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)

COUT

Sets port C of the 24-bit I/O port to be an output port.

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.

DATAM3TER

Displays calculated data using the following equation:

$$D = \frac{(M - E_2)}{(E_3 + E4(D - E_2))}$$

Where,

D : Display data
M : Measured data
E_2 : Defined by `INPUDATM2` command
E_3 : Defined by `INPUDATM3` command
E_4 : Defined by `INPUDATM4` command

DATAMNONE

Displays measurement data without calculation.

DATAMTHRU

Displays calculated data using the following equation:

$$D = \frac{M}{E_1}$$

Where,

D	: Display data
M	: Measured data
E_1	: Defined by `INPUDATM1` command

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

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

Outputs the plotting parameters to the default values.

(`DEFAULT SETUP` under (COPY))

DIN

Set port D of the 24-bit I/O port to be an input port.

DISA *parameter*

Selects the display allocation mode. (Query)

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 87510A's CRT.

(`ALL BASIC` under (DISPLAY); Query)

DISAALLI

Displays only the measurement graticule on the HP 87510A's CRT.

(`ALL INSTRUMENT` under DISPLAY; Query)

DISABASS

Displays only the HP Instrument BASIC status on the HP 87510A's CRT.

(`BASIC STATUS` under DISPLAY; Query)

DISAHIHB

Displays the measurement graticule (top half) and the HP Instrument display (bottom half) on the HP 87510A's CRT.

(`HALF INSTR HALF BASIC` under DISPLAY; Query)

DISBLIST

Displays BIN sorting table on the HP 87510A's CRT.

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 87510A's internal disk drive in LIF (Logical Interchange Format) format.

(`DEFINE FORMAT,LIF` under SAVE ; Query)

DISG {ON|OFF}

Sets the graticule display on or off.

(`GRATICULE on off` under DISPLAY; 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)

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.

DISPDATM

Displays traces of both measured data and memory data.

DISPDDM

Displays the trace of the results of measured data divided by memory data.

DISPDMM

Displays the trace of the results of measured data subtracted from memory data.

DISPMEMO

Displays a trace of memory data.

DIST {ON|OFF}

Sets the trace display on or off.

(`TRACE on off` under DISPLAY; Query)

DONE

Completes the measurement of the selected standard calibration.

(`DONE: RESPONSE` under CAL `RESPONSE & ISOL'N`)

DOUT

Sets D port of the 24-bit I/O port to output port.

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)

EDITBINL

Begins editing the BIN sorting table.

(EDIT BIN SORT LINE under SYSTEM)

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.

EQUCPARA?

Executes four element analysis of a crystal resonator, and outputs parameters, C_0, C_1, L_1, and R_1. For more information, refer to "EQUPARA?" in Appendix E. (Data format: C_0, C_1, L_1, R_1)

EQUCPARS?

Executes four 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, and f_2. For more information, refer to "EQUPARA?" in Appendix E. (Data format: C_0, C_1, L_1, R_1, f_s, f_a, f_r, f_1, f_2)

ESB?

Outputs the event status register B value.

ESNB *value*

Specifies the bits of event status register B.

value 0 to 32,767 ($=2^{15}-1$)

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*

Copies file on flexible and RAM disks.

string1	Source file name. String. Up to 12 characters.
string2	Source device name. `"MEMORY"` or `"DISK"`
string3	Destination file name. String. Up to 12 characters.
string4	Destination device name. `"MEMORY"` or `"DISK"`

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
POLA	Polar chart format
LINM	Linear magnitude format
REAL	Real format
IMAG	Imaginary format
EXPP	Expanded phase format
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

FNVNARR

Sets the FN VCO to NARROW.

FNVNORM

Sets FN VCO to NORMAL.

(Under SERVICE MENU under (SYSTEM); Query)

FNVOPEN

Sets the FN VCO to OPEN.

(Under SERVICE MENU under (SYSTEM); Query)

FNVWIDE

Sets FN VCO to WIDE.

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.

FREQ

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)

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, 4,000, or 8,000(Hz)
suffix refer to "Suffix"

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 87510A. (option 005 only)

INP8IO?

Inputs data from the 4-bit parallel input port to the HP 87510A, and outputs the data to a computer.(option 005 only)

INPT?

Outputs value which tells whether there is pulse input at the Input1 port of the 24-bit I/O port. When there is pulse input at Input1, the return value is a 1. When there is not, the return value is a 0. Once INPT? returns 1, next INPT? query returns 0 until the next pulse input has occurred at Input1.

INPUCALC {01-03} *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 87510A internal format (714 bytes of binary data))

INPUD

Executes a 3-term 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"

INPUDATM1 *value*

Inputs the complex parameter E_1 for the `DATAMTHRU` command. Default complex value is $1 + j0$.

value Complex number (Data format: real, imaginary)

INPUDATM2 *value*

Inputs the complex parameter E_2 for the `DATAM3TER` command. Default complex value is $0 + j0$.

value Complex value (Data format: real, imaginary)

INPUDATM3 *value*

Inputs the complex parameter E_3 for the `DATAM3TER` command. Default complex value is $0 + j0$.

value Complex value (Data format: real, imaginary)

INPUDATM4 *value*

Inputs the complex parameter E4 for the DATAM3TER command. Default complex value is $1 + j0$.

value Complex value (Data format: real, imaginary)

INPUFORM *value*

Inputs formatted data.

value Complex value (Data format: real, imaginary)

INPULOAA *value*

Inputs the real LOAD data array for a 3-term calibration.

value Complex number (Data format: real, imaginary)

INPUMEM *value*

Inputs data to the memory array.

value Complex number (Data format: real, imaginary)

INPUMEMTP

Enters the *n*th point's memory-trace data. This command can only be used by the EXECUTE which is an HP instrument BASIC command.

value point number. 0 to 801

INPUOPEA *value*

Inputs the real OPEN data array for a 3-term calibration.

value Complex number (Data format: real, imaginary)

INPUSHOA *value*

Inputs the real SHORT data array for a 3-term calibration.

value Complex number (Data format: real, imaginary)

INPUTMEM *value*

Inputs data to the memory trace.

value Complex number (Data format: real, imaginary)

IOPO?

Returns the installed option number of the I/O port of the rear panel. If not option is installed, IOPO? returns string, "STD". If Option 005 is installed, IOPO? returns "005", and Option 006 is installed, IOPO? returns "006". (query only)

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)

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.

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.

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 (Units) (Polar, Lin mag, Real, and Imaginary formats)
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 (Units) (Polar, Lin mag, Real, and Imaginary formats)
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)

LIMIOPOIN

Sets the limit line test to execute at each measurement point.

(`LMT TST ON [POINT]` under SYSTEM)

LIMIOSEND

Sets the limit line test to execute at the end of the sweep.

(`LMT TST ON [SWP END]` under SYSTEM)

LIMISTIO *value* [*suffix*]

Sets a stimulus offset value for limit testing.

(`STIMULUS OFFSET` under SYSTEM; Query)

value	−300 (MHz) to 300 (MHz)
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 (Units) (Polar, Lin mag, Real, and Imaginary formats)
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 (Units) (Polar, Lin mag, Real, and Imaginary formats)

suffix refer to "Suffix"

LIMS *value* [*suffix*]

Sets the starting stimulus value of a limit testing segment.

(STIMULUS VALUE under SYSTEM; Query)

value 1 (kHz) to 300 (MHz)

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 (Units) (Polar, Lin mag, Real, and Imaginary formats)

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)

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

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

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 1 (kHz) to 300 (MHz)

suffix refer to "Suffix"

MARK {STAR|STOP}

Changes the stimulus start or stop value to the active marker value.

(MARKER → START, MARKER → STOP under (MKR FCTN))

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)

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)

	-5.0×10^{6} to 5.0×10^{6} (deg, polar format)
suffix	refer to "Suffix"

MARKFSTI *value* [*suffix*]

Sets the fixed marker stimulus value offset.

(`FIXED MKR STIMULUS` under (MKR); Query)

value	−5 (GHz) to 5 (GHz)
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} (Units) (Polar, Lin mag, Real, and Imaginary formats)
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))

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)

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
A	A measurement
R	R measurement

MEASA

Measures the absolute power amplitude at input A.

(`A` 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)

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)

NEGL

Sets the output of the 24-bit I/O port to the negative logic.

NEXP

Displays the next page of information in a tabular listing onto the display.

(NEXT PAGE under COPY)

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 Appendix E. (Data format: Local Maximum value, stimulus)

NUMG *value*

Triggers a user-specified number of sweeps, and returns to the HOLD mode.

(NUMBER OF GROUPS under MENU)

value Greater than 0

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)

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)

OPEP

Lists the key parameters for both channels 1 and 2 on the display.

(OPERATING PARAMETERS under COPY)

OPTI?

Returns installed option number of the front panel ports. If nothing is installed, OPTI? returns the string, "STD". If Option 004 (delete reference channel option) is installed, OPTI? returns "004". (query only)

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.

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)

OSR?

Outputs the operational status register value.

OUT1ENVH

Sets OUTPUT1 set to HIGH when a pulse input has occurred at INPUT1.

OUT1ENVL

Sets OUTPUT1 set to LOW when a pulse input has occurred at INPUT1.

OUT1H

Sets OUTPUT1 to HIGH.

OUT1L

Sets OUTPUT1 to LOW.

OUT2ENVH

Sets OUTPUT2 set to HIGH when a pulse input has occurred at INPUT1.

OUT2ENVL

Sets OUTPUT2 set to LOW when a pulse input has occurred at INPUT1.

OUT2H

Sets OUTPUT2 to HIGH.

OUT2L

Sets OUTPUT2 to LOW.

OUT8IO *value*

Outputs the data to the 8-bit parallel output port. (Option 005 only)

value 0 to 255

OUTAIO *value*

Output decimal data specified as the parameter to port A (8 bit) of the 24-bit I/O port.

value 0 to 255

OUTBIO *value*

Output decimal data specified as the parameter to port B (8 bit) of the 24-bit I/O port.

value 0 to 255

OUTCIO *value*

Output decimal data specified as the parameter to port C (4 bit) of the 24-bit I/O port.

value 0 to 15

OUTDIO *value*

Output decimal data specified as the parameter to port D (4 bit) of the 24-bit I/O port.

value 0 to 15

OUTEIO *value*

Output decimal data specified as the parameter to port E (8 bit) of the 24-bit I/O port.

value 0 to 255

OUTFIO *value*

Output decimal data specified as the parameter to port F (16 bit) of the 24-bit I/O port.

value 0 to 65535

OUTGIO *value*

Output decimal data specified as the parameter to port G (20 bit) of the 24-bit I/O port.

value 0 to 1048575

OUTHIO *value*

Output decimal data specified as the parameter to port H (24 bit) of the 24-bit I/O port.

value 0 to 16777215

OUTPCALC {01-03}?

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))

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 Appendix E. (Data format:loss, const loss, bandwidth, center frequency, Q, ΔL.F1, ΔR.F1, ΔL.F2, ΔR.F2, passband ripple, rejection level, spurious level, pole_x1, pole_stimulus1, pole_x2, pole_stimulus2)

value1	center frequency, fc
value2	*x1*
value3	*x2*
value4	POLE? parameter
value5	f1
value6	f2
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"

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 *x*dB 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. (option 005 only)

OUTPINPCIO?

Outputs the data entered from port C (4 bit) of the 24-bit I/O port.

OUTPINPDIO?

Outputs the data entered from port D (4 bit) of the 24-bit I/O port.

OUTPINPEIO?

Outputs the data entered from port E (8 bit) of the 24-bit I/O 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)

OUTPMEMOT?

Outputs 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? *value*

Outputs the memory data at a specified point. (Data format: real, imaginary)

value 1 to "number of points"

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)

OUTPMSTA?

Outputs the marker statistics. (Data format: mean, standard deviation, peak to peak)

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)

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 Appendix E.

value1
value2

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)

OUTPRESR?

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

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"

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 Appendix E. (Data format:loss, bandwidth, center frequency, Q, ΔL.F1, ΔR.F1, ΔL.F2, ΔR.F2, passband ripple, rejection level, spurious level, pole_x1, pole_stimulus1, pole_x2, pole_stimulus2)

value1 *x1*
value2 *x2*
value3 POLE? parameter

value4	f1
value5	f2
suffix	refer to "Suffix"

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)
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	-5.0×10^5 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".

PEAK?

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

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)

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 Appendix E. (Data format: left local minimum, stimulus, right local minimum, stimulus)

value

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)

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)

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)

POSL

Sets output of the 24-bit I/O port to the positive logic.

POWE *value* [dBm]

Sets the source output level.

(POWER under MENU; Query)

value −15 to +5 (dBm)

PREP

Displays the previous page of information in a tabular listing.

(PREV PAGE under COPY)

PRES

Presets the instrument state. (PRESET)

PRINALL

Copies the measurement display to the printer according to plotting options.

(PRINT under COPY)

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)

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

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) (Polar formats)
-5.0×10^{6} to 5.0×10^{6} (Units) (Lin man, Real, or Imaginary formats)

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)

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 "RPLMEA?" in Appendix E in 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 "RPLRHEI? and RPLLHEI?" in Appendix E in Appendix E.

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 Appendix E. (Data format: sum, stimulus)

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))

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

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 `SAVCA{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)

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)

SCAC

Couples the data and memory trace to be scaled.

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) (Polar format) 1.0×10^{-11} to 10,000 (Units/div) (Lin mag, Real, and Imaginary formats)
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.

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

SEAMAX

Moves the active marker to the maximum point on the trace.

(MAX under MKR FCTN; Query)

SEAMEAN

Moves the active marker to the mean point on the trace.

(SEARCH: MEAN 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 (Units) (Polar, Lin mag, Real, and Imaginary 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

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 87510A in calculating measured impedance with 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)

SMOO {ON|OFF}

Sets the smoothing function to ON or OFF.

(SMOOTHING on off under AVG; 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 (%)

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 299.999 (MHz)
suffix refer to "Suffix"

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

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

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-C}

Measures the calibration standard in the current standard class.

(`OPEN`, `SHORT`, `THRU` under CAL)

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	1(kHz) to 300 (MHz)
suffix	refer to "Suffix"

STAS *value1* [*suffix*], *value2* [*suffix*]

Sets start and stop stimulus values.

(START and STOP)

value1	start frequency. 1 (kHz) to 300 (MHz)
value2	stop frequency. 1 (kHz) to 300 (MHz)
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)

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	1 (kHz) to 300 (MHz)
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	1 (kHz) to 300 (MHz)
suffix	refer to "Suffix"

STODDISK

Selects internal flexible disk drive for mass storage device.

STODMEMO

Selects RAM disk drive for mass storage device.

STOP *value* [*suffix*]

Defines the stop value of the stimulus. (STOP; Query)

Sets the stop frequency of a segment.

(STOP under MENU; Query)

value	1 (kHz) to 300 (MHz)
suffix	refer to "Suffix"

STPSIZE *value* [*suffix*]

Specifies the frequency step for a list sweep table.

(STEP SIZE under MENU; Query)

value	0 to 299.999 (MHz)
suffix	refer to "Suffix"

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

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 Appendix E. (Data format: stimulus)

value	1 (kHz) to 300 (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 Appendix E. (Data format: stimulus)

value 1 (kHz) to 300 (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 Appendix E. (Data format: stimulus)

value 1 (kHz) to 300 (MHz)
suffix refer to "Suffix"

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))

TEST *value*

Selects the test number.

(Under SERVICE MENU under (SYSTEM); Query)

value 0 to 85

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"

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)

VELOFACT *value*

Enters the velocity factor used by the HP 87510A 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 (Units) (Polar, Lin mag, Real, and Imaginary formats)

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?

Outputs the contents of the standard event status register.

*IDN?

Outputs the HP 87510A ID. (Data format: manufacturer, model, serial no., firmware rev.)

*OPC

Tells the HP 87510A 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 87510A.

value 0 to 30

*RST

Resets the HP 87510A 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 87510A when the trigger mode is set to EXTERNAL trigger.

*TST?

Executes an internal self-test and returns the test result.

*WAI

Makes the HP 87510A 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
MEASA	A
MEASR	R
MEAS *parameter*	

Conversion Menu

CONVOFF	OFF
CONVZTRA	Z: Trans
CONVYTRA	Y: Trans
CONV1DS	1/S
CONV MP{4|8|16}	4 * Phase 8 * Phase 16 * Phase
CONVMP{4|8|16}	4 * Phase 8 * Phase 16 * Phase
CONV *parameter*	

(FORMAT) Key

Format Menu

LOGM	LOG MAG
PHAS	PHASE
DELA	DELAY
LINM	LIN MAG
EXPP	EXPANDED PHASE
LOGMP	LOG MAG & PHASE
LOGMD	LOG MAG & DELAY

Format More Menu

REAL	REAL
IMAG	IMAGINARY
POLA	POLAR
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]

Electrical Delay Menu

ELED *value*	ELECTRICAL DELAY
PHAO *value*	PHASE OFFSET

(DISPLAY) Key

Display Menu

DUAC{ON|OFF}	DUAL CHAN on off
SPLD{ON|OFF}	SPLIT DISP on off
TITL *string*	TITLE
DIST{ON|OFF}	TRACE on off

Display More Menu

BEEPDONE{ON|OFF}	BEEP DONE on off
BEEPWARN{ON|OFF}	BEEP WARN on off
DISG	GRATICULE on off
FREQ	FREQUENCY BLANK

Display Allocation Menu

DISAALLI	ALL INSTRUMENT
DISAHIHB	HALF INSTR HALF BASIC
DISAALLB	ALL BASIC
DISABASS	BASIC STATUS
DISA *parameter*	

(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
SAVEUSEK	SAVE USER KIT
MODI1	MODIFY
CALK *parameter*	

Calibrate More Menu

VELOFACT *value*	VELOCITY FACTOR
SETZ *value*	SET ZO

Reference Plane Menu

PORE{ON|OFF}	EXTENSIONS on off
PORTR *value*	EXTENSION INPUT R
PORTA *value*	EXTENSION INPUT A

Calibration Menu

CALN	CALIBRATE: NONE
CALIRESP	RESPONSE
CALIRAI	RESPONSE & ISOL'N
CALIS111	3TERM S11-1PORT
CALI *parameter*	

Response Cal Menu

STANA	SHORT
STANB	OPEN
STANC	THRU
RESPDONE	DONE: RESPONSE

Response and Isolation Cal Menus

RAIRESP	RESPONSE
DONE	DONE: RESPONSE
RAIISOL	ISOL'N STD
RAID	DONE RESPONSE ISOL'N CAL

3-Term Cal Menus

CLASS11A	[S11] : OPEN
CLASS11B	SHORT
CLASS11C	LOAD
SAV1	DONE: 1-PORT CAL

Modify Cal Kit Menu

LABK	LABEL KIT
KITD	KIT DONE

Define Standard Menu

DEFS*value*	STD NO.1 TO STD NO.8
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
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
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*	

(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

(SPCL FNCT) Key

Special Function Menu

OUTPFILT? -3	-3 dB BAND WIDTH
OUTPFILT? *value*	-X dB BAND WIDTH and BAND WIDTH VALUE
EQUCPARA	EQUIVALENT CKT

Waveform Analysis Setting Menu

ANAOCH1	ANALY ON [CH1]
ANAOCH2	ANALY ON [CH2]
ANAODATA	ANALY FOR [DATA]
ANAOMEMO	ANALY FOR [SUB]
ANARANGE	ANALY MIN RANGE and ANALY MAX RANGE

Stimulus Function Block

STAR *value*	START
STOP *value*	STOP
CENT *value*	CENTER
SPAN *value*	SPAN
STAS *value1,value2*	START and STOP
CENS *value1,value2*	CENTER and SPAN

MENU Key

Stimulus Menu

POWE *value*	POWER
POIN *value*	NUMBER of POINTS
REST	MEASURE RESTART
COUC{ON|OFF}	COUPLED CH on off

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]
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
POIN	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

BIN Sort Menu

BINSLINE	BIN LINE on off
BINS	BIN SORT on off
BINOA	OUTPUT TO [A PORT]
BINOB	OUTPUT TO [B PORT]
EDITBINL	EDIT BIN SORT LINE

BIN Sort Edit Menu

BINSEDI	BIN
BINESB	BIN for ESB
BINSDEL	DELETE
BINSADD	ADD
BINSDON	DONE

BIN Sort Table Edit Menu

BINU	UPPER LIMIT
BINL	LOWER LIMIT
BINP	OUTPUT PATTERN
BINO	OUT OF LMT PATTERN
BINEDONE	DONE

Clear Menu

BINCLEL	CLEAR LIST YES

Limits Menu

LIMILINE{ON|OFF}	LIMIT LINE on off
LIMITEST{ON|OFF}	LIMIT TEST on off
BEEPFAIL{ON|OFF}	BEEP FAIL on off
LIMIOPOIN	LMT TST ON [POIN]
LIMIOEND	LMT TST ON [SWP END]

EDITLIML	EDIT LIMIT LINE

Edit Limits Menu

LIMSEDI *value*	EDIT or SEGMENT
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
LIMSDON	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
PLOT	PLOT
COPA	COPY ABORT
COPT{ON|OFF}	COPY TIME on off
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 SUB
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
DISBLIST	BIN SORT TABLE

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 & SP
DISMCTSP	DISP MODE: CTR & 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
DFLT	DEFAULT SETUP
NEXP	NEXT PAGE
PREP	PREV PAGE
RESD	RESTORE DISPLAY

SAVE and RECALL Keys

Save Menu

SAVDALL	ALL
SAVDSTA	STATE ONLY
SAVDDAT	DATA ONLY
RESAVD *string*	RE-SAVE FILE
STODDISK	STOR DEV [DISK]
STODMEMO	STOR DEV [MEMORY]

Title Menu

STODDISK	STOR DEV [DISK]
STODMEMO	STOR DEV [MEMORY]

ASCII Save Menu

SAVDGRA	GRAPHICS
SAVDASC	DATA ONLY

Define Extension Menu

GRAE	GRAPHICS [.HPG]
ASCE	ASCII DATA [.TXT]

Define Save Data Menu

SAVCA{ON|OFF}	CAL ARY on off
SAVTA{ON|OFF}	TRACE ARY on off
SAVTM{ON|OFF}	SUB ARY on off

Disk Menu

PURG *string*	PURGE FILE
CRED	CREATE DIRECTORY
CHAD	CHANGE DIRECTORY
INID	INITIALIZE DISK
DISFLIF	INITIALIZE DISK [LIF]
DISFDOS	INITIALIZE DISK [DOS]
STODDISK	STOR DEV [DISK]
STODMEMO	STOR DEV [MEMORY]

Recall Menu

RECD *string*	RECALL FILE

Service Function

DCBUS *value*
DESTOFF
DESTON
EXET
EXTRLOCK?
FBUS *value*
FIRLPNOR
FIRLPOPE
FIRR?
FNDAUTO
FNDMANU
FNDVALU *value*
FNVNARR
FNVNORM
FNVOPEN
FNVWIDE
IFRAUTO
IFRCH?
IFRX1
IFRX1X8
IFRX64
IFRX8X1
OUTPFBUS?
OUTPTESS? *value*
RECCOFF
RECCON
REOPNORM
REOPOPEN
SELD
SOUCOFF
SOUCON
TESC
TEST *value*

IEEE 488.2 Common Commands

*CLS
*ESE *value*
*ESE?
*ESR?
*IDN?
*OPC
*OPC?
*PCB *value*
*RST
*SRE *value*
*SRE?
*STB?
*TRG
*TST?
*WAI

Commands Which Don't Have Equivalent Softkey Labels

CIN
CLES
COUT
CURD
DATAM3TER
DATAMNONE
DATAMTHRU
DIN
DISP
DISPDATA
DISPDATM
DISPDDM
DISPDMM
DISPMEMO
DOUT
DSKEY
ENKEY
EQUCPARS?
ESB?
ESNB *value*
FORM2
FORM3
FORM4
FORM5
INP8IO
INP8IO?
INPT?
INPUCALC{01-03} *value*
INPUCALK *value*
INPUD
INPUDATAP *value*
INPUDATM1 *real,imag*
INPUDATM2 *real,imag*
INPUDATM3 *real,imag*
INPUDATM4 *real,imag*
INPUFORM *value*
INPULOAA*values*
INPUOPEA*values*
INPUSHOA *values*
INPUTMEM *value*
IOPO?
KEY *value*
LMAX? *value*
LMIN? *value*
MARD
MARKBUCK *value*
NEGL
NEXPK?
NUMLMAX?
NUMLMIN?
OPTI?
OSE *value*
OSER?
OSNT
OSPT
OSR?
OUT1ENVH
OUT1ENVL
OUT1H
OUT1L
OUT2ENVH
OUT2ENVL
OUT2H
OUT2L
OUT8IO *value*
OUTAIO *value*
OUTBIO *value*
OUTCIO *value*
OUTDIO *value*
OUTEIO *value*
OUTFIO *value*
OUTGIO *value*
OUTHIO *value*
OUTPCALC{01-03}?
OUTPCALK?
OUTPCFIL? *fc,x1,x2,D,f1,f2*
OUTPDATAP? *value*
OUTPDATAT?
OUTPERRO?
OUTPFAIP?
OUTPFORM?
OUTPFORMP? *value*
OUTPIFORM?
OUTPINP8IO
OUTPINPCIO?
OUTPINPDIO?
OUTPINPEIO?
OUTPIRFORM?
OUTPIRTMEM?
OUTPITMEM?
OUTPLIMF?
OUTPLIML?
OUTPLIMM?
OUTPMARK?
OUTPMAX?
OUTPMEAN?
OUTPMEMO?
OUTPMEMOP? *value*
OUTPMEMOT
OUTPMIN?
OUTPMINMAX?
OUTPMSTA?
OUTPMWID?
OUTPMWIL?
OUTPMWLF?
OUTPRESO?
OUTPRESR?
OUTPRESR?
OUTPRFORM?
OUTPRTMEM?
OUTPSTIM?
OUTPTITL?
OUTPTMEM?
OUTPTMEMP? *value*
OUTPXFIL?*x1,x2,D,f1,f2*
PEAK?
POLE? *value*
POSL
PSOFT{ON|OFF}
RPLENV?
RPLHEI?
RPLLHEI?
RPLMEA?
RPLPP?
RPLRHEI?
RPLVAL?
SAVC
SCAC
SCAU
STIDROUT *number,value*
STIMROUT *number,value*
TARL? *value*
TARR?*value*
THRR *value*

Status Reporting

Status byte totals three status registers which indicate the internal condition of an instrument. Figure B-1 shows the status reporting structure of the HP 87510A.

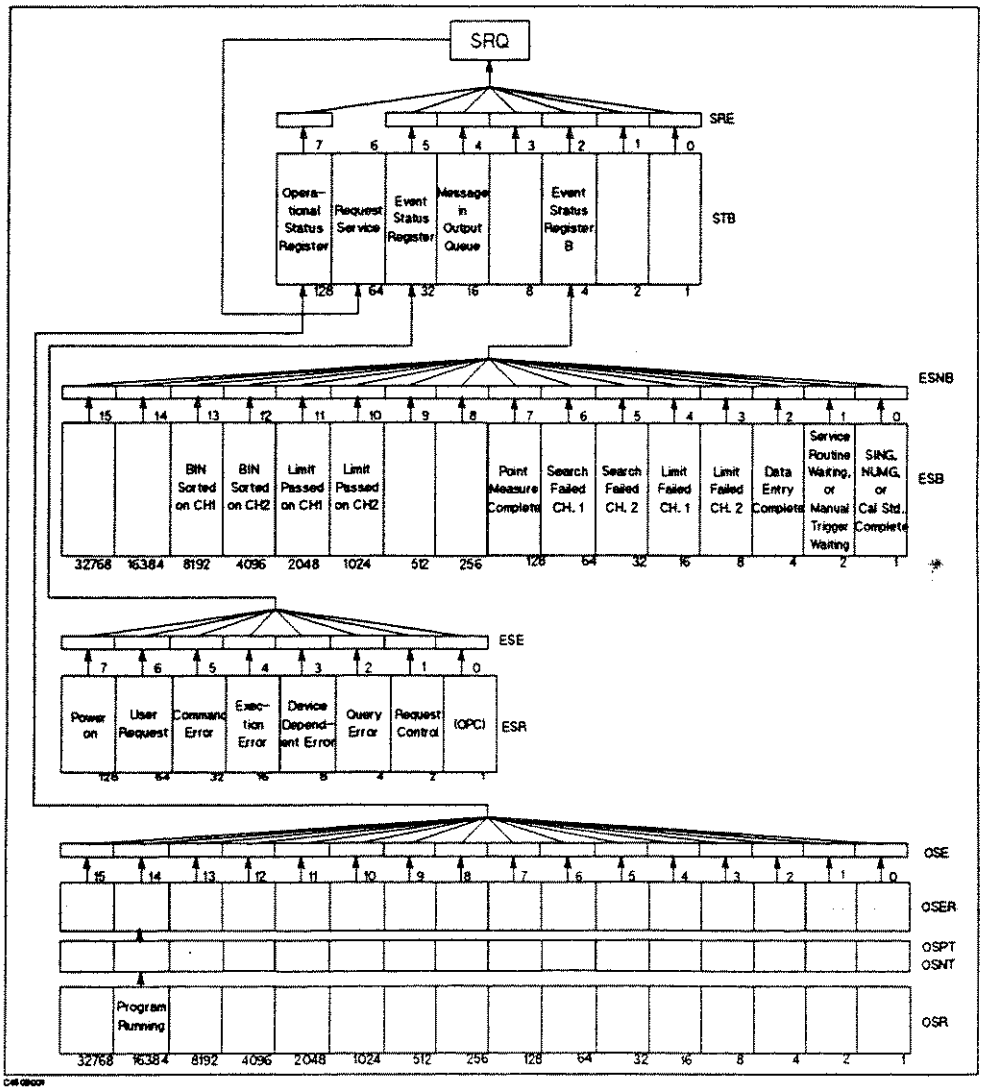


Figure B-1. Status Reporting Structure

The HP 87510A has a status reporting system to report the condition of the instrument. Status bytes consists of 8-bit registers, each bit represents specific instrument conditions. The value of the status byte can be read by using SPOLL(717) statement from an external controller. This command reads value directly from the HP 87510A without being set to remote. So, you can operate front panel keys while a controller is reading the status byte. Contents of the status

byte can also be read by using the *STB? command. Reading the status byte has no effect on the contents of the status byte. Table B-1 shows contents of status byte.

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.

For example, to read the contents of Message in the output queue,

```
10  Stat=SPOLL(717)
20  Stb4=BIT(Stat,4)
30  PRINT Stb4
40  END
```

Figure B-2. Example of Reading Status Byte (1)

or,

```
10  ASSIGN @Hp87510 TO 717
20  OUTPUT @Hp87510;"*STB?"
30  ENTER @Hp87510;Stat
40  Stb4=BIT(Stat,4)
50  PRINT Stb4
60  END
```

Figure B-3. Example of Reading Status Byte (2)

The Event Status Register (ESR), Event Status register B (ESB), and Operational Status Register (OSR) are subordinate to the status byte. Each register is set a bit with condition which is watched by status bit. Status bit is cleared when is read by query or CLES command is executed.

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 87510A 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 87510A 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 87510A'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 87510A listening formats or a data element type is unacceptable to the HP 87510A. 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 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 87510A has set the manual trigger to the 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 measurement point of a sweep has been completed.
10	Limit Passed, Ch 2	Limit test passed on channel 2.
11	Limit Passed, Ch 1	Limit test passed on channel 1.
12	BIN Sorted, Ch2	Sorted at specified BIN on channel 2.[2]
13	BIN Sorted, Ch1	Sorted at specified BIN on channel 1.[2]

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 87510A 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.

2 BIN is specified by BINESB command

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.

Each status register has a register mask which enables generating Service ReQuest (SRQ) with condition of a status bit. For instance, to generate an SRQ when the HP 87510A completes the specified number of sweep, enable ESNB bit 1 which is the mask register for ESB 0 ("SING, NUMG, or Cal Std. Complete") which shows sweep completion and SRE bit 2. This makes a path from ESB bit 0 to an SRQ. This example is listed as a program listing:

```
10  ASSIGN @Hp87510 TO 717
20  !
30  OUTPUT @Hp87510;"CLES"    ! Clears status registers
40  OUTPUT @Hp87510;"ESNB 1" ! Enables mask register of "SING. NUMG. or
50  !                         ! Cal Std. Complete" of ESB
60  OUTPUT @Hp87510;"*SRE 4" ! Enables mask register of "Event Status
70  !                         ! Register B" of STB
80  !
90  ON INTR 7 GOTO End        ! Declare SRQ interrupt
100 ENABLE INTR 7;2
100 OUTPUT @Hp87510;"SING"    ! Execute single sweep
110 GOTO 110                  ! Endless loop
120 !
130 End:                      ! Exit from loop when sweep is completed
140 END
```

Figure B-4. Example of Generating a Service ReQuest (SRQ)

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 87510A'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.)

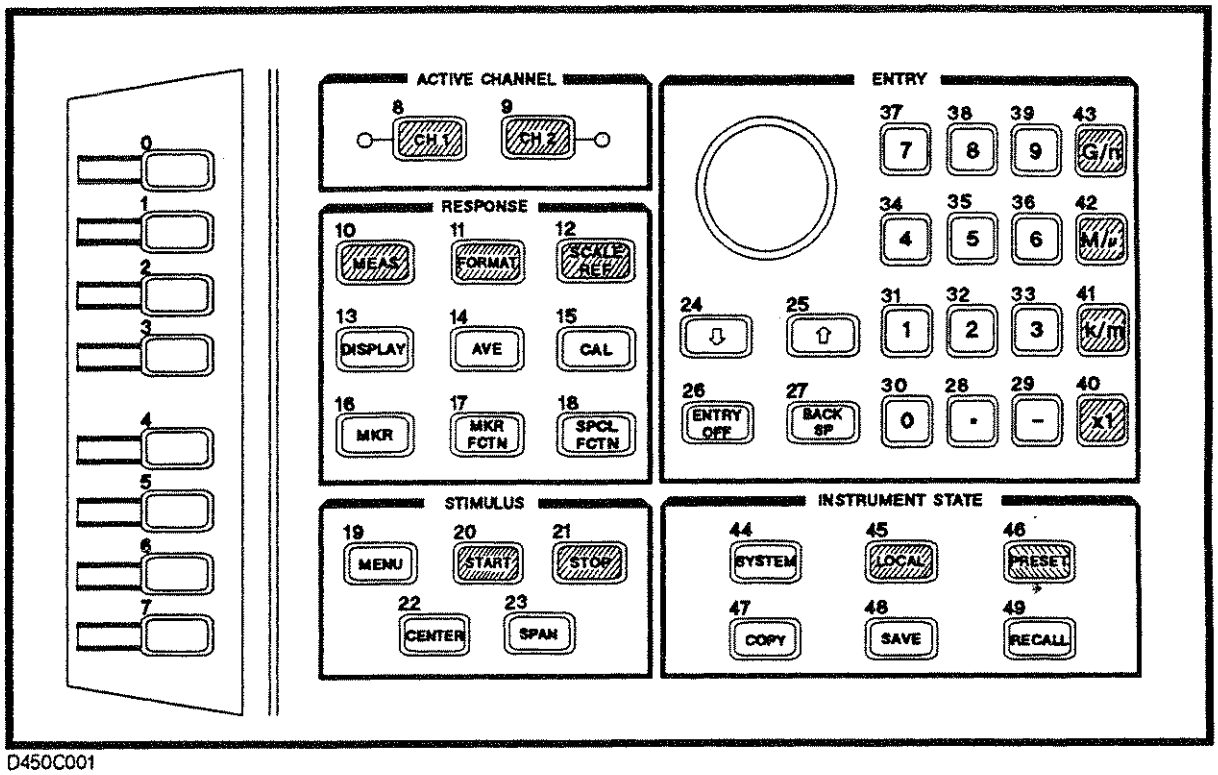
OSNT (Operational Status Negative Transition Filter)

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 87510A'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.)

Key Codes

Figure C-1 shows the codes of the front panel keys for using the KEY HP-IB command.



D450C001

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
Response:	•		
Response and isolation:			
Response		•	
Isolation		•	
Reflection:			
S11A (opens)			•
S11B (shorts)			•
S11C (loads)			•

Table D-2. Calibration Array

Array	Response[1]	Response and Isolation[1]	1-port
1	E_T	E_X	E_1
2		E_T	E_2
3			E_3

1 Meaning of subscript: X = crosstalk; T = transmission tracking.

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

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 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
ANARFULL
ANAODATA
ANAOMEMO
ANAOCH1
ANAOCH2
THRR
```

ANARANG 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.

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.

THRR

Sets threshold ripple height for waveform analysis commands. 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.

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.

A sensitivity of ripple search can be set by THRR command. For details about THRR, refer to "THRR".

```
RPLPP?
RPLHEI?
RPLRHEI?
RPLLHEI?
RPLENV?
RPLMEA?
RPLVAL?
POLE?
```

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.

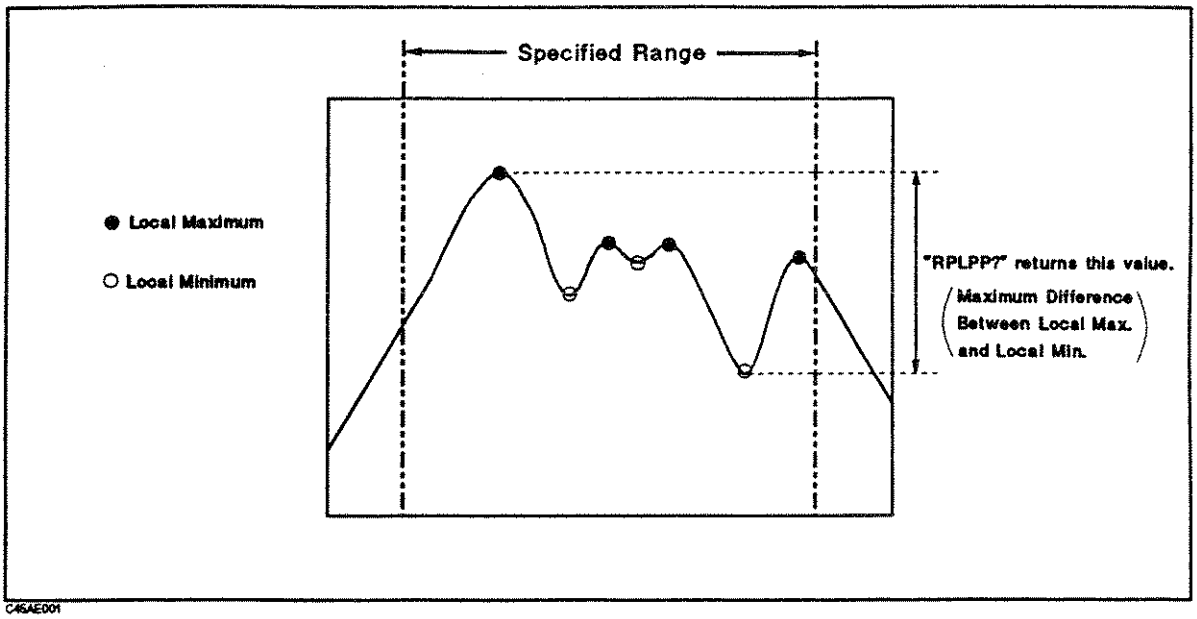


Figure E-1. RPLPP?

```
10 ASSIGN @Hp87510 TO 717                          ! When iBASIC is used,    *
15                                                 ! Change 717 to 800.
20 OUTPUT @Hp87510;"ANAOCH1"                       ! Select channel 1 for analysis
30 OUTPUT @Hp87510;"ANARANG 69.99E6,70.01E6"       ! Set freq. range for analysis.
35                                                 ! (69.99 MHz through 70.01 MHz)
40 OUTPUT @Hp87510;"ANAODATA"                      ! Select DATA trace for analysis
50 OUTPUT @Hp87510;"RPLPP?"                        ! Search for ripple
60 ENTER @Hp87510;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.

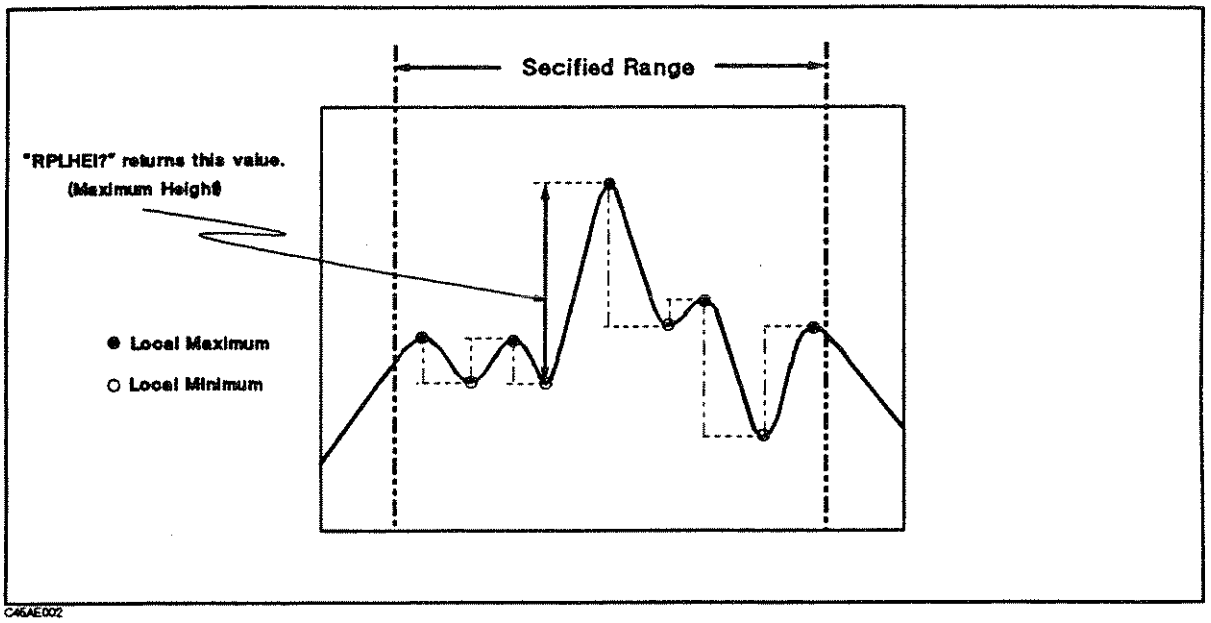


Figure E-3. RPLHEI?

```
10 ASSIGN @Hp87510 TO 717      ! When iBASIC is used, change 717 to 800
20 OUTPUT @Hp87510;"ANAOCH1"   ! Select channel 1 for analysis
30 OUTPUT @Hp87510;"ANARFULL"  ! Range for analysis is equal to
35                             ! the stimulus range.
40 OUTPUT @Hp87510;"ANAODATA"  ! Select DATA trace for analysis
50 OUTPUT @Hp87510;"RPLHEI?"   ! Search for ripple
60 ENTER @Hp87510;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, and RPLLHEI? searches only for the local minimum to the left from each local maximum point as shown in Figure E-5. Both commands return the maximum height by HP-IB. If no ripple is detected, a zero is returned.

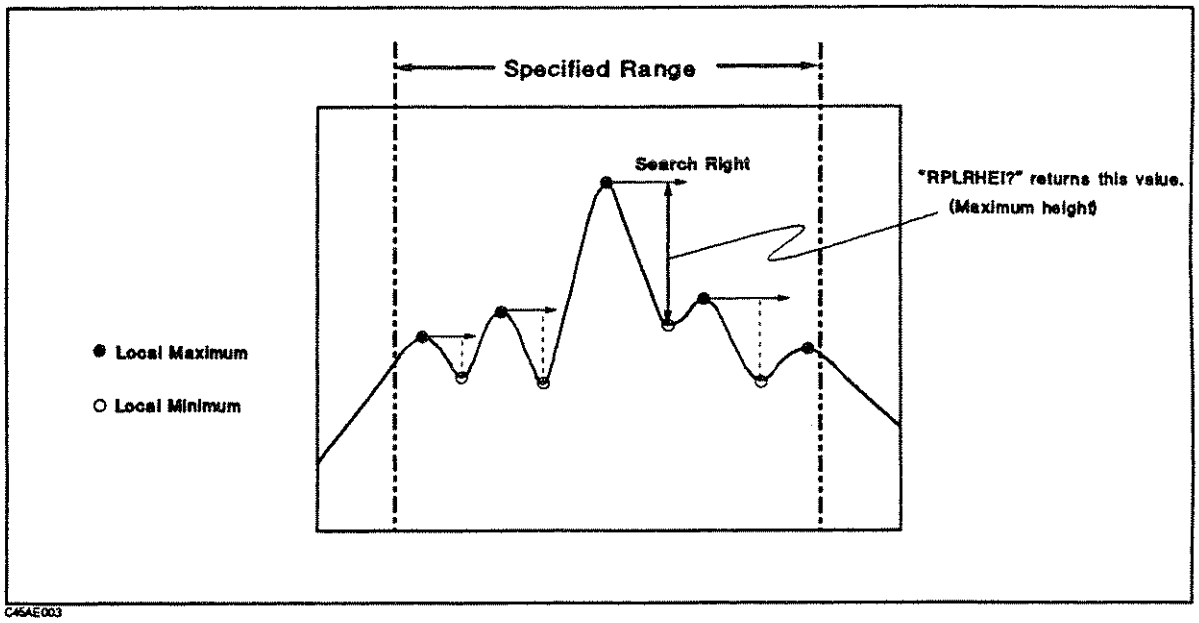


Figure E-5. RPLRHEI?

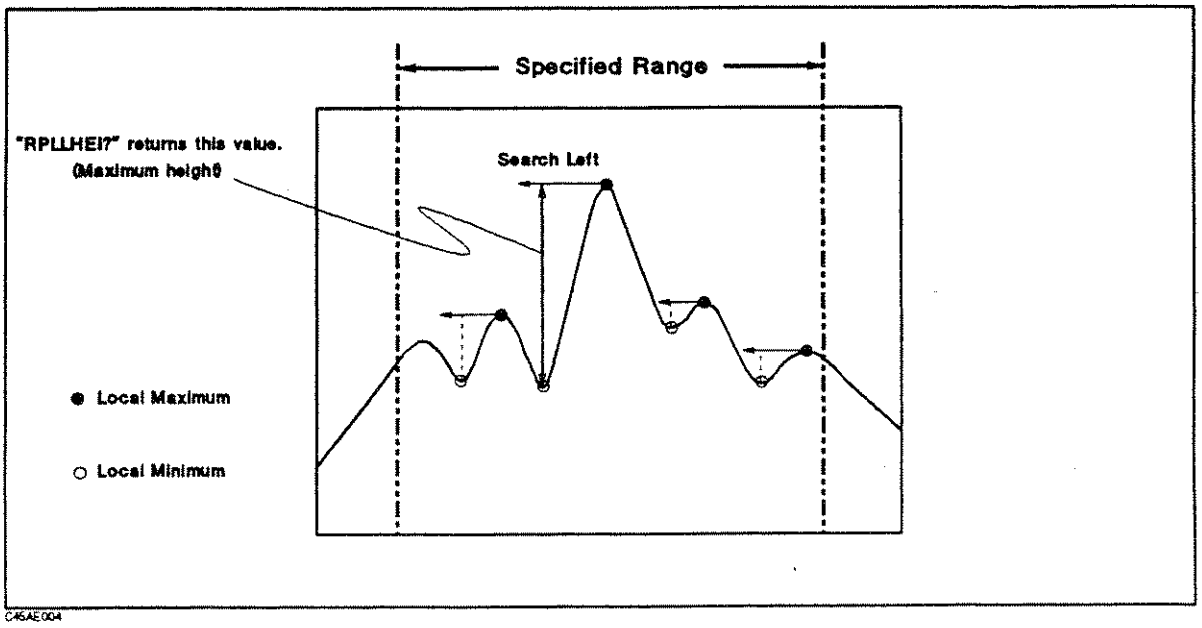


Figure E-6. RPLLHEI?

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.

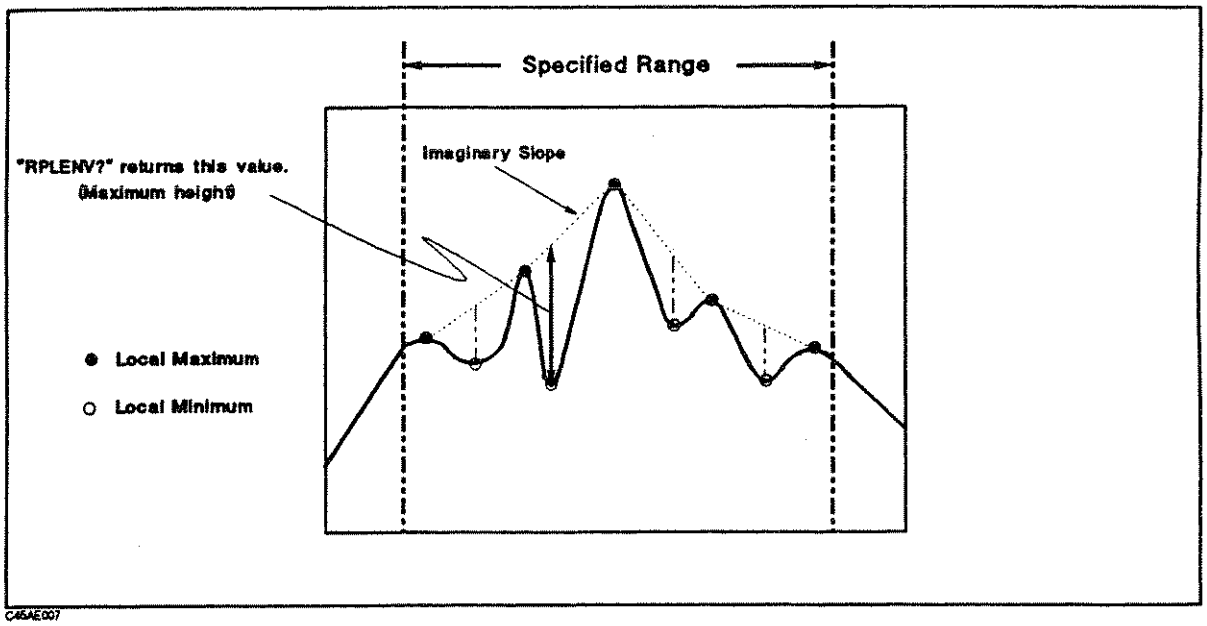


Figure E-7. RPLENV?

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.

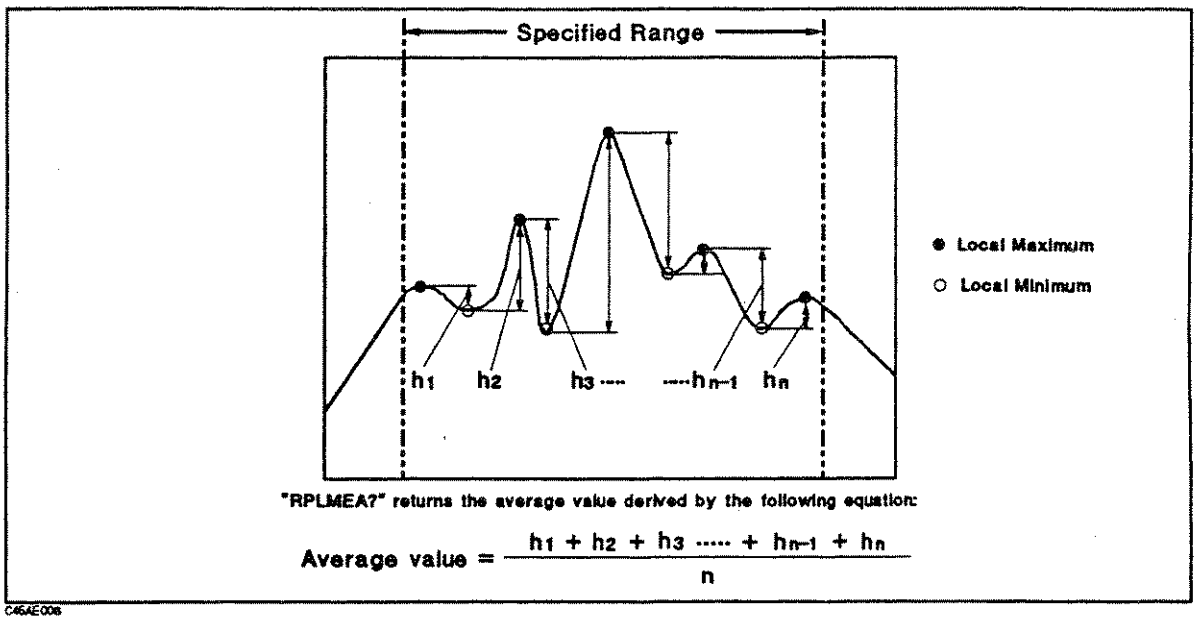


Figure E-8. RPLMEA?

```
110 ASSIGN @Hp87510 TO 717      ! When iBASIC is used, change 717 to 800
120 OUTPUT @Hp87510;"ANAOCH1"   ! Select channel 1 for analysis
130 OUTPUT @Hp87510;"ANARFULL"  ! Range for analysis is equal to
135                             ! the stimulus range.
140 OUTPUT @Hp87510;"ANAODATA"  ! Select DATA trace for analysis
150 OUTPUT @Hp87510;"RPLRHEI?"  ! Search right for ripple
160 ENTER @Hp87510;Right_ripple ! Get ripple value
170 OUTPUT @Hp87510;"RPLLHEI?"  ! Search left for ripple
180 ENTER @Hp87510;Left_ripple  ! Get ripple value
190 OUTPUT @Hp87510;"RPLENV?"   ! Search for "envelope ripple"
200 ENTER @Hp87510;Env_ripple   ! Get envelope value
210 OUTPUT @Hp87510;"RPLMEA?"   ! Search for ripple and average ripple values
220 ENTER @Hp87510;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

RPLVAL?

The RPLVAL? command 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 E-10. If the corresponding points are not found, a zero will be returned.

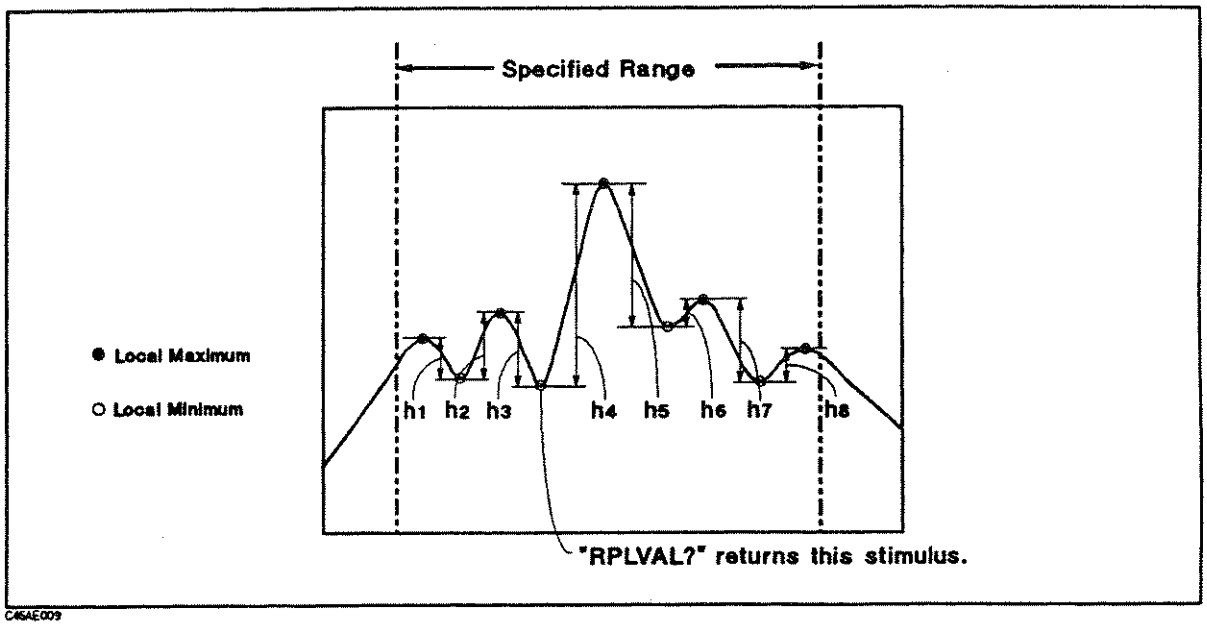


Figure E-10.

POLE?

The POLE? command 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, and returns the first qualifying local minimums found with their corresponding stimulus values. Refer to Figure E-11. The command parameter should be a negative value. If such a point is not found, a zero will be returned.

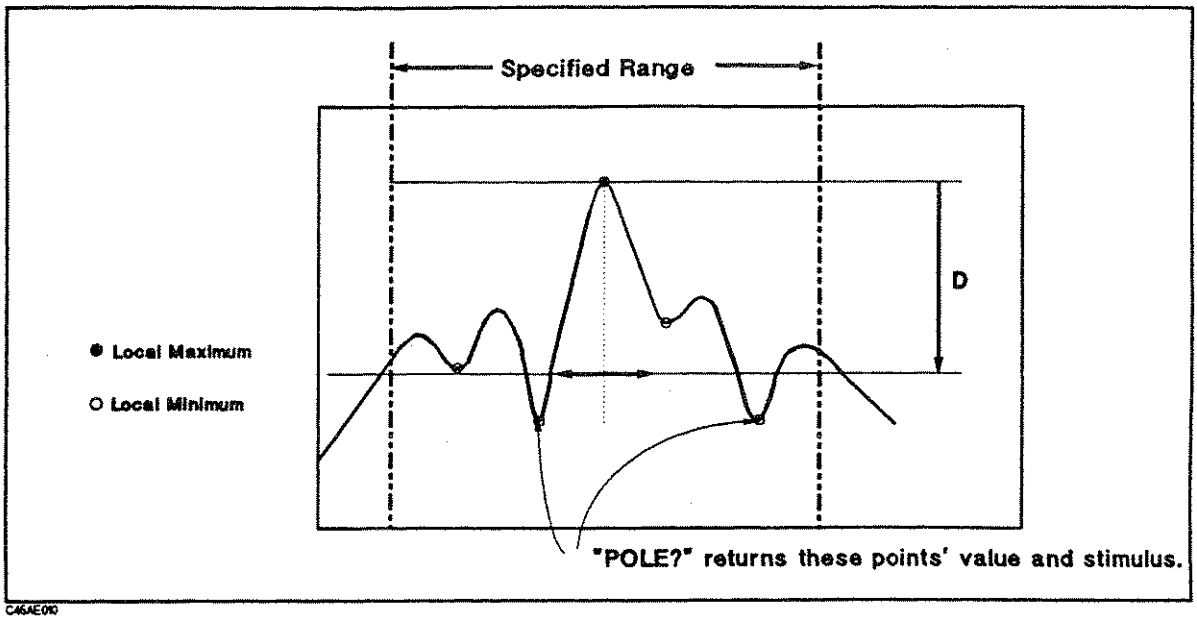


Figure E-11. POLE?

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?
PEAK?
NEXPK?
NUMLMAX?
NUMLMIN?
LMAX?
LMIN?
TARR?
TARL?
```

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.

PEAK?

The PEAK? command returns the maximum local maximum within the specified range with its corresponding stimulus value. If there are two or more maximum local maximums, the minimum stimulus value is returned. The HP 87510A records the maximum local maximum and its stimulus value. If such a local maximum is not found, a zero will be returned.

NEXPK?

The NEXPK? command returns the maximum local maximum (within the specified range) having a value less than the value recorded by the HP 87510A. It also returns the corresponding stimulus value. 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 87510A. If such a local maximum is not found, a zero will be returned.

NUMLMAX?

The NUMLMAX? command returns the number of local maximums within the specified range.

NUMLMIN?

The NUMLMIN? command returns the number of local minimums within the specified range.

LMAX?

The LMAX? command returns the nth local maximum counted from the left end of the specified range. n is a command parameter. If such a local maximum is not found, 3.40282347E+38 will be returned.

LMIN?

The LMIN? command returns the nth local minimum counted from the left end of the specified range. n is a command parameter. If such a local minimum is not found, 3.40282347E+38 will be returned.

TARR?

The TARR? command 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. If the point is not found, a zero will be returned.

TARL?

The TARL? command 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. If such a point is not found, a zero will be returned.

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]*
OUTPXFIL?
OUTPCFIL?
OUTPRESO?
OUTPRESR?
OUTPRESF?

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 *x*dB 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-12 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 *x*dB 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 *x*dB points can not be found.

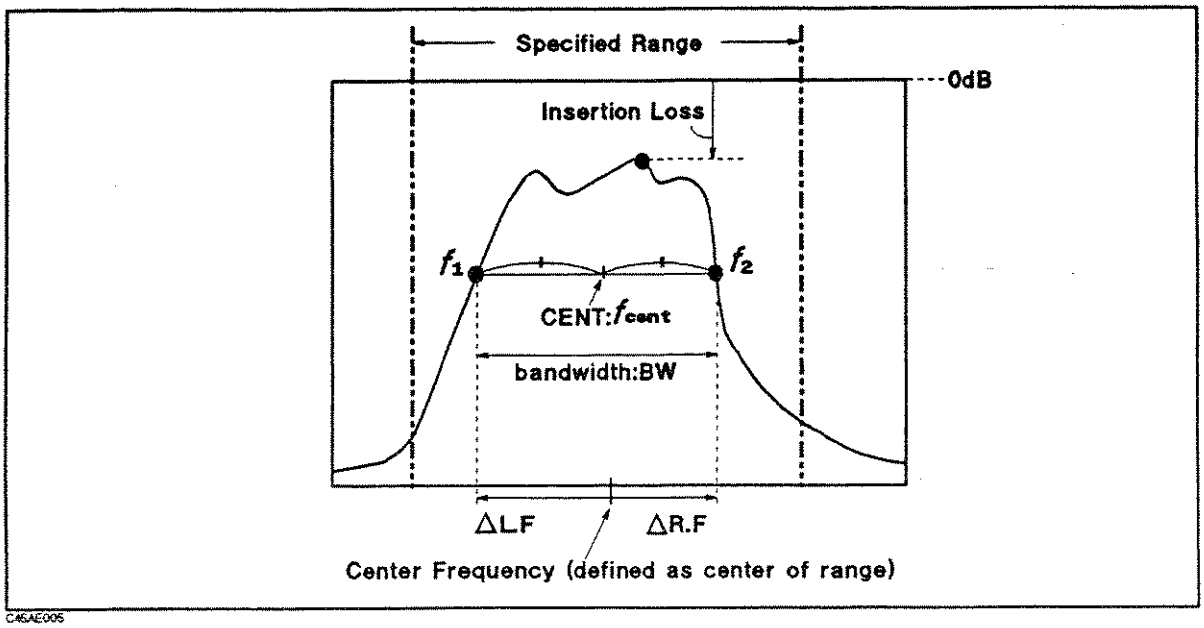


Figure E-12. Output Filter Parameters Example

```
100 ASSIGN @Hp87510 TO 717                    ! If iBASIC is used,
105                                           ! Change 717 to 800.
110 OUTPUT @Hp87510;";PRES"                   ! Preset the HP 8751A.
120 OUTPUT @Hp87510;";HOLD"                   ! Sweep hold
130 OUTPUT @Hp87510;";DISAALLB"               ! Display allocation is ALL BASIC
140 OUTPUT @Hp87510;";CENT 70E6;SPAN 100E3"   ! CENTER 70 MHz, SPAN 100 kHz
150 OUTPUT @Hp87510;";AR"                     ! Measure AR
160 OUTPUT @Hp87510;"ANAOCH1"                 ! Select CHANNEL 1 to be used
170 OUTPUT @Hp87510;"ANARANG 69.95E6,70.05E6" ! Analysis range is between
175                                           ! 69.95 MHz and 70.05 MHz
176                                           ! by the analysis command.
180 OUTPUT @Hp87510;"ANAODATA"                ! Select DATA TRACE to be used
185                                           ! by the analysis command.
190 OUTPUT @Hp87510;";SING"                   ! Trigger sweep
200 OUTPUT @Hp87510;"OUTPFILT? -3"            ! Query -3 dB bandwidth and
                                              ! other filter parameters.
210 ENTER @Hp87510;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-13. Sample Program for OUTPFILT

OUTPXFIL?

The OUTPXFIL? command returns the parameters output by the OUTFILT? command, insertion loss, BW (bandwidth), fcent (frequency center), Q, L.F, R.F, pass band ripple, L.F2 and R.F2 of two points which are X2 dB below the maximum peak, blocking 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.

The returned insertion loss, BW, Q, fcent, L.F, and R.F are the same as those of the OUTPFILT? command. For other parameters, refer to Figure E-12.

The pass band ripple is the maximum difference between a local maximum and minimum within the parameter-specified range, f_1 to f_2. L.F2 and R.F2 indicate the differences between the left and right cutoff points and the center point of a specified range like L.F and R.F. The blocking level is the difference between the maximum value to the left of f_1 and the maximum value within the specified range. The 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?".

If two cutoff points which are xdB below the maximum peak are not found, zeros will be returned for all parameters.

If two cutoff points which are X2 dB below the maximum value are not found, zeroes will be returned for L.F2 and R.F2.

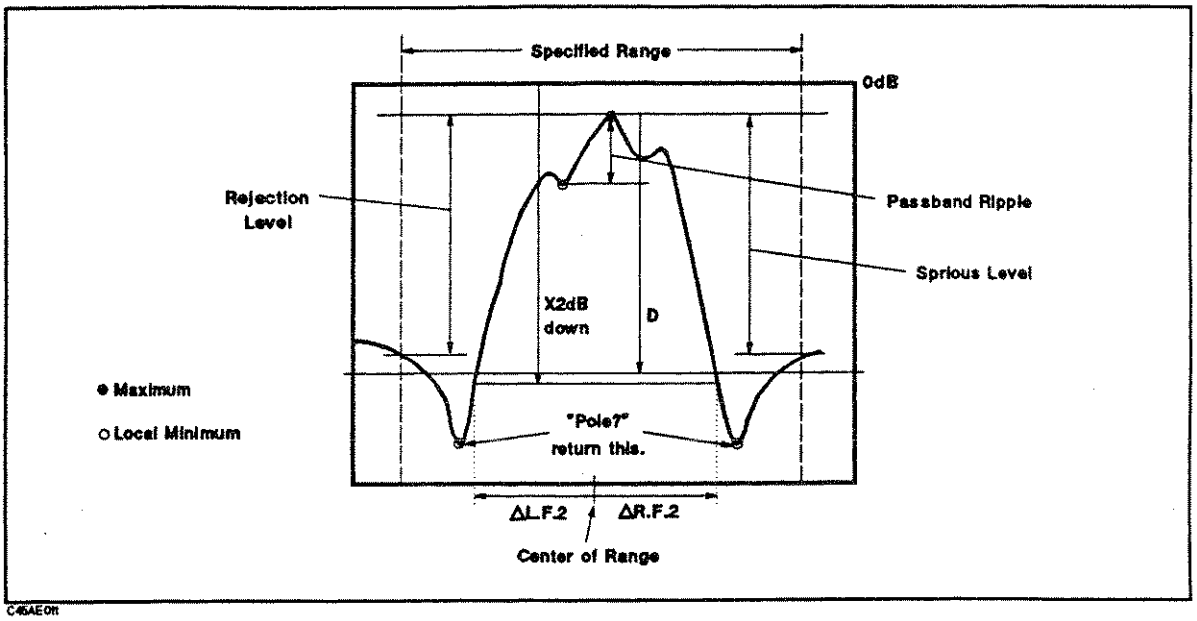


Figure E-14. OUTPXFIL?

OUTPCFIL?

The OUTPCFIL? command returns an insertion loss, point on fc, BW, frequency center, Q, L.F, R.F, pass band ripple, L.F2 and R.F2 of two points which are X2 dB below the maximum peak, blocking level, spurious level, and POLE? command result (local minimum (left) and its stimulus and local minimum (right) and its stimulus). Refer to Figure E-18. The insertion loss is the absolute value of the difference between the maximum value within the specified range and 0 dB. The point on fc is the point on the nominal frequency given as a command parameter. BW is the stimulus width between two cutoff points which are X1 dB below the point on fc. The center frequency (fcent) 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.

L.F is the stimulus width from fc to f_1. R.F is the stimulus width from fc to f_2. The pass band ripple is the maximum difference between a local maximum and local minimum between f_1 and f_2.

L.F2 and R.F2 are stimulus widths between fc and the left and right cutoff points which are X2 dB below the point on f_c.

The blocking 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 xdB below the point on fc are not found, zeros will be returned. If two points which are x2 dB below the point on fc are not found, zeros will be returned for L.F2 and R.F2.

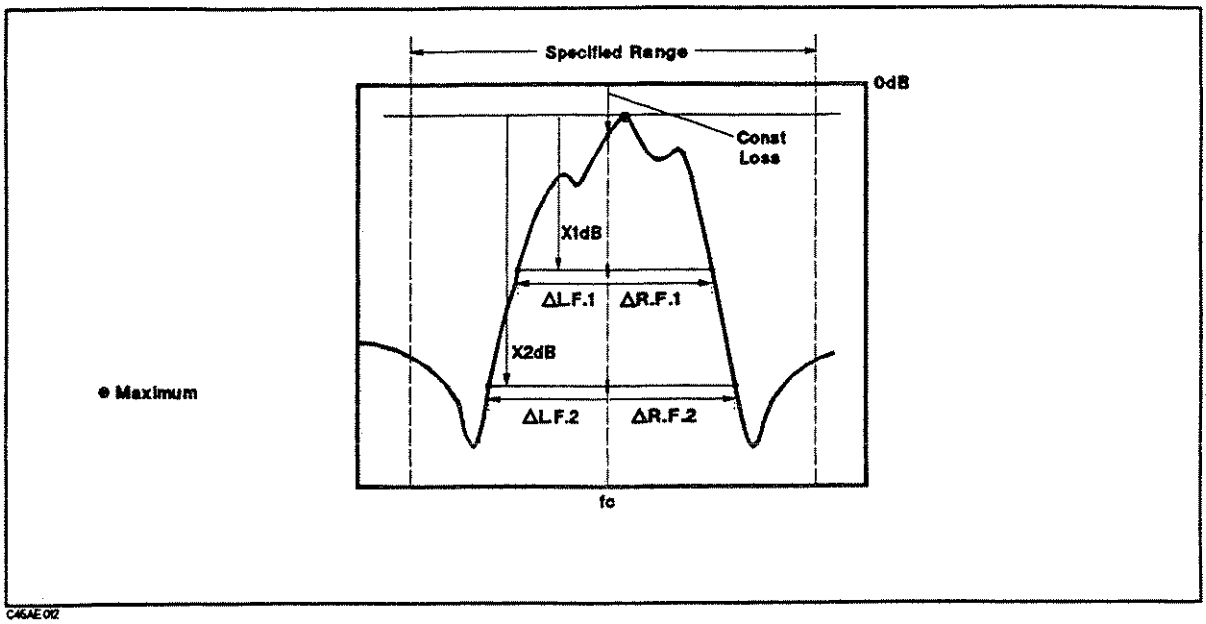


Figure E-15. OUTPCFIL?

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-16 shows a typical example of an crystal 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.

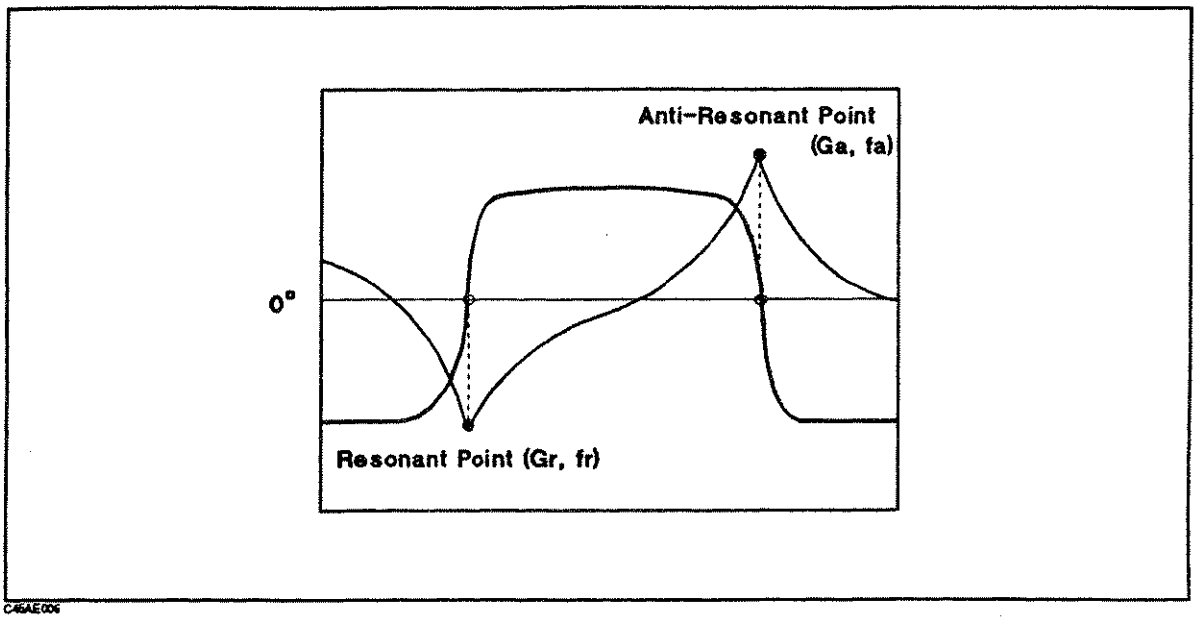


Figure E-16. OUTPRESO?

```
100 ASSIGN @Hp87510 TO 800              ! If iBASIC is used,
115                                     ! Change 717 to 800.
110 ASSIGN @Hp87510a TO 800;FORMAT OFF  ! Path for ENTER statement
120 OUTPUT @Hp87510;";HOLD"             ! Sweep hold
130 OUTPUT @Hp87510;";DISAALLB"         ! Display allocation is ALL BASIC
140 OUTPUT @Hp87510;"ANAOCH1"           ! Select CHANNEL 1 to be used by
150 OUTPUT @Hp87510;"ANARFULL"          ! Analysis range is full
155                                     ! the analysis command.
160 OUTPUT @Hp87510;"ANAODATA"          ! Select DATA TRACE to be used
165                                     !  by the analysis command.
170 OUTPUT @Hp87510;"FORM3"             ! Set format to IEEE 64
180 OUTPUT @Hp87510;"OUTPRESO?"         ! Query Res/Ant-res. point.
190 ENTER @Hp87510 USING "#,8A";A$      ! Enter header
200 ENTER @Hp87510a;Zr,Fr,Za,Fa         ! Get result
210 ENTER @Hp87510 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-17. Sample Program for OUTPRESO

OUTPRESR?

The OUTPRESR? command analyzes the ripple of a resonator which has the characteristics shown in Figure E-19.

When the OUTPRESR? command is issued, the HP 87510A searches for the 0° phase point from the left end of the specified range. The HP 87510A 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:

- Gain and stimulus value of the resonant point
- Gain and stimulus value of the anti-resonant point
- Maximum value of the difference between the local maximum and the adjacent left-hand local minimum which are at left of the resonant point
- 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
- 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

If there are three or more phase 0° points within the specified range, the HP 87510A returns the values of first two points found. If there is only one phase 0° point, the HP87510A 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 87510A will return zeros for all parameters.

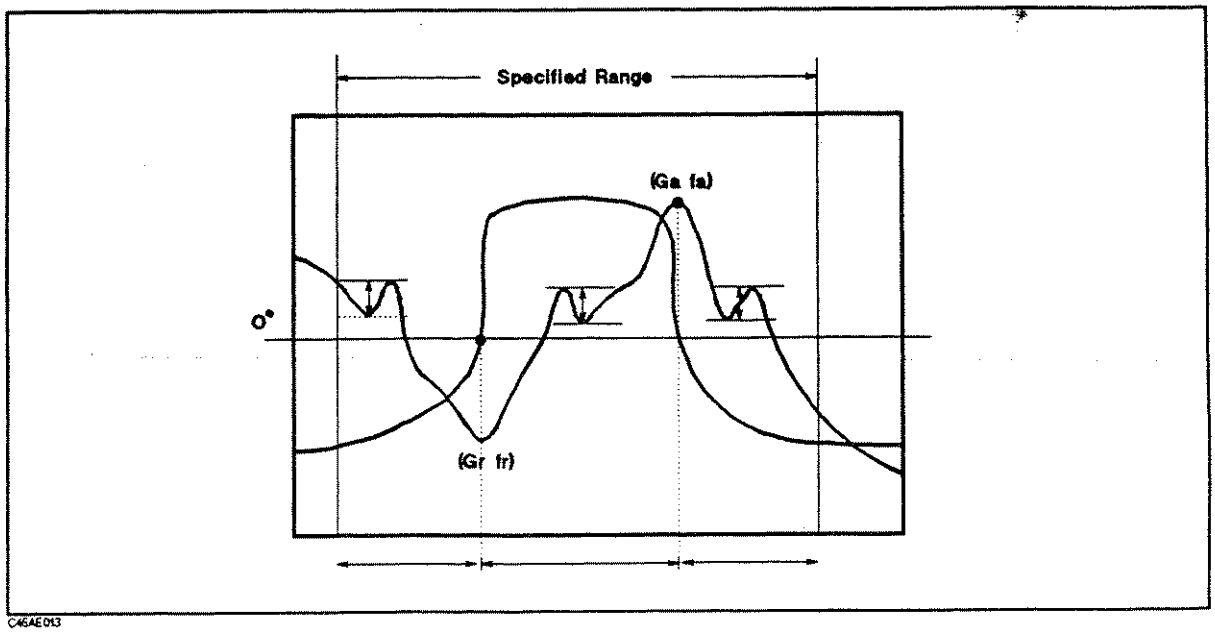


Figure E-18. OUTPRESR?

OUTPRESF?

OUTPRESF? searches maximum local-maximum (fs) and minimum local-minimum (fp) within specified range, then, searches x1 dB below points for both side from fs and x2 dB above points for both side from fp. The first point founded on the left-hand side of fs is fs1, and right-hand is fs2. In a similar way, fp1 is first point found on the left-hand side of fp, and fp2 is right-hand point. See Figure E-19.

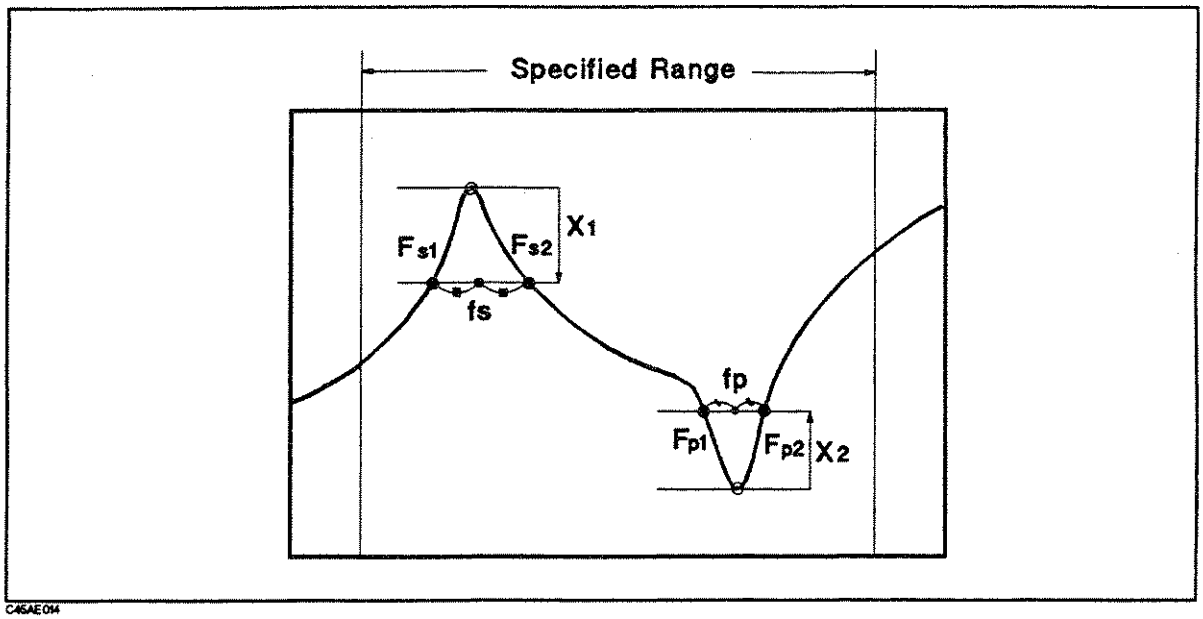


Figure E-19. OUTPRESF?

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 admittance conversion is selected.

EQUCPARA?

The EQUCPARA? command makes a 4-device equivalent circuit analysis for the crystal resonator and returns equivalent circuit constants. The EQUCPARA? regards the following circuits as equivalent circuits:

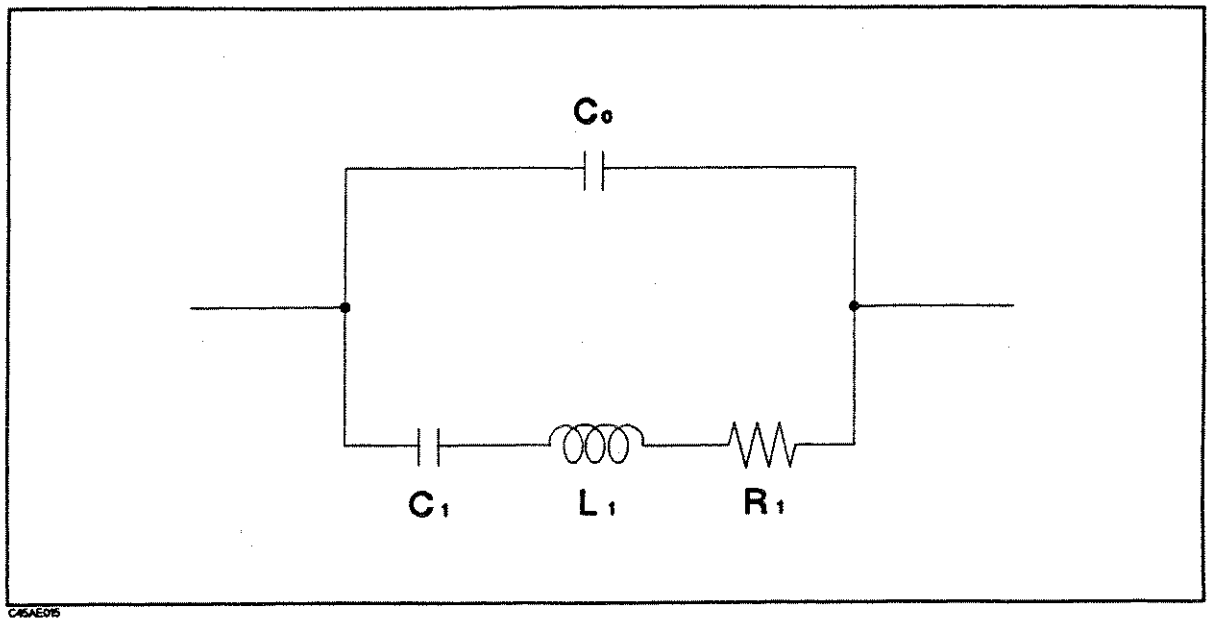


Figure E-20. Four-Device Equivalent Circuit for Crystal Resonator

Where,

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

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

1. Obtains the admittance characteristic circle diagram.
2. Obtains the susceptance (Bfs) and its frequency (fs) at the maximum conductance (Gmax) point.
3. Obtains frequencies f_1 and f_2 ($f_1 < f_2$) of two points where the conductance is half the maximum conductance (Gmax).
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:

$$R_1 = \frac{1}{Gmax}$$

$$L_1 = \left|\frac{Q \times R_1}{2\pi f_s}\right|$$

$$C_1 = \frac{1}{QR_1 \times 2\pi f_s}$$

$$C_0 = \left(\frac{f_r^2}{f_a^2 - f_r^2}\right)$$

Where,

$$Q = \left| \frac{f_s}{f_2 - f_1} \right|$$

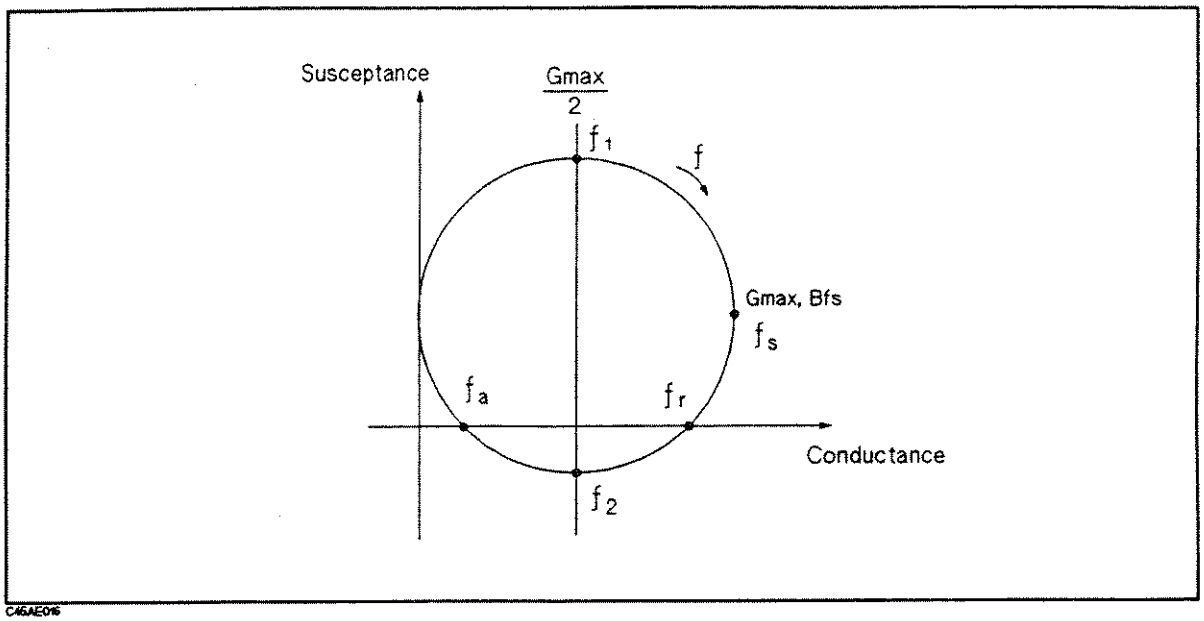


Figure E-21. Admittance Characteristic Chart

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

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

EQUCPARS?

The EQUCPARS? *command returns f_s, f_a, f_r, f_1, and f_2 in addition to C_0, C_1, L_1, and R_1 which are returned by the* EQCUPARA? *command. For more information on parameters, see "EQCUPARA?".*

HP-IB EXECUTE Commands

Execute Command and HP-IB Command

HP Instrument BASIC of the HP 87510A has an EXECUTE *command which can execute HP-IB commands faster than in the ordinary way, for example, using the* OUTPUT *statement of HP BASIC and Instrument BASIC.* EXECUTE *command can execute the following HP-IB commands:*

Available HP-IB Commands for EXECUTE

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

For details about EXECUTE, *refer to Using the HP Instrument BASIC.*

EXECUTE Specific Command

The following HP-IB commands give different result, when used with the EXECUTE *command and than when used with the* OUTPUT *statement.*

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

Following HP-IB Commands are only available for the EXECUTE *command. You can not execute them using the* OUTPUT *statement. The effective channel for these commands are dependent on the setting of* ANAOCH1 *and* ANAOCH2. *For details about* ANAOCH1 *and* ANAOCH2, *refer to "ANAOCH1/ANAOCH2" in Appendix E.*

- INPUDATTP
- INPUMEMTP
- OUTPDATTP?
- OUTPMEMTP?

INPUDATTP

Enters data to the nth point of a data trace. Command parameters; data point number, real and imaginary part of input data, are passed to the HP 87510A by using a register. Data point number is set to register 0, real part of input data is set to register 1, and imaginary part of input data is set to register 3.

INPUMEMTP

Enters data to the nth point of a memory trace. Command parameters are data point number, real and imaginary part of input data. Data point number is set to register 0, real part of input data is set to register 1, and imaginary part of input data is set to register 3.

OUTPDATTP?

Outputs the data-trace data for the specified point. Command parameter, point number of data trace, is set to register 0. Query returns real part of specified point to register 0 and imaginary part of specified point to register 1.

OUTPMEMTP?

Outputs the memory data at a specified point. Command parameter, point number of data trace, is set to register 0. Query returns real part of specified point to register 0 and imaginary part of specified point to register 1.

One-Point Correction

HP 87510A has a one point correction function, which corrects each measurement point using a coefficient constant. There are two ways for one-point correction. One uses 1 coefficient, and another uses 3 coefficients.

1 Coefficient Command

This correction command corrects measured data on each point using the following equation:

$$CorrectedData = \frac{MeasuredData}{Coefficient1} \qquad (G.1)$$

This equation is the same as correction equation used for frequency response calibration. In this case, coefficient 1 is an error term, transmission tracking (E_t).

HP-IB Command

The following HP-IB commands are used to execute this correction:

INPUDATM1 *real,imaginary*

This command sets coefficient 1.

DATAMTHRU

Calculates measured data by using equation G.1.

3-Coefficient Command

This correction command corrects measured data on each point by using following equation:

$$CorrectedData = \frac{MeasuredData - Coefficient2}{Coefficient3 + Coefficient4\,(MeasuredData - Coefficient2)} \qquad (G.2)$$

This equation is the same as the correction equation used for a 3-term calibration. In this case, coefficient 1 is E_1, coefficient 2 is E_2, and coefficient 3 is E_3.

HP-IB Command

The following HP-IB commands are used to execute this correction:

INPUDATM2 *real,imaginary*

This command sets coefficient 2.

INPUDATM3 *real,imaginary*

This command sets coefficient 3.

INPUDATM4 *real,imaginary*

This command sets coefficient 4.

DATAM3TER

Calculates measurement data by using equation G.1.

Cancel of 1-Point Correction

To cancel a 1-point correction, execute `DATAMNONE`.

Sample Program

The following program shows a sample of using the `DATAMTHRU` command.

```
10    ASSIGN @Hp87510 TO 717
20    OUTPUT @Hp87510;"CALIRESP" ! Execute frequency response calibration
30    ON INTR 7 GOTO Sweep_end
40    OUTPUT @Hp87510;"CLES"
50    OUTPUT @Hp87510;"*SRE 4;ESNB 1"
60    REPEAT
70    UNTIL SPOLL(@Hp87510)=0
80    ENABLE INTR 7;2
90    OUTPUT @Hp87510;"STANC"
100 Loop_top:GOTO Loop_top
110 Sweep_end:!
120   OUTPUT @Hp87510;"RESPDONE"
130   DIM Dat(200,1)
140   OUTPUT @Hp87510;"OUTPCALC01?" ! Reads calibration data array
150   ENTER @Hp87510;Dat(*)
160   OUTPUT @Hp87510;"INPUDATM1";Dat(1,0),Dat(1,1) ! Arbitrary point data
165   ! on trace is as coefficient of DATAMTHRU
170   OUTPUT @Hp87510;"DATAMTHRU"
180   OUTPUT @Hp87510;"SORROW"  ! Turn off the frequency response cal.
190   OUTPUT @Hp87510;"CONT"
200   END
```

Difference between 1-Point Correction and Calibration

HP 87510A corrects data automatically by using interpolated error correction feature if the stimulus settings is changed when calibration is turned on. In this case, the HP 87510A calculates error correction data, and this requires some time. On the other hand, 1-port correction applies the same error coefficient for all points. So, a 1-port correction does not need an interpolation time. If error coefficient does not requires consideration of frequency response, you should use a 1-point correction feature to reduce the interpolation time.

Using HP Instrument BASIC with the HP 87510A

Printed in JAPAN December 1991

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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.

December 1991..... 1st. Edition

Contents

Figures

Tables

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.

Note

In this manual, we assume that operator uses HP-HIL keyboard. HP-HIL keyboard is supplied as option. For details about option of the HP 87510A Instrument BASIC, refer to "About Option of the HP 87510A" in Chapter 2.

- Chapter 2 describes how to connect a keyboard. This chapter also provides information for option of the HP Instrument BASIC.
- Chapter 3 introduces the HP 87510A'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 87510A 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 87510A.
- The Appendix provides references for BASIC commands and HP-IB commands specific to HP 87510A'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

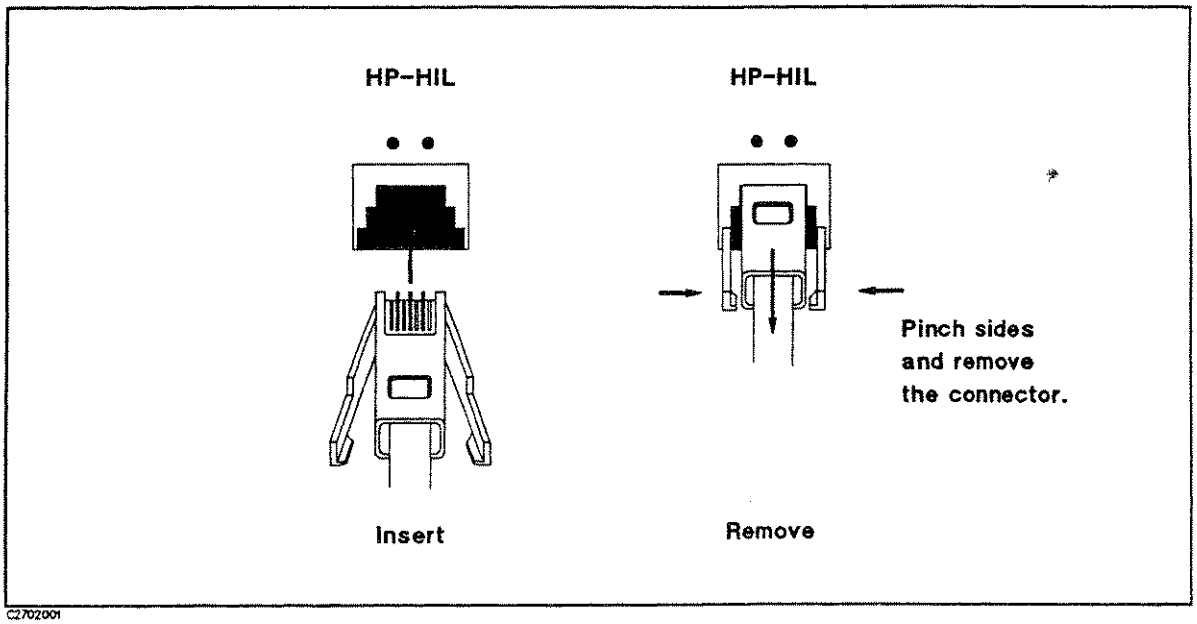


Figure 2-1. Connecting the HP-HIL Keyboard

About Option of the HP 87510A

Following option is prepared for the HP Instrument BASIC of the HP 87510A.

Ordering Information

Product Number	Description
HP 87510A Option 002	HP-HIL Keyboard HP Instrument BASIC Manual Set (This manual set describes the HP Instrument BASIC programming language. This manual set assumes that you have read *Using HP Instrumaent BASIC with the HP 87510A*. See the following.)

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 87510A 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 87510A; 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 87510A.

Using HP Instrument BASIC with the HP 87510A for the First Time

Note

If you have not used the HP 87510A, read the *User's Guide* in the *Operation Manual* and study its contents before reading this manual.

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 87510A's screen is allocated for instrument operation after power ON, allocate screen area for BASIC when you want to use it. The HP 87510A 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 like 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 like this:

   6

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

You can use arithmetic operations such as:

+ 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:

   100000

   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 100 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 parses 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 87510A
```

Using Softkeys from Keyboard

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

Entering BASIC Statements from the Front Panel Keys

HP 87510A 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 FILE UTILITY 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.

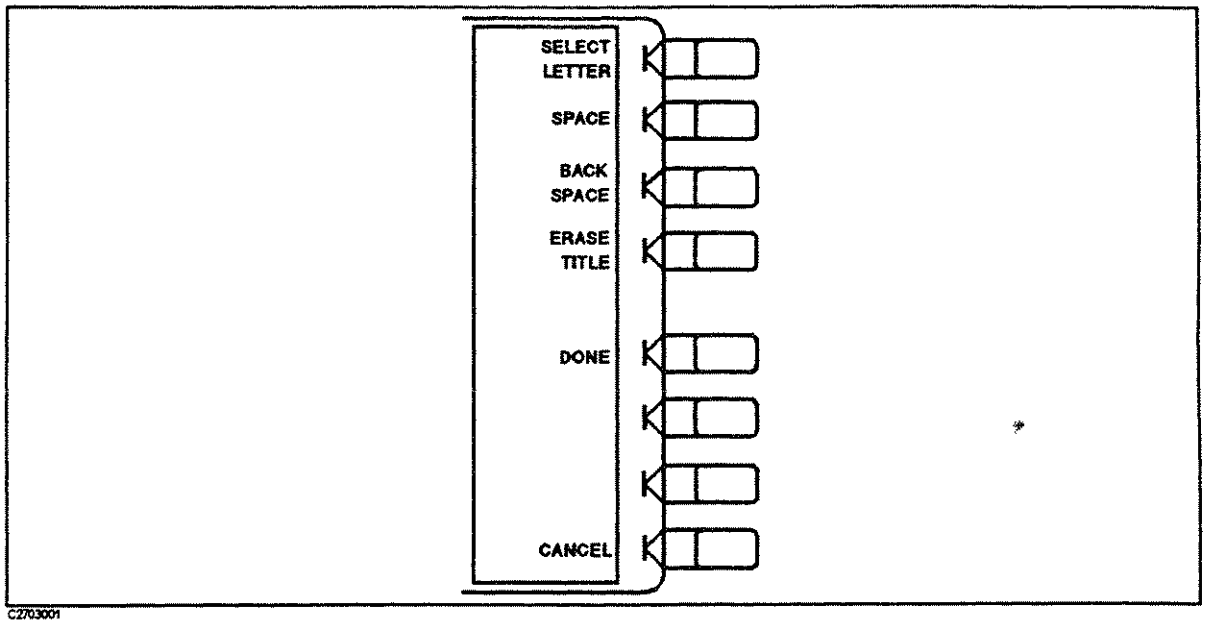


Figure 3-1. Command Entry Menu

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 87510A 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.

Writing Programs

Controlling the HP 87510A

Instrument BASIC system can control the instrument (itself) through the "*internal*" HP-IB bus. This means that the HP 87510A 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 87510A'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 : 87510 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	A/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 can be performed by pressing keys and softkeys from the front panel 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 @Hp87510

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

```
10 ASSIGN @Hp87510 TO 800_
```

4. Press the following key:

   (x1)

   The system reads the entire line.

```
10 ASSIGN @Hp87510 TO 800
20 _
```

5. Press the following softkey:

   OUTPUT @Hp87510

   The following characters are displayed on the screen:

```
10 ASSIGN @Hp87510 TO 800
20 OUTPUT @Hp87510;""
```

6. Press the following key and softkey 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 @Hp87510 TO 800
20 OUTPUT @Hp87510;";PRES"
```

   Then press (x1).

7. Press the following key to select measurement parameter as A/R:

   OUTPUT @Hp87510 (MEAS) A/R

   The program code is automatically generated:

```
10 ASSIGN @Hp87510 TO 800
20 OUTPUT @Hp87510;";PRES"
30 OUTPUT @Hp87510;";AR"
```

   Then enter (x1).

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

(SYSTEM) IBASIC OUTPUT @Hp87510 (CENT) 70(M/μ) (SPAN) 100 (k/m) (x1)

```
10 ASSIGN @Hp87510 TO 800
20 OUTPUT @Hp87510;";PRES"
30 OUTPUT @Hp87510;";AR"
40 OUTPUT @Hp87510;";CENT 70E6;SPAN 100E3"
50 _
```

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

   OUTPUT @Hp87510 (SCALE REF) AUTO SCALE (x1)

```
10 ASSIGN @Hp87510 TO 800
20 OUTPUT @Hp87510;";PRES"
30 OUTPUT @Hp87510;";AR"
40 OUTPUT @Hp87510;";CENT 70E6;SPAN 100E3"
50 OUTPUT @Hp87510;";AUTO"
60 _
```

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

    END (x1)

```
10 ASSIGN @Hp87510 TO 800
20 OUTPUT @Hp87510;";PRES"
30 OUTPUT @Hp87510;";AR"
40 OUTPUT @Hp87510;";CENT 70E6;SPAN 100E3"
50 OUTPUT @Hp87510;";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. 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 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 @Hp87510 TO 800
20 OUTPUT @Hp87510;";PRES"
30 OUTPUT @Hp87510;";AR"
40 OUTPUT @Hp87510;";CENT 70E6;SPAN 100E3"
50 OUTPUT @Hp87510;";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 87510A 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 87510A 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 scree, 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

5

Saving and Getting Programs

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

- Saving programs
- Listing file names
- Getting programs

Note

HP Instrument BASIC on the HP 87510A can communicate only with the built-in disk drive and RAM disk memory, 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 87510A User's Guide.*

Note

The HP 87510A 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.

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, not lead `FILE UTILITY`.

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 87510A 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 87510A 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. 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 87510A 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 24-bit I/O port(8 bit I/O port if option 005 was installed), the external RUN/CONT connector in the HP 87510A, 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.

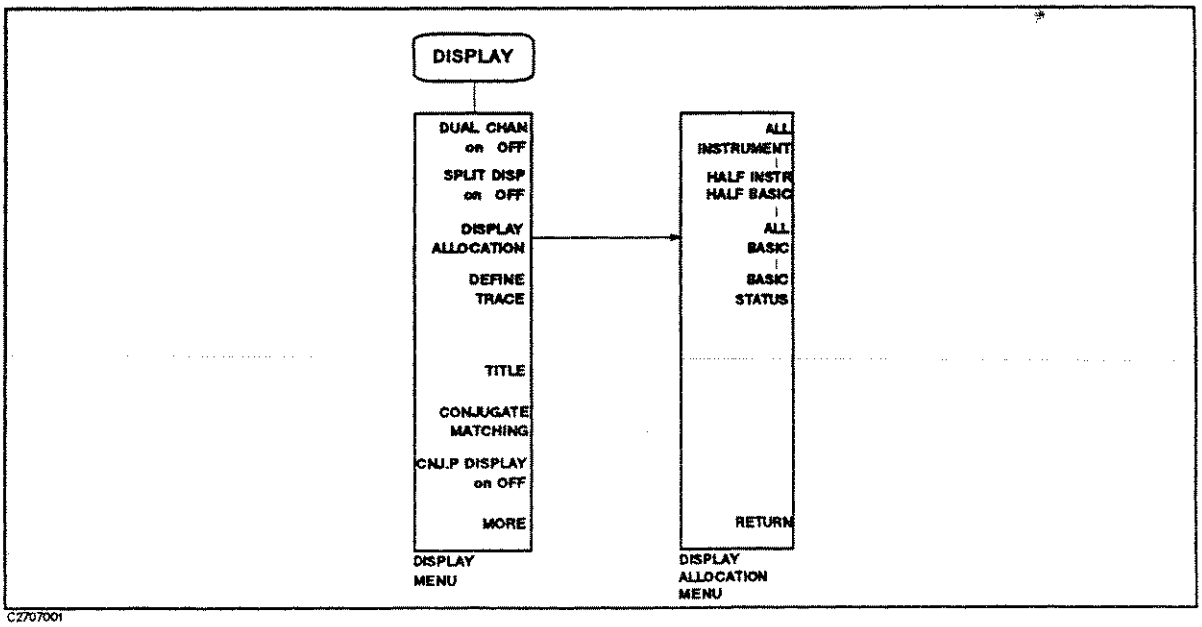


Figure 7-1. Display Allocation Menu

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.

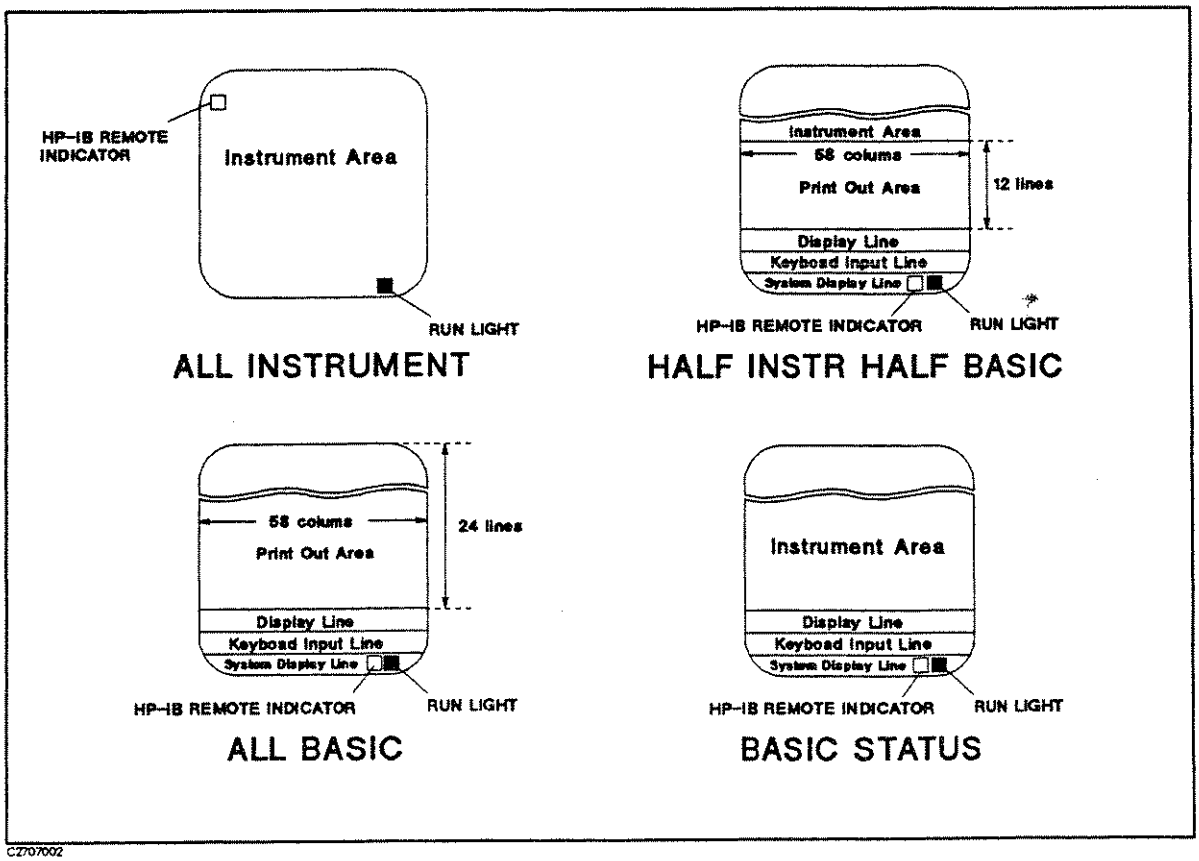


Figure 7-2. Display Allocation

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.

Graphics

HP 87510A Instrument BASIC adds graphics capability to the HP 87510A. You can draw pictures on the CRT display independent of the grids and traces.

The HP 87510A 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.

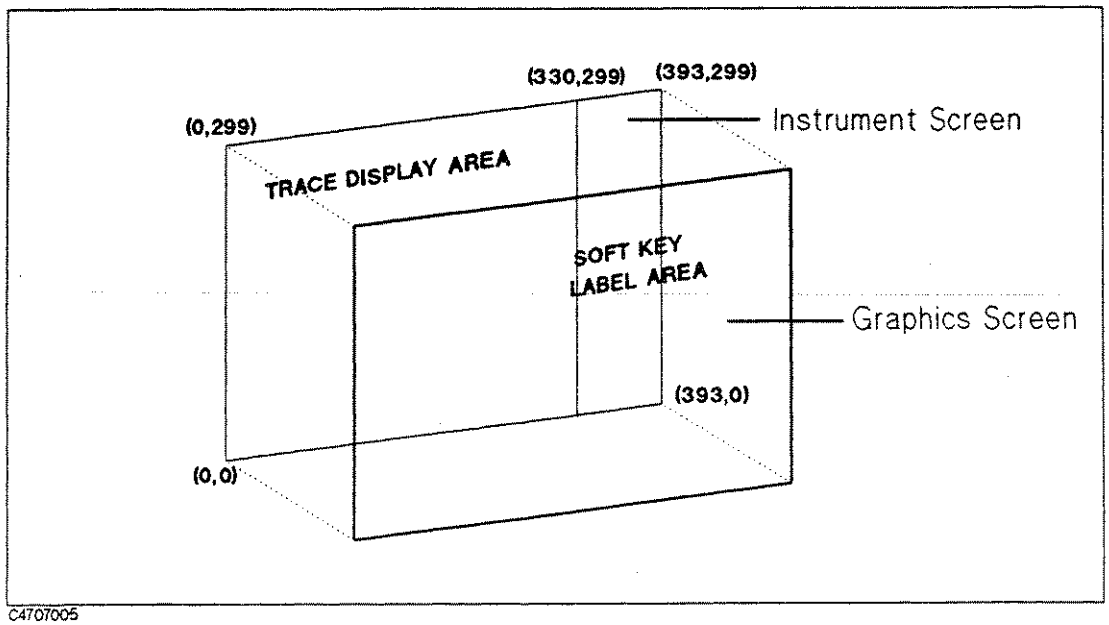


Figure 7-3. Screen Structure

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 (393,299). 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 87510A Instrument BASIC has three graphics commands; MOVE, DRAW, 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.
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 87510A Operation Manual.*

Initial settings

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

- 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 line from coordinate (50,200) to coordinate (300,200) on the display.

```
GCLEAR                  ! INITIALIZE GRAPHICS MODE
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 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 24-bit I/O port in BASIC programs

The HP 87510A has 24-bit I/O(Input/Output) port for data input and output. This I/O port can assign as 8 kinds of port from A port to H port. Figure 7-4 shows pin assignment of the 24-bit I/O port.

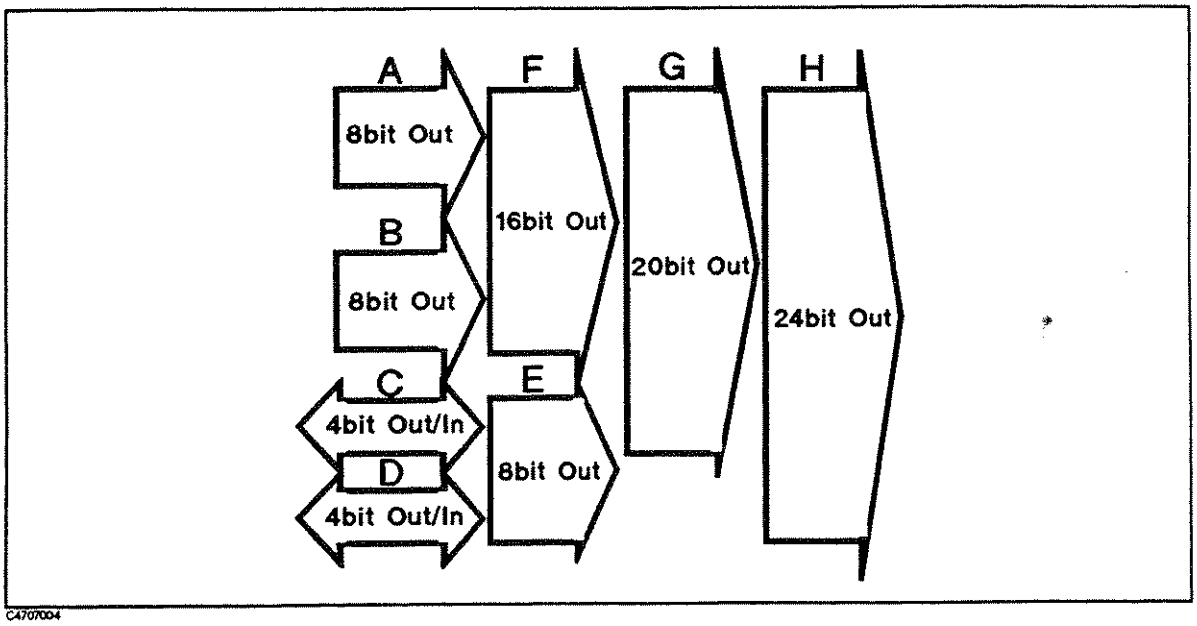


Figure 7-4. 24-bit I/O Port

Instrument BASIC can directly control the 24-bit I/O port without using HP-IB commands. This is faster than using HP-IB commands.

To control I/O port, following commands are used:

READIO(select_code,register_number)

This command reads data from specified I/O port. I/O port is specified by register number as listed in "READIO" in Appendix A. HP 87510A has 3 types of input port.

Table 7-1.

Port Name	Register Number	Number of Bits
Port C	2	4
Port D	3	4
Port E	4	8

Select cort is always 15 in HP 87510A.

WRITEIO select_code,register_number,register_data

This command writes data to specified I/O port. I/O port is specified by registser number as listed in Table 7-2. HP 87510A has 8 types of output port.

Table 7-2.

Port Name	Register Number	Number of Bits
Port A	0	8
Port B	1	8
Port C	2	4
Port D	3	4
Port E	4	8
Port F	5	16
Port G	6	20
Port H	7	24

Select cort is always 15 in HP 87510A.

For more information on the 24-bit I/O port, refer to "I/O port" in Appendix C of *HP 87510A Reference Manual*. Sample procedures to use the 8 bit I/O port are shown in "I/O Operation from Instrument BASIC" in Chapter 10 in this manual.

For details about form of `READIO` and `WRITEIO` commands, refer to Appendix A.

Using the 8-bit I/O Port in BASIC Programs (option 005 only)

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)	reads 4-bit data from the 8-bit I/O Port and returns as decimal value.
WRITEIO 15,0;	outputs decimal value of 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 87510A Reference 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. At the positive-going edge of a pulse more than 20 μsec wide (T_p) in the LOW state will trigger RUN or CONT.

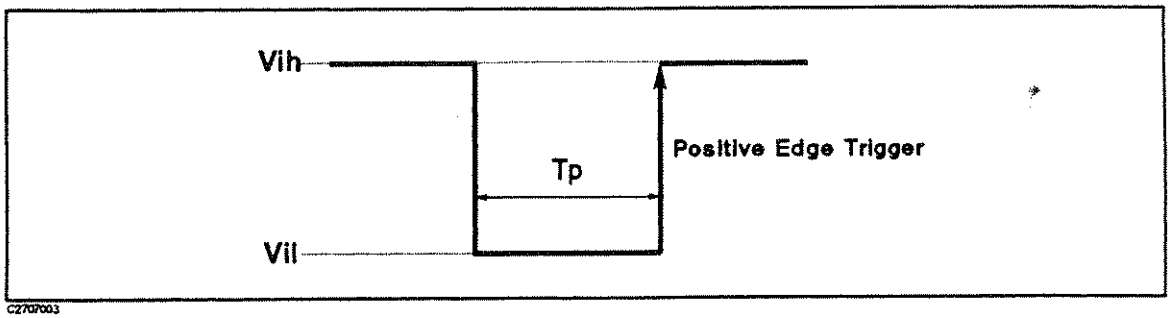


Figure 7-5. RUN/CONT Trigger Signal

File System Exceptions

The HP 87510A 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 87510A 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 RAM disk memory.

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 87510A allows you to create a special program file called "AUTOST". This program is automatically loaded and run every time the HP 87510A 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 87510A is turned ON.

The first checks to see if there an "AUTOREC" file on the disk, if there is the system reads the AUTOREC file to set up the instrument and then loads and runs the AUTOST program. (For more information on AUTOREC, refer to Chapter 11 of *HP 87510A 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 Chapter 10.

Increasing Program Speed

Since the HP 87510A'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 thrughput), set the HP 87510A 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.
- Use `EXECUTE` command for HP-IB command processing. For details about `EXECUTE` command, refer to "EXECUTE" in Appendix A.

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:

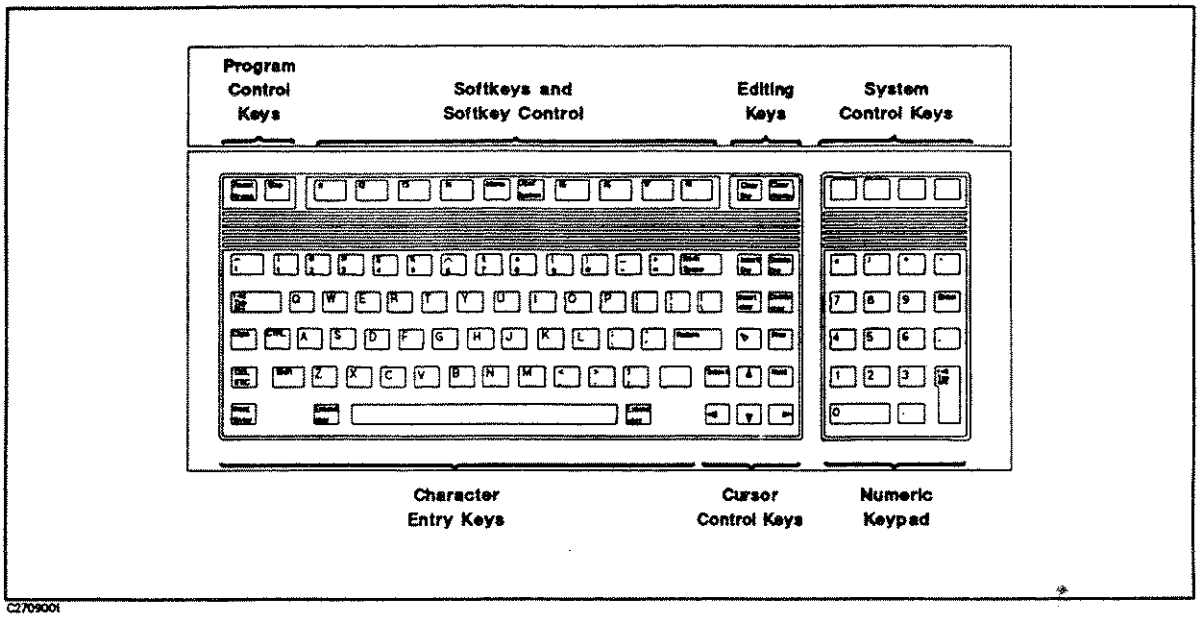
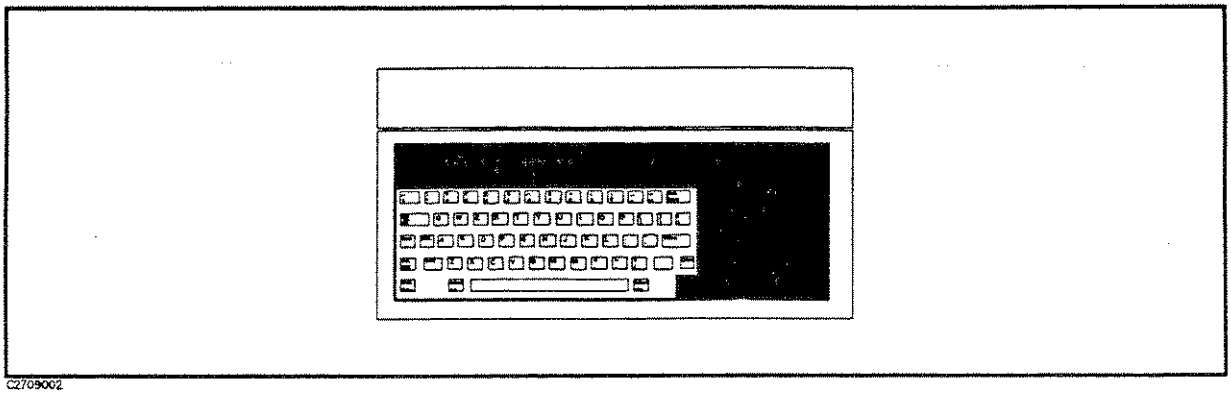


Figure 9-1. HIL-Keyboard

Character Entry Keys



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.

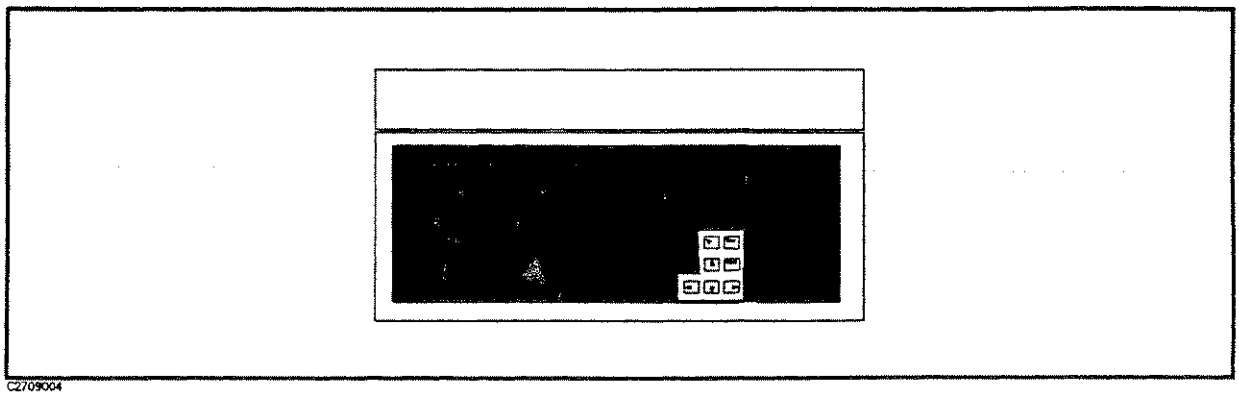
(CTRL) In the EDIT mode, (CTRL) allows you to control the editor in the same as using the cursor-control, display-control, and editing keys. For more detail, refer to "Using (CTRL) Key in Edit Mode".

(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

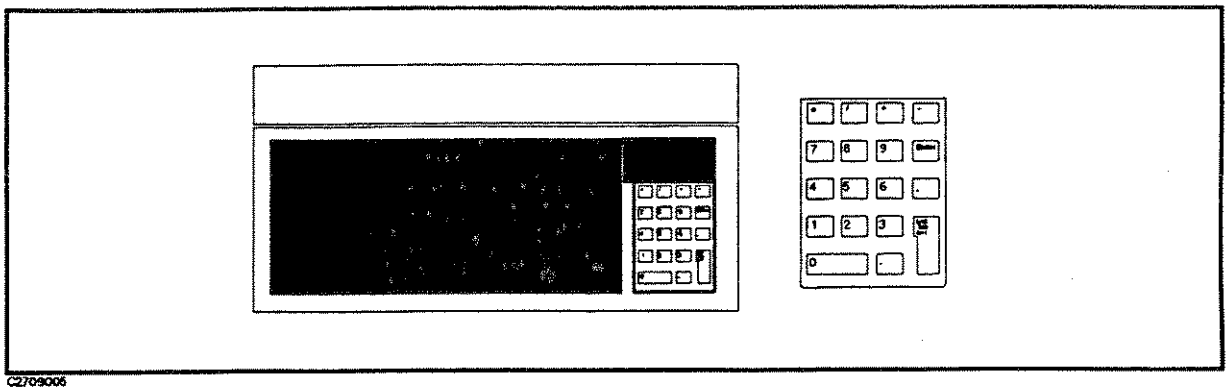
(▲)(▼) allow you to scroll lines up and down in the print display area. Shifted, these keys cause the display to scroll towards the top or bottom of the display.

(▶)(◀) 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



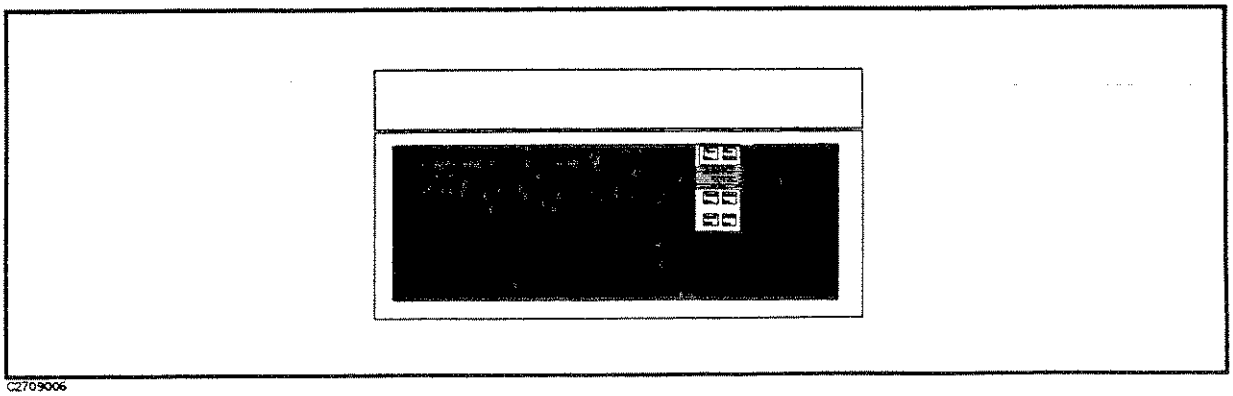
C2709006

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 87510A.

(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).

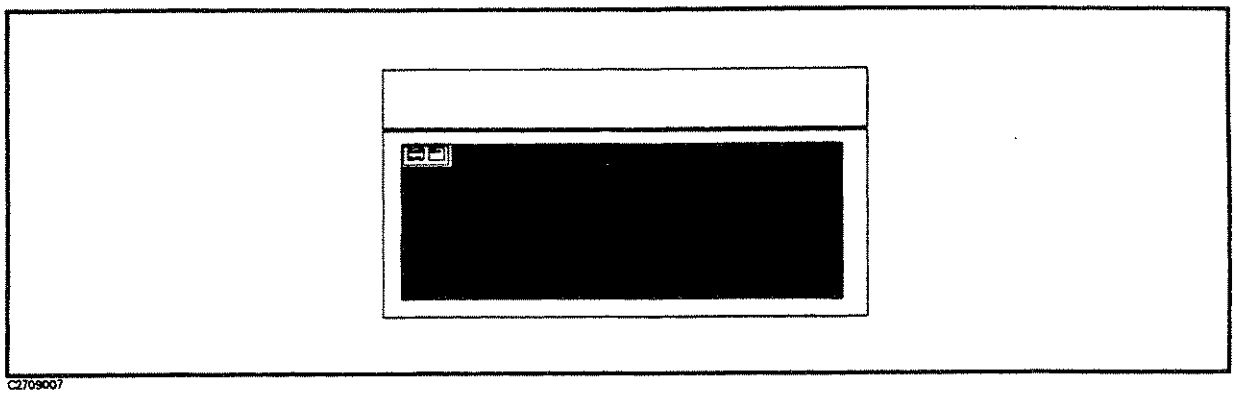
Insert char — performs no function. HP Instrument BASIC is always in the insert mode. The characters you type are always inserted to the left of the cursor.

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.

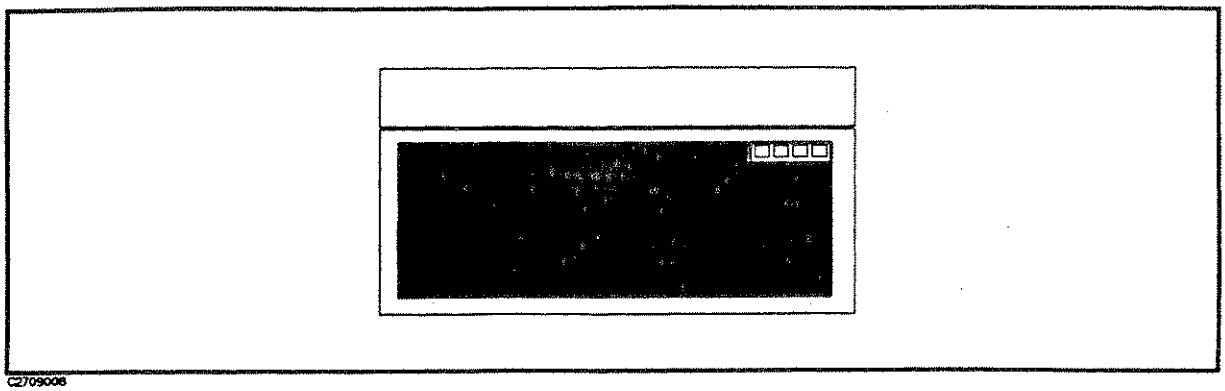
Shift-Stop **stops** program execution after the current line. To restart the program, press `Run` in the System menu.

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.

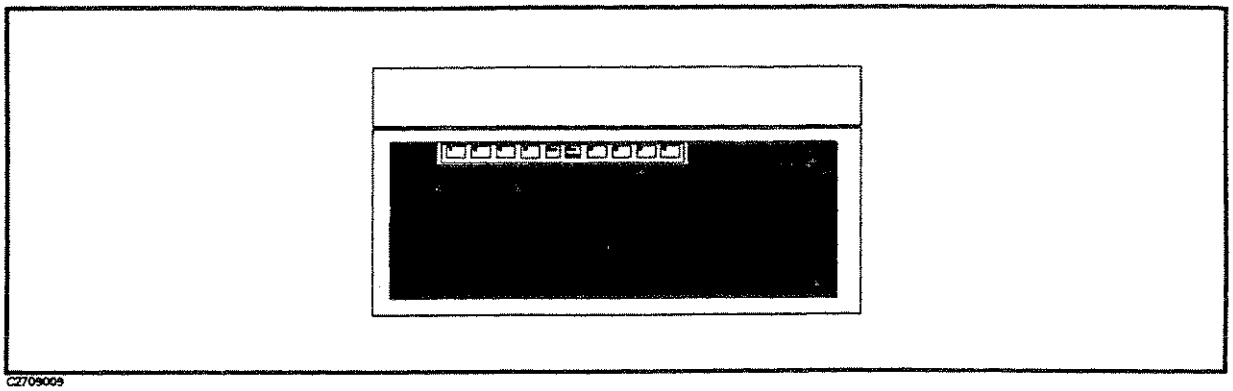
(Key-2) (Run) starts a program running from the beginning.

(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



C2709009

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 87510A'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 87510A performs the same functions as pressing the f1 through f8 function keys.

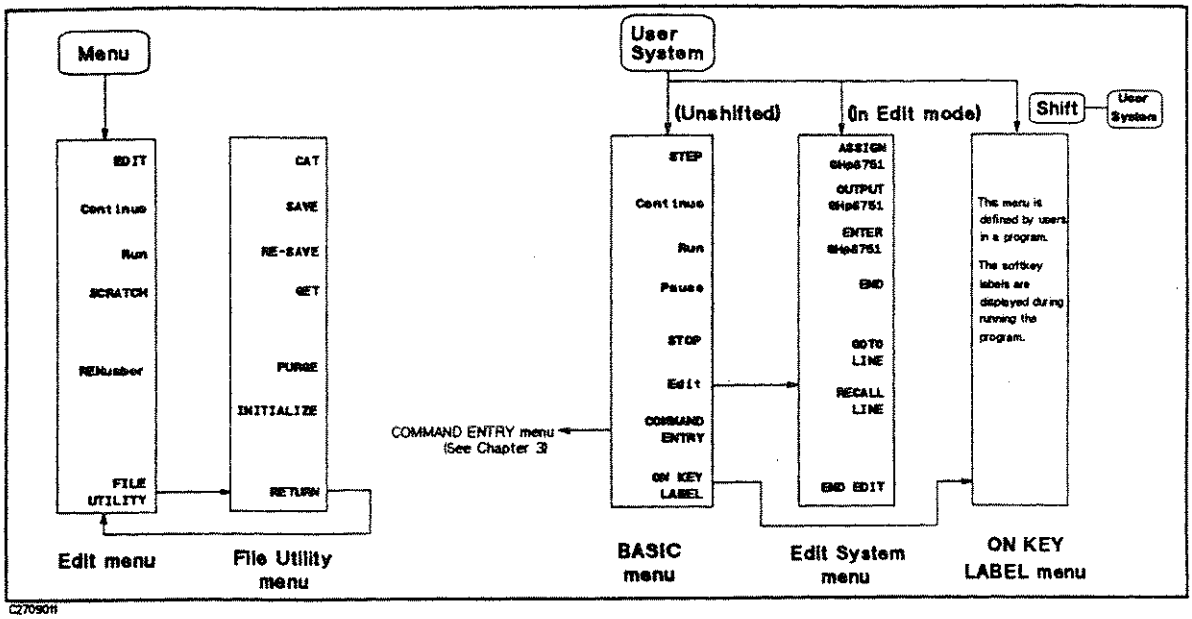


Figure 9-2. Softkey Menus Accessed from (Menu) and (User System) Key

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

Above listed menus are described in Chapter 12 of *HP 87510A Operation Manual.*

Using [CTRL] Key in Edit Mode

In the edit mode, pressing [CTRL], holding it down and 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 [▲]).

Controlling the Front Panel Keys from the HP-HIL keyboard

Pressing [Extend char] along with another key allows you to control the front panel keys of the HP 87510A. The following table shows which key performs the same function as the key on the HP 87510A's front panel.

If you press ...	It performs the same function as pressing ...
[Extend char]-[1]	[MKR] key
[Extend char]-[2]	[MKR FCTN] key
[Extend char]-[3]	[ATTEN] key
[Extend char]-[4]	[DISPLAY] key
[Extend char]-[5]	[AVE] key
[Extend char]-[6]	[CAL] key
[Extend char]-[7]	[MEAS] key
[Extend char]-[8]	[FORMAT] key
[Extend char]-[9]	[SCALE REF] key
[Extend char]-[Select]	[SYSTEM] key
[Extend char]-[▲]	[LOCAL] key
[Extend char]-[Next]	[PRESET] key
[Extend char]-[◀]	[COPY] key
[Extend char]-[▼]	[SAVE] key
[Extend char]-[▶]	[RECALL] key
[Extend char]-[Menu]	[MENU] key
[Extend char]-[Clear line]	[CH 1] key
[Extend char]-[Clear display]	[CH 2] key
[Extend char]-[Key-1][1]	[STOP] key
[Extend char]-[Key-2][2]	[START] key
[Extend char]-[Key-3][3]	[CENTER] key
[Extend char]-[Key-4][4]	[SPAN] key

1 Above the [*] key

2 Above the [/] key

3 Above the [+] key

4 Above the [−] key

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 87510A Instrument BASIC application programs. Included are several typical types of programs and three application programs for the HP 87510A. The topics covered in this chapter are:

- Sample programs for controlling the HP 87510A
- Sample programs for I/O operation
- Sample programs for using Instrument BASIC simultaneously with an external controller
- Application programs

Controlling the HP 87510A Using the Instrument BASIC

HP Instrument BASIC will allow you to easily control the HP 87510A. This section describes the basic techniques for using Instrument BASIC to control the HP 87510A. In this section, the following sample programs are described:

- Sending HP-IB commands to the HP 87510A
- Detecting end of sweep
- Executing the limit line test
- Trace data transfer
- ON KEY.... LABEL function

Note

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

For example:

```
100 OUTPUT @Hp87510;";TITL ""This is a test."" "
```

Sends string, ;TITL "This is a test., to the HP 87510A. (TITL displays a title.)

```
200 File_name$="TEST"
210 OUTPUT @Hp87510;"SAVDDAT""";File_name$;""""
```

Sends string, SAVDDAT "TEST", to the HP 87510A. (SAVDDAT saves internal data arrays.)

Sending HP-IB Commands to the Gain Phase Analyzer Part of the HP 87510A

To Send HP-IB the Command in the Ordinary Way

The gain phase analyzer and HP Instrument BASIC in the HP 87510A should be regarded as two separate instruments interfaced by an internal 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 @Hp87510 TO 800  ! Assign HP-IB path to the HP 87510A
20 OUTPUT @Hp87510;"LOGM;" ! Set HP 87510A to LOG MAG formant
30 END
```

Figure 10-1. Sending HP-IB Command(1)

To Send an HP-IB Command Using the EXECUTE Command

```
 10 ASSIGN @Hp87510 TO 800
 20 WRITEIO 8,0; 100E6     ! Store start frequency,100 MHz to register 0
 30 WRITEIO 8,1; 200E6     ! Store stop frequency, 200 MHz to register 1
 40 EXECUTE "ANARANG"      ! "ANARANG" command need two parameters
 50 !
 60 EXECUTE "OUTPRESO?"    ! "OUTPRESO?" query returns four parameters
 70 Za=READIO(8,0)         ! Read first return value, Za from register 0
 80 Fa=READIO(8,1)         !
 90 Zr=READIO(8,2)         ! same as line 70
100 Fr=READIO(8,3)         !
110 PRINT Za,",",Fa,",",Zr,",",Fr
120 END
```

Figure 10-2. Sending HP-IB Command(2)

Detecting the End of Sweep

When you execute sweep of the HP 87510A from instrument BASIC, you must wait to send next HP-IB command until the sweep is completed. If you send next HP-IB command before the sweep is completed, this command may not be accepted correctly to the HP 87510A. For this reason, you must detect end of sweep in your instrument BASIC program, except for single sweep with EXECUTE command.

Detecting the End of a Single Sweep

SING command which makes sweep one time, with EXECUTE command, waits until the sweep is completed. So, in this case, you must try not to detect the end of sweep in your program. Figure 10-3 shows an example of SING with EXECUTE command.

```
10 ASSIGN @Hp87510 TO 800
20 EXECUTE "SING"
30 PRINT "SWEEP COMPLETED"
40 END
```

Figure 10-3. Detecting the End of A Single Sweep

Detecting the End of a Group Sweep

When you execute a group sweep, the end of sweep is detected from condition of a status register bit. The HP 8751A's *Event Status register B* (ESB) which is one of status registers, reports the instrument status of the HP 8751A. The status bit named "SING, NUMG, Cal. Std Complete Bit" 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 *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 @Hp87510 TO 800
20 !
30 OUTPUT @Hp87510;"*CLS"    ! \
40 OUTPUT @Hp87510;"*SRE 4" !   > Initialize to enable SRQ
50 OUTPUT @Hp87510;"ESNB 1" ! /
60 ON INTR 8 GOTO Jump
70 ENABLE INTR 8
80 OUTPUT @Hp87510;"NUMG 30"
90 GOTO 90                   ! Repeat this line until sweep is completed
100 !
110 Jump:!                   ! When 30 times sweep completed, come to this line
120 PRINT "SWEEP COMPLETED"
130 END
```

Figure 10-4. Detecting the End of Group Sweep

Executing the Limit Line Test

This sample program shows how to transfer an Instrument BASIC limit line table to the HP 87510A and execute limit line test. By using this sample program, you can easily create a complex table. To increase the number of limit segments, add to the "DATA" lzine (lines 140 through 170) and adjust the "FOR" statement (line 190) accordingly.

```
10 !PROGRAM LIMIT LINE
20 !
30 ASSIGN @Hp87510 TO 800
40 OUTPUT @Hp87510;"DISAALLI" ! Set display mode to All Instrument
50 OUTPUT @Hp87510;"HOLD"
60 !                      Limit Line Table
70 !---- Frequency(MHz) -- Upper Limit(dB) -- Lower Limit(dB)
80 DATA      30,                -40,              -80
90 DATA      65,                  0,              -15
100 DATA     70,                  0,              -20
110 DATA    100,                -30,              -70
120 !
130 FOR I=1 TO 4                          ! If you change number of DATA,
140   READ Stimulus(I),Upper(I),Lower(I) ! increase value of I.
150 NEXT I                                !
160 !
170 OUTPUT @Hp87510;"LIMILINEON"  !
180 OUTPUT @Hp87510;"EDITLIMIL"   ! Start editing the limit line table
190 OUTPUT @Hp87510;"LIMCLEL"     !
200 !
220 FOR I=1 TO                    ! Modify this line
230   OUTPUT @Hp87510;"LIMSADD"
240   OUTPUT @Hp87510;"LIMS ";Stimulus(I);"MHz"
250   OUTPUT @Hp87510;"LIMU ";Upper(I)
260   OUTPUT @Hp87510;"LIML ";Lower(I)
270   OUTPUT @Hp87510;"LIMSDON"
280 NEXT I
290 OUTPUT @Hp87510;"LIMEDONE"    ! Done editing the limit line table
300 !
310 OUTPUT @Hp87510;"LIMITESTON"
320 OUTPUT @Hp87510;"*CLS"
330 EXECUTE "SING"                ! Execute single sweep
340 !
350 ! Inform the result of limit line test by beep
360 OUTPUT @Hp87510;"ESB?"        ! Read limit test result from ESB
370 ENTER @Hp87510;Stat           ! then enter to variable "Stat"
380 IF BIT(Stat,4) THEN           ! If test is failed then beep 1 time
390   BEEP   !FAIL (2 BEEPS)
400   WAIT .5
410   BEEP
420 ELSE                          ! If test is passed then beep 2 times
430   BEEP   !PASS (1 BEEP)
440 END IF
450 !
460 END
```

Figure 10-5. Executing the Limit Line Test

Trace Data Transfer

There are two formats in which to transfer data to an Instrument BASIC program, ASCII and 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 simpler. 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.

Output Trace Data

The following sample programs transfer measurement data from the HP 8751A to data array "Dat". Figure 10-6 shows data transfer using ASCII format, Figure 10-7 shows data transfer using binary format.

```
10 ASSIGN @Hp87510 TO 800
20 DIM Dat(1:201,1:2)
30 OUTPUT @Hp87510;"HOLD"
40 OUTPUT @Hp87510;"FORM4"      ! Output in ASCII format
50 OUTPUT @Hp87510;"OUTPFORM?"
60 ENTER @Hp87510;Dat(*)
70 PRINT Dat(*)
80 END
```

Figure 10-6. Output ASCII Format Data

```
10 ASSIGN @Hp87510 TO 800
20 DIM Dat(1:201,1:2)
30 OUTPUT @Hp87510;"HOLD"
40 OUTPUT @Hp87510;"FORM3"       ! Output in IEEE 64bit format
50 ASSIGN @Dt TO 800;FORMAT OFF  ! Set "@Dt" to binary data path
60 !
70 OUTPUT @Hp87510;"OUTPFORM?"
80 ENTER @Hp87510 USING "%,8A";Header$     ! Reading header
90 ENTER @Dt;Dat(*)       ! Reading Trace data
100 ENTER @Hp87510 USING "%,1A";Terminate$ ! Reading Terminator
110 OUTPUT @Hp87510;"FORM4"                ! Set to ASCII format mode
120 END
```

Figure 10-7. Output Binary Format Data

Input Trace Data

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

```
10 ASSIGN @Hp87510 TO 800
20 DIM Dat(1:201,1:2)
30 OUTPUT @Hp87510;"HOLD"              ! Halt sweep
40 OUTPUT @Hp87510;"FORM4"             ! Set to ASCII format mode
50 OUTPUT @Hp87510;"INPUFORM ";Dat(*) ! Send "Dat" data to trace
60 END
```

Figure 10-8. Input ASCII Format Data

In binary format, when the defined data length is different from the actual data length, an error occurs. You must set the length of both data to be equal. Data length is specified as an 8-byte string; data header. A data header consists "#6", and following 6-byte strings which shows size of data. For details of data headers, refer to Chapter 2 of *HP-IB Programming Manual.*

For instance, it assumes that number of points are 201, the entire data size becomes 3216 bytes because each points has 16-byte data. The data header expresses this size as the string, "#6003216".

```
10 ASSIGN @Hp87510 TO 800
20 DIM Dat(1:201,1:2)
30 OUTPUT @Hp87510;"HOLD"          !
40 OUTPUT @Hp87510;"FORM3"         ! Set format to IEEE 64bit
50 ASSIGN @Dt TO 800;FORMAT OFF    ! Set "@Dt" as data path
60 Nop=201                         ! Number of points are 201
70 Datasize=Nop*16                 ! Calculate data size
80 Headlength=LEN(VAL$(Datasize)) ! Enter Data length to Headlength
90 IF Headlength<6 THEN           !
100   Headstring$=VAL$(Nop*16)
110   REPEAT                       ! Enter "0" until 6 byte
120     Headstring$="0"&Headstring$
130     Headlength=LEN(Headstring$)
140   UNTIL Headlength=6
150 ELSE
160   Headstring$=VAL$(Nop*16)
170 END IF
180 OUTPUT @Hp87510 USING "#,9A";"INPUFORM "     ! Start data transfer
190 OUTPUT @Hp87510 USING "#,K";"#6";Headstring$ ! Send header as 8 byte
200 OUTPUT @Dt;Dat(*),END   ! Send data and terminator
210 OUTPUT @Hp87510;"FORM4" ! Back to ASCII format
220 END
```

Figure 10-9. Input 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 of 70 MHz.

```
10 ASSIGN @Hp87510 TO 800
20 ON KEY 1 LABEL "3dB" CALL Filter3db          !
30 ON KEY 2 LABEL "BndRejct" CALL Band_reject   !
40 ON KEY 8 LABEL "QUIT" GOSUB Quit             !
50 OUTPUT @Hp87510;"KEY 44"                     ! SYSTEM key
60 OUTPUT @Hp87510;"KEY 0"                      ! IBASIC key
70 OUTPUT @Hp87510;"KEY 7"                      ! ON KEY LABEL key
80 LOOP
90 END LOOP
100 Quit:!
110 END
120 !
130 SUB Filter3db
140   ASSIGN @Hp87510 TO 800
150   OUTPUT @Hp87510;"MARKOFF;MARK1 70MHZ"
160   OUTPUT @Hp87510;"DELR1;"
170   OUTPUT @Hp87510;"WIDTON;
180   OUTPUT @Hp87510;"WIDV -3"
190 SUBEND
200 SUB Band_reject
210   ASSIGN @Hp87510 TO 800
220   OUTPUT @Hp87510;"MARKOFF;MARK1 70MHZ"
230   OUTPUT @Hp87510;"DELR1"
240   OUTPUT @Hp87510;"MARK2"
250   OUTPUT @Hp87510;"TRACKON"
260   OUTPUT @Hp87510;"SEAMIN"
270 SUBEND
```

Figure 10-10. On Key Label

I/O Operation from Instrument BASIC

This section describes the input/output operations using the 24-bit I/O port and the built-in disk drive. The following sample programs are covered in this section:

- Data transfer using the 24-bit I/O port
  - Reading data from the 24-bit I/O port
  - Writing data to the 24-bit I/O port
- Disk I/O for an built-in disk drive
  - Saving trace data
  - Loading trace data

Data Transfer Using the 24-bit I/O Port

Following two examples shows input and output operations of the 24-bit I/O port.

Reading Data from the 24-bit I/O Port

This sample program shows how to directly read a specific data bit from the 24-bit I/O port.

```
10 ASSIGN @Hp87510 TO 800
20 OUTPUT @Hp87510;"CIN"
30 Read_bit=2
40 A=BIT(READIO(15,2),Read_bit)    ! Reading data from C port
50 IF A THEN
60   PRINT "Specified bit is ON."  ! If A is true, bit2 is ON
70 ELSE
80   PRINT "Specified bit is OFF." ! If A is false, bit2 is OFF
90 END IF
100 END
```

Figure 10-11. Reading 24-bit I/O Port

This sample program shows a sample of writing data to the 24-bit I/O port. When you use the output port of the 24-bit I/O port, output data must be a decimal data. Although, binary-expressed data is useful and obviouly to set each bit ON or OFF. If you want to sets bit by bit of the ouptut port using binary data, use the IVAL or DVAL command of Instrument BASIC. This command allows you to convert data from binary to decimal. The following example shows writing binary data to 24-bit I/O port by using the DVAL command.

```
10 DIM Bin_dat$[24]                        ! Reserve space for 24 characters
20 Bin_dat$="111101011111001011011111"     ! 24bit data in binary expression
30 ASSIGN @Hp87510 TO 800
40 OUTPUT @Hp87510;"COUT;DOUT"
50 Decimal_dat=DVAL(Bin_dat$,2)            ! Convert 24bit data to decimal
60 !
70 WRITEIO 15,7;Decimal_dat                ! Output data to 24-bit Ouput port
80 END
```

Figure 10-12. Writing Data to the 24-Bit I/O Port

Disk I/O for Built-in Disk Drive

The HP 8751A has a built-in disk drive and RAM disk memory. You can save or get data using these disks 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 @Hp87510 TO 800
20 DIM File_name$[10]
30 INPUT "ENTER FILE NAME (up to 10 Characters)",File_name$
40 !
50 OUTPUT @Hp87510;"SAVDDAT """;File_name$;""""
60 END
```

Figure 10-13. Saving Trace data

Loading Trace Data

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

```
10 ASSIGN @Hp87510 TO 800
20 INPUT "ENTER RETRIEBE FILE NAME (without EXT.)",File_name$
30 OUTPUT @Hp87510;"STODDISK"  ! Select flexible disk drive
31                             ! When you want to use RAM disk,
32                             ! change "STODDISK" to "STODMEMO"
40 DIM Dat(1:201,1:2)          ! Assume data size of "Dat" is 201 points
50 File_name$=File_name$&"_D"  ! Add extension "_D" to filename
51                             ! When you want to use DOS format,
52                             ! change extension "_D" to ".DAT"
60 ASSIGN @File TO File_name$  ! Open target file
70 ENTER @File USING "17X,#"
80 INTEGER Nop
90 ENTER @File;Nop
100 ENTER @File USING "4X,#"
110 ENTER @File;Dat(*)          ! Load data from file
120 ASSIGN @File TO *           ! Close file
130 PRINT Dat(*)
140 END
```

Figure 10-14. 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 between controllers
- Transferring a program to Instrument BASIC
- Running an external controller program
- Referring to an external controller's data array contents

In this section, we assume that external controller and Instrument BASIC controller are connected with an HP-IB interface.

Passing Control

The HP-IB bus can only have one active controller at same time. If more than one controller is on the same bus, then the controllers must use a handshaking procedure 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. And, the printer is connected with the HP-IB interface.

```
10 Hp87510=717
20 INPUT "Press ENTER key",Answer$  ! Wait until ENTER key is pressed
30 PASS CONTROL Hp87510             ! Pass control to HP 87510A
40 END
```

Figure 10-15. Passing Control (for External Controller)

```
10 PRINTER IS 701           !
20 ON ERROR GOTO Not_active ! HP 87510A can not print until pass controlled,
30 Not_active:!             ! program can not proceed to the next line
40 PRINT "HELLO, WORLD!"    ! When pass controlled, exit and prints
50 OFF ERROR                ! Cancel error intrrupt
60 END
```

Figure 10-16. Passing Control (for Instrument BASIC)

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 @Hp87510 TO 717
20 OUTPUT @Hp87510;"*RST"
30 OUTPUT @Hp87510;"PROG:DEL:ALL" ! Scratch program on BASIC editor
40 INPUT "FILENAME?",File_name$
50 DIM Line$[1024]
60 OUTPUT @Hp87510;"PROG:DEF #0"  ! Send header
70 ASSIGN @File TO File_name$     ! Open file and assign data path
80 ON ERROR GOTO Done
90 LOOP
100   Line$=""
110   ENTER @File;Line$           ! Read and input program source code
120   OUTPUT @Hp87510;Line$       ! Send to external controller
130 END LOOP
140 Done: !     ! Ended reading from file
150 OFF ERROR     ! Cancel error intrrupt
160 OUTPUT @Hp87510;" " END       ! Send terminator
170 ASSIGN @File TO *             ! Close file
180 END
```

Figure 10-17. Program Download

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, then 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 @Hp87510 TO 717
20 OUTPUT @Hp87510;"PROG:DEF #0"   ! Start program transfer
30 OUTPUT @Hp87510;"10 PRINT ""HELLO, WORLD!""" !
40 OUTPUT @Hp87510;"20 END"    !
50 OUTPUT @Hp87510;" " END    ! End of program transfer
60 !
70 OUTPUT @Hp87510;"PROG:STAT RUN"         ! RUN sent program
80 END
```

Figure 10-18. Run External Instrument BASIC Program

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

```
70 OUTPUT @Hp87510;"PROG:EXEC ""RUN"""
```

Accessing the Contents of a Data Array in an 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 @Hp87510 TO 717
20 DIM Passed(1:201,1:2)
30 OUTPUT @Hp87510;"PROG:NUMB? ""Dat"";"
40 ENTER @Hp87510;Passed(*) ! Instrument BASIC's array "Dat" data is enter
50 !                        !  to array "Passed"
60 END
```

Figure 10-19. Accessing External Controller's Program Array

Application Programs

This section covers the following application programs:

- Sharing one printer with two controllers
- Loading BASIC programs using soft keys
- Using BIN sorting function with the 24-bit I/O port

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

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 the same HP-IB bus
- Figure 10-20 is executed on the external controller
- Figure 10-21 is in editor of the Instrument BASIC

```
 10 Hp87510=717
 20 !
 30 OUTPUT Hp87510;"PROG:STAT RUN" ! Make Instrument BASIC 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 Hp87510
100 ON ERROR GOTO Not_active
110 Not_active:   ! Waiting until control is back
120 PRINT "THIS LINE IS PRINTED OUT FROM EXT. CONTROLLER AGAIN."
130 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.
 80 PRINT "NOW I'LL DUMP 87510A'S SCREEN TO PRINTER"
 90 ASSIGN @Hp87510 TO 800
100 OUTPUT @Hp87510;"DISABASS"
110 OUTPUT @Hp87510;"PRINALL"
120 PRINT "THIS LINE IS PRINTED OUT BELOW THE DUMP LIST."
130 PRINT "SO YOU'LL KNOW IF YOU USE HP-IB FROM IBASIC AND";
140 PRINT " INSTRUMENT AT THE SAME TIME,";
150 PRINT "PREEMPTIVELY EXECUTED PROCESS DOES WORK FIRST,THEN NEXT."
160 PRINT ""
170 !
180 !Now I've done my work, so I'll pass control back to the ext. controller
190 PASS CONTROL 721
200 END
```

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

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 can name this program file, "AUTOST", so it will be executed 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 @Hp87510 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 @Hp87510;"KEY 44"
220 OUTPUT @Hp87510;"KEY 0"
230 OUTPUT @Hp87510;"KEY 7"       ! Display ON KEY LABEL softkey
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 10-22. 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 10-23. Automatic Program Execution (2/2)

BIN Sorting Using the 24-bit I/O Port

The HP 87510A has BIN sorting function which enables setting and testing, using a multiple limit line test feature. BIN sorting result output is only available through the I/O port. In this section shows an example using BIN sorting with handler and the 24-bit I/O port.

This program uses three ports of 24-bit I/O port. The first one is output A which is the output port for the BIN sorting result to an external handler. The other Rest two ports are OUTPUT1 and OUTPUT2. These ports are used to synchronize timing with a hander.

If the OUTPUT1 bit is set, it indicates that the instrument is ready to accept a trigger input from the handler. OUTPUT2 is used to indicate the instrument is processing data. In this example, although, the length of time of a bit set on OUTPUT2 is very short, because the processing time is very short.

```
10 !PROGRAM BIN SORT WITH HANDLER
20 ASSIGN @Hp87510 TO 800
30 !
40 ! Setting the Gain Phase Analyzer
50 OUTPUT @Hp87510;"CHAN1;AR;LOGM"
60 OUTPUT @Hp87510;"CENT 70MHZ;SPAN 0"
70 OUTPUT @Hp87510;"EXTTPOIN"
80 !
90 ! Editing the BIN sort table
100 OUTPUT @Hp87510;"BINCLEL"
110 OUTPUT @Hp87510;"EDITBINL"
120 OUTPUT @Hp87510;"BINSADD"
130 OUTPUT @Hp87510;"BINU 10DB;BINL -10DB"
140 OUTPUT @Hp87510;"BINP 1"
150 OUTPUT @Hp87510;"BINO 255"
160 OUTPUT @Hp87510;"BINSDON;BINSADD"
170 OUTPUT @Hp87510;"BINU 20DB;BINL -20DB"
180 OUTPUT @Hp87510;"BINP 2"
190 OUTPUT @Hp87510;"BINSDON;BINSADD"
200 OUTPUT @Hp87510;"BINU 30DB; BINL -30DB"
210 OUTPUT @Hp87510;"BINP 3"
220 OUTPUT @Hp87510;"BINSDON"
230 OUTPUT @Hp87510;"BINEDONE"
240 !
250 ! Setting the BIN sorting
260 OUTPUT @Hp87510;"BINOA"
270 OUTPUT @Hp87510;"BINSLINEON"
280 !
290 ! Setiing the I/O port
300 OUTPUT @Hp87510;"NEGL"
310 OUTPUT @Hp87510;"OUT1ENVL" ! Output 1 indicates waiting for trigger input
320 OUTPUT @Hp87510;"OUT2ENVH" ! Output 2 indicates processing is in progress
330 !
340 ! Executing BIN sorting
350 ON ERROR GOTO 370
360 OUTPUT @Hp87510;"BINSON"
370 I=1
380 DISP I
390 LOOP
400   OUTPUT @Hp87510;"OUT1H"
410   REPEAT
420     OUTPUT @Hp87510;"INPT?"
430     ENTER @Hp87510;Inpt
440   UNTIL Inpt
450   OUTPUT @Hp87510;"EXTTPOIN; OUT2L"
460   I=I+1  ! Counts a number of DUT.  If "I" value exceeds integer
470   DISP I !  limitation of Instrument BASIC, "I" value will reset to 0.
480 END LOOP
490 !
500 END
```

Figure 10-24. BIN sorting with 24-bit I/O Port

11

HP 87510A Specific HP Instrument BASIC Features

This chapter lists and summarizes the HP Instrument BASIC features specific to the HP 87510A. 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 87510A
- HP-IB commands specific to Instrument BASIC

Available I/O Interface and Select Codes

Available interfaces and their select codes in HP 87510A 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 87510A does not have an RS-232C interface.

Display

The HP 87510A'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 87510A 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.

Disk Drive

The HP 87510A's Instrument BASIC has the following disk drive limitations.

- External disk drives are not supported.
- HFS format is not supported.
- Disk types which can be initialized by the HP 87510A'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

RAM Disk Memory

A part of the RAM (Random Access Memory) of the HP 87510A may be used as a virtual disk drive; RAM disk memory. RAM disk memory can be operate same as internal disk drive. Accordingly, the usable RAM size is reduced to 63K bytes. The RAM, aided by a battery, can save data for 72 hours after the main power is shut off.

Note Data in the RAM is saved for 72 hours after the HP 87510A is turned off. However, it is recommended that valuable programs and data be copied to floppy disk to avoid accidental destruction.

To switch system's storage units between the disk in the disk drive and RAM disk under control of the Instrument BASIC, use the following HP-IB commands:

`STODDISK` selects the built-in disk drive as a storage unit.

`STODMEMO` selects the RAM disk as a storage unit.

To copy a file between the disk and RAM disk, use an `FILC` command.

Note The FILC command cannot be used to copy a file if the format (LIF or DOS) of the disk in the built-in disk drive is different from that of the RAM disk.

The RAM disk must be initialized before use. Select an LIF or DOS format before initialization. Use the front panel key or enter an HP-IB command to initialize the RAM disk. (For the procedure for initialization using the front panel, refer to Chapter 14 "Save and Recall Functions" of the HP 87510A Reference Manual.) When using an HP-IB command to initialize the RAM disk, execute the following procedure:

```
10  ASSIGN @Hp87510 TO 800
20  OUTPUT @Hp87510;"STORMEMO"
30  OUTPUT @Hp87510;"DISFLIF"
40  OUTPUT @Hp87510;"INID"
50  END
```

Figure 11-1.

BASIC Statements not Implemented

The following statements are listed in the *HP Instrument BASIC Language Reference* but not implemented in the HP 87510A's Instrument BASIC.

- OFF CYCLE
- ON CYCLE
- PEN

BASIC Statements Specific to HP 87510A

The following statements are NOT listed in the *HP Instrument BASIC Language Reference* but are available in the HP 87510A's Instrument BASIC.

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

These keywords are described in Appendix A.

HP-IB Commands Specific to HP 87510A's Instrument BASIC

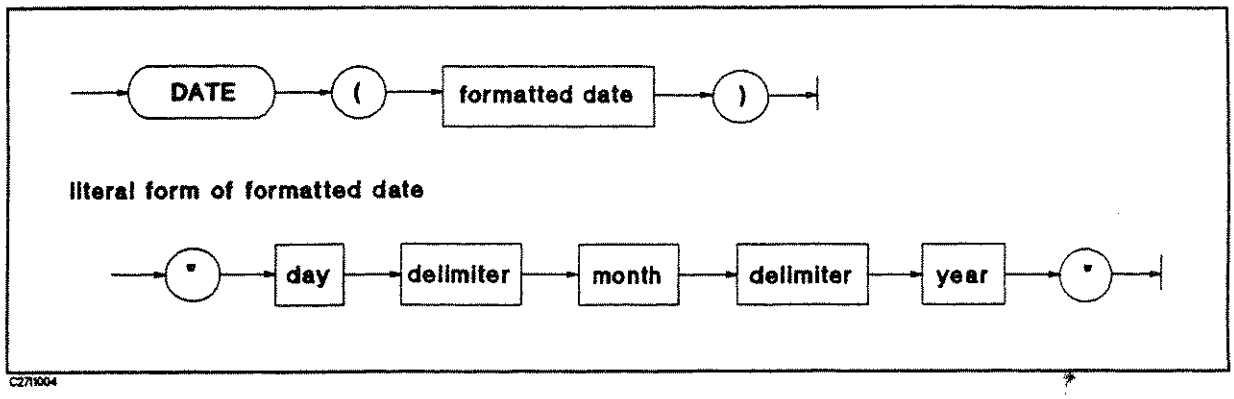
The HP 87510A's Instrument BASIC provides an HP-IB command set called "PROGram Subsystem", which is used to control HP 87510A's Instrument BASIC system from an external controller. These statements are only executable from external controllers. All PROGram subsystem commands are described in Appendix B.

BASIC Commands Specific to HP 87510A

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.



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.

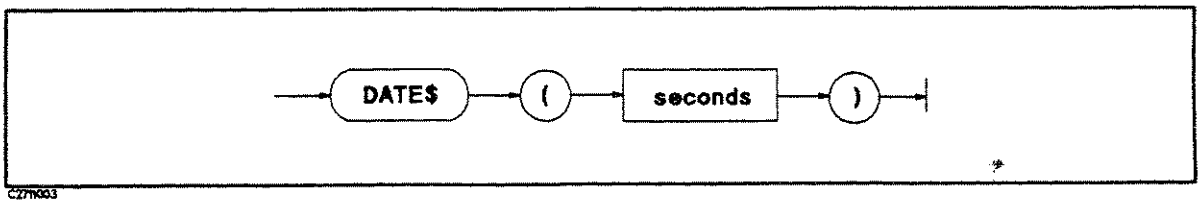
Specifying invalid date, such as the thirty-first of February, will cause an error.

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).



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.

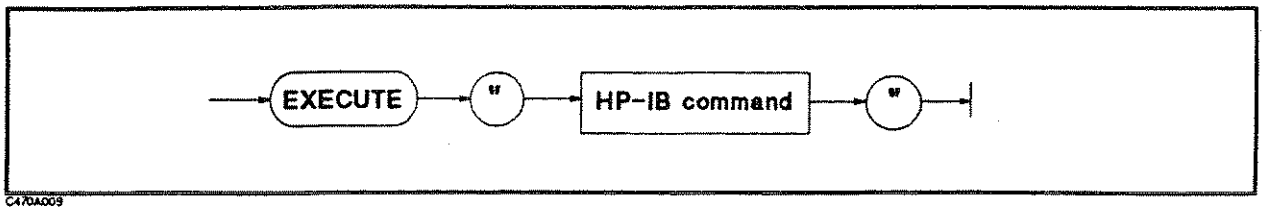
The first letter of the month is capitalized and the rest are lowercase charters.

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

EXECUTE

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

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



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

Table A-1. HP-IB Commands for EXECUTE

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

Note

The HP 87510A executes EXECUTE "SING" to carry out sweep once. Execution of the next statement is suppressed until sweep is completed. In this case, completion of the sweep need not be supervised using a status register.

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:

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

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

OUTPUT @HP87510;"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:

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

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

```
OUTPUT @HP87510;"OUTPRESO?"
ENTER @HP87510;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.

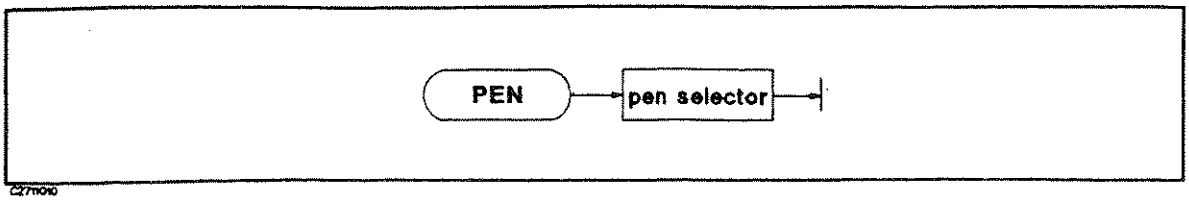
For the format of the READIO function, refer to "READIO."

GCLEAR

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

This statement PERFORMS the following functions:

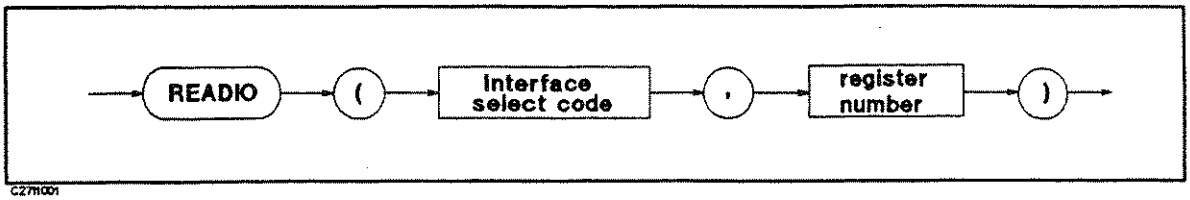
- Clears the graphics screen
- MOVE 0,0 (see MOVE)



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) 2 to 4 (Select code 15); 0 (Select code 15:option 005 only)

Example Statements

```
Ioport=READIO(15,2)

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

Semantics

The HP 87510A 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 3. 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.

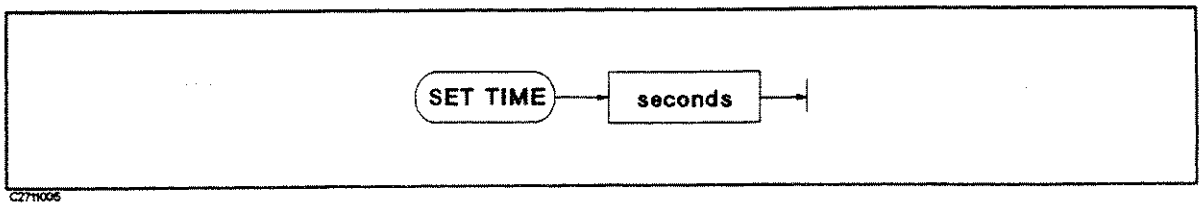
To read data from an I/O port, specify the I/O port number with a register number. Relationships between I/O ports and register numbers are as follows:

Port Name	Register Number	Number of bit
Port C	2	4
Port D	3	4
Port E	4	8
Option 005 I/O port	0	4

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
```

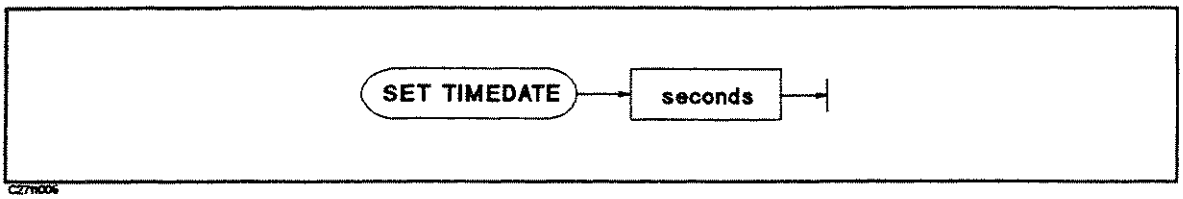
Semantics

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

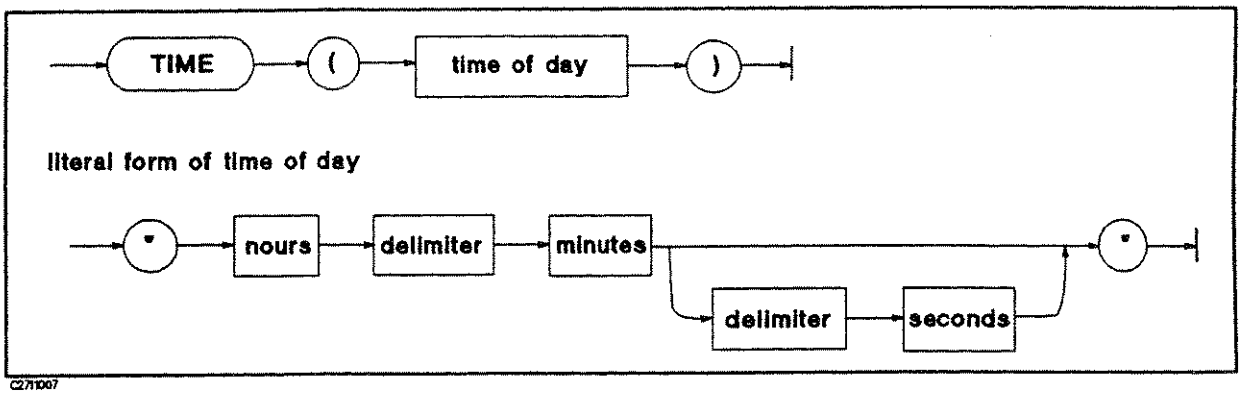
Semantics

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.*)



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

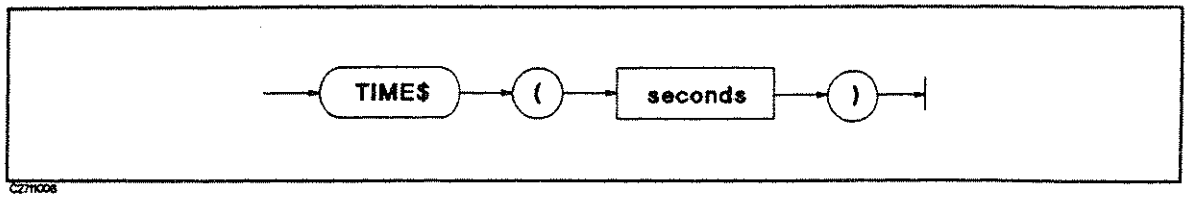
TIME returns a positive integer, in the range 0 thru 86,399, equivalent to the number of seconds past midnight.

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)
```

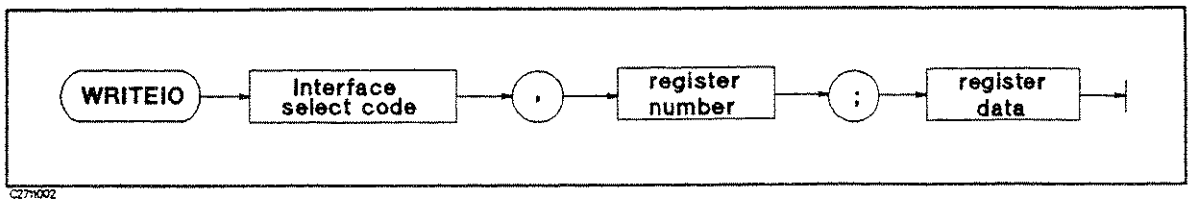
Semantics

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.

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 a specified 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 to 7 (Select code 15) 0 (selec code 15:option 005 only)
register data	numeric expression	−2147483648 thru +2147483647

Example Statements

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

Semantics

The HP 87510A uses a WRITE command to write data to an 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 an 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:

```
WRITEIO 8,0; 100E6
WRITEIO 8,1; 200E6
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.

When writing data to an I/O port, specify the I/O port number using the corresponding register number. Relationships between I/O port numbers and register numbers are as follows:

Port Name	Register Number	Number of bit
Port A	0	8
Port B	1	8
Port C	2	4
Port D	3	4
Port E	4	8
Port F	5	16
Port G	6	20
Port H	7	24
Option 005 I/O port	0	8

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 87510A's Instrument BASIC. For example, an external controller can be used to control the retrieval and execution of Instrument BASIC programs from the HP 87510A'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 87510A commands are divided into three types: HP-IB common commands, HP-IB commands to control the HP 87510A 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 87510A. (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 87510AHP-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.

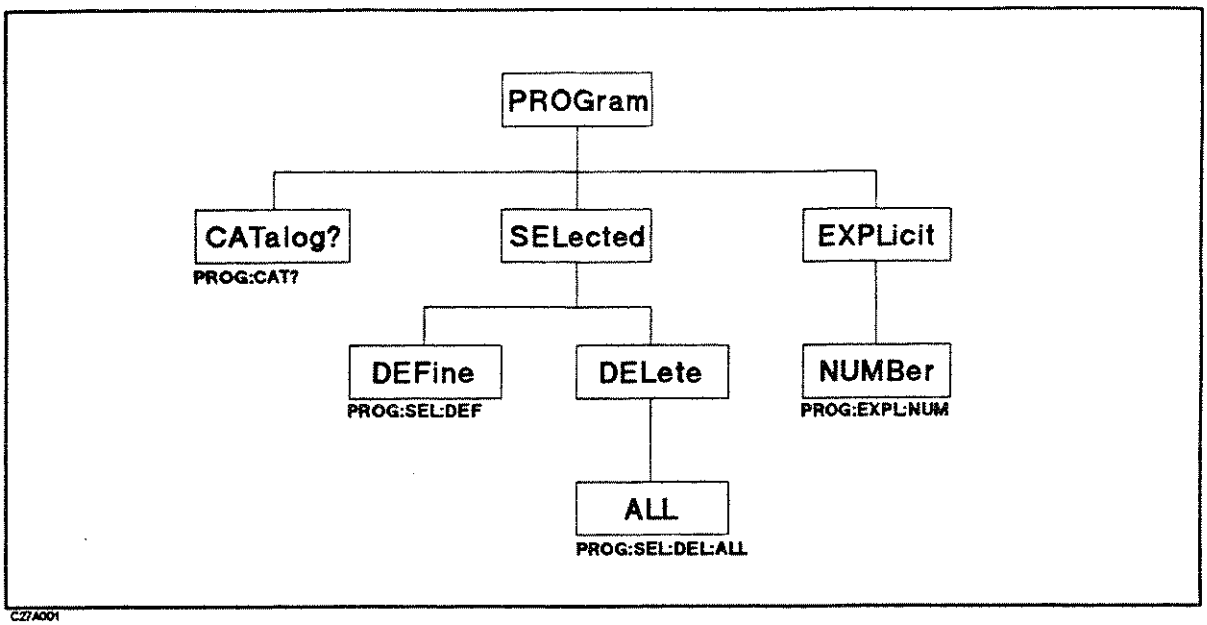


Figure B-1. Command Tree Example

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

The purpose of the PROGram is to provide the administrative features needed to generate and control a BASIC program resident in an instrument.

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 87510A.

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

:PROGram:CATalog?

The CATalog query commands returns program name "prog" if the HP 87510A Instrument BASIC gets a program. IF no programs are currently defined then the response is a null string (" ").

:PROGram[:SELected]: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.

PROGram[:SELected]:DELete[:SELected]

Deletes the program on BASIC editor of the HP 87510A. If the program is in the RUN state a "Program currently running" error (–284) shall be generated.

:PROGram[:SELected]:DELete:ALL

Deletes the program on BASIC editor of the HP 87510A. If the program is in the RUN state a "Program currently running" error (–284) shall be generated.

:PROGram[:SELected]:EXECute *<program command>*

Executes the program command. <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.

:PROGram[:SELected]:MALLocate {*<nbytes>*|DEFault}

Performs no function in the HP 87510A's Instrument BASIC. HP 87510A's memory space is fixed at 512 kbyte.

:PROGram[:SELected]:NAME *<progname>*

Performs no function in the HP 87510A's Instrument BASIC.

:PROGram[:SELected]:NUMBer *<varname>*,*<nvalues>*

Sets or queries the contents of numeric program variables and arrays in the program on BASIC editor of the HP 87510A. 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.

:PROGram[:SELected]:STATe {RUN|PAUSe|STOP|CONTinue}

The STATe command is used to either set the state or query the state of program on BASIC editor of the HP 87510A. 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

:PROGram[:SELected]:STRing <*varname*>,<*svalues*>

The STRing command is used to set and query the contents of string program variables and arrays in program on BASIC editor of the HP 87510A. 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.

:PROGram[:SELected]:WAIT

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

Note

Following commands under the `EXPLicit` node perform functions the same as the ones under `SELected` node montioned above. `EXPLicit` commands are included in the HP 87510A due to keep compatibility with other SCPI instruments. So, you do not have to use `EXPLicit` commands for the HP 87510A.

Note

Since the HP 87510A Instrument BASIC executes a single program at once, the program name for EXPLicit commands is always PROG.

:PROGram:EXPLicit:DEFine <*progname*>, <*program*>

Refer to ":PROGram[:SELected]:DEFine <*program*>".

:PROGram:EXPLicit:DELete *<program>*

Refer to "PROGram[:SELected]:DELete[:SELected]".

:PROGram:EXPLicit:EXECute *<progname>,<program command>*

Refer to ":PROGram[:SELected]:EXECute *<program command>*".

:PROGram:EXPLicit:MALLocate *<progname>*, {*<nbytes>*|**DEFault**}

Refer to ":PROGram[:SELected]:MALLocate {*<nbytes>*|DEFault}".

:PROGram:EXPLicit:NUMBer *<progname>,<varname>,<nvalues>*

Refer to ":PROGram[:SELected]:NUMBer *<varname>,<nvalues>*".

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

Refer to ":PROGram[:SELected]:STATe {RUN|PAUSe|STOP|CONTinue}".

:PROGram:EXPLicit:STRing *<progname>,<varname>,<svalues>*

Refer to ":PROGram[:SELected]:STRing *<varname>,<svalues>*".

:PROGram:EXPLicit:WAIT

Refer to ":PROGram[:SELected]:WAIT".

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HP 87510A

Manual Supplement

HEWLETT PACKARD

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 and an HP 41941A/B impedance probe.

The sample program uses a 3-term 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.

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 a 3-term calibration method.

ZPROBE_CAL calibrates HP 41941A/B impedance probe using a 3-term calibration method.

Preparation

The following items are required to run this program.

- Sample program disk (furnished: 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 resistor
  - HP 41941A/B impedance probe (calibration standards are furnished with the 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 87510A.

Measurement Setup

You must set measurement settings before using the sample program.

1. Turn the HP 87510A 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 87510A as shown in Figure 1-1.

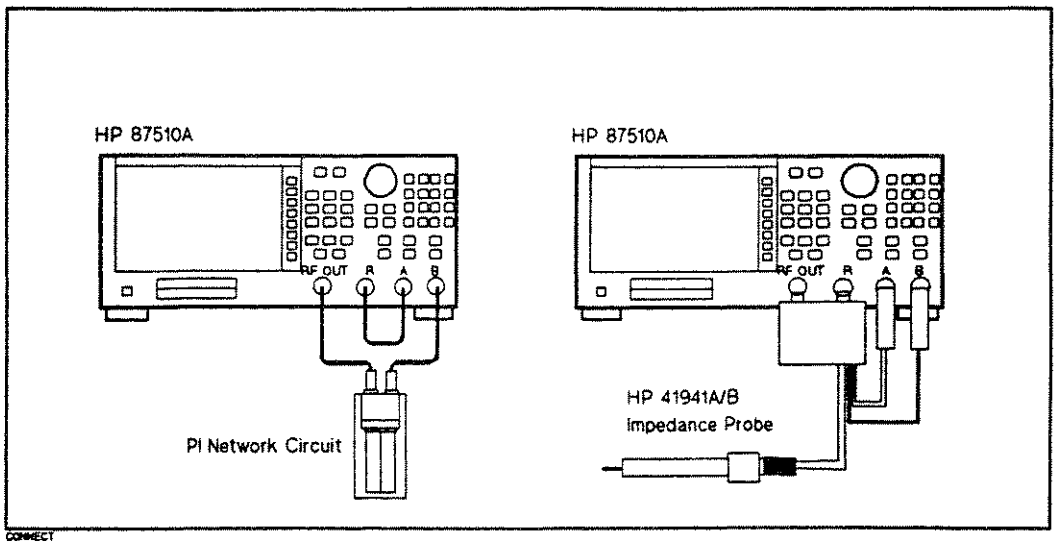

Figure 1-1. Measurement Configuration

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 "PI_CAL" by using the rotary knob or keyboard, then press DONE or (Return).
   When you use an impedance probe, 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.

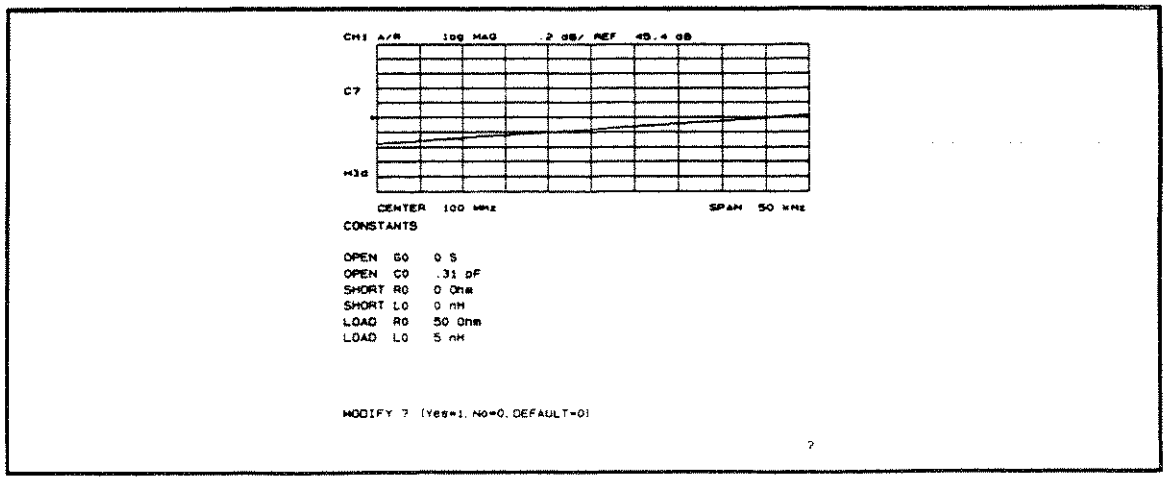

Figure 1-2. Standard Value Setting Menu

If you use the default value, just press the (x1) or (Return) key.

To change constants:

a. Type 1, then press [x1] or [Return] to modify standard values.

b. HP 87510A 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 87510A 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 time. 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 0S calibration standard (impedance probe), then press `OPEN`. When completed, double parentheses enclose the `OPEN` softkey label.
SHORT	Connect a short bar (π-network) or 0Ω calibration standard (impedance probe), then press `SHORT`. When completed, double parentheses enclose the `SHORT` softkey label.
LOAD (50 ohm)	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 87510A is calculating the calibration coefficients. After computation, calibration is completed with message and the HP 87510A gets ready for measurement, and then, the sample program is terminated.

Measurement

After running the sample program, the HP 87510A 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 87510A gain-phase analyzer.

Using the π-Network Circuit

Use the impedance conversion function of the HP 87510A 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 HP 41941A/B impedance probe, conversion function is not necessary. Because the result is already displayed by impedance. If you want to read the value by marker directly, the HP 87510A must be set to the [FORMAT] `LIN MAG` format.

To see the characteristic of a crystal resonator in impedance format, press [FORMAT] `LOG MAG`

To see the characteristic 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 1-3 shows a standard model for standards of π-network circuit.

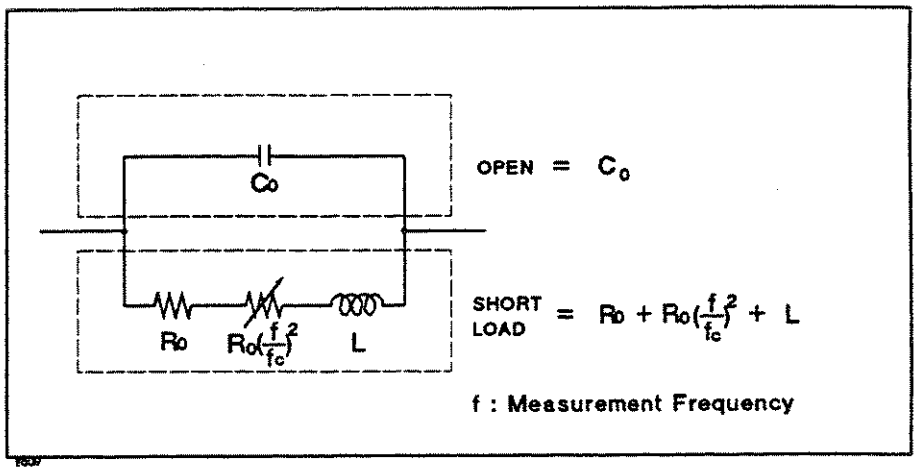

Figure 1-3. Equivalent Circuit of Standards

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

Table 1-1. 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 page 3-2 of *HP 41941A/B Operation Note* . The sample program uses this data for the default values.

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