HP E5100A/B Network Analyzer

Programming Manual

SERIAL NUMBERS

This manual applies directly to instruments with serial number prefix
"JP2KC" and above, and whose firmware is version 2.01 and above.
For additional important information about serial numbers,
read "Serial Number" in Appendix A of this Manual.
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Typeface Conventions

**Bold**

Boldface type is used when a term is defined. For example: **icons** are symbols.

**Italics**

Italic type is used for emphasis and for titles of manuals and other publications.

Italic type is also used for keyboard entries when a name or a variable must be typed in place of the words in italics. For example: `copy filename` means to type the word `copy`, to type a space, and then to type the name of a file such as `file1`.

**Computer**

Computer font is used for on-screen prompts and messages.

**HARDKEYS**

Labeled keys on the instrument front panel are enclosed in `[]`.

**SOFTKEYS**

Softkeys located to the right of the LCD display are enclosed in `()`.
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Introduction

How to Use This Manual

This manual introduces HP-IB programming for the HP E5100A/B. It provides additional information on how to write programs that might be difficult to understand when using only the HP-IB Command Reference. It also provides information, techniques, and examples of how to effectively control HP-IB instruments.

To use this manual effectively, you need one of the following HP-IB controllers:

- HP Instrument BASIC (The HP E5100A/B has this function unless Option UKR Delete HP Instrument BASIC is installed). That is an internal HP-IB controller in the HP E5100A/B.
- An HP 9000 Series 200 or 300 computer that has HP BASIC 3.0 or later. The HP BASIC 3.0 must have the HPiB, GRAPH, I0, KBD, and ERR binaries.

This manual helps you to learn how to write programs that control the HP E5100A/B. To help you learn quickly, many sample modules and programs are provided.

Target Reader

The target reader of this manual is a programmer who wants to control the HP E5100A/B through the HP-IB interface.

This manual explains HP-IB programming using HP BASIC. Therefore, you should have some experience using BASIC. If you have never written a program in BASIC, review the applicable documentation listed at the end of this chapter before starting this manual. This manual does not require extensive knowledge of BASIC programming.

This manual assumes you understand the operations and features of the HP E5100A/B. If you have never operated the HP E5100A/B, read the User’s Guide to learn how to operate the HP E5100A/B.

What’s in This Manual?

The following chapters are provided in this manual:

- Chapter 1 “Introduction” provides an introduction to this manual, how to use a sample program, an HP-IB overview, hardware preparation, and a description of the sample program disk. This chapter provides important information that is used throughout this manual. You should read this chapter first.

- Chapter 2 “Setup and Measurement Program” provides HP-IB command basics. It also shows how to build a measurement program including setups, compensating, triggering, and getting data. If you want to build an automated measurement program, read this chapter.

- Chapter 3 “Data Processing and Transfer” shows the data processing flow and the arrays of the analyzer, describes how to access an internal data array (including trace data or
calibration data). If you want to get measured trace data from the analyzer, read this chapter.

- Chapter 5 “Using Status Reporting Function” describes the status reporting system of the analyzer and how to use it. This chapter also describes an SRQ interrupt. If you want to obtain the analyzer's status using a BASIC program, read this chapter.

- Chapter 4 “Using the I/O Port” provides information on how to use the I/O port on the rear panel. If you want to use the I/O port for communicating with an external instrument (such as a handler), read this chapter.

- Chapter 6 “Programming Miscellaneous” provides information not directly concerned with measurements, but useful for programming. This includes accessing the disk, controlling Instrument BASIC, or debugging a program.

- Chapter 7 “Sample Programs” describes sample programs for some applications.

- Chapter 8 “Command Reference” provides a summary of all available HP-IB commands.

- Appendix A “Manual Changes” shows revision information for this manual.

---

**How to Use the Program Modules**

This manual provides many sample program modules that are not in a complete program style. You can easily understand the module's objective because the program module does not include unnecessary code. You can use these modules to build your own program by combining them.

The program modules are provided in the following style and typeface:

```
SAMPLE CODE  This is a comment for the sample code.
```

As shown in the example above, a module has no line number, no initializing steps, and no END statement. All these are required for an executable BASIC program.

**Building a Working Program Using Program Modules**

To make a program that uses sample program modules, perform the following steps:

1. Add an initializing module at the beginning of your program.
2. Arrange the program modules.
3. Add an END statement on the last line executed by your program.

The line numbers are added automatically by the BASIC editor.

**Initializing Module**

The initializing module defines a hardware identifier as a variable to eliminate the difference between Instrument BASIC and HP BASIC. Usually, you can use the same program for Instrument BASIC and HP BASIC by changing the initializing module. The initializing module also initializes the HP-IB.

The following are typical initializing modules for a program:
Module 1-1. Instrument BASIC Initialization

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASSIGN @E5100 TO 800</td>
<td>Assigning HP-IB address to 800.</td>
</tr>
<tr>
<td>Scode=8</td>
<td>Assigning interface select code to 8.</td>
</tr>
<tr>
<td>ABORT Scode</td>
<td>Get active control.</td>
</tr>
<tr>
<td>CLEAR @E5100</td>
<td>Preset the interface.</td>
</tr>
<tr>
<td>OUTPUT @E5100;&quot;DISAHIHB&quot;</td>
<td>Set display mode.</td>
</tr>
</tbody>
</table>

Module 1-2. External Controller Initialization

Each module of this manual assumes that one of the initializing modules exists at the beginning of the program, and uses the following variables without additional explanation:

@E5100 Represents the device selector of the HP E5100A/B. 800 is for Instrument BASIC and 717 is for the external controller.

Scode Represents the interface select code to which the HP E5100A/B is connected. 8 is for Instrument BASIC and 7 is for the external controller.

Example

For example, a complete program using Module 2-2 in Chapter 2 and Instrument BASIC, is shown below:

```
10 ASSIGN @E5100 TO 800 ! Module 1-1
20 Scode=8
30 ABORT Scode
40 CLEAR @E5100
50 OUTPUT @E5100;"DISAHIHB" !
60 !
70 OUTPUT @E5100;"PRES;CHAN2" ! Module 2-2
80 !
90 END
```
**HP-IB Overview**

The HP-IB is a general purpose digital interface system that is used to integrate the controller, measurement instruments, and peripherals into a system. HP-IB is Hewlett-Packard’s implementation of the IEEE 488 Bus.

**Controller**

The controller is a device that can address an HP-IB device to talk (output data) or listen (receive data).

The active controller can control the other devices on the bus at that time (when multiple controllers are connected). Only one controller can be active at a time. The active controller can pass control to another controller by using the PASS CONTROL command.

Only one controller can be the system controller on the same bus. The system controller is the active controller when the system is turned on. When another controller is the active controller, the system controller can become the active controller at any time by executing ABORT select-code.
Device Selector

HP-IB device control is accomplished by sending commands from the active controller. The active controller can select the target device for the commands by specifying the device selector.

Figure 1-1. HP-IB Device and Address

Figure 1-1 shows the relationship between the HP-IB address and the device selector. For example, the device selector of the HP E5100A/B on HP-IB with an address of "17," is "717" on the HP-IB.

HP Instrument BASIC is connected in the HP E5100A/B internally by the internal interface. The interface select code of the internal interface is "8" to distinguish it from the external select code of "7."

You can use any address from "00" to "30" to specify the internally connected analyzer from Instrument BASIC, because only the analyzer is connected to the internal interface. This manual uses address "00," thus the device selector is "800."
Preparation for Operation

This section describes HP-IB cable connection and address setting for HP-IB control. You can choose one of the following two methods to control the analyzer:

- Using the Instrument BASIC controller (except for Option UKR).
- Using an external controller.

In both cases, you can use the following procedure to prepare the controller and the analyzer:

1. Connect the HP-IB cables.
2. Set the HP-IB Address.
3. Prepare the controller for use.

Using Instrument BASIC as the Controller (except for Option UKR)

The HP Instrument BASIC system is a BASIC controller that is built into the analyzer. HP Instrument BASIC is a subset of HP BASIC.

You can control the HP E5100A/B internally by using HP Instrument BASIC. HP Instrument BASIC has the capability to be a system controller. The other HP-IB instruments are also controllable through the HP-IB connector that is located on the rear panel of the HP E5100A/B.

1. Connecting the HP-IB Cables For Instrument BASIC

A connection between the analyzer and Instrument BASIC is not required because they are already connected via the internal interface in the analyzer. See Figure 1-1. However, if any other HP-IB instruments must be connected, see “Connecting External HP-IB Cables” on the next page.

2. Setting the HP-IB Address For Instrument BASIC

This is not required because the front panel setting of the HP-IB address does not affect the internal interface. You can use any address to specify the analyzer via the internal interface as described in “Device Selector”.

3. Setting Up Instrument BASIC

To set up Instrument BASIC, perform the following steps:

1. Connect the DIN keyboard to the rear panel connector. (See the User’s Guide.)
2. Turn the analyzer power on.
3. To allocate the Instrument BASIC output area on the LCD display for the PRINT statement, press \textbf{Display} DISPLAY ALLOCATION HALF INSTR HALF BASIC.
4. Press \textbf{System} I-BASIC EDIT to open the Instrument BASIC editor.

For more information on how to use the Instrument BASIC editor, see the Using HP Instrument BASIC.

If you connect the keyboard after turning on the analyzer, press \textbf{Preset} to enable key inputs.
Using an External Controller

You can use an external controller to control the analyzer by using the HP-IB interface on the rear panel. Connect the controller and the analyzer using an HP-IB cable.

1. Connecting External HP-IB Cables

Connect the analyzer and external instruments with HP-IB cables. The HP-IB connector is on the rear panel of the analyzer.

The rules for connecting HP-IB cables are as follows:
- The total number of HP-IB devices can be up to 15 instruments.
- The total length of all the cables used can be up to 20m or 2m for each instrument.

You can connect the HP-IB cables in any configuration (linear, star, or combination), as long as the above rules are satisfied.

Note: Do not use a screwdriver when connecting the HP-IB cables. The screwdriver slots in the lock screws are provided for REMOVAL only.

2. Setting the HP-IB Address

The analyzer has no hardware switch for setting the HP-IB address. You can only set it by front panel operation. To change the HP-IB address of the analyzer, perform the following steps:

1. Press [System] HP-IB.

2. Press ADDRESS: E5100A or ADDRESS: E5100B.

3. Enter the new address by using the numerical keys. (Avoid duplication with the HP-IB address of the external controller.)

4. Press [x] to complete the operation.

When you want to control another HP E5100A/B, change the HP-IB address to avoid duplication of addresses on the same bus.

When the analyzer receives any HP-IB command from an external controller, Local is appeared on the display to indicate the analyzer is in the remote mode. In remote mode, front panel key operation is disabled. To cancel the remote mode, press the Local.

3. Preparing For HP BASIC Operation

To prepare HP BASIC for operation, see your HP BASIC system manual.
Sample Program Disk

The sample programs (not the program modules) in this manual are included on the furnished Sample Program Disk (HP Part Number E5100-61001).

Loading a Program from Disk

To use an IBASIC sample program, load it into Instrument BASIC and then run it.
1. Insert the Sample Program Disk into the internal disk drive that is below the display.
2. Press Display DISPLAY ALLOCATION BASIC STATUS.
3. MSI ":INTERNAL,4"
4. Type, GET "filename" Return.

To use an external controller sample program, load it into an external controller and run it.
1. Set up HP BASIC on your external controller.
2. Insert the Sample Program Disk into the disk drive of the controller.
3. Set the current directory to the disk drive.
4. Type, GET "filename" Return.

The applicable filename is printed in front of the sample programs in this manual.

Reading the Sample Program Disk on a PC

Because the sample program disk is provided in the LIF (Logical Interchange Format) that is used on an HP controller, you cannot read this disk on a PC. If you want to convert the program into DOS format that can be read by a PC, perform the following steps:
1. Prepare a DOS formatted disk (3.5 inch).
2. Load the program into the Instrument BASIC from the sample program disk. See "Loading a Program from Disk" for the procedure.
3. Remove the sample program disk, then insert the DOS formatted disk.
4. Type, SAVE "filename" Return.

The analyzer supports either LIF or DOS format, and automatically detects which format disk is used.

Note You cannot initialize a disk in the LIF format with the HP E5100A/B.
Related Documentation Information

You can obtain more detailed information than provided by this manual by referring to the following documents.

The following manuals are provided with the HP E5100A/B.

- **HP E5100A/B Function Reference** explains all functions accessed from the front panel key.
- **HP E5100A/B User's Guide** to learn about the analyzer itself and its front panel key operation.

The following manual is also provided with the HP E5100A/B unless Option UKR (Delete HP Instrument BASIC) is installed.


The following documents also provide related information:

- **HP BASIC Programming Guide** for learning HP BASIC programming. (Furnished with the HP BASIC system.)
- **Tutorial Description of the Hewlett-Packard Interface Bus** for an overview of the HP-IB and IEEE 488 standard (HP literature no. 5952-0156).
Setup and Measurement Program

This chapter describes a basic measurement program that includes setups, user calibration, triggering, and getting data. This chapter discusses the following topics:

- Overview of HP-IB Control.
- Automating a Measurement Procedure.
- Sample Program: Basic Measurement Program.

Overview of HP-IB Control

Before starting to program, you should know how to send an HP-IB command to the analyzer. This section describes the following items:

- Sending HP-IB commands.
- Sending a query and reading the response.

If you have experience programming HP-IB instruments, you can skip this section and go to "Automating a Measurement Procedure".

Sending HP-IB Commands

HP BASIC and Instrument BASIC use the OUTPUT statement to send HP-IB commands that control HP-IB devices. For example:

```
OUTPUT @E5100;"PRES"   Presets the analyzer.
```

Module 2-1. Presetting the Analyzer

This line sends the HP-IB command within the double quotes (PRES) to the HP-IB device at address @E5100. This command presets the analyzer. This is equivalent to pressing the [Preset] key.

You can send multiple commands in a single line by separating each HP-IB command with a semicolon (;).

```
OUTPUT @E5100;"PRES;DISAHIB"  Sends PRES and DISAHIB by single line.
```

Module 2-2. Sending Multiple Commands in a Line
Sending a Query and Reading the Response

There are commands that return a response after being sent. These commands are called queries. A query has a question mark (?) at the end of the command.

You can retrieve the response by using the ENTER statement as shown below:

```
OUTPUT @E5100;"CENT?"  This line queries center frequency setting.
ENTER @E5100;Center    This line retrieves the return value.
```

Module 2-3. Querying Center Frequency Setting

You must retrieve the response into the correct type variable. In the example above, the query returns a value, depending on the current center frequency setting. Therefore, the second line retrieves the response into a numeric type variable (Center).

The response data type, numeric or string, for each command is shown in the reference section of the HP-IB Command Reference.
Automating a Measurement Procedure

This section describes the sample program modules and equivalent commands for setting up the analyzer using the following functions:

1. Setting the Active Channel
2. Setting the Measurement and Format
3. Sweep Setup
4. Calibration
5. Device Connection
6. Triggering a Measurement
7. Data Processing and Transfer
8. Exiting the Program

1. Setting the Active Channel

To begin setting the Measurement, Format, Calibration, Display, and Marker functions of the analyzer, specify the active channel first because it affects all these settings.

<table>
<thead>
<tr>
<th>Setups</th>
<th>Key Operations</th>
<th>HP-IB Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active channel 1</td>
<td>Meas/Format</td>
<td>CHAN1</td>
</tr>
<tr>
<td></td>
<td>ACTIVE CH [CH2]</td>
<td></td>
</tr>
</tbody>
</table>

1: Press this softkey to alter the label to [CH1] when the label is [CH2].

The equivalent program is as follows:

```
OUTPUT @E5100;"CHAN1"  Sets the active channel to channel 1.
```

Module 2-4. Setting the Active Channel

2. Setting the Measurement and Format

<table>
<thead>
<tr>
<th>Setups</th>
<th>Key Operations</th>
<th>HP-IB Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gain-Phase Mode</td>
<td>Meas/Format</td>
<td>ANAMODE GAINP</td>
</tr>
<tr>
<td></td>
<td>FUNCTION[]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GAIN-PHASE</td>
<td></td>
</tr>
<tr>
<td>A/R Measurement</td>
<td>Meas A/R</td>
<td>MEAS AR</td>
</tr>
<tr>
<td>LOG MAG Format</td>
<td>FORMAT LOG MAG</td>
<td>FMT LOGM</td>
</tr>
</tbody>
</table>

The equivalent program for setting Active Channel, Measurement, and Format is as follows:
Module 2-5. Active Channel/Measurement/Format Setup

3. Sweep Setup

<table>
<thead>
<tr>
<th>Setups</th>
<th>Key Operations</th>
<th>HP-IB Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Center Frequency to 70 MHz</td>
<td>CENTER 70 MHz</td>
<td>CENT 70MHZ</td>
</tr>
<tr>
<td>Frequency Span to 100 kHz</td>
<td>SPAN 100 kHz</td>
<td>SPAN 100KHZ</td>
</tr>
</tbody>
</table>

The equivalent program is as follows:

OUTPUT @E5100;"CHN1.MEAS.ART;FMT LOGM"  Sets the Active Channel to 1, the Measurement to A/R, and the Format to LOG MAG.

Module 2-6. Sweep Setup

**Note**
You must be careful with the order of commands when you execute them. The HP E5100A/B has 2 pairs of channel settings and 2 stimulus settings, and they can be set up separately. A setup is applied to the currently selected active channel or active stimulus. You must, therefore, set up the active channel/stimulus before performing other setups.

4. Calibration

The key operations and corresponding HP-IB commands are described below:

<table>
<thead>
<tr>
<th>Setups</th>
<th>Key Operations</th>
<th>HP-IB Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response Calibration Startup</td>
<td>CAL RESPONSE</td>
<td>CALI RESP</td>
</tr>
<tr>
<td>THRU Measurement</td>
<td>THRU</td>
<td>STANC</td>
</tr>
<tr>
<td>Completion of Calibration</td>
<td>DONE:RESPONSE</td>
<td>RESPDONE</td>
</tr>
</tbody>
</table>

As an example, let's look at a frequency response calibration procedure and its corresponding HP-IB commands.

As described in the setup process, you must execute HP-IB commands in the correct order using OUTPUT statements to perform calibration. In addition, there is another important consideration: You must pause the program when the HP E5100A/B is measuring the calibration standard or is calculating the calibration coefficient.

The reason that you must pause the program is that the measurement modules of the HP E5100A/B and Instrument BASIC process data independently. Instrument BASIC, therefore, would try to execute the next command before the instrument measurement module completes...
its job. This can occur when the measurement module is processing a time consuming job (for example, a sweep or a calibration coefficient calculation). The measurement module cannot process an HP-IB command if the module receives it during a process. Therefore, you must synchronize the measurement module and the process used by the controller to execute HP-IB commands successfully. The following modules show a way to synchronize these two procedures.

Calibration Process
1. Setup the calibration mode.

```
OUTPUT 0E5100;"CALI RESP" Sets the calibration mode to Response.
```

Module 2-7. Calibration Mode Setup

2. Connect a standard and perform a measurement.

You can use the STANC? Query to make a calibration measurement and to check to check for the completion of the sweep because the sweep process requires extra time. When you execute STANC?, it returns 1 as soon as the HP-IB command executed immediately before it is completed. The program does not proceed to the next step until the ENTER statement receives the return value from the Query.

```
INPUT "CONNECT THRU, THEN PRESS ANY KEY",A$ Shows the prompt message and waits for the key entry.
OUTPUT 0E5100;"STANC?"
ENTER 0E5100;tmp Performs a measurement.
```

Module 2-8. Connection and Measurement

3. The calibration coefficient is calculated when the measurement is completed. You can also pause the program during a calibration coefficient calculation. RESPDONE? is used to monitor for the completion of the calculation.

```
OUTPUT 0E5100;"RESPDONE?"
ENTER 0E5100;tmp Performs the calculation of calibration coefficient.
```

Module 2-9. Calculation of the Calibration Coefficient

The calibration is now complete and the HP E5100A/B is ready to make a measurement.

5. Device Connection

You must tell the operator to connect a device. This statement uses INPUT to pause the program until data is entered from the keyboard.

```
INPUT "CONNECT OUT, THEN PRESS [RETURN]",A$ Displays a message and waits for the data entry
```

Module 2-10. Device Connection

The program starts a measurement when a device is connected. You need to pause the program, as you needed to do for a calibration, until the measurement completes.
6. Triggering a Measurement
If the measurement sweeps only once, you can omit the process to monitor for the completion of the sweep by executing the following line:

```
EXECUTE "SING"  Execute a single measurement.
```

Module 2-11. Triggering a Measurement

When the SING command is executed by the EXECUTE statement, the program pauses until the sweep completes.

Note
---
You cannot use this method from an external controller because only the HP E5100A/B Instrument BASIC supports the EXECUTE command. You must use the same method as you do for the multiple sweep to synchronize the completion of sweep and the program.

---

When You are Using an External Controller
When you are using an external controller, you can use the *SING? Query to make a single measurement and check the completion of a sweep.

```
OUTPUT &E5100:"SING?"
ENTER &E5100;Tmp
```

Module 2-12. Triggering Module For an External Controller

7. Data Processing and Transfer
You can use a Query command to extract the measurement data required.

The following process executes the command OUTPMAX? (which returns the maximum value within the display range).

```
OUTPUT &E5100:"OUTPMAX?"  A Query to return the maximum value.
Enter &E5100;Value
PRINT "Maximum value:";Value;"dB"  Display the return value.
```

Module 2-13. Data Processing and Transfer

8. Exiting the Program
Exit the program. You can also repeat a measurement using the GOTO statement.

```
END  Exits the program.
```

Module 2-14. Exiting the Program
Sample Program -1: Basic Measurement

The following is a list of the program described in this section. You can refer to the this program to check the explanations.

**Disk**

This program is contained in the attached sample disk with the file name **BASIC** (For Instrument BASIC). The program for an external controller has the name **BASIC.E**.

```
110  ASSIGN @E5100 TO 800 ! IBASIC INITIALIZATION
120  Scode=8 ! [MODULE 1-1]
130  CLEAR @E5100 !
140  OUTPUT @E5100;"DISAHIB" !
150  !
160  OUTPUT @E5100;"PRES" ! ANALYZER PRESETTING
170  ! [MODULE 2-1]
180  !
190  OUTPUT @E5100;"CHAN1;ANAMODE GAINP;MEAS AR;FMT LOGM" ! CHAN/MEAS/FORMAT SETUP
200  ! [MODULE 2-5]
210  !
220  OUTPUT @E5100;"CENT 70MHZ" ! SWEEP SETUP
230  OUTPUT @E5100;"SPAN 100KHZ" ! [MODULE 2-6]
240  !
250  OUTPUT @E5100;"CALI RESP" ! CAL MODE SETUP
260  ! [MODULE 2-7]
270  !
280  INPUT "CONNECT THRU, THEN PRESS [RETURN].",Dum$ ! CONNECTION & CAL MEASUREMENT
290  OUTPUT @E5100;"STANC?" ! [MODULE 2-8]
300  ENTER @E5100;Tmp !
310  !
340  OUTPUT @E5100;"RESPDONE?" ! CALCULATION OF CAL COEFFICIENT
350  ENTER @E5100;Tmp ! [MODULE 2-9]
360  !
400  DISP "RESPONSE CAL COMPLETED" ! DISPLAY MESSAGE
410  !
420  INPUT "CONNECT DUT, THEN PRESS [RETURN].",Dum$ ! PROMPT DEVICE CONNECTION
430  ! [MODULE 2-12]
440  !
450  EXECUTE "SING" ! TRIGGERING MEASUREMENT
460  ! [MODULE 2-13]
470  !
480  OUTPUT @E5100;"AUTO" ! AUTO SCALING
490  !
500  OUTPUT @E5100;"OUTPMAX?" ! DATA PROCESSING & TRANSFER
510  ENTER @E5100;Value ! [MODULE 2-14]
520  PRINT "MAXIMUM VALUE:",Value,"dB"
530  !
540  END ! EXITING PROGRAM
550  ! [MODULE 2-15]
```
Column Parameters and Variables

As explained in the previous section, an HP-IB command that requires a parameter is executed as follows:

```
OUTPUT &E5100;"CENT 70MHZ"  Sets the center frequency to 70 MHz.
```

Module 2-15. Command with Fixed Value

In this case, the parameter value is fixed in the program. You can, however, use a variable to change the parameter depending on the situation.

```
OUTPUT &E5100;"CENT ";Center  Sets the center frequency to Center.
```

Module 2-16. Command with Valuable

This statement passes the variable `Center` to the HP-IB command `CENT` as a parameter. You can place a parameter outside of double quotes and separate them with a semicolon to use a variable as a parameter. (You must always insert a space after a command.)

The following shows an HP-IB command that takes a character string parameter.

```
OUTPUT &E5100;"SAVGRA ""filename"""" Saves the graphic image as the filename.
```

Module 2-17. Command with Character String Parameter

Character strings are usually double quoted ("'). In this case, however, you must double the double quotes (""') for the inside double quotes because an HP-IB command itself is already double quoted.

You can also use single quotes(') instead of double double quotes("'').

```
OUTPUT &E5100;"SAVGRA 'filename'
```

Module 2-18. Command with Character String Parameter

You can also use a variable as a string character parameter.

```
OUTPUT &E5100;"SAVGRA "filename$""
```

Module 2-19. Command with Variable as String Character Parameter

This statement is basically the same as the numeric value variable example. You must, however, place a single quote before and after `filename$` because a string character must be single quoted.

To close a double double quote, you must use a quadruple double quote. You must use a double double quote (""') to close a single quote.

The following examples are both valid. (The command `PROG:EXEC""GET.....` can be executed from an external controller only.)

2-8  Setup and Measurement Program
Module 2-20. Command With Double Quotes

OUTPUT @E5100;"PROG:EXEC ""GET """"Filename"""嶷"""

Module 2-21. Command With Single Quotes

OUTPUT @E5100;"PROG:EXEC 'GET "'Filename'"'"
Data Processing and Transfer

Introduction
This chapter describes data processing and how to access the internal data arrays.
The following information is covered in this chapter:
- Data arrays.
- Data transfer method.
- Sample program: compensation data transfer.

Data Arrays
The analyzer has data arrays that contain measurement data, error correction data, and
stimulus data. You can read or write data to these arrays using HP-IB commands.
Figure 3-1 and Figure 3-2 show simplified diagrams of the data processing in the analyzer.
Figure 3.1. Simplified Data Processing Flow 1
Figure 3-2. Simplified Data Processing Flow 2

Dotted line boxes represent data arrays that hold intermediate or processed data. The following section describes each of these data arrays.
Raw Data Array

The raw data array stores the results of all the preceding data processing operations including the correction by calibration data. The data is in a complex form (real/imaginary pairs) and read out with the commands OUTPRAW? . When you want to use your own compensation method for a measurement data, ① take out the raw data from the raw data array (see Module 3-1), ② apply your compensation method to this data, ③ enter the compensated data into the data array (Module 3-2).

The following example module queries for raw data and retrieves it:

<table>
<thead>
<tr>
<th>Enter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIM Dat(1:201,1:2)</td>
<td>Define NOPx2 for receiving complex data.</td>
</tr>
<tr>
<td>OUTPUT @E5100;&quot;OUTPRAW?&quot;</td>
<td>Query raw data array.</td>
</tr>
<tr>
<td>ENTER @E5100;Dat(*)</td>
<td></td>
</tr>
</tbody>
</table>

### Module 3-1. Getting Raw Data Array

- **Related HP-IB Commands**
  
  The following command is used for sending data to the raw data array:

  ![Image](image)

  **INPURAW, data** Sends data to the raw data array of the active channel.

Data Array

This is the raw data with error correction applied. The array is for the currently measured parameter, and is in a complex form (real/imaginary pairs). The data array data is read out with OUTPDATA? or OUTPDATAP? . The OUTPMEMO? or OUTPMEMOP? query reads the trace memory if available (which is also error corrected). Neither raw nor data array data reflect post-processing functions such as electrical delay offset or trace math.

The following example module sets data for the data array:

<table>
<thead>
<tr>
<th>Enter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>OUTPUT @E5100;&quot;INPUDATA?&quot;;Dat(*)</td>
<td>Sets data to data array.</td>
</tr>
</tbody>
</table>

### Module 3-2. Setting Data Array Data

- **Related HP-IB Commands**
  
  The following command is used to query the data array data:

  ![Image](image)

  **OUTPDATA, data** Queries data in data array of the active channel.

Unformatted Data Array

This is the array of the complex number pairs that will be formatted in the next stage. The unformatted data cannot be read out.
Formatted Data Array

This is the array for the data being displayed. It reflects all post-processing functions such as electrical delay. The units of the array read out depend on the current display format.

This data array is generally the most useful because it is the same information as that seen on the display. When you want to use data with a selected parameter unit, use this array.

The following example module queries the data trace array and retrieves it:

<table>
<thead>
<tr>
<th>DIM Dat(1:201,1:2)</th>
<th>Define NOPx2 for receiving complex data.</th>
</tr>
</thead>
<tbody>
<tr>
<td>OUTPUT @ES100:&quot;OUTPFORM?&quot;</td>
<td>Query data trace array.</td>
</tr>
<tr>
<td>ENTER @ES100:Dat(*)</td>
<td>OUTPFORM outputs data in a complex format.</td>
</tr>
</tbody>
</table>

Module 3.3. Getting Data Trace Array

- Related HP-IB Commands

The following commands are used for accessing the data trace array:

**OUTPFORM?**
- Outputs data trace array of the active channel.

**OUTPRITMEM?**
- Outputs memory trace array of the active channel.

Using the following commands, you can access a data trace array for the inactive channel. These commands are useful to get data from both traces without altering the active channel.

**OUTPIFORM?**
- Outputs data trace array of inactive channel.

**OUTPRITMEM?**
- Outputs memory trace array of the inactive channel.

Calibration Coefficient Array

The results of a calibration are stored as arrays of calibration coefficients that are used by the error correction routines. Each array corresponds to a specific error term in the error model. The calibration coefficients are read out with OUTPCALC{01|03}?.

For detailed information about the calibration and error model, see the Function Reference.

Accessing Arrays

If you want to enter calibration data from the controller to the calibration coefficient array, the analyzer must have previously done the calibration to enable the calibration data. To do this, perform the following steps:

1. Execute a dummy calibration to validate the correction.
2. Send the new calibration coefficients.

Note that the calibration coefficients are complex data.

- Related HP-IB Commands

The following commands are used to access the calibration coefficient array:

**OUTPCALC{01|02|03}?**
- Outputs the specified calibration coefficient array data of the active channel.

**INPUCALC{01|02|03}**
- Sets the specified calibration coefficient array data of the active channel.
Arrays for Memory Trace

When you store the trace data into the trace memory by sending the DATI command or by pressing DATA ---- MEM, the data array data is stored into the memory array. Memory array data passes through the formatting process, and then is stored into the memory trace array that is being displayed on the LCD display. See Figure 3-1 and Figure 3-2.

Besides the 16-trace limitation, the number of traces that can be stored into trace memory at one time depends on the capacity of the system memory and the number of points in the traces. The analyzer always reserves memory for 3 traces. The remaining memory is shared with the Instrument BASIC graphics.

Accessing Memory Array

You can only read data for the memory array that is activated. The memory array is read only. The following example module reads data from the memory array:

```
DIM Dat(1:201,1:2)
OUTPUT #E5100;'"OUTPTMEM?" Queries an activated memory array.
ENTER #E5100;Dat(*) Receives the query response.
```

Module 3-4. Getting Memory Array Data

Accessing Trace Array

You can read or write trace array data. The following example module sets data for the trace array. You have to execute a trace-to-memory store procedure before setting a memory to display:

```
OUTPUT #E5100;"DATI" Store trace data into trace array memory to allocate a trace array area.
OUTPUT #E5100;"OUTPTMEM?" Queries a trace array.
OUTPUT #E5100;Dat(*) Receives the query response.
```

Module 3-5. Setting Trace Array Data

- Related HP-IB Commands

The following commands are used to query the contents of the memory trace array:

```
OUTPTMEM? Outputs the memory trace of the active channel.
OUTPTMEM? Outputs the memory trace of the inactive channel.
```
Data Transfer Methods

This section describes the data transfer methods. When you get or send the data array's data, there are two methods for data transfer: ASCII and binary.

![Diagram of data transfer methods: ASCII Transfer and Binary Transfer](image)

Figure 3-3. Simplified Internal Process of ASCII and Binary Transfer

Because the ASCII transfer passes through the formatted process, the program does not care about the data format. On the other hand, the binary transfer directly passes the data, but you have to indicate what data is transferred using the data header. The binary transfer is faster than the ASCII transfer.

ASCII Transfer

The ASCII format transfer is the easiest way to transfer array data between the analyzer and the controller. You do not have to worry about the data format because the analyzer and the controller automatically handles the formatting of the transferred data in this format. You can just send or retrieve array data by using the OUTPUT and ENTER statements.

The ASCII transfer format is sent as a 14-character (data) or 22-character (stimulus) string for each data point. This string includes a digit, sign or decimal point. Therefore, the data length of 201 points of complex data is 6030 bytes. (Including data delimiter “LF" for each data.)

To retrieve data from the analyzer using the ASCII format transfer, the following procedure is used:

1. Define a data array that is the same size as the data to be retrieved.
2. Specify the data transfer format is ASCII.
3. Send the data query command.
4. Retrieve the data.

```
DIM Dat(1:201,1:2)  Define the data array for receiving.
OUTPUT @E5100;"FORM4"  Specify the ASCII format.
OUTPUT @E5100;"OUTPDATA?"  Query the data trace.
ENTER @E5100;Dat(*)  Retrieve the data.
```

Module 3-6. Retrieving Data from the Analyzer Using ASCII Transfer

Sending data to the analyzer is easy, just specify a format, then send the data:

```
OUTPUT @E5100;"FORM4"  Specify the ASCII format.
OUTPUT @E5100;"INPDATA ";Dat(*)  Send command and data.
```

Module 3-7. Sending Data to Analyzer by ASCII Transfer

**Binary Transfer**

For a faster data transfer, use the binary format. There are three formats for binary transfer. The following list shows the data format that the analyzer outputs when you query the data:

- **IEEE 64-bit Floating Point Format**

  Figure 3-4 shows the data transfer format of the IEEE 64-bit floating point format. Data is stored internally in the 200/300 series computer with the IEEE 64-bit floating point format, eliminating the need for any reformatting by the computer. In this mode, each number takes 8 bytes.

![Figure 3-4. IEEE 64-bit floating point format](image)

- **IEEE 32-bit Floating Point Format**

  Figure 3-5 shows the data transfer format the IEEE 32-bit floating point format. In this mode, each data point is 4 bytes. The difference from the 64-bit format is a significant digit. The 64-bit format has double the precision of this format.
**Figure 3-5. IEEE 32-bit floating point format**

- **MS-DOS® Format**
  This mode is a modification of the IEEE 32-bit floating point format with the byte order reversed. The MS-DOS format also has a four-byte header that must be read to maintain the data order. In this mode, a PC can store the data internally without reformatting it.

**Data Header**
As shown in Figure 3-4 and Figure 3-5, the data header always precedes the data itself in binary format transfer. When you use a binary transfer, you must handle the data header with the data body.

When you query data in binary format, the analyzer outputs a fixed length (8 byte) data header. You can handle the data header as 8-byte strings for this purpose.

When you send the data to data array using binary transfer, you must prepare the data header for the data you send. The data header indicates the size of the transferred data. The data header consists of the following three parts: sharp (#), Number of bytes of “Data Size”, and data size.

**Figure 3-6. Binary Data Header**

For example, the data size of 201 points of complex data in the 64-bit format is 3216 byte (≈201×2×8). The “3216” is 4 digit (4 byte) number. Thus, the data header is “#43216”. The queried data header that is generated from the analyzer is a fixed length header of 8 bytes that is obtained by adding “0” before “Data Size”. For example, the data header above becomes “#6003216” as an 8-byte string. You can use either type of header to send data to the array.
Getting Data from the Analyzer

To get a data from the analyzer using the binary transfer method, the following procedure is used:

1. Assign a binary data path. (Specifying format off.)
2. Specify the data transfer format as binary.
3. Define a data array that is the same size as the data that will be retrieved.
4. Send the data query command.
5. Retrieve the data header.
6. Retrieve the data.
7. Retrieve the terminator.
8. Set the transfer format to ASCII mode if binary transfer is finished.

The binary data is sent in a mixed format of an ASCII header and a binary data body as shown in Figure 3-4 and Figure 3-5. To retrieve data correctly, you must retrieve the data header and data itself independently.

The following is a sample module for receiving data using the IEEE 64-bit format:

```
ASSIGN @Dt TO 800;FORMAT OFF
OUTPUT @E5100;"FORM3"
DIM Dat(1;201,1;2)
OUTPUT @E5100;"OUTPDATA?"
ENTER @E5100 USING ";,8A;Header$"
ENTER @Dt;Dat(*)
ENTER @E5100;End$
OUTPUT @E5100;"FORM4"
```

Module 3-8. Getting Data from Analyzer Using Binary Transfer

Note
Binary data transfer to the analyzer is not allowed. Use ASCII transfer for sending data to the analyzer.

Related HP-IB Commands
The following commands are used to specify the data transfer format.

- **FORM2** Selects IEEE 32-bit floating point format.
- **FORM3** Selects IEEE 64-bit floating point format.
- **FORM4** Selects ASCII format.
- **FORM5** Selects MS-DOS format.
Sample Program -2: Binary Data Transfer

This is a sample program for the trace data transfer that uses the IEEE 64 bit floating decimal point format. This program transfers the data at each measured trace point in the binary format and displays them on the screen.

Disk
This program is contained in the attached sample disk with the file name BINARY (For Instrument BASIC). The program for an external controller has the name BINARY-E.

110 ASSIGN @E5100 TO 800;FORMATON! IBASIC INITIALIZATION
120 ASSIGN @Dt TO 800;FORMAT OFF !
130 Scode=6 !
140 CLEAR @E5100 !
150 !
160 DIM Dat(1:201),Stim(1:201) ! VARIABLE DECLARATION
170 !
180 OUTPUT @E5100;"PRES" ! MEASUREMENT SETUP
190 OUTPUT @E5100;"CHAN1;ANAMODE GAINP;MEAS AR;FMT LOGM"
200 INPUT "Enter center frequency (MHz)",F_cent
210 INPUT "Enter frequency span (kHz)",F_span
220 OUTPUT @E5100;"CENT ";F_cent*1.E+6
230 OUTPUT @E5100;"SPAN ";F_span*1000
240 !
250 EXECUTE "SING" ! TRIGGERING MEASUREMENT
260 ! [MODULE 2-12]
270 !
280 OUTPUT @E5100;"PQIN?" ! GETTING DATA USING BINARY TRANSFER
290 ENTER @E5100;Nop !
300 OUTPUT @E5100;"FORM3" !
310 OUTPUT @E5100;"OUTPRFORM?" !
320 ENTER @E5100 USING ",8A";Header$
330 ENTER @Dt;Dat(*) !
340 ENTER @E5100 USING ",1A";End$
350 !
360 OUTPUT @E5100;"OUTPSTIM?" ! TRANSFER STIMULUS VALUE IN BINARY
370 ENTER @E5100 USING ",8A";Header$
380 ENTER @Dt;Stim(*) !
390 ENTER @E5100 USING ",1A";End$
400 !
410 ASSIGN @Dt TO * ! DISPLAY TRANSFERRED DATA
420 FOR I=1 TO Nop !
430 PRINT "POINT";I,Stim(I);"[Hz]",Dat(I);"[dB]"
440 NEXT I !
450 !
460 END ! END OF PROGRAM
Using the I/O Port

Introduction
The HP E5100A/B has a 24 bit I/O port on the rear panel. This section explains how to use this I/O port from BASIC.

The 24 bit I/O port has the following pin layout. See Appendix D 'Parallel I/O (Standard and Option 006)' of the User's Guide.

![Figure 4-1. The I/O Port Pin Layout](image)

Following is the description of how to use lines that can be controlled by Instrument BASIC.

Output Port (Pin 5 to 28)
The HP E5100A/B can select 8 types of output ports depending on the output data width. Note that port C (Pin 21 to 24) and port D (Pin 25 to 28) can also function as input ports.

There are 2 ways to output data to an I/O port.
- Use the WRITEIO statement of Instrument BASIC.
- Use OUTAIO to OUTHIO of the HP-IB command.

Data Output
Use the following procedure to output data:

1. If you want to use output ports other than A, B or F, you must specify ports C and D as output ports.
### Ports Used | HP-IB Commands Executed
---|---
Port C (4 Bit) | COUT
Port D (4 Bit) | DOUT
Port E (8 Bit) | COUT, DOUT
Port G (20 Bit) | COUT
Port H (24 Bit) | COUT, DOUT

2. Output data from a controller through the I/O ports. Use the following commands to output data.

<table>
<thead>
<tr>
<th>Ports Used</th>
<th>HP-IB Commands</th>
<th>Instrument BASIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Port A (8 Bit)</td>
<td>OUTPAIO data</td>
<td>WRITEIO 15,0; data</td>
</tr>
<tr>
<td>Port B (8 Bit)</td>
<td>OUTPBI0 data</td>
<td>WRITEIO 15,1; data</td>
</tr>
<tr>
<td>Port C (4 Bit)</td>
<td>OUTFCIO data</td>
<td>WRITEIO 15,2; data</td>
</tr>
<tr>
<td>Port D (4 Bit)</td>
<td>OUTPDI0 data</td>
<td>WRITEIO 15,3; data</td>
</tr>
<tr>
<td>Port E (8 Bit)</td>
<td>OUTPEIO data</td>
<td>WRITEIO 15,4; data</td>
</tr>
<tr>
<td>Port F (16 Bit)</td>
<td>OUTPFIO data</td>
<td>WRITEIO 15,5; data</td>
</tr>
<tr>
<td>Port G (20 Bit)</td>
<td>OUTPGIO data</td>
<td>WRITEIO 15,6; data</td>
</tr>
<tr>
<td>Port H (24 Bit)</td>
<td>OUTPHIO data</td>
<td>WRITEIO 15,7; data</td>
</tr>
</tbody>
</table>

If you output data to port C or D (including ports E, G and H) when they are specified as input ports, a warning message **CAUTION: WRONG I/O PORT DIRECTION** will be displayed.

When data is outputted, a negative pulse will be outputted to the write strobe output (pin 31) of the output port. Monitor this output to synchronize the transfer when you are reading the data outputted to the I/O port from an external device.

### Input Port (Pin 21 to 28)

As described in the previous section, input ports can also function as output ports. If you want to input data, you must set ports C and D to the input mode before processing the data. If ports C and D are set to the input mode, their I/O status line (pins 29 and 30) will be set to LOW. Be sure to check the I/O status lines (pins 29 and 30) of ports C and D to make sure they are set to the input mode when you want to import data from an outside source.

There are 2 ways to read data from an I/O port.

- Use the **READIO** statement of Instrument BASIC.
- Use **OUTPINPCIO?** to **OUTPINPEIO?** of the HP-IB command.

### Data Input

Use the following procedure to input data from an external device:

1. Set ports C and D as input ports.
<table>
<thead>
<tr>
<th>Ports Used</th>
<th>HP-IB Commands</th>
<th>Instrument BASIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Port C (4 Bit)</td>
<td>CIN</td>
<td></td>
</tr>
<tr>
<td>Port D (4 Bit)</td>
<td>DIN</td>
<td></td>
</tr>
<tr>
<td>Port E (8 Bit)</td>
<td>CIN,DIN</td>
<td></td>
</tr>
</tbody>
</table>

2. Monitor the I/O status lines (pins 29 and 30) of ports C and D to make sure they are set to LOW. (If positive logic is specified by the POSL command, the input mode will be HIGH.)

3. Input data to the input ports.

4. Execute the following command from the controller to read the data inputted to the I/O ports.

<table>
<thead>
<tr>
<th>Ports Used</th>
<th>HP-IB Commands</th>
<th>Instrument BASIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Port C (4 Bit)</td>
<td>OUTPINPCIO? data</td>
<td></td>
</tr>
<tr>
<td>Port D (4 Bit)</td>
<td>OUTPINPDIO? data</td>
<td></td>
</tr>
<tr>
<td>Port E (8 Bit)</td>
<td>OUTPINPEIO? data</td>
<td></td>
</tr>
</tbody>
</table>

The INPUT1 Input (Pin 2) is provided to inform the HP E5100A/B of a data input. See the "INPUT1 Input (Pin 2), OUTPUT1 Output (Pin 3), OUTPUT2 Output (Pin 4)" commands for additional information.

**INPUT1 Input (Pin 2), OUTPUT1 Output (Pin 3), OUTPUT2 Output (Pin 4)**

To synchronize the HP E5100A/B and an external device at a measurement, the status lines are assigned to pins 2 to 4. Their functions are described in the following paragraphs.

**INPUT1 Input (Pin 2)**

Used to send timing information from an outside source. If there is input to this pin, OUTPUT1 and OUTPUT2 are set to the specified status.

**OUTPUT1 Output (Pin 3), OUTPUT2 Output (Pin 4)**

Used to send the status of the HP E5100A/B to an external device. This is set to the status specified at the INPUT1 input. You can also set this to any status using an HP-IB command.

The status of OUTPUT1 and OUTPUT2 at the INPUT1 input is set by the following commands.

**Commands to Set the Status of OUTPUT1 and OUTPUT2 at the INPUT1 Input**

<table>
<thead>
<tr>
<th>LOW</th>
<th>HIGH</th>
</tr>
</thead>
<tbody>
<tr>
<td>OUTPUT1</td>
<td>OUT1ENVL</td>
</tr>
<tr>
<td>OUTPUT2</td>
<td>OUT2ENVL</td>
</tr>
</tbody>
</table>

You can also use the following commands to set OUTPUT1 and OUTPUT2 to any status.
**Examples of Data I/O**

Let’s look at an example of data I/O that uses the status line. OUTPUT1 and OUTPUT2 are used as the status indicators.

**OUTPUT1**  
Set to HIGH when the HP E5100A/B completes a measurement and data process and is waiting for a trigger.

**OUTPUT2**  
Set to HIGH while the HP E5100A/B is performing a measurement.

The following is a timing chart to describe the status.

![Timing Chart](image)

**Figure 4-2. INPUT1, OUTPUT1, OUTPUT2 Timing Chart**

1. Specify the status of OUTPUT1 and OUTPUT2 at the INPUT1 input. See Figure 4-2 to set OUTPUT1 to LOW and set OUTPUT2 to HIGH.

   ```
   OUTPUT &E5100;"OUT1ENVL"
   OUTPUT &E5100;"OUT2ENVH"
   ```

2. Start a measurement. Set a trigger at the INPUT1 input to perform a measurement. HIGH is set to OUTPUT1 to go back to the beginning of the loop to wait for a trigger when the data process is completed. You can check the timing of data input to the INPUT1 port by using the **INPT?** query.
ON ERROR GOTO Finished
LOOP
OUTPUT #E5100;"OUT1H"
REPEAT
OUTPUT #E5100;"INPT?"
ENTER #E5100;Inpt
UNTIL Inpt=1
:
:
OUTPUT #E5100;"OUT2L"
:
:
END LOOP
Finished:

Set OUTPUT1 to HIGH.

Wait for an INPUT1 input.

OUTPUT1 is set to LOW and OUTPUT2 is set to HIGH by the INPUT1 input.

Set a trigger and perform a measurement.

Set OUTPUT2 to LOW at the completion of measurement.

Process the measured data.

Module 5-1. Using Data I/O
The Parallel I/O Mode A (Option 005 Only)

The HP E5100A/B Option 005 has an Input-4 Bit/Output-8 Bit I/O port. The following is a description of how to use the Option 005 I/O port from a BASIC program.

**Data Output (4 Bit)**

You can use the following methods to output data:

- For Instrument BASIC, use the **WRITEIO** statement.
  
  ```plaintext
  WRITEIO 15,2;data
  ```

- For HP BASIC use an HP-IB command **OUT8IO**.
  
  ```plaintext
  OUTPUT @E5100;"OUT8IO ";data
  ```

**Data Input (8 Bit)**

You can use the following methods to read inputted data:

- For Instrument BASIC, use the **READIO** statement.
  
  ```plaintext
  Data=READIO(15,2)
  ```

- For HP BASIC use the HP-IB command **INPSIO** or **OUTPINPSIO**.

```
OUTPUT @E5100;"INPSIO?" Output data from the I/O port directly.
ENTER @E5100;Data The return value is 4 bit data.
```

**Module 5-2. Reading Input Data**

Or

```
OUTPUT @E5100;"INPSIO" Read data from the I/O port to the memory and output it from the memory.
OUTPUT @E5100;"OUTPINPSIO?" The return value is 8 bit data with 0s in its upper 4 bits.
ENTER @E5100;Data
```

**Module 5-3. Reading Input Data**
Using Status Reporting Function

The analyzer has status registers that report system conditions. The register contents are changed depending on the particular condition of the analyzer. By reading this register, you can determine the specific analyzer status.

This chapter provides the following information:

- General status register model.
- Status register structure of the HP E5100A/B.
- How to use status register in a program.
- Sample program: performing calibration.

General Status Register Model

The analyzer has a status reporting system to report the condition of the analyzer.

![Diagram of General Status Register Model]

**Figure 5-1. General Status Register Model**

The status reporting system has a hierarchical structure as shown in Figure 5-1. When the analyzer condition satisfies the particular condition, the corresponding bit of the event register is set "1". Therefore, you can check the analyzer condition by reading the event register.

When the event register bit is set to "1", and corresponding enable register bit is also "1", the summary bit of the status byte register is set to "1". You can read the status byte register by using the serial poll.
If the corresponding bit of the service request enable register is “1”, the service request (SRQ) is generated with the positive transition of the status byte register bit. By generating the SRQ, you can notify the controller that the analyzer is requesting service.

**Event Register**

Reflects the correspondent analyzer condition as a bit status. These bits monitor the changing analyzer state continuously and change the bit status as required.

You cannot change bit status by HP-IB command.

The analyzer has the following event registers:

- Instrument Event Status Register.
- Standard Event Status Register.
- Operation Status Event Register.

**Enable Register**

The enable register selects which event register bits can set the bit in the summary bit of the status byte register that is connected to SRQ generation. The register bits work like mask bits. When you want to set a bit in the status byte register by a specific register condition, set the corresponding enable register to 1. This sets a 1 bit in the status byte register with a corresponding event register bit.

Use this register to select which event register bits generate the SRQ.

All event registers have a corresponding enable register for each bit.

**Status Byte Register**

If enabled event register is set to 1, the corresponding bit of the status byte register is set to 1. This register also indicates the output queue and SRQ status.

The value of the status byte register can be read by using the SPPOLL statement or the *STB? query from the controller. SPPOLL reads the status byte register value directly without the analyzer being set to remote. Therefore, you can continue to operate front panel keys while a controller is reading the status byte register. On the other hand, the *STB? query sets the analyzer to remote mode. Reading the status byte register by either command does not affect the contents of the status byte register, except that SPPOLL clears the RQS bit.

A serial poll initiated by using the SPPOLL command reads bit 6 of the status byte register as the RQS bit. The *STB? command reads bit 6 as the MSS bit.

SRQ (Service Request) can be generated by the status byte register by setting the service request enable register. For more information about SRQ, see “SRQ and Interrupt” in this chapter.
Transition Filter and Condition Register

The transition filter allows you to select which transitions of the analyzer condition will set a bit in the event register.

When the status register has a transition filter, there is a lower register called a condition register under the event register. The transition filter is between the event register and the condition register. The transition filter enables you to select a positive and/or negative transition of the condition register bit to set a bit in the corresponding event register. For example, if you set the negative transition filter, a 1 is set in the event register by changing from 1 to 0 in the event register.

![Diagram of Transition Filter and Condition Register]

**Figure 5-2. Transition Filter and Condition Register**

For the HP E5100A/B, only the “Program Running” bit of the operation status register has a transition filter. By using the transition filter, you can generate an SRQ either at the start or the end of the program execution.
Status Register Structure

Status byte totals three status registers which indicate the internal condition of an instrument. Figure 5-3 shows the status reporting structure of the HP E5100A/B.

![Diagram of Status Register Structure]

**Figure 5-3. Status Reporting Structure**

The HP E5100A/B has a status reporting system to report the condition of the instrument. Status byte 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 E5100A/B 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 5-1 shows contents of status byte.

5-4 Using Status Reporting Function
### Table 5-1. Status Bit Definitions of the Status Byte (STB)

<table>
<thead>
<tr>
<th>Bit</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Check event status register B</td>
<td>One of the enabled bits in event status register B has been set.</td>
</tr>
<tr>
<td>4</td>
<td>Message Available</td>
<td>“1” is set when Output Queue has data and “0” is set when Output Queue has no data.</td>
</tr>
<tr>
<td>5</td>
<td>Summary bit of event status register</td>
<td>One of the enabled bits in the event status register has been set.</td>
</tr>
<tr>
<td>6</td>
<td>MSS (Master Summary Status Bit)</td>
<td>One of the enabled status byte bits is causing an SRQ.</td>
</tr>
<tr>
<td>7</td>
<td>Operational status summary bit</td>
<td>One of the enabled bits in the operational status register has been set.</td>
</tr>
</tbody>
</table>

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 5-4. Example of Reading Status Byte (1)**

Or,

```
10 ASSIGN @E5100; TO 717
20 OUTPUT @E5100;"STB?"
30 ENTER @E5100;Stat
40 Stb4=BIT(Stat,4)
50 PRINT Stb4
60 END
```

**Figure 5-5. 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 *CLS command is executed.
Table 5-2. Status Bit Definitions of the Event Status Register (ESR)

<table>
<thead>
<tr>
<th>Bit</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Operation complete</td>
<td>A command for which OPC has been enabled, and completed an operation.</td>
</tr>
<tr>
<td>2</td>
<td>Query error</td>
<td>1. The HP E5100A/B has been addressed to talk, but there is nothing in the output queue to transmit.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Data in the Output Queue has been lost.</td>
</tr>
<tr>
<td>3</td>
<td>Device dependent error</td>
<td>An error, other than a command error, a query error, and an execution error has occurred.</td>
</tr>
<tr>
<td>4</td>
<td>Execution error</td>
<td>1. A program data element following a header exceeded its input range, or is inconsistent with the HP E5100A/B's capabilities.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. A valid program message could not be properly executed due to some instrument condition.</td>
</tr>
<tr>
<td>5</td>
<td>Command error</td>
<td>1. An IEEE 488.2 syntax error has been occurred. Possible violations include, a data element violated the HP E5100A/B listening formats or a data element type is unacceptable to the HP E5100A/B.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>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.</td>
</tr>
<tr>
<td>7</td>
<td>Power on</td>
<td>A power-on sequence has occurred.</td>
</tr>
</tbody>
</table>

Table 5-3. Status Bit Definitions of the Event Status Register B (ESB)

<table>
<thead>
<tr>
<th>Bit</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Sweep or group complete, or cal std. complete</td>
<td>A single sweep or group has been completed since the last read of the register. Operates in conjunction with SING or NUMG.</td>
</tr>
<tr>
<td>3</td>
<td>Limit failed, 4</td>
<td>Limit test failed on trace 4.</td>
</tr>
<tr>
<td>4</td>
<td>Limit failed, 3</td>
<td>Limit test failed on trace 3.</td>
</tr>
<tr>
<td>5</td>
<td>Limit failed, 2</td>
<td>Limit test failed on trace 2.</td>
</tr>
<tr>
<td>6</td>
<td>Limit failed, 1</td>
<td>Limit test failed on trace 1.</td>
</tr>
<tr>
<td>10</td>
<td>Limit Passed, 4</td>
<td>Limit test passed on trace 4.</td>
</tr>
<tr>
<td>11</td>
<td>Limit Passed, 3</td>
<td>Limit test passed on trace 3.</td>
</tr>
<tr>
<td>12</td>
<td>Limit Passed, 2</td>
<td>Limit test passed on trace 2.</td>
</tr>
<tr>
<td>13</td>
<td>Limit Passed, 1</td>
<td>Limit test passed on trace 1.</td>
</tr>
</tbody>
</table>
Table 5-4.
Status Bit Definitions of the Operational Status Register (OSR)

<table>
<thead>
<tr>
<th>Bit</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>Program running</td>
<td>An HP Instrument BASIC program is running.</td>
</tr>
</tbody>
</table>

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 E5100A/B 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 @E5100 TO 717
20 !
30 OUTPUT @E5100;"CLRS" ! Clears status registers
40 OUTPUT @E5100;"ESNB 1" ! Enables mask register of "SING, NUMG, or
50 !                              ! Cal Std. Complete" of ESB
60 OUTPUT @E5100;"SRE 4" ! Enables mask register of "Event Status
70 !                              ! Register B" of STB
80 !
90 CN INTR 7 GOTO End           ! Declare SRQ interrupt
100 ENABLE INTR 7;2
100 OUTPUT @E5100;"SING" ! Execute single sweep
110 GOTO 110                    ! Endless loop
120 !
130 End:
140 END                         ! Exit from loop when sweep is completed
```

Figure 5-6. 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 E5100A/B'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 E5100A/B’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.)
How to Use the Status Registers in a Program

You can use the status registers to determine the specific analyzer status in the program. To determine the contents of the status register, the following methods are used:

- Read an event register directly.
- Use the Service Request (SRQ).

**Reading an Event Register Directly**

You can read the contents of the event register directly to determine the specific analyzer condition. Use this method if you do not need to know the timing of the event register changes. The following procedure reads the register directly:

1. Query the event register contents.
2. Retrieve a return value.
3. Check the bit condition using the BASIC **BIT** function.

```plaintext
OUTPUT &E5100;"ESB?"
ENTER &E5100;Eeb
IF BIT(Eeb,4) THEN
   DISP "LIMIT TEST FAILED AT Ch 1."
END IF
```

**Module 4-1. Reading an Event Register**

- Related HP-IB Commands. The following query commands can be used to read the contents of an event register directly.

  *STB? Returns Status Byte Register contents.
  *ESR? Returns Event Status Register contents.
  ESB? Returns Instrument Event Status Register contents.
  OSR? Returns Operation Status Register contents.
SRQ and Interrupt

You can initialize your program to enable interrupt processing by the Service Request (SRQ) from the analyzer. The analyzer generates an SRQ when the specified condition is satisfied.

The SRQ itself does not contain information on the SRQ source. However, the Request Service (RQS) bit in the Status Byte Register of the SRQ source device is set to 1. If multiple devices are connected on the bus, you can check the RQS bit (bit 6) of the analyzer by using a serial poll, SPOLL.

Use the SRQ interrupt if you want to determine when the condition changes. The following procedure is used to set the SRQ interrupt:

1. Define the branch for the interruption. (Use ON INTR statement.)
2. Set the enable register for the correspondent event register bit to 1.
3. Set the service request enable register bit for the correspondent status byte register bit to 1.
4. Clear the status register before enabling the SRQ interruption.
5. Enable the SRQ interruption. (Use ENABLE INTR statement.)
6. Start the event.
7. Wait for the SRQ. Usually, the program waits within an endless loop.
8. If multiple devices that can generate an SRQ exist on the HP-IB, you should check bit 6 of the status byte register of the target device. If the SRQ is generated from the target device, the status byte register bit 6 is set to 1.

The following example uses an SRQ interruption for detecting the end of sweep. Bit 0 of the instrument event status register is used for this purpose.

```
ON INTR Scode GOTO Sweep_end
OUTPUT $E5100;"ESNB 1"
OUTPUT $E5100;"$RSE 4"
OUTPUT $E5100;"CLS"
OUTPUT $E5100;"GPC?"
ENTER $E5100;0pc
1
OUTPUT $E5100;"HOLD"
ENABLE INTR Scode;2
OUTPUT $E5100;"SING"
Waiting: GOTO Waiting
Sweep_end:
IF NOT BIT(SPOLL($E5100),6) THEN
  ENABLE INTR Scode;2
  GOTO Waiting
END IF
```

Module 4-2. Detecting Sweep End Using SRQ and Interrupt

**Note**  
*CLS clears only the event registers and the status byte register. The enable register and transition filter settings are not altered by executing the *CLS command. To clear the enable register and transition filter, use the PRES command.

Figure 5-7 shows the SRQ generation sequence of the example above.
Figure 5-7. SRQ Generation Sequence

- Related HP-IB Commands

The following HP-IB commands are used for setting the SRQ generation:

*SRE decimal
Sets the service request enable register.

*ESE decimal
Sets the enable register for event status register.

ESNB decimal
Sets the enable register for instrument event status register.

OSE decimal
Sets the enable register for operation status register.

OSPT decimal
Sets the transition filter to positive for operation status register.

OSNT decimal
Sets the transition filter to negative for operation status register.
Programming Miscellaneous

Introduction
This chapter describes methods to use the HP E5100A/B, Instrument BASIC and an external controller together and some notes on the operation. The later sections introduce techniques for programming and hints to increase process speed.

This chapter describes the following topics:
- Using an External Controller and the HP E5100A/B Together
- Controlling Instrument BASIC from an External Controller
- Programming Techniques

Using an External Controller and the HP E5100A/B Together
The HP E5100A/B has the ability to function as a controller to control other HP-IB devices. If you want to use an external controller, you can also use both of them on the same bus. This section explains how to use the two controllers on the same bus.

Locking Out Local Operation (LOCAL LOCKOUT)
If you are controlling the HP E5100A/B with an external controller, the HP E5100A/B is in the remote mode. In the remote mode, the front panel key operations are not accepted. You can, however, press the LOCAL key to cancel the remote mode. To prevent the operator from pressing the LOCAL key by mistake and changing the device setup, you can make all keys (including the LOCAL key itself) unavailable. This status is called Local Lockout.

You can set local lockout as follows.

```
ASSIGN Scode TO 7
LOCAL LOCKOUT Scode
```

Module 6-1. Setting Local Lockout

You can cancel local lockout by sending the LOCAL command.

```
LOCAL Scode  Cancel the all devices on the bus.
LOCAL &E5100  Cancel any one device.
```

Module 6-2. Canceling Local Lockout
How To Pass Control (PASS CONTROL)

Though more than one controller can be on the same bus, only one controller can actually control the bus at any one time. The controller that has the right to control the bus is called the Active Controller.

The controller that has control at system startup is called the System Controller. The system controller is specified physically and it cannot be controlled and changed by a program. If you want to use more than one controller, you must pass control to the other controller. The PASS CONTROL statement of BASIC is used to transfer control to another controller.

```plaintext
PASS CONTROL @E5100
```

Module 6-3. Pass Control

Only the active controller can execute this statement.

The system controller can become the active controller at any time by executing the ABORT statement.

```plaintext
ABORT 7
```

Module 6-4. Abort

Only the system controller can execute this statement.
Controlling Instrument BASIC From an External Controller

The HP E5100A/B has a command called the Program Subsystem command that enables an external controller to control Instrument BASIC. The program subsystem command enables you to execute a program written in Instrument BASIC or refer to the variables used by Instrument BASIC from an external controller. This section will describe the following topics related to the program subsystem command usage.

- Referring to and Transferring an Array
- Remote Processing a BASIC Command
- Transferring a Program

**Note**
The following commands and programs are all executed on an external controller.

**Note**
The program subsystem command is based on SCPI (Standard Commands for Programmable Instrument).

**Referring to and Transferring an Array**
You may need to exchange data between programs when you are using an external controller and Instrument BASIC together. This section describes how to use the program subsystem command to exchange data.

**Referring to a Numeric Variable**
Execute the following statements to refer to numeric variable data in Instrument BASIC from an external controller:

```
OUTPUT @E5100;"PROG:NUMB? 'Dat'"
Enter @E5100;Dat
```

Module 6-5. Referring to a Numeric Variable

**Referring to a String Character Variable**
Similarly, refer to a string character variable as follows:

```
OUTPUT @E5100;"PROG:STR? 'String$'"
Enter @E5100;String$
```

Module 6-6. Referring to a String Character Variable
Transferring a Numeric Variable

Execute a command with a variable name and data as a parameter to transfer numeric data to a variable in Instrument BASIC.

```
OUTPUT $E5100;'PROG:NUMB 'Center',100000000"
INPUT "ENTER CENTER FREQUENCY",Center
OUTPUT $E5100;'PROG:NUMB 'Center',":Center
```

Module 6-7. Transferring a Numeric Variable

Transferring a String Character Variable

Execute a command with a variable name and data as a parameter to transfer string character data to a variable in Instrument BASIC.

```
OUTPUT $E5100;'PROG:STR 'File$','TEST1''
File$="TEST1"
OUTPUT $E5100;'PROG:STR 'File$','";File$;"
```

Module 6-8. Transferring a String Character Variable

Referring to and Transferring an Array

Similarly, you can refer to the contents of an array.

```
DIM Dat_array(1:201,1:2) Define an array of the same size as the array you are referring to.
OUTPUT $E5100;'PROG:NUMB 'Dat_array''
ENTER $E5100;Dat_array(*)
```

Module 6-9. Transferring Array

You cannot refer to an array by each element (Ex. PROG:NUMB? 'Dat_array(1,1)'). Execute a command with an array name and data as a parameter to transfer array data.

```
OUTPUT $E5100;'PROG:NUMB "'Dat_array"",";Dat_array(*)
```

Module 6-10. Referring to Array

In fact, the program is more complex because you have to synchronize two programs. See "Sample Program -3: Controlling Instrument BASIC from an External Controller".

Remote Processing a BASIC Command (PROG:EXEC)

You can remote process a BASIC command supported by the HP 5100A/B’s BASIC command lines.

Following is an example of how to use the PROG:EXEC command.
Module 6-11. PROG:EXEC Command

Controlling the Process Status

You can check or set the process status of a BASIC program from an external controller.

Controlling the Process Status of Instrument BASIC

You can use the PROG:STAT command to control the process status of Instrument BASIC from an external controller.

Module 6-12. PROG:STAT Command

See the HP-IB Command Reference for detail.

Checking the Process Status of an Instrument BASIC Program

The following are examples of how to remote check the process status of Instrument BASIC.

- Use the PROG:STAT?Query.
  Depending on the return value, you can see if the process is in the RUN, PAUSE or STOP status.

Module 6-13. PROG:STAT? Query

- Check the bit 14 of OSR (Operation Status Register).

  B 14 of the OSR is set depending on the process status of Instrument BASIC. A 1 is set if the process is running, or a 0 is set if it is stopped (including the PAUSE status).

Module 6-14. Checking Operation Status Register

When you want to generate an SRQ according to the process status of Instrument BASIC, you can select whether you want to generate it at the start of program or at the completion of program by specifying OSPT or OSNT.
Module 6-15. Generating SRQ

Change OSPT to OSNT to generate an SRQ at the completion of program.

Note: CLES or *CLS cannot clear OSPT or OSNT. Execute OSPT 0 or OSNT 0 to clear the setup.

- Use the PROG:WAIT? command to pause an external controller until a program completes. 1 is returned at the completion of running Instrument BASIC if you execute the PROG:WAIT?Query. If you read the return value by the ENTER statement, the program will pause until the value is returned.

Module 6-16. PROG:WAIT Command

- Use Instrument BASIC to set the variable to indicate the program status and refer to this variable by the PROG:NUMB? or PROG:STR?Query from an external controller. This is useful when you want to know the actual process status of an Instrument BASIC program. Ex. Check if a calibration is completed. You can have controllers to cooperate and communicate with each other in detail if you use the CASE statement in an external controller to branch to appropriate process depending on the contents of this variable. A sample program that uses this method is in “Sample Program -3: Controlling Instrument BASIC from an External Controller”.

Transferring a Program

You can transfer a program between an external controller and Instrument BASIC.

Transferring from an External Controller to Instrument BASIC

The following example transfers a program on the disk in an external controller to the Instrument BASIC editor through HP-IB.
Module 6-17. Transferring a Program to the Instrument BASIC Editor

Instrument BASIC checks the transferred program and comments out lines that have grammatical errors.

Transferring from Instrument BASIC to an External Controller
You can also transfer a program from the Instrument BASIC editor to an external controller.
The following example stores each Instrument BASIC line to a character string array PROGS$.

Module 6-18. Transferring a Program From the Instrument BASIC Editor
Sample Program -3: Controlling Instrument BASIC from an External Controller

This program runs an external controller and Instrument BASIC at the same time to synchronize the function of both sides. To check the process status of Instrument BASIC from an external controller, you must set up a variable (Stat$) to indicate the program status of Instrument BASIC. In the external controller, use the SELECT ... CASE statement to process data according to the contents of Stat$.

Actually, Instrument BASIC handles processes such as setups, calibrations, measurements and data analysis and then transfers the results to the external controller. The external controller requests the process at each step.

![Control Flow Diagram]

Figure 6-1.
Controlling Instrument BASIC from an External Controller (The Control Flow)
The Program for Instrument BASIC

Disk

This program is contained in the attached sample disk with the file name IB_CNTL.

110  ASSIGN @E5100 TO 800 ! IBASIC INITIALIZATION
120  Scode=8
130  CLEAR @E5100
140  !
150  Stat$="SETTING"
160  Cal$=""
170  Center=0
180  Span=0
190  !
200  OUTPUT @E5100;"DISAHIHB" ! MEASUREMENT SETUP
210  OUTPUT @E5100;"PRES"
220  OUTPUT @E5100;"CHAN1;ANAMODE GAINP;MEAS AR;FMT LOGM"
230  OUTPUT @E5100;"HOLD"
240  !
250  EXECUTE "ANAOCH1" ! SETUP WAVEFORM ANALYSIS
260  EXECUTE "ANARFULL"
270  EXECUTE "ANAOADATA"
280  !
290  PAUSE
300  !
310  OUTPUT @E5100;"CENS ";Center,Span
320  !
330  Stat$="CALIBRATION"
340  PAUSE
350  !
360  IF Cal$="Y" OR Cal$="y" THEN GOSUB R_cal
370  !
380  LOOP
390  Stat$="CONNECT DEVICE"
400  DISP "CONNECT DEVICE"
410  PAUSE
420  !
430  Stat$="MEASUREMENT"
440  DISP "NOW MEASURING..."
450  EXECUTE "SING"
460  !
470  WRITEIO 8.0,-3
480  EXECUTE "OUTPFILT?"
490  DIM Ret(5)
500  FOR I=0 TO 5
510     Ret(I)=READIO(8,I)
520     NEXT I
530  !
540  PAUSE
550  END LOOP
560  !
570  STOP
The Program for the External Controller

Disk

This program is contained in the attached sample disk with the file name IBCTRL.E.

110 ASSIGN @E5100 TO 717  ! EXT CONTROLLER INITIALIZATION
120 Scode=7  !
130 ABORT Scode  !
140 !
150 INPUT "Center Frequency (MHz) ?",Center  ! SWEEP CONDITION ENTRY
160 Center=Center*1.E+6  !
170 INPUT "SPAN (kHz) ?",Span  !
180 Span=Span*1000.  !
190 !
200 OUTPUT @E5100;"CLES"  !
210 OUTPUT @E5100;"*CFC?"  !
220 ENTER @E5100;0pc  !
230 !
240 OUTPUT @E5100;"PROG:STAT RUN"  !
250 !
260 OUTPUT @E5100;"OSNT 16384; OSPT 0"  !
270 OUTPUT @E5100;"OSE 16384;*SRE 128"  !
280 ON INTR Scode GOTO Paused  !
290 !
300 Begin:  !
310 WAIT .5  !
320 ENABLE INTR Scode;2  !
330 LOOP  !
340 END LOOP  !
350 Paused:  !
360 !
370 OUTPUT @E5100;"PROG:STR? 'Stat$'"  !
380 ENTER @E5100;Stat$  !
390 !
400 SELECT Stat$  !

6-10 Programming Miscellaneous
410 CASE """"SETTING"""
420   OUTPUT @E5100;"PROG:NUMB'CENTER',";Center
430   OUTPUT @E5100;"PROG:NUMB'SPAN',";Span
440   GOSUB Continue
450
460   CASE """"CALIBRATION"""
470     INPUT "CAL?",Cal$
480   OUTPUT @E5100;"PROG:STR 'Cal$',"";Cal$;""
490   GOSUB Continue
500
510   CASE """"CONNECT R"""
520     INPUT "Connect THRU, Then Press [ENTER]",A$
530   GOSUB Continue
540
550   CASE """"CONNECT DEVICE"""
560     INPUT "Connect Device, Then Press [ENTER]",A$
570   GOSUB Continue
580
590   CASE """"MEASUREMENT"""
600     DIM Ret(5)
610   OUTPUT @E5100;"PROG:NUMB? 'RET'"
620   ENTER @E5100;Ret(*)
630     CLEAR SCREEN
640   PRINT "LOSS:",Ret(0),"[dB],BW:",Ret(1),"[Hz]"
650   PRINT "CENT Freq:",Ret(2),"[Hz],Q:",Ret(3)
660   PRINT "D.LF:",Ret(4),"[Hz],D.RF:",Ret(5),"[Hz]"
670   GOSUB Continue
680
690 END SELECT
700   GOTO Begin
710
720   GOTO Continue:
730   OUTPUT @E5100;"CLE"S"
740   OUTPUT @E5100;"*OPC?"
750   ENTER @E5100;OpC
760   OUTPUT @E5100;"PROG:STAT CONT"
770   RETURN
780   END

END OF PROGRAM
Programming Techniques

This section provides information that you may find useful when you write a program to control the HP E5100A/B using BASIC.

This section provides the following information:
- Using a Disk
- Using a Softkey Label
- Measuring the Processing Time
- Checking HP-IB Errors
- Tips for Increasing Speed

Using a Disk

The HP E5100A/B has 2 storage devices: a disk drive and a RAM disk drive. There are 2 ways to access these storage devices from a controller.

- Accessing Via the Measurement Module
  Use this method to save or read information, such as the setup of the HP E5100A/B, by using the HP-IB command.

The following program saves measurement setup data to the internal disk with a specified file name.

```
10  ASSIGN @E5100 TO 717
20  INPUT "Enter File Name (without extension)"; File_name$  
30  OUTPUT @E5100;"STODDISK"                          Use STODMEMO for the RAM disk.
40  OUTPUT @E5100;"SAVDSATA """";File_name$;""""
50  END
```

Module 6-19. Saving Measurement Setup Data

The following program loads the saved setup data to the HP E5100A/B.

```
10  ASSIGN @E5100 TO 717
20  INPUT "Enter File Name (with extension)"; File_name$
30  File_name$=UPC$(File_name$)                       You must specify a file name in capital letters.
40  OUTPUT @E5100;"STODDISK"
50  OUTPUT @E5100;"RECD """";File_name$;"""
60  END
```

Module 6-20. Loading Measurement Setup Data

- Accessing Directly from Instrument BASIC
  This method accesses a file directly without going through the HP E5100A/B. You use this method when you are handling file data itself. See Chapter 7 “Data Storage and Retrieval” of HP Instrument BASIC Programming Technique for more information.

The following program stores trace data on the internal disk into an array Dat in the program.

6-12 Programming Miscellaneous
10 ASSIGN @5100 TO 717
20 INPUT "Enter File Name (without extension)", File_name$  
30 MSI ":INTERNAL,4"  
40 DIM Dat(1:201,1:2)
50 File_name$=UPCS(File_name$)&"_B"
60 !
70 ASSIGN @File TO File_name$
80 ENTER @File USING "17X,"$
90 ENTER @File;Nop
100 ENTER @File USING "4X,"
110 ENTER @File;Dat(+)  
120 ASSIGN @File TO  
130 PRINT Dat(*)
140 END

Module 6-21. Storing Trace Data

Note: The setups STODISK/STODMEMO and MSI are stored independently. This  
causes the RAM disk to be accessed by an HP disk access command, as long as  
STODMEMO is executed, even though the internal disk drive is selected by  
MSI.

Using a Softkey Label (ON KEY LABEL)

You can use the ON KEY LABEL statement to display your own softkey label.

ON KEY 1 LABEL "ORIGIN"  LABEL" GOSUB Jump1  
!  
END LOOP

Module 6-22. Using a Softkey Label

The label is displayed only when the program is running. You must, therefore, use an infinite loop to keep the programming running.

Up to a 20-character softkey label can be displayed.

Displaying the Softkey Label

The softkey label displayed by ON KEY LABEL is displayed when SYSTEM I-BASIC  
ON KEY LABELS are pressed.

You can use the HP-IB command BASL to display the softkey label.

OUTPUT @5100;"BASL" Display the softkey label.

Module 6-23. Using Softkey Label

See "Sample Program -4: Reading and Running a Program by a Softkey Operation" which uses the softkey label.
Measuring the Processing Time (TIMEDATE)
You can use the real time clock of the HP E5100A/B to time the processing of a program.
You can time a process as follows:

```
Start_time=TIMEDATE
: [The processes to time.]
:
End_time=TIMEDATE
Total=End_time-Start_time
PRINT Total,"seconds of processing"
```

Module 6-24. Measuring Processing Time

The real time clock measures in seconds [s].

Checking HP-IB Errors (OUTPERRO?)
You can check if an HP-IB error occurred in a program by using the OUTPERRO?Query. You can use this function to easily find bugs when you are debugging a program. You can check for an HP-IB error as follows:

```
DIM Err$[50]
!
OUTPUT @E5100;"OUTPERRO?"
ENTER @E5100;Err$
DISP Err$
```

Module 6-25. Checking HP-IB Errors

For example, the following message will be displayed if you use the above procedure to check an error occurred when you send a wrong HP-IB command.

-113, "Undefined header"

You can look at “Error Messages” in the HP-IB Command Reference to see if the command sent is supported by the HP E5100A/B.

An error message is stored in the error queue. Execute *CLS or CLES to clear the error queue.

Tips for Increasing Speed
This section describes how to increase the processing speed of a program. Please modify your program if you find that you can use some of these suggestions.

- Try not to use markers for a data analysis. If you have to use them, use the MARD OFF command to erase the marker display.
- Use EXECUTE (only for Instrument BASIC).

Note
The EXECUTE process may not complete successfully if an external controller sends an HP-IB command while Instrument BASIC is processing another command using the EXECUTE statement. The HP E5100A/B may even stop in certain circumstances. To prevent this, do not send a new command from an external controller while the HP E5100A/B is processing a command.
See “Sample Program -3: Controlling Instrument BASIC from an External Controller” for an actual method.

- For Instrument BASIC, do not use the **ON INTR** interrupt.
  Do not use an interrupt process but refer to the status register directly.

```basic
REPEAT
  OUTPUT &E5100;"*ESB?"
  ENTER &E5100;Es
UNTIL BIT(Esb,0)Monitor the completion of sweep.
```

**Module 6-26. Refering to Status Register**

- Try not to switch active channels. Turn dual channels on if you need switch channels.

The following commands are valid for inactive channels.

- **OUTPIFORM?** Output the format array data on the inactive channel.
- **OUTPIRFORM?** Output the actual part of format array data on the inactive channel.
- **OUTPITMEM?** Output the sub trace data on the inactive channel.
- **OUTPIRITMEM?** Output the actual part of sub trace data on the inactive channel.

The trigger command is valid for the active channel. You can, however, use the **REST** command (**MEASUREMENT:RESTART** of **MENU**) to remeasure both the active channel and the inactive channel without switching.

- Use subroutines instead of subprograms.
- Comment out or delete unnecessary lines.
Sample Program -4: Reading and Running a Program by a Softkey Operation

This program displays the file names contained in the inserted disk on the softkey labels and executes the selected file as a program. With this program, you need only softkey operation to easily execute a program.

If you rename this file as AUTOST, it will be automatically executed at the startup. This is convenient when no keyboard is connected to the instrument.

Disk

This program is contained in the attached sample disk with the file name LABEL (For Instrument BASIC). The program for an external controller is not provided.

```
110  ASSIGN @E5100 TO 800          ! INITIALIZATION
120  DIM Dir$(1:200)[80],File$(1:200)[10]
130  !
140  CAT TO Dir$(*)                ! STORE FILENAMES ON DISK
150  !
160  File_end=0                    ! READ FILENAMES
170  File_number=1
180  WHILE File_end=0 AND File_number<200
190  File$(File_number)=Dir$(File_number+7)[1:10]
200  IF File$(File_number)="" THEN
210    File_end=1
220    File_number=File_number-1
230  ELSE
240    File_number=File_number+1
250  END IF
260  END WHILE
270  !
280  Max_page=INT(File_number/6)+1  ! SET ON-KEY-LABEL DISPLAY
290  Npage=1
300  OUTPUT @E5100;"BASL"
310  !
320  Head:
330  Page=(Npage-1)*6
340  !
350  ON KEY 1 LABEL File$(Page+1) GOSUB Jump1  ! DISPLAY FILENAMES ON LABELS
360  ON KEY 2 LABEL File$(Page+2) GOSUB Jump2
370  ON KEY 3 LABEL File$(Page+3) GOSUB Jump3
380  ON KEY 4 LABEL File$(Page+4) GOSUB Jump4
390  ON KEY 5 LABEL File$(Page+5) GOSUB Jump5
400  ON KEY 6 LABEL File$(Page+6) GOSUB Jump6
410  ON KEY 7 LABEL "NEXT PAGE" GOTO Jump7
420  ON KEY 8 LABEL "PREV.PAGE" GOTO Jump8
430  !
440  LOOP                            ! WAIT KEY ENTRY
450  END LOOP
460  !
470  Jump1:GET File$(Page+1)         ! GET SELECTED FILE
480  Jump2:GET File$(Page+2)        !
490  Jump3:GET File$(Page+3)        !
```

6-16 Programming Miscellaneous
500 Jump1: GET File$(Page+4)  !
510 Jump2: GET File$(Page+5)  !
520 Jump3: GET File$(Page+6)  !
530 Jump4: Npage=Npage+1  !
540 IF Npage>Max_page THEN Npage=Max_page  !
550 GOTO Head  !
560 Jump5: Npage=Npage-1  !
570 IF Npage<=1 THEN Npage=1  !
580 GOTO Head  !
590 !
600 END  ! END OF PROGRAM
Using the Parallel Processing

Because the HP 87510A performs measurement and analysis sequentially, the total throughput time is summary of the measurement time plus the time required to analyze the measurement data. However, the HP E5100A/B can perform the measurement and analyze the data simultaneously. This parallel processing improves the total throughput as shown in the following figure:

![Diagram showing Normal and Parallel Processing](image)

**Figure 6-2. Parallel Processing**

The parallel processing flow is as follows: The digital signal processor (DSP) measures the DUT, and at the same time the CPU processes the previous measurement’s data in parallel with the current measurement. Parallel processing is useful for a production line that successively measures and analyzes many devices and performs GO/NO-GO testing. It cannot be used to make a single measurement and analyze the data at the same time.

**Programming for Parallel Processing**

The following commands are provided for parallel processing:

- **TRIGMEAS**: Triggers the measurement for parallel processing. The DSP starts measuring the DUT.
- **MOVADARY**: Enters measurement data triggered by the TRIGMEAS command to a data array. The CPU then analyzes this data in parallel with the next measurement. This command must be executed for each measurement.
- **ADTUTRAC**: Starts data process into the data trace array. This command must be executed for each measurement.

The following program example shows a parallel processing program that uses these commands:
Module 6-27. Parallel Processing

The following commands must be programmed as one group.

```
OUTPUT &E5100;"MOVADARY"   ! Data transfer
OUTPUT &E5100;"TRIGMEAS"   ! Start measuring
OUTPUT &E5100;"ADT0TRAC"   ! Start parallel processing

OUTPUT &E5100;"PEAK?"      ! Analysis command in parallel processing
ENTER &E5100;F(pk,0:pk)    ! Detects two peaks

OUTPUT &E5100;"NXPEAK?"    !
ENTER &E5100;F_nxpk,0_nxpk!

END LOOP
```

Commands that are executed during parallel processing should be put after ADT0TRAC.

Sample Program -4a : Parallel Processing

The following is a program listing that shows how to use parallel processing. This program executes the analysis commands during the time the DSP measures the DUT. As a result, the total throughput time is improved.

```
110      ! CONCURRENT PROCESS
120      !
130      *
140      ASSIGN &E5100  TO 800
150      CLEAR &E5100
160      DIM Pnext(1:10),Fnext(1:10)
170      L1=5
180      *
190      GSUSUB Setting
200      GSUSUB THROUPAL
210      GSUSUB Measure
220      STOP
230      *
240      Setting:        !
250      Fc=7.5E+7        !70MHz
260      Fspan=1.00000    !100kHz
270      Fbw=8000        !6kHz
280      Nop=201
```
290  !
300  OUTPUT @ES100;"PRES"
310  OUTPUT @ES100;"POIN ";Nop
320  OUTPUT @ES100;"CHAN1;ANAMODE GAINP" MEAS AR;FMT LOGM"
330  OUTPUT @ES100;"HOLD"
340  OUTPUT @ES100;"CENT ";Fc ";SPAN ";Fspan
350  OUTPUT @ES100;"IFBW ";Ifbw
360  RETURN
370  !
380  Thru-Cal: !
390  OUTPUT @ES100;"CALI RESP" !Select and execute THRU CAL
400  OUTPUT @ES100;"STANC?"
410  ENTER @ES100;Tmp
420  OUTPUT @ES100;"RESPDONE?"
430  ENTER @ES100;Tmp
440  RETURN
450  !
460  Measure: !
470  EXECUTE "ANA00CH1" ! Select channel for analysis and set analysis range
480  EXECUTE "ANARFULL" !
490  EXECUTE "ANAGDATA" !
500  !
510  N=100
520  INPUT "Enter loop N :";N
530  Tstart=TIMEDATE
540  EXECUTE "TRIGMEAS" ! 1st. measurement
550  I=1
560  WHILE I<=N ! Repeat measurement and analysis
570  EXECUTE "MOVADARY" ! Enters measurement data for parallel processing
580  EXECUTE "TRIGMEAS" ! Triggers measurement for parallel processing
590  EXECUTE "ADTCFRAC" ! Starts parallel processing
600  EXECUTE "PEAK?" ! Commands executed in parallel processing
610  Pmax=READIO(8,0) !
620  Fmax=READIO(8,1) !
630  FOR K=1 TO Ll
640  EXECUTE "NEXPK?" !
650  Pnext(K)=READIO(8,0) !
660  Fnext(K)=READIO(8,1) !
670  NEXT K
680  I=I+1
690  END WHILE
700  Tstop=TIMEDATE
710  !
720  PRINT "PEAK(MAX) :";Pmax;"[dB] \(\times10^\text{E+6}\);[MHz]"
730  FOR K=1 TO Ll
740  PRINT "PEAK(NEXT[ \(\times,\times\) ]):";Pnext(K);"[dB] \(\times10^\text{E+6}\);[MHz]"
750  NEXT K
760  PRINT "LOOP :";N;" NEX[K] :";Ll
770  PRINT "TIME(AVE.) :";(Tstop-Tstart)/N*1000;"[msec]"
780  RETURN
790  !
800  END
Notes for Parallel Processing

- Use the TRIGMEAS command to trigger the measurement in parallel processing.

- The following command sequence is required:
  1. TRIGMEAS (Trigger 1st. measurement)
  2. LOOP
  3. MDVADARY (Enter data)
  4. TRIGMEAS (Trigger measurement)
  5. ADTOTRAC (Start parallel processing)
  6. Analysis commands

- The parallel processing command sequence is used from the program.

- There is no advantage in using parallel processing when the analyzer is doing very high speed measurements. This is true because the parallel processing is processed during the measurement. Also, there is no advantage if very complex analysis is done in parallel processing because it takes long time to analyze the data. Parallel processing is not recommended under the following conditions:
  1. When using a short measurement time (less than 0.2msec/point).
  2. When using filter and resonator analysis commands (such as OUTFXIL?, OUTPRESO?).
  3. When data is transferred through HP-IB.
  4. When a single measurement and analysis is done.
Application Sample Programs

This chapter provides you with sample programs that you can use for actual measurements.

- Setting Up and Performing the List Sweep
- Saving and Setting Up Calibration Data
- Analyzing a Ceramic Resonator
- Analyzing a Crystal Resonator

Some of the sample programs listed in this chapter do not include subroutines. In these cases, the required subroutines and their function are listed at the beginning of each sample program. The programs in the sample program disk contain all the necessary subroutines.
Sample Program -5: Setting Up and Performing the List Sweep

This program sets up the list sweep table and performs a list sweep.

When you run this program, the program will ask you the number of segments, the segment range and the number of displayed points so that you can easily set up the list sweep table.

Disk
This program is contained in the attached sample disk with the file name LIST_SWP (for Instrument BASIC). The program for an external controller has the name LISTSWP_.E.

```
110  ASSIGN @E5100 TO 800     ! IBASIC INITIALIZATION
120  CLEAR @E5100
130  OUTPUT @E5100;"DISAHIHB"
140  !
150  DIM Table(1:31,1:3)       ! VARIABLE DECLARATION
160  !
170  INPUT "Number of segments?",Numb ! ENTER AND DISPLAY NUMBER OF SEGMENTS
180  !
190  PRINT USING "10A,11A,11A,20A";"Segment","Start(MHz)","Stop(MHz)","Number of points"
200  !
210  FOR I=1 TO Numb           ! GOTO TABLE SETUP ROUTINE
220  GOSUB Loadpoin
230  NEXT I
240  !
250  LOOP                      ! ASK IF EDIT NEEDED
260  INPUT "Do you want to edit? (Y/N)",An$   
270  EXIT IF An$="N" OR An$="n"
280  INPUT "Segment Number?",I
290  GOSUB Loadpoin
300  END LOOP
310  !
320  OUTPUT @E5100;"PRES"      ! MEASUREMENT SETUP
330  OUTPUT @E5100;"CHAN1;ANAMODE GAINP;MEAS AR;FMT LOGM" !
340  !
350  OUTPUT @E5100;"EDITLIST"  ! TABLE SETUP
360  OUTPUT @E5100;"CLEL"      !
370  FOR I=1 TO Numb
380  OUTPUT @E5100;"SADD"      !
390  OUTPUT @E5100;"STAR ";Table(I,1)*1.E+6
400  OUTPUT @E5100;"STOP ";Table(I,2)*1.E+6
410  OUTPUT @E5100;"POIN ";Table(I,3)
420  OUTPUT @E5100;"SDOM"     
430  NEXT I
440  OUTPUT @E5100;"EDITDONE"  !
450  OUTPUT @E5100;"SWPT LIST" !
460  OUTPUT @E5100;"LISDOBASE" !
470  !
480  OUTPUT @E5100;"SING?"     ! MAKE A MEASUREMENT
490  ENTER @E5100;Tmp
```

7-2 Application Sample Programs
500 OUTPUT &E5100;"AUTO" ! AUTO SCALING
510 STOP ! STOP PROGRAM
520 !
530 Loadpoin: ! TABLE PARAMETER SETUP SUBROUTINE
540 INPUT "Enter start frequency (MHz)",Table(I,1)
550 INPUT "Enter stop frequency (MHz)",Table(I,2)
560 INPUT "Enter number of points",Table(I,3)
570 IF Table(I,3)=1 THEN Table(I,2)=Table(I,1)
580 PRINT TABXY(0,I+1);RPT$(" ",58)
590 PRINT TABXY(0,I+1);I;TAB(11);Table(I,1);TAB(22);Table(I,2);
TAB(35);Table(I,3)
600 RETURN !
610 !
620 END ! END OF PROGRAM
Saving and Resetting Calibration Data

This program saves and resets calibration data.

This program transfers error correction data in the calibration coefficient array memory of the HP E5100A/B to an external controller, saves the data and uses that data in the file as calibration data.

Calibration coefficient arrays corresponding to each error item are stored in three memories as complex numbers. This sample transfers the error data of a frequency response calibration (stored in the array 1) and resets it. See Appendix D of the HP-IB Command Reference for each error item and its corresponding calibration coefficient array.

You can use either of the following two ways to save calibration data:

1. Use the SAVDSTA command to save the data with the measurement setup data to the HP E5100A/B's internal disk or the RAM disk memory.

2. Transfer calibration data to a controller and save it to the disk in the controller.

This section lists the program for example 2. See "Using a Disk" of Chapter 3 for example 1.

Sample Program -6: Saving Calibration Data in an External Controller

This program transfers calibration data to an external controller and saves it to a file.

Disk

This program is contained in the attached sample disk with the file name CALSTR.E (for the external controller). The program for Instrument BASIC is not provided.

```
110 ASSIGN @E5100 TO 717;FORMAT ON     ! INITIALIZATION
120 ASSIGN @ Dt TO 717;FORMAT OFF       !
130 Scode=7                              !
140 CLEAR @E5100                        !
150 CLEAR @Dt                           !
160 !
170 DIM Dat(1:201,1:2)                   !
180 Nop=201                             !
190 !
200 GOSUB Setup                        ! CALL SUBROUTINES
210 GOSUB Cal                           !
220 GOSUB Get_cal_data                  !
230 GOSUB Save_cal_data                 !
240 GOTO Ending                        !
250 !
260 Setup:                              ! MEASUREMENT SETUP
270 INPUT "CENTER? [MHz]", F_cent     !
280 F_cent=F_cent*1.E+6                  !
290 INPUT "SPAN? [kHz]", F_span         !
300 F_span=F_span*1000                   !
310 OUTPUT @E5100;"PRES"                !
320 OUTPUT @E5100;"CHAN1;ANAMODE GAINP;MEAS AR;FMT LOGM"
330 OUTPUT @E5100;"HOLD"               !
340 OUTPUT @E5100;"POIN ";Nop          !
```
Sample Program -7: Setting Up Calibration Data from an External Controller

This program transfers the calibration data saved in an external controller by CALSTOR_E to the HP E5100A/B and sets it up again.

To set the calibration function on again, you must measure the standard to calculate the calibration coefficient. You cannot, however, set the calibration function on if you transferred calibration data only. This means that a measurement was not performed. This sample program, therefore, performs a dummy calibration measurement and transfers calibration data to set the calibration function on. (The subroutine Dummy_cal)

If you change the setup (for example, the frequency range) of the HP E5100A/B after transferring calibration coefficient, the transferred calibration coefficient becomes invalid. You must, therefore, set up the HP E5100A/B before transferring calibration data.
This program is contained in the attached sample disk with the file name CALSET.E (for the external controller). The program for Instrument BASIC is not provided.

110 ASSIGN @E5100 TO 717;FORMAT ON ! INITIALIZATION
120 ASSIGN @Dt TO 717;FORMAT OFF
130 Scode=7
140 CLEAR @E5100
150 CLEAR @Dt
160 !
170 DIM Dat(1:201,1:2)
180 Nop=201
190 !
200 GOSUB Setup ! CALL SUBROUTINES
210 GOSUB Load_cal_data
220 GOSUB Dummy_cal
230 GOSUB Send_cal_data
240 GOTO Ending
250 !
260 Setup:
270 INPUT "CENTER? [MHz]",F_cent
280 F_cent=F_cent*1.E+6
290 INPUT "SPAN? [kHz]",F_span
300 F_span=F_span*1000
310 OUTPUT @E5100;"PRES"
320 OUTPUT @E5100;"CHAN1;ANAMODE GAINP;MEAS AR;FMT LOGM"
330 OUTPUT @E5100;"HOLD"
340 OUTPUT @E5100;"POIN ";Nop
350 OUTPUT @E5100;"CENS ";F_cent,F_span
360 RETURN
370 !
380 Dummy_cal:
390 OUTPUT @E5100;"CALI RESP"
400 OUTPUT @E5100;"STANC?"
420 ENTER @E5100;Tmp
430 !
440 Cal_end:
450 OUTPUT @E5100;"RESPDOWE?"
470 ENTER @E5100;Tmp
480 RETURN
490 !
500 Load_cal_data:
510 INPUT "Enter File Name (with extension)",File$
520 ASSIGN @File TO File$
530 ENTER @File;Dat(*)
540 ASSIGN @File TO *
550 RETURN
560 !
570 Send_cal_data:
580 INPUT "PRESS [RETURN] TO SEND CAL DATA FROM HP ES100A/B.",Dum$
590 OUTPUT @E5100;"FORM4"
600 OUTPUT @E5100;"INPUCALCO1 ";Dat(*)
610 !
610 RETURN
620 !
630 Ending:
640 ASSIGN @Dt TO *
650 !
660 END
Sample Program -8: Analyzing a Ceramic Resonator

This program analyses the resonant impedance and ripple of a ceramic resonator.

A waveform analysis command OUTPCERR? is used for the measurement. The parameters to be measured are \( Z_r, f_r, Z_a, f_a, R_p1, R_p2, \) and \( R_p3 \). See "OUTPCERR?" of the HP-IB Command Reference for more information.

Measurement Conditions:
- The Log Amplitude & The Phase Format
- Impedance Conversion ON
- Frequency Response Calibration

Items to Prepare:
- A device (a ceramic resonator)
- A cable (or a fixture) to connect the device and the HP E5100A/B
- THRU calibration standard

This program is contained in the attached sample disk with the file name CER_RES (for Instrument BASIC). The program for an external controller is not provided.

110 ASSIGN @E5100 TO 800 ! IBASIC INITIALIZATION
120 CLEAR @E5100
130 !
140 OUTPUT @E5100;"PRES" ! MEASUREMENT SETUP
150 OUTPUT @E5100;"CHAN1;HOLD"
160 OUTPUT @E5100;"ANAMODE ZTRAN;MEAS AR;FMT MAGZP;SCAY 1"
170 OUTPUT @E5100;"COUC OFF"
180 OUTPUT @E5100;"DUAC OFF"
190 OUTPUT @E5100;"POIN 201"
200 OUTPUT @E5100;"IFBW 4KHZ"
210 OUTPUT @E5100;"POWE 0"
240 OUTPUT @E5100;"DISALIH"
250 !
260 INPUT "Center Frequency (kHz)";Center ! SWEEP CONDITION ENTRY
270 Center=Center*1000.
280 INPUT "Frequency Span (kHz)";Span
290 Span=Span*1000.
300 OUTPUT @E5100;"CENS ";Center,Span
310 !
320 GOSUB Thru_cal ! GOTO CAL ROUTINE
330 !
340 EXECUTE "ANAOCH1" ! WAVEFORM ANA SETUP
350 EXECUTE "ANAODATA"
360 EXECUTE "ANARFULL"
370 !
380 WRITEIO 8,0;0.05 ! MEASUREMENT
390 EXECUTE "THRR"
400 LOOP
410 DISP "Connect Device and Press Continue."
420 PAUSE !
430 DISP "MEASURING" !
440 EXECUTE "SING" !
450 EXECUTE "OUTPCR?" !
460 Rr=READIO(8,0) !
470 Fr=READIO(8,1) !
480 Ra=READIO(8,2) !
490 Fa=READIO(8,3) !
500 Rpl_left=READIO(8,4) !
510 Rpl_center=READIO(8,5) !
520 Rpl_right=READIO(8,6) !
530 GOSUB Printing !
540 END LOOP !
550 STOP !
560 !
570 Printing: ! DISPLAY PARAMETERS
580 PRINT USING "5A,6D.3D,6A";"Fr ";Fr/1000.;"(kHz)"
590 PRINT USING "5A,6D.3D,6A";"Rr ";Rr;" (ohm)"
600 PRINT USING "5A,6D.3D,6A";"Fa ";Fa/1000.;"(kHz)"
610 PRINT USING "5A,6D.3D,7A";"Ra ";Ra/1000.;"(kohm)"
620 PRINT USING "12A,3D.3D,5A";"Ripple LEFT ";Rpl_left;" (dB)"
630 PRINT USING "14A,3D.3D,5A";"Ripple CENTER ";Rpl_center;" (dB)"
640 PRINT USING "13A,3D.3D,5A";"Ripple RIGHT ";Rpl_right;" (dB)"
650 RETURN !
660 !
670 Thru_cal: ! THRU CALIBRATION
680 DISP "Connect THRU standard and Press Continue." !
690 PAUSE !
700 DISP !
710 OUTPUT ØE5100;"CALI RESP" !
750 OUTPUT ØE5100;"STANC?" !
780 ENTER ØE5100;Tmp !
800 OUTPUT ØE5100;"RESPDONE?" !
810 ENTER ØE5100;Tmp !
830 RETURN !
840 !
850 END ! END OF PROGRAM
Sample Program -9: Analyzing a Crystal Resonator

This program measures the resonant frequency (Phase 0°), the resonant impedance (Phase 0°) and the equalizing circuit constant of a crystal resonator.

The measured parameters are as follows:

The resonance parameter (OUTPRESO? is Zr,Fr used.)

The equalizing circuit constant (EQUCO? C0, C1, L1, R1, G0, R0 and EQUCPARA? are used.)

Measurement conditions are as follows:

- A π network fixture is used.
- The drive level [μW] of a crystal at resonance and the resonant impedance [Ω] are used to calculate and set the power level [dBm] of the HP E5100A/B.
- Uses the list sweep to perform two types of measurements: the parallel capacity measurement point and the measurement near the resonant point.

Required Subroutines

**Power_set:** The drive level [μW] of a crystal at resonance and the resonant impedance [Ω] are used to calculate the power level [dBm].

**List_set:** Set up the list sweep table.

**Pi_cal:** A calibration subroutine for a π fixture.

**Printing:** Display analysis data on the screen.

---

Disk

This program is contained in the attached sample disk with the file name FRCL_EQV (for Instrument BASIC). The program for an external controller is not provided.
110 DIM Startf(1:2),Stopf(1:2),Ifbw(1:2),Nop(1:2)
120 !
130 ASSIGN @E5100 TO 800
140 CLEAR @E5100
150 !
160 OUTPUT @E5100;"PRES"
170 OUTPUT @E5100;"CHAN1;ANAMODE ZTRAN;MEAS AR;FMT MAGZP;SCAY 1"
180 OUTPUT @E5100;"HOLD"
190 OUTPUT @E5100;"DUAC OFF"
200 OUTPUT @E5100;"COUC OFF"
210 OUTPUT @E5100;"DISG OFF"
220 OUTPUT @E5100;"DISAHIHB"
230 !
240 INPUT "Center frequency ? (MHz)",Center
250 Center=Center*1.E+6
260 INPUT "Span frequency ? (kHz)",Span
270 Span=Span*1000.
280 !
290 GOSUB Power_set
300 OUTPUT @E5100;"POWE ",Power
310 !
320 GOSUB List_set
330 !
340 !
350 GOSUB Pi_cal
360 !
370 EXECUTE "ANAOCH1"
380 EXECUTE "ANARFULL"
390 EXECUTE "ANADDATA"
400 !
410 DISP "CONNECT DEVICE, and PRESS CONTINUE."
420 PAUSE
430 DISP
440 !
450 MEASUREMENT
460 !
470 LOOP
480 !
490 !
500 !
510 EXECUTE "SING"
520 !
530 EXECUTE "OUTPRESO?"
540 Ci=READIO(8,0)
550 Fr=READIO(8,1)
560 !
570 WRITEIO 8,0;Center*.9
580 EXECUTE "EQUCO?"
590 CO=READIO(8,0)
600 !
610 EXECUTE "EQUCPARA?"
620 !
630 CO=READIO(8,0)
640 Ci=READIO(8,1)
650 L1=READIO(8,2)
660 R1=READIO(8,3)
670 G0=READIO(8,4)
690 RG=READIO(8,5)
700 !
710 ! EXECUTE "EUCPARS4?"
720 ! ! CC=READIO(8,0)
730 ! Ci=READIO(8,1)
740 ! Li=READIO(8,2)
750 ! Ri=READIO(8,3)
760 !
770 GOSUB Printing
780 !
790 DISP "CONNECT NEXT DEVICE and Press Continue."
800 PAUSE
810 !
820 END LOOP
830 !
840 STOP
850 !
860 Power_set: !
870 !
880 DATA 10
890 DATA 15
900 !
910 READ W
920 READ R
930 !
940 INPUT "POWER (uW)",W
950 W=W/1.E+6
960 !
970 INPUT "RESISTANCE (OHM)",R
980 !
990 ! Power level calculation
1000 !
1010 Pi_r3=12.5
1020 R0=50
1030 R1=50
1040 R2=50
1050 R3=83.3
1060 R4=159
1070 R5=66.2
1080 R6=14.2
1090 Pi_r2=R6*(R3*R4+R5*(R3+R4))/(R3+R4+(R5+R6))
1100 V0_a=(Pi_r2+Pi_r3)*SQRT(W/R)
1110 Vp=(R3*R4+(R3+R4)*(R5+R6))/(R4*R6)*V0_a
1120 V0=(R0+R1+R2)/(R1+R2)*Vp
1130 V1=V0/4
1140 Power=10*LGT(1000*V1^2/50)
1150 !
1160 RETURN
1170 !
1180 !
1190 Pi_cal: !
1200 OUTPUT OF5100;"CALIS111"
1210 !
1220 DISP "Connect SHORT, and press [Continue]"
1230 PAUSE
1240  OUTPUT @E5100;"CLASS1?B?"
1260  ENTER @E5100;Tmp
1270  !
1280  DISP "Leave the terminal OPEN, and press [Continue]"
1290  PAUSE
1300  OUTPUT @E5100;"CLASS1?A?"
1320  ENTER @E5100;Tmp
1330  !
1340  DISP "Connect LOAD, and press [Continue]"
1350  PAUSE
1360  OUTPUT @E5100;"CLASS1?C?"
1380  ENTER @E5100;Tmp
1390  !
1400  OUTPUT @E5100;"SAV?I?"
1420  ENTER @E5100;Tmp
1430  !
1440  RETURN
1450  !
1460  !
1470  Printing:  !
1480  !
1490  CLEAR SCREEN
1500  !
1510  PRINT TABXY(1,1);"RESULT"
1520  PRINT USING "25A,3D.8D,6A:";"RESONANCE FREQUENCY (Fr) ";Fr/I.E+6:"; (MHz)"
1530  PRINT USING "14A,15X,5D.2D,6A:";"CI (Zr) VALUE ";Ci;" (ohm)"
1540  PRINT
1550  PRINT USING "10A,5X,5D.3D,5A:";"CO VALUE ";Co*1.E+12:"; (pF)"
1560  PRINT USING "10A,5X,5D.5D,5A:";"C1 VALUE ";C1*1.E+12:"; (pF)"
1570  PRINT USING "10A,5X,5D.3D,5A:";"L1 VALUE ";L1*1000;" (mH)"
1580  PRINT USING "10A,5X,5D.3D,6A:";"R1 VALUE ";R1;" (ohm)"
1590  PRINT USING "10A,5X,5D.3D,5A:";"GO VALUE ";GO*1000;" (mS)"
1600  PRINT USING "10A,5X,5D.3D,6A:";"RO VALUE ";RO;" (ohm)"
1610  !
1620  RETURN
1630  !
1640  List_set:!
1650  Startf(I)=Center* .9
1660  Stopf(I)=Center* .9
1670  Nop(I)=1
1680  Ifbw(I)=1000
1690  Startf(2)=Center-Span/2
1700  Stopf(2)=Center+Span/2
1710  Nop(2)=200
1720  Ifbw(2)=1000
1730  !
1740  OUTPUT @E5100;";EDITLIST;EDITLIST1;CLEL"
1750  FOR I=1 TO 2
1760    OUTPUT @E5100;"SADD"
1770  OUTPUT @E5100;"STAR ";Startf(I)
1780  OUTPUT @E5100;"STOP ";Stopf(I)
1790  OUTPUT @E5100;"POIN ";Nop(I)
1800  OUTPUT @E5100;"IFB?W ";Ifbw(I)
1810  OUTPUT @E5100;"SDON"
1820  NEXT I
1830 OUTPUT @E5100;"EDITDONE"
1840 OUTPUT @E5100;"SWPT LIST"
1850 OUTPUT @E5100;";LISDOBASE"
1860 RETURN
1870 !
1880 END
Command Reference

Common Command

*CLS
Clears the error queue, the status byte register, the event register of the standard operation status register structure, and the standard event status register. (no query)

Examples

```
OUTPUT #E5100;"*CLS"
```

*ESE value
Sets the enable bits of the standard status register.

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>Query Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 ~ 255 (decimal expression of enable bits of the operation status register)</td>
<td>&lt;value&gt;</td>
</tr>
</tbody>
</table>

Examples

```
OUTPUT #E5100;"*ESE 1"
OUTPUT #E5100;"*ESE?"
ENTER #E5100;A
```

*ESR?
Outputs the contents of the standard event status register. (Query only)

<table>
<thead>
<tr>
<th>Query Response</th>
<th>&lt;value&gt;</th>
</tr>
</thead>
</table>

Examples

```
OUTPUT #E5100;"*ESR?"
ENTER #E5100;A
```

*IDN?
Outputs the HP E5100A/B ID. (Query only)
**IDN?**

<table>
<thead>
<tr>
<th>Query Response</th>
<th>&lt;manufacturer&gt; &lt;model&gt; &lt;serial no.&gt; &lt;firmware rev.&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;manufacturer&gt;: HEWLETT-PACKARD</td>
</tr>
<tr>
<td></td>
<td>&lt;model&gt;: E5100A</td>
</tr>
<tr>
<td></td>
<td>&lt;serial no.&gt;: serial number, such as JP3KA00101</td>
</tr>
<tr>
<td></td>
<td>&lt;firmware rev.&gt;: firmware revision number, such as REV1.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Examples</th>
<th>OUTPUT #E5100;&quot;*IDN?&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ENTER #E5100;A$</td>
</tr>
</tbody>
</table>

**OPC**

Tells the analyzer to set bit 0 (Operation Complete bit) in the Standard Event Status Register when it completes all pending operations.

*OPC? query places an ASCII character I into the analyzer's output queue when all pending operations have been completed.

<table>
<thead>
<tr>
<th>Query Response</th>
<th>[I]</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Examples</th>
<th>OUTPUT 717;&quot;*OPC&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OUTPUT 717;&quot;*OPC?&quot;</td>
</tr>
<tr>
<td></td>
<td>ENTER 717;A</td>
</tr>
</tbody>
</table>

**PCB value**

Specifies the address of a controller that is temporarily passing HP-IB control to the HP E5100A/B.

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>0 to 30</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Query Response</th>
<th>&lt;value&gt;</th>
</tr>
</thead>
</table>

| Examples       | OUTPUT #E5100;"*PCB 0"                            |

**RST**

Resets the HP E5100A/B to its initial settings. See Function Reference for more information on default settings. (No Query)

**SRE value**

Sets the enable bits of the status byte register.

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>0 to 255 (decimal expression of enable bits of the status byte register)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Query Response</th>
<th>&lt;value&gt;</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Examples</th>
<th>OUTPUT #E5100;&quot;*SRE 1&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OUTPUT #E5100;&quot;*SRE?&quot;</td>
</tr>
<tr>
<td></td>
<td>ENTER #E5100;A</td>
</tr>
</tbody>
</table>
# *STB?*
Reads the status byte by reading the master summary status bit.

<table>
<thead>
<tr>
<th>Query Response</th>
<th>&lt;value&gt;</th>
</tr>
</thead>
</table>
| Examples      | OUTPUT ®E5100;"*STB?"  
               | ENTER ®E5100;A |

# *TRG*
Triggers the HP E5100A/B when the trigger mode is set to EXTERNAL trigger. (No Query)

| Examples | To start measurement:  
          | OUTPUT ®E5100;"*TRG" |

# *TST?*
Executes a power-on self test and returns the test result. (No Query)

| Query Response | {0|1} |
|---------------|-----|
| 0 : No error  |
| Examples      | OUTPUT ®E5100;"*TST?"  
               | ENTER ®E5100;A |

# *WAI*
Makes the HP E5100A/B wait until all previously sent commands are completed. (No Query)
Command Reference

ADTOTRAC
Starts data process. This command is only used for the parallel processing using with TRIGMEAS and MOVADARY. (No Query)

ANAMODE \{GAINP|ZREFL|ZTRAN\}
Select measurement function.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Meas/Format</th>
<th>FUNCTION</th>
<th>Measurement</th>
<th>Refl. Trans</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td></td>
<td></td>
<td>GAINP : Gain-Phase measurement</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ZREFL : Reflection impedance measurement</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ZTRAN : Transmission impedance measurement</td>
<td></td>
</tr>
<tr>
<td>Query Response</td>
<td></td>
<td></td>
<td>{ GAINP</td>
<td>ZREFL</td>
</tr>
<tr>
<td>Examples</td>
<td></td>
<td></td>
<td>OUTPut $E5100;&quot;ANAMODE GAINP&quot;</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>OUTPut $E5100;&quot;ANAMODE?&quot;</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ENTER $E5100;A$</td>
<td></td>
</tr>
</tbody>
</table>

ANAOCCH\{1-4\}
Selects channel for waveform analysis. For details, refer to Appendix D. (No Query)

Examples
| OUTPUT 717; "ANAOCCH1" |

ANAODATA
Selects a data trace for waveform analysis. For details, refer to Appendix D. (No Query)

Examples
| OUTPUT 717; "ANAODATA" |
| OUTPUT 717; "ANAODATA?" |
| ENTER 717; A |

ANAOMEMO
Selects a sub-trace for waveform analysis. For details, refer to Appendix D. (No Query)
**ANARANG** `value1[suffix], value2[suffix]`

Sets the waveform analysis stimulus range by entering the START (`value1`) and STOP (`value2`) values. For details, refer to Appendix D.

| Parameter Range | `<value1>`: `10x10^3` (10k) to `300x10^6` (300M) Hz  
|                 | `<value2>`: `10x10^3` (10k) to `300x10^6` (300M) Hz  
| Query Response  | `{value1}{value2}`  
| Examples        | OUTPUT 717;"ANARANG 1000,10000"  

**ANARANGP** `<value1>, <value2>`

Sets the waveform analysis stimulus range by entering the point number of START and point number of STOP values.

| Parameter Description | `<value1>`: The point number of START (1 to NOP)  
|                       | `<value2>`: The point number of STOP (1 to NOP)  
| Query Response        | `{value1}{value2}`  
| Examples               | OUTPUT @E5100;"ANARANGP 10,100"  
|                        | OUTPUT @E5100;"ANARANGP?"  
|                        | ENTER @E5100; A, B  

**ANARFULL**

Sets the analysis range equal to the full stimulus range. For details, refer to Appendix D. (No Query)

**AR**

This command equals MEAS AR. See MEAS.

**ATRC** `{1,2}`

Selects the active trace for the marker function.

| Equivalent Key Sequence | Marker  | ACTIVE TRC [1]  
|-------------------------|---------|-----------------  
| Parameter Description  | 1: Main trace  
|                        | 2: Sub trace  
| Query Response         | `{01}`  
| Examples                | OUTPUT @E5100;"ATRC"  
|                        | OUTPUT @E5100;"ATRC?"  
|                        | ENTER @E5100;A  

---
### ATTI(A|R|B|C) \{0|25\}

Selects the attenuator value at an input port.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Parameter Description</th>
<th>Query Response</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0 : 0 dB</td>
<td>{0\25}</td>
</tr>
<tr>
<td></td>
<td>25 : 25 dB</td>
<td></td>
</tr>
</tbody>
</table>

**Examples**

```
OUTPUT G5100;"ATTIA 25"

OUTPUT G5100;"ATTIA?"
ENTER G5100;A
```

### ATTI(A)|AUTO\{OFF|ON\}0\1

Select the attenuator auto mode at the port A ON or OFF. The auto mode automatically selects the proper attenuator value.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Parameter Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OFF \textsuperscript{*} or 0 : AUTO OFF</td>
</tr>
<tr>
<td></td>
<td>ON \textsuperscript{*} or 1 : AUTO ON</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Query Response</th>
<th>{0|1}</th>
</tr>
</thead>
</table>

**Examples**

```
OUTPUT G5100;"ATTIAAUTO ON"

OUTPUT G5100;"ATTIAAUTO?"
ENTER G5100;A
```

### ATTIBAUTO \{OFF|ON|0|1\}

Select the attenuator auto mode at the port B ON or OFF. The auto mode automatically selects the proper attenuator value.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Parameter Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OFF \textsuperscript{*} or 0 : AUTO OFF</td>
</tr>
<tr>
<td></td>
<td>ON \textsuperscript{*} or 1 : AUTO ON</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Query Response</th>
<th>{0\1}</th>
</tr>
</thead>
</table>

---

8.6 Command Reference
ATTICAUTO {OFF|ON|0|1}
Select the attenuator auto mode at the port C ON or OFF. The auto mode automatically selects the proper attenuator value.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>System ATTENUATOR PROT:C AUTO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>OFF or 0 : AUTO OFF</td>
</tr>
<tr>
<td></td>
<td>ON or 1 : AUTO ON</td>
</tr>
<tr>
<td>Query Response</td>
<td>{0</td>
</tr>
</tbody>
</table>

ATTIRAUTO {OFF|ON|0|1}
Select the attenuator auto mode at the port R ON or OFF.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>System ATTENUATOR PROT:R AUTO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>OFF or 0 : AUTO OFF</td>
</tr>
<tr>
<td></td>
<td>ON or 1 : AUTO ON</td>
</tr>
<tr>
<td>Query Response</td>
<td>{0</td>
</tr>
</tbody>
</table>

ATTW value
Sets the waiting time when the attenuator switch is changed at the power sweep mode. (Option 010 only, No warning will be shown even if this command is executed with the HP E5100A/B with no option 010.) The power-on default setting is 1 ms.

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>0 to 100 sec.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>{value} (sec)</td>
</tr>
</tbody>
</table>

Examples
- OUTPUT 717;"ATTW 10"
- OUTPUT 717;"ATTW?"
- ENTER 717;A

AUTO
Selects the scale/div value automatically to fit the trace data to the display.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Display AUTO SCALE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT 717;&quot;AUTO&quot;</td>
</tr>
</tbody>
</table>
**BASL**
Displays the softkey label defined by HP Instrument BASIC. (No Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>System 1-BASIC ON KEY LABEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100;&quot;BASL&quot;</td>
</tr>
</tbody>
</table>

**BEEPDONE {ON|OFF|0|1}**
Sets the operation completion beeper ON or OFF.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>DISPLAY MORE BEEP DONE ON off</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>OFF and 0 : operation completion beeper OFF ON and 1 : operation completion beeper ON</td>
</tr>
<tr>
<td>Query Response</td>
<td>{0</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT 717;&quot;BEEPDONE ON&quot;</td>
</tr>
<tr>
<td></td>
<td>OUTPUT 717;&quot;BEEPDONE?&quot;</td>
</tr>
<tr>
<td></td>
<td>ENTER 717;A</td>
</tr>
</tbody>
</table>

**BEEPFAIL {ON|OFF|1|0}**
Sets the limit fail beeper ON or OFF.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>System LIMIT MENU BEEP FAIL ON off</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>OFF and 0 : limit fail beeper OFF ON and 1 : limit fail beeper ON</td>
</tr>
<tr>
<td>Query Response</td>
<td>{0</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT 717;&quot;BEEPFAIL ON&quot;</td>
</tr>
<tr>
<td></td>
<td>OUTPUT 717;&quot;BEEPFAIL?&quot;</td>
</tr>
<tr>
<td></td>
<td>ENTER 717;A</td>
</tr>
</tbody>
</table>

**BEEPWARN {ON|OFF}**
Sets the warning beeper ON or OFF.
CALCOPY\[<value1>, <value2>\]

Equivalent Key Sequence  | DISPLAY MORE BEEP WARN ON off
---|---
Parameter Description  | OFF and 0: warning beeper OFF  
 | ON and 1: warning beeper ON
Query Response  | \{\}1\}
Examples  | OUTPUT 717;"BEEP WARN ON"
 | OUTPUT 717;"BEEP WARN?"
 | ENTER 717;A

BINSIZE\[<value>\]
Specify the number of continuous data outputted to the I/O port by INPUTRACB.
Specify the maximum value in the second parameter of INPUTRACB. (Option 022 only)

Parameter Range  | 0 to 6
Query Response  | \{<value>\}
Examples  | OUTPUT \#E5100;"BINSIZE 2"
 | OUTPUT \#E5100;"BINSIZE?"
 | ENTER \#E5100;A

BOTV\[<value>\]
Sets the value at the bottom line of the graticule.

Equivalent Key Sequence  | DISPLAY BOTTOM VALUE
---|---
Parameter Range  | -10^6 to 10^6
Query Response  | \{<value>\}
Examples  | OUTPUT \#E5100;"BOTV 100"
 | OUTPUT \#E5100;"BOTV?"
 | ENTER \#E5100;A

CALCOPY\[<value1>, <value2>\]
Copy CAL data and CAL settings between two channels. (No Query)

Parameter Description  | \(<value1>\) : Source channel  
 | \(<value2>\) : Destination channel
Examples  | OUTPUT \#E5100;"CALCOPY 1,2"
**CALI parameter**

Selects the measurement calibration type. (Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Cal</th>
<th>CALIBRATE: NONE, RESPONSE, RESPONSE &amp; ISOLATION, 3 TERM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td></td>
<td>NONE : No calibration</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RESP : Response measurement calibration</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RAI : Response and isolation measurement calibration</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ONEP : 1-port 3-term measurement calibration</td>
</tr>
</tbody>
</table>

| Query Response          |     | {NONE|RESP|RAI|ONEP}                                  |
| Examples                |     | OUTPUT @E5100; "CALI NONE"                    |
|                         |     | ENTER @E5100; A$                                |

**CALK {O|S|L} {LS|RS|CP} <value>**

Sets the value of calibration kit of the active measurement mode.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Cal</th>
<th>MODIFY CAL KIT OPEN STD, SHORT STD, LOAD STD, Ra, Ls, Cp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Range</td>
<td></td>
<td>O : OPEN</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S : SHORT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>L : LOAD</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LS : Ln</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RS : Rn</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CP : Cp</td>
</tr>
</tbody>
</table>

| Query Response          |     | {value}                                                |
| Examples                |     | OUTPUT @E5100; "CALKLS, 49.9"                       |
|                         |     | ENTER @E5100; A                                       |

**CENS value1 [suffix], value2 [suffix]**

Sets center and span stimulus value.

<table>
<thead>
<tr>
<th>Parameter Description</th>
<th>&lt;value1&gt; : Center value</th>
<th>&lt;value2&gt; : Span value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Range</td>
<td>&lt;value1&gt; : 10x10^2 (-10k) to 300x10^6 (-300M) Hz</td>
<td>&lt;value2&gt; : 0 to 2.9999x10^8 (-299.99M) Hz</td>
</tr>
</tbody>
</table>

| Examples                |     | OUTPUT @E5100; "CENS 193.95MHz, 100KHz"             |
CENT value [suffix]
Sets the center stimulus value.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Center</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Range</td>
<td>$10 \times 10^3$ (-10k) to $300 \times 10^6$ (=300M) Hz</td>
</tr>
<tr>
<td>Query Response</td>
<td>{value}</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100;&quot;CENT 99.95MAHZ&quot;</td>
</tr>
<tr>
<td></td>
<td>OUTPUT @E5100;&quot;CENT?&quot;</td>
</tr>
<tr>
<td></td>
<td>ENTER @E5100;A</td>
</tr>
</tbody>
</table>

CHAD string
Changes the current directory.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Save/Recall</th>
<th>FILE</th>
<th>UTILITY</th>
<th>CHANGE</th>
<th>DIRECTORY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>&lt;string&gt; :Directory path name</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100;&quot;CHAD &quot;...&quot;&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CHAN \{1|2|3|4\}
Selects the active measurement channel. (No Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Meas/Format</th>
<th>ACTIVE CH [ ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT 717;&quot;CHAN 1&quot;</td>
<td></td>
</tr>
</tbody>
</table>

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

| Examples | OUTPUT 717;"CIN" |

CIVAL\d\d\d<value>
Enters the CI value.
CIVAL<v value>

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>MENU2 USER.C1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Range</td>
<td>$10^{-15}$ to 1 G [Ω]</td>
</tr>
<tr>
<td>Query Response</td>
<td>{value}</td>
</tr>
</tbody>
</table>
| Examples                | OUTPUT $\&E5100;$"CIVAL 10"
OUTPUT $\&E5100;$"CIVAL?"
ENTER $\&E5100;A

CLASS11 {A|B|C}

Selects port 1 (S11) one-port calibration standard class: S11A (open), S11B (short), or S11C (load). (No Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Cal [S11] OPEN, SHORT, LOAD</th>
</tr>
</thead>
</table>
| Parameter Description   | A: OPEN
B: SHORT
C: LOAD |
| Examples                | OUTPUT $\&E5100;$"CLASS11A"

CLEL

Clears the current frequency list. (No Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Sweep</th>
</tr>
</thead>
</table>
| Examples                | OUTPUT $\&E5100;$"CLEL"

CLEM{1-4}

Clears the marker. (No Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Marker CLEAR MARKER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT $&amp;E5100;$&quot;CLEM1&quot;</td>
</tr>
</tbody>
</table>

8-12 Command Reference
CLEMNU3
Clears the softkey definitions of Menu3. (No Query)

Examples

OUTPUT @E5100;"CLEMNU3"

CLES
Clears the status byte, the event status register, the event status register B, and the operational status register.
(No Query)

Examples

OUTPUT @E5100;"CLES"

CONT
Continuous trigger. (No Query)

Equivalent Key Sequence

| Trigger CONTINUOUS |

Examples

OUTPUT @E5100;"CONT"

CONV {OFF|ZTRA|YTRA|ZREF|YREF}
Selects the measurement data conversion setting. This command is available when the ANAMODE is set to Gain-Phase mode.

Equivalent Key Sequence

| Measure Format | FUNCTION ( 1 ) |

Parameter Description
OFF : Conversion OFF
ZTRA : Z:transmission
YTRA : Y:transmission
ZREF : Z:Reflection
YREF : Y:Reflection

Query Response

{OFF|ZTRA|YTRA|ZREF|YREF}

Examples

OUTPUT @E5100;"CONV ZTRA"
OUTPUT @E5100;"CONV Y"
ENTER @E5100;AS
CORR \{ON\|OFF\}
Sets the error correction function ON or OFF.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>\texttt{CORRECTION} ON \texttt{off}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>{0|1}</td>
</tr>
</tbody>
</table>
| Parameter Range         | OFF and 0 : error correction function OFF 
                          ON and 1 : error correction function ON |
| Examples                | OUTPUT \$E5100;"CORR OFF"            |
|                         | OUTPUT \$E5100;"CORR?"               |
|                         | ENTER \$E5100;A                      |

COUC \{ON\|OFF\}
Sets the channel coupling of stimulus values ON or OFF.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>\texttt{COUPLED C} ON \texttt{off}</th>
</tr>
</thead>
</table>
| Parameter Description   | OFF and 0 : channel coupling OFF 
                          ON and 1 : channel coupling ON |
| Query Response          | \{0\|1\}                            |
| Examples                | OUTPUT \$E5100;"COUC OFF"           |
|                         | OUTPUT \$E5100;"COUC?"               |
|                         | ENTER \$E5100;A                      |

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

| Examples                | OUTPUT \$E5100;"COUT" |

CRED \texttt{string}
Create a directory (only MS-DOS format). (No Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>\texttt{FILE UTILITY} CREATE DIRECTORY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>&lt;string&gt; : Up to 8 characters for directory name and up to 3 characters for extension</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT $E5100;&quot;CRED &quot;DATA&quot;&quot;</td>
</tr>
</tbody>
</table>

8-14 Command Reference
**CURD?**
Outputs current directory. (Query only)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>{Save/Recall} FILE UTILITY CURRENT DIRECTORY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>{string}</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100;&quot;CURD?&quot;</td>
</tr>
<tr>
<td></td>
<td>ENTER @E5100;A$</td>
</tr>
</tbody>
</table>

**CURMPOIN?**
Outputs the latest measurement point number and measurement data. (Query only)

<table>
<thead>
<tr>
<th>Query Response</th>
<th>{numeric1}{numeric2}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>{numeric1} : measurement point number</td>
</tr>
<tr>
<td></td>
<td>{numeric2} : Formatted data (complex value, data format: real, imaginary)</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100;&quot;CURMPOIN?&quot;</td>
</tr>
<tr>
<td></td>
<td>ENTER @E5100;A,B,C</td>
</tr>
</tbody>
</table>

**CWFREQ value [suffix]**
Sets the frequency for power sweep.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>{Sweep} CWFREQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Range</td>
<td>10x10^3 (-10k) to 300x10^2 (-300M) Hz</td>
</tr>
<tr>
<td>Query Response</td>
<td>{value}</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100;&quot;CWFREQ 100KHZ&quot;</td>
</tr>
<tr>
<td></td>
<td>OUTPUT @E5100;&quot;CWFREQ?&quot;</td>
</tr>
<tr>
<td></td>
<td>ENTER @E5100;A</td>
</tr>
</tbody>
</table>

**DATI**
Saves the data trace to the memory trace. (No Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>{Display} DEFINE TRACE DATA-&gt;MEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100;&quot;DATI&quot;</td>
</tr>
</tbody>
</table>

---

Command Reference 8-15
DAYMYEAR
Sets the displayed date mode to day/month/year order. (No Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>System Mode Set Clock DayMonYear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100;&quot;DAYMYEAR&quot;</td>
</tr>
</tbody>
</table>

DELA
This command equals FMT DELA. See FMT.

DELO
Sets the delta marker mode OFF. (No Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Marker A Mode Menu A Mode Off</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100;&quot;DELO&quot;</td>
</tr>
</tbody>
</table>

DELR{1-4}
Selects the delta reference marker.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>AMODE Menu AREF MARK AREF=1 to AREF=4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>{value}</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100;&quot;DELR1&quot;</td>
</tr>
<tr>
<td></td>
<td>OUTPUT @E5100;&quot;DELR1?&quot;</td>
</tr>
<tr>
<td></td>
<td>ENTER @E5100;A</td>
</tr>
</tbody>
</table>

DELRFIXM
Sets the user-specified fixed reference marker. (No Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Marker AMODE Menu A Ref=A FIXED MARK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100;&quot;DELRFIXM&quot;</td>
</tr>
</tbody>
</table>
**DIN**
Set port D of the 24-bit I/O port to be an input port. (No Query)

Examples

```
OUTPUT &E5100;"DIN"
```

**DISA parameter**
Selects the display allocation mode.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Display</th>
<th>DISPLAY ALLOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ALLI : All instrument</td>
<td></td>
</tr>
<tr>
<td></td>
<td>HIHB : Half instrument half BASIC</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ALLB : All BASIC</td>
<td></td>
</tr>
<tr>
<td></td>
<td>BASS : BASIC status</td>
<td></td>
</tr>
<tr>
<td>Query Response</td>
<td>(ALLI</td>
<td>HIHB</td>
</tr>
<tr>
<td>Examples</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>OUTPUT &amp;E5100;&quot;DISA HIHB&quot;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>OUTPUT &amp;E5100;&quot;DISA?&quot;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ENTER &amp;E5100:A$</td>
<td></td>
</tr>
</tbody>
</table>

**DISG \{ON|OFF\}**
Sets the graticule display on or off.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Display</th>
<th>GRATICLE ON</th>
<th>off</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Range</td>
<td>(OFF</td>
<td>ON</td>
<td>0</td>
</tr>
<tr>
<td>Query Response</td>
<td>(0</td>
<td>1)</td>
<td></td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT &amp;E5100;&quot;DISG ON&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>OUTPUT &amp;E5100;&quot;DISG?&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ENTER &amp;E5100:A</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**DISP parameter**
Selects the display trace type.
**DISP parameter**

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Display MORE MORE TRACE:DATA MEMORY, DATA and MEMORY, DATA-MEM, DATA/MEM</th>
</tr>
</thead>
</table>
| **Parameter Range**     | DATA : Data only
                          MEMO : Memory only
                          DATM : Data and memory
                          DDM : Data divided by memory
                          DMM : Data minus memory |

| **Query Response**      | {DATA|MEMO|DATM|DDM|DMM} |

**Examples**

- OUTPUT $E5100;"DISP DATA"
- OUTPUT $E5100;"DISP?"
- ENTER $E5100;A$

**DIST {ON|OFF}**

Sets the trace display on or off.

(TRACE on off under DISPLAY; Query)

| **Parameter Range**     | OFF or 0 : trace display OFF
                          ON or 1 : trace display ON |

| **Query Response**      | {0|1} |

**Examples**

- OUTPUT $E5100;"DIST ON"

**DONE**

Completes the measurement of the selected standard calibration. (No Query)

| Equivalent Key Sequence | Cal DONE |

**Examples**

- OUTPUT $E5100;"DONE"

**DOUT**

Sets D port of the 24-bit I/O port to output port. (No Query)

**Examples**

- OUTPUT $E5100;"DOUT"
DSKEY
Disables the front panel keys and the rotary knob. To enable the keys and knob again, send the ENKEY command.

Examples

DUAC {ON|OFF}
Selects the dual (ON) or single (OFF) channels display.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Display</th>
<th>MULTICHAN ON off</th>
</tr>
</thead>
</table>
| Parameter Range         | OFF and 0 : Active channel only
                       | ON and 1 : Dual channel |
| Query Response          | {0|1} |
| Examples                | OUTPUT @E5100:"DUAC ON"
                       | OUTPUT @E5100:"DUAC?"
                       | ENTER @E5100;A |

EDITDONE
Completes editing the frequency list for the list sweep. (No Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Sweep</th>
<th>LIST DONE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT 717;&quot;EDITDONE&quot;</td>
<td></td>
</tr>
</tbody>
</table>

EDITLIS1
Selects list 1 for editing. (No Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Sweep</th>
<th>LIST NO. 1 EDIT LIST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100;&quot;EDITLIS1&quot;</td>
<td></td>
</tr>
</tbody>
</table>
EDITLIST

Selects list 2 for editing. (No Query)

Equivalent Key Sequence | Sweep LIST NO 1 EDIT LIST
--- | ---
Examples | OUTPUT #E5100;"EDITLIST"

EDITLIST

Begins editing the frequency list. (No Query)

Equivalent Key Sequence | Sweep EDIT LIST
--- | ---
Examples | OUTPUT #E5100;"EDITLIST"

ELED value [s]

Sets the electrical delay.

Equivalent Key Sequence | Display MORE ELECTRICAL DELAY
--- | ---
Parameter Range | -10 to 10 [sec.]
Query Response | {value}
Examples | OUTPUT #E5100;"ELED 0"
OUTPUT #E5100;"ELED?"
Enter #E5100;A

ENKEY

Re-enables the front panel keys and the rotary knob which have been disabled by the DSKEY command. (No Query)

EQUCO? value

Returns $C_0$ of the equivalent circuit of the resonator at specified frequency. $C_0$ is calculated by using the following equation:

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

Where,

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

If Z-conversion is selected, $C_0$ is calculated by using following equations:
\[ C_0 = \frac{-1}{B_s \times \omega_s} \]

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

If \( B_s \) is 0 when the Z-conversion is activated, \texttt{EQUCO?} returns 0.

(Query only)

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>1000 (=1k) to 3.0 x 10^9 (=300M) [Hz]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>{value(C0)}</td>
</tr>
</tbody>
</table>
| Examples             | OUTPUT \$E5100;"EQUCO? 100MHZ"
                     | ENTER \$E5100;C0
                     | PRINT "C0=",C0
                     | Query \( C_0 \) at 100 MHz.
                     | Receive the returned \( C_0 \).
                     | Display \( C_0 \) on the CRT.          |

\textbf{EQUCPARA5?}

Executes the equivalent circuit analysis for a resonator using the same equivalent circuit of \texttt{EQUCPARA?}, but does not output \( G_0 \). \texttt{EQUCPARA5?} does not display the warning even an anti-resonance frequency is not in the analysis range. (Query only)

<table>
<thead>
<tr>
<th>Query Response</th>
<th>{value1}, {value2}, {value3}, {value4}, {value5}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>{value1}: C0</td>
</tr>
<tr>
<td></td>
<td>{value2}: C1</td>
</tr>
<tr>
<td></td>
<td>{value3}: L1</td>
</tr>
<tr>
<td></td>
<td>{value4}: R1</td>
</tr>
<tr>
<td></td>
<td>{value5}: R0</td>
</tr>
</tbody>
</table>
| Examples             | OUTPUT \$E5100;"EQUCPARA5?"
                     | ENTER \$E5100;A,B,C,D,E                                |

\textbf{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 “EQUCPARA?” in Appendix D. (Query only)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Menu 2</th>
<th>EQUIVALENT CRT 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>{numeric1}, {numeric2}, {numeric3}, {numeric4}, {numeric5}, {numeric6}</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&lt;numeric1&gt; : ( C_0 )</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&lt;numeric2&gt; : ( C_1 )</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&lt;numeric3&gt; : ( L_1 )</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&lt;numeric4&gt; : ( R_1 )</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&lt;numeric5&gt; : ( G_0 )</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&lt;numeric6&gt; : ( R_0 )</td>
<td></td>
</tr>
</tbody>
</table>
| Examples                | OUTPUT \$E5100;"EQUCPARA?"
                     | ENTER \$E5100;A,B,C,D |

Command Reference 8-21
**EQUCPARS4?**

Executes four element analysis of a crystal resonator, and outputs parameters, $C_0$, $C_1$, $L_1$, $R_1$, $f_0$, $f_a$, $f_r$, $f_1$, $f_2$. (Query only)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Menu 2</th>
<th>EQUIVALENT CKT 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Query Response</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$&lt;\text{numeric1}&gt;$ : $C_0$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$&lt;\text{numeric2}&gt;$ : $C_1$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$&lt;\text{numeric3}&gt;$ : $L_1$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$&lt;\text{numeric4}&gt;$ : $R_1$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$&lt;\text{numeric5}&gt;$ : $f_a$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$&lt;\text{numeric6}&gt;$ : $f_r$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$&lt;\text{numeric7}&gt;$ : $f_1$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$&lt;\text{numeric8}&gt;$ : $f_2$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Examples**

```
OUTPUT @E5100;"EQUCPARS4?"
ENTER @E5100;A,B,C,D,E,F,G,H,I
```

1. $f_1 < f_2$

**EQUCPARS?**

Executes four elements analysis of a crystal resonator, and outputs parameters, $C_0$, $C_1$, $L_1$, $R_1$, $f_a$, $f_r$, $f_1$, and $f_2$. For more information, refer to "EQUCPARS?" in Appendix D. (Query only)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>SPCL_FNCT</th>
<th>EQUIVALENT CKT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Parameter Range</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Query Response</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$&lt;\text{value1}&gt;$ : $C_0$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$&lt;\text{value2}&gt;$ : $C_1$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$&lt;\text{value3}&gt;$ : $L_1$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$&lt;\text{value4}&gt;$ : $R_1$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$&lt;\text{value5}&gt;$ : $f_a$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$&lt;\text{value6}&gt;$ : $f_r$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$&lt;\text{value7}&gt;$ : $f_1$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$&lt;\text{value8}&gt;$ : $f_2$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$&lt;\text{value9}&gt;$ : $f_1$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$&lt;\text{value10}&gt;$ : $C_0$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$&lt;\text{value11}&gt;$ : $R_0$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Examples**

```
OUTPUT 717;"EQUCPARS?"
ENTER 717;A,B,C,D,E,F,G,H,I
```

1. $f_1 < f_2$
**EQUM value**

Specifies how many points are used for an approximation of a circle for \( \text{EQUCPARA?} \) and \( \text{EQUCPARS?} \) command. The default value is 8. For a detail information about EQUM, refer to "\( \text{EQUCPARA?} \)" in Appendix D.

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>2 to 801</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>{value}</td>
</tr>
</tbody>
</table>
| Examples        | OUTPUT \$E5100;"EQUM 30"
|                 | OUTPUT \$E5100;"EQUM?"
|                 | ENTER \$E5100;A |

**ESB?**

Outputs the event status register B value. (Query only)

<table>
<thead>
<tr>
<th>Query Response</th>
<th>{value}</th>
</tr>
</thead>
</table>
| Examples       | OUTPUT \$E5100;"ESB?"
|                 | ENTER \$E5100;A |

**ESNB value**

Specifies the bits of event status register B.

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>( 0 ) to ( 32767 ) (decimal expression of the event status register)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>{value}</td>
</tr>
</tbody>
</table>
| Examples        | OUTPUT \$E5100;"ESNB 0"
|                 | OUTPUT \$E5100;"ESNB?"
|                 | ENTER \$E5100;A |

**EXET value**

Executes the service test. (No Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>System EXECUTE TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>{value} : test number</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT $E5100;&quot;EXET 11&quot;</td>
</tr>
</tbody>
</table>
EXPC {ON|OFF}
Sets the interpolated error correction ON or OFF.

| Parameter Description | OFF and 0 : interpolation OFF  
|                       | ON and 1 : interpolation ON  
| Query Response        | {0|1}  
| Examples              | OUTPUT @E5100;"EXPC OFF"  
                           | OUTPUT @E5100;"EXPC?"  
                           | ENTER @E5100;A  

EXPZP {ON|OFF|1|0}
Selects the expanded phase format for the impedance measurement.

| Equivalent Key Sequence | Meas/Format | FORMAT EXP PHASE ON OFF  
|                         |             | TEST  
| Parameter Description   | ON, 1 : expanded phase format ON  
|                         | OFF, 0 : expanded phase format OFF  
| Query Response          | {1|0}  
| Examples                | OUTPUT @E5100;"EXPZP ON"  
                           | OUTPUT @E5100;"EXPZP?"  
                           | ENTER @E5100;A  

EXTRLOCK?
Outputs the state of the external reference (locked or unlocked). (Query only)

| Parameter Range         | 0 : unlocked  
|                         | 1 : locked  
| Query Response          | {0|1}  
| Examples                | OUTPUT @E5100;"EXTRLOCK?"  
                           | ENTER @E5100;A  

EXTT parameter
Selects the external trigger mode.
### Equivalent Key Sequence

**FMT** parameter

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>[Trigger] TRIG EVENT [TRIG ON SWEEP]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>{OFF|ONSWEE}</td>
</tr>
<tr>
<td>Examples</td>
<td></td>
</tr>
</tbody>
</table>

```
OUTPUT #E5100; "EXIT OFF"
OUTPUT #E5100; "EXIT?"
Enter #E5100; #5
```

### FILC string1,string2,string3,string4

Copies file on flexible and RAM disks. (No Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>SAVE FILE UTILITY COPY FILE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td></td>
</tr>
<tr>
<td>&lt;string1&gt;</td>
<td>Source file name. String.</td>
</tr>
<tr>
<td>&lt;string2&gt;</td>
<td>Source device name. &quot;MEMORY&quot; or &quot;DISK&quot;</td>
</tr>
<tr>
<td>&lt;string3&gt;</td>
<td>Destination file name.</td>
</tr>
<tr>
<td>&lt;string4&gt;</td>
<td>Destination device name.</td>
</tr>
</tbody>
</table>

```
OUTPUT 717; "FILC ""DAT1.TXT"", ""MEMORY"", ""DAT1.TXT"", ""DISK""
```

1 Internal flexible disk drive:DISK; Internal RAM disk drive:MEMORY

### FMT parameter

Selects the display format.
FMT parameter

Equivalent Key Sequence


Parameter Range

| LOGM | Log magnitude format |
| PHAS | Phase format |
| DELA | Delay format |
| LINM | Linear magnitude format |
| REAL | Real format |
| IMAG | Imaginary format |
| LOGMP | Log magnitude and phase format |
| LOGMD | Log magnitude and delay format |
| LINMP | Linear magnitude and phase format |
| LINMD | Linear magnitude and delay format |
| EXPP | Expanded phase format |
| MAGZP | | [Z] & phase format |
| MAGYP | | [Y] & phase format |
| IMPRX | | R-X format |
| ADMGB | | G-B format |
| MAGZ | | [Z] format |
| MAGY | | [Y] format |
| PHAZ | Phase, format |
| PHAY | Phase, format |
| IMPR | | R format |
| IMPX | | X format |
| ADMG | | G format |
| ADBM | | B format |
| MAGZDF | | [Z-A] format for tracking measurement (option 023 only) |

Query Response

{LOGM | PHAS | DELA | LINM | REAL | IMAG | LOGMP | LOGMD | LINMP | LINMD | EXPP | MAGZP | MAGYP | IMPRX | ADMGB | MAGZ | MAGY | PHAZ | PHAY | IMPR | IMPX | ADMG | ADBM | MAGZDF}

Examples

OUTPUT 717; "FMT LOGM"

OUTPUT 717; "FMT?"
ENTER 717; A$

FORM2

Sets the IEEE 32-bit floating point format to transfer trace data and waveform analysis (Refer to Appendix E) data via HP-IB. (No Query)

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. (No Query)
FORM4
Sets the ASCII transfer format to transfer the trace data and waveform analysis (Refer to Appendix E) data via HP-IB. (No Query)

FORM5
Sets MS-DOS format to transfer the trace data and waveform analysis (Refer to Appendix E) data via HP-IB. (No Query)

GRAPFORM [{PCL|TIFF}]
Selects the graphic format to be save the display image on the disk drive.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Save/Recall</th>
<th>GRAPH FMT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>{PCL</td>
<td>TIFF}</td>
</tr>
<tr>
<td>PCL : PCL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TIFF : TIFF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Query Response</td>
<td>{PCL</td>
<td>TIFF}</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100; &quot;GRAPFORM TIFF&quot;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>OUTPUT @E5100; &quot;GRAPFORM?&quot;</td>
<td></td>
</tr>
</tbody>
</table>
|                         | ENTER @E5100; A$

GRODAPER value [pct]
Sets the group delay aperture.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Measure/Format</th>
<th>GROUP DELAY APERTURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Range</td>
<td>1 to 200 (% of span) [%]</td>
<td></td>
</tr>
<tr>
<td>Query Response</td>
<td>(value)</td>
<td></td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100; &quot;GRODAPER 30&quot;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>OUTPUT @E5100; &quot;GRODAPER?&quot;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ENTER @E5100; A</td>
<td></td>
</tr>
</tbody>
</table>

HOLD
Holds the present measurement.
**HOLD**

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Trigger</th>
<th>HOLD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>{1</td>
<td>0}</td>
</tr>
<tr>
<td></td>
<td>0: Sweep mode</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1: Hold mode</td>
<td></td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100;'HOLD'</td>
<td></td>
</tr>
<tr>
<td></td>
<td>OUTPUT @E5100;'HOLD?'</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ENTER @E5100;A</td>
<td></td>
</tr>
</tbody>
</table>

**IDN?**

Outputs the analyzer ID.

<table>
<thead>
<tr>
<th>Query Response</th>
<th>HEWLET-PACKARD,E5100A,IP1KCmmmm.n.nn</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mmmmm: serial number</td>
</tr>
<tr>
<td></td>
<td>n.nn: revision number</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100;'IDN?'</td>
</tr>
<tr>
<td></td>
<td>ENTER @E5100;A$</td>
</tr>
</tbody>
</table>

**IFBW value**

Sets the bandwidth value for IF bandwidth reduction.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Sweep</th>
<th>IF BW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Range</td>
<td>2, 20, 200, 1000, 4000, 8000 [Hz]</td>
<td></td>
</tr>
<tr>
<td>Query Response</td>
<td>{value}</td>
<td></td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100;'IFBW 200HZ'</td>
<td></td>
</tr>
<tr>
<td></td>
<td>OUTPUT @E5100;'IFBW?'</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ENTER @E5100;A</td>
<td></td>
</tr>
</tbody>
</table>

**IFBWAUTO**

Automatically selects the proper IF bandwidth for each measurement point. (No Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Sweep</th>
<th>IF BW [ ]</th>
<th>IF BW AUTO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100;'IFBWAUTO'</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**INID**

Initializes the disk in the built-in flexible disk drive. (No Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Save/Recall</th>
<th>FILE</th>
<th>UTILITY</th>
<th>INITIALIZE DISK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>OUTPUT @E5100;&quot;STDDISK&quot;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>OUTPUT @E5100;&quot;INID&quot;</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**INP8IO**

Inputs data from the 4-bit parallel input port to the HP E5100A/B. (option 005 only)

<table>
<thead>
<tr>
<th>Query Response</th>
<th>{value}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td></td>
</tr>
<tr>
<td></td>
<td>OUTPUT @E5100;&quot;INP8IO&quot;</td>
</tr>
<tr>
<td></td>
<td>OUTPUT @E5100;&quot;OUTPINP8IO?&quot;</td>
</tr>
<tr>
<td></td>
<td>ENTER @E5100;A</td>
</tr>
<tr>
<td></td>
<td>OUTPUT @E5100;&quot;INP8IO?&quot;</td>
</tr>
<tr>
<td></td>
<td>ENTER @E5100;A</td>
</tr>
</tbody>
</table>

**INPT?**

Outputs value which tells whether there is pulse input at the Input 1 port of the 24-bit I/O port. (Query only)

| Query Response | {1|0} |
|----------------|-----|
|                | 0 : There is not pulse input at the Input 1. |
|                | 1 : there is pulse input at the Input 1. |
|                | Once INPT? returns 1, next INPT? query returns 0 until the next pulse input has occurred at Input 1. |
| Examples       |         |
|                | OUTPUT @E5100;"INPT?" |
|                | ENTER @E5100;A |

**INPUCALC {01-03} value**

Stores the measurement calibration error coefficient set real/imaginary pairs input via HP-IB into instrument memory. The data transfer format must be used ASCII format when this command. (No Query)

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>&lt;value&gt; : Complex number (Data format: real, imaginary)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>DIM A(1:201,1:2)</td>
</tr>
<tr>
<td></td>
<td>NOP: 201</td>
</tr>
<tr>
<td></td>
<td>!Set calibration error coefficient</td>
</tr>
<tr>
<td></td>
<td>OUTPUT @E5100;&quot;INPUCALC01 &quot;:A(*)</td>
</tr>
</tbody>
</table>
INPUDATA <value1>,<value2>, ..., <valuem>
Enters data to the data array of the active channel. (No Query)

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>&lt;value&gt; : Complex value (data format: Real, Imaginary)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>DIM A(1:201,1:2)</td>
</tr>
<tr>
<td></td>
<td>! Set data to enter memory array</td>
</tr>
<tr>
<td></td>
<td>OUTPUT #E5100;&quot;INPUDATA&quot;;A(*)</td>
</tr>
</tbody>
</table>

INPUFORM value
Inputs formatted data. (No Query)

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>&lt;value&gt; : Complex value (Data format: real, imaginary)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>DIM A(1:201,1:2)</td>
</tr>
<tr>
<td></td>
<td>! Set formatted data</td>
</tr>
<tr>
<td></td>
<td>OUTPUT #E5100;&quot;INPUFORM&quot;;A(*)</td>
</tr>
</tbody>
</table>

INPUIFORM <value1>,<value2>, ..., <valuem>
Enters data to the formatted data of the inactive channel. (No Query)
When the number of channel is 3 or 4, this command enters data of the following channel:

<table>
<thead>
<tr>
<th>Active Channel</th>
<th>Channel the INPUIFORM?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>&lt;value&gt; : Complex value (data format: Real, Imaginary)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>DIM A(1:201,1:2)</td>
</tr>
<tr>
<td></td>
<td>! Set data to enter memory array</td>
</tr>
<tr>
<td></td>
<td>OUTPUT #E5100;&quot;INPUIFORM&quot;;A(*)</td>
</tr>
</tbody>
</table>

INPUMEMO <value1>,<value2>, ..., <valuem>
Enters data to the memory array of the active channel. (No Query)

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>&lt;value&gt; : Complex value (data format: Real, Imaginary)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>DIM A(1:201,1:2)</td>
</tr>
<tr>
<td></td>
<td>! Set data to enter memory array</td>
</tr>
<tr>
<td></td>
<td>OUTPUT #E5100;&quot;INPUMEMO&quot;;A(*)</td>
</tr>
</tbody>
</table>
**INPURAW** <value (1)>, <value (2)>, ... , <value (n)>

Enters data to the raw data array of the active channel. (No Query)

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>&lt;value&gt; : Complex value (data format: real, imaginary)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>DIM A(1:201,1:2)</td>
</tr>
<tr>
<td></td>
<td>! Set data to enter to raw array</td>
</tr>
<tr>
<td></td>
<td>OUTPUT @E5100; &quot;INPURAW&quot;; A(*)</td>
</tr>
<tr>
<td></td>
<td><strong>NOP: 201</strong></td>
</tr>
</tbody>
</table>

**INPUFORM** <value1>, <value2>, ... , <value n>

Enters data to the format data array of the active channel. (No Query)

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>&lt;value&gt; : Complex value (data format: real, imaginary)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>DIM A(1:201,1:2)</td>
</tr>
<tr>
<td></td>
<td>! Set data to enter to format array</td>
</tr>
<tr>
<td></td>
<td>OUTPUT @E5100; &quot;INPUFORM&quot;; A(*)</td>
</tr>
<tr>
<td></td>
<td><strong>NOP: 201</strong></td>
</tr>
</tbody>
</table>

**INPURTMEM** <value (1)>, <value (2)>, ... , <value (n)>

Enters data to the sub-trace array of the active channel. The sub-trace is available when the number of channels is set to 2. (No Query)

<table>
<thead>
<tr>
<th>Parameter Description</th>
<th>&lt;value&gt; : real value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>DIM A(1:201)</td>
</tr>
<tr>
<td></td>
<td>! Set data to enter to sub-trace</td>
</tr>
<tr>
<td></td>
<td>OUTPUT @E5100; &quot;INPURTMEM&quot;; A(*)</td>
</tr>
<tr>
<td></td>
<td><strong>NOP: 201</strong></td>
</tr>
</tbody>
</table>

**INPUSTMIL** <value1>, <value2>, ... , <value n>

Enters data to the stimulus data array of the active channel. (No Query)

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>10 x 10^5 (+10k) to 300 x 10^6 (+300M) Hz (frequency sweep)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-9 to +11 dBm (-48 to +22 dBm option 010 only) (power sweep)</td>
</tr>
<tr>
<td>Examples</td>
<td>DIM A(1:201)</td>
</tr>
<tr>
<td></td>
<td>! Set stimulus data</td>
</tr>
<tr>
<td></td>
<td>OUTPUT @E5100; &quot;INPUSTMIL&quot;; A(*)</td>
</tr>
<tr>
<td></td>
<td><strong>NOP: 201</strong></td>
</tr>
</tbody>
</table>
**INPUTRAC**: `<value1>,<value2>,<value3>`

Pass the phase value to trap at a measured point and specify whether data is outputted to the I/O port or not when the measured value reaches the phase value. The data to be outputted to the I/O port is specified by INPUTRACB. (No Query, Option 022 only)

<table>
<thead>
<tr>
<th>Parameter Description</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;value1&gt;</code></td>
<td>The measured point number</td>
</tr>
<tr>
<td><code>&lt;value2&gt;</code></td>
<td>The trap phase value</td>
</tr>
<tr>
<td><code>&lt;value3&gt;</code></td>
<td>I/O output ON/OFF</td>
</tr>
</tbody>
</table>

**Examples**

```
OUTPUT #E5100;"INPUTRAC 10, 0, ON"
```

**INPUTRACB**: `<value1>,<value2>,<value3>`

Pass the data outputted to the I/O port when the measured value of phase reaches the limit value specified by the INPUTRAC command. Multiple data up to 6 data can be outputted continuously to the I/O port. (No Query, Option 022 only)

<table>
<thead>
<tr>
<th>Parameter Description</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;value1&gt;</code></td>
<td>The measured point number</td>
</tr>
<tr>
<td><code>&lt;value2&gt;</code></td>
<td>The order of output I/O data (1 to 6)</td>
</tr>
<tr>
<td><code>&lt;value3&gt;</code></td>
<td>Data Query Response</td>
</tr>
</tbody>
</table>

**Examples**

```
OUTPUT #E5100;"INPUTRACB 5, 1, ";DVAL("1010",2)  
OUTPUT #E5100;"INPUTRACB 5, 2, ";DVAL("0100",2)  
OUTPUT #E5100;"INPUTRACB 5, 3, ";DVAL("0000",2)  
```

If HP E5100A/B OPT. 022 is set up by the above commands, the data described in the following figure will be outputted to the I/O port when the measured phase reaches the target value at the measured point 5.

![Diagram of Data Output Timing Chart](image)

**Figure 8-1. The Data Output Timing Chart**
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)

<table>
<thead>
<tr>
<th>Query Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>{STD(005(006)), STD : Standard I/O port, 005 : Option 005 I/O port, 006 : Option 006 I/O port}</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Examples</th>
</tr>
</thead>
</table>
| OUTPUT @E5100;"IOPO?"  
ENTER @E5100:A$ |

LIMILINE \{ON|OFF\}

Sets limit line display ON or OFF.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>SYSTEM LIMIT LINE ON off</th>
</tr>
</thead>
</table>
| Parameter Range         | OFF : Limit lines OFF  
ON : Limit lines ON |
| Query Response          | {1|0}  
0 : Limit lines OFF  
1 : Limit lines ON |

<table>
<thead>
<tr>
<th>Examples</th>
</tr>
</thead>
</table>
| OUTPUT 717;"LIMILINE ON"  
OUTPUT 717;"LIMILINE?"  
ENTER 717;A |

LIMITEST \{ON|OFF\}

Sets the limit testing ON or OFF.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>SYSTEM LIMIT TEST ON off</th>
</tr>
</thead>
</table>
| Parameter Range         | OFF : Limit testing OFF  
ON : Limit testing ON |
| Query Response          | {1|0}  
OUTPUT @E5100;"LIMITEST ON"  
OUTPUT @E5100;"LIMITEST?"  
ENTER @E5100:A |
**LINFREQ**
This command equals SWPT LINF. See SWPT.

**LINM**
This command equals FMT LINM. See FMT.

**LISDFBASE**
Display trace on frequency base when the frequency list sweep is used. (No Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Sweep SWEEP TYPE MENU MORE LIST DISP: FREQ BASE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100;&quot;LISDFBASE&quot;</td>
</tr>
</tbody>
</table>

**LISDOBASE**
Displays the measured data on order base.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Sweep SWEEP TYPE MENU MORE ORDER BASE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100;&quot;LISDOBASE&quot;</td>
</tr>
</tbody>
</table>

**LISFREQ**
This command equals SWPT LIST. See SWPT.

**LISSLIS1**
Activates LIST 1 for the list sweep. (No Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Sweep SWEEP TYPE MENU MORE LIST [ ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100;&quot;LISSLIS1&quot;</td>
</tr>
</tbody>
</table>

**LISSLIS2**
Activates LIST 2 for the list sweep. (No Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Sweep SWEEP TYPE MENU MORE LIST [ ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100;&quot;LISSLIS2&quot;</td>
</tr>
</tbody>
</table>
LMAX? value
Outputs the nth local maximum value from the left of range which is set by the ANARANG command. (Query only)

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>1 to</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>{value} 3.40282347E+38 will be output when no appropriate points are found.</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100; &quot;LMAX 1&quot;</td>
</tr>
<tr>
<td></td>
<td>OUTPUT @E5100; &quot;LMAX?&quot;</td>
</tr>
<tr>
<td></td>
<td>ENTER @E5100; A</td>
</tr>
</tbody>
</table>

LMIN? value
Outputs the nth local minimum value from the left of range which is set by the ANARANG command. (Query only)

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>1 to</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>{value} 3.40282347E+38 will be output when no appropriate points are found.</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100; &quot;LMIN 1&quot;</td>
</tr>
<tr>
<td></td>
<td>OUTPUT @E5100; &quot;LMIN?&quot;</td>
</tr>
<tr>
<td></td>
<td>ENTER @E5100; A</td>
</tr>
</tbody>
</table>

LOGM
This command equals FMT LOGM. See FMT.

LOGMD
This command equals FMT LOGMD. See FMT.

LOGMP
This command equals FMT LOGMP. See FMT.

LOWELIMI <value1><value2><value3> ... <valuenn>
Sets the lower limit values of the limit line. The lower value can be set at each measurement point.
LOWELIMI <value1><value2><value3> ... <valueN>

Parameter Description
n = Number of points
<value> : Lower value of limit line

Query Response
{value1} {value2} {value3} ... {valueN}

Examples
DIM A(1:201)

NOP: 201
Set lower value of limit line

OUTPUT &E5100;"LOWELIMI";A(*)

OUTPUT &E5100;"LOWELIMI?"
ENTER &E5100;A(*)

MARD {ON|OFF}
Displays (ON) or does not display (OFF) markers and the marker information on the screen.

Parameter Range
OFF : Marker display OFF
ON : Marker display ON

Query Response
{1|0}

0 : Marker display OFF
1 : Marker display ON

Examples
OUTPUT &E5100;"MARD OFF"

OUTPUT &E5100;"MARD?"
ENTER &E5100;A

MARK {1-4}
Selects the active marker and sets the marker stimulus value.

Equivalent Key Sequence

Parameter Range
<value> : 10×10^3 (−10k) to 300×10^6 (−300M) Hz
<value> : −9 to +11 dBm (−48 to +22 dBm option 010 only) (Option 010, frequency sweep only)

Query Response
{value}

Examples
OUTPUT &E5100;"MARK1 20MHz"

OUTPUT &E5100;"MARK1?"
ENTER &E5100;A
**MARKBuck value**
Moves the active marker to specified data point number. (No Query)

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>1 to “number of points”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT #E5100;&quot;MARKBuck 20&quot;</td>
</tr>
</tbody>
</table>

**MARKCENT**
Changes the stimulus center value to the active marker value. (No Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Center, Span, Start, Stop, MARKER—CENTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT #E5100;&quot;MARKCENT&quot;</td>
</tr>
</tbody>
</table>

**MARKCONT**
Interpolates between measured points to allow the markers to be placed at any point on the trace.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Marker, MKR_MODE_MENU, CONTINUOUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT #E5100;&quot;MARKCONT&quot;</td>
</tr>
</tbody>
</table>

**MARKCOUP**
Couples the marker stimulus values for the two display channels.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Marker, MKR_MODE_MENU, MARKERS: COUPLED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT #E5100;&quot;MARKCOUP&quot;</td>
</tr>
</tbody>
</table>

**MARKDISC**
Places markers only on measured trace points determined by the stimulus settings.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Marker, MKR_MODE_MENU, MARKERS: DISCRETE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT #E5100;&quot;MARKDISC&quot;</td>
</tr>
</tbody>
</table>
**MARKFSTI** `value` `[suffix]`

Sets the fixed marker stimulus value offset.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Marker</th>
<th>AMODE MENU</th>
<th>FIXED MRR POSITION</th>
<th>FIXED MRR STIMULUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Range</td>
<td><code>&lt;value&gt;</code> : 10 k to 300 MHz  &lt;br&gt;  <code>&lt;value&gt;</code> : -64 to 18 dBm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Query Response</td>
<td><code>{value}</code></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Examples                | OUTPUT @E5100;"MARKFSTI"  
OUTPUT @E5100;"MARKFSTI?"  
ENTER @E5100;A |

**MARKFVAL** `value` `[suffix]`

Sets the fixed marker position value offset.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Marker</th>
<th>AMODE MENU</th>
<th>FIXED MRR POSITION</th>
<th>FIXED MRR VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Range</td>
<td><code>-500x10^5</code> to <code>500x10^5</code></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Query Response</td>
<td><code>{value}</code></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Examples                | OUTPUT @E5100;"MARKFVAL"  
OUTPUT @E5100;"MARKFVAL?"  
ENTER @E5100;A |

**MARKL** `{ON|OFF}`

Displays (ON) or does not display (OFF) the list of stimulus values and response values of all markers.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>MARK</th>
<th>MRR LIST on OFF</th>
</tr>
</thead>
</table>
| Parameter Range         | OFF : Marker list OFF  
ON : Marker list ON |
| Query Response          | 0 : Marker list OFF  
1 : Marker list ON |
| Examples                | OUTPUT @E5100;"MARKL OFF"  
OUTPUT @E5100;"MARKL?"  
ENTER @E5100;A |
MARKODATA
Enables the marker to move on the measurement data trace.

Examples | OUTPUT @E5100: "MARKODATA"

MARKOFF
Turns off all the markers and the delta reference marker.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Marker ALL MKR OFF</th>
</tr>
</thead>
</table>

Examples | OUTPUT @E5100: "MARKOFF"

MARKOMEMO
Enables the marker to move on the memory data trace.

Examples | OUTPUT @E5100: "MARKOMEMO"

MARKREF
Changes the reference value to the active marker's response value, without changing the reference position. (No Query)

Examples | OUTPUT @E5100: "MARKREF"

MARKSPAN
Changes the start and stop values of the stimulus span to the active marker and the delta reference marker.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Center Span Start Stop MARKER-SPAN</th>
</tr>
</thead>
</table>

Examples | OUTPUT 717: "MARKSPAN"

Command Reference 8-39
MARKSTAR
Changes the start value of the stimulus to the active marker value. (No Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Center</th>
<th>Span</th>
<th>Start</th>
<th>Stop</th>
<th>MARKER → START</th>
</tr>
</thead>
</table>

Examples

OUTPUT 717; "MARKSTAR"

MARKSTOP
Changes the stop value of the stimulus to the active marker value. (No Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Center</th>
<th>Span</th>
<th>Start</th>
<th>Stop</th>
<th>MARKER → STOP</th>
</tr>
</thead>
</table>

Examples

OUTPUT 717; "MARKSTOP"

MARKTIME \{OFF|ON\}
Sets the x-axis marker readout to the sweep time (ON), or cancels the setting (OFF).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Mkr TIME on OFF</th>
</tr>
</thead>
</table>

Parameter Range

OFF: Marker time OFF
ON: Marker time ON

Query Response

{1|0}

Examples

OUTPUT 0E5100; "MARKTIME ON"
OUTPUT 0E5100; "MARKTIME?"
Enter 0E5100; A

MARKUNCO

Allows the marker stimulus values to be controlled independently on each channel.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Marker UNCOUPE</th>
</tr>
</thead>
</table>

Examples

OUTPUT 0E5100; "MARKUNCO"
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.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Marker AMODE MENU MKR ZERO AREP=0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT #E5100;&quot;MARKZERO&quot;</td>
</tr>
</tbody>
</table>

MAXPOIN?
Outputs the maximum number of the measurement points. (Query only)

| Query Response | (401|801|1601) |
|----------------|--------|
| Examples       | OUTPUT #E5100;"MAXPOIN?"           |
|                | ENTER #E5100;A                      |

MAXPORT?
Outputs the number of ports (receivers). (Query only)

| Query Response | (1|2|3|4) |
|----------------|-----|
| Examples       | OUTPUT #E5100;"MAXPORT?"           |
|                | ENTER #E5100;A                      |

MEAS1PT? <value>
Outputs measurement value at the point number specified by the parameter.
When the trap function is turn on (TRAP ON), MEAS1PT waits to start a measurement until the phase value is in the condition specified by INPUTAC command, and returns the query response.

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>1 to NOP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>{value}</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT #E5100;&quot;MEAS1PT? 10000000&quot;</td>
</tr>
<tr>
<td></td>
<td>OUTPUT #E5100;&quot;MEAS1PT?&quot;</td>
</tr>
<tr>
<td></td>
<td>ENTER #E5100;A</td>
</tr>
</tbody>
</table>
MEAS parameter
Selects the parameters or inputs to be measured.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>MEAS A/R, R, A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>AR : A/R measurement</td>
</tr>
<tr>
<td></td>
<td>BR : A/R measurement</td>
</tr>
<tr>
<td></td>
<td>CR : A/R measurement</td>
</tr>
<tr>
<td></td>
<td>RA : R/A measurement</td>
</tr>
<tr>
<td></td>
<td>BA : B/A measurement</td>
</tr>
<tr>
<td></td>
<td>CA : C/A measurement</td>
</tr>
<tr>
<td></td>
<td>RB : R/B measurement</td>
</tr>
<tr>
<td></td>
<td>AB : A/B measurement</td>
</tr>
<tr>
<td></td>
<td>CB : C/B measurement</td>
</tr>
<tr>
<td></td>
<td>RC : R/C measurement</td>
</tr>
<tr>
<td></td>
<td>AC : A/C measurement</td>
</tr>
<tr>
<td></td>
<td>BC : B/C measurement</td>
</tr>
<tr>
<td></td>
<td>R : R measurement</td>
</tr>
<tr>
<td></td>
<td>A : A measurement</td>
</tr>
<tr>
<td></td>
<td>B : B measurement</td>
</tr>
<tr>
<td></td>
<td>C : C measurement</td>
</tr>
</tbody>
</table>

| Query Response | {AR|BR|CR|RA|BA|CA|RB|AB|CB|RC|AC|BC|R|A|B|C} |
|----------------|----------------------------------|
| Examples       | OUTPUT &E5100;"MEAS AR"          |
|                | OUTPUT &E5100;"MEAS?"             |
|                | ENTER &E5100;A$                  |

MEASA
This command equals MEAS A. See MEAS.

MEASR
This command equals MEAS R. See MEAS.

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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Marker</th>
<th>UTILITY</th>
<th>MENU</th>
<th>STATISTICS</th>
<th>ON</th>
<th>OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Range</td>
<td>OFF :</td>
<td>Marker</td>
<td>statistic</td>
<td>OFF</td>
<td>ON :</td>
<td>Marker statistic ON</td>
</tr>
<tr>
<td>Query Response</td>
<td>{1</td>
<td>0}</td>
<td>0 :</td>
<td>Marker statistic OFF</td>
<td>1 : Marker statistic ON</td>
<td></td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT &amp;E5100;&quot;MEASTAT ON&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>OUTPUT &amp;E5100;&quot;MEASTAT?&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ENTER &amp;E5100;A$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Command Reference
**MOVADARY**

**MENU3\(\langle value\rangle,\langle string1\rangle,\langle string2\rangle,\langle string3\rangle\)**

Defines the user softkey mene of Menu3. (No Query)

<table>
<thead>
<tr>
<th>Parameter Description</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\langle value\rangle)</td>
<td>Softkey position (1 to 8)</td>
</tr>
<tr>
<td>(\langle string1\rangle)</td>
<td>Upper softkey label (Up to ten characters)</td>
</tr>
<tr>
<td>(\langle string2\rangle)</td>
<td>Lower softkey label (Up to ten characters)</td>
</tr>
<tr>
<td>(\langle string3\rangle)</td>
<td>HP-IB command to be executed</td>
</tr>
</tbody>
</table>

**Examples**

```
OUTPUT @E5100;"MENU3 1,""START"",""100 MHz"",",""STAR 100MA""
```

**MOHMSW \{A\|B\},\{ON\|OFF\}**

Sets 1 MΩ input ON or OFF. (option 101 only)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>System INPUT Z PORT A</td>
<td>A: Port A</td>
</tr>
<tr>
<td>PROT B</td>
<td>B: Port B</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter Description</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Port A</td>
</tr>
<tr>
<td>B</td>
<td>Port B</td>
</tr>
<tr>
<td>ON</td>
<td>1 MΩ input</td>
</tr>
<tr>
<td>OFF</td>
<td>50 Ω input</td>
</tr>
</tbody>
</table>

**Query Response**

\{ON\|OFF\}

**Examples**

```
OUTPUT @E5100;"MOHMSW A,ON"
OUTPUT @E5100;"MOHMSW A"
ENTER @E5100;A$
```

**MONDYEAR**

Changes the displayed date to the “month:day:year” format. (No Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>System MORE SET CLOCK</td>
<td>MORE SET CLOCK DATE MODE: MONDAYEAR</td>
</tr>
</tbody>
</table>

**Examples**

```
OUTPUT @E5100;"MONDYEAR"
```

**MOVADARY**

Enters measurement data triggered by TRIGMEAS command. This command is only used for the parallel processing using with TRIGMEAS and MOVADARY. (No Query)
MULC {OFF|ON|0|1}
Selects the multi (ON) or single (OFF) channels display.

Equivalent Key Sequence

Parameter Description
OFF and 0 : Active channel only
ON and 1 : Multi-channel

Query Response
{0\{1}

Examples
OUTPUT @E5100;"MULC ON"
OUTPUT @E5100;"MULC?"
ENTER @E5100;A

NEGL
Sets the output of the 24-bit I/O port to the negative logic. (No Query)

Examples
OUTPUT @E5100;"NEGL"

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 D. (Query only)

Query Response
{value1}{value2}

Examples
OUTPUT @E5100;"NEXPK?"
ENTER @E5100;A,B

NUMC <value>
Sets the number of channel.

Equivalent Key Sequence

Parameter Range
1 to 4

Query Response
{value}

Examples
OUTPUT @E5100;"NUMC 3"
OUTPUT @E5100;"NUMC?"
ENTER @E5100;A

8-44 Command Reference
NUMG *value*
Triggers a user-specified number of sweeps, and returns to the HOLD mode. (No Query)

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>Greater than 0, integer only</th>
</tr>
</thead>
</table>

| Examples         | OUTPUT @E5100;"NUMG 10" |

NUMLMAX?
Outputs the number of local maximums within the range set by the ANARANG command. (Query only)

<table>
<thead>
<tr>
<th>Query Response</th>
<th>{value} (number of local maximums)</th>
</tr>
</thead>
</table>

| Examples         | OUTPUT @E5100;"NUMLMAX?"
                 | ENTER @E5100;A |

NUMLMIN?
Outputs the number of local minima within the range set by the ANARANG command. (Query only)

<table>
<thead>
<tr>
<th>Query Response</th>
<th>{value} (number of local minima)</th>
</tr>
</thead>
</table>

| Examples         | OUTPUT @E5100;"NUMLMIN?"
                 | ENTER @E5100;A |

NUMLMINMAX?
Outputs the total number of the local maximum and local minimum points within the range specified by the ANARANG command. (Query only)

<table>
<thead>
<tr>
<th>Query Response</th>
<th>{value}</th>
</tr>
</thead>
</table>

| Examples         | OUTPUT @E5100;"NUMLMINMAX?"
                 | ENTER @E5100;A |

OSE *value*
Enables the operational status register.

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>0 to 65535 ((-2^{16}) – 1, decimal expression of enable bits of the operational status register)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Query Response</th>
<th>{value}</th>
</tr>
</thead>
</table>

| Examples          | OUTPUT @E5100;"OSE 1" |
**OSER?**
Outputs the current value in the event register of an operational status register. (Query only)

<table>
<thead>
<tr>
<th>Query Response</th>
<th>{value}</th>
</tr>
</thead>
</table>
| **Examples**   | OUTPUT @E5100; "OSER?"
|                | ENTER @E5100; A |

**OSNT**
Sets the negative transition filter of an operational status register.

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>0 to 65535 ((=2^{16}-1), decimal expression of the operational status register)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>{value}</td>
</tr>
</tbody>
</table>
| **Examples**    | OUTPUT @E5100; "OSNT 1"
|                | OUTPUT @E5100; "OSNT?"
|                | ENTER @E5100; A |

**OSPT**
Sets the positive transition filter of an operational status register.

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>0 to 65535 ((=2^{16}-1), decimal expression of the operational status register)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>{value}</td>
</tr>
</tbody>
</table>
| **Examples**    | OUTPUT @E5100; "OSPT 1"
|                | OUTPUT @E5100; "OSPT?"
|                | ENTER @E5100; A |

**OSR?**
Outputs the operational status register value. (Query only)

<table>
<thead>
<tr>
<th>Query Response</th>
<th>{value}</th>
</tr>
</thead>
</table>
| **Examples**   | OUTPUT @E5100; "OSR?"
|                | ENTER @E5100; A |
OUT1ENVH
Sets OUTPUT1 set to HIGH when a pulse input has occurred at INPUT1. (No Query)

Examples
OUTPUT @E5100;"OUT1ENVH"

OUT1ENVL
Sets OUTPUT1 set to LOW when a pulse input has occurred at INPUT1. (No Query)

Examples
OUTPUT @E5100;"OUT1ENVL"

OUT1H
Sets OUTPUT1 to HIGH. (No Query)

Examples
OUTPUT @E5100;"OUT1H"

OUT1L
Sets OUTPUT1 to LOW. (No Query)

Examples
OUTPUT @E5100;"OUT1L"

OUT2ENVH
Sets OUTPUT2 set to HIGH when a pulse input has occurred at INPUT1 of the 24 bit I/O port. (No Query)

Examples
OUTPUT @E5100;"OUT2ENVH"

OUT2ENVL
Sets OUTPUT2 set to LOW when a pulse input has occurred at INPUT1 of the 24 bit I/O port. (No Query)

Examples
OUTPUT @E5100;"OUT2ENVL"
OUT2H
Sets OUTPUT2 to HIGH. (No Query)

Examples
| OUTPUT @E5100;"OUT2H" |

OUT2L
Sets OUTPUT2 to LOW. (No Query)

Examples
| OUTPUT @E5100;"OUT2L" |

OUTSIO value
Outputs the data to the 8-bit parallel output port. (Option 005 only, No Query)

Parameter Range | 0 to 255
Examples
| OUTPUT @E5100;"OUTSIO 0" |

OUTAIO value
Output decimal data specified as the parameter to port A (8 bit) of the 24-bit I/O port. (No Query)

Parameter Range | 0 to 255
Examples
| OUTPUT @E5100;"OUTAIO 0" |

OUTBIO value
Output decimal data specified as the parameter to port B (8 bit) of the 24-bit I/O port. (No Query)

Parameter Range | 0 to 255
Examples
| OUTPUT @E5100;"OUTBIO 0" |
**OUTCIO value**

Output decimal data specified as the parameter to port C (4 bit) of the 24-bit I/O port. (No Query)

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>0 to 15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT $E5100;&quot;OUTCIO 0&quot;</td>
</tr>
</tbody>
</table>

**OUTDIO value**

Output decimal data specified as the parameter to port D (4 bit) of the 24-bit I/O port. (No Query)

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>0 to 15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT $E5100;&quot;OUTDIO 0&quot;</td>
</tr>
</tbody>
</table>

**OUTEIO value**

Output decimal data specified as the parameter to port E (8 bit) of the 24-bit I/O port. (No Query)

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>0 to 255</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT $E5100;&quot;OUTEIO 0&quot;</td>
</tr>
</tbody>
</table>

**OUTFIO value**

Output decimal data specified as the parameter to port F (16 bit) of the 24-bit I/O port. (No Query)

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>0 to 65535</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT $E5100;&quot;OUTFIO 0&quot;</td>
</tr>
</tbody>
</table>

**OUTGIO value**

Output decimal data specified as the parameter to port G (20 bit) of the 24-bit I/O port. (No Query)

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>0 to 1048575</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT $E5100;&quot;OUTGIO 0&quot;</td>
</tr>
</tbody>
</table>
OUTHIO value
Output decimal data specified as the parameter to port H (24 bit) of the 24-bit I/O port. (No Query)

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>0 to 16777215</th>
</tr>
</thead>
</table>

Examples

```
OUTPUT @E5100;"OUTHIO 0"
```

OUTPCALC{01-03}?
Outputs the active calibration set array of the active channel. (Query only)

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>Query Response</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>{value (1)} {value (2)} \ldots {value (n)};</td>
</tr>
<tr>
<td></td>
<td>\n: Number of points</td>
</tr>
<tr>
<td></td>
<td>\value: Complex value (data format : real, imaginary)</td>
</tr>
</tbody>
</table>

Examples

```
DIM A (1:201,1:2) 
NOP: 201 
OUTPUT @E5100;"OUTCALCO1?"
ENTER @E5100;A(*)
```

OUTPCERR?
Outputs the ceramic resonator parameters within the range specified by the ANARANGE command. (Query only)

<table>
<thead>
<tr>
<th>Query Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>{value}, {value2}, {value3}, {value4}, {value5}, {value6}, {value7}</td>
</tr>
</tbody>
</table>

```
\{value\}: Gain at fr (Gr) 
\{value2\}: Resonant frequency (Fr) 
\{value3\}: Gain at (fa) 
\{value4\}: Anti-resonant frequency fa (Gfa) 
\{value5\}: Maximum ripple height in left side of resonant point 
\{value6\}: Maximum ripple height between resonant and anti-resonant point 
\{value7\}: Maximum ripple height in right side of anti-resonant point 
```

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

This command is only available when the "LOG MAG & Phase", "LOG MAG & Delay" or "LOG MAG" formats are selected. If another format is selected, the query returns 0.

If Z-conversion is selected, then the impedance at fr (Zr) instead of the Gr and the impedance at fa (Zfa) instead of the Gfa are returned.

<table>
<thead>
<tr>
<th>Query Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>{value}, {value2}, \ldots, {value7}</td>
</tr>
</tbody>
</table>

Examples

```
OUTPUT @E5100;"OUTPCERR?"
```

Query the ceramic resonator parameters. 
```
ENTER @E5100;Gr,Fr,Gs, Fa,Rp11,Rp12,Rp13
```

Receive the all return values.
OUTPCF2?I<value1>,<value2>,<value3>,<value4>,<value5> ... ,<value+n>4>

OUTPCF2?I<value1>,<value2>,<value3>,<value4>,<value5> ... ,<value+n>4>

Outputs filter parameters within the range specified by the ANARANG command. This command outputs the same parameters as OUTPCFII and outputs up to 20 sets of frequency offsets from center frequency (f0) to left and right cutoff points (Δfleft n, Δfright n).

Where,
- If two cutoff points which are x, dB below the maximum peak are not found, zeros will be returned for all parameters.
- If two cutoff points which are X, dB below the maximum value are not found, zeroes will be returned for Δfleft n and Δfright n.
- If no peaks are found, zeroes will be returned for Polex1, Polestim1, Pole x2, Polestim2.

<table>
<thead>
<tr>
<th>Parameter Description</th>
<th>&lt;value1&gt;</th>
<th>Nominal frequency (f0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;value2&gt;</td>
<td>Difference value from the maximum value (D)</td>
<td></td>
</tr>
<tr>
<td>&lt;value3&gt;</td>
<td>Stop frequency of rejection band (f1)</td>
<td></td>
</tr>
<tr>
<td>&lt;value4&gt;</td>
<td>Start frequency of spurious level range (f2)</td>
<td></td>
</tr>
<tr>
<td>&lt;value5&gt;</td>
<td>Relative offset value from maximum peak value to determine the cutoff point (x1 [dB])</td>
<td></td>
</tr>
<tr>
<td>&lt;value6&gt;</td>
<td>Relative offset value from maximum peak value to determine the cutoff point (x2 [dB])</td>
<td></td>
</tr>
<tr>
<td>&lt;value+n&gt;</td>
<td>Relative offset value from maximum peak value to determine the cutoff point (x_n [dB]) (2≤n≤20)</td>
<td></td>
</tr>
</tbody>
</table>

Query Response

{value1}{value2} ... {value2n+11)}

{value1} : insertion loss
{value2} : constant loss (Lossc)
{value3} : x1 dB bandwidth
{value4} : center frequency (fcent)
{value5} : Q
{value6} :Ripple value at the passband
{value7} :Rejection
{value8} :Spurious level
{value9} :Left pole (negative peak in the left side of the maximum value)
(Polex1)
{value10} :Stimulus value of Polex1 (Polestim1)
{value11} :Right pole (negative peak in the right side of the maximum value)
(Polex2)
{value12} :Stimulus value of Polex2 (Polestim2)
{value13} :difference between f0 and the left point of cutoff frequency (Δfleft1)
{value14} :difference between f0 and the right point of cutoff frequency (Δfright1)
{value15} :Δfleft2
{value16} :Δfright2
...
{value2n+10} :Δfleft n
{value2n+11} :Δfright n

Examples

OUTPUT @E5100;"OUTPCF2? 90M,0.1,90.2,3,10,12,20"
ENTER @E5100;A(10),B(*)
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 x1dB and x2dB to the maximum peak value to determine the cutoff points, same parameter with POLE?, and f1 and f2 for determining rejection level and spurious level respectively. For details, refer to Appendix D. (Query only)

<table>
<thead>
<tr>
<th>Parameter Description</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;value1&gt;</td>
<td>Nominal frequency (f0)</td>
</tr>
<tr>
<td>&lt;value2&gt;</td>
<td>Relative offset value from maximum peak value to determine the cutoff point (x1) [dB]</td>
</tr>
<tr>
<td>&lt;value3&gt;</td>
<td>Relative offset value from maximum peak value to determine the cutoff point (x2) [dB]</td>
</tr>
<tr>
<td>&lt;value4&gt;</td>
<td>POLE? parameter</td>
</tr>
<tr>
<td>&lt;value5&gt;</td>
<td>Stop frequency of rejection band (f1)</td>
</tr>
<tr>
<td>&lt;value6&gt;</td>
<td>Start frequency of spurious level range (f2)</td>
</tr>
</tbody>
</table>

Query Response

{value1}, {value2}, ..., {value6}

{value1} : insertion loss
{value2} : constant loss
{value3} : dB bandwidth
{value4} : center frequency
{value5} : Q
{value6} : difference between the middle point of the analysis range and the left point of cutoff frequency
{value7} : difference between the middle point of the analysis range and the right point of cutoff frequency
{value8} : difference between the middle point of the analysis range and the left point of cutoff frequency
{value9} : difference between the middle point of the analysis range and the right point of cutoff frequency
{value10} : Ripple value at the passband
{value11} : Rejection
{value12} : Spurious level
{value13} : Left pole (negative peak in the left side of the maximum value)
{value14} : Stimulus value of the left pole
{value15} : Right pole (negative peak in the right side of the maximum value)
{value16} : Stimulus value of the right pole

Examples

DIM ANS(1:16)
OUTPUT @ES100;"OUTPCFIL?";7.0E6,-10,-20,-40,1E3,1E3
ENTER @ES100;ANS(*)

OUTPDATA?

Outputs data trace value. (Query only)

<table>
<thead>
<tr>
<th>Query Response</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>{numeric (1)}</td>
<td>{numeric (2)} ... {numeric (n)}</td>
</tr>
<tr>
<td>n</td>
<td>Number of points</td>
</tr>
<tr>
<td>numeric</td>
<td>Complex value (data format: real, imaginary)</td>
</tr>
</tbody>
</table>

Examples

DIM A(1:201,1:2)  NOP: 201
OUTPUT @ES100;"OUTPDATA?"
ENTER @ES100;A(*)

8-52  Command Reference
OUTPDATAP <value>
Outputs the data at the specified point from the data array.

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>&lt;value&gt;: number of points (1 to NOP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>{value}</td>
</tr>
<tr>
<td></td>
<td>value: Complex data (data format: real, imaginary)</td>
</tr>
</tbody>
</table>
| Examples        | OUTPUT #E5100;"OUTPDATAP? 1"
                 | ENTER #E5100;A |

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. (Query only)

<table>
<thead>
<tr>
<th>Query Response</th>
<th>{value1} {value2} ... {value16}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>DIM A(1:16)</td>
</tr>
<tr>
<td></td>
<td>OUTPUT #E5100;&quot;STIDROUT1&quot;;Freq</td>
</tr>
<tr>
<td></td>
<td>OUTPUT #E5100;&quot;OUTPDATAT?&quot;</td>
</tr>
<tr>
<td></td>
<td>ENTER #E5100;A(*)</td>
</tr>
</tbody>
</table>

OUTPDATTP? value
Outputs the data-trace data at the specified point. (Query only)

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>value: point number n (1 to Number of Points)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>{numeric}</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT #E5100;&quot;OUTPDATTP &quot;;1</td>
</tr>
<tr>
<td></td>
<td>ENTER #E5100;A</td>
</tr>
</tbody>
</table>

OUTPERRO?
Outputs the error message in the error queue. (Query only)

<table>
<thead>
<tr>
<th>Query Response</th>
<th>{value}, {string}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;value&gt; : Error number</td>
</tr>
<tr>
<td></td>
<td>&lt;string&gt; : Error string</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT #E5100;&quot;OUTPERRO?&quot;</td>
</tr>
<tr>
<td></td>
<td>ENTER #E5100;A, ERR$</td>
</tr>
</tbody>
</table>
OUTPFILT? value

Outputs filter parameters within the range specified by the ANARANG command. Command parameter sets the offset of xdB to the maximum peak value to determine the cutoff points. For details, refer to Appendix D. (Query only)

<table>
<thead>
<tr>
<th>Parameter Description</th>
<th>(&lt;\text{value}&gt;) : Relative offset value from maximum x[dB]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>{value1}, {value2}, ... , {value6}</td>
</tr>
<tr>
<td></td>
<td>{value1} : Insertion loss</td>
</tr>
<tr>
<td></td>
<td>{value2} : xdB bandwidth</td>
</tr>
<tr>
<td></td>
<td>{value3} : Center frequency</td>
</tr>
<tr>
<td></td>
<td>{value4} : Q</td>
</tr>
<tr>
<td></td>
<td>{value5} : Difference between the middle value of analysis range and the left cutoff frequency (AL.F)</td>
</tr>
<tr>
<td></td>
<td>{value6} : Difference between the middle value of analysis range and the right cutoff frequency (AR.F)</td>
</tr>
</tbody>
</table>

Examples

```
OUTPUT @E5100; "OUTPFILT? -3"
ENTER @E5100; ANS(*)
```

OUTPFORM?

Outputs the formatted trace data. (Query only)

<table>
<thead>
<tr>
<th>Query Response</th>
<th>{value (1)} {value (2)} ... {value (n)}</th>
</tr>
</thead>
<tbody>
<tr>
<td>n: Number of point</td>
<td></td>
</tr>
<tr>
<td>value: complex value (data format : Real, Imaginary)</td>
<td></td>
</tr>
</tbody>
</table>

Examples

```
DIM A(1:201,1:2)
NOP: 201
OUTPUT @E5100; "OUTPFORM?"
ENTER @E5100; A(*)
```

OUTPFORMP? value

Outputs the formatted trace data at the specified point. (Query only)

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>1 to &quot;number of points&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>{value}</td>
</tr>
<tr>
<td></td>
<td>value : complex value (data format : real, imaginary)</td>
</tr>
</tbody>
</table>

Examples

```
OUTPUT @E5100; "OUTPFORMP?"
ENTER @E5100; A,B
```
OUTPIFORM?
Outputs the formatted data from the inactive channel. (Query only)
When the number of channel is 3 or 4, this command outputs data from the following channel:

<table>
<thead>
<tr>
<th>Active Channel</th>
<th>Channel the OUTPIFORM? command outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>

Query Response

\{value (1)\} \{value (2)\} \ldots \{value (n)\}

n: number of points
value: Complex value (data format: real, imaginary)

Examples

```
DIM A(1:201,1:2)    \text{NOP: 20I}
OUTPUT @E5100;"OUTPIFORM?"
ENTER @E5100;A(*)
```

OUTPINP8IO?
Outputs the data entered from the 4-bit parallel input port. (option 005 only; Query only)

Query Response

\{value\}

Examples

```
OUTPUT @E5100;"OUTPINP8IO?"
ENTER @E5100;A
```

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

Query Response

\{value\}

Examples

```
OUTPUT @E5100;"OUTPINPCIO?"
ENTER @E5100;A
```

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

Query Response

\{value\}

Examples

```
OUTPUT @E5100;"OUTPINPDIO?"
ENTER @E5100;A
```
OUTPINPEIO?
Outputs the data entered from port E (8 bit) of the 24-bit I/O port. (Query only)

<table>
<thead>
<tr>
<th>Query Response</th>
<th>{value}</th>
</tr>
</thead>
</table>
| Examples       | OUTPUT \$E5100;"OUTPINPEIO?"  
ENTER \$E5100;A |

OUTPIRFORM?
Outputs the real part of the formatted data from the inactive channel. (Query only)

<table>
<thead>
<tr>
<th>Query Response</th>
<th>{value (1)} {value (2)} ... {value (n)}</th>
</tr>
</thead>
<tbody>
<tr>
<td>\n: Number of points</td>
<td></td>
</tr>
</tbody>
</table>
| Examples       | DIM A(1:201)  
OUTPUT \$E5100;"OUTPIRFORM?"  
ENTER \$E5100;A(\*) |

OUTPIRTMEM?
Outputs the real part of the trace memory data from the inactive channel. (Query only)
When the number of channel is 3 or 4, this command outputs data from the following channel:

<table>
<thead>
<tr>
<th>Active Channel</th>
<th>Channel the OUTPIRFORM? command outputs data</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Query Response</th>
<th>{value (1)} {value (2)} ... {value (n)}</th>
</tr>
</thead>
<tbody>
<tr>
<td>\n: Number of points</td>
<td></td>
</tr>
</tbody>
</table>
| Examples       | DIM A(1:201)  
OUTPUT \$E5100;"OUTPIRTMEM?"  
ENTER \$E5100;A(\*) |

OUTPMARK?
Outputs the active marker values. (Query only)
### OUTPMEMO?

Outputs memory trace value. (Query only)

<table>
<thead>
<tr>
<th>Query Response</th>
<th>{numeric {1} {numeric {2} \ldots {numeric {n}}}</th>
</tr>
</thead>
<tbody>
<tr>
<td>{numeric {1}}</td>
<td>marker value</td>
</tr>
<tr>
<td>{numeric {2}}</td>
<td>marker aux. value</td>
</tr>
<tr>
<td>{numeric {n}}</td>
<td>stimulus</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>OUTPUT @E5100;&quot;OUTPMEMO?&quot;</td>
</tr>
<tr>
<td>ENTER @E5100;A(*)</td>
</tr>
</tbody>
</table>

### OUTPMAX?

Outputs the maximum value within the range specified with the ANARANG command. For details, refer to Appendix D. (Query only)

<table>
<thead>
<tr>
<th>Query Response</th>
<th>{numeric {1}, {numeric {2}}</th>
</tr>
</thead>
<tbody>
<tr>
<td>{numeric {1}}</td>
<td>maximum value</td>
</tr>
<tr>
<td>{numeric {2}}</td>
<td>stimulus value</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>OUTPUT @E5100;&quot;OUTPMAX?&quot;</td>
</tr>
<tr>
<td>ENTER @E5100;A,B</td>
</tr>
</tbody>
</table>

### OUTPMEMAN?

Outputs the mean value within the range specified with the ANARANG command. For details, refer to Appendix D. (Query only)

<table>
<thead>
<tr>
<th>Query Response</th>
<th>{value}</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>OUTPUT @E5100;&quot;OUTPMEMAN?&quot;</td>
</tr>
<tr>
<td>ENTER @E5100;A</td>
</tr>
</tbody>
</table>

### OUTPMEMO?

Outputs memory trace value. (Query only)

<table>
<thead>
<tr>
<th>Query Response</th>
<th>{numeric {1}} {numeric {2}} \ldots {numeric {n}}</th>
</tr>
</thead>
<tbody>
<tr>
<td>{numeric {1}}</td>
<td>{numeric {2}} \ldots {numeric {n}}</td>
</tr>
<tr>
<td>n : Number of points</td>
<td>Complex value (data format: real, imaginary)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIM A(1:201,1:2)</td>
</tr>
<tr>
<td>NOP: 201</td>
</tr>
<tr>
<td>OUTPUT @E5100;&quot;OUTPMEMO?&quot;</td>
</tr>
<tr>
<td>ENTER @E5100;A(*)</td>
</tr>
</tbody>
</table>
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. (Query only)

<table>
<thead>
<tr>
<th>Query Response</th>
<th>{numeric1}, {numeric2} ... {numeric16}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>DIM A(1:16)</td>
</tr>
<tr>
<td></td>
<td>OUTPUT @E5100;&quot;STIMROUT1&quot;;Freq</td>
</tr>
<tr>
<td></td>
<td>OUTPUT @E5100;&quot;OUTPMEMOT?&quot;</td>
</tr>
<tr>
<td></td>
<td>ENTER @E5100;A(*)</td>
</tr>
</tbody>
</table>

OUTPMEMTOP? value

Outputs the memory data at a specified point. (Query only)

<table>
<thead>
<tr>
<th>Parameter Description</th>
<th>value : point number n:(1 to Number of Points)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>{numeric1}, {numeric2}</td>
</tr>
<tr>
<td></td>
<td>{numeric1} : real part</td>
</tr>
<tr>
<td></td>
<td>{numeric2} : imaginary part</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100;&quot;OUTPMEMTOP? &quot;;1</td>
</tr>
<tr>
<td></td>
<td>ENTER @E5100;A,B</td>
</tr>
</tbody>
</table>

OUTPMIN?

Outputs the minimum value within the range specified with the ANARANG command. For details, refer to Appendix D. (Query only)

| Query Response        | {numeric1}, {numeric2}                         |
|                       | {numeric1} : minimum value                     |
|                       | {numeric2} : stimulus value                    |
| Examples              | OUTPUT @E5100;"OUTPMIN?"                        |
|                       | ENTER @E5100;A,B                               |

OUTPMINMAX?

Outputs the maximum and minimum values within the range specified with the ANARANG command. For details, refer to Appendix D. (Query only)
### OUTPMWID?

**Equivalent Key Sequence**

<table>
<thead>
<tr>
<th>Menu 2</th>
<th>RESONANT (MINMAX)</th>
</tr>
</thead>
</table>

**Query Response**

\{numeric1\}, \{numeric2\}, \{numeric3\}, \{numeric4\}

- \{numeric1\} : minimum value
- \{numeric2\} : stimulus value
- \{numeric3\} : maximum value
- \{numeric4\} : stimulus value

**Examples**

`OUTPUT @E5100;"OUTPMWID?"`

`ENTER @E5100;A,B,C,D`

### OUTPMSTA?

Outputs the marker statistics within the specified range by the ANARANG command. (Query only)

**Equivalent Key Sequence**

<table>
<thead>
<tr>
<th>Marker</th>
<th>UTILITY MENU STATISTICS ON off</th>
</tr>
</thead>
</table>

**Query Response**

\{numeric1\}, \{numeric2\}, \{numeric3\}

- \{numeric1\} : mean
- \{numeric2\} : standard deviation
- \{numeric3\} : peak to peak

**Examples**

`OUTPUT @E5100;"OUTPMSTA?"`

`ENTER @E5100;A,B,C`

---

**Note**

Marker UTILITY MENU STATISTICS ON displays the marker statistics within the entire display range.

---

### OUTPMWID?

Outputs the results of the bandwidth search. (Query only)

**Equivalent Key Sequence**

<table>
<thead>
<tr>
<th>Marker</th>
<th>UTILITY MENU WIDTH ON off</th>
</tr>
</thead>
</table>

**Query Response**

\{numeric1\}, \{numeric2\}, \{numeric3\}

- \{numeric1\} : bandwidth
- \{numeric2\} : center
- \{numeric3\} : Q

**Examples**

`OUTPUT @E5100;"WIDV -5"`

`OUTPUT @E5100;"WIDT ON"`

`OUTPUT @E5100;"OUTPMWID?"`

`ENTER @E5100;A,B,C`
OUTPMWIL?

Outputs the results of the bandwidth search with the bandwidth, center value, Q, and the insertion loss. (Query only)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Marker</th>
<th>UTILITY</th>
<th>MENU</th>
<th>WIDTH</th>
<th>ON</th>
<th>OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>{value1}, {value2}, {value3}, {value4}</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>{value1} : Bandwidth</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>{value2} : Center value</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>{value3} : Q</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>{value4} : Insertion loss</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Examples

OUTPUT @E5100;"WIDY -5"
OUTPUT @E5100;"MARK1"
OUTPUT @E5100;"SEAMAX"
OUTPUT @E5100;"WIDY ON"
OUTPUT @E5100;"OUTPMWIL?"
Enter @E5100;A,B,C,D

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. (Query only)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Marker</th>
<th>UTILITY</th>
<th>MENU</th>
<th>WIDTH</th>
<th>ON</th>
<th>OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>{numeric1}, {numeric2}, ..., {numeric6}</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>{numeric1} : Bandwidth</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>{numeric2} : Center</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>{numeric3} : Q</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>{numeric4} : Insertion loss</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>{numeric5} : ΔL,F</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>{numeric6} : ΔR,F</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Examples

OUTPUT @E5100;"WIDY -5"
OUTPUT @E5100;"WIDY ON"
OUTPUT @E5100;"OUTPMWLF?"
Enter @E5100;A,B,C,D,E,F

OUTPRAW?

Outputs the raw data array of the active channel. (Query only)

<table>
<thead>
<tr>
<th>Query Response</th>
<th>{value (1)} {value (2)} ... {value (n)}</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>Number of points</td>
</tr>
<tr>
<td>value</td>
<td>Complex value(data format : Real, Imaginary)</td>
</tr>
</tbody>
</table>

Examples

DIM A(1:201,1:2)
OUTPUT @E5100;"OUTPRAW?"
Enter @E5100;A(•)
OUTPRESF? `value1,value2`

Returns the stimulus of the maximum local maximum and its 1dB below points of both sides, and the stimulus of minimum local-minimum and its 2dB above points of both sides. For more details, refer to Appendix D. (Query only)

| Parameter Description | <numeric1> : down vale from the maximum peak x1[dB]  
|                       | <numeric2> : down value from the minimum peak x2[dB]  
| Query Response        | {numeric1}, {numeric2}, ..., {numeric6}  
|                       | {numeric1} : center frequency between f_{f1} and f_{f2}  
|                       | {numeric2} : center frequency between f_{p1} and f_{p2}  
|                       | {numeric3} : left point of x1dB down points from the maximum peak : f_{f1}  
|                       | {numeric4} : right point of x1dB down points from the maximum peak : f_{f2}  
|                       | {numeric5} : left point of x2dB down points from the maximum peak : f_{p1}  
|                       | {numeric6} : right point of x2dB down points from the maximum peak : f_{p2}  
| Examples              | DIM ANS(1:6)  
|                       | OUTPUT @ES100; "OUTPRESF? ";-3,3  
|                       | ENTER @ES100; ANS(*)  

OUTPRESO?  

Outputs the series resonant (Resonant) and parallel resonant (Anti-Resonant) parameters, 0° phase point frequency f_r, (Resonant frequency) and f_a (Anti-Resonant frequency), and the corresponding gain values G_r and G_a. For details, refer to Appendix D. (Query only)

| Equivalent Key Sequence | Menu② RESONANT (0° PHASE)  
|-------------------------|---------------------------  
| Query Response          | {numeric1}, {numeric2}, ..., {numeric4}  
|                       | {numeric1} : resonance impedance (G_r)  
|                       | {numeric2} : resonance frequency (f_r)  
|                       | {numeric3} : anti-resonance impedance (G_a)  
|                       | {numeric4} : anti-resonance frequency (f_a)  
| Examples                | DIM ANS(1:4)  
|                       | OUTPUT @ES100; "OUTPRESO?"  
|                       | ENTER @ES100; ANS(*)  

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 D. (Query only)
OUTPRESR?

Query Response

\{\text{numeric}1\}, \{\text{numeric}2\}, \ldots, \{\text{numeric}7\}

\{\text{numeric}1\} : resonance impedance (G_{r})
\{\text{numeric}2\} : resonance frequency (f_{r})
\{\text{numeric}3\} : anti-resonance impedance (G_{a})
\{\text{numeric}4\} : anti-resonance frequency (f_{a})
\{\text{numeric}5\} : maximum difference of local maximum and its left local minimum on left of resonant point (rp1)
\{\text{numeric}6\} : maximum difference of local maximum and its right local minimum between resonant and anti-resonant points (rp2)
\{\text{numeric}7\} : maximum difference of the local maximum and its left local minimum on the right of the anti-resonant point (rp3)

Examples

```plaintext
DIM ANS(1:7)
OUTPUT @E5100; "OUTPRESR?"
ENTER @E5100; ANS(*)
```

OUTPRFORM?

Outputs the main trace array of the active channel. (Query only)

Query Response

\{\text{value} (1)\}, \{\text{value} (2)\}, \ldots, \{\text{value} (n)\}

\text{n} : Number of points
\text{value} : Real value

Examples

```plaintext
DIM A(1:201)
OUTPUT @E5100; "OUTPRFORM?"
ENTER @E5100; A(*)
```

OUTPRFORMP? \(<\text{value}>\)

Outputs the specified points of the main trace array of the active channel. (This command equals OUTPDATTTP?) (Query only)

<table>
<thead>
<tr>
<th>Parameter Description</th>
<th>(&lt;\text{value}&gt;): Point number to output : (1 to Number of points)</th>
</tr>
</thead>
</table>

Query Response

\{\text{value}\}

Examples

```plaintext
OUTPUT @E5100; "OUTPRFORMP? 2"
ENTER @E5100; A
```

OUTPRTMEM?

Outputs the sub-trace array of the active channel. (Query only)

Query Response

\{\text{value} (1)\}, \{\text{value} (2)\}, \ldots, \{\text{value} (n)\}

\text{n} : Number of points
\text{value} : Real value

Examples

```plaintext
DIM A(1:201)
OUTPUT @E5100; "OUTPRTMEM?"
ENTER @E5100; A(*)
```
OUTPRTMEMP? <value>

Outputs the specified points of the sub-trace array of the active channel. (This command equals OUTPMEMTP?) The sub-trace is available when the number of channels is set to 2. (Query only)

<table>
<thead>
<tr>
<th>Parameter Description</th>
<th>&lt;value&gt;: Point number: (1 to Number of points)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>&lt;value&gt;</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100:&quot;OUTPRTMEMP? 2&quot;</td>
</tr>
<tr>
<td></td>
<td>ENTER @E5100;A</td>
</tr>
</tbody>
</table>

OUTPSTIM?

Outputs the stimulus array data from the active channel. (Query only)

<table>
<thead>
<tr>
<th>Query Response</th>
<th>{numeric (1)} {numeric (2)} ... {numeric (n)} (n=number of points)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>DIM A(1:201) NOP: 201</td>
</tr>
<tr>
<td></td>
<td>OUTPUT @E5100:&quot;OUTPSTIM?&quot;</td>
</tr>
<tr>
<td></td>
<td>ENTER @E5100;A(*)</td>
</tr>
</tbody>
</table>

OUTPTITL?

Outputs the display title for the active channel. (Query only)

<table>
<thead>
<tr>
<th>Query Response</th>
<th>{string}: less than 54 characters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100:&quot;OUTPTITL?&quot;</td>
</tr>
<tr>
<td></td>
<td>ENTER @E5100;A$</td>
</tr>
</tbody>
</table>

OUTPTRAC?L<value>

Outputs the phase value to trap at a measured point and the setting of I/O port at the point specified by the parameter. The phase value and the I/O port setting are specified by INPUTRAC command. (Query only, Option 022 only)

<table>
<thead>
<tr>
<th>Parameter Description</th>
<th>&lt;value&gt;: measurement point number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>&lt;value&gt; {0</td>
</tr>
<tr>
<td></td>
<td>{value} : Phase value</td>
</tr>
<tr>
<td></td>
<td>{0</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100:&quot;OUTPTRAC? 10&quot;</td>
</tr>
<tr>
<td></td>
<td>ENTER @E5100;A,B</td>
</tr>
</tbody>
</table>
**OUTPTRACB?\{"value1\},\{"value2\}**

Outputs the data outputted to the I/O port when the measured value of phase reaches the limit value. The data outputted to the I/O port is specified by INPUTRACB command. (Query only, Option 022 only)

| Parameter Description | \<value1\> : Measurement point number  
| \<value2\> : Output port number (1 to 6) |
|----------------------|----------------------------------------|
| Query Response       | \{value\}                              |
|                      | \{value\} : Data                       |
| Examples             | OUTPUT \#E5100;"INPUTRACB? 10,1"       |
|                      | ENTER \#E5100;A                         |

**OUTPXF2?\{"value1\},\{"value2\},\{"value3\}, \ldots ,\{"value\n
Outputs filter parameters within the range specified by the ANARANG command. This command outputs the same parameters as OUTPXFIL and outputs up to 20 sets of frequency offsets from center of the analysis range to left and right cutoff points. (Query only)

Where,

- If two cutoff points which are \(x_1\) dB below the maximum peak are not found, zeros will be returned for all parameters.
- If two cutoff points which are \(X_n\) dB below the maximum value are not found, zeroes will be returned for \(\Delta f_{left}\) and \(\Delta f_{right}\).
- If no peaks are found, zeroes will be returned for Pole_{x1}, Pole_{stim1}, Pole_{x2}, Pole_{stim2}.  

8-64 Command Reference
OUTPXFLI? value1,value2,value3,value4,value5

Parameter Description

<value1> : difference from the maximum value
<value2> : stop frequency in rejection band
<value3> : start frequency of spurious level range
<value4> : offset to the maximum peak value to determine the cutoff points \( x_1 \) [dB]
<value5> : offset to the maximum peak value to determine the cutoff points \( x_2 \) [dB]

\( <value + n> \) : offset to the maximum peak value to determine the cutoff points \( x_n \) [dB]
(2 ≤ n ≤ 20)

Query Response

\{value1\} \{value2\} \{value3\} \{value4\} \{value5\} \{value6\} \{value7\} \{value8\} \{value9\} \{value10\} \{value11\} \{value12\} \{value13\} \{value14\} \{value15\} \{value16\} \{value17\} \{value18\} \{value19\} \{value20\}

\{value1\}: insertion loss
\{value2\}: \( x_1 \) dB bandwidth
\{value3\}: center frequency
\{value4\}: \( Q \)
\{value5\}: passband ripple
\{value6\}: rejection level
\{value7\}: spurious level
\{value8\}: negative peak in the left range (pole\(_{x1}\))
\{value9\}: stimulus value of negative peak in the left range (pole\(_{stim1}\))
\{value10\}: negative peak in the right range (pole\(_{x2}\))
\{value11\}: stimulus value of negative peak in the right range (pole\(_{stim2}\))
\{value12\}: frequency offset from center of the analysis range to left cutoff point (\( \Delta f_{left1} \))
\{value13\}: frequency offset from center of the analysis range to right cutoff point (\( \Delta f_{right1} \))
\{value14\}: \( \Delta f_{left2} \)
\{value15\}: \( \Delta f_{right2} \)

\{value6+n\}: \( \Delta f_{left} \) n
\{value6+n\}: \( \Delta f_{right} \) n

Examples

OUTPUT \$E5100;"OUTPXFLI? 3,90M,95M,3,10,12,15,20"
ENTER \$E5100;A(10),B(10)

OUTPXFLI? 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 D. (Data format: loss, bandwidth, center frequency, \( Q \), \( \Delta L.F1 \), \( \Delta R.F1 \), \( \Delta L.F2 \), \( \Delta R.F2 \), passband ripple, rejection level, spurious level, pole\(_{x1}\), pole\(_{stimulus1}\), pole\(_{x2}\), pole\(_{stimulus2}\)) (Query only)
OUTPXFIL? value1,value2,value3,value4,value5

Parameter Range

<numeric1> : offset to the maximum peak value to determine the cutoff points
<numeric2> : offset to the maximum peak value to determine the cutoff points
<numeric3> : difference from the maximum value (same parameter as POLE?)
<numeric4> : stop frequency in rejection band
<numeric5> : start frequency of spurious level range

Query Response

{numeric1}, {numeric2}, ..., {numeric15}

{numeric1} : insertion loss
{numeric2} : x dB bandwidth
{numeric3} : center frequency
{numeric4} : Q
{numeric5} : frequency offset from center of the analysis range to left cutoff point (ΔL.F1)
{numeric6} : frequency offset from center of the analysis range to right cutoff point (ΔR.F1)
{numeric7} : frequency offset from center of the analysis range to left cutoff point (ΔL.F2)
{numeric8} : frequency offset from center of the analysis range to right cutoff point (ΔR.F2)
{numeric9} : passband ripple
{numeric10} : rejection level
{numeric11} : spurious level
{numeric12} : negative peak in the left range (pole_x1)
{numeric13} : stimulus value of negative peak in the left range (pole_stimulus1)
{numeric14} : negative peak in the right range (pole_x2)
{numeric15} : stimulus value of negative peak in the right range (pole_stimulus2)

Examples

DIM ANS(1:15)
OUTPUT #E5100;"OUTPXFIL? ";-10,-20,-40,1E3,1E5
ENTER #E5100;ANS(*)

PARS {OFF|ON|0|1}

Sets the partial search of the marker search function on or off.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Marker</th>
<th>MKR SEARCH</th>
<th>I</th>
<th>SEARCH RANGE</th>
<th>PART SRCH</th>
<th>ON</th>
<th>OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Range</td>
<td>OFF or 0 : partial search ON</td>
<td>ON or 1 : partial search OFF</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Query Response

{10}

Examples

OUTPUT #E5100;"PARS ON"

OUTPUT #E5100;"PARS?"
ENTER #E5100;A
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 D. (Data format: maximum Local-maximum value, stimulus)

<table>
<thead>
<tr>
<th>Query Response</th>
<th>{numeric1} {numeric 2}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>{numeric1} : maximum value</td>
</tr>
<tr>
<td></td>
<td>{numeric2} : stimulus</td>
</tr>
</tbody>
</table>

| Examples        | OUTPUT @E5100;"PEAK?"
|                | ENTER @E5100:A,B |

PEAKLIST? value
Outputs the n peak values in order of the peak value within the range specified by the ANARANG command.

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>1 to NOP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>{value}</td>
</tr>
</tbody>
</table>

| Examples        | DIM A(1:5,1:2)     |
|                | OUTPUT @E5100;"PEAKLIST? 5" |
|                | ENTER @E5100:A(*)   |

PHAO value [deg]
Adds or subtracts a phase offset.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Display PHASE OFFSET</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Range</td>
<td>-360 to +360 [°]</td>
</tr>
<tr>
<td>Query Response</td>
<td>{value}</td>
</tr>
</tbody>
</table>

| Examples        | OUTPUT @E5100;"PHAO 90"
|                | OUTPUT @E5100;"PHAO?"
|                | ENTER @E5100:A       |

PHAS
This command equals FMT PHAS. See FMT.
**PICIRC {1|0|ON|OFF}**

Selects to use π network test fixture. When PICIRC is set to ON, the analyser sets the test signal power level so that the power level applied to the DUT is equal to the power setting value, even the power unit is selected as W or A. This command uses the Ci value set by CIVAL. The power unit can be selected by POWU.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>System PT CIRCUIT ON off</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>ON or 1: π network test fixture is used</td>
</tr>
<tr>
<td></td>
<td>OFF or 0: π network test fixture is not used</td>
</tr>
<tr>
<td>Query Response</td>
<td>{1</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT #E5100;&quot;PICIRC ON&quot;</td>
</tr>
<tr>
<td></td>
<td>OUTPUT #E5100;&quot;PICIRC?&quot;</td>
</tr>
<tr>
<td></td>
<td>ENTER #E5100;A</td>
</tr>
</tbody>
</table>

**POIN value**

Sets the number of the data points per sweep.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Sweep NUMBER OF POINTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Range</td>
<td>2 to 1601</td>
</tr>
<tr>
<td>Query Response</td>
<td>{value}</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT #E5100;&quot;POIN 201&quot;</td>
</tr>
<tr>
<td></td>
<td>OUTPUT #E5100;&quot;POIN?&quot;</td>
</tr>
<tr>
<td></td>
<td>ENTER #E5100;A</td>
</tr>
</tbody>
</table>

**POLE? value**

Outputs the first found local minimum for both sides 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 D. (Data format: left local minimum, stimulus, right local minimum, stimulus) (Query only)

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>TBD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>{numeric1} {numeric2} {numeric3} {numeric4}</td>
</tr>
<tr>
<td></td>
<td>{numeric1} : local minimum (left)</td>
</tr>
<tr>
<td></td>
<td>{numeric2} : stimulus</td>
</tr>
<tr>
<td></td>
<td>{numeric3} : local minimum (right)</td>
</tr>
<tr>
<td></td>
<td>{numeric4} : stimulus</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT #E5100;&quot;POLE? -50&quot;</td>
</tr>
<tr>
<td></td>
<td>ENTER #E5100;A,B,C,D</td>
</tr>
</tbody>
</table>

8-68 Command Reference
POSL
Sets output of the 24-bit I/O port to the positive logic. (No Query)

Examples

POWE value [dBm]
Sets the source output level.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>POWER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Range</td>
<td>-9 to +11 dBm (-48 to +22 dBm option 010 only)</td>
</tr>
<tr>
<td>Query Response</td>
<td>(numeric)</td>
</tr>
</tbody>
</table>
| Examples                | OUTPUT @E5100;"POWE 0"
OUTPUT @E5100;"POWE?"
ENTER @E5100;A |

POWS
This command equals SWPT POWE. See SWPT.

POWU|{DBM|WATT|AMP}
Selects the unit for the test signal power input.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>SRC. UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>DBM : dBm</td>
</tr>
<tr>
<td></td>
<td>WATT : W</td>
</tr>
<tr>
<td></td>
<td>AMP : A</td>
</tr>
<tr>
<td>Query Response</td>
<td>{DBM</td>
</tr>
</tbody>
</table>
| Examples                | OUTPUT @E5100;"POWU WATT"
OUTPUT @E5100;"POWU?"
ENTER @E5100;A |

PRES
Presets the instrument state.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Preset</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100;&quot;PRES&quot;</td>
</tr>
</tbody>
</table>
**PRINALL**

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

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>System PRINT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT 0E5100;'PRINALL'</td>
</tr>
</tbody>
</table>

**PRIR[<string>]**

Displays the query value of the HP-IB command given as a parameter. The query value is displayed on the Instrument BASIC print area.

<table>
<thead>
<tr>
<th>Parameter Description</th>
<th>&lt;string&gt; &gt; Query command</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT 0E5100;'MENU 1, &quot;START&quot;, &quot;FREQ&quot;, &quot;PRIR 'STAR?'&quot;'</td>
</tr>
</tbody>
</table>

**PTABORT[ON|OFF]**

Sets the measurement abort ON/OFF when the phase value is over the limit during the tracking. (Option 023 only)

| Parameter Description | ON : Abort a measurement when the tracking is failed  
|                       | OFF : Continue a measurement even the tracking is failed |
| Query Response        | [1|0] |
| Examples              | OUTPUT 0E5100;'PTABORT ON'  
|                       | OUTPUT 0E5100;'PTABORT?'  
|                       | ENTER 0E5100;A |

**PTFOVHD[<value>]**

Input the parameters required to display the time base at the temperature characteristic measurement (the aging measurement). Refer to “Compensation of Sweep Time for Aging Characteristics” in Appendix H for inputting. (Option 023 only)

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>0 to 1 sec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>{value}</td>
</tr>
</tbody>
</table>
**PTFR**: \(<value>\)
Input the start frequency for tracking. (Option 023 only)

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>10 kHz to 300 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>(&lt;value&gt;)</td>
</tr>
</tbody>
</table>

**Examples**
- OUTPUT @E5100;"PTFR 199 kHz"
- OUTPUT @E5100;"PTFR?"
  ENTER @E5100;A

**PTFRSR**: \(<value>\)
Sets the range for searching for \(F_r\). (Option 023 only)

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>0 Hz to 100 kHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>(&lt;value&gt;) (Hz)</td>
</tr>
</tbody>
</table>

**Examples**
- OUTPUT @E5100;"PTFRSR 5000"
- OUTPUT @E5100;"PTFRSR?"
  ENTER @E5100;A

**PTPARA**: \(<value>\)
Sets the tracking parameter. The tracking parameter is given by the SRCHFR? command query. (Option 023 only)

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>(-1000) to (1000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>(&lt;value&gt;)</td>
</tr>
</tbody>
</table>

**Examples**
- OUTPUT @E5100;"SRCHFR?"
  ENTER @E5100;Fr,Ci,Param
- OUTPUT @E5100;"PTPARA";Param
- OUTPUT @E5100;"PTPARA?"
  ENTER @E5100;A

**PTTRACK**: \{OFF\|ON\}
Set the phase tracking ON/OFF. (Option 023 only)
**PTTRACK** \{OFF\|ON\}

| Parameter Description | OFF : The phase tracking is OFF  
ON : The phase tracking is ON |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>{0</td>
</tr>
</tbody>
</table>
| Examples              | OUTPUT &E5100; "PTTRACK ON"     
OUTPUT &E5100; "PTTRACK?" 
Enter &E5100; a |

**PTREPN** \(<value>\)

Sets the number of tracking on each point. (Option 023 only)

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>1 to 1,000,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>{value}</td>
</tr>
</tbody>
</table>
| Examples              | OUTPUT &E5100; "PTREPN 5" 
OUTPUT &E5100; "PTREPN?" 
Enter &E5100; a |

**PTSTAT?**

Returns the status of the phase tracking. (Query only, Option 023 only)

| Query Response | {0|1} |
|----------------|-----|
|                | 0  : Error encountered during phase tracking 
1  : The phase tracking was successful. |
| Examples       | OUTPUT &E5100; "PTSTAT?" 
Enter &E5100; a |

**PTTRGLMT** \(<value>\)

Defines the range value for a phase, which is used for the phase tracking. (Option 023 only)

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>0° to 180°</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>{value}</td>
</tr>
</tbody>
</table>
| Examples        | OUTPUT &E5100; "PTTRGLMT 8" 
OUTPUT &E5100; "PTTRGLMT?" 
Enter &E5100; a |
PTTRGPHS\(<value>\)
Defines the phase at the resonant point. (Option 023 only)

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>-180° to 180°</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>{value}</td>
</tr>
</tbody>
</table>
| Examples        | OUTPUT @E5100;"PTTRGPHS 0"
|                 | OUTPUT @E5100;"PTTRGPHS?"
|                 | ENTER @E5100;A |

PURG \textit{string}
Removes a file saved on the disk in the built-in flexible disk drive. (No Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Save/Recall FILE UTILITY PURGE FILE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>(&lt;\text{string})&gt; File name, up to 10 characters including the extension</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100;&quot;PURG &quot;&quot;&quot;&quot;TEST_S&quot;&quot;&quot;</td>
</tr>
</tbody>
</table>

RAID
Completes the response and isolation calibration. (No Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Cal \texttt{DONE}:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100;&quot;RAID&quot;</td>
</tr>
</tbody>
</table>

RAISOL
Executes the isolation measurement for the response and isolation calibration. (No Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Cal \texttt{ISOL N STD}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100;&quot;RAISOL&quot;</td>
</tr>
</tbody>
</table>

RAIRESP
Selects the response class for the response and isolation calibration. (No Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Cal \texttt{RESPONSE}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100;&quot;RAIRESP&quot;</td>
</tr>
</tbody>
</table>
**RECD string**

Loads the instrument states or data from the disk in the built-in flexible disk drive. (No Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>RECALL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Range</td>
<td>File name, Up to 10 characters including the extension</td>
</tr>
<tr>
<td>Query Response</td>
<td>{string}</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT #E5100; &quot;RECD &quot;&quot;TEST_S&quot;&quot;&quot;&quot;</td>
</tr>
</tbody>
</table>

**REFP value**

Sets the position of the reference line on the graticule of a Cartesian format.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>REFERENCE POSITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Range</td>
<td>0 to 10 [Div]</td>
</tr>
<tr>
<td>Query Response</td>
<td>{value}</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT #E5100; &quot;REFP 0&quot;</td>
</tr>
<tr>
<td></td>
<td>OUTPUT #E5100; &quot;REFP?&quot;Enter #E5100; A</td>
</tr>
</tbody>
</table>

**REFV value [suffix]**

Changes the value of the reference line, moving the measurement trace correspondingly.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>REFERENCE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>{value}</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT #E5100; &quot;REFV 0&quot;</td>
</tr>
<tr>
<td></td>
<td>OUTPUT #E5100; &quot;REFV?&quot;Enter #E5100; A</td>
</tr>
</tbody>
</table>

**RESAVD string**

Updates an already saved file on the disk in the built-in flexible disk drive. (No Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>RE-SAVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Range</td>
<td>File name up to 10 characters including the extension</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT #E5100; &quot;RESAVD &quot;&quot;TEST_S&quot;&quot;&quot;&quot;</td>
</tr>
</tbody>
</table>

8-74 Command Reference
**RESPDONE**

Completes the response calibration. (No Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Cal&gt; DONE:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100;&quot;RESPDONE&quot;</td>
</tr>
</tbody>
</table>

**REST**

Aborts the sweep in progress, then restarts the measurement. (No Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Trigger&gt; MEASURE RESTART</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100;&quot;REST&quot;</td>
</tr>
</tbody>
</table>

**RFOUTSW {1|2}**

Changes the RF OUTPUT port. (option 003 only)

| Equivalent Key Sequence | Sweep> SWEEP TYPE MENU RF OUTPUT [0|1] |
|-------------------------|--------------------------------------|
| Parameter Description   | 1: RF OUT 1  |
|                         | 2: RF OUT 2  |
| Query Response          | {0|1} |
| Examples                | OUTPUT @E5100;"RFOUTSW 1" |
|                         | OUTPUT @E5100;"RFOUTSW?" |
|                         | ENTER @E5100;A |

**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 "RPLENV?" in Appendix D in Appendix D. (Query only)

<table>
<thead>
<tr>
<th>Query Response</th>
<th>{value}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100;&quot;RPLENV?&quot;</td>
</tr>
<tr>
<td></td>
<td>ENTER @E5100;A</td>
</tr>
</tbody>
</table>
RPLHEI?
Searches for the maximum height between neighboring ripple peaks and outputs the resultant data via HP-IB. For details, refer to “RPLHEI?” in Appendix D in Appendix D. (Query only)

<table>
<thead>
<tr>
<th>Query Response</th>
<th>{value}</th>
</tr>
</thead>
</table>
| Examples       | OUTPUT @E5100;"RPLHEI?"
                | ENTER @E5100;A |

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 “RPLLHEI?” in Appendix D in Appendix D. (Query only)

<table>
<thead>
<tr>
<th>Query Response</th>
<th>{value}</th>
</tr>
</thead>
</table>
| Examples       | OUTPUT @E5100;"RPLLHEI?"
                | ENTER @E5100;A |

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 Appendix D. (Query only)

<table>
<thead>
<tr>
<th>Query Response</th>
<th>{value}</th>
</tr>
</thead>
</table>
| Examples       | OUTPUT @E5100;"RPLMEA?"
                | ENTER @E5100;A |

RPLMM?
Outputs the difference value between the maximum and minimum values within the range specified with the ANARANG command. (The maximum and minimum values are same as ones OTUPMINMAX? outputs.) (Query only)

<table>
<thead>
<tr>
<th>Query Response</th>
<th>{value}</th>
</tr>
</thead>
</table>
| Examples       | OUTPUT @E5100;"RPLMM?"
                | ENTER @E5100;A |

8-76  Command Reference
RPLPP?
Searches for the maximum ripple peak to peak value and outputs the resultant data via HP-IB. For details, refer to "RPLPP?" in Appendix D in Appendix D. (Query only)

<table>
<thead>
<tr>
<th>Query Response</th>
<th>{value}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100;&quot;RPLPP?&quot;</td>
</tr>
<tr>
<td></td>
<td>ENTER @E5100;A</td>
</tr>
</tbody>
</table>

RPLPPS?
Searches for the maximum ripple peak to peak value and outputs the resultant data and stimulus values at these points. (Query only)

<table>
<thead>
<tr>
<th>Query Response</th>
<th>{numeric1} {numeric2} {numeric3}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>{numeric1} : maximum ripple peak</td>
</tr>
<tr>
<td></td>
<td>{numeric2} : stimulus value at local maximum point</td>
</tr>
<tr>
<td></td>
<td>{numeric3} : stimulus value at local minimum point</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100;&quot;RPLPPS?&quot;</td>
</tr>
<tr>
<td></td>
<td>ENTER @E5100;A,B,C</td>
</tr>
</tbody>
</table>

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?" in Appendix D in Appendix D. (Query only)

<table>
<thead>
<tr>
<th>Query Response</th>
<th>{value}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100;&quot;RPLRHEI?&quot;</td>
</tr>
<tr>
<td></td>
<td>ENTER @E5100;A</td>
</tr>
</tbody>
</table>

RPLIVAL?
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 AMARANG command. For more information, refer to Appendix D. (Data format: sum, stimulus) (Query only)

<table>
<thead>
<tr>
<th>Query Response</th>
<th>{numeric1}{numeric2}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>{numeric1} : Maximum value of sum</td>
</tr>
<tr>
<td></td>
<td>{numeric2} : stimulus value of local minimum</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100;&quot;RPLIVAL?&quot;</td>
</tr>
<tr>
<td></td>
<td>ENTER @E5100;A,B</td>
</tr>
</tbody>
</table>
RPOS
This command equals REFP. See REFP.

SADD
Adds a new segment to a list sweep table. (No Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Sweep</th>
<th>SWEEP</th>
<th>TYPE</th>
<th>MENU</th>
<th>EDIT</th>
<th>LIST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100; &quot;SADD&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SAV1
Saves the 3 term calibration results. (No Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>CAL</th>
<th>DONE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100; &quot;SAV1&quot;</td>
<td></td>
</tr>
</tbody>
</table>

SAVCA {OFF|ON|0|1}
Selects whether or not the calibration coefficients arrays are to be saved.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Save/Recall</th>
<th>SAVE</th>
<th>DEFINE</th>
<th>SAVE DATA</th>
<th>CAL</th>
<th>ARRAY</th>
<th>ON</th>
<th>OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>{OFF</td>
<td>ON</td>
<td>1</td>
<td>0}</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>OFF or 0 : calibration coefficients arrays are not saved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ON or 1 : calibration coefficients arrays are saved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Query Response</td>
<td>{1</td>
<td>0}</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100; &quot;SAVCA ON&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>OUTPUT @E5100; &quot;SAVCA?&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ENTER @E5100; A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SAVDA {ON|OFF|1|0}
Sets the data array to be saved (ON) or not (OFF).
SAVDDAT string

Equivalent Key Sequence
{Save/Recall} SAVE, DEFINE, SAVE DATA, DATA ARRAY, ON, OFF

Parameter Description
{OFF|ON|1|0}
- OFF or 0: OFF
- ON or 1: ON

Query Response
{1|0}

Examples
- OUTPUT @E5100;"SAVDA ON"
- OUTPUT @E5100;"SAVDA?"
- ENTER @E5100; A

SAVDALL string

Saves the instrument states, the data array, and the memory array to the disk in the built-in flexible disk drive. (No Query)

Equivalent Key Sequence
{Save/Recall} SAVE, ALL

Parameter Range
File name, up to 8 characters

Examples
- OUTPUT @E5100; "SAVDALL ""TEST"

SAVDASC string

Save the current measurement data in ASCII file format. (No Query)

Equivalent Key Sequence
{Save/Recall} SAVE, DATA ONLY, (ASCII SAVE)

Parameter Range
File name, up to 8 characters

Examples
- OUTPUT @E5100; "SAVDASC ""DATASCII"

SAVDDAT string

Saves the internal data arrays. (No Query)

Equivalent Key Sequence
{Save/Recall} SAVE, DATA ONLY, (BINARY SAVE)

Parameter Range
File name up to 8 characters

Query Response
{string}

Examples
- OUTPUT @E5100; "SAVDDAT ""DATABASE"
**SAVDGRAP <string>**

Saves the display image to the disk in the built-in flexible disk drive or the RAM disk drive. Two graphic file formats, TIFF and PCL, are available. GRAPFORM command is used to select the format. (No Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Save/Recall</strong> SAVE GRAPHICS</td>
</tr>
<tr>
<td>Parameter Range</td>
<td>Up to 8 characters</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100;&quot;SAVDGRAP &quot;&quot;RESULT1&quot;&quot;&quot;&quot;</td>
</tr>
</tbody>
</table>

**SAVDMNU3 <string>**

Save the user definition of softkey accessed from **Menu3**. (No Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Save/Recall</strong> SAVE MENU3</td>
</tr>
<tr>
<td>Parameter Range</td>
<td>Up to 8 characters</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100;&quot;SAVDMNU3 &quot;&quot;USERMENU&quot;&quot;&quot;&quot;</td>
</tr>
</tbody>
</table>

**SAVDSTA string**

Saves only the instrument states and the calibration coefficients to the disk in the built-in flexible disk drive. (No Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Save/Recall</strong> SAVE STATE ONLY</td>
</tr>
<tr>
<td>Parameter Range</td>
<td>File name up to 8 characters</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100;&quot;SAVDSTA &quot;&quot;ST1&quot;&quot;&quot;&quot;</td>
</tr>
</tbody>
</table>

**SAVFA {OFF|ON|0|1}**

Sets the formatted arrays to be saved (ON) or not (OFF).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Save/Recall</strong> SAVE DEFINE SAVE DATA FORMD ARRAY ON OFF</td>
</tr>
<tr>
<td>Query Response</td>
<td>{1</td>
</tr>
<tr>
<td></td>
<td>OFF or 0 : formatted arrays are not saved ON or 1 : formatted arrays are saved</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100;&quot;SAVFA ON&quot;</td>
</tr>
<tr>
<td></td>
<td>OUTPUT @E5100;&quot;SAVFA?&quot;</td>
</tr>
<tr>
<td></td>
<td>ENTER @E5100;A</td>
</tr>
</tbody>
</table>
### SAVMA {OFF|ON|0|1}
Sets the memory array to be saved (ON) or not (OFF).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>{OFF</td>
<td>ON</td>
</tr>
</tbody>
</table>

- OFF or 0 : OFF
- ON or 1 : ON

<table>
<thead>
<tr>
<th>Query Response</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>{1</td>
<td>0}</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Examples</th>
</tr>
</thead>
</table>
| OUTPUT @E5100;"SAVMA ON"
| OUTPUT @E5100;"SAVMA?"
| ENTER @E5100;A |

### SAVRA {OFF|ON|0|1}
Sets the raw data arrays to be saved (ON) or not (OFF).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>{OFF</td>
<td>ON</td>
</tr>
</tbody>
</table>

- OFF or 0 : raw arrays are not saved
- ON or 1 : raw arrays are saved

<table>
<thead>
<tr>
<th>Query Response</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>{1</td>
<td>0}</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Examples</th>
</tr>
</thead>
</table>
| OUTPUT @E5100;"SAVRA ON"
| OUTPUT @E5100;"SAVRA?"
| ENTER @E5100;A |

### SAVTA {OFF|ON|0|1}
Sets the trace arrays to be saved (ON) or not (OFF).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>{OFF</td>
<td>ON</td>
</tr>
</tbody>
</table>

- OFF or 0 : trace arrays are not saved
- ON or 1 : trace arrays are saved

<table>
<thead>
<tr>
<th>Query Response</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>{1</td>
<td>0}</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Examples</th>
</tr>
</thead>
</table>
| OUTPUT @E5100;"SAVTA ON"
| OUTPUT @E5100;"SAVTA?"
| ENTER @E5100;A |
SAVTMA \{OFF|ON|0|1\}

Sets the memory trace arrays to be saved (ON) or not (OFF).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Save/Recall</th>
<th>SAVE</th>
<th>DEFINE</th>
<th>SAVE DATA</th>
<th>SUB ARRAY</th>
<th>ON</th>
<th>OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>{1</td>
<td>0}</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>OFF or 0</td>
<td>sub trace arrays are not saved</td>
<td>ON or 1</td>
<td>sub trace arrays are saved</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Examples

OUTPUT \#E5100;'"SAVTMA ON"

OUTPUT \#E5100;'"SAVTMA?"

ENTER \#E5100;A

SCAFDATA

Selects the data trace to be scaled. (No Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Display</th>
<th>SCALE MENU</th>
<th>SCALL FOR</th>
<th>[ ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OUTPUT #E5100;'&quot;SCAFDATA&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SCAFMEMO

Selects the sub-trace to be scaled. (No Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Display</th>
<th>SCALE MENU</th>
<th>SCALL FOR</th>
<th>[ ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OUTPUT #E5100;'&quot;SCAFMEM&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SCAL value

Changes the response value scale per graticule division.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Display</th>
<th>SCALE MENU</th>
<th>SCAL/ DIV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.001 to 500 : (Log mag format)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.01 to 500 : (Phase format)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1x10^{-4} to 10 : (Delay format)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1x10^{-11} to 10000 : (Lin mag, Real, and Imaginary formats)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Query Response

{\{value\}}

Examples

OUTPUT \#E5100;'"SCAL 1"

OUTPUT \#E5100;'"SCAL?"

ENTER \#E5100;A
SCAY \{1|0\}
Selects Y-axis scale from log scale and linear scale.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>\textbf{Mess/Format}</th>
<th>\textbf{FORMAT Y-AXIS[ ]}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>0: Linear scale</td>
<td>1: LOG scale</td>
</tr>
<tr>
<td>Query Response</td>
<td>{0</td>
<td>1}</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT &amp;E5100;&quot;SCAY 1&quot;</td>
<td></td>
</tr>
</tbody>
</table>

SDEL
Deletes a segment from a list sweep table. (No Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>\textbf{Sweep} \textbf{SWEEP TYPE MENU EDIT LIST}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT &amp;E5100;&quot;SDEL&quot;</td>
</tr>
</tbody>
</table>

SDON
Completes editing a segment of a list sweep table. (No Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>\textbf{Sweep} \textbf{SWEEP TYPE MENU EDIT LIST}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT &amp;E5100;&quot;SDON&quot;</td>
</tr>
</tbody>
</table>

SEAL
Searches the trace for the next occurrence of the target value to the left of the marker. (No Query)

| Examples                | OUTPUT \&E5100;"SEAL"                             |

SEALMAX
Moves the active marker to the maximum peak point on the trace in the search range. (No Query)

| Examples                | OUTPUT \&E5100;"SEALMAX"                          |
SEALMIN
Moves the active marker to the minimum peak point on the trace in the search range. (No Query)

Examples

OUTPUT @E5100; "SEALMIN"

SEAM \{OFF|MAX|MIN|TARG|MEAN|LMAX|LMIN|PPEAK\}
Selects the marker search function. (Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>[ Marker ] [ MARK SEARCH ] [ SEARCH: MAX, MIN, TARGET ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>OFF : Marker search function OFF</td>
</tr>
<tr>
<td></td>
<td>MAX : Maximum</td>
</tr>
<tr>
<td></td>
<td>MIN : Minimum</td>
</tr>
<tr>
<td></td>
<td>TARG : Target</td>
</tr>
<tr>
<td></td>
<td>MEAN : Mean</td>
</tr>
<tr>
<td></td>
<td>LMAX : Local maximum</td>
</tr>
<tr>
<td></td>
<td>LMIN : Local minimum</td>
</tr>
<tr>
<td></td>
<td>PPEAK : Peak to peak</td>
</tr>
</tbody>
</table>

| Query Response          | \{OFF|MAX|MIN|TARG|MEAN|LMAX|LMIN|PPEAK\} |
|-------------------------|------------------------------------------|
| Examples                | OUTPUT @E5100; "SEAM PEAK"               |
|                         | OUTPUT @E5100; "SEAM?"                   |
|                         | ENTER @E5100; A$                          |

SEAMAX
Moves the active marker to the maximum point on the trace. (No Query)

Examples

OUTPUT @E5100; "SEAMAX"

SEAMEAN
Moves the active marker to the mean point on the trace. (No Query)

Examples

OUTPUT @E5100; "SEAMEAN"
SEAMIN
Moves the active marker to the minimum point on the trace. (No Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Marker MKR SEARCH MIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100;&quot;SEAMIN&quot;</td>
</tr>
</tbody>
</table>

SEAOFF
Turns off the marker search function. (No Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Marker MKR SEARCH TRACING ON OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100;&quot;SEAOFF&quot;</td>
</tr>
</tbody>
</table>

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. (No Query)

| Examples | OUTPUT @E5100;"SEAPPEAK" |

SEAR
Searches the trace for the next occurrence of the target value to the right of the marker. (No Query)

| Examples | OUTPUT @E5100;"SEAR" |

SEARSTOR
Stores the search range, which is defined between the active marker and the delta reference marker. (No Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Marker MKR SEARCH SEARCH RANGE SEARCH RNG STORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100;&quot;SEARSTOR&quot;</td>
</tr>
</tbody>
</table>
**SEATARG value**
Places the active marker at a specified target point on a trace.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Marker MRR SEARCH[ ] TARGET</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Range</td>
<td>(-5 \times 10^3) to (5 \times 10^5)</td>
</tr>
<tr>
<td>Query Response</td>
<td>{value}</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT #E5100;&quot;SEATARG 0&quot;</td>
</tr>
<tr>
<td></td>
<td>OUTPUT #E5100;&quot;SEATARG?&quot;</td>
</tr>
<tr>
<td></td>
<td>ENTER #E5100;A</td>
</tr>
</tbody>
</table>

**SEDI value**
Determines a segment of a list sweep table to be modified.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Sweep SWEEP TYPE MENU EDIT LIST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Range</td>
<td>1 to 31</td>
</tr>
<tr>
<td>Query Response</td>
<td>{value}</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT #E5100;&quot;SEDI&quot;</td>
</tr>
<tr>
<td></td>
<td>OUTPUT #E5100;&quot;SEDI?&quot;</td>
</tr>
<tr>
<td></td>
<td>ENTER #E5100;A</td>
</tr>
</tbody>
</table>

**SEET {ON|OFF}**
SEET ON makes the analyzer display both of text displayed using PRINT statement of HP Instrument BASIC and measurement traces.

| Query Response          | \{0|1\}                        |
|-------------------------|-------------------------------|
| Examples                | OUTPUT #E5100;"SEET ON"       |
|                         | OUTPUT #E5100;"SEET?"         |
|                         | ENTER #E5100;A                |

**SETCDATE year,month,day**
Changes date of the internal clock.
SETZ value [ohm]

Equivalent Key Sequence | System SET CLOCK
---|---
Parameter Range | 
\(<\text{numeric\,(year)}\>): 1901 to 2059  
\(<\text{numeric\,(month)}\>): 1 to 12  
\(<\text{numeric\,(day)}\>): 1 to 31
Query Response | \{numeric\,(year)\} \{numeric\,(month)\} \{numeric\,(day)\}
Examples | OUTPUT @E5100;"SETDATE 1993,1,1"

OUTPUT @E5100;"SETDATE?"
ENTER @E5100;A,B,C

SETCTIME value 1,value 2,value 3
Changes time of the internal clock.

Equivalent Key Sequence | System SET CLOCK
---|---
Parameter Range | 
\(<\text{value\,(hour)}\>): 0 to 23  
\(<\text{value\,(minute)}\>): 0 to 59  
\(<\text{value\,(second)}\>): 0 to 59
Query Response | \{numeric\,1\}\{numeric\,2\}\{numeric\,3\}
  \{numeric\,1\}: hour  
  \{numeric\,2\}: minute  
  \{numeric\,3\}: second
Examples | OUTPUT @E5100;"SETCTIME 10,30,0"

OUTPUT @E5100;"SETCTIME?"
ENTER @E5100;A,B,C

SETZ value [ohm]
Sets the characteristic impedance used by the HP E5100A/B in calculating measured impedance.

Equivalent Key Sequence | Cal SET Z0
---|---
Parameter Range | 0.1 to 5x10\(^6\) [Ω]
Query Response | \{value\}
Examples | OUTPUT @E5100;"SETZ 75"

OUTPUT @E5100;"SETZ?"
ENTER @E5100;A
**SING?**
Makes a single measurement sweep and returns 1 when the sweep is completed.  (Query Only)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Trigger SINGLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>1</td>
</tr>
</tbody>
</table>
| Examples                | OUTPUT &E5100;"SING?"
                         | ENTER &E5100A   |

**SINSPEAK {ON|OFF}**
SINSPEAK ON makes the analyzer search the maximum or minimum point with each sweep.

| Query Response | {0|1}           |
|----------------|----------------|
| Examples       | OUTPUT &E5100;"SINSPEAK ON"
                | OUTPUT &E5100;"SINSPEAK?"
                | ENTER &E5100;A |

**SMOO {ON|OFF}**
Sets the smoothing function to ON or OFF.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Display SMOOTHING on OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Range</td>
<td>OFF or 0 : smoothing OFF</td>
</tr>
</tbody>
</table>
<pre><code>                      | ON or 1 : smoothing ON    |
</code></pre>
<p>| Query Response          | {1|0}                     |</p>
| Examples                | OUTPUT &E5100;"SMOO ON"
                          | OUTPUT &E5100;"SMOO?"
                          | ENTER &E5100;A |

**SMOOAPER value [pct]**
Changes the value of the smoothing aperture as a percent of the span.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Display SMOOTHING APERTURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Range</td>
<td>0.05 to 100 [%]</td>
</tr>
<tr>
<td>Query Response</td>
<td>{value}</td>
</tr>
</tbody>
</table>
| Examples                | OUTPUT &E5100;"SMOOAPER 10"
                          | OUTPUT &E5100;"SMOOAPER?"
                          | ENTER &E5100;A |
SPAN value [HZ|KHZ|MAHZ|GHZ|DBM]
Sets the frequency span of a segment about a specified center frequency.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>SPAN</th>
</tr>
</thead>
</table>
| Parameter Range         | 0 to 299.999x10^6 (–299.999 MHz) : Hz (frequency)  
                          | 0 to 70 : dBm (power) |
| Query Response          | {value} |
| Examples                | OUTPUT #E5100;"SPAN 100MHZ"
                          | OUTPUT #E5100;"SPAN?"
                          | ENTER #E5100;A |

SPLD {ON|OFF|0|1}
Sets the multi channel display mode.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Display SPLIT DISP ON off</th>
</tr>
</thead>
</table>
| Parameter Description   | OFF or 0 : a full-screen single graticule display  
                          | ON or 1 : a split display with two half-screen graticules |
| Query Response          | {1|0} |
| Examples                | OUTPUT #E5100;"SPLD ON"
                          | OUTPUT #E5100;"SPLD?"
                          | ENTER #E5100;A |

SRCHFR?U{1|2|3|4},<value>
Search for the resonance frequency (F_r). (Query only, Option 023 only)

<table>
<thead>
<tr>
<th>Parameter Description</th>
<th>Search mode:</th>
</tr>
</thead>
</table>
|                         | 1 : Rough (High speed)  
                          | 2 : Normal  
                          | 3 : Fine  
                          | 4 : Finer (Slow)  
                          | <value> : Waiting time during searching (sec) |
| Query Response          | {value1}, {value2},{value3} |
|                         | {value1} : F_r [Hz]  
                          | {value2} : CI [0]  
                          | {value3} : Tracking parameter |
| Examples                | OUTPUT #E5100;"SRCHFR? 2,0"
                          | ENTER #E5100;A,B,C |
STANC

Measures the calibration standard in the THRU. (No Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Cal THRU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT 5E5100; &quot;STANA&quot;</td>
</tr>
</tbody>
</table>

STAR value [suffix]

Defines the start value of the stimulus.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>START</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Range</td>
<td>$10 \times 10^3$ (= 10k) to $300 \times 10^6$ (= 300M) Hz</td>
</tr>
<tr>
<td></td>
<td>$-9$ to $+11$ dBm ($-48$ to $+22$ dBm option 010 only)</td>
</tr>
<tr>
<td>Query Response</td>
<td>{value}</td>
</tr>
</tbody>
</table>
| Examples                | OUTPUT 5E5100; "STAR 100KHZ"
OUTPUT 5E5100; "STAR?"
ENTER 5E5100; A |

STAS value1[HZ|KHZ|MAHZ|GHZ|DBM], value2 [HZ|KHZ|MAHZ|GHZ|DBM]

Sets start and stop stimulus values.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>START STOP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Range</td>
<td>$10 \times 10^3$ (= 10k) to $300 \times 10^6$ (= 300M) Hz</td>
</tr>
<tr>
<td></td>
<td>$-9$ to $+11$ dBm ($-48$ to $+22$ dBm option 010 only)</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT 5E5100; &quot;STAS 100KHZ,1MHZ&quot;</td>
</tr>
</tbody>
</table>

STAW value

Sets the wait time for sweep.

| Parameter Range         | 0 to 100 (sec.) |
| Query Response          | {value} |
| Examples                | OUTPUT 5E5100; "STAW 1"
OUTPUT 5E5100; "STAW?"
ENTER 5E5100; A |
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.

| Parameter Range | 10 x 10^3 (-10k) to 300 x 10^6 (-300M) Hz  
|                 | -9 to +11 dBm (-48 to +22 dBm option 010 only) |
| Query Response  | \{value\} |
| Examples        | OUTPUT @E5100; "STIDROUT1 100KHZ"
                | OUTPUT @E5100; "STIDROUT1?"
                | ENTER @E5100; A |

STIMROUT{1-16} value [suffix]
Sets stimulus of memory trace up to 16 for OUTPDATAT? query. To execute STIMROUT? query, pass a number as the parameter.

| Parameter Range | 10 x 10^3 (-10k) to 300 x 10^6 (-300M) Hz  
|                 | -9 to +11 dBm (-48 to +22 dBm option 010 only) |
| Query Response  | \{value\} |
| Examples        | OUTPUT @E5100; "STIMROUT1 100KHZ"
                | OUTPUT @E5100; "STIMROUT1?"
                | ENTER @E5100; A |

STOD{DISK|MEMO}
Selects mass storage device. (No Query)

| Equivalent Key Sequence | (Save/Recall) FILE UTILITY STOR DEV \{\} |
| Parameter Range         | STODDISK : internal flexible disc  
|                         | STODMEMO : internal RAM disk memory |
| Examples                | OUTPUT @E5100; "STODDISK" |
|                         | OUTPUT @E5100; "STODMEMO" |

STOMDISK
Stores the all files in the RAM disk to the FLASH disk. (No Query)

| Equivalent Key Sequence | (Save/Recall) BACK UP MEMO DISK |
| Examples                | OUTPUT @E5100; "STOMDISK" |
STOP value [suffix]
Defines the stop value of the stimulus.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>STOP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Range</td>
<td>$10 \times 10^3 \text{ (} -10k \text{) to } 300 \times 10^6 \text{ (} -300M \text{) Hz}$</td>
</tr>
<tr>
<td></td>
<td>$-9 \text{ to } +11 \text{ dBm (} -48 \text{ to } +22 \text{ dBm option 010 only)}$</td>
</tr>
<tr>
<td>Query Response</td>
<td>{value}</td>
</tr>
</tbody>
</table>
| Examples                | OUTPUT @E5100; "STOP 100MHZ"
                        | OUTPUT @E5100; "STOP?"
                        | ENTER @E5100; A |

STPSIZE value [HZ|KHZ|MAHZ]
Specifies the frequency step for a list sweep table.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>SWEEP</th>
<th>SWEEP TYPE M</th>
<th>E</th>
<th>EDIT L</th>
<th>IST STEP SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Range</td>
<td>$10 \times 10^3 \text{ (} -10k \text{) to } 300 \times 10^6 \text{ (} -300M \text{) Hz}$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Query Response</td>
<td>{value}</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Examples                | OUTPUT @E5100; "STPSIZE 1MHZ"
                        | OUTPUT @E5100; "STPSIZE?"
                        | ENTER @E5100; A |

STR {ON|OFF}
Sets the trace storage ON or OFF.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Display</th>
<th>STORAGE ON OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Range</td>
<td>ON : Display storage ON</td>
<td></td>
</tr>
</tbody>
</table>
<pre><code>                    | OFF : Display storage OFF |
</code></pre>
<p>| Query Response          | {0|1} |
| Examples                | OUTPUT @E5100; &quot;STR ON&quot; |</p>
**SWED {DOWN|UP}**

Sets the sweep direction.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>[Sweep] SWEEP TYPE [ ] SWEEP DIR [ ]</th>
</tr>
</thead>
</table>

| Parameter Description   | UP : sweep from START to STOP  
<table>
<thead>
<tr>
<th></th>
<th>DOWN : sweep from STOP to START</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>{DOWN</td>
</tr>
</tbody>
</table>
| Examples                | OUTPUT @E5100;"SWED DOWN"  
|                         | OUTPUT @E5100;"SWED?"  
|                         | ENTER @E5100;A$                  |

**SWET value [s]**

Manually sets the sweep time.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>[Sweep] SWEEP TIME [ ]</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>6.0x10^-4 to 864001 [sec]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>{value}</td>
</tr>
</tbody>
</table>
| Examples                | OUTPUT @E5100;"SWET 1"    
|                         | OUTPUT @E5100;"SWET?"    
|                         | ENTER @E5100;A$            |

1 depends on stimulus settings

**SWETAUTO**

Automatically sets the sweep time. (No Query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>[Sweep] SWEEP TIME [ ] SWEEP TIME AUTO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100;&quot;SWETAUTO ON&quot;</td>
</tr>
</tbody>
</table>

**SWPT {LINF|LOGF|LIST|POWE|RAMPF}**

Selects the sweep type.
SWPT {LINF|LOGF|LIST|POWE|RAMPF}

Equivalent Key Sequence
Sweep SWEEP TYPE MENU LIN FREQ, POWER, LIST

Parameter Description
LINF : Linear frequency sweep
LIST : Frequency list sweep
POWE : Power sweep
RAMPF : Ramp sweep

Query Response
{LINF|LIST|POWE|RAMPF}

Examples
OUTPUT @E5100; "SWPT LINF"
OUTPUT @E5100; "SWPT?"
ENTER @E5100; @S

TARL? value
Output stimulus of the first fund point which has a value specified by the parameter of this command for left direction from the right edge of analysis range which is set by the ANARANGE command. For more information, see Appendix D. (Data format: stimulus) (Query only)

Parameter Range
\(-5.0\times10^5\) to \(5.0\times10^5\)

Query Response
\{value\}

Examples
OUTPUT @E5100; "TARL? -10"
ENTER @E5100; @A

TARR? value
Outputs stimulus of the first found point which has value specified by parameter of this command for right direction from left edge of analysis range which is set by ANARANG command. For more information, refer to Appendix D. (Query only)

Parameter Range
\(-5.0\times10^5\) to \(5.0\times10^5\)

Query Response
\{value\}

Examples
OUTPUT @E5100; "TARR? -10"
ENTER @E5100; @A

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

Parameter Range

Query Response
\{value\}

Examples
OUTPUT @E5100; "THRR -50"
TIMO\{ON|OFF\{0|1\}\}
Sets the time limit for the trapping on/off. (Option 022 only)

| Parameter Description | ON or 1: ON
OFF or 0: OFF |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>{1</td>
</tr>
</tbody>
</table>

Examples

```
OUTPUT @E5100;"TIMO ON"
OUTPUT @E5100;"TIMO?"
Enter @E5100:A
```

TITL \texttt{string}
Sends the string to the title area on the display.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Display</th>
<th>TITL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Range</td>
<td>up to 53 characters</td>
<td></td>
</tr>
<tr>
<td>Query Response</td>
<td>{string}</td>
<td></td>
</tr>
</tbody>
</table>
| Examples                | OUTPUT @E5100;"TITL \""COMMENT\""""
OUTPUT @E5100;"TITL?"
Enter @E5100:A$ |

TOPV\{value\}
Sets the value at the top line of the graticule.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Display</th>
<th>TOP VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Range</td>
<td>-10^9 to 10^9</td>
<td></td>
</tr>
<tr>
<td>Query Response</td>
<td>{value}</td>
<td></td>
</tr>
</tbody>
</table>
| Examples                | OUTPUT @E5100;"TOPV 100"
OUTPUT @E5100;"TOPV?"
Enter @E5100:A |

TOTIME\{value\}
Sets the limit time for the trapping. (Option 022 only)
TOTIME\(<value>\)

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>0 to</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>{value} (ms)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Examples</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>OUTPUT @E5100;&quot;TOTIME 2000&quot;</td>
<td></td>
</tr>
<tr>
<td>OUTPUT @E5100;&quot;TOTIME?&quot;</td>
<td></td>
</tr>
<tr>
<td>ENTER @E5100;A</td>
<td></td>
</tr>
</tbody>
</table>

TRABGE

Sets the condition so that the measurement is advanced to the next point when a measurement value (phase value) is greater than or equal to the threshold value specified by the INPUTRAC command. (Option 022 only)

| Query Response | \{1|0\} |
|----------------|------|
| Examples       | |
| OUTPUT @E5100;"TRABGE" |
| OUTPUT @E5100;"TRABGE?" |
| ENTER @E5100;A |

TRABLE

Sets the condition so that the measurement is advanced to the next point when a measurement value (phase value) is less than or equal to the threshold value specified by the INPUTRAC command. (Option 022 only)

| Query Response | \{1|0\} |
|----------------|------|
| Examples       | |
| OUTPUT @E5100;"TRABLE" |
| OUTPUT @E5100;"TRABLE?" |
| ENTER @E5100;A |

TRACK \{OFF\ON\0\1\}

Tracks the search at the specified target value with each new sweep.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Marker</th>
<th>MKR SEARCH</th>
<th>[ ] TRACKING ON OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>{value} {0</td>
<td>1}</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Examples</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>OUTPUT @E5100;&quot;TRACK ON&quot;</td>
<td></td>
</tr>
<tr>
<td>OUTPUT @E5100;&quot;TRACK?&quot;</td>
<td></td>
</tr>
<tr>
<td>ENTER @E5100;A</td>
<td></td>
</tr>
</tbody>
</table>

8-96 Command Reference
TRAFDATA
Set the trap function on the data trace. (Option 022 only)

| Query Response | {0|1} |
|----------------|------|
| Examples       | OUTPUT @E5100;"TRAFDATA"
|                | OUTPUT @E5100;"TRAFDATA?"
|                | ENTER @E5100;A |

TRAFMEMO
Set the trap function on the sub trace. (Option 022 only)

| Query Response | {0|1} |
|----------------|------|
| Examples       | OUTPUT @E5100;"TRAFMEMO"
|                | OUTPUT @E5100;"TRAFMEMO?"
|                | ENTER @E5100;A |

TRAP{OFF|ON|0|1}
Set the trap function on/off. (Option 022 only)

| Parameter Description | OFF or 0 : Set the trap function off.
<table>
<thead>
<tr>
<th></th>
<th>ON or 1 : Set the trap function on.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>{0</td>
</tr>
</tbody>
</table>
| Examples              | OUTPUT @E5100;"TRAP ON"
|                       | OUTPUT @E5100;"TRAP?"
|                       | ENTER @E5100;A |

TRAR{<value1>,<value2>}
Set the start and the end points for the partial sweep for the trap function.

If the start point and the end point are not between 1 to the value specified by Number of Point, HP E5100A/B option 022 will perform a sweep within the possible range. Use this function to reserve wider sweep range so that you can change the sweep range by simply changing this setup. This way, you can save more measurement time than changing the whole sweep setup. (Option 022 only)
**TRAR** $\langle\text{value1}\rangle$, $\langle\text{value2}\rangle$

<table>
<thead>
<tr>
<th>Parameter Description</th>
<th>$\langle\text{value1}\rangle$: The start point for the partial sweep $\langle\text{value2}\rangle$: The end point for the partial sweep</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>${$\text{value1}$}$ ${$\text{value2}$}$</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT $#E5100$; &quot;TRAR 10, 20&quot;</td>
</tr>
<tr>
<td></td>
<td>OUTPUT $#E5100$; &quot;TRAR?&quot;</td>
</tr>
<tr>
<td></td>
<td>ENTER $#E5100$; A,B</td>
</tr>
</tbody>
</table>

**TRIGMEAS**

Triggers DSP to start measurement and get measurement data into DSP. This command is only used for the parallel processing using with MOVADARY and ADTCTRAC command. (No Query)

**TRIM** $\langle\text{CONT|HOLD|SING}\rangle$

Selects the trigger mode.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Trigger: HOLD, SINGLE, CONTINUOUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>CONT: continuous sweep</td>
</tr>
<tr>
<td></td>
<td>HOLD: hold</td>
</tr>
<tr>
<td></td>
<td>SING: single sweep</td>
</tr>
<tr>
<td>Query Response</td>
<td>$\langle\text{CONT</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT $#E5100$; &quot;TRIM SING&quot;</td>
</tr>
<tr>
<td></td>
<td>OUTPUT $#E5100$; &quot;TRIM?&quot;</td>
</tr>
<tr>
<td></td>
<td>ENTER $#E5100$; A$</td>
</tr>
</tbody>
</table>

**UPDD** $\langle\text{ON|OFF}\rangle$

Sets the refresh of the display on or off. When UPDD is turned OFF, the operating speed to measure or setup will be faster. It is recommended to use this command with ALL BASIC to avoid to make a misreading because the status display on the LCD may not coincide with a current status when UPDD is turned OFF. This command is not effect to the limit table.

| Query Response | $\{0|1\}$ |
|----------------|-----------|
| Examples       | OUTPUT $\#E5100$; "UPDD ON" |
|                | OUTPUT $\#E5100$; "UPDD?" |
|                | ENTER $\#E5100$; A |

8-98 Command Reference
UPPELIMI <value1><value2><value3> ... <valuenn>

Sets the upper limit values of the limit line. The upper value can be set at each measurement point.

<table>
<thead>
<tr>
<th>Parameter Description</th>
<th>n - Number of points &lt;value&gt; : Upper value of limit line</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>{value1} {value2} {value3} ... {valuenn}</td>
</tr>
<tr>
<td>Examples</td>
<td>DIM A(1:201)</td>
</tr>
<tr>
<td></td>
<td>NOP. 201</td>
</tr>
<tr>
<td></td>
<td>Set upper value of limit line</td>
</tr>
<tr>
<td></td>
<td>OUTPUT @E5100;&quot;UPPELIMI&quot;;A(*)</td>
</tr>
<tr>
<td></td>
<td>OUTPUT @E5100;&quot;UPPELIMI?&quot;</td>
</tr>
<tr>
<td></td>
<td>ENTER @E5100;A(*)</td>
</tr>
</tbody>
</table>

WIDT {ON|OFF|0|1}

Sets the bandwidth search feature (ON) or not (OFF).

<table>
<thead>
<tr>
<th>Equivalent Key</th>
<th>Marker</th>
<th>UTILITY MENU WIDTHS ON OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sequence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parameter Description</td>
<td>OFF or 0 : Bandwidth search OFF</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ON or 1 : Bandwidth search ON (display center stimulus value, bandwidth, Q, insertion loss, frequency difference between center and cut off points)</td>
<td></td>
</tr>
<tr>
<td>Query Response</td>
<td>{1</td>
<td>0}</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100;&quot;WIDT ON&quot;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>OUTPUT @E5100;&quot;WIDT?&quot;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ENTER @E5100;A</td>
<td></td>
</tr>
</tbody>
</table>

WIDV value

Sets the amplitude parameter that defines the start and stop points for a bandwidth search.

<table>
<thead>
<tr>
<th>Equivalent Key</th>
<th>Marker</th>
<th>UTILITY MENU WIDTH VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sequence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parameter Range</td>
<td>-5x10^5 to 5x10^5</td>
<td></td>
</tr>
<tr>
<td>Query Response</td>
<td>{value}</td>
<td></td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT @E5100;&quot;WIDV 0&quot;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>OUTPUT @E5100;&quot;WIDV?&quot;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ENTER @E5100;A</td>
<td></td>
</tr>
</tbody>
</table>
**WRIT16**

Set the bit width of the data outputted to the I/O port while performing the trap function to 16 bit. The port F is used. (Option 022 only)

| Query Response | \{0|1\} |
|----------------|-------|
| Examples       | OUTPUT $E5100;"WRIT16" |
|                | OUTPUT $E5100;"WRIT16?" |
|                | ENTER $E5100;A |

**WRIT24**

Set the bit width of the data outputted to the I/O port while performing the trap function to 24 bit. The port H is used. (Option 022 only)

| Query Response | \{0|1\} |
|----------------|-------|
| Examples       | OUTPUT $E5100;"WRIT24" |
|                | OUTPUT $E5100;"WRIT24?" |
|                | ENTER $E5100;A |
SCPI Command (PROGram sub-system command)

:PROG:CATalog?

Returns all the defined program names. The program name is always "PROG", because the analyzer's HP Instrument BASIC only executes a single program at a time. This command can be used from an external controller only. (Query only)

<table>
<thead>
<tr>
<th>Query Response</th>
<th>{&quot;PROG&quot;}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT $E5100;:&quot;PROG:CAT?&quot;</td>
</tr>
<tr>
<td></td>
<td>ENTER $E5100;A$</td>
</tr>
</tbody>
</table>

:PROG[:SELected]:DEFine

Creates and downloads programs. The DEFine query uploads programs. This command can be used from an external controller only.
### :PROGram[:SELEceted]:DEFine[:<block>]

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Parameter Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;block&gt; : block data of program</td>
<td></td>
</tr>
</tbody>
</table>

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

- **#0**: Allows the OUTPUT statement to send program line until END is specified in the OUTPUT statement.
- **#2MM...M**: Specifies the program size.
  - M specifies the number of digits that define the program size
  - M...M is program size in byte (M digits)

Each line of the program must be separated by <CR> or <CR> <LF>. When the size of the <block> exceeds the amount of available memory in the instrument, the program lines are saved up to the point of memory overflow.

In the response to the DEFINE query, the selected program and its size are returned. The selected program must be in either the paused or stopped state for the program to be uploaded. The <block> is uploaded as definite length arbitrary block response data. The program size is returned in the first line as the header, then program lines are returned.

<table>
<thead>
<tr>
<th>Query Response</th>
<th>{&lt;block&gt;}</th>
</tr>
</thead>
</table>

**Examples**

```plaintext```
OUTPUT &E5100; ":PROG:DEF #0"
OUTPUT &E5100; "10 PRINT " "HELLO!""
OUTPUT &E5100; "20 END"
OUTPUT &E5100; " END

DIM A$[100000]
OUTPUT &E5100; ":PROG:DEF?"
ENTER &E5100 USING ":1, 2A"; HEAD$ ! Gets the header.
B=VAL(HEAD$[2]) !
FOR I=1 TO B !
  ENTER &E5100 USING ":1, A"; HEAD$ !
NEXT I !
ENTER &E5100 USING ":-K"; A$ ! Gets the program.
```

### :PROGram[:SELEceted]:DELeTe[:SELEceted]

Deletes the program in the BASIC editor of the analyzer. This command can be used from an external controller only. (No query)

**Examples**

```
OUTPUT &E5100; ":PROG:DEL"
```
:PROG[:SEL]:STAT{RUN|PAUSE|STOP|CONT}

:PROG[:SEL]:DELe:ALL
Deletes the program in the BASIC editor of the analyzer. This command can be used from an external controller only. (No query)

Examples

```
OUTPUT $E5100;"":PROG:DEL:ALL"
```

:PROG[:SEL]:EXEC{<string>}
Executes the program command. The program must be in either paused or stopped before the EXECute command is allowed. This command can be used from an external controller only. (No query)

<table>
<thead>
<tr>
<th>Parameter Description</th>
<th>&lt;string&gt; : Legal program command</th>
</tr>
</thead>
</table>
| Examples              | OUTPUT $E5100;"":PROG:EXEC ""STEP""

:PROG[:SEL]:NUMBER{<string>,<numeric (1)>,[,<numeric (2)>][, ... [,<numeric (n)>]}
Sets or queries the contents of numeric program variables and arrays in the program on the BASIC editor of the analyzer. This command can be used from an external controller only.

<table>
<thead>
<tr>
<th>Parameter Description</th>
<th>&lt;string&gt; : Name of an existing variable in the selected program (either character data or string data)</th>
<th>&lt;numeric&gt; : Variable value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>[numeric (1)] [numeric (2)] [ ... [numeric (n)]]</td>
<td></td>
</tr>
</tbody>
</table>
| Examples              | OUTPUT $E5100;"":PROG:NUM 1,1"

:PROG[:SEL]:STAT{RUN|PAUSE|STOP|CONT}
Sets or queries the state of the program in the BASIC editor of the analyzer. The table below defines the affect of setting the state to the specified state from each of the possible current states. This command can be used from an external controller only.

<table>
<thead>
<tr>
<th>Desired State</th>
<th>Current State</th>
</tr>
</thead>
<tbody>
<tr>
<td>RUN</td>
<td>PAUSE</td>
</tr>
<tr>
<td>RUN</td>
<td>RUN</td>
</tr>
<tr>
<td>CONT</td>
<td>RUN</td>
</tr>
<tr>
<td>PAUSE</td>
<td>PAUSE</td>
</tr>
<tr>
<td>STOP</td>
<td>STOP</td>
</tr>
</tbody>
</table>

Command Reference 8-103
**:PROGرام[:SEلected]:STATة[:RUN|PAUsэ|STOP|CONTиnue]**

<table>
<thead>
<tr>
<th>Query Response</th>
<th>{&quot;RUN&quot;,&quot;PAUsэ&quot;,&quot;STOP&quot;}</th>
</tr>
</thead>
</table>
| Examples       | OUTPUT 8E5100:"PROG:STAT ""STOP"""

OUTPUT 8E5100:"PROG:STAT?"
ENTER 8E5100:A$

**:PROGرام[:SEلected]:STRиng<стринг (varname)>,<стринг (value1)>[1],<стринг (value2)>[1, ... [1],<стринг (value n)>**

Sets or queries the contents of string program variables and arrays in the program in the BASIC editor of the analyzer. If a string value is too long it is truncated when stored in the program’s variable. This command can be used from an external controller only.

<table>
<thead>
<tr>
<th>Parameter Description</th>
<th>&lt;стринг(varname) &gt; : Name of an existing variable in the selected program (either character data or string data). &lt;стринг(value) &gt; : Variable value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>{стринг(1)} [{стринг(2)}] [... [{стринг(n)}]</td>
</tr>
</tbody>
</table>
| Examples              | OUTPUT 8E5100:"PROG:STR ""A$"", ""TEST""""

OUTPUT 8E5100:"PROG:STR? ""A$"""
ENTER 8E5100:B$

OUTPUT 8E5100:"PROG:STR? 'A$'"
ENTER 8E5100:B$

**:PROGرام[:SEلected]:WAIT**

Causes no further commands or queries to be executed until the defined program exits from the RUN state. That is, the program is either stopped or paused. This command can be used from an external controller only.

<table>
<thead>
<tr>
<th>Query Response</th>
<th>{1} (1 is returned when the program is either stopped or paused.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT 8E5100:&quot;PROG:WAIT&quot;</td>
</tr>
</tbody>
</table>

OUTPUT 8E5100:"PROG:WAIT?"
ENTER 8E5100:A
Manual Changes

Introduction
This appendix contains the information required to adapt this manual to earlier versions or configurations of the analyzer than the current printing date of this manual. The information in this manual applies directly to the HP E5100A/B Network Analyzer serial number prefix listed on the title page of this manual.

Manual Changes
To adapt this manual to your HP E5100A/B, see Table A-1 and Table A-2, and make all the manual changes listed opposite your instrument’s serial number and firmware version.

Instruments manufactured after the printing of this manual may be different from those documented in this manual. Later instrument versions will be documented in a manual changes supplement that will accompany the manual shipped with that instrument. If your instrument’s serial number is not listed on the title page of this manual or in Table A-1, it may be documented in a yellow MANUAL CHANGES supplement.

In additions to change information, the supplement may contain information for correcting errors (Errata) in the manual. To keep this manual as current and accurate as possible, Hewlett-Packard recommends that you periodically request the latest MANUAL CHANGES supplement.

For information concerning serial number prefixes not listed on the title page or in the MANUAL CHANGE supplement, contact the nearest Hewlett-Packard office.

Turn on the line switch or execute the *IDN? command by HP-IB to confirm the firmware version. See the HP-IB Command Reference manual for information on the *IDN? command.

Table A-1. Manual Changes by Serial Number

<table>
<thead>
<tr>
<th>Serial Prefix or Number</th>
<th>Make Manual Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>JPIKC</td>
<td>Change 1</td>
</tr>
</tbody>
</table>

Table A-2. Manual Changes by Firmware Version

<table>
<thead>
<tr>
<th>Version</th>
<th>Make Manual Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rev. 1.xx</td>
<td>Change 1 and 2</td>
</tr>
<tr>
<td>Rev. 2.00</td>
<td>Change 2</td>
</tr>
</tbody>
</table>
Serial Number

Hewlett-Packard uses a two-part, ten-character serial number that is stamped on the serial number plate (see Figure A-1) attached to the rear panel. The first five digits and the letter are the serial prefix and the last five digits are the suffix.

![Serial Number Plate](image)

Figure A-1. Serial Number Plate
Change 1

The firmware revision 1.xx does not support the following commands. Please delete the descriptions about these commands in this manual.

ANARANGP
CALCOPY
CIVAL
CLEMNU3
EQUCPARA
GRAPFORM
INPUStIM
MARKTIME
MENU3
OUTPCF2
OUTPXF2
PICIRC
PRIR
POWU
RPLMM
SAVDGRAP
SAVDMMNU3

Change 2

The firmware revision 1.xx and 2.00 do not support the following commands. Please delete the descriptions about these commands in this manual.

MAXPOIN
MAXPORT
## Command Summary

### Meas/Format Menu

<table>
<thead>
<tr>
<th>Key Label</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>FUNCTION</td>
<td>ANAMODE</td>
</tr>
<tr>
<td>MEAS</td>
<td>MEAS</td>
</tr>
<tr>
<td>FORMAT</td>
<td>FMT</td>
</tr>
<tr>
<td>GROUP</td>
<td>GRODAPER</td>
</tr>
<tr>
<td>DELY</td>
<td></td>
</tr>
<tr>
<td>APERTURE</td>
<td></td>
</tr>
<tr>
<td>NUM of CH</td>
<td>NUMC</td>
</tr>
<tr>
<td>ACTIVE CH</td>
<td>CHAN</td>
</tr>
</tbody>
</table>

### Function Menu

<table>
<thead>
<tr>
<th>Key Label</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>GAIN-PHASE</td>
<td>ANAMODE GAINP</td>
</tr>
<tr>
<td>IMPEDANCE:Ref1</td>
<td>ANAMODE ZREFL</td>
</tr>
<tr>
<td>Trans</td>
<td>ANAMODE ZTRAN</td>
</tr>
</tbody>
</table>
Port Select Menu

<table>
<thead>
<tr>
<th>Key Label</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>A/R</td>
<td>MEAS AR</td>
</tr>
<tr>
<td>B/R</td>
<td>MEAS BR</td>
</tr>
<tr>
<td>C/R</td>
<td>MEAS CR</td>
</tr>
<tr>
<td>R/A</td>
<td>MEAS RA</td>
</tr>
<tr>
<td>B/A</td>
<td>MEAS BA</td>
</tr>
<tr>
<td>C/A</td>
<td>MEAS CA</td>
</tr>
<tr>
<td>R/B</td>
<td>MEAS RB</td>
</tr>
<tr>
<td>A/B</td>
<td>MEAS AB</td>
</tr>
<tr>
<td>C/B</td>
<td>MEAS CB</td>
</tr>
<tr>
<td>R</td>
<td>MEAS R</td>
</tr>
<tr>
<td>A</td>
<td>MEAS A</td>
</tr>
<tr>
<td>B</td>
<td>MEAS B</td>
</tr>
<tr>
<td>C</td>
<td>MEAS C</td>
</tr>
</tbody>
</table>

Gain-Phase Format Menu

<table>
<thead>
<tr>
<th>Key Label</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOG MAG &amp; PHASE</td>
<td>FMT LOGMP</td>
</tr>
<tr>
<td>LOG MAG &amp; DELAY</td>
<td>FMT LOGMD</td>
</tr>
<tr>
<td>LIN MAG &amp; PHASE</td>
<td>FMT LINMP</td>
</tr>
<tr>
<td>LIN MAG &amp; DELAY</td>
<td>FMT LINMD</td>
</tr>
<tr>
<td>REAL &amp; IMAGINARY</td>
<td>FMT RIMAG</td>
</tr>
<tr>
<td>LOG MAG</td>
<td>FMT LOGM</td>
</tr>
<tr>
<td>LIN MAG</td>
<td>FMT LINM</td>
</tr>
<tr>
<td>PHASE</td>
<td>FMT PHAS</td>
</tr>
<tr>
<td>DELAY</td>
<td>FMT DELA</td>
</tr>
<tr>
<td>REAL</td>
<td>FMT REAL</td>
</tr>
<tr>
<td>IMAGINARY</td>
<td>FMT IMAG</td>
</tr>
<tr>
<td>EXPANDED PHASE</td>
<td>FMT EXPP</td>
</tr>
</tbody>
</table>
Z Format Menu

<table>
<thead>
<tr>
<th>Key Label</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z &amp; PHASE z</td>
<td>FMT MAGZP</td>
</tr>
<tr>
<td>Y &amp; PHASE y</td>
<td>FMT MAGYP</td>
</tr>
<tr>
<td>R-X</td>
<td>FMT IMPRX</td>
</tr>
<tr>
<td>G-B</td>
<td>FMT ADMGB</td>
</tr>
<tr>
<td>Z</td>
<td>FMT MAGZ</td>
</tr>
<tr>
<td>Y</td>
<td>FMT MAGY</td>
</tr>
<tr>
<td>PHASE z</td>
<td>FMT PHAZ</td>
</tr>
<tr>
<td>PHASE y</td>
<td>FMT PHAY</td>
</tr>
<tr>
<td>R</td>
<td>FMT IMPR</td>
</tr>
<tr>
<td>X</td>
<td>FMT IMPX</td>
</tr>
<tr>
<td>G</td>
<td>FMT ADMG</td>
</tr>
<tr>
<td>B</td>
<td>FMT ADMB</td>
</tr>
<tr>
<td>Y-AXIS</td>
<td>SCAV</td>
</tr>
<tr>
<td>EXPARED PHASE</td>
<td>OFF EXPZP</td>
</tr>
</tbody>
</table>

Display

Display Menu (1/3) (2/3) (3/3)

<table>
<thead>
<tr>
<th>Key Label</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUTOSCALE</td>
<td>AUTO</td>
</tr>
<tr>
<td>MULTI CH on OFF</td>
<td>MULC</td>
</tr>
<tr>
<td>SPLIT DISP on OFF</td>
<td>SPLD</td>
</tr>
<tr>
<td>SMOOTHING on OFF</td>
<td>SMOO</td>
</tr>
<tr>
<td>SMOOTHING APERTURE</td>
<td>SMOOPAPER</td>
</tr>
<tr>
<td>ELECTRICAL DELAY</td>
<td>ELED</td>
</tr>
<tr>
<td>PHASE OFFSET</td>
<td>PHAO</td>
</tr>
<tr>
<td>TITLE</td>
<td>TITL</td>
</tr>
<tr>
<td>STORAGE on OFF</td>
<td>STR</td>
</tr>
<tr>
<td>GRATICULE on OFF</td>
<td>DISG</td>
</tr>
</tbody>
</table>
### Linear Scale Menu

<table>
<thead>
<tr>
<th>Key Label</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCALE/DIV</td>
<td>SCAL</td>
</tr>
<tr>
<td>REFERENCE POSITION</td>
<td>REFP</td>
</tr>
<tr>
<td>REFERENCE VALUE</td>
<td>REFV</td>
</tr>
<tr>
<td>MARKER -&gt; REFERENCE</td>
<td>MARKREF</td>
</tr>
<tr>
<td>ACTIVE TRC</td>
<td>ATRC</td>
</tr>
</tbody>
</table>

### Log Scale Menu

<table>
<thead>
<tr>
<th>Key Label</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOP VALUE</td>
<td>TOPV</td>
</tr>
<tr>
<td>BOTTOM VALUE</td>
<td>BOTV</td>
</tr>
<tr>
<td>ACTIVE TRC</td>
<td>ATRC</td>
</tr>
</tbody>
</table>

### Define Trace Menu

<table>
<thead>
<tr>
<th>Key Label</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRACE: DATA</td>
<td>DISPDATA</td>
</tr>
<tr>
<td>MEMORY</td>
<td>DISPMEMO</td>
</tr>
<tr>
<td>DATA and MEMORY</td>
<td>DSPDATM</td>
</tr>
<tr>
<td>DATA-MEM</td>
<td>DSPDMM</td>
</tr>
<tr>
<td>DATA/MEM</td>
<td>DSPDDM</td>
</tr>
<tr>
<td>DATA-&gt;MEMORY</td>
<td>DATI</td>
</tr>
</tbody>
</table>

### Basic Allocation Menu

<table>
<thead>
<tr>
<th>Key Label</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALL INSTRUMENT</td>
<td>DISAALLI</td>
</tr>
<tr>
<td>HALF INSTR HALF BASIC</td>
<td>DISAHIHB</td>
</tr>
<tr>
<td>ALL BASIC</td>
<td>DISAALLB</td>
</tr>
<tr>
<td>BASIC STATUS</td>
<td>DISABASS</td>
</tr>
</tbody>
</table>
Gain-Phase CAL Menu

<table>
<thead>
<tr>
<th>Key Label</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>CORRECTION on OFF</td>
<td>CORR</td>
</tr>
<tr>
<td>CALIBRATE: NONE</td>
<td>CALI NONE</td>
</tr>
<tr>
<td>RESPONSE</td>
<td>CALI RESP</td>
</tr>
<tr>
<td>RESPONSE &amp; ISOL'N</td>
<td>CALI RAI</td>
</tr>
<tr>
<td>1-PORT 3-TERM</td>
<td>CALI ONE</td>
</tr>
<tr>
<td>SET ZO</td>
<td>SETZ</td>
</tr>
</tbody>
</table>

Thru CAL Menu

<table>
<thead>
<tr>
<th>Key Label</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>THRU</td>
<td>STANC</td>
</tr>
<tr>
<td>DONE:</td>
<td>RESPDONE</td>
</tr>
</tbody>
</table>

Response & Isolation CAL Menu

<table>
<thead>
<tr>
<th>Key Label</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>RESPONSE</td>
<td>RAIRESP</td>
</tr>
<tr>
<td>ISOL'N STD</td>
<td>RAIISOL</td>
</tr>
<tr>
<td>DONE:</td>
<td>RAID</td>
</tr>
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</table>

Gain-Phase 3 Term CAL Menu

<table>
<thead>
<tr>
<th>Key Label</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPEN</td>
<td>CALSS11A</td>
</tr>
<tr>
<td>SHORT</td>
<td>CLASS11B</td>
</tr>
<tr>
<td>LOAD</td>
<td>CLASS11C</td>
</tr>
<tr>
<td>DONE:</td>
<td>SAV1</td>
</tr>
</tbody>
</table>
Gain-Phase CAL STD value menu

<table>
<thead>
<tr>
<th>Key Label</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPEN STD</td>
<td>CALKO{RS</td>
</tr>
<tr>
<td>SHORT STD</td>
<td>CALKS{RS</td>
</tr>
<tr>
<td>LOAD STD</td>
<td>CALKL{RS</td>
</tr>
</tbody>
</table>

Z: Refl CAL Menu

<table>
<thead>
<tr>
<th>Key Label</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>CORRECTION on OFF</td>
<td>CORR</td>
</tr>
<tr>
<td>CALIBRATE: NONE</td>
<td>CALI NONE</td>
</tr>
<tr>
<td>1-PORT 3-TERM</td>
<td>CALI ONP</td>
</tr>
<tr>
<td>SET ZO</td>
<td>SETZ</td>
</tr>
</tbody>
</table>

Z: Refl CAL Menu

<table>
<thead>
<tr>
<th>Key Label</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPEN</td>
<td>CLASS11A</td>
</tr>
<tr>
<td>SHORT</td>
<td>CLASS11B</td>
</tr>
<tr>
<td>LOAD</td>
<td>CLASS11C</td>
</tr>
<tr>
<td>DONE: SAV1</td>
<td></td>
</tr>
</tbody>
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Z: Refl CAL STD value menu

<table>
<thead>
<tr>
<th>Key Label</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPEN STD</td>
<td>CALKO{RS</td>
</tr>
<tr>
<td>SHORT STD</td>
<td>CALKS{RS</td>
</tr>
<tr>
<td>LOAD STD</td>
<td>CALKL{RS</td>
</tr>
</tbody>
</table>

Z: Trans CAL Menu

<table>
<thead>
<tr>
<th>Key Label</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>CORRECTION on OFF</td>
<td>CORR</td>
</tr>
<tr>
<td>CALIBRATE: NONE</td>
<td>CALI NONE</td>
</tr>
<tr>
<td>3 TERM</td>
<td>CALI ONEP</td>
</tr>
<tr>
<td>1 TERM</td>
<td>CALI RESP</td>
</tr>
<tr>
<td>SET ZO</td>
<td>SETZ</td>
</tr>
</tbody>
</table>
### Z: Trans 3 Term CAL Menu

<table>
<thead>
<tr>
<th>Key Label</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPEN</td>
<td>CALSS11A</td>
</tr>
<tr>
<td>SHORT</td>
<td>CALSS11B</td>
</tr>
<tr>
<td>LOAD</td>
<td>CALSS11C</td>
</tr>
<tr>
<td>DONE:</td>
<td>SAV1</td>
</tr>
</tbody>
</table>

### 1 Term CAL Menu

<table>
<thead>
<tr>
<th>Key Label</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>THRU</td>
<td>STANC</td>
</tr>
<tr>
<td>DONE:</td>
<td>RESPDONE</td>
</tr>
</tbody>
</table>

### Z: Trans CAL STD value menu

<table>
<thead>
<tr>
<th>Key Label</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPEN STD</td>
<td>CALK0{RS</td>
</tr>
<tr>
<td>SHORT STD</td>
<td>CALKS{RS</td>
</tr>
<tr>
<td>LOAD STD</td>
<td>CALKL{RS</td>
</tr>
</tbody>
</table>

### Marker Menu

<table>
<thead>
<tr>
<th>Key Label</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACTIVE MARKER</td>
<td>MARK{1</td>
</tr>
<tr>
<td>CLEAR MARKER</td>
<td>CLEM{1</td>
</tr>
</tbody>
</table>

### Marker Search Menu

<table>
<thead>
<tr>
<th>Key Label</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEARCH:MAX</td>
<td>SEAMAX</td>
</tr>
<tr>
<td>MIN</td>
<td>SEAMIN</td>
</tr>
<tr>
<td>TARGET</td>
<td>SEATARG</td>
</tr>
<tr>
<td>TRACKING:ON</td>
<td>TRACK</td>
</tr>
<tr>
<td>TRACKING:OFF</td>
<td>TRACK</td>
</tr>
</tbody>
</table>
**Search Range Menu**

<table>
<thead>
<tr>
<th>Key Label</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEARCH RNG STORE</td>
<td>SEARSTOR</td>
</tr>
<tr>
<td>PART SRCH on OFF</td>
<td>PARS</td>
</tr>
</tbody>
</table>

**Marker Utility Menu**

<table>
<thead>
<tr>
<th>Key Label</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>STATISTICS on OFF</td>
<td>MEASTAT</td>
</tr>
<tr>
<td>WIDTHS on OFF</td>
<td>WIDT</td>
</tr>
<tr>
<td>WIDTH VALUE</td>
<td>WIDV</td>
</tr>
<tr>
<td>MKR LIST on OFF</td>
<td>MARKL</td>
</tr>
</tbody>
</table>

**ΔMode Menu**

<table>
<thead>
<tr>
<th>Key Label</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>Δ REF MARKER</td>
<td>DELR{1</td>
</tr>
<tr>
<td>ΔREF=Δ FIXED MKR</td>
<td>DELRFIXM</td>
</tr>
<tr>
<td>Δ MODE OFF</td>
<td>DELO</td>
</tr>
<tr>
<td>MKR ZERO</td>
<td>MARKZERO</td>
</tr>
</tbody>
</table>

**Fixed Marker Position Menu**

<table>
<thead>
<tr>
<th>Key Label</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIXED MKR STIMULUS</td>
<td>MARKFSTI</td>
</tr>
<tr>
<td>FIXED MKR VALUE</td>
<td>MARKFVAL</td>
</tr>
</tbody>
</table>

**Marker Mode Menu**

<table>
<thead>
<tr>
<th>Key Label</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>MARKERS: DISCRETE</td>
<td>MARKDISC</td>
</tr>
<tr>
<td>CONTINUOUS</td>
<td>MARKCONT</td>
</tr>
<tr>
<td>MARKERS: COUPLED</td>
<td>MARKCOUP</td>
</tr>
<tr>
<td>UNCOUPLED</td>
<td>MARKUNCO</td>
</tr>
<tr>
<td>MKR TIME on OFF</td>
<td>MARKTIME</td>
</tr>
</tbody>
</table>
### Sweep Menu

<table>
<thead>
<tr>
<th>Key Label</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>SWEEP TYPE MENU</td>
<td>SWPT</td>
</tr>
<tr>
<td>SWEEP TIME</td>
<td>SWET</td>
</tr>
<tr>
<td>NUMBER of POINTS</td>
<td>POIN</td>
</tr>
<tr>
<td>POWER</td>
<td>POWE</td>
</tr>
<tr>
<td>CW FREQ</td>
<td>CWFREQ</td>
</tr>
<tr>
<td>IF BW</td>
<td>IFBW</td>
</tr>
<tr>
<td>COUPLED CH on OFF</td>
<td>COUC</td>
</tr>
<tr>
<td>ACTIVE CH [CH1]</td>
<td>CHAN</td>
</tr>
</tbody>
</table>

### Sweep Type Menu

<table>
<thead>
<tr>
<th>Key Label</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIN FREQ</td>
<td>SWPT LINF</td>
</tr>
<tr>
<td>POWER SWEEP</td>
<td>SWPT POWE</td>
</tr>
<tr>
<td>LIST FREQ</td>
<td>SWPT POWE</td>
</tr>
<tr>
<td>LIST NO. []</td>
<td>LISSLIS{1</td>
</tr>
<tr>
<td>LIN FREQ [STEP]</td>
<td>SWPT RAMPF</td>
</tr>
<tr>
<td>LIN FREQ [RAMP]</td>
<td>SWPT LINF</td>
</tr>
<tr>
<td>SWEEP DIR []</td>
<td>SWED</td>
</tr>
<tr>
<td>LIST DISP: FREQ BASE</td>
<td>LISDFBASE</td>
</tr>
<tr>
<td>ORDER BASE</td>
<td>LISOBASE</td>
</tr>
</tbody>
</table>

### Sweep Time Menu

<table>
<thead>
<tr>
<th>Key Label</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>SWEEP TIME AUTO</td>
<td>SWETAUTO</td>
</tr>
</tbody>
</table>
## Trigger Menu

<table>
<thead>
<tr>
<th>Key Label</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>HOLD</td>
<td>TRIM HOLD</td>
</tr>
<tr>
<td>SINGLE</td>
<td>TRIM SING</td>
</tr>
<tr>
<td>CONTINUOUS</td>
<td>TRIM CONT</td>
</tr>
<tr>
<td>TRIG EVENT</td>
<td>EXTT{ON</td>
</tr>
<tr>
<td>MEASURE</td>
<td>RESTART</td>
</tr>
</tbody>
</table>

## Start, Stop, Center, Span

<table>
<thead>
<tr>
<th>Key Label</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start</td>
<td>STAR</td>
</tr>
<tr>
<td>Stop</td>
<td>STOP</td>
</tr>
<tr>
<td>Center</td>
<td>CENT</td>
</tr>
<tr>
<td>Span</td>
<td>SPAN</td>
</tr>
</tbody>
</table>

→ Function Menu

<table>
<thead>
<tr>
<th>Key Label</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>MKR→START</td>
<td>MARKSTAR</td>
</tr>
<tr>
<td>MKR→STOP</td>
<td>MARKSTOP</td>
</tr>
<tr>
<td>MKR→CENTER</td>
<td>MARKCENT</td>
</tr>
<tr>
<td>MKR→SPAN</td>
<td>MARKSPAN</td>
</tr>
<tr>
<td>MKR→REFERENCE</td>
<td>MARKREF</td>
</tr>
</tbody>
</table>
### System Menu (1/3) (2/3) (3/3)

<table>
<thead>
<tr>
<th>Key Label</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRINT</td>
<td>PRINALL</td>
</tr>
</tbody>
</table>

### Clock Menu

<table>
<thead>
<tr>
<th>Key Label</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>TIME HH:MM:SS</td>
<td>SETCTIME</td>
</tr>
<tr>
<td>DATE MM/DD/YY</td>
<td>SETCDATE</td>
</tr>
<tr>
<td>DATE MODE: MonDayYear</td>
<td>MONDAYEAR</td>
</tr>
<tr>
<td>DayMonYear</td>
<td>DAYMYEAR</td>
</tr>
</tbody>
</table>

### Att Setting Menu

<table>
<thead>
<tr>
<th>Key Label</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUTO</td>
<td>ATTI{R</td>
</tr>
<tr>
<td>0 dB</td>
<td>ATTI{R</td>
</tr>
<tr>
<td>25 dB</td>
<td>ATTI{R</td>
</tr>
</tbody>
</table>

### Save/Recall Menu

<table>
<thead>
<tr>
<th>Key Label</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recall</td>
<td>RECD</td>
</tr>
<tr>
<td>BACKUP MEMO DISK</td>
<td>STOMDISK</td>
</tr>
<tr>
<td>STOR DEV [ ]</td>
<td>STOD{DISK</td>
</tr>
</tbody>
</table>
Save Menu

<table>
<thead>
<tr>
<th>Key Label</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALL</td>
<td>SAVALL</td>
</tr>
<tr>
<td>STATE ONLY</td>
<td>SAVDSTA</td>
</tr>
<tr>
<td>DATA ONLY(BINARY)</td>
<td>SAVDDAT</td>
</tr>
<tr>
<td>DATA ONLY(ASCII)</td>
<td>SAVDASC</td>
</tr>
<tr>
<td>RE-SAVE FILE</td>
<td>RESAVD</td>
</tr>
</tbody>
</table>

File Utility Menu

<table>
<thead>
<tr>
<th>Key Label</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>PURGE FILE</td>
<td>PURG</td>
</tr>
<tr>
<td>CREATE DIRECTORY</td>
<td>CRED</td>
</tr>
<tr>
<td>CHANGE DIRECTORY</td>
<td>CHAD</td>
</tr>
<tr>
<td>COPY FILE</td>
<td>FILC</td>
</tr>
<tr>
<td>INITIALIZE</td>
<td>INID</td>
</tr>
</tbody>
</table>

Binary Define Save Data Menu

<table>
<thead>
<tr>
<th>Key Label</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAW ARRY on OFF</td>
<td>SAVCA</td>
</tr>
<tr>
<td>CAL ARRY on OFF</td>
<td>SAVRA</td>
</tr>
<tr>
<td>DATA ARRY on OFF</td>
<td>SAVDA</td>
</tr>
<tr>
<td>MEM ARRY on OFF</td>
<td>SAVMA</td>
</tr>
<tr>
<td>FORMD ARRY on OFF</td>
<td>SAVFA</td>
</tr>
<tr>
<td>MAIN ARRAY on OFF</td>
<td>SAVTA</td>
</tr>
<tr>
<td>SUB ARRAY on OFF</td>
<td>SAVTMA</td>
</tr>
</tbody>
</table>

ASCII Define Save Data Menu

<table>
<thead>
<tr>
<th>Key Label</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAIN ARRAY on OFF</td>
<td>SAVTA</td>
</tr>
<tr>
<td>SUB ARRAY on OFF</td>
<td>SAVTMA</td>
</tr>
</tbody>
</table>
### MISC Save Menu

<table>
<thead>
<tr>
<th>Key Label</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAVE GRAPHICS</td>
<td>SAVDGRAP</td>
</tr>
<tr>
<td>GRAPH [ ]</td>
<td>GRAPFORM</td>
</tr>
<tr>
<td>SAVE MENU3</td>
<td>SAVDMNU3</td>
</tr>
<tr>
<td>RE-SAVE</td>
<td>RESAVD</td>
</tr>
</tbody>
</table>

### Menu 2

<table>
<thead>
<tr>
<th>Key Label</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>USER CI [ ]</td>
<td>CIVAL</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Key Label</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>SRC UNIT [ ]</td>
<td>POWU</td>
</tr>
<tr>
<td>PICIRCUIT ON OFF</td>
<td>PICIRC</td>
</tr>
</tbody>
</table>
Data I/O Format

Data Format

The HP E5100A/B can output data over HP-IB in four different formats. The type of format affects what kind of data array is declared (real or integer), since the format determines what type of data is transferred.

Form 2

IEEE 32-bit floating point format. In this mode, each number takes 4 bytes. This means that a 201 point transfer takes 1,608 bytes. Figure C-1 shows the data transfer format of Form 2.

![Figure C-1. Form 2 Data Transfer Format](image)

Form 3

IEEE 64-bit floating point format. In this mode, each number takes 8 bytes. This means that a 201-point transfer takes 3,216 bytes. Data is stored internally in the 200/300 series computer with the IEEE 64-bit floating point format, eliminating the need for any reformatting by the computer. Figure C-2 shows the data transfer format of Form 3.

![Figure C-2. Form 3 Data Transfer Format](image)
Form 4

ASCII data transfer format. In this mode, each number is sent as a 24 character string, each character being a digit, sign, or decimal point. Use this format, when HP E5100A/B enters data to an internal array using INPUxxx command.

Form 5

MS-DOS® personal computer format. This mode is a modification of IEEE 32-bit floating point format with the byte order reversed. Form 5 also has a four byte header which must be read in so that data order is maintained. In this mode, an MS-DOS® PC can store data internally without reformatting it.
Internal Data Array

The data is stored in data arrays, denoted by double-line boxes in Figure C-3.

![Data Processing Flow Diagram](image)

Figure C-3. Data Processing Flow Diagram

The following tables list HP-IB commands to output and enter data from/to the internal array.

### Table C-1. Data Array Output Commands

<table>
<thead>
<tr>
<th>Array Name</th>
<th>Array Output</th>
<th>One Point Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw Data Array</td>
<td>OUTPRAW?</td>
<td>-</td>
</tr>
<tr>
<td>Cal. Coef. Array</td>
<td>OUTPCALC{01</td>
<td>02</td>
</tr>
<tr>
<td>Data Array</td>
<td>OUTPDATA?</td>
<td>-</td>
</tr>
<tr>
<td>Memory Array</td>
<td>OUTPMEMO?</td>
<td>-</td>
</tr>
<tr>
<td>Formatted Array</td>
<td>OUTPFORM?</td>
<td>OUTPFORMP?</td>
</tr>
<tr>
<td>Main Array</td>
<td>OUTPRFORM?</td>
<td>OUTPRFORMP?</td>
</tr>
<tr>
<td>Sub Array</td>
<td>OUTPRTMEM?</td>
<td>OUTPRTMEMP?</td>
</tr>
</tbody>
</table>

### Table C-2. Data Array Input Commands

<table>
<thead>
<tr>
<th>Array Name</th>
<th>Array Input</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw Data Array</td>
<td>INPURAW?</td>
</tr>
<tr>
<td>Cal. Coef. Array</td>
<td>INPUCALC{01</td>
</tr>
<tr>
<td>Data Array</td>
<td>INPUDATA?</td>
</tr>
<tr>
<td>Memory Array</td>
<td>INPUMEMO?</td>
</tr>
<tr>
<td>Formatted Array</td>
<td>INPUFORM?</td>
</tr>
<tr>
<td>Main Array</td>
<td>INPURFORM?</td>
</tr>
<tr>
<td>Sub Array</td>
<td>INPURTMEM?</td>
</tr>
</tbody>
</table>
Waveform Analysis Commands

The HP E5100A/B has added a command set that can be used to analyze waveforms of specific devices. The waveform analysis commands analyze and output the results using only a single command. This appendix provides information about the added waveform analysis commands.

The commands are divided into five groups as follows:

- Waveform analysis setup commands
- Maximum/Minimum/Mean search commands
- Ripple analysis commands
- Filter and Resonator analysis commands
- Equivalent circuit analysis commands
Conventions and Definitions

This section describes the conventions and definitions that are used to describe the waveform analysis commands.

1. **ANARANG**
2. Sets the stimulus range for the waveform.
3. **Syntax**
4. 
   \[ \text{ANARANG} \ start, stop \]
   
   Where,
   
   \[ \begin{align*}
   0 & \quad \text{start} & \text{Start value of the analysis range} \\
   1 & \quad \text{stop} & \text{Stop value of the analysis range}
   \end{align*} \]
5. **Query Response**
6. **Semantics**
7. **Note**
8. **Examples**

<table>
<thead>
<tr>
<th></th>
<th>Command name.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Command description.</td>
</tr>
<tr>
<td>3</td>
<td>Command syntax</td>
</tr>
<tr>
<td></td>
<td>This part shows the syntax of the command. You must put a space between the command and the parameters.</td>
</tr>
<tr>
<td>4</td>
<td>Command parameter description</td>
</tr>
<tr>
<td></td>
<td>The first column of the table lists the register number that is used by the EXECUTE command. You must put the parameter in the indicated register before using the EXECUTE command. For example (in the above case):</td>
</tr>
</tbody>
</table>
|   | \begin{align*}
|   | \text{WRITE} 15,0; \text{Start} & \text{Put "Start" in register 0.} \\
|   | \text{WRITE} 15,1; \text{Stop} & \text{Put "Stop" in register 1.} \\
|   | \text{EXECUTE "ANARANG"} & \text{Execute "ANARANG".} \\
|   | \end{align*} |
|   | The second column lists the parameter name that is shown in the Syntax area. The third column describes the parameters. |
| 5 | Query response.                                        |
|   | This part shows what values will be returned as the query response. The description of the query response is similar to the description of the Syntax area shown above. |
| 6 | Semantics                                              |
|   | This part describes how the command obtains the values for the query response. |
| 7 | Note                                                   |
|   | This part describes the required conditions or limitations when using the command. |
| 8 | Examples                                               |
|   | This part shows examples of how to use the command. Examples are provided for both HP BASIC on an external controller and Instrument BASIC on the analyzer. |
Waveform Analysis Setup Commands

The following commands are used for setting up the conditions for waveform analysis:

- ANAOCH{1|2|3|4}
- ANARANG
- ANARANGP
- ANARFULL
- ANACDATA
- ANAMEMO
- THR

The settings are effective for all of the waveform analysis commands.

**ANAOCH{1|2|3|4}**

Selects channel for waveform analysis.

**Syntax**

```
ANAOCH{1|2|3|4}
```

**Query**

`boolean`

**Response**

Where,

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td><code>boolean</code></td>
<td>1 or 0. Channel 1 is selected (1) or is not selected (0) for waveform analysis.</td>
</tr>
</tbody>
</table>

**Note**

- The ANAOCH{1|2|3|4} channel setting is independent of the active channel setting.
ANARANG
Sets the stimulus range for waveform analysis commands by start and stop value.

Syntax
ANARANG start, stop

Where,

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>start</td>
<td>Start value of the analysis range.</td>
</tr>
<tr>
<td>1</td>
<td>stop</td>
<td>Stop value of the analysis range.</td>
</tr>
</tbody>
</table>

Query Response

start, stop

Note
- The waveform analysis range is independent of the marker search range.
- You can set the range for each channel independently. Therefore, you need to set the analysis channel using ANA0CH1 or ANA0CH2 before using ANARANG.
- The waveform analysis range will be truncated to fit the displayed stimulus range if the setting is exceeded.
- If the displayed stimulus range is changed, the waveform analysis range is set equal to the displayed range.
- Store the waveform analysis range setting using SAVE ALL or SAVE STATE ONLY.
- The waveform analysis range is set to equal to the displayed stimulus range when the power is turned on.

Examples
INPUT "Enter Start for Analysis Range.",Start
INPUT "Enter Stop for Analysis Range.",Stop
OUTPUT $E5100;"ANARANG ";Start,Stop

ANARANGP
Sets the waveform analysis stimulus range by entering the point number of START and point number of STOP values.

Syntax
ANARANG value 1, value 2

Where,

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>value 1</td>
<td>Start point number of the analysis range.</td>
</tr>
<tr>
<td>1</td>
<td>value 2</td>
<td>Stop point number of the analysis range.</td>
</tr>
</tbody>
</table>

Query Response

start point number, stop point number

Note
- The power on default setting and other actions are same as that of ANARANG.

Examples
INPUT "Enter Start Point Number for Analysis Range.",Startp
INPUT "Enter Stop Point Number for Analysis Range.",Stopp
OUTPUT $E5100;"ANARANGP ";Startp,Stopp

D4 Waveform Analysis Commands
ANARFULL
Sets the waveform analysis range equal to the displayed stimulus range. (No Query)

Syntax
ANARFULL

Note
- You can set the range for each channel independently. Therefore, you need to set the analysis channel using ANA0CH1 or ANA0CH2 before using ANARFULL.

ANAODATA
Selects the date trace for waveform analysis.

Syntax
ANAODATA

Query
boolean

Response
Where,

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>boolean</td>
<td>1 or 0. Data trace is selected (1) or is not selected (0) for waveform analysis.</td>
</tr>
</tbody>
</table>

Note
- You can select the trace for each channel independently. Therefore, you need to set the analysis channel using ANA0CH1 or ANA0CH2 before using ANAODATA.

ANAOMEMO
Selects the date trace for waveform analysis.

Syntax
ANAOMEMO

Query
boolean

Response
Where,

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>boolean</td>
<td>1 or 0. Sub-trace is selected (1) or is not selected (0) for waveform analysis.</td>
</tr>
</tbody>
</table>

Note
- You can select the trace for each channel independently. Therefore, you need to set the analysis channel using ANA0CH1 or ANA0CH2 before using ANAOMEMO.
THRR

Sets threshold ripple height for waveform analysis commands.

Syntax

\[
\text{THRR} \ height
\]

Where,

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>height</td>
<td>(Peak height) - (negative peak height)</td>
</tr>
</tbody>
</table>

![Figure D-1. THRR](image)

Query

\[ height \]

Response

Semantics

- Ripple height is defined as the difference between the positive peak and the negative peak.
- Waveform analysis commands search only for ripples greater than the threshold value, any others are ignored.

Note

- Default threshold value is 0.

Examples

INPUT "Enter Pos. Peak Gain [dB].", Local_max
INPUT "Enter Neg. Peak Gain [dB].", Local_min
Height=Local_max-Local_min
OUTPUT @E5100;"THRR ";Height
Maximum/Minimum/Mean Value Search Commands

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

- OUTPMAX?
- OUTPMIN?
- OUTPMINMAX?
- OUTPMEAN?
- PEAK?
- NEXPK?
- NUMLMAX?
- NUMLMIN?
- LMAX?
- LMIN?
- TAR?
- TARL?

OUTPMAX?

Returns the maximum point value and its stimulus within the specified range. (Query only)

**Syntax**

OUTPMAX?

**Query**

MAX, f_max

**Response**

Where,

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>MAX</td>
<td>Maximum value</td>
</tr>
<tr>
<td>1</td>
<td>f_max</td>
<td>Stimulus at maximum point (Frequency or Power)</td>
</tr>
</tbody>
</table>

**Examples**

OUTPUT @E5100; "OUTPMAX?"
ENTER @E5100; Max_value, F_max
PRINT Max_value, F_max

OUTPMIN?

Returns the minimum point value and its stimulus within the specified range. (Query only)

**Syntax**

OUTPMIN?

**Query**

MIN, f_min

**Response**

Where,

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>MIN</td>
<td>Minimum value</td>
</tr>
<tr>
<td>1</td>
<td>f_min</td>
<td>Stimulus at minimum point (Frequency or Power)</td>
</tr>
</tbody>
</table>
OUTPMINMAX?
Returns the maximum and minimum values and their stimulus values within the specified range. (Query only)

Syntax  OUTPMINMAX?
Query    MIN, f_min, MAX, f_max
Response Where,

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>MIN</td>
<td>Minimum value</td>
</tr>
<tr>
<td>1</td>
<td>f_min</td>
<td>Stimulus at minimum point (Frequency or Power)</td>
</tr>
<tr>
<td>2</td>
<td>MAX</td>
<td>Maximum value</td>
</tr>
<tr>
<td>3</td>
<td>f_max</td>
<td>Stimulus at maximum point (Frequency or Power)</td>
</tr>
</tbody>
</table>

Examples  OUTPUT @E5100;"OUTPMINMAX?"
          ENTER @E5100;Min_value,F_min,Max_value,F_max
          PRINT "MIN: ", Min_value,F_min
          PRINT "MAX:", Max_value,F_max

OUTPMean?
Returns the mean value within the specified range. (Query only)

Syntax  OUTPMean?
Query    mean
Response Where,

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>mean</td>
<td>Mean value.</td>
</tr>
</tbody>
</table>

Examples  OUTPUT @E5100;"OUTPMean?"
          ENTER @E5100;Mean
          PRINT Mean
PEAK?

Returns maximum peak and its stimulus within the specified range. (Query only)

Syntax   PEAK?
Query    \( MAX_{\text{peak}}, f_{\text{maxpeak}} \)
Response Where,

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>( MAX_{\text{peak}} )</td>
<td>Maximum peak value</td>
</tr>
<tr>
<td>1</td>
<td>( f_{\text{maxpeak}} )</td>
<td>Stimulus at maximum peak</td>
</tr>
</tbody>
</table>

Semantics

- The analyzer defines the searched value and point as a reference point for the next NEXPK? command. The reference point is stored using \( \text{SAVE} \) \( \text{ALL} \) or \( \text{STATE ONLY} \).

Note

- If the search fails, the analyzer returns 0, 0.

Examples

\[
\text{OUTPUT } \#E5100; \text{"PEAK?"}
\]
\[
\text{ENTER } \#E5100; \text{Peak},F_{\text{maxpeak}}
\]
\[
\text{PRINT } \text{"Peak:"}, \text{Peak}, \text{"[dB],"}, F_{\text{maxpeak}}, \text{"[Hz]"}
\]

NEXPK?

Returns the maximum peak having a value less than the value that was found using last PEAK? or NEXPK? command within the specified range. It also returns the corresponding stimulus value. (Query only)

Syntax   NEXPK?
Query    \( \text{Peak}, f_{\text{peak}} \)
Response Where,

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>( \text{Peak} )</td>
<td>Searched peak value</td>
</tr>
<tr>
<td>1</td>
<td>( f_{\text{peak}} )</td>
<td>Searched stimulus</td>
</tr>
</tbody>
</table>

Note

- The analyzer defines the searched value and point as a reference point for the next NEXPK? command. The reference point is stored using \( \text{SAVE} \) \( \text{ALL} \) or \( \text{STATE ONLY} \).

- If the multiple corresponded points are found, the analyzer returns right-hand nearest peak of the reference point.

- If the search fails, the analyzer returns 0, 0.

Examples

\[
\text{OUTPUT } \#E5100; \text{"NEXPK?"}
\]
\[
\text{ENTER } \#E5100; N_{\text{peak}},F_{\text{npeak}}
\]
\[
\text{PRINT } N_{\text{peak}}, F_{\text{npeak}}
\]
**NUMLMAX?**
Returns the number of positive peaks within the specified range. (Query only)

**Syntax**  
NUMLMAX?

**Query**  
\( n \)

**Response**  
Where,

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>( n )</td>
<td>Number of peaks</td>
</tr>
</tbody>
</table>

**Note**  
- If the search fails, the analyzer returns 0.

**Examples**
```
OUTPUT @E5100; "NUMLMAX?"
ENTER @E5100; N
PRINT N
```

**NUMLMIN?**
Returns the number of negative peaks within the specified range. (Query only)

**Syntax**  
NUMLMIN?

**Query**  
\( n \)

**Response**  
Where,

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>( n )</td>
<td>Number of negative peaks</td>
</tr>
</tbody>
</table>

**Note**  
- If the search fails, the analyzer returns 0.
LMAX?
Returns the nth positive peak counted from the left end of the range.
Syntax  LMAX? n
Where,

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
</table>
| 0        | n         | Peak counted from the left end of the range.

Query  \(LMAX_n\)
Response
Where,

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>(LMAX_n)</td>
<td>Value of nth peak</td>
</tr>
</tbody>
</table>

Note  ■ If the search fails, the analyzer returns 3.40282346639E+38.
Examples

```
OUTPUT @E5100;"LMAX? 5"
ENTER @E5100;Lmax
PRINT Lmax
```

LMIN?
Returns the nth negative peak counted from the left end of the range.
Syntax  LMIN? n
Where,

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>n</td>
<td>Negative peak counted from the left end of the range.</td>
</tr>
</tbody>
</table>

Query  \(LMIN_n\)
Response
Where,

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>(LMIN_n)</td>
<td>Value of nth negative peak</td>
</tr>
</tbody>
</table>

Note  ■ If the search fails, the analyzer returns 3.40282346639E+38.
TARR?
Searches to the right for the point having the specified parameter-value from the left end of the range, and returns its stimulus.

**Syntax**
\[ \text{TARR? target} \]

**Where,**

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>target</td>
<td>Search value.</td>
</tr>
</tbody>
</table>

**Query Response**
\[ s_{\text{target}} \]

**Where,**

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>s_{\text{target}}</td>
<td>Stimulus of the first point found.</td>
</tr>
</tbody>
</table>

**Note**
- If the search fails, the analyzer returns 0.

**Examples**
- INPUT "Enter Target Value.",Target
- OUTPUT @E5100;"TARR? ";Target
- ENTER @E5100;F_target
- PRINT F_target

TARL?
Searches to the left for the point having the specified parameter-value from the right end of the range, and returns its stimulus.

**Syntax**
\[ \text{TARL? target} \]

**Where,**

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>target</td>
<td>Search value.</td>
</tr>
</tbody>
</table>

**Query Response**
\[ s_{\text{target}} \]

**Where,**

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>s_{\text{target}}</td>
<td>Stimulus of the first point found.</td>
</tr>
</tbody>
</table>

**Note**
- If the search fails, the analyzer returns 0.
Ripple Analysis Commands

Ripple analysis commands analyze the ripples of the waveform and return the results.

- RPLPP?
- RPLHEI?
- RPLRHEI?
- RPLLLHEI?
- RPLENV?
- RPLMEA?
- RPLMM?
- RPLVAL?
- POLE?

**RPLPP?**

Returns the maximum difference between the positive peak and the negative peak within the specified range. (Query only)

**Syntax**

RPLPP?

**Query**

MAX_{diff}

**Response**

Where,

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>MAX_{diff}</td>
<td>Maximum difference between positive and negative peak.</td>
</tr>
</tbody>
</table>

![Diagram of analysis range with peaks and negative peaks, and text explaining RPLPP command.]

**Figure D-2. RPLPP?**

**Note**

- If the search fails, the analyzer returns 0.

**Examples**

```
ASSIGN #E5100 TO 717
OUTPUT #E5100;"ANAOC1;ANARFULL;ANAODATA"
OUTPUT #E5100;"RPLPP?"
ENTER #E5100;Max_diff
PRINT Max_diff;"[dB]"
END
```
RPLHEI?
Returns the maximum difference between adjacent positive and negative peaks. (Query only)

Syntax    RPLHEI?
Query     value
Response  Where,

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>value</td>
<td>Maximum difference between adjacent positive and negative peaks.</td>
</tr>
</tbody>
</table>

Figure D-3. RPLHEI?

Note  ■ If the search fails, the analyzer returns 0.

Examples
ASSIGN @E5100 TO 717
OUTPUT @E5100;"ANA0CH1;ANARFULL;ANAODATA"
OUTPUT @E5100;"RPLHEI?"
ENTER @E5100; Adj_diff
PRINT Adj_diff;"[dB]"
END

D-14  Waveform Analysis Commands
RPLRHEI?

Returns the maximum difference between the positive peak and the right-hand adjacent negative peak. (Query only)

Syntax  RPLRHEI?
Query    value
Response Where,

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>value</td>
<td>Maximum difference between the positive peak and the right-hand adjacent negative peak.</td>
</tr>
</tbody>
</table>

![Diagram showing analysis range and peak search]

Figure D-4. RPLRHEI?

Note: If the search fails, the analyzer returns 0.

Examples

```
ASSIGN @E5100 TO 717
OUTPUT @E5100;"ANAOC1;ANARFULL;ANADATA"
OUTPUT @E5100;"RPLRHEI?"
ENTER @E5100;Adj_diff
PRINT Adj_diff;"[dB]"
END
```
RPLLHEI?

Returns the maximum difference between the positive peak and the left-hand adjacent negative peak. (Query only)

Syntax    RPLLHEI?
Query     value
Response  Where,

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>value</td>
<td>Maximum difference between the positive peak and the left-hand adjacent negative peak.</td>
</tr>
</tbody>
</table>

Figure D-5. RPLLHEI?

Note  ■ If the search fails, the analyzer returns 0.

Examples  ASSIGN @E5100 TO 717
OUTPUT @E5100;"ANA0CH1;ANARFULL;ANADATA"
OUTPUT @E5100;"RPLLHEI?"
ENTER @E5100;Adj_diff
PRINT Adj_diff;"[dB]"
END
**RPLENV?**

Returns the maximum height between the negative peak and the intersection of an imaginary slope line between the adjacent positive peaks. (Query only)

**Syntax**  
`RPLENV?`

**Query**  
`value`

**Response**  
Where,

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td><code>value</code></td>
<td>Maximum height between the negative peak and the intersection of an imaginary slope line between the adjacent positive peaks. (See Figure D-6.)</td>
</tr>
</tbody>
</table>

![Figure D-6. RPLENV?](image)

**Note**  
- If the search fails, the analyzer returns 0.

**Examples**

```
OUTPUT @E5100;"ANAOCH1;ANARFULL;ANAODATA"
OUTPUT @E5100;"RPLENV?"
ENTER @E5100;Env_diff
PRINT Env_diff;"[dB]"
END
```
RPLMEA?

Returns the mean of the difference between the adjacent positive and negative peaks within the specified range. (Query only)

**Syntax**
RPLMEA?

**Query**
value

**Response**
Where,

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>value</td>
<td>Mean of the difference between the adjacent positive and negative peaks. (See Figure D-7)</td>
</tr>
</tbody>
</table>

Figure D-7. RPLMEA?

**Note**
- If the search fails, the analyzer returns 0.

**Examples**

```plaintext
OUTPUT @E5100;"ANACCH1;ANARFULL;ANADATA"
OUTPUT @E5100;"RPLMEA?"
ENTER @E5100;Mean_diff
PRINT Mean_diff;"[dB]"
END
```
RPLMM

Outputs the difference value between the maximum and minimum values within the range specified with the ANARANG command. (The maximum and minimum values are same as ones OTUPMINMAX? outputs.) (Query only)

**Syntax**

RPLMM?

**Query**

*value*

**Response**

Where,

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td><em>value</em></td>
<td>difference value between the maximum and minimum values</td>
</tr>
</tbody>
</table>

**Note**

- If the search fails, the analyzer returns 0.

**Examples**

```
OUTPUT $E5100 ;"ANA0CH1;ANARFULL;ANA0DATA"
OUTPUT $E5100 ;"RPLMM?"
ENTER $E5100 ;Max_min
PRINT Max_min;"[dB]"
END
```
**RPLVAL?**

Returns the maximum total of the differences between the negative peaks and the adjacent positive peaks on both sides and the stimulus of the corresponding negative peak. (Query only)

**Syntax**

RPLVAL?

**Query**

Rpl\textsubscript{val}, stimulus

**Response**

Where,

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Rpl\textsubscript{val}</td>
<td>Maximum total of the differences between the negative peaks and the adjacent positive peaks on both sides. (See Figure D-8)</td>
</tr>
<tr>
<td>1</td>
<td>stimulus</td>
<td>Stimulus of the corresponding negative peak</td>
</tr>
</tbody>
</table>

![Diagram of analysis range with peaks and negative peaks labeled.](image)

**Figure D-8. RPLVAL?**

**Note**

- If the search fails, the analyzer returns 0.

**Examples**

```plaintext
OUTPUT @E5100;"ANA0CH1;ANARFULL;ANAODATA"
OUTPUT @E5100;"RPLVAL?"
ENTER @E5100;Val,Stim
PRINT Val;"[dB]";Stim;"[Hz]"
END
```

D-20  Waveform Analysis Commands
POLE?

Returns the stimulus and value of the first negative peak found on each side of the maximum point that are below the specified value from the maximum peak. (Query only)

Syntax

POLE? D

Where,

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>D</td>
<td>Difference from the maximum peak.</td>
</tr>
</tbody>
</table>

Query $x_1, stim_1, x_2, stim_2$

Response

Where,

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>$x_1$</td>
<td>Left negative peak value.</td>
</tr>
<tr>
<td>1</td>
<td>$stim_1$</td>
<td>Stimulus of $x_1$.</td>
</tr>
<tr>
<td>2</td>
<td>$x_2$</td>
<td>Right negative peak value.</td>
</tr>
<tr>
<td>3</td>
<td>$stim_2$</td>
<td>Stimulus of $x_2$.</td>
</tr>
</tbody>
</table>

![Diagram showing analysis range and peak values](image)

Figure D-9. POLE?

Note

- If the search fails, the analyzer returns 0.
- Give the command parameter as a negative value. For instance, to specify 50 dB down from the maximum peak as a reference level, the parameter is -50.

Examples

ASSIGN $E5100$ TO 717
OUTPUT $E5100$;"ANACCH1;ANARFULL;ANACDATA"
OUTPUT $E5100$;"POLE? -50"
ENTER $E5100;X1,S1,X2,S2$
PRINT "LEFT ":\";X1;\"[dB]\";S1;\"[Hz]\""
PRINT "RIGHT":\";X2;\"[dB]\";S2;\"[Hz]\"
END
Filter and Resonator Analysis Commands

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

- OUTPFILT?
- OUTPXFIL?
- OUTPXF2?
- OUTPCFIL?
- OUTPCF2?
- OUTFRESO?
- OUTFRESR?
- OUTFRESF?
- OUTPCERR?
OUTPFILT?
Analyzes the filter and returns the parameters.

**Syntax**
OUTPFILT? \( x \)

Where,

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>( x )</td>
<td>The dB value down the bandwidth filter.</td>
</tr>
</tbody>
</table>

**Query Response**

\( \text{Loss, BW, } f_{\text{cent}}, \ Q, \ \Delta f_{\text{left}}, \ \Delta f_{\text{right}} \) (Total6)

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>( \text{Loss} )</td>
<td>Insertion loss</td>
</tr>
<tr>
<td>1</td>
<td>( \text{BW} )</td>
<td>( x ) dB down bandwidth</td>
</tr>
<tr>
<td>2</td>
<td>( f_{\text{cent}} )</td>
<td>Center frequency</td>
</tr>
<tr>
<td>3</td>
<td>( Q )</td>
<td>Q (Quality factor)</td>
</tr>
<tr>
<td>4</td>
<td>( \Delta f_{\text{left}} )</td>
<td>Frequency difference between the left cutoff point and the middle of the range.</td>
</tr>
<tr>
<td>5</td>
<td>( \Delta f_{\text{right}} )</td>
<td>Frequency difference between the right cutoff point and the middle of the range.</td>
</tr>
</tbody>
</table>

![Diagram](image.png)

**Figure D-10. OUTPFILT?**

**Semantics**
- Insertion loss is the maximum value within the specified range.
- \( x \) dB bandwidth is the frequency difference between both of the \( x \)dB down cutoff points.
- Center frequency is the middle point of both cutoff points.
- \( Q \) is calculated using the following equation:

\[
Q = \frac{\sqrt{f_{\text{cl}} \times f_{\text{cr}}}}{\text{BW}}
\]

**Note**
If both of the two cutoff points are not found, the analyzer returns 0 for all values of the query response.

Examples

10 ASSIGN @E5100 TO 717
20 CALL Sweep(1) ! Goes to the subroutine.
30 OUTPUT @E5100;"ANA0CH1;ANARFULL;ANAODATA"
40 OUTPUT @E5100;"OUTPFILT? -3"
50 ENTER @E5100;Loss,Bw,Fc,Q,Df1,Dfr
60 PRINT "Loss:";Loss;"[dB] Bw:";Bw;"[Hz]"
70 PRINT "Fc:";Fc;"[Hz] Q:";Q
80 PRINT "Df1:";Df1;"[Hz] Dfr:";Dfr;"[Hz]"
90 END
100 SUB Sweep(Ch)! Sweep End Detection Subroutine
101 ! (Parameter: No. of channel)
110 ASSIGN @E5100 TO 717
120 ON INTR 7 GOTO Sweep_end
130 OUTPUT @E5100;"TRGS BUS"
140 OUTPUT @E5100;"ESNB 2; *SRE 4"
150 FOR I=1 TO Ch
160 OUTPUT @E5100;"*CLS;*OPC?"
170 ENTER @E5100;Opv
180 ENABLE INTR 7;2
190 TRIGGER @E5100
200 Waiting;GOTO Waiting
210 Sweep_end:!
220 NEXT I
230 SUBEND
OUTPXFIL?

Outputs filter parameters within the range specified by the ANARANG command.

Syntax

\textbf{OUTPXFIL? } x_1, x_2, D, f_1, f_2

Where,

\begin{center}
\begin{tabular}{|c|c|p{7cm}|}
\hline
\textbf{Register} & \textbf{Parameter} & \textbf{Description} \\
\hline
0 & \(x_1\) & The dB value down the bandwidth filter. (1) \(x_1\)[dB] \\
1 & \(x_2\) & The dB value down the bandwidth filter. (2) \(x_2\)[dB] \\
2 & \(D\) & Difference from maximum value. (Same as POLE?) parameter.) \\
3 & \(f_1\) & Stop frequency of the range for the rejection level. \\
4 & \(f_2\) & Start frequency of the range for the spurious level. \\
\hline
\end{tabular}
\end{center}

Query

\textit{Loss, BW, } f_{\text{cent}}, \textit{ Q, } \Delta f_{\text{left}}, \Delta f_{\text{right}}, \Delta f_{\text{left2}}, \Delta f_{\text{right2}}, \textit{ Pass, Reject, Spurious, Pole}_{x1}, \textit{ Pole}_{\text{stim1}}, \textit{ Pole}_{x2}, \textit{ Pole}_{\text{stim2}} (15)

Response

\begin{center}
\begin{tabular}{|c|c|p{7cm}|}
\hline
\textbf{Register} & \textbf{Parameter} & \textbf{Description} \\
\hline
0 & \textit{Loss} & Insertion loss \\
1 & \textit{BW} & \(x_1\) dB down bandwidth \\
2 & \textit{f}_{\text{cent}} & Center frequency \\
3 & \textit{Q} & Q \\
4 & \(\Delta f_{\text{left}}\) & Frequency difference between the left cutoff point \((f_{\text{cl}})\) and the middle of the range. \\
5 & \(\Delta f_{\text{right}}\) & Frequency difference between the right cutoff point \((f_{\text{cr}})\) and the middle of the range. \\
6 & \(\Delta f_{\text{left2}}\) & Frequency difference between the left cutoff point \((f_{\text{cl2}})\) and the middle of the range. \\
7 & \(\Delta f_{\text{right2}}\) & Frequency difference between the right cutoff point \((f_{\text{cr2}})\) and the middle of the range. \\
8 & \textit{Pass} & Passband ripple \\
9 & \textit{Reject} & Rejection level \\
10 & \textit{Spurious} & Spurious level \\
11 & \textit{Pole}_{x1} & First negative peak found to the left of the maximum point. \\
12 & \textit{Pole}_{\text{stim1}} & Stimulus of \textit{Pole}_{x1}. \\
13 & \textit{Pole}_{x2} & First negative peaks found to the right of the maximum point. \\
14 & \textit{Pole}_{\text{stim2}} & Stimulus of \textit{Pole}_{x2}. \\
\hline
\end{tabular}
\end{center}
Semantics

- Insertion loss, $x_I$ dB bandwidth, center frequency, $Q$, $\Delta f_{\text{left}}$, and $\Delta f_{\text{right}}$ are the same as the responses of OUTFILT?.
- $\Delta f_{\text{left}}$ and $\Delta f_{\text{right}}$ are the frequency differences between both sides at the $x_2$ dB down cutoff points ($f_{c2}$ and $f_{e2}$) and the middle of the range.
- Passband ripple is the frequency difference of the maximum positive peak and the minimum negative peak between the $x_I$ dB down cutoff points ($f_{cl}, f_{cr}$).
- Rejection level is the frequency difference from the insertion loss to the maximum level in the range from the left edge of analysis range to $f_s$.
- Spurious level is the frequency difference from the insertion loss to the maximum level between $f_2$ and the right edge of analysis range.
- $\text{Pole}_{21}$, $\text{Pole}_{stim1}$, $\text{Pole}_{22}$, $\text{Pole}_{stim2}$ are the same as the query response of POLE? with the parameter $D$.

Note

- If both of the two $x_2$ dB down cutoff points are not found, the analyzer returns 0 for all values of the query response.
- If both of the two $x_2$ dB down cutoff points are not found, the analyzer returns 0 for $\Delta f_{\text{left}}$ and $\Delta f_{\text{right}}$.
- If the corresponding peak for POLE? is not found, the analyzer returns 0 for $\text{Pole}_{21}$, $\text{Pole}_{stim1}$, $\text{Pole}_{22}$, and $\text{Pole}_{stim2}$.

Examples

10 ASSIGN UE5100 TO 717
20 OUTPUT UE5100;'CENT 70MHZ; SPAN 100KHZ'
30 CALL Sweep(1) ! Goes to sub routine.
40 OUTPUT UE5100;'ANACH1;ANARFULL;ANADATA'
50 OUTPUT UE5100;'OUTXPFL? -3,-10,-50,69.98MHZ,70.02MHZ'
60 ENTER UE5100;Loss,Br,Fc,Q,Df1,Dfr,DFr2,Pass,Reject,Spurious,Pole1,Pole1,Pole2,Fp2
70 PRINT "Loss:";Loss;"[dB] BW:";Br;"[Hz] fc:";Fc;"[Hz]"  
80 PRINT "Q:";Q;" Df1:";Df1;"[Hz] Dfr:";Dfr;"[Hz]"  
90 PRINT "Df12:";Df12;"[Hz] Dfr2:";Dfr2;"[Hz] Pass:";Pass;"[dB]"  
100 PRINT "Reject:";Reject;"[dB] Spurious:";Spurious;"[dB]"

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110 PRINT "Pole (left):"; Pole1; ";[dB]"; Fp1; ";[Hz]"
120 PRINT "Pole (right):"; Pole2; ";[dB]"; Fp2; ";[Hz]"
130 END
OUTPXF2?

Outputs filter parameters within the range specified by the ANARANG command. This command outputs the same parameters as OUTPXFIL and outputs up to 20 sets of frequency offsets from center of the analysis range to left and right cutoff points. (Query only)

**Syntax**

OUTPXF2? D, f₁, f₂, x₁, x₂, ..., xₙ Where,

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.</td>
<td>D</td>
<td>Difference from maximum value. (Same as POLE? parameter.)</td>
</tr>
<tr>
<td>1.</td>
<td>f₁</td>
<td>Stop frequency of the range for the rejection level.</td>
</tr>
<tr>
<td>2.</td>
<td>f₂</td>
<td>Start frequency of the range for the spurious level.</td>
</tr>
<tr>
<td>3.</td>
<td>x₁</td>
<td>The dB value down the bandwidth filter. (1) x₁[dB]</td>
</tr>
<tr>
<td>4.</td>
<td>x₂</td>
<td>The dB value down the bandwidth filter. (2) x₂[dB]</td>
</tr>
<tr>
<td>...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>n+2.</td>
<td>xₙ</td>
<td>The dB value down the bandwidth filter. (n) xₙ[dB]</td>
</tr>
</tbody>
</table>

**Query**

Loss, BW, fₒ, fₛ, Q, Pass, Reject, Suprious, Pole₁, Poleₛ₁, Pole₂, Poleₛ₂, Δf_left, Δf_right, Δf_left₂, Δf_right₂, ..., Δf_leftₙ, Δf_rightₙ (2n+11)

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Loss</td>
<td>Insertion loss</td>
</tr>
<tr>
<td>1</td>
<td>BW</td>
<td>x₁ dB down bandwidth</td>
</tr>
<tr>
<td>2</td>
<td>fₒ</td>
<td>Center frequency</td>
</tr>
<tr>
<td>3</td>
<td>Q</td>
<td>Q</td>
</tr>
<tr>
<td>4</td>
<td>Pass</td>
<td>Passband ripple</td>
</tr>
<tr>
<td>5</td>
<td>Reject</td>
<td>Rejection level</td>
</tr>
<tr>
<td>6</td>
<td>Suprious</td>
<td>Spurious level</td>
</tr>
<tr>
<td>7</td>
<td>Pole₁</td>
<td>First negative peak found to the left of the maximum point.</td>
</tr>
<tr>
<td>8</td>
<td>Poleₛ₁</td>
<td>Stimulus of Pole₁.</td>
</tr>
<tr>
<td>9</td>
<td>Pole₂</td>
<td>First negative peaks found to the right of the maximum point.</td>
</tr>
<tr>
<td>10</td>
<td>Poleₛ₂</td>
<td>Stimulus of Pole₂.</td>
</tr>
<tr>
<td>11</td>
<td>Δf_left</td>
<td>Frequency difference between the left cutoff point (fₒ) and the middle of the range.</td>
</tr>
<tr>
<td>12</td>
<td>Δf_right</td>
<td>Frequency difference between the right cutoff point (fₛ) and the middle of the range.</td>
</tr>
<tr>
<td>13</td>
<td>Δf_left₂</td>
<td>Frequency difference between the left cutoff point (fₒ) and the middle of the range.</td>
</tr>
<tr>
<td>14</td>
<td>Δf_right₂</td>
<td>Frequency difference between the right cutoff point (fₛ) and the middle of the range.</td>
</tr>
<tr>
<td>...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2n+9</td>
<td>Δf_leftₙ</td>
<td>Frequency difference between the left cutoff point (fₒ) and the middle of the range.</td>
</tr>
<tr>
<td>2n+10</td>
<td>Δf_rightₙ</td>
<td>Frequency difference between the right cutoff point (fₛ) and the middle of the range.</td>
</tr>
</tbody>
</table>
Semantics

- Insertion loss, \( x_i \) dB bandwidth, center frequency, \( Q \), \( \Delta f_{\text{left}} \), and \( \Delta f_{\text{right}} \) are the same as the responses of OUTPFILT?.

- \( \Delta f_{\text{left}} \) and \( \Delta f_{\text{right}} \) are the frequency differences between both sides at the \( x_i \) dB down cutoff points \( f_{\text{c, left}} \) and \( f_{\text{c, right}} \) and the middle of the range.

- Passband ripple is the frequency difference of the maximum positive peak and the minimum negative peak between the \( x_i \) dB down cutoff points \( f_{\text{c, left}}, f_{\text{c, right}} \).

- Rejection level is the frequency difference from the insertion loss to the maximum level in the range from the left edge of analysis range to \( f_i \).

- Spurious level is the frequency difference from the insertion loss to the maximum level between \( f_i \) and the right edge of analysis range.

- \( \text{Pole}\_{\text{left}}, \text{Pole}\_{\text{stim1}}, \text{Pole}\_{\text{left}}, \text{Pole}\_{\text{stim2}} \) are the same as the query response of POLE? with the parameter \( D \).

Note

- If both of the two \( x_i \) dB down cutoff points are not found, the analyzer returns 0 for all values of the query response.

- If both of the two \( x_i \) dB down cutoff points are not found, the analyzer returns 0 for \( \Delta f_{\text{left}}, \Delta f_{\text{right}} \).

- If the corresponding peak for POLE? is not found, the analyzer returns 0 for \( \text{Pole}\_{\text{left}}, \text{Pole}\_{\text{stim1}}, \text{Pole}\_{\text{left}}, \text{Pole}\_{\text{stim2}} \).

Examples

10 ASSIGN \&E5100 TO 717
20 OUTPUT \&E5100; "CENS 70MHz, 100kHz"
30 OUTPUT \&E5100; "SING?"
40 ENTER \&E5100; Tmp
50 OUTPUT \&E5100; "ANAOG1; ANARFULL; ANAODATA"
60 OUTPUT \&E5100; "OUTPFILT -3, 69.98MHz, 70.02MHz, -3, -10, -12, -50"
70 ENTER \&E5100; Loss, Bw, Fc, Q, Pass, Reject, Spurious, Pole1, Fp1, Pole2, Fp2,
     Df1, Dfr, Df1, Df12, Dfr2, Df13, Dfr3, Df14, Dfr4
80 PRINT "Loss:"; Loss; "[dB] Bw:"; Bw; "[Hz] fc:"; Fc; "[Hz]"
90 PRINT "Q:"; Q; " Df1:"; Df1; "[Hz] Dfr:"; Dfr; "[Hz]"
100 PRINT "Df12:"; Df12; "[Hz] Dfr2:"; Dfr2; "[Hz] Pass:"; Pass; "[dB]"
110 PRINT "Df13:"; Df13; "[Hz] Dfr3:"; Dfr3; "[Hz] Pass:"; Pass; "[dB]"
120 PRINT "Df14:"; Df14; "[Hz] Dfr4:"; Dfr4; "[Hz] Pass:"; Pass; "[dB]"
130 PRINT "Reject:"; Reject; "[dB] Spurious:"; Spurious; "[dB]"
140 PRINT "Pole (left):"; Pole1; "[dB] "; Fp1; "[Hz]"
150 PRINT "Pole (right):"; Pole2; "[dB] "; Fp2; "[Hz]"
160 END
OUTPCFIL?

Analyzes the filter at the nominal frequency, and returns the parameters.

**Syntax**

\[ \text{OUTPCFIL? } f_c, x_1, x_2, D, f_1, f_2 \]

Where,

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>( f_c )</td>
<td>Nominal frequency</td>
</tr>
<tr>
<td>1</td>
<td>( x_1 )</td>
<td>The dB value down the bandwidth filter. (1) ( x_1 )[dB]</td>
</tr>
<tr>
<td>2</td>
<td>( x_2 )</td>
<td>The dB value down the bandwidth filter. (2) ( x_2 )[dB]</td>
</tr>
<tr>
<td>3</td>
<td>( D )</td>
<td>Difference from maximum value. (Same as POLE? parameter.)</td>
</tr>
<tr>
<td>4</td>
<td>( f_1 )</td>
<td>Stop frequency of the range for the rejection level.</td>
</tr>
<tr>
<td>5</td>
<td>( f_2 )</td>
<td>Start frequency of the range for the spurious level.</td>
</tr>
</tbody>
</table>

**Query**

\( \text{Loss, Loss}_c, BW, f_{\text{center}}, Q, \Delta f_{\text{left}}, \Delta f_{\text{right}}, \Delta f_{\text{left2}}, \Delta f_{\text{right2}}, \text{Pass, Reject, Spurious, Pole}_{x1}, \text{Pole}_{x1\text{stim}}, \text{Pole}_{x2}, \text{Pole}_{x2\text{stim}} \) (Total 16)

**Response**

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Loss</td>
<td>Insertion loss</td>
</tr>
<tr>
<td>1</td>
<td>Loss(_c)</td>
<td>Const Loss</td>
</tr>
<tr>
<td>2</td>
<td>BW</td>
<td>( x_1 ) dB down bandwidth</td>
</tr>
<tr>
<td>3</td>
<td>( f_{\text{center}} )</td>
<td>Center frequency</td>
</tr>
<tr>
<td>4</td>
<td>Q</td>
<td>Q</td>
</tr>
<tr>
<td>5</td>
<td>( \Delta f_{\text{left}} )</td>
<td>Frequency difference between the left cutoff point ( f_{\text{left}} ) and the middle of the range.</td>
</tr>
<tr>
<td>6</td>
<td>( \Delta f_{\text{right}} )</td>
<td>Frequency difference between the right cutoff point ( f_{\text{right}} ) and the middle of the range.</td>
</tr>
<tr>
<td>7</td>
<td>( \Delta f_{\text{left2}} )</td>
<td>Frequency difference between the left cutoff point ( f_{\text{left2}} ) and the middle of the range.</td>
</tr>
<tr>
<td>8</td>
<td>( \Delta f_{\text{right2}} )</td>
<td>Frequency difference between the right cutoff point ( f_{\text{right2}} ) and the middle of the range.</td>
</tr>
<tr>
<td>9</td>
<td>Pass</td>
<td>Passband ripple</td>
</tr>
<tr>
<td>10</td>
<td>Reject</td>
<td>Rejection level</td>
</tr>
<tr>
<td>11</td>
<td>Spurious</td>
<td>Spurious level</td>
</tr>
<tr>
<td>12</td>
<td>Pole(_{x1})</td>
<td>First negative peaks found to the left of the maximum point.</td>
</tr>
<tr>
<td>13</td>
<td>Pole(_{x1\text{stim}})</td>
<td>Stimulus of Pole(_{x1}).</td>
</tr>
<tr>
<td>14</td>
<td>Pole(_{x2})</td>
<td>First negative peak found to the right of the maximum point.</td>
</tr>
<tr>
<td>15</td>
<td>Pole(_{x2\text{stim}})</td>
<td>Stimulus of Pole(_{x2}).</td>
</tr>
</tbody>
</table>

D-30  Waveform Analysis Commands
Semantics

- Insertion loss, rejection level, spurious level, \(Pole_{x1}, Pole_{x2}, Pole_{stim1}, Pole_{stim2}\), and \(Pole_{stim3}\) are the same as the responses of OUTPFILT?.

- The const loss is the value of the point that is specified by command parameter, \(f_c\).

- \(x_1\) dB bandwidth is the frequency difference between two \(x_1\) dB down cutoff points \((f_{dl}, f_{cr})\) from the const loss point.

- Center frequency is the middle point of \(f_{dl}\) and \(f_{cr}\).

- \(Q\) is calculated using the following equation:

\[
Q = \frac{\sqrt{f_{cl} \times f_{cr}}}{BW}
\]

- \(\Delta f_{left}\) and \(\Delta f_{right}\) are the frequency differences between both sides at the \(x_1\) dB down cutoff points \((f_{dl} \text{ and } f_{cr})\) and \(f_c\).

- \(\Delta f_{left2}\) and \(\Delta f_{right2}\) are the frequency differences between both sides at the \(x_2\) dB down cutoff points \((f_{dl2} \text{ and } f_{cr2})\) and \(f_c\).

- Passband ripple is the frequency difference of maximum positive peak and minimum negative peak between \(x_1\) dB down cutoff points \((f_{dl1}, f_{cr1})\).

Note

- If both of the two \(x_1\) dB down cutoff points are not found, the analyzer returns 0 for all values of the query response.

- If both of the two \(x_2\) dB down cutoff points are not found, the analyzer returns 0 for \(\Delta f_{left2}\) and \(\Delta f_{right2}\).

- If the corresponding peak for POLE? is not found, the analyzer returns 0 for \(Pole_{x1}, Pole_{stim1}, Pole_{x2}, \text{ and } Pole_{stim2}\).

Examples

10 ASSIGN @E5100 TO 717
20 OUTPUT @E5100;"CENT 70MHz; SPAN 100KHZ"
30 CALL Sweep(1) ! Goes to sub routine. (See OUTPFILT?)
40 OUTPUT @E5100;"ANAOCIH;ANARFULL;ANADOATA"
50 OUTPUT @E5100;"OUTPCFIL? 70MHz,-3,-10,-50,69.98MHz,70.02MHz"
60 ENTER @E5100;Loss,Lc,Bw,Fc,Q,Df1,Dfr,Df12,Dfr2,Pass,Reject, Spurious,Pole1,Fp1,Pole2,Fp2
70 PRINT "Loss:";Loss;"[dB] Const Loss:";Lc;"[dB]"
80 PRINT "Bw:";Bw;"[Hz] Fc:";Fc;"[Hz]"
90 PRINT "Q:";Q;" Df1:";Df1;"[Hz] Dfr:";Dfr;"[Hz]"
100 PRINT "Df12:";Df12;"[Hz] Dfr2:";Dfr2;"[Hz] Pass:";Pass;"[dB]"
110 PRINT "Reject:";Reject;"[dB] Spurious:";Spurious;"[dB]"
120 PRINT "Pole (left):";Pole1;"[dB] ";Fp1;"[Hz]"
130 PRINT "Pole (right):";Pole2;"[dB] ";Fp2;"[Hz]"
140 END
OUTPCF2?

Analyzes the filter at the nominal frequency, and returns the parameters. This command outputs the same parameters as OUTPCFIL and outputs up to 20 sets of frequency offsets from center frequency ($f_c$) to left and right cutoff points ($\Delta f_{\text{left } n}$, $\Delta f_{\text{right } n}$).

**Syntax**

```
OUTPCFIL? $f_c$, $D$, $f_1$, $f_2$, $x_1$, $x_2$, ..., $x_n$
```

Where,

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>$f_c$</td>
<td>Nominal frequency</td>
</tr>
<tr>
<td>1</td>
<td>$D$</td>
<td>Difference from maximum value. (Same as POLE? parameter.)</td>
</tr>
<tr>
<td>2</td>
<td>$f_1$</td>
<td>Stop frequency of the range for the rejection level.</td>
</tr>
<tr>
<td>3</td>
<td>$f_2$</td>
<td>Start frequency of the range for the spurious level.</td>
</tr>
<tr>
<td>4</td>
<td>$x_1$</td>
<td>The dB value down the bandwidth filter. (1) $x_1$[dB]</td>
</tr>
<tr>
<td>5</td>
<td>$x_2$</td>
<td>The dB value down the bandwidth filter. (2) $x_2$[dB]</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>: level.</td>
</tr>
<tr>
<td>n+3</td>
<td>$x_n$</td>
<td>The dB value down the bandwidth filter. (n) $x_n$</td>
</tr>
</tbody>
</table>

**Query**

Loss, Loss_c, BW, frent, $Q$, Pass, Reject, Spurious, Pole_x1, Pole_sim1, Pole_x2, Pole_sim2, $\Delta f_{\text{left } 1}$, $\Delta f_{\text{right } 1}$, $\Delta f_{\text{left } 2}$, $\Delta f_{\text{right } 2}$, ..., $\Delta f_{\text{left } n}$, $\Delta f_{\text{right } n}$ (2n+11)

**Response**

Waveform Analysis Commands D-33
<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Loss</td>
<td>Insertion loss</td>
</tr>
<tr>
<td>1</td>
<td>Loss&lt;sub&gt;e&lt;/sub&gt;</td>
<td>Const Loss</td>
</tr>
<tr>
<td>2</td>
<td>BW</td>
<td>x&lt;sub&gt;1&lt;/sub&gt; dB down bandwidth</td>
</tr>
<tr>
<td>3</td>
<td>f&lt;sub&gt;cent&lt;/sub&gt;</td>
<td>Center frequency</td>
</tr>
<tr>
<td>4</td>
<td>Q</td>
<td>Q</td>
</tr>
<tr>
<td>5</td>
<td>Pass</td>
<td>Passband ripple</td>
</tr>
<tr>
<td>6</td>
<td>Reject</td>
<td>Rejection level</td>
</tr>
<tr>
<td>7</td>
<td>Spurious</td>
<td>Spurious level</td>
</tr>
<tr>
<td>8</td>
<td>Pole&lt;sub&gt;z1&lt;/sub&gt;</td>
<td>First negative peaks found to the left of the maximum point.</td>
</tr>
<tr>
<td>9</td>
<td>Pole&lt;sub&gt;stim1&lt;/sub&gt;</td>
<td>Stimulus of Pole&lt;sub&gt;z1&lt;/sub&gt;.</td>
</tr>
<tr>
<td>10</td>
<td>Pole&lt;sub&gt;z2&lt;/sub&gt;</td>
<td>First negative peak found to the right of the maximum point.</td>
</tr>
<tr>
<td>11</td>
<td>Pole&lt;sub&gt;stim2&lt;/sub&gt;</td>
<td>Stimulus of Pole&lt;sub&gt;z2&lt;/sub&gt;.</td>
</tr>
<tr>
<td>12</td>
<td>Δf&lt;sub&gt;left&lt;/sub&gt;</td>
<td>Frequency difference between the left cutoff point (f&lt;sub&gt;cl&lt;/sub&gt;) and the middle of the range.</td>
</tr>
<tr>
<td>13</td>
<td>Δf&lt;sub&gt;right&lt;/sub&gt;</td>
<td>Frequency difference between the right cutoff point (f&lt;sub&gt;cr&lt;/sub&gt;) and the middle of the range.</td>
</tr>
<tr>
<td>14</td>
<td>Δf&lt;sub&gt;left2&lt;/sub&gt;</td>
<td>Frequency difference between the left cutoff point (f&lt;sub&gt;cl2&lt;/sub&gt;) and the middle of the range.</td>
</tr>
<tr>
<td>15</td>
<td>Δf&lt;sub&gt;right2&lt;/sub&gt;</td>
<td>Frequency difference between the right cutoff point (f&lt;sub&gt;cr2&lt;/sub&gt;) and the middle of the range.</td>
</tr>
<tr>
<td></td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>2n+10</td>
<td>Δf&lt;sub&gt;left n&lt;/sub&gt;</td>
<td>Frequency difference between the left cutoff point (f&lt;sub&gt;cl n&lt;/sub&gt;) and the middle of the range.</td>
</tr>
<tr>
<td>2n+11</td>
<td>Δf&lt;sub&gt;right n&lt;/sub&gt;</td>
<td>Frequency difference between the right cutoff point (f&lt;sub&gt;cr n&lt;/sub&gt;) and the middle of the range.</td>
</tr>
</tbody>
</table>

**Semantics**
- Insertion loss, constant loss, x<sub>1</sub> dB bandwidth, Center frequency, Q, passband ripple, rejection level, spurious level, Pole<sub>z1</sub>, Pole<sub>stim1</sub>, Pole<sub>z2</sub> are the same as the responses of OUTPCFILT?.
- Δf<sub>left n</sub> and Δf<sub>right n</sub> are the frequency differences between both sides at the x<sub>n</sub> dB down cutoff points (f<sub>cl n</sub> and f<sub>cr n</sub>) and f.<

**Note**
- If both of the two x<sub>1</sub> dB down cutoff points are not found, the analyzer returns 0 for all values of the query response.
- If both of the two x<sub>2</sub> dB down cutoff points are not found, the analyzer returns 0 for Δf<sub>left n</sub> and Δf<sub>right n</sub>.
- If the corresponding peak for POLE? is not found, the analyzer returns 0 for Pole<sub>z1</sub>, Pole<sub>stim1</sub>, Pole<sub>z2</sub>, and Pole<sub>stim2</sub>.

**Examples**
```
10 ASSIGN @E5100 TO 717
20 OUTPUT @E5100;"CENS 70MHz,100kHz"
30 OUTPUT @E5100;"SING?"
40 ENTER @E5100;Tmp
50 OUTPUT @E5100;"ANADC1;ANARFULL;ANACDATA"
60 OUTPUT @E5100;"OUTPCF2? 70MHz,-50,69.98MHz,70.02MHz,-3,-10,-20"
```

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70 ENTER @E5100;Loss,Lc,Bw,Fc,Q,Pass,Reject,Surplus,Pole1,Fp1,Pole2,Fp2,
    Dfl,Dfr,Dfl2,Dfr2,Dfl3,Dfr3
80 PRINT "Loss:";Loss;"(dB) Const Loss:";Lc;"(dB)"
90 PRINT "Bw:";Bw;"(Hz) Fc:";Fc;"(Hz)"
100 PRINT "Q:";Q;" Dfl:";Dfl;"(Hz) Dfr:";Dfr;"(Hz)"
110 PRINT "Dfl2:";Dfl2;"(Hz) Dfr2:";Dfr2;"(Hz)"
110 PRINT "Dfl3:";Dfl3;"(Hz) Dfr3:";Dfr3;"(Hz) Pass:";Pass;"(dB)"
120 PRINT "Reject:";Reject;"(dB) Surplus:";Surplus;"(dB)"
130 PRINT "Pole (left):";Pole1;"(dB) ";Fp1;"(Hz)"
140 PRINT "Pole (right):";Pole2;"(dB) ";Fp2;"(Hz)"
150 END
OUTPRESO?

Returns resonator specific parameters. (Query only)

Syntax: OUTPRESO?

Query: \( Z_r, f_r, Z_a, f_a \) (Total 4)

Response: Where,

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>( Z_r )</td>
<td>Resonant impedance</td>
</tr>
<tr>
<td>1</td>
<td>( f_r )</td>
<td>Resonant frequency</td>
</tr>
<tr>
<td>2</td>
<td>( Z_a )</td>
<td>Anti-resonant impedance</td>
</tr>
<tr>
<td>3</td>
<td>( f_a )</td>
<td>Anti-resonant frequency</td>
</tr>
</tbody>
</table>

Figure D-13. OUTPRESO?

Semantics: OUTPRESO? executes the following actions and returns their values:

1. Searches for the 0° phase point from the left edge of the analysis range.
2. Defines the first point found as the resonant point, and then returns its impedance and its frequency.
3. Defines the next point found as the anti-resonant point, and then returns its impedance and its frequency.

Note: You must select the following conditions to use this command:

- Dual Channel & Coupled Channel: ON
- Impedance Conversion: ON
- Analysis channel: LOG MAG format
- Non-analysis channel: Phase format

- OUTPRESO? returns the first two found 0° phase point events if there are more than three corresponding points.
- If there is only one 0° phase point in the range, OUTPRESO? defines that point as a resonant point and returns 0 for \( Z_a \) and \( f_a \).
- If there is no 0° point, OUTPRES0? returns 0 for all parameters.
- If the impedance conversion is off, OUTPRES0? returns the magnitude (dB) at the 0° phase point.

**Examples**

```
10 ASSIGN @E5100 TO 717
20 OUTPUT @E5100;"DUAC ON; COUC ON"
30 OUTPUT @E5100;"CHAN2; FMT PHAS"
40 OUTPUT @E5100;"CHAN1; FMT LOGM; CONV ZTRA"
50 OUTPUT @E5100;"CENT 70MHZ; SPAN 100KHZ"
60 CALL Sweep(2) ! Goes to sub routine. (See OUTFILT?)
61 ! Parameter is 2 because of Dual Channel ON.
70 OUTPUT @E5100;"ANA0CH1;ANARFULL;ANA0DATA"
80 OUTPUT @E5100;"OUTPRES0?"
90 ENTER @E5100;Zr,Fr,Za,Fa
100 PRINT "Resonant:";Zr;"[ohm],";Fr;"[Hz]"
110 PRINT "Anti-Resonant:";Za;"[ohm],";Fa;"[Hz]"
120 END
```
OUTPRESR?
Returns the resonator specific parameters. (Query only)

Syntax
OUTPRESR?

Query
$Z_r, f_r, Z_a, f_a, Rpl_1, Rpl_2, Rpl_3$ (Total 7)

Response
Where,

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>$Z_r$</td>
<td>Resonant impedance</td>
</tr>
<tr>
<td>1</td>
<td>$f_r$</td>
<td>Resonant frequency</td>
</tr>
<tr>
<td>2</td>
<td>$Z_a$</td>
<td>Anti-resonant impedance</td>
</tr>
<tr>
<td>3</td>
<td>$f_a$</td>
<td>Anti-resonant frequency</td>
</tr>
<tr>
<td>4</td>
<td>$Rpl_1$</td>
<td>Maximum left height of the ripple where is on the left side of the resonant point.</td>
</tr>
<tr>
<td>5</td>
<td>$Rpl_2$</td>
<td>Maximum height right of the ripple that is between the resonant and anti-resonant points.</td>
</tr>
<tr>
<td>6</td>
<td>$Rpl_3$</td>
<td>Maximum height left of the ripple that is on the right side of the resonant point.</td>
</tr>
</tbody>
</table>

Figure D-14. OUTPRESR?

Semantics
- OUTPRESR? executes the following actions:
  1. Searches for the 0° phase point from the left edge of the analysis range.
  2. Defines the first point found as the resonant point, and then returns its impedance and its frequency.
  3. Defines the next point found as the anti-resonant point, and then returns its impedance and its frequency.
  4. Returns the maximum height of the ripple, $Rpl_1$, that is the difference between the peak and left adjacent negative peak.
  5. Returns the maximum height of the ripple, $Rpl_3$, that is the difference between the peak and right adjacent negative peak.

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6. Returns the maximum height of the ripple, \( R_{pl} \), that is the difference between the peak and left adjacent negative peak.

**Note**
- You must select the following conditions to use this command:
  - Dual Channel & Coupled Channel: ON
  - Impedance Conversion: ON
  - Analysis channel: LOG MAG format
  - Non-analysis channel: Phase format

- **OUTPRESR?** returns the first two 0° phase point events found if there are more than three corresponding points points.

- If there is only one 0° phase point in the range, **OUTPRESR?** defines that point as a resonant point and returns 0 for \( Z_r, f_r, R_{pl}, R_{p2}, \) and \( R_{p3} \).

- If there is no 0° point, **OUTPRESR?** returns 0 for all parameters.

**Examples**

```
10 ASSIGN @E5100 TO 717
20 OUTPUT @E5100;"DUAC ON; COUC ON"
30 OUTPUT @E5100;"CHAN2; FMT PHAS"
40 OUTPUT @E5100;"CHAN1; FMT LOGM; CONV ZTRA"
50 OUTPUT @E5100;"CENT 70MHZ; SPAN 100KHZ"
60 CALL Sweep(2) ! Goes to sub routine. (See OUTPFILT?)
70 OUTPUT @E5100;"ANADCH1;ANARFULL;ANACDATA"
80 OUTPUT @E5100;"OUTPRESR?"
90 ENTER @E5100;Zr,Fr,Za,Fr,Fa,R1,R2,R3
100 PRINT "Resonant:";Zr;"[ohm],";Fr;"[Hz]"
110 PRINT "Anti-Resonant:";Za;"[ohm],";Fa;"[Hz]"
120 PRINT "Ripple L:";R1;"[dB]"
130 PRINT "Ripple M:";R2;"[dB]"
140 PRINT "Ripple R:";R3;"[dB]"
150 END
```
OUTPRESF?

Returns the resonator specific parameters. (Query only)

Syntax

OUTPRESF? $x_1$, $x_2$

Where,

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>$x_1$</td>
<td>Value down from the maximum peak.</td>
</tr>
<tr>
<td>1</td>
<td>$x_2$</td>
<td>Value above the maximum peak.</td>
</tr>
</tbody>
</table>

Query

$f_{s1}$, $f_p$, $f_{s2}$, $f_{p1}$, $f_{p2}$ (Total 6)

Response

Where,

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>$f_s$</td>
<td>Middle point frequency between $f_{s1}$ and $f_{s2}$.</td>
</tr>
<tr>
<td>1</td>
<td>$f_p$</td>
<td>Middle point frequency between $f_{p1}$ and $f_{p2}$.</td>
</tr>
<tr>
<td>2</td>
<td>$f_{s1}$</td>
<td>Left one of the two points $x_1$ dB down from the maximum peak.</td>
</tr>
<tr>
<td>3</td>
<td>$f_{s2}$</td>
<td>Right one of the two points $x_1$ dB down from the maximum peak.</td>
</tr>
<tr>
<td>4</td>
<td>$f_{p1}$</td>
<td>Left one of the two points $x_2$ dB above the minimum negative peak.</td>
</tr>
<tr>
<td>5</td>
<td>$f_{p2}$</td>
<td>Right one of the two points $x_2$ dB above the minimum negative peak.</td>
</tr>
</tbody>
</table>

Figure D-15. OUTPRESF?

Semantics

OUTPRESF? executes the following actions:

1. Searches for the maximum peak in the analysis range.
2. Searches for the $x_1$ dB below points on both sides, and defines the first found left and right side points as $f_{s1}$ and $f_{s2}$, respectively.

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3. Defines the middle point between \( f_{sl} \) and \( f_{sx} \) to \( f_s \).

4. Searches for the \( x_2 \) dB above points on both sides, and defines the first found left and right side points as \( f_{pl} \) and \( f_{ps} \), respectively.

5. Defines the middle point between \( f_{pl} \) and \( f_{ps} \) as \( f_p \).

**Note**
- If there is no corresponding peak in the range, OUTPRESF? returns 0 for all parameters.
- If the maximum peak cannot be found, OUTPRESF? returns 0 for \( f_n, f_{sl}, \) and \( f_{sx} \).
- If the minimum negative peak cannot be found, OUTPRESF? returns 0 for \( f_n, f_{pl}, \) and \( f_{ps} \).
- Specify the negative value for \( x_1 \) and positive value for \( x_2 \).

**Examples**

10 ASSIGN @E5100 TO 717
20 OUTPUT @E5100;"FMT LOGM; CENT 60.06MHZ; SPAN 20kHz"
30 CALL Sweep(1) ! Goes to sub routine. (See OUTPFILT?)
40 OUTPUT @E5100;"ANAOCH1;ANARFULL;ANAODATA"
50 OUTPUT @E5100;"OUTPRESF? -3dB,3dB"
60 ENTER @E5100;Fs,Fp,Fs1,Fs2,Fp1,Fp2
70 PRINT "Series-Resonant":;Fs;"[Hz]"
80 PRINT "Parallel-Resonant":;Fp;"[Hz]"
90 END
OUTPCERR?
Returns the ceramic resonator specific parameters. (Query only)

Syntax
OUTPCERR?

Query
Zr, fr, Za, fa, Rp1, Rp2, Rp3 (Total?)

Response
Where,

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Zr</td>
<td>Resonant impedance</td>
</tr>
<tr>
<td>1</td>
<td>fr</td>
<td>Resonant frequency</td>
</tr>
<tr>
<td>2</td>
<td>Za</td>
<td>Anti-resonant impedance</td>
</tr>
<tr>
<td>3</td>
<td>fa</td>
<td>Anti-resonant frequency</td>
</tr>
<tr>
<td>4</td>
<td>Rp1</td>
<td>Maximum height of the ripple that is on the left side of the resonant point.</td>
</tr>
<tr>
<td>5</td>
<td>Rp2</td>
<td>Maximum height of the ripple that is between the resonant and anti-resonant points.</td>
</tr>
<tr>
<td>6</td>
<td>Rp3</td>
<td>Maximum height of the ripple that is on the right side of the resonant point.</td>
</tr>
</tbody>
</table>

Figure D-16. OUTPCERR?

Semantics
- You need to select the LOG MAG format (FMT LOGM) and turn impedance conversion on (CONV ZTRA) to use this command.
- OUTPCERR? executes the following actions:
  1. Searches for the minimum negative peak in the range and defines it as a resonant point. Then returns the resonant impedance, Zr, and resonant frequency, fr.
  2. Searches for the maximum peak in the range and defines it as a anti-resonant point. Then returns the anti-resonant impedance, Za, and anti-resonant frequency, fa.
3. Returns the maximum height of the ripple, \( R_{pl} \), that is the difference between the peak and left adjacent negative peak.

4. Returns the maximum height of the ripple, \( R_{pl} \), that is the difference between the peak and right adjacent negative peak.

5. Returns the maximum height of the ripple, \( R_{pl} \), that is the difference between the peak and left adjacent negative peak.

**Note**
- This command can be used when the LOG MAG format (FMT LOGM) is selected. If another format is selected, OUTPCERR? returns 0 for all parameters.
- If no corresponding ripple is found, OUTPCERR? returns 0.

**Examples**

```
10 ASSIGN @E5100 TO 717
20 OUTPUT @E5100;"FMT LOGM; CONV ZTRA; CENT 60.02MHZ; SPAN 20kHz"
30 CALL Sweep(1) ! Goes to sub routine. (See OUTPFIL?)
40 OUTPUT @E5100;"ANACCH1;ANARFULL;ANA0DATA"
50 OUTPUT @E5100;"OUTPCERR?"
60 ENTER @E5100;Zr,Fr,Za,Fa,R1,R2,R3
70 PRINT "Resonant:";Zr;"[ohm],";Fr;"[Hz]"
80 PRINT "Anti-Resonant:";Za;"[ohm],";Fa;"[Hz]"
90 PRINT "Ripple L:";R1;"[dB]"
100 PRINT "Ripple M:";R2;"[dB]"
110 PRINT "Ripple R:";R3;"[dB]"
120 END
```

**Equivalent circuit analysis commands**

The following commands are for the equivalent circuit analysis. They are easy to use for specific device analysis because they can output many parameters using only a single command.

- EQUCPARA?
- EQUM
- EQUCPARA5?
- EQUCPARS?
- EQUCO?
- EQUCPARS4?
EQUCPARA?

Returns the six-device equivalent circuit parameters of the crystal resonator. (Query only)

Syntax

EQUCPARA?

Query

$C_0$, $C_1$, $L_1$, $R_1$, $G_0$, $R_0$ (Total 6)

Response

Where,

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>$C_0$</td>
<td>Parallel capacitance</td>
</tr>
<tr>
<td>1</td>
<td>$C_1$</td>
<td>Motional capacitance</td>
</tr>
<tr>
<td>2</td>
<td>$L_1$</td>
<td>Motional inductance</td>
</tr>
<tr>
<td>3</td>
<td>$R_1$</td>
<td>Motional resistance</td>
</tr>
<tr>
<td>4</td>
<td>$G_0$</td>
<td>Electrode conductance</td>
</tr>
<tr>
<td>5</td>
<td>$R_0$</td>
<td>Electrode resistance</td>
</tr>
</tbody>
</table>

Figure D-17. Six-Device Equivalent Circuit of Crystal Resonator

Semantics

- EQUCPARA? executes the following actions:

1. Obtains the admittance characteristic circle diagram.
2. Obtains the maximum conductance. ($G_{max}$)
3. Obtains frequencies $f_1$ and $f_2$ ($f_1 < f_2$) of the two points where the conductance is half the maximum conductance ($G_{max}$).
4. Calculates $f_s$ by $f_s = \sqrt{f_1 \times f_2}$.
5. Obtains susceptance $B_{f_2}$ at $f_s$.
6. Calculates $\omega_s$ by $\omega_s = 2 \times \pi \times f_s$.
7. Assumes that the frequency at which the phase becomes $0^\circ$ near the parallel resonance frequency is $f_a$, and obtains its conductance $G_a$.
8. Calculates $\omega_a$ by $\omega_a = 2 \times \pi \times f_a$.
9. Assumes that the frequency at which the phase becomes $0^\circ$ near the series resonance frequency is $f_s$.

10. Calculates the constants using the above values and the following equations:

\[
Q_s = \frac{f_s}{f_2 - f_1} \quad C_o' = \frac{B_1 + B_2}{2\omega_s} \\
L_1 = \frac{Q_1}{\omega_s G_{\text{max}}} \quad R_1 = \frac{C_o'}{C_0 G_{\text{max}}} \\
C_i = \frac{G_{\text{max}}}{\omega_s Q_s} \quad R_o = \frac{1}{G_{\text{max}}} - R_1 \\
C_o = \frac{B_1\omega_s}{\omega_s}
\]

* "EQUCPARA?" interpolates the $0^\circ$ phase points even if it does not exist in measured data.

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

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

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

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

**EQUM**

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

**value** 2 to 801

**Note**

- You must select the following conditions or Polar format to use this command:
  - Dual Channel & Coupled Channel: ON
  - Impedance Conversion: ON
  - Analysis channel: LOG MAG format
  - Non-analysis channel: Phase format

**Examples**

10 ASSIGN @E5100 TD 717
20 OUTPUT @E5100;"FMT POLA; CONV YTRA; CENT 60.06MHz; SPAN 20kHz"
30 CALL Sweep(1) ! Goes to sub routine. (See OUTPFILT?)
40 OUTPUT @E5100;"ANAOCH1;ANARFULL;ANAOADATA"
50 OUTPUT @E5100;"EQUCPARA?"
60 ENTER @E5100;CO,C1,L1,R1,G0,RO
70 PRINT "CO:";CO;" C1:";C1
80 PRINT "L1:";C1;" R1:";R1
90 PRINT "G0:";G0;" RO:";RO
100 END

Waveform Analysis Commands D-45
EQUCPARA5?
Executes the equivalent circuit analysis for a resonator using the same equivalent circuit of EQUCPARA?, but does not output G0. EQUCPARA5? does not display the warning even an anti-resonance frequency is not in the analysis range. (Query only)

Syntax EQUCPARA5?
Query $C_0$, $C_I$, $L_I$, $R_I$, $R_o$ (Total 5)
Response Where,

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>$C_0$</td>
<td>Parallel capacitance</td>
</tr>
<tr>
<td>1</td>
<td>$C_I$</td>
<td>Motional capacitance</td>
</tr>
<tr>
<td>2</td>
<td>$L_I$</td>
<td>Motional inductance</td>
</tr>
<tr>
<td>3</td>
<td>$R_I$</td>
<td>Motional resistance</td>
</tr>
<tr>
<td>4</td>
<td>$R_o$</td>
<td>Electrode resistance</td>
</tr>
</tbody>
</table>
EQUCPARS?
Outsuts the six-device equivalent circuit parameters of the crystal resonator. (Query only)

Syntax          EQUCPARS?
Query           $C_0, C_1, L_I, R_t, f_s, f_m, f_r, f_1^*, f_2^*, G_0, R_0$ (Total 11)
Response        $f_1 < f_2$

For information about each parameter, see “EQUCPARA?”.

Note
- You must select the following conditions or Polar format to use this command:
  - Dual Channel & Coupled Channel: ON
  - Impedance Conversion: ON
  - Analysis channel: LOG MAG format
  - Non-analysis channel: Phase format

If another format is selected, 0 will be returned for query response.
EQUCO? value

Returns the parallel capacitance \( C_0 \) of the equivalent circuit of the resonator at the specified frequency. (Query only)

Syntax

\[
\text{EQUCO? value}
\]

Where,

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>value</td>
<td>Frequency for ( C_0 )</td>
</tr>
</tbody>
</table>

Query C0

Response

Where,

<table>
<thead>
<tr>
<th>Register</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>C0</td>
<td>Parallel capacitance</td>
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Semantics

- \( C_0 \) is calculated using the following equation:

\[
C_0 = \frac{B_s}{\omega_s}
\]

Where,

- \( B_s \) Imaginary part of the point on \( f_s \).
- \( \omega_s = 2\pi f_s \)
- \( f_s \) Frequency that is specified by the command parameter.

- If the impedance conversion is selected, \( C_0 \) is calculated using the following equation:

\[
C_0 = \frac{-1}{B_s \times \omega_s}
\]

Note

- You must select the following conditions or Polar format to use this command:
  - Dual Channel & Coupled Channel: ON
  - Impedance Conversion: ON
  - Analysis channel: LOG MAG format
  - Non-analysis channel: Phase format

If another format is selected, 0 will be returned for query response.

- If the specified frequency is out of analysis range, 0 will be returned.

- If \( B_s \) is 0 when the impedance conversion is selected, EQUCO? returns 0.

Examples

10 ASSIGN @E5100 TO 717
20 OUTPUT @E5100;"DUAC ON; COUC ON"
30 OUTPUT @E5100;"CHAN2; FMT PHAS"
40 OUTPUT @E5100;"CHAN1; FMT LOGM; CONV ZTRA"
50 OUTPUT @E5100;"CENT 60.06MHz; SPAN 20kHz"
60 CALL Sweep(2) ! Goes to sob routine. (See OUTPFILT?)
70 OUTPUT @E5100;"ANADCH1;ANARFULL;ANADDATA"
80 OUTPUT @E5100;"EQUCO? 60.06MHz"
90 ENTER @E5100;C0
100 PRINT "C0:";C0
EQUCPARS4?

Returns the 4-device equivalent circuit parameters of the crystal resonator. (Query only)

Syntax  
EQUCPARS4?

Query  
$C_0$, $C_1$, $L_1$, $R_1$, $f_s$, $f_a$, $f_r$, $f_l$, $f_2$ (Total9)

Response  
Where,

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<td>Frequency at the point where the half of maximum conductance.</td>
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<tr>
<td>8</td>
<td>$f_2$</td>
<td>Frequency at the point where the half of maximum conductance. ($f_l &lt; f_2$)</td>
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Figure D-18. Four-Device Equivalent Circuit of Crystal Resonator

Semantics  
- You need to select the polar format (FMT POLA) and turn the admittance conversion on to use this command.
- EQUCPARS4? executes the following actions:
  1. Obtains the admittance characteristic circle diagram. (See Figure D-19.)
  2. Obtains the susceptance ($B_{fs}$) and its frequency ($f_s$) at the maximum conductance ($G_{max}$) point.
  3. Obtains frequencies $f_l$ and $f_2$ ($f_l < f_2$) of the two points where the conductance is half the maximum conductance ($G_{max}$).
4. Assumes that the frequency at which the phase becomes 0° near the parallel resonance frequency is \( f_a \).

5. Assumes that the frequency at which the phase becomes 0° near the series resonance frequency is \( f_r \).

6. Calculates the constants using the above values and the following equations:

\[
C_0 = \frac{f_r^2}{f_a^2 - f_r^2} \times C_1
\]

\[
C_1 = \frac{1}{QR_{2} \cdot 2 \pi f_s}
\]

\[
Q = \frac{|f_s|}{|f_a - f_s|}
\]

\[
R_1 = \frac{1}{G_{\text{max}}}
\]

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

\[
C_0 = \frac{B_{f_1}}{2 \pi f_s}
\]

Where, \( B_{f_1} \) is the susceptance at the \( G_{\text{max}} \) point.

![Admittance Characteristic Circle Diagram](image)

**Figure D-19. Admittance Characteristic Circle Diagram**

**Note**

* This command is only available when Polar format and the admittance conversion is on. If these are not selected, 0 will be returned.

**Examples**

10 ASSIGN E5100 TO 717
20 OUTPUT E5100;"FMT POLA;" CONV YTRA; CENT 60.06MHz; SPAN 20kHz"
30 CALL Sweep(1) ! Goes to sub routine. (See OUTFILT?)
40 OUTPUT E5100;"ANAOCH1;ANARFULL;ANAODATA"
50 OUTPUT E5100;"EQUCPARS4?"
60 ENTER E5100;C0,C1,L1,R1
70 PRINT "C0:";C0;" C1:";C1
80 PRINT "L1:";L1;" R1:";R1
90 END
## Command HP 87510A vs. HP E5100A

### COMMAND

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<tr>
<td>STIMROUT(1-16)</td>
<td>SUPPORT</td>
<td>SUPPORT</td>
</tr>
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<td>STOD(DISK(MEMO))</td>
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<td>HP 87510A</td>
<td>HP E5100A</td>
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<td>-----------</td>
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<td>SUPPORT</td>
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</tr>
<tr>
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<td>SUPPORT</td>
<td>NO SUPPORT</td>
</tr>
<tr>
<td>TBL?</td>
<td>SUPPORT</td>
<td>SUPPORT</td>
</tr>
<tr>
<td>TESC</td>
<td>SUPPORT</td>
<td>NO SUPPORT</td>
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<td>NO SUPPORT</td>
</tr>
<tr>
<td>THRM</td>
<td>SUPPORT</td>
<td>SUPPORT</td>
</tr>
<tr>
<td>TIM?</td>
<td>SUPPORT</td>
<td>SUPPORT</td>
</tr>
<tr>
<td>TITL</td>
<td>SUPPORT</td>
<td>SUPPORT</td>
</tr>
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<td>SUPPORT</td>
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<td>SUPPORT</td>
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<td>SUPPORT</td>
</tr>
<tr>
<td>TRAFDATA</td>
<td>SUPPORT</td>
<td>SUPPORT</td>
</tr>
<tr>
<td>TRAFMEMO</td>
<td>SUPPORT</td>
<td>SUPPORT</td>
</tr>
<tr>
<td>TRAF</td>
<td>SUPPORT</td>
<td>SUPPORT</td>
</tr>
<tr>
<td>TRAR</td>
<td>SUPPORT</td>
<td>SUPPORT</td>
</tr>
<tr>
<td>TRIGMEAS</td>
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<td>SUPPORT</td>
</tr>
<tr>
<td>TRIM</td>
<td>NO SUPPORT</td>
<td>SUPPORT</td>
</tr>
<tr>
<td>UPPD</td>
<td>SUPPORT</td>
<td>SUPPORT</td>
</tr>
<tr>
<td>UPPELIMI</td>
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<td>SUPPORT</td>
</tr>
<tr>
<td>VELOFACT</td>
<td>SUPPORT</td>
<td>NO SUPPORT</td>
</tr>
<tr>
<td>WIDIN</td>
<td>SUPPORT</td>
<td>NO SUPPORT</td>
</tr>
<tr>
<td>WIDSOUT</td>
<td>SUPPORT</td>
<td>NO SUPPORT</td>
</tr>
<tr>
<td>WIDT</td>
<td>SUPPORT</td>
<td>SUPPORT</td>
</tr>
<tr>
<td>WIDY</td>
<td>SUPPORT</td>
<td>SUPPORT</td>
</tr>
<tr>
<td>WRIT16</td>
<td>SUPPORT</td>
<td>SUPPORT</td>
</tr>
<tr>
<td>WRIT24</td>
<td>SUPPORT</td>
<td>SUPPORT</td>
</tr>
</tbody>
</table>
Keyword Guide to Porting

The following sections summarize the differences in the HP-IB commands of the HP 87510A and the HP E5100A/B. This appendix is intended only as a quick reference to the keywords and their compatibility. For detailed information, see the Chapter 8.

The following table is summary of this appendix

<table>
<thead>
<tr>
<th></th>
<th>HP 87510A</th>
<th>HP E5100A</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Trigger</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SRQ</td>
<td></td>
<td>SING?</td>
</tr>
<tr>
<td>SING</td>
<td></td>
<td>TRIM SING</td>
</tr>
<tr>
<td><strong>Calibration</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>*OPC?</td>
<td></td>
<td>STANC?, RAIRES?, RAIISO?, CLASS11[A</td>
</tr>
<tr>
<td>*OPC?</td>
<td></td>
<td>RESPDONE, RAID?, SAV1</td>
</tr>
<tr>
<td><strong>Data Transfer</strong></td>
<td>FORM2, FORM3, FORM5</td>
<td>No support for data input. (use FORM4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mean/Format</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AR, MEAS, MEASR</td>
<td></td>
<td>Full support</td>
</tr>
<tr>
<td>LOGM, PHAS, DELA, LINM, LOGMP, LOGMD, REAL, IMAG</td>
<td>Full support</td>
<td></td>
</tr>
<tr>
<td>EXPP</td>
<td></td>
<td>PNT EXPP</td>
</tr>
<tr>
<td>POLAR</td>
<td></td>
<td>No support</td>
</tr>
<tr>
<td>CONVZTRA, CONVZREF, CONVYTRA, CONVYREF</td>
<td>ANAMODE, ZREFL, ANAMODE, YREFL</td>
<td></td>
</tr>
<tr>
<td><strong>Analysis Function</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BINSLINE, BINS, BINOA, BINOB, EDITBRL</td>
<td>No support</td>
<td></td>
</tr>
<tr>
<td>EDITLIS1, EDITLIS2</td>
<td></td>
<td>UPELIMI, LOWELIMI</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>KEY</td>
<td></td>
<td>No support</td>
</tr>
</tbody>
</table>
Trigger Function

Single Trigger (SRQ)
Use the SING? command instead of SRQ to generate a single trigger. SING? initiates a single measurement sweep and returns 1 when the sweep is completed.

```
OUTPUT @E5100;"SING?"
ENTER @E5100;Tmp$
```

Single Trigger Mode (SING)
Use the TRIM SING command instead of SING to select a single trigger as the trigger mode.

---

Calibration

Calibration Measurement (OPC)
Use the STANC?, RAIRESP?, RAIISO?, CLASS11[AB|C]? query commands instead of the OPC command (which is used to detect that calibration measurement is completed). These query commands make a calibration measurement and return 1 when the calibration measurement is completed.

Calibration Done (OPC)
Use the RESEPONE?, RAID? and SAV1 query commands instead of the OPC command (which is used to detect that the calibration coefficient calculation is completed). These query commands calculate and save the calibration coefficient into the internal array and return 1 when the operation is completed.

---

Data Transfer Command

Binary Transfer Commands (FORM2, FORM3, FORM4)
Use ASCII transfer (FORM4) when data is entered from an external controller to the HP E5100A/B. The HP E5100A/B does not support binary transfer for data input.
Input Port (AR, MEASA, MEASR)

The following commands are used to select an input port for the HP 87510A. The AR, MEASA, and MEASR commands are supported (see the following table).

<table>
<thead>
<tr>
<th>Equivalent Softkey</th>
<th>HP 87510A</th>
<th>HP E5100A</th>
</tr>
</thead>
<tbody>
<tr>
<td>A/R</td>
<td>MEAS AR</td>
<td>MEAS AR</td>
</tr>
<tr>
<td>B/R</td>
<td>MEAS BR</td>
<td></td>
</tr>
<tr>
<td>C/R</td>
<td>MEAS CR</td>
<td></td>
</tr>
<tr>
<td>B/A</td>
<td>MEAS BA</td>
<td></td>
</tr>
<tr>
<td>C/A</td>
<td>MEAS CA</td>
<td></td>
</tr>
<tr>
<td>R/A</td>
<td>MEAS RA</td>
<td></td>
</tr>
<tr>
<td>A/B</td>
<td>MEAS AB</td>
<td></td>
</tr>
<tr>
<td>C/B</td>
<td>MEAS CB</td>
<td></td>
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<td>R/B</td>
<td>MEAS RB</td>
<td></td>
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<td>A/C</td>
<td>MEAS AC</td>
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<td>R/C</td>
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<tr>
<td>R</td>
<td>MEAS R</td>
<td>MEAS R</td>
</tr>
<tr>
<td>A</td>
<td>MEAS A</td>
<td>MEAS A</td>
</tr>
<tr>
<td>B</td>
<td>MEAS B</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>MEAS C</td>
<td></td>
</tr>
</tbody>
</table>

Use the MEAS? query command to confirm the current port.

```
OUTPUT @E5100;MEAS?
ENTER @E5100; Port$
```

Format (LOGM, PHAS, DELA, LINM, EXPP, LOGMP, LOGMD, REAL, IMAG, POLAR)

The following commands are supported:

```
LOGM, PHAS, DELA, LINM, LOGMP, LOGMD, REAL, IMAG
```

Use the FMT EXPP command instead of EXPP for selecting Expanded Phase format. EXPP is not supported.

Polar chart format (POLAR) is not supported. (Refer to the following table.)
Table F-2.

<table>
<thead>
<tr>
<th>Equivalent Softkey</th>
<th>HP 87510A</th>
<th>HP E5100A</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOG MAG &amp; PHASE</td>
<td>FMT LOGM or LOGMP</td>
<td>FMT LOGM or LOGMP</td>
</tr>
<tr>
<td>LOG MAG &amp; DELAY</td>
<td>FMT LOGMD or LOGMD</td>
<td>FMT LOGMD or LOGMD</td>
</tr>
<tr>
<td>LIN MAG &amp; PHASE</td>
<td>-</td>
<td>FMT LINMP</td>
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<tr>
<td>LIN MAG &amp; DELAY</td>
<td>-</td>
<td>FMT LINMD</td>
</tr>
<tr>
<td>REAL &amp; IMAGINARY</td>
<td>-</td>
<td>FMT RIMAG</td>
</tr>
<tr>
<td>LOG MAG</td>
<td>FMT LOGM or LOGM</td>
<td>FMT LOGM or LOGM</td>
</tr>
<tr>
<td>LIN MAG</td>
<td>FMT LINM or LINM</td>
<td>FMT LINM or LINM</td>
</tr>
<tr>
<td>PHASE</td>
<td>FMT PHAS or PHAS</td>
<td>FMT PHAS or PHAS</td>
</tr>
<tr>
<td>DELAY</td>
<td>FMT PHAS or PHAS</td>
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</tr>
<tr>
<td>REAL</td>
<td>FMT REAL or REAL</td>
<td>FMT REAL or REAL</td>
</tr>
<tr>
<td>IMAGINARY</td>
<td>FMT IMAG or IMAG</td>
<td>FMT IMAG or IMAG</td>
</tr>
<tr>
<td>EXPANDED PHASE</td>
<td>FMT EXPP or EXPP</td>
<td>FMT EXPP (EXPP is not supported)</td>
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</tr>
<tr>
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</tr>
</tbody>
</table>

Use the FMT? query command to confirm the current format.

OUTPUT QE5100;FMT?
ENTER QE5100; Format$

Impedance Conversion Function (CONVZTRA, CONVZREF, CONVYTRA, CONVYREF)

Use the impedance measurement mode ANAMODE instead of the conversion function, even though the HP E5100A/B supports the CONV commands.

Table F-3.

<table>
<thead>
<tr>
<th>Impedance Conversion (HP 87510A)</th>
<th>Impedance Measurement Mode (HP E5100A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONVZTRA</td>
<td>ANAMODE ZTRAN</td>
</tr>
<tr>
<td>CONVZREF</td>
<td>ANAMODE ZREFL</td>
</tr>
<tr>
<td>CONVYTRA</td>
<td>ANAMODE ZTRAN;FMT MAGY</td>
</tr>
<tr>
<td>CONVYREF</td>
<td>ANAMODE ZREFL;FMT MAGY</td>
</tr>
</tbody>
</table>

F-4  Keyword Guide to Porting
Analysis Commands

BIN sort (BINSLINE, BINS, BINOA, BINOB, EDITBINL)
The HP E5100A/B does not support the BIN sort function.

Limit Line Edit (EDITLIS1, EDITLIS2)
Use UPELIMI and LOWELIMI commands to define a limit line. The HP E5100A/B does not support the EDITLIS1 and EDITLIS2 commands of the HP 87510A.

Other Commands

KEY command
The HP E5100A/B does not support the KEY command.
Option 022

Overview

This option enables you to control metal deposition during a deposition process of crystal resonators.

Metal deposition is used during a manufacturing to adjust the frequency of a crystal resonator. The resonant frequency of a crystal resonator becomes lower as deposition proceeds. HP E5100A/B OPT. 022, as described in Figure G-1, monitors the phase at a specified frequency \( f_1 \) and outputs preset data to the I/O port when the measured phase goes under 0 (or any value you specify as you wish).

HP E5100A/B OPT. 022, then, moves its focus to the next frequency \( f_2 \) and performs another measurement. When the measured phase reaches the specified value again, it outputs different data to the I/O port. This output to the I/O port controls the amount of metal deposition to achieve efficient and accurate metal deposition. This option's function is called the Trap Function because it awaits the phase to match the preset phase at a certain frequency.

![Figure G-1. The Trap Function](image-url)
Using HP E5100A/B Option 022

You must use a program to use the trap function to control a deposition process.

A sample program is provided in the sample program disk. This chapter explains how to measure a device using the sample program.

The sample program for the trap function is prepared under the following conditions.

- A π network test fixture is used.
- Characteristic impedance is set at 12.5Ω to support standard π network test fixture.

This sample program measures a device using the trap function on the channel 1. When the program sees the resonant frequency of the resonator matching the final trap frequency, it switches the focus to the channel 2 to perform a frequency sweep and verifies the resonant frequency.

HP E5100A/B option 022 starts performing the trap function from the measured point at the right of the screen. As deposition proceeds, the resonant frequency of resonator becomes lower and the measured frequency goes from right to left. This is because the function waits for the measured phase to go under 0° (actually the phase value specified by INPUTRAC) at the measured point so that it can output certain data to the I/O port and move to the next measured point to repeat the process.

The more detailed description of the program function is discussed for the sample program with its default setup. The default setup is completed between lines 1750 and 2060 in "The Sample Program List". Please refer to this section for the setup. Figure G-2 describes the status of the channel 1 with this setup.

![Diagram](image)

**Figure G-2. How HP E5100A/B option 022 Works with the Default Setup**
An Example of Trapping

1. The leftmost frequency on the screen is the stop frequency for the trap function.
   (19.979MHz)

2. The rightmost frequency on the screen is the start frequency for the trap function.
   (19.998979 MHz = 19.979×(1 + 1000E−6))

3. A phase is continuously measured at the rightmost frequency on the screen.

4. When deposition proceeds and the phase becomes 0, HP E5100A/B option 022 outputs 8 to
   the I/O port.

5. HP E5100A/B option 022 moves the measured point to the second point from the right (it
   changes the measured frequency) and measures the phase.

6. Since the output data is not specified for this I/O port, the output data to the I/O port
   remain unchanged when the phase becomes 0.

7. HP E5100A/B option 022 goes to the third measured point from the right to perform the trap
   function.

8. At the 4th measured point from the right, HP E5100A/B option 022 outputs 4 to the I/O
   port.

9. HP E5100A/B option 022 continues to measure at the rest of measured points until it
   reaches the stop frequency for the trap function.

---

**Note**

You can specify at which measured point and what data to output to the I/O port.

---

As soon as HP E5100A/B option 022 completes the trap function on the channel 1, it performs
a normal frequency sweep on the channel 2 to verify the resonant point. When HP E5100A/B
option 022 completes the sweep, it calculates the resonant frequency and resonant impedance
and displays them at the lower half of the screen. (Figure G-3)

There are 4 waveforms on the screen because the measurement screen at the upper half of the
screen displays the waveforms of the channel 1 over those of the channel 2.
**Figure G-3. The Displayed Measurement Result**

---

**Required Parameters**

Following parameters are required to execute this program.

- **Parameters Required for the Trap Function (Channel 1)**
  - The stop frequency for the trap function
  - The start frequency for the trap function (Input in the ratio (ppm) to the stop frequency for the trap function)
  - The IF bandwidth
  - The number of measured points
  - The phase value to trap at each measured point and data to output when the value matches

- **Parameters Specified for a Frequency Sweep (Channel 2)**
  - The frequency sweep span
  - The IF bandwidth
  - The number of measured points
  - The wait time interval between the completion of the trap function and the start of frequency sweep.
The Sample Program List

The list of a sample program 022 is explained below. This list contains the important portion only.

490  ASSIGN @E5100 TO 800
500  CLEAR @E5100
510  
520  DIM Bin(1:20)
530  DIM Dat$[80],Lw$[20],Err$[50],Lmt_flag$(1:20)
540  
550  OUTPUT @E5100;"FRES"
560  GOSUB Setting
570  GOSUB Power_setup
580  GOSUB Set_ch1
590  GOSUB Pi_cal
600  CLEAR SCREEN
610  GOSUB Set_ch1_part2
620  OUTPUT @E5100;"COUC OFF"
630  GOSUB Setup_monitor
640  GOSUB Set_ch2
650  GOSUB Measurement
660  
670  STOP
680  
690  
700  
710  ! *************** SUBROUTINES *******************
720  
730  ! *************** DEFAULT VALUES ************
740  
750  Default_set: 
760  ZO=12.5
770  F_nominal=19.97G  ! (MHz)
780  Span_adj=1000  ! (ppm)
790  Span_fr=100  ! (ppm)
800  Ifbw1=1000  ! (Hz)
810  Ifbw2=1000  ! (Hz)
820  Nopi=11  ! NOP for CH1
830  Nop2=51  ! NOP for CH2
840  Wait_check=100  ! WAIT TIME for Fr check after EVAPOLATION
850  RETURN
860  
870  
880  Default_power: 
890  W=10  ! POWER = 10 (uW)
900  R=10  ! CI = 10 (ohm)
910  RETURN
920  
930  
940  Lmt_flag$: 
950  
960  ! Lmt.Flag
970  ! ---------------
980  DATA "0,ON","0000000000000001"  ! 1
990  DATA "0,OFF"
1000  DATA "0,OFF"
1010  DATA "0,OFF"
1020  DATA "0,ON","0000000000000010"  ! 2
1030  DATA "0,OFF"
1040  DATA "0,OFF"
1050  DATA "0,ON","0000000000000100"  ! 4
1060  DATA "0,OFF"
1070  DATA "0,OFF"
1080  DATA "0,ON","0000000000001000"  ! 8
1090!
1100!
1110!
1120!  ***************************************************************************
1130!
1140 Setting: !
1150!
1160 GOSUB Default_set
1170! OUTPUT @E5100;"GSE 16384;0SNT 16384;5SRE 128"
! SET INTERRUPT for DATA TRANSFER between NA and EXT PC
1180 OUTPUT @E5100;"CLS"
1190 OUTPUT @E5100;"DISAIHB"
1200 OUTPUT @E5100;"CHAN1;HOLD"
1210 OUTPUT @E5100;"TRAP OFF"
1220 OUTPUT @E5100;"CHAN2;HOLD"
1230 OUTPUT @E5100;"TRAP OFF"
1240 OUTPUT @E5100;"CHAN1"
1250 OUTPUT @E5100;"DUAC ON"
1260 OUTPUT @E5100;"CDOC ON"
1270 OUTPUT @E5100;"LINFREQ"
1280 INPUT "Nominal frequency (MHz) ?",F_nominal
1290 F_nominal=F_nominal*1.E+6
1300 INPUT "Adjustment Span (ppm) ?",Span_adj
1310 Span_adj=Span_adj/1.E+6
1320 Span_adj=F_nominal*Span_adj
1330 Startf=F_nominal
1340 Stopf=F_nominal+Span_adj
1350 INPUT "Span for Fr check (ppm) ?",Span_fr
1360 Span_fr=Span_fr/1.E+6
1370 Span_fr=F_nominal*Span_fr
1380 INPUT "IFBW at CH1 (Hz) ?",Ifbw1
1390 INPUT "IFBW at CH2 (Hz) ?",Ifbw2
1400! INPUT "NOP for EVAPOLATION at CH1 ? ",Nop1
1410 INPUT "NOP for Fr check at CH2 ? ",Nop2
1420 INPUT "WAIT TIME after EVAPOLATION (msec) ?",Wait_check
1430 Wait_check=Wait_check/1000
1440 EXECUTE "ANAOCH2"
1450 EXECUTE "ANAODATA"
1460 EXECUTE "ANARFULL"
1470 RETURN
1480!
1490!
1500 Power_setup: !
1510 GOSUB Default_power
1520 INPUT "POWER (uW) ",W
1530 W=W/1.E+6
1540 INPUT "RESONANT RESISTANCE (ohm) ",R
1550!
1560! Power level calculation
1570!
1580 Pi=r=12.5
1590 R0=50
1600 R1=50
1610 R2=50
1620 R3=r=3.3
1630 R4=159
1640 R5=66.2
1650 R6=14.2
1660 Pi=r=2R6/(R3*R4+R5*(R3+R4)/(R3*R4+(R3+R4)*R5+R6))
1670 V0=-(Pi=r+R1+Pi=r)*SQRT(W/R)
1680 Vp=(R3*R4+(R3+R4)*(R5+R6))/(R4*R5)*V0+a
1690 V0=(R0+R1+R2)/(R1+R2)*Vp
1700 V1=V0/4
1710 Power=10*eLGT(1000*V1^2/50)
1720 RETURN
1730!

G-6  Option 022
1740  !
1750  Set_ch1:!
1760  OUTPUT @E5100;"CHAN1;AR;LOGMD"
1770  OUTPUT @E5100;"HOLD"
1780  OUTPUT @E5100;"PWUE ";Power
1790  OUTPUT @E5100;"STAR ";Startf-(Span_fr)*(7/8)  ! SET START FREQ for CAL
1800  OUTPUT @E5100;"STOP ";Stopf
1810  OUTPUT @E5100;"POIN ";Nop1
1820  OUTPUT @E5100;"IFSW ";Ifbw1
1830  OUTPUT @E5100;";DISG OFF"
1840  OUTPUT @E5100;";SWED DOWN"
1850  RETURN
1860  !
1870  !
1880  Set_ch1_part2:!
1890  OUTPUT @E5100;"STAR ";Startf
1900  RETURN
1910  !
1920  !
1930  Set_ch2:!
1940  OUTPUT @E5100;"CHAN2;AR;LOGMD"
1950  OUTPUT @E5100;"HOLD"
1960  ! OUTPUT @E5100;"PWUE ";Power
1970  ! OUTPUT @E5100;"LINIFREQ"
1980  OUTPUT @E5100;"STOP ";Startf+(Span_fr)*(1/8)
1990  ! SET STOP FREQ for CH2 based on START FREQ at CH1
2000  OUTPUT @E5100;"STAR ";Startf-(Span_fr)*(7/8)
2010  OUTPUT @E5100;"POIN ";Nop2
2020  OUTPUT @E5100;"IFSW ";Ifbw2
2030  OUTPUT @E5100;";DISG OFF"
2040  OUTPUT @E5100;";SETZ ";Z0
2040  OUTPUT @E5100;";CONDRTA"
2050  RETURN
2060  !
2070  !
2080  !
2090  !
2100 Setup_monitor:!
2110  MONITOR function setup
2120 !
2130  Start_pt=1
2140  !
2150  OUTPUT @E5100;"WRIT16"  ! Set the Number of PIN of I/O Port
2160  !
2170  RESTORE Lmt_flag
2180  !
2190  FOR I=Start_pt TO Stop_pt
2200  READ Lmt_flag$(I)
2210  OUTPUT @E5100;"INPUTRAC ",RVAL$(I)&","&klt_flag$(I)
2220  ! Set I/O output Points
2230  READ Lw$(I)
2240  Bin(I)=DVAL(Lw$(I),2)
2250  OUTPUT @E5100;"INPUTRAC ",RVAL$(I)&",1,"&Bin(I)
2260  ! Set I/O output info
2270  ELSE
2280  OUTPUT @E5100;"INPUTRAC ",RVAL$(I)&",1,0"
2290  END IF
2300  NEXT I
2310  !
2320  OUTPUT @E5100;"TRAR ";Start_pt,Stop_pt
2330  OUTPUT @E5100;"TAFMEMO"
2340  !
2350  RETURN
2360  !
2370  !  ********** MEASUREMENT **********
2380  !
2390  !
2400  Measurement:!
2410  !
2420  LOOP
2430  DISP "CONNECT DEVICE, and PRESS CONTINUE."
2440  PAUSE
2450  DISP "MEASURING"
2460  !
2470  OUTPUT @E5100:"UPDD OFF"
2480  OUTPUT @E5100:"CHAN1"
2490  OUTPUT @E5100:"UPDD ON"
2500  EXECUTE "SING"
2510  !
2520  WAIT Wait_check
2530  !
2540  OUTPUT @E5100:"UPDD OFF"
2550  OUTPUT @E5100:"CHAN2"
2560  OUTPUT @E5100:"UPDD ON"
2570  EXECUTE "SING"
2580  !
2590  GOSUB Analysis
2600  GOSUB Printing
2610  END LOOP
2620  !
2630  RETURN
2640  !
2650  !  **********************
2660  !
2670  Analysis:!
2680  EXECUTE "OUTPRES0?"
2690  Ci=READID(8,0)
2700  Fr=READID(8,1)
2710  RETURN
2720  !
2730  !
2740  Printing:!
2750  CLEAR SCREEN
2760  PRINT USING "25A,4D.8D,6A";"RESONANT FREQUENCY ",Fr/1.E+6:" (MHz)"
2770  PRINT USING "25A,5X,6D.D,6A";"RESONANT RESISTANCE ",Ci," (ohm)"
2780  RETURN
2790  !
2800  !
2810  !
2820  !  *************** CALIBRATION ***************
2830  !
2840  Pi_cal:!
2850  !
2860  GOSUB Declarations
2870  GOSUB Setup_pi
2880  GOSUB Ckt_const_pi
2890  GOSUB Modify_calkit
2900  GOSUB Meas_pi
2910  RETURN
2920  !
2930  Declarations:!
2940  INTEGER Yes_pi,No_pi,Ans_pi
2950  Yes_pi=1
2960  No_pi=0
2970  INTEGER Open_pi,Short_pi,Load_pi
2980  Open_pi=1
2990  Short_pi=2
3000  Load_pi=3
3010  Maxstd_pi=3
3020  INTEGER R0_pi,C0_pi,L0_pi,Fc_pi
RO_pi=1
C0_pi=2
LO_pi=3
Fc_pi=4
Maxle_pi=4
INTEGER Real_pi,Imag_pi
Real_pi=1
Imag_pi=2
File_pi$="PI_DATA"
INTEGER Nop_pi
REAL Const_pi(1:3,1:4)! (STD TYPE, L C R Fc)
!
RETURN

************
SET UP INSTRUMENT

************
Setup_pi:  !
OUTPUT @E5100;"DISARHIB"
RETURN
!
************
EQUIVALENT CIRCUIT CONSTANTS

************
Ckt_const_pi:  !
GOSUB Init_const_pi
Modify_pi=No_pi
LOOP
PRINT "CONSTANTS"
PRINT "\n"
PRINT "OPEN CO",Const_pi(Open_pi,C0_pi);"pF"
PRINT "SHORT RO",Const_pi(Short_pi,RO_pi);"Ohm"
PRINT "SHORT LO",Const_pi(Short_pi,LO_pi);"nH"
PRINT "LOAD RO",Const_pi(Load_pi,RO_pi);"Ohm"
PRINT "LOAD LO",Const_pi(Load_pi,LO_pi);"nH"
!
Ans_pi=No_pi
INPUT "MODIFY ? (Yes=1,No=0,DEFAULT=0)",Ans_pi
EXIT IF Ans_piYes_pi
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!
3690 ENTER @E5100;Z0_pi
3700 !
3710 Const_pi(Open_pi,C0_pi)=Const_pi(Open_pi,C0_pi)*Z0_pi
3720 Const_pi(Short_pi,C0_pi)=Const_pi(Short_pi,C0_pi)/Z0_pi
3730 Const_pi(Short_pi,B0_pi)=Const_pi(Short_pi,B0_pi)/Z0_pi
3740 Const_pi(Load_pi,C0_pi)=Const_pi(Load_pi,C0_pi)/Z0_pi
3750 Const_pi(Load_pi,B0_pi)=Const_pi(Load_pi,B0_pi)/Z0_pi
3760 !
3770 RETURN
3780 !
3790 Init_const_pi: !
3800 ON ERROR GOTO Cannot_open_pi
3810 !
3820 ! FROM BACKUP DATA FILE
3830 !
3840 ASSIGN @File_pi TO File_pi$
3850 ENTER @File_pi;Const_pi(*
3860 ASSIGN @File_pi TO *
3870 OFF ERROR
3880 GOTO Getdata_end_pi
3890 Cannot_open_pi: !
3900 OFF ERROR
3910 DISP "FILE NOT FOUND. USE CURRENT SETTING."
3920 File_notfound: !
3930 LOOP
3940 ON KEY 1 LABEL " E5100A DEFAULT" GOTO E5100a_data
3950 ON KEY 5 LABEL " 87510A DEFAULT" GOTO Hp87510a_data
3960 END LOOP
3970 !
3980 E5100a_data: !
3990 OUTPUT @E5100;"CALKCCP?"
4000 ENTER @E5100;Const_pi(Open_pi,C0_pi)
4010 OUTPUT @E5100;"CALKSRS?"
4020 ENTER @E5100;Const_pi(Short_pi,B0_pi)
4030 OUTPUT @E5100;"CALKSLS?"
4040 ENTER @E5100;Const_pi(Short_pi,L0_pi)
4050 OUTPUT @E5100;"CALKLLS?"
4060 ENTER @E5100;Const_pi(Load_pi,B0_pi)
4070 OUTPUT @E5100;"CALKCCP?"
4080 ENTER @E5100;Const_pi(Load_pi,L0_pi)
4090 RETURN
4100 !
4110 Hp87510a_data: !
4120 RETURN
4130 !
4140 !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
4150 ! RE-SAVE BACKUP DATA FILE
4160 !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
4170 Backup_pi: !
4180 Ans_pi=Yes_pi
4190 INPUT "SAVE THOSE DATA? (YES=1,NO=0,DEFAULT=1) " , Ans_pi
4200 IF Ans_pi=No_pi THEN RETURN
4210 !
4220 ON ERROR GOSUB Createfile_pi
4230 ASSIGN @File_pi TO File_pi$
4240 OFF ERROR
4250 !
4260 ON ERROR GOTO Create_err_pi
4270 OUTPUT @File_pi;Const_pi(*)
4280 OUTPUT @File_pi;END
4290 ASSIGN @File_pi TO *
4300 OFF ERROR
4310 GOTO Backup_end_pi
4320 Create_err_pi: !
4330 OFF ERROR
4340 PRINT "CANT CREATE BAKC-UP DATA FILE"

G-10 Option 022
Backup_end_pi: !
RETURN !
Createfile_pi: !
REAL IS 8 BYTES
CREATE BDAT File_pi3,Maxstd_pi*Maxele_pi,8
RETURN
!
************************
MODIFY CAL KIT
************************
Modify_calkit: !
IF Modify_pi THEN
PRINT "MODIFYING..."
OUTPUT @E5100;"CALKCFP";Const_pi(Open_pi,C0_pi)
OUTPUT @E5100;"CALKRS";Const_pi(Short_pi,RO_pi)
OUTPUT @E5100;"CALKLS";Const_pi(Short_pi,LO_pi)
OUTPUT @E5100;"CALKRS";Const_pi(Load_pi,RO_pi)
OUTPUT @E5100;"CALKLS";Const_pi(Load_pi,LO_pi)
END IF
DISP
RETURN
!
************************
MEASURE SEQUENCIAL
************************
Meas_pi: !
!
OUTPUT @E5100;"CALIS111"
Onkey_loop: !
LOOP
IF Open_done_pi THEN
ON KEY 1 LABEL " ((OPEN))" GOTO Meas_open_pi
ELSE
ON KEY 1 LABEL " OPEN " GOTO Meas_open_pi
END IF
IF Short_done_pi THEN
ON KEY 2 LABEL " ((SHORT))" GOTO Meas_short_pi
ELSE
ON KEY 2 LABEL " SHORT " GOTO Meas_short_pi
END IF
IF Load_done_pi THEN
ON KEY 3 LABEL " ((LOAD))" GOTO Meas_load_pi
ELSE
ON KEY 3 LABEL " LOAD " GOTO Meas_load_pi
END IF
ON KEY 5 LABEL " CAL BREAK" GOSUB Break_pi
!
All_done_pi=Open_done_pi*Short_done_pi*Load_done_pi
IF All_done_pi THEN
ON KEY 8 LABEL " DONE:3 TERM CAL" GOTO Meas_end_pi
DISP "PRESS 'DONE' IF FINISHED WITH CAL."
ELSE
OFF KEY 8
DISP "CONNECT STD THEN PRESS KEY TO MEASURE."
END IF
!
END LOOP

Meas_open_pi: !
OUTPUT @E5100;"CLASS11A;#OPC?"
ENTER @E5100;Opc
Open_done_pi=1
GOTO Onkey_loop
5000 !
5010  Meas_short_pi:  !
5020  OUTPUT @E5100;"CLASS11B;#GPC?"
5030  ENTER @E5100;OpC
5040  Short_done_pi=1
5050  GOTO Onkey_loop
5060  !
5070  Meas_load_pi:  !
5080  OUTPUT @E5100;"CLASS11C;#GPC?"
5090  ENTER @E5100;OpC
5100  Load_done_pi=1
5110  GOTO Onkey_loop
5120  !
5130  Break_pi:  !
5140  DISP "CAL BREAK."
5150  GOSUB Quit_pi
5160  STOP
5170  !
5180  Meas_end_pi:  !
5190  OFF KEY
5200  BEEP 500,.3
5210  OUTPUT @E5100;"SAV!"
5220  DISP ""
5230  RETURN
5240  !
5250  !******************************
5260  ! EXIT PROCEDURE
5270  !******************************
5280  Quit_pi:  !
5290  OFF KEY
5300  BEEP 500,.2
5310  RETURN
5320  !
5330  END
HP-IB Commands of Option 022

**BINSIZE\<<\text{value}\>>**

Specify the number of continuous data outputted to the I/O port by INPUTRACB. Specify the maximum value in the second parameter of INPUTRACB. (Option 022 only)

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>0 to 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>{\text{value}}</td>
</tr>
</tbody>
</table>
| Examples        | OUTPUT \#E5100;"BINSIZE 2"  
OUTPUT \#E5100;"BINSIZE?"  
ENTER \#E5100;A |

**INPUTRAC\<<\text{value1}\>,\langle value2\rangle,\langle value3\rangle**

Pass the phase value to trap at a measured point and specify whether data is outputted to the I/O port or not when the measured value reaches the phase value. The data to be outputted to the I/O port is specified by INPUTRACB. (No Query, Option 022 only)

| Parameter Description | \text{value1} : The measured point number  
\text{value2} : The trap phase value  
\text{value3} : I/O output ON/OFF |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>OUTPUT #E5100;&quot;INPUTRAC 10, 0, ON&quot;</td>
</tr>
</tbody>
</table>

**INPUTRACB\<<\text{value1}\>,\langle value2\rangle,\langle value3\rangle**

Pass the data outputted to the I/O port when the measured value of phase reaches the limit value specified by the INPUTRAC command. Multiple data up to 6 data can be outputted continuously to the I/O port. (No Query, Option 022 only)

| Parameter Description | \text{value1} : The measured point number  
\text{value2} : The order of output I/O data (1 to 6)  
\text{value3} : Data Query Response |
|-----------------------|-----------------------------------------|
| Examples              | OUTPUT \#E5100;"INPUTRACB 5, 1, ";DVAL("1010",2)  
OUTPUT \#E5100;"INPUTRACB 5, 2, ";DVAL("0100",2)  
OUTPUT \#E5100;"INPUTRACB 5, 3, ";DVAL("0000",2) |

If HP E5100A/B OPT. 022 is set up by the above commands, the data described in the following figure will be outputted to the I/O port when the measured phase reaches the target value at the measured point 5.
MEAS1PT? <\text{value}> 

Outputs measurement value at the point number specified by the parameter. When the trap function is turn on (TRAP ON), MEAS1PT waits to start a measurement until the phase value is in the condition specified by INFUTRAC command, and returns the query response.

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>1 to NOP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>{\text{value}}</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT $E5100;&quot;MEAS1PT? 10000000&quot;</td>
</tr>
<tr>
<td></td>
<td>OUTPUT $E5100;&quot;MEAS1PT?&quot;</td>
</tr>
<tr>
<td></td>
<td>ENTER $E5100;A</td>
</tr>
</tbody>
</table>

OUTPTRAC?\#\#<\text{value}> 

Outputs the phase value to trap at a measured point and the setting of I/O port at the point specified by the parameter. The phase value and the I/O port setting are specified by INFUTRAC command. (Query only, Option 022 only)

<table>
<thead>
<tr>
<th>Parameter Description</th>
<th>{\text{value}} : measurement point number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>{\text{value}} {0|1}</td>
</tr>
<tr>
<td></td>
<td>{\text{value}} : Phase value</td>
</tr>
<tr>
<td></td>
<td>{1|0} : I/O port setting (ON/OFF)</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT $E5100;&quot;OUTPTRAC? 10&quot;</td>
</tr>
<tr>
<td></td>
<td>ENTER $E5100;A,B</td>
</tr>
</tbody>
</table>
OUTPTRACB? <value1>,<value2>
Outputs the data outputted to the I/O port when the measured value of phase reaches the limit value. The data outputted to the I/O port is specified by INPUTRACB command. (Query only, Option 022 only)

| Parameter Description | <value1>: Measurement point number  
<value2>: Output port number (1 to 6) |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>{value}</td>
</tr>
<tr>
<td></td>
<td>{value}: Data</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT #E5100; &quot;INPUTRACB? 10,1&quot;</td>
</tr>
<tr>
<td></td>
<td>ENTER #E5100; A</td>
</tr>
</tbody>
</table>

TIMO{ON|OFF}[0|1]
Sets the time limit for the trapping on/off. (Option 022 only)

| Parameter Description | ON or 1: ON  
OFF or 0: OFF |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>{1</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT #E5100; &quot;TIMO ON&quot;</td>
</tr>
<tr>
<td></td>
<td>OUTPUT #E5100; &quot;TIMO?&quot;</td>
</tr>
<tr>
<td></td>
<td>ENTER #E5100; A</td>
</tr>
</tbody>
</table>

TOTIME<value>
Sets the limit time for the trapping. (Option 022 only)

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>0 to</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>{value} (ms)</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT #E5100; &quot;TOTIME 2000&quot;</td>
</tr>
<tr>
<td></td>
<td>OUTPUT #E5100; &quot;TOTIME?&quot;</td>
</tr>
<tr>
<td></td>
<td>ENTER #E5100; A</td>
</tr>
</tbody>
</table>

TRABGE
Sets the condition so that the measurement is advanced to the next point when a measurement value (phase value) is greater than or equal to the threshold value specified by the INPUTRAC command. (Option 022 only)
TRABGE

Query Response | {1|0}
---|---
Examples | OUTPUT @E5100; "TRABGE"

OUTPUT @E5100; "TRABGE?"
ENTER @E5100; A

TRABLE

Sets the condition so that the measurement is advanced to the next point when a measurement value (phase value) is less than or equal to the threshold value specified by the INPUTTRAC command. (Option 022 only)

Query Response | {1|0}
---|---
Examples | OUTPUT @E5100; "TRABLE"

OUTPUT @E5100; "TRABLE?"
ENTER @E5100; A

TRAFDATA

Set the trap function on the data trace. (Option 022 only)

Query Response | {0|1}
---|---
Examples | OUTPUT @E5100; "TRAFDATA"

OUTPUT @E5100; "TRAFDATA?"
ENTER @E5100; A

TRAFMEMO

Set the trap function on the sub trace. (Option 022 only)

Query Response | {0|1}
---|---
Examples | OUTPUT @E5100; "TRAFMEMO"

OUTPUT @E5100; "TRAFMEMO?"
ENTER @E5100; A
TRAP{l|OFF|ON|O|1|}
Set the trap function on/off. (Option 022 only)

<table>
<thead>
<tr>
<th>Parameter Description</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFF or 0</td>
<td>Set the trap function off.</td>
</tr>
<tr>
<td>ON or 1</td>
<td>Set the trap function on.</td>
</tr>
</tbody>
</table>

| Query Response | {0|1} |

| Examples | OUTPUT @E5100;"TRAP ON"

OUTPUT @E5100;"TRAP?"
ENTER @E5100:A

TRAR{<\text{value1}>,<\text{value2}>}
Set the start and the end points for the partial sweep for the trap function.
If the start point and the end point are not between 1 to the value specified by Number of Points, HP E5100A/B option 022 will perform a sweep within the possible range. Use this function to reserve wider sweep range so that you can change the sweep range by simply changing this setup. This way, you can save more measurement time than changing the whole sweep setup. (Option 022 only)

<table>
<thead>
<tr>
<th>Parameter Description</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;\text{value1}&gt;</td>
<td>The start point for the partial sweep</td>
</tr>
<tr>
<td>&lt;\text{value2}&gt;</td>
<td>The end point for the partial sweep</td>
</tr>
</tbody>
</table>

| Query Response | {value1}{value2} |

| Examples | OUTPUT @E5100;"TRAR 10, 20"

OUTPUT @E5100;"TRAR?"
ENTER @E5100:A,B

WRIT16
Set the bit width of the data outputted to the I/O port while performing the trap function to 16 bit. The port F is used. (Option 022 only)

| Query Response | {0|1} |

| Examples | OUTPUT @E5100;"WRIT16"

OUTPUT @E5100;"WRIT16?"
ENTER @E5100:A
WRIT24

Set the bit width of the data outputted to the I/O port while performing the trap function to 24 bit. The port H is used. (Option 022 only)

<table>
<thead>
<tr>
<th>Query Response</th>
<th>0:1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td></td>
</tr>
<tr>
<td>OUTPUT @E5100: &quot;WRIT24&quot;</td>
<td></td>
</tr>
</tbody>
</table>

OUTPUT @E5100: "WRIT24?"
ENTER @E5100:A
Option 023

Overview

This option enables you to measure the drive level characteristics of the resonant frequency (Fr) and the resonant impedance (Cl) of crystal resonators quickly and precisely.

To realize a quick measurement of resonant characteristics, this option adopts the Phase Tracking. The phase tracking will control the source signal to trace a specific resonant phase value (generally 0°) to calculate the frequency and the impedance at the phase. The drive level characteristic measurement, the function's most typical usage, realizes a very quick measurement because it measures only the resonant frequency and the resonant impedance as it sweeps the drive level. HP E5100A option 023 will display the result as described in Figure H-1 where X-axis representing drive level and Y-axis representing resonant frequency and resonant impedance. Instead of an absolute value, a relative value based on the resonant frequency at the minimum level or the nominal resonant frequency is used as the resonant frequency.

![Figure H-1. Measuring Drive Level Characteristics](image)

You can also measure the aging characteristics of the resonant frequency and the resonant impedance by setting the drive level fixed and performing the phase tracking. One application of this aging characteristic measurement may be that you can change the temperature around a resonator with time to measure characteristics of temperature. Instead of an absolute value, a
relative value based on the resonant frequency at the minimum level or the nominal resonant frequency is used as the resonant frequency.

![Diagram of |Z| and Δf over time](image)

**Figure H-2. The Aging Characteristic Measurement**

---

**Measuring Drive Level Characteristics using Phase Tracking Function**

You must use a program to use the phase tracking to measure drive level characteristics or aging characteristics (the temperature characteristic measurement). Sample programs are provided in the sample program disk. This chapter explains how to measure these characteristics using a sample program.

The following procedure shows how to set and measure the drive level characteristics using the phase tracking function. HP-IB command are shown in parentheses.

1. **Measurement Settings for Phase Tracking**
   - Select the ratio measurement (MEAS AR)
   - Select the impedance measurement mode (ANAMODE ZTRAN)
   - Select the power sweep (SWPT POWE)
   - Select the order base display (LISDOBASE)
   - Select Z-ΔF format (FMT MAGZDF)
2. Setting for Using π Network Test Fixture

The following settings are required when a π Network Test Fixture is used.

- Set Z0 (SETZ)
- Select Watt as the power unit (POWU WATT)
- Select using π network test fixture (PICIRC ON)
- Set CI value (CIVAL)

In the sample program, Characteristic impedance is set at 12.5Ω to support a standard π test fixture.

3. Settings for the Drive Level Measurement

The following settings are required for measuring the drive level characteristics.

- Make a drive level table and input it as the sweep table. (INFUSTIM)

The result will be similar to Figure H-3 because both the up sweep and the down sweep measurements are performed at the same time for a drive level.

![Graph of |Z| - Δf vs Drive Level](image)

**Figure H-3. An Example of the Measurement Result**

**Note**

Set enough power (For example, SPAN = 0 dBm, CENTER = 0 dBm) and set the CW frequency as you measure DUT when you execute calibration measurement.

If the calibration is measured under the low power level, measurement results are not stable.
4. Settings Parameters for Tracking Function
The following process is required for the tracking function.

- Set the start frequency for tracking (PFFR, unit: Hz)
- Set the range from the start frequency for tracking to search the resonant point $F_r$ (PFFRSE, unit: Hz)
- Set the range value for a phase (PFRRGLMT, unit: deg.)
- Set the measurement abort ON/OFF when the phase is over the limit (PFARMT)
- Define the phase at the resonant point. (PFRRPHS)
- Set the number of tracking for each measurement point (PFREPN)

5. Searching for Resonant Point
HP E5100A/B searches the range specified by PFFRSE command for the resonant point, which is defined by PFRRPHS. When the resonant point is measured, HP E5100A/B automatically sets the test signal level to the same level as START and uses the calibration data at the start point. Then Get $F_r$, CI, and the tracking parameter at the resonant point. (SRECHFR?)

6. Tracking Measurement
To start the tracking, the following procedure is required.

- Set the phase tracking ON (PFRRPH)
- Set the reference frequency (PFFR)
- Set the tracking parameter given by the SRECHFR? query response (PFPARA)
- Check the status of phase tracking (PFSTAT?)

7. The Measurement Result
This program gives you the following result.

Figure G-2 describes the result screen. The upper half of the screen shows the measurement and the lower half shows the resonant frequency at the minimum drive level and resonant frequencies and resonant impedance of typical drive levels (in [W]) are displayed.

Values along the horizontal axis on the screen (drive levels) are displayed in the unit specified by the marker. The data trace indicates resonant impedance and the sub trace indicates resonant frequency ($\Delta f$).

When HP E5100A option 023 displays a resonant frequency ($\Delta f$), it displays the value relative to the reference frequency specified by PFFR command.
Figure H-4. A Displayed Result

Sample Program List

10 CLEAR SCREEN
20 ! MAIN
30
40 GOSUB Constants
50 GOSUB Setting
60 GOSUB Cal_setting
70 GOSUB Pi_cal
80 CLEAR SCREEN
90 GOSUB Set_watt
100 GOSUB Set_watt_list
110 GOSUB Set_phase_track
120 GOSUB Start_loop
130 STOP
140 !
150 ! DECLARE CONSTANTS
160 Constants: !
170 Z0=12.5
180 Ci=24
190 W_min=.001 !uW
200 W_max=1000 !uW
210 Ifbw=1000
220 Tgt_phase=0
230 Track_num=2
240 N_hop=100
250 Tgt_limit=8
260 !
270 Src_rng=2000 !ppm
280 Src_node=1
290 Src_wait=0
300 Fr_trg=6.6E+7
310 RETURN
320 !
! INSTRUMENT SETUP ****************************************************

340 Setting: !
350 ASSIGN @E5100 TO 800
360 OUTPUT @E5100;"CHAN1;MEAS AR;ANAMODE ZTRAN"
370 OUTPUT @E5100;"HOLD"
380 OUTPUT @E5100;"COUC OFF"
390 OUTPUT @E5100;"IFSW ";ifsw
400 OUTPUT @E5100;"POIN ";P_nop*2
410 OUTPUT @E5100;"FMT MAGZDP"
420 OUTPUT @E5100;"MULC OFF;SPLD ON;DISANIH"
430 RETURN
440 !
450 Cal_setting:!!
460 OUTPUT @E5100;"SWFT LINF"
470 OUTPUT @E5100;"CENT ";Fr_trg
480 OUTPUT @E5100;"SPAN ";Srchnrg*1.E-6*Fr_trg
490 OUTPUT @E5100;"POWE ";0
500 RETURN
510 !
520 Pi_cal: !
530 PRINT TABXY(0,11);"PERFORM PI-CAL"
540 INPUT "CONNECT OPEN, THEN PRESS ENTER",Tmp$
550 OUTPUT @E5100;"CALI ONEP;CLASS11A?"
560 ENTER @E5100;Tmp
570 INPUT "CONNECT SHORT, THEN PRESS ENTER",Tmp$
580 OUTPUT @E5100;"CLASS11B?"
590 ENTER @E5100;Tmp
600 INPUT "CONNECT LOAD, THEN PRESS ENTER",Tmp$
610 OUTPUT @E5100;"CLASS11C?"
620 ENTER @E5100;Tmp
630 OUTPUT @E5100;"SAVI?"
640 ENTER @E5100;Tmp
650 INPUT "CONNECT DEVICE, THEN PRESS ENTER",Tmp$
660 RETURN
670 !
680 Set_watt: !
690 OUTPUT @E5100;"SWPT POWE"
700 OUTPUT @E5100;"LISDOBAS;SWED UP"
710 OUTPUT @E5100;"ATTW .002"
720 OUTPUT @E5100;"SETZ ";20
730 OUTPUT @E5100;"POWN WATT;PICIRC ON"
740 OUTPUT @E5100;"CIVAL ";Ci
750 RETURN
760 !
770 ! SETTING POWER LIST (WATT) ******************************************
780 Set_watt_list: !
790 ALLOCATE Pwr(1:2*P_nop)
800 P_min=W_min*1.E-6
810 P_max=W_max*1.E-6
820 OUTPUT @E5100;"STAS ";P_min,P_max
830 P_step=(P_max-P_min)/(P_nop-1)
840 K=2*P_nop
850 FOR I=1 TO P_nop
860 P=P_min+P_step*(I-1)
870 Pwr(I)=P
880 Pwr(K)=P
890 K=K-1
900 NEXT I
910 OUTPUT @E5100;"STIM ";Pwr(*)
920 RETURN
930 !
940 ! PHASE TRACKING SETTING ***********************************************
950 Set_phase_trk: !
960 OUTPUT @E5100;"FTRR ";Fr_trg!
970 OUTPUT @E5100;"FTRSR ";Srchnrg*Fr_trg*1.E-6
980 OUTPUT @E5100;"FTRSLMT ";Tgt_limit

H-6 Option 023
990  OUTPUT @E5100:"PTABORT ON"
1000  OUTPUT @E5100:"PTTGRPHS ":Tgt_phase
1010  OUTPUT @E5100:"PTEFPW ":Track_num
1020  OUTPUT @E5100:"PTRACK ON"! TRACKING MODE ON
1030  RETURN
1040  !
1050  ! SEARCH "ACTUAL" FR **********************************************
1060  Start_loop:  
1070  LOOP
1080  BEEP
1090  OUTPUT @E5100:"PTFR ":Fr_trg!
1100  OUTPUT @E5100:"SRCHFR? ":Srch_mode,Srch_wait
1110  ENTER @E5100:Srcd_trd,Fr,Ci,Ft,param
1120  IF Srd_trd=1 THEN
1130  PRINT TABXY(0,10),"Fr Search FAILED  
1140  BEEP
1150  BEEP
1160  GOTO Prompt
1170  END IF
1180  !
1190  ! DLD CHARACTERISTICS MEASUREMENT ******************************
1200  !
1210  OUTPUT @E5100:"PTFR ":Srched_fr
1220  OUTPUT @E5100:"PTPARA ":Pt_param
1230  OUTPUT @E5100:"SING?"
1240  ENTER @E5100;Dummy
1250  !
1260  OUTPUT @E5100:"PTSTAT?"
1270  ENTER @E5100;Result
1280  IF Result=0 THEN
1290  BEEP
1300  BEEP
1310  PRINT TABXY(0,10),"Phase Track FAILED"
1320  GOTO Prompt
1330  END IF
1340  !
1350  GOSUB Analysis
1360  !
1370  GOSUB Printing
1380  !
1390  Prompt:  
1400  INPUT "CONNECT NEXT DEVICE and Press Continue.",Tmp$ 
1410  !
1420  END LOOP
1430  !
1440  Analysis:  ! DATA ANALYSIS
1450  OUTPUT @E5100:"ANARFULL"
1460  OUTPUT @E5100:"ANAGMEMO"
1470  OUTPUT @E5100:"OUTPMINMAX?"
1480  ENTER @E5100;Min_df,Minf_p,Max_df,Maxdf_p
1490  OUTPUT @E5100:"ANADATA"
1500  OUTPUT @E5100:"OUTPMINMAX?"
1510  ENTER @E5100;Min_z,Min_zp,Max_z,Max_zp
1520  RETURN
1530  !
1540  Printing:  ! PRINTING ROUTINE
1550  PRINT TABXY(0,1)
1560  PRINT USING "27A,5X,3D,9D,X,5A";"RESONANT FREQ at MIN power",Srched_fr*
1570  1.E-6, "(Hz)"
1590  [MIN], Min_df, "(Hz)", [MAX], Max_df, "(Hz)"
1600  PRINT USING "X,10A,2X,5A,2X,3Z,2D,X,5A,2X,3Z,2D,X,5A";"IMPE DANCE: ",
1610  [MIN], Min_z, "(ohm)", [MAX], Max_z, "(ohm)"
1620  !
1630  PRINT TABXY(0,6)
1640  PRINT USING "5A,X,4A,4X,10A,X,5A,2X,20A,X,4A";"POWER", "(uW)", "RESISTANCE"
E", "(ohm)" , "FREQUENCY DIFFERENCE" , "(Hz)"
1620 FOR I=1 TO 3
1630 Point=10^((I-1)
1640 OUTPUT #E5100; "OUTPFORM? " : Point
1650 ENTER #E5100; Z, Df
1660 PRINT USING "X,4D.4D,11X,3D.2D,12X,4D.3D" : Pwr(Point)*1.E+6, Z, Df
1670 NEXT I
1680 PRINT TABXY(0, 10), " 
1690 !
1700 RETURN
1710 !
1720 END
Measuring Aging Characteristics

You can measure the aging characteristics by setting the drive level fixed and performing the phase tracking. You can also read out the time value using the marker time mode. Basically, the measurement setting is almost same as that of the drive level characteristics measurement except for the signal level is constant.

Compensation of Sweep Time for Aging Characteristics

The actual measurement time contents not only the sweep time but also the overhead time to process signal during measurement. PTFOVHD adds the overhead time to the marker time value as to compensate the measurement time value.

The following list shows how to use PTFOVHD command.

Sub-routine for Measuring Aging Characteristics

```
770 Meas_time: !
780    OUTPUT @E5100;'"PTrack ON"
790    OUTPUT @E5100;'"SWETAUTO"
800    Ti=TIMEDATE
810    OUTPUT @E5100;'"SING?"
820    ENTER @E5100;Dummy
830    Meas_time=TIMEDATE-T1
840    OUTPUT @E5100;'"SWET?"
850    ENTER @E5100;Anal_sweep_t
860    Pt_ovhd=((Meas_time-.005)/Track_num-Anal_sweep_t)/Nop
870    OUTPUT @E5100;'"PTFOVHD";Pt_ovhd
880    OUTPUT @E5100;'"MARKTIME ON"
890    RETURN
```

Notes on the Phase Tracking

When the Phase Tracking Fails

Followings are problems and solutions caused during the phase tracking:

- The resonator cannot keep up with a sweep because there are not enough drive level measurement points.

  Solution: Increase the number of measurement points and repeat a measurement.

  Increase the number of tracking at each point (PTREPN)

- The actual resonant frequency is out of the sweep span.

  Solution: Check the resonant frequency and repeat a measurement.

- The resonator cannot keep up with a sweep because it is too fast.

  Solution: Set the sweep time slower on the front panel and repeat a measurement.

  Increase the number of tracking at each point (PTREPN)

- A tangent response is observed during a sweep.

  Solution: Set the attenuator switching time slower and repeat a measurement.

- HP E5100A can not find the resonance point (F_r)

  Solution: Change the search mode of SRCHFR? to 3 or 4.
Increase the number of parameter of PTFRSR.

The above list shows the possible causes of problems. You may want to investigate the cause by setting the display to “Z-Phase” to check at which point tracking exceeded the range and failed.

Limitations on the Phase Tracking

The following is a list of limitations on a measurement when the phase tracking is ON (PTRACK ON).

- The time specified by the SWEEP TIME and the actual sweep time differ.

---

### HP-IB Commands for Option 023

**FMT\-MAGZDF**

Sets the format as Z-Δ format for tracking measurement. (Option 023 only)

Examples

```
OUTPUT #E5100; "FMT MAGZDF"
```

**PTABORT\{ON|OFF\}**

Sets the measurement abort ON/OFF when the phase value is over the limit during the tracking. (Option 023 only)

<table>
<thead>
<tr>
<th>Parameter Description</th>
<th>Query Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON : Abort a measurement when the tracking is failed</td>
<td>{1</td>
</tr>
<tr>
<td>OFF : Continue a measurement even the tracking is failed</td>
<td></td>
</tr>
</tbody>
</table>

Examples

```
OUTPUT #E5100; "PTABORT ON"
```

```
OUTPUT #E5100; "PTABORT?"
ENTER #E5100; A
```

**PTFOVHD\<value>**

Input the parameters required to display the time base at the temperature characteristic measurement (the aging measurement). Refer to “Compensation of Sweep Time for Aging Characteristics” for inputting. (Option 023 only)

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>Query Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 1 sec</td>
<td>{value}</td>
</tr>
</tbody>
</table>
PTFR\(<value>\)
Input the start frequency for tracking. (Option 023 only)

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>10 kHz to 300 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>(&lt;value&gt;)</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT &amp;E5100;&quot;PTFR 199 kHz&quot;</td>
</tr>
<tr>
<td></td>
<td>OUTPUT &amp;E5100;&quot;PTFR?&quot;</td>
</tr>
<tr>
<td></td>
<td>ENTER &amp;E5100;A</td>
</tr>
</tbody>
</table>

PTFRSR\(<value>\)
Sets the range for searching for $F_r$. (Option 023 only)

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>0 Hz to 100 kHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>(&lt;value&gt;) (Hz)</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT &amp;E5100;&quot;PTFRSR 5000&quot;</td>
</tr>
<tr>
<td></td>
<td>OUTPUT &amp;E5100;&quot;PTFRSR?&quot;</td>
</tr>
<tr>
<td></td>
<td>ENTER &amp;E5100;A</td>
</tr>
</tbody>
</table>

PTPARA\(<value>\)
Sets the tracking parameter. The tracking parameter is given by the SRCHFR? command query. (Option 023 only)

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>-1000 to 1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>(&lt;value&gt;)</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPUT &amp;E5100;&quot;SRCHFR?&quot;</td>
</tr>
<tr>
<td></td>
<td>ENTER &amp;E5100;Fr,Ci,Param</td>
</tr>
<tr>
<td></td>
<td>OUTPUT &amp;E5100;&quot;PTPARA&quot;;Param</td>
</tr>
<tr>
<td></td>
<td>OUTPUT &amp;E5100;&quot;PTPARA?&quot;</td>
</tr>
<tr>
<td></td>
<td>ENTER &amp;E5100;A</td>
</tr>
</tbody>
</table>

PTRACK\(<OFF|ON>\)
Set the phase tracking ON/OFF. (Option 023 only)
PTTRACK\{OFF|ON\}

Parameter Description

OFF : The phase tracking is OFF
ON : The phase tracking is ON

Query Response  
{0|1}

Examples

OUTPUT \$E5100;"PTTRACK ON"

OUTPUT \$E5100;"PTTRACK?"
ENTER \$E5100;A

PTREPN\{value\}

Sets the number of tracking on each point. (Option 023 only)

Parameter Range

1 to 1,000,000

Query Response

{\{value\}

Examples

OUTPUT \$E5100;"PTREPN 5"

OUTPUT \$E5100;"PTREPN?"
ENTER \$E5100;A

PTSTAT?

Returns the status of the phase tracking. (Query only, Option 023 only)

Query Response

{0|1}

0 : Error encountered during phase tracking
1 : The phase tracking was successful.

Examples

OUTPUT \$E5100;"PTSTAT?"
ENTER \$E5100;A

PTTRGLMT\{value\}

Defines the range value for a phase, which is used for the phase tracking. (Option 023 only)

Parameter Range

0° to 180°

Query Response

{\{value\}

Examples

OUTPUT \$E5100;"PTTRGLMT 8"

OUTPUT \$E5100;"PTTRGLMT?"
ENTER \$E5100;A
PTTRGPHS $\{ value \}$
Defines the phase at the resonant point. (Option 023 only)

<table>
<thead>
<tr>
<th>Parameter Range</th>
<th>(-180^\circ ) to (180^\circ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>{value}</td>
</tr>
</tbody>
</table>
| Examples        | OUTPUT \$E5100;"PTTRGPHS 0"
                 | OUTPUT \$E5100;"PTTRGPHS?"
                 | ENTER \$E5100;A |

SRCHFR? $\{1|2|3|4\},<value>$
Search for the resonance frequency \(F_r\). (Query only, Option 023 only)

<table>
<thead>
<tr>
<th>Parameter Description</th>
<th>Search mode:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1) : Rough (High speed)</td>
</tr>
<tr>
<td></td>
<td>(2) : Normal</td>
</tr>
<tr>
<td></td>
<td>(3) : Fine</td>
</tr>
<tr>
<td></td>
<td>(4) : Finer (Slow)</td>
</tr>
<tr>
<td></td>
<td>(&lt;value&gt;) : Waiting time during searching (sec)</td>
</tr>
<tr>
<td>Query Response</td>
<td>{value1}, {value2},{value3}</td>
</tr>
<tr>
<td></td>
<td>{value1} : (F_r) [Hz]</td>
</tr>
<tr>
<td></td>
<td>{value2} : (C_l) [\Omega]</td>
</tr>
<tr>
<td></td>
<td>{value3} : Tracking parameter</td>
</tr>
</tbody>
</table>
| Examples              | OUTPUT \$E5100;"SRCHFR? 2,0"
                 | ENTER \$E5100;A,B,C             |
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