Agilent Technologies 8935 Series E6380A CDMA Cellular/PCS Base Station Test Set

Application Guide

Firmware Version: B.03.10 and above

Agilent Part Number E6380-90016

Revision F

Printed in UK

January 2001

Notice

Information contained in this document is subject to change without notice.

Contents

1 General Information

This chapter contains generic information about the product, safety, warranty, sales and service offices, power cables, and other information.

Manufacturer's Declaration

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

This product has the following sound pressure emission specification:

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

Herstellerbescheinigung

Diese Information steht im Zusammenhang mit den Anforderungen der Maschinenlärminformationsverordnung vom 18 Januar 1991.

- Schalldruckpegel Lp < 70 dB(A).
- Am Arbeitsplatz.
- Normaler Betrieb.
- Nach ISO 7779:1988/EN 27779:1991 (Typprüfung).

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 61010-1+A1+A2:1992 Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use 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.


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

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.

For Continued protection against fire hazard, replace the line fuse(s) with T 250 V 5.0 A fuse(s) or the same current rating and type. Do not use repaired fuses or short circuited fuseholders.

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.

WARNING

Always use the three-prong ac power cord supplied with this product. Failure to ensure adequate earth grounding by not using this cord may cause personal injury and/or product damage.

This product is designed for use in Installation Category II and Pollution Degree 3 per IEC 61010 and IEC 60664 respectively.

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

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

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.

Lifting and Handling

When lifting and handling the Agilent 8935 CDMA Cellular/PCS Base Station Test Set use ergonomically correct procedures. Lift and carry by the strap on the side panel.

When moving the Test Set more than a few feet, be sure to replace the front screen cover.

Consumables

Two AA alkalyne batteries are supplied with the Test Set and must be replaced periodically. When replacing batteries always dispose of old batteries in a conscientious manner, following manufacturer's instructions.

Product Markings

The CE mark shows that the product complies with all relevant European legal Directives (if accompanied by a year, it signifies when the design was proven).

The CSA mark is a registered trademark of the Canadian Standards Association.

Certification

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

DECLARATION OF CONFORMITY

According to ISO/IEC Guide 22 and CEN/CENELEC EN45014

Manufacturer's Name:	**Agilent Technologies UK Limited**
Manufacturer's Address:	Electronic Products Solutions Group - Queensferry South Queensferry West Lothian, EH30 9TG Scotland, United Kingdom

Declares that the product

Product Name:	CDMA Base Station Test Set
Model Number:	E6380A
Product Options:	This declaration covers all options of the above product as detailed in TCF A-5951-9852-02.

EMC:

Conforms with the protection requirements of European Council Directive 89/336/EEC on the approximation of the laws of the member states relating to electromagnetic compatibility, against EMC test specifications EN 55011:1991 (Group 1, Class A) and EN 50082-1:1992.

As Detailed in:	Electromagnetic Compatibility (EMC) Technical Construction File (TCF) No. A-5951-9852-02.
Assessed by:	DTI Appointed Competent Body EMC Test Centre, GEC-Marconi Avionics Ltd., Maxwell Building, Donibristle Industrial Park, Hillend, Dunfermline KY11 9LB Scotland, United Kingdom

Technical Report Number:6893/2201/CBR, dated 23 September 1997

Safety:

The product conforms to the following safety standards:

IEC 61010-1(1990) +A1(1992) +A2(1995) / EN 61010-1:1993
IEC 60825-1(1993) / EN 60825-1:1994
Canada / CSA-C22.2 No. 1010.1-93

The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC, and carries the CE mark accordingly

South Queensferry, Scotland. ***1st November 2000*** R M Evans

R.M. Evans / Manufacturing Engineering Manager

For further information, please contact your local Agilent Technologies sales office, agent, or distributor.

Agilent Technologies Warranty Statement for Commercial Products

E6380A CDMA/Cellular PCS Base Station Test Set

Duration of Warranty: 1 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 WARRANTYOR CONDITION, WHETHER WRITTEN OR ORAL IS EXPRESSED OR IMPLIED AND Agilent SPECIFICALLY DISCLAIMS ANY IMPLIED WARRANTIES OR CONDITIONS OR 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 EXTENTLAWFULLY 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.

Assistance

Product maintenance agreements and other customer assistance agreements are available for Agilent Technologies products. For any assistance, contact your nearest Agilent Technologies Sales and Service Office.

Table 1-1 Regional Sales and Service Offices

United States of America: Agilent Technologies Test and Measurement Call Center P.O. Box 4026 Englewood, CO 80155-4026 (tel) 1 800 452 4844	Canada: Agilent Technologies Canada Inc. 5150 Spectrum Way Mississauga, Ontario L4W 5G1 (tel) 1 877 894 4414	Europe: Agilent Technologies European Marketing Organization P.O. Box 999 1180 AZ Amstelveen The Netherlands (tel) (3120) 547 9999
Japan: Agilent Technologies Japan Ltd. Measurement Assistance Center 9-1 Takakura-Cho, Hachioji-Shi, Tokyo 192-8510, Japan (tel) (81) 456-56-7832 (fax) (81) 426-56-7840	Latin America: Agilent Technologies Latin America Region Headquarters 5200 Blue Lagoon Drive, Suite #950 Miami, Florida 33126 U.S. A. (tel) (305) 267 4245 (fax) (305) 267 4286	Australia/New Zealand: Agilent Technologies Australia Pty Ltd. 347 Burwood Highway Forest Hill, Victoria 3131 (tel) 1 800 629 485 (Australia) (fax) (61 3) 9272 0749 (tel) 0 800 738 378 (New Zealand) (fax) (64 4) 802 6881
Asia Pacific: Agilent Technologies 24/F, Cityplaza One, 111 Kings Road, Taikoo Shing, Hong Kong (tel) (852) 3197 7777 (fax) (852) 2506 9233		

Power Cables

Power Cables

Table 1-2 Power Cables

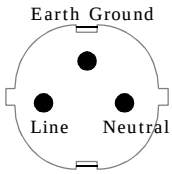
Plug Type	Plug Descriptions male/female	Agilent Part # (cable & plug)	Cable Descriptions
	**Straight/Straight** **Straight/90°**	**8120-1689** **8120-1692**	**79 inches, mint gray** **79 inches, mint gray**
Used in the following locations			
Afghanistan, Albania, Algeria, Angola, Armenia, Austria, Azerbaijan, Azores			
Bangladesh, Belgium, Benin, Bolivia, Boznia-Herzegovina, Bulgaria, Burkina Faso, Burma, Burundi, Byelarus			
Cameroon, Canary Islands, Central AfricanRepublic, 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, Kyrgystan			
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			

Table 1-2 Power Cables

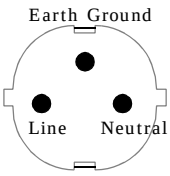
Plug Type	Plug Descriptions male/female	Agilent Part # (cable & plug)	Cable Descriptions
	**Straight/Straight** **Straight/90°**	**8120-1689** **8120-1692**	**79 inches, mint gray** **79 inches, mint gray**
Saudi Arabia (220V), Senegal, Slovak Republic, Slovenia, Somalia, Spain, Spanish Africa, Sri Lanka, St.Pierce Islands			
Sweden, Syria			
Tajikistan, Thailand, Togo, Tunisia, Turkey, Turkmenistan			
USSR, Ukraine, Uzbekistan			
Western Africa, Western Sahara			
Yugoslavia			
Zaire			

Table 1-3 Power Cables

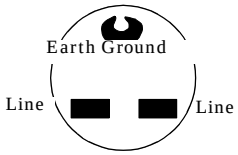
Plug Type	Plug Descriptions male/female	Agilent Part # (cable & plug)	Cable Descriptions
	Straight/Straight	8120-0698	90 inches, black
Used in the following locations			
Peru			

Table 1-4 Power Cables

Plug Type	Plug Descriptions male/female	Agilent Part # (cable & plug)	Cable Descriptions
	Straight/Straight Straight/90°	8120-2104 8120-2296	79 inches, gray 79 inches, gray
Used in the following locations			
Switzerland			

Table 1-5 Power Cables

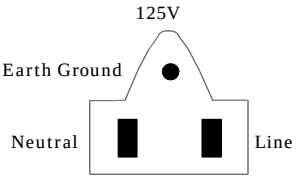
Plug Type	Plug Descriptions male/female	Agilent Part # (cable & plug)	Cable Descriptions
	Straight/Straight Straight/90 Straight/Straight	8120-1378 8120-1521 8120-1751	90 inches, jade gray 90 inches, jade gray 90 inches, jade gray
Used in the following locations			
American Samoa			
Bahamas, Barbados, Belize, Bermuda, Brazil,			
Caicos, Cambodia, Canada, Cayman Islands, Columbia, Costa Rica, Cuba			
Dominican Republic			
Ecuador, El Salvador			
French West Indies			
Guam, Guatemala, Guyana			
Haiti, Honduras			
Jamaica			
Korea			
Laos, Leeward and Windward Is., Liberia			
Mexico, Midway Islands			

Table 1-5 Power Cables

Plug Type	Plug Descriptions male/female	Agilent Part # (cable & plug)	Cable Descriptions
Nicaragua			
Other Pacific Islands			
Panama, Philippines, Puerto Rico			
Saudi Arabia (115V,127V), Suriname			
Taiwan, Tobago, Trinidad, Trust Territories of Pacific Islands			
Turks Island			
United States			
Venezuela, Vietnam, Virgin Islands of the US			
Wake Island			

Table 1-6 Power Cables

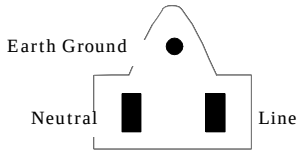
Plug Type	Plug Descriptions male/female	Agilent Part # (cable & plug)	Cable Descriptions
JIS C 8303, 100 V 	Straight/Straight Straight/90°	8120-4753 8120-4754	90 inches, dark gray 90 inches, dark gray
Used in the following locations			
Japan			

Table 1-7 Power Cables

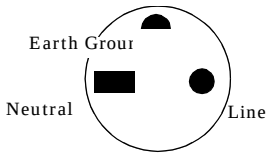
Plug Type	Plug Descriptions male/female	Agilent Part # (cable & plug)	Cable Descriptions
	90° /STRAIGHT 90°/90° Straight/Straight	8120-2956 8120-2957 8120-3997	79 inches, gray 79 inches, gray 79 inches, gray

Table 1-7 Power Cables

Plug Type	Plug Descriptions male/female	Agilent Part # (cable & plug)	Cable Descriptions
Used in the following locations			
Denmark			
Greenland			

Table 1-8 Power Cables

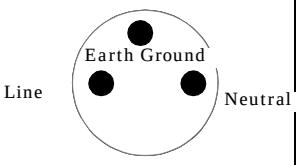
Plug Type	Plug Descriptions male/female	Agilent Part # (cable & plug)	Cable Descriptions
	Straight/Straight Straight/90°	8120-4211 8120-4600	79 inches, mint gray 79 inches, mint gray
Used in the following locations			
Botswana			
India			
Lesotho			
Malawi			
South-West Africa (Namibia), Swaziland			
Zambia, Zimbabwe			

Table 1-9 Power Cables

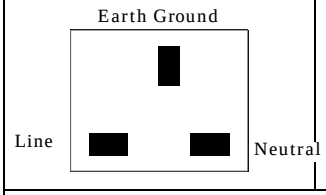
Plug Type (Male)	Plug Descriptions male/female	Agilent Part # (cable & plug)	Cable Descriptions
	90°/Straight 90°/90°	8120-1351 8120-1703	90 inches, mint gray 90 inches, mint gray
Used in the following locations			
Bahrain, British Indian Ocean Terr., Brunei			
Canton, Cyprus			

Table 1-9 Power Cables

Plug Type (Male)	Plug Descriptions male/female	Agilent Part # (cable & plug)	Cable Descriptions
Enderbury Island, Equatorial Guinea			
Falkland Islands, French Pacific Islands			
Gambia, Ghana, Gibraltar, Guinea			
Hong Kong			
Ireland			
Kenya, Kuwait			
Macao, Malaysia, Mauritius			
Nigeria			
Qatar			
Seychelles, Sierra Leone, Singapore, Southern Asia, Southern Pacific Islands, St. Helena, Sudan			
Tanzania			
Uganda, United Arab Emirates, United Kingdom			
Yeman (Aden & Sana)			

Table 1-10 Power Cables

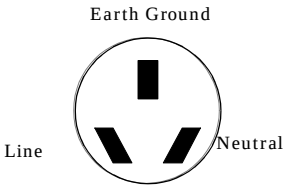
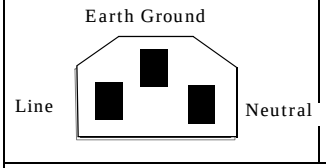
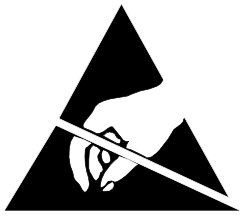
Plug Type	Plug Descriptions male/female	Agilent Part # (cable & plug)	Cable Descriptions
	Straight/Straight Straight/90°	8120-1369 8120-0696	79 inches, gray 80 inches, gray
Used in the following locations			
Argentina, Australia			
China (People's Republic)			
New Zealand			
Papua New Guinea			
Uruguay			

Table 1-10 Power Cables

Plug Type	Plug Descriptions male/female	Agilent Part # (cable & plug)	Cable Descriptions
Western Samoa			

Table 1-11 Power Cables

Plug Type	Plug Descriptions male/female	Agilent Part # (cable & plug)	Cable Descriptions
	Straight/Straight Straight/Straight Straight/90° Straight/90°	8120-1860 8120-1575 8120-2191 8120-4379	60 inches, jade gray 30 inches, jade gray 60 inches, jade gray 15.5 inches, jade gray
Used in the following locations			
System Cabinets			



ATTENTION

Static Sensitive
Devices

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

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

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

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

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

Documentation

Conventions Used in This Manual

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

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

NOTE HP-IB and GPIB are one and the same.

What is in This Manual

- This document presents a step-by-step approach to CDMA base station testing using the Test Set, including what you need to know before you can start testing.

What is Not in This Manual

- General operation of the Test Set, such as changing display screens and their associated controls, is discussed in the Reference Guide (Agilent part number E6380-90019).
- Detailed operation of the Test Set's spectrum analyzer and oscilloscope. Although there are basic explanations in this manual, more detail is provided in the Reference Guide.
- How to control your base station, switch system, or any other software or hardware associated with your cell site equipment. Each manufacturer and cellular service provider has their own cell site control and base station configuration procedures that go beyond the scope of this documentation.
- How to perform IBASIC programming operations, such as writing, editing, copying, or cataloguing programs. Programming the Test Set is explained in the *Programming Manual* (Agilent part number E6380-90018), and the IBASIC language is explained in the *Agilent Instrument BASIC User's Handbook* (Agilent part number E2083-90005).

Which Document is Required?

The following documents are part of the Agilent 8935 document set. Use the table to help you decide which document you need.

Table 1-12 Document Navigation

Document	Part Number	Usage
CDMA Application Guide	E6380-90016	Use this manual for basic CDMA measurements and for getting started with the Test Set.
AMPS Application Guide	E6380-90017	Use this manual for making AMPS base station measurements.
Reference Guide	E6380-90019	Use this manual for screen and field descriptions and general operation information about the Test Set.
GPIB Syntax Reference Guide	E6380-90073	Use this manual as a reference to the syntax and use of all available GPIB commands.
Programmer's Guide	E6380-90018	Use this manual to learn GPIB syntax and for learning how to program the Test Set.
Assembly Level Repair Guide (this manual)	E6380-90015	Use this manual to perform calibration on the Test Set and for general service information.
Technical Specifications Publication	5966-0512E	Test Set's specifications data sheet
CDROM	E6380-90027	Includes all of the above documents.

Trademark Acknowledgments

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ProComm, is a registered trademark of DataStorm Technologies, Inc.

HyperTerminal© is a registered trademark of Hilgraeve, Incorporated.

Pentium® is a registered trademark of Intel Corporation.

2 Getting Started with CDMA Test

This chapter introduces you to the Agilent Technologies 8935 Test Set and its CDMA functions. For information on other functions in the Test Set, see "Which Document is Required?" on page 7 To proceed immediately to the test procedures, see "Tests That You Can Perform with the Test Set" on page 40.

About the Test Set

Product Description

This Test Set is a tool which will help you in testing CDMA base stations at both the cellular band and the PCS band. It also allows you to test AMPS base stations. (This guide discusses CDMA testing. For more information about AMPS testing, refer to the *Manual AMPS Base Station Tests Guide.*)

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

- Code Domain Power Analyzer
- CDMA Analyzer
- CDMA Generator
- Spectrum Analyzer
- I/Q Diagram
- Power Meter (both wideband and channel)

Other tools include

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

Who Should Use this Test Set

If you are installing, commissioning or maintaining CDMA sites operating at either the PCS frequencies or cellular frequencies, this Test set can assist you in testing these base stations.

Batteries

There are two methods by which the Test Set backs up its RAM. One is a set of two AA batteries mounted behind the rear panel of the Test Set. You must periodically change these batteries. The second method of RAM backup is an internal battery. It is not user serviceable.

CAUTION Failure to take prompt action may result in loss of RAM data including Agilent Technologies Instrument BASIC (IBASIC) programs and SAVE / RECALL states stored in the RAM.

NOTE Do not use rechargeable batteries.

To change the AA batteries, use the following procedure:

1. Turn off power and unplug the Test Set.
2. Remove the six screws in the rear panel using a TX-15 TORX (R) screwdriver.
3. Remove the rear cover.
4. Replace the AA batteries.
5. Replace and reconnect the rear panel. Dispose of used batteries properly.

Getting Help

If you have problems using this Test Set, and cannot find the solution in these documents or the Help screens, please use one of the following contacts:

- Your local or regional sales office (see "Attention" on page 23)
- U.S. Call Center: 800 542-4844
- Korea Agilent Technologies Direct: (82/2) 769-0800
- Canada Agilent Technologies Direct: (800) 387-3154
- European Call center: +31 20 547-9990
- Test and Measurement Organization on the web.

What's Included with this Test Set

The equipment commonly shipped with the base Test Set is listed below. Options that you order with your Test Set may change this list.

- Test Set
- Documentation
  - — CDMA Applications Guide
  - — CD-ROM with the above listed manual, *Manual AMPS Base Station Tests, Assembly Level Repair Manual, Programmer's Guide,* and *Agilent Technologies 8935 Reference Guide* in Adobe™ Acrobat Reader format (.pdf).
- Power cord
- Cover for the front panel of the Test Set
- Cover for the side panel of the Test Set
- Warranty Card

Manual and Automatic Operation Modes

You can operate the Test Set in either of two modes: Manual or Automatic. Controlling the Test Set with the keypad is Manual Operation. Controlling the Test Set with a program is Automatic Operation.

Use Manual Mode when you want to control the Test Set with the front panel. Manual operation is described in this document.

Use Automatic Mode when you want to control the Test Set with its internal IBASIC controller. To use the Test Set in Automatic Mode, you must load an IBASIC program into the Test Set's memory.

IBASIC programs

You can obtain an IBASIC program in two ways: either write it yourself, or purchase a software package from Agilent Technologies. To write programs yourself, refer to the *Programmer's Guide*, included with the Test Set's documentation.

Many Agilent Technologies software packages are base station-specific packages. Base station-specific software packages provide automated testing of a manufacturer's base station to greatly reduce test times and provide test setup repeatability. Once configured, the software typically controls both the base station and the Test Set and prompts the user to make the required connections during testing. Test results can be printed and/or saved to a file for later use. Contact your local Agilent Technologies Sales Office to find out which software packages are currently available.

Maximizing the Accuracy of Your Measurements

This Test Set is designed to make highly accurate measurements. However, to ensure that you have the most accurate measurements available, you can perform the following tasks:

Calibration

You should calibrate the Test Set whenever you change a module or add a hardware option.You may want to calibrate when you upgrade firmware. See the *Assembly Level Repair Manual* for calibration procedures.

There is also a field named **Calibrate** in the CDMA ANALYZER screen. This field is used to calibrate the Channel Power measurement. See "Channel Power (1.23 MHz and 30 kHz)" on page 49. Note that cables must be removed from the Test Set's inputs before using **Calibrate**.

Temperature Compensation

The Test Set is internally compensated for temperature. However, you will find that on some screens a zeroing function appears. For example, in the RF ANL screen, the **TX Pwr Zero** function appears. This is a routine optimization function, and generates calibration offsets when selected. This will compensate for temperature related drift, thereby maximizing measurement accuracy.

The **Pwr Zero** function in the CDMA ANALYZER screen is the same as the **TX Pwr Zero** function. Cables do not need to be removed from the Test Set's inputs for **Pwr Zero**. The offsets are stored in static RAM, and the Test System uses them when measuring Average Power with a DUT attached. The offsets are updated whenever you zero the power meter, and the latest values are stored for the life of the static RAM backup battery.

When to zero the power

By default, power zeroing is performed automatically. Automated or manual zeroing is controlled by the **Auto Zero** field.

If you choose to zero power manually, you should zero power frequently if the Test System is still warming up, about two to three times within the first two hours.You should zero power occasionally even if the Test System is on continuously. (Occasionally can mean daily, weekly or monthly, as you choose).

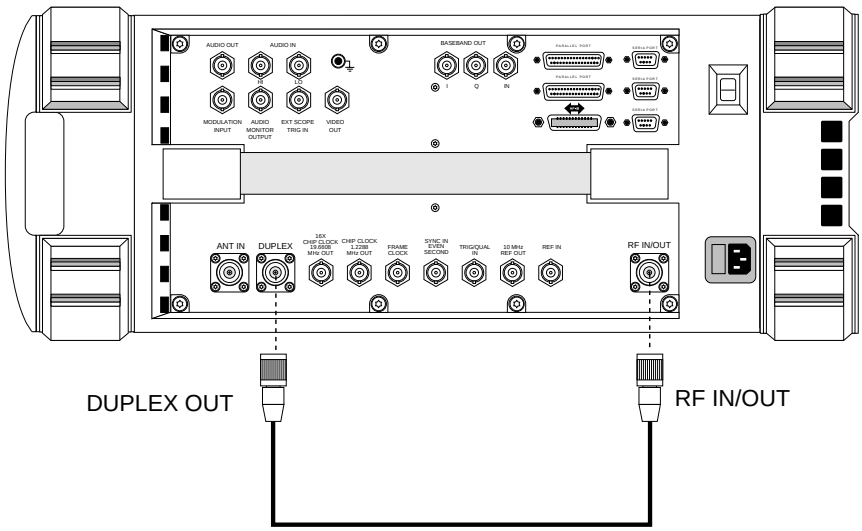
Display a CDMA Signal (Loopback Test)

This section will guide you through the process of displaying a CDMA signal at a PCS frequency. It is intended to make you feel more comfortable with using the Test Set. If you are ready to begin testing, proceed to Chapter 3 , "Testing CDMA Base Stations," on page 39.

Connections for CDMA Loopback Test

Connect the Test Set in the following manner.

Figure 2-1 CDMA Loopback Test Connections



Get Started with the Test Set

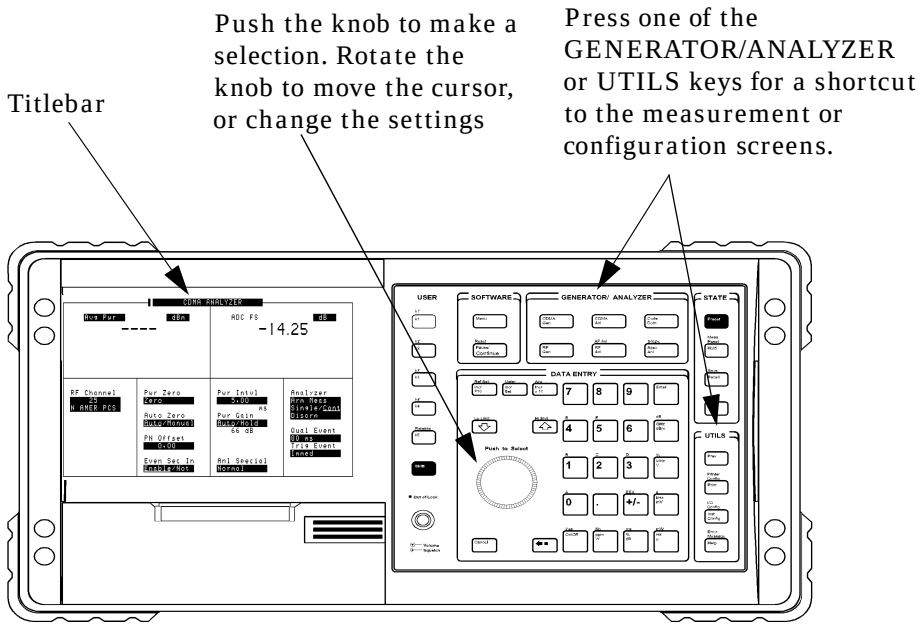
1. Plug in the Test Set.
2. Turn on the Test Set (or press **Preset**) if it is already on. The CDMA ANALYZER screen will be displayed.
3. Press the **Inst Config** key.
4. Select **RF Display**, and set the field to **Freq**.
5. Verify your connections. See "Connections for CDMA Loopback Test" on page 35

NOTE

Here are some tips for selecting screens and fields:

- Rotate the knob to move the cursor around the screen. Reverse video boxes indicate fields that can be selected. Press the knob to make selections.
- A selected field has a blinking double arrow cursor >>. The arrows go away and blinking stops when the field is not selected.
- To change settings in a field on the screen, push the knob, or press the **Enter** key.
- The measurement screen is changed using the title bar at the top of the screen and the cursor control knob, the GENERATOR/ANALYZER keys, or the UTILS keys.
- Use the top row of the GENERATOR/ANALYZER keys to move around in the CDMA screens.

Figure 2-2 Using the cursor-control Knob or Screen Keys



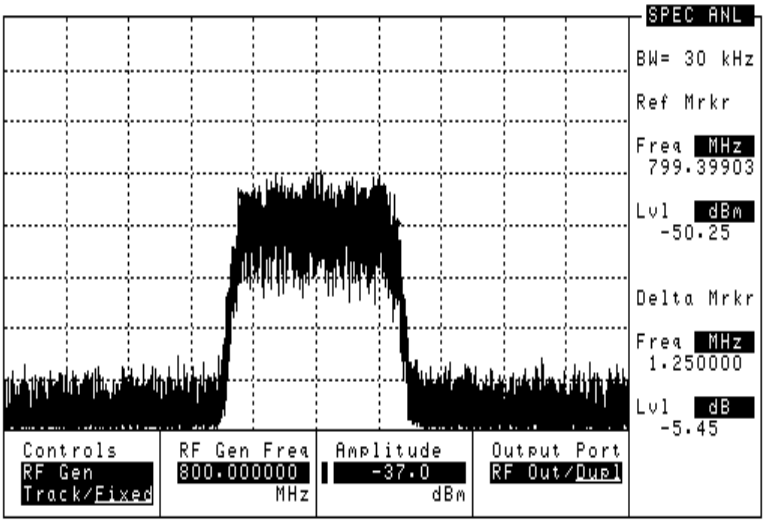
Generate a CDMA Signal

1. Press the **CDMA Gen** key to go to the CDMA GENERATOR screen.
2. Select **RF Gen Freq** and use the keypad to set the frequency to 1881.52 MHz.
3. Select **Output Port** and verify that the port is set to **Dupl**.
4. Select **Amplitude** and set the amplitude to –10 dBm.
5. Select **Gen Dir** and set it to **Fwd**.

Display a CDMA Signal

1. Press the **CDMA Anl** key to go to the CDMA ANALYZER screen.
2. Select **Tune Freq** and use the keypad to set the frequency to 1881.52 MHz.
3. Press the **Spec Anl** key to go to the SPECTRUM ANALYZER screen.
4. The CDMA signal should be displayed.

Figure 2-3 CDMA Loopback Signal



What to Do Next

Congratulations! You are now ready to begin testing your CDMA Base Station. Proceed to Chapter 3 , “Testing CDMA Base Stations.”

3 Testing CDMA Base Stations

This chapter explains how to test CDMA Base Stations with the Agilent Technologies 8935 Test Set. For information on performing other tasks with the Test Set, see "Which Document is Required?" on page 7.

Tests That You Can Perform with the Test Set

This Test Set is designed to perform tests you would normally use in the setup, commissioning, and maintenance of a CDMA base station. These tests are listed below. For other utility procedures of the Test Set, see Chapter 4 , "Utility Procedures," on page 77.

- General
  - — "Setup and Configuration" on page 41
- Transmitter Tests (TX tests)
  - — "Average Power" on page 46
  - — "Channel Power (1.23 MHz and 30 kHz)" on page 49
  - — "Adjacent Channel Power (ACP)" on page 53
  - — Frequency Error: see "Rho (Modulation Quality)" on page 73
  - — Carrier Feedthrough: see "Rho (Modulation Quality)" on page 73
  - — Time Offset: see "Rho (Modulation Quality)" on page 73
  - — "Rho (Modulation Quality)" on page 73
  - — Code Domain Phase: see "Code Domain Phase" on page 60
  - — Code Domain Power for IS-95: see "Code Domain Power" on page 59
  - — Code Domain Timing: see "Code Domain Timing" on page 60
  - — Code Domain Power for IS-2000: see "Code Domain Power" on page 63
  - — Code Domain Power & Noise: see "Code Domain Power & Noise" on page 64
  - — Code Domain Complex Power: see "Code Domain Complex Power" on page 65
  - — Code Domain Fast Power Synchronize: see "Code Domain Fast Power Synchronize" on page 66
  - — "IQ Plot" on page 69
  - — "Transmit Spectrum" on page 75
- Receiver Tests (RX Tests) – Receiver Tests typically require the Base Station to report FER (Frame Error Rate), and otherwise communicate with the Test Set. This information varies between Base Station manufacturers. Receiver Tests made with this Test Set are performed within Agilent Technologies software. See your local sales representative for available base station-specific software.

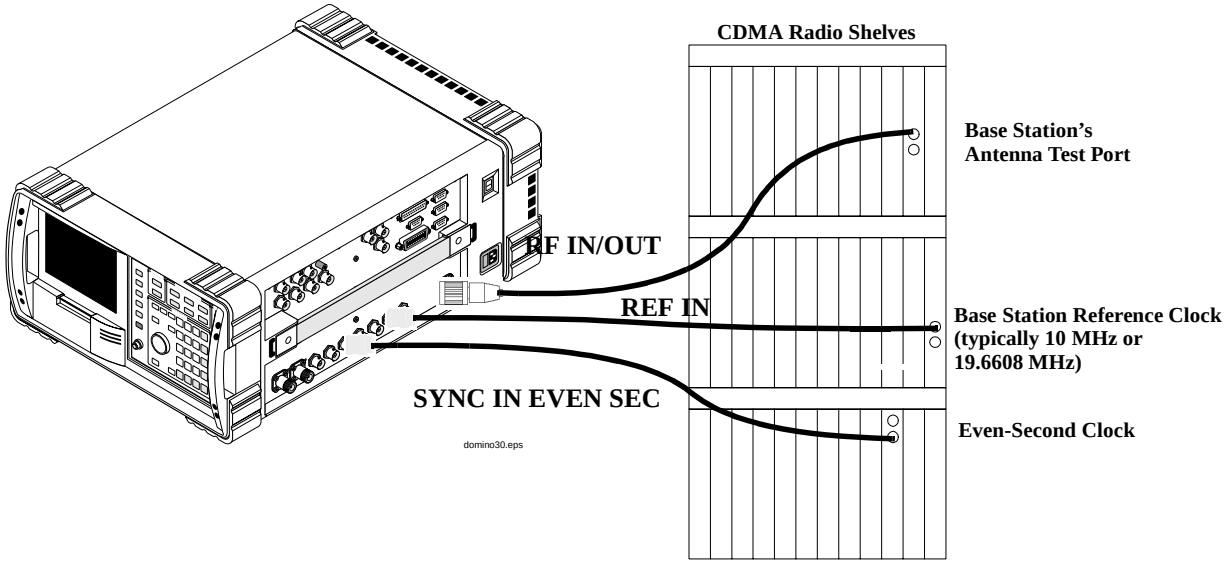
Setup and Configuration

How you set up your Test Set will depend, of course, on the device you are testing. However, there are several parameters that are common to most setups. These are described in the following sections.

- "Connections Between the Test Set and the Device Under Test (DUT)" on page 41
- "Configuring the Test Set with Your Base Station's Information" on page 42
- "Saving and Recalling Instrument Setups" on page 44

Connections Between the Test Set and the Device Under Test (DUT)

Figure 3-1 Connections for Testing a CDMA Base Station



Synchronizing Your Base Station to the Test Set

The RF signal is the signal you are testing. It typically comes from the Base Station's Antenna Test Port.

The Even-Second clock is used for the Time Offset measurement.

The REF IN is used for both the Time Offset and the Frequency Error measurements. Several different signals are available, but typically this signal is either 10 MHz or 19.6608 MHz (16x Chip Clock).

Configuring the Test Set with Your Base Station's Information

When you are starting to test a Base Station with the Test Set, you must supply information about the Base Station to the Test Set.

1. Make connections to your Base Station as shown in Figure 3-1 on page 41.

   If you have a low level signal, you may want to use the ANT IN port instead of the RF IN/OUT port. see "Choosing Between RF In/Out, Antenna and Duplex Ports" on page 43.

2. Press **Preset** or turn on the Test Set.
3. Select RF Channel in the CDMA ANALYZER screen. The RF signal can be displayed either by Channel number or Frequency. See "Changing Between Channel Mode and Frequency Mode" on page 79
4. Enter the channel number (or frequency) of your base station.
5. Press the **Inst Config** key to go to the INSTRUMENT CONFIGURE screen.
6. Select **Ext Ref In** This is the reference signal your Base Station provides to synchronize with the Test Set.
7. Select the reference frequency of your Base Station. Typical values are 10 MHz or 16x the chip clock (19.6608 MHz).
8. Select **Ref Select** and choose either **Auto**, **Internal** or **External**. Auto allows the Test Set to switch between Internal or External References, based on presence of the External signal at the Ref In port. **Internal** or **External** select either the internal or external reference signals.
9. Press the **Spec Anl** key to display the spectrum analyzer. This will give you a visual confirmation of your signal.

Choosing Between RF In/Out, Antenna and Duplex Ports

For testing input signals, you can choose between RF IN/OUT and ANT IN. For generating signals, you can choose between RF IN/OUT and DUPLEX OUT.

The RF IN/OUT port is for measuring higher power signals look at spc sheet. It has the highest allowable input power. This port is also an output port for the internal signal generator.

The ANT IN port is used for lower level signals (consult your Test Set specifications to qualify the specific signal and level). This is an input only. It is frequently used for off-the-air measurements.

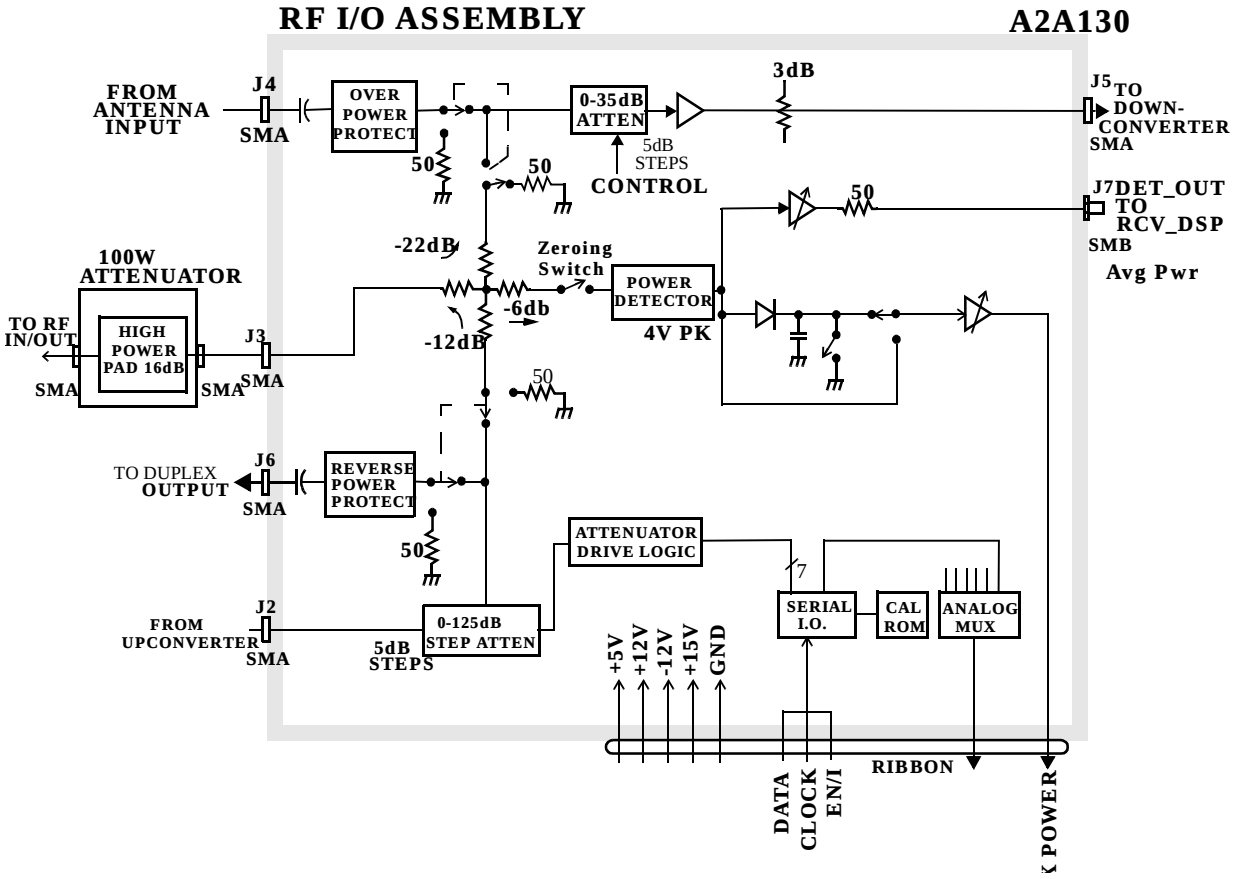
The DUPLEX OUT is the output of the signal generator. It is typically used to test receivers and as a calibration source.

The input port is chosen by selecting the **Input Port** field in the CDMA ANALYZER screen. Note that the Input Port cannot be selected while the Average Power measurement is displayed, since that measurement can only be made on the RF IN/OUT port.

The output port is chosen by selecting the **Output Port** field in the CDMA GENERATOR screen.

Refer to "Block Diagram for RF, DUPLEX, and ANT Ports" on page 44 for more detail about the input ports.

Figure 3-2 Block Diagram for RF, DUPLEX, and ANT Ports



Saving and Recalling Instrument Setups

The SAVE and RECALL functions allow you to store different instrument setups and retrieve them later, eliminating the task of re-configuring the Test Set. You can save these setups to any of the following media: Internal Memory, an External PCMCIA card, or an External RAM card.

To Save an Instrument Setup

1. If you want to select the Save medium, see "To Choose the Save/Recall Location" on page 45.
2. Make any changes to the instrument that you want to save in a register.
3. Press and release the **Shift** key then the **Recall** key to access the SAVE function.
4. Use the **DATA** keys or the **Save** menu to enter the register's name.

To Recall an Instrument Setup

1. If you want to select the Save medium, see "To Choose the Save/Recall Location" on page 45.
2. Press the **Recall** key.
3. Use the knob to select the desired setup to be recalled from the **Recall** menu.

To Choose the Save/Recall Location

1. Press and release the **Shift** key then the **Inst Config** key to display the I/O CONFIGURE screen.
2. Select the **Save/Recall** field.
3. Select the desired Save medium (Internal, Card, RAM).

Average Power

Average power measures the average power of full bandwidth of the received signal. To measure the power only in a single 1.23 MHz CDMA channel, see "Channel Power (1.23 MHz and 30 kHz)" on page 49.

This measurement is made only at the RF IN/OUT port. It can be measured while the Base Station is active.

NOTE If any other signals are present, Average Power will measure them also! Average Power is a broadband measurement, so if there are other signals present it will also measure their contributions. If you suspect other signals may be present it is recommended that you bring down all channels and use Avg Power on the signal of interest alone or consider using the Channel Power measurement ("Channel Power (1.23 MHz and 30 kHz)" on page 49) which fits this application better because it filters other channels out.

Prerequisites

You will need to do the following before measuring Average Power:

- ❏ Connect your signal to the RF IN/OUT port of the Test Set, and connect the reference signal to the REF IN port.
- ❏ Know the channel number or frequency of your transmitter.

CAUTION **Overpower Damage** — Refer to the Test Set's side panel for maximum input power level. Exceeding this level can cause permanent instrument damage.

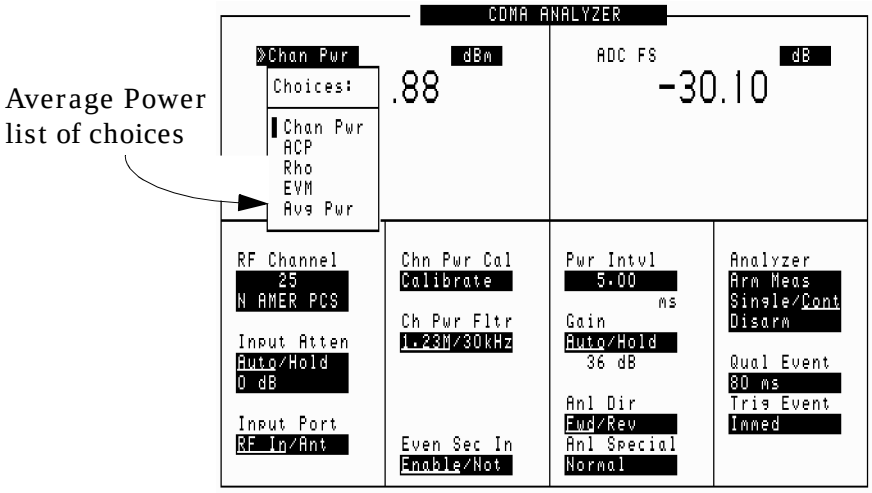
Procedure

NOTE You can zero the power meter with the **Pwr Zero** field to ensure the greatest accuracy. By default, however, the power meter is automatically zeroed.

1. Press the **CDMA Anl** key to go to the CDMA ANALYZER screen.
2. Zero the power meter if necessary. Select **Pwr Zero** to zero the meter.
3. Select **RF Channel** or **Tune Freq**, depending on whether your channels are selected by channel number or by frequency.
4. Enter the channel number or RF frequency of your transmitter. This ensures that you will have the correct calibration factor for the power measurement.

5. Select the measurement on the left side of the display (default is **Avg Pwr**).
6. Select **Avg Pwr** from the list of choices. Now the Average Power measurement is displayed.

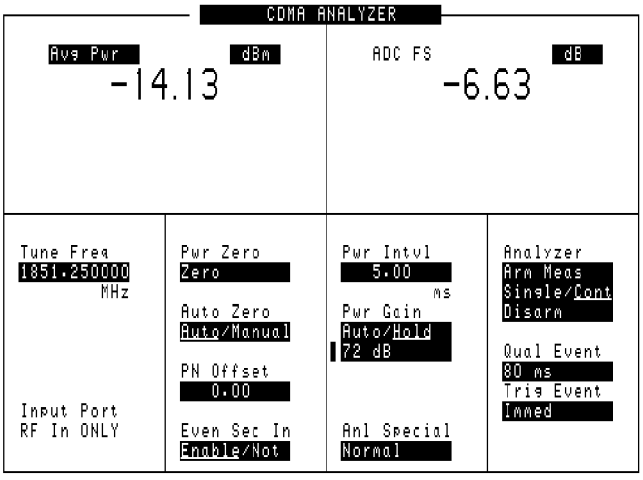
Figure 3-3 Average Power Measurement List of Choices



7. Set the **Pwr Intvl** to your desired averaging time. A higher time produces a more accurate result. Maximum value is 26.66 milliseconds.
8. The Average power should be displayed.

Results

Figure 3-4 Average Power Measurement Results



Notes

You can control the time interval of the averaging by changing the **Pwr Intvl.** Default is 5 milliseconds.

You should enter the channel number or center frequency of your transmitter signal, since the measurement is calibrated based on that frequency.

NOTE

What is ADC FS?

ADC FS (Analog to Digital Converter Full Scale) is an indicator which shows how close the measured power is to the maximum allowed input power to the internal Analog-to-Digital converter (ADC).

For all measurements except Average Power, ADC FS should be in the range of –1 to –20 dB.

For the Average Power measurement, the range is –1 to –10 dB.

Channel Power (1.23 MHz and 30 kHz)

1.23 MHz Channel Power measures the power in the 1.23 MHz band of the chosen CDMA channel. This measurement can be made on an active site (if you are measuring at an RF test port). This measurement is particularly useful if you are measuring power in the presence of other signals.

30 kHz Channel Power measures the power in a 30 kHz band.

Prerequisites

You will need to do the following before measuring either Channel Power:

- ❏ Know the channel number or frequency of your transmitter.
- ❏ To maximize the accuracy of the Channel Power measurement, calibrate it as needed. You will need to calibrate the 1.23 MHz and the 30 kHz channel power measurements separately. Conditions for calibration are:

Channel Power Calibration Conditions

- Whenever a 5°C ambient temperature change has occurred
- Whenever the frequency or channel number has been changed
- During or just after the 30 minute warm-up period

Channel Power Calibration Procedure

Once the prerequisites have been met, use the following procedure to calibrate Channel Power:

1. Verify that there are no cables attached to the RF IN/OUT or Ant In ports.
2. Press the **CDMA Anl** key to go to the CDMA ANALYZER screen.
3. Select **RF Channel** or **Tune Frequency**, depending on whether your channels are selected by Channel Number or by frequency
4. Enter the channel number or frequency of your transmitter.
5. Select the measurement on the left side of the display. Select **Chan Pwr** from the list of choices.
6. Select **1.23M** from the **Ch Pwr Fltr** field. This will allow you to calibrate the 1.23 MHz channel power.
7. Select Calibrate to calibrate the 1.23 MHz Channel Power measurement. The calibration may require a few seconds to finish.

8. Select **30kHz** from the **Ch Pwr Fltr** field. This will allow you to calibrate the 30 kHz channel power.
9. Select Calibrate to calibrate the 30 kHz Channel Power measurement. The calibration may require a few seconds to finish.

1.23 MHz Channel Power Measurement Procedure

Once the prerequisites have been met, use the following procedure to measure 1.23 MHz Channel Power:

1. Connect your signal to the RF IN/OUT port.
2. Press the **CDMA Anl** key to go to the CDMA ANALYZER screen.
3. Select **RF Channel** or **Tune Frequency**, depending on whether your channels are selected by channel number or by frequency.
4. Enter the channel number or frequency of your transmitter.
5. Select the measurement on the left side of the display. Select **Chan Pwr** from the list of choices. Note that the fields change on the CDMA ANALYZER screen.
6. Select **1.23M** from the **Ch Pwr Fltr** field.
7. The Channel Power measurement should be displayed.

NOTE

What is ADC FS?

ADC FS is an indicator which shows how close the measured power is to the maximum allowed input power to the internal Analog-to-Digital converter (ADC).

For all measurements except Average Power, ADC FS should be in the range of –1 to –20 dB.

For the Average Power measurement, the range is –1 to –10 dB.

30 kHz Channel Power Measurement Procedure

Once the prerequisites have been met, use the following procedure to measure 30 kHz Channel Power:

1. Measure 1.23 MHz Channel Power. See previous procedure.
2. Know the frequency offset for the specification you are testing.
3. Make sure the Test Set is set to Frequency mode. See "Changing Between Channel Mode and Frequency Mode" on page 79.
4. Set the **Tune Frequency** to the offset frequency as per your specification. See "Calculate the measured value as the specification requires." on page 51.
5. Select **30kHz** from the **Ch Pwr Fltr** field.
6. The 30 kHz Channel Power measurement should be displayed.
7. Calculate the measured value as the specification requires.

Table 3-1 Some Frequency Offset Specifications for 30 kHz Channel Power Measurements

Standard	Offset	Resolution Bandwidth	Specification
PN-3645 Proposed IS-97-A	> ±750 kHz	1.23 MHz/30 kHz	45 dB
	> ±1.98 MHz	1.23 MHz/30 kHz	60 dB
SP3383 Ballot Version	> ±885 kHz	1.23 MHz/30 kHz	45 dB

NOTE

What is ADC FS?

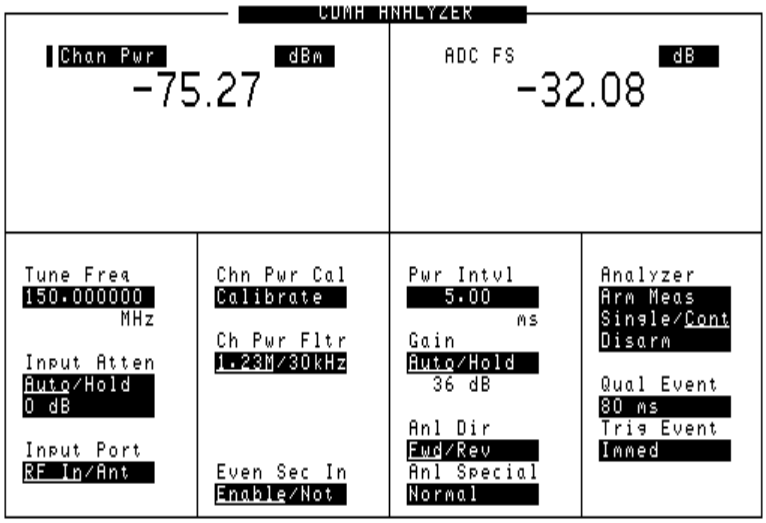
ADC FS is an indicator which shows how close the measured power is to the maximum allowed input power to the internal Analog-to-Digital converter (ADC).

For all measurements except Average Power, ADC FS should be in the range of –1 to –20 dB.

For the Average Power measurement, the range is –1 to –10 dB.

Results

Figure 3-5 Channel Power Measurement



Notes

This power measurement measures power in the 1.23 MHz bandwidth of the CDMA signal, as defined by the channel number or frequency you have chosen. For a measurement that measures over the full input bandwidth, see “Average Power” on page 46.

Adjacent Channel Power (ACP)

Adjacent channel power can be measured at frequency offsets of 0 to 3 MHz, and filter bandwidths of 10 kHz to 1.23 MHz with 500 Hz resolution. This measurement returns three, channel-tuned power values: center channel power, upper ACP ratio, and lower ACP ratio.

NOTE This measurement must be calibrated using the **ACP Cal** field each time the tune frequency is changed. You must always remove power at the ANT IN or RF IN/OUT connector before calibrating channel power to ensure accurate calibration.

Prerequisites

You will need to do the following before measuring Adjacent Channel Power:

- ❏ Know the channel number or frequency of your transmitter.
- ❏ To maximize the accuracy of the Channel Power measurement, calibrate it as needed. You will need to calibrate the 1.23 MHz and the 30 kHz channel power measurements separately. Conditions for calibration are:

Calibration Conditions

- Whenever a 5°C ambient temperature change has occurred
- Whenever the frequency or channel number has been changed
- During or just after the 30 minute warm-up period

Adjacent Channel Power Calibration Procedure

Once the prerequisites have been met, use the following procedure to calibrate Adjacent Channel Power:

1. Verify that there are no cables attached to the RF IN/OUT or ANT IN ports.
2. Press the **CDMA Anl** key to go to the CDMA ANALYZER screen.
3. Select **RF Channel** or **Tune Frequency**, depending on whether your channels are selected by Channel Number or by frequency
4. Enter the channel number or frequency of your transmitter.
5. Select the measurement on the left side of the display. Select **APC** from the list of choices.
6. Select **Calibrate** (under **ACP Cal**) to calibrate the measurement. The calibration may require a few seconds to finish.

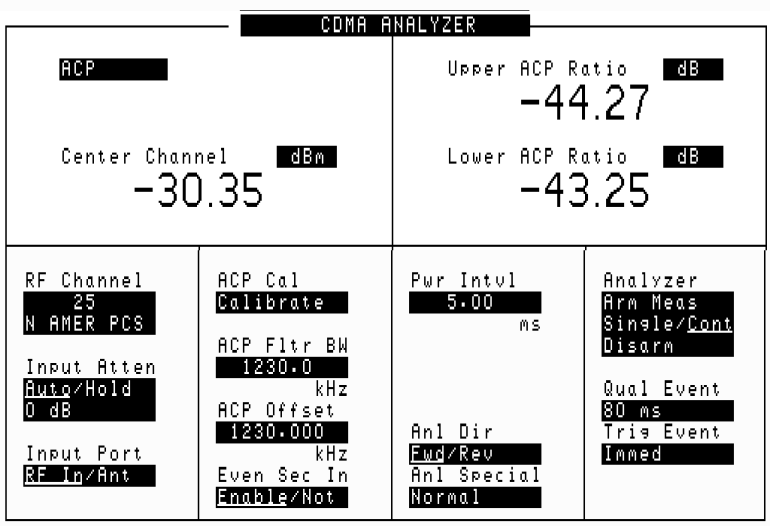
Adjacent Channel Power Measurement Procedure

Once the prerequisites have been met and ACP has been calibrated, use the following procedure to measure ACP:

1. Connect your signal to the RF IN/OUT or ANT IN port (maximum power levels are marked on the front panel next to the connectors).
2. Press the **CDMA Anl** key to go to the CDMA ANALYZER screen.
3. Set the **Input Port** field to the port you connected your signal to in step 1 (**RF IN** or **ANT**).
4. Select **RF Channel** or **Tune Frequency**, depending on whether your channels are selected by channel number or by frequency.
5. Enter the channel number or frequency of your transmitter.
6. Select the measurement on the left side of the display. Select **ACP** from the list of choices. Note that the fields change on the CDMA ANALYZER screen.
7. Set a frequency offset in the **ACP Offset** field. Valid values are 0 to 3 MHz.
8. Set the bandwidth of the filter for the adjacent channel measurement in the **ACP Fltr BW** field. Valid values are 10 kHz to 1.23 MHz.
9. Three measurements are displayed (see Figure 3-6 on page 55).
   - **Center Channel** - the channel power at the center frequency
   - **Upper ACP Ratio** - the ratio of the total power in the specified bandwidth at the specified offset above the center frequency, to the power at the center frequency.
   - **Lower ACP Ratio** - the ratio of the total power in the specified bandwidth at the specified offset below the center frequency, to the power at the center frequency.

Results

Figure 3-6 Adjacent Channel Power Measurement



Code Domain Testing

The Code Domain Analyzer enables you to perform a suite of measurements on your base station transmitter and in accordance with the international standards IS-95 or IS-2000. These tests are intended to be made with one or more code channels turned on. Each code channel is represented by its Walsh code on these displays.

To access the standard of interest (IS-95 or IS-2000), select it from **CDMA Standard** in the INSTRUMENT CONFIGURE screen.

For more detail regarding the Code Domain and how these standards affect code domain measurements, See "Code Domain Notes – IS-95" on page 62. or "Code Domain Measurements – IS-2000" on page 62.

The following measurements can be made from the CODE DOMAIN ANALYZER, IS-95 screen:

- Pilot Time Tolerance (**Time Offset**)
- Frequency Offset (**Freq Err**)
- Carrier Feedthrough (**CarFT**) (Pilot channel only)
- Code Domain Power (**Power**)
- Fast Power (**Fast Pwr**)
- Code Domain Timing (**Timing**)
- Code Domain Phase (**Phase**)
- PN Offset
- Estimated Rho
- Channel Power (1230 kHz only)

The following measurements can be made from the CODE DOMAIN ANALYZER, IS-2000 screen:

- Pilot Time Tolerance (**Time Offset**)
- Frequency Offset (**Freq Err**)
- Carrier Feedthrough (**CarFT**) (Pilot channel only)
- Code Domain Power (**Power**)
- Fast Power (**Fast Pwr**)
- Code Domain Power & Noise (**Power & Noise**)
- Code Domain Complex Power (**Complex Power**)
- Code Domain Fast Power Synchronize (**Fst Pwr Sync**)
- PN Offset

- Estimated Rho
- Channel Power (1230 kHz only)

PN Offset is a measured value when **Find PN** is set to **Auto** in the CDMA ANALYZER screen. Otherwise it is a value set by the user.

Estimated Rho is a calculated value which estimates Rho even though the received signal is not pilot only. This measurement is useful when you cannot take the base station out of service.

Prerequisites

You will need to do the following before making Code Domain measurements:

- ❑ Connect your transmitter signal to the RF IN/OUT port of the Test Set.
- ❑ Know the channel number or frequency of your transmitter.
- ❑ Know the PN offset for the Base Station. (Or you can measure it. See "PN Offset Search" on page 70.)

CAUTION **Overpower Damage** — Refer to the Test Set's side panel for maximum input power level. Exceeding this level can cause permanent instrument damage.

Procedure

Use these steps to select and run the Code Domain Tests:

1. Select the standard of interest by pressing the **Inst Config** key to go to the INSTRUMENT CONFIGURE SCREEN, and then, from the **CDMA Std** field, select either **IS-95** or **IS-2000**.
2. Press the **Code Dom** key to go to the CODE DOMAIN ANALYZER screen.
3. Update the **RF Channel** or **Tune Freq** field for the Base Station being tested, if it is not already correct.
4. Select the **Controls** menu.
5. Select **PN Setup** from the list of choices. This will display the **PN Offset** field.
6. Update the **PN Offset** for the Base Station being tested, if it is not already correct.
7. **TmOfs**, **Freq Err**, **CarFT, PN Offset and Est. Rho** should be displayed.
8. Select the **Controls** menu again, and select **Main**.

9. Select the **Measurement** field and choose from the listed set of available measurements. For IS-95 these will be: **Power**, **Fast Power**, **Timing**, and **Phase**. For IS-2000 these will be: **Power**, **Fast Power**, **Power & Noise**, **Complex Power** and **Fst Pwr Sync**.
10. Select the **Controls** menu again, and select **Marker**. The results for the measurement you have chosen are displayed.

Results

Figure 3-7 The Code Domain Analyzer Display (IS-95).

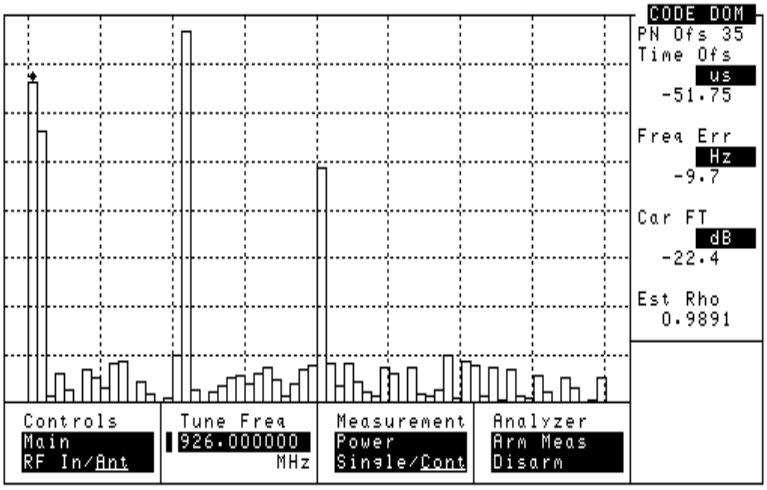
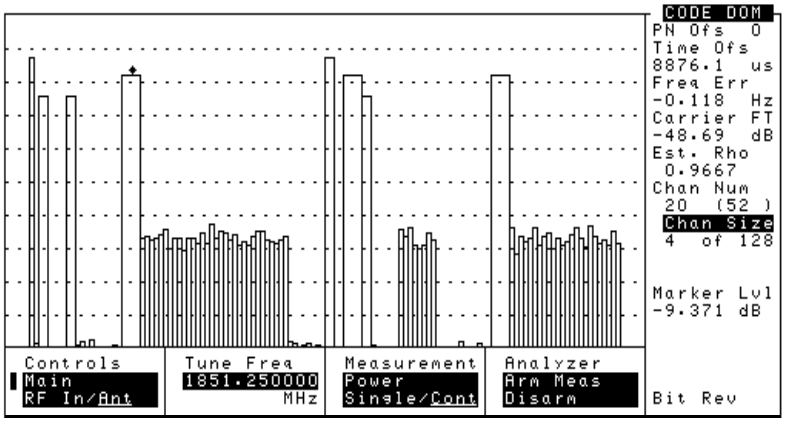


Figure 3-8 The Code Domain Analyzer Display (IS-2000)



Code Domain Measurements – IS-95

If you have selected the IS-95 standard from the INSTRUMENT CONFIGURE screen, the Code Domain screen will appear as described in this section, with the Walsh Code ordering following the Hadamard paradigm, with 64 channels, total.

If you wish to make use of the extended Walsh ordering - Bit Reverse - as described by the IS-2000 standard, see See “Code Domain Measurements – IS-2000” on page 62.

Below are brief descriptions of the measurements available in the Code Domain Analyzer (IS-95).

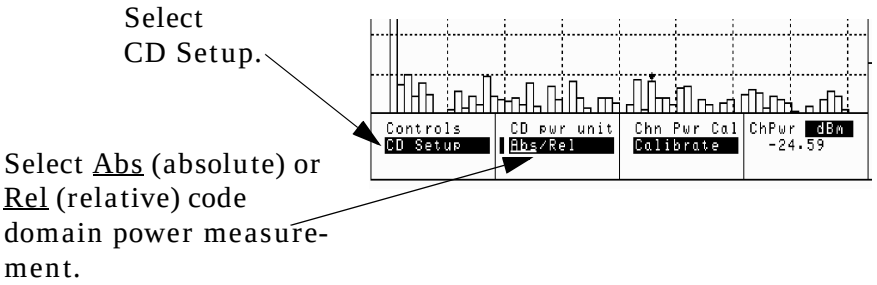
Code Domain Power

Code Domain Power based on the IS-95 standard displays the power for each of the 64 Walsh Channels. Each Walsh Channel level is displayed as an individual vertical bar. This allows a comparison of signal levels between the Pilot, Sync, Paging, and Traffic channels.

The Test Set provides two code domain power measurements in this mode:

- Absolute code domain power displays the power in each of the 64 Walsh channels, relative to the total power inside a 1.23 MHz bandwidth centered at the tune frequency. The 64 Walsh channels (0 through 63) are represented by a vertical bar on the analyzer’s display. To measure absolute code domain power the **Ch pwr unit** field on the **CD Setup** menu must be set to **Abs** (see Figure 3-9). Use the **Marker** controls to move the marker to the Walsh channel (**Walsh Chan**) you want to measure.
- Relative code domain power displays the power in each of the 64 Walsh channels, relative to the pilot’s power. (Pilot power is approximately two-thirds of the total power.) The 64 Walsh codes (0 through 63) are represented by a vertical bar on the analyzer’s display. To measure relative code domain power the **Ch pwr unit** field on the **CD Setup** menu must be set to **Rel** (see Figure 3-9). Use the **Marker** controls to move the marker to the Walsh channel (**Walsh Chan**) you want to measure.

Figure 3-9 Selecting Absolute or Relative Code Domain Power



Fast Power

Fast Power is a faster method of measuring Code Domain Power. A value for Time Offset must be transferred from a non-fast power measurement before measurements begin, or when changes to the following fields occur:

- Data Rate (CDMA GENERATOR screen)
- PN Offset (CDMA ANALYZER screen)
- Opt CDMA TB (INSTRUMENT CONFIGURE screen)
- Ext Ref In (INSTRUMENT CONFIGURE screen)

To transfer the Time Offset, use the following procedure.

1. Make at least one of the following measurements:
   - Power
   - Timing
   - Phase
2. Select **FP Setup** from the Controls menu.
3. Select **Ofs Trnsfer**.
4. The offset is now transferred.

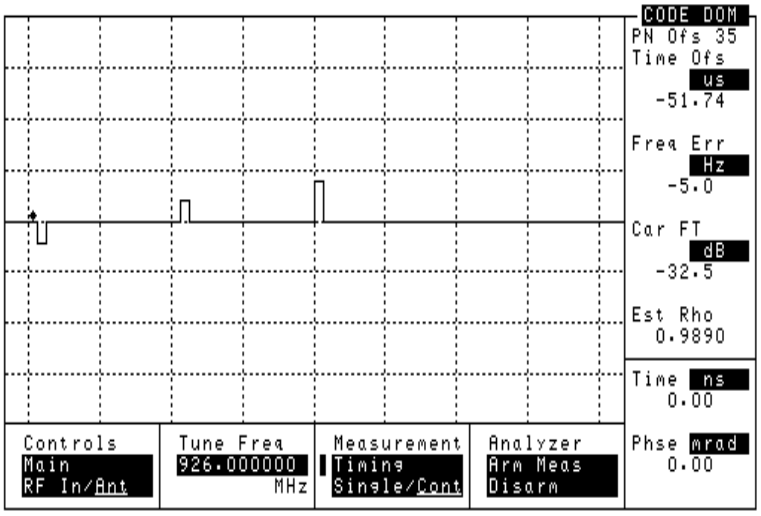
Code Domain Phase

Code Domain Phase displays the phase error for each of the 64 Walsh channels relative to the Pilot channel. Displays above the zero reference in the center of the screen indicate that the Walsh channel leads the Pilot channel in phase. Displays below the zero reference in the center of the screen indicate that the Walsh channel lags the Pilot channel in phase. Move the marker to read the Phase for each individual channel.

Code Domain Timing

Code Domain Timing displays the time offset for each of the 64 Walsh channels. This measurement is relative to the Pilot channel, which is Walsh code zero. Displays above the reference indicate that the Walsh channel is leading the Pilot channel in time. Displays below the reference indicate that the Walsh channel is lagging the Pilot channel in time. Move the marker to read the Timing for each individual channel.

Figure 3-10 Code Domain Timing



Time Offset

Time Offset indicates how well your transmitter's signal is time-aligned to system time. The displayed value takes into account the PN Sequence Offset Index of your transmitter that is entered in the PN Offset field (**PN Setup**).

Frequency Error

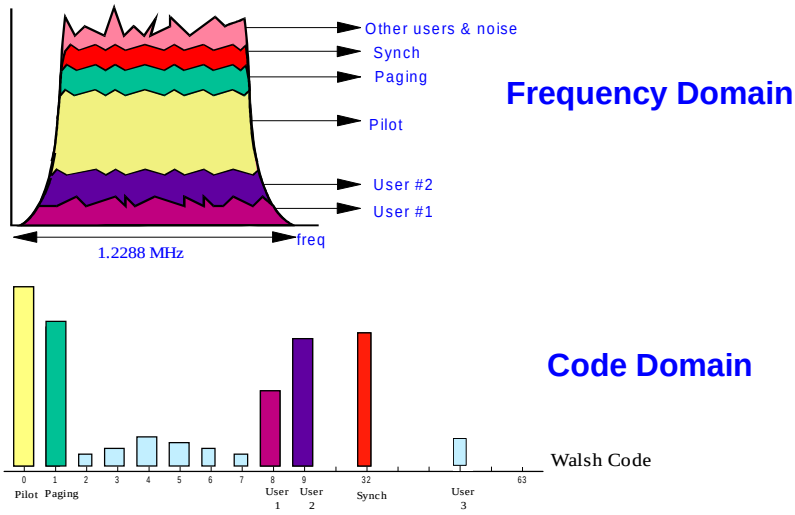
Frequency error is the frequency difference between your transmitter's actual center frequency and the frequency (or channel) you entered.

Carrier Feedthrough

Used to measure performance of the I/Q modulator of your transmitter. Extremely low values indicate a very good I/Q modulator. Higher values indicate potential problems with the I/Q modulator. If Carrier Feedthrough measures more than approximately -25 dBc, there may be problems with the Base Station. Unit of measure is dBc.

Code Domain Notes – IS-95

Figure 3-11 Code Domain



On a spectrum analyzer, you can view the 1.23 MHz forward link channel; it would appear as the envelope of the top figure. But how much of the total signal, as viewed on the spectrum analyzer, is attributed to each individual Walsh code? You cannot tell using frequency domain analysis. This, again, requires a new measurement method.

The measurement mode used is called "code domain analysis". In code domain analysis, the individual Walsh codes are decoded and displayed individually. The contribution of each Walsh channel to the total signal is measured and displayed as a bar indicating the relative power in the channel.

Figure 3-11 shows a typical display of code domain power. Note the contribution to the total signal from the pilot, sync, and paging channels. In this example, there are also three users of traffic channels on the forward link.

Inactive channels are important to measure, too. Excess power in the inactive channels means reduced capacity in the sector.

Code Domain Measurements – IS-2000

If you have selected IS-2000 in the INSTRUMENT CONFIGURE screen, the Code Domain screen will appear as described in this section, with 128 channels.

If you wish to make use of the traditional Walsh ordering - Hadamard - as described by the IS-95 standard, select **Aux** from the Controls menu and then select **Hadamard** from the Meas Order field.

Below are brief descriptions of the measurements available in the Code Domain Analyzer.

Code Domain Power

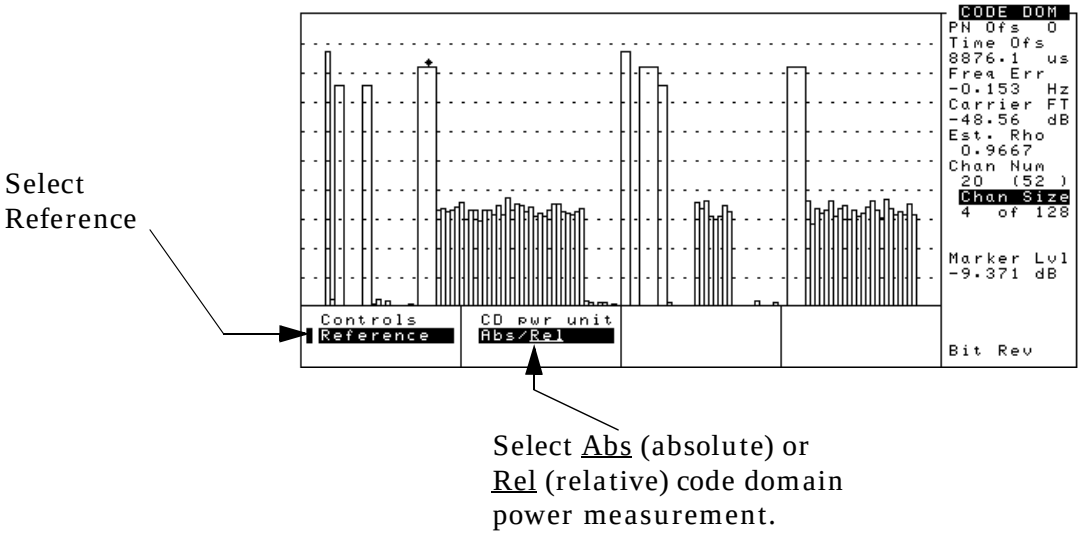
Code Domain Power displays the power for each of the 128 Walsh codes. Each Channel level is displayed as a vertical bar. Instances in which the Walsh order is less than 7 will result in a vertical bar composed of a number of walsh codes reflecting the channel "spreading" that has been allocated to this signal (see "Code Domain Notes – IS-2000" on page 67 for additional information on channel size and spreading.)

As with IS-95 Power measurements, the power of each vertical bar provides an immediate picture of the current transmission status and allows comparison of signal levels among the Pilot, Sync, Paging, and Traffic channels. However, these channels may have different locations and slightly different meanings in the IS-2000 standard. Refer to "Code Domain Notes – IS-2000" on page 67 for additional information.

As with IS-95 Code Domain measurements, you may measure the absolute or the relative power. However, in IS-2000 mode this is specified by selecting the **Reference** control and then specifying **Abs** or **Rel** in the **Ch pwr unit** field:

- Absolute Code Domain Power displays the power in each of the 128 Walsh codes, relative to the total power inside a 1.23 MHz bandwidth centered at the tune frequency. To measure absolute code domain power the **Ch pwr unit** field on the **Reference** menu must be set to **Abs** (see Figure 3-9). Use the **Marker** controls to move the marker to the Walsh code (**Chan Num**) you want to measure.
- Relative code domain power displays the power in each of the 128 Walsh codes, relative to the pilot's power. (Pilot power is approximately two-thirds of the total power.) To measure relative code domain power the **Ch pwr unit** field on the **Reference** menu must be set to **Rel** (see Figure 3-9). Use the **Marker** controls to move the marker to the supplemental or Walsh (**Chan Num**) you want to measure.

Figure 3-12 Selecting Absolute or Relative Code Domain Power – IS-2000



Fast Power

Fast Power is a faster method of measuring Code Domain Power. A non-fast power measurement must first be made before Fast Power measurement begins, or when changes to the following fields occur:

- Data Rate (CDMA GENERATOR screen)
- PN Offset (CDMA ANALYZER screen)
- Opt CDMA TB (INSTRUMENT CONFIGURE screen)
- Ext Ref In (INSTRUMENT CONFIGURE screen)

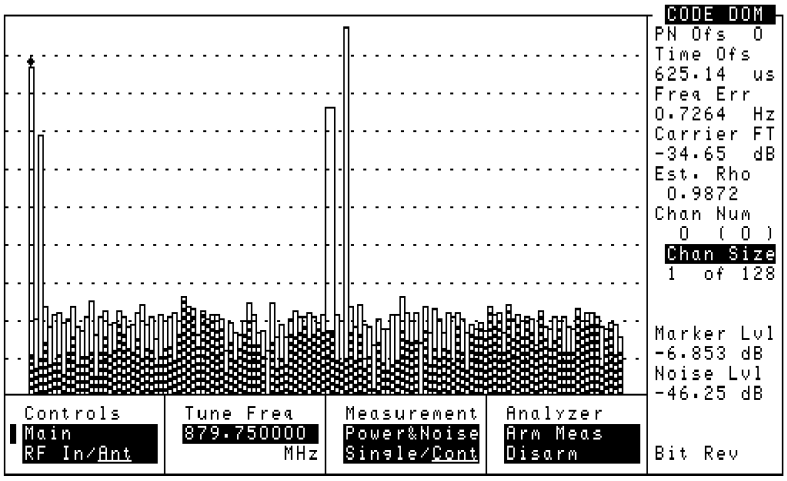
To set up for a Fast Power measurement, use the following procedure.

1. Make a Fast Power Synchronize (**Fst Power Sync**) measurement.
2. Once a measurement is made, the Fast Power parameters are established.

Code Domain Power & Noise

The Power & Noise option displays the Code Domain channels along with channel noise, shown as hatch marks within each channel area. This makes troubleshooting signal-to-noise problems easy.

Figure 3-13 Code Domain Power & Noise



Code Domain Complex Power

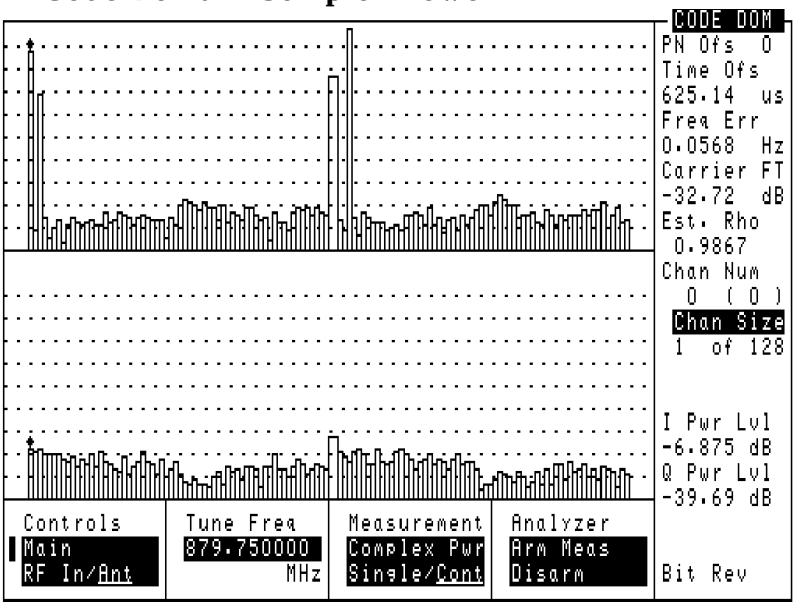
Complex Power provides a view of the Code Domain Power in according to both the IS-95 and the IS-2000 standards as follows:

- IS-95 *and* IS-2000, or I view – is shown in the top trace. In this view signals which are active in both the IS-95 and IS-2000 standards appear. For example, in Figure 3-14, Channel 1, the channel reserved for the pilot in IS-95 is active in the top trace and inactive in the bottom, which shows the IS-2000 view alone.
- IS-2000 alone, or Q view – is shown in the bottom trace. Any channels which are reserved for use by the IS-95 protocol will appear inactive in this view.

To view the Complex Power in the Code Domain:

1. Select **IS-2000** in the INSTRUMENT CONFIGURE screen.
2. Select the CODE DOMAIN screen.
3. Select **Main** from the Controls menu.
4. Select **Complex Power** in the Measurement field.

Figure 3-14 Code Domain Complex Power



Time Offset

Time Offset indicates how well your transmitter's signal is time-aligned to system time. The displayed value takes into account the PN Sequence Offset Index of your transmitter that is entered on the CDMA ANALYZER screen.

Frequency Error

Frequency error is the frequency difference between your transmitter's actual center frequency and the frequency (or channel) you entered.

Carrier Feedthrough Used to measure performance of the I/Q modulator of your transmitter. Extremely low values indicate a very good I/Q modulator. Higher values indicate potential problems with the I/Q modulator. If Carrier Feedthrough measures more than approximately -25 dBc, there may be problems with the Base Station. Unit of measure is dBc.

Code Domain Fast Power Synchronize

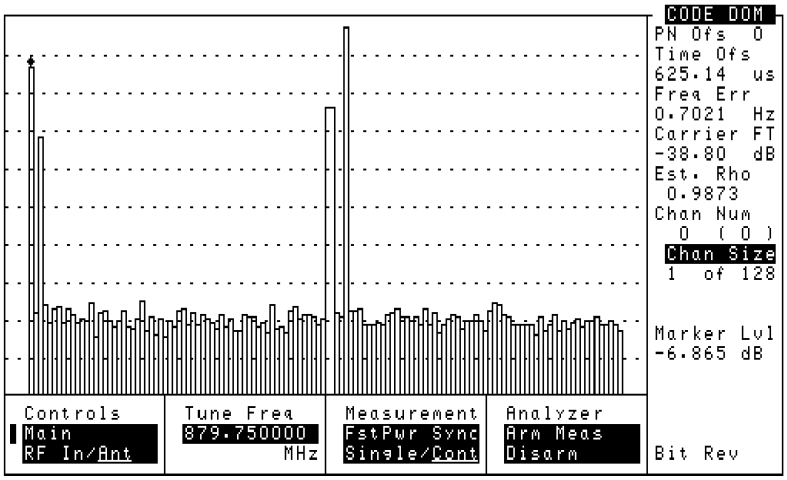
Fast Power Synchronize provides a way to establish all the measurement parameters needed to make Fast Power measurements. As a convenience, these parameters are also set with Power, Power and Noise, and Complex Power.

To make a Fast Power Synchronize measurement in the Code Domain:

1. Select **IS-2000** in the INSTRUMENT CONFIGURE screen.
2. Select the CODE DOMAIN screen.
3. Select **Main** from the Controls menu.

4. Select **Fst Pwr Sync** in the Measurement field.

Figure 3-15 Fast Power Synchronize

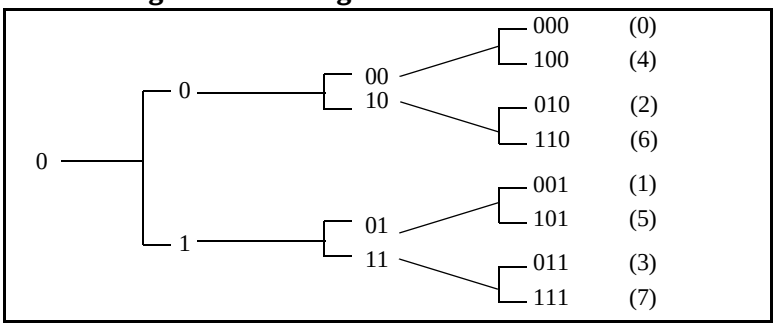


Code Domain Notes – IS-2000

The IS-95 standard includes only 64 Walsh codes which map directly into channels, numbered consecutively from 0 to 63 (Hadamard ordering). This provided a uniform channel size regardless of purpose.

The IS-2000 standard allows up to 128 Walsh codes. In addition, to handle the wide range of data rates available in IS-2000 (9.6 kbps for voice up to 307.2 kbps for low mobility data), variable length Walsh code spreading is used. The code tree representation, shown in Figure 3-16, of the variable length Walsh codes is useful in understanding how these codes are generated and how they can be selected to maintain orthogonality.

Figure 3-16 Building a tree using the Bit Reverse method



To generate a Walsh code tree, take the initial code, first add a place (bit) in the most significant number's (MSN) place. Then, for the upper branch, give this bit the value "0". Finally, for the lower branch give this number the value "1". This process proceeds to generate more and more branches until you have reached the desired Walsh code length. The code sets are denoted by their length in bits which corresponds to the

vertical columns (all codes that have the same Spread Factor) in the tree.

The Walsh order (number of bits that comprises the specified code) indicates the bit number to use to spread the data. Before being spread, data is assigned to the Walsh codes encompassed by the spread. After encoding and interleaving, the data is spread according to the Walsh order.

In addition to variable length spreading, an individual Pilot is added to each mobile to allow synchronous detection by the base station. The reverse link uses I and Q long codes scrambled with the I and Q short codes to produce a new modulation format called HPSK (Hybrid Phase Shift Keying). HPSK reduces the dynamic range of the modulation to allow less expensive output amplifiers for modules. The net result is a doubling of the spectral efficiency of the system compare to earlier standards.

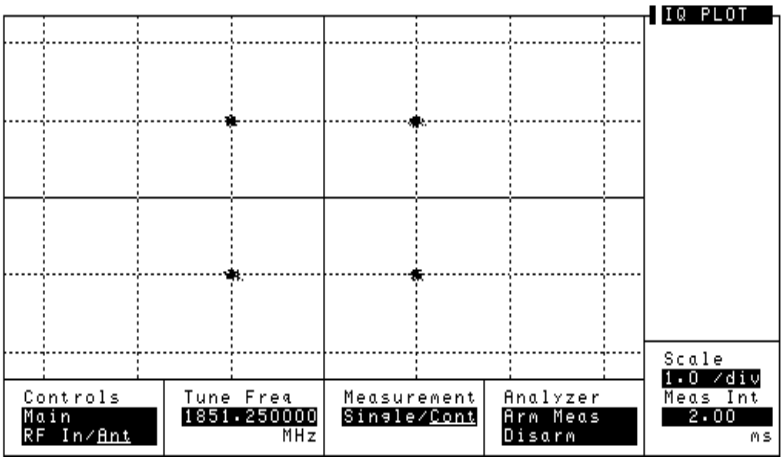
In IS-2000, Pilot and Synch forward (base to mobile) channels still use IS-95 coding (channels 0 and 63), with up to seven Paging channels (also IS-95 coding). However, the following forward channels are now additionally available:

- Broadcast Channel – for system overhead messages
- Quick Paging Channel – indicates whether pages will occur in upcoming slots
- Common Power Control Channel – used to reduce interference and collisions during system access
- Common Assignment Channel – also used to reduce interference
- Common Control Channels – can be used efficiently with a Broadcast channel that will handle system overhead
- Dedicated Control Channels – carries signaling data and power control data in connection with traffic channels
- Many Traffic channels – including one fundamental channel and up to seven forward supplemental channels for high speed data

IQ Plot

The I/Q PLOT can also be selected from the list of available measurements on the Test Set.

Figure 3-17 IQ PLOT screen



The I/Q PLOT screen graphically shows I/Q decision points. This is a useful troubleshooting tool when investigating Rho problems

Visual presentation helps identify I/Q errors. Figure 3-17 shows no errors. However, the 4 point groupings could be skewed away from perfect square or offset indicating a phase error. This will result in interference from I to Q and from Q to I. Phase errors can result from crosstalk between I and Q in the base station baseband processing section, misaligned LOs or intermodulation between Walsh codes.

To view the I/Q plot:

1. Select the I/Q PLOT screen.

PN Offset Search

There are two ways to provide your Base Station's PN Offset value to the Test Set. The first way is to enter the value directly in the PN Offset field. The second is to have the Test Set determine the value from the received signals.

"Procedure to Enter the PN Offset Manually" on page 71

"Procedure to Measure the PN Offset" on page 71

Each whole offset is equal to 64 chips (=52.08 ms). Fractional values are rounded off, and can be entered, in increments of 0.015625 (1 chip). Once entered, this value is shared by all CDMA screens.

This value is used by the analyzer when the **Even Sec** field on the CDMA GENERATOR screen is set to **Enable**.

NOTE When the **Even Sec In** field is set to **Not**, changes to the **PN Offset** field have no effect on the analyzer.

Prerequisites

You will need to do the following before measuring Rho:

- ❏ Connect your transmitter signal to the RF IN/OUT port of the Test Set.
- ❏ Connect your Even Second Clock to the Even Sec/Sync In port of the Test Set. (Required only for Time Offset measurement)
- ❏ Connect your Base Station Reference signal to the REF IN port of the Test Set.
- ❏ Know the channel number or frequency of your transmitter.

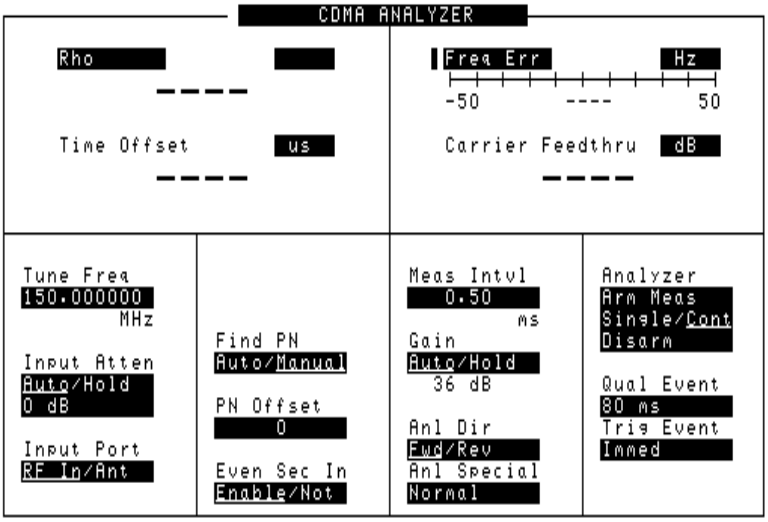
CAUTION **Overpower Damage** — Refer to the Test Set's side panel for maximum input power level. Exceeding this level can cause permanent instrument damage.

Procedure to Enter the PN Offset Manually

1. Press the **CDMA Anl** key to go to the CDMA ANALYZER screen.
2. Select Rho from the measurement field in the upper left corner of the display.
3. Enter the channel number or RF frequency of your transmitter.
4. Select **Manual** from the **Find PN** field.
5. Update the **PN Offset** for the Base Station being tested, if it is not already correct.

Results

Figure 3-18 Manual PN Offset fields



Procedure to Measure the PN Offset

1. Press the **CDMA Anl** key to go to the CDMA ANALYZER screen.
2. Select Rho from the measurement field in the upper left corner of the display.
3. Enter the channel number or RF frequency of your transmitter.
4. Select **Auto** from the **Find PN** field.
5. Select the measurement on the right side of the display (default is **Freq Err**).
6. Select **PN Offset** from the list of choices. Now the PN Offset measurement is displayed. The PN Offset value is also displayed in

the Code Domain screen.

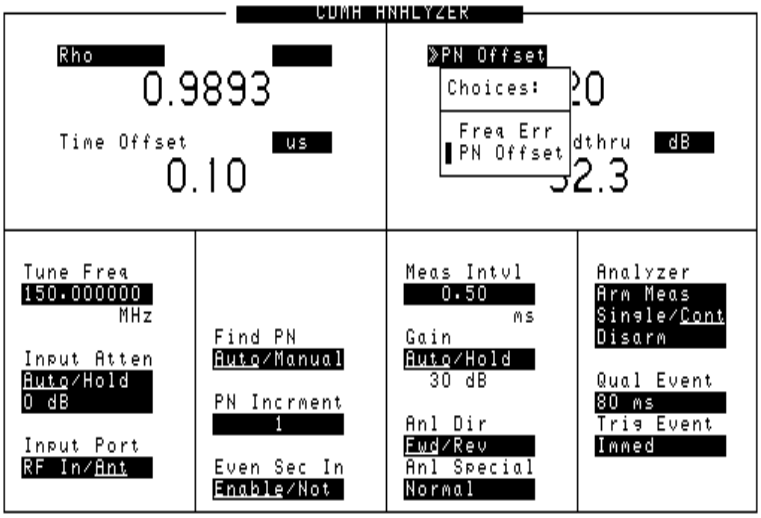
NOTE

The PN Increment field allows you to search based on a step size of your choice. If PN Increment = 1 (default), the search will step through PN values by one PN at a time. If PN Increment = 5, it will step through PN values 0, 5, 10, and so on. The Measured PN displayed will be a multiple of 5, even if the actual PN is not a multiple of 5.

If you know that all base stations in the area have fixed increments, then set the PN Increment field to that increment value. If you don't know, then use the default value of 1.

Results

Figure 3-19 Measured PN Offset



Rho (Modulation Quality)

In this measurement, the modulated signal is compared to an ideal reference waveform to determine the performance of the transmitter's modulation circuitry. Rho values are in the range of 0 to 1. A value of 1 indicates perfect correlation to the reference (high modulation quality). CDMA Base Station standards require that transmitters have rho performance of 0.912 or higher.

With the Rho measurement, the following data is provided:

- Rho
- Frequency Error

  Frequency error is the frequency difference between your transmitter's actual center frequency and the frequency (or channel) you entered.
- Time Offset

  Time offset indicates how well your transmitter's signal is time-aligned to system time. The displayed value takes into account the PN Sequence Offset of your transmitter.
- Carrier Feedthrough

  Used to measure performance of the I/Q modulator of your transmitter. Extremely low values indicate a very good I/Q modulator. Higher values indicate potential problems with the I/Q modulator. If Carrier Feedthrough measures more than approximately –20 dB, there may be problems with the Base Station. Unit of measure is dBc.

Prerequisites

You will need to do the following before measuring Rho:

- ❏ Connect your transmitter signal to the RF IN/OUT port of the Test Set.
- ❏ Connect your Even Second Clock to the Even Sec/Sync In port of the Test Set. (Required only for Time Offset measurement)
- ❏ Connect your Base Station Reference signal to the REF IN port of the Test Set.
- ❏ Set up your Base Station to transmit Pilot channel only.
- ❏ Know the channel number or frequency of your transmitter.
- ❏ Know the PN offset for the Base Station.

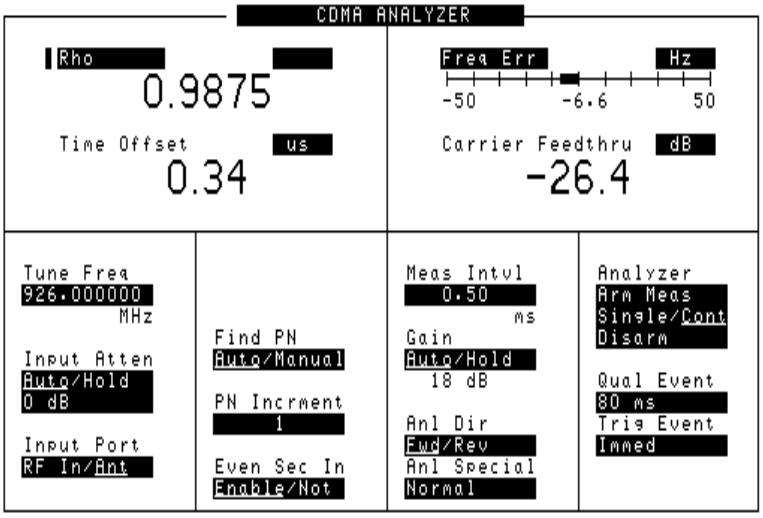
CAUTION **Overpower Damage** — Refer to the Test Set's side panel for maximum input power level. Exceeding this level can cause permanent instrument damage.

Procedure

1. Press the **CDMA Anl** key to go to the CDMA ANALYZER screen.
2. Select **RF Channel** or **Tune Frequency**, depending on whether your channels are selected by channel number or by frequency.
3. Enter the channel number or RF frequency of your transmitter.
4. Update the **PN Offset** for the Base Station being tested, if it is not already correct.
5. Select the measurement on the left side of the display (default is **Avg Pwr**).
6. Select **Rho** from the list of choices. Now the Rho measurement is displayed.
7. Rho, Time Offset, Frequency Error, and Carrier Feedthrough should be displayed.

Results

Figure 3-20 Rho measurement

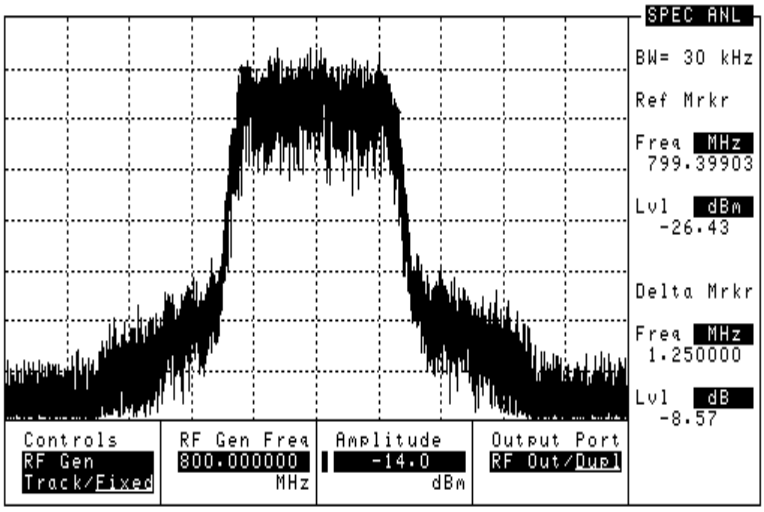


Transmit Spectrum

Viewing the Transmit Spectrum can give you information about your CDMA signal and about other signals in the nearby frequencies.

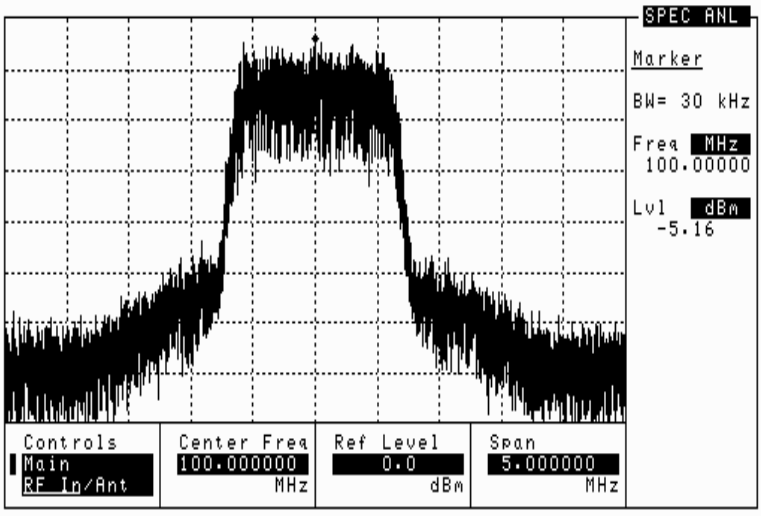
Look for a CDMA signal that has the characteristic shape.

Figure 3-21 Standard CDMA Signal



Seeing “Shoulders” on the Spectrum Analyzer display is one common distortion of the CDMA shape. This problem usually occurs when there is a problem with the power amplifier of the Base Station. The bandwidth of the “Shoulders” is usually about twice the bandwidth of the 1.2288 MHz CDMA signal.

Figure 3-22 CDMA Signal with “Shoulders” Distortion



Sometimes the “Shoulders” also occur when there is an interfering signal near the CDMA signal. In this case, the “Shoulders” are usually much smaller in bandwidth.

Prerequisites

You will need to do the following before you look at the transmit spectrum:

- ❑ Connect your transmitter signal to either the RF IN/OUT or the ANT IN port. You can also use an antenna on the ANT IN port if you want to view the signal off the air.

Procedure

1. Press the **Spec Anl** key to go to the SPECTRUM ANALYZER screen.
2. Select **RF Channel** or **Tune Frequency**, depending on whether your desired channel is selected by channel number or by frequency.
3. Enter the channel number or frequency of your transmitter.
4. Adjust the **Ref Level** of the signal to better display your signal.
5. The spectrum of your signal should be displayed. Look for “shoulders” or interfering signals.

4 Utility Procedures

This chapter contains procedures and instructions that will help you make the most efficient use of your Test Set.

Beeper

The beeper notifies you when a message is displayed. Since a message may be removed from the screen before you notice it, it is better to leave the beeper on to alert you to errors during operation.

The beeper's volume setting is retained when the instrument is turned off.

Beeper Control

1. Press the **Inst Config** key to go to the INSTRUMENT CONFIGURE screen.
2. Select **Beeper**.
3. Choose from **Off**, **Quiet**, or **Loud**.

Changing Between Channel Mode and Frequency Mode

There are two ways to tune the Test Set's Generator and Analyzer: by channel number or by frequency. Default is channel mode, with **N AMER PCS** being the default system channel standard.

Channel mode is useful when you don't necessarily know the frequency of the channel you are testing, but you do know the channel number and the channel standard.

Frequency mode is useful when you are concerned about specific frequencies. That may be when you are searching for interfering signals, or when you want to put the Test Set in loopback mode.

- When **Chan** is selected, you enter the RF Generator's and the RF Analyzer's channel numbers directly using the keypad or knob. You can also choose a system channel standard.

  Channel mode automatically sets the RF Generator's and the RF Analyzer's frequency separation according to the system's channel standard.

- When **Freq** is selected, the **RF Channel** field on all screens is replaced by frequency fields:

  — **RF Gen Freq** in the CDMA GENERATOR and RF GENERATOR screens

  — **Tune Freq** in the CDMA ANALYZER, RF ANALYZER, IQ Plot and CODE DOMAIN ANALYZER screens

  — **Center Freq** in the SPECTRUM ANALYZER screen

  The frequency separation for frequency mode can be set in the INSTRUMENT CONFIGURE screen.

Procedure to Change Between Channel and Frequency Modes

1. Press the **Inst Config** key to go to the INSTRUMENT CONFIGURE screen.
2. Select **RF Display**. The value toggles between **Freq** and **Chan**.
   - If you selected **Chan**, you should choose your desired channel standard from the **RF Chan Std** field.
   - If you selected **Freq**, you can turn the **RF Offset On** or **Off** in the **RF Offset** field. The frequency difference controlled by the **RF Offset** is set in the **(Gen) - (Anl)** field.

Changing Between IS-95 Mode and IS-2000 Mode

There are two ways to make Code Domain measurements:

- Using the IS-95 standard
- Using the IS-2000 (or CDMA2000) standard

IS-95 mode is used to view Code Domain measurements using the Hadamard ordering and the 64 Walsh codes specified by the standard.

IS-2000 mode is used to view Code Domain measurements and the 128 Wash codes with channel spreading.

- When **IS-95 only** is selected, Code Domain measurements can be made for Power, Fast Power, Timing and Phase for the 64 Walsh channels specified by this standard.
- When **IS-2000** is selected, Power, Fast Power, and Fast Power Synchronize measurements can be made using 128 Walsh channels as specified by this standard. In addition, the following become accessible:
  - Code Domain **Power & Noise** in the CODE DOMAIN analyzer screen
  - Code Domain **Complex Power** in the CODE DOMAIN analyzer screen

Procedure to Change Between IS-95 and IS-2000 Modes

1. Press the **Inst Config** key to go to the INSTRUMENT CONFIGURE screen.
2. Select **CDMA Std**. The selections available are **IS-95 only** and **IS-2000**.

Measuring Insertion Losses

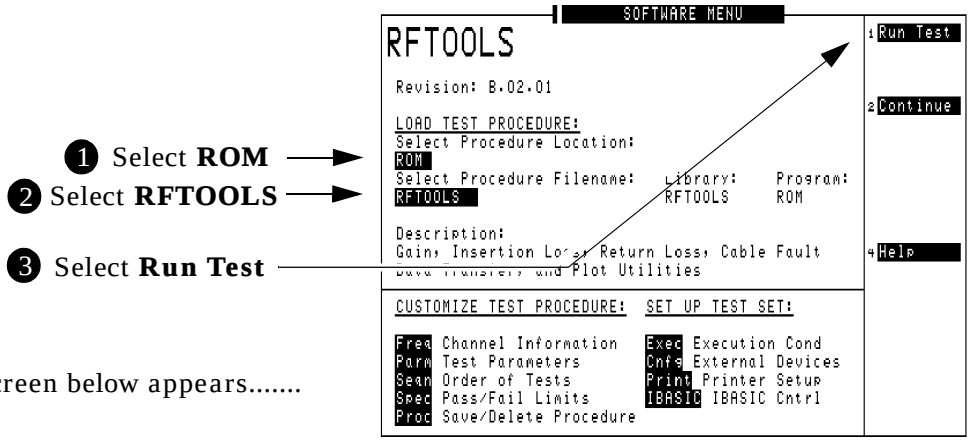
To make accurate power and receiver measurements, the signal loss through the cables or other devices used in your test setup must be known and entered into the Test Set's INSTRUMENT CONFIGURE screen to compensate for these losses.

Signal losses are measured using a built-in automated routine that runs on the Test Set's IBASIC controller. Losses can be calibrated at a discrete (single) frequency or over a frequency range. This is one routine included in a set of utility procedures called the RF TOOLS.

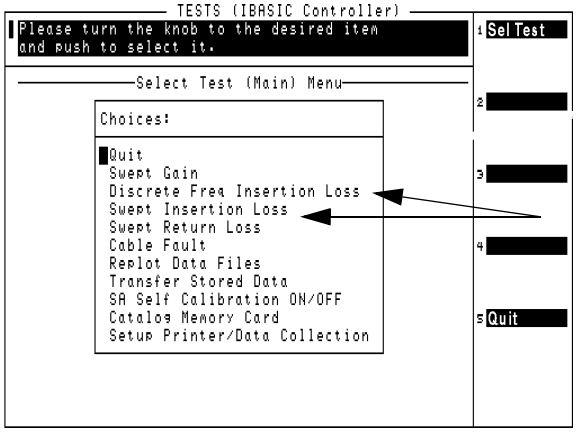
During the test, a calibrated signal is fed through two 6 dB attentuators/pads (such as Mini-Circuits model NAT-6-60) and a short type-N male-to-male cable to establish a known reference point. The Test Set then prompts you to connect the device under test to measure the additional loss through that device. (The pads and cable are not part of the standard equipment shipped with the Test Set.)

Figure 4-1 on page 81 shows how to load and run the RFTOOLS routines and select the desired insertion loss test.

Figure 4-1 Loading and Running the Insertion Loss Test



When the screen below appears.....



...use the knob to move the cursor and select either **Discrete Freq Insertion Loss** or **Swept Insertion Loss**. When run, the test prompts you to enter the necessary test frequency information and displays setup diagrams. Make the indicated connections and follow instructions

Memory Cards

The slot on the front of the Test Set is used for memory cards. The memory cards are used for the following:

- Storage of Save/Recall registers
- Loading of software (either Agilent Technologies or self-written)
- Collecting data (only when using software)
- Upgrading firmware or software

Memory Cards and Initialization

There are several types of memory cards available, and the following cards are used with the Test Set:

- SRAM: used for Save/Recall and data storage
- Flash ROM: used when upgrading firmware
- OTP (One Time Programmable): used for Agilent Technologies software

Flash ROM cannot be used for collecting data and Save/Recall.

Data cannot be loaded on Flash ROM and OTP cards with the Test Set's memory card slot. SRAM can be initialized with the Test Set.

Initializing SRAM Cards for Save/Recall and Data Collection

1. Insert the SRAM card into the slot. If the card is uninitialized, a message will appear at the top of the display.
2. Press **Shift** and **IO Confg** to display the I/OCONFIGURE screen.
3. Using the knob, locate the **FORMAT CARD** field.
4. Select the **FORMAT CARD** field. A prompt will appear at the top of the display. Pressing **Yes** will erase and initialize the card.

Oscilloscope

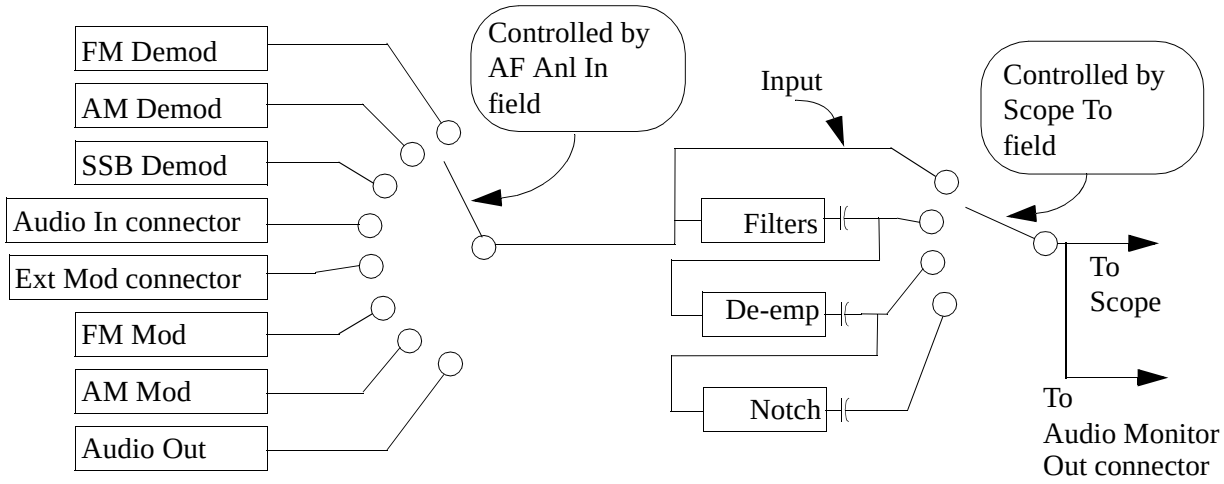
The built-in 50 kHz oscilloscope provides

- multiple triggering formats (internal and external)
- single-shot and pre-trigger viewing for single events
- full marker capability with automatic level and time readout

Time/division, volts/division and vertical offset are displayed and can be changed using the front-panel knob.

Input to the Oscilloscope is provided from various sources including direct inputs to the Audio Input and Modulation Input connectors. Oscilloscope functions are accessed from the AF ANL and OSCILLOSCOPE screens.

Figure 4-2 Inputs and Filters for the Oscilloscope



Selecting the Oscilloscope's Input

1. Press **Shift**, then **RF Anl** to select the AF ANALYZER screen.
2. Select the **AF Anl Input** field. A list of choices should appear.
3. Select the desired input to the scope:
   - **FM Demod** for FM demodulated audio from input signals connected to the RF IN/OUT or ANT IN connectors.
   - **AM Demod** for AM demodulated audio from input signals connected to the RF IN/OUT or ANT IN connectors.
   - **SSB Demod** for SSB demodulated audio from input signals connected to the RF IN/OUT or ANT IN connectors.
   - **Audio In** for a signal connected to the AUDIO IN connector.
   - **Ext Mod** for a signal connected to the rear panel MODULATION INPUT connector.
   - **FM Mod** for the FM modulated audio from the RF Gen section.
   - **AM Mod** for the AM modulated audio from the RF Gen section.
   - **Audio Out** for the signal present at the AUDIO OUT connector.
4. The input to the Scope is displayed on the SCOPE screen.

Selecting the Oscilloscope's Filters

1. Press **Shift**, then **RF Anl** to select the AF ANALYZER screen.
2. Select the **Scope To** field. A list of choices should appear.
3. Select the desired filtering for the signal:
   - **Input** if you want no filtering (Input is DC coupled)
   - **Filters** to route the audio to the Oscilloscope after passing through Filters #1 and #2. (AC coupled)
   - **De-emp** to route the audio to the Oscilloscope after passing through Filters #1 and #2, and the De-Emphasis circuitry.(AC coupled)
   - **Notch** to route the audio to the Oscilloscope after passing through Filters #1 and #2, the De-Emphasis circuitry, and Notch circuitry.(AC coupled)

Triggering the Oscilloscope

You can control following Triggering features of the oscilloscope:

- Trigger: external or internal
- Automated or normal triggering
- Continuous or single shot triggering
- Trigger level
- Trigger delay

The oscilloscope is triggered using the Trigger menu. Select this menu with the following procedure:

1. Press **Shift**, then **Scope** to go to the OSCILLOSCOPE screen.
2. Select the **Controls** field, then choose **Trigger** from the list of choices.

Using the Marker

The marker is used to help you make measurements with the oscilloscope. By repositioning the marker, you can measure the level and time.

The Marker is controlled using the Marker menu. Select this menu with the following procedure:

1. Press **Shift**, then **Scope** to go to the OSCILLOSCOPE screen.
2. Select the Controls field, the choose Marker from the list of choices.

Online Help

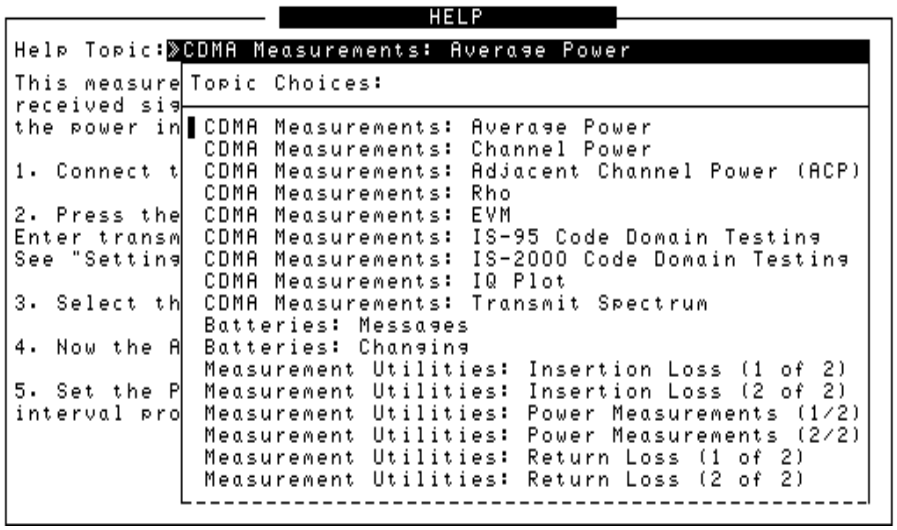
The Test Set contains help screens which briefly identify the most commonly used features of the Test Set.

Access the Help screens by pressing the **Help** key. Use the knob to select the Help Topic of interest.

Pressing the **Prev** key allows you to switch between the HELP screen and the previous screen you had accessed. This is particularly useful when you are following a procedure described in the HELP screen.

Help Screen Display

Figure 4-3 Help Screen Display



Ports: GPIB, Serial and Parallel

NOTE For the purposes of this documentation, the terms “GPIB” and “HP-IB” are used interchangeably.

There are three types of data ports on the Test Set: GPIB, Serial, and Parallel. They each have specific purposes.

GPIB Port

A special port is provided on the Test Set for IBASIC communications. It is used to control the Test Set with an external IBASIC controller.

This port can be used with an external programming device when writing programs, although it is also common to program the Test Set using a serial port.

The default address of the GPIB port is 14. This is commonly used in Agilent Technologies Instrument BASIC (IBASIC) programs. An example command providing output to the port is `OUTPUT 714;"*RST"` , which presets the Test Set.

It has two modes, which correspond to modes useful when programming the Test Set. Talk&Listn is the normal mode. Use Control only when you need to control GPIB instruments external to the Test Set.

Controlling the GPIB Port

1. Press **Shift**, then the **Inst Config** key to display the I/O CONFIGURE screen.
2. Set the address of the GPIB port with the **HP-IB Adrs** field.
3. Use the Mode field to set the mode to either Talk& Listn or Control.

Serial Ports

Three serial ports are available on the Test Set. SERIAL 9 is used for printing, IBASIC control and data communications. SERIAL 10 is used only for data communications from IBASIC. SERIAL 11 is reserved for future use with special software that enables remote operation through a PC.

Configuring Serial Ports

All serial ports are configured via the I/O CONFIGURE screen. Baud Rate, Parity, Data Length, Stop Length and Flow Control are all configured in this screen.

1. Press Shift, then I/O Config to go to the I/O CONFIGURE screen.
2. Select **Serial Port** to choose the port you want to configure.
3. Change the settings for the port as desired.

NOTE

Do not set **Flow Cntl** to **Hardware** on the I/O CONFIGURE screen for the serial port until you have a device attached to the port that can respond to the flow control communications.

Example: Assume you have a printer attached to Serial Port 9. Power is off to the printer. Before you start to run any IBASIC software (for example, the RFTOOLS program), you must make sure the printer is attached and power is on to the printer.

Additionally, port 9 can be configured for IBASIC control from this screen. See "Configuring Serial Port 9 for IBASIC Communications" on page 89.

Using Serial Ports for Printing

Serial Port 9 is the only serial port that can be used for printing. See "Printing" on page 92.

1. If you want to change the serial port configuration, see "Configuring Serial Port 9 for IBASIC Communications" on page 89. It is not necessary to change the **Serial_9 In** field.
2. Press Shift, then Printer Config to display the CONFIGURE PRINTING screen.
3. Select **Printer Port**. Choose **Serial 9** to direct the output to Serial Port 9.
4. Press Print to print the screen.

Configuring Serial Port 9 for IBASIC Communications

The internal connection to Serial Port 9 is controlled in the I/O CONFIGURE screen. The port has two purposes with IBASIC:

- **Inst**: Serial Port 9 is connected to a terminal (that is, a PC running a terminal emulator program such as HyperTerminal©). IBASIC commands are input from the terminal and are used to control the Test Set.
- **IBASIC**: Serial Port 9 is connected to a device that can communicate with an IBASIC program already running inside the Test Set. Typically used for input/output to a PC or other device.

1. Press Shift, then I/O Config to go to the I/O CONFIGURE screen.
2. Select **Serial_9 In** to toggle between **Inst** and **IBASIC**.

Parallel Ports

There are two parallel ports on the Test Set.

Parallel Port 15 is the only parallel port that can be used for printing. It can be selected in the PRINTER CONFIGURATION screen.

Both parallel ports (Port 15 and Port 16) may be used for controlling a Base Station. The port can be put in an input or an output mode. The data is then written or read under IBASIC control. When in either of these modes, the printing function on Port 15 is disabled.

Power Measurements

There are several power measurements available in this Test Set. They are listed below, along with brief descriptions.

Average Power

CDMA ANALYZER screen. Measures the average power of the full bandwidth of the input signal (RF IN/OUT port only). The most used and the most accurate CDMA power measurement. Typically used when only one CDMA signal is present. Since this measurement measures the full bandwidth of the input signal, if more than one signal is present, the power measurement will reflect the average power of all signals. See “Average Power” on page 46.

Channel Power

CDMA ANALYZER screen. Channel Power measures the power in the 1.23 MHz band of the chosen CDMA channel. The frequency or channel of the transmitter must first be entered in the Tune Frequency or RF Channel field. Often used with low level signals or when making measurements in the presence of interfering signals. Use this measurement when there are multiple CDMA channels at the input to the Test Set. See “Channel Power (1.23 MHz and 30 kHz)” on page 49.

Code Domain Power – IS-95

CODE DOMAIN screen, IS-95 mode. Measures the power for each of the 64 Walsh Channels relative to the total power inside a 1.23 MHz bandwidth centered at the Tune Frequency. See “Code Domain Measurements – IS-95” on page 59.

Code Domain Power – IS-2000

CODE DOMAIN screen, IS-2000 mode. Measures the power for each of the 128 Walsh Channels relative to the total power inside a 1.23 MHz bandwidth centered at the Tune Frequency. See “Code Domain Measurements – IS-2000” on page 62.

Fast Power

CODE DOMAIN screen (IS-95 and IS-2000). A faster method of measuring Code Domain Power. A value for Time Offset must be transferred from a non-fast power measurement before measurements begin. See “Code Domain Testing” on page 56.

Power & Noise

CODE DOMAIN screen (IS-2000). Measures Code Domain Power along with channel noise. See “Code Domain Testing” on page 56.

Complex Power

CODE DOMAIN screen (IS-2000). Measures Code Domain Power for both IS-95 channels and IS-2000 channels. Allows viewing of both channel types simultaneously. See “Code Domain Testing” on page 56.

TX Power

RF ANALYZER screen. Measures the peak power of cosine wave signals. Used for testing FM/AM radios. Choose between Peak and Sampled power. Do not use with CDMA, since this will result in erroneous readings. Refer to the “Agilent Technologies 8935 Series E6380A CDMA Cellular/PCS Base StationTest Set Application Guide” Application Guide for more information.

Printing

You can print from the Test Set via Parallel Port 15, Serial Port 9, or the GPIB port.

Note that data collection is not the same as printing. Data collection can only be done from a software program.

Configuring the Test Set for Printing

1. Press **Shift**, then **Printer Config** to display the PRINTER CONFIGURATION screen.
2. Select the **Model** field and choose the printer that most closely matches your printer.
3. Select the **Printer Port** field and choose the port you will connect the printer to. If necessary, use the I/O CONFIGURE screen to set up addresses and communication modes.

   a. SERIAL PORT 9: This is the uppermost serial port. Configuration defaults are 9600, none, 8, 1, Xon/Xoff.

NOTE

Do not turn Flow Control on (set **Flow Cntl** to "Hardware" in the I/O CONFIGURE screen) for the serial port until you have a device attached to the port that can respond to the flow control communications.

Example: Assume you have a printer attached to Serial Port 9. Power is off to the printer. Before you start to run any IBASIC software (for example, the RFTOOLS program), you must make sure the printer is attached and power is on to the printer.

   b. GPIB: The GPIB address (**HP-IB Adrs**) is set to printer address 701. Enter this number as 01. Set **Mode** to CONTROL. (The default address 14 is reserved for an external controller.)

   c. PARALLEL PORT: There are two ports available. Port 15 (the printer port) is the uppermost port.

4. Connect the proper cable to the connector you selected.
   - SERIAL PORT: Use a standard NULL MODEM cable.
   - GPIB: GPIB cable (such as Agilent Technologies 10833B)
   - PARALLEL PORT: Parallel cable
5. Change **FF** (Form Feed) and **Lines/Page** as needed.

Printing a Screen

1. Configure the Test Set for Printing.
2. Go to the screen you want to print.
3. Press the **Hold** key if you want to temporarily stop the measurement. (Optional)
4. Press the **Print** key. Data will be sent to the printer.
5. To cancel the print, go to the PRINTER CONFIGURE screen and select **Abort Print**.

Measuring Swept Return Loss

This procedure measures the return loss (VSWR) of an antenna using an IBASIC program that is in the Test Set's memory. An external directional bridge must be provided (such as an Eagle RLB 150X5 Option N5A or equivalent).

Press the **Menu** key to access the SOFTWARE MENU screen, and follow the instructions illustrated on the following pages.

Figure 4-4 Loading and Running the Return Loss Program

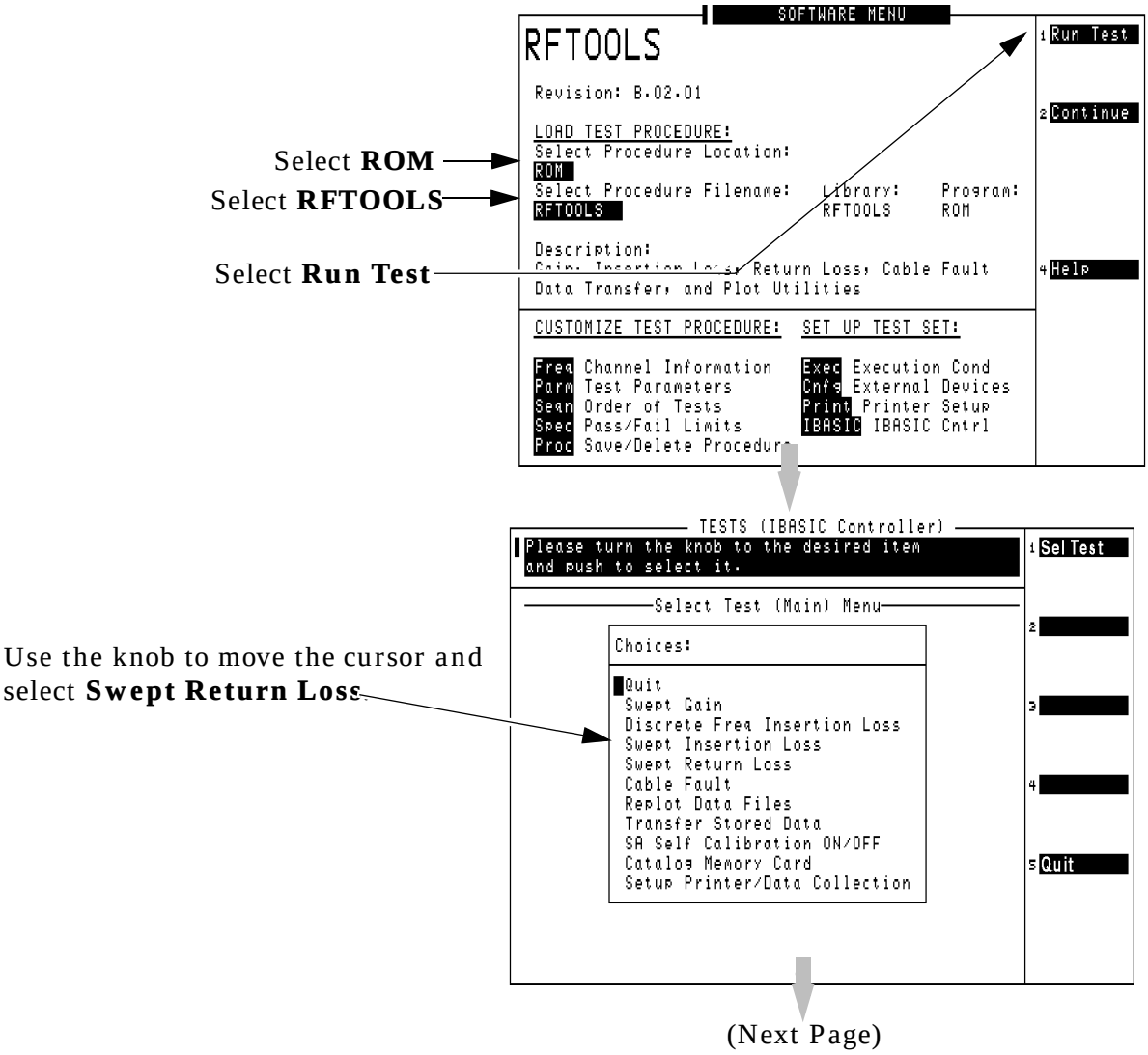


Figure 4-5 Entering Swept Return Loss Measurement Information

Enter the **Start** and **Stop Frequency** values for the measurement.

The **Max expected loss** value is used to determine the graphics scaling when the measurement is displayed.

The **DUPLEX OUT level** is adjustable to reduce the RF level used when measuring the loss of sensitive devices, and to minimize the amount of transmitted power during the test (if necessary).

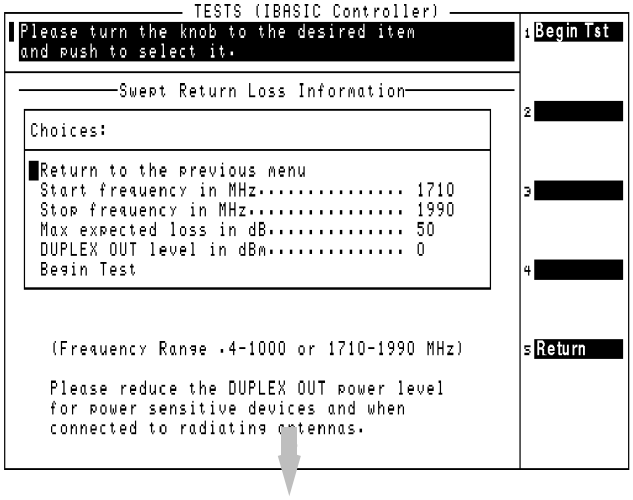
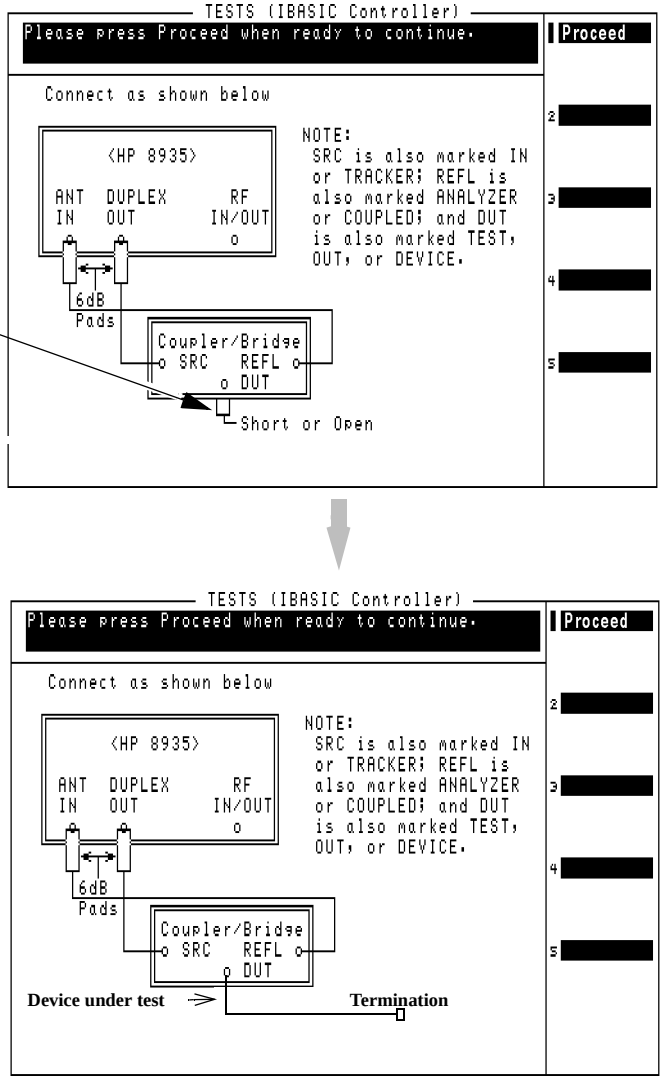


Figure 4-6 Swept Return Loss Measurement Connections



Two 6 dB attenuators (pads), two short cables, and the return loss bridge are used to establish a calibration reference **without the device under test connected**. Press **Proceed(k1)** to continue.

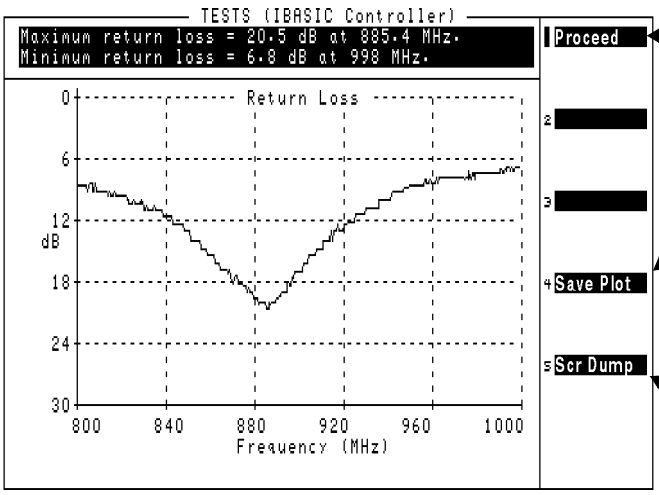
As indicated by the NOTE on the drawing, your return loss bridge may be marked differently than shown.

When measuring the swept return loss of a transmission line that is not terminated at an antenna, terminate the line into a 50Ω load.

After connecting your device under test, press **Proceed(k1)** to make the measurement.

The plot in Figure 4-7 is for a cellular band antenna, swept from 800 MHz to 999 MHz. The plot (and the text above it) indicates that the maximum return loss is at 885.4 MHz. This is the point where the antenna is radiating the maximum amount of signal being fed into it from the return loss bridge, and therefore the Test Set is receiving the least amount of reflected (returned) energy back.

Figure 4-7 Swept Return Loss Measurement Results



Proceed to the run the test again or to select a different test.

Save Plot to an initialized writeable PC card. (See "Memory Cards" on page 82.)

Perform a **Screen Dump** to print the screen to a connected printer. (See "Printing" on page 92.)

Software: Loading

Instructions for loading software are included with the software package. Refer to the software package's User Guide for instructions on how to load the software.

Tracking Generator

The Tracking Generator is primarily used for measuring Return Loss and Insertion Loss. It also allows for quick and accurate characterization of filters, duplexers, combiners, and RF to IF conversions. Broadband RF devices can be characterized with single sweeps due to the full-span sweep capability to 1 GHz. The tracking generator also includes amplitude and frequency offset. Output from the Tracking Generator are provided at either the side panel RF IN/OUT or DUPLEX OUT connector.

Using the Tracking Generator

To measure Return Loss, see "Measuring Swept Return Loss" on page 94. To measure Insertion Loss, see "Measuring Insertion Losses" on page 81.

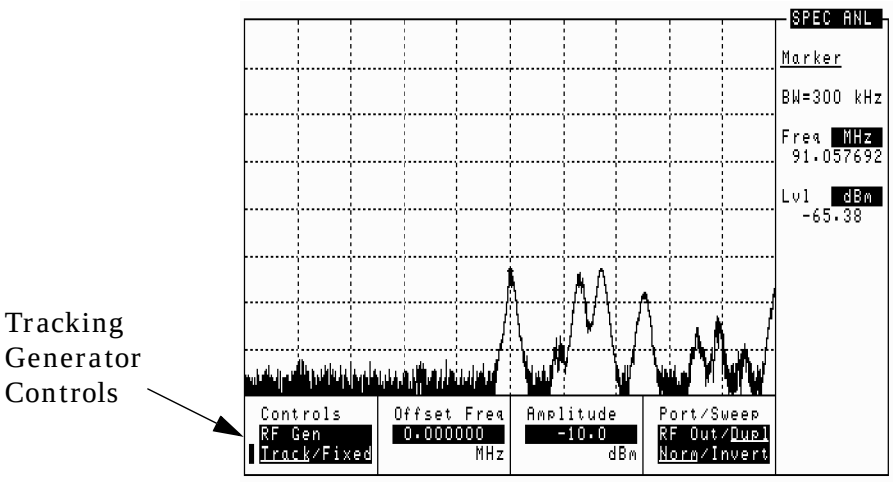
Features of the Tracking Generator are listed below.

- Sweep: the start and stop frequencies of the sweep are determined by the Spectrum Analyzer's **Main** Menu. The **Span** determines the band, and **Center Freq** defines the midpoint of the sweep.
- **Offset Freq**: sets the difference between the instantaneous frequency of the Tracking Generator and the center frequency of the Spectrum Analyzer. This value can be positive or negative.
- **Amplitude**: sets the amplitude of the signal.
- **Norm/Invert**: With Norm, the Tracking Generator sweeps from low to high frequencies. With Invert, it sweeps from high to low frequencies.

NOTE The offset function is useful when looking at frequency translating devices, or anytime you need to sweep around a frequency while analyzing another. During normal operation, offset is set to "0.00".

Figure 4-9

Figure 4-9 Spectrum Analyzer with Tracking Generator Controls Displayed



User Keys

User keys instantly access instrument settings without using the knob. You can use user keys to move quickly between fields on the same screen, and to access field settings that are not normally available on the screen you are using. When the user key is pressed, the cursor instantly moves to, and selects, the assigned field.

Global user keys are used to access settings that are not available on the current screen. Three global user keys are available: k1', k2', and k3'. (To use one of these keys, press **Shift**, then the user key.)

Local user keys are used to move between settings on the screen that is displayed. Five local user keys are available for each screen: k1, k2, k3, k4, and k5. You can assign these keys yourself, or use the factory preset assignments.

Displaying the Pre-assigned Local User Keys

1. Press the **Shift** key.
2. Press the **Assign** key (**k4**).
3. Press **Enter**. Now the factory preset keys are displayed.

Assigning a Local User Key

1. Move the cursor to the field you want to assign to a user key.
2. Press the **Shift** key.
3. Press the **Assign** key (**k4**).
4. Press the user key you want to assign to the field you chose. The number of the user key will appear beside the field when you move the cursor.

Assigning a Global User Key

1. Move the cursor to the field you want to assign to a user key.
2. Press the **Shift** key.
3. Press the **Assign** key (**k4**).
4. Press the **Shift** key.
5. Press the user key you want to assign to the field you chose. Global user keys are k1', k2', and k3'. The number of the user key does not appear beside the field when using global user keys.

To Release a User Key Assignment

Perform the same procedure for assigning a key, but instead of pressing the **Assign** key **(k4)**, press the **Release** key (**k5**).

Voltmeter

The Voltmeter is available in the Test Set, and can measure low level DC or AC voltages. The input to the Voltmeter is controlled by the **AF Anl In** field in the AF ANALYZER screen.

CAUTION Do not exceed the rated input to the Test Set for the DC Level and AC Level measurements. Refer to the specifications for input limits.

The connector best suited to making AC Level and DC Level measurements is the Audio In port.

Measuring AC Level and DC Level

1. Press **Shift**, then **AF Anl** to go to the AF ANALYZER screen.
2. Select **AF Anl In** and choose **Audio In**.
3. Select **Audio In Lo** and choose **Gnd**. This sets the Audio In Lo port to ground, which allows you to measure voltage at the Audio In Hi port.
4. Attach a probe (for example a 1:1 oscilloscope probe) to the Audio In Hi connector.
5. **AC Level** should be displayed. You may need to select **AF Freq**, and choose **DC Level** from the list of choices, if it is not already displayed.

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