HEWLETT PACKARD

HP 8751A Network Analyzer Programming Manual Set

HP 8751A

Network Analyzer

Programming Manual

MANUAL IDENTIFICATION

Model Number: HP 8751A
Date Printed: November 1991
Part Number: 08751-90013

This supplement contains information for correcting manual errors and for adapting the manual to newer instruments that contains improvements or modifications not documented in the existing manual.

To use this supplement
1. Make all ERRATA corrections
2. Make all appropriate serial-number-related changes listed below

SERIAL PREFIX OR NUMBER	MAKE MANUAL CHANGES
3315J and 3315A	1,2,3,4

» New Item

FIRMWARE VERSION	MAKE MANUAL CHANGES
5.00	1,2,3,4

» CHANGE 1 Manual Changes for Using HP Instrument BASIC with the HP 8751A

» CHANGE 2 Manual Changes for HP-IB Programming Manual

» CHANGE 3 Added Waveform Analysis Commands

» CHANGE 4 Calibration Sample Program

NOTE

Manual change supplement are revised as often as necessary to keep manuals as current and accurate as possible. Hewlett-Packard recommends that you periodically request the latest edition of this supplement. Free copies are available from all HP offices. When requesting copies, quote the manual identification information from your supplement, or the model number and print date from the title page of the manual.

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1

Manual Changes for Using HP Instrument BASIC with the HP 8751A

Page 9-7, Figure 9-2

- Change figure 9-2 to the following figure:

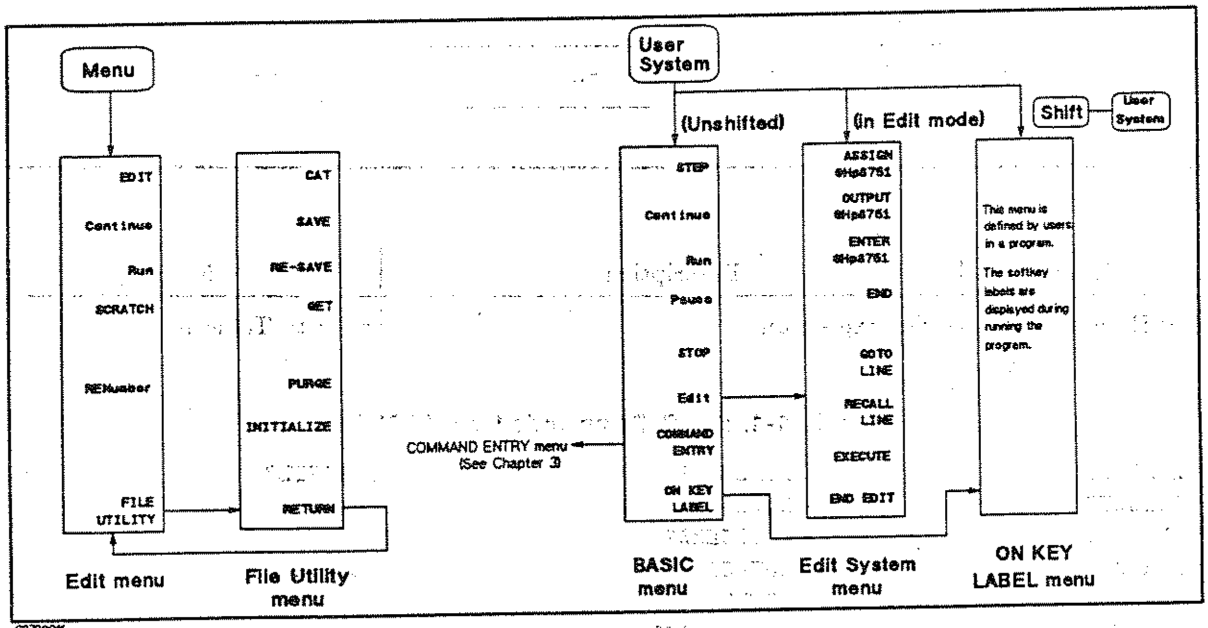


Figure 9-2. Softkey Menus Accessed from (Menu) and (User System) Key

Page 9-9, Edit System Menu

- Add the following description:

EXECUTE produces the command "EXECUTE""" at the cursor's current position.

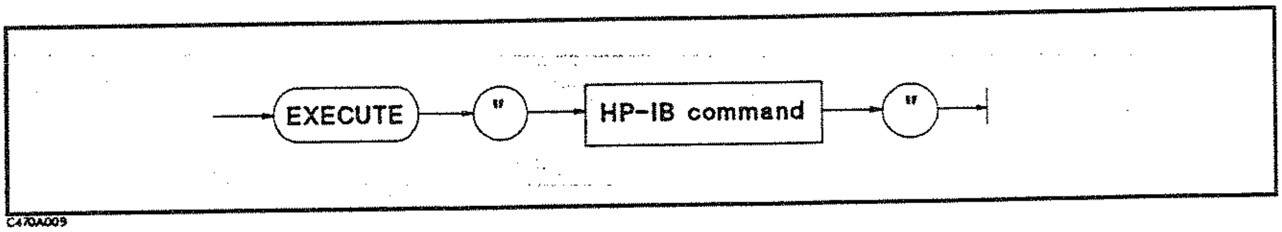
Page A-1, BASIC Commands Specific to HP 8751A

- Add the following description:

EXECUTE

Keyboard Executable	Yes
Programmable	Yes
In an IF ... THEN ...	Yes

This command executes specific HP-IB commands faster than OUTPUT statement.



C470A009

Item	Description	Range
HP-IB command	string expression	refer to Table 1-1

Table 1-1. HP-IB Commands for EXECUTE

ANAOCH1	NUMLMAX?	OUTPXFIL?
ANAOCH2	NUMLMIN?	PEAK?
ANAODATA	OUTPCERR?	POLE?
ANAOMEMO	OUTPCFIL?	RPLENV?
ANARANG	OUTPDATAT?	RPLHEI?
ANARFULL	OUTPDATTP?	RPLLHEI?
EQUCO?	OUTPFILT?	RPLMEA?
EQUCPARA?	OUTPMAX?	RPLPP?
EQUCPARS?	OUTPMEAN?	RPLRHEI?
EQUCPARS4?	OUTPMEMOT?	RPLVAL?
EQUM	OUTPMEMTP?	SING
INPUDATTP	OUTPMIN?	TARL?
INPUMEMTP	OUTPMINMAX?	TARR?
LMAX?	OUTPRESF?	THRR
LMIN?	OUTPRESO?	
NEXPK?	OUTPRESR?	

Semantics

To transfer HP-IB command parameters, use a WRITEIO command. This command must be executed before the EXECUTE command. One WRITEIO command is required to transfer one parameter. For example, to transfer two ANARANGE command parameters to the EXECUTE command, write the program as follows:

```
100 WRITEIO 8,0; 100E6
110 WRITEIO 8,1: 200E6
120 EXECUTE "ANARANG"
```

The above program can also be written in the HP-IB command format as follows:

```
100 OUTPUT @HP8751;"ANAGNGE";100E6,200E6
```

Using an OUTPUT command reduces the number of source program lines. On the other hand, using an EXECUTE command accelerates the execution speed.

For the format of the WRITEIO command, refer to "WRITEIO."

To receive a query command's return value, use a READIO function. Since the READIO function returns only one specified return value, four return values (Za, Fa, Zr, and Fr) of the query command "OUTPRESO?" must be received by writing the program as follows:

```
100 EXECUTE "OUTPRESO?"
110 Za=READIO(8,0)
120 Fa=READIO(8,1)
130 Zr=READIO(8,2)
140 Fr=READIO(8,3)
```

The program can also be written in the HP-IB command format as follows:

```
100 OUTPUT @HP8751;"OUTPRESO?"
110 ENTER @HP8751;Za,Fa,Zr,Fr
```

Just like the transfer of HP-IB parameters, using an OUTPUT command reduces the number of source program lines and using an EXECUTE command accelerates the execution speed.

For the format of the READIO function, refer to "READIO."

EXECUTE Specific Command

The following HP-IB command gives different result, when used with the EXECUTE command and than when used with the OUTPUT command.

SING — When executing the SING command, which makes a single sweep, using the EXECUTE command, Instrument BASIC waits before proceeding to the next program-line until completion of the sweep. If SING is executed by OUTPUT, Instrument BASIC executes the next program line, and the program should be designed to the time by the controller by the using sweep end detection technique. By using EXECUTE for SING, above technique is not necessary.

EXECUTE Unique Commands

The following HP-IB commands are only available for the EXECUTE command. You can not execute them using the OUTPUT command. The effective channel for these commands are dependent on the setting of ANAOCH1 and ANAOCH2.

- INPUDATTP
- INPUMEMTP
- OUTPDATTP?
- OUTPMEMTP?

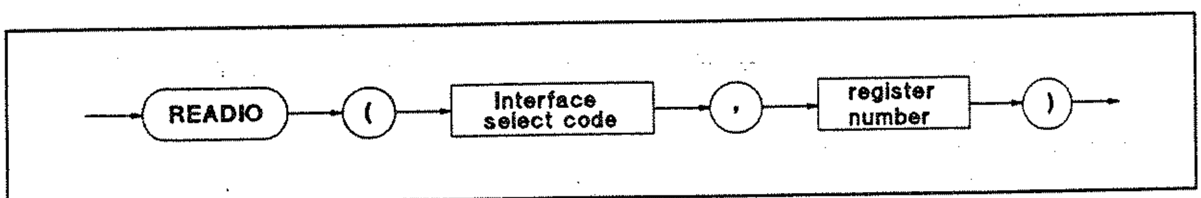
Page A-7, BASIC Commands Specific to HP 8751A, READIO

- Change to the following description:

READIO

Keyboard Executable	Yes
Programmable	Yes
In an IF ... THEN ...	Yes

This function reads the contents of the register used for an I/O port or EXECUTE command.



Item	Description	Range
select code	numeric expression	8: EXECUTE register 15: I/O port
register number	numeric expression	0 to 800 (Select code 8) 0 (Select code 15);

Example Statements

```
Ioport=READIO(15,0)

EXECUTE "OUTPRESO?"
Za=READIO(8,0)
Fa=READIO(8,1)
Zr=READIO(8,2)
Fr=READIO(8,3)
```

Semantics

The HP 8751A uses the READIO command to read data from an I/O port or to receive a query command's return value after the EXECUTE command has been executed.

To receive a query command's return value, set the select code to 8. To read data from an I/O port, set the select code to 15.

The EXECUTE command stores the query command's return values in registers. The READIO command reads a return value from one of these registers. Return values are sequentially stored in registers 0 to 800. For example, when EXECUTE"OUTPURESO?" is executed, four return values Za, Fa, Zr, and Fr are stored in four registers, register 0 to register 3. Za is stored in register 0, Fa in register 1, Zr in register 2, and Fr in register 3. To read a return value stored by the READIO command, specify the appropriate register number. Refer to example statements.

To read data from an I/O port, specify the I/O port number with a register number(0).

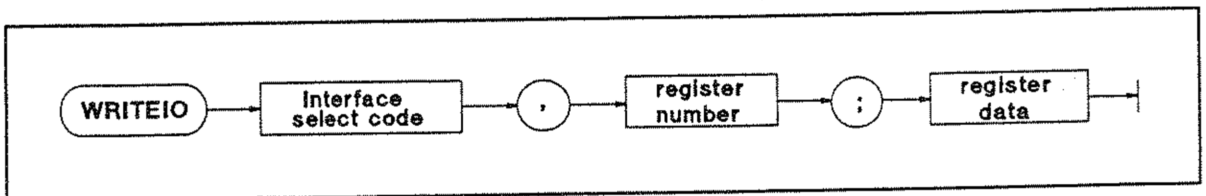
Page A-8, BASIC Commands Specific to HP 8751A, WRITEIO

- Change to the following description:

WRITEIO

Keyboard Executable	Yes
Programmable	Yes
In an IF ... THEN ...	Yes

This statement writes register data in decimal notation to a specified EXECUTE command parameter register or to the I/O port.



Item	Description	Range
select code	numeric expression	8: EXECUTE register 15: I/O port
register number	numeric expression	0 to 800 (Select code 8) 0 (Select code 15)
register data	numeric expression	–2147483648 thru +2147483647

Example Statements

```
WRITEIO 15,0;12
WRITEIO 8,0;100E6
```

Semantics

The HP 8751A uses a WRITE command to write data to the I/O port or to transfer command parameters.

To transfer a parameter to the EXECUTE command, set the select code to 8. To write data to the I/O port, set the select code to 15.

The EXECUTE command uses the data stored in a register as a parameter. To store this parameter, the WRITEIO command must be executed before the EXECUTE command. The WRITEIO command stores one parameter in one register like the READIO command. For an HP-IB command that requires multiple parameters, as many WRITEIO commands as the number of parameters. For example, to execute an ANARANG command requiring two parameters using an EXECUTE command, specify the following:

```
100 WRITEIO 8,0; 100E6
110 WRITEIO 8,1; 200E6
120 EXECUTE "ANARANG"
```

The EXECUTE command sequentially reads parameters stored in registers. In the above example, parameters are stored in registers 0 and 1. Accordingly, the EXECUTE command reads 100E6 as the first parameter, then reads 200E6 as the second parameter.

2

Manual Changes for HP-IB Programming Manual

Add the following HP-IB commands

EQUC0?␣<*value*>[suffix]

Returns C_0 at the frequency point specified by the parameter. (Data format: C_0)

EQUCPARA?

Executes six element analysis of a crystal resonator, and outputs parameters, C_0, C_1, L_1, R_1, G_0, and R_0. For more information, refer to "EQUCPARA?" in Chapter 3. (Data format: C_0, C_1, L_1, R_1, G_0, R_0)

EQUCPARS?

Executes six elements analysis of a crystal resonator, and outputs parameters, C_0, C_1, L_1, R_1, f_s, f_a, f_r, f_1, f_2, G_0, *and* R_0. For more information, refer to "EQUCPARS?" in Chapter 3. (Data format: C_0, C_1, L_1, R_1, f_s, f_a, f_r, f_1, f_2, G_0, R_0)

EQUCPARS4?

Executes four element analysis of a crystal resonator, and outputs parameters, C_0, C_1, L_1, R_1, f_s, f_a, f_r, f_1, and f_2. For more information, refer to "EQUCPARA?" in Chapter 3. (Data format: C_0, C_1, L_1, R_1, f_s, f_a, f_r, f_1, f_2)

EQUM␣<*value*>[suffix]

Specifies how many points are used for an approximation of a circle for `EQUCPARA?` and `EQUCPARS?` command. The default value is 8.

INPUD

Executes an S_{11} 1-port calibration by using real data which are set with `INPULOAA`, `INPUOPEA`, and `INPUSHOA` commands.

INPUDATTP *value1,value2[suffix]*

Enters data to the *n*th point of a data trace.

value1	point number, *n*. 0 to 801
value2	input data. complex value. (Data format:Real, Imaginary)
suffix	refer to "Suffix".

INPULOAA *value*

Inputs the real LOAD data array for a S_{11} 1-port calibration.

value	Complex number (Data format: real, imaginary)

INPUMEMTP *value1,value2[suffix]*

Enters data to the *n*th point of a memory trace.

value1	point number, *n*. 0 to 801
value2	input data. complex value. (Data format:Real, Imaginary)
suffix	refer to "Suffix".

INPUOPEA *value*

Inputs the real OPEN data array for a S_{11} 1-port calibration.

value	Complex number (Data format: real, imaginary)

INPUSHOA *value*

Inputs the real SHORT data array for a S_{11} 1-port calibration.

value	Complex number (Data format: real, imaginary)

LMIN? *value*

Outputs the *n*th local minimum value from the left of range which is set by the `ANARANG` command. (Data format: local minimum)

value	*n*, integer

NEXPK?

Outputs the maximum local maximum value and its stimulus next to the value last found by the `PEAK?`, or `NEXPK?` commands. For more information, refer to Chapter 3. (Data format: Local Maximum value, stimulus)

NUMLMAX?

Outputs the number of local maximums within the range set by the ANARANG command. (Data format: number)

NUMLMIN?

Outputs the number of local minimum within the range set by the ANARANG command. (Data format: number)

LMAX? *value*

Outputs the *n*th local maximum value from the left of range which is set by the ANARANG command. (Data format: local maximum)

value	*n*, integer

OUTPCFIL? *value1,value2,value3,value4,value5,value6*

Outputs filter parameters within the range specified by the ANARANG command. Command parameter sets nominal frequency, the offset of $x1$dB and $x2$dB to the maximum peak value to determine the cutoff points, same parameter with POLE?, and f_1 and f_2 for determining rejection level and spurious level respectively. For details, refer to Chapter 3. (Data format: *loss, const loss, bandwidth, center frequency, Q, ΔL.F1, ΔR.F1, ΔL.F2, ΔR.F2, pass band ripple, rejection level, spurious level, pole_x1, pole_stimulus1, pole_x2, pole_stimulus2*)

value1	center frequency, fc
value2	x_1
value3	x_2
value4	POLE? parameter
value5	f_1
value6	f_2
suffix	refer to "Suffix".

OUTPDATAT?

Outputs data trace value on 16 points stimulus which is set by the STIDROUT command. If there are points that is not set by the STIDROUT command, the OUTPDATAT? returns the value at 100 kHz. (Data format: real × 16)

OUTPDATTP?

Outputs the data-trace data at the specified point (Data format: real, imaginary).

value	1 to number of points

OUTPMEMOT?

Outputs the memory trace value on 16 points stimulus which is set by the STIMROUT command. If there are points that is not set by STIMROUT command, OUTPMEMOT? returns the value at 100 kHz. (Data format: real × 16)

OUTPMEMTP?

Outputs the memory-trace data at the specified point (Data format: real, imaginary)

value	1 to number of points

OUTPRESF? *value1,value2*

Returns the stimulus of the maximum local-maximum and its *x1*dB below points of both sides, and the stimulus of minimum local-minimum and its *x2*dB above points of both sides. For more details, refer to Chapter 3.

value1
value2

OUTPRESR?

Outputs same parameter as OUTPRESO? and maximum difference, rpl_1 of local maximum and its left local minimum on left of resonant point, maximum difference, rpl_2 of local maximum and its right local minimum between resonant and anti-resonant points, and the maximum difference, rpl_3 of the local maximum and its left local minimum on the right of the anti-resonant point. For details, refer to Chapter 3. (Data format:*Gr, fr, Ga, fa, rpl1, rpl2, rpl3*)

OUTPCERR?

Outputs ceramic resonator parameters. (Data format: G_r, F_r, G_a, F_a, rpl_1, rpl_2, *and* rpl_3)

OUTPXFIL? *value1,value2,value3,value4,value5*

Outputs filter parameters within the range specified by the ANARANG command. Command parameter sets the offset of *x1*dB and *x2*dB to the maximum peak value to determine the cutoff points, same parameter as POLE?, and f_1 and f_2 for determining the rejection level and the spurious level respectively. For details, refer to Chapter 3. (Data format:*loss, bandwidth, center frequency, Q, ΔL.F1, ΔR.F1, ΔL.F2, ΔR.F2, pass band ripple, rejection level, spurious level, pole_x1, pole_stimulus1, pole_x2, pole_stimulus2*)

value1	*x1*
value2	*x2*
value3	POLE? parameter
value4	f_1
value5	f_2
suffix	refer to "Suffix".

PEAK?

Outputs the maximum local maximum value and its stimulus within range which is set by the `ANARANG` command. For more information, refer to Chapter 3. (Data format: maximum Local-maximum value, stimulus)

PENNCH1DATA *value*

Selects the number of the pen to plot the data trace for channel 1. The default pen is 1.

value 0 to 6

PENNCH1MEMO *value*

Selects the number of the pen to plot the memory trace for channel 1. The default pen is 5.

value 0 to 6

PENNCH2DATA *value*

Selects the number of the pen to plot the data trace for channel 2. The default pen is 2.

value 0 to 6

PENNCH2MEMO *value*

Selects the number of the pen to plot the memory trace for channel 2. The default pen is 6.

value 0 to 6

PENNGRAT *value*

Selects the number of the pen to plot the graticule. The default pen is 3.

value 0 to 6

PENNIBPEN1 *value*

Selects the number of the pen to plot the pen 1 used by the HP Instrument BASIC graphic commands. The default pen is 1.

value 0 to 6

PENNIBPEN2 *value*

Selects the number of the pen to plot the pen 2 used by the HP Instrument BASIC graphic commands. The default pen is 2.

value 0 to 6

PENNIBPEN3 *value*

Selects the number of the pen to plot the pen 3 used by the HP Instrument BASIC graphic commands. The default pen is 3.

value	0 to 6

PENNIBPEN4 *value*

Selects the number of the pen to plot the pen 4 used by the HP Instrument BASIC graphic commands. The default pen is 4.

value	0 to 6

PENNIBPEN5 *value*

Selects the number of the pen to plot the pen 5 used by the HP Instrument BASIC graphic commands. The default pen is 5.

value	0 to 6

PENNIBPEN6 *value*

Selects the number of the pen to plot the pen 6 used by the HP Instrument BASIC graphic commands. The default pen is 6.

value	0 to 6

PENNIBTEXT *value*

Selects the number of the pen to plot the text in the HP Instrument BASIC screen. The default pen is 4.

value	0 to 6

PENNTEXT *value*

Selects the number of the pen to plot the text. The default pen is 4.

value	0 to 6

POLE? *value*

Outputs the first found local minimum for both side from the maximum point below the value which is the subtracted parameter from the maximum value. For example, to specify as −10 dB down, a command parameter becomes a -10. For more information, refer to Chapter 3. (Data format: *left local minimum, stimulus, right local minimum, stimulus*)

value

RPLVAL?

Outputs the maximum sum of the difference between the local minimum and the both sides local maximum, and the stimulus of the corresponding local minimum within range which is specified by `ANARANG` command. For more information, refer to Chapter 3. (Data format: sum, stimulus)

STIDROUT{1-16} *value* [*suffix*]

Sets stimulus of data trace up to 16 for `OUTPDATAT?` query. To execute `STIDROUT?` query, pass a number as the parameter.

value	5 (Hz) to 500 (MHz) −50 to 15 (dBm)
suffix	refer to "Suffix".

STIMROUT{1-16} *value* [*suffix*]

Sets stimulus of memory trace up to 16 for `OUTPDATAT?` query. To execute `STIDROUT?` query, pass a number as the parameter.

value	5 (Hz) to 500 (MHz)
suffix	refer to "Suffix".

TARL? *value*

Outputs stimulus of first found point which has value specified by parameter of this command from right of range which is set by `ANARANG` command. For more information, refer to Chapter 3. (Data format: stimulus)

value	5 (Hz) to 500 (MHz)
suffix	refer to "Suffix".

TARR? *value*

Outputs stimulus of first found point which has value specified by parameter of this command from left of range which is set by `ANARANG` command. For more information, refer to Chapter 3. (Data format: stimulus)

value	5 (Hz) to 500 (MHz)
suffix	refer to "Suffix".

Outputs stimulus of first found point which has value specified by parameter of this command from left of range which is set by `ANARANG` command. For more information, refer to Chapter 3. (Data format: stimulus)

value	5 (Hz) to 500 (MHz)
suffix	refer to "Suffix".

THRR *value*

Specifies threshold height of peak for waveform analysis command. Waveform analysis commands ignore ripples which has less height than specified value.

value	-5.0×10^5 to 5.0×10^5 (dB) (Log mag format) -5.0×10^5 to 5.0×10^5 (deg) (Phase and Expanded phase formats) -5.0×10^5 to 5.0×10^5 (s) (Delay format) -5.0×10^5 to 5.0×10^5 (Units) (Polar, Lin mag, Real, and Imaginary formats)
suffix	refer to "Suffix".

Delete the following HP-IB commands

- STEINORM
- STEOOPEN
- STEODAUT
- STEODMAN
- STEODVAL

3

Added Waveform Analysis Commands

This chapter provides information about the waveform analysis commands added. The commands are divided into five groups as follows:

- Waveform analysis setting commands
  - THRR
- Maximum/Minimum/Mean search commands
  - PEAK?
  - NEXPK?
  - NUMLMAX?
  - NUMLMIN?
  - LMAX?
  - LMIN?
  - TARR?
  - TARL?
- Ripple analysis commands
  - RPLVAL?
  - POLE
- Filter and Resonator analysis commands
  - OUTPXFIL?
  - OUTPCFIL?
  - OUTPRESR?
  - OUTPRESF?
  - OUTPCERR?
- Equivalent circuit analysis commands
  - EQUCPARA?
  - EQUM
  - EQUCPARS?
  - EQUCO?
  - EQUCPARS4?

THRR

Sets threshold ripple height for waveform analysis commands.

Syntax

THRR *height*

Query Response

height

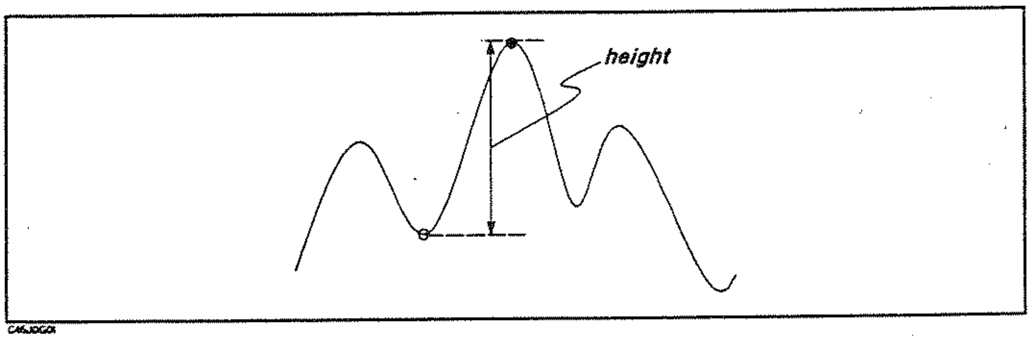


Figure 3-1. THRR

Note

Ripple height is defined as difference between local maximum and local minimum. Waveform analysis command searches only greater ripples than threshold value, and others are ignored. Default threshold value is 0.

Example

For the external controller:

```
INPUT "Enter Local Max Gain [dB].",Local_max
INPUT "Enter Local Min Gain [dB].",Local_min
Height=Local_max-Local_min
OUTPUT @Hp8751;"THRR ";Height
```

For Instrument BASIC:

```
INPUT "Enter Local Max Gain [dB].",Local_max
INPUT "Enter Local Min Gain [dB].",Local_min
Height=Local_max-Local_min
WRITEIO 8,0;Height
EXECUTE "THRR"
```

Maximum/Minimum/Mean Value Search Command

The following commands return the maximum, minimum, and mean value of a trace within the range specified by the `ANARANG` command.

PEAK?

Returns the maximum local maximum within the specified range with its corresponding stimulus value.

Syntax

```
PEAK?
```

This command is query only.

Query Response

$MAX_{peak}, f_{maxpeak}$

Note

- If there are two or more maximum local maximums, the minimum stimulus value is returned. The HP 8751A records the maximum local maximum and its stimulus value.
- If the corresponding points are not found, a zero will be returned.

Example

For the external controller:

```
OUTPUT @Hp8751;"PEAK?"
ENTER @Hp8751;Peak,F_maxpeak
PRINT "Peak:",Peak,"[dB],",F_maxpeak,"[Hz]"
```

For Instrument BASIC:

```
EXECUTE "PEAK?"
PRINT "Peak:",READIO(8,0),"[dB],",READIO(8,1),"[Hz]"
```

NEXPK?

Returns the maximum local maximum (within the specified range) having a value less than the value recorded by the HP 8751A. It also returns the corresponding stimulus value.

Syntax

```
NEXPK?
```

This command is query only.

Query Response

Peak, f_{peak}

Note

- If two or more such local maximums are found, this command returns the local maximum having a stimulus value larger than the stimulus value recorded by the HP 8751A.
- If the corresponding points are not found, a zero will be returned.

Example

For the external controller:

```
OUTPUT @Hp8751;"NEXPK?"
ENTER @Hp8751;N_peak,F_npeak
PRINT N_peak,F_npeak
```

For Instrument BASIC:

```
EXECUTE "PEAK?"
I=1
REPEAT
  PRINT I,READIO(8,0),READIO(8,1)
  EXECUTE "NEXPK?"
  I=I+1
UNTIL READIO(8,0)=0
```

NUMLMAX?

Returns the number of local maximums within the specified range.

Syntax

```
NUMLMAX?
```

This command is query only.

Query Response

n

Example

For the external controller:

```
OUTPUT @Hp8751;"NUMLMAX?"
ENTER @Hp8751;N
PRINT N
```

For Instrument BASIC:

```
EXECUTE "NUMLMAX?"
PRINT READIO(8,0)
```

NUMLMIN?

Returns the number of local minimums within the specified range.

Syntax

```
NUMLMIN?
```

This command is query only.

Query Response

n

LMAX?

Returns the nth local maximum counted from the left end of the specified range. n is a command parameter.

Syntax

```
LMAX? n
```

This command is query only.

Query Response

$LMAX_n$

Note

If the corresponding local maximum is not found, 3.40282347E+38 will be returned.

Example

For the external controller:

```
OUTPUT @Hp8751;"LMAX? 5"
ENTER @Hp8751;Lmax
PRINT Lmax
```

For Instrument BASIC:

```
INPUT "?",N
WRITEIO 8,0;N
EXECUTE "LMAX?"
PRINT READIO(8,0)
```

LMIN?

Returns the nth local minimum counted from the left end of the specified range. n is a command parameter.

Syntax

```
LMIN? n
```

This command is query only.

Query Response

$LMIN_n$

Note

If such a local minimum is not found, 3.40282347E+38 will be returned.

TARR?

Searches for the point having the parameter-specified value rightward from the left end of the specified range. If it is found, the TARR? command returns it and its corresponding stimulus value.

Syntax

TARR? *target*

This command is query only.

Query Response

f_{target}

Note

If the corresponding points are not found, a zero will be returned.

Example

For the external controller:

```
INPUT "Enter Target Value.",Target
OUTPUT @Hp8751;"TARR? ";Target
ENTER @Hp8751;F_target
PRINT F_target
```

For Instrument BASIC:

```
INPUT "Enter Target Value.",Target
WRITEIO 8,0;Target
EXECUTE "TARR?"
PRINT READIO(8,0)
```

TARL?

Searches for the point having the parameter-specified value leftward from the right end of the specified range. If it is found, the TARL? command returns it and its corresponding stimulus value.

Syntax

TARL? *target*

This command is query only.

Query Response

f_{target}

Note

If the corresponding points are not found, a zero will be returned.

Ripple Analysis Command

RPLVAL?

Returns the maximum total of the differences between the local minimums and the adjacent left-hand and right-hand local maximums within the range specified by the ANARANG command and the stimulus value of the minimum total by the HP-IB bus. Refer to Figure 3-2.

Syntax

```
RPLVAL?
```

This command is query only.

Query Response

Rpl_{val}, *stimulus*

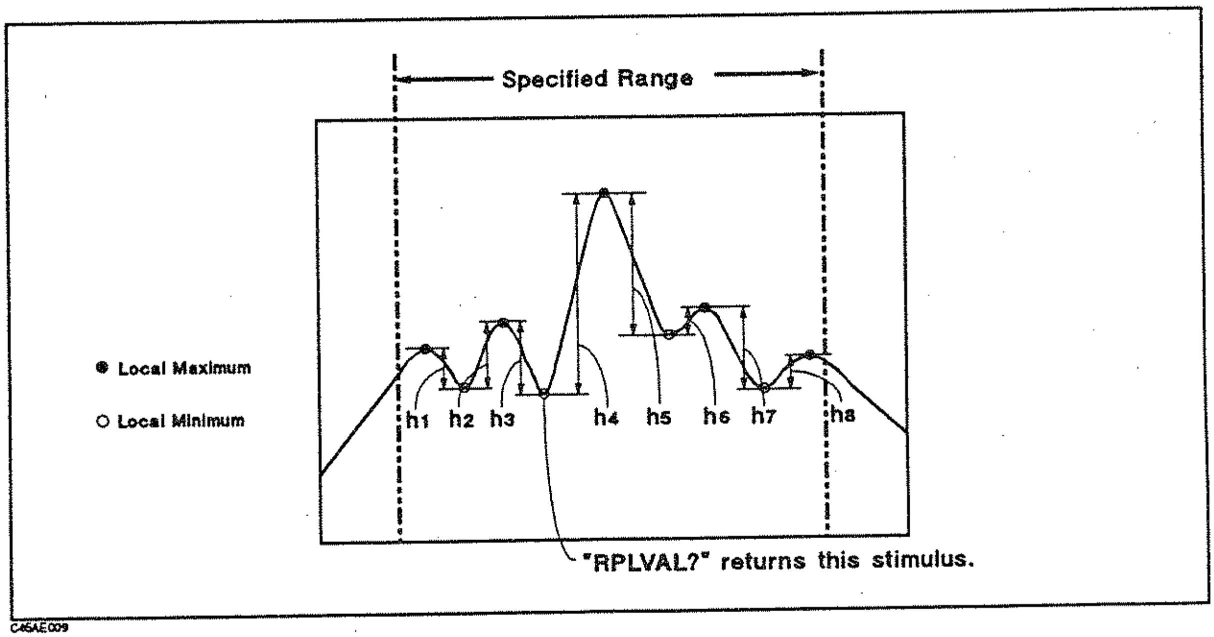


Figure 3-2. RPLVAL?

Note

If the corresponding points are not found, a zero will be returned.

Example

For the external controller:

```
ASSIGN @Hp8751 TO 717
OUTPUT @Hp8751;"ANAOCH1;ANARFULL;ANAODATA"
OUTPUT @Hp8751;"RPLVAL?"
ENTER @Hp8751;Val,Stim
PRINT Val;"[dB]";Stim;"[Hz]"
END
```

For Instrument BASIC:

```
EXECUTE "ANAOCH1"
EXECUTE "ANARFULL"
EXECUTE "ANAODATA"
EXECUTE "RPLVAL?"
PRINT READIO(8,0);"[dB]"
PRINT READIO(8,1);"[Hz]"
END
```

POLE?

Searches from the maximum value point for the leftward and rightward local minimums which are blow the value obtained by subtracting the parameter-specified value from the maximum value (D), and returns the first qualifying local minimums found with their corresponding stimulus values. Refer to Figure 3-3.

Syntax

POLE? *D*

This command is query only.

Query Response

x_1, $stimulus_1$, x_2, $stimulus_2$

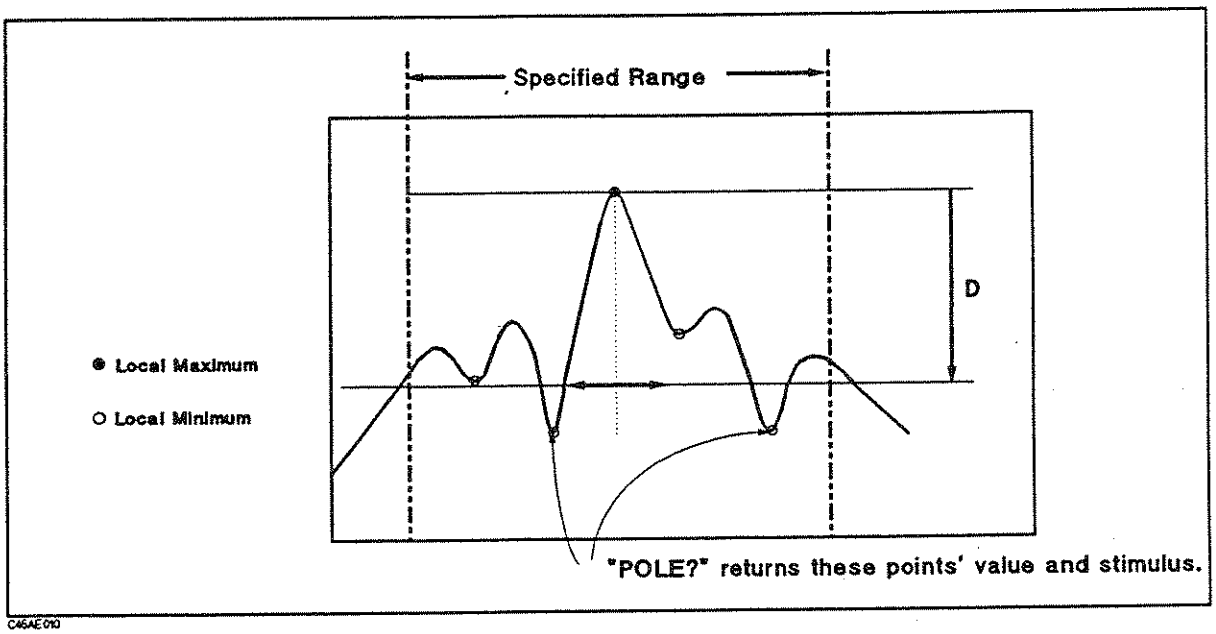


Figure 3-3. POLE?

Note

- The command parameter should be a negative value.
- If such a point is not found, a zero will be returned.

Example

For the external controller:

```
ASSIGN @Hp8751 TO 717
OUTPUT @Hp8751;"ANAOCH1;ANARFULL;ANAODATA"
OUTPUT @Hp8751;"POLE? -50"
ENTER @Hp8751;X1,S1,X2,S2
PRINT "LEFT :";X1;"[dB]";S1;"[Hz]"
PRINT "RIGHT:";X2;"[dB]";S2;"[Hz]"
END
```

For Instrument BASIC:

```
EXECUTE "ANAOCH1"
EXECUTE "ANARFULL"
EXECUTE "ANAODATA"
WRITEIO 8,0;-50
EXECUTE "POLE?"
PRINT "LEFT :";READIO(8,0);"[dB]";READIO(8,1);"[Hz]"
PRINT "RIGHT:";READIO(8,2);"[dB]";READIO(8,3);"[Hz]"
END
```

Filter and Resonator Analysis Command

The following commands are device related. They are easy to use for specific device analysis because they will output many parameters with only a single command.

OUTPXFIL?

The OUTPXFIL? command returns the parameters output by the OUTFILT? command, insertion loss, *BW* (bandwidth), f_{cent} (frequency center), Q, $\Delta L.F$, $\Delta R.F$, *Ripple* (pass band ripple), $\Delta L.F_2$ and $\Delta R.F_2$ of two points which are x_2 dB below the maximum peak, rejection level, spurious level, and POLE? command result (local minimum (left) and its stimulus and local minimum (right) and its stimulus). The OUTPXFIL? command makes an analysis within the range specified by the ANARANG command and returns the result via the HP-IB.

Syntax

OUTPXFIL? x_1, x_2, D, f_1, f_2

Query Response

Loss, BW, f_{cent}, Q, $\Delta L.F_1$, $\Delta R.F_1$, $\Delta L.F._2$, $\Delta R.F._2$, *Passband-ripple, Rejection-level, Spurious-level,* $Pole_{x1}$, $Pole_{stim1}$, $Pole_{x2}$, $Pole_{stim2}$

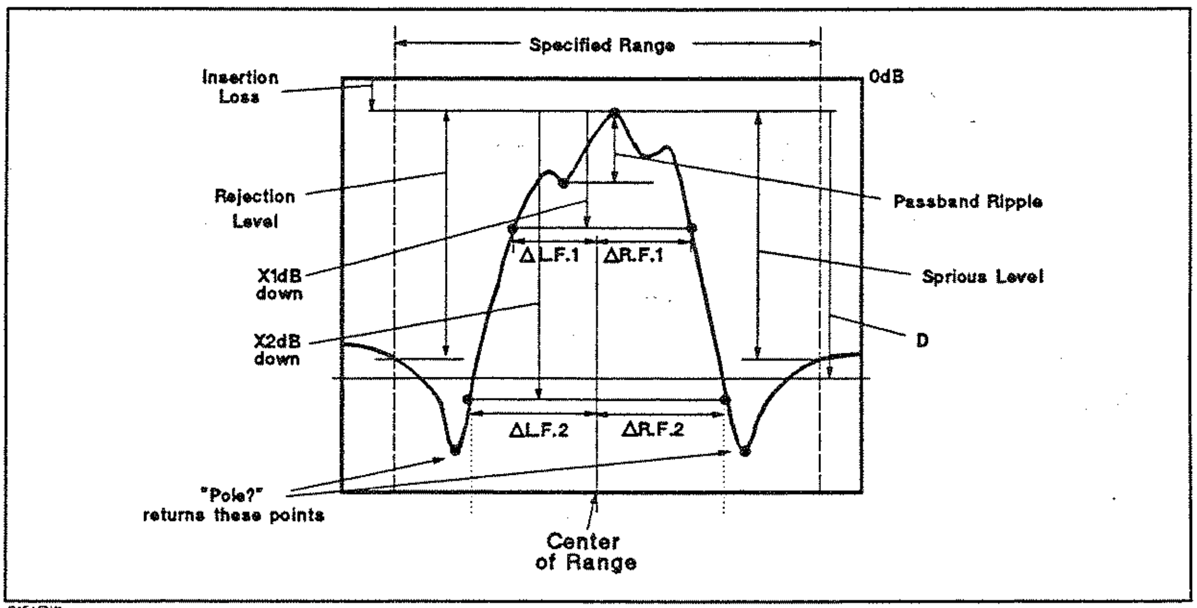


Figure 3-4. OUTPXFIL?

Description

- The returned *insertion loss*, *BW*, Q, f_{cent}, $\Delta L.F_1$, and $\Delta R.F_1$ are the same as those of the OUTPFILT? command.
- **Passband-ripple** is the maximum difference between a local maximum and minimum within the parameter-specified range, f_1 to f_2.
- **ΔL.F$_2$** and **ΔR.F$_2$** indicate the differences between the left and right cutoff points and the center point of a specified range like $\Delta L.F_1$ and $\Delta R.F_1$
- **Rejection-level** is the difference between the maximum value to the left of f_1 and the maximum value within the specified range.
- **Spurious-level** is the difference between the maximum value to the right of f_2 and the maximum value within the specified range.

- The OUTPXFIL? command uses the third command parameter D to return the same result (local minimum (left) and its stimulus and local minimum (right) and its stimulus) as that of the POLE? command. For more information on the POLE? command, see "POLE? *value*" in Chapter 2.

Note

- If two cutoff points which are x_1 dB below the maximum peak are not found, zeros will be returned for all parameters.
- If two cutoff points which are x_2 dB below the maximum value are not found, zeroes will be returned for $\Delta L.F_2$ and $\Delta R.F_2$.

Example

For the external controller:

```
10 ASSIGN @Hp8751 TO 717
20 OUTPUT @Hp8751;"CENS 70MHz,100kHz"
30 CALL Sweep("SING")
40 OUTPUT @Hp8751;"ANAOCH1;ANARFULL;ANAODATA"
50 OUTPUT @Hp8751;"OUTPXFIL? -3,-10,-50,69.98MHz,70.02MHz"
60 ENTER @Hp8751;Loss,Bw,Fc,Q,Dfl,Dfr,Dfl2,Dfr2,Pass,Reject,
Spurious,Pole1,Fp1,Pole2,Fp2
70 PRINT "Loss:";Loss;"[dB] BW:";Bw;"[Hz] fc:";Fc;"[Hz]"
80 PRINT "Q:";Q;" Dfl:";Dfl;"[Hz] Dfr:";Dfr;"[Hz]"
90 PRINT "Dfl2:";Dfl2;"[Hz] Dfr2:";Dfr2;"[Hz] Pass:";Pass;"[dB]"
100 PRINT "Reject:";Reject;"[dB] Spurious:";Spurious;"[dB]"
110 PRINT "Pole (left):";Pole1;"[dB] ";Fp1;"[Hz]"
120 PRINT "Pole (right):";Pole2;"[dB] ";Fp2;"[Hz]"
130 END
1100 SUB Sweep(Swp$)
1110 ASSIGN @Hp8751 TO 717
1120 OUTPUT @Hp8751;"CLES"
1130 OUTPUT @Hp8751;"*OPC?"
1140 ENTER @Hp8751;Opc
1150 OUTPUT @Hp8751;Swp$
1160 REPEAT
1170   OUTPUT @Hp8751;"ESB?"
1180   ENTER @Hp8751;Esb
1190 UNTIL BIT(Esb,0)
1210 SUBEND
```

For Instrument BASIC:

```
10 ASSIGN @Hp8751 TO 800
20 OUTPUT @Hp8751;"CENS ";7.E+7,100000
30 EXECUTE "SING"
40 EXECUTE "ANAOCH1"
50 EXECUTE "ANARFULL"
60 EXECUTE "ANAODATA"
70 WRITEIO 8,0;-3
80 WRITEIO 8,1;-10
90 WRITEIO 8,2;-50
```

```
100 WRITEIO 8,3;6.998E+7
110 WRITEIO 8,4;7.002E+7
120 EXECUTE "OUTPXFIL?"
130 PRINT "Passband Ripple:";READIO(8,8);"[dB]"
140 PRINT "Rejection Level:";READIO(8,9);"[dB]"
150 PRINT "Spurious Level:";READIO(8,10);"[dB]"
160 END
```

OUTPCFIL?

Returns an insertion loss, point on f_c, BW, *frequency center*, Q, $\Delta L.F$, $\Delta R.F$, *pass band ripple*, $\Delta L.F_2$ and $\Delta R.F_2$ of two points which are x_2 dB below the maximum peak, rejection level, spurious level, and `POLE?` command result (local minimum (left) and its stimulus and local minimum (right) and its stimulus). Refer to Figure 3-5.

Syntax

`OUTPCFIL?` f_c, x_1, x_2, D, f_1, f_2

This command is query only.

Query Response

Loss, $Loss_c$, BW, f_{cent}, Q, $\Delta L.F_1$, $\Delta R.F_1$, $\Delta L.F_2$, $\Delta R.F_2$, *Passband-ripple*, *Rejection-level*, *Spurious*, $Pole_{x1}$, $Pole_{stim1}$, $Pole_{x2}$, $Pole_{stim2}$

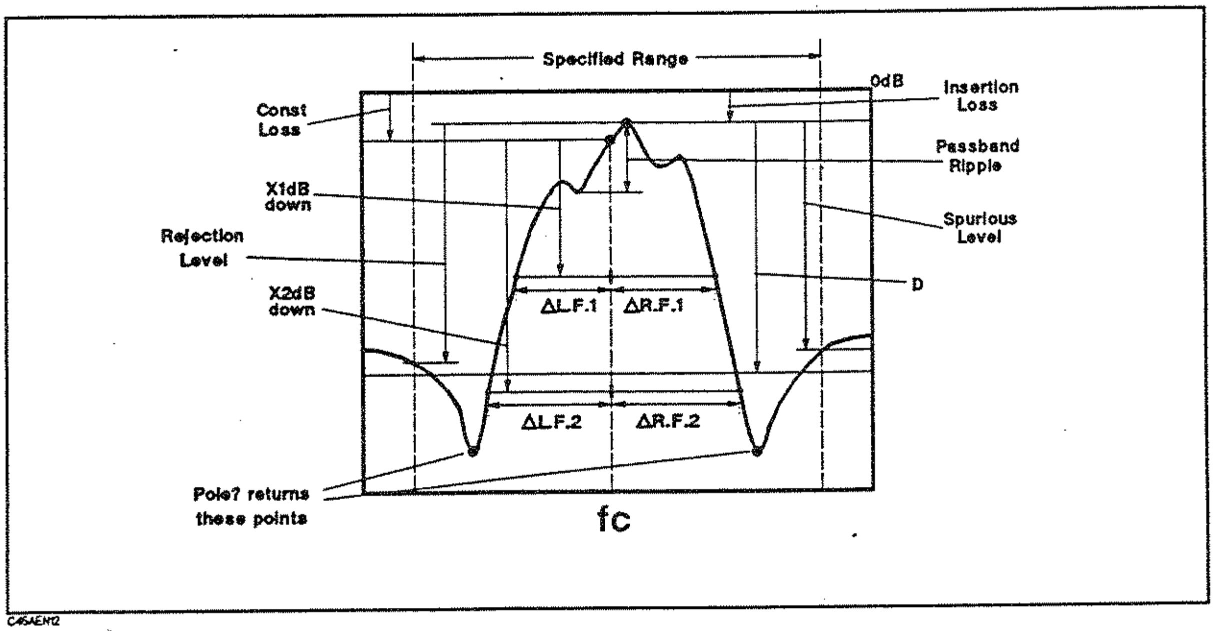


Figure 3-5. OUTPCFIL?

Description

- The insertion loss (**Loss**) is the absolute value of the difference between the maximum value within the specified range and 0 dB.
- The constant insertion loss ($\mathbf{Loss_c}$) is the absolute value of the difference between the value at the point on f_c and 0 dB.
- BW is the stimulus width between two cutoff points which are x_1 dB below the point on f_c. (The point on f_c is the point on the nominal frequency given as a command parameter.)
- The center frequency ($\mathbf{f_{cent}}$) is the stimulus value of the center of two cutoff points (f_1 and f_2).
- **Q** is calculated using the values of BW, f_1, and f_2.
- $\mathbf{\Delta L.F_1}$ is the stimulus width from f_c to f_1.
- $\mathbf{\Delta R.F_1}$ is the stimulus width from f_c to f_2.

- ΔL.F_2 and ΔR.F_2 are stimulus widths between *fc* and the left and right cutoff points which are x_2 dB below the point on f_c.
- The pass band ripple (Pass) is the maximum difference between a local maximum and local minimum between f_l and f_2.

Note

- The rejection level, spurious level, and POLE? command output result are the same as those of the OUTPXFIL? command.
- The OUTPCFIL? command uses the fourth command parameter *D* to return the same result (local minimum (left) and its stimulus and local minimum (right) and its stimulus) as that of the POLE? command.
- If two cutoff points which are x_l dB below the point on f_c are not found, zeros will be returned.
- If two points which are x_2 dB below the point on fc are not found, zeros will be returned for $\Delta L.F_2$ and $\Delta R.F_2$.

Example

For the external controller:

```
10 ASSIGN @Hp8751 TO 717
20 OUTPUT @Hp8751;"CENS 70MHz,100kHz"
30 CALL Sweep("SING") ! (Refer to OUTPXFIL?)
40 OUTPUT @Hp8751;"ANAOCH1;ANARFULL;ANAODATA"
50 OUTPUT @Hp8751;"OUTPCFIL? 70MHz,-3,-10,-50,69.98MHz,70.02MHz"
60 ENTER @Hp8751;Loss,Lc,Bw,Fc,Q,Dfl,Dfr,Dfl2,Dfr2,Pass,Reject,
Spurious,Pole1,Fp1,Pole2,Fp2
70 PRINT "Loss:";Loss;"[dB] Const Loss:";Lc;"[dB]"
80 PRINT "BW:";Bw;"[Hz] Fc:";Fc;"[Hz]"
90 PRINT "Q:";Q;" DFl:";Dfl;"[Hz] DFr:";Dfr;"[Hz]"
100 PRINT "Dfl2:";Dfl2;"[Hz] Dfr2:";Dfr2;"[Hz] Pass:";Pass;"[dB]"
110 PRINT "Reject:";Reject;"[dB] Spurious:";Spurious;"[dB]"
120 PRINT "Pole (left):";Pole1;"[dB] ";Fp1;"[Hz]"
130 PRINT "Pole (right):";Pole2;"[dB] ";Fp2;"[Hz]"
140 END
```

For Instrument BASIC:

```
10 ASSIGN @Hp8751 TO 800
20 OUTPUT @Hp8751;"CENS ";7.E+7,100000.
30 EXECUTE "SING"
40 EXECUTE "ANAOCH1"
50 EXECUTE "ANARFULL"
60 EXECUTE "ANAODATA"
70 WRITEIO 8,0;7.E+7
80 WRITEIO 8,1;-3
90 WRITEIO 8,2;-10
100 WRITEIO 8,3;-50
110 WRITEIO 8,4;6.998E+7
120 WRITEIO 8,5;7.002E+7
130 EXECUTE "OUTPCFIL?"
```

```
140 PRINT "Const Loss:";READIO(8,1);"[dB]"
150 END
```

OUTPRESR?

Analyzes the ripple of a resonator which has the characteristics shown in Figure 3-7.

Syntax

```
OUTPRESR?
```

This command is query only.

Query Response

Z_r, f_r, Z_a, f_a, Rpl_1, Rpl_2, Rpl_3

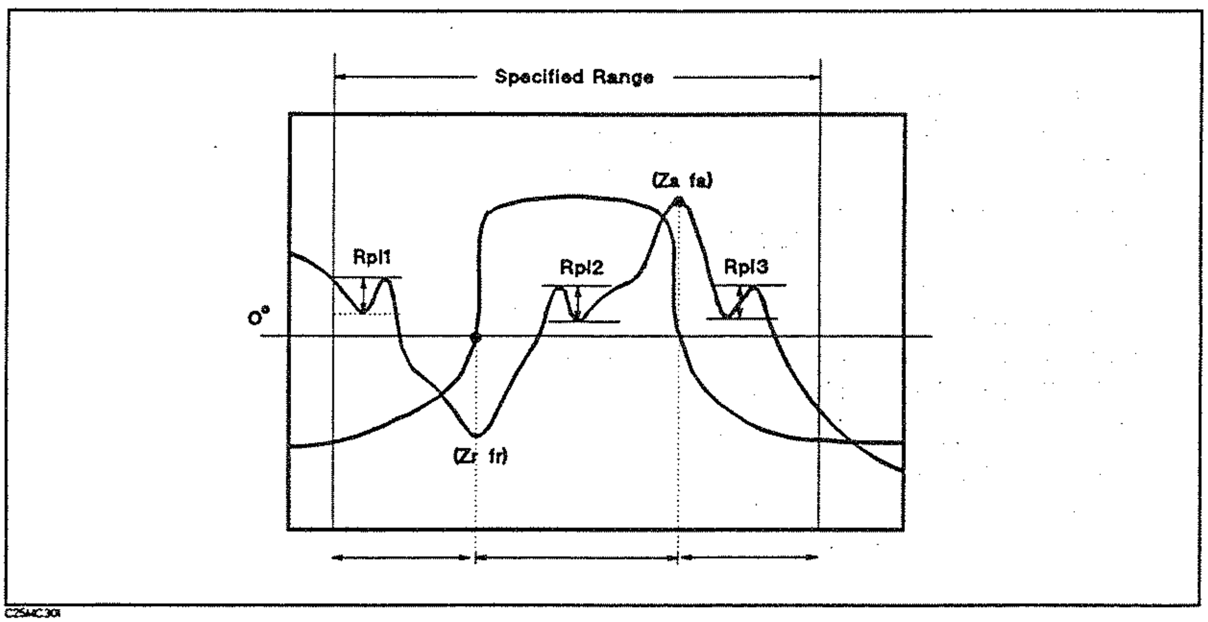


Figure 3-6. OUTPRESR?

Description

When the OUTPRESR? command is issued, the HP 8751A searches for the 0° phase point from the left end of the specified range. The HP 8751A regards the first found point as the resonant point and the second found point as the anti-resonant point. Then, it searches for and returns the following parameters by the HP-IB:

- Z_r and f_r are the gain and stimulus value of the resonant point.
- Z_a and f_a are the gain and stimulus value of the anti-resonant point.
- Rpl_1 is the maximum value of the difference between the local maximum and the adjacent left-hand local minimum which are at left of the resonant point
- Rpl_2 is the maximum value of the difference between the local maximum and the maximum value of the adjacent right-hand local minimum which are between the resonant and antiresonant points.
- Rpl_3 is the maximum value of difference between the local maximum and the maximum value of the adjacent left-hand local minimum which are at the right of the resonant point.

Note

- If there are three or more phase 0° points within the specified range, the HP 8751A returns the values of first two points found.
- If there is only one phase 0° point, the HP 8751A regards the first found point as the resonant point and returns the stimulus and amplitude values and returns a zero for the anti-resonant parameter.
- If there is no phase 0° point within the range, zeros will be returned for all parameters.
- If Z-conversion was made previously, the above values are returned as impedance values.
- This command is available only in the LOG MAG & Phase format. Therefore, the `ANAODATA` and `ANAOMEMO` commands are ignored. If the format is not "LOG MAG & Phase," the HP 8751A will return zeros for all parameters.

Example

For the external controller:

```
10 ASSIGN @Hp8751 TO 717
20 OUTPUT @Hp8751;"LOGMP; CONVZTRA; CENS 70MHz,100kHz"
30 CALL Sweep("SING") ! (Refer to OUTPXFIL?)
40 OUTPUT @Hp8751;"ANAOCH1;ANARFULL;ANAODATA"
50 OUTPUT @Hp8751;"OUTPRESR?"
60 ENTER @Hp8751;Zr,Fr,Za,Fa,R1,R2,R3
70 PRINT "Resonant:";Zr;"[ohm],";Fr;"[Hz]"
80 PRINT "Anti-Resonant:";Za;"[ohm],";Fa;"[Hz]"
90 PRINT "Ripple L:";R1;"[dB]"
100 PRINT "Ripple M:";R2;"[dB]"
110 PRINT "Ripple R:";R3;"[dB]"
120 END
```

For Instrument BASIC:

```
10 ASSIGN @Hp8751 TO 800
20 OUTPUT @Hp8751;"LOGMP;CONVZTRA"
30 OUTPUT @Hp8751;"CENS ";7.E+7,100000.
40 EXECUTE "SING"
50 EXECUTE "ANAOCH1"
60 EXECUTE "ANARFULL"
70 EXECUTE "ANAODATA"
80 EXECUTE "OUTPRESR?"
90 PRINT "Resonant:";READIO(8,0);"[ohm],";READIO(8,1);"[Hz]"
100 PRINT "Anti-Resonant:";READIO(8,2);"[ohm],";READIO(8,3);"[Hz]"
110 PRINT "Ripple L:";READIO(8,4);"[dB]"
120 PRINT "Ripple M:";READIO(8,5);"[dB]"
130 PRINT "Ripple R:";READIO(8,6);"[dB]"
140 END
```

OUTPRESF?

Searches maximum local-maximum (f_s) and minimum local-minimum (f_p) within specified range, then, searches x_1 dB below points for both side from f_s and x_2 dB above points for both side from f_p. The first point founded on the left-hand side of f_s is f_{s1}, and right-hand is f_{s2}. In a similar way, f_{p1} is first point found on the left-hand side of f_p, and f_{p2} is right-hand point. See Figure 3-7.

Syntax

OUTPRESF? x_1, x_2

This command is query only.

Query Response

f_s, f_p, f_{s1}, f_{s2}, f_{p1}, f_{p2}

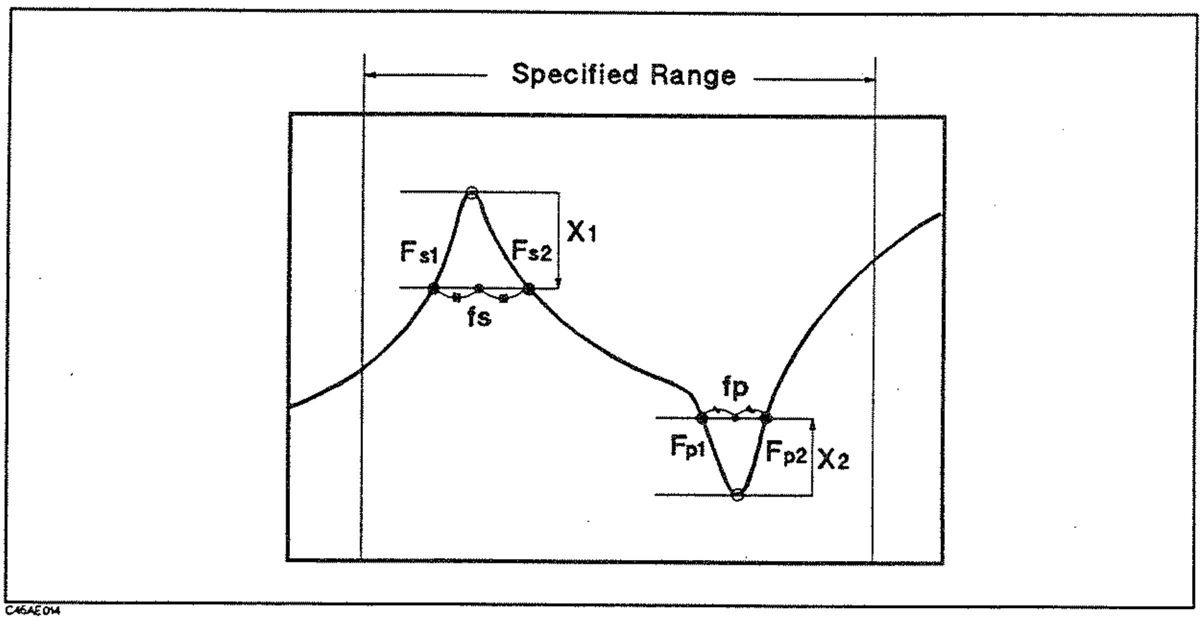


Figure 3-7. OUTPRESF?

Example

For the external controller:

```
10 ASSIGN @Hp8751 TO 717
20 OUTPUT @Hp8751;"LOGM; CENS 60.06MHz, 20kHz"
30 CALL Sweep("SING") ! (Refer to OUTPXFIL?)
40 OUTPUT @Hp8751;"ANAOCH1;ANARFULL;ANAODATA"
50 OUTPUT @Hp8751;"OUTPRESF? -3dB,3dB"
60 ENTER @Hp8751;Fs,Fp,Fs1,Fs2,Fp1,Fp2
70 PRINT "Series-Resonant:";Fs;"[Hz]"
80 PRINT "Parallel-Resonant:";Fp;"[Hz]"
90 END
```

For Instrument BASIC

```
10 ASSIGN @Hp8751 TO 800
20 OUTPUT @Hp8751;"LOGM"
30 OUTPUT @Hp8751;"CENS ";7.E+7,100000.
40 EXECUTE "SING"
50 EXECUTE "ANAOCH1"
60 EXECUTE "ANARFULL"
70 EXECUTE "ANAODATA"
80 WRITEIO 8,0;-3
90 WRITEIO 8,1;3
100 EXECUTE "OUTPRESF?"
110 PRINT "Series-Resonant:";READIO(8,0);"[Hz]
120 PRINT "Parallel-Resonant:";READIO(8,1);"[Hz]
130 END
```

OUTPCERR?

Outputs the ceramic resonator parameters; G_r, f_r, G_a, f_a, rpl_1, rpl_2, rpl_3.

Syntax

```
OUTPCERR?
```

This command is query only.

Query Response

G_r, f_r, G_a, f_a, rpl_1, rpl_2, rpl_3

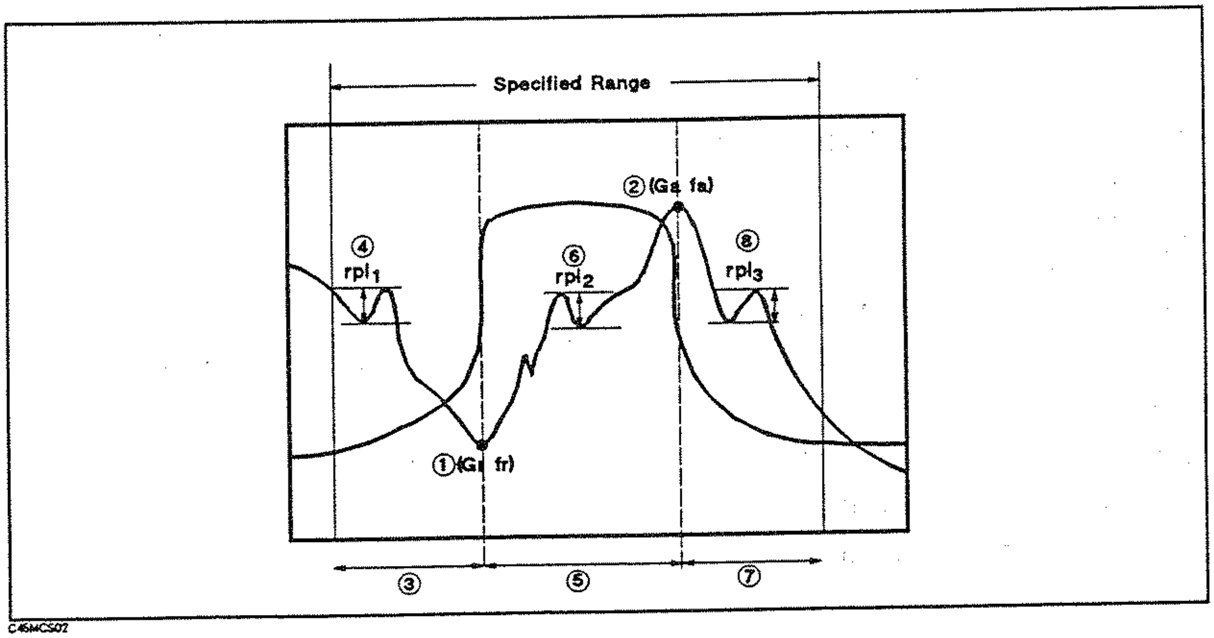


Figure 3-8. OUTPCERR?

Description

- G_r is gain at the point on f_r.
- f_r is resonant frequency.
- G_a is gain at the point on f_a.
- f_a is anti-resonant frequency.
- rpl_1 is the maximum ripple height in left side of resonant point.
- rpl_2 is the maximum ripple height between resonant and anti-resonant point.
- rpl_3 is the maximum ripple height in right side of anti-resonant point

Description

When OUTPCERR? is sent, instrument performs followings:

1. Searches for the minimum peak in the analysis range, then returns its gain G_r and frequency f_r.
2. Searches for the maximum peak in the analysis range, then returns its gain G_a and frequency f_a.

3. Sets the end point of the analysis range to f_r.
4. Searches the maximum height of the local maximum and the adjacent left-hand local minimum within range, then outputs as rpl_l.
5. Sets the start of the analysis range to f_r, and the end of the analysis range to f_a.
6. Searches the maximum height of the local maximum and the maximum value of the adjacent right-hand local minimum which are between the resonant and anti resonant points, then outputs as rpl_2.
7. Sets the start of the analysis range to f_a, and the end of the analysis range to the frequency that was initial setting.
8. Searches the maximum value of difference between the local maximum and the maximum value of the adjacent left-hand local minimum which are at the right of the resonant point, then outputs as rpl_3.

Notes

This command is only available when the following formats are selected;

- LOG MAG & Phase
- LOG MAG & Delay
- LOG MAG

If another format is selected, the query returns 0.

If Z-conversion is selected, then the Z_r instead of the G_r and the Z_a instead of the G_a are returned.

Where,

Z_r	Impedance at f_r
Z_a	Impedance at f_a

If OUTPCERR? could not find any ripples, the query returns 0.

This command can be invoked with the EXECUTE command of Instrument BASIC.

Example

For the external controller:

```
10 ASSIGN @Hp8751 TO 717
20 OUTPUT @Hp8751;"LOGM; CONVZTRA; CENS 60.02MHz,20kHz"
30 CALL Sweep("SING") ! (Refer to OUTPXFIL?)
40 OUTPUT @Hp8751;"ANAOCH1;ANARFULL;ANAODATA"
50 OUTPUT @Hp8751;"OUTPCERR?"
60 ENTER @Hp8751;Zr,Fr,Za,Fa,R1,R2,R3
70 PRINT "Resonant:";Zr;"[ohm],";Fr;"[Hz]"
80 PRINT "Anti-Resonant:";Za;"[ohm],";Fa;"[Hz]"
90 PRINT "Ripple L:";R1;"[dB]"
100 PRINT "Ripple M:";R2;"[dB]"
110 PRINT "Ripple R:";R3;"[dB]"
120 END
```

For Instrument BASIC:

```
10 ASSIGN @Hp8751 TO 800
20 OUTPUT @Hp8751;"LOGM"
30 OUTPUT @Hp8751;"CENS ";6.002E+7,20000.
40 EXECUTE "SING"
50 EXECUTE "ANAOCH1"
60 EXECUTE "ANARFULL"
70 EXECUTE "ANAODATA"
80 EXECUTE "OUTPCERR?"
90 PRINT "Resonant:";READIO(8,0);"[ohm],";READIO(8,1);"[Hz]"
100 PRINT "Anti-Resonant:";READIO(8,2);"[ohm],";READIO(8,3);"[Hz]"
110 PRINT "Ripple L:";READIO(8,4);"[dB]"
120 PRINT "Ripple M:";READIO(8,5);"[dB]"
130 PRINT "Ripple R:";READIO(8,6);"[dB]"
140 END
```

Equivalent Circuit Analysis Commands

The following commands make an equivalent circuit analysis for the measurement data and return the analysis result. The equivalent circuit analysis is made within the range specified by the `ANARANG` command. Following commands are only available when the polar format and impedance or admittance conversion is selected.

EQUCPARA?

Outputs six-device equivalent circuit parameters of the crystal resonator; C_0, C_1, L_1, R_1, G_0, R_0.

Syntax

```
EQUCPARA?
```

This command is query only.

Query Response

C_0, C_1, L_1, R_1, G_0, R_0

Each term represents equivalent circuit as shown below:

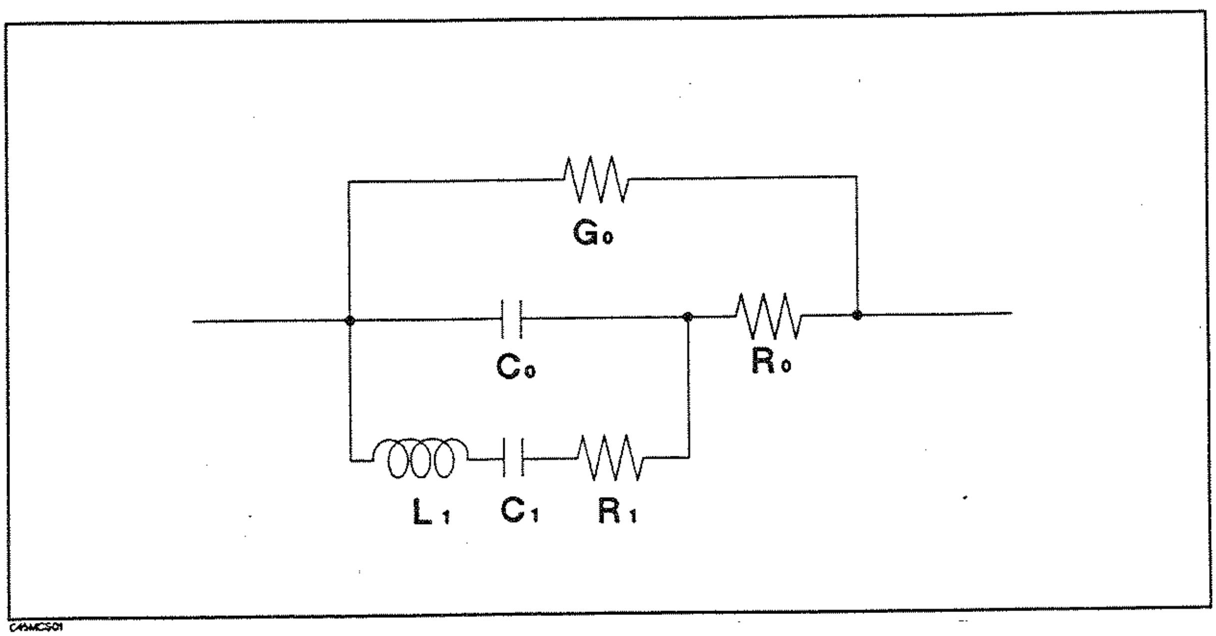


Figure 3-9. Six-Device Equivalent Circuit of Resonator

Descriptions

When `EQUCPARA?` is sent, instrument performs followings:

1. Obtains the admittance characteristic circle diagram.
2. Obtains the maximum conductance (G_{max}).
3. Obtains frequencies f_1 and f_2 ($f_1 < f_2$) of two points where the conductance is half the maximum conductance (G_{max}).

4. Calculate f_s by $f_s = \sqrt{f_1 \times f_2}$.
5. Obtains susceptance B_{fs} at f_s.
6. Calculate ω_s by $\omega_s = 2 \times \pi \times f_s$.
7. Assumes that the frequency at which the phase becomes 0°* near the parallel resonance frequency is f_a, and obtains its conductance G_a.
8. Calculate ω_a by $\omega_a = 2 \times \pi \times f_a$.
9. Assumes that the frequency at which the phase becomes 0°* near the series resonance frequency is f_r.
10. Calculates the constants using the above values and the following equations:

$$Q_s = \frac{f_s}{f_2 - f_1} \qquad C_o' = \frac{B_1 + B_2}{2\omega_s}$$

$$L_1 = \frac{Q_s}{\omega_s G_{max}} \qquad R_1 = \frac{C_o'}{C_o G_{max}}$$

$$C_1 = \frac{G_{max}}{\omega_s Q_s} \qquad R_o = \frac{1}{G_{max}} - R_1$$

$$C_o = \frac{B_{fs}}{\omega_s} \qquad G_o = G_a - \frac{R_1 \omega_a{}^2 C_o{}^2}{1 + R_o R_1 \omega_a{}^2 C_o{}^2}$$

* EQUCPARA? interpolates the 0° phase points even if it does not exist in measured data.

If the number of points between the maximum peak point (f_{Bmax}) and the minimum peak point (f_{Bmin}) of the conductance is less than 10 points, EQUCPARA? approximates an admittance circle. The circle approximation can be performed if there are 3 points for analyze. You can specify how many points are used for circle approximation by using EQUM command for reducing the analysis time.

If EQUCPARA? fails a circle approximation, 0 will be return for all parameters.

If there are only 2 points for analysis, EQUCPARA? returns four-device equivalent circuit parameters. In this case, EQUCPARA? returns 0 for G_0 and R_0.

If there is only 1 point for analysis, EQUCPARA? returns 0 for all parameters.

EQUM *value*

Specifies how many points are used for an approximation of a circle for EQUCPARA? and EQUCPARS? command. EQUCPARA? (or EQUCPARS?) thins the measured points out for the specified points, then make circle approximation. When the EQUM parameter is set greater than the number of points, EQUCPARA? uses all points for the circle approximation. Default value is 8.

value	2 to 801

Notes

This command is only available when the LOG MAG & Phase, or Polar format is selected. If the other format is selected, 0 will be returned for query response.

This command can be invoked with the EXECUTE command of Instrument BASIC.

Example

For the external controller:

```
10  OUTPUT 717;"POLA"                    Set to POLAR format.
100 OUTPUT 717;"EQUCPARA?"               Send the EQUCPARA? query to the HP 8751A.
110 ENTER 717;C0,C1,L1,R1,G0,R0          Receive the equivalent circuit parameters.
120 PRINT "C0=",C0,",C1=",C1             Display the equivalent circuit parameter
130 PRINT "L1=",L1,",R1=",R1             on the CRT.
140 PRINT "G0=",G0,",R0=",R0
150 END
```

For Instrument BASIC:

```
10  OUTPUT 800;"POLA"                    Set to POLAR format.
20  EXECUTE "SING"                       Make a single sweep.
100 WRITEIO 8,0;4                        Put the parameter of EQUM on a register.
101 !                                    You must put the command parameter on the register
102 !                                    before you use the EXECUTE command.
110 EXECUTE "EQUM"                       Invoke the EQUM command.
111 !                                    The EXECUTE runs the command faster
112 !                                    than the OUTPUT statement
120 EXECUTE "EQUCPARA?                   Invoke the EQUCPARA? query.
130 C0=READIO(8,0)                       Read the first return value from the register.
131 !                                    HP 8751A returns the query response
132 !                                    to the register.
140 C1=READIO(8,1)                       Read the second return value.
150 PRINT "C0=",C0,",C1=",C1             Display the equivalent circuit parameters.
160 L1=READIO(8,2)                       Read the third return value.
170 R1=READIO(8,3)                       Read the fourth return value.
180 PRINT "L1=",L1,",R1=",R1             Display the lest of query response.
190 END
```

EQUCPARS?

Outputs six-device equivalent circuit parameters of the crystal resonator; C_0, C_1, L_1, R_1, f_s, f_a, f_r, $f_1{}^*$, $f_2{}^*$, G_0, R_0.

Syntax

```
EQUCPARS?
```

Query Response

C_0, C_1, L_1, R_1, f_s, f_a, f_r, $f_1{}^*$, $f_2{}^*$, G_0, R_0

* $f_1 < f_2$.

For information about each parameter, refer to "EQUCPARA?".

Notes

This command is only available when the LOG MAG & Phase, or Polar format is selected. If the other format is selected, 0 will be returned for query response.

This command can be invoked with the EXECUTE command of Instrument BASIC.

EQUC0? *value*

Returns C_0 of the equivalent circuit of the resonator at specified frequency.

Syntax

EQUCO? *value* [*suffix*]

Where,

value	5 to 5.0×10^8 (Hz)
suffix	HZ (KHZ, MHZ, GHZ are also available)

This command is query only.

Query Response

C_0

Description

C_0 is calculated by using the following equation:

$$C_0 = \frac{B_s}{\omega_s}$$

Where,

B_s	Imaginary part on f_s
ω_s	$2 \times \pi \times f_s$
f_s	Frequency which is specified as command parameter

If Z-conversion is selected, C_0 is calculated by using following equations:

$$C_0 = \frac{-1}{B_s \times \omega_s}$$

Notes

This command is only available when LOG MAG & Phase or Polar format is selected. If another format is selected, 0 will be returned. If the specified frequency is out of analysis range, 0 will be returned.

If B_s is 0 when the Z-conversion is activated, EQUCO? returns 0.

This command can be invoked with the EXECUTE command of Instrument BASIC.

Example

For the external controller:

```
100 OUTPUT 717;"EQUCO? 100MHZ"   Query C0 at 100 MHz.
110 ENTER 717;CO                 Receive the returned C0.
120 PRINT "CO=",CO               Display C0 on the CRT.
130 END
```

For Instrument BASIC:

```
100 WRITEIO 8,0;1.E+8   Put the command parameter, 100 MHz, on the register.
110 EXECUTE "EQUCO?"    Invoke the EQUCO? query.
```

```
120 CO=READIO(8,0)       Read a return value and enter to the variable CO.
130 PRINT "CO=",CO       Display C0 on the CRT.
140 END
```

EQUCPARAS4?

Makes a 4-device equivalent circuit analysis for the crystal resonator and returns equivalent circuit constants (C_0, C_1, L_1, R_1) and f_s, f_a, f_r, f_1, and f_2.

Syntax

```
EQUCPARAS4?
```

Query Response

C_0, C_1, L_1, R_1, f_s, f_a, f_r, f_1, f_2

Description

The EQUCPARAS4? regards the following circuits as equivalent circuits:

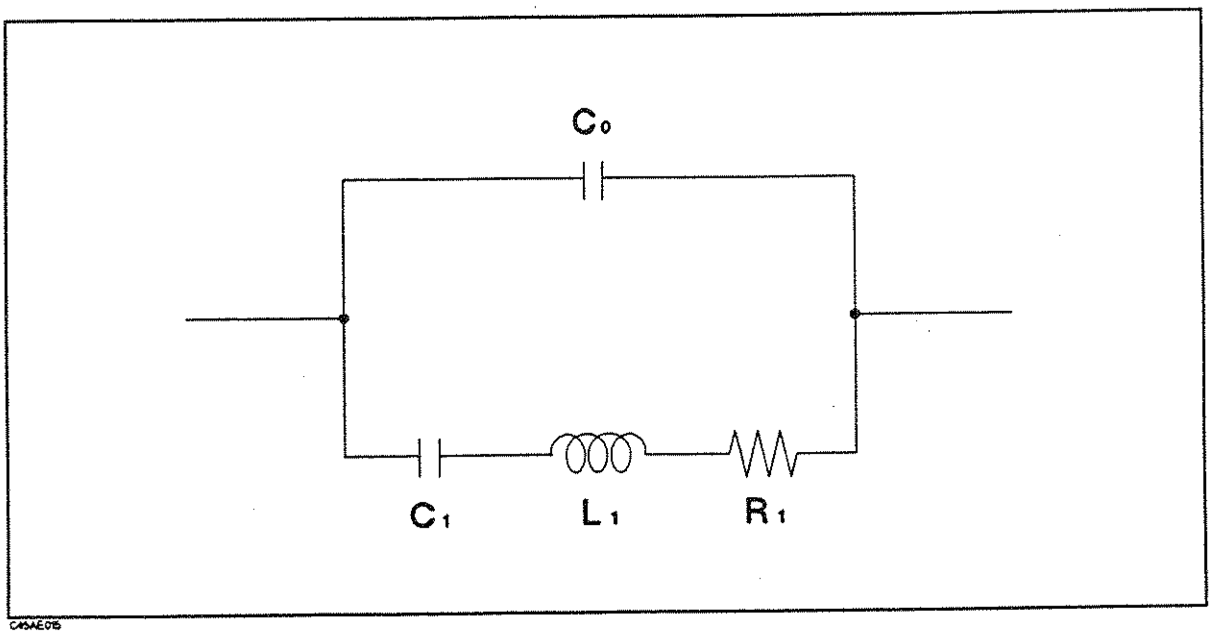


Figure 3-10. Four-Device Equivalent Circuit for Crystal Resonator

Where,

C_0	: Parallel capacity
C_1	: Motional capacity
L_1	: Motional inductance
R_1	: Motional resistance

The EQUCPARAS4? command obtains the above constants in the following procedure:

1. Obtains the admittance characteristic circle diagram.
2. Obtains the susceptance (B_{fs}) and its frequency (f_s) at the maximum conductance (G_{max}) point.
3. Obtains frequencies f_1 and f_2 ($f_1 < f_2$) of two points where the conductance is half the maximum conductance (G_{max}).

4. Assumes that the frequency at which the phase becomes 0° near the parallel resonance frequency is f_a.
5. Assumes that the frequency at which the phase becomes 0° near the series resonance frequency is f_r.
6. Calculates the constants using the above values and the following equations:

$$C_0 = \frac{f_r^2}{f_a^2 - f_r^2} \times C_1 \qquad Q = \left|\frac{f_s}{f_2 - f_1}\right|$$

$$C_1 = \frac{1}{QR_1 2\pi f_s} \qquad R_1 = \frac{1}{G_{max}}$$

$$L_1 = \frac{QR_1}{2\pi f_s}$$

If there are no f_r and f_a points on the admittance chart, C_0 is calculated using the following equation:

$$C_0 = \frac{Bfs}{2\pi f_s}$$

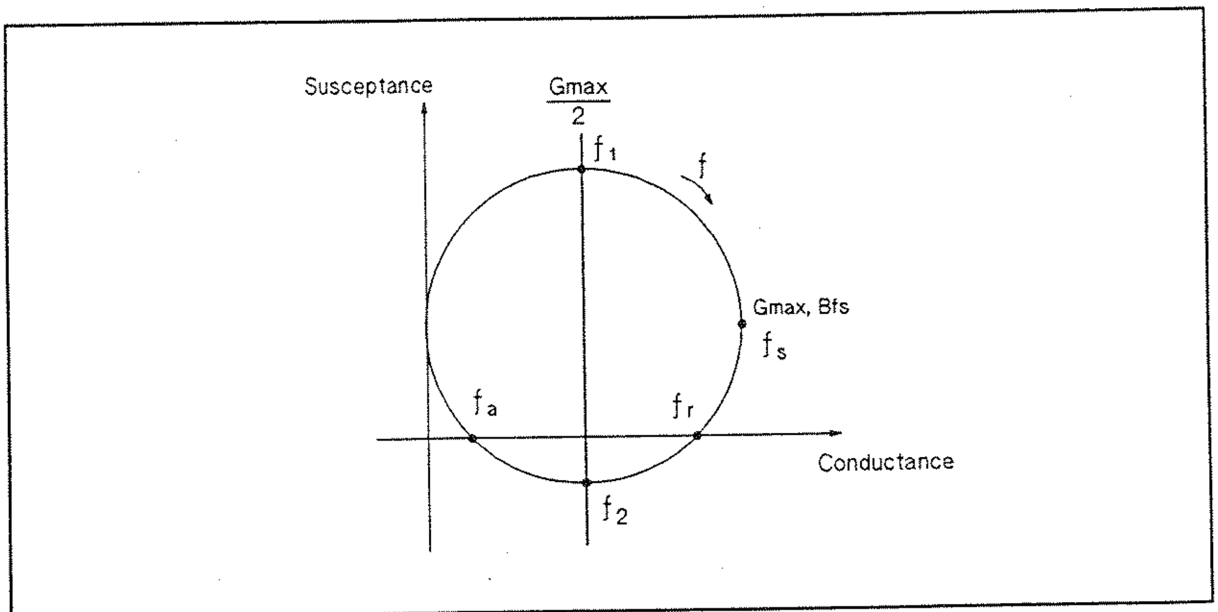


Figure 3-11. Admittance Characteristic Chart

Example

For the external controller:

```
10 ASSIGN @Hp8751 TO 717
20 OUTPUT @Hp8751;"POLA; CONVYTRA; CENS 60.06MHz,20kHz"
30 CALL Sweep("SING") ! (Refer to OUTPXFIL?)
40 OUTPUT @Hp8751;"ANAOCH1;ANARFULL;ANAODATA"
50 OUTPUT @Hp8751;"EQUCPARS4?"
60 ENTER @Hp8751;C0,C1,L1,R1
70 PRINT "C0:";C0;" C1:";C1
80 PRINT "L1:";L1;" R1:";R1
```

```
90 END
```

For Instrument BASIC:

```
10 ASSIGN @Hp8751 TO 800
20 OUTPUT @Hp8751;"POLA; CONVYTRA"
30 OUTPUT @Hp8751;"CENS ";6.006E+7,20000.
40 EXECUTE "ANAOCH1"
50 EXECUTE "ANARFULL"
60 EXECUTE "ANAODATA"
70 EXECUTE "EQUCPARS4?"
80 PRINT "C0=";READIO(8,0);",C1=";READIO(8,1)
90 PRINT "L1=";READIO(8,2);",R1=";READIO(8,3)
100 END
```

4

Calibration Sample Program

Introduction

This supplement describes a usage of sample program for measuring impedance or admittance characteristics of crystal resonator by using a π-network circuit or an HP 41941A/B impedance probe.

The sample program uses an S_{11} 1-Port calibration method which measures three standards, OPEN, SHORT, and LOAD. This compensates an error of a π-network circuit or an HP 41941A/B impedance probe and enables accurate measurement.

The sample program disk is available. Please order Sample Program Disk (HP Part Number 87510-87002), if you need.

Usage of Sample Program

The file name of sample programs contained in sample program disk are as follows:

PI_CAL	calibrates π-network circuit using an S_{11} 1-Port calibration method.
ZPROBE_CAL	calibrates HP 4194A/B impedance probe using an S_{11} 1-Port calibration method.

Preparation

The following items are required to run this program.

- Sample program disk (HP Part Number 87510-87002)
- Fixture and calibration standards (Select one of the selections listed below)
  - π-network circuit, shorting bar, and a 50 Ω standard wrists
  - HP 41941A/B impedance probe (calibration standards are furnished with HP 41941A/B)

If you own keyboard, it will be convenient to enter the values. If you have not, sample program can be execute only using front panel keys of the HP 8751A.

Measurement Setup

You must set measurement settings before using the sample program.

1. Turn the HP 8751A ON.
2. Setup stimulus range and other settings to agree with your measurement settings.
3. Connect the π-network circuit or the impedance probe to the HP 8751A as shown in Figure 4-1.

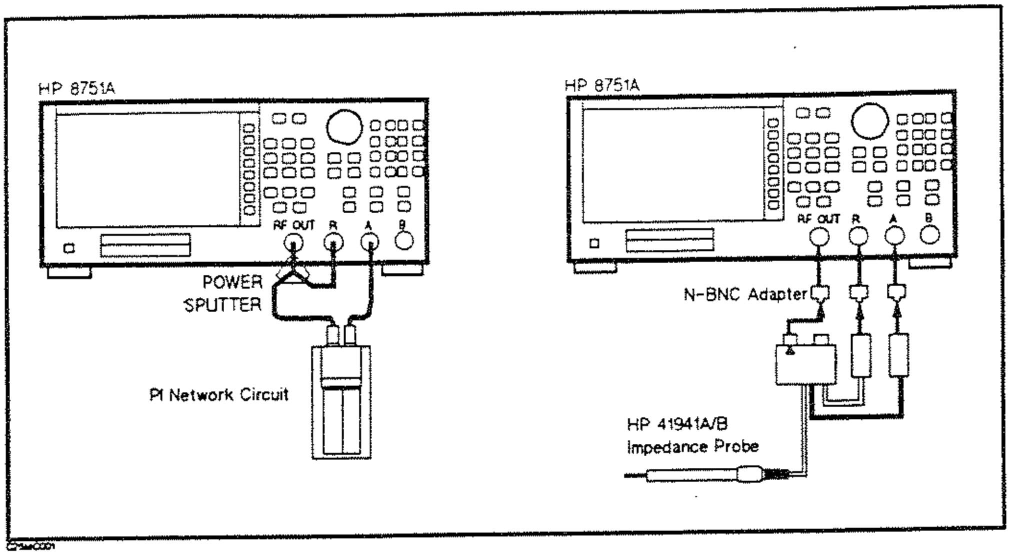


Figure 4-1. Measurement Configuration

Executing the SAMPLE PROGRAM

4. Insert diskette into the disk drive.
5. Load program. Press (SYSTEM) IBASIC FILE UTILITY GET. When you use a π-network circuit, enter GET "ZPROBE_CAL" then press DONE or (Return).
6. Run program. Press RUN softkey from front-panel, or type RUN then press Return from keyboard.
7. Enter constants.

   Pre-defined standard values are displayed on bottom half of the display.

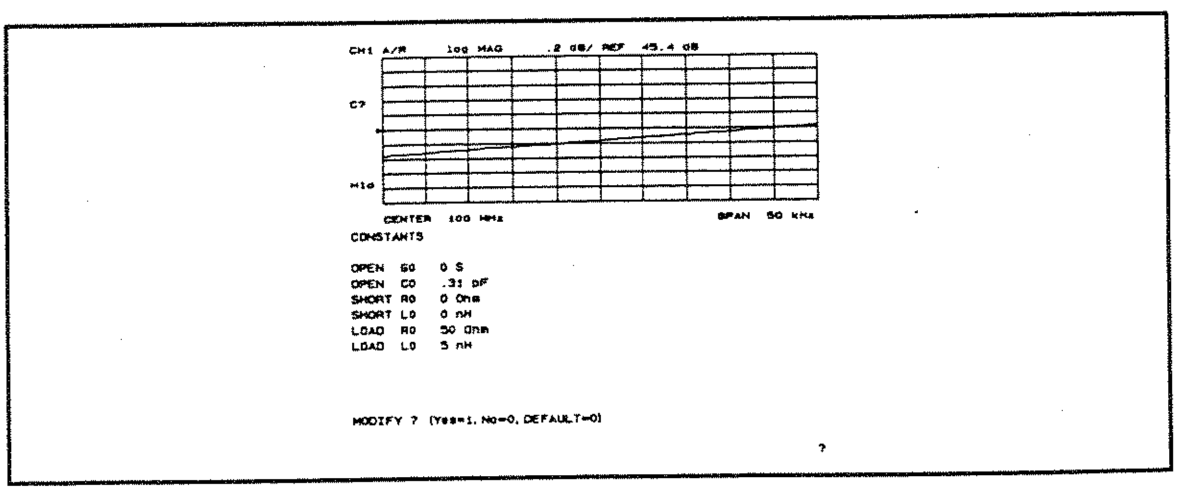


Figure 4-2. Standard Value Setting Menu

If you use the default value, just press the (X1) or (Return) key. To change constants:

a. Type 1, the press x1 or Return to modify standard values.

b. HP 8751A prompts for new standard value.
Enter new standard value by using numeric keys.
If you do not want to change the value, just press (X1) or (Return) for each standard.

After modification of standard values, HP 8751A asks you saving new data to file. If you want to save modified data, press (X1) or (Return) key. Saved data is used as default when you run program next tome. If you want to use pre-defined data, purge files of "PI_DATA" in a case of "PI_CAL", or "Z_DAT" in a case of "ZPROBE_CAL" from disk.

8. Connect Standards and measure.

OPEN	Connect nothing (π-network) or OS calibration standard (impedance probe), then press OPEN. When completed, double parentheses enclose the OPEN softkey label.
SHORT	Connect a short bar (π-network) or 0 ohm calibration standard (impedance probe), then press SHORT.
LOAD(50 Ω)	Connect a 50 Ω standard (both), then press LOAD. When completed, double parentheses enclose the LOAD softkey label.

To abort calibration, press CAL BREAK. The program will be terminated.

9. Complete measuring standards.
Press DONE: 3 TERM CAL to complete calibration.

Message, "COMPUTING CAL COEFFICIENTS" will be displayed while the HP 8751A is calculating the calibration coefficients. After computation, calibration is completed with message and the HP 8751A gets ready for measurement, and then, the sample program is terminated.

Measurement

After running the sample program, the HP 8751A is calibrated and you can measure the crystal resonator. This section discusses how to measure the crystal resonator's impedance and admittance characteristics using the HP 8751A gain-phase analyzer.

Using the π-Network Circuit

Use the impedance conversion function of the HP 8751A when using the π-network circuit.

To see the characteristics of a crystal resonator in impedance format, press (MEAS) CONVERSION Z: Trans.

To see the characteristics of a crystal resonator in admittance format, press (MEAS) CONVERSION Y: Trans.

Using the Impedance Probe

When you use the HP41941A/B impedance probe, conversion function is not necessary. Because the result is already display by impedance. If you want to read the value by marker directly, the HP 8751A must be set to the (FORMAT) LIN MAG format.

To see the characteristics of a crystal resonator in impedance format, press (FORMAT) LOG MAG.

To see the characteristics of a crystal resonator in admittance format, press (FORMAT) LOG MAG, and (MEAS) CONVERSION 1/S.

Actual Data for Standard

This section describes about the standard values used in the sample program.

π-Network Circuit

Figure 4-3 shows a standard model for standards of π-network circuit.

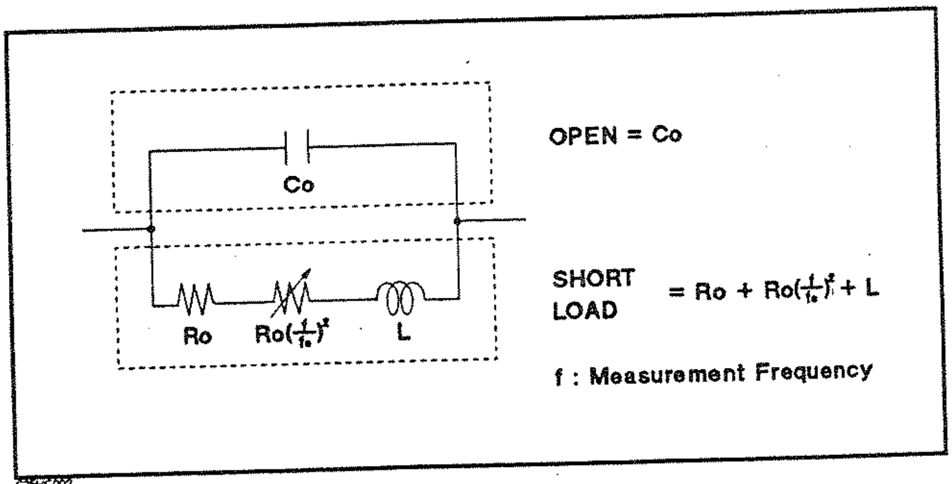


Figure 4-3. Equivalent Circuit of Standards

In the sample program, the default standard values are as follows:

Table 4-1. Default Values of the Standard for π-Network Circuit

Parameter	Standard Value		
	OPEN	SHORT	LOAD
C_0	0.1 pF	—	—
R_0	—	1 $\mu\Omega$	50 Ω
L	—	2 nH	8 nH
f_c	—	1.2 GHz	1.2 GHz

Impedance Probe

The reference values for the standard for HP 41941A/B impedance probe are given on the HP 41941A/B Operation Note. The sample program uses this data for the default values.

Sample Program List

PI_CAL

```
10 !**************************************************
20 !*
30 !* FILE:          PI_CAL
40 !* DESCRIPTION:   PI NETWORK FIXTURE CALIBRATION
50 !*                PROGRAM
60 !* AUTHOR:        MOTOHIRO KAMEDA,YHP
70 !* CREATED:       THU NOV 7 1991
80 !* MODIFIED:      WED FEB 10 1993
90 !* PRODUCT:       HP87510A
100 !* REVISION:      1.01
110 !*
120 !*   (c) Copyright 1992, 1993, Hewlett-Packard Co,
130 !*              All right reserved.
140 !*
150 !*
160 !*  Customer shall have the personal, non-
170 !* transferable rights to use, copy or modify
180 !* this SAMPLE PROGRAM for Customer's internal
190 !* operations.  Customer shall use the SAMPLE
200 !* PROGRAM solely and exclusively for its own
210 !* purpose and shall not license, lease, market
220 !* or distribute the SAMPLE PROGRAM or modification
230 !* or any part thereof.
240 !*
250 !*  HP shall not be liable for the quality,
260 !* performance or behavior of the SAMPLE PROGRAM.
270 !* HP especially disclaims that the operation of
280 !* the SAMPLE PROGRAM shall be uninterrupted or
290 !* error free.  This SAMPLE PROGRAM is provided
300 !* AS IS.
310 !*
320 !*  HP DISCLAIMS THE IMPLIED WARRANTIES OF
330 !* MARCHANTABILITY AND FITNESS FOR A PARTICULAR
340 !* PURPOSE.
350 !*
360 !*  HP shall not be liable for any infringement
370 !* of any patent, trademark, copyright or other
380 !* proprietary rights by the SAMPLE PROGRAM or
390 !* its use.  HP does not warrant that the SAMPLE
400 !* PROGRAM is free from infringements or such
410 !* rights of third parties.  However, HP will not
420 !* knowingly infringe or deliver a software that
430 !* infringes the patent, trademark, copyright or
440 !* other proprietary right of a third party.
450 !*
460 !**************************************************
```

```
470 !
480 !!!!!!!!!!!!!!!!!!!!
490 !!  MAIN ROUTINE  !!
500 !!!!!!!!!!!!!!!!!!!!
510 Main_pi:!
520 !
530 ! DECLARATIONS
540 !
550   INTEGER Yes_pi,No_pi,Ans_pi
560     Yes_pi=1
570     No_pi=0
580   INTEGER Open_pi,Short_pi,Load_pi
590     Open_pi=1
600     Short_pi=2
610     Load_pi=3
620     Maxstd_pi=3
630   INTEGER RO_pi,CO_pi,LO_pi,Fc_pi
640     RO_pi=1
650     CO_pi=2
660     LO_pi=3
670     Fc_pi=4
680     Maxele_pi=4
690   INTEGER Real_pi,Imag_pi
700     Real_pi=1
710     Imag_pi=2
720   !
730   !
740   !
750       ! I/O
760     Isc_pi=8                              ! SELECT CODE
770     ASSIGN @Hp87510_pi TO 800             ! ASCII I/O
780     ASSIGN @Hp87510b_pi TO 800;FORMAT OFF ! BINARY I/O
790       ! DATA BUCK-UP FILE
800     File_pi$="PI_DATA"
810       ! NUMBER OF POINTS (NOP)
820     INTEGER Nop_pi
830       ! FREQUENCY (801 IS MAXIMUM OF NOP)
840     DIM Freq_pi(1:801)
850       ! ACTUAL COMPLEX DATA (POINT, Real OR Imag)
860     DIM Actopen_pi(1:801,1:2)
870     DIM Actshort_pi(1:801,1:2)
880     DIM Actload_pi(1:801,1:2)
890       ! EQUIVALENT CIRCUIT CONSTANTS
900     REAL Const_pi(1:3,1:4)  ! (STD TYPE,L C R Fc)
910 !
920 ! BEGIN EXECUTION
930 !
940     GOSUB Setup_pi
950     GOSUB Ckt_const_pi
960     !
970     GOSUB Meas_pi
```

```
980      GOSUB Calc_pi
990      !
1000      DISP "CAL DONE."
1010      GOSUB Quit_pi
1020      !
1030 Main_end_pi:!
1040 STOP
1050 !
1060 !!!!!!!!!!!!!!!!!!!!!!!!
1070 !!  SET UP INSTRUMENT !!
1080 !!!!!!!!!!!!!!!!!!!!!!!!
1090 Setup_pi:!
1100      OUTPUT @Hp87510_pi;"DISAHIHB"    ! HALF BASIC
1110      DISP "WAIT A MINUTE."
1120      !
1130      ! SETTING INSTRUMENTS
1140      !
1150      OUTPUT @Hp87510_pi;"HOLD"  ! TRIGGER HOLD
1160      OUTPUT @Hp87510_pi;"FORM3" ! DATA FORMAT
1170      OUTPUT @Hp87510_pi;"BEEPDONE OFF" ! BEEP OFF
1180      !
1190      ! GET NUMBER OF POINTS
1200      !
1210      OUTPUT @Hp87510_pi;"POIN?" ! NUMBER OF POINTS
1220      ENTER @Hp87510_pi;Nop_pi      !
1230      !
1240      ! GET FREQUENCY DATA
1250      !
1260      OUTPUT @Hp87510_pi;"OUTPSTIM?"
1270      ENTER @Hp87510_pi USING "%,8A";A_pi$  ! HEADER
1280      FOR I_pi=1 TO Nop_pi
1290        ENTER @Hp87510b_pi;Freq_pi(I_pi)       ! BINARY I/O
1300      NEXT I_pi
1310      ENTER @Hp87510_pi USING "%,A";B_pi$   ! LF^EOI
1320      !
1330 Setup_end_pi:!
1340 RETURN
1350 !
1360 !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
1370 !!  EQUIVALENT CIRCUIT CONSTANTS  !!
1380 !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
1390 Ckt_const_pi:!
1400    !
1410    !  DEFAULT CONSTANTS SETTING
1420    !
1430      GOSUB Init_const_pi
1440    !
1450    !  LOOP
1460    !
1470      Modify_pi=No_pi
1480      LOOP
```

```
1490      !
1500      !  DISPLAY CONSTANTS
1510      !
1520        PRINT "CONSTANTS"
1530        PRINT ""
1540        PRINT "OPEN  CO",Const_pi(Open_pi,CO_pi);"pF"
1550        PRINT "SHORT RO",Const_pi(Short_pi,RO_pi);"Ohm"
1560        PRINT "SHORT LO",Const_pi(Short_pi,LO_pi);"nH"
1570        PRINT "LOAD  RO",Const_pi(Load_pi,RO_pi);"Ohm"
1580        PRINT "LOAD  LO",Const_pi(Load_pi,LO_pi);"nH"
1590      !
1600      ! CONFIRM
1610      !
1620        Ans_pi=No_pi
1630        INPUT "MODIFY ? (Yes=1,No=0,DEFAULT=0)",Ans_pi
1640    EXIT IF Ans_piYes_pi
1650      !
1660      ! MODIFY
1670      !
1680        Modify_pi=Yes_pi
1690        !
1700        INPUT "OPEN CO (pF)",Const_pi(Open_pi,CO_pi)
1710        !
1720        INPUT "SHORT RO (Ohm)",Const_pi(Short_pi,RO_pi)
1730        INPUT "SHORT LO (nH)",Const_pi(Short_pi,LO_pi)
1740        !
1750        INPUT "LOAD RO (Ohm)",Const_pi(Load_pi,RO_pi)
1760        INPUT "LOAD LO (nH)",Const_pi(Load_pi,LO_pi)
1770        !
1780    END LOOP
1790  !
1800  !  RE-SAVE BACK-UP DATA FILE
1810  !
1820    IF Modify_pi THEN GOSUB Backup_pi
1830  !
1840  !  UNIT CONVERSION
1850  !
1860          ! pF --> F
1870    Const_pi(Open_pi,CO_pi)=Const_pi(Open_pi,CO_pi)*1.E-12
1880          ! nH --> H
1890    Const_pi(Short_pi,LO_pi)=Const_pi(Short_pi,LO_pi)*1.E-9
1900    Const_pi(Load_pi,LO_pi)=Const_pi(Load_pi,LO_pi)*1.E-9
1910  !
1920  ! NORMALIZE BY CHARACTERISTIC IMPEDANCE
1930  !
1940    REAL ZO_pi                    !
1950    OUTPUT @Hp87510_pi;"SETZ?" ! CHARACTERISTIC
1960    ENTER @Hp87510_pi;ZO_pi       !   IMPEDANCE
1970      !
1980    Const_pi(Open_pi,CO_pi)=Const_pi(Open_pi,CO_pi)*ZO_pi      !
1990    Const_pi(Short_pi,RO_pi)=Const_pi(Short_pi,RO_pi)/ZO_pi    !
```

```
2000     Const_pi(Short_pi,LO_pi)=Const_pi(Short_pi,LO_pi)/ZO_pi     !
2010     Const_pi(Load_pi,RO_pi)=Const_pi(Load_pi,RO_pi)/ZO_pi       !
2020     Const_pi(Load_pi,LO_pi)=Const_pi(Load_pi,LO_pi)/ZO_pi       !
2030   !
2040 !
2050 RETURN
2060 !
2070 !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
2080 !!  GET CONSTANTS FROM BACK-UP DATA FILE  !!
2090 !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
2100 Init_const_pi:!
2110     ON ERROR GOTO Cannot_open_pi
2120       !
2130       !  FROM BACK-UP DATA FILE
2140       !
2150         ASSIGN @File_pi TO File_pi$  ! FILE OPEN
2160         ENTER @File_pi;Const_pi(*)   ! GET DATA
2170         ASSIGN @File_pi TO *      ! FILE CLOSE
2180         OFF ERROR
2190         GOTO Getdata_end_pi
2200 Cannot_open_pi:    !
2210       !
2220       ! DEFAULT CONSTANTS WHEN CAN'T OPEN DATA FILE
2230       !
2240         OFF ERROR
2250         Const_pi(Open_pi,CO_pi)=.1        ! pF
2260                                   !
2270         Const_pi(Short_pi,RO_pi)=1.E-6   ! Ohm
2280         Const_pi(Short_pi,LO_pi)=2.      ! nH
2290         Const_pi(Short_pi,Fc_pi)=1.2E+9  ! Hz
2300                                   !
2310         Const_pi(Load_pi,RO_pi)=50.      ! Ohm
2320         Const_pi(Load_pi,LO_pi)=8.       ! nH
2330         Const_pi(Load_pi,Fc_pi)=1.2E+9   ! Hz
2340 Getdata_end_pi:    !
2350 RETURN
2360 !
2370 !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
2380 !!  RE-SAVE BACK-UP DATA FILE  !!
2390 !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
2400 Backup_pi:!
2410     Ans_pi=Yes_pi
2420     INPUT "SAVE THOSE DATA ? (Yes=1,No=0,DEFAULT=1)",Ans_pi
2430     IF Ans_pi=No_pi THEN RETURN
2440     !
2450   ON ERROR GOSUB Creatfile_pi
2460     ASSIGN @File_pi TO File_pi$    ! OPEN FILE
2470   OFF ERROR
2480     !
2490   ON ERROR GOTO Create_err_pi
2500     OUTPUT @File_pi;Const_pi(*)    ! WRITE DATA
```

```
2510     OUTPUT @File_pi;END
2520     ASSIGN @File_pi TO *         ! CLOSE FILE
2530     OFF ERROR
2540     GOTO Backup_end_pi
2550 Create_err_pi:  !
2560     OFF ERROR
2570     PRINT "CAN'T CREATE BACK-UP DATA FILE."
2580 Backup_end_pi:  !
2590 RETURN
2600 !
2610 Creatfile_pi:!
2620       ! REAL IS 8 BYTES
2630     CREATE BDAT File_pi$,Maxstd_pi*Maxele_pi,8
2640 RETURN
2650 !
2660 !!!!!!!!!!!!!!!
2670 !!  MEASURE  !!
2680 !!!!!!!!!!!!!!!
2690 Meas_pi:!
2700   INTEGER True_pi,False_pi
2710     True_pi=1
2720     False_pi=0
2730   INTEGER Open_done_pi,Short_done_pi,Load_done_pi
2740     Open_done_pi=False_pi
2750     Short_done_pi=False_pi
2760     Load_done_pi=False_pi
2770   !
2780   !  DISPLAY USER SOFT-KEY
2790   !
2800     OFF KEY
2810     OUTPUT @Hp87510_pi;"KEY 44"
2820     OUTPUT @Hp87510_pi;"KEY 0"
2830     OUTPUT @Hp87510_pi;"KEY 7"
2840   !
2850   !  MEASUREMENT BEGINS
2860   !
2870     OUTPUT @Hp87510_pi;"CALIS111" ! BEGIN CALIBRATION
2880 Meas_begin_pi:  !
2890     !
2900     ! SETTING USER SOFT-KEY
2910     !
2920       IF Open_done_pi THEN
2930         ON KEY 1 LABEL "  ((OPEN))" GOTO Meas_open_pi
2940       ELSE
2950         ON KEY 1 LABEL "    OPEN   " GOTO Meas_open_pi
2960       END IF
2970       !
2980       IF Short_done_pi THEN
2990         ON KEY 2 LABEL " ((SHORT))" GOTO Meas_short_pi
3000       ELSE
3010         ON KEY 2 LABEL "   SHORT   " GOTO Meas_short_pi
```

```
3020         END IF
3030         !
3040         IF Load_done_pi THEN
3050           ON KEY 3 LABEL "  ((LOAD))" GOTO Meas_load_pi
3060         ELSE
3070           ON KEY 3 LABEL "    LOAD  " GOTO Meas_load_pi
3080         END IF
3090         !
3100         ON KEY 5 LABEL " CAL BREAK" GOSUB Break_pi
3110         !
3120         All_done_pi=Open_done_pi*Short_done_pi*Load_done_pi
3130         IF All_done_pi THEN
3140           ON KEY 8 LABEL "     DONE:3 TERM CAL" GOTO Meas_end_pi
3150           DISP "PRESS 'DONE' IF FINISHED WITH CAL."
3160         ELSE
3170           OFF KEY 8
3180           DISP "CONNECT STD THEN PRESS KEY TO MEASURE."
3190         END IF
3200         !
3210         GOTO 3210    ! WAITING SOFT-KEY INPUT
3220     !
3230     !  MEASURE OPEN STANDARD  !!
3240     !
3250 Meas_open_pi:  !
3260       DISP "WAIT--MEASURING CAL STANDARD."
3270       Open_done_pi=False_pi     ! RESET FLAG
3280       GOSUB Setsrq_pi
3290       ON INTR Isc_pi GOTO Cal_done_1_pi
3300       ENABLE INTR Isc_pi;2
3310       OUTPUT @Hp87510_pi;"CLASS11A" ! MEASURE
3320       GOTO 3320           ! WAITING CAL-DONE INTRRUPT
3330 Cal_done_1_pi:  !
3340       GOSUB Resetsrq_pi
3350       Open_done_pi=True_pi      ! SET FLAG
3360       BEEP 500,.2
3370       GOTO Meas_begin_pi
3380     !
3390     !  MEASURE SHORT STANDARD
3400     !
3410 Meas_short_pi:  !
3420       DISP "WAIT--MEASURING CAL STANDARD."
3430       Short_done_pi=False_pi    ! RESET FLAG
3440       GOSUB Setsrq_pi
3450       ON INTR Isc_pi GOTO Cal_done_2_pi
3460       ENABLE INTR Isc_pi;2
3470       OUTPUT @Hp87510_pi;"CLASS11B" ! MEASURE
3480       GOTO 3480           ! WAITING CAL-DONE INTRRUPT
3490 Cal_done_2_pi:  !
3500       GOSUB Resetsrq_pi
3510       Short_done_pi=True_pi     ! SET FLAG
3520       BEEP 500,.2
```

```
3530      GOTO Meas_begin_pi
3540    !
3550    !  MEASURE LOAD STANDARD
3560    !
3570 Meas_load_pi:  !
3580      DISP "WAIT--MEASURING CAL STANDARD."
3590      Load_done_pi=False_pi      ! RESET FLAG
3600      GOSUB Setsrq_pi
3610      ON INTR Isc_pi GOTO Cal_done_3_pi
3620      ENABLE INTR Isc_pi;2
3630      OUTPUT @Hp87510_pi;"CLASS11C" ! MEASURE
3640      GOTO 3640           ! WAITING CAL-DONE INTRRUPT
3650 Cal_done_3_pi:  !
3660      GOSUB Resetsrq_pi
3670      Load_done_pi=True_pi       ! SET FLAG
3680      BEEP 500,.2
3690      GOTO Meas_begin_pi
3700    !
3710    !  CAL BREAK
3720    !
3730 Break_pi:  !
3740      DISP "CAL BREAK."
3750      GOSUB Quit_pi
3760      STOP
3770    !
3780 Meas_end_pi:!
3790 OFF KEY
3800 RETURN
3810 !
3820 !!!!!!!!!!!!!!!!!!!
3830 !!  CALCULATION  !!
3840 !!!!!!!!!!!!!!!!!!!
3850 Calc_pi:!
3860   DISP "COMPUTING CAL COEFFICIENTS."
3870   REAL Re_pi,Im_pi,Amp_pi
3880   !
3890   ! CALCULATE ACTUAL DATA
3900   !
3910   ! S21A=2Ya/(1+2Ya)
3920   !
3930     !
3940     ! ACTUAL OPEN DATA
3950     !
3960     FOR I_pi=1 TO Nop_pi
3970       Re_pi=0.
3980       Im_pi=(-1./(2.*PI*Freq_pi(I_pi)*Const_pi(Open_pi,C0_pi)))
3990       Amp_pi=(Re_pi+2.)^2+Im_pi^2
4000       Actopen_pi(I_pi,Real_pi)=2.*(Re_pi+2.)/Amp_pi
4010       Actopen_pi(I_pi,Imag_pi)=-2.*Im_pi/Amp_pi
4020     NEXT I_pi
4030     !
```

```
4040      ! ACTUAL SHORT DATA
4050      !
4060      FOR I_pi=1 TO Nop_pi
4070        Re_pi=Const_pi(Short_pi,R0_pi)*(1.+(Freq_pi(I_pi)/
Const_pi(Short_pi,Fc_pi))^2)
4080        Im_pi=2.*PI*Freq_pi(I_pi)*Const_pi(Short_pi,L0_pi)
4090        Amp_pi=(Re_pi+2.)^2+Im_pi^2
4100        Actshort_pi(I_pi,Real_pi)=2.*(Re_pi+2.)/Amp_pi
4110        Actshort_pi(I_pi,Imag_pi)=-2.*Im_pi/Amp_pi
4120      NEXT I_pi
4130      !
4140      ! ACTUAL LOAD DATA
4150      !
4160      FOR I_pi=1 TO Nop_pi    ! ACTUAL DATA FOR LOAD
4170        Re_pi=Const_pi(Load_pi,R0_pi)*(1.+(Freq_pi(I_pi)/
Const_pi(Load_pi,Fc_pi))^2)
4180        Im_pi=2.*PI*Freq_pi(I_pi)*Const_pi(Load_pi,L0_pi)
4190        Amp_pi=(Re_pi+2.)^2+Im_pi^2
4200        Actload_pi(I_pi,Real_pi)=2.*(Re_pi+2.)/Amp_pi
4210        Actload_pi(I_pi,Imag_pi)=-2.*Im_pi/Amp_pi
4220      NEXT I_pi
4230    !
4240    !  SEND ACTUAL DATA
4250    !
4260      Head_pi$="#6"&IVAL$(16*Nop_pi,10)  ! MAKE HEADER
4270      !
4280      ! SEND OPEN DATA
4290      !
4300        OUTPUT @Hp87510_pi;"INPUOPEA ";
4310        OUTPUT @Hp87510_pi;Head_pi$;
4320        FOR I_pi=1 TO Nop_pi
4330          OUTPUT @Hp87510b_pi;Actopen_pi(I_pi,Real_pi),
Actopen_pi(I_pi,Imag_pi);
4340        NEXT I_pi
4350        OUTPUT @Hp87510_pi;"",END
4360      !
4370      ! SEND SHORT DATA
4380      !
4390        OUTPUT @Hp87510_pi;"INPUSHOA "; ! SHORT DATA
4400        OUTPUT @Hp87510_pi;Head_pi$;
4410        FOR I_pi=1 TO Nop_pi
4420          OUTPUT @Hp87510b_pi;Actshort_pi(I_pi,Real_pi),
Actshort_pi(I_pi,Imag_pi);
4430        NEXT I_pi
4440        OUTPUT @Hp87510_pi;"",END
4450      !
4460      ! SEND LOAD DATA
4470      !
4480        OUTPUT @Hp87510_pi;"INPULOAA "; ! LOAD DATA
4490        OUTPUT @Hp87510_pi;Head_pi$;
4500        FOR I_pi=1 TO Nop_pi
```

```
4510         OUTPUT @Hp87510b_pi;Actload_pi(I_pi,Real_pi),
Actload_pi(I_pi,Imag_pi);
4520       NEXT I_pi
4530       OUTPUT @Hp87510_pi;"",END
4540   !
4550   !  CALCULATE COEFFICIENTS
4560   !
4570     OUTPUT @Hp87510_pi;"INPUD"
4580   !
4590 Calc_end_pi:!
4600 RETURN
4610 !
4620 !!!!!!!!!!!!!!!!!!!!!!
4630 !!  EXIT PROCEDURE  !!
4640 !!!!!!!!!!!!!!!!!!!!!!
4650 Quit_pi:!
4660     OFF KEY
4670  !   OUTPUT @Hp87510;"*CLS"
4680  !   OUTPUT @Hp87510;"ESNB 0"
4690  !   OUTPUT @Hp87510;"*SRE 0"
4700     OUTPUT @Hp87510_pi;"FORM4"
4710  !   OUTPUT @Hp87510;"CONT"
4720  !   OUTPUT @Hp87510_pi;"BEEPDONE ON"
4730  !   OUTPUT @Hp87510_pi;";DISABASS"
4740     BEEP 500,.2
4750 RETURN
4760 !!!!!!!!!!!!!!
4770 !!  SET SRQ  !!
4780 !!!!!!!!!!!!!!
4790 Setsrq_pi:!
4800     OUTPUT @Hp87510_pi;"*CLS"   ! SETTING CAL-DONE INTR
4810     OUTPUT @Hp87510_pi;"ESNB 1"
4820     OUTPUT @Hp87510_pi;"*SRE 4"
4830 RETURN
4840 !
4850 Resetsrq_pi:!
4860     OUTPUT @Hp87510_pi;"*CLS"
4870     OUTPUT @Hp87510_pi;"ESNB 0"
4880     OUTPUT @Hp87510_pi;"*SRE 0"
4890 RETURN
4900 !
4910 !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
4920 END
```

ZPROBE_CAL

```
10 !*************************************************
20 !*
30 !* FILE:         ZPROBE_CAL
40 !* DESCRIPTION:  IMPEDANCE PROBE CALIBRATION
50 !*              PROGRAM
60 !* AUTHER:       MOTOHIRO KAMEDA,YHP
70 !* CREATED:      MON NOV 29 1991
80 !* MODIFIED:     WED DEC 4 1991
90 !* PRODUCT:      HP87510A
100 !* REVISION:     1.0
110 !*
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430 !* infringes the patent, trademark, copyright or
440 !* other proprietary right of a third party.
450 !*
460 !*************************************************
470 !
480 !!!!!!!!!!!!!!!!!!!!
490 !!  MAIN ROUTINE  !!
```

```
500 !!!!!!!!!!!!!!!!!!!!
510 Main:!
520 !
530 ! DECLARATIONS
540 !
550   INTEGER Yes,No,Ans
560     Yes=1
570     No=0
580   INTEGER Open,Short,Load
590     Open=1
600     Short=2
610     Load=3
620     Maxstd=3
630   INTEGER R0,C0,L0,Fc
640     R0=1
650     C0=2
660     L0=3
670     G0=4
680     Maxele=4
690   INTEGER Real,Imag
700     Real=1
710     Imag=2
720   !
730   !
740   !
750       ! I/O
760     Isc=8                            ! SELECT CODE
770     ASSIGN @Hp87510 TO 800           ! ASCII I/O
780     ASSIGN @Hp87510b TO 800;FORMAT OFF ! BINARY I/O
790       ! DATA BUCK-UP FILE
800     File$="Z_DAT"
810       ! NUMBER OF POINTS (NOP)
820     INTEGER Nop
830       ! FREQUENCY (801 IS MAXIMUM OF NOP)
840     DIM Freq(1:801)
850       ! ACTUAL COMPLEX DATA (POINT, Real OR Imag)
860     DIM Actopen(1:801,1:2)
870     DIM Actshort(1:801,1:2)
880     DIM Actload(1:801,1:2)
890       ! EQUIVALENT CIRCUIT CONSTANTS
900     REAL Const(1:3,1:4)  ! (STD TYPE,L C R Fc)
910 !
920 ! BEGIN EXECUTION
930 !
940     GOSUB Setup
950     GOSUB Ckt_const
960     !
970     GOSUB Meas
980     GOSUB Calc
990     !
1000     DISP "CAL DONE."
```

```
1010     GOSUB Quit
1020     !
1030 Main_end:!
1040 STOP
1050 !
1060 !!!!!!!!!!!!!!!!!!!!!!!!
1070 !!  SET UP INSTRUMENT !!
1080 !!!!!!!!!!!!!!!!!!!!!!!!
1090 Setup:!
1100     OUTPUT @Hp87510;"DISAHIHB"    ! HALF BASIC
1110     DISP "WAIT A MINUTE."
1120     !
1130     ! SETTING INSTRUMENTS
1140     !
1150     OUTPUT @Hp87510;"HOLD"  ! TRIGGER HOLD
1160     OUTPUT @Hp87510;"FORM3" ! DATA FORMAT
1170     OUTPUT @Hp87510;"BEEPDONE OFF" ! BEEP OFF
1180     !
1190     ! GET NUMBER OF POINTS
1200     !
1210     OUTPUT @Hp87510;"POIN?" ! NUMBER OF POINTS
1220     ENTER @Hp87510;Nop      !
1230     !
1240     ! GET FREQUENCY DATA
1250     !
1260     OUTPUT @Hp87510;"OUTPSTIM?"
1270     ENTER @Hp87510 USING "%,8A";A$  ! HEADER
1280     FOR I=1 TO Nop
1290       ENTER @Hp87510b;Freq(I)       ! BINARY I/O
1300     NEXT I
1310     ENTER @Hp87510 USING "%,A";B$   ! LF^EOI
1320     !
1330 Setup_end:!
1340 RETURN
1350 !
1360 !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
1370 !!  EQUIVALENT CIRCUIT CONSTANTS  !!
1380 !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
1390 Ckt_const:!
1400   !
1410   !  DEFAULT CONSTANTS SETTING
1420   !
1430     GOSUB Init_const
1440   !
1450   !  LOOP
1460   !
1470     Modify=No
1480     LOOP
1490       !
1500       !  DISPLAY CONSTANTS
1510       !
```

```
1520         PRINT "CONSTANTS"
1530         PRINT ""
1540         PRINT "OPEN  GO",Const(Open,GO);"S"
1550         PRINT "OPEN  CO",Const(Open,CO);"pF"
1560         PRINT "SHORT RO",Const(Short,RO);"Ohm"
1570         PRINT "SHORT LO",Const(Short,LO);"nH"
1580         PRINT "LOAD  RO",Const(Load,RO);"Ohm"
1590         PRINT "LOAD  LO",Const(Load,LO);"nH"
1600       !
1610       ! CONFIRM
1620       !
1630         Ans=No
1640         INPUT "MODIFY ? (Yes=1,No=0,DEFAULT=0)",Ans
1650     EXIT IF AnsYes
1660       !
1670       ! MODIFY
1680       !
1690         Modify=Yes
1700         !
1710         INPUT "OPEN GO (S)",Const(Open,GO)
1720         INPUT "OPEN CO (pF)",Const(Open,CO)
1730         !
1740         INPUT "SHORT RO (Ohm)",Const(Short,RO)
1750         INPUT "SHORT LO (nH)",Const(Short,LO)
1760         !
1770         INPUT "LOAD RO (Ohm)",Const(Load,RO)
1780         INPUT "LOAD LO (nH)",Const(Load,LO)
1790         !
1800     END LOOP
1810   !
1820   !  RE-SAVE BACK-UP DATA FILE
1830   !
1840     IF Modify THEN GOSUB Backup
1850   !
1860   !  UNIT CONVERSION
1870   !
1880           ! pF --> F
1890     Const(Open,CO)=Const(Open,CO)*1.E-12
1900           ! nH --> H
1910     Const(Short,LO)=Const(Short,LO)*1.E-9
1920     Const(Load,LO)=Const(Load,LO)*1.E-9
1930   !
1940 Ckt_const_end:!
1950 RETURN
1960 !
1970 !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
1980 !!  GET CONSTANTS FROM BACK-UP DATA FILE  !!
1990 !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
2000 Init_const:!
2010      ON ERROR GOTO Cannot_open
2020        !
```

```
2030        !  FROM BACK-UP DATA FILE
2040        !
2050          ASSIGN @File TO File$  ! FILE OPEN
2060          ENTER @File;Const(*)   ! GET DATA
2070          ASSIGN @File TO *      ! FILE CLOSE
2080          OFF ERROR
2090          GOTO Getdata_end
2100 Cannot_open:     !
2110        !
2120        ! DEFAULT CONSTANTS WHEN CAN'T OPEN DATA FILE
2130        !
2140          OFF ERROR
2150          Const(Open,G0)=0.       ! S
2160          Const(Open,C0)=.31      ! pF
2170                                  !
2180          Const(Short,R0)=0.      ! Ohm
2190          Const(Short,L0)=0.      ! nH
2200                                  !
2210          Const(Load,R0)=50.      ! Ohm
2220          Const(Load,L0)=5.       ! nH
2230 Getdata_end:     ! .
2240     OFF ERROR
2250 RETURN
2260 !
2270 !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
2280 !!  RE-SAVE BACK-UP DATA FILE  !!
2290 !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
2300 Backup:!
2310     Ans=Yes
2320     INPUT "SAVE THOSE DATA ? (Yes=1,No=0,DEFAULT=1)",Ans
2330     IF Ans=No THEN GOTO Backup_end
2340     !
2350   ON ERROR GOSUB Creatfile
2360     ASSIGN @File TO File$    ! OPEN FILE
2370   OFF ERROR
2380     !
2390   ON ERROR GOTO Cannot_create
2400     OUTPUT @File;Const(*)    ! WRITE DATA
2410     OUTPUT @File;END
2420     ASSIGN @File TO *        ! FILE CLOSE
2430     OFF ERROR
2440     GOTO Backup_end
2450 Cannot_create:  !
2460     OFF ERROR
2470     PRINT "CAN'T CREATE BACK-UP DATA FILE."
2480 Backup_end:  !
2490 RETURN
2500 !
2510 Creatfile:!
2520       ! REAL IS 8 BYTES
2530     CREATE BDAT File$,Maxstd*Maxele,8
```

```
2540 RETURN
2550 !
2560 !!!!!!!!!!!!!!!
2570 !!  MEASURE  !!
2580 !!!!!!!!!!!!!!!
2590 Meas:!
2600   INTEGER True,False
2610     True=1
2620     False=0
2630   INTEGER Open_done,Short_done,Load_done
2640     Open_done=False
2650     Short_done=False
2660     Load_done=False
2670   !
2680   !  DISPLAY USER SOFT-KEY
2690   !
2700     OFF KEY
2710     OUTPUT @Hp87510;"KEY 44"
2720     OUTPUT @Hp87510;"KEY 0"
2730     OUTPUT @Hp87510;"KEY 7"
2740   !
2750   !  MEASUREMENT BEGINS
2760   !
2770     OUTPUT @Hp87510;"CALIS111" ! BEGIN CALIBRATION
2780 Meas_begin:  !
2790     !
2800     ! SETTING USER SOFT-KEY
2810     !
2820       IF Open_done THEN
2830         ON KEY 1 LABEL "  ((OPEN))" GOTO Meas_open
2840       ELSE
2850         ON KEY 1 LABEL "    OPEN   " GOTO Meas_open
2860       END IF
2870       !
2880       IF Short_done THEN
2890         ON KEY 2 LABEL " ((SHORT))" GOTO Meas_short
2900       ELSE
2910         ON KEY 2 LABEL "   SHORT   " GOTO Meas_short
2920       END IF
2930       !
2940       IF Load_done THEN
2950         ON KEY 3 LABEL "  ((LOAD))" GOTO Meas_load
2960       ELSE
2970         ON KEY 3 LABEL "    LOAD   " GOTO Meas_load
2980       END IF
2990       !
3000       ON KEY 5 LABEL " CAL BREAK" GOSUB Break
3010       !
3020       All_done=Open_done*Short_done*Load_done
3030       IF All_done THEN
3040         ON KEY 8 LABEL "     DONE:3 TERM CAL" GOTO Meas_end
```

```
3050          DISP "PRESS 'DONE' IF FINISHED WITH CAL."
3060        ELSE
3070          OFF KEY 8
3080          DISP "CONNECT STD THEN PRESS KEY TO MEASURE."
3090        END IF
3100        !
3110        GOTO 3110   ! WAITING SOFT-KEY INPUT
3120    !
3130    !  MEASURE OPEN STANDARD  !!
3140    !
3150 Meas_open:  !
3160      DISP "WAIT--MEASURING CAL STANDARD."
3170      Open_done=False    ! RESET FLAG
3180      GOSUB Setsrq
3190      ON INTR Isc GOTO Cal_done_1
3200      ENABLE INTR Isc;2
3210      OUTPUT @Hp87510;"CLASS11A" ! MEASURE
3220      GOTO 3220          ! WAITING CAL-DONE INTRRUPT
3230 Cal_done_1:  !
3240      GOSUB Resetsrq
3250      Open_done=True     ! SET FLAG
3260      BEEP 500,.2
3270      GOTO Meas_begin
3280    !
3290    !  MEASURE SHORT STANDARD
3300    !
3310 Meas_short:  !
3320      DISP "WAIT--MEASURING CAL STANDARD."
3330      Short_done=False   ! RESET FLAG
3340      GOSUB Setsrq
3350      ON INTR Isc GOTO Cal_done_2
3360      ENABLE INTR Isc;2
3370      OUTPUT @Hp87510;"CLASS11B" ! MEASURE
3380      GOTO 3380          ! WAITING CAL-DONE INTRRUPT
3390 Cal_done_2:  !
3400      GOSUB Resetsrq
3410      Short_done=True    ! SET FLAG
3420      BEEP 500,.2
3430      GOTO Meas_begin
3440    !
3450    !  MEASURE LOAD STANDARD
3460    !
3470 Meas_load:  !
3480      DISP "WAIT--MEASURING CAL STANDARD."
3490      Load_done=False    ! RESET FLAG
3500      GOSUB Setsrq
3510      ON INTR Isc GOTO Cal_done_3
3520      ENABLE INTR Isc;2
3530      OUTPUT @Hp87510;"CLASS11C" ! MEASURE
3540      GOTO 3540          ! WAITING CAL-DONE INTRRUPT
3550 Cal_done_3:  !
```

```
3560     GOSUB Resetsrq
3570     Load_done=True     ! SET FLAG
3580     BEEP 500,.2
3590     GOTO Meas_begin
3600   !
3610   !  CAL BREAK
3620   !
3630 Break:  !
3640     DISP "CAL BREAK."
3650     GOSUB Quit
3660     STOP
3670   !
3680 Meas_end:!
3690 OFF KEY
3700 RETURN
3710 !
3720 !!!!!!!!!!!!!!!!!!!
3730 !!  CALCULATION  !!
3740 !!!!!!!!!!!!!!!!!!!
3750 Calc:!
3760   DISP "COMPUTING CAL COEFFICIENTS."
3770   !
3780   ! CALCULATE ACTUAL DATA
3790   !
3800   ! S21A=2Ya/(1+2Ya)
3810   !
3820     !
3830     ! ACTUAL OPEN DATA
3840     !
3850     REAL Yre,Yim
3860     FOR I=1 TO Nop
3870       Yre=Const(Open,G0)
3880       Yim=2.*PI*Freq(I)*Const(Open,C0)
3890       Actopen(I,Real)=Yre/(Yre^2+Yim^2)
3900       Actopen(I,Imag)=-Yim/(Yre^2+Yim^2)
3910     NEXT I
3920     !
3930     ! ACTUAL SHORT DATA
3940     !
3950     FOR I=1 TO Nop
3960       Actshort(I,Real)=Const(Short,R0)
3970       Actshort(I,Imag)=2.*PI*Freq(I)*Const(Short,L0)
3980     NEXT I
3990     !
4000     ! ACTUAL LOAD DATA
4010     !
4020     FOR I=1 TO Nop    ! ACTUAL DATA FOR LOAD
4030       Actload(I,Imag)=2.*PI*Freq(I)*Const(Load,L0)
4040       Actload(I,Real)=Const(Load,R0)
4050     NEXT I
4060   !
```

```
4070   !  SEND ACTUAL DATA
4080   !
4090     Head$="#6"&IVAL$(16*Nop,10)  ! MAKE HEADER
4100     !
4110     ! SEND OPEN DATA
4120     !
4130       OUTPUT @Hp87510;"INPUOPEA ";
4140       OUTPUT @Hp87510;Head$;
4150       FOR I=1 TO Nop
4160         OUTPUT @Hp87510b;Actopen(I,Real),Actopen(I,Imag);
4170       NEXT I
4180       OUTPUT @Hp87510;"",END
4190     !
4200     ! SEND SHORT DATA
4210     !
4220       OUTPUT @Hp87510;"INPUSHOA "; ! SHORT DATA
4230       OUTPUT @Hp87510;Head$;
4240       FOR I=1 TO Nop
4250         OUTPUT @Hp87510b;Actshort(I,Real),Actshort(I,Imag);
4260       NEXT I
4270       OUTPUT @Hp87510;"",END
4280     !
4290     ! SEND LOAD DATA
4300     !
4310       OUTPUT @Hp87510;"INPULOAA "; ! LOAD DATA
4320       OUTPUT @Hp87510;Head$;
4330       FOR I=1 TO Nop
4340         OUTPUT @Hp87510b;Actload(I,Real),Actload(I,Imag);
4350       NEXT I
4360       OUTPUT @Hp87510;"",END
4370   !
4380   !  CALCULATE COEFFICIENTS
4390   !
4400     OUTPUT @Hp87510;"INPUD"
4410   !
4420 Calc_end:!
4430 RETURN
4440 !
4450 !!!!!!!!!!!!!!!!!!!!!!
4460 !!  EXIT PROSEDURE  !!
4470 !!!!!!!!!!!!!!!!!!!!!!
4480 Quit:!
4490     OFF KEY
4500     OUTPUT @Hp87510;"*CLS"
4510     OUTPUT @Hp87510;"ESNB 0"
4520     OUTPUT @Hp87510;"*SRE 0"
4530     OUTPUT @Hp87510;"FORM4"
4540     OUTPUT @Hp87510;"CONT"
4550     OUTPUT @Hp87510;"BEEPDONE ON"
4560     OUTPUT @Hp87510;";DISABASS"
4570     BEEP 500,.2
```

```
4580 RETURN
4590 !!!!!!!!!!!!!!!
4600 !!  SET SRQ  !!
4610 !!!!!!!!!!!!!!!
4620 Setsrq:!
4630     OUTPUT @Hp87510;"*CLS"   ! SETTING CAL-DONE INTR
4640     OUTPUT @Hp87510;"ESNB 1"
4650     OUTPUT @Hp87510;"*SRE 4"
4660 RETURN
4670 !
4680 Resetsrq:!
4690     OUTPUT @Hp87510;"*CLS"
4700     OUTPUT @Hp87510;"ESNB 0"
4710     OUTPUT @Hp87510;"*SRE 0"
4720 RETURN
4730 !
4740 !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
4750 END
```

HP 8751A Network Analyzer

Programming Manual Set

SERIAL NUMBERS

This manual applies directly to instruments with serial number prefix 3146. For additional important information about serial numbers, read "Serial Number" in the General Information section of the Operation Manual.

HEWLETT PACKARD

HP Part No. 08751-90013
Microfiche Part No. 08751-90063
Printed in Japan November 1991

Notice

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Using HP Instrument BASIC with the HP 8751A

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Manual Printing History

The manual printing date and part number indicate its current edition. The printing date changes when a new edition is printed. (Minor corrections and updates which are incorporated at reprint do not cause the date to change.) The manual part number changes when extensive technical changes are incorporated.

January 1991..... 1st. Edition

November 1991..... 2nd. Edition

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1

Welcome to HP Instrument BASIC

Welcome to HP Instrument BASIC.

This guide will help you to learn how to effectively use HP Instrument BASIC. It will help you to perform typical operations involving program creation, editing, and execution. It will also show you how to save and recall programs, and how to make the best use of HP Instrument BASIC's front-panel and keyboard interface.

If you are new to programming or to HP's dialect of BASIC, take the time to read this guide and perform the exercises. For many users, this will provide all the information that is needed to create and run programs. If you are familiar with any HP 9000 Series 200/300 BASIC, be sure to read the section "For Experienced Programmers" in this chapter.

Overview of HP Instrument BASIC

When installed in your instrument, HP Instrument BASIC can be used for a wide range of applications from simple recording and playback of measurement sequences to remote control of other instruments.

HP Instrument BASIC is a complete system controller residing inside your instrument. It communicates with your instrument via HP-IB commands and can also communicate with other instruments, computers, and peripherals over the HP-IB interface.

Using HP Instrument BASIC

HP Instrument BASIC can run applications written to enhance your instrument's performance.

HP Instrument BASIC's programming interface includes an editor and a set of programming utilities. The utilities allow you to perform disk I/O, renumber, secure, or delete all or part of your program.

The HP Instrument BASIC command set is similar to the command set of HP 9000 Series 200/300 BASIC. In fact, HP Instrument BASIC programs can be run on any HP BASIC workstation with few if any changes. Porting information can be found in the *HP Instrument BASIC Programming Techniques*.

How to Use This Manual

The tasks in each chapter, when performed in sequential order, demonstrate a typical use of HP Instrument BASIC and covers the most common tasks. Read the overview and try the sample tasks in each chapter to get you started. For more background information, you can read further into each chapter; otherwise, go to the next exercises and continue the session. You can refer back to the individual chapters for more information as necessary. Here is a brief guide to help you locate the necessary information in this manual and the other HP Instrument BASIC manuals.

- Chapter 2 describes how to connect a keyboard. This chapter also provides information on retrofitting Option 002 HP Instrument BASIC if your HP 8751A does not have HP Instrument BASIC installed.
- Chapter 3 introduces the HP 8751A's Instrument BASIC system.
- Chapters 4 and 5 show creating, getting, and saving programs to teach you front panel and keyboard operation.
- Chapter 6 introduces you to the editing environment.
- Chapter 7 describes interfacing features for display, I/O port, external connecter to trigger RUN/CONTinue of a program, and the built-in disk drive.
- Chapter 8 introduces special features for auto loading a program, and the On Key Label function (softkeys defined in a program). This chapter also describes techniques for speeding up your programs.
- Chapter 9 provides a handy reference guide to HP 8751A Instrument BASIC's key definitions for the HP-HIL keyboard.
- Chapter 10 provides application programs and useful techniques for developing programs.
- Chapter 11 summarizes the unique features specified for the HP 8751A.
- The Appendix provides references for BASIC commands and HP-IB commands specific to HP 8751A's Instrument BASIC.
- IF you want to port HP 9000 Series 200/300 BASIC programs to HP Instrument BASIC refer to Chapter 10, "Keyword Guide to Porting", in the *HP Instrument BASIC Programming Techniques*.

For Experienced Programmers

If you are familiar with HP 9000 Series 200/300 BASIC, this manual is a good starting point to introduce you to the Instrument BASIC operating and programming environment, and to provide you with examples of intermediate and advanced HP Instrument BASIC programs.

You will find detailed information on HP Instrument BASIC in the following books:

- *HP Instrument BASIC Programming Techniques*
- *HP Instrument BASIC Interfacing Techniques*
- *HP Instrument BASIC Language Reference*

including keyword descriptions, error messages, interface specifics, and programming techniques.

2

Preparing to Use HP Instrument BASIC

This chapter will give you the information you need to use HP Instrument BASIC.

Connecting the Keyboard

Note Turn off your instrument before inserting or removing the keyboard connector.

When you use HP Instrument BASIC, connect the furnished keyboard to the HP-HIL connector on the front panel as shown in Figure 2-1

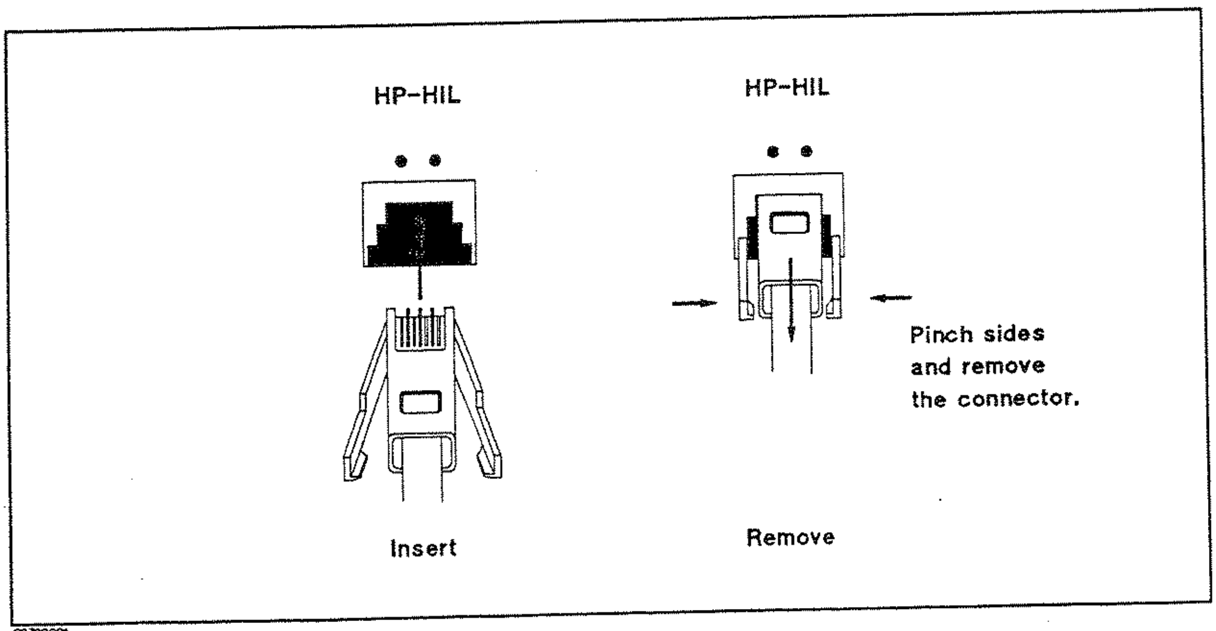


Figure 2-1. Connecting the HP-HIL Keyboard

If Your HP 8751A Does Not Have HP Instrument BASIC Installed

Option 002 HP Instrument BASIC can be retrofitted using the HP 16298D HP Instrument BASIC Retrofit Kit.

Ordering Information

Product Number	Description
HP 16298D	HP Instrument BASIC Retrofit Kit ROM Sets RAM Set Key Board (with cable and template) HP Instrument BASIC Users Handbook (This manual set describes the HP Instrument BASIC programming language. This manual set assumes that you have read *Using HP Instrument BASIC with the HP 8751A.*)
Option 910	Add *HP 8751A Programing Manual Set* (this manual)
Option 008	Add *HP 8751A Programing Manual Set* (Japanese)
Option 009	Delete Key Board

For more information, contact your nearest Hewlett-Packard office.

3

Introduction to the System

This chapter describes using the display and the keyboard. Read this chapter before using Instrument BASIC with the HP 8751A for the first time. The topics covered in this chapter are:

- Notation used in this Manual
- Turning on the Analyzer
- Allocating screen area for BASIC
- Using the keyboard
- Entering BASIC Statements from the Front Panel Keys

Notation Used in this Manual

The following list describes the notation used in this manual.

COMPUTER FONT	This is either what you see as the system's response to your commands, or this is what you should type in exactly as shown in an example.
italic font	When you see examples with italics in them, you have to replace the italic words with your own (that is, if the italic word is *file_name*, then you supply the real file name in place of *file_name*).
(Key)	If you see a word in a box, it refers to an actual key on your keyboard or to an actual key on the front panel of the HP 8751A; for example, look on your keyboard for (Break) (upper left on the HP-HIL keyboard).
(Shift)-(key)	When a key is prefaced with (Shift)-, it means you press the (Shift) key, and hold it down while pressing the next key (like you do when shifting case).
Key	If you see a word on a half-tone background, it refers to a softkey on the front panel of the HP 8751A.

to the System

Using HP Instrument BASIC with the HP 8751A for the First Time

Note

If you have not used the HP 8751A, read the *User's Guide* in the *Operation Manual* and study its contents before reading this manual.

Turning on the Analyzer

The analyzer will display the message "INSTALLED OPTIONS: 002" on the screen when you turn on the analyzer, if your HP 8751A has Option 002 HP Instrument BASIC installed.

If this message is not displayed, the analyzer does not have Option 002 installed. See "If Your HP 8751A Does Not Have HP Instrument BASIC Installed" in Chapter 2.

Allocating Screen Area for BASIC

Let's try

1. Press the following key and softkeys:

   [DISPLAY] DISPLAY ALLOCATION ALL BASIC

   The screen is cleared and all of the screen area is allocated for BASIC.

2. Press the following softkey:

   ALL INSTRUMENT

   The total screen area is reallocated as the instrument display.

3. Press the following softkey:

   HALF INSTR HALF BASIC

   The screen area is allocated so that the upper half of the screen is used for instrument operation and the lower half is used for BASIC.

4. Press the following softkey:

   BASIC STATUS

   Three blank lines appear at the display line (lower area of the screen). This area is used by BASIC system to input commands and to display messages.

Since all of the HP 8751A's screen is allocated for instrument operation after power ON, allocate screen area for BASIC when you want to use it. The HP 8751A provides four display allocation types. Select one of them using the softkey DISPLAY ALLOCATION under [DISPLAY].

More information on the display allocations for the BASIC area is described in "Display Features" in Chapter 7.

Using the Keyboard

What can the Keyboard be Used for?

The HP-HIL keyboard can be used as follows:

- Performing Calculations from the keyboard
- Entering active functions
- Entering titles
- Executing commands
- Controlling the Instrument

The following sample operations show you how to use these functions.

Performing Calculations from the Keyboard

1. Press the following key and softkeys:

   (DISPLAY) DISPLAY ALLOCATION ALL BASIC

   The screen is cleared and a cursor appears at the bottom left of screen.

2. Type this:

   3*2 (Return)

   The characters you type are displayed at the current cursor position. After pressing (Return), the system responds with the answer at the bottom of screen.

   6

You can perform calculations while in any display allocation type except for ALL INSTRUMENT.

You can use the following arithmetic operations:

+ for addition
– for subtraction
/ for division
* for multiplication
^ for exponentiation

as well as parenthesis. For a list of evaluation priority of arithmetic expressions, see "Numeric Computation" in the *HP Instrument BASIC Programming Techniques* part of the *HP Instrument BASIC Users Handbook*.

Entering Arguments to the Active Instrument Functions

The numeric keys on the keyboard can be used to input the arguments for an active instrument function the same as using the front panel keys.

1. Press the following key and softkeys:

   (DISPLAY) DISPLAY ALLOCATION ALL INSTRUMENT

2. Then press the following key:

   (START)

The current start frequency is displayed on the screen and becomes the active instrument function.

3. Type a value to change the frequency from the keyboard. For example, type this:

   5000

   The START value is cleared and the value you typed is displayed.

4. Then press the following key form the keyboard:

   (Return)

   The START value is changed to 5 kHz.

5. Next, type the following value and key:

   2E6 (Return)

   After pressing (Return) the active function value is changed to 2 MHz. You can use the character "E" and "e" in an exponential expression.

Pressing (Back space) on the keyboard deletes the last entry. This performs the same function as pressing (BACK SP) on the front panel.

Entering Titles

The character entry keys can be used to enter a title on the screen instead of using front panel operation.

Example Procedure

1. Press the following key and softkey:

   (DISPLAY) TITLE

   A cursor appears at the top left of the graticule.

2. Type in characters using the keyboard, the characters you type appear at the top of the graticule.

3. Press the following key to terminate entry:

   (Return)

You can enter standard upper-case and lower-case letters for the title, using the (Shift) key to access the alternate case as usual. For more information on the character entry keys see "Character Entry Keys" in Chapter 9.

Executing Commands

You can type in and execute commands from the keyboard at all times except when:

- the display allocation is "ALL INSTRUMENT"
- there is currently a command being executed.
- EDIT mode

At all other times, you can type in commands and press (Return) to present them to the system for execution. The system processes the command and takes the appropriate action.

Example Command (Checking System Identification)

1. Press the following key and softkey:

   (DISPLAY) HALF INSTR HALF BASIC

2. To check system identification, type the following command:

   SYSTEM$("SYSTEM ID") (Return)

3. The system returns:

   HP 8751A

Using Softkeys from Keyboard

Pressing (f1) through (f8) on the keyboard performs the same function as pressing a softkey on the front panel.

3. Introduction to the System

Entering BASIC Statements from the Front Panel Keys

HP 8751A Instrument BASIC allows you to enter and execute statements from the front panel keys, if the external HP-HIL keyboard is not connected.

Press the following key and softkeys from the front panel:

(SYSTEM) IBASIC COMMAND ENTRY

The Command Entry menu is displayed on the softkey menu area (as shown in Figure 3-1), and the active entry area displays the letters, the digits 0 through 9, and some special characters including mathematical symbols. Three sets of letters can be scrolled using the step keys, (⇑) and (⇓). To enter a statement, press the step keys for the desired letter set, rotate the knob until the arrow "↑" points at the first letter, then press SELECT LETTER. Repeat this until the complete statement is entered, then press DONE to execute the statement.

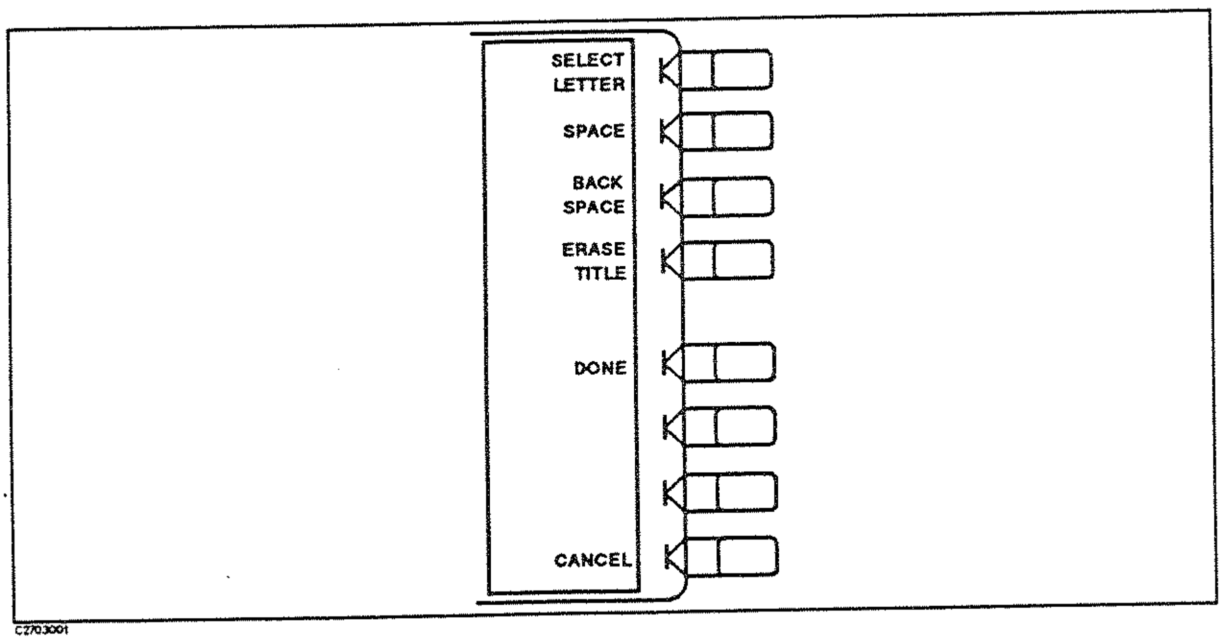


Figure 3-1. Command Entry Menu

SELECT LETTER selects the character pointed to by "↑".

SPACE inserts a space.

BACK SPACE deletes the last character entered.

ERASE TITLE deletes all characters entered.

DONE terminates command entry, and executes the command you entered.

CANCEL cancels command entry and returns to the BASIC menu.

4

Writing and Running Programs

This chapter describes how to write, execute (run), and list programs. The example program in this chapter also describes how to control the HP 8751A from an HP Instrument BASIC program. Topics covered in this chapter are:

- Getting into/out of the EDIT mode
- Writing programs
- Running programs
- Listing programs

Getting into/out of the EDIT Mode

When you write a program, you must be in the EDIT mode.

Getting into the EDIT Mode

Press the following key and softkeys from the front panel:

(SYSTEM) IBASIC Edit

The system enters the EDIT mode. You can also get into the EDIT mode when the Display Allocation is not ALL INSTRUMENT. Type EDIT and press (Return) from the keyboard (for more information about the EDIT mode, see Chapter 6).

Getting out of the EDIT Mode

Press the following softkey from the front panel:

END EDIT

The system exits the EDIT mode. If END EDIT does not appear on the softkey menu, press (SYSTEM) IBASIC from the front panel, END EDIT will appear at the bottom of the menu.

You can also get out of the EDIT mode from the keyboard. Press (Stop), (ESC), or (Clear display), and the system will immediately exit the EDIT mode.

Programs

Writing Programs

Controlling the HP 8751A

Instrument BASIC system can control the instrument (itself) through the "*internal*" HP-IB bus. This means that the HP 8751A with Instrument BASIC includes both a controller and an instrument in the same box which are connected through an internal HP-IB bus.

Note

The following example program assumes that the HP 8751A's HP-IB address is 17 (factory setting). Press the following keys to set your analyzer's address to 17, if it was set to another address.

(LOCAL) SET ADDRESSES ADDRESS : 8751 17 (x1)

Since the select code of the *internal* HP-IB interface is 8, the device selector of the analyzer in the example programs is 817.

For more information on HP-IB addresses and device selectors, refer to "Device Selectors" in the *HP Instrument BASIC Interfacing Techniques* furnished with Option 002 and "Available I/O Interface and Select Codes" in Chapter 11.

Writing an Example Program

The following example program selects the following measurement settings:

Channel Block	Channel 1 (default)
Response Block	S_{21} (or B/R) LOG MAG format (default) Display scale to 0.5 dB/DIV
Stimulus	Center frequency: 70 MHz Span frequency: 100 kHz

The examples in this guide are based on the HP 8751A and HP 87511A/B S-parameter system. Pressing keys and softkeys from the front panel can perform the following example procedure without using the external keyboard.

Let's Try

1. Turn the instrument ON.
2. Press the following key and softkeys from the front panel:

   (SYSTEM) IBASIC Edit

   The system enters the EDIT mode. The cursor appears at line number 10, which is the default line number of the first program line, as follows:

```
10 _
```

3. Press the following softkey:

   ASSIGN @Hp8751

   The commands are automatically entered at the current cursor position like this:

```
10 ASSIGN @Hp8751 TO 800_
```

4. Press the following key:

   (X1)

   The system reads the entire line.

```
10 ASSIGN @Hp8751 TO 800
20 _
```

5. Press the following softkey:

   OUTPUT @Hp8751

   The following characters are displayed on the screen:

```
10 ASSIGN @Hp8751 TO 800
20 OUTPUT @Hp8751;""
```

6. Press the following key to preset the instrument:

   (PRESET)

   The HP-IB command to preset the instrument "PRES" is automatically entered at the current cursor position like this:

```
10 ASSIGN @Hp8751 TO 800
20 OUTPUT @Hp8751;";PRES"
```

   Then press (X1).

7. Press the following key to select measurement parameter as S_{21}:

   OUTPUT @Hp8751 (MEAS) Trans:FWD S21 [B/R]

   The program code is automatically generated:

Writing and Running Programs

```
10 ASSIGN @Hp8751 TO 800
20 OUTPUT @Hp8751;";PRES"
30 OUTPUT @Hp8751;";S21"
```

Then enter (X1).

8. Press the following keys and softkeys to set the center frequency and frequency span:

   (SYSTEM) IBASIC OUTPUT @Hp8751 (CENT) 70(M/μ) (SPAN) 100 (k/m) (X1)

```
10 ASSIGN @Hp8751 TO 800
20 OUTPUT @Hp8751;";PRES"
30 OUTPUT @Hp8751;";S21"
40 OUTPUT @Hp8751;";CENT 70E6;SPAN 100E3"
50 _
```

9. Then press the following keys and softkeys to execute the auto scale function:

   OUTPUT @Hp8751 (SCALE REF) AUTO SCALE (X1)

```
10 ASSIGN @Hp8751 TO 800
20 OUTPUT @Hp8751;";PRES"
30 OUTPUT @Hp8751;";S21"
40 OUTPUT @Hp8751;";CENT 70E6;SPAN 100E3"
50 OUTPUT @Hp8751;";AUTO"
60 _
```

10. To terminate the program, the END command should be entered. Press the following softkey and key:

    END (X1)

```
10 ASSIGN @Hp8751 TO 800
20 OUTPUT @Hp8751;";PRES"
30 OUTPUT @Hp8751;";S21"
40 OUTPUT @Hp8751;";CENT 70E6;SPAN 100E3"
50 OUTPUT @Hp8751;";AUTO"
60 END
70 _
```

11. Press the following softkey to exit the EDIT mode:

    END EDIT

    The screen returns back to the instrument display.

You can write the same program from the keyboard. Using the keyboard is very useful when you write a larger and more complex program, type comments in a program, etc. For more information on how to use the keyboard, refer to Chapter 9.

Executing (Running) Programs

Press the following key and softkeys from the front panel to execute the program:

(SYSTEM) IBASIC Run

The system executes the program. You can execute the RUN statement from the keyboard. When you execute a statement from the keyboard, the BASIC command line must be allocated on the screen. If it is not, you must allocate it. For example:

(DISPLAY) DISPLAY ALLOCATION BASIC STATUS

And then type RUN command and press (Return) key from the key board as follows:

RUN (Return)

Listing Programs

The system can list the program on the screen and to a printer.

Listing on the Screen

You can list a program on the screen as follows:

1. Since the system lists a program in the print area, the print area must be allocated on the screen. For example:

    (DISPLAY) DISPLAY ALLOCATE ALL BASIC

    All of the screen area is allocated for the print area.

2. Type as follows:

    LIST (Return)

    The system lists the program as follows:

```
10 ASSIGN @Hp8751 TO 800
20 OUTPUT @Hp8751;";PRES"
30 OUTPUT @Hp8751;";S21"
40 OUTPUT @Hp8751;";CENT 70E6;SPAN 100E3"
50 OUTPUT @Hp8751;";AUTO"
60 END
```

Listing to the Printer

Note

For hard copy output, an HP-IB cable must connect the analyzer to the printer.

1. Tell the HP 8751A the printer's address.
   a. Set the printer's address to 1. If you don't know how to set its address, refer to the printer's manual.
   b. Check that the address recognized as the printer by the HP 8751A is 1 (factory set value) as follows:

      [LOCAL] SET ADDRESSES ADDRESS : PRINTER

      The address is displayed on the screen. If the address displayed is not 1, press the following keys:

      1 [X1]

2. Set the output device to a printer as follows:

   PRINTER IS 701 [Return]

3. Type and press as follows:

   LIST [Return]

   The program is listed on the printer.

4. To again list to the screen, type:

   PRINTER IS CRT

If You Want to Know More Information

This chapter is an introduction to using HP Instrument BASIC. For more information, see the following chapters and documents.

For more information on ..	see..
EDIT mode	Chapter 6
Keyboard and softkeys	Chapter 9
Display Allocation	"Display Features" in Chapter 7
HP Instrument BASIC commands	*HP Instrument BASIC Language Reference* furnished with Option 002
HP-IB commands	*HP-IB Programing Manual* and Appendix B

Programs

5

Saving and Getting Programs

This chapter describes how to save and get programs to or from the built-in disk and the RAM disk. Topics of this chapter are:

- Selecting Storage Devices
- Saving programs
- Listing file names
- Getting programs

Note

HP Instrument BASIC on the HP 8751A can communicate only with the built-in disk drive and the RAM disk, not an external disk drive.

If you are using the disk drive for the first time, see "Disk Drive Tutorial" in Chapter 5 of the *HP 8751A User's Guide*.

Note

The HP 8751A can use either LIF(Logical Interchange Format) or DOS formatted disks. The instrument automatically detects the disk format. It is able to use most of the same operations for either disk format.

Note

Use the built-in flexible disk to store important data, because the RAM disk data is lost when the power to the RAM disk memory is lost for more than 72 hours. The operating time of the battery backup for the RAM disk memory is approximately 72 hours after the analyzer is turned OFF.

Selecting Storage Devices

1. If the display allocation is All Instrument, change the allocation. For example:

   DISPLAY DISP ALLOCATION ALL BASIC

2. Select a storage device as follows:

   To use the built-in flexible disk drive, type the following statement from the keyboard and press Enter.

   ```
   MSI ":INTERNAL"
   ```

   To use the RAM disk memory, type the following statement from the keyboard and press Enter.

   ```
   MSI ":MEMORY"
   ```

Saving Programs (SAVE)

1. If the display allocation is All Instrument, change the allocation. For example:

   (DISPLAY) DISP ALLOCATION ALL BASIC

2. Press the (Menu) key from the keyboard and press the keys and softkeys shown and type in the filename to which you will store the program

   (Menu) FILE UTILITY SAVE *file-name* (Return)

   The program is stored on the disk.

Note

To lead to the FILE UTILITY softkey, press the (Menu) key on the HP-HIL keyboard, do not use the (MENU) key on the front panel. Pressing the (MENU) key on the front panel will lead to the Stimulus menu, it will not lead to the FILE UTILITY softkey.

Note

If you get "ERROR 54 Duplicate file name", a file on the disk already has the name you are trying to use. In this case, you have three choices:

- Pick a new file name that doesn't already exist. To determine which file names are already being used, execute the "CAT" command (see below).
- You may want to replace the existing file with a new one. To replace an existing file, use the "RE-SAVE" statement.
- PURGE the old file, then SAVE the new one.

Listing File Names (CAT)

Listing to Screen

Press the following keys and softkeys:

1. If the display allocation is All Instrument or BASIC STATUS, change the allocation to either Half INSTRument Half BASIC or ALL BASIC. For example:

   (DISPLAY) DISP ALLOCATION ALL BASIC

2. Then press the following keys and softkeys (press (Menu) key on the keyboard):

   (Menu) FILE UTILITY CAT (Return)

   The file names stored on the disk are listed on the screen.

Note

Since the CAT statement outputs 80 columns to a line and the maximum number of columns to a screen is 58, each line is wrapped at the 59th column. If you do not want the list to wrap around, execute the following statement before executing the CAT command.

```
PRINTER IS CRT;WIDTH 80
```

CAT will list the file names with no wrap around, but anything after the 59th column in the output can not be seen.

Listing to Printer

Note

For hard copy output, an HP-IB cable must connect the analyzer to the printer.

1. Tell the HP 8751A the printer's address.
   a. Set the printer's address to 1. If you don't know how to set its address, refer to the printer's manual.
   b. Check the address recognized as printer by the HP 8751A is 1 (factory set value) as follows:

      [LOCAL] SET ADDRESSES ADDRESS : PRINTER

      The address is displayed on the screen. If the address displayed is not 1, press the following keys:

      1 [X1]
2. Set the output device to be a printer as follows:

   PRINTER IS 701;WIDTH 80 [Return]
3. Type and press as follows:

   CAT [Return]

   The program is listed on the printer.
4. To get the output device back to CRT:

   PRINTER IS CRT [Return]

Retrieving Programs (GET)

You can retrieve a program from the disk as follows:

1. If the display allocation is All Instrument, change the allocation to either Half INSTRument Half BASIC or ALL BASIC. For example:

   [DISPLAY] DISP ALLOCATION ALL BASIC
2. Press the following keys and softkeys and type the filename you want to retrieve:

   [Menu] (on the keyboard) FILE UTILITY GET *file-name* [Return]

If You Need More Information

This chapter is an introduction to saving and retrieving programs on a disk. For more information, see the following chapters and documents:

For more information on ..	see..
File Utilities for BASIC	"File Utility Menu" in Chapter 9
Initializing a disk	"Initialize Menu" in Chapter 11 of *HP 8751A Reference Manual*
Downloading a program	"Transferring a Program to Instrument BASIC" in Chapter 10

6

Editing Programs

This section describes how to edit programs using the EDIT mode. The topics covered in this section are:

- Getting into/out of the EDIT mode
- Editing programs in the EDIT mode
- Renumbering programs

Getting Into/Out of the EDIT Mode

Getting Into the EDIT Mode using the Front Panel Keys

Pressing the following keys and softkey allows you to enter the EDIT mode immediately, irrespective of Display Allocation.

(SYSTEM) (IBASIC) Edit

Entering the EDIT Mode from the Keyboard

Press/type the following keys to enter the commands and parameter to enter the EDIT mode with the cursor positioned at the specified line number. The *line number* can be omitted.

(Menu) EDIT *line_number* (Return)
(Press the (Menu) key on the keyboard)
or
EDIT *line_number* (Return)

To use the keyboard, the Keyboard Input Line must be allocated on the screen. If it is not, press (DISPLAY) DISPLAY ALLOCATION and select any allocation except for All Instrument.

Getting Out of the EDIT Mode

The EDIT mode is exited by pressing (Stop), (ESC), and (Clear display) from keyboard, or pressing the END EDIT softkey.

Edit Mode Commands

This section describes how to edit a program while in the EDIT mode, the topics are:

- Deleting characters
- Inserting characters
- Moving the cursor
- Scrolling lines and pages
- Jumping lines
- Inserting/deleting/recalling lines
- Clearing lines

Deleting Characters

There are two functions you can use to delete characters, "Back space" and "Delete character".

Back Space

Pressing [BACK SP] on the front panel or [Back space] on the keyboard erases the character to the left of the cursor and moves cursor left to the position of the erased character.

Delete Character

Pressing [Delete char] from the keyboard deletes the character at the cursor's position.

Insert Character

The EDIT mode is always in the insert mode. Characters you type at the keyboard are inserted before the current cursor position. (Pressing [Insert char] performs no function.)

Moving the Cursor

The following key operations allow you to move the cursor horizontally along a line.

From the front panel	From the keyboard
Turning the knob	Pressing [◀] and [▶]

Scrolling Lines and Pages

Scrolling Lines

The following key operations enable you to scroll lines up and down.

From the front panel	From the keyboard
Pressing [⇧] and [⇩]	pressing [▲] and [▼]

Scrolling Pages

Pressing (Prev) and (Next) from the keyboard causes the display to scroll up and down in one-half page increments.

Jumping from the Current Line

Jumping to a Specified Line

You can specify a line by using a line number or a label name when jumping from the current line as follows:

GOTO LINE *line_number* (Return)

or

GOTO LINE *label_name* (Return)

If the label specified is not defined in the program, an error will occur.

Jumping to the Top/Bottom of a Program

Pressing the following keys allows you to jump to top or bottom of the program.

(Shift)-(▲)

(Shift)-(▼)

Insert/Delete/Recall Lines

(Insert line) inserts a new line above the current cursor position.

(Delete line) deletes the line at which the cursor is at.

RECALL LINE recalls the last deleted line.

Clear Line

Pressing (Clear line) clears a line from the current cursor position to the end of the line.

Renumbering Program Line Numbers

The REN command allows you to renumber the program currently in memory. You should execute the REN command after exiting the EDIT mode. Press the following keys and softkey, to renumber a program (press the (Menu) key on the keyboard).

(Menu) RENumber (Return)

You can specify the starting value, increment value, beginning line number, and the ending line number when renumbering a program as follows (press (Menu) key on the keyboard):

(Menu) RENumber *starting_value*, *increment* IN *beginning_line_number*, *ending_line_number*

line_label can be also use instead of *line_number*. For more information refer to the *HP Instrument BASIC Language Reference* furnished with Option 002.

7

Program I/O

This chapter describes how to write programs that use the CRT, the 8-bit I/O port, the external RUN/CONT connector in the HP 8751A, and the DOS file system.

Topics covered in this chapter are:

- Display features
- Modifying text color
- Graphics
- I/O port
- External RUN/CONTinue connector
- Using the file system

Display Features

There are four allocation types. `DISPLAY ALLOCATION` under the (DISPLAY) key allows you to select one of the four allocation types.

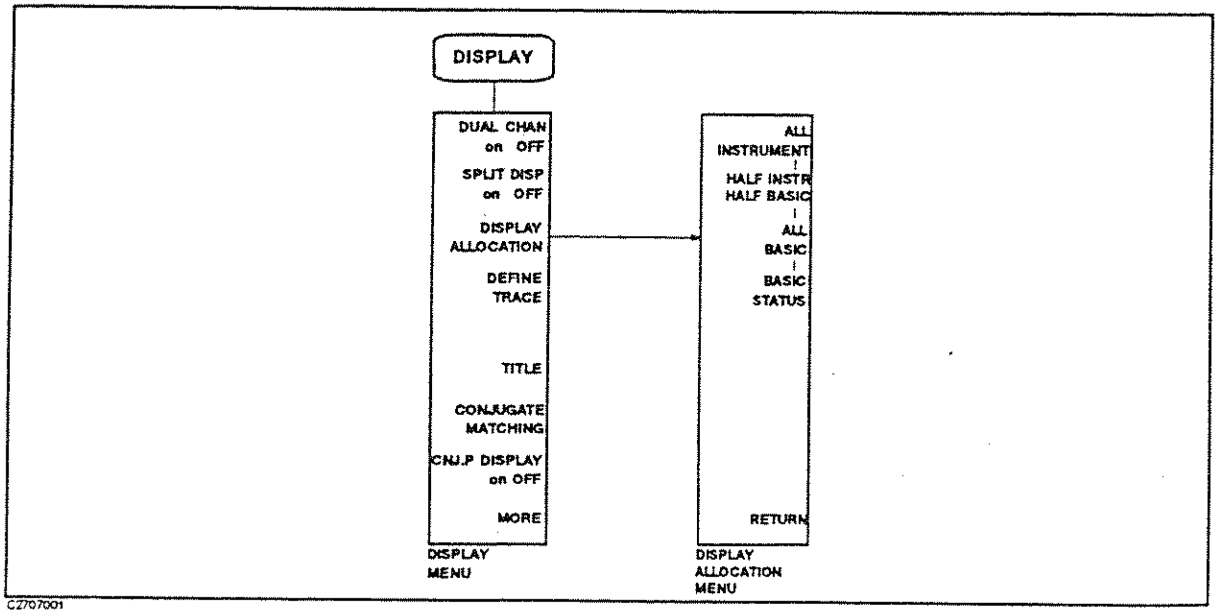


Figure 7-1. Display Allocation Menu

All Instrument

This is the default allocation. In this allocation, all of the screen area is allocated for the instrument display (graticule, parameter display, measurement readings). You can not enter BASIC statements from the keyboard when the All Instrument allocation is in effect.

Half Instrument/Half BASIC

The upper half of the screen is allocated as the instrument screen and the lower half is allocated as the BASIC screen.

All BASIC

All of the screen is allocated for BASIC.

BASIC Status

In this mode, the graticule shrinks and three lines at the bottom of screen are allocated for BASIC.

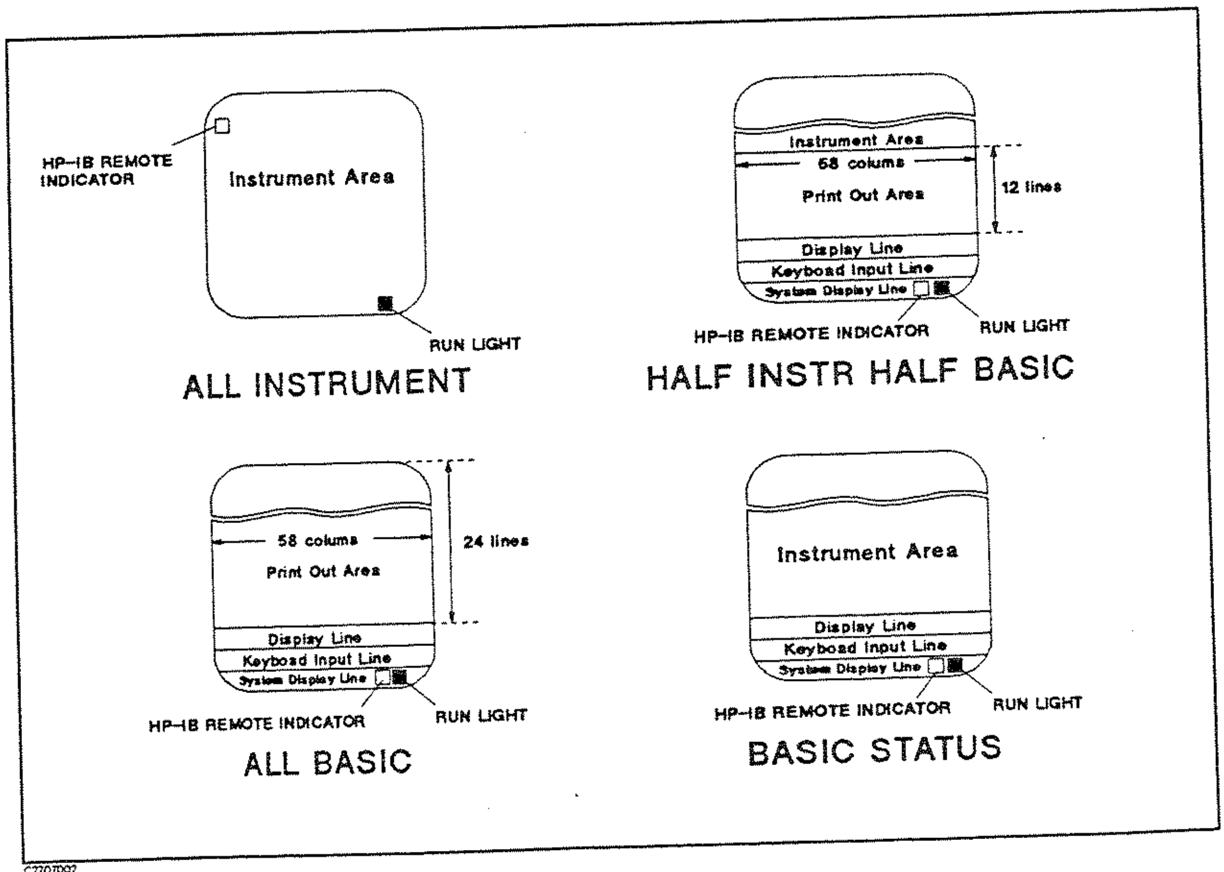


Figure 7-2. Display Allocation

Run Light Indications

␣ (blank)	Program stopped; can execute commands; CONTINUE not allowed.
_	Program paused; can execute commands; CONTINUE is allowed.
?	BASIC program waiting for input from keyboard; cannot execute commands.
*	This indication has two possible meanings: 1. Program running; can NOT execute commands. CONTINUE not allowed. 2. System executing commanded entered from keyboard; can NOT enter commands.

HP-IB Remote Indicator

"RMT" is displayed when the analyzer is in the remote state. In the All Instrument mode screen allocation, this indicator is displayed at the upper left of screen. In the other screen allocations, it is displayed at lower right of screen.

7. Program I/O

Modify Text Color

You can change colors of text in the area allocated for BASIC. Press the following:

(DISPLAY) MORE ADJUST DISPLAY MODIFY COLORS MORE IBASIC

The Color Adjust menu to modify the text color is displayed on the screen. For more information on modifying colors, refer to "Adjusting Color" in Chapter 6 of the *HP 8751A Reference Manual*.

Graphics

HP 8751A Instrument BASIC adds graphics capability to the HP 8751A. You can draw pictures on the CRT display independent of the grids and traces.

The HP 8751A has two screens, the instrument screen and the graphics screen. These two screens are always displayed together on the CRT and are not separately selectable. The instrument screen consists of a trace display area and a softkey label area. The Instrument BASIC editor is also displayed on the trace display area. The graphics screen covers the entire instrument screen as shown in Figure 7-3. The graphics screen is like an independent transparent overlay in front of the instrument screen. So, you can draw figures in both the trace display and softkey label areas.

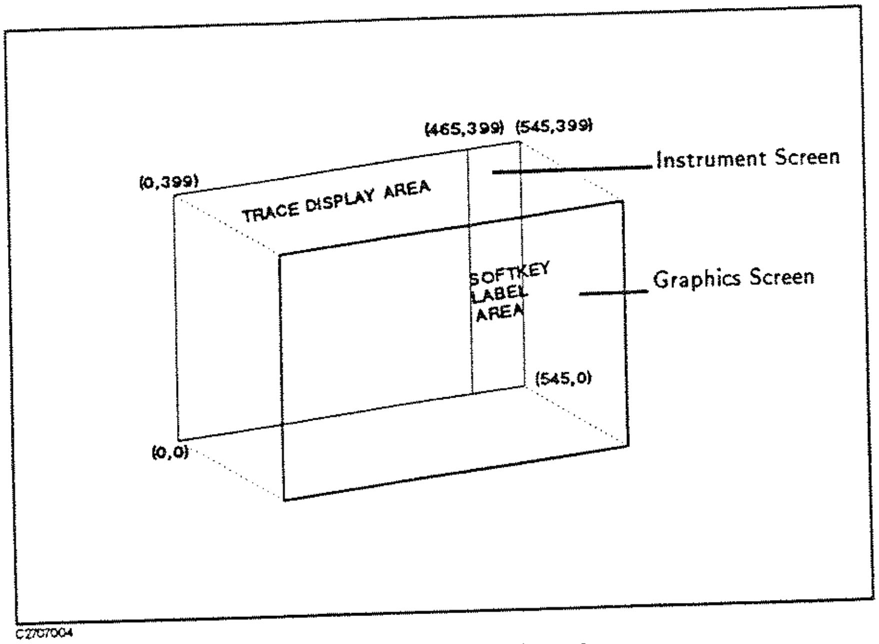


Figure 7-3. Screen Structure

Each point on the graphics screen is addressable using a coordinate address as shown in Figure 7-3. The bottom left corner is the origin (0,0) and the top right corner is the maximum horizontal and vertical end points (545,399). The MOVE and DRAW statement parameters are specified using these coordinate values. Since the aspect ratio of a graphics screen is 1, you need not adjust aspect ratio when drawing figures.

Instrument BASIC Graphics Commands

HP 8751A Instrument BASIC has four graphics commands; MOVE, DRAW, PEN, and GCLEAR.

MOVE — moves the pen from its current position to the specified coordinates.

DRAW — draws a line from the current pen position to the specified coordinates.

PEN — selects the pen color on graphics screen used to draw a line. Pen color can be modified using the modify color function. The default pen colors are:

Table 7-1. Default Pen Color of Graphics Screen

PEN	Color
1	WHITE
2	RED
3	YELLOW
4	GREEN
5	CYAN
6	BLUE

If pen selector > 0 then use PEN (pen selector - 1) MOD 6 + 1
If pen selector ≤ 0 then use PEN 1

GCLEAR clears the graphics screen, moves the pen from its current position to the origin (0,0), and selects pen 1.

Hard Copies

Graphics hard copies can be obtained with the printing or plotting function.

PLOT

PLOT under COPY plots the display image (both of an instrument screen and a graphics screen) to a graphics plotter. Plotter pens are specified by the PEN number.

PRINT

PRINT under COPY prints a display image on a printer. Refer to Chapter 10 of *Reference of HP 8751A Operation Manual*. When COLOR under Print/Plot setup menu is selected, a color graphics image can be printed. PRINT COLOR under the Print/Plot Setup Menu toggles the print color mode between the default color settings and the user selected color settings. The [FIXED] mode prints graphics using the default settings listed in Table 7-1, but a white(PEN 1) line will be printed in black. The [VARIABLE] mode prints graphics in colors that are as similar as possible to the displayed colors, and the colors are user modifiable.

Initial settings

When power is turned ON, the default settings are as follows:

- PEN 1
- MOVE 0,0

Example of Graphics Programming

This section describes an example of a simple program for drawing lines on the graphics screen.

Drawing a Straight Line

The following Instrument BASIC program will draw a red line from coordinate (50,200) to coordinate (300,200) on the display.

```
GCLEAR                  ! INITIALIZE GRAPHICS MODE
PEN 2                   ! SELECT RED PEN
MOVE 50,200             ! MOVE PEN TO COORDINATE  (50,200)
DRAW 300,200            ! DRAW A LINE TO COORDINATE (300,200)
END
```

Drawing a Circle

Trying to express all graphical images using only straight lines is tedious, slow, and difficult. This example describes a subprogram you can use to draw a circle. It can draw a circle by

7.Program I/O

passing the center coordinates and the radius as arguments to the following subroutine. This subroutine can be used as a base for drawing arcs, setting different values for Theta, etc.

```
SUB Drawcircle(Centx,Centy,R)   !
  DEG                           ! USE DEGREES FOR ANGLE EXPRESSIONS
  X=Centx+R                     !
  Y=Centy                       !
  MOVE X,Y                      ! MOVE PEN TO INITIAL POINT
  For Theta=1 to 360            !
    X=INT(COS(Theta)*R+Centx)   ! NEXT X COORDINATE ON CIRCLE
    Y=INT(SIN(Theta)*R+Centy)   ! NEXT Y COORDINATE ON CIRCLE
    DRAW X,Y                    ! DRAW LINE TO NEXT POINT ON CIRCLE
  NEXT Theta                    ! UNTIL STARTING POINT IS REACHED
SUBEND                          !
```

Using the 8-bit I/O Port in BASIC Programs

Instrument BASIC can directly control the 8-bit I/O port without using HP-IB commands. This is faster than using HP-IB commands.

READIO(15,0) — inputs the lower 4-bit nibble from the 8-bit I/O Port and uses this as the low 4-bit nibble, the upper 4-bit nibble is set to all zeros like this:

MSB LSB
8-Bit Byte = 0000xxxx

WRITEIO 15,0; — outputs 8-bit data to the OUT 0 thru 7 lines of the 8-bit I/O port. The OUT 0 signal is the LSB (least significant bit), while the OUT 7 signal is the MSB (most significant bit).

Note

An error may occur with any select code other than 15, and with any register number other than 0.

For more information on the 8-bit I/O port, refer to "I/O port" in Appendix C of *HP 8751A Reference Manual*. Sample procedures using the 8-bit I/O port are shown in "I/O Operation from Instrument BASIC" in Chapter 10 of this manual.

Using the External RUN/CONT Connector

You can use the RUN or CONT commands in a program by inputting a TTL-compatible signal to the External RUN/CONT connector on the rear panel. The positive-going edge of a pulse more than 20 μsec wide (T_P) in the LOW state will trigger RUN or CONT.

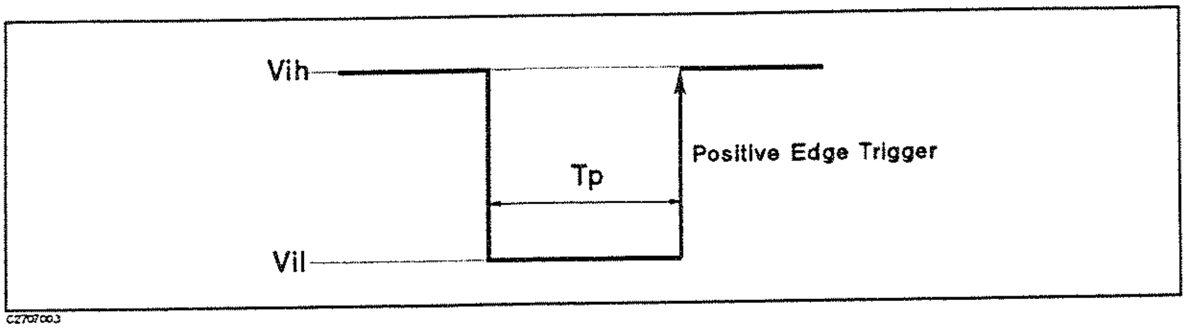


Figure 7-4. RUN/CONT Trigger Signal

File System Exceptions

The HP 8751A supports both a LIF and DOS file formats. When using the LIF format disk, the CREATE and CREATE DIR commands will generate an error.

Since the HP 8751A does not support an external disk drive, the MASS STORAGE IS (MSI) statement cannot specify volumes other than the built-in disk drive (volume specifier "INTERNAL,4", the default volume) and the RAM disk memory (volume specifier "MEMORY,0").

8

Special Features and Advanced Techniques

The topics covered in this chapter are :

- Auto start feature
- On key label function
- Increasing program speed

Autoloading and Running a Program Automatically (AUTOST)

The HP 8751A allows you to create a special program file called "AUTOST". This program is automatically loaded and run every time the HP 8751A is turned ON.

When you use this capability, the disk on which you saved AUTOST must be inserted in the disk drive before the HP 8751A is turned ON, or the AUTOST file must be saved on the RAM disk.

The instrument first searches the disk for the AUTOST file. If there is not, the system searches the RAM disk memory.

If there is an "AUTOREC" file on the disk or the RAM disk memory, the system first reads the AUTOREC file to set up the instrument and then searches for the AUTOST program. (For more information on AUTOREC, refer to Chapter 11 of *HP 8751A Reference Manual*.)

On Key Label Function

HP Instrument BASIC allows you to define softkeys from within a program. The softkey labels you define will appear when pressing the (User) key on the keyboard. The labels are displayed while running the program.

The `ON KEY` statement is used to define the softkeys. For example:

```
......
100 ON KEY 1 GOTO 150
110 ON KEY 2 LABEL "Print",2 GOSUB Report
......
```

The `KEY` statement is used to display the softkey labels defined. The following set of statements is same as key stroke of (SYSTEM) IBASIC ON KEY LABEL :

```
......
200 OUTPUT @Hp8751;"KEY 44"        ! SYSTEM key
210 OUTPUT @Hp8751;"KEY 0"         ! IBASIC softkey
220 OUTPUT @Hp8751;"KEY 7"         ! ON KEY LABEL softkey
```

. . . . . .

For more information on the ON KEY statement, refer to the *HP Instrument BASIC Language Reference* furnished with Option 002.

Example programs for ON KEY LABEL keys are shown in "Application Programs" in Chapter 10.

Increasing Program Speed

Since the HP 8751A's CPU interleaves processing measurements and executing a program, program execution speed depends on the measurement conditions. The display process also requires processing time.

To increase program speed (increase throughput), set the HP 8751A to the following conditions:

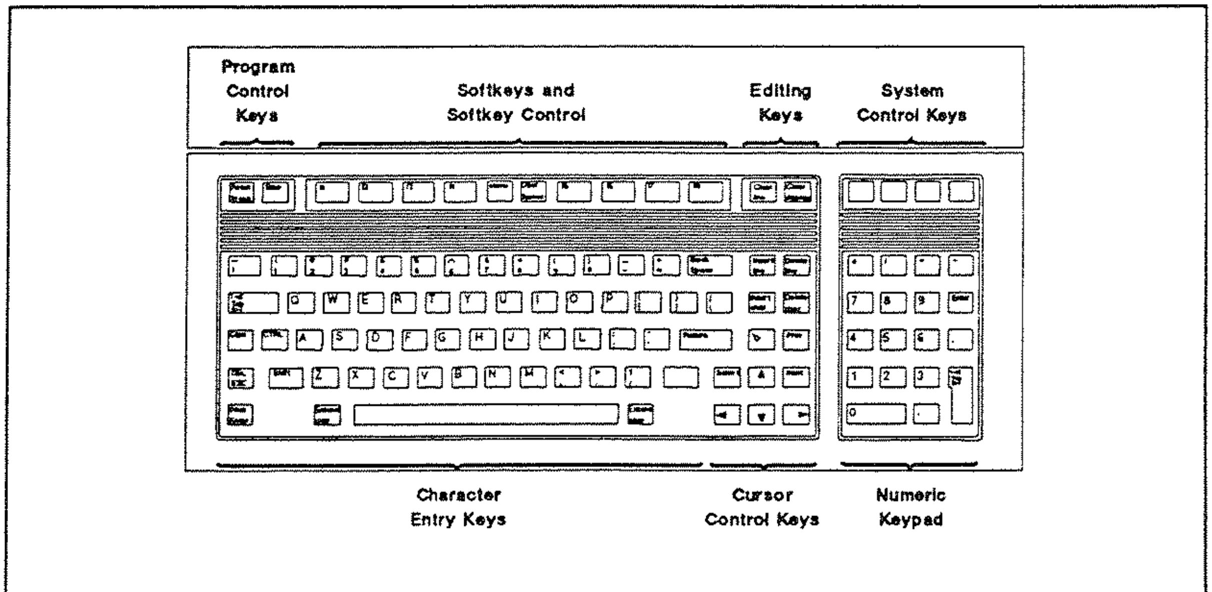
- If you do not need to measure DUT during executing a program, set TRIGGER MODE to HOLD.
- If you need to measure DUT but do not need to display traces on the screen, set DISPLAY ALLOCATION to ALL BASIC.
- If you need to measure DUT and display traces but do not need to use marker function, set all markers to OFF.
- If you need to measure DUT,display traces, and marker functions but do not need to display markers on the screen, use the `MARD OFF` HP-IB command to erase the marker display.
- When you use the 8-bit I/O port, use the `READIO` and `WRITEIO` commands.
- If you change channels in a program, set Dual Channel to ON before changing channels.

For example, when you change channels in a program, set Dual Channel to ON and Display Allocation to All BASIC to decrease the switching time between channels 1 and 2.

9

The HP-HIL Keyboard

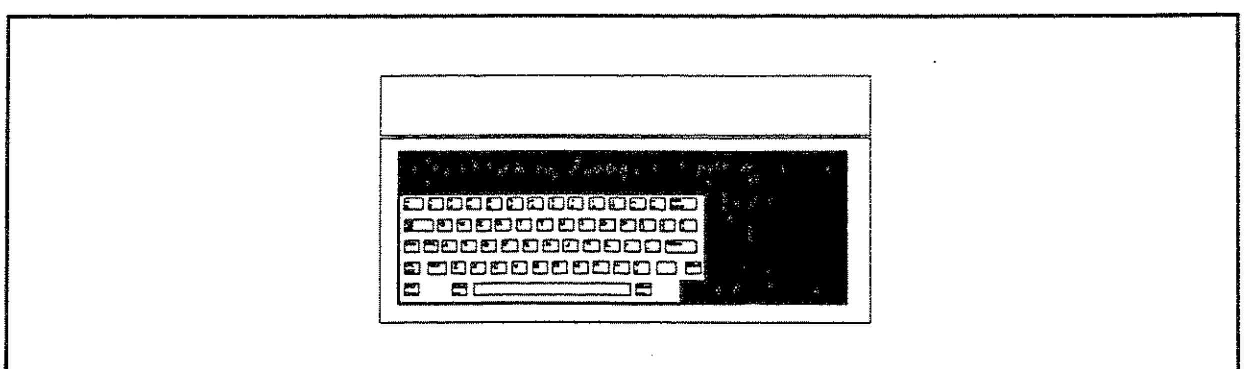
The HP-HIL keyboard keys are arranged into the following functional groups:



C2709001

Figure 9-1. HIL-Keyboard

Character Entry Keys



C2709002

The character entry keys are arranged in the familiar QWERTY typewriter layout, but with additional features.

Caps — sets the unshifted keyboard to either upper-case (which is the default after power ON) or lower-case (normal typewriter operation).

Shift — You can enter standard upper-case and lower-case letters, using the Shift key to access the alternate case.

Return — has three functions:

- When a running program prompts you for data, respond by typing in the requested data and then press Return. This signals the program that you have provided the data and that it can resume execution.
- When typing in program source code, the Return key is used to store each line of program code.
- After typing in a command, the Return key causes the command to be executed.
- In the EDIT mode, the Return key is used to store each line of program code.

Enter — is the same as pressing the Return key.

Print — (Shift-Enter) performs no function.

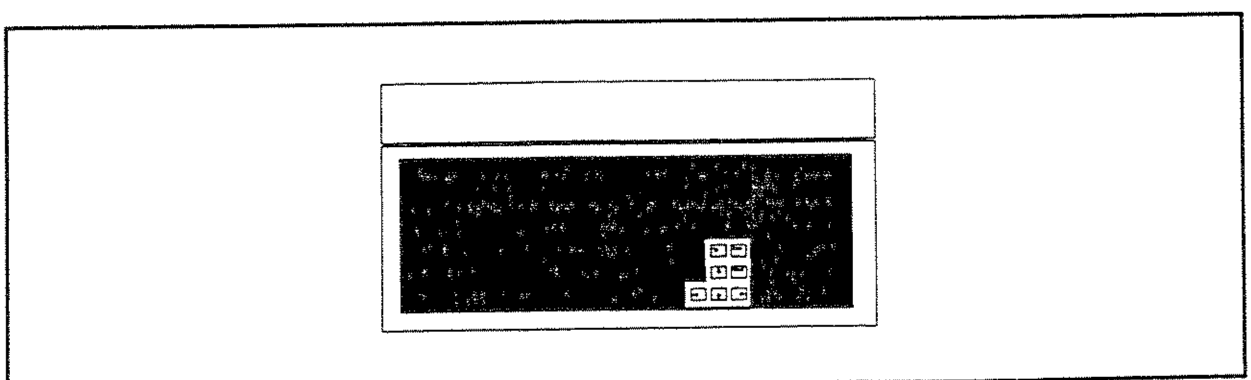
CTRL — In the EDIT mode, CTRL allows you to control the editor in the same as using the cursor-control, display-control, and editing keys. For more detail, refer to "Using CTRL Key in Edit Mode".

Select — The select key performs no function.

Back space — erases the character to the left of the cursor and moves the cursor to the erased character's position on the line.

Tab — performs no function.

Cursor-Control and Display-Control Keys



C2709004

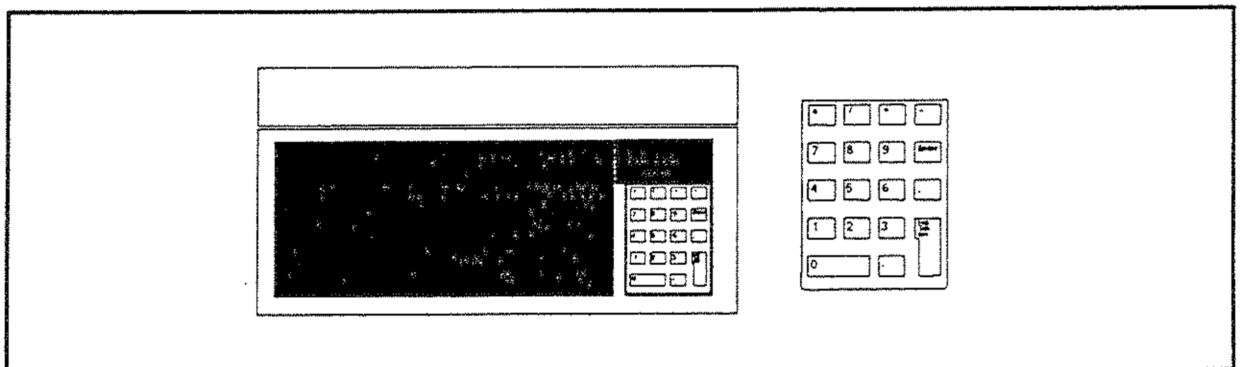
(▲) (▼) allow you to scroll lines up and down in the print display area. Shifted, these keys cause the display to scroll towards the top or bottom of the display.

(▶) (◀) allow you to move horizontally along a line. Shifted, these keys allow you to "jump" to the left and right limits of the current line.

(Next) (Prev) cause the display to scroll up or down in one-half page increments.

(▼) performs no function.

Numeric Keypad



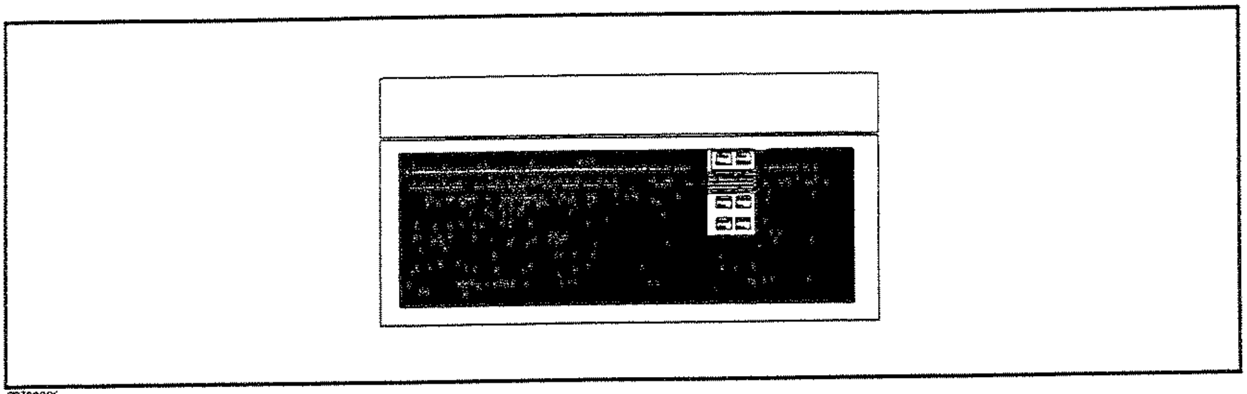
C2709005

The numerical keypad provides a convenient way to enter numbers and perform arithmetic operations. Just type in the arithmetic expression you want to evaluate, then press (Enter). The result is displayed in the lower-left corner of the screen.

(Enter) performs the same function as the (Return) key. The numerical keypad serves the same function as the numerical keypad on the front panel of the HP 8751A.

(Tab) performs no function.

Editing Keys



C2709006

Insert line inserts a new line above the cursor's current position (edit mode only).

Delete line deletes the line containing the cursor (edit mode only).

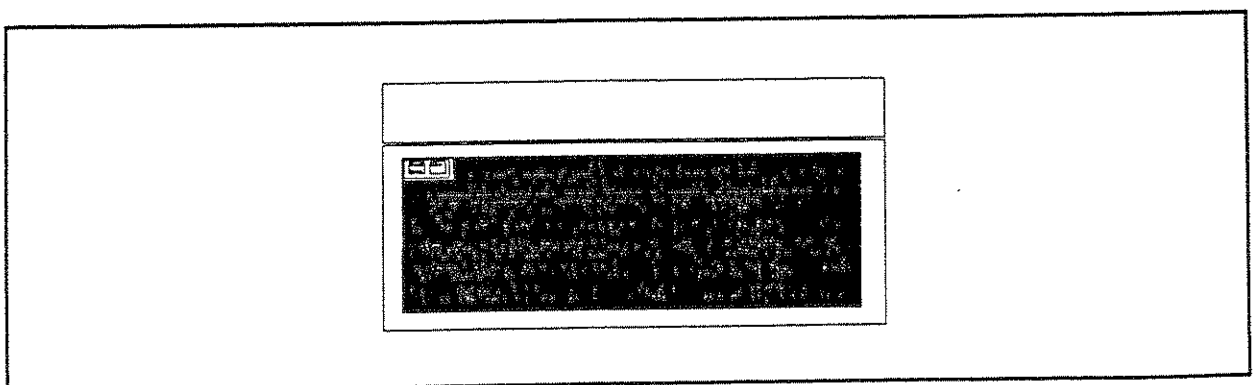
Insert char performs no function. HP Instrument BASIC is always in the insert mode. The characters you type are always inserted to the left of the cursor.

Delete char deletes the character at the cursor's position.

Clear line clears from the current cursor position to the end of the line.

Clear display clears the entire alpha screen. In EDIT mode, this exits the EDIT mode.

Program Control Keys



C2709007

The following keys allow you to control execution of the program stored in the analyzer's memory.

Stop Unshifted-Stop pauses program execution after the current line. Pressing `Continue` in the System menu resumes program execution from the point where it was paused.

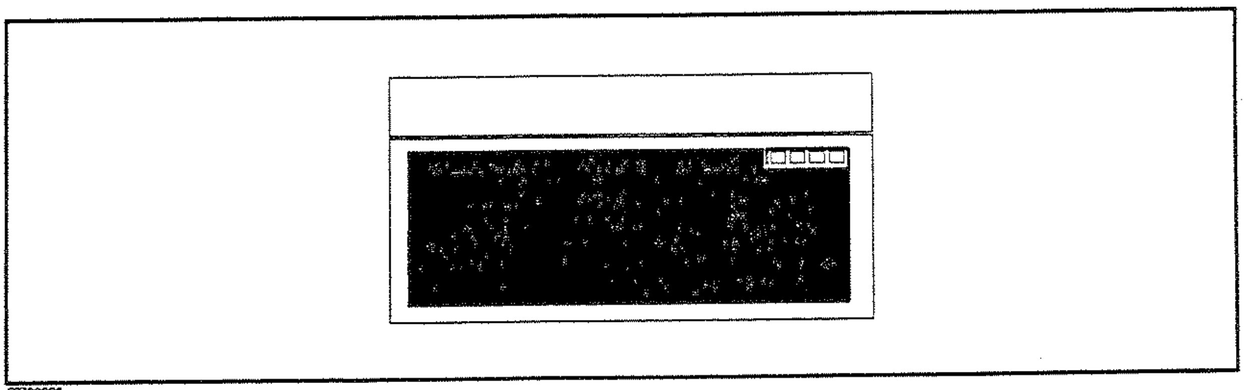
Shift-Stop stops program execution after the current line. To restart the program, press Run in the System menu.

When in the editor mode, Stop exits the edit mode.

Break pauses program execution when the computer is performing or trying to perform an I/O operation. Press Break instead of unshifted-Stop when the computer is hung up during an I/O operation, because unshifted-Stop works only after the computer finishes the current program line.

Shift-Break resets program execution immediately without erasing the program from memory (BASIC RESET).

System Control Keys



C2709008

The unlabeled keys above the numeric keypad control various system functions related to the program.

To easily identify the keys in the following description, we'll use the following convention:

- Key-1—Above the * key.
- Key-2—Above the / key.
- Key-3—Above the + key.
- Key-4—Above the − key.

Key-1 (Recall) Unshifted-Key-1 (Recall) recalls the last line the you entered, executed, or deleted. Several previous lines can be recalled this way. Recall is particularly handy to use when you mistype a line. Instead of retyping the entire line, you can recall it, edit it using the editing keys, and enter or execute it again.

Shift-Key 1 moves forward through the recall stack.

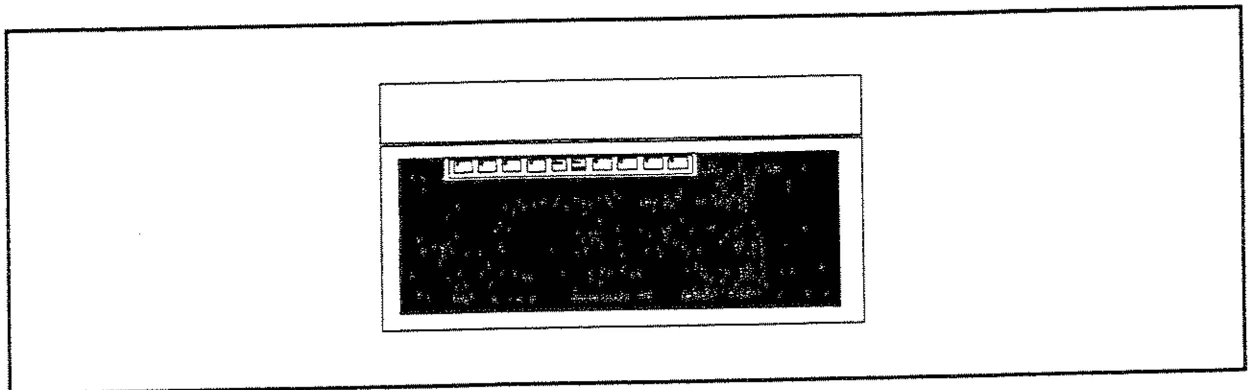
Key-2 (Run) starts a program running from the beginning.

Key-3 (Continue) resumes program execution from the point where it was paused.

Key-4 (IBASIC) allows you to type BASIC commands on Keyboard Input Line. If Display Allocation is All Instrument, pressing this key changes the Display Allocation to BASIC Status.

Shift-Key-4 changes Display Allocation to All Instrument.

Softkeys and Softkey Control



C2709003

There are eight softkeys (labeled f1 through f8 and two keys that control the definition of the softkeys (Menu and User System). The softkey labels are indicated on the right of the HP 8751A's screen.

Softkey Control Keys

Pressing the following:

Menu leads to the Edit menu, which controls programs and the editor.

User System (Unshifted-User System) leads to the BASIC menu from which to control a BASIC program. This menu is the same menu displayed when pressing SYSTEM IBASIC from the front panel.

In the edit mode, pressing User System leads to the Edit System menu, which provides softkeys to conveniently enter BASIC commands.

Shift-User System (User) leads to the ON KEY LABEL menu, which are user defined softkeys in a BASIC program. (For information on getting to this menu through Instrument BASIC, see "On Key Label Function" in Chapter 8.)

Softkeys

Figure 9-2 shows the softkey menus accessed from the (Menu) and (User System) keys. Pressing a softkey performs the command labeled or produces a sequence of characters on the keyboard input line (or on the "current line" in the EDIT mode).

Pressing the softkeys on the front panel of the HP 8751A performs the same functions as pressing the (f1) through (f8) function keys.

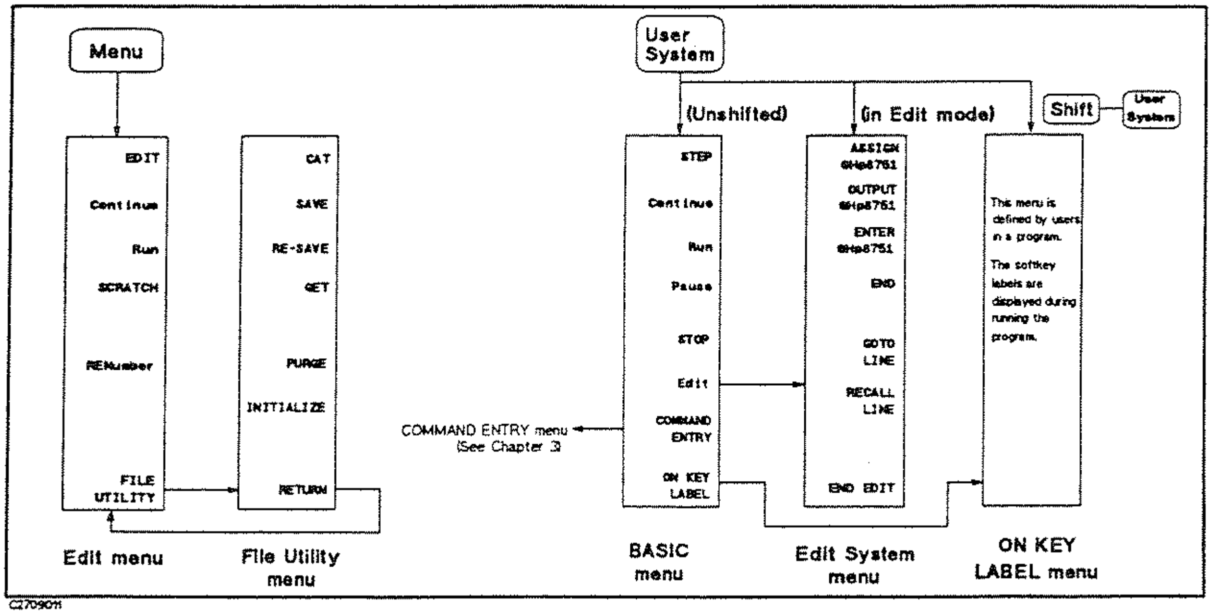


Figure 9-2. Softkey Menus Accessed from (Menu) and (User System) Key

Softkeys Accessed from (Menu) Key

Edit Menu

Pressing the following:

`EDIT` produces the command "EDIT" on the keyboard input line. After EDIT is entered, pressing (Return) enters the edit mode.

`Continue` resumes program execution from the point where it was paused.

`Run` immediately executes a program.

`SCRATCH` produces the command "SCRATCH". The SCRATCH erases the program in memory. After SCRATCH is entered, pressing (Return) executes the command.

`RENumber` produces the characters "REN". REN renumbers all of the program lines currently in memory.

`FILE UTILITY` leads to the File Utility softkey menu to access the disk.

File Utility Menu

Pressing the following:

CAT	produces the command "CAT". CAT lists the contents of a mass storage directory.
SAVE	produces the command "SAVE""". SAVE creates an ASCII file and copies program lines as strings into that file.
RE-SAVE	produces the command "RE-SAVE""". RE-SAVE creates a specified ASCII file if it does not exist; otherwise, it re-writes a specified ASCII file by copying program lines as strings into that file.
GET	produces the command "GET""". GET reads the specified ASCII file and attempts to store the strings into memory as program lines.
PURGE	produces the command "PURGE""". PURGE deletes a file or directory from the directory of a mass storage media.
INITIALIZE	produces the command "INITIALIZE". INITIALIZE prepares mass storage media for use by the computer. When INITIALIZE is executed, any data on the media is lost.
RETURN	goes back to Edit menu.

Softkeys Accessed form (User System) Key

(User System) key allows you to access three different softkey flows dependent on conditions as follows:

- Pressing unshifted-(User System) accesses the Program Control menu
- Pressing (Shift)-(User System) accesses the ON KEY LABEL menu.
- In editor mode, pressing unshifted-(User System) accesses the Edit System menu

The details of each menu is described below.

BASIC Menu (Unshifted (User System) Key)

Pressing the following:

Step	allows you to execute one program line at a time. This is particularly useful for debugging.
Continue	resumes program execution from the point where it was paused.
RUN	starts a program from its beginning.
Pause	pauses program execution after the current program line has executed.
Stop	stops program execution after the current line. To restart the program, press Run.
Edit	enters into the EDIT mode.
COMMAND ENTRY	leads to the Command Entry menu. (See "Entering BASIC Statements from the Front Panel Keys" in Chapter 3.)

ON KEY LABEL leads to a softkey menu defined during program execution, if the softkey menu has been defined.

Edit System Menu

In the edit mode, pressing the (User System) key leads to the softkey menu to produce the character which are the BASIC commands and editor control commands most often used in developing and running BASIC programs.

ASSIGN @Hp8751 produces the command "ASSIGN @Hp8751 TO 800" at the cursor's current position.

OUTPUT @Hp8751 produces the command "OUTPUT @Hp8751;""" at the cursor's current position.

ENTER @Hp8751 produces the command "ENTER @Hp8751;" at the cursor's current position.

END produces the command "END".

GOTO LINE allows you to move the cursor to any line number or to label, after pressing GOTO LINE, type a line number or a label and then press (Return), the cursor moves to the specified line or label.

RECALL LINE recalls the last deleted line.

END EDIT exits the edit mode.

ON KEY LABEL Menu

Softkeys in this menu are defined in a program, and the softkeys are labeled during program execution. For more information on using this feature, refer to "ON KEY" in Chapter 2 of the *HP Instrument BASIC Language Reference* furnished with Option 002.

Using (CTRL) Key in Edit Mode

In the edit mode, holding down (CTRL), while pressing another key allows you to control the editor in the same way as pressing control keys such as (▲), (▼), (Insert line), etc.

If you press ...	It performs ...
CTRL-a	moves the cursor to beginning of line, (the same function as Shift-◀).
CTRL-b	moves cursor backward one character, (the same function as ◀).
CTRL-d	deletes a character, (the same function as Delete char).
CTRL-e	moves the cursor to end of the line, (the same function as Shift-▶).
CTRL-f	moves cursor forward character along a line, (the same function as ▶).
CTRL-g	allows you to move the cursor to any line number or label, after press CTRL-g, type a line number or label name and press Return, the cursor moves to the specified line, (the same function as GOTO LINE).
CTRL-h	deletes backward one character, (the same function as Back Space).
CTRL-j	performs the same function as Return.
CTRL-k	deletes a line from the cursor's current position to the end of the line.
CTRL-m	performs the same function as Return.
CTRL-n	moves the cursor to the next line, (the same function as ▼).
CTRL-o	inserts a new line above the cursor's current position, (the same function as Insert line).
CTRL-p	moves the cursor to the previous line, (the same function as ▲).

10

Application Programs

This chapter discusses HP Instrument BASIC programming with examples. Examples correspond to actual measurement situations. These Instrument BASIC examples will supply useful information for developing HP 8751A Instrument BASIC application programs. Included are several typical types of programs and three application programs for the HP 8751A. The topics covered in this chapter are:

- Sample programs for controlling the HP 8751A
- Sample programs for I/O operation
- Sample programs for using Instrument BASIC simultaneously with an external controller
- Application programs

Note Hewlett-Packard is NOT LIABLE for any damages incurred while using the sample programs given in this manual.

Controlling the HP 8751A using Instrument BASIC

HP Instrument BASIC will allow you to easily control the HP 8751A. This section describes the basic techniques for using Instrument BASIC to control the HP 8751A. In this section, the following sample programs are described:

- Sending HP-IB commands to the HP 8751A
- Detecting end of sweep
- Trace data transfer
- ON KEY.... LABEL function
- Setting the limit line table from Instrument BASIC

Note Two quotes, in succession, will embed a quote with in a string when a quotation mark needs to be in a string.

For example:

```
100 OUTPUT @Hp8751;";TITL ""This is a test."" "
```

Outputs `;TITL "This is a test."` to `@Hp8751`.

(TITL displays a title.)

```
200 File-name$="TEST"
210 OUTPUT @Hp8751;"SAVDDAT""";File-name$;""""
```

Outputs `SAVDDAT "TEST";` to `@Hp8751`.

(`SAVDDAT` saves internal data arrays.)

Sending HP-IB Commands to the Network Analyzer part of the HP 8751A

The network analyzer and HP Instrument BASIC in the HP 8751A should be regarded as two separate instruments interfaced by an internal HP 8751A HP-IB bus. So, to distinguish between the internal and external HP-IB interfaces, use select code "8" for the internal HP-IB interface, (the external select code is "7"). For more information on HP-IB commands, refer to *HP-IB Programming Manual*.

This sample program sends the HP-IB command by using the HP-IB interface from Instrument BASIC to the analyzer.

```
 10 ASSIGN @Hp8751 TO 800   ! Assign HP 8751A to HP-IB address "800"
..........
500 OUTPUT @Hp8751;"LOGM;" ! Set the HP 8751A to LOG MAG format
..........
600 END
```

Figure 10-1. Sending HP-IB Command

Setting the Limit Line Table from Instrument BASIC

This sample program shows how to transfer an Instrument BASIC limit line table to the HP 8751A. By using this sample program, you can create a complex table easily. To increase the number of limit segments, add to the "DATA" line (line 140 through 170) and adjust the "FOR" statement (line 190) accordingly.

```
100 ASSIGN @Hp8751 TO 800
110 DIM Stimulus(1:4),Upper(1:4),Lower(1:4)
120 !                        Limit Line Table
130 !--- Frequency(MHz) --- Upper Limit(dB) -- Lower Limit(dB)
140 DATA 30,                 -40,              -80
150 DATA 65,                   0,              -15
160 DATA 70,                   0,              -20
170 DATA 100,                -30,              -70
190 FOR I=1 TO 4                              !
200   READ Stimulus(I),Upper(I),Lower(I) ! Reading 4 data arrays
210 NEXT I                                    !
230 OUTPUT @Hp8751;"LIMILINEON"           ! Limit line ON
240 OUTPUT @Hp8751;"EDITLIMIL"            ! Edit limit line
250 OUTPUT @Hp8751;"LIMCLEL"              ! Clear Limit Table
260 FOR I=1 TO 4
270   OUTPUT @Hp8751;"LIMSADD"                    ! Add limit segment
280   OUTPUT @Hp8751;"LIMS ";Stimulus(I);"MHz" ! Set Stimulus
290   OUTPUT @Hp8751;"LIMU ";Upper(I)             ! Set Upper limit
300   OUTPUT @Hp8751;"LIML ";Lower(I)             ! Set Lower limit
310   OUTPUT @Hp8751;"LIMSDON"                    !
320 NEXT I
330 OUTPUT @Hp8751;"LIMEDONE"      ! Finish this limit table editing
340 OUTPUT @Hp8751;";LIMITESTON " ! TURN ON LIMIT TEST
350 OUTPUT @Hp8751;"*CLS"          ! CLEAR STATUS BYTE
360 OUTPUT @Hp8751;"*SRE 4"
370 OUTPUT @Hp8751;"ESNB 1"
380 ON INTR 8 GOTO End_sweep
390 ENABLE INTR 8
400 OUTPUT @Hp8751;"SING"             ! SINGLE SWEEP
410 Loop_top:GOTO Loop_top            ! WAIT FOR END OF SWEEP
420 End_sweep:
450 OUTPUT @Hp8751;"ESB?"
460 ENTER @Hp8751;Stat   !READ STATUS BIT 4 (1=FAIL, 0=PASS)
470 IF BIT(Stat,4) THEN
480   BEEP                            ! FAIL ( 2 BEEP )
490   WAIT .5
500   BEEP
510 ELSE
520   BEEP                            ! PASS ( 1 BEEP )
530 END IF
540 END
```

Figure 10-2. Setting Limit Line Table

Detecting End of Sweep

The HP 8751A's *Event Status register B* (ESB) reports the instrument status of the HP 8751A. The status bit named "Sweep or group of complete" in the ESB returns a bit value of 1 when a single sweep or group of sweeps have been completed. For details of ESB, SRE, and ESNB, refer to Appendix B in *HP-IB Programming Manual*.

This sample program shows how to detect the end of measurement sweep using Instrument BASIC. In Figure 10-3, Instrument BASIC declares "ON INTR" (ON INTERRUPT) in line 50. When the end of sweep is detected as an SRQ (Service ReQuest) and the program branches to a specified subprogram. SRE and ESNB must be enabled before ON INTR is used. This sample program is useful when you want to process something only while a sweep is in progress.

```
10 ASSIGN @Hp8751 TO 800
20 OUTPUT @Hp8751;"*CLS"   !
30 OUTPUT @Hp8751;"*SRE 4" ! Initializing
40 OUTPUT @Hp8751;"ESNB 1" !
50 ON INTR 8 GOTO Jump
60 ENABLE INTR 8
70 OUTPUT @Hp8751;"NUMG 30"
80 GOTO 80                 ! Repeat this line until sweep ends
90 !--- If 30 sweeps completed, then jump to subprogram ---!
100 Jump:!                 ! Jump to this line when sweep ended
110 PRINT "SWEEP COMPLETED."
120 END
```

Figure 10-3. Detecting End of Sweep

Trace Data Transfer

There are two formats in which to transfer data to an Instrument BASIC program, ASCII or binary. The binary format transfers data faster, but the program is more complex than is the ASCII format transfer program, because it is necessary to specify the data format in detail. If you do not need high speed data transfer, use the ASCII data format because the program becomes more simple. If you want to transfer data faster, the binary data format transfer is appropriate. The following sample programs use both the ASCII and the binary formats.

Assume that the number of measurements points is 201.

Input Trace Data

The following sample programs transfer measurement data from the HP 8751A to data array "Dat".

```
 10 ASSIGN @Hp8751 TO 800
 20 DIM Dat(1:201,1:2)
100 OUTPUT @Hp8751;"HOLD"        ! Sweep HOLD
110 OUTPUT @Hp8751;"FORM4"       ! Set the Data format to ASCII format
120 OUTPUT @Hp8751;"OUTPFORM?"   ! Query formatted data
130 ENTER @Hp8751;Dat(*)         ! Enter data
140 PRINT Dat(*)                 ! Print data on the screen
200 END
```

Figure 10-4. Input ASCII Format Data

```
 10 ASSIGN @Hp8751 TO 800
 20 DIM Dat(1:201,1:2)
 90 OUTPUT @Hp8751;"HOLD"        ! Sweep HOLD
100 OUTPUT @Hp8751;"FORM3"       ! Set the data format to IEEE 64 bit format
110 ASSIGN @Dt TO 800;FORMAT OFF ! Assign "@Dt" to binary data line
120 !
130 OUTPUT @Hp8751;"OUTPFORM?"                ! Order the formatted data
140 ENTER @Hp8751 USING "%,8A";Header$        ! Read header
150 ENTER @Dt;Dat(*)                          ! Read trace data
160 ENTER @Hp8751 USING "%,1A";Terminate$     ! Read terminator
170 OUTPUT @Hp8751;"FORM4"                    ! Go back to ASCII format
200 END
```

Figure 10-5. Input Binary Format Data

Output Trace Data

Following sample programs transfer Instrument BASIC trace array data to the HP 8751A.

```
10 ASSIGN @Hp8751 TO 800
20 DIM Dat(1:201,1:2)
90 OUTPUT @Hp8751;"HOLD"                ! Sweep HOLD
100 OUTPUT @Hp8751;"FORM4"              ! Set ASCII data transfer format
110 OUTPUT @Hp8751;"INPUFORM ";Dat(*) ! Transfer array data to data trace
120 END
```

Figure 10-6. Output ASCII Format Data

In binary format, when the defined data length is different from the actual data length, an error occurs. You must set same length of both data. In the following sample program, the data length is adjusted in line 130 because "Nop" varies with your measurement settings.

```
10 ASSIGN @Hp8751 TO 800
20 DIM Dat(1:201,1:2)
100 OUTPUT @Hp8751;"HOLD"          ! Halt the sweep
110 OUTPUT @Hp8751;"FORM3"         ! Set the data format to IEEE 64bit
120 ASSIGN @Dt TO 800;FORMAT OFF ! Assign "@Dt" to binary data line
130 Nop=201                        ! Number of points are 201
140 Noplength=LEN(VAL$(Nop*16))
150 IF Noplength<4 THEN
160   REPEAT
170     Nopstring$="0"&VAL$(Nop*16)
180     Noplength=LEN(Nopstring$)
190   UNTIL Noplength=4
200 ELSE
210   Nopstring$=VAL$(Nop*16)
220 END IF
230 OUTPUT @Hp8751 USING "#,9A";"INPUFORM "       ! Send transfer command
240 OUTPUT @Hp8751 USING "#,K";"#600";Nopstring$ ! Send number of data
250 OUTPUT @Dt;Dat(*),END     ! Transfer data of array "Dat" and terminator
260 OUTPUT @Hp8751;"FORM4"
300 END
```

Figure 10-7. Output Binary Format Data

ON KEY.... LABEL Function

By using this sample program, several front key operations and BASIC processing steps can be combined and executed as a single softkey operation. For details of the "ON KEY" command, refer to *HP Instrument BASIC Language Reference*.

This sample program shows how to enter a user-defined function which is executable as a softkey command. Assume that the DUT is bandpass filter with a center frequency is 70 MHz.

```
10 ASSIGN @Hp8751 TO 800
20 ON KEY 1 LABEL "3dB" CALL Filter3db          ! Define softkeys
30 ON KEY 2 LABEL "BndRejct" CALL Band_reject !
40 ON KEY 8 LABEL "QUIT" GOSUB Quit             !
50 OUTPUT @Hp8751;"KEY 44"                      ! SYSTEM key
60 OUTPUT @Hp8751;"KEY 0"                       ! IBASIC softkey
70 OUTPUT @Hp8751;"KEY 7"                       ! ON KEY LABEL softkey
80 LOOP
90 END LOOP
100 Quit:!
110 END                    ! End of main program
120 !
130 SUB Filter3db
140   ASSIGN @Hp8751 TO 800
150   OUTPUT @Hp8751;"MARK1 70MHZ"
160   OUTPUT @Hp8751;"DELR1;"
170   OUTPUT @Hp8751;"WIDTON;"
180   OUTPUT @Hp8751;"WIDV -3"
190 SUBEND
200 SUB Band_reject
210   ASSIGN @Hp8751 TO 800
220   OUTPUT @Hp8751;"MARK1 70MHZ"
230   OUTPUT @Hp8751;"DELR1"
240   OUTPUT @Hp8751;"MARK2"
250   OUTPUT @Hp8751;"TRACKON"
260   OUTPUT @Hp8751;"SEAMIN"
270 SUBEND
```

Figure 10-8. On Key Label

I/O Operation from Instrument BASIC

This section describes the input/output operations using the 8-bit I/O port and the built-in disk drive. The following sample programs are covered in this section:

- Signal transfer using the 8-bit I/O port
  - Reading data from the 8-bit I/O port
  - Writing data to the 8-bit I/O port
- Disk I/O for an built-in disk drive
  - Saving trace data
  - Loading trace data

Signal Transfer Using the 8-bit I/O Port

Reading Data from the 8-bit I/O Port

This sample program shows how to directly read a specific data bit from the 8-bit I/O port.

```
10 Read_bit=2                      !
20 A=BIT(READIO(15,0),Read_bit)  !
30 PRINT A                         !
40 END                             !
```

Figure 10-9. Reading 8 Bit I/O Port

Writing Data to the 8-bit I/O Port

This sample program shows a sample of writing data to the 8-bit I/O port. When you use the 8-bit I/O port, data has to be set and transferred as bits. Both `Write_bit` and `Write2_bit` are first set ON, and then `Write2_bit` is set to OFF. For details of the Instrument BASIC commands "`WRITEIO`" and "`READIO`", refer to "Using the 8-bit I/O Port in BASIC Programs" in Chapter 7.

```
 50 Write_bit=1                    ! Assigning Write_bit to Bit 1
 60 Write_bit_ptn=2^Write_bit      ! Write_bit_ptn is ON state of Write_bit
 70 Write2_bit=3                   ! Assigning Write2_bit to Bit 3
 80 Write2_bit_ptn=2^Write2_bit    ! Write2_bit_ptn is ON state of Write2_bit
 90 !
100 !------------  Both bits are ON  -------------
110 Io_reg=BINIOR(Write_bit_ptn,Write2_bit_ptn)
120 WRITEIO 15,0;Io_reg
130 !
140 !--------  Set only Write2_bit to OFF --------
150 Io_reg=BINAND(Io_reg,BINCMP(Write2_bit_ptn))
160 WRITEIO 15,0;Io_reg
200 END
```

Figure 10-10. Writing Data To The 8-bit I/O Port

Disk I/O for Built-in Disk Drive

The HP 8751A has a built-in disk drive. So, you can save or get data easily with Instrument BASIC.

Saving Trace Data

This sample program saves the HP 8751A's current raw measurement data to an arbitrarily named file.

```
 10 ASSIGN @Hp8751 TO 800
 20 DIM File_name$[10]
100 INPUT "ENTER FILE NAME (up to 10 Characters)",File_name$
110 !
120 OUTPUT @Hp8751;"SAVRAON"            ! Set to save only raw data
130 OUTPUT @Hp8751;"SAVDDAT """;File_name$;"""""
140 END
```

Figure 10-11. Saving Trace Data

Loading Trace Data

This sample program loads trace data from the built-in disk drive into array "Dat".

```
10 DIM Dat(1:201,1:2)
100 INPUT "ENTER FILE NAME",File_name$
200 File_name$=File_name$&"_D"  ! Add extension to a data file name
201                             ! If DOS format disk is used,
202                             ! change "_D" to ".DAT".
210 ASSIGN @File TO File_name$
220 ENTER @File;Dat(*)
230 ASSIGN @File TO *           ! Close the file
231 PRINT Dat(*)
240 END
```

Figure 10-12. Loading Trace Data

Simultaneously using Instrument BASIC and an External Controller

This section describes sample programs that are useful when two controllers are used on the same bus. The following sample programs are covered:

- Passing control
- Transferring a program to Instrument BASIC
- Running an external controller program
- Referring to an external controller's data array contents

Assume that external controller and Instrument BASIC controller are connected with an HP-IB interface in this section.

Passing Control

The HP-IB bus can only have one active controller at a time. If more than one controller is on the same bus then the controllers must use a handshaking system to pass control from one controller to another.

This sample program shows how to pass control of an HP-IB bus from the external controller to Instrument BASIC. The external controller is active first. If Instrument BASIC attempts to print out before being passed control, then an HP-IB error will occur, an interrupt generated, and the program will jump to the label "Not_active". When it passes control to the HP 8751A, the program is released from the ERROR interrupt and will then execute a print out.

Assume that the following two programs are simultaneously running on an external controller and on HP 8751A Instrument BASIC program respectively.

```
40 Hp8751=717
50 PASS CONTROL Hp8751        ! Pass control to the HP 8751A
60 END
```

Figure 10-13. Passing Control from External Controller

```
30 PRINTER IS 701
40 ON ERROR GOTO Not_active ! Waiting for control to be passed in line 50
50 Not_active:!             ! of the external controller BASIC
60 PRINT "HELLO WORLD!"     ! If it was not passed control yet, HPIB error
70 !                        ! occurred and back to label "Not_active"
80 OFF ERROR
90 END
```

Figure 10-14. Receiving Control

Transferring a Program to Instrument BASIC

This sample program transfers a program from an external controller's disk to Instrument BASIC memory through the HP-IB interface.

This sample program must be executed on the external controller.

```
 10 ASSIGN @Hp8751 TO 717
100 OUTPUT @Hp8751;"*RST"
110 OUTPUT @Hp8751;"PROG:DEL:ALL" ! Scratch program (refer to Appendix B)
120 INPUT "FILENAME?",File_name$
130 DIM Line$[1024]
140 OUTPUT @Hp8751;"PROG:DEF #0"  ! Send header
150 ASSIGN @File TO File_name$    ! Open file and assign data path
160 ON ERROR GOTO Done
170 LOOP
180   Line$=""
190   ENTER @File;Line$           ! Read and input program source code
200   OUTPUT @Hp8751;Line$        ! Send to iBASIC
210 END LOOP
220 Done: !
230 OFF ERROR
240 OUTPUT @Hp8751;Line$
250 OUTPUT @Hp8751;" " END        ! Send terminator
260 ASSIGN @File TO *             ! Close file
300 END
```

Figure 10-15. Program Down-load

Running an External Instrument BASIC Program

This sample program runs on an external controller and commands an HP 8751A to load a program from its own built-in disk and run it.

Assume that the Instrument BASIC program file "PROGRAM1" is stored on the built-in disk of the external HP 8751A. This sample program is executed from the external controller.

```
10 ASSIGN @Hp8751 TO 717
100 OUTPUT @Hp8751;"PROG:DEF #0"
110 OUTPUT @Hp8751;"10 GET ""PROGRAM1""" ! "Filename" is object file name
120 OUTPUT @Hp8751;"20 END"
130 OUTPUT @Hp8751;" " END
140 !
150 OUTPUT @Hp8751;"PROG:STAT RUN"        ! RUN program
200 END
```

Figure 10-16. Run External Instrument BASIC Program

You can run an external program using the following command in line 150 of the above program.

```
150 OUTPUT Hp8751;"PROG:EXEC ""RUN"""
```

Accessing the Contents of a Data Array in the Instrument BASIC Program from an External Controller

This sample program shows how to read array data of an Instrument BASIC program from an external controller.

Assume that array "Dat" is defined as `DIM Dat(1:201,1:2)` in a program of the Instrument BASIC and contains trace data. This sample program must be executed from an external controller.

```
10 ASSIGN @Hp8751 TO 717
300 DIM Passed(1:201,1:2)
310 OUTPUT @Hp8751;"PROG:NUMB? ""Dat"";"
320 ENTER @Hp8751;Passed(*) ! Instrument BASIC's array "Dat" data is entered
330 !                       !  to array "Passed"
340 END
```

Figure 10-17. Accessing External Controller's Program Array

Application Programs

This section covers the following application programs:

- Searching for the resonant and anti-resonant frequency of a crystal resonator
- Sharing one printer with two controllers
- Loading BASIC programs using soft keys

These programs are executable as they stand, but you should make adjustment for your applications, such as frequency settings and so on.

Searching for Resonant and Anti-resonant Frequency of a Crystal Resonator

This program uses the marker target search function to determine the resonant frequency f_r and anti-resonant frequency f_a by searching for the 0° phase point. To improve throughput, the measurement display is turned off in this program.

```
10 !PROGRAM CRYSTAL
20 !
30 ASSIGN @Hp8751 TO 800
40 INPUT "ENTER CENTER FREQUENCY [MHz]",Center_f
50 INPUT "ENTER SPAN FREQUENCY [MHz]",Span_f
60 OUTPUT @Hp8751;"BR;LOGMP"
70 OUTPUT @Hp8751;"CENT ";Center_f;"MHZ"
80 OUTPUT @Hp8751;"SPAN ";Span_f;"MHZ"
90 !
100 End_sweep=0
110 OUTPUT @Hp8751;"*CLS"
120 OUTPUT @Hp8751;"SING"
130 REPEAT
140   OUTPUT @Hp8751;"ESB?"
150   ENTER @Hp8751;Esb
160 UNTIL BIT(Esb,End_sweep)
170 !
180 DIM A(1:3),B(1:3)
190 OUTPUT @Hp8751;"CONVZTRA"
200 OUTPUT @Hp8751;"MARK1 0"
210 OUTPUT @Hp8751;"MARKOMAMO"
220 OUTPUT @Hp8751;"SEATARG 0"
230 OUTPUT @Hp8751;"OUTPMARK?"
240 ENTER @Hp8751;A(*)
250 OUTPUT @Hp8751;"SEAR"
260 OUTPUT @Hp8751;"OUTPMARK?"
270 ENTER @Hp8751;B(*)
280 !
290 PRINT USING "3A,3D.6D,4A";"fr=",A(3)/1.E+6," MHz"
300 PRINT USING "3A,3D.6D,4A";"fa=",B(3)/1.E+6," MHz"
310 !
320 END
```

Figure 10-18. Searching For Resonant/Anti-resonant Frequency

```
fr= 31.998495 MHz
fa= 32.005149 MHz
```

Figure 10-19. Example of Result on CRT Display

Sharing One Printer Between Two Controllers

This program shows a sample of sharing one printer between two controllers. The HP 8751A and the external controller uses the printer in sequence, the HP 8751A uses the printer first. The following is assumed:

- Two controllers and one printer on one HP-IB bus
- Figure 10-20 is in memory of the external controller
- Figure 10-21 is in memory of the Instrument BASIC controller

```
10     Hp8751a=717
30     OUTPUT Hp8751a;"PROG:STAT RUN" ! Make iBASIC run state
40 !
50     PRINTER IS 701
60     PRINT "THIS LINE IS PRINTED OUT FROM EXT. CONTROLLER."
70     PRINT "NOW I'LL PASS CONTROL TO ALLOW IBASIC TO USE PRINTER."
80     PRINT ""
90     PASS CONTROL Hp8751a
100    ON ERROR GOTO Not_active
110 ! Waiting for control to be passed back.
120 Not_active:         !  Now I returned to an active controller.
130     REMOTE Hp8751a  !  I can use HP-IB again.
170     PRINT "THIS LINE IS PRINTED OUT FROM EXT. CONTROLLER AGAIN."
180     END
```

Figure 10-20. Sharing a Printer (Program For External Controller)

```
10 Printer=701
20 PRINTER IS Printer
30 ON ERROR GOTO Not_active
40 !
50 Not_active:!
60 PRINT "THIS LINE IS PRINTED FROM IBASIC"
70            ! NOW I'm an active controller. I can freely use HP-IB.
90 PRINT "NOW I'LL DUMP 8751A'S SCREEN TO PRINTER"
100 ASSIGN @Hp8751 TO 800
110 OUTPUT @Hp8751;"DISABASS"
120 OUTPUT @Hp8751;"PRINALL"
130 PRINT "THIS LINE IS PRINTED OUT BELOW THE DUMP LIST."
140 PRINT "SO YOU'LL KNOW IF YOU USE HP-IB FROM IBASIC AND";
150 PRINT " INSTRUMENT AT THE SAME TIME,";
160 PRINT "PREEMPTIVELY EXECUTED PROCESS DOES WORK FIRST, THEN NEXT."
170 PRINT ""
200                    ! Now I've done my work, so I'll pass control back
210 PASS CONTROL 721 ! to the ext. controller

220 END
```

Figure 10-21. Sharing a Printer (Program for Instrument BASIC)

10.Application Programs

Automatic Program Execution

This program displays up to eight program file names in the HP 8751A's softkey label area, from which one of the programs can be selected and executed by just pressing a softkey. This feature lets you execute a program without using the keyboard. You only need to select the softkey of the program you want to execute.

You should name the file of this program, "AUTOST", so this program file will execute automatically when the HP 8751A is turned ON.

When you want to recall this program again after execution of an object file, you simply add the command `GET "AUTOST"` just before the `END` statement line of your object program code.

```
10 !ON KEY LABEL FUNCTION
20 !
30 ASSIGN @Hp8751 TO 800
40 DIM Dir$(1:200)[80],File$(1:200)[10]
50 !
60 CAT TO Dir$(*)
70 !
80 File_end=0
90 File_number=1
100 WHILE File_end=0 AND File_number<200
110   File$(File_number)=Dir$(File_number+7)[1,10]
120   IF File$(File_number)="" THEN
140      File_end=1
141      File_number=File_number-1
143   ELSE
144      File_number=File_number+1
150   END IF
170 END WHILE
180 !
190 Max_page=INT(File_number/6)+1
200 Npage=1
210 OUTPUT @Hp8751;"KEY 44"
220 OUTPUT @Hp8751;"KEY 0"
230 OUTPUT @Hp8751;"KEY 7"
240 Head: !
250 Page=(Npage-1)*6
260   ON KEY 1 LABEL File$(Page+1) GOSUB Jump1
270   ON KEY 2 LABEL File$(Page+2) GOSUB Jump2
280   ON KEY 3 LABEL File$(Page+3) GOSUB Jump3
290   ON KEY 4 LABEL File$(Page+4) GOSUB Jump4
300   ON KEY 5 LABEL File$(Page+5) GOSUB Jump5
310   ON KEY 6 LABEL File$(Page+6) GOSUB Jump6
320   ON KEY 7 LABEL "NEXT PAGE" GOTO Jump7
330   ON KEY 8 LABEL "PREV.PAGE" GOTO Jump8
```

Figure 10-23. Automatic Program Execution (1/2)

```
340 !
350 LOOP
360 END LOOP
370 !
380 Jump1:GET File$(Page+1)
390 Jump2:GET File$(Page+2)
400 Jump3:GET File$(Page+3)
410 Jump4:GET File$(Page+4)
420 Jump5:GET File$(Page+5)
430 Jump6:GET File$(Page+6)
440 Jump7:Npage=Npage+1
450       IF Npage>Max_page THEN Npage=Max_page
460       GOTO Head
470 Jump8:Npage=Npage-1
480       IF Npage<=1 THEN Npage=1
490       GOTO Head
500 !
510 END
```

Figure 10-22. Automatic Program Execution (2/2)

11

HP 8751A Specific HP Instrument BASIC Features

This chapter lists and summarizes the HP Instrument BASIC features specific to the HP 8751A. Details of each feature are described in the previous chapters and in the appendixes.

This chapter covers the following topics:

- I/O interfaces
- Display
- Keyboard
- Disk drive
- BASIC statements not implemented
- BASIC statements specific to HP 8751A
- HP-IB commands specific to Instrument BASIC

Available I/O Interface and Select Codes

Available interfaces and their select codes in HP 8751A Instrument BASIC are listed in the following table.

Select Codes	Devices
1	CRT
2	Keyboard
7	External HP-IB interface
8	Internal HP-IB interface

Note The HP 8751A does not have an RS-232C interface.

Display

The HP 8751A's Instrument BASIC has four display allocation types. The following table lists the number of lines and columns in the BASIC print area for each display allocation. It also shows the keyboard input line status for each allocation. When the keyboard input line is available, you can execute BASIC commands from the keyboard.

Display Allocation	BASIC Print Area		Keyboard Input Line
	Columns	Lines	
All Instrument	0	0	not available
Half INSTRument Half BASIC	58	12	available
ALL BASIC	58	24	available
BASIC Status	0	0	available

For more information on display allocation, refer to "Display Features" in Chapter 7.

The HP 8751A can be connected an external monitor. For information on the recommended monitor, refer to "SYSTEM ACCESSORIES AVAILABLE" in *General Information*.

Keyboard

For information on the keyboard, see Chapter 9.

Storage Devices

The HP 8751A's Instrument BASIC has the following disk drive limitations.

- A built-in flexible disk drive and a RAM disk memory are supported.
- External disk drives are not supported.
- HFS format is not supported.
- Disk types which can be initialized by the HP 8751A's Instrument BASIC INITIALIZE statement are 720 kByte (2DD, gray discs) and 1.44 MByte (2HD, black discs). 270 kByte (blue discs) discs can not be initialized.
- The only INITIALIZE format option is the default (256 byte/sector).

DOS formats supported. The DOS formats supported are:

- 720 kbyte, 80 tracks, double-sided, 9 sectors/track
- 1.44 Mbyte, 80 tracks, double-sided, 18 sectors/track

BASIC Statements not Implemented

The following statements are listed in the *HP Instrument BASIC Language Reference* but not implemented in the HP 8751A's Instrument BASIC.

- `OFF CYCLE`
- `ON CYCLE`

BASIC Statements Specific to HP 8751A

The following statements are NOT listed in the *HP Instrument BASIC Language Reference* but are available in the HP 8751A's Instrument BASIC.

- `DATE`
- `DATE$`
- `READIO`
- `SET TIME`
- `SET TIMEDATE`
- `TIME`
- `TIME$`
- `WRITEIO`

These keywords are described in Appendix A.

HP-IB Commands Specific to HP 8751A's Instrument BASIC

The HP 8751A's Instrument BASIC provides an HP-IB command set called "PROGram Subsystem", which is used to control HP 8751A's Instrument BASIC system from an external controller. These statements are only executable from external controllers. All PROGram subsystem commands are described in Appendix B.

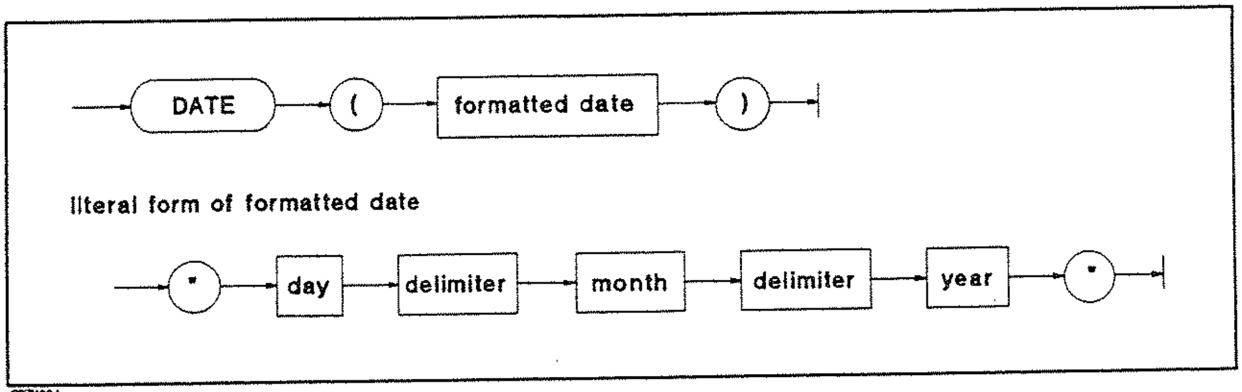
A

BASIC Commands Specific to HP 8751A

DATE

Keyboard Executable	Yes
Programmable	Yes
In an IF ... THEN ...	Yes

This function converts data formatted as (DD MMM YYY) into the numeric value used to set the clock.



C271004

Item	Description	Range
formatted date	string expression	(see drawing and text)
day	integer constant	1 thru end-of-month
month	Literal (letter case ignored)	JAN, FEB, MAR, APR, MAR, APR, MAY, JUN, JUL, AUG, SEP, OCT, NOV, DEC
year	integer constant	1900 thru 2079

Example Statements

```
PRINT DATE("21 MAY 1991")
SET TIMEDATE DATE("1 Jan 1991")
Days=(DATE("1 JAN 1991")-DATE("11 NOV 1990")) DIV 86400
```

Semantics

Using a value from the DATE function as the argument for SET TIMEDATE will set the clock to midnight on the date specified. The results from the DATE and TIME functions must be combined to set the date and time of day.

If the DATE function is used as an argument for SET TIMEDATE to set the clock, the date must be in the range: 1 Mar 1900 thru 4 Aug 2079.

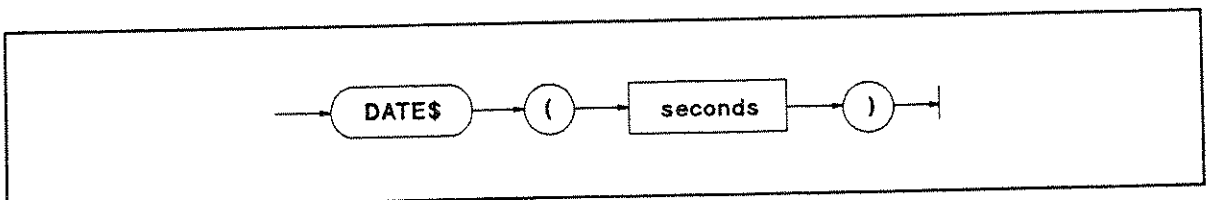
Specifying invalid date, such as the thirty-first of February, will cause an error.

Leading blanks or non-numeric characters are ignored. ASCII spaces are recommended as delimiters between the day, month and year. However, any non-alphanumeric character, except the negative sign (−), may be used as the delimiter.

DATE$

Keyboard Executable   Yes
Programmable   Yes
In an IF ... THEN ...   Yes

This function formats the number of seconds into a date (DD MMM YYY).



C27HOO3

Item	Description	Range
seconds	numeric expression	−4.623 683 256E+12 thru 4.653 426 335 039 9E+13

Example Statements

```
PRINT DATE$(TIMEDATE)
DISP DATE$(2.111510608E+11)
```

Semantics

The date returned is in the form: DD MMM YYYY, where DD is the day of the month, MMM is the month mnemonic, and YYYY is the year.

The day is blank filled to two character positions. Single ASCII spaces delimit the day, month, and year.

The first letter of the month is capitalized and the rest are lowercase charters.

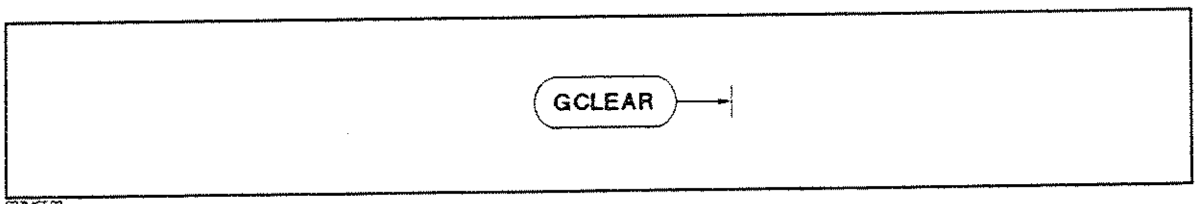
Years less than the year 0 are expressed as negative years.

GCLEAR

Keyboard Executable	Yes
Programmable	Yes
In an IF ... THEN ...	Yes

This statement PERFORMS the following functions:

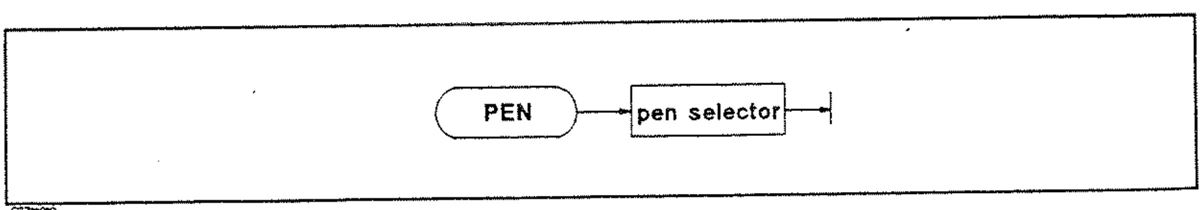
- Clears the graphics screen
- Selects PEN 1 (see PEN)
- MOVE 0,0 (see MOVE)



PEN

Keyboard Executable	Yes
Programmable	Yes
In an IF ... THEN ...	Yes

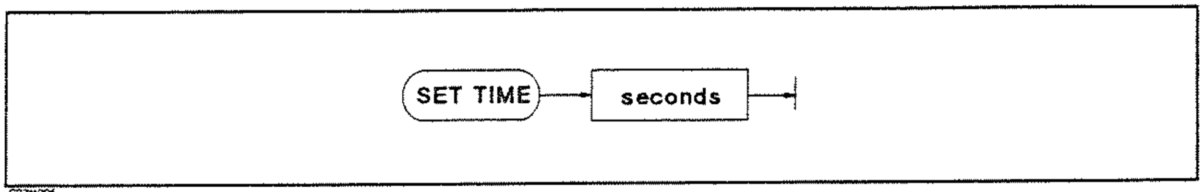
This command selects the pen to be used for drawing graphic images and for plotting.



SET TIME

Keyboard Executable	Yes
Programmable	Yes
In an IF ... THEN ...	Yes

This statement resets the time-of-day given by the real-time clock.



Item	Description	Range
seconds	numeric expression, rounded to the nearest hundredth	0 thru 86 399.99

Example Statements

```
SET TIME 0
SET TIME Hours*3600+Minutes*60
```

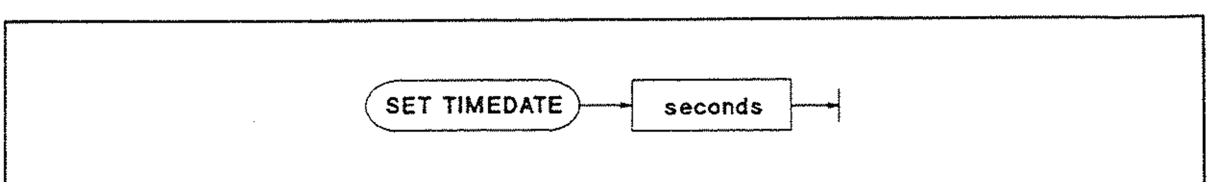
Semantics

SET TIME changes only the time within the current day, not the date. The new clock setting is equivalent to (TIMEDATE DIV 86 400)x86 400 plus the specified setting.

SET TIMEDATE

Keyboard Executable	Yes
Programmable	Yes
In an IF ... THEN ...	Yes

This statement resets the absolute seconds (time and day) given by the real-time clock.



Item	Description	Range
seconds	numeric expression, rounded to the nearest hundredth	2.086 629 12E+12 thru 2.143 252 224E+11

Example Statements

```
SET TIMEDATE TIMEDATE+86400
SET TIMEDATE Strange_number
```

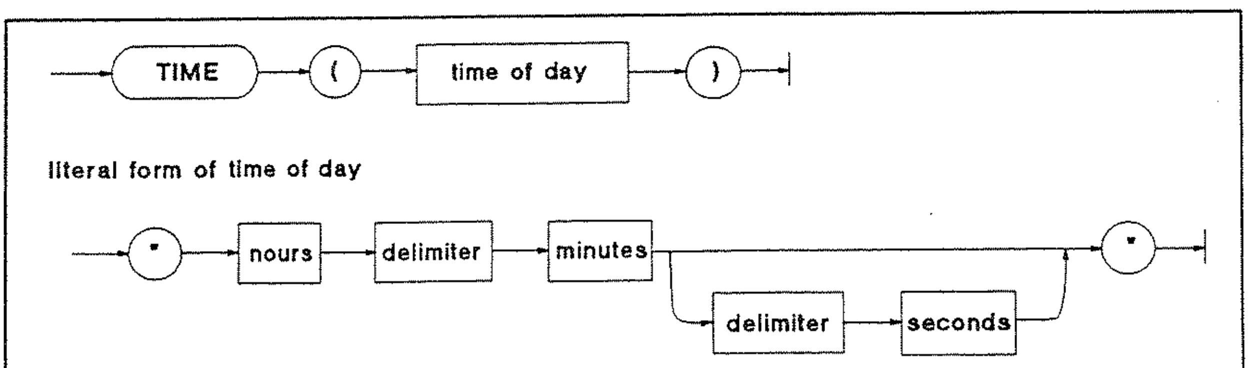
Semantics

The volatile clock is set to 2.086 629 12E+11 (midnight March 1, 1900) at power-on. If there is a battery-backed (non-volatile) clock, then the volatile clock is set to its value at power-up. If the computer is linked to an SRM system (and has no battery-backed clock), then the volatile clock is set to the SRM clock value when the SRM and DCOMM binaries are loaded. The clock values represent Julian time, expressed in seconds.

TIME

Keyboard Executable   Yes
Programmable   Yes
In an IF ... THEN ...   Yes

This function converts data formatted as time of day (HH:MM:SS), into the number of seconds past midnight. (For information on using TIME as a secondary keyword, see the OFF TIME, ON TIME, and SET TIME statements. The OFF TIME and ON TIME are described in *HP Instrument BASIC Language Reference*.)



C2711007

Item	Description	Range
time of day	string expression representing the time in 24 hour format	(set drawing)
hours	literal	0 thru 23
minutes	literal	0 thru 59
seconds	literal; default = 0	0 thru 59.99
delimiter	literal; single character	(see text)

Example Statements

```
Seconds=TIME(T$)
SET TIME TIME("8:37:20")
ON TIME TIME("12:10") GOSUB Lunch
```

Semantics

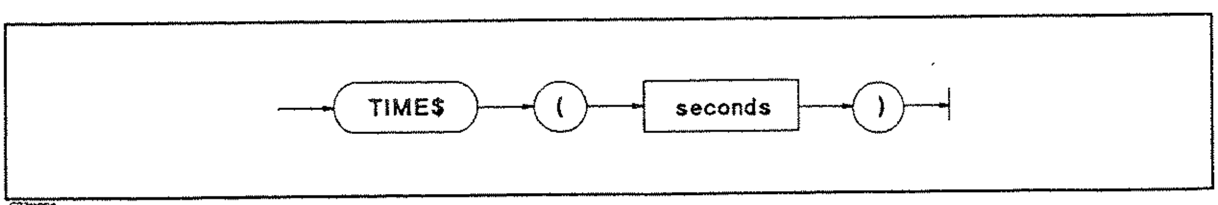
TIME returns a positive integer, in the range 0 thru 86,399, equivalent to the number of seconds past midnight.

While any number of non-numeric characters may be used as a delimiter, a single colon is recommended. Leading blanks and non-numeric characters are ignored.

TIME$

Keyboard Executable Yes
Programmable Yes
In an IF ... THEN ... Yes

This function converts the number of seconds past midnight into a string representing the time of day (HH:MM:SS).



Item	Description	Range
seconds	numeric expression, truncated to the nearest second; seconds past midnight	0 thru 86 399

Example Statements

```
DISP "The time is:  ";TIME$(TIMEDATE)
PRINT TIME$(45296)
```

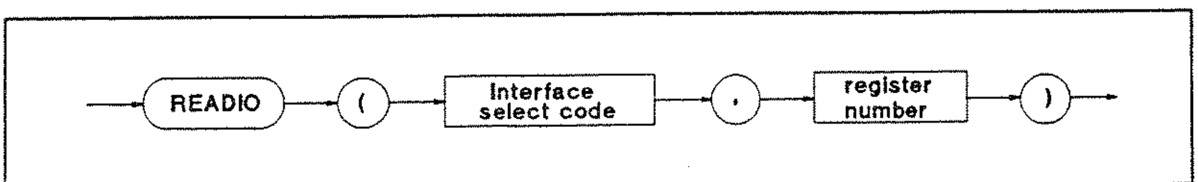
Semantics

TIME$ takes the time in seconds and returns the time of day in the form HH:MM:SS, where HH represents hours, MM represents minutes, and SS represents seconds. A module 86,400 is performed on the parameter before it is formatted as a time of day.

READIO

Keyboard Executable	Yes
Programmable	Yes
In an IF ... THEN ...	Yes

This function reads the contents of the specified hardware register on the specified interface, or reads the specified byte or word in memory.



Item	Description	Range
select code	numeric expression	15
register number or memory address	numeric expression	0

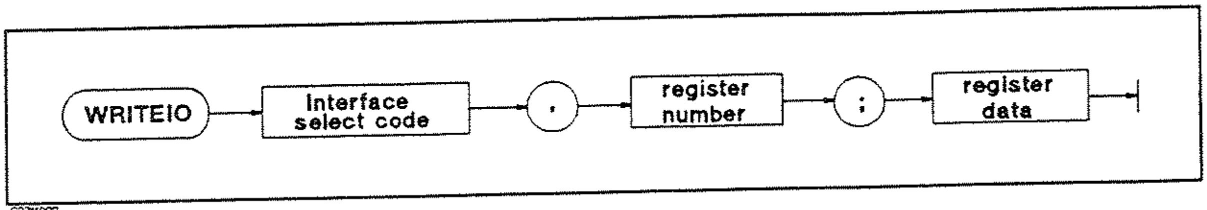
Example Statements

```
IOPORT=READIO(15,0)
PRINT "I/O port";I;"=";READIO(15,0)
```

WRITEIO

Keyboard Executable	Yes
Programmable	Yes
In an IF ... THEN ...	Yes

This statement writes an integer representation of the register-data parameter into the specified hardware register on the specified interface, or into memory. The actual action resulting from this operation depends on the interface and register (or memory address) selected.



C2711002

Item	Description	Range
select code	numeric expression	15
register number or memory address	numeric expression	0
register or memory data	numeric expression	-2^{31} thru $+2^{31}-1$

Example Statements

```
WRITEIO 15,0;Set_io
WRITEIO 15,0;12
```

Note

For information on the 8-bit I/O port, refer to "Using the 8-bit I/O Port in BASIC Programs" in Chapter 7 in this manual and "I/O port" in Appendix C of *HP 8751A Reference Manual.*

B

HP-IB Instrument BASIC Commands

This chapter provides descriptions of the PROGram subsystem, which is an HP-IB command set used to control the HP 8751A's Instrument BASIC. For example, an external controller can be used to control the retrieval and execution of Instrument BASIC programs from the HP 8751A's built-in disk drive. Commands under the PROGram subsystem are the common commands specified by Standard Commands for Programmable Instruments (SCPI).

For more information on SCPI, refer to *Beginner's Guide to SCPI* (P/N:H2325-90001). Order it at your nearest HP sales office.

Notation Conventions and Definitions

The following conventions and definitions are used in this chapter to describe HP-IB operation.

< > Angular brackets enclose words or characters that are used to symbolize a program code parameter or an HP-IB command.

[ ] Square brackets indicates that the enclosed items are optional.

{ } When several items are enclosed by braces, one and only one of these elements may be selected.

Command Structure

The HP 8751A commands are divided into three types: HP-IB common commands, HP-IB commands to control the HP 8751A and PROGram subsystem commands (SCPI commands). The HP-IB common commands are defined in IEEE std. 488.2-1987, and these commands are common for all devices. The HP-IB unique commands are used to control the HP 8751A. (Where possible, the unique commands are compatible with HP 8750 and HP 8510 series.) The HP-IB common and unique commands are described in *HP 8751A HP-IB Programming Manual*.

The commands under the PROGram subsystem are used to control Instrument BASIC with an external controller and they are described in this chapter. The PROGram subsystem has a tree structure which is nested three levels deep. So the lower level commands are legal only when the PROGram command have been selected. A colon (:) is used to separate the higher and lower level commands. See Figure B-1 for a sample.

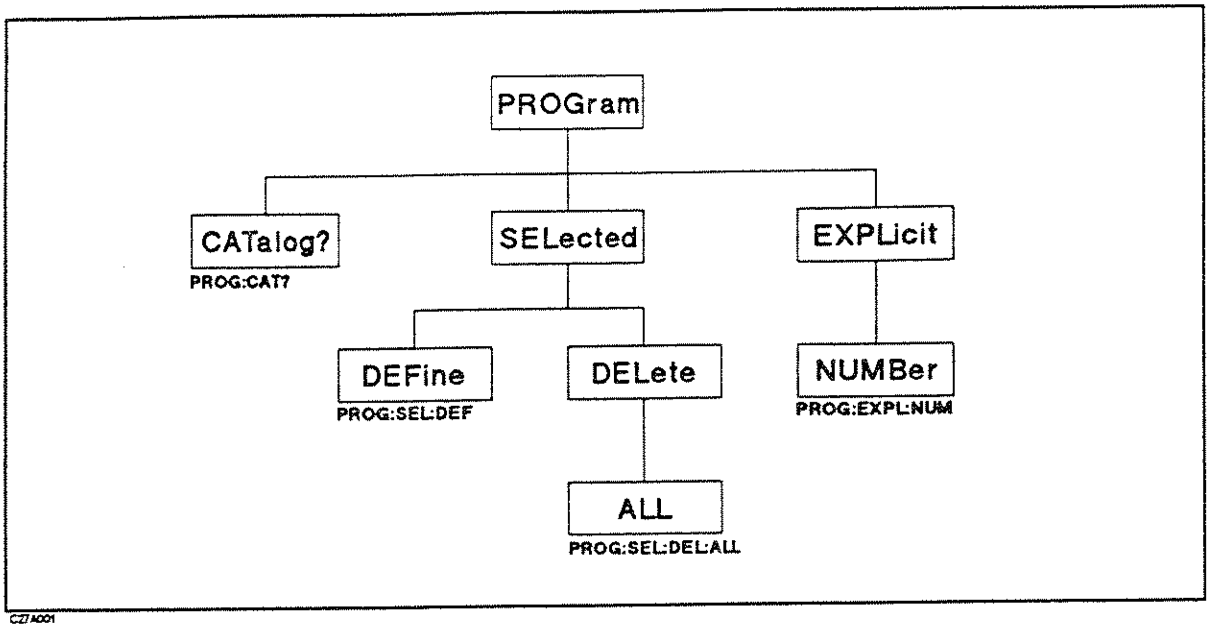


Figure B-1. Command Tree Example

Basic Rules

The basic rules of the command tree are as follows:

- Letter case (upper and lower) is ignored.

  For example,
  `PROG:CAT? = prog:cat? = PrOg:CAt?`

- Spaces (␣ used to indicate a space) must not be placed before and/or after the colon (:).

  For example,
  (wrong) `PROG␣:␣CAT?` → (right) `PROG:CAT?`

- The command can be completely spelled out or be abbreviated. (The rules for command abbreviation are described later in this section)

  For example,
  `PROGRAM:CATALOG? = PROG:CAT?`

- The command header should be followed by a question mark (?) to generate a query for that command.

  For example,
  `PROG:CAT?`

The semicolon (;) can be used as a separator to execute multiple commands on a single line. The multiple command rules are as follows:

- Commands at the same level and in the PROGram subsystem command group can be separated by a semicolon (;) on a multiple command line.

  For example,
  `PROG:STAT PAUSE:NUMB A;STAT CONT`

- To restart commands from the highest level (PROGram command), a semicolon (;) must be used as the separator, and then a leading colon (:), which shows that the restarted command is a command at the top of the command tree.

  For example,
  `PROG:NUMB A;:PROG:EXPL:WAIT`

- The HP-IB common commands can restart only after a semicolon on a multiple command line.

  For example,
  `PROG:DEL:ALL;*RST`

- The HP-IB common commands keeps the previous command's level in a multiple command line.

  For example,
  `PROG:STAT STOP;*RST;STAT RUN`

- The HP-IB unique commands can restart only after a semicolon on a multiple command line.

  For example,
  `PROG:STAT STOP;CENT 100E6`

- After the HP-IB unique commands, the PROGram subsystem commands must restart from the highest level (:PROGram) since the unique commands do not keep the previous commands' level in a multiple command line.

  For example,
  `PROG:STAT STOP;CENT 100E6;:PROG:STAT RUN`

Command Abbreviations

Every command and character parameter has at least two forms, a short form and a long form. In some cases they will be the same. The short form is obtained using the following rules.

- If the long form has four characters or less, the long form and short form are the same.
- If the long form has more than 4 characters,
  - If the 4th character is a vowel, the short form is the first 3 characters of the long form.
  - If the 4th character is not a vowel, the short form is the first 4 characters.

  For example:

  `WAIT` abbreviates to `WAIT`
  `DEFine` abbreviates to `DEF`
  `STRing` abbreviates to `STR`
  `PROGram` abbreviates to `PROG`

- If the long form mnemonic is defined as a phrase rather than as a single word, then the long form mnemonic is the first character of the first word(s) followed by the entire last word. The above rules, when the long form mnemonic is a single word, are then applied to the resulting long form mnemonic to obtain the short form.

For example:

Memory ALLocate abbreviates to MALL. (The long form is MALLOCATE.)

PROGram Subsystem

Note Because PROGram subsystem is designed to be compatible with other HP instruments, PROGram subsystem includes commands which are not necessary or used by the HP 8751A.

The purpose of the PROGram is to provide the administrative features needed to generate and control a BASIC program resident in an instrument. Two distinct methods of accessing a particular program are provided in the PROGram subsystem. One method employs EXPLicit reference for each command. This method requires the program name to be always specified. The other method allows a single program to be SELected at a time, and the related commands access only the currently selected program.

Note Because the HP 8751A Instrument BASIC can not get or execute multiple programs at once, the PROGram subsystem of the HP 8751A accesses only one program at time even when EXPLicit is used.

An *RST received from a remote controller, by HP-IB, will stop execution of the program.

<table>
<tr><th>KEYWORDS</th><th>PARAMETER FORM</th><th>NOTES</th></tr>
<tr><td>PROGram</td><td></td><td></td></tr>
<tr><td>:CATalog?</td><td></td><td>[query only]</td></tr>
<tr><td>[:SELected]</td><td></td><td></td></tr>
<tr><td>:DEFine</td><td><program></td><td></td></tr>
<tr><td>:DELete</td><td></td><td>[no query]</td></tr>
<tr><td>[:SELected]</td><td></td><td></td></tr>
<tr><td>:ALL</td><td></td><td></td></tr>
<tr><td>:EXECute</td><td><program command></td><td>[no query]</td></tr>
<tr><td>:MALLocate</td><td>{<nbytes> DEFault}</td><td></td></tr>
<tr><td>:NAME</td><td><progname></td><td></td></tr>
<tr><td>:NUMBer</td><td><varname>,<nvalues></td><td></td></tr>
<tr><td>:STATe</td><td>{RUN|PAUSe|STOP|CONTinue}</td><td></td></tr>
<tr><td>:STRing</td><td><varname>,<svalues></td><td></td></tr>
<tr><td>:WAIT</td><td></td><td></td></tr>
<tr><td>:EXPLicit</td><td></td><td></td></tr>
<tr><td>:DEFine</td><td><progname>,<program></td><td></td></tr>
<tr><td>:DELete</td><td><progname></td><td></td></tr>
<tr><td>:EXECute</td><td><progname>,<program command></td><td>[no query]</td></tr>
<tr><td>:MALLocate</td><td><progname>,{<nbytes>|DEFault}</td><td></td></tr>
<tr><td>:NUMBer</td><td><progname>,<varname>,<nvalues></td><td></td></tr>
<tr><td>:STATe</td><td><progname>,{RUN|PAUSe|STOP|CONTinue}</td><td></td></tr>
<tr><td>:STRing</td><td><progname>,<varname>,<svalues4></td><td></td></tr>
<tr><td>:WAIT</td><td></td><td></td></tr>
</table>

See "Transferring a Program to Instrument BASIC" in Chapter 10, "Running an External Instrument BASIC Program" in Chapter 10, "Accessing the Contents of a Data Array in the Instrument BASIC Program from an External Controller" in Chapter 10, and "Passing Control" in Chapter 10 for the sample procedures and programs using the PROGram subsystem.

Note

Use commands under the SELected node for the HP 8751A Instrument BASIC, (do not use one under EXPLicit node). Because you do not have to specify a program name if you use SELected.

The commands under the SELected node perform functions as same as ones under the EXPLicit node.

:CATalog?

The CATalog query commands returns the program name "prog" if the HP 8751A Instrument BASIC gets a program. IF no programs are currently defined then the response is a null string (" ").

[:SELected]

All the commands under this node access the program on the BASIC program editor of the HP 8751A.

:DEFine <program>

The DEFine command is used to create and down-load programs. The DEFine query is also used to up-load programs.

The <program> download must be arbitrary block program data containing lines of program code. The first line of <program> must be a header, which shows program size. There is two format of the header as follows:

`#0` Allows that `OUTPUT` statement can send program line until END is specified in `OUTPUT` statement.

`#NMM.... M` Specifies program size defined.
`N` shows number of figures, which shows program size
`M.... M` is program size in byte (`N` figures)

Each line of the program must be separated by <CR> or <CR><LF>. Any line in which a syntax error is detected will be turned into a comment and a Program syntax error (−285) will be generated. Where the size of <program> exceeds the amount of available memory in the instrument, program lines will be saved up to the point of memory overflow. When overflow occurs a Program syntax error (−285) error will be generated.

In the DEFine query, the selected program and its size will be returned. The selected program will be in either the PAUSed or STOPped state for the program to be up-loaded. If the program is in the RUN state a "Program currently running" error (−284) will be generated. The <program> will be up-loaded as definite length arbitrary block response data. The program size is returned at first line as the header, then program line will be returned.

:DELete

The :DELete command deletes the program from the HP 8751A.

[:SELected]

Note The HP 8751A Instrument BASIC always selects "prog" if a program is loaded, you cannot select any other name.

The optional SELected command causes the selected program to be deleted. If the selected program name is not DEFined then an "Illegal program name" error (−282) will be generated. If the selected program is in the RUN state a "Program currently running" error (−284) shall be generated.

:ALL

ALL is used to specify all programs in the device are to be deleted. But there is only one program in the HP 8751A, ALL performs same function as SELected. If the program is in the RUN state a "Program currently running" error (−284) will be generated and no programs will be deleted.

:EXECute <program command>

The EXECute Command executes the program command in the selected program environment. <program command> is string data representing any legal program command. If the string data is not legal, then a "Program syntax error" (−285) will be generated. The selected program will be in either the PAUSed or STOPped state before the EXECute command will be allowed. If the program is in the RUN state a "Program currently running" error (−284) will be generated.

:MALLocate {<nbytes>|DEFault}

Note The MALLcoate command performs no function in the HP 8751A's Instrument BASIC. HP 8751A's memory space is fixed at 512 kbyte.

:NAME <progname>

Note You do not have to use the NAME commands for the HP 8751A Instrument BASIC. The program on the BASIC program editor is always selected. The program name is always "PROG".

The NAME command defines the name of the program to be selected. If the program name <progname> already exists then the existing program will be selected. If the program name does not exist then the new name will be selected, but no program shall be defined by this selection. <progname> is char data. *RST causes the selected name to become the PROG.

:NUMBer <varname>,<nvalues>

The NUMBer command is used to set and query the contents of numeric program variables and arrays in the currently selected program. The current selected program must be a DEFined program, otherwise an "Illegal program name" error (−282) will be generated. The variable specified in <varname> should be the name of an existing variable in the selected program, otherwise an "Illegal variable name" error (−283) will be generated. <varname> can be either char data or string data. <nvalues> is a list of comma separated numeric values which are used to set <varname>. If the specified variable cannot hold all of the specified numeric values then a "Parameter not allowed" error (−108) will be generated.

:STATe {RUN|PAUSe|STOP|CONTinue}

The STATe command is used to either set the state or query the state of a selected program. The matrix below defines the effect of setting the STATe to the desired value from each of the possible current states. In certain cases a parameter error "Settings conflict" (−221) shall be generated.

Desired State	Current State		
	RUN	PAUSE	STOP
RUN	error (−221)	RUN	RUN
CONT	error (−221)	RUN	error (−221)
PAUSE	PAUSE	PAUSE	STOP
STOP	STOP	STOP	STOP

:STRing <varname>,<svalues>

The STRing command is used to set and query the contents of string program variables and arrays in the current selected program. The current selected program must be a DEFined program, otherwise an "Illegal program name" error (−282) will be generated. The variable specified in <varname> will be the name of an existing variable in the selected program, otherwise an "Illegal variable name" error (−283) will be generated. <varname> can be either char data or string data. <svalues> is a list of comma separated strings which are used to set <varname>. If the specified variable cannot hold all of the specified string values then a "Parameter not allowed" error (−108) will be generated. If a string value is too long then it will be truncated when stored in the programs variable.

:WAIT

The WAIT command waits for the selected program to enter the non running state.

:EXPLicit

Note

Use commands under the SELected node for the HP 8751A Instrument BASIC, (do not use one under EXPLicit node). Because you do not have to specify a program name if you use SELected.

All the commands under the EXPLicit node perform functions the same as the ones under the SELected node mentioned above.

All the commands under the EXPLicit node reference directly the desired program by name. The <program> parameter is required for these commands.

Note

Since the HP 8751A Instrument BASIC executes a single program at once, the program name for EXPLicit commands is always PROG.

:DEFine <progname>, <program>

The DEFine command is used to create and download programs. The DEFine query is used to up-load programs.

The <program> down-loaded must be arbitrary block program data containing lines of program code.

The first line of <program> must be a header, which shows program size. There is two format of the header as follows:

`#0`	Allows that `OUTPUT` statement can send program line until END is specified in OUTPUT statement.
`#NMM.... M`	Specifies program size defined. `N` shows number of figures, which shows program size `M.... M` is program size in byte (`N` figures)

Each line of the program must be separated by <CR> or <CR><LF>. Any line in which a syntax error is detected will be turned into a comment and a Program syntax error (−285) will be generated. Where the size of <program> exceeds the amount of available memory in the instrument, program lines will be saved up to the point of memory overflow. When overflow occurs a Program syntax error (−285) error will be generated.

In the DEFine query, the specified program name must be "prog" for HP 8751A, otherwise an "Illegal program name" error (−282) will be generated. The specified program must be in either the PAUSed or STOPped state for the program to be up-loaded. If the program is in the RUN state a "Program currently running" error (−284) will be generated. The <program> will be up-loaded as definite length arbitrary block response data.

:DELete <program>

The delete command is used to delete in the HP 8751A. If the specified program name is not "prog" then an "Illegal program name" error (−282) will be generated. If the program is in the RUN state a "Program currently running" error (−284) will be generated.

:EXECute <progname>,<program command>

The EXECute command executes the program command in the specified program environment. <program command> is string data representing any legal program command. If the string data is not legal, then a "Program syntax error" (−285) will be generated. The specified program will be in either the PAUSed or STOPped state before the EXECute command will be allowed. If the program is in the RUN state a "Program currently running" error (−284) will be generated.

:MALLocate <progname>, {<nbytes>|DEFault}

Note

The MALLcoate commands performs no function for the HP 8751A's Instrument BASIC. HP 8751A's memory space is fixed at 512 kbyte.

:NUMBer <progname>,<varname>,<nvalues>

The NUMBer command is used to set and query the contents of numeric program variables and arrays in the specified program. The specified program must be a DEFined program, otherwise an "Illegal program name" error (−282) will be generated. The variable specified in <varname> must be the name of an existing variable in the specified program, otherwise an "Illegal variable name" error (−283) will be generated. <varname> can be either char data or string data. <nvalues> is a list of comma separated numeric values which are used to set <varname>. If the specified variable cannot hold all of the specified numeric values then a "Parameter not allowed" error (−108) will be generated.

:STATe <progname>,{RUN|PAUSe|STOP|CONTinue}

The STATe command is used to either set the state or to query the state of the specified program. The matrix below defined the effect of setting the STATe to the desired value from each of the possible current states. In certain cases a parameter error "Settings conflict" (−221) will be generated.

Desired state	Current state		
	RUN	PAUSE	STOP
RUN	error (−221)	RUN	RUN
CONT	error (−221)	RUN	error (−221)
PAUSE	PAUSE	PAUSE	STOP
STOP	STOP	STOP	STOP

:STRing <progname>,<varname>,<svalues>

The STRing command is used to set and query the contents of string program variables and arrays in the specified program. The specified program must be a DEFined program, otherwise an "Illegal program name" error (−282) will be generated. The variable specified in <varname> must be the name of an existing variable in the specified program, otherwise an "Illegal Variable name" error (−283) will be generated. <varname> can be either char data or string data. <svalues> is a list of comma separated strings which are used to set

<varname>. If the specified variable cannot hold all of the specified string values then a "Parameter not allowed" error (−108) will be generated. If a string value is too long then it will be truncated when stored in the program's variable.

:WAIT

The WAIT command waits for the specified program to enter the non running state.

C

Manual Changes

INTRODUCTION

This appendix contains the information required to adapt this manual to earlier versions or configurations of the HP 8751A than the current printing date of this manual. The information in this manual applies directly to the HP 8751A Network Analyzer serial number prefix listed on the title page of this manual.

MANUAL CHANGES

To adapt this manual to your HP 8751A, refer to Table C-1 and Table C-2, and make all of the manual changes listed opposite your instrument's serial number and firmware version.

Instruments manufactured after the printing of this manual may be different than those documented in this manual. Later instrument versions will be documented in a manual changes supplement that will accompany the manual shipped with that instrument. If your instrument's serial number is not listed on the title page of this manual or in Table C-1, it may be documented in a *yellow MANUAL CHANGES* supplement.

Turn on the line switch or execute the "*IDN?" command by HP-IB to confirm the firmware version. Refer to HP-IB Programing Manual for the information on the "*IDN?" command. For additional information on serial number coverage, refer to Chapter 1 in General Information.

Table C-1. Manual Changes by Serial Number

Serial Prefix or Number	Make Manual Changes
3026	Change 1
3123	Change 2

Table C-2. Manual Changes by Firmware Version

Version	Make Manual Changes
2.00 and below	Change 1
3.00 through 3.02	Change 2

C Manual Changes

CHANGE 1

Page 5-1, "Saving and Getting Programs"

Delete the following note.

Note The HP 8751A can use either LIF (Logical Interchange Format) or DOS formatted disks. The instrument automatically detects the disk format. It is able to use most of the same operations for either disk format.

Page 7-3, "Graphics"

Delete this section.

Page 7-7, "File System Exceptions"

Replace the description to the following description.

Since the LIF file format is the only compatible disk format for the built-in disk drive, the `CREATE` statement is not implemented for the HP 8751A Instrument BASIC of Revision 2.00.

Since HFS is not allowed, the `CREATE DIR` statement is not implemented.

Since an external disk drive is not allowed with the HP 8751A, the MASS STORAGE IS (`MSI`) statement cannot specify any volume except for the built-in disk drive (it's volume specifier is `INTERNAL,4`, which is default).

Page 11-2,"Disk Drive"

Replace the following description with "HFS format is not supported."

- DOS and HFS are not supported.

Page 11-2,"Disk Drive"

Delete the following description from "Disk Drive".

DOS formats supported. The DOS formats supported are:

- 720 kbyte, 80 tracks, double-sided, 9 sectors/track
- 1.44 Mbyte, 80 tracks, double-sided, 18 sectors/track

Page 11-3, "BASIC Statement not Implemented"

Add following items:

- `CREATE`
- `CREATE DIR`
- `DRAW`
- `GCLEAR`
- `MOVE`
- `PEN`
- `WILD CARD`

Page A-3

Delete the following items from "HP 8751A Specific HP Instrument BASIC Feature".

GCLEAR
PEN

CHANGE 2

The RAM disk memory is not supported. Delete all descriptions of the RAM disk memory in this manual.

Index

HP 8751A Network Analyzer

HP-IB Programming Manual

SERIAL NUMBERS

This manual applies directly to instruments with serial number prefix 3146. For additional important information about serial numbers, read "Serial Number" in the General Information section of the Operation Manual.

HEWLETT PACKARD

Printed in Japan November 1991

Contents

Figures

Tables

1

General Information

This manual is a tutorial introduction to remote operation of the HP 8751A Network Analyzer using an HP 9000 series 200 or 300 computer with BASIC programming examples. The following is a brief description of each chapter and appendix.

Chapter 2 describes programming basics and provides example programs.

Chapter 3 lists HP-IB commands in alphabetic order.

Appendix A summarizes HP-IB commands according to their softkey labels.

Appendix B describes the status byte register and the other registers of the HP 8751A.

Appendix C provides the codes of the front panel keys for using the KEY HP-IB command.

Appendix D describes the calibration types and the standard classes, and the calibration coefficients.

Appendix E provides information on the waveform analysis function.

Appendix F provides reference information for converting HP-IB programs of the HP 8753C into HP 8751A programs.

Error Messages lists error messages with explanations.

The reader should become familiar with the operation of the HP 8751A before controlling it by HP-IB. This manual is not intended to teach the BASIC programming language or to discuss HP-IB theory of operation; refer to the following documents which are better suited to these tasks.

- For more information concerning the operation of the HP 8751A, refer to the following:

  HP 8751A User's Guide

  HP 8751A Reference Manual

- For more information concerning BASIC, refer to the manual set for the BASIC revision being used:

  BASIC Programming Techniques

  BASIC Language Reference

- For more information concerning HP-IB, refer to the following:

  BASIC Interfacing Techniques

  Tutorial Description of the Hewlett-Packard Interface Bus

  Condensed Description of the Hewlett-Packard Interface Bus

2

Programming Basics

This chapter describes programming basics and provides example programs.

2.Programming Basics

Preparing for HP-IB Control

To run the examples in this chapter, the following equipment is required:

Required Equipment

1. HP 8751A Network Analyzer
2. HP 9000 Series 200 or 300 computer or an IBM compatible PC with a measurement co-processor or card (HP 82300 or 82324) with enough memory to hold BASIC, needed binaries (refer to "Powering Up the System"), and at least 64 kilobytes of program space.

   A disk drive is required to load BASIC, if no internal disk drive is available.
3. BASIC 3.0 or higher operating system.
4. HP 10833A/B/C/D HP-IB cables to interconnect the computer, the HP 8751A, and any peripherals.

Optional Equipment

1. HP 87511A S-parameter Test Set
2. HP 85032B 50 Ω type-N calibration kit
3. HP 11857D Cable Kit
4. Accessory kit
5. Device under test (DUT)
6. Cables to connect DUT
7. Printer

Powering Up the System

1. Set up the HP 8751A as shown in Figure 2-1.

   Connect the HP 8751A to the computer with an HP-IB cable.

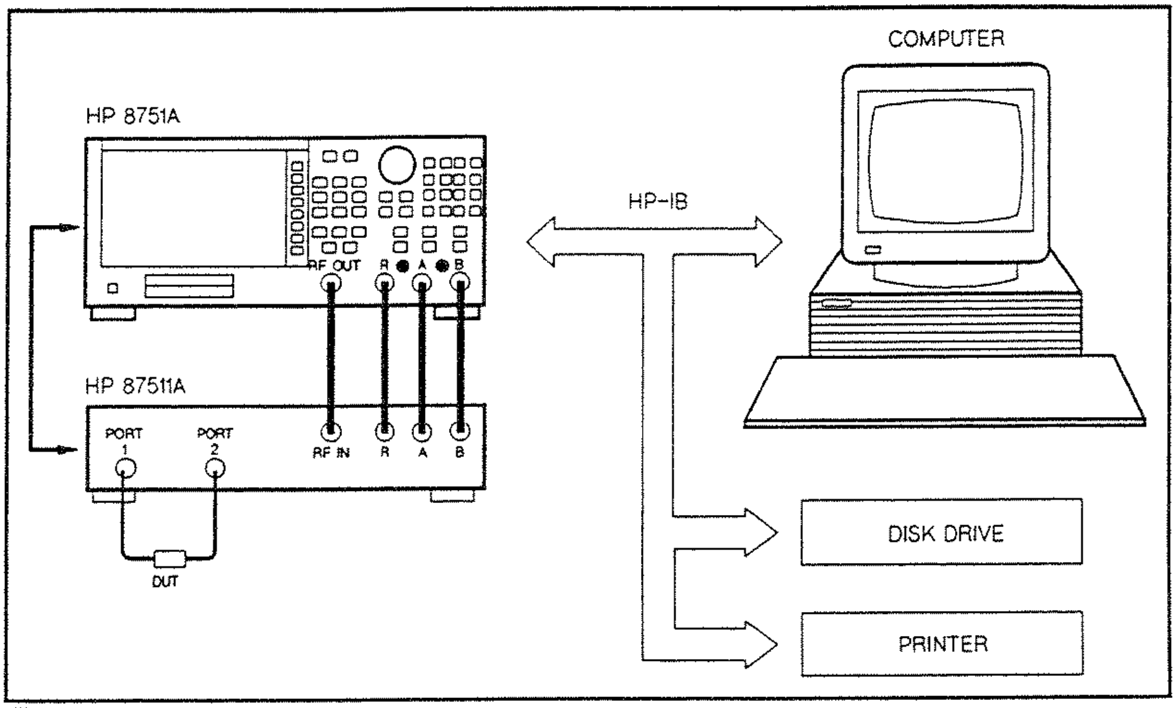


Figure 2-1. HP-IB Connections in a Typical Setup

2. Turn on the computer and load the BASIC operating system.

   Load the following BASIC binary extensions:

   HPIB, GRAPH, IO, KBD, and ERR.

   Depending on the disk drive, a binary such as CS80 may be required.

3. Turn the HP 8751A ON.

   To verify the HP 8751A's address, press (LOCAL) and select SET ADDRESSES ADDRESS: 8751. If the address has been changed from the default value (17), return it to 17 while performing the examples in this document by pressing (1) (7) (x1).

   Make sure the HP 8751A is in the ADDRESSABLE ONLY mode, as indicated under the (LOCAL) key. This is the only mode in which the HP 8751A will accept HP-IB commands.

4. On the computer, type the following:

   OUTPUT 717;"PRES" (Return) (or (EXECUTE))

   This will preset the HP 8751A. If preset does not occur, there is a problem. First check all HP-IB addresses and connections: most HP-IB problems are caused by an incorrect address and bad or loose HP-IB cables.

Note

Only the HP 9000 Model 226 and 236 computers have an EXECUTE key. The Model 216 has an EXEC key with the same function. All other computers use the Return key for both the execute and enter functions. The notation Return is used in this document.

2. Programming Basics

Measurement Programming

This section describes how to organize the commands into a measurement sequence. Figure 2-2 shows a typical measurement sequence.

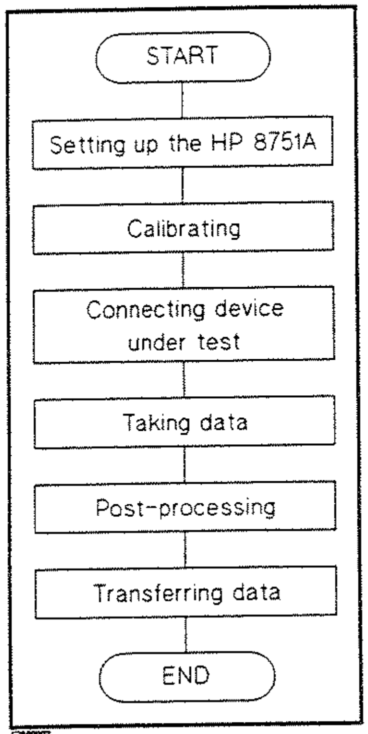


Figure 2-2. Typical Measurement Sequence

- Setting up the HP 8751A

  Define the measurement by setting all of the basic measurement parameters. These include all the stimulus parameters: sweep type, span, sweep time, number of points, and RF power level. They also include the parameter to be measured, and both IF averaging and IF bandwidth. These parameters define the way data is gathered and processed within the instrument, and to change one of these parameters requires that a new sweep be triggered.

  There are other parameters that can be set within the HP 8751A that do not affect data gathering directly, such as smoothing, trace scaling or trace math. These functions are classed as post processing functions: they can be changed with the HP 8751A in the hold mode, and the data will correctly reflect the current state.

  The save/recall registers provide a rapid way of setting up an entire instrument state.

- Calibrating

  Measurement calibration is normally performed once the HP 8751A state has been defined. Measurement calibration is not required to make a measurement, but it does improve measurement accuracy.

  There are several ways to calibrate the HP 8751A as follows:

  - The simplest is to stop the program and have the operator perform the calibration from the front panel.

- Alternatively, the computer can be used to guide the operator through the calibration, as discussed in "Frequency Response Calibration" and "1-Port Reflection Calibration".
- The last option is to transfer calibration data from a previous calibration back into the instrument, as discussed in "Reading Calibration Data".

- Connecting device under test

  Have the operator connect and adjust the device. The computer can be used to speed the adjustment process by setting up such functions such as limit testing, bandwidth searches, and trace statistics. All adjustments take place at this stage so that there is no danger of taking data from the device while it is being adjusted.

- Taking data

  With the device connected and adjusted, measure its frequency response, and store the data in the HP 8751A so that there is a valid trace to analyze.

  The single sweep command `SING` is designed to ensure a valid sweep. All stimulus changes are completed before the sweep is started, and the HP-IB hold state is not released until the formatted trace is displayed. When the sweep is complete, the HP 8751A is put into the hold mode, storing the data inside the HP 8751A.

  The number of groups command `NUMG` is designed to work the same as single sweep, except that it triggers n sweeps. This is useful, for example, in making a measurement with an averaging factor of n. Both single sweep and number of groups restart averaging.

- Post-processing

  With valid data to operate on, the post-processing functions can be used. Referring ahead to Figure 2-9, any function that affects the data after the error correction stage can be used. The most useful functions are trace statistics, marker searches, and electrical delay offset. If a 2-port calibration is active, then any of the four S-parameters can be viewed without taking a new sweep.

- Transferring data

  Lastly, read the results out of the HP 8751A. All the data output commands are designed to ensure that the data transmitted reflects the current state of the HP 8751A:

  - `OUTPDATA`, `OUTPRAW`, `OUTPFORM`, etc., will not transmit data until all formatting functions have been completed.
  - `OUTPLIML`, `OUTPLIMM`, and `OUTPLIMF` will not transmit data until the limit test has occurred, if limit testing is turned ON.
  - `OUTPMARK` will activate a marker if one is not already selected, and it will make sure that any current marker searches have completed before transmitting data.
  - `OUTPMSTA` makes sure that statistics have been calculated for the current trace before transmitting data. If statistics is not turned ON, it will turn statistics ON to update the current values, and then turn it OFF.
  - `OUTPMWID` makes sure that a bandwidth search has been executed for the current trace before transmitting data. If bandwidth search is not turned ON, it will turn the search ON to update the current values, and then turn it OFF.

Data transfer is discussed further in "Data Transfer from the HP 8751A to a Computer".

Basic Programming Examples

Note

Because the sample programs are design to control the HP 8751A from external controller using HP-IB, you will have to change some statements when you use HP 8751A Instrument BASIC (Option 002) to control the internal network function.

Change as follows:

"ASSIGN @Hp8751 TO 717" to "ASSIGN @Hp8751 TO 800"
"ASSIGN @Dt TO 717;FORMAT OFF" to "ASSIGN @Dt TO 800;FORMAT OFF"
"ABORT 7" to "ABORT 8"

Where 717 is an external controller's device selector (HP-IB interface code 7 and HP-IB address 17). 800 is the internal HP-IB device selector when Instrument BASIC controls the internal network function.

Setting Up a Measurement

In general, the procedure for setting up measurements on the HP 8751A via HP-IB follows the same sequence as if the setup was performed manually. There is no required order, as long as the desired frequency range, number of points and power level are set prior to performing the calibration.

By interrogating the HP 8751A to determine the actual values of the start and stop frequencies, or the center frequency and frequency span, the computer can keep track of the actual frequencies.

This example illustrates how a basic measurement can be set up on the HP 8751A. The program will first select the desired parameter, the measurement format, and then the frequency range.

This example sets up a measurement of transmission log magnitude on channel 1. When prompted for the center frequency and the frequency span, enter any value in Hz from 1.0×10^5 (for the S-parameter Test Set) to 5.0×10^8. These will be entered into the HP 8751A, and the frequencies will be displayed.

```
10    !
20    ! Setting Up a Measurement
30    !
40    ASSIGN @Hp8751 TO 717  ! If you use iBASIC, replace "717" with "800".
50    ABORT 7                ! If you use iBASIC, replace "7" to "8"
60    CLEAR @Hp8751
70    !
80    OUTPUT @Hp8751;"PRES"              ! Preset HP 8751A
90    OUTPUT @Hp8751;"CHAN1; S21; LOGM"
100   INPUT "Enter center frequency (Hz).",F_cent
110   INPUT "Enter frequency span (Hz).",F_span
120   OUTPUT @Hp8751;"CENT ";F_cent      ! Set Center frequency
130   OUTPUT @Hp8751;"SPAN ";F_span      ! Set frequency span
140   !
150   OUTPUT @Hp8751;"CENT?"
160   ENTER @Hp8751;F_centr
170   OUTPUT @Hp8751;"SPAN?"
180   ENTER @Hp8751;F_spanr
190   PRINT "Center frequency:",F_centr;"Hz"
200   PRINT "Frequency span:",F_spanr;"Hz"
210   END
```

Figure 2-3. Sample Program: Setting Up a Measurement

Line 40	Assign the HP 8751A HP-IB address. If you are using the Instrument BASIC (Option 002) to control the internal network function, change 717 to 800
Lines 50 and 60	Prepare for HP-IB control.
Line 80	Preset the HP 8751A.
Line 90	Make channel 1 the active channel, and measure transmission parameter, S_{21}, display its magnitude in dB.
Lines 100 and 110	Input the center frequency and the frequency span.
Lines 120 and 130	Send the center frequency and the frequency span to the HP 8751A.
Lines 150 through 180	Query the center frequency and the frequency span.
Lines 190 and 200	Show the current center frequency and the frequency span.

Performing a Measurement Calibration

This section will demonstrate how to coordinate a measurement calibration by HP-IB control. The HP-IB program follows the key strokes required to calibrate from the front panel: there is a command for every step.

The general keystrokes sequence is to select the calibration, measure the calibration standards, and then declare the calibration done. The actual sequence depends on the calibration kit and changes slightly for 2-port calibrations, which are divided into three calibration sub-sequences.

Calibration Kits

The calibration kit tells the HP 8751A what standards to expect at each step of the calibration. The set of standards associated with a given calibration is termed a class. Refer to Appendix D for the relation between the calibration types and the standard classes.

For example, measuring the SHORT during a 1-port calibration is one calibration step. All of the SHORTs that can be used for this calibration step make up the class, which is called class $S_{11}B$. For the 7 mm calibration kits, class $S_{11}B$ has only one standard. For type-N calibration kits, class $S_{11}B$ has two standards: male and female SHORTs.

When doing a 1-port calibration using the 7 mm calibration kit by HP-IB, sending `CLASS11B` will automatically measure the SHORT. In type-N, sending `CLASS11B` brings up the menu with the male and female SHORT options. To select a standard, use `STANA` or `STANB`. The `STAN` command is appended with the letters A through G, corresponding to the standards list under softkeys 1 through 7, softkey 1 being the topmost softkey.

Each full 2-port calibration is divided into three sub-sequences: transmission, reflection, and isolation. Each sub-sequence is treated like a calibration in its own right; each must be opened, have all the standards measured, and then be declared done. The opening and closing statements for the transmission sub-sequence are `TRAN` and `TRAD`. The opening and closing statements for the reflection sub-sequence are `REFL` and `REFD`. The opening and closing statements for isolation are `ISOL` and `ISOD`.

Frequency Response Calibration

The following program does a response calibration using a THRU calibration device. This program simplifies the calibration for the operator by giving explicit directions on the computer's display.

```
100   !
110   ! Frequency Response Calibration
120   !
130   ASSIGN @Hp8751 TO 717 ! If you use iBASIC, replace "717" "800".
140   ABORT 7               ! If you use iBASIC, replace "7" with "8".
150   CLEAR 717
160   !
170   OUTPUT @Hp8751;"PRES"
180   OUTPUT @Hp8751;"CHAN1; S21; LOGM"
190   INPUT "Enter center frequency (Hz).",F_cent
200   INPUT "Enter frequency span (Hz).",F_span
210   OUTPUT @Hp8751;"CENT ";F_cent  ! Set Center frequency
220   OUTPUT @Hp8751;"SPAN ";F_span  ! Set Span frequency
230   !
240   OUTPUT @Hp8751;"HOLD"      ! Sweep mode is HOLD
250   OUTPUT @Hp8751;"CALKN50"   ! Select 50ohms type-N Cal. kit
260   OUTPUT @Hp8751;"CALIRESP"  ! Select Response cal.
270   INPUT "Connect THRU, then press [Return].",Dum$
280   ON INTR 7 GOTO Sweep_end   ! Define a branch when an interrupt occurs
290   OUTPUT @Hp8751;"CLES"      ! Clear all status register
300   OUTPUT @Hp8751;"*SRE 4;ESNB 1" ! Set enable STB and ESB
310 REPEAT                       ! Wait until all status register is clear
320   UNTIL SPOLL(@Hp8751)=0     ! Check STB
330   ENABLE INTR 7;2            ! Enable interrupt
340   OUTPUT @Hp8751;"STANE"     ! Measure THRU
350 Loop_top:  GOTO Loop_top     ! Wait until the meas. end
360 Sweep_end:!
370   !
380   OUTPUT @Hp8751;"RESPDONE"  ! Calculating cal coefficient
390   OUTPUT @Hp8751;"*OPC?"     ! \ Wait until calculating ends
400   ENTER @Hp8751;Dum          ! /
410   OUTPUT @Hp8751;"CONT"      !
420   DISP "Response cal completed."
430   END
```

Figure 2-4. Sample Program: Frequency Response Calibration

Line 240	Set the trigger to the HOLD mode.
Line 250	Select the 50 Ω type-N calibration kit.
Line 260	Open the calibration by calling the response calibration.
Line 270	Ask for a THRU, and wait for the operator to connect it.
Line 290	Clear all status registers.

Line 340	Select and measures the THRU. There is more than one standard in this calibration, so you must identify the specific standard within this calibration. The THRU is the third softkey selection from the top in the menu, so use the STANC command to select THRU as the standard.
Lines 350	Wait for the standard to be measured.
Lines 380 through 400	Affirm completion of the calibration, and wait for calculation completion.
Line 410	Set the trigger to the CONTINUOUS mode.

1-Port Reflection Calibration

The following program does a 1-port calibration using the 50 Ω type-N calibration kit. The program assumes that the port being calibrated is a 50 Ω, type-N female test port. This program simplifies the calibration for the operator by giving explicit directions on the computer display.

```
10    !
20    ! 1-port Reflection Calibration
30    !
40    ASSIGN @Hp8751 TO 717 ! When iBASIC is used, replace "717" with "800".
50    ABORT 7               ! When iBASIC is used, replace "7" with "8".
60    CLEAR @Hp8751
70    !
80    OUTPUT @Hp8751;"PRES"
90    OUTPUT @Hp8751;"CHAN1; S21; LOGM"
100   INPUT "Enter center frequency (Hz).",F_cent
110   INPUT "Enter frequency span (Hz).",F_span
120   OUTPUT @Hp8751;"CENT ";F_cent
130   OUTPUT @Hp8751;"SPAN ";F_span
140   !
150   OUTPUT @Hp8751;"HOLD"     ! Sweep mode is HOLD
160   OUTPUT @Hp8751;"CALKN50"  ! 50 ohms type N cal kit
170   OUTPUT @Hp8751;"CALIS111" ! S11 cal
180   !
190   INPUT "Connect OPEN at port 1, then press [Return].",Dum$
200   OUTPUT @Hp8751;"CLASS11A" ! OPEN standard
220   Command$="STANA"          ! Female OPEN std. measurement
230   GOSUB Op_end              ! Measure std. and wait until measurement ends
240   OUTPUT @Hp8751;"DONE"     ! Complete meas. of OPEN std.
250   !
260   INPUT "Connect SHORT at port 1, then press [Return].",Dum$
270   OUTPUT @Hp8751;"CLASS11B" ! SHORT standard
290   Command$="STANA"          ! Female SHORT std. measurement
300   GOSUB Op_end              ! Measure std. and wait until measurement ends
310   OUTPUT @Hp8751;"DONE"     !
320   !
```

Figure 2-5. 1-Port Reflection Calibration (1/2)

```
330   INPUT "Connect LOAD at port 1, then press [Return].",Dum$
350   Command$="CLASS11C"  ! LOAD std. measurement
360   GOSUB Op_end         ! Measure std. and wait until measurement ends
370   !
380   OUTPUT @Hp8751;"SAV1"  ! Calculate cal coefficient
390   OUTPUT @Hp8751;"*OPC?" ! Wait until calculating ends
400   ENTER @Hp8751;Dum      !
410   OUTPUT @Hp8751;"CONT"  ! Sweep mode is CONT
420   DISP "1-port cal completed."
430   STOP
440   !
450 Op_end:!
460   ON INTR 7 GOTO Sweep_end ! Define a branch when an interrupt occurs.
470   OUTPUT @Hp8751;"CLES"    ! Clear status registers
480   OUTPUT @Hp8751;"*SRE 4;ESNB 1" ! Set enable bits of STB and ESB
490   REPEAT                   ! Wait until status registers are clear.
500   UNTIL SPOLL(@Hp8751)=0   ! Check STB
510   ENABLE INTR 7;2          ! Set enable interrupt
520   OUTPUT @Hp8751;Command$  ! Measure std
530 Loop_top:GOTO Loop_top     ! Wait until measurement end
540 Sweep_end:!
550   RETURN
560   END
```

Figure 2-5. 1-Port Reflection Calibration (2/2)

Line 170	Open the calibration by calling the S_{11} 1-port calibration.
Line 200	Select the OPEN standard.
Line 220	Select the female OPEN standard.
Line 230	Start measuring the standard and wait until the measurement ends.
Line 240	Complete the OPEN standard measurement.
Line 270	Select the SHORT standard.
Line 290	Select the female SHORT standard.
Line 310	Complete the SHORT standard measurement.
Line 350	Select the LOAD standard, and start measuring the standard.
Line 380	Save the calibration.
Line 410	Set the trigger to the CONTINUOUS mode.
Line 450 through 500	Start measuring a standard and wait until sweep ends.

Data Transfer from the HP 8751A to a Computer

Trace information can be read out of the HP 8751A in several ways. Data can be read off the trace selectively using the markers, or the entire trace can be read out.

Using Markers to Obtain Trace Data at Specific Points

If only specific information such as a single point off the trace or the result of a marker search is needed, the marker output command can be used to read the information.

Marker data is read out with the command OUTPMARK. This command causes the HP 8751A to transmit three numbers: marker value 1, marker value 2, and marker stimulus value. Refer to Table 2-1 for all the different possibilities for values one and two.

```
100    !
110    ! Using Markers to Obtain Trace Data at Specific Points
120    !
130    ASSIGN @Hp8751 TO 717 ! If you use iBASIC, replace "717" with "800".
140    ABORT 7               ! If you use iBASIC, replace "7" with "8".
150    CLEAR @Hp8751
160    !
170    OUTPUT @Hp8751;"PRES" ! Preset HP 8751A
180    OUTPUT @Hp8751;"CHAN1; S21; LOGM"
190    INPUT "Enter center frequency (Hz).",F_cent
200    INPUT "Enter frequency span (Hz).",F_span
210    OUTPUT @Hp8751;"CENT ";F_cent
220    OUTPUT @Hp8751;"SPAN ";F_span
230    !
240    ON INTR 7 GOTO Sweep_end        ! Define branch when interrupt occurs
250    OUTPUT @Hp8751;"CLES"           ! Clear all status register
260    OUTPUT @Hp8751;"*SRE 4;ESNB 1"  ! Set enable bits of STB and ESB
270    REPEAT                          ! Wait until status registers are clear
280    UNTIL SPOLL(@Hp8751)=0          ! Check STB
290    ENABLE INTR 7;2                 ! Set enable interrupt
300    OUTPUT @Hp8751;"SING"           ! Sweep mode is SINGLE
310 Loop_top:GOTO Loop_top             ! Wait until sweep end
320 Sweep_end:  !
330    !
340    OUTPUT @Hp8751;"AUTO"        ! Auto scale
350    OUTPUT @Hp8751;"MARK1"       ! Marker 1 ON
360    OUTPUT @Hp8751;"SEAMAX"      ! Search MAX
370    OUTPUT @Hp8751;"OUTPMARK?"   ! Output marker value
380    ENTER @Hp8751;Val1,Val2,Stim
390    DISP "Min val:",Val1;"dB"
400    DISP "Stim:",Stim;"Hz"
410    END
```

Figure 2-6. Sample Program: Using Markers to Obtain Trace Data at Specific Points

Lines 240 through 320   Collect one sweep of data, and wait for completion.

Line 340 Bring the trace data in view on the HP 8751A's display.
Line 350 Activate marker 1.
Line 360 Have the HP 8751A search for the trace maximum.
Line 370 Output the marker values at that point.
Line 380 Read marker value 1, marker value 2, and the stimulus value.

Table 2-1. Units as a Function of Display Format

Display Format	Marker Mode	OUTPMARK value 1, value 2	OUTPFORM value 1, value 2	Marker Readout[1] value, aux value
LOG MAG		dB,[2]	dB,[2]	dB,[2]
PHASE		degrees,[2]	degrees,[2]	degrees,[2]
DELAY		seconds,[2]	seconds,[2]	seconds,[2]
SMITH	LIN MKR	lin mag, degrees	real, imag	lin mag, degrees
CHART	LOG MKR Re/Im R + jX G + jB	dB, degrees real, imag real, imag ohms real, imag Siemens	real, imag real, imag real, imag real, imag	dB, degrees real, imag real, imag ohms real, imag Siemens
POLAR	LIN MKR LOG MKR Re/Im	lin mag, degrees dB, degrees real, imag	real, imag real, imag real, imag	lin mag, degrees dB, degrees real, imag
LIN MAG		lin mag,[2]	lin mag,[2]	lin mag,[2]
REAL		real,[2]	real,[2]	real,[2]
SWR		SWR,[2]	SWR,[2]	SWR,[2]

1 The marker readout values are the marker values displayed in the upper left hand corner of the display. They also correspond to the value and aux value associated with the fixed marker.

2 Value not significant in this form, but is included in data transfers.

Trace Transfer

Getting trace data out of the HP 8751A with a 200/300 series computer can be broken down into three steps:

1. Setting up the receive array.
2. Telling the HP 8751A to transmit the data.
3. Accepting the transferred data.

Data inside the HP 8751A is always stored in pairs, to accommodate real/imaginary values, for each data point. Therefore, the receiving array has to be two elements wide, and as deep as the number of points being measured. The memory space for this array must be declared before any data is transferred from the HP 8751A to the computer.

Data Format. The HP 8751A can transmit data over HP-IB in four different formats. The type of format affects what kind of data array is declared (real or integer), since the format determines what type of data is transferred.

- Form 2

  IEEE 32-bit floating point format. In this mode, each number takes 4 bytes. This means that a 201 point transfer takes 1,608 bytes. Figure 2-7 shows the data transfer format of Form 2.

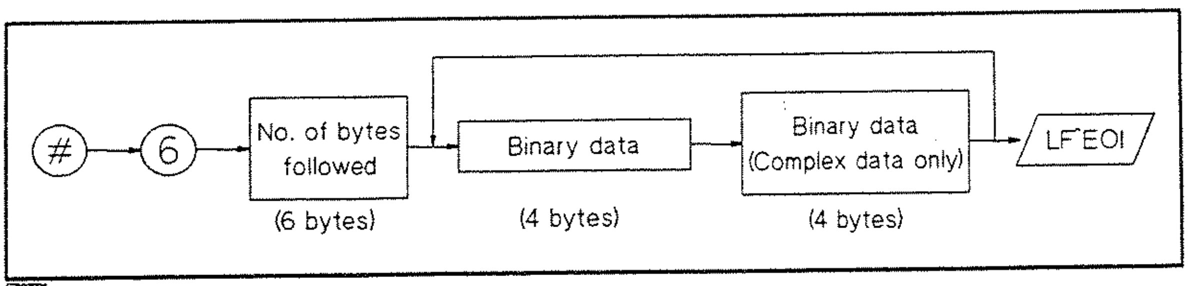


Figure 2-7. Form 2 Data Transfer Format

- Form 3

  IEEE 64-bit floating point format. In this mode, each number takes 8 bytes. This means that a 201-point transfer takes 3,216 bytes. Data is stored internally in the 200/300 series computer with the IEEE 64-bit floating point format, eliminating the need for any reformatting by the computer. Figure 2-8 shows the data transfer format of Form 3.

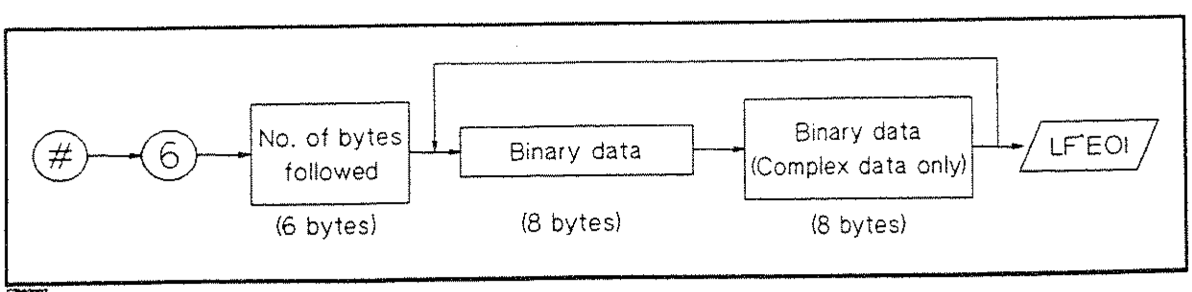


Figure 2-8. Form 3 Data Transfer Format

- Form 4

  ASCII data transfer format. In this mode, each number is sent as a 24 character string, each character being a digit, sign, or decimal point.

- Form 5

  MS-DOS® personal computer format. This mode is a modification of IEEE 32-bit floating point format with the byte order reversed. Form 5 also has a four byte header which must be read in so that data order is maintained. In this mode, an MS-DOS® PC can store data internally without reformatting it.

Data Levels. Different levels of data can be read out of the HP 8751A (Refer to Figure 2-9).

- Raw data

  The basic measurement data, reflecting the stimulus parameters, IF averaging, and IF bandwidth. If a full 2-port measurement calibration is ON, there are four raw arrays kept: one for each raw S-parameter. The data is read out with the commands `OUTPRAW{1-4}?`. Normally, only raw data array 1 is available, and it holds the current parameter. If a 2-port calibration is ON the four arrays S_{11}, S_{21}, S_{12}, and S_{22} are on, respectively. This data is in real/imaginary pairs.

- Error corrected data

  This is the raw data with error correction applied. The array is for the currently measured parameter, and is in real/imaginary pairs. The error corrected data is read out with `OUTPDATA?` or `OUTPDATAP?`. `OUTPMEMO?` or `OUTPMEMOP?` reads the trace memory if available, which is also error corrected. Neither raw nor error corrected data reflect such post-processing functions as electrical delay offset, or trace math.

- Unformatted data

  This is the array of the complex number pairs which will be converted into a scalar number in the next stage. The unformatted data is read out with `OUTPUFORM?`.

- Formatted data

  This is the array of data being displayed. It reflects all post-processing functions such as electrical delay, and the units of the array read out depends on the current display format. Refer to Table 2-1 for various units as a function of display format. The formatted data is read out with `OUTPFORM?`, `OUTPRFORM?`, `OUTPFORMP?`, `OUTPTMEM?`, `OUTPRTMEM?`, `OUTPTMEMP?`, `OUTPIFORM?`, `OUTPIRFORM?`, `OUTPITMEM?` or `OUTPIRTMEM?`.

- Calibration coefficients

  The results of a calibration are stored arrays of calibration coefficients which are used by the error correction routines. Each array corresponds to a specific error term in the error model. The calibration coefficients are read out with `OUTPCALC{01|12}?`.

Formatted data is generally the most useful, being the same information seen on the display. However, if post-processing is not necessary, as may be the case with smoothing, error corrected data is more desirable. Error corrected data also gives you the opportunity to load the data into the instrument and apply post-processing at a later time.

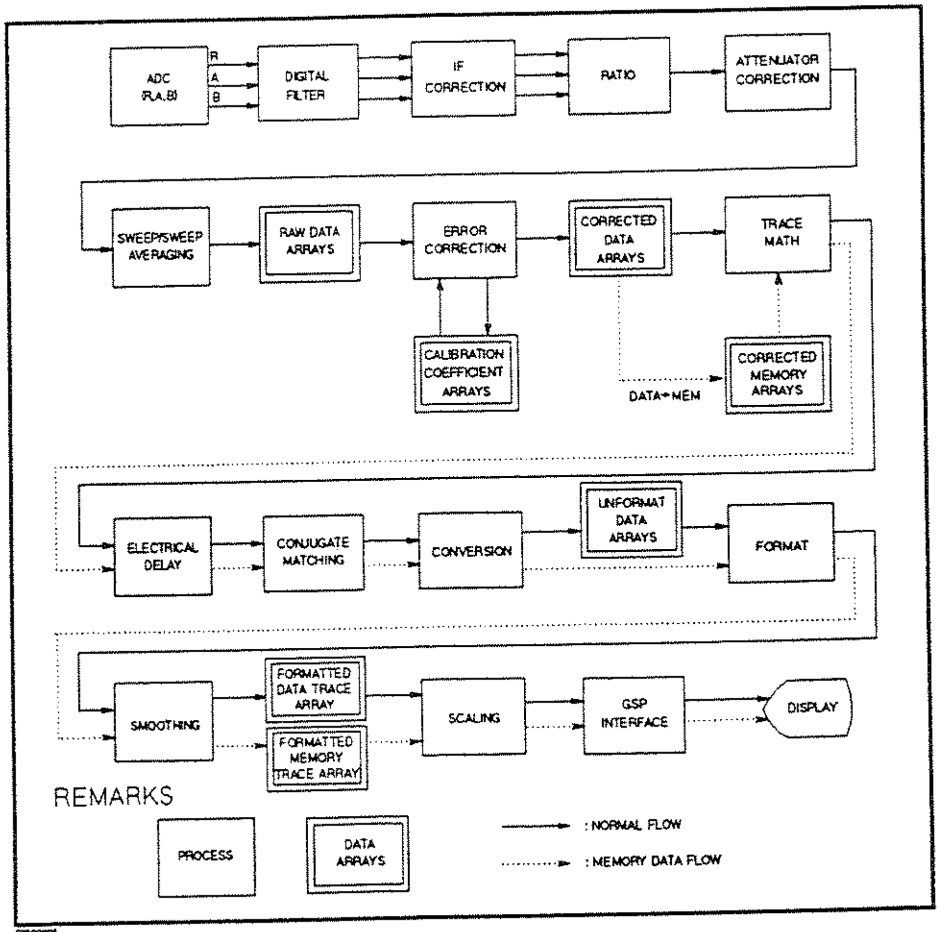


Figure 2-9. Data Processing Flow

Table 2-2. HP-IB Commands to Output Data Array

Data Output	Active Channel						Inactive Channel	
	RAW Data	Corrected Data		Unformatted Data	Formatted Data		Formatted Data	
		Data	Memory		Data Trace	Memory Trace	Data Trace	Memory Trace
Complex Data at All Points[1]	OUTPRAW1? OUTPRAW2? OUTPRAW3? OUTPRAW4?	OUTPDATA?	OUTPMEMO?	OUTPUFORM?	OUTPFROM?	OUTPTMEM?	OUTPPIFORM?	OUTPITMEM?
Complex Data at Specified Point[2]		OUTPDATAP?	OUTPMEMOP?		OUTPFORMP?	OUTPTMMP?		
Real Data at All Point[3]					OUTPRFORM?	OUTPRTMEM?	OUTPIRFORM?	OUTPIRTMEM?

1 Number of data output is two times of the Number Of Points (NOP).

2 Number of data output is two (a real part and an imaginary part).

3 Number of data output is equal to NOP.

Data Transfer Using ASCII Transfer Format (Form 4). When Form 4 is used, each number is sent as a 24 character string, each character being a digit, or decimal point.

```
10    !
20    ! Data Transfer Using ASCII Transfer Format
30    !
40    DIM Dat(1:201),Stim(1:201)
50    ASSIGN @Hp8751 TO 717  ! When iBASIC is used, replace "717" with "800".
60    ABORT 7                ! When iBASIC is used, replace "7" with "8".
70    CLEAR @Hp8751
80    !
90    OUTPUT @Hp8751;"PRES"              ! Preset HP 8751A
100   OUTPUT @Hp8751;"CHAN1; S21; LOGM"
110   INPUT "Enter center frequency (Hz).",F_cent
120   INPUT "Enter frequency span (Hz).",F_span
130   OUTPUT @Hp8751;"CENT ";F_cent
140   OUTPUT @Hp8751;"SPAN ";F_span
150   !
160   ON INTR 7 GOTO Sweep_end        ! Define branch when interrupt occurs
161   OUTPUT @Hp8751;"CLES"           ! Clear status registers
163   OUTPUT @Hp8751;"*SRE 4;ESNB 1" ! Set enable bits of STB and ESB
164   REPEAT                          ! Wait until status registers are clear
165   UNTIL SPOLL(@Hp8751)=0          ! Check STB
166   ENABLE INTR 7;2                 ! Set enable interrupt
170   OUTPUT @Hp8751;"SING"           ! Sweep mode is SINGLE
180 Loop_top:GOTO Loop_top            ! Wait until sweep end
190 Sweep_end:            !
220   !
230   OUTPUT @Hp8751;"POIN?"      ! Query NOP
240   ENTER @Hp8751;Nop
260   OUTPUT @Hp8751;"FORM4"      ! Set ASCII Transfer Format
270   !
280   OUTPUT @Hp8751;"OUTPRFORM?" ! Real part of the formatted trace data
290   ENTER @Hp8751;Dat(*)
300   !
310   OUTPUT @Hp8751;"OUTPSTIM?"  ! Stimulus data
320   ENTER @Hp8751;Stim(*)
330   !
340   FOR I=1 TO Nop
350     PRINT Stim(I);"Hz",Dat(I);"dB"
360   NEXT I
380   END
```

Figure 2-10. Sample Program: Data Transfer using ASCII Transfer Format (Form 4)

Lines 230 and 240	Find out how many points to expect.
Line 260	Tell the HP 8751A to use the ASCII transfer format.
Line 280	Request the real part of the formatted trace data.

Line 290	Transfer the data from the HP 8751A to the computer, and put it in the receiving array Dat(*).
Lines 310 and 320	Request and transfer the stimulus data.

Data Transfer using IEEE 64-bit Floating Point Format (Form 3). To use Form 3, the computer is told to stop formatting the incoming data with the ENTER statement. This is done by defining an I/O path with formatting OFF. Form 3 also has an eight-byte header to deal with. The first two bytes are the ASCII characters "#6" that indicate that a fixed length block transfer follows, and the next 6 bytes form an integer containing number of bytes in the block to follow. The header must be read in so that data order is maintained.

```
10    !
20    ! Data Transfer Using IEEE 64-bit Floating Point Format
30    !
40    DIM Dat(1:201),Stim(1:201)
50    ASSIGN @Hp8751 TO 717 ! When iBASIC is used,, replace "717" with "800".
60    ABORT 7               ! When iBASIC is used, replace "7" to "8".
70    CLEAR @Hp8751         ! When iBASIC is used,, replace "717" with "800".
80    !
90    OUTPUT @Hp8751;"PRES"            ! Preset HP 8751A
100   OUTPUT @Hp8751;"CHAN1; S21; LOGM"
110   INPUT "Enter center frequency (Hz)",F_cent
120   INPUT "Enter frequency span (Hz)",F_span
130   OUTPUT @Hp8751;"CENT ";F_cent
140   OUTPUT @Hp8751;"SPAN ";F_span
150   !
160   ON INTR 7 GOTO Sweep_end ! Define branch when interrupt occurs
170   OUTPUT @Hp8751;"CLES"    ! Clear all status register
180   OUTPUT @Hp8751;"*SRE 4;ESNB 1" ! Set enable bits of STB and ESB
190   REPEAT                   ! Wait until status registers are clear.
200   UNTIL SPOLL(@Hp8751)=0   ! Check STB
210   ENABLE INTR 7;2          ! Set enable interrupt
220   OUTPUT @Hp8751;"SING"    ! Sweep mode is SINGLE
230 Loop_top:GOTO Loop_top     ! Wait until measurement ends
240 Sweep_end:                 !
250   !
260   OUTPUT @Hp8751;"POIN?"   ! Query NOP
270   ENTER @Hp8751;Nop
280   OUTPUT @Hp8751;"FORM3"         ! IEEE 64-bit Floating Point Format
290   ASSIGN @Dt TO 717;FORMAT OFF ! Define a data I/O path
300                                ! If iBASIC is used, change 717 to 800.
310   OUTPUT @Hp8751;"OUTPRFORM?"  ! Real part of formatted data trace
320   ENTER @Dt USING "#,8A";A$    ! Enter header
330   ENTER @Dt;Dat(*)             ! Enter data
340   ENTER @Dt USING "#,1A";B$    ! Enter terminator
350   !
360   OUTPUT @Hp8751;"OUTPSTIM?"   ! Stimulus data
370   ENTER @Dt USING "#,8A";A$    ! Enter header
380   ENTER @Dt;Stim(*)            ! Enter data
```

Figure 2-11. Sample Program: Data Transfer using IEEE 64-bit Floating Point Format (Form 3) (1/2)

```
390   ENTER @Dt USING "#,1A";B$      ! Enter terminator
400   !
410   ASSIGN @Dt TO *                ! Clear I/O path
420   FOR I=1 TO Nop
430     PRINT Stim(I);"Hz",Dat(I);"dB"
440   NEXT I
450   END
```

Figure 2-11.
Sample Program: Data Transfer using IEEE 64-bit Floating Point Format (Form 3) (2/2)

Line 280	Tell the HP 8751A to output data using Format 3.
Line 290	Define a data I/O path with ASCII formatting OFF. The I/O path points to the HP 8751A, and can be used to read or write data to the HP 8751A, as long as that data is in binary rather than ASCII format.
Line 320	Enter the header.
Line 330	Enter the data.
Line 340	Enter the terminator.
Line 410	Close the I/O path.

Application Example

The following example measures the transmission parameter of a bandpass filter and obtains the typical parameters: -3 dB bandwidth, Center frequency, and Insertion loss.

```
10   !
20   ! Bandpass Filter Test
30   !
40   ASSIGN @Hp8751 TO 717 ! When iBASIC is used, replace "717" with "800".
50   ABORT 7               ! When iBASIC is used, replace "7" to "8".
60   CLEAR @Hp8751
70   !
80   OUTPUT @Hp8751;"PRES" ! Preset HP 8751A
90   OUTPUT @Hp8751;"CHAN1; S21; LOGM" ! Set up measurement parameters
100  INPUT "Enter center frequency (Hz).",F_cent
110  INPUT "Enter frequency span (Hz).",F_span
120  OUTPUT @Hp8751;"CENT ";F_cent
130  OUTPUT @Hp8751;"SPAN ";F_span
140  !
150  OUTPUT @Hp8751;"HOLD"       ! Perform cal measurement
160  OUTPUT @Hp8751;"CALKN50"
170  OUTPUT @Hp8751;"CALIRESP"
180  INPUT "Connect THRU, then press [Return].",Dum$
200  Command$="STANC"
210  GOSUB Op_end
220  OUTPUT @Hp8751;"RESPDONE"
230  INPUT "Cal completed. Connect DUT, then press [Return].",Dum$
240  !
250  OUTPUT @Hp8751;"CLES"       ! Clear all status register
260  Command$="SING"             ! Trigger a sweep
270  GOSUB Op_end                 ! Wait until sweep ends
280  !
290  OUTPUT @Hp8751;"MARK1"      ! Marker 1 ON
300  OUTPUT @Hp8751;"SEAMAX"     ! Search MAX.
310  OUTPUT @Hp8751;"OUTPMARK?"  ! Query marker value
320  ENTER @Hp8751;Loss
330  !
340  OUTPUT @Hp8751;"DELR1"      ! Select MKR1 as delta ref. marker
350  OUTPUT @Hp8751;"WIDV -3"    ! Width value is -3
360  OUTPUT @Hp8751;"WIDTON"     ! Width ON
370  OUTPUT @Hp8751;"OUTPMWID?"  ! Query width parameters
380  ENTER @Hp8751;Bw,Cent,Q
390  !
```

Figure 2-12. Sample Program: Application Example (Bandpass Filter Test) (1/2)

```
400   PRINT "-3dB bandwidth= ",Bw;"Hz"
410   PRINT "Center frequency= ",Cent;"Hz"
420   PRINT "Insertion loss= ",Loss;"dB"
430   STOP
440   !
450 Op_end:!
460   ON INTR 7 GOTO Sweep_end ! Define a branch when an interrupt occurs.
470   OUTPUT @Hp8751;"CLES"    ! Clear status registers
480   OUTPUT @Hp8751;"*SRE 4;ESNB 1" ! Set enable bits of STB and ESB
490   REPEAT                   ! Wait until status registers are clear.
500   UNTIL SPOLL(@Hp8751)=0   ! Check STB
510   ENABLE INTR 7;2          ! Set enable interrupt
520   OUTPUT @Hp8751;Command$  ! Measure std
530 Loop_top:GOTO Loop_top     ! Wait until measurement end
540 Sweep_end:!
550   RETURN
510   END
```

Figure 2-12. Sample Program: Application Example (Bandpass Filter Test) (2/2)

Lines 80 through 130	Set up measurement.
Lines 150 through 230	Do a response calibration.
Lines 250 through 270	Collect one sweep of data.
Lines 290 through 320	Get the insertion loss value using the marker search function.
Lines 340 through 380	Take the −3 dB bandwidth value and the center frequency value using the bandwidth search function.

Advanced Programming Examples

Using List Frequency Mode

The list frequency mode lets you select the specific points or frequency spacing between points at which measurements are to be made. Sampling specific points reduces the measurement time since additional time is not spent measuring device characteristics at unnecessary frequencies.

This example shows how to create a list frequency table and send it to the HP 8751A. The command sequence for entering a list frequency table imitates the key sequence followed when entering a table from the front panel: there is a command for every key press. Editing a segment is also the same as the key sequence, but the HP 8751A automatically reorders each edited segment in order of increasing start frequency.

This example takes advantage of the computer's capabilities to simplify creating and editing the table. The table is entered and completely edited before being transmitted to the HP 8751A. To simplify the programming task, options such as entering step size are not included.

```
10    !
20    ! Using List Frequency Mode
30    !
40    DIM Table(1:31,1:3)
50    ASSIGN @Hp8751 TO 717 ! When iBASIC is used, change "717" to "800".
60    ABORT 7               ! When iBASIC is used, change "7" to "8".
70    CLEAR @Hp8751
80    !
90    INPUT "Number of segments?",Numb
100   !
110   PRINTER IS CRT
120   CLEAR SCREEN
130   PRINT USING "10A,10A,10A,20A";"Segment","Start(Hz)","Stop(Hz)",
      "Number of points"
140   !
150   FOR I=1 TO Numb
160     GOSUB Loadpoin
170   NEXT I
180   !
190   LOOP
200     INPUT "Do you want to edit? (Y/N)",An$
210   EXIT IF An$="N" OR An$="n"
220     INPUT "Segment Number?",I
230     GOSUB Loadpoin
240   END LOOP
250   !
260   OUTPUT @Hp8751;"PRES"            ! Preset HP 8751A
270   OUTPUT @Hp8751;"CHAN1; S21; LOGM"
```

Figure 2-13. Sample Program: Using List Frequency Mode (1/2)

```
280   !
290   OUTPUT @Hp8751;"EDITLIST"      ! Freq. List Edit mode
300   OUTPUT @Hp8751;"CLEL"          ! Clear list
310   FOR I=1 TO Numb
320     OUTPUT @Hp8751;"SADD"                ! Add new segment
330     OUTPUT @Hp8751;"STAR ";Table(I,1)    ! Start freq. of segment
340     OUTPUT @Hp8751;"STOP ";Table(I,2)    ! Stop freq. of segment
350     OUTPUT @Hp8751;"POIN ";Table(I,3)    ! Number of points
360     OUTPUT @Hp8751;"SDON"                ! Complete editing segment
370   NEXT I
380   OUTPUT @Hp8751;"EDITDONE"      ! Complete editing list
390   OUTPUT @Hp8751;"LISFREQ"       ! List freq. mode ON
400   OUTPUT @Hp8751;"LISDOBASE"     ! List Display Order Base
410   !
420   ON INTR 7 GOTO Sweep_end       ! Define branch when interrupt occurs
430   OUTPUT @Hp8751;"CLES"          ! Clear all status registers
440   OUTPUT @Hp8751;"*SRE 4;ESNB 1" ! Set enable bits of STB and ESB
450   REPEAT                         ! Wait until status registers are clear
460   UNTIL SPOLL(@Hp8751)=0         ! Check STB
470   ENABLE INTR 7;2
480   OUTPUT @Hp8751;"SING"          ! Trigger a sweep
490 Loop_top:GOTO Loop_top
500 Sweep_end:              !
510                         !
520   OUTPUT @Hp8751;"AUTO"          ! Auto scale
530   STOP
540   !
550 Loadpoin:   !
560   INPUT "Enter start frequency (Hz)",Table(I,1)
570   INPUT "Enter stop frequency (Hz)",Table(I,2)
580   INPUT "Enter number of points",Table(I,3)
590   IF Table(I,3)=1 THEN Table(I,2)=Table(I,1)
600   PRINT TABXY(0,I+1);I;TAB(10);Table(I,1);TAB(20);Table(I,2);
      TAB(35);Table(I,3)
610   RETURN
620   END
```

Figure 2-13. Sample Program: Using List Frequency Mode (2/2)

Line 90	Find out how many segments to expect.
Lines 110 through 130	Clear the screen and print the table header.
Lines 150 through 170	Read in each segment.
Lines 190 through 240	Edit the table until editing is no longer needed.
Line 290	Activate the frequency list edit mode, and open the list frequency table for editing.
Line 300	Delete any existing segments.
Lines 310 through 370	Enter the segment values.
Line 380	Close the table.
Line 390	Turn on the list frequency mode.

Line 400	Display the trace for only the listed frequency ranges.
Lines 550 through 610	Enter in a segment.
Lines 560 through 580	Enter the segment values.
Line 570	Set the stop frequency equal to the start frequency to avoid ambiguity, if only one point is in the segment.
Line 600	Print the segment out.

2. Programming Basics

Using Limit Lines to Perform Limit Testing

This example shows how to create a limit table and send it to the HP 8751A. The command sequence for entering a limit table imitates the key sequence followed when entering a table from the front panel: there is a command for every key press. Editing a limit is also the same as the key sequence, but remember that the HP 8751A automatically reorders the table in order of increasing start frequency.

This example takes advantage of the computer's capabilities to simplify creating and editing the table. The table is entered and completely edited before being transmitted to the HP 8751A. To simplify the programming task, options such as entering offsets are not included.

```
10    !
20    ! Setting Up Limit Lines
30    !
40    DIM Table(1:31,1:3)
50    ASSIGN @Hp8751 TO 717 ! When iBASIC is used, replace "717" with "800".
60    ABORT 7               ! When iBASIC is used, replace "7" to "8".
70    CLEAR @Hp8751
80    !
90    OUTPUT @Hp8751;"PRES"   ! Preset HP 8751A
100   OUTPUT @Hp8751;"CHAN1; S21; LOGM"
110   OUTPUT @Hp8751;"SING"   ! Sweep mode is SINGLE
120   INPUT "Enter start frequency (Hz)",F_start
130   INPUT "Enter stop frequency (Hz)",F_stop
140   OUTPUT @Hp8751;"STAR ";F_start
150   OUTPUT @Hp8751;"STOP ";F_stop
160   !
170   INPUT "Number of limits?",Numb
180   !
190   PRINTER IS 1
200   CLEAR SCREEN
210   PRINT USING "10A,15A,15A,15A";"Segment","Stimulus(Hz)",
      "Upper(dB)","Lower(dB)"
220   !
230   FOR I=1 TO Numb
240     GOSUB Loadlimit
250   NEXT I
260   !
270   LOOP
280     INPUT "Do you want to edit? (Y/N)",An$
290   EXIT IF An$="N" OR An$="n"
300     INPUT "Segment Number?",I
310     GOSUB Loadlimit
320   END LOOP
330   !
```

Figure 2-14. Sample Program: Setting up Limit Lines (1/2)

```
340   OUTPUT @Hp8751;"EDITLIML"      ! Edit limit line table
350   OUTPUT @Hp8751;"LIMCLEL"       ! Delete limit table
360   FOR I=1 TO Numb
370     OUTPUT @Hp8751;"LIMSADD"           ! Add segment
380     OUTPUT @Hp8751;"LIMS ";Table(I,1) ! Stimulus break point
390     OUTPUT @Hp8751;"LIMU ";Table(I,2) ! Upper limit value
400     OUTPUT @Hp8751;"LIML ";Table(I,3) ! Lower limit value
410     OUTPUT @Hp8751;"LIMSDON"           ! Complete editing segment
420   NEXT I
430   !
440   OUTPUT @Hp8751;"LIMEDONE"    ! Complete editing limit table
450   OUTPUT @Hp8751;"LIMILINEON" ! Display limit line
460   OUTPUT @Hp8751;"LIMITESTON" ! Limit test ON
470   ON INTR 7 GOTO Sweep_end     ! Define branch when interrupt occurs
480   OUTPUT @Hp8751;"CLES"        ! Clear all status register
490   OUTPUT @Hp8751;"*SRE 4;ESNB 1" ! Set enable bits of STB and ESB
500   REPEAT                       ! Wait until status registers are clear
510   UNTIL SPOLL(@Hp8751)=0       ! Check STB
520   ENABLE INTR 7;2              ! Set enable interrupt
530   OUTPUT @Hp8751;"SING"        ! Trigger a sweep
540 Loop_top:  GOTO Loop_top
550 Sweep_end:                     !
560                                !
570   OUTPUT @Hp8751;"OUTPFAIP?"   ! Ask number of fail point
580   ENTER @Hp8751;Result         ! Enter number of fail point
590   IF Result=0 THEN
600      PRINT "PASS"
610   ELSE
620      PRINT "FAIL"
630   END IF
640   STOP
650   !
660 Loadlimit:!
670   INPUT "Enter stimulus value (Hz)",Table(I,1)
680   INPUT "Enter upper limit value (dB)",Table(I,2)
690   INPUT "Enter lower limit value (dB)",Table(I,3)
700   PRINT TABXY(0,I+1);I;TAB(11);Table(I,1);TAB(27);Table(I,2)
      ;TAB(42);Table(I,3)
710   RETURN
720   END
```

Figure 2-14. Sample Program: Setting up Limit Lines (2/2)

Line 40	Create a table to hold the limit values. It will contain the stimulus value (frequency), the upper limit value, and the lower limit value.
Line 170	Find out how many limits to expect.
Lines 190 through 210	Clear the screen and print the table header.
Lines 230 through 250	Read in each segment.
Lines 270 through 320	Edit the table until editing is no longer needed.

Line 340	Begin editing the limit line table.
Line 350	Delete any existing limits.
Lines 360 through 420	Enter the segment values.
Line 440	Close the table.
Line 450	Display the limits.
Line 460	Activate the limit testing.
Lines 570 through 630	Detect result of the test and display PASS or FAIL.
Lines 660 through 710	Enter a segment.

Storing and Recalling Instrument States

This example demonstrates ways of storing and recalling entire instrument states using HP-IB.

Coordinating disk storage

This example shows how to save and recall the instrument STATES from the disk installed in the built-in disk drive.

```
10    !
20    ! Storing Instrument States
30    !
40    DIM Err$[50]
50    ASSIGN @Hp8751 TO 717 ! When iBASIC is used, replace "717" with "800".
60    ABORT 7               ! When iBASIC is used, replace "7" to "8".
70    CLEAR @Hp8751
80    OUTPUT @Hp8751;"*CLS"
90    OUTPUT @Hp8751;"PRES" ! Preset HP 8751A
100   OUTPUT @Hp8751;"CHAN1; S21; LOGM"
110   INPUT "Enter center frequency (Hz).",F_cent
120   INPUT "Enter frequency span (Hz).",F_span
130   OUTPUT @Hp8751;"CENT ";F_cent
140   OUTPUT @Hp8751;"SPAN ";F_span
150   !
160   INPUT "File name? (up to 8 char.)",Name$
161   OUTPUT @Hp8751;"STODDISK"                  ! Storage device is DISK
170   OUTPUT @Hp8751;"SAVDSTA """;Name$;""";"  ! Save Instrument states
180   OUTPUT @Hp8751;"*OPC?"
190   ENTER @Hp8751;Dum
200   OUTPUT @Hp8751;"OUTPERRO?"
210   ENTER @Hp8751;Err,Err$
220   IF Err THEN
230     PRINT "Error occurred."
240     PRINT Err$
250     STOP
260   ELSE
270     INPUT "Save done. Press [Return] to recall.",Dum$
280   END IF
290   !
300   OUTPUT @Hp8751;"PRES"
310   OUTPUT @Hp8751;"RECD """;Name$;"_S""";"  ! Recall instrument state
315           ! If DOS format disk is used, replace "_S" with ".STA".
320   OUTPUT @Hp8751;"*OPC?"
330   ENTER @Hp8751;Dum
340   DISP "Done."
350   END
```

Figure 2-15. Sample Program: Storing Instrument States

Line 160	Get the name of the file to be created.
Line 170	Save the instrument states and the calibration coefficients with the file name. The file name must be preceded and followed by double quotation marks, and the only way to do that with an OUTPUT statement is to use two sets of quotation marks: "".
Lines 180 and 190	Wait for completion of the save operation.
Lines 200 and 210	Determine whether or not an error occurred.
Lines 220 through 280	If an error is detected, print the error number and the error message. If an error is not detected, prompt the user to continue the program.
Line 310	Add the extension to the file name and recall the file.

Reading Calibration Data

This example demonstrates how to read measurement calibration data out of the HP 8751A, and how to return the data to the HP 8751A.

The data used to perform measurement error correction is stored inside the HP 8751A in up to twelve calibration coefficient arrays. Each array stores a specific error coefficient, and is stored and transmitted as an error corrected data array: each point is a real/imaginary pair, and the number of points in the array is the same as the number of points in the sweep. The four data formats also apply to the transfer of calibration coefficient arrays. Appendix D specifies where the calibration coefficients are stored for different calibration types.

A computer can read out the error coefficients using the `OUTPCALC{01-12}` commands. Each calibration type uses only as many arrays as needed, starting with array 1. Therefore, it is necessary to know the type of calibration about to be read out: attempting to read an array not being used in the current calibration causes the "REQUESTED DATA NOT CURRENTLY AVAILABLE" warning to be displayed.

A computer can also store calibration coefficients in the HP 8751A. To do this, declare the type of calibration data about to be stored in the HP 8751A just as if you were about to perform that calibration. Then, instead of calling up different classes, transfer the calibration coefficients using the `INPUCALC{01-12}` commands. When all the coefficients are in the HP 8751A, activate the calibration by issuing the command `SAVC`, to have the HP 8751A take a sweep measurement.

This example reads the response calibration coefficients into a very large array, from which they can be examined, modified, stored, or returned to the HP 8751A.

```
10    !
20    ! Reading Calibration Data
30    !
40    DIM Dat(1:201,1:2)
50    DIM Head$[6]
60    ASSIGN @Hp8751 TO 717  ! When iBASIC is used, replace "717" with "800".
70    ABORT 7     ! When iBASIC is used, replace "7" to "8".
80    CLEAR @Hp8751
90    !
100   INPUT "Connect THRU and press [Return] to do cal.",Dum$
110   GOSUB Setup
120   GOSUB Cal
130   OUTPUT @Hp8751;"SAVC"     ! Re-draw trace
140   OUTPUT @Hp8751;"POIN?"    ! Ask Number of points
150   ENTER @Hp8751;Nop         ! Enter NOP
170   !
180   INPUT "Press [Return] to transmit cal data.",Dum$
190   ASSIGN @Dt TO 717;FORMAT OFF  ! Set data I/O path
200   OUTPUT @Hp8751;"FORM3"        ! IEEE 64-bit Floating Point Format
210   OUTPUT @Hp8751;"OUTPCALC01?"  ! Query calibration array
220   ENTER @Dt USING "#,8A";A$     ! Enter header
230   ENTER @Dt;Dat(*)              ! Enter data
240   ENTER @Dt USING "#,1A";B$     ! Enter terminator
250   INPUT "Transmit done. Disconnect THRU and press [Return].",Dum$
260   !
270   GOSUB Setup
280   GOSUB Cal
290   OUTPUT @Hp8751;"SAVC"         ! Re-draw trace
300   !
310   INPUT "Press [Return] to retransmit cal data.",Dum$
320   V$=VAL$(Nop*2*8)
330   Numv=LEN(V$)
340   Head$="000000"                ! Initialize header value
350   FOR I=1 TO Numv
360     Head$[7-I,7-I]=V$[Numv-I+1,Numv-I+1]
370   NEXT I
380   !
390   OUTPUT @Hp8751;"INPUCALC01 ";       ! Store cal data by HP-IB
400   OUTPUT @Dt USING "#,8A";"#6"&Head$ ! Send header
410   OUTPUT @Dt;Dat(*),END               ! Send data
420   OUTPUT @Hp8751;"SAVC"               ! Re-draw trace
430   !
440   ASSIGN @Dt TO *                     ! Clear I/O path
460   DISP "Retransmit completed. Connect DUT."
470   OUTPUT @Hp8751;"CONT"               ! Sweep mode is CONT
480   STOP
490   !
```

Figure 2-16. Reading Calibration Data (1/2)

```
500 Setup:  !
510   F_cent=7.E+7
520   F_span=200000.
530   OUTPUT @Hp8751;"PRES;"
540   OUTPUT @Hp8751;"CHAN1; S21; LOGM"
550   OUTPUT @Hp8751;"CENT ";F_cent
560   OUTPUT @Hp8751;"SPAN ";F_span
570   OUTPUT @Hp8751;"SING"
580   RETURN
590   !
600 Cal:  !
620   OUTPUT @Hp8751;"CALIRESP"
630   ON INTR 7 GOTO Sweep_end
640   OUTPUT @Hp8751;"CLES"
650   OUTPUT @Hp8751;"*SRE 4;ESNB 1"
660   REPEAT
670   UNTIL SPOLL(@Hp8751)=0
680   ENABLE INTR 7;2
690   OUTPUT @Hp8751;"STANC"
700 Loop_top:GOTO Loop_top
710 Sweep_end:          !
720   !
730   OUTPUT @Hp8751;"RESPDONE"
740   OUTPUT @Hp8751;"*OPC?"
750   ENTER @Hp8751;Dum
760   RETURN
770   END
```

Figure 2-16. Reading Calibration Data (2/2)

Line 50	Declare the dimension part of the file header.
Line 110	Preset and set up the HP 8751A, and hold the trigger.
Line 120	Perform a response calibration.
Line 130	Re-draw the trace with the calibration data.
Line 210	Request outputting the calibration data.
Line 220	Enter the file header.
Line 230	Enter the calibration data.
Line 240	Enter the file terminator.
Line 280	Perform the calibration to set the correction ON.
Line 320	Calculate the number of bytes transferred, and represents it in the string format.
Line 330	Count the number of characters in the string which contains the number of bytes transferred.
Line 340	Enter 0 as the initial value in all header arrays.
Line 350 through 370	Place the number of bytes transferred to the header array digit by digit from the sixth array to the first array of the header.
Line 390 through 410	Send the file header and calibration data.

Miscellaneous Programming Examples

Controlling Peripherals

The purpose of this section is to demonstrate how to coordinate printers or plotters with the HP 8751A.

The HP 8751A has two operating modes with respect to HP-IB, as set under the LOCAL menu: System controller mode and Addressable only mode. The system controller mode is used when no controller is present. The addressable only mode is how a computer can control the HP 8751A and passes active control to the HP 8751A so that the HP 8751A can plot or print.

Note that the HP 8751A assumes that the address of the computer is correctly stored in its HP-IB addresses menu under the ADDRESS: CONTROLLER entry. If this address is incorrect, control will not return to the computer.

If the HP 8751A is in Addressable only mode and receives a command telling it to plot or print, it sets bit 1 in the event status register to indicate that it needs control of the bus. If the computer then uses the HP-IB control command to pass control to the HP 8751A, the HP 8751A will take control of the bus, and access the peripheral. When the HP 8751A no longer needs control, it will pass it back to the computer.

Control should not be passed to the HP 8751A before it has set event status register bit 1, Request Active Control. If the HP 8751A receives control before the bit is set, control is passed immediately back.

While the HP 8751A has control, it is free to address devices to talk and listen as needed. The only functions denied it are the ability to assert the interface clear line (IFC), and remote line (REN). These are reserved for the system controller. As active controller, the HP 8751A can send messages to and read replies back from printers and plotters.

This example prints the display.

```
10    !
20    ! Controlling Peripherals
30    !
40    DIM Err$[100]
50    ASSIGN 717 TO @Hp8751  !
60    !
70    OUTPUT @Hp8751;"*CLS"   ! Clear status reporting system
80    OUTPUT @Hp8751;"*ESE 2" ! Enable Request Active Control bit of ESE
90    !
100   OUTPUT @Hp8751;"PRINALL"
110   REPEAT
120     Stat=SPOLL(@Hp8751)
130   UNTIL BIT(Stat,5)
140   !
150   PASS CONTROL @Hp8751    ! Pass active control to HP 8751
160   DISP "Printing."
170   REPEAT
180     STATUS 7,6;Hpib
190   UNTIL BIT(Hpib,6)
200   DISP "Done."
205   ABORT 7                 ! Return active control to system controller
210   !
220   OUTPUT @Hp8751;"OUTPERRO?"
230   ENTER @Hp8751;Err,Err$
240   IF Err THEN DISP Err$
250   END
```

Figure 2-17. Sample Program: Controlling Peripherals

Line 70	Clear the status reporting system.
Line 80	Enable the Request Active Control bit in the event status register.
Line 100	Request printing.
Lines 110 through 130	Wait until the HP 8751A requests control.
Line 150	Pass active control to the HP 8751A.
Line 170 through 190	Wait until the print is finished and control is returned.
Line 205	Return active control to the system controller.
Line 220 through 240	If an error occurred, print the error number and the error message.

Transferring disk data files

The built-in disk drive is often used to store data files in addition to instrument states. The file name is then appended with two characters to indicate what is in the file. "_D" indicates the file contains the internal data array using the SAVE DATA ONLY or the SAVDDAT command. Refer to "Saving and Recalling Instrument States and Data" in the *Reference Manual* for the file structure.

This example demonstrates how to recall a data file stored by the built-in disk drive into a computer using the disk drive connected to the computer.

Before running the program, store the data to the disk installed in the built-in disk drive, remove the disk, and put the disk in to the computer's disk drive.

```
10    !
20    ! Transferring Disk Data Files
30    !
50    INTEGER Nop
60    DIM Sw$(1:7)[8],Numseg(1:7)
70    DATA "Raw",8,"Cal",24,"Data",2,"Mem",2,"Unform",2,"Trace",2
      ,"Tracemem",2
80    !
90    INPUT "File name (with extension)?",File$
100   ASSIGN @Path TO File$
110   ENTER @Path USING "6X,#"
120   Numdat=0
130   PRINT "Data contained:"
140   FOR I=1 TO 7
150     READ Dat$,Num
160     GOSUB Datasw
170   NEXT I
180   PRINT
190   ENTER @Path USING "4X,#"
200   !
210   INPUT "Press [Return] to read data.",Dum$
220   FOR J=1 TO Numdat
230     FOR I=1 TO Numseg(J)
240       PRINT Sw$(J);I
250       GOSUB Dataseg
260       PRINT
270     NEXT I
280     PRINT
290     IF JNumdat THEN INPUT "Press [Return] to read next data.",Dum$
300   NEXT J
310   ASSIGN @Path TO *
320   STOP
330   !
```

Figure 2-18. Sample Program: Transferring Disk Data Files

```
340 Dataseg:  !
350   ENTER @Path;Nop
360   ENTER @Path USING "4X,#"
370   FOR K=1 TO Nop
380     ENTER @Path;X,Y
390     PRINT K,X,Y
400   NEXT K
410   ENTER @Path USING "4X,#"
420   RETURN
430   !
440 Datasw:  !
450   ENTER @Path USING "B,#";Sw
460   IF Sw THEN
470     Numdat=Numdat+1
480     Sw$(Numdat)=Dat$
490     Numseg(Numdat)=Num
500     PRINT Sw$(Numdat)
510   END IF
520   RETURN
530   END
```

Figure 2-18. Sample Program: Transferring Disk Data Files (2/2)

Lines 50 and 60	Set up the data of possible data groups.
Line 90	Get the file name to load. The file name must be included the extension: "_D"(for LIF) or `.DAT`(for DOS).
Line 100	Define an I/O path which points to the chosen file.
Line 110	Enter bytes for internal use only.
Line 120 through 170	Read the data switches and examine the data contained.
Line 190	Enter bytes of internal use only.
Line 220 through 300	Enter a data group.
Line 230 through 270	Enter a data segment.
Line 310	Close the I/O path.
Lines 340 through 420	Read a data switch.
Lines 440 through 520	Enter a data segment.
Line 450	Enter the number of data bytes which follow.
Line 460	Enter bytes of internal use only.
Lines 470 through 500	Read the data.
Line 510	Enter the bytes of internal use only.

Status Reporting

The HP 8751A has a status reporting mechanism that gives information about specific functions and events inside the HP 8751A. The status byte is an 8-bit register with each bit summarizing the state of one aspect of the HP 8751A. For example, the error queue summary bit will always be set if there are any errors in the queue. The value of the status byte can be read with the SPOLL statement. This command does not automatically put the HP 8751A into the remote mode, thus giving the operator access to the HP 8751A front panel functions. Reading the status byte does not affect its value. The sequencing bit can be set by the operator during execution of a test sequence.

The status byte also summarizes two event status registers and one operational status register that monitor specific conditions inside the HP 8751A. The status byte also has a bit that is set when the HP 8751A is issuing a service request over HP-IB, and a bit that is set when the HP 8751A has data to send out over HP-IB. Refer to Appendix B for a definition of the status registers.

The error queue holds up to 20 instrument errors and warnings in the order that they occurred. Each time the HP 8751A detects an error condition and displays a message on the CRT, it also puts the error in the error queue. If there are any errors in the queue, bit 3 of the status byte will be set. The errors can be read from the queue with the OUTPERRO? command, which causes the HP 8751A to transmit the error number and the error message of the oldest error in the error queue (first in first out).

It is also possible to generate interrupts using the status reporting mechanism. The status byte bits can be enabled to generate a service request (SRQ) when set. The computer can in turn be set up to generate an interrupt on SRQ.

To be able to generate an SRQ, a bit in the status byte has to be enabled using *SRE *n*. A one in a bit position enables that bit in the status byte. Therefore, *SRE 8 enables an SRQ on bit 3, check error queue, since 8 equals 0000 1000 in binary representation. That means that whenever an error is put into the error queue and bit 3 is set, and the SRQ line is asserted. The only way to clear the SRQ is to disable bit 3, re-enable bit 3, or read out all the errors from the queue.

A bit in the event status register can be enabled so that it is summarized by bit 5 of the status byte. If any bit is enabled in the event status register, bit 5 of the status byte will also be set. For example, *ESE 66 enables bits 1 and 6 of the event status register, since 66 equals 0100 0010 in binary representation. Therefore, whenever active control is requested or a front panel key is pressed, bit 5 of the status byte will be set. Similarly, ESNB *n* enables bits in event status register B so that they will be summarized by bit 2 in the status byte.

To generate an SRQ from an event status register, enable the desired event status register bit. Then enable the status byte to generate an SRQ. For instance, *ESE 32 and *SRE 32 enable the syntax error bit, so that when the syntax error bit is set, the summary bit in the status byte will be set, and it enables an SRQ on bit 5 of the status byte.

During the sample program (Figure 2-19) is running, you can try get into the subroutine "Err_report:" when this program is executed in an external controller and Instrument BASIC is installed in your HP 8751A.

Type a command in command line on the HP 8751A from the keyboard to occur an error:

For example :

```
OUTPUT 800;"HELLO"
```

Because HELLO is not the command of HP 8751A, an error will occur.

```
10     !
20     ! Generating Interrupts
30     !
40     ASSIGN @Hp8751 TO 717
50     !
60     OUTPUT @Hp8751;"*CLS"      ! Clear status reporting system
70     OUTPUT @Hp8751;"*ESE 32"   ! Enable bit-5 of ESR
80     OUTPUT @Hp8751;"*SRE 32"   ! Enable bit-5 or status byte
90     !
100    ON INTR 7 GOSUB Err_report
110    ENABLE INTR 7;2
120    !
130    LOOP
140    END LOOP
150    STOP
160    !
170 Err_report:!
180    Stat=SPOLL(@Hp8751)
190    OUTPUT @Hp8751;"*ESR?"
200    ENTER @Hp8751;Estat
210    PRINT "Syntax error detected."
220    !
230    OUTPUT @Hp8751;"OUTPERRO?"   ! Ask error
240    ENTER @Hp8751;Err,Err$       ! Enter error number and message
250    PRINT Err,Err$
260    !
270    ENABLE INTR 7
280    RETURN
290    END
```

Figure 2-19. Sample Program: Generating Interrupts

Line 60	Clear the status reporting system.
Line 70	Enable bit 5 of the event status register.
Line 80	Enable bit 5 of the status byte so that an SRQ will generated when a syntax error occurs.
Line 100	Tell the computer where to branch on an interrupt.
Line 110	Tell the computer to enable an interrupt from interface 7 (HP-IB) when value 2 (bit 1: SRQ bit) of the interrupt register is set. A branch to `Err_report` will disable the interrupt, so the return from `Err_report` re-enables it. If there is more than one instrument on the bus capable of generating an SRQ, it is necessary to use serial poll to determine which device has issued the SRQ. In this case, we assume the HP 8751A issued it. A branch to `Err_report` will disable the interrupt, so the return from `Err_report` re-enable it.
Line 130 and 140	Do nothing loop.
Line 180	Clear the SRQ bit of the status byte.

Lines 190 and 200	Read the register to clear the bit.
Lines 230 through 250	Instruct the HP 8751A to output the error number and the error message, and print them.

3

HP-IB Programming Reference

This chapter provides a reference for HP-IB operation of the HP 8751A. Use this information as a reference to the syntax requirements and general function of the individual commands.

This chapter lists the commands in alphabetical order. Refer to Appendix A for a functional list of the commands.

Refer to the *Reference Manual* for the details of each function, or to the *Service Manual* for the details of the service related functions.

HP-IB Command Syntax

① ② ③ ④ ⑤ ⑥

ATTIR {0dB|20dB}

Sets the attenuator value at input R to 0 dB or 20 dB. (INPUT-R: 0dB or 20 dB under [ATTN] ; Query)

ATTP1 *value* [DB]

Sets the attenuator value at port 1 of an S-parameter Test Set used with the HP 8751A. (ATTENUATOR PORT 1 under [MENU] ; Query)

value 0 to 70 (dB), in 10 (dB) step.

① Upper case bold characters represent the program codes which must appear exactly as shown with no embedded spaces. Upper and lower case characters are equivalent.

② Characters enclosed in the { } brackets are qualifiers attached to the root mnemonic. There can be no spaces or symbols between the root mnemonic and its appendage.

For example:

{ON|OFF} shows that either ON or OFF can be attached to the root mnemonic. CONM{ON|OFF} means CONMON or CONMOFF.

{1-4} shows that the numeral 1, 2, 3, or 4 can be attached to the root mnemonic. DELR{1-4} means DELR1, DELR2, DELR3, or DELR4.

③ A constant or a pre-assigned simple or complex numeric or string variable transferred to the HP 8751A. There must be a space between it and the code.

④ Square brackets indicate that the enclosed information is optional.

⑤ Key or softkey which has the same function.

⑥ "Query" indicates that the command can be queried. Refer to "Query Commands".

Note

A semicolon (;) is required as a separator for each program command except for the last command.

For example, either of the following is acceptable.

```
OUTPUT Hp8751;"CHAN1; S11; LOGM;"
OUTPUT Hp8751;"CHAN1; S11; LOGM"
```

Query Commands

All instrument functions can be interrogated to find the current On/Off state or value.

For instrument state commands, append the question mark (?) character instead of {ON|OFF} to interrogate the state of the functions. The HP 8751A responds to the next controller ENTER operation with a "1" or a "0" to indicate ON or OFF, respectively.

For settable functions such as SCAL *value*, using SCAL? causes the HP 8751A to respond to the next controller ENTER operation by outputting the current function value then clearing the instrument entry area.

If a command that does not have a defined response is interrogated, the instrument outputs a zero.

- Example 1

  AB

```
OUTPUT Hp8751;"AB?;"
ENTER Hp8751;Reply
PRINT "Input port is AB?",
IF Reply then PRINT "Yes"
IF NOT Reply the PRINT "No"
```

- Example 2

  ATTIA{0DB|20DB}

```
OUTPUT Hp8751;"ATTIA?;"
ENTER Hp8751;Reply$
PRINT "Port A attenuator value is ";Reply$
```

- Example 3

  ADDRCONT *value*

```
OUTPUT Hp8751;"ADDRCONT?;"
ENTER Hp8751;Reply
PRINT "Controller HP-IB address is ";Reply
```

Suffix

The following suffixes can be used as the units of the stimulus values:

Frequency:	Hz (default), MHz
Power:	dBm (default)
Attenuator:	dB (default)
Log mag:	dB (default)
Delay time:	s (default)
Phase:	deg (default)
Capacitance:	F (default)
Inductance:	H (default)
Impedance:	ohm (default)

If no suffix is used, the HP 8751A assumes the default values for the instruction. Upper and lower case characters are equivalent.

Code Naming Conventions

The HP-IB Commands of HP 8751A are derived from their front panel key titles (where possible), according to the naming conventions below.

Some codes require additional parameters (on, off, 1, 2, etc.). Codes that have no front panel equivalent are HP-IB only commands, and use a similar convention based on the common name of the function. Where possible, HP 8751A codes are compatible with HP 8753 and HP 8510 codes.

Table 3-1. HP-IB Code Naming Conventions

Convention	For HP-IB Code Use	Example	
		Key Title	HP-IB Code
One word	First four letters	POWER START	POWE STAR
Two words	First three letters of first word and first letter of second word	ELECTRICAL DELAY SEARCH RIGHT	ELED SEAR
Two words in a group	First four letters of both	MARKER → CENTER	MARKCENT
Three Words	First three letters of first word, first letter of second word, and first four letters of third word	CAL KIT: 7mm SEARCH RNG STORE	CALK7MM SEARSTOR

3.HP-IB Programming Reference

AB

Calculates and displays the complex ratio of input A to input B.

(A/B under (MEAS); Query)

ABODCALI

Aborts the dc detector's output voltage linearity calibration.

(ABORT DC CAL under (CAL))

ACTLHFRE

Sets the active inductor (L) high frequency.

(Under SERVICE MENU under (SYSTEM); Query)

ACTLLFRE

Sets the active inductor (L) low frequency.

(Under SERVICE MENU under (SYSTEM); Query)

ACTLNORM

Sets the active inductor (L) normal.

(Under SERVICE MENU under (SYSTEM); Query)

ADDRCONT *value*

Sets the HP-IB address which the HP 8751A will use to communicate with an external controller.

(ADDRESS: CONTROLLER under (LOCAL); Query)

value 0 to 30

ADDRPLOT *value*

Sets the HP-IB address which the HP 8751A will use to communicate with the plotter.

(ADDRESS: PLOTTER under (LOCAL); Query)

value 0 to 30

ADDRPRIN *value*

Sets the HP-IB address which the HP 8751A will use to communicate with the printer.

(ADDRESS: PRINTER under LOCAL; Query)

value	0 to 30

ANAOCH1

Selects channel 1 for waveform analysis. For details, refer to Appendix E. (Query)

ANAOCH2

Selects channel 2 for waveform analysis. For details, refer to Appendix E. (Query)

ANAODATA

Selects a data trace for waveform analysis. For details, refer to Appendix E. (Query)

ANAOMEMO

Selects a memory trace for waveform analysis. For details, refer to Appendix E. (Query)

ANARANG *value*[*suffix*],*value*[*suffix*]

Sets the waveform analysis stimulus range by entering the START and STOP values. For details, refer to Appendix E. (Query)

value	5 to 5.0×10^8 (Hz, Frequency sweep) or -50 to $+15$ (Power sweep)
suffix	Refer to "Suffix"

ANARFULL

Sets the analysis range equal to the full stimulus range. For details, refer to Appendix E.

AR

Calculates and displays the complex ratio of input A to input R.

(A/R under MEAS; Query)

ASCE *string*

Sets user defined extension for ASCII save file in MS-DOS format. Default setting is ".TXT". Modified extension is kept in SRAM even if power is OFF.

(DEFINE EXTENSION ASCII DATA under SAVE : Query)

string	Extension name. Up to 3 characters

3.HP-IB Programming Reference

ATTIA{0DB|20DB}

Sets the attenuator value at input A to 0 dB or 20 dB.

(INPUT-A: 0dB or 20dB under ATTEN; Query)

ATTIB{0DB|20DB}

Sets the attenuator value at input B to 0 dB or 20 dB.

(INPUT-B: 0dB or 20dB under ATTEN; Query)

ATTIR{0dB|20dB}

Sets the attenuator value at input R to 0 dB or 20 dB.

(INPUT-R: 0dB or 20dB under ATTEN; Query)

ATTP1 *value* [dB]

Sets the attenuator value at port 1 of an S-parameter test set used with the HP 8751A.

(ATTENUATOR PORT 1 under MENU; Query)

value 0 to 70, in 10 step

ATTP2 *value* [dB]

Sets the attenuator value at port 2 of an S-parameter test set used with the HP 8751A.

(ATTENUATOR PORT 2 under MENU; Query)

value 0 to 70, in 10 step

AUTO

Selects the scale/div value automatically to fit the trace data to the display.

(AUTO SCALE under SCALE REF)

AVER{ON|OFF}

Sets the averaging function ON or OFF for the active channel.

(AVERAGING on off under AVG; Query)

AVERFACT *value*

Sets the averaging factor.

(AVERAGING FACTOR under [AVG]; Query)

value 1 to 999

AVERREST

Resets and restarts averaging.

(AVERAGING RESTART under [AVG])

BACI *value*

Sets the background intensity of the display as a percent of the white level.

(BACKGROUND INTENSITY under [DISPLAY]; Query)

value 0 to 100

BDC

Displays a dc voltage at input B.

(Bdc under [MEAS]; Query)

BDCR

Calculates and displays the ratio of a dc voltage at input B to the reference signal at input R.

(Bdc/R under [MENU]; Query)

BEEPDONE{ON|OFF}

Sets the operation completion beeper ON or OFF.

(BEEP DONE on off under [DISPLAY]; Query)

BEEPFAIL{ON|OFF}

Sets the limit fail beeper ON or OFF.

(BEEP FAIL on off under [SYSTEM]; Query)

BEEPWARN{ON|OFF}

Sets the warning beeper ON or OFF.

(BEEP WARN on off under DISPLAY; Query)

BR

Calculates and displays the complex ratio of input B to input R.

(B/R under MENU; Query)

C0 *value*

Enters the constant term of the open circuit capacitor model value, C_0.

(C0 under CAL)

value 0 to 1,000 ($\times$ 10^{-15} F)

C1 *value*

Enters the constant term of the open circuit capacitor model value, C_1.

(C1 under CAL)

value 0 to 1,000 ($\times$ 10^{-27} F/Hz)

C2 *value*

Enters the constant term of the open circuit capacitor model value, C_2.

(C2 under CAL)

value 0 to 1,000 ($\times$ 10^{-36} F/Hz^2)

CALCASSI

Shows the tabular listing of the calibration kit class assignment.

(CLASS ASSIGNMENT under COPY)

CALI *parameter*

Selects the measurement calibration type. (Query)

parameter	*description*
NONE	No calibration
RESP	Response measurement calibration
RAI	Response and isolation measurement calibration
S111	1-Port measurement calibration at port 1
S221	1-Port measurement calibration at port 2
FUL2	Full 2-Port measurement calibration
ONE2	One-path 2-Port measurement calibration

CALIFUL2

Selects the full 2-port measurement calibration.

(FULL 2-PORT under CAL; Query)

CALIONE2

Selects the one-path 2-port measurement calibration.

(ONE-PATH 2-PORT under CAL; Query)

CALIRAI

Selects the response and isolation measurement calibration.

(RESPONSE & ISOL'N under CAL; Query)

CALIRESP

Selects the response measurement calibration.

(RESPONSE under CAL; Query)

CALIS111

Selects the 1-port measurement calibration at port 1.

(S11 1-PORT under CAL; Query)

CALIS221

Selects the 1-port measurement calibration at port 2.

(S22 1-PORT under CAL; Query)

CALK *parameter*

Selects the calibration kit. (Query)

parameter	*description*
APC7	7 mm
N50	Type-N 50 Ω
N75	Type-N 75 Ω
USED	User-defined

CALK7MM

Selects the 7 mm calibration kit.

(CAL KIT: 7mm under CAL; Query)

CALKN50

Selects the 50 Ω type-N calibration kit.

(N 50Ω under CAL; Query)

CALKN75

Selects the 75 Ω type-N calibration kit.

(N 75Ω under CAL; Query)

CALKUSED

Selects a calibration kit model defined or modified by the user.

(USER KIT under CAL; Query)

CALN

Selects using no calibration.

(CALIBRATE: NONE under CAL; Query)

CALP

Calculates the parameters of the conjugate matching circuit.

(CALCULATE PARAMETERS under DISPLAY)

CALS *value*

Provides the tabular listing of the standard setting.

(STD NO.1 to STD NO.8 under COPY)

value 1 to 8

CBRI *value*

Sets the color brightness in percent.

(BRIGHTNESS under DISPLAY; Query)

value 0 to 100 (%)

CENT *value* [*suffix*]

Sets the center stimulus value.

((CENTER), or CENTER under (MENU); Query)

value	5 to 5.0×10^8 (Hz, frequency sweep) −50 to +15 (dBm, power sweep only)
suffix	Refer to "Suffix"

CHAD *string*

Changes the current directory (only MS-DOS format).

(CHANGE DIRECTORY under (SAVE))

string	Directory path

CHAIRANG

Changes the IF range set channel (R to A to B).

(Under SERVICE MENU under (SYSTEM))

CHAN1

Selects channel 1 as the active measurement channel. ((CH 1); Query)

CHAN2

Selects channel 2 as the active measurement channel. ((CH 2); Query)

CLAD

Completes specifying a class.

(CLASS DONE (SPE'D) under (CAL))

CLASS11{A|B|C}

Selects port 1 (S11) one-port calibration standard class: S11A (open), S11B (short), or S11C (load).

([S11] : OPEN, SHORT, or LOAD under (CAL))

3.HP-IB Programming Reference

CLASS22{A|B|C}

Selects port 2 (S22) one-port calibration standard class: S22A (open), S22B (short), or S22C (load).

([S22] : OPEN, SHORT, or LOAD under (CAL))

CLEL

Clears the current frequency list.

(CLEAR LIST YES under (MENU))

CLEM{1-8}

Clears the marker.

(MARKER 1 to MARKER 8 under (MKR))

CLES

Clears the status byte, the event status register, the event status register B, and the operational status register.

CLEPTRIP

Clears the power trip.

(CLEAR POWER TRIP under (MENU))

COLO{CH1D|CH1M|CH2D|CH2M|GRAT|TEXT|WARN}

Specifies the display element to change color: channel 1 data, channel 1 memory and limit lines, channel 2 data, channel 2 memory and limit lines, a text, or a warning message.

(CH1 DATA, CH1 MEM LIMIT LN, CH2 DATA, CH2 MEM LIMIT LN, GRATICULE, TEXT, WARNING under (DISPLAY))

COLOIBT

Specifies display element color: the HP Instrument BASIC text.

(IBASIC under (DISPLAY))

COLO{PEN1|PEN2|PEN3|PEN4|PEN5|PEN6}

Specifies display element color: the graphics pen pallet.

(PEN 1 to PEN 6 under [DISPLAY])

COLOR *value*

Specifies the saturation percent of the specified display element.

(COLOR under [DISPLAY]; Query)

value 0 to 100 (%)

CONM{ON|OFF}

Sets conjugate matching ON or OFF.

(CONJ MATCH on off under [DISPLAY]; Query)

CONPCP *value* [F]

Displays or changes parameter value Cp for the selected conjugate matching circuit.

(Cp under [DISPLAY]; Query)

value 1.0×10^{-18} to 1.0×10^{9} (F)

CONPCS *value* [F]

Displays or changes parameter value Cs for the selected conjugate matching circuit.

(Cs under [DISPLAY]; Query)

value 1.0×10^{-18} to 1.0×10^{9} (F)

CONPLP *value* [H]

Displays or changes parameter value Lp for the selected conjugate matching circuit.

(Lp under [DISPLAY]; Query)

value 1.0×10^{-18} to 1.0×10^{9} (H)

CONPLS *value* [H]

Displays or changes parameter value Ls for the selected conjugate matching circuit.

(PARAMETER:Ls under [DISPLAY]; Query)

value 1.0×10^{-18} to 1.0×10^{9} (H)

CONPDISP{ON|OFF}

Displays or does not display the conjugate matching parameters on the CRT.

(`CNJ.P DISP on off` under [DISPLAY])

CONT

Continuous trigger.

(`CONTINUOUS` under [MENU]; Query)

CONV *parameter*

Selects the measurement data conversion setting(impedance, admittance, or multiple phase). (Query)

parameter	*description*
OFF	Conversion OFF
ZREF	Z:reflection
ZTRA	Z:transmission
YREF	Y:reflection
YTRA	Y:transmission
ONEDS	Reciprocal (1/S)
MP4	Multiply phase by 4
MP8	Multiply phase by 8
MP16	Multiply phase by 16

CONVMP{4|8|16}

Multiplies the current phase trace by a multiplier factor specified by a qualifier (4, 8, or 16).

(`4 * Phase`,`8 * Phase`,`16 * Phase` under [MEAS]; Query)

CONV1DS

Expresses the data in inverse S-parameter values.

(`1/S` under [MEAS]; Query)

CONVOFF

Turns off all parameter conversion operations.

(`OFF` under [MEAS]; Query)

CONVYREF

Converts reflection data to its equivalent admittance values.

(Y: Refl under MEAS; Query)

CONVYTRA

Converts transmission data to its equivalent admittance values.

(Y: Trans under MEAS; Query)

CONVZREF

Converts reflection data to its equivalent impedance values.

(Z: Refl under MEAS; Query)

CONVZTRA

Converts transmission data to its equivalent impedance values.

(Z: Trans under MEAS; Query)

COPA

Aborts printing or plotting in progress.

(COPY ABORT under COPY)

COPT{ON|OFF}

Sets the time stamp function ON or OFF.

(COPY TIME on off under COPY; Query)

CORR{ON|OFF}

Sets the error correction function ON or OFF.

(CORRECTION on off under CAL; Query)

COUC{ON|OFF}

Sets the channel coupling of stimulus values ON or OFF.

(COUPLED CH on off under MENU; Query)

CRED *string*

Create a directory (only MS-DOS format).

(CREATE DIRECTORY under SAVE)

string Up to 8 characters for directory name and up to 3 characters for extension

CURD?

Outputs current directory.

(CURRENT DIRECTORY under SAVE)

CWFREQ *value* [*suffix*]

Sets the frequency for power sweep.

(CWFREQ under MENU; Query)

value 5 to 5.0×10^8 (Hz)
suffix Hz or MHz

DATI

Stores the active channel data to trace memory.

(DATA → MEM under DISPLAY)

DAYMYEAR

Sets the displayed date mode to day/month/year order.

(DayMonYear under SYSTEM; Query)

DCBUS *value*

Selects the DC bus.

(Under SERVICE MENU under SYSTEM; Query)

value 0 to 20

DCCOR{ON|OFF}

Sets the dc detector linearity correction ON or OFF.

(DC CORR on off under CAL; Query)

DEFC

Returns all traces, lines, and text to the default colors.

(DEFAULT COLORS under [Display])

DEFS *value*

Defines the number of the calibration standards to be modified.

(DEFINE STANDARD under [CAL])

value 1 to 8

DELA

Selects the Delay format for the current measurement.

(DELAY under [FORMAT]; Query)

DELO

Sets the delta marker mode OFF.

(Δ MODE OFF under [MKR]; Query)

DELR{1-8}

Selects the delta reference marker.

(Δ REF = 1 to Δ REF = 8 under [MKR]; Query)

DELRFIXM

Sets the user-specified fixed reference marker.

(ΔREF=Δ FIXED MKR under [MKR]; Query)

DESTOFF

Sets destructive RAM testing OFF. (DATA in RAM will be restored when test is completed.)

(Under SERVICE MENU under [SYSTEM]; Query)

DESTON

Sets destructive RAM testing ON. (DATA in RAM will be lost.)

(Under SERVICE MENU under [SYSTEM]; Query)

DFLT

Returns the plotting parameters to the default values.

(DEFAULT SETUP under (COPY))

DISA *parameter*

Selects the display allocation mode. (Query) (Option 002 only)

parameter	*description*
ALLI	All instrument
HIHB	Half instrument half BASIC
ALLB	All BASIC
BASS	BASIC status

DISAALLB

Displays only the HP Instrument BASIC display on the HP 8751A's CRT.

(ALL BASIC under (DISPLAY); Query) (Option 002 only)

DISAALLI

Displays only the measurement graticule on the HP 8751A's CRT.

(ALL INSTRUMENT under (DISPLAY); Query) (Option 002 only)

DISABASS

Displays only the HP Instrument BASIC status on the HP 8751A's CRT.

(BASIC STATUS under (DISPLAY); Query) (Option 002 only)

DISAHIHB

Displays the measurement graticule (top half) and the HP Instrument display (bottom half) on the HP 8751A's CRT.

(HALF INSTR HALF BASIC under (DISPLAY); Query) (Option 002 only)

DISFDOS

Sets the format for initializing the flexible disk in the internal disk drive in MS-DOS format.

(DEFINE FORMAT ,DOS under (SAVE) ; Query)
Supported MS-DOS formats are:

- 720 kbyte, 80 tracks, double-sided, 9 sector/track
- 1.44 Mbyte, 80 tracks, double-sided, 18 sector/track

DISFLIF

Sets the format for initializing the flexible disk in the HP 8751A's internal disk drive in LIF (Logical Interchange Format) format.

(DEFINE FORMAT, LIF under SAVE ; Query)

DISL{1|2}

Selects list sweep table 1 or 2 to be displayed and hard copied.

(DISL1 or DISL2 under COPY)

DISLLIST

Displays the limit table on the display.

(DISPLAY LIST under COPY)

DISMCTSP

Displays the list sweep stimulus range in the center and span format.

(CTR & SPAN under COPY; Query)

DISMMD

Selects the middle and delta format for the limit testing table.

(MID & DLT under COPY; Query)

DISMNUM

Displays the list sweep stimulus resolution in the number of points format.

(NUMBER of POINTS under COPY; Query)

DISMSTEP

Displays the list sweep stimulus resolution in the step size format.

(STEP SIZE under COPY; Query)

DISMSTSP

Displays the list sweep stimulus range in the start and stop format.

(DISP MODE: ST & SP under COPY; Query)

Reference

DISMUL

Selects the upper and lower format for the limit testing table.

(DISP MODE: UPR & LWR under [COPY]; Query)

DISP *parameter*

Selects the display trace type. (Query)

parameter	*description*
DATA	Data only
MEMO	Memory only
DATM	Data and memory
DDM	Data divided by memory
DMM	Data minus memory

DISPDATA

Displays a trace of measured data.

(DISPLAY: DATA under [DISPLAY]; Query)

DISPDATM

Displays traces of both measured data and memory data.

(DATA and MEMORY under [DISPLAY]; Query)

DISPDDM

Displays the trace of the results of measured data divided by memory data.

(DATA/MEM under [DISPLAY]; Query)

DISPDMM

Displays the trace of the results of measured data subtracted from memory data.

(DATA-MEM under [DISPLAY]; Query)

DISPMEMO

Displays a trace of memory data.

(MEMORY under [DISPLAY]; Query)

DONE

Completes the measurement of the selected standard calibration.

(DONE: OPENS, DONE: SHORTS, or DONE:LOADS under CAL)

DSKEY

Disables the front panel keys and the rotary knob. To enable the keys and knob again, send the ENKEY command.

DUAC{ON|OFF}

Selects the dual (ON) or single (OFF) channels display.

(DUAL CHAN on off under DISPLAY; Query)

EDITDONE

Completes editing the frequency list for the list sweep.

(LIST DONE under MENU)

EDITLIML

Begins editing the limit line table.

(EDIT LIMIT LINE under SYSTEM)

EDITLIS1

Selects list 1 for editing.

(EDIT: LIST 1 under MENU; Query)

EDITLIS2

Selects list 2 for editing.

(LIST 2 under MENU; Query)

EDITLIST

Begins editing the frequency list.

(EDIT LIST under MENU)

ELED *value* [S]

Sets the electrical delay.

(ELECTRICAL DELAY under SCALE REF; Query)

value −10 to 10 (s)

ENKEY

Re-enables the front panel keys and the rotary knob which have been disabled by the DSKEY command.

ESB?

Outputs the event status register B value.

ESNB *value*

Specifies the bits of event status register B.

value 0 to 32,767 ($=2^{15}-1$)

EXEDCALI

Executes the dc detector lineality calibration.

(EXECUTE DC CAL under CAL)

EXET

Executes the service test.

(Under SERVICE MENU under SYSTEM)

EXPP

Selects the expanded phase format for the current measurement.

(EXPANDED PHASE under FORMAT; Query)

EXTRLOCK?

Outputs the state of the external reference (locked or unlocked).

(Under SERVICE MENU under SYSTEM)

EXTT *parameter*

Selects the external trigger mode. (Query)

parameter	*description*
OFF	External trigger OFF (internal trigger mode ON)
ONSWEE	On sweep
ONPOIN	On point
MAN	Manual trigger mode on point

EXTTOFF

Sets the internal measurement trigger mode (external trigger OFF).

(TRIGGER: TRIG OFF under MENU; Query)

EXTTON

Sets the external measurement trigger mode to ON. When triggered, one measurement sweep is executed.

(EXT. TRIG ON SWEEP under MENU; Query)

EXTTPOIN

Sets the external measurement trigger mode to ON. When triggered, one point is measured.

(EXT. TRIG ON POINT under MENU; Query)

FBUS *value*

Selects the frequency bus.

(Under SERVICE MENU under SYSTEM)

value	0 to 5

FILC *string1*, *string2*, *string3*, *string4*

File copy command.

(FILE UTILITIES under SAVE)

string1	Source file name
string2	Source device name ("DISK" or "MEMORY")
string3	Destination file name
string4	Destination device name ("DISK" or "MEMORY")

string2 and *string4* must be either "DISK" or "MEMORY". "DISK" selects the built-in flexible disk and "MEMORY" selects the RAM disk memory. FILC can not copy files between the RAM disk memory and the flexible disk when the RAM disk and flexible disk formats are different.

FIRLANOR

Sets first local ALC to NORMAL.

(Under SERVICE MENU under SYSTEM; Query)

FIRLAOPE

Sets first local ALC to OPEN.

(Under SERVICE MENU under SYSTEM; Query)

FIRLPNOR

Sets first local PLL to NORMAL.

(Under SERVICE MENU under SYSTEM; Query)

FIRLPOPE

Sets first local PLL to OPEN.

(Under SERVICE MENU under SYSTEM; Query)

FIRR?

Outputs the firmware revision.

(Under SERVICE MENU under SYSTEM)

FMT *parameter*

Selects the display format. (Query)

parameter	*description*
LOGM	Log magnitude format
PHAS	Phase format
DELA	Delay format
SMIC	Smith chart format
POLA	Polar chart format
LINM	Linear magnitude format
SWR	SWR format
REAL	Real format
IMAG	Imaginary format
EXPP	Expanded phase format
INVSCHAR	Admittance Smith chart
LOGMP	Log magnitude and phase format
LOGMD	Log magnitude and delay format

FNDAUTO

Sets FN DAC to AUTO.

(Under SERVICE MENU under SYSTEM; Query)

FNDMANU

Sets FN DAC to MANUAL.

(Under SERVICE MENU under SYSTEM; Query)

FNDVALU *value*

Sets the FN DAC value.

(Under SERVICE MENU under SYSTEM; Query)

value 0 to 255

FNVNORM

Sets FN VCO to NORMAL.

(Under SERVICE MENU under SYSTEM; Query)

FNVOPEN

Sets FN VCO to OPEN.

(Under SERVICE MENU under SYSTEM; Query)

FORM2

Sets the IEEE 32-bit floating point format to transfer trace data and waveform analysis (Refer to Appendix E) data via HP-IB.

FORM3

Sets the IEEE 64-bit floating point format to transfer the trace data and waveform analysis (Refer to Appendix E) data via HP-IB.

FORM4

Sets the ASCII transfer format to transfer the trace data and waveform analysis (Refer to Appendix E) data via HP-IB.

FORM5

Sets MS-DOS format to transfer the trace data and waveform analysis (Refer to Appendix E) data via HP-IB.

FREO

Erases the frequency annotation on the display. Preset to turn ON.

(FREQUENCY BLANK under [DISPLAY]; Query)

FULP

Selects full page plotting.

(FULL PAGE under [COPY]; Query)

FWDI

Selects forward isolation calibration.

(FWD ISOL'N ISOL'N STD under [CAL])

FWDM

Selects forward match calibration.

(FWD. MATCH THRU under [CAL])

FWDT

Selects forward transmission calibration.

(FWD. TRANS. THRU under [CAL])

GRAE *string*

Sets user defined extension for HP-GL file saved in MS-DOS format. Default setting is ".HPG". The modified extension is kept in SRAM even when power is turned OFF.

(DEFINE EXTENSION GRAPHICS under [SAVE] : Query)

string	Extension name. Up to 3 characters

GRODAPER *value* [pct]

Sets the group delay aperture.

(GROUP DELAY APERTURE under [AVG]; Query)

value	1 to 200 (%)

HOLD

Holds the present measurement.

(HOLD under MENU; Query)

IFBW *value [suffix]*

Sets the bandwidth value for IF bandwidth reduction.

(IF BW under AVG; Query)

value	2, 20, 200, 1,000, or 4,000 (Hz)
suffix	Hz or MHz

IFBWAUTO

Automatically selects the proper IF bandwidth for each measurement point.

(IF BW AUTO under AVG; Query)

IFRAUTO

Sets the auto range mode for the IF range of the selected channel.

(Under SERVICE MENU under SYSTEM; Query)

IFRCH?

Outputs the IF range set channel.

(Under SERVICE MENU under SYSTEM)

IFRX1

Sets the X1 range for the IF range.

(Under SERVICE MENU under SYSTEM; Query)

IFRX1X8

Sets X1, X8 range for the IF range.

(Under SERVICE MENU under SYSTEM; Query)

IFRX64

Sets X64 range for the IF range.

(Under SERVICE MENU under SYSTEM; Query)

IFRX8X1

Sets X8, X1 range for the IF range.

(Under SERVICE MENU under SYSTEM; Query)

IMAG

Displays only the imaginary (reactive) portion of the measured data in Cartesian format.

(IMAGINARY under FORMAT; Query)

INID

Initializes the disk in the built-in flexible disk drive.

(INITIALIZE DISK under SAVE/RECALL)

INP8IO

Inputs data from the 4-bit parallel input port to the HP 8751A.

INP8IO?

Inputs data from the 4-bit parallel input port to the HP 8751A, and outputs the data to a computer.

INPUCALC{01-12} *value*

Stores the measurement calibration error coefficient set real/imaginary pairs input via HP-IB into instrument memory. Refer to Appendix D for calibration array assignments.

value Complex number (Data format: real, imaginary)

INPUCALK *value*

Stores the calibration kit data transmitted by the OUTPCALK? command.

value Block data (Data format: HP 8751A internal format (714 bytes of binary data))

INPUDATA *value*

Inputs the error corrected data.

value Complex number (Data format: real, imaginary)

INPUFORM *value*

Inputs formatted data.

value Complex number (Data format: real, imaginary)

INPURAW{1-4} *value*

Inputs raw data.

value Complex number
(Data format: real, imaginary)

INPUUFORM *value*

Inputs unformatted data. This command is invalid, when MEMORY or DATA and MEMORY is selected as a trace.

value Complex number (Data format: real, imaginary)

INTE *value*

Sets the display intensity as a percent of the brightest setting.

(INTENSITY under [DISPLAY]; Query)

value 0 to 100 (%)

INVSCHAR

Displays an inverse Smith chart (admittance Smith chart) format.

(INV SMITH CHART under [FORMAT]; Query)

ISOD

Completes the isolation part of the 2-port calibration.

(ISOLATION DONE under [CAL])

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ISOL

Begins the isolation part of the 2-port calibration.

(ISOLATION under CAL)

KEY *value*

Sends the key code for a key or a softkey on the front panel. This is equivalent to actually pressing a key. Refer to Appendix C for key codes.

value 0 to 49

KITD

Ends the calibration kit modification process.

(KIT DONE under CAL)

LABEFWD{M|T} *string*

Defines the label for forward match or forward transmission class when modifying the calibration kit.

(FWD. MATCH or LABEL: FWD. TRANS. under CAL)

string Up to ten characters may be used.

LABERES{I|P} *string*

Defines the label for response and isolation, or response class when modifying the calibration kit.

(RESPONSE & ISOL'N or RESPONSE under CAL)

string Up to ten characters may be used.

LABEREV{M|T} *string*

Defines the label for reverse match or reverse transmission class when modifying the calibration kit.

(REV.MATCH or REV.TRANS. under CAL)

string Up to ten characters may be used.

LABES11{A|B|C} *string*

Defines the label for S11A (opens), S11B (shorts), or S11C (loads) class when modifying the calibration kit.

(LABEL: S11A, S11B, or S11C under CAL)

string Up to ten characters may be used.

LABES22{A|B|C} *string*

Defines the label for S22A (opens), S22B (shorts), or S22C (loads) class when modifying the calibration kit.

(LABEL: S22A, S22B, or S22C under CAL)

string Up to ten characters may be used

LABK *string*

Defines the calibration kit label when modifying the calibration kit.

(LABEL KIT under CAL)

string Up to ten characters may be used.

LABS *string*

Defines the calibration standard label when modifying the calibration kit.

(LABEL STD under CAL)

string Up to ten characters may be used.

LEFL

Sets the plot quadrant to the lower left.

(LEFT LOWER under COPY; Query)

LEFU

Sets the plot quadrant to the upper left.

(LEFT UPPER under COPY; Query)

LIMCLEL

Clears all of segments in the limit test.

(CLEAR LIST YES under SYSTEM)

LIMD *value* [*suffix*]

Sets the limits delta value from the specified middle value.

(DELTA LIMITS under SYSTEM; Query)

value
0 to 5.0×10^5 (dB) (Log mag format)
0 to 5.0×10^5 (deg) (Phase and Expanded phase formats)
0 to 5.0×10^5 (s) (Delay format)
0 to 5.0×10^5 (ohm) (Smith chart and admittance chart formats)
0 to 5.0×10^5 (Units) (Polar, Lin mag, Real, and Imaginary formats)
0 to 5.0×10^5 (SWR format)

LIMD *value* [*suffix*]

suffix Refer to "Suffix"

LIMEDONE

Completes editing the limit table.

(DONE under SYSTEM)

LIMIAMPO *value* [*suffix*]

Sets an amplitude offset value for limit testing.

(AMPLITUDE OFFSET under SYSTEM; Query)

value	-5.0×10^5 to 5.0×10^5 (dB) (Log mag format) -5.0×10^5 to 5.0×10^5 (deg) (Phase and Expanded phase format) -5.0×10^5 to 5.0×10^5 (s) (Delay format) -5.0×10^5 to 5.0×10^5 (Ω) (Smith chart and admittance chart formats) -5.0×10^5 to 5.0×10^5 (Units) (Polar, Lin mag, Real, and Imaginary formats) -5.0×10^5 to 5.0×10^5 (SWR format)
suffix	Refer to "Suffix"

LIMILINE{ON|OFF}

Sets limit lines ON or OFF.

(LIMIT LINE on off under SYSTEM; Query)

LIMIMAOF

Sets the active marker value to the amplitude offset for limit testing.

(MARKER → AMP. OFS under SYSTEM)

LIMISTIO *value* [*suffix*]

Sets a stimulus offset value for limit testing.

(STIMULUS OFFSET under SYSTEM; Query)

value	-5.0×10^8 to 5.0×10^8 (Hz, frequency sweep) -50 to 50 (dBm, power sweep)
suffix	Refer to "Suffix"

LIMITEST{ON|OFF}

Sets the limit testing ON or OFF.

(LIMIT TEST on off under (SYSTEM); Query)

LIML *value* [*suffix*]

Sets the lower limit value for a limit testing segment.

(LOWER LIMIT under (SYSTEM); Query)

value	-5.0×10^5 to 5.0×10^5 (dB) (Log mag format) -5.0×10^5 to 5.0×10^5 (deg) (Phase and Expanded phase formats) -5.0×10^5 to 5.0×10^5 (s) (Delay format) -5.0×10^5 to 5.0×10^5 (Ω) (Smith chart and admittance chart formats) -5.0×10^5 to 5.0×10^5 (Units) (Polar, Lin mag, Real, and Imaginary formats) -5.0×10^5 to 5.0×10^5 (SWR format)
suffix	Refer to "Suffix"

LIMM *value* [*suffix*]

Sets the middle value of delta limits.

(MIDDLE VALUE under (SYSTEM); Query)

value	-5.0×10^5 to 5.0×10^5 (dB) (Log mag format) -5.0×10^5 to 5.0×10^5 (deg) (Phase and Expanded phase formats) -5.0×10^5 to 5.0×10^5 (s) (Delay format) -5.0×10^5 to 5.0×10^5 (Ω) (Smith Chart and admittance chart formats) -5.0×10^5 to 5.0×10^5 (Units) (Polar, Lin mag, Real, and Imaginary formats) -5.0×10^5 to 5.0×10^5 (SWR format)
suffix	Refer to "Suffix"

LIMS *value* [*suffix*]

Sets the starting stimulus value of a limit testing segment.

(STIMULUS VALUE under (SYSTEM); Query)

value	5 to 5.0×10^8 (Hz, frequency sweep) -50 to 15 (dBm, power sweep)
suffix	Refer to "Suffix"

LIMSADD

Adds a new segment to the end of the limit list.

(ADD under SYSTEM)

LIMSDEL

Deletes a limit testing segment.

(DELETE under SYSTEM)

LIMSDON

Completes editing the limit segments.

(DONE under SYSTEM)

LIMSEDI *value*

Opens the segment to define or modify the stimulus and limit values.

(EDIT under SYSTEM; Query)

value	1 to 18

LIMU *value* [*suffix*]

Sets the upper limit value for a limit testing segment.

(UPPER LIMIT under SYSTEM; Query)

value	-5.0×10^5 to 5.0×10^5 (dB) (Log mag format) -5.0×10^5 to 5.0×10^5 (deg) (Phase and Expanded phase formats) -5.0×10^5 to 5.0×10^5 (s) (Delay format) -5.0×10^5 to 5.0×10^5 (ohm) (Smith chart and admittance chart formats) -5.0×10^5 to 5.0×10^5 (Units) (Polar, Lin mag, Real, and Imaginary formats) -5.0×10^5 to 5.0×10^5 (SWR format)
suffix	Refer to "Suffix"

LINFREQ

Activates a linear frequency sweep.

(LIN FREQ under MENU; Query)

LINM

Displays the linear magnitude format.

(LIN MAG under FORMAT; Query)

LINT{DATA|MEMO} *value*

Selects the line type of a trace for plotting.

(LINE TYPE DATA or LINE TYPE MEMORY under COPY)

value 0 to 7

LISDFBASE

Displays the measured data for the range between the minimum and maximum frequency set in the "Edit List Menu."

(LIST DISP: FREQ BASE under MENU; Query)

LISDOBASE

Displays the measured data for only the frequency ranges set in the "Edit List Menu."

(ORDER BASE under MENU; Query)

LISFREQ

Activates the frequency list sweep mode.

(LIST FREQ under MENU; Query)

LISSLIS1

Activates LIST 1 for the list sweep.

(SWEEP BY: LIST 1 under MENU; Query)

LISSLIS2

Activates LIST 2 for the list sweep.

(LIST 2 under MENU; Query)

LISV

Displays a tabular listing of all the stimulus values and their current measured values.

(LIST VALUES under [COPY])

LOGFREQ

Activates log frequency sweep mode.

(LOG FREQ under [MENU]; Query)

LOGM

Displays in log magnitude format.

(LOG MAG under [FORMAT]; Query)

LOGMD

Displays the log magnitude trace and delay trace simultaneously.

(LOG MAG & DELAY under [FORMAT]; Query)

LOGMP

Displays the log magnitude trace and phase trace simultaneously.

(LOG MAG & PHASE under [FORMAT]; Query)

MANTRIG

Triggers measurement at a single point.

(MANUAL TRG ON POINT under [MENU]; Query)

MARD<ON|OFF>

Displays (ON) or does not display (OFF) markers and the marker information on the screen. (Query)

MARK{1-8} *value* [*suffix*]

Selects the active marker, and moves it to the specified stimulus value.

(MARKER 1 to MARKER 8 under [MKR]; Query)

value	5 to 5.0×10^8 (Hz, frequency sweep) -50 to $+15$ (dBm, power sweep)
suffix	Refer to "Suffix"

MARKBUCK *value*

Moves the active marker to specified data point number.

value 1 to "number of points"

MARKCENT

Changes the stimulus center value to the active marker value.

(MARKER → CENTER under (MKR FCTN))

MARKCONT

Interpolates between measured points to allow the markers to be placed at any point on the trace.

(CONTINUOUS under (MKR); Query)

MARKCOUP

Couples the marker stimulus values for the two display channels.

(MARKERS: COUPLED under (MKR); Query)

MARKDELA

Enters the group delay at the active marker point of a fixed frequency aperture to the electrical delay to balance the phase of the DUT.

(MARKER → DELAY under (SCALE REF))

MARKDISC

Places markers only on measured trace points determined by the stimulus settings.

(MARKERS: DISCRETE under (MKR); Query)

MARKFAUV *value* [*suffix*]

Sets the fixed marker auxiliary value offset.

(FIXED MKR AUX VALUE under (MKR); Query)

value -5.0×10^6 to 5.0×10^6 (Ω, Smith chart and admittance chart formats)
-5.0×10^6 to 5.0×10^6 (deg, polar format)

suffix Refer to "Suffix"

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MARKFSTI *value* [*suffix*]

Sets the fixed marker stimulus value offset.

(FIXED MKR STIMULUS under MKR; Query)

value	-5.0×10^9 to 5.0×10^9 (Hz, frequency sweep) $-99{,}999$ to $99{,}999$ (dBm, power sweep)
suffix	Refer to "Suffix"

MARKFVAL *value* [*suffix*]

Sets the fixed marker position value offset.

(FIXED MKR VALUE under MKR; Query)

value	-5.0×10^5 to 5.0×10^5 (dB) (Log mag format) -5.0×10^5 to 5.0×10^5 (deg) (Phase and Expanded phase formats) -5.0×10^5 to 5.0×10^5 (s) (Delay format) -5.0×10^5 to 5.0×10^5 (Ω) (Smith chart and admittance chart formats) -5.0×10^5 to 5.0×10^5 (Units) (Polar, Lin mag, Real, and Imaginary formats) -5.0×10^5 to 5.0×10^5 (SWR format)
suffix	Refer to "Suffix"

MARKL{ON|OFF}

Displays (ON) or does not display (OFF) the list of stimulus values and response values of all markers.

(MKR LIST on off under MKR; Query)

MARKMIDD

Sets the middle value for the delta limit using the active marker value.

(MIDDLE VALUE under SYSTEM)

MARKODATA

Enables the marker to move on the measurement data trace.

(MARKERS ON [DATA] under MKR; Query)

MARKOFF

Turns off all the markers and the delta reference marker.

(ALL MKR OFF under MKR; Query)

MARKOMEMO

Enables the marker to move on the memory data trace.

(MARKERS ON [MEMO] under (MKR); Query)

MARKPEAD

Changes the differential stimulus value and the response value of the peak when searching for the local max, min, and peak-to-peak.

(MARKER → PEAK DEF under (MKR FCTN))

MARKREF

Changes the reference value to the active marker's response value, without changing the reference position.

(MARKER → REFERENCE under (SCALE REF) or (MKR FCTN))

MARKSPAN

Changes the start and stop values of the stimulus span to the active marker and the delta reference marker.

(MARKER → SPAN under (MKR FCTN))

MARK{STAR|STOP}

Changes the stimulus start or stop value to the active marker value.

(MARKER → START, MARKER → STOP under (MKR FCTN))

MARKSTIM

Sets the stimulus value of a segment to the active marker value.

(MARKER → STIMULUS under (SYSTEM))

MARKTIME{ON|OFF}

Sets the x-axis marker readout to the sweep time (ON), or cancels the setting (OFF).

(MKR TIME on off under (MKR); Query)

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MARKUNCO

Allows the marker stimulus values to be controlled independently on each channel.

(UNCOUPLED under (MKR); Query)

MARKZERO

Puts a fixed reference marker at the present active marker position, and makes the fixed marker stimulus and response values at that position equal to zero.

(MKR ZERO under (MKR))

MEAS *parameter*

Selects the parameters or inputs to be measured. (Query)

parameter	*description*
AR	A/R measurement
BR	B/R measurement
AB	A/B measurement
A	A measurement
B	B measurement
R	R measurement
S11	S11 measurement
S12	S12 measurement
S21	S21 measurement
S22	S22 measurement
BDC	Bdc measurement
BDCR	Bdc/R measurement

MEASA

Measures the absolute power amplitude at input A.

(A under (MEAS); Query)

MEASB

Measures the absolute power amplitude at input B.

(B under (MEAS); Query)

MEASR

Measures the absolute power amplitude at input R.

(R under (MEAS); Query)

MEASTAT{ON|OFF}

Calculates and displays the mean, standard deviation, and peak-to-peak values among the search range (ON), or does not display them (OFF).

(STATICS under [MKR FCTN]; Query)

MIXLPNOR

Sets the mixer local port to NORMAL.

(Under SERVICE MENU under [SYSTEM]; Query)

MIXLPTES

Sets the mixer local port to TEST.

(Under SERVICE MENU under [SYSTEM]; Query)

MODI1

Leads to the modify calibration kit menu, where a calibration kit can be user-modified.

(MODIFY under [CAL])

MONDYEAR

Changes the displayed date to the "month:day:year" format.

(DATE MODE: MonDayYear under [SYSTEM]; Query)

NEXP

Displays the next page of information in a tabular listing onto the display.

(NEXT PAGE under [COPY])

NUMG *value*

Triggers a user-specified number of sweeps, and returns to the HOLD mode.

(NUMBER OF GROUPS under [MENU])

value Greater than 0

OFSD *value* [s]

Specifies the one-way electrical delay from the measurement (reference) plane to the standard.

(OFFSET DELAY under (CAL))

value −10 to 10 (s)

OFSL *value*

Specifies energy loss, due to skin effect, along a one-way length of coaxial cable offset.

(OFFSET LOSS under (CAL))

value 0 to 1.0×10^{19} (Ω/s)

OFSZ *value* [ohm]

Specifies the characteristic impedance of the coaxial cable offset.

(OFFSET Z0 under (CAL))

value 0.1 to 5.0×10^{6} (Ω)

OMII

Omits the correction for isolation of a 2-port calibration.

(OMIT ISOLATION under (CAL))

OPEP

Lists the key parameters for both channels 1 and 2 on the display.

(OPERATING PARAMETERS under (COPY))

OSE *value*

Enables the operational status register.

value 0 to 32,767

OSER?

Outputs the current value in the event register of an operational status register.

OSR?

Outputs the operational status register value.

OSNT

Sets the negative transition filter of an operational status register. For details, refer to Appendix B. (Query)

OSPT

Sets the positive transition filter of an operational status register. For details, refer to Appendix B. (Query)

OUT8IO *value*

Outputs the data to the 8-bit parallel output port.

value	0 to 32,767

OUTPCALC{01-12}?

Outputs the active calibration set array of the active channel (Data format: real, imaginary). Refer to Appendix D for the calibration set array.

OUTPCALK?

Outputs the active calibration kit. (Data format: block data (714 bytes of binary data))

OUTPDATA?

Outputs the error corrected data (Data format: real, imaginary).

OUTPDATAP? *value*

Outputs the error corrected data at the specified point (Data format: real, imaginary).

value	1 to "number of points"

OUTPERRO?

Outputs the error message in the error queue (Data format: Error number (ASCII), "string").

OUTPFAIP?

Outputs number of the failed point of the limit test.

OUTPFBUS?

Outputs the FBUS data.

(Under SERVICE MENU under (SYSTEM))

OUTPFILT? *value*[*suffix*]

Outputs filter parameters within the range specified by the ANARANG command. Command parameter sets the offset of xdB to the maximum peak value to determine the cutoff points. For details, refer to Appendix E. (Data format:loss, bandwidth, center frequency, Q, ΔL.F, ΔR.F)

value	Relative offset value from maximum
suffix	Refer to "Suffix"

OUTPFORM?

Outputs the formatted trace data (Data format: real, imaginary)

OUTPFORMP? *value*

Outputs the formatted trace data at the specified point (Data format: real, imaginary)

value	1 to "number of points"

OUTPIFORM?

Outputs the formatted data from the inactive channel (Data format: real, imaginary)

OUTPINP8IO?

Outputs the data entered from the 4-bit parallel input port.

OUTPIRFORM?

Outputs the real part of the formatted data from the inactive channel.

OUTPIRTMEM?

Outputs the real part of the trace memory data from the inactive channel.

OUTPITMEM?

Outputs the trace memory data from the inactive channel. (Data format: real, imaginary)

OUTPLIMF?

Outputs the limit test results only for the failed points. (Data format: stimulus, result (0 for fail, −1 for no test), upper limit, lower limit; Form 4)

OUTPLIML?

Outputs the limit test results for each point. (Data format: stimulus, result (1 for pass, 0 for fail, −1 for no test), upper limit, lower limit; Form 4)

OUTPLIMM?

Outputs the limit test result for the marker position. (Data format: stimulus, result (1 for pass, 0 for fail, −1 for no test), upper limit, lower limit)

OUTPMARK?

Outputs the active marker values. (Data format: marker value, marker aux. value, stimulus)

OUTPMAX?

Outputs the maximum value within the range specified with the `ANARANG` command. For details, refer to Appendix E. (Data format:maximum, stimulus)

OUTPMEAN?

Outputs the mean value within the range specified with the `ANARANG` command. For details, refer to Appendix E. (Data format:mean)

OUTPMEMO?

Outputs the memory data from the active channel. (Data format: real, imaginary)

OUTPMEMOP? *value*

Outputs the memory data from the active channel at a specified point. (Data format: real, imaginary)

value	1 to "number of points"

OUTPMSTA?

Outputs the marker statistics. (Data format: mean, standard deviation, peak to peak)

OUTPMIN?

Outputs the minimum value within the range specified with the ANARANG command. For details, refer to Appendix E. (Data format:minimum, stimulus)

OUTPMINMAX?

Outputs the maximum and minimum values within the range specified with the ANARANG command. For details, refer to Appendix E. (Data format:maximum, stimulus, minimum, stimulus)

OUTPMWID?

Outputs the results of the bandwidth search. (Data format: bandwidth, center, Q)

OUTPMWIL?

Outputs the results of the bandwidth search with the insertion loss value. (Data format: bandwidth, center, Q, and loss)

OUTPMWLF?

Outputs the results of the bandwidth search with the insertion loss, the difference between the center frequency and the lower cutoff frequency (ΔL.F), and the difference between the center frequency and the upper cutoff frequency (ΔR.F) values. (Data format: bandwidth, center, Q, loss, ΔL.F, and ΔR.F)

OUTPRAW{1-4}?

Outputs the uncorrected data arrays for the active channel. (Data format: real, imaginary)

OUTPRESO?

Outputs the series resonant (Resonant) and parallel resonant (Anti-Resonant) parameters, $0°$ phase point frequency fr (Resonant frequency) and fa (Anti-Resonant frequency), and the corresponding gain values Gr and Ga. For details, refer to Appendix E. (Data format:Gr, fr, Ga, fa)

OUTPRFORM?

Outputs the real part of the formatted data from the active channel.

OUTPRTMEM?

Outputs the real part of the trace memory data from the active channel.

OUTPSTIM?

Outputs the stimulus array data from the active channel.

OUTPTESS? *value*

Outputs the specified test number's result.

(Under SERVICE MENU under (SYSTEM))

value	0 to 85

OUTPTITL?

Outputs the display title for the active channel (less than 54 characters).

OUTPTMEM?

Outputs the memory trace data from the active channel. (Data format: real, imaginary)

OUTPTMEMP? *value*

Outputs the memory trace data from the active channel at a specified point. (Data format: real, imaginary)

value	1 to "number of points"

OUTPUFORM?

Outputs the unformatted data from the active channel. (Data format: real, imaginary)

PARS{ON|OFF}

Sets the partial search of the marker search function on or off.

(PART SRCH on off under (MKR FCTN); Query)

PEADX *value* [*suffix*]

Defines the differential stimulus value of the peak for searching for the local max, min, and peak-to-peak.

(PEAK DEF: ΔX under (MKR FCTN); Query)

value	−5000 to 5000 (MHz) (Frequency sweep) −500 to 500 (dBm) (Power sweep)
suffix	Refer to "Suffix".

PEADY *value* [*suffix*]

Defines the differential response value of the peak for searching for the local max, min, and peak-to-peak.

(ΔY under MKR FCTN; Query)

value	−5.0E+5 to 5.0E+5 (dB) (Log mag format) −5.0E+5 to 5.0E+5 (deg) (Phase and Expanded phase formats) −5.0E+5 to 5.0E+5 (s) (Delay format) −5.0E+5 to 5.0E+5 (ohm) (Smith chart and Inv. Smith chart formats) −5.0E+5 to 5.0E+5 (Units) (Polar, Lin mag, Real, and Imaginary formats) −5.0E+5 to 5.0E+5 (SWR format)
suffix	Refer to "Suffix".

PHAO *value* [deg]

Adds or subtracts a phase offset.

(PHASE OFFSET under SCALE REF; Query)

value	−360 to +360 (deg).

PHAS

Displays a Cartesian format of the phase portion of the data, measured in degrees.

(PHASE under FORMAT; Query)

PLOALL

Selects plotting all the information displayed on the display except for the softkey.

(PLOT: ALL under COPY; Query)

PLOC *parameter*

Selects the plot elements. (Query)

parameter	*description*
DONLY	Data only
DGRAT	Data and graticule
ALL	All information displayed

PLODGRAT

Selects the measured data and memory data with the graticules for plotting.

(DATA & GRATCL under COPY; Query)

PLODONLY

Selects the measured data and the memory data without the graticules for plotting.

(DATA ONLY under COPY; Query)

PLOS{FAST|SLOW}

Sets the plotting speed to fast or slow.

(PLOT SPEED under COPY)

PLOT

Plots the display to a graphics plotter.

(PLOT under COPY)

POIN *value*

Sets the number of the data points per sweep.

(NUMBER of POINTS under MENU; Query)

value	2 to 801.

POLA

Displays in the polar format.

(POLAR under FORMAT; Query)

POLM *parameter*

Selects the polar marker. (Query)

parameter	*description*
LOG	Log
LIN	Linear
RI	Real and imaginary

POLMLIN

Displays the linear magnitude and the phase of the active polar marker.

(LIN MKR under MKR; Query)

POLMLOG

Displays the logarithmic magnitude and the phase of the active polar marker.

(LOG MKR under (MKR); Query)

POLMRI

Displays a real and imaginary pair of the active polar marker.

(Re/Im MKR under (MKR); Query)

PORE{ON|OFF}

Sets the reference plane extension mode ON or OFF.

(EXTENSIONS on off under (CAL); Query)

PORT1 *value* [s]

Extends the reference plane for measurement of S_{11}, S_{21}, and S_{12}.

(EXTENSION PORT 1 under (CAL); Query)

value −10 to 10 (s)

PORT2 *value* [s]

Extends the reference plane for measurement of S_{22}, S_{12}, and S_{21}.

(EXTENSION PORT 1 under (CAL); Query)

value −10 to 10 (s)

PORTA *value* [s]

Adds electrical delay to the input A reference plan for any A input measurements including S-parameters.

(EXTENSION INPUT A under (CAL); Query)

value −10 to 10 (s)

PORTB *value* [s]

Adds electrical delay to the input B reference plane for any B input measurements including S-parameters.

(EXTENSION INPUT B under (CAL); Query)

value −10 to 10 (s)

PORTR *value* [s]

Adds electrical delay to extend the reference plane at input R to the end of cable.

(EXTENSION INPUT R under CAL; Query)

value −10 to 10 (s)

POWDAUTO

Sets the power DAC to auto.

(Under SERVICE MENU under SYSTEM)

POWDMANU

Sets the power DAC to MANUAL.

(Under SERVICE MENU under SYSTEM)

POWDVALU *value*

Sets the power DAC value.

(Under SERVICE MENU under SYSTEM)

value 0 to 4,095

POWE *value* [dBm]

Sets the source output level.

(POWER under MENU; Query)

value −50 to +15 (dBm)

POWLANOR

Sets the power level ALC to NORMAL.

(Under SERVICE MENU under SYSTEM)

POWLAOPE

Sets the power level ALC to OPEN.

(Under SERVICE MENU under SYSTEM)

POWS

Activates a power sweep mode.

(POWER SWEEP under [MENU]; Query)

PREP

Displays the previous page of information in a tabular listing.

(PREV PAGE under [COPY])

PRES

Presets the instrument state. ([PRESET])

PRIC

Selects color printing.

(COLOR under [COPY]; Query)

PRICFIXE

Selects the default colors for printing a hard copy.

(PRINT COLOR [FIXED] under [COPY]; Query)

PRICVARI

Selects the colors as similar as possible to the display for printing a hard copy.

(PRINT COLOR [VARIABLE] under [COPY]; Query)

PRINALL

Copies the measurement display to the printer according to plotting options.

(PRINT under [COPY])

PRIS

Sets the print command to the default selection.

(PRINT: STANDARD under [COPY]; Query)

PSOFT{ON|OFF}

Selects the plot softkey label option ON or OFF.

PURG *string*

Removes a file saved on the disk in the built-in flexible disk drive.

(PURGE FILE under SAVE/RECALL)

string File name, up to 10 characters including the extension

QUAD *parameter*

Selects the quadrant plot setting.

parameter	*description*
LEFU	Upper left
LEFL	Lower left
RIGU	Upper right
RIGL	Lower right
FULP	Full-size

RAID

Completes the response and isolation calibration.

(DONE RESP ISOL'N CAL under CAL)

RAIISOL

Selects the isolation class for the response and isolation calibration.

(ISOL'N STD under CAL)

RAIRESP

Selects the response class for the response and isolation calibration.

(RESPONSE under CAL)

REAL

Displays only the real (resistive) portion of the measured data in Cartesian format.

(REAL under FORMAT; Query)

RECC

Recalls the previously saved color set.

(RECALL COLORS under DISPLAY)

RECCOFF

Sets the receiver correction OFF.

(Under SERVICE MENU under SYSTEM; Query)

RECCON

Sets the receiver correction ON.

(Under SERVICE MENU under SYSTEM; Query)

RECD *string*

Loads the instrument states or data from the disk in the built-in flexible disk drive.

(RECALL FILE under SAVE/RECALL)

string File name, Up to 10 characters including the extension

REFD

Completes with the reflection part of the full 2-port calibration.

(REFLECT'N DONE under CAL)

REFL

Begins the reflection part of the full 2-port calibration.

(REFLECT'N under CAL)

REFP *value*

Sets the position of the reference line on the graticule of a Cartesian format.

(REFERENCE POSITION under SCALE REF; Query)

value 0 to 10 (Div)

REFV *value* [*suffix*]

Changes the value of the reference line, moving the measurement trace correspondingly.

(REFERENCE VALUE under SCALE REF; Query)

value	−500 to 500 (dB) (Log mag format) -5.0×10^6 to 5.0×10^6 (deg) (Phase or Expanded phase formats) −0.5 to 0.5 (s) (Delay format) 1.0×10^{-11} to 500 (Units) (Smith chart, admittance chart, or Polar formats) -5.0×10^6 to 5.0×10^6 (Units) (Lin man, Real, or Imaginary formats) -5.0×10^6 to 5.0×10^6 (SWR format)
suffix	Refer to "Suffix"

RESAVD *string*

Updates an already saved file on the disk in the built-in flexible disk drive.

(RE-SAVE FILE under SAVE)

string	File name up to 10 characters including the extension

RESC

Resumes the last measurement calibration sequence.

(RESUME CAL SEQUENCE under CAL)

RESD

Turns off the tabular listing and returns the measurement display to the screen.

(RESTORE DISPLAY under COPY)

RESPDONE

Completes the response calibration.

(DONE: RESPONSE under CAL)

REST

Aborts the sweep in progress, then restarts the measurement.

(MEASURE RESTART under MENU)

REVI

Selects the reverse isolation calibration.

(REV ISOL'N ISOL'N STD under CAL)

REVM

Selects the reverse match calibration.

(REV. MATCH THRU under CAL)

REVT

Selects the reverse transmission calibration.

(REV. TRANS. THRU under CAL)

RFOPNORM

Sets the RF OSC PLL to NORMAL.

(Under SERVICE MENU under SYSTEM; Query)

RFOPOPEN

Sets the RF OSC PLL to OPEN.

(Under SERVICE MENU under SYSTEM; Query)

RIGL

Draws a quarter-page plot in the lower right quadrant of the page.

(RIGHT LOWER under COPY; Query)

RIGU

Draws a quarter-page plot in the upper right quadrant of the page.

(RIGHT UPPER under COPY; Query)

RPLENV?

Searches all sets of neighboring peaks and their included valleys for the maximum perpendicular height from the valley minimum point included between neighboring peaks, to the intersection of an imaginary slope line drawn between the maximum peak points of the neighboring peaks in range specified by ANARANG, and outputs the resultant data via HP-IB. For details, refer to Figure E-7 in Appendix E.

RPLHEI?

Searches for the maximum height between neighboring ripple peaks and outputs the resultant data via HP-IB. For details, refer to Figure E-3 in Appendix E.

RPLLHEI?

Searches for the maximum height between neighboring ripple peaks (measured from the ripple maximum peak point to the valley minimum point to the left of the ripple peak) and outputs the resultant data via HP-IB. For details, refer to Figure E-6 in Appendix E.

RPLMEA?

Averages all heights between neighboring local maximums and minimums within a specified range and outputs the result by HP-IB. If no ripple is detected, a zero is returned. For details, refer to Figure E-8 in Appendix E.

RPLPP?

Searches for the maximum ripple peak to peak value and outputs the resultant data via HP-IB. For details, refer to Figure E-1 in Appendix E.

RPLRHEI?

Searches for the maximum height between neighboring ripple peaks (measured from the ripple peak to the valley point to the right of the ripple peak) and outputs the resultant data via HP-IB. For details, refer to Figure E-5 in Appendix E.

RSCO

Resets the modified colors to the default colors.

(RESET COLOR under DISPLAY)

S11

Selects the S-parameter test set for measurement of S_{11}.

(Refl: FWD S11 (A/R) under MEAS; Query)

S12

Selects the S-parameter test set for measurement of S_{12}.

(Trans: REV S12 (A/R) under MEAS; Query)

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S21

Selects the S-parameter test set for measurement of S_{21}.

(Trans: FWD S21 (B/R) under [MEAS]; Query)

S22

Selects the S-parameter test set for measurement of S_{22}.

(Refl: REV S22 (B/R) under [MEAS]; Query)

SADD

Adds a new segment to a list sweep table.

(ADD under [MENU])

SAV1

Saves the 1-port calibration results.

(DONE: 1-PORT CAL under [CAL])

SAV2

Saves the 2-port calibration results.

(DONE: 2-PORT CAL under [CAL])

SAVC

Re-draws a trace using current error coefficient array data.

SAVCA{ON|OFF}

Selects whether or not the calibration coefficients arrays are to be saved.

(CAL ARY on off under [SAVE]; Query)

SAVDALL *string*

Saves the instrument states, the data array, and the memory array to the disk in the built-in flexible disk drive.

(SAVE ALL under [SAVE])

string	File name, up to 8 characters

SAVDA{ON|OFF}

Sets the data arrays to be saved (ON) or not (OFF).

(DATA ARY on off under [SAVE]; Query)

SAVDASC "*string*"

Save the current measurement data in ASCII file format.

(ASCII SAVE DATA ONLY under [SAVE])

string File name, up to 8 characters

SAVDDAT *string*

Saves the internal data arrays which is defined by the SAVRA{ON|OFF}, SAVCA{ON|OFF}, SAVDA{ON|OFF}, SAVMA{ON|OFF}, SAVUA{ON|OFF}, SAVTA{ON|OFF}, and SAVTMA{ON|OFF}.

(SAVE DATA ONLY under [SAVE])

string File name up to 8 characters

SAVDGRA "*string*"

Saves the current display image in an HP-GL file.

(ASCII SAVE GRAPHICS under [SAVE])

string File name up to 8 characters

SAVDSTA *string*

Saves only the instrument states and the calibration coefficients to the disk in the built-in flexible disk drive.

(SAVE STATE ONLY under [SAVE])

string File name up to 8 characters

SAVEUSEK

Stores the user-modified or user-defined calibration kit into memory.

(SAVE USER KIT under [CAL])

SAVMA{ON|OFF}

Sets the memory arrays to be saved (ON) or not (OFF).

(MEMORY ARY on off under [SAVE]; Query)

SAVRA{ON|OFF}

Sets the raw data arrays to be saved (ON) or not (OFF).

(RAW ARY on off under SAVE; Query)

SAVTA{ON|OFF}

Sets the trace arrays to be saved (ON) or not (OFF).

(TRACE ARY on off under SAVE; Query)

SAVTMA{ON|OFF}

Sets the memory trace arrays to be saved (ON) or not (OFF).

(T.MEM ARY on off under SAVE; Query)

SAVUA{ON|OFF}

Sets the unformatted data arrays to be saved (ON) or not (OFF).

(UNFORM ARY on off under SAVE; Query)

SCAC

Couples the data and memory trace to be scaled.

(D&M SCALE [COUPLE] under SCALE REF; Query)

SCAFDATA

Selects the data trace to be scaled.

(SCALE FOR [DATA] under SCALE REF; Query)

SCAFMEMO

Selects the memory trace to be scaled.

(SCALE FOR [MEMORY] under SCALE REF; Query)

SCAL *value* [*suffix*]

Changes the response value scale per graticule division.

(SCALE/DIV under SCALE REF; Query)

value	0.001 to 500 (dB/div) (Log mag format) 0.01 to 500 (deg/div) (Phase format) 1.0×10^{-11} to 10,000 (deg) (Expanded phase format) 1.0×10^{-14} to 10 (s/div) (Delay format)

	1.0×10^{-11} to 10,000 (Units FS) (Smith chart, admittance chart, and Polar format)
	1.0×10^{-11} to 10,000 (Units/div) (Lin mag, Real, and Imaginary formats)
	1.0×10^{-11} to 10,000 (/div) (SWR format)
suffix	Refer to "Suffix"

SCAPFULL

Selects the normal full size scale for plotting.

(SCALE: FULL under [COPY])

SCAPGL

Fits the lower graticule to the user-defined P1 and P2.

(LOWER GRATICULE under [COPY])

SCAPGU

Fits the upper graticule to the user-defined P1 and P2.

(UPPER GRATICULE under [COPY])

SCAU

Uncouples the data and memory trace to be scaled.

(D&M SCALE [UNCOUPLE] under [SCALE REF]; Query)

SDEL

Deletes a segment from a list sweep table.

(DELETE under [MENU])

SDON

Completes editing a segment of a list sweep table.

(SEGMENT DONE under [MENU])

SEAL

Searches the trace for the next occurrence of the target value to the left of the marker.

(SEARCH LEFT under [MKR FCTN])

SEALMAX

Moves the active marker to the maximum peak point on the trace in the search range.

(LOCAL MAX under MKR FCTN; Query)

SEALMIN

Moves the active marker to the minimum peak point on the trace in the search range.

(LOCAL MIN under MKR FCTN; Query)

SEAM *parameter*

Selects the marker search function. (Query)

parameter	*description*
OFF	Marker search function OFF
MAX	Maximum
MIN	Minimum
TARG	Target
MEAN	Mean
LMAX	Local maximum
LMIN	Local minimum
PPEAK	Peak to peak

SEAMEAN

Moves the active marker to the mean point on the trace.

(SEARCH: MEAN under MKR FCTN; Query)

SEAMAX

Moves the active marker to the maximum point on the trace.

(MAX under MKR FCTN; Query)

SEAMIN

Moves the active marker to the minimum point on the trace.

(MIN under MKR FCTN; Query)

SEAOFF

Turns off the marker search function.

(SEARCH: OFF under MKR FCTN; Query)

SEAPPEAK

Moves the active marker and the delta reference marker to the maximum peak point and the minimum peak point on the trace in the search range.

(PEAK-PEAK under MKR FCTN; Query)

SEAR

Searches the trace for the next occurrence of the target value to the right of the marker.

(SEARCH RIGHT under MKR FCTN)

SEARSTOR

Stores the search range, which is defined between the active marker and the delta reference marker.

(SEARCH RNG STORE under MKR FCTN)

SEATARG *value* [*suffix*]

Places the active marker at a specified target point on a trace.

(TARGET under MKR FCTN; Query)

value	-5.0×10^5 to 5.0×10^5 (dB) (Log mag format) -5.0×10^5 to 5.0×10^5 (deg) (Phase and Expanded phase formats) -5.0×10^5 to 5.0×10^5 (s) (Delay format) -5.0×10^5 to 5.0×10^5 (Ω) (Smith chart and admittance chart formats) -5.0×10^5 to 5.0×10^5 (Units) (Polar, Lin mag, Real, and Imaginary format) $-5.0\times10^5$to 5.0×10^5 (SWR format)
suffix	Refer to "Suffix"

SEDI *value*

Determines a segment of a list sweep table to be modified.

(SEGMENT under MENU; Query)

value	1 to 31

SELC *parameter*

Selects the conjugate matching circuit type. (Query)

parameter	*description*
LSLP	L_s-L_p
LSCP	L_s-C_p
CSLP	C_s-L_p
CSCP	C_s-C_p
LPLS	L_p-L_s
LPCS	L_p-C_s
CPLS	C_p-L_s

3. HP-IB Programming Reference

SELC *parameter*

CPCS	C_p-C_s

SELCCPCS

Selects the "Cp-Cs" circuit for conjugate matching.

(Cp-Cs under [DISPLAY]; Query)

SELCCPLS

Selects the "Cp-Ls" circuit for conjugate matching.

(Cp-Ls under [DISPLAY]; Query)

SELCCSCP

Selects the "Cs-Cp" circuit for conjugate matching.

(Cs-Cp under [DISPLAY]; Query)

SELCCSLP

Selects the "Cs-Lp" circuit for conjugate matching.

(Cs-Lp under [DISPLAY]; Query)

SELCLPCS

Selects the "Lp-Cs" circuit for conjugate matching.

(Lp-Cs under [DISPLAY]; Query)

SELCLPLS

Selects the "Lp-Ls" circuit for conjugate matching.

(Lp-Ls under [DISPLAY]; Query)

SELCLSCP

Selects the "Ls-Cp" circuit for conjugate matching.

(Ls-Cp under [DISPLAY]; Query)

SELCLSLP

Selects the "Ls-Lp" circuit for conjugate matching.

(Ls-Lp under DISPLAY; Query)

SELD

Executes the self diagnostics.

(Under SERVICE MENU under SYSTEM)

SETCDATE *year,month,day*

Changes date of the internal clock.

(MONTH, DAY, and YEAR under SYSTEM; Query)

year	1901 to 2059
month	1 to 12
day	1 to 31

SETCTIME *hour,min,sec*

Changes time of the internal clock.

(HOUR, MIN, and SEC under SYSTEM; Query)

hour	0 to 23
min	0 to 59
sec	0 to 59

SETZ *value* [ohm]

Sets the characteristic impedance used by the HP 8751A in calculating measured impedance with the Smith chart markers and conversion parameters.

(SET Z0 under CAL; Query)

value	0.1 to 5.0×10^6 (Ω)

SING

Makes a single measurement sweep, then sets the HOLD mode.

(SINGLE under MENU)

3.HP-IB Programming Reference

SMIC

Displays a Smith chart format.

(SMITH CHART under FORMAT; Query)

SMIM *parameter*

Selects the form for the Smith marker. (Query)

parameter	*description*
LIN	Linear
LOG	Log
RI	Real and imaginary
RX	R+jX
GB	G+jB

SMIMGB

Displays the complex admittance values of the active marker position on a Smith chart in rectangular form.

(G+jB MKR under MKR; Query)

SMIMLIN

Displays the linear magnitude value and the phase of the active marker position on a Smith chart.

(LIN MKR under MKR; Query)

SMIMLOG

Displays the logarithmic magnitude value and the phase of the active marker on a Smith chart.

(LOG MKR under MKR; Query)

SMIMRI

Displays the values of the active marker on a Smith chart as a real and imaginary pair.

(Re/Im MKR under MKR; Query)

SMIMRX

Displays the complex impedance values of the active marker on a Smith chart in rectangular form.

(R+jX MKR under MKR; Query)

SMOOAPER *value* [pct]

Changes the value of the smoothing aperture as a percent of the span.

(SMOOTHING APERTURE under (AVG); Query)

value	0.05 to 100 (%)

SMOO{ON|OFF}

Sets the smoothing function to ON or OFF.

(SMOOTHING on off under (AVG); Query)

SOUCOFF

Sets the source correction to OFF.

(Under SERVICE MENU under (SYSTEM); Query)

SOUCON

Sets the source correction to ON.

(Under SERVICE MENU under (SYSTEM); Query)

SPAN *value* [*suffix*]

Sets the frequency span of a segment about a specified center frequency.

((SPAN) or SPAN under (MENU); Query)

value	0 to 499,999,995 (Hz)
suffix	Hz or MHz

SPECFWDM *value*,[*value*,[*value*,[*value*,[*value*,[*value*,[*value*]]]]]]

Enters the standard numbers to specify standard class required for a forward match (THRU).

(FWD.MATCH under (CAL))

value	1 to 8

SPECFWDT *value*,[*value*,[*value*,[*value*,[*value*,[*value*,[*value*]]]]]]

Enters the standard numbers to specify standard class required for a forward transmission (THRU) calibration.

(FWD.TRANS. under (CAL))

value	1 to 8

3. HP-IB Programming Reference

SPECRESI *value*,[*value*,[*value*,[*value*,[*value*,[*value*,[*value*]]]]]]

Enters the standard numbers to specify standard class required for a response and isolation calibration.

(RESPONSE & ISOL'N under CAL)

value 1 to 8

SPECRESP *value*,[*value*,[*value*,[*value*,[*value*,[*value*,[*value*]]]]]]

Enters the standard numbers to specify standard class required for a response calibration.

(RESPONSE under CAL)

value 1 to 8

SPECREVM *value*,[*value*,[*value*,[*value*,[*value*,[*value*,[*value*]]]]]]

Enters the standard numbers to specify standard class required for a reverse match (THRU) calibration.

(REV. MATCH under CAL)

value 1 to 8

SPECREVT *value*,[*value*,[*value*,[*value*,[*value*,[*value*,[*value*]]]]]]

Enters the standard numbers to specify standard class required for a reverse transmission (THRU) calibration.

(REV. TRANS. under CAL)

value 1 to 8

SPECS11A *value*,[*value*,[*value*,[*value*,[*value*,[*value*,[*value*]]]]]]

Enters the standard numbers to specify the first standard class (S_{11A}) required for an S_{11} 1-port calibration.

(SPECIFY: S11A under CAL)

value 1 to 8

SPECS11B *value*,[*value*,[*value*,[*value*,[*value*,[*value*,[*value*]]]]]]

Enters the standard numbers to specify the second standard class (S_{11B}) required for an S_{11} 1-port calibration.

(S11B under CAL)

value 1 to 8

SPECS11C *value*,[*value*,[*value*,[*value*,[*value*,[*value*,[*value*]]]]]]

Enters the standard numbers to specify third standard class (S_{11C}) required for an S_{11} 1-port calibration.

(S11C under CAL)

value	1 to 8

SPECS22A *value*,[*value*,[*value*,[*value*,[*value*,[*value*,[*value*]]]]]]

Enters the standard numbers to specify the first standard class (S_{22A}) required for an S_{22} 1-port calibration.

(SPECIFY: S22A under CAL)

value	1 to 8

SPECS22B *value*,[*value*,[*value*,[*value*,[*value*,[*value*,[*value*]]]]]]

Enters the standard numbers to specify the second standard class (S_{22B}) required for an S_{22} 1-port calibration.

(S22B under CAL)

value	1 to 8

SPECS22C *value*,[*value*,[*value*,[*value*,[*value*,[*value*,[*value*]]]]]]

Enters the standard numbers to specify the third standard class (S_{22C}) required for an S_{22} 1-port calibration.

(S22C under CAL

value	1 to 8

SPLD{ON|OFF}

Sets the dual channel display mode: a full-screen single graticule display (OFF), or a split display with two half-screen graticules (ON).

(SPLIT DISP on off under DISPLAY; Query)

STAN{A-G}

Measures the calibration standard in the current standard class.

(OPEN, SHORT, THRU, LOAD, etc. under CAL)

3. HP-IB Programming Reference

STAR *value* [*suffix*]

Defines the start frequency of the stimulus. (START; Query)

Sets the start frequency of a segment.

(SEGMENT START under MENU; Query)

value	5 to 5.0×10^8 (Hz, frequency sweep) −50 to 15 (dBm, power sweep)
suffix	Refer to "Suffix"

STDD

Completes the current standard definition.

(STD DONE (DEFINED) under CAL)

STDT *parameter*

Selects the standard type. (Query)

parameter	*description*
OPEN	Open
SHOR	Short
LOAD	Load
DELA	Transmission line
ARBI	Arbitrary impedance

STDTARBI

Defines the standard type to LOAD with an arbitrary impedance.

(ARBITRARY IMPEDANCE under CAL; Query)

STDTDELA

Defines the standard type as transmission line of specified length.

(DELAY/THRU under CAL; Query)

STDTLOAD

Defines the standard type as LOAD (termination).

(LOAD under CAL; Query)

STDTOPEN

Defines the standard type as an OPEN.

(OPEN under CAL; Query)

STDTSHOR

Defines the standard type as a SHORT.

(SHORT under CAL; Query)

STEODAUT

Sets the step OSC DAC to AUTO.

(Under SERVICE MENU under SYSTEM; Query)

STEODMAN

Sets the step OSC DAC to MANUAL.

(Under SERVICE MENU under SYSTEM; Query)

STEODVAL *value*

Sets the step OSC DAC value.

(Under SERVICE MENU under SYSTEM; Query)

value 0 to 255

STEONORM

Sets the step OSC DAC to NORMAL.

(Under SERVICE MENU under SYSTEM; Query)

STEOOPEN

Sets the step OSC DAC to OPEN.

(Under SERVICE MENU under SYSTEM; Query)

STODDISK

Selects the built-in flexible disk.

(Under SAVE; Query)

STODMEMO

Selects the RAM disk memory.

(Under [SAVE]; Query)

STOP *value [suffix]*

Defines the stop value of the stimulus. ([STOP]; Query)

Sets the stop frequency of a segment.

(STOP under [MENU]; Query)

value	5 to 5.0×10^8 (Hz) -50 to $+15$ (dBm)
suffix	Refer to "Suffix"

STPSIZE *value [suffix]*

Specifies the frequency step for a list sweep table.

(STEP SIZE under [MENU]; Query)

value	0 to 499,999,995 (Hz)
suffix	Hz or MHz

SVCO

Saves the modified color set.

(SAVE COLORS under [DISPLAY])

SWET *value* [s]

Manually sets the sweep time.

(SWEEP TIME under [MENU]; Query)

value	6.0×10^{-4} to 86,400 (s)

SWETAUTO

Automatically sets the sweep time.

(SWEEP TIME AUTO under [MENU]; Query)

SWPT *parameter*

Selects the sweep type. (Query)

parameter	*description*
LINF	Linear frequency
LOGF	Log frequency
LIST	Frequency list
POWE	Power

SWR

Selects the SWR display for the active channel.

(SWR under FORMAT; Query)

TERI *value* [ohm]

Specifies the (arbitrary) impedance of the standard.

(TERMINAL IMPEDANCE under CAL)

value 0 to 10,000 (Ω)

TESC

Continues the test.

(Under SERVICE MENU under SYSTEM)

TESS?

Outputs the test set identifier: 1 for an S-parameter test set, or 0 for none.

TEST *value*

Selects the test number.

(Under SERVICE MENU under SYSTEM; Query)

value 0 to 85

TINT *value*

Adjusts the hue of the specified display element.

(TINT under DISPLAY; Query)

value 0 to 100

TITL *string*

Sends the string to the title area on the display.

(TITLE under DISPLAY; Query)

string up to 53 characters

TRACK{ON|OFF}

Tracks the search at the specified target value with each new sweep.

(TRACKING on off under MKR FCTN; Query)

TRAD

Completes the transmission part of the full 2-port calibration.

(TRANS. DONE under CAL)

TRAN

Begins the transmission part of the full 2-port calibration.

(TRANSMISSION under CAL)

VELOFACT *value*

Enters the velocity factor used by the HP 8751A to calculate the equivalent electrical length.

(VELOCITY FACTOR under CAL; Query)

value 0 to 10

WIDSIN

Searches for the cutoff point on the trace within the current cutoff points.

(SEARCH IN under MKR FCTN)

WIDSOUT

Searches for the cutoff point on the trace outside of the current cutoff points.

(SEARCH OUT under MKR FCTN)

WIDT{ON|OFF}

Sets the bandwidth search feature (ON) or not (OFF).

(WIDTHS on off under MKR FCTN; Query)

WIDV *value* [*suffix*]

Sets the amplitude parameter that defines the start and stop points for a bandwidth search.

(WIDTH VALUE under MKR FCTN; Query)

value	-5.0×10^5 to 5.0×10^5 (dB) (Log mag format) -5.0×10^5 to 5.0×10^5 (deg) (Phase and Expanded phase formats) -5.0×10^5 to 5.0×10^5 (s) (Delay format) -5.0×10^5 to 5.0×10^5 (Ω) (Smith chart and admittance chart formats) -5.0×10^5 to 5.0×10^5 (Units) (Polar, Lin mag, Real, and Imaginary formats) $-5.0\times10^5$to 5.0×10^5 (SWR format)
suffix	Refer to "Suffix"

*CLS

Clears the status byte register, the event register of the standard operation status register structure, and the standard event status register.

*ESE *value*

Sets the enable bits of the standard status register. (Query)

value	0 to 255 (decimal expression of enable bits of the operation status register)

*ESR?

Returns the contents of the standard event status register.

*IDN?

Returns the HP 8751A ID. (Data format: manufacturer, model, serial no., firmware rev.)

*OPC

Tells the HP 8751A to set bit 0 (OPeration Complete bit) in the standard event status register when it completes all pending operations. (Query)

*PCB *value*

Specifies the address of a controller that is temporarily passing HP-IB control to the HP 8751A. (Option 002 only)

value	0 to 30

*RST

Resets the HP 8751A to its initial settings.

*SRE *value*

Sets the enable bits of the status byte register. (Query)

value	0 to 255 (decimal expression of enable bits of the status byte register)

*STB?

Reads the status byte by reading the master summary status bit.

*TRG

Triggers the HP 8751A when the trigger mode is set to EXTERNAL trigger.

*TST?

Executes an internal self-test and returns the test result.

*WAI

Makes the HP 8751A wait until all previously sent commands are completed.

A

HP-IB Commands Summary

This appendix summarizes the HP-IB instrument commands of the HP 8751A according to the their softkey labels.

Active Channel Block

CHAN1	[CH 1]
CHAN2	[CH 2]

Response Function Block

[MEAS] Key

Input Port Menu

AR	A/R
BR	B/R
AB	A/B
MEASA	A
MEASB	B
MEASR	R

S-Parameter Menu

S11	Refl: FWD S11 (A/R)
S21	Trans: FWD S21 (B/R)
S12	Trans: REV S12 (A/R)
S22	Refl: REV S22 (B/R)
BDC	Bdc
BDCR	Bdc/R
MEAS *parameter*	

A.HP-IB Commands Summary

Conversion Menu

CONVOFF	OFF
CONVZREF	Z: Refl
CONVZTRA	Z: Trans
CONVYREF	Y: Refl
CONVYTRA	Y: Trans
CONV1DS	1/S
CONV MP{4|8|16}	4 * Phase 8 * Phase 16 * Phase
CONVMP{4|8|16} CONV *parameter*	

FORMAT Key

Format Menu

LOGM	LOG MAG
PHAS	PHASE
DELA	DELAY
SMIC	SMITH CHART
POLA	POLAR
LINM	LIN MAG
SWR	SWR

Format More Menu

REAL	REAL
IMAG	IMAGINARY
EXPP	EXPANDED PHASE
INVSCHAR	INV SMITH CHART
LOGMP	LOG MAG & PHASE
LOGMD	LOG MAG & DELAY
FMT *parameter*	

SCALE REF Key

Scale Reference Menu

AUTO	AUTO SCALE
SCAL *value*	SCALE/DIV
REFP *value*	REFERENCE POSITION
REFV *value*	REFERENCE VALUE
MARKREF	MARKER → REFERENCE
SCAFDATA	SCALE FOR [DATA]

SCAFMEMO	SCALE FOR [MEMORY]
SCAC	D&M SCALE [COUPLE]
SCAU	D&M SCALE [UNCOUPLE]

Electrical Delay Menu

MARKDELA	MARKER → DELAY
ELED *value*	ELECTRICAL DELAY
PHAO *value*	PHASE OFFSET
CONPDISP{ON|OFF}	CONJ.P DISP on off

(DISPLAY) Key

Display Menu

DUAC{ON|OFF}	DUAL CHAN on off
SPLD{ON|OFF}	SPLIT DISP on off
TITL *string*	TITLE

Display More Menu

BEEPDONE{ON|OFF}	BEEP DONE on off
BEEPWARN{ON|OFF}	BEEP WARN on off
FREO	FREQUENCY BLANK

Display Allocation Menu

DISAALLI	ALL INSTRUMENT
DISAHIHB	HALF INSTR HALF BASIC
DISAALLB	ALL BASIC
DISA *parameter*	

Trace Math Menu

DISPDATA	DISPLAY: DATA
DISPMEMO	MEMORY
DISPDATM	DATA and MEMORY
DISPDDM	DATA/MEM
DISPDMM	DATA−MEM
DATI	DATA → MEM
DISP *parameter*	

Conjugate Matching Menu

CONM{ON|OFF}	CONJ MATCH on off
CALP	CALCULATE PARAMETERS

A.HP-IB Commands Summary

CONPLS *value*	PARAMETER: Ls
CONPLP *value*	Lp
CONPCS *value*	Cs
CONPCP *value*	Cp

Select Circuit Menu

SELCLSLP	Ls-Lp
SELCLSCP	Ls-Cp
SELCCSLP	Cs-Lp
SELCCSCP	Cs-Cp
SELCLPLS	Lp-Ls
SELCLPCS	Lp-Cs
SELCCPLS	Cp-Ls
SELCCPCS	Cp-Cs
SELC *parameter*	

Adjust Display Menu

INTE *value*	INTENSITY
BACI *value*	BACKGROUND INTENSITY
DEFC	DEFAULT COLORS
SVCO	SAVE COLORS
RECC	RECALL COLORS

Modify Colors Menu

COLOCH1D	CH1 DATA
COLOCH1M	CH1 MEM LIMIT LN
COLOCH2D	CH2 DATA
COLOCH2M	CH2 MEM LIMIT LN
COLOGRAT	GRATICULE
COLOWARN	WARNING
COLOTEXT	TEXT
COLOIBT	IBASIC
COLOPEN{1-6}	PEN 1 to PEN 6

Color Adjust Menu

TINT *value*	TINT
CBRI *value*	BRIGHTNESS
COLOR *value*	COLOR
RSCO	RESET COLOR

(AVG) Key

Average Menu

AVERREST	AVERAGING RESTART
AVERFACT *value*	AVERAGING FACTOR
AVER{ON|OFF}	AVERAGING on off
SMOOAPER *value*	SMOOTHING APERTURE
SMOO{ON|OFF}	SMOOTHING on off
GRODAPER *value*	GROUP DELAY APERTURE
IFBW *value*	IF BW

IF Bandwidth Menu

IFBWAUTO	IF BW AUTO

(CAL) Key

Correction Menu

CORR{ON|OFF}	CORRECTION on off
RESC	RESUME CAL SEQUENCE

Select Cal Kit Menu

CALK7MM	CAL KIT: 7mm
CALKN50	N 50Ω
CALKN75	N 75Ω
CALKUSED	USER KIT
MODI1	MODIFY
SAVEUSEK	SAVE USER KIT
CALK *parameter*	

Calibrate More Menu

VELOFACT *value*	VELOCITY FACTOR
SETZ *value*	SET Z0

Reference Plane Menu

PORE{ON|OFF}	EXTENSIONS on off
PORTR *value*	EXTENSION INPUT R
PORTA *value*	EXTENSION INPUT A
PORTB *value*	EXTENSION INPUT B
PORT1 *value*	EXTENSION PORT 1
PORT2 *value*	EXTENSION PORT 2

DC Correction Menu

DCCOR{ON|OFF}	DC CORR on off
EXEDCALI	EXECUTE DC CAL
ABODCALI	ABORT DC CAL

Calibration Menu

CALN	CALIBRATE: NONE
CALIRESP	RESPONSE
CALIRAI	RESPONSE & ISOL'N
CALIS111	S11 1-PORT
CALIS221	S22 1-PORT
CALIFUL2	FULL 2-PORT
CALIONE2	ONE-PATH 2-PORT
CALI *parameter*	

Response Cal Menu

RESPDONE	DONE: RESPONSE

Response and Isolation Cal Menu

RAIRESP	RESPONSE
RAIISOL	ISOL'N STD
RAID	DONE RESPONSE ISOL'N CAL

S11 and S22 1-Port Cal Menus

CLASS11A	[S11] : OPEN
CLASS11B	SHORT
CLASS11C	LOAD
CLASS22A	[S22] : OPEN
CLASS22B	SHORT
CLASS22C	LOAD
SAV1	DONE: 1-PORT CAL
STAN{A-G}	OPEN[M], OPEN[F], SHORT[M], SHORT[F], load1, load2, and so on.
DONE	DONE: OPENS, DONE: SHORTS, or DONE: LOADS

Full 2-Port Cal Menus

REFL	REFLECT'N
TRAN	TRANSMISSION
ISOL	ISOLATION
CLASS11A	[S11] : OPEN

CLASS11B	SHORT
CLASS11C	LOAD
CLASS22A	[S22] : OPEN
CLASS22B	SHORT
CLASS22C	LOAD
REFD	REFLECT'N DONE
FWDT	FWD. TRANS. THRU
FWDM	FWD. MATCH THRU
REVT	REV. TRANS. THRU
REVM	REV. MATCH THRU
STAN{A-G}	OPEN[M], OPEN[F], SHORT[M], load1, load2, thru1, thru2, and so on.
TRAD	TRANS. DONE
OMII	OMIT ISOLATION
FWDI	FWD. ISOL'N ISOL'N STD
REVI	REV. ISOL'N ISOL'N STD
ISOD	ISOLATION DONE
DONE	DONE: OPENS, DONE: SHORTS, or DONE: LOADS

One-Path 2-Port Cal Menus

REFL	REFLECT'N
TRAN	TRANSMISSION
ISOL	ISOLATION
CLASS11A	[S11] : OPEN
CLASS11B	SHORT
CLASS11C	LOAD
REFD	REFLECT'N DONE
FWDT	FWD. TRANS. THRU
FWDM	FWD. MATCH THRU
OMII	OMIT ISOLATION
FWDI	FWD. ISOL'N ISOL'N STD
STAN{A-G}	open1, open2, short1, short2, load1, load2, thru1, thru2, and so on.
ISOD	ISOLATION DONE
SAV2	DONE: 2-PORT CAL
DONE	DONE: OPENS, DONE: SHORTS, or DONE: LOADS

Modify Cal Kit Menu

DEFS *value*	DEFINE STANDARD
LABK *string*	LABEL KIT
KITD	KIT DONE

Define Standard Menus

STDTOPEN	OPEN
STDTSHOR	SHORT
STDTLOAD	LOAD
STDTDELA	DELAY/THRU
STDTARBI	ARBITRARY IMPEDANCE
C0 *value*	C0
C1 *value*	C1
C2 *value*	C2
TERI *value*	TERMINAL IMPEDANCE
LABS *string*	LABEL STD
STDD	STD DONE (DEFINED)
STDT *parameter*	

Specify Offset Menu

OFSD *parameter*	OFFSET DELAY
OFSL *parameter*	OFFSET LOSS
OFSZ *parameter*	OFFSET Z0

Specify Class Menus

SPECS11A *value,value, ...*	SPECIFY: S11A
SPECS11B *value,value, ...*	S11B
SPECS11C *value,value, ...*	S11C
SPECS22A *value,value, ...*	SPECIFY: S22A
SPECS22B *value,value, ...*	S22B
SPECS22C *value,value, ...*	S22C
SPECFWDT *value,value, ...*	FWD.TRANS.
SPECREVT *value,value, ...*	REV.TRANS.
SPECFWDM *value,value, ...*	FWD.MATCH
SPECREVM *value,value, ...*	REV.MATCH
SPECRESP *value,value, ...*	RESPONSE
SPECRESI *value,value, ...*	RESPONSE & ISOL'N
CLAD	CLASS DONE (SPE'D)

Label Class Menus

LABES11A	LABEL: S11A
LABES11B	S11B
LABES11C	S11C
LABES22A	LABEL: S22A
LABES22B	S22B
LABES22C	S22C
LABEFWDT	LABEL: FWD. TRANS.
LABEREVT	REV.TRANS.
LABEFWDM	FWD. MATCH
LABEREVM	REV.MATCH
LABERESP	RESPONSE
LABERESI	RESPONSE & ISOL'N

(MKR) Key

Marker Menu

MARKOFF	ALL MKR OFF
MARKODATA	MARKERS ON [DATA]
MARKOMEMO	MARKERS ON [MEMORY]
MARKL{ON|OFF}	MKR LIST on off
MARKZERO	MKR ZERO

Active Marker Menu

MARK{1-8} *value*	MARKER 1 to 8

Clear Marker Menu

CLEM{1-8}	MARKER 1 to 8

Delta Marker Mode Menu

DELRFIXM	ΔREF=Δ FIXED MKR
DELO	Δ MODE OFF

Delta Marker Menu

DELR{1-8}	Δ REF=1 to Δ REF=8

Fixed Marker Menu

MARKFSTI *value*	FIXED MKR STIMULUS
MARKFVAL *value*	FIXED MKR VALUE
MARKFAUV *value*	FIXED MKR AUX VALUE

Marker Mode Menu

MARKDISC	MARKERS: DISCRETE
MARKCONT	CONTINUOUS
MARKCOUP	MARKERS: COUPLED
MARKUNCO	UNCOUPLED
MARKTIME{ON|OFF}	MKR TIME on off

Polar Marker Menu

POLMLIN	LIN MKR
POLMLOG	LOG MKR
POLMRI	Re/Im MKR
POLM *parameter*	

Smith Marker Menu

SMIMLIN	LIN MKR
SMIMLOG	LOG MKR
SMIMRI	Re/Im MKR
SMIMRX	R+jX MKR
SMIMGB	G+jB MKR
SMIM *parameter*	

(MKR FCTN) Key

Marker Function Menu

MARKSTAR	MARKER → START
MARKSTOP	MARKER → STOP
MARKCENT	MARKER → CENTER
MARKSPAN	MARKER → SPAN
MARKREF	MARKER → REFERENCE
MEASTAT{ON|OFF}	STATISTICS

Search Range Menu

SEARSTOR	SEARCH RNG STORE
PARS{ON|OFF}	PART SRCH on off

Marker Search Menu

SEAOFF	SEARCH: OFF
SEAMAX	MAX
SEAMIN	MIN
SEATARG *value*	TARGET

TRACK{ON|OFF}	TRACKING on off

Target Menu

SEATARG	TARGET
SEAL	SEARCH LEFT
SEAR	SEARCH RIGHT

Marker Search More Menu

SEAMEAN	SEARCH: MEAN
SEALMAX	LOCAL MAX
SEALMIN	LOCAL MIN
SEAPPEAK	PEAK-PEAK
MARKPEAD	MARKER → PEAK DEF
PEADX *value*	PEAK DEF: ΔX
PEADY *value*	ΔY
SEAM *parameter*	

Width Menu

WIDV *value*	WIDTH VALUE
WIDSIN	SEARCH IN
WIDSOUT	SEARCH OUT
WIDT{ON|OFF}	WIDTHS on off

(ATTEN) Key

ATTIA0DB	INPUT-A: 0dB
ATTIA20DB	20dB
ATTIB0DB	INPUT-B: 0dB
ATTIB20DB	20dB
ATTIR0DB	INPUT-R: 0dB
ATTIR20DB	20dB

Stimulus Function Block

STAR *value*	START
STOP *value*	STOP
CENT *value*	CENTER
SPAN *value*	SPAN

MENU Key

Stimulus Menu

POWE *value*	POWER
POIN *value*	NUMBER of POINTS
REST	MEASURE RESTART
COUC{ON|OFF}	COUPLED CH on off
CWFREQ *value*	CW FREQ

Power Menu

POWE *value*	POWER
CLEPTRIP	CLEAR POWER TRIP
ATTP1 *value*	ATTENUATOR PORT 1
ATTP2 *value*	ATTENUATOR PORT 2

Sweep Time Menu

SWET *value*	SWEEP TIME
SWETAUTO	SWEEP TIME AUTO

Trigger Menu

HOLD	HOLD
SING	SINGLE
NUMG	NUMBER OF GROUPS
CONT	CONTINUOUS
EXTTOFF	TRIGGER: TRIG OFF
EXTTON	EXT. TRIG ON SWEEP
EXTTPOIN	EXT. TRIG ON POINT
MANTRIG	MANUAL TRG ON POINT
EXTT *parameter*	

Sweep Type Menu

LINFREQ	LIN FREQ
LOGFREQ	LOG FREQ
LISFREQ	LIST FREQ [LIST 1] or LIST FREQ [LIST 2]

POWS	POWER SWEEP
LISDFBASE	LIST DISP: FREQ BASE
LISDOBASE	ORDER BASE
EDITLIST	EDIT LIST
SWPT *parameter*	

List Sweep Menu

LISSLIS1	SWEEP by: LIST 1
LISSLIS2	LIST 2

Edit List Menu

EDITLIS1	EDIT: LIST 1
EDITLIS2	LIST 2
SEDI *value*	SEGMENT
SDEL	DELETE
SADD	ADD
CLEL	CLEAR LIST
EDITDONE	LIST DONE

Edit Segment Menu

MARKSTAR	MKR → START
MARKSTOP	MKR → STOP
POINT	NUMBER of POINTS
STPSIZE *value*	STEP SIZE
POWE *value*	POWER
IFBW *value*	IF BW
SDON	SEGMENT DONE

Edit Segment More Menu

STAR *value*	SEGMENT: START
STOP *value*	STOP
CENT *value*	CENTER
SPAN *value*	SPAN

Clear List Menu

CLEL	CLEAR LIST YES

Instrument State Function Block

(SYSTEM) Key

Real Time Clock Menu

SETCTIME *hour,min,sec*	TIME HH:MM:SS
SETCDATE *year,month,day*	DATE MM:DD:YY
MONDYEAR	DATE MODE: MonDayYear
DAYMYEAR	DayMonYear

Limits Menu

LIMILINE{ON|OFF}	LIMIT LINE on off
LIMITEST{ON|OFF}	LIMIT TEST on off
BEEPFAIL{ON|OFF}	BEEP FAIL on off
EDITLIML	EDIT LIMIT LINE

Edit Limits Menu

LIMSEDI *value*	EDIT
LIMSDEL	DELETE
LIMSADD	ADD
LIMEDONE	DONE

Edit Segment Menu

LIMS *value*	STIMULUS VALUE
MARKSTIM	MARKER → STIMULUS
LIMU *value*	UPPER LIMIT
LIML *value*	LOWER LIMIT
LIMD *value*	DELTA LIMITS
LIMM *value*	MIDDLE VALUE
MARKMIDD	MARKER → MIDDLE
LIMEDONE	DONE

Clear List Menu

LIMCLEL	CLEAR LIST YES

Offset Limit Menu

LIMISTIO *value*	STIMULUS OFFSET
LIMIAMPO *value*	AMPLITUDE OFFSET
LIMIMAOF	MARKER → AMP. OFS

(LOCAL) Key

ADDRPLOT *value*	ADDRESS: PLOTTER
ADDRPRIN *value*	ADDRESS: PRINTER
ADDRCONT *value*	ADDRESS: CONTROLLER

(PRESET) Key

PRES	(PRESET)

(COPY) Key

Copy Menu

PRINALL	PRINT [STANDARD]
PLOT	PLOT
COPA	COPY ABORT
COPT{ON|OFF}	COPY TIME on off

Print/Plot Setup Menu

PRIS	PRINT: STANDARD
PRIC	COLOR
PRICFIXE	PRINT COLOR [FIXED]
PRICVARI	PRINT COLOR [VARIABLE]
DFLT	DEFAULT SETUP

Select Quadrant Menu

LEFU	LEFT UPPER
LEFL	LEFT LOWER
RIGU	RIGHT UPPER
RIGL	RIGHT LOWER
FULP	FULL PAGE
QUAD *parameter*	

Define Plot Menu

PLOALL	PLOT: ALL
PLODGRATY	DATA & GRATICL
PLODONL	DATA ONLY
LINTDATA	LINE TYPE DATA
LINTMEMO	LINE TYPE MEMORY
PLOSFAST	PLOT SPEED [FAST]
PLOSSLOW	PLOT SPEED [SLOW]

PLOC *parameter*

Scale Plot Menu

SCAPFULL	SCALE: FULL
SCAPGU	UPPER GRATICULE
SCAPGL	LOWER GRATICULE

Copy More Menu

LISV	LIST VALUES
OPEP	OPERATING PARAMETERS

Copy Cal Kit Menu

CALCASSI	CLASS ASSIGNMENT

Copy Standard Number Menu

CALS *value*	STD NO.1 to STD NO.8

Copy List Sweep Menu

DISL1	DISPLAY: LIST1
DISL2	LIST2
DISMSTSP	DISP MODE: ST & SPAN
DISMNUM	NUMBER of POINTS
DISMSTEP	STEP SIZE

Copy Limit Test Menu

DISLLIST	DISPLAY LIST
DISMUL	DISP MODE: UPR & LWR
DISMMD	MID & DLT

Screen Menu

PRINALL	PRINT [STANDARD]
PLOT	PLOT
COPA	COPY ABORT
COPT{ON|OFF}	COPY TIME on off
NEXP	NEXT PAGE
PREP	PREV PAGE
RESD	RESTORE DISPLAY

SAVE and RECALL Keys

Save Menu

RESAVD *string*	RE-SAVE FILE
SAVDASC	DATA ONLY
SAVDGRA	GRAPHICS
ASCE	ASCII DATA [.TXT]
GRAE	GRAPHICS [.HPG]
STODDISK	STOR DEV [DISK]
STODMEMO	STOR DEV [MEMO]

Define Save Menu

SAVDALL *string*	SAVE ALL
SAVDSTA *string*	SAVE STATE ONLY
SAVDDAT *string*	SAVE DATA ONLY

Define Save Date Menu

SAVRA{ON|OFF}	RAW ARY on off
SAVCA{ON|OFF}	CAL ARY on off
SAVDA{ON|OFF}	DATA ARY on off
SAVMA{ON|OFF}	MEMORY ARY on off
SAVUA{ON|OFF}	UNFORM ARY on off
SAVTA{ON|OFF}	TRACE ARY on off
SAVTMA{ON|OFF}	T MEM ARY on off

Disk Menu

PURG *string*	PURGE FILE
INID	INITIALIZE DISK
FILC	COPY FILE
CHAD	CHANGE DIRECTORY
CRED	CREATE DIRECTORY
DISFLIF	FORMAT [LIF]
DISFDOS	FORMAT [DOS]

Recall Menu

RECD *string*	RECALL FILE

Service Function

ACTLHFRE
ACTLLFRE
ACTLNORM
CHAIRANG
DCBUS *value*
DESTOFF
DESTON
EXET
EXTRLOCK?
FBUS *value*
FIRLANOR
FIRLAOPE
FIRLPNOR
FIRLPOPE
FIRR?
FNDAUTO
FNDMANU
FNDVALU *value*
FNVNORM
FNVOPEN
IFRAUTO
IFRCH?
IFRX1
IFRX1X8
IFRX64
IFRX8X1
MIXLPNOR
MIXLPTES
OUTPFBUS?
OUTPTESS? *value*
POWDAUTO
POWDMANU
POWDVALU *value*
POWLAOPE
POWLANOR
RECCOFF
RECCON
REOPNORM
REOPOPEN
SELD
SOUCOFF
SOUCON
STEODAUT
STEODMAN
STEODVAL *value*
STEONORM
STEOOPEN
TESC
TEST *value*

Commands Which Don't Have Equivalent Softkey Labels

ANAOCH1
ANAOCH2
ANAODATA
ANAOMEMO
ANARANG *value,value*
ANARFULL
CLES
ESB?
ESNB *value*
FORM2
FORM3
FORM4
FORM5
INP8IO
INPUCALC{01-12} *value*
INPUCALK *value*
INPUDATA *value*
INPUFORM *value*
INPURAW1 *value*
INPURAW2 *value*
INPURAW3 *value*
INPURAW4 *value*
INPUUFORM *value*
KEY *value*
MARKBUCK *value*
OSE *value*
OSER?
OSNT
OSPT
OSR?
OUT8IO *value*
OUTPCALC{01-12}?
OUTPCALK?
OUTPDATA?
OUTPDATAP? *value*
OUTPERRO?
OUTPFAIP?
OUTPFILT? *value*
OUTPFORM?
OUTPFORMP? *value*
OUTPIFORM?
OUTPINP8IO
OUTPIRFORM?
OUTPIRTMEM?
OUTPITMEM?
OUTPLIMF?
OUTPLIML?
OUTPLIMM?
OUTPMARK?
OUTPMAX?
OUTPMEAN?
OUTPMEMO?
OUTPMEMOP? *value*
OUTPMIN?
OUTPMINMAX?
OUTPMSTA?
OUTPMWID?
OUTPRAW1?
OUTPRAW2?
OUTPRAW3?
OUTPRAW4?
OUTPRESO?
OUTPRFORM?
OUTPRTMEM?
OUTPSTIM?
OUTPTITL?
OUTPTMEM?
OUTPTMEMP? *value*
OUTPUFORM?
PSOFT{ON|OFF}
RPLENV?
RPLHEI?
RPLLHEI?
RPLMEA?
RPLPP?
RPLRHEI?
SAVC
TESS?

IEEE 488.2 Common Commands

*CLS
*ESE *value*
*ESE?
*ESR?
*IDN?
*OPC
*OPC?
*PCB *value*
*RST
*SRE *value*
*SRE?
*STB?
*TRG
*TST?
*WAI

B

Status Reporting

Figure B-1 shows the status reporting structure of the HP 8751A. Table B-1, Table B-2, Table B-3, and Table B-4 describe the status bits of each register.

Using status registers, refer to "Status Reporting" in Chapter 2.

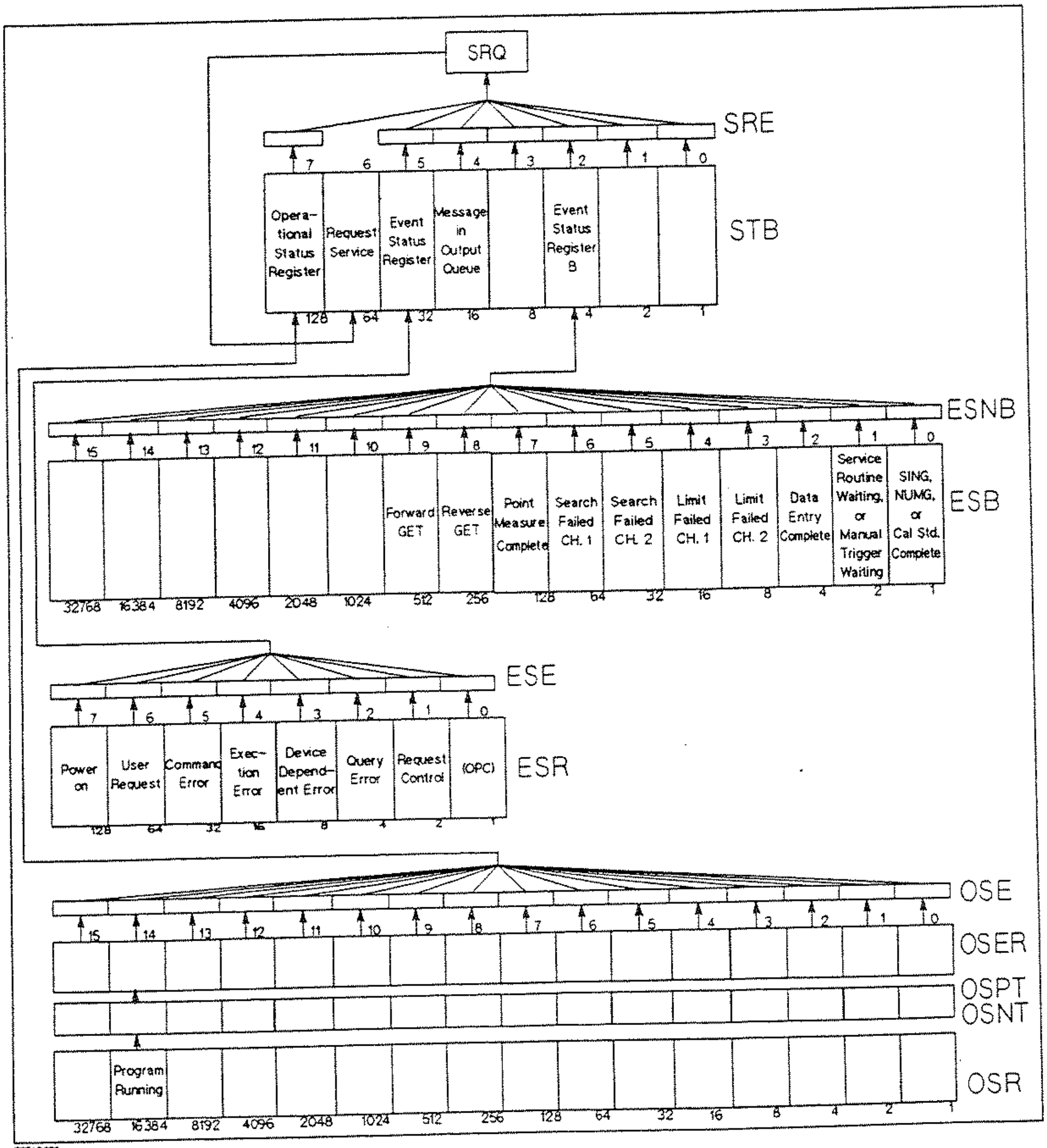


Figure B-1. Status Reporting Structure

Table B-1. Status Bit Definitions of the Status Byte (STB)

Bit	Name	Description
2	Check event status register B	One of the enabled bits in event status register B has been set.
4	Message in output queue	A command has prepared information to be output, but it has not been read yet.
5	Check event status register	One of the enabled bits in the event status register has been set.
6	Request service	One of the enabled status byte bits is causing an SRQ.
7	Operational status summary bit	One of the enabled bits in the operational status register has been set.

Table B-2. Status Bit Definitions of the Event Status Register (ESR)

Bit	Name	Description
0	Operation complete	A command for which OPC has been enabled and completed an operation.
1	Request control	The HP 8751A has been commanded to perform an operation that requires control of a peripheral, and needs control of HP-IB.
2	Query error	1. The HP 8751A has been addressed to talk, but there is nothing in the output queue to transmit. 2. Data in the Output Queue has been lost.
3	Device dependent error	An error other than a command error, a query error, and an execution error has occurred.
4	Execution error	1. A program data element following a header exceeded its input range, or is inconsistent with the HP 8751A's capabilities. 2. A valid program message could not be properly executed due to some instrument condition.
5	Command error	1. An IEEE 488.2 syntax error has been occurred. Possible violations include, a data element violated the HP 8751A listening formats or a data element type is unacceptable to the HP 8751A. 2. A semantic error which indicates that an unrecognized header was received has occurred. Unrecognized headers include incorrect device-specific headers and incorrect or unimplemented IEEE 488.2 common commands. 3. A Group Execute Trigger (GET) was entered into the Input Buffer of a program message.
6	User request	The operator has pressed a front panel key or an optional keyboard key or turned the rotary knob.
7	Power on	A power on sequence has occurred since the last read of the register.

Table B-3. Status Bit Definitions of the Event Status Register B (ESB)

Bit	Name	Description
0	Sweep or group complete, or cal std. complete	A single sweep or group has been completed since the last read of the register. Operates in conjunction with SING or NUMG.
1	Service routine waiting or done, or manual trigger waiting	1. An internal service routine has completed an operation, or is waiting for an operator response. 2. The HP 8751A has set the manual trigger on point mode and is waiting for a manual trigger.
2	Data entry complete	A terminator key has been pressed.
3	Limit failed, Ch 2	Limit test failed on channel 2.
4	Limit failed, Ch 1	Limit test failed on channel 1.
5	Search failed, Ch 2	A marker search was executed on channel 2, but the target value was not found.
6	Search failed, Ch 1	A marker search was executed on channel 1, but the target value was not found.
7	Point measurement complete[1]	One point measurement of a sweep has completed.
8	Waiting for reverse GET	A one-path 2-port calibration is active, and the instrument has stopped, waiting for the operator to connect the device for a reverse measurement.
9	Waiting for forward GET	A one-path 2-port calibration is active, and the instrument has stopped, waiting for the operator to connect the device for a forward measurement.

1 This bit is set only when the related bits of both SRE and ESNB are enabled.

In the case of the manual trigger on point mode, HP 8751A accepts the next trigger while current measurement is in progress (up to the number of points). Use bit 1 and bit 7 correctly to synchronize measurement and external triggering. For example, 1) wait until bit 1 is set, 2) trigger, and 3) wait until bit 7 is set.

Table B-4. Status Bit Definitions of the Operational Status Register (OSR)

Bit	Name	Description
14	Program running	An HP Instrument BASIC program is running.

OSPT, OSNT

OSPT (Operational Status Positive Transition Filter)

Sets the positive transition filter. Setting a bit in OSPT will cause a 0 to 1 transition in the corresponding bit of the associated operational status register (OSR) to cause a 1 to be written in the associated bit of corresponding operational status event register (OSER.

Because only bit 17 of the HP 8751A's OSR is used to show program status, when bit 17 of OSPT is set to 1, starting a program causes a 1 to be written in bit 17 of OSER. (And then a 1 is written in bit 7 of STB.)

OSNT (Operational Status Negative Transition Filter)

Sets the negative transition filter. Setting a bit in the negative transition filter will cause a 1 to 0 transition in the corresponding bit of the associated operational status register to cause a 1 to be written in the associated bit of corresponding operational status event register.

Because only bit 17 of the HP 8751A's OSR the is used to show program status, when bit 17 of OSNT is set to 1, stopping a program causes a 1 to be written in bit 17 of OSER. (And then a 1 is written in bit 7 of STB.)

C

Key Codes

Figure C-1 shows the codes of the front panel keys for using the KEY HP-IB command.

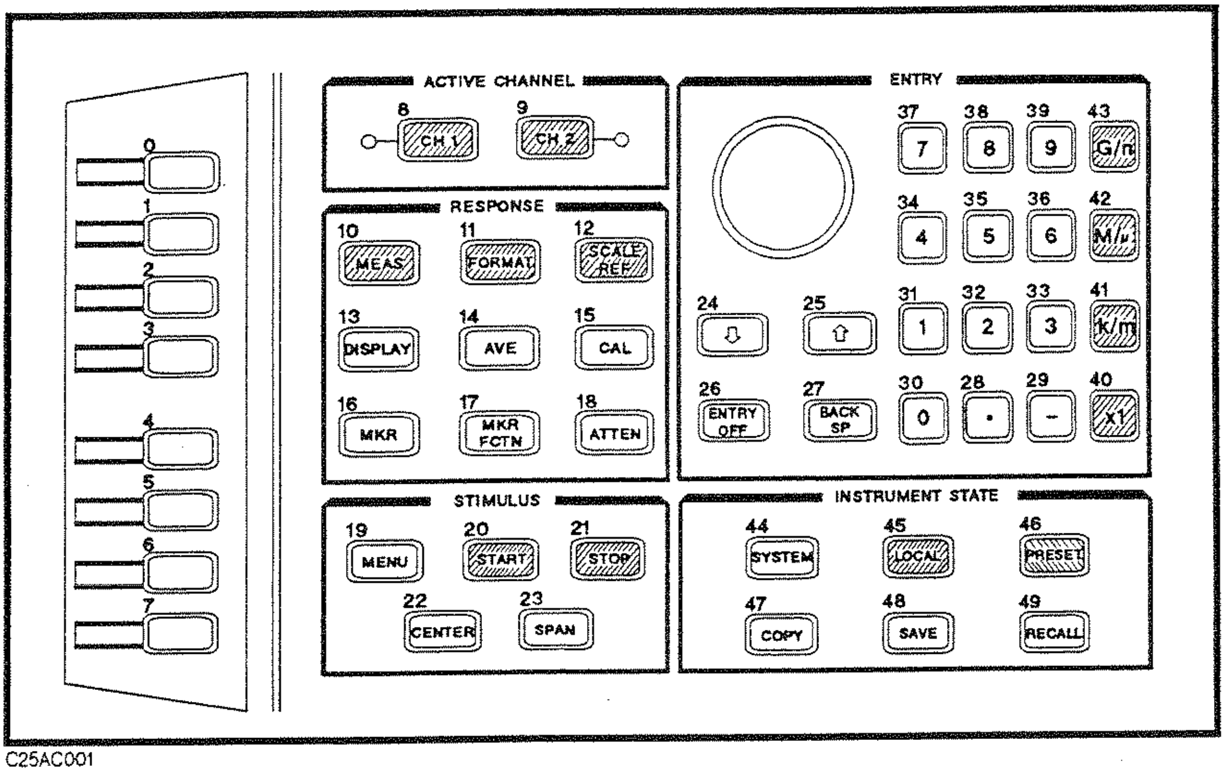


Figure C-1. Key Codes

D

Calibration Types and Standard Classes, and Calibration Arrays

Table D-1 lists which standard classes are required for each calibration type. Table D-2 specifies where the calibration coefficients are stored for different calibration types.

Table D-1. Calibration Types and Standard Classes

Class	Response	Response and Isolation	S_{11} 1-port	S_{22} 1-port	One-path 2-port	Full 2-port
Response:	•					
Response and isolation:						
Response		•				
Isolation		•				
Reflection:[1]					•	•
S11A (opens)			•		•	•
S11B (shorts)			•		•	•
S11C (loads)			•		•	•
S22A (opens)				•		•
S22B (shorts)				•		•
S22C (loads)				•		•
Transmission:[1]					•	•
Forward match					•	•
Forward thru					•	•
Reverse match						•
Reverse thru						•
Isolation:[1]					•	•
Forward					•	•
Reverse						•

1 These subheadings must be called when doing 2-port calibrations.

Table D-2. Calibration Array

Array	Response[1]	Response and Isolation[1]	1-port[1]	2-port[1,2]
1	E_R or E_T	E_X (E_D)[3]	E_D	E_{DF}
2		E_T (E_R)	E_S	E_{SF}
3			E_R	E_{RF}
4				E_{XF}
5				E_{LF}
6				E_{TF}
7				E_{DR}
8				E_{SR}
9				E_{RR}
10				E_{XR}
11				E_{LR}
12				E_{TR}

1 Meaning of first subscript: D=directivity; S=source match; X=crosstalk; L=load match; T=transmission tracking.

Meaning of second subscript: F=forward; R=reverse.

2 One path, 2-port cal duplicates arrays 1 to 6 in arrays 7 to 12.

3 Response and isolation corrects for crosstalk and transmission tracking in transmission measurements, and for directivity and reflection tracking in reflection measurements.

E

Waveform Analysis Commands

The HP 8751A has several commands for analyzing measurement waveforms. These commands allow you to perform analysis with a single command instead of combining marker functions.

This appendix provides information about these waveform analysis commands. The commands are divided into four groups as follows:

- Waveform analysis setting commands
- Ripple analysis commands
- Maximum/Minimum/Mean search commands
- Filter and Resonator analysis commands

Waveform analysis commands are not executable from a softkey. They are available only as HP-IB commands.

When a query command is sent, the HP 8751A searches, calculates, and then returns the resultant data by HP-IB. Nothing will be displayed on the CRT during this time. This makes possible faster and easier operation than using the marker function in an HP-IB program.

Note Figures E-1 to 7 are concept figures to show how the commands work, and they are different from an actual measurement display. Actually, nothing will change on the CRT when a command is executed.

Setting Commands for Waveform Analysis

The following commands specify the analysis range for the previously mentioned waveform analysis commands.

ANARANG *value[suffix],value[suffix]*
ANARFULL
ANAODATA
ANAOMEMO
ANAOCH1
ANAOCH2

ANARANG *value[suffix],value[suffix]* and ANARFULL

ANARANG sets the stimulus range for the waveform analysis commands. This analysis range is specified independently from the marker search range. When the HP 8751A is turned ON, the default setting for the analysis range is equal to the full stimulus range.

When the analysis range exceeds the stimulus range, the analysis range is reset to match the stimulus range. For example, If the analysis range is set from 80 MHz to 100 MHz when the stimulus range is 75 MHz to 95 MHz, the HP 8751A resets the analysis range to 80 MHz to 95 MHz. If the stimulus setting is modified after the analysis range is set, the HP 8751A resets the analysis range to the full range of the new stimulus range.

Analysis range information can not be saved using the instrument state saving function.

ANARFULL sets the waveform analysis range equal to the full stimulus range.

ANAOCH1/ANAOCH2

These commands select the channel to be used by the waveform analysis commands. ANAOCH1 selects channel 1 and ANAOCH2 selects channel 2. The channel selected is independent of active channel.

ANAODATA and ANAOMEMO

These commands select the object trace to be used by the waveform analysis commands. ANAODATA selects a data trace and ANAOMEMO selects a memory trace for waveform analysis.

Note

The target trace (data or memory) can be specified independently for each channel. The ANAODATA/ANAOMEMO command is effective for the currently selected channel. So, the ANAODATA/ANAOMEMO command should be set after switching channel using the ANAOCH1/ANAOCH2 command.

Ripple Analysis Command

The following commands analyze ripple of trace data and return the resultant data by HP-IB. The effective analysis range for these commands is specified with the ANARANG command. The HP 8751A starts ripple analysis when it receives a query.

```
RPLPP?
RPLHEI?
RPLRHEI?
RPLLHEI?
RPLENV?
RPLMEA?
```

RPLPP?

The RPLPP? command calculates the amplitude between the local maximum and minimum points within a specified range as shown in Figure E-1 and outputs the resultant data by HP-IB. If no ripple is detected, a zero is returned.

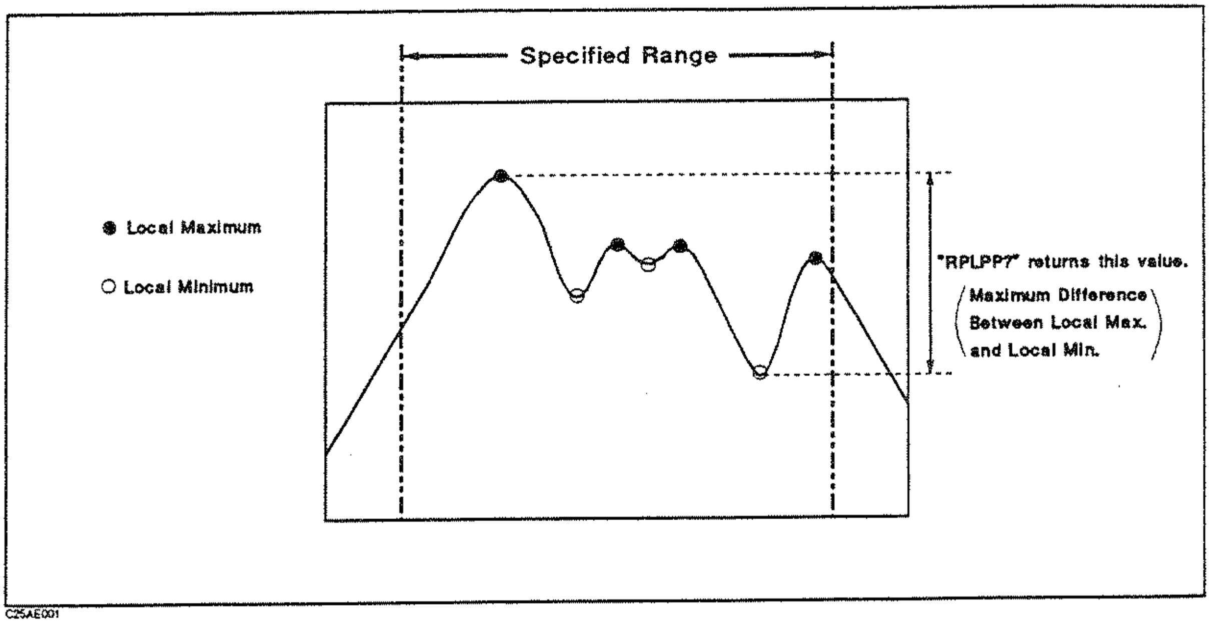


Figure E-1. RPLPP?

```
10 ASSIGN @Hp8751 TO 717                   ! When iBASIC is used,
15                                         ! Change 717 to 800.
20 OUTPUT @Hp8751;"ANARANG 69.99E6,70.01E6" ! Set freq. range for analysis.
25                                         ! (69.99 MHz through 70.01 MHz)
30 OUTPUT @Hp8751;"ANAODATA"               ! Select DATA trace for analysis
40 OUTPUT @Hp8751;"ANAOCH1"                ! Select channel 1 for analysis
50 OUTPUT @Hp8751;"RPLPP?"                 ! Search for ripple
60 ENTER @Hp8751;Ripple                    ! Get ripple value
70 PRINT Ripple;" dB"                      ! Print ripple value
80 END
```

Figure E-2. Sample Program for RPLPP

RPLHEI?

The RPLHEI? command searches for the maximum height between all neighboring local maximums and minimums within a specified range, as shown in Figure E-3 and outputs the resultant data by HP-IB. If no ripple is detected, a zero is returned.

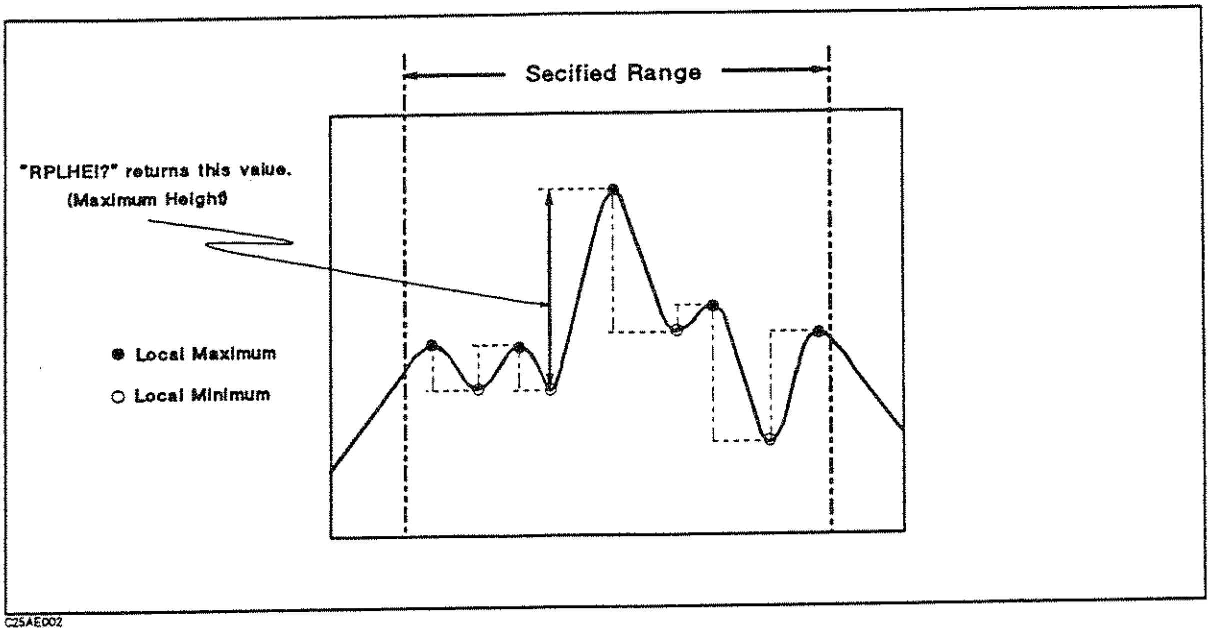


Figure E-3. RPLHEI?

```
10 ASSIGN @Hp8751 TO 717       ! When iBASIC is used, change 717 to 800
20 OUTPUT @Hp8751;"ANARFULL"  ! Range for analysis is equal to
25                             ! the stimulus range.
30 OUTPUT @Hp8751;"ANAODATA"  ! Select DATA trace for analysis
40 OUTPUT @Hp8751;"ANAOCH1"   ! Select channel 1 for analysis
50 OUTPUT @Hp8751;"RPLHEI?"   ! Search for ripple
60 ENTER @Hp8751;Ripple        ! Get ripple value
70 PRINT Ripple;" dB"          ! Print ripple value
80 END
```

Figure E-4. Sample Program for RPLHEI

RPLRHEI? and RPLLHEI?

These commands also search for the maximum height between neighboring local maximums and minimums within a specified range as does the RPLHEI command. But RPLRHEI? searches only for the local minimum to the right from each local maximum point as shown in Figure E-5, and RPLLHEI? searches only for the local minimum to the left from each local maximum point as shown in Figure E-6. Both commands return the maximum height by HP-IB. If no ripple is detected, a zero is returned.

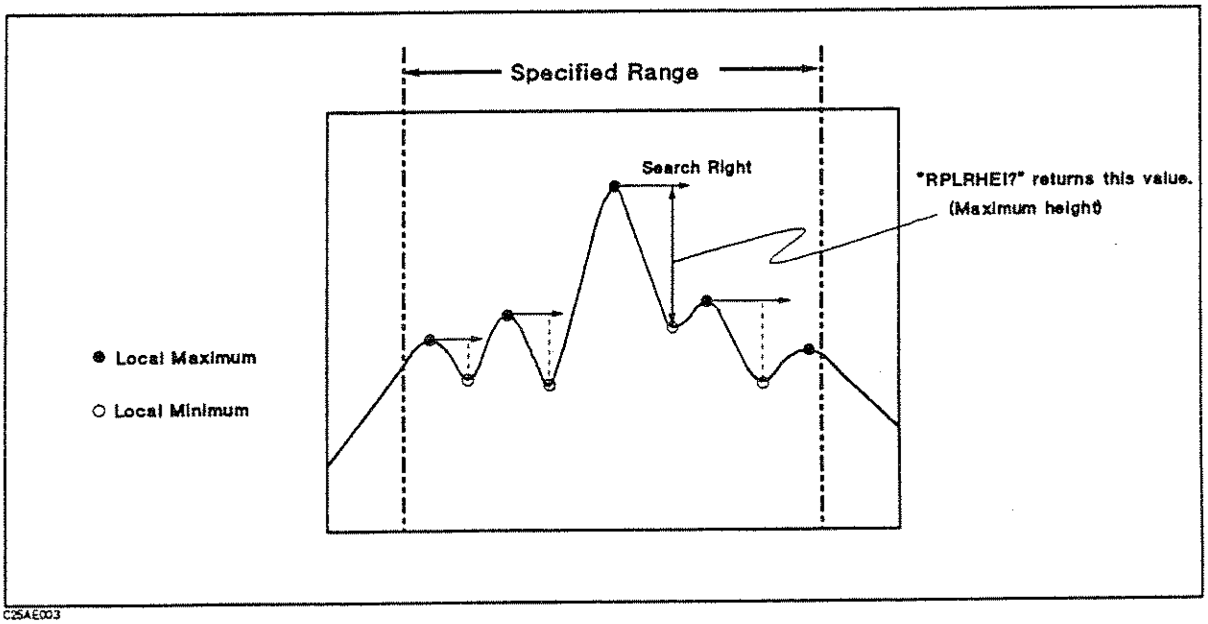


Figure E-5. RPLRHEI?

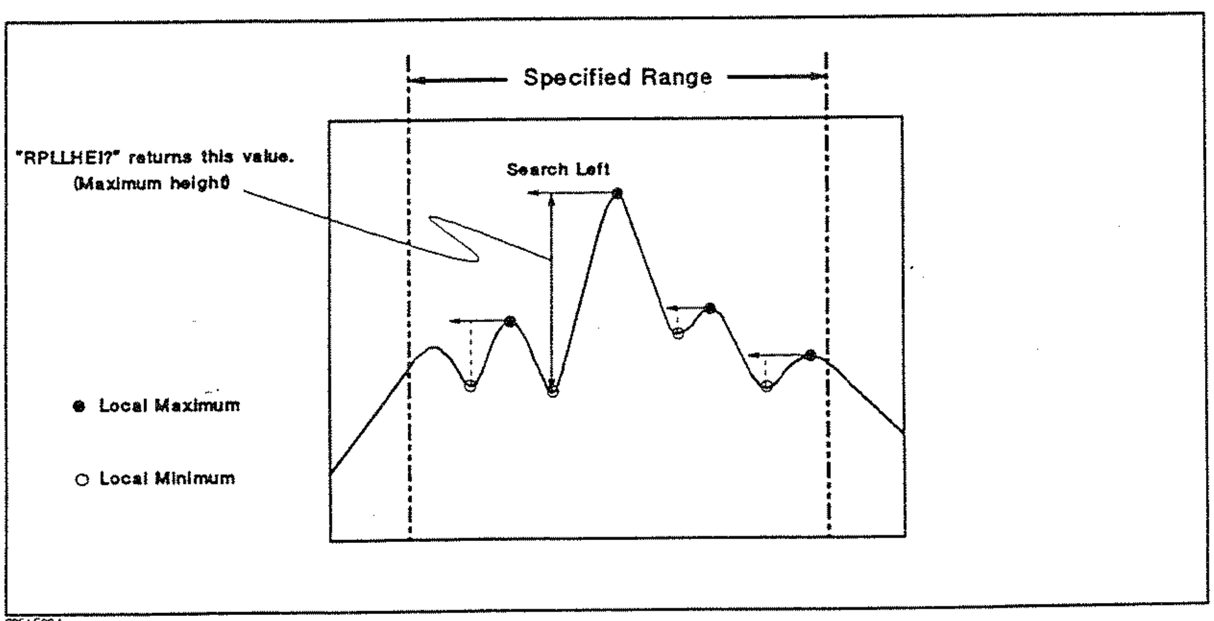


Figure E-6. RPLLHEI?

E. Waveform Analysis Commands

RPLENV?

This command searches all neighboring peaks and their included valleys for the maximum height, perpendicular from the valley minimum point between neighboring peaks, to the intersection of an imaginary slope line drawn between the neighboring local maximums as shown in Figure E-7, and outputs the resulting maximum envelope value by HP-IB. If no ripple is detected, a zero is returned.

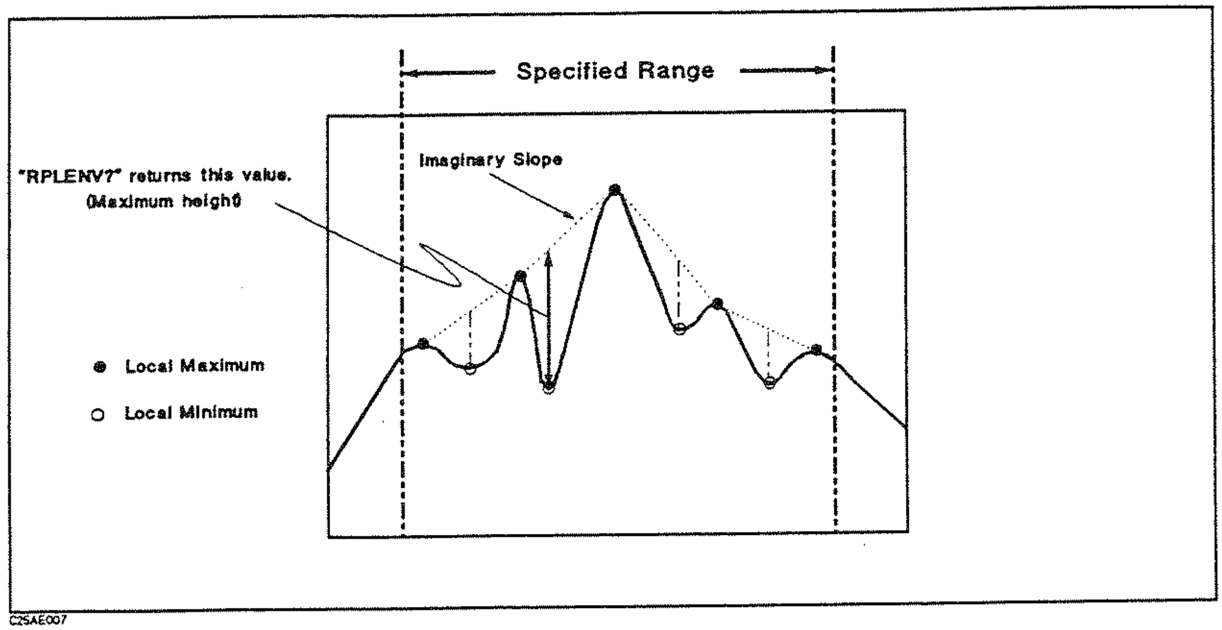
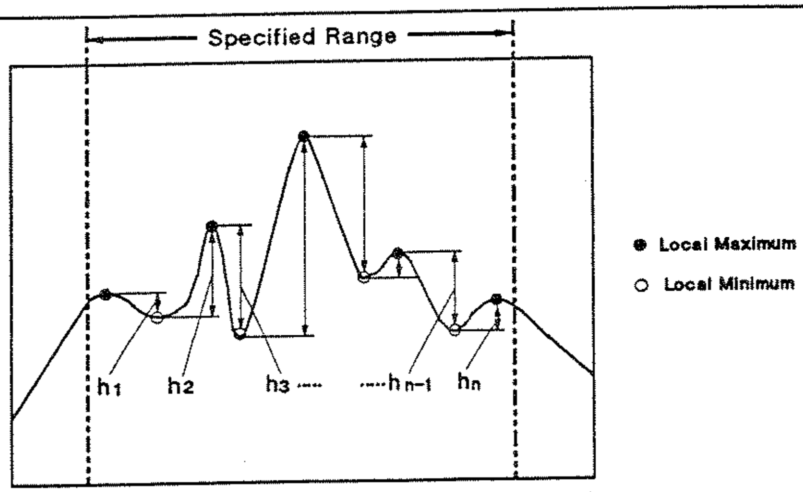


Figure E-7. RPLENV?

RPLMEA?

This command averages all heights between neighboring local maximums and minimums within a specified range as shown in Figure E-8 and outputs the average value by HP-IB. If no ripple is detected, a zero is returned.



"RPLMEA?" returns the average value derived by the following equation:

$$\text{Average value} = \frac{h_1 + h_2 + h_3 \cdots\cdots + h_{n-1} + h_n}{n}$$

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Figure E-8. RPLMEA?

```
110 ASSIGN @Hp8751 TO 717       ! When iBASIC is used, change 717 to 800
120 OUTPUT @Hp8751;"ANARFULL"   ! Range for analysis is equal to
125                             ! the stimulus range.
130 OUTPUT @Hp8751;"ANAODATA"   ! Select DATA trace for analysis
140 OUTPUT @Hp8751;"ANAOCH1"    ! Select channel 1 for analysis
150 OUTPUT @Hp8751;"RPLRHEI?"   ! Search right for ripple
160 ENTER @Hp8751;Right_ripple  ! Get ripple value
170 OUTPUT @Hp8751;"RPLLHEI?"   ! Search left for ripple
180 ENTER @Hp8751;Left_ripple   ! Get ripple value
190 OUTPUT @Hp8751;"RPLENV?"    ! Search for "envelope ripple"
200 ENTER @Hp8751;Env_ripple    ! Get envelope value
210 OUTPUT @Hp8751;"RPLMEA?"    ! Search for ripple and average ripple values
220 ENTER @Hp8751;Mean_ripple   ! Get average value
230 PRINT "Right Ripple ";Right_ripple ! Print ripple values
240 PRINT "Left Ripple  ";Left_ripple  !
250 PRINT "Env. Ripple  ";Env_ripple   !
260 PRINT "Mean Ripple  ";Mean_ripple  !
280 END
```

Figure E-9. Sample Program for RPLRHEI, RPLLHEI, RPLENV and RPLMEA

Maximum/Minimum/Mean Value Search Command

The following commands return the maximum, minimum, and mean value of a trace within the range specified by the ANARANG command.

```
OUTPMAX?
OUTPMIN?
OUTPMINMAX?
OUTPMEAN?
```

OUTPMAX?/OUTPMIN?/OUTPMINMAX?

These commands search for a maximum/minimum/mean value within a specified range and returns it with its corresponding stimulus value by HP-IB. OUTPMAX? returns the maximum value and OUTPMIN? returns the minimum value. OUTPMINMAX? returns both the maximum and minimum values.

OUTPMEAN?

OUTPMEAN? returns the mean value within a specified range by HP-IB.

Filter and Resonator Analysis Command

The following commands are device related. They are easy to use for specific device analysis because they will output many parameters with only a single command.

OUTPFILT? *value[suffix]*
OUTPRESO?

OUTPFILT? *value[suffix]*

OUTPFILT? returns filter specific parameters, insertion loss, BW(bandwidth), f_{cent}, Q, ΔL.F and ΔR.F within the range specified by the ANARANG command.

This command has parameter which sets the offset of xdB to the maximum peak value to determine the cutoff point. For example, use "−3dB" for the parameter value of OUTPFILT? command to determine the cutoff point to 3 dB below the maximum peak.

Figure E-10 shows a typical example of a bandpass filter measurement trace. The insertion loss is the absolute value of the difference of the maximum within a specified range and 0 dB. BW is the stimulus width between two cutoff points (f_1 and f_2) and the center point of two cutoff points are given as f_{cent}. Q is calculated as:

$$Q = \frac{\sqrt{f_1 \times f_2}}{BW}$$

ΔL.F is the stimulus difference between the left xdB cutoff point and the center point of a specified range. Similarly, ΔR.F is the difference between the right cutoff point and the center of a specified range.

Zeros will be returned for all parameters when two xdB points can not be found.

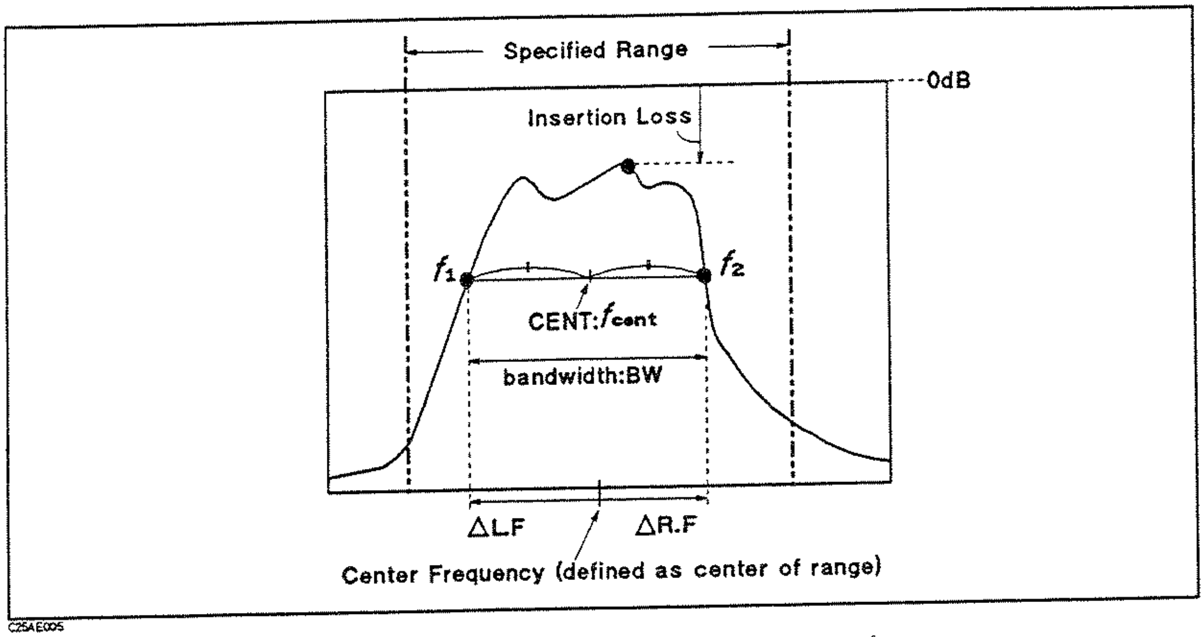

Figure E-10. Output Filter Parameters Example

```
100 ASSIGN @Hp8751 TO 717                    ! If iBASIC is used,
105                                          ! Change 717 to 800.
110 OUTPUT @Hp8751;";PRES"                   ! Preset the HP 8751A.
120 OUTPUT @Hp8751;";HOLD"                   ! Sweep hold
130 OUTPUT @Hp8751;";DISAALLB"               ! Display allocation is ALL BASIC
140 OUTPUT @Hp8751;";CENT 70E6;SPAN 100E3"   ! CENTER 70 MHz, SPAN 100 kHz
150 OUTPUT @Hp8751;";S21"                    ! Measure S21
160 OUTPUT @Hp8751;"ANARANG 69.95E6,70.05E6" ! Analysis range is between
165                                          ! 69.95 MHz and 70.05 MHz
170 OUTPUT @Hp8751;"ANAOCH1"                 ! Select CHANNEL 1 to be used
175                                          ! by the analysis command.
180 OUTPUT @Hp8751;"ANAODATA"                ! Select DATA TRACE to be used
180                                          ! by the analysis command.
190 OUTPUT @Hp8751;";SING"                   ! Trigger sweep
200 OUTPUT @Hp8751;"OUTPFILT? -3"            ! Query -3 dB bandwidth and
                                             ! other filter parameters.
210 ENTER @Hp8751;Il,Bw,Fc,Q,Lf,Rf           ! Get filter parameters
220 PRINT "INSERTION LOSS  ",Il;"dB"         ! Print parameters
230 PRINT "BANDWIDTH       ",Bw/1000;"kHz"
240 PRINT "CENTER FREQUENCY",Fc/1.E+6;"MHz"
250 PRINT "Q FACTOR        ",Q
260 PRINT "LEFT FREQ.      ",Lf/1000;"kHz"
270 PRINT "RIGHT FREQ.     ",Rf/1000;"kHz"
280 END
```

Figure E-11. Sample Program for OUTPFILT

OUTPRESO?

`OUTPRESO?` returns resonator specific parameters, the resonant frequency(f_r) and the anti-resonant frequency(f_a) within a specified range, and the magnitude values(G_r, G_a). (Data format: G_r, f_r, G_a, f_a)

Figure E-12 shows a typical example of an X'tal resonator measurement trace. When the `OUTPRESO?` command is sent, the HP 8751A searches for the 0° phase point, from the left to end of the specified range. The HP 8751A regards the first point found as the resonant point and the second point found as the anti-resonant point and returns the stimulus and magnitude data by HP-IB.

If there are three or more 0° points within a specified range, the HP 8751A returns data on the first two points found. If there is only one 0° point within a specified range, the HP 8751A considers this point to be the resonant point and returns zeros for G_a and f_a. If there is no 0° phase point within a specified range, the HP 8751A will return zeros for all parameters.

This command is available only when in the LOG MAG & Phase format. So, the `ANAODATA`, `ANAOMEMO` commands are disregarded. If the format is not "LOG MAG & Phase", the HP 8751A will return zeros for all parameters.

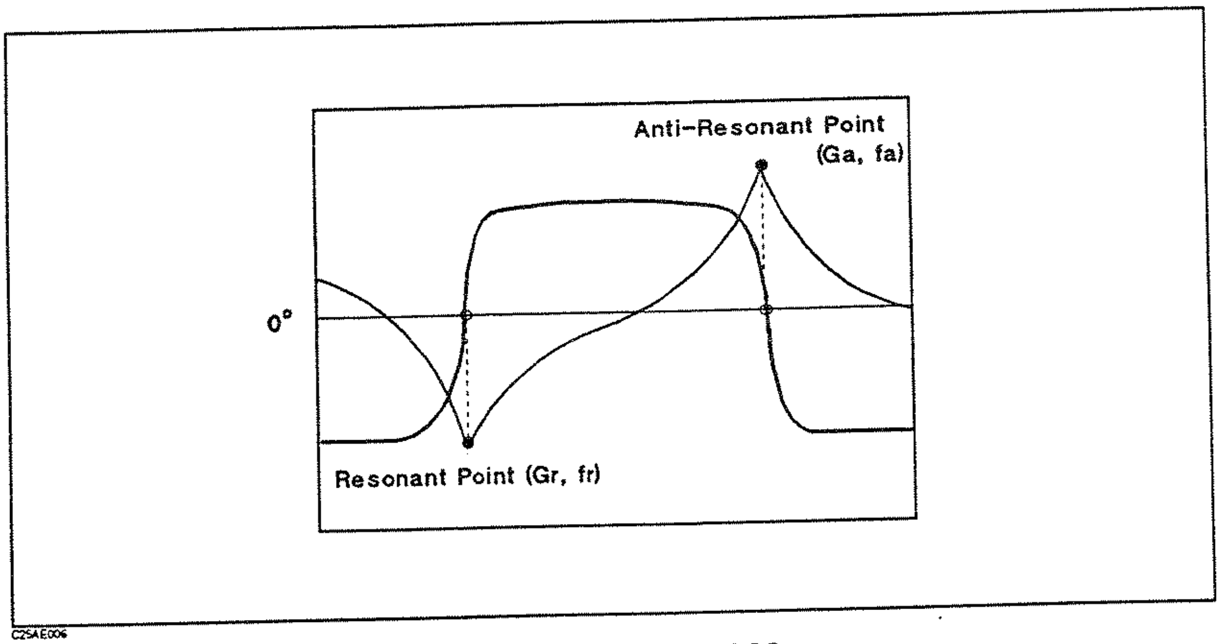

Figure E-12. OUTPRESO?

```
100 ASSIGN @Hp8751 TO 800                ! If iBASIC is used,
115                                      ! Change 717 to 800.
110 ASSIGN @Hp8751a TO 800;FORMAT OFF    ! Path for ENTER statement
120 OUTPUT @Hp8751;";HOLD"               ! Sweep hold
130 OUTPUT @Hp8751;";DISAALLB"           ! Display allocation is ALL  BASIC
140 OUTPUT @Hp8751;"ANARFULL"            ! Analysis range is full
150 OUTPUT @Hp8751;"ANAOCH1"             ! Select CHANNEL 1 to be used by
155                                      ! the analysis command.
160 OUTPUT @Hp8751;"ANAODATA"            ! Select DATA TRACE to be used
165                                      !  by the analysis command.
170 OUTPUT @Hp8751;"FORM3"               ! Set format to IEEE 64
180 OUTPUT @Hp8751;"OUTPRESO?"           ! Query Res/Ant-res. point.
190 ENTER @Hp8751 USING "#,8A";A$        ! Enter header
200 ENTER @Hp8751a;Zr,Fr,Za,Fa           ! Get result
210 ENTER @Hp8751 USING "#,1A";B$        ! Enter tail
220 PRINT "RES POINT   ",Zr;"dB"         ! Print parameters
230 PRINT "RES F  ",Fr/1.E+6;"MHz"
240 PRINT "ANT.R POINT        ",Za
250 PRINT "ANT.R FREQ.      ",Fa/1.E+6;"MHz"
260 END
```

Figure E-13. Sample Program for OUTPRESO

F

Comparison of the HP 8751A and HP 8753C Network Analyzer HP-IB Commands

This document provides reference information for converting HP-IB programs of the HP 8753C into HP 8751A programs.

Functional Difference between HP 8753C and HP 8751A

Most of the differences between HP 8753C and HP 8751A programs are due to functional differences of the instruments, as detailed below:

1. Some functions of the HP 8753C are not supplied by the HP 8751A. These functions are:
   - Time domain transform
   - Test sequence
   - Five internal learn string registers
   - Power meter cal
   - External source(auto, manual) mode, Tuned receiver mode
   - Harmonic measurement
2. HP-IB bus mode is different.
   - HP 8753C
     - SYSTEM CONTROLLER
     - TALKER/LISTENER & USE PASS CONTROL
   - HP 8751A
     - SYSTEM CONTROLLER
     - ADDRESSABLE ONLY

   In the SYSTEM CONTROLLER mode, the HP 8753C and the HP 8751A have the same capability except for control of an external disk drive or power meter, which is not available with the HP 8751A. ADDRESSABLE ONLY mode of the HP 8751A has the capability of both TALKER/LISTENER mode and USE PASS CONTROL mode of the HP 8753C.
3. Save-recall function of the HP 8751A is different from that of the HP 8753C. Unlike the HP 8751A, the HP 8753C has multiple internal save-recall registers and can control an external disk drive. The HP 8751A has a built-in disk drive for multiple save or recall of instrument states, calibration arrays, list sweep tables, or data.

Built-in Disk Drive

The HP 8751A has built-in disk drive which store data, instrument states or list sweep table. Save-recall commands for the HP 8751A are listed below.

`RESAVD["string"];` Update a file already saved.
`SAVDALL["string"];` Save the instrument states and the Data and Memory array.
`SAVDSTA["string"];` Save the instrument states including list sweep tables and the calibration coefficient.
`SAVDDAT["string"];` Save the internal data arrays defined by:

- `SAVRA<ON|OFF>;` Raw data array
- `SAVCA<ON|OFF>;` Calibration coefficient array
- `SAVDA<ON|OFF>;` Data array
- `SAVMA<ON|OFF>;` Memory array
- `SAVUA<ON|OFF>;` Unformatted array
- `SAVTA<ON|OFF>;` Trace array
- `SAVTMA<ON|OFF>;` Memory trace array

`PURG["string"];` Purge file.
`INID;` Initializes the disk.
`RECD["string"];` Load the instrument states or data from disk.

For more information, see operation manual of HP 8751A.

Comparison of HP-IB commands for the HP 8751A and HP 8753C

Most HP-IB commands for the HP 8753C are the same as the commands for the HP 8751A. These commands are referred to as "same" in the table below. Some of the commands listed below have the same function for the two instruments, but have different syntax. Also listed are commands used by the HP 8753C only.

There is one difference between HP 8753C and HP 8751A command syntax. For the HP 8751A, a space must be placed between the command and value or string.

For example: `AVERFACT[value];`

- `AVERFACT⊔8` must be used for the HP 8751A, and can be used for the HP 8753C. (⊔ is a space.)
- `AVERFACT8` can be used for the HP 8753C
- `TITL⊔""DEVICE1""` must be used for the HP 8751A, and can be used for the HP 8753C
- `TITL""DEVICE1""` can be used for the HP 8753C

Note

The `WAIT` statement is used for the detection of the end of sweep in the HP 8753C. The equivalent code for the HP 8751A is as follows:

```
REPEAT
  OUTPUT @Hp8751;"ESB?"
  ENTER @Hp8751;Stat
UNTIL BIT(Stat,0)
```

HP 8753C Commands	HP 8751A Commands	Description
AB;	same	A/B measurement
ADDRCONT;	same	External controller HP-IB address
ADDRDISC[value];	HP 8753C only	External disk drive HP-IB address The HP 8751A cannot control an external disk as a system controller. See "Built-in Disk Drive".
ADDRPLOT[value];	same	Plotter HP-IB address
ADDRPRIN[value];	same	Printer HP-IB address
ALTAB;	COUCOFF; (only Dual Channel mode)	Alternate sweep The HP 8751A selects alternate sweep when coupled channel is turn off (COUCOFF;), or alternate measurement at each point when coupled channel is turn on (COUCON;).
ANAB;	HP 8753C only	Analog bus Enable
ANAI;	HP 8753C only	Analog Input measurement
AR;	same	A/R measurement
ASEG;	HP 8753C only	Measure all frequency list segments The HP 8751A always measures all segments.
ASSS;	HP 8753C only	Assert sequence status bit Test sequence is not available.
ATTP<1|2>[value];	same	Port attenuator value
AUTO;	same	Autoscale
AVERFACT[value];	same	Averaging factor
AVER<ON|OF>;	same	Averaging function
AVERREST;	same	Reset and restarts averaging
BACI[0-100];	same	Background intensity of CRT
BEEPDONE<ON|OFF>;	same	Operation completion beeper
BEEPFAIL<ON|OFF>;	same	Limit fail beeper
BEEPWARN<ON|OFF>;	same	Warning beeper
BR;	same	B/R measurement
C0;	same	Open circuit capacitor, C_0
C1;	same	Open circuit capacitor, C_1
C2;	same	Open circuit capacitor, C_2
C3;	HP 8753C only	Open circuit capacitor, C_3 Not available with the HP 8751A.
CAL1;	KEY 15;KEY 2;	Display calibration menu
CALIFUL2;	same	Full 2-port cal
CALIONE2;	same	One-path 2-port cal
CALIRAI;	same	Response and isolation cal

F Comparison of the HP 8751A and HP 8753C Network Analyzer HP-IB Commands

HP 8753C Commands	HP 8751A Commands	Description
CALIRESP;	same	Response cal
CALIS111;	same	S_{11} 1-port cal
CALIS221;	same	S_{22} 1-port cal
CALK35MM;	HP 8753C only	3.5 mm cal kit
CALK7MM;	same	7 mm cal kit
CALKN50;	same	50 Ω type-N cal kit
CALKN75;	same	75 Ω type-N cal kit
CALKUSED;	same	User cal kit
CALN;	same	No cal
CBRI[0-100];	same	Color brightness
CENT[value[suffix]];	same	Center stimulus value
CHAN1;	same	Channel 1 as active channel
CHAN2;	same	Channel 2 as active channel
CHOPAB;	COUCON;	Chopper sweep
		The HP 8751A selects chopper sweep (alternate measurement at each point) when coupled channel is turn on (COUCON;). See also ALTAB;.
CLAD;	same	Complete specifying the class
CLASS11A;	same	S_{11} 1-port cal standard class
CLASS11B;	same	S_{11} 1-port cal standard class
CLASS11C;	same	S_{11} 1-port cal standard class
CLASS22A;	same	S_{22} 1-port cal standard class
CLASS22B;	same	S_{22} 1-port cal standard class
CLASS22C;	same	S_{22} 1-port cal standard class
CLEA<1-5>;	HP 8753C only	Clear Save & Recall register
CLEARALL;	HP 8753C only	Clear all Save & Recall registers
		HP 8751A has no multiple internal save-recall registers. See "Built-in Disk Drive".
CLEAL;	CLEL;	Clear frequency list
CLEL;	same	Clear frequency list
CLES;	*CLS;	Clear status byte
CLS;	*CLS;	Clear status byte
COAX;	HP 8753C only	Select cal standard as Coaxial
		HP 8751A always uses Coaxial.
COLOCH1D;	same	Channel 1 Data to change color
COLOCH1M;	same	Channel 1 Memory to change color
COLOCH2D;	same	Channel 2 Data to change color
COLOCH2M;	same	Channel 2 Memory to change color
COLOGRAT;	same	Graticule to change color
COLOTEXT;	same	Text to change color

<table>
<tr><th>HP 8753C Commands</th><th>HP 8751A Commands</th><th>Description</th></tr>
<tr><td>COLOWARN;</td><td>same</td><td>Warning message to change color</td></tr>
<tr><td>COLOR[0-100];</td><td>same</td><td>Saturation percent</td></tr>
<tr><td>CONT;</td><td>same</td><td>Continuous trigger</td></tr>
<tr><td>CONV1DS;</td><td>same</td><td>1/S conversion operation</td></tr>
<tr><td>CONVOFF;</td><td>same</td><td>No conversion operation</td></tr>
<tr><td>CONVYREF;</td><td>same</td><td>Y:REF conversion operation</td></tr>
<tr><td>CONVYTRA;</td><td>same</td><td>Y:TRANSE conversion operation</td></tr>
<tr><td>CONVZREF;</td><td>same</td><td>Z:REF conversion operation</td></tr>
<tr><td>CONVZTRA;</td><td>same</td><td>Z:TRANSE conversion operation</td></tr>
<tr><td>COPYFRFT;</td><td>HP 8753C only</td><td>Copy file titles to register titles</td></tr>
<tr><td>COPYFRRT;</td><td>HP 8753C only</td><td>Copy register titles to disk
The HP 8751A has no multiple internal save-recall registers. See "Built-in Disk Drive".</td></tr>
<tr><td>CORI<ON|OFF>;</td><td>HP 8753C only</td><td>Interpolative error correction
The HP 8751A automatically activates interpolation and has no command to manually turned it off.</td></tr>
<tr><td>CORR<ON|OFF>;</td><td>same</td><td>Error correction</td></tr>
<tr><td>COUC<ON|OFF>;</td><td>same</td><td>Channel coupling of stimulus value</td></tr>
<tr><td>COUP<ON|OFF>;</td><td>HP 8753C only</td><td>Couple power when uncoupled channels</td></tr>
<tr><td>CWFREQ[value[suffix]];</td><td>same</td><td>Frequency for single frequency mode</td></tr>
<tr><td>CWTIME;</td><td>HP 8753C only</td><td>CW time sweep mode is not available</td></tr>
<tr><td>DATI;</td><td>same</td><td>Store Data to Trace Memory</td></tr>
<tr><td>DEFC;</td><td>same</td><td>Default color</td></tr>
<tr><td>DEFS;</td><td>same</td><td>Define cal standard</td></tr>
<tr><td>DELA;</td><td>same</td><td>Delay format</td></tr>
<tr><td>DELO;</td><td>same</td><td>Delta marker mode OFF</td></tr>
<tr><td>DELR<1-4>;</td><td>DELR<1-8>;</td><td>Delta reference marker
HP 8753C has 4 markers. HP 8751A has 8 markers.</td></tr>
<tr><td>DELRFIXM;</td><td>same</td><td>Fixed reference marker</td></tr>
<tr><td>DEMOAMPL;</td><td>HP 8753C only</td><td>Amplitude demodulation</td></tr>
<tr><td>DEMOOFF;</td><td>HP 8753C only</td><td>Demodulation OFF</td></tr>
<tr><td>DEMOPHAS;</td><td>HP 8753C only</td><td>Phase demodulation
Time domain is not available to HP 8751A.</td></tr>
<tr><td>DFLT;</td><td>same</td><td>Default plotting parameters</td></tr>
<tr><td>DISM<ON|OFF>;</td><td>MARKL<ON|OFF>;</td><td>Marker list</td></tr>
<tr><td>DISPDATA;</td><td>same</td><td>Display DATA</td></tr>
<tr><td>DISPDATM;</td><td>same</td><td>Display DATA and MEMORY</td></tr>
</table>

<table>
<tr><th>HP 8753C Commands</th><th>HP 8751A Commands</th><th>Description</th></tr>
<tr><td>DISPDDM;</td><td>same</td><td>Display DATA/MEMORY</td></tr>
<tr><td>DISPDMM;</td><td>same</td><td>Display DATA−MEMORY</td></tr>
<tr><td>DISPMEMO;</td><td>same</td><td>Display MEMORY only</td></tr>
<tr><td>DIVI;</td><td>DISPDDM;</td><td>Display DATA/MEMORY</td></tr>
<tr><td>DONE;</td><td>same</td><td>Complete cal measurement of standard class</td></tr>
<tr><td>DOWN;</td><td>Key 24;</td><td>Decrement active function value</td></tr>
<tr><td>DUAC<ON|OFF>;</td><td>same</td><td>Dual channel</td></tr>
<tr><td>DUPLSE<1-6>SEQ<1-6>;</td><td>HP 8753C only</td><td>Duplicate test sequence
Test sequence is not available to HP 8751A.</td></tr>
<tr><td>EDITDONE;</td><td>same</td><td>Complete editing frequency list</td></tr>
<tr><td>EDITLIML;</td><td>same</td><td>Edit limit line table</td></tr>
<tr><td>EDITLIST;</td><td>same</td><td>Edit frequency list</td></tr>
<tr><td>ELED;</td><td>same</td><td>Electrical delay</td></tr>
<tr><td>EMIB;</td><td>HP 8753C only</td><td>Beep during test sequence
Test sequence is not available to HP 8751A</td></tr>
<tr><td>ENTO;</td><td>KEY 26;</td><td>Entry OFF</td></tr>
<tr><td>ESB?;</td><td>same</td><td>Output event status register B</td></tr>
<tr><td>ESE[value];</td><td>*ESE[value];</td><td>Set enable bit of standard status register</td></tr>
<tr><td>ESNB[value];</td><td>same</td><td>Specify bits of event status register B</td></tr>
<tr><td>ESR?;</td><td>*ESR?;</td><td>Output event status register</td></tr>
<tr><td>EXET;</td><td>same</td><td>Execute service test</td></tr>
<tr><td>EXTMDATA<ON|OFF>;</td><td>HP 8753C only</td><td>Error-corrected data</td></tr>
<tr><td>EXTMFORM<ON|OFF>;</td><td>HP 8753C only</td><td>Formatted data</td></tr>
<tr><td>EXTMGRAP<ON|OFF>;</td><td>HP 8753C only</td><td>User graphics</td></tr>
<tr><td>EXTMRAW<ON|OFF>;</td><td>HP 8753C only</td><td>Raw data arrays
Specify data types included in register storage to disk. The HP 8751A cannot control an external disk as a system controller. See also "Built-in Disk Drive".</td></tr>
<tr><td>EXTT<ON|OFF>;</td><td>same</td><td>External trigger mode</td></tr>
<tr><td>EXTTPOIN;</td><td>same</td><td>External trigger on point</td></tr>
<tr><td>FOCU[1-100];</td><td>HP 8753C only</td><td>CRT focus</td></tr>
<tr><td>FORM1;</td><td>HP 8753C only</td><td>Instrument internal binary</td></tr>
<tr><td>FORM2;</td><td>same</td><td>IEEE 32-bit floating point</td></tr>
<tr><td>FORM3;</td><td>same</td><td>IEEE 64-bit floating point</td></tr>
<tr><td>FORM4;</td><td>same</td><td>ASCII</td></tr>
<tr><td>FROM5;</td><td>same</td><td>PC-DOS 32-bit floating point</td></tr>
</table>

HP 8753C Commands	HP 8751A Commands	Description
FREO;	same	Frequency blank
FREQOFFS<ON|OFF>;	HP 8753C only	Frequency offset mode
		Frequency offset operation is not available to HP 8751A
FRER;	CONT;	Continuous trigger
FULP;	same	Full page plot
FWDI;	same	Forward isolation class
FWDM;	same	Forward match
FWDT;	same	Forward transmission
GATECENT[value[suffix]];	HP 8753C only	Gate center
GATE<ON|OFF>;	HP 8753C only	Gate
GATESPAN;	HP 8753C only	Gate time span
GATESTAR;	HP 8753C only	Gate start time
GATESTOP;	HP 8753C only	Gate stop time
GATEMAXI;	HP 8753C only	Maximum shape gate
GATSMINI;	HP 8753C only	Minimum shape gate
GATESNORM;	HP 8753C only	Normal shape gate
GATESWIDE;	HP 8753C only	Wide shape gate
		Gating time domain response is not available to HP 8751A.
HOLD;	same	Trigger hold
IDN?;	*IDN?;	Output ID
IFBW[value];	same	IF bandwidth
IMAG;	same	Imaginary format
INID;	same	Initialize disk
INPUCALC<01-12>;	same	Input cal data
INPUCALK;	same	Input cal kit data
INPUDATA;	same	Input cal data
INPUFORM;	same	Input formatted data
INPULEAS;	HP 8753C only	Learn string
INPURAW<1-4>;	same	Input Raw data
INSMEXSA;	HP 8753C only	External source, auto
INSMEXSM;	HP 8753C only	External source, manual
INSMNETA;	HP 8753C only	Standard analyzer
INSMTUNR;	HP 8753C only	Turned receiver
		External source mode and tuned receiver mode are not available to HP 8751A. The HP 8751A works only as standard analyzer.
INTE[0-100];	same	CRT intensity
ISOD;	same	Done with isolation of 2-port cal
ISOL;	same	Begin isolation part of 2-port cal

HP 8753C Commands	HP 8751A Commands	Description
KEY[keycode];	same	Send keycode. Some keycodes are different from the HP 8753C's. See keycode table in HP 8751A HP-IB Programming manual, Appendix C.
KITD;	same	Done with modify cal kit
KOR?;	HP 8753C only	Output key code or knob count
LABEFWDM["string"];	same	Forward match class label
LABEFWDT["string"];	same	Forward transmission class label
LABERESI["string"];	same	Response and isolation class label
LABERESP["string"];	same	Response class label
LABEREVM["string"];	same	Reverse match label
LABEREVT["string"];	same	Reverse transmission label
LABES11A["string"];	same	S_{11A} class label
LABES11B["string"];	same	S_{11B} class label
LABES11C["string"];	same	S_{11C} class label
LABES22A["string"];	same	S_{22A} class label
LABAS22B["string"];	same	S_{22B} class label
LABES22C["string"];	same	S_{22C} class label
LABK["string"];	same	Calibration kit label
LABS["string"];	same	Calibration standard label
LEFL;	same	Plot to left lower
LEFU;	same	Plot to left upper
LIMD[value];	same	Delta limit
LIMIAMPO[value];	same	Limit line amplitude offset
LIMILINE<ON|OFF>;	same	Limit line
LIMIMAOF[value[suffix]];	same	Marker to limit line amplitude offset
LIMISTIO[value[suffix]];	same	Limit line stimulus offset
LIMITEST<ON|OFF>;	same	Limit test
LIML[value];	same	Lower limit
LIMM[value];	same	Middle limit
LIMS[value];	same	Limit segment start stimulus value
LIMTFL;	HP 8753C only	Flat line
LIMTSL;	HP 8753C only	Sloping line
LIMTSP;	HP 8753C only	Single point
LIMU[value];	same	Upper limit
LINFREQ;	same	Linear frequency sweep
LINM;	same	Linear magnitude format
LINTDATA[value];	same	Line type to plot Data trace
LINTMEMO[value];	same	Line type to plot Memory trace
LISFREQ;	same	Frequency list sweep
LISV;	same	List data value

HP 8753C Commands	HP 8751A Commands	Description
LOAD<1-5>;	HP 8753C only	Recall disk file
LOADREC<1-5>;	HP 8753C only	Load receiver cal data
LOADSOU<1-5>;	HP 8753C only	Load source cal data
		HP 8751A does not have multiple internal save-recall register. See "Built-in Disk Drive".
LOGFREQ;	same	Log frequency sweep
LOGM;	same	Log magnitude format
LRN?;	HP 8753C only	Output learn string
MANTRIG;	same	Manual trigger on a single point
MARK<1-4>[value[suffix]];	MARK<1-8>[value[suffix]];	Select active marker
		HP 8753C has 4 markers. HP 8751A has 8 markers.
MARKBUCK[0-(NOP-1)];	MARKBUCK[1-NOP];	Move active marker to specified point
MARKCENT[value[suffix]];	same	Marker → CENTER
MARK<COUP|UNCO>;	same	Marker coupling
MARKDELA;	same	Marker → DELAY
MARK<DISC|CONT>;	same	Select Discrete or Continuous
MARKFAUV[value[suffix]];	same	Fixed marker auxiliary value offset
MARKFSTI[value[suffix]];	same	the fixed marker stimulus value offset
MARKFVAL[value];	same	Fixed marker position value offset
MARKMAXI;	SEAMAX;	Search maximum value
MARKMIDD;	same	Change segment middle value to marker amplitude
MARKMINI;	SEAMIN;	Search minimum value
MARKOFF;	same	Marker OFF
MARKREF;	same	Marker → REFERENCE
MARKSPAN;	same	Marker → SPAN
MARKSTAR;	same	Marker → START
MARKSTIM;	same	Change segment stimulus value to marker stimulus value
MARKSTOP;	same	Marker → STOP
MARKZERO;	same	Move fixed marker to active marker position
MAXF[value[suffix]];	HP 8753C only	Maximum frequency of cal standard
		You do not need to define the maximum frequency with the HP 8751A frequency range.
MEASA;	same	A measurement
MEASB;	same	B measurement
MEASR;	same	R measurement
MEASTAT<ON|OFF>;	same	Select trace statistics

HP 8753C Commands	HP 8751A Commands	Description
MENUAVG;	KEY 14;	Display Average menu
MENUCAL;	KEY 15;	Display Correction menu
MENUCOPY;	KEY 47;	Display Copy menu
MENUDISP;	KEY 13;	Display Display menu
MENUFORM;	KEY 11;	Display Format menu
MENUMARK;	KEY 16;	Display Marker menu
MENUMEAS;	KEY 10;	Display Input Port menu or S-parameter menu
MENUMRKF;	KEY 17;	Display Marker Function menu
MENU<ON|OFF>;	HP 8753C only	Softkey menu ON/OFF
MENURECA;	KEY 49;	Display Recall (File) menu
MENUSAVE;	KEY 48;	Display Save menu
MENUSCAL;	KEY 12;	Display Scale menu
MENUSTIM;	KEY 19;	Display Stimulus menu
MENUSYST;	KEY 44;	Display System menu
MINF[value[suffix]];	HP 8753C only	Minimum frequency of cal standard You do not need to define the minimum frequency with the HP 8751A frequency range.
MINU;	DISPDMM;	DATA-MEMORY
MODI1;	same	Modify cal kit menu
NEXP;	same	Next page
NOOP;	HP 8753C only	No operation
NUMG[value];	same	Number of groups
OFSD[value[suffix]];	same	Offset delay
OFSL[value];	same	Offset loss
OFSOINDR[value];	HP 8753C only	Optical refractive index
OFSOLENG[value];	HP 8753C only	Physical length
OFSOLOSS[value];	HP 8753C only	Optical loss
OFSORPOW[value];	HP 8753C only	Percent reflectance
OFSZ[value];	same	Electrical offset line Z_0
OMII;	same	Omit isolation cal of 2-port cal
OPC[?];	*OPC[?];	Operation complete
OPEP;	same	List parameters
OUTPACTI;	HP 8753C only	Active function value
OUTPAFR;	HP 8753C only	Single processor RF frequency
OUTPAPER;	HP 8753C only	Smoothing aperture
OUTPCALC<01-12>;	OUTPCALC<01-12>?;	Active cal set array
OUTPCALK;	OUTPCALK?;	Current cal kit
OUTPCALR;	HP 8753C only	Receiver cal data
OUTPCALS;	HP 8753C only	Source cal data External source mode and tuned receiver mode are not available.

HP 8753C Commands	HP 8751A Commands	Description
OUTPDATA;	OUTPDATA?;	Active channel corrected data
OUTPERRO;	OUTPERRO?;	Error message
OUTPFORM;	OUTPFORM?;	Active channel formatted data
OUTPIDEN;	*IDN?;	Instrument ID string
OUTPKEY;	HP 8753C only	Last key pressed
OUTPLEAS;	HP 8753C only	Instrument learn string
OUTPLIMF;	OUTPLIMF?;	Limit test, failed point
OUTPLIML;	OUTPLIML?;	Limit test, each point
OUTPLIMM;	OUTPLIMM?;	Limit test, marker position
OUTPMARK;	OUTPMARK?;	Actve marker
OUTPPUL;	HP 8753C only	Pulse width
OUTPMEMO;	OUTPMEMO?;	Current memory data
OUTPMSTA;	OUTPMSTA?;	Marker stats
OUTPMWID;	OUTPMWID?;	Bandwidth search
OUTPMWIL;	HP 8753C only	Band search
OUTPPLOT;	HP 8753C only	HP-GL plot string
OUTPPMCAL<1|2>	HP 8753C only	Power meter cal
OUTPPRIN;	HP 8753C only	Raster dump to printer
OUTPRAW<1-4>;	OUTPRAW<1-4>?;	Raw data
OUTPRFFR;	HP 8753C only	External source frequency
		External source mode is not available to HP 8751A.
OUTPSEQ<1-6>;	HP 8753C only	Test sequence
		Test sequence function is not available to HP 8751A.
OUTPSTAT;	*STB?;.	Status byte
OUTPTESS;	OUTPTESS?;	Test status
OUTPTITL;	OUTPTITL?;	Display title
OUTPTPLL;	HP 8753C only	True PLL sequence
PAUS;	HP 8753C only	Pause in test sequence
		Test sequence function is not available.
PCB[value];	*PCB[value];	Pass Control Back address
PDATAOFF;	The following commands are almost the same:	Data trace plot OFF
	DISPMEMO;PLOALL;	Memory trace and all information displayed
	DISPMEMO;PLODGART;	Memory trace and graticule
	DISPMEMO;PLODONLY;	Memory trace only

HP 8753C Commands	HP 8751A Commands	Description
PDATAON;	The following commands are almost the same:	Data trace plot on
	DISPDATA;PLOALL;	Data trace and all information displayed
	DISPDDM;PLOALL;	Both Data and Memory trace, and all information displayed
	DISPDATA;PLODGART;	Data trace and graticule
	DISPDDM;PLODGART;	Both Data and Memory trace, and graticule
	DISPDATA;PLODONLY;	Data trace only
	DISPDDM;PLODONLY;	Both Data and Memory trace only
PENNDATA[value];	HP 8753C only	Data trace plot color
PENNGART[value];	HP 8753C only	Graticule plot color
PENNMARK[value];	HP 8753C only	Markers and marker text plot color
PENNMEMO[value];	HP 8753C only	Memory trace plot color
PENNTEXT[value];	HP 8753C only	Text and user graphics plot color
		If PRICFIXE; is active, the HP 8751A prints a hard copy with default color. If PRICVARI; is active, the HP 8751A prints a hard copy with color as similar as possible to the display.
PGRATOFF;	PLODONLY;	Graticule plot OFF
PGRATON;	PLODGART; PLOALL;	Graticule plot ON
		PLODONLY; plots trace only, PLODGART; plots both trace and graticule, and PLOALL; plots all the information displayed.
PHAO[value];	same	Phase offset
PHAS;	same	Phase format
PLOS<FAST|SLOW>;	same	Plotting speed
PLOT;	same	Plot display
PMEMOFF;	The following commands are almost the same:	Memory trace plot OFF
	DISPDATA;PLOALL;	Data trace and all information displayed
	DISPDATA;PLOGRAT;	Data trace and graticule
	DISPDATA;PLODDONLY;	Data trace only

HP 8753C Commands	HP 8751A Commands	Description
PMEMON;	The following commands are almost the same:	Memory trace plot ON
	DISPMEMO;PLOALL;	Memory trace and all information displayed
	DISPDDM;PLOALL;	Both Data and Memory trace, and all information displayed
	DISPMEMO;PLOGRAT;	Memory trace and graticule
	DISPDDM;PLOGRAT;	Both Data and Memory trace, and graticule
	DISPMEMO;PLODDONLY;	Memory trace only
	DISPDDM;PLODDONLY;	Both Data and Memory trace only
PMARKOFF;	The following commands are almost the same	Marker and Marker text plot OFF
	PLODGRAT;	Trace and graticule
	PLODONLY;	Trace only
PMARKON;	The following command is almost the same:	Marker and Marker text plot ON
	PLOALL;	All information displayed
POIN[value];	same	Number of points
POLA;	same	Polar format
POLMLIN;	same	Linear marker for polar format
POLMLOG;	same	Log marker for polar format
POLMRI;	same	Real & imaginary marker for polar format
PORE<ON|OFF>;	same	Port extensions
PORT1[value[suffix]];	same	Port1 extension
PORT2[value[suffix]];	same	Port2 extension
PORTA[value[suffix]];	same	A port extension
PORTB[value[suffix]];	same	B port extension
PORTR[value[suffix]];	same	R port extension
POWE[value];	same	Output power level
POWLFREQ;	HP 8753C only	Frequency in power loss list
POWLLIST;	HP 8753C only	Edit power loss list
POWLLOSS;	HP 8753C only	Power loss in power loss list
		Power meter calibration is not available to HP 8751A.
POWS<ON|OFF>;	same	Power sweep
POWT<ON|OFF>;	HP 8753C only	Power trip
		HP 8751A automatically sets power trip function ON. To reset power trip, use CLEPTRIP;.
PRES;	same	Preset
PRIC;	same	Color print
PRINALL;	same	Print
PRIS;	same	Default print set

HP 8753C Commands	HP 8751A Commands	Description
PSOFT<ON|OFF>;	same	Plot softkey labels
PTEXTOFF;	The following commands are almost the same:	Text plot OFF
	PLOGRAT;	Trace and graticule
	PLODONLY;	Trace only
PTEXTON;	The following command is almost the same:	Text plot ON
	PLOALL;	All information displayed
PURG<1-5>;	HP 8753C only	HP 8751A has not internal save-recall register. See above, "Built-in Disk Drive".
RAID;	same	Done with response & isolation cal
RAIISOL;	same	Isolation class for response and isolation cal
RAIRESP;	same	Response class for response and isolation cal
REAL;	same	Real format
RECA<1-5>;	HP 8753C only	Recall instrument state HP 8751A has not internal save-recall register. See above, "Built-in Disk Drive".
RECO;	RECC	Recall color
REFD;	same	Done with reflection part of full 2-port cal
REFL;	same	Reflection part of full 2-port cal
REFP[value];	same	Reference position
REFT;	HP 8753C only	Recall register titles from disk The HP 8751A cannot control an external disk as a system controller. See above, "Built-in Disk Drive".
REFV[value];	same	Reference value
RESC;	same	Resume cal sequence
RESD;	same	Restore display
RESPDONE;	same	Done with response cal
REST;	same	Measurement restart
REVI;	same	Reverse isolation class
REVM;	same	Reverse match class
REVT;	same	Reverse transmission class
RIGL;	same	Quarter-page plot in lower right
RIGU;	same	Quarter-page plot in upper right
RSCO;	same	Reset color
RST;	*RST;	Reset

HP 8753C Commands	HP 8751A Commands	Description
S11;	same	S11 measurement
S12;	same	S12 measurement
S21;	same	S21 measurement
S22;	same	S22 measurement
SADD;	same	Add new segment
SAMC<ON|OFF>;	HP 8753C only	Internal sampler correction
SAV1;	same	Done with 1-port cal
SAV2;	same	Done with 2-port cal
SAVC;	same	Re-draw a trace using error coefficient array data
SAVE<1-5>;	HP 8753C only	Save state in register HP 8751A has no multiple internal save-recall registers. See above, "Built-in Disk Drive".
SAVEUSEK;	same	Save user kit
SAVUASCI;	HP 8753C only	Save using CITI file ASCII
SAVUBINA;	HP 8753C only	Save using binary
SCAL[value];	same	
SCAPFULL;	same	
SCAPGRAT;	HP 8753C only	Use SCAPGU; to fit the upper graticule or use SCAPGL; to fit the lower, to user-defined P1 and P2 scaling point on the plotter.
SDEL;	same	Delete segment
SDON;	same	Done with editing segment
SEAL;	same	Search left
SEAMAX;	same	Search maximum
SEAMIN;	same	Search minimum
SEAOFF;	same	Search OFF
SEAR;	same	Search right
SEATARG[value];	same	Search target point
SEDI[value];	same	Segment
SETZ;	same	Set characteristic impedance Z_0
SING;	same	Single sweep
SLOPE[value];	HP 8753C only	Power slope value
SLOP<ON|OFF>;	HP 8753C only	Power slope Power slope function is not available to HP 8751A.
SMIC;	same	Smith chart format
SMIMGB;	same	G+jB marker for Smith chart
SMIMLIN;	same	Linear marker for Smith chart

HP 8753C Commands	HP 8751A Commands	Description
SMIMLOG;	same	Log marker for Smith chart
SMIMRI;	same	Real & imaginary marker for Smith chart
SMIMRX;	same	R+jX marker for Smith chart
SMOOAPER[0.1-20[%]];	SMOOAPER[0.05-100[%]].	Smoothing aperture range for HP 8751A is between 0.05% to 100%. Range for HP 8753C is 0.1% to 20%.
SMOO<ON|OFF>;	same	Smoothing function
SOFR;	FIRR?;	Firmware revision
SOFT<1-8>;	KEY<0-7>;	Press softkeys
SPAN[value[suffix]];	same	Stimulus span
SPECFWDM A[,B ... [,G]];	same	FWD MATCH standard class
SPECFWDT A[,B ... [,G]];	same	FWD TRANS standard class
SPECRESI A[,B ... [,G]];	same	Response & isolation standard class
SPECRESP A[,B ... [,G]];	same	Response standard class
SPECREVM A[,B ... [,G]];	same	Rev match standard class
SPECTEVT A[,B ... [,G]];	same	Rev trans standard class
SPECS11A A[,B ... [,G]];	same	S_{11A} standard class
SPECS11B A[,B ... [,G]];	same	S_{11B} standard class
SPECS11C A[,B ... [,G]];	same	S_{11C} standard class
SPECS22A A[,B ... [,G]];	same	S_{22A} standard class
SPECS22B A[,B ... [,G]];	same	S_{22B} standard class
SPECS22C A[,B ... [,G]];	same	S_{22C} standard class
SPEG<ON|OFF>;	HP 8753C only	Gate marker
		Gated time domain is not available to HP 8751A.
SPLD<ON|OF>;	same	Split display
SRE[value];	*SRE[value];	Enable bits of status byte
SSEG[value];	HP 8753C only	Single segment of frequency list
		The HP 8751A always measures all segments.
STAN<A-G>;	same	Measure standard
STAR[value[suffix]];	same	START
STB?;	*STB?;	Status byte
STDD;	same	Done with standard definition
STDTARBI;	same	Arbitrary impedance standard type
STDTDELA;	same	Delay/Thru standard type
STDTLOAD;	same	Load standard type
STDTOPEN;	same	Open standard type
STDTSHOR;	same	Short standard type

HP 8753C Commands	HP 8751A Commands	Description
STOP[value[suffix]];	same	STOP
STOR<1-5>;	HP 8753C only	Store file to disk
		HP 8751A has no multiple internal save-recall registers. See "Built-in Disk Drive".
STPSIZE[value[suffix]];	same	Step size for list sweep
SVCO;	same	Save colors
SWEA;	SWETAUTO;	Sweep time AUTO
SWET[value[suffix]];	same	Sweep time
SWR;	same	SWR format
TALKLIST;	HP 8753C only	Talker/Listener mode
		HP 8753C has two modes for remote programming by HP-IB, Talker/Listener (TALKLIST;) and Use Pass Control (USEPASC;). HP 8751A requires Addressable Only mode for remote programming. This mode combines Talker/Listener and Pass Control modes, eliminating the need to change modes.
TERI[value];	same	Arbitrary impedance value (terminal impedance)
TESS?;	same	Test set ID
TEST[value];	same	Service test number
TINT[0-100];	same	Hue to modify color
TITF<1-5>["string"];	HP 8753C only	Disk file
TITL["string"];	same	CRT title
TITR<1-5>["string"];	HP 8753C only	Save/recall register
TITSEQ<1-6>["string"];	HP 8753C only	Test sequence
TITSQ["string"];	HP 8753C only	Current test sequence
TITTMEM["string"];	HP 8753C only	Trace memory
TITTPMTR["string"];	HP 8753C only	Power meter address
TITTPRIN["string"];	HP 8753C only	Printer address
TRACK<ON|OFF>;	same	Marker search tracking
TRAD;	same	Done with full 2-port cal
TRAN;	same	Transmission part of full 2-port cal
TRAP;	HP 8753C only	Frequency with transform ON
TRAS[value[suffix]];	HP 8753C only	Frequency span with transform
TRIG;	*TRIG;	Trigger
TST?;	*TST?;	Self test

HP 8753C Commands	HP 8751A Commands	Description
TTLOH;	HP 8753C only	Active level HIGH
TTLOL;	HP 8753C only	Active level LOW
UP;	KEY 25	Increment active function value
USPASC;	HP 8753C only	Instrument enters Use Pass Control mode
		To control the HP 8751A over HP-IB, HP 8751A requires Addressable Only mode, that lets you also to use pass control. See also TALKLIST;.
VELOFACT[value];	same	Velocity factor
VOFF;	HP 8753C only	Frequency offset value
		Frequency offset operation is not available to HP 8751A.
WAIT;	HP 8753C only[1]	Wait for a clean sweep
*WAI;	same	Wait until all previously sent commands are completed
WAVE;	HP 8753C only	Wave guide cal standard
		HP 8751A uses only coax standard.
WIDT<ON|OFF>;	same	Bandwidth search
WIDV[value];	same	Width value
WINDMAXI;	HP 8753C only	Maximum window
WINDMINI;	HP 8753C only	Minimum window
WINDNORM;	HP 8753C only	Normal window
WINDOW;	HP 8753C only	Arbitary window
WINDUSEMOFF;	HP 8753C only	Above commands define windows
WINDUSEMON;	HP 8753C only	Memory trace defines window
		Time domain is not available to HP 8751A.
WRSK<1-8>["string"];	HP 8753C only	New softkey label

1 See NOTE before Table F-1.

Manual Changes

INTRODUCTION

This appendix contains the information required to adapt this manual to earlier versions or configurations of the HP 8751A than the current printing date of this manual. The information in this manual applies directly to the HP 8751A Network Analyzer serial number prefix listed on the title page of this manual.

MANUAL CHANGES

To adapt this manual to your HP 8751A, refer to Table G-1 and Table G-2, and make all of the manual changes listed opposite your instrument's serial number and firmware version.

Instruments manufactured after the printing of this manual may be different than those documented in this manual. Later instrument versions will be documented in a manual changes supplement that will accompany the manual shipped with that instrument. If your instrument's serial number is not listed on the title page of this manual or in Table G-1, it may be documented in a *yellow MANUAL CHANGES* supplement.

Turn on the line switch or execute the "*IDN?" command by HP-IB to confirm the firmware version. Refer to HP-IB Programing Manual for information on the "*IDN?" command. For additional information on serial number coverage, refer to Chapter 1 in General Information.

Table G-1. Manual Changes by Serial Number

Serial Prefix or Number	Make Manual Changes
3026	Change 1
3123	Change 2

Table G-2. Manual Changes by Firmware Version

Version	Make Manual Changes
2.00 and below	Change 1
3.0 through 3.02	Change 2

CHANGE 1

Chapter 1

- Delete the following sentence.

Appendix E provides information about the waveform analysis function.

"Figure 2-15. Sample Program: Storing Instrument States" in chapter 2

- Delete line 161.

Chapter 3

- Delete the following HP-IB commands.

ANAOCH1
ANAOCH2
ANAODATA
ANAOMEMO
ANARANG *value*[*suffix*],*value*[*suffix*]
ANARFULL
ASCE *string*
CHAD *string*
COLO{PEN1|PEN2|PEN3|PEN4|PEN5|PEN6}
CONVMP{4|8|16}
CRED *string*
CURD?
DISFDOS
DISFLIF
FILC
GRAE *string*
OSER?
OSNT
OSPT
OUTPFILT? *value*[*suffix*]
OUTPMAX?
OUTPMEAN?
OUTPMIN?
OUTPMINMAX?
OUTPRESO?
RPLENV?
RPLHEI?
RPLLHEI?
RPLPP?
RPLRHEI?
SAVDASC "*string*"
SAVDGRA "*string*"
STODDISK
STODMEMO

- Replace the CONV command description with the following description:

Selects the measurement data conversion setting, impedance or admittance. (Query)

parameter OFF, ZREF, ZTRA, YREF, YTRA, ONEDS

- Replace the FORM2 command description with the following description:

Sets the IEEE 32-bit floating point format to transfer the trace data by HP-IB.

- Replace the FORM3 command description with the following description:

Sets the IEEE 64-bit floating point format to transfer the trace data by HP-IB.

- Replace the FORM4 command description with the following description:

Sets the ASCII transfer format to transfer the trace data by HP-IB.

- Replace the FORM5 command description with the following description:

Sets the DOS format to transfer the trace data by HP-IB.

Appendix A

- Delete the following items.

ASCE	ASCII DATA [.TXT]
COLOPEN{1-6}	PEN 1 to PEN 6
CONV MP{4|8|16}	4 * Phase 8 * Phase 16 * Phase
CONVMP{4|8|16}	
CRED	CREATE DIRECTORY
DISFDOS	FORMAT [DOS]
DISFLIF	FORMAT [LIF]
FILC	COPY FILE
GRAE	GRAPHICS [.HPG]
SAVDASC	DATA ONLY
SAVDGRA	GRAPHICS
STODDISK	STOR DEV [DISK]
STODMEMO	STOR DEV [MEMO]

G.Manual Changes

“Commands Which Don’t Have Equivalent Softkey Labels” in Appendix A

- Delete the following items.

  ANAOCH1
  ANAOCH2
  ANAODATA
  ANAOMEMO
  ANARANG *value,value*
  ANARFULL
  RPLENV?
  RPLHEI?
  RPLLHEI?
  RPLPP?
  RPLRHEI?
  OUTPFILT? *value*
  OUTPMAX?
  OUTPMEAN?
  OUTPMIN?
  OUTPMINMAX?
  OUTPRESO?
  OSER?
  OSNT
  OSPT

Appendix B

- Replace Figure B-1 with the following figure.

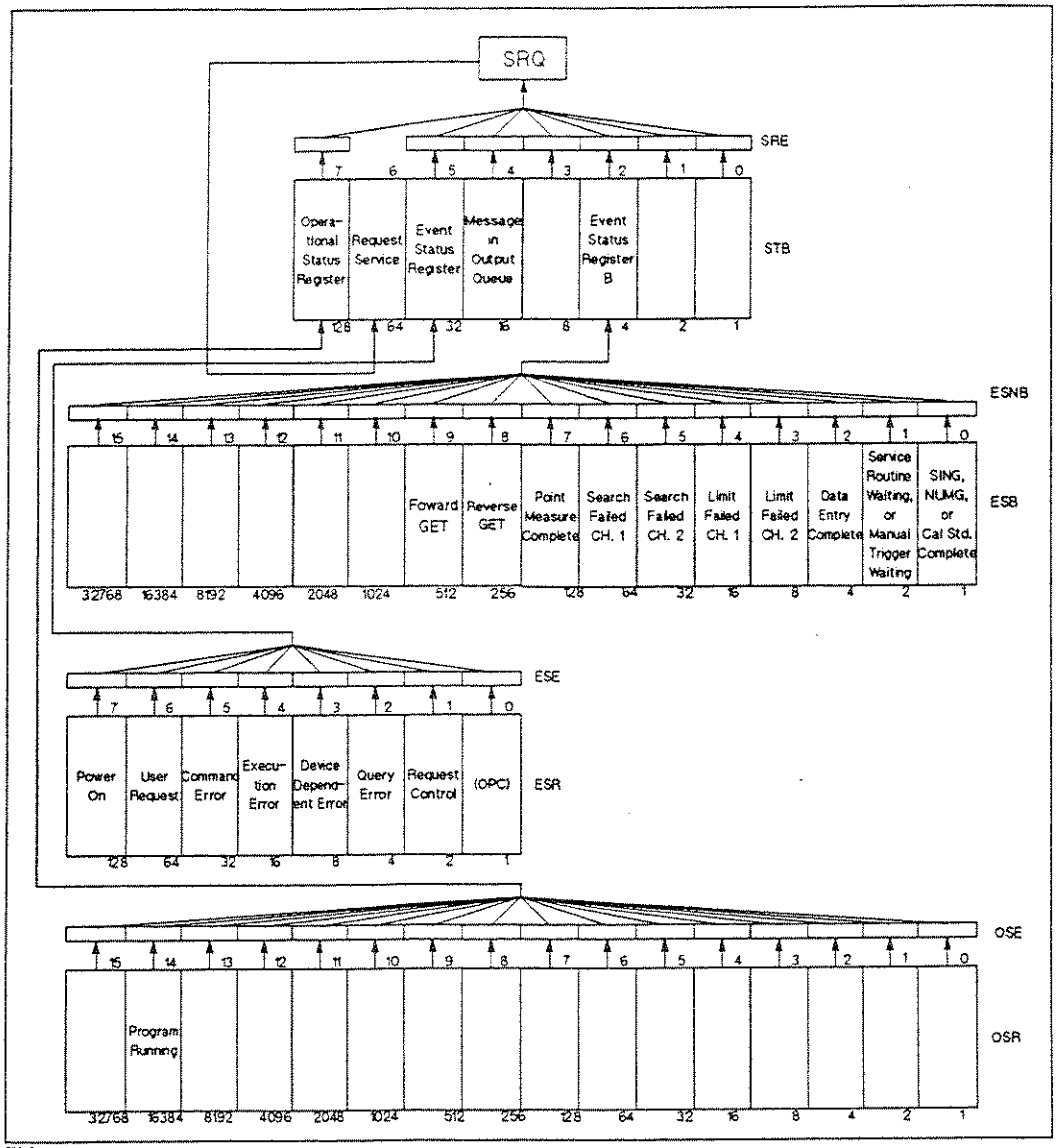

Figure G-1. Status Reporting Structure

- Delete "OSPT, OSNT" section

Appendix E "Waveform Analysis Commands"

- Delete this appendix.

Error Messages

- Delete the following item.

106 CAN'T SAVE GRAPHICS WHEN COPY IN PROGRESS

CHANGE 2

"Figure 2-15. Sample Program: Storing Instrument States" in chapter 2

- Delete line 161.

Chapter 3

- Delete the following HP-IB commands:

  FILC
  STODDISK
  STODMEMO

- Add the following HP-IB commands:

  CURD?

"SAVE and RECALL Keys" in Appendix A

- Delete the following items

FILC	COPY FILE
DISFLIF	FORMAT [LIF]
DISFDOS	FORMAT [DOS]

- Add the following items:

CURD	CURRENT DIRECTORY
DISFLIF	INITIALIZE [LIF]
DISFDOS	INITIALIZE [DOS]

Error Messages

This section lists the error messages that are displayed on the analyzer display or transmitted by the instrument over HP-IB. Each error message is accompanied by an explanation, and suggestions are provided to help in solving the problem. Where applicable, references are given to related sections of the Operation and Maintenance manuals.

When displayed, error messages are usually preceded with the word "CAUTION:". That part of the error message has been omitted here for the sake or brevity. Some messages are for information only, and do not indicate an error condition. Two listings are provided: the first is in alphabetical order, and the second in numerical order.

In addition to error messages, instrument status is indicate by status notations in the left margin of the display. Examples are "*", "msH", and "P↓". Sometimes these appear in conjunction with error messages. A complete listing of status and notations and their meanings is provided in "Front and Rear Panel" in the *Reference Manual*.

ERROR MESSAGES IN ALPHABETICAL ORDER

160 +12V OUT OF SPEC

Severe error. Contact your nearest Hewlett-Packard office.

161 +15V(A) OUT OF SPEC

Severe error. Contact your nearest Hewlett-Packard office.

158 +18V OUT OF SPEC

Severe error. Contact your nearest Hewlett-Packard office.

162 +22V OUT OF SPEC

Severe error. Contact your nearest Hewlett-Packard office.

163 +65V OUT OF SPEC

Severe error. Contact your nearest Hewlett-Packard office.

157 −12.6V OUT OF SPEC

Severe error. Contact your nearest Hewlett-Packard office.

156 −15V OUT OF SPEC

Severe error. Contact your nearest Hewlett-Packard office.

193 1st IF OFFSET OSC TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

191 1st LOCAL AMP TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

187 1st LOCAL MIXER LOCAL PORT ALC TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

150 A1 CPU EXT BUS TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

142 A1 ROM TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

A40 HEAT SINK TOO HOT

The temperature sensors on the A4 post-regulator assembly have detected an over-temperature condition. Turn the power OFF and let the instrument cool down for approximately 10 minutes. If this message is displayed again, contact your nearest Hewlett-Packard office.

166 Ach +5V(A)/2 OUT OF SPEC

Severe error. Contact your nearest Hewlett-Packard office.

174 Ach A/D LINEARITY POOR

Severe error. Contact your nearest Hewlett-Packard office.

167 Ach A/D REF VOLTAGE OUT OF SPEC

Severe error. Contact your nearest Hewlett-Packard office.

171 Ach RECEIVER FUNCTIONALLY POOR

Severe error. Contact your nearest Hewlett-Packard office.

177 Ach/Rch IF GAIN OUT OF SPEC

Severe error. Contact your nearest Hewlett-Packard office.

6 ADDITIONAL STANDARD NEEDED

Error correction for the selected calibration class cannot be computed until all the necessary standards have been measured.

14 BACKUP DATA LOST

Data check-sum error on the battery backup memory has occurred. The battery is recharged for approximately 10 minutes after power was turned ON.

144 **BACKUP RAM TEST FAILED**

Severe error. Contact your nearest Hewlett-Packard office.

168 **Bch −5.2V(A)/2 OUT OF SPEC**

Severe error. Contact your nearest Hewlett-Packard office.

175 **Bch A/D LINEARITY POOR**

Severe error. Contact your nearest Hewlett-Packard office.

169 **Bch A/D REF VOLTAGE OUT OF SPEC**

Severe error. Contact your nearest Hewlett-Packard office.

172 **Bch RECEIVER FUNCTIONALLY POOR**

Severe error. Contact your nearest Hewlett-Packard office.

178 **Bch/Rch IF GAIN OUT OF SPEC**

Severe error. Contact your nearest Hewlett-Packard office.

−160 **Block data error**

Block data is improper.

−168 **Block data not allowed**

Block data is not allowed.

9 CALIBRATION ABORTED

The calibration in progress was terminated due to the change of the active channel or the stimulus parameters.

7 CALIBRATION REQUIRED

No valid calibration coefficients were found when user attempted to turn calibration ON. Refer to "Measurement Calibration" in the *Reference Manual*.

61 CAN'T CHANGE-ANOTHER CONTROLLER ON BUS

The analyzer cannot assume the mode of system controller until the active controller is removed from the bus or relinquishes the bus.

107 CAN'T SAVE GRAPHICS WHEN COPY IN PROGRESS

If user attempts to save graphics when a print or plot is in progress, this error message is displayed.

−148 **Character data not allowed**

Character data not allowed for this operation.

−144 **Character data too long**

Character data is too long (maximum length is 12 characters).

137 CONTINUOUS SWITCHING NOT ALLOWED

The current measurement requires the S-parameter test set to switch automatically between forward and reverse measurements (driving test port 1 and, then test port 2). Refer to "Stimulus Function Block" in the *Reference Manual*.

−253 CORRUPT MEDIA

A legal program command could not be executed because of corrupt media; for example, a bad disk or wrong format.

13 CURRENT PARAMETER NOT IN CAL SET

HP-IB only. Correction is not valid for the selected measurement parameter. Refer to "Measurement Calibration" in the *Reference Manual*.

−222 **Data out of range**

Numerical parameter of HP-IB command is out of the range defined.

−104 **Data type error**

Improper data type used (for example, string data was expected, but numeric data was received).

10 DC CALIBRATION ABORTED

Pressing the ABORT DC CAL softkey causes the analyzer to abort the DC detector linearity calibration in progress.

98 DC OVERLOAD ON INPUT A

97 DC OVERLOAD ON INPUT B

99 DC OVERLOAD ON INPUT R

The DC voltage at one of the three receiver inputs approach the DC voltage damage level. Refer to "Instrument Specifications" in the *General Information* section for DC damage level information.

−255 DIRECTORY FULL

A legal program command could not be executed because the media directory was full.

143 DRAM TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

145 EEPROM TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

183 EEPROM WRITE FAILED

Severe error. Contact your nearest Hewlett-Packard office.

12 EXCEEDED 7 STANDARDS PER CLASS

A maximum of seven standards can be defined for any class. Refer to "Measurement Calibration" in the *Reference Manual*.

5 EXTERNAL REFERENCE UNLOCKED

The frequency of the external reference signal input to the connector on the rear panel deviates from 10/N MHz, where N is an integer between 1 to 10, and phase lock can no longer be maintained. Refer to "Front and Rear Panel" in the *Reference Manual* for details about the signal requirements.

159 FAN POWER OUT OF SPEC

Severe error. Contact your nearest Hewlett-Packard office.

154 FDC CHIP TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

−257 FILE NAME ERROR

A legal program command could not be executed because the file name on the device media was in error; for example, an attempt was made to copy to a duplicate file name.

−256 FILE NAME NOT FOUND

A legal program command could not be executed because the file name on the device media was not found; for example, an attempt was made to read or copy a nonexistent file.

192 FN FREQ TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

182 FN PRETUNE-DAC/MONITOR FAILURE

Severe error. Contact your nearest Hewlett-Packard office.

62 FORMAT NOT VALID FOR MEASUREMENT

The conversion function except the 1/S mode is not valid for the Smith, Inverse Smith, and SWR formats.

32 FORMAT TYPE IS NOT SMITH

The conjugate matching function is only valid in the Smith chart format.

148 FPC TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

−105 **GET not allowed**

GET is not allowed inside a program message.

151 GSP I/F TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

155 HPIB CHIP TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

147 INTR TIMER TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

−161 **Invalid block data**

Invalid block data was received (for example, END received before length satisfied).

−141 **Invalid character data**

Bad character data or unrecognized character data was received.

−121 **Invalid character in number**

Invalid character in numeric data.

−101 **Invalid character**

Invalid character was received.

105 INVALID FILE NAME

HP-IB only. The file name for the RECALL, PURGE, or RE-SAVE function must have an "_A", "_D", or "_S" extension. Refer to "Saving and Recalling Instrument States and Data" in the *Reference Manual* for more information.

−103 **Invalid separator**

The message unit separator (for example, ";", ",") is improper.

−151 **Invalid string data**

Invalid string data was received (for example, END received before close quote).

−131 **Invalid suffix**

Units are unrecognized, or the units are not appropriate.

153 KEY CHIP TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

108 LIF-DOS COPY NOT ALLOWED

If the user tries to copy a file between the RAM disk and the flexible disk when the format of the RAM disk is different from the format of the flexible disk, this message is displayed.

57 **LIF-DOS copy not allowed**

If the user tries to copy a file between the RAM disk and the flexible disk when the format of the RAM disk is different from the format of the flexible disk, this message is displayed.

67 LIST TABLE EMPTY OR INSUFFICIENT TABLE

The frequency list is empty. To implement the list frequency mode, add segments to the list table. Refer to "Stimulus Function Block" in the *Reference Manual*.

81 LOCAL MAX NOT FOUND

The maximum peak whose sharpness is defined by the peak define function cannot be found.

82 LOCAL MIN NOT FOUND

The minimum peak whose sharpness is defined by the peak define function cannot be found.

−250 MASS STORAGE ERROR

A mass storage error occurred. This error message is used when the device cannot detect the more specific errors described for errors −251 trough −259.

−254 MEDIA FULL

A legal program command could not be executed because the media was full.

−258 MEDIA PROTECTED

A legal program command could not be executed because the media was protected; for example, the disk was write-protected.

−251 MISSING MASS STORAGE

A legal program command could not be executed because of missing mass storage; for example, attempt to access an external disk drive by using Instrument BASIC.

−252 MISSING MEDIA

A legal program command could not be executed because of a missing media; for example, no disk.

−109 **Missing parameter**

A command with an improper number of parameters received.

179 MIXER LINEARITY POOR

Severe error. Contact your nearest Hewlett-Packard office.

8 NO CALIBRATION CURRENTLY IN PROGRESS

The RESUME CAL SEQUENCE softkey is not valid unless a calibration was already in progress. Start a new calibration. Refer to "Measurement Calibration" in the *Reference Manual*.

112 NO DATA TRACE DISPLAYED

The SCALE FOR [DATA] is selected while the data trace is not displayed.

77 NO DATA TRACE

The MARKER ON [DATA] is selected while the data trace is not displayed.

106 NO LEGAL FILES ON DISK

There are no files on the disk with extensions, "_A", "_D", or "_S". Refer to "Saving and Recalling Instrument States and Data" in the *Reference Manual* for more information.

83 NO MARKER DELTA - PEAK DEF NOT SET

The MARKER → PEAK DEF softkey requires that delta marker mode be turned ON, with at least two markers displayed. Refer to "Using Markers" in the *Reference Manual*.

80 NO MARKER DELTA - RANGE NOT SET

The SEARCH RNG STORE softkey requires that delta marker mode be turned ON, with at least two markers displayed. Refer to "Using Markers" in the *Reference Manual*.

79 NO MARKER DELTA - SPAN NOT SET

The MARKER → SPAN softkey requires that delta marker mode be turned ON, with at least two markers displayed. Refer to "Using Markers" in the *Reference Manual.*

113 NO MEMORY TRACE DISPLAYED

The SCALE FOR [MEMORY] is selected while the memory trace is not displayed.

78 NO MEMORY TRACE

The MARKER ON [MEMORY] is selected while the memory trace is not displayed.

118 NO VALID Ach ABS MAG CORRECTION CONSTANTS

Severe error. Contact your nearest Hewlett-Packard office.

119 NO VALID Bch ABS MAG CORRECTION CONSTANTS

Severe error. Contact your nearest Hewlett-Packard office.

123 NO VALID DC FULL SCALE CORRECTION CONSTANTS

Severe error. Contact your nearest Hewlett-Packard office.

126 NO VALID FN PRETUNE CORRECTION CONSTANTS

Severe error. Contact your nearest Hewlett-Packard office.

124 NO VALID HF PWR LIN CORRECTION CONSTANTS

Severe error. Contact your nearest Hewlett-Packard office.

125 NO VALID LF PWR LIN CORRECTION CONSTANTS

Severe error. Contact your nearest Hewlett-Packard office.

30 NO VALID MEMORY TRACE

If a memory trace is to be displayed or otherwise used, a data trace must first be stored to memory. Refer to "Response Function Block" in the *Reference Manual.*

122 NO VALID RATIO A/B CORRECTION CONSTANTS

Severe error. Contact your nearest Hewlett-Packard office.

120 NO VALID RATIO A/R CORRECTION CONSTANTS

Severe error. Contact your nearest Hewlett-Packard office.

121 NO VALID RATIO B/R CORRECTION CONSTANTS

Severe error. Contact your nearest Hewlett-Packard office.

117 NO VALID Rch ABS MAG CORRECTION CONSTANTS

Severe error. Contact your nearest Hewlett-Packard office.

127 NO VALID STEP OSC CORRECTION CONSTANTS

Severe error. Contact your nearest Hewlett-Packard office.

31 NOT AVAILABLE FOR THIS FORMAT

The D&M SCALE [COUPLED] softkey is not valid when the format is either LOG MAG & PHASE, or LOG MAG & DELAY.

41 NOT ENOUGH DATA

HP-IB only. The amount of data sent to the analyzer is less than that expected.

11 NOT VALID FOR PRESENT TEST SET

The calibration requested is inconsistent with the test set present. This message occurs in the following situations:

- A full 2-port calibration is requested with a test set other than an S-parameter test set.
- A one-path 2-port calibration is requested with an S-parameter test set (this procedure is typically used with a transmission/reflection test set).

−128 **Numeric data not allowed**

Numerical data not allowed for this operation.

−123 **Numeric overflow**

Numerical data value was too large (exponent magnitude >32,000).

95 OVERLOAD ON INPUT A, POWER REDUCED

94 OVERLOAD ON INPUT B, POWER REDUCED

96 OVERLOAD ON INPUT R, POWER REDUCED

When the power level at one of the three receiver inputs exceeds a certain level greater than the maximum input level, the RF output power level is automatically reduced to minimum and the annotation "P↓" appears in the left margin of the display. Refer to "Stimulus Function Block" in the *Reference Manual*.

−108 **Parameter not allowed**

Too many parameters for the command received.

21 PLOT ABORTED

Pressing the COPY ABORT softkey causes the analyzer to abort the plot in progress.

25 PLOTTER NOT READY-PINCH WHEELS UP

If user attempts to plot when the plotter's pinch wheels are up, this message is displayed.

23 PLOTTER:not on, not connected, wrong address

The plotter does not respond to control. Verify power to the plotter, and check the HP-IB connection between the analyzer and the plotter. Ensure that the plotter address recognized by the analyzer matches the HP-IB address set on the plotter itself. Refer to "Instrument State Function Block" in the *Reference Manual* for instruction on setting peripheral addresses.

181 POOR PRETUNE TRACKING

Severe error. Contact your nearest Hewlett-Packard office.

186 POWER LINEARITY TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

POWER SHUT DOWN (ANALOG SYSTEM)

Severe error. Contact your nearest Hewlett-Packard office.

4 POWER SHUT DOWN (FDD, FRONT PANEL)

Severe error. Contact your nearest Hewlett-Packard office.

20 PRINT ABORTED

Pressing the COPY ABORT softkey causes the analyzer to abort the plot in progress.

24 PRINT/PLOT IN PROGRESS, ABORT WITH COPY ABORT

If a print or plot is in progress and a second print or plot is attempted, this message is displayed and the second attempt is ignored. To abort a print or plot in progress, press COPY ABORT.

22 PRINTER:not on, not connected, wrong address

The printer does not respond to control. Verify power to the plotter, and check the HP-IB connection between the analyzer and the printer. Ensure that the printer address recognized by the analyzer matches the HP-IB address set on the printer itself. Refer to "Instrument State Function Block" in the *Reference Manual* for instruction on setting peripheral addresses.

−112 **Program mnemonic too long**

Program mnemonic is too long (maximum length is 12 characters).

−430 Query DEADLOCKED

Input buffer and output buffer are full; cannot continue.

−400 Query error

Query is improper.

−410 Query INTERRUPTED

Query is followed by DAB or GET before the response was completed.

−440 Query UNTERMINATED after indefinite response

The query which requests arbitrary data response (`*IDN?` and `*OPT?` queries) was sent before usual queries in a program message. (for example, `FREQ?;*IDN?` was expected, but `*IDN?;FREQ?` is received.)

−420 Query UNTERMINATED

Addressed to talk, incomplete program message received.

146 RATE TIMER TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

164 Rch +5V(D)/2 OUT OF SPEC

Severe error. Contact your nearest Hewlett-Packard office.

173 Rch A/D LINEARITY POOR

Severe error. Contact your nearest Hewlett-Packard office.

165 Rch A/D REF VOLTAGE OUT OF SPEC

Severe error. Contact your nearest Hewlett-Packard office.

170 Rch RECEIVER FUNCTIONALLY POOR

Severe error. Contact your nearest Hewlett-Packard office.

149 REALTIME CLOCK TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

REAR PANEL FAN STOPPED

The analyzer detected that the rear panel fan stopped and automatically shut down the power.

104 RECALL ERROR: INSTR STATE PRESET

A serious error, for example corrupted data, is detected on recalling a file, and this forced the analyzer to be PRESET.

185 RF AMP FLATNESS TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

188 RF MIXER LOCAL PORT ALC TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

194 RF OSC TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

190 RF POWER LEVEL ALC(HF) TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

189 RF POWER LEVEL ALC(LF) TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

103 SAVE ERROR

A serious error, for example physically damaged disk surface, is detected on saving a file.

176 SOURCE ATTENUATOR OUT OF SPEC

Severe error. Contact your nearest Hewlett-Packard office.

184 STEP OSC TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

−150 **String data error**

String data is improper.

−158 **String data not allowed**

String data is not allowed.

−138 **Suffix not allowed**

A suffix is not allowed for this operation.

−102 **Syntax error**

Unrecognized command or data type was received.

−124 **Too many digits**

Numerical data length was too long (more than 255 digits received).

−350 **Too many errors**

Too many errors occurred in HP-IB commands.

68 TOO MANY SEGMENTS OR POINTS

Frequency list mode is limited to 31 segments or 801 points. Refer to "Stimulus Function Block" in the *Reference Manual* for more information.

50 TOO MANY SEGMENTS

The maximum number of segments for the limit line table is 18. Refer to "Instrument State Function Block" in the *Reference Manual*.

−223 **Too much data**

Either there is too much binary data to send to the analyzer when the data transfer format is FORM 2, FORM 3 or FORM 5, or the amount of data is greater than the number of points.

40 TOO MUCH DATA

The number of data to be sent to the analyzer is greater than that expected.

−113 **Undefined header**

Undefined header or an unrecognized command was received (operation not allowed).

180 VCO MISADJUSTED, RETRY THIS TEST

Severe error. Contact your nearest Hewlett-Packard office.

152 VRAM TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

ERROR MESSAGES IN NUMERICAL ORDER

POWER SHUT DOWN (ANALOG SYSTEM)

Severe error. Contact your nearest Hewlett-Packard office.

A40 HEAT SINK TOO HOT

The temperature sensors on the A4 post-regulator assembly have detected an over-temperature condition. Turn the power OFF and let the instrument cool down for approximately 10 minutes. If this message is displayed again, contact your nearest Hewlett-Packard office.

REAR PANEL FAN STOPPED

The analyzer detected that the rear panel fan stopped and automatically shut down the power.

4 POWER SHUT DOWN (FDD, FRONT PANEL)

Severe error. Contact your nearest Hewlett-Packard office.

5 EXTERNAL REFERENCE UNLOCKED

The frequency of the external reference signal input to the connector on the rear panel deviates from 10/N MHz, where N is an integer between 1 to 10, and phase lock can no longer be maintained. Refer to "Front and Rear Panel" in the *Reference Manual* for details about the signal requirements.

6 ADDITIONAL STANDARDS NEEDED

Error correction for the selected calibration class cannot be computed until all the necessary standards have been measured.

7 CALIBRATION REQUIRED

No valid calibration coefficients were found when user attempted to turn calibration ON. Refer to "Measurement Calibration" in the *Reference Manual*.

8 NO CALIBRATION CURRENTLY IN PROGRESS

The RESUME CAL SEQUENCE softkey is not valid unless a calibration was already in progress. Start a new calibration. Refer to "Measurement Calibration" in the *Reference Manual*.

9 CALIBRATION ABORTED

The calibration in progress was terminated due to change of the active channel or stimulus parameters.

10 DC CALIBRATION ABORTED

Pressing the ABORT DC CAL softkey causes the analyzer to abort the DC detector linearity calibration in progress.

11 NOT VALID FOR PRESENT TEST SET

The calibration requested is inconsistent with the test set present. This message occurs in the following situations:

- A full 2-port calibration is requested with a test set other than an S-parameter test set.
- A one-path 2-port calibration is requested with an S-parameter test set (this procedure is typically used with a transmission/reflection test set).

12 EXCEEDED 7 STANDARDS PER CLASS

A maximum of seven standards can be defined for any class. Refer to "Measurement Calibration" in the *Reference Manual*.

13 CURRENT PARAMETER NOT IN CAL SET

HP-IB only. Correction is not valid for the selected measurement parameter. Refer to "Measurement Calibration" in the *Reference Manual.*

14 BACKUP DATA LOST

Data check-sum error on the battery backup memory has occurred. The battery is recharged for approximately 10 minutes after power was turned ON.

20 PRINT ABORTED

Pressing the COPY ABORT softkey causes the analyzer to abort the plot in progress.

21 PLOT ABORTED

Pressing the COPY ABORT softkey causes the analyzer to abort the plot in progress.

22 **PRINTER:not on, not connect, wrong address**

The printer does not respond to control. Verify power to the plotter, and check the HP-IB connection between the analyzer and the printer. Ensure that the printer address recognized by the analyzer matches the HP-IB address set on the printer itself. Refer to "Instrument State Function Block" in the *Reference Manual* for instruction on setting peripheral addresses.

23 **PLOTTER:not on, not connect, wrong address**

The plotter does not respond to control. Verify power to the plotter, and check the HP-IB connection between the analyzer and the plotter. Ensure that the plotter address recognized by the analyzer matches the HP-IB address set on the plotter itself. Refer to "Instrument State Function Block" in the *Reference Manual* for instruction on setting peripheral addresses.

24 PRINT/PLOT IN PROGRESS, ABORT WITH COPY ABORT

If a print or plot is in progress and a second print or plot is attempted, this message is displayed and the second attempt is ignored. To abort a print or plot in progress, press COPY ABORT.

25 PLOTTER NOT READY-PINCH WHEELS UP

If user attempts to plot when the plotter's pinch wheels are up, this message is displayed.

30 NO VALID MEMORY TRACE

If a memory trace is to be displayed or otherwise used, a data trace must first be stored to memory. Refer to "Response Function Block" in the *Reference Manual.*

31 NOT AVAILABLE FOR THIS FORMAT

The D&M SCALE [COUPLED] softkey is not valid when the format is either LOG MAG & PHASE, or LOG MAG & DELAY.

32 FORMAT TYPE IS NOT SMITH

The conjugate matching function is only valid in the Smith chart format.

40 TOO MUCH DATA

The amount of data to be sent to the analyzer is greater than that expected.

41 NOT ENOUGH DATA

HP-IB only. The amount of data sent to the analyzer is less than that expected.

50 TOO MANY SEGMENTS

The maximum number of segments for the limit line table is 18. Refer to "Instrument State Function Block" in the *Reference Manual.*

57 LIF-DOS copy not allowed

If the user tries to copy a file between the RAM disk and the flexible disk when the format of the RAM disk is different from the format of the flexible disk, this message is displayed.

61 CAN'T CHANGE- ANOTHER CONTROLLER ON BUS

The analyzer cannot assume the mode of system controller until the active controller is removed from the bus or relinquishes the bus.

62 FORMAT NOT VALID FOR MEASUREMENT

The conversion function except the 1/S mode is not valid for the Smith, Inverse Smith, and SWR formats.

67 LIST TABLE EMPTY OR INSUFFICIENT TABLE

The frequency list is empty. To implement the list frequency mode, add segments to the list table. Refer to "Stimulus Function Block" in the *Reference Manual.*

68 TOO MANY SEGMENTS OR POINTS

Frequency list mode is limited to 31 segments or 801 points. Refer to "Stimulus Function Block" in the *Reference Manual* for more information.

77 NO DATA TRACE

The MARKER ON [DATA] is selected while the data trace is not displayed.

78 NO MEMORY TRACE

The MARKER ON [MEMORY] is selected while the memory trace is not displayed.

79 NO MARKER DELTA - SPAN NOT SET

The MARKER → SPAN softkey requires that delta marker mode be turned ON, with at least two markers displayed. Refer to "Using Markers" in the *Reference Manual*.

80 NO MARKER DELTA - RANGE NOT SET

The SEARCH RNG STORE softkey requires that delta marker mode be turned ON, with at least two markers displayed. Refer to "Using Markers" in the *Reference Manual*.

81 LOCAL MAX NOT FOUND

The maximum peak whose sharpness is defined by the peak define function cannot be found.

82 LOCAL MIN NOT FOUND

The minimum peak whose sharpness is defined by the peak define function cannot be found.

83 NO MARKER DELTA - PEAK DEF NOT SET

The MARKER → PEAK DEF softkey requires that delta marker mode be turned ON, with at least two markers displayed. Refer to "Using Markers" in the *Reference Manual*.

94 OVERLOAD ON INPUT B, POWER REDUCED

95 OVERLOAD ON INPUT A, POWER REDUCED

96 OVERLOAD ON INPUT R, POWER REDUCED

When the power level at one of the three receiver inputs exceeds a certain level greater than the maximum input level, the RF output power level is automatically reduced to minimum and the annotation "P↓" appears in the left margin of the display. Refer to "Stimulus Function Block" in the *Reference Manual*.

97 DC OVERLOAD ON INPUT B

98 DC OVERLOAD ON INPUT A

99 DC OVERLOAD ON INPUT R

The DC voltage at one of the three receiver inputs approach the DC voltage damage level. Refer to "Instrument Specifications" in the *General Information* section for DC damage level information.

103 SAVE ERROR

A serious error, for example physically damaged disk surface, is detected on saving a file.

104 RECALL ERROR: INSTR STATE PRESET

A serious error, for example corrupted data, is detected on recalling a file, and this forced the analyzer to be PRESET.

Messages

105 INVALID FILE NAME

HP-IB only. The file name for the RECALL, PURGE, or RE-SAVE function must have an "_A", "_D", or "_S" extension. Refer to "Saving and Recalling Instrument States and Data" in the *Reference Manual* for more information.

106 NO LEGAL FILES ON DISK

There are no files on the disk with extensions, "_A", "_D", or "_S". Refer to "Saving and Recalling Instrument States and Data" in the *Reference Manual* for more information.

107 CAN'T SAVE GRAPHICS WHEN COPY IN PROGRESS

If user attempts to save graphics when a print or plot is in progress, this error message is displayed.

108 LIF-DOS COPY NOT ALLOWED

If the user tries to copy a file between the RAM disk and the flexible disk when the format of the RAM disk is different from the format of the flexible disk, this message is displayed.

112 NO DATA TRACE DISPLAYED

The SCALE FOR [DATA] is selected while the data trace is not displayed.

113 NO MEMORY TRACE DISPLAYED

The SCALE FOR [MEMORY] is selected while the memory trace is not displayed.

117 NO VALID Rch ABS MAG CORRECTION CONSTANTS

Severe error. Contact your nearest Hewlett-Packard office.

118 NO VALID Ach ABS MAG CORRECTION CONSTANTS

Severe error. Contact your nearest Hewlett-Packard office.

119 NO VALID Bch ABS MAG CORRECTION CONSTANTS

Severe error. Contact your nearest Hewlett-Packard office.

120 NO VALID RATIO A/R CORRECTION CONSTANTS

Severe error. Contact your nearest Hewlett-Packard office.

121 NO VALID RATIO B/R CORRECTION CONSTANTS

Severe error. Contact your nearest Hewlett-Packard office.

122 NO VALID RATIO A/B CORRECTION CONSTANTS

Severe error. Contact your nearest Hewlett-Packard office.

123 NO VALID DC FULL SCALE CORRECTION CONSTANTS

Severe error. Contact your nearest Hewlett-Packard office.

124 NO VALID HF PWR LIN CORRECTION CONSTANTS

Severe error. Contact your nearest Hewlett-Packard office.

125 NO VALID LF PWR LIN CORRECTION CONSTANTS

Severe error. Contact your nearest Hewlett-Packard office.

126 NO VALID FN PRETUNE CORRECTION CONSTANTS

Severe error. Contact your nearest Hewlett-Packard office.

127 NO VALID STEP OSC CORRECTION CONSTANTS

Severe error. Contact your nearest Hewlett-Packard office.

137 CONTINUOUS SWITCHING NOT ALLOWED

The current measurement requires the S-parameter test set to switch automatically between forward and reverse measurements (driving test port 1 and, then test port 2). Refer to "Stimulus Function Block" in the *Reference Manual*.

142 A1 ROM TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

143 DRAM TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

144 BACKUP RAM TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

145 EEPROM TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

146 RATE TIMER TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

147 INTR TIMER TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

148 FPC TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

149 REALTIME CLOCK TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

150 A1 CPU EXT BUS TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

151 GSP I/F TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

152 VRAM TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

153 KEY CHIP TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

154 FDC CHIP TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

155 HPIB CHIP TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

156 −15V OUT OF SPEC

Severe error. Contact your nearest Hewlett-Packard office.

157 −12.6V OUT OF SPEC

Severe error. Contact your nearest Hewlett-Packard office.

158 +18V OUT OF SPEC

Severe error. Contact your nearest Hewlett-Packard office.

159 FAN POWER OUT OF SPEC

Severe error. Contact your nearest Hewlett-Packard office.

160 +12V OUT OF SPEC

Severe error. Contact your nearest Hewlett-Packard office.

161 +15V(A) OUT OF SPEC

Severe error. Contact your nearest Hewlett-Packard office.

162 +22V OUT OF SPEC

Severe error. Contact your nearest Hewlett-Packard office.

163 +65V OUT OF SPEC

Severe error. Contact your nearest Hewlett-Packard office.

164 Rch +5V(D)/2 OUT OF SPEC

Severe error. Contact your nearest Hewlett-Packard office.

165 Rch A/D REF VOLTAGE OUT OF SPEC

Severe error. Contact your nearest Hewlett-Packard office.

166 Ach +5V(A)/2 OUT OF SPEC

Severe error. Contact your nearest Hewlett-Packard office.

167 Ach A/D REF VOLTAGE OUT OF SPEC

Severe error. Contact your nearest Hewlett-Packard office.

168 Bch −5.2V(A)/2 OUT OF SPEC

Severe error. Contact your nearest Hewlett-Packard office.

169 Bch A/D REF VOLTAGE OUT OF SPEC

Severe error. Contact your nearest Hewlett-Packard office.

170 Rch RECEIVER FUNCTIONALLY POOR

Severe error. Contact your nearest Hewlett-Packard office.

171 Ach RECEIVER FUNCTIONALLY POOR

Severe error. Contact your nearest Hewlett-Packard office.

172 Bch RECEIVER FUNCTIONALLY POOR

Severe error. Contact your nearest Hewlett-Packard office.

173 Rch A/D LINEARITY POOR

Severe error. Contact your nearest Hewlett-Packard office.

174 Ach A/D LINEARITY POOR

Severe error. Contact your nearest Hewlett-Packard office.

175 Bch A/D LINEARITY POOR

Severe error. Contact your nearest Hewlett-Packard office.

176 SOURCE ATTENUATOR OUT OF SPEC

Severe error. Contact your nearest Hewlett-Packard office.

177 Ach/Rch IF GAIN OUT OF SPEC

Severe error. Contact your nearest Hewlett-Packard office.

178 Bch/Rch IF GAIN OUT OF SPEC

Severe error. Contact your nearest Hewlett-Packard office.

179 MIXER LINEARITY POOR

Severe error. Contact your nearest Hewlett-Packard office.

180 VCO MISADJUSTED, RETRY THIS TEST

Severe error. Contact your nearest Hewlett-Packard office.

181 POOR PRETUNE TRACKING

Severe error. Contact your nearest Hewlett-Packard office.

182 FN PRETUNE-DAC/MONITOR FAILURE

Severe error. Contact your nearest Hewlett-Packard office.

183 EEPROM WRITE FAILED

Severe error. Contact your nearest Hewlett-Packard office.

184 STEP OSC TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

185 RF AMP FLATNESS TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

186 POWER LINEARITY TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

187 1st LOCAL MIXER LOCAL PORT ALC TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

188 RF MIXER LOCAL PORT ALC TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

189 RF POWER LEVEL ALC(LF) TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

190 RF POWER LEVEL ALC(HF) TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

191 1st LOCAL AMP TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

192 FN FREQ TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

193 1st IF OFFSET OSC TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

194 RF OSC TEST FAILED

Severe error. Contact your nearest Hewlett-Packard office.

−440 Query UNTERMINATED after indefinite response

The query which requests arbitrary data response (`*IDN?` and `*OPT?` queries) was sent before usual queries in a program message. (for example, `FREQ?;*IDN?` was expected, but `*IDN?;FREQ?` is received.)

−430 Query DEADLOCKED

Input buffer and output buffer are full; cannot continue.

−420 Query UNTERMINATED

Addressed to talk, incomplete program message received.

−410 Query INTERRUPTED

Query is followed by DAB or GET before the response was completed.

−400 Query error

Query is improper.

−350 Too many errors

Too many errors occurred in HP-IB commands.

−258 MEDIA PROTECTED

A legal program command could not be executed because the media was protected; for example, the disk was write-protected.

−257 FILE NAME ERROR

A legal program command could not be executed because the file name on the device media was in error; for example, an attempt was made to copy to a duplicate file name.

−256 FILE NAME NOT FOUND

A legal program command could not be executed because the file name on the device media was not found; for example, an attempt was made to read or copy a nonexistent file.

−255 DIRECTORY FULL

A legal program command could not be executed because the media directory was full.

−254 MEDIA FULL

A legal program command could not be executed because the media was full.

−253 CORRUPT MEDIA

A legal program command could not be executed because of corrupt media; for example, a bad disk or wrong format.

−252 MISSING MEDIA

A legal program command could not be executed because of a missing media; for example, no disk.

−251 MISSING MASS STORAGE

A legal program command could not be executed because of missing mass storage; for example, attempt to access an external disk drive by using Instrument BASIC.

−250 MASS STORAGE ERROR

A mass storage error occurred. This error message is used when the device cannot detect the more specific errors described for errors −251 trough −259.

−223 Too much data

Either there is too much binary data to send to the analyzer when the data transfer format is FORM 2, FORM 3 or FORM 5, or the amount of data is greater than the number of points.

−222 Data out of range

Numerical parameter of HP-IB command is out of the range defined.

−168 Block data not allowed

Block data is not allowed.

−161 Invalid block data

Invalid block data was received (for example, END received before length satisfied).

−160 Block data error

Block data is improper.

−158 String data not allowed

String data is not allowed.

−151 Invalid string data

Invalid string data was received (for example, END received before close quote).

−150 String data error

String data is improper.

−148 Character data not allowed

Character data not allowed for this operation.

−144 Character data too long

Character data is too long (maximum length is 12 characters).

−141 Invalid character data

Bad character data or unrecognized character data was received.

−138 Suffix not allowed

A suffix is not allowed for this operation.

−131 Invalid suffix

Units are unrecognized, or the units are not appropriate.

−128 Numeric data not allowed

Numerical data not allowed for this operation.

−124 Too many digits

Numerical data length was too long (more than 255 digits received).

−123 Numeric overflow

Numerical data value was too large (exponent magnitude > 32,000).

−121 Invalid character in number

Invalid character in numeric data.

−113 Undefined header

Undefined header or an unrecognized command was received (operation not allowed).

−112 Program mnemonic too long

Program mnemonic is too long (maximum length is 12 characters).

−109 Missing parameter

A command with an improper number of parameters was received.

−108 Parameter not allowed

Too many parameters for the command received.

−105 GET not allowed

GET is not allowed inside a program message.

−104 Data type error

Improper data type used (for example, string data was expected, but numeric data was received).

−103 Invalid separator

The message unit separator (for example, ";", ",") is improper.

−102 Syntax error

Unrecognized command or data type was received.

−101 Invalid character

Invalid character was received.

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May, 1990
P/N 04284-90009

HEWLETT PACKARD

Printed in Japan 9/94

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