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User's Guide Supplement for Option 000

Performance Upgrade Kit

**IMPORTANT! Read the Installation Note
included in this upgrade kit before starting.**



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Option 000 Performance Upgrade Kit

Introduction

The performance upgrade kit offers:

- A new CPU board which can improve analyzer measurement speeds. For most applications, the analyzer will benefit from a 3-5 times increase in measurement speeds when using the fastest IF bandwidth.
- Firmware revisions with enhancements and features such as an IF bandwidth filter setting of 6000 Hz and a new frequency sweep mode called swept list mode. Using swept list mode can increase throughput by up to six times over a stepped sweep. Also, this mode expands the list table to include a power value and IF bandwidth for each segment.

Note

This document is intended to supplement the analyzer User's Guide with a print date of July 1997 or later. If your manual set has an earlier print date, it lacks a full explanation of all of your current analyzer features. For a list of all these features and for part number information you will need to order new manuals, refer to the sections "Firmware History" and "Information on Manuals, " located later in this document.

The analyzer measurement speeds documented in your current User's *Guide* are now improved as shown in the section "Analyzer Measurement Speeds, " located later in this document.

This document also explains new firmware enhancements and features that you now have as a result of your upgrade.

Note

In the unlikely event that you need to order a CPU repair kit, request HP part number 08753-60315 (new assembly) or 08753-69315 (rebuilt assembly). Also, refer to the figure "Module Exchange Procedure" in the *Service Guide*.

New Preset Conditions

New Preset Conditions	Preset Value
List Frequency Sweep Mode	Swept
I List, Power	Off
List IFBW	Off
IF Bandwidth	3700 Hz

For a complete listing of all analyzer preset conditions, see the section titled "Preset Conditions," located later in this document.

Analyzer Measurement Speeds

The performance upgrade kit contains a new CPU board that can improve analyzer measurement speeds, depending on analyzer type and settings. When using the fastest IF bandwidth, a 3-5 times increase in speed is noted for most applications. The following tables show typical measurement speeds:

Typical Recall State Times

Operations	Channel	Points	Raw Offset and Spur Avoid	Total Time (secs)		Recall-Only Time (secs)	
				Standard Analyzer	With Performance Upgrade	Standard Analyzer	With Performance Upgrade
Recall and Sweep	Dual Chan.	1601	On	3.89	1.01	3.18	.578
Recall and Sweep	Dual Chan.	1601	Off	2.008	.641	1.298	.208
Sweep only (no Recall)	Dual Chan.	1601	n/a	0.71	.443	no recall	no recall
Recall and Sweep	Dual Chan.	201	On	0.955	.227	.740	.145
Recall and Sweep	Dual Chan.	201	off	0.734	.180	.519	.102
Sweep only (no Recall)	Dual Chan.	201	n/a	0.215	.081	no recall	no recall
Recall and Sweep	Single Chan.	1601	On	2.134	.778	1.424	.345
Recall and Sweep	Single Chan.	1601	Off	1.251	.578	.541	.145
Instrument State: CF= 1 GHz, Span= 2 MHz, error correction OFF, display blanked . HP-IB commands sent for timing are Recall;OPC?;SING; or, for sweep only, OPC?;SING;. Note: Pressing DISPLAY BLANK DISPLAY improves recall time with performance upgrade but has no effect on the standard instrument.							

Typical Sweep Time vs. Number of Points

Number of Points	Sweep Time (secs) ¹	
	Standard Analyzer ²	With Performance Upgrade ³
51	0.090	0.062
101	0.120	0.066
201	0.170	0.106
401	0.270	0.181
801	0.470	0.330
1601	0.870	0.633

1 Preset condition, CF= 1 GHz, Span= 100 MHz, error correction OFF; includes retrace time.

2 3000 Hz IF BW preset condition

3 3700 Hz IF BW preset condition. Measurement speed can be improved by selecting the widest IF BW setting of 6000 Hz.

Typical Sweep Time vs. IF Bandwidth

IF BW	Sweep Time (secs) ¹	
	Standard Analyzer	With Performance Upgrade
6000	N/A	0.077
3700	0.150	0.102
3000	0.176	0.128
1000	0.312	0.254
300	0.980	0.707
100	2.070	2.010
30	7.240	6.980
10	21.60	21.40

1 Preset condition, CF= 1 GHz, Span= 100 MHz; includes retrace time.

Typical Measurement Speed: Data Output and Error Correction to an External PC

Mode (data output to external PC)	Time (secs) 1-parameter		Time (secs) 2-parameters		Time (secs) 3-parameters		Time (secs) 4-parameters	
	Standard Analyzer	With Performance Upgrade	Standard Analyzer	With Performance Upgrade	Standard Analyzer	With Performance Upgrade	Standard Analyzer	With Performance Upgrade
Take4	0.475	0.215	0.475	0.215	0.475	0.215	0.475	0.215
Normal error correction	0.902	0.15	1.04	0.25	2.28	0.29	2.90	0.35
Narrow band, IF BW = 3700 Hz, 201 points, CF = 1.8 GHz, Span = 200 MHz, RAW OFFSET OFF								
Take4 mode used in conjunction with an HP Omnibook 5500CT laptop, 133 MHz Pentium®, running HP VEE 4.0 as program language.								

Typical Minimum Cycle Time (secs)

Number of Points	IF Bandwidth		
	6000 Hz	3700 Hz	3000 Hz
11	0.0025	0.0041	0.0055
51	0.0125	0.0191	0.0255
101	0.0250	0.0379	0.0505
201	0.0500	0.0754	0.1005
401	0.1000	0.1504	0.2005
801	0.2000	0.3004	0.4005
1601	0.4000	0.6004	0.8005

Typical Measurement Times

Typical Time for Completion (ms)				
	Number of Points			
	51	201	401	1601
Measurement				
Uncorrected	40	77	127	428
1-port cal	40	77	127	428
2-port cal ²	70	145	244	845
Time Domain Conversion³	14	46	91	392
HP-IB Data Transfer⁴				
Binary (Internal)	6	11	17	52
IEEE754 floating point format				
32 bit	8	15	25	79
64 bit	9	22	40	137
ASCII	40	147	289	1142

1 HP 8753D Option 000, S11 1-port calibration, with a 6 kHz IF bandwidth. Includes system retrace time, but does not include band-switch time. Time domain gating is assumed off.

2 HP 8753D Option 000, S21 measurement with full 2-port calibration, using a 6 kHz IF bandwidth. Includes system retrace time and RF switching time, but does not include band-switch time. Time domain gating is assumed off.

3 HP 8753D Option 000 and Option 010 only, gating off.

4 Measured with HP Omnibook 5500 (133 MHz Pentium) series computer.

Firmware Enhancements and Features

Note This section explains the firmware enhancements and features now installed in your analyzer as a result of your upgrade. It is possible, depending on your analyzer's previous firmware revision, that you already had some of these features.

New IF Bandwidth Setting

The IF bandwidth filter setting of 6000 Hz can now be selected in addition to the previously available settings of 10, 30, 100, 300, 1000, 3000, and 3700 Hz.

Note If your device under test has a long electrical length and you have selected a very fast analyzer sweep speed, the 6000 Hz IF bandwidth filter setting may have degraded trace noise performance. To improve the trace noise performance, you should experiment with the following suggestions:

- decrease the frequency span
 - increase the number of measurement points
 - decrease the sweep speed
 - decrease the IF bandwidth filter setting
 - use the stepped list frequency sweep mode
-

Swept List Mode

Swept list mode, which is now the preset condition, is one of two list frequency sweep modes now available. It is accessed via the LIST FREQ [SWEPT] softkey (or HP-IB command LISTTYPELSWP). The swept list mode allows the analyzer to sweep a list of arbitrary frequency points which are defined and modified in a way similar to the stepped list mode.

However, this mode takes data while **sweeping** through the defined frequency points, increasing throughput by up to 6 times over a stepped sweep. In addition, this mode allows the test port power and IF bandwidth to be set independently for each segment that is defined. The only restriction is that you cannot specify overlapping frequency segments.

Similar to stepped list mode, the LIST FREQ [SWEPT] softkey also provides access to the segment menu. However, swept list mode expands the way segments can be defined. See below for information on how to enter or modify the list segments.

Swept Edit List Menu

The EDIT LIST softkey within the sweep type menu provides access to the edit list menu. The function of this menu is the same as in the stepped list mode.

Swept Edit Subsweep Menu

Using the EDIT or ADD softkey within the edit list menu will display the edit subsweep menu. This menu lets you select measurement frequencies arbitrarily. By using this menu it is possible to define the exact frequencies to be measured on a point-by-point basis at specific power levels and IF bandwidth settings. The total sweep is defined with a list of subsweeps.

The frequency subsweeps, or segments, can be defined in any of the following terms:

- start/stop/number of points/power/IFBW
- start/stop/step/power/IFBW
- center/span/number of points/power/IFBW
- center/span/step/power/IFBW

See the following measurement example for information on how to set the segment power and IF bandwidth.

The subsweeps may be entered in any particular order but they cannot overlap. The analyzer sorts the segments automatically and lists them on the display in order of increasing start frequency, even if they are entered in center/span format. The data is shown on the display as a single trace that is a composite of all data taken. The trace may appear uneven because of the distribution of the data points, but the frequency scale is linear across the total range.

Once the list frequencies have been defined or modified, the list frequency sweep mode can be selected with the LIST FREQ [SWEPT] softkey in the sweep type menu. The frequency list parameters can also be saved with an instrument state.

Setting Segment Power

To enable the SEGMENT POWER function (HP-IB command SEGPOWER[D]), you must first select LIST POWER ON off in the edit subsweep menu (or HP-IB command LISPWRMON). List power is off by default, and the asterisks that appear in the “power” column of the list table indicate that power for the sweep is being set by the normal analyzer power controls.

The following three paragraphs do NOT apply to the HP 8753D Option 011.

The power settings for all segments are restricted to a single power range. This prevents the attenuator from switching to different settings mid-sweep. Select the power range and then edit the list table to specify the segment powers. If the power range is selected after the list has been defined, the list settings may be affected.

When analyzer port power is uncoupled, the segment power level can be set independently for each port. To do this, you must first select a measurement parameter to activate the port whose power you want to set. For example, select S11 to set port 1 power, or S22 to set port 2 power. (Notice that the list mode table will only display the currently selected port in the table. This is due to restricted display space.)

When analyzer port power is uncoupled, the LIST POWER ON off softkey can also be set independently for each port. For example, you may choose to set LIST POWER ON off (or HP-IB command LISPWRMON) for forward measurements and LIST POWER on OFF (or HP-IB command LISPWRMOFF) for reverse measurements. In this case, the power would be set according to values in the list when measuring the forward parameters. When measuring the reverse parameters, the power would be set according to the normal analyzer power controls.

Setting Segment IF Bandwidth

To enable the SEGMENT IF BW function (HP-IB command SEGIFBW [D]), you must first select LIST IF BW ON off in the edit subsweep menu (or HP-IB command LISIFBWMON). List IF bandwidth is off by default, and the asterisks that appear in the “IFBW” column of the list table indicate that the IF bandwidth for the sweep is being set by the normal analyzer controls.

Narrow IF bandwidths require more data samples per point and thus slow down the measurement time. Selectable IF bandwidths can increase the throughput of the measurement by allowing the user to specify narrow bandwidths only where needed.

Measurements Using the Swept List Mode

The ability to completely customize the frequency sweep while using swept list mode is useful when setting up a measurement for a device with high dynamic range, like a filter. The following measurement of a filter illustrates the advantages of using the swept list mode.

Connect the Device Under Test.

1. Connect the DUT between Port 1 and Port 2.
2. Set the following measurement parameters:

MEAS Trans: FWD S21 (B/R)

CENTER 900 (M/μ)

SPAN 500 (M/μ)

Observe the Characteristics of the Filter.

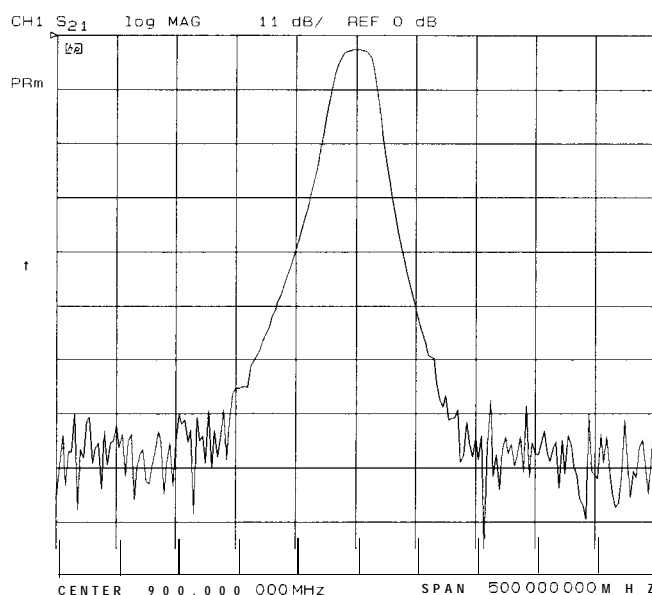


Figure I-1. Characteristics of a Filter

- Generally, the pass band of a filter exhibits low loss. A relatively low incident power may be needed to avoid overdriving the next stage of the DUT (if that stage contains an amplifier) or the network analyzer receiver.
- Conversely, the stop band of a filter generally exhibits high isolation. To measure this characteristic, the dynamic range of the system will have to be maximized. This can be done by increasing the incident power and narrowing the IF bandwidth.

Choose the Measurement Parameters.

1. Decide the frequency ranges of the segments that will cover the stop bands and pass band of the filter. For this example, the following ranges will be used:

Lower	stop	band.	.	.	.650	to	880	MHz
Pass	band.	.	.	.880	to	920	MHz	
Upper	stop	band.	.	.920	to	1150	MHz	

2. To set up the swept list measurement, press

MENU SWEEP TYPE MENU EDIT LIST

Set Up the Lower Stop Band Parameters

3. To set up the segment for the lower stop band, press

ADD

START **650** **M/μ**

STOP **880** **M/μ**

NUMBER of POINTS **51** **x1**

4. To increase the dynamic range in the stop band by increasing the incident power and narrowing the IF bandwidth, press

MORE

LIST POWER ON off SEGMENT POWER **10** **x1**

LIST IF **BW** ON off SEGMENT IF BW **1000** **x1**

RETURN DONE

Set Up the Pass Band Parameters

5. To set up the segment for the pass band, press

ADD

CENTER **900** **M/μ**

SPAN **40** **M/μ**

STEP SIZE **.2** **M/μ**

6. To specify a lower power level for the pass band, press

MORE

SEGMENT POWER **-10** **x1**

SEGMENT IF BW **3700** **x1**

RETURN DONE

Set Up the Upper Stop Band Parameters

7. To set up the segment for the upper stop band, press

ADD

START **920** **M/μ**

STOP **1150** **M/μ**

NUMBER of POINTS **51** **x1**

8. To maximize the dynamic range in the stop band (increasing the incident power and narrowing the IF bandwidth), press

MORE

SEGMENT POWER **10** **x1**

SEGMENT IF BW **300** **x1**

RETURN DONE

9. Press DONE LIST FREQ [SWEPT] .

Calibrate and Measure.

1. Remove the DUT and connect a thru between the test ports.
2. Perform a full two-port calibration.
3. With the thru connected, set the scale to autoscale to observe the benefits of using swept list mode.
 - The segments used to measure the stop bands have less noise, thus maximizing dynamic range within the stop band frequencies.
 - The segment used to measure the pass band has been setup for faster sweep speed with more measurement points.

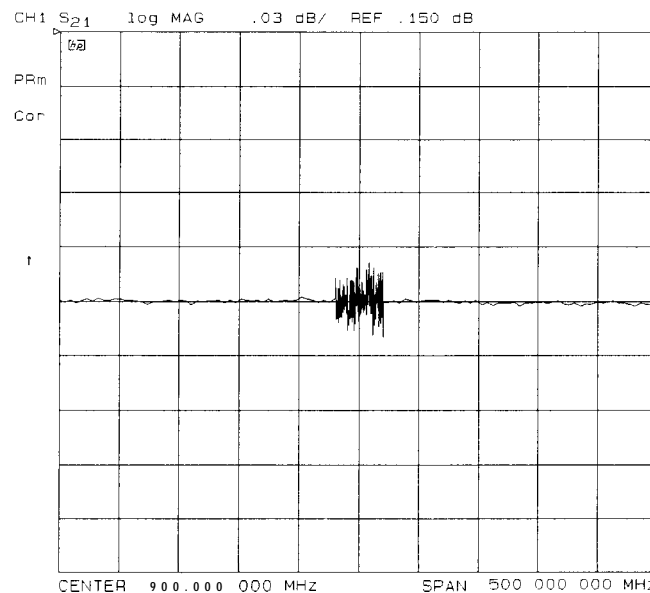
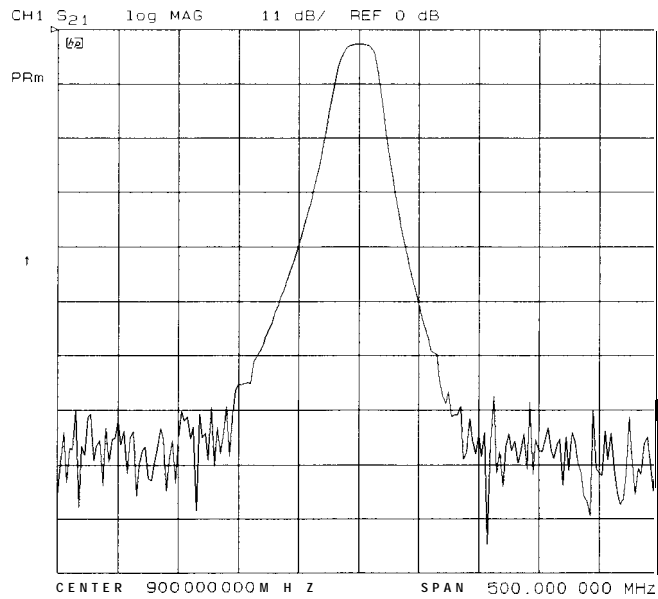
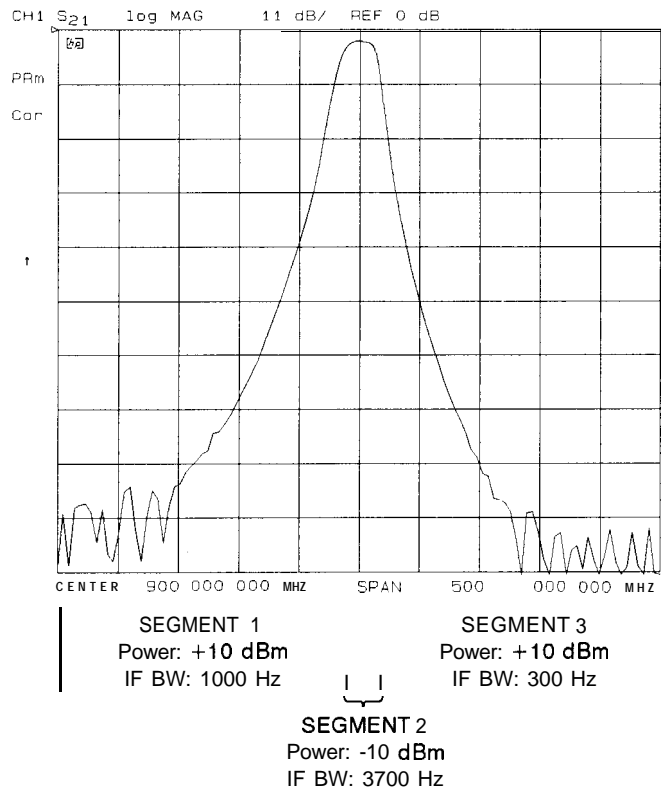


Figure 1-2. Calibrated Swept List Thru Measurement

4. Reconnect the filter and adjust the scale to compare results with the first filter measurement that used a linear sweep.
 - In Figure 1-3, notice that the noise level has decreased over 10 dB, confirming that the noise reduction techniques in the stop bands were successful.
 - In Figure 1-3, notice that the stop band noise in the third segment is slightly lower than in the first segment. This is due to the narrower IF bandwidth of the third segment (300 Hz).



**Filter Measurement Using Linear Sweep
(Power: 0 dBm/IF BW: 3700 Hz)**



pg651e

Figure 1-3. Filter Measurement Using Swept List Mode

Detecting IF Delay

IF delay occurs during swept measurements when the signal from the analyzer source is delayed in reaching the analyzer receiver because of an electrically long device. Because the receiver is sweeping, the delayed signal will be attenuated due to the internal IF filter.

For most measurements, swept list mode will be the optimum choice. If there is any doubt about the effect of IF delay, perform the following test:

1. Set up the measurement using the swept list mode, as in the above procedure.
2. Make the measurement and save the data trace to memory:

DISPLAY DATA -> MEMORY DISPLAY: DATA and MEMORY

3. Then switch to stepped list mode:

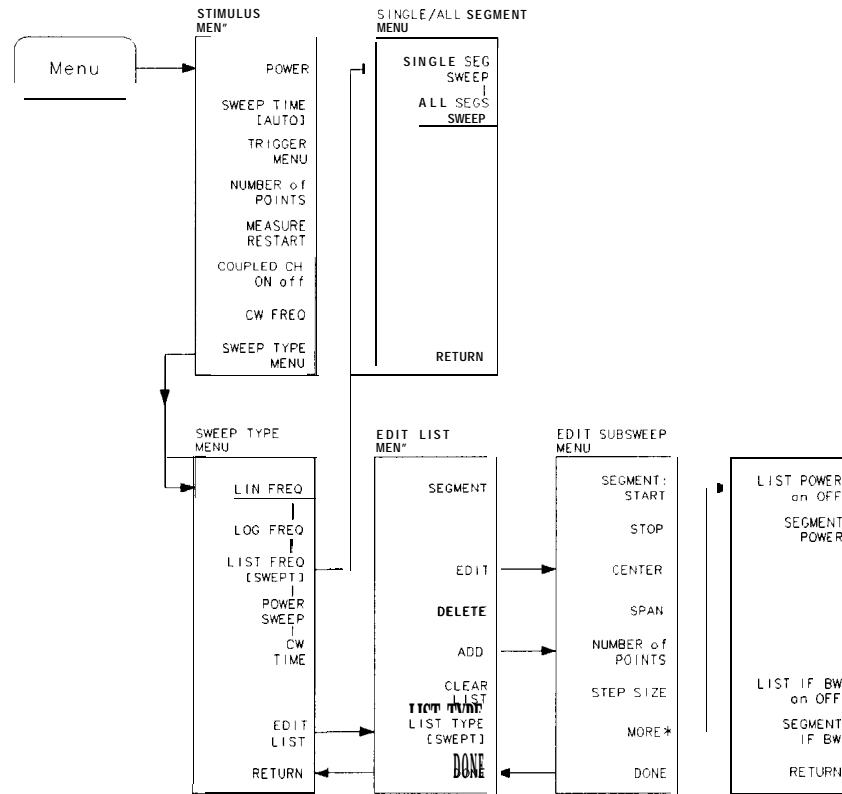
MENU SWEEP TYPE **MENU** EDIT LIST LIST TYPE: [STEPPED] DONE

- If there is no difference between the measurements in either list mode, then use the swept list mode.
- If the memory trace indicates that there is more attenuation in swept list mode, it may be due to IF delay. You can usually remedy this problem by increasing the sweep time.

Note IF bandwidths of 30 to 10 Hz cause the sweep (or that segment of the sweep) to be stepped, thus eliminating IF delay.

Revised Menu Map

The following revised menu map shows the new softkeys for the Swept List Mode:



* CW FREQ appears when LIST TYPE [STEPPED] is selected

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Figure I-4. Revised Menu Map for the Swept List Mode

New Key Definitions

LIST FREQ [SWEPT] or [STEPPED]	Provides two user-definable arbitrary frequency list modes. This list is defined and modified using the edit list menu and the edit subsweep menu. Up to 30 frequency subsweeps (called "segments") of several different types can be specified, for a maximum total of 1632 points. One list is common to both channels. Once a frequency list has been defined and a measurement calibration performed on the full frequency list, one or all of the frequency segments can be measured and displayed without loss of calibration.
LIST TYPE [SWEPT]	Selects either stepped or swept list mode.
LIST POWER on OFF	<p>Enables or disables the ability to set independent power levels for each segment in a swept list measurement.</p> <p>The following paragraph does NOT apply to the HP 8753D Option 011. When on, sets power range mode to manual to set a range for the power values. (The range can be chosen using the PWR RANGE key.) The power values can be entered using the SEGMENT POWER key. If ports are uncoupled, the power can be set independently for each port.</p> <p>When off, the SEGMENT POWER key will not function and the power column in the swept list table will display asterisks. In this case, the power is set by the normal test port power value.</p>
SEGMENT POWER	<p>Enters absolute power values in the swept list table. The power values are restricted to the current power range setting.</p> <p>The following paragraph does NOT apply to the HP 8753D Option 011.</p> <p>If port power is uncoupled, power applies to the currently selected port, otherwise it applies to both ports. (The list table only displays one port's power values at time due to limited display area.) To set the alternate port's power level you must exit the edit list menus, select a measurement that activates the alternate port, and then re-enter the edit list menus.</p> <p>This key is disabled if LIST POWER is set to OFF.</p>
LIST IF BW on OFF	Enables or disables the ability to set independent IF bandwidths for each segment in a swept list measurement.
SEGMENT IF BW	Enters the IF bandwidth for the active segment in a swept list table.

Cross Reference of Key Function to Programming Command

Key	Name	Command
LIST TYPE [STEPPED]	List Type Stepped	LISTTYPELSTP
LIST TYPE [SWEPT]	List Type Swept	LISTTYPELSWP
LIST POWER on OFF	List Power Off	LISPWRMOFF
LIST POWER ON off	List Power On	LISPWRMON
SEGMENT POWER	Segment Power	SEGPOWER
LIST IF BW on OFF	List IF Bandwidth Off	LISIFBWMOFF
LIST IF BW ON off	List IF Bandwidth On	LISIFBWMON
SEGMENT IF BW	Segment IF Bandwidth	SEGIFBW

Softkey Locations

Softkey	Front-Panel Access Key
LIST FREQ [SWEPT]	MENU
LIST TYPE [SWEPT]	MENU
LIST POWER on OFF	MENU
SEGMENT POWER	[MENU]
LIST IF BW on OFF	MENU
SEGMENT IF BW	[MENU]

New HP-IB Commands

HP-IB Cmd	Description
LISIFBWM< ON OFF>	Enables/disables the IFBW setting for a list-frequency table in swept list mode.
LISPWRM<ON OFF>	Enables/disables the power setting for a list-frequency table in swept list mode.
LISTTYPE<LSTP LSWP>	Selects either the stepped list mode or the swept list mode to use with a list-frequency table.
SEGIFBW[D]	Sets the IFBW for the active segment of a list-frequency table in swept list mode.
SEGPOWER[D]	Sets the power for the active segment of a list-frequency table in swept list mode.

Example Program: Setting Up a List-Frequency Table In Swept List Mode

The purpose of this example program is to show how to create two tables: a list-frequency table in swept list mode, and a limit-test table. Both tables are then transmitted to the analyzer.

The following is an outline of the program's processing sequence:

- An array for the type of limit line is defined and initialized.
- An array for the list table (frequency list and limit lines) is defined and initialized with data.
- An I/O path is assigned for the analyzer.
- The system is initialized.
- A variable is initialized with the number of segments in the list table.
- The analyzer is placed in hold mode and the port powers are uncoupled for the active channel.
- The existing list frequencies are edited and the analyzer swept list mode is selected.
- The analyzer is instructed to set the IF bandwidth and power for each port according to the values from the list table.
- The new frequency list table is sent to the analyzer.
- The sweep mode is set to list frequency mode and S21 measurement. A single sweep is taken.
- The analyzer display is autoscaled.
- The existing limit lines are edited and cleared.
- The new limit table is sent to the analyzer.
- The limit lines and limit test are turned on.
- The analyzer is released from remote control and the program ends.

The program is written as follows:

```
1  ! This program creates a swept list table for a specific filter measurement.
2  ! The program first builds a list frequency table from a hardcoded set of
3  ! list segments. It then builds a limit table based on the same hardcoded
4  ! data. When modifying the table data below, make sure that no two segments
5  ! overlap in frequency.
6  !
7  ! EXAMP6A2
8  !
9  !-----
10 ! The following constants are used to represent limit line "type"
11 ! in the table below.
12 !
13 No_limit=0
14 !
15 ! 1 = flat line
16 ! 2 = sloped line
17 ! 3 = single point (also used to terminate a line segment)
18 !-----
19 !
20 DIM Limtype$(1:3)[2]
```

```

21 DATA FL, SL, SP
22 READ Limtype$(*)
23 !
24 ! The list below has the following entries:
25 !     Start:  start frequency
26 !     stop:   Segment stop
27 !     Pts:    Segment number of points
28 !     PI:     Power at port 1
29 !     P2:     Power at port 2
30 !     IFBW:   Segment IFBW
31 !     upper:  Upper Limit
32 !     lower:  Lower Limit
33 !     strt type: Limit Line type for start of segment
34 !     end type:  Limit Line type for end of segment
35 ! -----
36 DIM Listtable(1:6,1:10)
37 Freqlist: !                                     |strt|end
38 ! List: Start | Stop I Pts I PI I P2 I IFBW I uppr I lower ltypeltype
39 ! -----
40 ! -----
41 DATA 570.000, 588.000, 5, 10, 0, 10, -90, -200, 1, 0
42 DATA 588.000, 598.000, 11, 0, 0, 100, -85, -200, I, 3
43 DATA 600.000, 664.000, 15, -10, -10, 3700, 0, 0, 0, 0
44 DATA 664.000, 678.000, 100, -10, -10, 3700, 0, -6, I, 3
45 DATA 678.000, 768.000, 10, -10, -10, 1000, 0, 0, 0, 0
46 DATA 768.000, 768.000, 1, 10, 0, 10, -90, -200, 3, 3
47 , -----
48 READ Listtable(*)
49 !
50 ASSIGN @Nwa TO 716 ! Assign an I/O path for the analyzer
51 !
52 CLEAR SCREEN
53 ! Initialize the system
54 ABORT 7
55 CLEAR @Nwa
56 OUTPUT @Nwa;"OPC?;PRES;"
57 ENTER @Nwa;Done
58 Numb=SIZE(Listtable,1) ! Number of segments in list table
59 OUTPUT @Nwa;"HOLD;" ! Hold mode allows faster set up
60 OUTPUT @Nwa;"PORTPUNCPLD;" ! Uncouple ports
61 !
62 ! Create the list frequency table from the table above
63 ! LISTTYPE = LSWP (swept list mode)
64 !
65 OUTPUT @Nwa;"EDITLIST;LISTTYPELSWP;"
66 !
67 ! Turn on list power mode for each port (uncoupled)
68 ! Turn on list ifbw mode
69 !
70 OUTPUT @Nwa;"LISIFBWMON;" ! IF bandwidth set by list
71 OUTPUT @Nwa;"S21;LISPWRMON;" ! Port 1 power set by list
72 OUTPUT @Nwa;"S22;LISPWRMON;" ! Port 2 power set by list
73 !
74 FOR I=1 TO Numb
75 OUTPUT @Nwa;"SADD;STAR";Listtable(I,1);"MHZ;"

```

```

76 OUTPUT @Nwa;"STOP";Listtable(I,2);"MHZ;"
77 OUTPUT @Nwa;"POIN";Listtable(I,3);""
78 OUTPUT @Nwa;"S11;" ! Port 1 active
79 OUTPUT @Nwa;"SEGPOWER";Listtable(I,4);""
80 OUTPUT @Nwa;"S22;" ! Port 2 active
81 OUTPUT @Nwa;"SEGPOWER";Listtable(I,5);""
82 OUTPUT @Nwa;"SEGIFBW";Listtable(I,6);""
83 OUTPUT @Nwa;"SDON;"
84 NEXT I
85 OUTPUT @Nwa;"EDITDONE;"
86 OUTPUT @Nwa;"LISFREQ;S21;OPC?;SING;"
87 ENTER @Nwa;Done
88 OUTPUT @Nwa;"AUTOSCAL;WAIT;"
89 !
90 ! Now create the corresponding limit table
91 !
92 OUTPUT @Nwa;"EDITLIML;CLEAL;" ! Initiate the limit table
93 FOR I=1 TO Numb
94 IF Listtable(I,9)<>No_limit THEN
95     OUTPUT @Nwa;"SADD" ! Add a new limit segment
96     OUTPUT @Nwa;"LIMS";Listtable(I,1);"MHZ"
97     OUTPUT @Nwa;"LIMU";Listtable(I,7)
98     OUTPUT @Nwa;"LIML";Listtable(I,8)
99     OUTPUT @Nwa;"LIMT";Limtype$(Listtable(I,9))
100    OUTPUT @Nwa;"SDON;"
101    IF Listtable(I,10)<>No_limit THEN !
102        OUTPUT @Nwa;"SADD " ! Add a new limit segment
103        OUTPUT @Nwa;"LIMS";Listtable(I,2);"MHZ"
104        OUTPUT @Nwa;"LIMT";Limtype$(Listtable(I,10))
105        OUTPUT @Nwa;"SDON;"
106    END IF
107 END IF
108 NEXT I
109 OUTPUT @Nwa;"EDITDONE;LIMILINEon;LIMITESTon;"
110 !
111 LOCAL @Nwa
112 END

```

Running the Program

This program requires no input from the operator.

First, the list-frequency table data and limit-test table data is read directly from the program code into the array. Next, the analyzer is set up to respond to the IF bandwidth and port power parameters of the list-frequency table. After the list-frequency data is entered into the analyzer, the list-frequency sweep mode is initiated and a single sweep is taken. Lastly, the limit-test table data is entered into the analyzer and the limit lines and limit test are activated.

The analyzer should now indicate whether the measurement trace passes or fails the limit test.

S2P Data File Suffixes

Data files with the S2P (Touchstone) ASCII format now have suffixes S1 or S2, dependent on the channel number.

Calibration Kit Labels

Calibration kit labels under the SELECT CAL KIT menu now include the HP calibration kit most commonly associated with that connector geometry.

Marker Display Format

Single parameter, linear magnitude marker display format now shows in engineering units (autoscales to U, mU, μ U, etc.). HP 8753D (including Option 011) only.

DEFINE STANDARD Menu

The DEFINE STANDARD menu for the selection of calibration standard “type” has been changed. To access this menu, press (CAL) CAL KIT MODIFY DEFINE STANDARD . The choices of open, short, load, delay/thru, and arbitrary impedance now work the same as the choices in other “one-of-n” menus. (For a “one-of-n” menu example, press the **FORMAT** key.) The DEFINE STANDARD menu remains displayed after pressing OPEN , or SHORT, or whatever “type” the user has selected, thus showing the latest selection for a particular calibration standard number. Further, a new message box appears above the active entry for calibration standard number. The message reads, “Select # with arrow keys, then press MODIFY STD” . Pressing the new softkey MODIFY STD DEFINITION then brings up the menu appropriate for the “type. ” For example, if an open was selected, the CO , Cl , etc. menu appears. If a load was selected, the FIXED , SLIDING, etc. menu appears.

These changes help the front panel user only. HP-IB operation remains unchanged.

New Error Messages

OVERLAP! LISTTYPECHANGED TO STEPPED

Error Number 211 The list type changed to stepped because one or more frequency segments in the swept list table overlapped. Change the frequency ranges of the overlapping segments and switch back to swept list mode.

ANALOGBUS DISABLED IN 6 kHz IFBW

Error Number 212 When you press **AVG** IF BW [6000] , the analog bus is disabled and not available for use in troubleshooting. For a description of the analog bus, refer to the analyzer's *Service Guide*.

RANGECAUSEDPOWERLVL CHANGE IN LIST (Doesnotapplytothe HP 8753D Option 011.)

Error Number 213 The selected power range changed the power level of one or more segments in the swept list table. Change the segment power or change the power range.

SEGMENT #n POWER OUTSIDERANGELIMIT (Does *not* applytothe HP 8753D Option 011.)

Information Message The selected power range does not support the power level of one or more segments in the swept list table. This message appears when swept list mode is not on and reports the first segment that is out of range. Change the segment power or change the power range.

SEGMENT #n START FREQ OVERLAPS PREVIOUS SEGMENT

Information Message A segment entered in the swept list table caused one or more frequency segments to overlap. This message appears when swept list mode is not on and reports the first segment that is overlapping another. Change the frequency ranges of the overlapping segments.

SOURCEPOWERDISABLED,EDITLISTMODETBL

Information Message When list power has been enabled and swept list mode is on, you will not be able to change the power level using the POWER key. To change the power level, edit the swept list table.

IFBW KEYDISABLED, EDITLISTMODETBL

Information When list IF bandwidth has been enabled and swept list mode is on, you will
Message not be able to change the IF bandwidth using the IF BW key. To change the IF
 bandwidth, edit the swept list table.

Preset Conditions

The performance upgrade kit contains new preset conditions which are footnoted in the following tables:

Preset Conditions (1 of 5)

Preset Conditions	Preset Value	Preset Conditions	Preset Value
Analyzer Mode		List Frequency Sweep Mode	** SWEPT²**
Analyzer Mode	Network Analyzer Mode	List Power	**Off²**
Frequency Offset	Off	List IFBW	**Off²**
Operation		Edit Mode	Start/Stop, Number of Points
Offset Value	0		
Harmonic Operation	Off		
Stimulus Conditions		Response Conditions	
Sweep Type	Linear Frequency	Parameter	Channel 1: S11; Channel 2: S21
Display Mode	Start/Stop	Conversion	Off
Trigger Type	Continuous	Format	Log Magnitude (all inputs)
External Trigger	Off	Display	Data
Sweep Time	100 ms, Auto Mode	Color Selections	Same as before PRESET
Start Frequency	See footnote ¹	Dual Channel	Off
Frequency Span (std.)	See footnote ¹	Active Channel	Channel 1
Frequency Span (Opt. 006)	See footnote ¹	Frequency Blank	Disabled
Start Time	0	Split Display	On
Time Span	100 ms	Intensity	If set to $\geq 15\%$, PRESET has no effect. If set to $< 15\%$, PRESET increases intensity to 15%.
SW Frequency	1000 MHz		
Source Power	0 dBm	Beeper: Done	On
Power Slope	0 dB/GHz; Off	Beeper: Warning	Off
Start Power	See footnote ¹	D2/D1 to D2	Off
Power Span	See footnote ¹	Title	Channel 1 = [hp] Channel 2 = Empty
Coupled Power	On	F Bandwidth	** 3700 Hz³**
Source Power	On	F Averaging Factor	16; Off
Coupled Channels	On	Smoothing Aperture	1% SPAN; Off
Coupled Port Power	On	Phase Offset	0 Degrees
Power Range	Auto; See footnote ¹		
Number of Points	101		
Frequency List			
Frequency List	Empty		

¹ This preset condition depends on the instrument type. See the User's *Guide*.

² This preset condition is new.

³ This preset condition is new for the HP 8753D (including Option 011) only.

Preset Conditions (2 of 5)

Preset Conditions	Preset Value	Preset Conditions	Preset Value
Response Conditions (continued)		Marker Aux Offset (Phase)	0 Degrees
Electrical Delay	0 ns	Marker Statistics	Off
Scale/Division	10 dB/Division	Polar Marker	Lin Mkr
		Smith Marker	R+jX Mkr
Calibration			
Correction	Off	Limit Lines	
Calibration Type	None	Limit Lines	Off
Calibration Kit	7-mm	Limit Testing	Off
System Z0	50 Ohms	Limit List	Empty
Velocity Factor	1	Edit Mode	Upper/Lower Limits
Extensions	Off	Stimulus Offset	0 Hz
Port 1	0 s	Amplitude Offset	0 dB
Port 2	0 s	Limit Type	Sloping Line
Input A	0 s	Beep Fail	Off
Input B	0 s		
Chop A and B	On	Time Domain	
Power Meter Calibration	Off	Transform	Off
Number of Readings		Transform Type	Bandpass
Power Loss Correction	Off	Start Transform	-20 nanoseconds
Sensor A/B	A	Transform Span	40 nanoseconds
Interpolated Error	Off	Gating	Off
Correction		Gate Shape	Normal
Markers (coupled)		Gate Start	- 10 nanoseconds
Markers 1, 2, 3, 4, 5	1 GHz; All Markers Off	Gate Span	20 nanoseconds
Last Active Marker		Demodulation	Off
Reference Marker	None	Window	Normal
Marker Mode	Continuous	Use Memory	Off
Display Markers	On		
Delta Marker Mode	Off	System Parameters	
Coupling	On	HP-IB Addresses	Last Active State
Marker Search	ML	HP-IB Mode	Last Active State
Marker Target Value	-3 dB	Focus	Last Active State
Marker Width Value	-3 dB; Off	Clock Time Stamp	On
Marker Tracking	Off	Preset: Factory/User	Last Selected State
Marker Stimulus Offset	0 Hz		
Marker Value Offset	0 dB		

Preset Conditions (3 of 5)

Preset Conditions	Preset Value	Preset Conditions	Preset Value
Copy Configuration		Spur Avoidance	On
Parallel Port	Last Active State	Aux Input Resolution	Low
Plotter Type	Last Active State	Analog Bus Node	11 (Aux Input)
Plotter Port	Last Active State		
Plotter Baud Rate	Last Active State	Plot	
Plotter Handshake	Last Active State	Plot Data	On
HP-IB Address	Last Active State	Plot Memory	On
Printer Type	Last Active State	Plot Graticule	On
Printer Port	Last Active State	Plot Text	On
Printer Baud Rate	Last Active State	Plot Marker	On
Printer Handshake	Last Active State	Autofeed	On
Printer HP-IB Address	Last Active State	Plot Quadrant	Full Page
		Scale Plot	Full
Disk Save Configuration		Plot Speed	Fast
(Define Store)		Pen Number:	
Data Array	off	Ch1 Data	2
Raw Data Array	off	Ch2 Data	3
Formatted Data Array	off	Ch1 Memory	5
Graphics	off	Ch2 Memory	6
Data Only	off	Ch1 Graticule	1
Directory Size	Default ¹	Ch2 Graticule	1
Save Using	Binary	Ch1 Text	7
Select Disk	Internal Memory	Ch2 Text	7
Disk Format	LIF	Ch1 Marker	7
		Ch2 Marker	7
Sequencing*		Line Type:	
Loop Counter	0	Ch1 Data	7
TTL OUT	High	Ch2 Data	7
		Ch1 Memory	7
Service Modes		Ch2 Memory	7
HP-IB Diagnostic	Off		
Source Phase Lock	Loop On		
Raw Offsets	On		

¹ The directory size is calculated as 0.013% of the floppy disk size (which is ≈ 256) or 0.005% of the hard disk size.

² Pressing preset turns off sequencing modify (edit) mode and stops any running sequence.

Preset Conditions (4 of 5)

Preset Conditions	Preset Value	Preset Conditions	Preset Value
Print		CH1 Mem	Green
Printer Mode	Last Active State	CH2 Data	Blue
Auto-Feed	On	CH2 Mem	Red
		Graticule	Cyan
Printer Colors		Warning	Black
CH1 Data	Magenta	Text	Black

Preset Conditions (5 of 5)

Format Table	Scale	Reference	
		Position	Value
Log Magnitude (dB)	10.0	5.0	0.0
Phase (degree)	90.0	5.0	0.0
Group Delay (ns)	10.0	5.0	0.0
Smith Chart	1.00	–	1.0
Polar	1.00	–	1.0
Linear Magnitude	0.1	0.0	0.0
Real	0.2	5.0	0.0
Imaginary	0.2	5.0	0.0
SWR	1.00	0.0	1.0

Information on Manuals

Table 1-1. Manuals

Title	Part Number
HP 8753D Network Analyzer User's Guide	08753-90257
HP 8753D Option 011 Network Analyzer User's Guide	08753-90304
HP 8753D Network Analyzer Programmer's Guide Including Option 011	08753-90256
HP 8753D Network Analyzer Service Guide	08753-90405
HP 8753D Option 011 Network Analyzer Service Guide	08753-90406
HP 8719D/8720D/8722D Network Analyzer User's Guide	08720-90288
HP 8719D/8720D/8722D Network Analyzer Programmer's Guide	08720-90293
HP 8719D/8720D/8722D Network Analyzer Service Guide	08720-90292
HP 8719D/8720D/8722D, 8753D Programming Examples Disk: HP BASIC	08753-10028
HP 8719D/8720D/8722D, 8753D Programming Examples Disk: QuickC & QuickBASIC	08753-10029

Firmware History

Firmware Revision 7.10 (includes all features of revisions 6.14 and 6.12)

Firmware Enhancements and Features

1. A new IF bandwidth filter setting of 6000 Hz can now be selected in addition to the previously available settings of 10, 30, 100, 300, 1000, 3000, and 3700 Hz.
2. Swept list mode, a new list frequency sweep mode, takes data while sweeping through the defined frequency points, increasing throughput by up to 6 times over a stepped sweep. In addition, this mode allows the test port power and IF bandwidth to be set independently for each segment that is defined.
3. New HP-IB commands:

HP-IB Cmd	Description
LISIFBW<ON OFF>	Enables/disables the IFBW setting for a list-frequency table in swept list mode.
LISPWRM<ON OFF>	Enables/disables the power setting for a list-frequency table in swept list mode.
LISTTYPE<LSTP LSWP>	Selects either the stepped list mode or the swept list mode to use with a list-frequency table.
SEGIFBW[D]	Sets the IFBW for the active segment of a list-frequency table in swept list mode.
SEGPOWER[D]	Sets the power for the active segment of a list-frequency table in swept list mode.

Firmware Revision 6.14 (includes all features of revision 6.12)

Firmware Revision 6.14 is the revised code for both the HP 8753D (including Option 011) and the HP 8719D/8720D/8722D Network Analyzers.

Firmware Enhancements and Features

1. A major improvement has been made in disk writes for the CITIfile and S2P (Touchstone) ASCII formats.
2. Error numbers (error table) are now synchronized with all revisions.
3. Data files with S2P now have suffixes dependent on the channel number (S1 or S2).
4. In operating parameters pages, the specific model number has been replaced with the word ANALYZER.
5. Calibration kit labels under the SELECT CAL KIT menu now include the HP calibration kit most commonly associated with that connector geometry.
6. Single parameter, linear magnitude marker display format now shows in engineering units (autoscales to U, mU, μ U, etc.). HP 8753D (including Option 011) only.
7. Changed the list table default frequency from MHz to GHz. HP 8719D/8720D/8722D only.
8. Updated the 7mm calibration constants based on the HP 85050 series calibration kits. HP 8719D/8720D/8722D only.

9. The DEFINE STANDARD menu for the selection of calibration standard “type” has been changed. To access this menu, press **(CAL)** CAL KIT MODIFY DEFINE STANDARD. The choices of open, short, load, delay/thru, and arbitrary impedance now work the same as the choices in other “one-of-n” menus. (For a “one-of-n” menu example, press the **(FORMAT)** key.) The DEFINE STANDARD menu remains displayed after pressing OPEN, or SHORT, or whatever “type” the user has selected, thus showing the latest selection for a particular calibration standard number. Further, a new message box appears above the active entry for calibration standard number. The message reads, “Select# with arrowkeys, then press MODIFY STD”. Pressing the new softkey MODIFY STD DEFINITION then brings up the menu appropriate for the “type.” For example, if an open was selected, the CO, CL, etc. menu appears. If a load was selected, the FIXED, SLIDING, etc. menu appears.

These changes help the front panel user only. HP-IB operation remains unchanged.

Firmware Problems Fixed

1. Fixed the problem experienced with downloading cal coefficients using INPUCALC when the number of coefficients in the current I-state does not match the download number of points.
2. Fixed the slow HP-IB access to the internal disk.
3. Fixed the inadvertent test set switching by programming the test port on each sweep. HP 8753D (including Option 011) only.
4. Fixed the sampler correction phase error experienced when measuring B/R with an IF bandwidth setting of 3700 Hz. HP 8753D (including Option 011) only.
5. Option 011, HP 85047A Test Set: fixed the unwanted activation of the doubler during attenuator changes. HP 8753D (including Option 011) only.
6. Fixed the POSSIBLE FALSE LOCK error message from appearing at incorrect times. HP 8719D/8720D/8722D only.
7. Option 400: fixed the loss of phase lock experienced under the following conditions—during the first sweep after test set switching, with power meter calibration on one port. HP 8719D/8720D/8722D only.
8. Fixed R channel drop-out when sweeping under the following conditions- CF= 2.55 GHz, Span= 100 MHz. HP 8719D/8720D/8722D only.

Firmware Revision 6.12

Firmware Revision 6.12 merges the codes of the HP 8753D (including Option 011) and the HP 8719D/8720D/8722D Network Analyzers.

Firmware Enhancements and Features

Carry-Over From the HP 8719D/8720D/8722D Network Analyzer. The following enhancements and features are a carry-over from the HP 8719D/8720D/8722D but are new in firmware revision 6.12 to the HP 8753D (including Option 011):

Note

To make sure you have all of the information on firmware revision 6.12 and previous firmware changes, verify that the print date of your manual set is July 1997 or later. If your manual set has an earlier print date, it lacks a full explanation of all of your current analyzer features. For part number information used in ordering new manuals, refer to the section “Information on Manuals,” located earlier in this document.

1. There are now 5 markers per channel (previously 4 per channel). The MARKER FCTN menu has been revamped accordingly.
2. Calibration features, such as the softkey DO BOTH FWD & REV in Full 2-Port or TRL calibration, are improved and more user friendly. It is easier to modify or create a TRL cal kit because separate TRL class entries are now allowed. HP-IB commands are like those for the HP 8510.
3. Minor improvements have been made to the user interface for disk operations. The file last selected on the disk directory page is remembered when the user selects SAVE/RECALL. If the user tries to save a file to the internal disk drive when the disk has been removed, the internal disk drive remains the selected drive.
4. Waveguide delay can now be selected by pressing **SCALE REF** ELECTRICAL DELAY .
5. The dump-graphics feature, previously added as a carry-over from the 8720C, can be selected by pressing **SYSTEM** SERVICE MENU TEST OPTIONS DUMP GRAPH . This feature can be toggled between on and off, which enables/disables the dumping of the graphical output during the System Verification service tests (SYS VER TESTS).
6. The SELL (set learn string revision) command has been updated to work with post 5.00 revisions (HP 8753D including Option 011). The current HP 875x can now generate and receive instrument learn strings from all the previous shipment releases. Disk compatibility between the various HP 8753 revisions and the current revision is now supported.
7. The following are the choices from the new CONFIGURE menu, selected by pressing **SYSTEM** I G U R E :
 - . TESTSET SW Toggles testset switching between continuous and hold.
 - RAW OFFSET Toggles attenuator and sampler cal offsets on or off.
 - SPUR AVOID Toggles spur avoidance on or off. HP 8753D (including Option 011) only.

New Enhancements and Features.

The following enhancements and features are new in firmware revision 6.12:

Note	To make sure you have all of the information on firmware revision 6.12 and previous firmware changes, verify that the print date of your manual set is July 1997 or later. If your manual set has an earlier print date, it lacks a full explanation of all of your current analyzer features. For part number information used in ordering new manuals, refer to the section "Information on Manuals, " located earlier in this document.
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1. The capability to store S-parameter data to component data files using the "Touchstone" format (S2P) has been added.
2. A new IF bandwidth filter setting of 3700 Hz has been added.
3. The individual power ranges will now allow 3 dB over and under the values shown with each power range selection.
4. Enhancements have been made to the file naming capability for files generated by the instrument during execution of a sequence. The new menu can be found by pressing **SAVE/RECALL** FILE UTILITIES SEQUENCE FILENAMING . The TITLE FILE menu also gained a new softkey to support the inclusion of the sequence loop counter in the filenames.
5. A method of external calibration, Take 4 mode, provides a remote-only command that directs the network analyzer to take a single "group" or sweep (consisting of a forward

and reverse sweep) and to collect the raw data for all 4 S-parameters. The user can then extract the raw data for the S-parameters (or the pre-raw data, which has not had sampler correction nor attenuator offsets applied) and perform the error correction in an external computer (using previously extracted calibration arrays).

6. A new feature, Adapter Removal, is designed for cases where the device under test is “non-insertable” and thus an adapter is required. This feature requires two full 2-port calibrations, one for each port, and subsequently provides a calibration for the test device with the effects of the adapter removed. The menu is found by pressing **CAL** MORE ADAPTER REMOVAL.

7. New HP-IB commands

HP-IB Cmd	Description
IFBW3700	Set IF Bandwidth to 3700 Hz.
SWPSTART	Sweep start (Take4).
RAWOFFS<ON OFF>	Raw Offsets (Take4).
TAKE4<ON OFF>	Take4 mode On/off.
SM8<ON OFF>	Spur Avoidance On/off. HP 8753D (including Option 011) only.
OUTPPREx	Output “pre-raw” arrays, x= 1-4 (Take4).
TITP	Title Plot to Disk file.
TITFO	Title the save state filename, only in sequence mode.
ADAP1[D]	Set adapter electrical delay.
ADPTCOAX	Set adapter to COAXial.
ADPTWAVE	Set adapter to WAVEguide.
MODS	Compute new cal set using adapter removal.
CALSPORT1	Recall cal set associated with Port 1 for adapter removal.
CALSPORT2	Recall cal set associated with Port 2 for adapter removal.

8. Additional Limit Line and Data Point Functions:

These HP-IB-only functions were previously available only with option K96, but have now been added to the standard firmware set. Example programs using these functions are available in the Programmer’s Guides with a print date of July 1997 or later.

HP-IB Cmd	Description
MINMAX	Enable/disable min/max recording per segment. Min and max values are recorded per limit segment.
OUTPAMAX	Output max values for all limit line segments.
OUTPAMIN	Output min values for all limit line segments.
OUTPSEGAM	Output limit test min/max all segments. Output the segment number, max stimulus, max value, min stimulus, min value for all active segments.
OUTPSEGM[n]	Output limit test min/max for a specified segment.

SELSEG[n]	Select segment number for the OUTPSEGF and OUTPSEGM commands to report on.
SELMAXPT	Select the last point number in the range of points that the OUTPDATR command will report.
SELMINPT	Select the first point number in the range of points that the OUTPDATR command will report.
SELPT[n]	Select point number that OUTPDATP will report.
OUTPDATP	Output trace data indexed by point (see SELPT).
OUTPDATR	Output trace data for range of points (see SELMINPT, SELMAXPT).
OUTPLIM1	Output status of limit test for channel 1.
OUTPLIM2	Output status of limit test for channel 2.
SELSEG[n]	Select segment number for the OUTPSEGF and OUTPSEGM commands to report on.
OUTPSEGAF	Output the segment number and its status for all active segments.
OUTPSEGF	Output limit test status per segment.
OUTPFAIP	Output Fail Point: this command is similar to OUTPLIMF except that it reports the number of failures first, followed by the stimulus and trace values for each failed point in the test (note: use command LIMITEST<ON> to function properly).

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