devices.

When handling or servicing equipment containing static sensitive devices, adequate precautions must be taken to prevent device damage or destruction.

Only those who are thoroughly familiar with industry accepted techniques for handling static sensitive devices should attempt to service circuitry with these devices.

In all instances, measures must be taken to prevent static charge build-up on work surfaces and persons handling the devices.
Conventions Used in This Manual

The following conventions are used throughout this manual to help clarify instructions and reduce unnecessary text:

- “Test Set” refers to the HP 8935 CDMA Cellular/PCS Base Station Test Set.
- Test Set keys are indicated like this: **Preset**
- Test Set screen information, such as a measurement result or an error message, is shown like this: **TX Channel Power -1.3 dBm**

What Is In This Manual

Chapter 1, “General Information,” on page 11
This chapter contains generic information about the product, safety, warranty, sales and service offices, power-cables, and other information.

Chapter 2, “Product Information,” on page 31
This chapter contains general information about the Test Set and how to service it.

Chapter 3, “Troubleshooting,” on page 43
This chapter explains how to isolate a problem to the defective assembly. Troubleshooting uses the Test Set’s built-in diagnostics. If diagnostics can’t identify the faulty assembly, supplementary information in the form of manual troubleshooting procedures is provided.

Chapter 4, “Preventative Maintenance,” on page 85
This chapter describes the preventative maintenance procedures recommended for the Test Set.

Chapter 5, “Disassembly,” on page 93
This chapter explains how to disassemble the Test Set for major assembly replacement.

Chapter 6, “Replaceable Parts,” on page 125
This chapter contains the replaceable assembly and component information for the Test Set. Use the illustrations in this chapter to identify the replaceable parts and the “Parts List” on page 140 for part numbers.
Chapter 7, “Periodic Adjustments,” on page 145
This chapter contains the periodic adjustment procedures for the Test Set.

Chapter 8, “Performance Tests,” on page 161
This chapter contains the performance test procedures for the Test Set. The tests in this chapter verify that the Test Set performs to its published specifications.

Chapter 9, “Performance Test Records,” on page 219
Use this chapter to record the results of the performance tests in Chapter 8, “Performance Tests,” on page 161.

Chapter 10, “Block Diagrams,” on page 267
This chapter contains block diagrams and descriptions that focus on how the Test Set generates signals and makes measurements. It also has I/O signal and pin number information that can be used to help isolate a problem to the assembly level if the Test Set’s diagnostic programs are unable to do so.
Which Document is Required?  The following documents are part of the HP 8935 document set. Use the table to help you decide which document you need.

<table>
<thead>
<tr>
<th>Document</th>
<th>Part Number</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>CDMA Application Guide</td>
<td>E 6380-90016</td>
<td>Use this manual for basic CDMA measurements and for getting started with the Test Set.</td>
</tr>
<tr>
<td>AMPS Application Guide</td>
<td>E 6380-90017</td>
<td>Use this manual for making AMPS base station measurements.</td>
</tr>
<tr>
<td>Reference Guide</td>
<td>E 6380-90019</td>
<td>Use this manual for screen and field descriptions and general operation information about the Test Set.</td>
</tr>
<tr>
<td>Programmer’s Guide</td>
<td>E 6380-90018</td>
<td>Use this manual to learn HP-IB syntax and for learning how to program the Test Set.</td>
</tr>
<tr>
<td>Assembly Level Repair Guide (this manual)</td>
<td>E 6380-90015</td>
<td>Use this manual to perform calibration on the Test Set and for general service information.</td>
</tr>
<tr>
<td>Technical Specifications Publication</td>
<td>5966-0512E</td>
<td>Test Set's specifications data sheet</td>
</tr>
</tbody>
</table>
General Information
2 Product Information

This chapter contains general information about the Test Set and how to service it.
Instrument Description

The HP 8935 CDMA Cellular/PCS Base Station Test Set is a one-box tool designed to meet the needs of installation teams, service providers, and network manufacturers when installing, testing, and maintaining CDMA base stations at both the cellular and PCS frequency bands. It also can be used to test AMPS base stations. Features include:

- Waveform quality $\rho$ (ρ), frequency error, code domain power, timing, and phase analysis
- Analog and digital (CDMA) capabilities
- Firmware upgradeable via PCMCIA to flash memory
- Automation software to increase measurement repeatability
- Built-in AWGN source for calibrated Eb/No settings

Figure 2-1 The HP 8935 CDMA Cellular/PCS Base Station Test Set

This Test Set utilizes a bright electroluminescent display for reading data. All connectors are recessed and mounted on one side allowing unobstructed, out-of-the-way hook up. Its rugged design includes a hand strap for portability, a membrane keypad, gasketed display, stand up operation, filtered airflow, and a rugged exterior to help the Test Set from bumps and shocks.

The user interface features pull down menus, one-key measurement execution, and fast measurement speed. Measurement data can be output to a printer or a PCMCIA memory card.
The Test Set’s firmware is user upgradeable with a PCMCIA card to flash memory. Thus, new features and capabilities can be added without returning the unit to the service center.

The Test Set contains a CDMA signal generator and a frequency translator which allow generation of CDMA signals at both cellular and PCS frequencies. CDMA tools include:

- Code Domain Analyzer
- CDMA Analyzer
- CDMA Generator
- Power Meter (both wideband and channel)

Other test tools include:

- Spectrum Analyzer
- Oscilloscope
- AMPS Analyzer
- AC/DC Voltmeter
- Audio and RF Generators
- Built-in IBASIC Controller

For documentation on this Test Set, see "Manuals" on page 41.
Instrument Assemblies

Table 2-1 and figure 2-2 on page 36 describe the assemblies of the HP 8935 CDMA Cellular/PCS Base Station Test Set.

Table 2-1

<table>
<thead>
<tr>
<th>Reference Designator</th>
<th>Assembly Name</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>Front Panel Assembly</td>
<td>Contains display and keyboard sub assemblies</td>
</tr>
<tr>
<td>A1A3</td>
<td>RPG Board</td>
<td>Interface for front-panel-knob rotary pulse generator</td>
</tr>
<tr>
<td>A2A1</td>
<td>Motherboard</td>
<td>Provides connection and interface for assemblies</td>
</tr>
<tr>
<td>A2A10</td>
<td>PCMCIA</td>
<td>Control of PC card reader</td>
</tr>
<tr>
<td>A2A20</td>
<td>Spectrum Analyzer</td>
<td>Signal spectrum analyzer</td>
</tr>
<tr>
<td>A2A21</td>
<td>Receiver</td>
<td>IF filtering and demodulation</td>
</tr>
<tr>
<td>A2A22</td>
<td>Receiver Synthesizer</td>
<td>Supplies LO signal for IF creation</td>
</tr>
<tr>
<td>A2A23</td>
<td>Reference</td>
<td>Standard or high-stability reference oscillator</td>
</tr>
<tr>
<td>A2A24</td>
<td>Output Section</td>
<td>Conditions signal for output of instrument</td>
</tr>
<tr>
<td>A2A25</td>
<td>Signal Generator Synthesizer</td>
<td>Provides CW signal for RF generator</td>
</tr>
<tr>
<td>A2A30</td>
<td>Memory/SBRC</td>
<td>Test Set’s RAM and gated bus control</td>
</tr>
<tr>
<td>A2A31</td>
<td>Controller</td>
<td>Overall instrument control</td>
</tr>
<tr>
<td>A2A32</td>
<td>Signaling Source and Analyzer</td>
<td>Source for the RF generator system and analyzer for the audio analyzer system</td>
</tr>
<tr>
<td>A2A33</td>
<td>Measurement</td>
<td>Provides oscilloscope, voltmeter, and counter functions</td>
</tr>
<tr>
<td>A2A34</td>
<td>Data Buffer</td>
<td>Provides data buffering and reverse link modulation</td>
</tr>
<tr>
<td>A2A36</td>
<td>Receive DSP (RX DSP)</td>
<td>Digital signal processing for the CDMA Analyzer</td>
</tr>
<tr>
<td>A2A40</td>
<td>Audio Analyzer 2</td>
<td>Provides audio distortion analysis</td>
</tr>
<tr>
<td>A2A44</td>
<td>Modulation Distribution</td>
<td>Source of FM</td>
</tr>
<tr>
<td>A2A50</td>
<td>Display Drive</td>
<td>Controls EL display</td>
</tr>
<tr>
<td>A2A70</td>
<td>Control Interface</td>
<td>Interface between instrument and side-panel parts</td>
</tr>
<tr>
<td>A2A80</td>
<td>Audio Analyzer 1</td>
<td>Provides audio filtering</td>
</tr>
<tr>
<td>A2A80A1</td>
<td>C-Message Filter</td>
<td>Audio filter</td>
</tr>
<tr>
<td>A2A80A2</td>
<td>6 kHz Bandpass Filter</td>
<td>Audio filter</td>
</tr>
<tr>
<td>A2A100</td>
<td>Generator Reference (Gen Ref)</td>
<td>CDMA data generation and instrument reference master (with external reference)</td>
</tr>
<tr>
<td>A2A110</td>
<td>Upconverter</td>
<td>Converts output signal to PCS frequencies</td>
</tr>
<tr>
<td>Reference Designator</td>
<td>Assembly Name</td>
<td>Function</td>
</tr>
<tr>
<td>----------------------</td>
<td>-----------------------</td>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td>A2A115</td>
<td>Downconverter</td>
<td>Converts input frequencies to instrument level IF</td>
</tr>
<tr>
<td>A2A120</td>
<td>LO IF/IQ Modulator</td>
<td>Receive-path IF downconversion and generator-path IQ modulation</td>
</tr>
<tr>
<td>A2A130</td>
<td>RF Input/Output</td>
<td>RF input and output is directed through one assembly</td>
</tr>
<tr>
<td>A2A200</td>
<td>100 W Attenuator</td>
<td>Provides high-power RF attenuation</td>
</tr>
<tr>
<td>A3</td>
<td>Power Supply assembly</td>
<td>Contains power supply, regulator, and fan assemblies</td>
</tr>
<tr>
<td>A3A1</td>
<td>Power Supply Regulator</td>
<td>Regulates the power supply voltages</td>
</tr>
</tbody>
</table>
Figure 2-2 Overall Block Diagram
Upgrades

Hardware and Firmware Enhancements

The hardware and firmware for this Test Set are being enhanced on a continuous basis. Hardware can be upgraded by ordering a specific retrofit kit. Firmware is upgraded by downloading new software or installing new PROMs. The firmware for this Test Set has gone through several revisions to improve performance and fix problems.

It is recommended that the firmware be upgraded to the latest revision whenever the Test Set is repaired or a performance problem is found. This is important especially if an assembly-level repair is performed by the exchange of assemblies - the replacement assemblies may require a later revision of the firmware for the assembly and/or Test Set to function correctly.

When downloading new firmware, a program is used that downloads the new firmware files from a PC memory card to the instrument. Table 2-2 and table 2-3 list the upgrade kits available. For ordering information, see "Service Information" on page 42.

Table 2-2  Firmware Upgrade Kits

<table>
<thead>
<tr>
<th>Kit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>HP 8935 R58</td>
<td>HP 8935 CDMA Cellular/PCS Base Station Test Set Firmware (for customer)</td>
</tr>
<tr>
<td>E6380-61858</td>
<td>HP 8935 CDMA Cellular/PCS Base Station Test Set Firmware (for HP support personnel)</td>
</tr>
</tbody>
</table>

Table 2-3  Hardware Upgrade Kit

<table>
<thead>
<tr>
<th>Kit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>HP 8935 1D5</td>
<td>High Stability Timebase</td>
</tr>
</tbody>
</table>

Load the Host Firmware

The following procedure loads the host firmware.

1. Power the Test Set off.
2. Insert the E6380-10001 memory card into the Test Set.
3. Power on the Test Set.
4. Follow the instructions on the screen.
5. After the firmware is downloaded, be sure to cycle the Test Set’s power off-and-on to complete this procedure.
Load the DSP Firmware

The following procedure loads the digital signal processor firmware.

1. Press the Preset key.
2. Insert the E6380-10002 memory card into the Test Set.
3. Press the Menu key.
4. Set the Select Procedure Location: field to Card.
5. Set the Select Procedure Filename field to DLFIRM.
6. Select Run Test (k1).
7. Follow the instructions on the screen.

After the firmware is downloaded, be sure to cycle the Test System’s power.
Checking Firmware Version

The following procedure checks the current version of firmware in the Test Set.

1. Power on the Test Set.

2. Press the **Inst Config** key. The INSTRUMENT CONFIGURE screen appears. The **host firmware level** appears in the upper right corner of this screen.

3. To find the Receive (RX) DSP firmware revision level, select the title bar of the INSTRUMENT CONFIGURE screen. A drop down menu appears.

4. Select SERVICE. The SERVICE screen appears, see figure 2-3.

**Figure 2-3 SERVICE Screen**

5. Select the **Latch** field.

6. Move the cursor to **rx_dsp_revision** under the **Choices**: menu and press the knob.

7. Read the **Value** data field. This is the **RX DSP firmware revision level**. The value is actually a date in the form YYYYMMDD (Y=year, M=month, D=day).
Repair Process

Repairing the Test Set consists of the following steps:

1. Isolate the problem to a faulty assembly within the Test Set. Refer to the Chapter 3, "Troubleshooting" on page 43.

2. Replace the faulty assembly.

3. Calibrate the Test System by regenerating calibration data, see Chapter 7, "Periodic Adjustments" on page 145.

4. Verify the performance of the Test Set, see Chapter 8, "Performance Tests" on page 161.
Manuals

Operation and servicing the HP 8935 CDMA Cellular/PCS Base Station Test Set are discussed in the following manuals:

- CDMA Application Guide E6380-90016
  This manual explains how to use the HP 8935 Test Set to manually test a CDMA Base Station. This document presents a step-by-step approach to CDMA base station testing using the Test Set, including what you need to know before you can start testing.

- Programmer’s Guide E6380-90018
  How to perform IBASIC programming operations, such as writing, editing, copying, or cataloguing programs.

- Assembly Level Repair Manual (ALR) - this manual E6380-90015
  Includes assembly, troubleshooting, diagnostics, and repair procedures and descriptions for the Test Set.

- Technical Specifications Publication 5966-0512E

- Reference Guide E6380-90019

- HP 8935 CDMA Cellular/PCS Base Station Test Set CD-ROM (Includes all or most of the above mentioned manuals).
Service Information

Factory Support

Troubleshooting assistance is available by e-mail (electronic mail), website, or telephone:

- Internet e-mail address  
  spokane_service@spk.hp.com

- Spokane Division Website  
  WWW home page - HP personnel only  
  http://www.spk.hp.com

- U.S.A. and Canada only, M-F 8am - 5 pm PST, 
  toll free  
  800-827-3848

- Outside North America, M-F 8 am - 5 pm PST, 
  phone  
  509-921-3848

- Application Support, M-F 8am - 5 pm PST, 
  phone  
  800-922-8920

Ordering Parts

To order parts, call HP Support Materials Organization (SMO):

- U.S.A only, 
  HP Direct Parts Ordering, phone  
  800-227-8164

- U.S.A and international, 
  HP Service Parts Identification, phone  
  916-783-8004
3 Troubleshooting

This chapter explains how to isolate a problem to the defective assembly. Troubleshooting uses the Test Set’s built-in diagnostics. If diagnostics can’t identify the faulty assembly, supplementary information in the form of manual troubleshooting procedures is provided.
How to Troubleshoot the Test Set

Document the result of each step in case you need to contact Hewlett-Packard for service assistance. General troubleshooting steps are illustrated in figure 3-2 on page 45.

NOTE

Periodic Adjustment Interval

The calibration programs Periodic Calibration, IQ Calibration and Eb/No Calibration should be performed after the replacement of any assembly referred to in table 7-1 on page 147, or at least every 24 months. See Chapter 7, "Periodic Adjustments" on page 145 for details.

On power-up, the Test Set runs the Self-Test Diagnostic. Most of the Test Set’s digital control functions are tested. The outcome of the test appears on the display (if operating) and on four LEDs see through an access hole in the cover, see figure 3-1.

Figure 3-1 LEDs
Step 1. Power-up the Test Set to run self diagnostics.

Did you hear a beep on power-up and/or is fan running?

YES

NO

Is display screen blank?

YES

NO

Turn off Test Set and remove external and internal covers.

Power-up Test Set and read Status LEDs for Self-Test errors

Refer to “Reading LED Codes” on page 53.

Self-Test error problem?

YES

Component problem. Repair Test Set and perform “Product Verification” on page 82.

NO

Display problem, replace display and perform “Product Verification” on page 82.

Does a Self-Test error appear?

YES

Refer to “Reading Front Panel or HP-IB Codes” on page 52.

NO

Misc. hardware or SBRC problems?

YES

Perform “Product Verification” on page 82.

NO

Display problem, replace display.

Perform “Product Verification” on page 82.

Step 2. Run the FUNCTIONAL DIAGNOSTICS on the SERVICE MENU. See “Using the SERVICE4 Diagnostics” on page 46.

Problem detected?

YES

Repair Test Set according to diagnostics.

NO

Turn off Test Set and remove external and internal covers.

Power-up Test Set and read Status LEDs for Self-Test errors. Refer to “Reading LED Codes” on page 53.

Problem detected?

YES

Repair Test Set according to diagnostics.

NO

Perform “Product Verification” on page 82.

Step 3. If you suspect that a problem still exists, run the AF, RF, and/or CDMA Diagnostics test of the SERVICE4 program. See “Using the SERVICE4 Diagnostics” on page 46.

Problem detected?

YES

Repair Test Set according to diagnostics.

NO

Perform “Product Verification” on page 82.


Problem detected?

YES

Repair Test Set according to findings.

NO

Perform “Product Verification” on page 82.
Using the SERVICE4 Diagnostics

The SERVICE4 Diagnostics include the functional diagnostics and the AF, RF, and CDMA diagnostics. You must load the SERVICE4 Diagnostics to complete steps 2 and 3 of the troubleshooting process.

NOTE

The measurement limits of the SERVICE4 Diagnostic tests are valid only at room temperature; that is, 20 to 25 ºC (65 to 75 ºF.)

Load the SERVICE4 Diagnostics

1. Press the Preset key.
2. Press the Menu key. The SOFTWARE MENU screen appears, see figure 3-3 on page 48.
3. Set the Select Procedure Location: field to ROM.
4. Set the Select Procedure Filename: field to SERVICE4.

You now have two options: you can define the test conditions for the Test Set (see following section) or you can run the SERVICE4 program (see "Begin Testing" on page 49).

Define Test Conditions

1. On the SOFTWARE MENU screen, select Execution Cond to access the TESTS (Execution Conditions) screen.
2. Set up the Output Results To: field.
   - Select Crt to view measurements only on the display.
   - Select Printer to print the test results as well as display them on the CRT. The printer is configured later in this procedure
3. Set the Output Results For: field to All
4. Set up the If Unit-Under-Test Fails: field.
   - Select Continue to continue to the next test point.
   - Select Stop to pause testing at that point.
5. Set up the Test Procedure Run Mode: field.
   - Select Continuous to run the tests continuously.
   - Select Single Step to pause after each measurement.
6. Verify that the Autostart Test Procedure on Power-Up: setting is Off.
NOTE

**Configure a Printer** - Only perform the following steps if you want to print test results to a printer, otherwise go to "Begin Testing" on page 49.

7. Press the **Menu** key to return to the SOFTWARE MENU screen.

8. Under **SET UP TEST SET:**, select **Print** to access the "TESTS (Printer Setup)" screen.

9. Under **PRINT SETUP:**; select **Model:** and the printer of your choice.
Troubleshooting
Using the SERVICE4 Diagnostics

Figure 3-3 SERVICE4 Program Screens

SOFTWARE MENU Screen

LOAD TEST PROCEDURE:
Select Procedure Location: ROM
Select Procedure Filename: SERVICE4
Description: Launches diagnostic and calibration programs.

CUSTOMIZE TEST PROCEDURE:
[No Lib] Program: ROM
Channel Information: Internal Paths
Test Parameters: Mod Distribution Internal Paths
Order of Tests: CDMA Diagnostics
Specific Pass/Fail Limits: Edit RF Diagnostic Limits
Proc: Periodic Calibration
Save/Delete Procedure: Eb/No Calibration

Functional Diagnostics Screen

INSTRUCTIONS: Position the menu pointer in front of the desired test using the Up and Down fields. Use the Select field to run the test. Use the Exit button to leave the program.

SERVICE MENU Screen

Move pointer to the desired program using the knob then press the knob. Press Help for information on the tests. Press Exit to abort.

RF Diagnostics Screen

Move pointer to desired program using the knob then press the knob. Press Help for information on the tests. Press Exit to abort. Run at room temperature after 15 minute warmup.

CDMA Loopback Screen

INSTRUCTIONS: Connect DUPLEX OUT to ANT IN with a short cable. Select Resume to continue, Exit to abort.

AF Diagnostics Screen

INSTRUCTIONS: Position the menu pointer in front of the desired test using the Up and Down fields. Use the Select field to run the test. Use the Exit button to leave the program.
10. Set the **Printer Port**: for the side-panel connector your printer is connected to.

    If an HP-IB printer is used, you need to enter the printer’s two-digit bus address when the **Printer Adrs** field appears (Example; enter **01** or **01** for bus address 701). Also, press the **Shift** key, then the **INST CONFIG** key to access the I\O CONFIGURE screen, and set the **Mode** field to **Control**.

11. Under **PAGE CONTROL**; set the **Lines/Page**; and Form Feed (**FF at Start**, and **FF at End**) parameters if necessary.

**Begin Testing**

1. On the SOFTWARE MENU screen, select the **Run Test** field (or press **k1**) and wait for the SERVICE MENU screen to appear, (see figure 3-3 on page 48).

2. Choose the test to run by turning the knob to move the pointer and then pressing the knob to select the test. See figure 3-3 on page 48.

3. Follow the instructions on the screen.

   As some of the tests run, you may be offered the options to alter test execution conditions by selecting:

   - **Loop** to run the test continuously
   - **Pause** to pause the tests
   - **Stp Fail** (stop-on-failure)
   - **Sgl Step** (single-step) to pause the test after each measurement
Self-Test Diagnostics (Step 1)

On power-up the Test Set runs a self-test diagnostic test. Most of the Test Set’s digital functions are tested. The outcome of the test appears on the display (if operating) and on four LEDs viewable through an access hole on the top internal cover.

The self-test diagnostic can be run three ways:

1. The test runs automatically when the Test Set is turned on. After the Test Set powers up, a message appears at the top of the display. If one or more tests fail, the message reports the failure with a hexadecimal code.

   During the test, coded failure information is displayed on four LEDs on the top of the Controller (A2A31) assembly, see figure 3-4 on page 51. The Test Set’s cover must be removed to view these LEDs. See chapter 3 for disassembly and replacement instructions.

2. The test runs when the Test Set receives the query *TST? over HP-IB. The resultant decimal code can be read over the bus.

3. The test runs when Functional Diagnostics are run and the Self Test is selected.

To Start Troubleshooting

1. Turn on the Test Set to automatically run the self test diagnostics.

2. After power-up, the top line of the Test Set’s display should show copyright information and the firmware revision code. The second line should display All self tests passed.

3. The CDMA ANALYZER screen should be displayed. Two conditions cause a different screen to be displayed on power-up:

   ❑ A SAVE/RECALL register named POWERON was saved to automatically power-up the box in a different state. Press the Preset key before proceeding; this will restore the Test Set to the factory power-up condition.

   ❑ The Autostart Test Procedure on Power-Up: field (of the “TESTS [Execution Conditions]” screen) is set to on to automatically run a loaded program. Press the Shift key, then press the Cancel key to stop the program. Press the Preset key to restore the Test Set to the factory power-up condition.

To turn the autostart function off, press the Menu key, then select Execution Cond (under the SET UP TEST SET: heading). The autostart function is at the bottom of the screen; turn it off.
Powers-up Messages
If the Test Set powers-up with “All self tests passed.” it is still possible to have the following digital problems:

- Intermittent failure in any digital assembly.
- Input or output failure on any I/O port of the A2A30 Memory/SBRC assembly.
- Key failure (other than stuck keys) on the A1A2 Keypad assembly.

If all self-test diagnostics pass, and the front-panel keys and knob work, you can assume that the digital control assemblies work.

If the Test Set powers-up with “One or more self-tests failed. Error code:<hexadecimal error code>:”, see “Reading Front Panel or HP-IB Codes” on page 52.

If the Test Set Fails to Power-up
- Remove the Test Set’s external cover and check the LEDs on the A2A31 Controller assembly, see figure 3-4. The LEDs should all light up immediately on power-up, and then go off several seconds after a beep is heard. If the LEDs do not light when the Test Set is powered-up, either the Controller or the Memory/SBRC (A2A30) assembly is faulty.

Figure 3-4 A2A31 Controller Assembly

LEDs

- If there is no image on the display, remove the Test Set’s covers and check the power supply LEDs: +5V, −12V, +12V (see figure 3-5). If one is out, the power supply or regulator board is faulty. If no LEDs are lit, confirm that the Test Set is connected to the main power source.
Troubleshooting
Self-Test Diagnostics (Step 1)

Figure 3-5  Power Supply LEDs

- If the Test Set does not power-up properly, but the fan operates and the power supply voltages are correct on the Power Supply Regulator (A3A1) outputs, the Controller (A2A31) may be failing. Check TP2 on the Controller for +5V. If +5V is present, the Controller assembly is faulty. If +5V is not present, one of the other assemblies is faulty and is pulling the +5V line low.

- If there is no display, but VIDEO OUT port on the side-panel has the signal shown in figure 3-6, then the A1A1 Display assembly is faulty. If the signal is not present, then Display Drive A2A50 assembly is faulty.

Figure 3-6  VIDEO OUT Signal

Reading Front Panel or HP-IB Codes

Failure codes are listed in the table below. If more than one failure occurs, the failure code will be the sum of the individual failure codes. The nature of the failure and the assembly most-likely at fault is also listed.
Troubleshooting  
Self-Test Diagnostics (Step 1)

Table 3-1  Return Values for Self-Test Diagnostic Failures

<table>
<thead>
<tr>
<th>Detected Failure Failed Assembly</th>
<th>Returned Error Code</th>
<th>Hexadecimal (displayed)</th>
<th>Decimal (HP-IB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microprocessor</td>
<td>A2A31 Controller</td>
<td>0002</td>
<td>2</td>
</tr>
<tr>
<td>ROM</td>
<td>A2A31 Controller</td>
<td>0004</td>
<td>4</td>
</tr>
<tr>
<td>RAM</td>
<td>A2A30 Memory/SBRC</td>
<td>0008</td>
<td>8</td>
</tr>
<tr>
<td>RAM</td>
<td>A2A30 Memory/SBRC</td>
<td>0010</td>
<td>16</td>
</tr>
<tr>
<td>Timer</td>
<td>A2A31 Controller</td>
<td>0020</td>
<td>32</td>
</tr>
<tr>
<td>Real-Time Clock</td>
<td>A2A30 Memory</td>
<td>0040</td>
<td>64</td>
</tr>
<tr>
<td>Keyboard (stuck key)</td>
<td>A1A2 Keypad</td>
<td>0080</td>
<td>128</td>
</tr>
<tr>
<td>RS-232 I/O</td>
<td>A2A30 Memory/SBRC</td>
<td>0100</td>
<td>256</td>
</tr>
<tr>
<td>Serial Bus Communication</td>
<td>Any Non-Optional assembly</td>
<td>0200</td>
<td>512</td>
</tr>
<tr>
<td>Signaling Board Self-Test</td>
<td>A2A32 Signaling Source/Analyzer</td>
<td>0400</td>
<td>1024</td>
</tr>
<tr>
<td>Display Drive Self-Test</td>
<td>A2A50 Display Drive</td>
<td>0800</td>
<td>2048</td>
</tr>
<tr>
<td>Miscellaneous Hardware</td>
<td>Several Possible Assemblies</td>
<td>1000</td>
<td>4096</td>
</tr>
</tbody>
</table>

a. Could also be the A2A31 Controller with a faulty key-down detector.
b. This checks the ability of the Controller to communicate with any hardware on the bus.
c. This message occurs if expected hardware is absent or not responding to the Controller.

Reading LED Codes

When the self-test diagnostic reports a failure, more information about the failure may be available inside the Test Set. This additional information is output to the four LEDs on the top of the A2A31 Controller assembly. The failure codes are sent out as code sequences. Figure 3-7, "Reading the Self-Test Diagnostic. The Internal LEDs," on page 55 and the tables following it document some of the more useful code sequences. You may need to run the Self-Test Diagnostic several times to decode a particular LED sequence.
The LEDs output self-test diagnostic codes only when the Test Set is powering up. The LEDs remain off when the self-test diagnostic is initiated through programming or when running the functional diagnostics. To read the LED codes, the Test Set’s cover must be removed.

If the Test Set has no faults that can be detected by the Self-Test Diagnostic, the four LEDs on the Controller assembly will light and remain on for about ten seconds. During that period, a short beep will be heard. Then the LEDs will extinguish and remain off.

If a fault is detected during the test:

1. The four LEDs will go on for about four seconds.

2. The LEDs will blink a failure code which corresponds to the error listed in table 3-1, "Return Values for Self-Test Diagnostic Failures" on page 53. Figure 3-8, "First LED Patterns," on page 56 shows the blinking LED codes.

3. Two non-blinking LED codes will follow. The interpretation of these codes depends on the preceding blinking code. Two sets of the non-blinking codes are listed: see figure 3-9, "Non-blinking LED Codes For Serial Bus Communication Failure," on page 57 and figure 3-10, "Non-Blinking LED Codes for Miscellaneous Hardware Failure," on page 58.

4. If there is more than one failure, the test will loop back to step 2 and repeat until the last failure is reported.

The pattern generated by the LEDs can be interpreted as a binary-weighting code. The LED (labeled 0) is the least-significant bit (see figure 3-7 on page 55).

For example if the LEDs blinking pattern is Off, On, On, On (reading left-to-right or LEDs “3 2 1 0”), the binary number is 0111 or decimal 7. The error codes shown in table 3-1, "Return Values for Self-Test Diagnostic Failures" on page 53 are weighted by the binary value. The weighted value for this example is decimal 27 = 128 or hexadecimal 80. (This failure is easy to simulate; simply power-up the Test Set while holding down a key.)
Figure 3-7  Reading the Self-Test Diagnostic. The Internal LEDs

1. Remove the Test Set’s external cover.
2. Turn power on.
3. Read the LED sequence (see illustration on right) and compare with the patterns below.

**NOTE**
For multiple failures, the failure patterns described below will repeat for all failures detected.

LED Sequences

<table>
<thead>
<tr>
<th>No Failures...</th>
<th>Failures... three patterns are displayed:</th>
<th>Failures... three patterns are displayed:</th>
</tr>
</thead>
<tbody>
<tr>
<td>■ The LEDs will light for approximately 10 seconds, then all will turn off.</td>
<td>■ The first blinks rapidly and indicates the type of failure.</td>
<td>■ The second and third patterns blink slowly and indicate failure details.</td>
</tr>
<tr>
<td><img src="LEDs.png" alt="LEDs" /></td>
<td><img src="LEDs.png" alt="LEDs" /></td>
<td><img src="LEDs.png" alt="LEDs" /></td>
</tr>
<tr>
<td><img src="LEDs.png" alt="LEDs" /></td>
<td><img src="LEDs.png" alt="LEDs" /></td>
<td><img src="LEDs.png" alt="LEDs" /></td>
</tr>
<tr>
<td><img src="LEDs.png" alt="LEDs" /></td>
<td><img src="LEDs.png" alt="LEDs" /></td>
<td><img src="LEDs.png" alt="LEDs" /></td>
</tr>
<tr>
<td><img src="LEDs.png" alt="LEDs" /></td>
<td><img src="LEDs.png" alt="LEDs" /></td>
<td><img src="LEDs.png" alt="LEDs" /></td>
</tr>
</tbody>
</table>

See the following tables. (This example indicates a Serial Bus Communication problem.) (This example indicates a faulty A2A80 Audio Analyzer 1 assembly.)

**LED Legend**

- ● = off
- ⚫ = rapid blink
- ⚽ = steady on or slow blink
Troubleshooting
Self-Test Diagnostics (Step 1)

Figure 3-8 First LED Patterns

If the first LED pattern displayed is... Then the failure is...

<table>
<thead>
<tr>
<th>3</th>
<th>2</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Microprocessor</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ROM Checksum (See note 1.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>RAM (See note 2.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>RAM (See note 3.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Timer</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Real-Time Clock</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Keyboard (stuck key or faulty key-down detector)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>RS-232 I/O</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Serial Bus Communication (see figure 3-9 on page 57)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Signaling Board Self Test</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Display Drive Self Test</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Miscellaneous Hardware (see figure 3-10 on page 58)</td>
</tr>
</tbody>
</table>

LED Legend
● = off
○ = rapid blink
★ = steady on or slow blink

NOTES

1. Second and third LED failure patterns:
   0001 and 0001 for any main ROM failure
   0001 and 0002 for boot ROM failure

2. Second and third LED failure patterns:
   0001 and 0001 for A2A30 Memory/SBRC board RAM failure
   0001 and 0002 for A2A31 Controller board RAM failure

3. Second and third LED failure patterns:
   0001 and 0001 for A2A30 Memory/SBRC board RAM failure
   0001 and 0010 for A2A30 Memory/SBRC board RAM failure
### Troubleshooting

#### Self-Test Diagnostics (Step 1)

Figure 3-9  Non-blinking LED Codes For Serial Bus Communication Failure

<table>
<thead>
<tr>
<th>LED Patterns Displayed</th>
<th>Failure Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>● ● ●  ●</td>
<td>A2A44 Modulation Distribution</td>
</tr>
<tr>
<td>● ●  ●  ●</td>
<td>A2A24 Output Section</td>
</tr>
<tr>
<td>● ●  ●  ●</td>
<td>A2A80 Audio Analyzer 1</td>
</tr>
<tr>
<td>●  ●  ●  ●</td>
<td>A2A40 Audio Analyzer 2</td>
</tr>
<tr>
<td>●  ●  ●  ●</td>
<td>A2A23 Reference</td>
</tr>
<tr>
<td>●  ●  ●  ●</td>
<td>A2A115 Downconverter</td>
</tr>
<tr>
<td>●  ●  ●  ●</td>
<td>A2A130 RF I/O</td>
</tr>
<tr>
<td>●  ●  ●  ●</td>
<td>A2A21 Receiver</td>
</tr>
<tr>
<td>●  ●  ●  ●</td>
<td>A2A20 Spectrum Analyzer</td>
</tr>
<tr>
<td>●  ●  ●  ●</td>
<td>A2A25 Signal Generator Synthesizer</td>
</tr>
<tr>
<td>●  ●  ●  ●</td>
<td>A2A22 Receiver Synthesizer</td>
</tr>
<tr>
<td>●  ●  ●  ●</td>
<td>A2A120 LO IF/IQ Modulator</td>
</tr>
<tr>
<td>●  ●  ●  ●</td>
<td>A2A110 Upconverter</td>
</tr>
<tr>
<td>●  ●  ●  ●</td>
<td>A2A100 CDMA Generator Reference</td>
</tr>
<tr>
<td>●  ●  ●  ●</td>
<td>A2A34 Data Buffer</td>
</tr>
</tbody>
</table>

#### LED Legend
- ● = off
- ● = rapid blink
- ☀ = steady on or slow blink
Figure 3-10  Non-Blinking LED Codes for Miscellaneous Hardware Failure

<table>
<thead>
<tr>
<th>If the second and third LED patterns displayed are...</th>
<th>Then the failure is...</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 2 1 0</td>
<td>3 2 1 0</td>
</tr>
<tr>
<td>● ● ● ● ☼</td>
<td>● ● ● ● ☼</td>
</tr>
<tr>
<td>● ● ● ● ☼</td>
<td>● ● ● ☼</td>
</tr>
<tr>
<td>● ● ● ● ☼</td>
<td>● ● ● ● ☼</td>
</tr>
<tr>
<td>● ● ● ● ☼</td>
<td>● ● ● ● ☼</td>
</tr>
<tr>
<td>● ● ● ● ☼</td>
<td>● ● ● ● ●</td>
</tr>
<tr>
<td>● ● ☼ ●</td>
<td>○ ○ ○ ○ ○</td>
</tr>
<tr>
<td>● ● ● ☼</td>
<td>○ ○ ○ ○ ○</td>
</tr>
</tbody>
</table>

**LED Legend**

- ● = off
- ☼ = rapid blink
- ☼ = steady on or slow blink
- ○ = don’t care
Functional Diagnostics (Step 2)

The Functional Diagnostics check whether or not major portions of the instrument are functioning. They may pinpoint faults in the circuitry to the faulty assembly, or they may direct the use of any or all of the AF, RF, CDMA diagnostics to more extensively test the circuitry. There are five tests which make up the Functional Diagnostics: RF Modules, Analog Modulation, CDMA Loopback, Self Test, and Power Supplies, see figure 3-11.

**NOTE**

The measurement limits of the Functional Diagnostic tests are valid only at room temperature; that is, 20 to 25 °C (65 to 75 °F.)

**Figure 3-11  Functional Diagnostics Screen**

**RF Modules**

The Average and TX power meters, RF analyzer, IF analyzer, DSP analyzer, and spectrum analyzer are used to test the signal generator. Both the internal and external paths of the RF/I/O assembly are used in the tests.
Analog Modulation

The demodulator in the RF analyzer, and the spectrum analyzer are used to check the accuracy, distortion, and residuals of the FM and AM frequencies. The counter is used to measure the audio frequency.

CDMA Loopback

CDMA Analyzer is used to measure Rho, Time Offset, Frequency Error, and Carrier Feedthrough on a signal from the CDMA Generator.

Self Test

The power-up Self-Test Diagnostics are run. Refer to "Self-Test Diagnostics (Step 1)" on page 50.

Power Supplies

The different levels of the power supply are measured with the internal voltmeter.
AF, RF, & CDMA Diagnostics (Step 3)

AF Diagnostics

This program tests the audio functions of the following assemblies:

- A2A40 Audio Analyzer 2
- A2A80 Audio Analyzer 1
- A2A44 Modulation Distribution
- A2A32 Signaling Source/Analyzer (AF Generators 1 and 2 only)
- A2A33 Measurement (only a few selected inputs)

After initial cabling, all tests can be run in a loop mode without further intervention. This makes it easier to catch intermittent failures.

NOTE

The measurement limits of the AF Diagnostic tests are valid only at room temperature; that is, 20 to 25 ºC (65 to 75 ºF.)

Figure 3-12 AF Diagnostics Screen

When a test fails, a diagnosis is given in three parts:

- A diagnostic code.
- The name of the assembly or assemblies most likely to have failed.
- A rating (high, medium, or low) of the confidence of the diagnosis.
RF Diagnostics

This program tests the RF functions of the following assemblies:

- A2A115 Downconverter
- A2A24 RF Output
- A2A25 Signal Generator Synthesizer
- A2A23 Reference
- A2A21 Receiver
- A2A22 Receiver Synthesizer
- A2A20 Spectrum Analyzer
- A2A130 RF I/O
- A2A110 Upconverter

Some tests require cabling before the RF Diagnostics can be run; but all tests can be run in a loop mode without further intervention. Running in loop mode makes it easier to catch intermittent failures.

NOTE

The measurement limits of the RF Diagnostic tests are valid only at room temperature; that is, 20 to 25 ºC (65 to 75 ºF.) Allow 15 minutes to warm-up.

Figure 3-13 RF Diagnostics Screen

When a test fails, a diagnosis is given in two parts:

- The name of the assembly or assemblies most likely to have failed.
- A rating (high, medium, or low) of the confidence of the diagnosis.
CDMA Diagnostics

This program tests the local oscillators and the power supplies of the following assemblies:

- A2A120 LO IF/IQ Modulator - LO IF portion only
- A2A100 CDMA Generator Reference

**NOTE**

**Before ordering a replacement assembly...**

Before ordering an assembly based on the results of the diagnostics, you should verify the diagnostics by other means if possible. This could include using manual troubleshooting procedures and descriptions of the AF, RF, and CDMA diagnostics in this chapter, and/or block diagrams in Chapter 10, “Block Diagrams,” on page 267. If you still lack confidence in troubleshooting or diagnosing the problem or faulty assembly, call "Factory Support", see page 42, for troubleshooting assistance.

**Figure 3-14 CDMA Diagnostics Screen**

SERVICE MENU Screen

INSTRUCTIONS
Connect DUPLEX OUT to ANT IN with a short cable.
Select Resume to continue, Exit to abort.

CDMA Diagnostics Screen
Frequently Encountered Diagnostic Messages

Warning/Error Messages

Error messages that appear on the second line of the Test Set's display frequently occur while any of the SERVICE4 program diagnostic tests are running. The most complete and general list of error messages is in the “Error Messages” chapter of the Test Set’s Reference Guide. (Some messages relating specifically to troubleshooting can be found in Appendix A, “Error Messages,” on page 305.) Some of the messages you can expect to occur while running the SERVICE4 program diagnostic tests are as follows:

• Direct latch write occurred. Cycle power when done servicing. The SERVICE4 program commonly generates this message. This message appears the first time the diagnostic program directly addresses a latch. The message should be ignored and cleared when you make a normal (not a diagnostic) measurement with the Test Set. To clear this message the Test Set should be turned off and back on again.

• Change Ref Level, Input Port or Attenuator (if using “Hold”). This message, and similar messages, can be generally ignored.

• Printer does not respond. This usually indicates that one or more settings on the TESTS (Printer Setup) screen are set incorrectly for your printer. Also, check that the printer’s power is on and that it is correctly cabled. For HP-IB printers make sure the printer is correctly addressed. If a serial printer is used, you may have to change the serial communication settings on the I/O CONFIGURE screen (press Shift then Inst Config to get to this screen). The message times-out after a few seconds, and the output destination is changed to CRT by the program.

• ERROR 173 IN XXXX Active/system controller req’d (where “XXXX” represents a line number). Indicates that the Test Set’s internal IBASIC computer must be set as a system controller for some reason. This usually indicates that the Printer Port field of the TESTS (Printer Setup) screen was set to HP-IB but the Mode field on the I/O CONFIGURE screen is set to Talk&Lstn instead of Control. Change the mode setting to Control and run the diagnostic again.
Timeouts

Certain failures may cause a frequency or voltage reading to time-out, that is, the time required for the measurement will be unreasonably long. If a timeout occurs, measurement execution will stop and an error message will be displayed.

- If frequency or voltage readings have been successfully made before the timeout, the assembly currently being tested or a multiplexer on the A2A33 Measurement assembly may be at fault.
- If most measurements fail, the A2A23 Reference assembly may be supplying faulty clock signals to the A2A33 Measurement assembly.
- Re-run the test to see if the timeout is intermittent.
Manual Troubleshooting Procedures

If you are not sure a problem exists, you should attempt to duplicate the suspected problem. This is especially important if the Test Set is being used in a new application where misapplication, or incorrect operation of the Test Set may be involved.

An HP 8924C Mobile Station Test Set combined with an HP 83236B Cellular Adapter can be used to simulate a high performance CDMA base station and may be useful in attempting to duplicate the problem.

Refer to following table to determine which Diagnostic Tests, Performance Tests, and Periodic Self Calibration Adjustments apply to an assembly. Downloading calibration data is discussed in Chapter 7, "Periodic Adjustments" on page 145.
### Table 3-2 Relating Assemblies to Troubleshooting Aids

<table>
<thead>
<tr>
<th>Ref. Designator</th>
<th>Assembly Name</th>
<th>SERVICE4 Program Diagnostic Test: Sub-Test</th>
<th>Performance Test to Perform&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Periodic Calibration&lt;sup&gt;b&lt;/sup&gt; Program</th>
<th>Cal.-Data Needed&lt;sup&gt;c&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1A2</td>
<td>Keypad</td>
<td>Functional Diagnostics: Self Test</td>
<td></td>
<td>PCMCIA Program System Power E6380-61811</td>
<td>No</td>
</tr>
<tr>
<td>A1A1</td>
<td>Display</td>
<td></td>
<td></td>
<td></td>
<td>No</td>
</tr>
<tr>
<td>A2A200</td>
<td>100W Attenuator</td>
<td>Functional Diagnostics: RF Modules</td>
<td></td>
<td>PCMCIA Program System Power E6380-61811</td>
<td>Yes</td>
</tr>
<tr>
<td>A2A130</td>
<td>RF Input/Output</td>
<td>RF Diagnostics: RF Input/Output</td>
<td>RF Generator: Level Accuracy</td>
<td>PCMCIA Program System Power E6380-61811</td>
<td>Yes</td>
</tr>
<tr>
<td>A2A34</td>
<td>Data Buffer</td>
<td>Functional Diagnostics: CDMA Loopback</td>
<td></td>
<td>SERVICE4: IQ Modulator, Eb/No</td>
<td>Yes</td>
</tr>
<tr>
<td>A2A110</td>
<td>Upconverter</td>
<td>RF Diagnostics: Upconverter</td>
<td></td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>A1A2</td>
<td>RPG Assembly</td>
<td></td>
<td></td>
<td></td>
<td>No</td>
</tr>
<tr>
<td>A1</td>
<td>Front Panel</td>
<td></td>
<td></td>
<td></td>
<td>No</td>
</tr>
<tr>
<td>A2A36</td>
<td>Receive DSP</td>
<td>Functional Diagnostics: CDMA Loopback</td>
<td></td>
<td></td>
<td>No</td>
</tr>
<tr>
<td>A2A10</td>
<td>PCMCIA</td>
<td></td>
<td></td>
<td></td>
<td>No</td>
</tr>
<tr>
<td>A2A32</td>
<td>Signaling Source/Analyzer</td>
<td>AF Diagnostics: Audio Frequency Generators 1 and 2</td>
<td></td>
<td></td>
<td>No</td>
</tr>
<tr>
<td>A2A31</td>
<td>Controller</td>
<td>Functional Diagnostics: Self Test</td>
<td></td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>A2A30</td>
<td>Memory/SBRC</td>
<td>Functional Diagnostics: Self Test</td>
<td></td>
<td></td>
<td>No</td>
</tr>
<tr>
<td>A2A115</td>
<td>Downconverter</td>
<td>RF Diagnostics: Downconverter</td>
<td></td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>A3A1</td>
<td>Power Supply Regulator</td>
<td>Functional Diagnostics: Self Test</td>
<td></td>
<td></td>
<td>No</td>
</tr>
<tr>
<td>A21</td>
<td>Fan</td>
<td></td>
<td></td>
<td></td>
<td>No</td>
</tr>
<tr>
<td>A2A50</td>
<td>Display Drive</td>
<td>Functional Diagnostics: Self Test</td>
<td></td>
<td></td>
<td>No</td>
</tr>
<tr>
<td>A23</td>
<td>Power Supply</td>
<td>Functional Diagnostics: Self Test</td>
<td></td>
<td></td>
<td>No</td>
</tr>
<tr>
<td>A2A25</td>
<td>Signal Generator Synthesizer</td>
<td>RF Diagnostics: Signal Generator Synthesizer</td>
<td>RF Generator: Harmonic and Spurious Spectral Purity</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>A2A120</td>
<td>LO-IF/IQ Modulator</td>
<td>CDMA Diagnostics LO_IF/IQ Mod.</td>
<td>SERVICE4: IQ Modulator, Eb/No</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>A2A24</td>
<td>RF Output</td>
<td>RF Diagnostics: Output</td>
<td></td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>A2A23</td>
<td>Reference</td>
<td>RF Diagnostics: Reference</td>
<td>RF Generator: Residual FM</td>
<td></td>
<td>Yes</td>
</tr>
</tbody>
</table>
# Troubleshooting
## Manual Troubleshooting Procedures

<table>
<thead>
<tr>
<th>Ref. Designator</th>
<th>Assembly Name</th>
<th>SERVICE4 Program Diagnostic Test: Sub-Test</th>
<th>Performance Test to Perform</th>
<th>Periodic Calibration Program</th>
<th>Cal.-Data Needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>A2A22</td>
<td>Receiver Synthesizer</td>
<td>RF Diagnostics: Receiver Synthesizer</td>
<td>RF Analyzer: Residual FM</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>A2A100</td>
<td>CDMA Generator Reference</td>
<td>CDMA Diagnostics: CDMA Gen. Ref.</td>
<td></td>
<td>SERVICE4: IQ Modulator, Eb/No</td>
<td>Yes</td>
</tr>
<tr>
<td>A2A21</td>
<td>Receiver</td>
<td>RF Diagnostics: Receiver</td>
<td>RF Analyzer: FM Accuracy</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>A3</td>
<td>Power Supply</td>
<td></td>
<td></td>
<td></td>
<td>No</td>
</tr>
<tr>
<td>A2A20</td>
<td>Spectrum Analyzer</td>
<td>RF Diagnostics: Spectrum Analyzer</td>
<td>Spectrum Analyzer</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>A2A70</td>
<td>Control Interface</td>
<td>Functional Diagnostics: Self Test</td>
<td></td>
<td></td>
<td>No</td>
</tr>
<tr>
<td>A2A44</td>
<td>Modulation Distribution</td>
<td>AF Diagnostics: Mod Distribution Internal Paths</td>
<td>AF Generator: AC Level Accuracy</td>
<td>SERVICE4: Periodic Calibration: AF Gen Gain, EXT Mod Path Gain</td>
<td>Yes</td>
</tr>
<tr>
<td>A2A80</td>
<td>Audio Analyzer 1</td>
<td>AF Diagnostics: Audio Analyzer 1 Internal Paths</td>
<td></td>
<td>SERVICE4: Periodic Calibration: Audio Analyzer Offset</td>
<td>Yes</td>
</tr>
<tr>
<td>A2A40</td>
<td>Audio Analyzer 2</td>
<td>AF Diagnostics: Audio Analyzer 2</td>
<td>AF Analyzer: AC Voltage Accuracy</td>
<td>SERVICE4: Periodic Calibration: VFN</td>
<td>Yes</td>
</tr>
<tr>
<td>A2A33</td>
<td>Measurement d</td>
<td>Functional Diagnostics: Self Test</td>
<td>Oscilloscope</td>
<td>SERVICE4: Periodic Calibration: Voltmeter Reference</td>
<td>Yes</td>
</tr>
<tr>
<td>A2A1</td>
<td>Motherboard</td>
<td></td>
<td></td>
<td></td>
<td>No</td>
</tr>
</tbody>
</table>

- a. See Chapter 4, "Preventative Maintenance" on page 85.
- c. See table 7-1, "Assemblies and Their Calibration Programs & Locations" on page 147.
- d. Measurement checked indirectly by all diagnostics.
Verify Test Set’s Reference Path

**Out-of-Lock (OOL) LEDs**

Out-of-lock (OOL) LEDs light when a phase-locked loop inside an assembly is failing. The Signal Generator Synthesizer, A2A25, and the Receiver Synthesizer, A2A22, assemblies have these LEDs mounted close to the top of the modules. The location of each LED is labeled on the assembly.

Verify that the CDMA Generator Reference (A2A100) and the Reference (A2A23) are working before troubleshooting the Receiver Synthesizer (A2A22) and/or the Signal Generator Synthesizer (A2A25) assemblies.

**Figure 3-15**
**CDMA Generator Reference (A2A100) Verification**

- Verify that a 1, 2, 5, or 10 MHz signal of >0.15 Vrms is being applied to the EXT REF IN connector.
- Verify that the 10 MHz REF OUT connector, outputs a 10 MHz signal of >0.5 Vrms.

**Figure 3-16 Simplified Reference Path Block Diagram**

If the 10 MHz signal is present, then this verifies the reference path through the CDMA Generator Reference and the Reference (A2A22) assemblies.

---

**NOTE**

There are other functions on these assemblies that are NOT verified.

**CDMA Generator Reference (A2A100) Assembly Verification.**

1. Turn the Test Set off and remove the external cover.
2. Remove the bottom cover and verify that the cable is connected between the EXT REF IN connector and J17 on the CDMA Generator Reference assembly.
3. Turn the Test Set on and verify that a 10 MHz signal is present on J15 of the CDMA Generator Reference assembly.
   
   If no signal or a poor signal appears at this connector, then the CDMA Generator Reference assembly is faulty.
4. Turn the Test Set off and remove the top covers.
5. Use screwdrivers to remove the Reference assembly.
6. Turn the Test Set on and verify that a 10 MHz signal is present on pin 20 of J63 and pin 19 of J18. This is the reference signal from the CDMA Generator Reference (A2A100) assembly.

If the 10 MHz signal is not present at all, then the CDMA Generator Reference (A2A100) assembly is faulty.

If the signal is present on pin 20 but not pin 19, then the Motherboard (A2A1) assembly is faulty (open or short).

**Reference, A2A23, Verification**

1. Turn the Test Set off and re-install the Reference assembly.

2. Use screwdrivers to remove the Receiver Synthesizer (A2A22) assembly.

3. Turn the Test Set on and verify that a 1 MHz signal of approximately –1 dBm is present on pin 3 of J21. This is the reference signal from the Reference assembly.

4. If the 1 MHz signal is not present, then the Reference assembly is probably faulty.

It is also possible that an open or shorted trace on the Motherboard (A2A1) assembly exists. Check the motherboard for continuity between J21 pin 3 (under the Receiver Synthesizer (A2A22) assembly) and J18 pin 2 (under the Reference assembly), and verify that the trace is not shorted to ground.
**Receiver Synthesizer, A2A22, Unlocked**

If the 1 MHz signal is present on pin 3 of J21, then the Receiver Synthesizer assembly is faulty.

**Signal Generator Synthesizer, A2A25, Unlocked**

1. Turn the Test Set off and use screwdrivers to remove the Signal Generator Synthesizer assembly.

2. If the signal is present, then the Signal Generator Synthesizer assembly is faulty.

3. Turn the Test Set on and verify that a 1 MHz signal of about −20 dBm is present on pin 3 of J12. This is the reference signal from the Reference (A2A23) assembly.

If the 1 MHz signal is not present, then the Reference (A2A23) assembly is probably faulty.

It is also possible that an open or shorted trace on the Motherboard (A2A1) assembly exists. Check the motherboard for continuity between J12 pin 3 (under the Signal Generator Synthesizer assembly) and J34 pin 1 (under the Reference (A2A23) assembly), and verify that the trace is not shorted to ground.

**Swapping Known-Good Assemblies**

Most swapped assemblies which use calibration data will operate well enough with the original assembly’s calibration data to troubleshoot and to run the diagnostics; do not expect the Test Set to meet its specifications. Some assemblies may appear to fail because of incorrect calibration data. It is also important to keep track of the original assemblies in the Test Set. If calibration data is lost, the assembly will have to be sent back to the factory.

Calibration data is generally stored in a socketed EEPROM on the A2A31 Controller. If the controller is replaced or swapped, the original EEPROM must be put in the new Test Set’s Controller. Should the EEPROM lose its data, the entire instrument will require a factory recuperation.

The assemblies that require downloaded calibration data from a memory card are:

- A2A20 Spectrum Analyzer
- A2A33 Measurement
- A2A200 100W Attenuator

Swapping these assemblies may cause some performance specification failures if the swapped in assembly’s calibration data cannot be downloaded.
The assemblies that require on-board calibration loaded at the factory are:

- A2A115 Downconverter
- A2A110 Upconverter
- A2A130 RF Input/Output
- A2A44 Output Section
- A2A21 Receiver
- A2A25 Signal Generator Synthesizer
- A2A22 Receiver Synthesizer
- A2A23 Reference

Swapping these assemblies should not cause a performance problem, as their calibration data resides with the assembly.

The assemblies that require a periodic calibration procedure are:

- A2A100 CDMA Generator Reference
- A2A130 RF Input/Output
- A2A120 LO IF/IQ Modulator
- A2A200 100W Attenuator
- A2A34 Data Buffer
- A2A80 Audio Analyzer 1
- A2A40 Audio Analyzer 2
- A2A33 Measurement
- A2A44 Modulation Distribution

Generally, these assemblies can be swapped without an immediate need of recalibration. In some cases though, a recalibration may be necessary to properly troubleshoot the instrument.
**Further Isolating RF Failures**

Isolating failures in the RF assemblies of the Test Set can be difficult. One problem occurs when the diagnostics use the built-in RF analyzer to test the built-in RF source, and vice versa. This is necessary to make the diagnostics self-contained, that is, they run without external equipment.

Some general-purpose, RF test equipment will be needed:

- RF signal generator
- RF modulation analyzer or spectrum analyzer.

**Isolating the RF Analyzer**

The RF Analyzer function uses the following assemblies. Refer to figure 3-17 and the block diagrams in chapter 10, "Block Diagrams".

- A2A115 Downconverter
- A2A21 Receiver
- A2A22 Receiver Synthesizer
- A2A20 Spectrum Analyzer

**Figure 3-17  Isolating the RF Analyzer**
To isolate an RF analyzer problem:

1. On the Test Set:
   a. Press Preset.
   b. Press the Inst Config to access the INSTRUMENT CONFIGURE screen.
      • Set the RF Display field to Freq.
      • Set the RF Offset field to Off.
   c. Press the RF Anl key (to go to the analog RF ANALYZER screen).
      • Set the Tune Freq to 100 MHz.
      • Set the Input Port to RF IN.

2. On the external RF signal generator:
   a. Set the frequency to 100 MHz CW.
   b. Set the amplitude to 0 dBm.
   c. Connect the output to the Test Set’s RF IN/OUT connector.

3. Set the RF signal generator’s frequency to 100, then 500, 900, and 1800 MHz. For each frequency reset the Tune Freq to that frequency. The Test Set’s measurements should read as follows:
   a. TX Power should read approximately 0.001 W for each frequency.
   b. Frequency should read 100, 500, 900, and 1800 MHz respectively.
   c. Press the Spec Anl key to access the analog spectrum analyzer. Observe the level and frequency of the signal.
**Isolating the RF Source**

The RF Generator function uses the following assemblies. Refer to figure 3-18 and the block diagrams in chapter 10, "Block Diagrams".

- A2A120 LO IF/IQ Modulator
- A2A25 Signal Generator Synthesizer
- A2A24 Output Section
- A2A110 Upconverter

**Figure 3-18**  **Isolating the RF Source**

To isolate the RF Source:

1. On the Test Set:
   a. Press Preset.
   b. Press the Inst Config key to access the INSTRUMENT CONFIGURE screen.
      - Set the RF Display field to Freq.
      - Set the RF Offset field to Off.
   c. Press the RF Gen key (to go to the analog RF GENERATOR screen).
   d. Set RF Gen Freq to 1800 MHz.
   e. Set Amplitude to 0 dBm.
   f. Set Output Port to Dupl.
2. On the external RF modulation analyzer or spectrum analyzer:
   a. Set the tuning for the signal generated by the Test Set.
   b. Connect the analyzer’s input to the Test Set’s DUPLEX OUT connector.

3. Set the Test Set’s **RF Gen Freq** to 1800, then 600, 300, and 150 MHz. For each frequency, the external RF analyzer should read as follows:
   a. Power should read approximately 0.001 W for each frequency.
   b. Frequency should read 1800, 600, 300, and 150 MHz respectively.
Service Screen

A large number of latch and DAC settings used throughout the Test Set can also be read and/or set to alter standard operation. The Service screen uses the internal voltmeter and frequency counter functions to monitor specific nodes in most assemblies. These functions are primarily intended to allow the automated internal diagnostic routines to verify proper instrument operation, and to allow the internal periodic adjustment routines to modify Test Set operation.

Use these functions for further troubleshooting when the diagnostics cannot isolate a failure to a specific assembly. To do this, you must understand how to operate the Test Set and, especially, understand how the assemblies in the Test Set work together.

How to Access the SERVICE Screen

1. Press the Preset key.
2. Rotate the knob to the screen’s title bar and select it (press knob). A drop down menu appears, see figure 3-19.

Figure 3-19 Service Screen

**SOFTWARE MENU Screen**

**SERVICE Screen**

### Options
- **Voltage**: Voltage settings
- **Frequency**: Frequency settings
- **Hex**: Hexadecimal settings

**Voltmeter Connection**

**Counter Correction**

**RAM Initialize**

**Latch**

**RAM Initialize**

Clear all RAM and restart
3. Rotate the knob and select SERVICE.

The SERVICE screen appears. For field descriptions, see "Field Names and Descriptions" on page 79.

Field Names and Descriptions

Voltmeter Connection

This field selects the desired circuit node for voltage measurements. To change the voltmeter connection, use the knob to select the Voltmeter Connection field. A Choices menu will appear. Move the cursor to the desired circuit node in the list and push the cursor control knob. The reading is displayed in the Voltage measurement field at the top-left of the display.

Because the nodes being measured must be in the range of 0 to ±5 volts, the measurement of some points are scaled to that measurement range. For example; the +12 Volt reference (MEAS_12V_REF) should measure about +5volts. The −12 Volt reference (MEAS_NEG_12V_REF) should measure about −5 volts. Many of the voltage measurements are only valid after a number of instrument settings are changed.

When run, the diagnostic routines make the necessary circuit changes and measurements automatically, comparing the measurements to known limits for each node.

Counter Connection

This field selects the desired circuit node to connect to the Test Set’s internal frequency counter. The reading is displayed in the Frequency measurement field at the top right of the display.

To change the counter connection, use the knob to select the Counter Connection field. A Choices menu will appear. Select the desired circuit node.

Gate Time

This field is used to adjust the Test Set’s internal frequency counter’s gate time. A shorter gate time may enable you to see frequency fluctuations that might not be seen using a longer gate time.

To change the gate time, use the knob to select the Gate Time field. When you select the field a flashing >> cursor is displayed. Rotate the cursor control knob until the desired gate time (10 to 1000 ms in 10 ms increments) is displayed, then press the cursor control knob.
Latch

This field is used to manually select the circuit latches that control switch, DAC, and gain settings within the Test Set. The value of the selected latch is displayed and changed in the Value field. Some settings are read-only.

To set a switch, DAC, or gain setting:

1. Use the knob to select the Latch field. A Choices menu will appear.
2. Move the cursor to the desired latch name and press the knob to select it.
3. Use the knob to select the Value field. A flashing >> cursor is displayed.
4. Rotate the cursor control knob to modify the value (hexadecimal).

**NOTE**

If any of the switches, DACs, or gain settings are changed with the Latch field, the Test Set will generate the message: Direct latch write occurred. Cycle power when done servicing." To clear this message, cycle the Test Set's power. Upon power-up, the internal controller will return the Test Set to its default settings and values.

The first part of the names in the Choices menu relates to the assembly where the switch, DAC, or gain setting is located. Some latch names are not listed here.

- dstr: A2A44 Modulation Distribution
- aud1: A2A80 Audio Analyzer 1
- aud2: A2A40 Audio Analyzer 2
- refs: A2A23 Reference
- rfio: A2A130 RF Input/Output
- dcvt: A2A115 Downconverter
- ucvt: A2A110 Upconverter
- out: A2A24 Output Section
- rcvr: A2A21 Receiver
- gsyn: A2A25 Signal Generator Synthesizer
- rsyn: A2A22 Receiver Synthesizer
- spec: A2A20 Spectrum Analyzer
- genRef: A2A100 CDMA Generator Reference
- genRef2: A2A100 CDMA Generator Reference
- lo_if: A2A120 LO IF/IQ Modulator
- meas: A2A33 Measurement
- metron: A2A33 Measurement
- afg1: A2A32 Signaling Source/Analyzer
- afg2: A2A32 Signaling Source/Analyzer
- buffModN: A2A34 Data Buffer
Value (hex)

This field displays and changes the hexadecimal value for the latch shown in the Latch field.

RAM Initialize

Selecting this field clears all SAVE registers and test programs, and any initialized RAM disk(s), that may be in RAM. It also resets all latches to their factory power-up configuration. If you have saved one or more instrument setups using the SAVE function, using this function will permanently remove them.
Product Verification

This section provides steps for verifying the Test Set's operation after a repair. Although in most cases this will be sufficient, this does not verify the ability of the instruments to meet CDMA Cellular/PCS Base Station specifications. Only by performing all of the Performance Tests in chapter 8, "Performance Tests" can you verify the instrument's performance. The following steps are suggested, you may choose to do more.

1. Run the Functional Diagnostics test of the SERVICE MENU (SERVICE4 program), see figure 3-20. The Functional Diagnostics tests verify the function of most of the assemblies in the Test Set.

   Figure 3-20   Functional Diagnostics

   SERVICE MENU
   Move pointer to desired program using the knob then press the knob. Press Help for information on the tests. Press Exit to abort.

   Functional Diagnostics Screen
   Move the pointer to the desired test using the knob then press the knob. Press the Exit key to abort.

   => Functional Diagnostics
      AF Diagnostics
      RF Diagnostics
      CDMA Diagnostics

   => RF Modules
      Analog Modulation
      CDMA Loopback
      Self Test
      Power Supplies

2. Perform a wideband sweep:

   a. Press Preset then press spec Anal to get the SPECTRUM ANALYZER screen.

   b. Set the RF Gen controls to Track, and the Port/Sweep field to Dupl. This directs the tracking generator to the DUPLEX OUT port.

   c. Connect the DUPLEX OUT port to the ANT IN port.
d. Set the **Main** control to **Ant**.

e. Set the **Center Freq** to 501 MHz, and the **Span** to 1 GHz. You should see a (roughly) flat line across the screen, varying about 4 dB. “**Generator sweep truncated**” may appear, but does not indicate a problem.

3. Run the Performance Tests associated with the repair as indicated in **table 3-2 on page 67**, or run all the tests in **Chapter 8, "Performance Tests" on page 161** to verify that the Test Set meets its overall performance specifications.
Troubleshooting

Product Verification
This chapter describes the preventative maintenance procedures recommended for the Test Set.
Hardware Maintenance

The following procedures should be performed on a regular basis to insure that your Test Set maintains optimum performance.

NOTE

Periodic Adjustment Interval

The calibration programs Periodic Calibration, IQ Calibration, and Eb/No Calibration should be performed after any assembly referred to in table 7-1 on page 147 is replaced, or at least every 24 months. See Chapter 7, "Periodic Adjustments" on page 145 for details.

NOTE

Performance Test Interval

The performance tests in Chapter 8, "Performance Tests" on page 161 should be performed when certain assemblies are repaired or replaced, or at least every 24 months. See table 3-2 on page 67 for those assemblies requiring performance testing/calibration.

Adjustments

- Periodic Calibrations

Adjustments for calibration are part of automated routines: Periodic Calibration, IQ Calibration, and Eb/No Calibration. These routines are contained in the Test Set’s ROM. Running these routines will adjust internal calibration and circuit paths for optimum performance. These routines can be run on any interval from six months to two years, depending on the severity of the application environment. These routines should also be run whenever a significant change to instrument’s hardware configuration is made. For instructions on running the periodic adjustment routines see Chapter 7, “Periodic Adjustments,” on page 145.

- Real Time Clock

The Test Set operates with a real-time clock that is user set. The real-time clock consists of both a numerical date and a time-of-day setting which may require changing due to repair (such as a battery or hardware repair) or shipping to a different time zone. The clock and date should be checked as part of routine maintenance. Incorrect settings may be an indication of faulty battery backup.

The date and time settings are entered by using the INSTRUMENT CONFIGURE screen. The Date field is a numerical number using the MMDDYY format. The Time field is a numerical number using a 24-hour military standard (example: 3:00 pm is 15.00 in military time). The date and time are maintained as part of RAM memory with battery backup.
Cleaning

- The Test Set contains an internal air filter. The filter requires periodic cleaning to remove dust and debris. Refer to "Cleaning the Air Filter" on page 89.

- RF assemblies A2A20 through A2A25 (see "Module and PC Board Assemblies" on page 104) should be removed and the bottom edges of the metal case cleaned with isopropyl alcohol or a mild cleaner. Cleaning the metal edges will insure that RF leakage protection is maintained.

Functionality

The Test Set has the capability to perform self tests for hardware failure and functionality. The self test diagnostics should be run whenever preventive maintenance, calibration, or repair has been performed. Self test diagnostics will help to insure that the instrument is performing reliably.

There are three diagnostic routines located in ROM of the Test Set: Functional Diagnostics, AF Diagnostics, and RF Diagnostics. Run these programs and follow the instructions listed on the screen. For instructions on running these diagnostics routines, see "Using the SERVICE4 Diagnostics" on page 46.

Integrity

The Test Set has been designed for rugged conditions, however parts can become loose or damaged over time and require repair or maintenance. The following items should be routinely checked:

- **Module Insertion and Alignment**
  
  The Test set contains circuit assemblies and RF modules that are mounted in sockets and board guides. It is extremely important that these assemblies be firmly seated and aligned in their guides. Remove the Test Set’s cover and check that boards align with the printed guides on the internal sheet metal covers. Ensure that each of the six RF module cases are firmly seated and locked in with their module bracket(s).

- **Type-N Connectors**
  
  The Test Set’s RF IN/OUT, ANT IN, and DUPLEX OUT connectors should be checked for damage or looseness. Damage can occur to the center conductor pin or the connector itself might become loosened. If damaged, the connector should be replaced. A loose connector can be re-tightened with the nut on the back side of the side panel. Refer to Chapter 5, “Disassembly,” on page 93 for information on the side-panel connectors.
Preventative Maintenance

Hardware Maintenance

- **Internal Cables and RF Connectors**

  The Test Set contains numerous cables and connectors that should be periodically checked for proper insertion and tightness. Remove the Test Set’s cover and visually check for any cables that may not be properly inserted. Check each RF cable connection for tightness, tighten where needed. Refer Chapter 5, “Disassembly,” on page 93 for information on the various cables and assemblies.
Maintenance Procedures

Cleaning the Air Filter

NOTE  The cleaning interval is dependent on the environmental conditions and application, it can be as often as six months in extremely dusty or dirty environments or as long as two years in a clean, well maintained facility.

The Test Set’s internal air filter requires periodic cleaning. Failure to periodically clean this filter may result in decreased internal airflow, increased internal operating temperature, and early failure of the Test Set.

1. Remove the front frame and external cover to access the air filter, see figure 4-1 on page 90. It is not necessary to remove the rear frame. Refer to Chapter 5, “Disassembly,” on page 93 for removing the front frame and external cover.
2. Lift the filter from the Test Set’s chassis. Use a vacuum to clean the filter. Use only a static-free vacuum cleaner or ionized air for the removal of dust and debris.

Memory Backup AA Battery

Two sets of batteries are used to back up the contents of the Test Set RAM. The first one is a set of two AA batteries mounted behind the rear panel of the Test Set. You must periodically change these batteries. The second battery is internally mounted and is not user serviceable.

CAUTION  Replace these batteries every 2-3 years. Failure to take prompt action may result in loss of RAM data including IBASIC programs and SAVE/RECALL states stored in the RAM.

To change the AA batteries, use the following procedure:

1. Switch power off and unplug the Test Set.
2. Remove the six screws in the rear panel using a TX-15 torx screwdriver, see figure 4-1 on page 90. It is not necessary to remove the front frame or external cover.
3. Remove the rear cover.
4. Replace the AA batteries. Do not use rechargeable batteries, and dispose the used batteries properly.
5. Re-install the rear panel.

Reset and GFI-Test Buttons

1. It is not necessary to remove the front frame or external cover. Remove the six screws in the rear panel using a TX-15 torx screwdriver, see figure 4-1.
Preventative Maintenance

Maintenance Procedures

1. To reset the Test Set, press the black button. To test the ground fault interrupter, press the red button.

2. Re-install the rear panel.

Figure 4-1  AA Batteries, Air Filter, and Reset/Test Buttons

PC Card Battery

External PC card (Epson-style and PCMCIA) contain batteries which require replacement. These batteries should be replaced every 12 months or whenever signs of lost data are noted. See figure 4-2 for battery replacement.
Figure 4-2   PCMCIA Card Battery Replacement
5 Disassembly

This chapter explains how to disassemble the Test Set for major assembly replacement.
Service Tools

Tools

One or more of the following tools may be required to access and/or remove various internal assemblies in the Test Set:

- TX-10 torx screwdriver
- TX-15 torx screwdriver
- Flat blade screwdriver
- 1/16-inch allen wrench
- 3/16-inch socket wrench
- 5/16-inch open-end wrench (for SMC connectors)
- 15/64-inch open-end wrench (for SMA connectors)
- 9/16-inch open-end wrench (for BNC connectors)
- 3/4-inch open-end wrench (for Type-N connectors)

Recommended Torque

- Tighten screws until snug. Overtightening can strip screws.
- SMA (RF) connectors: 9.0 lb-in. (102 N-cm)
- SMC (RF) connectors: 6.0 lb-in. (68 N-cm)
- Nuts holding semi-rigid coax to motherboard: 6.0 lb-in. (68 N-cm)
Assembly Replacements

With some assemblies you will receive a memory card that contains factory-generated calibration data for that assembly. For new replacements, there will also be an instruction sheet for loading the calibration data into your Test Set.

External equipment is not required for running the diagnostic routines. If diagnostic routines cannot isolate the problem, an oscilloscope, voltmeter, and spectrum analyzer may be required for further troubleshooting. A second Test Set is helpful for troubleshooting performance test failures.

Table 3-2 on page 67 and table 7-1 on page 147 show which assemblies need calibration data as well as which performance tests and periodic self-calibration adjustments are recommended after replacing an assembly.

**NOTE**

**Periodic Adjustment Intervals**

The adjustment programs Periodic Calibration, IQ Calibration, and Eb/No Calibration should be performed after any assembly referred to in table 7-1 on page 147 is replaced, or at least every 24 months. See Chapter 7, “Periodic Adjustments,” on page 145 for details. Run these programs to optimize the performance of the Test Set.

**NOTE**

**Performance Test Intervals**

The performance tests in Chapter 8, "Performance Tests" on page 161 should be performed when certain assemblies are repaired or replaced, or at least every 24 months. See table 3-2 on page 67 for those assemblies requiring performance testing/calibration.

**Replacement Parts**

For replacement part numbers, see Chapter 6, "Replaceable Parts" on page 125. For cable routing information refer to table 5-2 on page 120.
Removing the External and Internal Covers

To access most of the components inside the Test Set, you must remove the front frame, external cover, and internal covers (see figure 5-1 and figure 5-2). It is not necessary to remove the side panel or rear frames in most cases. You must remove the rear frame to access the memory AA backup-batteries, power supply assemblies, or to test and/or reset the ground fault interrupter (GFI).

External Covers

1. To remove the front frame, remove the eight screws securing it and pull it away from the chassis, see figure 5-1.

2. After removing the front frame, remove the external cover by sliding it slightly forward and away from the chassis.

3. To access the backup batteries, power supply, or GFI, remove the rear frame by removing the 6 screws securing it to the chassis. Pull the rear frame away from the chassis.

4. To remove the side panel frame, remove the handle and eight screws securing this frame to the chassis.

Figure 5-1  External Cover Removal
Internal Covers

There are internal covers protecting the top- and bottom-side assemblies of the Test Set. To remove the top covers, see "Top Internal Covers" below. To remove the bottom cover, see "Bottom Internal Cover" on page 99.

Top Internal Covers

1. Remove the front frame and external cover, see "External Covers" on page 96. Side panel and rear frame removal is not necessary.

2. To access the top-side assemblies, remove the MP13 and MP12 internal covers by removing the screws securing these covers to the chassis, see figure 5-2.

3. Lift the MP14 cover to access the PCB assemblies.

Refer to figure 5-3 on page 98 to help you identify the assemblies and components in the Test Set.

Figure 5-2   Top Internal Covers
Figure 5-3  Topside View of Test Set
Bottom Internal Cover
To access the assemblies on the bottom side of the Test Set, turn the Test Set over, remove the screws shown in figure 5-4, and lift the bottom internal cover from the chassis.

**CAUTION**
If the top covers are off, be careful. The exposed digital boards can be easily damaged. Some of the digital boards have pull-rings that can easily get hooked and pull assemblies from their connections.

Use figure 5-5 on page 100 to identify the assemblies on the bottom side of the Test Set.

**Figure 5-4** Bottom Internal Cover

Screws (x27)

MP15
Cover-Bottom
Disassembly
Removing the External and Internal Covers

Figure 5-5  Bottom View of Test Set (without Bottom Cover)
A1 Disassembly

1. Remove the front frame, external cover, and internal top and bottom covers, see "Removing the External and Internal Covers" on page 96.

2. Remove the eight screws securing the A1 assembly to the A2 assembly, see figure 5-6.


To replace a component or subassembly on the A1 assembly, see figure 5-7 on page 102.

Figure 5-6 A1 Assembly
Figure 5-7  A1 Assemblies and Components
**A2 Disassembly**

This section describes how to disassemble the A2 assembly. Use table 5-1 below to see which assemblies are replaceable.

**NOTE**

**Periodic Adjustment Intervals**

The adjustment programs Periodic Calibration, IQ Calibration, and Eb/N0 Calibration should be performed after any assembly referred to in table 7-1 on page 147 is replaced, or at least every 24 months. See Chapter 7, "Periodic Adjustments" on page 145 for details. Run these programs to optimize the performance of the Test Set.

**NOTE**

**Performance Test Intervals**

The performance tests in Chapter 8, "Performance Tests" on page 161 should be performed when certain assemblies are repaired or replaced, or at least every 24 months. See table 3-2 on page 67 for those assemblies requiring performance testing/calibration.

**Table 5-1**

<table>
<thead>
<tr>
<th>A2 Assemblies</th>
<th>see page 103</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module and PC Board Assemblies</td>
<td></td>
</tr>
<tr>
<td>Control Interface Assembly</td>
<td>see page 108</td>
</tr>
<tr>
<td>PCMCIA Assembly Remove the front frame, external cover, and the front internal cover from the Test Set, see &quot;Top Internal Covers&quot; on page 97.</td>
<td>see page 107</td>
</tr>
<tr>
<td>RF Input/Output, Upconverter, &amp; Downconverter Assemblies</td>
<td>see page 109</td>
</tr>
<tr>
<td>LO IF/IQ Modulator and CDMA Generator Reference (Gen Ref) Assemblies</td>
<td>see page 111</td>
</tr>
<tr>
<td>Attenuator Assembly</td>
<td>see page 113</td>
</tr>
<tr>
<td>Motherboard Assembly</td>
<td>see page 114</td>
</tr>
</tbody>
</table>

**Module and PC Board Assemblies**

1. Remove the Test Set’s external and top internal covers, see "Removing the External and Internal Covers" on page 96.

2. Remove modules using a flat-blade screwdriver to pry them upward from the chassis, see figure 5-8 on page 104.

3. Remove PC board assemblies by lifting them from the chassis (some assemblies have pull rings) and then disconnect any cables that may be attached to it. See figure 5-9 on page 105 for cable connections.
NOTE For cable routing information see table 5-2 "Wire/Cable List" on page 120.

Figure 5-8 Module and PC Board Assemblies
Figure 5-9  PC Board Assemblies

DATA BUFFER, A2A34 Assembly

- J22 to A2A1 J76 "DATA IN"
- W25 to panel "DATA IN"
- W6 to A2A1 J76 "DATA IN"
- J4 "19.6 MHz IN"
- W26 to A2A1 J75 "16X CHIP"

RECEIVE DSP, A2A36 Assembly

- W33 to panel "DATA IN"
- J6 to A2A1 "E"
- W30 to A2A1 J76 "4X CHIP"
- J4 to A2A1 J75 "16X CHIP"

MEMORY/SBRC, A2A30 Assembly

- J3 TP4

CONTROLLER, A2A31 Assembly

- J1 TP1 TP2
- J4
- P2 P1

1/4 turn to remove or secure option board.
A2A80A1 and A2A80A2 Filter Assembly Removal

To remove either of the filter option assemblies on the A2A80 Audio Analyzer 1 assembly:

1. Remove the A2A80 assembly from the Test Set.

2. Turn the plastic hex nut on each standoff a quarter turn and push the standoffs through their holes to release the filter board from the host board, see figure 5-10. It may be necessary to compress or squeeze the expandable flanges to slide them through the mounting holes.

Figure 5-10 A2A80 Audio Analyzer 1 Assembly
**PCMCIA Assembly** Remove the front frame, external cover, and the front internal cover from the Test Set, see "Top Internal Covers" on page 97.

3. Remove the memory card from the card slot.

4. See figure 5-11. Remove the two screws and disconnect ribbon cable W201 from the PCMCIA assembly. Lift the assembly from the chassis.

---

**Figure 5-11** PCMCIA Assembly Removal

![PCMCIA Assembly Removal Diagram]

---

*Figure 5-11 PCMCIA Assembly Removal*
Control Interface Assembly

1. Remove the standoffs and screwlocks from the connector panel as shown in figure 5-12 from the Test Set.

2. Disconnect ribbon cable W204 from the A2A70 assembly to remove the assembly.

Figure 5-12 Control Interface Assembly Removal
RF Input/Output, Upconverter, & Downconverter Assemblies

The RF Input/Output A2A130, Upconverter A2A130, and Downconverter A2A115 assemblies are secured in an interlocking manner and are disassembled in the following order:

**RF Input/Out Assembly Removal**

1. Remove the bottom cover of the Test Set. See "Removing the External and Internal Covers" on page 96.
3. Remove the four torx screws (MP101) securing the RF Input/Output assembly to the other assemblies.
4. Slide the RF Input/Output assembly away from the Downconverter assembly's slot to remove the assembly.

**Upconverter Assembly Removal**

1. Remove the RF Input/Output.
2. Disconnect cables: W101, W210, W100, and W24
3. Remove the four torx screws securing this assembly and lift it away from the chassis.

**Downconverter Assembly Removal**

1. Remove the RF Input/Output and Upconverter assemblies as previously instructed.
2. Disconnect cables: W110, W212, W56, and W57
3. Remove the four torx screws securing this assembly and lift it away from the chassis.

When reassembling, reverse the order of disassembly, that is, install the Downconverter assembly first, the Upconverter second, and the RF Input/Output assembly last. For wire/cable routing information, see table 5-2 "Wire/Cable List" on page 120.
Figure 5-13 RF Input/Output, Upconverter, & Downconverter Removal
LO IF/IQ Modulator and CDMA Generator Reference (Gen Ref) Assemblies

Before the Gen Ref assembly can be removed, the LO IF/IQ Modulator assembly has to be removed first. See figure 5-14 on page 112.

Removing the LO IF/IQ Modulator Assembly
1. Remove the bottom cover, see "Bottom Internal Cover" on page 99.
2. Disconnect the cables shown in figure 5-14 on page 112.
3. Remove the nine torx screws that secure this assembly to the chassis.

Removing the Gen Ref Assembly
1. Remove the LO IF/IQ Modulator assembly.
2. Disconnect the cables shown in figure 5-14 on page 112.
3. Remove the nine torx screws securing the assembly to the chassis and lift the assembly.

When re-installing the assemblies, install the Gen Ref assembly first.
Figure 5-14 LO IF/IQ Modulator & CDMA Generator Reference Removal

LO IF/IQ MOD Assembly A2A120

Gen Ref Assembly A2A100

W214

MP101 (x9)

MP101 (x7)

MP101 (x8)

a2a120_2.eps

Gen Ref Assembly A2A100

LO IF/IQ MOD Assembly A2A120

W213

W62 GRY

W53 BRN

MP101 (x4)

MP101 (x5)

MP101 (x8)

W58 RED

W63 YEL

W52 BLK

W51 WHT

W64 GRN

W215

W216

MP101 (x9)

W58 RED

W63 YEL

W52 BLK

W51 WHT

W64 GRN
Attenuator Assembly

1. Remove the front, side, and rear external covers, and the top and bottom internal covers, see "Removing the External and Internal Covers" on page 96.

2. Remove the power supply assembly, see "A3 Disassembly" on page 116.

3. Turn the Test Set over and disconnect flex connectors W120 and W123 from the attenuator, see figure 5-15.

4. Remove the four screws that secure the attenuator to the chassis, see figure 5-15.

Figure 5-15  Attenuator Assembly Removal
Disassembly

A2 Disassembly

Motherboard Assembly

1. Remove all external and internal (top and bottom) covers from the Test Set, see "Removing the External and Internal Covers" on page 96.

2. Remove all the modules and PC board assemblies. See "Module and PC Board Assemblies".

3. Remove the A1 front panel and A3 rear panel assemblies. See "A1 Disassembly" on page 101 and "A3 Disassembly".

4. Remove the six torx screws securing the sheet metal divider and then remove the divider, see figure 5-16 on page 115.

5. Disconnect all the connectors on the topside of the motherboard.

6. Disconnect all the connectors on the bottom side of the motherboard.

7. Remove the 11 torx screws securing the motherboard to the chassis and lift it up to remove it.

To reassemble the Test Set, perform the previous steps in reverse order. For wire/cable routing information, see table 5-2 "Wire/Cable List" on page 120.
Figure 5-16  Motherboard Removal
A3 Disassembly

1. Remove the Test Set’s external and internal covers, see "Removing the External and Internal Covers" on page 96.

2. Remove the eighteen torx screws securing the A3 assembly to the A2 assembly, see figure 5-17.

3. Move the A3 assembly away from the A2 assembly and disconnect cables W220 and W221.

Figure 5-17 A3 Rear Panel Assembly
Removing the Power Supply Regulator Assembly

To remove the A3A1 regulator assembly, disconnect the cables and the four torx screws shown in figure 5-18.

Figure 5-18 A3A1 Regulator Assembly

Removing the Power Supply Assembly

1. Remove the regulator board.
2. Remove the power supply cover from the A3 assembly, see figure 5-19 on page 118.
4. Remove the four screws securing the power supply to the A3 assembly.
Figure 5-19  Power Supply Removal

Power Supply Cover

Rear Sub-Panel

Power Supply Assembly

Part of GFI Assembly.
**Power Supply Switch, Fan, & Battery Holder Assemblies**

1. Remove the regulator assembly, see "Removing the Power Supply Regulator Assembly" on page 117, and power-supply cover and subassemblies, see "Removing the Power Supply Assembly" on page 117.

2. To remove the fan, remove the three screws shown in figure 5-20.

3. The A3S1 power switch assembly is normally riveted in place. However, this assembly is replaceable, and screws can be used to replace the rivets, see figure 5-20.

**Figure 5-20 Fan and Power Switch Assemblies**

NOTE: Battery Holder (shown below) is part of A3A1 assembly.
## Wire/Cable Information

### Table 5-2 Wire/Cable List

<table>
<thead>
<tr>
<th>Wire #</th>
<th>From</th>
<th>To</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1</td>
<td>&quot;AUDIO OUT&quot; (Panel)</td>
<td>A2A1 J 8</td>
<td>E6380-61039</td>
</tr>
<tr>
<td>W2</td>
<td>&quot;AUDIO IN - HI&quot; (Panel)</td>
<td>A2A1 J 9</td>
<td>E6380-61039</td>
</tr>
<tr>
<td>W3</td>
<td>&quot;AUDIO IN - LO&quot; (Panel)</td>
<td>A2A1 J 11</td>
<td>E6380-61039</td>
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<tr>
<td>W4</td>
<td>&quot;BASEBAND OUT - I&quot; (Panel)</td>
<td>A2A34 J 402</td>
<td>E6380-61043</td>
</tr>
<tr>
<td>W5</td>
<td>&quot;BASEBAND OUT - Q&quot; (Panel)</td>
<td>A2A34 J 502</td>
<td>E6380-61043</td>
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<tr>
<td>W6</td>
<td>&quot;DATA IN&quot; (Panel)</td>
<td>A2A34 J 22</td>
<td>E6380-61045</td>
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<tr>
<td>W7</td>
<td>&quot;ANALOG MODULATION IN&quot; (Panel)</td>
<td>A2A1 J 36</td>
<td>E6380-61039</td>
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<tr>
<td>W8</td>
<td>&quot;SCOPE MONITOR OUT&quot; (Panel)</td>
<td>A2A1 J 37</td>
<td>E6380-61039</td>
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<tr>
<td>W9</td>
<td>&quot;EXT SCOPE TRIG IN&quot; (Panel)</td>
<td>A2A1 J 38</td>
<td>E6380-61039</td>
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<tr>
<td>W10</td>
<td>&quot;VIDEO OUT&quot; (Panel)</td>
<td>A2A1 J 39</td>
<td>E6380-61039</td>
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<tr>
<td>W11</td>
<td>A2A100 J 5 (RED)</td>
<td>&quot;16X CHIP CLOCK 19.6608 MHz OUT&quot; (RED - Panel)</td>
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<td>(future use) A2A100 J 6</td>
<td>N/A</td>
<td>N/A</td>
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<td></td>
<td>(future use) A2A100 J 16</td>
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<tr>
<td>W12</td>
<td>A2A100 J 7 (BLU)</td>
<td>&quot;CHIP CLOCK 1.2288 MHz OUT&quot; (BLU - Panel)</td>
<td>E6380-61074</td>
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<tr>
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<td>A2A100 J 9 (WHT)</td>
<td>&quot;FRAME CLOCK OUT&quot; (WHT - Panel)</td>
<td>E6380-61072</td>
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<tr>
<td>W14</td>
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<td>&quot;EVEN SECOND SYNC IN&quot; (GRY - Panel)</td>
<td>8120-5837</td>
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<td>W15</td>
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<td>&quot;TRIGGER QUALIFIER IN&quot; (PRL - Panel)</td>
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<td>W16</td>
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<td>&quot;10 MHz REF OUT&quot; (ORG - Panel)</td>
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<td>A2A100 J 17</td>
<td>&quot;EXT REF IN&quot; (GRN - Panel)</td>
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<td>W25</td>
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<td>A2A34 J 709 &quot;1.2200 MHz_DATA_OUT&quot;</td>
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<tr>
<td>W26</td>
<td>A2A1 J 75</td>
<td>A2A34 J 4 &quot;19.6 MHz IN&quot;</td>
<td>E 6380-61042</td>
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<tr>
<td>W27</td>
<td>A2A1 &quot;B&quot;</td>
<td>A2A34 J 501</td>
<td>E 6380-61040</td>
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<tr>
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<td>A2A1 &quot;F&quot;</td>
<td>A2A34 J 401</td>
<td>E 6380-61040</td>
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<td>W29</td>
<td>A2A1 &quot;A&quot;</td>
<td>A2A36 J 6</td>
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<td>A2A36 J 3</td>
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<td>A2A34 J 400</td>
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<td>W33</td>
<td>A2A1 J 78</td>
<td>A2A36 J 4</td>
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<td>W50</td>
<td>A2A1 &quot;C&quot; (BLK)</td>
<td>A2A120 J 3 I/Q &quot;I IN&quot; (BLK)</td>
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<td>W51</td>
<td>A2A1 &quot;D&quot; (WHT)</td>
<td>A2A120 J 2 I/Q &quot;Q IN&quot; (WHT)</td>
<td>E 6380-61065</td>
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<td>A2A130 J 7 (RF I/O - GRY)</td>
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<td>A2A120 J 4 LO/IF &quot;3.69 MIF&quot; (BRN)</td>
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<td>A2A100 J 8 (YEL)</td>
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<td>E6380-61022</td>
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<td>A2A70 J 1</td>
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<td>A2A110 J 4</td>
<td>A2A1 J 32 &quot;Up Converter&quot;</td>
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<td>A2A1 J 34</td>
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<td>A2A1 J 62</td>
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<td>A3A1 J 2</td>
<td>A2A1 J 54</td>
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<td>W221</td>
<td>A3A1 J 5</td>
<td>A2A1 J 73 (multiconductor power cable)</td>
<td>E6380-61036</td>
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<td>A3A1 J 6</td>
<td>POWER SUPPLY, A3A2 J 14</td>
<td>E6380-61049</td>
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<td>POWER SUPPLY, A3A2 J 13</td>
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<td>(cable part of A3A4 assembly)</td>
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<td>A3A1 J7</td>
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<td>POWER SWITCH, A3S1</td>
<td>A3A1 J3</td>
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<td>LINE MODULE ASSEMBLY, A3A3</td>
<td>OEM POWER SUPPLY, J7</td>
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Disassembly

Wire/Cable Information
6 Replaceable Parts

This chapter contains the replaceable assembly and component information for the Test Set. Use the illustrations in this chapter to identify the replaceable parts and the “Parts List” on page 140 for part numbers.
Replacement & Ordering Parts

Direct Parts Ordering

Call Hewlett-Packard parts specialists at 1-800-227-8164, or see "Factory Support" on page 42. They can help you identify parts and can also take your order.

Assembly Replacements

With some assemblies you will receive a Memory Card that contains factory-generated calibration data for that assembly. There will also be an instruction sheet for loading the calibration data into your Test Set after you've replaced the assembly.

NOTE Periodic Adjustment Interval

The calibration programs Periodic Calibration, IQ Calibration, and Eb/No Calibration should be performed after any assembly referred to in table 7-1 on page 147 is replaced, or at least every 12 months. See Chapter 7, "Periodic Adjustments" on page 145 for details.

NOTE Performance Test Interval

The performance tests in Chapter 8, "Performance Tests" on page 161 should be performed when certain assemblies are repaired or replaced, or at least every 24 months. See table 3-2 on page 67 for those assemblies requiring performance testing/calibration.
Parts Identification

Major Assembly Overview

Shown below is a top view of the Test Set with external and internal covers removed. The Test Set can be separated into three major assemblies designated: A1, A2, and A3. Throughout this chapter the reference designator for each sub assembly is prefixed with its major assembly’s designator. Take for example the PCMCIA assembly’s reference designator A2A10: “A2” refers to the A2 major assembly and “A10” refers to the PCMCIA sub assembly which is part of A2.

Figure 6-1  Major Assemblies
Covers and Chassis Parts

Figure 6-2  External and Internal Covers

External Cover  MP7
Air Filter Pad  MP8
Foot MP6 (x4)
Rear Frame  MP11
MP101 (x6)

Front Frame  MP2
Name Plate  MP3

Impact Cover  MP1
Door Latch  MP4
Door Spring  MP5
Foot MP6 (x4)
MP101 (x8)

MP1 (x17)
MP13 Cover
MP14 Cover
MP15

MP101 (x28)

Bottom Cover  MP15

Strap MP10

Side Panel  MP9

Labels  MP17

MP101 (x8)

CVPRS3.EPS

k1
k1'
k2
k3
k4
k5
Shift
Shift
k2'
k3'
k4'
Release
Menu
Pause/Continue
CDMA
Gen
RF
Gen
CDMA
Anl
RF
Anl
Code
Dom
Spec
Anl
Preset
Hold
Recall
Local
Meas
Reset
Save
ADRS
Prev
Print
Inst
Config
Help
Printer
Config
I/O
Config
Error
Message
AF Anl
Scope
Reset
mW
Hz
V
s
kHz
mV
%
MHz
V
GHz
dBm
Enter
ms
%
D
dB V
D
+/

3
6
9

No
ppm
W
C
.
F
2
5
8

Yes
On/Off
B
0
E
1
4
7

Hi limit
Avg
Incr
x 10

Meter
Incr
Set
Cancel
Lo Limit
Ref Set
Incr
10

dB
A
EEX
Unlock
Volume
Squelch
Push to Select
REFERENCE
Internal
External
A1 Assemblies

Figure 6-3  A1 Assembly - Front Panel

Screen MP35
Frame MP34
MP103 (x8)
Speaker A1LS1
Knob MP33
Knob MP31
Knob MP32
Washer MP37
Knob MP30
Keypad A1A2
(Display A1A1
(screen metal frame included)

MP34
MP32
MP102 (x4)
W200
W203
MP104 (x3)
A1R1
A1A3
MP103 (x8)
A2 Assemblies

Module and PCB Board Assemblies

Figure 6-4
PCB Assemblies.

Figure 6-5

DATA BUFFER, A2A34 Assembly
- J22 to A2A1 J76 "DATA IN"
- W25 to A2A1 J76 "DATA IN"
- J42 "19 MHz IN"
- W26 to A2A1 J75 "16X CHIP"

RECEIVE DSP, A2A36 Assembly
- J4 to A2A1 "E"
- W30 to A2A1 J78 "4X CHIP"

MEMORY/SBRC, A2A30 Assembly

CONTROLLER, A2A31 Assembly
- J1
- P1
- P2

1/4 turn to remove or secure option board.
PCMCIA Assembly

Figure 6-6

Attenuator Assembly

Figure 6-7
Control Interface Assembly & Connectors

Figure 6-8

Control Interface Board
A2A70

W204

A2J2

Screw (x4)
MP110

A2J3

Same for A2J3 and A2J4.

Nut
MP20 (17x)

A2J2

Screwlock
MP107 (x10)

Washer
MP108 (x10)

Nut
MP106 (x2)

Washer
MP109 (x2)

A2A70 to Controller Assembly
A2A31 J1

Screw (x4)
MP110

Nut
MP20 (17x)

Same for A2J3 and A2J4.
RF/IO, Up Converter, and Down Converter Assemblies

Figure 6-9
LO IF/IQ MOD and GEN REF Assemblies

Figure 6-10
Motherboard and Sub Frame

Figure 6-11
A3 Rear Panel Assembly

Figure 6-12

Regulator Assembly A3A1

Power Supply A3A2

Rear Sub-Panel MP50

Battery Holder A3A4

Ground Fault Interrupter & Line Module
(Part of MP50 Assembly)

Switch A3S1

Fan A3B1

Power Supply Cover MP51

Part of A3A4 Battery Holder Assembly

from GFI assembly
Cable Assemblies

Figure 6-13  Cables, Top View
Figure 6-14  Cables, Panel and Bottom Side Views

**Parts Identification**
## Parts List

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<th>Description</th>
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Replaceable Parts

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Replaceable Parts

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This chapter contains the periodic adjustment procedures for the Test Set.
Periodic Adjustments

Some assemblies or combinations of assemblies require periodic adjustments to compensate for variations in circuit performance due to age or environment.

There are two types of calibration data:

- Factory-generated digital data either on memory cards, or on ROMs (which are on the assemblies themselves)
- Data generated internally by running calibration programs

In either case calibration data is loaded into non-volatile memory on the A2A31 Controller.

NOTE

Because calibration data resides on the A2A31 Controller assembly, it is important that whenever the assembly is replaced that the data be transferred from the original assembly to the new one. The calibration data resides in a socketed EEPROM which can be moved with little danger of losing its contents. Refer to the instructions accompanying the replacement assembly for details.

To download calibration data supplied on a memory card, follow the instructions that come with the replacement assembly. To create and download calibration data for assemblies requiring a periodic adjustment, follow the steps later in this chapter. For a summary of assemblies and their calibration requirements, see table 7-1, "Assemblies and Their Calibration Programs & Locations" on page 147.
## Table 7-1  Assemblies and Their Calibration Programs & Locations

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<td>A2A40 Audio Analyzer 2</td>
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Equipment

**Equipment for the Periodic Adjustments Programs**

- For the **Timebase Reference Using a Counter** calibration you will need to connect a frequency counter to the rear-panel 10 MHz REF OUTPUT connector. The accuracy of the counter will determine the accuracy of the Test Set’s internal reference. You will use the counter to set the timebase reference DACs.

- For the **Timebase Reference Using a Source** calibration you will need to connect a signal generator to the front-panel ANT IN connector.

- For the **Voltmeter References** calibration you will need a DC voltmeter that can measure ±5 V with ±0.015% accuracy.

---

**Figure 7-1 Periodic Adjustments Menu**

![Periodic Adjustments Menu](percal.eps)

Move the pointer to desired test using the knob then press the knob. Press Exit key to abort.

**Periodic Calibration Menu**

- Functional Diagnostics
- AF Diagnostics
- RF Diagnostics
- CDMA Diagnostics
- Edit RF Diagnostic Limits
- Periodic Calibration
- IQ Calibration
- Eb/No Calibration

**SERVICE MENU Screen**

Move pointer to desired program using the knob then press the knob. Press Help for information on the tests. Press Exit to abort.
Equipment Needed for the System Power Calibration Program

For the **System Power Calibration** program you will need the equipment listed in **table 7-2**. Because this calibration program is written specifically for this equipment, no substitutions are possible.

![Table 7-2](image)

**Table 7-2**  
**Equipment List for System Power Calibration Program**

<table>
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<tr>
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<td>HP 8663A</td>
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<td></td>
<td>HP ESG-2000A, -3000A, or -4000A</td>
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<tr>
<td></td>
<td>HP ESG-D2000A, -D3000A, or -D4000A</td>
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<tr>
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<td>HP 437B</td>
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<td>HP 438A</td>
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<td>HP EPM-441A</td>
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<td>HP 8901B</td>
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<td>HP-IB Cables</td>
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<td>(2 cables required, 3 if HP-IB printer is used.)</td>
<td></td>
</tr>
<tr>
<td>Printer (optional)</td>
<td>Any serial, parallel, or HP-IB printer</td>
</tr>
</tbody>
</table>
A Word About Storing Calibration Factors

You should understand the calibration-factor-storage process before running any of the following programs: Periodic Calibration, IQ Calibration, Eb/No Calibration, or System Power Calibration.

As a program runs, calibration factors are computed and applied. When all the calibration factors have been acquired, the program stops and asks if the user wants the calibration factors to be stored. At this point, it should be emphasized that the new calibration factors are now being used by the Test Set. If you do not store them at this point, they will be used by the Test Set until the power is switched off even though they have not been stored.

If you do not store the calibration factors but run another calibration program and then store the calibration factors, the calibration factors from the previous program will be stored along with the calibration factors just acquired unless the power is cycled between the tests. Storing calibration factors copies the calibration factors from volatile to non-volatile memory (that is, memory that is not erased when the power is turned off).

Also, when storing calibration factors, be sure to wait for the message **Updating Flash Calibration Files... DO NOT Interrupt Power!** to disappear before continuing. Depending on the number of calibration factors being stored, this may take several minutes.
Running the Periodic, IQ, or Eb/No Calibration Programs

1. Press Menu to access the SOFTWARE MENU screen.
2. Select the field under Select Procedure Location:
3. Select ROM under the Choices: menu.
4. Select the field under Select Procedure Filename:
5. Select SERVICE4, see figure 7-2.
6. Select Run Test (key k1).
7. From the SERVICE MENU, select the desired calibration program to perform.
   - Periodic Calibration - for more detailed information, see “Periodic Calibration Menu Descriptions” on page 154.
   - IQ Calibration - for more detailed information, see “IQ Calibration Program Description” on page 159
   - Eb/No Calibration - for more detailed information, see “Eb/No Calibration Program Description” on page 160
8. Follow the instructions on the screen.
Periodic Adjustments
Running the Periodic, IQ, or Eb/No Calibration Programs

**Figure 7-2** SERVICE MENU Screen

![Service Menu Screen](servsrn1.eps)

**SOFTWARE MENU Screen**

LOAD TEST PROCEDURE:
- Select Procedure Location: [ROM]
- Select Procedure Filename: SERVICE
- Description: Launches diagnostic and calibration programs.

CUSTOMIZE TEST PROCEDURE:
- Customization Options:
- Success:
- Failure:
- Exit:

SERVICE MENU Screen

Move pointer to the desired program using the knob then press the knob. Press Help for information on the tests. Press Exit to abort.

- Functional Diagnostics
- AF Diagnostics
- RF Diagnostics
- CDMA Diagnostics
- Edit RF Diagnostic Limits
- Periodic Calibration
- IQ Calibration
- Eb/No Calibration

![Service Menu Screen](servscn2.eps)
Running the System Power Calibration Program

This adjustment program is not found in ROM of the Test Set. This program resides on a PCMCIA Memory Card, part-number E6380-61811. It has to be downloaded from the memory card.

This program generates system power calibration factors for the Test Set. The purpose of this program is to generate calibration factors for the RF Input/Output Section module, high power attenuator, and cables. This assures that the Test Set will meet its power measurement accuracy specifications after repair.

An RF signal generator and a power splitter produce two signals with the same power level. One signal is measured by the power meter, the other is applied to the input of the Test Set. The program measures these levels at selected frequencies and then generates calibration factors so the Test Set readings match the power readings. These calibration factors are stored in the Test Set.

Communication between the active instrument(s) is through the Test Set’s HP-IB port. An optional printer can be connected to the Test Set’s HP-IB, serial, or parallel port. Typically this is done from the Printer Setup field of the SOFTWARE menu screen.

To run the System Power Calibration program:

1. Connect HP-IB cables from the Test Set to the signal generator and power meter.
2. Insert the PCMCIA Memory Card, P/N E6380-61811, into the Test Set’s memory card slot.
3. Press Menu to access the SOFTWARE MENU screen.
4. Select the field under **Select Procedure Location:**
5. Select **Card** under the **Choices:** menu.
6. Select the field under **Select Procedure Filename:**
7. Select **SYSPWR0**
8. Select **Run Test** (key k1).
9. Follow the instructions on the screen.
Periodic Calibration Menu Descriptions

This section describes the adjustment programs listed under the Periodic Calibration menu.

Figure 7-3 Periodic Calibration

Timebase Reference Using a Counter

This program is used to manually tune the timebase reference using a frequency counter as the time standard. This procedure has two basic steps:

1. Manual adjustment of the two (coarse and fine) timebase tuning DACs.
2. Downloading the DAC settings into the Test Set.

If you have not already adjusted the two timebase tuning DACs, exit the program if needed (by selecting the Adj user key), and follow the instructions in “Setting the Timebase Latches” on page 158.

If you have adjusted the timebase DACs, run this program and select the Cal user key to make the setting permanent.

As an alternate method, you can select the option Timebase Reference Using a Source (see following section) and adjust the timebase to a time standard connect to the front-panel ANT IN connector.
**Timebase Reference Using a Source**

This program automatically tunes the timebase tuning DACs to the signal at the front-panel ANT IN connector, which is input at the frequency that is keyed in from the front-panel keypad. If an external 10 MHz reference is being used, it must be disconnected.

In order for the calibration to be valid, the signal applied to the ANT IN connector must have the following characteristics.

1. The level should be between −30 and +20 dBm (0.001 and 100 mW).
2. The frequency should be between 0.4 and 1000 MHz.
3. The frequency must be as accurate as the application of the Test Set requires.
4. The Test Set must be able to tune to within 10 or 100 kHz of the reference signal with the Test Set’s current timebase reference settings. If this condition is not met, either the keyed-in frequency is incorrect or the Test Set is faulty.
5. The signal must be a CW signal. Specifically, any FM must be less than 100 Hz peak as measured by the Test Set.
6. The coarse tune DAC must be between 3 and 250 (decimal); otherwise, the frequency of the source is out of reach by the tuning DAC.

After the coarse and fine tune DAC settings have been determined, the values are downloaded into the Test Set’s memory.

**Voltmeter References**

When you select the Voltmeter Reference calibration, instructions are displayed explaining how to measure the negative and positive references with an external voltmeter. The user is required to key in the readings. If the readings are within range, the two values are automatically downloaded.

For the Test Set to meet published specifications, the external DC voltmeter must be ±0.015% accurate when measuring ±5 V. The voltmeter is connected to the test points on the Measurement board, A2A33 assembly, see figure 7-4.
Audio Frequency Generator Gain

The gain of the following paths is calibrated:

- The internal paths that run from Audio Frequency Generators 1 and 2 (individually) through the Modulation Distribution assembly, to the monitor select output, then onto Audio Analyzer 1 to the DVM.

- The paths that run from Audio Frequency Generators 1 and 2 (individually) through the Modulation Distribution assembly to the AUDIO OUT connector, externally to the rear-panel MODULATION IN connector, then again through the Modulation Distribution assembly to the monitor select output and to the DVM.

The above-measured levels are used to adjust the output level of the audio generators so that they produce a calibrated level to the modulation inputs of the RF generator. These measurements are made at DC. Both positive and negative levels are measured to produce an optimum calibration factor.
External Modulation Path Gain

The **Audio Frequency Generator Gain** program should be performed before running the **External Modulation Path Gain** program.

The “path” in this program runs from the external MODULATION IN connector through the Modulation Distribution assembly, through the Monitor Select Switch, and then through Audio Analyzer 1 to the Test Set’s internal DVM. The dc source is Audio Frequency Generator 1 through the AUDIO IN connector and an external cable.

The goal of this procedure is to set the External Level Amplifier gain DAC (on the Modulation Distribution assembly) to produce a gain of exactly 4 between the MODULATION IN connector and output of the Monitor Select Switch. This requires measuring the input and output levels, calculating the gain, changing the DAC setting, and then repeating the process until the calculated gain equals 4.

Audio Analyzer 1 Offset

Two DC offsets are measured and downloaded as calibration factors to the Audio Analyzer 1 assembly. These measurements are determined under the following conditions:

- Input-select switch grounded
- AUDIO INPUT selected with return conductor grounded

Variable Frequency Notch Filter

The calibration factors for tuning the variable-frequency notch filter are determined as follows:

The input to the filter is set to 10 evenly-spaced frequencies between 300 and 10000 Hz. The DAC that tunes the notch filter is adjusted for best null of the tune error voltage. From this data, three coefficients of a parabola which best fit the tuning data are calculated using a least-squares curve fit. The coefficients are then automatically downloaded into the Test Set’s non-volatile memory.
Setting the Timebase Latches

The `refs_DAC_coarse` and `ref_DAC_fine` values adjust the frequency of the Test Set’s internal 10 MHz reference. They are stored in memory. The controller reads the values and sends the appropriate adjustment to the A2A23 Reference assembly.

The following procedure is to be used when running the program "Timebase Reference Using a Counter" on page 154.

1. Press Shift, Duplex Config to access the CONFIGURE screen.
2. Select SERVICE under the To Screen menu.
3. Connect a frequency counter to the rear-panel 10 MHz REF OUTPUT connector.
4. Select the Latch field.
5. Select `refs_DAC_coarse` under the Choices: menu.
6. Select the Value field.
7. Rotate the knob until the counter reads as close to 10 MHz as possible.
8. Select the Latch field.
9. Select `refs_DAC_fine` under the Choices: menu.
10. Select the Value field.
11. Rotate the knob until the counter reads as close to 10 MHz as possible.
12. Store the new DAC values (timebase calibration data) in non-volatile memory by selecting and running the Timebase Reference Using a Counter routine from the Periodic Calibration Menu. See "Timebase Reference Using a Counter" on page 154.
IQ Calibration Program Description

The goal of IQ Calibration is to minimize the carrier feedthrough while maximizing the Rho of the IQ signal. There are four DACs involved in this adjustment:

- buffModN_I_DC_offset_DAC,
- buffModN_Q_DC_offset_DAC,
- buffModN_signal_delta_DAC,
- genRef_IQ_quad_DAC

The I and Q dc offset DACs and the signal delta DAC are on the A2A34 Data Buffer assembly and the Quad DAC is on the A2A100 CDMA Generator Reference. These DACs can be accessed in the list of Latches on the SERVICE screen. All the DACs are initially set to 127 before starting the calibration adjustment, and the calibration is carried out at several equally spaced frequencies between 800 and 1000 MHz.

The instrument is set into a CDMA loopback mode and the calibration is carried out by first adjusting the I and Q dc offset DACs while monitoring the carrier feedthrough (CFT). Both CFT and rho are measured by the A2A36 Receive DSP. Once the CFT is minimized (through an iterative process), the signal delta and the quad DACs are adjusted while monitoring rho. When rho is maximized (again through an iterative process), the calibration adjustment is complete. At power down, each DAC setting at each frequency is downloaded to the calibration ROM on the A2A31 Controller assembly.

Figure 7-5 IQ Calibration
The Eb/No calibration is a CDMA loopback measurement. Before the Eb/No measurement begins, four preliminary measurements are made with the CDMA generator in the data mode: (1) The difference in channel power between forward and reverse modes is measured to determine the loss to be accounted for when the all-pass filter is in forward mode. (2) Rho is measured in both the forward and reverse paths. (3) The time offset is measured and its value entered. (4) Fast power is measured to assure that the signal is “noiseless.”

The generator is then set to the Eb/No mode at values of 7, 10, 12, 14, 16, 18, and 20 dB, and one hundred measurements of fast power are made at each value. (This takes several minutes to complete.) The measured data is then processed and converted into calibration factors.
8 Performance Tests

This chapter contains the performance test procedures for the Test Set. The tests in this chapter verify that the Test Set performs to its published specifications.
Procedure and Equipment

How to Use the Performance Tests

- Run the Performance Tests in table 8-2, "Performance Tests & Records Location" on page 164 using the specified Test Equipment from table 8-1, "Required Test Equipment by Model" on page 163.

- Compare and record the data for each test onto the applicable Performance Test Record (PTR). Table 8-2 on page 164 shows the page number of the PTR associated with each performance test.

Test Set Operation

To perform the following performance test procedures you need to know basic Test Set operation. You should be familiar with the front panel, the various display screens, and knob operation (cursor control). You should be able to operate the Test Set's RF generator, RF analyzer, AF generators, AF analyzer, spectrum analyzer, and oscilloscope.

NOTE

Press Preset on the Test Set before beginning each test.

Test Equipment and Operation

The test equipment shown in table 8-1, "Required Test Equipment by Model" on page 163 is needed to do all of the performance tests. Usually, a setup drawing at the beginning of each test procedure shows the equipment and hook-up needed for that particular test. Generic names are used for the test equipment shown in the setup drawings.

To find alternatives to the equipment listed in table 8-1, look up their specifications in the Hewlett-Packard Test and Measurement Catalog and use the specifications to find equivalent instruments.

The test procedures give critical instrument settings and connections, but they don't tell how to operate the instruments. Refer to each instrument's operating manual.
### Performance Tests

#### Procedure and Equipment

#### Table 8-1 Required Test Equipment by Model

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Model Name</th>
<th>Test Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>HP 11715A</td>
<td>AM/FM Test Source</td>
<td>20-23</td>
</tr>
<tr>
<td>Mini-Circuits ZFL-2000 or equivalent&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Amplifier 1</td>
<td>5</td>
</tr>
<tr>
<td>GTC RF Products GRF 5016 or equivalent&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Amplifier 2</td>
<td>27, 28</td>
</tr>
<tr>
<td>HP 8903B</td>
<td>Audio Analyzer</td>
<td>4, 10, 12, 16, 18, 20-22</td>
</tr>
<tr>
<td>HP 5316A</td>
<td>Counter</td>
<td>11, 16</td>
</tr>
<tr>
<td>HP 8902A</td>
<td>Measuring Receiver</td>
<td>1-5, 17, 19-22, 25, 27, 28</td>
</tr>
<tr>
<td>HP 11793A</td>
<td>Microwave Converter</td>
<td>1-5, 25</td>
</tr>
<tr>
<td>HP 3458A</td>
<td>Multimeter</td>
<td>8-9, 12, 15, 18</td>
</tr>
<tr>
<td>HP 11687A</td>
<td>Power Splitter</td>
<td>19, 27, 28</td>
</tr>
<tr>
<td>HP 11722A</td>
<td>Sensor Module</td>
<td>5, 19, 25, 27, 28</td>
</tr>
<tr>
<td>HP ESG-2000A A</td>
<td>Signal Generator</td>
<td>1-5, 19, 24, 25, 27, 28</td>
</tr>
<tr>
<td>HP 8644B</td>
<td>Signal Generator (High Performance)</td>
<td>4</td>
</tr>
<tr>
<td>HP 8562A</td>
<td>Spectrum Analyzer</td>
<td>6-7</td>
</tr>
<tr>
<td>HP E6380-61811</td>
<td>System Power Calibration Program Software Kit</td>
<td>19</td>
</tr>
<tr>
<td>HP 89441A with options AYA, AY9, UFG</td>
<td>Vector Signal Analyzer</td>
<td>26, 29</td>
</tr>
</tbody>
</table>

---

<sup>a</sup> Required amplifier specifications are frequency range 1.7 to 2.0 GHz, gain >18 dB, noise figure <5 dB. For more information about Mini-Circuits, contact them at (718) 934-4500 or http://www.minicircuits.com.

<sup>b</sup> Required amplifier specifications are frequency range 1.0 to 2.0 GHz, gain of 43 dB, output power of +20 dBm. For more information about GTC, contact them at (310) 673-8422 or GTC@primenet.com
### Table 8-2 Performance Tests & Records Location

<table>
<thead>
<tr>
<th>Performance Test (in this chapter)</th>
<th>Test Record in Chapter 9, “Performance Test Records.”</th>
</tr>
</thead>
<tbody>
<tr>
<td>“RF Generator FM Distortion Performance Test 1” on page 166</td>
<td>page 220</td>
</tr>
<tr>
<td>“RF Generator FM Accuracy Performance Test 2” on page 168</td>
<td>page 222</td>
</tr>
<tr>
<td>“RF Generator FM Flatness Performance Test 3” on page 170</td>
<td>page 224</td>
</tr>
<tr>
<td>“RF Generator Residual FM Performance Test 4” on page 172</td>
<td>page 226</td>
</tr>
<tr>
<td>“RF Generator Level Accuracy Performance Test 5” on page 176</td>
<td>page 228</td>
</tr>
<tr>
<td>“RF Generator Harmonics Spectral Purity Performance Test 6” on page 181</td>
<td>page 236</td>
</tr>
<tr>
<td>“RF Generator Spurious Spectral Purity Performance Test 7” on page 182</td>
<td>page 239</td>
</tr>
<tr>
<td>“AF Generator AC Level Accuracy Performance Test 8” on page 183</td>
<td>page 241</td>
</tr>
<tr>
<td>“AF Generator DC Level Accuracy Performance Test 9” on page 184</td>
<td>page 243</td>
</tr>
<tr>
<td>“AF Generator Residual Distortion Performance Test 10” on page 185</td>
<td>page 244</td>
</tr>
<tr>
<td>“AF Generator Frequency Accuracy Performance Test 11” on page 186</td>
<td>page 246</td>
</tr>
<tr>
<td>“AF Analyzer AC Level Accuracy Performance Test 12” on page 187</td>
<td>page 247</td>
</tr>
<tr>
<td>“AF Analyzer Residual Noise Performance Test 13” on page 188</td>
<td>page 248</td>
</tr>
<tr>
<td>“AF Analyzer Distortion and SINAD Accuracy Performance Test 14” on page 189</td>
<td>page 249</td>
</tr>
<tr>
<td>“AF Analyzer DC Level Accuracy Performance Test 15” on page 190</td>
<td>page 250</td>
</tr>
<tr>
<td>“AF Analyzer Frequency Accuracy to 100 kHz Performance Test 16” on page 191</td>
<td>page 251</td>
</tr>
<tr>
<td>“AF Analyzer Frequency Accuracy at 400 kHz Performance Test 17” on page 192</td>
<td>page 252</td>
</tr>
<tr>
<td>“Oscilloscope Amplitude Accuracy Performance Test 18” on page 193</td>
<td>page 253</td>
</tr>
<tr>
<td>“RF Analyzer Level Accuracy Performance Test 19” on page 195</td>
<td>page 254</td>
</tr>
<tr>
<td>“RF Analyzer FM Accuracy Performance Test 20” on page 196</td>
<td>page 256</td>
</tr>
<tr>
<td>“RF Analyzer FM Distortion Performance Test 21” on page 198</td>
<td>page 257</td>
</tr>
<tr>
<td>“RF Analyzer FM Bandwidth Performance Test 22” on page 200</td>
<td>page 258</td>
</tr>
<tr>
<td>“RF Analyzer Residual FM Performance Test 23” on page 203</td>
<td>page 259</td>
</tr>
<tr>
<td>“Spectrum Analyzer Image Rejection Performance Test 24” on page 204</td>
<td>page 260</td>
</tr>
<tr>
<td>“CDMA Generator RF In/Out Amplitude Level Accuracy Performance Test 25” on page 207</td>
<td>page 261</td>
</tr>
<tr>
<td>“CDMA Generator Modulation Accuracy Performance Test 26” on page 211</td>
<td>page 263</td>
</tr>
</tbody>
</table>
### Performance Test (in this chapter)

<table>
<thead>
<tr>
<th>Performance Test</th>
<th>Test Record in Chapter 9, “Performance Test Records.”</th>
</tr>
</thead>
<tbody>
<tr>
<td>“CDMA Analyzer Average Power Level Accuracy Performance Test 27” on page 213.</td>
<td>page 264</td>
</tr>
<tr>
<td>“CDMA Analyzer Channel Power Level Accuracy Performance Test 28” on page 214.</td>
<td>page 265</td>
</tr>
<tr>
<td>“CDMA Analyzer Modulation Accuracy Performance Test 29” on page 216.</td>
<td>page 266</td>
</tr>
</tbody>
</table>
RF Generator FM Distortion
Performance Test 1

The purpose of this test is to verify that the Test Set’s RF generator FM distortion performance meets the specification limits in PTR (Performance Test Record) table 9-1, "RF Generator FM Distortion Test 1 Record" on page 220. The FM distortion of the RF generator is measured directly by the measuring receiver. The Test Set’s internal audio generator provides the modulation source.

NOTE
Two setups are shown below. The first setup can measure signals to 1 GHz. Since the FM generator in the Test Set translates FM in the lower band directly into the 1.7 to 2 GHz range, testing to 1 GHz is adequate when verifying a repair. The second setup has a microwave converter which covers the full measurement range of FM signals to 2 GHz.

Initial Setup

Figure 8-1  Setup for Measurements to 1 GHz

Figure 8-2  Setup for Measurements to 2 GHz Using a Microwave Converter
Procedure

Steps 1, 2, and 3 in the following procedure apply to both of the setups (shown in figure 8-1 and figure 8-2 on page 166).

1. On the measuring receiver:
   a. Reset the instrument.
   b. Set the high-pass filter to 300 Hz.
   c. Set the low-pass filter to 3 kHz.
   d. Set the measurement mode to FM.
   e. Set the measurement mode to audio distortion.
   f. If the microwave converter is being used, set the frequency offset mode to exit the mode (27.0 Special).

2. On the Test Set:
   a. Press *Preset*.
   b. Select the INSTRUMENT CONFIGURE screen.
   c. Set the RF Display field to *Freq*.
   d. Select the CDMA GENERATOR screen.
   e. Set the CW RF Path field to *Bypass*.
   f. Select the RF GENERATOR screen.
   g. Set the RF Gen Freq to 10 MHz.
   h. Set the Amplitude to -10 dBm.
   i. Set the AFGen1 To field to FM at 99 kHz deviation with the FM set to On.

3. For frequencies up to 1000 MHz measure the FM distortion (audio distortion) at the RF frequencies and deviations shown in the Performance Test Record (PTR) and compare the measured distortion to the limits.

   **The following steps are for measurements to 2 GHz.**

4. On the signal generator:
   a. Set the frequency to 1500 MHz CW.
   b. Set the level to +8 dBm or whatever level is suitable for the microwave converter’s LO input.

5. On the measuring receiver:
   a. Set the frequency offset mode to enter and enable the LO frequency (27.3 Special).
   b. Key in the LO frequency (in MHz) which is 1500.

6. On the Test Set, for frequencies of 1700 and 2000 MHz, measure the FM distortion at the deviations shown in the PTR and compare the measured distortion to the limits.
RF Generator FM Accuracy
Performance Test 2

The FM accuracy of the RF generator is measured directly by the measuring receiver. The Test Set’s internal audio generator provides the modulation source.

**NOTE**

Two setups are shown below. The first setup can measure signals to 1 GHz. Since the FM generator in the Test Set translates FM in the lower band directly into the 1.7 to 2 GHz range, testing to 1 GHz is adequate when verifying a repair. The second setup has a microwave converter which covers the full measurement range of FM signals to 2 GHz.

**Initial Setup**

**Figure 8-3** Setup for Measurements to 1 GHz

**Figure 8-4** Setup for Measurements to 2 GHz Using a Microwave Converter
Procedure

Steps 1, 2, and 3 in the following procedure apply to both of the setups (shown in figure 8-3 and figure 8-4 on page 168).

1. On the measuring receiver:
   a. Reset the instrument.
   b. Set the high-pass filter to 300 Hz.
   c. Set the low-pass filter to 3 kHz.
   d. Set the measurement mode to FM.
   e. Set the FM de-emphasis off.
   f. If the microwave converter is being used, set the frequency offset mode to exit the mode (27.0 Special).

2. On the Test Set:
   a. Press Preset.
   b. Select the INSTRUMENT CONFIGURE screen.
   c. Set the RF Display field to Freq.
   d. Select the CDMA GENERATOR screen.
   e. Set the CW RF Path field to Bypass.
   f. Select the RF GENERATOR screen.
   g. Set the RF Gen Freq to 10 MHz.
   h. Set the Amplitude to -10 dBm.
   i. Set the AFGen1 To field to FM at 99 kHz deviation with the FM set to On.

3. For frequencies up to 1000 MHz measure the FM deviation at the RF frequencies and deviations shown in the Performance Test Record (PTR) and compare the measured deviation to the limits.

   The following steps are for measurements to 2 GHz.

4. On the signal generator:
   a. Set the frequency to 1500 MHz CW.
   b. Set the level to +8 dBm or whatever level is suitable for the microwave converter’s LO input.

5. On the measuring receiver:
   a. Set the frequency offset mode to enter and enable the LO frequency (27.3 Special).
   b. Key in the LO frequency (in MHz) which is 1500.

6. On the Test Set, for frequencies of 1700 and 2000 MHz, measure the FM at the deviations shown in the PTR and compare the measured deviation to the limits.
RF Generator FM Flatness Performance Test 3

The FM flatness of the RF generator is measured directly by the measuring receiver. The Test Set's internal audio generator provides the modulation source.

NOTE

Two setups are shown below. The first setup can measure signals to 1 GHz. Since the FM generator in the Test Set translates FM in the lower band directly into the 1.7 to 2 GHz range, testing to 1 GHz is adequate when verifying a repair. The second setup has a microwave converter which covers the full measurement range of FM signals to 2 GHz.

Initial Setup

**Figure 8-5** Setup for Measurements to 1 GHz

**Figure 8-6** Setup for Measurements to 2 GHz Using a Microwave Converter
Procedure

Steps 1, 2, and 3 in the following procedure apply to both of the setups (shown in figure 8-5 and figure 8-6 on page 170).

1. On the measuring receiver:
   a. Reset the instrument.
   b. Set the measurement mode to FM.
   c. If the microwave converter is being used, set the frequency offset mode to exit the mode (27.0 Special).

2. On the Test Set:
   a. Press Preset.
   b. Select the INSTRUMENT CONFIGURE screen.
   c. Set the RF Display field to Freq.
   d. Select the CDMA GENERATOR screen.
   e. Set the CW RF Path field to Bypass.
   f. Select the RF GENERATOR screen.
   g. Set the RF Gen Freq to 512 MHz.
   h. Set the Amplitude to -10 dBm.
   i. Set the AFGen1 To field to FM at 50 kHz deviation with the FM set to On.

3. For frequencies up to 1000 MHz measure the FM deviation at the RF frequencies and rates shown in the Performance Test Record (PTR). Convert the measurement results to dB referenced to the deviation measured at 1 kHz using the following formula and compare the calculated deviation to the limits in the PTR.

   \[
   dB = 20 \cdot \log\left(\frac{\text{Deviation}}{\text{Deviation at 1 kHz}}\right)
   \]

   The following steps are for measurements to 2 GHz.

4. On the signal generator:
   a. Set the frequency to 1500 MHz CW.
   b. Set the level to +8 dBm or whatever level is suitable for the microwave converter’s LO input.

5. On the measuring receiver:
   a. Set the frequency offset mode to enter and enable the LO frequency (27.3 Special).
   b. Key in the LO frequency (in MHz) which is 1500.

6. On the Test Set, for frequencies of 1700 and 2000 MHz, measure the FM deviation at the rates shown in the PTR. Convert the measurement results as was done in step 3 and compare the calculated deviation to the limits.
RF Generator Residual FM Performance Test 4

The residual FM of the RF generator is measured directly by the measuring receiver. An external LO is used to improve the residual FM of the measuring receiver. An audio analyzer with a CCITT psophometric filter is required to measure the demodulated FM.

NOTE
Two setups are shown below and on the following page. The first setup is capable of measuring signals to 1 GHz. The second setup has a microwave converter which covers the full measurement range of FM signals to 2 GHz. The microwave converter’s LO must be a low residual FM synthesizer.
Initial Setup

**Figure 8-7** Setup for Measurements to 1 GHz

**Figure 8-8** Setup for Measurements to 2 GHz Using a Microwave Converter
Procedure

Steps 1 to 5 in the following procedure apply to both setups (shown in figure 8-7 and figure 8-8 on page 173).

1. On the signal generator (to be used as the measuring receiver’s LO):
   a. Set the frequency to 11.5 MHz.
   b. Set the level to 0 dBm.

2. On the measuring receiver:
   a. Reset the instrument.
   b. Set the IF to 1.5 MHz (3.2 Special).
   c. Set the high-pass filter to 50 Hz.
   d. Set the low-pass filter to 15 kHz.
   e. Set the measurement mode to FM.
   f. If the instrument has an external LO switch, enable the external LO mode (23.1 Special).
   g. If the microwave converter is being used, set the frequency offset mode to exit the mode (27.0 Special).

3. On the audio analyzer:
   a. Reset the instrument.
   b. Set the measurement mode to AC level.
   c. Select the CCITT Weighting filter.
   d. Set the low-pass filter to 30 kHz.

4. On the Test Set:
   a. Press Preset.
   b. Select the INSTRUMENT CONFIGURE screen.
   c. Set the RF Display field to Freq.
   d. Select the CDMA GENERATOR screen.
   e. Set the CW RF Path field to Bypass.
   f. Select the RF GENERATOR screen.
   g. Set the RF Gen Freq to 10 MHz.
   h. Set the Amplitude to −10 dBm.

5. For frequencies up to 1000 MHz and for each line in the Performance Test Record (PTR) do the following:
   a. Set the signal generator (used as an LO for the measuring receiver) to the LO frequency shown in the PTR.
   b. Set the Test Set to the RF frequencies shown in the PTR.
   c. Measure the ac level (in mV) on the audio analyzer.
   d. Multiply the measured ac levels by 1000 to convert them to FM deviation in Hz and compare the computed results to the limits shown in the PTR.
The following steps are for measurements to 2 GHz.

6. On the signal generator:
   a. Set the frequency to 1500 MHz CW for 1700 MHz, 1800 MHz CW for 2000 MHz.
   b. Set the level to +8 dBm or whatever level is suitable for the microwave converter’s LO input.

7. On the measuring receiver:
   a. Set the frequency offset mode to enter and enable the LO frequency (27.3 Special).
   b. Key in the LO frequency (in MHz) which is 1500 MHz.

8. On the Test Set, for frequencies of 1700 and 2000 MHz, continue on as in step 5.
RF Generator Level Accuracy Performance Test 5

Using a measuring receiver and sensor module, at several frequencies up to 1 GHz, the Test Set is set to generate levels between \(-10\) and \(125\) dBm (in 5 dB steps) at its DUPLEX OUT connector. The level is measured with the tuned RF level feature of the measuring receiver. At each frequency the measuring receiver connection is moved to the RF IN/OUT and the level measured from -40 to \(-125\) dBm. As the test proceeds you may be required to recalibrate the measuring receiver.

To extend the measurement frequency to 2 GHz the second method uses a microwave converter and amplifier to extend the measurement range (see figure 8-10 on page 178).

Setup 1

Figure 8-9    Setup 1 for Measurements to 1 GHz
Procedure 1

Steps 1 to 5 in the following procedure apply to Setup 1 shown in figure 8-9 on page 176.

1. Before connecting the test set to the measuring receiver:
   a. Reset the instrument.
   b. Zero and calibrate the sensor module.

   **NOTE**
   Make sure the sensor module’s calibration data is entered into the measuring receiver.

2. Connect the equipment as shown in Setup 1 whether intending to measure frequencies to 1 GHz or 2 GHz.

3. On the measuring receiver:
   a. Set the measurement mode to RF Power.
   b. Set the display to log.

4. On the Test Set:
   a. Press **Preset**.
   b. Select the INSTRUMENT CONFIGURE screen.
   c. Set the **RF Display** field to **Freq**.
   d. Select the CDMA GENERATOR screen.
   e. Set the **CW RF Path** field to **Bypass**.
   f. Select the RF GENERATOR screen.
   g. Set the **RF Gen Freq** to 3 MHz.
   h. Set the **Amplitude** to −10 dBM.

5. For each frequency in the Performance Test Record (PTR) do the following:
   a. Set the measuring receiver to measure frequency.
   b. Set the Test Set level to −10 dBM.
   c. After the measuring receiver has acquired the signal, set the measuring receiver to measure tuned RF level.
   d. Measure the RF level at the levels shown in the PTR at the Test Set's **DUPLEX OUT** port and compare the measured RF level to the limits. If the measuring receiver displays the need to recalibrate, press the CALIBRATE key and wait for calibration to be completed.
   e. Move the sensor module to the Test Set's **RF IN/OUT** port.
   f. On the Test Set set the **Output Port** field to **RF Out** and repeat the measurements for the levels shown in the PTR and compare the measured RF level to the limits.
   g. Move the sensor module back to the Test Set's **DUPLEX OUT** port and set the **Output Port** to **Dupl**.
Setup 2

Figure 8-10 Setup 2 for Measurements of 1700 and 2000 MHz
Procedure 2

Steps 1 to 5 in the following procedure apply to Setup 1 shown in figure 8-9 on page 176.

1. Connect the sensor module on the measuring receiver to the DUPLEX OUT port of the Test Set.

2. On the Test Set:
   a. Set the Amplitude to -10 dBm.
   b. Set the RF Gen Freq to 1700 MHz.

3. On the measuring receiver:
   a. Set the measurement mode to RF power.
   b. Key in 1700 MHz.
   c. Measure and record the RF power at the DUPLEX OUT port.

4. On the Test Set set the RF Gen Freq to 2000 MHz.

5. On the measuring receiver:
   a. Key in 2000 MHz.
   b. Measure and record the RF power at the DUPLEX OUT port.

Steps 6 to 8 apply to Setup 2 shown in figure 8-10 on page 178.

6. Make the connections shown in Setup 2.

7. On the signal generator set the level to +8 dBm or whatever level is suitable for the microwave converter’s LO input.

8. For frequencies of 1700 and 2000 MHz perform the following:
   a. On the signal generator set the frequency to 1900 MHz CW and 2200 MHz CW respectively.
   b. Reset the measuring receiver.
   c. On the measuring receiver set the frequency offset mode to enter and enable the LO frequency (27.3 Special) then key in the signal generator (LO) frequency (in MHz) which is 1900 or 2200 MHz respectively.
   d. On the measuring receiver set the measurement mode to tuned RF level and the measurement units to dBm then press SET REF.
   e. Measure and record the RF level at the levels down to and including -80 dBm shown in the PTR at the Test Set's DUPLEX OUT port. If the measuring receiver displays the need to recalibrate, press the CALIBRATE key and wait for calibration to be completed.
   f. After recording the reading at -80 dBm insert an RF amplifier into the output of the Test Set.
   g. Record the new measured level at -80 dBm.
h. Continue measuring the level down to -125 dBm.

i. Move the input to the microwave converter to the RF IN/OUT port without the amplifier inserted.

j. Measure and record the RF level at the levels down to and including -80 dBm shown in the PTR at the Test Set’s RF IN/OUT port.

k. After recording the reading at -80 dBm insert an RF amplifier into the output of the Test Set.

l. Record the new measured level at -80 dBm.

m. Continue measuring the level down to -125 dBm.

n. Correct the measured reading for each level measured without the amplifier as follows: Add the RF power measured in step 3c or 5b to the measured level. (For example, if the level in step 3c is -10.2 dBm and the level at -55 dBm is -45.1 dB, record a level of -10.2 + (-45.1) = 55.3 dBm.) Compare the corrected values with the limits in the PTR.

o. Correct the measured reading for each level measured with the amplifier by summing the following values:

   + RF power measured at -10 dBm in step 3c or 5b
   + RF level measured at -80 dBm in step 8i
   – RF level measured at -80 dBm in step 8j
   + RF level measured in step 8k

For example, if:

RF power measured at -10 dBm in step 3b or 5b = -10.2 dBm
RF level measured at -80 dBm in step 8i = -70.1 dB
RF level measured at -80 dBm in step 8j = -52.6 dB
RF level measured at -100 dBm in step 8k = -73.2 dB

the corrected level at -100 dBm is -10.2 + (-70.1) – (-52.6) + (-73.2) = 100.9 dBm. Compare the corrected values with the limits in the PTR.
RF Generator Harmonics Spectral Purity Performance Test 6

Harmonic signals with the carrier set to several frequencies and two different levels (maximum output and minimum level vernier) are searched for by an RF spectrum analyzer.

Setup

Figure 8-11

Spectrum Analyzer

Procedure

1. Set up the spectrum analyzer in accordance with its operating manual.

2. On the Test Set:
   a. Press Preset.
   b. Select the INSTRUMENT CONFIGURE screen.
   c. Set the RF Display field to Freq.
   d. Select the CDMA GENERATOR screen.
   e. Set the CW RF Path field to Bypass.
   f. Select the RF GENERATOR screen.
   g. Set the RF Gen Freq to 1 MHz.
   h. Set the Amplitude to -10 dBm.

3. Set the test set’s RF generator to the frequencies and levels shown in the Performance Test Record (PTR) and measure the second and third harmonics. For each measurement convert the harmonic level to dB below the fundamental (dBc) and compare the computed levels to the limits.
RF Generator Spurious Spectral Purity Performance Test 7

Spurious signals with the carrier set to several frequencies and two different levels (maximum output and minimum level vernier) are searched for by an RF spectrum analyzer.

Setup

Figure 8-12

![Spectrum Analyzer](image)

Procedure

1. Set up the spectrum analyzer in accordance with its operating manual.
2. On the Test Set:
   a. Press *Preset*.
   b. Select the INSTRUMENT CONFIGURE screen.
   c. Set the *RF Display* field to *Freq*.
   d. Select the CDMA GENERATOR screen.
   e. Set the *CW RF Path* field to *Bypass*.
   f. Select the RF GENERATOR screen.
   g. Set the *RF Gen Freq* to 242 MHz.
   h. Set the *Amplitude* to −10 dBm.
3. Set the test set’s RF generator to the frequencies and levels shown in the Performance Test Record (PTR) and measure the level of the spurious signals at the frequencies shown. For each measurement convert the harmonic level to dB below the fundamental (dBc) and compare the computed levels to the limits.
AF Generator AC Level Accuracy Performance Test 8

There are two audio generators. AC level accuracy is measured directly with a digital multimeter.

Setup

Figure 8-13

Procedure

1. Set the multimeter to measure AC volts.
2. On the Test Set:
   a. Press Preset.
   b. Select the RF GENERATOR screen.
   c. Set the AFGen1 To and AFGen2 To fields to Audio Out.
3. On the Test Set for Audio Frequency Generator 1 do the following:
   a. Set the AFGen2 To level field to Off.
   b. Set the audio frequency and level as shown in the Performance Test Record (PTR) and measure the AC level. Compare the measured voltage to the limits.
4. On the Test Set for Audio Frequency Generator 2 do the following:
   a. Set the AFGen1 To level field to Off and AFGen1 To level field to On.
   b. Set the audio frequency and level as shown in the PTR and measure the AC level. Compare the measured voltage to the limits.
AF Generator DC Level Accuracy Performance Test 9

There are two DC generators. DC level accuracy is measured directly with a digital multimeter.

Setup

Figure 8-14

Procedure

1. Set the multimeter to measure DC volts.
2. On the Test Set:
   a. Press **Preset**.
   b. Select the RF GENERATOR screen.
   c. Set the **AFGen1 To** and **AFGen2 To** fields to **Audio Out**.
   d. Set the **AFGen1 Freq** and **AFGen2 Freq** fields to **0.0 Hz**.
   e. Set the **Audio Out** field to **DC**.
3. On the Test Set for Audio Frequency Generator 1 do the following:
   a. Set the **AFGen2 To** level field to **Off**.
   b. Set the audio frequency and level as shown in the Performance Test Record (PTR) and measure the DC level. Compare the measured voltage to the limits.
4. On the Test Set for Audio Frequency Generator 2 do the following:
   a. Set the **AFGen1 To** level field to **Off** and **AFGen1 To** level field to on.
   b. Set the audio frequency and level as shown in the PTR and measure the DC level. Compare the measured voltage to the limits.
AF Generator Residual Distortion
Performance Test 10

Audio distortion is measured directly with an audio analyzer.

Setup

Figure 8-15

Procedure

1. On the audio analyzer:
   a. Reset the instrument.
   b. Select the 80 kHz low-pass filter.
   c. Set the measurement mode to distortion.

2. On the Test Set:
   a. Press Preset.
   b. Select the RF GENERATOR screen.
   c. Set the AFGen1 To and AFGen2 To fields to Audio Out.

3. On the Test Set for Audio Frequency Generator 1 do the following:
   a. Set the AFGen2 To level field to Off.
   b. Set the audio frequency and level as shown in the Performance Test Record (PTR) and measure the audio distortion. Compare the measured distortion to the limits.

4. On the Test Set for Audio Frequency Generator 2 do the following:
   a. Set the AFGen1 To level field to Off and AFGen1 To level field to on.
   b. Set the audio frequency and level as shown in the PTR and measure the audio distortion. Compare the measured distortion to the limits.
AF Generator Frequency Accuracy
Performance Test 11

Frequency accuracy is measured directly with a frequency counter. The counter must be able to resolve 0.005% at 20 Hz.

Setup

Procedure

1. Set the counter to measure frequency.

2. On the Test Set:
   a. Press Preset.
   b. Select the RF GENERATOR screen.
   c. Set the AFGen1 To and AFGen2 To fields to Audio Out.

3. On the Test Set for Audio Frequency Generator 1 do the following:
   a. Set the AFGen2 To level field to Off.
   b. Set the audio frequency and level as shown in the Performance Test Record (PTR) and measure the audio frequency. Compare the measured frequency to the limits.

4. On the Test Set for Audio Frequency Generator 2 do the following:
   a. Set the AFGen1 To level field to Off and AFGen1 To level field to on.
   b. Set the audio frequency and level as shown in the PTR and measure the audio frequency. Compare the measured frequency to the limits.
AF Analyzer AC Level Accuracy Performance Test 12

To measure AC voltage accuracy, an AC signal is measured by an external multimeter and compared to the Test Set’s internal AC voltmeter reading.

Setup

Figure 8-17

Procedure

1. Set the digital multimeter to measure AC volts.
2. On the Test Set:
   a. Press Preset.
   b. Select the AF ANALYZER screen.
   c. Set the AF Anl In field to Audio In.
   d. Set the Filter 2 field to >99kHz LPF.
   e. Set the Audio In Lo field to Gnd.
   f. Set the Detector field to RMS.
   g. Set the Settling field to Slow.
3. Set the audio analyzer’s source to the frequencies and levels shown in the Performance Test Record. (Adjust the level until the digital multimeter reads the correct level.)
4. Measure the AC level on the Test Set and compare the measured level to the limits.
AF Analyzer Residual Noise Performance Test 13

The AC level of the audio input is measured with no signal source connected.

Setup

Figure 8-18

Procedure

1. On the Test Set:
   a. Press Preset.
   b. Select the AF ANALYZER screen.
   c. Set the AF Anl In field to Audio In.
   d. Set the Filter 2 field to 15kHz LPF.
   e. Set the Audio In Lo field to Gnd.
   f. Set the Detector field to RMS.

2. Measure the AC level (residual noise) on the Test Set and compare the measured level to the limits shown in the Performance Test Record.
AF Analyzer Distortion and SINAD Accuracy Performance Test 14

A calibrated distortion source is created by summing the two internal audio generators. Levels are measured separately by the internal AC voltmeter. One source is set to a harmonic two or three times the frequency of the other. The measured distortion and SINAD is compared with the calculated value.

Setup

Figure 8-19

Procedure

1. On the Test Set:
   a. Press **Preset**.
   b. Select the AF ANALYZER screen.
   c. Set the **AF Anl In** field to **Audio In**.
   d. Set the **Audio In Lo** field to **Gnd**.
   e. Set the **Detector** field to **RMS**.
   f. Select the RF GENERATOR screen.
   g. Set the **AFGen1 To** field to **Audio Out**.
   h. Set the **AFGen1 To** level field to **1.00 V**.
   i. Set the **AFGen2 To** field to **Audio Out**.

2. For the frequency (the harmonic) and level settings of Audio Frequency Generator 2 shown in the Performance Test Record, measure the distortion and SINAD on the Test Set and compare the measured values to the limits.
AF Analyzer DC Level Accuracy Performance Test 15

To measure DC level accuracy, a DC signal is measured by an external digital multimeter and compared to the Test Set’s internal DC voltmeter reading.

**Setup**

**Figure 8-20**

**Procedure**

1. Set the multimeter to measure DC volts.
2. On the Test Set:
   a. Press **Preset**.
   b. Select the AF ANALYZER screen.
   c. Set the **AF Anl In** field to **Audio In**.
   d. Set the **Audio In Lo** field to **Gnd**.
   e. Select the RF GENERATOR screen.
   f. Set the **AFGen1 To** field to **Audio Out**.
   g. Set the **AFGen1 Freq** field to **0.0 Hz**.
   h. Set the **Audio Out** field to **DC**.
   i. Set the level of Audio Frequency Generator 1 as shown in the Performance Test Record and measure the DC level. Compare the measured voltage to the limits.
AF Analyzer Frequency Accuracy to 100 kHz
Performance Test 16

To measure frequency accuracy up to 100 kHz, an AC signal at the audio input is measured by an external frequency counter and compared to the Test Set’s internal audio frequency counter.

Setup

Figure 8-21

Procedure

1. Set the frequency counter to measure frequency.
2. On the Test Set:
   - b. Select the AF ANALYZER screen.
   - c. Set the AF Anl In field to Audio In.
   - d. Set the Filter 2 field to >99kHz LPF.
   - e. Set the Audio In Lo field to Gnd.
3. Set the audio analyzer’s source to 1 V and set the frequencies as shown in the Performance Test Record. Measure the frequency on the Test Set and compare the measured frequency to the limits.
AF Analyzer Frequency Accuracy at 400 kHz
Performance Test 17

To measure frequency accuracy at 400 kHz, the RF signal from the Test Set’s DUPLEX OUT port is applied to the audio input and the input to the measuring receiver and the two measured frequencies are compared.

Setup

Figure 8-22

Procedure

1. On the measuring receiver:
   a. Reset the instrument.
   b. Set the measurement mode to frequency.
2. On the Test Set:
   a. Press **Preset**.
   b. Select the INSTRUMENT CONFIGURE screen.
   c. Set the **RF Display** field to **Freq**.
   d. Select the CDMA GENERATOR screen.
   e. Set the **CW RF Path** field to **Bypass**.
   f. Select the RF GENERATOR screen.
   g. Set the **RF Gen Freq** to **0.4 MHz**.
   h. Set the **Amplitude** to **−21 dBm** (20 mV).
   i. Select the AF ANALYZER screen.
   j. Set the **AF Anl In** field to **Audio In**.
   k. Set the **Filter 2** field to **>99kHz LPF**.
   l. Set the **Audio In Lo** field to **Gnd**.
3. Measure the audio frequency on the measuring receiver and the Test Set and note the frequency difference. Compare the calculated difference to the limits shown in the Performance Test Record.
Oscilloscope Amplitude Accuracy Performance Test 18

A 5 V ac signal from the audio analyzer is measured by both an external multimeter and by the Test Set’s internal oscilloscope. Since the oscilloscope reads peak volts, the RMS reading of the multimeter is multiplied by the square root of two.

Setup

Figure 8-23
Procedure

1. Set the digital multimeter to measure ac volts.
2. On the Test Set:
   a. Press **Preset**.
   b. Select the AF ANALYZER screen.
   c. Set the **AF Anl In** field to **Audio In**.
   d. Set the **Filter 2** field to **>99kHz LPF**.
   e. Set the **Audio In Lo** field to **Gnd**.
   f. Select the SCOPE screen.
   g. Set the **Controls** field to **Marker** and move the cursor to the **Marker To Peak+** field.
3. Set the audio analyzer’s source to 1 kHz and 5 V and fine adjust the level until the voltmeter reads 5 V.
4. Set the frequency as shown in the Performance Test Record (PTR). For each setting, perform the following:
   a. Adjust the level until the digital multimeter reads 5 V.
   b. Set **Controls** to **Main** and adjust the **Time/Div** on the Test Set to display 2 to 3 cycles of the waveform.
   c. Set **Controls** to **Marker** and press the knob (with the cursor in the **Marker To Peak+** field) to move the marker to the peak of the waveform.
   d. Read the **Lvl** and compare the reading to the limits in the PTR.
RF Analyzer Level Accuracy
Performance Test 19

Level accuracy is measured using a system power calibration program that resides on a memory card.

Procedure

1. Obtain the memory card containing the System Power Calibration program.
2. Run the System Power Calibration as follows:
   a. Insert the memory card into the memory card slot.
   b. Select the SOFTWARE MENU screen.
   c. Set the Select Procedure Location field to Card.
   d. Set the Select Procedure Filename field to SYSPWR0.
   e. Press the Run Test key.
3. Follow the instructions as they are presented. As the power difference is displayed, write these numbers in the Performance Test Record and compare them with the limits. (If two passes are chosen, average the two sets of data.) After the acquisition of levels is complete, select No when asked if you want the calibration factors downloaded into the Test Set’s memory.

Figure 8-24
RF Analyzer FM Accuracy Performance Test 20

The AM/FM test source provides the RF signal with FM. The signal is measured both by the Test Set’s internal RF analyzer and the measuring receiver. The FM signal comes from the external audio source in the audio analyzer. The audio level is varied until the modulation is at the desired FM deviation as measured by the measuring receiver.

**NOTE**
Use the AM/FM test source output labeled FM÷32 for 12.5 MHz and the output labeled FM for 400 MHz. You can measure the frequency with the measuring receiver and adjust it with the carrier frequency tune knob, but the exact frequency is not critical.

**Setup**

Figure 8-25
Procedure

1. On the AM/FM test source, set the test mode to FM.

2. On the measuring receiver:
   a. Reset the instrument.
   b. Set the measurement mode to FM.
   c. Set the detector to RMS.

3. On the audio analyzer:
   a. Reset the instrument.
   b. Set the output frequency to 50 Hz.

4. On the Test Set:
   a. Press Preset.
   b. Select the INSTRUMENT CONFIGURE screen.
   c. Set the RF Display field to Freq.
   d. Select the CDMA GENERATOR screen.
   e. Set the CW RF Path field to Bypass.
   f. Select the RF ANALYZER screen.
   g. Set the Tune Freq to 12.5 MHz.
   h. Set the Input Port field to Ant.
   i. Set the IF Filter field to 230 kHz.
   j. Select the AF ANALYZER screen.
   k. Set the AF Anl In field to FM Demod.
   l. Set the Filter 2 field to >99kHz LP.
   m. Set the Detector field to RMS.

5. For each RF output from the AM/FM test source (12.5 MHz and 400 MHz corresponding to the FM÷32 and FM outputs) shown in the Performance Test Record (PTR), do the following:
   a. Set the audio analyzer’s frequency (rate) as shown in the PTR.
   b. Adjust the audio analyzer’s level until the measuring receiver reads the FM deviation shown in the PTR.
   c. Read the FM deviation on the Test Set and compare the results to the limits shown in the PTR.
RF Analyzer FM Distortion
Performance Test 21

An audio signal from the audio analyzer provides FM for the AM/FM test source. The AM/FM test source provides an RF signal (with FM) to the Test Set’s internal RF analyzer. The measuring receiver is used to monitor FM deviation as the level of the audio signal from the audio analyzer is varied. The audio analyzer then measures distortion introduced by the Test Set.

Setup

Figure 8-26

Audio Analyzer

AM/FM Test Source

Measuring Receiver
Procedure

1. On the AM/FM test source, set the test mode to FM.

2. On the measuring receiver:
   a. Reset the instrument.
   b. Set the measurement mode to FM.
   c. Set the high-pass filter to 300 Hz.
   d. Set the low-pass filter to 3 kHz.

3. On the audio analyzer:
   a. Reset the instrument.
   b. Set the output frequency to 1 kHz.
   c. Set the measurement mode to distortion.

4. On the Test Set:
   a. Press \texttt{Preset}.
   b. Select the INSTRUMENT CONFIGURE screen.
   c. Set the \texttt{RF Display} field to \texttt{Freq}.
   d. Select the CDMA GENERATOR screen.
   e. Set the \texttt{CW RF Path} field to \texttt{Bypass}.
   f. Select the RF ANALYZER screen.
   g. Set the \texttt{Tune Freq} to \texttt{400 MHz}.
   h. Set the \texttt{Input Port} field to \texttt{Ant}.
   i. Set the \texttt{IF Filter} field to \texttt{230 kHz}.
   j. Select the AF ANALYZER screen.
   k. Set the \texttt{AF Anl In} field to \texttt{FM Demod}.
   l. Set the \texttt{Filter 1} field to \texttt{300Hz HPF}.
   m. Set the \texttt{Filter 2} field to \texttt{3kHz LPF}.
   n. Set the \texttt{Detector} field to \texttt{Pk+}.

5. For each FM deviation setting shown in the Performance Test Record (PTR) do the following:
   a. Adjust the audio analyzer’s level until the measuring receiver reads the FM deviation shown in the PTR.
   b. Read the distortion on the audio analyzer and compare the results to the limits shown in the PTR.
RF Analyzer FM Bandwidth Performance Test 22

An audio signal from the audio analyzer provides FM for the AM/FM test source. The AM/FM test source provides an RF signal (with FM) to the Test Set’s internal RF analyzer. The measuring receiver is used to monitor FM deviation as the level of the audio signal from the audio analyzer is varied. The audio rate is varied in several steps from 20 Hz to 70 kHz. The difference between the maximum and minimum FM peak deviation is noted.

Setup

Figure 8-27
Procedure

1. On the AM/FM test source, set the test mode to FM.

2. On the measuring receiver:
   a. Reset the instrument.
   b. Set the measurement mode to FM.
   c. Set the all filters off.

3. On the audio analyzer:
   a. Reset the instrument.
   b. Set the output frequency to 1 kHz.

4. On the Test Set:
   a. Press *Preset*.
   b. Select the INSTRUMENT CONFIGURE screen.
   c. Set the *RF Display* field to *Freq*.
   d. Select the CDMA GENERATOR screen.
   e. Set the *CW RF Path* field to *Bypass*.
   f. Select the RF ANALYZER screen.
   g. Set the *Tune Freq* to 400 MHz.
   h. Set the *Input Port* field to *Ant*.
   i. Set the *IF Filter* field to 230 kHz.
   j. Set the *Squelch* field to *Open*.
   k. Select the AF ANALYZER screen.
   l. Set the *AF Anl In* field to *FM Demod*.
   m. Set the *Filter 2* field to >99kHz LP.
   n. Set the *Detector* field to *Pk+*. 
Performance Tests
RF Analyzer FM Bandwidth Performance Test 22

5. Set the audio analyzer to the following frequencies: 20 Hz, 100 Hz, 1 kHz, 10 kHz, 35 kHz, and 70 kHz. For each frequency adjust the audio analyzer’s level until the measuring receiver reads 25 kHz FM deviation and record the deviation read on the Test Set.

6. Of the FM deviations measured by the Test Set find the maximum and minimum deviations and make the following calculation:

\[ dB = 20 \cdot \log \left( \frac{\text{Maximum Deviation}}{\text{Minimum Deviation}} \right) \]

Record the dB difference in the Performance Test Record and compare it with the limits shown.
RF Analyzer Residual FM
Performance Test 23

The AM/FM test source provides a CW signal with minimal residual FM. The FM is measured by the Test Set’s internal RF analyzer.

Setup

Figure 8-28

Procedure

1. On the AM/FM test source, set the test mode to residual FM.
2. On the Test Set:
   a. Press Preset.
   b. Select the INSTRUMENT CONFIGURE screen.
   c. Set the RF Display field to Freq.
   d. Select the CDMA GENERATOR screen.
   e. Set the CW RF Path field to Bypass.
   f. Select the RF ANALYZER screen.
   g. Set the Tune Freq to 560 MHz.
   h. Set the Input Port field to Ant.
   i. Set the IF Filter field to 230 kHz.
   j. Select the AF ANALYZER screen.
   k. Set the AF Anl In field to FM Demod.
   l. Set the Filter 1 field to 300Hz HPF.
   m. Set the Filter 2 field to 3kHz LPF.
   n. Set the Detector field to RMS.
3. Read the FM deviation (residual FM) and record the deviation read on the Test Set in the Performance Test Record and compare it to the limits.
Spectrum Analyzer Image Rejection Performance Test 24

This test has two procedures. The first procedure measures the spectrum analyzer’s ability to reject image frequencies. The spectrum analyzer is tuned to a signal frequency while an image signal from the signal generator is applied to the antenna input port.

The second procedure measures the spectrum analyzer’s residual response at several frequencies.

Setup

Figure 8-29 Spectrum Analyzer Image Rejection Test 24
Procedure 1

1. On the signal generator:
   a. Set the level to -20 dBm.
   b. Set the frequency to 613.6 MHz.
   c. Set modulation off.

2. On the Test Set:
   a. Press Preset.
   b. Select the INSTRUMENT CONFIGURE screen.
   c. Set the RF Display field to Freq.
   d. Select the CDMA GENERATOR screen.
   e. Set the CW RF Path field to Bypass.
   f. Select the SPEC ANL screen.
   g. Set the RF In/Ant field to Ant.
   h. Set the Ref Level field to -25 dBm.
   i. Set the Span field to 5 kHz.
   j. Set the Controls field to Marker.
   k. Set the Marker To field to Center Freq.
   l. Set the Controls field back to Main.

3. Set the signal generator’s frequency and the Test Set’s spectrum analyzer center frequency as shown in the Performance Test Record (PTR) and read the image response on the spectrum analyzer. The image response is the spectrum analyzer’s marker level (in dBm) minus the signal generator’s output level (minus -20 dBm). (In other words, add 20 dB to the marker level.) Compare the results to the limits.
Performance Tests

Spectrum Analyzer Image Rejection Performance Test 24

Procedure 2

1. Disconnect the signal generator from the Test Set.

2. On the Test Set:
   a. Set the Controls field to Auxiliary.
   b. Set the Input Attenuation field to Hold at 0 dB.
   c. Set the Controls field back to Marker.
   d. Set the Marker To field to Center Freq.
   e. Set the Controls field to Main.
   f. Set the Span field to 10 MHz.
   g. Set the Ref Level field to −20 dBm.

3. Set the Test Set’s Center Freq field to the frequencies shown in the PTR and measure the residual response on the spectrum analyzer’s marker field and compare it to the limits.
CDMA Generator RF In/Out Amplitude Level Accuracy Performance Test 25

The amplitude level accuracy of the CDMA generator is measured directly with a measuring receiver up to 1 GHz. Between 1 GHz and 2 GHz a microwave converter is also used to extend the measurement frequency to 2 GHz. When using the microwave converter, an amplifier is used below $-80 \text{ dBm}$.

Each frequency is measured at the DUPLEX OUT port, then the measurements are made at the RF IN/OUT port. This is due to the performance of the tuned RF level feature of the measuring receiver.

Setup 1

Figure 8-30  Setup 1 for Measurements to 1 GHz
Procedure 1

The following procedure applies to Setup 1 (shown in figure 8-30).

1. Before connecting the equipment, on the measuring receiver:
   a. Reset the instrument.
   b. Zero and calibrate the sensor module.

   NOTE
   Make sure the sensor module’s calibration data is entered into the measuring receiver.

2. Connect the equipment as shown in Setup 1.

3. On the measuring receiver:
   a. Set the measurement mode to RF Power.
   b. Set the display to log.
   c. Key in 4.4 SPCL.
   d. Key in 8.3 SPCL.

4. On the Test Set:
   a. Press Preset.
   b. Select the CDMA GENERATOR screen.
   c. Set the RF Gen Freq field to 836.52 MHz.
   d. Set the CW RF Path field to Bypass.
   e. Set the Amplitude to -10 dBm.

5. Set the measuring receiver to measure frequency.

6. After the measuring receiver has acquired the signal, set the measuring receiver to measure tuned RF level.

7. Measure the RF level at the levels shown in the PTR at the Test Set's DUPLEX OUT port and compare the measured RF level to the limits. If the measuring receiver displays the need to recalibrate, press the calibrate key and wait for calibration to be completed.

8. Move the sensor module to the Test Set's RF IN/OUT port.

9. On the Test Set set the Output Port field to RF Out and repeat the measurements for the levels shown in the PTR and compare the measured RF level to the limits.

10. Move the sensor module back to the Test Set's DUPLEX OUT port and set the Output Port to Dupl.
Setup 2

Figure 8-31 Setup 2 for Measurements of 1700 and 2000 MHz

Procedure 2

The following procedure applies to Setup 2 shown in figure 8-31 above.

1. Connect the sensor module on the measuring receiver to the DUPLEX OUT port of the Test Set.

2. On the Test Set:
   a. Set the Amplitude to -10 dBm.
   b. Set the RF Gen Freq to 1851.25 MHz.

3. On the measuring receiver:
   a. Set the measurement mode to RF power.
   b. Key in 1851.25 MHz.
   c. Measure and record the RF power at the DUPLEX OUT port.

4. Make the connections shown in Setup 2.

5. On the signal generator, set the level to +8 dBm or whatever level is suitable for the microwave converter’s LO input.

6. On the signal generator, set the frequency to 2051.25 MHz CW.

7. Reset the measuring receiver.

8. On the measuring receiver, set the frequency offset mode to enter and enable the LO frequency (27.3 Special) then enter the signal generator (LO) frequency (in MHz) which is 2051.25 MHz.
9. On the measuring receiver, set the measurement mode to tuned RF level and the measurement units to dBm then press set reference.

10. Measure and record the RF level at the levels down to and including -80 dBm shown in the PTR at the Test Set's DUPLEX OUT port. If the measuring receiver displays the need to recalibrate, press the calibrate key and wait for calibration to be completed.

11. After recording the reading at −70 dBm, insert an RF amplifier into the output of the Test Set.

12. Record the new measured level at −70 dBm.

13. Continue on measuring the level down to −110 dBm.

14. Move the input to the microwave converter to the RF IN/OUT port without the amplifier inserted.

15. Measure and record the RF level at the levels down to and including −80 dBm shown in the PTR at the Test Set’s RF IN/OUT port.

16. After recording the reading at −80 dBm, insert an RF amplifier into the output of the Test Set.

17. Record the new measured level at −80 dBm.

18. Continue on measuring the level down to −120 dBm.

19. Correct the measured reading for each level measured without the amplifier as follows: Add the RF power measured in step 3c to the measured level. (For example, if the level in step 3c is −10.2 dBm and the level at −55 dBm is −45.1 dB, record a level of −10.2 + (−45.1) = −55.3 dBm.) Compare the corrected values with the limits in the PTR.

20. Correct the measured reading for each level measured with the amplifier by summing the following values:

   + RF power measured at −10 dBm in step 3c or 5b
   + RF level measured at −80 dBm in step 8i
   − RF level measured at −80 dBm in step 8j
   + RF level measured in step 8k

   For example, if

   RF power measured at −10 dBm in step 3b or 5b = −10.2 dBm
   RF level measured at −80 dBm in step 8i = −70.1 dB
   RF level measured at −80 dBm in step 8j = −52.6 dB
   RF level measured at −100 dBm in step 8k = −73.2 dB

   the corrected level at −100 dBm is −10.2 + (−70.1) − (−52.6) + (−73.2) = 100.9 dBm. Compare the corrected values with the limits in the PTR.
CDMA Generator Modulation Accuracy Performance Test 26

The modulation accuracy of the CDMA generator is directly measured with a vector signal analyzer at the DUPLEX OUT port. Because the vector signal analyzer cannot measure rho directly, the modulation accuracy is measured in EVM (Error Vector Magnitude) % rms and rho is calculated from the EVM data.

Setup

Figure 8-32 CDMA Generator Modulation Accuracy Test 26

![Diagram of the Vector Signal Analyzer and DUPLEX OUT port connection]
Performance Tests
CDMA Generator Modulation Accuracy Performance Test 26

Procedure

1. On the Test Set:
   a. Press \textit{Preset}.
   b. Press \textit{CDMA GEN} key
   c. Set \textit{RF Gen Freq} to 836.52 MHz.
   d. Set \textit{CW RF} path to \textit{IQ}.
   e. Set \textit{Output Port} to \textit{Duplic}.
   f. Set \textit{Amplitude} to $-10$ dBm.
   g. Set \textit{Gen Dir} to \textit{Rev}.

2. On the Vector Signal Analyzer:
   a. Press the \textit{Frequency} key.
   b. Set center frequency to 836.52 MHz.
   c. Set the span to 2.6 MHz.
   d. Press the \textit{Instrument Mode} key
   e. Press the \textit{Digital Demodulation} (F4) key
   f. Press the \textit{Demodulation Setup} (F5) key
   g. Press the \textit{Demodulation Format} (F1) key
   h. Press the \textit{Standard Setups} (F7) key.
   i. Press the \textit{CDMA Mobile} (F7) key.
   j. Press the \textit{D} key.

3. Use the following equation to calculate rho.

$$\rho = \frac{1}{1 + EVM^2}$$

$$\rho = \rho \quad EVM = \text{Error Vector Magnitude (}\% \text{ rms)}$$

4. Compare and record the rho calculated in table 9-27, "CDMA Generator Modulation Accuracy Test 26 Record" on page 263

5. Set the CDMA GEN frequency on the Test Set and change the center frequency on the Vector Signal Analyzer to the 1931.25 MHz.

6. Calculate rho (using the above equation), and record the result (rho) in table 9-27, "CDMA Generator Modulation Accuracy Test 26 Record" on page 263.
CDMA Analyzer Average Power Level Accuracy Performance Test 27

The CDMA average-power-level accuracy is verified by comparing the measured power in a CW signal with the power level measured by a power meter.

Setup

Figure 8-33 CDMA Analyzer Average Power Level Accuracy Test 27

Procedure

1. On the measuring receiver:
   a. Set the measurement mode to RF Power.
   b. Calibrate the power sensor.
2. On the signal generator:
   a. Set the frequency to 836.52 MHz.
   b. Set the amplitude so the measuring receiver reads 4 mW.
3. On the Test Set:
   a. Press Preset
   b. Set the Avg Pwr Units to Watts.
   c. Set Tune Freq to 836.52 MHz.
4. Record the Avg Pwr reading in the PTR (see table 9-28, "CDMA Analyzer Average Power Level Accuracy Test 27 Record" on page 264.
5. Repeat steps 2 and 3 for each of the frequencies and levels listed in the PTR.
CDMA Analyzer Channel Power Level Accuracy Performance Test 28

The tuned channel power level accuracy is verified by comparing the measured power in a CW signal with the power level measured by a measuring receiver.

Setup

Figure 8-34 CDMA Analyzer Channel Power Level Accuracy Test 28
Procedure

1. On the measuring receiver
   a. Set the display mode to LOG.
   b. Set the measurement mode to RF Level.
   c. Calibrate the power sensor.
2. On the signal generator:
   a. Set the frequency to 836.52 MHz.
   b. Set the output level so the measuring receiver reads 11 dBm
3. On the Test Set:
   a. Push Preset.
   b. Change the Avg Pwr field to Chan Pwr.
   c. Set the Tune Freq to 836.52 MHz
   d. Select Calibrate under Chn Pwr Cal.
4. Record the Chan Pwr measurement in the PTR, see table 9-29, "CDMA Analyzer Channel Power Level Accuracy Test 28 Record" on page 265.
5. Repeat steps 2 and 3 for each of the data points listed in the PTR.

NOTE
The Chan Pwr Cal is only required when the frequency is changed.
CDMA Analyzer Modulation Accuracy
Performance Test 29

This test verifies the performance of the Test Set’s CDMA analyzer. The CDMA analyzer is performing properly if the rho values calculated as the results of the following procedure fall within the lower and upper limits specified in table "CDMA Analyzer Modulation Accuracy Test 29 Record" on page 266.

To determine rho, the signal from the Test Set’s CDMA generator is compared with a known-calibrated vector signal analyzer. This is done by setting the Test Set’s CDMA generator in forward channel (QPSK) mode and then measuring modulation accuracy with the vector signal analyzer. Since the vector signal analyzer cannot measure rho directly, the EVM (Error Vector Magnitude) % rms is measured and rho is calculated from the EVM data.

Setup

Figure 8-35 CDMA Analyzer Modulation Accuracy Test 29
Procedure

1. On the Test Set:
   a. Press the **Preset** key.
   b. Press the **CDMA Gen** key. The CDMA GENERATOR screen appears, see figure 8-36 on page 217.
   c. Set the **RF Gen Freq** to **881.52 MHz**.
   d. Ensure the **CW RF path** is set to **IQ**.
   e. Ensure the **Output Port** is set to **Dupl**.
   f. Set the **Amplitude** to **-10 dBm**.

   **Figure 8-36  CDMA GENERATOR Screen**

   ![CDMA GENERATOR Screen](cdmagen1.eps)

   g. Set **Gen Dir** to **FWD** and **EQ In**, see figure 8-36.
   h. Press the **CDMA Anl** key. The CDMA ANALYZER screen appears, see figure 8-37.
   i. Set the **Tune Freq** to **881.52 MHz**.
   j. Change measurement field from **Avg Pwr** to **Rho** see figure 8-37.
Performance Tests
CDMA Analyzer Modulation Accuracy Performance Test 29

2. On the vector signal analyzer:
   a. Set the center frequency to 881.52 MHz.
   b. Set the span to 2.6 MHz.
   c. Press the Instrument Mode key.
   d. Press the Digital Demodulation (F4) key.
   e. Press the Demodulation Setup (F5) key.
   f. Press the Demodulation Format (F1) key.
   g. Press the Standard Setups (F7) key.
   h. Press the CDMA Base (F6) key.
   i. Press the display button.

3. Use the following formula to calculate \( \rho \).

\[
\rho = \frac{1}{1 + EVM^2}
\]

\[\rho = \text{rho}
\]

\[EVM = \text{Error Vector Magnitude (}\%\text{rms)}\]

4. Compare and record the result in PTR table, "CDMA Analyzer Modulation Accuracy Test 29 Record" on page 266.

5. Repeat the previous steps for a frequency of 1851.25 MHz and record the results in PTR table, "CDMA Analyzer Modulation Accuracy Test 29 Record" on page 266.
9  Performance Test Records

Use this chapter to record the results of the performance tests in Chapter 8, “Performance Tests,” on page 161.
RF Generator FM Distortion Performance Test 1 Record

For test procedure, see “RF Generator FM Distortion Performance Test 1” on page 166.

Table 9-1 RF Generator FM Distortion Test 1 Record

<table>
<thead>
<tr>
<th>Level  (dBm)</th>
<th>RF (MHz)</th>
<th>Deviation (kHz)</th>
<th>Rate (kHz)</th>
<th>FM Distortion Limits (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>−10</td>
<td>10</td>
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<tr>
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</tr>
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<tr>
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<td>656.25</td>
<td>50</td>
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<td>0.50</td>
</tr>
<tr>
<td>−10</td>
<td>656.25</td>
<td>5</td>
<td>1</td>
<td>0.50</td>
</tr>
<tr>
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<td>99</td>
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<tr>
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<td>5</td>
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<td>0.50</td>
</tr>
<tr>
<td>−10</td>
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</table>
### RF Generator FM Distortion Performance Test 1 Record

<table>
<thead>
<tr>
<th>Level (dBm)</th>
<th>RF (MHz)</th>
<th>Deviation (kHz)</th>
<th>Rate (kHz)</th>
<th>FM Distortion Limits (%)</th>
</tr>
</thead>
<tbody>
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<td>0.50</td>
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</table>

<table>
<thead>
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<th>Level (dBm)</th>
<th>RF (MHz)</th>
<th>Deviation (kHz)</th>
<th>Rate (kHz)</th>
<th>FM Distortion Limits (%)</th>
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The following entries are for the 2 GHz setup.
RF Generator FM Accuracy Performance Test 2 Record

For test procedure, see “RF Generator FM Accuracy Performance Test 2” on page 168.

Table 9-2 RF Generator FM Accuracy Test 2 Record

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<th>Level (dBm)</th>
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### Performance Test Records

#### RF Generator FM Accuracy Performance Test 2 Record

<table>
<thead>
<tr>
<th>Level (dBm)</th>
<th>RF (MHz)</th>
<th>Deviation (kHz)</th>
<th>Rate (kHz)</th>
<th>FM Deviation Limits (kHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-10</td>
<td>1000</td>
<td>3</td>
<td>1</td>
<td>2.845 3.155</td>
</tr>
<tr>
<td>-10</td>
<td>1700</td>
<td>99</td>
<td>1</td>
<td>95.035 102.965</td>
</tr>
<tr>
<td>-10</td>
<td>1700</td>
<td>50</td>
<td>1</td>
<td>47.750 52.25</td>
</tr>
<tr>
<td>-10</td>
<td>1700</td>
<td>3</td>
<td>1</td>
<td>2.845 3.155</td>
</tr>
<tr>
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<td>2000</td>
<td>99</td>
<td>1</td>
<td>95.035 102.965</td>
</tr>
<tr>
<td>-10</td>
<td>2000</td>
<td>50</td>
<td>1</td>
<td>47.750 52.25</td>
</tr>
<tr>
<td>-10</td>
<td>2000</td>
<td>3</td>
<td>1</td>
<td>2.845 3.155</td>
</tr>
</tbody>
</table>

The following entries are for the 2 GHz setup.
RF Generator FM Flatness Performance Test 3 Record

For test procedure, see “RF Generator FM Flatness Performance Test 3” on page 170.

Table 9-3 RF Generator FM Flatness Test 3 Record

<table>
<thead>
<tr>
<th>Level (dBm)</th>
<th>RF (MHz)</th>
<th>Deviation (kHz)</th>
<th>Rate (kHz)</th>
<th>Computed FM Flatness Limits (dB)</th>
<th>Measured Reading (kHz)</th>
<th>Computed Results (dB)</th>
</tr>
</thead>
<tbody>
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<td></td>
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<td></td>
<td></td>
<td>Lower</td>
<td>Upper</td>
<td>Reading</td>
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<td>521</td>
<td>50</td>
<td>0.1</td>
<td>−1</td>
<td>1</td>
<td></td>
</tr>
<tr>
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<td>521</td>
<td>50</td>
<td>0.2</td>
<td>−1</td>
<td>1</td>
<td></td>
</tr>
<tr>
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<td>521</td>
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<td>2</td>
<td>−1</td>
<td>1</td>
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</tr>
<tr>
<td>−10</td>
<td>521</td>
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<td>−1</td>
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</tr>
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<td>−10</td>
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<td>50</td>
<td></td>
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<td>−1</td>
<td>1</td>
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<tr>
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<td>975.5</td>
<td>50</td>
<td>0.2</td>
<td>−1</td>
<td>1</td>
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<tr>
<td>−10</td>
<td>975.5</td>
<td>50</td>
<td>2</td>
<td>−1</td>
<td>1</td>
<td></td>
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<tr>
<td>−10</td>
<td>975.5</td>
<td>50</td>
<td>10</td>
<td>−1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>−10</td>
<td>975.5</td>
<td>50</td>
<td>25</td>
<td>−1</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

The following entries are for the 2 GHz setup.

| −10         | 1700     | 50              |            | Reference                         |                        |                       | 0 dB                  |
| −10         | 1700     | 50              | 0.1        | −1                               | 1                      |                       |                       |
| −10         | 1700     | 50              | 0.2        | −1                               | 1                      |                       |                       |
| −10         | 1700     | 50              | 2          | −1                               | 1                      |                       |                       |
| −10         | 1700     | 50              | 10         | −1                               | 1                      |                       |                       |
| −10         | 1700     | 50              | 25         | −1                               | 1                      |                       |                       |
| −10         | 2000     | 50              |            | Reference                         |                        |                       | 0 dB                  |
| −10         | 2000     | 50              | 0.1        | −1                               | 1                      |                       |                       |
## RF Generator FM Flatness Performance Test 3 Record

<table>
<thead>
<tr>
<th>Level (dBm)</th>
<th>RF (MHz)</th>
<th>Deviation (kHz)</th>
<th>Rate (kHz)</th>
<th>Computed FM Flatness Limits (dB)</th>
<th>Measured Reading (kHz)</th>
<th>Computed Results (dB)</th>
</tr>
</thead>
<tbody>
<tr>
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<td>0.2</td>
<td>−1</td>
<td>1</td>
<td>1</td>
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<tr>
<td>−10</td>
<td>2000</td>
<td>50</td>
<td>2</td>
<td>−1</td>
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<td>2000</td>
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<td>−10</td>
<td>2000</td>
<td>50</td>
<td>25</td>
<td>−1</td>
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RF Generator Residual FM
Performance Test 4 Record

For test procedure, see “RF Generator Residual FM Performance Test 4” on page 172.

Table 9-4 RF Generator Residual FM Test 4 Record

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<tr>
<th>LO (MHz)</th>
<th>RF (MHz)</th>
<th>Residual FM Limits (Hz)</th>
<th>Upper</th>
<th>Actual</th>
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<tr>
<td>101.5</td>
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<td>7</td>
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<tr>
<td>249.5</td>
<td>248</td>
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<td></td>
</tr>
<tr>
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<td>4</td>
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</tr>
<tr>
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<td>400</td>
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<td></td>
</tr>
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<td></td>
</tr>
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<td>LO (MHz)</td>
<td>RF (MHz)</td>
<td>Residual FM Limits (Hz)</td>
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</tr>
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<td>---------</td>
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<td>7</td>
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</tbody>
</table>

The following entries are for the 2 GHz setup.

<table>
<thead>
<tr>
<th>LO (MHz)</th>
<th>RF (MHz)</th>
<th>Residual FM Limits (Hz)</th>
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</thead>
<tbody>
<tr>
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<td>501.5</td>
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</table>
RF Generator Level Accuracy
Performance Test 5 Record

For test procedure, see “RF Generator Level Accuracy Performance Test 5” on page 176.

**NOTE**
Levels marked with a * are too low for measurement with the harmonic LO mixing method of Procedure 1.

Table 9-5  RF Generator Level Accuracy  Test 5 Record

<table>
<thead>
<tr>
<th>Port</th>
<th>RF (MHz)</th>
<th>Level (dBm)</th>
<th>Level Limits (dBm)</th>
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<td>−96.500</td>
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## Performance Test Records

**RF Generator Level Accuracy Performance Test 5 Record**

<table>
<thead>
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<th>Port</th>
<th>RF (MHz)</th>
<th>Level (dBm)</th>
<th>Level Limits (dBm)</th>
</tr>
</thead>
<tbody>
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<td></td>
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<td>Upper</td>
</tr>
<tr>
<td>DUPLEX OUT</td>
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<td>–76.500</td>
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<td>–81.500</td>
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## Performance Test Records

### RF Generator Level Accuracy Performance Test 5 Record

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<thead>
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<th>Port</th>
<th>RF (MHz)</th>
<th>Level (dBm)</th>
<th>Level Limits (dBm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Lower</td>
<td>Upper</td>
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<tr>
<td>DUPLEX OUT</td>
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<td>−46.500</td>
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RF Generator Harmonics Spectral Purity Performance Test 6 Record

For test procedure, see “RF Generator Harmonics Spectral Purity Performance Test 6” on page 181.

Table 9-6 RF Generator Harmonics Spectral Purity Test 6 Record

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## Performance Test Records

**RF Generator Harmonics Spectral Purity Performance Test 6 Record**

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RF Generator Spurious Spectral Purity Performance Test 7 Record

For test procedure, see “RF Generator Spurious Spectral Purity Performance Test 7” on page 182.

Table 9-7 RF Generator Spurious Spectral Purity Test 7 Record

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AF Generator AC Level Accuracy
Performance Test 8 Record

For test procedure, see “AF Generator AC Level Accuracy Performance Test 8” on page 183.

Table 9-8  AF Generator AC Level Accuracy Test 8 Record

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</tr>
<tr>
<td>1</td>
<td>1000</td>
<td>75</td>
<td>70.000</td>
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<tr>
<td>1</td>
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<td>4000</td>
<td>3885.000</td>
</tr>
<tr>
<td>1</td>
<td>100</td>
<td>700</td>
<td>682.500</td>
</tr>
<tr>
<td>1</td>
<td>100</td>
<td>75</td>
<td>70.000</td>
</tr>
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<td>682.500</td>
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<td>75</td>
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<td>4000</td>
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<td>10000</td>
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<td>4000</td>
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</tr>
<tr>
<td>2</td>
<td>1000</td>
<td>700</td>
<td>682.500</td>
</tr>
<tr>
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<td>1000</td>
<td>75</td>
<td>70.000</td>
</tr>
<tr>
<td>AF Generator</td>
<td>Frequency (Hz)</td>
<td>Level (mV)</td>
<td>AC Level Limits (mV)</td>
</tr>
<tr>
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<td>----------------</td>
<td>------------</td>
<td>----------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lower</td>
</tr>
<tr>
<td>2</td>
<td>100</td>
<td>4000</td>
<td>3885.000</td>
</tr>
<tr>
<td>2</td>
<td>100</td>
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<td>682.500</td>
</tr>
<tr>
<td>2</td>
<td>100</td>
<td>75</td>
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</tbody>
</table>
AF Generator DC Level Accuracy Performance Test 9 Record

For test procedure, see “AF Generator DC Level Accuracy Performance Test 9” on page 184.

Table 9-9 AF Generator DC Level Accuracy Test 9 Record

<table>
<thead>
<tr>
<th>AF Generator</th>
<th>Level (mV)</th>
<th>DC Level Limits (mV)</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Lower</td>
<td>Upper</td>
<td>Actual</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>4000</td>
<td>3820.000</td>
<td>4180.000</td>
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<tr>
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<td>925.000</td>
<td>1075.000</td>
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<td></td>
</tr>
<tr>
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<td>4000</td>
<td>3820.000</td>
<td>4180.000</td>
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<tr>
<td>2</td>
<td>1000</td>
<td>925.000</td>
<td>1075.000</td>
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</tr>
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</table>
# AF Generator Residual Distortion Performance Test 10 Record

For test procedure, see “AF Generator Residual Distortion Performance Test 10” on page 185.

Table 9-10 AF Generator Residual Distortion Test 10 Record

<table>
<thead>
<tr>
<th>AF Generator</th>
<th>Frequency (Hz)</th>
<th>Level (mV)</th>
<th>Distortion Limits (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>Lower</td>
</tr>
<tr>
<td>1</td>
<td>25000</td>
<td>4000</td>
<td>0.000</td>
</tr>
<tr>
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<td>25000</td>
<td>2000</td>
<td>0.000</td>
</tr>
<tr>
<td>1</td>
<td>25000</td>
<td>200</td>
<td>0.000</td>
</tr>
<tr>
<td>1</td>
<td>10000</td>
<td>4000</td>
<td>0.000</td>
</tr>
<tr>
<td>1</td>
<td>10000</td>
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<td>0.000</td>
</tr>
<tr>
<td>1</td>
<td>1000</td>
<td>4000</td>
<td>0.000</td>
</tr>
<tr>
<td>1</td>
<td>1000</td>
<td>2000</td>
<td>0.000</td>
</tr>
<tr>
<td>1</td>
<td>1000</td>
<td>200</td>
<td>0.000</td>
</tr>
<tr>
<td>1</td>
<td>100</td>
<td>4000</td>
<td>0.000</td>
</tr>
<tr>
<td>1</td>
<td>100</td>
<td>2000</td>
<td>0.000</td>
</tr>
<tr>
<td>1</td>
<td>100</td>
<td>200</td>
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<td>0.000</td>
</tr>
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<td>25000</td>
<td>200</td>
<td>0.000</td>
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<td>4000</td>
<td>0.000</td>
</tr>
<tr>
<td>2</td>
<td>10000</td>
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<tr>
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<td>1000</td>
<td>200</td>
<td>0.000</td>
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<tr>
<td>AF Generator</td>
<td>Frequency (Hz)</td>
<td>Level (mV)</td>
<td>Distortion Limits (%)</td>
</tr>
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<td>----------------</td>
<td>------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lower</td>
</tr>
<tr>
<td>2</td>
<td>100</td>
<td>4000</td>
<td>0.000</td>
</tr>
<tr>
<td>2</td>
<td>100</td>
<td>2000</td>
<td>0.000</td>
</tr>
<tr>
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<td>100</td>
<td>200</td>
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**AF Generator Frequency Accuracy Performance Test 11 Record**

For test procedure, see “AF Generator Frequency Accuracy Performance Test 11” on page 186.

Table 9-11 AF Generator Frequency Accuracy Test 11 Record

<table>
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<tr>
<th>AF Generator</th>
<th>Frequency (Hz)</th>
<th>Frequency Limits (Hz)</th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Lower</td>
<td>Upper</td>
<td>Actual</td>
</tr>
<tr>
<td>1</td>
<td>25000</td>
<td>24993.750</td>
<td>25006.250</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>10000</td>
<td>9997.500</td>
<td>10002.500</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>5000</td>
<td>4998.750</td>
<td>500.125</td>
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</tr>
<tr>
<td>1</td>
<td>2000</td>
<td>1999.500</td>
<td>2000.500</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1000</td>
<td>999.750</td>
<td>1000.250</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>500</td>
<td>499.875</td>
<td>500.125</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>200</td>
<td>199.950</td>
<td>200.050</td>
<td></td>
</tr>
<tr>
<td>1</td>
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</tr>
<tr>
<td>1</td>
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<td>49.988</td>
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<td></td>
</tr>
<tr>
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<td>19.995</td>
<td>20.005</td>
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</tr>
<tr>
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<td>25000</td>
<td>24993.750</td>
<td>25006.250</td>
<td></td>
</tr>
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<tr>
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<td>4998.750</td>
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<td>2</td>
<td>50</td>
<td>49.988</td>
<td>50.012</td>
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<td>2</td>
<td>20</td>
<td>19.995</td>
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</table>
### AF Analyzer AC Level Accuracy Performance Test 12 Record

For test procedure, see “AF Analyzer AC Level Accuracy Performance Test 12” on page 187.

#### Table 9-12: AF Analyzer AC Voltage Accuracy Test 12 Record

<table>
<thead>
<tr>
<th>Frequency (Hz)</th>
<th>Level (mV)</th>
<th>AC Voltage Limits (mV)</th>
<th>Lower</th>
<th>Upper</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>15000</td>
<td>5000</td>
<td>4849.850</td>
<td>5150.150</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>5000</td>
<td>4849.850</td>
<td>5150.150</td>
<td></td>
<td></td>
</tr>
<tr>
<td>200</td>
<td>5000</td>
<td>4849.850</td>
<td>5150.150</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>5000</td>
<td>4849.850</td>
<td>5150.150</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15000</td>
<td>500</td>
<td>484.850</td>
<td>515.150</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>500</td>
<td>484.850</td>
<td>515.150</td>
<td></td>
<td></td>
</tr>
<tr>
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<td>500</td>
<td>484.850</td>
<td>515.150</td>
<td></td>
<td></td>
</tr>
<tr>
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<td>500</td>
<td>484.850</td>
<td>515.150</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15000</td>
<td>50</td>
<td>48.350</td>
<td>51.650</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>50</td>
<td>48.350</td>
<td>51.650</td>
<td></td>
<td></td>
</tr>
<tr>
<td>200</td>
<td>50</td>
<td>48.350</td>
<td>51.650</td>
<td></td>
<td></td>
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<td>20</td>
<td>50</td>
<td>48.350</td>
<td>51.650</td>
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Table 9-13 AF Analyzer Residual Noise Test 13 Record

<table>
<thead>
<tr>
<th>Residual Noise Limits (µV)</th>
<th>Upper</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>150</td>
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</tbody>
</table>
AF Analyzer Distortion and SINAD Accuracy
Performance Test 14 Record

For test procedure, see “AF Analyzer Distortion and SINAD Accuracy Performance Test 14” on page 189.

Table 9-14  AF Analyzer Distortion and SINAD Accuracy Test 14 Record

<table>
<thead>
<tr>
<th>AF Generator 2 Frequency (kHz)</th>
<th>AF Generator 2 Level (mV)</th>
<th>Measurement Type</th>
<th>Distortion and SINAD Limits</th>
</tr>
</thead>
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<td></td>
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</tr>
<tr>
<td>2</td>
<td>100</td>
<td>Distortion</td>
<td>8.856%</td>
</tr>
<tr>
<td>2</td>
<td>100</td>
<td>SINAD</td>
<td>19.043 dB</td>
</tr>
<tr>
<td>3</td>
<td>100</td>
<td>Distortion</td>
<td>8.856%</td>
</tr>
<tr>
<td>3</td>
<td>100</td>
<td>SINAD</td>
<td>19.043 dB</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>Distortion</td>
<td>0.890%</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>SINAD</td>
<td>39.000 dB</td>
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<tr>
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<td>10</td>
<td>Distortion</td>
<td>0.890%</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td>SINAD</td>
<td>39.000 dB</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>Distortion</td>
<td>0.445</td>
</tr>
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<td>2</td>
<td>5</td>
<td>SINAD</td>
<td>45.021</td>
</tr>
<tr>
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<td>5</td>
<td>Distortion</td>
<td>0.445</td>
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<td>3</td>
<td>5</td>
<td>SINAD</td>
<td>45.021</td>
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</table>
AF Analyzer DC Level Accuracy
Performance Test 15 Record

For test procedure, see “AF Analyzer DC Level Accuracy Performance Test 15” on page 190.

Table 9-15 AF Analyzer DC Level Accuracy Test 15 Record

<table>
<thead>
<tr>
<th>AF Generator 1 Level (mV)</th>
<th>DC Voltage Limits (mV)</th>
</tr>
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<tr>
<td></td>
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</tr>
<tr>
<td>5000</td>
<td>4905.000</td>
</tr>
<tr>
<td>500</td>
<td>450.000</td>
</tr>
</tbody>
</table>
AF Analyzer Frequency Accuracy to 100 kHz
Performance Test 16 Record

For test procedure, see “AF Analyzer Frequency Accuracy to 100 kHz Performance Test 16” on page 191.

Table 9-16  AF Analyzer Frequency Accuracy to 100 kHz Test 16 Record

<table>
<thead>
<tr>
<th>Frequency (Hz)</th>
<th>Frequency Limits (Hz)</th>
<th>Lower</th>
<th>Upper</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>19.986</td>
<td>20.014</td>
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<td>100</td>
<td>99.970</td>
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<td></td>
<td></td>
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<tr>
<td>1000</td>
<td>999.790</td>
<td>1000.210</td>
<td></td>
<td></td>
</tr>
<tr>
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<td>9997.90</td>
<td>10002.10</td>
<td></td>
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<tr>
<td>100000</td>
<td>99979</td>
<td>100021</td>
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</tr>
</tbody>
</table>
AF Analyzer Frequency Accuracy at 400 kHz
Performance Test 17 Record

For test procedure, see “AF Analyzer Frequency Accuracy at 400 kHz Performance Test 17” on page 192.

Table 9-17  AF Analyzer Frequency Accuracy at 400 kHz  Test 17 Record

<table>
<thead>
<tr>
<th>Frequency Difference Limits (kHz)</th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Lower</td>
<td>0.080</td>
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</tr>
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<td>Upper</td>
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</tr>
<tr>
<td>Actual</td>
<td>0.080</td>
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</tbody>
</table>
Oscilloscope Amplitude Accuracy
Performance Test 18 Record

For test procedure, see “Oscilloscope Amplitude Accuracy Performance Test 18” on page 193.

Table 9-18 Oscilloscope Amplitude Accuracy Test 18 Record

<table>
<thead>
<tr>
<th>Frequency (kHz)</th>
<th>Amplitude Limits (V)</th>
</tr>
</thead>
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<tr>
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<tr>
<td>1</td>
<td>6.765</td>
</tr>
<tr>
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<td>6.765</td>
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<tr>
<td>50</td>
<td>5.000</td>
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</table>
RF Analyzer Level Accuracy
Performance Test 19 Record

For test procedure, see “RF Analyzer Level Accuracy Performance Test 19” on page 195.

Table 9-19
RF Analyzer Level Accuracy Test 19 Record

<table>
<thead>
<tr>
<th>Frequency (MHz)</th>
<th>Level Difference Limits (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lower</td>
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<tr>
<td>30</td>
<td>−0.212</td>
</tr>
<tr>
<td>50</td>
<td>−0.212</td>
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<tr>
<td>100</td>
<td>−0.212</td>
</tr>
<tr>
<td>150</td>
<td>−0.212</td>
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<tr>
<td>200</td>
<td>−0.212</td>
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<tr>
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<tr>
<td>300</td>
<td>−0.212</td>
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<tr>
<td>350</td>
<td>−0.212</td>
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<tr>
<td>400</td>
<td>−0.212</td>
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<td>−0.212</td>
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<tr>
<td>500</td>
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<tr>
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</tr>
<tr>
<td>700</td>
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<td>−0.212</td>
</tr>
<tr>
<td>900</td>
<td>−0.212</td>
</tr>
<tr>
<td>950</td>
<td>−0.212</td>
</tr>
<tr>
<td>1000</td>
<td>−0.212</td>
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<tr>
<td>1700</td>
<td>−0.212</td>
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<td>Frequency (MHz)</td>
<td>Level Difference Limits (dB)</td>
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<td>-------------------------------</td>
</tr>
<tr>
<td></td>
<td>Lower</td>
</tr>
<tr>
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<td>-0.212</td>
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<td>1775</td>
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<td>-0.212</td>
</tr>
<tr>
<td>1825</td>
<td>-0.212</td>
</tr>
<tr>
<td>1850</td>
<td>-0.212</td>
</tr>
<tr>
<td>1875</td>
<td>-0.212</td>
</tr>
<tr>
<td>1900</td>
<td>-0.212</td>
</tr>
<tr>
<td>1925</td>
<td>-0.212</td>
</tr>
<tr>
<td>1950</td>
<td>-0.212</td>
</tr>
<tr>
<td>1975</td>
<td>-0.212</td>
</tr>
<tr>
<td>2000</td>
<td>-0.212</td>
</tr>
</tbody>
</table>
RF Analyzer FM Accuracy
Performance Test 20 Record

For test procedure, see “RF Analyzer FM Accuracy Performance Test 20” on page 196.

Table 9-20 RF Analyzer FM Accuracy Test 20 Record

<table>
<thead>
<tr>
<th>RF (MHz)</th>
<th>Deviation (kHz)</th>
<th>Rate (Hz)</th>
<th>FM Deviation Limits (kHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lower</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.5</td>
<td>1</td>
<td>50</td>
<td>0.960</td>
</tr>
<tr>
<td>12.5</td>
<td>1</td>
<td>1000</td>
<td>0.960</td>
</tr>
<tr>
<td>12.5</td>
<td>1</td>
<td>25000</td>
<td>0.960</td>
</tr>
<tr>
<td>12.5</td>
<td>10</td>
<td>50</td>
<td>9.600</td>
</tr>
<tr>
<td>12.5</td>
<td>10</td>
<td>1000</td>
<td>9.600</td>
</tr>
<tr>
<td>12.5</td>
<td>10</td>
<td>25000</td>
<td>9.600</td>
</tr>
<tr>
<td>400</td>
<td>10</td>
<td>50</td>
<td>9.600</td>
</tr>
<tr>
<td>400</td>
<td>10</td>
<td>1000</td>
<td>9.600</td>
</tr>
<tr>
<td>400</td>
<td>10</td>
<td>25000</td>
<td>9.600</td>
</tr>
<tr>
<td>400</td>
<td>17</td>
<td>50</td>
<td>16.320</td>
</tr>
<tr>
<td>400</td>
<td>17</td>
<td>1000</td>
<td>16.320</td>
</tr>
<tr>
<td>400</td>
<td>17</td>
<td>25000</td>
<td>16.320</td>
</tr>
</tbody>
</table>
RF Analyzer FM Distortion
Performance Test 21 Record

For test procedure, see “RF Analyzer FM Distortion Performance Test 21” on page 198.

Table 9-21 RF Analyzer FM Distortion Test 21 Record

<table>
<thead>
<tr>
<th>FM Deviation (kHz)</th>
<th>FM Distortion Limits (%)</th>
<th>Upper</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>75</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
RF Analyzer FM Bandwidth Performance Test 22 Record

For test procedure, see “RF Analyzer FM Bandwidth Performance Test 22” on page 200.

Table 9-22 RF Analyzer FM Bandwidth Test 22 Record

<table>
<thead>
<tr>
<th>FM Deviation Difference Limits (dB)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper的实际值</td>
<td>3.0</td>
</tr>
</tbody>
</table>
RF Analyzer Residual FM Performance Test 23 Record

For test procedure, see “RF Analyzer Residual FM Performance Test 23” on page 203.

Table 9-23 RF Analyzer Residual FM Test 23 Record

<table>
<thead>
<tr>
<th>FM Deviation Limits (Hz)</th>
<th>Upper</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Spectrum Analyzer Image Rejection
Performance Test 24 Record

For test procedure, see “Spectrum Analyzer Image Rejection Performance Test 24” on page 204.

Table 9-24  Spectrum Analyzer Image Rejection (Image) Test 24 Record

<table>
<thead>
<tr>
<th>RF Generator Frequency (MHz)</th>
<th>Spectrum Analyzer Frequency (MHz)</th>
<th>Image Response Limits (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>613.6</td>
<td>385.0</td>
<td>−50</td>
</tr>
<tr>
<td>873.6</td>
<td>645.0</td>
<td>−50</td>
</tr>
<tr>
<td>883.6</td>
<td>655.0</td>
<td>−50</td>
</tr>
<tr>
<td>1023.6</td>
<td>795.0</td>
<td>−50</td>
</tr>
<tr>
<td>1000.0</td>
<td>771.4</td>
<td>−50</td>
</tr>
<tr>
<td>576.4</td>
<td>805.0</td>
<td>−50</td>
</tr>
<tr>
<td>771.4</td>
<td>1000.0</td>
<td>−50</td>
</tr>
<tr>
<td>319.02</td>
<td>300.0</td>
<td>−50</td>
</tr>
</tbody>
</table>

Table 9-25  Spectrum Analyzer Image Rejection (Residual) Test 24 Record

<table>
<thead>
<tr>
<th>Spectrum Analyzer Center Frequency (MHz)</th>
<th>Residual Response Limits (dBm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Upper</td>
</tr>
<tr>
<td>5.534</td>
<td>−70</td>
</tr>
<tr>
<td>10.0</td>
<td>−70</td>
</tr>
<tr>
<td>20.0</td>
<td>−70</td>
</tr>
<tr>
<td>21.4</td>
<td>−70</td>
</tr>
<tr>
<td>107.126</td>
<td>−70</td>
</tr>
<tr>
<td>164.28</td>
<td>−70</td>
</tr>
<tr>
<td>257.139</td>
<td>−70</td>
</tr>
<tr>
<td>271.4</td>
<td>−70</td>
</tr>
<tr>
<td>347.607</td>
<td>−70</td>
</tr>
<tr>
<td>500.0</td>
<td>−70</td>
</tr>
</tbody>
</table>
CDMA Generator RF In/Out Amplitude Level Accuracy Performance Test 25 Record

For test procedure, see “CDMA Generator RF In/Out Amplitude Level Accuracy Performance Test 25” on page 207.

Table 9-26 CDMA Generator RF In/Out Test

<table>
<thead>
<tr>
<th>RF (MHz)</th>
<th>Level (dBm)</th>
<th>Measured Level Limits (dBm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Lower</td>
</tr>
<tr>
<td><strong>DUPLEX OUT</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>836.52</td>
<td>−10</td>
<td>−11.5</td>
</tr>
<tr>
<td>836.52</td>
<td>−30</td>
<td>−31.5</td>
</tr>
<tr>
<td>836.52</td>
<td>−50</td>
<td>−51.5</td>
</tr>
<tr>
<td>836.52</td>
<td>−70</td>
<td>−71.5</td>
</tr>
<tr>
<td>836.52</td>
<td>−90</td>
<td>−91.5</td>
</tr>
<tr>
<td>836.52</td>
<td>−110</td>
<td>−111.5</td>
</tr>
<tr>
<td><strong>RF IN/OUT</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>836.52</td>
<td>−40</td>
<td>−41.5</td>
</tr>
<tr>
<td>836.52</td>
<td>−60</td>
<td>−61.5</td>
</tr>
<tr>
<td>836.52</td>
<td>−80</td>
<td>−81.5</td>
</tr>
<tr>
<td>836.52</td>
<td>−100</td>
<td>−101.5</td>
</tr>
<tr>
<td>836.52</td>
<td>−120</td>
<td>−121.5</td>
</tr>
<tr>
<td><strong>DUPLEX OUT</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1851.25</td>
<td>−10</td>
<td>−11.5</td>
</tr>
<tr>
<td>1851.25</td>
<td>−30</td>
<td>−31.5</td>
</tr>
<tr>
<td>1851.25</td>
<td>−50</td>
<td>−51.5</td>
</tr>
<tr>
<td>1851.25</td>
<td>−70</td>
<td>−71.5</td>
</tr>
<tr>
<td>1851.25</td>
<td>−90</td>
<td>−91.5</td>
</tr>
<tr>
<td>1851.25</td>
<td>−110</td>
<td>−111.5</td>
</tr>
<tr>
<td><strong>RF IN/OUT</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1851.25</td>
<td>−40</td>
<td>−41.5</td>
</tr>
<tr>
<td>1851.25</td>
<td>−60</td>
<td>−61.5</td>
</tr>
</tbody>
</table>
### Performance Test Records

**CDMA Generator RF In/Out Amplitude Level Accuracy Performance Test 25 Record**

<table>
<thead>
<tr>
<th>RF (MHz)</th>
<th>Level (dBm)</th>
<th>Measured Level Limits (dBm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Lower</td>
</tr>
<tr>
<td>1851.25</td>
<td>−80</td>
<td>−81.5</td>
</tr>
<tr>
<td>1851.25</td>
<td>−100</td>
<td>−101.5</td>
</tr>
<tr>
<td>1851.25</td>
<td>−120</td>
<td>−121.5</td>
</tr>
</tbody>
</table>
CDMA Generator Modulation Accuracy Performance Test 26 Record

For test procedure, see “CDMA Generator Modulation Accuracy Performance Test 26” on page 211.

<table>
<thead>
<tr>
<th>RF (MHz)</th>
<th>Level (dBm)</th>
<th>Measured EVM (%rms)</th>
<th>Calculated Rho</th>
</tr>
</thead>
<tbody>
<tr>
<td>836.52</td>
<td>−10</td>
<td>0.96</td>
<td>0.96</td>
</tr>
<tr>
<td>1851.25</td>
<td>−10</td>
<td>0.96</td>
<td>0.96</td>
</tr>
</tbody>
</table>
CDMA Analyzer Average Power Level Accuracy Performance Test 27 Record

For test procedure, see “CDMA Analyzer Average Power Level Accuracy Performance Test 27” on page 213.

Table 9-28 CDMA Analyzer Average Power Level Accuracy Test 27 Record

<table>
<thead>
<tr>
<th>RF (MHz)</th>
<th>Level (mW)</th>
<th>Measured Level Limits (mW)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Lower</td>
</tr>
<tr>
<td>836.52</td>
<td>4</td>
<td>3.70</td>
</tr>
<tr>
<td>836.52</td>
<td>10</td>
<td>9.25</td>
</tr>
<tr>
<td>1851.25</td>
<td>4</td>
<td>3.70</td>
</tr>
<tr>
<td>1851.25</td>
<td>10</td>
<td>9.25</td>
</tr>
</tbody>
</table>
CDMA Analyzer Channel Power Level Accuracy
Performance Test 28 Record

For test procedure, see “CDMA Analyzer Channel Power Level Accuracy Performance Test 28” on page 214.

Table 9-29 CDMA Analyzer Analyzer Channel Power Level Accuracy Test 28 Record

<table>
<thead>
<tr>
<th>RF (MHz)</th>
<th>Level (dBm)</th>
<th>Measured Level Limits (dBm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Lower</td>
</tr>
<tr>
<td>836.52</td>
<td>11</td>
<td>10</td>
</tr>
<tr>
<td>836.52</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>836.52</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>836.52</td>
<td>–4</td>
<td>–5</td>
</tr>
<tr>
<td>836.52</td>
<td>–9</td>
<td>–10</td>
</tr>
<tr>
<td>836.52</td>
<td>–14</td>
<td>–15</td>
</tr>
<tr>
<td>836.52</td>
<td>–19</td>
<td>–20</td>
</tr>
<tr>
<td>1851.25</td>
<td>11</td>
<td>10</td>
</tr>
<tr>
<td>1851.25</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>1851.25</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>1851.25</td>
<td>–4</td>
<td>–5</td>
</tr>
<tr>
<td>1851.25</td>
<td>–9</td>
<td>–10</td>
</tr>
<tr>
<td>1851.25</td>
<td>–14</td>
<td>–15</td>
</tr>
<tr>
<td>1851.25</td>
<td>–19</td>
<td>–20</td>
</tr>
</tbody>
</table>
CDMA Analyzer Modulation Accuracy
Performance Test 29 Record

For test procedure, see “CDMA Analyzer Modulation Accuracy Performance Test 29” on page 216.

CDMA Analyzer Modulation Accuracy Test 29 Record

<table>
<thead>
<tr>
<th>RF (MHz)</th>
<th>Level (dBm)</th>
<th>Calculated Rho Error</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Lower Limit</td>
</tr>
<tr>
<td>881.52</td>
<td>−10</td>
<td>−0.005</td>
</tr>
<tr>
<td>1851.25</td>
<td>−10</td>
<td>−0.005</td>
</tr>
</tbody>
</table>
This chapter contains block diagrams and descriptions that focus on how the Test Set generates signals and makes measurements. It also has I/O signal and pin number information that can be used to help isolate a problem to the assembly level if the Test Set’s diagnostic programs are unable to do so.
Introduction

Shown in figure 10-1 on page 269 is a block-diagram overview of the Test Set. This chapter is organized into the following sections which provide a detailed view of each individual assembly shown in the overview:

- RF Input/Output
- RF Analyzer
- Audio Analyzer
- CDMA Analyzer
- CDMA Generator
- Audio Generator
- RF Generator
- Reference/Regulator
- Instrument Control

Input/output and switch information is included to help you determine if voltages and signals are getting to the assemblies with the proper levels, shapes, and frequencies. Line names and connector pin numbers are given on the block diagrams when applicable.
Block Diagrams

Introduction
RF Input/Output Section

RF Power Measurement

An RF power measurement can only be made by supplying a signal to the RF IN/OUT port of the Test Set. See figure 10-2 on page 271. A power splitter then splits the signal between an RF analysis path and a power measurement path. The power detector has a direct path to the A2A36 Receive DSP where average power measurements are made. There's also a diode peak detector to provide a peak power measurement through the A2A33 Measurement assembly.

Accuracy is insured by factory-generated calibration data which is stored in CAL ROM. The A2A200 100W-attenuator also has calibration data which affects RF power measurements.

Input Gain Control

Step attenuators in the A2A130 Input/Output Section are switched in and out, manually or automatically. This keeps the input level within an optimum range for the mixers, IF amplifiers, and detectors.
RF Analyzer Section

Frequency Conversion

The A2A115 Downconverter, see figure 10-3 on page 274, produces an IF of 114.3, 385.7 or 614.3 MHz. The LO is provided by the A2A22 Receiver Synthesizer, see figure 10-4 on page 275. The IF frequencies developed are as follows in table 10-1.

<table>
<thead>
<tr>
<th>Input RF (MHz)</th>
<th>1st LO (MHz)</th>
<th>IF (MHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 385.7</td>
<td>614.7 to 1000</td>
<td>614.3</td>
</tr>
<tr>
<td>385.7 to 800</td>
<td>500 to 914.3</td>
<td>114.3</td>
</tr>
<tr>
<td>800 to 1000</td>
<td>685.7 to 885.7</td>
<td>114.3</td>
</tr>
<tr>
<td>1400 to 2200</td>
<td>1014.3 to 1814.3</td>
<td>385.7</td>
</tr>
</tbody>
</table>

Filters are automatically switched in to remove image and other interfering signals. The frequency ranges of the filters are as follows:

- 150 MHz low-pass
- 150 MHz - 386 MHz bandpass
- 350 MHz - 650 MHz tunable bandpass
- 650 MHz - 1000 MHz tunable bandpass
- 1400 MHz - 2200 MHz tunable bandpass

Modulation Measurement

The A2A21 Receiver assembly demodulates the IF into its FM, AM, and SSB components, see figure 10-5 on page 276. The demodulated signal is sent to the Audio Analyzer section for measurement.
Spectrum Analysis

The LO on the A2A20 Spectrum Analyzer is swept across the span by the Controller, see figure 10-6 on page 277. The LO starts sweeping when the oscilloscope circuits on the A2A33 Measurement board trigger the display sweep to start. As the LO sweeps, the spectrum analyzer filters and then amplifies the IF signal in a logarithmic detector so the signal voltage will be proportional to the log of power. The signal voltage is measured by a sampler on the Measurement board and displayed.

Spectrum analyzer resolution bandwidth is determined by switching bandwidth IF filters on the A2A20 Spectrum Analyzer. These filters are set by the Controller as a function of the span selected from the front panel.
Figure 10-3  Downconverter Assembly, A2A115
Figure 10-4  Receiver Synthesizer Assembly, A2A22

RECEIVER SYNTHESIZER ASSEMBLY, A2A22

Ref Present

Ref Present Det

14dB

Gain Ctrl

4

OUT OF

LOCK

Det

Buffer

Loop Control

Control

GAIN CONT

1MHz

From Ref

+40V

A

A

A

GND

Swp Start Rcvr

Out of Lock

Ref Present

500-1000 MHz

0dBm

P/O Motherboard A2A1

Group Serial I/O

From Meas

P/O SMB

To Down-Converter

Note: The diagram shows the receiver synthesizer assembly for A2A22, including various components such as buffer, loop control, and gain control, along with their connections and specifications like 1MHz from reference and 500-1000 MHz with 0dBm output.
Figure 10-5  Receiver Assembly, A2A21
Figure 10-6  Spectrum Analyzer Assembly, A2A20
Audio Analyzer Section

Input Level Control

Switchable gain amplifiers on the A2A80 Audio Analyzer #1 (see figure 10-7 on page 279) and A2A40 Audio Analyzer #2 (see figure 10-8 on page 280) assemblies keep the audio input signal within a range suitable for the detectors.

AC and DC Level Measurements

Detected voltages from the Peak+, Peak −, and RMS detectors are measured on the A2A33 Measurement assembly. The Controller calculates the displayed value taking into account the detector selected from the front panel, the gain of the amplifiers, and the source of the input signal (demodulators, front panel).

Distortion and SINAD Measurements

Distortion and SINAD can be measured on 300 Hz to 10 kHz audio signals. The Controller calculates distortion and SINAD by comparing the ratio of the voltage after the variable notch filter to the ratio of the voltage before the notch filter.

Oscilloscope Functions

The Test Set has no specialized oscilloscope assemblies. The A2A80 and A2A40 Audio Analyzer assemblies, A2A33 Measurement assembly, and the Controller work together to perform the oscilloscope functions.

The audio or dc signal to be displayed goes from the A2A40 Audio Analyzer 2 assembly to a sampler on the A2A33 Measurement assembly (the same sampler used by the Spectrum Analyzer). The Controller calculates the display level by taking the value of the measured signal at each point of the sweep, the gain of the signal path in the Audio Analyzer assemblies, and the volts-per-division setting.

The oscilloscope's trigger signals from the side-panel connector, the A2A32 Signaling Source/Analyzer assembly, and the internal trigger signal are used by the A2A33 Measurement assembly and the Controller to determine when to start the scope sweep. The Controller adds the pre-triggering time entered from the front panel.
Figure 10-9 Measurement Assembly, A2A33
CDMA Analyzer Section

IF Conversion

To downconvert the CDMA the signal, the 114.3 MHz IF is mixed with a 110.6136 MHz LO to produce a 3.6864 MHz IF in the A2A120 LO IF/IQ Modulator assembly, see figure 10-11 on page 284. The oscillator that produces the LO signal is phase locked to a 10 MHz signal from the A2A100 CDMA Generator Reference assembly, see figure 10-13 on page 287.

CDMA Signal Analysis

The 3.6864 MHz signal goes to the A2A36 Receive DSP assembly, see figure 10-12 on page 285. The Receive DSP assembly analyzes the 3.6864 MHz signal to make IQ modulation measurements, such as rho, timing accuracy, carrier feedthrough, and phase error.

Power Measurements

The A2A36 Receive DSP assembly also makes average power measurements through a direct link from the A2A130 RF Input/Output assembly.
Figure 10-11  LO IF/IQ Modulator Assembly, A2A120

LO IF Conversion

[Diagram of LO IF Conversion]
Figure 10-12  Receive DSP Assembly, A2A36

- SMB
- Gain: -10 to +30 dB
- 8 MHz 12-bit ADC
- 128K Flash EPROM
- 256K Fast RAM
- TMS320C30 DSP
- Reset 1
- INT 0, INT 1
- Serial Port 1
- Serial Port 2
- 6-bit DAC
- MUX
- EXT Trigger
- 100 ohm
- DET OUT
- FROM RF IO ASSY
- EXP BUS
- PRIMARY BUS
- DATA LATCHES (4)
- INT0, INT1
- TRIG OUT
- +15, +5 V
- DET_OUT FROM CDMA GEN/REF
- 128K FAST RAM
- 32 MHz
- 12-bit A/D
- SAMPLE
- GENERATOR
- EXT BUS
- DATA IN
- 512x8 BI-FIFO
CDMA Generator Section

Data Generation

The A2A34 Data Buffer, see figure 10-14 on page 288, generates or buffers external data that emulates a CDMA traffic channel and outputs this data to the A2A100 CDMA Generator Reference, see figure 10-13 on page 287. The CDMA Generator Reference assembly converts the data into I and Q drive signals and sends it back to the Data Buffer to be summed with calibrated noise sources. The signals are then passed to the A2A120 LO IF/IQ Modulator for modulation with RF.

CDMA Reference

The A2A100 CDMA Generator Reference, see figure 10-13 on page 287, supplies all the CDMA clocks for the A2A36 Receive DSP and the A2A34 Data Buffer. The CDMA Generator Reference also provides reference switching for an external or the internal reference source.
Figure 10-13  CDMA Generator/Reference Assembly, A2A100
Figure 10-14  Data Buffer Assembly, A2A34
Audio Generator Section

Waveform Generation

The A2A32 Signal Source and Analyzer, see figure 10-15 on page 290, gets frequency and wave shape information from the Controller. Waveform values are calculated real-time by a digital waveform synthesis IC. The LFS1 output is always a sine-wave. The LFS2 output is a sine-wave unless one of the function generator waveforms is selected, or signaling is selected from the front panel.

Level Control

Audio level is controlled by the A2A44 Modulation Distribution assembly, see figure 10-16 on page 291, by using a DAC and variable attenuators. The leveled audio signal is passed on to the RF Generator section.
Figure 10-15  Signal Source & Analyzer Assembly, A2A32
Figure 10-16  Modulation Distribution Assembly, A2A44

[Block Diagram of Modulation Distribution Assembly, A2A44]
RF Generator Section

Frequency Generation

The A2A25 Signal Generator Synthesizer (figure 10-17 on page 294) develops a 500 MHz to 1000 MHz signal which is phase-locked to the 200 kHz reference from the A2A23 Reference Assembly (figure 10-21 on page 299). An out-of-lock indicator LED lights if the phase-lock-loop is out-of-lock. When you turn the Test Set’s power on, the LED lights for a few seconds then goes out. If it stays on or comes on again, the loop is out-of-lock.

The A2A44 Output Section assembly (figure 10-19 on page 296) develops the RF Generator’s 0.4 to 000 MHz frequency range by mixing, dividing, or passing the 500 MHz to 1000 MHz from the Signal Generator Synthesizer. The frequencies are derived as shown in table 10-2.

The A2A110 Upconverter assembly (figure 10-20 on page 297) develops the RF generator’s 1.2 to 2.0 GHz range by mixing the 800-1000 MHz signal from the output section with a 1.5-3.0 GHz LO.

Table 10-2

<table>
<thead>
<tr>
<th>Output Frequency</th>
<th>Derivation</th>
</tr>
</thead>
<tbody>
<tr>
<td>400 kHz - 250 MHz</td>
<td>mix</td>
</tr>
<tr>
<td>250 MHz - 500 MHz</td>
<td>divide</td>
</tr>
<tr>
<td>500 MHz - 1 GHz</td>
<td>pass</td>
</tr>
<tr>
<td>1.7 GHz - 2.0 GHz</td>
<td>mix</td>
</tr>
</tbody>
</table>
Level Control

The A2A44 Output Section assembly (figure 10-19 on page 296) has an automatic-level-control (ALC) loop that acts as a vernier control of RF level between \(-2\) and \(+9\) dBm. A step attenuator in the A2A130 RF Input/Output assembly takes the level down to \(-127\) dBm (\(-137\) dBm at the RF IN/OUT connector) in 5 dB steps.

Assemblies that affect output level calibration have factory-generated calibration data stored in the Test Set’s EEPROM. Calibration data is fed to digital-to-analog-converters which control level-adjustable devices in the RF path. These assemblies are:

- A2A200 100 W-Attenuator
- A2A130 RF Input/Output
- A2A24 Output Section

Modulation

Amplitude modulation (AM) is done on the A2A24 Output Section assembly. The modulating signal from the A2A44 Modulation Distribution assembly is applied to the ALC loop’s control voltage.

IQ modulation is done on the A2A120 LO IF/IQ Modulator assembly. The IQ signal from the A2A34 Data Buffer is modulated onto the RF signal from the A2A25 Signal Generator Synthesizer assembly.
Figure 10-17  Signal Generator Synthesizer Assembly, A2A25
Figure 10-18  IQ Modulator Assembly (Part of LO IF/IQ Modulator Assembly), A2A120
Figure 10-19  Output Section Assembly, A2A24
Figure 10-20  Upconverter Assembly, A2A110

[Diagram of upconverter assembly with various labels and connections, including SMA connectors, SMA cables, and different frequency ranges such as 170-1890 MHz, 1840-2000 MHz, -10 dBm, +8 dBm, 800-1000 MHz, off AMP, +1.5-3 GHz, LO-SPEED, I.O., VOLTAGE, MUX, CAL, ROM, CONTROL, MEAS, CHIRP, TRIG, DAC, P_OUT_DET, P_OUT_DET_GND, +9V, +40V, -12V, +12V, +5V, DATA, CLOCK, EN/I, RIBBON CABLE, and additional circuit components such as Amps and DACs.]
Reference/Regulator Section

Reference

All frequencies are derived from a 10 MHz reference which can come from an external reference or from a 10 MHz crystal oscillator on the A2A23 Reference assembly. There are two versions of the Reference assembly. The standard Reference assembly has a temperature compensated crystal oscillator (TCXO), and the Option 005 (High Stability Time Base) Reference assembly has an oven controlled crystal oscillator (OCXO). The A2A23 Reference assembly develops the local oscillator (LO) and reference signals needed by the assemblies that make up the RF generator, RF analyzer, spectrum analyzer, and the A2A33 Measurement assembly.

Power Supply Regulators

Power supply regulators are distributed to all of the modules and assemblies by the A3A1 Power Supply Regulator assembly through the motherboard.

Power Supply

The A3A2 Power Supply assembly is a switching type supply. The power supply generates five different dc supplies. They are:

- +5.5 Vdc
- +13.4 Vdc
- −13.4 Vdc
- +43.5 Vdc
- −12 Vdc AUX

Power Supply voltages are distributed to all of the modules and assemblies through the motherboard.
Figure 10-21  Reference Assembly, A2A23

REFERENCE ASSEMBLY, A2A23

10 MHz, TCXO OR OPTIONAL OCXO

1000 MHz ON/OFF

1000 MHz TO SIDE PANEL

2 DACS ADJUST

1000 MHz REF IN

OUT-OF-LOCK OVERRIDE

10 MHz REF IN

2.2 FREQ DOUBLER (2 x 10 MHz)

10 MHz to side panel

10 MHz TCXO

+12V AUX

+10M +50 REF OUT:
ARE < -90dBc SPURS
10M (RCVR) < -110 dBc > 5 kHz

REF TO SA

CMOS 10MHz TO

+12.4

-12.4

-10dBm

TO RCVR SSB BFO

10MHz TO SA

20MHz TO

COUNTER 20MHz TO

REF SYN RCVR

REF CMOS 1MHz TO

+5dBm

-10dBm

TO RCVR

TO SA

-110 dBc > 5 kHz

-90dBc SPURS

10MHz REF IN

(2 DACS ADJUST)

10MHz REF IN

+10M REF OUT:
ARE < -90dBc SPURS
10M (RCVR) < -110 dBc > 5 kHz

REF TO SA

CMOS 1MHz TO

+12.4

-12.4

TO RCVR SSB BFO

+10M REF OUT:
ARE < -90dBc SPURS
10M (RCVR) < -110 dBc > 5 kHz

REF TO SA

CMOS 1MHz TO

+12.4

-12.4

TO RCVR SSB BFO

10MHz REF IN

(2 DACS ADJUST)
Figure 10-22  Power Supply Regulator Assembly, A3A1
Instrument Control Section

Digital Control

The Test Set’s Digital Control is driven by two assemblies:

- A2A30 Memory/SBRC
- A2A31 Controller

The controller receives user control information by either the A2A70 Control Interface or by the front panel. Operating firmware on the A2A30 Memory/SBRC is then used by the A2A31 Controller to generate digital control for the Test Set. The digital control bus information is passed back to the A2A30 Memory/SBRC which controls most of the Test Set’s modules and assemblies.

Display

The Test Set’s Display data is first generated by the A7 Controller and then passed on to the A20 CRT drive. The A20 CRT drive converts the digital information into analog vertical and horizontal drive signals for the A22 CRT display. The A20 CRT drive also provides brightness and contrast signals for the A22 CRT display.
Figure 10-23  Memory/SBRC Assembly, A2A30

Block Diagrams
Instrument Control Section

- Memory/SBRC Assembly, A2A30
- Figure 10-23
- Memory/SBRC Assembly, A2A30
- Block Diagrams
- Instrument Control Section
**Figure 10-24**  Controller Assembly, A2A31
Error Messages
General Information About Error Messages

Several types of messages may be displayed on the Test Set’s screen. Error messages usually appear at the top of the start-up or default screen as shown in figure A-1.

Figure A-1 Error Message Location

Error messages descriptions can be found in the following manuals:

- HP 8935A Reference Guide
- HP 8935A Assembly Level Repair Manual (this manual)
- HP Instrument BASIC User’s Handbook (HP P/N E2083-9005)

The type of message determines which manual to refer to for more information. There are four types of messages:

- Positive numbered error messages
- IBASIC error messages
- HP-IB error messages
- Text only messages

The following paragraphs give a brief description of each message format and direct you to the manual to look in for information about error messages displayed in that format.

NOTE BEEPER OPERATION: Messages are always accompanied by a BEEP from the internal speaker, unless the Beep field on the INSTRUMENT CONFIGURE screen is set to Off.
CAUTION

IF YOU HEAR A LOUD SIREN OR WARBLING SOUND, THIS IS THE OVER POWER WARNING!

Remove any connections to the side panel RF IN/OUT, DUPLEX OUT, and ANTENNA IN connectors. NEVER turn off the Test Set while RF power is being applied to these connectors. After RF power is removed, turn the Test Set off and then back on. The Test Set should power up in its factory preset state (unless a POWERON Save/Recall register was saved). The siren should not come back on.
Power-Up Self-Test Error Messages

The following message is typical of an error message you might encounter on the Test Set’s power-up.

One or more self tests failed. Error code: 0080

In this example, the hexadecimal code 0080 corresponds to the error message “Keyboard Failure (stuck key).” For examples of other power-up error messages, see “Reading Front Panel or HP-IB Codes” on page 52.
Diagnostics Messages

The following message may occur when initiating and running the Functional Diagnostics program.

Direct latch write occurred. Cycle power when done servicing.

For other diagnostic messages see “Frequently Encountered Diagnostic Messages” on page 64.

When a measurement is out of limits, a message is displayed at the end of the test which indicates the following:

• Suspected faulty assembly.
• Confidence level of the assertion: low, medium, or high
• Failure code

For a description of the test, including an interpretation of the failure codes, see Chapter 3, “Troubleshooting” on page 43.
Calibration Download Failure Error Message

The following message occurs at powerup when the downloading of calibration data is unsuccessful.

Cal file checksum incorrect. File reset to default values.

It indicates that the calibration data is corrupt, and although the Test Set will function, measurements will be inaccurate. Calibration data is downloaded from a memory card when certain assemblies are replaced, or it is generated when the Periodic Calibration program is run. This message will not occur again at powerup unless another unsuccessful downloading occurs.
Flash ROM Firmware Upgrade Error Messages

Test Set's firmware is stored in flash ROMs. With flash ROMs, the firmware can be quickly upgraded with new firmware from a memory card. It is not necessary to open the Test Set and replace individual ICs. Should problems arise in the process of uploading the new firmware, the user is notified by messages on the display which state the situation and suggest any actions to be taken.

The firmware upgrade process begins when the user inserts the firmware upgrade memory card into the front-panel memory card socket and turns the Test Set on. The Test Set notes the presence of a valid firmware upgrade card and proceeds to upload the firmware on the memory card into the flash ROMs on the A16 Host Controller assembly. Any failures that occur during the upload process are immediately reported and the upload is aborted.

The error messages that may be displayed during a firmware upgrade are listed in alphabetical order in the following paragraphs. Supplemental fault information is included.

Memory Card Checksum Error
The memory card may be at fault. The card reader on the Memory board could also be faulty.

Memory Card Read Error
This error will always appear if the user removes the memory card during the upload process. The memory card itself could be faulty or, less likely, the card reader on the Memory board.

Memory Erase Error
This fault is most likely caused by either the flash ROMs themselves or the controller circuits. In either case replace the A16 Host Controller assembly.

Memory Write Error
This fault is most likely caused by either the flash ROMs themselves or the controller circuits. In either case replace the A16 Host Controller assembly.

Programming Voltage Error
The programming voltage is supplied to the flash ROMs from the power supply through the Controller assembly. The fault is most likely on the Controller but can be caused by the Filter/Regulator assembly.
Error Messages
Flash ROM Firmware Upgrade Error Messages

ROM Checksum Error

With the new firmware loaded into the Test Set’s flash ROMs, the checksum on the ROM is tested. A faulty checksum is most likely caused by the flash ROMs themselves or possibly the controller circuits. In either case replace the A16 Controller assembly.
Self-Calibration Error Messages

Voltmeter Self Calibration Failed. Error = 223, 0x0000ffff (EXAMPLE)

The example noted above is one of many messages that may occur during self-calibration. When the Test Set is powered up and at timed intervals for certain measurements, the Test Set calibrates itself internally. Calibration usually takes 20 to 30 ms. The following measurements are calibrated at these timed intervals:

- Voltmeter: approximately every 3 minutes
- Counter: approximately every 3 minutes
- Oscilloscope: approximately every 3 minutes
- Spectrum Analyzer: approximately every 4 minutes

Should a self-calibration fail, an error message is displayed. The error code (223, 0x0000ffff in the example above) will vary depending on the particular failure. Failures of this type are generally caused by hardware. Since a general self-calibration occurs immediately after power-up, these failures often appear as though they are power-up self-test errors.

When a self-calibration failure occurs, check the A37 Measurement assembly first since most of the measurement circuitry described above is located on it. However, in the case of the spectrum analyzer calibration, check the A32 Spectrum Analyzer assembly first. The A27 Reference assembly may also cause its own self-calibration failure or a Spectrum Analyzer error message. (The error message in the example above can be generated by unplugging the A27 Reference before powering up the Test Set.)

After displaying a self-calibration error message, the Test Set will proceed with the measurement using default calibration factors. Depending on the nature of the failure, subsequent measurements may look normal. The error message will persist.
Text Only Error Messages

Text only error messages are generally associated with manual operation of the Test Set. Text only error messages can also be displayed while running the Test Set’s built-in diagnostic or calibration utility programs. Diagnostic messages are described in "Frequently Encountered Diagnostic Messages" on page 64.

Text only error messages take the form:

This is an error message.

For example:

• Input value out of range - occurs when trying to set a value above or below its capability (such as attempting to set the RF Gen Freq field to 2 GHz).

• Turn off either AM or FM setting - occurs when trying to perform simultaneous AM and FM modulation.
Positive Numbered Error Messages

Positive numbered error messages usually occur when trying to save or retrieve an IBASIC file, or when trying to run a faulty IBASIC program. Refer to the HP Instrument BASIC User’s Handbook for information on IBASIC error messages.

Positive numbered error messages take the form:

```
ERROR XX "error message"
```

For example:

- Error 54 Duplicate file name - occurs when trying to save a file to a device where a file with the same name already exists.

- Error 5 Improper Context Terminator - occurs when an END, SUBEND, or FNEND statement is not present in the program when required.
IBASIC Error Messages

IBASIC Error Messages are associated with IBASIC language operation. IBASIC error messages can have both positive and negative numbers (but always start with "IBASIC Error:"), Refer to the HP Instrument BASIC User’s Handbook for information on positive numbered error messages. Refer to the HP-IB Error Messages section of the HP 8935 Reference Guide for information on negative numbered error messages (the error message associated with a negative number is the same for HP-IB errors and IBASIC errors).

IBASIC error messages take the form:

IBASIC Error: -XX error message

For example:

IBASIC Error: -286 Program runtime error
HP-IB Error Messages

HP-IB Error Messages are associated with HP-IB operation. Refer to the HP 8935 Reference Guide for information on HP-IB error messages.

HP-IB error messages take the form:

   HP-IB Error: -XX error message
or

   HP-IB Error error message

For example:

   HP-IB Error: -410 Query INTERRUPTED.
or

   HP-IB Error: Input value out of range.
Non-Recoverable Firmware Error

This error occurs when the Test Set encounters a condition that the firmware doesn't understand - causing the Test Set to halt operation until power is cycled. The message appears in the center of the Test Set’s display and (except for the two lines in the second paragraph) has the form:

Non-recoverable firmware error. Please record the 2 lines of text below and contact Hewlett Packard through your local service center or by calling 1-800-827-3848 (USA, toll-free) ask to speak to the 8935 Service Engineer.

'Address error exception'
at line number 0

Follow the instructions in the message.

Unfortunately, you cannot recover from this condition without turning the Test Set off. The error may not reoccur when you turn the Test Set back on and rerun the test where the error message first occurred. If the failure reoccurs, you should record exactly what the configuration of the instrument was when the error appeared, and contact HP. This information will help us determine the proper course of action for your repair.

If This Error Occurs at Power-Up

If the Test Set displays this error when first powered up, disabling Test Set operation, it could be related to the Autostart field on the main TESTS screen. This field causes the Test Set to automatically run the last program loaded in memory when the Test Set is powered up. If the program is corrupted, the Test Set will automatically “lock up.”

The only way to recover from this condition is to clear the Test Set’s operating RAM. This will clear any IBASIC program, Save/Recall registers, and RAM disks that have been saved, as well as three calibration factors. The calibration factors are easily re-entered; the IBASIC programs, Save/Recall registers, and RAM disks must be re-loaded or re-initialized after clearing memory.

To clear the Test Set’s RAM:

1. Turn the Test Set off.
2. Hold the Code Dom and Hz/V keys down.
3. Turn the power on (with the buttons still held down) and wait until the initial power-up screen is displayed.
Use the following procedure to re-enter the three calibration factors that were erased when RAM is cleared. Use the GENERATOR ANALYZER screen keys (to the left of the cursor control knob) to access the required screens.

1. Access the RF GENERATOR screen and select DC FM Zero (under the FM Coupling field).
2. Disconnect any cables from the ANT IN or RF IN/OUT connectors.
3. Access the RF ANALYZER screen and select Zero under the TX Pwr Zero field.
4. Access the AF ANALYZER screen and select Zero under the DC Current field.
Error Messages
Non-Recoverable Firmware Error
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<table>
<thead>
<tr>
<th>A</th>
<th>6 kHz BPF. See Audio Filters (A2A80A1, A2A80A2)</th>
</tr>
</thead>
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