# Service Guide

## Agilent Technologies
## 8712ET/ES and 8714ET/ES
## RF Network Analyzers


Agilent Technologies

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Agilent Techologies certifies that this product met its published specifications at the time of shipment from the factory. Agilent Techologies further certifies that its calibration measurements are tractable 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.

### Regulatory Information

The regulatory information is in the *User's Guide* supplied with the analyzer.

### Safety, Warranty, and Assistance

Refer to Chapter 9 for information on safety, warranty, and assistance.

## How to Use This Guide

**This guide uses the following conventions:**

(FRONT PANEL KEY): This represents a key physically located on the instrument.

 **Softkey** : This indicates a "softkey," a key whose label is determined by the instruments firmware, and is displayed on the right side of the instrument's screen next to the eight unlabeled keys.

Screen Text: This indicates text displayed on the instrument's screen.

**This guide contains servicing information for the following instruments:**

- 8712ET
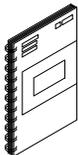- 8712ES
- 8714ET
- 8714ES

# 8712ET/ES and 8714ET/ES Network Analyzer Documentation Map
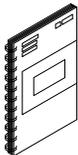
The **CDROM** provides the contents of all of the documents listed below.

The **User's Guide** shows how to make measurements, explains commonly-used features, and tells you how to get the most performance from the analyzer.
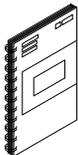
The **LAN Interface User's Guide Supplement** shows how to use a local area network (LAN) for programming and remote operation of the analyzer.

The **Automating Measurements User's Guide Supplement** provides information on how to configure and control test systems for automation of test processes.
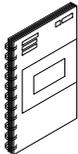
The **Programmer's Guide** provides programming information including GPIB and SCPI command references, as well as short programming examples.

The **Example Programs Guide** provides a tutorial introduction using BASIC programming examples to demonstrate the remote operation of the analyzer.

The **Service Guide** provides the information needed to adjust, troubleshoot, repair, and verify analyzer conformance to published specifications.

The **HP Instrument BASIC User's Handbook** describes programming and interfacing techniques using HP Instrument BASIC, and includes a language reference.

The **HP Instrument BASIC User's Handbook Supplement** shows how to use HP Instrument BASIC to program the analyzer.

The **Option 100 Fault Location and Structural Return Loss Measurements User's Guide Supplement** provides theory and measurement examples for making fault location and SRL measurements. (Shipped only with Option 100 analyzers.)

The **CATV Quick Start Guide** provides abbreviated instructions for testing the quality of coaxial cables. (Shipped only with Option 100 analyzers.)

The **Cellular Antenna Quick Start Guide** provides abbreviated instructions for verifying the performance of cellular antenna systems. (Shipped only with Option 100 analyzers.)

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# 1 Performance Checks

This chapter is divided into three parts:

- "Performing the Operator's Check" on page 1-3

- "Performance Test Software" on page 1-10

- "Specifications" on page 1-36

The operator's check can be used as a quick 80% confidence test. The only equipment required for this check is a type-N cable and a good quality 50Ω type-N load (75Ω for Option 1EC analyzers).

The performance tests will verify that the analyzer meets its published specifications with greater than a 95% confidence level. The performance tests require an external controller running HP BASIC and are completely automated.

The specifications provide a complete definition of the warranted and non-warranted characteristics of the analyzer.

# Performing the Operator's Check

The operator's check should be performed when you receive your instrument, and any time you wish to have confidence that the analyzer is working properly. The operator's check does not verify conformance to specifications, but should give you a high degree of confidence that the instrument is performing properly if it passes.

The operator's check consists of making the following measurements with the cable that was supplied with your analyzer:

| 8712ET/8714ET | 8712ES/8714ES |
|---|---|
| transmission | $S_{21}$ and $S_{12}$ |
| broadband power | broadband power |
| reflection | $S_{11}$ and $S_{22}$ |
| reflection[1] | $S_{11}$ and $S_{22}$[1] |

1.with a 50Ω or 75Ω load, instead of the cable

## Equipment List

To perform the operator's check, you will need the following:

- A known good cable such as the one that was supplied with your analyzer. The cable you use should have ≤0.5 dB of insertion loss up to 1.3 GHz, and ≤0.75 dB of insertion loss from 1.3 to 3.0 GHz.

- A known good load (>40 dB return loss) that matches the test port impedance of your analyzer such as one from calibration kit HP/Agilent 85032B/E (50Ω) or HP/Agilent 85036B/E (75Ω).

NOTE        The illustrations depicting the analyzer's display in this section were made using an 8714ET. Other models' displays will have minor differences in annotation.

# Make a Transmission (or S21 and S12) Measurement(s)

1. Connect the equipment as shown in Figure 1-1. Use a known good cable such as the one that was supplied with your analyzer.

| NOTE | The quality of the cable will affect these measurements; make sure you use a cable with the characteristics described in "Equipment List" on page 1-3. |
| --- | --- |

**Figure 1-1**    **Equipment Setup for Performing the Operator's Check**
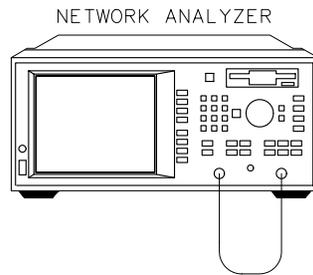


2. Press (PRESET) (SCALE) (.1) **Enter** .

3. Press (POWER) (0) **dBm** .

4. Press (CAL) **Default Response** .

5. Verify that the data trace falls within ±0.5 dB of 0 dB. See Figure 1-2 for a typical 8714 result. The 8712 should look similar, but will end at 1300 MHz.

**Figure 1-2**     **Verify Transmission (or S$_{21}$ and S$_{12}$) Measurement**



```
 ▶1: Transmission      Log Mag   0.1 dB/  Ref   0.00 dB
 ▷2: Off

     dB
      .4
      .3
      .2
      .1
Ch1▶
     -.1                                                    1
     -.2
     -.3
     -.4
     Abs
     Start 0.300 MHz              Stop 3 000.000 MHz
```

± 0.5

po653b_c
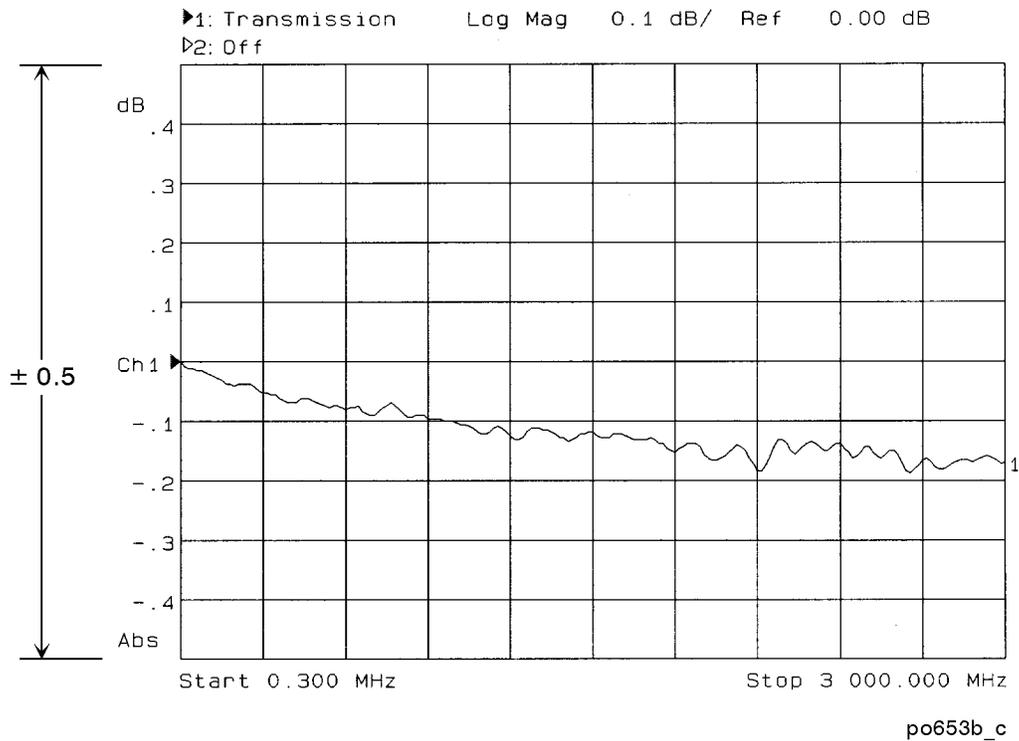
**Perform the following steps on ES model analyzers only.**

6. Press (MEAS 1) **S12 Rev Trans** .

7. Press (CAL) **Default Response** .

8. Verify again that the data trace falls within ±0.5 dB of 0 dB. See Figure 1-2.

# Make a Broadband Power Measurement

1. Leave the cable connected to the analyzer as shown in Figure 1-1.

**NOTE**     The quality of the cable will affect these measurements; make sure you use a cable with the characteristics described in "Equipment List" on page 1-3.

2. Press `MEAS 1`.

3. If **Power** is not displayed, press **More** .

4. Press **Power** `FREQ` **Start** `10` **MHz** `SCALE` `1` **Enter** .

5. Press `POWER` `0` **dBm** .

6. Verify that the data trace is within ±2 dB of 0 dBm. See Figure 1-3 for a typical 8714 result. The 8712 should look similar, but will end at 1300 MHz.

**Figure 1-3**          **Verify Broadband Power Measurement**
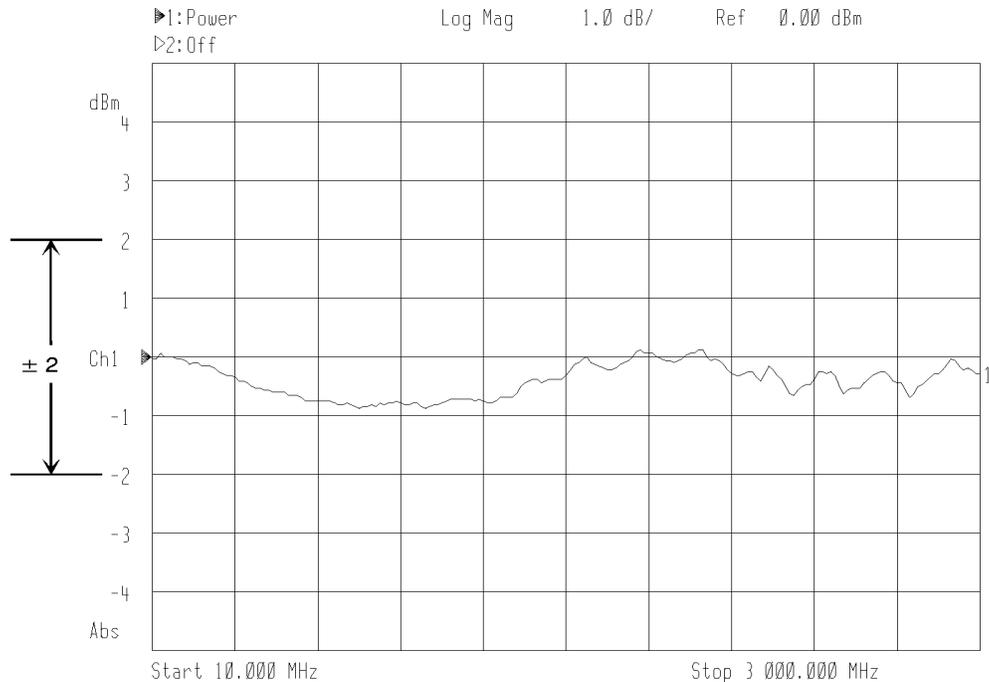


pp638es

# Make a Reflection (or S11 and S22) Measurement with a Cable

1. Leave the cable connected to the analyzer as shown in Figure 1-1.

| NOTE | The quality of the cable will affect these measurements; make sure you use a cable with the characteristics described in "Equipment List" on page 1-3. |
|---|---|

2. Press (PRESET) (MEAS 1).

3. For ES models, press **S11 Refl Port1** .
   For ET models, press **Reflection** .

4. Press (SCALE) (10) **Enter** .

5. Press (POWER) (0) **dBm** .

6. Press (CAL) **Default 1-Port** .

7. Verify that the data trace falls completely below –16 dB. See Figure 1-4 for a typical 8714 result. The 8712 should look similar, but will end at 1300 MHz.

   **Figure 1-4     Verify Reflection (or S$_{11}$ and S$_{22}$) Measurement**
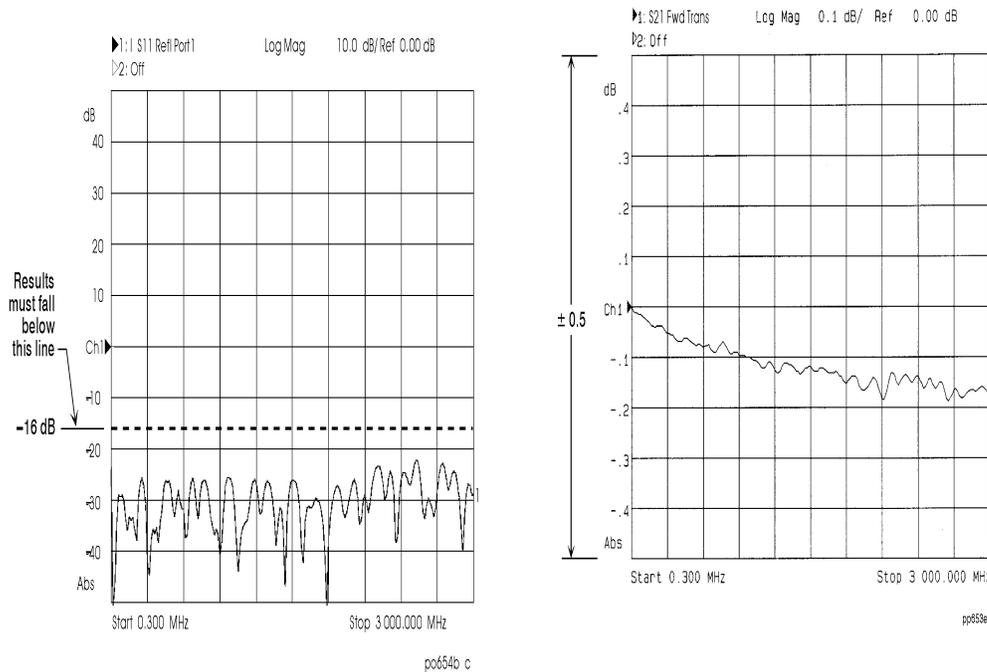


Perform the following steps on ES model analyzers only.

8. Press (MEAS 1) **S22 Refl Port2** .

9. Press (CAL) **Default 1-Port** .

10. Verify again that the data trace falls completely below –16 dB. See Figure 1-4.

# Make a Reflection (or S11 and S22) Measurement with a Load

1. Disconnect the cable and connect a known good load to the RF OUT/PORT 1 test port as shown in Figure 1-5.

   **Figure 1-5        Connect the Load**
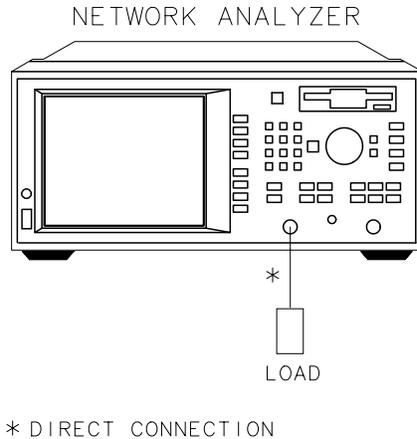
   

2. For ES models, press `MEAS 1` **S11 Refl Port1** .

3. Verify that the data trace falls below −30 dB. If the data trace is off the screen, press `SCALE` **Reference Level** and the key until the trace moves up onto the screen.

**Perform the remaining steps on ES model analyzers only.**

4. Disconnect the load from PORT 1 and connect it to PORT 2 as shown in Figure 1-6.

   **Figure 1-6        Connect the Load to Port 2 (ES Models only)**
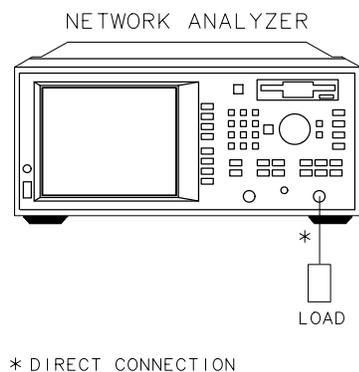
   

5. Press `MEAS 1` **S22 Refl Port2** .

6. Verify that the data trace falls below −30 dB. If the data trace is off the screen, press `SCALE` **Reference Level** and the key until the trace moves up onto the screen.

This concludes the operator's check. However, further confidence can be obtained by performing the following:

- Measure a known filter to verify that its measured response is the same as is expected. (A 175 MHz filter is supplied with the analyzer.) Verify both the frequency accuracy and noise floor.

- Check broadband response with the filter using conversion-loss mode (same as B*/R*).

- If the analyzer's frequency accuracy is critical for your application, verify a CW frequency using a frequency counter. Verify to ±.005% accuracy (for example, ± 2500 Hz at 500 MHz). Ensure that the analyzer is placed in trigger-hold mode (press (MENU) **Trigger** **Hold** ) to measure frequencies.

## If the Analyzer Fails the Operator's Check

First, repeat the operator's check using a different cable and load to eliminate these as a possible cause of failure. Second, if the floppy disk from the factory labeled "Correction Constants" is available, reload the "Correction Constants" (CCs) per Chapter 8, "Correction Constants and Firmware." (The floppy disk was shipped with the instrument from the factory.) Then repeat the Operator's Check.

If your analyzer does not meet the criteria in the operator's check, your analyzer may need adjustment or servicing. Contact any Agilent Technologies sales or service office for assistance. Refer to Table 9-1 on page 9-7 for the nearest office. Before shipping your analyzer, fill out and attach the blue repair tag, located at the back of this manual.

# Performance Test Software

The performance test software provides automated tests for verifying that the analyzer meets its published specifications with greater than a 95% confidence level. The performance test software must be run on an external controller running HP BASIC (the analyzer's internal IBASIC cannot be used). The performance tests can be considered a check of the overall calibration of the instrument. Unlike the adjustments described in Chapter 2, the performance test software only checks the performance of the analyzer. No changes are made to the calibration constants stored in the instrument. When a performance test fails, usually one or more adjustments should be performed to attempt to improve the performance before repairing or replacing hardware.

Results of the automated performance tests can be printed out at any time. They include all specifications, limits, and uncertainties. Although no manual tests are provided, each of the automated tests is described in enough detail to allow a knowledgeable technician to perform all needed tests in an accurate manner. See "Performance Test Notes and Descriptions" on page 1-23.

The printed test results list uncertainties for each measurement. These uncertainties are for reference only, and are not taken into consideration when making pass/fail determinations. The listed uncertainties do not depend on the level of the measured signal; they assume a signal at the specified level. Generally, uncertainties assume published specifications for all instruments and devices. For the 110 dB step attenuator and the 20 dB fixed attenuator, device-specific calibration data is required.

Performance test record cards are not provided; the printed results of the automated performance testing serve as the test record for this product. See " **PRINT RESULTS** " in "Using the Program" on page 1-19 for details on pass/fail indications for individual tests. When a test report contains no "FAIL" indicators, an analyzer is considered to have passed the performance tests.

Many instrument users require a periodic, documented check of instrument performance. This is usually referred to as a "periodic calibration." Successful completion of the performance tests (no "FAIL" indicators) should suffice for the requirements of a periodic calibration. Do not confuse the term "periodic calibration" with the terms "user calibration" or "default calibration" which both refer to measurement calibrations utilized by operators when measuring devices with the analyzer.

## Required Software and Controller

The performance test software is written for an HP 9000 Series 200, 300, or 700 workstation (or equivalent), running HP BASIC 5.1 or greater. There is also a version available to run on a PC under HP BASIC for Windows with a GPIB interface card. Operation is essentially identical to that described for an HP workstation computer.

| | |
|---|---|
| NOTE | To order the performance test software, contact the nearest Agilent Technologies sales or service office listed in Table 9-1 on page 9-7. The workstation version is HP part number 08714-10001 (LIF format). The PC version is HP part number 08714-10002 (DOS format), and requires HP BASIC for Windows (HP model number E2060B), and a GPIB interface card. |

The performance test software automates all the performance verification tests for the 8712ET/ES and the 8714ET/ES. It will test all option combinations, including both 50Ω and 75Ω versions.

| | |
|---|---|
| NOTE | This program cannot be used to test an HP/Agilent 8711A, any HP/Agilent 871xB, or any HP/Agilent 871xC. To test an HP/Agilent 8711A, order HP part number 08711-10011. To test an HP/Agilent 871xB, order HP part number 08712-10011. Both of these programs are in LIF format only. To test an HP/Agilent 871xC, order HP part number 08712-10017 (LIF format) or 08712-10018 (DOS format). |

| | |
|---|---|
| NOTE | All the data files and configuration files used in this program are compatible with the previous 871xB and 871xC versions of this program. It is not necessary to regenerate or modify any of these files. If you are adding this program to the same directory as the 871xB/C software, only the main program file (CAL871XE) need be transferred. |

The performance test software is provided on a single disk. You can run the program directly from the disk, although it is recommended that you run it from your system's hard disk for best performance. Generally, the program can be stopped, reset and re-run with little or no loss of data. The LIF version program will operate on a LIF-based system, or an SRM/HFS environment. The DOS version is limited to DOS environments.

Operation is a simple menu driven system with some softkey selections. For ease of use, the ⟨Return⟩ / ⟨Enter⟩ / ⟨Execute⟩ keys on your computer's keyboard can always be used as softkey #1—the most frequently used key.

| | |
|---|---|
| NOTE | All necessary instructions and test setup diagrams are contained within the program. |

A disk file is generated for each analyzer, and the results of each test are stored in that file. This file is updated after each test so that results will not be accidentally lost. A printout can be obtained for any previously tested analyzer.

## Estimated Time

Before running the performance tests, turn on the analyzer and allow it to warm up for one hour. Performance test times are kept to a minimum, allowing analyzers to be fully tested within one to two hours after the initial warmup.

# Equipment

In addition to a computer, printer, RF cables, BNC cables, GPIB cables, and adapters, Table 1-1 lists the equipment that is required to test and adjust the analyzer.

**Table 1-1  Required Equipment for Performance Tests**

| Description | HP/Agilent Model # | 50$\Omega$ STD | 75$\Omega$ | Notes |
|---|---|---|---|---|
| Function generator | 8116A or 33120A | ✓ | ✓ | No substitute. (The 8116A is preferred.) |
| Power meter | 437B, 438A E4418A or E4419A | ✓ | ✓ | Do *not* use an 436A. |
| Power sensor, 50$\Omega$ | 8482A | ✓ | ✓ | |
| Power sensor, 75$\Omega$ | 8483A | — | ✓ | |
| Cal kit type-N 50$\Omega$ | 85032B Opt 001[1] | ✓ | — | |
| Cal kit type-N 75$\Omega$ | 85036B | — | ✓ | |
| External 110 dB step attenuator | 8496A/G | ✓ | ✓ | |
| Attenuator/switch driver | 11713A | ✓ | ✓ | Needed only if using an 8496G programmable 110 dB step attenuator. |
| Spectrum analyzer | 8560 series, 8566B | ✓ | ✓ | Others may be substituted.[2] |
| 20 dB attenuator 50$\Omega$ | 8491A/B/C Opt 020 | ✓ | — | |
| 20 dB attenuator 75$\Omega$[3] | 0955-0768 | — | ✓ | |
| 6 dB attenuator 50$\Omega$ | 8491A/B/C Opt 006 | ✓ | — | |
| 3 dB attenuator 50$\Omega$ | 8491A/B/C Opt 003 | ✓ | — | |
| 3 dB attenuator 75$\Omega$ | 0955-0765 | — | ✓ | |
| Power splitter, 50$\Omega$ | 0955-0751,11667A | ✓ | — | |
| Power splitter, 75$\Omega$ | 0955-0752 | — | ✓ | |
| Minimum loss pad (quantity: 2) | 11852B | — | ✓ | |
| Precision cable 50$\Omega$ | 8120-8862 or 8120-6469 | ✓ | — | |
| Precision cable 75$\Omega$ | 8120-8898 or 8120-6468 | — | ✓ | |

1. An 85032B Option 001 is a subset of the standard 85032B. This option eliminates four 7-mm adapters that are not needed, resulting in a significant cost savings.
2. The spectrum analyzer used must be compatible with the 8566B, both in the GPIB commands for the basic remote control functions and in frequency accuracy. Any of the 856x series is acceptable, the 8560E is the least expensive. The 859x series is not acceptable because of the marginal frequency accuracy.
3. The 75$\Omega$ 20 dB attenuator can be substituted with two minimum loss pads and a 50$\Omega$ 10 dB attenuator. NOTE: a set of 75$\Omega$ attenuators (3,6,10,20 dB) is available as 86213A.

# File Structure

The program disk contains several different files in addition to the main program file. The following list describes the files found on the performance test software disk.

**CAL871XE**     This is the main program file.

**Cfg_xxxx**     This is the configuration file. The variable xxxx represents any user-defined name or Dflt (default). This file contains all the configuration set-ups for the program such as:

- file directories and paths
- test equipment serial numbers
- GPIB addresses
- types of test equipment
- other optional choices

If more than one configuration file exists on the disk, the program will prompt you to select a specific configuration file to load. If none exists, the program will create a default file.

**P1D_xxxx**     The cal factor file for the HP/Agilent 8481D sensor. The variable xxxx represents the last four digits of the HP/Agilent 8481D or HP/Agilent 8484A sensor's serial number.

**P2A_xxxx**     The cal factor file for the HP/Agilent 8482A sensor. The variable xxxx represents the last four digits of the 8482A sensor's serial number.

**P3A_xxxx**     The cal factor file for the HP/Agilent 8483A sensor. The variable xxxx represents the last four digits of the 8483A sensor's serial number.

**Stp_xxxx**     The actual attenuation values for the external 110 dB step attenuator. The variable xxxx represents the last four digits in the attenuator's serial number. Attenuator values are measured at 30 MHz on an accurate system (such as an HP/Agilent 8902A Option 050).

**Pd5_xxxx**     The actual value of the 20 dB 50Ω attenuator as measured by an accurate system. Values are attenuation versus frequency. The variable xxxx represents the last four digits in the attenuator's serial number.

**Pd7_xxxx**     The actual value of the 20 dB 75Ω attenuator as measured by an accurate system. Values are attenuation versus frequency. The variable xxxx represents the last four digits in the attenuator's serial number.

**dxxExxxx**     The data file that holds the analyzer's test results. The variable xxxx represents the last four digits in the analyzer's serial number. The file "d2TExxxx" holds data for an 8712ET, "d4SExxxx" for an 8714ES.

**CurEDUTx**     The data file that holds the test results of the most recently tested analyzer regardless of model or serial number. The variable x can represent any character 0 to 9.

**INSTALL**    This program is not necessary but can help speed the installation of the LIF version program. It automatically copies the required files into the desired location.

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NOTE    Several data files are present on the disk with the "xxxx" suffix. These are default files that allow operation of the program *without* correction factors. The values in these file are nominal values. For example: 100 percent for all sensor cal factors; 20 dB for the 20 dB attenuators; 10.00, 20.00, 30…dB for the external step attenuator, and so on. This is provided as a convenience only to demonstrate or learn about the program. The default configuration file will access these files if no user-defined serial number is specified. A warning message will be displayed if the program is using these default files.

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## Configuration File

The configuration (config) file is the file that customizes this program for your usage. It contains specific information for your setup. Some of the items contained in this file include:

- the GPIB addresses of all the test equipment

- the GPIB address of the analyzer under test

- the model numbers of the test equipment

- the serial numbers of sensors, fixed attenuators, and the external 110 dB step attenuator

- the disk drive locations (path and directories)

- other items specific to your setup

Ideally, only one configuration file should exist on the program disk so that the program will automatically load only that file. However, it is possible to have several configuration files stored on the same disk. In this case, the program will list all of the available files and prompt you to select one. This is useful if more than one setup is commonly used or if one performance test software disk serves several workstations.

## Getting Started

| | |
|---|---|
| CAUTION | Make a copy of the performance test software disk for day-to-day use. The master copy should remain stored in a safe place. This will decrease the likelihood of damage to the master disk. |

| | |
|---|---|
| NOTE | The DOS version, which is used in conjunction with HP BASIC for Windows, requires the proper setup of the GPIB interface card and drivers. This document assumes that users are familiar with HP BASIC for Windows, that it is running, and that it has been properly installed and configured. |

First, find all serial numbers of the calibration devices required, such as external step attenuators, sensors, and fixed attenuators for both 50Ω and 75Ω devices (if applicable). Verify the GPIB addresses you will be using, as well as the mass storage directories and locations.

If you plan to operate this program only from the supplied floppy disk, insert the disk into the computer's disk drive and skip step 1 next.

## Performance Test Software Installation

1. To install this program to the hard drive, either copy all files (except "INSTALL") to the hard drive, or load and run the "INSTALL" program. The INSTALL program will automatically copy all required files to your specified destination drive or directory (HFS, SRM or LIF format). The INSTALL program is only contained in the LIF software version.

| | |
|---|---|
| NOTE | Any directory name used must be less than 80 characters long, and preferably less than 60 characters, for best visibility. |

2. Set the computer's "Mass Storage Is" (MSI) command to the directory or drive location of the main program file (CAL871XE).

3. GET and RUN the CAL871XE program. The program will display the initial screen with the software part number, revision date and current time/date. If the current time or date is incorrect, select the **SET TIME** softkey to set it.

4. Press **RESUME** . Remember that the (Return) key can also be used as softkey #1.

5. Press **CONFIG** to enter the configuration screen.

   This menu allows you to enter all the specific information that pertains to your particular configuration (such as test equipment, addresses, and serial numbers). The configuration file's selection descriptions and their initial default values are listed below.

## Configuration Menu

In this section, the default values for the parameters listed in **bold** type appear in parenthesis.

**The analyzer's GPIB address (716).** The first selection is the analyzer's (DUT) GPIB address. Please note that this is the only address that has both the Interface Select Code (ISC) and the device number associated with it. This address can be any valid address with any valid ISC. The ISC does *not* have to be the same as all the other test equipment (which must be all on the same ISC). Generally the full address for the DUT is set to either 716 or 816. This also sets the ISC to 7 or 8 respectively. The factory default GPIB device address for the analyzer is 16.

**The ISC for the test equipment (7).** This selection is the ISC for all the associated test equipment. This is generally 7 or 8 and may be the same as that for the DUT.

**The power meter model number (437B) and address (13).** These two selections are for the power meter model number and address.

| CAUTION | The program will accept the 436A power meter as a valid selection, but it is not recommended or supported and may cause the program to halt execution. |
| --- | --- |

**The spectrum analyzer (8566B) and address (18).** This is the spectrum analyzer selection. Any of the listed models will suffice, but keep in mind that if you do not use a frequency counter, then the spectrum analyzer must have high degree of frequency accuracy since it will be used as the frequency counter.

**The function generator model number (8116A or 33120A) and address (14).** This selection is for the function generator and address. The 8116A is the only valid selection at this time.

**The attenuator switch driver model number (11713A) and address (28).** Next is the attenuator switch driver selection and address. At this time, the only two choices are the 11713A and "NONE". If "NONE" is selected, the program will prompt you to manually set the external 110 dB step attenuator each time it needs to be changed. Since this is inconvenient, the use of an 11713A with a 8496G model attenuator is highly recommended.

**The frequency counter model number (5342A) and address (02).** The frequency counter model number and its address are next. If "NONE" is selected, the program will use the spectrum analyzer to measure frequency accuracy.

**The voltmeter model number (3456A) and address (22).** This selection is not currently used by this program.

**The printer address (01).** The printer address is next. No model number is needed here; all GPIB printers should work equally well. For the DOS version, entering any valid number except 10 will direct the output to the attached GPIB printer. Selecting an address of 10 will redirect the output to the defined Windows default printer. Typically this will be a printer attached to the computer's parallel port or a networked printer. On the DOS version (HP BASIC for Windows), the default address is set to 10.

**The program directory and the mass storage unit specifier (the current MSI device).** The program directory and Mass Storage Unit Specifier (MSUS) are next. These should point to the location of the CAL871XE program and all of its required data files (all the files contained on the disk). If you are running this program from a floppy disk, the program directory entry should be blank. If using an HFS or SRM system, the entire directory name should be entered here (e.g. /TESTS/ANALYZER/NETWORK/8712E). The entire length must be less than 80 characters (preferably less than 60 for easier viewing). The MSUS, which indicates the physical address of the disk drive, also has an 80-character limit. For the DOS version, this is typically just the drive letter (for example, C:). When the program is first run, the default will be the current MSI device.

**The data directory and MSUS.** The next two entries are the data directory and MSUS. These should point to the location where the results of each DUT will be stored (if applicable). The data directory and MSUS are otherwise similar to the program directory, including the defaults.

**The sensor's, external 110 dB step attenuator's, and fixed attenuator's (pad's) serial numbers (xxxx).** Six of the next seven entries will contain the *last four* digits of the serial numbers for the power meter sensors, the step attenuator, and the 20 dB attenuators. This allows the program to load the proper correction values for each device.

The disk contains files that match these default serial numbers (xxxx), but the correction data contained within these files is invalid (e.g. 100 percent for all sensor cal factors). This allows the program to be run for experimental or training purposes only. As a precaution, a warning message will be displayed if a default file is loaded.

**The step attenuator's 40 dB card selection (3).** This selection is choice of the 40 dB step section. The 8496G step attenuator contains one 10 dB section, one 20 dB section, and two 40 dB sections. This selection specifies which of the two 40 dB attenuator card sections of the 8496G step attenuator is to be used; section 3 or 4. Enter the value (3 or 4) for which you have calibration data.

For example, when the step attenuator was calibrated, one of the two 40 dB sections was selected for the 40, 50, 60, and 70 dB attenuation value. The data corresponding to the selected 40 dB section must be input to ensure valid measurement data when using attenuations of 40 dB or greater. For purposes of identification, section 3 of the attenuator is the section that is engaged when button #3 or #7 of the 11713A is lit.

This entry is not applicable if you are using a manual attenuator.

**The beeper (on).** The last selection will suppress or enable the beeper, as desired.

**The current DUT file suffix (1).** This file, "CurEDUTx," contains the test-result data of the current device under test. Up to ten different file names can be specified. This allows multiple users to operate from one system storage medium, such as an SRM environment. This entry can be ignored for single-user applications.

## Config file and cal data generation.

1. Once all desired changes have been made, the program will ask if you want to store the data just entered. A specific 4-character file name suffix can be provided if more than one configuration is required. Leaving the file name blank will result in the default file name of "Cfg_dflt." If the program finds only one config file, that file will be loaded automatically. If more than one is discovered, the program will list the file names found and allow you to choose one. At this point the program will also ask you if a hardcopy printout is desired.

2. After the config file has been generated, the proper data files containing the correction values must be generated. Press   **CAL DATA ENTRY**  . You will be shown a list including:

   • 3 sensors

   • an external 110 dB step attenuator

   • two 20 dB attenuators (pads)

   You will need to enter the correction data for every piece of test equipment included in this list that you will be using to test the analyzer. Select the desired item.

**Sensors.** All sensors require both frequency and cal factor data. Frequencies must always be in MHz and cal factors in percent. The first entry requested will be the last four digits of the serial number. The computer will search for a current configuration file containing this information. If one is present, the program will query you to either view or edit the old values.

Assuming you are editing the data, the 50 MHz reference cal factor will be requested next. This value must use percent as its units and be within the range of 50 and 150 percent.

After the cal factor is entered, the program will request that all frequency/cal factor pairs be entered. Any frequency entered must be greater than zero. You must start with the lowest frequency for which you have data and sequentially enter higher frequencies until done. Each entry must consist of both a frequency in MHz and the cal factor in percent, separated by a comma (e.g. 500, 98.6). Each frequency entered must be higher than the previous entry. These cal factor values must be between 75 and 125 percent.

---

| TIP | If a mistake is made, you can back up one entry and re-enter a value by entering a negative frequency. If you accidentally enter only the frequency (instead of a frequency/cal factor pair), the computer will wait for the cal factor to be entered; however the only prompt will be a "?". |
|---|---|

---

Each entry is shown on the CRT. When all entries are completed, enter "0,0" to exit the data entry portion of the program. At this point the program will redisplay all of the values entered and ask if you want to store them. (Check to make sure there are no entries for a zero value frequency.)

| TIP | Even if you find a mistake, it will be easier to answer yes, then go back and re-edit the values. Otherwise you will have to re-enter all of the values again. |
|---|---|

**20 dB Attenuators (Pads).** A procedure similar to the sensor data entry procedure is used to enter the frequency/attenuation values for the 20 dB attenuators. Valid entries for the 20 dB attenuator range from 17.5 to 23.5 dB with all frequency entries being greater than zero.

**External 110 dB Step Attenuator.** Step attenuator data is only measured at 30 MHz so only one value needs to be entered for each nominal attenuation step. All values are relative to the 0 dB setting, which is defined as zero (i.e. the program does not care about insertion loss at the 0 dB setting).

Valid entries are within 3 dB of the nominal attenuation setting with all entries being greater than zero. The program will request data up to 110 dB of attenuation.

# Using the Program

| NOTE | Remember that the (Return) / (Enter) / (Execute) key on your computer's keyboard can be used as softkey #1. |
|---|---|

When the program is first run, the initial information screen is presented. This contains the program name, revision number, date and other miscellaneous information. You are presented with four softkey choices: **RESUME** , **SET TIME** , **HELP** , and **EXIT** .

**SET TIME** allows you to set the time and date. If the date has never been set, the program will force you to enter it regardless of whether or not this softkey is pressed.

**HELP** will present some very brief instructions and other information.

**EXIT** will terminate the program.

**RESUME** will continue execution of the program and proceed to the main menu.

## Main Menu

The main menu provides seven softkey choices. An eighth choice may be displayed if you are returning to this menu from the test selection menu.

**CONFIG** allows you to define a particular configuration of test equipment, mass storage, and GPIB addresses. This selection is described earlier in "Configuration File" on page 1-14.

**LOAD CONFIG** allows you to select one of several configurations to choose from. If only one is available, it is automatically loaded without further confirmation. If several are available, you are instructed to select one.

**CAL DATA ENTRY** allows you to enter correction factors for sensors, attenuators and attenuators. See "Configuration File" on page 1-14.

`PRINT RESULTS` allows you to print or view test results from the current DUT or any previously tested analyzer, assuming the data was archived. You can also add comments or correct any header information that was previously entered.

Printed test results have a "pass/fail" column for indicating the outcome of each part of each test. The possible outcomes are

| | |
|---|---|
| **PASS** | Applies to a warranted specification. The test has passed. |
| **FAIL** | Applies to a warranted specification. The test has failed. |
| **Not Tested** | Indicates the test was performed, but the result was not checked. This is usually due to limited capability of the test equipment. |
| **No Spec** | Applies to a nonwarranted characteristic or typical parameter. The test result is satisfactory (within the indicated limits). |
| **No Spec\*** | Applies to a nonwarranted characteristic or typical parameter. The test result is marginal (outside the indicated limits). If the result is substantially outside the limit, there may be cause for concern about the proper operation of the analyzer. |

`NEW DUT` will appear only after an analyzer has been tested. This softkey must be selected *before* you begin to test another analyzer.

| | |
|---|---|
| NOTE | This is the only way that the program can tell that the analyzer under test has changed. Once selected, this softkey selection will disappear, indicating that the program is ready to search for a new analyzer model/serial number. |

`GPIB Addr's` will display the current expected addresses of all required test equipment. In addition it will allow you to check each listed address for the presence of an active device. It will not indicate which device is set to which address. It only indicates whether or not the device at a given address is capable of handshaking properly. `EXIT` returns to the previous menu.

`RESUME` will continue the program and look for an analyzer at the specified address. Make sure that the power is switched on and that the GPIB cable is connected before pressing `RESUME`.

Once the program finds the analyzer, the serial number is interrogated and the disk is searched for any previous test results. If none are found, a message is displayed and you are then allowed to enter any pertinent data regarding this new DUT such as owner, technician, repair order, comments etc. The test selection menu is then presented.

## Test Selection Menu

The test selection menu can be divided into three main categories:

- eleven automated analyzer performance tests

- four utility procedures

- two external broadband detector performance tests (HP/Agilent 86200B or 86201B)

Data for each of the eleven performance tests is archived upon completion.

The four utility programs are described as follows:

1. **Set Serial Number** utility allows you to enter a serial number into the analyzer. This may be required after some types of repairs.

CAUTION     *Enter the number carefully*; it cannot be easily changed once it has been entered. If a mistake is made, it will be necessary to contact an Agilent Technologies service center for correction.

2. The **Step Attenuator Test** is a cyclical stress test designed to show any weakness in the mechanical (and therefore, electrical) integrity of the built-in attenuator. (The attenuator is standard equipment on ES models and is supplied as Option 1E1 on ET models.) For each cycle, the attenuator card is switched in and out with each resulting trace measured. Minimum and maximum excursions are then noted. The test is performed at a low frequency and a high frequency. The number of cycles is selected by the user. A minimum of twenty-five is recommended. One hundred cycles will take about five to ten minutes depending upon computer speed. There is no pass/fail indication but trace variances of more than 0.1 dB should warrant further investigation or increased monitoring for signs of wear.

3. **Measure Step Attenuator** (external) is a utility file that uses a power meter to measure the actual insertion loss at 30 MHz for the 110 dB step attenuator. This routine should only be used as a last resort if no other method of obtaining data is available. Generally the attenuator should be measured using one of the following methods:

- sending the device to a calibration standards lab

- measuring the device with an 8753D with full two-port correction

- measuring the device with an 8902A Option 050

4. **Measure 20 dB Pad** is similar to the **Measure Step Attenuator** utility, but is used for characterizing the 20 dB pad.

NOTE     The listed uncertainties shown on the test results assume that one of these three choices was used and *not* the built-in routine, which has a much higher degree of uncertainty.

The detector performance tests consists of an absolute power accuracy test and a frequency response test as described in the *HP/Agilent 86200B/86201B RF Detectors User's and Service Guide*. These tests are only for testing these two specific detector models. Archiving of data is not done for these tests.

## Additional Information

The program gives full step-by-step instructions along with connection diagrams. For clarity, some of the required adapters may not be depicted in the connection diagrams. Generally, solid connection lines between devices indicate a cable connection, where as a dotted line indicates a direct connection (adapters may be required). All required equipment should be connected and switched on before proceeding with any test, since the program will occasionally need to write to a device before it is shown in the connection diagram. If the device is not connected, the program will time-out before the connection diagram is drawn. The time-out limit is set to 30 seconds for all devices. If the program should stop for any reason, the computer may be reset and the program run again with little or no loss of data (if a SCRATCH C is *not* performed).

## Performance Test Notes and Descriptions

The test descriptions explain how each test is performed in case it is necessary to perform them manually without the automated test software. They are also provided to give automated test users a general idea of what each test measures and how it is performed under computer control.

Before running or manually performing the performance tests, turn on the analyzer and allow it to warm up for one hour.

The performance tests relate to the analyzer's specifications, listed in Table 1-6, Table 1-7, Table 1-8 and Table 1-9 in "Specifications" starting on page 1-36. Each value listed in these tables is classified as a "specification," a "characteristic," a "nominal," or a "typical." If you are using the automated software, you can print the test results to indicate the outcome of each test. See " **PRINT RESULTS** " in "Using the Program" on page 1-19 for an explanation of pass/fail information.

| NOTE | The numbers preceding each of the tests in this section correspond to the test number in the automated performance tests. |
|------|--------------------------------------------------------------------------------------------------------------------------|

## PT01: Frequency Accuracy

This test measures the frequency accuracy of the output of the analyzer.

**Test Process.** Set the analyzer to several CW frequencies while in trigger-hold mode. Connect a frequency measuring device to the output of the analyzer. The device used to measure the frequency can either be a frequency counter or a spectrum analyzer with a high degree of frequency accuracy. If the network analyzer under test has Option 1EC (75Ω system impedance and connectors) a minimum loss pad will be required in order to connect a 50Ω frequency counter or spectrum analyzer.

**Specification Verified.** This test verifies the "Test Port Output: CW Accuracy" specification in Table 1-8  starting on page 1-57.

**If This Test Fails.** Failures of this test are rare. If this test should fail by a small amount, adjust the reference crystal oscillator by performing the "Frequency Accuracy Adjustment" on page 2-5. If it fails by a significant amount, and the A3 fractional-N/reference assembly's 10 MHz reference output is accurate, suspect excessive noise on the RF output of the source.

## PT02: Gain Compression

This test measures narrowband gain compression at or near the maximum rated input levels for the analyzer.

**Test Process.** Set the power output to the lesser of +10 dBm or the maximum value for the analyzer's model and option configuration. Set the system bandwidth for narrow (250 Hz). Perform an enhanced-response calibration for a transmission measurement. Measure transmission on a through cable over the full frequency range of the analyzer. Insert a 20 dB fixed attenuator and measure transmission again. The difference is compared to the known insertion loss of the calibrated 20 dB fixed attenuator to determine gain compression. Gain compression must be less than the limit stated in the specification.

This test process is performed once for an ET model analyzer and twice for an ES model (both forward and reverse directions).

**Specification Verified.** This test verifies the "Test Port Input: Maximum Input Level" specification in Table 1-9 starting on page 1-63. In some cases, the test must be performed at a power level less than the +10 dBm level indicated in the specification.

**If This Test Fails.** If this test fails, replace the PC board on the A5 receiver assembly.

### PT03: Noise Floor

This test makes transmission (ratioed) measurements to determine the noise floor for both narrowband and broadband measurements.

**Test Process.** Preset the analyzer and set the power level to 0 dBm. Set the system bandwidth to Fine (15 Hz). Set the averaging factor to 4 and enable averaging. Connect loads to both test ports. Perform a Response and Isolation calibration. The peak value for a given measurement trace is considered to be the level of noise floor. For ES models repeat the test for an S12 measurement.

Repeat the test process above for a conversion loss measurement (without the Response and Isolation calibration). This will measure the broadband noise floor.

**Specification Verified.** This test verifies the "Test Port Input: Noise Floor" specification in Table 1-9  starting on page 1-63. (The measurement process defined above is considered to be equivalent to the measurement process described in the specification's footnote.)

**If This Test Fails.** First verify that all cable connections and screws are secure, then perform the "Switched Gain Correction, Adjustment #102" on page 2-10.

## PT04: Dynamic Accuracy

This test measures narrowband ratio measurement accuracy over a range of power levels at 30 MHz. A 110 dB step attenuator is needed—typically an 8496A or 8496G is used. Two minimum loss pads must be used with a 75Ω analyzer (Option 1EC).

**Test Process.** Connect the step attenuator between the test ports on the analyzer. Set the CW frequency to 30 MHz and select fine system bandwidth (15 Hz). Set the power to 0 dBm for 50Ω analyzers and to 13 dBm for 75Ω analyzers. Record the transmission (or S21) readings for attenuator settings from 0 dB through 90 dB, in 10 dB increments. Apply the correction factors for the attenuator setting for each reading before checking against the specification. The reading at –20 dB should be used as the reference power. Use averaging, if necessary, to improve the test results. For ES models, repeat the test for S12 measurements.

**Specification Verified.** This test verifies the "Test Port Input: Dynamic Accuracy" specification in Table 1-9  starting on page 1-63. It checks the magnitude accuracy, but not the phase accuracy.

**If This Test Fails.** First, perform the "Switched Gain Correction, Adjustment #102" on page 2-10. If the problem persists, suspect calibration errors in the step attenuator used to perform this adjustment; see "The step attenuator's 40 dB card selection (3)" on page 1-17. Crosstalk can also affect this test; verify that all cables and screws are secure.

## PT05: Power Flatness

This test checks the maximum variation in output power across the frequency range of the analyzer.

**Test Process.** Connect a calibrated power sensor to the RF OUT/PORT 1 test port. Determine the power levels to test:

1. Refer to "Test Port Output: Power Sweep Ranges" in Table 1-8  starting on page 1-57.

2. Find the entry for the model and option configuration of the analyzer under test.

3. In the "Attn = 0 dB" column of the table, the power sweep range is defined in the form "$n$ to Pmax". Use $n$ as one power level to measure, use Pmax as another power level to measure, and use the midpoint between the two as the third power level to measure.

4. If the analyzer under test is an ET model with Option 1E1, or an ES model, then also use a midpoint power level from each of the following three columns: "Attn = 10 dB", "Attn = 20 dB" and "Attn = 30 dB".

5. For each separate power level, record the reading on the power meter at 27 different frequencies, across the frequency range of the analyzer. Correct the power readings using the frequency flatness data for the power sensor. The difference between the max and min values for the 27 readings should be within the specified flatness limit as stated in "Test Port Output: Level Accuracy in Table 1-8  starting on page 1-57. Note that the specifications are listed in the form of $\pm n$ dB. This equates to an allowable $2n$ variation (max–min). Measurement of power levels below –30 dBm are outside the specified range of the power sensor and should not be included in the test.

6. For ES models, make the same set of measurements in the reverse transmission direction (S12) with the power sensor connected to PORT 2.

| NOTE | Be sure to zero the power meter before making any series of measurements below –19 dBm. |
| --- | --- |

A second test is performed by the test software to check for obvious power level inconsistencies that might not be detected by the specification check. It is a precaution to ensure that no power holes (drop-outs) exist. A through cable is connected and the analyzer is swept from 10 MHz to its high-end frequency using 1601 points per sweep. The resulting B* trace is checked for any significant power holes that could have been missed during the previous section of this test. For all ES models and for ET models with Option 1E1, repeat the full-sweep test for the three power levels tested in step 4 above.

When power holes are detected by this test, it is considered to be a failure of the specification.

**Specification Verified.** This test verifies the "Test Port Output: Level Accuracy" specification in Table 1-8  starting on page 1-57. Notice that values for 75Ω instruments above 2 GHz are nonwarranted characteristics, *not* warranted specifications.

**If This Test Fails.** Repeat the test, verifying that all connections are secure. If the test still fails, perform the "Source Power Correction, Adjustment #104" on page 2-15.

## PT06: Absolute Power Accuracy

This test verifies the accuracy of the B* broadband detector from the maximum input level of +16 dBm down to the specified noise floor. The test is designed to be performed at 30 MHz, however 15 MHz may be used if the frequency range of the signal source does not extend to 30 MHz. The 8116A is the preferred signal source, however the 33120A may be used as an alternative. An external 110 dB step attenuator is used to vary the test signal over the power range to be tested.

**Test Process.** Connect the step attenuator to the output of the signal generator. Set the frequency to 30 MHz (preferred) or 15 MHz. Connect a 6 dB pad to the output of the step attenuator. For 75Ω analyzers, use a minimum loss pad in place of the 6 dB attenuator. Calibrate the power meter and use it to measure the output from the 6 dB pad. Set the step attenuator to 0 dB. Adjust the output from the signal generator so that the power output from the 6 dB pad is +16.0 dBm. Record the exact reading. Use calibration data from the power sensor to compensate for the frequency difference between the power meter calibration and the signal generator. Disconnect the power sensor and connect the 6 dB pad to the RF IN/PORT 2 test port on the analyzer. Set the system bandwidth to narrow (250 Hz). Repeat the previously used steps for the signal generator output, and record the readings on B*. Switch the step attenuator as necessary to provide levels from +16 dBm to −44 dBm to the analyzer. Record the B* reading for each level and correct the readings using the calibration data for the step attenuator. Averaging may be used as needed. Each power reading on B* must meet the specified accuracy until the noise floor is reached.

**Specification Verified.** This test verifies the "Test Port Input: Power Accuracy" characteristic in Table 1-9 starting on page 1-63. In some cases, it may be performed at 15 MHz instead of the specified 30 MHz.

**If This Test Fails.** If you are using a programmable attenuator, first verify that the correct 40 dB section of the step attenuator is being used. See "The step attenuator's 40 dB card selection (3)" on page 1-17. If the correct attenuator is being used, perform the "B* Amplitude Correction, Adjustment #110" on page 2-21.

## PT07: Broadband Frequency Response

This test checks the frequency response flatness of the broadband B* detector. It is checked at a nominal –6 dBm signal level.

**Test Process.** Connect the output of the analyzer to a power splitter. Connect the power splitter outputs to the analyzer and to a calibrated power meter. Preset the analyzer and make sure the power level is set for 0 dBm. Step the analyzer through a cycle of approximately 12 CW frequencies while the B* and power meter readings are recorded. (The CW frequencies must include 10 MHz and 1.3 or 3.0 GHz, as appropriate.) Swap the output connections on the splitter and repeat the process. Average the two sets of readings to eliminate differences within the power splitter. Calculate the difference between the B* reading and the power meter reading for each frequency. Use a reading at 30 MHz as a reference. Subtract the reference from each of the other differences, and check the results against the specification.

Adapters are generally required for this test. A 75Ω analyzer requires a 75Ω power splitter and power sensor. A power divider may be used in place of the power splitter.

**Specification Verified.** This test verifies the "Test Port Input: Broadband Flatness" characteristic in Table 1-9 starting on page 1-63. This test also verifies the "Test Port Input: Frequency Range" specification for broadband in Table 1-9.

**If This Test Fails.** Repeat the test after verifying that all connections are secure. There is no corresponding adjustment for this test.

## PT08: Directivity

This test checks directivity, source match, and load match. The uncorrected (raw) directivity and source match values are derived from the measurement calibration arrays. Load match is checked using a calibration performed at the end of a through cable.

These tests require an 85032B calibration kit (standard or Option 001) for a 50Ω analyzer, or an 85036B calibration kit for a 75Ω analyzer. The standard economy (E) versions of these kits do not provide the necessary components to perform these procedures.

| NOTE | The three tests described below assume that an ES model is operating in the forward (S21) direction. These tests should be repeated for the reverse direction (S12) on ES model analyzers. |
|---|---|

**Test Process for Directivity.** Preset the analyzer and set the power level to 0 dBm. Measure reflection on channel 1. Perform a "1-port" calibration on ET models, or a "user 1-port" calibration on ES models. Leave the load attached. Disable measurement calibration by pressing the following keys (SYSTEM OPTIONS) **Service** **Service Utilities** **Meas Cal Options** **Meas Cal** (OFF should be in caps). Access the reflection tracking array, press **View Array Master** **Tracking** . Combine the traces by pressing (DISPLAY) **Data/Mem**. The resulting trace should be completely below the values for the specification (*not* the typical).

**Test Process for Source Match.** (These instructions assume that the directivity test has been completed and that the calibration is still valid.) Access the source match array. To meet the specification, the trace must be below the limit indicated in the specification (not the typical). For example, if the specification for 300 kHz to 1.3 GHz is 18 dB, the trace must be below –18 dB for that frequency range.

**Test Process for Load Match.** Preset the analyzer. Connect a type-N cable to the RF OUT/PORT 1 test port. Perform a 1-port calibration at the free end of the cable. Be sure to specify a male calibration kit ("Type-N (m)"). Note that during the open portion of the calibration, the extender pin must be placed over the center conductor of the cable. Connect the cable to RF IN/PORT 2. The reflection trace must be below the limits given in the load match specification (not the typical).

**Specifications Verified.** These tests verify performance of the following items in the "System Performance, Uncorrected" category of Table 1-6 on page 1-55 and Table 1-7 on page 1-56:

• Directivity

• Source Match (ratio)

• Load Match

**If This Test Fails.** If directivity (uncorrected) fails, the most likely cause is a defective coupler: the A coupler for the forward direction, or the B coupler for the reverse direction. Source match depends mostly on hardware in the A5 receiver assembly. Load match is solely dependent upon the A5 receiver assembly. If either of these two tests fail, first inspect the two type-N connectors for damage, especially on 75Ω instruments. If load match fails, also suspect the A5 receiver assembly limiter or transfer switch.

### PT09: Harmonics

This test uses a spectrum analyzer to measure harmonics on the network analyzer output at 18 different frequencies. Harmonics above 2.9 GHz are not checked.

**Test Process.** Connect the output of the analyzer to the spectrum analyzer with a high quality type-N cable. Step the analyzer through 18 CW frequencies, ranging from 0.3 MHz to 1440 MHz. Set the analyzer power to the maximum specified level for each frequency. Check all harmonics below 2.9 GHz for conformance to the specification. When this test is performed under computer control, the time bases of the two instruments are connected and the network analyzer's Ext Ref function is turned on.

**Specification Verified.** This test verifies the "Test Port Output: Signal Purity: Harmonics" specification in Table 1-8  starting on page 1-57.

**If This Test Fails.** If the harmonics test fails, perform the "Source Power Correction, Adjustment #104" on page 2-15. The most likely cause of a harmonics test failure is the A4 source assembly.

## PT10: Trace Noise

This test checks trace noise magnitude on narrowband and broadband transmission measurements. The measurement trace is normalized to remove the effects of frequency response on the baseline. The marker statistics for standard deviation (SDev) are considered to be equivalent to an RMS calculation.

**Test Process.** Connect a through cable. Preset the analyzer and set the power level to 0 dBm. Set the system bandwidth to narrow (250 Hz). Set the averaging factor to 8 and enable averaging. Normalize the trace, then turn off the averaging. Position marker 1 at the beginning of the trace and position marker 2 at the end of the trace. Use the marker math statistics feature to display the SDev value. SDev is equal to the RMS value of the trace noise.

Repeat this test for a conversion loss measurement, and set the start frequency to 10 MHz. For ES models, repeat this test for a reverse transmission (S12) measurement.

**Specification Verified.** This test verifies the "Test Port Input: Trace Noise" specification in Table 1-9  starting on page 1-63.

**If This Test Fails.** When this test fails by less than 1/2 the specified value, try using an averaging factor of 16 or 32. Almost anything within the entire analyzer system can contribute to excessive trace noise. The most likely assemblies to fail are the A5, A4, and A3, in that order. If trace noise can be isolated to only one input (A, B or R), then the problem is most likely in the A5 receiver assembly. Otherwise, suspect A4 or A3.

## PT11: Crosstalk

This test measures the crosstalk between the output signal path and the input signal path inside the analyzer at maximum specified output power level. The test makes a narrowband transmission measurement with shorts connected to both test ports.

**Test Process.** Attach a short to each test port on the analyzer. Preset the analyzer and set the power level to the maximum power specified for the particular model/option configuration of the instrument. Set the system bandwidth to fine (15 Hz) and the averaging factor to 4. Enable averaging. Check the trace; it must be below the crosstalk limit given in the specification. For example, if the specification is 80 dB, the trace must be below –80 dB.

For ES models, repeat the test for a reverse transmission (S12) measurement.

**Specification Verified.** This test verifies the "System Performance, Uncorrected: Crosstalk" specification in Table 1-6 on page 1-55 and Table 1-7 on page 1-56.

**If This Test Fails.** Check cabling and shielding on the A4 source board and the A5 receiver assembly.

# Specifications

## Definitions

All specifications and characteristics apply over a 25 °C ±5 °C range (unless otherwise stated) and sixty minutes after the instrument has been turned on.

**Specification (spec.):** Warranted performance. Specifications include guardbands to account for the expected statistical distribution, measurement uncertainties, and changes in performance due to environmental conditions.

**Characteristic (char.):** A performance parameter that the product is expected to meet before it leaves the factory, but is not verified in the field and is not covered by the product warranty. A characteristic includes the same guardbands as a specification.

**Typical (typ.):** Expected performance of an average unit which does not include guardbands. It is not covered by the product warranty.

**Nominal (nom.):** A general descriptive term that does not imply a level of performance. It is not covered by the product warranty.

**Calibration:** The process of measuring known standards from a calibration kit to characterize the systematic (repeatable) errors of a network analyzer.

**Corrected (residual) Performance:** Indicates performance after error correction (calibration). It is determined by the quality of calibration standards and how well "known" they are, plus system repeatability, stability, and noise.

**Uncorrected (raw) Performance:** Indicates instrument performance without error correction. The uncorrected performance affects the stability of a calibration.

# System Performance

**Table 1-2   System Performance, Corrected, 50Ω, 2-Port Calibration**

| 8712ES/8714ES (50 Ω) 85031B (7-mm, 50 Ω) Cal Kit, User 2-Port Calibration | | |
|---|---|---|
| **Description** | **Specification[1] (in dB)** | |
| | **300 kHz to 1.3 GHz** | **1.3 GHz to 3 GHz** |
| Directivity | 55 | 51 |
| Source Match | 51 | 49 |
| Load Match | 55 | 51 |
| Reflection Tracking | ±0.012 | ±0.005 |
| Transmission Tracking | ±0.033 | ±0.035 |
| **Transmission Uncertainty (Specification)[1,2]** | | |



| **Reflection Uncertainty (Specification)[1]** | | |
|---|---|---|



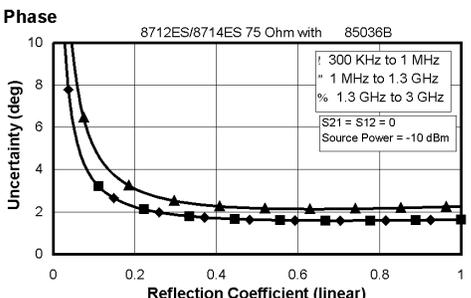1. These specifications apply for measurements made using "fine" bandwidth, no averaging, and at an environmental temperature of 25° ± 5 °C, with less than 1 °C deviation from the calibration temperature.
2. For transmission measurements, the effect of crosstalk is neglected and S12 = S21 for S21 <1.0, S12 = 1 / S21 for S21 > 1.0.

**Table 1-2   System Performance, Corrected, 50$\Omega$, 2-Port Calibration (continued)**

| 8712ES/8714ES (50 $\Omega$) 85032B/E (Type-N, 50 $\Omega$) Cal Kit, User 2-Port Calibration | | |
|---|---|---|
| **Description** | **Specification[1] (in dB)** | |
| | **300 kHz to 1.3 GHz** | **1.3 GHz to 3 GHz** |
| Directivity | 50 | 47 |
| Source Match | 42 | 36 |
| Load Match | 50 | 47 |
| Reflection Tracking | ±0.02 | ±0.02 |
| Transmission Tracking | ±0.04 | ±0.055 |

**Transmission Uncertainty (Specification)[1,2]**

Magnitude — 8712ES/8714ES Full Two Port Cal Using 85032B

! 300 KHz to 1 MHz
" 1 MHz to 1.3 GHz
% 1.3 GHz to 3 GHz

Uncertainty (dB) vs Transmission Coefficient (dB)

S11 = S22 = 0
Source Power = -10 dBm

Phase — 8712ES/8714ES Full Two Port Cal Using 85032B

! 300 KHz to 1 MHz
" 1 MHz to 1.3 GHz
% 1.3 GHz to 3 GHz

Uncertainty (degrees) vs Transmission Coefficient (dB)

S11 = S22 = 0
Source Power = -10 dBm

**Reflection Uncertainty (Specification)[1]**

Magnitude — 8712ES/8714ES with 85032B

! 300 KHz to 1 MHz
" 1 MHz to 1.3 GHz
% 1.3 GHz to 3 GHz

S21 = S12 = 0
Source Power = -10 dBm

Uncertainty (linear) vs Reflection Coefficient (linear)

Phase — 8712ES/8714ES with 85032B

! 300 KHz to 1 MHz
" 1 MHz to 1.3 GHz
% 1.3 GHz to 3 GHz

S21 = S12 = 0
Source Power = -10 dBm

Uncertainty (deg) vs Reflection Coefficient (linear)

1. These specifications apply for measurements made using "fine" bandwidth, no averaging, and at an environmental temperature of 25° ± 5 °C, with less than 1 °C deviation from the calibration temperature.
2. For transmission measurements, the effect of crosstalk is neglected and S12 = S21 for S21 <1.0, S12 = 1 / S21 for S21 > 1.0.

**Table 1-2   System Performance, Corrected, 50Ω, 2-Port Calibration (continued)**

| 8712ES/8714ES (50 Ω) 85033D (3.5 mm, 50 Ω) Cal Kit, User 2-Port Calibration | | |
|---|---|---|
| **Description** | **Specification[1] (in dB)** | |
| | **300 kHz to 1.3 GHz** | **1.3 GHz to 3 GHz** |
| Directivity | 46 | 43 |
| Source Match | 44 | 41 |
| Load Match | 46 | 43 |
| Reflection Tracking | ±0.016 | ±0.008 |
| Transmission Tracking | ±0.04 | ±0.05 |
| **Transmission Uncertainty (Specification)[1,2]** | | |



| **Reflection Uncertainty (Specification)[1]** | | |
|---|---|---|



1. These specifications apply for measurements made using "fine" bandwidth, no averaging, and at an environmental temperature of 25° ± 5 °C, with less than 1 °C deviation from the calibration temperature.
2. For transmission measurements, the effect of crosstalk is neglected and S12 = S21 for S21 <1.0, S12 = 1 / S21 for S21 > 1.0.

**Table 1-2  System Performance, Corrected, 50Ω, 2-Port Calibration (continued)**

| 8712ES/8714ES (50 Ω) 85038A (7-16, 50 Ω) Cal Kit, User 2-Port Calibration | | |
|---|---|---|
| **Description** | **Specification[1] (in dB)** | |
| | **300 kHz to 1.3 GHz** | **1.3 GHz to 3 GHz** |
| Directivity | 40 | 40 |
| Source Match | 37 | 37 |
| Load Match | 40 | 40 |
| Reflection Tracking | ±0.1 | ±0.09 |
| Transmission Tracking | ±0.054 | ±0.063 |

**Transmission Uncertainty (Specification)[1,2]**



**Reflection Uncertainty (Specification)[1]**



1. These specifications apply for measurements made using "fine" bandwidth, no averaging, and at an environmental temperature of 25° ± 5 °C, with less than 1 °C deviation from the calibration temperature.
2. For transmission measurements, the effect of crosstalk is neglected and S12 = S21 for S21 <1.0, S12 = 1 / S21 for S21 > 1.0.

**Table 1-3   System Performance, Corrected, 75Ω, 2-Port Calibration**

| 8712ES/8714ES (75 Ω) 85036B/E (Type-N, 75 Ω) Cal Kit, User 2-Port Calibration | | |
|---|---|---|
| **Description** | **Specification[1] (in dB)** | |
| | **300 kHz to 1.3 GHz** | **1.3 GHz to 3 GHz** |
| Directivity | 48 | 43 |
| Source Match | 41 | 35 |
| Load Match | 48 | 43 |
| Reflection Tracking | ±0.021 | ±0.02 |
| Transmission Tracking | ±0.042 | ±0.062 |
| **Transmission Uncertainty (Specification)[1,2]** | | |

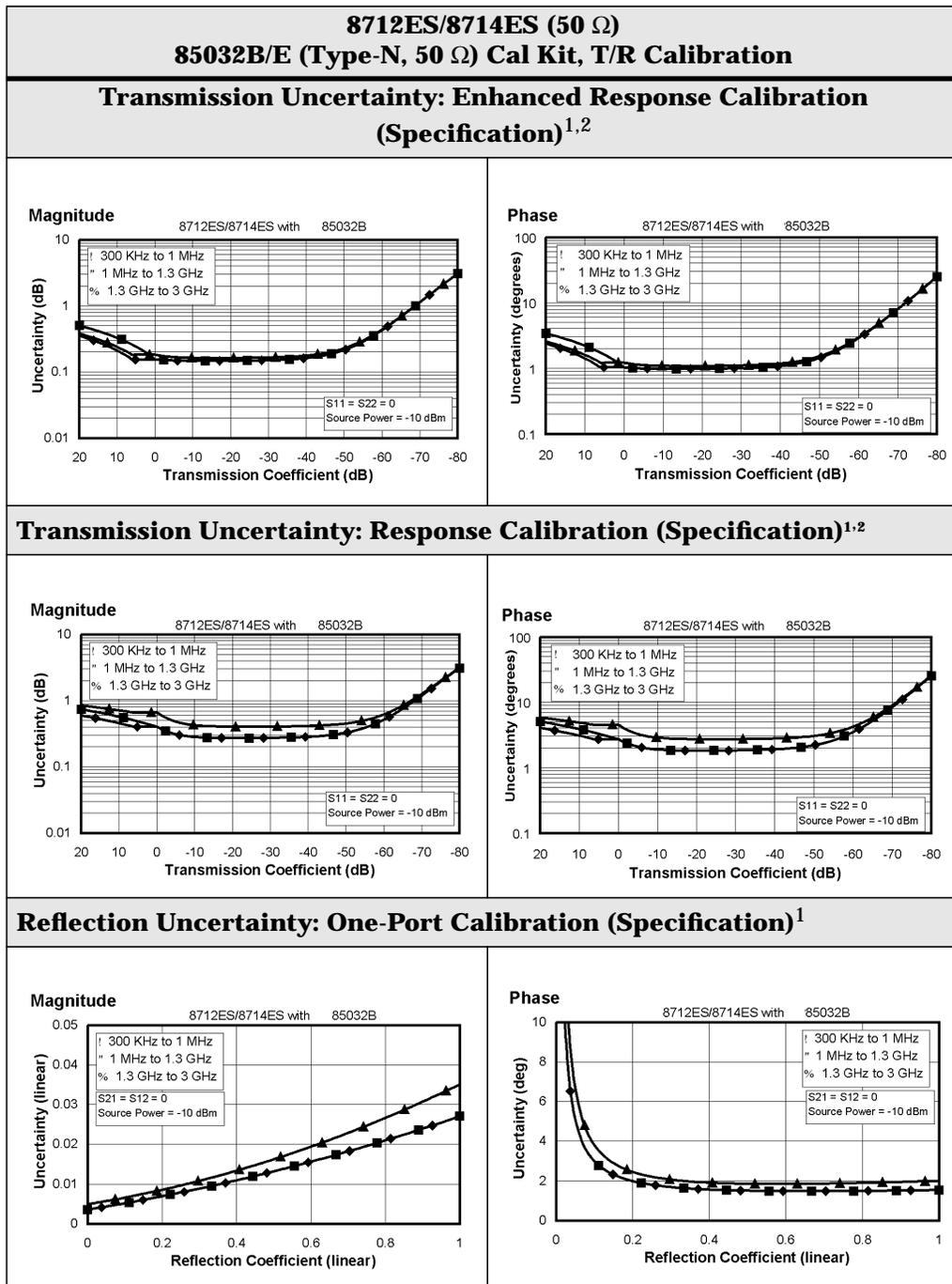

| **Reflection Uncertainty (Specification)[1]** | | |
|---|---|---|



1. These specifications apply for measurements made using "fine" bandwidth, no averaging, and at an environmental temperature of 25° ± 5 °C, with less than 1 °C deviation from the calibration temperature.
2. For transmission measurements, the effect of crosstalk is neglected and S12 = S21 for S21 <1.0, S12 = 1 / S21 for S21 > 1.0.

**Table 1-3   System Performance, Corrected, 75Ω, 2-Port Calibration (continued)**

| 8712ES/8714ES (75 Ω) 85039B (Type-F, 75 Ω) Cal Kit, User 2-Port Calibration | | |
|---|---|---|
| **Description** | **Specification[1] (in dB)** | |
| | **300 kHz to 1.0 GHz** | **1.0 GHz to 3 GHz** |
| Directivity | 40 | 40 |
| Source Match | 30 | 30 |
| Load Match | 40 | 40 |
| Reflection Tracking[2] | ±0.071 | ±0.025 |
| Transmission Tracking[2] | ±0.073 | ±0.090 |

**Transmission Uncertainty (Specification)[1,3]**



**Reflection Uncertainty (Specification)[1]**



1. These specifications apply for measurements made using "fine" bandwidth, no averaging, and at an environmental temperature of $25° \pm 5$ °C, with less than 1 °C deviation from the calibration temperature.
2. Assumes using an 85039B cal kit, and a DUT with a center pin conforming to the 0.77 to 0.86 mm limits.
3. For transmission measurements, the effect of crosstalk is neglected and S12 = S21 for S21 <1.0, S12 = 1 / S21 for S21 > 1.0.

**Table 1-4  System Performance, Corrected, 50Ω, T/R Calibration**

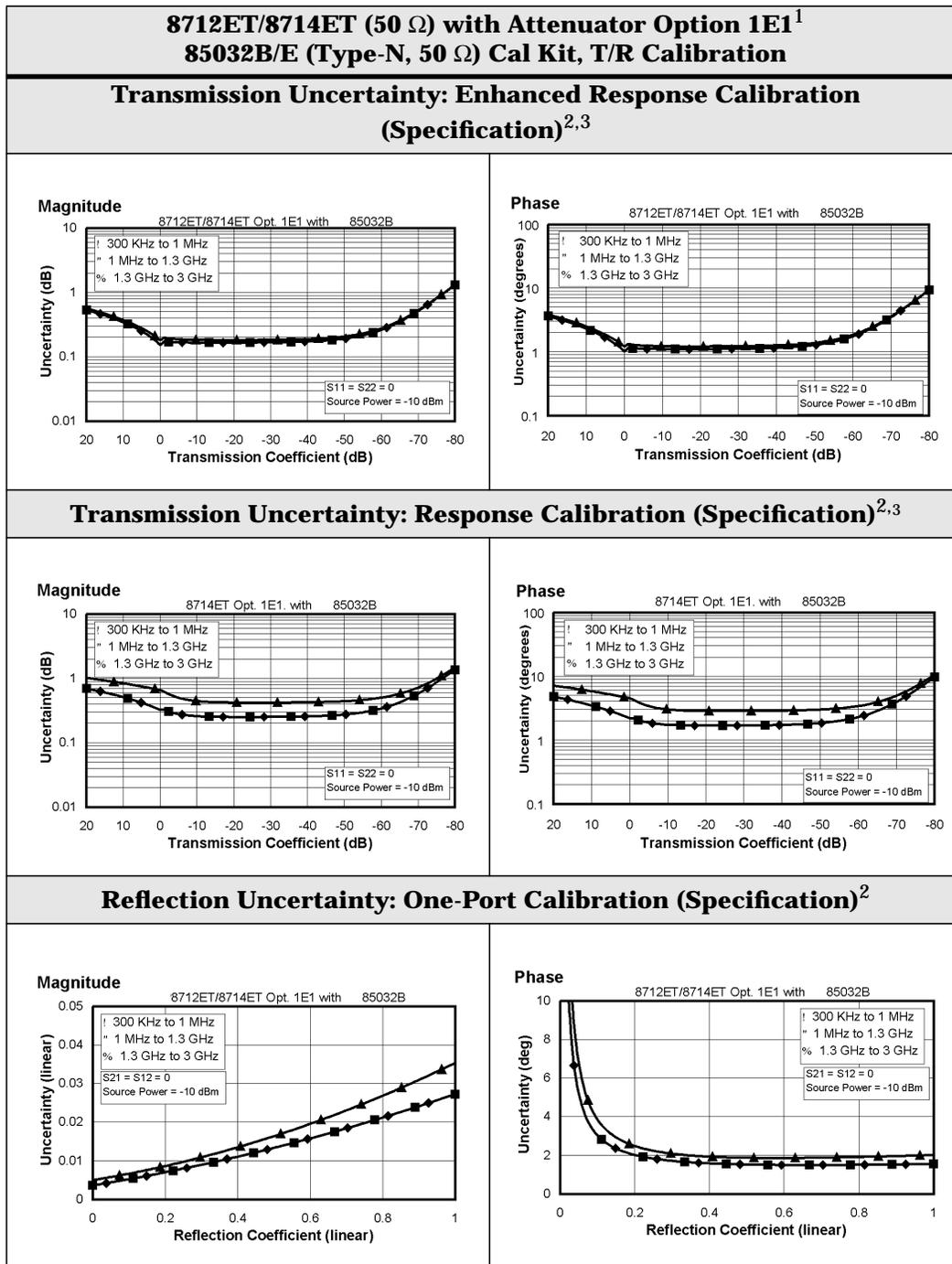| 8712ES/8714ES (50 Ω) 85032B/E (Type-N, 50 Ω) Cal Kit, T/R Calibration | | |
|---|---|---|
| **Description** | **Specification[1] (in dB)** | |
| | **300 kHz to 1.3 GHz** | **1.3 GHz to 3 GHz** |
| Directivity | 50 | 47 |
| Source Match: | | |
|     Reflection (One-Port Cal) | 42 | 36 |
|     Transmission (Enhanced Response Cal) | 42 | 36 |
|     Transmission (Response Cal) | 18 | 15 |
| Load Match | 18 | 15 |
| Reflection Tracking | ±0.02 | ±0.02 |
| Transmission Tracking: | | |
|     Enhanced Response Cal | ±0.040 | ±0.055 |
|     Response Cal | ±0.17 | ±0.3 |

1. These specifications apply for measurements made using "fine" bandwidth, no averaging, and at an environmental temperature of $25° \pm 5$ °C, with less than 1 °C deviation from the calibration temperature.

**Table 1-4   System Performance, Corrected, 50Ω, T/R Calibration (continued)**

**8712ES/8714ES (50 Ω)**
**85032B/E (Type-N, 50 Ω) Cal Kit, T/R Calibration**

**Transmission Uncertainty: Enhanced Response Calibration (Specification)[1,2]**



**Transmission Uncertainty: Response Calibration (Specification)[1,2]**



**Reflection Uncertainty: One-Port Calibration (Specification)[1]**



1. These specifications apply for measurements made using "fine" bandwidth, no averaging, and at an environmental temperature of 25° ± 5 °C, with less than 1 °C deviation from the calibration temperature.
2. For transmission measurements, the effect of crosstalk is neglected and S12 = S21 for S21 <1.0, S12 = 1 / S21 for S21 > 1.0.

**Table 1-4  System Performance, Corrected, 50Ω, T/R Calibration (continued)**

| 8712ET/8714ET (50 Ω) with Attenuator Option 1E1[1] 85032B/E (Type-N, 50 Ω) Cal Kit, T/R Calibration | | |
|---|---|---|
| **Description** | **Specification[2] (in dB)** | |
| | **300 kHz to 1.3 GHz** | **1.3 GHz to 3 GHz** |
| Directivity | 50 | 47 |
| Source Match: | | |
| Reflection (One-Port Cal) | 42 | 36 |
| Transmission (Enhanced Response Cal) | 42 | 36 |
| Transmission (Response Cal) | 21 | 15 |
| Load Match | 18 | 15 |
| Reflection Tracking | ±0.02 | ±0.02 |
| Transmission Tracking: | | |
| Enhanced Response Cal | ±0.039 | ±0.055 |
| Response Cal | ±0.13 | ±0.3 |

1. Option 1E1 adds a 60 dB step attenuator to the 8712ET and 871414ET.
2. These specifications apply for measurements made using "fine" bandwidth, no averaging, and at an environmental temperature of 25° ± 5 °C, with less than 1 °C deviation from the calibration temperature.

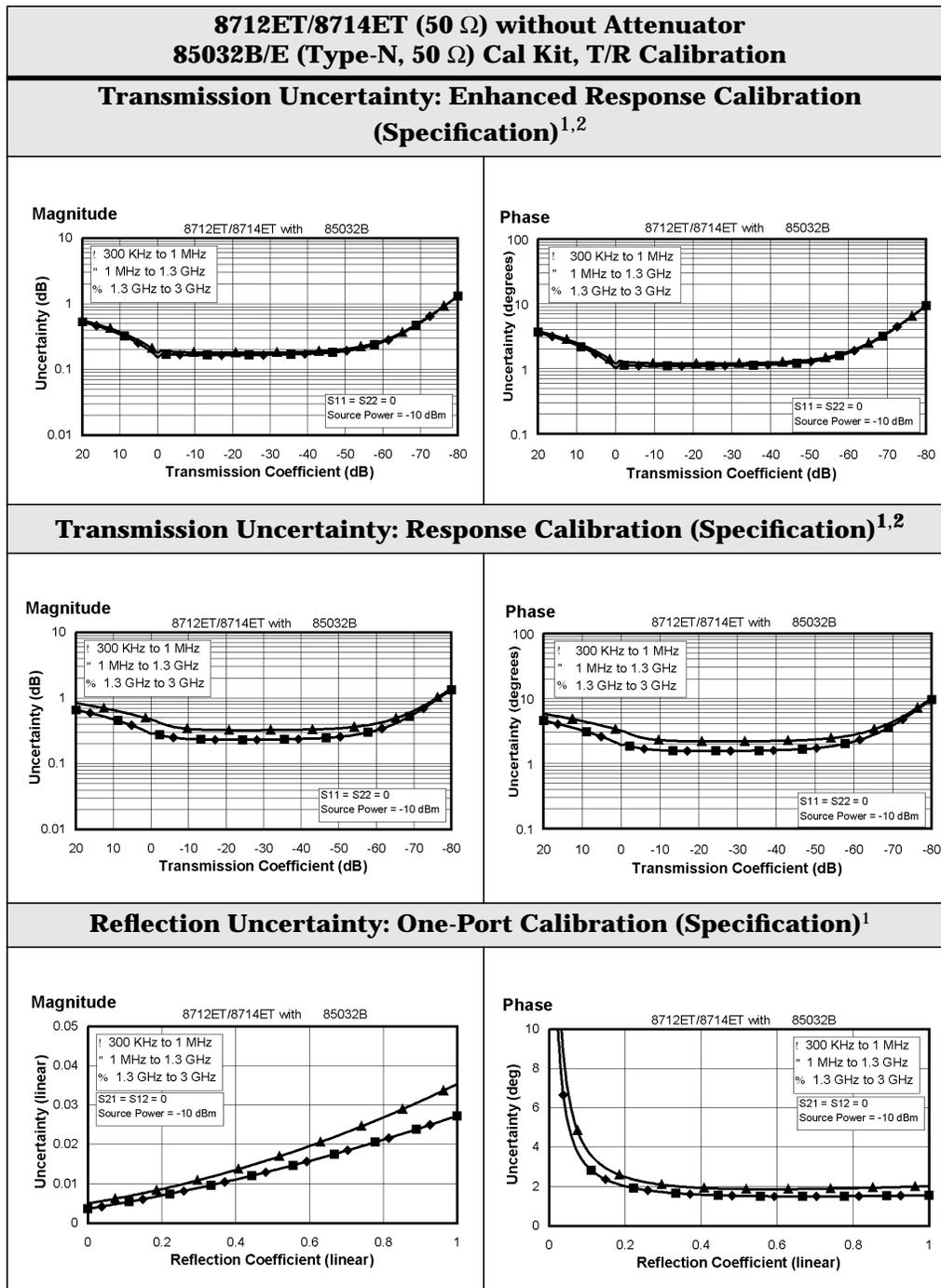**Table 1-4   System Performance, Corrected, 50Ω, T/R Calibration (continued)**

| 8712ET/8714ET (50 Ω) with Attenuator Option 1E1[1] 85032B/E (Type-N, 50 Ω) Cal Kit, T/R Calibration |
| --- |
| **Transmission Uncertainty: Enhanced Response Calibration (Specification)[2,3]** |



| **Transmission Uncertainty: Response Calibration (Specification)[2,3]** |
| --- |



| **Reflection Uncertainty: One-Port Calibration (Specification)[2]** |
| --- |



1. Option 1E1 adds a 60 dB step attenuator to the 8712ET/8714ET.
2. These specifications apply for measurements made using "fine" bandwidth, no averaging, and at an environmental temperature of 25° ± 5 °C, with less than 1 °C deviation from the calibration temperature.
3. For transmission measurements, the effect of crosstalk is neglected and S12 = S21 for S21 <1.0, S12 = 1 / S21 for S21 > 1.0.

**Table 1-4  System Performance, Corrected, 50Ω, T/R Calibration (continued)**

| 8712ET/8714ET (50 Ω) without Attenuator<br>85032B/E (Type-N, 50 Ω) Cal Kit, T/R Calibration | | |
|---|---|---|
| **Description** | **Specification[1] (in dB)** | |
| | **300 kHz<br>to 1.3 GHz** | **1.3 GHz<br>to 3 GHz** |
| Directivity | 50 | 47 |
| Source Match: | | |
|    Reflection (One-Port Cal) | 42 | 36 |
|    Transmission (Enhanced Response Cal) | 42 | 36 |
|    Transmission (Response Cal) | 23 | 19 |
| Load Match | 18 | 15 |
| Reflection Tracking | ±0.02 | ±0.02 |
| Transmission Tracking: | | |
|    Enhanced Response Cal | ±0.039 | ±0.052 |
|    Response Cal | ±0.105 | ±0.197 |

1. These specifications apply for measurements made using "fine" bandwidth, no averaging, and at an environmental temperature of 25° ± 5 °C, with less than 1 °C deviation from the calibration temperature.

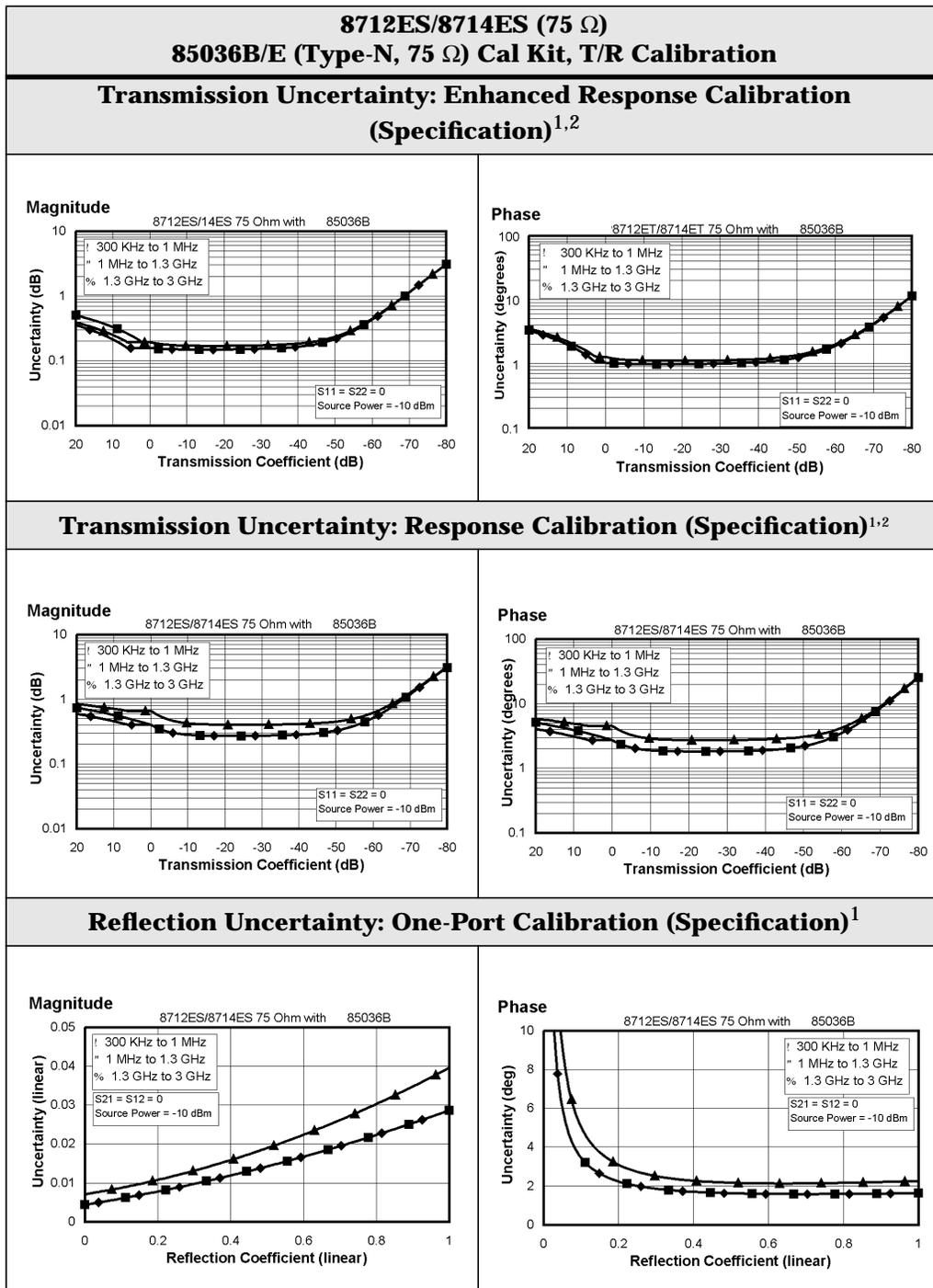**Table 1-4   System Performance, Corrected, 50Ω, T/R Calibration (continued)**



1. These specifications apply for measurements made using "fine" bandwidth, no averaging, and at an environmental temperature of 25° ± 5 °C, with less than 1 °C deviation from the calibration temperature.
2. For transmission measurements, the effect of crosstalk is neglected and S12 = S21 for S21 <1.0, S12 = 1 / S21 for S21 > 1.0.

**Table 1-5  System Performance, Corrected, 75Ω, T/R Calibration**

| 8712ES/8714ES (75 Ω) 85036B/E (Type-N, 75 Ω) Cal Kit, T/R Calibration | | |
|---|---|---|
| **Description** | **Specification[1] (in dB)** | |
| | **300 kHz to 1.3 GHz** | **1.3 GHz to 3 GHz** |
| Directivity | 48 | 43 |
| Source Match: | | |
|    Reflection (One-Port Cal) | 41 | 35 |
|    Transmission (Enhanced Response Cal) | 41 | 35 |
|    Transmission (Response Cal) | 18 | 15 |
| Load Match | 18 | 15 |
| Reflection Tracking | ±0.021 | ±0.02 |
| Transmission Tracking: | | |
|    Enhanced Response Cal | ±0.042 | ±0.062 |
|    Response Cal | ±0.17 | ±0.3 |

1. These specifications apply for measurements made using "fine" bandwidth, no averaging, and at an environmental temperature of 25° ± 5 °C, with less than 1 °C deviation from the calibration temperature.

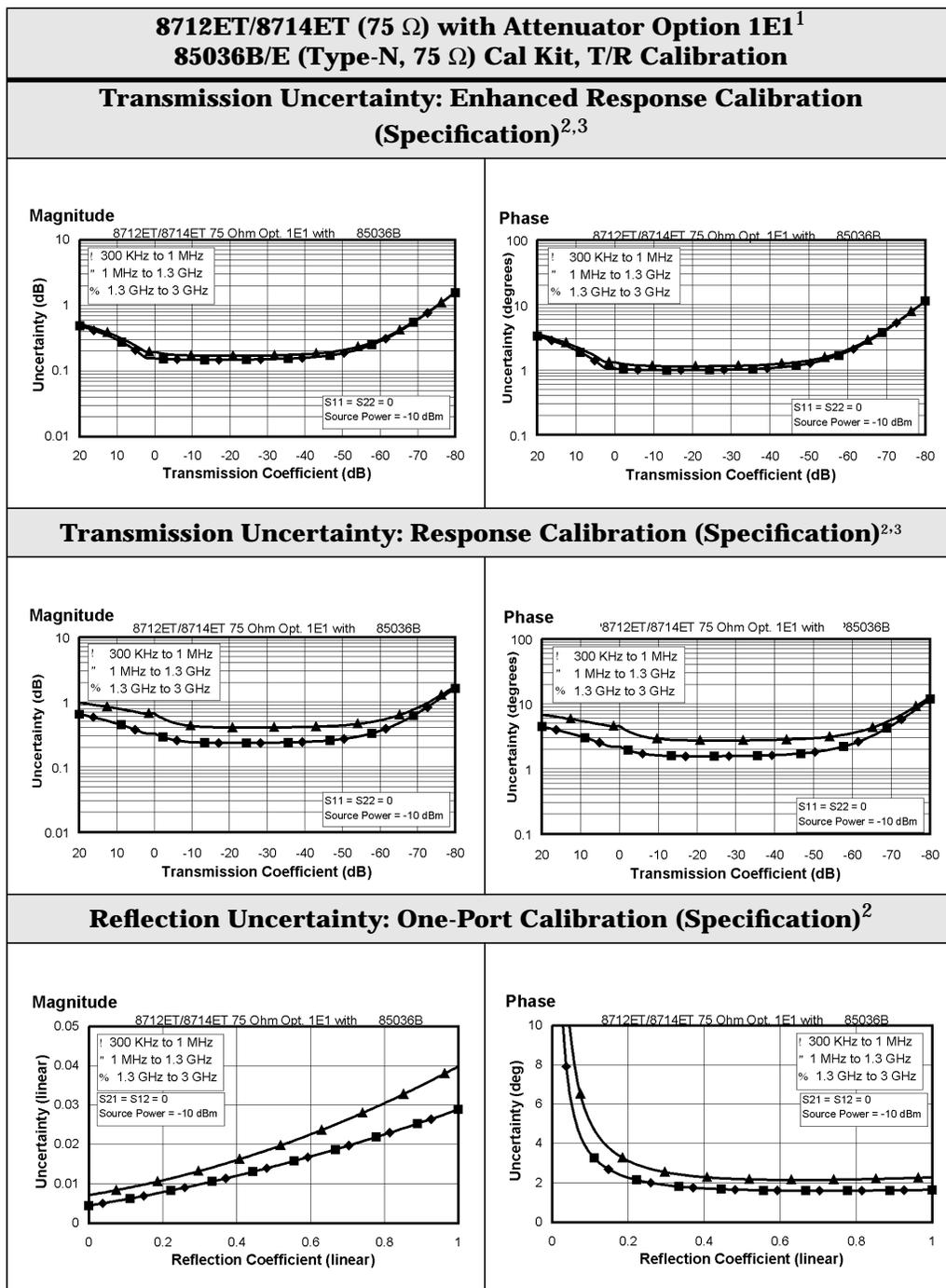**Table 1-5   System Performance, Corrected, 75Ω, T/R Calibration (continued)**

### 8712ES/8714ES (75 Ω)
### 85036B/E (Type-N, 75 Ω) Cal Kit, T/R Calibration

#### Transmission Uncertainty: Enhanced Response Calibration (Specification)[1,2]



#### Transmission Uncertainty: Response Calibration (Specification)[1,2]



#### Reflection Uncertainty: One-Port Calibration (Specification)[1]



1. These specifications apply for measurements made using "fine" bandwidth, no averaging, and at an environmental temperature of 25° ± 5 °C, with less than 1 °C deviation from the calibration temperature.

2. For transmission measurements, the effect of crosstalk is neglected and S12 = S21 for S21 <1.0, S12 = 1 / S21 for S21 > 1.0.

**Table 1-5   System Performance, Corrected, 75Ω, T/R Calibration (continued)**

| 8712ET/8714ET (75 Ω) with Attenuator Option 1E1[1] 85036B/E (Type-N, 75 Ω) Cal Kit, T/R Calibration | | |
|---|---|---|
| **Description** | **Specification[2] (in dB)** | |
| | **300 kHz to 1.3 GHz** | **1.3 GHz to 3 GHz** |
| Directivity | 48 | 43 |
| Source Match: | | |
|     Reflection (One-Port Cal) | 41 | 35 |
|     Transmission (Enhanced Response Cal) | 41 | 35 |
|     Transmission (Response Cal) | 21 | 15 |
| Load Match | 18 | 15 |
| Reflection Tracking | ±0.021 | ±0.02 |
| Transmission Tracking: | | |
|     Enhanced Response Cal | ±0.04 | ±0.062 |
|     Response Cal | ±0.125 | ±0.295 |

1. Option 1E1 adds a 60 dB step attenuator to the 8712ET/8714ET.
2. These specifications apply for measurements made using "fine" bandwidth, no averaging, and at an environmental temperature of 25° ± 5 °C, with less than 1 °C deviation from the calibration temperature.

**Table 1-5  System Performance, Corrected, 75Ω, T/R Calibration (continued)**

| 8712ET/8714ET (75 Ω) with Attenuator Option 1E1[1] |
| :---: |
| 85036B/E (Type-N, 75 Ω) Cal Kit, T/R Calibration |

### Transmission Uncertainty: Enhanced Response Calibration (Specification)[2,3]

**Magnitude**

8712ET/8714ET 75 Ohm Opt. 1E1 with    85036B

!   300 KHz to 1 MHz
"   1 MHz to 1.3 GHz
%   1.3 GHz to 3 GHz

Uncertainty (dB)

S11 = S22 = 0
Source Power = -10 dBm

Transmission Coefficient (dB)

**Phase**

8712ET/8714ET 75 Ohm Opt. 1E1 with    85036B

!   300 KHz to 1 MHz
"   1 MHz to 1.3 GHz
%   1.3 GHz to 3 GHz

Uncertainty (degrees)

S11 = S22 = 0
Source Power = -10 dBm

Transmission Coefficient (dB)

### Transmission Uncertainty: Response Calibration (Specification)[2,3]

**Magnitude**

8712ET/8714ET 75 Ohm Opt. 1E1 with    85036B

!   300 KHz to 1 MHz
"   1 MHz to 1.3 GHz
%   1.3 GHz to 3 GHz

Uncertainty (dB)

S11 = S22 = 0
Source Power = -10 dBm

Transmission Coefficient (dB)

**Phase**

8712ET/8714ET 75 Ohm Opt. 1E1 with    85036B

!   300 KHz to 1 MHz
"   1 MHz to 1.3 GHz
%   1.3 GHz to 3 GHz

Uncertainty (degrees)

S11 = S22 = 0
Source Power = -10 dBm

Transmission Coefficient (dB)

### Reflection Uncertainty: One-Port Calibration (Specification)[2]

**Magnitude**

8712ET/8714ET 75 Ohm Opt. 1E1 with    85036B

!   300 KHz to 1 MHz
"   1 MHz to 1.3 GHz
%   1.3 GHz to 3 GHz
S21 = S12 = 0
Source Power = -10 dBm

Uncertainty (linear)

Reflection Coefficient (linear)

**Phase**

8712ET/8714ET 75 Ohm Opt. 1E1 with    85036B

!   300 KHz to 1 MHz
"   1 MHz to 1.3 GHz
%   1.3 GHz to 3 GHz
S21 = S12 = 0
Source Power = -10 dBm
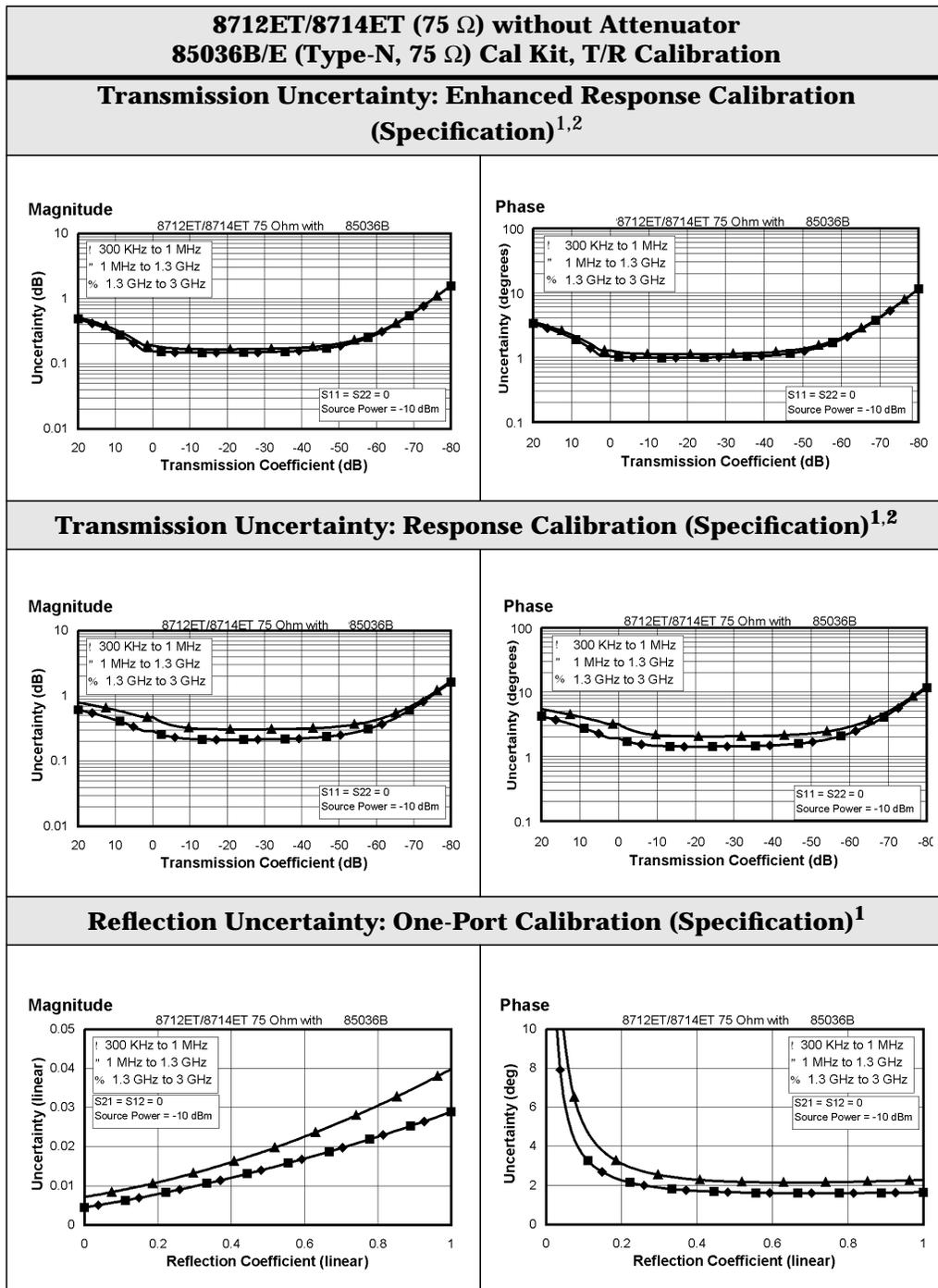
Uncertainty (deg)

Reflection Coefficient (linear)

1. Option 1E1 adds a 60 dB step attenuator to the 8712ET/8714ET.
2. These specifications apply for measurements made using "fine" bandwidth, no averaging, and at an environmental temperature of $25° \pm 5 °C$, with less than 1 °C deviation from the calibration temperature.
3. For transmission measurements, the effect of crosstalk is neglected and S12 = S21 for S21 <1.0, S12 = 1 / S21 for S21 > 1.0.

**Table 1-5  System Performance, Corrected, 75Ω, T/R Calibration (continued)**

| 8712ET/8714ET (75 Ω) without Attenuator 85036B/E (Type-N, 75 Ω) Cal Kit, T/R Calibration | | |
|---|---|---|
| **Description** | **Specification[1] (in dB)** | |
| | **300 kHz to 1.3 GHz** | **1.3 GHz to 3 GHz** |
| Directivity | 48 | 43 |
| Source Match: | | |
|    Reflection (One-Port Cal) | 41 | 35 |
|    Transmission (Enhanced Response Cal) | 41 | 35 |
|    Transmission (Response Cal) | 23 | 19 |
| Load Match | 18 | 15 |
| Reflection Tracking | ±0.021 | ±0.02 |
| Transmission Tracking: | | |
|    Enhanced Response Cal | ±0.04 | ±0.058 |
|    Response Cal | ±0.11 | ±0.2 |

1. These specifications apply for measurements made using "fine" bandwidth, no averaging, and at an environmental temperature of 25° ± 5 °C, with less than 1 °C deviation from the calibration temperature.

**Table 1-5  System Performance, Corrected, 75Ω, T/R Calibration (continued)**

**8712ET/8714ET (75 Ω) without Attenuator**
**85036B/E (Type-N, 75 Ω) Cal Kit, T/R Calibration**

**Transmission Uncertainty: Enhanced Response Calibration (Specification)[1,2]**



**Transmission Uncertainty: Response Calibration (Specification)[1,2]**



**Reflection Uncertainty: One-Port Calibration (Specification)[1]**



1. These specifications apply for measurements made using "fine" bandwidth, no averaging, and at an environmental temperature of 25° ± 5 °C, with less than 1 °C deviation from the calibration temperature.
2. For transmission measurements, the effect of crosstalk is neglected and S12 = S21 for S21 <1.0, S12 = 1 / S21 for S21 > 1.0.

**Table 1-6  System Performance, Uncorrected, 50Ω**

| 8712ET/ES and 8714ET/ES (50 Ω) | | | | | | |
|---|---|---|---|---|---|---|
| **Description** | **8712ES/8714ES** | | **8712ET/8714ET with Attenuator Option 1E1**[1] | | **8712ET/8714ET (without Attenuator)** | |
| | **300 kHz to 1.3 GHz** | **1.3 GHz to 3 GHz** | **300 kHz to 1.3 GHz** | **1.3 GHz to 3 GHz** | **300 kHz to 1.3 GHz** | **1.3 GHz to 3 GHz** |
| **Specification**[2] **(in dB)** | | | | | | |
| Directivity[3] | 29 | 23 | 29 | 21 | 29 | 23 |
| Source Match (Ratio)[4] | 18 | 15 | 21 | 15 | 23 | 19 |
| Load Match[5] | 18 | 15 | 18 | 15 | 18 | 15 |
| Crosstalk[6] | 88 | 88 | 97 | 97 | 97 | 97 |
| **Typical**[2] **(in dB)** | | | | | | |
| Directivity | 40 | 35 | 42 | 32 | 42 | 32 |
| Source Match (Ratio) | 23 | 20 | 26 | 21 | 30 | 23 |
| Load Match | 24 | 21 | 24 | 22 | 24 | 22 |
| Reflection Tracking | ±2.0 | ±2.0 | ±1.0 | ±1.5 | ±1.0 | ±1.0 |
| Transmission Tracking | ±2.0 | ±2.0 | ±1.5 | ±1.5 | ±1.5 | ±1.5 |
| Crosstalk[6] | 95 | 95 | 105 | 105 | 105 | 105 |

1. Option 1E1 adds a 60 dB step attenuator to the 8712ET/8714ET.
2. These numbers apply for a measurement made using the "Fine" bandwidth at an environmental temperature of 25° ± 5 °C.
3. The uncorrected directivity of a network analyzer is calculated in linear terms by dividing the reflection measurement of an ideal load by the average of the reflection measurements of an ideal short and an ideal open.
4. The uncorrected source match is the source match of the network analyzer when making a ratioed, uncalibrated measurement.
5. The uncorrected load match is the match of the network analyzer port used on the load side of a measurement.
6. Measured by setting output power to the maximum specified setting, connecting shorts to both ports, and measuring transmission. Typical and specified crosstalk values are 5 dB worse than those shown in the table below 1 MHz (for all models) and above 2.2 GHz (for 8714ET/ES models).

**Table 1-7  System Performance, Uncorrected, 75$\Omega$**

| 8712ET/ES and 8714ET/ES (75 $\Omega$) | | | | | | |
|---|---|---|---|---|---|---|
| **Description** | **8712ES/8714ES** | | **8712ET/8714ET with Attenuator Option 1E1[1]** | | **8712ET/8714ET (without Attenuator)** | |
| | **300 kHz to 1.3 GHz** | **1.3 GHz to 3 GHz** | **300 kHz to 1.3 GHz** | **1.3 GHz to 3 GHz** | **300 kHz to 1.3 GHz** | **1.3 GHz to 3 GHz** |
| **Specification[2] (in dB)** | | | | | | |
| Directivity[3] | 27 | 19 | 27 | 19 | 27 | 18 |
| Source Match (Ratio)[4] | 18 | 15 | 21 | 15 | 23 | 19 |
| Load Match[5] | 18 | 15 | 18 | 15 | 18 | 15 |
| Crosstalk[6] | 88 | 88 | 97 | 97 | 97 | 97 |
| **Typical[2] (in dB)** | | | | | | |
| Directivity | 40 | 30 | 40 | 30 | 40 | 30 |
| Source Match (Ratio) | 23 | 20 | 24 | 20 | 28 | 23 |
| Load Match | 24 | 22 | 24 | 22 | 24 | 22 |
| Reflection Tracking | ±1.5 | ±1.5 | ±1.0 | ±1.5 | ±1.0 | ±1.0 |
| Transmission Tracking | ±1.5 | ±1.5 | ±1.5 | ±1.5 | ±1.0 | ±1.0 |
| Crosstalk[6] | 95 | 95 | 105 | 105 | 105 | 105 |

1. Option 1E1 adds a 60 dB step attenuator to the 8712ET/8714ET.
2. These numbers apply for a measurement made using the "Fine" bandwidth at an environmental temperature of 25° ± 5 °C.
3. The uncorrected directivity of a network analyzer is calculated in linear terms by dividing the reflection measurement of a perfect load by the average of the reflection measurements of an ideal short and an ideal open.
4. The uncorrected source match is the source match of the network analyzer when making a ratioed, uncalibrated measurement.
5. The uncorrected load match is the match of the network analyzer port used on the load side of a measurement.
6. Measured by setting output power to the maximum specified setting, connecting shorts to both ports, and measuring transmission. Typical and specified crosstalk values are 5 dB worse than those shown in the table below 1 MHz (for all models) and above 2.2 GHz (for 8714ET/ES models).

# Test Port Output

**Table 1-8  Test Port Output**

| 8712ET/ES and 8714ET/ES Test Port Output | | |
|---|---|---|
| **Description** | **Specification** | **Supplemental Information** |
| **Frequency** | | |
| Range: | | |
|    8712ET/ES | 300 kHz to 1.3 GHz | |
|    8714ET/ES | 300 kHz to 3.0 GHz | |
| Resolution | 1 Hz | |
| Stability | | ±5 ppm, 0° to 55 °C, typ. |
| CW Accuracy | ±5 ppm at 25° ±5 °C | <1Hz at 10% change in line voltage, typ. |
| **Signal Purity** | | |
|  Harmonics: | | |
|    8712ET/ES | <−20 dBc at <1 MHz <br> <−30 dBc at >1 MHz | |
|    8714ET/ES | <−30 dBc | |
| Nonharmonic Spurious: | | |
|    8712ET/ES, <50 kHz from carrier | | <−25 dBc, char. |
|    8712ET/ES, >50 kHz from carrier | | <−20 dBc at <1MHz, char. <br> <−30 dBc at >1MHz, char. |
|    8714ET/ES, <50 kHz from carrier | | <−25 dBc, char. |
|    8714ET/ES, >50 kHz from carrier | | <−30 dBc, char. |
| Phase Noise (at 10 kHz offset): | | |
|    8712ET/ES | | <−67 dBc/Hz, char. |
|    8714ET/ES | | <−67 dBc/Hz, char. |
| Residual AM (in 100 kHz bandwidth) | | <−50 dBc, nom. |
| Residual FM (30 Hz to 15 kHz) | | <1.5 kHz peak, nom. |

**Table 1-8  Test Port Output (continued)**

| 8712ET/ES and 8714ET/ES Test Port Output | | |
|---|---|---|
| **Description** | **Specification** | **Supplemental Information** |
| **Output Power** | | |
| Level Accuracy: | | |
|   8712ET: | | |
|     50 Ω: | | |
|       With Attenuator Option 1E1[1] | ±2.0 dB | |
|       Without Attenuator Option 1E1 | ±1.0 dB | |
|     75 Ω: | | |
|       With Attenuator Option 1E1[1] | ±3.0 dB | |
|       Without Attenuator Option 1E1 | ±1.5 dB | |
|   8712ES: | | |
|     50 Ω | ±2.0 dB | |
|     75 Ω | ±3.0 dB | |
|   8714ET: | | |
|     50 Ω: | | |
|       With Attenuator Option 1E1[1] | ±2.0 dB | |
|       Without Attenuator Option 1E1 | ±1.0 dB | |
|     75 Ω: | | |
|       With Attenuator Option 1E1[1] | ±3.0 dB at <2 GHz | ±3.0 dB at >2 GHz, char. |
|       Without Attenuator Option 1E1 | ±1.5 dB at <2 GHz | ±1.5 dB at >2 GHz, char. |
|   8714ES: | | |
|     50 Ω | ±2.0 dB | |
|     75 Ω | ±3.0 dB at <2 GHz | ±3.0 dB at >2 GHz, char. |

1. Option 1E1 adds a 60 dB step attenuator to the 8712ET/8714ET.

**Table 1-8  Test Port Output (continued)**

| 8712ET/ES and 8714ET/ES Test Port Output | | |
| --- | --- | --- |
| **Description** | **Specification** | **Supplemental Information** |
| **Output Power (continued)** | | |
| Minimum Power Setting: | | |
|   8712ET: | | |
|     50 Ω: | | |
|       With Attenuator Option 1E1[1] | | −60 dBm, nom. |
|       Without Attenuator Option 1E1 | | 0 dBm, nom. |
|     75 Ω: | | |
|       With Attenuator Option 1E1[1] | | −60 dBm, nom. |
|       Without Attenuator Option 1E1 | | −3 dBm, nom. |
|   8712ES: | | |
|     50 Ω | | −60 dBm, nom. |
|     75 Ω | | −60 dBm, nom. |
|   8714ET: | | |
|     50 Ω: | | |
|       With Attenuator Option 1E1[1] | | −60 dBm, nom. |
|       Without Attenuator Option 1E1 | | −5 dBm, nom. |
|     75 Ω: | | |
|       With Attenuator Option 1E1[1] | | −60 dBm, nom. |
|       Without Attenuator Option 1E1 | | −8 dBm, nom. |
|   8714ES: | | |
|     50 Ω | | −60 dBm, nom. |
|     75 Ω | | −60 dBm, nom. |

1. Option 1E1 adds a 60 dB step attenuator to the 8712ET/8714ET.

**Table 1-8  Test Port Output (continued)**

| 8712ET/ES and 8714ET/ES Test Port Output | | | |
|---|---|---|---|
| **Description** | **Specification** | | **Supplemental Information** |
| **Output Power (continued)** | | | |
| | **<1 GHz** | **>1 GHz** | |
| Maximum Power Setting:[1] | | | |
| 8712ET: | | | |
| 50 Ω: | | | |
| With Attenuator Option 1E1[2] | 15 dBm | 12 dBm | |
| Without Attenuator Option 1E1 | 16 dBm | 13 dBm | |
| 75 Ω: | | | |
| With Attenuator Option 1E1[2] | 12 dBm | 9 dBm | |
| Without Attenuator Option 1E1 | 13 dBm | 10 dBm | |
| 8712ES: | | | |
| 50 Ω | 13 dBm | 10 dBm | |
| 75 Ω | 10 dBm | 7 dBm | |
| 8714ET: | | | |
| 50 Ω: | | | |
| With Attenuator Option 1E1[2] | 10 dBm | 9 dBm | |
| Without Attenuator Option 1E1 | 11 dBm | 10 dBm | |
| 75 Ω: | | | |
| With Attenuator Option 1E1[2] | 7 dBm | 6 dBm at <2 GHz | 6 dBm at >2 GHz, char. |
| Without Attenuator Option 1E1 | 8 dBm | 7 dBm at <2 GHz | 7 dBm at >2 GHz, char. |
| 8714ES: | | | |
| 50 Ω | 9 dBm | 7 dBm | |
| 75 Ω | 6 dBm | 4 dBm at <2 GHz | 4 dBm at >2 GHz, char. |

1. Maximum power setting is the highest power setting allowed that maintains the network analyzer's specified level accuracy.
2. Option 1E1 adds a 60 dB step attenuator to the 8712ET/8714ET.

**Table 1-8  Test Port Output (continued)**

| 8712ET/ES and 8714ET/ES Test Port Output | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Description** | **Nominal (in dBm)** | | | | | | |
| **Output** | | | | | | | |
| Power Sweep Ranges: | **Attn = 0 dB** | **Attn = 10 dB** | **Attn = 20 dB** | **Attn = 30 dB** | **Attn = 40 dB** | **Attn = 50 dB** | **Attn= 60 dB** |
| 8712ET: | | | | | | | |
| 50 Ω: | | | | | | | |
| With Attenuator Option 1E1[1] | −1 to Pmax[2] | −11 to 2 | −21 to −8 | −31 to −18 | −41 to −28 | −51 to −38 | −60 to −48 |
| Without Attenuator Option 1E1 | 0 to Pmax[2] | | | | | | |
| 75 Ω: | | | | | | | |
| With Attenuator Option 1E1[1] | −4 to Pmax[2] | −14 to −1 | −24 to −11 | −34 to −21 | −44 to −31 | −54 to −41 | −60 to −51 |
| Without Attenuator Option 1E1 | −3 to Pmax[2] | | | | | | |
| 8712ES: | | | | | | | |
| 50 Ω | −3 to Pmax[2] | −13 to 0 | −23 to −10 | −33 to −20 | −43 to −30 | −53 to −40 | −60 to −50 |
| 75 Ω | −6 to Pmax[2] | −16 to −3 | −26 to −13 | −36 to −23 | −46 to −33 | −56 to −43 | −60 to −53 |
| 8714ET: | | | | | | | |
| 50 Ω: | | | | | | | |
| With Attenuator Option 1E1[1] | −6 to Pmax[2] | −16 to −1 | −26 to −11 | −36 to −21 | −46 to −31 | −56 to −41 | −60 to −51 |
| Without Attenuator Option 1E1 | −5 to Pmax[2] | | | | | | |
| 75 Ω: | | | | | | | |
| With Attenuator Option 1E1[1] | −9 to Pmax[2] | −19 to −4 | −29 to −14 | −39 to −24 | −49 to −34 | −59 to −44 | −60 to −54 |
| Without Attenuator Option 1E1 | −8 to Pmax[2] | | | | | | |
| 8714ES: | | | | | | | |
| 50 Ω | −8 to Pmax[2] | −18 to −3 | −28 to −13 | −38 to −23 | −48 to −33 | −58 to −43 | −60 to −53 |
| 75 Ω | −11 to Pmax[2] | −21 to −6 | −31 to −16 | −41 to −26 | −51 to −36 | −60 to −46 | −60 to −56 |

1. Option 1E1 adds a 60 dB step attenuator to the 8712ET/8714ET.
2. Pmax = maximum power setting

**Table 1-8  Test Port Output (continued)**

| 8712ET/ES and 8714ET/ES Test Port Output | | |
|---|---|---|
| **Description** | **Specification** | **Supplemental Information** |
| **Output Power (continued)** | | |
| Power Resolution | 0.01 dB | |
| Attenuator Switch Points: | | |
| 8712ET: | | |
| 50 Ω | | −1, −11, −21, −31, −41, −51 dBm, nom. |
| 75 Ω | | −4, −14, −24, −34, −44, −54 dBm, nom. |
| 8712ES: | | |
| 50 Ω | | −3, −13, −23, −33, −43, −53 dBm, nom. |
| 75 Ω | | −6, −16, −26, −36, −46, −56 dBm, nom. |
| 8714ET: | | |
| 50 Ω | | −6, −16, −26, −36, −46, −56 dBm, nom. |
| 75 Ω | | −9, −19, −29, −39, −49, −59 dBm, nom. |
| 8714ES: | | |
| 50 Ω | | −8, −18, −28, −38, −48, −58 dBm, nom. |
| 75 Ω | | −11, −21, −31, −41, −51 dBm, nom. |

# Test Port Input

**Table 1-9  Test Port Input**

| 8712ET/ES and 8714ET/ES Test Port Input | | |
|---|---|---|
| **Description** | **Specification** | **Supplemental Information** |
| **Frequency Range** | | |
| 8712ET/ES: | | |
|    Narrowband | 300 kHz to 1.3 GHz | |
|    Broadband | 10 MHz to 1.3 GHz | |
| 8714ET/ES: | | |
|    Narrowband | 300 kHz to 3.0 GHz | |
|    Broadband | 10 MHz to 3.0 GHz | |
| **Maximum Input Level** | | |
| 8712ET/8714ET | +10 dBm at 0.5 dB compression | |
| 8712ES and 8714ES: | | |
| Narrowband, Frequency >1 MHz | +10 dBm at 0.3 dB compression | |
| Narrowband, Frequency <1 MHz | +10 dBm at 0.5 dB compression | |
| Broadband | | +16 dBm at 0.55 dB compression |
| **Damage Level** | | |
| 8712ET/8714ET | +20 dBm; ±30 VDC | |
| 8712ES/8714ES | +26 dBm; ±30 VDC | |
| **Broadband Flatness** | | |
| 8712ET/ES and 8714ET/ES | | ±1 dB, characteristic |

**Table 1-9  Test Port Input (continued)**

| 8712ET/ES and 8714ET/ES Test Port Input | | | | |
|---|---|---|---|---|
| **Description** | **Spec.** **(in dBm)** | **Typical** **(in dBm)** | | |
| | | **System Bandwidths:** | | |
| | | **Fine** **(15 Hz)** | **Fine** **(15 Hz)** | **Med Wide** **(4000 Hz)** | **Wide** **(6500 Hz)** |
| **Noise Floor**[1] | | | | |
| 8712ET/8714ET: | | | | |
|   50 Ω: | | | | |
|     Narrowband | −105 | −111 | −86 | −48 |
|     Broadband (Internal) | −50 | −55 | −48 | −32 |
|   75 Ω: | | | | |
|     Narrowband | −104 | −109 | −84 | −46 |
|     Broadband (Internal) | −47 | −52 | −45 | −30 |
| 8712ES/8714ES: | | | | |
|   50 Ω: | | | | |
|     Narrowband | −96 | −105 | −80 | −47 |
|     Broadband (Internal) | −38 | −43 | −36 | −23 |
|   75 Ω: | | | | |
|     Narrowband | −95 | −104 | −80 | −47 |
|     Broadband (Internal) | −35 | −40 | −33 | −20 |

1. Noise floor is defined as the RMS value of the trace (in linear format) for a transmission measurement in CW Frequency mode, with the RF connectors terminated in loads, output power set to 0 dBm, and no averaging. The noise floor specifications and typicals for narrowband detection measurements assume that an isolation calibration has been performed using an average factor of 16. For the 8712ES/8714ES, external broadband detectors will provide a lower noise floor than the internal broadband detectors.

**Table 1-9  Test Port Input (continued)**

| 8712ET/ES and 8714ET/ES Test Port Input | | | | |
|---|---|---|---|---|
| **Description** | **Spec. (in dB)** | **Typical (in dB)** | | |
| | | **System Bandwidths:** | | |
| | | **Fine (15 Hz)** | **Fine (15 Hz)** | **Med Wide (4000 Hz)** | **Wide (6500 Hz)** |
| **System Dynamic Range**[1] | | | | |
| 8712ET: | | | | |
| 50 Ω: | | | | |
| With Attenuator Option 1E1[2]: | | | | |
| Narrowband | 115 | 121 | 96 | 58 |
| Broadband (Internal) | 60 | 67 | 60 | 44 |
| Without Attenuator Option 1E1 | | | | |
| Narrowband | 115 | 121 | 96 | 58 |
| Broadband (Internal) | 62 | 68 | 61 | 45 |
| 75 Ω: | | | | |
| With Attenuator Option 1E1[2]: | | | | |
| Narrowband | 110 | 118 | 93 | 55 |
| Broadband (Internal) | 53 | 61 | 54 | 39 |
| Without Attenuator Option 1E1 | | | | |
| Narrowband | 113 | 119 | 94 | 56 |
| Broadband (Internal) | 56 | 62 | 55 | 40 |

1. The System Dynamic Range is calculated as the difference between the receiver noise floor and the minimum of either the source maximum output (maximum power setting minus output power level accuracy) or the receiver maximum input. System Dynamic Range applies to transmission measurements only, since reflection measurements are limited by directivity. The System Dynamic Range for 8714ET/ES 75 Ω analyzers is not a specification for frequencies >2 GHz; it is a characteristic. For the 8712ES/8714ES, external broadband detectors will provide more dynamic range than the internal broadband detectors.
2. Option 1E1 adds a 60 dB step attenuator to the 8712ET/8714ET.

**Table 1-9  Test Port Input (continued)**

| 8712ET/ES and 8714ET/ES Test Port Input | | | | | |
|---|---|---|---|---|---|
| **Description** | **Spec. (in dB)** | **Typical (in dB)** | | | |
| | | **System Bandwidths:** | | | |
| | | **Fine (15 Hz)** | **Fine (15 Hz)** | **Med Wide (4000 Hz)** | **Wide (6500 Hz)** |
| **System Dynamic Range** [1] **(continued)** | | | | | |
| 8714ET: | | | | | |
| 50 Ω: | | | | | |
| With Attenuator Option 1E1[2]: | | | | | |
| Narrowband | 112 | 120 | 95 | 57 | |
| Broadband (Internal) | 57 | 64 | 57 | 41 | |
| Without Attenuator Option 1E1 | | | | | |
| Narrowband | 114 | 121 | 96 | 58 | |
| Broadband (Internal) | 59 | 65 | 58 | 42 | |
| 75 Ω: | | | | | |
| With Attenuator Option 1E1[2]: | | | | | |
| Narrowband | 107 | 115 | 90 | 52 | |
| Broadband (Internal) | 50 | 58 | 51 | 36 | |
| Without Attenuator Option 1E1 | | | | | |
| Narrowband | 110 | 116 | 91 | 53 | |
| Broadband (Internal) | 53 | 59 | 52 | 37 | |

1. The System Dynamic Range is calculated as the difference between the receiver noise floor and the minimum of either the source maximum output (maximum power setting minus output power level accuracy) or the receiver maximum input. System Dynamic Range applies to transmission measurements only, since reflection measurements are limited by directivity. The System Dynamic Range for 8714ET/ES 75 Ω analyzers is not a specification for frequencies >2 GHz; it is a characteristic. For the 8712ES/8714ES, external broadband detectors will provide more dynamic range than the internal broadband detectors.
2. Option 1E1 adds a 60 dB step attenuator to the 8712ET/8714ET.

**Table 1-9  Test Port Input (continued)**

| 8712ET/ES and 8714ET/ES Test Port Input | | | | |
|---|---|---|---|---|
| Description | Spec. (in dB) | Typical (in dB) | | |
| | | System Bandwidths: | | |
| | | Fine (15 Hz) | Fine (15 Hz) | Med Wide (4000 Hz) | Wide (6500 Hz) |
| System Dynamic Range[1] (continued) | | | | |
| 8712ES: | | | | |
|    50 Ω: | | | | |
|      Narrowband | 104 | 115 | 90 | 57 |
|      Broadband (Internal) | 46 | 53 | 46 | 33 |
|    75 Ω: | | | | |
|      Narrowband | 99 | 111 | 87 | 54 |
|      Broadband (Internal) | 39 | 47 | 40 | 27 |
| 8714ES: | | | | |
|    50 Ω: | | | | |
|      Narrowband | 101 | 112 | 87 | 54 |
|      Broadband (Internal) | 43 | 50 | 43 | 30 |
|    75 Ω: | | | | |
|      Narrowband | 96 | 108 | 84 | 51 |
|      Broadband (Internal) | 36 | 44 | 37 | 24 |

1. The System Dynamic Range is calculated as the difference between the receiver noise floor and the minimum of either the source maximum output (maximum power setting minus output power level accuracy) or the receiver maximum input. System Dynamic Range applies to transmission measurements only, since reflection measurements are limited by directivity. The System Dynamic Range for 8714ET/ES 75 Ω analyzers is not a specification for frequencies >2 GHz; it is a characteristic. For the 8712ES/8714ES, external broadband detectors will provide more dynamic range than the internal broadband detectors.

**Table 1-9  Test Port Input (continued)**

| 8712ET/ES and 8714ET/ES Test Port Input | | | | | |
|---|---|---|---|---|---|
| **Description** | **Spec. (in dB)** | **Typical (in dB)** | | | |
| | | **System Bandwidths:** | | | |
| | | **Fine (15 Hz)** | **Fine (15 Hz)** | **Med Wide (4000 Hz)** | **Wide (6500 Hz)** |
| **Receiver Dynamic Range**[1] | | | | | |
| 8712ET/8714ET: | | | | | |
| 50 Ω: | | | | | |
| Narrowband | 115 | 121 | 96 | 58 | |
| Broadband (Internal) | 66 | 71 | 64 | 48 | |
| 75 Ω: | | | | | |
| Narrowband | 114 | 119 | 94 | 56 | |
| Broadband (Internal) | 63 | 68 | 61 | 46 | |
| 8712ES/8714ES: | | | | | |
| 50 Ω: | | | | | |
| Narrowband | 106 | 115 | 90 | 57 | |
| Broadband (Internal) | 54 | 59 | 52 | 39 | |
| 75 Ω: | | | | | |
| Narrowband | 105 | 114 | 90 | 57 | |
| Broadband (Internal) | 51 | 56 | 49 | 36 | |

1. The Receiver Dynamic Range is calculated as the difference between the receiver noise floor and the receiver maximum input. Receiver Dynamic Range applies to transmission measurements only, since reflection measurements are limited by directivity. The Receiver Dynamic Range for 8714ET/ES 75 Ω analyzers is not a specification for frequencies >2 GHz; it is a characteristic. For the 8712ES/8714ES, external broadband detectors will provide more dynamic range than the internal broadband detectors.

**Table 1-9  Test Port Input (continued)**

| 8712ET/ES and 8714ET/ES Test Port Input | | | | |
|---|---|---|---|---|
| **Description** | **Spec.** | **Typical** | | |
| | | **System Bandwidths:** | | |
| | | **Narrow (250 Hz)** | **Narrow (250 Hz)** | **Med Wide (4000 Hz)** | **Wide (6500 Hz)** |
| **Trace Noise**[1] | | | | |
| 8712ET/8712ES: | | | | |
| Narrowband: | | | | |
| Magnitude | 0.01 dB rms | 0.03 dB-pp | 0.12 dB-pp | 0.28 dB-pp |
| Phase | | 0.2 Deg-pp | 2.5 Deg-pp | 3.4 Deg-pp |
| Broadband: | | | | |
| Magnitude | 0.01 dB rms | 0.01 dB-pp | 0.02 dB-pp | 0.15 dB-pp |
| 8714ET/8714ES: | | | | |
| Narrowband: | | | | |
| Magnitude | 0.01 dB rms | 0.02 dB-pp | 0.06 dB-pp | 0.23 dB-pp |
| Phase | | 0.2 Deg-pp | 0.8 Deg-pp | 1.8 Deg-pp |
| Broadband: | | | | |
| Magnitude | 0.01 dB rms | 0.01 dB-pp | 0.03 dB-pp | 0.16 dB-pp |

1. Trace noise is defined for a transmission measurement in CW mode, using a "through" cable having 0 dB loss, with the source set to 0 dBm, and the analyzer's averaging function toggled off.

**Table 1-9  Test Port Input (continued)**

| 8712ET/ES and 8714ET/ES Test Port Input |
|---|
| **Dynamic Accuracy (Specification)** [1,2] |
| 8712ET/8714ET: |



| 8712ES/8714ES: |
|---|
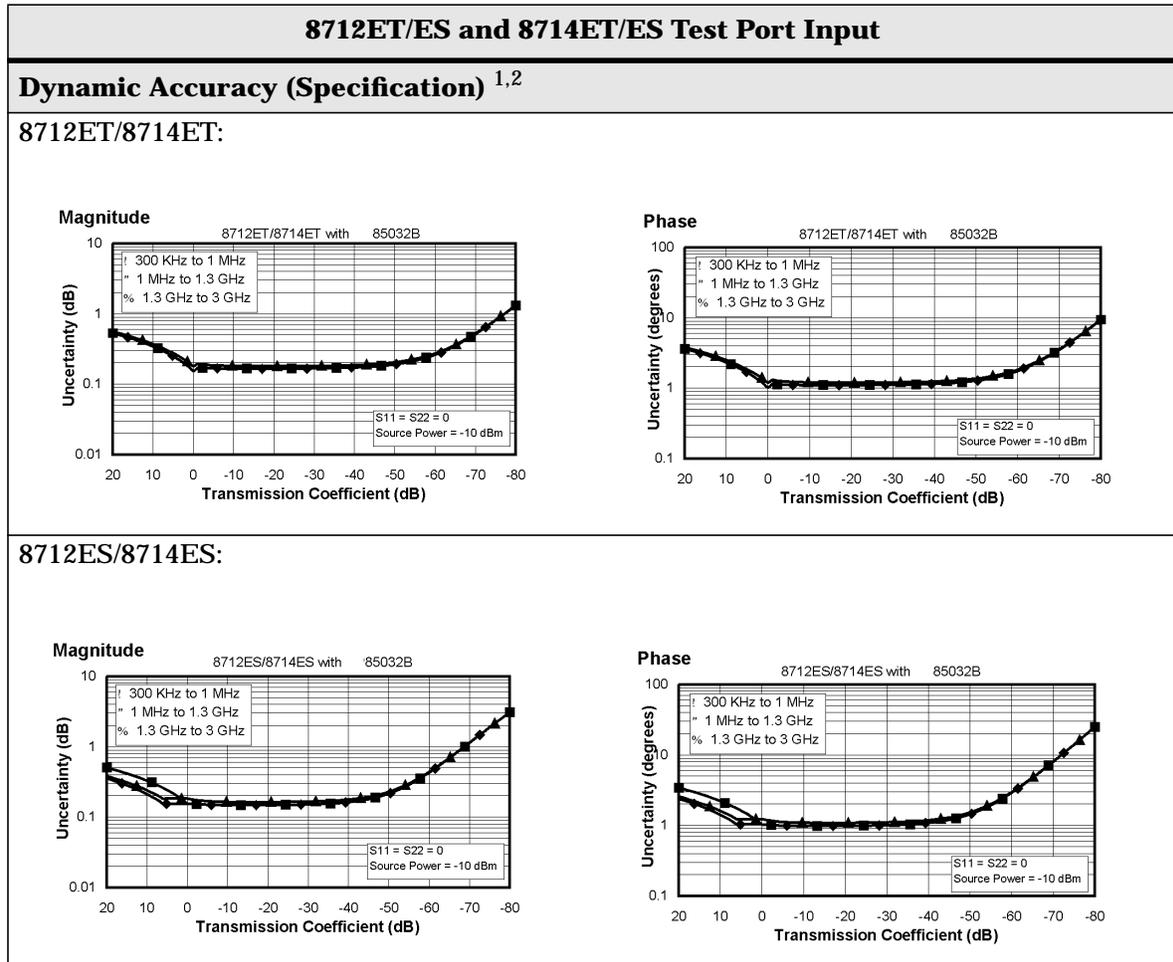


1. Narrowband detection mode
2. The reference power for dynamic accuracy is −20 dBm.

**Table 1-9  Test Port Input (continued)**

| 8712ET/ES and 8714ET/ES Test Port Input |
|---|
| **Power Accuracy: (Characteristic)** |

8712ET/8714ET[1]:



8712ES/8714ES[1]:



1. At 30 MHz, broadband mode, internal detectors

**Table 1-9  Test Port Input (continued)**

| 8712ET/ES and 8714ET/ES Test Port Input |
|---|
| **Group Delay Accuracy[1] (Characteristic)** |
| 8712ET/ES and 8714ET/ES |



1. Valid for 85032B/E (type-N 50 Ω) and 85036B/E (type-N 75 Ω) cal kits using either a two-port or enhanced response calibration.

# General Information

**Table 1-10 General Information**

| 8712ET/ES and 8714ET/ES General Information | | |
|---|---|---|
| **Description** | **Specification** | **Supplemental Information** |
| **Display Range** | | |
| Magnitude | 200 dB (at 20 dB/div), max | |
| Phase | 1800° (at 180°/div), max | |
| Polar | 1 MUnit, max | |
| **Display Resolution** | | |
| Magnitude | 0.01 dB/div, min | |
| Phase | 0.1°/div, min | |
| Polar | 10 μUnit Full Scale, min | |
| **Reference Level Range** | | |
| Magnitude | 500 dB, max | |
| Phase | 360°, max | |
| **Reference Level Resolution** | | |
| Magnitude | 0.01 dB, min | |
| Phase | 0.01°, min | |
| **Marker Resolution** | | |
| Magnitude | 0.001 dB, min | |
| Phase | 0.01°, min | |
| Polar | 0.01 μUnit, min; 0.01°, min | |
| **Group Delay Aperture** | | |
| Minimum | 20% of frequency span | |
| Maximum | frequency span ÷ (# of points − 1) | |
| **Group Delay Range** | | |
| | 1 ÷ (2 x minimum aperture) | The maximum delay is limited to measuring no more than 180° of phase change within the minimum aperture. |

**Table 1-10 General Information (continued)**

| 8712ET/ES and 8714ET/ES General Information | | |
|---|---|---|
| **Description** | **Specification** | **Supplemental Information** |
| **System Bandwidths** | | |
| Wide (6500 Hz) | | 6500 Hz, nom |
| Medium Wide (4000 Hz) | | 4000 Hz, nom |
| Medium (3700 Hz) | | 3700 Hz, nom |
| Medium Narrow (1200 Hz) | | 1200 Hz, nom |
| Narrow (250 Hz) | | 250 Hz, nom |
| Fine (15 Hz) | | 15 Hz, nom |
| **Rear Panel** | | |
| Auxiliary Input:<br><br>    Connector<br>    Impedance<br>    Range<br>    Accuracy<br>    Damage Level | <br><br><br><br>$\pm10$ V<br>$\pm3\%$ (reading) + 20 mV<br>>+15 V; <−15 V | <br>Female BNC<br>10 k$\Omega$, nom. |
| External Trigger In/Out:<br><br><br><br><br><br>Damage Level | <br><br><br><br><br><br><−0.2 V; >+5.2 V | Female BNC; Open-collector with 681 $\Omega$ nom. pullup resistor to +5 V, nom. Normally high, pulsed low after each data point is measured. |
| Limit Test Output:<br><br><br><br><br>Damage Level | <br><br><br><br><br><−0.2 V; >+5.2 V | Female BNC; Open-collector with 681 $\Omega$ nom. pullup resistor to +5 V, nom. Normally high, pulled low when limit test fails. |
| User TTL Input/Output:<br><br><br><br><br><br>Damage Level | <br><br><br><br><br><br><−0.2 V; >+5.2 V | Female BNC; Open-collector with 681 $\Omega$ nom. pullup resistor to +5 V nom. Programmable as: high-sweep output; trigger input; general I/O for IBASIC. |

**Table 1-10 General Information (continued)**

| 8712ET/ES and 8714ET/ES General Information | | |
|---|---|---|
| **Description** | **Specification** | **Supplemental Information** |
| **Rear Panel (continued)** | | |
| External Reference In: | | |
|    Input Frequency | | 10 MHz, nom. |
|    Input Power | | –5 dBm to +12 dBm, nom. |
|    Input Impedance | | 50 Ω, nom. |
| VGA Video Output | | 15-pin mini D-Sub; female. Firmware supports normal and inverse video color formats. |
| HPIB | | Type-57, 24-pin; Microribbon female |
| X and Y External Detector Inputs | | 12-pin circular; female |
| Parallel Port | | 25-pin D-Sub (DB-25); female |
| LAN | | 8-pin RJ45; female |
| RS232 | | 9-pin D-Sub (DB-9); male |
| Mini-DIN Keyboard/Barcode Reader | | 6-pin mini DIN (PS/2); female |
| Line Power[1]: | | |
|    Frequency | 47 Hz to 63 Hz | |
|    Voltage at 115 V setting | 90 V to 132 V | 115 V, nom. |
|    Voltage at 220 V setting | 198 V to 264 VAC | 230 V, nom. |
|    Power | 300 VA, max | 230 W, nom. |
| **Front Panel** | | |
| RF Connectors | | Type-N female; 50 Ω, nom. (*With Option 1EC only: Type-N female*; 75 Ω, nom.) |
| Probe Power: | | 3-pin connector; male |
|    Positive Supply | 200 mA, max | +15 V, nom; 0.75 A fuse, nom; |
|    Negative Supply | 250 mA, max | –12.6 V, nom; 0.75 A fuse, nom. |

1. A third-wire ground is required.

**Table 1-10 General Information (continued)**

| 8712ET/ES and 8714ET/ES General Information | | |
|---|---|---|
| **Description** | **Specification** | **Supplemental Information** |
| **General Environmental** | | |
| ESD | | Minimize using static-safe work procedures and an antistatic bench mat (part number 9300-0797). |
| Dust | | Minimize for optimum reliability. |
| **Operating Environment** | | |
| Temperature | 0 °C to +55 °C | |
| Humidity | 5% to 95% at +40 °C | |
| Altitude | 0 to 4.5 km (15,000 ft) | |
| **Storage Conditions** | | |
| Temperature | −40° C to +70 °C | |
| Humidity | 0% to 95% RH at +65 °C (noncondensing) | |
| Altitude | 0 to 15.24 km (50,000 ft) | |
| **Cabinet Dimensions** | | |
| Height × Width × Depth | | $179 \times 425 \times 514$ mm, nom. ($7.0 \times 16.75 \times 20.25$ in, nom.) Cabinet dimensions exclude front and rear protrusions. |
| **Weight** | | |
| Shipping | | 34.8 kg (77 lb), nom. |
| Net | | 24.4 kg (54 lb), nom. |

**Table 1-10 General Information (continued)**

| Cal Type | Number of Chans | Meas BW | Number of Points | Freq Span[2] | Cycle Time[3] | Recall State & Cal[4] | Data Xfer[5] | Meas Cycle[6] |
|---|---|---|---|---|---|---|---|---|
| 1-Port | 1 | 6500 | 201 | 100 MHz | 72 ms | | | |
| 1-Port | 1 | 6500 | 201 | 2 GHz | 0.16 s | | | |
| 1-Port | 1 | 4000 | 11 | 100 MHz | 37 ms | | | |
| 1-Port | 1 | 4000 | 21 | 100 MHz | 42 ms | | | |
| 1-Port | 1 | 4000 | 51 | 100 MHz | 55 ms | 0.47 s | 26 ms | 0.63 s |
| 1-Port | 1 | 4000 | 101 | 100 MHz | 76 ms | | | |
| 1-Port | 1 | 4000 | 201 | 100 MHz | 0.12 s | 0.58 s | 38 ms | 0.76 s |
| 1-Port | 1 | 4000 | 201 | 2 GHz | 0.18 s | | | |
| 1-Port | 1 | 4000 | 401 | 100 MHz | 0.21 s | | | |
| 1-Port | 1 | 4000 | 801 | 100 MHz | 0.38 s | | | |
| 1-Port | 1 | 4000 | 1601 | 100 MHz | 0.73 s | 1.6 s | 0.16 s | 2.5 s |
| 1-Port | 1 | 3700 | 201 | 100 MHz | 0.16 s | | | |
| 1-Port | 1 | 3700 | 201 | 2 GHz | 0.22 s | | | |
| 1-Port | 1 | 1200 | 201 | 100 MHz | 0.33 s | | | |
| 1-Port | 1 | 1200 | 201 | 2 GHz | 0.40 s | | | |
| 1-Port | 1 | 250 | 201 | 100 MHz | 1.5 s | | | |
| 1-Port | 1 | 250 | 201 | 2 GHz | 1.6 s | | | |
| 1-Port | 1 | 15 | 201 | 100 MHz | 12.3 s | | | |
| 1-Port | 1 | 15 | 201 | 2 GHz | 12.3 s | | | |
| 1-Port | 2 | 4000 | 51 | 100 MHz | 56 ms | 0.63 s | 58 ms | 0.84 s |
| 1-Port | 2 | 4000 | 201 | 100 MHz | 0.12 s | 0.84 s | 80 ms | 1.1 s |
| 1-Port | 2 | 4000 | 1601 | 100 MHz | 0.74 s | 2.6 s | 0.31 s | 3.7 s |
| 2-Port | 1 | 4000 | 51 | 100 MHz | 0.11 s | 0.5 s | 26 ms | 0.72 s |
| 2-Port | 1 | 4000 | 201 | 100 MHz | 0.24 s | 0.67 s | 38 ms | 1.04 s |
| 2-Port | 1 | 4000 | 1601 | 100 MHz | 1.5 s | 2.2 s | 0.16 s | 3.95 s |
| 2-Port | 2 | 4000 | 51 | 100 MHz | 0.11 s | 0.71 s | 60 ms | 1.13 s |
| 2-Port | 2 | 4000 | 201 | 100 MHz | 0.25 s | 0.94 s | 78 ms | 1.47 s |
| 2-Port | 2 | 4000 | 1601 | 100 MHz | 1.5 s | 3.5 s | 0.31 s | 5.48 s |

The table header contains the title **8712ET/ES and 8714ET/ES General Information** spanning all columns, with **Measurement Speed Conditions[1]** spanning the first five columns and **Typical** spanning the last four columns.

**See footnotes on the following page.**

1. Measurements are always made with error correction enabled.
2. Center frequency is set to 1 GHz.
3. "Cycle Time" is the time required for the analyzer to finish one complete sweep cycle including the forward sweep, retrace, bandcrossings, and calculation time when in the "Continuous Sweep" mode.
4. This is the time to recall both the system state and calibration data.
5. "Data Transfer" is performed using an HP S700 workstation. The GPIB port is used to transfer "corrected" 64-bit, floating point numbers (real and imaginary).
6. A "Measurement Cycle" is defined as the time required for an HP S700 workstation to control the analyzer to: (1) recall the state and calibration (analyzer is now in "sweep hold" mode), (2) sweep (using the ":INIT1;*OPC?" command), and (3) transfer data. This may be less than the sum of the other columns since a complete "Cycle Time" doesn't need to be done for the controller to transfer data.

# Features

## Measurement

### Number of Display Measurements

Two measurement displays are available. Each measurement can have independent instrument sweep and control parameters (including frequency settings, IF bandwidth, power level, number of trace points, averaging, format, and scale). The instrument can display a single measurement or dual measurements, on a split (two graticules) or overlaid (one graticule) screen.

### Measurement Choices

- **Narrowband**:

    **ET models:** reflection (A/R), transmission (B/R), A, B, R

    **ES models:** $S_{11}$ (A/R), $S_{22}$ (B/R), $S_{21}$ (B/R), $S_{12}$ (A/R), A, B, R

- **Broadband**: X, Y, Y/X, X/Y, Y/R*, power (B*, R*), conversion loss (B*/R*)

NOTE: X and Y denote external broadband-detector inputs; * denotes internal broadband detectors.

### Formats

- rectilinear: log or linear magnitude, SWR

- phase, group delay, real and imaginary, Smith chart, and polar

### Trace Functions

The analyzer can display current-measurement data, memory data or current-measurement with memory data simultaneously. Division of current-measurement data by memory data is also available.

### Display Annotations

Analyzer display annotations include start/stop, center/span, or CW frequency, scale/division, reference level, marker data, softkey labels, warning and caution messages, screen titles, time and date, and pass/fail indication.

### Limits

Measurement data can be compared to any combination of line or point limits for pass/fail testing. User-defined limits can also be applied to an amplitude- or frequency-reference marker. A limit-test TTL output is available on the rear panel for external control or indiction. Limits are only available in rectilinear formats.

### Data Markers

Each measurement channel has eight markers. Markers are coupled between channels. Any one of eight markers can be the reference marker for delta-marker operation. Annotation for up to four markers can be displayed at one time.

### Marker Functions

Markers can be used in absolute or delta modes. Other marker functions include: mkr→center, mkr→reference, mkr→electrical delay, searches, tracking, and statistics. Marker searches include: mkr to max, mkr to min, mkr→target, mkr bandwidth, notch, multi-peak, and multi-notch. The marker-tracking function enables continuous update of marker search values on each sweep. Marker statistics enable measurement of the mean, peak-to-peak, and standard deviation of the data between two markers. For rapid tuning and testing of cable-TV broadband amplifiers, slope and flatness functions are also available.

## Storage

### Internal Memory

1.5 Mbytes of nonvolatile storage is available to store instrument states, measurement data, screen images, and IBASIC programs. Instrument states can include all control settings, limit lines, memory data, calibration coefficients, and custom display titles. If no other data files are saved in nonvolatile memory, between about 30 and 150 instrument states (depending on the instrument parameters) can be saved. Approximately 32 Mbytes of volatile memory is also available for temporary storage of instrument states, measurement data, screen images, and IBASIC programs.

### Disk Drive

Trace data, instrument states (including calibration data), and IBASIC programs can also be saved on floppy disks using the built-in 3.5" disk drive. All files are stored in MS-DOS® -compatible format. Instrument data can be stored in binary or ASCII format (including Touchstone/.s1p format), and screen graphics can be saved as PCX (bit mapped), HP-GL (vector), or PCL5 (printer) files.

### Network File System (NFS)

Remote files and directories, such as those stored on a computer, can behave like local files and directories stored within the analyzer through the use of NFS and the LAN interface. This allows test data from the analyzer to be saved directly to a remote directory—the remote machine does not have to initiate an ftp session to retrieve the data. The analyzer has a built-in NFS client. For Windows-based applications, third-party NFS-server software must be installed on the PC. NFS is fully supported in most versions of UNIX.

# Data Hardcopy

Hardcopy prints can be made using PCL and PCL5 printers (such as HP DeskJet or LaserJet series of printers), or Epson-compatible graphics printers. Single color and multicolored formats are supported. Hardcopy plots can be automatically produced with HP-GL-compatible plotters such as the HP 7475A, or with printers that support HP-GL. The analyzer provides Centronics (parallel), RS-232C, GPIB, and LAN interfaces.

# Automation

### Controlling via GPIB

**Interface**: GPIB interface operates to IEEE 488.2 and SCPI standard interface commands.

**Control:** The analyzer can either be the system controller, or pass bus control to another active controller.

**Data Transfer Formats**:

- ASCII

- 32- or 64-bit IEEE 754 floating-point format

- mass memory-transfer commands allow file transfer between external controller and analyzer

### Controlling via LAN

The built-in LAN interface and firmware support data transfer and control via direct connection to a 10 Base-T (Ethertwist) network. A variety of standard protocols are supported, including TCP/IP, sockets, ftp, http, telnet, bootp, and NFS. The LAN interface is a standard feature.

**SCPI:** The analyzer can be controlled by sending Standard Commands for Programmable Instruments (SCPI) commands within a telnet session or via a socket connection and TCP/IP (the default socket port is 5025). The analyzer's socket applications programming interface (API) is compatible with Berkeley sockets, Winsock and other standard socket APIs. Socket programming can be done in a variety of environments, including C programs, HP VEE, SICL LAN, or Java applets. A standard web browser and the analyzer's built-in web page can be used to remotely enter SCPI commands via a Java applet.

**FTP:** Instrument state and data files can be transferred via file-transfer protocol (ftp). An internal dynamic data disk, which is an ftp directory, provides direct access to instrument states, screen dumps, trace data, and operating parameters..

**HTTP:** The instrument's built-in web page can be accessed with any standard web browser using hypertext transfer protocol (http) and the analyzer's IP address. The built-in web page can be used to control the network analyzer, view screen images, download documentation, and link to other sites for firmware upgrades and VXI*plug&play* drivers. Some word processor and spreadsheet programs, such as Microsoft Word 97® and Excel 97®, provide methods to directly import graphics and data with http via a LAN connection.

**SICL LAN:** SICL LAN is a LAN protocol using the Standard Instrument Control Library (SICL). It provides control of your analyzer over the LAN using a variety of computing platforms, I/O interfaces, and operating systems. With SICL LAN, a remote analyzer can be controlled over the LAN with the same methods used for a local analyzer connected directly to the controller with GPIB. SICL LAN can also be used with Windows 95/98/NT, or HP-UX.

**Bootp:** Bootstrap protocol (bootp) allows a network analyzer to automatically configure itself at power-on with the necessary information to operate on the network. After a bootp request is sent by the analyzer, the host server downloads an IP address, a gateway address, and a subnet mask. In addition, the analyzer can request an IBASIC file, which automatically executes after the transfer is complete. For Windows-based applications, third-party bootp-server software must be installed on the PC. Bootp is fully supported in most versions of UNIX.

## Programming using IBASIC

As a standard feature, all 8712ET/ES and 8714ET/ES network analyzers come with the Instrument BASIC programming language (IBASIC). IBASIC facilitates automated measurements and control of other test equipment, improving productivity. For simpler applications, you can use IBASIC as a keystroke recorder to easily automate manual measurements. Or, you can use an optional, standard PC keyboard to write custom test applications that include:

- special softkey labels

- tailored user prompts

- graphical setup diagrams

- barcode-reading capability

- control of other test instruments via the GPIB, serial or parallel interfaces

# Measurement Calibration

Measurement calibration significantly reduces measurement uncertainty due to errors caused by system directivity, source match, load match, frequency response, and crosstalk. The analyzer features factory-installed default calibrations that use vector error correction, so that measurements can be made on many devices without performing a user calibration.

For greater accuracy, especially for special test setups with significant loss or reflection, user calibrations should be performed. For reflection measurements, both one-port and two-port calibrations are available (two-port calibration requires an ES model). For transmission measurements, the following calibrations are available: response, response and isolation, enhanced response, and two-port (two-port calibration requires an ES model).

## Calibration Interpolation

Calibration interpolation is always active. The analyzer automatically recalculates the error coefficients when the test frequencies or the number of points have changed. The resulting frequency range must be within the frequency range used during the user calibration. If this is not the case, the analyzer reverts to the factory default calibration. When calibration interpolation is used, the analyzer displays the C? annotation. System performance is not specified for measurements using calibration interpolation.

## Available Calibrations

### ES models only

- **Two-Port Calibration**
  Compensates for frequency response, load match, source match, and directivity errors while making S-parameter measurements of transmission ($S_{21}$, $S_{12}$) and reflection ($S_{11}$, $S_{22}$). Compensates for crosstalk when the  **Isolation on OFF**  softkey is toggled ON. Requires open, short, load, and through standards.

### ET and ES models: transmission measurements

- **Normalization**
  Simultaneous magnitude and phase correction of frequency response errors. Requires a through connection. Used for both narrowband and broadband detection. Does not support calibration interpolation.

- **Response**
  Simultaneous magnitude and phase correction of frequency response errors. Requires a through connection.

- **Response and Isolation**
  Compensates for frequency response and crosstalk errors. Requires a load termination on both test ports and a through standard.

- **Enhanced Response**
  Compensates for frequency response and source match errors. Requires open, short, load and through standards.

### ET and ES models: reflection measurements

- **One-Port calibration**
  Compensates for frequency response, directivity, and source match errors. Requires an open, short, and load standards.

## Calibration Kits

Data for several standard calibration kits are stored in the instrument for use by calibration routines. They include:

- 3.5 mm (85033D with Option 001[1])

- type-F 75 ohm (85039B)

- type-N 50 ohm (85032B with Option 001[1], or 85032E[2])

- type-N 75 ohm (85036B/E[2])

- 7 mm (APC-7) (85031B)

- 7-16 (85038A[3]/F[4]/M[5])

In addition, you can also describe the standards for a user defined kit (for example, open-circuit capacitance coefficients, offset short length, or through-standard loss).

For more information about calibration kits available from Agilent Technologies, consult the RF Economy Network Analyzers Configuration Guide, literature number 5967-6315E.

---

1. Option 001 doesn't include 7 mm adaptors.
2. "E" version doesn't include adaptors or cal standards with female connectors.
3. Contains cal standards with female connectors and male connectors.
4. Contains cal standards with female connectors only.
5. Contains cal standards with male connectors only.

# Options

**75 Ohms (Option 1EC)**
Provides 75 ohm system impedance.

**Fault location and structural return loss (Option 100)**
For fully characterizing cable performance and antenna-feedline systems, this option provides both fault location and structural return loss capability. Fault-location measurements help identify where cable or system faults, such as bends, shorts, or corroded or damaged connectors, occur. In addition to displaying faults in terms of distance into the cable or feedline, the magnitude of the fault is also displayed.

Structural return loss is a special case of return loss (reflection) measurements, optimized for measuring periodic reflections of small magnitude. These periodic reflections can occur from physical damage to the cable caused by rough handling, or from minor imperfections imparted during the manufacturing process. Structural return loss problems occur when these periodic reflections sum at half-wavelength intervals, causing high signal reflection (and low transmission) at the corresponding frequency.

**Step Attenuator (Option 1E1)***: 8712ET/8714ET only*
This option adds a built-in 60 dB step attenuator, extending the source output power low-end range to –60 dBm. This attenuator is a standard feature on the 8712ES/8714ES.

**Transport case and fault location and structural return loss (Option 101)**
Combines a rugged transport and operation case (part number 08712-60059) with Option 100 for field measurements of fault location and structural return loss.

## Test Sets

**87050E multiport test sets**
Provides a complete solution for testing 50 ohm multiport devices like duplexers, power dividers, or multi-couplers. Test sets can be configured with four, eight, or twelve test ports (for more information, please consult the product brochure, literature number 5968-4763E).

**87075C multiport test sets**
Provides a complete solution for testing 75 ohm multiport devices like CATV distribution amplifiers or multi-taps. Test sets can be configured with six or twelve test ports (for more information, please consult the product brochure, literature number 5968-4766E).

**Switching test sets**
Switching test sets enhance productivity by allowing multiple measurements with a single connection to the device under test. They are available in 50 and 75 ohm versions, in a variety of configurations and connector types. Please contact your sales representative for more information.

# 2 Adjustments

# Introduction

This chapter contains procedures to adjust the analyzer. Generally these adjustment procedures are only used when hardware has been replaced in the instrument, or if there is a failure in the operators check or the performance tests (see Chapter 1). Refer to Table 3-1, "Post Repair Procedures," on page 3-23 to determine which adjustment procedures you need to do when a particular part has been replaced.

Adjustments #102 through #111 affect the correction constants that are stored in the non-volatile memory of the instrument. As adjustments are performed, new correction constants are created.The user controls when the new correction constants are stored in the non-volatile memory. The frequency accuracy adjustment, which could require a potentiometer adjustment, and the serial number (Adjustment #100) do not affect the correction constants.

Before performing adjustments, turn on the analyzer and allow it to warm up for one hour. Most adjustments are accessed through the analyzer's service menus.

You should perform the adjustment procedures in the order given here:

1.  "Frequency Accuracy Adjustment"on page 2-5

2.  "Switched Gain Correction, Adjustment #102"on page 2-10

3.  "External Detector Gain Correction, Adjustment #103"on page 2-12

4.  "Auxiliary Input Correction, Adjustment #111"on page 2-14

5.  "Source Power Correction, Adjustment #104"on page 2-15

6.  "B Amplitude Correction, Adjustment #105"on page 2-18

7.  "Reflection (One-Port) Correction, Adjustment #107"on page 2-19

8.  "Transmission Correction, Adjustment #106"on page 2-20

9.  "B* Amplitude Correction, Adjustment #110"on page 2-21

10."R* Amplitude Correction, Adjustment #108"on page 2-23

11."R* Frequency Response Correction, Adjustment #109"on page 2-25

| CAUTION | Procedures 2 through 11 all generate correction constants. For efficient operation, these correction constants must be handled properly. Please read the "Correction Constants (CCs) Storage" on page 2-4 carefully. |
|---|---|

| CAUTION | The preset power level is user-definable. After pressing (PRESET) in any adjustment procedure, change the power level to 0 dBm if necessary. |
|---|---|

| NOTE | During the adjustments, the analyzer will display a list of instructions in which the names for the connectors may vary. For user clarification, "REFLECTION," "RF OUT," and "PORT 1" all refer to the connector closest to the analyzer's display, while "TRANSMISSION," "RF OUT," and "PORT 2" all refer to the connector farthest from the display. |
|---|---|

# Required Equipment

**Table 2-1   Required Equipment for Adjustments**

| Description | HP/Agilent Model # | 50Ω STD | 75Ω | Notes |
|---|---|---|---|---|
| Power meter | 437B, 438A<br>E4418A, E4419A | ✓ | ✓ | Do *not* use an 436A. |
| Power sensor, 50Ω | 8482A | ✓ | ✓ | |
| Low power sensor | 8481D or 8484A | ✓ | ✓ | For the ES models and ET Option 1E1. |
| Cal kit type-N 50Ω | 85032B Opt 001[1] | ✓ | — | |
| Cal kit type-N 75Ω | 85036B | — | ✓ | |
| 6 dB attenuator 50Ω | 8491A/B/C Opt 006 | ✓ | — | Required for adjustments only if analyzer does not have an internal attenuator installed. |
| 10 dB attenuator 50Ω[2] | 8491A/B/C Opt 010 | ✓ | — | Required for adjustments only if analyzer does not have an internal attenuator installed. |
| 10 dB attenuator 75Ω[2] | 0955-0767 | — | ✓ | Required for adjustments only if analyzer does not have an internal attenuator installed. (May substitute 2 min loss pads.) |
| 20 dB attenuator 50Ω | 8491A/B/C Opt 020 | ✓ | — | Required for adjustments only if analyzer does not have an internal attenuator installed. |
| 20 dB attenuator 75Ω[2] | 0955-0768 | — | ✓ | Required for adjustments only if analyzer does not have an internal attenuator installed. (May substitute 2 min loss pads and a 50Ω 10 dB pad.) |
| Minimum loss pad | 11852B | — | ✓ | |
| Frequency counter | 535xB or equivalent | — | — | May not be required.[3] |
| Precision cable 50Ω | 8120-8862 or 8120-6469 | ✓ | — | |
| Precision cable 75Ω | 8120-8898 or 8120-6468 | — | ✓ | |
| Voltage reference source | 08712-60031 | ✓ | ✓ | Included in the service kit, part number 08712-60012. |
| 10 dB attenuator 50Ω | 8491A, Option 010 | ✓ | — | Generally not needed; occasionally required for adjustment #104. |
| BNC cable, 50Ω | 8120-1839 or equivalent | ✓ | ✓ | |
| Adapter, type-N (m) to BNC (f) | 1250-0780 or equivalent | ✓ | ✓ | |

1. An 85032B Option 001 is a subset of the standard 85032B. This option eliminates four 7-mm adapters that are not needed, resulting in a significant cost savings.
2. The required attenuators depend on the firmware revision of the analyzer. The attenuators listed above apply to all versions of firmware.
3. The frequency counter is useful when very accurate frequency measurements are needed. However, if you are using a synthesized spectrum analyzer, the frequency can be measured by using the spectrum analyzer. Note that the frequency measurement using a spectrum analyzer will not be quite as accurate as a frequency counter, but is sufficient in most cases. (An 8560 series spectrum analyzer may be used.)

# Correction Constants (CCs) Storage

During normal operation, the network analyzer uses correction constants that are stored in the RAM buffer. When the analyzer's line power is switched on, the analyzer copies the current correction constants from the CPU EPROM into the RAM buffer.

During the adjustment tests, the analyzer generates correction constants and saves them to the RAM buffer only. If the power is switched off without performing the steps below, the newly generated correction constants will be lost.

To transfer the newly generated correction constants from the RAM buffer to the CPU EPROM, press the following keys:

(SYSTEM OPTIONS) **Service** **Update Corr Const** **Store CC to EPROM** .

To make a backup copy of the correction constants to a 3.5" disk, perform the following steps:

1. Insert a formatted 3.5" disk into the analyzer's internal disk drive.

2. Press (SYSTEM OPTIONS) **Service** **Update Corr Const** **Store CC to Disk** . This creates a file (or writes over an existing file) where the correction constants are stored. This file allows you to quickly restore the adjustment data if you replace the CPU board.

When performing the adjustment procedures, it is beneficial to store the correction constants to the 3.5" disk. This allows you to restore data quickly in case you need to switch off the analyzer's line power before completing the adjustments.

| CAUTION | If the analyzer's line power is switched off at any time during the adjustments, you *must* reload the previously stored correction constants (if they have been saved to disk) before proceeding. Failure to do so will result in the loss of previously performed adjustment data at the time of the next correction constant data save. The adjustments will have to be performed again. |
|---|---|
| | If the correction constants were never saved to disk, the adjustments will have to be performed again as well. |

# Frequency Accuracy Adjustment

In this adjustment, the frequency accuracy of the analyzer's source is calibrated by adjusting the 10 MHz internal reference clock.

## Required Equipment

| Equipment Description | Recommended HP/Agilent Model or Part Number | |
|---|---|---|
| | **For 50Ω Analyzers** | **For 75Ω Analyzers** |
| Frequency counter | 535xB | 535xB |
| BNC cable | 8120-1839 | 8120-1839 |
| Minimum loss pad | N/A | 11852B |
| Adapter, type-N(m) to BNC(f) | 1250-0780 | 1250-0780 |

### Warmup Time

Allow the analyzer to warm up for one hour.

### Estimated Adjustment Time

This adjustment takes approximately five minutes to perform.

## Procedure

1. Connect the equipment as shown in Figure 2-1.

**Figure 2-1 Setup for Frequency Accuracy Adjustment**
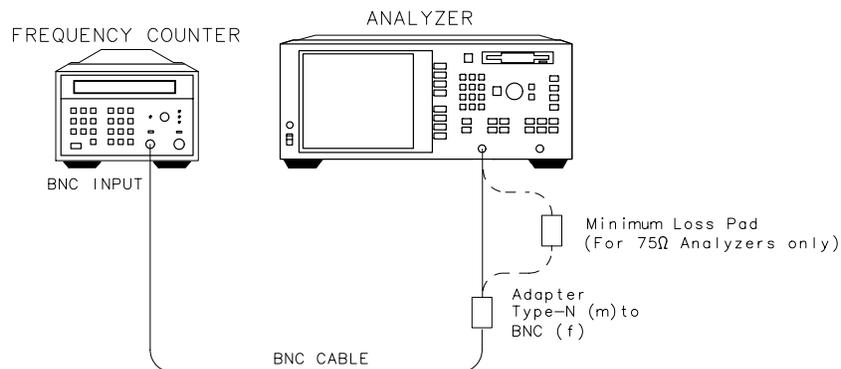
2.  Set the frequency counter input switches to the "10 Hz – 500 MHz" and 50Ω positions.

3.  On the analyzer, press (PRESET) (see caution on page 2-2) (FREQ) **CW** (500) **MHz** (MENU) **Trigger Hold**. If the frequency counter reading is 500 MHz ±2500 Hz, you do not need to make this adjustment. However, you can still make this adjustment to improve the frequency accuracy.

4.  To proceed with the adjustment, disconnect the frequency counter and adapter(s) from the analyzer's RF OUT/ PORT 1 port (see Figure 2-1 on page 2-5).

5.  Remove the handles and front panel by following these steps and referring to Figure 2-2.

    a.  Remove the trim strip from the handles.

    b.  Remove the screws attaching each handle to the analyzer.

    c.  Pull the analyzer toward you until it extends about two inches over the edge of the table top.

    d.  Grasp and pull the front panel with two hands: one on the top-middle of the panel, and the other on the bottom-middle of the panel.

**Figure 2-2    Removing the Handles and Front Panel**
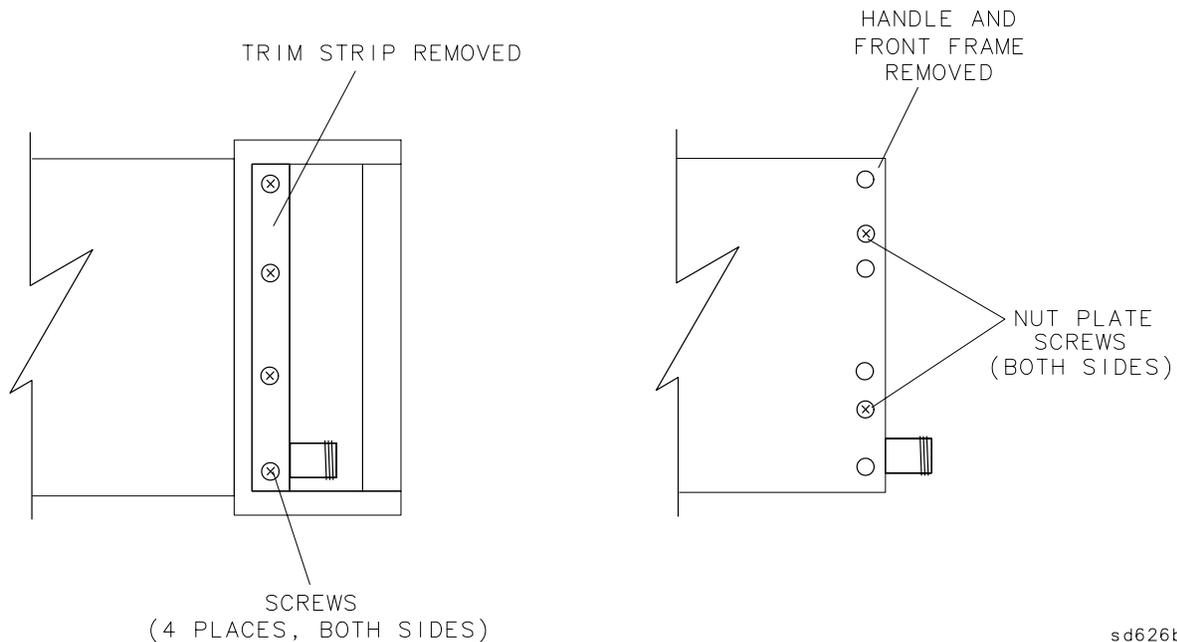


6.  Reconnect the frequency counter and adapter(s) to the RF OUT/PORT 1 port (see Figure 2-1 on page 2-5).

7.  To obtain a counter reading of 500 MHz ±2500 Hz or better, adjust R204 on the fractional-N/reference assembly (A3) (accessible through a hole in shield of the A3 assembly).

8.  Reassemble the analyzer.

# Set Serial Number, Adjustment #100

Adjustment #100 *cannot* be used to set an established serial number. The procedure outlined below can only be used to enter the serial number if the analyzer displays a default serial number value of ?????????? (ten question marks).

If it is necessary to modify a serial number that is other than the default value, contact the nearest Agilent Technologie sales or service office (see Chapter 9).

| NOTE | Where XXXXXXXXXX appears throughout this procedure, replace those characters with the serial number of your analyzer, but maintain the leading and following apostrophes (both are ASCII character 39). For example, if the serial number of your analyzer is US34405555, the HP BASIC line of code would be: |
|---|---|

```
OUTPUT 800;"DIAG:SNUM 'US34405555'"
```

IMPORTANT: Make sure there is a space between SNUM and the first apostrophe.

## Required Equipment

A PC-compatible keyboard is required.

If a keyboard is not available, this adjustment can be done from the front panel. (Refer to the note in the following procedure.)

### Estimated Adjustment Time

This adjustment takes approximately two minutes to perform.

## Procedure

1. Write down the 10-character serial number, exactly as shown on the analyzer rear-panel label.

2. With an external keyboard connected, press (ESC) to view the IBASIC command line. Then type the following:

```
OUTPUT 800;"DIAG:SNUM 'XXXXXXXXXX'"
```

then press (ENTER).

| NOTE | If you are using the front panel to set the serial number, enter the following IBASIC code, then "run" the program. |
|---|---|

```
OUTPUT 800;"DIAG:SNUM 'XXXXXXXXXX'"

END
```

Refer to Chapter 5 of the *HP Instrument Basic User's Handbook Supplement* for information on programming from the front panel of the instrument.

3. Press (SYSTEM OPTIONS) **Service** **Instrument Info** to verify that you correctly installed the serial number. The serial number is displayed in the dialogue box.

## In Case of Difficulty

If the analyzer displays an error message that tells you the serial number has the wrong format, check the rear-panel serial number tag again and verify that you have the correct serial number.

If the analyzer displays an error message that tells you "Serial number already set," it means that a serial number is already installed on that CPU board and therefore cannot be changed. For further instructions, contact your nearest Agilent Technologies sales or service office.

# LO Power Correction, Adjustment #101

| NOTE | Adjustment # 101 is not required for the 8712ET/ES or the 8714ET/ES. The adjustment may be performed but will not affect the operation of the instrument. |
|------|------|

# Switched Gain Correction, Adjustment #102

In this adjustment, the analyzer measures correction values for the switched gains in the Intermediate Frequency (IF) stages for each analyzer channel. The analyzer applies the corrected gains to the R, A, and B input channels to put the signal in the correct range for proper analog to digital converter (ADC) operation.

## Required Equipment

| Equipment Description | Recommended HP/Agilent Model or Part Number | |
|---|---|---|
| | For 50Ω Analyzers | For 75Ω Analyzers |
| Type-N cable | any 50Ω | any 75Ω |
| 20 dB attenuator[1] | 8491A Opt 020 | 0955-0768 |
| Voltage reference source (p/o service kit)[1, 2] | 08712-60031 | 08712-60031 |
| 6 dB attenuator[1] | 8491A/B/C Opt 006 | – |
| 10 dB attenuator[1] | 8491A/B/C Opt 010 | 0955-0767 |
| Minimum loss pad[1] | – | 11852B |

1. These items may not be needed; see text below.
2. Cable 8120-5514 must be used with the voltage reference source box; the normal power sensor cable will not work. (This cable is included as a part of 08712-60031.)

All the ES models and the ET Option 1E1 models have an internal RF step attenuator, so the attenuators and minimum loss pad listed above are not necessary. The standard ET models require various attenuators. As adjustments are performed, prompts for the operator will indicate the required attenuator values.

The attenuators required for a particular ET model depend on the firmware revision level of the network analyzer. The attenuators listed above apply to all versions of the firmware. In some cases, an appropriate 50Ω attenuator may be combined with two minimum loss pads to provide the necessary 75Ω attenuation. When substituting attenuators, the nominal value of the replacement combination should be within 3 dB of the value requested by the screen prompt. (The nominal value of a minimum loss pad is 5.7 dB.)

If the voltage reference source is not available, any stable dual ± 24 mV DC voltage source will work. This source voltage is not critical; any value between 20 mV and 30 mV should suffice. See adjustment #103, next, for connection information, which is identical to this adjustment.

**Warmup Time**

Allow the analyzer to warm up for one hour.

**Estimated Adjustment Time**

This adjustment takes approximately two minutes to perform.

# Procedure

1. Press (PRESET) (SYSTEM OPTIONS) **Service** **Test and Adjustments**
   **Select Adjustment** (102) (ENTER) **Execute Test** .

2. This is a fully automated adjustment handled by the internal firmware. Follow the instructions on the analyzer's display. If you are using the voltage reference source, note that no connection is needed other than the 12 pin connection cable.

   When prompted for an attenuator pad, a combination of attenuator pads may be used as a substitute as long as the nominal value of the combination is within 3 dB of the requested value.

   The analyzer presets after the test is done.

3. If you are *not* going to make any more adjustments, press (SYSTEM OPTIONS)
   **Service** **Update Corr Const** **Store CC to EPROM** .

   If you *are* going to make more adjustments, save the correction constant data that you have generated so far.

   a. Insert a formatted disk into the internal disk drive.

   b. Press (SYSTEM OPTIONS) **Service** **Update Corr Const** **Store CC to Disk** .
   This creates a file (or writes over an existing file) where the correction constants are stored.

# External Detector Gain Correction, Adjustment #103

This adjustment generates correction constants for the receiver to make both external detector and internal broadband measurements. Perform this test whether or not you plan to use external detectors.

In this test, an accurate ±0.5 V is provided to both the X and Y detector inputs by the voltage reference source.

## Required Equipment

| Equipment Description | Recommended HP/Agilent Part Number |
|---|---|
| Voltage reference source[1] (part of service kit) | 08712-60031 |

1. Cable 8120-5514 must be used with the voltage reference source box; the normal power sensor cable will not work. (This cable is included as a part of 08712-60031.)

---

NOTE          If a voltage reference source is not available, connect the requested voltages to the external detector connector as shown in Figure 2-3. Note that both a positive and negative voltage are required simultaneously, and both must be referenced to ground.

pin D = V+

pin C = V−

pin K = GND

These voltages may be obtained from a dual power supply, however it is possible to derive the required voltages from the external detector connector itself.

pin B = −15 V with respect to GND (pin K)

pin A = +15 with respect to GND (pin K)

---

**Figure 2-3   External Detector Connector, Front View**
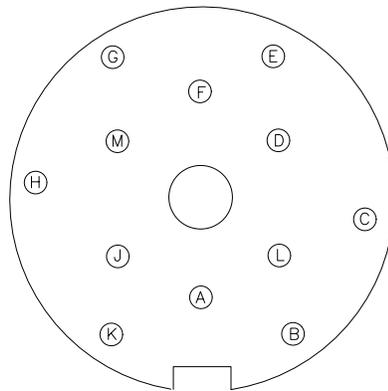


sd623b

## Warmup Time

Allow the analyzer to warm up for one hour.

## Estimated Adjustment Time

This adjustment takes approximately two minutes to perform.

# Procedure

1. Press (PRESET) (SYSTEM OPTIONS) **Service** **Test and Adjustments**
   **Select Adjustment** (103) (ENTER) **Execute Test** .

2. This is a fully automated adjustment handled by the internal firmware. Follow the instructions on the analyzer's display. If you are using the voltage reference source, note that no connection is needed other than the 12 pin connection cable.

   If the analyzer fails the adjustment test, resulting in a warning message, check the connections, voltages, and switch positions, then rerun the test.

3. If you are *not* going to make any more adjustments, press (SYSTEM OPTIONS)
   **Service** **Update Corr Const** **Store CC to EPROM** .

   If you *are* going to make more adjustments, save the correction constant data that you have generated so far.

   a. Insert a formatted disk into the internal disk drive.

   b. Press (SYSTEM OPTIONS) **Service** **Update Corr Const** **Store CC to Disk** .
      This creates a file (or writes over an existing file) where the correction constants are stored.

# Auxiliary Input Correction, Adjustment #111

This adjustment generates correction constants for the auxiliary input. The analyzer computes the offset and gain of the auxiliary input circuitry by measuring two voltages (0 and +10.000 DC volts) that are applied to the auxiliary input.

## Required Equipment

| Equipment Description | Recommended HP/Agilent Part Number |
|---|---|
| Voltage reference source (part of service kit)[1] | 08712-60031 or any +10.000 V voltage source. |
| 50Ω BNC cable | any known good cable |

1. Cable 8120-5514 must be used with the voltage reference source box; the normal power sensor cable will not work. (This cable is included as a part of 08712-60031.)

NOTE        The voltage reference source provides +10 V at its BNC connector. This connector must be connected to the AUX input on the rear panel of the analyzer.

### Warmup Time

Allow the analyzer to warm up for one hour.

### Estimated Adjustment Time

This adjustment takes approximately one minute to perform.

## Procedure

1. Press (PRESET) (SYSTEM OPTIONS) **Service** **Test and Adjustments** **Select Adjustment** (111) (ENTER) **Execute Test** .

2. This is a fully automated adjustment handled by the internal firmware. Follow the instructions on the analyzer's display.

3. If you are *not* going to make any more adjustments, press (SYSTEM OPTIONS) **Service** **Update Corr Const** **Store CC to EPROM** .

   If you *are* going to make more adjustments, save the correction constant data that you have generated so far.

   a. Insert a formatted disk into the internal disk drive.

   b. Press (SYSTEM OPTIONS) **Service** **Update Corr Const** **Store CC to Disk** . This creates a file (or writes over an existing file) where the correction constants are stored.

# Source Power Correction, Adjustment #104

In this adjustment, the analyzer creates a table of values that corrects the source output power over different frequencies and power levels. For all ES models, separate tables of values are created for the forward and reverse direction through the device under test (DUT).

The analyzer reads values from a power meter to determine the actual source output level. An HP/Agilent power meter is required for this test (see table below). Other power meters will not be controlled correctly by the analyzer.

## Required Equipment

| Equipment Description | Recommended HP/Agilent Model or Part Number | |
|---|---|---|
| | **For 50Ω Analyzers** | **For 75Ω Analyzers** |
| Power meter[1] | E4418A (EPM-441A) <br> E4419A (EPM-442A) <br> 437B or 438A | E4418A (EPM-441A) <br> E4419A (EPM-442A) <br> 437B or 438A |
| Power sensor | 8482A | 8482A |
| High sensitivity power sensor[2] | 8481D or 8484A | 8481D or 8484A |
| 10 dB attenuator[3] | 8491A Opt. 010 | N/A |
| Minimum loss pad | N/A | 11852B |
| GPIB cable | 10833A | 10833A |

1. The EPM-441A and EPM-442A, *with versions prior to A 2.02.00 firmware,* cannot be controlled by the analyzer. These versions do not have the 438A command set firmware. These versions of firmware may be upgraded at a service center (see Chapter 9).
2. All ES models as well as the ET models with the 1E1 option have an RF step attenuator installed. For these instruments, you will need an 8481D power sensor and an 11708A 30 dB reference attenuator to perform this adjustment procedure. The 11708A is supplied with the power sensor.
3. The 10 dB attenuator is generally not needed, but may be required if the uncorrected maximum output power level is unusually high for a given analyzer.

### Warmup Time

Allow the analyzer to warm up for one hour.

### Estimated Adjustment Time

This adjustment takes approximately five to fifteen minutes to run, depending on the installed options.

# Procedure

**Figure 2-4  Setup for Source Power Correction**
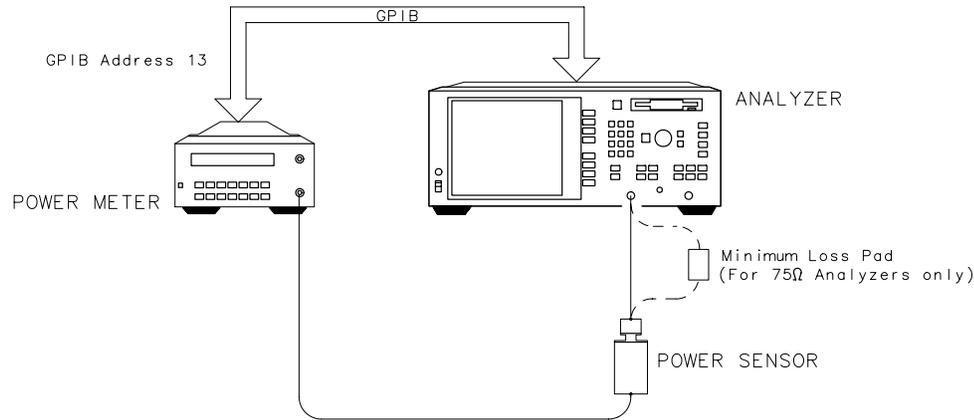


NOTE        Before you begin this adjustment, you should store a copy of the correction
            constants in a disk file for later retrieval, if you have not done so already.

1. Switch the power meter on and let it warm up for at least five minutes.

2. Connect an GPIB cable between the analyzer and the power meter. Set the GPIB
   address of the power meter to 13. Disconnect any controller that may be on the GPIB
   bus.

NOTE        If the power meter is not a 437B or 438A, select the following from the GPIB
            menu, located on the *power meter:*

            **437B**  on the E4418A (EPM-441A)

            **438A**  on the E4419A (EPM-442A)

3. Press (PRESET) (SYSTEM OPTIONS)  **Service   Test and Adjustments**
   **Select Adjustment**  (104) (ENTER)  **Execute Test** .

4. Follow the instructions on the analyzer's display.

5. When the test is done, disconnect the power sensor and press (PRESET)
   (SYSTEM OPTIONS)  **GPIB   Talker Listener** .

6. If you are *not* going to make any more adjustments, press  **SYSTEM OPTIONS**
   **Service   Update Corr Const   Store CC to EPROM** .

   If you *are* going to make more adjustments, save the correction constant data that you
   have generated so far.

a.  Insert a formatted disk into the internal disk drive.

b.  Press ⬭SYSTEM OPTIONS⬭ **Service** **Update Corr Const** **Store CC to Disk** .
    This creates a file (or writes over an existing file) where the correction constants are
    stored.

## In Case of Difficulty

If the system locks up or the power meter does not respond to the analyzer, make sure the
GPIB cable is correctly connected and the GPIB address on the power meter is set to 13.

If a "log error" occurs on the power meter during the low power adjustment and the test
stops, you will need to do the test again. Save CCs to disk and then switch the analyzer off
and preset the power meter.

| NOTE | If you must cycle the analyzer's line power, and you did not store the correction constants to disk before starting this adjustment, you need to repeat all of the adjustments done up to this point, then repeat the source power correction. If you did save the correction constants to disk, recall the correction constants data from disk as described in Chapter 8, "Correction Constants and Firmware," then go back to step 1 to repeat this adjustment. |
|------|---|

# B Amplitude Correction, Adjustment #105

This adjustment corrects the B narrowband input so that it displays a flat 0 dB trace with an input of 0 dBm from the analyzer's internal source. The results are stored in a correction table that is accessed during operation.

For ES model analyzers, separate correction tables are created for the A input and the B input.

## Required Equipment

| Equipment Description | Recommended Model or Part Number | |
|---|---|---|
| | **For 50Ω Analyzers** | **For 75Ω Analyzers** |
| Type-N cable | 8120-6469 or 8120-8862[1] | 8120-6468 or 8120-8898[1] |

1. These cables are preferred because they have a better match and lower loss, which result in a better default calibration.

### Warmup Time

Allow the analyzer to warm up for one hour.

### Estimated Adjustment Time

This adjustment takes approximately one minute to perform.

## Procedure

1. Press (PRESET) (SYSTEM OPTIONS) **Service** **Test and Adjustments** **Select Adjustment** (105) (ENTER) **Execute Test** .

2. Follow the instructions on the analyzer's display.

3. If you are *not* going to make any more adjustments, press (SYSTEM OPTIONS) **Service** **Update Corr Const** **Store CC to EPROM** .

   If you *are* going to make more adjustments, save the correction constant data that you have generated so far.

   a. Insert a formatted disk into the internal disk drive.

   b. Press (SYSTEM OPTIONS) **Service** **Update Corr Const** **Store CC to Disk** . This creates a file (or writes over an existing file) where the correction constants are stored.

# Reflection (One-Port) Correction, Adjustment #107

This adjustment corrects for errors in reflection measurements. The analyzer measures an open, a short, and a load to perform a one-port reflection calibration and then stores the values in a correction table.

For all ES analyzers, separate correction tables are created for reflection corrections at PORT 1 and for reflection corrections at PORT 2.

## Required Equipment

| Equipment Description | Recommended HP/Agilent Model or Part Number | |
|---|---|---|
| | For 50Ω Analyzers | For 75Ω Analyzers |
| Calibration kit | 85032B/E | 85036B/E |

### Warmup Time

Allow the analyzer to warm up for one hour.

### Estimated Adjustment Time

This adjustment takes approximately three minutes to perform.

## Procedure

1. Press (PRESET) (SYSTEM OPTIONS) **Service** **Test and Adjustments** **Select Adjustment** (107) (ENTER) **Execute Test** .

2. Follow the instructions on the analyzer's display.

3. If you are *not* going to make any more adjustments, press (SYSTEM OPTIONS) **Service** **Update Corr Const** **Store CC to EPROM** .

    If you *are* going to make more adjustments, save the correction constant data that you have generated so far.

    a. Insert a formatted disk into the internal disk drive.

    b. Press (SYSTEM OPTIONS) **Service** **Update Corr Const** **Store CC to Disk** . This creates a file (or writes over an existing file) where the correction constants are stored.

# Transmission Correction, Adjustment #106

This adjustment performs a transmission response calibration to correct for frequency response in narrowband B/R measurements. It is recommended that you use a short-length, high quality cable to perform this adjustment.

## Required Equipment

| Equipment Description | Recommended Model or Part Number | |
|---|---|---|
| | **For 50Ω Analyzers** | **For 75Ω Analyzers** |
| Type-N cable | 8120-6469 or 8120-8862[1] | 8120-6468 or 8120-8898[1] |

1. These cables are preferred because they have a better match and lower loss, which result in a better default calibration.

### Warmup Time

Allow the analyzer to warm up for one hour.

### Estimated Adjustment Time

This adjustment takes approximately one minute to perform.

## Procedure

1. Press (PRESET) (SYSTEM OPTIONS) **Service** **Test and Adjustments** **Select Adjustment** (106) (ENTER) **Execute Test** .

2. Follow the instructions listed on the analyzer's display.

3. If you are *not* going to make any more adjustments, press (SYSTEM OPTIONS) **Service** **Update Corr Const** **Store CC to EPROM** .

   If you *are* going to make more adjustments, save the correction constant data that you have generated so far.

   a. Insert a formatted disk into the internal disk drive.

   b. Press (SYSTEM OPTIONS) **Service** **Update Corr Const** **Store CC to Disk** . This creates a file (or writes over an existing file) where the correction constants are stored.

# B* Amplitude Correction, Adjustment #110

In this adjustment, correction data is generated to calibrate the internal broadband B* channel detector for accuracy and power at 30 MHz.

## Required Equipment

| Equipment Description | Recommended HP/Agilent Model or Part Number | |
| --- | --- | --- |
| | For 50Ω Analyzers | For 75Ω Analyzers |
| Type-N cable | 8120-4781 or 8120-6469[1] | 8120-2408 or 8120-6468[1] |
| 20 dB attenuator[2] | 8491A Opt. 020 | 0955-0768 |

1. These cables are preferred because they have a better match and lower loss, which result in a better default calibration.
2. This item may not be required; see text below.

NOTE        Adjustments 104 and 105 must be completed before performing this adjustment.

The required equipment for this adjustment varies depending upon whether or not the analyzer has an internal step attenuator installed (ET model analyzers with option 1E1 and ES model analyzers). If the analyzer has an internal attenuator, then only a type-N cable is needed to complete the adjustment. If an attenuator is not installed, then a 20 dB attenuator of the proper impedance will also be required.

If a 75Ω 20 dB attenuator is not readily available for Option 1EC analyzers, you can substitute two back-to-back minimum loss pads with a 6 dB 50Ω attenuator inserted in between (several adapters may also be required).

### Warmup Time

Allow the analyzer to warm up for one hour.

### Estimated Adjustment Time

This adjustment takes approximately three minutes to perform.

## Procedure

1. Press (PRESET) (SYSTEM OPTIONS) **Service** **Test and Adjustments**
   **Select Adjustment** (110) (ENTER) **Execute Test** .

2. This is a fully automated adjustment handled by the internal firmware. Follow the instructions on the analyzer's display.

   The analyzer presets after the test is done.

3. If you are *not* going to make any more adjustments, press **Service**
   **Update Corr Const** **Store CC to EPROM** .

   a. Insert a formatted disk into the internal disk drive.

   b. Press (SYSTEM OPTIONS) **Service** **Update Corr Const** **Store CC to Disk** .
      This creates a file (or writes over an existing file) where the correction constants are stored.

# R* Amplitude Correction, Adjustment #108

This adjustment generates correction constants to improve absolute power accuracy in R* measurements. (Frequency effects are corrected in "R* Frequency Response Correction, Adjustment #109.")

## Required Equipment

| Equipment Description | Recommended HP/Agilent Model or Part Number | |
|---|---|---|
| | **For 50Ω Analyzers** | **For 75Ω Analyzers** |
| Type-N (m) termination (p/o 85032B/E or 85036B/E) | 00909-60009 | 00909-60019 |

---

CAUTION    You must perform adjustment #103 (external detector correction) and adjustment #104 (source power correction) before running the R* amplitude correction adjustment.

---

### Warmup Time

Allow the analyzer to warm up for one hour.

### Estimated Adjustment Time

This adjustment takes approximately two minutes to perform.

## Procedure

1. Press (PRESET) (SYSTEM OPTIONS) **Service  Test and Adjustments  Select Adjustment** (108) (ENTER) **Execute Test** .

2. Follow the instructions on the analyzer's display.

   If the analyzer displays an error message and aborts the adjustment, the calibration data from adjustments #103 and #104 are probably corrupt, and adjustments #103 and #104 should be performed again.

3. If you are *not* going to make any more adjustments, press (SYSTEM OPTIONS) **Service  Update Corr Const  Store CC to EPROM** .

   If you *are* going to make more adjustments, save the correction constant data that you have generated so far.

   a. Insert a formatted disk into the internal disk drive.

b.  Press $\boxed{\text{SYSTEM OPTIONS}}$ **Service** **Update Corr Const** **Store CC to Disk** .
    This creates a file (or writes over an existing file) where the correction constants are
    stored.

# R* Frequency Response Correction, Adjustment #109

This adjustment corrects for frequency response errors in R* measurements.

| CAUTION | You must perform adjustment #108 (R* amplitude correction) before running the R* frequency response correction adjustment. |
|---|---|

## Required Equipment

| Equipment Description | Recommended HP/Agilent Model or Part Number | |
|---|---|---|
| | For 50Ω Analyzers | For 75Ω Analyzers |
| Type-N (m) termination (p/o 85032B/E or 85036B/E) | 00909-60009 | 00909-60019 |

### Warmup Time

Allow the analyzer to warm up for one hour.

### Estimated Adjustment Time

This adjustment takes approximately one minute to perform.

## Procedure

1. Press (PRESET) (SYSTEM OPTIONS) **Service** **Test and Adjustments** **Select Adjustment** (109) (ENTER) **Execute Test** .

2. Follow the instructions on the analyzer's display.

3. If you are *not* going to make any more adjustments, press (SYSTEM OPTIONS) **Service** **Update Corr Const** **Store CC to EPROM** .

   If you *are* going to make more adjustments, save the correction constant data that you have generated so far.

   a. Insert a formatted disk into the internal disk drive.

   b. Press (SYSTEM OPTIONS) **Service** **Update Corr Const** **Store CC to Disk** . This creates a file (or writes over an existing file) where the correction constants are stored.

| CAUTION | Store the Correction Constants (CCs) to the EPROM. Loss of data will occur if the CCs are not saved. Refer to "Correction Constants (CCs) Storage"on page 2-4, for detailed instructions. |
|---|---|

# 3 Assembly Replacement

# Introduction

This chapter describes how to disassemble and reassemble your analyzer for the purpose of replacing a failed assembly. It also contains specific instructions for replacing each assembly.

A section on ordering parts, "How to Order Parts" on page 3-24, is included at the end of this chapter.

| NOTE | Some individual components of each assembly may also be replaced. See Chapter 7, "Parts List," for a list of the parts that are available for replacement. |
|---|---|

| WARNING | **Parts of this instrument may have sharp edges. Work carefully to avoid injury.** |
|---|---|

| WARNING | **These 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.** |
|---|---|

## Required Tools

- TORX drivers, sizes T-10 and T-15

- 5/8-inch wrench (for BNC nuts)

- 5/16-inch wrench (preferably the modified wrench included in the service kit)

- 5/16-inch nut driver (required only to replace the display)

- 5/16 inch 10 in-lb torque wrench

- 7/32 inch wrench (included in service kit)

# Assembly Removal/Replacement Procedures

The following sections describe how to remove your analyzer's major assemblies:

- "A1 Front Panel Assembly Replacement" on page 3-4

- "A2 CPU Board Assembly Replacement" on page 3-6

- "A3 Fractional-N/Reference Assembly Replacement" on page 3-10

- "A4 Source Assembly Replacement" on page 3-11

- "A5 Receiver Assembly Component Replacement" on page 3-13

- "A6 Power Supply Assembly Replacement" on page 3-19

- "A7 Display Assembly Replacement" on page 3-20

- "A8 Internal Disk Drive Assembly Replacement" on page 3-22

| NOTE | For your convenience, brief disassembly instructions are located on a label on the bottom of the analyzer. |
| --- | --- |

# A1 Front Panel Assembly Replacement

The A1 assembly comes in two different versions for both the ET and ES models: 50Ω and 75Ω. However, the difference is only cosmetic. Both assemblies have all the front panel components including frame, keyboard, keypad, and knob. The assemblies do not include the model number nameplate, which must be ordered separately, nor do they include the type-N connectors which are part of the A5 receiver assembly.

If the front frame has been damaged, but the keypad and knob are acceptable, you can save money by ordering only the following three parts (refer to Table 7-3 on page 7-5):

- front frame

- nameplate (choose according to model number)

- front plastic dress panel (choose 50Ω or 75Ω version)

---

**CAUTION**     Perform the following procedures *only* at an approved ESD workstation. See Figure 4-1 on page 4-3.

---

## Removing the Front Panel Assembly

1. Disconnect the power cord.

2. Remove the trim strip and the front handles. See Figure 3-1.

**Figure 3-1. Removing the Handles and Front Panel Assembly**



TRIM STRIP REMOVED

HANDLE AND
FRONT FRAME
REMOVED

NUT PLATE
SCREWS
(BOTH SIDES)

SCREWS
(4 PLACES, BOTH SIDES)

sd626b
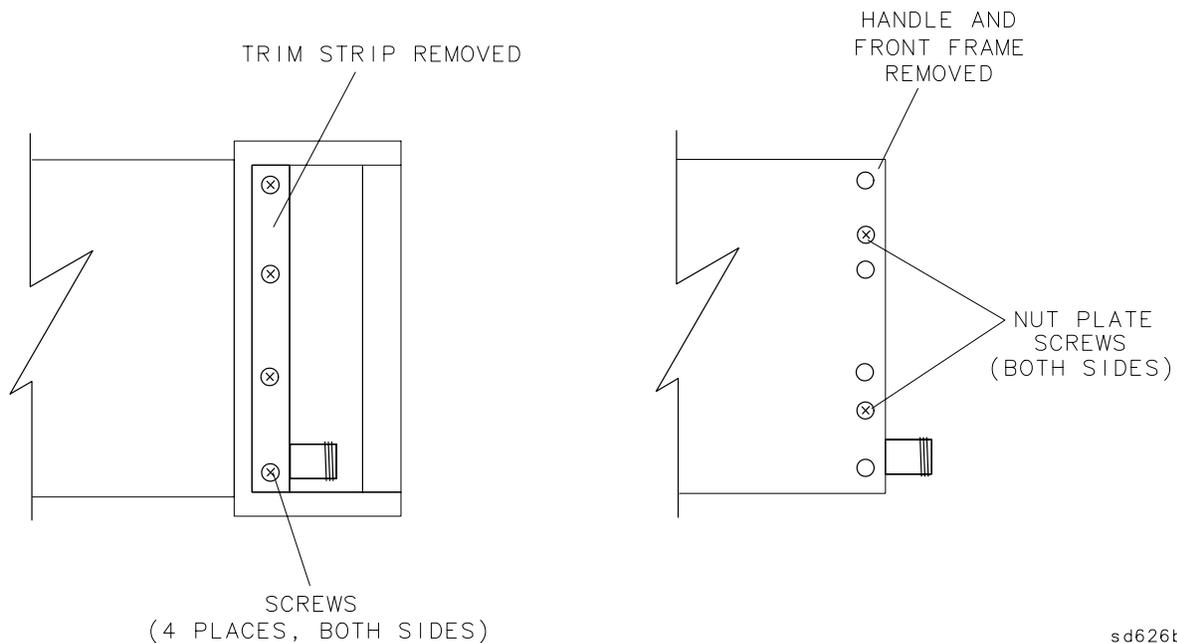
3. Pull the center top of the front panel up slightly and pull the center bottom down slightly to release the two centered catches.

---

4.  Pull the front panel several inches away from the cabinet.

5.  Disconnect the ribbon cable from the circuit board.

    - If you are planning to remove the A3 (fractional-N), A4 (source), or A5 (receiver) assemblies, remove the handle nut plate on the right side.

    - If you are planning to remove the A6 (power supply) or the A7 (display) assemblies, remove the handle nut plate on the left side.

    - If you are planning to remove the A2 (CPU board) assembly, you should remove both handle nut plates.

6.  To remove the front panel knob, gently pull it off its shaft.

7.  To remove the knob, disconnect the five-wire cable from A1J2. Remove the knob, hex nut, and washer.

| NOTE | If you are replacing a probe power fuse, the fuses are located in sockets on the A1 front panel assembly. See Item 6 in Table 7-3 on page 7-5. |
|------|---|

## Installing the Front Panel Assembly

To install the front panel, reverse the steps of the "Removing the Front Panel Assembly" procedure.

# A2 CPU Board Assembly Replacement

| CAUTION | Failure to follow instructions may result in an improperly operating analyzer. |
|---|---|
| | Make a copy of the correction constants (see Chapter 8) before replacing the A2 CPU assembly. |
| | Ensure that your analyzer's firmware disk is available before replacing the A2 CPU assembly. The replacement A2 CPU assembly may be shipped from the factory with a different firmware revision than your current firmware revision. If the replacement A2 CPU assembly was shipped with a different firmware revision, but the original firmware revision is desired, you can restore the original firmware from the analyzer's firmware disk. See "Upgrading or Re-Installing Firmware" on page 8-5. |

The replacement A2 CPU assemblies are supplied *without* a bootROM chip and with the latest version of firmware installed.

To restore the same operation that your original A2 CPU assembly had (which depended upon the installed options and model number), adhere to the following instructions. If you do not wish to use the latest version of firmware, you will need a firmware disk containing the version desired.

| CAUTION | Perform the following *only* at an approved ESD workstation. See Figure 4-1 on page 4-3. |
|---|---|

## Removing the CPU Board Assembly

| WARNING | **Danger of explosion if battery is incorrectly replaced. Replace with the same or equivalent type recommended. Discard used batteries according to manufacturer's instructions** |
|---|---|

1. Disconnect the power cord.

2. Disconnect all cables from the top row of connectors on the rear panel. Next, refer to Figure 3-2 on page 3-7 and remove the anchoring screw just above the GPIB connector.

**Figure 3-2. Location of the Anchoring Screw on the CPU Assembly**
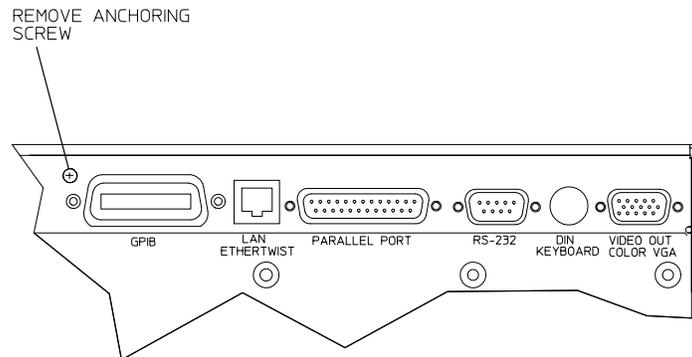


sd61c

3. Remove the front panel assembly (see "Removing the Front Panel Assembly" on page 3-4). Remove both the nut plates on the left and right handles.

4. Remove the display assembly (see "Removing the Front Panel Assembly" on page 3-4).

5. Remove the CPU assembly from its cavity.

6. Exchange the bootROM chips as follows:

---

NOTE        **Exchanging the bootROM must be done in order for the CPU board to function.**

---

a. Locate bootROM U335 chip on the old assembly. See Figure 3-3 on page 3-8.

b. Carefully use the IC extractor tool (included in the service kit) to remove the bootROM chip.

c. Carefully insert the original bootROM chip into the replacement CPU board, making sure that it is properly oriented.

**Figure 3-3. Location of the BootROM Chip, U335 and Jumper J301**
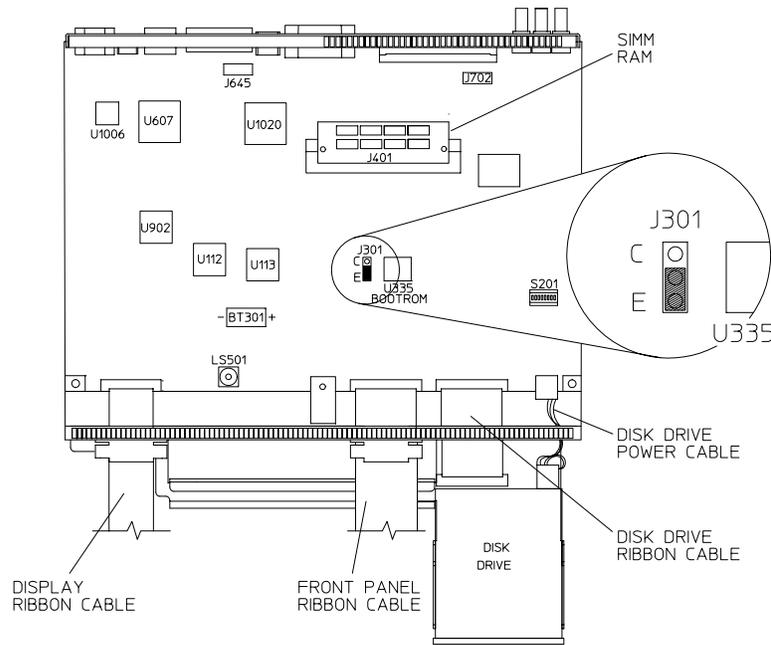


sp67es

7.  Transfer any modified (Single Inline Memory Module) SIMM:

    If the original board has a larger SIMM installed, transfer the larger SIMM to the new CPU assembly.

| NOTE | As shipped from the factory, all analyzers have 32 MB of SIMM memory. To increase the amount of memory, remove the existing SIMM and replace it with a higher capacity SIMM. |
|---|---|

8.  Check the jumper at J301 (see Figure 3-3) and verify that it is set for your analyzer's model type. All ET and ES models should have the jumper on the "E" designation. The "C" designation is for the previous HP/Agilent 871xC models.

9.  Transfer the A8 3.5" internal disk drive assembly:

    Remove the disk drive from the old board and install it on the replacement assembly.

10. Transfer all cable assemblies:

    Remove all cable assemblies from the old board and properly attach them to the replacement board.

The replacement CPU board is now ready to be installed.

| NOTE | In the unlikely event that the bootROM has failed, then the replacement board (which has the transferred bootROM installed) will also "fail." A "minimum configuration" bootROM is included in the service kit to help isolate this type of failure. If it is proven that the bootROM has failed, contact your nearest Agilent Technologies sales or service office for assistance. |
|------|---|

| NOTE | If you have ordered a rebuilt-exchange assembly, the failed CPU assembly must be returned with the SIMM module installed. |
|------|---|

## Installing the CPU Board Assembly

To install the CPU board assembly into the analyzer, reverse the steps of the "Removing the CPU Board Assembly" procedure.

# A3 Fractional-N/Reference Assembly Replacement

**CAUTION**     Perform the following *only* at an approved ESD workstation. See Figure 4-1 on page 4-3.

## Removing the Fractional-N/Reference Assembly

1. Disconnect the power cord.

2. Remove the front panel assembly (see "Removing the Front Panel Assembly" on page 3-4). Remove the handle nut plate on the right side only.

3. Ensure that there is no cable connected to the EXT REF IN BNC connector on the rear panel.

4. Remove the nut and washer from the EXT REF IN BNC connector on the rear panel.

5. Disconnect the two flexible cables from the front of the assembly. See Figure 3-4.

   **Figure 3-4. Cable Locations on the Fractional-N/Reference Assembly**



6. Grasp the handle tab and pull forward to release the assembly. Once released, the assembly will easily slide out of its cavity.

## Installing the Fractional-N/Reference Assembly

To install the fractional-N/referecnce assembly into the analyzer, reverse the steps of the"Removing the Fractional-N/Reference Assembly" procedure.

# A4 Source Assembly Replacement

| | |
|---|---|
| NOTE | The source board has a low frequency version (8712ET/ES) and high frequency version (8714ET/ES); make sure you have the proper board. |

| | |
|---|---|
| CAUTION | Perform the following *only* at an approved ESD workstation. See Figure 4-1 on page 4-3. |

## Removing the Source Assembly

1. Disconnect the power cord.

2. Remove the backplane cover by unscrewing the two hold-down screws and sliding the cover off.

3. Remove the rear panel screw (SCREW 9 as indicated on the rear-panel label) located to the right of the XA4J1 connector.

4. Remove the front panel assembly (see "Removing the Front Panel Assembly" on page 3-4). Remove the handle nut plate on the right side only.

5. Disconnect the four cables from the front of the source assembly. See Figure 3-5.

**Figure 3-5. Cable Locations on the A4 Source Assembly**
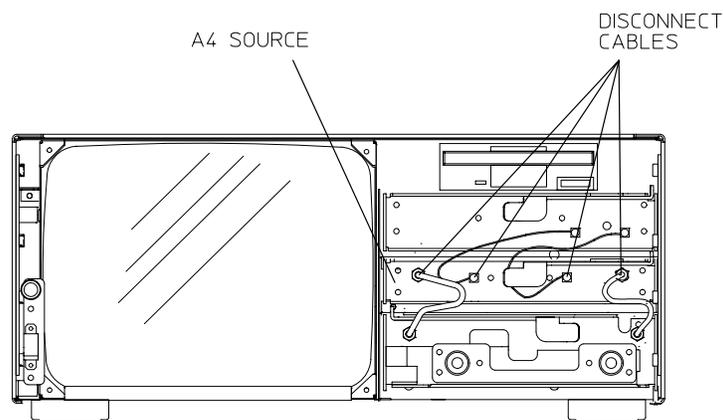


6. Grasp the handle tab and pull it forward to release the assembly. Once released, the assembly will easily slide out of its cavity.

# Installing the Source Assembly

| CAUTION | Be very careful when reconnecting the semirigid cables (items numbered 1 and 4 in Table 7-2 on page 7-4). They are not interchangeable. Ensure that one cable is not confused with the other. It is possible to force the wrong cable onto the wrong connector, resulting in damage to the connectors or the cables. Tighten to 10 in-lb of torque. |
|---------|---|

| NOTE | Insure that SCREW 9 is re-installed and secure when you have completed reassembling the analyzer |
|------|---|

To install the source assembly into the analyzer, reverse the steps of the "Removing the Source Assembly" procedure.

# A5 Receiver Assembly Component Replacement

The A5 receiver board is *not* intended to be replaced at the assembly level. The receiver assembly can be troubleshot down to module or component level. Instructions for replacing the module and components are included in this section.

| | |
|---|---|
| **CAUTION** | Perform the following *only* at an approved ESD workstation. See Figure 4-1 on page 4-3. |

| | |
|---|---|
| **NOTE** | When connecting an SMA adapter (see item 2 in Table 7-8, Table 7-9, and Table 7-10), use the 7/32-inch wrench to hold the adapter in place while tightening the attaching cables. |

## Removing the Receiver Assembly

1. Disconnect the power cord.

2. Disconnect any cables from the EXT DET X-input, EXT DET Y-input, and AUX INPUT rear panel BNC connectors.

3. Remove nuts and washers from the AUX INPUT BNC connector.

4. Remove the three anchoring screws on the bottom of the analyzer. See Figure 3-6.

**Figure 3-6. Location of the A5 Receiver Anchoring Screws**
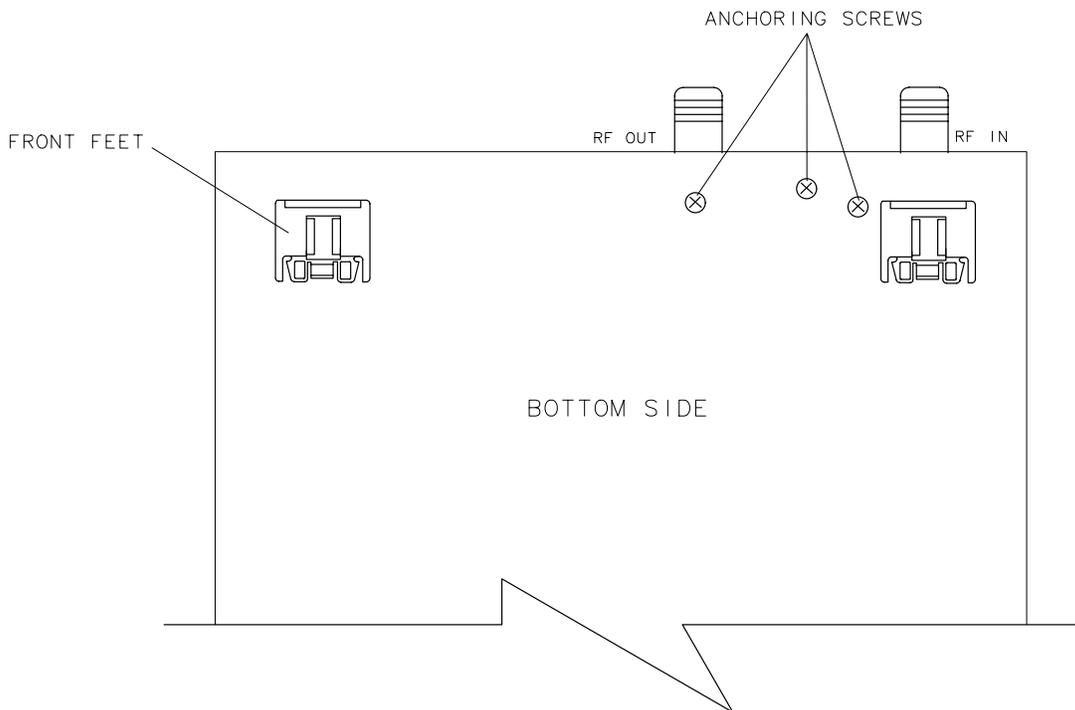
5. Remove the front panel assembly (see "Removing the Front Panel Assembly" on page 3-4). Remove the handle nut plate on the right side only.

6. Two semirigid cables connect the A5 assembly to the A4 assembly. Completely loosen one nut on each cable where it connects to the A4 assembly, then separate the cable from the A4 assembly.

7. Grasp the handle tab and pull forward to release the assembly. Once released, the assembly will easily slide out of its cavity.

| NOTE | If one or both RF port connectors are damaged, you *must* replace the plate that contains both connectors. Do *not* attempt to replace a single connector by itself. These connectors have been machine-pressed into the plate to prevent undesired rotation. It is not possible to duplicate this in the field. This plate assembly can be replaced separately. |
|------|---|

## Removing the Individual Components from the A5 Receiver Assembly

After the receiver assembly is removed from the instrument, individual components can be accessed. Follow the special assembly instructions in these sections:

• Removing the Receiver PC Board

• Removing the Coupler

• Removing the Switch (ES Analyzers)

• Removing the Attenuator (ES and Option 1E1 Analyzers)

• Removing the Limiter (ET Analyzers)

### Removing the Receiver PC Board.

| NOTE | The ET Option 1E1 and ES models have an attenuator board. A short ribbon cable connects the receiver board to the attenuator board. After the receiver board is removed you will want to transfer the attenuator ribbon cable to the new receiver board. The standard ET models do not have this board or ribbon cable. |
|------|---|

1. From the attenuator board, disconnect at J1 the ribbon cable that connects to the receiver board.

2. On the receiver board, loosen and lift the four semirigid cables off the connectors  J1 (LO IN), J2 (R RF IN), J3 (A RF IN), and J4 (B RF IN).

3. Remove the six screws that connect the frame to the main PC board. These screws are located just inside of the long metal frame. There are three screws on each side.

4. Carefully separate the receiver PC board from the mainframe.

5. Disconnect the attenuator ribbon cable from the old receiver board. Set the cable aside to be used with the new receiver board.

## Installing the Receiver PC Board.

| NOTE | If the receiver PC board is being replaced, an installation note may be included with the replacement board. When an installation note is included with the PC board, follow the instructions carefully. In some cases, a firmware upgrade for the network analyzer is required when replacing the receiver PC board. The installation note will indicate if this is necessary. |
|------|------|

1. Inspect the receiver board for damage.

2. Check that the jumper, J17, located toward the back of the board near the rear connectors, is set correctly (50Ω for standard analyzers or 75Ω for Option 1EC analyzers).

3. Transfer the attenuator ribbon cable from the old receiver board to the new receiver board. Plug it into J13.

4. Inspect all the connectors and the semirigid cables on the mainframe for damage.

5. Reverse the procedure used to remove the receiver board from the mainframe.

6. Tighten the semirigid cable connectors to 10 in-lb of torque.

7. Plug the ribbon cable into J1 on the attenuator board.

## Removing the Coupler.

1. Loosen, but do not disconnect, the input semirigid cable on the front of the coupler. The inflexibility of the input cable does not allow much room for movement; removing it could damage the cable and the input of the coupler.

| CAUTION | Be careful not to damage the center pins of the semirigid cables. Moving the cables out of the coupler connector exposes the center conductor pin to damage. |
|---------|------|

2. Disconnect the remaining semirigid cables from the coupler. Move the cable ends to the side of the coupler connectors. These cables are more flexible than the input cables and can be moved off the coupler connectors.

3. Remove the two screws that attach the coupler to the metal deck. Depending on the analyzer model, the two screws either go through the body of the coupler or through a bracket that secures the coupler.

4. Carefully slide the coupler away from the front semirigid cable. Be careful to keep the connector on the coupler aligned with the end of the cable when separating the two. If the cable is removed from the coupler at an angle, the center conductor of the coupler may be bent. (This is particularly important for the 75Ω coupler.) Lift the coupler out of the assembly.

**Installing the Coupler.**

1. Make sure the new coupler is of the correct impedance (50Ω or 75Ω) for the analyzer.

2. Inspect all the connectors and the semirigid cables for damage.

3. Reverse the procedure used to remove the coupler.

4. Tighten the semirigid cable connectors to 10 in-lb of torque.

**Removing the Switch (ES Analyzers).**

1. Disconnect the 3-wire power/control cable from the J3 connector on the attenuator PC board.

2. With the special shaved wrench, loosen and lift the two outside cables off the switch

3. Loosen and remove the center cable from the switch and the attenuator.

4. Loosen and remove the two screws that attach the switch to the attenuator PC board.

**Installing the Switch.**

| NOTE | Make sure the center semirigid cable is routed under the adjacent cable. See item 23 in the illustration on page 7-14, for a visual representation of the cable. |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|

1. Inspect all the connectors and the semirigid cables for damage.

2. Reverse the procedure used to remove the switch.

3. Tighten the semirigid cable connectors to 10 in-lb of torque.

| CAUTION | To prevent damage to the power-control cable when sliding the receiver assembly into the chassis, route the excess 3-wire cable under the nearby semirigid cable. |
|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**Removing the Attenuator (ES and Option 1E1 Analyzers).**

1. Disconnect the two semirigid cables from the attenuator. On ES models, loosen and disconnect the three cables from the switch as in the procedure "Removing the Switch (ES Analyzers)" on page 3-16.

2. Disconnect the ribbon cable at J1 on the attenuator PC board.

3. Reroute the excess length of 3-wire cable so that it is above the adjacent semirigid cabling.

4. Remove the four corner screws of the attenuator PC board. Carefully lift the board out of the assembly taking care not to damage any pins or cables.

5. Disconnect the smaller ribbon cable from J2 on the attenuator PC board.

6. Lay the board with attenuator on a flat surface. Remove the two screws that fasten the attenuator to the bottom of the board.

7. Lift the attenuator off of the PC board.

## Installing the Attenuator.

1. Inspect all the connectors and the semirigid cables for damage.

2. Reverse the procedure used to remove the attenuator.

3. Tighten the semirigid cable connectors to 10 in-lb of torque.

**Removing the Limiter (ET Analyzers).**

1. One of the limiters is secured by a plastic clamp. The clamp has two arms that snap open and closed. To open the clamp, pull up on the end of the arm on top.

2. When removing a limiter from cabling, first loosen the nut that is captured on the limiter and disconnect that end of the limiter.

CAUTION    When applying significant torque to the nut, use a wrench or pliers to keep the end of the semirigid cable from rotating.

   a. If the limiter is connected to J6 via a semirigid cable (rather than directly connected), remove the cable (see item 13 in Table 7-9 on page 7-13) before loosening the nut on the other end of the limiter.

3. When loosening the nut on the other end of the limiter, use the 7/32-inch wrench to keep the body of the limiter from rotating.

**Installing the Limiter.**

1. Reverse the procedure used to remove the limiter.

2. If the limiter is secured with a plastic clamp, first place the more narrow arm of the clamp against the body of the limiter. Then press the second arm over the first arm until its end snaps securely onto the first arm.

## Installing the Receiver Assembly

CAUTION    Be very careful when reconnecting the semirigid cables (items numbered 1 and 4 in Table 7-2 on page 7-4) They are not interchangeable. Ensure that one cable is not confused with the other. It is possible to force the wrong cable onto the wrong connector, resulting in damage to the connectors/cables. Tighten to 10 in-lb of torque.

1. Before inserting the receiver assembly into the chassis, be sure to inspect all cabling to make sure it is below the level of the top of the couplers.

2. To install the receiver assembly into the analyzer, reverse the steps of the "Removing the Receiver Assembly" on page 3-13.

# A6 Power Supply Assembly Replacement

The power supply is a single assembly. The only lower level part available for replacement is the cooling fan.

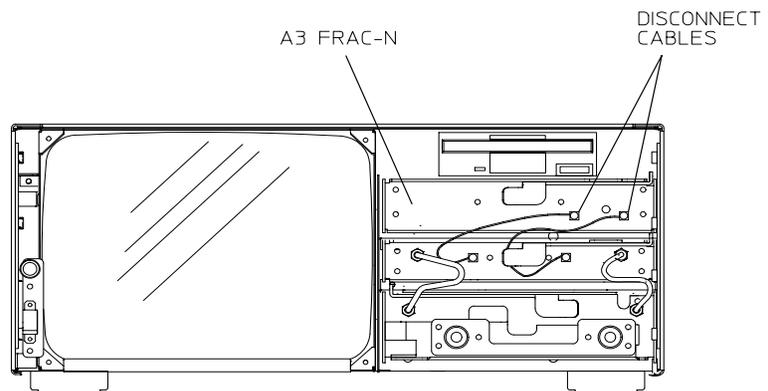CAUTION        Perform the following *only* at an approved ESD workstation. See Figure 4-1 on page 4-3.

## Removing the Power Supply Assembly

1.  Disconnect the power cord.

2.  Remove the front panel assembly (see "Removing the Front Panel Assembly" on page 3-4). Remove the handle nut plate on the left side only.

3.  Remove the display enclosure (see the following section "Removing the Display Assembly" on page 3-20

4.  Remove the four screws along the rear edge of the display enclosure.

5.  Remove the screw from the display access panel.

6.  Open the display access panel and disconnect the two-wire cable from the power supply.

7.  Remove the power supply from the housing.

## Installing the Power Supply Assembly

To install the power supply assembly, reverse the steps in the "Removing the Power Supply Assembly" procedure.

# A7 Display Assembly Replacement

The display consists of the CRT assembly and a matched circuit board. Both assemblies must be replaced at the same time.

| | |
|---|---|
| CAUTION | Perform the following *only* at an approved ESD workstation. See Figure 4-1 on page 4-3. |

## Removing the Display Assembly

1. Disconnect the power cord.

2. Remove SCREW 7 (two places) as indicated on the rear-panel label.

3. Remove the two screws (located on the display side of the analyzer) from the bottom of the analyzer chassis.

4. Remove the front panel assembly (see "Removing the Front Panel Assembly" on page 3-4). Remove the handle nut plate on the left side only.

5. Pull out the enclosure 2 or 3 inches from its cavity.

6. Disconnect the ribbon cable from the jack behind the top of the CRT.

7. Completely withdraw the enclosure from its cavity.

8. Remove the screw from the display access panel and open the panel.

9. Disconnect all associated cables from the CRT and its circuit board.

10. Remove the four nuts and washers (one set from each corner) that secure the CRT to the display enclosure. Withdraw the CRT from the enclosure.

11. Remove the 2 screws that secure the circuit board to the display enclosure. Withdraw the circuit board from the enclosure.

### Replacing the Power Switch or the Brightness Control

1. Remove the display enclosure from the analyzer.

2. Locate the switch and the brightness control at the left side of the display. Remove both of these from the display flange.

3. Both the switch and brightness controls and their associated cables must be replaced as a unit.

## Adjusting the Position of the CRT

If the display does not seem to be level (the scan lines do not appear to be horizontal) after the display is replaced, the position of the CRT may need to be adjusted within the display enclosure.

1. Loosen the four nuts (one from each corner) that secure the CRT to the display enclosure.

2. Reposition the CRT.

3. Tighten the four nuts.

# A8 Internal Disk Drive Assembly Replacement

The disk drive must be replaced if it fails. However, before replacing the drive, try cleaning the drive with a suitable cleaning device, or by spraying it with clean compressed air. Most "failed" drives are only in need of a cleaning.

| CAUTION | Perform the following *only* at an approved ESD workstation. See Figure 4-1 on page 4-3. |
|---|---|

## Removing the 3.5" Disk Drive Assembly

1. Disconnect the power cord.

2. Remove the front panel assembly (see "Removing the Front Panel Assembly" on page 3-4).

3. Remove the CPU assembly (see "Removing the CPU Board Assembly" on page 3-6).

4. Remove the four screws anchoring the disk drive to the CPU assembly.

5. Disconnect the ribbon cable and power cable.

## Installing the 3.5" Disk Drive Assembly

To install the 3.5" disk drive assembly into the analyzer, reverse the steps of the "Removing the 3.5" Disk Drive Assembly" procedure.

# Post Repair Procedures

Table 3-1 describes the adjustments and performance tests that are required after one or more of the analyzer's assemblies are replaced. For detailed information on the verification tests, refer to Chapter 1; for detailed procedures on the adjustments, refer to Chapter 2.

**Table 3-1  Post Repair Procedures**

| Replaced Assembly | Required Adjustments | Suggested Performance Tests |
|---|---|---|
| A1 Front Panel | None | Functional tests only[1] |
| A2 CPU | **Reload correction constant file from disk OR (if CCs are not available) perform these tests the order below:**<br>Switched Gain Correction, adj #102<br>External Detector Gain Correction, adj. #103<br>Aux Input Correction, adj. #111<br>Source Power Correction, adj. #104<br>B Amplitude Correction, adj. #105<br>Reflection Correction, adj. #107<br>Transmission Correction, adj. #106<br>B* Amplitude Correction, adj. #110<br>R* Amplitude Correction, adj. #108<br>R* Frequency Response Correction, adj. #109 | Functional tests only[1]<br>**OR:**<br>Broadband Frequency Response (PT07)<br>Dynamic Accuracy (PT04)<br>Absolute Power Accuracy (PT06)<br>Directivity (PT08)<br>Power Flatness (PT05) |
| A3 Fractional-N/Reference | Frequency Accuracy Adjustment | Trace Noise (PT10)<br>Frequency Accuracy (PT09)<br>Harmonics (PT09) |
| A4 Source | Source Power Correction, adj. #104<br>B Amplitude Correction, adj. #105<br>Reflection Correction, adj. #107<br>Transmission Correction, adj. #106 | Power Flatness (PT05)<br>Harmonics (PT09)<br>Trace Noise (PT10)<br>Crosstalk (PT11) |
| A5 Receiver Assembly[2] | Switched Gain Correction, adj #102<br>External Detector Gain Correction, adj. #103<br>Aux Input Correction, adj. #111<br>Source Power Correction, adj. #104<br>B Amplitude Correction, adj. #105<br>Reflection Correction, adj. #107<br>Transmission Correction, adj. #106<br>B* Amplitude Correction, adj. #110<br>R* Amplitude Correction, adj. #108<br>R* Frequency Response Correction, adj. #109 | Noise Floor (PT03)<br>Power Flatness (PT05)<br>Broadband Frequency Response (PT07)<br>Dynamic Accuracy (PT04)<br> Harmonics (PT09)<br>Absolute Power Accuracy (PT06)<br>Directivity (PT08)<br>Gain Compression (PT02)<br>Crosstalk (PT11)<br>Trace Noise (PT10) |
| A6 Power Supply | None | Power-on self tests |
| A7 Display | Check display intensity | Functional tests only[1] |
| A8 3.5" Internal Disk Drive | None | Functional tests only[1] |

1. Functional tests include turning on the analyzer and performing a simple measurement.
2. If the entire receiver assembly *or* any of its components have been replaced, perform all of the recommended adjustments and verifications.

# How to Order Parts

To order parts, follow the steps below:

1.  Locate and identify the part number from Chapter 7.

2.  Identify the quantity of parts desired.

3.  If in the United States, call the Direct Ordering Department at (800) 227-8164.

| NOTE | The Direct Ordering Department is open Monday through Friday, from 6 am to 5 pm, Pacific Time. You will be assisted by a parts specialists with direct on-line access to the parts listed in this manual. Four-day delivery is standard; one-day (hotline) delivery is available for an additional charge. |
|------|---|

4.  If outside of the United States, contact the nearest Agilent Technologies sales or service office (see Table 9-1).

5.  If the parts you need are not listed, contact the nearest Agilent Technologies sales or service office listed in Table 9-1.

## Save Money by Ordering R-E (Rebuilt-Exchange) Assemblies

If you need to replace an assembly and would like to save money, consider a R-E (rebuilt-exchange) assembly. These factory-repaired and tested assemblies are available on a trade-in basis. They meet all factory specifications required of a new assembly. They are designated (R-E) in Chapter 7.

# 4 Troubleshooting and Block Diagrams

# Introduction

This chapter is divided into four main, symptom-related sections. Refer to the section that best describes the problem you are observing, based on the results of your initial observation.

**Category 1 Failures:**

- dead or no response
- no display
- unreadable display
- error message/code displayed

**Category 2 Failures:**

- No error message, but nonfunctional measurement, for example, a through-line transmission trace is not flat and centered around 0 dB.

**Category 3 Failures:**

- inaccurate (but reasonably functional) measurements

**Category 4 Failures:**

- Peripheral device problems such as:
    - GPIB problems
    - printer problems
    - keyboard problems
    - disc drive maintenance

## General Notes

| WARNING | ***Always* unplug the analyzer's line power before removing or installing an assembly.** |
|---|---|

| WARNING | **These 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.** |
|---|---|

| CAUTION | The preset power level is user-definable. When pressing (PRESET), change the power level to 0 dBm if necessary. |
|---|---|

| CAUTION | If you need to disassemble the instrument, be sure to work at an antistatic workstation and use a grounded wrist strap to prevent damage from electrostatic discharge (ESD). See Figure 4-1 on page 4-3. |
|---|---|

**Figure 4-1  Example of an Antistatic Workstation**
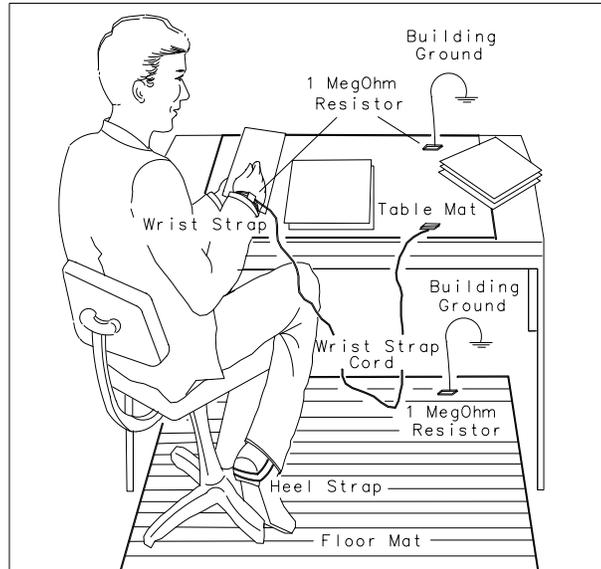


- For disassembly procedures, see Chapter 3.

| WARNING | **Some parts in the analyzer have sharp edges. Work carefully to avoid injury.** |

- Before replacing an assembly, inspect the board for obvious, easy-to-fix defects. Examples include:

  - bent pins on ICs

  - no solder in holes around the edges of shields

  - cold solder joints

## Service Kit

The service kit (08712-60012) for the 871x series analyzers contains several parts that are useful for adjusting and servicing the analyzer. The following parts are included:

- extender board assembly that allows you to operate selected internal board assemblies outside the analyzer chassis

- GPIB connector extender that allows you to mate an GPIB cable when the extender board assembly is attached to the analyzer

- two SMB extension cables, 12 inches long (30-cm)

- modified 5/16-inch wrench for better access to SMA cable nuts

- IC extractor tool for removing ICs such as the U335 bootROM

- 6-inch (150-mm) semirigid coaxial extension cable

- non-shielded display ribbon cable used to connect the display when the A2 CPU board is operated outside the chassis

- voltage reference source used to perform several adjustments. The source provides ±0.5 V, ±24 mV, and +10 V supplies.

- two "minimum configuration" bootROMs (one is for model 871xC)

- 7/32-inch wrench

- spare limiter to facilitate troubleshooting

## How to Use the Extender Board

The CPU (A2), fractional-N/reference (A3), source (A4), and receiver (A5) board assemblies can all be operated outside of the chassis with the extender board. This can be very helpful if you are troubleshooting a problematic board or assembly.

The supplied display ribbon cable is needed to connect to the display if the CPU assembly is connected to the extender board.

The SMB extension cables may be needed for the fractional-N/reference or source assemblies.

The A4 source and A5 receiver assemblies will need two flexible SMA RF cables (not supplied) to make the analyzer fully operational while either of these boards are connected to the extender board.

To use the extender board, follow these instructions:

1. Loosen the two screws on the back cover of the analyzer.

2. Slide the cover to the right and remove it.

3. Attach the lower half of the extender assembly to where the cover was previously located.

4. Align the hold-down screws and tighten securely; the board will not function if not tightened sufficiently.

5. Attach the two ribbon cable connectors as shown in Figure 4-2.

The board under test plugs into the 96-pin connector. When properly connected, both the top half of the extender assembly and the attached board under test can rest on top of the analyzer.

| NOTE | If it is necessary to connect a computer to the analyzer while using the extender board, then the GPIB connector extender (supplied) will be required in order to make a connection. |
|------|---|

**Figure 4-2  Connecting the Extender Board**
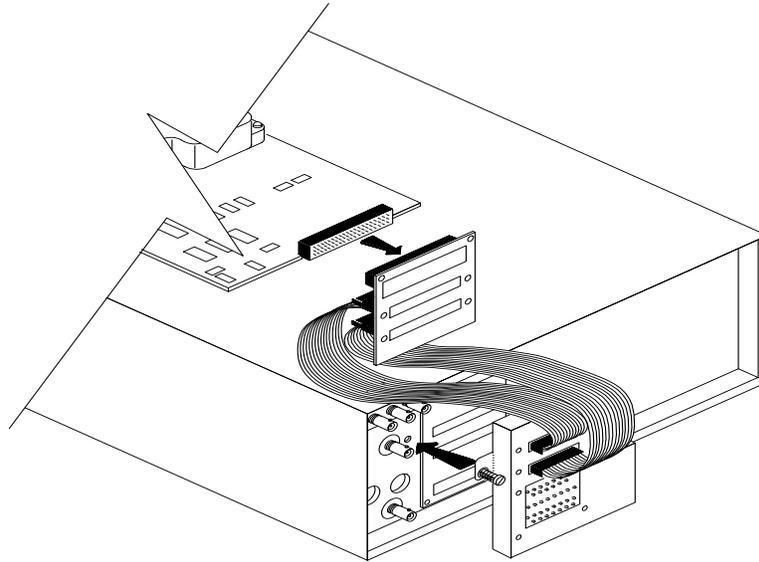


## Initial Observations — Normal Power-up Sequence

Prepare the analyzer for observation by performing these steps:

1. Disconnect all accessories and peripherals.

2. Remove the disk (if any) from the internal disk drive.

3. Connect a known-good cable between the RF OUT/PORT 1 and RF IN/PORT 2 ports.

Switch on the analyzer and watch for the proper power-up sequence:

1. Immediately after the analyzer's line power is switched on, the disk drive light activates briefly and a "beep" is audible from the CPU.

2. The CRT lists the bootROM self-tests being performed. (The CRT may take a few seconds to warm up.) If all bootROM self-tests pass, the analyzer beeps twice.

3. The disk-drive light illuminates briefly and the firmware loads from ROM.

4. The analyzer runs all of the remaining self-tests and the CRT displays the PASS/FAIL status of the self-tests.

5. During the next few seconds, these messages appear on CRT:

   • `Initializing`

   • `Calculating correction coefficients`

   • Other messages may appear briefly, depending on the analyzer's state at the time that the power was switched off.

6. Information on the model number, firmware revision, and installed options is displayed. The graticule may also be displayed, depending on the analyzer's power-down state.

Press (PRESET) (see the caution on page 4-2). The display should show a flat line about 0 dB. If it does not, ensure that the cable connecting the RF OUT/PORT 1 port to the RF IN/PORT 2 port is good and securely connected.

If the analyzer will not switch on, check the AC line power. Make sure that the line voltage selector switch (located below the AC power plug) is set correctly. Check the fuse.

If the analyzer does not go through the steps above, or if any error messages appear, or if the problem persists, refer to "Category 1 Failures: Dead or No Display" on page 4-7.

| NOTE | If any error is generated during the power-up sequence, the analyzer will halt after displaying the error message. At this point, if you press any key on the analyzer, it will attempt to resume operation. However, *erroneous or unstable operation may result*. The option of ignoring the error message is provided only as a troubleshooting aid. |

## Operator's Check

Perform the operator's check procedure as described in Chapter 1. It is a simple test of the analyzer's measurement capability. If the test passes and peripherals are not involved, duplicate the operating conditions under which the system failed and refer to the appropriate section in this chapter if the problem reoccurs.

# Category 1 Failures: Dead or No Display

This category of failure usually involves one of the following:

- defective A6 power supply
- defective A2 CPU
- poor contact with the rear plane connector board
- digital failure in any board assembly
- defective display

## Troubleshooting the Power Supply Assembly (A6)

Begin here if the problem appears to be power supply related.

### Check the Rear Panel LEDs

Switch the analyzer's line power on. Check the condition of the two LEDs visible through the hole in the rear panel to the right of the AC power plug.

1. **If the green LED is on and the red LED is off**

   This represents a normal condition. Go to "Measuring the Power Supply Voltages" on page 4-8 to confirm that the power supplies are functioning properly.

2. **If neither LED is on**

   Check the line fuse, located in a holder above the AC power jack, and replace it with the spare provided if necessary. Check the AC power line. If the LEDs are still off, replace the power supply.

3. **If the green LED is on, the red LED is on steadily, and the fan is off**

   Check the line voltage selector switch, located below the AC power jack. If the setting is correct, remove the power supply/display assembly and make sure that the cable from the on/standby switch to the power supply assembly is connected.With the power supply/display assembly outside the analyzer, plug it in and switch the analyzer's line power on.

   a. **If the fan is still off**

      Check the four green power supply LEDs visible from the right side of the display enclosure (as viewed from the front). If the LEDs are on, the fan is probably broken. Replace the fan or the entire power supply assembly.

4. **If the green LED is on, the red LED is on steadily, and the fan is on**

   Go to "Measuring the Power Supply Voltages" on page 4-8. Note that it is normal for both the green and red LEDs to be on when the power switch is in STANDBY, but not when the switch is in the on position.

5. **If the green LED is on, and the red LED is blinking**

The power supply is in shutdown. Remove the power supply/display assembly from analyzer, plug it in and switch the analyzer's line power on.

   a. **If the red LED is still blinking**

   Replace the power supply.

   b. **If the red LED is now off**

   Go to "Removing the Assemblies" on page 4-9 (the supply is most likely being loaded down by another assembly).

## Measuring the Power Supply Voltages

Remove the backplane cover from the rear panel. Figure 4-3 shows the pinout for J1. There are four main supplies, each with its own return, plus the standby voltage which powers the nonvolatile SRAM on the CPU board. Measure the voltages with a voltmeter. Values should be within 5% of nominal for all but the +13 V supply.

**Figure 4-3  Power Supply Connector, as Viewed from Rear Panel**
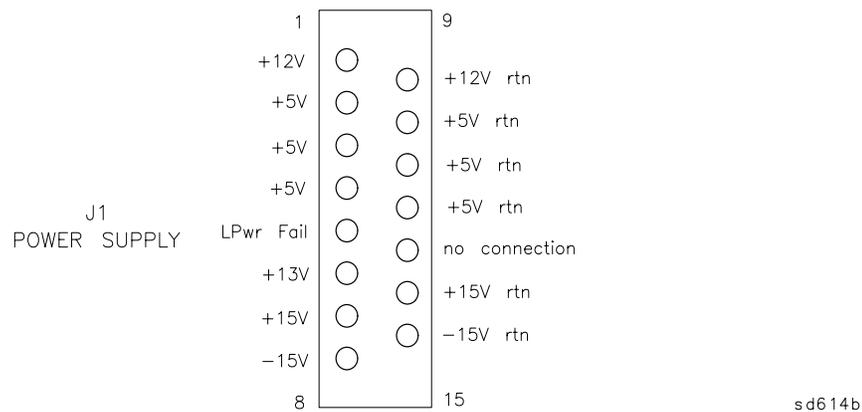


1. **If the voltages are not correct**

Remove the power supply/display assembly, plug in the AC power, and switch the analyzer's line power on. Check the four power supply LEDs visible from the right side of the display enclosure (as viewed from the front).

   a. **If one or more LEDs are off**

   Replace the power supply.

   b. **If all the LEDs are on**

   Reseat the power supply/display assembly, making sure there's a good connection to the rear panel. Measure the voltages again. If the problem persists, check connectors on the power supply and on the backplane board.

**2. If the voltages are correct, but there is a probe power problem**

Remove the front panel and check the fuses on the back of the front-panel PC board.

**Continue with the section** "Troubleshooting Digital Group Problems".

## Removing the Assemblies

If your problem has not been solved at this point in the troubleshooting process, it is highly probable that one of the assemblies is causing the power supply to shut down. This may be caused by the other boards having bad contact with the backplane. Give each board a push to make sure it is firmly seated. If the problem persists, remove the assemblies one at a time, and note which one is causing the shutdown. Refer to Chapter 3, "Assembly Replacement" for disassembly instructions.

---

NOTE          It is possible for the flexible metal "fingers" or a backplane connector pin to break off and cause a short, so check for loose pieces of metal.

Verify that none of the pins on the back-panel connector are bent. This is a common cause of shorted supplies or other nonfunctional problems.

---

Suggested order for assembly removal (easiest to most difficult):

1. front panel assembly (A1)

2. display assembly (A7) (remove the ribbon cable while it is outside the analyzer; reinstall and see if the power supply is still shut down). If the A7 display assembly appears to be causing shutdown, open the display enclosure cover (see Table 7-12, "A7 Display Assembly and Cable Locations," on page 7-17) and make sure the board assembly is firmly seated.

3.  fractional-N/reference assembly (A3)

4.  source assembly (A4)

5. receiver assembly (A5)

6. CPU (A2) and the disk drive assembly (A8)

# Troubleshooting Digital Group Problems

## Error During Power-up

1. If there is no beep at power-up, but the CRT display is normal

The problem is probably in the sound generator or speaker on the CPU board. Check the sound generator ICs (U500-U503, U515-U517, and U300) and the speaker (LS501), or replace the CPU board (refer to "Removing the CPU Board Assembly" on page 3-6).

2. If there is no beep at power-up and no CRT display

The problem is most likely one of two conditions:

- no power to CPU board (no CPU LEDs on)

- another fault in the CPU assembly

Look through the TEST RESULTS hole on the rear panel to see if the LEDs are lit. If none of the LEDs are lit, push the CPU board all the way into the backplane connector to ensure a good connection. Note that it is also possible for the board to have a bad or intermittent backplane connection and yet receive enough power to activate the LEDs.

If the LEDs are on, remove the CPU board (remove rear panel screws first). Then reinstall the CPU board, making sure to push it all the way in so that it connects properly with the backplane. If there is still no beep at power-up and the CPU error code LED continues to display an "8," replace the entire CPU board (refer to "Removing the CPU Board Assembly" on page 3-6).

3. If the disk drive light does not illuminate

Make sure the power (3-wire) cable and ribbon cable are connected from the disk drive to the CPU board. Check the cables. The problem can be either a bad disk drive or bad drive circuitry on the CPU. If a 3.5" disk drive controller error message appears during power-up, replace the CPU. Otherwise, replace the disk drive.

4. If there is no CRT display

Adjust the front panel intensity knob clockwise to increase the brightness. If there is still no CRT display, remove the display and check the ribbon cable connection to the CPU board. If the problem persists, check the output from the VIDEO OUT COLOR VGA connector on the rear panel with a VGA display.

a. If the VIDEO OUT COLOR VGA signal appears good

The problem is most likely either the display assembly or the ribbon cable.

b. If the VIDEO OUT COLOR VGA signal appears bad

The video circuitry is probably bad. Replace the CPU (refer to "Removing the CPU Board Assembly" on page 3-6) or confirm video signals.

5.  **If an error occurs while firmware is being loaded (after 2 beeps are heard)**

    Reload the firmware from disk by inserting the firmware disk into the internal disk drive and switching the analyzer's line power on. Press (BEGIN) at the `Load firmware?` query. The process will take a few minutes. Watch the CRT for information during the loading procedure.

    If the analyzer locks up during or after the firmware loading, try clearing the SRAM:

    a.  Cycle the analyzer's power.

    b.  After about 8 seconds, the analyzer will emit a double beep. Immediately after this double beep, press (PRESET) several times.

    c.  The analyzer will pause after performing the CPU main self-tests and ask if you want to zero the SRAM. Answer YES by pressing the (BEGIN) key. Reload the firmware from disk again.

6.  **If a self-test fails**

    The analyzer indicates the number of the first failed self-test in two ways:

    •  An error message appears on the CRT, if possible.

    •  The "Test Status" LEDs display a number code corresponding to the number of the failed test.

## Test Status LEDs

These include one red LED, one green LED, and a 7-segment LED which display the digits 0 through 9. The viewing hole is located to the left of the GPIB connector behind the metal backplane cover. The red and green LEDs are located to the left of the 7-segment LED when viewed from the rear panel.

### Test Status LED codes

Below is a list of LED configurations.

•  Red LED and 7-segment LED on: test numbers 1 through 9, as shown on 7-segment display.

•  Green LED and 7-segment LED on: tests 10 through 19. Add 10 to value shown on 7-segment display.

•  Only green LED on: all self-tests passed.

Table 4-1 lists the power-up self-tests by number, with a description of the error messages and troubleshooting information. Some of the troubleshooting hints may require the use of a service extender board. Reference designators for main ICs are noted on the PC boards. Note that replacing the defective board is always an option; you need not troubleshoot to the component level.

Check the Test Status LEDs, then locate that test number in the table to determine what to do. For test numbers above 19, the name of the test is usually in the failure message, so look for the test name in Table 4-1 on page 4-13. Refer to Table 5-1, "Analyzer Self-Tests," on page 5-5, for detailed descriptions of each test.

| NOTE | Not all error messages are listed in the table. Many error messages describe the problem clearly and require no further explanation, so they are not included in this guide. |
| --- | --- |
| | Some error messages are only partially reproduced, because the remainder of the message is specific to the error (e.g., provides address at which the failure occurred). |
| | <num>indicates either an address or a value. These may be in decimal or hexadecimal notation. |

**Table 4-1  Analyzer Self-Tests**

| Test | Test Name | Applicable Error Messages and Notes |
|---|---|---|
| 1 | 680x0 Processor | Errors begin with "CPU TEST FAIL." <br><br> Remove CPU board, and check U105, U106, and TP103 (CPU clock). Then check U121 and U122. If test still fails, replace CPU board. |
| 2 | BootROM Checksum | Errors: <br> Bad checksum table at … <br> ROM Checksum Failure in bank… <br> Checksum Table is Blank. ROM may be blank. <br> Unexpected ROM Id at `<num>`. <br> Bad ROM count in Checksum table… <br> Bad ROM size in Checksum table… <br><br> This tests checksum of bootROM chip. Replace CPU board or U335. |
| 3 | Main ROM Checksum | Errors: Same as for test #2. <br><br> This tests checksum of main flash EPROM. Reload firmware from floppy disk. If test still fails, replace the CPU board or check U301 and the EPROM chips U302-U305 or U308 and U309 (whichever are loaded). |
| 4 | DRAM | Errors: <br> Memory size too small. <br> Bus error. <br> At address `<num>`, write `<num>` read `<num>` <br> RAM bit errors: `<num>` <br> RAM refresh errors: `<num>` <br><br> Test writes/reads test patterns. Checks reported size of DRAM on power-up display. Memory size should be about 32 MB. <br><br> Replace CPU board or check the following: <br> DRAM control circuitry U412-U414, DL401 <br> DRAM data interface chips U406-U409, U421-U424 <br> DRAM address MUX U427-U432 <br> DRAM SIMM (J401) |
| 5 | (Not used) | |
| 6 | 340x0 GSP Processor | Test not implemented. |
| 7 | GSP Video | Test not implemented. |
| **Note: Tests numbered: 8, 11, and 14–17 are not run during power-up.** | |

| Test | Test Name | Applicable Error Messages and Notes |
|---|---|---|
| 8 | (number not used) | Test number not used because test status LED powers up with this as default. An "8" on the LED indicates the 68030 was unable to power-up and execute basic instructions. Check power supplies. If power supplies are good, then replace CPU board. |
| 9 | DSP SRAM | Errors: same as for test #4.<br><br>Checks program SRAM used by the digital signal processor. Typical memory size about 65536 bytes. Replace CPU board, or check SRAM chips U716 and U717, and chips U704, U705, and U713. |
| 10 | 320C32 DSP Processor | Test not implemented. |
| 11 | 68030 &320C32 Communication | Test not implemented. |
| 12 | Backplane Bus | Errors:<br>Reference clock not toggling.<br>Unable to gain control of DSP bus.<br>Cannot perform backplane bus tests.<br>Access error: wrote <num>, read <num>,<br>right shift=<num><br>Source board: Failed self-test.<br>Receiver board: Failed self-test.<br><br>Test reads version numbers from fractional-N/ref, source, and receiver boards.<br>Checks for 5 MHz clock from fractional-N/reference board. Make sure all boards are pushed in and making good contact with backplane.<br>Check 10 MHz output from A3J3. If not found, see "Troubleshooting the Fractional-N/ Reference Board (A3)" on page 4-30. Replace CPU board or check U807, U810, and U811. |
| 13 | Non-volatile SRAM | Errors:<br>SRAM battery test FAILED - Saved states lost.<br>SRAM battery test ERROR - Cannot access SRAM.<br><br>Tests integrity of battery-backed SRAM; detects loss of power to SRAM.<br>Writes/reads pattern to part of SRAM.<br>Remove CPU board and measure voltage on battery BT301; replace if below 2.2 volts. Replace CPU board or check the U327 and U100 controller, U329 and U330 SRAM, and U325 voltage regulator. |
| 14 | LAN | Tests the operation of the LAN circuitry.<br>Replace U1020. |
| Note: Tests numbered: 8, 11, and 14–17 are not run during power-up. | | |

| Test | Test Name | Applicable Error Messages and Notes |
|---|---|---|
| 15 | CPU Support Circuitry | Errors: Stuck interrupt.<br><br>Tests interrupt circuitry.<br>Replace CPU board, or check U106, U109, and U110. |
| 16 | Analog Bus | Errors:<br>CPU +5 V supply is out of range!<br>Vpp Flash Supply is out of range!<br><br>Tests analog bus ADC on CPU board.<br>Replace CPU board; check power supplies, or check U300, U338, and Q300 voltage regulator chips for Vpp. Also check the analog bus ADC chips U223, U222, and VR201. |
| 17 | Real Time Clock | Tests ability to write/read to real time clock. |
| 18 | Front Panel Interface | Errors:<br>Front panel keyboard FAILED.<br>Command write timeout.<br>Read input timeout.<br>Clear input buffer failed.<br>Echo byte test failed.<br><br>Tests front panel control processor. Replace CPU board or check U510, U511 and U507. |
| 19 | Floppy Disk Controller | Error:<br>Floppy Disk controller FAILED.<br>Error number `<num>`<br><br>Tests controller chip, accesses registers, writes commands, and verifies response.<br>Replace CPU board or check U607, U603, U604, and U606. |
| 20 | GPIB Interface | Error: GPIB test FAILED.<br>Data bit error on these bits: (followed by list)<br><br>Tests GPIB interface, writes to chip and verifies response. Test not performed if anything connected to GPIB. Replace CPU board or check U524-U526. |
| 21 | RS-232 Interface | Errors:<br>RS-232 interface test FAILED.<br>Bus error.<br>Cannot access.<br>Data bit error on these bits: (followed by list)<br><br>Tests RS-232 portion of the Super I/O chip, accesses registers on chip, and checks for clock input.<br>Replace CPU board or check Super I/O chip, U607, or its clock, U606. |
| **Note: Tests numbered: 8, 11, and 14–17 are not run during power-up.** | | |

| Test | Test Name | Applicable Error Messages and Notes |
|------|-----------|-------------------------------------|
| 22 | DIN Keyboard Interface | Errors:<br>DIN Keyboard test FAILED<br>Problem with DIN Keyboard Power Supply! Check Fuse.<br><br>Tests DIN keyboard control portion of the Super I/O. Replace CPU board or check Super I/O chip, U607, or its clock, U606. |
| 23 | Centronics Interface | Errors:<br>Centronics port test FAILED.<br>Strobe bit error.<br>Printer reset bit error.<br>Printer select bit error.<br><br>Replace CPU board or check Super I/O chip, U607, or its clock, U606. |
| **Note: Tests numbered: 8, 11, and 14–17 are not run during power-up.** | | |

# Error Occurs During DSP Initialization or Calculating Coefficients

## Clearing the Nonvolatile SRAM

1. Cycle the analyzer's power.

2. After about 25 seconds, the analyzer will emit a double beep. Immediately after this double beep, press (PRESET) several times.

3. The analyzer will pause after performing the CPU main self-tests and ask if you want to zero the SRAM. (Note the caution message!) Answer YES by pressing the (BEGIN) key. Continue troubleshooting if the error persists.

## Measuring the 5 MHz Reference Signal

The DSP requires this signal from the fractional-N/reference assembly for proper operation. This signal is routed on the backplane board. Make sure that the fractional-N/reference assembly is pushed all the way in and making good contact with the backplane. Measure the 5 MHz signal at J101-C24 on the backplane board with an oscilloscope. If the signal is present, refer to "Testing the DSP Circuit" on page 4-21 to check the DSP, or replace the CPU board (refer to "Removing the CPU Board Assembly" on page 3-6).

### If there is no 5 MHz signal at the backplane

Check the reference circuit on the fractional-N/reference board. If an external reference signal is used, make sure it's a 10 MHz signal with a power level of at least –5 dBm.

If the internal 10 MHz reference is being used, check the crystal oscillator output at A3J202, which is located on the front of the fractional-N assembly (A3). If the 10 MHz signal is not present, replace the fractional-N/reference assembly (A3). (Refer to "Removing the Fractional-N/Reference Assembly" on page 3-10.)

## Front Panel Problems

If the analyzer appears to power-up normally but will not respond to keystrokes, verify that none of the keys are stuck. If the front panel keys are still not responding properly, remove the front panel and make sure the ribbon cable is properly connected between the front panel assembly and the CPU.

Inspect the keypad and the PC board. Replace both if either assembly is defective. The large knob assembly can be replaced separately. Inspect the ribbon cable closely and verify that it is in good condition. Try removing the ribbon cable clamp located on the CPU board to verify this is not causing a short.

If an inspection of the front panel assembly reveals no obvious defects, replace the CPU board (refer to "Removing the CPU Board Assembly" on page 3-6).

## Other Power-Up Problems

A power-up sequence problem can also be caused by a problem with the SRAM. Since the symptom will depend on what state the analyzer was in during its power-up sequence, there can be a variety of problems. Try clearing the SRAM (see "Clearing the Nonvolatile SRAM" on page 4-16 for instructions). If the problem persists, the DRAM is probably bad and/or the CPU board needs to be replaced (refer to "Removing the CPU Board Assembly" on page 3-6).

## Other Error Messages

In some unusual cases, an error message similar to that shown below may occur. This may indicate a defective component, an anomaly in the firmware code, or an unspecified operating condition. In general, however, this message should never be seen. If it does appear, follow the instructions, then cycle power. If the problem reoccurs, try clearing SRAM (see "Clearing the Nonvolatile SRAM" on page 4-16). If the problem still exists, try reloading the firmware. If the problem persists, contact the nearest Agilent Technologies sales or service office for further instructions.

```
*********************************************
 UNRECOVERABLE ERROR:

 Please report the error "xxxx.nn"
 to your local Agilent Service or Sales office.

 To help us fix this problem quickly,
 please note what you were doing when
 this error occurred.  Any related operating
 information might be helpful, such as:
      Measurement type, # points,
      IBASIC and SCPI commands,
      printer and disk info, etc.

 Thank you for reporting this error.
 Cycle power to continue.
 *********************************************
```

The error number is in the form "xxxx.nn", where *nn* is a number from 0 to 31, and *xxxx* is one of these names:

```
ARRY DBUG FPKP HPIB IBAS IBSL IBfp IBkr
 MMGR PLOT SELB TCH1 TCH2 TIME idle root
```

Examples include: ARRY.04, FPKP.08, and TCH1.10 among other types.

# Category 2 Failures: No Error Messages but One or More Measurements Are Nonfunctional

This section is divided into three parts. The first two parts contain separate sections to troubleshoot the ET and ES analyzers in a step-by-step process. If the step-by-step procedures are unsuccessful, the third part contains general troubleshooting information.

## Category 2 (ET Analyzer Troubleshooting)

This process assumes that a single assembly or part has failed in an otherwise fully functional ET model analyzer. Go through the numbered symptoms in this section and find the one that best describes the failure.

The block diagrams in Figure 4-4 and Figure 4-5 show the signal flow through the RF portion of the receiver assembly, while the shaded area lists the normal signal trace levels for each detector. These figures apply to symptoms 2 through 9.

**Using the figures as a template to troubleshoot**

Figure 4-4 and Figure 4-5 assist you in troubleshooting by supplying normal trace levels that occur for each detector in the open state and with a thru cable attached. Compare the trace levels for the analyzer under test with the trace levels in the figures and find which traces or trace are abnormal. Go through the symptoms in the order listed, find the first symptom that matches the measurement results. Follow the instructions for that symptom.

| NOTE | Use these trace definitions when applying the measured results to symptoms 2 through 9: |
| --- | --- |
| | • For a trace to meet the "Above –10 dBm" trace level, *all parts* of the trace must be *above –10 dBm.* |
| | • For a trace to meet the "Below –10 dBm" trace level, *all parts* of the trace must be *below –10 dBm.* |
| | • For a trace to be considered noisy, the peak to peak noise must be greater than 5 dB. |

| NOTE | Refer to Chapter 7 for detailed part lists and assembly drawings. |
|------|-------------------------------------------------------------------|

## Steps Associated with Figure 4-4

1. Leave the RF OUT and RF IN ports open.

2. Set the analyzer to the default condition by pressing (PRESET) (POWER) (0) **dBm**.

3. Observe the traces at each detector and compare to the normal signal trace levels in Figure 4-4. Press **Detection Options** in the (MEAS 1) menu. For narrowband traces, press **Narrowband Internal** and **A** , **B** , or **R** keys. For broadband detectors, press **Broadband Internal** and the **R\*** or **B\*** keys.

**Figure 4-4**



ET Receiver with Opens
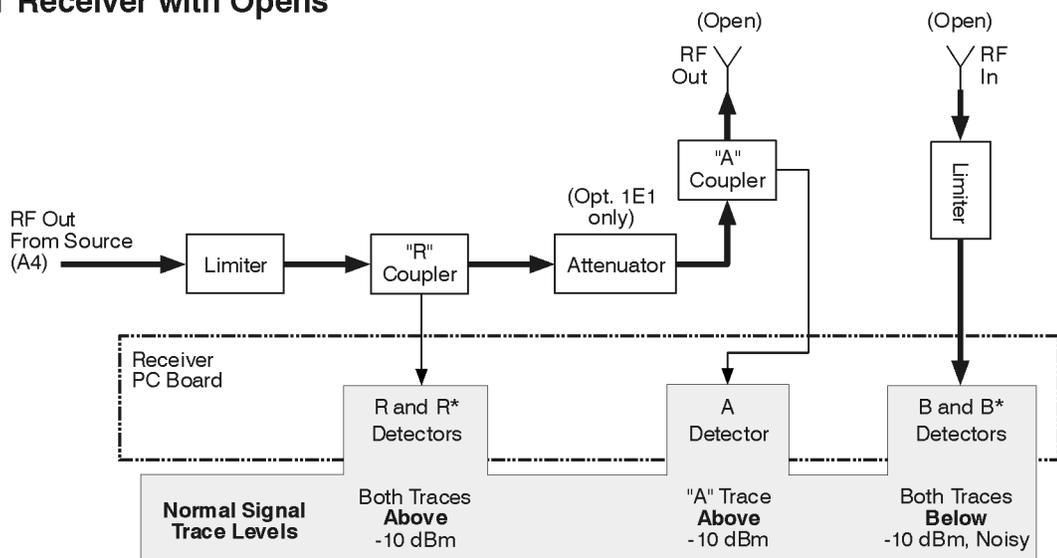
sp620es

## Steps Associated with Figure 4-5

1.  Connect a thru cable between RF OUT and RF IN.

2.  Press $\boxed{\text{MEAS 1}}$ **Transmissn**.

3.  Observe the traces at each detector and compare to the normal signal trace levels in Figure 4-5. Press **Detection Options** in the $\boxed{\text{MEAS 1}}$ menu. For narrowband traces, press **Narrowband Internal** and **A** , **B** , or **R** keys. For broadband detectors, press **Broadband Internal** and the **R\*** or **B\*** keys.

**Figure 4-5**

### ET Receiver with Thru Cable
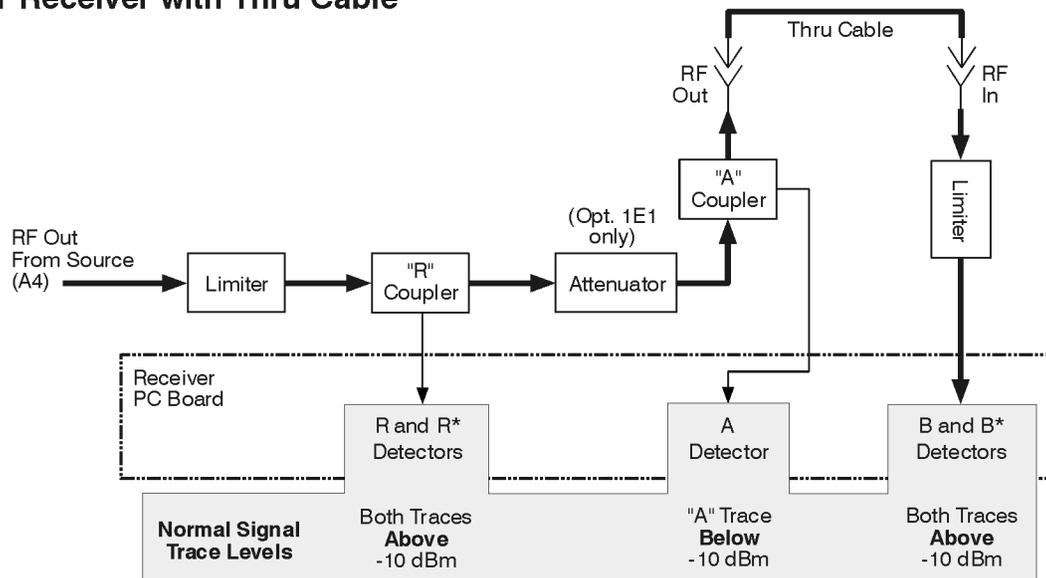


sp621es

---

| NOTE | The following troubleshooting descriptions are for the ET models that include the attenuator (Option 1E1). However, this troubleshooting section can also be applied to the standard ET analyzers. For a standard ET analyzer, the A coupler and R coupler functions are combined into one dual directional coupler. |
|---|---|

---

### Symptom 1: Trace at ± 200 dB

A flat trace at ±200 dB indicates that the Digital Signal Processing (DSP) circuit is not getting data (zero data).

1.  Check the connections; make sure the receiver and the CPU board are making good solid contact to the backplane connectors.

2.  If the boards are firmly connected, the problem is most likely the DSP circuit on the CPU board or the ADCs on the receiver board. To determine the exact cause of failure, perform the steps in "Testing the DSP Circuit" on page 4-21.

Testing the DSP Circuit

To check the DSP circuit, substitute the receivers's ADC clock and data signals with similar signals created on the CPU board.

1.  Turn off the analyzer and remove the CPU board (refer to "Removing the CPU Board Assembly" on page 3-6).

2.  Locate J702 on the CPU assembly (J702 is an eight-by-three jumper located above the DSP metal shield). Temporarily place the jumper in the TEST position as marked on the board. The replacement signals will now be created by the CPU board.

3.  Power-up the instrument and observe the analyzer display. Follow the instructions below:

    a.  If a random noisy trace is observed around 0 dB, the CPU board assembly is functioning properly. Replace the receiver PC board of the receiver assembly (A5). (Refer to "Removing the Receiver PC Board" on page 3-14.) For additional confirmation of the need to replace the receiver PC board, perform the steps in "Troubleshooting the Receiver ADC" on page 4-32.

    b.  If no random noisy trace is observed around 0 dB, replace the CPU board assembly. (Refer to "Removing the CPU Board Assembly" on page 3-6.)

    c.  Return the jumper at J702 to its normal position.

Symptom 2: All Traces Are Below −10dB

This symptom indicates that no power is reaching any of the detectors.

1.  Measure the RF output power level from the source (A4) at A4J4. Press ⌊FREQ⌋ **CW** ⌊50⌋ **MHz** ⌊POWER⌋ ⌊0⌋ **dBm** ⌊MENU⌋ **Trigger Hold** .

    a.  If the power level is *below* −5 dBm, replace the source assembly (A4). (Refer to "Removing the Source Assembly" on page 3-11.)

    b.  If the power level is *above* −5 dBm, this indicates that the limiter in the source path on the receiver board is damaged. Replace the source limiter (refer to "Removing the Limiter (ET Analyzers)" on page 3-18).

    c.  If the problem persists, the R coupler could be damaged. Replace the R coupler (refer to "Removing the Coupler" on page 3-15).

Symptom 3: R* and B* Traces Are Normal, All Others Noisy

If the broadband detectors give a normal response and the narrowband detectors are noisy, the LO source could be damaged. To verify this, follow these steps:

1.  Perform "Verifying the 10 MHz reference signal" on page 4-30.

    a.  If the 10 MHz verify process fails, it indicates a problem with the 10 MHz reference circuit. Replace the fractional-N/reference assembly (A3). (Refer to "Removing the Fractional-N/Reference Assembly" on page 3-10.)

    b.  If the 10 MHz verify process passes, a problem with the LO source on the source board could exist. Replace the source assembly (A4). (Refer to "Removing the Source Assembly" on page 3-11.)

### Symptom 4: R and R* Traces Are Always Below −10 dBm or Noisy

If other traces are normal, something in the R signal path could be damaged.

1. Check the power out of the coupled port on the R coupler.

   a. If the power level is below −20 dBm, replace the R coupler (refer to "Removing the Coupler" on page 3-15).

   b. If the power level is above −20 dBm, replace the receiver PC board from the receiver assembly (A5). (Refer to "Removing the Receiver PC Board" on page 3-14.)

### Symptom 5: If the R and R* Traces Are Normal, while A, B and B* Traces Are Always Below −10 dBm

This failure indicates that there is a power interruption after the R coupler.

1. Replace the A coupler (refer to "Removing the Coupler" on page 3-15).

2. If the problem persists and the analyzer is an Option 1E1, replace the attenuator (refer to "Removing the Attenuator (ES and Option 1E1 Analyzers)" on page 3-16).

### Symptom 6: B and B* Traces Are Always Below −10 dBm and/or Are Always Noisy

This failure indicates a problem after the A coupler.

1. First check that the thru cable is not damaged and that it is transferring the signal.

2. If the cable is good, replace the B limiter (refer to "Removing the Limiter (ET Analyzers)" on page 3-18).

3. If the problem persists, replace the receiver PC board from the receiver assembly (A5). (Refer to "Removing the Receiver PC Board" on page 3-14.)

### Symptom 7: A Trace Is Always Below −10 dBm and/or Is Always Noisy

If other inputs are normal, something in the A signal path could be damaged.

1. The most likely failure is the coupled port in the A coupler. Measure the signal output level at the coupled port with the RF OUT port open. The signal level should be above −20 dBm. If the signal level is below −20 dBm, replace the A coupler (refer to "Removing the Coupler" on page 3-15).

2. If the problem persists, replace the receiver PC board from the receiver assembly (A5). (Refer to "Removing the Receiver PC Board" on page 3-14.)

### Symptom 8: R Trace Is Normal and R* Trace is Noisy *OR* the R Trace Is Noisy and the R* Trace Is Normal

This failure can be isolated to the R or R* detectors and points to the receiver PC board in receiver assembly (A5).

1. Replace the receiver PC board from the receiver assembly (A5). (Refer to "Removing the Receiver PC Board" on page 3-14.)

**Symptom 9: B Trace Is Normal and B\* Trace Is Noisy *OR* the B Trace Is Noisy and the B\* Is Normal**

This failure is very similar to symptom 8, however this failure points to the B or B\* detectors on the receiver PC board.

1. Replace the receiver PC board from the receiver assembly (A5). (Refer to "Removing the Receiver PC Board" on page 3-14.)

| | |
|---|---|
| NOTE | If the analyzer is not repaired by the previous steps, or the symptoms do not address the problem, go to "General Troubleshooting for Both ET and ES Models" on page 4-30. |

# Category 2 (ES Analyzer Troubleshooting)

This process assumes that a single assembly or part has failed in an otherwise fully functional ES model analyzer. Go through the numbered symptoms in this section and find the one that best describes the failure.

The block diagrams in Figure 4-6, Figure 4-7, and Figure 4-8 show the signal flow through the RF portion of the receiver assembly, while the shaded area lists the normal signal trace levels for each detector. These figures apply to symptoms 2 through 11.

**Using the figures as a template to troubleshoot**

Figure 4-6, Figure 4-7, and Figure 4-8 assist you in troubleshooting by providing normal trace levels that occur for each detector in the different setups indicated in the figures. Compare the trace levels for the analyzer under test with the trace levels in the figures and find which traces or trace are abnormal. Go through the symptoms in the order listed, find the first symptom that matches the measurement results. Follow the instructions for that symptom.

| | |
|---|---|
| NOTE | Refer to Chapter 7, "Parts List" for detailed part lists and assembly drawings. |

| | |
|---|---|
| NOTE | Use these trace definitions when applying the measured results to symptoms 2 through 9: |

- For a trace to meet the "Above –10 dBm" trace level, *all parts* of the trace must be *above –10 dBm.*

- For a trace to meet the "Below –10 dBm" trace level, *all parts* of the trace must be *below –10 dBm.*

- For a trace to be considered noisy, the peak to peak noise must be greater than 5 dB.

## Steps Associated with Figure 4-6

1.  Leave PORT 1 and PORT 2 open.

2.  Set the analyzer to the default condition by pressing (PRESET) (POWER) (0) **dBm** .

3.  Observe the traces for each detector and compare to the normal signal trace levels in Figure 4-6. Press **Detection Options** in the (MEAS 1) menu. For narrowband traces, press **Narrowband Internal** and the detector trace needed to observe, **A** , **B** , or **R** keys. For broadband detectors, press **Broadband Internal** and the **R\*** or **B\*** keys.

**Figure 4-6**



ES Receiver with Opens (Forward)
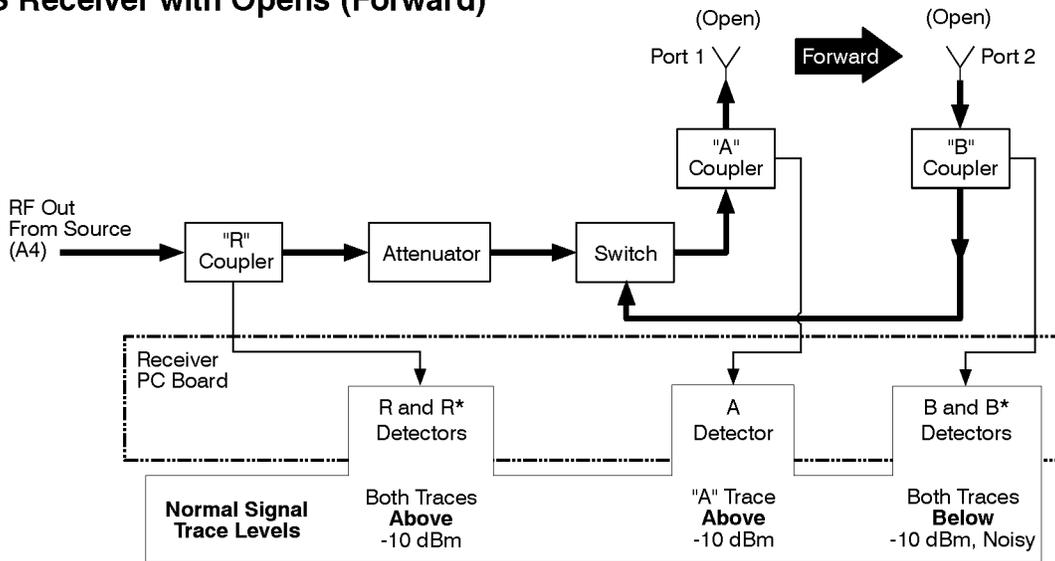
sp624es

## Steps Associated with Figure 4-7

1. Connect a thru cable between PORT 1 and PORT 2.

2. Press ⸢MEAS 1⸥  **S21 Fwd Trans** .

3. Observe the traces for each detector and compare to the normal signal trace levels in Figure 4-7. Press **Detection Options** in the ⸢MEAS 1⸥ menu. For narrowband traces, press **Narrowband Internal** and **A** , **B** , or **R** keys. For broadband detectors, press **Broadband Internal** and the **R\*** or **B\*** keys.

**Figure 4-7**

### ES Receiver with Thru Cable (Forward)
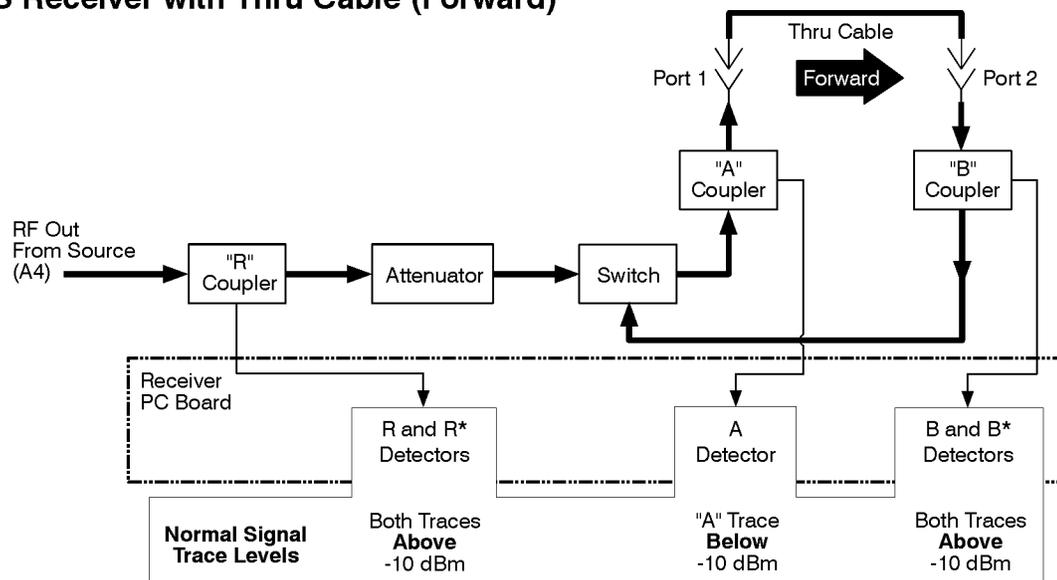


sp622es

## Steps Associated with Figure 4-8

1. Leave on or connect a thru cable PORT 1 and PORT 2.

2. Press ⎡MEAS 1⎤ **S12 Rev Trans** .

3. Observe the traces for each detector and compare to the normal signal trace levels in Figure 4-8. Press **Detection Options** in the ⎡MEAS 1⎤ menu. For narrowband traces, press **Narrowband Internal** and **A** , **B** , or **R** keys.

**Figure 4-8**

### ES Receiver with Thru Cable (Reverse)
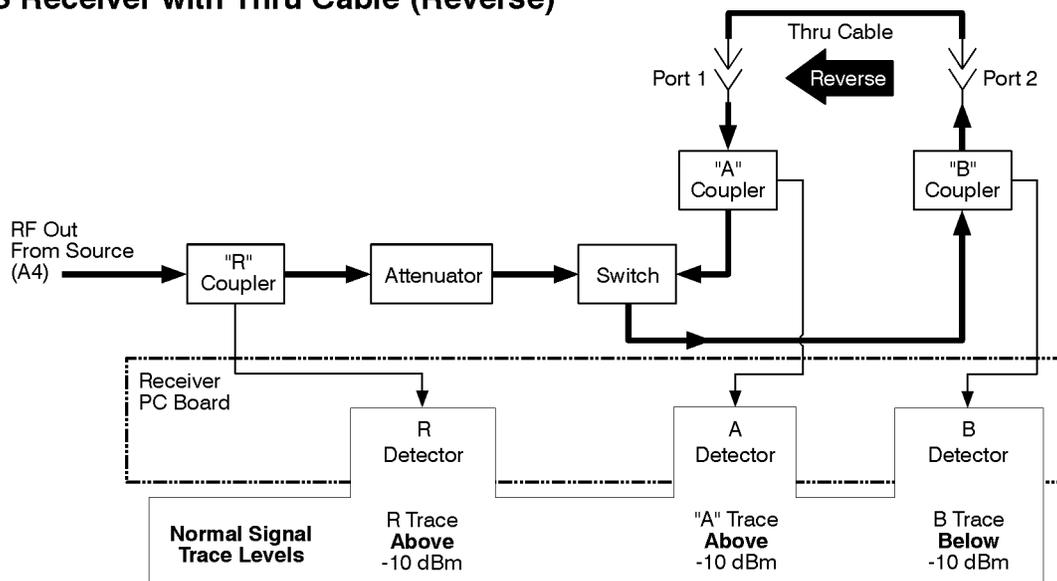


sp623es

### Symptom 1: Trace at ±200 dB

A flat trace at ±200 dB indicates that the Digital Signal Processing (DSP) circuit is not getting data (zero data).

1. Check the connections: make sure the receiver and the CPU board are making good solid contact to the backplane connectors.

2. If the boards are firmly connected, the problem is most likely the DSP circuit on the CPU board, or the ADCs on the receiver board. To determine the exact cause of failure, perform the steps in "Testing the DSP Circuit."

### Testing the DSP Circuit

To check the DSP circuit, substitute the receivers's ADC clock and data signals with similar signals created on the CPU board.

1. Turn off the analyzer. To remove the CPU board, refer to "Removing the CPU Board Assembly" on page 3-6.

2. Locate J702 on the CPU assembly (J702 is an eight-by-three jumper located above the DSP metal shield). Temporarily place the jumper in the TEST position as marked on the board. The replacement signals will now be created by the CPU board.

3. Power-up the instrument and observe the analyzer display. Follow the instructions below:

   a. If a random noisy trace is observed around 0 dB, the CPU board assembly is functioning properly. Replace the receiver PC board of the receiver assembly (A5). (Refer to "Removing the Receiver PC Board" on page 3-14.) For additional confirmation of the need to replace the receiver PC board, perform the steps in "Troubleshooting the Receiver ADC" on page 4-32.

   b. If no random noisy trace is observed around 0 dB, replace the CPU board assembly (A2). (Refer to "Removing the CPU Board Assembly" on page 3-6.)

   c. Return the jumper at J702 to its normal position.

### Symptom 2: All Traces Are Below −10dB

This symptom indicates that no power is reaching any of the detectors.

1. Measure the RF output power level from the source (A4) at A4J4. Press (FREQ) **CW** (50) **MHz** (POWER) (0) **dBm** (MENU) **Trigger Hold** .

   a. If the power level is *below* −5 dBm, replace the source assembly (A4). (Refer to "Removing the Source Assembly" on page 3-11.)

   b. If the power level is *above* −5 dBm, the R coupler could be damaged. Replace the R coupler (refer to "Removing the Coupler" on page 3-15).

### Symptom 3: R* and B* Traces Are Normal, All Others Noisy

If the broadband detectors give a normal response and the narrowband detectors are noisy, the LO source could be damaged. To verify this, follow these steps:

1. Perform the process "Verifying the 10 MHz reference signal" on page 4-30.

   a. If the 10 MHz verify process fails, it indicates a problem with the 10 MHz reference circuit. Replace the fractional-N/reference assembly (A3). (Refer to "Removing the Fractional-N/Reference Assembly" on page 3-10.)

   b. If the 10 MHz verify process passes, a problem with the LO source on the source board could exist. Replace the source assembly (A4). (Refer to "Removing the Source Assembly" on page 3-11.)

### Symptom 4: R and R* Traces Are Always Below –10 dBm or Noisy

If other traces are normal, something in the R signal path could be damaged.

1.  Check the power level out of the coupled port on the R coupler.

    a.  If the power level is below –20 dBm, replace the R coupler (refer to "Removing the Coupler" on page 3-15).

    b.  If the power level is above –20 dBm, replace the receiver PC board from the receiver assembly (A5). (Refer to "Removing the Receiver PC Board" on page 3-14.)

### Symptom 5: A, B and B* Traces Are Always Below –10 dBm for the Forward and/or the Reverse Signal Directions

If other traces are normal, this indicates a failure in the switch or the attenuator. A failure in the switch is the more likely problem.

1.  If the symptom exists in both the forward and reverse directions, check the power level out of the attenuator.

    a.  If the power level is below –5 dBm, replace the attenuator (refer to "Removing the Attenuator (ES and Option 1E1 Analyzers)" on page 3-16).

    b.  If the power level is above –5 dBm, replace the switch (refer to "Removing the Switch (ES Analyzers)" on page 3-16).

2.  If the symptom exists in only one direction, replace the switch.

### Symptom 6: B and B* Traces Are Always Below –10 dBm and/or Are Always Noisy

This failure indicates a problem with the coupled signal from the B coupler.

1.  Check the power level out of the coupled port on the B coupler (PORT 2 open, reverse direction).

    a.  If the power is below –20 dBm, replace the B coupler (refer to "Removing the Coupler" on page 3-15).

    b.  If the power is above –20 dBm at the coupled port, replace the receiver PC board from the receiver assembly (A5). (Refer to "Removing the Receiver PC Board" on page 3-14.)

### Symptom 7: A Trace Is Always Below –10 dBm and/or Is Always Noisy

This failure indicates a problem with the coupled signal from the A coupler.

1.  Check the power level out of the coupled port on the A coupler (PORT 1 open, reverse direction).

    a.  If power is below –20 dBm, replace the A coupler (refer to "Removing the Coupler" on page 3-15).

    b.  If the power is above –20 dBm at the coupled port, replace the receiver PC board from the receiver assembly (A5). (Refer to "Removing the Receiver PC Board" on page 3-14.)

**Symptom 8: R Trace Is Normal and R\* Trace Is Noisy *OR* the R Trace Is Noisy and the R\* Trace Is Normal**

This failure can be isolated to the R or R\* detectors and points to the receiver PC board in receiver assembly (A5).

1.  Replace the receiver PC board from the receiver assembly (A5). (Refer to "Removing the Receiver PC Board" on page 3-14.)

**Symptom 9: B Trace Is Normal and B\* Trace Is Noisy *OR* the B Trace Is Noisy and the B\* Trace Is Normal**

This failure is very similar to symptom 8, however, this failure points to the B or B\* detectors on the receiver PC board.

1.  Replace the receiver PC board from the receiver assembly (A5). (Refer to "Removing the Receiver PC Board" on page 3-14.)

**Symptom 10: B and B\* Traces Are Always Above –10 dBm When a Thru Cable Is Connected**

This symptom indicates a bad termination in the switch.

1.   Replace the switch (refer to "Removing the Switch (ES Analyzers)" on page 3-16).

**Symptom 11: A Trace Is Always Above –10 dBm When a Thru Cable Is Connected**

This symptom indicates a bad termination in the switch.

1.   Replace the switch (refer to "Removing the Switch (ES Analyzers)" on page 3-16).

---

| NOTE | If the analyzer is not repaired by the previous steps, or the symptoms do not fit, continue to the."General Troubleshooting for Both ET and ES Models" on page 4-30. |
|------|---|

---

# General Troubleshooting for Both ET and ES Models

This section describes further troubleshooting practices for both the ET and ES analyzers. The focus of this section is a more detailed look at the fractional-N/referecnce board assembly (A3), the source board assembly (A4) and the ADC check for the receiver board assembly (A5).

## Troubleshooting the Fractional-N/ Reference Board (A3)

### Verifying the 10 MHz reference signal

Perform these steps.

1. Remove the handles and front panel (refer to "Removing the Front Panel Assembly" on page 3-4).

2. Connect an oscilloscope or a frequency counter to A3J2 (the connector on the right) to measure the 10 MHz output from the A3 fractional-N/reference board (refer to "Removing the Fractional-N/Reference Assembly" on page 3-10).

---

NOTE    The output signal must be measured with a 50Ω load attached to the RF OUT/PORT1 port. Typically this signal consists of a 2 V, 15 ns pulse into 50Ω. The frequency should be 10 MHz ± 50 Hz (see Chapter 2, "Adjustments" to adjust the frequency of the internal reference).

---

If the signal is not 10 MHz, verify that the external reference has not been selected by pressing (MENU) and making sure that **Ext Ref on OFF** is displayed. If it is still not correct, replace the fractional-N/reference board (refer to "Removing the Fractional-N/Reference Assembly" on page 3-10).

### Measuring the Sweep Output Fractional-N/Reference Assembly

1. Set the analyzer in the CW and trigger hold modes and step through the frequencies in Table 4-2. Check the fractional-N output at A3J301 (the connector on the left). It is recommended that you use a spectrum analyzer's 10 MHz reference signal as the 10 MHz external reference for the network analyzer.

   The typical amplitude of this signal should be in the 0 to +4 dBm range. Any harmonics should be less than −*16 dBc*.

**Table 4-2    Source Frequency Versus Fractional-N Frequency**

| 8712ET/ES | | 8714ET/ES | |
|---|---|---|---|
| **Source Frequency** | **Fractional-N Frequency** | **Source Frequency** | **Fractional-N Frequency** |
| 300 kHz | 36.567187 MHz | 300 kHz | 31.993251 MHz |
| 500 MHz | 44.375 MHz | 500 MHz | 38.825087 MHz |

| 8712ET/ES | | 8714ET/ES | |
|---|---|---|---|
| Source Frequency | Fractional-N Frequency | Source Frequency | Fractional-N Frequency |
| 1.3 GHz | 56.875 MHz | 1.3 GHz | 49.762587 MHz |
| | | 2.0 GHz | 43.336806 MHz |
| | | 3.0 GHz | 57.008681 MHz |

2.  If one of the fractional-N outputs is not correct, press (MENU) **Spur Avoid Options** . Make sure the dither function is off, since the frequencies will be different for dither on. If the problem persists, replace the A3 fractional-N/reference assembly (refer to "Removing the Fractional-N/Reference Assembly" on page 3-10).

## Troubleshooting the Source Assembly (A4)

NOTE        The following measurement values assume a properly adjusted instrument. If no correction constants have been loaded, the power levels given may vary a few dB either way.

### Checking the RF Output

Perform the following steps to check the RF output of the source assembly.

1.  Measure the RF output signal directly out of the source board at A4J4. Press (PRESET) (POWER) (0) **dBm** and set the output frequency to CW mode to 50 MHz by pressing (FREQ) **CW** (50) **MHz** . The RF output should be at 50 MHz ±250 Hz. The exact power level of this will vary depending upon the installed options, but should typically be in the +1 to +9 dBm range.

2.  Set the frequency to 3000 MHz (1300 MHz for 8712ET/ES) and measure the power again. This power level should be in the range of +2 to +10 dBm, again depending upon the installed options. Frequency accuracy should be 3000 MHz ±15 kHz or (1300 MHz ±6.500 kHz for HP 8712ET/ES).

Checking the LO Output

Now check the LO output from the source at A4J1. Use the same conditions as above.

1. Measure the LO when the RF out is set to 50 MHz. The LO should always be 27.778 kHz *above* the RF signal. Repeat for 3000 MHz (1300 MHz for 8712ET/ES). Power levels for the LO should be in the +2.0 to +14 dBm (+6 to +14 dBm range for the 8712ET/ES), regardless of frequency.

If either of the outputs from the source board (A4) are not correct when the inputs from the A3 fraction-N/reference board are correct, replace the source board (refer to "Removing the Source Assembly" on page 3-11).

## Troubleshooting the Receiver ADC

| NOTE | This process should only be used after the results of the "Testing the DSP Circuit" procedure under Symptom 1 indicate that the CPU board is functioning properly. This process may be used to confirm a problem with the ADC circuits on the receiver board. |
|------|-----|

| CAUTION | If you are performing this test after "Testing the DSP Circuit," ensure that jumper J702 on the CPU (A2) board is returned to its normal position. |
|---------|-----|

To confirm an ADC problem when the trace is at ±200 dB, check for activity at the receiver's backplane connector.

1. Remove the metal cover on the back of the instrument to access the backplane. The receiver connector is at the bottom of the analyzer and is labeled XA5J1 on the PC board.

2. Check the pins listed in the following table.

**Table 4-3 Backplane Signal Activity at the Receiver Connector (XA5J1)**

| Pin Number | Type of Signal |
|:----------:|:--------------:|
| C27 | ADC_DAT1 |
| A27 | ADC_CLK1 |
| C26 | ADC_DAT2 |
| A26 | ADC_CLK2 |

3. If any of these signals is a DC level (which means no activity), replace the receiver PC board from the receiver assembly (A5). (Refer to "Removing the Receiver PC Board" on page 3-14.)

# Category 3 Failures: Inaccurate (but reasonably functional) Measurements

## Troubleshooting Inaccurate Data

### Mechanical Problems

Check adapters, cables, and test port connectors for damage. Gauge the test port connectors. Ensure that the cables between the source (A4) and receiver (A5) assemblies are properly connected.

### Receiver Detector Problems

Perform the following receiver adjustments in the order below, which are described in Chapter 2, "Adjustments." If the problem is in both narrowband and broadband modes, combine the tests and follow the order in Chapter 2, "Adjustments."

**Narrowband Mode Problems:**

| | |
|---|---|
| Switched Gain Correction | Adjustment #102 |
| B Amplitude Correction | Adjustment #105 |
| Reflection (One-Port) Correction | Adjustment #107 |

**Broadband Mode Problems:**

| | |
|---|---|
| Switched Gain Correction | Adjustment #102 |
| External Detector Gain Correction | Adjustment #103 |
| B* Amplitude Correction | Adjustment #110 |
| R* Amplitude Correction | Adjustment #108 |
| R* Frequency Response Correction | Adjustment #109 |

### Problems with Trace or Data Drift

If data seems to drift, it may be caused by very poor uncorrected directivity. Drift can also be caused by poor cables connected to the DUT.

1. First, move the cables connected to the DUT. If the drift on the display follows cable movements, change test cables. If the test cables are working properly, go to the next sections, "Troubleshooting Trace Drift for ET Models" or "Troubleshooting Trace Drift for ES Models."

## Troubleshooting Trace Drift for ET Models.

To check the uncorrected performance of the analyzer, follow the steps below. Refer to Figure 4-4 on page 4-19 and Figure 4-5 on page 4-20 for the part designators.

### Checking the Uncorrected Directivity of the RF OUT Coupler

1. Set the analyzer to the default condition by pressing (PRESET) (POWER) (0) **dBm**.

2. To turn off calibrations, press (SYSTEM OPTIONS) **Service** **Service Utilities** **Meas Cal Options** **Meas Cal on OFF** .

3. Leave the RF OUT port open.

4. Press (MEAS 1) **Reflection** (CAL) **Normalize** .

5. Attach a good load to the RF OUT port (preferably from a calibration kit).

6. The directivity limits are −25 dB for a 50Ω analyzer and −15 dB for a 75Ω analyzer. Compare the trace to the appropriate limit.

   a. Replace the A coupler if any part of the trace is above the appropriate limit. Refer to "Removing the Coupler" on page 3-15.

7. If the uncorrected directivity for RF OUT passes, go to "Checking the Uncorrected Directivity of the R Coupler and the Load Match of RF IN."

### Checking the Uncorrected Directivity of the R Coupler and the Load Match of RF IN

1. Leave the load connected to the RF OUT port and display the trace for the R detector by pressing (MEAS 1) **More** **Detection Options** **R** .

2. Normalize the load response for use as a reference by pressing (CAL) **Normalize** **Normalize** . (Pressing **Normalize** twice will update the reference trace.)

3. Remove the load from the RF OUT connector. All of the trace should be between +5 dB and −5 dB. If it is outside this range, the directivity of the R coupler is unacceptable. Replace the R coupler from the receiver assembly (A5).

4. If the previous checks passed, remove the load and connect a high quality thru cable between the RF OUT and RF IN connectors.

5. Turn off the normalization by pressing (CAL) **Normalize**.

6. Press (MEAS 1) **Reflection** .

7. If the max point of the trace is above −12 dB, there is a port match problem in the RF IN path. Replace the limiter in the B input path. If the problem persists, replace the receiver PC board on the receiver assembly (A5). (Refer to "Removing the Receiver PC Board" on page 3-14.)

## Troubleshooting Trace Drift for ES Models.

To check the uncorrected performance of the analyzer, follow the steps below. Refer to Figure 4-6 on page 4-24, Figure 4-7 on page 4-25, and Figure 4-8 on page 4-26 for part designators.

### Checking the Uncorrected Directivity of the PORT 1, PORT 2, and the R Couplers

1.  Set the analyzer to the default condition by pressing (PRESET) (POWER) (0) **dBm** .

2.  To turn off calibrations, press (SYSTEM OPTIONS) **Service** **Service Utilities** **Meas Cal Options** **Meas Cal on OFF** .

3.  Leave PORT 1 open.

4.  Press (MEAS 1) **S11 Refl Port 1** (CAL) **Normalize** .

5.  Attach a good load to PORT 1, preferably from a cal kit.

6.  The directivity limits are –25 dB for a 50Ω analyzer and –15 dB for a 75Ω analyzer. Compare the trace to the appropriate limit.

    a.  Replace the A coupler if any part of the trace is above the appropriate limit. Refer to "Removing the Coupler" on page 3-15.

7.  If the previous step has passed, leave the load connected to PORT 1 and look at the display for the R detector. Press (MEAS 1) **More** **Detection Options** **Narrowband Internal** **R** .

8.  Normalize the load response for use as a reference. Press (CAL) **Normalize** **Normalize** . (Pressing **Normalize** twice will update the reference trace.)

9.  Remove the load from the PORT 1 connector. All of the trace should be between +5 dB and –5 dB. If it is outside this range, the directivity of the R coupler is unacceptable. Replace the R coupler from the receiver assembly (A5).

10. When the previous step has passed, continue with the next step.

11. Press (MEAS 1) **S22 Refl Port 2** (CAL) **Normalize** **Normalize** .

12. Attach a good load to PORT 2, preferably from a cal kit.

13. The directivity limits are –25 dB for a 50Ω analyzer and –15 dB for a 75Ω analyzer. Compare the trace to the appropriate limit.

    a.  Replace the B coupler if any part of the trace is above the appropriate. Refer to "Removing the Coupler" on page 3-15.

14. If the previous checks pass, leave the S22 trace displayed, press (CAL) **Normalize** and go to "Checking the Switch Terminations."

### Checking the Switch Terminations

1. Remove the load and connect a a high quality thru cable between PORT 1 and PORT 2.

2. If the max point of the S22 trace is above –12 dB, there is a port match problem in the PORT 1 path. The most likely cause is a defective load in the switch. Replace the switch (refer to "Removing the Switch (ES Analyzers)" on page 3-16). If the problem persists, replace the A coupler. (Refer to "Removing the Coupler" on page 3-15.)

3. To check PORT 2, press MEAS 1 **S11 Refl Port 1** .

4. If the max point of the trace is above –12 dB, there is a port match problem in the PORT 2 path. The most likely cause is a defective load in the switch. Replace the switch (refer to "Removing the Switch (ES Analyzers)" on page 3-16). If the problem persists, replace the B coupler. (Refer to "Removing the Coupler" on page 3-15.)

## Additional Troubleshooting Tips

If data is okay with just a through cable connected (after preset), but bad in an application, check for the following:

Verify that you are looking at the expected measurement; especially check:

- data vs. memory or data/memory display

- channel 1 vs. channel 2 data trace

- channel 1 vs. channel 2 y-axis labels (when both channels are on)

- "Rel" vs. "Abs" y-axis scale

- system bandwidth

- narrowband vs. broadband mode

- If testing long cables, slow the sweep time down until no changes are seen.

Make sure the span is not too narrow. This may cause interpolation errors with the default or full-band calibrations. Perform a user-defined calibration at the desired frequency range.

Mismatch errors can cause inaccuracies up to a few tenths of a dB. This is usually noticeable as ripple in a low-loss transmission display, and is typically more noticeable in an 8712ET/ES than in an 8714ET/ES. Excessive ripple can indicate poor source or input match. Measure the match using the performance tests. If OK, try using an attenuator or making an enhanced response calibration to improve match.

# RF Power Problems

Check all cables and cable connections on the receiver board; tighten if necessary.

If the problem is caused by a power hole, try moving the cables to see if the power hole moves or disappears. If it does, the cable is probably defective.

If the analyzer has a step attenuator and the problem only occurs with the attenuator engaged (<0 dBm for the 8712ET/ES and <−5 dBm for the 8714ET/ES), replace the step attenuator assembly. Otherwise, replace the receiver assembly (A5). (Refer to "Removing the Receiver PC Board" on page 3-14.)

# Category 4 Failures: Peripheral Device Problems

## DIN Keyboard

If a DIN keyboard interface test failure was reported during power-up, there may be a problem with the +5 V power supply for the DIN keyboard.

Verify that the keyboard is connected properly. (If necessary, use a DIN (f) to mini-DIN (m) adaptor.) Make sure that the keyboard is compatible with the analyzer. The analyzer should work with HP mini-DIN keyboards that are U.S. English versions, and most (but not all) IBM PC/AT compatible keyboards. Connect the keyboard to a computer or another analyzer to see if it is functioning, or try using a different keyboard.

Some keyboards draw excessive current on the +5 V power supply and cause the self-healing fuse on the CPU board to open. If the self-healing fuse opens, node 29 on the Analog Bus will measure well below 4.5 V. See Table 5-4 on page 5-16.

If you determine that the keyboard interface is defective, replace the CPU board (refer to "Removing the CPU Board Assembly" on page 3-6).

## RS-232 Printers and Plotters

If an RS-232 interface problem was reported during power-up (with no peripheral connected), there may be a problem with the RS-232 portion of the Super I/O chip, U607, or its clock, U606. Replace the CPU board (refer to "Removing the CPU Board Assembly" on page 3-6).

Make sure the printer's or plotter's line power is switched on, that it has paper and pens, that its pinch wheels are down, etc. Plotters should not be in VIEW mode. Verify that the RS-232 device has been selected as the hardcopy device by pressing (HARDCOPY) **Select Copy Port**. The highlighted line shows the current device selection. Baud rate, parity, and handshake information can be accessed by selecting the corresponding softkeys on the right side of the CRT. If any of this is incorrect, enter the correct information. Refer to the printer or plotter manual for proper parameters. Refer to your analyzer's *User's Guide* for more details on hardcopy options.

Try to make a print or plot from another instrument or a computer to confirm that the printer/plotter is working. If it is, replace the CPU board.

## Floppy Disk Drive Maintenance

Depending on the environment your analyzer is in, airflow from the front panel can cause a disk drive to become dirty. A dirty disk drive can have a symptom of not reading or writing to the floppy disk. The failure is usually intermittent.

A regular cleaning schedule should be adhered to. A commercially available disk cleaning kit is recommended. Replace the disk drive if cleaning does not restore the drive to full operation. Refer to "Removing the 3.5" Disk Drive Assembly" on page 3-22, for a detailed procedure to remove the floppy disk drive.

# Centronics (Parallel) Printers and Plotters

If a Centronics interface problem is indicated during power-up (with no peripheral connected), there may be a problem with the Centronics interface portion of the Super I/O (U607). Replace the CPU board (refer to "Removing the CPU Board Assembly" on page 3-6).

Make sure the printer's or plotter's line power is switched on, that it has paper and pens, that its pinch wheels are down, and so forth. Plotters should not be in VIEW mode. Verify that the Centronics device has been selected as the hardcopy device by pressing (HARDCOPY) **Select Copy Port** . The highlighted line on the CRT shows the current device selection. The second line should say "Centronics." If this is incorrect, enter the correct information. Refer to your analyzer's *User's Guide* for more details on hardcopy options.

If everything seems okay but you still cannot print or plot, remove the CPU board and check jumper J645, near the GPIB and parallel connectors at the rear of the board. Make sure the jumper is in the "RUN" position instead of "TEST."

Try to make a print or plot from another instrument or a computer to confirm that the printer/plotter is working. If it is, replace the CPU board.

# GPIB Systems

If a GPIB interface problem is indicated during power-up (with nothing connected to the GPIB port), there may be a problem with the GPIB controller chip (U524) or the interface chips (U525, U526). Replace the CPU board (refer to "Removing the CPU Board Assembly" on page 3-6.)

Check the analyzer's GPIB functions with a known working peripheral such as a plotter, printer, or disk drive. Press (PRESET) (SYSTEM OPTIONS) **GPIB** **System Controller** to allow the analyzer to control the peripheral. Check the GPIB address on the peripheral, then set the analyzer to recognize this address by following the instructions in the next section.

## GPIB Problems with Printers or Plotters

For GPIB printers or plotters, press (HARDCOPY) **Select Copy Port** and select the appropriate GPIB device. The currently selected device is shown on the first line of the display, and for GPIB devices, the GPIB address is shown on the second line.

To change the address, press **Print/Plot GPIB Addr** and enter the correct value (from 0 to 30.)

NOTE    The default GPIB address expected by the analyzer for both printers and plotters is 5, but the factory default address of most printers is 1.

Make sure the printer or plotter has line power switched on, that it has paper and pens, that its pinch wheels are down, and so forth. Plotters should not be in VIEW mode. Press **Prior Menu** **Start** to do a print or plot. If the result is not a copy of the display (as selected by **Define Hardcopy** ), suspect GPIB problems in the analyzer.

## General Checks for GPIB Systems

If the analyzer does not respond to an external controller, verify that the analyzer is in talker/listener mode by pressing (SYSTEM OPTIONS) **GPIB** . The analyzer cannot respond if it is in system-controller mode.

Make sure the controller is using the proper select code and addresses.

Be sure GPIB cable length limits are not exceeded. See your analyzer's *User's Guide* for more detailed information.

Refer to the "GPIB Programming" chapter of the *Programmer's Guide* to troubleshoot programming problems. Replace the CPU board if the analyzer appears to have a GPIB problem.

# LAN Troubleshooting

Problems with the LAN network can be difficult to solve. Software and protocol problems can make it difficult to determine if the analyzer's hardware is working properly, or if there is some problem with the LAN or cabling. The purpose of this section is to determine if the analyzer's hardware is functioning properly. While the turn-on self-test verifies some LAN hardware functionality, it is limited to internal testing only. Incorrect IP addresses will prevent proper operation. Improper subnet masks may allow only one-way communication, while improper gateway addresses may exclude outside LAN access.

## Ping Command

The analyzer has the built-in capability of performing a "ping" operation. Ping will request the analyzer to send a few bytes of information to a specific LAN device. That device will then signal the analyzer that it has received the information. The analyzer computes the approximate round trip time of the communication cycle and displays it. For a full test of two-way communications, a ping test should be performed in two directions. The first should be **from the analyzer** to the network. The second should be **from the network** to the analyzer. In the second case, any other network device capable of sending a ping command could be used, assuming it is connected to the same network. This could be a computer or even another analyzer.

## How to Ping

Follow the steps below to verify proper LAN operation (assuming you have a functioning LAN). If no LAN is available, see

1. Make sure the IP address on the analyzer is set properly and that it is unique. Press (SYSTEM OPTIONS) **LAN** **LAN Port Setup** . The IP address of the analyzer should be displayed. If it reads `0.0.0.0`, then it has not yet been programmed. To program the IP address, press **87xxx IP Address** and use the keypad to enter the new address.

2. Make sure the subnet mask is `0.0.0.0`. If not, note the current setting and then set it to `0.0.0.0`. This mask can be set by pressing (SYSTEM OPTIONS) **LAN** **LAN Port Setup** **Subnet Mask** .

3. Make sure the LAN is enabled by pressing (SYSTEM OPTIONS) **LAN**
   **LAN State ON off** . If the state was previously off, then it is necessary to cycle the
   power again before the LAN will function.

4. Find and note the IP address of another working LAN device on the same network.
   Make sure this device is turned on, connected, and is functioning properly.

5. Press (SYSTEM OPTIONS) **LAN** **LAN Port Setup** **Diagnostic Utilities**
   **IP Address to Ping** . Enter the IP address of the other LAN device.

6. Press **Perform Ping** .

7. The analyzer will attempt 4 cycles of communications with the indicated LAN device. It
   will display the time it took to complete each cycle. Each cycle will time-out in one
   second if no communication is established and the message `Timeout waiting for`
   `reply` will be displayed. It is common for the first of the four cycles to time-out even
   though subsequent cycles pass. See below for an example output of a successful ping.

   ```
   Resolving 15.4.43.255.
   Pinging 15.4.43.255.

   64 bytes from 15.4.43.255: time=60 ms
   64 bytes from 15.4.43.255: time=50 ms
   64 bytes from 15.4.43.255: time=60 ms
   64 bytes from 15.4.43.255: time=50 ms
   Finished PING test.
   ```

This establishes one way communication from the analyzer to the network. Reverse
communication should also be verified. Determining this, though, is dependent upon your
network setup and software. Generally, you will need to issue a ping command using the IP
address of the analyzer to be tested. For example, using Windows 95 and while at a DOS
prompt, type in `ping xxx.xxx.xxx.xxx`, then press (ENTER) (the letters x represent the
IP address of the analyzer). If full communication can be established, then the computer
display will show the cycle time for each of four cycle attempts (similar to that in step 7).
Other software may behave slightly differently, but all should function basically the same.

If the analyzer will talk to the network, but the network will not talk to the analyzer, then
the computer or device used from the network may have a subnet mask that excludes
communication with the IP address chosen for the analyzer. Any subnet mask other than
`0.0.0.0` will exclude operation from some addresses. Changing the subnet mask of a
computer or other device should only be attempted by a qualified network administrator.
Failure to communicate due to a subnet mask incompatibility does not indicate any failure
of the analyzer.

If the analyzer fails to ping in either direction, and assuming the subnet masks are okay,
then the fault must be isolated to the analyzer or to the network. Contact a qualified
network administrator or refer to the *Agilent Technologies 8712ET/ES and 8714ET/ES
LAN Interface User's Guide Supplement* for more troubleshooting information. You may
also substitute a known working analyzer to help isolate the fault.

## Testing between Two Analyzers

The ability of the analyzer's LAN to function can be easily tested by connecting two analyzers together using a short length of cable with two RJ-45 connectors on each end. However, a "crossover" cable must be used in order for this to work. Some network hubs have the capability to make a crossover connection using two normal, or straight-through, cables. If this is available, use it; otherwise a crossover cable can be made by following the directions in the next section

## Constructing a Crossover Cable.

A crossover cable can be made from a normal LAN cable by connecting pin 1 from each connector to pin 3 of the other connector. Likewise pin 2 should be connected to pin 6.

1. Strip away a few inches of the outside jacket insulation from the middle of a standard LAN cable that has an RJ-45 connector on each end

---

NOTE        Most, but not all, LAN cables use the color coding listed in Table 4-4.

---

**Table 4-4 List of Pin and Color Code Designations of a LAN cable**

| Pin Number | Color[1] |
|---|---|
| 1 (transmit +) | White/orange |
| 2 (transmit −) | Orange |
| 3 (receive +) | White/green |
| 4 | Blue |
| 5 | White/blue |
| 6 (receive −) | Green |
| 7 | White/brown |
| 8 | Brown |

1.   If your cable does not use this scheme, you will have to determine each conductor with a continuity tester.

2. Cut the wires going to pins 1, 2, 3, and 6. Strip away a small amount of insulation from each of the eight cut ends.

   a. Connect the wire from pin 1 on one side of the cable to the wire from pin 3 on the other side of the cable.

   b. Connect the wire from pin 3 on one side of the cable to the wire from pin 1 on the other side of the cable.

   c. Connect the wire from pin 2 on one side of the cable to the wire from pin 6 on the other side of the cable.

   d. Connect the wire from pin 6 on one side of the cable to the wire from pin 2 on the other side of the cable.

**Figure 4-9 Construction of a Cross-Over Cable**
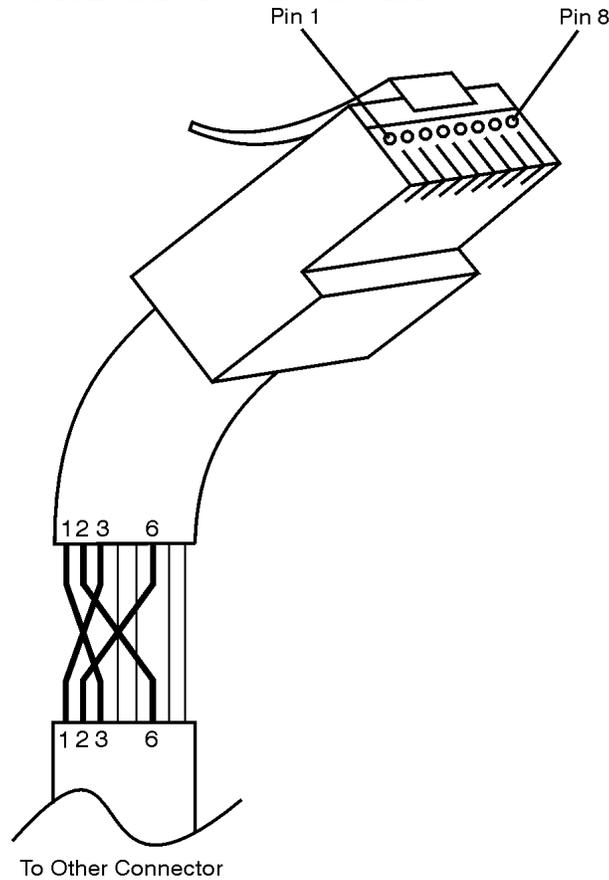


sd623c

3. Insulate all exposed wires so they cannot short together. Label this as a crossover cable so it cannot be confused with normal cable.

Set the IP addresses on two analyzers. The addresses can be set to anything, but they must be different. Make sure the subnet mask and gateway addresses are set to `0.0.0.0` and that the LAN is active ( **LAN State ON off** ) on both analyzers. If necessary, refer to "How to Ping" on page 4-40. Connect the two analyzers together using either a crossover cable or a crossover hub.

Now follow the steps in "How to Ping" in order to have the first analyzer ping the second analyzer. When done, repeat the procedure having the second analyzer ping the first. If both procedures function properly, the LAN circuitry on both analyzers is verified. If neither function, then the following could be wrong:

• One or both IP addresses could be wrong.

• One or both LAN states could be set to off.

• The crossover cable could be miswired.

• One or both analyzers could be defective.

If possible, eliminate the possibility of a defective analyzer by substitution of a known working unit. Once the analyzer has been proven to be working properly, concentration can be placed on the network itself.

Below is a list of LAN cables available. For information ordering replacement parts, see "How to Order Parts" on page 3-24.

**Table 4-5 Available HP/Agilent LAN Cables**

| Cable | Description |
|-------|-------------|
| 92268A | 4-meter with attached 8-pin connectors |
| 92268B | 8-meter with attached 8-pin connectors |
| 92268C | 16-meter with attached 8-pin connectors |
| 92268D | 32-meter with attached 8-pin connectors |
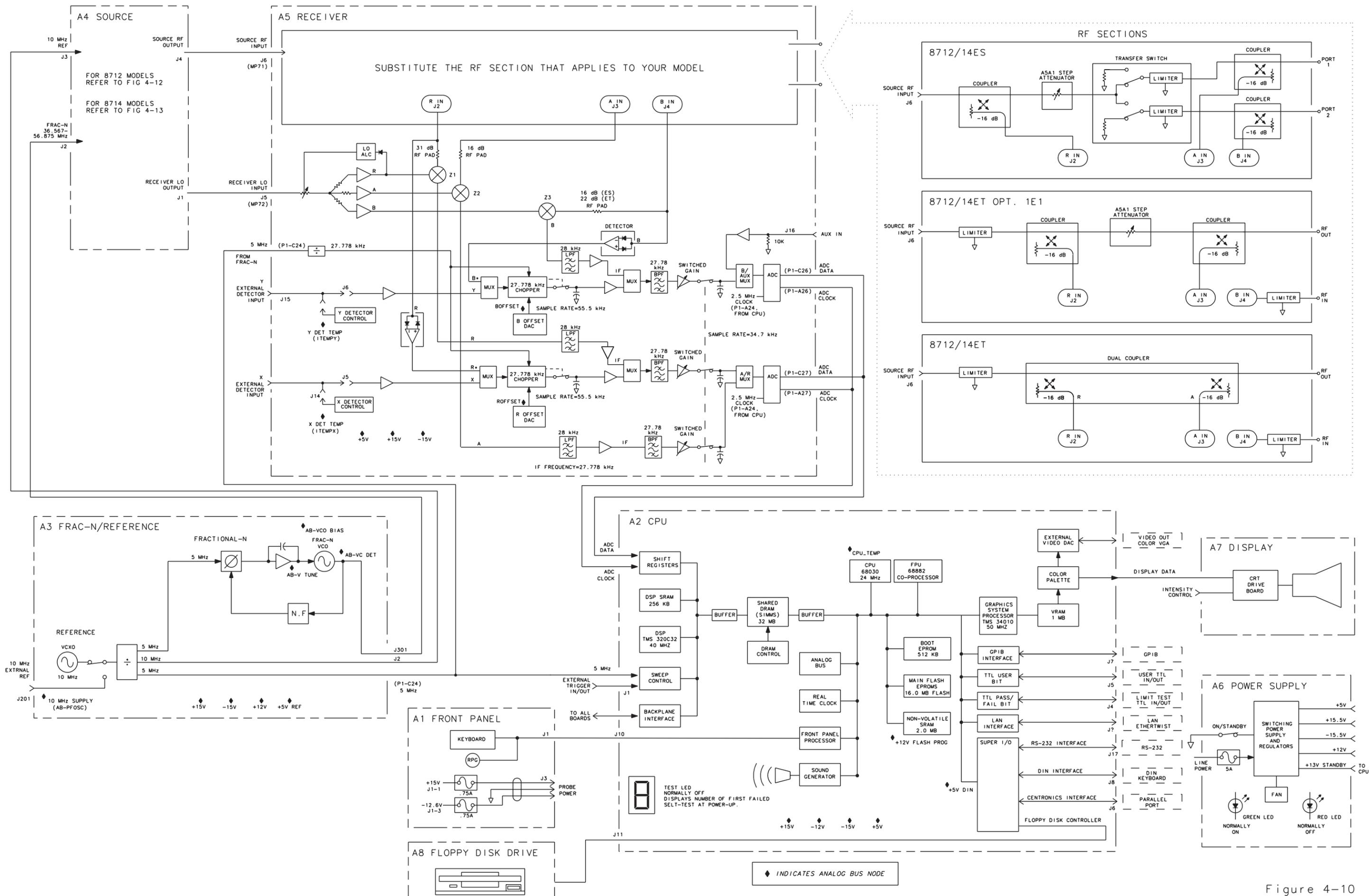
Figure 4-10
8712ET/ES and 8714ET/ES OVERALL BLOCK DIAGRAM

sp63es

## Figure 4-12  8712ET/ES A4 Source Board

**Figure 4-13  8714 ET/ES A4 Source Board**
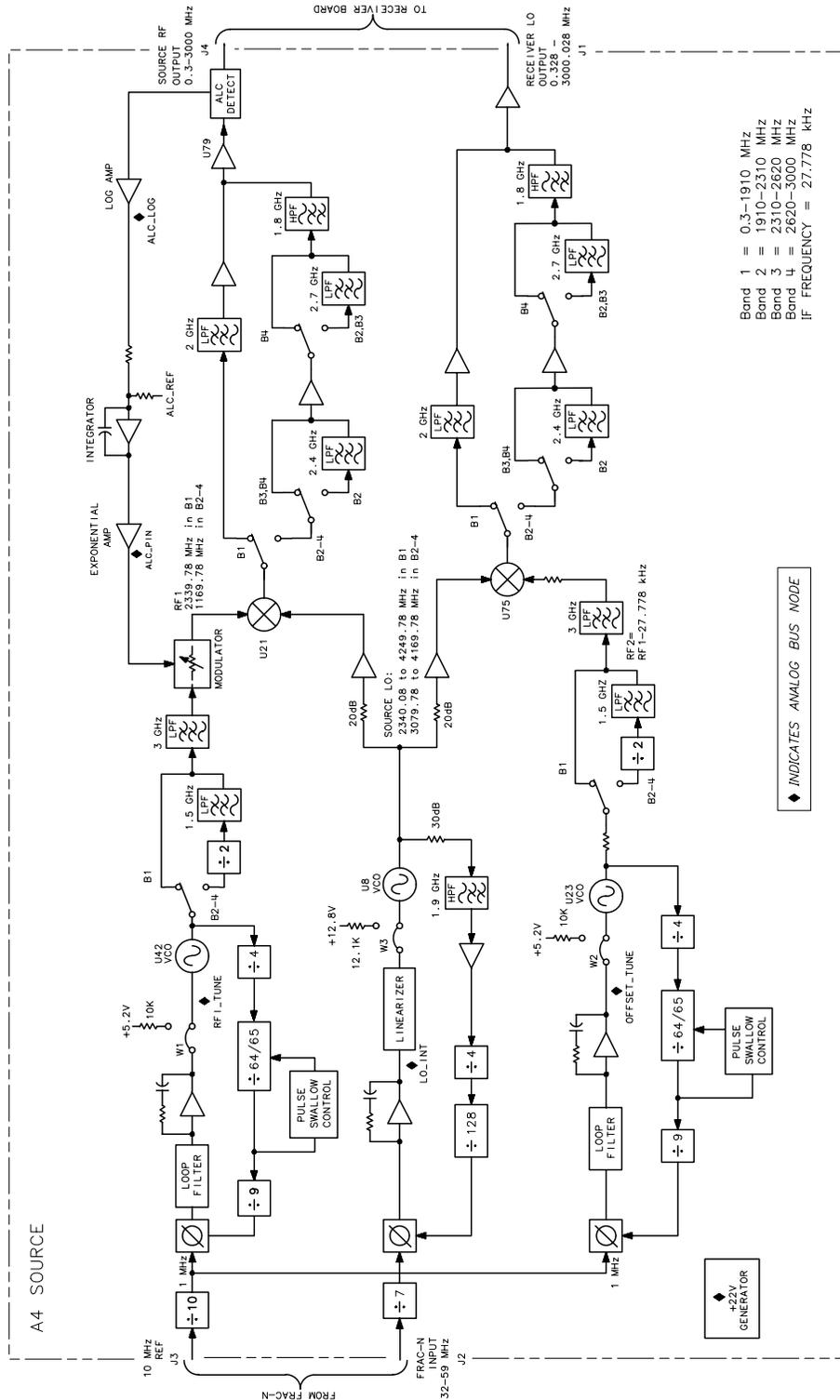
# 5 Service Related Menus

# Introduction

This chapter describes the functions of the service key menus. Each section title is a selection in the service menu, and under these titles are the related soft keys. These menus are used to test, verify, adjust, control, and troubleshoot the analyzer. Internal diagnostics and adjustments include self-tests and adjustment tests. The service functions allow you to put the analyzer into different states to help with troubleshooting.

The service menu is accessed by pressing (SYSTEM OPTIONS) **Service** . Refer to Figure 5-1 on page 5-3 for the service key menu maps.

Also included in this chapter are miscellaneous service functions and GPIB commands. A procedure to clear nonvolatile memory (SRAM) is included in "Miscellaneous Service Functions" on page 5-22. Equivalent GPIB commands for some of the service menu keystrokes are found in "GPIB Command Reference for Service" on page 5-23.

| CAUTION | The functions that appear under the **Service Utilities** menu are provided as a convenience for service personnel. When these features are used, *the response of the analyzer is not specified*. |
| --- | --- |

**Figure 5-1  Service Key Menus**



SERVICE MENUS

SYSTEMS
OPTIONS

IBasic
LAN
GPIB
System
Config
Operating
Parameters
.
Service
.

**Tests and
Adjustments**
Select
Self-Test
Select
Adjustment
Execute
Test
.
.
.
Stop Test
.

**Meas Cal
Options**
Meas Cal
ON off
Detect Cal
ON off
.
View Array
Master
View Array
Interpol
View Array
Scalar
.
Restore
Data Disp

**View Array
Master**
Directivity
Source
Match
Tracking
Narrowband
Response
Load
Match
Isolation
·····> Path
forward rev
.

**Service**
Tests and
Adjustments
Instrument
Info
.
.
Update
Corr Const
.
Service
Utilities
.

**Servc Util
Menu 1**
Meas Cal
Options
Analog
Bus
IF Gain
Adj Test
Results
Select
Array
Display
Array
Next Menu
.

**Analog
Bus**
Select
Node
Sample
.
.
.
.
.
.

**View Array
Interpol**
Directivity
Source
Match
Tracking
Narrowband
Response
Load
Match
Isolation
·····> Path
FWD rev
.

**Detector
Zero DACs**
X & R*
Chan DAC
Y & B*
Chan DAC
.
.
.
.
.
.

**IF
Gain**
Input
[R]   A   B
IF Gain
AUTO   man
High
MedHigh
Medium
Low
More
IF     Gain
.

**View Array
Scalar**
Master R*
Freq Resp
Interp R*
Freq Resp
B* Pow
Restore
Data Disp

**Servc Util
Menu 3**
.
Multiport
Tset Ctrl
Data-Mem
Freq Annot
Use Percnt
.
Adj Limits
ON off
.
.

**Servc Util
Menu 2**
ALC DAC
Attenuator
LO Control
Detector
Zero DACs
Bandcross
on OFF
Next Menu
.

sw61e

# Tests and Adjustments Menu

**Select Self-Test** : Allows you to select a diagnostic self-test. Tests may be selected by entering the number of the test with the keypad, or using the front-panel knob or ⇑ ⇓ keys to scroll through the list of tests. The number, description, and test status of the currently selected test are shown. Possible test status notations are: "PASSED," "FAILED," and "NOT DONE." See Table 5-1, "Analyzer Self-Tests," on page 5-5 for a listing of all the tests and their descriptions.

If any test fails, refer to Chapter 4, "Troubleshooting and Block Diagrams."

Some tests are run only during power-up and the results of these tests will be displayed when the test is selected. However, these tests cannot be executed from this menu.

**Select Adjustment** : Allows you to select an adjustment. Adjustments are listed in numerical order. The adjustments can be performed in numerical order, but the preferred order is shown in Chapter 2, "Adjustments." To select an adjustment, use the numeric keypad to enter the adjustment number, or use the front-panel knob or ⇑ ⇓ keys to scroll through the list. The number, description, and test status of the currently selected test are shown. Possible test status notations are: "PASSED," "FAILED" and "NOT DONE." See Chapter 2, "Adjustments,"  for a listing of the adjustments and their descriptions.

**Execute Test** : Executes the selected test or adjustment.

**Stop Test** : This stops any test that is currently running.

# Select Self-Test Menu

Internal tests can be used in troubleshooting the analyzer. Only the ones marked with an asterisk in Table 5-1 are executed during the power-up sequence. The pass/fail status of these tests can be checked by scrolling through the list of self-tests. Also, if any test fails during power-up, the number of the first test to fail will be displayed on the "Test Results" LED which is visible through an opening in the analyzer's rear panel. The "Select Self Test Menu" can be located by selecting ⌈SYSTEM OPTIONS⌉ **Service** **Test & Adjustments** **Select Self-Test** .

| NOTE | There are two LEDs to the left of the seven-segment "Test Results" LED on the rear panel of the analyzer. The red LED is on for self-tests 1 through 9, and the green LED is on for tests 10 through 19. If all tests pass, the green LED will be on, and the red LED and the seven-segment LED will be off. |
|---|---|

**Table 5-1   Analyzer Self-Tests**

| Test Number | Test Name | Description |
|---|---|---|
| * 1 | 680x0 Processor | Executes internal tests of 68030 main CPU and 68882 coprocessor. Checks all registers. Checks logic, math, shift/rotate, and bit manipulation instructions. |
| *2 | BootROM Checksum | Checksum of bootROM to verify bootROM firmware code. |
| *3 | Main ROM Checksum | Checksum of flash EPROM to check main firmware. |
| *4 | Main Dram | Writes a series of test patterns to the DRAM and reads them back. Checks size of DRAM. |
| 5 | SIMM Dram | Not used. |
| *6 | 340x0 GSP Processor | Not implemented. |
| *7 | GSP Video | Not implemented. |
| 8 | (Not used.) | This test number is not used because the test status LED powers up with the number "8" as the default. If there is a problem with the 68030 CPU, this "8" will remain displayed on the LED. Check power supplies. If good, then replace CPU board. |
| *9 | DSP SRAM | Checks the program SRAM used by the TMS 320C32 digital signal processor. |
| *10 | 320C32 DSP Processor | Tests the TMS 320C32 digital signal processor. |
| 11 | 68030 and 320C32 Communication | Not implemented. |
| *12 | Backplane Bus | Tests the ability of the 68030 to access the other boards through the backplane assembly. |
| * Denotes a test run during power-up. | | |

| Test Number | Test Name | Description |
|---|---|---|
| *13 | Non-volatile SRAM | Tests the integrity of the contents of battery-backed SRAM. Detects loss of power to the SRAM. |
| *14 | Digital IF Control | Tests the operation of the LAN circuitry. |
| 15 | CPU Support Circuitry | Tests various circuits that are required for the main processor (68030) to operate. Tests timers and interrupts. Attempts to clear and disable all interrupts. Tests each interrupt signal to the 68030 to make sure that none of them are asserted. |
| 16 | Analog Bus | Tests the analog bus control circuitry and +5 V and EPROM Vpp on the CPU board. |
| 17 | Real Time Clock | Tests the real time clock and tries to access registers on the chip. |
| *18 | Front Panel Interface | Tests the front panel control processor. Tries to access registers on the chip. |
| *19 | Floppy Disk Controller | Tests the 3.5" internal disk controller portion of the Super I/O chip. Tries to access registers on the chip. Writes commands to the chip, and verifies correct response. Also steps the floppy disk drive's head from track 0 to 9, and back to 0, to test the ability to find track 0. |
| *20 | GPIB Interface | Tests the GPIB interface circuitry. Tries to access registers on the chip. Writes commands to the chip, and verifies correct response. |
| *21 | RS-232 Interface | Tests the RS-232 portion of the Super I/O chip. Tries to access registers on the chip. Checks for missing clock input to the chip. |
| *22 | DIN Keyboard Interface | Tests the DIN keyboard control portion of the Super I/O. Tries to access registers on the chip. |
| *23 | Centronics Interface | Tests the Centronics interface portion of the Super I/O. |
| 24 | Front Panel Key | Prompts user to press any keys and displays information on the key pressed. Press (PRESET) three times to exit. |
| 25 | Erase Non-Volatile SRAM | Tests all locations of battery-backed SRAM by writing zeroes. This erases existing data. Wait 30 seconds, then cycle power. |
| 26 | Source PLL Lock | Not implemented. |
| 27 | X External Detector ID | Not implemented. |
| 28 | Y External Detector ID | Not implemented. |
| 29 | RS-232 Port | Prompts user to connect a printer or terminal, and then sends characters to the port. |
| 30 | Centronics Port | Prompts user to connect a printer, and then sends characters to the port. |
| * Denotes a test run during power-up. | | |

| Test Number | Test Name | Description |
|:---:|---|---|
| 31 | DIN Keyboard Port | Prompts user to connect a DIN keyboard. Displays feedback on detected key presses. |
| 32 | GPIB Port | Prompts user to disconnect GPIB cable. Tests GPIB hardware. Prompts user to connect a printer, and then sends characters to the port. |
| 33 | Test TTL Pass/Fail Bit Test | Prompts user to disconnect cable and then tests the hardware. Prompts user to ground the BNC and then tests the hardware. |
| 34 | Test TTL User Bit Test | Prompts user to disconnect cable and then tests the hardware. Prompts user to ground the BNC and then tests the hardware. |

# Select Adjustment Menu

Adjustments generate correction constants (CCs) which compensate for the hardware performance of the analyzer. Correction constants are stored in segmented flash EPROMs along with the firmware. The data is copied to RAM during power-up. Running an adjustment test modifies the data in RAM, but it does not alter the data in EPROM.

To store the new CCs into EPROM, refer to Chapter 8, "Correction Constants and Firmware." All the adjustments are listed in Table 5-2. For details on how to perform all necessary adjustments, refer to Chapter 2, "Adjustments."

Results of several adjustments can be viewed by selecting (SYSTEM OPTIONS) **Service Test & Adjustments**  **Adj Tests Results** . While this information was designed more for factory use (and can vary considerably from unit to unit), the information regarding the date and time of the last adjustment performance/modification can be very useful. This is updated each time an adjustment is performed. However, this date will be lost if the correction constants are not stored to EPROM before the analyzer's line power is cycled. Date format is defined under the **Set Clock** menu, which is in the (SYSTEM OPTIONS) **System Config** menu.

**Table 5-2   Analyzer Adjustments**

| Adjustment Number | Title | Comments |
|---|---|---|
| 100 | Set Serial Number | Not implemented; serial numbers can only be set over GPIB. Indicates "Not Done" if there is no serial number; indicates "Passed" when a serial number is resident. |
| 101 | LO Power Correction | Not required. |
| 102 | Switched Gain Correction | Sets the low and high gain corrections for the receiver, which are needed for accuracy at low input power levels. |
| 103 | External Detector Gain Correction | The external X and Y detectors convert the detected power level into a voltage for the analyzer's receiver. In this adjustment, known voltages are applied to the detector input ports. The analyzer then generates correction constants for the receiver to use in interpreting the detector voltage level. |
| 104 | Source Power Correction | Source power correction. Generates power correction arrays for both the ALC and internal step attenuator (if installed). |
| 105 | B Amplitude Correction | B amplitude correction. Corrects B narrowband input so that it reads 0 dBm properly. |
| 106 | Transmission Correction | Transmission correction. Performs transmission cal to correct B/R to read 0 dB. |
| 107 | Reflection Correction | Reflection correction. Performs one-port cal to correct for narrowband reflection (A/R) measurements. |
| 108 | R* Amplitude Correction | R* amplitude correction. Generates absolute power lookup table for the R* input at 30 MHz. |
| 109 | R* Frequency Response Correction | R* frequency response correction. Generates frequency response correction for the broadband R* input. |
| 110 | B* Amplitude Correction | B* amplitude correction. Generates absolute power correction table for the broadband B* input at 30 MHz. |
| 111 | Auxiliary Input Correction | Auxiliary input correction. Corrects for offset and gain of the auxiliary input circuitry. |

# Instrument Info

Displays a window with the following information:

- Analyzer model and firmware revision

- BootROM version

- Analyzer serial number

- Installed options

- System impedance

- Installed memory

# Update Corr Const Menu

For a complete description of when and how to use these keys, refer to "Storing and Recalling Correction Constants (CC)" on page 8-2. The following is a brief description.

 **Install CC From Disk** : Loads permanent copy of correction constant data from disk to EPROM. This key combines the functions of  **Load CC from Disk**  and  **Store CC to EPROM** 

 **Help Message** : Displays a banner which describes the keys of this menu.

 **Load CC From Disk** : This copies the contents of the correction constant file from the internal floppy disk drive into RAM. You cannot select an alternate disk drive. It allows you to copy a partially modified set of data into RAM and then continue with the rest of the adjustments.

 **Store CC To EPROM** : This will copy the current contents of the analyzer's CCs data that is contained in RAM to permanent storage in the EPROM.

 **Store CC To Disk** : At power-up, correction constants are copied from the flash EPROM to a RAM buffer. Any changes to the correction constants are made to the buffer only. Pressing this key creates a disk file that contains the correction constants from the buffer. This file is always written to the internal disk drive, regardless of the disk drive selected using the save/recall functions. The file will write over any existing file with the same name.

# Service Utilities Menu 1

This menu allows manual control of several sections of the A4 source and A5 receiver assemblies. This can be a helpful tool in troubleshooting these circuits.

| CAUTION | Most of these utilities *are for factory use only*. Modification of any values or settings *can result in improper operation or inaccurate results*. If in doubt as to the status of any settings, simply cycle the analyzer's line power. These settings will then be defaulted to the correct values. |
|---|---|

**Meas Cal Options** : Goes to the Measurement Calibration Options menu. From this menu you can activate/deactivate the measurement calibrations and detector calibrations, as well as access the View Array Master and View Array Interpolate menus (described in detail later).

**Analog Bus** : Goes to the Analog Bus menu. (See following pages.)

**IF Gain** : *For Factory Use Only*

**Adj Test Results** : Results of several adjustments can be viewed by selecting this key. While this information is designed for factory use and can vary considerably from unit to unit, the date and time that the last adjustment was done or modified can be helpful information. This is updated each time an adjustment is performed. However, this date will be lost if the correction constants are not stored to EEPROM before power is cycled. Date format is as defined under the **Set Clock** menu, which is in the (SYSTEM OPTIONS) **System Config** menu.

**Select Array** , **Display Array** : These two selections are virtually identical and both display the same data. Information displayed is the stored correction for the indicated parameter. ES model analyzers have two arrays for some parameters: one for the forward direction, and one for the reverse direction. The current measurement direction determines which array is displayed. Assuming no adjustments have been performed since power was cycled, these arrays represent the correction constants stored in EEPROM.

Viewing this data is useful in determining the measured raw performance of the analyzer, as well as the quality of the adjustment procedure used to store the correction constant data. Since this data represents the correction constants determined by performing the adjustments, it is also an indication of how the adjustments were performed. If any of these arrays show significant discontinuities, suspect either a hardware problem in the analyzer, or a hardware problem in the equipment used to perform the adjustment.

Data displayed is always the full band correction regardless of the current start/stop frequency settings. Absolute values are generally offset by a significant amount, so meaningful information can only be derived from the relative values. Table 5-3 lists all of the analyzer's 42 correction arrays along with a brief description and typical value ranges.

**Next Menu** : Leads to the Service Utilities Menu 2 and Service Utilities Menu 3 which allow you to manually control the ALC DAC, step attenuator, and LO power.

**Table 5-3   Contents of the Correction Constant Storage Arrays**

| Array Number | Description | Typical Correction | Comments |
|---|---|---|---|
| 0 | One-port Directivity | < 10 dB (8714ET/ES) < –5 dB (8712ET/ES) | This data is related to the raw directivity of the reflection port coupler (but does not equal it). |
| 1 | One-port Source Match | < –14 dB | This represents the source match of the reflection port. |
| 2 | One-port Tracking | < 5 dB variation | This is related to the frequency response of the A (reflection port) input. |
| 3 | B Amplitude Response (narrowband) | < 5 dB variation | This is related to the frequency response of the transmission port input (B input). |
| 4 | B/R Amplitude Response (narrowband) | < 5 dB variation | This is related to the frequency response of the transmission port input (B input). |
| 5-32 | ALC Corrections for the 7 attenuator steps, 0 through 6, and assorted DAC values. | See Comments. | These curves all represent the power correction tables generated mostly by adjustment #104. For each the seven different attenuator settings, four different ALC settings are measured for flatness. From this, the ALC correction table is generated. Since each trace only has about 20 points, it may appear slightly discontinuous; this is normal. For units without an internal attenuator, the correction should be flat for any attenuation value other than zero. Higher ALC values represent higher power levels. |
| 33 | B* Amplitude Linearization (broadband) | See Comments. | This is the correction curve for the absolute B* power measurement. It represents voltage (Y-axis) out vs. power in. It is normal for the last few horizontal divisions to be a flat line. |
| 34 | R* Amplitude Linearization | See Comments. | As above, but for the R* diode. |
| 35 | B* Frequency Response | 0 | Not implemented. Always a flat line at 0. |
| 36 | R* Frequency Response | 0 3 dB | This is the correction curve for the absolute B* power measurement. It represents voltage (Y-axis) out vs. power in. It is normal for the last few horizontal divisions to be a flat line. |
| 37 | AM Delay Insertion Loss | See comments. | Not Applicable. |

| Array Number | Description | Typical Correction | Comments |
|---|---|---|---|
| 38 | B* Diode Slope | See Comments. | A typical trace will be flat for the first and last few divisions. This trace represents the change in slope of power-in vs. voltage out. The slope is constant (zero) for both the log and linear portions of the diode curve. Only the transitional area will show something other than a flat line. |
| 39 | R* Diode Slope | See Comments. | As above but for the R* diode. |
| 40 | B* Amplitude -Raw Voltage vs. Power | For Service Use | Displays the Diode characteristic of the broadband diode in the B detector. The Y axis displays (dB per mV) while the X axis displays raw input power. |
| 41 | R* Amplitude -Raw Voltage vs. Power | For Service Use | Displays the Diode characteristic of the broadband diode in the R detector. The Y axis displays (dB per μV) while the X axis displays raw input power. |
| 42 | Load Match | Typical response is below –20 dB | Displays the stored Load Match of the RF OUT port for the ET analyzers or for the ES analyzers PORT 1 and PORT2. |

# Meas Cal Options Menu

The analyzer uses arrays of calibration data to improve the measurements made by the hardware. This menu allows you to disable the calibration, and view the calibration data arrays.

**Meas Cal ON off** : Allows the cal arrays to be used in processing measurement data. This function controls both the user-performed calibrations and the default factory cal. This includes transmission, reflection, and frequency response cal arrays (both broadband and narrowband). This function provides a way to examine the uncorrected performance of the hardware in the analyzer. When this function is off, "Cx" is displayed near the upper right-hand corner of the display.

**Detect Cal ON off** : Allows you to switch off the power cal for both the internal and external broadband detectors.

**View Array Master** : Selects the master (uninterpolated) cal arrays from the master to be displayed. These are the cal arrays from the currently active calibration (default, full band, or user-defined).

**View Array Interpol** : Selects the interpolated cal arrays from the master to be displayed. These are the cal arrays from the currently active calibration (default, full band, or user-defined). If the frequency range of the analyzer has not been changed since the last calibration was performed, then this is the same as the master.

**View Array Scalar** : Selects the scalar cal arrays from the master to be displayed.

# Analog Bus Menu

The analyzer has an analog bus that can be used to troubleshoot hardware problems on some of the boards in the analyzer. This is done by sampling analog bus nodes, which provide measurements at selected points on the boards. Nominal values for each node are provided in Table 5-4.

 **Select Node** : Allows you to select an analog bus node to be measured. The currently selected node description and number are displayed. A node may be selected by using the keypad to enter the number, or by using the front-panel knob or the keys to scroll through the list.

 **Sample** : Triggers a data measurement of the selected analog bus node.

**Table 5-4  Analog Bus Nodes**

| Number | Name | Description |
|--------|------|-------------|
| | **A4 Source Assembly Nodes** | |
| 1 | +47 V (for 8712ET/ES) <br> +22 V (for 8714ET/ES) | Source assembly power supply. Nominal value: <br> +44 V to +50 V (8712ET/ES) <br> +20 V to +24 V (8714ET/ES) |
| 2 | VCO RF 1 Tune | VCO tuning voltage for the RF1 phase lock loop on the source board (RF1_TUNE on the schematic). Typical values are 7 to 11 volts. A value higher than about 11.5 V may indicate a saturated op amp or bad VCO. |
| 3 | LO Integrator | Output of integrator in the source LO loop (LO_INT on the schematic). Voltage decreases as source frequency increases. For the 8712ET/ES, the voltage decreases about 9 volts over the frequency range. For the 8714ET/ES, the voltage decreases about 7 volts over a.3 to 1910 MHz range; voltage shifts at about 1910 MHz. |
| 4 | VCO Offset Tune | VCO tuning voltage for the RF2 phase lock loop on the source board (OFFSET_TUNE on the schematic). Value varies with the source frequency setting. Normal values are 6 to 10 volts. A value higher than about 11.5 V may indicate a saturated op amp. |
| 5 | Output Amp Temp | Shows the temperature at the output amplifier on the source board (OUTPUT_AMP_TEMP on the schematic). Normal values are 30 to 45 degrees Celsius. *Not available on the 8714ET/ES.* |
| 6 | ALC Log Amp | ALC log amp output on the source board (ALC_LOG on the schematic). Value depends on the source power level. Normal values are –1.75 to –0.5 volts. |

| Number | Name | Description |
|---|---|---|
| 7 | ALC PIN modulator | Voltage to ALC PIN modulator on the source board. This value increases as the source power increases. Normal values range from 3.0 to 10.5 volts. |
| **A5 Receiver Assembly Nodes** | | |
| 8 | +5 V on RCVR | +5 V power supply on the receiver board. Normal values are 4.5 to 5.5 DC volts. |
| 9 | +15 V on RCVR | +15 V power supply on the receiver board. Normal values are 13.5 to 16.5 DC volts. |
| 10 | −15 V on RCVR | −15 V power supply on the receiver board. Normal values are −16.5 to −13.5 DC volts. |
| 11 | X Det Temperature | X detector temperature (ITEMPX on the receiver schematic). A typical value is 30 degrees Celsius when a detector is connected. If no detector is connected, the typical value is around 0° Celsius. |
| 12 | Y Det Temperature | Y detector temperature (ITEMPY on the receiver schematic). A typical value is 30° Celsius when a detector is connected. If no detector is connected, the typical value is around 0° Celsius. |
| 13 | B*/Y Autozero | Offset used for the B chopper on the receiver board (BOFFSET on the schematic). Typical values are −12.0 to +12.0 volts. |
| 14 | R*/X Autozero | Offset used for the R chopper on the receiver board (ROFFSET on the schematic). Typical values are −12.0 to +12.0 volts. |
| 15 | B* Detector Temp | Temperature of B* internal detector on the receiver board (BTEMP on the schematic). Typical values are 20 to 60° Celsius; this will depend on the ambient temperature. *Not available on 8714ET/ES.* |
| **A3 Frac-N Assembly Nodes** | | |
| 16 | VCO Output Detector | Detector off = 0 V or Detector on < −.2 V |
| 17 | VCO Bias Supply | Normal ranges are −6.0 V to −2.0 V. |
| 19 | +5 Reference | Normal values are +4.75 V to +5.25 V. |
| 18 | VCO Voltage Drive | The 8714 range is −5.5 V to +8 V, while the 8712 range is −3.1V to +7.3 V. |
| 20 | 10 Mhz Oscillator Supply | Normal values are +4.7 V to +5.3 V. |
| 21 | +15 V Supply | Normal values are +13.5 to +16.5 DC volts. |

| Number | Name | Description |
|--------|------|-------------|
| 22 | −15 V Supply | Normal values are −16.5 to −13.5 DC volts |
| 23 | +12 V Supply | Normal values are +13.5 to +10.5 DC volts. |
| **A2 CPU Assembly Nodes** | | |
| 24 | +5 V on CPU | +5 V power supply on the CPU board. Normal values are +4.5 to +5.5 volts. |
| 25 | +12 V Flash Prog Voltage | +12 V Vpp supply for writing to the flash EPROM on the CPU board. This voltage is normally OFF, so the value should be less than +2.5 V. The "on" voltage level is checked during the power-up tests, and an error message is displayed if the level is incorrect. |
| 26 | CPU Temp | Temperature sensor on CPU board (CPU_TEMP on the schematic). Typical values are 30 to 60° Celsius; this will depend partly on the ambient temperature. |
| 27 | +15 V on CPU | Normal values are +14.57 V to +16.43 V. |
| 28 | −12 V on CPU | (−12.6 V Probe power node) The range is −12.1V to −13.1 V. |
| 29 | 5 V on DIN Keyboard | 5 V applied to the external PC compatible keyboard. The range is +4.99 V to +5.40 V. |
| 30 | −15 V | Normal values are −16.43 V to −14.57 V. |

# Service Utilities Menu 2

**ALC DAC** : Allows manual adjustment of the Automatic Level Control (ALC) DAC, which controls the source output ("RF OUT" or "PORT1"connector) power level. Disables the ALC power calibration until a power level is entered using the Power menu.

**Attenuator** : Allows manual control of the internal step attenuator, if one is installed.

**LO Control** : Allows manual adjustment of the DAC which controls the LO output power. The LO DAC is used by the 8712ET/ES receiver board only.

**Detector Zero DACs** : *For Factory Use Only.*

**Bandcross ON off** : *For Factory Use Only*

**Next Menu** : Leads to Service Utilities Menu 3.

# Service Utilities Menu 3

**Multiport TsetControl** : When the analyzer has been configured to use an external test set, this key accesses a menu to control the ports of an 87075C or other multiport test set.

**Data-Mem** : This key subtracts a data trace stored in memory from the displayed data trace. To store a displayed data trace in memory, press (DISPLAY) **Data->Mem** .

**Freq Annot Use Percnt** : *For Service Use Only.*

**Adj Limits ON off** : *For Factory Use Only.*

# View Array Master Menu /View Array Interpol Menu

These keys allow you to view the actual calibration data arrays that are currently in use. The arrays are copied into a memory trace for easy analysis. This allows you to scale them, and use markers to read out actual values.

 **Directivity** : Displays the directivity cal array as a memory trace. This is related to the raw directivity of the analyzer but it does not equal it. The raw directivity is determined by dividing the tracking array below by this directivity array.

 **Source Match** : Displays the source match cal array as a memory trace. This is the raw (or uncorrected A/R) source match of PORT 1.

 **Tracking** : Displays the tracking (narrowband frequency response of coupler with 100% reflection) cal array as a memory trace.

 **Narrowband Response** : Displays the narrowband transmission frequency response cal array as a memory trace.

 **Load Match** : Displays the load match cal array as a memory trace.

 **R* Freq Response** : Displays the broadband R* frequency response cal array as a memory trace.

 **B* Pow** : Displays the broadband power level as a memory trace.

 **Restore Data Display** : Presets the analyzer.

# Miscellaneous Service Functions

## Clearing Nonvolatile Memory (SRAM)

This is also referred to as "zeroing" the nonvolatile SRAM, because the procedure causes the analyzer to write zeroes into the nonvolatile SRAM locations in memory. Note that this will erase any files saved to internal memory (non-vol RAM disk). This will *not* affect correction constants.

1. Cycle the analyzer's power.

2. After about 25 seconds, the analyzer will emit a double beep. Immediately after this double beep, press [PRESET] several times.

3. The analyzer will pause after performing the CPU main self-tests and ask if you want to zero the SRAM. (Note the caution message!) Answer yes by pressing the [BEGIN] key. Press softkey #8 (bottom softkey) if you want to continue without clearing the memory.

# GPIB Command Reference for Service

Some of the service menu keys have equivalent remote GPIB commands. The analyzer uses the SCPI programming language. For more information about SCPI and GPIB, refer to the "GPIB Programming" section of the *Programers Guide*. Service-related SCPI commands are listed in the following sections.

## Syntax Summary

The following conventions are used when SCPI commands are being described:

1. Angle brackets (<>) are used to enclose required parameters within a command or query. The definition of the variable is usually explained in the accompanying text.

2. Square brackets ([ ]) are used to enclose implied or optional parameters within a command or query.

3. UPPER/lower case characters are used to indicate the short form (upper-case) of a given mnemonic. The remaining (lower-case) letters are the rest of the long form mnemonic. Either the short form or the long form may be used.

## Softkey SCPI Commands

This section lists the service menu keys in the order they appear on the menu map. See Figure 5-1 on page 5-3. Each softkey is shown with its corresponding short-form SCPI command.

Some SCPI commands do not correspond directly to a softkey. These are listed in the alphabetical command summary in Table 5-6, "Alphabetical SCPI Command Summary," on page 5-25, which also lists the long form of each SCPI command.

**Table 5-5    Softkey SCPI Commands**

| Keystrokes | SCPI Command |
|---|---|
| **Tests and Adjustments Menu** | |
| Select Self-Test | `TEST:SEL <num>` |
| Select Adjustment | `TEST:SEL <num>` |
| Execute Test | `TEST:STAT RUN` |
| Stop Test | `TEST:STAT STOP` |
| **Meas Cal Options Menu** | |
| Meas Cal ON off | `SENS[1|2]:CORR[:STAT] <ON|1|OFF|0>` |
| **Update Corr Const Menu** | |
| Store CC to Disk | `DIAG:CCON:STOR:DISK` |
| Store CC to EPROM | `DIAG:CCON:STOR:EEPR` |
| Load CC from Disk | `DIAG:CCON:LOAD` |

# Alphabetical SCPI Command Summary

This section contains the service-related GPIB mnemonics recognized by the analyzer with a short description of each command. All commands have a query form unless specified in the "Form" column as command only or query only. To change a command into a query, add a "?".

The "Form" column also gives the parameter type returned by the analyzer in response to a query. NR1 (integers), NR2 (floating point numbers with explicit decimal point), and NR3 (floating point number in scientific notation) refer to different types of numeric data. CHAR (character data) and STRING (string data, enclosed in quotes) are also used to describe response types. These parameter types are described in the "SCPI Command Summary" section in the analyzers *Programmer's Guide*.

**Table 5-6  Alphabetical SCPI Command Summary**

| Command | Form | Description |
|---|---|---|
| `DIAGnostic:BANDcross [:STATe]<OFF\|0\|ON\|1>` | NR1 | (8714ET/ES only) Turns bandswitching on or off. |
| `DIAGnostic:CCONstants:COPY` | Command | Copies correction constants from EPROM to RAM. |
| `DIAGnostic:CCONstants:DEFaults` | Command | Restores the default correction constants to EPROM and RAM. |
| `DIAGnostic:CCONstants:ERASe: EEPRom` | Command | Erases EPROM. |
| `DIAGnostic:CCONstants:LOAD` | Command | Loads correction constants from internal disk drive. |
| `DIAGnostic:CCONstants:INSTalled?` | Query only NR1 | Queries if correction constants are installed. Returns a "1" if true, and a "0" if false. |
| `DIAGnostic:CCONstants:STORe:DISK` | Command | Stores correction constant data to a file on the internal disk drive. |
| `DIAGnostic:CCONstants:STORe:EEPRom` | Command | Stores correction constant data from the RAM buffer into flash EPROM. |
| `DIAGnostic:CPU:MEMory[:WORD] <addr num><data num>` | NR1 | Writes a 16-bit data value to a 68030 address. Queries returns an integer with the 16-bit value at the selected address. |
| `DIAGnostic:SNUMber <string>` | STRING | Stores a serial number into memory. The string must be 10 characters long. The query form returns the current serial number. |
| `*IDN?` | Query STRING | Returns a string that uniquely identifies the analyzer, including model number, serial number, and firmware revision. |
| `*OPT?` | Query STRING | Returns a string identifying the installed options, in the form "1E1, 1C2, etc...." |
| `SENSe[1\|2]:CORRection[:STATe] <ON \|1\|OFF\|0>` | NR1 | Switches measurement calibration ON or OFF. |
| `TEST:RESult?` | Query CHAR | Queries the result of the selected adjustment or self-test. Response will be NULL\|PASS\|FAIL. |
| `TEST:SELect <num>` | NR1 | Selects the adjustment or self-test to execute. |

| Command | Form | Description |
|---|---|---|
| `TEST:STATe <string>` | CHAR | Selects the state of the active adjustment or self-test. Choose from RUN\|CONTinue\|STOP. Query response will be NULL\|PAUS\|DONE. |
| `TEST:VALue <num>` | NR1 | Sets or queries a value for an adjustment or self-test. |
| `*TST?` | Query NR1 | Returns the result of a complete selftest. An ASCII 0 (zero) indicates no failures found. Any other character indicates a failure. |

# 6 Theory of Operation

# Introduction

This chapter begins with a general description of the operation of the network analyzer system. This is followed by more detailed discussion of the operating theory of functional groups within the network analyzer. The operation of each group is described briefly, to the assembly level only. Detailed component-level circuit theory is not provided here.

Simplified block diagrams illustrate the operation of each functional group. A more detailed overall block diagram is provided at the end of Chapter 4, "Troubleshooting and Block Diagrams."

# System Theory

The analyzer integrates a synthesized RF source with built-in couplers for signal separation, a combination narrowband and broadband receiver, and a display. Figure 6-1 and Figure 6-2 show the simplified system block diagrams of the ET and ES analyzer models.

In the analyzer, the fractional-N/reference (A3) and source (A4) assemblies provide the synthesized RF source output. The receiver (A5) assembly separates the signals into reference, reflected, and transmitted signals. These inputs are processed as either narrowband or broadband signals. They are then multiplexed into ADCs (analog to digital converters), where they are converted into digital signals. The digital data is processed by the CPU (A2) assembly and sent to the A7 display.

## The Analyzer Functional Groups

Each functional group consists of one or more assemblies that perform one of the basic instrument functions. These groups are discussed in the following main sections:

- "Power Supply (A6)" on page 6-6
- "Digital Control Group" on page 6-6
- "Source Group" on page 6-8
- "Receiver Assembly (A5)" on page 6-12

**Figure 6-1   Simplified Block Diagram of the ET Model Analyzers**
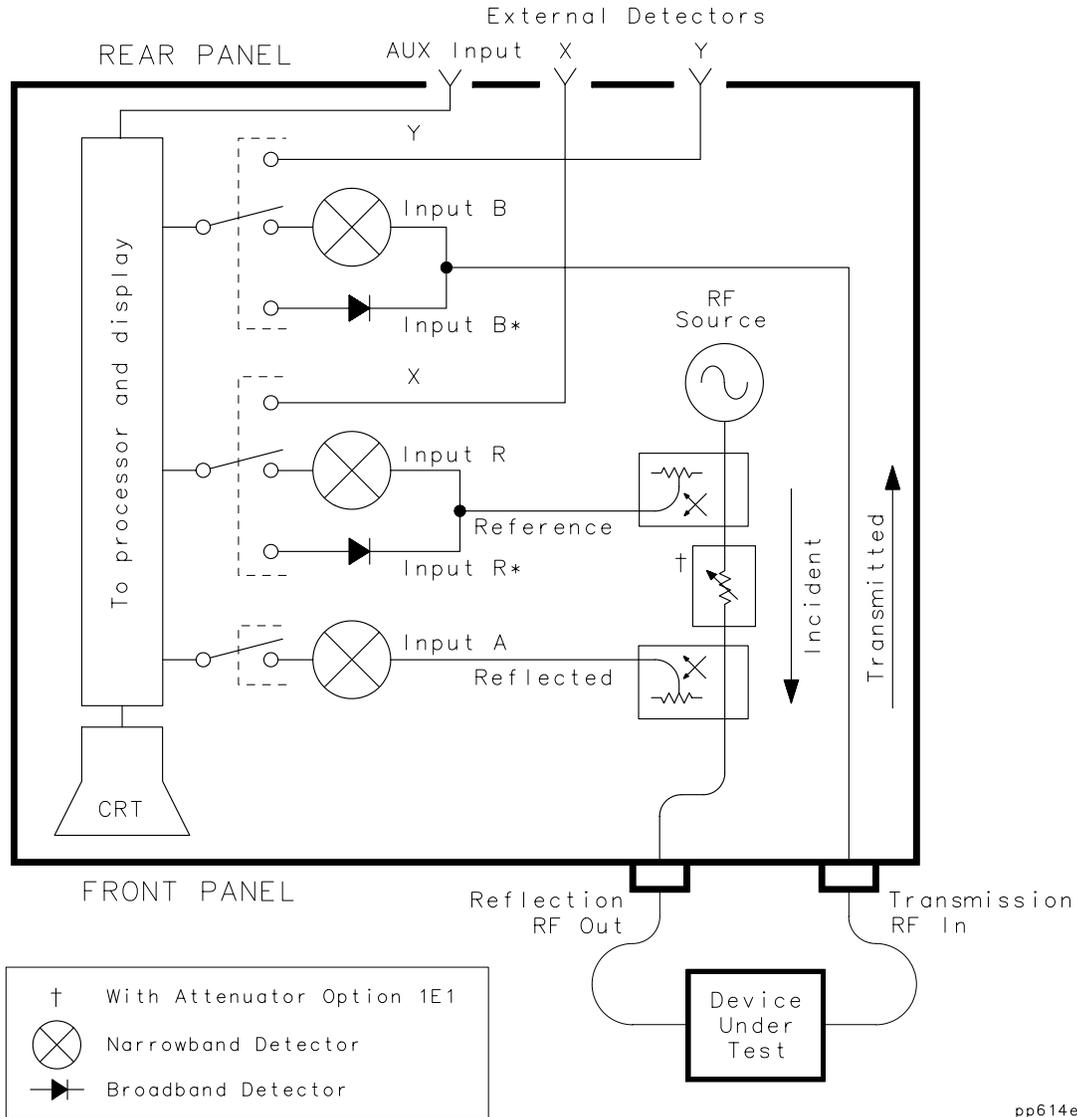


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## Figure 6-2  Simplified Block Diagram of the ES Model Analyzers
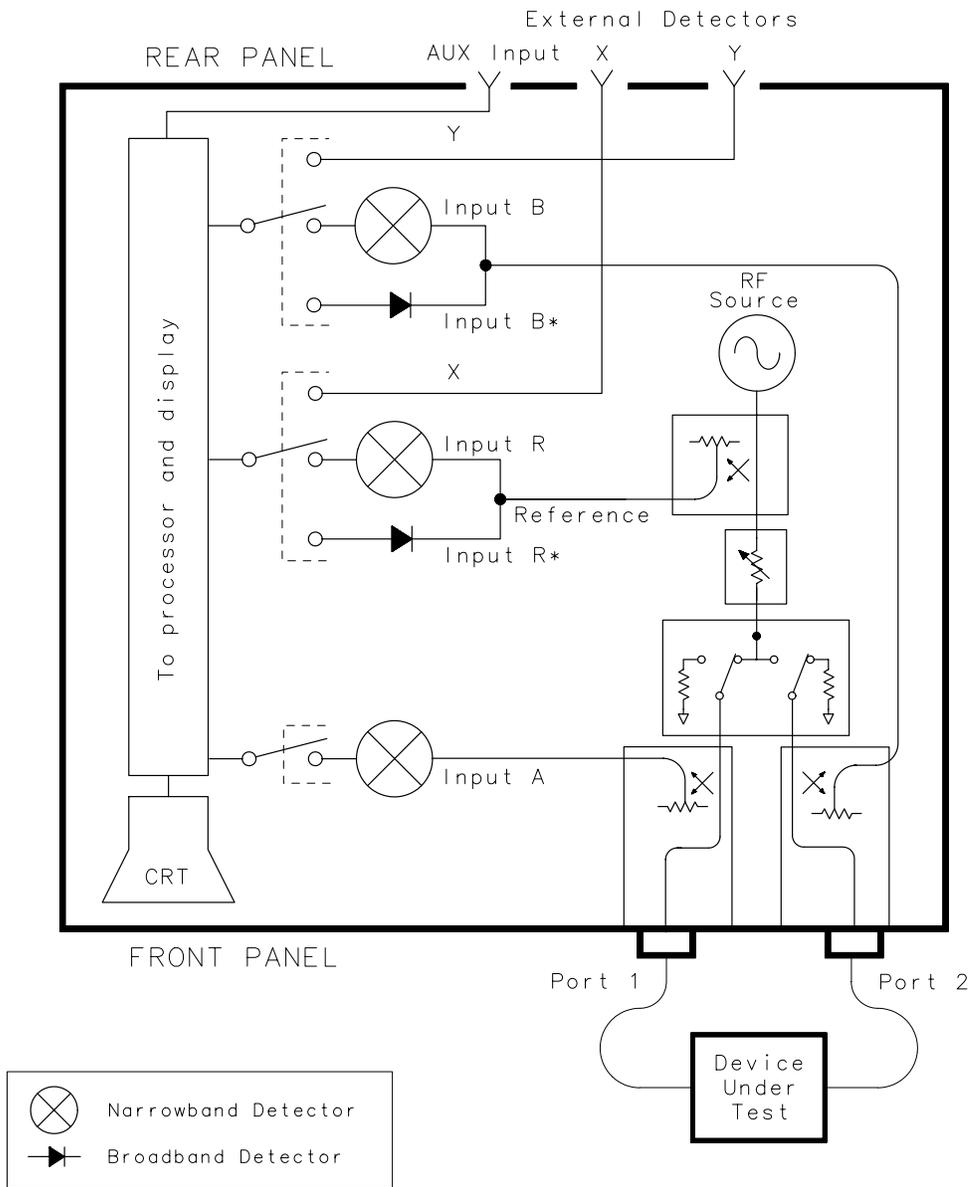
# Power Supply (A6)

The power supply group consists of the power supply assembly. This switching power supply provides regulated DC voltages to power all assemblies in the analyzer through a connection to the backplane. The backplane serves as a motherboard to provide power, data, and control signal connections to the various assemblies.

A voltage selector switch, accessible at the rear panel, adapts the analyzer to local line voltages of approximately 115 V or 220 V nominal. Refer to your analyzer's *User's Guide* for line voltage tolerances and other power considerations.

The power supply has a standby state (instead of an off state) when the AC power is connected. In standby, the A6 assembly provides a standby supply, measuring between +12 V and +13 V, to power the non-volatile SRAM on the CPU board. (A battery provides power to the non-volatile SRAM when the instrument is disconnected from AC power.) The power supply switches on when the on/standby switch is grounded. In the on state, the power supply provides the following supplies to the instrument: +5 V, +15 V, −15 V, and +12 V.

Two diagnostic LEDs are visible from the rear panel. The green LED is on in normal operation. It is off when the line power is absent or set too low, or if the line fuse has blown. The red LED is on in standby but off during normal operation. It will blink to indicate a power supply shutdown. Refer to Chapter 4, "Troubleshooting and Block Diagrams," for more details.

# Digital Control Group

This group includes the front panel (A1), CPU (A2), display (A7) and 3.5" internal disk drive (A8) assemblies.

### Front Panel Assembly (A1)

The A1 front panel assembly allows the user to control the analyzer. It includes a keyboard and a front panel knob. A probe power jack that supplies +15 V and −12.6 V is available for use with RF probes and other accessories. Fuses for these supplies are on the back of the A1 front panel assembly PC board.

### CPU Assembly (A2)

The A2 CPU assembly provides most of the control, interface, and data processing functions in the analyzer. It contains several microprocessors and many different types of memory, as shown on the analyzer's overall block diagram.

The main CPU is an MC 68030 microprocessor which is augmented by a floating point coprocessor (68882). It is the master controller for the analyzer, including the other dedicated processors on the CPU assembly. When the analyzer is the system controller in a GPIB system, it also controls peripheral devices through the GPIB interface.

The TMS 320C32 digital signal processor (DSP) receives the digital data from the A5 receiver assembly and performs data processing functions such as digital filtering, averaging, and applying error correction. It has some dedicated SRAM for running its firmware, and it also uses some shared DRAM and SRAM which is used to transfer data with the CPU.

The TMS 34010 graphics system processor (GSP) is responsible for converting data from the CPU into video signals to drive the A7 display assembly. It also produces an external video output which is accessible from the rear panel and is VGA compatible.

A number of processors on the CPU assembly allow the analyzer to interface with the outside world. The front panel processor handles inputs from the front panel keyboard and large front panel knob.

The super I/O processor is used to provide the following interfaces:

- The *Floppy disk controller* controls the 3.5" internal disk drive.

- The *DIN keyboard interface* allows you to connect an external keyboard to the analyzer. This is very useful when writing programs with IBASIC.

- The *Centronics interface* allows the analyzer to control printers and plotters with a parallel interface.

- The *RS-232 interface* allows the analyzer to control printers and plotters that have a serial interface.

- The *LAN interface* provides a network connection for networking test stations (instruments) to a server.

The GPIB interface allows the analyzer to be a *system controller* or a *talker/listener* on a GPIB bus. In addition, there are two TTL outputs for a user bit and a limit test pass/fail bit. There is also an external trigger input for sweep control.

The firmware for the analyzer is stored in two places. A bootROM contains low-level firmware that allows the analyzer to run some power-on self-tests, and perform functions such as loading firmware from a disk. The main firmware, which includes the analyzer's operating system and additional self-tests, is stored in segmented EPROMs, along with the correction constant data for the instrument. Both the bootROM and the main EPROMs are flash EPROMs. They can be erased and reprogrammed without removing the CPU assembly from the analyzer. Because the main EPROMs are segmented, upgrading firmware or correction constants can be done independently.

The nonvolatile SRAM is used to store instrument-state and peripheral-state settings. It is also used as a RAM disk by the save/recall functions, which refer to the nonvolatile SRAM as "NON-VOL RAM DISK." This nonvolatile SRAM is powered by a +12 V to +13 V supply when the analyzer is in standby, and by a battery when the AC power is disconnected.

The CPU assembly also contains SIMM DRAM. This SIMM DRAM is used for volatile storage of data and for use by IBASIC programs. The CPU board only accepts one SIMM (32 MB of SIMM memory is installed at the factory).

### Display Assembly (A7)

The display includes a monochrome 20.8-cm (9-inch) CRT and a matching driver board. Video signals are produced by the A2 CPU assembly and sent to the A7 assembly for display on the CRT. An intensity adjustment is accessible from the front panel. This is a VGA compatible display with a horizontal scan rate of 31.41 kHz.

### 3.5" Internal Disk Drive Assembly (A8)

The 3.5" disk drive is referred to by the analyzer as the internal disk. It accepts double density or high density 3.5" disks. It can read from either LIF or DOS format disks, but can only write to DOS disks. The analyzer can format disks only in DOS format (the LIF format is not supported).

## Source Group

The source group consists of the A3 fractional-N/reference assembly and the A4 source assembly. The source assembly theory is split into 8712ET/ES and 8714ET/ES descriptions.

Firmware on the CPU controls the operation of the source and the fractional-N board including:

- the frequency of the signal output of the source board and fractional-N board

- the frequency translation in the source board

### Fractional-N/Reference Assembly (A3)

The fractional-N/reference assembly provides signals to the A4 source board and various reference signals used throughout the analyzer. The fractional-N circuit, which is part of the phase-locked loop, generates a 30 to 60 MHz synthesized signal that is applied to the A4 source assembly. The reference circuitry generates three reference signals. It uses either the internal 10 MHz crystal oscillator or an external 10 MHz reference signal to generate the 10 MHz signal and the two 5 MHz signals. The 10 MHz signal is used by the A4 source assembly. One 5 MHz signal is used in the fractional-N VCO phase lock loop. The other 5 MHz signal goes to the backplane, where it is routed to the CPU (A2) and receiver (A5) assemblies for use in signal processing.

### 8712ET/ES Source Assembly (A4)

The source assembly provides two output signals. One signal is the main source RF output signal which has a range of 0.3 to 1300 MHz. The other signal serves as the internal receiver local oscillator (LO) for downconverting narrowband signals. The two signals are independently phase-locked, and they are separated from one another by the receiver intermediate frequency (IF) of 27.778 kHz.

The RF and the receiver LO output signals are generated from 3 phase-locked VCOs, called RF1, SOURCE LO and RF2 (refer to Figure 6-3). In normal operation the following occurs:

*   The RF1 VCO is phase-locked to a 10 MHz reference signal, from the fractional-N board, to produce a stationary 2340 MHz signal.

*   The RF2 VCO is also phase locked to the same 10 MHz reference to produce a stationary signal that is offset from RF1 by the receiver IF of 27.778 kHz.

*   The SOURCE LO VCO is phase locked to the 30 to 60 MHz output from the fractional-N board.The output of the SOURCE LO VCO is a swept frequency of 2340.3 to 3640.0 MHz that mixes with the VCO outputs of the RF1 and RF2.

**Figure 6-3   Simplified Block Diagram of the 8712ET/ES A4 Source**
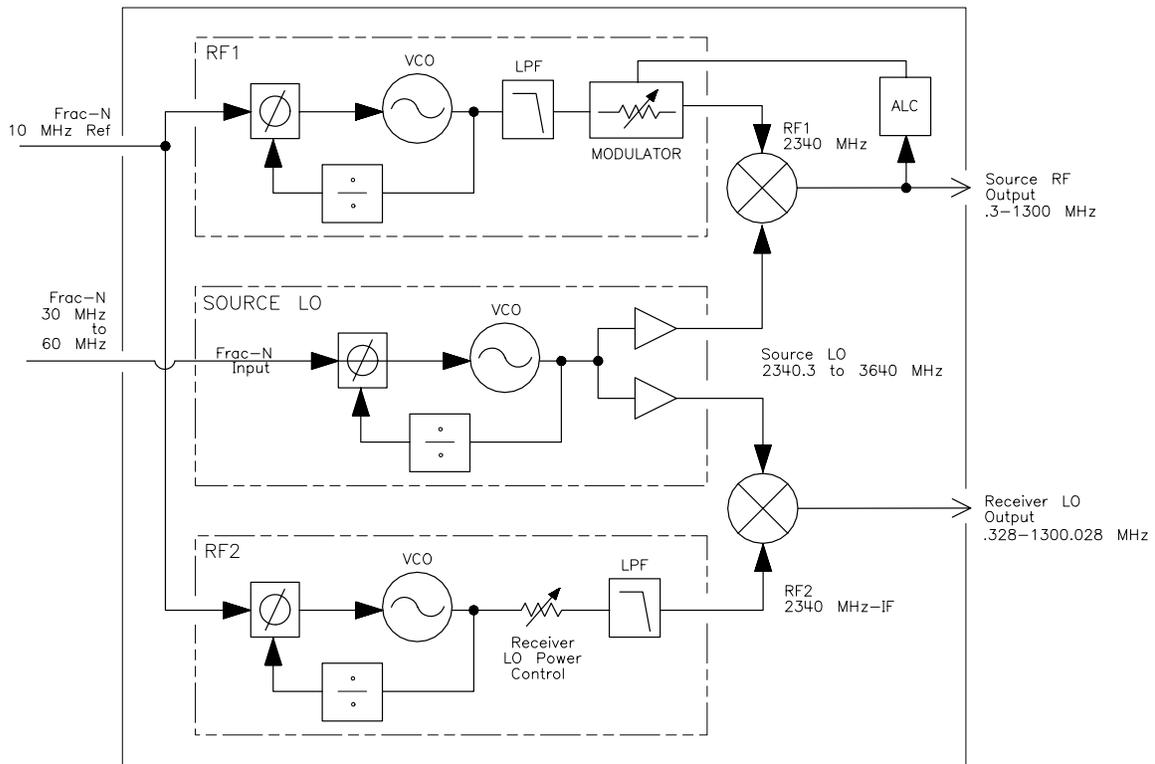
The power level of the Source RF output is controlled by the firmware on the CPU board. The firmware digitally controls the level setting in the ALC/MODULATOR feedback loop. The firmware combines the desired output level with data from Adjustment #104 to determine the level settings for the ALC/MODULATOR feedback loop. (See Chapter 2, "Adjustments," for more details on the adjustment procedure.) The firmware is able to vary the Source RF output level over a range of approximately 10 dB.

**Controlling Spurs.**

Spurs are inherent in the design of the system. Spurs are small unwanted spikes of signal that occur in measurements. Most spurs are predictable, as they are a function of the LO frequency of the receiver.

The source has a "dither" mode for spur avoidance. When dither is on, the RF1 frequency changes from 2340 MHz to 2304 MHz, and the RF2 frequency changes to (2304 MHz + IF) to maintain the 27.778 kHz offset between these two signals. Because of these changes, the mixing products from the two source mixers will be at different frequencies, resulting in spurs that have shifted in frequency when compared to the dither off state. This feature can be used in two ways.

You can select **Dither** (under (MENU)) **Spur Avoid Options**, which causes the analyzer to shift the RF1 and RF2 frequencies to the "dither on" values for all subsequent sweeps, until dither is switched off again. This is useful if you are only interested in a narrow frequency span. Switching dither on successfully moves a spur out of the span of interest. You can also select **Spur Avoid**. In this case, the analyzer will approach a known spur frequency, switch dither on until it sweeps past the spur, then switch dither off again until it gets to the next spur. This method is more suitable for wider frequency spans, but it slows down the sweep because of the time required to switch the dither function on and off.

**8714ET/ES Source Assembly (A4)**

The 8714ET/ES source assembly is similar to the previously described source assembly in the 8712ET/ES. However, because of the wider frequency range of the 8714ET/ES, there are some differences in theory. These differences are described below.

The source is designed with four different frequency bands:

- Band 1= 0.3–1910 MHz
- Band 2= 1910–2310 MHz
- Band 3= 2310–2620 MHz
- Band 4= 2620–3000 MHz

The differences between bands 2, 3, and 4 result from different filter changes. Filters are automatically inserted or removed from the RF and LO signals to minimize spurs. The major change is between bands 1 and 2.

In band 1, below 1.91 GHz, the source is very similar to that of the 8712ET/ES. However, the fractional-N input is first divided by 7 instead of 4, the source LO is divided by 512 instead of 256, and the RF1 signal is 2339.777778 instead of 2340 MHz. The formula for a Fractional-N to RF output frequency is therefore:

$RF_{out} = (Fractional\text{-}N \times 512/7) - 2339.777778$

(all frequencies in MHz)

This is very similar to the 8712ET/ES formula:

$RF_{out} = (Fractional\text{-}N \times 256/4) - 2340$

The 8714ET/ES fractional-N input frequency will vary from about 32 to 58 MHz as opposed to the 8712ET/ES variation of about 36.6 to 57 MHz. In both cases the pulse swallow circuitry maintains the RF2 signal to be 27.778 kHz below the RF1 signal so that the final LO will be 27.778 kHz above the RF, thus generating the proper IF.

In bands 2 through 4, above 1.91 GHz, the RF1 and RF2 signals are divided by 2 to provide an RF1 frequency of 1169.777778 MHz (the ratio is not exactly 1/2 due to differences in the way the pulse swallow circuitry works). The formula for RF output frequency now becomes:

$RF_{out} = (Fractional\text{-}N \times 512/7) - 1169.777778$

The Fractional-N signal now varies from about 42 to 57 MHz to provide the 1910 to 3000 MHz RF output in bands 2 through 4. This means that during a full band sweep of 0.3 MHz to 3 GHz, the fractional-N output will first sweep from about 32 to 58 MHz, then reset to 42 MHz, and sweep again up to 57 MHz.

## Receiver Assembly (A5)

The theory of operation for the receiver is split into two sections that cover the ET models and the ES models.

### 8712ET and 8714ET Receiver Assembly

The main function of the receiver assembly is to separate and measure signals associated with the DUT (device under test) and convert those signals to digital data for further processing on the CPU board. The receiver assembly also routes the RF signal to the DUT. Figure 6-4 is a block diagram of the ET receiver assembly.

**Figure 6-4 Block Diagram of the 8712ET and 8714ET Receiver Assembly**
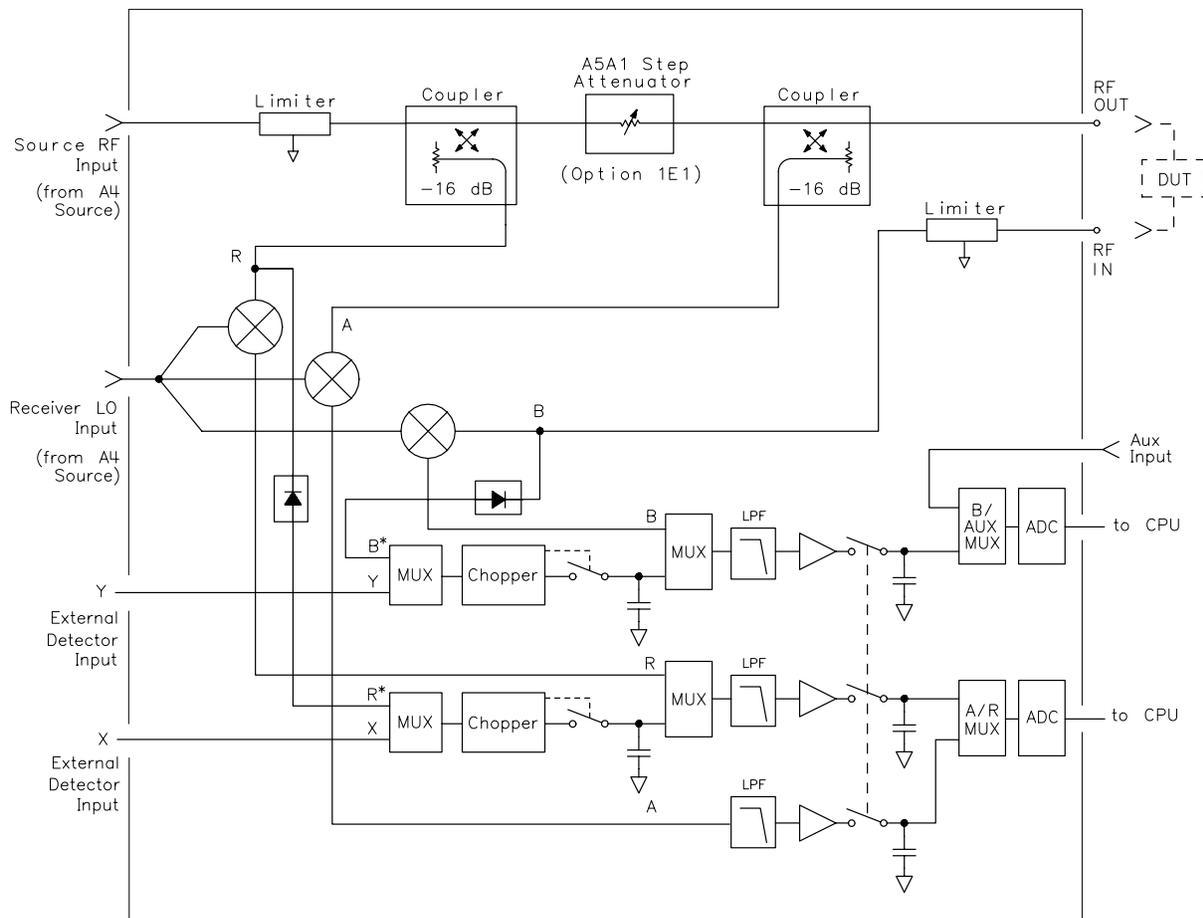


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## RF Path of the ET Analyzer.

The RF output signal from the source assembly passes through two directional couplers before going to the RF OUT front panel connector. As the source signal passes through the first coupler, part of the signal is routed to the R input on the receiver board to be used as a reference signal. The second coupler transmits the signal to the RF OUT front panel connector and receives the reflected signal from this port. The reflected signal is routed to the A input on the receiver board. The signal output from the RF OUT front panel connector goes through the DUT and enters the instrument at the RF IN connector. This signal is routed to the B input on the receiver board.

| NOTE | As seen in Figure 6-4, the ET Option 1E1 models have an RF step attenuator (A5A1) in the signal path between the two couplers. The standard ET models have one dual directional coupler in place of the two couplers pictured. The signal path and theory are the same. |
|---|---|

## Narrowband and Broadband Processing.

The RF signals at the R, A, and B inputs on the receiver board can be processed as narrowband measurements. Each RF signal is mixed with the LO signal from the A4 source assembly. The mixing produces a downconversion to an IF of 27.778 kHz. The downconverted signal is filtered, amplified, and sent to the ADCs on the receiver PC board.

The RF signals at the R and B inputs can also be processed as broadband signals. The RF input is converted to a DC signal with a diode detector. The DC signal is chopped at a 27.778 kHz rate and then sampled at a rate of 55.5 kHz. The signal is then filtered, amplified and sent to the ADCs. These internal broadband inputs are referred to as B* and R*. These inputs are used to make absolute power measurements.

One or two external broadband detectors can be connected to the rear panel. These detectors convert the measured RF signal into DC signals, which are referred to as the X and Y inputs. The DC inputs are multiplexed into the same choppers used for the B* and R* detectors. The B* and Y inputs share a chopper, as do the R* and X inputs. The signal then follows the same path as the one used for the internal broadband detection.

There is also a rear panel connector for an auxiliary input. This input allows the measurement of DC or low frequency AC signals from −10 to +10 volts.

The analyzer uses adjustment routines to generate correction constant (CC) data for all of the internal narrowband and broadband inputs. For the external detectors, the correction constants are stored in an EEPROM in the detector. This data can be read by the receiver to correct the data for the X and Y inputs. There are two 16-bit ADCs on the receiver assembly. The two ADCs are multiplexed between the various narrowband/broadband, internal/external signals. The ADCs require a 2.5 MHz clock signal from the CPU board. They convert the 27.778 kHz signal into digital data, which is then sent to the digital signal processor (DSP) on the A2 CPU board.

**Differences between 50Ω and 75Ω Analyzers.**

Connections for the DUT (RF OUT and RF IN) are available in both 50Ω and 75Ω versions. The two versions are identical except for the following:

- the type-N connectors (RF OUT and RF IN)

- the cable between the RF OUT connector and the directional coupler

- The directional coupler connected to the RF OUT. The transition from 75Ω to 50Ω occurs within the directional coupler.

| NOTE | The 75Ω type-N connector at the RF IN port is specially constructed with an internal 25Ω resistor to accomplish the 75Ω to 50Ω transition within the connector. |
|------|------|

**Limiters.**

Limiters are used to protect the circuitry on the receiver board from damage by overpower or electrostatic discharge (ESD). The limiters are discrete parts, as shown in Figure 6-4. The limiters begin limiting the applied signal at about +26 dBm. They protect the receiver board much like a fuse: when a very high amount of power is applied to an input, the limiter "fails" and becomes an open circuit. In actual practice, application of an excessive amount of power to the input can change the characteristics of the limiter without creating an open circuit condition. In this case, the limiter may exhibit symptoms of a degraded match and/or increased attenuation.

## 8712ES and 8714ES Receiver Assembly

The main function of the receiver assembly is to separate and measure signals associated with the DUT and convert those signals to digital data for further processing on the CPU board. The receiver assembly also routes the RF signal to the DUT. The ES receiver is capable of routing the source RF signal either direction through the DUT. Figure 6-5 shows a block diagram of the ES receiver assembly.

**Figure 6-5    Block Diagram of the 8712ES and 8714ES Receiver Assembly**
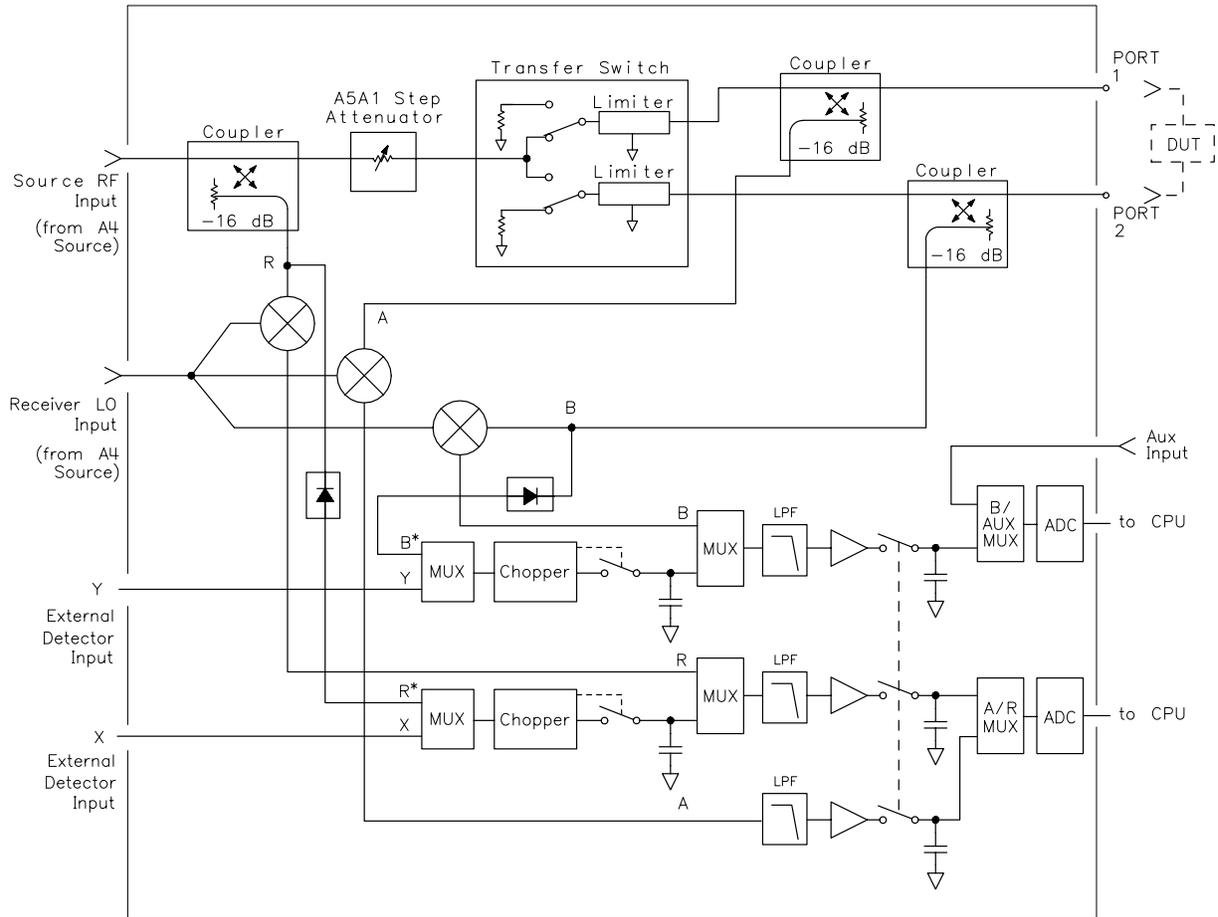


sp616es

## RF Path of the ES Analyzer.

| NOTE | The following description assumes the transfer switch position is set to provide output to the DUT through PORT 1 as pictured in Figure 6-5. |
|---|---|

The RF output signal from the source assembly is routed through a coupler, an attenuator, the transfer switch, and a second coupler before being output to the DUT at one of the front panel ports.

As the RF source signal passes through the first coupler, part of the signal is routed to the R input on the receiver board to be used as a reference signal. The RF signal then travels through the attenuator, transfer switch, and the second coupler to the DUT. The second coupler samples the reflected signal from the DUT. For the switch position shown, the sample of the reflected signal is routed to the A input on the receiver board. The signal goes through the DUT and enters the instrument at PORT 2. The signal coming from the DUT into PORT 2 is sampled by a directional coupler. The sample is routed to the B input on the receiver board.

| NOTE | When the transfer switch position is the opposite of that shown in Figure 6-5, the functions of the receiver inputs A and B are reversed. |
|---|---|

## Narrowband and Broadband Processing.

The other functions of the ES receiver are similar to the functions described in the Narrowband and Broadband Processing description of the ET receiver. The operation of A, B, R, B*, R*, X, Y detectors and the auxiliary inputs are identical.

## Differences between the 50Ω and 75Ω Analyzers.

Connections for the DUT (PORT 1 and PORT 2) are available in both 50Ω and 75Ω versions. The two versions are identical except for the following:

- the type-N connectors (PORT 1 and PORT 2)

- the cable between each type-N connector and its corresponding directional coupler

- The directional couplers for the A and B receiver inputs. For 75Ω units, the transition from 75Ω το 50Ω occurs within the directional couplers.

## Limiters.

Limiters are used to protect the circuitry on the receiver board (A5) from damage by overpower or electrostatic discharge (ESD). The limiters are not discrete parts but are built into the transfer switch, shown in Figure 6-5. Limiters protect the receiver board much like a fuse: when a very high amount of power is applied to an input, the limiter "fails" and becomes an open circuit. In actual practice, application of an excessive amount of power to the input can cause the limiter to modify its characteristics but not become an open circuit. In this case, the limiter may exhibit symptoms of a degraded match and/or increased attenuation.

# 7 Parts List

# Analyzer Hardware

The analyzer has been designed to have a minimal number of different screw types. Most applications require one of only two screw types. All are TORX screws requiring a TORX driver (PN=pan head; FL=flat head). Listed below are all the required screws. For clarity, these are not listed on the following parts lists for each assembly.

**Table 7-1  Analyzer Hardware**

| Part Number | Description | Where Used (Quantity) | Torque | Driver |
|---|---|---|---|---|
| 0515-0430 | M3 x 6 PN | Most places; all sheet metal | 7 in-lbs | T10 |
| 0515-0664 | M3 x 12 PN | All casting shields | 7 in-lbs | T10 |
| 0515-1946 | M3 x 6 FL | Handle nut plate screws (4) | 7 in-lbs | T10 |
| 0515-0943 | M4 x 12 FL | Handle screws (8) | 21 in-lbs | T15 |
| 0515-0658 | M2 x 6 PN | Power switch (2) | 3 in-lbs | T6 |
| 0515-0374 | M3 x 10 PN | Connector, Display Ribbon Cable (2) | 7 in-lbs | T10 |
| Note: All semirigid coax cables should be tightened to 10 in-lbs. | | | | |

# Specific Assembly and Cable Locations

The following tables and figures describe the replaceable parts for each of the analyzer's major assemblies. For information on ordering replacement parts, see "How to Order Parts" on page 3-24.

**Table 7-2  8712ET/ES and 8714ET/ES Major Assembly and Cable Locations**



sp610es
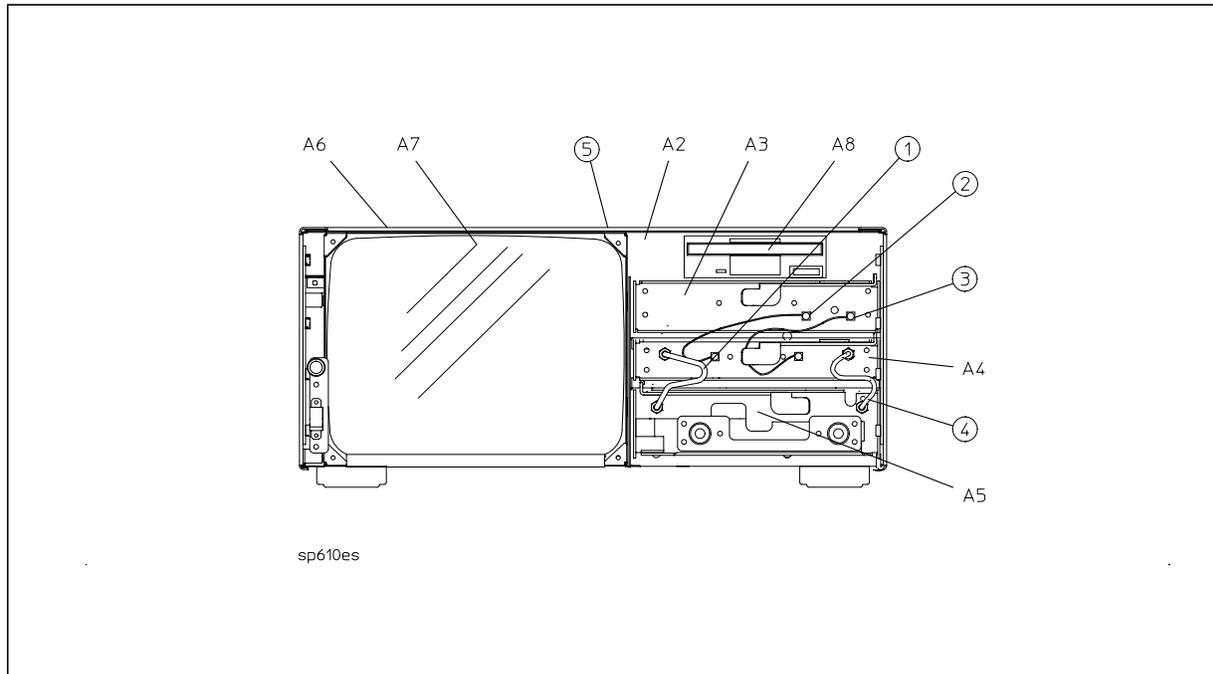
| Item | Description | HP/Agilent Part Number | Quantity |
|------|-------------|------------------------|----------|
| A1 | Front panel assembly (removed) | See Table 7-3 | 1 |
| A2 | CPU assembly (not shown) | See Table 7-4 | 1 |
| A3 | Fractional-N/reference assembly | See Table 7-5 | 1 |
| A4 | Source assembly | | 1 |
| | 8712ET/ES | See Table 7-6 | |
| | 8714ET/ES | See Table 7-7 | |
| A5 | Receiver assembly | | 1 |
| | 8712/14ET | See Table 7-8 | |
| | 8712/14ET Opt. 1E1 | See Table 7-9 | |
| | 8712/14ES | See Table 7-10 | |
| A6 | Power supply (not shown) | See Table 7-11 | 1 |
| A7 | Display assembly | See Table 7-12 | 1 |
| A8 | 3.5" internal disk drive (part of the CPU assembly) | See Table 7-4 | 1 |
| 1 | Semirigid Cable, A4J1 to A5J5, LO | 08714-20052 | 1 |
| 2 | SMB Cable, A4J2 to A3J301 | 08753-60061 | 1 |
| 3 | SMB Cable, A4J3 to A3J202 | 08753-60061 | 1 |
| 4 | Semirigid Cable, A4J4 to A5J6, RF | 08714-20053 | 1 |
| 5 | Backplane cover (not shown) | 08712-00002 | 1 |

**Table 7-3  A1 Front Panel Assembly and Cable Locations**
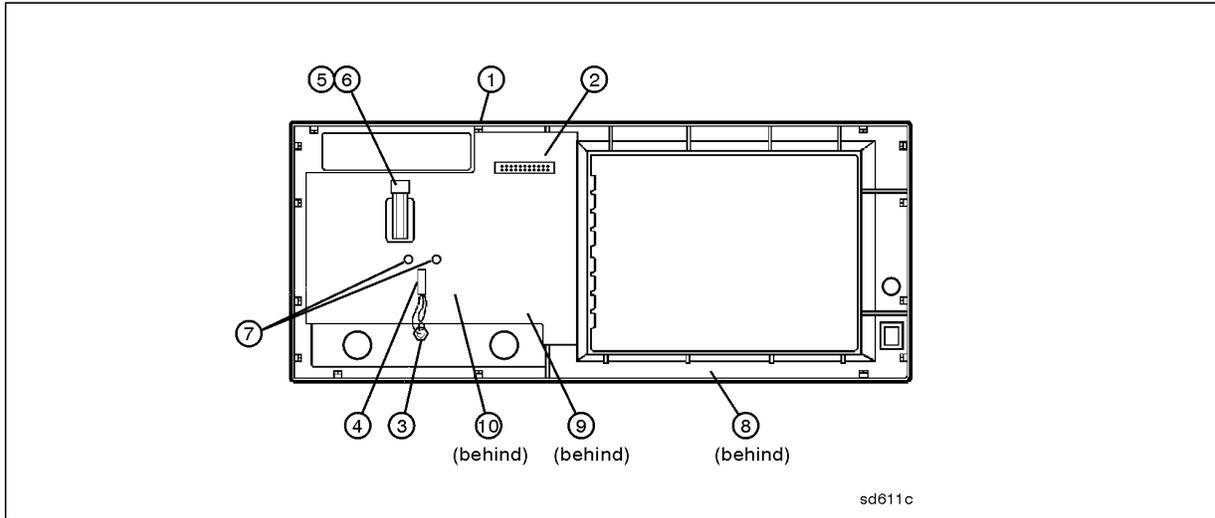


| Item | Description | HP/Agilent Part Number | Quantity |
|------|-------------|------------------------|----------|
| 1 | Front panel assembly, ES models, 50Ω[a] | 08714-60020 | 1 |
| | Front panel assembly, ES models, 75Ω[a] | 08714-60021 | 1 |
| | Front panel assembly, ET models, 50Ω[a] | 08714-60022 | 1 |
| | Front panel assembly, ET models, 75Ω[a] | 08714-60023 | 1 |
| | Front frame | 08712-40002 | 1 |
| 2 | Keyboard assembly | 08711-60101 | 1 |
| 3 | Probe power socket | 1252-7267 | 1 |
| 4 | Probe power cable assembly (includes socket) | 08712-60035 | 1 |
| 5 | RPG (Rotary Pulse Generator) assembly | 1990-1525 | 1 |
| 6 | Knob (for RPG, on reverse side) | 08712-40005 | 1 |
| 7 | Fuse for power probe socket, 0.75 A, 125 V, N | 2110-0424 | 2 |
| 8 | Nameplate Label, 8712ET | 08712-80036 | 1 |
| | Nameplate Label, 8714ET | 08714-80008 | 1 |
| | Nameplate Label, 8712ES | 08712-80037 | 1 |
| | Nameplate Label, 8714ES | 08714-80009 | 1 |
| 9 | Panel, plastic front overlay, 50Ω ES models | 08714-80004 | 1 |
| | Panel, plastic front overlay, 75Ω ES models | 08714-80006 | 1 |
| | Panel, plastic front overlay, 50Ω ET models | 08714-80005 | 1 |
| | Panel, plastic front overlay, 75Ω ET models | 08714-80007 | 1 |
| 10 | Key pad | 08730-20001 | 1 |

a. This part number represents a complete assembly. The assembly contains other items listed on this page (*exception*: Item #8, Nameplate Label, is not included and must be ordered separately).

**Table 7-4  A2 CPU Assembly and Cable Locations**



sp611es
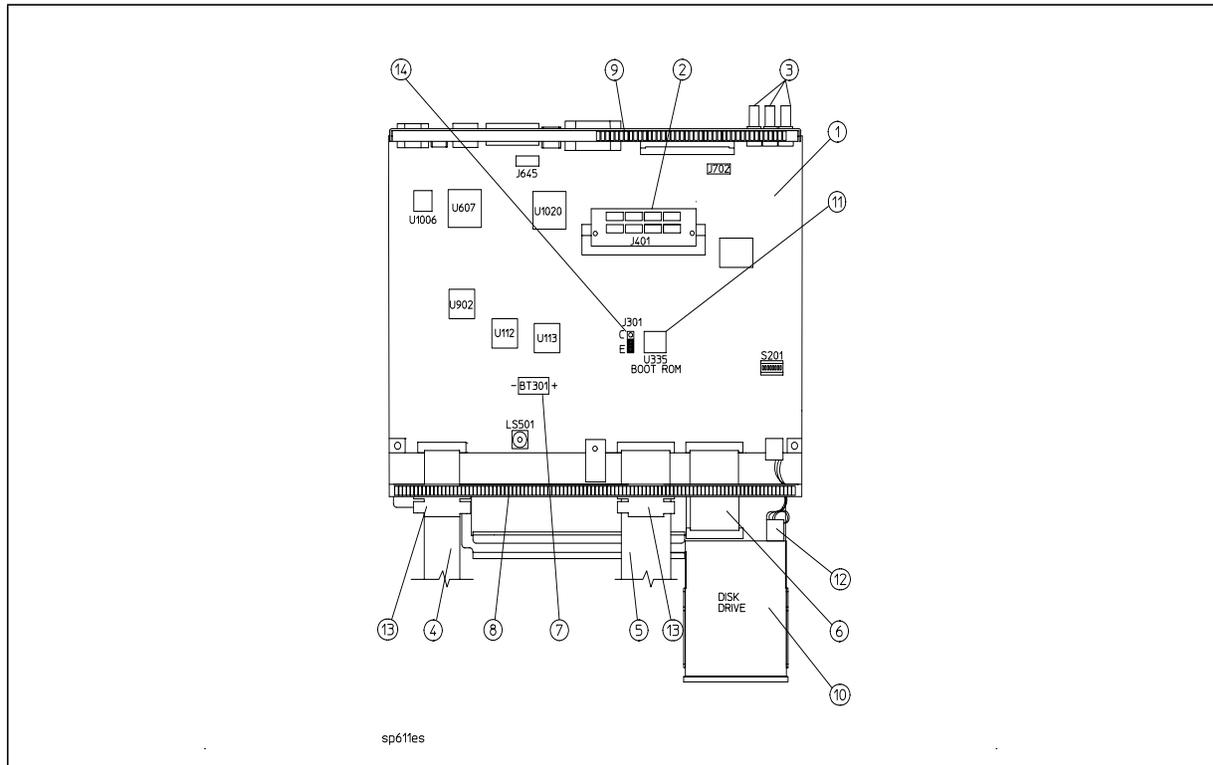
| Item | Description | HP/Agilent Part Number | Quantity |
|------|-------------|------------------------|----------|
| 1 | A2 CPU assembly (new) | 08714-60175 | 1 |
|   | A2 CPU assembly (R-E) | 08714-69175 | |
| 2 | DRAM SIMM (72 pin) 32 MB | 1818-5622 | 1 |
| 3 | BNC jacks | 1250-1842 | 4 |
| 4 | Cable, ribbon, display assembly | 8120-5526 | 1 |
| 5 | Cable, ribbon, Front panel assembly | 8120-5527 | 1 |
| 6 | Cable, ribbon, 3.5" internal disk drive assembly | 8120-6474 | 1 |
| 7 | Battery, 3.0 V, (see "Lithium Battery Disposal" on page 9-4) | 1420-0338 | 1 |
| 8 | CPU front shield assembly | 08712-60044 | 1 |
| 9 | CPU rear shield assembly | 08712-00013 | 1 |
| 10 | A8 3.5" internal Disk Drive Assembly (NOT part of A2 CPU assembly) | 0950-3106 | 1 |
| 11 | BootROM U335 | 08714-80013 | 1 |
| 12 | 3.5" internal disk drive power cable | 08712-60015 | 1 |
| 13 | Clamp, ribbon cable | 08712-00014 | 2 |
| 14 | Jumper | 1258-0141 | 1 |

**Table 7-5   A3 Fractional-N/Reference Assembly and Cable Locations**



sp615es
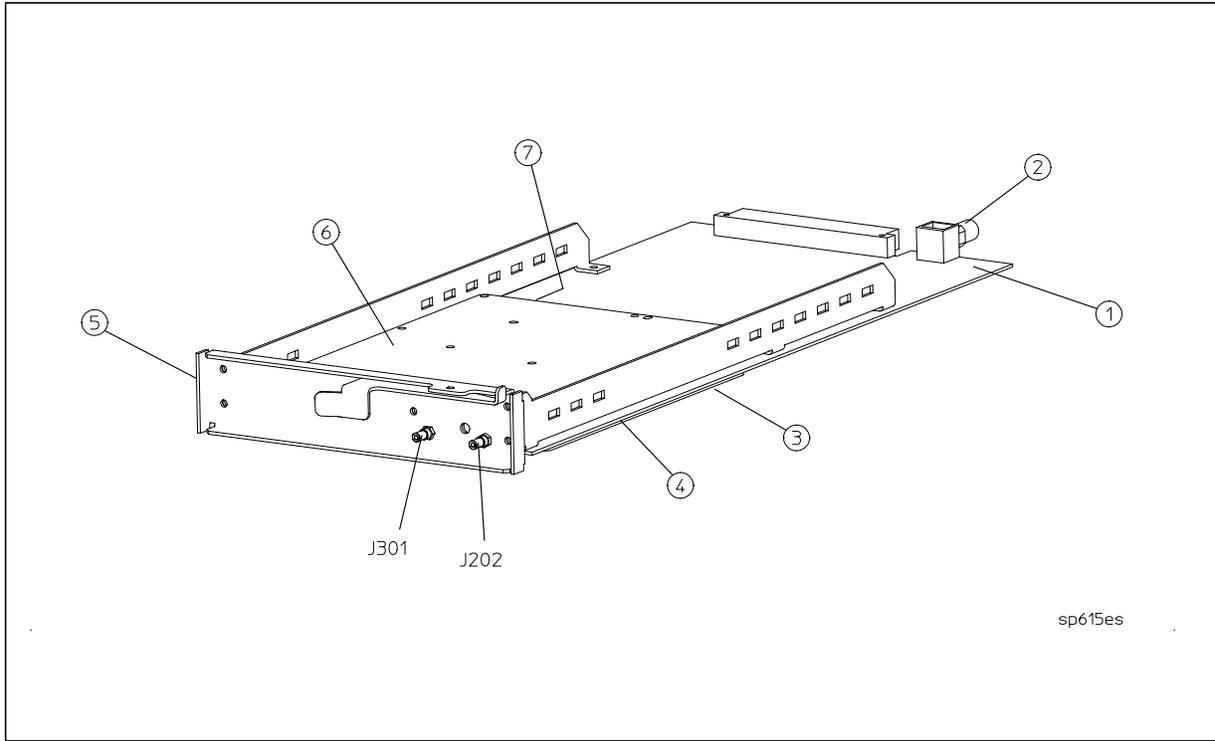
| Item | Description | HP/Agilent Part Number | Quantity |
|------|-------------|------------------------|----------|
| 1 | A3 Fractional-N/reference circuit board assembly | 08714-60171 | 1 |
| | A3 Fractional-N/reference circuit board assembly (R-E) | 08714-69171 | |
| 2 | J6 external reference input jack, BNC | 1250-1842 | 1 |
| | Hex nut for BNC jack (not shown) | 2950-0054 | 1 |
| | Washer for BNC jack (not shown) | 2190-0068 | 1 |
| 3 | Shield, Bottom | 08714-20050 | 1 |
| 4 | Gasket, Bottom | 08714-20051 | 1 |
| 5 | Front shield/handle assembly, fractional-N/reference | 08714-60024 | 1 |
| 6 | Shield, Top | 08714-20049 | 1 |
| 7 | Gasket, Top | 08714-20044 | 1 |
| J301 | Connector, SMB, fractional-N output | 1250-1512 | 1 |
| J202 | Connector, SMB, 10 MHz reference output | 1250-1512 | 1 |

**Table 7-6   8712ET/ES A4 Source Assembly and Cable Locations**



sd650b
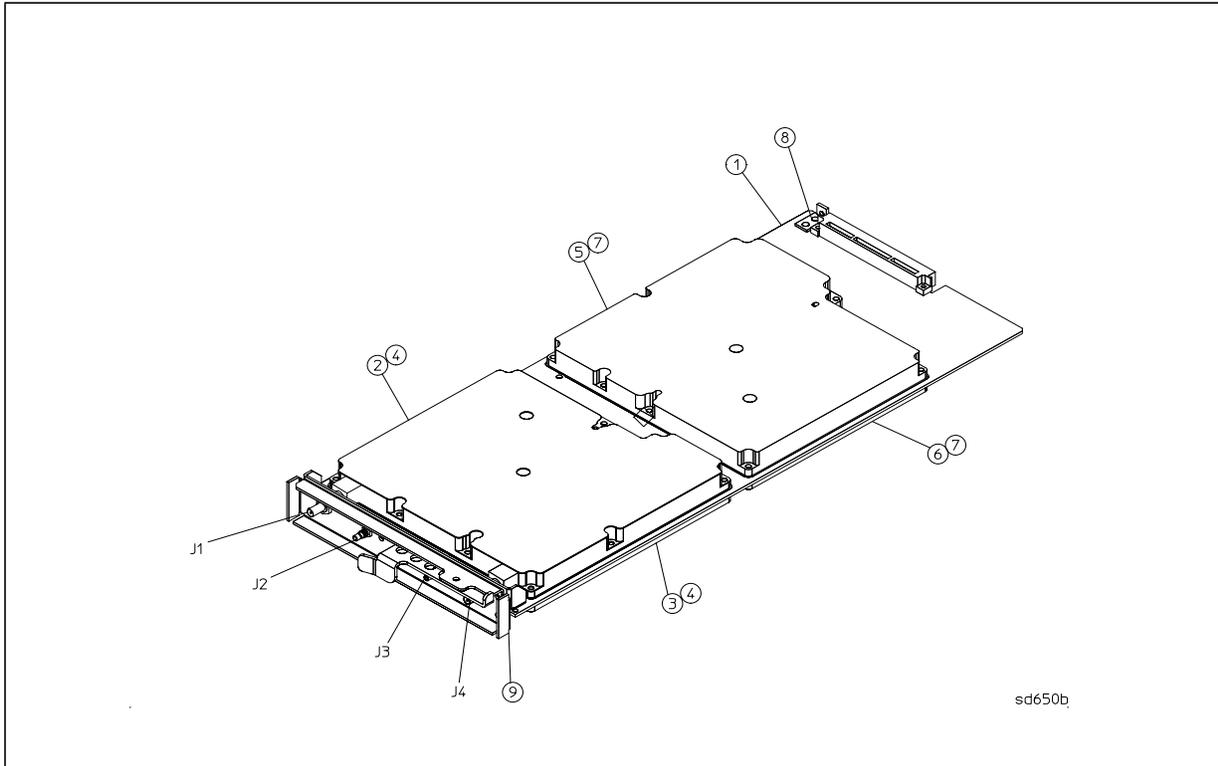
| Item | Description | HP/Agilent Part Number | Quantity |
|------|-------------|------------------------|----------|
| 1 | A4 Source assembly (new) | 08712-60076 | 1 |
|  | A4 Source assembly (R-E) | 08712-69076 |  |
| 2 | Front shield (top) | 08711-20022 | 1 |
| 3 | Front shield (bottom) | 08711-20023 | 1 |
| 4 | Front shield gasket | 08711-20043 | 2 |
| 5 | Rear shield (top) | 08711-20024 | 1 |
| 6 | Rear shield (bottom) | 08711-20025 | 1 |
| 7 | Rear shield gasket | 08711-20044 | 2 |
| 8 | L bracket | 1400-1669 | 1 |
| 9 | Front shield/handle | 08712-60007 | 1 |
| J1, J4 | Connector, SMA | 1250-1986 | 2 |
| J2, J3 | Connector, SMB | 1250-1512 | 2 |
|  | Lock washer 0.195 in. (not shown, for SMB) | 2190-0124 | 2 |
|  | Nut - Hex 10-32 in. (not shown, for SMB) | 2950-0078 | 2 |

**Table 7-7   8714ET/ES A4 Source Assembly and Cable Locations**
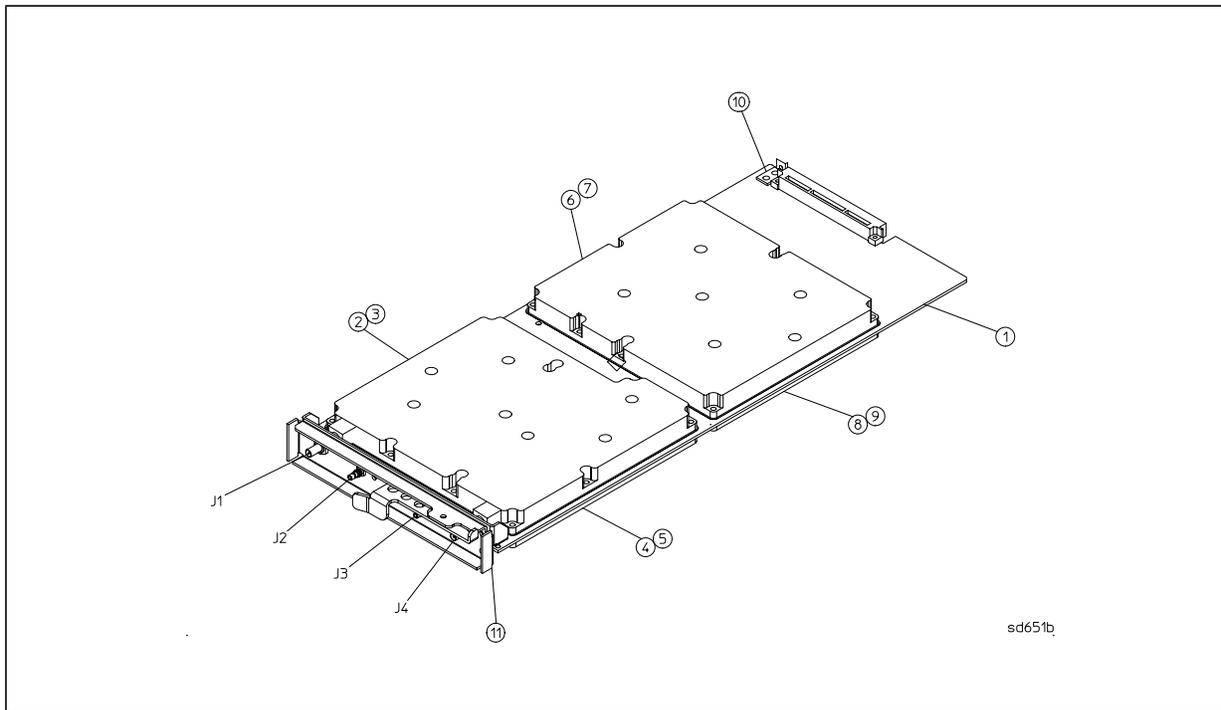


| Item | Description | HP/Agilent Part Number | Quantity |
|---|---|---|---|
| 1 | A4 Source assembly | 08713-60064 | 1 |
|  | A4 Source assembly (R-E) | 08713-69064 |  |
| 2 | Front shield (top) | 08713-20039 | 1 |
| 3 | Front shield gasket (top) | 08713-20028 | 1 |
| 4 | Front shield (bottom) | 08713-20041 | 1 |
| 5 | Front shield gasket (bottom) | 08713-20030 | 1 |
| 6 | Rear shield (top) | 08713-20040 | 1 |
| 7 | Rear shield gasket (top) | 08713-20029 | 1 |
| 8 | Rear shield (bottom) | 08713-20042 | 1 |
| 9 | Rear shield gasket (bottom) | 08713-20031 | 1 |
| 10 | L-bracket | 1400-1669 | 1 |
| 11 | Front shield/handle | 08712-60007 | 1 |
| J1, J4 | Connector, SMA | 1250-1986 | 2 |
| J2, J3 | Connector, SMB | 1250-1512 | 2 |
|  | Lockwasher 0.195 in. (not shown for J2 and J3) | 2190-0124 | 2 |
|  | Nut - Hex 10-32 in. (not shown for J2 and J3) | 2950-0078 | 2 |

J2 R

J4 B

J3 A

J1
LO

J5 (LO IN)

RF OUT

(SOURCE IN) J6

RF IN

sp612es
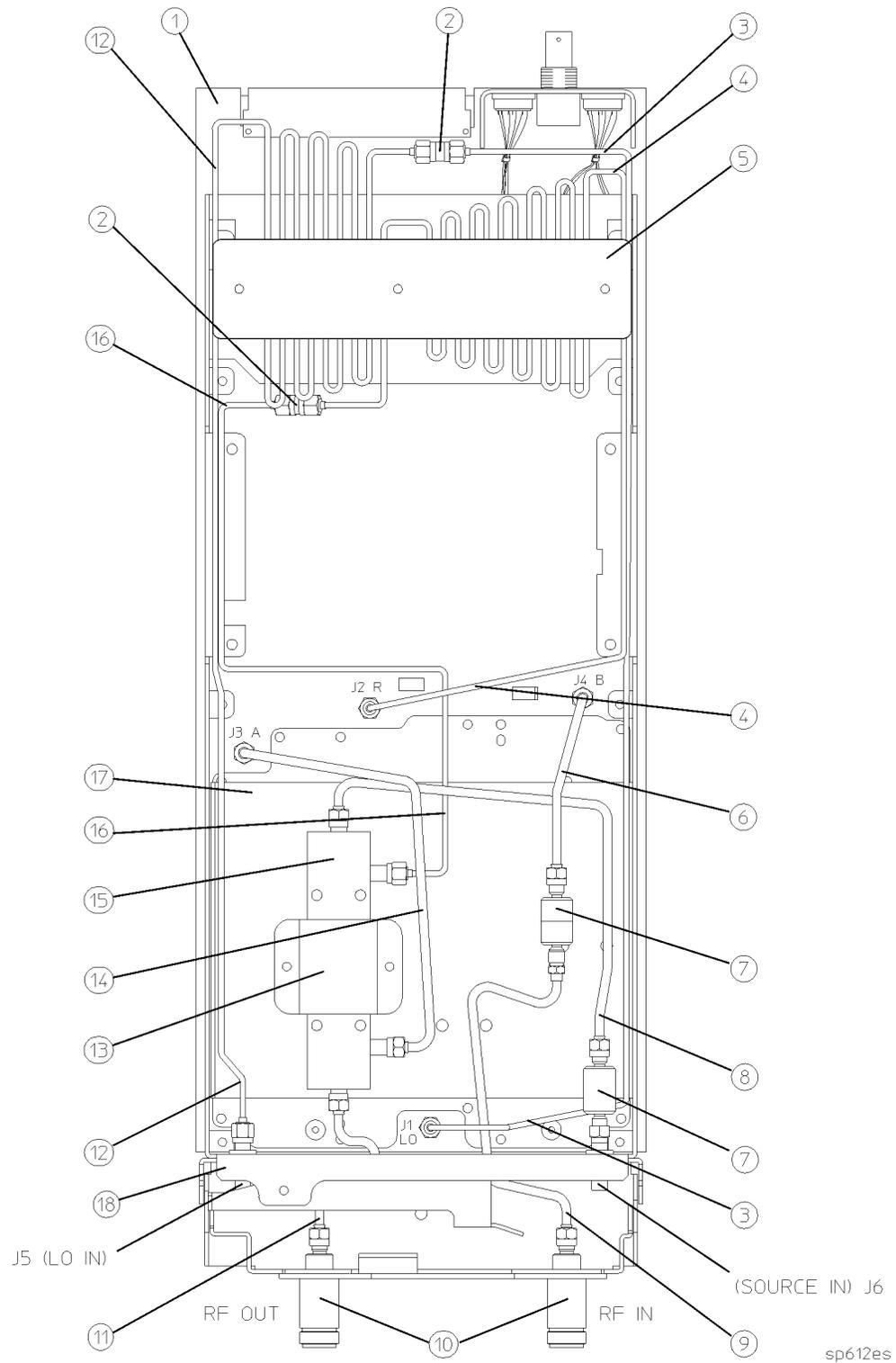
**Table 7-8   8712ET and 8714ET A5 Receiver Assembly and Cable Locations**

| Item | Description | HP/Agilent Part Number | Quantity |
|---|---|---|---|
| 1 | A5 receiver PC board, for TR model | 08714-60177 | 1 |
|  | A5 receiver PC board, for TR model (R-E) | 08714-69177 |  |
| 2 | Adapter, SMA f to f | 1250-1158 | 2 |
| 3 | Cable, J1 (LO) to SMA to cable (Item 12) | 08714-20033 | 1 |
| 4 | Cable, J2 (R) to SMA to cable (Item 16) | 08714-20032 | 1 |
| 5 | Brace for cables | 08714-00004 | 1 |
| 6 | Cable, J4 (B) to RF IN limiter | 08714-20046 | 1 |
| 7 | 3 GHz Limiter | 5087-7051 | 2 |
| 8 | Cable, coupler (Item 15) to limiter J6 (SOURCE IN) | 08714-20028 | 1 |
| 9 | Cable, RF IN (Item 10) to RF IN limiter to cable (Item 6) | 08714-20045 | 1 |
| 10 | 50Ω Test port assembly, RF OUT and RF IN | 08711-60038 | 1 |
|  | 75Ω Test port assembly, RF OUT and RF IN | 08711-60039 | 1 |
| 11 | 50Ω Cable, RF OUT test port (Item 10) to coupler (Item 15) | 08714-20011 | 1 |
|  | 75Ω Cable, RF OUT test port (Item 10) to coupler (Item 15) | 08714-20034 | 1 |
| 12 | Cable, J5 (LO IN) to cable (Item 3) | 08714-20019 | 1 |
| 13 | Bracket, secures coupler | 08714-00003 | 1 |
| 14 | Cable, J3 (A) to coupler (Item 15) | 08714-20024 | 1 |
| 15 | 50Ω Dual directional coupler | 5087-7048 | 1 |
|  | 50Ω Dual directional coupler (R-E) | 5087-6048 |  |
|  | 75Ω Dual directional coupler | 5087-7049 | 1 |
|  | 75Ω Dual directional coupler (R-E) | 5087-6049 |  |
| 16 | Cable, coupler (Item 15) to cable (item4) | 08714-20026 | 1 |
| 17 | Sheet Metal Coupler Deck | 08714-00002 | 1 |
| J5, J6 | Connectors, SMA | 1250-1986 | 2 |
| 18 | Sheet Metal Frame, Attaches to PC Board (Item 1) | 08714-60001 | 1 |

sp613es
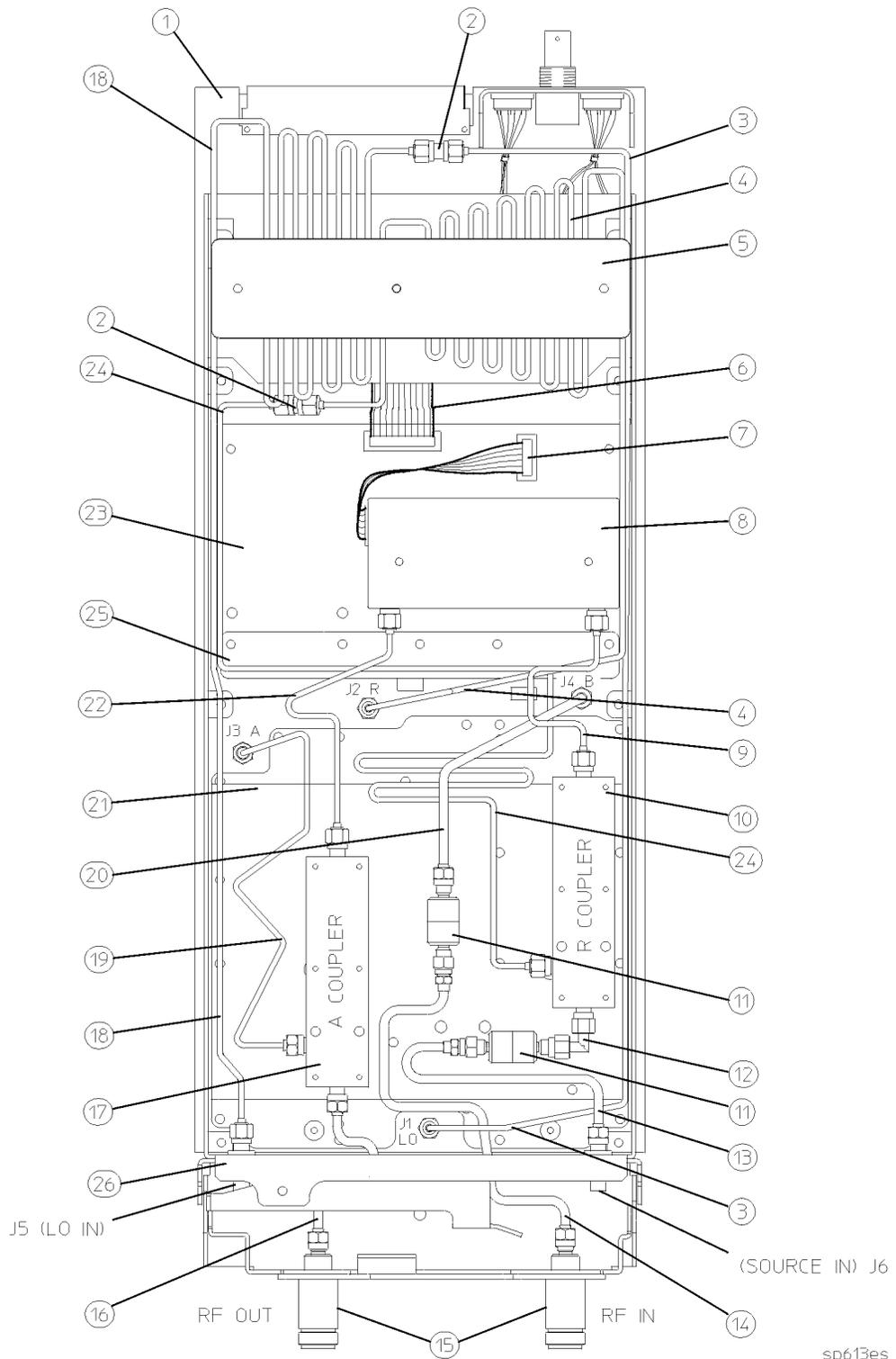
**Table 7-9  8712ET and 8714ET Opt 1E1 A5 Receiver Assembly and Cable Locations**

| Item | Description | HP/Agilent Part Number | Quantity |
|---|---|---|---|
| 1 | A5 receiver PC board, for TR models | 08714-60177 | 1 |
| | A5 receiver PC board, for TR models (R-E) | 08714-69177 | |
| 2 | Adapter, SMA f to f | 1250-1158 | 2 |
| 3 | Cable, J1 (LO) to SMA to cable (Item 18) | 08714-20033 | 1 |
| 4 | Cable, J2 (R) to SMA to cable (Item 24) | 08714-20032 | 1 |
| 5 | Brace for cables | 08714-00004 | 1 |
| 6 | Ribbon Cable, attenuator board to receiver board | 8120-8742 | 1 |
| 7 | Ribbon Cable, control and power for attenuator | 8120-8741 | 1 |
| 8 | RF step attenuator | 33321-60044 | 1 |
| 9 | Cable, R coupler (Item 15) to attenuator (Item 8) | 08714-20016 | 1 |
| 10 | 50Ω directional coupler, SOURCE IN path | 5087-7028 | 1 |
| | 50Ω directional coupler (R-E) | 5087-6028 | |
| | 75Ω directional coupler | 5087-7029 | 1 |
| | 75Ω directional coupler (R-E) | 5087-6029 | |
| 11 | 3 GHz Limiter | 5087-7051 | 2 |
| 12 | Adapter, angled SMA m to m | 1250-2189 | 1 |
| 13 | Cable, ((SOURCE IN) J6) to SOURCE IN limiter | 08714-20055 | 1 |
| 14 | Cable, RF IN (Item 15) to RF IN limiter | 08714-20047 | 1 |
| 15 | 50Ω Test port assembly, RF OUT and RF IN | 08711-60038 | 1 |
| | 75Ω Test port assembly, RF OUT and RF IN | 08711-60039 | 1 |
| 16 | 50Ω cable, RF OUT (Item 15) to A coupler (Item 17) | 08714-20011 | 1 |
| | 75Ω cable, RF OUT (Item 15) to A coupler (Item 17) | 08714-20034 | 1 |
| 17 | 50Ω directional coupler | 5087-7028 | 1 |
| | 50Ω directional coupler (R-E) | 5087-6028 | |
| 18 | Cable, J5 (LO IN) to SMA to cable (Item 3) | 08714-20019 | 1 |
| 19 | Cable, J3 (A) to A coupler (Item 17) | 08714-20014 | 1 |
| 20 | Cable, J4 (B) to RF IN limiter to cable (Item 14) | 08714-20048 | 1 |
| 21 | Sheet Metal Coupler Deck | 08714-00002 | 1 |
| 22 | Cable, A coupler (Item 17) to attenuator (Item 8) | 08714-20022 | 1 |
| 23 | PC board, attenuator | 08714-60170 | 1 |
| 24 | Cable, R coupler (item10) to cable (Item 4) | 08714-20056 | 1 |
| J5, J6 | Connectors, SMA | 1250-1986 | 2 |
| 25 | Brace for Attenuator PC Board (Item 23) | 08714-00005 | 1 |
| 26 | Sheet Metal Frame, Attaches to PC Board (Item 1) | 08714-60001 | 1 |

sp614es
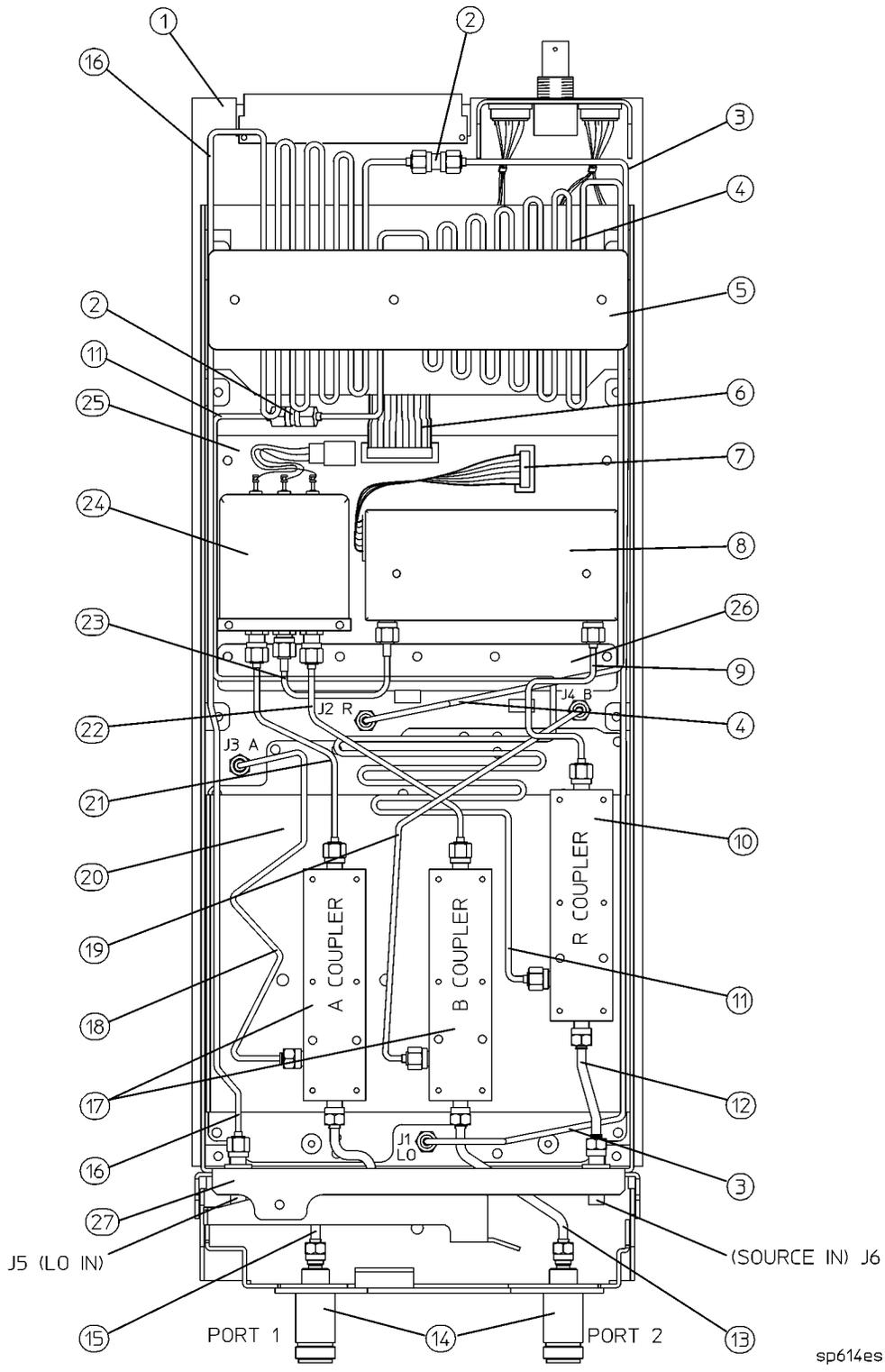
**Table 7-10  8712ES and 8714ES A5 Receiver Assembly and Cable Locations**

| Item | Description | Part Number | Quantity |
|------|-------------|-------------|----------|
| 1 | A5 receiver PC board for S parameter models | 08714-60002 | 1 |
|  | A5 receiver PC board for S parameter models (R-E) | 08714-69002 |  |
| 2 | Adapter, SMA f to f | 1250-1158 | 2 |
| 3 | Cable, J1 (LO) to SMA to cable (Item 16) | 08714-20033 | 1 |
| 4 | Cable, J2 (R) to SMA to cable (Item 11) | 08714-20032 | 1 |
| 5 | Brace for cables | 08714-00004 | 1 |
| 6 | Ribbon Cable, attenuator board to receiver board | 8120-8742 | 1 |
| 7 | Ribbon Cable, control and power for attenuator | 8120-8741 | 1 |
| 8 | RF step attenuator | 33321-60044 | 1 |
| 9 | Cable, coupler (Item 10) to attenuator (Item 8) | 08714-20016 | 1 |
| 10 | 50Ω directional coupler, (SOURCE IN) path | 5087-7028 | 1 |
|  | 50Ω directional coupler (R-E) | 5087-6028 |  |
| 11 | Cable, coupler (Item 10) to SMA to cable (Item 4) | 08714-20015 | 1 |
| 12 | Cable, J6 (SOURCE IN) to coupler (Item 10) | 08714-20012 | 1 |
| 13 | 50Ω Cable, PORT 2 (Item 14) to B coupler input | 08714-20035 | 1 |
|  | 75Ω Cable, PORT 2 (Item 14) to B coupler input | 08714-20010 | 1 |
| 14 | 50Ω Test port assembly, PORT 1 and PORT 2 | 08711-60038 | 1 |
|  | 75Ω Test port assembly, PORT 1 and PORT 2 | 08714-60006 | 1 |
| 15 | 50Ω Cable, PORT 1 (Item 14) to A coupler input | 08714-20011 | 1 |
|  | 75Ω Cable, PORT 1 (Item 14) to A coupler input | 08714-20034 | 1 |
| 16 | Cable, J5 (LO IN) to SMA to cable (Item 3) | 08714-20019 | 1 |
| 17 | 50Ω directional coupler, PORT 1 and PORT 2 | 5087-7028 | 2 |
|  | 50Ω directional coupler (R-E) | 5087-6028 |  |
|  | 75Ω directional coupler, PORT 1 and PORT 2 | 5087-7029 | 2 |
|  | 75Ω directional coupler (R-E) | 5087-6029 |  |
| 18 | Cable, J3 (A) to A coupler (PORT 1) | 08714-20014 | 1 |
| 19 | Cable, J4 (B) to B coupler (PORT 2) | 08714-20013 | 1 |
| 20 | Sheet Metal Coupler Deck | 08714-00002 | 1 |
| 21 | Cable, A coupler (PORT 1) to switch (Item 24) | 08714-20018 | 1 |
| 22 | Cable, B coupler (PORT 2) to switch (Item 24) | 08714-20017 | 1 |
| 23 | Cable, step attenuator (Item 8) to switch (Item 24) | 08714-20020 | 1 |
| 24 | RF Switch | 5087-7027 | 1 |
|  | RF Switch (R-E) | 5087-6027 |  |
| 25 | PC board, attenuator | 08714-60170 | 1 |
| J5, J6 | Connectors, SMA | 1250-1986 | 2 |
| 26 | Brace for Attenuator PC Board (Item 25) | 08714-00005 | 1 |
| 27 | Sheet Metal Frame, Attaches to PC Board (Item 1) | 08714-60001 | 1 |

**Table 7-11  A6 Power Supply Assembly and Cable Locations**
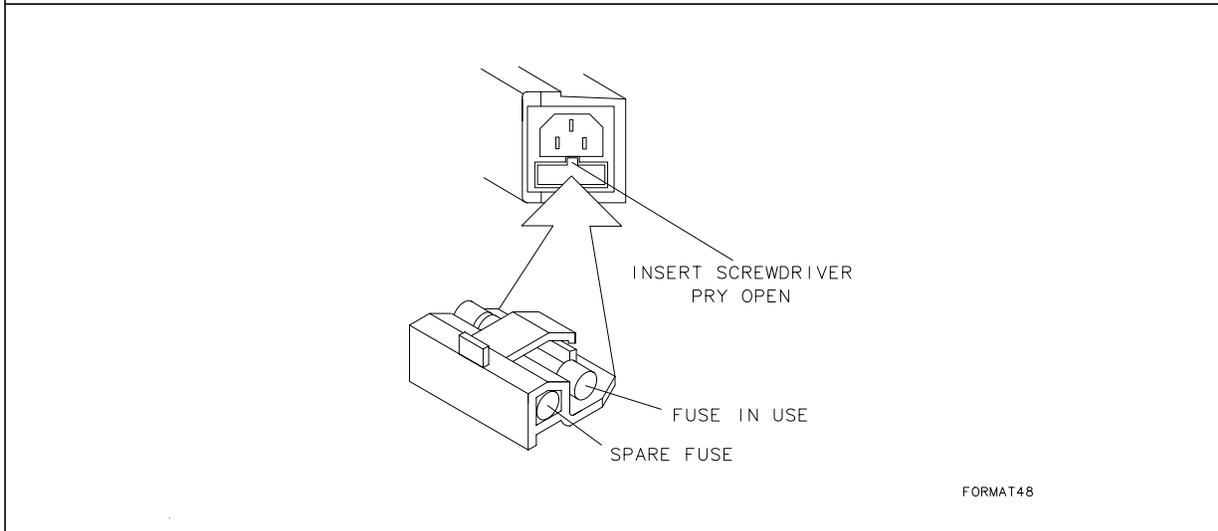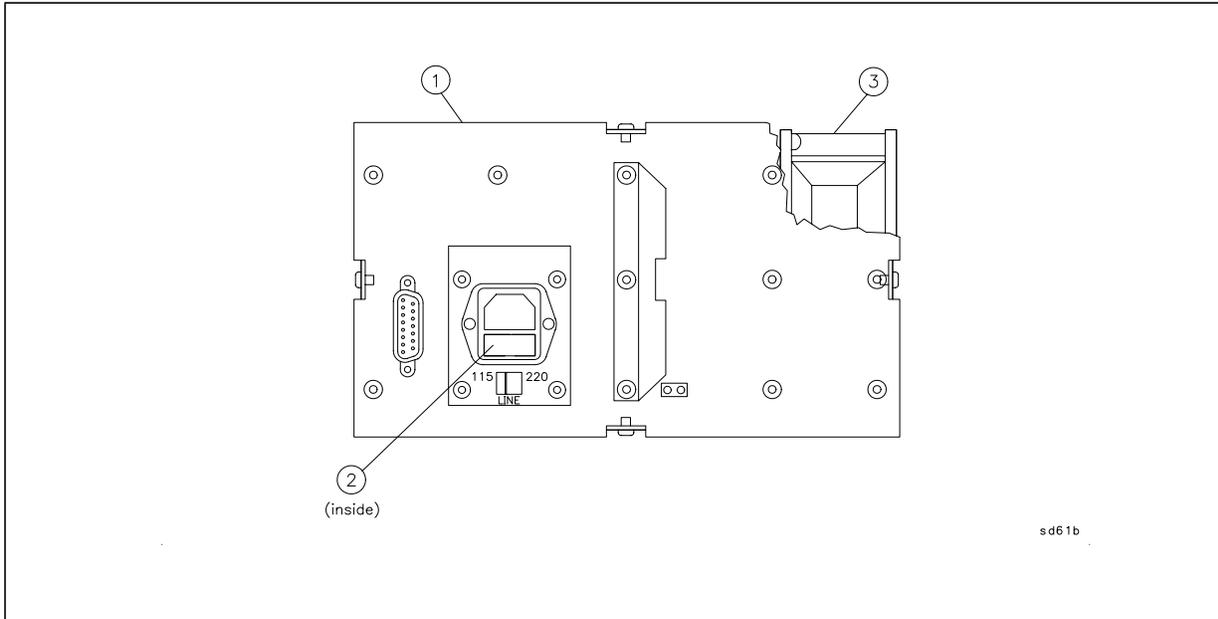


| Item | Description | HP/Agilent Part Number | Quantity |
|------|-------------|------------------------|----------|
| 1 | A6 power supply assembly (new) | 0950-2201 | 1 |
|  | A6 power supply assembly (R-E) | 5062-3437 | |
| 2 | Fuse, 5 A, 250 V, time-lag (5 × 20 mm), N | 2110-0709 | 1 |
| 3 | Fan assembly | 5062-3412 | 1 |

**Table 7-12  A7 Display Assembly and Cable Locations**



sd648b
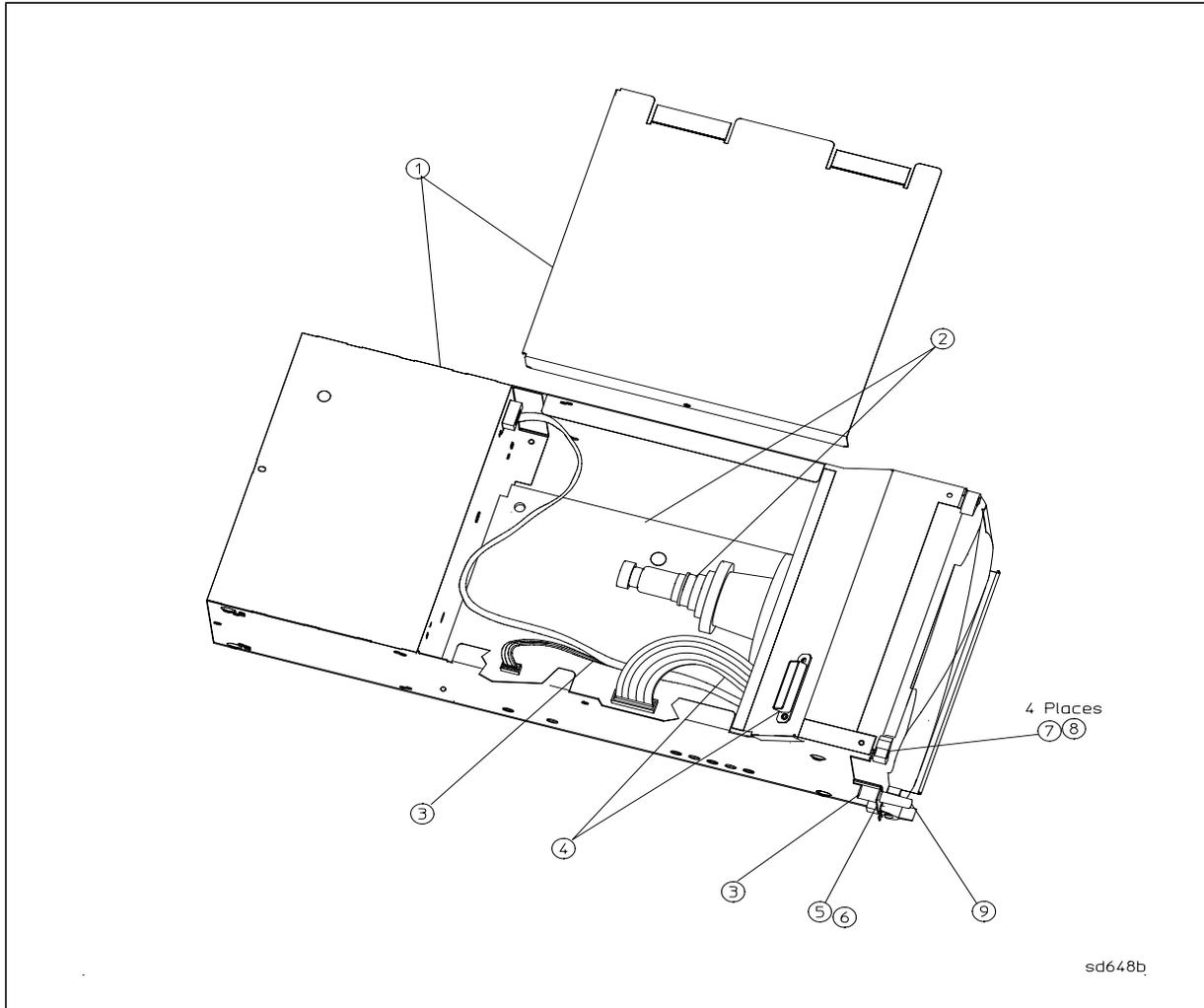
| Item | Description | HP/Agilent Part Number | Quantity |
|------|-------------|------------------------|----------|
| 1 | Display enclosure (sheet metal only) | 08712-60010 | 1 |
| 2 | CRT with board | 2090-0558 | 1 |
| 3 | Switch, intensity control, and cable assembly | 08711-60165 | 1 |
| 4 | Cable, display 20C w/headers | 8120-5525 | 1 |
| 5 | Lock washer 0.256 in. ID | 2190-0067 | 1 |
| 6 | Nut 1/4-36 | 2950-0216 | 2 |
| 7 | Washer, flat 0.125 in. ID | 3050-0116 | 4 |
| 8 | Nut M3 | 0535-0031 | 4 |
| 9 | Knob, intensity | 08712-40004 | 1 |
| | Bracket, monitor board (not shown) | 08712-00005 | 1 |

**Table 7-13  Cabinet Parts**

| Description | HP/Agilent Part Number |
|---|---|
| Chassis (includes connector board and labels) | 08712-60041 |
| Power cord (varies by country, consult your representative) | |
| Front handle (2 per analyzer) | 5063-9203 |
| Front handle trim (2 per analyzer) | 5041-9181 |
| Front handle nut plate (2 per analyzer) | 08711-00007 |
| Screws for front handles (8 per analyzer) | 0515-0943 |
| Foot (4 per analyzer) | 08712-40003 |
| RFI spring strip, 16 in. (cut as required) | 8160-0775 |
| Backplane cover | 08712-00002 |
| Disassembly label (on bottom of analyzer) | 08712-80016 |
| Rear panel label | 08712-80011 |
| Rack mount kit (for use with or without handles) | 08712-60036 |
| Fuse, power supply 5 A, 250 V, time delay, $5 \times 20$ mm (2 per analyzer) | 2110-0882 |

**Table 7-14  Software**

| Description | HP/Agilent Part Number |
|---|---|
| 8712ET/ES and 8714ET/ES Performance test program (LIF and DOS) | 08714-60049 |
| Example programs disk (DOS format) | 08714-10003 |
| Example programs disk (LIF format) | 08714-10004 |
| Firmware Upgrade Kit, current version | 08714-60045 |

**Table 7-15 Accessories**

| Description | HP/Agilent Part Number |
|---|---|
| 50Ω 3.5-mm calibration kit | 85033C Opt 001 |
| 50Ω type-N calibration kit | 85032B/E |
| 50Ω 3.5-mm accessory kit | 11878A |
| 50Ω type-N accessory kit | 11853A |
| 50Ω BNC accessory kit | 11854A |
| 50Ω type-N to TNC adapter kit | 86212A |
| 50Ω to 75Ω minimum loss pad | 11852B |
| 75Ω type-N calibration kit | 85036B/E |
| 75Ω type-N accessory kit (adapters, shorts, loads) | 11855A |

| Description | HP/Agilent Part Number |
|---|---|
| **ACCESSORIES** (continued) | |
| 75Ω type-N to 75Ω BNC assembly kit | 11856A |
| 75Ω type-N to type-F adapter kit | 86211A |
| 24-inch BNC test port cable (50Ω) | 8120-1839 |
| 50Ω type-N, male-to-male test port cable (precision) | 8120-8862 |
| 50Ω type-N, male-to-male test port cable (economy) | 8120-6469 |
| 75Ω type-N, male-to-male test port cable (precision) | 8120-8898 |
| 75Ω type-N, male-to-male test port cable (economy) | 8120-6468 |
| 75Ω type-N, male-to-female test port cable (precision) | 8120-2409 |
| Power splitter 2-way, 50Ω, 3 GHz | 0955-0751 |
| Power splitter 2-way, 75Ω, 3 GHz | 0955-0752 |
| 50Ω type-N, 200 MHz band pass filter | 0955-0759 |
| 75Ω, 3 dB Attenuator, 3 GHz | 0955-0765 |
| 75Ω, 6 dB Attenuator, 3 GHz | 0955-0766 |
| 75Ω, 10 dB Attenuator, 3 GHz | 0955-0767 |
| 75Ω, 20 dB Attenuator, 3 GHz | 0955-0768 |
| 1.0 meter GPIB cable | 10833A |
| 2.0 meter GPIB cable | 10833B |
| 4.0 meter GPIB cable | 10833C |
| 0.5 meter GPIB cable | 10833D |
| 2.0 meter (standard) detector cable | 8120-5514 |
| 20.0 meter detector cable | 8120-5515 |
| probe power connector (f) body | 5060-0466 |
| probe power connector (f) sleeve | 5040-0494 |
| Keyboard | D4950B |
| Keyboard template | 08712-80028 |
| DIN (f) to mini-DIN (m) adaptor (for keyboard) | 1252-4141 |
| High frequency probe | 85024A |
| 50Ω RF scalar detector | 86200B |
| 50Ω RF bridge, 300 kHz to 3 GHz | 86205A |
| 75Ω RF scalar detector | 86201B |
| 75Ω RF bridge, 300 kHz to 3 GHz | 86207A |

**Table 7-16  Upgrade Kits**

| Description | HP/Agilent Part Number |
|---|---|
| 8712ET/ES and 8714ET/ES Firmware upgrade kit with Current Version | 08714-60045 |
| 8712ET and 8714ET 50Ω Attenuator upgrade kit | 08714-60043 |
| 8712ET and 8714ET 75Ω Attenuator upgrade kit | 08714-60044 |
| Option 100 (fault location and SRL) upgrade kit | 08714-60046 |
| Option 101 (fault location and SRL) upgrade kit with case | 08714-60047 |

**Table 7-17  Service Tools**

| Description | HP/Agilent Part Number |
|---|---|
| Service tool kit:<br><br>Extender board assembly<br>GPIB connector extender<br>Two SMB extension cables, 12 inches long (30-cm)<br>Modified 5/16-inch wrench I.C. extractor<br>Non-shielded display ribbon cable<br>6-inch (150-mm) Semirigid coaxial extender cable<br>Voltage reference source<br>Two bootROMS, (one for the 871XC, one for the 871XET/ES)<br>7/32 inch wrench, modified (08714-20172)<br>limiter (for troubleshooting purposes) | 08712-60012 |

**Table 7-18 Documentation**

| Description | HP/Agilent Part Number |
|---|---|
| 8712ET/8714ET User's Guide | 08714-90011 |
| 8712ES/8714ES User's Guide | 08714-90012 |
| 8712ET/ES and 8714ET/ES LAN Interface User's Guide Supplement | 08714-90013 |
| 8712ET/ES and 8714ET/ES Automating Measurements User's Guide Supplement | 08714-90014 |
| 8712ET/ES and 8714ET/ES Programmer's Guide | 08714-90015 |
| 8712ET/ES and 8714ET/ES Example Programs Guide | 08714-90016 |
| 8712ET/ES and 8714ET/ES Service Guide | 08714-90017 |
| IBASIC User Handbook | E2086-90005 |
| 8712ET/ES and 8714ET/ES IBASIC Handbook Supplement | 08714-90019 |
| 8712ET/ES and 8714ET/ES Option 100 Fault Location/SRL User's Guide Supplement | 08714-90020 |
| 8712ET/ES and 8714ET/ES CATV Quick Start Guide (Option 100 Fault Location/SRL) | 08714-90021 |
| 8712ET/ES and 8714ET/ES Cellular Antenna Quick Start Guide (Option 100 Fault Location/SRL) | 08714-90022 |
| 8712ET/ES and 8714ET/ES Component Level Information Package (CLIP)[a] | 08714-90023 |
| 8712ET/ES and 8714ET/ES Documentation Set on CD ROM | 08714-90051 |

a.   CLIP is scheduled for availability in late 1999.

# 8 Correction Constants and Firmware

# Storing and Recalling Correction Constants (CC)

| NOTE | Firmware and correction constants reside in segmented flash EPROMs. Because the EPROMs are segmented, it is possible to upgrade either firmware or correction constants independently. |
|------|------|

**Figure 8**-1  **Correction Constants Flow by Keystroke and Cycling Power**
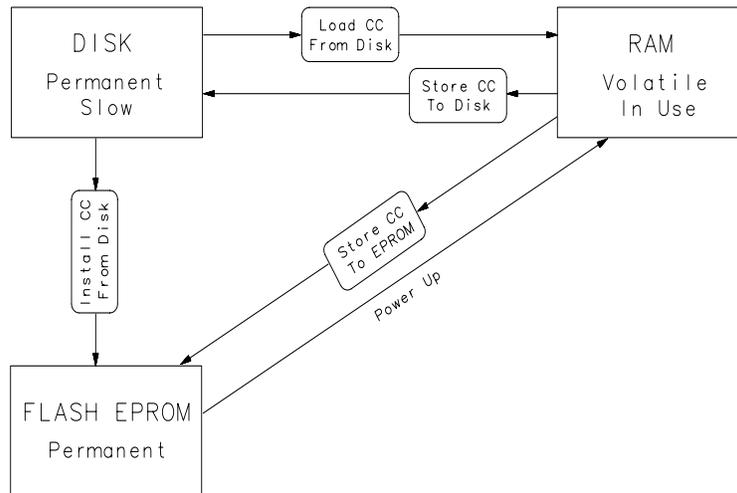


Correction constants are what give the analyzer its accuracy as well as its default calibration. Incorrect or missing correction constants will result in the following poor performance:

- non-zero transmission trace when a good quality through cable is connected

- non-zero return loss measurement with a short or open circuit

- poor directivity

- output power inaccuracy

Analyzer-specific correction constants are provided with each instrument shipped from the factory. The correction constants are provided on a 3.5" floppy disk and consist of one file that is about 25 kilobytes in size. Although each file is serial number specific, the same file *name* is used for each analyzer. Since this is the case, files for different instruments must remain stored on different disks. It is important that the proper disk be used with the proper instrument.

Do not format or re-use the correction constants disk shipped with the analyzer unless you are certain that the data on it is no longer needed. In general, correction constants cannot be totally erased; they can only be updated (overwritten). The disk shipped with each

analyzer should be kept in a safe place and write-protected so that it cannot be accidentally erased. Generally, this disk will never be needed unless the CPU assembly needs to be replaced.

New correction constants can be generated by performing the built-in adjustment routines. (Refer to Chapter 2, "Adjustments," for detailed information.) Results from these adjustments are always stored in volatile RAM. The user can then transfer this data to either the internal floppy disk or the permanent EPROM.

The following correction constants procedures can be performed:

- "Storing Correction Constants to Disk" on page 8-3 (used to make a backup copy)
- "Loading Correction Constants from Disk" on page 8-3 (this places them into volatile RAM)
- "Storing Correction Constants to EPROM" on page 8-4 (permanently overwrites existing CCs with what is currently in RAM)
- "Installing Correction Constants from Disk" on page 8-4 (a combination of loading CCs from disk and storing to EPROM)

## Storing Correction Constants to Disk

This will copy the current contents of the analyzer's CC data that is contained in RAM to the internal disk drive. The instrument writes (or overwrites) a file named "CC_DATX," where X is the last digit of the analyzer's model number. This is generally used to make a backup copy and may be very useful if the analyzer ever needs servicing.

1. Insert a formatted disk into the internal disk drive. (If needed, format the disk with the file utilities menu under (SAVE RECALL)).

| CAUTION | Do not format the correction constants disk shipped with the analyzer unless you are certain that the data on it is no longer needed. |

2. Press (SYSTEM OPTIONS) **Service** **Update Corr Const** **Store CC To Disk** .

## Loading Correction Constants from Disk

This will load a copy of the CC data that is on disk into temporary RAM. Once in RAM, the analyzer will continue to use that data until turned off. A warning message will be displayed if some adjustments have not been done or if the serial number contained in the file does not match the instrument serial number. To permanently save this data to EPROM, you must also subsequently select **Store CC to EPROM** .

1. Insert the proper correction constants disk into the internal disk drive.

2. Press (SYSTEM OPTIONS) **Service** **Update Corr Const** **Load CC From Disk** .

## Storing Correction Constants to EPROM

This will copy the current contents of the analyzer's CC data that is contained in RAM to permanent storage in the EPROM. This procedure should be done when you are satisfied that the current correction constants in temporary RAM are complete and correct. Once stored to EPROM, a backup copy should made on a floppy disk using the "Storing Correction Constants to Disk" procedure.

1.  Press (SYSTEM OPTIONS) **Service** **Update Corr Const** **Store CC to EPROM** .

## Installing Correction Constants from Disk

This procedure automatically loads CCs from disk and stores them in EPROM. This procedure is typically done after replacing the CPU board assembly in order to return the analyzer to its previously calibrated state.

1.  Insert the proper correction constants disk into the internal disk drive.

2.  Press (SYSTEM OPTIONS) **Service** **Update Corr Const** **Install CC From Disk** .

## In Case of Difficulties

If the message ROM Appears to be Blank is displayed on power-up, try re-loading firmware from disk. Refer to "How to Upgrade or Re-Install the Firmware" on page 8-5.

If the message Warning: No Correction Constants Installed is displayed on power-up, install the correction constants from disk using the "Install Correction Constants from Disk" procedure.

If you suspect that the current CC data is inaccurate, first try reinstalling CC data using the "Install Correction Constants from Disk" procedure. If this does not seem to improve the situation, try erasing all of Static RAM (SRAM) by using the following procedure. Note that this will erase any data in the non-volatile RAM, but it will not affect the CC data.

1.  Cycle the analyzer's power.

2.  After about 25 seconds, the analyzer will emit a double beep. Immediately after this double beep, press (PRESET) several times.

3.  The analyzer will pause after performing the CPU main self-tests and ask if you want to zero the SRAM. Answer YES by pressing the (BEGIN) key.

4.  When the analyzer completes its power up routine, it will be placed in the factory default condition. Verify that the analyzer is now producing correct measurement results. If not, the analyzer may have to be repaired or re-calibrated.

| | |
|---|---|
| NOTE | If the CC data still appears to be inaccurate, perform the adjustments in Chapter 2, "Adjustments." |

# Upgrading or Re-Installing Firmware

Firmware is contained on two high-density floppy disks which are in DOS format. Firmware disks are shipped with each analyzer. New firmware is released periodically as improvements are made. You should always keep at least one copy of firmware in a safe place because you cannot create firmware disks yourself.

If you are upgrading from firmware revision E.05.xx to E.06.xx, you first need to save the analyzer's CC data to a floppy disk. It is not necessary to save the CC data if you already have firmware revision E.06.xx loaded in your analyzer. Upgrading firmware will erase any data stored in the non-volatile memory such as instrument states and programs. If these files are needed, copy them to a floppy disk before proceeding.

The following is a generalized procedure for upgrading or re-installing the firmware. Follow any specific instructions contained in your firmware update kit.

## How to Upgrade or Re-Install the Firmware

1.  Confirm your current firmware revision by pressing (SYSTEM OPTIONS) **Service Instrument Info** .

2.  If your current firmware revision is E.05.xx, you need to create a "CC DATA" disk. To do so, follow the procedure in "Storing Correction Constants to Disk" on page 8-3 before continuing with the next step. If your current firmware revision is E.06.xx, continue with the next step.

3.  Insert firmware disk #1 and cycle the analyzer's line power. The analyzer indicates that it detects a firmware disk and is about to install the new firmware.

4.  Press (BEGIN) when prompted. The firmware will begin to load. When prompted, insert firmware disk #2. Loading of firmware takes about fifteen minutes.

5.  When prompted, remove the firmware disk and cycle the power again.

6.  *If you are upgrading from firmware revision E.05.xx to E.06.xx:*

    • When the analyzer powers up again, you will briefly see a warning message indicating that correction constants are not installed, after which you will see the "Update-Corr-Const" help message. Insert the "CC DATA" disk you created earlier in this procedure, and press **Install Corr Const** . This loads the CC data from the disk into the analyzer's RAM and into the EPROM for permanent storage.

    • After the CC data has been installed, cycle the power to the analyzer again. The firmware upgrade is now complete.

    • Store the "CC DATA" disk and the firmware disks in a safe place.

## Obtaining Firmware

The current firmware revision may be ordered as a set of floppy disks from Agilent Technologies. See Table 7-14 on page 7-18 for the part number.

The current firmware revision may also be downloaded, free of charge, through the internet. Go to the following URL:

```
http://www.agilent.com
```

From there, use the search funtion to search for **08714-60045**. Follow the link that indicates the most recent firmware revision.

# 9 Safety, Warranty, and Assistance

# Safety Symbols

The following safety symbols are used throughout this manual. Familiarize yourself with each of the symbols and its meaning before operating this instrument.

| | |
|---|---|
| CAUTION | Caution denotes a hazard. It calls attention to a procedure that, if not correctly performed or adhered to, would result in damage to or destruction of the instrument. Do not proceed beyond a caution note until the indicated conditions are fully understood and met. |

| | |
|---|---|
| WARNING | **Warning denotes a hazard. It calls attention to a procedure which, if not correctly performed or adhered to, could result in injury or loss of life. Do not proceed beyond a warning note until the indicated conditions are fully understood and met.** |

# General Safety Considerations

## Safety Earth Ground

| | |
|---|---|
| WARNING | **This is a Safety Class I product (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 the instrument, is likely to make the instrument dangerous. Intentional interruption is prohibited.** |

## Servicing

| | |
|---|---|
| WARNING | **These 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.** |

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

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

| | |
|---|---|
| WARNING | **For continued protection against fire hazard replace line fuse only with same type and rating (F 5A/250V). The use of other fuses or material is prohibited.** |

| | |
|---|---|
| WARNING | **The detachable power cord is the instrument disconnecting device. It disconnects the mains circuits from the mains supply before other parts of the instrument. The front panel switch is only a standby switch and is not a LINE switch (disconnecting device).** |

| | |
|---|---|
| WARNING | **Danger of explosion if battery is incorrectly replaced. Replace with the same or equivalent type recommended. Discard used batteries according to manufacturer's instructions** |

# Lithium Battery Disposal

If the battery on the CPU Board (A2) becomes ready for disposal, dispose of it according to your country's requirements. If required, you can return the battery to the nearest Agilent Technologies sales or service office (refer to Table 9-1 in this chapter) for disposal.

**DO NOT THROW BATTERIES AWAY BUT COLLECT AS SMALL CHEMICAL WASTE.**

sk780a

# Warranty

| NOTE | The actual warranty on your instrument depends on the date it was ordered as well as whether or not any warranty options were purchased at that time. To determine the exact warranty on your instrument, contact the nearest Agilent Technologies sales or service office with the model and serial number of your instrument. See Table 9-1 for a list of sales and service offices. |
|------|---|

This Agilent Technologies instrument product is warranted against defects in material and workmanship for the warranty period. During the warranty period, Agilent Technologies will, at its option, either repair or replace products which prove to be defective.

If the warranty covers repair or service to be performed at Buyer's facility, then the service or repair will be performed at the Buyer's facility at no charge within Agilent service travel areas. Outside Agilent service travel areas, warranty service will be performed at Buyer's facility only upon Agilent's prior agreement, and Buyer shall pay Agilent's round-trip travel expenses. In all other areas, products must be returned to a service facility designated by Agilent.

If the product is to be returned to for service or repair, it must be returned to a service facility designated by Agilent Technologies. Buyer shall prepay shipping charges to Agilent Technologies and Agilent Technologies shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to Agilent Technologies from another country.

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

## Limitation of Warranty

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

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

## Exclusive Remedies

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

# Assistance

Product maintenance agreements and other customer assistance agreements are available for Agilent Technologies products.

For any assistance, contact the nearest Agilent Technologies sales and service office.

# Shipment for Service

If you are sending the instrument to Agilent Technologies for service, ship the analyzer to the nearest Agilent service center for repair, including a description of any failed test and any error message. Ship the analyzer, using the original or comparable anti-static packaging materials. A listing of Agilent Technologies sales and service offices is provided in Table 9-1.

**Table 9-1        Agilent Technologies Sales and Service Offices**

| UNITED STATES |
| --- |
| **Instrument Support Center**<br>Agilent Technologies Company<br>(800) 403-0801 |

| EUROPEAN FIELD OPERATIONS | | |
| --- | --- | --- |
| **Headquarters**<br>Agilent Technologies S.A.<br>150, Route du Nant-d'Avril<br>1217 Meyrin 2/ Geneva<br>Switzerland<br>(41 22) 780.8111 | **France**<br>Agilent Technologies France<br>1 Avenue Du Canada<br>Zone D'Activite De Courtaboeuf<br>F-91947 Les Ulis Cedex<br>France<br>(33 1) 69 82 60 60 | **Germany**<br>Agilent Technologies GmbH Agilent<br>Technologies Strasse<br>61352 Bad Homburg v.d.H<br>Germany<br>(49 6172) 16-0 |
| **Great Britain**<br>Agilent Technologies Ltd.<br>Eskdale Road, Winnersh Triangle<br>Wokingham, Berkshire RG41 5DZ<br>England<br>(44 118) 6996622 | | |

| INTERCON FIELD OPERATIONS | | |
| --- | --- | --- |
| **Headquarters**<br>Agilent Technologies Company<br>3495 Deer Creek Rd.<br>Palo Alto, CA 94304-1316<br>USA<br>(415) 857-5027 | **Australia**<br>Agilent Technologies Australia Ltd.<br>31-41 Joseph Street<br>Blackburn, Victoria 3130<br>(61 3) 895-2895 | **Canada**<br>Agilent Technologies (Canada) Ltd.<br>17500 South Service Road<br>Trans-Canada Highway<br>Kirkland, Quebec H9J 2X8<br>Canada<br>(514) 697-4232 |
| **Japan**<br>Agilent Technologies Japan, Ltd.<br>Measurement Assistance Center<br>9-1, Takakura-Cho, Hachioji-Shi<br>Tokyo 192-8510, Japan<br>TEL (81)- 426-56-7832<br>FAX (81)- 426-56-7840 | **Singapore**<br>Agilent Technologies Singapore (Pte.)<br>Ltd.<br>150 Beach Road<br>#29-00 Gateway West<br>Singapore 0718<br>(65) 291-9088 | **Taiwan**<br>Agilent Technologies Taiwan<br>8th Floor, H-P Building<br>337 Fu Hsing North Road<br>Taipei, Taiwan<br>(886 2) 712-0404 |
| **China**<br>China Agilent Technologies Co.<br>38 Bei San Huan X1 Road<br>Shuang Yu Shu<br>Hai Dian District<br>Beijing, China<br>(86 1) 256-6888 | | |

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