Agilent Technologies E8285A CDMA Mobile Station Test Set

Assembly Level Repair

Firmware Version: A.01.29 to A.02.04 (100-1000, 1700-2000 MHz)
Firmware Version: A.04.53 and above (800-1000, 1700-2000 MHz)

Agilent Part Number E8285-90033

Revision C
Printed in U.S.A.
June 2000

Agilent Technologies
Innovating the HP Way
Notice

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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 a sound pressure emission (at the operator position) < 70 dB(A).

- Sound Pressure Lp < 70 dB(A).
- At Operator Position.
- Normal Operation.

Herstellerbescheinigung


- Schalldruckpegel Lp < 70 dB(A).
- Am Arbeitsplatz.
- Normaler Betrieb.
Safety Considerations

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.

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 circuited fuseholders.
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 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.
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.
Agilent Technologies Warranty Statement for Commercial Products

E8285A CDMA Mobile Station Test Set

Duration of Warranty: One Year

1. Agilent warrants Agilent hardware, accessories and supplies against defects in materials and workmanship for the period specified above. If Agilent receives notice of such defects during the warranty period, Agilent will, at its option, either repair or replace products which prove to be defective. Replacement products may be either new or like-new.

2. Agilent warrants that Agilent software will not fail to execute its programming instructions, for the period specified above, due to defects in material and workmanship when properly installed and used. If Agilent receives notice of such defects during the warranty period, Agilent will replace software media which does not execute its programming instructions due to such defects.

3. Agilent does not warrant that the operation of Agilent products will be uninterrupted or error free. If Agilent is unable, within a reasonable time, to repair or replace any product to a condition as warranted, customer will be entitled to a refund of the purchase price upon prompt return of the product.

4. Agilent products may contain remanufactured parts equivalent to new in performance or may have been subject to incidental use.

5. The warranty period begins on the date of delivery or on the date of installation if installed by Agilent. If customer schedules or delays Agilent installation more than 30 days after delivery, warranty begins on the 31st day from delivery.

6. Warranty does not apply to defects resulting from (a) improper or inadequate maintenance or calibration, (b) software, interfacing, parts or supplies not supplied by Agilent, (c) unauthorized modification or misuse, (d) operation outside of the published environmental specifications for the product, or (e) improper site preparation or maintenance.

7. TO THE EXTENT ALLOWED BY LOCAL LAW, THE ABOVE WARRANTIES ARE EXCLUSIVE AND NO OTHER WARRANTY OR CONDITION, WHETHER WRITTEN OR ORAL IS EXPRESSED OR IMPLIED AND AGILENT SPECIFICALLY DISCLAIMS ANY IMPLIED WARRANTIES OR CONDITIONS OF MERCHANTABILITY, SATISFACTORY QUALITY, AND FITNESS FOR A PARTICULAR PURPOSE.
8. Agilent will be liable for damage to tangible property per incident up to the greater of $300,000 or the actual amount paid for the product that is the subject of the claim, and for damages for bodily injury or death, to the extent that all such damages are determined by a court of competent jurisdiction to have been directly caused by a defective Agilent product.

9. TO THE EXTENT ALLOWED BY LOCAL LAW, THE REMEDIES IN THIS WARRANTY STATEMENT ARE CUSTOMER’S SOLE AND EXCLUSIVE REMEDIES. EXCEPT AS INDICATED ABOVE, IN NO EVENT WILL AGILENT OR ITS SUPPLIERS BE LIABLE FOR LOSS OF DATA OR FOR DIRECT, SPECIAL, INCIDENTAL, CONSEQUENTIAL (INCLUDING LOST PROFIT OR DATA), OR OTHER DAMAGE, WHETHER BASED IN CONTRACT, TORT, OR OTHERWISE.

FOR CONSUMER TRANSACTIONS IN AUSTRALIA AND NEW ZEALAND: THE WARRANTY TERMS CONTAINED IN THIS STATEMENT, EXCEPT TO THE EXTENT LAWFULLY PERMITTED, DO NOT EXCLUDE RESTRICT OR MODIFY AND ARE IN ADDITION TO THE MANDATORY STATUTORY RIGHTS APPLICABLE TO THE SALE OF THIS PRODUCT TO YOU.
DECLARATION OF CONFORMITY
according to ISO/IEC Guide 22 and EN 45014

Manufacturer’s Name: Agilent Technologies

Manufacturer’s Address: Spokane Division
24001 E. Mission Avenue
Liberty Lake, Washington 99019-9599
USA

declares that the product

Product Name: CDMA Mobile Station Test Set
Model Number: Agilent Technologies E8285A
Product Options: All

conforms to the following Product specifications:


EMC: CISPR 11:1990/EN 55011:1991- Group 1, Class A
IEC 61000-3-2:1995 / EN 61000-3-2: 1995
EN 50082-1:1992
IEC 801-3:1984 3V/m
IEC 801-4:1988 0.5 kV Sig. Lines, 1 kV Power Lines

Supplementary Information:

This product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC and carries the CE-marking accordingly.

Spokane, Washington USA November 20, 1998

Vince Roland
Reliability & Regulatory Engineering Manager

European Contact: Your local Agilent Technologies and Service Office or Agilent Technologies GmbH
Department ZQ/Standards Europe, Herrenberger Strasse 130, D-71034 Böblingen, Germany (FAX+49-7031-14-3143)
<table>
<thead>
<tr>
<th>Country</th>
<th>Address</th>
<th>Phone</th>
<th>Fax</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>Agilent Technologies Test and Measurement Call Center</td>
<td>(tel) 1 800 452 4844</td>
<td></td>
</tr>
<tr>
<td></td>
<td>P.O. Box 4026</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Englewood, CO 80155-4026</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canada</td>
<td>Agilent Technologies Canada Inc.</td>
<td>(tel) 1 877 894 4414</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5159 Spectrum Way</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mississauga, Ontario</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>L4W 5G1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Europe</td>
<td>Agilent Technologies European Marketing Organization</td>
<td>(tel) (3120) 547 9999</td>
<td></td>
</tr>
<tr>
<td></td>
<td>P.O. Box 999</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1180 AZ Amstelveen</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The Netherlands</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Japan</td>
<td>Agilent Technologies Japan Ltd. Measurement Assistance Center</td>
<td>(tel) (81) 456-56-7832</td>
<td>(fax) (81) 426-56-7840</td>
</tr>
<tr>
<td></td>
<td>9-1 Takakura-Cho, Hachioji-Shi, Tokyo 192-8510, Japan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Latin America</td>
<td>Agilent Technologies Latin America Region Headquarters</td>
<td>(tel) (305) 267 4245</td>
<td>(fax) (305) 267 4286</td>
</tr>
<tr>
<td></td>
<td>5200 blue Lagoon Drive, Suite #950</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Miami, Florida 33126</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>U.S.A.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australia/New Zealand</td>
<td>Agilent Technologies Australia Pty Ltd</td>
<td>(tel) 1 800 629 485 (Australia)</td>
<td>(fax) (61 3) 9272 0749</td>
</tr>
<tr>
<td></td>
<td>347 Burwood Highway</td>
<td>(tel) 0 800 738 378 (New Zealand)</td>
<td>(fax) (64 4) 802 6881</td>
</tr>
<tr>
<td>Asia Pacific</td>
<td>Agilent Technologies</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>19/F, Cityplaza One, 111 Kings Road, Taikoo shing, Hong Kong, SAR</td>
<td>(tel) (852) 2599 7899</td>
<td>(fax) (852) 2506 9233</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


Agilent Technologies E8285A Support Contacts

The documentation supplied with your Test Set is an excellent source of reference, application, and service information. Please use these manuals if you are experiencing technical problems:

Table 2 Support Documentation

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Application Guide</td>
<td>Assembly Level Repair</td>
</tr>
<tr>
<td>Reference Guide</td>
<td>CD-ROM</td>
</tr>
</tbody>
</table>

If you have used the manuals and still have application questions, contact your local Agilent Technologies Sales Representative.

Repair assistance is available for the Agilent E8285A CDMA Mobile Station Test Set from the factory by phone and e-mail. External and internal Agilent users can contact the factory via email. Parts information is also available from Agilent.

When calling or writing for repair assistance, please have the following information ready:

- Instrument model number (E8285A)
- Instrument Serial Number (tag located on the rear panel).
- Installed options - if any (tag located on the rear panel).
- Instrument firmware revision (displayed at the top of the screen when the Test Set is powered up, and is also displayed on the CONFIGURE screen).

Support Telephone Numbers:

1 800 827 3848 (RF Comms Service Assistance, U.S. only)
1 509 921 3848 (RF Comms Service Assistance, International)
1 800 227 8164 (Agilent Direct Parts Ordering, U.S. only)
1 800 403 0801 (Agilent Instrument Support Center, U.S. only)
1 916 783 0804 (Agilent Service Parts Identification, U.S. & Intl.)
## Power Cables

### Table 3

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

**Used in the following locations:**

- Bangladesh, Belgium, Benin, Bolivia, Bozna-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. Pierre Islands
<table>
<thead>
<tr>
<th>Plug Type</th>
<th>Plug Descriptions male/female</th>
<th>Agilent Part # (cable &amp; plug)</th>
<th>Cable Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweden, Syria</td>
<td>Straight/Straight Straight/90°</td>
<td>8120-0698</td>
<td>90 inches, black</td>
</tr>
<tr>
<td>Tajikistan, Thailand, Togo, Tunisa, Turkey, Turkmenistan</td>
<td>Straight/Straight Straight/90°</td>
<td>8120-2104 8120-2296</td>
<td>79 inches, gray 79 inches, gray</td>
</tr>
<tr>
<td>USSR, Ukraine, Uzbekistan</td>
<td>Straight/Straight Straight/90°</td>
<td>8120-0698</td>
<td>90 inches, black</td>
</tr>
<tr>
<td>Western Africa, Western Sahara</td>
<td>Straight/Straight Straight/90°</td>
<td>8120-0698</td>
<td>90 inches, black</td>
</tr>
<tr>
<td>Yugoslavia</td>
<td>Straight/Straight Straight/90°</td>
<td>8120-0698</td>
<td>90 inches, black</td>
</tr>
<tr>
<td>Zaire</td>
<td>Straight/Straight Straight/90°</td>
<td>8120-0698</td>
<td>90 inches, black</td>
</tr>
</tbody>
</table>

**Table 4**

**Table 5**
<table>
<thead>
<tr>
<th>Plug Type</th>
<th>Plug Descriptions male/female</th>
<th>Agilent Part # (cable &amp; plug)</th>
<th>Cable Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Straight/Straight</td>
<td>125V 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 Islands, 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 U.S.
- Wake Island
### Table 7

<table>
<thead>
<tr>
<th>Plug Type</th>
<th>Plug Descriptions male/female</th>
<th>Agilent 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 8

<table>
<thead>
<tr>
<th>Plug Type</th>
<th>Plug Descriptions male/female</th>
<th>Agilent 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 9

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

**Used in the following locations:**
- Botswana
- India
- Lesotho
- Malawi
- South-West Africa (Namibia), Switzerland
- Zambia, Zimbabwe

### Table 10

<table>
<thead>
<tr>
<th>Plug Type</th>
<th>Plug Descriptions male/female</th>
<th>Agilent Part # (cable &amp; plug)</th>
<th>Cable Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earth Ground Neutral Line Earth Ground Neutral</td>
<td>Straight/Straight Straight/Straight 90° Straight/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
### Table 11

<table>
<thead>
<tr>
<th>Plug Type (Male)</th>
<th>Plug Descriptions male/female</th>
<th>Agilent Part # (cable and plug)</th>
<th>Cable Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="icon.png" alt="Diagram" /></td>
<td>90°/Straight 90°/90°</td>
<td>8120-1351 8120-1703</td>
<td>90 inches, mint gray 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>
<thead>
<tr>
<th>Plug Type</th>
<th>Plug Descriptions male/female</th>
<th>Agilent Part # (cable &amp; plug)</th>
<th>Cable Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Straight/Straight</td>
<td>8120-1369</td>
<td>79 inches, gray</td>
</tr>
<tr>
<td></td>
<td>Straight/90°</td>
<td>8120-0696</td>
<td>80 inches, gray</td>
</tr>
<tr>
<td>Used in the following locations:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Argentina, Australia</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>China (People's Republic)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New Zealand</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Papua New Guinea</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uruguay</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Western Samoa</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
ATTENTION
Static Sensitive Devices

This instrument was constructed in an ESD (electro-static discharge) protected environment. This is because most of the semi conductor 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.
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1 Introduction

This manual explains how to repair and calibrate the Agilent Technologies E8285A CDMA/PCS Mobile Station Test Set; called the “Test Set” throughout this manual.

Throughout this manual you will see this note:

NOTE

Test Sets with firmware revision A.04.5X and above operate only at RF frequencies from 800 to 1000 MHz and 1700 to 2000 MHz. A text only error message “Input value out of range”, will be displayed if invalid frequencies are set.

The purpose of this note is to bring attention to RF frequency band coverage provided by firmware revision A.04.5X and above. Test Sets with firmware revision A.02.XX and below can operate at RF frequencies from 100 (usable to 30 MHz) to 1000 and 1700 to 2000 MHz.
Test Set Description

Several analog and digital test instruments are integrated into the E8285A CDMA Mobile Station Test Set to test Code Division Multiple Access (CDMA) digital cellular, PCS, and several types of analog mobile phones, such as AMPS, NAMPS, and TACS.

Figure 1-1  The E8285A CDMA Mobile Station Test Set

Some of the instrument functions in the Test Set include:

- Synthesized AM, FM, and IQ modulation signal generator
- AM, FM and IQ modulation analyzer
- Duplex offset signal generator
- SSB demodulator
- RF power meter
- Audio and RF frequency counter and RF frequency error meter
- AC and DC voltmeter
- Distortion, SINAD, and signal-to-noise-ratio meters
- Two variable audio sources
- Oscilloscope
- Spectrum analyzer and tracking generator (optional)
- Signaling encoder and decoder
- DC current meter
Some of these functions are directly replaceable assemblies (such as the spectrum analyzer); some functions are digitally derived from other assemblies (such as the oscilloscope). Most of the replaceable assemblies are plug-in components.

Most instrument functions can be controlled by front-panel (local) controls and by remote commands (using a connected controller). Power on/off, volume, and squelch controls cannot be accessed remotely. Controls are grouped together on display screens that are usually associated with a specific task (such as making a call to a CDMA mobile phone).

An Instrument BASIC (IBASIC) controller is also built into the Test Set to allow automated operation without using an external controller. This computer also has the ability to be a system controller to other test system instruments. Refer to the Test Set’s user’s guide for information on using the IBASIC computer (also referred to as the IBASIC controller).
Product Description

The E8285A CDMA Mobile Test Set is designed to meet the needs of Cellular Provider Point of Sale Retailers, manufacturing customers, and other customers who require CDMA Mobile Phone test capability. The Test Set is very similar to its predecessor, the Agilent Technologies 8924C with the addition of newly designed RF I/O module, upconverter and downconverter assemblies. These assemblies extend the Test Set frequency range to cover the 1800-1900 MHz PCS Cellular band as well as providing standard 800 MHz cellular band coverage.

Internal Operating System

A Motorola® 68020 – 33 MHz microprocessor acts as the host processor of the Test Set. It receives commands from the front-panel controls and communicates directly with almost every assembly inside the Test Set. The host is also in constant communication with several other microprocessors located throughout the Test Set.

Communications to the GPIB, serial, and parallel ports are through the control interface assembly to the host processor.

This processor is also the core for the internal IBASIC computer. The IBASIC computer is used to load and run various software packages for automated radio tests. It is also responsible for executing the internal diagnostic routines used to troubleshoot a failing instrument.

Instrument Frequency References

The Test Set reference timebase path consists of two assemblies, an ovenized high stability reference assembly and a CDMA reference assembly. These two assemblies provide all frequency, phase, and timing signals used to accurately synthesize all of the Test Set’s source and analysis signals. A master reference signal can originate from either an external source at the 10 MHz input on the rear panel, or from the internal 10 MHz phase locked loop oscillator located on the high stability reference assembly. The high stability reference assembly provides timebase references for the analog assemblies and a 10 MHz reference signal to the CDMA reference assembly. The CDMA reference assembly uses this signal to generate clock and timing signals for internal CDMA assemblies, provide the 10 MHz output signal to the rear panel, and generate the AWGN (Additive White Gaussian Noise) I & Q noise source signals.
Figure 1-2  Reference Signal Generation

Rear Panel External Reference In 1, 2, 5, 10 MHz

OCXO High Stability Reference Assembly

10 MHz In

Rear Panel External Reference Out 10 MHz

CDMA Reference Assembly

AWGN

To internal analog assemblies. See block diagrams for more information.

To I/Q Modulator Assembly

To internal digital assemblies. See block diagrams for more information.
RF Analysis

RF signals connected to the front panel RF IN/OUT connector or ANTENNA IN connector go to the RF I/O module. The signal level and RF frequency are measured, and the level is adjusted using fixed step and variable attenuators in the separate downconverter module.

CAUTION Over-Power Damage

The ANTENNA IN connector is only used for very low level signals (60 mW or less), and cannot be used for Transmitter (TX) Power measurements. Exceeding this limit may destroy the RF I/O module. The RF IN/OUT connector is used to measure direct mobile transmitter power up to 2.5 Watts continuous.

The downconverter mixes the input signal with a local oscillator signal from the Receiver Synthesizer assembly to produce a 114.3 MHz, 614.3, or 385.7 MHz IF signal (depending on the frequency of the received signal). The signal goes through a bandpass filter and then on to the Receiver assembly.

If the IF is 614.3 or 385.7 MHz, the Receiver assembly mixes the signal with a 500 MHz local oscillator (LO) signal from the Reference assembly to obtain the 114.3 MHz IF. If the IF is 114.3 MHz, the signal bypasses this downconversion. The 114.3 MHz signal divides into two paths.

Figure 1-3 Received Signal Downconversion

![Diagram of Received Signal Downconversion](image)
AM, FM, or SSB Modulation Analysis

For AM, FM, or SSB signals, the 114.3 MHz signal is downconverted to 10.7 MHz and routed through a user-selected IF bandpass filter (15 kHz or 230 kHz) that is centered around the 10.7 MHz IF. AM and SSB signals are demodulated at this point; FM signals are downconverted to a 700 kHz IF before demodulation. The demodulated signal is routed to the Audio Analyzer 1 assembly for audio frequency filtering. This assembly is also connected to the front-panel AUDIO IN connector for direct audio measurements. Several low pass and high pass filters can be selected, as well as a C-Message or optional CCITT bandpass filter. Frequency and voltage measurements are then made on this signal by the Measurement assembly. The signal is then routed to the Audio Analyzer 2 assembly.

The Audio Analyzer 2 assembly routes the signal through a user-selectable detector. A variable frequency notch filter may also be selected for SINAD and distortion measurements. The detector’s signal is then sent to several other assemblies:

- The Measurement assembly measures and displays the modulation level (such as FM deviation) and provide the input to the oscilloscope.
- The Signaling Source Analyzer assembly for signaling decoding.
- The rear-panel AUD MONITOR OUTPUT connector for external use of the demodulated signal.
- The front-panel VOLUME control and internal speaker to listen to the demodulated signal.

Figure 1-4 AM, FM, and SSB Signal Demodulation and Filtering
CDMA Signal Analysis

The 114.3 MHz IF also goes to the CDMA LO/IF Demodulation assembly. This assembly provides a through path to the spectrum analyzer (Option 102) for all RF signals, and also provides down conversion for CDMA signals, measurements and call processing.

To downconvert the CDMA signal, the 114.3 MHz IF is mixed with a 117.9864 MHz local oscillator (LO) signal to produce a 3.6864 MHz IF. (The LO signal is from an oscillator that is phase locked to a 10 MHz signal from the CDMA Reference module.)

The 3.6864 MHz signal is split and goes to the Receiver DSP assembly, and also through a variable-gain IF amplifier before IQ demodulation. The demodulated I and Q baseband signals are then routed to the Digital Cellsite assemblies.

Under control from the Protocol Processor assembly, the Digital Cellsite assemblies use the demodulated IQ information to set up and maintain calls to CDMA phones. The Digital Cellsite 1 assembly also supplies feedback to the CDMA LO/IF Demodulation assembly to control the level of the variable-gain IF amplifier into the demodulator.

The Receive DSP assembly converts, digitizes, and provides final analysis on the 3.6864 MHz signal to make measurements, such as rho, timing accuracy, carrier feedthrough, and phase error.

Figure 1-5 Analyzing CDMA Signals
RF Signal Generation

The Signal Generator Synthesizer assembly creates a 500 to 1000 MHz signal. The reference signal for the synthesizer is supplied by the High Stability Reference assembly. The synthesizer's frequency is varied using a divider network in the feedback circuit of the phase locked loop. Any FM modulation signal (from the Modulation Distribution assembly), and the frequency sweep signal for the spectrum analyzer and tracking generator, are integrated into this feedback loop. If a CDMA signal is not being generated, the 500-1000 MHz signal is passed through the I/Q Modulator assembly, bypassing the I/Q modulator.

IQ Modulation

If a CDMA signal is being generated, the signal is I/Q modulated in the I/Q Modulator assembly, using data from the Analog Cellsite assembly. The Analog Cellsite assembly gets its data from the two Digital Cellsite assemblies, which are controlled by the Protocol Processor assembly. Up to eight code channels of CDMA modulation data and noise may be summed into the IQ modulator at one time. These channels provide phone paging, synchronization, voice (traffic) transmission, and other CDMA system functions.

Final Frequency Conversion and Leveling

NOTE

Test Sets with firmware revision A.04.5X and above operate only at RF frequencies from 800 to 1000 MHz and 1700 to 2000 MHz. A text only error message “Input value out of range”, will be displayed if invalid frequencies are set.

The RF Output assembly performs three tasks:

- Mixes or divides the 500 to 1000 MHz signal to produce signals below 500 MHz (down to 30 MHz). A 1 GHz LO from the Reference assembly is used for mixing.
- Provides AM modulation (when selected).
- Controls the signal level out of the assembly using an Automatic Level Control (ALC) loop.

The signal from the RF Output assembly is sent to one of two paths in the Upconverter assembly. RF frequencies from 30 MHz to 1 GHz route through the bypass path. PCS frequencies are upconverted to supply frequencies from 1700 to 2000 MHz. The user-selected frequency contains desired modulation (AM, FM, or CDMA), or a continuous wave (CW) signal. The level has been adjusted to provide the required level (after going through RF I/O assembly).
RF and Duplex Outputs

NOTE

Test Sets with firmware revision A.04.5X and above operate only at RF frequencies from 800 to 1000 MHz and 1700 to 2000 MHz. A text only error message “Input value out of range”, will be displayed if invalid frequencies are set.

The RF I/O assembly receives the signal from the Upconverter assembly and routes it to the selected output connector: RF IN/OUT or DUPLEX OUT. The signal first goes to a variable attenuator for level control.

If the DUPLEX OUT connector is selected, the signal then goes directly to that connector without additional attenuation. If the RF IN/OUT connector is used as an output, the signal passes through additional attenuation before reaching the connector. This is why a greater signal level can be output through the DUPLEX OUT connector than through the RF IN/OUT connector.
**Figure 1-6  RF Generation Path Overview**

**Signal Generator Synthesizer**
- 1 MHz from Reference Assembly
- FM Mod. from Mod. Dist.
- Spec. Analyzer Sweep
- Protocol Processor

**IQ Modulator Assembly**
- 500-1000 MHz
- 4 channels of I&Q data
- ADC & Summing
- AWGN (Noise) from CDMA Reference

**Output Assembly**
- 500-1000 MHz (main band)
- 250-500 MHz (÷2 band)
- 250 kHz-250 MHz (downconverted band)
- 1 GHz from Reference Assembly

**Upconverter Assembly**
- Amplitude Modulator
- RF Amp
- Automatic Level Control
- RF Amplitude Adjust from Host Controller

**RF I/O Assembly**
- Variable Step Attenuator
- DUPLEX OUT
- RF IN/OUT
- To the Receiver Assembly
Troubleshooting Strategy

You can repair the Test Set yourself or send it to your local Agilent Technologies Instrument Support Center. Before starting a repair, you should become familiar with basic Test Set operation using the user’s guide.

Troubleshooting relies on built-in diagnostics. Because some diagnostic results may be ambiguous, further interpretation and testing may be required. There are several diagnostic routines built into the Test Set:

- Power-up self-test diagnostics to test controller functioning. These are automatically run when the instrument is turned on, and can also be run after the instrument has been on.
- RF (Radio Frequency) assembly diagnostics.
- AF (Audio Frequency) assembly diagnostics.
- Digital assembly diagnostics for CDMA signals.

Troubleshooting hints in this manual include:

- Instructions on how to begin troubleshooting (see chapter 2, "Troubleshooting").
- Block diagrams and theory of operation (this chapter and chapter 8, "Block Diagrams").
- Detailed information about the built-in diagnostics (see chapter 2, "Troubleshooting").
- Error message explanations (see chapter 10, "Error Messages").
Repair Process

Repairing the Test Set consists of:

- Identifying the faulty assembly – see chapter 2, "Troubleshooting"
- Ordering a replacement assembly – see chapter 3, "Disassembly and Replaceable Parts"
- Replacing the faulty assembly – see chapter 3, "Disassembly and Replaceable Parts"
- Downloading calibration data – see chapter 2, "Troubleshooting" and regenerating calibration data – see See “System Power Calibration Program” on page 39.
- Performing periodic calibration – see chapter 5, "Periodic Adjustments/Calibration"
- Functional Verification – see chapter 4, "Functional Verification"
Calibration and Performance Verification

The Test Set periodically requires some maintenance to verify that it meets its published specifications. See “Periodic Adjustments” on page 126. Periodic Adjustments (calibration) consists of running several built-in calibration programs. The recommended interval for periodic adjustments is 12 months. An external frequency counter and dc voltmeter are required. See Chapter 5, "Periodic Adjustments/Calibration" on page 5.

NOTE
The recommended Test Set calibration interval is 24 months. This is accomplished by performing the performance tests (see Chapter 6, “Performance Tests,” on page 141) or sending the Test Set to an Agilent Calibration Center or other qualified calibration lab.

The performance tests verify that the Test Set performs as indicated in the Specifications. These tests should be performed if the Test Set's operation is suspect, even though it passes all internal diagnostic checks. This identifies whether a problem actually exists in the Test Set, or if an application problem exists outside of the Test Set.

Several assemblies, when replaced, require running specific periodic calibration procedures to create calibration factors for that assembly. In other cases, the calibration data will be included with the replacement assembly on a memory card. Instructions that come with the replacement assembly explain how to download the calibration data. (This is not considered part of periodic calibration.)

NOTE
When troubleshooting the Test Set, it is sometimes desirable to swap a known-good assembly (perhaps from another Test Set) for a suspected-faulty assembly. If the swapped assembly requires calibration data, most assemblies will operate well enough with the original assembly’s calibration data to troubleshoot and run the diagnostics. However, do not expect the Test Set to meet its specifications. Also, some assemblies may appear to fail because of the incorrect calibration data.
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. 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 GPIB port. An optional printer can be connected to the Test Set's GPIB, 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 GPIB 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 the Tests key to access the TESTS (Main 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 (K1 key).
9. Follow the instructions on the screen.
Test Equipment Needed for the System Power Calibration Program

For the System Power Calibration program you will need the equipment listed in table 1-1. Because this calibration program is written specifically for this equipment, no substitutions are possible.

Table 1-1 Equipment List for System Power Calibration Program

<table>
<thead>
<tr>
<th>Equipment Type</th>
<th>Agilent Technologies Model Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signal Generator</td>
<td>8648B Option 1EA</td>
</tr>
<tr>
<td>Power Meter</td>
<td>436A</td>
</tr>
<tr>
<td></td>
<td>437B</td>
</tr>
<tr>
<td></td>
<td>438A</td>
</tr>
<tr>
<td></td>
<td>EPM-441A</td>
</tr>
<tr>
<td></td>
<td>EPM-442A</td>
</tr>
<tr>
<td></td>
<td>8901B</td>
</tr>
<tr>
<td></td>
<td>8902A</td>
</tr>
<tr>
<td>Power Sensor</td>
<td>8482A</td>
</tr>
<tr>
<td></td>
<td>ECP-E18A</td>
</tr>
<tr>
<td></td>
<td>11722A</td>
</tr>
<tr>
<td>Power Splitter</td>
<td>11667A</td>
</tr>
<tr>
<td>GPIB Cables (2 cables required, 3 if GPIB printer is used.)</td>
<td>Any GPIB cable</td>
</tr>
<tr>
<td>Printer (optional)</td>
<td>Any serial, parallel, or GPIB printer</td>
</tr>
</tbody>
</table>
E 8285A Support Contacts

The documentation supplied with your Test Set is an excellent source of reference, applications, and service information. Please use these manuals if you are experiencing technical problems:

- Operation and reference information are included in the E 8285A CDMA Mobile Station Test Set User’s Guide (p/n E 8285-90018).
- Calibration and repair information in this manual.

If you have used the manuals and still have application questions, contact your local representative.

Repair assistance is available from the factory by phone and email. Internal Agilent Technologies users can contact the factory through email. Parts information is also available from Agilent Technologies. When calling or writing for repair assistance, please have the following information ready:

- Instrument model number
- Instrument serial number; tag located on the rear panel.
- Installed options - if any; tag located on the rear panel.
- Instrument firmware revision; displayed at the top of the screen when the Test Set is powered up, and is also displayed on the CONFIGURE screen.

Support Telephone Numbers and Email Address

- Call Center .................................................................1-800-922-8920
- Instrument Support Center ........................................1-800-403-0801
- RF Comms Service Assistance, International .........................1-509-921-3848
  U.S. only ...............................................................................1-800-827-3848
- Service Parts Identification, U.S. & International ....................1-916-783-0804
- Direct Parts Ordering, U.S. only ...........................................1-800-227-8164
- Email .................................................................Spokane_Service@agilent.com
Hardware and Firmware Enhancements

NOTE

Test Sets with firmware revision A.04.5X and above operate only at RF frequencies from 800 to 1000 MHz and 1700 to 2000 MHz. A text only error message “Input value out of range”, will be displayed if invalid frequencies are set.

The hardware and firmware of the Test Set are enhanced on a continuous basis. If an assembly is replaced, it is recommended that the firmware be upgraded at the same time. This is important if an assembly-level repair is performed because exchange assemblies, which may be of a later revision than the one being replaced, may require a later revision of the firmware to function correctly.
Ordering New Manuals

The Test Set is designed to allow future upgrades to hardware and firmware which may obsolete some of the material in this manual. For the latest document revisions and information, call the Direct Parts Ordering office (U.S. only), 1-800-227-8164.

For local and remote operating information, including descriptions of all controls, connectors, and programming syntax, refer to the E8285 User’s Guide, part number E8285-90018.

For application information refer to the E8285 Application Guide, p/n E8285-90019. Also, all manuals are available on CD-ROM, p/n E8285-10003.
Introduction

Ordering New Manuals
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 Agilent Technologies for service assistance. General troubleshooting steps are illustrated in figure 2-2 on page 47.

NOTE
Periodic Adjustment Interval

The calibration programs Periodic Calibration, IQ Calibration and IQ Demod Path Calibration should be performed after the replacement of any assembly referred to in table 5-1, "Assembly Calibration Information" on page 127, or at least every 24 months. See Chapter 5, "Periodic Adjustments/Calibration" on page 125 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 (DIAG) LEDs 0, 1, 2, and 3 viewable digital controller unit, see figure 2-1 (you must remove the external and top-internal covers to view the LEDs).

Figure 2-1 LEDs
How to Troubleshoot the Test Set

Power-up the Test Set to run self diagnostics.

Is display blank?

YES

Fan is not running or does Test Set shut off after a few seconds?

YES

1. Check for a faulty fan.
2. Check for a faulty power supply.
3. Check for a faulty assembly pulling down line voltage.

NO

NO

1. Check EL Display or ribbon cable.
2. Check display driver.

Does a self test error message appear?

YES

Refer to “Reading Front Panel or GPIB Codes” on page 51.

NO

Is error code SRBC or miscellaneous hardware related?

YES

Turn off Test Set and remove external and internal top covers. Power-up Test Set and read Status LEDs for Self-Test errors. Refer to “Reading LED Codes” on page 53.

NO

Run the Functional Diagnostics on the SERVICE MENU. See “AF, RF, and CDMA Diagnostics” on page 64.

Problem detected?

YES

Repair Test Set according to the diagnostic recommendations.

NO

If you still suspect a problem, use the manual troubleshooting procedures. See “Manual Troubleshooting Procedures” on page 70.

Problem detected?

YES

Repair Test Set according to findings.

NO

Perform the functional verification tests, refer to Chapter 4, “Functional Verification” on page 111.

All OK?

YES

END

NO
Troubleshooting
Self-Test Diagnostics

Self-Test Diagnostics

On power-up the Test Set runs a diagnostic self-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 and the digital controller board (you must remove the external and top-internal covers to view the LEDs).

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 board, see figure 2-1 on page 46. The Test Set’s cover must be removed to view these LEDs. See Chapter 3, “Disassembly and Replaceable Parts,” on page 83 for disassembly and replacement instructions.

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

3. The test runs when the Self Test menu item of the Functional Diagnostics menu is selected.

To Start Troubleshooting

NOTE
Test Sets with firmware revision A.04.5X and above operate only at RF frequencies from 800 to 1000 MHz and 1700 to 2000 MHz. A text only error message “Input value out of range”, will be displayed if invalid frequencies are set.

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

   • If the Test Set does not power up, see "If the Test Set Fails to Power-up" on page 49.

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

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.

   • If the Test Set powers-up with “One or more self-tests failed. Error code:<hexadecimal error code>:”, see "Reading Front Panel or GPIB Codes" on page 51.

   • See "Frequently Encountered Diagnostic Messages" on page 68 for other error messages that might appear on the second line of the display.

3. The CDMA CALL CONTROL 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 Test Set 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 **Tests** 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**.

**If the Test Set Fails to Power-up**

1. Is the Test Set plugged in? Listen for fan operation. If you don’t hear it, check the line fuse, see **figure 2-3**.

2. 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 2-5 on page 51**). 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. (Also, see step 5.)

3. Check the LEDs on the Controller assembly, see **figure 2-5 on page 51**. 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 assembly is faulty.
4. 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 outputs, the Controller may be failing. Check TP2 on the Controller for +5V. If +5V is present, the Controller assembly is faulty.

5. If there is no display, but VIDEO OUT port on the rear panel has the signal shown in figure 2-4, then the Display assembly is faulty. If the signal is not present, then Display Drive assembly is faulty.

Figure 2-4 VIDEO OUT Signal
Reading Front Panel or GPIB 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.
<table>
<thead>
<tr>
<th>Detected Failure</th>
<th>Failed Assembly</th>
<th>Returned Error Code</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><strong>Hexadecimal</strong> (displayed)</td>
</tr>
<tr>
<td>Microprocessor</td>
<td>Digital Controller</td>
<td>0002</td>
</tr>
<tr>
<td>ROM</td>
<td>Digital Controller</td>
<td>0004</td>
</tr>
<tr>
<td>RAM</td>
<td>Memory/SBRC</td>
<td>0008</td>
</tr>
<tr>
<td>RAM</td>
<td>Memory/SBRC</td>
<td>0010</td>
</tr>
<tr>
<td>Timer</td>
<td>Controller</td>
<td>0020</td>
</tr>
<tr>
<td>Real-Time Clock</td>
<td>Memory</td>
<td>0040</td>
</tr>
<tr>
<td>Keyboard (stuck key)</td>
<td>Keypad a</td>
<td>0080</td>
</tr>
<tr>
<td>RS-232 I/O</td>
<td>Memory/SBRC</td>
<td>0100</td>
</tr>
<tr>
<td>Serial Bus Communication</td>
<td>Any Non-Optional assembly b</td>
<td>0200</td>
</tr>
<tr>
<td>Signaling Board Self-Test</td>
<td>Signaling Source/Analyzer</td>
<td>0400</td>
</tr>
<tr>
<td>Display Drive Self-Test</td>
<td>Display Drive</td>
<td>0800</td>
</tr>
<tr>
<td>Miscellaneous Hardware</td>
<td>Several Possible Assemblies c</td>
<td>1000</td>
</tr>
</tbody>
</table>

a. Could also be the digital controller with a faulty key-down detector.
b. This checks the ability of the digital controller to communicate with any hardware on the bus.
c. This message occurs if expected hardware is absent or not responding to the digital 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 digital controller assembly. The failure codes are sent out as code sequences. Figure 2-6, "Reading the Self-Test Diagnostic. The Internal LEDs," on page 54 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.

**NOTE**

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 2-1, "Return Values for Self-Test Diagnostic Failures" on page 52. Figure 2-7, "First LED Patterns," on page 55 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 2-8, "Non-blinking LED Codes For Serial Bus Communication Failure," on page 56 and figure 2-9, "Non-Blinking LED Codes for Miscellaneous Hardware Failure," on page 57.

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 2-6 on page 54).

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 2-1, "Return Values for Self-Test Diagnostic Failures" on page 52 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.)
Troubleshooting
Self-Test Diagnostics

Figure 2-6  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 on the digital controller board (see below) and compare with the patterns below.

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

<table>
<thead>
<tr>
<th>LED Legend</th>
</tr>
</thead>
<tbody>
<tr>
<td>● = off</td>
</tr>
<tr>
<td>☀ = rapid blink</td>
</tr>
<tr>
<td>☀ = steady on or slow blink</td>
</tr>
</tbody>
</table>

### LED Sequences

**No Failures...**
- The LEDs will light for approximately 10 seconds, then all will turn off.

**Failures... three patterns are displayed:**
- The first blinks rapidly and indicates the type of failure.
  - **0 1 2 3**

- The second and third patterns blink slowly and indicate failure details.
  - **0 1 2 3**

See the following tables. (This example indicates a Serial Bus Communication problem.)

### Digital Controller Board

![Diagram of Digital Controller Board]
# Troubleshooting
## Self-Test Diagnostics

### Figure 2-7 First LED Patterns

<table>
<thead>
<tr>
<th>LED Pattern</th>
<th>Failure Location</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>0</strong> ● ● ●</td>
<td>Microprocessor</td>
</tr>
<tr>
<td>● ⚡ ● ●</td>
<td>ROM Checksum (See note 1.)</td>
</tr>
<tr>
<td>⚡ ⚡ ● ●</td>
<td>RAM (See note 2.)</td>
</tr>
<tr>
<td>● ● ⚡ ●</td>
<td>RAM (See note 3.)</td>
</tr>
<tr>
<td>⚡ ● ⚡ ⚡</td>
<td>Timer</td>
</tr>
<tr>
<td>● ⚡ ⚡ ⚡</td>
<td>Real-Time Clock</td>
</tr>
<tr>
<td>⚡ ⚡ ⚡ ⚡</td>
<td>Keyboard (stuck key or faulty key-down detector)</td>
</tr>
<tr>
<td>● ● ⚡ ⚡</td>
<td>Control Interface (See note 4.)</td>
</tr>
<tr>
<td>⚡ ● ⚡ ⚡</td>
<td>Serial Bus Communication (see figure 2-8 on page 56)</td>
</tr>
<tr>
<td>● ⚡ ⚡ ⚡</td>
<td>Signaling Board Self Test</td>
</tr>
<tr>
<td>⚡ ⚡ ⚡ ⚡</td>
<td>Display Drive Self Test</td>
</tr>
<tr>
<td>● ● ⚡ ⚡</td>
<td>Miscellaneous Hardware (see figure 2-9 on page 57)</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 Memory/SBRC board RAM failure
   - 0001 and 0002 for Controller board RAM failure

3. Second and third LED failure patterns:
   - 0001 and 0001 for Memory/SBRC board RAM failure
   - 0001 and 0101 for Memory/SBRC board RAM failure

4. Second and third LED failure patterns for Control Interface:
   - 0001 and 0001 for Serial Port 9 failure
   - 0001 and 0010 for Serial Port 10 failure
   - 0001 and 0101 for Serial Port 11 failure
   - 0001 and 0100 for Serial Port 14 failure
   - 0001 and 1101 for Parallel Port 15 failure
   - 0001 and 1110 for Parallel Port 16 failure
### Troubleshooting

#### Self-Test Diagnostics

**Figure 2-8** Non-blinking LED Codes For Serial Bus Communication Failure

<table>
<thead>
<tr>
<th>LED Patterns</th>
<th>Failure Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>:star: ● ● ●</td>
<td>Modulation Distribution</td>
</tr>
<tr>
<td>● :star: ● ●</td>
<td>Output Section</td>
</tr>
<tr>
<td>:star: :star: ● ●</td>
<td>Audio Analyzer 1</td>
</tr>
<tr>
<td>● ● :star: ● ●</td>
<td>Audio Analyzer 2</td>
</tr>
<tr>
<td>:star: ● :star: ● ●</td>
<td>Reference</td>
</tr>
<tr>
<td>● ● :star: ● ● ●</td>
<td>RF Input/Output</td>
</tr>
<tr>
<td>:star: :star: :star: ● ●</td>
<td>Downconverter</td>
</tr>
<tr>
<td>● ● ● :star: ●</td>
<td>Receiver</td>
</tr>
<tr>
<td>:star: ● ● :star: ●</td>
<td>Spectrum Analyzer</td>
</tr>
<tr>
<td>● :star: :star: ●</td>
<td>Signal Generator Synthesizer</td>
</tr>
<tr>
<td>● ● :star: :star:</td>
<td>Upconverter</td>
</tr>
<tr>
<td>:star: ● ● ● ●</td>
<td>LO IF/IQ Modulator</td>
</tr>
<tr>
<td>● ● ● :star: ●</td>
<td>CDMA Generator Reference</td>
</tr>
<tr>
<td>:star: ● ● ●</td>
<td>Digital Cellsite</td>
</tr>
</tbody>
</table>

#### LED Legend
- ● = off
- :star: = rapid blink
- ☀ = steady on or slow blink
### Figure 2-9  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>0 1 2 3 0 1 2 3</td>
<td></td>
</tr>
<tr>
<td>☀ ● ● ● ☀ ● ● ●</td>
<td>Reference</td>
</tr>
<tr>
<td>☀ ● ● ● ● ☀ ● ●</td>
<td>Audio Filter 1 - C-Message Filter</td>
</tr>
<tr>
<td>☀ ● ● ● ● ☀ ● ●</td>
<td>Audio Filter 2 - 6 kHz BPF</td>
</tr>
<tr>
<td>● ☀ ● ● ● ● ☀ ☀ ☀ ☀</td>
<td>Receive DSP</td>
</tr>
<tr>
<td>☀ ● ● ● ● ● ☀ ☀ ☀ ☀ ☀</td>
<td>Digital Cellsite 1 and 2</td>
</tr>
</tbody>
</table>

**LED Legend**
- ● = off
- ☀ = rapid blink
- ☀ = steady on or slow blink
- ☀ = don’t care
Functional Diagnostics

The Diagnostics (of the SERVICE7 MENU, shown in figure 2-13 on page 61) check whether or not major portions of the Test Set 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.

Accessing the Diagnostic Tests

CAUTION

A fifteen minute warm up is required. The measurement limits of the SERVICE7 diagnostic tests are valid only at room temperature; that is, 20º to 25ºC (65º to 75ºF).

1. Press the Preset key.
2. Press the Tests key. The TEST (Main Menu) screen appears, see figure 2-10 on page 58.
3. Set the Select Procedure Location: field to ROM.
4. Set the Select Procedure Filename: field to SERVICE7.

5. To define test conditions, see "Define Test Conditions" on page 59. To configure the Test Set for a printer, see "Configuring a Printer" on page 60.
6. On the Tests (Main Menu), select the Run Test field (or press K1), and wait for the SERVICE MENU to appear, see figure 2-13 on page 61.
7. Choose the diagnostic test (Functional, AF, RF, or CDMA) to run by turning the knob to move the pointer and then pressing the knob to select the test.
8. 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
- **Sngl** (single) to pause the test after each measurement
- **Sngl Step** (single-step) to pause the test after each measurement

For descriptions of the diagnostic options, refer to:

- "Functional Diagnostics Menu" on page 62.
- "AF Diagnostics" on page 64
- "RF Diagnostics" on page 65
- "CDMA Diagnostics" on page 67

**Define Test Conditions**

1. On the TESTS (Main Menu) screen (see figure 2-13), select **Exec Execution Cond** to access the TESTS (Execution Conditions) screen.

   **Figure 2-11** TESTS (Execution Conditions)

<table>
<thead>
<tr>
<th>TESTS (Execution Conditions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output Results To:</td>
</tr>
<tr>
<td>CRT/Printer</td>
</tr>
<tr>
<td>Output Results For:</td>
</tr>
<tr>
<td>All/Failed</td>
</tr>
<tr>
<td>Output Heading:</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>If Unit-Under-Test Fails:</td>
</tr>
<tr>
<td>Continue/Stop</td>
</tr>
<tr>
<td>Test Procedure Run Mode:</td>
</tr>
<tr>
<td>Continuous/Single Test</td>
</tr>
<tr>
<td>Autostart Test Procedure On Pwr-Up:</td>
</tr>
<tr>
<td>Off/On</td>
</tr>
</tbody>
</table>

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.
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**.

### Configuring a Printer

Only perform the following steps if you want to print test results to a printer.

1. Press the Tests key.
2. On the TESTS (Main Menu) select **Print Printer Setup**. The TESTS (Printer Setup) screen appears.

3. Under **PRINT SETUP**:, select **Model** and the printer of your choice.

4. Set the **Printer Port** for the side-panel connector your printer is connected to (Parallel 15, Serial 9, or GPIB).
   - If an GPIB printer is used, you need to enter the printer’s two-digit bus address when the **Printer Adrs** field appears (Example; enter 1 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**.

5. Under **PAGE CONTROL**:, set the **Lines/Page** and Form Feed (**FF at Start**:, and **FF at End**:) parameters if necessary.
Figure 2-13  SERVICE7 Program Screens

TESTS (Main Menu)

TESTS (Main Menu)  SERVICE7

LOAD TEST PROCEDURE

Select Procedure Location:

- Run
- Continue
- Help

SERVICE MENU

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

- RF Diagnostics
  - CDMA Diagnostics
  - Audio Diagnostics

CDMA Diagnostics

Move the pointer to the desired test using the knob then press the knob. Press Service Menu to go to the Service Menu. Exit to abort.

- RF Diagnostics
  - CDMA Diagnostics
  - Audio Diagnostics
Functional Diagnostics Menu

To run the Functional Diagnostics, see "Accessing the Diagnostic Tests" on page 58.

**NOTE**

The diagnostics are intended to help in locating the source of catastrophic failures. Occasionally, a test will fail with the test results being only slightly out of limits. Such failures do not necessarily indicate that the Test Set is operating outside of its published specifications or that it is otherwise faulty. Further testing (such as running the performance tests) will be required in such cases.

**NOTE**

Many of the internal diagnostic and calibration procedures use low-level latch commands to control the instrument settings. Many latch settings persist even through a preset. They can only be reset by an instrument power down or by explicitly resetting each latch. This phenomenon is the reason the message "**Direct latch write occurred. Cycle power when done servicing.**" is displayed the first time a latch is written to. Because latch settings persist, problems can arise in running these programs. For example, prematurely terminating a test in a diagnostic (using the Pause and Exit keys) and restarting another test may cause failures in that test because of improper latch settings. It is best to run tests to completion before starting another one. Also, be sure to cycle the power off and on when done servicing the Test Set.

**Figure 2-14  Functional Diagnostics Screen**
RF Modules
The Average and TX power meters, Channel Power Meter, RF analyzer, IF analyzer and spectrum analyzer are used to test the signal generator. Both the internal and external paths of the RF/IO 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 Test Mode Rho on a signal from the CDMA Generator. This test is only a rough indicator of CDMA functionality.

Self Test
The power-up Self-Test Diagnostics are run. Refer to "Self-Test Diagnostics" on page 48.

Power Supplies
The different levels of the power supply are measured with the internal voltmeter.
Troubleshooting
AF, RF, and CDMA Diagnostics

AF, RF, and CDMA Diagnostics

NOTE
The diagnostics are intended to help in locating the source of catastrophic failures. Occasionally, a test will fail with the test results being only slightly out of limits. Such failures do not necessarily indicate that the Test Set is operating outside of its published specifications or that it is otherwise faulty. Further testing (such as running the performance tests) will be required in such cases.

NOTE
Many of the internal diagnostic and calibration procedures use low-level latch commands to control the instrument settings. Many latch settings persist even through a preset. They can only be reset by an instrument power down or by explicitly resetting each latch. This phenomenon is the reason the message "Direct latch write occurred. Cycle power when done servicing." is displayed the first time a latch is written to. Because latch settings persist, problems can arise in running these programs. For example, prematurely terminating a test in a diagnostic (using the Pause and Exit keys) and restarting another test may cause failures in that test because of improper latch settings. It is best to run tests to completion before starting another one. Also, be sure to cycle the power off and on when done servicing the Test Set.

AF Diagnostics

This program tests the audio functions of the following assemblies:

- Audio Analyzer 2
- Audio Analyzer 1
- Modulation Distribution
- Signaling Source/Analyzer (AF Generators 1 and 2 only)
- 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. To run the AF diagnostics, see "Accessing the Diagnostic Tests" on page 58.

NOTE
A fifteen minute warm up is required. The measurement limits of the SERVICE7 diagnostic tests are valid only at room temperature; that is, 20º to 25ºC (65º to 75ºF).
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 of the confidence (high, medium, or low) of the diagnosis.

**RF Diagnostics**

This program tests the RF functions of the following assemblies:

- Downconverter
- RF Output
- Signal Generator Synthesizer
- Reference
- Receiver
- Receiver Synthesizer
- Spectrum Analyzer (optional)
- RF I/O
- 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. To run these diagnostics, see “RF Diagnostics” on page 65.
A fifteen minute warm up is required. The measurement limits of the SERVICE4 diagnostic tests are valid only at room temperature; that is, 20° to 25°C (65° to 75°F).

Test Sets with firmware revision A.04.5X and above operate only at RF frequencies from 800 to 1000 MHz and 1700 to 2000 MHz. A text only error message “Input value out of range”, will be displayed if invalid frequencies are set.

When a test fails, a diagnosis is given as:

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

The Digital Diagnostics test the assemblies required for CDMA-formatted IQ modulation.

These assemblies include:
- CDMA Reference
- LO/IF Demod
- I/Q Modulator
- Cell Site Analog

The CDMA Reference, LO/IF Demod, and I/Q Modulator are also used when generating or analyzing analog signals.

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 8, “Block Diagrams,” on page 249. If you still lack confidence in troubleshooting or diagnosing the problem or faulty assembly, call the Agilent Call Center (1-800-922-8920) for troubleshooting assistance.

Figure 2-17 CDMA Diagnostics Screen
Frequently Encountered Diagnostic Messages

Warning/Error Messages

**NOTE**

Test Sets with firmware revision A.04.5X and above operate only at RF frequencies from 800 to 1000 MHz and 1700 to 2000 MHz. A text only error message “Input value out of range”, will be displayed if invalid frequencies are set.

Error messages that appear on the second line of the Test Set’s display frequently occur while any of the SERVICE7 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 Chapter 10, "Error Messages” on page 291.) Some of the messages you can expect to occur while running the SERVICE7 program diagnostic tests are as follows:

- **Direct latch write occurred. Cycle power when done servicing.** The SERVICE7 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 GPIB 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 Agilent-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.
Time-outs

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 Measurement assembly may be at fault.
- If most measurements fail, the Reference assembly may be supplying faulty clock signals to the Measurement assembly.
- Re-run the test to see if the timeout is intermittent.
NOTE

Test Sets with firmware revision A.04.5X and above operate only at RF frequencies from 800 to 1000 MHz and 1700 to 2000 MHz. A text only error message "Input value out of range", will be displayed if invalid frequencies are set.

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 Agilent 8924C Mobile Station Test Set combined with an Agilent 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 6, "Performance Tests" on page 141.

Table 2-2  Relating Assemblies to Troubleshooting Aids

<table>
<thead>
<tr>
<th>Assembly Name</th>
<th>SERVICE7 Program Diagnostic Test: Sub-Test</th>
<th>Performance Test to Perform(^a)</th>
<th>Periodic Calibration(^b) Program</th>
<th>Cal.-Data Needed(^c)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keypad</td>
<td>Functional Diagnostics: Self Test</td>
<td></td>
<td></td>
<td>No</td>
</tr>
<tr>
<td>Display</td>
<td></td>
<td></td>
<td></td>
<td>No</td>
</tr>
<tr>
<td>RF I/O</td>
<td>RF Diagnostics: RF Input/Output</td>
<td>RF Generator: Level Accuracy</td>
<td>PCMCTA Program System Power E5380-61811</td>
<td>Yes</td>
</tr>
<tr>
<td>Digital Cellsite 1 &amp; 2</td>
<td>Functional Diagnostics: CDMA Loopback</td>
<td></td>
<td>SERVICE7: IQ Modulator</td>
<td>Yes</td>
</tr>
<tr>
<td>Upconverter</td>
<td>RF Diagnostics: Upconverter</td>
<td></td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>RPG Assembly</td>
<td></td>
<td></td>
<td></td>
<td>No</td>
</tr>
<tr>
<td>Front Panel</td>
<td></td>
<td></td>
<td></td>
<td>No</td>
</tr>
<tr>
<td>Receive DSP</td>
<td>Functional Diagnostics: CDMA Loopback</td>
<td></td>
<td></td>
<td>No</td>
</tr>
<tr>
<td>PCMCIA</td>
<td></td>
<td></td>
<td></td>
<td>No</td>
</tr>
<tr>
<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>Controller</td>
<td>Functional Diagnostics: Self Test</td>
<td></td>
<td></td>
<td>No</td>
</tr>
<tr>
<td>Memory/SBRC</td>
<td>Functional Diagnostics: Self Test</td>
<td></td>
<td></td>
<td>No</td>
</tr>
<tr>
<td>Downconverter</td>
<td>RF Diagnostics: Downconverter</td>
<td></td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Power Supply Regulator</td>
<td>Functional Diagnostics: Self Test</td>
<td></td>
<td></td>
<td>No</td>
</tr>
<tr>
<td>Fans</td>
<td></td>
<td></td>
<td></td>
<td>No</td>
</tr>
<tr>
<td>Assembly Name</td>
<td>SERVICE7 Program Diagnostic Test: Sub-Test</td>
<td>Performance Test to Perform</td>
<td>Periodic Calibration Program</td>
<td>Cal.-Data Needed</td>
</tr>
<tr>
<td>---------------------</td>
<td>-------------------------------------------------------------</td>
<td>------------------------------</td>
<td>-------------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>Display Drive</td>
<td>Functional Diagnostics: Self Test</td>
<td></td>
<td></td>
<td>No</td>
</tr>
<tr>
<td>Power Supply</td>
<td>Functional Diagnostics: Self Test</td>
<td></td>
<td></td>
<td>No</td>
</tr>
<tr>
<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>LO-IF/IQ Modulator</td>
<td>CDMA Diagnostics LO_IF/IQ Mod.</td>
<td>SERVICE7: IQ Modulator</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>RF Output</td>
<td>RF Diagnostics: Output</td>
<td></td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Reference</td>
<td>RF Diagnostics: Reference</td>
<td>RF Generator: Residual FM</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Receiver Synthesizer</td>
<td>RF Diagnostics: Receiver Synthesizer</td>
<td>RF Analyzer: Residual FM</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>CDMA Generator Reference</td>
<td>CDMA Diagnostics: CDMA Gen. Ref.</td>
<td>SERVICE7: IQ Modulator</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Receiver</td>
<td>RF Diagnostics: Receiver</td>
<td>RF Analyzer: FM Accuracy</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Power Supply</td>
<td></td>
<td></td>
<td></td>
<td>No</td>
</tr>
<tr>
<td>Spectrum Analyzer (optional)</td>
<td>RF Diagnostics: Spectrum Analyzer</td>
<td>Spectrum Analyzer</td>
<td></td>
<td>Yes^d</td>
</tr>
<tr>
<td>Control Interface</td>
<td>Functional Diagnostics: Self Test</td>
<td></td>
<td></td>
<td>No</td>
</tr>
<tr>
<td>Modulation Distribution</td>
<td>AF Diagnostics: Mod Distribution Internal Paths</td>
<td>AF Generator: AC Level Accuracy</td>
<td>SERVICE7: Periodic Calibration: AF Gain, EXT Mod Path Gain</td>
<td>Yes</td>
</tr>
<tr>
<td>Audio Analyzer 1</td>
<td>AF Diagnostics: Audio Analyzer 1 Internal Paths</td>
<td></td>
<td>SERVICE7: Periodic Calibration: Audio Analyzer Offset</td>
<td>Yes</td>
</tr>
<tr>
<td>Audio Analyzer 2</td>
<td>AF Diagnostics: Audio Analyzer 2</td>
<td></td>
<td>SERVICE7: Periodic Calibration: VFN</td>
<td>Yes</td>
</tr>
<tr>
<td>Measurement e</td>
<td>Functional Diagnostics: Self Test</td>
<td>Oscilloscope</td>
<td>SERVICE7: Periodic Calibration: Voltmeter Reference</td>
<td>Yes^f</td>
</tr>
<tr>
<td>Motherboard</td>
<td></td>
<td></td>
<td></td>
<td>No</td>
</tr>
</tbody>
</table>

a. See Chapter 6, "Performance Tests" on page 141.
b. See Chapter 5, "Periodic Adjustments/Calibration" on page 125.
c. See table 5-1, "Assembly Calibration Information" on page 127 of Chapter 5, "Periodic Adjustments/Calibration."
d. PCMCIA smart card supplied with kit.
e. Measurement checked indirectly by all diagnostics.
f. PCMCIA smart card supplied with kit.
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 and the receiver synthesizer 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 and the reference are working before troubleshooting the receiver synthesizer and/or the signal generator synthesizer assemblies.

Figure 2-18 Out-of-lock LEDs

CDMA Generator Reference 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. Remove the Reference assembly.

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

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

Reference Verification

1. Turn the Test Set off and re-install the Reference assembly.
2. Remove the Receiver Synthesizer 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 assembly exists. Check the motherboard for continuity between J21 pin 3 under the Receiver Synthesizer assembly and J18 pin 2 under the Reference assembly, and verify that the trace is not shorted to ground.

Receiver Synthesizer Unlocked

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

Signal Generator Synthesizer Unlocked

1. Turn the Test Set off and 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 assembly.

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 assembly exists. Check the motherboard for continuity between J12 pin 3 (under the Signal Generator Synthesizer assembly) and J34 pin 1 (under the Reference 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 daughter board’s socketed EEPROM on the digital controller assembly. 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 factory restoration.

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

- Spectrum Analyzer (optional)
- Measurement

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:

- Downconverter
- Upconverter
- RF I/O
- Output Section
- Receiver
- Signal Generator Synthesizer
- Receiver Synthesizer
- 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:

- CDMA Reference
- RF Input/Output
- LO IF/IQ Modulator
- Audio Analyzer 1
- Audio Analyzer 2
- Measurement
- 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

NOTE
Test Sets with firmware revision A.04.5X and above operate only at RF frequencies from 800 to 1000 MHz and 1700 to 2000 MHz. A text-only error message “Input value out of range”, will be displayed if invalid frequencies are set.

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 2-19 and the block diagrams in chapter 8, "Block Diagrams".

- Downconverter
- Receiver
- Receiver Synthesizer
- Spectrum Analyzer (optional)

Figure 2-19 Isolating the RF Analyzer

*OPP = Over Power Protection
†RPP = Reverse Power Protection
To isolate an RF analyzer problem:

1. On the Test Set:
   a. Press **Preset**.
   b. Press the **Config** to access the CONFIGURE screen.
      - Set the **RF Display** field to **Freq**.
      - Set the **RF Offset** field to **Off**.
   c. Rotate the knob to the field under analog, press the knob and select RF ANL (to go to the analog RF ANALYZER screen).
      - Set the **Tune Freq** to **900 MHz**.
      - Set the **Input Port** to **RF IN**.

2. On the external RF signal generator:
   a. Set the frequency to 900 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 900 and then 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 900 and 1800 MHz respectively.
   c. If the Test Set has the optional spectrum analyzer, 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 2-20 and the block diagrams in chapter 8, "Block Diagrams".

- LO IF/IQ Modulator
- Signal Generator Synthesizer
- Output Section
- Upconverter

Figure 2-20 Isolating the RF Source
To isolate the RF Source:

1. On the Test Set:
   a. Press Preset.
   b. Press the Config key to access the 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 MHz and then 900 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 and 900 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.

To Access the SERVICE Screen

1. Press the Config key on the Test Set.
2. On the CONFIGURE screen, rotate the Test Set’s selector knob and select SERVICE, see figure 2-21.

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

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 +5 volts. 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.
Troubleshooting

Service Screen

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

**Figure 2-21 Service Screen**

<table>
<thead>
<tr>
<th>Range Hold</th>
<th>Auto Off</th>
<th>Hold Off</th>
<th>Store/Replay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode</td>
<td>10 MHz</td>
<td>100 MHz</td>
<td>1 GHz</td>
</tr>
</tbody>
</table>

**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.
Module
This field is used to manually select the module that contains the circuit latches to be selected.

Latch
This field is used to manually select the circuit latches in the module selected in the Module field above. The latches 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 latch:
1. Use the knob to select the Module. A Choices menu will appear.
2. Move the cursor to the desired module name and press the knob to select it.
3. Use the knob to select the latch field. A Choices menu will appear.
4. Move the cursor to the desired latch name and press the knob to select it.
5. Use the knob to select the Value field. A flashing >> cursor is displayed.
6. Rotate the cursor control knob or key in a number on the keypad to modify the value (hexadecimal).

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.
Troubleshooting
Service Screen
This chapter contains information for the removal and replacement of the assemblies in the Test Set. Illustrations and a parts list are provided for parts identification.
Disassembly and Replaceable Parts

Before You Start

**CAUTION**
Perform the procedures in this chapter only at a static-safe workstation. The printed circuit assemblies in this instrument are sensitive to static electricity damage. Wear an anti-static wrist strap that is connected to earth ground.

**NOTE**
Test Sets with firmware revision A.04.5X and above operate only at RF frequencies from 800 to 1000 MHz and 1700 to 2000 MHz. A text only error message "Input value out of range", will be displayed if invalid frequencies are set.

**Recommended Torque**

- Screws: Tighten until just snug, use care not to strip threads.
- RF connectors -
  - SMA type: 9.0 lb-in. (102 N-cm)
  - SMC type: 6.0 lb-in. (68 N-cm)

**Tools**

One or more of the following tools may be required to access and remove Test Set’s assemblies.

- TX-10 Torx screwdriver
- TX-15 Torx screwdriver
- Flat-blade screwdriver
- 7-mm socket wrench
- 1/16-inch allen wrench
- 3/16-inch socket wrench
- 1/4-inch open-end wrench
- 5/16-inch open-end wrench
- 29-mm socket
Ordering Replacement Parts and Support

Repair assistance is available from the factory by phone and email. When calling or writing for repair assistance, please have the following information ready:

- Instrument model number
- Instrument serial number (tag located on the rear panel).
- Installed options - if any (tag located on the rear panel).
- Instrument firmware revision - displayed at the top of the screen when the Test Set is powered up, and is also displayed on the CONFIGURE screen.

Telephone Numbers and Email

- 1-800-922-8920 Agilent Technologies Call Center
- 1-800-827-3848 (Spokane Division Service Assistance, U.S. only)
- 1-509-921-3848 (Spokane Division Service Assistance, International)
- 1-800-227-8164 (Agilent Technologies Direct Parts Ordering, U.S. only)
- 1-916-783-0804 (Agilent Technologies Service Parts Identification, U.S. & International)
- 1-800-403-0801 (Agilent Technologies Instrument Support Center)
- Email: spokane_service@agilent.com

Downloading Calibration Data

Most assemblies in the Test Set require calibration data. To ensure that the Test Set remains calibrated after an assembly is replaced, new calibration data must be downloaded. When required, calibration data is provided on a PCMCIA memory card that is included with the replacement assembly. Refer to Table 2-2, “Relating Assemblies to Troubleshooting Aids,” on page 70 of Chapter 2, “Troubleshooting,” to see which modules require calibration.
**Calibration Data Download Procedure**

1. Switch the Test Set’s power off.
2. Remove the faulty assembly.
3. Install the replacement assembly.
4. Switch the Test Set’s power on.
5. Insert the memory card.
6. Press the Tests key.
7. Set the **Select Procedure Location**: field to **Card**.
8. Set the **Select Procedure Filename**: field to **DNLDCAL**.
9. Press the K1 key to run the test.
10. Follow the instructions on the screen.
Disassembly Procedures

This section provides instructions for disassembling the Test Set. The procedures provided in this chapter are mainly organized in sequential order of Test Set disassembly. For component and assembly part numbers refer to the "Parts List" on page 105. The callouts for the parts used in the following illustrations are the same as their descriptions in the parts list.

External and Internal Covers

1. Remove the rear bumpers – two screws secure each bumper. See Figure 3-1.
2. Remove the strap handles (STRAP_HANDLE) from the Test Set.
3. Slide the external cover from the front frame.
4. To access the top-side assemblies remove the screws securing the top internal covers and remove it. See Figure 3-2 on page 88.
5. To access the bottom-side assemblies remove the screws securing the bottom internal cover and remove it. See Figure 3-2 on page 88.

Figure 3-1 Cover Removal
Disassembly and Replaceable Parts
Disassembly Procedures

Figure 3-2  Top and Bottom Internal Covers

DIGITAL_CVR
RF_COVER

SMM4.0_10SEMPNTX
(Qty. 20)

HOLDDOWN_PCB

FOOT_BOTTOM (Qty. 5)
SMM4.0_10SEMPNTX

COVER_BOTTOM
SMM4.0_10SEMPNTX

SMM4.0_10SEMPNTX
(Qty. 20)
Top-Side Assemblies

1. Remove the external and internal covers, see "External and Internal Covers" on page 87.

2. Using Figure 3-3, identify the module or board assembly you want to remove and lift the module or board assembly from the mother board.

Figure 3-3 Top-Side Assemblies
Audio Analyzer and Filter Assemblies

Figure 3-4  Audio Analyzer and Filter Assemblies

1/4 turn to remove or secure board.

<table>
<thead>
<tr>
<th>Opt.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>CCITT_FLTR</td>
</tr>
<tr>
<td>STD</td>
<td>C_MESS_FLTR</td>
</tr>
</tbody>
</table>

6KHZ_BPF_#014

AUDIO_ANALYZER_1_KIT
Replacing the Controller

NOTE

Restoring Calibration Data in Controller Assembly
Calibration data for the entire Test Set is stored in EEPROM on the controller (CONTROLLER_-KIT) assembly, see Figure 3-5. When replacing the controller assembly, you must remove the “CAL MODULE” daughter-board from the old controller assembly and install it onto the replacement controller assembly to preserve the calibration data for the instrument.

“Boot Code” is the firmware that initializes the Test Set on power-up. It also is used at power-up to see if a firmware revision card has been inserted in the PCMCIA card port. This code is stored in the “CAL MODULE” daughter-board on the controller (CONTROLLER_-KIT) assembly. If a new version of boot code needs to be installed, carefully remove the old daughter-board and insert the new one, being careful of the orientation. To replace the controller assembly:

1. Remove the external and internal covers, see “External and Internal Covers” on page 87

2. Locate the controller board (see Figure 3-3 on page 89), disconnect the ribbon cables (see Figure 3-5), and pull it out from the Test Set.

3. Carefully remove the CAL MODULE daughter-board from the original assembly and install it on the replacement.

Figure 3-5 Controller and “CAL MODULE” Assemblies
Disassembly and Replaceable Parts
Disassembly Procedures

Batteries (Memory and Regulator Assemblies)

Figure 3-6  MEMORY_(SRBC)_KIT Assembly

Figure 3-7  REGULATOR_-KIT Assembly
Bottom-Side Assemblies

1. Remove the external and internal cover, see "External and Internal Covers" on page 87.
2. Use Figure 3-8 through Figure 3-13 to identify and remove the assembly desired.

Figure 3-8 Bottom-Side Assemblies
NOTE: There is a combined MOTHERBOARD/CHASSIS KIT.
**Downconverter Assembly**
To remove this assembly disconnect the cables, connectors, and 4 screws shown in Figure 3-10.

**Figure 3-10**  Downconverter Removal

**Upconverter Assembly**
To remove this assembly disconnect the cables, connectors, and 4 screws shown in Figure 3-11.

**Figure 3-11**  Upconverter Removal
RF I/O and Coaxial Switch Assemblies

To remove the RF I/O or coaxial switch assembly, or other associated components, see Figure 3-12.

Figure 3-12    RF I/O and Coaxial Switch Assemblies Removal

NOTE 1: To remove this cable, it is necessary to loosen the coaxial switch.
PCMCIA Assembly

To remove this assembly, disconnect the ribbon cable and 2 screws securing the assembly.

Figure 3-13 PCMCIA Assembly Removal
**Motherboard Assembly**

1. Remove the external and internal covers, see "External and Internal Covers" on page 87.

2. Remove all top and bottom side subassemblies from the Test Set (see previous disassembly procedures).

3. Remove the bracket relay from the chassis, see Figure 3-14.

4. Remove the screws securing the motherboard to the chassis.

**Figure 3-14  Motherboard Disassembly**

![Motherboard Disassembly Diagram]
Disassembly and Replaceable Parts
Disassembly Procedures

Front Panel Assembly

The front-panel assembly must be removed from the Test Set's chassis before any of the front panel subassemblies can be removed.

1. Remove the external and internal covers, see "External and Internal Covers" on page 87.
2. Remove the cables, BNC nuts, and 6 screws securing the front panel frame to the Test Set’s chassis, see Figure 3-15.
3. See Figure 3-16 on page 100 to identify the desired subassembly for removal.

Figure 3-15 Front Panel Assembly
Figure 3-16  Front Panel Subassemblies
Fan

1. Remove the external and internal-top covers. See "External and Internal Covers" on page 87.

2. To remove either fan (see Figure 3-17) disconnect its power connector to the motherboard, and remove the 4 screws securing the fan to the Test Set chassis.

Figure 3-17 Fan Removal
Disassembly and Replaceable Parts

Disassembly Procedures

Power Supply

1. Remove the external and internal top and bottom cover, see Figure 3-2 on page 88.

2. Remove the 6 screws securing the power supply assembly to the Test Set’s chassis, see Figure 3-18.

3. Refer to Figure 3-19, “Power Supply Subassemblies,” on page 103 and Figure 3-20, “Power Supply Assembly Rear Panel,” on page 104 to identify the desired subassembly for removal.

Figure 3-18 Power Supply Assembly
**Figure 3-19**  Power Supply Subassemblies

*NOTE:* When reassembling power supply assembly to chassis, ensure guide pins are aligned properly into chassis.
Disassembly and Replaceable Parts
Disassembly Procedures

Figure 3-20 Power Supply Assembly Rear Panel

CELLSITE/TRIGGERS

CONN_SCREWLOCK_F (Qty. 14)

NUT-HEX-DBL-CHAM (Qty. 9)

- SA TRIG OUT

WSHR_LK_1941D (Qty2)

STDF_3271_6-32 (Qty. 2)

LINE_MODULE

CA_CX_BNC-DSUB_2
## Parts List

### Table 3-1: Replaceable Parts

<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>6KHZ_BPF_#014_AY</td>
<td>08920-60268</td>
</tr>
<tr>
<td>ANALOG_C-SITE_KIT (FW Rev A.04.54 and below)</td>
<td>08924-61807</td>
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### Disassembly and Replaceable Parts

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4 Functional Verification

The purpose of this chapter is to provide loopback self-tests and mobile phone test procedures that quickly verify the functional performance of the Test Set.
Purpose

The purpose of this chapter is to provide loopback self-tests and mobile phone test procedures that quickly verify the functional performance of the Test Set while racked in a test system or operating stand-alone. If racked in a test system, removing the Test Set should be avoided if all functional performance tests pass. Performing and passing all tests will result in a very high level of confidence that the Test Set is functioning properly. This document is not intended to provide complete troubleshooting instruction for hardware failures.

The desired results of the following procedures are:

• To isolate the cause of test system problems quickly if related to the Test Set
• To minimize unnecessary Test Set swapping
• To identify the root cause of poor test system yields if related to the Test Set
• To improve user test system quality confidence level
• To educate current and new production technicians on Agilent Technologies products
Process Efficiency Recommendations

A. Identify a test-standard “Golden Mobile” phone for each production line. This phone will be used to verify your test system and Test Set performance.

B. Characterize components of each test system:
   - Generate baseline performance data for each Test Set
   - Generate baseline performance data for each fixture
   - Generate baseline normalization data for external path losses

C. Maintain Test System binder to include:
   - Test Set baseline data
   - Fixture baseline data
   - Test system normalization calibration tables
   - Test system maintenance records. (Performance Verification and PTR Records, Table 4-1 on page 123)

D. Create troubleshooting kits to include:
   - Golden mobile phone
   - Cables and adapters
   - Maintenance record sheets
   - Firmware cards

E. Use Save/Recall registers to speed-up testing.
NOTE
Test Sets with firmware revision A.04.5X and above operate only at RF frequencies from 800 to 1000 MHz and 1700 to 2000 MHz. A text only error message “Input value out of range”, will be displayed if invalid frequencies are set.

Analog loopback configures the Test Set to test all of its major functions. A problem located in the RF and audio source or RF and audio analyzer paths will become evident.

In this configuration, the RF and audio generators will be used to simulate a low level modulated transmitter signal. The RF receiver will be used to demodulate this signal and pass it on to the audio analyzer to make the SINAD measurement.

1. Press the green Preset key to configure instrument to default settings.
2. Connect a short RF cable between the DUPLEX OUT port and the ANTENNA IN port.
3. Configure the instrument for loopback mode.
   3a. Press the Config key and set the following fields:
       • RF Display: Freq
       • RF Offset: On
       • (Gen) - (Anl): 0 MHz
   3b. Press the AF analyzer key and set the following fields:
       • Speaker ALC: ON
       • Speaker Vol: POT
   3c. Press the Duplex key and set the following fields:
       • Tune Freq: 501 MHz (FW rev A.02.XX and below)
         900 MHz (FW rev A.04.5X and above)
       • Input Port: Ant
       • RF Gen Freq: 501 MHz (FW rev A.02.XX and below)
         900 MHz (FW rev A.04.5X and above)
       • Amplitude: –80 dBm
       • Output Port: Dupl
       • AFGen1 To: FM / 3.10 kHz
       • AF Anl In: FM Demod
       • Filter 1 300 HPF
       • Filter 2 3 kHz LPF
       • De-Emphasis OFF
       • Detector RMS*SQR2
4. Turn up the VOLUME knob to hear the 1 kHz tone.
5. SINAD meter should read >35 dB.
6. Change the Amplitude setting to \(-100\) dBm, the SINAD meter should read >12 dB.
7. Record results in Table 4-1 on page 123.

SUGGESTION: Store instrument settings as a Save/Recall register (press the Save key). Name the register SINAD.
**Wideband Sweep**

NOTE

Test Sets with firmware revision A.04.5X and above operate only at RF frequencies from 800 to 1000 MHz and 1700 to 2000 MHz. A text only error message "**Input value out of range**", will be displayed if invalid frequencies are set.

NOTE

This functional performance test requires the spectrum analyzer option in the Test Set.

Wideband sweep configures the Test Set to test all of its major functions. A problem located in the RF source or RF analyzer paths will become evident. In this configuration, the spectrum analyzer and tracking generator will be used to test and view the RF level and flatness of the RF source and RF analyzer over a 1 GHz span.

1. Begin by using the same setup as analog loopback (Recall “SINAD” register)
2. Connect a short RF cable between the RF IN/OUT port and the ANTENNA IN port
3. Configure the instrument for wideband sweep mode.
   3a. Press the Spectrum analyzer key. On the SPECTRUM ANALYZER screen set the following fields:
      - Set the **Ref Level** field to 0 dBm
      - Set the **Span** field to 1 GHz (FW rev A.02.XX and below)
      - 200 MHz (FW rev A.04.5X and above)
   3b. On the SPECTRUM ANALYZER / RF Gen screen, set the following fields:
      - Set the **Controls field** to RF Gen Track
      - Set the **Port/Sweep field** to RF Out
4. Sweep should be:
   - Continuous across the display with no RF level dropouts
   - Fairly flat, about 4 to 5 dB difference between end points
5. Record results in the **Table 4-1 on page 123**.

SUGGESTION: Store instrument settings as a Save/Recall register (press the Save key). Name the register WB_SWEEP
Channel Power Loopback Verification Test

Channel power is extremely important in the ability of the Test Set to maintain a link with and properly control power output levels of the mobile phone under test. Channel power loopback verification is a quick way to ensure that both the average and channel power measurements are working properly.

1. Press the green Preset key to configure instrument to default settings.

2. Connect a short RF cable between the RF IN/OUT port and DUPLEX OUT port.

3. Configure the Test Set for channel power loopback mode (this is a non-standard user mode).
   3a. Press the (CDMA SCREENS) Call control key and set the RF Chan Std field to US PCS.
   3b. Press the Config key and set the following fields:
       - RF Display: Freq
       - RF Offset: On
       - (Gen) – (Anl): 0 MHz
       - Output Port: Dupl
       - Input Port: RF In
   3c. Press the (CDMA SCREENS) Call control key. On the CDMA CALL CONTROL screen, set the following fields:
       - RF Gen Freq: 1900 MHz
       - Place cursor on the Avg Power field and select Chan Power
       - Place cursor on the Power Meas field.
       - Press the knob or Enter key to begin calibration routine
       - Press the Yes key to continue the calibration routine

4. Perform the Channel Power Loopback Measurement:
   - Place cursor on the Sctr A Pwr field
   - Step the Sctr A Pwr level from -5 to -60 dBm in 5 dB increments.
   - Measured channel power should be within a few dB of the sector power output level setting

NOTE
The "Ideal Mobile Power" value is not applicable for this test

5. Record results in Table 4-1 on page 123.

Suggestion: Store instrument settings as a Save/Recall register (press the Save key). Name the register CPWR_LB.
ROM-Based Diagnostics and Calibration

Comprehensive internal IBASIC diagnostics are provided to aid in troubleshooting the Test Set. These diagnostic programs use external cabling and the internal measurement and path setting capabilities of the Test Set to diagnose itself for RF and audio hardware problems. No external test equipment is necessary.

As the diagnostic programs execute, detected problems will be reported with a suggested defective assembly and its probability of failure. Refer to the appropriate Assembly Level Repair section for more information.

1. Press the Preset key to configure instrument to default settings.
2. Press the Tests key to access to TESTS (Main Menu) screen, see Figure 4-1 on page 119.
3. For Select Procedure Location: select ROM
4. For Select Procedure Filename: select SERVICE7
5. Press the K1 key. The SERVICE MENU appears.
6. Load and execute each of the following diagnostic and calibration programs:
   - Under Functional Diagnostics; select RF Modules, Analog Modulation, and CDMA Loopback
   - AF Diagnostics
   - RF Diagnostics
   - CDMA Diagnostics
   - IQ Calibration
   - IQ Demod Path Calibration

**NOTE**
Disregard all other diagnostic or calibration programs that appear on the SERVICE MENU and are not listed in step 6.

7. Load and execute PCB_CAL program:
   - Press the Tests key to access the TESTS (Main Menu) screen.
   - For Select Procedure Location: select ROM
   - For Select Procedure Filename: select PCB_CAL
   - Press K1 to execute.

8. Record results in the Table 4-1 on page 123.
Figure 4-1  SERVICE MENU

TESTS (Main Menu)

SERVICE7

LOAD TEST PROCEDURE:  SET UP TEST SET:
Select Procedure Location:  Exec Execution Cond
ROM  O Analog
Select Procedure Filename:  REV SPEC
Library:  RK TEST
Program:  RK TEST

DESCRIPTION:
Launches diagnostic and calibration programs.

CUSTOMIZE TEST PROCEDURE:
Free Channel Information
Free Test Parameters
Sele Order of Tests
Save Pass/Fail Limits
Save/Save/Delete Procedure

SERVICE MENU
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
  COMA Diagnostics
  Edit Diagnostic Limits
  Periodic Calibration
  IQ Calibration
  IQ Device Path Calibration

Chapter 4  119
Channel Power Calibration

To ensure the accuracy of the Test Set power measurement, channel power calibration should be run before the mobile phone functional test portion of the performance verification test plan.

1. Press the Preset key to configure instrument to default settings.

2. Connect a short RF cable between the RF IN/OUT port and DUPELEX OUT port.

3. Calibrate the channel power measurement:
   - Press the (CDMA SCREENS) Call control key
   - Set RF Chan Std field to US PCS
   - Set Avg Power field to Chan Power
   - Place the cursor on the Power Meas field and select Calibrate
   - Press the knob or Enter key to begin calibration routine.

4. Record results in the Table 4-1 on page 123.

Suggestion: Store instrument settings as a Save/Recall register (press the Save key). Name the register CPWR_CAL.
### CDMA Mobile Phone Functional Test

1. Connect the mobile phone to the Test Set.
2. Setup for call processing:

**NOTE**

Knowledge of the mobile’s System ID, RF Channel, and RF Channel capability are essential to call processing. Therefore, the mobile phone functional test may not be successful if this information is not known.

2a. Press (CDMA SCREENS) Cell config key. On the CDMA CELL SITE CONFIGURATION screen:
- For the System ID field, if known, enter system ID number.
- For the Rgstr SID field, enter system ID number (same as System ID field).
- Set the Pwr Up Reg field to On.

2b. Press the Config key and set the Date field for one month in advance.

2c. Press the (CDMA SCREENS) Call control key:
- Place cursor on the Avg Power field and select Chan Power
- For the RF Chan Std field enter appropriate RF channel standard
- For the Protocol field select appropriate protocol
- For the RF Channel field enter appropriate RF channel
- For the Traffic Data Mode field select Svc Opt 2
- For the Sctr A Pwr field enter –55 dBm/BW

Suggestion: Store instrument settings as a Save/Recall register (press the Save key). Name the register CP.

3. Turn mobile phone on:
- Ensure Test Set’s Call Status “Transmitting” annunciator is lit.
- Mobile should obtain service with the Test Set.
- If capable, mobile will do a power-up registration within 20 seconds indicated by the ESN appearing below the MS Database field.
- Mobile RSSI indicator shows four bars.
- Mobile may display date and time setting of Test Set.

4. Originate Call
- Dial ‘123’ on mobile then press YES or Send
- Test Set’s Connected annunciator should be lit
- Mobile should be in a connected “Svc Opt 2” state.
- Press No or End on mobile to end call.

5. Page mobile phone:
Functional Verification

CDMA Mobile Phone Functional Test

- Press the Call/Page key on the Test.
- Test Set should page the mobile.
- Mobile should automatically connect to Test Set.

6. Mobile phone measurements (record all test results in Table 4-1 on page 123)

6a. Receiver FER Test:
- Press the (CDMA SCREENS) RX test key
- Set the Display Interim Results field to Yes
- Set the FER Spec field to 0.50%
- Set Str A Pwr: field to –90 dBm/BW (when no isolation box is used)
- Set Meas Cntl field to Single
- Begin measurement, highlight the Arm field. Test Set should return a Passed Status

6b. Transmitter Rho Test:
- Press the (CDMA SREENS) TX test key.
- Set Meas Cntl field to Cont. Measured Traffic Rho should be >0.980

6c. Mobile Channel Power Test:
- Press the (CDMA SCREENS) Call control key.
- Set Chan Power field to Chan Power. Measured channel power should be about ±1.5 dB of the calculated “Ideal Mobile Power” value.

7. End call - press the End/Release button on the Test Set.
## Table 4-1 Functional Verification Test Record

<table>
<thead>
<tr>
<th>Test Description</th>
<th>Pass/Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Up Self-Test</td>
<td>Pass/Fail</td>
</tr>
<tr>
<td>All self tests passed</td>
<td></td>
</tr>
<tr>
<td>Channel Power Loopback Verification Test</td>
<td>Pass/Fail</td>
</tr>
<tr>
<td>Channel Power Accuracy</td>
<td></td>
</tr>
<tr>
<td>Analog Loopback</td>
<td>Pass/Fail</td>
</tr>
<tr>
<td>SINAD @–80 dB &gt; 25 dB</td>
<td></td>
</tr>
<tr>
<td>SINAD @–100 dB &gt; 12 dB</td>
<td></td>
</tr>
<tr>
<td>Wideband Sweep</td>
<td>Pass/Fail</td>
</tr>
<tr>
<td>Acceptable flatness = (Max level - Min level) = &lt;5 dB</td>
<td></td>
</tr>
<tr>
<td>TESTS (Main Menu) Screen ROM Diagnostic Programs</td>
<td>Pass/Fail</td>
</tr>
<tr>
<td>SERVICE7 / Functional Diagnostics / RF Modules</td>
<td></td>
</tr>
<tr>
<td>SERVICE7 / Functional Diagnostics / Analog Modulation</td>
<td></td>
</tr>
<tr>
<td>SERVICE7 / Functional Diagnostics / CDMA Loopback</td>
<td></td>
</tr>
<tr>
<td>SERVICE7 / AF Diagnostics (All Tests)</td>
<td></td>
</tr>
<tr>
<td>SERVICE7 / RF Diagnostics (All Tests)</td>
<td></td>
</tr>
<tr>
<td>SERVICE7 / CDMA Diagnostics (All Tests)</td>
<td></td>
</tr>
<tr>
<td>TESTS (Main Menu) Screen Calibration Programs</td>
<td>Pass/Fail</td>
</tr>
<tr>
<td>SERVICE7 / IQ Calibration</td>
<td></td>
</tr>
<tr>
<td>SERVICE7 / IQ Demod Path Calibration</td>
<td></td>
</tr>
<tr>
<td>PCB_CAL</td>
<td></td>
</tr>
<tr>
<td>Channel Power Calibration Procedure (see “Channel Power Calibration” on page 120)</td>
<td>Pass/Fail</td>
</tr>
<tr>
<td>Channel Power Cal</td>
<td></td>
</tr>
<tr>
<td>Call Setup Procedures (see “CDMA Mobile Phone Functional Test” on page 121)</td>
<td>Pass/Fail</td>
</tr>
<tr>
<td>Register Mobile</td>
<td></td>
</tr>
</tbody>
</table>
### Table 4-1  Functional Verification Test Record

<table>
<thead>
<tr>
<th>Test Case</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Page to Mobile</td>
<td></td>
</tr>
<tr>
<td>Origination from Mobile</td>
<td></td>
</tr>
<tr>
<td>Functional Tests Procedures (see “CDMA Mobile Phone Functional Test” on page 121)</td>
<td>Pass / Fail</td>
</tr>
<tr>
<td>Receiver FER</td>
<td></td>
</tr>
<tr>
<td>Transmitter Rho</td>
<td></td>
</tr>
<tr>
<td>Mobile Channel Power</td>
<td></td>
</tr>
</tbody>
</table>
5 Periodic Adjustments/Calibration

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-board ROMs (which are on the assemblies themselves)
- Data generated internally by running calibration programs (ROM-based or external “System Power Calibration Program” on page 39)

In either case calibration data is loaded into non-volatile memory on the controller assembly.

NOTE

Because calibration data resides on the Controller assembly, it is important that whenever this assembly is replaced that the data be transferred from the original assembly to the new one. The calibration data resides on a “CAL MODULE” daughter-board which can be moved with little danger of losing its contents. Insure that the serial number of the daughter-board matches the serial number of the Test Set. 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 5-1, ”Assembly Calibration Information” on page 127.
**Table 5-1  Assembly Calibration Information**

<table>
<thead>
<tr>
<th>Assembly</th>
<th>Calibration Data Location</th>
<th>Calibration Program: Sub Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>Audio Analyzer 1</td>
<td></td>
<td>Periodic Calibration: Audio Analyzer 1 Offset</td>
</tr>
<tr>
<td>Modulation Distribution</td>
<td></td>
<td>Periodic Calibration: External Modulation Path Gain, and, AF GEN Gain</td>
</tr>
<tr>
<td>Upconverter</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Output Section</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Signal Generator Synthesizer</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Reference</td>
<td>X</td>
<td>Periodic Calibration: Timebase Reference</td>
</tr>
<tr>
<td>Receiver</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Receiver Synthesizer</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Spectrum Analyzer</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Downconverter</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Measurement</td>
<td>X</td>
<td>Periodic Calibration: Voltmeter References</td>
</tr>
<tr>
<td>RF I/O</td>
<td>X</td>
<td>See “System Power Calibration Program” on page 39.</td>
</tr>
<tr>
<td>CDMA Reference</td>
<td></td>
<td>IQ Calibration</td>
</tr>
<tr>
<td>Controller</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>LO IF/IQ Demodulator</td>
<td></td>
<td>IQ Calibration, and IQ Demod Path Calibration</td>
</tr>
<tr>
<td>Digital Cellsite 1 or 2</td>
<td></td>
<td>IQ Calibration</td>
</tr>
<tr>
<td>IQ Modulation</td>
<td></td>
<td>IQ Calibration</td>
</tr>
<tr>
<td>Analog Cellsite</td>
<td></td>
<td>PCB Cal (ROM-based)</td>
</tr>
<tr>
<td>Audio Analyzer 2</td>
<td></td>
<td>Periodic Calibration: Variable Frequency Notch Filter</td>
</tr>
</tbody>
</table>

*RF I/O: RF Input/Output, CDMA: Code Division Multiple Access, LO: Local Oscillator*
Test 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 ANTENNA IN connector.

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

Figure 5-1  Periodic Calibration Menu
Storing Calibration Factors

You should understand the calibration-factor-storage process before running any of the following programs: Periodic Calibration, IQ Calibration, IQ Demod Path 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 IQ Demod Path Calibration Programs

1. Press Tests key to access the TESTS (Main Menu) screen, see Figure 5-2.
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 SERVICE7 from the Choices: menu.
6. Select Run Test (K1 key).
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 131.
   - IQ Calibration - for more detailed information, see “IQ Calibration Program Description” on page 137
   - IQ Demod Path Calibration - for more detailed information, see "IQ Demod Path Calibration Program Description" on page 139.
8. Follow the instructions on the screen.

Figure 5-2 SERVICE MENU’s Calibration Programs
Periodic Calibration Menu Descriptions

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

Figure 5-3 Periodic Calibration

Periodic Calibration Menu Screen
Periodic Adjustments/Calibration
Periodic Calibration Menu Descriptions

**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. Coarse and fine manual adjustment of the two 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 135.

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 ANTENNA IN connector.

**Timebase Reference Using a Source**

This program automatically tunes the timebase tuning DACs to the signal at the front-panel ANTENNA 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 ANTENNA 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 800 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 assembly, see figure 5-4.

**Figure 5-4 Measurement Assembly Test Points**

![Measurement Board Assembly Diagram](imageURL)

**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 10,000 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.
135

Periodic Adjustments/Calibration
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 Reference assembly.

The following procedure is to be used when running the program "Timebase Reference Using a Counter" on page 132.

1. Press Config key to access the CONFIGURE screen, see Figure 5-5.
2. On the CONFIGURE screen, select SERVICE, the SERVICE screen appears.

Figure 5-5 SERVICE Screen

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 132.
IQ Calibration Program Description

The goal of IQ Calibration (see Figure 5-6 on page 138) 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 Data Buffer assembly and the Quad DAC is on the 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 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 Controller assembly.
Figure 5-6 IQ Calibration

TESTS (Main Menu)

SERVICE7

LOAD TEST PROCEDURE
Select Procedure Location: ROM
Select Procedure Filename: IQ.CAL
Program: IQ.CAL
Library: ROM

Description: Launched diagnostic or test menu

CUSTOMIZE TEST PROCEDURE

SERVICE MENU
Press Channel Information: Press Parameters
Test Parameters: Press Order of Tests
Spec Press/Fail Limits: Press Delete Process

Additional tests include:
- Functional Diagnostics
- RF Diagnostics
- Power Diagnostics
- Connect Diagnostics
- Edit Diagnostic Limits
- Edit Diagnostic Limits
- RF Calibration
- IQ Calibration
- IQ Enable Path Calibration

TESTS LIBRARY Controller

<table>
<thead>
<tr>
<th>Frequency (MHz)</th>
<th>Carrier Feedthrough (dB)</th>
<th>Quadrature</th>
<th>Tester Feedthrough (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>500.00</td>
<td>-86.2</td>
<td>-94.0</td>
<td></td>
</tr>
<tr>
<td>550.00</td>
<td>-86.2</td>
<td>-94.0</td>
<td></td>
</tr>
<tr>
<td>600.00</td>
<td>-86.2</td>
<td>-94.0</td>
<td></td>
</tr>
<tr>
<td>650.00</td>
<td>-86.2</td>
<td>-94.0</td>
<td></td>
</tr>
<tr>
<td>700.00</td>
<td>-86.2</td>
<td>-94.0</td>
<td></td>
</tr>
<tr>
<td>750.00</td>
<td>-86.2</td>
<td>-94.0</td>
<td></td>
</tr>
<tr>
<td>800.00</td>
<td>-86.2</td>
<td>-94.0</td>
<td></td>
</tr>
<tr>
<td>850.00</td>
<td>-86.2</td>
<td>-94.0</td>
<td></td>
</tr>
<tr>
<td>900.00</td>
<td>-86.2</td>
<td>-94.0</td>
<td></td>
</tr>
<tr>
<td>950.00</td>
<td>-86.2</td>
<td>-94.0</td>
<td></td>
</tr>
<tr>
<td>1000.00</td>
<td>-86.2</td>
<td>-94.0</td>
<td></td>
</tr>
</tbody>
</table>

Cal factors have been tested. Press Resume.
IQ Demod Path Calibration Program Description

Figure 5-7  IQ Modulation Path Calibration

LOAD TEST PROCEDURE:
Select Procedure Local
[ :) Continue
Select Procedure File

TESTS (Main Menu)

SERVICE

TESTS (IBASIC Controller)

DESCRIPTION:
Lunched diagnostic analysis tool.

CUSTOMIZE TEST PROCEDURE:
Free Channel Information
Free Test Parameters
Start Order of Tests
Set Pass/Fail Limits
Save/Save/Delete Process

SERVICE MENU

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
- RF Diagnostics
- IQ Diagnostics
- CDRH Diagnostics
- Edit Diagnostic Limits
- Periodic Calibration
- IQ Calibration
- IQ Demod Path Calibration

TESTS (IBASIC Controller)

Calibration Information
Old DRC Offset 04
New DRC Offset 35
Old Demod Nominal Power -24.3077868
New Demod Nominal Power -24.63160545
Mobile power at port -6.5060125
Mobile power at LO1F -19.1259232

Results:

139
Periodic Adjustments/Calibration

IQ Demod Path Calibration Program Description
6 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

NOTE

The recommended Test Set calibration interval is 24 months. This is accomplished by performing the performance tests or sending the Test Set to an Agilent Calibration Center or other qualified calibration lab.

- Run the Performance Tests in table 6-2, "Performance Tests & Records Location" on page 144 using the specified Test Equipment from table 6-1, "Required Test Equipment by Model" on page 143.

- Compare and record the data for each test onto the applicable Performance Test Record (PTR). Table 6-2 on page 144 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 (optional), and oscilloscope.

NOTE

Test Sets with firmware revision A.04.5X and above operate only at RF frequencies from 800 to 1000 MHz and 1700 to 2000 MHz. A text only error message “Input value out of range”, will be displayed if invalid frequencies are set.

NOTE

Press Preset on the Test Set before beginning each test.

Test Equipment and Operation

The test equipment shown in table 6-1, "Required Test Equipment by Model" on page 143 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 6-1, look up their specifications in the Agilent Technologies 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.
Table 6-1  Required Test Equipment by Model

<table>
<thead>
<tr>
<th>Agilent Model Number</th>
<th>Model Name</th>
<th>Test Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mini-Circuits ZFL-2000 or equivalent(^a)</td>
<td>Amplifier 1</td>
<td>5</td>
</tr>
<tr>
<td>GTC RF Products GRF 5016 or equivalent(^b)</td>
<td>Amplifier 2</td>
<td>27, 28</td>
</tr>
<tr>
<td>3458A</td>
<td>Multimeter</td>
<td>8-9, 12, 15, 18</td>
</tr>
<tr>
<td>5316A</td>
<td>Counter</td>
<td>11, 16</td>
</tr>
<tr>
<td>8562A</td>
<td>Spectrum Analyzer</td>
<td>6-7</td>
</tr>
<tr>
<td>8663A</td>
<td>Signal Generator (High Performance)</td>
<td>4, 20-23, 28</td>
</tr>
<tr>
<td>8648B Option 1EA</td>
<td>Signal Generator</td>
<td>19</td>
</tr>
<tr>
<td>8902A</td>
<td>Measuring Receiver</td>
<td>1-5, 17, 19-22, 25, 27</td>
</tr>
<tr>
<td>8903B</td>
<td>Audio Analyzer</td>
<td>4, 10, 12, 16, 18, 20-22</td>
</tr>
<tr>
<td>11667A</td>
<td>Power Splitter</td>
<td>19, 27, 28</td>
</tr>
<tr>
<td>11722A</td>
<td>Sensor Module</td>
<td>5, 19, 25, 27</td>
</tr>
<tr>
<td>11793A</td>
<td>Microwave Converter</td>
<td>1-5</td>
</tr>
<tr>
<td>E4420B</td>
<td>Signal Generator</td>
<td>1-5, 24, 27</td>
</tr>
<tr>
<td>E6380-61811(^c)</td>
<td>System Power Calibration Program Software Kit</td>
<td>19</td>
</tr>
<tr>
<td>89441A with options AYA, AY9, UFG</td>
<td>Vector Signal Analyzer</td>
<td>26</td>
</tr>
<tr>
<td>EPM-438</td>
<td>Power Meter</td>
<td>25, 28</td>
</tr>
<tr>
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\(^a\) 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.

\(^b\) 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.

\(^c\) To order the System Power Calibration Card see “Ordering Replacement Parts and Support” on page 85.
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RF Generator FM Distortion Performance Test 1

The purpose of this test is to verify that the Test Set meets the specification limits in PTR (Performance Test Record) table 7-1, "RF Generator FM Distortion Test 1 Record" on page 202. 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 6-1 Setup for Measurements to 1 GHz

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

NOTE

Test Sets with firmware revision A.04.5X and above operate only at RF frequencies from 800 to 1000 MHz and 1700 to 2000 MHz. A text only error message “Input value out of range”, will be displayed if invalid frequencies are set.

Steps 1, 2, and 3 in the following procedure apply to both of the setups (shown in figure 6-1 and figure 6-2 on page 146).

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 CONFIGURE screen.
   c. Set the RF Display field to Freq.
   d. Set the RF Offset to Off.
   e. Set the Output Port field to Dupl.
   f. Select the RF GENERATOR screen.
   g. Set the RF Gen Freq field to the appropriate RF frequency (based on the firmware revision; see NOTE above) from the Performance Test Record.
   h. Set the Amplitude to -10 dBm.
   i. Set the AFGen1 To field to FM at 99 kHz deviation.

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 purpose of this test is to verify that the Test Set meets the specification limits in PTR (Performance Test Record) table 7-2, "RF Generator FM Accuracy Test 2 Record" on page 204. 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 6-3  Setup for Measurements to 1 GHz

![Measuring Receiver and Signal Generator Diagram](image)

Figure 6-4  Setup for Measurements to 2 GHz Using a Microwave Converter

![Measuring Receiver, Microwave Converter, and Signal Generator Diagram](image)
Performance Tests
RF Generator FM Accuracy Performance Test 2

Procedure

NOTE
Test Sets with firmware revision A.04.5X and above operate only at RF frequencies from 800 to 1000 MHz and 1700 to 2000 MHz. A text only error message “Input value out of range”, will be displayed if invalid frequencies are set.

Steps 1, 2, and 3 in the following procedure apply to both of the setups (shown in figure 6-3 and figure 6-4 on page 149).

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 CONFIGURE screen.
   c. Set the RF Display field to Freq.
   d. Set the RF Offset to Off.
   e. Set the Output Port field to Dupl.
   f. Select the RF GENERATOR screen.
   g. Set the RF Gen Freq field to the appropriate RF frequency (based on the firmware revision; see NOTE above) from the Performance Test Record.
   h. Set the Amplitude to -10 dBm.
   i. Set the AFGen1 To field to FM at 99 kHz deviation.

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 purpose of this test is to verify that the Test Set meets the specification limits in PTR (Performance Test Record) table 7-3, "RF Generator FM Flatness Test 3 Record" on page 206. 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 6-5 Setup for Measurements to 1 GHz

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

**NOTE**
Test Sets with firmware revision A.04.5X and above operate only at RF frequencies from 800 to 1000 MHz and 1700 to 2000 MHz. A text only error message “**Input value out of range**”, will be displayed if invalid frequencies are set.

Steps 1, 2, and 3 in the following procedure apply to both of the setups (shown in figure 6-5 and figure 6-6 on page 152).

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 CONFIGURE screen.
   c. Set the **RF Display** field to **Freq**.
   d. Set the **RF Offset** to **Off**.
   e. Set the **Output Port** field to **Dupl**.
   f. Select the RF GENERATOR screen.
   g. Set the **RF Gen Freq** field to the appropriate RF frequency (based on the firmware revision; see **NOTE** above) from the Performance Test Record.
   h. Set the **Amplitude** to **-10 dBm**.
   i. Set the **AFGen1 To** field to **FM at 50 kHz** deviation.

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 purpose of this test is to verify that the Test Set meets the specification limits in PTR (Performance Test Record) table 7-4, "RF Generator Residual FM Test 4 Record" on page 208. 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, see figure 6-7 and figure 6-8 on page 156. 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 6-7** Setup for Measurements to 1 GHz
Procedure

**NOTE**

Test Sets with firmware revision A.04.5X and above operate only at RF frequencies from 800 to 1000 MHz and 1700 to 2000 MHz. A text only error message “**Input value out of range**”, will be displayed if invalid frequencies are set.

Steps 1 to 5 in the following procedure apply to both setups (shown in figure 6-7 and figure 6-8 on page 156).

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 CONFIGURE screen.
   c. Set the RF Display field to Freq.
   d. Set RF Offset to Off.
   e. Set RF Output to Dupl.
   f. Select the RF GENERATOR screen.
   g. Set the RF Gen Freq field to the appropriate RF frequency (based on the firmware revision; see NOTE above) from the Performance Test Record.
   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

The purpose of this test is to verify that the Test Set meets the specification limits in PTR (Performance Test Record) table 7-5, "RF Generator Level Accuracy Test 5 Record" on page 210. 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 function 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 6-10 on page 160).

Setup 1

Figure 6-9 Setup 1 for Measurements to 1 GHz

Procedure 1

**NOTE**

Test Sets with firmware revision A.04.5X and above operate only at RF frequencies from 800 to 1000 MHz and 1700 to 2000 MHz. A text only error message “Input value out of range”, will be displayed if invalid frequencies are set.

Steps 1 to 5 in the following procedure apply to Setup 1 shown in figure 6-9 on page 158.

1. Before connecting the Test Set to the measuring receiver:
   a. Reset the instrument.
   b. Zero and calibrate the sensor module.
Performance Tests
RF Generator Level Accuracy Performance Test 5

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 CONFIGURE screen.
   c. Set the RF Display field to Freq.
   d. Set the RF Offset to Off.
   e. Set the Output Port field to Dupl.
   f. Select the RF GENERATOR screen.
   g. Set the RF Gen Freq field to the appropriate RF frequency (based on the firmware revision; see NOTE above) from the Performance Test Record.
   h. Set the Amplitude to −11 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 −15 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.
Procedure 2

Steps 1 to 5 in the following procedure apply to Setup 2 shown in figure 6-10 on page 160.

1. Make the connections as shown on Setup 2.
2. On the Test Set:
   a. Set the Amplitude to -11 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.
6. On the signal generator set the level to +8 dBm or whatever level is suitable for the microwave converter’s LO input.

7. 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 -83 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 -83 dBm insert an RF amplifier into the output of the Test Set.

g. Record the new measured level at -83 dBm.

h. Continue measuring the level down to −116 dBm.

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

j. Measure and record the RF level at the levels down to and including −83 dBm shown in the PTR at the Test Set's RF IN/OUT port.

k. After recording the reading at −83 dBm insert an RF amplifier into the output of the Test Set.

l. Record the new measured level at −83 dBm.

m. Continue measuring the level down to −116 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 −11 dBm in step 3c or 5b
+ RF level measured at −83 dBm in step 7i
− RF level measured at −83 dBm in step 7j
+ RF level measured in step 7k
For example, if:

RF power measured at −11 dBm in step 3b or 5b = −10.2 dBm
RF level measured at −83 dBm in step 7i = −70.1 dB
RF level measured at −83 dBm in step 7j = −52.6 dB
RF level measured at −101 dBm in step 7k = −73.2 dB

the corrected level at −101 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

The purpose of this test is to verify that the Test Set meets the specification limits in PTR (Performance Test Record) table 7-6, "RF Generator Harmonics Spectral Purity Test 6 Record" on page 218. 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 6-11

Procedure

NOTE

Test Sets with firmware revision A.04.5X and above operate only at RF frequencies from 800 to 1000 MHz and 1700 to 2000 MHz. A text only error message “Input value out of range”, will be displayed if invalid frequencies are set.

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

2. On the Test Set:
   a. Press Preset.
   b. Select the CONFIGURE screen.
   c. Set the RF Display field to Freq.
   d. Set the RF Offset to Off.
   e. Set the Output Port field to Dupl.
   f. Select the RF GENERNATOR screen.
   g. Set the RF Gen Freq field to the appropriate RF frequency (based on the firmware revision; see NOTE above) from the Performance Test Record.
   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

The purpose of this test is to verify that the Test Set meets the specification limits in PTR (Performance Test Record) table 7-7, "RF Generator Spurious Spectral Purity Test 7 Record" on page 221. 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 6-12

Procedure

NOTE
Test Sets with firmware revision A.04.5X and above operate only at RF frequencies from 800 to 1000 MHz and 1700 to 2000 MHz. A text only error message “Input value out of range”, will be displayed if invalid frequencies are set.

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

2. On the Test Set:
   a. Press Preset.
   b. Select the CONFIGURE screen.
   c. Set the RF Display field to Freq.
   d. Set the RF Offset to Off.
   e. Set the Output Port field to Dupl.
   f. Select the RF GENERATOR screen.
   g. Set the Amplitude to -10 dBm.
   h. Set the RF Gen Freq field to the appropriate RF frequency (based on the firmware revision; see NOTE above) from the Performance Test Record.
Performance Tests
RF Generator Spurious Spectral Purity Performance Test 7

3. Set the Test Set’s RF generator to the frequencies 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

The purpose of this test is to verify that the Test Set meets the specification limits in PTR (Performance Test Record) table 7-8, "AF Generator AC Level Accuracy Test 8 Record" on page 223. There are two audio generators. AC level accuracy is measured directly with a digital multimeter.

Setup

Figure 6-13

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 **AFGen2 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

The purpose of this test is to verify that the Test Set meets the specification limits in PTR (Performance Test Record) table 7-9, "AF Generator DC Level Accuracy Test 9 Record" on page 225. There are two DC generators. DC level accuracy is measured directly with a digital multimeter.

Setup

Figure 6-14

Multimeter

INPUT

AUDIO OUT

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.
      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 AFGen2 To level field to on.
      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

The purpose of this test is to verify that the Test Set meets the specification limits in PTR (Performance Test Record) table 7-10, "AF Generator Residual Distortion Test 10 Record" on page 226. Audio distortion is measured directly with an audio analyzer.

Setup

Figure 6-15

![Audio Analyzer Diagram]

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 AFGen2 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

The purpose of this test is to verify that the Test Set meets the specification limits in PTR (Performance Test Record) table 7-11, "AF Generator Frequency Accuracy Test 11 Record" on page 228. Frequency accuracy is measured directly with a frequency counter. The counter must be able to resolve 0.005% at 20 Hz.

Setup

Figure 6-16

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 AFGen2 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

The purpose of this test is to verify that the Test Set meets the specification limits in PTR (Performance Test Record) table 7-12, "AF Analyzer AC Voltage Accuracy Test 12 Record" on page 229. 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 6-17

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 1 field to <20 Hz HPF.
   e. Set the Filter 2 field to >99kHz LPF.
   f. Set the De-Emphasis field to Off.
   g. Set the Detector field to RMS.
   h. 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 purpose of this test is to verify that the Test Set meets the specification limits in PTR (Performance Test Record) table 7-13, "AF Analyzer Residual Noise Test 13 Record" on page 230. The AC level of the audio input is measured with no signal source connected.

Setup

Figure 6-18

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 1 field to <20 Hz HPF.
   e. Set the Filter 2 field to 15kHz LPF.
   f. Set De-Emphasis field to Off.
   g. Set the Detector field to RMS.
   h. Set the Audio In Lo field to 600 To Hi.
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.
3. Set the Filter 2 field to >99kHz LP.
4. 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

The purpose of this test is to verify that the Test Set meets the specification limits in PTR (Performance Test Record) table 7-14, "AF Analyzer Distortion and SINAD Accuracy Test 14 Record" on page 231. 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 6-19

![Setup Diagram]

Procedure

1. 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 To** level field to **1.00 V** and **AFGen1 Freq** field to **1 kHz**.
   e. Set the **AFGen2 To** level field to **100 mv** and **AFGen2 Freq** field to **2 kHz**.

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

The purpose of this test is to verify that the Test Set meets the specification limits in PTR (Performance Test Record) table 7-15, "AF Analyzer DC Level Accuracy Test 15 Record" on page 232. 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 6-20

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 lower-right measurement to **DC level**.
   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

The purpose of this test is to verify that the Test Set meets the specification limits in PTR (Performance Test Record) table 7-16, "AF Analyzer Frequency Accuracy to 100 kHz Test 16 Record" on page 233. 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 6-21

Procedure

1. Set the frequency counter to measure frequency.
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 1 field to <20 Hz HPF.
   e. Set the Filter 2 field to >99kHz LPF.
   f. Set the lower-right measurement display to AF Freq.
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

The purpose of this test is to verify that the Test Set meets the specification limits in PTR (Performance Test Record) table 7-17, "AF Analyzer Frequency Accuracy at 400 kHz Test 17 Record" on page 234. 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 6-22

Procedure

1. On the signal generator:
   a. Set amplitude to 0 dBm.
   b. Set the frequency to 400 kHz.
2. On the measuring receiver:
   a. Reset the instrument.
   b. Set the measurement mode to frequency.
3. 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.
4. 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

The purpose of this test is to verify that the Test Set meets the specification limits in PTR (Performance Test Record) table 7-18, "Oscilloscope Amplitude Accuracy Test 18 Record" on page 235. 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 6-23

Audio Analyzer

Multimeter

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. Select the SCOPE screen.
   f. 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

The purpose of this test is to verify that the Test Set meets the specification limits in PTR (Performance Test Record) table 7-19, "RF Analyzer Level Accuracy Test 19 Record" on page 236. Level accuracy is measured using a system power calibration program that resides on a memory card.

Procedure

1. Obtain the memory card (see Table 6-1 on page 143) containing the System Power Calibration software 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 6-24
RF Analyzer FM Accuracy
Performance Test 20

The purpose of this test is to verify that the Test Set meets the specification limits in PTR (Performance Test Record) table 7-20, "RF Analyzer FM Accuracy Test 20 Record" on page 238. The signal generator provides the RF signal with FM. An audio signal from the audio analyzer provides FM for the signal generator. 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. Results from this test give an indication of problems in the audio section of the Test Set.

Setup

Figure 6-25

Procedure

1. On the measuring receiver:
   a. Reset the instrument.
   b. Set the measurement mode to FM.
   c. Set the detector to PK+.
   d. Set the LP Filter to 3 kHz.
2. On the audio analyzer:
   a. Reset the instrument.
   b. Set the output frequency to 1 kHz.
c. Set the amplitude to \(1.42\) V.

3. On the signal generator:
   a. Set the output frequency to \(840\) MHz.
   b. Set the amplitude to \(0.0\) dBm.
   c. Set the function to FM with EXT AC Modulation.

4. On the Test Set:
   a. Press Preset.
   b. Select the CONFIGURE screen.
   c. Set the RF Display field to Freq.
   d. Set the (Gen)-(Anl) field to 0 MHz.
   e. Select the RF ANALYZER screen.
   f. Set the Tune Freq to 840 MHz.
   g. Set the IF Filter field to 230 kHz.
   h. Select the AF ANALYZER screen.
   i. Set the AF Anl In field to FM Demod.
   j. Set the Filter 1 field to \(<20\) Hz HPF.
   k. Set the Filter 2 field to 3 kHz LP.
   l. Set the Detector field to PK+.

5. For each RF output from the signal generator shown in the Performance Test Record (PTR), do the following:
   a. Set the audio analyzer’s frequency (rate) as shown in the PTR.
   a. Set the appropriate Filter 2 on the Test Set and LP Filter on the measuring receiver to match the output frequency of the audio analyzer.
   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

The purpose of this test is to verify that the Test Set meets the specification limits in PTR (Performance Test Record) table 7-21, "RF Analyzer FM Distortion Test 21 Record" on page 239. An audio signal from the audio analyzer provides FM for the signal generator. The signal generator 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 6-26

Procedure

1. 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.
2. On the audio analyzer:
Performance Tests
RF Analyzer FM Distortion Performance Test 21

1. a. Reset the instrument.
b. Set the output frequency to 1 kHz.
c. Set the output amplitude to 1.4 V.
d. Set the measurement mode to distortion.

2. On the signal generator:
   a. Set the output frequency to 840 MHz.
b. Set the output amplitude to 0.0 dBm.
c. Set the function to FM with EXT AC Modulation.
d. Set the MOD LEVEL to 5 kHz.

3. On the Test Set:
   a. Press Preset.
b. Select the INSTRUMENT CONFIGURE screen.
c. Set the RF Display field to Freq.
d. Select the RF ANALYZER screen.
e. Set the Tune Freq to 840 MHz.
f. Set the Input Port field to Ant.
g. Set the IF Filter field to 230 kHz.
h. Set Squelch field to Open.
i. Select the AF ANALYZER screen.
j. Set the AF Anl In field to FM Demod.
k. Set the Filter 1 field to 300Hz HPF.
l. Set the Filter 2 field to 3kHz LPF.
m. Set the Detector field to Pk+.

4. 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

The purpose of this test is to verify that the Test Set meets the specification limits in PTR (Performance Test Record) table 7-22, "RF Analyzer FM Bandwidth Test 22 Record" on page 240. An audio signal from the audio analyzer provides FM for the signal generator. The signal generator 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 6-27

Procedure

1. On the measuring receiver:
   a. Reset the instrument.
   b. Set the measurement mode to FM.
   c. Set the all filters off.
2. On the audio analyzer:
   a. Reset the instrument.
   b. Set the output frequency to 1 kHz.
   c. Set the output amplitude to 1.4 V.

3. On the signal generator:
   a. Set the output frequency to 840 MHz.
   b. Set the output amplitude to 0.0 dBm.
   c. Set the function to FM with EXT AC Modulation.
   d. Set the MOD LEVEL to 25 kHz.

4. On the Test Set:
   a. Press **Preset**.
   b. Select the **CONFIGURE** screen.
   c. Set the **RF Display** field to **Freq**.
   d. Select the RF **ANALYZER** screen.
   e. Set the **Tune Freq** to **840 MHz**.
   f. Set the **Input Port** field to **Ant**.
   g. Set the **IF Filter** field to **230 kHz**.
   h. Set the **Squelch** field to **Open**.
   i. Select the AF **ANALYZER** screen.
   j. Set the **AF Anl In** field to **FM Demod**.
   k. Set the **Filter 2** field to **>99kHz LP**.
   l. Set the **Detector** field to **Pk+**.

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 purpose of this test is to verify that the Test Set meets the specification limits in PTR (Performance Test Record) table 7-23, "RF Analyzer Residual FM Test 23 Record" on page 241. The signal generator provides a CW signal with minimal residual FM. The FM is measured by the Test Set’s internal RF analyzer.

Setup

Figure 6-28

Procedure

1. On the signal generator:
   a. Set the output frequency to 840 MHz.
   b. Set the output amplitude to 0.0 dBm.
   c. Set the function to MOD OFF.

2. On the Test Set:
   a. Press **Preset**.
   b. Select the CONFIGURE screen.
   c. Set the **RF Display** field to **Freq**.
   d. Select the RF ANALYZER screen.
   e. Set the **Tune Freq** to **840 MHz**.
   f. Set the **Input Port** field to **Ant**.
   g. Set the **IF Filter** field to **230 kHz**.
   h. Select the AF ANALYZER screen.
   i. Set the **AF Anl In** field to **FM Demod**.
   j. Set the **Filter 1** field to **300Hz HPF**.
   k. Set the **Filter 2** field to **3kHz LPF**.
   l. Set the **Detector** field to **RMS**.
3. Read the FM deviation (residual FM) for each RF frequency (840 and 1800 MHz) 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

The purpose of this test is to verify that the Test Set meets the specification limits in PTR (Performance Test Record) table 7-24, "Spectrum Analyzer Image Rejection (Image) Test 24 Record" on page 242. 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.

Setup

Figure 6-29 Spectrum Analyzer Image Rejection Test 24

Procedure

1. On the signal generator:
   a. Set the level to -20 dBm.
   b. Set the frequency to 1229 MHz.
   c. Set modulation off.
2. On the Test Set:
   a. Press Preset.
   b. Select the CONFIGURE screen.
   c. Set the RF Display field to \textbf{Freq}.
   d. Select the SPEC ANL screen.
e. Set the RF In/Ant field to Ant.
f. Set the Ref Level field to −25 dBm.
g. Set the Span field to 5 kHz.
h. Set the Controls field to Marker.
i. Set the Marker To field to Center Freq.
j. 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
CDMA Generator RF IN/OUT Amplitude Level Accuracy Performance Test 25

CDMA Generator RF IN/OUT Amplitude Level Accuracy Performance Test 25

The purpose of this test is to verify that the Test Set meets the specification limits in PTR (Performance Test Record) table 7-25, "CDMA Generator RF In/Out Test 25 Record" on page 243. The amplitude level accuracy of the CDMA generator is measured directly with a power meter. These measurements are made at the top and bottom of the CDMA generator’s vernier range.

NOTE
Two setups follow. 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.

Setups
Figure 6-30 Setup 1 for Measurements to 1 GHz

![Diagram of Setup 1 for Measurements to 1 GHz]

Procedure

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 Test Set:
   a. Press **Preset**.
   b. Select the CONFIGURE screen and set RF display to **freq**.
   c. Select the CDMA CALL CONTROL screen.
   d. Set the **RF Gen Freq** field to **836.52 MHz**.
   e. Select the CDMA GENERATOR CONTROL screen.
   f. Set the **Sctr A Pwr** to **–20.5 dBm**.

4. On the measuring receiver:
   a. Set the measurement mode to **RF Power**.
   b. Set the display to log.
   c. Press the Calibrate key.

5. Set the Test Set to the frequencies and levels listed in the PTR and record the values.
Performance Tests
CDMA Generator DUPLEX OUT Amplitude Level Accuracy Performance Test 26

CDMA Generator DUPLEX OUT Amplitude Level Accuracy Performance Test 26
The purpose of this test is to verify the amplitude level accuracy of the CDMA generator at the DUPLEX OUT port by using the CDMA analyzer to verify it meets the specification limits in PTR (Performance Test Record) table 7-26, "CDMA Generator DUPLEX OUT Sector B Power Level Accuracy Test 26 Record" on page 244.

Setup

Figure 6-31 CDMA Generator Modulation Accuracy Test 26

Procedure

1. Press Preset.

   2. Select the CONFIGURE screen and set the RF Display field to Freq.

   3. Set the (Gen)-(Anl) field to 0 MHz.

   4. Set the Output Port field to Dupl.

   5. Select the CDMA GENERATOR CONTROL screen.

   6. Set the Scrt A Pwr field to Off.

   7. Set the RF Gen Freq to 840 MHz.

   8. Set the Scrt B Pwr field to the values listed in the PTR for Sector B. See Appendix Table 7-26, “CDMA Generator DUPLEX OUT Sector B Power Level Accuracy Test 26 Record,” on page 244.

   9. Go to the CDMA CELLULAR MOBILE TRANSMITTER TEST screen.

   10. Read the Avg Power (average power) and record it in the PTR.

   11. Select the CDMA GENERATOR CONTROL screen.

   12. Set the Sector B Power field to Off.
13. Set the **AWGN Power** field to the values listed in the PTR for AWGN power. See table 7-27, “CDMA Generator DUPLEX OUT AWGN Power Level Accuracy Test 26 Record” on page 244.

14. Select the CDMA CALL CONTROL screen.

15. Change the **Avg Power** measurement field to **Chan Power** (Channel Power).

16. Calibrate the channel power by selecting **Calibrate** in the **Power Meas** field.

17. Select the CDMA GENERATOR CONTROL screen.

18. Read the channel power and record it in the PTR.
CDMA Generator Modulation Accuracy
Performance Test 27

The purpose of this test is to verify that the Test Set meets the specification limits in PTR (Performance Test Record) table 7-28, "CDMA Generator Modulation Accuracy Test 27 Record" on page 245. 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 6-32 CDMA Generator Modulation Accuracy Test 26

![Vector Signal Analyzer](image)

DUPLEX OUT

INPUT

Procedure

1. On the Test Set:
   a. Press **Preset**.
   b. Select the CONFIGURE screen.
   c. Set the **RF Display** field to **Freq**.
   d. Set the **(Gen)-(Anl)** field to **0 MHz**.
   e. Set the **Output Port** field to **Dupl**.
   f. Select the CDMA CALL CONTROL screen.
   g. Set the **RF Gen Freq** field to **881.52 MHz**.
   h. Select the CDMA GENERATOR CONTROL screen.
   i. Set the **Scrt A Pwr** field to **-10 dBm**.
   j. Turn off the **Synth**, **Pager**, and **Traffic** fields.
   k. Set the **Pilot** field to **0 dB**.
2. On the Vector Signal Analyzer:
   a. Press the **Frequency** key.
   b. Set center frequency to 881.52 MHz.
   c. Set the span to 2.6 MHz.
   d. Press the **Instrument Mode** key
   e. Press the **Digital Demodulation** (F4) key
   f. Press the **Demodulation Setup** (F5) key
   g. Press the **Demodulation Format** (F1) key
   h. Press the **Standard Setup** (F7) key.
   i. Press the **CDMA Base** (F7) key.
   j. Press the **d** key.
   k. Read the Rho measurement or:

3. Use the following equation to calculate rho.

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

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

4. Compare and record the rho error calculated in table 7-28, "CDMA Generator Modulation Accuracy Test 27 Record" on page 245

5. Set the CDMA GEN frequency on the Test Set and change the center frequency on the Vector Signal Analyzer to the 1956.25 MHz.

6. Calculate rho (using the above equation), and record the result (rho) in table 7-28, "CDMA Generator Modulation Accuracy Test 27 Record" on page 245.
Performance Tests
CDMA Analyzer Average Power Level Accuracy Performance Test 28

CDMA Analyzer Average Power Level Accuracy
Performance Test 28

The purpose of this test is to verify that the Test Set meets the specification limits in PTR (Performance Test Record) table 7-29, "CDMA Analyzer Average Power Level Accuracy Test 28 Record" on page 246. 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 6-33 CDMA Analyzer Average Power Level Accuracy Test 27

![Diagram of test setup]

Procedure

1. On the signal generator:
   a. Set the frequency to 881.52 MHz.
   b. Set the amplitude so the measuring receiver reads 0 dBm.
2. On the Test Set:
   a. Press **Preset**
   b. Select the CONFIGURE screen.
   c. Set the **RF Display** field to **Freq**.
   d. Set the **(Gen)-(Anl)** field to **0 MHz**.
   e. Select CDMA CALL CONTROL.
   f. Set **Tune Freq** to 881.52 MHz.
   g. Set the **Avg Pwr Units** to **mW**.

3. Record the **Avg Pwr** reading in the PTR (see table 7-29, “CDMA Analyzer Average Power Level Accuracy Test 28 Record” on page 246).

4. Repeat steps 2 and 3 for each of the frequencies and levels listed in the PTR.
Performance Tests
CDMA Analyzer Channel Power Level Accuracy Performance Test 29

CDMA Analyzer Channel Power Level Accuracy Performance Test 29

The purpose of this test is to verify that the Test Set meets the specification limits in PTR (Performance Test Record) table 7-30, "CDMA Analyzer Channel Power Level Accuracy Test 29 Record" on page 247. 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 6-34 CDMA Analyzer Channel Power Level Accuracy Test 28

![Diagram of setup](image)

Procedure

1. On the measuring receiver
   a. Set the display mode to **LOG**.
   b. Set the measurement mode to **RF POWER**.
   c. Calibrate the power sensor.
2. On the signal generator:
   a. Set the frequency to 836.52 MHz (45 MHz below RF generator frequency).
   b. Set the output level so the measuring receiver reads 11 dBm.
3. On the Test Set:
   a. Press **Preset**.
   b. Change the **Avg Pwr** field to **Chan Pwr**.
   c. Verify the **RF Channel** is set at **384**.
   d. Select **Calibrate** under **Chn Pwr Cal**.
4. Record the **Chan Pwr** measurement in the PTR table 7-30, "CDMA Analyzer Channel Power Level Accuracy Test 29 Record" on page 247.
5. Repeat steps 2 and 3 for each of the data points listed in the PTR.
6. For PCS frequencies:
   a. Set the **RF CHAN Std** to **US PCS**.
   b. Verify the **RF Channel** is set at **525**.

**NOTE**
The **Chan Pwr Cal** is only required when the frequency is changed.
Performance Tests

CDMA Analyzer Channel Power Level Accuracy Performance Test 29
Use this chapter to record the results of the performance tests in Chapter 6, “Performance Tests,” on page 141.

**NOTE**

Test Sets with firmware revision A.04.5X and above operate only at RF frequencies from 800 to 1000 MHz and 1700 to 2000 MHz. A text only error message “Input value out of range”, will be displayed if invalid frequencies are set.
RF Generator FM Distortion
Performance Test 1 Record

For test procedure, see “RF Generator FM Distortion Performance Test 1” on page 146.

Table 7-1 RF Generator FM Distortion Test 1 Record

<table>
<thead>
<tr>
<th>Applicable Firmware Revision</th>
<th>RF (MHz)</th>
<th>Deviation (kHz)</th>
<th>Rate (kHz)</th>
<th>FM Distortion Limits (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0A.02.XX</td>
<td>30</td>
<td>99</td>
<td>1</td>
<td>0.50</td>
</tr>
<tr>
<td>0A.02.XX</td>
<td>30</td>
<td>5</td>
<td>1</td>
<td>0.50</td>
</tr>
<tr>
<td>0A.02.XX</td>
<td>312.5</td>
<td>5</td>
<td>1</td>
<td>0.50</td>
</tr>
<tr>
<td>0A.02.XX</td>
<td>425</td>
<td>50</td>
<td>1</td>
<td>0.50</td>
</tr>
<tr>
<td>0A.02.XX</td>
<td>501</td>
<td>99</td>
<td>1</td>
<td>0.50</td>
</tr>
<tr>
<td>0A.02.XX</td>
<td>501</td>
<td>50</td>
<td>1</td>
<td>0.50</td>
</tr>
<tr>
<td>0A.02.XX</td>
<td>501</td>
<td>5</td>
<td>1</td>
<td>0.50</td>
</tr>
<tr>
<td>0A.02.XX</td>
<td>568.75</td>
<td>50</td>
<td>1</td>
<td>0.50</td>
</tr>
<tr>
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<td>656.25</td>
<td>99</td>
<td>1</td>
<td>0.50</td>
</tr>
<tr>
<td>0A.02.XX</td>
<td>656.25</td>
<td>50</td>
<td>1</td>
<td>0.50</td>
</tr>
<tr>
<td>0A.02.XX</td>
<td>656.25</td>
<td>5</td>
<td>1</td>
<td>0.50</td>
</tr>
<tr>
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</tr>
<tr>
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<td>50</td>
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<td>0.50</td>
</tr>
<tr>
<td>0A.02.XX</td>
<td>750</td>
<td>5</td>
<td>1</td>
<td>0.50</td>
</tr>
<tr>
<td>ALL</td>
<td>856.25</td>
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<td>0.50</td>
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<tr>
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<td>0.50</td>
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<tr>
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<tr>
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<td>0.50</td>
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<tr>
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<td>99</td>
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<td>0.50</td>
</tr>
<tr>
<td>ALL</td>
<td>1000</td>
<td>50</td>
<td>1</td>
<td>0.50</td>
</tr>
<tr>
<td>ALL</td>
<td>1000</td>
<td>11</td>
<td>1</td>
<td>0.50</td>
</tr>
<tr>
<td>ALL</td>
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<td>5</td>
<td>1</td>
<td>0.50</td>
</tr>
</tbody>
</table>
### RF Generator FM Distortion Performance Test 1 Record

<table>
<thead>
<tr>
<th>Applicable Firmware Revision</th>
<th>RF (MHz)</th>
<th>Deviation (kHz)</th>
<th>Rate (kHz)</th>
<th>FM Distortion Limits (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALL</td>
<td>1000</td>
<td>6</td>
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<td>0.50</td>
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<td>1000</td>
<td>8</td>
<td>1</td>
<td>0.50</td>
</tr>
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<td>0.50</td>
</tr>
<tr>
<td>ALL</td>
<td>998.401</td>
<td>8</td>
<td>1</td>
<td>0.50</td>
</tr>
<tr>
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<td>768.001</td>
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<td>0.50</td>
</tr>
<tr>
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<td>512.001</td>
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<td>0.50</td>
</tr>
<tr>
<td>≤A.02.XX</td>
<td>511.601</td>
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<td>1</td>
<td>0.50</td>
</tr>
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<td>1</td>
<td>0.50</td>
</tr>
</tbody>
</table>

The following entries are for the 2 GHz setup.

| ALL                          | 1700     | 99              | 1          | 1.00                     |
| ALL                          | 1700     | 50              | 1          | 1.00                     |
| ALL                          | 1700     | 5               | 1          | 1.00                     |
| ALL                          | 2000     | 99              | 1          | 1.00                     |
| ALL                          | 2000     | 50              | 1          | 1.00                     |
| ALL                          | 2000     | 5               | 1          | 1.00                     |
RF Generator FM Accuracy
Performance Test 2 Record

For test procedure, see “RF Generator FM Accuracy Performance Test 2” on page 149.

Table 7-2  RF Generator FM Accuracy Test 2 Record

<table>
<thead>
<tr>
<th>Applicable Firmware Revision</th>
<th>RF (MHz)</th>
<th>Deviation (kHz)</th>
<th>Rate (kHz)</th>
<th>FM Deviation Limits (kHz)</th>
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</thead>
<tbody>
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<td></td>
<td>Lower</td>
</tr>
<tr>
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<td>30</td>
<td>99</td>
<td>1</td>
<td>95.035</td>
</tr>
<tr>
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<td>3</td>
<td>1</td>
<td>2.845</td>
</tr>
<tr>
<td>≤A.02.XX</td>
<td>312.5</td>
<td>3</td>
<td>1</td>
<td>2.845</td>
</tr>
<tr>
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<td>425</td>
<td>50</td>
<td>1</td>
<td>47.750</td>
</tr>
<tr>
<td>≤A.02.XX</td>
<td>501</td>
<td>99</td>
<td>1</td>
<td>95.035</td>
</tr>
<tr>
<td>≤A.02.XX</td>
<td>501</td>
<td>50</td>
<td>1</td>
<td>47.750</td>
</tr>
<tr>
<td>≤A.02.XX</td>
<td>501</td>
<td>3</td>
<td>1</td>
<td>2.845</td>
</tr>
<tr>
<td>≤A.02.XX</td>
<td>568.75</td>
<td>50</td>
<td>1</td>
<td>47.750</td>
</tr>
<tr>
<td>≤A.02.XX</td>
<td>656.25</td>
<td>99</td>
<td>1</td>
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<tr>
<td>≤A.02.XX</td>
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<td>1</td>
<td>47.750</td>
</tr>
<tr>
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<td>656.25</td>
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<td>1</td>
<td>2.845</td>
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<td>95.035</td>
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<tr>
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<td>50</td>
<td>1</td>
<td>47.750</td>
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<tr>
<td>≤A.02.XX</td>
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<td>1</td>
<td>2.845</td>
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<tr>
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<td>856.25</td>
<td>99</td>
<td>1</td>
<td>95.035</td>
</tr>
<tr>
<td>ALL</td>
<td>856.25</td>
<td>50</td>
<td>1</td>
<td>47.750</td>
</tr>
<tr>
<td>ALL</td>
<td>856.25</td>
<td>3</td>
<td>1</td>
<td>2.845</td>
</tr>
<tr>
<td>ALL</td>
<td>956.25</td>
<td>50</td>
<td>1</td>
<td>47.750</td>
</tr>
<tr>
<td>ALL</td>
<td>976.002</td>
<td>3</td>
<td>1</td>
<td>2.845</td>
</tr>
<tr>
<td>ALL</td>
<td>1000</td>
<td>99</td>
<td>1</td>
<td>95.035</td>
</tr>
<tr>
<td>ALL</td>
<td>1000</td>
<td>50</td>
<td>1</td>
<td>47.750</td>
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<tr>
<td>ALL</td>
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<td>11</td>
<td>1</td>
<td>10.115</td>
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</table>
### Applicable Firmware Revision

<table>
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<tr>
<th>Applicable Firmware Revision</th>
<th>RF (MHz)</th>
<th>Deviation (kHz)</th>
<th>Rate (kHz)</th>
<th>FM Deviation Limits (kHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<td></td>
<td><strong>Lower</strong></td>
</tr>
<tr>
<td><strong>ALL</strong></td>
<td>1000</td>
<td>3</td>
<td>1</td>
<td>2.845</td>
</tr>
</tbody>
</table>

The following entries are for the 2 GHz setup.

<table>
<thead>
<tr>
<th>Applicable Firmware Revision</th>
<th>RF (MHz)</th>
<th>Deviation (kHz)</th>
<th>Rate (kHz)</th>
<th>FM Deviation Limits (kHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ALL</strong></td>
<td>1700</td>
<td>99</td>
<td>1</td>
<td>95.035</td>
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<tr>
<td><strong>ALL</strong></td>
<td>1700</td>
<td>50</td>
<td>1</td>
<td>47.750</td>
</tr>
<tr>
<td><strong>ALL</strong></td>
<td>1700</td>
<td>3</td>
<td>1</td>
<td>2.845</td>
</tr>
<tr>
<td><strong>ALL</strong></td>
<td>2000</td>
<td>99</td>
<td>1</td>
<td>95.035</td>
</tr>
<tr>
<td><strong>ALL</strong></td>
<td>2000</td>
<td>50</td>
<td>1</td>
<td>47.750</td>
</tr>
<tr>
<td><strong>ALL</strong></td>
<td>2000</td>
<td>3</td>
<td>1</td>
<td>2.845</td>
</tr>
</tbody>
</table>
RF Generator FM Flatness Performance Test 3 Record

For test procedure, see “RF Generator FM Flatness Performance Test 3” on page 152.

Table 7-3  RF Generator FM Flatness Test 3 Record

<table>
<thead>
<tr>
<th>Applicable Firmware Revision</th>
<th>Level (dBm)</th>
<th>RF (MHz)</th>
<th>Deviation (kHz)</th>
<th>AFGEN1 Freq. Rate (kHz)</th>
<th>Computed FM Flatness Limits (dB)</th>
<th>Measured Reading (kHz)</th>
<th>Computed Results (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤A.02.XX</td>
<td>−10</td>
<td>521</td>
<td>50</td>
<td>1</td>
<td>Reference</td>
<td></td>
<td>0 dB</td>
</tr>
<tr>
<td>≤A.02.XX</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>
<td>≤A.02.XX</td>
<td>−10</td>
<td>521</td>
<td>50</td>
<td>0.2</td>
<td>−1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>≤A.02.XX</td>
<td>−10</td>
<td>521</td>
<td>50</td>
<td>2</td>
<td>−1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>≤A.02.XX</td>
<td>−10</td>
<td>521</td>
<td>50</td>
<td>10</td>
<td>−1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>≤A.02.XX</td>
<td>−10</td>
<td>521</td>
<td>50</td>
<td>25</td>
<td>−1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>ALL</td>
<td>−10</td>
<td>975.5</td>
<td>50</td>
<td>Reference</td>
<td></td>
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<td>975.5</td>
<td>50</td>
<td>0.1</td>
<td>−1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>ALL</td>
<td>−10</td>
<td>975.5</td>
<td>50</td>
<td>0.2</td>
<td>−1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>ALL</td>
<td>−10</td>
<td>975.5</td>
<td>50</td>
<td>2</td>
<td>−1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>ALL</td>
<td>−10</td>
<td>975.5</td>
<td>50</td>
<td>10</td>
<td>−1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>ALL</td>
<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.

<p>| ALL                         | −10         | 1700     | 50              | Reference               |                                |                        | 0 dB                 |
| ALL                         | −10         | 1700     | 50              | 0.1                     | −1                              | 1                      |
| ALL                         | −10         | 1700     | 50              | 0.2                     | −1                              | 1                      |
| ALL                         | −10         | 1700     | 50              | 2                       | −1                              | 1                      |
| ALL                         | −10         | 1700     | 50              | 10                      | −1                              | 1                      |
| ALL                         | −10         | 1700     | 50              | 25                      | −1                              | 1                      |
| ALL                         | −10         | 2000     | 50              | Reference               |                                |                        | 0 dB                 |
| ALL                         | −10         | 2000     | 50              | 0.1                     | −1                              | 1                      |</p>
<table>
<thead>
<tr>
<th>Applicable Firmware Revision</th>
<th>Level (dBm)</th>
<th>RF (MHz)</th>
<th>Deviation (kHz)</th>
<th>AFGEN1 Freq. Rate (kHz)</th>
<th>Computed FM Flatness Limits (dB)</th>
<th>Measured Reading (kHz)</th>
<th>Computed Results (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALL</td>
<td>−10</td>
<td>2000</td>
<td>50</td>
<td>0.2</td>
<td>−1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>ALL</td>
<td>−10</td>
<td>2000</td>
<td>50</td>
<td>2</td>
<td>−1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>ALL</td>
<td>−10</td>
<td>2000</td>
<td>50</td>
<td>10</td>
<td>−1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>ALL</td>
<td>−10</td>
<td>2000</td>
<td>50</td>
<td>25</td>
<td>−1</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>
RF Generator Residual FM

Performance Test 4 Record

For test procedure, see “RF Generator Residual FM Performance Test 4” on page 155.

Table 7-4

<table>
<thead>
<tr>
<th>Applicable Firmware Revision</th>
<th>LO (MHz)</th>
<th>RF (MHz)</th>
<th>Residual FM Limits (Hz)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Upper</td>
</tr>
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<td>30</td>
<td>7</td>
</tr>
<tr>
<td>≤A.02.XX</td>
<td>101.5</td>
<td>100</td>
<td>7</td>
</tr>
<tr>
<td>≤A.02.XX</td>
<td>249.5</td>
<td>248</td>
<td>7</td>
</tr>
<tr>
<td>≤A.02.XX</td>
<td>251.5</td>
<td>250</td>
<td>4</td>
</tr>
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<td>≤A.02.XX</td>
<td>401.5</td>
<td>400</td>
<td>4</td>
</tr>
<tr>
<td>≤A.02.XX</td>
<td>501.5</td>
<td>500</td>
<td>4</td>
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<td>≤A.02.XX</td>
<td>502.5</td>
<td>501</td>
<td>7</td>
</tr>
<tr>
<td>≤A.02.XX</td>
<td>512.701</td>
<td>511.201</td>
<td>7</td>
</tr>
<tr>
<td>≤A.02.XX</td>
<td>513.101</td>
<td>511.601</td>
<td>7</td>
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<td>513.501</td>
<td>512.001</td>
<td>7</td>
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<td>626.5</td>
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<td>735</td>
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<td>751.5</td>
<td>750</td>
<td>7</td>
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<td>≤A.02.XX</td>
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<td>768.001</td>
<td>7</td>
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<tr>
<td>ALL</td>
<td>846.5</td>
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<td>ALL</td>
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</tr>
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<td>7</td>
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<td>900</td>
<td>7</td>
</tr>
<tr>
<td>ALL</td>
<td>999.901</td>
<td>998.401</td>
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</tr>
<tr>
<td>Applicable Firmware Revision</td>
<td>LO (MHz)</td>
<td>RF (MHz)</td>
<td>Residual FM Limits (Hz)</td>
</tr>
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</tbody>
</table>

The following entries are for the 2 GHz setup.

| ALL | 201.5  | 1700 | 14 |
| ALL | 501.5  | 2000 | 14 |
RF Generator Level Accuracy
Performance Test 5 Record

For test procedure, see “RF Generator Level Accuracy Performance Test 5” on page 158.

Table 7-5  RF Generator Level Accuracy  Test 5 Record

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### Performance Test Records

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

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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 163.

Table 7-6  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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<th>Harmonic Limits (dBc)</th>
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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 165.

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

<table>
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<th>Spurious Source</th>
<th>RF Freq (MHz)</th>
<th>Spur Freq (MHz)</th>
<th>Spurious Signal Limits (dBc)</th>
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<td>Spur Freq (MHz)</td>
<td>Spurious Signal Limits (dBc)</td>
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AF Generator AC Level Accuracy
Performance Test 8 Record

For test procedure, see “AF Analyzer AC Level Accuracy Performance Test 12” on page 171.

Table 7-8  AF Generator AC Level Accuracy Test 8 Record

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<th>Frequency (Hz)</th>
<th>Level (mV)</th>
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<td>70.000</td>
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<td>3885.000</td>
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## Performance Test Records

### AF Generator AC Level Accuracy Performance Test 8 Record

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<th>AC Level Limits (mV)</th>
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<td>4000</td>
<td>3885.000</td>
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</table>
AF Generator DC Level Accuracy Performance Test 9 Record

For test procedure, see “AF Generator DC Level Accuracy Performance Test 9” on page 168.

Table 7-9  AF Generator DC Level Accuracy Test 9 Record

<table>
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<th>Level (mV)</th>
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# AF Generator Residual Distortion Performance Test 10 Record

For test procedure, see “AF Generator Residual Distortion Performance Test 10” on page 169.

## Table 7-10 AF Generator Residual Distortion Test 10 Record

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<td>0.125</td>
</tr>
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<td>AF Generator</td>
<td>Frequency (Hz)</td>
<td>Level (mV)</td>
<td>Distortion Limits (%)</td>
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<td>4000</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 170.

Table 7-11  AF Generator Frequency Accuracy Test 11 Record

<table>
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<tr>
<th>AF Generator</th>
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<td>24993.750</td>
</tr>
<tr>
<td>1</td>
<td>10000</td>
<td>9997.500</td>
</tr>
<tr>
<td>1</td>
<td>5000</td>
<td>4998.750</td>
</tr>
<tr>
<td>1</td>
<td>2000</td>
<td>1999.500</td>
</tr>
<tr>
<td>1</td>
<td>1000</td>
<td>999.750</td>
</tr>
<tr>
<td>1</td>
<td>500</td>
<td>499.875</td>
</tr>
<tr>
<td>1</td>
<td>200</td>
<td>199.950</td>
</tr>
<tr>
<td>1</td>
<td>100</td>
<td>99.975</td>
</tr>
<tr>
<td>1</td>
<td>50</td>
<td>49.988</td>
</tr>
<tr>
<td>1</td>
<td>20</td>
<td>19.995</td>
</tr>
<tr>
<td>2</td>
<td>25000</td>
<td>24993.750</td>
</tr>
<tr>
<td>2</td>
<td>10000</td>
<td>9997.500</td>
</tr>
<tr>
<td>2</td>
<td>5000</td>
<td>4998.750</td>
</tr>
<tr>
<td>2</td>
<td>1000</td>
<td>999.750</td>
</tr>
<tr>
<td>2</td>
<td>500</td>
<td>499.875</td>
</tr>
<tr>
<td>2</td>
<td>200</td>
<td>199.950</td>
</tr>
<tr>
<td>2</td>
<td>100</td>
<td>99.975</td>
</tr>
<tr>
<td>2</td>
<td>50</td>
<td>49.988</td>
</tr>
<tr>
<td>2</td>
<td>20</td>
<td>19.995</td>
</tr>
</tbody>
</table>
AF Analyzer AC Level Accuracy Performance Test 12 Record

For test procedure, see “AF Analyzer AC Level Accuracy Performance Test 12” on page 171.

<table>
<thead>
<tr>
<th>Frequency (Hz)</th>
<th>Level (mV)</th>
<th>AC Voltage Limits (mV)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Lower</td>
</tr>
<tr>
<td>15000</td>
<td>5000</td>
<td>4850.00</td>
</tr>
<tr>
<td>2000</td>
<td>5000</td>
<td>4850.00</td>
</tr>
<tr>
<td>200</td>
<td>5000</td>
<td>4850.00</td>
</tr>
<tr>
<td>20</td>
<td>5000</td>
<td>4850.00</td>
</tr>
<tr>
<td>15000</td>
<td>500</td>
<td>48.50</td>
</tr>
<tr>
<td>2000</td>
<td>500</td>
<td>48.50</td>
</tr>
<tr>
<td>200</td>
<td>500</td>
<td>48.50</td>
</tr>
<tr>
<td>20</td>
<td>500</td>
<td>48.50</td>
</tr>
</tbody>
</table>
AF Analyzer Residual Noise Performance Test 13 Record

For test procedure, see “AF Analyzer Residual Noise Performance Test 13” on page 172.

Table 7-13  AF Analyzer Residual Noise Test 13 Record

<table>
<thead>
<tr>
<th>Residual Noise Limits (µV)</th>
<th>Filter 2</th>
<th>Upper</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 kHz LPF</td>
<td></td>
<td>150</td>
<td></td>
</tr>
<tr>
<td>&gt;99 kHz LP</td>
<td></td>
<td>450</td>
<td></td>
</tr>
</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 173.

Table 7-14 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>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lower</td>
</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>
</tr>
<tr>
<td>3</td>
<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>
<tr>
<td>2</td>
<td>5</td>
<td>SINAD</td>
<td>45.021 dB</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>Distortion</td>
<td>0.445 %</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>SINAD</td>
<td>45.021 dB</td>
</tr>
</tbody>
</table>
AF Analyzer DC Level Accuracy Performance Test 15 Record

For test procedure, see “AF Analyzer DC Level Accuracy Performance Test 15” on page 174.

Table 7-15  
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>
</thead>
<tbody>
<tr>
<td></td>
<td>Lower</td>
</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 175.

<table>
<thead>
<tr>
<th>Frequency (Hz)</th>
<th>Frequency Limits (Hz)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lower</td>
</tr>
<tr>
<td>21</td>
<td>20.896</td>
</tr>
<tr>
<td>100</td>
<td>99.880</td>
</tr>
<tr>
<td>1000</td>
<td>999.700</td>
</tr>
<tr>
<td>10000</td>
<td>9997.90</td>
</tr>
<tr>
<td>100000</td>
<td>99979.9</td>
</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 176.

Table 7-17  AF Analyzer Frequency Accuracy at 400 kHz Test 17 Record

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

For test procedure, see “Oscilloscope Amplitude Accuracy Performance Test 18” on page 177.

Table 7-18 Oscilloscope Amplitude Accuracy Test 18 Record

<table>
<thead>
<tr>
<th>Frequency (kHz)</th>
<th>Amplitude Limits (V)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lower</td>
<td>Upper</td>
<td>Actual</td>
</tr>
<tr>
<td>1</td>
<td>6.765</td>
<td>7.377</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>6.765</td>
<td>7.377</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>5.000</td>
<td>10.000</td>
<td></td>
</tr>
</tbody>
</table>
RF Analyzer Level Accuracy Performance Test 19 Record

For test procedure, see “RF Analyzer Level Accuracy Performance Test 19” on page 179.

Table 7-19 RF Analyzer Level Accuracy Test 19 Record

<table>
<thead>
<tr>
<th>Applicable Firmware Revision</th>
<th>Frequency (MHz)</th>
<th>Level Difference Limits (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lower</td>
<td>Upper</td>
</tr>
<tr>
<td>≤A.02.XX</td>
<td>30</td>
<td>−0.314</td>
</tr>
<tr>
<td>≤A.02.XX</td>
<td>50</td>
<td>−0.314</td>
</tr>
<tr>
<td>≤A.02.XX</td>
<td>100</td>
<td>−0.314</td>
</tr>
<tr>
<td>≤A.02.XX</td>
<td>150</td>
<td>−0.314</td>
</tr>
<tr>
<td>≤A.02.XX</td>
<td>200</td>
<td>−0.314</td>
</tr>
<tr>
<td>≤A.02.XX</td>
<td>250</td>
<td>−0.314</td>
</tr>
<tr>
<td>≤A.02.XX</td>
<td>300</td>
<td>−0.314</td>
</tr>
<tr>
<td>≤A.02.XX</td>
<td>350</td>
<td>−0.314</td>
</tr>
<tr>
<td>≤A.02.XX</td>
<td>400</td>
<td>−0.314</td>
</tr>
<tr>
<td>≤A.02.XX</td>
<td>450</td>
<td>−0.314</td>
</tr>
<tr>
<td>≤A.02.XX</td>
<td>500</td>
<td>−0.314</td>
</tr>
<tr>
<td>≤A.02.XX</td>
<td>550</td>
<td>−0.314</td>
</tr>
<tr>
<td>≤A.02.XX</td>
<td>600</td>
<td>−0.314</td>
</tr>
<tr>
<td>≤A.02.XX</td>
<td>650</td>
<td>−0.314</td>
</tr>
<tr>
<td>≤A.02.XX</td>
<td>700</td>
<td>−0.314</td>
</tr>
<tr>
<td>≤A.02.XX</td>
<td>750</td>
<td>−0.314</td>
</tr>
<tr>
<td>ALL</td>
<td>800</td>
<td>−0.314</td>
</tr>
<tr>
<td>ALL</td>
<td>850</td>
<td>−0.314</td>
</tr>
<tr>
<td>ALL</td>
<td>900</td>
<td>−0.314</td>
</tr>
<tr>
<td>ALL</td>
<td>950</td>
<td>−0.314</td>
</tr>
<tr>
<td>ALL</td>
<td>1000</td>
<td>−0.314</td>
</tr>
<tr>
<td>ALL</td>
<td>1700</td>
<td>−0.334</td>
</tr>
<tr>
<td>ALL</td>
<td>1725</td>
<td>−0.334</td>
</tr>
<tr>
<td>Applicable Firmware Revision</td>
<td>Frequency (MHz)</td>
<td>Level Difference Limits (dB)</td>
</tr>
<tr>
<td>------------------------------</td>
<td>----------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>ALL</td>
<td>1750</td>
<td>Lower: -0.334, Upper: 0.334</td>
</tr>
<tr>
<td>ALL</td>
<td>1775</td>
<td>Lower: -0.334, Upper: 0.334</td>
</tr>
<tr>
<td>ALL</td>
<td>1800</td>
<td>Lower: -0.334, Upper: 0.334</td>
</tr>
<tr>
<td>ALL</td>
<td>1825</td>
<td>Lower: -0.334, Upper: 0.334</td>
</tr>
<tr>
<td>ALL</td>
<td>1850</td>
<td>Lower: -0.334, Upper: 0.334</td>
</tr>
<tr>
<td>ALL</td>
<td>1875</td>
<td>Lower: -0.334, Upper: 0.334</td>
</tr>
<tr>
<td>ALL</td>
<td>1900</td>
<td>Lower: -0.334, Upper: 0.334</td>
</tr>
<tr>
<td>ALL</td>
<td>1925</td>
<td>Lower: -0.334, Upper: 0.334</td>
</tr>
<tr>
<td>ALL</td>
<td>1950</td>
<td>Lower: -0.334, Upper: 0.334</td>
</tr>
<tr>
<td>ALL</td>
<td>1975</td>
<td>Lower: -0.334, Upper: 0.334</td>
</tr>
<tr>
<td>ALL</td>
<td>2000</td>
<td>Lower: -0.334, Upper: 0.334</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 180.

Table 7-20 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>840</td>
<td>1</td>
<td>1</td>
<td>0.950</td>
</tr>
<tr>
<td>840</td>
<td>1</td>
<td>10</td>
<td>0.950</td>
</tr>
<tr>
<td>840</td>
<td>10</td>
<td>1</td>
<td>9.500</td>
</tr>
<tr>
<td>840</td>
<td>10</td>
<td>10</td>
<td>9.500</td>
</tr>
<tr>
<td>1000</td>
<td>1</td>
<td>1</td>
<td>0.950</td>
</tr>
<tr>
<td>1000</td>
<td>1</td>
<td>10</td>
<td>0.950</td>
</tr>
<tr>
<td>1000</td>
<td>10</td>
<td>1</td>
<td>9.500</td>
</tr>
<tr>
<td>1000</td>
<td>10</td>
<td>10</td>
<td>9.500</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 182.

Table 7-21 RF Analyzer FM Distortion Test 21 Record

<table>
<thead>
<tr>
<th>FM Deviation (kHz)</th>
<th>FM Distortion Limits (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Upper</td>
</tr>
<tr>
<td>5</td>
<td>1.000</td>
</tr>
<tr>
<td>25</td>
<td>1.000</td>
</tr>
<tr>
<td>75</td>
<td>1.000</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 184.

Table 7-22 RF Analyzer FM Bandwidth Test 22 Record

<table>
<thead>
<tr>
<th>FM Deviation Difference Limits (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<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 186.

<table>
<thead>
<tr>
<th>RF (MHz)</th>
<th>FM Deviation Limits (Hz)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Upper</td>
</tr>
<tr>
<td>840</td>
<td>7.0</td>
</tr>
<tr>
<td>1800</td>
<td>14.0</td>
</tr>
</tbody>
</table>
Performance Test Records
Spectrum Analyzer Image Rejection Performance Test 24 Record

Spectrum Analyzer Image Rejection Performance Test 24 Record

For test procedure, see “Spectrum Analyzer Image Rejection Performance Test 24” on page 188.

Table 7-24 Spectrum Analyzer Image Rejection (Image) Test 24 Record

<table>
<thead>
<tr>
<th>Applicable Firmware Revision</th>
<th>RF Generator Frequency (MHz)</th>
<th>Spectrum Analyzer Frequency (MHz)</th>
<th>Image Response Limits (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;A.02.XX</td>
<td>1229</td>
<td>0.4</td>
<td>-47</td>
</tr>
<tr>
<td>&lt;A.02.XX</td>
<td>1379.6</td>
<td>151</td>
<td>-47</td>
</tr>
<tr>
<td>&lt;A.02.XX</td>
<td>616.6</td>
<td>385</td>
<td>-47</td>
</tr>
<tr>
<td>&lt;A.02.XX</td>
<td>873.6</td>
<td>645</td>
<td>-47</td>
</tr>
<tr>
<td>&lt;A.02.XX</td>
<td>883.6</td>
<td>655</td>
<td>-47</td>
</tr>
<tr>
<td>&lt;A.02.XX</td>
<td>1023.6</td>
<td>795</td>
<td>-47</td>
</tr>
<tr>
<td>&lt;A.02.XX</td>
<td>1000</td>
<td>771.4</td>
<td>-47</td>
</tr>
<tr>
<td>ALL</td>
<td>928.6</td>
<td>1700</td>
<td>-47</td>
</tr>
<tr>
<td>ALL</td>
<td>1078.6</td>
<td>1850</td>
<td>-47</td>
</tr>
<tr>
<td>ALL</td>
<td>2078.6</td>
<td>1850</td>
<td>-47</td>
</tr>
<tr>
<td>ALL</td>
<td>1227.6</td>
<td>1999</td>
<td>-47</td>
</tr>
<tr>
<td>ALL</td>
<td>576.4</td>
<td>805</td>
<td>-47</td>
</tr>
<tr>
<td>ALL</td>
<td>771.4</td>
<td>1000</td>
<td>-47</td>
</tr>
<tr>
<td>ALL</td>
<td>1228.6</td>
<td>2000</td>
<td>-47</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 190.

Table 7-25 CDMA Generator RF In/Out Test 25 Record

<table>
<thead>
<tr>
<th>Sector</th>
<th>RF (MHz)</th>
<th>Level (dBm)</th>
<th>Measured Level Limits (dBm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lower</td>
</tr>
<tr>
<td>A</td>
<td>881.52</td>
<td>−20.50</td>
<td>−21.75</td>
</tr>
<tr>
<td>A</td>
<td>881.52</td>
<td>−25.49</td>
<td>−26.74</td>
</tr>
<tr>
<td>B</td>
<td>881.52</td>
<td>−20.50</td>
<td>−21.75</td>
</tr>
<tr>
<td>B</td>
<td>881.52</td>
<td>−25.49</td>
<td>−26.74</td>
</tr>
<tr>
<td>A</td>
<td>1956.25</td>
<td>−21.50</td>
<td>−22.85</td>
</tr>
<tr>
<td>A</td>
<td>1956.25</td>
<td>−26.49</td>
<td>−27.84</td>
</tr>
<tr>
<td>B</td>
<td>1956.25</td>
<td>−21.50</td>
<td>−22.85</td>
</tr>
<tr>
<td>B</td>
<td>1956.25</td>
<td>−26.49</td>
<td>−27.84</td>
</tr>
</tbody>
</table>
CDMA Generator DUPLEX OUT Amplitude Level Accuracy Performance Test 26

For test procedure, see “CDMA Generator DUPLEX OUT Amplitude Level Accuracy Performance Test 26” on page 192.

<table>
<thead>
<tr>
<th>RF Freq. (MHz)</th>
<th>Level (dBm)</th>
<th>Measured Level Limits (dBm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lower</td>
<td>Upper</td>
</tr>
<tr>
<td>840</td>
<td>−10.50</td>
<td>−11.75</td>
</tr>
<tr>
<td>840</td>
<td>−15.49</td>
<td>−16.74</td>
</tr>
<tr>
<td>1890.52</td>
<td>−11.50</td>
<td>−12.85</td>
</tr>
<tr>
<td>1890.52</td>
<td>−16.49</td>
<td>−17.84</td>
</tr>
</tbody>
</table>

Table 7-27  
CDMA Generator DUPLEX OUT AWGN Power Level Accuracy Test 26 Record

<table>
<thead>
<tr>
<th>RF Freq. (MHz)</th>
<th>Level (dBm)</th>
<th>Measured Level Limits (dBm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lower</td>
<td>Upper</td>
</tr>
<tr>
<td>840</td>
<td>−7.50</td>
<td>−9.25</td>
</tr>
<tr>
<td>840</td>
<td>−9</td>
<td>−10.75</td>
</tr>
<tr>
<td>1890.52</td>
<td>−7.50</td>
<td>−9.35</td>
</tr>
<tr>
<td>1890.52</td>
<td>−9</td>
<td>−10.85</td>
</tr>
</tbody>
</table>
CDMA Generator Modulation Accuracy
Performance Test 27 Record

For test procedure, see “CDMA Generator Modulation Accuracy Performance Test 27” on page 194.

Table 7-28 CDMA Generator Modulation Accuracy Test 27 Record

<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></td>
<td></td>
<td></td>
<td>Lower Limit</td>
</tr>
<tr>
<td>881.52</td>
<td>−10</td>
<td></td>
<td>0.97</td>
</tr>
<tr>
<td>1956.25</td>
<td>−10</td>
<td></td>
<td>0.97</td>
</tr>
</tbody>
</table>
CDMA Analyzer Average Power Level Accuracy Performance Test 28 Record

For test procedure, see “CDMA Analyzer Average Power Level Accuracy Performance Test 28” on page 196.

Table 7-29 CDMA Analyzer Average Power Level Accuracy Test 28 Record

<table>
<thead>
<tr>
<th>RF (MHz)</th>
<th>Level (dBm)</th>
<th>Measured Level Limits (mW)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Lower</td>
</tr>
<tr>
<td>881.52</td>
<td>0</td>
<td>-0.343</td>
</tr>
<tr>
<td>881.52</td>
<td>-10</td>
<td>-10.39</td>
</tr>
<tr>
<td>1956.25</td>
<td>0</td>
<td>-0.366</td>
</tr>
<tr>
<td>1956.25</td>
<td>-10</td>
<td>-10.41</td>
</tr>
</tbody>
</table>
CDMA Analyzer Channel Power Level Accuracy Performance Test 29 Record

For test procedure, see “CDMA Analyzer Channel Power Level Accuracy Performance Test 29” on page 198.

Table 7-30 CDMA Analyzer Channel Power Level Accuracy Test 29 Record

<table>
<thead>
<tr>
<th>Sig. Gen. Freq. Setting (MHz)</th>
<th>RF Channel (MHz)</th>
<th>Level (dBm)</th>
<th>Measured Level Limits (dBm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lower</td>
</tr>
<tr>
<td>836.52</td>
<td>384</td>
<td>11</td>
<td>10.25</td>
</tr>
<tr>
<td>836.52</td>
<td>384</td>
<td>6</td>
<td>5.25</td>
</tr>
<tr>
<td>836.52</td>
<td>384</td>
<td>1</td>
<td>0.25</td>
</tr>
<tr>
<td>836.52</td>
<td>384</td>
<td>–4</td>
<td>–4.75</td>
</tr>
<tr>
<td>836.52</td>
<td>384</td>
<td>–9</td>
<td>–9.75</td>
</tr>
<tr>
<td>836.52</td>
<td>384</td>
<td>–14</td>
<td>–14.75</td>
</tr>
<tr>
<td>836.52</td>
<td>384</td>
<td>–19</td>
<td>–19.75</td>
</tr>
<tr>
<td>1876.52</td>
<td>525</td>
<td>11</td>
<td>10.25</td>
</tr>
<tr>
<td>1876.52</td>
<td>525</td>
<td>6</td>
<td>5.25</td>
</tr>
<tr>
<td>1876.52</td>
<td>525</td>
<td>1</td>
<td>0.25</td>
</tr>
<tr>
<td>1876.52</td>
<td>525</td>
<td>–4</td>
<td>–4.75</td>
</tr>
<tr>
<td>1876.52</td>
<td>525</td>
<td>–9</td>
<td>–9.75</td>
</tr>
<tr>
<td>1876.52</td>
<td>525</td>
<td>–14</td>
<td>–14.75</td>
</tr>
<tr>
<td>1876.52</td>
<td>525</td>
<td>–19</td>
<td>–19.75</td>
</tr>
</tbody>
</table>
Performance Test Records
CDMA Analyzer Channel Power Level Accuracy Performance Test 29 Record
This chapter contains block diagrams and descriptions that focus on how the Test Set generates signal and performs measurements.
Signal Flow and Interconnections

Shown in Figure 8-1, “Signal Flow and Interconnections,” on page 252 is a block-diagram overview of the Test Set. For details on individual assemblies refer to Table 8-1 on page 251.

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.
<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 8-1</td>
<td>“Signal Flow and Interconnections,”</td>
<td>252</td>
</tr>
<tr>
<td>Figure 8-2</td>
<td>“RF I/O,”</td>
<td>254</td>
</tr>
<tr>
<td>Figure 8-3</td>
<td>“Downconverter,”</td>
<td>257</td>
</tr>
<tr>
<td>Figure 8-4</td>
<td>“Receiver Synthesizer,”</td>
<td>258</td>
</tr>
<tr>
<td>Figure 8-5</td>
<td>“Receiver,”</td>
<td>259</td>
</tr>
<tr>
<td>Figure 8-6</td>
<td>“Digital Cellsite 1 &amp; 2,”</td>
<td>260</td>
</tr>
<tr>
<td>Figure 8-7</td>
<td>“Analog Cell Site (FW Rev A.04.54 and below),”</td>
<td>261</td>
</tr>
<tr>
<td>Figure 8-8</td>
<td>“Analog Cell Site (FW Rev A.05.03 and above),”</td>
<td>262</td>
</tr>
<tr>
<td>Figure 8-9</td>
<td>“Protocol Processor,”</td>
<td>263</td>
</tr>
<tr>
<td>Figure 8-10</td>
<td>“Spectrum Analyzer,”</td>
<td>265</td>
</tr>
<tr>
<td>Figure 8-11</td>
<td>“Audio Analyzer 1,”</td>
<td>267</td>
</tr>
<tr>
<td>Figure 8-12</td>
<td>“Audio Analyzer 2,”</td>
<td>268</td>
</tr>
<tr>
<td>Figure 8-13</td>
<td>“Measurement Board,”</td>
<td>269</td>
</tr>
<tr>
<td>Figure 8-14</td>
<td>“Signaling and Analyzer Assembly,”</td>
<td>270</td>
</tr>
<tr>
<td>Figure 8-15</td>
<td>“IQ Modulator,”</td>
<td>272</td>
</tr>
<tr>
<td>Figure 8-16</td>
<td>“LO/IF/Demodulator,”</td>
<td>273</td>
</tr>
<tr>
<td>Figure 8-17</td>
<td>“Digital Signal Processor 1 (DSP1),”</td>
<td>274</td>
</tr>
<tr>
<td>Figure 8-18</td>
<td>“CDMA Reference,”</td>
<td>276</td>
</tr>
<tr>
<td>Figure 8-19</td>
<td>“Signaling and Analyzer Assembly,”</td>
<td>277</td>
</tr>
<tr>
<td>Figure 8-20</td>
<td>“Modulation Distribution,”</td>
<td>278</td>
</tr>
<tr>
<td>Figure 8-21</td>
<td>“Signal Generator Synthesizer,”</td>
<td>281</td>
</tr>
<tr>
<td>Figure 8-22</td>
<td>“RF Output Section,”</td>
<td>282</td>
</tr>
<tr>
<td>Figure 8-23</td>
<td>“Upconverter,”</td>
<td>283</td>
</tr>
<tr>
<td>Figure 8-24</td>
<td>“High Stability Reference,”</td>
<td>285</td>
</tr>
<tr>
<td>Figure 8-25</td>
<td>“Regulator,”</td>
<td>286</td>
</tr>
<tr>
<td>Figure 8-26</td>
<td>“Memory SBRC,”</td>
<td>288</td>
</tr>
<tr>
<td>Figure 8-27</td>
<td>“Controller,”</td>
<td>289</td>
</tr>
<tr>
<td>Figure 8-28</td>
<td>“Display Driver,”</td>
<td>290</td>
</tr>
<tr>
<td>Figure 8-29</td>
<td>“GPIB/Serial,”</td>
<td>291</td>
</tr>
</tbody>
</table>
Figure 8-1: Signal Flow and Interconnections
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 8-2, “RF I/O,” on page 254. 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 Receive DSP where average power measurements are made. There’s also a diode peak detector to provide a peak power measurement through the Measurement assembly.

Accuracy is insured by factory-generated calibration data which is stored in CAL ROM.

Input Gain Control

Step attenuators in the RF 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.
Block Diagrams
RF Input/Output Section

Figure 8-2 RF I/O
RF Analyzer Section

Frequency Conversion

NOTE: Test Sets with firmware revision A.04.5X and above operate only at RF frequencies from 800 to 1000 MHz and 1700 to 2000 MHz. A text only error message “Input value out of range”, will be displayed if invalid frequencies are set.

The Downconverter, see Figure 8-3 on page 257, produces an IF of 114.3, 385.7 or 614.3 MHz. The LO is provided by the Receiver Synthesizer, see Figure 8-4 on page 258. The IF frequencies developed are as follows in Table 8-2.

Table 8-2  Downconverter Signal Paths

<table>
<thead>
<tr>
<th>Tune Frequency (MHz)</th>
<th>RF Filter</th>
<th>IF Frequency (MHz)</th>
<th>Conversion Module</th>
<th>LO Filter (LO freq range)</th>
<th>RSYN_500_1000M Range (MHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>.4 to &lt;150</td>
<td>150 MHz LPF</td>
<td>614.3</td>
<td>high-side LO</td>
<td>NA</td>
<td>614.7-764.3</td>
</tr>
<tr>
<td>150 to &lt;380.7</td>
<td>150-386 MHz BPF</td>
<td>614.3</td>
<td>high-side LO</td>
<td>NA</td>
<td>764.3-995.0</td>
</tr>
<tr>
<td>380.7 to &lt;650</td>
<td>350-650 MHz TBPF</td>
<td>114.3</td>
<td>high-side LO</td>
<td>NA</td>
<td>945.0-764.3</td>
</tr>
<tr>
<td>650 to &lt;800</td>
<td>600-1000 MHz TBPF</td>
<td>114.3</td>
<td>high-side LO</td>
<td>NA</td>
<td>764.3-914.3</td>
</tr>
<tr>
<td>800 to 1000</td>
<td>600-1000 MHz TBPF</td>
<td>114.3</td>
<td>low-side LO</td>
<td>NA</td>
<td>685.7-885.7</td>
</tr>
<tr>
<td>1400 to &lt;1614.3</td>
<td>1400-2200 MHz TBPF</td>
<td>385.7</td>
<td>high-side LO</td>
<td>PDC/Unlic_PCS (1600-2000 MHz)</td>
<td>892.85-1000.0^a</td>
</tr>
<tr>
<td>1614.3 to 2000</td>
<td>1400-2200 MHz TBPF</td>
<td>385.7</td>
<td>low-side LO</td>
<td>PCS (1200-1620 MHz)</td>
<td>614.3-807.15^b</td>
</tr>
<tr>
<td>&gt;2000 to 2200</td>
<td>1400-2200 MHz TBPF</td>
<td>385.7</td>
<td>low-side LO</td>
<td>PDC/Unlic_PCS (1600-2000 MHz)</td>
<td>807.15-907.15^c</td>
</tr>
</tbody>
</table>

^a. This LO input is doubled to 1785.7-2000 MHz prior to mixing.
^b. This LO input is doubled to 1228.6-1614.3 MHz prior to mixing.
^c. This LO input is doubled to 1614.3-1814.3 MHz prior to mixing.
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 Receiver assembly, see Figure 8-5 on page 259, demodulates the IF into its FM, AM, and SSB components. The demodulated signal is sent to the Audio Analyzer section for measurement.
Figure 8-4  Receiver Synthesizer
Figure 8-5  Receiver
Figure 8-6  Digital Cellsite 1 & 2
Figure 8-7  Analog Cell Site (FW Rev A.04.54 and below)
Block Diagrams
RF Analyzer Section

Figure 8-8  Analog Cell Site (FW Rev A.05.03 and above)
Figure 8-9  Protocol Processor

![Protocol Processor Diagram]
**Spectrum Analyzer**

**Spectrum Analysis (option 102)**

The LO on the Spectrum Analyzer, see figure 8-10 on page 265, is swept across the span by the Controller. The LO starts sweeping when the oscilloscope circuits on the 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 Spectrum Analyzer. These filters are set by the Controller as a function of the span selected from the front panel.
Figure 8-10  Spectrum Analyzer
Audio Analyzer Section

Input Level Control

Switchable gain amplifiers on the Audio Analyzer 1 and Audio Analyzer 2 (figure 8-11 on page 267, and figure 8-12 on page 268) 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 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 and Audio Analyzer assemblies, Measurement assembly (figure 8-13 on page 269), and the Controller (figure 8-27 on page 289) work together to perform the oscilloscope functions.

The audio or dc signal to be displayed goes from the Audio Analyzer 2 assembly to a sampler on the 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 Signaling Source and Analyzer assembly (figure 8-19 on page 277), and the internal trigger signal are used by the 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 8-11  Audio Analyzer 1
Figure 8-13  Measurement Board
Figure 8-14  Signaling and Analyzer Assembly
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 IQ Modulator assembly, see figure 8-15 on page 272. The oscillator that produces the LO signal is phase locked to a 10 MHz signal from the CDMA Reference assembly, see figure 8-18 on page 276.

CDMA Signal Analysis

The 3.6864 MHz signal goes to the DSP assembly. The 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 DSP assembly also makes average power measurements through a direct link from the RF Input/Output assembly (figure 8-2 on page 254).
Figure 8-16  LO/IF/Demodulator
Figure 8-17  Digital Signal Processor 1 (DSP1)
CDMA Generator Section

Data Generation

The Digital Cellsite assembly, see figure 8-6 on page 260, generates or buffers external data that emulates a CDMA traffic channel and outputs this data to the CDMA Reference, see figure 8-18 on page 276. The CDMA Reference assembly converts the data into I and Q drive signals and sends it back to the Digital Cellsite assembly to be summed with calibrated noise sources. The signals are then passed to the IQ Modulator (figure 8-15 on page 272) for modulation with RF.

CDMA Reference

The CDMA Reference supplies all the CDMA clocks for the Receive DSP and the Digital Cellsite assemblies. The CDMA Reference also provides reference switching for an external or the internal reference source.
Figure 8-18  CDMA Reference
Audio Generator Section

Waveform Generation

The Signal Source and Analyzer, see figure 8-19 on page 277, 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 Modulation Distribution assembly, see figure 8-20 on page 278, by using a DAC and variable attenuators. The leveled audio signal is passed on to the RF Generator section.

Figure 8-19 Signaling and Analyzer Assembly
Figure 8-20  Modulation Distribution
RF Generator Section

Frequency Generation

NOTE Test Sets with firmware revision A.04.5X and above operate only at RF frequencies from 800 to 1000 MHz and 1700 to 2000 MHz. A text only error message "Input value out of range", will be displayed if invalid frequencies are set.

The Signal Generator Synthesizer (figure 8-21 on page 281) develops a 500 MHz to 1000 MHz signal which is phase-locked to the 200 kHz reference from the Reference Assembly (figure 8-24 on page 285). 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 RF Output Section assembly (figure 8-22 on page 282) develops the RF Generator’s 30 to 2000 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 8-3.

The Upconverter assembly (figure 8-23 on page 283) develops the RF generator’s 1.7 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 8-3

<table>
<thead>
<tr>
<th>Output Frequency</th>
<th>Derivation</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 MHz - 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 RF Output Section assembly (figure 8-22 on page 282) 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 RF I/O assembly (figure 8-2 on page 254) takes the level down to −127 dBm (−137 dBm at the RF I/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:

- RF I/O
Modulation

Amplitude modulation (AM) is done on the RF Output Section assembly (figure 8-22 on page 282). The modulating signal from the Modulation Distribution assembly is applied to the ALC loop’s control voltage.

IQ modulation is done on the IQ Modulator assembly (figure 8-15 on page 272). Digital Cellsite is modulated onto the RF signal from the Signal Generator Synthesizer assembly (figure 8-21 on page 281).
Block Diagrams
RF Generator Section

Figure 8-22 RF Output Section
Figure 8-23  Upconverter
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 Reference assembly (figure 8-24 on page 285). The High Stability 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 Measurement assembly.

Power Supply Regulator

Power supply regulators (figure 8-25 on page 286) are distributed to all of the modules and assemblies by the Power Supply Regulator assembly through the motherboard.

Power Supply

The 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 8-25  Regulator
Instrument Control Section

Digital Control

The Test Set’s digital control is driven by two assemblies:

- Memory/SBRC
- Controller

The controller receives user control information by either the control interface or by the front panel. Operating firmware on the Memory/SBRC (figure 8-26 on page 288) is then used by the Controller (figure 8-27 on page 289) assembly to generate digital control for the Test Set. The digital control bus information is passed back to the Memory/SBRC assembly which controls most of the Test Set’s modules and assemblies.

Display

The Test Set’s display data is first generated by the Controller and then passed on to the Display Driver (figure 8-28 on page 290). The Display Driver converts the digital information into analog vertical and horizontal drive signals for the display. The Display Driver drive also provides brightness and contrast signals for the display.
Figure 8-26  Memory SBRC
Figure 8-27  Controller

Block Diagrams
Instrument Control Section
Figure 8-28  Display Driver

![Diagram](image_url)
GPIB Serial

Figure 8-29  GPIB/Serial

![GPIB/Serial Diagram]

- CTRL_FACE_BUS
- GPIB
- GPIB/Serial T89C14
- ACE TL16PR552
- ACE TL16PR552
- GLUE EPM7128S
- SERIAL_9, SERIAL_10, PARALLEL_15, SERIAL_11, SERIAL_14, PARALLEL_16
- SA TRG RP
- R.P.
- NC
Block Diagrams
GPIB Serial
This chapter describes the SERVICE screen as a diagnostic aid for the Test Set.
Troubleshooting with the SERVICE Screen

The SERVICE screen, see Figure 9-1 on page 295, uses the internal voltmeter and frequency counter functions to monitor specific nodes in most assemblies. A large number of latch and DAC settings used throughout the Test Set can also be read and/or set to alter standard operation. These functions are primarily intended to allow the automated internal diagnostic routines to verify proper instrument operation, and to allow the periodic adjustment routines (PER_CAL3, CDMA_CAL, and PCB_CAL) to modify Test Set operation.

Access to these functions under manual control is provided to allow 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.

Detailed manual Test Set operation is provided in the Agilent Technologies E8285A User’s Guide. Refer to Chapter 8, “Block Diagrams,” on page 249 for information on how the overall instrument and each module work.

How to Access the SERVICE Screen

1. Press Preset key.
2. Press the Config key on the Test Set to access the CONFIGURE screen, see Figure 9-1 on page 295.
3. Select the SERVICE field in bottom-right corner of the screen.

Field Names and Descriptions

Voltmeter Connection

This field (see Figure 9-1) selects the desired circuit node for voltage measurements. To change the voltmeter connection, move the cursor in front of the Voltmeter Connection field and push the cursor control knob. 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 diagnostic MUX points 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 +5 volts. 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, move the cursor in front of the **Counter Connection** field and push the cursor control knob. A **Choices** menu will appear, then move the cursor to the desired circuit node and push the cursor control knob.

**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, move the cursor in front of the **Gate Time** field and push the cursor control knob. Rotate the cursor control knob until the desired gate time (10 to 1000m in 10m increments) is displayed, then press the cursor control knob.

**Latch**

This field is used to manually alter 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. Move the cursor in front of the **Latch** field and push the cursor control knob. A **Choices** menu will appear.
2. Move the cursor to the desired latch name and push the cursor control knob.
3. Move the cursor in front of the **Value** field and push the cursor control knob.
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: Modulation Distribution
- aud1: Audio Analyzer 1
- aud2: Audio Analyzer 2
- refs: Reference
- inpt: Input
• out: Output
• rcvr: Receiver
• gsyn: Signal Generator Synthesizer
• rsyn: Receiver Synthesizer
• spec: Spectrum Analyzer
• meas: Measurement
• metron: Measurement
• afg1: Signaling Source/Analyzer
• afg2: Signaling Source/Analyzer
• sgnl: Displays version number of the Signaling Source/Analyzer firmware.
• cellSite1: Cell Site 1 Digital board
• cellSite2: Cell Site 2 Digital board
• cdmaRef: CDMA Reference
• iq_mod: I/Q Modulator
• loif: LO/IF Demod
• main_dsp: Main DSP Receiver
• aux_dsp: optional DSP Receiver
• protocol: Protocol Processor

**Value (hex)**

This field displays and changes the 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.
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