User's Guide Supplement

Firmware Revisions 7.60 and Above
for the
Agilent Technologies
8719D/20D/22D
and
8753E and 8753E Option 011

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User's Guide Supplement

**Firmware Revisions 7.60 and Above
for the
HP 8719D/20D/22D,
HP 8753E, and HP 8753E Option 011**

HEWLETT® PACKARD

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 represents a "softkey", a key whose label is
                                determined by the instrument firmware.

Contents

Contents

Introduction

This document is intended for those who installed firmware upgrade 7.60 and above into their network analyzer. This upgrade gives your analyzer four-parameter display capability enabling you to measure and display all four S-parameters of a two-port device simultaneously. It also makes it easier to characterize duplexers using the HP 8753D Option K36 duplexer test adapter or similar adapter.

This supplement describes the new features of this firmware upgrade and how to use them. It is assumed that you have a basic knowledge of the analyzer. Where appropriate, this supplement refers to the analyzer's user's guide when it will enhance your understanding of the features in this upgrade.

Four-Parameter Display Overview

The four-parameter display firmware upgrade adds two channels to your analyzer. These new channels, 3 and 4, make it possible to measure and display all four S-parameters of a device simultaneously.

Although independent of the other channels in most respects, channels 3 and 4 are permanently coupled to channels 1 and 2, respectively, by stimulus. That is, if channel 1 is set for a center frequency of 200 MHz and a span of 50 MHz, channel 3 will have the same stimulus values. This is a reciprocal relationship in that changes made to channel 3's stimulus immediately apply to channel 1. The coupling between channels are:

Channel 1= Channel 3 (by stimulus)
Channel 2 = Channel 4 (by stimulus)

Channels 1 and 2 are referred to as the *primary channels* and channels 3 and 4 are referred to as the *auxiliary channels*. Once channel 3 or 4 is made active, it can be configured independently of its primary channel in these variables:

- Measurement
- Format
- Scale/Div
- Reference position
- Reference value
- Electrical delay
- Phase offset
- Memory trace storage
- Markers
- Limit lines
- Trace colors

Four-Parameter Display and Calibration

For the measurement examples used in this supplement, a full two-port calibration covering the entire frequency range of the analyzer was used. Interpolated error correction was then turned on to narrow the calibration to the range of the device under test (DUT).

NOTE   With firmware revision 7.60 and above, a full two-port calibration is not required to utilize the four parameter display functions. The following examples resulting from a full two-port calibration are to be used as a guideline.

The calibration may be recalled from a previously saved instrument state or performed before enabling an auxiliary channel. If recalled, you may need to modify some of the parameters from the recalled instrument state in order to test your particular device. The recalled calibration must cover the range of the device to be tested.

Enabling and Activating the Auxiliary Channels

The primary channel hardkeys, (Chan 1) and (Chan 2), now activate auxiliary channels 3 and 4, as well as primary channels 1 and 2. Before an auxiliary channel can be made active, it must be enabled by setting **AUXCHAN on OFF** to **ON** in the Display menu. Enabled and active are defined as:

Enabled: A channel must be enabled before it can be made active. Both primary channels are always enabled. The auxiliary channels must be enabled via the Display menu before they can be made active by the primary channel hardkeys (Chan 1) or (Chan 2).

Active: When made active, a channel can be configured for measurement type, format, limit lines, etc.

Auxiliary channel 3 or 4 is enabled by pressing (Chan 1) or (Chan 2) (Display) **DUAL|QUAD SETUP** **AUXCHAN on OFF** to **ON**.

Once the auxiliary channels are enabled, a hardkey will alternately make a primary channel or its auxiliary channel active. The amber LED adjacent to the (Chan 1) or (Chan 2) hardkey indicates which channel is active: when the LED is constantly lit, the primary channel is active; when it is flashing, the auxiliary channel is active. Pressing a channel hardkey toggles between a primary channel and its auxiliary channel.

Quick Four-Parameter Display Setup

To quickly set up a four-parameter display, you can use the `4-PARAMETER SHORTCUT KEYS` menu to set up a choice of common configurations.

To use the **4 PARAM DISPLAYS** menu to quickly set up a four-parameter display, press:

(Display) **DUAL|QUAD SETUP** **4 PARAM DISPLAYS**

Pressing **TUTORIAL** brings up a screen which color-codes each channel to the keys which affect it. For example, in Setup A, channel 1 is shown in yellow as well as the keys (Chan 1), **MEAS S11**, and **AUXCHAN on OFF**. Pressing all of the keys listed below Setup A in order from top to bottom achieves the same results (four-parameter display) as pressing **SETUP A** in the **4-PARAM DISPLAYS** menu.

Figure 1   4 Parameter Displays Menu
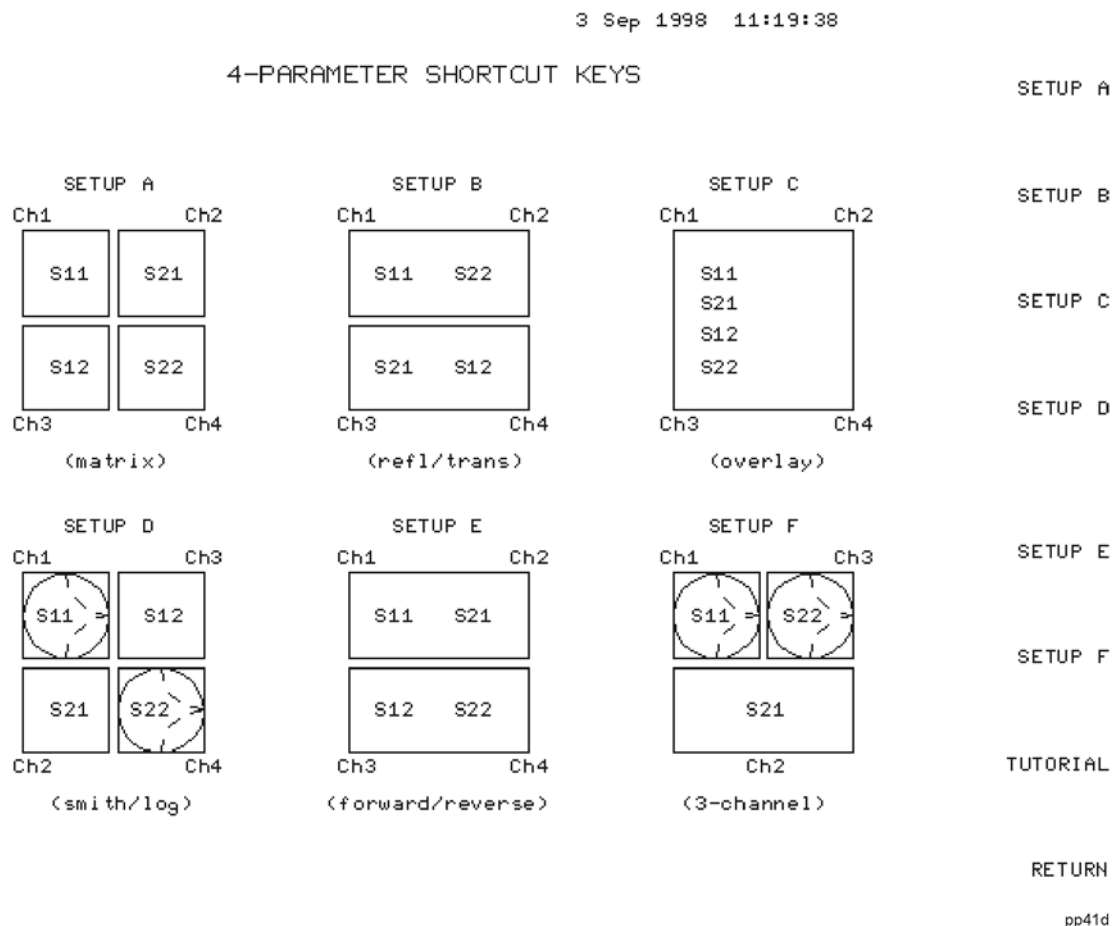
Measurement Examples

Displaying All Four S-Parameters of a Two-Port Device

This measurement example demonstrates how to display all four S-parameters of a two-port device. (If you are using an HP 8753E Option 011, you must have an S-parameter test set connected to your analyzer.) In this example, the device to be tested is a bandpass filter with a center frequency of 134 MHz.

NOTE   The measurement examples in this supplement use a two-port calibration covering the entire range of the analyzer, then narrowed to the range of the DUT using interpolated error correction.

---

1. Press (Preset).

2. Connect the DUT to the analyzer.

3. Set the format type for the DUT. This example uses **LOGMAG** format.

4. If channel 1 is not active, make it active by pressing (Chan 1).

5. Press (Display) **DUAL|QUAD SETUP**. Set **DUAL CHAN on OFF** to **ON**, **AUX CHAN on OFF** to **ON**, and **SPLIT DISP** to **4X**.

The display will appear as shown in Figure 2, "Three-Channel Display," on page 6. Channel 1 is in the upper left-hand quadrant of the display, channel 2 is in the upper right-hand quadrant, and channel 3 is in the lower half of the display.

Notice that the default S-parameters are: S_{11} for channel 1; S_{21} for channel 2; and S_{12} for channel 3. These can be changed by making a channel active, then pressing (Meas) and selecting a different S-parameter for the channel.

Figure 2   Three-Channel Display
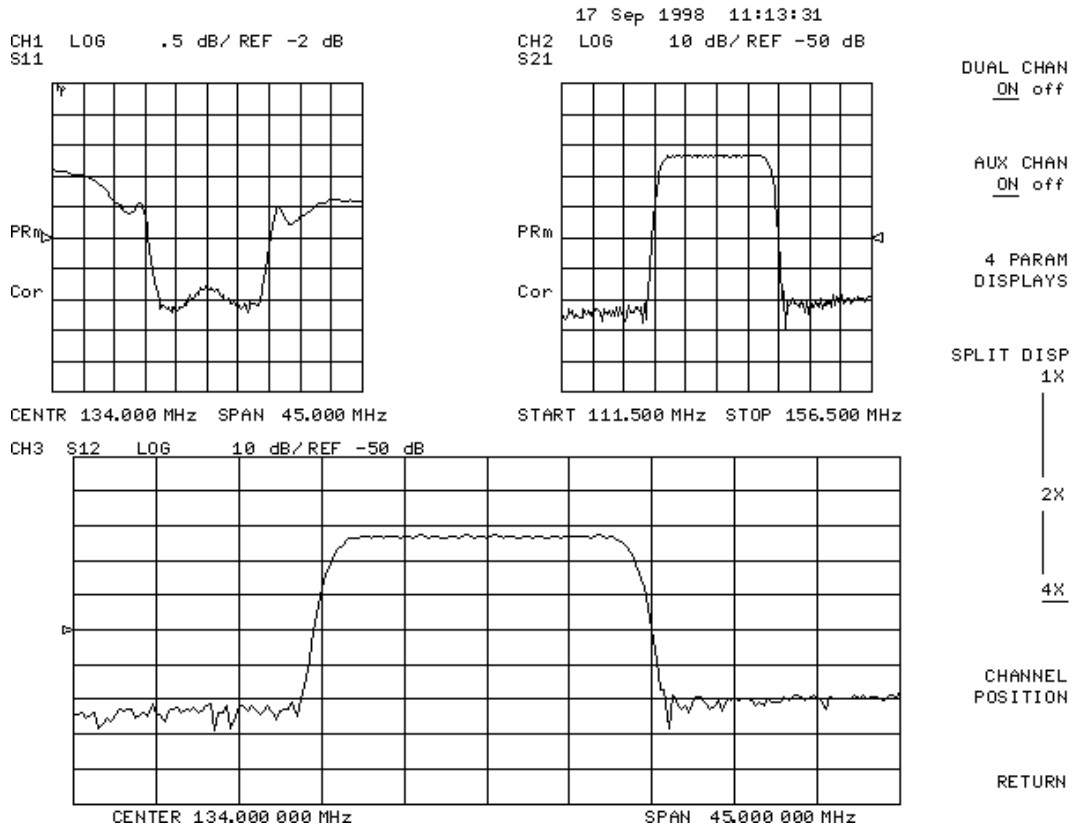
6. Press ⎡Chan 2⎤ and set **AUX CHAN on OFF** to **ON** .
   This enables channel 4, and the screen now displays four separate graticules as shown
   in Figure 3. Channel 1 is in the upper left-hand quadrant of the display, channel 2 is in
   the upper-right, channel 3 is in the lower-left, and channel 4 is in the lower-right.
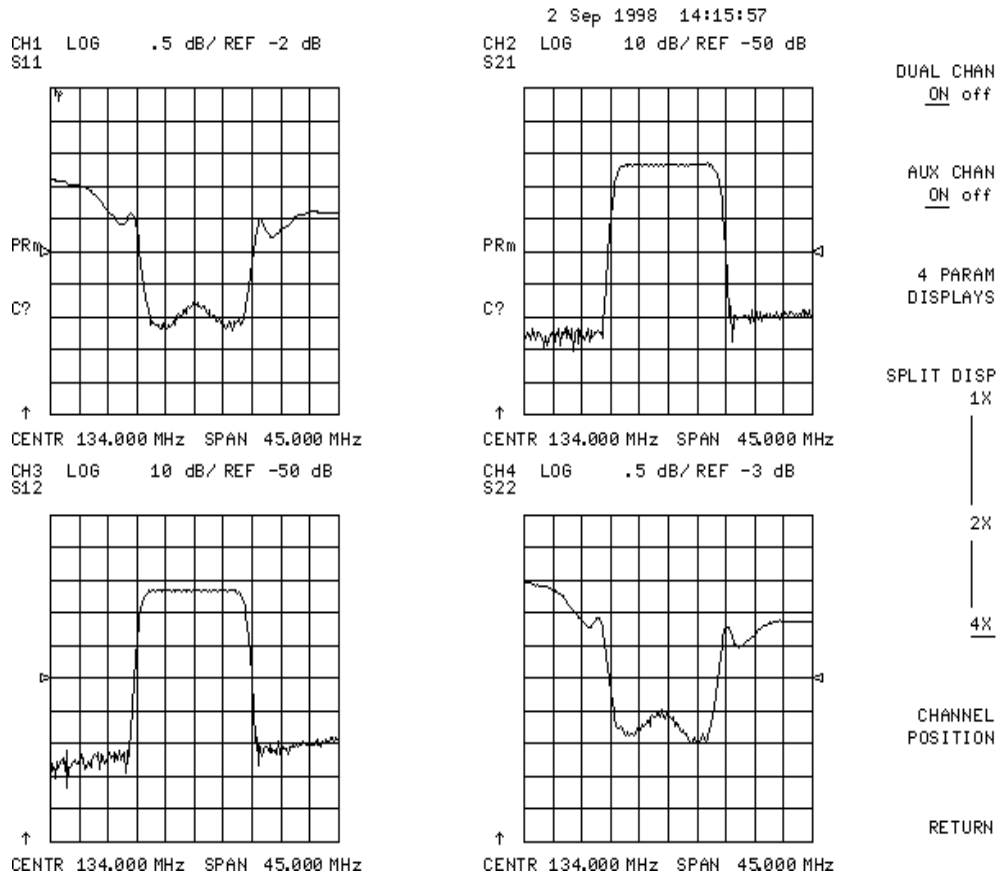
Figure 3   Four-Channel Display

Activate the Auxiliary Channels

7. Press (Chan 2).
   The amber LED adjacent to the (Chan 2) hardkey flashes. This indicates that channel 4 is now active and can be configured.

8. Press (Marker) **MARKER 1** and **MARKER 2** .
   Markers 1 and 2 appear on all four channel traces and can be moved using the front panel control knob.

9. Press (Chan 1).
   The LED is constantly lit, indicating channel 1 is active. Press (Chan 1) again and notice that the LED flashes, indicating that channel 3 is active.

10. Rotate the front panel control knob.
    Notice that marker 2 moves in all four channels.

Uncouple the Display Markers

11. Press (Marker Fctn) **MARKER MODE MENU** .
    Set **MARKERS COUPLED UNCOUPLED** to **UNCOUPLED** .

12. Rotate the front panel control knob.
    Notice that marker 2 moves only on channel 3. If you activate another channel and rotate the control knob, the marker will move only in that channel.

Characterizing a Duplexer

This measurement example demonstrates how to characterize a 3-port device, in this case a duplexer, using four-parameter display mode. (If you are using an HP 8753E Option 011, you must have an S-parameter test set connected to your analyzer.) You must use a test adapter to route the signals from the analyzer (a two-port instrument) to the duplexer (a three-port device). This example procedure is performed using an 8753E and one of the following test adapters:

❏ HP 8753D Option K36 duplexer test adapter

❏ HP 8753D Option K39 3-port test adapter

1. Press (Preset).

2. Connect the test adapter to the analyzer according to the instructions for your particular model. Connect any test fixture or cables to the duplexer test adapter.

3. Set up channel 1 for the Tx-Ant stimulus parameters (start/stop frequency, power level, IF bandwidth).

4. Uncouple the primary channels from each other:
   Press (Menu), then set COUPLED CH on OFF   to OFF .

5. Set up control of the test adapter so that channel 1 is Tx:
   Press (Seq) TTL I/O   TTL OUT   TESTSET I/O FWD   (7) (x1) TESTSET I/O REV
   (7) (x1).

6. Perform a full 2-port calibration on channel 1 (refer to the user's guide if necessary).

   Press (Cal) CALIBRATE MENU   FULL 2-PORT .

NOTE   Make sure you connect the standards to the Tx port of the test adapter (or a cable attached to it) for the FORWARD calibration, and to the Ant port for the REVERSE calibration.

---

7. Press (Chan 2).

8. Set up channel 2 for the Ant port-to-Rx port stimulus parameters.

9. Set up control of the test adapter so that channel 2 is Rx:
   Press (Seq) TTL I/O   TTL OUT   TESTSET I/O FWD   (6) (x1) TESTSET I/O REV
   (6) (x1).

10. Perform a full 2-port calibration on channel 2 (refer to the user's guide if necessary).

   Press (Cal) CALIBRATE MENU   FULL 2-PORT .

NOTE   Make sure you connect the standards to the Rx port of the test adapter (or a cable attached to it) for the FORWARD calibration, and to the Ant port for the REVERSE calibration.

---

11. Connect the DUT to the test adapter.

12. To set up a 2-graticule, 4-parameter display with Tx-Ant measurements on the top graticule and Ant Rx measurements on the bottom graticule, perform the following:

   • Press $\boxed{\text{Display}}$ **DUAL|QUAD SETUP**, then set **DUAL CHAN on OFF** to **ON**.

   • **AUX CHAN on OFF** to **ON**

   • Press $\boxed{\text{Chan 1}}$.

   • **AUX CHAN on OFF** to **ON**

13. Save this state in the analyzer by pressing $\boxed{\text{Save/Recall}}$ **SAVE STATE**.

14. The display will be similar to Figure 4.

   Normally, a 2-port calibration requires a forward and reverse sweep to complete before the displayed trace updates. For faster tuning, it is possible to set the number of sweeps for the active display (S_{11} and S_{21} for channel 1) to update more often than the unused parameters. In this example we chose 8 updates of the forward parameters to 1 update of the reverse channel 1, and 8 updates of the reverse to 1 update of the forward in channel 2 (where the active parameters are S_{22} and S_{12}).

   Press $\boxed{\text{Chan 1}}$ $\boxed{\text{System}}$ **CONFIGURE MENU** **TESTSET SW CONTINUOUS** $\boxed{8}$ $\boxed{\text{x1}}$.
   Press $\boxed{\text{Chan 2}}$ $\boxed{\text{System}}$ **CONFIGURE MENU** **TESTSET SW CONTINUOUS** $\boxed{8}$ $\boxed{\text{x1}}$.

Figure 4   Duplexer Measurement

22 Nov 1999 13:20:21

```
CH1    S21      LOG      20 dB/      REF-60 dB
CH2    S21      LOG      20 dB/      REF-60 dB
```



```
CH3    S11      LOG      10 dB/      REF-0 dB
CH4    S11      LOG      10 dB/      REF-0 dB
```



```
CH1/   CH3    CENTER    850 . 000 000   MHz          SPAN    200 . 000 000   MHz
CH2/   CH4    CENTER    850 . 000 000   MHz          SPAN    200 . 000 000   MHz
```
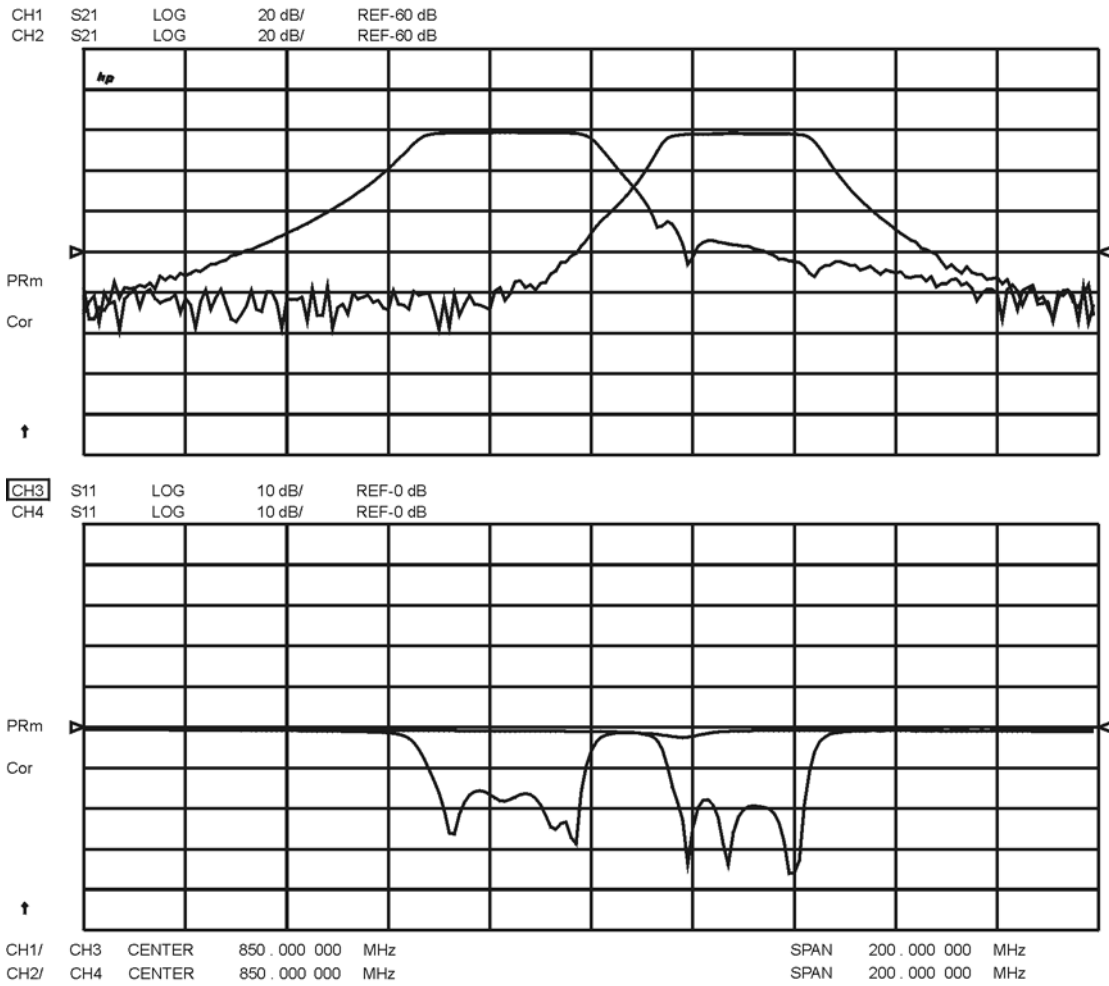
pp42d

Configuring Four-Parameter Display

Adjusting the Position of Displayed Channels

Once a multi-channel display has been created, the channels can be positioned using the **CHANNEL POSITION** softkey in the (Display) menu. The following example shows how to arrange the channels on your display.

1. Set up a four-channel display as described in "Measurement Examples" on page 5.

2. Press (Display) **DUAL|QUAD SETUP** **CHANNEL POSITION** . In the 4X column, $\begin{bmatrix} [1] & [2] \\ [3] & [4] \end{bmatrix}$ is selected (underlined).

3. Press $\begin{bmatrix} [1] & [3] \\ [2] & [4] \end{bmatrix}$ and notice that channels 2 and 3 exchange places on the screen.

You also have a choice of channel position in the 2X display mode. If $\begin{bmatrix} 1 \,\&\, 2 \\ 3 \,\&\, 4 \end{bmatrix}$ is selected, channels 1 and 2 will both be on the upper graticule. If $\begin{bmatrix} 1 \,\&\, 3 \\ 2 \,\&\, 4 \end{bmatrix}$ is selected, channels 1 and 3 will both be in the upper graticule, and channels 2 and 4 will both be in the lower graticule.

Note that the number of channels appearing in 2X or 4X display mode is a function of the interaction between how many auxiliary channels are enabled, and the state of softkeys **DUAL CHAN on OFF** and **SPLIT DISPLAY 1X 2X 4X** . Refer to Table 1, "Display Softkey Interaction," on page 13, for a description of this interaction.

Adjusting the Display Colors

The colors of the auxiliary channels' elements may be changed in the (Display) menu. Press (Display) **MORE** **ADJUST DISPLAY** **MODIFY COLORS** **MORE** to change the colors of the auxiliary channels. Channel-specific display elements whose color may be modified are data, limit lines, and memory traces.

Once an auxiliary channel element has been selected for color modification, its tint, brightness, and color may be changed in the same way that a primary channel's display colors are changed. For example, pressing **CH3 DATA LIMIT LN** opens the "Color Adjust Menu" where you can adjust the display colors according to your preference.

Table 6, "Auxiliary Channel Default Display Colors," on page 29, lists the default auxiliary channel display trace colors.

Interaction between Display Softkeys

The interaction between softkeys DUAL CHAN on OFF , AUX CHAN on OFF , and
SPLIT DISP 1X 2X 4X in the display menu determines the number of displayed channels.
Table 1 describes the interaction between these softkeys. The CHANNEL POSITION
softkey in the display menu determines how the channels are displayed.

Table 1   Display Softkey Interaction

NUMBER OF GRIDS	SPLIT DISP	DUAL CHAN ON	AUX CHANNELS ON
1	1X	XX[a]	XX[a]
	1X/2X/4X	Off	None
2	2X or 4X	Off	One or both
	2X	On	XX[a]
3	4X	On	One
4	4X	On	Both

a. XX as an entry means that the value entered does not affect the number of
   grids displayed.

Enhanced Response Calibration

The enhanced response calibration, activated by pressing the **ENHANCED RESPONSE** softkey within the calibrate menu, provides a one-port calibration to correct for directivity, source match, frequency response for reflection measurements, and frequency response for transmission measurements.

Enhanced response calibration improves accuracy in transmission measurements compared to a response calibration or a response and isolation calibration.

Enhanced Frequency Response Error Correction

The enhanced frequency response error correction removes the following errors:

- directivity errors of the test setup

- source match errors of the test setup

- isolation errors of the test setup (optional)

- frequency response of the test setup

1. Press (Preset).

2. Select the type of measurement you want to make.

   ❏ If you want to make measurements in the forward direction (S_{21} S_{11}), press

      (Meas) **Trans: FWD S21 (B/R)**

   ❏ If you want to make measurements in the reverse direction (S_{12} S_{22}), press

      (Meas) **Trans: REV S12 (A/R)**

3. Set any measurement parameters that you want for the device measurement: power, format, number of points, or IF bandwidth.

4. To access the measurement correction menus, press (Cal).

5. If your calibration kit is different than the kit specified under the **CAL KIT [ ]** softkey, press **CAL KIT**   **SELECT CAL KIT** (select your type of kit) **RETURN** .

   If your type of calibration kit is not listed in the displayed menu, refer to the user's guide.

6. To select the correction type, press ⟮Cal⟯ **CALIBRATE MENU**
   ENHANCED RESPONSE and select the correction type.

   ❏ If you want to make measurements in the forward direction, press
   S11/S21 ENH. RESP. .

   ❏ If you want to make measurements in the reverse direction, press
   S22/S12 ENH. RESP. .

7. To measure the reflection standards, press **REFLECT'N** .

8. Connect a shielded open circuit to PORT 1 (or PORT 2 for reverse measurements).

NOTE   Include any adapters that you will have in the device measurement. That is,
connect the standard to the particular connector where you will connect your
device under test.

Figure 5   **Standard Connections for Enhanced Response Calibration**
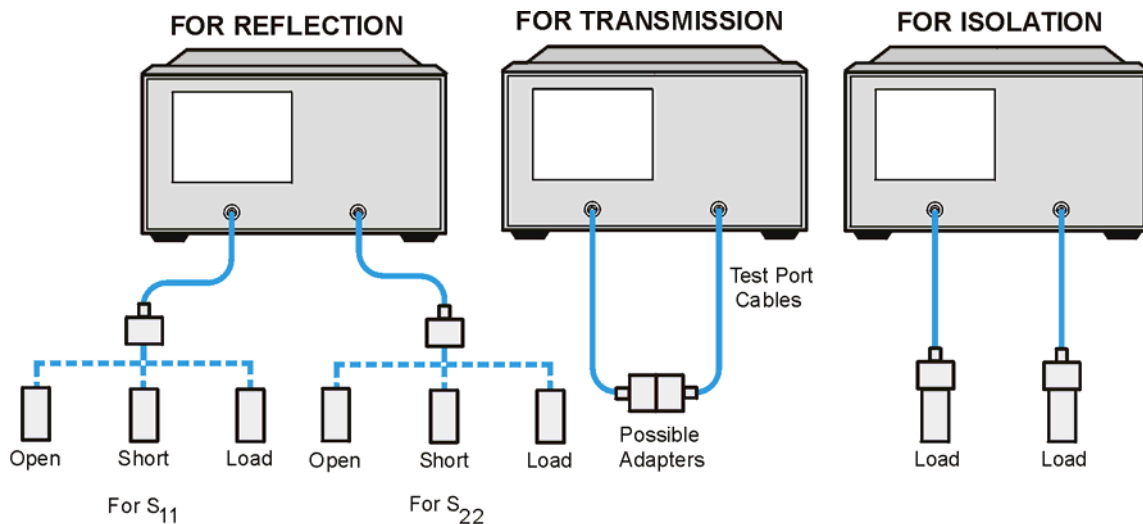
9. To measure the standard, press **OPEN** .

   The analyzer displays `WAIT - MEASURING CAL STANDARD` during the standard
   measurement. The analyzer underlines the **OPEN** softkey after it measures the
   standard.

10. Disconnect the open, and connect a short circuit to the test port.

11. To measure the standard, press **SHORT** .

   The analyzer measures the short circuit and underlines the **SHORT** softkey.

12. Disconnect the short, and connect an impedance-matched load to the test port.

13. To measure the standard, press: **LOADS** , select the type of load you are using, and then press **LOADS DONE** when the analyzer has finished measuring the load.

Notice that the **LOADS** softkey is now underlined.

14. To compute the reflection correction coefficients, press **STANDARDS DONE** .

15. To start the transmission portion of the correction, press **TRANSMISSION** .

16. Make a "thru" connection between the points where you will connect your device under test as shown in Figure 5, on page 15.

NOTE Include any adapters or cables that you will have in the device measurement. That is, connect the standard device where you will connect your device under test.

NOTE The thru in most calibration kits is defined with zero length. The correction will *not* work properly if a non-zero length thru is used, unless the calibration kit is modified to change the defined thru to the length used. This is important for measurements of non-insertable devices (devices having ports that are both male or both female). The modified calibration kit must be saved as the user calibration kit, and the **USER KIT** softkey must be selected before the calibration is started.

---

17. To measure the standard, press:

FWD TRANS THRU or **REV TRANS THRU**

FWD MATCH THRU or **REV MATCH THRU**

STANDARDS DONE

The analyzer underlines the softkey label after it makes each measurement.

18. Press **ISOLATION** and select from the following two options:

❏ If you will be measuring devices with a dynamic range less than 90 dB, press

OMIT ISOLATION

❏ If you will be measuring devices with a dynamic range greater than 90 dB, follow these steps:

a. Connect impedance-matched loads to the test ports. Include the adapters that you would include for your device measurement.

| NOTE | If you will be measuring highly reflective devices such as filters, use the test device connected to the reference plane and terminated with a load, for the isolation standard. |

    b. Activate at least four times more averages than desired during the device measurement.

    c. Press (Cal) **RESUME CAL SEQUENCE** **ISOLATION** **FWD or REV ISOLATION** **ISOLATION DONE** .

19. To compute the error coefficients, press **DONE FWD or REV ENH RESP** .

The analyzer displays the corrected measurement trace. The analyzer also shows the notation Cor at the left of the screen, indicating that error correction is on.

20. Return the averaging to the original state of the measurement.

| NOTE | You can save or store the measurement correction to use for later measurements. Refer to the chapters "Printing, Plotting, and Saving Measurement Results" and "Preset State and Memory Allocation" in your instrument's user's guide. |

21. This completes the enhanced response correction procedure. You can connect and measure your device under test.

Editing Enhanced Response Calibration Cal Kit Definitions

Table 2 illustrates the relationship between the calibration standard to classes, as it relates to editing of the calibration kit definitions in the network analyzer.

Table 2   Relationship between Calibrations and Classes

Class	Response	Response & Isolation	S11 1-port	S22 1-port	One path 2-port	Full 2-port	TRL/ LRM	Fwd Enh Resp	Rev Enh Resp
Reflection:[a]					•	•	•	•	•
S11A, RE FW MTCH			•		•	•	•	•	
S11B, LN FW MTCH			•		•	•	•	•	
S11C, LN FW TRAN			•		•	•	•	•	
S22A, LN RV MTCH				•		•	•		•
S22B, LN RV TRAN				•		•	•		•
S22C, LN RV TRAN				•		•	•		•
Transmission:[a]					•	•	•	•	•
Forward match					•	•	•	•	
Forward trans					•	•	•	•	
Reverse match						•	•		•
Reverse trans						•	•		•
Isolation:[a]					•	•	•	•	•
Forward					•	•	•	•	
Reverse						•	•		•
Response	•								
Response and isolation:									
Response		•							
Isolation		•							
TRL thru:[b]							•		
TRL reflect:[b]							•		
TRL line or match[b]:							•		

a. These subheadings must be called when doing full 2-port calibrations.
b. These subheadings must be called when doing TRL 2-port calibrations

Table 3   Error Coefficient Arrays

Array	Response	Response and Isolation	1-port	Enhanced Response	2-port [a]	TRL/LRM
01	E_R or E_T	E_X $(E_D)^b$	E_D	E_D	E_{DF}	E_{DF}
02		E_T (E_R)	E_S	E_S	E_{SF}	E_{SF}
03			E_R	E_R	E_{RF}	E_{RF}
04				E_X	E_{XF}	E_{XF}
05				$E_L{}^c$	E_{LF}	E_{LF}
06				E_T	E_{TF}	E_{TF}
07					E_{DR}	E_{DR}
08					E_{SR}	E_{SR}
09					E_{RR}	E_{RR}
10					E_{XR}	E_{XR}
11					E_{LR}	E_{LR}
12					E_{TR}	E_{TR}

a. One path, 2-port cal duplicates arrays 1 to 6 in arrays 7 to 12.
b. Response and isolation corrects for crosstalk and transmission tracking in transmission measurements, and for directivity and reflection tracking in reflection measurements.
c. This term is used to generate the calibration coefficients, but is not used during measurement error correction.

Meaning of first subscript:

D: directivity

S: source match

R: reflection tracking

X: crosstalk or isolation

L: load match

T: transmission tracking

Meaning of second subscript:

F: forward

R: reverse

Markers

There are five markers available to each auxiliary channel, and they can be configured similarly to the primary channel markers.

Normally, the markers are coupled. For example, moving marker 1 (using the front panel control knob) moves marker 1 on all displayed channels. To move a marker on a single channel, uncouple all markers by pressing (Marker Fctn) **MARKER MODE MENU**, and setting **MARKERS:COUPLED UNCOUPLED** to **UNCOUPLED**.

If you want to see the traces clearly but need to keep marker information displayed, press the backspace key (←) beneath the front panel control knob. This will hide the softkey menu and move the marker information into the softkey menu area. The softkey menu can be restored and the marker information moved back into the graticules by pressing (←) again, or any softkey or hardkey that brings up a menu.

Figure 6, "Marker Display Before Pressing the Backspace Key," on page 21, shows a four-parameter display with four markers on for all channels. After pressing the backspace key, the display appears as in Figure 7. Notice that the softkey menu is not visible and that the marker information for channels 2 and 4 has moved to the right side of the screen.

Rules Governing the Interaction between the Backspace Key, Markers, and the Softkey Menu

- The backspace key will not hide the softkey menu if an active entry is in progress, such as when you are entering a new stimulus value.

- Marker information will move into the softkey menu area only if there are two or more markers present in the right-half of the display.

- The softkey menu is restored when the backspace key or another hardkey or softkey which brings up a menu is pressed.

Figure 6   Marker Display Before Pressing the Backspace Key
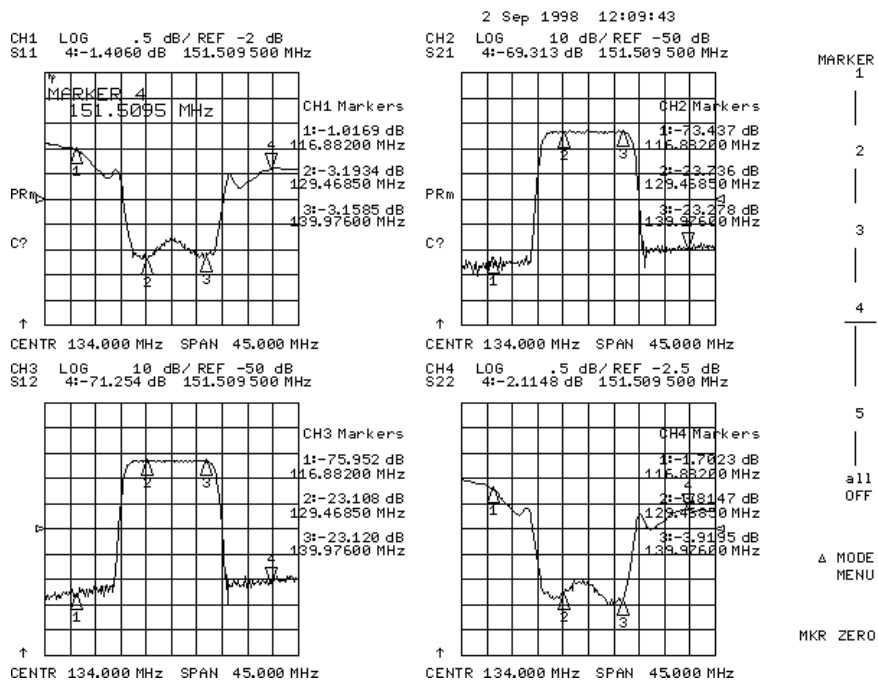
**Figure 7   Marker Display After Pressing the Backspace Key**
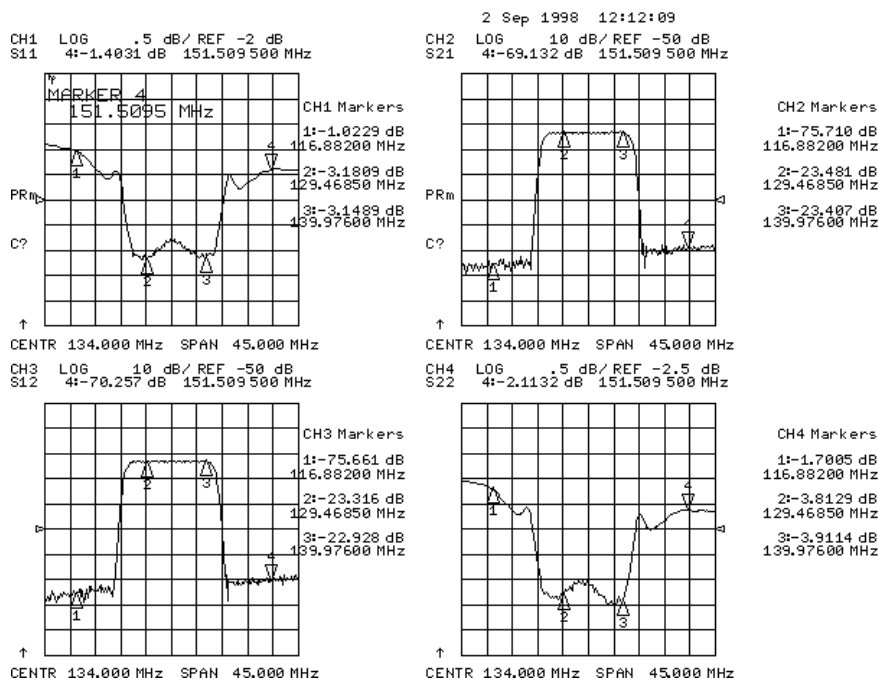
To Search for a Specific Amplitude

These functions place the marker at an amplitude-related point on the trace. If you switch on tracking, the analyzer searches every new trace for the target point.
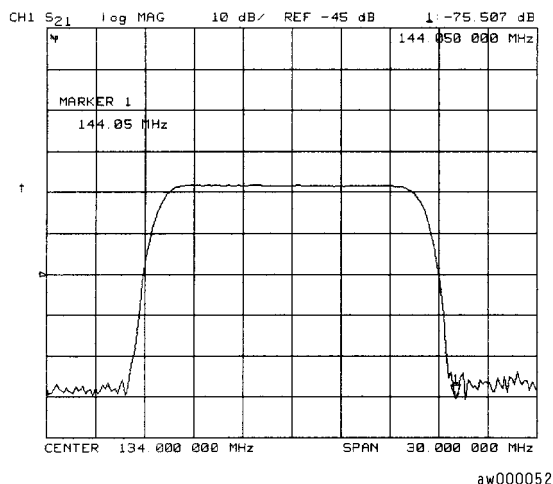
Searching for the Maximum Amplitude

1. Press (Marker Fctn) **MKR SEARCH** to access the marker search menu.

2. Press **SEARCH: MAX** to move the active marker to the maximum point on the measurement trace.

Figure 8   Example of Searching for the Maximum Amplitude Using a Marker

aw000051
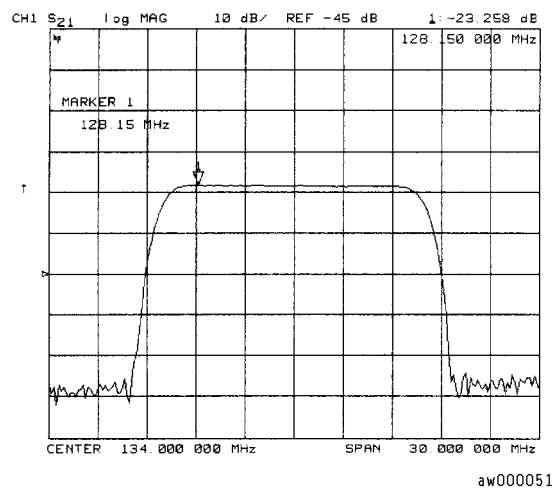
Searching for the Minimum Amplitude

1. Press (Marker Fctn) **MKR SEARCH** to access the marker search menu.

2. Press **SEARCH: MIN** to move the active marker to the minimum point on the measurement trace.

Figure 9   Example of Searching for the Minimum Amplitude Using a Marker

aw000052

Searching for a Target Amplitude

1. Press (Marker Fctn) **MKR SEARCH** to access the marker search menu.

2. Press **SEARCH: TARGET** to move the active marker to the target point on the measurement trace.

3. If you want to change the target amplitude value (default is –3 dB), press **TARGET** and enter the new value from the front panel keypad. You may also press (Marker Search) **TARGET VALUE** to enter the new value.

4. If you want to search for multiple responses at the target amplitude value, press **SEARCH LEFT** and **SEARCH RIGHT** .

Figure 10   Example of Searching for a Target Amplitude Using a Marker
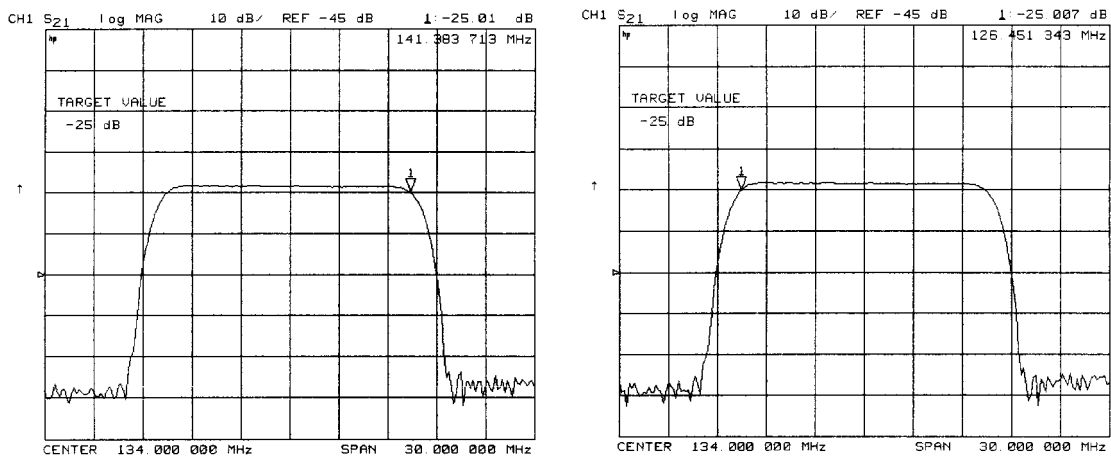
pg6230

Searching for a Bandwidth

The analyzer can automatically calculate and display the bandwidth (BW:), center frequency (CENT:), Q, and loss of the device under test at the center frequency. (Q stands for "quality factor," defined as the ratio of a circuit's resonant frequency to its bandwidth.) These values are shown in the marker data readout.

1. Press (Marker Fctn) **MKR SEARCH** and **SEARCH: MAX** to place the marker near the center of the filter passband.

2. Press (Marker) **MKR ZERO** if you want the bandwidth relative to the maximum.

3. Press (Marker Fctn) **MKR SEARCH** to access the marker search menu.

4. Press **WIDTHS ON** to calculate the center stimulus value, bandwidth, and the Q of a bandpass or band reject shape on the measurement trace.

5. If you want to change the amplitude value (default is −3 dB) that defines the passband or reject band, press **WIDTH VALUE** and enter the new value from the front panel keypad.

Figure 11   Example of Searching for a Bandwidth Using Markers

aw000055
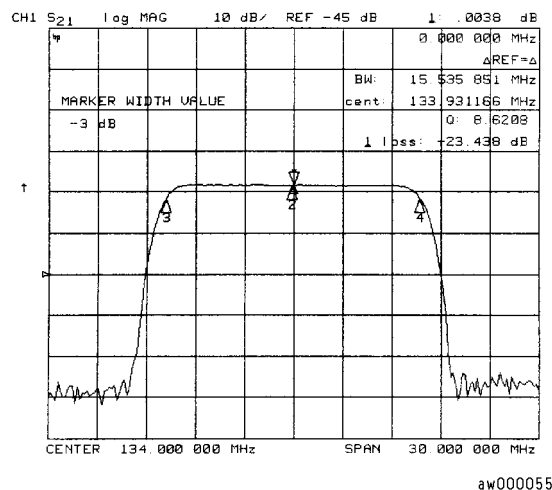
Tracking the Amplitude that You Are Searching

1. Set up an amplitude search by following one of the previous procedures in .

2. Press (Marker Fctn) **MKR SEARCH** **TRACKING ON** to track the specified amplitude search with every new trace and put the active marker on that point.

   When tracking is not activated, the analyzer finds the specified amplitude on the current sweep and the marker remains at the same stimulus value, regardless of changes in the trace response value with subsequent sweeps.

Additions and Changes to the Network Analyzer User Interface

This section describes the four-parameter display, and the enhanced response calibration features of firmware 7.60 and above.

New Remote Commands

The firmware upgrade adds new remote commands for configuring the new display functions, and for performing enhanced response calibration. Table 4 lists these new remote commands. Where a command has the same effect as a front-panel key, the key name is listed in the column "Equivalent Key." These are new commands, and they do not change the commands of earlier versions of firmware.

Table 4   New Remote Commands

Mnemonic	OPC-Compatible	Action	Equivalent Key
AUXC	Yes	Enables and disables auxiliary channels.	**AUX CHAN on OFF**
CHAN 3	Yes	Makes channel 3 active.	**CHAN 1**
CHAN 4	Yes	Makes channel 4 active.	**CHAN 2**
COLOCH3D	No	Selects channel 3 data/limit line color.	**CH3 DATA LIMIT**
COLOCH3M	No	Selects channel 3 memory trace color.	**CH3 MEM**
COLOCH4D	No	Selects channel 4 data/limit line color.	**CH4 DATA LIMIT**
COLOCH4M	No	Selects channel 4 memory trace color.	**CH4 MEM**
COLOLREF	No	Selects the display reference line color.	**REF LINE**
D2XUPCH3	No	Orients channels in 2-grid display with channel 3 on top.	2X: [1 & 3] [2 & 4]
D2XUPCH2	No	Orients channels in 2-grid display with channel 2 on top.	2X: [1 & 2] [3 & 4]
D4XUPCH3	No	Orients channels in 4-grid display with channel 3 in upper right-hand quadrant of display.	4X: [1] [3] [2] [4]
D4XUPCH2	No	Orients channels in 4-grid display with channel 2 in upper right-hand quadrant of display.	4X: [1] [2] [3] [4]
SPLID1	No	Displays all active channels in one full-size graticule.	**SPLIT DISP 1X**

Table 4   New Remote Commands
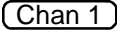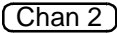
Mnemonic	OPC-Compatible	Action	Equivalent Key
SPLID2	No	Displays all active channels in two full-size graticules.	SPLIT DISP 2X
SPLID4	No	Displays each active channel in four separate graticules.	SPLIT DISP 4X
PCOLODATA3	No	Prints color for channel 3 data.	CH3 DATA [COLOR]
PCOLODATA4	No	Prints color for channel 4 data.	CH4 DATA [COLOR]
PCOLOMEMO3	No	Prints color for channel 3 memory.	CH3 MEM [COLOR]
PCOLOMEMO4	No	Prints color for channel 4 memory.	CH4 MEM [COLOR]
PCOLOREFL	No	Prints color for the reference line.	REF LINE [COLOR]
CALIERC	No	Begins an enhanced response calibration sequence (forward direction).	S11/21 ENH. RESP
ERCDONE	Yes	Concludes an enhanced response calibration (forward direction).	DONE FWD ENH. RESP
CALIRERC	No	Begins an enhanced response calibration sequence (reverse direction).	S22/12 ENH. RESP
RERCDONE	Yes	Concludes an enhanced response calibration (reverse direction).	DONE REV ENH. RESP
CALK716	No	Selects the HP 85038A 7-16 cal kit for calibration.	7-16 HP 85038

Softkey and Hardkey Functions

The new four-parameter display hardkey and softkey functions are described in Table 5.

Table 5   New Hardkey and Softkey Functions

Key	Function
⌐Chan 1⌐	Makes channel 1 or auxiliary channel 3 active.
⌐Chan 2⌐	Makes channel 2 or auxiliary channel 4 active.
AUX CHAN on OFF	Enables and disables an auxiliary channel.
4 PARAM DISPLAYS	Describes the basic features of four-parameter display and provides quick setup keys.
SPLIT DISP 1X 2X 4X	Splits the screen into 1, 2, 3, or 4 separate grids.
CHANNEL POSITION	Orients the auxiliary channels below or adjacent to their primary channels.
⌐⟵⌐ (backspace key)	Turns off the softkey menu and, if there is more than one marker in the right-half of the display, moves the marker information into the softkey menu area. Makes marker information and trace data easier to view.
CH3 DATA LIMIT LN	Selects channel 3 data and limit lines display for color modification.
CH3 MEM	Selects channel 3 display memory trace for color modification.
CH4 DATA LIMIT LN	Selects channel 4 data and limit lines display for color modification.
CH4 MEM	Selects channel 4 display memory trace for color modification.
REF LINE	Selects the display reference line for color modification.
GRATICULE	Selects the display graticule for color modification.
TEXT	Selects display text for color modification.
CH3 DATA [COLOR]	Selects Channel 3 print data for color modification.
CH3 MEM [COLOR]	Selects Channel 3 print memory for color modification.
CH4 DATA [COLOR]	Selects Channel 4 print data for color modification.
CH4 MEM [COLOR]	Selects Channel 4 print memory for color modification.
REF LINE [COLOR]	Selects the print reference line for color modification.
DO BOTH FWD THRUS	Activates both forward measurements (reflection and transmission) of the thru standard from the selective enhanced response calibration menus.
DO BOTH REV THRUS	Activates both reverse measurements of the thru standard S_{22}/S_{12} from the S_{11}/S_{21} selective enhanced response calibration menus.
DONE FWD ENH RESP.	Concludes the enhanced response calibration (forward direction).

Table 5   New Hardkey and Softkey Functions

Key	Function
DONE REV ENH RESP.	Concludes the enhanced response calibration (reverse direction).
ENHANCED RESPONSE	Provides access to the series of menus used to perform an enhanced response calibration.
REV ISOL'N	Measures the reverse isolation of the calibration standard during an enhanced response cal.
S11/21 ENH. RESP	Provides an S_{11} and S_{21} enhanced response calibration (forward direction). Enhanced response generates a 1-port cal for S_{11} and an improved calibration over the response cal for S_{21}.
S22/12 ENH. RESP	Provides an S_{22} and S_{12} enhanced response calibration (reverse direction). Enhanced response generates a 1-port cal for S_{22} and an improved calibration over the response cal for S_{12}.

Display Colors

lists the default values for the auxiliary channels display colors.

Table 6   Auxiliary Channel Default Display Colors

Display Element	Tint	Brightness	Color
Ch3 Data/Limit Line	85	100%	100%
Ch3 Memory	90	100%	100%
Ch4 Data Limit/Line	33	100%	100%
Ch4 Memory	45	100%	100%

Changes to Menu Maps

In the ⁨Save/Recall⁩ menu, **ISTATE UTILITIES** has been removed from the **FILE UTILITIES** sub-menu.

In the ⁨Cal⁩ menu, the default status of interpolated error-correction is now set to **ON** .

In the **CONFIGURATION** sub-menu of the ⁨System⁩ menu, **USER SETTINGS** has been added. Pressing **USER SETTINGS** leads to **PRESET SETTINGS** , then to **CAL INTERP on OFF** . Pressing this key will cause the analyzer to power-up with interpolated error-correction turned off.

Changes to the Display

The symbols C? and C2 have been changed to CΔ. The meaning is the same as the original notation as described in Chapter 1, "Description and Options" in your analyzer's user's guide.

Display Menu Map

This menu map shows the new (Display) menu and sub-menus. The most significant change to the (Display) menu is the addition of the **DUAL|QUAD SETUP** sub-menu.

Figure 12   Display Menu Map
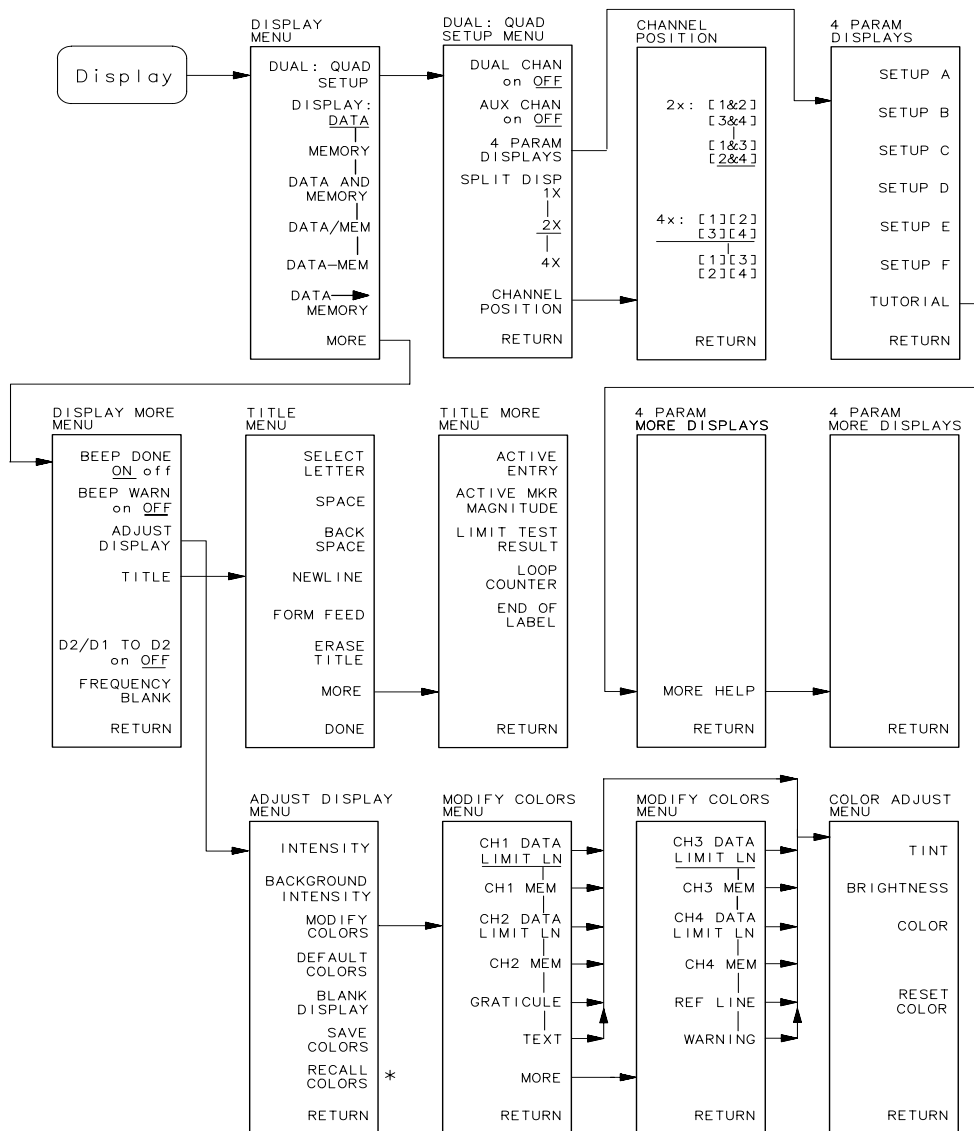
✻ APPEARS ONLY WHEN COLORS HAVE BEEN SAVED.

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Status Reporting Structure

The status reporting structure of your analyzer has been changed to include extra bits associated with the auxiliary channels. Notice the addition of bits 8 through 11 to event status register B.

Figure 13   Status Reporting Structure
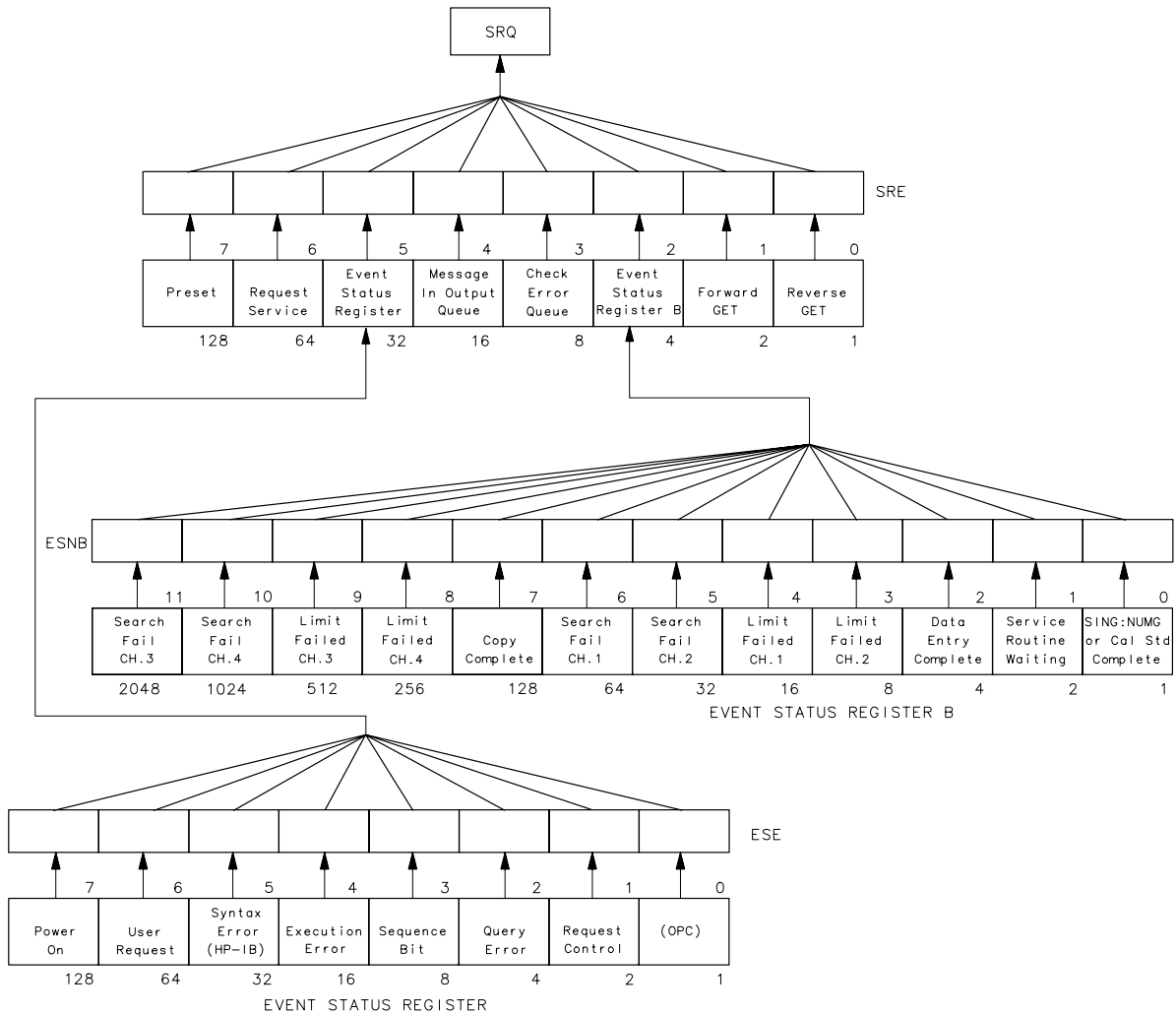
New Error Messages

The four-parameter display firmware upgrade includes new error messages. They are shown below, along with a description of each new message.

❏ `CAUTION: AUX CHANNEL(S) RESTORED`

`ERROR NUMBER 214`

This message is displayed when a calibration is restored (from a recalled instrument state) and that instrument state had one or both auxiliary channel(s) enabled.

Preset Conditions

Pressing (Preset) sets the new softkeys to the values shown in Table 7. Where a softkey existed prior to the release of four-parameter display firmware, but its preset value has changed as a result of this firmware upgrade, the softkey name is preceded by an asterisk.

Table 7 Preset Values of Softkeys

Softkey	Power On or Preset
AUX CHAN ON OFF	OFF
SPLIT DISP 1X 2X 4X	2X
CHANNEL POSITION	2X: [1 & 3] [2 & 4]
	4X: [1] [2] [3] [4]
Channel 3 (measurement/format)	S12/Log Magnitude
Channel 4 (measurement/format)	S22/Log Magnitude
CH 3 DATA LIMIT LN (display color)	Magenta
CH 4 DATA LIMIT LN (display color)	Green
CH 3 MEM (display color)	Magenta
CH 4 MEM (display color)	Green
REF LINE (display color)	White
GRATICULE (display color)	Grey
TEXT (display color)	White
CH3 DATA (print color)	Magenta
CH3 MEM (print color)	Green
CH4 DATA (print color)	Blue
CH4 MEM (print color)	Red
REF LINE (print color)	Black
* **INTERPOL ON off**	ON

Saving Measurement Data to Disk

This section describes the changes four-parameter display firmware makes to data files saved to disk. For more information on saving data files to disk, refer to the chapters "Printing, Plotting, and Saving Measurement Results" and "Preset State and Memory Allocation" in your user's guide.

Data Files (Binary or ASCII)

A binary or ASCII softkey selection may be used to select the manner in which the data is saved.

If **DATA ARRAY** is selected, and one or both auxiliary channels are displayed, files with extensions .d3 and/or .d4 will be saved.

If **FORMAT ARRAY** is selected and one or both auxiliary channels are displayed, files with extensions .f3 and/or .f4 are saved.

New Binary Instrument State File

Files with .I, .P, and .W suffixes contain instrument state settings in a binary format which are only meant to be read by the network analyzer, and not to be interpreted by the user.

A file with a "W" suffix is saved to disk anytime an instrument state is saved to disk. This file can only be read by analyzers with four-parameter display capability.

Miscellaneous

Power Ranges

The power ranges extend to allow for 12 dB under-range and 6 dB over-range for each channel on the HP 8719D/20D/22D, and a 6 dB under-range and 6 dB over-range on the HP 8753E.

HPGL Graphics (Noise Figure Meter HP 8970B Only)

The HPGL graphics scaling has been changed to allow a larger screen display of noise figure measurements.

Sampler Cal

The firmware revision 7.60 and higher adds a sampler calibration for models HP 8719/20/22.

To set the instrument so that the sampler cal is on, press (System) **SERVICE MENU** **SERVICE MODES** **MORE** **SAMPLR COR on OFF** .

New Power Meter Support

The firmware revision 7.60 and higher allows for use of HP E4419/E4418 power meters, in conjunction with power sensors HP E4412A and HP E4413A, as well as power sensors traditionally used with the HP 436/437/438 power meters.

If the power sensor being used is not one of the E-Series power sensors, the sensor calibration factors need to be entered into the table for the appropriate sensor (A or B) on the network analyzer (the same procedure as is done when using the HP 436/437/438 series of power meters).

If the power sensor is one of the E-Series sensors, the power meter reads the factors from the sensor itself, so the calibration factor table on the network analyzer is not used.

To ensure that the network analyzer will correctly apply the required correction factors, press: (Local) **SET ADDRESSES** . Set **POWER METER[436A]** to **POWER METER [438A/437]** .

IDN?

The IDN? query string outputs the identification string:

`HEWLETT PACKARD, 87NNEX, xxxxxxxxxx, X.XX` where **87NNEX** is the model number of the instrument, **xxxxxxxxxx** is the serial number of the instrument, and **X.XX** is the firmware revision of the instrument.

Rear Panel Service Test

The Rear Panel Service Test (Test# 13) has changed to refer to the test as the HPIB Test (Test #13), with the exception of the HP 8719/20/22 where the test is displayed as the GPIB Test (Test #13).

One Path, Two Port Calibration Type Remote Commands

The remote commands for the 1 path, 2-port calibration are still supported. However, the one path, 2-port calibration is no longer available from the front panel.

Calibration Kit 7-16

HP 85038A 7-16 connector calibration kit has been added for firmware revision 7.60 and higher.

Hewlett-Packard Sales and Service Offices

Table 8   Hewlett-Packard Sales and Service Offices

UNITED STATES
Instrument Support Center Hewlett-Packard Company (800) 403-0801

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Index

Index

reporting
  status structure, 31

S

sampler cal, 35
saving
  ASCII files, 34
  binary files, 34
  data files, 34
  measurement data to disk, 34
  new binary instrument state
      file, 34
searching for specific amplitude,
    22
softkeys
  functions, new, 27
  interaction between display, 13
  preset values, 33
s-parameters
  displaying all 4 of a 2-port
      device, 5
specific amplitude, 22
  bandwidth, searching for, 24
  maximum amplitude, searching
      for, 22
  minimum amplitude, searching
      for, 22
  search for, 22
  target amplitude, searching for,
      23
  tracking the amplitude, 24
status reporting structure, 31
structure
  status reporting, 31

T

target amplitude, searching for,
    23
test
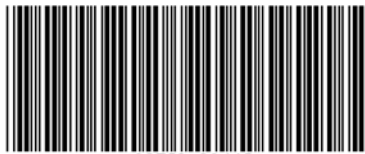 rear panel, 36
tracking the amplitude, 24

U

uncouple the display markers, 8
user interface
  additions and changes to the
      network analyzer, 25

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This information supersedes all prior HP contact information.			
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