Agilent 4294A Precision Impedance Analyzer

Programming Manual

Seventh Edition

FIRMWARE REVISIONS
This manual applies directly to instruments that have the firmware revision 1.11.
For additional information about firmware revisions, see Appendix A.

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Notices

The information contained in this document is subject to change without notice.

Agilent Technologies Japan, Ltd.

Kobe Instrument Division

1-3-2, Murotani, Nishi-Ku, Kobe-shi, Hyogo, 651-2241 Japan

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Sample Program Disk

A sample program disk (Agilent Part Number 04294-18020) is supplied with this manual. The disk contains the sample programs listed in this manual.

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Contents

1 To make effective use of this manual

This chapter describes the contents and the use of this manual and makes references to various other manuals.

Contents of this manual

This manual is a guide to writing BASIC programs for the Agilent 4294A precision impedance analyzer.

Chapter 1 , “To make effective use of this manual.”

This chapter describes the contents and the use of this manual and makes references to various other manuals.

Chapter 2 , “Remote Control, Overview.”

This chapter describes how to set up a GPIB remote control system and the basic use of GPIB commands.

Chapter 3 , “Setting Measurement Conditions.”

This chapter describes how to set measurement conditions.

Chapter 4 , “Preparing For Accurate Measurement.”

This chapter describes how to apply adapter setting, user calibration, fixture compensation, and port extension compensation.

Chapter 5 , “Starting a Measurement (Trigger) and Detecting the Completion of a Measurement (End of Sweeps).”

This chapter describes how to generate a trigger to start a measurement and how to detect the completion of a measurement.

Chapter 6 , “Reading/Writing Measurement Data.”

This chapter describes how to read and write measurement data and how to obtain level monitoring and limit test results.

Chapter 7 , “Processing Measurement Results.”

This chapter describes how to process measurement results using the marker function, the equivalent circuit analysis function, the trace bandwidth analysis function, and analysis commands.

Chapter 8 , “Saving/Recalling a Measurement Result/Measurement Setup.”

This chapter describes how to save/recall a measurement result, measurement setup, and other data into/from a file.

Chapter 9 , “Communication with External Equipment (Using the I/O Ports).”

This chapter describes how to use the 8-bit I/O port and the 24-bit I/O port of the Agilent 4294A to communicate with external equipment (for example, handlers in production lines).

Chapter 10 , “Handling Errors.”

This chapter describes how to handle errors that may occur in the Agilent 4294A while running a program.

Chapter 11 , “Using HP Instrument BASIC.”

This chapter gives an overview of HP Instrument BASIC and explains how to use the keyboard. Read this chapter before using the HP Instrument BASIC program installed in the Agilent 4294A.

Chapter 12 , “Using LAN.”

This chapter describes LAN (Local Area Network)-based file transfer and remote control.

Chapter 13 , “Application Sample Programs.”

This chapter provides sample measurements (sample programs).

Chapter 14 , “Using Printer.”

This chapter describes the procedures for printing out your measurement results with a printer.

Chapter 15 , “Setting the Display (LCD).”

This chapter describes the procedures for setting the displayed colors of traces and characters as well as the brightness of the LCD display.

Chapter 16 , “GPIB Command Reference.”

This chapter is the GPIB command reference for the Agilent 4294A. The IEEE common commands, the 4294A commands, and the Instrument BASIC control commands are described in alphabetical order.

Appendix A , “Manual Changes.”

This appendix contains the information required to adapt this manual to earlier versions or configurations of the Agilent 4294A than the current printing date of this manual. The information in this manual applies directly to a 4294A model that has a serial number prefix listed on the title page of this manual.

Appendix B , “Status Reporting System.”

This appendix describes the status reporting system of the Agilent 4294A.

Appendix C , “GPIB command table.”

This appendix provides the Agilent 4294A GPIB command list sorted according to function.

Appendix D , “Error messages.”

The Agilent 4294A provides error messages to indicate its operating status. This appendix describes the error messages of the the 4294A.

How To Use This Manual

This manual may be used as follows depending on how familiar you are with writing BASIC programs.

1. If you have experience in writing programs for the GPIB system, pick sample programs suitable for your application out of those given in this manual.
2. If you have no experience in writing programs for GPIB equipment, it is best for you to read this manual thoroughly from the beginning. In particular, Chapter 2 , “Remote Control, Overview,” describes entry-level programming skills.
3. Sample programs can be useful as “programming hints” for some GPIB commands. For descriptions of GPIB commands in detail, see Chapter 16 , “GPIB Command Reference.”
4. You can also use HP Instrument BASIC functions with the Agilent 4294A. Chapter 11 , “Using HP Instrument BASIC,” describes how to use Instrument BASIC. Read this chapter if you are a novice in Instrument BASIC.

Sample programs

The HP BASIC sample programs given in this manual are stored in text form in the sample program disk (part number 04294-18010) attached to this manual. These sample programs are in DOS format.

How to load a sample program

To use a sample program, load it into HP BASIC by use of the GET command. The example below shows a command in which the sample program setup.bas is loaded.

GET "setup.bas"

Other manuals attached to this unit

Read the manuals below when using the Agilent 4294A.

Operation Manual (part number: 04294-900x0)

Most basic information necessary for using the Agilent 4294A is described in this manual. It includes installation procedures, explanations of measurement operations, example measurements, performances (specifications), and information on options and accessories. For GPIB programming, see this manual together with “HP Instrument BASIC User's Handbook”.

HP Instrument BASIC User’s Handbook (part number: E2083-90005)

This manual explains how to use HP Instrument BASIC by giving sample programs and general suggestions, and a description of every HP Instrument BASIC command. This manual has three parts: “HP Instrument BASIC Programming Technique,” “HP Instrument BASIC Interface Technique,” and “HP Instrument BASIC Language Reference.”

Service Manual (option 0BW only) (part number: 04294-901x0)

This manual describes how to adjust and repair the Agilent 4294A and how to carry out performance tests. This manual will be attached if you choose option 0BW.

2 Remote Control, Overview

This chapter describes how to set up a GPIB remote control system and the basic use of GPIB commands.

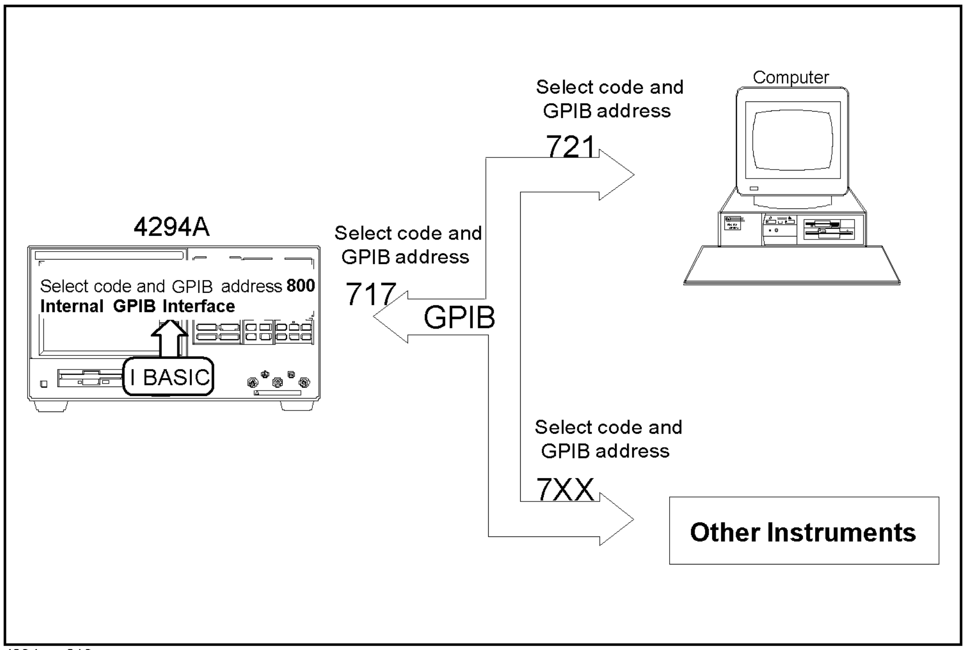
GPIB Remote Control System, Overview

This section describes the configuration of the GPIB remote control system.

System configuration

Connect the Agilent 4294A and an external controller (computer) with a GPIB cable. Figure 2-1 shows an overview of the configuration of an GPIB remote control system.

Figure 2-1 **Configuration of GPIB remote control system**



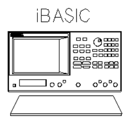
4294ape013

What is GPIB?

GPIB (General Purpose Interface Bus) is one of the interface standards for connecting a computer and peripheral devices and complies with IEEE 488.1, IEC-625, IEEE 488.2 and JIS-C1901, which are worldwide standards. Using the GPIB interface allows you to control the Agilent 4294A from an external computer. The computer sends commands and instructions through the GPIB to the 4294A and receives data sent from the 4294A.

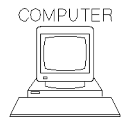
Necessary equipment

1. The Agilent 4294A precision impedance analyzer and accessories necessary for measuring test samples
2. GPIB system controller



You can use the Agilent 4294A as a system controller. To use HP Instrument BASIC without an external computer, set the 4294A to system controller mode. For details, see Chapter 11 , “Using HP Instrument BASIC.”

or



You can use an external computer as a system controller. This requires an HP Vectra PC (or an IBM PC compatible) mounted with a GPIB interface such as HP 82341D or the HP 9000 series 700 mounted with a GPIB interface such as HP E2071D. In either case, software such as HP BASIC for Windows or the like is required for controlling this unit through the GPIB. The HP 9000 series 300 may also be used, but if this computer is used several peripheral devices are also required.

To use an external computer as a system controller:

a. set the 4294A in addressable-only mode.

   Press **[Local] - ADDRESSABLE ONLY**.

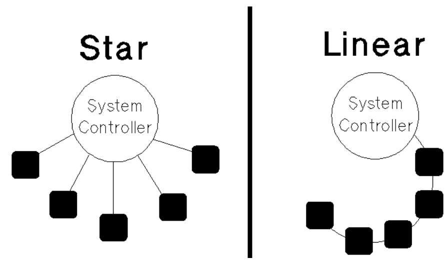
b. Set the GPIB's address to 17.

   Press **[Local] - ADDRESS HPIB: - [1] - [7] - [×1]**.

3. Peripheral devices compliant with the intended use and various additional devices
4. GPIB cables (10833A/B/C/D) used for connecting the computer, the Agilent 4294A, and peripheral devices

The system size you can set up

- You can connect up to 15 devices with a single GPIB system.
- The length of a cable that connects one device with another must not be more than 4 meters. The total length of connection cables used in a single GPIB system should not be more than 2 meters times the number of devices (counting the controller as one device). You cannot set up a system makeup in which the total cable length exceeds 20 meters.
- Limit the number of connectors attached to a single device to four. Attaching five or more connectors exerts excessive force on them and may cause failure.
- Star, linear, and combinational cable configurations are allowed. You must not use a loop configuration.



Controller

A device that can permit talking (outputting data) and listening (receiving data) is called a controller, as opposed to a GPIB device.

The active controller, if connected to two or more controllers, can control other devices on the bus. Only one controller among multiple controllers can be active at a given time. The active controller can pass control to another controller by use of the PASS CONTROL command.

When the power of the system controller is turned on, it becomes the active controller. When another controller is active, the system controller can execute the "ABORT <select code>" command at any time so that it becomes the active controller.

Device selector

GPIB device control is carried out by receiving commands from the active controller. The active controller can operate the device selector to select a target device.

HP Instrument BASIC is connected to the Agilent 4294A by its interface installed in the 4294A. The interface select code of the built-in interface is set to 8 so as to distinguish it from the external select code 7.

Since this unit alone is connected to the built-in interface, any address from "00" through "30" may be used to specify the analyzer used with the internal connection from Instrument BASIC. In this unit, address "00" is used so that the device selector turns to "800".

Sending GPIB Command Messages

GPIB commands

GPIB commands can be grouped into two classes:

IEEE common commands

Commands defined by IEEE488.2

Agilent 4294A commands

Commands specific to the Agilent 4294A. These include all of the measurement functions and some of the general-purpose functions.

Message syntax

Descriptions of the syntax used in sending program messages from the GPIB are given below. A program message is sent from an external controller to a measuring instrument. The content of a program message is composed of a series of commands that are properly set off and terminated by delimiters and a message terminator.

Uppercase letters and lowercase letters

The difference between uppercase and lowercase letters is disregarded.

Program message terminator

A program message must terminate with one of three program message terminators: <new line>, <^END>, or <new line><^END>. <^END> means that EOI turns to the active level on the GPIB interface as soon as the immediately preceding data byte is sent out. For example, the OUTPUT statement of HP BASIC automatically sends a message terminator along with the last data byte.

Parameters

A space (ASCII code 32) must be put between the last command mnemonic and the first parameter.

To send two or more parameters by a single command, each parameter must be delimited by a comma (,).

A message including two or more commands

To send two or more commands within a single message, each command must be delimited by a semicolon (;). An example is given below in which the “PRES” command and the “*CLS” command are sent within a single message.

```
OUTPUT 717;"PRES;*CLS"
```

The Basics of Writing/Running Programs

An easy way to write a program

The following describes a procedure for writing an Instrument BASIC program as an example of simple programming. For more on how to use Instrument BASIC, see Chapter 11 , “Using HP Instrument BASIC.”

This example sets the Agilent 4294A as shown below.

ACTIVE TRACE block	Trace A (default setting)
MEASUREMENT block	Cs-Rs Linear Y-axis format (default setting) Display scale: automatic
SWEEP block	Center frequency: 70 MHz Span frequency: 100 kHz

In this example, the program can be input by only using the keys located on the front panel without having to touch the keyboard. You can also enter the program with the keyboard.

Step 1. Turn on the Agilent 4294A.

Step 2. Press the following key and soft keys.

[System] - **IBASIC** - **Edit**

The system goes into system edit mode. The cursor appears on line 10.

```
10 _
```

Step 3. Press the following soft keys.

ASSIGN @Hp4294

The command automatically appears at the cursor position.

```
10 ASSIGN @Hp4294 TO 800_
```

Step 4. Press the entry following key.

[×1]

The command is entered into the System, and the cursor moves to the next line.

```
10 ASSIGN @Hp4294 TO 800

20 _
```

Step 5. Press the following soft keys.

OUTPUT @Hp4294

Character strings appear as shown below.

```
10 ASSIGN @Hp4294 TO 800

20 OUTPUT @Hp4294;""
```

Step 6. Press the following instrument state key to enter the preset command.

[Preset]

The GPIB command ";PRES" to be used for presetting the equipment automatically appears at the cursor position.

```
10 ASSIGN @Hp4294 TO 800
20 OUTPUT @Hp4294;";PRES"
```

Next, press**[×1]**.

NOTE To send two or more commands within a single OUTPUT statement, you need to delimit the commands by a semicolon. In entering GPIB commands with the control panel keys, a semicolon is automatically placed before each command.

Step 7. Press the following soft keys to set the measurement parameters Cs-Rs.

OUTPUT @Hp4294 - **[Meas]** - **Cs-Rs**

Program code is generated as shown below.

```
10 ASSIGN @Hp4294 TO 800
20 OUTPUT @Hp4294;";PRES "
30 OUTPUT @Hp4294;";MEAS CSR"
```

Next, press **[×1]**.

Step 8. Press the following keys and soft keys to set a center frequency and a span frequency.

[System] - **IBASIC** - **OUTPUT @Hp4294** - **[Cent]** - **[7]** - **[0]** - **[M/µ]** - **[Span]** - **[1]** - **[0]** - **[0]** - **[k/m]** - **[×1]**

```
10 ASSIGN @Hp4294 TO 800
20 OUTPUT @Hp4294;";PRES"
30 OUTPUT @Hp4294;";MEAS CSR"
40 OUTPUT @Hp4294;";CENT 70E6;SPAN 100E3"
50 _
```

Step 9. Press the following keys and soft keys to achieve automatic scaling.

[System] - **IBASIC** - **OUTPUT @Hp4294** - **[Scale Ref]** - **AUTO SCALE** - **[×1]**

```
10 ASSIGN @Hp4294 TO 800
20 OUTPUT @Hp4294;";PRES"
30 OUTPUT @Hp4294;";MEAS CSR"
40 OUTPUT @Hp4294;";CENT 70E6;SPAN 100E3"
50 OUTPUT @Hp4294;";AUTO"
60 _
```

Step 10. Enter the END command to quit the program.

[System] - **IBASIC** - **END** - **[×1]**

```
10 ASSIGN @Hp4294 TO 800

20 OUTPUT @Hp4294;";PRES"

30 OUTPUT @Hp4294;";MEAS CSR"

40 OUTPUT @Hp4294;";CENT 70E6;SPAN 100E3"

50 OUTPUT @Hp4294;";AUTO"

60 END

70 _
```

Step 11. Press the following soft key to exit edit mode.

done

The measurement screen returns.

NOTE In certain cases, some operations to handle user calibration or other tasks cannot be properly programmed.

Running the program

Press the following key and soft keys to run the program.

[System] - **IBASIC** - **Run**

The System runs the program. You can also run the program by typing as below.

RUN **[Enter]**

Saving and Reading the Program

Saving the program generated

A simple saving procedure is given here. For details see “Saving a Program (SAVE)” on page 145.

Step 1. First, connect the keyboard.

Step 2. Press the key and soft keys as given below to switch the screen.

[Display] - more 1/2 - ALLOCATION - ALL BASIC

Step 3. Select a storage unit in which to save the program.

[System] - IBASIC - more 1/3 - MASS STORE[]

Step 4. Pressing [INTERNAL] selects a floppy disk, [MEMORY] selects a volatile memory disk (RAM disk), or [FLASH MEMORY] selects a nonvolatile memory disk (flash memory disk) for the storage unit.

Step 5. Press the key and soft keys as given below.

[System] - IBASIC - more 1/3 - SAVE

Then, the screen will look like as shown below.

SAVE ""

Step 6. Enter an optional file name with the keyboard. If a file having the same name is present in the storage unit, the SAVE command cannot save the file. Either give another file name or use the RE-SAVE command to overwrite the existing file.

Reading the saved file

Step 1. Press the key and soft keys as given below to switch the screen.

[Display] - more 1/2 - ALLOCATION - ALL BASIC

Step 2. Select the storage unit on which a file in view is present.

[System] - IBASIC - more 1/3 - MASS STORE[]

Step 3. Press the key and soft keys as given below.

[System] - IBASIC - more 1/3 - GET

Step 4. Enter the name of the file in view with the keyboard.

Step 5. If you are not sure of your file name, use the CAT command to list files and then look up the file name.

Remote Control using a LAN

The Agilent 4294A can be connected to a local area network (LAN). Connecting the 4294A to its external controller via a LAN allows you to efficiently send GPIB commands to and read data from the external controller.

For how to connect to a LAN and how to set up remote control, see Chapter 12 , "Using LAN."

3 Setting Measurement Conditions

This chapter describes how to set measurement conditions.

Setting Measurement Parameters

To set measurement parameters, use the command given below. This command sets measurement parameters for both trace A and trace B at the same time.

- "MEAS" on page 348

You can set measurement parameters in the combinations shown in Table 3-1 depending on the parameters used at the time of sending a command.

Table 3-1 **Measurement parameters**

Parameters for sending a command	Parameters to be set	
	Trace A	Trace B
IMPH	|Z|	θ
IRIM	R	X
LSR	Ls	Rs
LSQ	Ls	Q
CSR	Cs	Rs
CSQ	Cs	Q
CSD	Cs	D
AMPH	|Y|	θ
ARIM	G	B
LPG	Lp	G
LPQ	Lp	Q
CPG	Cp	G
CPQ	Cp	Q
CPD	Cp	D
COMP	Z	Y
IMLS	|Z|	Ls
IMCS	|Z|	Cs
IMLP	|Z|	Lp
IMCP	|Z|	Cp
IMRS	|Z|	Rs
IMQ	|Z|	Q
IMD	|Z|	D
LPR	Lp	Rp
CPR	Cp	Rp

The following gives brief descriptions of the measurement parameters in Table 3-1:

|Z|	Impedance amplitude (absolute value)
|Y|	Admittance amplitude (absolute value)
θ	Impedance phase (for |Z|-θ), Admittance phase (for |Y|-θ)
Z	Impedance (complex number (R+jX))
Y	Admittance (complex number (G+jB))
R, Rs	Equivalent series resistance
X	Equivalent series reactance
Ls	Equivalent series inductance
Cs	Equivalent series capacitance
Rp	Equivalent parallel resistance
G	Equivalent parallel conductance
B	Equivalent parallel susceptance
Lp	Equivalent parallel inductance
Cp	Equivalent parallel capacitance
D	Dissipation factor
Q	Quality factor (Inverse of D)

Setting Measurement Signals

Setting the oscillator

To set an oscillator level, use the commands given below.

- "POWMOD" on page 404
- "POWE" on page 403

Either a voltage or a current can be used to set the oscillator level. First, specify whether you use voltage or a current with the "POWMOD" command and then set a level with the "POWE" command.

To set the oscillator frequency during oscillator level sweep and dc bias sweep, use the command given below.

- "CWFREQ" on page 285

Setting a dc bias

To turn on or off the dc bias output or to select an output mode, use the commands given below.

- "DCO" on page 291
- "DCMOD" on page 291

To set a dc bias level, use the commands given below.

- "DCI" on page 290
- "DCV" on page 295

To set a dc bias output range, use the command given below.

- "DCRNG" on page 294

If the dc bias output is either in constant voltage mode or in constant current mode, use the commands given below to set the limit of the current output or the voltage output. In both constant voltage mode and constant current mode, set the limit of output level in terms of voltage.

- "MAXDCV" on page 347
- "MINDCV" on page 350

Setting a Sweep Condition

Setting a sweep parameter

Choose a sweep parameter from among the oscillator frequency, oscillator level, and dc bias level. To set the parameter, use the command given below.

- "SWPP" on page 449

The following settings for the sweep condition will be stored in memory for each parameter chosen above.

Setting a sweep range

There are two ways to set the sweep range: by specifying the central value and span of the sweep range or by specifying the start point and endpoint of the sweep range. To specify the central value and the span, use the commands given below.

- "CENT" on page 277
- "SPAN" on page 442

To specify the start point and the endpoint, use the commands given below.

- "STAR" on page 444
- "STOP" on page 446

To set the number of measurement points within the sweep range, use the command given below.

- "POIN" on page 401

Setting sweep time

To set the sweep time, use the command given below.

- "SWET" on page 448

You can set the point delay time (waiting time for measurement start at each measurement point) and the sweep delay time (waiting time for sweep start at each sweep). To set them, use the commands given below.

- "PDELT" on page 397
- "SDELT" on page 426

Setting a sweep direction

To set the sweep direction, use the command given below.

- "SWED" on page 448

Setting a sweep type

To set the sweep type, use the command given below.

- "SWPT" on page 449

Setting the On-screen Arrangement

You carry out most of the on-screen arrangement settings independently for trace A and trace B. After made, these will take effect on the active trace. Thus you need to use the command given below to properly switch the active trace settings from one trace to the other.

- "TRAC" on page 457

Setting how the way traces are displayed

You can select one of two ways to display traces A and B: overlapping the traces in the same area or horizontally splitting the screen into two halves to display the traces separately. When the traces are overlapped, you can set an inactive trace so that it disappears. To make these settings, use the commands given below.

- "SPLD" on page 443
- "HIDI" on page 318

If the measurement results are stored in a memory trace (carried out with the "DATMEM" command on page 285), then set the trace to display by using the command given below.

- "DISP" on page 301

To turn on the function that allows you to accumulate a group of overlapping measurement results without updating each trace's display, use the command given below.

- "ACCUD" on page 263

NOTE The parameters set by use of the "SPLD" and "ACCUD" commands are common to traces A and B.

If a phase is used as the measurement parameter, you can select the unit for the phase to display. You can also specify whether or not to display extended phases (repeatedly displaying phases outside the range of -180 ° to +180 °). To make these settings, use the commands given below.

- "PHAU" on page 398
- "EXPP" on page 314

If a scalar value is used as the measurement parameter, you can set an offset for the data to be displayed in a data trace by using the command given below.

- "DATOVAL" on page 286

Setting a display scale

If both a data trace and a memory trace are concurrently displayed, you can separately set different scales to these traces. Use the commands given below to specify whether to use the same scale for both data and memory traces or to specify which trace to set a scale to when not using the same scale.

- “SCAC” on page 422
- “SCAF” on page 422

NOTE The commands above are closely related to displaying a trace, that is, there can be instances in which executing these commands for a purpose other than properly setting a display trace causes an error; for example, changing the settings of the trace to display also changes other items in a linked manner. Therefore, you need to carefully plan the sequence of executing commands in writing a program.

Three ways of setting a display scale are available depending on the display format to be set with the command given below. Accordingly, you need to set a display format before setting a display scale.

- “FMT” on page 315

NOTE The display format you can choose varies depending on the measurement parameters.

NOTE Settings for the display scale and display format are set for each parameter. That is, the settings are determined by the parameters selected in the active trace at the time the settings are made, and are not the settings for trace A or trace B.

The following sections describe the method used for each type of format.

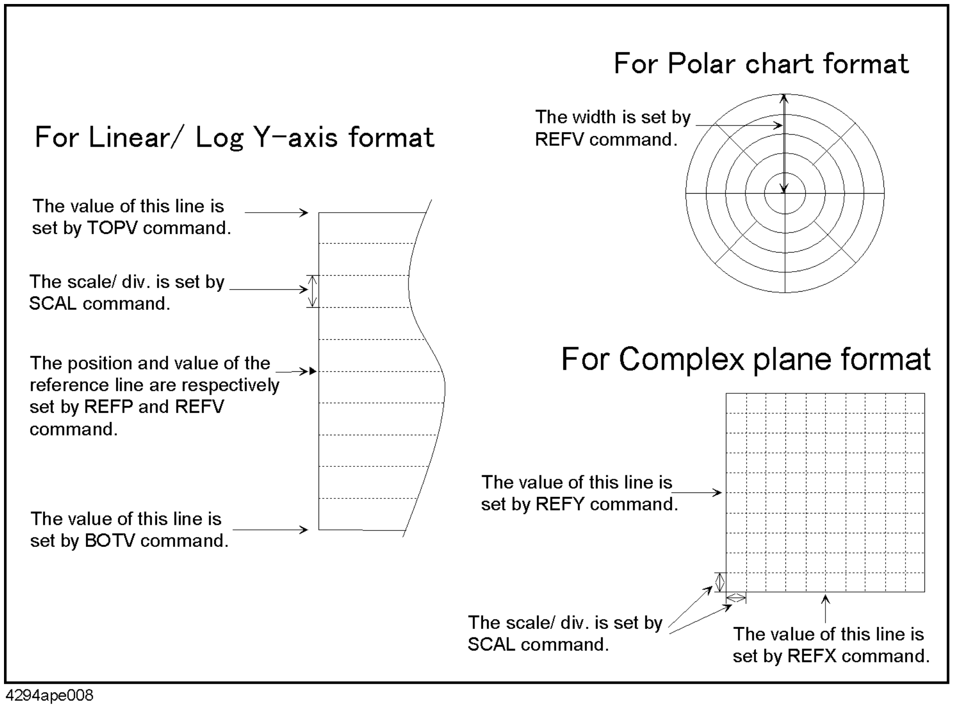
Linear/log Y-axis format

Since the display scale of the X-axis depends on the sweep settings, only set the display scale of the Y-axis (the axis showing the measurement parameter). To set the scale, choose the scale parameter by using one of the commands given below.

- “SCAL” on page 423
- “REFP” on page 408
- “REFV” on page 409
- “TOPV” on page 456
- “BOTV” on page 273

In the case of a log Y-axis, however, you can only make the settings with the “TOPV” and “BOTV” commands. The relations between the commands and the scale parameters are shown in Figure 3-1.

Figure 3-1 **Commands for setting display scale parameters**



Polar chart format

Make the settings by using the full-scale value (the value of the outermost circle) only. To make the settings, use the command given below.

- “REFV” on page 409

Complex plane format

Set the scale parameters by using the commands given below.

- “SCAL” on page 423
- “REFX” on page 410
- “REFY” on page 410

The center line of the grid along the X-axis and that along the Y-axis are always used as the lines for the reference values and cannot be changed. The relations between the commands and the scale parameters are shown in Figure 3-1.

Setting Averaging

Setting a measurement bandwidth

To set a measurement bandwidth, use the command given below.

- "BWFACT" on page 274

Setting averaging

Setting sweep averaging

To set or control sweep averaging, use the command given below.

- "AVER" on page 269
- "AVERFACT" on page 269
- "AVERREST" on page 269

Setting point averaging

To set point averaging, use the commands given below.

- "PAVER" on page 396
- "PAVERFACT" on page 396

Combining Two or More Sweep Conditions (List Sweep)

You can carry out a sweep (list sweep) by combining the segments that set the sweep condition; these segments can provide up to 18 identical sweep parameters. To carry out a list sweep, prepare a table of segments. At the start and the end of the table, send the commands given below.

- “EDITLIST” on page 310
- “EDITDONE” on page 310

NOTE If the “EDITDONE” command is not executed, the resulting settings from making, editing, and deleting with the commands given below will not take effect. (The table to be used in carrying out a list sweep is left as it was before the execution of the “EDITLIST” command.)

Making/editing a segment

To make a new segment, use the commands given below. The “SADD” command adds a segment so that you can edit it. To make settings for a segment’s parameters, use the commands for setting identical parameters described in “Setting Measurement Signals” on page 38, “Setting a Sweep Condition” on page 39 and “Setting Averaging” on page 43. After setting the parameters, send the “SDON” command to finish setting the segment.

- “SADD” on page 415
- “SDON” on page 426

Each segment is assigned a segment number (a row number in the table) for specifying the segment to be set, changed or deleted. To specify the number of the segment to be worked on, use the command given below.

- “SEGM” on page 435

Executing the “SADD” command makes an additional insertion under the line of the specified segment (if no segment is specified, then the segment to be worked on at the time of executing the command involved), and the added segment becomes the target of setting. Thus you don't need to specify segment numbers for the “SADD” command while making a new table by adding segments in the intended sequence. You need to specify a segment number only when adding a new segment at a position between two existing segments.

To change the parameter settings of existing segments, use the command given below to make a specified segment changeable (if no segment is specified, then the segment to be worked on at the time of executing the command involved). After changing the parameters, send the “SDON” command to finish changing segments.

- “SEDI” on page 434

Deleting a segment

To delete a segment, use the commands given below.

- “SDEL” on page 425
- “CLEL” on page 279

The “SDEL” command deletes a specified segment from the table (if no table is specified, then he segment to be worked on at the time of executing the command involved). The “CLEL” command deletes all segments from the table.

Setting the trace color of each segment

To specify the trace color of each segment, use the command given below.

- “SCOL” on page 424

Setting the Limit Test Functions

To turn on or off the limit test functions, use the command given below.

- "LIMITEST" on page 328

To use the limit test functions, you need to make a limit line table, which includes the limits of sweep ranges (segments) defined by start points and endpoints. When beginning and finishing a table, send the commands given below.

- "EDITLIML" on page 310
- "LIMEDONE" on page 326

NOTE With the "LIMEDONE" command not executed, the settings resulting from making, editing, and deleting with the commands given below will not take effect, and the limit line table is left as it was before execution of the "EDITLIML" command.

Making/editing a segment

To make a new segment, use the command given below. This command adds a segment that is ready to be edited.

- "LIMSADD" on page 330

To set a segment's range (its start point and end point), use the commands given below.

- "LIMSTAR" on page 334
- "MKRLIMSTAR" on page 353
- "LIMSTOP" on page 336
- "MKRLIMSTOP" on page 353

To set a range for limiting start points, use the commands given below.

- "LIMUSTAR" on page 337
- "LIMLSTAR" on page 328
- "LIMVSTAR" on page 339
- "MKRLIMVSTAR" on page 354
- "LIMDSTAR" on page 325

To set a range for limiting endpoints, use the commands given below.

- "LIMUSTOP" on page 338
- "LIMLSTOP" on page 329
- "LIMVSTOP" on page 340
- "MKRLIMVSTOP" on page 354
- "LIMDSTOP" on page 326

To turn on or off the ranges for limiting individual segments, use the command given below.

- "LIMSTEST" on page 335

After setting the parameters, send the command given below to finish setting segments.

- "LIMSDON" on page 331

Each segment is assigned a segment number (a row number in the limit line table) for specifying the segment to be set, changed, or deleted. To specify the number of the segment to be worked on, use the command given below.

- "LIMSEGM" on page 333

Executing the "LIMSADD" command makes an additional insertion under the line of a specified segment (if no segment is specified, then the segment to be worked on at the time of executing the command involved), and the added segment becomes the target of setting. Thus you don't need to specify segment numbers when using the "LIMSADD" command to make a new table by adding segments in the intended sequence. You only need to specify a segment number only when adding a new segment at an arbitrary position of an existing table.

To change the parameters settings of existing segments, use the command given below to make a specified segment changeable (if no segment is specified, then the segment to be worked on at the time of executing the command involved). After changing the parameters, send the "LIMSDON" command to finish changing the segments.

- "LIMSEDI" on page 332

Deleting a segment

To delete a segment, use the commands given below.

- "LIMSDEL" on page 331
- "LIMCLEL" on page 324

The "LIMSDEL" command deletes a specified segment (if no segment is specified, then the segment to be worked on at the time of executing the command involved) from the limit line table. The "LIMCLEL" command deletes all of the segments included in the limit line table.

Moving offset ranges

To move limit lines that define a range in parallel, you can set an offset distance for any range among all of the segments by using the commands given below.

- "LIMIAMPO" on page 327
- "LIMIPRMO" on page 327

Saving/Recalling Measurement Conditions

You can save the measurement conditions in a file. By saving frequently used measurement conditions, you can set the Agilent 4294A to a desired measurement condition by merely recalling the corresponding file when needed, avoiding the need to send a number of commands. To save or recall measurement conditions, use the commands given below. See Chapter 8 , "Saving/Recalling a Measurement Result/Measurement Setup," for details of saving/recalling.

- "SAVDSTA" on page 419
- "RECD" on page 408

A Sample Program for Setting Measurement Conditions

The following is a sample program for setting measurement conditions. The program is given the file name setup.bas and stored on the sample program disk.

This program resets the Agilent 4294A, then makes the settings shown below, and finally delivers the completion message when the settings are completed.

Item		Setting
Adaptor setting		No adaptor
Measurement parameter		A: Impedance amplitude B: Impedance phase
Limit of dc bias output		15 V
dc bias range		10 mA range
Type of sweep		List sweep (refer to a separate table)
How to indicate list sweeps		Segment by segment
Separation of trace A and trace B		Turned on
Whether to lay a trace over another		Turned on
Trace A	Trace to be displayed	DATA
	Display format	Log Y axis format
	The maximum value to be displayed on the screen	1E-3
	The minimum value to be displayed on the screen	1E-9
Trace B	Trace to be displayed	DATA
	Display format	Linear Y axis format
	Position of the grid's reference line	5
	Value of the grid's reference line	0
	Value for one graduation of the grid	72
	Unit of indicating a phase	° (degrees)
	Whether to turn on of off the extended phase indication	Turned on

Setting in the list sweep table	Segment 1	Segment 2	Segment 3
Start frequency	1 MHz	20 MHz	40 MHz
Stop frequency	20 MHz	40 MHz	100 MHz
Number of measurement points	21	51	21
Oscillator output setting mode	In voltage	In voltage	In voltage
Oscillator output level	1 V	1 V	1 V
dc bias output mode	Constant voltage	Constant voltage	Constant voltage
dc bias output level	10 V	10 V	10 V
Measurement bandwidth	Bandwidth 1	Bandwidth 5	Bandwidth 1
Number of points used in averaging	1	4	1
Trace color	Pen 1	Pen 2	Pen 3

Lines 90 to 130 These lines distinguish between an external controller and the Instrument BASIC and set the GPIB address.

Lines 150 to 180 These lines substitute the settings of adapter selection, measurement parameters, and limits of dc bias output and of dc bias range to the variables Adapter$, Meas_para$, Dc_b_max, Dc_b_rng$, respectively.

Lines 220 to 500 These lines substitute the parameter settings necessary for making a list sweep table to the variables List_star(*), List_stop(*), Nop(*), Osc_mode$(*), Osc_pow(*), Dc_b_mode$(*), Dc_bias(*), Bw_fact$(*), and P_ave(*).

Lines 540 to 680 These line substitute the display-related parameter settings to the variables Split$, Accumulate$, Disp_a$, Disp_b$, Fmt_a$, Fmt_b$, Top_v_a, Btm_v_a, Ref_p_b, Ref_v_b, Scal_b, Phase_unit$, and Exp_phase$.

Lines 700 to 710 These lines reset the Agilent 4294A and then set the adapter selection to the variable Adapter$.

Lines 750 to 900 These lines make a list sweep table.

Lines 920 to 970 These lines set the measurement parameter to Meas_para$, limit of dc bias output to Dc_b_max, dc bias range to Dc_b_rng$, On/Off setting of dc bias to On and set the type of sweep to List Sweep and the display format to Segment By Segment.

Lines 980 to 990 These lines set the display parameters common to traces A and B.

Lines 1030 to 1070 These lines set the display parameters of trace A.

Lines 1110 to 1180 These lines set the display parameters of trace B.

Lines 1200 to 1230 These lines wait for execution of the commands used to make settings, indicate the message of completion, and end the program.

Example 3-1 **Setting measurement conditions**

```
10      DIM Adapter$[9],Meas_para$[5],Dc_b_rng$[9],Buff$[9]
20      DIM Osc_mode$(1:3)[9],Dc_b_mode$(1:3)[9],Bw_fact$(1:3)[9]
30      DIM Split$[9],Accumulate$[9],Disp_a$[9],Disp_b$[9]
40      DIM Fmt_a$[9],Fmt_b$[9],Phase_unit$[9],Exp_phase$[9]
50      REAL List_star(1:3),List_stop(1:3),Osc_pow(1:3),Dc_bias(1:3)
60      REAL Dc_b_max,Top_v_a,Btm_v_a,Ref_v_b,Scal_b
70      INTEGER Nop(1:3),P_ave(1:3),Ref_p_b
80      !
90      IF SYSTEM$("SYSTEM ID")="HP4294A" THEN
100       ASSIGN @Hp4294a TO 800
110     ELSE
120       ASSIGN @Hp4294a TO 717
130     END IF
140     !
150     Adapter$="OFF"
160     Meas_para$="IMPH"
170     Dc_b_max=15.0
180     Dc_b_rng$="M10"
190     !
200     ! List Sweep Table
210     ! -- Segment 1 --
```

```
220     List_star(1)=1.0E+6
230     List_stop(1)=2.0E+7
240     Nop(1)=21
250     Osc_mode$(1)="VOLT"
260     Osc_pow(1)=1.0
270     Dc_b_mode$(1)="CVOLT"
280     Dc_bias(1)=10.0
290     Bw_fact$(1)="1"
300     P_ave(1)=1
310     ! -- Segment 2 --
320     List_star(2)=2.0E+7
330     List_stop(2)=4.0E+7
340     Nop(2)=51
350     Osc_mode$(2)="VOLT"
360     Osc_pow(2)=1.0
370     Dc_b_mode$(2)="CVOLT"
380     Dc_bias(2)=10.0
390     Bw_fact$(2)="5"
400     P_ave(2)=4
410     ! -- Segment 3 --
420     List_star(3)=4.0E+7
430     List_stop(3)=1.0E+8
440     Nop(3)=21
450     Osc_mode$(3)="VOLT"
460     Osc_pow(3)=1.0
470     Dc_b_mode$(3)="CVOLT"
480     Dc_bias(3)=10.0
490     Bw_fact$(3)="1"
500     P_ave(3)=1
510     !
520     ! Display Setting
530     !
540     Split$="ON"
550     Accumulate$="ON"
560     ! -- Trace A --
570     Disp_a$="DATA"
580     Fmt_a$="LOGY"
590     Top_v_a=1.0E-3
600     Btm_v_a=1.0E-9
610     ! -- Trace B --
620     Disp_b$="DATA"
630     Fmt_b$="LINY"
640     Ref_p_b=5
650     Ref_v_b=0.
660     Scal_b=72.0
670     Phase_unit$="DEG"
680     Exp_phase$="ON"
690     !
700     OUTPUT @Hp4294a;"PRES"
710     OUTPUT @Hp4294a;"E4TP "&Adapter$
720     !
730     ! List Sweep Tabel Edit
740     !
750     OUTPUT @Hp4294a;"EDITLIST"
760     FOR I=1 TO 3
770       OUTPUT @Hp4294a;"SADD"
780       OUTPUT @Hp4294a;"STAR ";List_star(I)
790       OUTPUT @Hp4294a;"STOP ";List_stop(I)
```

```
800       OUTPUT @Hp4294a;"POIN ";Nop(I)
810       OUTPUT @Hp4294a;"POWMOD "&Osc_mode$(I)
820       OUTPUT @Hp4294a;"POWE ";Osc_pow(I)
830       OUTPUT @Hp4294a;"DCMOD "&Dc_b_mode$(I)
840       OUTPUT @Hp4294a;"DCV ";Dc_bias(I)
850       OUTPUT @Hp4294a;"BWFACT "&Bw_fact$(I)
860       OUTPUT @Hp4294a;"PAVERFACT ";P_ave(I)
870       OUTPUT @Hp4294a;"SDON"
880       OUTPUT @Hp4294a;"SCOL ";((I-1) MOD 6)+1
890     NEXT I
900     OUTPUT @Hp4294a;"EDITDONE"
910     !
920     OUTPUT @Hp4294a;"MEAS "&Meas_para$
930     OUTPUT @Hp4294a;"MAXDCV ";Dc_b_max
940     OUTPUT @Hp4294a;"DCRNG "&Dc_b_rng$
950     OUTPUT @Hp4294a;"DCO ON"
960     OUTPUT @Hp4294a;"SWPT LIST"
970     OUTPUT @Hp4294a;"LISPAN SEGMENT"
980     OUTPUT @Hp4294a;"SPLD "&Split$
990     OUTPUT @Hp4294a;"ACCUD "&Accumulate$
1000    !
1010    ! Trace A Setting
1020    !
1030    OUTPUT @Hp4294a;"TRAC A"
1040    OUTPUT @Hp4294a;"DISP "&Disp_a$
1050    OUTPUT @Hp4294a;"FMT "&Fmt_a$
1060    OUTPUT @Hp4294a;"TOPV ";Top_v_a
1070    OUTPUT @Hp4294a;"BOTV ";Btm_v_a
1080    !
1090    ! Trace B Setting
1100    !
1110    OUTPUT @Hp4294a;"TRAC B"
1120    OUTPUT @Hp4294a;"DISP "&Disp_b$
1130    OUTPUT @Hp4294a;"FMT "&Fmt_b$
1140    OUTPUT @Hp4294a;"REFP ";Ref_p_b
1150    OUTPUT @Hp4294a;"REFV ";Ref_v_b
1160    OUTPUT @Hp4294a;"SCAL ";Scal_b
1170    OUTPUT @Hp4294a;"PHAU "&Phase_unit$
1180    OUTPUT @Hp4294a;"EXPP "&Exp_phase$
1190    !
1200    OUTPUT @Hp4294a;"*OPC?"
1210    ENTER @Hp4294a;Buff$
1220    PRINT "Measurement Condition Setup Complete"
1230    END
```

4 Preparing For Accurate Measurement

This chapter describes how to apply adapter setting, user calibration, fixture compensation, and port extension compensation.

Adapter Setting

To select an adapter, use the command given below.

- “E4TP” on page 309

If you select any adapter other than NONE, you need to measure the data indicated in the table below to calculate the setup data.

Adapter	Phase	Open	Short	Load
NONE	Unnecessary	Unnecessary	Unnecessary	Unnecessary
4TP 1M	Necessary	Unnecessary	Unnecessary	Necessary
4TP 2M	Necessary	Unnecessary	Unnecessary	Necessary
7mm 42942A	Necessary	Necessary	Necessary	Necessary
PROBE 42941A	Necessary	Necessary	Necessary	Necessary

To measure data, use the command given below.

- “ECAL{P|A|B|C}” on page 309

After measuring the necessary data, execute the command given below to calculate the setup data for the selected adapter and then store this in the nonvolatile memory (EEPROM).

- “ECALDON” on page 309

NOTE If you execute the “ECAL{P|A|B|C}” command to measure unnecessary data, an error occurs and the command is ignored.

To suspend the above process, execute the command given below.

- “ECALQUI” on page 310

A sample program for adapter setting is shown in Example 4-1. This program is given the file name adapter.bas and is stored on the sample program disk.

This program selects 7mm 42942A for adapter setting, measures phase data, open data, short data and load data and then stores them in nonvolatile memory.

Lines 40 to 100	These lines distinguish between the external controller and Instrument BASIC and set the GPIB address and the select code.
Line 110	This line substitutes the adapter selection to the variable Adapter$.
Lines 130 to 160	These lines reset the Agilent 4294A and then set the adapter selection to the variable Adapter$.
Lines 180 to 190	These lines set 1 to Bit 8 of the instrument event status register (the bit for completion of the measurement of calibration data and compensation data) and to Bit 2 of the service request enable register so that SRQ can be used.

Lines 210 to 310	These lines measure phase data, open data, short data and load data by using the subprogram FNAdap_setup. If an error is detected after any measurement, the program is terminated.
Lines 330 to 350	These lines calculate setup data and store them in non-volatile memory.
Lines 360 to 380	These lines indicate the message of completion and terminate the program.

The following describes FNAdap_setup, a data measurement subprogram for calculating setup data, which is shown in lines 420 to 800.

Line 450	This line clears the status byte register.
Lines 460 to 470	These lines prompt for the connection of the standard for measurement specified by Standard$ and wait for you to press the y key and the return key.
Lines 490 to 500	These lines set the branch target for an SRQ interrupt to make the SRQ interrupt effective.
Lines 510 to 600	These lines send the commands to execute the measurement specified by Standard$.
Line 620	This line waits for measurement to finish.
Lines 640 to 740	These lines check whether an error has occurred during measurement. If no error occurred, then these lines indicate the message of measurement completion and return a 0 as the return value from the subprogram. If an error occurred, then these lines indicate an error message, execute the command that suspends data measurement, and return -1 as the return value from the subprogram.
Lines 760 to 780	These lines are steps for any key other than the y key pressed in response to line 470. These lines execute the command that suspends data measurement and then return -1 as the return value from the subprogram.

Example 4-1 **Data measurement for adapter setting**

```
10      DIM Adapter$[9],Buff$[9]
20      INTEGER Scode,Result
30      CLEAR SCREEN
40      IF SYSTEM$("SYSTEM ID")="HP4294A" THEN
50        ASSIGN @Hp4294a TO 800
60        Scode=8
70      ELSE
80        ASSIGN @Hp4294a TO 717
90        Scode=7
100     END IF
110     Adapter$="APC7"
120     !
130     OUTPUT @Hp4294a;"PRES"
140     OUTPUT @Hp4294a;"*OPC?"
150     ENTER @Hp4294a;Buff$
160     OUTPUT @Hp4294a;"E4TP "&Adapter$
170     !
180     OUTPUT @Hp4294a;"ESNB 256"
190     OUTPUT @Hp4294a;"*SRE 4"
```

```
200    !
210    Result=FNAdap_setup(@Hp4294a,Scode,"Phase")
220    IF Result<>0 THEN Prog_end
230    !
240    Result=FNAdap_setup(@Hp4294a,Scode,"Open")
250    IF Result<>0 THEN Prog_end
260    !
270    Result=FNAdap_setup(@Hp4294a,Scode,"Short")
280    IF Result<>0 THEN Prog_end
290    !
300    Result=FNAdap_setup(@Hp4294a,Scode,"Load")
310    IF Result<>0 THEN Prog_end
320    !
330    OUTPUT @Hp4294a;"ECALDON"
340    OUTPUT @Hp4294a;"*OPC?"
350    ENTER @Hp4294a;Buff$
360    PRINT "All Data Measurement Complete"
370    !
380 Prog_end: END
390    !
400    ! Adapter Setup Data Measurement Function
410    !
420  DEF FNAdap_setup(@Hp4294a,INTEGER Scode,Standard$)
430    DIM Inp_char$[9],Err_mes$[50]
440    INTEGER Err_no
450    OUTPUT @Hp4294a;"*CLS"
460    PRINT "Set "&Standard$&"-Connection"
470    INPUT "OK? [Y/N]",Inp_char$
480    IF UPC$(Inp_char$)="Y" THEN
490      ON INTR Scode GOTO Meas_end
500      ENABLE INTR Scode;2
510      SELECT Standard$
520        CASE "Phase"
530          OUTPUT @Hp4294a;"ECALP"
540        CASE "Open"
550          OUTPUT @Hp4294a;"ECALA"
560        CASE "Short"
570          OUTPUT @Hp4294a;"ECALB"
580        CASE "Load"
590          OUTPUT @Hp4294a;"ECALC"
600      END SELECT
610      PRINT "Now measuring..."
620 Meas_wait:  GOTO Meas_wait
630 Meas_end:  !
640      OUTPUT @Hp4294a;"OUTPERRO?"
650      ENTER @Hp4294a;Err_no,Err_mes$
660      IF Err_no=0 THEN
670        PRINT Standard$&" Data Measurement Complete"
680        RETURN 0
690      ELSE
700        PRINT "Error: "&Err_mes$
710        PRINT "Program Interruption"
720        OUTPUT @Hp4294a;"ECALQUI"
730        RETURN -1
740      END IF
750    ELSE
760      PRINT "Program Interruption"
770      OUTPUT @Hp4294a;"ECALQUI"
```

```
780      RETURN -1
790    END IF
800  FNEND
```

User Calibration

Selecting either 7mm or PROBE while setting the adapter allows you to use the user calibration functions. To turn the user calibration functions on or off, use the command given below. If no user calibration coefficients have been retained, the user calibration functions cannot be turned on.

- "CALST" on page 276

To measure open data, short data and load data for calculating the user calibration coefficients, use the command given below.

- "CAL{A|B|C}" on page 274

NOTE User calibration data and fixture compensation data are measured either at fixed points preset by the Agilent 4294A (fixed measurement points) or at sweep measurement points set at the time of command execution (user measurement points). In the former case, the compensation coefficient at a sweep measurement point is obtained by interpolation. To select points for measuring data, use the "CALP" command on page 275.

To set standard values to be used in measuring these data, use the commands given below.

- "DCALOPEN{G|C}" on page 288
- "DCALSHOR{R|L}" on page 289
- "DCALLOAD{R|L}" on page 287

After measuring individual data, execute the command given below to calculate the user calibration coefficient and to store it in volatile memory (RAM).

- "CALDON" on page 274

NOTE To calculate the user calibration coefficient, all of the open data, short data and load data are required. If you execute this command before measurement of the data is fully completed, an error occurs and the command is ignored.

To suspend the above process, execute the command given below.

- "CALQUI" on page 275

To read measured open data, short data or load data, use the command given below.

- “OUTPCALC{1-3}?” on page 373

You can calculate the user calibration coefficients by entering open data, short data and load data (data read by the above or a similar command). To enter data, use the command given below.

- “INPUCALC{1-3}” on page 320

NOTE Enter data after setting the standard values used in measuring the data because these values are needed to calculate user calibration coefficients.

NOTE To use the input data, you need to enter all of the open data, short data and load data. At the instant when all the data are entered, the calibration coefficient is automatically calculated and stored in volatile memory. Therefore, you don't need to execute the “CALDON” command if you enter all the data.

NOTE Enter data after making settings identical to the data measurement points (fixed measurement points, user-selected measurement points) set at the time when the input data were acquired. In addition, in the case of user-selected measurement points, enter data after making sweep settings identical to the data measurement points.

Example 4-2 shows a sample program for measuring data to be used for calculating a user calibration coefficient. This program is given the file name user_cal.bas and is stored on the sample program disk.

After you enter standard values for open data, short data and load data, this program measures open data, short data and load data, calculates the user calibration coefficient, and stores it in volatile memory.

Lines 50 to 110	These lines distinguish between the external controller and Instrument BASIC and set the GPIB address and the select code.
Line 120	This line substitutes the selection of data measurement points to the variable Cal_point$.
Lines 160 to 190	These lines reset the Agilent 4294A and then set data measurement points to Cal_point$.
Lines 230 to 280	These lines use the subprogram Inp_data to acquire standard values for open data, short data, and load data.
Lines 290 to 340	These lines prepare the standard values you entered for subsequent use. The open standard capacitance needs to be in femtofarad, so these lines make necessary conversion.
Lines 380 to 390	These lines set 1 to Bit 8 of the instrument event status register (the bit for the completion of the measurement of calibration data and compensation data) and to Bit 2 of the service request enable register so that SRQ can be used.
Lines 410 to 480	These lines measure open data, short data and load data by using the subprogram FNUser_cal. If an error is detected after any measurement, the program is terminated.
Lines 500 to 520	These lines calculate the user calibration coefficient and store it in

volatile memory.

Lines 530 to 540 These lines indicate the message of completion and terminate the program.

The following describes FNUser_cal, a data measurement subprogram for user calibration, which is shown in lines 580 to 920.

Line 610 This line clears the status byte register.

Lines 620 to 630 These lines prompt for the connection of the standard for measurement specified by Standard$ and wait for you to press the y key and the return key.

Lines 650 to 660 These lines set the branch target for an SRQ interrupt to make the SRQ interrupt effective.

Lines 670 to 740 These lines send the commands to execute the standard measurement specified by Standard$.

Line 760 This line waits for the measurement to finish.

Lines 780 to 880 These lines check whether an error has occurred during measurement. If no error occurred, then these lines indicate the message of measurement completion and return 0 as the return value from the subprogram. If an error occurred, then these lines indicate an error message, execute the command that suspends data measurement, and return -1 as the return value from the subprogram.

Lines 900 to 920 These lines are steps for any key other than the y key pressed in response to line 630. These lines execute the command that suspends date measurement and then return -1 as the return value from the subprogram.

The following describes the subprogram Inp_data for entering the data shown in lines 980 to 1090.

Line 1000 This line returns to the start line of input if an error occurs due to an invalid input or similar reason. This allows you to make entries again.

Lines 1020 to 1030 These lines prompt you to enter a data item specified by Mes$ and wait for you to enter it.

Lines 1040 to 1060 These lines indicate the value entered and wait for you to press either the y key or the n key to notify whether the input is correct or not.

Line 1070 This line returns to the start line of input if any key other than the y key is pressed in response to line 1060.

Example 4-2 **Data measurement for user calibration**

```
10      DIM Input_val$[9],Buff$[9],Adapter$[9]
20      REAL Open_g,Open_c,Short_r,Short_l,Load_r,Load_l
30      INTEGER Scode,Err_no
40      CLEAR SCREEN
50      IF SYSTEM$("SYSTEM ID")="HP4294A" THEN
60        ASSIGN @Hp4294a TO 800
70        Scode=8
80      ELSE
90        ASSIGN @Hp4294a TO 717
100       Scode=7
110     END IF
120     Cal_point$="USER"
130     !
140     ! Initial Setting
150     !
160     OUTPUT @Hp4294a;"PRES"
170     OUTPUT @Hp4294a;"*OPC?"
180     ENTER @Hp4294a;Buff$
190     OUTPUT @Hp4294a;"CALP ";Cal_point$
200     !
210     ! Entry Standard Value
220     !
230     CALL Inp_data("Open(G)",Open_g)
240     CALL Inp_data("Open(C)",Open_c)
250     CALL Inp_data("Short(R)",Short_r)
260     CALL Inp_data("Short(L)",Short_l)
270     CALL Inp_data("Load(R)",Load_r)
280     CALL Inp_data("Load(L)",Load_l)
290     OUTPUT @Hp4294a;"DCALOPENG ";Open_g
300     OUTPUT @Hp4294a;"DCALOPENC ";Open_c/1.E-15
310     OUTPUT @Hp4294a;"DCALSHORR ";Short_r
320     OUTPUT @Hp4294a;"DCALSHORL ";Short_l
330     OUTPUT @Hp4294a;"DCALLOADR ";Load_r
340     OUTPUT @Hp4294a;"DCALLOADL ";Load_l
350     !
360     ! Data Measurement
370     !
380     OUTPUT @Hp4294a;"ESNB 256"
390     OUTPUT @Hp4294a;"*SRE 4"
400     !
410     Result=FNUser_cal(@Hp4294a,Scode,"Open")
420     IF Result<>0 THEN Prog_end
430     !
440     Result=FNUser_cal(@Hp4294a,Scode,"Short")
450     IF Result<>0 THEN Prog_end
460     !
470     Result=FNUser_cal(@Hp4294a,Scode,"Load")
480     IF Result<>0 THEN Prog_end
490     !
500     OUTPUT @Hp4294a;"CALDON"
510     OUTPUT @Hp4294a;"*OPC?"
520     ENTER @Hp4294a;Buff$
530     PRINT "All Data Measurement Complete"
540 Prog_end:  END
550     !
```

```
560    ! User Calibration Data Measurement Function
570    !
580  DEF FNUser_cal(@Hp4294a,INTEGER Scode,Standard$)
590    DIM Inp_char$[9],Err_mes$[50]
600    INTEGER Err_no
610    OUTPUT @Hp4294a;"*CLS"
620    PRINT "Set "&Standard$&"-Connection"
630    INPUT "OK? [Y/N]",Inp_char$
640    IF UPC$(Inp_char$)="Y" THEN
650      ON INTR Scode GOTO Meas_end
660      ENABLE INTR Scode;2
670      SELECT Standard$
680        CASE "Open"
690          OUTPUT @Hp4294a;"CALA"
700        CASE "Short"
710          OUTPUT @Hp4294a;"CALB"
720        CASE "Load"
730          OUTPUT @Hp4294a;"CALC"
740      END SELECT
750      PRINT "Now measuring..."
760 Meas_wait:  GOTO Meas_wait
770 Meas_end:  !
780      OUTPUT @Hp4294a;"OUTPERRO?"
790      ENTER @Hp4294a;Err_no,Err_mes$
800      IF Err_no=0 THEN
810        PRINT Standard$&" Data Measurement Complete"
820        RETURN 0
830      ELSE
840        PRINT "Error: "&Err_mes$
850        PRINT "Program Interruption"
860        OUTPUT @Hp4294a;"CALQUI"
870        RETURN -1
880      END IF
890    ELSE
900      PRINT "Program Interruption"
910      OUTPUT @Hp4294a;"CALQUI"
920      RETURN -1
930    END IF
940  FNEND
950    !
960    ! Data Input Function
970    !
980  SUB Inp_data(Mes$,Inp_val)
990    DIM Inp_char$[30]
1000   ON ERROR GOTO Inp_start
1010 Inp_start:!
1020   PRINT "Input "&Mes$
1030   INPUT "Value?",Inp_char$
1040   Inp_val=VAL(UPC$(Inp_char$))
1050   PRINT "Input value: ";Inp_val
1060   INPUT "OK? [Y/N]",Inp_char$
1070   IF UPC$(Inp_char$)<>"Y" THEN Inp_start
1080   OFF ERROR
1090 SUBEND
```

Fixture Compensation

To turn on or off the open/short/load compensation of the fixture compensation functions, use the command given below. You can set open/short/load compensations independently. However, if no compensation coefficients are retained, the functions cannot be turned on.

- “COMST{A|B|C}” on page 282

To measure open data, short data and load data for calculating compensation coefficients in open/short/load compensation of the fixture compensation functions, use the commands given below. Executing these commands calculates fixture compensation coefficients of measured data and stores them in volatile memory (RAM). In addition, the compensation function for measured data is turned on.

- “COM{A|B|C}” on page 281

NOTE User calibration data and fixture compensation data are measured either at fixed points preset by the Agilent 4294A (fixed measurement points) or at sweep measurement points set at the time of command execution (user-selected measurement points). In the case of the former, the compensation coefficient at a sweep measurement point is obtained by interpolation. To select points for measuring data, use the “CALP” command on page 275.

To set standard values to be used in measuring these data, use the commands given below.

- “DCOMOPEN{G|C}” on page 293
- “DCOMSHOR{R|L}” on page 294
- “DCOMLOAD{R|L}” on page 292

To read open data, short data or load data measured, use the command given below.

- “OUTPCOMC{1-3}?” on page 374

You can calculate fixture compensation coefficients by entering open data, short data and load data (data read by the above or similar command). To enter data, use the command given below. Executing these commands calculates the fixture compensation coefficients of measured data and stores them in volatile memory (RAM). In addition, the compensation function for measured data is turned on.

- “INPUCOMC{1-3}” on page 321

NOTE Enter data after setting the standard values used in measuring the data because these values are needed to calculate fixture compensation coefficients.

NOTE Enter data after making settings identical to the data measurement points (fixed measurement points, user-selected measurement points) set at the time when the input data were acquired. In addition, in the case of the user-selected measurement points, enter data after making the sweep settings identical to the data measurement points.

Example 4-3 shows a sample program for measuring data to be used for calculating a fixture compensation coefficient. This program is given the file name com_meas.bas and is stored on the sample program disk.

Enter standard values for open data, short data and load data. This program then measures open data, short data and load data at fixed measurement points preset by the Agilent 4294A and stores the measured data and the defined standard values in a flash disk (nonvolatile memory disk) by giving the data the filenames COM_DATA and STD_VAL, respectively.

Lines 60 to 150 These lines distinguish between the external controller and Instrument BASIC and set the GPIB address and select code. In the case of Instrument BASIC, flash memory is used as the storage unit.

Lines 160 to 180 These lines substitute the selection of data measurement points to the variable Cal_point$, the name of the file to be retained measured data to the variable File$, and the name of the file to be retained as standard value to the variable Std_file$.

Lines 220 to 250 These lines reset the Agilent 4294A and then substitutes the data measurement points to Cal_point$.

Lines 290 to 340 These lines use the subprogram Inp_data to acquire standard values to enter open data, short data and load data.

Lines 350 to 400 These lines set the standard values. The open standard capacitance needs to be in femtofarad, so these lines make the necessary conversion.

Lines 440 to 450 These lines set 1 to Bit 8 of the instrument event status register (the bit for the completion of the measurement of calibration data and compensation data) and to Bit 2 of the service request enable register so that SRQ can be used.

Lines 470 to 540 These lines measure open data, short data and load data by using the subprogram FNFixt_comp. If an error is detected after any measurement, the program is terminated.

Lines 580 to 740 These lines select the IEEE 64-bit floating-point format for the data transfer format, read open data, short data and load data to store them in the arrays Com_o(*), Com_s(*), and Com_l(*), respectively.

Lines 790 to 810 These lines delete a file named File$ if already exists.

Lines 830 to 860 This lines create a file named File$ and write the data stored in the arrays Com_o(*), Com_s(*), Com_l(*) to that file.

Lines 880 to 900 These lines delete a file named Std_file$ if already exists.

Lines 910 to 950 This lines create a file named File$ and write the open/short/load standard values.

Lines 970 to 980 These lines indicate the message of completion and terminate the program.

The following describes FNFixt_comp, a data measurement subprogram for fixture compensation, which is shown in lines 1020 to 1280.

Line 1050 This line clears the status byte register.

Lines 1060 to 1070 These lines prompt the connection for the measurement specified by

Standard$ and wait for you to press the y key and the return key.

Lines 1090 to 1100 These lines set the branch target for an SRQ interrupt to make the SRQ interrupt effective.

Lines 1110 to 1180 These lines send the commands to execute the standard measurement specified by Standard$.

Line 1200 This line waits for measurement to finish.

Lines 1220 to 1230 These lines indicate the message of measurement completion and return 0 as the return value from the sub-program.

Lines 1250 to 1260 These lines are steps for any key other than the y key pressed in response to line 970. These lines return -1 as the return value from the sub-program.

See Example 4-2 on page 61 for the subprogram Inp_data.

Example 4-3 **Date measurement for fixture compensation**

```
10      DIM Adapter$[9],Buff$[9],File$[20],Std_file$[20],Cal_point$[9],
Size$[9]
20      DIM Com_o(1:100,1:2),Com_s(1:100,1:2),Com_l(1:100,1:2)
30      REAL Open_g,Open_c,Short_r,Short_l,Load_r,Load_l
40      INTEGER Result,Scode
50      CLEAR SCREEN
60      IF SYSTEM$("SYSTEM ID")="HP4294A" THEN
70        ASSIGN @Hp4294a TO 800
80        ASSIGN @Binary TO 800;FORMAT OFF
90        MASS STORAGE IS ":INTERNAL1,5"
100       Scode=8
110     ELSE
120       ASSIGN @Hp4294a TO 717
130       ASSIGN @Binary TO 717;FORMAT OFF
140       Scode=7
150     END IF
160     Cal_point$="FIXED"
170     File$="COM_DATA"
180     Std_file$="STD_VAL"
190     !
200     ! Initial Setting
210     !
220     OUTPUT @Hp4294a;"PRES"
230     OUTPUT @Hp4294a;"*OPC?"
240     ENTER @Hp4294a;Buff$
250     OUTPUT @Hp4294a;"CALP ";Cal_point$
260     !
270     ! Entry Standard Value
280     !
290     CALL Inp_data("Open(G)",Open_g)
300     CALL Inp_data("Open(C)",Open_c)
310     CALL Inp_data("Short(R)",Short_r)
320     CALL Inp_data("Short(L)",Short_l)
330     CALL Inp_data("Load(R)",Load_r)
340     CALL Inp_data("Load(L)",Load_l)
350     OUTPUT @Hp4294a;"DCOMOPENG ";Open_g
360     OUTPUT @Hp4294a;"DCOMOPENC ";Open_c/1.E-15
370     OUTPUT @Hp4294a;"DCOMSHORR ";Short_r
380     OUTPUT @Hp4294a;"DCOMSHORL ";Short_l
390     OUTPUT @Hp4294a;"DCOMLOADR ";Load_r
400     OUTPUT @Hp4294a;"DCOMLOADL ";Load_l
410     !
420     ! Data Measurement
430     !
```

```
440    OUTPUT @Hp4294a;"ESNB 256"
450    OUTPUT @Hp4294a;"*SRE 4"
460    !
470    Result=FNFixt_comp(@Hp4294a,Scode,"Open")
480    IF Result<>0 THEN Prog_end
490    !
500    Result=FNFixt_comp(@Hp4294a,Scode,"Short")
510    IF Result<>0 THEN Prog_end
520    !
530    Result=FNFixt_comp(@Hp4294a,Scode,"Load")
540    IF Result<>0 THEN Prog_end
550    !
560    ! Data Reading
570    !
580    OUTPUT @Hp4294a;"FORM3"
590    !
600    OUTPUT @Hp4294a;"OUTPCOMC1?"
610    ENTER @Hp4294a USING "#,2A";Buff$
620    ENTER @Hp4294a USING "#,6A";Size$
630    ENTER @Binary;Com_o(*)
640    ENTER @Hp4294a USING "#,1A";Buff$
650    !
660    OUTPUT @Hp4294a;"OUTPCOMC2?"
670    ENTER @Hp4294a USING "#,8A";Buff$
680    ENTER @Binary;Com_s(*)
690    ENTER @Hp4294a USING "#,1A";Buff$
700    !
710    OUTPUT @Hp4294a;"OUTPCOMC3?"
720    ENTER @Hp4294a USING "#,8A";Buff$
730    ENTER @Binary;Com_l(*)
740    ENTER @Hp4294a USING "#,1A";Buff$
750    !
760    ! Data Saving
770    !
780    Data_size=VAL(Size$)*3
790    ON ERROR GOTO Skip_purge1
800    PURGE File$
810 Skip_purge1: OFF ERROR
820    PRINT "Compensation Data Save file: "&File$
830    CREATE File$,Data_size
840    ASSIGN @File TO File$;FORMAT OFF
850    OUTPUT @File;Com_o(*),Com_s(*),Com_l(*)
860    ASSIGN @File TO *
870    !
880    ON ERROR GOTO Skip_purge2
890    PURGE Std_file$
900 Skip_purge2: OFF ERROR
910    PRINT "Standard Value Save file: "&Std_file$
920    CREATE Std_file$,48
930    ASSIGN @File TO Std_file$;FORMAT OFF
940    OUTPUT @File;Open_g,Open_c,Short_r,Short_l,Load_r,Load_l
950    ASSIGN @File TO *
960    !
970    PRINT "All Data Measurement Complete"
980 Prog_end: END
990    !
1000   ! Fixture Compensation Data Measurement Function
1010   !
1020 DEF FNFixt_comp(@Hp4294a,INTEGER Scode,Standard$)
1030   DIM Inp_char$[9],Err_mes$[50]
1040   INTEGER Err_no
1050   OUTPUT @Hp4294a;"*CLS"
1060   PRINT "Set "&Standard$&"-Connection"
1070   INPUT "OK? [Y/N]",Inp_char$
```

```
1080   IF UPC$(Inp_char$)="Y" THEN
1090     ON INTR Scode GOTO Meas_end
1100     ENABLE INTR Scode;2
1110     SELECT Standard$
1120       CASE "Open"
1130         OUTPUT @Hp4294a;"COMA"
1140       CASE "Short"
1150         OUTPUT @Hp4294a;"COMB"
1160       CASE "Load"
1170         OUTPUT @Hp4294a;"COMC"
1180     END SELECT
1190     PRINT "Now measuring..."
1200 Meas_wait: GOTO Meas_wait
1210 Meas_end: !
1220     PRINT Standard$&" Data Measurement Complete"
1230     RETURN 0
1240   ELSE
1250     PRINT "Program Interruption"
1260     RETURN -1
1270   END IF
1280 FNEND
1290   !
1300   ! Data Input Function
1310   !
1320 SUB Inp_data(Mes$,Inp_val)
1330   DIM Inp_char$[30]
1340   ON ERROR GOTO Inp_start
1350 Inp_start:!
1360   PRINT "Input "&Mes$
1370   INPUT "Value?",Inp_char$
1380   Inp_val=VAL(UPC$(Inp_char$))
1390   PRINT "Input value: ";Inp_val
1400   INPUT "OK? [Y/N]",Inp_char$
1410   IF UPC$(Inp_char$)<>"Y" THEN Inp_start
1420   OFF ERROR
1430 SUBEND
```

Example 4-4 shows a sample program that takes in data for use in fixture compensation. This sample program is given the file name com_inpu.bas and is stored on the sample program disk.

This program reads open data, short data and load data from the files (COM_DATA and STD_VAL) retained by the program shown in Example 4-3 and sets them.

Lines 50 to 140 — These lines distinguish between the external controller and Instrument BASIC and set the GPIB address and the select code. In the case of Instrument BASIC, flash memory is used as the storage unit.

Lines 150 to 180 — These lines substitute the selection of data measurement points, the number of compensation data measurement points (100 for fixed measurement points), the name of the file for reading compensation data, and the name of the file for reading standard value to the variables Cal_point$, Point, File$ and Std_file$, respectively.

Lines 220 to 250 — These lines reset the Agilent 4294A and then assign the data measurement points to Cal_point$.

Lines 290 to 310 — These lines read open data, short data and load data from the file named File$ in the sequence shown in Example 4-3 to store them in the arrays Com_o(*), Com_s(*), and Com_l(*), respectively.

Lines 330 to 350 — These lines read open/short/load standard values from the file named Std_file$ in sequence as written in Example 4-3 and store them in the variables Open_g, Open_c, Short_r, Short_l, Load_r, and Load_l respectively.

Lines 390 to 440 — These lines set the standard values. The open standard capacitance needs to be in femtofarad, so these lines make the necessary conversion.

Line 480 — This line selects the IEEE 64-bit floating-point format for the data transfer format.

Line 490 — This line calculates data size from the program variable Point and creates a header to be used at the time of data transfer.

Lines 510 to 580 — These lines enter data for open/short/load compensation. When the data are entered, the open/short/load compensation of the fixture compensation functions is turned on.

Example 4-4 **Data entry for fixture compensation**

```
10      DIM Header$[9],Cal_point$[9],File$[20],Std_file$[20]
20      DIM Com_o(1:100,1:2),Com_s(1:100,1:2),Com_l(1:100,1:2)
30      REAL Open_g,Open_c,Short_r,Short_l,Load_r,Load_l
40      INTEGER Scode,Point
50      IF SYSTEM$("SYSTEM ID")="HP4294A" THEN
60        ASSIGN @Hp4294a TO 800
70        ASSIGN @Binary TO 800;FORMAT OFF
80        MASS STORAGE IS ":INTERNAL1,5"
90        Scode=8
100     ELSE
110       ASSIGN @Hp4294a TO 717
120       ASSIGN @Binary TO 717;FORMAT OFF
130       Scode=7
140     END IF
```

```
150     Cal_point$="FIXED"
160     Point=100
170     File$="COM_DATA"
180     Std_file$="STD_VAL"
190     !
200     ! Initial Setting
210     !
220     OUTPUT @Hp4294a;"PRES"
230     OUTPUT @Hp4294a;"*OPC?"
240     ENTER @Hp4294a;Buff$
250     OUTPUT @Hp4294a;"CALP ";Cal_point$
260     !
270     ! Load Data
280     !
290     ASSIGN @File TO File$
300     ENTER @File;Com_o(*),Com_s(*),Com_l(*)
310     ASSIGN @File TO *
320     !
330     ASSIGN @File TO Std_file$
340     ENTER @File;Open_g,Open_c,Short_r,Short_l,Load_r,Load_l
350     ASSIGN @File TO *
360     !
370     ! Define Standard Value
380     !
390     OUTPUT @Hp4294a;"DCOMOPENG ";Open_g
400     OUTPUT @Hp4294a;"DCOMOPENC ";Open_c/1.E-15
410     OUTPUT @Hp4294a;"DCOMSHORR ";Short_r
420     OUTPUT @Hp4294a;"DCOMSHORL ";Short_l
430     OUTPUT @Hp4294a;"DCOMLOADR ";Load_r
440     OUTPUT @Hp4294a;"DCOMLOADL ";Load_l
450     !
460     ! Input Compensation Data
470     !
480     OUTPUT @Hp4294a;"FORM3"
490     Header$="#6"&IVAL$(Point*2*8,10)
500     !
510     OUTPUT @Hp4294a;"INPUCOMC1 "&Header$;
520     OUTPUT @Binary;Com_o(*),END
530     !
540     OUTPUT @Hp4294a;"INPUCOMC2 "&Header$;
550     OUTPUT @Binary;Com_s(*),END
560     !
570     OUTPUT @Hp4294a;"INPUCOMC3 "&Header$;
580     OUTPUT @Binary;Com_l(*),END
590     !
600     END
```

Port Extension Compensation

With either 7 mm or PROBE selected as the adapter, you can compensate the delay time due to port extension by using the port extension compensation functions when connecting an extension cable to the adapter.

- “PORE” on page 401

With the port extension compensation functions turned on, you can set the extent of compensation in terms of the value resulting from converting either delay time or an electrical length formulated as delay time × ray velocity. To set the extent of compensation, use the commands given below.

- “PORTZ” on page 402
- “PORTL” on page 402

5 Starting a Measurement (Trigger) and Detecting the Completion of a Measurement (End of Sweeps)

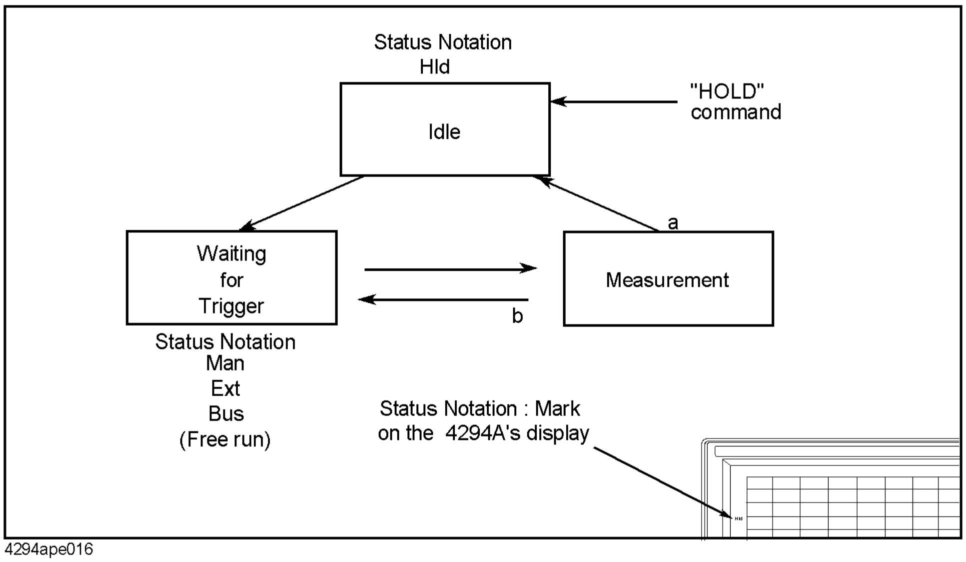
This chapter describes how to generate a trigger to start a measurement and how to detect the completion of a measurement.

Triggering a Measurement (Starting a Measurement)

Trigger system

The trigger system of the Agilent 4294A has three states: “Idle,” “Waiting for Trigger,” and “Measurement” as shown in Figure 5-1.

Figure 5-1 **Trigger system**



The state transitions in the trigger system are described below.

Executing the following command causes a transition to the “Idle” state.

- “HOLD” on page 318

Setting the number of sweeps with the following commands causes a transition to the “Waiting for Trigger” state.

Command	Number of measurements
“SING” on page 437	Once
“NUMG” on page 364	Specified number of times
“CONT” on page 282	Continuous (until “HOLD”, “SING”, or “NUMG” is executed)

Generating a trigger in the “Waiting for Trigger” state causes a transition to the “Measurement” state and initiates a measurement (one or more sweeps). The method used to generate a trigger varies with the trigger source setting. To set the trigger source, use the following command.

- “TRGS” on page 459

Trigger source setting	Method of generating a trigger
Internal trigger (INT)	Automatically generates an internal trigger.
External trigger (EXT)	Enters a trigger signal from the EXT TRIGGER terminal on the rear panel to generate a trigger.
GPIB/LAN trigger (BUS)	Executes the “*TRG” command on page 261 or the HP BASIC TRIGGER command to generate a trigger.
Manual trigger (MAN)	Uses the following key sequence on the front panel to generate a trigger: **[Trigger]** - **SOURCE[ ]** - **MANUAL**

The state transition after the completion of each sweep varies depending on the sweep count setting.

Once — Transitions to the “Idle” state (a in Figure 5-1).

Specified number of times — Repeats a transition to the “Waiting for Trigger” state until the specified number of sweeps are completed (b in Figure 5-1). After the completion of the specified number of sweeps, there is a transition to the “Idle” state (a in Figure 5-1).

Continuous — Repeats a transition to the trigger wait state (b in Figure 5-1).

Triggering a measurement

To make measurements continuously (to automatically generate triggers continuously)

Step 1. Use the “TRGS” command to set the trigger source to the internal trigger.

Step 2. Use the “CONT” command to set the sweep setting to continuous sweep.

To make a measurement at any desired time (to generate a trigger from an external controller)

Step 1. Use the “TRGS” command to set the trigger source to the internal trigger.

Step 2. Use the “SING” or “NUMG” command to execute a single sweep or the specified number of sweeps at any desired time.

Or

Step 1. Use the “TRGS” command to set the trigger source to the GPIB/LAN trigger.

Step 2. Use the “CONT” command to set the sweep setting to continuous sweep.

Step 3. Execute the “*TRG” command on page 261 or the HP BASIC TRIGGER command (execute the group execution trigger) at any desired time.

NOTE You can use the group execution trigger (GET) when you want to simultaneously trigger all devices connected to the controller that can be triggered.

Waiting for the Completion of One or More Sweeps (Detecting the Completion of a Measurement)

Using the status register

You can detect the state of the Agilent 4294A through its status register. The completion of one or more sweeps is indicated by the instrument event status register. To detect the completion of one or more sweeps from a program using the information in this register, use an SRQ (service request).

To detect the completion of one or more sweeps with an SRQ, use the commands below.

- “*SRE” on page 260
- “ESNB” on page 314

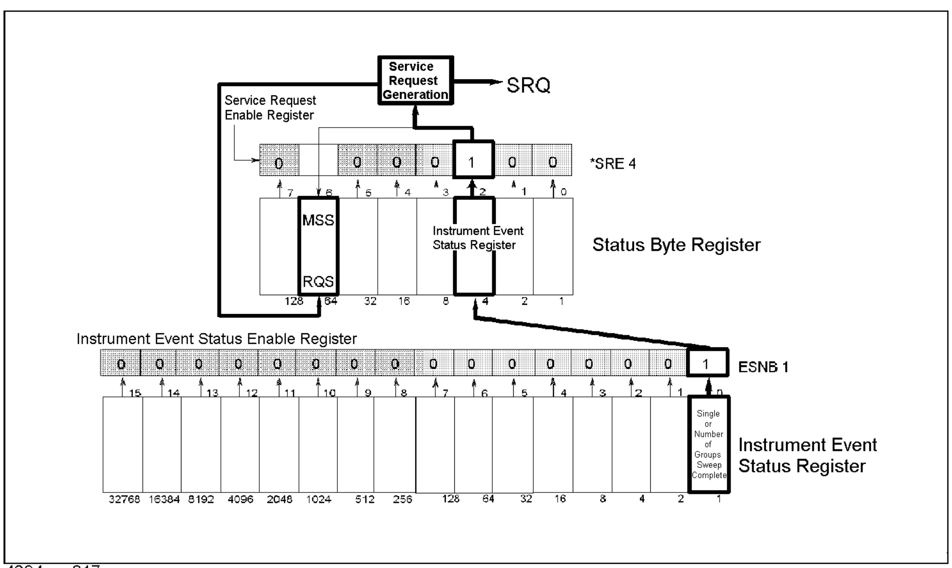
The procedure is as follows:

Step 1. Make the setting so that the Agilent 4294A generates an SRQ when the sweep completion bit in the instrument event status register is set to “1.”

Step 2. Generate a trigger to start one or more sweeps.

Step 3. Perform the interrupt processing in the program when an SRQ is generated.

Figure 5-2 **SRQ generation sequence (at the end of one or more sweeps)**



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Example 5-1 is a sample program using an SRQ to detect the completion of sweeps. This program is stored on the sample program disk with the swp_srq.bas filename.

This program sets the sweep averaging factor to 4, makes the SRQ setting, and then performs four sweeps. When an SRQ is generated at the completion of the sweeps, the program displays the completion message and then finishes.

Lines 30 to 90	Identifies the external controller and Instrument BASIC and sets the GPIB address and the select code.
Lines 110 to 130	Sets the trigger source to the internal trigger and sets the sweep averaging factor to 4.
Lines 150 to 160	Enables Bit 0 (sweep completion bit) in the instrument event status register and sets Bit 2 in the service request enable register to 1.

NOTE In addition to the sweep completion bit, another bit is provided separately to indicate the completion of data measurements for adapter setting, user calibration, and fixture compensation. To detect the completion of these measurements, enable Bit 8 in the instrument event status register.

Lines 170 to 190	Clears the status byte register and the instrument event status register.
Lines 210 to 220	Sets the branch destination for the SRQ interrupt and enables the SRQ interrupt can be used.
Line 230	Executes the command to perform four sweeps.
Line 250	Waits for the completion of the sweeps.
Line 260	Displays the sweep completion message.

Example 5-1 **Detecting the completion of sweeps using an SRQ**

```
10      DIM Buff$[9]
20      INTEGER Scode
30      IF SYSTEM$("SYSTEM ID")="HP4294A" THEN
40        ASSIGN @Hp4294a TO 800
50        Scode=8
60      ELSE
70        ASSIGN @Hp4294a TO 717
80        Scode=7
90      END IF
100     !
110     OUTPUT @Hp4294a;"TRGS INT"
120     OUTPUT @Hp4294a;"AVERFACT 4"
130     OUTPUT @Hp4294a;"AVER ON"
140     !
150     OUTPUT @Hp4294a;"ESNB 1"
160     OUTPUT @Hp4294a;"*SRE 4"
170     OUTPUT @Hp4294a;"*CLS"
180     OUTPUT @Hp4294a;"*OPC?"
190     ENTER @Hp4294a;Buff$
200     !
210     ON INTR Scode GOTO Swp_end
220     ENABLE INTR Scode;2
230     OUTPUT @Hp4294a;"NUMG 4"
240     PRINT "Waiting..."
250 Swp_wait:  GOTO Swp_wait
260 Swp_end:  PRINT "Sweep Complete"
270     END
```

Using the *OPC? command

The “SING” command on page 437 and “NUMG” command on page 364 are overlap commands whose executions are finished at the completion of one or more sweeps. Therefore, if you start one or more sweeps with these commands, you can detect their completion with the following command.

- “*OPC?” on page 259

Example 5-2 shows a sample program to detect the completion of a sweep by using the “*OPC?” command. This program is stored on the sample program disk with the swp_opc.bas filename.

This program starts a sweep from the “SING” command, waits for the completion of this command’s execution with the “*OPC?” command (the completion of a single sweep), displays a message at the completion of the sweep, and then finishes.

Lines 20 to 60	Identifies the external controller and Instrument BASIC and sets the GPIB address.
Line 80	Sets the trigger source to the internal trigger.
Lines 90	Starts a single sweep.
Lines 110 to 120	Executes the “*OPC?” command and waits for 1 to be returned (the completion of the sweep).
Line 130	Displays the sweep completion message.

Example 5-2 **Detecting the completion of a sweep using the “*OPC?” command**

```
10      DIM Buff$[9]
20      IF SYSTEM$("SYSTEM ID")="HP4294A" THEN
30        ASSIGN @Hp4294a TO 800
40      ELSE
50        ASSIGN @Hp4294a TO 717
60      END IF
70      !
80      OUTPUT @Hp4294a;"TRGS INT"
90      OUTPUT @Hp4294a;"SING"
100     PRINT "Waiting..."
110     OUTPUT @Hp4294a;"*OPC?"
120     ENTER @Hp4294a;Buff$
130     PRINT "Sweep Complete"
140     END
```

Inserting a wait

You can use a setting to make the controller wait for the completion of one or more sweeps performed by the Agilent 4294A (for example, using the WAIT command of HP BASIC). This method is simple, but if you set an inappropriate wait, unexpected errors could occur.

6 Reading/Writing Measurement Data

This chapter describes how to read and write measurement data and how to obtain level monitoring and limit test results.

Data Transfer Format

The format applicable when you read measurement parameter settings from the Agilent 4294A (as when you read the sweep start point with “STAR?”) is the ASCII format, regardless of which data transfer format has been specified.

You can select either the ASCII format (default) or one of the binary formats for reading measurement data, waveform analysis results and so on from the Agilent 4294A (as when you read a data trace array with “OUTPDTRC?”). As for binary formats, you can select the IEEE 32-bit floating point format, IEEE 64-bit floating point format, or MS-DOS personal computer format as the appropriate format for your controller. Use the following commands for selecting a desired data transfer format:

Data Transfer Format	Command
IEEE 32-bit floating point format	“FORM2” on page 316
IEEE 64-bit floating point format	“FORM3” on page 316
ASCII format (Default)	“FORM4” on page 317
MS-DOS personal computer format	“FORM5” on page 317

ASCII format (Form 4)

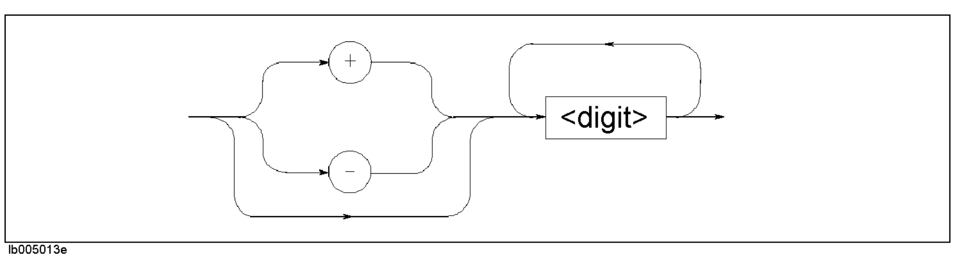
When you select the ASCII format as the data transfer format, numbers are transferred as ASCII bytes, each of which corresponds to one of the formats shown below. Note that numbers are separated from one another with a comma (“,”) in accordance with the IEEE 488.2 specification.

NOTE Each numeric data character string is different in length from the others. Before extracting each piece of data from character strings, therefore, you must remember that commas do not always appear in the same locations.

- Integer Format

  Figure 6-1 shows this format. Numbers are expressed as integers. For example, 201 is expressed as “+201” or “201.”

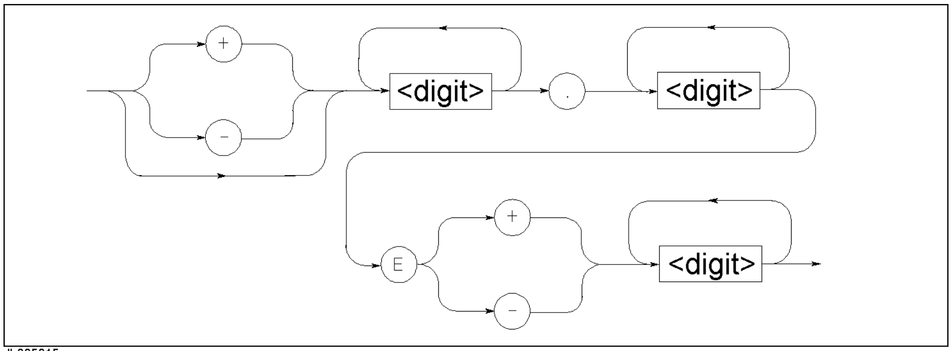
Figure 6-1 **Integer Format**



- Floating Point Format

  Figure 6-2 shows this format. Numbers are expressed with floating points. For example, 1000 is expressed as “1.0E3.”

Figure 6-2 Floating Point Format

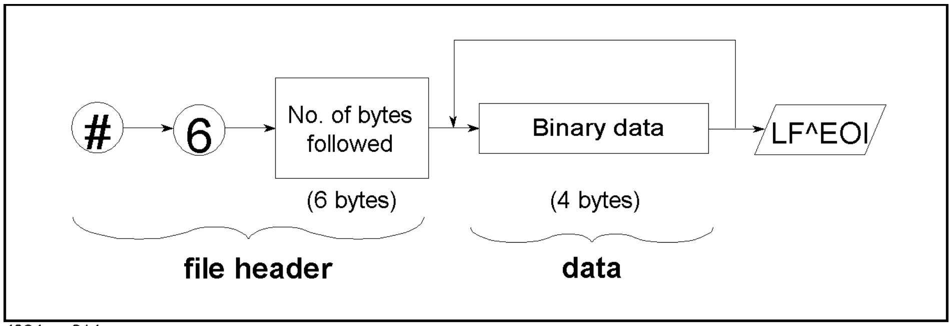


lb005015e

IEEE 32-bit floating point format (Form 2)

In this format, each number is expressed by four bytes. Therefore, data containing 201 measured values is 1,608 bytes long (two pieces of data per measurement point). Numbers are transferred in the format shown in Figure 6-3.

Figure 6-3 IEEE 32-bit Floating Point Data Transfer Format

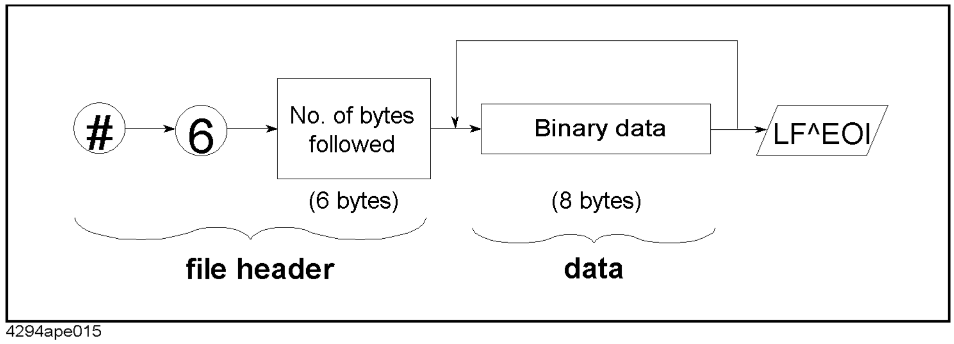


4294ape014

IEEE 64-bit floating point format (Form 3)

With this format, each number is expressed with eight bytes. Therefore, data containing 201 measured values is 3,216 bytes long (2 pieces of data per measurement point). Numbers are transferred in the format shown in Figure 6-4.

Figure 6-4 **IEEE 64-bit Floating Point Data Transfer Format**



MS-DOS personal computer format (Form 5)

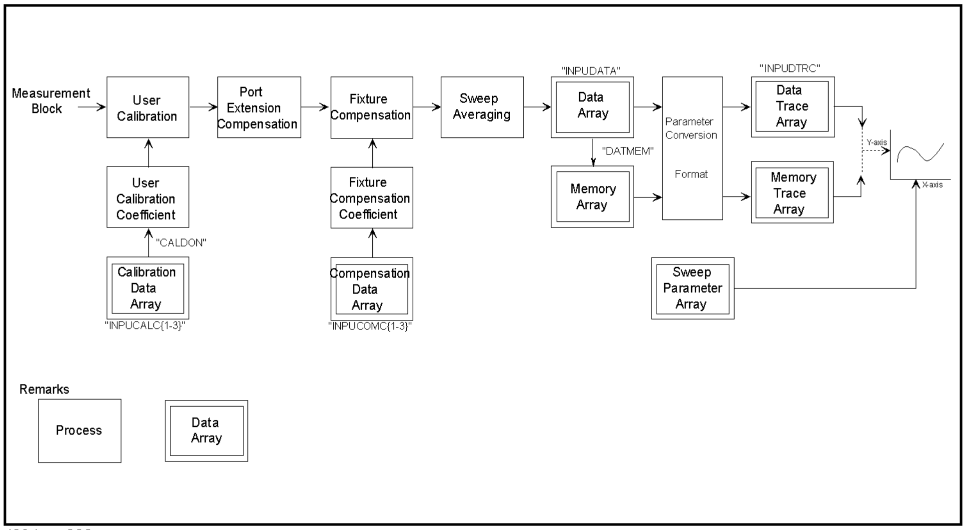
This format is identical to the IEEE 32-bit floating point format except that data bytes are arranged in the reverse order. You do not need to reformat your data as you manipulate it on a personal computer in the DOS environment.

Internal Data Processing

Data processing sequence

Figure 6-5 outlines the sequence of data processing performed within the Agilent 4294A.

Figure 6-5 **Agilent 4294A Data Processing Sequence**



4294ape020

The following describe each of the data arrays shown in Figure 6-5.

Internal data arrays

Data array

The data array contains the results of user calibration, port extension compensation, sweep averaging and fixture compensation performed on the measured data. Each result is stored as a complex number (R-X). Use the following commands to read or write the data array.

- “OUTPDATA?” on page 375
- “OUTPDATAP?” on page 375
- “INPUDATA” on page 321

Memory array

The memory array contains a copy of the data array available when the “DATMEM” command on page 285 is executed. Use the following commands to read the memory array. Note that you cannot write any part of the memory array.

- “OUTPMEMO?” on page 385
- “OUTPMEMOP?” on page 385

Data trace array

The data trace array contains data that appears on the screen as data trace, that is, the result of measurement parameter conversion and arithmetic performed on the data array. Each result is stored as a complex number, regardless of whether the data is a scalar or vector. Therefore, if the data is a scalar, "0" is stored in the imaginary number part. Use the following commands to read or write the data trace array.

- "OUTPDTRC?" on page 378
- "OUTPDTRCP?" on page 379
- "INPUDTRC" on page 322

Memory trace array

The memory trace array contains data that appears on the screen as memory trace, that is, the result of parameter conversion performed on the memory array. Use the following commands to read the memory trace array. Note that you cannot write any part of the memory trace array.

- "OUTPMTRC?" on page 388
- "OUTPMTRCP?" on page 389

Calibration data array

The calibration data array contains open, short and load measurement data used for calculation of the user calibration coefficient. These data are stored as complex numbers. Three different types of arrays are available to choose from depending on the type of measurement data (open, short, or load data).

Array Number*1	Stored Data
1	Open measurement data (G-B) for user calibration coefficient calculation
2	Short measurement data (R-X) for user calibration coefficient calculation
3	Load measurement data (R-X) for user calibration coefficient calculation

*1.This number corresponds to the number provided at the end of the command.

Use the following commands to read or write the calibration data array.

- "OUTPCALC{1-3}?" on page 373
- "INPUCALC{1-3}" on page 320

The calibration coefficient is calculated and stored in volatile memory (RAM) when all arrays are written.

Compensation data array

The compensation data array contains open, short and load measurement data used for calculation of the fixture compensation coefficient. These data are stored as complex numbers. Three different types of arrays are available to choose from depending on the type of measurement data (open, short, or load data).

Array Number*1	Stored Data
1	Open measurement data (G-B) for fixture compensation coefficient calculation
2	Short measurement data (R-X) for fixture compensation coefficient calculation
3	Load measurement data (R-X) for fixture compensation coefficient calculation

*1. This number corresponds to the number provided at the end of the command.

Use the following commands to read or write the compensation data array.

- “OUTPCOMC{1-3}?” on page 374
- “INPUCOMC{1-3}” on page 321

Sweep parameter array

The sweep parameter array contains sweep parameters for all measurement points. Use the following commands to read the sweep parameter array. Note that you cannot write any part of the sweep parameter array.

- “OUTPSWPRM?” on page 394
- “OUTPSWPRMP?” on page 394

Saving array as file

You can save an internal data array as a file. This feature saves time and effort because you can recall the file later and avoid the need to again perform the arithmetic. Use the following commands to save or recall an internal data array. See Chapter 8 , “Saving/Recalling a Measurement Result/Measurement Setup,” for more information.

- “SAVCAL” on page 416
- “SAVDAT” on page 417
- “SAVDTRC” on page 420
- “SAVMEM” on page 420
- “SAVMTRC” on page 421
- “SAVDASC” on page 416
- “SAVDDAT” on page 417
- “RECD” on page 408

NOTE

You can save an internal data array in the touchstone format by “SAVDS1P” on page 418. But you cannot recall the file.

Reading/Writing Data

Reading/writing measurement data

Reading/writing array in ASCII format

Example 6-1 shows the process of reading and writing array data in the ASCII format. This program is available under the filename of “data_b2a.bas” on the sample program disk.

This program reads the data trace array for trace B in ASCII format and writes it to the data trace array for trace A.

Lines 30 to 70	Identifies the external controller and Instrument BASIC and sets the GPIB address.
Line 90	Substitutes the number of measurement points into the “Nop” variable.
Lines 110 to 120	Specifies ASCII format as data transfer format and sets the number of measurement points to Nop.
Lines 140 to 150	Holds the trigger and displays traces A and B on separate screens.
Lines 160 to 190	Specifies trace B as active trace, performs auto scaling, and reads the display format to assign it the “Fmt$” variable.
Lines 210 to 220	Reads the data trace array for trace B and stores it in Trc(*).
Lines 240 to 250	Specifies trace A as active trace and sets the display format to “Fmt$.”
Line 260	Writes “Trc(*)” to the data trace array for trace A.
Line 270	Performs auto-scaling.

Example 6-1 **Reading/Writing Data Trace Array in the ASCII Format**

```
10      DIM Trc(1:201,1:2),Fmt$[9]
20      INTEGER Nop
30      IF SYSTEM$("SYSTEM ID")="HP4294A" THEN
40        ASSIGN @Hp4294a TO 800
50      ELSE
60        ASSIGN @Hp4294a TO 717
70      END IF
80      !
90      Nop=201
100     !
110     OUTPUT @Hp4294a;"FORM4"
120     OUTPUT @Hp4294a;"POIN ";Nop
130     !
140     OUTPUT @Hp4294a;"HOLD"
150     OUTPUT @Hp4294a;"SPLD ON"
160     OUTPUT @Hp4294a;"TRAC B"
170     OUTPUT @Hp4294a;"AUTO"
180     OUTPUT @Hp4294a;"FMT?"
190     ENTER @Hp4294a;Fmt$
200     !
210     OUTPUT @Hp4294a;"OUTPDTRC?"
220     ENTER @Hp4294a;Trc(*)
230     !
```

```
240     OUTPUT @Hp4294a;"TRAC A"
250     OUTPUT @Hp4294a;"FMT "&Fmt$
260     OUTPUT @Hp4294a;"INPUDTRC ";Trc(*)
270     OUTPUT @Hp4294a;"AUTO"
280     !
290     END
```

Reading/writing data array in a binary format

Example 6-2 shows the process of reading and writing array in binary format. This program is available under the filename of “mem2dat.bas” on the sample program disk.

This program reads the memory trace array for trace A in the IEEE 64-bit floating point format and writes it to the data trace array.

Lines 30 to 90	Identifies the external controller and Instrument BASIC and sets the GPIB address.
Lines 110 to 120	Substitutes the trace selected as the active trace and the number of measurement points into the corresponding variables Act_trc$ and Nop, respectively.
Lines 140 to 150	Specifies the IEEE 64-bit floating point format as data transfer format and sets the number of measurement points to Nop.
Lines 170 to 180	Holds the trigger and sets the active trace to Act_trc$.
Lines 190 to 200	Clears error queue and specifies memory trace as the trace to be displayed.
Lines 210 to 220	Checks for errors.
Line 240	An error message appears if error No. 34 occurs (error indicating that an attempt was made to use memory trace when no data has been stored as memory trace). In the event of this error, program execution stops without performing any operation.
Lines 260 to 270	Executes a memory trace array read command, reads the header, and substitutes it into the “Header$” variable.
Line 280	Reads the memory trace array and stores it in “Trc(*)” (array variable). Binary data must be read without being formatted; therefore, an I/O path (@Binary) that has been set to read without being formatted is used.
Line 290	Reads the terminator (LF^EOI) provided at the end of the data.
Line 310	Specifies data trace as the trace to be displayed.
Lines 320 to 330	Writes “Trc(*)” to the data trace array by first sending a data trace array write command with “Header$” (header part). Next, “Trc(*)” (data part) is sent. When the data part is sent, an I/O path (@Binary) that has been set to send without being formatted is used.

Example 6-2 **Reading/Writing Data Trace Array in a Binary Format**

```
10      DIM Trc(1:201,1:2),Act_trc$[9],Err_mes$[50],Header$[9],Buff$[9]
20      INTEGER Err_no,Nop
30      IF SYSTEM$("SYSTEM ID")="HP4294A" THEN
40        ASSIGN @Hp4294a TO 800
50        ASSIGN @Binary TO 800;FORMAT OFF
60      ELSE
70        ASSIGN @Hp4294a TO 717
80        ASSIGN @Binary TO 717;FORMAT OFF
90      END IF
100     !
110     Act_trc$="A"
120     Nop=201
130     !
140     OUTPUT @Hp4294a;"FORM3"
150     OUTPUT @Hp4294a;"POIN ";Nop
160     !
170     OUTPUT @Hp4294a;"HOLD"
180     OUTPUT @Hp4294a;"TRAC "&Act_trc$
190     OUTPUT @Hp4294a;"*CLS"
200     OUTPUT @Hp4294a;"DISP MEMO"
210     OUTPUT @Hp4294a;"OUTPERRO?"
220     ENTER @Hp4294a;Err_no,Err_mes$
230     IF Err_no=34 THEN
240       PRINT Err_mes$
250     ELSE
260       OUTPUT @Hp4294a;"OUTPMTRC?"
270       ENTER @Hp4294a USING "#,8A";Header$
280       ENTER @Binary;Trc(*)
290       ENTER @Hp4294a USING "#,1A";Buff$
300       !
310       OUTPUT @Hp4294a;"DISP DATA"
320       OUTPUT @Hp4294a;"INPUDTRC "&Header$;
330       OUTPUT @Binary;Trc(*),END
340     END IF
350     !
360     END
```

Reading level monitoring results

To read monitoring results of oscillator (OSC) power and dc bias levels, you need to use the following commands to turn ON the level monitor function before starting measurements:

- “OMON” on page 365
- “BMON” on page 272

Use the following commands to read the level monitoring results:

- “OUTPVAC?” on page 394
- “OUTPVACP?” on page 395
- “OUTPIAC?” on page 380
- “OUTPIACP?” on page 381
- “OUTPDC?” on page 376
- “OUTPDCP?” on page 376

Example 6-3 shows a sample program to read the level monitoring results. This program is available under the filename of “lvl_mon.bas” on the sample program disk.

This program specifies the oscillator power and dc bias levels, turns ON the level monitor function, performs a sweep once, and reads and displays the level monitoring results.

Lines 50 to 110	Identifies the external controller and Instrument BASIC and sets the GPIB address.
Lines 130 to 170	Substitutes the selected signal source output mode, the signal source output level, the dc bias level, the dc bias range, and the selected dc bias monitor function into the corresponding variables Osc_mode$, Osc_pow, Dc_bias, Dc_b_rng$, and Mon_bias$, respectively.
Lines 190 to 220	Resets the Agilent 4294A and then sets the sweep start point, the sweep stop point, and the number of measurement points to 10 MHz, 20 MHz, and 11, respectively.
Lines 230 to 270	Sets the signal source output mode, the signal source output level, the dc bias level, and the dc bias range to Osc_mode$, Osc_pow, Dc_bias and Dc_b_rng$, respectively.
Lines 280 to 300	Turns ON the dc bias output and the signal source output level monitor function and sets the selected dc bias monitor function to Mon_bias$.
Lines 320 to 340	Performs sweep once and waits for the sweep to be completed.
Line 360	Specifies the IEEE 64-bit floating point format as data transfer format.
Lines 380 to 410	Reads the signal source voltage level found by monitoring and stores it in “Mon_osc_v(*).”
Lines 430 to 460	Reads the signal source current level found by monitoring and stores it in “Mon_osc_i(*).”
Lines 480 to 510	Reads the DC bias level found by monitoring and stores it in “Mon_bias(*).”
Lines 530 to 560	Reads the sweep parameter array and stores it in “Swp_prm(*).”

Lines 580 to 630 Displays the contents of “Swp_prm(*)”, “Mon_osc_v(*)”, “Mon_osc_i(*)”, and “Mon_bias(*).”

Example 6-3 **Reading Level Monitoring Results**

```
10    DIM Mon_osc_v(1:11),Mon_osc_i(1:11),Mon_bias(1:11),Swp_prm(1:11)
20    DIM Osc_mode$[9],Mon_bias$[9],Header$[9],Buff$[9],Img$[30]
30    REAL Osc_pow,Dc_bias
40    CLEAR SCREEN
50    IF SYSTEM$("SYSTEM ID")="HP4294A" THEN
60      ASSIGN @Hp4294a TO 800
70      ASSIGN @Binary TO 800;FORMAT OFF
80    ELSE
90      ASSIGN @Hp4294a TO 717
100     ASSIGN @Binary TO 717;FORMAT OFF
110   END IF
120   !
130   Osc_mode$="VOLT"
140   Osc_pow=1.0
150   Dc_bias=12.0
160   Dc_b_rng$="M10"
170   Mon_bias$="VOLT"
180   !
190   OUTPUT @Hp4294a;"PRES"
200   OUTPUT @Hp4294a;"STAR 10MHZ"
210   OUTPUT @Hp4294a;"STOP 20MHZ"
220   OUTPUT @Hp4294a;"POIN 11"
230   OUTPUT @Hp4294a;"POWMOD "&Osc_mode$
240   OUTPUT @Hp4294a;"POWE ";Osc_pow
250   OUTPUT @Hp4294a;"DCMOD VOLT"
260   OUTPUT @Hp4294a;"DCV ";Dc_bias
270   OUTPUT @Hp4294a;"DCRNG "&Dc_b_rng$
280   OUTPUT @Hp4294a;"DCO ON"
290   OUTPUT @Hp4294a;"OMON ON"
300   OUTPUT @Hp4294a;"BMON "&Mon_bias$
310   !
320   OUTPUT @Hp4294a;"SING"
330   OUTPUT @Hp4294a;"*OPC?"
340   ENTER @Hp4294a;Buff$
350   !
360   OUTPUT @Hp4294a;"FORM3"
370   !
380   OUTPUT @Hp4294a;"OUTPVAC?"
390   ENTER @Hp4294a USING "#,8A";Header$
400   ENTER @Binary;Mon_osc_v(*)
410   ENTER @Hp4294a USING "#,1A";Buff$
420   !
430   OUTPUT @Hp4294a;"OUTPIAC?"
440   ENTER @Hp4294a USING "#,8A";Header$
450   ENTER @Binary;Mon_osc_i(*)
460   ENTER @Hp4294a USING "#,1A";Buff$
470   !
480   OUTPUT @Hp4294a;"OUTPDC?"
490   ENTER @Hp4294a USING "#,8A";Header$
500   ENTER @Binary;Mon_bias(*)
510   ENTER @Hp4294a USING "#,1A";Buff$
520   !
530   OUTPUT @Hp4294a;"OUTPSWPRM?"
540   ENTER @Hp4294a USING "#,8A";Header$
550   ENTER @Binary;Swp_prm(*)
560   ENTER @Hp4294a USING "#,1A";Buff$
570   !
580   Img$="D.2DE,X,Z.4D,X,D.4DE,X,2D.3D"
```

```
590     PRINT "LEVEL MONITOR RESULT"
600     PRINT "Freq[Hz] OscV[V] OscI[A]   DC V[V]"
610     FOR I=1 TO 11
620       PRINT USING Img$;Swp_prm(I),Mon_osc_v(I),Mon_osc_i(I),Mon_bias(
I)
630     NEXT I
640     END
```

Reading limit test results

To read limit test results, use the following commands:

- “OUTPFAIP?” on page 380
- “OUTPLIML?” on page 383
- “OUTPLIMF?” on page 383
- “OUTPLIMM?” on page 384

Example 6-3 shows a sample program for reading limit test results. This program is available under the filename of “lim_test.bas” on the sample program disk.

This program creates a limit line table, turns ON the limit test function, performs sweep once, and reads and displays those pieces of measurement data found to be unacceptable.

Lines 100 to 140	Identifies the external controller and Instrument BASIC and sets the GPIB address.
Lines 150 to 220	Substitutes the measurement parameter selection, the sweep start point, the sweep stop point, the number of measurement points, the maximum and minimum values of screen for trace A, and the maximum and minimum values of screen for trace B into the corresponding variables Meas_para$, Star, Stop, Nop, Top_a, Btm_a, Top_b, and Btm_b, respectively.
Lines 240 to 410	Substitutes the start point, the upper and lower limits for start point, the stop point, and the upper and lower limits for stop point for each of the limit line table segments into the corresponding variables Lim_star_a(*), U_lim_star_a(*), L_lim_star_a(*), Lim_stop_a(*), U_lim_stop_a(*), and L_lim_stop_a(*), respectively.
Lines 430 to 600	Substitutes the parameters of the limit line table for trace B into the corresponding variables Lim_star_b(*), U_lim_star_b(*), L_lim_star_b(*), Lim_stop_b(*), U_lim_stop_b(*), and L_lim_stop_b(*) respectively.
Lines 620 to 670	Resets the Agilent 4294A and then sets the measurement parameters, the sweep start point, the sweep stop point, and the number of measurement points to the corresponding variables Meas_para$, Star, Stop, and Nop and enables traces A and B to be displayed on separate screens.
Lines 690 to 710	Specifies trace A as the active trace and sets the maximum and minimum value of the screen for trace A to Top_a and Btm_a, respectively.
Lines 720 to 850	Creates a limit line table for trace A and turns ON the limit test function.

Line 870 to 890	Specifies trace B as the active trace and sets the maximum and minimum value of the screen for trace B to Top_b and Btm_b, respectively.
Lines 900 to 1030	Creates a limit line table for trace B and turns ON the limit test function.
Lines 1050 to 1070	Performs a sweep once and waits for the sweep to be completed.
Lines 1090 to 1110	Specifies trace A as the active trace and then reads the number of measurement points for trace A where the measurement data were found to be unacceptable.
Lines 1130 to 1230	Specifies the ASCII format as the data transfer format and reads and displays the sweep parameter value, test result, and upper and lower limits for each of the measurement points for trace A where the measurement data were found to be unacceptable.
Line 1250	Displays a message if the measurement data at all measurement points for trace A were found to be acceptable.
Lines 1280 to 1300	Specifies trace B as the active trace and then reads the number of measurement points for trace B where the measurement data were found to be unacceptable.
Lines 1320 to 1420	Specifies the ASCII format as data transfer format and reads and displays the sweep parameter value, test result, and upper and lower limits for each of the measurements points for trace B where the measurement data were found to be unacceptable.
Line 1440	Displays a message if the measurement data at all measurement points for trace B were found to be acceptable.

Example 6-4 **Reading Limit Test Results**

```
10      REAL Star,Stop,Top_a,Btm_a,Top_b,Btm_b
20      REAL Fail_res_a(1:41,1:4),Fail_res_b(1:41,1:4)
30      REAL Lim_star_a(1:3),U_lim_star_a(1:3),L_lim_star_a(1:3)
40      REAL Lim_stop_a(1:3),U_lim_stop_a(1:3),L_lim_stop_a(1:3)
50      REAL Lim_star_b(1:3),U_lim_star_b(1:3),L_lim_star_b(1:3)
60      REAL Lim_stop_b(1:3),U_lim_stop_b(1:3),L_lim_stop_b(1:3)
70      DIM Meas_para$[9],Buff$[9]
80      INTEGER Nop,Fail_nop
90      CLEAR SCREEN
100     IF SYSTEM$("SYSTEM ID")="HP4294A" THEN
110       ASSIGN @Hp4294a TO 800
120     ELSE
130       ASSIGN @Hp4294a TO 717
140     END IF
150     Meas_para$="CSD"
160     Star=1.0E+7
170     Stop=5.0E+7
180     Nop=41
190     Top_a=2.0E-5
200     Btm_a=0.
210     Top_b=.02
220     Btm_b=0.
230     !
240     Lim_star_a(1)=1.0E+7
250     U_lim_star_a(1)=1.2E-5
260     L_lim_star_a(1)=8.E-6
270     Lim_stop_a(1)=2.0E+7
280     U_lim_stop_a(1)=1.2E-5
290     L_lim_stop_a(1)=8.E-6
300     Lim_star_a(2)=2.0E+7
310     U_lim_star_a(2)=1.2E-5
320     L_lim_star_a(2)=8.E-6
330     Lim_stop_a(2)=4.0E+7
340     U_lim_stop_a(2)=1.5E-5
350     L_lim_stop_a(2)=5.E-6
360     Lim_star_a(3)=4.0E+7
370     U_lim_star_a(3)=1.5E-5
380     L_lim_star_a(3)=5.E-6
390     Lim_stop_a(3)=5.0E+7
400     U_lim_stop_a(3)=1.5E-5
410     L_lim_stop_a(3)=5.E-6
420     !
430     Lim_star_b(1)=1.0E+7
440     U_lim_star_b(1)=.005
450     L_lim_star_b(1)=0.
460     Lim_stop_b(1)=2.0E+7
470     U_lim_stop_b(1)=.005
480     L_lim_stop_b(1)=0.
490     Lim_star_b(2)=2.0E+7
500     U_lim_star_b(2)=.005
510     L_lim_star_b(2)=0.
520     Lim_stop_b(2)=4.0E+7
530     U_lim_stop_b(2)=.01
540     L_lim_stop_b(2)=0.
550     Lim_star_b(3)=4.0E+7
560     U_lim_star_b(3)=.01
570     L_lim_star_b(3)=0.
580     Lim_stop_b(3)=5.0E+7
590     U_lim_stop_b(3)=.01
600     L_lim_stop_b(3)=0.
610     !
```

```
620     OUTPUT @Hp4294a;"PRES"
630     OUTPUT @Hp4294a;"MEAS "&Meas_para$
640     OUTPUT @Hp4294a;"STAR ";Star
650     OUTPUT @Hp4294a;"STOP ";Stop
660     OUTPUT @Hp4294a;"POIN ";Nop
670     OUTPUT @Hp4294a;"SPLD ON"
680     !
690     OUTPUT @Hp4294a;"TRAC A"
700     OUTPUT @Hp4294a;"TOPV ";Top_a
710     OUTPUT @Hp4294a;"BOTV ";Btm_a
720     OUTPUT @Hp4294a;"EDITLIML"
730     FOR I=1 TO 3
740       OUTPUT @Hp4294a;"LIMSADD"
750       OUTPUT @Hp4294a;"LIMSTAR ";Lim_star_a(I)
760       OUTPUT @Hp4294a;"LIMUSTAR ";U_lim_star_a(I)
770       OUTPUT @Hp4294a;"LIMLSTAR ";L_lim_star_a(I)
780       OUTPUT @Hp4294a;"LIMSTOP ";Lim_stop_a(I)
790       OUTPUT @Hp4294a;"LIMUSTOP ";U_lim_stop_a(I)
800       OUTPUT @Hp4294a;"LIMLSTOP ";L_lim_stop_a(I)
810       OUTPUT @Hp4294a;"LIMSTEST ON"
820       OUTPUT @Hp4294a;"LIMSDON"
830     NEXT I
840     OUTPUT @Hp4294a;"LIMEDONE"
850     OUTPUT @Hp4294a;"LIMITEST ON"
860     !
870     OUTPUT @Hp4294a;"TRAC B"
880     OUTPUT @Hp4294a;"TOPV ";Top_b
890     OUTPUT @Hp4294a;"BOTV ";Btm_b
900     OUTPUT @Hp4294a;"EDITLIML"
910     FOR I=1 TO 3
920       OUTPUT @Hp4294a;"LIMSADD"
930       OUTPUT @Hp4294a;"LIMSTAR ";Lim_star_b(I)
940       OUTPUT @Hp4294a;"LIMUSTAR ";U_lim_star_b(I)
950       OUTPUT @Hp4294a;"LIMLSTAR ";L_lim_star_b(I)
960       OUTPUT @Hp4294a;"LIMSTOP ";Lim_stop_b(I)
970       OUTPUT @Hp4294a;"LIMUSTOP ";U_lim_stop_b(I)
980       OUTPUT @Hp4294a;"LIMLSTOP ";L_lim_stop_b(I)
990       OUTPUT @Hp4294a;"LIMSTEST ON"
1000      OUTPUT @Hp4294a;"LIMSDON"
1010    NEXT I
1020    OUTPUT @Hp4294a;"LIMEDONE"
1030    OUTPUT @Hp4294a;"LIMITEST ON"
1040    !
1050    OUTPUT @Hp4294a;"SING"
1060    OUTPUT @Hp4294a;"*OPC?"
1070    ENTER @Hp4294a;Buff$
1080    !
1090    OUTPUT @Hp4294a;"TRAC A"
1100    OUTPUT @Hp4294a;"OUTPFAIP?"
1110    ENTER @Hp4294a;Fail_nop
1120    !
1130    IF Fail_nop>0 THEN
1140      OUTPUT @Hp4294a;"FORM4"
1150      OUTPUT @Hp4294a;"OUTPLIMF?"
1160      FOR I=1 TO Fail_nop
1170        ENTER @Hp4294a USING "#,K,K,K,K";Fail_res_a(I,1),Fail_res_a(I,
2),Fail_res_a(I,3),Fail_res_a(I,4)
1180      NEXT I
1190      PRINT "-- Trace A Failed Point --"
1200      PRINT "Frequency  L_Limit   U_Limit"
1210      FOR I=1 TO Fail_nop
1220        PRINT Fail_res_a(I,1),Fail_res_a(I,4),Fail_res_a(I,3)
1230      NEXT I
1240    ELSE
```

```
1250     PRINT "-- Trace A All Pass --"
1260   END IF
1270   !
1280   OUTPUT @Hp4294a;"TRAC B"
1290   OUTPUT @Hp4294a;"OUTPFAIP?"
1300   ENTER @Hp4294a;Fail_nop
1310   !
1320   IF Fail_nop>0 THEN
1330     OUTPUT @Hp4294a;"FORM4"
1340     OUTPUT @Hp4294a;"OUTPLIMF?"
1350     FOR I=1 TO Fail_nop
1360       ENTER @Hp4294a USING "#,K,K,K,K";Fail_res_b(I,1),Fail_res_b(I,2),Fail_res_b(I,3),Fail_res_b(I,4)
1370     NEXT I
1380     PRINT "-- Trace B Failed Point --"
1390     PRINT "Frequency  L_Limit   U_Limit"
1400     FOR I=1 TO Fail_nop
1410       PRINT Fail_res_b(I,1),Fail_res_b(I,4),Fail_res_b(I,3)
1420     NEXT I
1430   ELSE
1440     PRINT "-- Trace B All Pass --"
1450   END IF
1460   !
1470   END
```

When to read/write data

If a read command is executed while a sweep is in progress, the data available when the command execution starts is read. To ensure the accuracy of the data you obtain, be sure to wait until the current sweep is complete before executing a read command. Considering the time it takes for your program to be executed to completion, an efficient approach is to synchronize the execution of a read command with the completion of the current sweep. To do this, use the status report structure and the “*OPC?” command on page 259. See “Waiting for the Completion of One or More Sweeps (Detecting the Completion of a Measurement)” on page 74 for more information.

To write data properly, you need to execute a write command while no sweep is in progress. You can write data while a sweep is in progress. In this case, however, the data you write will be overwritten. You can suspend the sweep by executing the “HOLD” command on page 318.

7 Processing Measurement Results

This chapter describes how to process measurement results using the marker function, the equivalent circuit analysis function, the trace bandwidth analysis function, and analysis commands.

Reading Measurement Data at Specific Measurement Points (Using the Marker Function)

You can use the marker to read measurement data at specific points on the trace or search for the point that meets a specific condition such as the maximum value. You need to use the following command to turn ON the marker before using it.

- “MKR” on page 350

You can use the main marker (marker No. 0; hereafter referred to as the marker) when you execute the above command. To use one or more submarkers (markers No. 1–7), use the following command to turn them ON:

- “SMKR{1-7}” on page 438

You can also use the Δ marker to obtain the result of subtraction of the Δ marker-specified value from the marker- or submarker-specified value or the difference between these values. Use the following command to turn ON the Δ marker:

- “DMKR” on page 302

When you turn ON a submarker or the Δ marker, it appears where the marker is currently located.

Moving the marker

Moving the marker to specific points

Use the following commands to move the marker, one of the submarkers, or the Δ marker to a desired measurement point or sweep parameter value on the trace:.

	Specific Measurement Point	Specific Sweep Parameter Value
Marker	“MKRP” on page 357	“MKRPRM” on page 358
Submarker	“SMKRP{1-7}” on page 439	“SMKRPRM{1-7}” on page 440
Δ Marker	“DMKRP” on page 304	“DMKRPRM” on page 305

Moving after search for positions that meet specific conditions

Use the following command to search for and move the marker to specific positions on the active trace such as maximum value, minimum value, peak, and measurement parameter value (target) specified with the “SEATARG” command (page 433):

- “SEAM” on page 427

When the active trace has two or more peaks or targets, the search is made as shown below after execution of the above command.

Peak	Maximum peak (minimum peak if the peak has been defined as negative peak)
Target	Target closest to the current marker position

You can use the following commands to sequentially search for the remaining peaks or targets.

- “SEANPK” on page 427
- “SEANPKL” on page 427
- “SEANPKR” on page 428
- “SEAL” on page 426
- “SEAR” on page 428

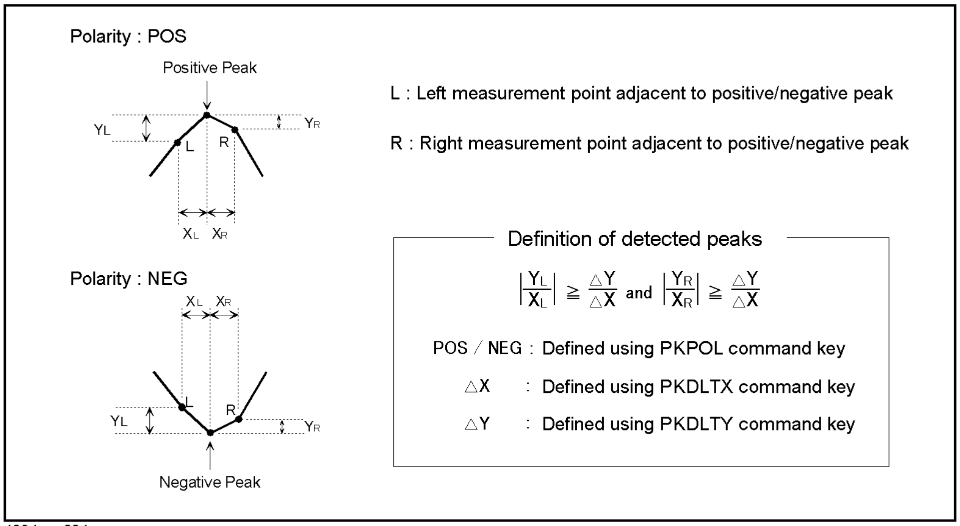
With the marker’s search function, you can search for measurement points, expressed as peaks, that meet the definitions given in Figure 7-1. Use the following commands to define a peak.

- “PKDLTX” on page 399
- “PKDLTY” on page 400
- “PKPOL” on page 400

You can use the following command to set ΔX and ΔY respectively to $|X_L|$ and $|Y_L|$ at the marker-specified measurement point.

- “MKRPKD” on page 357

Figure 7-1 Defining Peak for Search by Marker



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Search is made over the entire sweep range, unless otherwise specified. You can, however, use the following commands to limit the range to be searched:

- “PARS” on page 395
- “SEARMAX” on page 429
- “SEARMAXP” on page 430
- “SEARMIN” on page 431
- “SEARMINP” on page 432
- “MKRTR” on page 359
- “SEARNG” on page 432
- “SEGMNUM” on page 436

Reading the marker-specified value

Use the following commands to read the marker-specified measurement or sweep parameter value.

	Measurement Parameter Value	Supplementary Reading for Measurement Parameter Value (Vector)	Sweep Parameter Value
Marker	"OUTPMKR?" on page 387		
	"MKRVAL?" on page 360	"MKRAUV?" on page 351	"MKRPRM" on page 358 Used for query
Submarker	"OUTPSMKR{1-7}?" on page 393		
	"SMKRVAL{1-7}?" on page 441	"SMKRAUV{1-7}?" on page 438	"SMKRPRM{1-7}" on page 440 Used for query
Δ Marker	"OUTPDMKR?" on page 377		
	"DMKRVAL" on page 306 Used for query*1	"DMKRAUV" on page 303 Used for query*1	"DMKRPRM" on page 305 Used for query

*1.You can read parameter values only when you use the fixed Δ marker.

You can use the following command to display a list of all marker-specified values on the Agilent 4294A LCD. Note, however, that you cannot use these commands to read these values.

- "MKRL" on page 352

Sample program for using the marker function

Example 7-1 shows a sample program for using the marker function. This program is available under the filename of "marker.bas" on the sample program disk.

This program performs sweep once, uses the marker function to search for the maximum peak and the minimum negative peak in the 10-100 MHz range, provides a submarker at each of these peaks, and reads and displays the submarker-specified values.

Lines 30 to 70 — Identifies the external controller and Instrument BASIC and sets the GPIB address.

Lines 90 to 110 — Substitutes the lower and upper border values for the search range and the trace selected as the active trace into the corresponding variables Sear_min$, Sear_max$, and Act_trc$, respectively.

Lines 130 to 160 — Resets the Agilent 4294A, performs a sweep once, and waits for the sweep to be completed.

Lines 180 to 190 — Sets the trace selected as the active trace to Act_trc$ and executes the auto scale to automatically set the scale parameters so that the waveforms fit on the screen.

Lines 210 to 240 — Turns ON the marker and sets the lower and upper border values for the search range to Sear_min$ and Sear_max$, respectively.

Lines 260 to 300 — Defines the peak by specifying "0.1/1e6" and "positive" as peak slope threshold and peak polarity, searches for the peak and moves the marker to that peak, and positions submarker 1 at the peak.

Lines 320 to 340 — Redefines the peak by specifying "negative" as peak polarity, searches for the peak and moves the marker to that negative peak, and positions submarker 2 at the peak.

Lines 360 to 430 Reads and displays submarker-specified measurement parameter values.

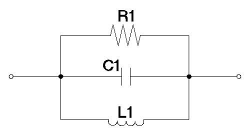
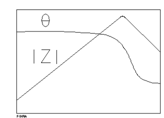
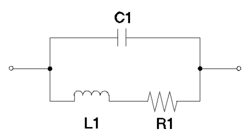
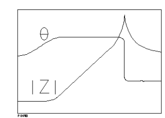
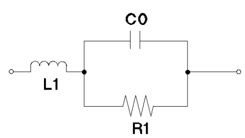
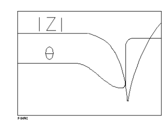
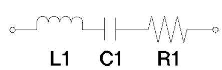
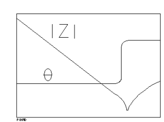
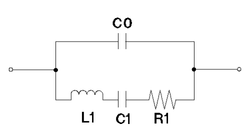
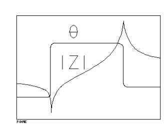
Example 7-1 **Searching for Peaks Using the Marker**

```
10      DIM Sear_min$[9],Sear_max$[9],Act_trc$[9],Buff$[9]
20      REAL P_peak,N_peak
30      IF SYSTEM$("SYSTEM ID")="HP4294A" THEN
40        ASSIGN @Hp4294a TO 800
50      ELSE
60        ASSIGN @Hp4294a TO 717
70      END IF
80      !
90      Sear_min$="10MHZ"
100     Sear_max$="100MHZ"
110     Act_trc$="A"
120     !
130     OUTPUT @Hp4294a;"PRES"
140     OUTPUT @Hp4294a;"SING"
150     OUTPUT @Hp4294a;"*OPC?"
160     ENTER @Hp4294a;Buff$
170     !
180     OUTPUT @Hp4294a;"TRAC "&Act_trc$
190     OUTPUT @Hp4294a;"AUTO"
200     !
210     OUTPUT @Hp4294a;"MKR ON"
220     OUTPUT @Hp4294a;"PARS ON"
230     OUTPUT @Hp4294a;"SEARMIN "&Sear_min$
240     OUTPUT @Hp4294a;"SEARMAX "&Sear_max$
250     !
260     OUTPUT @Hp4294a;"PKDLTX 1MHZ"
270     OUTPUT @Hp4294a;"PKDLTY 0.1"
280     OUTPUT @Hp4294a;"PKPOL POS"
290     OUTPUT @Hp4294a;"SEAM PEAK"
300     OUTPUT @Hp4294a;"SMKR1 ON"
310     !
320     OUTPUT @Hp4294a;"PKPOL NEG"
330     OUTPUT @Hp4294a;"SEAM PEAK"
340     OUTPUT @Hp4294a;"SMKR2 ON"
350     !
360     OUTPUT @Hp4294a;"SMKRVAL1?"
370     ENTER @Hp4294a;P_peak
380     OUTPUT @Hp4294a;"SMKRVAL2?"
390     ENTER @Hp4294a;N_peak
400     !
410     PRINT "Search Range: "&Sear_min$&" - "&Sear_max$
420     PRINT "Positive Peak: ";P_peak;"[ohm]"
430     PRINT "Negative Peak: ";N_peak;"[ohm]"
440     END
```

Analyzing Measurement Results

Equivalent circuit analysis

With the Agilent 4294A, five different circuit models are available for equivalent circuit analysis as shown below depending on the type of measurement results obtained.

Equivalent Circuit Analysis Model		Sample Types	Typical Frequency Characteristics [*1]
A		Inductor with Large Core Loss	
B		Inductor and Resistor	
C		Resistor with Large Resistance	
D		Capacitor	
E		Oscillator and Vibrator	

*1.Measurement parameter: |Z|-θ, Vertical display format: logged |Z| and linear θ

Use the following command to select the desired circuit model.

- “EQUC” on page 311

Use the following command to perform equivalent circuit analysis.

- “CALECPARA” on page 275

NOTE The applicable range for equivalent circuit analysis is the same as the range searched by the marker.

When you execute the "CALECPARA" command, the analysis results will be automatically displayed. You can use the following command to select whether to display these results on the screen.

- "DISECPARA" on page 299

Use the following command for query to read equivalent circuit analysis results (equivalent circuit parameters: R1, C1, L1, C0).

- "DEFEC{R1|C1|L1|C0}" on page 296

You can use parameter values (R1, C1, L1, C0) obtained through equivalent circuit analysis to perform frequency characteristic simulation for such values and display the simulation results as memory trace. To do this, use the following command.

- "SIMFCHAR" on page 437

You can use the "DEFEC{R1|C1|L1|C0}" command (page 296) to specify the desired value of each of the parameters R1, C1, L1, and C0. Therefore, you can display frequency characteristics simulated based on desired parameter values.

Example 7-2 shows a sample equivalent circuit analysis program. This program is available under the filename "circuit.bas" on the sample program disk.

This program performs a sweep once, selects equivalent circuit model E, performs equivalent circuit analysis, and reads and displays the analysis results. This program also performs frequency characteristic simulation based on parameter values obtained through the analysis.

Lines 30 to 70	Identifies the external controller and Instrument BASIC and sets the GPIB address.
Lines 90 to 110	Substitutes the sweep center value, the sweep span value, and the selected equivalent circuit model into the corresponding variables Cent, Span, and model$, respectively.
Lines 130 to 160	Resets the Agilent 4294A, sets impedance amplitude and phase as measurement parameters, and sets the sweep center value and the sweep span value to Cent and Span, respectively.
Lines 170 to 240	Performs a sweep once, performs auto scaling, and executes the auto scale to automatically set the scale parameters so that the waveforms fit on the screen.
Lines 250 to 260	Sets the selected equivalent circuit model to "Model$" and performs equivalent circuit analysis.
Lines 270 to 400	Reads and displays equivalent circuit parameters R1, C1, L1, and C0.
Line 420	Performs frequency characteristic simulation.

Example 7-2 **Equivalent Circuit Analysis**

```
10      DIM Model$[9],Buff$[9]
20      REAL Cent,Span,R1,C1,L1,C0
30      IF SYSTEM$("SYSTEM ID")="HP4294A" THEN
40        ASSIGN @Hp4294a TO 800
50      ELSE
60        ASSIGN @Hp4294a TO 717
70      END IF
80      !
```

```
90      Cent=6.0E+7
100     Span=2.0E+4
110     Model$="E"
120     !
130     OUTPUT @Hp4294a;"PRES"
140     OUTPUT @Hp4294a;"MEAS IMPH"
150     OUTPUT @Hp4294a;"CENT ";Cent
160     OUTPUT @Hp4294a;"SPAN ";Span
170     OUTPUT @Hp4294a;"SING"
180     OUTPUT @Hp4294a;"*OPC?"
190     ENTER @Hp4294a;Buff$
200     !
210     OUTPUT @Hp4294a;"TRAC A"
220     OUTPUT @Hp4294a;"AUTO"
230     OUTPUT @Hp4294a;"TRAC B"
240     OUTPUT @Hp4294a;"AUTO"
250     OUTPUT @Hp4294a;"EQUC CIR"&Model$
260     OUTPUT @Hp4294a;"CALECPARA"
270     OUTPUT @Hp4294a;"DEFECR1?"
280     ENTER @Hp4294a;R1
290     OUTPUT @Hp4294a;"DEFECC1?"
300     ENTER @Hp4294a;C1
310     OUTPUT @Hp4294a;"DEFECL1?"
320     ENTER @Hp4294a;L1
330     OUTPUT @Hp4294a;"DEFECC0?"
340     ENTER @Hp4294a;C0
350     !
360     PRINT " --- Result ---"
370     PRINT "R1 :";R1;"[ohm]"
380     PRINT "C1 :";C1;"[F]"
390     PRINT "L1 :";L1;"[H]"
400     PRINT "C0 :";C0;"[F]"
410     !
420     OUTPUT @Hp4294a;"SIMFCHAR"
430     END
```

Statistics analysis

The Agilent 4294A allows you to analyze statistics (average, standard deviation, difference between maximum and minimum). Use the following command to turn this function ON or OFF.

- "MEASTAT" on page 349

NOTE The statistics analysis function is available when the marker function is ON.

The applicable range for statistics analysis is the same as the range searched by the marker.

You can execute the above command to display analysis results. Use the following command to read analysis results.

- "OUTPMSTA?" on page 388

Bandwidth analysis

The Agilent 4294A provides a trace bandwidth analysis function and allows you to analyze the active trace's bandwidth. Use the following command to turn ON this function.

- "WIDT" on page 461

NOTE The trace bandwidth analysis function is available when the marker function is ON.

The applicable range for bandwidth search is the same as the range searched by the marker.

When the trace bandwidth analysis function is ON, you can search to the right and left of the current marker position for cutoff points. When the search is complete, submarkers 2, 3, and 1 will appear, respectively, at the leftmost and rightmost cutoff points and at the center midway between the two cutoff points.

You can use the trace bandwidth analysis function to analyze the following parameters:

- Bandwidth (*Width* in Figure 7-2)
- Sweep Parameter Value at the Center between the Two Cutoff Points (*Center* in Figure 7-2)
- Q value (=*Center*/*Width*)
- Marker-specified Measurement Parameter Values (Note, however, that one of the two different sets of parameter values appears depending on which Δ marker is ON. When the tracking Δ marker is ON, the marker-specified parameter values will appear. When the fixed Δ marker is ON, those values, obtained by subtracting the fixed Δ marker-specified values from the marker-specified values, will appear.)

NOTE Normally, trace bandwidth analysis is made when the marker searches for peaks. Therefore, the above values appear to the right of "Peak:" on the Agilent 4294A display. However, if the marker is not positioned at any of the peaks, the above values do not represent parameter values obtained at a peak.

- Value Obtained by Subtracting the Value at the Center of the Sweep Range from the Sweep Parameter Value at the Leftmost Cutoff Point (sweep parameter value when the fixed Δ marker is ON) (*ΔL.F* in Figure 7-2)
- Value Obtained by Subtracting the Value at the Center of the Sweep Range from the Sweep Parameter Value at the Rightmost Cutoff Point (sweep parameter value when the fixed Δ marker is ON) (*ΔR.F* in Figure 7-2)

Use the following command to selects the method to set a cutoff point in the trace bandwidth analysis function.

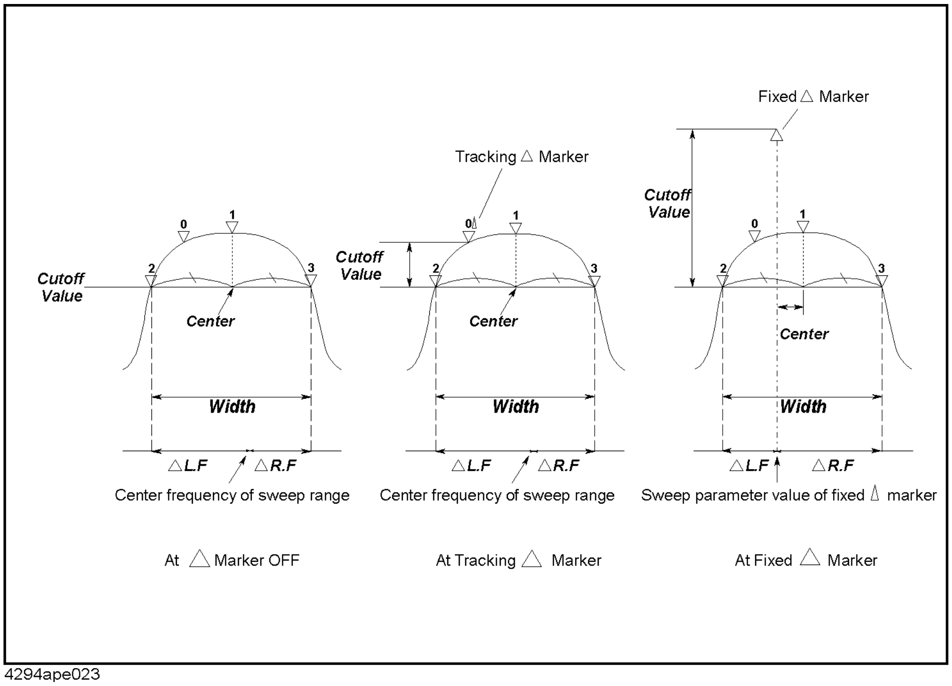
- "WIDVTYPE" on page 462

If the free cutoff value setting is selected with the "WIDVTYPE" command, use the following commands to specify measurement parameters (Cutoff Value in Figure 7-2) at cutoff points:

- "WIDFVAL" on page 460

NOTE When you wish to use the "WIDFVAL" command to specify measurement parameters at cutoff points and when the Δ marker is ON, you must remember that the value obtained by subtracting the value you enter from the Δ marker-specified value will be specified as the measurement parameter value at the cutoff point, as shown in Figure 7-2.

Figure 7-2 **Trace bandwidth analysis**



Use the following command to read the results of trace bandwidth analysis.

- "OUTPMWID?" on page 390

You can use the following command to search for a measurement point that meets the cutoff point requirements and that is located outside the cutoff point found during the initial search.

- "WIDSOUT" on page 461

Use the following command to return to the initial cutoff point from the measurement point found using the above command.

- "WIDSIN" on page 460

Example 7-3 shows a sample program for trace bandwidth analysis. This program is available under the filename "band_ana.bas" on the sample program disk.

This program performs a sweep once, searches for the bandwidth, and reads and displays the results of trace bandwidth analysis.

Lines 30 to 70	Identifies the external controller and Instrument BASIC and sets the GPIB address.
Lines 90 to 110	Substitutes the sweep center value, the sweep span value, and the trace selected as the active trace into the corresponding variables Cent, Span, and Act_trc$, respectively.
Lines 130 to 160	Resets the Agilent 4294A, sets impedance amplitude and phase as measurement parameters, and sets the sweep center value and the sweep span value to Cent and Span, respectively.
Lines 170 to 190	Performs a sweep once and waits for the sweep to be completed.
Lines 210 to 220	Sets the active trace to Act_trc$ and executes the auto scale to automatically set the scale parameters so that the waveforms fit on the screen.

Lines 230 to 240	Turns ON the marker function, searches for a peak, and moves the marker to the peak.
Lines 250 to 260	Specifies the measurement parameter at the cut-off point to $1/\sqrt{2}$ of that obtained at the marker position and then turns ON the bandwidth search function.
Lines 270 to 280	Reads the analysis results and substitutes the obtained values into the corresponding variables B_wid, B_cent, B_q, Peak, Delta_l, and Delta_r.
Lines 310 to 370	Displays analysis results if the content of B_wid is not 0.
Line 390	Displays a message to inform you that no cutoff point has been found if the content of B_wid is 0.

Example 7-3 **Trace bandwidth analysis**

```
10      DIM Act_trc$[9],Buff$[9]
20      REAL Cent,Span,B_wid,B_cent,B_q,Peak,Delta_l,Delta_r
30      IF SYSTEM$("SYSTEM ID")="HP4294A" THEN
40        ASSIGN @Hp4294a TO 800
50      ELSE
60        ASSIGN @Hp4294a TO 717
70      END IF
80      !
90      Cent=6.0E+7
100     Span=2.0E+4
110     Act_trc$="A"
120     !
130     OUTPUT @Hp4294a;"PRES"
140     OUTPUT @Hp4294a;"MEAS IMPH"
150     OUTPUT @Hp4294a;"CENT ";Cent
160     OUTPUT @Hp4294a;"SPAN ";Span
170     OUTPUT @Hp4294a;"SING"
180     OUTPUT @Hp4294a;"*OPC?"
190     ENTER @Hp4294a;Buff$
200     !
210     OUTPUT @Hp4294a;"TRAC "&Act_trc$
220     OUTPUT @Hp4294a;"AUTO"
230     OUTPUT @Hp4294a;"MKR ON"
240     OUTPUT @Hp4294a;"SEAM PEAK"
250     OUTPUT @Hp4294a;"WIDVTYPE DIVS2"
260     OUTPUT @Hp4294a;"WIDT ON"
270     OUTPUT @Hp4294a;"OUTPMWID?"
280     ENTER @Hp4294a;B_wid,B_cent,B_q,Peak,Delta_l,Delta_r
290     !
300     IF B_wid<>0. THEN
310       PRINT " --- Result ---"
320       PRINT "Width        :";B_wid;"[Hz]"
330       PRINT "Center       :";B_cent;"[Hz]"
340       PRINT "Q            :";B_q
350       PRINT "Peak         :";Peak;"[ohm]"
360       PRINT "Delta Left   :";Delta_l;"[Hz]"
370       PRINT "Delta Right  :";Delta_r;"[Hz]"
380     ELSE
390       PRINT "Cutoff point NOT found!"
400     END IF
410     END
```

Various analysis methods available with waveform analysis commands

The Agilent 4294A provides waveform analysis commands that allow you, for example, to search for the maximum and minimum values on the waveform and analyze waveform ripples and resonator parameters.

Use the following commands to specify the applicable range for analysis and the trace to be analyzed.

- “ANARANG” on page 267
- “ANASEGM” on page 268
- “ANARFULL” on page 268
- “ANAODATA” on page 266
- “ANAOMEMO” on page 266

Use the following command to define the peak for analysis.

- “THRR” on page 452

NOTE The analysis range and the peak definition specified using the above commands are available only for waveform analysis commands. Note that the above range and the definition are irrelevant to the search range and the peak definition available during search using the marker or to the analysis range available during equivalent circuit analysis.

Searching for maximum and minimum values

Use the following waveform analysis commands to search for and read the maximum and minimum values on the active trace.

- “OUTPMAX?” on page 384
- “OUTPMIN?” on page 386
- “OUTPMINMAX?” on page 386

You can perform the same function by using the marker search function to move the marker to each of the maximum and minimum value positions and reading the marker-specified value at each position.

NOTE The analysis range for waveform analysis commands is specified separately from that for marker search. Therefore, one or both of the maximum and minimum values for these ranges may differ if these ranges are different.

Searching for peaks

Use the following commands to search for and read peak values on the active trace.

- “PEAK?” on page 397
- “NEXPK?” on page 363
- “NPEAK?” on page 364
- “NEXNPK?” on page 362
- “LMAXS?” on page 343
- “LMINS?” on page 344

You can perform the same function by using the marker search function to move the marker to each of the peaks and reading the marker-specified value.

NOTE The analysis range and the peak definition for waveform analysis commands are specified separately from those for marker search. Therefore, you may obtain different results if the ranges or the definitions are different.

Searching for points on the trace that match specific measurement parameter values

Use the following commands to search for a point on the active trace that matches the desired measurement parameter value and to read the sweep parameter value at that point.

- “TARR?” on page 451
- “TARL?” on page 450

You can perform the same function by using target search, one of the marker search functions, to move the marker to the position on the trace that matches the desired measurement parameter value and reading the sweep parameter value at that point.

NOTE The analysis range for waveform analysis commands is specified separately from that for marker search. Therefore, one or both of the maximum and minimum values for these ranges may differ if these ranges are different.

Analyzing ripple

Use the following commands to analyze ripples (differences between measurement parameter values at peaks and their adjacent negative peaks) and the differences between maximum and minimum peaks on the active trace and to read the results.

- “RPLHEI?” on page 413
- “RPLLHEI?” on page 413
- “RPLRHEI?” on page 414
- “RPLPP?” on page 413
- “RPLPPS?” on page 414

Analyzing ceramic resonator and crystal resonator parameters

Use the following commands to analyze ceramic resonator or crystal resonator parameters and read the analysis results.

- “OUTPRESO?” on page 391
- “OUTPRESR?” on page 392
- “OUTPCERR?” on page 373
- “EQUCPARS4?” on page 312
- “EQUC0?” on page 311

NOTE You can use these waveform analysis commands when you wish to analyze the frequency as measurement parameter and |Z|-θ as sweep parameter.

See the descriptions of commands in Chapter 16 , “GPIB Command Reference,” for more information on the parameters you can analyze.

Example 7-4 shows a sample program for ceramic resonator parameter analysis using the “OUTPCERR?” command. This program is available under the filename “ana_com.bas” on the sample program disk.

This program performs a sweep once, uses the “OUTPCERR?” command to analyze ceramic resonator parameters, and reads and displays the analysis results.

Lines 30 to 70	Identifies the external controller and Instrument BASIC and sets the GPIB address.
Lines 90 to 120	Assigns the sweep center value, the sweep span value, the trace selected for analysis, and the peak threshold the corresponding variables Cent, Span, Ana_trc$, and Thrr, respectively.
Lines 140 to 180	Resets the Agilent 4294A, sets impedance amplitude and phase as measurement parameters, sets the sweep center value and the sweep span value, respectively, to Cent and Span, and specifies log Y-axis format as display format.
Lines 190 to 250	Performs a sweep once and then performs the auto scale to automatically set the scale parameters so that the waveforms fit on the screen.
Lines 270 to 290	Specifies the entire sweep range as the analysis range and sets the trace selected for analysis and the peak threshold to “Ana_trc$” and “Thrr,” respectively.
Line 300 to 310	Executes the “OUTPCERR?” command to read analyzed parameters.
Lines 330 to 380	Displays the analysis results.

Example 7-4 **Ceramic Resonator Parameter Analysis**

```
10      DIM Ana_trc$[9],Buff$[9]
20      REAL Cent,Span,Thrr,Zr,Fr,Za,Fa,R1,R2,R3
30      IF SYSTEM$("SYSTEM ID")="HP4294A" THEN
40        ASSIGN @Hp4294a TO 800
50      ELSE
60        ASSIGN @Hp4294a TO 717
70      END IF
80      !
90      Cent=6.0E+7
100     Span=2.0E+4
110     Ana_trc$="DATA"
120     Thrr=2.0
130     !
140     OUTPUT @Hp4294a;"PRES"
150     OUTPUT @Hp4294a;"MEAS IMPH"
160     OUTPUT @Hp4294a;"CENT ";Cent
170     OUTPUT @Hp4294a;"SPAN ";Span
180     OUTPUT @Hp4294a;"FMT LOGY"
190     OUTPUT @Hp4294a;"SING"
200     OUTPUT @Hp4294a;"*OPC?"
210     ENTER @Hp4294a;Buff$
220     OUTPUT @Hp4294a;"TRAC A"
230     OUTPUT @Hp4294a;"AUTO"
240     OUTPUT @Hp4294a;"TRAC B"
250     OUTPUT @Hp4294a;"AUTO"
```

```
260   !
270   OUTPUT @Hp4294a;"ANARFULL"
280   OUTPUT @Hp4294a;"ANAO"&Ana_trc$
290   OUTPUT @Hp4294a;"THRR ";Thrr
300   OUTPUT @Hp4294a;"OUTPCERR?"
310   ENTER @Hp4294a;Zr,Fr,Za,Fa,R1,R2,R3
320   !
330   PRINT " --- Analysis Result ---"
340   PRINT "Resonant     :";Zr;"[ohm]",Fr;"[Hz]"
350   PRINT "Anti-Resonant:";Za;"[ohm]",Fa;"[Hz]"
360   PRINT "Ripple L     :";R1;"[ohm]"
370   PRINT "Ripple M     :";R2;"[ohm]"
380   PRINT "Ripple R     :";R3;"[ohm]"
390   END
```

8 Saving/Recalling a Measurement Result/Measurement Setup

This chapter describes how to save/recall a measurement result, measurement setup, and other data into/from a file.

Save/Recall of a File

Specifying a location for save/recall

You can select a mass storage for saving/recalling a file from the flash disk (non-volatile), the RAM disk (volatile), or a diskette. To select a mass storage, use the following command.

- "STOD" on page 445

To change the current directory, use the following command.

- "CHAD" on page 278

Saving data into a file

You can save a measurement result, calibration/compensation data (internal data arrays), measurement setup, and image on the LCD screen into a file.

To save one or more internal data arrays, use the following command to select the arrays you want to save.

- "SAVCAL" on page 416
- "SAVDAT" on page 417
- "SAVDTRC" on page 420
- "SAVMEM" on page 420
- "SAVMTRC" on page 421

There are 2 commands available for save to a file. The difference between these 2 commands is their file format of the save (ASCII format or binary format).

- "SAVDASC" on page 416
- "SAVDDAT" on page 417

The following command available for save a data array to a file in the touchstone format.

- "SAVDS1P" on page 418

A measurement setup is saved as an instrument state including the calibration data array, the compensation data array, and the memory array, in binary format. To save a measurement setup, use the following command.

- "SAVDSTA" on page 419

You can use the following command to save data into a file, giving it the name of AUTOREC.STA. The file having the AUTOREC.STA filename is automatically recalled at power-on.

- "SAVPSTA" on page 421

An image on the LCD screen is saved in TIFF format. To save an image on the LCD screen, use the following command.

- "SAVDTIF" on page 419

An extension is added to a filename depending on the contents of the file.

Table 8-1 **Filename extension**

Extension	Contents of a file
.TXT	File of a measurement result and calibration/compensation data (internal data arrays) saved in ASCII format
.DAT	File of a measurement result and calibration/compensation data (internal data arrays) saved in binary format
.STA	File of an instrument state (measurement setup and internal data arrays) saved in binary format
.TIF	File of an image on the LCD screen saved in TIFF format

A filename created when a save command is executed is as follows:

- If you specify a filename with no extension, an extension shown in Table 8-1 is added to the specified filename.
- If you specify a filename with its extension, the specified filename is used as it is.

NOTE When specifying a filename using a save execution command, use a filename with no extension or a filename with the extension that matches with its contents.

When executing a file save command, you cannot specify an already existing file (in other words, you cannot update the file). To update a file, use the following command.

- “RESAVD” on page 411

Recalling a file

You can recall a measurement result, calibration/compensation data (internal data arrays), and measurement setup saved in a file (whose extension is “.DAT” or “.STA”) to restore its contents on the 4294A. To recall a file, use the following command.

- “RECD” on page 408

NOTE To recall the contents of a file, specify a filename with its extension.

Copying/deleting a file

To copy a file, use the following command.

- “FILC” on page 315

To delete a file, use the following command.

- “PURG” on page 406

NOTE To copy/delete a file, specify a filename with its extension.

Creating a directory

To create a directory, use the following command.

- “CRED” on page 284

Sample Program for Save/Recall

Example 8-1 shows a sample program to save a file. This program is stored on the sample program disk as the file_sav.bas file.

This program sets the save destination mass storage to the flash disk and saves data the user specified using a user specified filename.

Lines 40 to 80	Identifies the external controller and Instrument BASIC and sets the GPIB address.
Line 100	Sets the mass storage to the flash disk.
Line 110	Uses the Inp_file_name subprogram to obtain a user-entered save filename and stores it in the File$ variable.
Line 130	Allows the user to return to the entry start line and enter the data again, if an error occurs when selecting the contents of a file due to, for example, a typing error.
Lines 150 to 200	Displays the list of save items (and file formats) and prompts the user to enter the desired number (1 to 4).
Line 210	Converts the entered value to an integer and substitutes it into the Content variable.
Line 220	If the value of Content is not an integer between 1 and 4, returns to the entry start line.
Lines 250 to 500	Depending on the value of Content, substitutes the extension and the save command name into the Extension$ variable and the Command$ variable, respectively. If the value of Content is 2 or 3, uses the Select_array subprogram to select the saved internal data array.
Line 530	Clears the error queue.
Line 540	Creates a program message to execute the save from the Command$ and File$ variables and sends it to the 4294A.
Lines 550 to 560	Checks for the occurrence of an error.
Lines 580 to 600	If an error of the -257 error number has occurred (error when a filename has a problem, for example, when a file having the same name exists), prompts the user to select from “Change File Name”, “Purge File”, or “End.”
Lines 610 to 630	If “Change File Name” is selected, uses the Inp_file_name subprogram again to obtain the user-entered save filename, and returns to the save start line.
Lines 650 to 670	If “Purge File” is selected, deletes the existing file having the same filename, and returns to the save start line.
Line 690	Displays the “Save Not Complete” message.
Lines 710 to 720	If an error of the -257 error number has not occurred, displays the “Save Complete” message and the save filename.

The Inp_file_name subprogram in lines 790 to 910, used to enter a save filename, is described below.

Line 820	Allows the user to return to the entry start line and enter the data again if an error occurs due to, for example, a typing error.
Lines 830 to 840	Prompts the user to enter a save filename (without extension) and waits for the entry of a filename.
Line 860	If the entered filename exceeds 8 characters, returns to the entry start line.
Lines 870 to 880	Displays the entered filename and waits for a conformation entry (y/n key).
Line 890	If a key other than the y key is pressed in line 880, returns to the entry start line.

The Select_array subprogram in lines 950 to 1040, used to select the internal data arrays you want to save, is described below.

Lines 970 to 980	Prompts a conformation entry of whether to save the Array_name$ internal data array and waits for the entry of the y key or the n key.
Line 1000	If the y key is pressed in line 980, uses the Com$ command to enable the save of Array_name$.
Line 1020	If a key other than the y key is pressed in line 980, uses the Com$ command to disable the save of Array_name$.

Example 8-1 **Save/recall**

```
10     DIM File$[9],Inp_char$[30],Err_mes$[50],Extension$[9],Command$[9]
20     INTEGER Content,Err_no
30     CLEAR SCREEN
40     IF SYSTEM$("SYSTEM ID")="HP4294A" THEN
50       ASSIGN @Hp4294a TO 800
60     ELSE
70       ASSIGN @Hp4294a TO 717
80     END IF
90     !
100    OUTPUT @Hp4294a;"STOD FLASH"
110    CALL Inp_file_name(File$)
120    !
130    ON ERROR GOTO Data_select
140 Data_select: !
150    PRINT "Select Saved Content"
160    PRINT " 1: State and Data"
170    PRINT " 2: Data (Binary file)"
180    PRINT " 3: Data (ASCII file)"
190    PRINT " 4: LCD Image"
200    INPUT "Input 1 to 4",Inp_char$
210    Content=IVAL(Inp_char$,10)
220    IF Content<1 OR Content>4 THEN Inp_start
230    OFF ERROR
240    !
250    SELECT Content
260      CASE 1
270        Extension$=".STA"
280        Command$="SAVDSTA"
290      CASE 2
300        PRINT "Select Data Content"
310        Select_array(@Hp4294a,"DATA TRACE","SAVDTRC")
320        Select_array(@Hp4294a,"MEMORY TRACE","SAVMTRC")
330        Select_array(@Hp4294a,"DATA","SAVDAT")
340        Select_array(@Hp4294a,"MEMORY","SAVMEM")
350        Select_array(@Hp4294a,"CAL & COMP DATA","SAVCAL")
360        Extension$=".DAT"
370        Command$="SAVDDAT"
380      CASE 3
390        PRINT "Select Data Content"
400        Select_array(@Hp4294a,"DATA TRACE","SAVDTRC")
410        Select_array(@Hp4294a,"MEMORY TRACE","SAVMTRC")
420        Select_array(@Hp4294a,"DATA","SAVDAT")
430        Select_array(@Hp4294a,"MEMORY","SAVMEM")
440        Select_array(@Hp4294a,"CAL & COMP DATA","SAVCAL")
450        Extension$=".TXT"
460        Command$="SAVDASC"
470      CASE 4
480        Extension$=".TIF"
490        Command$="SAVDTIF"
500    END SELECT
510    !
520 Save_file: !
530    OUTPUT @Hp4294a;"*CLS"
540    OUTPUT @Hp4294a;Command$&" """&File$&""""
550    OUTPUT @Hp4294a;"OUTPERRO?"
560    ENTER @Hp4294a;Err_no,Err_mes$
570    IF Err_no=(-257) THEN
580      PRINT "Error: "&Err_mes$
590      PRINT "[C]hange File Name / [P]urge File / [E]nd"
600      INPUT "Input C or P or E",Inp_char$
610      IF UPC$(Inp_char$)="C" THEN
```

```
620         CALL Inp_file_name(File$)
630         GOTO Save_file
640       END IF
650       IF UPC$(Inp_char$)="P" THEN
660         OUTPUT @Hp4294a;"PURG """&File$&Extension$&""""
670         GOTO Save_file
680       END IF
690       PRINT "Save NOT Complete"
700     ELSE
710       PRINT "Save Complete"
720       PRINT "  Save File Name: "&File$&Extension$
730     END IF
740     !
750     END
760     !
770     ! File Name Input Function
780     !
790   SUB Inp_file_name(Inp_name$)
800     DIM Inp_char$[30]
810     ON ERROR GOTO Inp_start
820 Inp_start: !
830     PRINT "Input Save File Name (without Extension)"
840     INPUT "Name?",Inp_char$
850     Inp_name$=UPC$(Inp_char$)
860     IF LEN(Inp_name$)>8 THEN Inp_start
870     PRINT "Input Name: "&Inp_name$
880     INPUT "OK? [Y/N]",Inp_char$
890     IF UPC$(Inp_char$)<>"Y" THEN Inp_start
900     OFF ERROR
910   SUBEND
920     !
930     ! Save Array Select Function
940     !
950   SUB Select_array(@Hp4294a,Array_name$,Com$)
960     DIM Inp_char$[9]
970     PRINT " Save "&Array_name$&" Array?"
980     INPUT "[Y]es or [N]o? Input [Y/N]",Inp_char$
990     IF UPC$(Inp_char$)="Y" THEN
1000      OUTPUT @Hp4294a;Com$&" ON"
1010    ELSE
1020      OUTPUT @Hp4294a;Com$&" OFF"
1030    END IF
1040  SUBEND
```

9 Communication with External Equipment (Using the I/O Ports)

This chapter describes how to use the 8-bit I/O port and the 24-bit I/O port of the Agilent 4294A to communicate with external equipment (for example, handlers in production lines).

Using the I/O Ports

8-bit I/O port

The 8-bit I/O port of the 4294A consists of the following TTL signal lines.

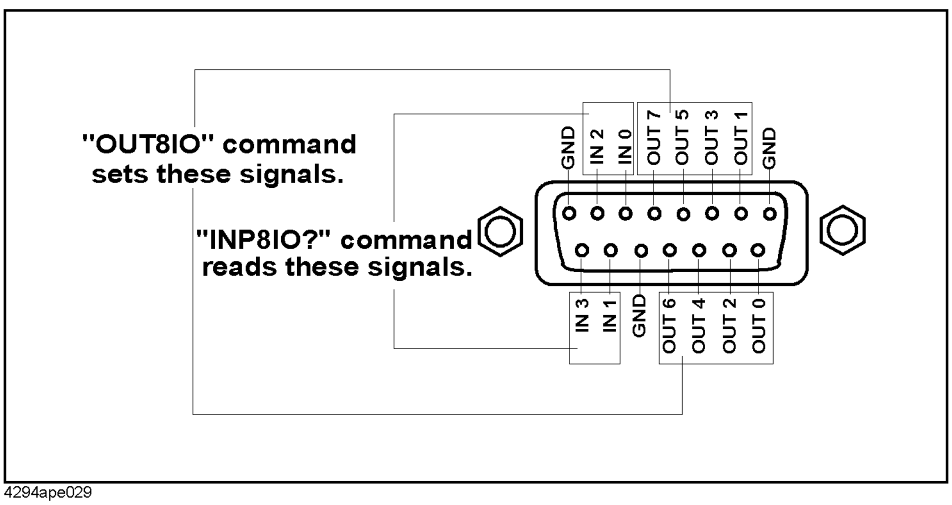
- OUT0 to OUT7 (8-bit output)
- IN0 to IN3 (4-bit input)
- GND (ground)

Definition of the I/O pins

Each signal of the 8-bit I/O port is described below. Figure 9-1 shows the pin assignment diagram.

OUT 0 to 7	Signal lines that can be set freely from the controller. Use these lines to send signals from the controller to external equipment. Once signals are outputted form the controller, the states of these signal lines are not changed until the controller outputs the next signals (latched).
IN 0 to 3	Signal lines that can be read out from the controller. Use these lines to send signals from external equipment to the controller.
GND (3 pins)	Ground line.

Figure 9-1 **8-bit I/O port**



8-bit I/O port control commands

To output 8-bit data through the OUT0 to OUT7 lines, use the following command. Data is outputted as 8-bit binary, assuming that OUT0 is LSB (least significant bit) and OUT7 is MSB (most significant bit).

GPIB command	"OUT8IO" on page 368
Instrument BASIC command	"WRITEIO 15,0;"

To read out 4-bit data through the IN0 to IN3 lines, use the following command. Data is read out as 4-bit binary, assuming that IN0 is LSB and IN3 is MSB.

GPIB command	"INP8IO?" on page 319
Instrument BASIC command	"READIO(15,0)"

24-bit I/O port

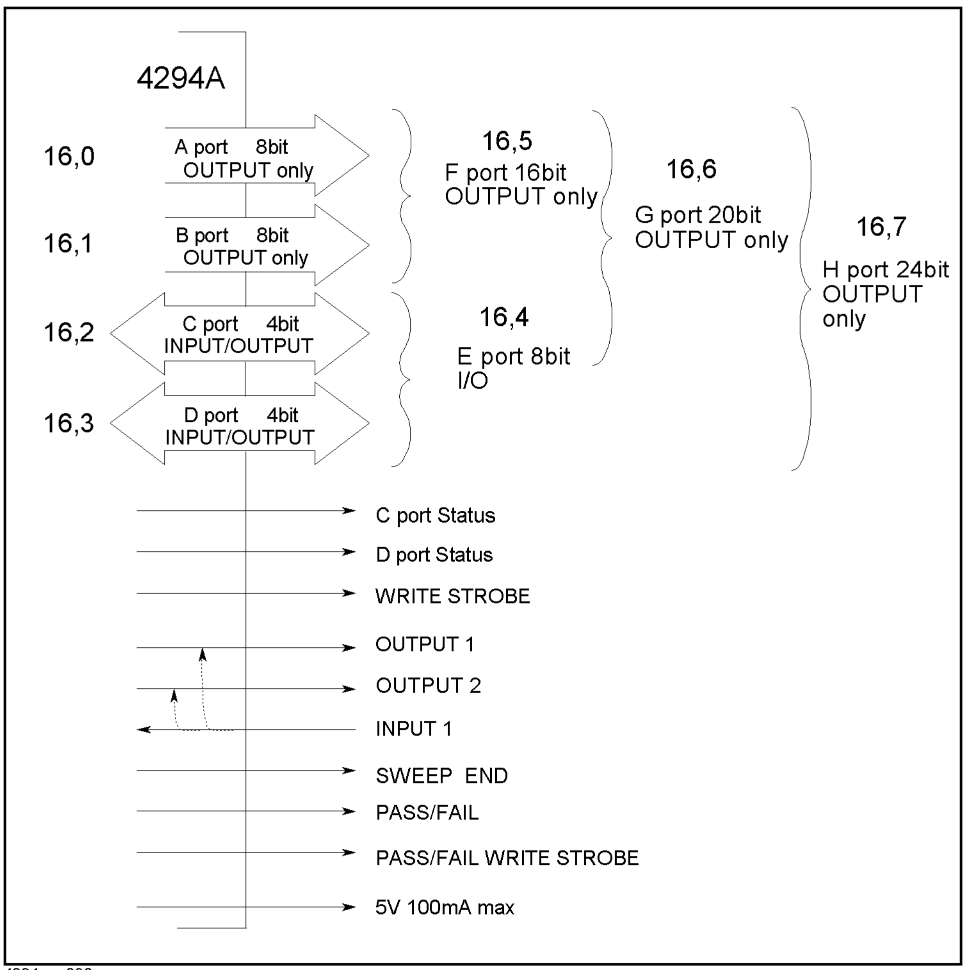
The 24-bit I/O port of the 4294A consists of 4 independent data input/output parallel ports, several control signal lines, and a power line. All the signals provide TTL level.

The data input/output port consists of 2 sets of 8-bit output ports and 2 sets of 4-bit bi-directional ports. You can use these ports as up to a 24-bit output port or up to a 8-bit input port, by using them concurrently.

The input/output signals are preset to negative logic, but you can change the setting to positive logic. The control signal lines include the measurement completion output or control signal outputs for handshaking. Figure 9-2 shows the overview diagram of the input/output ports and the control signal lines.

NOTE If a device cannot be connected directly to the 24-bit I/O interface connector on the rear panel of the 4294A, a 36-pin cable (part number: 04278-61650) is available. By connecting this cable, the distance from the 24-bit I/O interface can be extended by 1 m.

Figure 9-2 **Overview diagram of the 24-bit I/O port**



4294ape030

Input/output port

The 24-bit I/O port of the 4294A consists of 2 sets of output ports and 2 sets of bi-directional ports as shown below.

- Output port

  Port A: 8-bit width (LSB: A0, MSB: A7)
  Port B: 8-bit width (LSB: B0, MSB: B7)

  The signals provide TTL level and latched when used as output.

- Bi-directional port

  Port C: 4-bit width (LSB: C0, MSB: C3)
  Port D: 4-bit width (LSB: D0, MSB: D3)

The signals provide TTL level and latched when used as output. To select the input/output direction, use the GPIB command. At power-on, both port C and port D are set to input.

You can combine some of the above 4 ports to use them as 4 kinds of ports as shown below.

- Bi-directional port

  Port E: 8-bit width (port C + port D, LSB: C0, MSB: D3)

- Output port

  Port F: 16-bit width (port A + port B, LSB: A0, MSB: B7)
  Port G: 20-bit width (port A + port B + port C, LSB: A0, MSB: C3)
  Port H: 24-bit width (port A + port B + port C + port D, LSB: A0, MSB: D3)

Control signal lines

The 24-bit I/O port has 9 kinds of output signal lines and 1 kind of input signal line. The signals except for the power line provide TTL level. Each signal is described below.

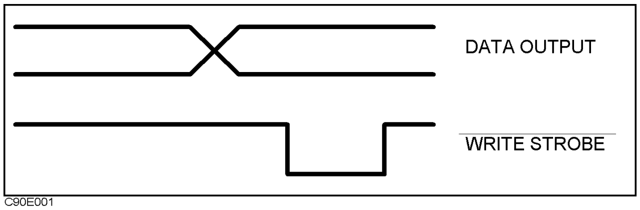
Port C status output, port D status output

Go LOW when Port C and port D are both set to input ports; HIGH when set to output ports. These output signals notify external equipment of the input/output settings of port C and port D.

Write strobe output for output ports

When data is outputted to one of the output ports, this write strobe output falls to indicate that data is outputted the I/O output port for external equipment. The pulse width is 10 μs (typical). Figure 9-3 shows the relationship between the write strobe output and data output.

Figure 9-3 **Relationship between the write strobe signal and data output**



INPUT1 input

When this input falls (a pulse is inputted), the OUTPUT1 output and the OUTPUT2 output go LOW or HIGH. The delay between the fall of the input and the state transition of both outputs is 200 ns (typical). To select LOW or HIGH of both outputs, use the GPIB command. The pulse width of a signal inputted to INPUT1 must be 1 µs or more.

OUTPUT1 output, OUTPUT2 output

These signal lines are latched output terminals that can be set to LOW or HIGH by a rise of the INPUT1 input or the GPIB command.

PASS/FAIL output

Outputs HIGH (for positive logic) or LOW (for negative logic) when the limit test result is PASS; LOW (for positive logic) or HIGH (for negative logic) when FAIL. This is available only when the limit test function is on.

Write strobe output for PASS/FAIL output

When the limit test result is outputted to the PASS/FAIL output line, a negative pulse is outputted to this write strobe output. The outputted pulse width is 10 µs (typical). This output signal notifies external equipment that the limit test result is outputted to the PASS/FAIL output.

SWEEP END output

Outputs a negative pulse when the 4294A completes a sweep. The outputted pulse width is 20 µs (typical). If the continuous sweep trigger is sent, a pulse is generated each time a sweep is completed.

+5V output

Provides a +5V output for external equipment. The maximum supply current is 100 mA. This line has no fuse, but, if over-current flows, the protection circuit of the 4294A operates and the main power to the 4294A is automatically cut off. When the cause of over-current is removed, the power to the 4294A is restored, but the instrument states are reset to the power-on states.

Definition of I/O pins

Figure 9-4 shows pin numbers, and Table 9-1 shows the relationship between signal lines and pin numbers.

Figure 9-4 Pin numbers of the 24-bit I/O port connector

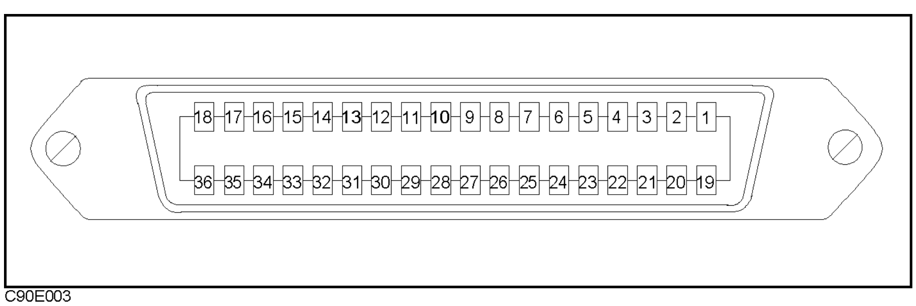
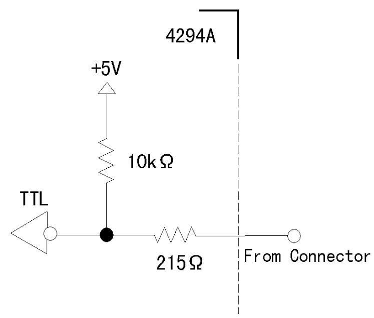
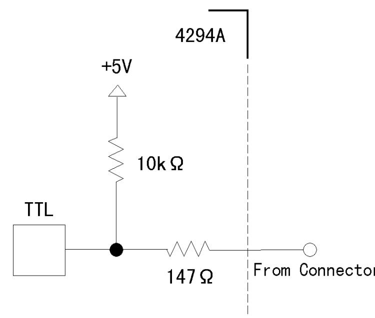
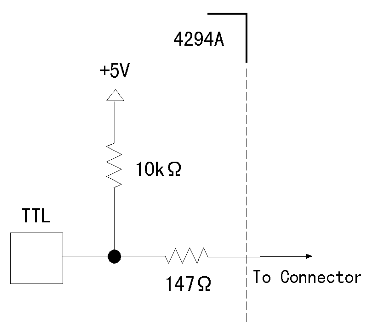
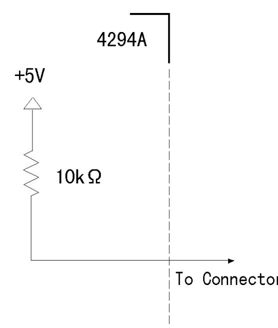


Table 9-1 Signal assignment

Pin number	Signal name	Signal specification
1	GND	0 V
2	INPUT1TTL	TTL level, pulse input (width: 1 µs or more)
3	OUTPUT1	TTL level, latch output
4	OUTPUT2	TTL level, latch output
5	Output port A0	TTL level, latch output
6	Output port A1	TTL level, latch output
7	Output port A2	TTL level, latch output
8	Output port A3	TTL level, latch output
9	Output port A4	TTL level, latch output
10	Output port A5	TTL level, latch output
11	Output port A6	TTL level, latch output
12	Output port A7	TTL level, latch output
13	Output port B0	TTL level, latch output
14	Output port B1	TTL level, latch output
15	Output port B2	TTL level, latch output
16	Output port B3	TTL level, latch output
17	Output port B4	TTL level, latch output
18	Output port B5	TTL level, latch output
19	Output port B6	TTL level, latch output
20	Output port B7	TTL level, latch output
21	Input/output port C0	TTL level, latch output
22	Input/output port C1	TTL level, latch output
23	Input/output port C2	TTL level, latch output
24	Input/output port C3	TTL level, latch output
25	Input/output port D0	TTL level, latch output
26	Input/output port D1	TTL level, latch output
27	Input/output port D2	TTL level, latch output
28	Input/output port D3	TTL level, latch output
29	Port C status	TTL level (input mode: LOW, output mode: HIGH)
30	Port D status	TTL level (input mode: LOW, output mode: HIGH)
31	Write strobe signal	TTL level, negative logic, pulse output (width: 10 µs; typical)
32	+5V pull-up	
33	SWEEP END signal	TTL level, negative logic, pulse output (width: 7 µs; typical)
34	+5V	+5V, 100 mA MAX
35	PASS/FAIL signal	TTL level (PASS: HIGH, FAIL: LOW), latch output
36	PASS/FAIL write strobe signal	TTL level, negative logic, pulse output (width: 10 µs; typical)

Basic input/output circuit

Table 9-2 Basic input/output circuit of the 24-bit I/O port

<table>
<tr><td rowspan="2">Basic circuit</td><td colspan="2">Input port</td></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>I/O pin</td><td>INPUT1</td><td>Ports C, D (input)[*1]</td></tr>
<tr><td rowspan="2">Basic circuit</td><td>Output port</td><td>Other</td></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>I/O pin</td><td>OUTPUT1, 2
Port A[*1], B[*1], C (output)[*1], D (output)[*1]
Write strobe signal
SWEEP END signal
Port C status, port D status</td><td>+5V pull-up</td></tr>
</table>

*1.Common to all bits

Preset states at power-on

The 24-bit I/O port is set at power-on as follows (not affected at reset).

Logic	Negative logic
Write strobe signal	HIGH
SWEEP END signal	HIGH
Port A	Negative 0 Æ HIGH
Port B	Negative 0 Æ HIGH
Port C	Input
Port D	Input
OUTPUT1	HIGH, HIGH at the fall of the INPUT1 input
OUTPUT2	HIGH, HIGH at the fall of the INPUT1 input
PASS/FAIL signal	(Negative) Æ HIGH

Commands to control the 24-bit I/O port

To output data to each output port (A to H), use the following commands.

GPIB command	Instrument BASIC command	Description
"OUTAIO" on page 369	"WRITEIO 16,0;"	Outputs 8-bit width data to port A.
"OUTBIO" on page 369	"WRITEIO 16,1;"	Outputs 8-bit width data to port B.
"OUTCIO" on page 370	"WRITEIO 16,2;"	Outputs 4-bit width data to port C.
"OUTDIO" on page 370	"WRITEIO 16,3;"	Outputs 4-bit width data to port D.
"OUTEIO" on page 371	"WRITEIO 16,4;"	Outputs 8-bit width data to port E.
"OUTFIO" on page 371	"WRITEIO 16,5;"	Outputs 16-bit width data to port F.
"OUTGIO" on page 372	"WRITEIO 16,6;"	Outputs 20-bit width data to port G.
"OUTHIO" on page 372	"WRITEIO 16,7;"	Outputs 24-bit width data to port H.

To use ports C, D, E, F, G and H as output ports, use the following commands to set ports C and D as output ports in advance.

- "COUT" on page 283
- "DOUT" on page 307

To read out data from each input port (C to E) to the controller, use the following commands.

GPIB command	Instrument BASIC command	Description
“OUTPINPCIO?” on page 381	“READIO(16,2)”	Reads out 4-bit width data from port C.
“OUTPINPDIO?” on page 382	“READIO(16,3)”	Reads out 4-bit width data from port D.
“OUTPINPEIO?” on page 382	“READIO(16,4)”	Reads out 8-bit width data from port E.

To use ports C, D, and E as input ports, use the following commands to set ports C and D as input ports in advance.

- “CIN” on page 278
- “DIN” on page 297

To select positive logic or negative logic for input/output signals of ports, use the following commands. You can save this setting into an instrument setup file using the save function.

- “NEGL” on page 362
- “POSL” on page 403

NOTE The above commands, used to change the positive logic/negative logic setting, are available for the following ports.

- Output ports A to H
- Input ports C to D
- PASS/FAIL signal

To make the setting so that OUTPUT1 and OUTPUT2 goes HIGH (or LOW) when a pulse is inputted into INPUT1, use the following commands.

- “OUT1ENV{H|L}” on page 367
- “OUT2ENV{H|L}” on page 368

To set OUTPUT1 and OUTPUT2 to HIGH (or LOW), use the following commands.

- “OUT1{H|L}” on page 367
- “OUT2{H|L}” on page 368

To check that any pulses have been inputted to INPUT1, use the following command.

- “INPT?” on page 319

Sample Program to Use the I/O Port

Communication with external equipment shows a sample program to communicate with external equipment through the 8-bit I/O. This program is stored on the sample program disk as the io_port.bas file.

Lines 20 to 60	Identifies the external controller and Instrument BASIC and sets the GPIB address.
Line 80	Sets an 8-bit data value to OUT0 to OUT7 (outputs to the external equipment). In this sample, 8 is set as an 8-bit data value, and therefore the OUT3 line is set to TRUE.
Lines 100 to 140	Waits for the external equipment to set the IN3 line to TRUE (to input 8 to IN0 to IN3 as a 4-bit data value).

Example 9-1 **Communication with external equipment**

```
10   INTEGER Inpio,Bit3_stat
20   IF SYSTEM$("SYSTEM ID")="HP4294A" THEN
30    ASSIGN @Hp4294a TO 800
40   ELSE
50    ASSIGN @Hp4294a TO 717
60   END IF
70   !
80   OUTPUT @Hp4294a;"OUT8IO 8"
90   !
100  REPEAT
110   OUTPUT @Hp4294a;"INP8IO?"
120   ENTER @Hp4294a;Inpio
130   Bit3_stat=BIT(Inpio,3)
140  UNTIL Bit3_stat=1
150  END
```

10 Handling Errors

This chapter describes how to handle errors that may occur in the Agilent 4294A while running a program.

Using the Status Register

Status of the 4294A can be detected using the status register. Occurrence of an error will be reflected to the standard event status register. SRQ (Service Request) is used to detect occurrence of an error in your program with information in this register.

Use the command below to detect completion of sweep via SRQ.

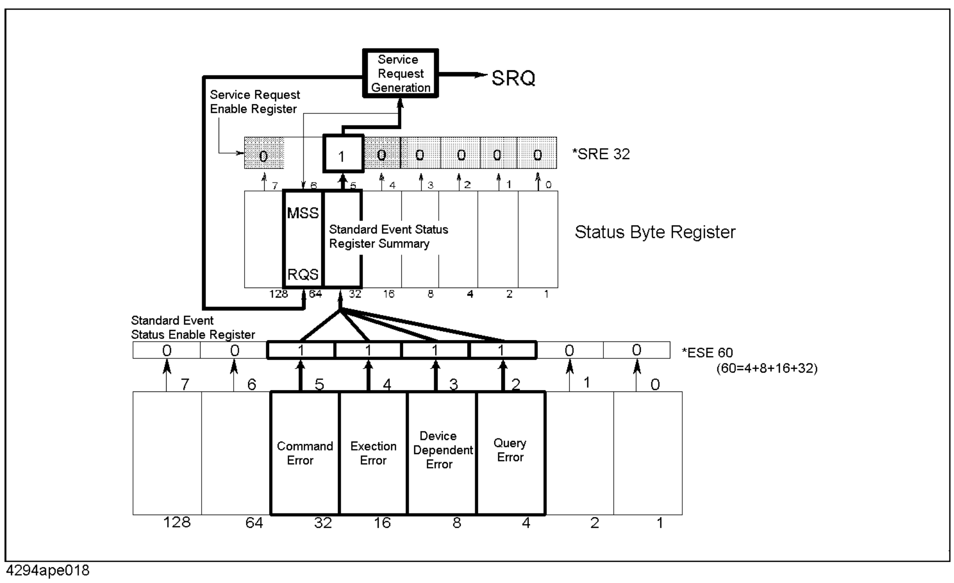
- “*SRE” on page 260
- “*ESE” on page 258

Here described is how to work with SRQ in your program.

Step 1. Set the 4294A to generate SRQ when “1” is assigned to the each error occurrence bit of the standard event status register.

Step 2. Perform an interruption processing at the time SRQ is generated.

Figure 10-1 **SRQ generation sequence (in response to an error)**



Using the Error Queue

When an error occurred, its number and message will be stored in the error queue. Thus, reading contents of the error queue will enable it to verify which error occurred. Use the command below to read contents of the error queue.

- "OUTPERRO?" on page 380

Some examples for using the error queue are given below:

1. Use the error queue to branching control of the program in response to an error. If no error occurred., contents read out from the error queue is 0 for the number and "No error" for the message. This can be used to verify occurrence of any error and thus used to branch processing flow of your program. This is also used to handle a specific error which may be predefined in the program. Refer also to the examples given in Example 4-1, Example 8-1 and so on.
2. Use the error queue to identify an error when it is detected via SRQ. See the example in Example 10-1.

Sample program for error handling

Example 10-1 is a sample program for detecting an error via SRQ. This program is saved in the file “error.bas” on the sample program disk.

This program performs necessary settings for SRQ, intentionally sends a command that the 4294A does not support to cause an error, then handles the error occurred. In the error handling, the error is identified, its error number and message are displayed followed by a message showing that the program is aborted.

Lines 30 to 90	Identifies the external controller and Instrument BASIC and sets the GPIB address and the select code.
Lines 110 to 120	Sets bit 2, 3, 4 and 5 of the standard event status register to be enabled and sets bit 5 of the service request enable register to 1.
Lines 130 to 150	Clears the status byte register, standard event status register, and error queue.
Lines 170 to 180	Defines the destination for branching by SRQ interruption and enables the SRQ interruption.
Lines 190 to 260	Sets a measurement parameter, a sweep start value, and a sweep stop value. An error occurs here because an unsupported command is used to set the start value.
Lines 290 to 300	Performs error handling. The number and message accompanied with the error is read out.
Lines 310 to 330	Displays a message showing an error has occurred, the error number, error message, and an another message telling that the program is aborted.
Line 350	Displays a message for normal termination of the program. Note that this will not be displayed unless the program is modified to employ an appropriate command for setting the start value.

Example 10-1 **Detecting of an error via SRQ**

```
10      DIM Buff$[9],Err_mes$[50]
20      INTEGER Scode,Err_no
30      IF SYSTEM$("SYSTEM ID")="HP4294A" THEN
40        ASSIGN @Hp4294a TO 800
50        Scode=8
60      ELSE
70        ASSIGN @Hp4294a TO 717
80        Scode=7
90      END IF
100     !
110     OUTPUT @Hp4294a;"*ESE 60"
120     OUTPUT @Hp4294a;"*SRE 32"
130     OUTPUT @Hp4294a;"*CLS"
140     OUTPUT @Hp4294a;"*OPC?"
150     ENTER @Hp4294a;Buff$
160     !
170     ON INTR Scode GOTO Err_proc
180     ENABLE INTR Scode;2
190     OUTPUT @Hp4294a;"MEAS CSQ"
200     PRINT "Set Meas Prm:Cs-Q"
210     OUTPUT @Hp4294a;"START 10MHZ"
220     PRINT "Set Start:10MHz"
230     OUTPUT @Hp4294a;"STOP 100MHZ"
240     PRINT "Set Stop:100MHz"
250     OUTPUT @Hp4294a;"*OPC?"
260     ENTER @Hp4294a;Buff$
270     GOTO Skip_err_proc
280 Err_proc: ! Error Process
290     OUTPUT @Hp4294a;"OUTPERRO?"
300     ENTER @Hp4294a;Err_no,Err_mes$
310     PRINT "Error occurred!!"
320     PRINT "  No:";Err_no,"Description: "&Err_mes$
330     PRINT "PROGRAM INTERRUPT!!"
340     GOTO Prog_end
350 Skip_err_proc: PRINT "PROGRAM DONE."
360 Prog_end: END
```

11 Using HP Instrument BASIC

This chapter gives an overview of HP Instrument BASIC and explains how to use the keyboard. Read this chapter before using the HP Instrument BASIC program installed in the Agilent 4294A.

HP Instrument BASIC, Overview

You can use HP Instrument BASIC in a wide variety of applications from mere automation of a measurement procedure to external GPIB equipment control.

HP Instrument BASIC, although incorporated in the 4294A, works as independent system control. Thus it can communicate, using GPIB commands, with external GPIB measuring equipment, computers, peripheral devices, let alone the 4294A's main unit via the GPIB interface.

The programming interface of HP Instrument BASIC comprises an editor and programming utilities. These utilities are to save, recall, re-number programs, and to delete a program in part or in whole.

The command set of HP Instrument BASIC looks similar to that of HP BASIC. Actually, with small modifications made, HP Instrument BASIC programs can be run using HP BASIC on an external computer. See “HP Instrument BASIC Programming Technique” in ***HP Instrument BASIC User's Handbook***.

Controlling the Agilent 4294A

HP Instrument BASIC can control the 4294A’s main unit via the internal GPIB bus. This means that 4294A has a measuring device and a controller coupled together with the GPIB bus within a case.

NOTE

The select code for the internal GPIB bus is set to 8. Any internal address from 0 through 30 is valid, so the 4294A's device selector in sample programs is set to “800”.

For details of the GPIB addresses and the device selectors, see “Device Selectors” in “HP Instrument BASIC Interfacing Techniques” in ***HP Instrument BASIC User's Handbook*** and “Device selector” on page 28.

Reserving an Area for BASIC on the Screen

When the 4294A is powered on, the measurement screen (ALL INSTRUMENT) shows up. The BASIC screen is made ready so as to use HP Instrument BASIC. In the 4294A, four screen layouts are available. Let's go over these four screen layouts.

Step 1. Press the following key and softkeys.

[Display] - **more 1/2** - **ALLOCATION**

Step 2. Press the following softkeys.

ALL BASIC

The screen is cleared and the whole screen is reserved for BASIC.

Step 3. Press the following softkeys.

ALL INSTRUMENT

Then, the whole screen area is reserved for the measurement screen.

Step 4. Press the following softkeys.

HALF INSTR HALF BASIC

The upper half of the screen is reserved for the measurement screen, and the lower half is reserved for BASIC.

Step 5. Press the following softkeys.

BASIC STATUS

Three blank lines appear at the bottom of the screen. The BASIC system uses this area for taking in commands and for displaying messages.

Entering BASIC Commands Using the Keys Located on the Front Panel

The 4294A HP Instrument BASIC, though with no keyboard connected, can be run with commands entered by front panel operation.

Press the following key and softkeys.

[System] - **IBASIC** - **more 1/3** - **more 2/3** - **COMMAND ENTRY**

The command entry menu appears in the soft menu area, and uppercase alphabetic letters, lowercase alphabetic letters, numerics, and specific symbols appear in the active input area. You can scroll these character sets by use of the step keys (**[↑]** or **[↓]**). Move the arrow "↑" to an intended character using the rotary knob, and press **SELECT LETTER**. Repeat these steps until you make up the character string of a command, and press **done**. The command will be run.

Editing a Program

Starting up and exiting edit mode

Starting up edit mode with key operation on the front panel

The following key operation allows you to start up edit mode regardless of the layout displayed on the screen.

[System] - **IBASIC** - **Edit**

Starting up edit mode by use of the keyboard

Enter the following command and parameter (a line number), then press the **[Enter]** key. These steps allow you to start up edit mode with the cursor displayed at the line having the specified line number. The line number may be omitted.

EDIT line number

NOTE With the screen layout ALL INSTRUMENT selected on the screen (with the whole screen used for the measurement layout), a character string entered by the operation above will not appear on the screen, but edit mode is started up.

Exiting edit mode with key operation on the front panel

The following key operation allows you to exit edit mode.

[System] - **IBASIC** - **done**

Exiting edit mode by use of the keyboard

Press either the **[Esc]** key or the **[Home]** key, or press the **[F8]** key while holding down the **[Shift]** key and the **[Alt]** key together. This key operation allows you to exit edit mode.

Editing a program

Here follows the way of editing a program in edit mode. For detailed information as to the keys on the keyboard, see “Keyboard” on page 154.

Deleting characters

To delete characters, you can use the two key given below.

Backspace	The **[Back Space]** key on the front panel or the **[Backspace]** key on the keyboard deletes a single character lying on the left side of the cursor and moves the cursor to the left one character space.
Delete character	The **[Delete]** key on the keyboard deletes the character lying at the cursor positions.

Inserting characters

In edit mode, character insertion mode is constantly ready. What you type on the keyboard is inserted at the cursor position (not in overwrite mode).

Moving the cursor

You can move the cursor either leftward or rightward by the key operation given below.

Front panel operation	Keyboard operation
Turn the rotary knob.	Press either the **[←]** key or the **[→]** key.

Scrolling lines

You can scroll lines up or down by the key operation given below.

Front panel operation	Keyboard operation
Press the step keys (**[↑]** or **[↓]**).	Press either the **[↑]** key or the **[↓]**.

Scrolling pages

Pressing either the **[Page Up]** key or the **[Page Down]** key on the keyboard allows you to scroll one page up or down.

Moving to a specified line

The operation given below allows you to move the cursor to a line you specify.

Step 1. Carry out the following operation on the front panel.

[System] - **IBASIC** - **GOTO LINE**

Step 2. Enter a line number by use of either the front panel or the keyboard, then press the **[Enter]**. If labels are defined in the program, you can specify the move destination by the label instead of the line number.

Moving to the beginning or to the tail end of a program.

Press either the **[↑]** key or the **[↓]** key while holding down the **[Shift]** key on the keyboard allows you to move either to the beginning or to the tail end of the program.

Inserting, deleting, or restoring a line

Pressing the **[Insert]** key while holding down the **[Shift]** key on the keyboard inserts a new line just over the current cursor-positioned line.

Pressing the **[Delete]** key while holding down the **[Shift]** key deletes the current cursor-positioned line.

Carrying out the following key operation on the front panel allows you to restore the line you last deleted.

[System] - **IBASIC** - **RECALL LINE**

Clearing a line

Pressing the **[End]** key while holding down the **[Shift]** key on the keyboard allows you to delete characters from the current cursor position to the end of that line.

Re-numbering a line number

The procedure given below allows you to re-number a line number of the program.

Step 1. Carry out the following key operation on the front panel.

[System] - **IBASIC** - **more 1/3** - **more 2/3** - **RENUMBER**

or type REN by use of the keyboard.

Step 2. Pressing either the **[×1]** key on the front panel or the **[Enter]** on the keyboard effects the following. The first line is numbered 10 after re-numbering, the subsequent lines are numbered in increments of 10, and the whole lines are re-numbered.

To specify the first line number to be effected after re-numbering, an increment, and a re-numbering range (the first line and the last line to cover an intended range), make entries as given below, then press the **[Enter]**.

REN <para1>, <para2> IN <para3>, <para4>

where

<para1>: the first line number to be effected after re-numbering
<para2>: the increment of adjacent line numbers
<para3>: the first line number of the range to be re-numbered
<para4>: the last line number of the range to be re-renumbered.

Running a Program

Step 1. Reserve the BASIC area. For the procedure, see “Reserving an Area for BASIC on the Screen” on page 139.

Step 2. Read the program that you want to execute. For the procedure, see “Reading a Program (GET)” on page 147.

Step 3. Carry out the following key operation on the front panel. Then the program is run.

[System] - **IBASIC** - **Run**

Or type RUN on the keyboard, then press the **[Enter]** key.

Running a program through the softkey interface

Step 1. Carry out the following key operation on the front panel. Then the 4294A displays a menu of softkeys that correspond to available program files residing on the selected storage device.

[System] - **PROGRAM MENU**

Step 2. Select your desired program by choosing the associated softkey. Then the 4294A executes the selected program.

Step 3. If you want to change the storage device, press the **STORE DEV[ ]** key and then press one of the softkeys; **FLOPPY** (floppy disk), **MEMORY** (RAM disk), and **FLASH MEMORY** (flash disk).

Automatically starting a program at power-on

A file having the “AUTOST” file name is automatically executed at power-on.

NOTE When the power is turned on, the 4294A checks for any “AUTOREC.STA” file. If an “AUTOREC.STA” file exists, it reads the information contained in the file, and then loads and executes the “AUTOST” program. The 4294A checks an “AUTOST” program on the floppy disk, then checks it on the flash disk.

Listing a Program (LIST)

You can output a program listing either on the screen or to the printer.

Displaying a program listing on the screen

You output a program listing on the screen as described below.

Step 1. Since a program listing is output on the BASIC area of the 4294A's LCD screen, you need to reserve the BASIC area before outputting a listing. For the procedure, see “Reserving an Area for BASIC on the Screen” on page 139.

Step 2. Type LIST on the keyboard, then press the **[Enter]** key.

Outputting a program listing to the printer

NOTE Check that the printer is connected to the 4294A.

Step 1. Type PRINTER IS PRT on the keyboard, then press the **[Enter]** key to route the output to the printer.

Step 2. Further, type LIST on the keyboard, and press the **[Enter]** key. Then the program listing will be output to the printer.

Step 3. Type PRINTER IS CRT on the keyboard, then press the **[Enter]** key to switch the output destination back to the 4294A's LCD screen.

Saving a Program (SAVE)

Step 1. To use the built-in floppy disk drive, insert a 2DD disk or 2HD disk into the floppy disk drive. (If the disk is not initialized, initialize it in DOS format. For the procedure see ***Operation Manual***.)

Step 2. Reserve the BASIC area. For the procedure, see “Reserving an Area for BASIC on the Screen” on page 139.

Step 3. Decide on which storage unit to use a floppy disk, RAM disk (volatile), or flash disk (non-volatile).

If you decide on it by use of the front panel, follow the procedure given below.

1. Carry out the key operation given below.

   [System] - **IBASIC** - **more 1/3** - **MASS STORE[]**

2. Press one of the softkeys; **FLOPPY** (floppy disk), **MEMORY** (RAM disk), and **FLASH MEMORY** (flash disk).

If you use the keyboard, enter one of the following, then press the **[Enter]** key.

- To decide on a floppy disk

  MSI ":INTERNAL,4"

- To decide on a RAM disk

  MSI ":MEMORY,0"

- To decide on a flash disk

  MSI ":INTERNAL1,5"

Step 4. Type the following on the keyboard, then press the **[Enter]** key.

SAVE "file name"

NOTE

If you type a file name already present on the applicable disk in saving a program, an error message “ERROR -257 File name error” appears, and the program is not saved. In this instance, you can use one of three ways given below to deal with this matter.

- Use a file name that is not present on the disk. To check the names of files held on the disk, use the CAT command.
- Overwrite an existing file with a new file by giving the same name. To overwrite a file held on the disk, use the RE-SAVE command.
- Use the PURGE command to erase the old file, and save the program as a new file.

Listing File Names (CAT)

Here follows how to list file names saved in the storage unit (the intended disk you save a file in)

Displaying a list of file names on the screen

Step 1. Since the list of file names is output on the BASIC area of the 4294A's LCD screen, you need to reserve the BASIC area before outputting the list. For the procedure, “Reserving an Area for BASIC on the Screen” on page 139.

Step 2. Carry out the following key operation on the front panel, then press the **[×1]** key. The file names will be listed.

[System] - **IBASIC** - **more 1/3** - **CAT**

Or type CAT on the keyboard, then press the **[Enter]** key.

Outputting a list of file names to the printer

NOTE Check that the printer is connected to the 4294A.

Step 1. Type PRINTER IS PRT;WIDTH 80 on the keyboard, then press the **[Enter]** key to route the output to the printer.

Step 2. Further, type CAT on the keyboard, and press the **[Enter]** key. Then the list of file names will be output to the printer.

Step 3. Type PRINTER IS CRT on the keyboard, then press the **[Enter]** key to switch the output destination back to the 4294A's LCD screen.

Reading a Program (GET)

Here follows the procedure of reading a program from the storage unit.

Step 1. To read a program from a floppy disk, inert it into the floppy disk drive.

Step 2. Reserve a BASIC area on the screen. For the procedure, see “Reserving an Area for BASIC on the Screen” on page 139.

Step 3. Decide on which storage unit to use a floppy disk, RAM disk (volatile), or flash disk (non-volatile).

If you decide on it by use of the front panel, follow the procedure given below.

1. Carry out the key operation given below.

   [System] - **IBASIC** - **more 1/3** - **MASS STORE[]**

2. Press one of the softkeys **FLOPPY** (floppy disk), **MEMORY** (RAM disk), and **FLASH MEMORY** (flash disk).

If you use the keyboard, enter one of the following, the press the **[Enter]** key.

- To decide on a floppy disk

  MSI ":INTERNAL,4"

- To decide on a RAM disk

  MSI ":MEMORY,0"

- To decide on a flash disk

  MSI ":INTERNAL1,5"

Step 4. Type the following on the keyboard, then press the **[Enter]** key.

GET "file name"

ON KEY LABEL Functions

HP Instrument BASIC provides you with a means to define softkeys within a program. Softkeys defined in a program will be displayed in the softkey label area if you press the **[F10]** while holding down the **[Shift]** key on the keyboard or if you press the keys **[System]** - **IBASIC** - **ON KEY LABELS** on the front panel. The labels are displayed only when the program is being run. An example is given below.

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

You can also automatically display the labels without pressing the **[Shift]** key while holding down the **[Shift]** key or without pressing the keys **[System]** - **IBASIC** - **ON KEY LABELS** on the front panel in the course of running a program. Since “KEY”(323page), one of GPIB commands, works in a manner equivalent to pressing the keys specified as parameters, the example below displays the softkeys specified by the ON KEY LABEL statement as if you press the keys **[System]** - **IBASIC** - **ON KEY LABELS**.

```
 :
200 OUTPUT @Hp4294a;"KEY 47"    ! [System] key
210 OUTPUT @Hp4294a;"KEY 0"     ! IBASIC softkey
220 OUTPUT @Hp4294a;"KEY 6"     ! ON KEY LABELS softkey
 :
```

For the details of the ON KEY LABEL statement, see “HP Instrument BASIC Language Reference” in ***HP Instrument BASIC User's Handbook***.

Pass Control Involved with an External Controller

Here follows the description of how to exchange the control priority (pass control) between Instrument BASIC and an external controller.

Pass control

To deliver active control from an external controller to HP Instrument BASIC, execute pass control on the external controller side. For example, with the GPIB address set to 17 in the 4294A, the following in HP BASIC serves the purpose.

PASS CONTROL 717

When the 4294A has the control priority, the 4294A can specify another device on the GPIB bus to freely exchange (talk/listen) data. Similarly to the system controller, the 4294A can transmit data either to a printer or to a plotter (talk) and receive (listen) responses either from the printer or from the plotter.

NOTE The features to assert the interface clear line (IFC) and the remote enable line (REN) appertain to the system controller. Even though HP Instrument BASIC is turned to an active controller, it cannot use these features.

ABORT 7 Asserting Interface Clear Line (IFC)

REMOTE 7 Asserting Remote Enable Line (REN)

To return the control priority to the 4294A, execute the following on the Instrument BASIC side.

PASS CONTROL 721

Also, resetting the GPIB bus as given below causes the control priority to return to the system controller.

ABORT 7

Communicating with an external controller

Example 11-1 shows an example of communication between an external controller and the 4294A Instrument BASIC. This example shows a program executable only on the external controller. It is given a file name prg_xfer.bas and is stored in the sample program disk.

This program transfers a program file saved in the external controller's storage unit (hard disk or the like) and executes the file.

Line 20	This line resets GPIB bus and returns the control priority to the system controller.
Line 30	This line sets the GPIB address.
Line 40	This line receives a user-entered file name of a program to transfer.
Lines 50 to 60	These lines delete existing programs held in Instrument BASIC, then transfer the header (the header that indicates that the size data portion hasn't been defined).
Lines 90 to 130	These lines read program lines, one by one, and transfer them.
Line 160	This line sends the signal of end of transmission (<LF>+EOI).
Line 190	This line executes the program transferred.

Example 11-1 **Transferring a program to Instrument BASIC**

```
10      DIM File_name$[20],Line$[1024]
20      ABORT 7
30      ASSIGN @Hp4294a TO 717
40      INPUT "FILENAME?",File_name$
50      OUTPUT @Hp4294a;"PROG:DEL:ALL"
60      OUTPUT @Hp4294a;"PROG:DEF #0"
70      ASSIGN @File TO File_name$
80      ON ERROR GOTO Done
90        LOOP
100         Line$=""
110         ENTER @File USING "K";Line$
120         OUTPUT @Hp4294a;Line$
130       END LOOP
140 Done:      !
150     OFF ERROR
160     OUTPUT @Hp4294a;" ",END
170     ASSIGN @File TO *
180     !
190     OUTPUT @Hp4294a;"PROG:EXEC ""RUN"""
200     END
```

Usable I/O Interfaces and Select Code

Interfaces usable in the 4294A Instrument BASIC and their select codes are as follow.

Select code	Device
1	LCD
2	Keyboard
7	External GPIB interface
8	Internal GPIB interface

External RUN/CONTinue Connector

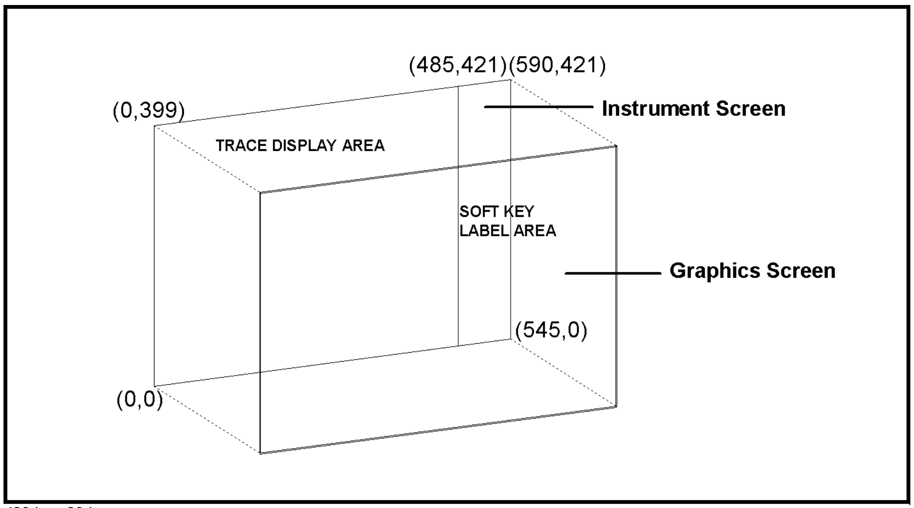
Applying a TTL-level signal to the RUN/CONT connector located on the 4294A's rear panel allows you to externally release either the RUN trigger or the CONT trigger for the program. The pulse to be applied needs to be of negative TTL level and to be not less than 20 µsec in pulse width. The trigger is made effective at the trailing edge of the pulse.

Displaying Graphics

You can draw graphics on the screen of the 4294A by use of HP Instrument BASIC.

the 4294A has two screens, that is, the instrument screen and the graphics screen. These screens are both always displayed on the LCD, and you cannot choose either of them to display. The instrument screen is made up of the area for displaying traces and the area for displaying softkey labels. The Instrument BASIC editor is also displayed in the area for displaying traces. The graphics screen covers the whole instrument screen as shown in Figure 11-1. The graphics screen allows what are displayed on the instrument screen to pass through as a transparent sheet, so you can draw graphics independently anywhere in the area for displaying traces and the area for displaying softkeys.

Figure 11-1 **The screen makeup of the Agilent 4294A**



4294ape034

A point on the graphic screen can be specified by the coordinates shown in Figure 11-1. The lower left corner of the screen corresponds to the origin (0, 0) and the upper right corner of the screen corresponds to the point (590, 421). You give these coordinates to the parameters in the MOVE and DRAW statements.

Graphics commands of Instrument BASIC

The 4294A HP Instrument BASIC offers three graphics-related commands; MOVE, DRAW, and GCLEAR.

MOVE	Moves the pen from the current pen position to the point specified by the coordinates given as a parameter.
DRAW	Draws a straight line from the current pen position to the point specified by the given coordinates.
GCLEAR	Clears the graphics screen, and moves the pen to the origin.

NOTE After initializing the graphics screen by use of GCLEAR, you can execute the MOVE command and the DRAW command up to 1998 times. Even if you execute the MOVE command and the DRAW command after that, nothing will be drawn.

Hard copy

You can produce hard copy output of graphics by use of the printing feature. Press the **START** key located under the **[Copy]** key.

Default setting

The default setting when the power is turned on is as follows.

- MOVE 0,0

A sample graphics program

Here follows a simple example to draw a line on the graphics screen.

Drawing a straight line

The program below draws a straight line from the point (50, 200) to another (300, 200).

```
GCLEAR               ! Initializes the graphics screen.
MOVE 50,200          ! Moves the pen to the point (50, 200).
DRAW 300,200         ! Draws a straight line to the point (300, 200).
END
```

Drawing a circle

Here follows an example of sub-program for drawing a circle. Giving coordinates of the center and a radius to this sub-programs as arguments allows you to draw a circle. Changing the start value and the end value of the parameter Theta in this sub-program allows you to draw a circular arc too.

```
SUB Drawcircle(Centx,Centy,R)    !
  DEG                            ! Uses "°" has the unit of agnle.
  X=Centx+R                      !
  Y=Centy                        !
  MOVE X,Y                       ! Moves the pen to the start point.
  For Theta=1 to 360             !
    X=INT(COS(Theta)*R+Centx)    ! Calculates the x coordinate of a
point on the circle
    Y=INT(SIN(Theta)*R+Centy)    ! Calculates the y coordinate of a
point on the circle.
    DRAW X,Y                     ! Draws a line to the point (X, Y)
  NEXT Theta                     !
SUBEND                           !
```

Keyboard

Here is the description of key bindings of the keyboard.

Character entry keys

The character keys are laid out the same as U.S. 101 keyboard. Additional features are as follows.

[Caps] Pressing this key switches between uppercase characters (default) and lowercase characters.

[Shift] With this key held down, uppercase characters entered turn to lowercase characters, lowercase characters entered turn to uppercase characters. When this key is pressed down, pressing a letter key produces an uppercase letter.

[Enter] This key has three features.

- When the program under execution requests a data entry, typing data and pressing this key in response to the request informs the program of the data entry.
- Typing the source code of a program and pressing this key stores it in memory.
- If you type a command and press this key, then the command will be executed.

[Ctrl] Using this key in edit mode allows you to use cursor control, display control, and the Edit keys. For details, see "The [Ctrl] in edit mode" on page 158.

[Backspace] Pressing this key erases a single character lying on the left side of the cursor and moves the cursor to the left one character space.

[Tab] This key has no effect.

Cursor control and display control

[↑] and **[↓]** These keys scroll up or down lines in the print output area on the display. Pressing this key while holding down the **[Shift]** causes the cursor to jump to the beginning or to the tail end of the print displayed.

[←] and **[→]** These keys move the cursor leftward or rightward within a line. Pressing this key while holding down the **[Shift]** key causes the cursor to jump either to the far-right position or to the far-left position of the line currently displayed.

[Page Up] and **[Page Down]**
Pressing these keys scrolls up or down the content of the screen page by page.

Numeric keys

The numeric keys are useful for entering numbers and operators. Simply typing an expression in the command line and pressing the Enter key displays the result at the lower left part of the screen.

[Enter] This key works the same as the **[Enter]** key.

[0]-**[9]** The numeric keys work the same as those on the front panel of the 4294A.

[Num Lock] This key has no effect. Pressing this key turns LED on or off, but the numeric keys can be used for entering numeric values only.

Edit keys

[Insert] HP Instrument BASIC constantly runs in insert mode, so this key has no effect.

[Shift]+**[Insert]** Pressing the **[Insert]** key while holding down the **[Shift]** key inserts a new line just over the cursor-positioned line (effective in edit mode only).

[Delete] Pressing this key deletes a single character over the cursor.

[Shift]+**[Delete]** Pressing the **[Delete]** key while holding down the **[Shift]** key deletes the cursor-positioned line (effective in edit mode only).

[End] Pressing this key deletes the cursor-positioned line but leaves the line number.

[Shift]+**[End]** Pressing the **[End]** key while holding down the **[Shift]** key deletes characters from the cursor position to the end of that line.

[Home] This key clears the alpha screen. If you are in edit mode, this key exits the edit mode.

Program control keys

Program control keys exert control over program execution.

[Pause/Break] Pressing this key or pressing the **[F4]** key while holding down the **[Alt]** key temporarily stops program execution. If you carry out the key operation **[System]** - **IBASIC** - **Continue** on the front panel of the 4294A, the temporary stop is canceled.

Pressing the **[F4]** key while holding down the **[Shift]** key and the **[Alt]** key together stops program execution. To resume executing the program, carry out the key operation **[System]** - **IBASIC** - **Run** on the front panel of the 4294A.

[Ctrl]+**[Pause/Break]** Pressing the **[Pause/Break]** key while holding down the **[Ctrl]** key resets program execution without erasing the program from memory (BASIC RESET).

Pressing the **[F5]** key while holding down the **[Alt]** key temporarily stops the execution of the program involved in I/O operation. If the System hangs up during I/O operation, press the **[F5]** key while holding down the **[Alt]** key instead of pressing the **[Pause/Break]** key or the key combination **[Alt]**+**[F4]**. The reason for this is that either the **[Pause]** key or the key combination **[Alt]** + **[F4]** doesn't work until the System finishes processing the current program line.

System control keys

[Shift]+**[Page Up]** Pressing the **[Page Up]** key while holding down the **[Shift]** key calls again the program line last entered (history feature). Pressing the key combination **[Shift]**+**[Page Up]** repeatedly calls program lines entered in the past in reverse sequence of entries. Using this feature when you made mistakes in what you type releases you from typing them over again. Pressing the key combination **[Shift]**+**[Page Down]** retrieves program lines in the direction opposite to the case effected by key combination **[Shift]**+**[Page Up]**, and displays program lines.

[Alt]+**[F3]** Pressing the **[F3]** key while holding down the **[Alt]** key executes the program.

[Alt]+**[F2]** Pressing the **[F2]** key while holding down the **[Alt]** key cancels the temporary stop of the program.

[F12] With "ALL INSTRUMENT" selected for display layout, pressing the **[F12]** key switches the layout to BASIC STATUS mode. Pressing the **[F12]** key while holding down the **[Shift]** key returns the display layout to "ALL INSTRUMENT".

Softkeys

The function keys **[F1]** through **[F8]** work the same as the softkeys located on the front panel of the 4294A. The softkey labels are displayed on the right hand part of the screen.

Soft control keys

[F9] This key turns on or off the BASIC menu to control a program and editor.

[Shift]+**[F9]** Pressing the **[F9]** key while holding down the **[Shift]** key displays the BASIC menu to control a program. Every time you press this key, the screen advances to the next page. This menu is the same as the one that appears when you carry out the key operation **[System]** - **IBASIC** (- **more 1/3** - **more 2/3**) on the 4294A's front panel.

[F10] This key displays the first page of the BASIC menu to control a program.

[Shift]+**[F10]** Pressing the **[F10]** key while holding down the **[Shift]** key displays the ON KEY LABEL menu that displays softkeys defined in the program. For details, see "ON KEY LABEL Functions" on page 148.

Softkeys accessed from [Shift]+[F9] key.

Pressing the **[F9]** key while holding down the **[Shift]** key calls the BASIC menu to be used for controlling a program. Pressing this softkey allows you to run a command or to generate program source code instead of keyboard entries. Each menu item is described below.

Step Executes the program line by line. Useful for debugging.

Continue Cancels the temporary stop of the program.

Run Runs the program.

Pause Runs the instruction on the current line, then temporarily stops running the program.

Stop Stops running the current line and subsequent lines. Pressing **Run** allows you to run the program from the beginning over again.

Edit Turns edit mode ready.

ON KEY LABELS Displays softkeys defined by the program.

CAT Generates the character string "CAT " in the BASIC command line. The CAT command lists file names held in the disk.

SAVE Generates the character string "SAVE """ in the BASIC command line. The SAVE command saves a program in the form of ASCII file.

RE-SAVE Generates the character string "RE-SAVE """ in the BASIC command line. RE-SAVE overwrites a specified file with the program. Use this to update an old file.

GET Generates the character string "GET """ in the BASIC command line. The GET command loads a specified ASCII file and reads it into editor's memory.

PURGE Generates the character string "PURGE """ in the BASIC command line. The PURGE command erases a specified file.

INITIALIZE Generates the character string "INITIALIZE " in the BASIC command line. The INITIALIZE command formats the disk so that the disk turns ready for use. If you execute this command, the contents of the disk will be fully lost.

MASS STORE [] Displays the menu for choosing a BASIC storage unit.

SCRATCH Generates the character string "SCRATCH " in the BASIC command line. If you press the **[Enter]** key in succession, the program handled in the editor will be erased from memory.

RENUMBER Generates the character string "REN " in the BASIC command line. If you press the **[Enter]** key in succession, the program line will be re-numbered.

LIST Generates the character string "LIST " in the BASIC command line. The LIST command outputs a program listing on the screen.

COMMAND ENTRY Displays the softkeys to be used for entering BASIC commands.

CLEAR I/O Stops I/O operation currently being carried out.

RESET LABELS Resets IBASIC (BASIC reset).

The [Ctrl] in edit mode

Pressing a certain key while holding down the **[CTRL]** key in edit mode works equivalently to one of the control keys such as **[↑]**, **[↓]** or **[Insert]**. Description of how these keys work is given below.

Key operation	Working
[Ctrl]+**[a]**	Moves the cursor to the beginning of the line. (Equivalent to **[Shift]**+**[¨]**)
[Ctrl]+**[b]**	Moves the cursor backward one character space. (Equivalent to **[¨]**)
[Ctrl]+**[d]**	Erases the character over the cursor. (Equivalent to **[Delete]**)
[Ctrl]+**[e]**	Moves the cursor to the end of the line. (Equivalent to **[Shift]**+**[→]**)
[Ctrl]+**[f]**	Moves the cursor rightward one character space. (Equivalent to **[→]**)
[Ctrl]+**[g]**	Causes the cursor to jump to an arbitrary line or to an arbitrary label. Specify either a line number or a label subsequent to **[Ctrl]**+**[g]**. (Equivalent to GOTO LINE)
[Ctrl]+**[h]**	Erases one character lying at the left of the cursor. (Equivalent to **[Backspace]**)
[Ctrl]+**[j]**	Works equivalently to the **[Enter]** key.
[Ctrl]+**[k]**	Erases characters from the cursor position to the end of the line. (Equivalent to **[Shift]**+**[End]**)
[Ctrl]+**[m]**	Works equivalently to the **[Enter]**.
[Ctrl]+**[n]**	Moves the cursor to the next line. (Equivalent to **[↓]**)
[Ctrl]+**[o]**	Inserts a line just over the cursor-positioned line. (Equivalent to **[Shift]**+**[Insert]**)
[Ctrl]+**[p]**	Moves the cursor to the preceding line. (Equivalent to **[↑]**)

Displaying program execution status

Here follows the description of the program status displayed at the lower right part of the screen.

What is displayed	Program status
None	Program completed. Possible to run a command. CONTINUE not usable.
_	Program stopped. Possible to run a command. CONTINUE not usable.
?	The program is waiting a keyboard entry. Not possible to run a command.
*	This mark is displayed in one of two cases given below. • Running a command. Not possible to run a command. CONTINUE not usable. • Running a command entered from the keyboard. Not possible to run a command.

Instrument BASIC Commands Specific to the Agilent 4294A

The commands given below are not carried on “HP Instrument BASIC Language Reference” in ***HP Instrument BASIC User's Handbook***, but they are available on HP Instrument BASIC of the 4294A. They can be run both by use of the keyboard and within programs. They, if used in a program, can be used in a single IF ... THEN .... line.

DATE

This function converts a date (day, month, year) into Julian seconds.

- Examples of use

```
PRINT DATE("21 MAY 1991")          ! Indicates Julian seconds
corresponding to May 21, 1991.
SET TIMEDATE DATE("1 Jan 1991")   ! Sets 00:00 a.m. January 1, 1991
                                  ! in the real time clock.
Days=(DATE("1 JAN 1991")-DATE("11 NOV 1990")) DIV 86400  !
```

NOTE Julian second is a value expressed in seconds counted since 00:00 a.m. November 24, 4713 B.C. to be used in the real time clock.

DATE$

This function converts Julian seconds into its corresponding date (day, month, year).

- Examples of use

```
PRINT DATE$(TIMEDATE) ! Indicates the date set in the real time clock.
DISP DATE$(2.111510608E+11)  ! Indicates the date corresponding to
                             ! 2.111510608E+11 Julian seconds.
```

READIO

This command reads the content of I/O ports.

Syntax: READIO(<numerical 1>,<numerical 2>)

Parameter	Description	Range of setting
<numeric 1>	Select code	One of 15, and 16 15: 8-bit I/O port 16: 24-bit I/O port
<numeric 2>	Register number	With the select code set to 15: 0 only With the select code set to 16: 2 to 4

- Example of use

```
Ioport=READIO(15,0) ! Assigns data in the 8-bit I/O port to
                    ! the variable Ioport.
```

SET TIME

This statement changes nothing but the time set in the real time clock (internal clock).

- Examples of use

```
SET TIME TIME("22:00:30")       ! Changes the time set in
                                ! the real time clock to 22:00:30.
SET TIME Hours*3600+Minutes*60  ! Changes the time set in
                               ! the real time clock to Hours:Minutes.
```

SET TIMEDATE

This statement changes Julian seconds set in the real time clock (internal clock).

- Example of use

```
SET TIMEDATE DATE("4 JAN 1993")+TIME("10:00:00") ! Set the real time
                                                 ! clock to 10 a.m.
                                                 ! January 4, 1993.
SET TIMEDATE TIMEDATE+86400                   ! Sets the real time
                                              ! clock forward one day.
```

TIME

This function indicates the elapsed time from 00:00 a.m. in seconds.

- Examples of use

```
Seconds=TIME("8:37:20")        ! The elapsed time expressed in seconds
                               ! from 00:00 a.m. to 08:37:20 a.m.
SET TIME TIME("8:37:20")       ! Sets the real time clock to 08:37:20.
ON TIME TIME("12:10") GOSUB Lunch  ! Jumps to Lunch when 12:10 comes.
```

TIME$

This function returns the elapsed time from 00:00 a.m. in the form of HH:MM:SS.

- Examples of use

```
DISP "The time is: ";TIME$(TIMEDATE) ! Current time set in the real
                                     ! time clock.
PRINT TIME$(45296)                   ! The time after an elapse of
                                      ! 45296 seconds from 00:00 a.m.
```

WRITEIO

This statement writes data either to I/O ports or to the registers for the EXECUTE command.

Syntax: WRITEIO <numeric 1>,<numeric 2>; <numeric 3>

Parameter	Description	Range of setting
<numeric 1>	Select code	One of 15, and 16 15: 8-bit I/O port 16: 24-bit I/O prot
<numeric 2>	Register number	With the select coded set to 15: 0 only With the select code set to 16: 0 to 7
<numeric 3>	Data in the register	With the select code set to 15: 0 to 255 With the select code set to 16: 0 to 16777215

- Examples of use

```
WRITEIO 15,0;12          ! Writes 12 to the 8 bit I/O port.
```

Instrument BASIC Commands that Cannot be Run on the Agilent 4294A

The commands given below are carried on “HP Instrument BASIC Language Reference” in ***HP Instrument BASIC User's Handbook***, but they cannot be run on HP Instrument BASIC of the 4294A.

- OFF CYCLE
- ON CYCLE

NOTE

The GCLEAR command and the ON TIMEOUT command have the following feature and limitation besides those described in “HP Instrument BASIC Language Reference” in ***HP Instrument BASIC User's Handbook***.

- GCLEAR

  Moves the pen to the origin (0,0).

- OFF TIMEOUT and ON TIMEOUT

  The interface select code can be set to 7 only.

12 Using LAN

This chapter describes LAN (Local Area Network)-based file transfer and remote control.

Advantages of LAN Connection

You can connect the Agilent 4294A with LAN. Connecting it with LAN allows you to make use of the functions given below.

- You can easily transfer files between an external computer and the 4294A.

  You can transfer files held in the 4294A to an external computer or vice versa bypassing floppy disks.

  You can directly save settings or measurement data held in the 4294A into an external computer. You can also recall files of settings held on an external computer into the 4294A.

- The 4294AYou can save Instrument BASIC programs held in the 4294A editor into an external computer. You can also download the files of Instrument BASIC programs to the 4294A editor and execute them.

- You can send GPIB commands to the 4294A and control it.

NOTE You cannot use some of functions usable within GPIB, such as service request, by way of LAN.

Getting Ready for Using LAN

Getting ready for LAN connection

Before connecting the 4294A with LAN, you set an IP address (a unique address within a single LAN assigned to a device to identify it in making LAN connection), a gateway IP address (the IP address of a routing device that connects your the 4294A's LAN with other LANs), and a sub-net mask (a numerical value used to judge whether your the 4294A needs to route communications through the gateway).

NOTE Obtain the settings of IP address, gateway address, and sub-net mask from your network administrator.

NOTE If your network doesn't need to be connected with devices on different physical networks, usually you need to set neither the gateway IP address nor the sub-net mask.

NOTE To validate the IP address, the gateway IP address, and the sub-net mask you set, you need to cycle power of the 4294A (power it off and power it on again).

Setting an IP address

Here follows the way of setting an IP address.

Step 1. Press the [**Local**] key in the INSTRUMENT STATE block on the front panel, and press the **IP ADRESS** key.

Step 2. Press the **1st** key, and enter the first number of the IP address delimited by a period.

Step 3. Press the **2nd** key, the **3rd** key, and the **4th** key, and similarly enter the second, the third, and the fourth numbers of the IP address delimited by a period.

Step 4. Press the **done** key.

To make settings with the GPIB command, use the command given below.

- "ADDRIP" on page 265

12. Using LAN

Setting a gateway IP address

Here follows the way of setting a gateway IP address.

Step 1. Press the [**Local**] key in the INSTRUMENT STATE block on the front panel, and press the **GATEWAY ADRESS** key.

Step 2. Press the **1st** key, and enter the first number of the gateway IP address delimited by a period.

Step 3. Press the **2nd** key, the **3rd** key, and the **4th**key, and similarly enter the second, the third, and the fourth numbers of the gateway IP address delimited by a period.

Step 4. Press the **done** key.

To make settings with the GPIB command, use the command given below.

- "ADDRGW" on page 264

Setting a sub-net mask

Here follows the way of setting a sub-net mask.

Step 1. Press the [**Local**] key in the INSTRUMENT STATE block on the front panel, and press the **SUBNET MASK** key.

Step 2. Press the **1st** key, and enter the first number of the sub-net mask delimited by a period.

Step 3. Press the **2nd** key, the **3rd** key, and the **4th** key, and similarly enter the second, the third, and the fourth numbers of the sub-net mask delimited by a period.

Step 4. Press the **done** key.

To make settings with the command, use the command given below.

- "SUBNET" on page 447

Displaying the MAC address

In the event that you need to look up the MAC address (a unique address assigned to the device) of the 4294A, follow the steps given below, the MAC address will be displayed on the LCD screen.

Step 1. Press the [**System**] key in the INSTRUMENT STATE block on the front panel, and press the **DIAGNOSTIC TEST** key.

Step 2. Pressing the **MAC ADDRESS** key causes the MAC address of the 4294A to appear on the LCD screen.

Connecting with LAN

Use a 10Base-T twisted pair (Ethertwist) cable to connect the LAN port (RJ-45 connector) located at the lower left of the 4294A's rear panel with a vacant port of the LAN in view.

Transferring Files

You can transfer files from the 4294A, if connected to LAN, to an external computer connected to the same LAN or vice versa by use of FTP (file transfer protocol).

NOTE The description given below assumes that you are familiar with the basic operation in a Window environment, such as Windows 95, Windows NT, and so on, and that you have basic knowledge about the operation of MS-DOS. For questions as to the operation of Windows 95 or other environment, see appropriate references.

File transfer procedure using ftp

A file transfer procedure that uses ftp (an FTP-based file transfer program) is described here by taking up an example in which you transfer a file (name: ex_pc.sta) located on the external computer in a Windows environment to the flash memory (non-volatile memory) of the 4294A (IP address: 1.10.100.50, host name: hp4294a) and you transfer a file (name: ex_ins.sta) located on the flash memory of the 4294A to an external computer.

Step 1. Start up the screen in which the MS-DOS prompt is ready.

Step 2. Move to the directory in which ex_pc.sta is stored.

Step 3. At the MS-DOS prompt, type either `ftp 1.10.100.50` or `ftp hp`4294a, and press the Return key.

Step 4. Pressing the Return key twice causes the ftp prompt to appear.

NOTE The file system of the 4294A is provided with neither user name protection nor password protection. Therefore, you can login as any user name without password for the account.

Step 5. Type `dir` at the ftp prompt and press the Return key, then a list of directories appears. The directories displayed correspond to the built-in storage units of the 4294A given below. For the dynamic data disk, see “Saving/Recalling a File in/from an External Computer” on page 171.

data	Dynamic data disk
int	Built-in floppy disk drive
nvram	Built-in flash memory disk (non-volatile memory)
ram	Built-in RAM disk (volatile memory)

Step 6. Type `cd nvram` at the ftp prompt and press the Return key to move to the flash memory.

Step 7. Type `binary` at the ftp prompt and press the Return key. This step sets file transfer mode to binary form.

NOTE Choose a file transfer mode in conformity with a file you transfer. That is, set the mode to ASCII form when dealing with a file having the extension “.TXT” or a program file in Instrument BASIC, otherwise set the mode to binary form.

Step 8. Type `put ex_pc.sta` at the ftp prompt and press the Return key. This completes the transfer from an external computer to flash memory.

Step 9. Type `get ex_ins.sta` at the ftp prompt and press the Return key. This completes the transfer from flash memory to an external computer.

Step 10. Type `quit` at the ftp prompt and press the Return key to quit ftp.

The chief commands used in ftp are briefly described below.

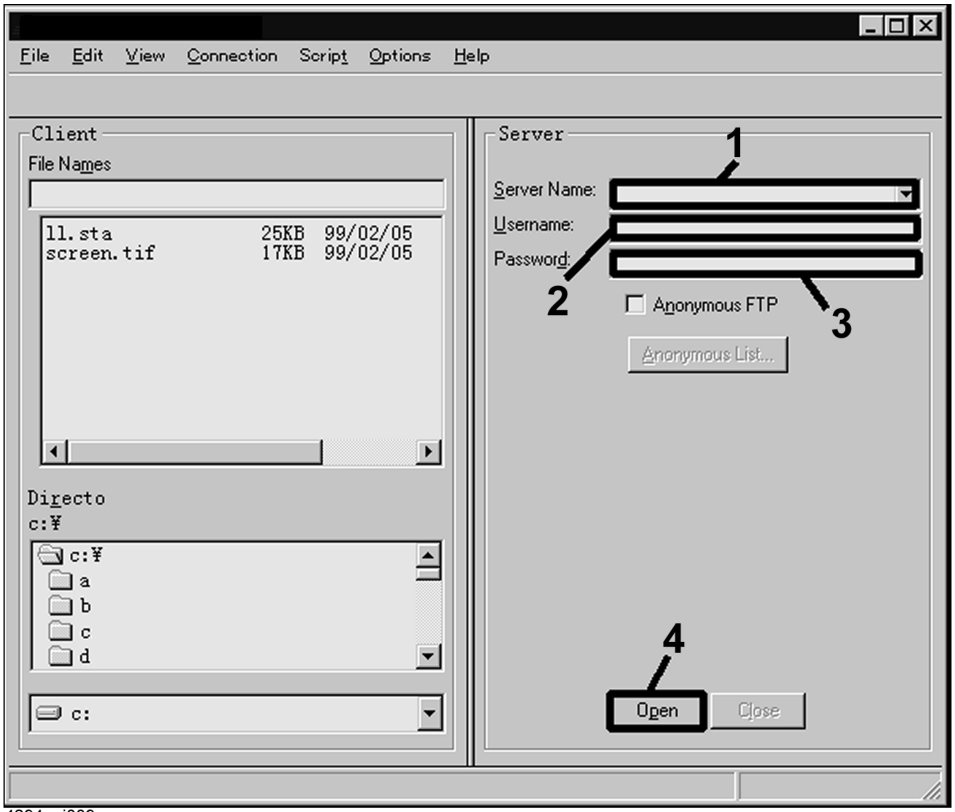
get	Transfers (Copies) a specified file from the current directory of the ftp server (the 4294A for the example above) to the ftp client (an external computer for the example above)
put	Transfers (Copies) a specified file from the ftp client to the ftp server's current directory.
binary	Sets file transfer mode to binary form.
ascii	Sets file transfer mode to ASCII form.
cd	Moves from the current directory to another.
dir	Lists the content of the current directory.
quit	Quits ftp.

File transfer procedure using a file transfer application

Using a file transfer application in a Windows environment allows you to easily transfer files thanks to the mouse. A general operation procedure in which such an application is used is briefly given below.

Step 1. Start up an applicable file transfer application. A screen as it is before connecting the 4294A (a screen like Figure 12-1, for example) appears.

Figure 12-1 **A sample screen of file transfer application (before connecting with the 4294A)**

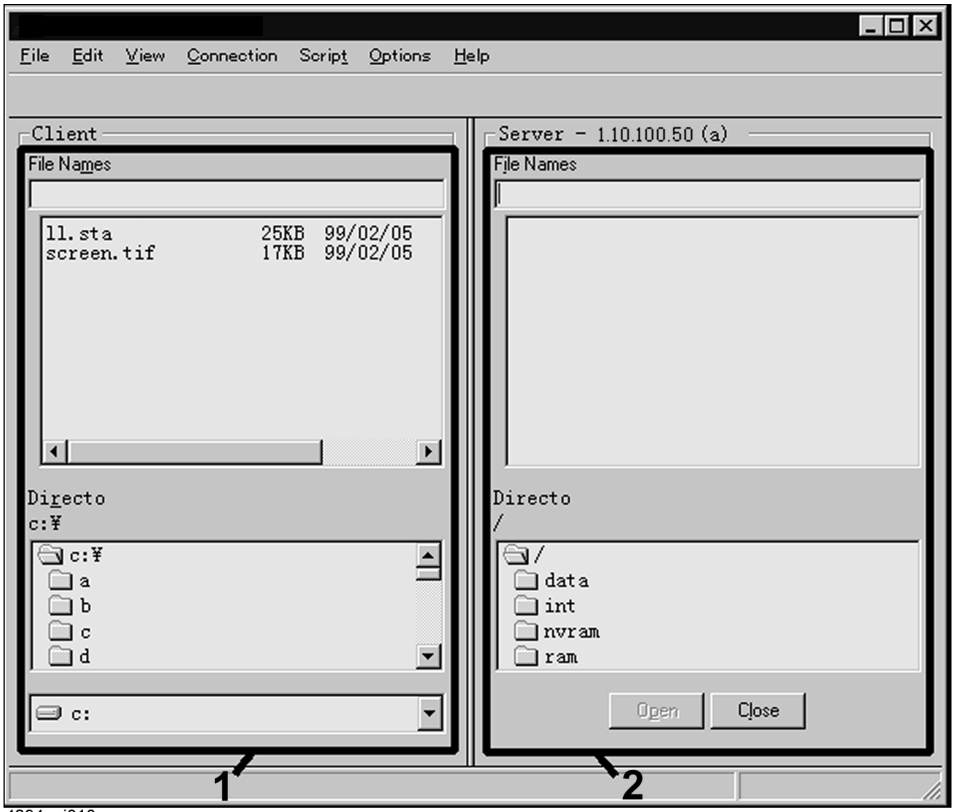


4294apj009

Step 2. Enter the IP address of the 4294A in the Server Name field (the field labeled 1 in Figure 12-1), enter suitable character(s) (any character(s) other than blank character(s)) in the User Name field (the field labeled 2 in Figure 12-1). You can leave the Password field (the field labeled 3 in Figure 12-1) blank.

Step 3. If you start connecting with the server (the 4294A) (click the button labeled 4 in Figure 12-1), then the content of the file system of the 4294A appears as shown in Figure 12-2.

Figure 12-2 **A sample screen of file transfer application (after connected with the 4294A)**



4294apj010

Step 4. Copy files, similarly to the usual procedure for copying files by use of Windows 95 Explorer, from the external computer side (the window labeled 1 in Figure 12-2) to the 4294Aside (the window labeled 2 in Figure 12-2), or from the 4294A side to the external computer.

Saving/Recalling a File in/from an External Computer

The dynamic data disk of the 4294A holds measurement data together with virtual files to be used to read the state of equipment settings or to make settings. Accessing from an external computer to files held in the dynamic data disk of the 4294A by use of ftp allows you to directly save/recall measurement data, files of equipment settings, or Instrument BASIC programs in/from an external computer.

That is, transferring files held in the dynamic data disk to an external computer brings about a result equivalent to carrying out the series of steps given below.

1. Saves measurement data, the state of equipment settings, or Instrument BASIC programs to files held in flash memory.
2. Transfers files saved in flash memory to an external computer.
3. Erases files held in flash memory.

Transferring files, such as measurement data, the state of equipment settings, etc., held on an external computer using virtual file names (see Table 12-1) brings about a result equivalent to carrying out the series of steps given below.

1. Transfers files held on an external computer to flash memory.
2. Either recalls transferred files or gets them in Instrument BASIC. (Executes the obtained programs in the case of prog_run.bas.)
3. Erases the files held in flash memory.

NOTE At the time you list the files in a directory by use of the dir command of ftp, or at the time you access the dynamic data disk, certain files are created temporarily in flash memory. Thus there can be instances in which you cannot list files or access the dynamic data disk if sufficient free space (more than the aggregate size of the files transferred) is not available in flash memory.

NOTE The dynamic data disk is a directory in which virtual files for FTP transfer are stored, so you cannot access the dynamic data disk by use of the usual file saving/recalling operation from the front panel or by use of the GPIB command.

Table 12-1 shows virtual files in the dynamic data disk and workings of file transfer.

Table 12-1 Virtual files held in the dynamic data disk and the workings of file transfer

File name	get/put*1	Description
state.sta	get	Saves the current settings and internal data arrays of the 4294A in files held on an external computer.
	put	Recalls the files held on an external computer containing the settings and internal data arrays into the 4294A.
data.dat	put	Recalls data files (files which were transferred by “get” of data_cal.dat, data_d.dat, data_m.dat, data_dt.dat, data_mt.dat or internal data array files which were got using the save/recall function) held on an external computer into the 4294A. The internal data arrays (calibration data, data, memory, data trace, memory trace) contained in the files are recalled.
data_cal.dat	get	Saves the current calibration data arrays and compensation data arrays of the 4294A to files held on an external computer in binary form.*2 The file name when you recall (“put”) the got file to the 4294A is data.dat.
data_d.dat	get	Saves the current data arrays of the 4294A in files held on an external computer in binary form. The file name when you recall (“put”) the got file to the 4294A is data.dat.
data_m.dat	get	Saves the current memory arrays of the 4294A in files held on an external computer in binary form. The file name when you recall (“put”) the got file to the 4294A is data.dat.
data_dt.dat	get	Saves the current data trace arrays of the 4294A in files held on an external computer in binary form. The file name when you recall (“put”) the got file to the 4294A is data.dat.
data_mt.dat	get	Saves the current memory trace arrays of the 4294A in files held on an external computer in binary form. The file name when you recall (“put”) the got file to the 4294A is data.dat.
prog.bas	get	Saves a Instrument BASIC program held on the 4294A in an external computer in ASCII form. *3
	put	Downloads a Instrument BASIC programs saved in an external computer in ASCII form to Instrument BASIC of the 4294A.*3
prog_run.bas	put	Downloads Instrument BASIC program saved in an external computer in binary form to Instrument BASIC of the 4294A, and runs it.*4
screen.tif	get	Saves what are displayed on the LCD screen in a file held on an external computer in TIFF format.
data_cal.txt	get	Saves the current calibration data arrays and compensation data arrays of the 4294A in files held on an external computer in ASCII form.*2
data_d.txt	get	Saves the current data arrays of the 4294A in files held on an external computer in ASCII form.
data_m.txt	get	Saves the current memory arrays of the 4294A in files held on an external computer in ASCII form.
data_dt.txt	get	Saves the current data trace arrays of the 4294A in files held on an external computer in ASCII form.
data_mt.txt	get	Saves the current memory trace arrays of the 4294A in files held on an external computer in ASCII form.

*1.get: Transfers files from the 4294A to an external computer
put: Transfers files from an external computer to the 4294A.

*2.If user calibration data haven't been measured or haven't been entered by use of applicable commands, the values of calibration arrays will not be contained in the files saved.

*3.This operation is ignored if an Instrument BASIC program is being edited or run on the 4294A.

*4.If an Instrument BASIC program is being edited or run on the 4294A, the process of editing or running is suspended, and Instrument BASIC is reset, then the programs are downloaded and run.

Controlling the Agilent 4294A

You can control the 4294A, if connected to LAN, from an external controller. The communication between an external controller and the 4294A is achieved by means of connecting sockets created by individual processes and by forming a network path between the process of the external controller and that of the 4294A. The sockets are endpoint nodes of network connection, and Port 23 and Port 5025 are ready for use as the sockets on the 4294A side. Port 23 is for interactive control using telnet (a user interface program based on the TELNET protocol), and displays a welcome message (Welcome to the 4294A) when connection is established. Port 5025 is prepared to be used from a program, and displays no welcome message.

You can also control the 4294A, by use of the dynamic data disk and Instrument BASIC programs described earlier.

Control by use of sockets

Interactive control by use of telnet

A control procedure that uses telnet is described here by taking up an example in which you control the 4294A (IP address: 1.10.100.50, host name: hp4294a) from an external computer installed in a Windows environment.

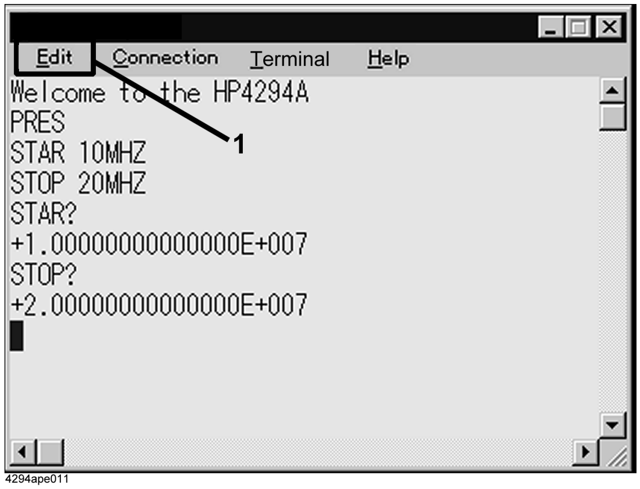
Step 1. Start up the screen in which the MS-DOS prompt is ready.

Step 2. At the MS-DOS prompt, type either `telnet 1.10.100.50` or `telnet hp4294a`, and press the Return key.

Step 3. The telnet screen is started up, and a welcome message “Welcome to the 4294A” appears on the screen. (In a UNIX environment, a welcome message appears under the line in which you typed `telnet 1.10.100.50`.)

Step 4. Enter a command under the welcome message and press the Return key, then the command is sent to the 4294A and run. Enter a Query command and press the Return key, then a Query response is displayed. Figure 12-3 shows the screen that appears after you reset the 4294A by use of the “PRES” command (page 404), set the sweep start point and end point to 10 MHz and 20 MHz respectively by use of the “STAR” command (page 444) and “STOP” command (page 446), and checked these settings.

Figure 12-3 **An example of control using telnet**



Step 5. Selecting "Disconnect" in the Connection menu on the telnet screen (1 in Figure 12-3) breaks the connection with the 4294A, then you select "Quit" in the Connection menu to quit telnet. (In a UNIX environment, typing **]** key while holding down the Control key causes the telnet prompt to appear, so typing `quit` at the telnet prompt breaks the connection with the 4294A and quits telnet as well.

NOTE

Two transfer modes are available in telnet.

In line mode, pressing the Return key sends characters entered up to that time to the 4294A. That is, characters are sent line by line. Thus if you make a mistake in typing a command, you can correct it by use of the Backspace key.

In character mode, a character typed is sent to the 4294A, that is, characters are sent one by one. Thus if you make a mistake in typing a command, it has already been sent, so you cannot use the Backspace key any longer to correct your mistake.

If telnet you use is an application in which you can choose between transfer modes, choose one according to your situation. For example, in the case of telnet in a UNIX environment, typing **]** key while holding down the Control key causes the telnet prompt to appear; at the telnet prompt, type either `mode line` (to choose line mode) or `mode character` (to choose character mode) and press the Return key to decide on which mode to use.

Control from a program

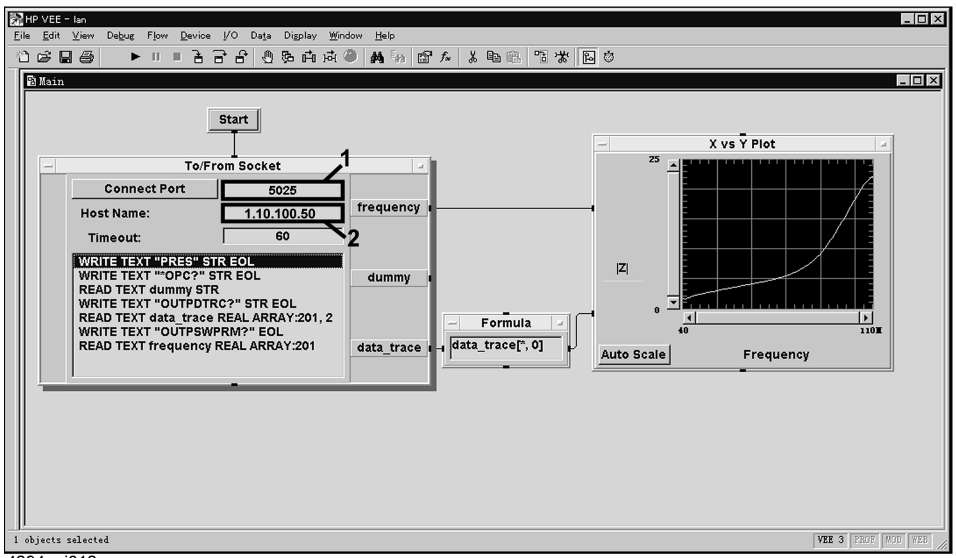
To control the 4294A from a program stored on an external controller, make connection by use of the socket of Port 5025.

NOTE You cannot use some of functions usable within GPIB, such as service request, by way of LAN.

Control with HP VEE

In HP VEE, using To/From Socket makes connection with the socket of Port 5025 so that you can control the 4294A. Figure 12-4 shows an example (in which the IP address 1.10.100.50 is assigned to the 4294A). Type `5025` in the Connection Port field (1 in Figure 12-4) and type either the IP address or the host name of the 4294A in the Host Name field (2 in Figure 12-4).

Figure 12-4 **An example of control using HP VEE**



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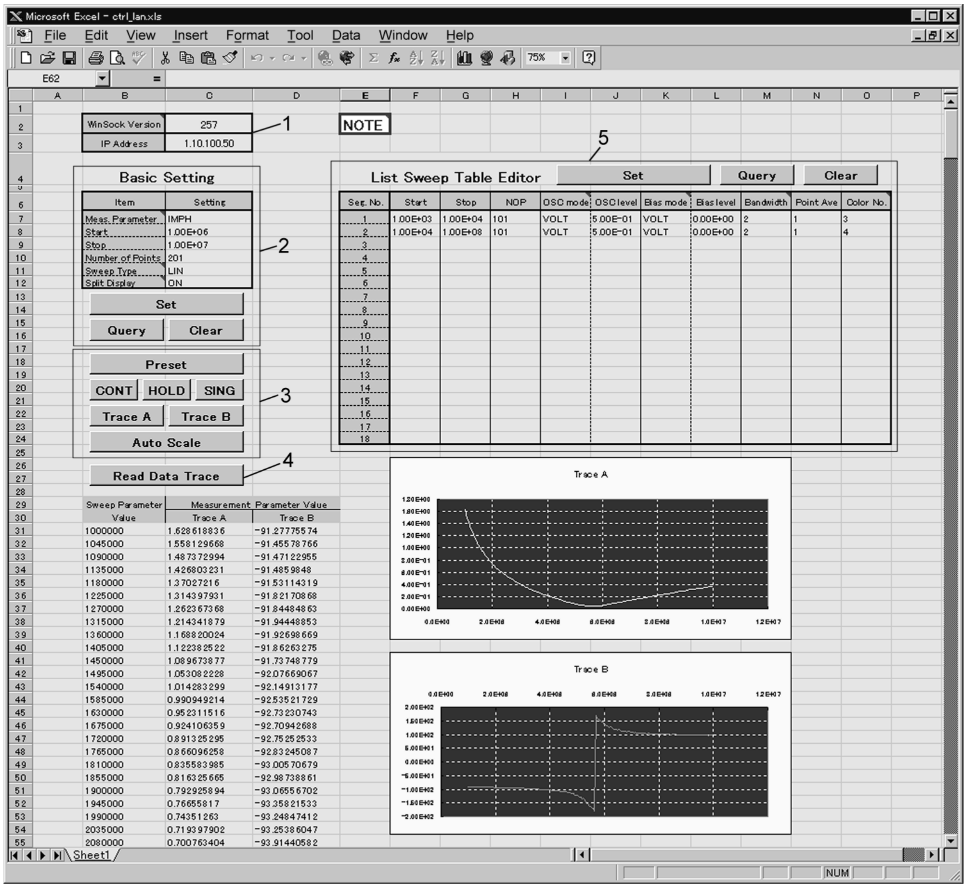
Control with languages, such as C and Visual Basic

Socket programming allows you to control the 4294A through socket programming from C language in a UNIX environment, or Visual C++ or Visual Basic in a Windows environment. Socket programming requires a library for network connection with TCP/IP protocol. For this purpose, BSD (Berkeley Software Distribution) Sockets API is supplied in the UNIX environment, while WinSock (WinSock1.1, or WinSock2.0), prepared by porting BSD Sockets onto Windows and extending it, in the Windows environment.

The sample program disk contains a sample program (ctrl_lan.bas: Microsoft Excel file) for control with Visual Basic (VBA macro).

First, let us begin with how to use this program. Opening this file will display the screen shown in Figure 12-5. Below are described how to operate each part of this screen.

Figure 12-5 **ctrl_lan.xls**



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In the part 1, type the version No. of WinSock API into the cell at the right to “WinSock Version.” Determine this version No. by multiplying the major version No. by 256, then adding this product to the minor version No. In the case of Version 1.1, for example, $256 \times 1 + 1 = 257$. Type the IP address of the 4294A into the cell at the right to “IP address.” If any of these two entries is wrong, this VBA macro will never work.

In the part 2, set the 4294A’s measurement parameters, the sweep range (starting and stopping points), the number of measurement points, the sweep type, and ON/OFF of trace A/B split display. Clicking the Set button will set these conditions as shown in the Settings Table; clicking the Query button will read the current settings of the 4294A. Clicking the Clear button will clear the Settings Table.

In the part 3, basic control of the 4294A is operated. Below is described what actions each button produces when pressed:

Preset	Returns to the initial setting.
CONT	Sets to continuous sweep.
HOLD	Holds sweep.
SING	Executes sweep once.
Trace A	Sets Trace A to active trace.
Trace B	Sets Trace B to active trace.
Auto Scale	Executes Auto Scale.

Clicking the Read Data Trace button in the part 4 will read values of data trace to display them in tabular and graphical formats. If the measurement parameter is COMPLEX Z-Y, these table and graph will not be displayed properly.

In the part 5, the List Sweep Table is set. Clicking the Set button will create the List Sweep Table, like the Settings Table; clicking the Query button will read the existing List Sweep Table of the 4294A. Clicking the Clear button will clear the Settings Table. A line on which the Start column has any value will be set in the table even if other columns are blank, and these blank columns will be filled with their initial value.

NOTE To enable the list sweep, you have to set the sweep type to LIST in the part 2 after setting the List Sweep Table.

Let us move to parts related to control with WinSock API in the VBA macro program.

To use WinSock API, you have to declare functions and define constants in the WinSock API definition file as shown in Example 12-1.

Example 12-1 **WinSock API definition file**

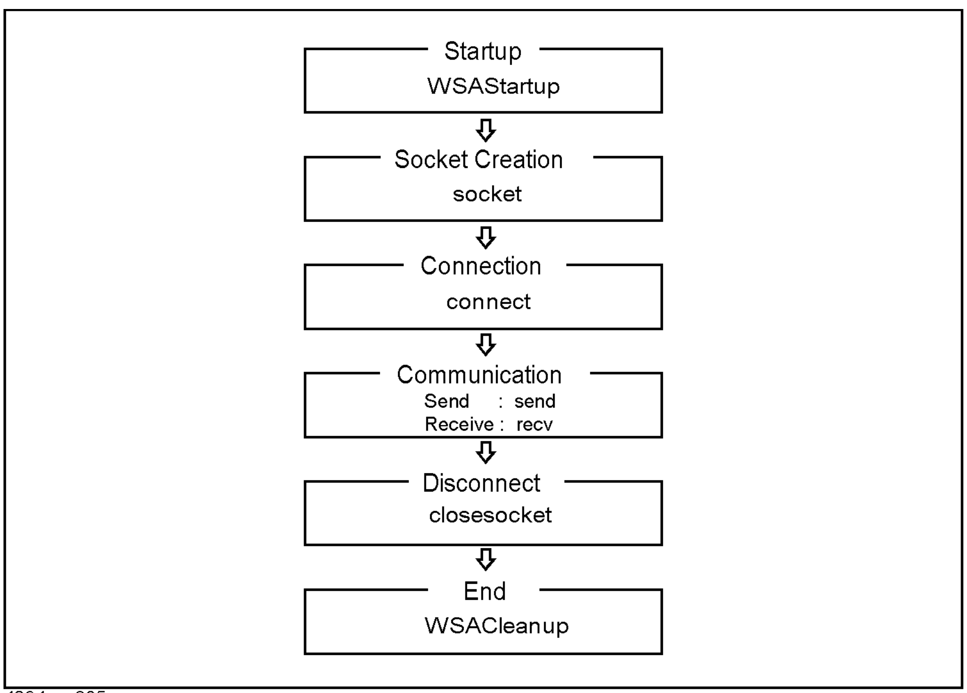
```
'This is the Winsock API definition file for Visual Basic

'Setup the variable type 'hostent' for the WSAStartup command
Type Hostent
  h_name As Long
  h_aliases As Long
  h_addrtype As String * 2
  h_length As String * 2
  h_addr_list As Long
End Type
Public Const SZHOSTENT = 16


'Set the Internet address type to a long integer (32-bit)
Type in_addr
   s_addr As Long
End Type


'A note to those familiar with the C header file for Winsock
'Visual Basic does not permit a user-defined variable type
'to be used as a return structure.  In the case of the
'variable definition below, sin_addr must
'be declared as a long integer rather than the user-defined
'variable type of in_addr.
Type sockaddr_in
   sin_family As Integer
   sin_port As Integer
   sin_addr As Long
   sin_zero As String * 8
End Type

Public Const WSADESCRIPTION_LEN = 256
Public Const WSASYS_STATUS_LEN = 128
Public Const WSA_DescriptionSize = WSADESCRIPTION_LEN + 1
Public Const WSA_SysStatusSize = WSASYS_STATUS_LEN + 1

'Setup the structure for the information returned from
'the WSAStartup() function.
Type WSAData
   wVersion As Integer
```

```
   wHighVersion As Integer
   szDescription As String * WSA_DescriptionSize
   szSystemStatus As String * WSA_SysStatusSize
   iMaxSockets As Integer
   iMaxUdpDg As Integer
   lpVendorInfo As String * 200
End Type

'Define socket return codes
Public Const INVALID_SOCKET = &HFFFF
Public Const SOCKET_ERROR = -1

'Define socket types
Public Const SOCK_STREAM = 1            'Stream socket
Public Const SOCK_DGRAM = 2             'Datagram socket
Public Const SOCK_RAW = 3               'Raw data socket
Public Const SOCK_RDM = 4               'Reliable Delivery socket
Public Const SOCK_SEQPACKET = 5         'Sequenced Packet socket


'Define address families
Public Const AF_UNSPEC = 0              'unspecified
Public Const AF_UNIX = 1                'local to host (pipes, portals)
Public Const AF_INET = 2                'internetwork: UDP, TCP, etc.
Public Const AF_IMPLINK = 3             'arpanet imp addresses
Public Const AF_PUP = 4                 'pup protocols: e.g. BSP
Public Const AF_CHAOS = 5               'mit CHAOS protocols
Public Const AF_NS = 6                  'XEROX NS protocols
Public Const AF_ISO = 7                 'ISO protocols
Public Const AF_OSI = AF_ISO            'OSI is ISO
Public Const AF_ECMA = 8                'european computer manufacturers
Public Const AF_DATAKIT = 9             'datakit protocols
Public Const AF_CCITT = 10              'CCITT protocols, X.25 etc
Public Const AF_SNA = 11                'IBM SNA
Public Const AF_DECnet = 12             'DECnet
Public Const AF_DLI = 13                'Direct data link interface
Public Const AF_LAT = 14                'LAT
Public Const AF_HYLINK = 15             'NSC Hyperchannel
Public Const AF_APPLETALK = 16          'AppleTalk
Public Const AF_NETBIOS = 17            'NetBios-style addresses
Public Const AF_MAX = 18                'Maximum # of address families


'Setup sockaddr data type to store Internet addresses
Type sockaddr
  sa_family As Integer
  sa_data As String * 14
End Type
Public Const SADDRLEN = 16


'Declare Socket functions

Public Declare Function closesocket Lib "wsock32.dll" (ByVal s As Long)
As Long

Public Declare Function connect Lib "wsock32.dll" (ByVal s As Long, addr
As sockaddr_in, ByVal namelen As Long) As Long

Public Declare Function htons Lib "wsock32.dll" (ByVal hostshort As Long)
As Integer

Public Declare Function inet_addr Lib "wsock32.dll" (ByVal cp As String)
As Long
```

```
Public Declare Function recv Lib "wsock32.dll" (ByVal s As Long, ByVal
buf As Any, ByVal buflen As Long, ByVal flags As Long) As Long

Public Declare Function recvB Lib "wsock32.dll" Alias "recv" (ByVal s As
Long, buf As Any, ByVal buflen As Long, ByVal flags As Long) As Long

Public Declare Function send Lib "wsock32.dll" (ByVal s As Long, buf As
Any, ByVal buflen As Long, ByVal flags As Long) As Long

Public Declare Function socket Lib "wsock32.dll" (ByVal af As Long, ByVal
socktype As Long, ByVal protocol As Long) As Long

Public Declare Function WSAStartup Lib "wsock32.dll" (ByVal
wVersionRequired As Long, lpWSAData As WSAData) As Long

Public Declare Function WSACleanup Lib "wsock32.dll" () As Long

Public Declare Function WSAUnhookBlockingHook Lib "wsock32.dll" () As
Long

Public Declare Sub CopyMemory Lib "kernel32" Alias "RtlMoveMemory"
(hpvDest As Any, hpvSource As Any, ByVal cbCopy As Long)
```

The basic flow of control with WinSock API is as shown in Figure 12-6:

Figure 12-6 **Flow of control with WinSock API**



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Below are described subprograms corresponding to each step in Figure 12-6:

Startup

The subprogram corresponding to Startup is StartIt (Example 12-2). StartIt uses the version of WinSock API entered into the part 1 of Figure 12-5 to start up and initialize WinSock API with the WSAStartup function of WinSock API. This WSAStartup function must always be executed at the start of WinSock. Parameters for this function are version No. (input) and startup information (output).

Example 12-2 **StartIt**

```
Sub StartIt()

    Dim StartUpInfo As WSAData

    'Version 1.1 (1*256 + 1) = 257
    'version 2.0 (2*256 + 0) = 512

    'Get WinSock version
    Sheets("Sheet1").Select
    Range("C2").Select
    version = ActiveCell.FormulaR1C1

    'Initialize Winsock DLL
    x = WSAStartup(version, StartUpInfo)

End Sub
```

Socket creation and connection

The subprogram corresponding to socket creation and connection is OpenSocket (Example 12-3). OpenSocket establishes a connection to the socket of the port specified by PortNumber, an input parameter, on a machine with the IP address specified by Hostname, an input parameter. Below are described steps of OpenSocket:

In (1), the inet_aadr function of WinSock API is used to convert an IP address delimited by "." to an Internet address.

In (2), the socket function of WinSock API is used to create a new socket and acquire the descriptor of this socket. If an error occurs during this operation, the function outputs a message and returns processing to the main program. Parameters for the socket function are Address Family (input), Socket Type (input) and Protocol No. (input).

In (3), a socket address is set. htons used at setting of the port No. is a WinSock API function that converts a 2-byte integer from the Windows-type byte order (little endian) to the network byte order (big endian).

In (4), the connect function of WinSock is used for connection to the 4294A. If an error occurs during this operation, the function outputs a message and returns processing to the main program. Parameters for the connect function are Socket Descriptor (input), Socket Address and Socket Address Size (input).

Example 12-3 **OpenSocket**

```
Function OpenSocket(ByVal Hostname As String, ByVal PortNumber As Integer) As
Integer

    Dim I_SocketAddress As sockaddr_in
    Dim ipAddress As Long

    ipAddress = inet_addr(Hostname)                     '..................(1)

    'Create a new socket
    socketId = socket(AF_INET, SOCK_STREAM, 0)          '
    If socketId = SOCKET_ERROR Then                     '
```

```
        MsgBox ("ERROR: socket = " + Str$(socketId))     '...................(2)
        OpenSocket = COMMAND_ERROR                       '
        Exit Function                                    '
    End If                                               '

    'Open a connection to a server

    I_SocketAddress.sin_family = AF_INET                 '
    I_SocketAddress.sin_port = htons(PortNumber)         '...................(3)
    I_SocketAddress.sin_addr = ipAddress                 '
    I_SocketAddress.sin_zero = String$(8, 0)             '

    x = connect(socketId, I_SocketAddress, Len(I_SocketAddress))  '
    If socketId = SOCKET_ERROR Then                               '
        MsgBox ("ERROR: connect = " + Str$(x))                    '..........(4)
        OpenSocket = COMMAND_ERROR                                '
        Exit Function                                             '
    End If                                                        '

    OpenSocket = socketId

End Function
```

Communication

The subprogram corresponding to transmit in communication is SendCommand (Example 12-4). SendCommand uses the send function of WinSock API to transmit a message (GPIB command) specified by command, an input parameter, to the 4294A. Parameters for the send function are Socket Descriptor (input), Transmit Message (input). Message Length (input) and Flag (input).

Example 12-4 **SendCommand**

```
Function SendCommand(ByVal command As String) As Integer

    Dim strSend As String

    strSend = command + vbCrLf

    count = send(socketId, ByVal strSend, Len(strSend), 0)

    If count = SOCKET_ERROR Then
        MsgBox ("ERROR: send = " + Str$(count))
        SendCommand = COMMAND_ERROR
        Exit Function
    End If

    SendCommand = NO_ERROR

End Function
```

Subprograms corresponding to receive in communication are RecvAscii (Example 12-5) and others. RecvAscii receives a message in the ASCII format, and store it dataBuf, an output parameter. The maximum length of a message it receives is specified through maxLength, an input parameter. Below are described steps of RecvAscii:

In (1), the recv function of WinSock API is used to receive a message (response to Query, an GPIB command) on a character-by-character basis. If an error occurs during this operation, the function outputs a message and returns processing to the main program. Parameters for the recv function are Socket Descriptor (input), Receipt Message (output), Message Length (input), and Flag (input).

In (2), whether a received character is LF (ASCII code No.: 10) is determined, and if LF, NULL (ASCII code No.: 0) is added to the tail of the character string dataBuf, receipt is ended, and processing returns to the main program.

In (3), the number of characters read immediately before is added to the count for checking the number of received characters, and characters read are added to the tail of the character string dataBuf.

Example 12-5 **RecvAscii**

```
Function RecvAscii(dataBuf As String, ByVal maxLength As Integer) As Integer

    Dim c As String * 1
    Dim length As Integer

    dataBuf = ""
    While length < maxLength
        DoEvents
        count = recv(socketId, c, 1, 0)                      '
        If count < 1 Then                                    '
            RecvAscii = RECV_ERROR                           '...................(1)
            dataBuf = Chr$(0)                                '
            Exit Function                                    '
        End If                                               '

        If c = Chr$(10) Then                                 '
           dataBuf = dataBuf + Chr$(0)                       '...................(2)
           RecvAscii = NO_ERROR                              '
           Exit Function                                     '
        End If                                               '

        length = length + count                              '...................(3)
        dataBuf = dataBuf + c                                '
    Wend

    RecvAscii = RECV_ERROR

End Function
```

Disconnection

The subprogram corresponding to disconnection is CloseConnection (Example 12-6). CloseConnection uses the closesocket function of WinSock API to disconnect communication, and deletes the socket. The parameter for the closesocket function is Socket Descriptor (input).

Example 12-6 **CloseConnection**

```
Sub CloseConnection()

    x = closesocket(socketId)

    If x = SOCKET_ERROR Then
        MsgBox ("ERROR: closesocket = " + Str$(x))
        Exit Sub
    End If

End Sub
```

End

The subprogram corresponding to end is EndIt (Example 12-7). EndIt uses the WSACleanup of WinSock API to disconnect WinSock API. WSACleanup must always be executed at the end of WinSock.

Example 12-7 **EndIt**

```
Sub EndIt()

    'Shutdown Winsock DLL
    x = WSACleanup()

End Sub
```

Example of control

Like autoscale (subprogram executed when the Auto Scale button is pressed) shown in Example 12-8, executing subprograms above in the sequence above will allow you to control the 4294A.

Example 12-8 **autoscale**

```
Sub autoscale()
'
' auto scaling
'
    Call StartIt
    Call get_hostname
    x = OpenSocket(Hostname$, ScpiPort)

    x = SendCommand("AUTO")

    Call CloseConnection
    Call EndIt

End Sub
```

NOTE When you execute more than one command by connecting and disconnecting a socket for every command, the sequence of execution may change.

- Connection → Command 1 → Command 2 → Disconnection

  Commands 1 and 2 are always executed in this sequence.

- Connection → Command 1 → Disconnection → Connection → Command 2 → Disconnection

  These commands may be in the sequence of Command 2 → command 1.

Control by making use of the dynamic data disk

You can achieve control from a program via LAN by combining Instrument BASIC programs and file transfers by use of the dynamic data disk. The procedure is given below.

Step 1. Transfer an Instrument BASIC program you want run to the dynamic data disk from an external controller under the name prog_run.bas.

Step 2. After having quit the program, transfer necessary measurement data (data_dt.dat and the like) to the external controller from the dynamic data disk.

NOTE Either in an instance in which you need to work on a measurement result by use of a certain program or in an instance in which you need to obtain a result (a result of limit test, or the like) that cannot be transferred directly from the dynamic data disk, write a program in such a way that it once stores necessary data in a file held on the storage devices of the 4294A, and transfer that file to the external controller after the program quits.

13 Application Sample Programs

This chapter provides sample measurements (sample programs).

Basic Measurement

Example 13-1 shows a sample program of a basic capacitor measurement. This program is stored on the sample program disk as the bsc_meas.bas file.

This program performs the same measurement described in “Learning basic operations” of the ***Agilent 4249A Operation Manual***. Connect the Agilent 16047E test fixture for lead parts to the Agilent 4294A, and then start the program. When “Set Open-Connection” appears, make the connection to measure data for open compensation, and press the **[y]** key and the **[Enter]** key. Then, when “Set Short-Connection” appears, perform the same operation to measure data for short compensation.

NOTE For how to use the 16047E, for example, the connection to measure data for open/short compensation, refer to its manual.

Then, when “Set DUT, then Push [Enter] key” appears, mount an already discharged capacitor onto the test fixture, and then press the **[Enter]** key. After the completion of a single sweep, the self-resonant point is searched for using the marker, and the frequency and the impedance at that point are displayed. After the display, “Once more? [Y]es/[N]o” appears. If you want to measure the capacitor again or another DUT, press the **[y]** key and the **[Enter]** key to continue the measurement. If you want to finish the measurement, press a key other than the **[y]** key and the **[Enter]** key. Figure 13-1 shows an example when executing this program using Instrument BASIC.

Lines 80 to 140	Identifies the external controller and Instrument BASIC and sets the GPIB address and the select code.
Lines 160 to 250	Substitutes the measurement conditions (adapter setting: NONE, measurement parameter: |Z|-θ, sweep parameter: frequency, sweep type: LOG, sweep start value: 100 Hz, sweep stop value: 100 MHz, bandwidth setting: 2, trace A display format: logarithmic Y axis, trace B display format: linear Y axis, trace A/B split display: on) into the variables: Adapter$, Meas_para$, Swp_para$, Swp_type$, Start, Stop, Bw$, Fmt_a$, Fmt_b$, and Spl_disp$, respectively.
Lines 290 to 300	Sets the adapter selection to Adapter$ and then triggers a reset.
Lines 310 to 360	Sets the measurement parameter to Meas_para$; the sweep parameter, Swp_para$; the sweep type, Swp_type$; the sweep start point, Start; the sweep stop point, Stop; the bandwidth, Bw$, respectively.
Lines 400 to 410	Enables bit 8 (calibration/compensation data measurement completion) in the instrument event status register to use an SRQ and sets bit 2 in the service request enable register to 1.
Lines 420 to 450	Uses the FNFixt_comp subprogram to measure open/short data. If an error is detected after each measurement, stops the program. For the FNFixt_comp subprogram, refer to the description in Example 4-3 on page 65.
Lines 490 to 530	Sets the trace A display format to Fmt_a$; the trace B display format, Fmt_b$; the trace A/B split display, Spl_disp$, respectively.
Lines 570 to 580	Prompts the user to connect a DUT, and waits for a press of the **[Enter]** key after the connection.

Lines 600 to 630	Performs a single sweep and waits for its completion.
Lines 670 to 700	Executes the auto scale on trace A and trace B to automatically set the scale parameters so that waveforms fit on the screen.
Lines 740 to 760	Searches for the minimum value (self-resonant point) on trace A using the marker.
Lines 780 to 860	Reads out the measurement parameter value (impedance) and the sweep parameter value (frequency) at the marker on trace A and displays them.
Lines 880 to 890	Prompts the user to determine whether to perform a measurement again. If the **[y]** key and the **[Enter]** key are pressed, returns to the DUT connection part (line 570).

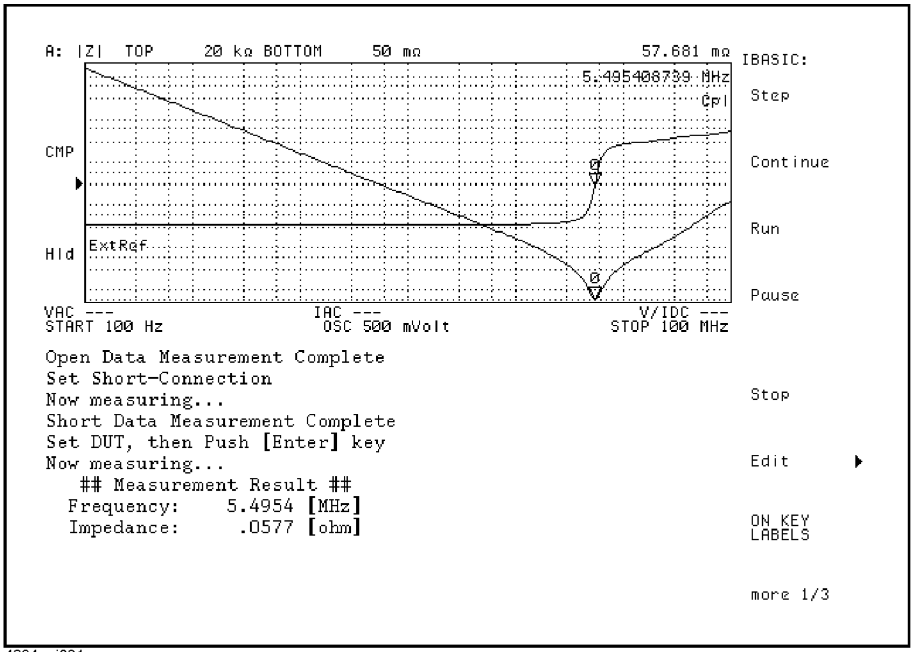
Example 13-1 **Measuring the self-resonant point of a capacitor**

```
10      DIM Adapter$[9],Meas_para$[5],Swp_para$[9],Swp_type$[9]
20      DIM Bw$[9],Fmt_a$[9],Fmt_b$[9],Spl_disp$[9]
30      DIM Buff$[9],Inp_char$[9]
40      REAL Start,Stop,Imp_val,Freq_val
50      INTEGER Scode,Result
60      CLEAR SCREEN
70      !
80      IF SYSTEM$("SYSTEM ID")="HP4294A" THEN
90        ASSIGN @Hp4294a TO 800
100       Scode=8
110     ELSE
120       ASSIGN @Hp4294a TO 717
130       Scode=7
140     END IF
150     !
160     Adapter$="OFF"
170     Meas_para$="IMPH"
180     Swp_para$="FREQ"
190     Swp_type$="LOG"
200     Start=100
210     Stop=1.0E+8
220     Bw$="2"
230     Fmt_a$="LOGY"
240     Fmt_b$="LINY"
250     Spl_disp$="ON"
260     !
270     ! Measurement Setting
280     !
290     OUTPUT @Hp4294a;"E4TP "&Adapter$
300     OUTPUT @Hp4294a;"PRES"
310     OUTPUT @Hp4294a;"MEAS "&Meas_para$
320     OUTPUT @Hp4294a;"SWPP "&Swp_para$
330     OUTPUT @Hp4294a;"SWPT "&Swp_type$
340     OUTPUT @Hp4294a;"STAR ";Start
350     OUTPUT @Hp4294a;"STOP ";Stop
360     OUTPUT @Hp4294a;"BWFACT "&Bw$
370     !
380     ! Fixture Compensation (Open/Short)
390     !
400     OUTPUT @Hp4294a;"ESNB 256"
410     OUTPUT @Hp4294a;"*SRE 4"
420     Result=FNFixt_comp(@Hp4294a,Scode,"Open")
430     IF Result<>0 THEN Prog_end
440     Result=FNFixt_comp(@Hp4294a,Scode,"Short")
450     IF Result<>0 THEN Prog_end
```

```
460    !
470    ! Display Setting
480    !
490    OUTPUT @Hp4294a;"TRAC A"
500    OUTPUT @Hp4294a;"FMT "&Fmt_a$
510    OUTPUT @Hp4294a;"TRAC B"
520    OUTPUT @Hp4294a;"FMT "&Fmt_b$
530    OUTPUT @Hp4294a;"SPLD "&Spl_disp$
540    !
550 Meas_start: ! Single Sweep Start
560    !
570    PRINT "Set DUT, then Push [Enter] key"
580    INPUT "",Inp_char$
590    !
600    OUTPUT @Hp4294a;"SING"
610    PRINT "Now measuring..."
620    OUTPUT @Hp4294a;"*OPC?"
630    ENTER @Hp4294a;Buff$
640    !
650    ! Auto Scaling
660    !
670    OUTPUT @Hp4294a;"TRAC A"
680    OUTPUT @Hp4294a;"AUTO"
690    OUTPUT @Hp4294a;"TRAC B"
700    OUTPUT @Hp4294a;"AUTO"
710    !
720    ! Minimum Point Search
730    !
740    OUTPUT @Hp4294a;"TRAC A"
750    OUTPUT @Hp4294a;"MKR ON"
760    OUTPUT @Hp4294a;"SEAM MIN"
770    !
780    OUTPUT @Hp4294a;"MKRVAL?"
790    ENTER @Hp4294a;Imp_val
800    OUTPUT @Hp4294a;"MKRPRM?"
810    ENTER @Hp4294a;Freq_val
820    !
830    PRINT "   ## Measurement Result ##"
840    PRINT USING "13A,4D.4D,6A";"  Frequency: ",Freq_val/1.E+6," [MHz]"
850    PRINT USING "13A,4D.4D,6A";"  Impedance: ",Imp_val," [ohm]"
860    PRINT ""
870    !
880    INPUT "Once more? [Y]es/[N]o",Inp_char$
890    IF UPC$(Inp_char$)="Y" OR UPC$(Inp_char$)="YES" THEN Meas_start
900 Prog_end: !
910    END
920    !
930    ! Fixture Compensation Data Measurement Function
940    !
950  DEF FNFixt_comp(@Hp4294a,INTEGER Scode,Standard$)
960    DIM Inp_char$[9],Err_mes$[50]
970    INTEGER Err_no
980    OUTPUT @Hp4294a;"*CLS"
990    PRINT "Set "&Standard$&"-Connection"
1000   INPUT "OK? [Y/N]",Inp_char$
1010   IF UPC$(Inp_char$)="Y" THEN
1020     ON INTR Scode GOTO Meas_end
1030     ENABLE INTR Scode;2
1040     SELECT Standard$
1050       CASE "Open"
1060         OUTPUT @Hp4294a;"COMA"
1070       CASE "Short"
1080         OUTPUT @Hp4294a;"COMB"
1090       CASE "Load"
```

```
1100        OUTPUT @Hp4294a;"COMC"
1110      END SELECT
1120      PRINT "Now measuring..."
1130 Meas_wait: GOTO Meas_wait
1140 Meas_end: !
1150      PRINT Standard$&" Data Measurement Complete"
1160      RETURN 0
1170    ELSE
1180      PRINT "Program Interruption"
1190      RETURN -1
1200    END IF
1210 FNEND
```

Figure 13-1 **An example of the execution result of the program in Example 13-1 (when executed using IBASIC)**



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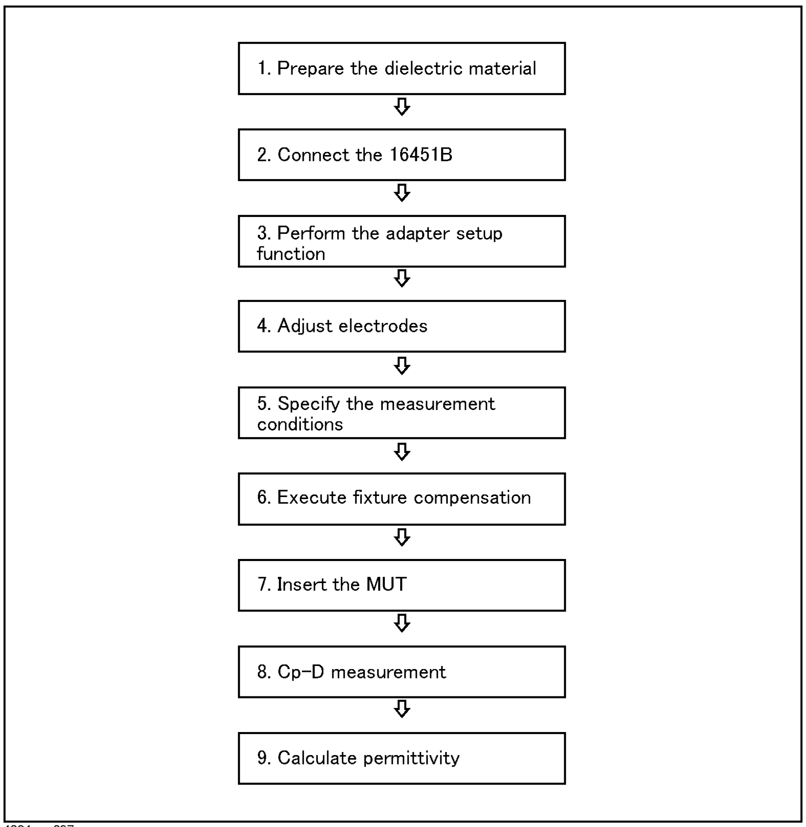
Measuring Dielectric Material

This section describes how to measure dielectric material using the 4294A and the 16451B dielectric test fixture.

Measurement Procedure

Figure 13-2 shows the flow of dielectric measurement.

Figure 13-2 **Flow of Dielectric Measurement**



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Step 1. Prepare the dielectric material

Fabricate the MUT to the appropriate size. If the contacting electrode method with thin film electrodes is employed, apply thin film electrodes to the surfaces of the MUT.

NOTE For details on how to handle the 16451B (the shape of material suitable for measurement, how to adjust the electrodes to be parallel, and so on), refer to the 16451B Operation and Service Manual.

Step 2. Connect the 16451B

Mount appropriate electrodes onto the 16451B and connect the 16451B to the UNKNOWN terminals of the 4294A.

Step 3. Perform the adapter setup function

Select 4TP 1M as the adapter, measure the phase data for calculating the setup data, calculate the setup data, and store it into the nonvolatile memory.

NOTE For details on how to set up the adapter when connecting the 16451B, refer to “Preparing Accessories for Measurement” in the 4294A Operation Manual.

Step 4. Adjust the electrodes

To enhance the measurement performance, a mechanism is provided to adjust the guarded and unguarded electrodes to be parallel to each other. By performing this adjustment, the occurrence of the airgap when using the contacting electrode method is minimized and an airgap with uniform thickness is created when using the non-contacting electrode method. The adjustment procedure is discussed in the operation manual of the 16451B.

Step 5. Specify the measurement conditions

Specify the measurement conditions including the measurement frequency and the measurement signal level.

Step 6. Execute fixture compensation

Execute OPEN/SHORT compensation to compensate the residual impedance of the 16451B. Measure OPEN/SHORT compensation data using the furnished attachment that comes with the 16451B to make OPEN/SHORT condition.

If the measurement frequency exceeds 5 MHz, you must perform LOAD compensation in addition to OPEN/SHORT compensation. Use an air capacitor (adjust the distance between the electrodes to obtain the value in the following table) as the standard when measuring the LOAD compensation data. As the standard value for LOAD compensation, use the equivalent parallel capacitance value (*Cp*) measured at a low frequency (100 kHz). (It is assumed that the air capacitor has no dependence on frequency.)

Electrodes	Value of Load (Air Capacitor)
A	50 pF ± 0.5 pF
B	5 pF ± 0.05 pF
C and D	1.5 pF ± 0.05 pF

NOTE The 4294A does not allow you to define the LOAD standard using the values Cp and G. Therefore, you must use the OPEN standard and the LOAD standard inversely. To be more specific, first, define the OPEN standard value as the LOAD standard and the LOAD standard value as the OPEN standard, and then use the connection for LOAD measurement when executing the OPEN measurement command and use the connection for OPEN measurement when executing the LOAD measurement command. For details, refer to the 4294A Operation Manual.

Actual measurement procedure for the LOAD standard (OPEN compensation data) is as follows: Adjust the distance between the 16451B’s electrodes, measure Cp at 100 kHz, and sets it as the OPEN compensation standard value (Cp: measured value and G: 0). Then, by maintaining the distance between the electrodes, measure data as the OPEN compensation data at the frequency points where you want to measure the material (execute the OPEN compensation data measurement command).

Step 7. Insert the MUT

Insert the MUT between the 16451B's electrodes.

Step 8. Cp-D measurement

Measure the equivalent parallel capacitance (*Cp*) and the dissipation factor (*D*). When using the non-contacting electrode method, perform the Cp-D measurement twice in this step: one with the MUT connected and the other not connected.

Step 9. Calculate permittivity

Using the following expressions and the result of the impedance measurement, calculate the complex relative permittivity ($\dot{\varepsilon}_r = \varepsilon_r' - j\varepsilon_r''$) and the dielectric dissipation factor (*Dt*) of the MUT.

Equation 13-1 **Expressions to calculate the complex relative permittivity (each term) and the dielectric dissipation factor when using the contacting electrode method**

$$\varepsilon_r' = \frac{t_a \times Cp}{\pi \times (d/2)^2 \times \varepsilon_0} \qquad \varepsilon_r'' = \frac{\varepsilon_r'}{D_t}$$

$$D_t = D$$

Equation 13-2 **Expressions to calculate the complex relative permittivity (each term) and the dielectric dissipation factor when using the non-contacting electrode method**

$$\varepsilon_r' = \frac{1}{1 - \left(1 - \frac{Cp_1}{Cp_2}\right) \times \frac{t_g}{t_a}} \qquad \varepsilon_r'' = \frac{\varepsilon_r'}{D_t}$$

$$D_t = D_2 + \varepsilon_r \times (D_2 - D_1) \times \left(\frac{t_g}{t_a} - 1\right)$$

Where,

ε0	Permittivity of vacuum (=8.854×10-12) [F/m]
Cp	Measured equivalent parallel capacitance value [F] (contacting electrode method)
*Cp*1	Measured equivalent parallel capacitance value when no MUT is inserted [F] (non-contacting electrode method)
*Cp*2	Measured equivalent parallel capacitance value when an MUT is inserted [F] (non-contacting electrode method)
D	Measured dissipation factor value (contacting electrode method)
*D*1	Measured dissipation factor value when no MUT is inserted (non-contacting electrode method)
*D*2	Measured dissipation factor value when an MUT is inserted (non-contacting electrode method)
ta	Thickness of MUT [m]
tg	Distance between the guarded and unguarded electrodes [m]
d	Electrode diameter [m]
π	Pi (circular constant)

Sample Program for Contacting Electrode Method

Example 13-2 shows a sample program to measure dielectric materials (contacting electrode method) (for HP Instrument BASIC). You can find the source file of this program, named permi_c.bas, on the sample program disk.

The steps to use the program are described below:

Step 1. Connect the 16451B dielectric test fixture to the 4294A, and start this program. When the message “Which electrode of 16451B is used? 0:A, 1:B, 2:C, 3:D” is displayed, select the electrodes you want to use by specifying the corresponding number (0 to 3).

Step 2. When the message “Perform the adapter setup? 0:Yes, 1:Skip” is displayed, enter 0 if you want to set up the adapter.

Step 3. When the message "Set the 16451B OPEN condition and press 'Continue'.” is displayed, bring the 16451B into OPEN condition and press the **Continue** key (2nd softkey from the top). The phase data for calculating the setup data will be measured.

Step 4. When the message “Set the micrometer of 16451B at 10um and press 'Continue'.” is displayed, turn the small knob of micrometer and adjust it until the micrometer indicates 10 μm and press the **Continue** key. (Steps 4 and 5 are required only when the electrodes you use are A or B.)

Step 5. When the message “Adjust the electrode until PASS is displayed” is displayed, turn the three adjustment screw (under the unguarded electrode) to adjust the electrodes to be parallel until the limit test results display PASS, and press the **Continue** key.

Step 6. When the message “Start frequency [Hz] = ?” is displayed, enter the frequency at the sweep start point. In the same way, enter the frequency at the sweep stop point, the sweep type, the signal source level, and the number of measurement points. When you have completed all entries, they are displayed followed by the message “Measurement condition is OK? 0:OK, 1:NO”. If you find no mistake, enter 0.

Step 7. When the message “Turn the micrometer's knob until PASS is displayed.” is displayed, turn the 16451B’s knob to adjust the distance between the electrodes until the limit test results display PASS (so that the air capacitor used as the LOAD standard becomes an appropriate value), and press the **Continue** key.

Step 8. When the message “Set the 16451B OPEN condition and press 'Continue'.” is displayed, bring the 16451B into OPEN condition and press the **Continue** key.

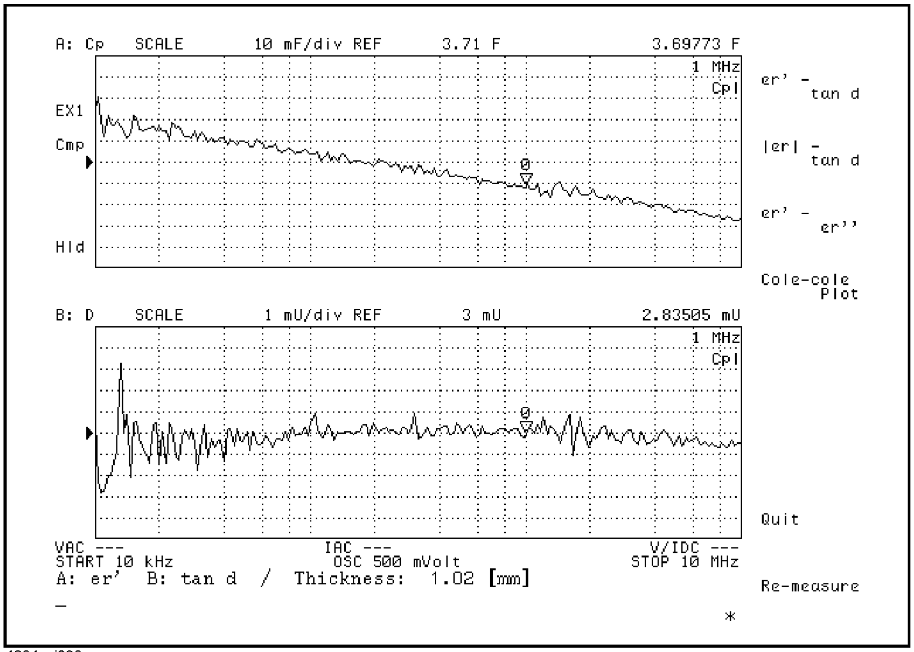
Step 9. When the message “Set the 16451B SHORT condition and press 'Continue'.” is displayed, bring the 16451B into SHORT condition and press the **Continue** key.

Step 10. When the message “Thickness of MUT [mm] = ?” is displayed, enter the thickness of the dielectric material (MUT) you want to measure. If you use electrode C or D, when the next message “Diameter of electrode [mm] = ?” is displayed, enter the electrode diameter.

Step 11. When the message “Set MUT between the electrodes and press 'Continue'.” is displayed, insert the MUT between the electrodes and press the **Continue** key to measure the equivalent parallel capacitance (Cp) and the dissipation factor (D).

Step 12. When the message “Select softkey to display each parameter.” is displayed, press the softkey for the parameter you want to display on the screen. Figure 13-5 shows an example of the screen display when selecting the real part of the complex relative permittivity (er') and the dielectric dissipation factor as displayed parameters. At this time, pressing the “Quit” softkey terminates the program and pressing the “Re-measure” softkey lets you repeat the procedure from Step 10.

Figure 13-3 **Example of the Result of Executing the Program of Example 13-2**



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The program is described in detail below:

Line 90	Sets the GPIB address.
Lines 100 to 110	Assigns the upper half of the LCD screen to measurement result display and the lower half to the HP Instrument BASIC, and terminates the sweep.
Line 130	Stores the permittivity of vacuum into the E0 variable.
Lines 140 to 180	Stores the conditions to adjust the electrodes into variables.
Lines 190 to 210	Stores the measurement conditions to evaluate the capacitance of the LOAD standard into variables.
Lines 220 to 290	Stores the limit range of the air capacitor, used as the LOAD standard, into variables.
Lines 300 to 340	Stores the OPEN standard values (resistance value: 100 GΩ, inductance value: 0 H), the SHORT standard values (resistance value: 0 Ω, inductance value: 0 H), and the LOAD standard values (conductance value: 0 S) into the Open_r, Open_l, Short_r, Short_l, and Load_g variables, respectively.
Lines 350 to 370	Stores the band width setting and the diameters of electrodes A and B into variables.
Lines 400 to 490	Displays the message at the start of the program.
Line 520	Passes control to a subroutine named Select_elec to select the electrodes to be used.
Line 530	Passes control to a subroutine named Adapter_setup to set up the adapter.
Line 540	Passes control to a subroutine named Adjust to adjust the electrodes to

be parallel.

Line 550	Passes control to a subroutine named Compen to execute fixture compensation.
Lines 570 to 580	Passes control to subroutines named Input_t and Input_d to set the MUT thickness and the electrode diameter.
Line 590	Passes control to a subroutine named Sweep to perform measurement.
Line 600	Passes control to a subroutine named Calc to calculate each parameter.
Line 610	Jumps to the Display line and displays each parameter.
Lines 640 to 960	The Select_elec subroutine.

Lines 660 to 670: Waits until you select the electrodes and enter the selection.

Lines 680 to 910: According to the electrode selection, sets the limit range of electrode adjustment and the limit range of the air capacitor used as the LOAD standard.

Lines 920 to 940: Prompts you to confirm the electrode selection.

Lines 980 to 1170 The Adapter_setup subroutine.

Lines 990 to 1040: Asks you if you want to perform adapter setup.

Lines 1060 to 1090: After reset, waits until you complete the connection for measuring the phase data and press the **Continue** key.

Lines 1100 to 1140: Sets 4TP 1M as the adapter selection, measures the phase compensation data, calculates the setup data, and saves it into the nonvolatile memory.

Lines 1190 to 1670 The Adjust subroutine.

Lines 1200 to 1310: When you use electrode A or B, asks you if you want to execute electrode adjustment.

Lines 1340 to 1510: Sets up the measurement conditions used when adjusting the electrodes to be parallel.

Lines 1540 to 1550: Waits until you finish turning the small knob and 16451B's micrometer indicates 10 μm and press the **Continue** key.

Lines 1560 to 1600: Waits until you adjust the electrodes so that the limit test results display PASS and press the **Continue** key.

Lines 1610 to 1650: Checks the limit test result.

Lines 1690 to 2670 The Compen subroutine.

Lines 1710 to 1760: Asks you if you want to execute fixture compensation.

Lines 1790 to 1990: Obtains the setting values (the sweep range, the sweep type, the signal source level, and the number of measurement points) from user input.

Lines 2010 to 2200: Sets the conditions for measurement where an air capacitor is used as the LOAD standard.

Lines 2230 to 2260: Waits until you adjust the distance between the electrodes so that the limit test results display PASS (an appropriate air capacitor value is obtained) and press the **Continue** key.

Lines 2270 to 2300: Checks the limit test result.

Lines 2330 to 2340: Retrieves the measurement result (Cp) and stores it into the Load_c variable for the LOAD standard value.

Lines 2360 to 2410: Sets up the measurement conditions used when performing fixture compensation.

Lines 2420 to 2470: Defines the values of each OPEN/SHORT/LOAD standard.

NOTE In order to define the LOAD standard using the values Cp and G, the OPEN standard and LOAD standard must be defined inversely.

Lines 2490 to 2640: Measures the compensation data for each of OPEN/SHORT/LOAD.

NOTE Because the OPEN and LOAD standards are defined inversely, the commands for measuring the OPEN and LOAD compensation data are also used inversely.

Lines 2690 to 2730 The Input_t subroutine.

Lines 2750 to 2890 The Input_d subroutine.

Lines 2270 to 2820: When you use electrode A or B, sets the electrode diameter from the values already set in the variables within the program.

Lines 2830 to 2870: When you use electrode C or D, sets the electrode diameter from user input.

Lines 2910 to 3100 The Sweep subroutine.

Lines 2920 to 2930: Waits until you insert the MUT into the 16451B and press the **Continue** key.

Lines 2940 to 3000: Measures Cp and D.

Lines 3010 to 3090: Retrieves the measurement results and stores them into the Cp_data and D_data arrays.

Lines 3120 to 3230 The Calc subroutine. Using the Cp_data and D_data arrays, calculates the complex relative permittivity and the dielectric dissipation factor.

Lines 3250 to 3350 Sets the softkey labels and the subroutines to be executed when each key is pressed. Then, waits until you press one of the softkeys.

Lines 3370 to 3580 Processing when the softkey labeled as “er' - tan d” is pressed. Displays the real part of the complex relative permittivity (ε_r') as trace A and the dielectric dissipation factor as trace B.

Lines 3600 to 3810 Processing when the softkey labeled as “|er| - tan d” is pressed. Displays the magnitude of the complex relative permittivity

($\sqrt{\varepsilon_r'^2 + \varepsilon_r''^2}$) as trace A and the dielectric dissipation factor as trace B.

Lines 3830 to 4040 Processing when the softkey labeled as “er' - er"” is pressed. Displays the real part of the complex relative permittivity (ε_r') as trace A and the imaginary part of the complex relative permittivity (ε_r'') as trace B.

Lines 4060 to 4190 Processing when the softkey labeled as “Cole-cole Plot” is pressed. Displays the COLE-COLE plot on the complex plane.

Lines 4210 to 4310 Processing when the softkey labeled as “Re-measure” is pressed.

Lines 4330 to 4430 Processing when the softkey labeled as “Quit” is pressed.

Example 13-2 **Dielectric (Relative Permittivity) Measurement (Contacting Electrode Method)**

```
10    !*************************************************************
20    !* 4294A + 16451B Permittivity Measurement (Contact Method)
30    !* Instrument BASIC Sample Program
40    !*************************************************************
50    DIM Cp_data(1:801,1:2),D_data(1:801,1:2),Err_data(1:801,1:2)
60    DIM Eri_data(1:801,1:2),Erm_data(1:801,1:2),Cole_data(1:801,1:2)
70    INTEGER Result
80    !
90    ASSIGN @Agt4294a TO 800
100   OUTPUT @Agt4294a;"DISA HIHB"
110   OUTPUT @Agt4294a;"HOLD"
120 Constants:   !
130   E0=8.854E-12
140   Adj_center=100000.
150   Adj_up_limit_a=1.E-9
160   Adj_low_limit_a=7.E-10
170   Adj_up_limit_b=2.E-11
180   Adj_low_limit_b=1.2E-11
190   Load_center=100000.
200   Load_ave=4
210   Load_bw=5
220   Load_up_limit_a=5.05E-11  ! [pF]
230   Load_lo_limit_a=4.95E-11
240   Load_up_limit_b=5.05E-12
250   Load_lo_limit_b=4.95E-12
260   Load_up_limit_c=1.55E-12
270   Load_lo_limit_c=1.45E-12
280   Load_up_limit_d=1.55E-12
290   Load_lo_limit_d=1.45E-12
300   Open_r=1.E+11             ! [ohm]
310   Open_l=0
320   Short_r=0
330   Short_l=0
340   Load_g=0
350   Bw=3
360   D_elec_a=.038             ! [m]
370   D_elec_b=.005
380   !
390   !########################################## Main
400 Disp_proc:!
410   CLEAR SCREEN
420   PRINT "4294A + 16451B Permittivity Measurement Program"
430   PRINT "  (Contact Method Measurment)"
440   PRINT ""
```

```
450   PRINT "[ ]    Select the main electrode of 16451B"
460   PRINT "[ ]    Perform the adapter setup (1m cable)"
470   PRINT "[ ]    Adjust the electrodes (Parallelizing)"
480   PRINT "[ ]    Perform fixture compensation"
490   PRINT "x: done, s: skip, n: not required."
500   !
510 Adjustment:   !
520   GOSUB Select_elec
530   GOSUB Adapter_setup
540   GOSUB Adjust
550   GOSUB Compen
560 Meas:  !
570   GOSUB Input_t
580   GOSUB Input_d
590   GOSUB Sweep
600   GOSUB Calc
610   GOTO Display
620   !
630   !########################################## Sub-routines
640 Select_elec:!
650   PRINT TABXY(5,4);"->"
660   DISP "Which electrode of 16451B is used?  0:A, 1:B, 2:C, 3:D";
670   INPUT "",Ans
680   SELECT Ans
690   CASE 0
700     Elec$="A"
710     Adj_up_limit=Adj_up_limit_a
720     Adj_low_limit=Adj_low_limit_a
730     Load_up_limit=Load_up_limit_a
740     Load_low_limit=Load_lo_limit_a
750   CASE 1
760     Elec$="B"
770     Adj_up_limit=Adj_up_limit_b
780     Adj_low_limit=Adj_low_limit_b
790     Load_up_limit=Load_up_limit_b
800     Load_low_limit=Load_lo_limit_b
810   CASE 2
820     Elec$="C"
830     Load_up_limit=Load_up_limit_c
840     Load_low_limit=Load_lo_limit_c
850   CASE 3
860     Elec$="D"
870     Load_up_limit=Load_up_limit_d
880     Load_low_limit=Load_lo_limit_d
890   CASE ELSE
900     GOTO Select_elec
910   END SELECT
920   DISP "The electrode ";Elec$;" is selected. OK?   0:OK, 1:No";
930   INPUT "",Ans
940   IF Ans<>0 THEN Select_elec
950   PRINT TABXY(2,4);"x]    "
960   RETURN
970   !
980 Adapter_setup:!
990   DISP "Perform the adapter setup?    0:Yes, 1:Skip";
1000  INPUT "",Ans
1010  IF Ans=1 THEN
1020    PRINT TABXY(2,5);"s]    "
1030    RETURN
1040  END IF
1050  F_adapt_setup=1
1060  OUTPUT @Agt4294a;"PRES"
1070  PRINT TABXY(5,5);"->"
1080  DISP "Set the 16451B OPEN condition and press 'Continue'."
```

```
1090  PAUSE
1100  DISP "Wait until the setup is finished."
1110  OUTPUT @Agt4294a;"E4TP M1"
1120  Result=FNUser_Corr(@Agt4294a,"Adapter_Phase")
1130  IF Result<>0 THEN Prog_end
1140  OUTPUT @Agt4294a;"ECALDON"
1150  DISP ""
1160  PRINT TABXY(2,5);"x]   "
1170  RETURN
1180  !
1190 Adjust:!
1200  IF Elec$="C" OR Elec$="D" THEN
1210    PRINT TABXY(2,6);"n]   "
1220    RETURN
1230  END IF
1240  IF F_adapt_setup=0 THEN
1250    DISP "Perform the electrode adjustment?    0:Yes, 1:Skip";
1260    INPUT "",Ans
1270    IF Ans=1 THEN
1280      PRINT TABXY(2,6);"s]   "
1290      RETURN
1300    END IF
1310  END IF
1320  F_adjust=1
1330  PRINT TABXY(5,6);"->"
1340  OUTPUT @Agt4294a;"SWPT LIN"
1350  OUTPUT @Agt4294a;"CENT ";Adj_center
1360  OUTPUT @Agt4294a;"SPAN 0"
1370  OUTPUT @Agt4294a;"POIN 2"
1380  OUTPUT @Agt4294a;"CALP USER"
1390  OUTPUT @Agt4294a;"MEAS CPD;TRAC A"
1400  OUTPUT @Agt4294a;"HIDI ON"
1410  OUTPUT @Agt4294a;"EDITLIML"
1420  OUTPUT @Agt4294a;"LIMCLEL ;LIMSADD"
1430  OUTPUT @Agt4294a;"LIMSTAR ";Adj_center
1440  OUTPUT @Agt4294a;"LIMSTOP ";Adj_center
1450  OUTPUT @Agt4294a;"LIMLSTAR ";Adj_low_limit
1460  OUTPUT @Agt4294a;"LIMUSTAR ";Adj_up_limit
1470  OUTPUT @Agt4294a;"LIMLSTOP ";Adj_low_limit
1480  OUTPUT @Agt4294a;"LIMUSTOP ";Adj_up_limit
1490  OUTPUT @Agt4294a;"LIMSDON;;LIMEDONE"
1500  OUTPUT @Agt4294a;"TOPV ";1.5*Adj_up_limit-.5*Adj_low_limit
1510  OUTPUT @Agt4294a;"BOTV ";1.5*Adj_low_limit-.5*Adj_up_limit
1520  !
1530  OUTPUT @Agt4294a;"LIMITEST OFF"
1540  DISP "Set the micrometer of 16451B at 10um and press 'Continue'."
1550  PAUSE
1560  OUTPUT @Agt4294a;"LIMITEST ON"
1570  OUTPUT @Agt4294a;"CONT"
1580  OUTPUT @Agt4294a;"MKR ON"
1590  DISP "Adjust the electrode until PASS is displayed"
1600  PAUSE
1610  OUTPUT @Agt4294a;"HOLD"
1620  OUTPUT @Agt4294a;"OUTPFAIP?"
1630  ENTER @Agt4294a;F_nop
1640  IF F_nop<>0 THEN Adj
1650  OUTPUT @Agt4294a;"LIMITEST OFF"
1660  PRINT TABXY(2,6);"x]   "
1670  RETURN
1680  !
1690 Compen:!
1700  IF F_adjust=0 THEN
1710    DISP "Perform the fixture compensation?    0:Yes, 1:Skip";
1720    INPUT "",Ans
```

```
1730    IF Ans=1 THEN
1740      PRINT TABXY(2,7);"s]   "
1750      RETURN
1760    END IF
1770  END IF
1780  PRINT TABXY(4,7);"->"
1790 Input_config:!
1800  DISP "Start frequency [Hz] = ?";
1810  INPUT "",Start
1820  DISP "Stop frequency [Hz] = ?";
1830  INPUT "",Stop
1840  DISP "Sweep type?   0:Linear, 1:Log";
1850  INPUT Ans
1860  IF Ans=1 THEN
1870    Swe_type$="LOG"
1880  ELSE
1890    Swe_type$="LIN"
1900  END IF
1910  DISP "OSC level [V] =?";
1920  INPUT "",Vosc
1930  DISP "Number of point?   [2-801]";
1940  INPUT Nop
1950  PRINT TABXY(1,10);"Start: ";Start;"[Hz]  Stop: ";Stop;"[Hz]";"
Nop: ";Nop
1960  PRINT TABXY(1,11);"Sweep Type: ";Swe_type$;"  OSC Level:
";Vosc;"[V]";
1970  DISP "Measurement condition is OK?       0:OK, 1:NO";
1980  INPUT "",Ans
1990  IF Ans<>0 THEN Input_config
2000  !
2010  OUTPUT @Agt4294a;"CALP USER"
2020  OUTPUT @Agt4294a;"MEAS CPD;TRAC A"
2030  OUTPUT @Agt4294a;"SWPT LIN"
2040  OUTPUT @Agt4294a;"CENT ";Load_center
2050  OUTPUT @Agt4294a;"SPAN 0"
2060  OUTPUT @Agt4294a;"POIN ";2
2070  OUTPUT @Agt4294a;"BWFACT ";Load_bw
2080  OUTPUT @Agt4294a;"PAVER ON;PAVERFACT ";Load_ave
2090  OUTPUT @Agt4294a;"LIMITEST ON;EDITLIML"
2100  OUTPUT @Agt4294a;"LIMCLEL ;LIMSADD"
2110  OUTPUT @Agt4294a;"LIMSTAR ";Load_center
2120  OUTPUT @Agt4294a;"LIMSTOP ";Load_center
2130  OUTPUT @Agt4294a;"LIMLSTAR ";Load_low_limit
2140  OUTPUT @Agt4294a;"LIMUSTAR ";Load_up_limit
2150  OUTPUT @Agt4294a;"LIMLSTOP ";Load_low_limit
2160  OUTPUT @Agt4294a;"LIMUSTOP ";Load_up_limit
2170  OUTPUT @Agt4294a;"LIMSDON;LIMEDONE"
2180  OUTPUT @Agt4294a;"TOPV ";1.5*Load_up_limit-.5*Load_low_limit
2190  OUTPUT @Agt4294a;"BOTV ";1.5*Load_low_limit-.5*Load_up_limit
2200  OUTPUT @Agt4294a;"HIDI ON"
2210  !
2220 Load_adj:!
2230  OUTPUT @Agt4294a;"CONT"
2240  OUTPUT @Agt4294a;"MKR ON"
2250  DISP "Turn the micrometer's knob until PASS is displayed."
2260  PAUSE
2270  OUTPUT @Agt4294a;"HOLD"
2280  OUTPUT @Agt4294a;"OUTPFAIP?"
2290  ENTER @Agt4294a;F_nop
2300  IF F_nop<>0 THEN Load_adj
2310  DISP ""
2320  OUTPUT @Agt4294a;"LIMITEST OFF"
2330  OUTPUT @Agt4294a;"OUTPDTRCP? 1"
2340  ENTER @Agt4294a;Load_c,Dummy
```

```
2350  !
2360  OUTPUT @Agt4294a;"STAR ";Start
2370  OUTPUT @Agt4294a;"STOP ";Stop
2380  OUTPUT @Agt4294a;"SWPT ";Swe_type$
2390  OUTPUT @Agt4294a;"POIN ";Nop
2400  OUTPUT @Agt4294a;"BWFACT ";Bw
2410  OUTPUT @Agt4294a;"POWMOD VOLT;POWE ";Vosc
2420  OUTPUT @Agt4294a;"DCOMOPENG ";Load_g
2430  OUTPUT @Agt4294a;"DCOMOPENC ";Load_c/1.E-15
2440  OUTPUT @Agt4294a;"DCOMSHORR ";Short_r
2450  OUTPUT @Agt4294a;"DCOMSHORL ";Short_l
2460  OUTPUT @Agt4294a;"DCOMLOADR ";Open_r
2470  OUTPUT @Agt4294a;"DCOMLOADL ";Open_l
2480  !
2490  Result=FNUser_Corr(@Agt4294a,"Compen_Open")
2500  IF Result<>0 THEN Prog_end
2510  !
2520  !
2530  DISP "Set 16451B OPEN condition and press 'Continue'."
2540  PAUSE
2550  Result=FNUser_Corr(@Agt4294a,"Compen_Load")
2560  IF Result<>0 THEN Prog_end
2570  !
2580  !
2590  DISP "Set 16451B SHORT condition and press 'Continue'."
2600  PAUSE
2610  Result=FNUser_Corr(@Agt4294a,"Compen_Short")
2620  IF Result<>0 THEN Prog_end
2630  !
2640  !
2650  DISP ""
2660  PRINT TABXY(2,7);"x]    "
2670  RETURN
2680  !
2690 Input_t:!
2700  DISP "Thickness of MUT [mm] = ?";
2710  INPUT "",Ans
2720  T_dut=Ans/1000
2730  RETURN
2740  !
2750 Input_d:!
2760  SELECT Elec$
2770  CASE "A"
2780    D_elec=D_elec_a
2790    RETURN
2800  CASE "B"
2810    D_elec=D_elec_b
2820    RETURN
2830  CASE ELSE
2840    DISP "Diameter of electrode [mm] = ?";
2850    INPUT "",D_elec
2860    D_elec=D_elec*.001
2870    RETURN
2880  END SELECT
2890  RETURN
2900  !
2910 Sweep: !
2920  DISP "Set MUT between the electrodes and press 'Continue'."
2930  PAUSE
2940  OUTPUT @Agt4294a;"DISA BASS"
2950  OUTPUT @Agt4294a;"MEAS CPD"
2960  OUTPUT @Agt4294a;"HIDI OFF"
2970  OUTPUT @Agt4294a;"SING"
2980  DISP "Now measuring Cp-D..."
```

```
2990  OUTPUT @Agt4294a;"*OPC?"
3000  ENTER @Agt4294a;Opc
3010  DISP "Now getting data..."
3020  OUTPUT @Agt4294a;"TRAC A"
3030  OUTPUT @Agt4294a;"AUTO"
3040  OUTPUT @Agt4294a;"OUTPDTRC?"
3050  ENTER @Agt4294a USING "%,K";Cp_data(*)
3060  OUTPUT @Agt4294a;"TRAC B"
3070  OUTPUT @Agt4294a;"AUTO"
3080  OUTPUT @Agt4294a;"OUTPDTRC?"
3090  ENTER @Agt4294a USING "%,K";D_data(*)
3100  RETURN
3110  !
3120 Calc: !
3130  FOR I=1 TO Nop
3140    Err_data(I,1)=(T_dut*Cp_data(I,1))/(PI*E0*(D_elec/2)^2)
3150    Err_data(I,2)=0
3160    Eri_data(I,1)=Err_data(I,1)*D_data(I,1)
3170    Eri_data(I,2)=0
3180    Erm_data(I,1)=SQR(Err_data(I,1)^2+Eri_data(I,1)^2)
3190    Erm_data(I,2)=0
3200    Cole_data(I,1)=Err_data(I,1)
3210    Cole_data(I,2)=Eri_data(I,1)
3220  NEXT I
3230  RETURN
3240  !
3250 Display:!
3260  ON KEY 1 LABEL "er' -          tan d",1 GOSUB Disp_er_d
3270  ON KEY 2 LABEL "|er| -         tan d",1 GOSUB Disp_em_d
3280  ON KEY 3 LABEL "er' -           er''",1 GOSUB Disp_er_ei
3290  ON KEY 4 LABEL "Cole-cole       Plot",1 GOSUB Disp_cole
3300  ON KEY 7 LABEL "Quit",1 GOTO Quit
3310  ON KEY 8 LABEL "Re-measure",1 GOTO Re_meas
3320  OUTPUT @Agt4294a;"USKEY"
3330  BEEP
3340  DISP "Select softkey to display each parameter."
3350 Loop:GOTO Loop
3360  !
3370 Disp_er_d:         !
3380  DISP "Now loading data..."
3390  OUTPUT @Agt4294a;"MEAS CPD"
3400  OUTPUT @Agt4294a;"HIDI OFF;SPLD ON"
3410  OUTPUT @Agt4294a;"TRAC A"
3420  OUTPUT @Agt4294a;"INPUDTRC ";
3430  FOR I=1 TO Nop
3440    OUTPUT @Agt4294a;Err_data(I,1),Err_data(I,2);
3450  NEXT I
3460  OUTPUT @Agt4294a;""
3470  OUTPUT @Agt4294a;"AUTO"
3480  OUTPUT @Agt4294a;"TRAC B"
3490  FOR I=1 TO Nop
3500    OUTPUT @Agt4294a;"INPUDTRC ";
3510    OUTPUT @Agt4294a;D_data(I,1),D_data(I,2);
3520  NEXT I
3530  OUTPUT @Agt4294a;""
3540  OUTPUT @Agt4294a;"AUTO"
3550  OUTPUT @Agt4294a;"TRAC A"
3560  BEEP
3570  DISP "A: er'  B: tan d  /  Thickness: ";T_dut*1000;"[mm]"
3580  RETURN
3590  !
3600 Disp_em_d: !
3610  DISP "Now loading data..."
3620  OUTPUT @Agt4294a;"MEAS CPD"
```

```
3630  OUTPUT @Agt4294a;"HIDI OFF;SPLD ON"
3640  OUTPUT @Agt4294a;"TRAC A"
3650  OUTPUT @Agt4294a;"INPUDTRC ";
3660  FOR I=1 TO Nop
3670    OUTPUT @Agt4294a;Erm_data(I,1),Erm_data(I,2);
3680  NEXT I
3690  OUTPUT @Agt4294a;""
3700  OUTPUT @Agt4294a;"AUTO"
3710  OUTPUT @Agt4294a;"TRAC B"
3720  FOR I=1 TO Nop
3730    OUTPUT @Agt4294a;"INPUDTRC ";
3740    OUTPUT @Agt4294a;D_data(I,1),D_data(I,2);
3750  NEXT I
3760  OUTPUT @Agt4294a;""
3770  OUTPUT @Agt4294a;"AUTO"
3780  OUTPUT @Agt4294a;"TRAC A"
3790  BEEP
3800  DISP "A: |er|  B: tan d  /  Thickness: ";T_dut*1000;"[mm]"
3810  RETURN
3820  !
3830 Disp_er_ei: !
3840  DISP "Now loading data..."
3850  OUTPUT @Agt4294a;"MEAS CPD"
3860  OUTPUT @Agt4294a;"HIDI OFF;SPLD ON"
3870  OUTPUT @Agt4294a;"TRAC A"
3880  OUTPUT @Agt4294a;"INPUDTRC ";
3890  FOR I=1 TO Nop
3900    OUTPUT @Agt4294a;Err_data(I,1),Err_data(I,2);
3910  NEXT I
3920  OUTPUT @Agt4294a;""
3930  OUTPUT @Agt4294a;"AUTO"
3940  OUTPUT @Agt4294a;"TRAC B"
3950  FOR I=1 TO Nop
3960    OUTPUT @Agt4294a;"INPUDTRC ";
3970    OUTPUT @Agt4294a;Eri_data(I,1),Eri_data(I,2);
3980  NEXT I
3990  OUTPUT @Agt4294a;""
4000  OUTPUT @Agt4294a;"AUTO"
4010  OUTPUT @Agt4294a;"TRAC A"
4020  BEEP
4030  DISP "A: er'  B: er''  /  Thickness: ";T_dut*1000;"[mm]"
4040  RETURN
4050  !
4060 Disp_cole: !
4070  DISP "Now loading data..."
4080  OUTPUT @Agt4294a;"MEAS COMP"
4090  OUTPUT @Agt4294a;"HIDI ON;SPLD OFF"
4100  OUTPUT @Agt4294a;"TRAC A"
4110  OUTPUT @Agt4294a;"INPUDTRC ";
4120  FOR I=1 TO Nop
4130    OUTPUT @Agt4294a;Cole_data(I,1),Cole_data(I,2);
4140  NEXT I
4150  OUTPUT @Agt4294a;""
4160  OUTPUT @Agt4294a;"AUTO"
4170  BEEP
4180  DISP "Cole-cole Plot     Thickness: ";T_dut*1000;"[mm]"
4190  RETURN
4200  !
4210 Re_meas: !
4220  DISP "Measure once more?       0:Yes, 1:Cancel";
4230  INPUT "",Ans
4240  SELECT Ans
4250  CASE 0
4260    GOTO Meas
```

```
4270  CASE 1
4280    GOTO Display
4290  CASE ELSE
4300    GOTO Re_meas
4310  END SELECT
4320  !
4330 Quit:  !
4340  DISP "Really quit the program?     0:Yes, 1:Cancel";
4350  INPUT "",Ans
4360  SELECT Ans
4370  CASE 0
4380    DISP "Bye."
4390  CASE 1
4400    GOTO Display
4410  CASE ELSE
4420    GOTO Quit
4430  END SELECT
4440 Prog_end: END
4450  !
4460  ! Correction Data Measurement Function
4470  !
4480  DEF FNUser_Corr(@Agt4294a,Type$)
4490   DIM Inp_char$[9],Err_mes$[50]
4500   INTEGER Err_no
4510   !
4520   OUTPUT @Agt4294a;"ESNB 256"
4530   OUTPUT @Agt4294a;"*SRE 4"
4540   OUTPUT @Agt4294a;"*CLS"
4550   !
4560    ON INTR 8 GOTO Meas_end
4570    ENABLE INTR 8;2
4580    SELECT Type$
4590     CASE "Adapter_Phase"
4600      OUTPUT @Agt4294a;"ECALP"
4610     CASE "Compen_Open"
4620      OUTPUT @Agt4294a;"COMA"
4630     CASE "Compen_Short"
4640      OUTPUT @Agt4294a;"COMB"
4650     CASE "Compen_Load"
4660      OUTPUT @Agt4294a;"COMC"
4670    END SELECT
4680    PRINT "Now measuring..."
4690 Meas_wait:  GOTO Meas_wait
4700 Meas_end:  !
4710    OUTPUT @Agt4294a;"OUTPERRO?"
4720    ENTER @Agt4294a;Err_no,Err_mes$
4730    IF Err_no=0 THEN
4740      PRINT Standard$&" Data Measurement Complete"
4750      RETURN 0
4760    ELSE
4770      PRINT "Error: "&Err_mes$
4780      PRINT "Program Interruption"
4790      OUTPUT @Agt4294a;"ECALQUI"
4800      RETURN -1
4810    END IF
4820  FNEND
```

Sample Program for Non-Contacting Electrode Method

Example 13-3 shows a sample program to measure dielectric materials (non-contacting electrode method) (for HP Instrument BASIC). You can find the source file of this program, named permi_nc.bas, on the sample program disk. This programs is very similar to Example 13-2, and therefore only its listing is given here.

Example 13-3 **Dielectric (Relative Permittivity) Measurement (Non-Contacting Electrode Method)**

```
10    !**************************************************************
20    !* 4294A + 16451B Permittivity Measurement (Non-Contact Method)
30    !* Instrument BASIC Sample Program
40    !**************************************************************
50    DIM Cp_data(1:801,1:2),D_data(1:801,1:2)
60    DIM Cp_data1(1:801,1:2),D_data1(1:801,1:2),Err_data(1:801,1:2)
70    DIM Cp_data2(1:801,1:2),D_data2(1:801,1:2),D_data3(1:801,1:2)
80    DIM Eri_data(1:801,1:2),Erm_data(1:801,1:2),Cole_data(1:801,1:2)
90    INTEGER Result
100   !
110   ASSIGN @Agt4294a TO 800
120   OUTPUT @Agt4294a;"DISA HIHB"
130   OUTPUT @Agt4294a;"HOLD"
140 Constants:   !
150   E0=8.854E-12
160   Adj_center=100000.
170   Adj_up_limit_a=1.E-9
180   Adj_low_limit_a=7.E-10
190   Adj_up_limit_b=2.E-11
200   Adj_low_limit_b=1.2E-11
210   Load_center=100000.
220   Load_ave=4
230   Load_bw=5
240   Load_up_limit_a=5.05E-11  ! [pF]
250   Load_lo_limit_a=4.95E-11
260   Load_up_limit_b=5.05E-12
270   Load_lo_limit_b=4.95E-12
280   Open_r=1.E+11             ! [ohm]
290   Open_l=0
300   Short_r=0
310   Short_l=0
320   Load_g=0
330   Nop=201
340   Ave=1
350   Bw=3
360   D_elec_a=.038             ! [m]
370   D_elec_b=.005
380   !########################################## Main
390 Disp_proc:!
400   CLEAR SCREEN
410   PRINT "4294A + 16451B Permittivity Measurement Program"
420   PRINT "  (Non-Contact Method Measurment)"
430   PRINT ""
440   PRINT "[ ]    Select the main electrode of 16451B"
450   PRINT "[ ]    Perform the adapter setup (1m cable)"
460   PRINT "[ ]    Adjust the electrodes (Parallelizing)"
470   PRINT "[ ]    Perform fixture compensation"
480   PRINT "x: done, s: skip, n: not required."
490   !
500 Adjustment: !
510   GOSUB Select_elec
520   GOSUB Adapter_setup
530   GOSUB Adjust
540   GOSUB Compen
```

```
550 Meas: !
560   GOSUB Input_t
570   GOSUB Input_d
580   DISP "Create the electrode gap Tg. Press 'Continue' when ready"
590   PAUSE
600   GOSUB Input_tg
610   DISP "Insert MUT between electrodes and press 'Continue'"
620   PAUSE
630   GOSUB Sweep
640   FOR I=1 TO Nop
650     FOR J=1 TO 2
660       Cp_data2(I,J)=Cp_data(I,J)
670       D_data2(I,J)=D_data(I,J)
680     NEXT J
690   NEXT I
700   DISP "Remove MUT and press 'Continue'"
710   PAUSE
720   GOSUB Sweep
730   FOR I=1 TO Nop
740     FOR J=1 TO 2
750      Cp_data1(I,J)=Cp_data(I,J)
760      D_data1(I,J)=D_data(I,J)
770     NEXT J
780   NEXT I
790   GOSUB Calc
800   GOTO Display
810   !######################################### Sub-routines
820 Select_elec: !
830   PRINT TABXY(5,4);"->"
840   DISP "Which electrode of 16451B is used?  0:A, 1:B";
850   INPUT "",Ans
860   SELECT Ans
870   CASE 0
880     Elec$="A"
890     Adj_up_limit=Adj_up_limit_a
900     Adj_low_limit=Adj_low_limit_a
910     Load_up_limit=Load_up_limit_a
920     Load_low_limit=Load_lo_limit_a
930   CASE 1
940     Elec$="B"
950     Adj_up_limit=Adj_up_limit_b
960     Adj_low_limit=Adj_low_limit_b
970     Load_up_limit=Load_up_limit_b
980     Load_low_limit=Load_lo_limit_b
990   CASE ELSE
1000    GOTO Select_elec
1010  END SELECT
1020  DISP "The electrode ";Elec$;" is selected. OK?   0:OK, 1:No";
1030  INPUT "",Ans
1040  IF Ans<>0 THEN Select_elec
1050  PRINT TABXY(2,4);"x]    "
1060  RETURN
1070  !
1080 Adapter_setup:!
1090  DISP "Perform the adapter setup?    0:Yes, 1:Skip";
1100  INPUT "",Ans
1110  IF Ans=1 THEN
1120    PRINT TABXY(2,5);"s]    "
1130    RETURN
1140  END IF
1150  F_adapt_setup=1
1160  OUTPUT @Agt4294a;"PRES"
1170  PRINT TABXY(5,5);"->"
1180  DISP "Set the 16451B OPEN condition and press 'Continue'."
```

```
1190  PAUSE
1200  DISP "Wait until the setup is finished."
1210  OUTPUT @Agt4294a;";E4TP OFF;E4TP M1"
1220  Result=FNUser_Corr(@Agt4294a,"Adapter_Phase")
1230  IF Result<>0 THEN Prog_end
1240  OUTPUT @Agt4294a;";ECALDON"
1250  DISP ""
1260  PRINT TABXY(2,5);"x]   "
1270  RETURN
1280  !
1290 Adjust:!
1300  IF Elec$="C" OR Elec$="D" THEN
1310    PRINT TABXY(2,6);"n]   "
1320    RETURN
1330  END IF
1340  IF F_adapt_setup=0 THEN
1350    DISP "Perform the electrode adjustment?    0:Yes, 1:Skip";
1360    INPUT "",Ans
1370    IF Ans=1 THEN
1380      PRINT TABXY(2,6);"s]   "
1390      RETURN
1400    END IF
1410  END IF
1420  F_adjust=1
1430  PRINT TABXY(5,6);"->"
1440  OUTPUT @Agt4294a;"SWPT LIN"
1450  OUTPUT @Agt4294a;";CENT ";Adj_center
1460  OUTPUT @Agt4294a;";SPAN ";0
1470  OUTPUT @Agt4294a;";POIN ";2
1480  OUTPUT @Agt4294a;";;CALP USER"
1490  OUTPUT @Agt4294a;";MEAS CPD;TRAC A"
1500  OUTPUT @Agt4294a;"HIDI ON"
1510  OUTPUT @Agt4294a;"EDITLIML"
1520  OUTPUT @Agt4294a;";LIMCLEL ;LIMSADD"
1530  OUTPUT @Agt4294a;";LIMSTAR ";Adj_center
1540  OUTPUT @Agt4294a;";LIMSTOP ";Adj_center
1550  OUTPUT @Agt4294a;";LIMLSTAR ";Adj_low_limit
1560  OUTPUT @Agt4294a;";LIMUSTAR ";Adj_up_limit
1570  OUTPUT @Agt4294a;";LIMLSTOP ";Adj_low_limit
1580  OUTPUT @Agt4294a;";LIMUSTOP ";Adj_up_limit
1590  OUTPUT @Agt4294a;";LIMSDON;;LIMEDONE"
1600  OUTPUT @Agt4294a;";TOPV ";1.5*Adj_up_limit-.5*Adj_low_limit
1610  OUTPUT @Agt4294a;";BOTV ";1.5*Adj_low_limit-.5*Adj_up_limit
1620  !
1630  OUTPUT @Agt4294a;"LIMITEST OFF"
1640  DISP "Set the micrometer of 16451B at 10um and press 'Continue'."
1650  PAUSE
1660  OUTPUT @Agt4294a;"LIMITEST ON"
1670  OUTPUT @Agt4294a;"CONT"
1680  OUTPUT @Agt4294a;";MKR ON"
1690  DISP "Adjust the electrode until PASS is displayed."
1700  PAUSE
1710  OUTPUT @Agt4294a;"HOLD"
1720  OUTPUT @Agt4294a;"OUTPFAIP?"
1730  ENTER @Agt4294a;F_nop
1740  IF F_nop<>0 THEN Adj
1750  OUTPUT @Agt4294a;"LIMITEST OFF"
1760  PRINT TABXY(2,6);"x]   "
1770  RETURN
1780  !
1790 Compen:!
1800  IF F_adjust=0 THEN
1810    DISP "Perform the fixture compensation?    0:Yes, 1:Skip";
1820    INPUT "",Ans
```

```
1830    IF Ans=1 THEN
1840      PRINT TABXY(2,7);"s]   "
1850      RETURN
1860    END IF
1870  END IF
1880  PRINT TABXY(4,7);"->"
1890 Input_config:!
1900  DISP "Start frequency [Hz] = ?";
1910  INPUT "",Start
1920  DISP "Stop frequency [Hz] = ?";
1930  INPUT "",Stop
1940  DISP "Sweep type?   0:Linear, 1:Log";
1950  INPUT Ans
1960  IF Ans=1 THEN
1970    Swe_type$="LOG"
1980  ELSE
1990    Swe_type$="LIN"
2000  END IF
2010  DISP "OSC level [V] =?";
2020  INPUT "",Vosc
2030  DISP "Number of point?   [2-801]";
2040  INPUT Nop
2050  PRINT TABXY(1,10);"Start: ";Start;"[Hz]  Stop: ";Stop;"[Hz]";"
Nop: ";Nop
2060  PRINT TABXY(1,11);"Sweep Type: ";Swe_type$;"  OSC Level:
";Vosc;"[V]";
2070  DISP "Measurement condition is OK?      0:OK, 1:NO";
2080  INPUT "",Ans
2090  IF Ans<>0 THEN Input_config
2100  !
2110  OUTPUT @Agt4294a;";;CALP USER"
2120  OUTPUT @Agt4294a;";MEAS CPD;TRAC A"
2130  OUTPUT @Agt4294a;"SWPT LIN"
2140  OUTPUT @Agt4294a;";CENT ";Load_center
2150  OUTPUT @Agt4294a;"SPAN 0"
2160  OUTPUT @Agt4294a;";POIN ";2
2170  OUTPUT @Agt4294a;"BWFACT ";Load_bw
2180  OUTPUT @Agt4294a;";PAVER ON;PAVERFACT ";Load_ave
2190  OUTPUT @Agt4294a;"LIMITEST ON;EDITLIML"
2200  OUTPUT @Agt4294a;";LIMCLEL ;LIMSADD"
2210  OUTPUT @Agt4294a;";LIMSTAR ";Load_center
2220  OUTPUT @Agt4294a;";LIMSTOP ";Load_center
2230  OUTPUT @Agt4294a;";LIMLSTAR ";Load_low_limit
2240  OUTPUT @Agt4294a;";LIMUSTAR ";Load_up_limit
2250  OUTPUT @Agt4294a;";LIMLSTOP ";Load_low_limit
2260  OUTPUT @Agt4294a;";LIMUSTOP ";Load_up_limit
2270  OUTPUT @Agt4294a;";LIMSDON;;LIMEDONE"
2280  OUTPUT @Agt4294a;"TOPV ";1.5*Load_up_limit-.5*Load_low_limit
2290  OUTPUT @Agt4294a;"BOTV ";1.5*Load_low_limit-.5*Load_up_limit
2300  OUTPUT @Agt4294a;"HIDI ON"
2310  !
2320 Load_adj:!
2330  OUTPUT @Agt4294a;"CONT"
2340  OUTPUT @Agt4294a;";MKR ON"
2350  DISP "Turn the micrometer's knob until PASS is displayed."
2360  PAUSE
2370  OUTPUT @Agt4294a;"HOLD"
2380  OUTPUT @Agt4294a;"OUTPFAIP?"
2390  ENTER @Agt4294a;F_nop
2400  IF F_nop<>0 THEN Load_adj
2410  DISP ""
2420  OUTPUT @Agt4294a;"LIMITEST OFF"
2430  OUTPUT @Agt4294a;"OUTPDTRCP? 1"
2440  ENTER @Agt4294a;Load_c
```

```
2450  !
2460  OUTPUT @Agt4294a;";STAR ";Start
2470  OUTPUT @Agt4294a;";STOP ";Stop
2480  OUTPUT @Agt4294a;";SWPT ";Swe_type$
2490  OUTPUT @Agt4294a;"POIN ";Nop
2500  OUTPUT @Agt4294a;";BWFACT ";Bw
2510  OUTPUT @Agt4294a;";POWMOD VOLT;POWE ";Vosc
2520  OUTPUT @Agt4294a;"DCOMOPENG ";Load_g
2530  OUTPUT @Agt4294a;"DCOMOPENC ";Load_c/1.E-15
2540  OUTPUT @Agt4294a;"DCOMSHORR ";Short_r
2550  OUTPUT @Agt4294a;"DCOMSHORL ";Short_l
2560  OUTPUT @Agt4294a;"DCOMLOADR ";Open_r
2570  OUTPUT @Agt4294a;"DCOMLOADL ";Open_l
2580  !
2590  Result=FNUser_Corr(@Agt4294a,"Compen_Open")
2600  IF Result<>0 THEN Prog_end
2610  !
2620  !
2630  DISP "Set 16451B OPEN condition and press 'Continue'."
2640  PAUSE
2650  Result=FNUser_Corr(@Agt4294a,"Compen_Load")
2660  IF Result<>0 THEN Prog_end
2670  !
2680  !
2690  DISP "Set 16451B SHORT condition and press 'Continue'."
2700  PAUSE
2710  Result=FNUser_Corr(@Agt4294a,"Compen_Short")
2720  IF Result<>0 THEN Prog_end
2730  !
2740  !
2750  DISP ""
2760  PRINT TABXY(2,7);"x]    "
2770  RETURN
2780  !
2790 Input_t:!
2800  DISP "Thickness of MUT [mm] = ?";
2810  INPUT "",Ans
2820  T_dut=Ans/1000
2830  RETURN
2840  !
2850 Input_tg:!
2860  DISP "Distance of Electrode Gap Tg [mm] = ?";
2870  INPUT "",Ans
2880  Tg=Ans/1000
2890  RETURN
2900  !
2910 Input_d:!
2920  SELECT Elec$
2930  CASE "A"
2940    D_elec=D_elec_a
2950  CASE "B"
2960    D_elec=D_elec_b
2970  END SELECT
2980  RETURN
2990  !
3000 Sweep: !
3010  OUTPUT @Agt4294a;"DISA BASS"
3020  OUTPUT @Agt4294a;"MEAS CPD"
3030  OUTPUT @Agt4294a;"HIDI OFF"
3040  OUTPUT @Agt4294a;"SING"
3050  DISP "Now measuring Cp-D..."
3060  OUTPUT @Agt4294a;"*OPC?"
3070  ENTER @Agt4294a;Opc
3080  DISP "Now getting data..."
```

```
3090  OUTPUT @Agt4294a;"TRAC A"
3100  OUTPUT @Agt4294a;"AUTO"
3110  OUTPUT @Agt4294a;"OUTPDTRC?"
3120  ENTER @Agt4294a USING "%,K";Cp_data(*)
3130  OUTPUT @Agt4294a;"TRAC B"
3140  OUTPUT @Agt4294a;"AUTO"
3150  OUTPUT @Agt4294a;"OUTPDTRC?"
3160  ENTER @Agt4294a USING "%,K";D_data(*)
3170  RETURN
3180  !
3190 Calc:  !
3200  FOR I=1 TO Nop
3210
D_data3(I,1)=(D_data2(I,1)+Err_data(I,1)*(D_data2(I,1)-D_data1(I,1))*((T
g/T_dut)-1))
3220    D_data3(I,2)=0
3230    Err_data(I,1)=1/(1-(1-(Cp_data1(I,1)/Cp_data2(I,1)))*(Tg/T_dut))
3240    Err_data(I,2)=0
3250    Eri_data(I,1)=Err_data(I,1)*D_data3(I,1)
3260    Eri_data(I,2)=0
3270    Erm_data(I,1)=SQR(Err_data(I,1)^2+Eri_data(I,1)^2)
3280    Erm_data(I,2)=0
3290    Cole_data(I,1)=Err_data(I,1)
3300    Cole_data(I,2)=Eri_data(I,1)
3310  NEXT I
3320  RETURN
3330  !
3340 Display:!
3350  ON KEY 1 LABEL "er' -          tan d",1 GOSUB Disp_er_d
3360  ON KEY 2 LABEL "|er| -         tan d",1 GOSUB Disp_em_d
3370  ON KEY 3 LABEL "er' -           er''",1 GOSUB Disp_er_ei
3380  ON KEY 4 LABEL "Cole-cole       Plot",1 GOSUB Disp_cole
3390  ON KEY 7 LABEL "Quit",1 GOTO Quit
3400  ON KEY 8 LABEL "Re-measure",1 GOTO Re_meas
3410  OUTPUT @Agt4294a;"USKEY"
3420  BEEP
3430  DISP "Select softkey to display each parameter."
3440 Loop: GOTO Loop
3450  !
3460 Disp_er_d: !
3470  DISP "Now loading data..."
3480  OUTPUT @Agt4294a;"MEAS CPD"
3490  OUTPUT @Agt4294a;"HIDI OFF;SPLD ON"
3500  OUTPUT @Agt4294a;"TRAC A"
3510  OUTPUT @Agt4294a;"INPUDTRC ";
3520  FOR I=1 TO Nop
3530    OUTPUT @Agt4294a;Err_data(I,1),Err_data(I,2);
3540  NEXT I
3550  OUTPUT @Agt4294a;""
3560  OUTPUT @Agt4294a;"AUTO"
3570  OUTPUT @Agt4294a;"TRAC B"
3580  FOR I=1 TO Nop
3590    OUTPUT @Agt4294a;"INPUDTRC ";
3600    OUTPUT @Agt4294a;D_data3(I,1),D_data3(I,2);
3610  NEXT I
3620  OUTPUT @Agt4294a;""
3630  OUTPUT @Agt4294a;"AUTO"
3640  OUTPUT @Agt4294a;"TRAC A"
3650  BEEP
3660  DISP "A: er'  B: tan d  /  Thickness: ";T_dut*1000;"[mm]"
3670  RETURN
3680  !
3690 Disp_em_d: !
3700  DISP "Now loading data..."
```

```
3710  OUTPUT @Agt4294a;"MEAS CPD"
3720  OUTPUT @Agt4294a;"HIDI OFF;SPLD ON"
3730  OUTPUT @Agt4294a;"TRAC A"
3740  OUTPUT @Agt4294a;"INPUDTRC ";
3750  FOR I=1 TO Nop
3760    OUTPUT @Agt4294a;Erm_data(I,1),Erm_data(I,2);
3770  NEXT I
3780  OUTPUT @Agt4294a;""
3790  OUTPUT @Agt4294a;"AUTO"
3800  OUTPUT @Agt4294a;"TRAC B"
3810  FOR I=1 TO Nop
3820    OUTPUT @Agt4294a;"INPUDTRC ";
3830    OUTPUT @Agt4294a;D_data3(I,1),D_data3(I,2);
3840  NEXT I
3850  OUTPUT @Agt4294a;""
3860  OUTPUT @Agt4294a;"AUTO"
3870  OUTPUT @Agt4294a;"TRAC A"
3880  BEEP
3890  DISP "A: |er|  B: tan d  /  Thickness: ";T_dut*1000;"[mm]"
3900  RETURN
3910  !
3920 Disp_er_ei: !
3930  DISP "Now loading data..."
3940  OUTPUT @Agt4294a;"MEAS CPD"
3950  OUTPUT @Agt4294a;"HIDI OFF;SPLD ON"
3960  OUTPUT @Agt4294a;"TRAC A"
3970  OUTPUT @Agt4294a;"INPUDTRC ";
3980  FOR I=1 TO Nop
3990    OUTPUT @Agt4294a;Err_data(I,1),Err_data(I,2);
4000  NEXT I
4010  OUTPUT @Agt4294a;""
4020  OUTPUT @Agt4294a;"AUTO"
4030  OUTPUT @Agt4294a;"TRAC B"
4040  FOR I=1 TO Nop
4050    OUTPUT @Agt4294a;"INPUDTRC ";
4060    OUTPUT @Agt4294a;Eri_data(I,1),Eri_data(I,2);
4070  NEXT I
4080  OUTPUT @Agt4294a;""
4090  OUTPUT @Agt4294a;"AUTO"
4100  OUTPUT @Agt4294a;"TRAC A"
4110  BEEP
4120  DISP "A: er'  B: er''  /  Thickness: ";T_dut*1000;"[mm]"
4130  RETURN
4140  !
4150 Disp_cole: !
4160  DISP "Now loading data..."
4170  OUTPUT @Agt4294a;"MEAS COMP"
4180  OUTPUT @Agt4294a;"HIDI ON;SPLD OFF"
4190  OUTPUT @Agt4294a;"TRAC A"
4200  OUTPUT @Agt4294a;"INPUDTRC ";
4210  FOR I=1 TO Nop
4220    OUTPUT @Agt4294a;Cole_data(I,1),Cole_data(I,2);
4230  NEXT I
4240  OUTPUT @Agt4294a;""
4250  OUTPUT @Agt4294a;"AUTO"
4260  BEEP
4270  DISP "Cole-cole Plot     Thickness: ";T_dut*1000;"[mm]"
4280  RETURN
4290  !
4300 Re_meas: !
4310  DISP "Measure once more?        0:Yes, 1:Cancel";
4320  INPUT "",Ans
4330  SELECT Ans
4340  CASE 0
```

```
4350    GOTO Meas
4360  CASE 1
4370    GOTO Display
4380  CASE ELSE
4390    GOTO Re_meas
4400  END SELECT
4410  !
4420 Quit: !
4430  DISP "Really quit the program?     0:Yes, 1:Cancel";
4440  INPUT "",Ans
4450  SELECT Ans
4460  CASE 0
4470    DISP "Bye."
4480  CASE 1
4490    GOTO Display
4500  CASE ELSE
4510    GOTO Quit
4520  END SELECT
4530 Prog_end: END
4540  !
4550  ! Correction Data Measurement Function
4560  !
4570  DEF FNUser_Corr(@Agt4294a,Type$)
4580   DIM Inp_char$[9],Err_mes$[50]
4590   INTEGER Err_no
4600   !
4610   OUTPUT @Agt4294a;"ESNB 256"
4620   OUTPUT @Agt4294a;"*SRE 4"
4630   OUTPUT @Agt4294a;"*CLS"
4640   !
4650    ON INTR 8 GOTO Meas_end
4660    ENABLE INTR 8;2
4670    SELECT Type$
4680     CASE "Adapter_Phase"
4690      OUTPUT @Agt4294a;"ECALP"
4700     CASE "Compen_Open"
4710      OUTPUT @Agt4294a;"COMA"
4720     CASE "Compen_Short"
4730      OUTPUT @Agt4294a;"COMB"
4740     CASE "Compen_Load"
4750      OUTPUT @Agt4294a;"COMC"
4760    END SELECT
4770    PRINT "Now measuring..."
4780 Meas_wait:  GOTO Meas_wait
4790 Meas_end:  !
4800    OUTPUT @Agt4294a;"OUTPERRO?"
4810    ENTER @Agt4294a;Err_no,Err_mes$
4820    IF Err_no=0 THEN
4830      PRINT Standard$&" Data Measurement Complete"
4840      RETURN 0
4850    ELSE
4860      PRINT "Error: "&Err_mes$
4870      PRINT "Program Interruption"
4880      OUTPUT @Agt4294a;"ECALQUI"
4890      RETURN -1
4900    END IF
4910  FNEND
```

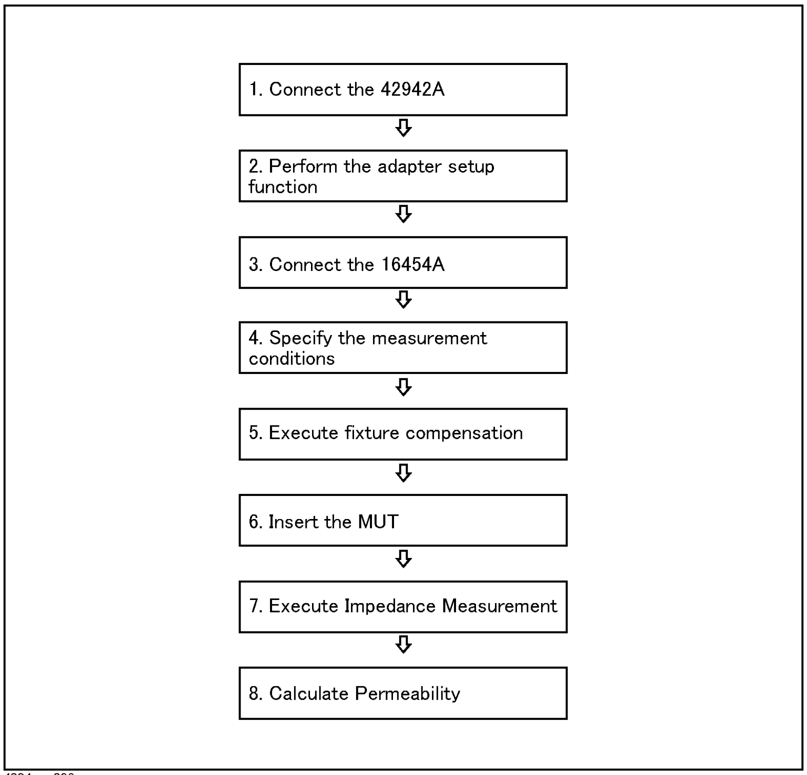
Measuring Magnetic Materials

This section describes how to measure magnetic materials using the 4294A (and the 42942A terminal adapter) and the 16454A magnetic material test fixture.

Measurement Procedure

Figure 13-2 shows the flow of magnetic material measurement.

Figure 13-4 **Flow of Magnetic Material Measurement**



4294ape038

Step 1. Connect the 42942A

Connect the 42942A to the UNKNOWN terminal of the 4294A.

Step 2. Perform the adapter setup function

Select 7mm 42942A as the adapter, measure phase/OPEN/SHORT/LOAD data for calculating the setup data, calculate the setup data, and store it into the nonvolatile memory.

NOTE For details on how to set up the adapter when connecting the 42942A, refer to “Preparing Accessories for Measurement” in the 4294A Operation Manual.

Step 3. Connect the 16454A

Connect either the small of large electrode of 16454A (whose size is suitable for the shape of the magnetic material (MUT) you want to measure) to the 42942A.

NOTE For details on how to handle the 16454A (the dimensions of the MUT suitable for measurement in each size (small or large)), refer to the 16454A Operation and Service Manual.

Step 4. Specify the measurement conditions

Specify the measurement conditions including the measurement frequency and the measurement signal level.

Step 5. Execute fixture compensation

Insert only the MUT holder and perform SHORT compensation

Step 6. Insert the MUT

Insert the MUT with the holder into the 16454A.

Step 7. Execute impedance measurement

Measure the impedance (R + jX).

Step 8. Calculate permeability

Using the following expressions and the result of the impedance measurement, calculate the complex relative permeability ($\dot{\mu}_r = \mu_r' - j\mu_r''$) and the loss tangent ($\tan\delta$) of the MUT.

Equation 13-3 **Expressions to calculate the complex relative permeability and the loss tangent**

$$\dot{\mu}_r = \frac{\dot{Z}m}{j(f \times \mu_0 \times h \times \ln(c/b))} + 1 = \frac{X}{f \times \mu_0 \times h \times \ln(c/b)} + 1 - j\frac{R}{f \times \mu_0 \times h \times \ln(c/b)}$$

$$\mu_r' = \frac{X}{f \times \mu_0 \times h \times \ln(c/b)} + 1 \qquad \mu_r'' = \frac{R}{f \times \mu_0 \times h \times \ln(c/b)}$$

$$\tan\delta = \frac{\mu_r''}{\mu_r'}$$

Where,

$\dot{\mu}_r$	Complex relative permeability of MUT
$\dot{Z}m = R + jX$	Impedance (complex number) [Ω]
μ_0	Permeability of vacuum (=1.257×10-6) [H/m]
f	Frequency [Hz]
h	Height of MUT [m]
c	Outside diameter of MUT [m]
b	Inside diameter of MUT [m]

Sample Program

Example 13-4 shows a sample program to measure magnetic materials (for HP Instrument BASIC). You can find the source file of this program, named permeabi.bas, on the sample program disk.

How to use the program is described below:

Step 1. Connect the 42942A terminal adapter to the 4294A, and start this program. When the message “Perform the adapter setup? 0:Yes, 1:Skip” is displayed, enter 0 if you want to set up the adapter.

Step 2. When the message “Connect OPEN (0S) to the 7mm port and press 'Continue'.” is displayed, connect OPEN to the 42942A and press the **Continue** key (2nd softkey from the top). The phase data and OPEN data for calculating the setup data will be measured.

Step 3. When the message “Connect SHORT (0-OHM) to the 7mm port and press 'Continue'.” is displayed, connect SHORT to the 42942A and press the **Continue** key to measure the SHORT data for calculating the setup data.

Step 4. When the message “Connect LOAD (50-OHM) to the 7mm port and press 'Continue'.” is displayed, connect LOAD to the 42942A and press the **Continue** key to measure the SHORT data for calculating the setup data.

Step 5. When the message “Connect the 16454A to the 7mm port and press 'Continue'.” is displayed, connect the 16454A to the 42942A and press the **Continue** key.

Step 6. When the message “Start frequency [Hz] = ?” is displayed, enter the frequency at the sweep start point. In the same way, enter the frequency at the sweep end point, the sweep type, the signal source level, the number of measurement points, and the band width. When you have completed all entries, they are displayed followed by the message “Measurement condition is OK? 0:OK, 1:NO”. If you find no mistake, enter 0.

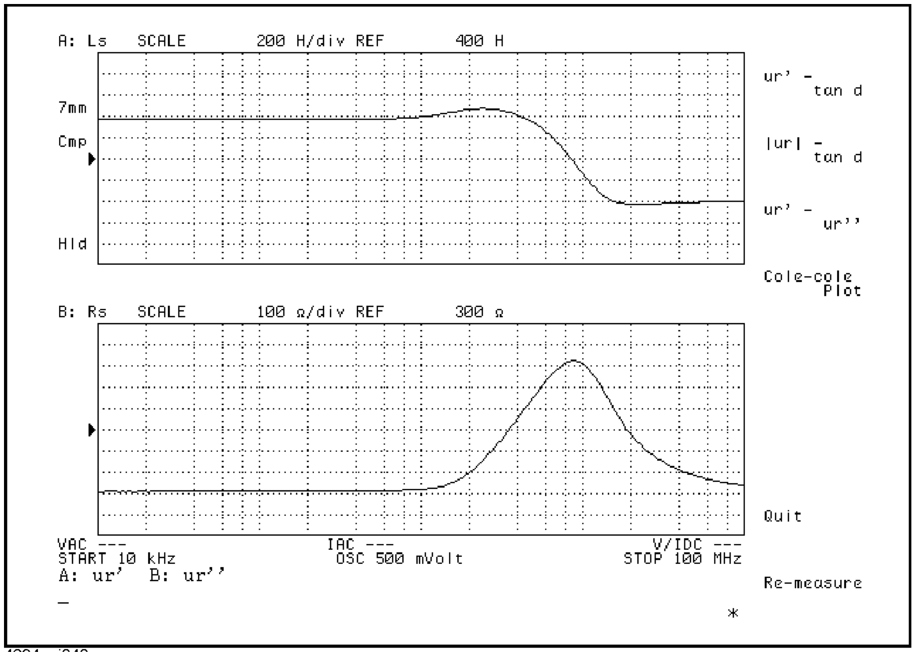
Step 7. When the message “Insert the MUT holder (without MUT) and press 'Continue'.” is displayed, make sure that only the holder is inserted into the 16454A and press the **Continue** key to measure the SHORT data for fixture compensation.

Step 8. When the message “Outer diameter of MUT [mm] = ?” is displayed, enter the outside diameter of the MUT. In the same way, enter the inside diameter and the height of the MUT.

Step 9. When the message “Insert MUT (with holder) into fixture and press 'Continue'.” is displayed, insert the MUT into the 16454A together with the holder and press the **Continue** key to measure the impedance.

Step 10. When the message “Select softkey to display each parameter.” is displayed, press the softkey for the parameter you want to display on the screen. Figure 13-5 shows an example of the screen display when selecting the real part (μ_r') and the imaginary part (μ_r'') of the complex relative permeability as displayed parameters. At this time, pressing the “Quit” softkey terminates the program and pressing the “Re-measure” softkey lets you repeat the procedure from Step 8.

Figure 13-5 **Example of the Result of Executing the Program of Example 13-4**



4294apj040

The program is described in detail below:

Lines 100 to 110 Sets the GPIB address and select code.

Lines 120 to 130 Assigns the upper half of the LCD screen to measurement result display and the lower half to the HP Instrument BASIC, and stops the sweep.

Line 150 Stores the permeability of vacuum into the U0 variable.

Lines 170 to 230 Displays the message at the start of the program.

Line 260 Passes control to a subroutine named Adapter_setup to set up the adapter.

Line 270 Passes control to a subroutine named Fixt_compen to execute fixture compensation.

Line 290 Passes control to a subroutine named Input_size to set the outside diameter, inside diameter, and height of the MUT.

Line 300 Passes control to a subroutine named Sweep to perform measurement.

Line 310 Passes control to a subroutine named Calc to calculate each parameter.

Line 320 Jumps to the Display line and displays each parameter.

Lines 350 to 860 The Adapter_setup subroutine.

Lines 360 to 420: Sets 42942A as the adapter and asks you if you want to perform adapter setup.

Lines 440 to 460: After reset, makes the setting to use SRQ.

Lines 480 to 500: After clearing the register, sets the branch destination for an SRQ interrupt, and enables the SRQ interrupt.

Lines 510 to 630: When you finish connecting OPEN and press the **Continue** key, measures phase and OPEN with the same connection.

Lines 640 to 810: Measures SHORT and LOAD in the same way.

Lines 820 to 850: Calculates the setup data and saves it into the nonvolatile memory.

Lines 880 to 1400 The Fixt_compen subroutine.

Lines 890 to 900: Waits until you connect the 16454A and press the **Continue** key.

Lines 920 to 970: Asks you if you want to execute fixture compensation.

Lines 1000 to 1220: Obtains the setting values (the sweep range, the sweep type, the signal source level, and the number of measurement points) from user input.

Lines 1240 to 1310: Sets up the measurement conditions.

Lines 1320 to 1370: After you finish the connection for SHORT measurement of the 16454A and press the **Continue** key, SHORT measurement is performed.

Lines 1420 to 1520 The Input_size subroutine. Sets the outside diameter, inside diameter, and height of the MUT from user input.

Lines 1540 to 1750 The Sweep subroutine.

Lines 1550 to 1560: Waits until you insert an MUT into the 16454A and press the **Continue** key.

Lines 1570 to 1630: Measures R and X.

Lines 1640 to 1720: Retrieves the measurement results and the frequency setting and stores them into the R_data, X_data, and Freq arrays.

Lines 1770 to 1920 The Calc subroutine. Using the R_data, X_data, and Freq arrays, calculates the complex relative permeability and the loss tangent.

Lines 1950 to 2040 Sets the softkey labels and the subroutines to be executed when each key is pressed. Then, waits until you press one of the softkeys.

Lines 2060 to 2270 Processing when the softkey labeled as “ur' - tan d” is pressed. Displays the real part of the complex relative permeability (μ_r') as trace A and the loss tangent as trace B.

Lines 2290 to 2500 Processing when the softkey labeled as “|ur| - tan d” is pressed. Displays the amplitude of the complex relative permeability ($\sqrt{\mu_r'^2 + \mu_r''^2}$) as trace A and the loss tangent as trace B.

Lines 2520 to 2730 Processing when the softkey labeled as “ur' - ur''” is pressed. Displays the real part of the complex relative permeability (μ_r') as trace A and the imaginary part of the complex relative permeability (μ_r'') as trace B.

Lines 2750 to 2880 Processing when the softkey labeled as “Cole-cole Plot” is pressed
Displays the COLE-COLE plot on the complex plane.

Lines 2900 to 3000 Processing when the softkey labeled as “Re-measure” is pressed.

Lines 3020 to 3120 Processing when the softkey labeled as “Quit” is pressed.

Example 13-4 **Magnetic Material (Relative Permeability) Measurement**

```
10    !**************************************************
20    !* 4294A + 16454A Permeability Measurement
30    !* Instrument BASIC Sample Program
40    !**************************************************
50    DIM R_data(1:801,1:2),X_data(1:801,1:2),Freq(1:801)
60    DIM Urr_data(1:801,1:2),Uri_data(1:801,1:2),Urm_data(1:801,1:2)
70    DIM Cole_data(1:801,1:2),Tan_d_data(1:801,1:2)
80    INTEGER Result
90    !
100   ASSIGN @Agt4294a TO 800
110   Scode=8
120   OUTPUT @Agt4294a;"DISA HIHB"
130   OUTPUT @Agt4294a;"HOLD"
140 Constants:   !
150   U0=1.257E-6
160   !########################################## Main
170 Disp_proc: !
180   CLEAR SCREEN
190   PRINT "4294A + 16454A Permeability Measurement Program"
200   PRINT ""
210   PRINT "[ ]    Perform the adapter setup (7mm)"
220   PRINT "[ ]    Perform fixture compensation"
230   PRINT "x: done, s: skip."
240   !
250 Adjustment: !
260   GOSUB Adapter_setup
270   GOSUB Fixt_compen
280 Meas:!
290   GOSUB Input_size
300   GOSUB Sweep
310   GOSUB Calc
320   GOTO Display
330   !
340   !########################################## Sub-routines
350 Adapter_setup: !
360   OUTPUT @Agt4294a;"E4TP APC7"
370   DISP "Perform the adapter setup?    0:Yes, 1:Skip";
380   INPUT "",Ans
390   IF Ans=1 THEN
400     PRINT TABXY(2,3);"s]    "
410     RETURN
420   END IF
430   F_adapt_setup=1
440   OUTPUT @Agt4294a;"PRES"
450   PRINT TABXY(5,3);"->"
460   OUTPUT @Agt4294a;"ESNB 256; *SRE 4"
470   !
480   OUTPUT @Agt4294a;"*CLS"
490   ON INTR Scode GOTO Phase_meas_end
500   ENABLE INTR Scode;2
510   DISP "Connect OPEN (0S) to the 7mm port and press 'Continue'."
520   PAUSE
530   DISP "Now measuring PHASE data..."
540   OUTPUT @Agt4294a;"ECALP"
550 Phase_meas_wait: GOTO Phase_meas_wait
```

```
560 Phase_meas_end: !
570   OUTPUT @Agt4294a;"*CLS"
580   ON INTR Scode GOTO Open_meas_end
590   ENABLE INTR Scode;2
600   DISP "Now measuring OPEN data..."
610   OUTPUT @Agt4294a;"ECALA"
620 Open_meas_wait: GOTO Open_meas_wait
630 Open_meas_end: !
640   OUTPUT @Agt4294a;"*CLS"
650   ON INTR Scode GOTO Short_meas_end
660   ENABLE INTR Scode;2
670   DISP "Connect SHORT (0-OHM) to the 7mm port and press 'Continue'."
680   PAUSE
690   DISP "Now measuring SHORT data..."
700   OUTPUT @Agt4294a;"ECALB"
710 Short_meas_wait: GOTO Short_meas_wait
720 Short_meas_end: !
730   OUTPUT @Agt4294a;"*CLS"
740   ON INTR Scode GOTO Load_meas_end
750   ENABLE INTR Scode;2
760   DISP "Connect LOAD (50-OHM) to the 7mm port and press 'Continue'."
770   PAUSE
780   DISP "Now measuring LOAD data..."
790   OUTPUT @Agt4294a;"ECALC"
800 Load_meas_wait: GOTO Load_meas_wait
810 Load_meas_end: !
820   DISP "Now storing setup data..."
830   OUTPUT @Agt4294a;"ECALDON"
840   DISP ""
850   PRINT TABXY(2,3);"x]   "
860   RETURN
870   !
880 Fixt_compen: !
890   DISP "Connect the 16454A to the 7mm port and press 'Continue'."
900   PAUSE
910   IF F_adapt_setup=0 THEN
920     DISP "Perform the fixture compensation?    0:Yes, 1:Skip";
930     INPUT "",Ans
940     IF Ans=1 THEN
950       PRINT TABXY(2,4);"s]   "
960       RETURN
970     END IF
980   END IF
990   PRINT TABXY(4,4);"->"
1000 Input_config:!
1010  DISP "Start frequency [Hz] = ?";
1020  INPUT "",Start
1030  DISP "Stop frequency [Hz] = ?";
1040  INPUT "",Stop
1050  DISP "Sweep type?   0:Linear, 1:Log";
1060  INPUT Ans
1070  IF Ans=1 THEN
1080    Swe_type$="LOG"
1090  ELSE
1100    Swe_type$="LIN"
1110  END IF
1120  DISP "OSC level [V] =?";
1130  INPUT "",Vosc
1140  DISP "Number of point?   [2-801]";
1150  INPUT Nop
1160  DISP "BW ?  [1-5]";
1170  INPUT Bw
1180  PRINT TABXY(1,10);"Start: ";Start;"[Hz]  Stop: ";Stop;"[Hz]";"
Nop: ";Nop
```

```
1190  PRINT TABXY(1,11);"Sweep Type: ";Swe_type$;"  OSC Level:
";Vosc;"[V]  BW: ";Bw;
1200  DISP "Measurement condition is OK?       0:OK, 1:NO";
1210  INPUT "",Ans
1220  IF Ans<>0 THEN Input_config
1230  !
1240  OUTPUT @Agt4294a;"CALP USER"
1250  OUTPUT @Agt4294a;"MEAS IRIM"
1260  OUTPUT @Agt4294a;"STAR ";Start
1270  OUTPUT @Agt4294a;"STOP ";Stop
1280  OUTPUT @Agt4294a;"SWPT ";Swe_type$
1290  OUTPUT @Agt4294a;"POIN ";Nop
1300  OUTPUT @Agt4294a;"BWFACT ";Bw
1310  OUTPUT @Agt4294a;"POWMOD VOLT;POWE ";Vosc
1320  DISP "Insert the MUT holder (without MUT) and press 'Continue'."
1330  PAUSE
1340  Result=FNUser_Corr(@Agt4294a,"Compen_Short")
1350  IF Result<>0 THEN Prog_end
1360  !
1370  !
1380  DISP ""
1390  PRINT TABXY(2,4);"x]    "
1400  RETURN
1410  !
1420 Input_size: !
1430  DISP "Outer diameter of MUT [mm] = ?";
1440  INPUT "",Ans
1450  C=Ans/1000
1460  DISP "Inner diameter of MUT [mm] = ?";
1470  INPUT "",Ans
1480  B=Ans/1000
1490  DISP "Height of MUT [mm] = ?";
1500  INPUT "",Ans
1510  H=Ans/1000
1520  RETURN
1530  !
1540 Sweep: !
1550  DISP "Insert MUT (with holder) into fixture and press 'Continue'."
1560  PAUSE
1570  OUTPUT @Agt4294a;"DISA BASS"
1580  OUTPUT @Agt4294a;"MEAS IRIM"
1590  OUTPUT @Agt4294a;"HIDI OFF"
1600  OUTPUT @Agt4294a;"SING"
1610  DISP "Now measuring R-X..."
1620  OUTPUT @Agt4294a;"*OPC?"
1630  ENTER @Agt4294a;Opc
1640  DISP "Now getting data..."
1650  OUTPUT @Agt4294a;"TRAC A"
1660  OUTPUT @Agt4294a;"AUTO"
1670  OUTPUT @Agt4294a;"OUTPDTRC?"
1680  ENTER @Agt4294a USING "%,K";R_data(*)
1690  OUTPUT @Agt4294a;"TRAC B"
1700  OUTPUT @Agt4294a;"AUTO"
1710  OUTPUT @Agt4294a;"OUTPDTRC?"
1720  ENTER @Agt4294a USING "%,K";X_data(*)
1730  OUTPUT @Agt4294a;"OUTPSWPRM?"
1740  ENTER @Agt4294a USING "%,K";Freq(*)
1750  RETURN
1760  !
1770 Calc: !
1780  OUTPUT @Agt4294a;"POIN?"
1790  ENTER @Agt4294a;Nop
1800  FOR I=1 TO Nop
1810    Urr_data(I,1)=(X_data(I,1)/(Freq(I)*U0*H*LOG(C/B)))+1
```

```
1820    Urr_data(I,2)=0
1830    Uri_data(I,1)=R_data(I,1)/(Freq(I)*U0*H*LOG(C/B))
1840    Uri_data(I,2)=0
1850    Tan_d_data(I,1)=Uri_data(I,1)/ABS(Urr_data(I,1))
1860    Tan_d_data(I,2)=0
1870    Urm_data(I,1)=SQR(Urr_data(I,1)^2+Uri_data(I,1)^2)
1880    Urm_data(I,2)=0
1890    Cole_data(I,1)=Urr_data(I,1)
1900    Cole_data(I,2)=Uri_data(I,1)
1910  NEXT I
1920  RETURN
1930  !
1940 Display: !
1950  ON KEY 1 LABEL "ur' -          tan d",1 GOSUB Disp_ur_d
1960  ON KEY 2 LABEL "|ur| -         tan d",1 GOSUB Disp_um_d
1970  ON KEY 3 LABEL "ur' -           ur''",1 GOSUB Disp_ur_ui
1980  ON KEY 4 LABEL "Cole-cole       Plot",1 GOSUB Disp_cole
1990  ON KEY 7 LABEL "Quit",1 GOTO Quit
2000  ON KEY 8 LABEL "Re-measure",1 GOTO Re_meas
2010  OUTPUT @Agt4294a;"USKEY"
2020  BEEP
2030  DISP "Select softkey to display each parameter."
2040 Loop: GOTO Loop
2050  !
2060 Disp_ur_d: !
2070  DISP "Now loading data..."
2080  OUTPUT @Agt4294a;"MEAS IMD"
2090  OUTPUT @Agt4294a;"HIDI OFF;SPLD ON"
2100  OUTPUT @Agt4294a;"TRAC A"
2110  OUTPUT @Agt4294a;"INPUDTRC ";
2120  FOR I=1 TO Nop
2130    OUTPUT @Agt4294a;Urr_data(I,1),Urr_data(I,2);
2140  NEXT I
2150  OUTPUT @Agt4294a;""
2160  OUTPUT @Agt4294a;"AUTO"
2170  OUTPUT @Agt4294a;"TRAC B"
2180  FOR I=1 TO Nop
2190    OUTPUT @Agt4294a;"INPUDTRC ";
2200    OUTPUT @Agt4294a;Tan_d_data(I,1),Tan_d_data(I,2);
2210  NEXT I
2220  OUTPUT @Agt4294a;""
2230  OUTPUT @Agt4294a;"AUTO"
2240  OUTPUT @Agt4294a;"TRAC A"
2250  BEEP
2260  DISP "A: ur'  B: tan d "
2270  RETURN
2280  !
2290 Disp_um_d: !
2300  DISP "Now loading data..."
2310  OUTPUT @Agt4294a;"MEAS IMD"
2320  OUTPUT @Agt4294a;"HIDI OFF;SPLD ON"
2330  OUTPUT @Agt4294a;"TRAC A"
2340  OUTPUT @Agt4294a;"INPUDTRC ";
2350  FOR I=1 TO Nop
2360    OUTPUT @Agt4294a;Urm_data(I,1),Urm_data(I,2);
2370  NEXT I
2380  OUTPUT @Agt4294a;""
2390  OUTPUT @Agt4294a;"AUTO"
2400  OUTPUT @Agt4294a;"TRAC B"
2410  FOR I=1 TO Nop
2420    OUTPUT @Agt4294a;"INPUDTRC ";
2430    OUTPUT @Agt4294a;Tan_d_data(I,1),Tan_d_data(I,2);
2440  NEXT I
2450  OUTPUT @Agt4294a;""
```

```
2460  OUTPUT @Agt4294a;"AUTO"
2470  OUTPUT @Agt4294a;"TRAC A"
2480  BEEP
2490  DISP "A: |ur|  B: tan d "
2500  RETURN
2510  !
2520 Disp_ur_ui: !
2530  DISP "Now loading data..."
2540  OUTPUT @Agt4294a;"MEAS LSR"
2550  OUTPUT @Agt4294a;"HIDI OFF;SPLD ON"
2560  OUTPUT @Agt4294a;"TRAC A"
2570  OUTPUT @Agt4294a;"INPUDTRC ";
2580  FOR I=1 TO Nop
2590    OUTPUT @Agt4294a;Urr_data(I,1),Urr_data(I,2);
2600  NEXT I
2610  OUTPUT @Agt4294a;""
2620  OUTPUT @Agt4294a;"AUTO"
2630  OUTPUT @Agt4294a;"TRAC B"
2640  FOR I=1 TO Nop
2650    OUTPUT @Agt4294a;"INPUDTRC ";
2660    OUTPUT @Agt4294a;Uri_data(I,1),Uri_data(I,2);
2670  NEXT I
2680  OUTPUT @Agt4294a;""
2690  OUTPUT @Agt4294a;"AUTO"
2700  OUTPUT @Agt4294a;"TRAC A"
2710  BEEP
2720  DISP "A: ur'  B: ur''  "
2730  RETURN
2740  !
2750 Disp_cole: !
2760  DISP "Now loading data..."
2770  OUTPUT @Agt4294a;"MEAS COMP"
2780  OUTPUT @Agt4294a;"HIDI ON;SPLD OFF"
2790  OUTPUT @Agt4294a;"TRAC A"
2800  OUTPUT @Agt4294a;"INPUDTRC ";
2810  FOR I=1 TO Nop
2820    OUTPUT @Agt4294a;Cole_data(I,1),Cole_data(I,2);
2830  NEXT I
2840  OUTPUT @Agt4294a;""
2850  OUTPUT @Agt4294a;"AUTO"
2860  BEEP
2870  DISP "Cole-cole Plot"
2880  RETURN
2890  !
2900 Re_meas: !
2910  DISP "Measure once more?        0:Yes, 1:Cancel";
2920  INPUT "",Ans
2930  SELECT Ans
2940  CASE 0
2950    GOTO Meas
2960  CASE 1
2970    GOTO Display
2980  CASE ELSE
2990    GOTO Re_meas
3000  END SELECT
3010  !
3020 Quit: !
3030  DISP "Really quit the program?     0:Yes, 1:Cancel";
3040  INPUT "",Ans
3050  SELECT Ans
3060  CASE 0
3070    DISP "Bye."
3080  CASE 1
3090    GOTO Display
```

```
3100  CASE ELSE
3110    GOTO Quit
3120  END SELECT
3130 Prog_end: END
3140  !
3150  ! Correction Data Measurement Function
3160  !
3170  DEF FNUser_Corr(@Agt4294a,Type$)
3180   DIM Inp_char$[9],Err_mes$[50]
3190   INTEGER Err_no
3200   !
3210   OUTPUT @Agt4294a;"ESNB 256"
3220   OUTPUT @Agt4294a;"*SRE 4"
3230   OUTPUT @Agt4294a;"*CLS"
3240   !
3250    ON INTR 8 GOTO Meas_end
3260    ENABLE INTR 8;2
3270    SELECT Type$
3280     CASE "Adapter_Phase"
3290      OUTPUT @Agt4294a;"ECALP"
3300     CASE "Compen_Open"
3310      OUTPUT @Agt4294a;"COMA"
3320     CASE "Compen_Short"
3330      OUTPUT @Agt4294a;"COMB"
3340     CASE "Compen_Load"
3350      OUTPUT @Agt4294a;"COMC"
3360    END SELECT
3370    PRINT "Now measuring..."
3380 Meas_wait:  GOTO Meas_wait
3390 Meas_end:  !
3400    OUTPUT @Agt4294a;"OUTPERRO?"
3410    ENTER @Agt4294a;Err_no,Err_mes$
3420    IF Err_no=0 THEN
3430      PRINT Standard$&" Data Measurement Complete"
3440      RETURN 0
3450    ELSE
3460      PRINT "Error: "&Err_mes$
3470      PRINT "Program Interruption"
3480      OUTPUT @Agt4294a;"ECALQUI"
3490      RETURN -1
3500    END IF
3510  FNEND
```

Measurement controlling oscillator level

Example 13-5 shows a sample program of a measurement by correctly applying specified test signal level at DUT using the oscillator level monitor function. This program is stored on the sample program disk as the alc.bas file.

Connect the Agilent 16047E test fixture for lead parts to the Agilent 4294A, and then start this program. When “Set Open-Connection” appears, make the connection to measure data for open compensation, and press the **[y]** key and the **[Enter]** key. Then, when “Set Short-Connection” appears, perform the same operation to measure data for short compensation.

NOTE For how to use the 16047E, for example, the connection to measure data for open/short compensation, refer to its manual.

Then, when “Set DUT, then Push [Enter] key” appears, mount an DUT onto the test fixture, and then press the **[Enter]** key. A measurement is operated at each measurement point using the manual sweep function, and the measurement result is displayed (refer to Figure 13-6). At the each measurement, the oscillator level is controlled to apply the correct signal level at DUT. After the completion of measurements at all points, “Once more? [Y]es/[N]o” appears. If you want to measure the capacitor again or another DUT, press the **[y]** key and the **[Enter]** key to continue the measurement. If you want to finish the measurement, press a key other than the **[y]** key and the **[Enter]** key.

Lines 80 to 140	Identifies the external controller and Instrument BASIC and sets the GPIB address and the select code.
Lines 160 to 250	Substitutes the measurement conditions (adapter setting: NONE, measurement parameter: |Z|-θ, sweep type: LOG, sweep start value: 1 kHz, sweep stop value: 10 MHz, Number of measurement points: 21, trace A display format: logarithmic Y axis, trace B display format: linear Y axis, oscillator level mode: CURR, test signal level: 1 mA) into the variables: Adapter$, Meas_para$, Swp_type$, Start, Stop, Nop, Fmt_a$, Fmt_b$, Power_mode$ and Level, respectively.
Lines 260 to 270	Substitutes the limit of difference between test signal level and its monitor level (1%), and the maximum number of times to iterate a setting the oscillator level into the variables: Err_limit and Iteration (10 times), respectively.
Lines 290 to 300	Sets the adapter selection to Adapter$ and then triggers a reset.
Lines 310 to 350	Sets the measurement parameter to Meas_para$; the sweep type, Swp_type$; the sweep start point, Start; the sweep stop point, Stop, respectively.
Lines 390 to 400	Enables bit 8 (calibration/compensation data measurement completion) in the instrument event status register to use an SRQ and sets bit 2 in the service request enable register to 1.
Lines 410 to 440	Uses the FNFixt_comp subprogram to measure open/short data. If an error is detected after each measurement, stops the program. For the FNFixt_comp subprogram, refer to the description in Example 4-3 on page 65.

Lines 460 to 500 — Turns on the manual sweep function and the level monitor function, and sets the oscillator level mode to Power_mode$.

Lines 520 to 600 — According to the oscillator level mode, substitutes the command name for reading the level monitor value, the range (lower limit and upper limit) of level setting into the variables: Command$, Range_l, and Range_u, respectively.

Lines 640 to 650 — Prompts the user to connect a DUT, and waits for a press of the **[Enter]** key after the connection.

Lines 670 to 700 — Displays header for list of measurement results, and substitutes the format to display the measurement results into the variable: Img$.

Lines 720 — Sets the measurement point.

Lines 730 to 750 — Sets the initial setting to control the oscillator level.

Lines 760 to 880 — Until the difference between the test signal level (target) and the monitor level is less than the variable: Err_limit, iterates setting and monitoring, and updating the oscillator level. (maximum number of iteration times is the variable: Iteration.)

Lines 890 to 970 — Reads out the measurement results and displays them according to Img$.

Lines 990 to 1010 — Sets the trace A display format to Fmt_a$, and then executes the auto scale on trace A to automatically set the scale parameters so that waveforms fit on the screen.

Lines 1020 to 1040 — Sets the trace B display format to Fmt_b$, and then executes the auto scale on trace B to automatically set the scale parameters so that waveforms fit on the screen.

Lines 1060 to 1070 — Prompts the user to determine whether to perform a measurement again. If the **[y]** key and the **[Enter]** key are pressed, returns to the DUT connection part (line 570).

Example 13-5 **Measurement controlling oscillator level**

```
10      DIM Adapter$[9],Meas_para$[9],Pow_mode$[9],Swp_type$[9]
20      DIM Fmt_a$[9],Fmt_b$[9],Buff$[9],Inp_char$[9],Img$[50]
30      REAL Start,Stop,Level,Data_a(1:2),Data_b(1:2)
40      REAL Err_limit,Range_l,Range_u
50      INTEGER Scode,Nop,Iteration,Result
60      CLEAR SCREEN
70      !
80      IF SYSTEM$("SYSTEM ID")="HP4294A" THEN
90        ASSIGN @Hp4294a TO 800
100       Scode=8
110     ELSE
120       ASSIGN @Hp4294a TO 717
130       Scode=7
140     END IF
150     !
160     Adapter$="OFF"
170     Meas_para$="IMPH"
180     Swp_type$="LOG"
190     Start=1.0E+3
200     Stop=1.0E+7
210     Nop=21
220     Fmt_a$="LOGY"
```

```
230     Fmt_b$="LINY"
240     Pow_mode$="CURR"
250     Level=.001
260     Err_limit=1.0      ! Osc Level Error Limit: 1[%]
270     Iteration=10
280     !
290     OUTPUT @Hp4294a;"E4TP "&Adapter$
300     OUTPUT @Hp4294a;"PRES"
310     OUTPUT @Hp4294a;"MEAS "&Meas_para$
320     OUTPUT @Hp4294a;"SWPT "&Swp_type$
330     OUTPUT @Hp4294a;"STAR ";Start
340     OUTPUT @Hp4294a;"STOP ";Stop
350     OUTPUT @Hp4294a;"POIN ";Nop
360     !
370     ! Fixture Compensation (Open/Short)
380     !
390     OUTPUT @Hp4294a;"ESNB 256"
400     OUTPUT @Hp4294a;"*SRE 4"
410     Result=FNFixt_comp(@Hp4294a,Scode,"Open")
420     IF Result<>0 THEN Prog_end
430     Result=FNFixt_comp(@Hp4294a,Scode,"Short")
440     IF Result<>0 THEN Prog_end
450     !
460     OUTPUT @Hp4294a;"MANS ON"
470     OUTPUT @Hp4294a;"POWMOD ";Pow_mode$
480     OUTPUT @Hp4294a;"OMON ON"
490     OUTPUT @Hp4294a;"*OPC?"
500     ENTER @Hp4294a;Buff$
510     !
520     IF Pow_mode$="VOLT" THEN
530       Command$="OUTPVACP? "
540       Range_l=.005
550       Range_u=1.0
560     ELSE
570       Command$="OUTPIACP? "
580       Range_l=.0002
590       Range_u=.02
600     END IF
610     !
620 Meas_start: !
630     !
640     PRINT "Set DUT, then Push [Enter] key"
650     INPUT "",Inp_char$
660     !
670     PRINT ""
680     PRINT "  #############  Measurement Result  #############"
690     PRINT "  Frequency   Monitor: "&Pow_mode$&"    Trace A     Trace B"
700     Img$="MD.5DE,2X,MD.4DE,4X,MD.4DE,X,MD.4DE"
710     FOR I=1 TO Nop
720       OUTPUT @Hp4294a;"MANP ";I
730       Set_lvl=Level
740       Count=0
750       Err=100.0
760       WHILE Count<Iteration AND ABS(Err)>Err_limit
770         OUTPUT @Hp4294a;"POWE ";Set_lvl
780         OUTPUT @Hp4294a;"SING"
790         OUTPUT @Hp4294a;"*OPC?"
800         ENTER @Hp4294a;Buff$
810         OUTPUT @Hp4294a;Command$;I
820         ENTER @Hp4294a;Mon_lvl
830         Err=(Level-Mon_lvl)/Level*100
840         Set_lvl=Level*(Set_lvl/Mon_lvl)
850         IF Set_lvl<Range_l THEN Set_lvl=Range_l
860         IF Set_lvl>Range_u THEN Set_lvl=Range_u
```

```
870        Count=Count+1
880      END WHILE
890      OUTPUT @Hp4294a;"TRAC A"
900      OUTPUT @Hp4294a;"OUTPDTRCP? ";I
910      ENTER @Hp4294a;Data_a(1),Data_a(2)
920      OUTPUT @Hp4294a;"TRAC B"
930      OUTPUT @Hp4294a;"OUTPDTRCP? ";I
940      ENTER @Hp4294a;Data_b(1),Data_b(2)
950      OUTPUT @Hp4294a;"OUTPSWPRMP? ";I
960      ENTER @Hp4294a;Swp_para
970      PRINT USING Img$;Swp_para,Mon_lvl,Data_a(1),Data_b(1)
980    NEXT I
990    OUTPUT @Hp4294a;"TRAC A"
1000   OUTPUT @Hp4294a;"FMT "&Fmt_a$
1010   OUTPUT @Hp4294a;"AUTO"
1020   OUTPUT @Hp4294a;"TRAC B"
1030   OUTPUT @Hp4294a;"FMT "&Fmt_b$
1040   OUTPUT @Hp4294a;"AUTO"
1050   !
1060   INPUT "Once more? [Y]es/[N]o",Inp_char$
1070   IF UPC$(Inp_char$)="Y" OR UPC$(Inp_char$)="YES" THEN Meas_start
1080 Prog_end:!
1090   END
1100   !
1110   ! Fixture Compensation Data Measurement Function
1120   !
1130 DEF FNFixt_comp(@Hp4294a,INTEGER Scode,Standard$)
1140   DIM Inp_char$[9],Err_mes$[50]
1150   INTEGER Err_no
1160   OUTPUT @Hp4294a;"*CLS"
1170   PRINT "Set "&Standard$&"-Connection"
1180   INPUT "OK? [Y/N]",Inp_char$
1190   IF UPC$(Inp_char$)="Y" THEN
1200     ON INTR Scode GOTO Meas_end
1210     ENABLE INTR Scode;2
1220     SELECT Standard$
1230       CASE "Open"
1240         OUTPUT @Hp4294a;"COMA"
1250       CASE "Short"
1260         OUTPUT @Hp4294a;"COMB"
1270       CASE "Load"
1280         OUTPUT @Hp4294a;"COMC"
1290     END SELECT
1300     PRINT "Now measuring..."
1310 Meas_wait: GOTO Meas_wait
1320 Meas_end: !
1330     PRINT Standard$&" Data Measurement Complete"
1340     RETURN 0
1350   ELSE
1360     PRINT "Program Interruption"
1370     RETURN -1
1380   END IF
1390 FNEND
```

Figure 13-6 **An example of the output at the execution of the program in Example 13-5**

```
 #############  Measurement Result  #############
 Frequency   Monitor: CURR    Trace A     Trace B
1.00000E+03   1.0051E-03     5.7868E-01  1.7915E+02
1.58489E+03   1.0021E-03     5.7978E-01  1.7871E+02
2.51189E+03   1.0014E-03     5.8124E-01  1.7816E+02
3.98107E+03   9.9914E-04     5.8055E-01  1.7681E+02
6.30957E+03   1.0075E-03     5.7941E-01  1.7607E+02
1.00000E+04   9.9661E-04     5.8421E-01  1.7353E+02
1.58489E+04   9.9532E-04     5.9138E-01  1.6945E+02
2.51189E+04   9.9565E-04     6.0615E-01  1.6341E+02
3.98107E+04   9.9705E-04     6.3609E-01  1.5481E+02
6.30957E+04   9.9976E-04     7.1339E-01  1.4395E+02
1.00000E+05   1.0039E-03     8.7667E-01  1.3063E+02
1.58489E+05   9.9645E-04     1.2035E+00  1.1840E+02
2.51189E+05   9.9707E-04     1.7492E+00  1.0860E+02
3.98107E+05   9.9899E-04     2.6883E+00  1.0159E+02
6.30957E+05   1.0027E-03     4.1729E+00  9.6967E+01
1.00000E+06   9.9993E-04     6.5710E+00  9.4055E+01
1.58489E+06   9.9788E-04     1.0369E+01  9.2241E+01
2.51189E+06   1.0034E-03     1.6376E+01  9.1094E+01
3.98107E+06   9.9963E-04     2.5871E+01  9.0381E+01
6.30957E+06   1.0015E-03     4.0942E+01  8.9965E+01
1.00000E+07   9.9141E-04     6.4823E+01  8.9751E+01
```

Measurement using scanner

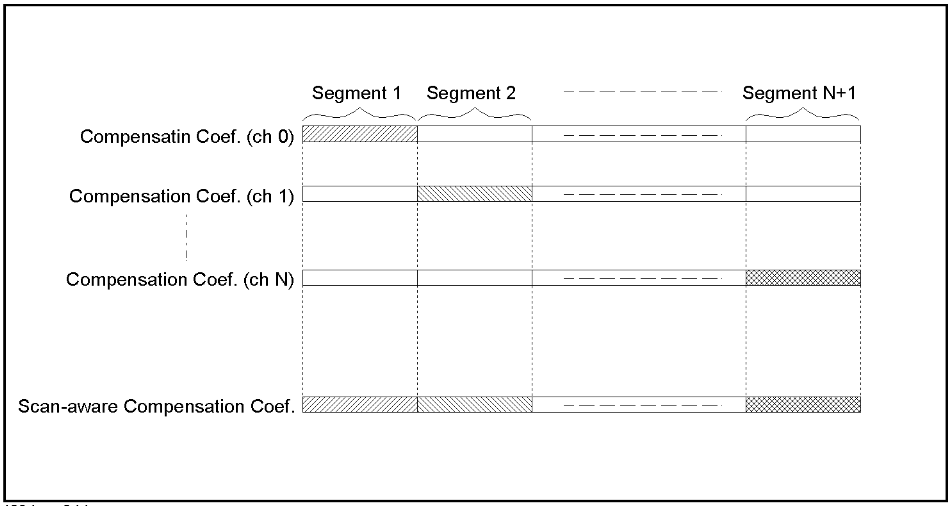
To perform measurement using the scanner while switching differnet channels, compensation for each channel must have been done. The 4294A lets you perform measurement while scanning channels, by making the connection as shown in 4294A and using functions including the list sweep, reading/writing compensation coefficients, and the manual sweep.

When performing measurement while scanning channels, you repeat the procedure "specifying a sweep segment using the manual sweep function → changing channels → measuring impedance." To make accurate measurement, you need to measure data for each channel and calculate its compensation coefficient.

To create the compensation coefficient for changing channels, execute the fixture compensation for each channel, read out compensation coefficients, and combine necessary part of them. An example is shown below.

Table 13-7 shows a schematic view of creating the scan-aware compensation coefficient. N+1 channels from 0 through N are used. Set the list sweep table so that the sweep condition for channel n corresponds to segment n+1. Execute the fixture compensation for channel 0 and read out the created compensation coefficient. The fixture compensation is performed for all segments; substitute the part of the read out compensation coefficient that corresponds to segment 1 into the part of the scan-aware compensation coefficient that corresponds to segment 1. For the other channels, perform the substitute operation from the fixture compensation to the scan-aware compensation coefficient. Finally, write the created compensation coefficient into the 4294A to bring the scan-aware compensation coefficient to take effect.

Figure 13-7 **Example of creating scan-aware compensation coefficient**



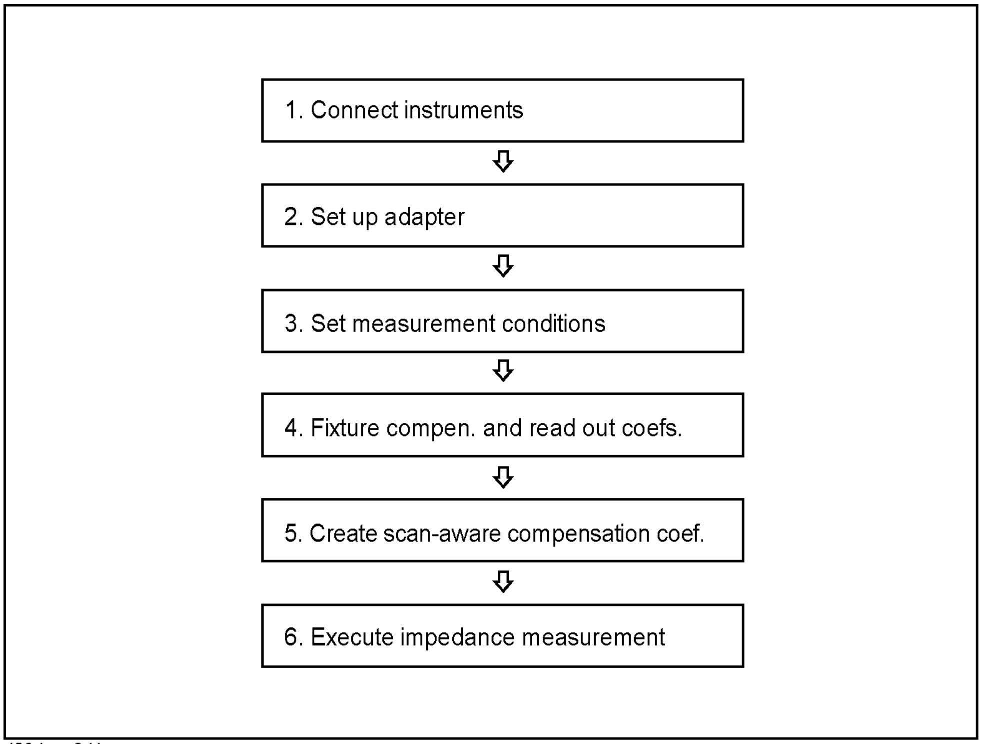
4294ape044

Measurement procedure

This section describes how to perform measurement while scanning 4 channels, using the 4294A, the Agilent 3499A Switch/Control System, and two 44472A Dual 1×4 RF Multiplexer Modules.

Figure 13-8 shows the flow of measurement with scanning.

Figure 13-8 **Scanning measurement flow**

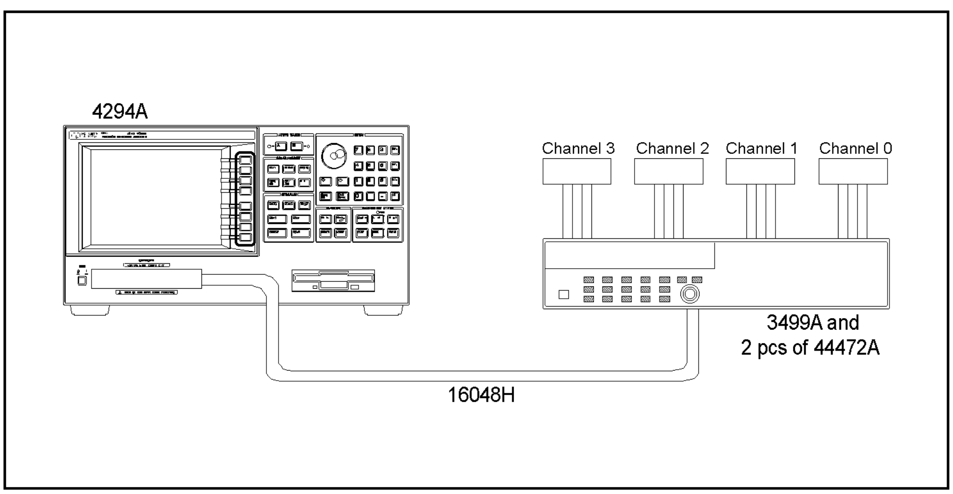


4294ape041

Step 1. Connecting the instruments

Connect the instruments as shown in Figure 13-9.

Figure 13-9 **Connection between 4294A and 3499A**

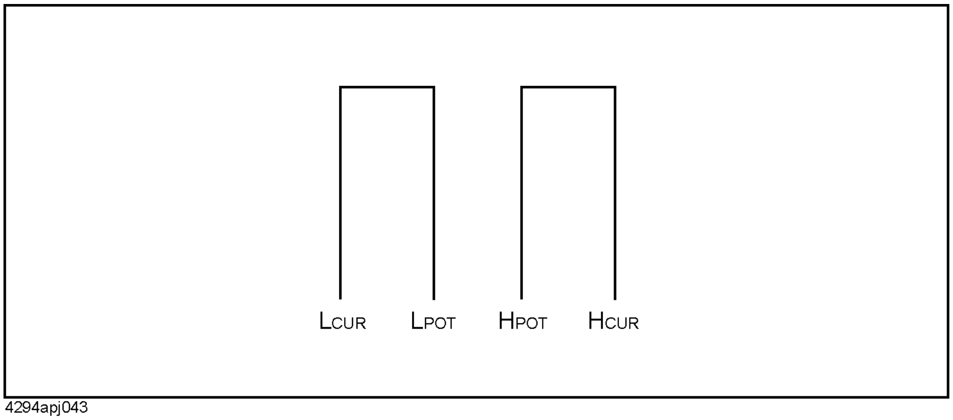


4294ape042

Step 2. Setting up the adapter

Select **4TP 2M** as the adapter and perform setup. Only the phase compensation is performed here. Because the phase compensation is common to all the channels, perform it for one channel. For the phase compensation, you need to bring the measurement terminal into the open state as shown in Figure 13-10.

Figure 13-10 **Open state**



Step 3. Setting the measurement conditions

Set the list sweep table. Set the sweep condition for each channel for each segment. In this sample program, the sweep conditions from channels 0 through 3 are assigned to segments 1 through 4.

Step 4. Reading out the compensation coefficient of the fixture compensation

For each channel, perform the open, short and load fixture compensations. For the load compensation, use a working standard whose value is known. Data measurement for the compensation coefficient is performed for all segments. After calculating the compensation coefficient, read out the compensation coefficient for each channel.

Step 5. Creating the scan-aware compensation coefficient

From the compensation coefficient array read out in Step 4, combine the segments that correspond to individual channels to create the scan-aware compensation coefficient.

Step 6. Executing impedance measurement

Change the sweep range of the manual sweep and the channels and perform impedance measurement for the multiple channels.

Sample program

Example 13-6 shows a sample measurement program assuming that it is used in a scanning system (4 channels). This program is stored in the sample program disk as scan.bas.

Lines 70 to 170 Identifies the external controller and Instrument BASIC and sets the GPIB address and select code.

Lines 200 to 230 Prepares data for the list sweep table using DATA statements. Segments correspond to channels 0 to 3 from the top.

Lines 250 to 300 Assigns the measurement conditions (adapter setting: 2-m test lead, measurement parameter: |Z|-q, sweep type: LIST, oscillator power level setting unit: VOLT, and DC bias setting unit: VOLT) into the variables Adapter$, Meas_para$, Swp_type$, Pow_mod$, and Dc_mod$, respectively.

Lines 340 to 370 Performs setting the 3499A. Make setting so that the system mode is 3488A mode, modules 1 and 2 are coupled, and channel 0 is closed.

Lines 410 to 450 Performs setting to set up the adapter. After preset, in order to use SRQ, enables the instrument event status register's bit 8 (calibration/compensation data measurement completion) and sets the service request enable register's bit 2 to 1.

Lines 460 to 500 Displays the message to prompt the user to bring channel 0 to the open state and then, using the subprogram FNSetup_4tp, measures the phase compensation data. The subprogram FNSetup_4tp will be described later.

Lines 540 to 560 Sets the measurement parameter to Meas_para$, the oscillator power level setting unit to Pow_mod$, and the DC bias setting unit to Dc_mod$, respectively.

Lines 570 to 740 Reads data from the DATA statements and creates the list sweep table. In this block, enters the position of the measurement point at the end of each segment to Point (n). Enters 0 to Point(0) to use it later for creating the compensation coefficient and setting the manual sweep range. After creating the list sweep table, sets the sweep mode to the list sweep.

Lines 780 to 790 Defines the compensation coefficient array variables: Open, Short, Load, and Temp. Temp is used temporarily to store the compensation coefficient read out from the 4294A. Because the compensation coefficient is a complex number, the array size is 2 times the total number of measurement points.

Lines 800 to 810 Sets the readout format for compensation coefficient to IEEE64-bit. Then, makes setting so that the measurement points at which the compensation data is measured are the points that the user has specified.

Line 850 Sets the switches of the 3499A to scan the channel.

Lines 860 to 880 Displays the connected channel and, using the subprogram FNFixt_comp, measures the open data. For information on the subprogram FNFixt_comp, see the description in Example 4-3 on page 65.

Lines 890 to 920 Reads out the open compensation coefficient calculated from the measurement data from the 4294A and enters it to the variable Temp.

Lines 930 to 960 Enters the sweep range for the channel from the variable Temp to Open. In this sample, the segment number for a channel is larger than the channel number by 1. For example, the sweep range for channel 0 is the sweep range of segment 1.

Lines 1000 to 1150 Performs the short compensation in the same way as the open compensation and creates the multiple channel support compensation coefficient.

Lines 1180 to 1190 Enters the load values used for the load compensation. In this sample, R:100 Ω and L:0 nH are set.

Lines 1200 to 1340 Performs the load compensation in the same way as the open compensation and creates the multiple channel support compensation coefficient.

Lines 1380 to 1430 Enters the created compensation coefficient to the 4294A.

Lines 1470 to 1480 Sets the trigger source to the internal trigger and stops the sweep.

Lines 1520 to 1530 In order to use SRQ, enables the instrument event status register's bit 1 (sweep completion) and sets the service request enable register's bit 2 to 1.

Lines 1590 to 1670 Starts the impedance measurement. Displays the message to prompt the user to connect DUTs to all channels.

Line 1680 Enables the manual sweep function.

Lines 1700 to 1710 Changes the switches of the 3499A to change the channel. A wait time is provided so that measurement does not start before switching is complete.

Lines 1720 to 1760 Enables service request interrupts.

Lines 1770 to 1780 Sets the manual sweep range and performs a sweep.

Lines 1920 to 2200 The subprogram to perform the fixture compensation. For more information, see the description in Example 4-3 on page 65.

Lines 2240 to 2500 The subprogram to set up the 4-terminal pair cable. Its details are as follows.

Line 2220

Clears the status byte register and the instrument event status register.

Lines 2230 to 2240

Displays the message that prompts the user to make connection for the measurement specified with Standart$ and waits for pressing the y key and the return key after the connection.

Lines 2260 to 2270

Sets the branch destination in response to SRQ interrupts and enables SRQ interrupts.

Lines 2290 to 2340

Sends the command to execute the measurement of the standard specified with Standard$.

Line 2350

Waits for completion of the measurement.

Lines 2370 to 2380

Displays the message indicating completion of the measurement and returns 0 as the return value from the subprogram.

Lines 2400 to 2410

The processing when a key other than the y key is pressed. Returns –1 as the return value form the subprogram.

Example 13-6 **Measurement with channel switching (scanning)**

```
10    DIM Adapter$[9],Meas_para$[5],Swp_type$[9]
20    DIM Fmt_a$[9],Fmt_b$[9],Start$[9],Stop$[9],Nop$[5],Osc$[9]
30    DIM Bias$[9],Bw$[5],Avg$[5],Header$[9],Buff$[9]
40    INTEGER Max_chan,Point(4),Scode,I,J,Opc
50    CLEAR SCREEN
60    !
70    IF SYSTEM$("SYSTEM ID")="HP4294A" THEN
80      ASSIGN @Agt4294a TO 800
90      ASSIGN @Binary TO 800;FORMAT OFF
100     ASSIGN @Agt3499a TO 809
110     Scode=8
120   ELSE
130     ASSIGN @Agt4294a TO 717
140     ASSIGN @Binary TO 717;FORMAT OFF
150     ASSIGN @Agt3499a TO 709
160     Scode=7
170   END IF
180   !
190   !    Start      Stop       NOP    OSC     BIAS  BW    AVG
200   DATA "100KHZ" , "200KHZ" , "21" , "0.5" , "0" , "2" , "1"
210   DATA "100KHZ" , "200KHZ" , "21" , "0.5" , "0" , "2" , "1"
220   DATA "100KHZ" , "500KHZ" , "81" , "0.5" , "0" , "2" , "1"
230   DATA "500KHZ" , "600KHZ" , "21" , "0.5" , "0" , "2" , "1"
240   !
250   Max_chan=3
260   Adapter$="M2"
270   Meas_para$="IMPH"
280   Swp_type$="LIST"
290   Pow_mod$="VOLT"
300   Dc_mod$="VOLT"
310   !
320   ! 3499A Setting
330   !
340   OUTPUT @Agt3499a;"SYSMODE HP3488A"
350   OUTPUT @Agt3499a;"RESET"
360   OUTPUT @Agt3499a;"CPAIR 1,2"
370   OUTPUT @Agt3499a;"CLOSE 100,110"
380   !
390   ! Adapter Setup
400   !
410   CLEAR SCREEN
420   OUTPUT @Agt4294a;"PRES"
430   OUTPUT @Agt4294a;"ESNB 256"
440   OUTPUT @Agt4294a;"*SRE 4"
450   OUTPUT @Agt4294a;"E4TP "&Adapter$
460   PRINT "##### Adapter Setup #####"
470   PRINT "Channel 0 is activated."
480   Result=FNSetup_4tp(@Agt4294a,Scode,"Open")
490   IF Result<>0 THEN Prog_end
500   OUTPUT @Agt4294a;"ECALDON"
510   !
520   ! 4294A Setting
530   !
540   OUTPUT @Agt4294a;"MEAS "&Meas_para$
550   OUTPUT @Agt4294a;"POWMOD "&Pow_mod$
560   OUTPUT @Agt4294a;"DCMOD "&Dc_mod$
```

```
570   OUTPUT @Agt4294a;"EDITLIST"
580   Point(0)=0
590   FOR I=0 TO Max_chan
600     READ Start$,Stop$,Nop$,Osc$,Bias$,Bw$,Avg$
610     Point(I+1)=Point(I)+IVAL(Nop$,10)
620     OUTPUT @Agt4294a;"SADD"
630     OUTPUT @Agt4294a;"MEAS "&Meas_para$
640     OUTPUT @Agt4294a;"STAR "&Start$
650     OUTPUT @Agt4294a;"STOP "&Stop$
660     OUTPUT @Agt4294a;"POIN "&Nop$
670     OUTPUT @Agt4294a;"BWFACT "&Bw$
680     OUTPUT @Agt4294a;"POWE "&Osc$
690     OUTPUT @Agt4294a;"DCV "&Bias$
700     OUTPUT @Agt4294a;"PAVERFACT "&Avg$
710     OUTPUT @Agt4294a;"SDON"
720   NEXT I
730   OUTPUT @Agt4294a;"EDITDONE"
740   OUTPUT @Agt4294a;"SWPT "&Swp_type$
750   !
760   ! Compensation
770   !
780   ALLOCATE
Open(1:Point(Max_chan+1),1:2),Short(1:Point(Max_chan+1),1:2)
790   ALLOCATE
Load(1:Point(Max_chan+1),1:2),Temp(1:Point(Max_chan+1),1:2)
800   OUTPUT @Agt4294a;"FORM3"
810   OUTPUT @Agt4294a;"CALP USER"
820   CLEAR SCREEN
830   PRINT "##### Open Compensation #####"
840   FOR I=0 TO Max_chan
850     OUTPUT @Agt3499a;"CLOSE 10"&VAL$(I)&",11"&VAL$(I)
860     PRINT "Channel "&VAL$(I)&" is activated."
870     Result=FNFixt_comp(@Agt4294a,Scode,"Open")
880     IF Result<>0 THEN Prog_end
890     OUTPUT @Agt4294a;"OUTPCOMC1?"
900     ENTER @Agt4294a USING "#,8A";Header$
910     ENTER @Binary;Temp(*)
920     ENTER @Agt4294a USING "#,1A";Buff$
930     FOR J=Point(I)+1 TO Point(I+1)
940       Open(J,1)=Temp(J,1)
950       Open(J,2)=Temp(J,2)
960     NEXT J
970     PRINT
980   NEXT I
990   CLEAR SCREEN
1000  PRINT "##### Short Compensation #####"
1010  FOR I=0 TO Max_chan
1020    OUTPUT @Agt3499a;"CLOSE 10"&VAL$(I)&",11"&VAL$(I)
1030    PRINT "Channel "&VAL$(I)&" is activated."
1040    Result=FNFixt_comp(@Agt4294a,Scode,"Short")
1050    IF Result<>0 THEN Prog_end
1060    OUTPUT @Agt4294a;"OUTPCOMC2?"
1070    ENTER @Agt4294a USING "#,8A";Header$
1080    ENTER @Binary;Temp(*)
1090    ENTER @Agt4294a USING "#,1A";Buff$
1100    FOR J=Point(I)+1 TO Point(I+1)
1110      Short(J,1)=Temp(J,1)
1120      Short(J,2)=Temp(J,2)
```

```
1130     NEXT J
1140     PRINT
1150   NEXT I
1160   CLEAR SCREEN
1170   PRINT "##### Load Compensation #####"
1180   OUTPUT @Agt4294a;"DCOMLOADR 100OHM"
1190   OUTPUT @Agt4294a;"DCOMLOADL 0H"
1200   FOR I=0 TO Max_chan
1210     OUTPUT @Agt3499a;"CLOSE 10"&VAL$(I)&",11"&VAL$(I)
1220     PRINT "Channel "&VAL$(I)&" is activated."
1230     Result=FNFixt_comp(@Agt4294a,Scode,"Load")
1240     IF Result<>0 THEN Prog_end
1250     OUTPUT @Agt4294a;"OUTPCOMC3?"
1260     ENTER @Agt4294a USING "#,8A";Header$
1270     ENTER @Binary;Temp(*)
1280     ENTER @Agt4294a USING "#,1A";Buff$
1290     FOR J=Point(I)+1 TO Point(I+1)
1300       Load(J,1)=Temp(J,1)
1310       Load(J,2)=Temp(J,2)
1320     NEXT J
1330     PRINT
1340   NEXT I
1350   !
1360   ! Make new compensation coefficients
1370   !
1380   OUTPUT @Agt4294a;"INPUCOMC1 "&Header$;
1390   OUTPUT @Binary;Open(*),END
1400   OUTPUT @Agt4294a;"INPUCOMC2 "&Header$;
1410   OUTPUT @Binary;Short(*),END
1420   OUTPUT @Agt4294a;"INPUCOMC3 "&Header$;
1430   OUTPUT @Binary;Load(*),END
1440   !
1450   ! Trigger Setting
1460   !
1470   OUTPUT @Agt4294a;"TRGS INT"
1480   OUTPUT @Agt4294a;"HOLD"
1490   !
1500   ! SRQ Setting
1510   !
1520   OUTPUT @Agt4294a;"ESNB 1"
1530   OUTPUT @Agt4294a;"*SRE 4"
1540   !
1550   ! Measuring DUT
1560   !
1570   CLEAR SCREEN
1580   PRINT "##### DUT Measurement #####"
1590   ON ERROR GOTO Dut_meas_start
1600   Dut_meas_start
1610   PRINT "Set DUTs for All Channels."
1620   INPUT "OK? [Y/N]",Buff$
1630   OFF ERROR
1640   IF UPC$(Buff$)<>"Y" THEN
1650     PRINT "Program Interruption"
1660     GOTO Prog_end
1670   END IF
1680   OUTPUT @Agt4294a;"MANS ON"
1690   FOR I=0 TO Max_chan
1700     OUTPUT @Agt3499a;"CLOSE 10"&VAL$(I)&",11"&VAL$(I)
```

```
1710    WAIT .2
1720    OUTPUT @Agt4294a;"*CLS"
1730    OUTPUT @Agt4294a;"*OPC?"
1740    ENTER @Agt4294a;Opc
1750    ON INTR 7 GOTO Sweep_end
1760    ENABLE INTR 7;2
1770    OUTPUT @Agt4294a;"MANR
"&VAL$(Point(I)+1)&","&VAL$(Point(I+1))
1780    OUTPUT @Agt4294a;"SING"
1790    PRINT "Measuring Channel ";VAL$(I)
1800 Sweep_wait: GOTO Sweep_wait
1810 Sweep_end: OFF INTR 7
1820  NEXT I
1830  OUTPUT @Agt3499a;"RESET"
1840  !
1850  PRINT "Measurement Completed"
1860  !
1870 Prog_end: !
1880  END
1890  !
1900  ! Fixture Compensation Data Measurement Function
1910  !
1920  DEF FNFixt_comp(@Agt4294a,INTEGER Scode,Standard$)
1930    DIM Inp_char$[9]
1940    OUTPUT @Agt4294a;"*CLS"
1950    ON ERROR GOTO Conpen_start
1960 Compen_start:   !
1970    PRINT "Set "&Standard$&"-Connection"
1980    INPUT "OK? [Y/N]",Inp_char$
1990    OFF ERROR
2000    IF UPC$(Inp_char$)="Y" THEN
2010      ON INTR Scode GOTO Meas_end
2020      ENABLE INTR Scode;2
2030      SELECT Standard$
2040        CASE "Open"
2050          OUTPUT @Agt4294a;"COMA"
2060        CASE "Short"
2070          OUTPUT @Agt4294a;"COMB"
2080        CASE "Load"
2090          OUTPUT @Agt4294a;"COMC"
2100      END SELECT
2110      PRINT "Now measuring..."
2120 Meas_wait: GOTO Meas_wait
2130 Meas_end: !
2140      PRINT Standard$&" Data Measurement Complete"
2150      RETURN 0
2160    ELSE
2170      PRINT "Program Interruption"
2180      RETURN -1
2190    END IF
2200  FNEND
2210  !
2220  ! 4TP Setup Function
2230  !
2240  DEF FNSetup_4tp(@Agt4294a,INTEGER Scode,Standard$)
2250    DIM Inp_char$[9]
2260    OUTPUT @Agt4294a;"*CLS"
2270    ON ERROR GOTO Setup_start
```

```
2280 Setup_start:   !
2290    PRINT "Set "&Standard$&"-Connection"
2300    INPUT "OK? [Y/N]",Inp_char$
2310    OFF ERROR
2320    IF UPC$(Inp_char$)="Y" THEN
2330      ON INTR Scode GOTO Meas_end
2340      ENABLE INTR Scode;2
2350      PRINT "Now measuring..."
2360      SELECT Standard$
2370        CASE "Open"
2380          OUTPUT @Agt4294a;"ECALP"
2390        CASE "Load"
2400          OUTPUT @Agt4294a;"ECALC"
2410      END SELECT
2420 Meas_wait: GOTO Meas_wait
2430 Meas_end: !
2440      PRINT Standard$&" Data Measurement Complete"
2450      RETURN 0
2460    ELSE
2470      PRINT "Program Interruption"
2480      RETURN -1
2490    END IF
2500  FNEND
```

File Transfer Function

This section describes how to use the file transfer function, showing you a sample program.

The file transfer function uses the external controller to transfer files between the selected storage device of this instrument (RAM disk, flash disk or diskette) and an external storage device (such as hard disk). This function allows you to:

- Directly access data you want to use on the external controller.

  For example, you can transfer the files saved on the 4294A storage deveice, such as graphic files or data array (ASCII format) files, to the external controller. Then, you can output the graphic file transferred from a printer connected to the external controller, or manage the data array (ASCII format) trasferred using a software running on the external controller.

- Use external storage devices, which have larger capacity compared to RAM disk, flash disk or a diskette.

  For example, if there are a great number of measurement conditions which require calibration, the amount of the setting data becomes extremely large, including calibration data. In this case, it is impractical to store all of these settings on the RAM disk, flash disk or a single diskette at a time. However, you can realize this functionality by transferring them to the external controller and then storing them on an external storage device.

- Perform remote measurement using the external controller with a few GPIB commands for basic measurement. You do not have to memorize further details (such as GPIB commands used for detailed settings).

  1. Preparation

     Use the keys on the front panel to establish the setting required for your measurement. Store it on the storage device of the 4294A, then transfer the file to the external controller, and store it on an external storage device. Repeat this procedure for all of the settings required for your measurement.

  2. Measurement

     Choose a necessary setting file from those stored and transfer it to the 4294A using the external controller. Then, recall the file to set the 4294A for the measurement and perform the measurement using the GPIB commands.

The storage device of the 4294A allows you to handle files listed below in the DOS format. Both binary files and ASCII files can be transferred.

- Binary files

  - Instrument settings and internal data array (STATE)
  - Internal data arrays (DATA ONLY binary)
  - Graphic images (GRAPHICS)

- ASCII files

  - Internal data arrays (DATA ONLY ascii)
  - Instrument BASIC programs

File Transfer from 4294A to External Controller

This program transfers a specified file in the current directory (RAM disk in the sample program of Example 13-7) of the 4294A to the current directory of the storage device (A drive in the sample program of Example 13-7) connected to the external controller, giving a file name you desire.

When executed, this program first prompts you to enter a source file name, as shown below. Enter the name of a file you want to transfer.

```
ENTER SOURCE FILE NAME ON INSTRUMENT ?
```

Then, the program prompts you to enter a destination file name as shown below, and in this example, SAMPLE.STA has been entered as the source file name. Enter the file name you want to give on the storage device. Note that a file with the same name will be overwritten, if it already exists.

```
ENTER SOURCE FILE NAME ON INSTRUMENT ?         SAMPLE.STA
ENTER DESTINATION FILE NAME ON CONTROLLER ?
```

Example 13-7 **Sample Program: File Transfer from 4294A to External Controller**

```
10   !
20   !  File transfer (Instrument -> Controller)
30   !
40   DIM Src_file$[50],Dst_file$[50]
50   ASSIGN @Agt4294 TO 717
60   OUTPUT @Agt4294;"*rst"
70   !
80   MASS STORAGE IS "a:\"
90   OUTPUT @Agt4294;"STOD MEMO"
100  !
110  PRINT "  ENTER SOURCE FILE NAME ON INSTRUMENT ?         ";
120  INPUT Src_file$
130  PRINT Src_file$
140  !
150  PRINT "  ENTER DESTINATION FILE NAME ON CONTROLLER ?    ";
160  INPUT Dst_file$
170  PRINT Dst_file$
180  !
190  Copy_from_instr(@Agt4294,Src_file$,Dst_file$)
200  !
210  END
220  !
230  !  copy_from_instrument
240  !
250  SUB Copy_from_instr(@Agt4294,Src_file$,Dst_file$)
260      DIM Len$[6],Img$[32],Dmy$[2]
270      !
280      ON ERROR GOTO Skip_purge
290      PURGE Dst_file$
300 Skip_purge:  OFF ERROR
310      CREATE Dst_file$,1
320      ASSIGN @Dst_file TO Dst_file$
330      !
340      CLEAR @Agt4294
350      OUTPUT @Agt4294;"CLES"
360      OUTPUT @Agt4294;"ROPEN """;Src_file$;""""
370      IF FNCheck_error(@Agt4294,"<CPFI: ropen>")=-1 THEN SUBEXIT
```

```
380        !
390        LOOP
400            OUTPUT @Agt4294;"READ?"
410            ENTER @Agt4294 USING "#,2A";Dmy$
420            ENTER @Agt4294 USING "#,6A";Len$
430            Block_size=VAL(Len$)
440            !
450            IF Block_size=0 THEN
460                ENTER @Agt4294 USING "%,A";Dmy$
470                ASSIGN @Dst_file TO *
480                OUTPUT @Agt4294;"CLOSE"
490                SUBEXIT
500            END IF
510            !
520            ALLOCATE Dat$[Block_size]
530            Img$="#,"&VAL$(Block_size)&"A"
540            ENTER @Agt4294 USING Img$;Dat$
550            ENTER @Agt4294 USING "%,A";Dmy$
560            OUTPUT @Dst_file USING Img$;Dat$
570            DEALLOCATE Dat$
580            !
590           IF FNCheck_error(@Agt4294,"<CPFI: block read>")=-1 THEN
SUBEXIT
600        END LOOP
610    SUBEND
620    !
630    !  Instrument Error Check
640    !
650    DEF FNCheck_error(@Agt4294,Str$)
660        DIM Err$[64]
670        INTEGER Err_no
680        OUTPUT @Agt4294;"OUTPERRO?"
690        ENTER @Agt4294;Err_no,Err$
700        IF Err_no<>0 THEN
710            PRINT "ERROR: ";Str$;"   ";Err$
720            RETURN -1
730        ELSE
740            RETURN 0
750        END IF
760    FNEND
```

Lines 80 to 90	Set the current directory of the external controller to A drive and sets the current directory of the 4294A to the RAM disk. You can set the current directory of the 4294A to the internal flexible disk using the `STODDISK` command. The A drive in the external controller may not be detected under a certain environment of the external controller, so change the drive depending on the situation.
Lines 110 to 170	Accept the entry of the source file name and the destination file name.
Line 190	Calls the subprogram to transfer a file from the 4294A to the external controller.
Lines 280 to 320	Prepare for writing to the destination file.
Lines 340 to 370	Prepare for reading the source file to the external controller.
Line 400	Executes the query command to read data.
Lines 410 to 430	Read the part indicating the length of the fixed length block data (see

	Figure 16-7 on page 407 to obtain the length of the data to be transferred.
Lines 450 to 500	Check the data length. If the data length is 0, the transfer process is terminated.
Lines 530 to 550	Adjusts the format and reads the data part.
Line 560	Writes the data to the destination file. The maximum length of data transferred at a time is 16 Kbytes. Therefore, if the size of the source file is greater than 16 Kbytes, the transfer routine, lines 400 to 590, is repeated until transferring all of the data is completed.
Lines 650 to 760	Provide a function to check that no error has occurred in the 4294A.

File Transfer from External Controller to 4294A

This program transfers a specified file in the current directory of the storage device (A drive in the sample program of Example 13-8) connected to the external controller to the current directory of the selected storage device (RAM disk in the sample program of Example 13-8) of the 4294A, giving a file name you desire.

This program, when executed, first prompts you to enter a source file name, as shown below. Enter the name of a file you want to transfer. Note that the file name of the LIF format can be distinguished between capital and small letters.

```
ENTER SOURCE FILE NAME ON CONTROLLER ?
```

Then, the program prompts you to enter a destination file name as shown below, and in this example, SAMPLE.STA has been entered as the source file name. Enter the size correctly in bytes.

```
ENTER SOURCE FILE NAME ON CONTROLLER ?         SAMPLE.STA
ENTER SOURCE FILE SIZE ?
```

Then, the program prompts you to enter the destination file name, as shown below (in this example, the size of SAMPLE.STA is 12288 bytes). Enter the file name you want to give on the destination storage device. Note that a file with the same name will be overwritten, if it already exists.

```
ENTER SOURCE FILE NAME ON CONTROLLER ?         SAMPLE.STA
ENTER SOURCE FILE SIZE ?                       12288
ENTER DESTINATION FILE NAME ON INSTRUMENT ?
```

Example 13-8 **Sample Program: File Transfer from External Controller to 4294A**

```
10   !
20   ! File transfer (Controller -> Instrument)
30   !
40   DIM Src_file$[50],Dst_file$[50]
50   ASSIGN @Agt4294 TO 717
60   OUTPUT @Agt4294;"*rst"
70   !
80   MASS STORAGE IS "a:\"
90   OUTPUT @Agt4294;"STOD MEMO"
100  !
110  PRINT "  ENTER SOURCE FILE NAME ON CONTROLLER ?         ";
120  INPUT Src_file$
130  PRINT Src_file$
140  !
```

```
150  PRINT "  ENTER SOURCE FILE SIZE ?                      ";
160  INPUT Src_size
170  PRINT Src_size
180  !
190  PRINT "  ENTER DESTINATION FILE NAME ON INSTRUMENT ?   ";
200  INPUT Dst_file$
210  PRINT Dst_file$
220  !
230  Copy_to_instr(@Agt4294,Src_file$,Src_size,Dst_file$)
240  !
250  END
260  !
270  !  copy_to_instrument
280  !
290  SUB Copy_to_instr(@Agt4294,Src_file$,Src_size,Dst_file$)
300      DIM Img$[32]
310      Max_bsize=16384
320      !
330      ASSIGN @Src_file TO Src_file$
340      !
350      CLEAR @Agt4294
360      OUTPUT @Agt4294;"CLES"
370      OUTPUT @Agt4294;"WOPEN """;Dst_file$;""""
380      IF FNCheck_error(@Agt4294," <CPTI: wopen>")=-1 THEN SUBEXIT
390      Xfr_done=0
400      !
410      LOOP
420          SELECT (Src_size-Xfr_done)
430              CASE >Max_bsize
440                  Block_size=Max_bsize
450              CASE 0
460                  ASSIGN @Src_file TO *
470                  OUTPUT @Agt4294;"CLOSE"
480                  SUBEXIT
490              CASE ELSE
500                  Block_size=(Src_size-Xfr_done)
510          END SELECT
520          Xfr_done=Xfr_done+Block_size
530          !
540          ALLOCATE Dat$[Block_size]
550          !
560          Img$="#,"&VAL$(Block_size)&"A"
570          ENTER @Src_file USING Img$;Dat$
580          !
590          Img$="8A,ZZZZZZ,"&VAL$(Block_size)&"A"
600          OUTPUT @Agt4294 USING Img$;"WRITE
#6",Block_size,Dat$,END
610          DEALLOCATE Dat$
620          IF FNCheck_error(@Agt4294," <CPTI: block write>")=-1
THEN SUBEXIT
630      END LOOP
640  SUBEND
650  !
660  !  Instrument Error Check
670  !
680  DEF FNCheck_error(@Agt4294,Str$)
690      DIM Err$[64]
700      INTEGER Err_no
```

```
710       OUTPUT @Agt4294;"OUTPERRO?"
720       ENTER @Agt4294;Err_no,Err$
730       IF Err_no<>0 THEN
740           PRINT "ERROR: ";Str$;"    ";Err$
750           RETURN -1
760       ELSE
770           RETURN 0
780       END IF
790   FNEND
```

Lines 80 to 90 — Set the current directory of the external controller to A drive and sets the current directory of the 4294A to the RAM disk. You can set the current directory of the 4294A to the internal flexible disk using the `STODDISK` command. The A drive in the external controller may not be detected under a certain environment of the external controller, so change the drive depending on the situation.

Lines 110 to 210 — Accept the entry of the source file name and its size and the destination file name.

Line 230 — Calls the subprogram to transfer a file from the external controller to the 4294A.

Lines 370 to 380 — Prepare for writing the file to the destination storage device.

Lines 420 to 510 — Calculate the length of the data that has not been transferred based on the source file size previously entered and the length of the data that has been already transferred. If the length of the remaining data does not exceed 16 Kbytes, it is set as the transfer data length; otherwise, 16 Kbytes is set as the transfer data length. Note that, if the length of the data not transferred is 0 at this time, the transfer process is terminated.

Lines 560 to 570 — Read data, whose amount is specified by the transfer data length, from the source file.

Lines 590 to 600 — Write data to the destination file in the fixed length block format (see Figure 16-7 on page 407). The maximum length of data transferred at a time is 16 Kbytes. Therefore, if the size of the source file is greater than 16 Kbytes, the transfer routine, lines 420 to 620, is repeated until transferring all of the data is completed.

Lines 680 to 790 — Provide a function to check that no error has occurred in the 4294A.

NOTE — To transfer a file from the external storage device to the 4294A, you must check the file size (number of bytes) in advance .

Displaying List of Files in Current Directory

This program displays the list of the files in the current directory.

Example 13-9 — **Sample Program: Displaying List of Files in Current Directory of 4294A**

```
10   !
20   ! File list
30   !
40   ASSIGN @Agt4294 TO 717
50   OUTPUT @Agt4294;"*rst"
60   !
```

```
70   Dir_instr(@Agt4294)
80   !
90   END
100  !
110  !  Dir_instr
120  !
130  SUB Dir_instr(@Agt4294)
140      DIM Stor_dev$[6],Curr_dir$[50],File_name$[13]
150      !
160      OUTPUT @Agt4294;"STOD?"
170      ENTER @Agt4294;Stor_dev$
180      OUTPUT @Agt4294;"CWD?"
190      ENTER @Agt4294;Curr_dir$
200      PRINT "["&Stor_dev$&"]: "&Curr_dir$
210      PRINT "Size[byte]    File Name"
220      PRINT "------------------------"
230      OUTPUT @Agt4294;"FNUM?"
240      ENTER @Agt4294;File_count
250      IF File_count>=1 THEN
260          FOR I=1 TO File_count
270              OUTPUT @Agt4294;"FNAME? ";I
280              ENTER @Agt4294;File_name$
290              OUTPUT @Agt4294;"FSIZE? """&File_name$&""""
300              ENTER @Agt4294;File_size
310             PRINT USING "XX,DDDDDD,XXXX,K";File_size,File_name$
320          NEXT I
330      END IF
340  SUBEND
```

Line 70	Calls the subprogram to display the list of the files in the current directory.
Lines 160 to 200	Check the storage device currently selected and its current directory name, and then display the result.
Lines 230 to 240	Check the number of the files in the current directory.
Lines 250 to 330	If there are any files in the current directory, check the name and size of every file and display them.

The following is the output result of the program, assuming that the selected storage device is the Ram disk and the current directory, \TEST, contains 2 files, FILE1.STA (size: 24576 bytes) and FILE2.TIF (size: 16384 bytes) and 1 directory, DIR1. For size of a directory, -1 is displayed. To view the list of the files in DIR1, use the CHAD' command to change the current directory to DIR1 and then execute this program again.

```
[MEMO]: \TEST
Size[byte]    File Name
------------------------
      -1    ..\
      -1    DIR1\
   24576    FILE1.STA
   16384    FILE2.TIF
```

14 Using Printer

This chapter describes the procedures for printing out your measurement results with a printer.

Printing onto a Printer Directly Connected to Agilent 4294A

The Agilent 4294A provides direct connection to a printer, allowing you to print a hardcopy of the LCD screen.

The printer can be connected to the printer parallel port on the rear panel of the 4294A. See ***Operation Manual*** for detailed information on the connection and supported printers.

Setting images to be printed

Besides traces, the following items can be displayed on the LCD for printing.

Items	Command
Sweep and measurement parameters for all measurement points	"LISV" on page 341
Current parameter values for setting of the instrument	"OPEP" on page 365
Setting values set for a user-defined calibration kit	"CALS" on page 275
Setting values for a fixture compensation standard	"COMS" on page 281
List sweep table	"DISL" on page 299
Limit line table	"DISLLIST" on page 299

Use the command below to restore the normal screen display from the screen with the above items.

- "RESD" on page 411

How to print screen

Set the LCD screen as you desired then use the command below to start printing.

- "PRINALL" on page 405

Use the command below to abort your printing.

- "COPA" on page 282

The following items can be set for the printing.

Item	Command	Initial settings [Unit]
Printing resolution (DPI)	"DPI" on page 308	75 [DPI]
Form feed	"FORMFEED" on page 317	Yes
Media orientation (Portrait/Landscape)	"LANDSCAPE" on page 324	Portrait
Left margin	"LMARG" on page 342	1 [inch]
Top margin	"TMARG" on page 455	1 [inch]
Softkey labels	"PRSOFT" on page 405	Not printed
Time and date	"COPT" on page 283	Not printed
Colors	"PRIC" on page 405	Black and white

Settings for the above items are stored in the non-volatile memory (SRAM), thus they do not revert to the initial settings by executing "PRES" command on page 404. Use the command below to restore the initial settings.

- "DFLT" on page 297

Printing onto a Printer Available on an External Computer

The 4294A can be connect to LAN (Local Area Network).

NOTE When a printer is directly connected to LAN (not a computer connected to LAN), it is not possible to print onto the computer from the 4294A connected to LAN.

From the 4294A connected to LAN, images on the LCD or files on the 4294A can be transferred to other computers connected to the same LAN. This means that printing onto a printer connected to an external computer can be achieved by first transferring an image to the computer then using the computer to print the image onto the printer.

NOTE When transferring a TIFF format file for printing, an appropriate application for processing the format must be installed on an external computer.

For example, follow the steps below to print an image on the LCD of the 4294A.

Step 1. Set the LCD screen so that a desired image for printing is displayed.

Step 2. Transfer a file named “screen.tif” on the dynamic data disk (a disk used for transferring internal data in the 4294A via LAN) to an external computer.

Step 3. Use the computer to print “screen.tif.”

Step 4. Remove “screen.tif” if it is no longer necessary.

NOTE See Chapter 12 , “Using LAN,” for connection to LAN and transferring files via LAN.

15 Setting the Display (LCD)

This chapter describes the procedures for setting the displayed colors of traces and characters as well as the brightness of the LCD display.

Setting the LCD Screen

Setting colors for images on the LCD screen

Colors can be separately specified for the following images on the LCD screen.

- Trace A (data trace type)
- Trace A (memory trace type)
- Trace B (data trace type)
- Trace B (memory trace type)
- Grid and part of softkey labels
- Text strings for warning notification
- Text strings other than measurement values and warning notification
- Text strings for Instrument BASIC.
- Pen 1 strings for Instrument BASIC.
- Pen 2 strings for Instrument BASIC.
- Pen 3 strings for Instrument BASIC.
- Pen 4 strings for Instrument BASIC.
- Pen 5 strings for Instrument BASIC.
- Pen 6 strings for Instrument BASIC.

NOTE When performing list sweep, one of the colors for the Instrument BASIC pens 1 to 6 will be assigned to a trace of each segment.

Use the command below to select an item for setting out of those listed above.

- “COLO” on page 280

Use the commands below to assign a color to the selected item with the above command.

- “CBRI” on page 276
- “COLOR” on page 281
- “TINT” on page 454

Setting overall condition for the LCD screen

Use the command below to specify brightness of the LCD screen.

- “INTE” on page 322

Use the command below to specify brightness of the background of the LCD screen.

- “BACI” on page 270

Restoring factory setting

Use the command below to restore the factory settings for coloring all of the items on the screen.

- “DEFC” on page 295

Use the command below to restore the factory setting for coloring of the item selected with “COLO”command.

- “RSCO” on page 414

Sample program for setting the LCD screen

Example 15-1 shows a sample program for setting colors for the LCD screen. This program is saved in the file “color.bas” on the sample program disk.

This program allows you to change the color of the data trace A to green and to increase the whiteness of colors for the pens 2 to 6 in the Instrument BASIC screen.

Lines 20 to 60	Identifies the external controller and Instrument BASIC and sets the GPIB address and the select code.
Lines 80 to 90	Substitutes hue of the data trace A and chroma of the pens 2 to 6 in the Instrument BASIC screen to the variables Trc_a_tint and Pen_clr, respectively.
Lines 110 to 120	Sets the hue of the data trace A to Trc_a_tint.
Lines 130 to 160	Sets the chroma of the pens 2 to 6 in the Instrument BASIC screen to Pen_clr.

Example 15-1 **Setting Colors in the LCD Screen**

```
10      INTEGER Trc_a_tint,Pen_clr
20      IF SYSTEM$("SYSTEM ID")="HP4294A" THEN
30        ASSIGN @Hp4294a TO 800
40      ELSE
50        ASSIGN @Hp4294a TO 717
60      END IF
70      !
80      Trc_a_tint=33
90      Pen_clr=50
100     !
110     OUTPUT @Hp4294a;"COLO TRAD"
120     OUTPUT @Hp4294a;"TINT ";Trc_a_tint
130     FOR I=2 TO 6
140       OUTPUT @Hp4294a;"COLO PEN"&VAL$(I)
150       OUTPUT @Hp4294a;"COLOR ";Pen_clr
160     NEXT I
170     END
```

16 GPIB Command Reference

This chapter is the GPIB command reference for the Agilent 4294A. The IEEE common commands, the 4294A commands, and the Instrument BASIC control commands are described in alphabetical order.

Notational conventions in this command reference

This section describes the rules to read the description of the commands in this chapter.

Syntax

Part with heading “Syntax” describes the syntax to send a command from the external controller to the 4294A. A syntax consists of a command part and a parameter part. The separator between the command part and the parameter part is a space.

If there are several parameters, the separator between adjacent parameters is a comma (,). 2 points (..) between commas indicate that parameters in that part are omitted. For example, <numeric1>,..,<numeric4> indicates that 4 parameters, <numeric1>,<numeric2>,<numeric3>,<numeric4>, are required. String-type parameters, <string>, <string 1>, and so on, must be enclosed in double quotation marks (").

You can omit any lowercase letters in syntax. For example, “:PROGram:CATalog?” on page 464 can be shortened as “:PROG:CAT?”.

The definition of symbols used in the syntax is as follows:

<>	Characters enclosed in this pair of symbols are necessary parameters when sending the command.
[]	Part enclosed in this parenthesis pair can be omitted.
{}	Part enclosed in this parenthesis pair indicates that you must select one of the items in this part. Individual items are separated by pipes (|).

Description

Part with heading “Description” describes how to use the command or the operation when executed.

Parameters

Part with heading “Parameters” describes necessary parameters when sending the command. When a parameter is a value type or a string type enclosed with <>, its description, allowable setting range, initial value, and so on are given; when a parameter is a selection type enclosed with { }, the description of each selection item is given.

Query response

Part with heading “Query response” describes the data format read out when query (reading out data) is available with this command.

Each readout parameter is enclosed with {}. If there are several items within {} separated by the pipe (|), only one of them is read out.

When several parameters are read out, they are separated with a comma (,). Note that, 2 points (..) between commas indicate that the data of that part is omitted. For example, {numeric1},..,{numeric4} indicates that 4 data items, {numeric1}, {numeric2}, {numeric3}, and {numeric4}, are read out.

<newline><^END> after the parameters is the program message terminator.

Corresponding key

Part with heading "Corresponding key" shows the operational procedure of the front panel keys that has the same effect as this command.

IEEE common command

This section describes the IEEE common commands.

*CLS

Syntax

*CLS

Description

Clears the error queue, Status Byte Register, Operation Status Register, Standard Event Status Register, and Instrument Event Status Register. This command has the same function as the “CLES” command on page 279. (No query)

Corresponding key

No front panel key is available to execute this function.

*ESE

Syntax

*ESE <numeric>

*ESE?

Description

Sets the value of the Standard Event Status Enable Register.

Parameters

	<numeric>
Description	Setting value of the register
Range	0 to 255
Initial value	0
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

No front panel key is available to execute this function.

*ESR?

Syntax *ESR?

Description Reads out the value of the Standard Event Status Register. Executing this command clears the register value. (Query only)

Query response {numeric}<newline><^END>

Corresponding key No front panel key is available to execute this function.

*IDN?

Syntax *IDN?

Description Reads out the manufacturer, model number, serial number, and firmware version number of the 4294A. (Query only)

Query response {string 1},{string 2},{string 3},{string 4}<newline><^END>

Readout data is as follows:

{string 1}	Manufacturer. HEWLETT-PACKARD is always read out.
{string 2}	Model number. 4294A is always read out.
{string 3}	10-digit serial number (example: JP1KF00101).
{string 4}	Firmware version number (example: 01.00).

Corresponding key No front panel key is available to execute this function.

*OPC

Syntax *OPC

Description Makes the setting, when the execution of all overlap commands (refer to "*WAI" on page 262) is completed, to set the OPC bit (bit 0) of the Standard Event Status Register. (No query)

Corresponding key No front panel key is available to execute this function.

*OPC?

Syntax *OPC?

Description Reads out 1 when the execution of all overlap commands (refer to "*WAI" on page 262) is completed. (Query only)

Query response {1}<newline><^END>

Corresponding key No front panel key is available to execute this function.

*OPT?

Syntax

*OPT?

Description

Reads out the identification number of an option installed in the 4294A. (Query only)

Query response

{string}<newline><^END>

If there is no installed option, a blank ("") is read out.

Corresponding key

No front panel key is available to execute this function.

*RST

Syntax

*RST

Description

Triggers a reset to the preset state. Although this preset state is almost the same as that of the reset result with the “PRES” command on page 404, there are some differences as follows. (No query)

- The sweep mode is set to HOLD.
- The HP Instrument BASIC is reset.

Corresponding key

No front panel key is available to execute this function.

*SRE

Syntax

*SRE <numeric>

*SRE?

Description

Sets the value of the Service Request Enable Register.

Parameters

	<numeric>
Description	Setting value of the register
Range	0 to 255
Initial value	0
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

No front panel key is available to execute this function.

*STB?

Syntax *STB?

Description Reads out the value of the Status Byte Register. (Query only)

Query response {numeric}<newline><^END>

Corresponding key No front panel key is available to execute this function.

*TRG

Syntax *TRG

Description If the trigger mode is set to GPIB/LAN (set to BUS with the “TRGS” command on page 459), triggers the 4294A waiting for a trigger. (No query)

Corresponding key No front panel key is available to execute this function.

*TST?

Syntax *TST?

Description Executes the self-test and reads out the result. (Query only)

Query response {1|0}<newline><^END>

	Description
1	The result of the self-test is FAIL.
0	The result of the self-test is PASS.

Corresponding key No front panel key is available to execute this function.

*WAI

Syntax

*WAI

Description

Waits for the execution of all overlap commands sent before this command to be completed. Overlap commands include the following. (No query)

- Commands the execution of which finishes when configuration parameters are transferred to the data processor:

"AVER" on page 269
"AVERREST" on page 269
"BWFACT" on page 274
"CALDON" on page 274
"CALQUI" on page 275
"CALP" on page 275
"CALST" on page 276
"CENT" on page 277
"COMST{A|B|C}" on page 282
"CWFREQ" on page 285
"DCI" on page 290
"DCMOD" on page 291
"DCO" on page 291
"ECALDON" on page 309
"EDITDONE" on page 310
"MAXDCV" on page 347
"MINDCV" on page 350
"MKRCENT" on page 351
"MKRDSPAN" on page 352
"MKRSTAR" on page 359
"MKRSTOP" on page 359
"MKRZM" on page 361
"PDELT" on page 397
"PEAKCENT" on page 398
"POIN" on page 401
"PORE" on page 401
"PORTL" on page 402
"PORTZ" on page 402
"POWE" on page 403
"POWMOD" on page 404
"PRES" on page 404
"RECD" on page 408
"SDELT" on page 426
"SPAN" on page 442
"STAR" on page 444
"STOP" on page 446
"SWED" on page 448
"SWET" on page 448
"SWPP" on page 449
"SWPT" on page 449

- Commands the execution of which finishes when the sweep finishes:

"NUMG" on page 364
"SING" on page 437

Corresponding key

No front panel key is available to execute this function.

The Agilent 4294A commands

This section describes the GPIB commands specific to the 4294A.

ACCUD

Syntax

ACCUD {ON|OFF|1|0}

ACCUD?

Description

Enables/disables the display mode to accumulate traces in which they are not cleared at each sweep.

Parameters

	Description
ON or 1	Enables the trace accumulating display.
OFF or 0 (Initial value)	Disables the trace accumulating display (the trace is cleared at each sweep and only the latest trace is displayed).

Query response

{1|0}<newline><^END>

Corresponding key

[Display] - **ACCUMULATE on OFF**

ADDRCONT

Syntax

ADDRCONT <numeric>

ADDRCONT?

Description

Sets the GPIB address of the controller of the 4294A.

Parameters

	<numeric>
Description	GPIB address of the controller
Range	1 to 30
Initial value	21
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Local] - **ADDRESS: CONTROLLER**

ADDRGW

Syntax

ADDRGW <1st>,<2nd>,<3rd>,<4th>

ADDRGW?

Description

Sets the gateway IP address when using the 4294A connected to LAN.

NOTE

To bring the setting of the changed gateway IP address to take effect, reboot (turn off and then on again) the 4294A after the setting.

Parameters

	<1st>*1	**<2nd>*1**	**<3rd>*1**	**<4th>*1**
Description	1st number of IP address	2nd number of IP address	3rd number of IP address	4th number of IP address
Range	0 to 255	0 to 255	0 to 255	0 to 255
Initial value	0	0	0	0
Resolution	1	1	1	1

***1.** For example, if the IP address is 1.10.100.50, <1st> is 1, <2nd> is 10, <3rd> is 100, and <4th> is 50.

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{1st},{2nd},{3rd},{4th}<newline><^END>

Corresponding key

[Local] - **GATEWAY ADDRESS** - **1st**, **2nd**, **3rd**, **4th**

ADDRIP

Syntax

ADDRIP <1st>,<2nd>,<3rd>,<4th>

ADDRIP?

Description

Sets the LAN IP address of the 4294A when using the 4294A connected to LAN.

NOTE

To bring the setting of the changed IP address to take effect, reboot (turn off and then on again) the 4294A after the setting.

Parameters

	<1st>*1	<2nd>*1	<3rd>*1	<4th>*1
Description	1st number of IP address	2nd number of IP address	3rd number of IP address	4th number of IP address
Range	0 to 255	0 to 255	0 to 255	0 to 255
Initial value	0	0	0	0
Resolution	1	1	1	1

*1. For example, if the IP address is 1.10.100.50, <1st> is 1, <2nd> is 10, <3rd> is 100, and <4th> is 50.

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{1st},{2nd},{3rd},{4th}<newline><^END>

Corresponding key

[Local] - IP ADDRESS - 1st, 2nd, 3rd, 4th

ANAODATA

Syntax

ANAODATA

ANAODATA?

Description

Selects the data trace as the target trace when performing analysis using the waveform analysis command. Only either the data trace or memory trace can be specified as the analysis target. After the execution of this command, executing the “ANAOMEMO” command makes the data trace to be no longer the analysis target.

When the measurement parameter is COMPLEX Z-Y, the analysis target is |Z| (for trace A) or |Y| (for trace B).

Query response

{1|0}<newline><^END>

	Description
1 (Initial value)	The data trace is selected as the analysis target trace.
0	The data trace is not selected as the analysis target trace (in other words, the memory trace is selected).

Corresponding key

No front panel key is available to execute this function.

ANAOMEMO

Syntax

ANAOMEMO

ANAOMEMO?

Description

Selects the memory trace as the target trace when performing analysis using the waveform analysis command. Only either the data trace or memory trace can be specified as the analysis target. After the execution of this command, executing the “ANAODATA” command makes the memory trace to be no longer the analysis target.

When the measurement parameter is COMPLEX Z-Y, the analysis target is |Z| (for trace A) or |Y| (for trace B).

Query response

{1|0}<newline><^END>

	Description
1	The memory trace is selected as the analysis target trace.
0 (Initial value)	The memory trace is not selected as the analysis target trace (in other words, the data trace is selected).

Corresponding key

No front panel key is available to execute this function.

ANARANG

Syntax

ANARANG <numeric 1>,<numeric 2>[HZ|MHZ|V|A]

ANARANG?

Description

Sets the analysis range when performing waveform analysis using the waveform analysis command. You specify the analysis range using the lower limit and the upper limit (or, the upper limit and the lower limit). If the lower/upper limit does not match with any measurement point sweep parameter values, the analysis range lower limit is set to the minimum measurement point larger than the specified value and the analysis range upper limit is set to the maximum measurement point smaller than the specified value.

If the sweep condition setting is changed, the analysis range is set to the entire sweep range. If the sweep range setting is zero span, the analysis range is always the entire sweep range (all measurement points).

Parameters

		<numeric 1>	**<numeric 2>**
Description		Analysis range lower limit (or upper limit)	Analysis range upper limit (or lower limit)
Range		Current sweep range	Current sweep range
When the sweep parameter is frequency	Initial value	40	110E6
	Unit	Hz	Hz
	Resolution	1E-3	1E-3
When the sweep parameter is OSC level (voltage)	Initial value	0	1
	Unit	V (volt)	V (volt)
	Resolution	1E-3	1E-3
When the sweep parameter is OSC level (current)	Initial value	40E-6	20E-3
	Unit	A (ampere)	A (ampere)
	Resolution	1E-6	1E-6
When the sweep parameter is dc bias level (voltage)	Initial value	0	0
	Unit	V (volt)	V (volt)
	Resolution	1E-3	1E-3
When the sweep parameter is dc bias level (current)	Initial value	0	0
	Unit	A (ampere)	A (ampere)
	Resolution	20E-6	20E-6

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric 1},{numeric 2}<newline><^END>

Corresponding key

No front panel key is available to execute this function.

ANARFULL

Syntax

ANARFULL

Description

Sets the analysis range to the entire sweep range when performing waveform analysis using the waveform analysis command. (No query)

Corresponding key

No front panel key is available to execute this function.

ANASEGM

Syntax

ANASEGM <numeric>

ANASEGM?

Description

When the sweep type is set to the list sweep, selects, from the list sweep table, the waveform analysis target segment when performing analysis using the waveform analysis function. The waveform analysis target segment number is initialized when the sweep type is set to the list sweep from other than the list sweep. Therefore, you have to set the waveform analysis target segment number each time.

Parameters

	<numeric>
Description	Waveform analysis target segment number
Range	1 to the number of segments in the list sweep table
Initial value	1
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

If the sweep type is not the list sweep, 0 is always read out.

Corresponding key

No front panel key is available to execute this function.

AUTO

Syntax

AUTO

Description

Automatically sets scale parameters so that the trace fits on the screen (executes the auto scale). (No query)

Corresponding key

[Scale Ref] - AUTO SCALE

AVER

Syntax

AVER {ON|OFF|1|0}

AVER?

Description

Enables/disables the sweep averaging function.

Parameters

	Description
ON or 1	Enables the sweep averaging function.
OFF or 0 (Initial value)	Disables the sweep averaging function.

Query response

{1|0}<newline><^END>

Corresponding key

[Bw/Avg] - AVERAGING on OFF

AVERFACT

Syntax

AVERFACT <numeric>

AVERFACT?

Description

Sets the averaging factor of the sweep averaging function.

Parameters

	<numeric>
Description	Averaging factor
Range	1 to 256
Initial value	16
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Bw/Avg] - AVERAGING FACTOR

AVERREST

Syntax

AVERREST

Description

Resets the data count used in averaging calculation of the sweep averaging function to 0. Measured data before the execution of this command is not used in averaging calculation. If this command is executed while the 4294A is performing a sweep, it is restarted. (No query)

Corresponding key

[Bw/Avg] - AVERAGING RESTART

BACI

Syntax

BACI <numeric>[PCT]

BACI?

Description

Sets the brightness of the background color on the display screen. You specify the brightness in a percentage of the white level (the level of white, larger means brighter).

Parameters

	<numeric>
Description	Percentage of the white level
Range	0 to 100
Initial value	0
Unit	% (percentage ratio)
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Display] - **more 1/2** - **MODIFY COLOR** - **BACKGROUND INTENSITY**

BEEPDONE

Syntax

BEEPDONE {ON|OFF|1|0}

BEEPDONE?

Description

Enables/disables the beep to notify the completion of operation (at the completion of calibration or saving instrument states).

Parameters

	Description
ON or 1 (initial value)	Enables the beep.
OFF or 0	Disables the beep.

Query response

{1|0}<newline><^END>

Corresponding key

[System] -**BEEPER** - **BEEP DONE on OFF**

BEEPFAIL

Syntax

BEEPFAIL {ON|OFF|1|0}

BEEPFAIL?

Description

Enables/disables the beep when the limit test result is FAIL.

Parameters

	Description
ON or 1	Enables the beep.
OFF or 0 (initial value)	Disables the beep.

Query response

{1|0}<newline><^END>

Corresponding key

[System] - LIMIT TEST - BEEP FAIL on OFF

BEEPWARN

Syntax

BEEPWARN {ON|OFF|1|0}

BEEPWARN?

Description

Enables/disables the beep when an error message is displayed or when an invalid key is pressed.

Parameters

	Description
ON or 1	Enables the beep.
OFF or 0 (initial value)	Disables the beep.

Query response

{1|0}<newline><^END>

Corresponding key

[System] -BEEPER - BEEP WARN on OFF

BLIGHT

Syntax

BLIGHT {ON|OFF|1|0}

BLIGHT?

Description

Toggles on and off the backlight of the LCD screen. If the backlight is off, you cannot read displayed information on the screen.

Parameters

	Description
ON or 1 (initial value)	Turns on the backlight.
OFF or 0	Turns off the backlight.

Query response

{1|0}<newline><^END>

Corresponding key

No front panel key is available to execute this function.

BMON

Syntax

BMON {OFF|VOLT|CURR}

BMON?

Description

Sets the measurement item in the dc bias level monitor function.

Parameters

	Description
OFF (initial value)	Turns off the dc bias level monitor function.
VOLT	Specifies the dc bias voltage level monitor.
CURR	Specifies the dc bias current level monitor.

Query response

{OFF|VOLT|CURR}<newline><^END>

Corresponding key

[Display] - **BIAS LEVEL [ ]** - **{OFF** | **VOLT** | **CURRENT}**

BOTV

Syntax

BOTV <numeric>[OHM|DEG|RAD|SIE|H|F|PCT]

BOTV?

Description

Sets the minimum value on the display screen in the Y axis (vertical axis) direction (the value of the bottom of the grid).

If the difference between this minimum value and the maximum value on the display screen in the Y axis direction (set with the "TOPV" command on page 456) is less than 10E-15 (for the log Y axis format, the ratio of the maximum value to the minimum value is less than 5), the maximum value is automatically changed so that it becomes larger than the value of the minimum value plus 10E-15 (for the log Y axis format, the value indicating that the ratio of the maximum value to the minimum value is 5). Also, the width of a single grid tick (SCALE/DIV) and the reference line value (REFERENCE VALUE) are automatically changed so that they match with the Y axis minimum value and maximum value setting.

For the log Y axis format, if the sign is different from the display screen maximum value setting, the sign of the maximum value is automatically changed to the same sign as the minimum value.

Parameters

	<numeric>
Description	Minimum value on the display screen in the Y axis (vertical axis) direction
Range	For formats other than the log Y axis format: -1E9 to 1E9 For the log Y axis format: -200E6 to 200E6
Initial value	For formats other than the log Y axis format: Varies depending on the measurement parameter as follows: For other than θ: 0 For θ: -180 For the log Y axis format: Varies depending on the measurement parameter as follows: For |Z|, R, X, Rs, Rp: 1 For θ: 100E-6 For |Y|, G, B, D: 1E-6 For Cs, Cp: 1E-9 For Ls, Lp: 10E-6 For Q: 1E-3
Unit	Varies depending on the measurement parameter (refer to the explanation of unit in "SCAL" on page 423).
Resolution	1E-15 [*1]

*1.This is the minimum value (when the set value is small). The resolution becomes larger as the set value becomes larger.

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Scale Ref] - **BOTTOM VALUE**

BWFACT

Syntax

BWFACT {1|2|3|4|5}

BWFACT?

Description

Sets the bandwidth. To set the bandwidth of each segment when creating the list sweep table, also use this command.

Parameters

	Description
1 (Initial value)	Specifies bandwidth 1 (shortest measurement time).
2	Specifies bandwidth 2.
3	Specifies bandwidth 3.
4	Specifies bandwidth 4.
5	Specifies bandwidth 5 (longest measurement time, accurate measurement).

Note that, if you use this command to create an additional segment, the setting of the previous segment is used as its initial value.

Query response

{numeric}<newline><^END>

Corresponding key

[Bw/Avg] - **BAND WIDTH [ ]** - **{1 FAST** | **2** | **3** | **4** | **5 PRECISE}**

CAL{A|B|C}

Syntax

CAL{A|B|C}

Description

Measures OPEN/SHORT/LOAD data for user calibration. The “CALA” command measures OPEN data; the “CALB” command, SHORT data; the “CALC” command, LOAD data. (No query)

Corresponding key

[CAL] - **USER CAL** - **EXCUTE CAL** - {**OPEN[ ]** | **SHORT[ ]** | **LOAD[ ]**}

CALDON

Syntax

CALDON

Description

Finishes the measurement of user calibration data, calculates the calibration coefficient from the measurement result, and stores it into the volatile memory (RAM). Executing this command automatically turns on the user calibration function (specified to ON with the “CALST” command on page 276). If all the measurements of OPEN/SHORT/LOAD data are not completed, executing this command causes an error and the command is ignored. (No query)

Corresponding key

[CAL] - **USER CAL** - **EXCUTE CAL** - **done**

CALECPARA

Syntax

CALECPARA

Description

Executes the equivalent circuit analysis depending on the equivalent circuit model specified with the “EQUC” command on page 311, and displays the analysis result (equivalent circuit parameters). The analysis range is the same as that of the marker search function. (No query)

Corresponding key

[Display] - **more 1/2** - **EQUIV CKT** - **CALCULATE PARAMETERS**

CALP

Syntax

CALP {FIXED|USER}

CALP?

Description

Specifies which measurement points are used for user calibration data and fixture compensation data: (fixed) measurement points provided by the 4294A or user created measurement points (measurement points in the sweep setting at the execution of calibration/compensation).

Parameters

	Description
FIXED (Initial value)	Uses the (fixed) measurement points provided by the 4294A.
USER	Uses the user created measurement points.

Query response

{FIXED|USER}<newline><^END>

Corresponding key

[Cal] - **COMP POINT [ ]**

CALQUI

Syntax

CALQUI

Description

Aborts the measurement of user calibration data. (No query)

Corresponding key

[CAL] - **USER CAL** - **EXCUTE CAL** - **cancel**

CALS

Syntax

CALS

Description

Lists the set values of the user calibration kit (values entered with the “DCALOPEN{G|C}”(288page), “DCALSHOR{R|L}”(289page), and “DCALLOAD{R|L}”(287page) commands). (No query)

Corresponding key

[Copy] - **SELECT CONTENTS** - **CAL KIT VALUE ➢**

CALST

Syntax

CALST {ON|OFF|1|0}

CALST?

Description

Toggles on and off the user calibration function. If the user calibration data is not stored (executed with the “CALDON” command on page 274), executing this command to turn on the calibration causes an error and the command is ignored.

Parameters

	Description
ON or 1	Turns on the user calibration function.
OFF or 0 (initial value)	Turns off the user calibration function.

Query response

{1|0}<newline><^END>

Corresponding key

[Cal] - **USER CAL** - **CORRECTION on OFF**

CBRI

Syntax

CBRI <numeric>[PCT]

CBRI?

Description

Sets the brightness of the display color of the item selected with the “COLO” command on page 280.

Parameters

	<numeric>
Description	Percentage of brightness (the brightest state: 100 %)
Range	0 to 100
Initial value	Varies depending on the display item selected with the “COLO” command on page 280.
Unit	% (percentage)
Resolution	1

Query response

{numeric}<newline><^END>

Corresponding key

[Display] - **more 1/2** - **MODIFY COLOR** - **MODIFY ITEM COLOR** - **MODIFY COLOR** - **BRIGHTNESS**

CENT

Syntax

CENT <numeric>[HZ|MHZ|V|A]

CENT?

Description

Sets the sweep range center value. To set the center value of each segment when creating the list sweep table, also use this command.

Parameters

		<numeric>
Description		Center value
When the sweep parameter is frequency	Range	40 to 110E6 (for the linear sweep) 50 to 109.9999E6 (for the log sweep)
	Initial value	55.00002E6
	Unit	Hz
	Resolution	1E-3
When the sweep parameter is OSC level (voltage)	Range	5E-3 to 1
	Initial value	0.502
	Unit	V (volt)
	Resolution	1E-3
When the sweep parameter is OSC level (current)	Range	200E-6 to 20E-3
	Initial value	10.1E-3
	Unit	A (ampere)
	Resolution	1E-6
When the sweep parameter is dc bias level (voltage)	Range	-40 to 40
	Initial value	0
	Unit	V (volt)
	Resolution	1E-3
When the sweep parameter is dc bias level (current)	Range	-100E-3 to 100E-3
	Initial value	0
	Unit	A (ampere)
	Resolution	10E-6

Note that, if you use this command to create a segment, the initial value when creating segment 1 is the current sweep range start value and the initial value when creating an additional segment is the sweep range stop value of the previous segment.

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Center]

CHAD

Syntax

CHAD <string>

Description

Change the current directory under which file operation is performed. To change it to a directory in a different mass storage, use the “STOD” command on page 445 to change the file operation target mass storage, and then execute this command. (No query)

Parameters

	<string>
Description	Change destination directory name
Range	8 characters or less

Use ".." (2 periods) as the directory name to move to the one-level upper directory.

Corresponding key

[Save] - FILE UTILITIES - CHANGE DIRECTORY ➢

CIN

Syntax

CIN

CIN?

Description

Sets the input/output direction of port C of the 24-bit I/O port to input (preset state).

To change the input/output direction of port C to output, use the “COUT” command on page 283.

Query response

{1|0}<newline><^END>

	Description
1	Input is selected as the input/output direction of port C.
0	Output is selected as the input/output direction of port C.

Corresponding key

No front panel key is available to execute this function.

CLEL

Syntax

CLEL

Description

In the creation/edit of the list sweep table, deletes all segments. Executing this command during the execution of segment creation/edit causes an error. If list sweep table creation/edit has not been started, executing this command automatically starts table creation/edit and then deletes all segments. (No query)

NOTE

Executing the “EDITDONE” command on page 310 brings the created/edited list sweep table to take effect.

Corresponding key

[Sweep] - **EDIT LIST** - **CLEAR LIST** ➢

CLES

Syntax

CLES

Description

Clears the error queue, Status Byte Register, Operation Status Register, Standard Event Status Register, and Instrument Event Status Register. This command has the same function as the “*CLS” command on page 258. (No query)

Corresponding key

No front panel key is available to execute this function.

CLOSE

Syntax

CLOSE

Description

Returns a file, which has been read/write-enabled using the “ROPEN”(412page) command or “WOPEN”(462page) command, to access-disabled status. If this command is executed before reading process using the “READ?”(407page) command completes, an error occurs.

Generally, this command is used in combination with the “ROPEN”(412page) command and “READ?”(407page) command or the “WOPEN”(462page) command and the “WRITE”(463page) command, as shown in Figure 16-8 on page 412. (No query)

Corresponding key

No front panel key is available to execute this function.

COLO

Syntax

COLO {TRAD|TRAM|TRBD|TRBM|GRAT|WARN|TEXT|IBT|PEN1|PEN2|PEN3|PEN4|PEN5|PEN6}

COLO?

Description

Specifies a display item to which the changes of the brightness (set with the “CBRI” command on page 276), chroma (set with the “COLOR” command on page 281), and tint (set with the “TINT” command on page 454) of the display color are applied.

Parameters

	Description
TRAD (Initial value)	Specifies the trace A data trace as the change target.
TRAM	Specifies the trace A memory trace as the change target.
TRBD	Specifies the trace B data trace as the change target.
TRBM	Specifies the trace B memory trace as the change target.
GRAT	Specifies the grid and some softkey labels as the change target.
WARN	Specifies warning notification text as the change target.
TEXT	Specifies the measured data and text except for warning notification text as the change target.
IBT	Specifies text on the Instrument BASIC screen as the change target.
PEN1-PEN6	Specifies pen 1 to pen 6 on the Instrument BASIC screen as the change target.

Query response

{TRAD|TRAM|TRBD|TRBM|GRAT|WARN|TEXT|IBT|PEN1|PEN2|PEN3|PEN4|PEN5|PEN6}<newline><^END>

Corresponding key

[Display] - **more 1/2** - **MODIFY COLOR** - **MODIFY ITEM COLOR** - {**TRC A DATA** | **TRC A MEM LIMIT LINE** | **TRC B DATA** | **TRC B MEM LIMIT LINE** | **GRATICULE**}

[Display] - **more 1/2** - **MODIFY COLOR** - **MODIFY ITEM COLOR** - **more 1/3** - {**WARNING** | **TEXT MARKER** | **IBASIC** | **PEN 1** | **PEN 2**}

[Display] - **more 1/2** - **MODIFY COLOR** - **MODIFY ITEM COLOR** - **more 1/3** - **more 2/3** - {**PEN 3** | **PEN 4** | **PEN 5** | **PEN 6**}

COLOR

Syntax

COLOR <numeric>[PCT]

COLOR?

Description

Sets the vividness (chroma) of the display color of the item selected with the “COLO” command on page 280.

Parameters

	<numeric>
Description	Percentage of the most vivid status (status in which white and black are not mixed completely)
Range	0 to 100
Initial value	Varies depending on the display item selected with the “COLO” command on page 280.
Unit	% (percentage)
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Display] - **more 1/2** - **MODIFY COLOR** - **MODIFY ITEM COLOR** - **MODIFY COLOR** - **COLOR**

COM{A|B|C}

Syntax

COM{A|B|C}

Description

Measures OPEN/SHORT/LOAD data for fixture compensation, calculates the compensation coefficient, and stores it into the volatile memory (RAM). The “COMA” command is for OPEN compensation data; the “COMB” command, for SHORT compensation data; the “COMC” command, for LOAD compensation data. (No query)

Corresponding key

[Cal] - **FIXTURE COMPEN** - {**OPEN** | **SHORT** | **LOAD**}

COMS

Syntax

COMS

Description

Lists the set values of the standard used for fixture compensation data measurement (the values entered with the “DCOMOPEN{G|C}” command on page 293, “DCOMSHOR{R|L}” command on page 294, and “DCOMLOAD{R|L}” command on page 292). (No query)

Corresponding key

[Copy] - **SELECT CONTENTS** - **COMPEN KIT VALUE ➢**

COMST{A|B|C}

Syntax

COMST{A|B|C} {ON|OFF|1|0}

COMST{A|B|C}?

Description

Toggles on and off the OPEN/SHORT/LOAD compensation of the fixture compensation function. The "COMSTA" command is used to set the OPEN compensation; the "COMSTB" command, the SHORT compensation; the "COMSTC" command, the LOAD compensation. If no fixture compensation coefficient has been stored (executed with the "COM{A|B|C}" command on page 281), executing this command to turn on the compensation causes an error and the command is ignored.

Parameters

	Description
ON or 1	Turns on the compensation.
OFF or 0 (Initial value)	Turns off the compensation.

Query response

{1|0}<newline><^END>

Corresponding key

[Cal] - **FIXTURE COMPEN** - {**OPEN on OFF** | **SHORT on OFF** | **LOAD on OFF**}

CONT

Syntax

CONT

CONT?

Description

Sets the sweep mode to the auto continuous sweep (CONT). In this mode, sweeps are repeated automatically and continuously.

Query response

{1|0}<newline><^END>

	Description
1 (Initial value)	The auto continuous sweep is selected as the sweep mode.
0	The auto continuous sweep is not selected as the sweep mode.

Corresponding key

[Trigger] - **CONTINUOUS**

COPA

Syntax

COPA

Description

Aborts printout. (No query)

Corresponding key

[Copy] - **ABORT**

COPT

Syntax

COPT {ON|OFF|1|0}

COPT?

Description

Enables/disables the output of the time and date to a printer.

Parameters

	Description
ON or 1	Enables the output of the time and date.
OFF or 0 (Initial value)	Disables the output of the time and date.

Query response

{1|0}<newline><^END>

Corresponding key

[Copy] - **SETUP** - **more 1/2** - **TIME on OFF**

COUT

Syntax

COUT

COUT?

Description

Sets the input/output direction of port C of the 24-bit I/O port to output.

To change the input/output direction of port C to input (preset state), use the "CIN" command on page 278.

Query response

{1|0}<newline><^END>

	Description
1	Output is selected as the input/output direction of port C.
0	Input is selected as the input/output direction of port C.

Corresponding key

No front panel key is available to execute this function.

CRED

Syntax CRED <string>

Description Creates a new directory under the current directory. To change the current directory, use the "CHAD" command on page 278. (No query)

Parameters

	<string>
Description	Name of a new directory
Range	8 characters or less

If the specified file name has characters that exceed the maximum length, only the string of up to the maximum length is valid and the remaining characters are ignored.

Corresponding key **[Save] - FILE UTILITIES - CREATE DIRECTORY ➢**

CWD?

Syntax CWD?

Description Returns the name of the current directory. (Query only)

Query response {string}<newline><^END>

Corresponding key No front panel key is available to execute this function.

CWFREQ

Syntax

CWFREQ <numeric>[HZ|MHZ]

CWFREQ?

Description

Sets the frequency of the oscillator for the oscillator (OSC) level sweep and dc bias level sweep.

Parameters

	<numeric>
Description	Frequency of the oscillator
Range	40 to 110E6
Initial value	1E6
Unit	Hz
Resolution	1E-3

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Source] - **FREQUENCY**

DATMEM

Syntax

DATMEM

Description

Copies the measured data into the memory array. It is copied to both the A and B traces.(No query)

Corresponding key

[Display] - **DEF TRACR[ ]** - **DATA → MEMORY**

DATOVAL

Syntax

DATOVAL <numeric>

DATOVAL?

Description

For the active trace (set with the “TRAC” command on page 457), if the measurement parameter is a scalar value, sets a value that is subtracted from the data trace (offset value). The contents of the data trace is the result of subtracting the offset value from the measured data (if the contents of the data trace is an operation result depending on the setting with the “DISP” command on page 301, the operation result).

Parameters

	<numeric>
Description	Offset value
Range	-100E6 to 100E6
Initial value	0
Resolution	1E-18

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Display] - **OFFSET**

DCALLOAD{R|L}

Syntax

DCALLOADR <numeric>[OHM]

DCALLOADL <numeric>[H]

DCALLOAD{R|L}?

Description

For user calibration data measurement (“CAL{A|B|C}” command on page 274), sets the resistance value (the “DCALLOADR” command) and the inductance value (the “DCALLOADL” command) of the LOAD standard of the calibration kit used to measure LOAD calibration data.

Parameters

	<numeric>
Description	Resistance value or inductance value
Range	For resistance value: -100E9 to 100E9 For inductance value: -1E6 to 1E6
Initial value	For resistance value: 50 For inductance value: 0
Unit	For resistance value: Ω (ohm) For inductance value: H (henry)
Resolution	1E-12

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[CAL] - **USER CAL** -**DEFINE VAUE** - {**LOAD RESIST (R)** | **LOAD INDUCT (L)**}

DCALOPEN{G|C}

Syntax

DCALOPENG <numeric>[SIE]

DCALOPENC <numeric>

DCALOPEN{G|C}?

Description

For user calibration data measurement (“CAL{A|B|C}” command on page 274), sets the conductance value (“DCALOPENG” command) and the capacitance value (“DCALOPENC” command) of the OPEN standard of the calibration kit used to measure OPEN calibration data.

Parameters

	<numeric>
Description	Conductance value or capacitance value
Range*1	-1E6 to 1E6
Initial value	0
Unit	For conductance value: S (siemens) For capacitance value: fF (femto farad)
Resolution	For conductance value: 1E-12 For capacitance value: 1

*1.The unit of range value is S (siemens) or F (farad).

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[CAL] - **USER CAL** -**DEFINE VAUE** - {**OPEN CONDUCT (G)** | **OPEN CAP (C)**}

DCALSHOR{R|L}

Syntax

DCALSHORR <numeric>[OHM]

DCALSHORL <numeric>[H]

DCALSHOR{R|L}?

Description

For user calibration data measurement (“CAL{A|B|C}” command on page 274), sets the resistance value (“DCALSHORR” command) and the inductance value (“DCALSHORL” command) of the SHORT standard of the calibration kit used to measure SHORT calibration data.

Parameters

	<numeric>
Description	Resistance value or inductance value
Range	-1E6 to 1E6
Initial value	0
Unit	For resistance value: Ω (ohm) For inductance value: H (henry)
Resolution	1E-12

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[CAL] - **USER CAL** -**DEFINE VAUE** - {**SHORT RESIST (R)** | **SHORT INDUCT (L)**}

DCI

Syntax

DCI <numeric>[A]

DCI?

Description

Sets the dc bias output level when the dc bias output mode is the current mode or constant-current mode. To set the dc bias output level of each segment when creating the list sweep table, also use this command.

Parameters

	<numeric>
Description	Output current value of dc bias
Range	-0.1 to 0.1
Initial value	0 (Note that the initial value is the current set value of the dc bias output current, when creating segment 1; the set value of the previous segment, when creating an additional segment.)
Unit	A (ampere)
Resolution	20E-6

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Source] - **BIAS MENU** - **CURRENT LEVEL**

DCMOD

Syntax

DCMOD {VOLT|CURR|CVOLT|CCURR}

DCMOD?

Description

Selects the dc bias output mode. To set the dc bias output mode of each segment when creating the list sweep table, also use this command.

Parameters

	Description
VOLT (initial value)	Specifies the voltage mode.
CURR	Specifies the current mode.
CVOLT	Specifies the constant-voltage mode.
CCURR	Specifies the constant-current mode.

Note that, if you use this command to create a segment, the initial value when creating segment 1 is the current dc bias output mode and the initial value when creating an additional segment is the set mode of the previous segment.

Query response

{VOLT|CURR|CVOLT|CCURR}<newline><^END>

Corresponding key

[Source] - **more 1/2** - **MODE [ ]** - {**VOLT** | **CURRENT** | **VOLT CONSTANT** | **CURRENT CONSTANT**}

DCO

Syntax

DCO {ON|OFF|1|0}

DCO?

Description

Turns on/off the dc bias output.

Parameters

	Description
ON or 1	Turns on the dc bias output.
OFF or 0 (initial value)	Turns off the dc bias output.

Query response

{1|0}<newline><^END>

Corresponding key

[Source] - **BIAS MENU** - **BIAS on OFF**

DCOMLOAD{R|L}

Syntax

DCOMLOADR <numeric>[OHM]

DCOMLOADL <numeric>[H]

DCOMLOAD{R|L}?

Description

For fixture compensation data measurement (“COM{A|B|C}” command on page 281), sets the resistance value (“DCOMLOADR” command) and the inductance value (“DCOMLOADL” command) of the LOAD standard used to measure LOAD compensation data.

Parameters

	<numeric>
Description	Resistance value or inductance value
Range	For resistance value: -100E9 to 100E9 For inductance value: -1E6 to 1E6
Initial value	For resistance value: 50 For inductance value: 0
Unit	For resistance value: Ω (ohm) For inductance value: H (henry)
Resolution	1E-12

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Cal] - **FIXTURE COMPEN** - **DEFINE VALUE** - **{LOAD RESIST (R)** | **LOAD INDUCT (L)}**

DCOMOPEN{G|C}

Syntax

DCOMOPENG <numeric>[SIE]

DCOMOPENC <numeric>

DCOMOPEN{G|C}?

Description

For fixture compensation data measurement (“COM{A|B|C}” command on page 281), sets the conductance value (“DCOMOPENG” command) and the capacitance value (“DCOMOPENC” command) of the OPEN standard used to measure OPEN compensation data.

Parameters

	<numeric>
Description	Conductance value or capacitance value
Range*1	-1E6 to 1E6
Initial value	0
Unit	For conductance value: S (siemens) For capacitance value: fF (femto farad)
Resolution	For conductance value: 1E-12 For capacitance value: 1

*1.The unit of range value is S (siemens) or F (farad).

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Cal] - **FIXTURE COMPEN** - **DEFINE VALUE** - {**OPEN CONDUCT (G)** | **OPEN CAP (C)**}

DCOMSHOR{R|L}

Syntax

DCOMSHORR <numeric>[OHM]

DCOMSHORL <numeric>[H]

DCOMSHOR{R|L}?

Description

For fixture compensation data measurement (“COM{A|B|C}” command on page 281), sets the resistance value (“DCOMSHORR” command) and the inductance value (“DCOMSHORL” command) of the SHORT standard used to measure SHORT compensation data.

Parameters

	<numeric>
Description	Resistance value or inductance value
Range	-10E6 to 10E6
Initial value	0
Unit	For resistance value: Ω (ohm) For inductance value: H (henry)
Resolution	1E-12

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Cal] - **FIXTURE COMPEN** - **DEFINE VALUE** - {**SHORT RESIST(R)**| **SHORT INDUCT(L)**}

DCRNG

Syntax

DCRNG {M1|M10|M100}

DCRNG?

Description

Sets the dc bias range.

Parameters

	Description
M1 (initial value)	Specifies the 1-mA range.
M10	Specifies the 10-mA range.
M100	Specifies the 100-mA range.

Query response

{M1|M10|M100}<newline><^END>

Corresponding key

[Source] - **more 1/2** - **MEAS RANGE [ ]** - {**1mA** | **10mA** | **100mA**}

DCV

Syntax

DCV <numeric>[V]

DCV?

Description

Sets the dc bias output level when the dc bias output mode is the voltage mode or constant-voltage mode. To set the dc bias output level of each segment when creating the list sweep table, also use this command.

Parameters

	<numeric>
Description	Output voltage value of the dc bias
Range	-40 to 40
Initial value	0 (Note that the initial value is the current set value of the dc bias output voltage when creating segment 1; the set value of the previous segment, when creating an additional segment.)
Unit	V (volt)
Resolution	1E-3

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Source] - **BIAS MENU** - **VOLTAGE LEVEL**

DEFC

Syntax

DEFC

Description

Returns all display color settings to the factory states. (No query)

Corresponding key

[Display] - **more 1/2** - **MODIFY COLOR** - **DEFAULT COLORS**

DEFEC{R1|C1|L1|C0}

Syntax

DEFECR1 <numeric>[OHM]

DEFEC{C1|C0} <numeric>[F]

DEFECL1 <numeric>[H]

DEFEC{R1|C1|L1|C0}?

Description

Defines an R1/C1/L1/C0 equivalent circuit parameter. The “DEFECR1” command defines R1; the “DEFECC1” command, C1; the “DEFECL1” command, L1; the “DEFECC0” command, C0, respectively. For equivalent circuit parameters, refer to “Equivalent circuit analysis” on page 100.

Parameters

	<numeric>
Description	Value of the equivalent circuit parameter
Range	-1E18 to 1E18
Initial value	0
Unit	Ω (for the “DEFECR1” command) F (for the “DEFECC1” command and the “DEFECC0” command) H (for the “DEFECL1” command)
Resolution	1E-18

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Display] - **more 1/2** - **EQUIV CKT** - **DEFINE PARAMETERS** - {**R1** | **C1** | **L1** | **C0**}

DFLT

Syntax

DFLT

Description

Returns the settings related to printout to the initial states (refer to the table below). (No query)

Setting item	Setting command	Initial state [unit]
Print resolution (DPI)	"DPI" on page 308	75 [DPI]
Form feed	"FORMFEED" on page 317	Enabled
Print orientation (portrait/landscape)	"LANDSCAPE" on page 324	Portrait
Left margin	"LMARG" on page 342	1 [inch]
Top margin	"TMARG" on page 455	1 [inch]
Softkey label output	"PRSOFT" on page 405	Disabled
Time and date output	"COPT" on page 283	Disabled
Print color	"PRIC" on page 405	Black and white

Corresponding key

[Copy] - DEFAULT SETTING

DIN

Syntax

DIN

DIN?

Description

Sets the input/output direction of port D (24-bit I/O port) to input (preset state).

To change the input/output direction of port D to output, use the "DOUT" command on page 307.

Query response

{1|0}<newline><^END>

	Description
1	Input is selected as the input/output direction of port D.
0	Output is selected as the input/output direction of port D.

Corresponding key

No front panel key is available to execute this function.

DISA

Syntax

DISA {ALLI|HIHB|ALLB|BASS}

DISA?

Description

Sets the allocation of the measurement result display screen and the HP Instrument BASIC (IBASIC) screen on the LCD screen.

Parameters

	Description
ALLI (initial value)	Uses the entire LCD screen as the measurement result display screen.
HIHB	Uses the upper half of the LCD screen as the measurement result display screen and the lower half as the HP IBASIC screen.
ALLB	Uses the entire LCD screen as the HP IBASIC.
BASS	Uses most of the LCD screen as the measurement result display screen, showing the state of HP IBASIC in three lines below the measurement result display screen.

Query response

{ALLI|HIHB|ALLB|BASS}<newline><^END>

Corresponding key

[Display] - **more1/2** - **ALLOCATION** - {**ALL INSTRUMENT** | **HALF INSTR HALF BASIC** | **ALL BASIC** | **BASIC STATUS**}

DISECIRC

Syntax

DISECIRC {ON|OFF|1|0}

DISECIRC?

Description

Toggles on and off the equivalent circuit model display.

Parameters

	Description
ON or 1	Turns on the equivalent circuit model display.
OFF or 0 (initial value)	Turns off the equivalent circuit model display.

Query response

{1|0}<newline><^END>

Corresponding key

[Display] - **more1/2** - **EQUIV CKT** - **CIRCUIT on OFF**

DISECPARA

Syntax

DISECPARA {ON|OFF|1|0}

DISECPARA?

Description

Toggles on and off the equivalent circuit parameter display. Executing equivalent circuit analysis (by the execution of “CALECPARA” command on page 275) automatically turns on the equivalent circuit parameter display.

Parameters

	Description
ON or 1	Turns on the equivalent circuit parameter display.
OFF or 0 (initial value)	Turns off the equivalent circuit parameter display.

Query response

{1|0}<newline><^END>

Corresponding key

[Display] - more1/2 - EQUIV CKT - PARAMETERS on OFF

DISL

Syntax

DISL

Description

Displays the list sweep table. (No query)

Corresponding key

[Copy] - SELECT CONTENTS - LIST SWEEP SEGMENTS ➢

DISLLIST

Syntax

DISLLIST

Description

Displays the limit line table. (No query)

Corresponding key

[Copy] - SELECT CONTENTS - LIMIT TEST SEGMENTS ➢

DISMAMP

Syntax

DISMAMP {UL|MD}

DISMAMP?

Description

Sets the limit range display format to display the limit line table.

Parameters

	Description
UL (initial value)	Specifies the range display format using the limit range upper limit and lower limit.
MD	Specifies the range display format using the limit range central value and range width.

Query response

{UL|MD}<newline><^END>

Corresponding key

[Copy] - **SELECT CONTENTS** - **LIMIT TEST SEGMENTS** - **DISP MODE[]**

DISMPRM

Syntax

DISMPRM {STSP|CTSP}

DISMPRM?

Description

Sets the sweep range display format to display the list sweep table.

Parameters

	Description
STSP (initial value)	Specifies the range display format using the sweep range start value and stop value.
CTSP	Specifies the range display format using the sweep range central value and range width.

Query response

{STSP|CTSP}<newline><^END>

Corresponding key

[Copy] - **SELECT CONTENTS** - **LIST SWEEP SEGMENTS** - **DISP MODE[]**

DISP

Syntax

DISP {DATA|MEMO|DATM|DMNM|DELP|DDVM}

DISP?

Description

For the active trace (set with the “TRAC” command on page 457), makes the setting related to the displayed trace.

If a parameter other than DATM is set, the scale setting target trace (set with the “SCAF” command on page 422) and the marker use target trace (set with the “MKRO” command on page 356) are also changed.

If no data has been copied to the memory trace (the “DATMEM” command on page 285 has not been executed), executing this command to set a parameter other than DATA causes an error and the command is ignored.

If the measurement parameter is a scalar value, executing this command to set DDVM causes an error and the command is ignored. If the measurement parameter is a vector value, executing this command to set DELP causes an error and the command is ignored.

Parameters

	Description [*1]
DATA (initial value)	Displays the data trace. The contents of the data trace is measured data (no operation).
MEMO [*2]	Displays the memory trace.
DATM [*2]	Displays both the data trace and the memory trace at the same time. The contents of the data trace is measured data (no operation).
DMNM [*2]	Displays the data trace. The contents of the data trace is the operation result of DATA - MEM.
DELP [*2,*3]	Displays the data trace. The contents of the data trace is the operation result of (DATA - MEM) / MEM.
DDVM [*2,*4]	Displays the data trace. The contents of the data trace is the operation result of DATA / MEM.

*1.In operation expressions in the description, DATA indicates measured data and MEM indicates data of the memory trace.
*2.Selectable only when data has been copied in the memory trace.
*3.Selectable only when the measurement parameter is a scalar value.
*4.Selectable only when the measurement parameter is a vector value.

Query response

{DATA|MEMO|DATM|DMNM|DELP|DDVM}<newline><^END>

Corresponding key

[Display] - **DEF TRACE[ ]** - {**DATA** | **MEMORY** | **DATA and MEMORY** | **DATA-MEM** | **DELTA %** | **DATA/MEM**}

DMKR

Syntax

DMKR {ON|FIX|TRAC|OFF}

DMKR?

Description

For the active trace (set with the “TRAC” command on page 457), makes the setting of the Δ marker. In the coupled marker mode (set with the “MKRCOUP” command on page 352), the setting is applied to both the A and B traces regardless of the active trace setting. If the marker function is off, executing this command causes an error and the command is ignored.

Parameters

	Description
ON	Turns on the Δ marker mode and places the Δ marker at the current marker position.
FIX	Turns on the Δ marker mode and places the fixed Δ marker at the current marker position.
TRAC	Turns on the Δ marker mode and places the tracking Δ marker at the current marker position.
OFF (initial value)	Turns off the Δ marker mode and clears the Δ marker.

Query response

{ON|FIX|TRAC|OFF}<newline><^END>

Corresponding key

[Marker] - **ΔMODE MENU** - {**ΔMKR** | **FIXED ΔMKR** | **TRACKING ΔMKR** | **ΔMKR OFF**}

DMKRAUV

Syntax

DMKRAUV <numeric>[OHM|DEG|RAD|SIE]

DMKRAUV?

Description

For the active trace (set with the “TRAC” command on page 457), if the measurement parameter is a vector value (for COMPLEX Z-Y), moves the fixed Δ marker at the position of the specified measurement parameter value (subsidiary readout). Executing this command as Query reads out the measurement parameter value of the fixed Δ marker (subsidiary readout).

If the measurement parameter is a scalar value (for other than COMPLEX Z-Y) or if the Δ marker mode is off, executing this command causes an error and the command is ignored.

Parameters

	<numeric>
Description	Specified measurement parameter value (subsidiary readout)
Range	-100E6 to 100E6
Initial value	0
Unit	Varies depending on the measurement parameter (refer to the explanation of unit in “SCAL” on page 423).

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Reads out the phase for the polar chart format. Reads out reactance (for trace A) or susceptance (for trace B) for the complex plane format.

Corresponding key

[Marker] - **ΔMODE MENU** - **FIXED ΔMKR AUX VALUE**

DMKRP

Syntax

DMKRP <numeric>

DMKRP?

Description

For the active trace (set with the “TRAC” command on page 457), moves the Δ marker to the specified measurement point. In the coupled marker mode (set with the “MKRCOUP” command on page 352), moves the Δ markers of both the A and B traces, regardless of the active trace setting. If this command is executed as Query, it reads out the measurement point number at the Δ marker position. If the Δ marker mode is off, executing this command causes an error and the command is ignored.

Parameters

	<numeric>
Description	Number of the destination measurement point (number given in order from the left edge assuming that the number of the left edge measurement point is 1)
Range	1 to the number of points
Initial value	1
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

No front panel key is available to execute this function.

DMKRPRM

Syntax

DMKRPRM <numeric>[HZ|MHZ|V|A]

DMKRPRM?

Description

For the active trace (set with the “TRAC” command on page 457), moves the Δ marker on the trace to the position of the specified sweep parameter value. Note that, for the fixed Δ marker, the Y axis (vertical axis) value is not changed before and after the move. In the coupled marker mode (set with the “MKRCOUP” command on page 352), regardless of the active trace setting, moves the Δ marker of both the A and B traces. If this command is executed as Query, it reads out the sweep parameter value at the Δ marker position. If the Δ marker mode is off, executing this command causes an error and the command is ignored.

Parameters

	<numeric>
Description	Sweep parameter value you want to specify
Range	Sweep start value to sweep stop value
Initial value	0
Unit	Varies depending on the sweep parameter (refer to the explanation of unit in “CENT” on page 277).
Resolution	Varies depending on the sweep parameter (refer to the explanation of resolution in “CENT” on page 277).

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Marker] - ΔMODE MENU - ΔMKR STIMULUS

DMKRVAL

Syntax

DMKRVAL <numeric>[OHM|DEG|RAD|SIE|H|F|PCT]

DMKRVAL?

Description

For the active trace (set with the “TRAC” command on page 457), moves the fixed Δ marker to the position of the specified measurement parameter value. Executing this command as Query reads out the measurement parameter value of the fixed Δ marker. If the Δ marker mode is off, executing this command causes an error and the command is ignored.

Parameters

	<numeric>
Description	Measurement parameter value you want to specify
Range	-100E6 to 100E6
Initial value	0
Unit	Varies depending on the measurement parameter (refer to the explanation of unit in “SCAL” on page 423)

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

If the measurement parameter is a scalar value (for other than COMPLEX Z-Y), the measurement parameter value is read out. If the measurement parameter is a vector value (for COMPLEX Z-Y), the readout is as follows.

- If the polar chart format is selected, the amplitude is read out.
- If the complex plane format is selected, resistance (for trace A) or conductance (for trace B) is read out.

Corresponding key

[Marker] - **ΔMODE MENU** - **FIXED ΔMKR VALUE**

DMODE

Syntax

DMODE {DMY|MDY}

DMODE?

Description

When the date printout setting is enabled (specified to ON with the “COPT” command on page 283), sets the display format of the date.

Parameters

	Description
DMY	Specifies the setting to display the date in the order of Day/Month/Year.
MDY (initial value)	Specifies the setting to display the date in the order of Month/Day/Year.

Query response

{DMY|MDY}<newline><^END>

Corresponding key

[System] - CLOCK -DATE MODE [ ]

DOUT

Syntax

DOUT

DOUT?

Description

Sets the input/output direction of port D (24-bit I/O port) to output.

To change the input/output direction of port D to input (preset state), use the “DIN” command on page 297.

Query response

{1|0}<newline><^END>

	Description
1	Output is selected as the input/output direction of port D.
0	Input is selected as the input/output direction of port D.

Corresponding key

No front panel key is available to execute this function.

DPI

Syntax

DPI <numeric>

DPI?

Description

Sets the print resolution (DPI) for printout.

Parameters

	<numeric>
Description	Print resolution
Range	75 to 600
Initial value	75
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Copy] - SETUP - DPI

DSKEY

Syntax

DSKEY

Description

Disables the operation of the front panel keys and the rotary knob. To enable their operation, execute the "ENKEY" command on page 310. (No query)

Corresponding key

No front panel key is available to execute this function.

E4TP

Syntax

E4TP {OFF|M1|M2|APC7|PROBE}

E4TP?

Description

Selects the adapter in the adapter setting.

Parameters

	Description
OFF (initial value)	Specifies no adapter (NONE).
M1	Specifies the Agilent 16048G (4TP 1M).
M2	Specifies the Agilent 16048H (4TP 2M).
APC7	Specifies the Agilent 42942A (7mm 42942A).
PROBE	Specifies the Agilent 42941A (PROBE 42941A).

Query response

{OFF|M1|M2|APC7|PROBE}<newline><^END>

Corresponding key

[Cal] - **ADAPTER [ ]** - {**NONE** | **4TP 1M** | **4TP 2M** | **7mm 42942A** | **PROBE 42941A**}

ECAL{P|A|B|C}

Syntax

ECAL{P|A|B|C}

Description

Measures the PHASE/OPEN/SHORT/LOAD data to calculate the setup data of the selected adapter. The “ECALP” command measures the PHASE data; the “ECALA” command, the OPEN data; the “ECALB” command, the SHORT data; the “ECALC” command, LOAD data. These data must be measured for each adapter (selected with the “E4TP” command on page 309). (No query)

Corresponding key

[Cal] - **ADAPTER [ ]** - **SETUP** - {**PHASE COMP [ ]** | **OPEN [ ]** | **SHORT [ ]** | **LOAD [ ]**}

ECALDON

Syntax

ECALDON

Description

Finishes the measurement of the data for the adapter setup and stores the measured data into the non-volatile memory. The setup data is stored as the data for the adapter selection specified at the measurement (data is stored for each adapter selection). (No query)

Corresponding key

[Cal] - **ADAPTER [ ]** - **SETUP** - **done**

ECALQUI

Syntax
ECALQUI

Description
Aborts the measurement of data to calculate the setup data of the selected adapter. (No query)

Corresponding key
[Cal] - **ADAPTER [ ]** - **SETUP** - **cancel**

EDITDONE

Syntax
EDITDONE

Description
Finishes the creation/edit of the list sweep table. Executing this command brings the created/edited table to take effect. (No query)

Corresponding key
[Sweep] - **EDIT LIST** - **done**

EDITLIML

Syntax
EDITLIML

Description
Starts the creation/edit of the limit line table. (No query)

Corresponding key
[System] - **LIMIT TEST** - **EDIT LIMIT LINE ➤**

EDITLIST

Syntax
EDITLIST

Description
Starts the creation/edit of the list sweep table. If a segment is being created/edited, executing this command causes an error and the command is ignored. (No query)

Corresponding key
[Sweep] - **EDIT LIST ➤**

ENKEY

Syntax
ENKEY

Description
Enables the operation of the front panel keys and the rotary knob that has been disabled with the “DSKEY” command on page 308. (No query)

Corresponding key
No front panel key is available to execute this function.

EQUC

Syntax

EQUC {CIRA|CIRB|CIRC|CIRD|CIRE}

EQUC?

Description

Selects an equivalent circuit model (A to E) used when executing the equivalent circuit analysis with the “CALECPARA” command on page 275. For details on each equivalent circuit model, refer to “Equivalent circuit analysis” on page 100.

Parameters

	Description
CIRA (initial value)	Specifies equivalent circuit model A.
CIRB	Specifies equivalent circuit model B.
CIRC	Specifies equivalent circuit model C.
CIRD	Specifies equivalent circuit model D.
CIRE	Specifies equivalent circuit model E.

Query response

{CIRA|CIRB|CIRC|CIRD|CIRE}<newline><^END>

Corresponding key

[Display] - **more 1/2** - **EQUIV CKT** - **SELECT CIRCUIT** - {**A** | **B** | **C** | **D** | **E**}

EQUC0?

Syntax

EQUC0? <numeric 1>[HZ|MHZ]

Description

If the sweep parameter is frequency, within the waveform analysis range specified with the “ANARANG” command on page 267, reads out equivalent circuit parameter C0 (parallel capacitance) at the specified frequency. If the sweep parameter is not frequency, executing this command causes an error and 0 is always read out.(Query only)

Parameters

	<numeric 1>
Description	Frequency you want to specify
Range	40 to 110E6
Unit	Hz
Resolution	1E-3

Query response

{numeric 2}<newline><^END>

	{numeric 2}
Description	C0 (parallel capacitance) at the specified frequency
Unit	F (farad)

Note that, if the specified frequency is out of the analysis range, 0 is read out.

Corresponding key

No front panel key is available to execute this function.

EQUCPARS4?

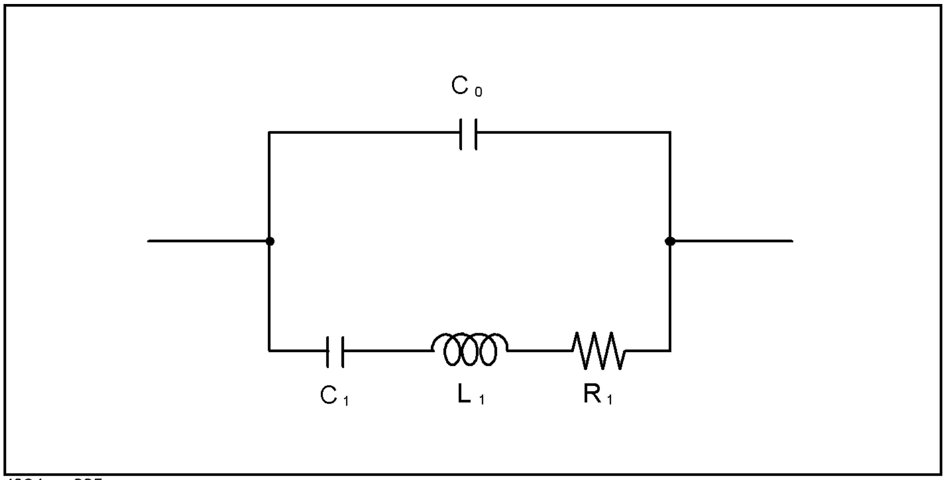
Syntax

EQUCPARS4?

Description

If the sweep parameter is frequency and the measurement parameter is |Z|-θ, within the waveform analysis range specified with the “ANARANG” command on page 267, analyzes the 4-device equivalent circuit parameters of a crystal oscillator (refer to Figure 16-1) using the admittance characteristic circle diagram (refer to Figure 16-2), and reads out them. If the sweep parameter is not frequency or the measurement parameter is not |Z|-θ, executing this command causes an error and all the readouts are 0. (Query only)

Figure 16-1 **4-device equivalent circuit of a crystal oscillator**



4294ape005

Query response

{numeric 1},{numeric 2},{numeric 3},{numeric 4},{numeric 5},{numeric 6},{numeric 7},{numeric 8},{numeric 9}<newline><^END>

Readouts are as follows:

{numeric 1}: Value of C_0 (parallel capacitance).

{numeric 2}: Value of C_1 (motional capacitance).

{numeric 3}: Value of L_1 (motional inductance).

{numeric 4}: Value of R_1 (motional resistance).

{numeric 5}: Value of f_s (motional (series) resonant frequency).

{numeric 6}: Value of f_a (anti-resonant frequency).

{numeric 7}: Value of f_r (resonant frequency).

{numeric 8}: Value of f_1 (frequency at which the conductance is half the maximum value).

{numeric 9}: Value of f_2 (frequency at which the conductance is half the maximum value). Note that $f_1<f_2$.

C_0, C_1, L_1 and R_1 are calculated using the following equations.

$C_0 = C_1 \times f_r^2/(f_a^2 - f_r^2)$

$C_1 = 1/(Q \times R_1 \times 2 \times \pi \times f_s)$

$L_1 = Q \times R_1/(2 \times \pi \times f_s)$

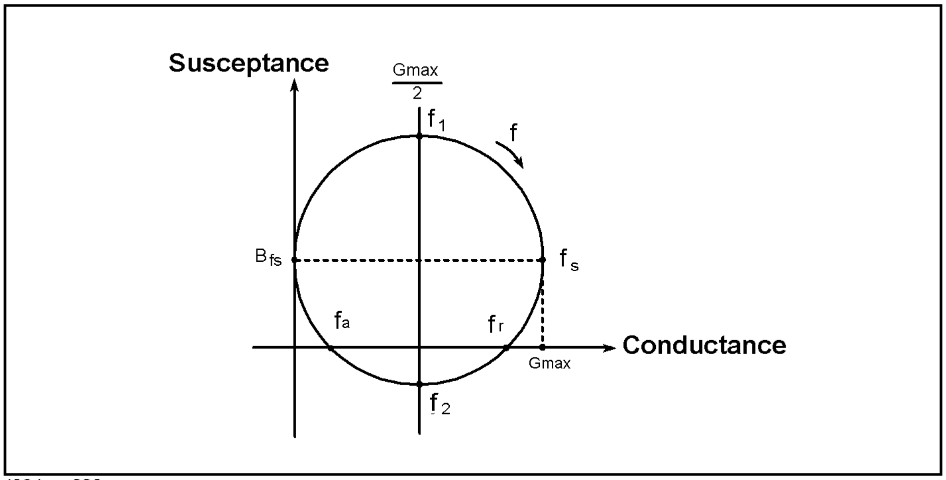
$R_1 = 1/G_{max}$

$Q = |f_s/(f_2 - f_1)|$

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

$C_0 = B_{fs}/(2 \times \pi \times f_s)$

Figure 16-2 **Admittance characteristic circle diagram**



4294ape006

Corresponding key No front panel key is available to execute this function.

ESB?

Syntax ESB?

Description Reads out the value of Instrument Event Status Register (Event Status Register B). (Query only)

Query response {numeric}<newline><^END>

Corresponding key No front panel key is available to execute this function.

ESNB

Syntax

ESNB <numeric>

ESNB?

Description

Sets the value of Instrument Event Status Enable Register (Event Status Enable Register B).

Parameters

	<numeric>
Description	Value of Instrument Event Status Enable Register
Range	0 to 65535
Initial value	0
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

No front panel key is available to execute this function.

EXPP

Syntax

EXPP {ON|OFF|1|0}

EXPP?

Description

For the active trace (set with the "TRAC" command on page 457), if the trace measurement parameter is phase, determines whether to perform the extended phase display (display in which phases out of the range between -180 and 180 are not rolled up). If the trace measurement parameter is not phase, executing this command causes an error and the command is ignored.

Parameters

	Description
ON or 1	Enables the extended phase display.
OFF or 0 (initial value)	Disables the extended phase display.

Query response

{1|0}<newline><^END>

Corresponding key

[Format] - **EXP PHASE on OFF**

FILC

Syntax

FILC <string 1>,<string 2>,<string 3>,<string 4>

Description

Copies a file. To specify a file, use a file name including its extension (refer to Table 8-1 on page 113). (No query)

Parameters

	<string 1>	<string 2>	<string 3>	<string 4>
Description	Copy source file name	Copy source device name	Copy destination file name	Copy destination device name
Range	12 characters or less (including the extension)	Select from "MEMO", "DISK", or "FLASH"*1	12 characters or less (including the extension)	Select from "MEMO", "DISK", or "FLASH" *1

*1.Each selection item indicates the device name as shown below.
"MEMO": RAM disk (volatile)
"DISK": Diskette
"FLASH": Flash disk (non-volatile)

Corresponding key

[Save] - **FILE UTILITIES** - **COPY FILE ➤**

FMT

Syntax

FMT {LINY|LOGY|POLA|COMP}

FMT?

Description

For the active trace (set with the “TRAC” command on page 457), selects the format to display the trace. Depending on the setting of the measurement parameter, the settable display format differs. Trying to select a non-settable display format causes an error and the command is ignored.

Parameters

For scalar measurement parameters:

	Description
LINY (initial value)	Specifies the linear Y axis format.
LOGY	Specifies the log Y axis format.

For vector measurement parameters:

	Description
POLA	Specifies the polar chart format.
COMP (initial value)	Specifies the complex plane format.

Query response

{LINY|LOGY|POLA|COMP}<newline><^END>

Corresponding key

[Format] - {**LIN** | **LOG** | **COMPLEX** | **POLAR**}

FNAME?

Syntax

FNAME? <numeric>

Description

Returns the file name corresponding to a specified number in the current directory. To each file, a number is assigned from 1 to "the number of the files" in alphabetical order. Use the "FNUM?"(316page) command to verify the number of the files in the current directory. (Query only)

Parameters

	<numeric>
Description	Specified file No.
Range	1 to "the number of the files in the current directory"

Query response

{string}<newline><^END>

Corresponding key

No front panel key is available to execute this function.

FNUM?

Syntax

FNUM?

Description

Returns the number of the files in the current directory. (Query only)

Query response

{numeric}<newline><^END>

Corresponding key

No front panel key is available to execute this function.

FORM2

Syntax

FORM2

Description

Sets the transfer format for reading array data to the IEEE 32-bit floating point format. For details about transfer formats, refer to "Data Transfer Format" on page 78. (No query)

Corresponding key

No front panel key is available to execute this function.

FORM3

Syntax

FORM3

Description

Sets the transfer format for reading array data to the IEEE 64-bit floating point format. For details about transfer formats, refer to "Data Transfer Format" on page 78. (No query)

Corresponding key

No front panel key is available to execute this function.

FORM4

Syntax

FORM4

Description

Sets the transfer format for reading array data to the ASCII format (preset state). For details about transfer formats, refer to "Data Transfer Format" on page 78. (No query)

Corresponding key

No front panel key is available to execute this function.

FORM5

Syntax

FORM5

Description

Sets the transfer format for reading array data to the MS-DOS personal computer format. For details about transfer formats, refer to "Data Transfer Format" on page 78. (No query)

Corresponding key

No front panel key is available to execute this function.

FORMFEED

Syntax

FORMFEED {ON|OFF|1|0}

FORMFEED?

Description

Enables/disables form feed for printout.

Parameters

	Description
ON or 1 (initial value)	Enables form feed.
OFF or 0	Disables form feed.

Query response

{1|0}<newline><^END>

Corresponding key

[Copy] - **SETUP** - **more 1/2** - **FORM FEED on OFF**

FSIZE?

Syntax

FSIZE? <string>

Description

Returns the size of a specified file in bytes. If the file does not exist, this command returns -1. (Query only)

Parameters

	Description
<string>	File name of up to 12 characters including its extension

Query response

{numeric}<newline><^END>

Corresponding key

No front panel key is available to execute this function.

HIDI

Syntax

HIDI {ON|OFF|1|0}

HIDI?

Description

Hides/shows the inactive trace and the grid.

Parameters

	Description
ON or 1	Hides them.
OFF or 0 (initial value)	Shows them.

Query response

{1|0}<newline><^END>

Corresponding key

[Display] - HIDE INACT on OFF

HOLD

Syntax

HOLD

HOLD?

Description

Sets the sweep mode to HOLD. In other words, the sweep is stopped.

Query response

{1|0}<newline><^END>

	Description
1	The sweep mode is set to HOLD.
0 (initial value)	The sweep mode is not set to HOLD.

Corresponding key

[Trigger] - HOLD

INID

Syntax

INID

Description

Initializes a disk inserted in the flexible disk drive, RAM disk, and flash disk. (No query)

Corresponding key

[Save] - **FILE UTILITIES** - **FORMAT ➤**

INP8IO?

Syntax

INP8IO?

Description

4-bit data is inputted to the 4294A through IN0 to IN3 of the 8-bit I/O port and the data is read out to the external controller. This command has the same function as the READIO(15,0) command of Instrument BASIC. (Query only)

Query response

{numeric}<newline><^END>

	{numeric}
Description	Decimal value for the 4-bit binary data inputted from IN0 to IN3, assuming that IN0 is LSB and IN3 is MSB.

Corresponding key

No front panel key is available to execute this function.

INPT?

Syntax

INPT?

Description

Reads out whether a pulse has been inputted to INPUT1 of the 24-bit I/O port, during the period between the last execution of this command and present time. After reading out the presence/absence of pulse inputs with this command, the no-pulse-input state occurs (the query response is 0). (Query only)

Query response

{1|0}<newline><^END>

	Description
1	Indicates that a pulse has been inputted into INPUT1.
0	Indicates that no pulse has been inputted into INPUT1.

Corresponding key

No front panel key is available to execute this function.

INPUCALC{1-3}

Syntax

INPUCALC{1|2|3} <numeric 1>,<numeric 2>,..,<numeric NOP×2-1>,<numeric NOP×2>

Description

Enters OPEN/SHORT/LOAD data for user calibration. Use the “INPUCALC1” command to enter OPEN data (G-B); the “INPUCALC2” command, SHORT data (R-X); the “INPUCALC3” command, LOAD data (R-X). When all the OPEN/SHORT/LOAD data is entered, the calibration coefficient is automatically calculated and it is stored into the non-volatile memory (backup memory). To use entered data, you are required to enter all the data.

Enter data after setting the standard values, because the standard values to be used in measuring data is needed to calculate user calibration coefficients.

A mismatch, between the number of required data at the execution of the command (defined by the measurement point setting for user calibration data (set with the “CALP” command on page 275) and the number-of-points setting) and the number of entered parameters, causes an error and the command is ignored. (No query)

Parameters

	Description
<numeric n×2-1>	Real part of the calibration data value (complex number) for the n-th measurement point
<numeric n×2>	Imaginary part of the calibration data value (complex number) for the n-th measurement point

Total of NOP×2 parameters are required because each measurement point value (complex number) is divided into 2 parameters for its real part and imaginary part. Where, NOP is the number of points (for user measurement points) or 100 (for fixed measurement points), and n is an integer between 1 and NOP.

Corresponding key

No front panel key is available to execute this function.

INPUCOMC{1-3}

Syntax

INPUCOMC{1-3} <numeric 1>,<numeric 2>,..,<numeric NOP×2-1>,<numeric NOP×2>

Description

Enters the OPEN/SHORT/LOAD compensation data for fixture compensation, calculates the compensation coefficient, and stores it into the non-volatile memory (backup memory). The “INPUCOMC1” command is for OPEN compensation data (G-B); the “INPUCOMC2” command, SHORT compensation data (R-X); the “INPUCOMC3” command, for LOAD compensation data (R-X).

Enter data after setting the standard values, because the standard values to be used in measuring data is needed to calculate fixture compensation coefficients.

A mismatch, between the number of required data at the execution of the command (defined by the measurement point setting for fixture compensation data (set with the “CALP” command on page 275) and the number-of-points setting) and the number of entered parameters, causes an error and the command is ignored. (No query)

Parameters

	Description
<numeric n×2-1>	Real part of the compensation data value (complex number) of the n-th measurement point.
<numeric n×2>	Imaginary part of the compensation data value (complex number) of the n-th measurement point.

Total of NOP×2 parameters are required because the fixture compensation data value (complex number) of each measurement point is divided into 2 parameters for its real part and imaginary part. Where, NOP is the number of points (for user measurement points) or 100 (for fixed measurement points), and n is an integer between 1 and NOP.

Corresponding key

No front panel key is available to execute this function.

INPUDATA

Syntax

INPUDATA <numeric 1>,<numeric 2>,..,<numeric NOP×2-1>,<numeric NOP×2>

Description

Enters a data array (refer to “Internal data arrays” on page 81). A mismatch, between the number-of-points setting at the execution of the command and the number of entered parameters, causes an error and the command is ignored. (No query)

Parameters

	Description
<numeric n×2-1>	Real part of the measurement parameter value (complex number) of the n-th measurement point.
<numeric n×2>	Imaginary part of the measurement parameter value (complex number) of the n-th measurement point.

Total of NOP×2 parameters are required because the measurement parameter value of each measurement point (complex number) is divided into 2 parameters for its real part and imaginary part. Where, NOP is the number of points, and n is an integer between 1 and NOP.

Corresponding key

No front panel key is available to execute this function.

INPUDTRC

Syntax

INPUDTRC <numeric 1>,<numeric 2>,..,<numeric NOP×2-1>,<numeric NOP×2>

Description

Enters a data trace array (refer to “Internal data arrays” on page 81). A mismatch, between the number-of-points setting at the execution of the command and the number of entered parameters, causes an error and the command is ignored. (No query)

Parameters

	Description
<numeric n×2-1>	The measurement parameter value of the n-th measurement point. If the measurement parameter is a vector value (COMPLEX Z-Y), the real part of the measurement parameter value (complex number).
<numeric n×2>	If the measurement parameter is a vector value (COMPLEX Z-Y), the imaginary part of the measurement parameter value (complex number) of the n-th measurement point. If the measurement parameter is a scalar value, the value is always 0.

Regardless of the measurement parameter setting, 2 parameters are required for each measurement point (total of NOP×2 parameters). Where, NOP is the number of points, and n is an integer between 1 and NOP.

Corresponding key

No front panel key is available to execute this function.

INTE

Syntax

INTE <numeric>[PCT]

INTE?

Description

Sets the brightness of the LCD screen.

Parameters

	<numeric>
Description	Percentage of the brightest status
Range	0 to 100
Initial value	100
Unit	% (percentage)
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Display] - more 1/2 - MODIFY COLOR - INTENSITY

KEY

Syntax

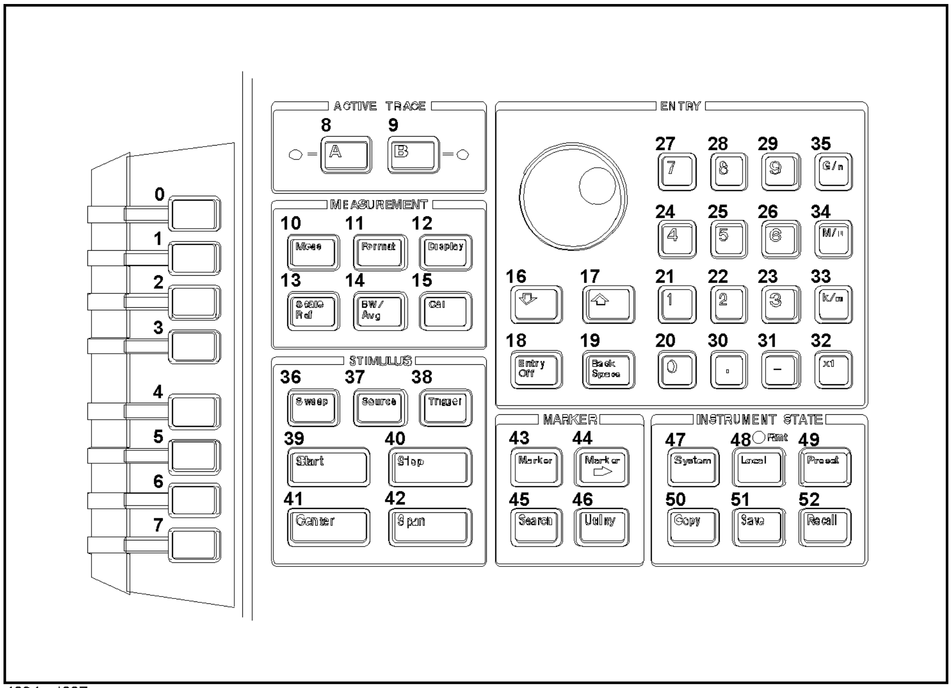
KEY <numeric>

KEY?

Description

Executing this command performs the same operation as a press of a specified front panel key. To specify a front panel key, use a key code. For the relationship between each key and its key code, refer to Figure 16-3.

Figure 16-3 **Key code of each key on the front panel**



4294apj007

Parameters

	<numeric>
Description	Key code of the front panel key you want to specify
Range	0 to 52
Initial value	-1
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

The readout is the key code last pressed.

Corresponding key

No front panel key is available to execute this function.

LANDSCAPE

Syntax

LANDSCAPE {ON|OFF|1|0}

LANDSCAPE?

Description

Enables/disables landscape printing for printout.

Parameters

	Description
ON or 1	Specifies landscape as the print direction.
OFF or 0 (initial value)	Specifies portrait as the print direction.

Query response

{1|0}<newline><^END>

Corresponding key

[Copy] - **SETUP** - **more 1/2** - **LANDSCAPE on OFF**

LIMCLEL

Syntax

LIMCLEL

Description

In the creation/edit of the limit line table, deletes all segments. Executing this command during the execution of segment creation/edit causes an error. If the creation/edit of the limit line table has not been started, executing this command automatically starts table creation/edit and then deletes all segments.(No query)

NOTE

Executing the “LIMEDONE” command on page 326 brings the created/edited limit line table to take effect.

Corresponding key

[System] - **LIMIT TEST** - **EDIT LIMIT LINE** - **CLEAR LIST ➢**

LIMDSTAR

Syntax

LIMDSTAR <numeric>[DEG|RAD|OHM|SIE|H|F|PCT]

LIMDSTAR?

Description

In the creation/edit of the limit line table, sets the limit width (=upper value - central value) of the start point of each segment (specified with the “LIMSTAR” command on page 334). Use this command, together with the “LIMVSTAR” command on page 339, when specifying the limits using the central value and the width.

If segment creation/edit has not been started, executing this command automatically starts the edit of the edit target segment and then sets the limit width of the start point.

If the creation/edit of the limit line table has not been started, executing this command automatically starts table creation/edit, starts the edit of the edit target segment and then sets the limit width of the start point.

Parameters

	<numeric>
Description	Limit width of the segment start point
Range	-1E9 to 1E9
Initial value	When creating segment 1: 0 When creating an additional segment: Set value of the previous segment
Unit	Varies depending on the measurement parameter (refer to the explanation of unit in “SCAL” on page 423).

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[System] - **LIMIT TEST** - **EDIT LIMIT LINE** - **EDIT** - **DELTA LIMIT**

LIMDSTOP

Syntax

LIMDSTOP <numeric>[DEG|RAD|OHM|SIE|H|F|PCT]

LIMDSTOP?

Description

In the creation/edit of the limit line table, sets the limit width (=upper value - central value) of the stop point of each segment (specified with the “LIMSTOP” command on page 336). Use this command, together with the “LIMVSTOP” command on page 340, when specifying the limits using the central value and the width.

If segment creation/edit has not been started, executing this command automatically starts the edit of the edit target segment and then sets the limit width of the stop point.

If the creation/edit of the limit line table has not been started, executing this command automatically starts table creation/edit, starts the edit of the edit target segment, and then sets the limit width of the stop point.

Parameters

	<numeric>
Description	Limit width of the segment stop point
Range	-1E9 to 1E9
Initial value	When creating segment 1: 0 When creating an additional segment: Set value of the previous segment
Unit	Varies depending on the measurement parameter (refer to the explanation of unit in “SCAL” on page 423).

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[System] - LIMIT TEST - EDIT LIMIT LINE - EDIT - more 1/3 - DELTA LIMIT

LIMEDONE

Syntax

LIMEDONE

Description

Finishes the creation/edit of the limit line table. Executing this command brings the created/edited table to take effect. (No query)

Corresponding key

[System] - LIMIT TEST - EDIT LIMIT LINE - done

LIMIAMPO

Syntax

LIMIAMPO <numeric>[DEG|RAD|OHM|SIE|H|F|PCT]

LIMIAMPO?

Description

For the active trace (set with the “TRAC” command on page 457), sets an offset value of the limit for the measurement parameter value.

Parameters

	<numeric>
Description	Offset value for the measurement parameter value
Range	-1E9 to 1E9
Initial value	0
Unit	Varies depending on the measurement parameter (refer to the explanation of unit in “SCAL” on page 423).

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[System] - LIMIT TEST - LIMIT LINE OFFSETS - AMPLITUDE OFFSET

LIMIPRMO

Syntax

LIMIPRMO <numeric>[HZ|MHZ|V|A]

LIMIPRMO?

Description

For the active trace (set with the “TRAC” command on page 457), sets an offset value of the limit for the sweep parameter value.

Parameters

	<numeric>
Description	Offset value for the sweep parameter value
Range	-1E9 to 1E9
Initial value	0
Resolution	Varies depending on the sweep parameter (refer to the explanation of resolution in “CENT” on page 277)

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[System] - LIMIT TEST - LIMIT LINE OFFSETS - SWP PARAM OFFSET

LIMITEST

Syntax

LIMITEST {ON|OFF|1|0}
LIMITEST?

Description

For the active trace (set with the “TRAC” command on page 457), toggles on and off the limit test function.

Parameters

	Description
ON or 1	Turns on the limit test function.
OFF or 0 (initial value)	Turns off the limit test function.

Query response

{1|0}<newline><^END>

Corresponding key

[System] - LIMIT TEST - LIMIT TEST on OFF

LIMLSTAR

Syntax

LIMLSTAR <numeric>[DEG|RAD|OHM|SIE|H|F|PCT]
LIMLSTAR?

Description

In the creation/edit of the limit line table, sets the lower limit of the start point of each segment (specified with the “LIMSTAR” command on page 334). Use this command, together with the “LIMUSTAR” command on page 337, when specifying the limits using the upper limit and the lower limit.

If segment creation/edit has not been started, executing this command automatically starts the edit of the edit target segment and then sets the lower limit of the start point.

If the creation/edit of the limit line table has not been started, executing this command automatically starts table creation/edit, starts the edit of the edit target segment, and then sets the lower limit of the start point.

Parameters

	<numeric>
Description	Lower limit of the segment start point
Range	-1E9 to 1E9
Initial value	When creating segment 1: 0 When creating an additional segment: Set value of the previous segment
Unit	Varies depending on the measurement parameter (refer to the explanation of unit in “SCAL” on page 423).

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[System] - LIMIT TEST - EDIT LIMIT LINE - EDIT - LOWER LIMIT

LIMLSTOP

Syntax

LIMLSTOP <numeric>[DEG|RAD|OHM|SIE|H|F|PCT]

LIMLSTOP?

Description

In the creation/edit of the limit line table, sets the lower limit of the stop point of each segment (specified with the “LIMSTOP” command on page 336). Use this command, together with the “LIMUSTOP” command on page 338, when specifying the limits using the upper limit and the lower limit.

If segment creation/edit has not been started, executing this command automatically starts the edit of the edit target segment and then sets the lower limit of the stop point.

If the creation/edit of the limit line table has not been started, executing this command automatically starts table creation/edit, starts the edit of the edit target segment, and then sets the lower limit of the stop point.

Parameters

	<numeric>
Description	Lower limit of the segment stop point
Range	-1E9 to 1E9
Initial value	When creating segment 1: 0 When creating an additional segment: Set value of the previous segment
Unit	Varies depending on the measurement parameter (refer to the explanation of unit in “SCAL” on page 423).

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[System] - LIMIT TEST - EDIT LIMIT LINE - EDIT - more 1/3 - LOWER LIMIT

LIMSADD

Syntax

LIMSADD [<numeric>]

Description

In the creation/edit of the limit line table, adds a new segment, changes the edit target segment to the added segment, and starts edit. The position where a segment is added is as follows:

- If a segment is specified:

  Added in the line below the specified segment.

- If no segment is specified:

  Added in the line below the segment specified as the edit target (set with the "LIMSEGM" command on page 333).

The number of the added segment is a value of the specified segment number (if no segment is specified, the edit target segment number before the execution of the command) plus 1, and the number of each following segment also increases by 1.

After the completion of the parameter setting of the segment, execute the "LIMSDON" command on page 331 to finish the edit work. After executing this command and the "LIMSEDI" command on page 332 (to start segment edit), executing this command, without executing the "LIMSDON" command, causes an error and the command is ignored.

If the creation/edit of the limit line table has not been started, executing this command automatically starts table creation/edit and then adds a segment. (No query)

Parameters

	<numeric>
Description	Segment number immediately before the addition and insertion location
Range	1 to the number of the segments in the limit line table
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Corresponding key

[System] - LIMIT TEST - EDIT LIMIT LINE - ADD ➢

LIMSDEL

Syntax

LIMSDEL [<numeric>]

Description

In the creation/edit of the limit line table, deletes the specified segment (if no segment is specified, the segment specified as the edit target) from the table.

The segment number of each segment after the deleted segment decreases by 1. As a result, the segment, whose number was changed to the same number as the deleted segment, is set to the edit target. Note that, if the last segment is deleted, the segment immediately before the deleted segment is set to the edit target. You can set any segment to the edit target using the "LIMSEGM" command on page 333.

During segment edit (after the execution of the "LIMSADD" command on page 330 or "LIMSEDI" command on page 332 and before the execution of the "LIMSDON" command on page 331), executing this command causes an error and the command is ignored.

If the creation/edit of the limit line table has not been started, executing this command automatically starts table creation/edit and then deletes the segment. (No query)

NOTE

Executing the "LIMEDONE" command on page 326 brings the created/edited limit line table to take effect.

Parameters

	<numeric>
Description	Segment number you want to delete
Range	1 to the number of the segments in the limit line table
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Corresponding key

[System] - **LIMIT TEST** - **EDIT LIMIT LINE** - **DELETE**

LIMSDON

Syntax

LIMSDON

Description

In the creation/edit of the limit line table, finishes segment creation/edit. Executing this command brings the created/edited segment to take effect. (No query)

NOTE

Executing the "LIMEDONE" command on page 326 brings the created/edited limit line table to take effect.

Corresponding key

[System] - **LIMIT TEST** - **EDIT LIMIT LINE** - **EDIT** - **done**

LIMSEDI

Syntax

LIMSEDI <numeric>

Description

In the creation/edit of the limit line table, starts the edit of the segment specified as the edit target (set with the “LIMSEGM” command on page 333). Note that, if a segment is specified, the edit target segment is changed to the specified segment and then the edit is started.

After the completion of the parameter setting of the segment, execute the “LIMSDON” command on page 331 to finish the edit work. After executing this command and the “LIMSADD” command on page 330 (to start segment edit), executing this command, without executing the “LIMSDON” command, causes an error and the command is ignored.

If the creation/edit of the limit line table has not been started, executing this command automatically starts table creation/edit and then starts the edit of the segment. (No query)

Parameters

	<numeric>
Description	Segment number you want to edit
Range	1 to the number of the segments in the limit line table
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Corresponding key

[System] - **LIMIT TEST** - **EDIT LIMIT LINE** - **EDIT ➤**

LIMSEGM

Syntax

LIMSEGM <numeric>

LIMSEGM?

Description

Sets the execution target segment used when no segment is specified at the execution of the "LIMSEDI" command on page 332, "LIMSADD" command on page 330, and "LIMSDEL" command on page 331. The setting of the execution target segment is initialized when the creation/edit of the limit line table is finished.

If the creation/edit of the limit line table is not started, executing this command automatically starts table creation/edit and then sets the execution target segment.

Parameters

	<numeric>
Description	Segment number you want to specify as the edit target
Range	1 to the number of the segments in the limit line table
Initial value	Segment number of the last line in the limit line table
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

If the creation/edit of the limit line table is not started, 0 is always read out.

Corresponding key

[System] - LIMIT TEST - EDIT LIMIT LINE - SEGMENT

LIMSQUI

Syntax

LIMSQUI

Description

In the creation/edit of the limit line table, aborts segment creation/edit. (No query)

Corresponding key

[System] - LIMIT TEST - EDIT LIMIT LINE - cancel

LIMSTAR

Syntax

LIMSTAR <numeric>[HZ|MHZ|V|A]

LIMSTAR?

Description

In the creation/edit of the limit line table, sets the sweep parameter value of each segment start point.

If segment creation/edit has not been started, executing this command automatically starts the edit of the edit target segment and then sets the sweep parameter value of the start point.

If the creation/edit of the limit line table has not been started, executing this command automatically starts table creation/edit, starts the edit of the edit target segment, and then sets the sweep parameter value of the start point.

Parameters

	<numeric>
Description	Sweep parameter value of the segment start point
Range	same as “STAR” command on page 444
Initial value	When creating segment 1: same as “STAR” command When creating an additional segment: Set value of the previous segment
Unit	same as “STAR” command
Resolution	same as “STAR” command

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[System] - LIMIT TEST - EDIT LIMIT LINE - EDIT - START

LIMSTEST

Syntax

LIMSTEST {ON|OFF|1|0}

LIMSTEST?

Description

In the creation/edit of the limit line table for the active trace (set with the “TRAC” command on page 457), toggles on and off the limit test function for each segment.

If segment creation/edit has not been started, executing this command automatically starts the edit of the edit target segment and then turns on/off the function.

If the creation/edit of the limit line table has not been started, executing this command automatically starts table creation/edit, starts the edit of the edit target segment, and then turns on/off the function.

Parameters

	Description
ON or 1 (initial value)	Turns on the segment limit test function.
OFF or 0	Turns off the segment limit test function.

Query response

{1|0}<newline><^END>

Corresponding key

[System] - **LIMIT TEST** - **EDIT LIMIT LINE** - **EDIT** - **more 1/3** - **more 2/3** - **TEST on OFF**

LIMSTOP

Syntax

LIMSTOP <numeric>[HZ|MHZ|V|A]

LIMSTOP?

Description

In the creation/edit of the limit line table, sets the sweep parameter value of each segment stop point.

If segment creation/edit has not been started, executing this command automatically starts the edit of the edit target segment and then sets the sweep parameter value of the stop point.

If the creation/edit of the limit line table has not been started, executing this command automatically starts table creation/edit, starts the edit of the edit target segment, and then sets the sweep parameter value of the stop point.

Parameters

	<numeric>
Description	Sweep parameter value of the segment stop point
Range	same as “STOP” command on page 446
Initial value	When creating segment 1: same as “STOP” command When creating an additional segment: Set value of the previous segment
Unit	same as “STOP” command
Resolution	same as “STOP” command

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[System] - **LIMIT TEST** - **EDIT LIMIT LINE** - **EDIT** - **more 1/3** - **STOP**

LIMUSTAR

Syntax

LIMUSTAR <numeric>[DEG|RAD|OHM|SIE|H|F|PCT]

LIMUSTAR?

Description

In the creation/edit of the limit line table, sets the upper limit of the start point of each segment (specified with the "LIMSTAR" command on page 334). Use this command, together with the "LIMLSTAR" command on page 328, when specifying the limits using the upper limit and the lower limit.

If segment creation/edit has not been started, executing this command automatically starts the edit of the edit target segment and then sets the upper limit of the start point.

If the creation/edit of the limit line table has not been started, executing this command automatically starts table creation/edit, starts the edit of the edit target segment, and then sets the upper limit of the start point.

Parameters

	<numeric>
Description	Upper limit of the segment start point
Range	-1E9 to 1E9
Initial value	When creating segment 1: 0 When creating an additional segment: Set value of the previous segment
Unit	Varies depending on the measurement parameter (refer to the explanation of unit in "SCAL" on page 423).

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[System] - LIMIT TEST - EDIT LIMIT LINE - EDIT - UPPER LIMIT

LIMUSTOP

Syntax

LIMUSTOP <numeric>[DEG|RAD|OHM|SIE|H|F|PCT]

LIMUSTOP?

Description

In the creation/edit of the limit line table, sets the upper limit of the stop point of each segment (specified with the “LIMSTOP” command on page 336). Use this command, together with the “LIMLSTOP” command on page 329, when specifying the limits using the upper limit and the lower limit.

If segment creation/edit has not been started, executing this command automatically starts the edit of the edit target segment and then sets the upper limit of the stop point.

If the creation/edit of the limit line table has not been started, executing this command automatically starts table creation/edit, starts the edit of the edit target segment, and then sets the upper limit of the stop point.

Parameters

	<numeric>
Description	Upper limit of the segment stop point
Range	-1E9 to 1E9
Initial value	When creating segment 1: 0 When creating an additional segment: Set value of the previous segment
Unit	Varies depending on the measurement parameter (refer to the explanation of unit in “SCAL” on page 423).

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[System] - **LIMIT TEST** - **EDIT LIMIT LINE** - **EDIT** - **more 1/3** - **UPPER LIMIT**

LIMVSTAR

Syntax

LIMVSTAR <numeric>[DEG|RAD|OHM|SIE|H|F|PCT]

LIMVSTAR?

Description

In the creation/edit of the limit line table, sets the limit central value of each segment start point (specified with the “LIMSTAR” command on page 334). Use this command, together with the “LIMDSTAR” command on page 325, when specifying the limits using the central value and the width.

If segment creation/edit has not been started, executing this command automatically starts the edit of the edit target segment and then sets the limit central value of the start point.

If the creation/edit of the limit line table has not been started, executing this command automatically starts table creation/edit, starts the edit of the edit target segment, and then sets the limit central value of the start point.

Parameters

	<numeric>
Description	Limit central value of the segment start point
Range	-1E9 to 1E9
Initial value	When creating segment 1: 0 When creating an additional segment: Set value of the previous segment
Unit	Varies depending on the measurement parameter (refer to the explanation of unit in “SCAL” on page 423).

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[System] - LIMIT TEST - EDIT LIMIT LINE - EDIT - MIDDLE VALUE

LIMVSTOP

Syntax

LIMVSTOP <numeric>[DEG|RAD|OHM|SIE|H|F|PCT]

LIMVSTOP?

Description

In the creation/edit of the limit line table, sets the limit central value of each segment stop point (specified with the "LIMSTOP" command on page 336). Use this command, together with the "LIMDSTOP" command on page 326, when specifying the limits using the central value and the width.

If segment creation/edit has not been started, executing this command automatically starts the edit of the edit target segment and then sets the limit central value of the stop point.

If the creation/edit of the limit line table has not been started, executing this command automatically starts table creation/edit, starts the edit of the edit target segment, and then sets the limit central value of the stop point.

Parameters

	<numeric>
Description	Limit central value of the segment stop point
Range	-1E9 to 1E9
Initial value	When creating segment 1: 0 When creating an additional segment: Set value of the previous segment
Unit	Varies depending on the measurement parameter (refer to the explanation of unit in "SCAL" on page 423).

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[System] - LIMIT TEST - EDIT LIMIT LINE - EDIT - more 1/3 - MIDDLE VALUE

LISPAN

Syntax

LISPAN {SINGLE|SEGMENT}

LISPAN?

Description

Sets the display of the frequency span at list sweep: using the range from the minimum value to the maximum value in all segments (single span), or using segment-by-segment allocation.

Parameters

	Description
SINGLE (initial value)	Specifies the single span display as the display method of the frequency span.
SEGMENT	Specifies the segment-by-segment display as the display method of the frequency span.

Query response

{SINGLE|SEGMENT}<newline><^END>

Corresponding key

[Sweep] - **LIST SPAN [ ]**

LISV

Syntax

LISV

Description

Displays the tabular list of all measurement points and measured values at each measurement point. Each measured value is updated each time a sweep is completed. To return to the normal measurement screen, execute the "RESD" command on page 411. (No query)

Corresponding key

[Copy] - **SELECT CONTENTS** - **LIST VALUE ➢**

LMARG

Syntax

LMARG <numeric>

LMARG?

Description

Sets the left margin (white space) on printed forms for printout.

Parameters

	<numeric>
Description	Left margin
Range	0 to 5
Initial value	1
Unit	inch
Resolution	0.01

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Copy] - **SETUP** - **LFT MARGIN**

LMAXS?

Syntax

LMAXS? <numeric 1>

Description

Reads out the measurement parameter value and sweep parameter value of the peak at the location specified with the order from the left edge of the sweep range among all peaks within the waveform analysis range set with the “ANARANG” command on page 267.

The peak searched for at the execution of this command satisfies the condition set with the “THRR” command on page 452. It is not related to the peak definition in the marker search function. (Query only)

Parameters

	<numeric 1>
Description	Location of the peak (the order of the peak from the left)
Range	1 to the number of points
Resolution	1

If the specified parameter is out of the setting range, the operation is the same as when no peak is detected.

Query response

{numeric 2},{numeric 3}<newline><^END>

	{numeric 2}	**{numeric 3}**
Description	Measurement parameter value	Sweep parameter value

If the specified peak is not detected, the readouts of {numeric 2} and {numeric 3} are 3.40282346638529E+038 and 0, respectively.

Corresponding key

No front panel key is available to execute this function.

LMINS?

Syntax

LMINS? <numeric 1>

Description

Reads out the measurement parameter value and sweep parameter value of the negative peak at the location specified with the order from the left edge of the sweep range among all negative peaks within the waveform analysis range set with the "ANARANG" command on page 267.

The negative peak searched for at the execution of this command satisfies the condition set with the "THRR" command on page 452. It is not related to the peak definition in the marker search function. (Query only)

Parameters

	<numeric 1>
Description	Location of the negative peak (the order of the negative peak from the left)
Range	1 to the number of points
Resolution	1

If the specified parameter is out of the setting range, the operation is the same as when no peak is detected.

Query response

{numeric 2},{numeric 3}<newline><^END>

	{numeric 2}	**{numeric 3}**
Description	Measurement parameter value	Sweep parameter value

If the specified negative peak is not detected, the readouts of {numeric 2} and {numeric 3} are 3.40282346639E+38 and 0, respectively.

Corresponding key

No front panel key is available to execute this function.

MANP

Syntax

MANP <value>

MANP?

Description

When the manual sweep function is on, sets a measurement point.

Parameters

	<value>
Description	A measurement point number (number assigned in order from the left end assuming that the left end measurement point is 1).
Range	1 to the number of measurement points
Preset value	1
Resolution	1

If the specified parameter is out of the allowable setup range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

After the execution of the command, the sweep range specified with the "MANR"(346page) command is canceled and the query response is (0,0).

Query response

{value}<newline><^END>

Equivalent key

No equivalent key is available on the front panel.

MANR

Syntax

MANR <value 1>,<value 2>

MANR?

Description

When the manual sweep function is on, sets a measurement range. You need to turn on the manual sweep with the “MANS”(347page) command before executing this command.

Parameters

	<value 1>	**<value 2>**
Description	The number of the sweep start point	The number of the sweep stop point
	Measurement point numbers are assigned in order from the left end assuming that the left end measurement point is 1.	
Range	1 to the number of measurement points or both <value 1> and <value 2> are 0.	
Preset value	0	0
Resolution	1	1

NOTE

When both <value 1> and <value 2> are 0, the measurement range for the manual sweep is set to the measurement point specified with the “MANP” on page 345 command.

Only when the specified parameters satisfy the condition value 1 < value 2, the sweep range is set properly. If this condition is not satisfied, the following occurs.

Condition	**Change of setting**
value ≤ 0	When both value 1 and value 2 are 0, they do not change. The sweep is performed for the point specified with the “MANP”(345page) command. Otherwise, 1 is set.
value > the number of measurement points	The value is set to the number of measurement points.
value 1 ≥ value 2	Value 1 is set to the value of value 2. The sweep is performed for the point specified with the “MANP”(345page) command.

Query response

{value 1},{value 2}<newline><^END>

Equivalent key

No equivalent key is available on the front panel.

MANS

Syntax

MANS {ON|OFF|1|0}

MANS?

Description

Turns on/off the manual sweep function.

Parameters

	Description
ON or 1	Turns on the manual sweep function.
OFF or 0 (initial value)	Turns off the manual sweep function.

Query response

{1|0}<newline><^END>

Corresponding key

[Sweep] - **MANUAL SWP on OFF**

MAXDCV

Syntax

MAXDCV <numeric>[V]

MAXDCV?

Description

Sets the voltage limit maximum value when the dc bias output mode is the constant-voltage mode or constant-current mode (CVOLT or CCURR has been specified with the “DCMOD” command on page 291).

Parameters

	<numeric>
Description	Voltage limit maximum value of the dc bias output
Range	-40 to 40
Initial value	40
Unit	V (volt)
Resolution	1E-3

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Source] - **BIAS MENU** - **MAX LIMIT VORTAGE**

MEAS

Syntax

MEAS {IMPH|IRIM|LSR|LSQ|CSR|CSQ|CSD|AMPH|ARIM|LPG|LPQ|CPG|CPQ|CPD|COMP|IMLS|IMCS|IMLP|IMCP|IMRS|IMQ|IMD|LPR|CPR}

MEAS?

Description

Selects impedance measurement parameters as a pair for trace A and trace B. Selecting COMP specifies the vector measurement; selecting others, the scalar measurement. There are functional differences between the vector measurement and the scalar measurement including available display formats and trace operations.

Parameters

	Set measurement parameters	
	Trace A	Trace B
IMPH (initial value)	|Z|	θ
IRIM	R	X
LSR	Ls	Rs
LSQ	Ls	Q
CSR	Cs	Rs
CSQ	Cs	Q
CSD	Cs	D
AMPH	|Y|	θ
ARIM	G	B
LPG	Lp	G
LPQ	Lp	Q
CPG	Cp	G
CPQ	Cp	Q
CPD	Cp	D
COMP	Z	Y
IMLS	|Z|	Ls
IMCS	|Z|	Cs
IMLP	|Z|	Lp
IMCP	|Z|	Cp
IMRS	|Z|	Rs
IMQ	|Z|	Q
IMD	|Z|	D
LPR	Lp	Rp
CPR	Cp	Rp

For details on each measurement parameter, refer to “Setting Measurement Parameters” on page 36.

Query response

{IMPH|IRIM|LSR|LSQ|CSR|CSQ|CSD|AMPH|ARIM|LPG|LPQ|CPG|CPQ|CPD|COMP|IMLS|IMCS|IMLP|IMCP|IMRS|IMQ|IMD|LPR|CPR}<newline><^END>

Corresponding key

[Meas] - {**|Z|-θ** | **R - X** | **Ls - Rs** | **Ls - Q** | **Cs - Rs** | **Cs - Q** | **Cs - D**}

[Meas] - **more 1/3** - {**|Y|-θ** | **G - B** | **Lp - G** | **Lp - Q** | **Cp - G** | **Cp - Q** | **Cp - D**}

[Meas] - **more 1/3** - **more 2/3** - {**COMPLEX Z-Y** | **|Z| - Ls** | **|Z| - Cs** | **|Z| - Lp** | **|Z| - Cs**}

[Meas] - **more 1/3** - **more 2/3** - **other** - {**|Z| - Rs** | **|Z| - Q** | **|Z| - D** | **Lp - Rp** | **Cp - Rp**}

MEASTAT

Syntax

MEASTAT {ON|OFF|1|0}

MEASTAT?

Description

For the active trace (set with the "TRAC" command on page 457), determines whether to, after the completion of each sweep, calculate the statistics (mean value, standard deviation, and difference value between the maximum value and the minimum value), of the search range in the trace selected as the marker use target trace (set with the "MKRO" command on page 356) and display the result on the screen.

Parameters

	Description
ON or 1	Enables the statistics display.
OFF or 0 (initial value)	Disables the statistics display.

Query response

{1|0}<newline><^END>

Corresponding key

[Utility] - **STATISTICS on OFF**

MINDCV

Syntax

MINDCV <numeric>[V]

MINDCV?

Description

Sets the voltage limit minimum value when the dc bias output mode is the constant-voltage mode or constant-current mode (CVOLT or CCURR has been specified with the “DCMOD” command on page 291).

Parameters

	<numeric>
Description	Voltage limit minimum value of the dc bias output
Range	-40 to 40
Initial value	-40
Unit	V (volt)
Resolution	1E-3

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Source] - **BIAS MENU** - **MIX LIMIT VOLTAGE**

MKR

Syntax

MKR {ON|OFF|1|0}

MKR?

Description

For the active trace (set with the “TRAC” command on page 457), toggles on and off the marker function. In the coupled marker mode (set with the “MKRCOUP” command on page 352), the setting is applied to both the A and B traces regardless of the active trace setting. Turning off the marker function using this command initializes the marker related settings.

Parameters

	Description
ON or 1	Turns on the marker function.
OFF or 0 (initial value)	Turns off the marker function.

Query response

{1|0}<newline><^END>

Corresponding key

[Marker] - **MKR ON off**

MKRAMPO

Syntax MKRAMPO

Description For the active trace (set with the “TRAC” command on page 457), sets the measurement parameter value at the marker position as the offset value of the limit for the measurement parameter value. (No query)

Corresponding key **[System] - LIMIT TEST - LIMIT LINE OFFSETS - MKR → AMP. OFST.**

MKRAUV?

Syntax MKRAUV?

Description For the active trace (set with the “TRAC” command on page 457), if the measurement parameter is a vector value (for COMPLEX Z-Y), reads out the subsidiary readout of the measurement parameter value at the marker position. (Query only)

Query response {numeric}<newline><^END>

If the measurement parameter is a scalar value (for other than COMPLEX Z-Y), 0 is always read out. If the measurement parameter is a vector value (for COMPLEX Z-Y), the value is as follows.

- If the polar chart format is selected, the phase is read out.
- If the complex plane format is selected, reactance (for trace A) or susceptance (for trace B) is reads out.

Corresponding key No front panel key is available to execute this function.

MKRCENT

Syntax MKRCENT

Description For the active trace (set with the “TRAC” command on page 457), sets the sweep parameter value at the marker position as the center value of the sweep range. To set the center value of each segment when creating the list sweep table, also use this command. If the marker function is off, executing this command causes an error and the command is ignored. (No query)

Corresponding key **[Marker→] - MKR → CENTER**

MKRCOUP

Syntax

MKRCOUP {ON|OFF|1|0}

MKRCOUP?

Description

As the marker move setting, selects the mode in which the markers on traces A and B are coupled when they are moved (coupled marker mode) or the mode in which the markers on traces A and B are moved separately. (uncoupled marker mode).

If the markers on traces A and B are at different positions when changing the mode from the uncoupled marker mode to the coupled marker mode, to the position of the marker on the active trace (set with the "TRAC" command on page 457), the other marker is moved.

Parameters

	Description
ON or 1 (initial value)	Specifies the coupled marker mode.
OFF or 0	Specifies the uncoupled marker mode.

Query response

{1|0}<newline><^END>

Corresponding key

[Marker] - MKR COUPLE ON off

MKRDSPAN

Syntax

MKRDSPAN

Description

For the active trace (set with the "TRAC" command on page 457), sets the sweep parameter value difference between the Δ marker and the marker as the span value of the sweep range. If the Δ marker mode is off, executing this command causes an error and the command is ignored. (No query)

Corresponding key

[Marker→] - MKRΔ → SPAN

MKRL

Syntax

MKRL {ON|OFF|1|0}

MKRL?

Description

For the active trace (set with the "TRAC" command on page 457), toggles on and off the marker list function. If the marker function is off, executing this command causes an error and the command is ignored.

Parameters

	Description
ON or 1	Turns on the marker list function.
OFF or 0 (initial value)	Turns off the marker list function.

Query response

{1|0}<newline><^END>

Corresponding key

[Utility] - MKR LIST on OFF

MKRLIMSTAR

Syntax

MKRLIMSTAR

Description

In the creation/edit of the limit line table, sets the sweep parameter value at the marker position as the sweep parameter value of the segment start point. This command is used, together with the “MKRLIMVSTAR” command on page 354, usually when setting the sweep parameter value and measured value at the marker position as the sweep parameter value and limit central value of the segment start point, respectively.

If segment creation/edit has not been started, executing this command automatically starts the edit of the edit target segment and then sets the sweep parameter value of the start point.

If the creation/edit of the limit line table has not been started, executing this command automatically starts table creation/edit, starts the edit of the edit target segment, and then sets the sweep parameter value of the start point.

If the marker function is off, executing this command causes an error and the command is ignored. (No query)

Corresponding key

[System] - **LIMIT TEST** - **EDIT LIMIT LINE** - **EDIT** - **more 1/3** - **more 2/3 - MKR → START**

MKRLIMSTOP

Syntax

MKRLIMSTOP

Description

In the creation/edit of the limit line table, sets the sweep parameter value at the marker position as the sweep parameter value of the segment stop point. This command is used, together with the “MKRLIMVSTOP” command on page 354, usually when setting the sweep parameter value and measured value at the marker position as the sweep parameter value and limit central value of the segment stop point, respectively.

If segment creation/edit has not been started, executing this command automatically starts the edit of the edit target segment and then sets the sweep parameter value of the stop point.

If the creation/edit of the limit line table has not been started, executing this command automatically starts table creation/edit, starts the edit of the edit target segment, and then sets the sweep parameter value of the stop point.

If the marker function is off, executing this command causes an error and the command is ignored. (No query)

Corresponding key

[System] - **LIMIT TEST** - **EDIT LIMIT LINE** - **EDIT** - **more 1/3** - **more 2/3 - MKR → STOP**

MKRLIMVSTAR

Syntax MKRLIMVSTAR

Description In the creation/edit of the limit line table, sets the measured value of the marker position as the limit central value of the segment start point. This command is used, together with the "MKRLIMSTAR" command on page 353, usually when setting the sweep parameter value and measured value at the marker position as the sweep parameter value and limit central value of the segment start point, respectively.

If segment creation/edit has not been started, executing this command automatically starts the edit of the edit target segment and then sets the limit central value of the start point.

If the creation/edit of the limit line table has not been started, executing this command automatically starts table creation/edit, starts the edit of the edit target segment, and then sets the limit central value of the start point.

If the marker function is off, executing this command causes an error and the command is ignored. (No query)

Corresponding key **[System]** - **LIMIT TEST** - **EDIT LIMIT LINE** - **EDIT** - **more 1/3** - **more 2/3** - **MKR → VALUE STAR**

MKRLIMVSTOP

Syntax MKRLIMVSTOP

Description In the creation/edit of the limit line table, sets the measured value of the marker position as the limit central value of the segment stop point. This command is used, together with the "MKRLIMSTOP" command on page 353, usually when setting the sweep parameter value and measured value at the marker position as the sweep parameter value and limit central value of the segment stop point, respectively.

If segment creation/edit has not been started, executing this command automatically starts the edit of the edit target segment and then sets the limit central value of the stop point.

If the creation/edit of the limit line table has not been started, executing this command automatically starts table creation/edit, starts the edit of the edit target segment, and then sets the limit central value of the stop point.

If the marker function is off, executing this command causes an error and the command is ignored. (No query)

Corresponding key **[System]** - **LIMIT TEST** - **EDIT LIMIT LINE** - **EDIT** - **more 1/3** - **more 2/3** - **MKR → VALUE STOP**

MKRMANP

Syntax MKRMANP

Description If the manual sweep function is on, sets the sweep parameter value at the marker position as the measurement point. (No query)

Corresponding key **[Marker→]** - **MKR → MANUAL SWP**

MKRMON

Syntax

MKRMON {OFF|ACV|ACI|DCV|DCI}

MKRMON?

Description

Enables/disables the display of the oscillator (OSC) level or dc bias level monitor value at the marker position measurement point. If you try to specify monitoring an item whose level monitor has been disabled in the oscillator level monitor function (set with the "OMON" command on page 365) or dc bias level monitor function (set with the "BMON" command on page 272), executing this command causes an error and the command is ignored.

Parameters

	Description
OFF (initial value)	Turns off the marker level monitor function.
ACV	Specifies the monitor value display of the oscillator voltage level.
ACI	Specifies the monitor value display of the oscillator current level.
DCV	Specifies the monitor value display of the dc bias voltage level.
DCI	Specifies the monitor value display of the dc bias current level.

Query response

{OFF|ACV|ACI|DCV|DCI}<newline><^END>

Corresponding key

[Utility] - **LEVEL MON [ ]** - {**OFF** | **AC-V** | **AC-I** | **DC-V** | **DC-I**}

MKRMOV

Syntax

MKRMOV {CONT|DISC}

MKRMOV?

Description

For the active trace (set with the "TRAC" command on page 457), switches between the continuous marker mode (markers can be moved to between measurement points) and the discrete marker mode (markers can be to measurement points only). In the coupled marker mode (set with the "MKRCOUP" command on page 352), regardless of the active trace setting, this setting is applied to both the A and B traces. In the continuous marker mode, the marker readout is an interpolated value derived from the data of the measurement points on both sides.

Parameters

	Description
CONT (initial value)	Specifies the continuous marker mode.
DISC	Specifies the discrete marker mode.

Query response

{CONT|DISC}<newline><^END>

Corresponding key

[Marker] - **MKR [ ]**

MKRO

Syntax

MKRO {DATA|MEMO}

MKRO?

Description

For the active trace (set with the “TRAC” command on page 457), sets the trace on which you want to use the markers. The displayed traces are the settable trace. Executing this command to specify a trace not displayed causes an error and the command is ignored.

Parameters

	Description
DATA (initial value)	Specifies the data trace.
MEMO	Specifies the memory trace.

Query response

{DATA|MEMO}<newline><^END>

Corresponding key

[Marker] -**MKR [ ]**

MKROFS

Syntax

MKROFS

Description

For the active trace (set with the “TRAC” command on page 457), sets the measurement parameter value at the marker position to the trace offset value. If the marker function is off, executing this command causes an error and the command is ignored. (No query)

Corresponding key

[Marker→] - **MKR → OFFSET**

MKRP

Syntax

MKRP <numeric>

MKRP?

Description

For the active trace (set with the “TRAC” command on page 457), moves the marker to the specified measurement point. In the coupled marker mode (set with the “MKRCOUP” command on page 352), regardless of the active trace setting, moves the markers on both the A and B traces. If this command is executed as Query, it reads out the measurement point number at the marker position. If the marker function is off, executing this command causes an error and the command is ignored.

Parameters

	<numeric>
Description	Number of the measurement point to which the marker is moved (the number assigned in order from the left edge assuming that the number of the leftmost measurement point is 1)
Range	1 to the number of points
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

In the continuous marker mode, the number of the largest measurement point that does not exceed the marker position is reads out.

Corresponding key

No front panel key is available to execute this function.

MKRPKD

Syntax

MKRPKD

Description

For the active trace (set with the “TRAC” command on page 457), sets ΔX and ΔY of the peak definition so that the current marker position is recognized as a peak. In other words, ΔX and ΔY are respectively set sweep parameter value difference and measurement parameter value difference between the maker and its left adjacent measurement point. Note that, if the Δ maker mode is on, ΔX and ΔY are respectively set sweep parameter value difference and measurement parameter value difference between the maker and the Δ maker.

If the marker function is off, executing this command causes an error and the command is ignored. (No query)

Corresponding key

[Search] - **PEAK** - **PEAK DEF MENU** - **MKR → PEAK DELTA**

MKRPRM

Syntax

MKRPRM <numeric>[HZ|MHZ|V|A]

MKRPRM?

Description

For the active trace (set with the “TRAC” command on page 457), moves the marker to the specified sweep parameter value. In the coupled marker mode (set with the “MKRCOUP” command on page 352), regardless of the active trace setting, moves the markers on both the A and B traces. If this command is executed as Query, it reads out the sweep parameter value of the marker position.

If the Δ marker mode is on, the marker moves the distance of the specified sweep parameter value relative to the Δ marker position. Therefore, specify the position to which you want to move the marker as the difference from the Δ marker. The readout, when this command is executed as query, is also the difference value from the Δ marker.

If the marker function is off, executing this command causes an error and the command is ignored.

Parameters

	<numeric>
Description	Position to which you want to move the marker
Range	“Sweep start value” to “sweep stop value”
Initial value	0
Unit	Varies depending on the sweep parameter (refer to the explanation of unit in “CENT” on page 277).
Resolution	Varies depending on the sweep parameter (refer to the explanation of resolution in “CENT” on page 277).

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Marker]

MKRREF

Syntax

MKRREF

Description

For the active trace (set with the “TRAC” command on page 457), sets the measurement parameter value at the marker position (regardless of on/off of the Δ marker mode, the marker readout when the Δ marker mode is off) as the reference value. If the marker function is off, executing this command causes an error and the command is ignored. (No query)

Corresponding key

[Scale Ref] - MKR → REFERENCE

MKRSTAR

Syntax MKRSTAR

Description For the active trace (set with the “TRAC” command on page 457), sets the sweep parameter value at the marker position as the sweep range start value. To set the start value of each segment when creating the list sweep table, also use this command. If the marker function is off, executing this command causes an error and the command is ignored. (No query)

Corresponding key **[Marker→] - MKR → START**

MKRSTOP

Syntax MKRSTOP

Description For the active trace (set with the “TRAC” command on page 457), sets the sweep parameter value at the marker position as the sweep range stop value. To set the stop value of each segment when creating the list sweep table, also use this command. If the marker function is off, executing this command causes an error and the command is ignored. (No query)

Corresponding key **[Marker→] - MKR → STOP**

MKRTR

Syntax MKRTR

Description For the active trace (set with the “TRAC” command on page 457), sets the range between the marker and the Δ marker as the partial search range. If the Δ marker mode is off, executing this command causes an error and the command is ignored. (No query)

Corresponding key **[Search] -SEARCH RANGE MENU - MKRΔ → SEARCH RNG**

MKRTRMAX

Syntax MKRTRMAX

Description For the active trace (set with the “TRAC” command on page 457), sets the marker position as the partial search range upper border value. If the marker function is off, executing this command causes an error and the command is ignored. (No query)

Corresponding key **[Search] -SEARCH RANGE MENU - MKR → MAXIMUM**

MKRTRMIN

Syntax

MKRTRMIN

Description

For the active trace (set with the “TRAC” command on page 457), sets the marker position as the partial search range lower border value. If the marker function is off, executing this command causes an error and the command is ignored. (No query)

Corresponding key

[Search] -**SEARCH RANGE MENU** - **MKR → MINIMUM**

MKRVAL?

Syntax

MKRVAL?

Description

For the active trace (set with the “TRAC” command on page 457), reads out the marker position measurement parameter value.

Query response

{numeric}<newline><^END>

If the measurement parameter is a scalar value (for other than COMPLEX Z-Y), the measurement parameter value is read out. If the measurement parameter is a vector value (for COMPLEX Z-Y), the readout is as follows:

- If the polar chart format is selected, the amplitude is read out.
- If the complex plane format is selected, resistance (for trace A) or conductance (for trace B) is read out.

Corresponding key

No front panel key is available to execute this function.

MKRXUNIT

Syntax

MKRXUNIT {STIM|TIME|RFREQ}

MKRXUNIT?

Description

For the active trace (set with the “TRAC” command on page 457), selects the method to display X-axis (horizontal axis) values of the marker. If the sweep parameter is not frequency, executing this command to select the relief time causes an error and the command is ignored.

Parameters

	Description
STIM (initial value)	Specifies the display in sweep parameter values.
TIME	Specifies the display in time*1.
RFREQ	Specifies the display in relief time (1/2πf, f: measurement frequency). (Selectable only when the sweep parameter is frequency.)

*1.The time spent from the sweep start until measurement completion of each point.

Query response

{STIM|TIME|RFREQ}<newline><^END>

Corresponding key

[Utility] - **MKR X-AXIS [ ]** - {**STIMULUS** | **TIME** | **1/(2πF)**}

MKRZM

Syntax

MKRZM

Description

For the active trace (set with the “TRAC” command on page 457), sets the marker sweep parameter value as the center value of the sweep range, and also sets the span value of the sweep range as the value of (span value before the execution of the command) × (zooming aperture value / 100). The zooming aperture value is set with the “ZMAPER” command on page 463. If the marker function is off, executing this command causes an error and the command is ignored. (No query)

Corresponding key

[Marker→] - **more 1/2** - **MKR ZOOM**

NEGL

Syntax

NEGL

NEGL?

Description

Sets the input/output signals of the 24-bit I/O port (data and test PASS/FAIL output) to negative logic (preset state). To specify positive logic, use the “POSL” command on page 403.

Query response

{1|0}<newline><^END>

	Description
1	Negative logic is specified.
0	Negative logic is not specified. In other words, positive logic is specified.

Corresponding key

No front panel key is available to execute this function.

NEXNPK?

Syntax

NEXNPK?

Description

Within the waveform analysis range set with the “ANARANG” command on page 267, searches for the minimum peak having a value more than the value of the negative peak that has been detected at the last execution of this command or the “NPEAK?” command on page 364, and reads out the measurement parameter value and sweep parameter value of the negative peak. If there are several applicable negative peaks, reads out the value of the leftmost negative peak within the analysis range. If no peak exists, 0 is read out.

The negative peak searched for at the execution of this command satisfies the condition set with the “THRR” command on page 452. It is not related to the peak definition in the marker search function. (Query only)

Query response

{numeric 1},{numeric 2}<newline><^END>

Readouts are as follows:

{numeric 1}: Measurement parameter value of the detected negative peak

{numeric 2}: Sweep parameter value of the detected negative peak

Corresponding key

No front panel key is available to execute this function.

NEXP

Syntax NEXP

Description When the measurement results are listed as a result of the execution of the “LISV” command on page 341, displays the next page of the list. To display the previous page, execute the “PREP” command on page 404. (No query)

Corresponding key **[Copy]** - **SELECT CONTENTS** - **LIST VALUE** - **NEXT PAGE**

NEXPK?

Syntax NEXPK?

Description Within the waveform analysis range set with the “ANARANG” command on page 267, searches for the maximum peak having a value less than the value of the peak that has been detected at the last execution of this command or the “PEAK?” command on page 397, and reads out the measurement parameter value and the sweep parameter value of the peak. If there are several applicable peaks, reads out the value of the leftmost peak within the analysis range. If no peak exists, 0 is read out.

The peak searched for at the execution of this command satisfies the condition set with the “THRR” command on page 452. It is not related to the peak definition in the marker search function. (Query only)

Query response {numeric 1},{numeric 2}<newline><^END>

Readout value are as follows:

{numeric 1}: Measurement parameter value of the detected peak

{numeric 2}: Sweep parameter value of the detected peak

Corresponding key No front panel key is available to execute this function.

NPEAK?

Syntax

NPEAK?

Description

Reads out the measurement parameter value and the sweep parameter value of the minimum negative peak within the waveform analysis range set with the “ANARANG” command on page 267. If there are several minimum negative peaks, reads out the value of the leftmost negative peak within the analysis range. If no negative peak exists, 0 is read out.

The negative peak searched for at the execution of this command satisfies the condition set with the “THRR” command on page 452. It is not related to the peak definition in the marker search function. (Query only)

Query response

{numeric 1},{numeric 2}<newline><^END>

Readouts are as follows:

{numeric 1}: Measurement parameter value of the minimum negative peak

{numeric 2}: Sweep parameter value of the minimum negative peak

Corresponding key

No front panel key is available to execute this function.

NUMG

Syntax

NUMG

Description

Performs sweeps the specified times. After the completion of the sweeps, the sweep mode is set to HOLD. (No query)

Parameters

	<numeric>
Description	Specified number of times
Range	1 to 999
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Trigger] - **NUMBER OF GROUPS**

OMON

Syntax

OMON {ON|OFF|1|0}

OMON?

Description

Toggles on and off the oscillator level monitor function.

Parameters

	Description
ON or 1	Turns on the oscillator level monitor function.
OFF or 0 (initial value)	Turns off the oscillator level monitor function.

Query response

{1|0}<newline><^END>

Corresponding key

[Display] - **OSC MON on OFF**

OPEP

Syntax

OPEP

Description

Lists the measurement parameter, sweep type, number of points, delay time (for each sweep, for each measurement point), sweep range (start value, stop value), and point averaging count on the LCD screen of the 4294A. (No query)

Corresponding key

[Copy] - **SELECT CONTENTS** - **OPERATING PARAMETERS ➤**

OSE

Syntax

OSE <numeric>

OSE?

Description

Sets the value of the Operation Status Enable Register.

Parameters

	<numeric>
Description	Value of the register
Range	0 to 65535
Initial value	0
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

No front panel key is available to execute this function.

OSER?

Syntax

OSER?

Description

Reads out the value of the Operation Status Event Register. (Query only)

Corresponding key

No front panel key is available to execute this function.

OSNT

Syntax

OSNT <numeric>

OSNT?

Description

Sets the value of the Negative Transition Filter of the Operation Status Register.

Parameters

	<numeric>
Description	Value of the filter
Range	0 to 65535
Initial value	0
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

No front panel key is available to execute this function.

OSPT

Syntax

OSPT <numeric>

OSPT?

Description

Sets the value of the Positive Transition Filter of the Operation Status Register.

Parameters

	<numeric>
Description	Value of the filter
Range	0 to 65535
Initial value	0
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

No front panel key is available to execute this function.

OSR?

Syntax

OSR?

Description

Reads out the value of the Operation Status Condition Register. (Query only)

Corresponding key

No front panel key is available to execute this function.

OUT1{H|L}

Syntax

OUT1{H|L}

Description

Sets OUTPUT1 of the 24-bit I/O port to HIGH (or LOW). (No query)

Corresponding key

No front panel key is available to execute this function.

OUT1ENV{H|L}

Syntax

OUT1ENV{H|L}

OUT1ENV{H|L}?

Description

Makes the setting so that OUTPUT1 goes to HIGH (or LOW) when a pulse is inputted to INPUT1 of the 24-bit I/O port.

Corresponding key

No front panel key is available to execute this function.

OUT2{H|L}

Syntax

OUT2{H|L}

Description

Sets the OUTPUT2 of the 24-bit I/O port to HIGH (or LOW). (No query)

Corresponding key

No front panel key is available to execute this function.

OUT2ENV{H|L}

Syntax

OUT2ENV{H|L}

OUT2ENV{H|L}?

Description

Makes the setting so that OUTPUT2 goes to HIGH (or LOW) when a pulse is inputted to INPUT1 of the 24-bit I/O port.

Corresponding key

No front panel key is available to execute this function.

OUT8IO

Syntax

OUT8IO <numeric>

Description

Outputs data to OUT0 to OUT7 of the 8-bit I/O port. Data is outputted as 8-bit binary, assuming that OUT0 is LSB and OUT7 is MSB. This command has the same function as the WRITEIO 15,0 command of Instrument BASIC. (Query only)

Parameters

	<numeric>
Description	Output data
Range	0 to 255
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Corresponding key

No front panel key is available to execute this function.

OUTAIO

Syntax

OUTAIO <numeric>

Description

Outputs data to output port A (A0 to A7) of the 24-bit I/O port. Data is outputted as 8-bit binary, assuming that A0 is LSB and A7 is MSB. This command has the same function as the WRITEIO 16,0 command of Instrument BASIC. (No query)

Parameters

	<numeric>
Description	Output data
Range	0 to 255
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Corresponding key

No front panel key is available to execute this function.

OUTBIO

Syntax

OUTBIO <numeric>

Description

Outputs data to output port B (B0 to B7) of the 24-bit I/O port. Data is outputted as 8-bit binary, assuming that B0 is LSB and B7 is MSB. This command has the same function as the WRITEIO 16,1 command of Instrument BASIC. (No query)

Parameters

	<numeric>
Description	Output data
Range	0 to 255
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Corresponding key

No front panel key is available to execute this function.

OUTCIO

Syntax

OUTCIO <numeric>

Description

If input/output port C of the 24-bit I/O port has been set to an output port (by the execution of the “COUT” command on page 283), outputs data to port C (C0 to C3). Data is outputted as 4-bit binary, assuming that C0 is LSB and C3 is MSB. If port C is set to an input port, executing this command causes an error and the command is ignored. This command has the same function as the WRITEIO 16,2 command of Instrument BASIC. (No query)

Parameters

	<numeric>
Description	Output data
Range	0 to 15
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Corresponding key

No front panel key is available to execute this function.

OUTDIO

Syntax

OUTDIO <numeric>

Description

If input/output port D of the 24-bit I/O port has been set to an output port (by the execution of the “DOUT” command on page 307), outputs data to port D (D0 to D3). Data is outputted as 4-bit binary, assuming that D0 is LSB and D3 is MSB. If port D is set to an input port, executing this command causes an error and the command is ignored. This command has the same function as the WRITEIO 16,3 command of Instrument BASIC. (No query)

Parameters

	<numeric>
Description	Output data
Range	0 to 15
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Corresponding key

No front panel key is available to execute this function.

OUTEIO

Syntax OUTEIO <numeric>

Description If input/output port E (port C + port D) of the 24-bit I/O port has been set to an output port (by the execution of the “COUT” command on page 283 and “DOUT” command on page 307), outputs data to port E. Data is outputted as 8-bit binary, assuming that C0 is LSB and D3 is MSB. If port C or port D is set to an input port, executing this command causes an error and the command is ignored. This command has the same function as the WRITEIO 16,4 command of Instrument BASIC. (No query)

Parameters

	<numeric>
Description	Output data
Range	0 to 255
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Corresponding key No front panel key is available to execute this function.

OUTFIO

Syntax OUTFIO <numeric>

Description Outputs data to output port F (port A + port B) of the 24-bit I/O port. Data is outputted as 16-bit binary, assuming that A0 is LSB and B7 is MSB. This command has the same function as the WRITEIO 16,5 command of Instrument BASIC. (No query)

Parameters

	<numeric>
Description	Output data
Range	0 to 65535
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Corresponding key No front panel key is available to execute this function.

OUTGIO

Syntax

OUTGIO <numeric>

Description

Outputs data to output port G (port A + port B + port C) of the 24-bit I/O port. Data is outputted as 20-bit binary, assuming that A0 is LSB and C3 is MSB. If port C is set to an input port, executing this command causes an error and the command is ignored. This command has the same function as the WRITEIO 16,6 command of Instrument BASIC. (No query)

Parameters

	<numeric>
Description	Output data
Range	0 to 1048575
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Corresponding key

No front panel key is available to execute this function.

OUTHIO

Syntax

OUTHIO <numeric>

Description

Outputs data to output port H (port A + port B + port C + port D) of the 24-bit I/O port. Data is outputted as 24-bit binary, assuming that A0 is LSB and D3 is MSB. If port C or port D is set to an input port, executing this command causes an error and the command is ignored. This command has the same function as the WRITEIO 16,7 command of Instrument BASIC. (No query)

Parameters

	<numeric>
Description	Output data
Range	0 to 16777215
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Corresponding key

No front panel key is available to execute this function.

OUTPCALC{1-3}?

Syntax OUTPCALC{1-3}?

Description Reads out the OPEN/SHORT/LOAD data for user calibration. Use the "OUTPCALC1" command to read out the OPEN data (G-B); the "OUTPCALC2" command, the SHORT data (R-X); the "OUTPCALC3" command, the LOAD data (R-X). (Query only)

Query response {numeric 1},{numeric 2},..,{numeric NOP×2-1},{numeric NOP×2}<newline><^END>

Reads out the real part and the imaginary part of each measurement point value (complex number) separately. Where, NOP is the number of points (for user measurement points) or 100 (for fixed measurement points), and n is an integer between 1 and NOP.

{numeric n×2-1}:	Value of the n-th measurement point (real part)
{numeric n×2}:	Value of the n-th measurement point (imaginary part)

Corresponding key No front panel key is available to execute this function.

OUTPCERR?

Syntax OUTPCERR?

Description If the sweep parameter is frequency and the measurement parameter is |Z|-θ, within the waveform analysis range specified with the "ANARANG" command on page 267, obtains the parameters of a ceramic resonator and reads out the results. If the sweep parameter is not frequency or if the measurement parameter is not |Z|-θ, executing this command causes an error and all readouts are 0. (Query only)

Query response {numeric 1},{numeric 2},{numeric 3},{numeric 4},{numeric 5},{numeric 6},{numeric 7}<newline><^END>

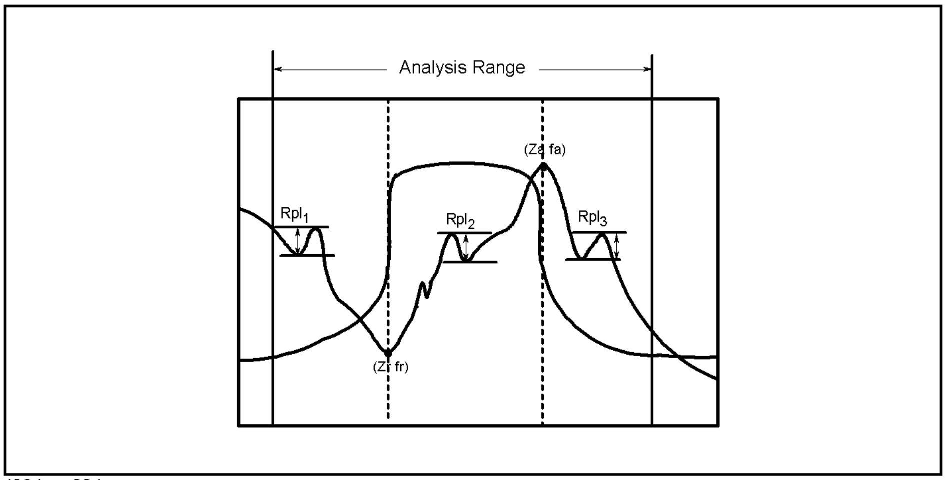
The readouts are as follows:

{numeric 1}:	Value of Z_r (resonant impedance).
{numeric 2}:	Value of f_r (resonant frequency).
{numeric 3}:	Value of Z_a (anti-resonant impedance).
{numeric 4}:	Value of f_a (anti-resonant frequency).
{numeric 5}:	Value of Rpl_1 (the maximum value of the left-side ripple (the sweep parameter difference between the peak and the left adjacent negative peak) within the range to the left of the resonant point within the waveform analysis range).
{numeric 6}:	Value of Rpl_2 (the maximum value of the right-side ripple (the sweep parameter difference between the peak and the right adjacent negative peak) within the range between the resonant point and the anti-resonant point within the waveform analysis range).
{numeric 7}:	Rpl_3 (the maximum value of the left-side ripple within the range to the right of the resonant point within the waveform analysis range).

This command defines the minimum negative peak as the resonant point and the maximum peak as the anti-resonant point. For parameters not obtained because no peak and negative peak are detected, 0 is read out.

The peak and negative peak used at the execution of this command satisfies the condition set with the “THRR” command on page 452. They are not related to the peak definition in the marker search function.

Figure 16-4 **Analyzed parameters of a ceramic resonator**



4294ape004

Corresponding key No front panel key is available to execute this function.

OUTPCOMC{1-3}?

Syntax OUTPCOMC{1-3}?

Description Reads out OPEN/SHORT/LOAD data for fixture compensation. Use the “OUTPCOMC1” command to read out OPEN data (G-B); the “OUTPCOMC2” command, SHORT data (R-X); the “OUTPCOMC3” command, LOAD data (R-X). (Query only)

Query response {numeric 1},{numeric 2},..,{numeric NOP×2-1},{numeric NOP×2}<newline><^END>

Reads out the real part and imaginary part of each measurement point value (complex number) separately. Where, NOP is the number of points (for user measurement points) or 100 (for fixed measurement points), and n is an integer between 1 and NOP.

{numeric n×2-1}: Value of the n-th measurement point (real part).

{numeric n×2}: Value of the n-th measurement point (imaginary part).

Corresponding key No front panel key is available to execute this function.

OUTPDATA?

Syntax

OUTPDATA?

Description

Reads out the values (complex number) of all measurement points in a data array (refer to “Internal data arrays” on page 81). (Query only)

Query response

{numeric 1},{numeric 2},..,{numeric NOP×2-1},{numeric NOP×2}<newline><^END>

Reads out the real part and imaginary part of each measurement point value (complex number) separately. Where, NOP is the number of points, and n is an integer between 1 and NOP.

{numeric n×2-1}: Measurement parameter value of the n-th measurement point (real part).

{numeric n×2}: Measurement parameter value of the n-th measurement point (imaginary part).

Corresponding key

No front panel key is available to execute this function.

OUTPDATAP?

Syntax

OUTPDATAP? <numeric 1>

Description

Reads out the value (complex number) of the specified measurement point in a data array (refer to “Internal data arrays” on page 81). (Query only)

Parameters

	<numeric 1>
Description	Number of the measurement point you want to read out (the number assigned in order from the left edge assuming that the number of the leftmost measurement point is 1)
Range	1 to the number of points
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric 2},{numeric 3}<newline><^END>

The real part and imaginary part are read out separately as shown below.

{numeric 2}: Measurement parameter value of the specified measurement point (real part).

{numeric 3}: Measurement parameter value of the specified measurement point (imaginary part).

Corresponding key

No front panel key is available to execute this function.

OUTPDC?

Syntax

OUTPDC?

Description

In the dc bias level monitor function, if monitoring voltage or current is enabled (VOLT or CURR has been specified with the “BMON” command on page 272), reads out the dc bias level voltage or current monitor value at all measurement points. (Query only)

Query response

{numeric 1},{numeric 2},..,{numeric NOP}<newline><^END>

Where, NOP is the number of points.

If the oscillator level monitor function is set to off, the readout are invalid.

Corresponding key

No front panel key is available to execute this function.

OUTPDCP?

Syntax

OUTPDCP? <numeric 1>

Description

In the dc bias level monitor function, if monitoring voltage or current is enabled (VOLT or CURR has been specified with the “BMON” command on page 272), reads out the dc bias level voltage or current monitor value of the specified measurement point. (Query only)

Parameters

	<numeric 1>
Description	Number of the measurement point you want to read out (the number assigned in order from the left edge assuming that the number of the leftmost measurement point is 1)
Range	1 to the number of points
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric 2}<newline><^END>

	{numeric 2}
Description	Voltage or current monitor value of the dc bias level

If the oscillator level monitor function is set to off, the readout is invalid.

Corresponding key

No front panel key is available to execute this function.

OUTPDMKR?

Syntax

OUTPDMKR?

Description

For the active trace (set with the “TRAC” command on page 457), reads out the measurement parameter value and sweep parameter value of the Δ marker position. If the Δ marker mode is off, executing this command causes an error and the readouts are invalid. (Query only)

Query response

{numeric 1},{numeric 2},{numeric 3}<newline><^END>

Readouts are as follows:

{numeric 1}: Readout of the measurement parameter value at the Δ marker position. If the measurement parameter is a scalar value (for other than COMPLEX Z-Y), the measurement parameter value is read out. If the measurement parameter is a vector value (for COMPLEX Z-Y), the readout is as follows:

- If the polar chart format is selected, the amplitude is read out.
- If the complex plane format is selected, resistance (for trace A) or conductance (for trace B) is read out.

{numeric 2}: Subsidiary readout of the measurement parameter value at the Δ marker position. If the measurement parameter is a scalar value (for other than COMPLEX Z-Y), 0 is always read out. If the measurement parameter is a vector value (for COMPLEX Z-Y), the readout is as follows:

- If the polar chart format is selected, the phase is read out.
- If the complex plane format is selected, reactance (for trace A) or susceptance (for trace B) is reads out.

{numeric 3}: Sweep parameter value at the Δ marker position.

Corresponding key

No front panel key is available to execute this function.

OUTPDTRC?

Syntax OUTPDTRC?

Description Reads out the values of all measurement points in a data trace array (refer to “Internal data arrays” on page 81). (Query only)

Query response {numeric 1},{numeric 2},..,{numeric NOP×2-1},{numeric NOP×2}<newline><^END>

Reads out the readout and subsidiary readout of the measurement parameter value of each measurement point as shown below. Where, NOP is the number of points, and n is an integer between 1 and NOP.

{numeric n×2-1}: Readout of the n-th measurement point. If the measurement parameter is a scalar value (for other than COMPLEX Z-Y), the measurement parameter value is read out. If the measurement parameter is a vector value (for COMPLEX Z-Y), resistance (for trace A) or conductance (for trace B) is read out.

{numeric n×2}: Subsidiary readout of the n-th measurement point. If the measurement parameter is a scalar value (for other than COMPLEX Z-Y), 0 is always read out. If the measurement parameter is a vector value (for COMPLEX Z-Y), reactance (for trace A) or susceptance (for trace B) is reads out.

Corresponding key No front panel key is available to execute this function.

OUTPDTRCP?

Syntax

OUTPDTRCP? <numeric 1>

Description

Reads out the value of the specified measurement point in a data trace array (refer to "Internal data arrays" on page 81). (Query only)

Parameters

	<numeric 1>
Description	Number of the measurement point you want to read out (the number assigned in order from the left edge assuming that the number of the leftmost measurement point is 1)
Range	1 to the number of points
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric 2},{numeric 3}<newline><^END>

Reads out the readout and subsidiary readout of the measurement parameter value as shown below.

{numeric 2}: Readout of the specified measurement point. If the measurement parameter is a scalar value (for other than COMPLEX Z-Y), the measurement parameter value is read out. If the measurement parameter is a vector value (for COMPLEX Z-Y), resistance (for trace A) or conductance (for trace B) is read out.

{numeric 3}: Subsidiary readout of the specified measurement point. If the measurement parameter is a scalar value (for other than COMPLEX Z-Y), 0 is always read out. If the measurement parameter is a vector value (for COMPLEX Z-Y), reactance (for trace A) or susceptance (for trace B) is read out.

Corresponding key

No front panel key is available to execute this function.

OUTPERRO?

Syntax

OUTPERRO?

Description

Reads out the oldest error among errors stored in the error queue of the 4294A. The size of the error queue is 10. (Query only)

Query response

{numeric},{string}<newline><^END>

	{numeric}	{string}
Description	Error number	Error message (string with double quotation marks ("))

If no error is stored in the error queue, the read-out error number is 0 and the error message is "No error."

Corresponding key

No front panel key is available to execute this function.

OUTPFAIP?

Syntax

OUTPFAIP?

Description

For the active trace (set with the “TRAC” command on page 457), reads out the number of points whose limit test result is FAIL. (Query only)

Query response

{numeric}<newline><^END>

Corresponding key

No front panel key is available to execute this function.

OUTPIAC?

Syntax

OUTPIAC?

Description

When the oscillator level monitor function is set to on (set to ON with “OMON” command on page 365), reads out the oscillator current level monitor values of all measurement points. (Query only)

Query response

{numeric 1},{numeric 2},..,{numeric NOP}<newline><^END>

Where, NOP is the number of points.

If the oscillator level monitor function is set to off, the readouts are invalid.

Corresponding key

No front panel key is available to execute this function.

OUTPIACP?

Syntax

OUTPIACP? <numeric 1>

Description

When the oscillator level monitor function is set to on (set to ON with "OMON" command on page 365), reads out the oscillator current level monitor value of the specified measurement point. (Query only)

Parameters

	<numeric 1>
Description	Number of the measurement point you want to read out (the number assigned in order from the left edge assuming that the number of the leftmost measurement point is 1)
Range	1 to the number of points
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric 2}<newline><^END>

	{numeric 2}
Description	Current monitor value of the oscillator level

If the oscillator level monitor function is set to off, the readout is invalid.

Corresponding key

No front panel key is available to execute this function.

OUTPINPCIO?

Syntax

OUTPINPCIO?

Description

When input/output port C of the 24-bit I/O port is set to an input port (by the execution of the "CIN" command on page 278), 4-bit data is inputted into the 4294A through port C (C0 to C3) and the data is read out to the external controller. If port C is set to an output port, executing this command causes an error and the command is ignored. This command has the same function as the READIO(16,2) command of Instrument BASIC.

Query response

{numeric}<newline><^END>

	{numeric}
Description	Decimal value for the 4-bit binary data inputted from C0-C3, assuming that C0 is LSB and C3 is MSB.

Corresponding key

No front panel key is available to execute this function.

OUTPINPDIO?

Syntax

OUTPINPDIO?

Description

When input/output port D of the 24-bit I/O port is set to an input port (by the execution of the “DIN” command on page 297), 4-bit data is inputted into the 4294A through port D (D0 to D3) and the data is read out to the external controller. If port D is set to an output port, executing this command causes an error and the command is ignored. This command has the same function as the READIO(16,3) command of Instrument BASIC.

Query response

{numeric}<newline><^END>

	{numeric}
Description	Decimal value for the 4-bit binary data inputted from D0-D3, assuming that D0 is LSB and D3 is MSB.

Corresponding key

No front panel key is available to execute this function.

OUTPINPEIO?

Syntax

OUTPINPEIO?

Description

When input/output port E (port C + port D) of the 24-bit I/O port is set to an input port (by the execution of the “CIN” command on page 278 and “DIN” command on page 297), 8-bit data is inputted into the 4294A through port E (C0-D3) and the data is read out to the external controller. If port E is set to an output port, executing this command causes an error and the command is ignored. This command has the same function as the READIO(16,4) command of Instrument BASIC.

Query response

{numeric}<newline><^END>

	{numeric}
Description	Decimal value for the 8-bit binary data inputted from C0-D3, assuming that C0 is LSB and D3 is MSB.

Corresponding key

No front panel key is available to execute this function.

OUTPLIMF?

Syntax OUTPLIMF?

Description For the active trace (set with the “TRAC” command on page 457), reads out the limit test results of measurement points that failed the test (FAIL). (Query only)

Query response {numeric 1},{numeric 2},..,{numeric F_NOP×4}<newline><^END>

Where, F_NOP is the number of points that failed the test, which can be obtained using the “OUTPFAIP?” command on page 380. As shown below, for each measurement point, NOP sets of values (sweep parameter value, test result, upper limit, and lower limit) are read out in this order (total of F_NOP×4 values).

{numeric n×4+1}: Sweep parameter value

{numeric n×4+2}: Limit test result (always 0)

{numeric n×4+3}: Upper border value of the limit

{numeric n×4+4}: Lower border value of the limit

Where, n is an integer between 0 and F_NOP - 1.

Note that if there is no failed measurement point, only 1 piece of data, whose value is 1, is read out.

Corresponding key No front panel key is available to execute this function.

OUTPLIML?

Syntax OUTPLIML?

Description For the active trace (set with the “TRAC” command on page 457), reads out the limit test results of all measurement points. (Query only)

Query response {numeric 1},{numeric 2},..,{numeric NOP×4}<newline><^END>

Where, NOP is the number of points specified using the “POIN” command on page 401. As shown below, for each measurement point, NOP sets of values (sweep parameter value, test result, upper limit, and lower limit) are read out in this order (total of NOP×4 values).

{numeric n×4+1}: Sweep parameter value

{numeric n×4+2}: Limit test result

0: FAIL

1: PASS

-1: Test was off.

{numeric n×4+3}: Upper border value of the limit

{numeric n×4+4}: Lower border value of the limit

Where, n is an integer between 0 and NOP-1.

Corresponding key No front panel key is available to execute this function.

OUTPLIMM?

Syntax

OUTPLIMM?

Description

For the active trace (set with the “TRAC” command on page 457), reads out the limit test result of measurement point of the marker position. If the marker function is off, executing this command causes an error and invalid values are read out. (Query only)

Query response

{numeric 1},{numeric 2},{numeric 3},{numeric 4}<newline><^END>

The readouts are as follows:

{numeric 1}: Sweep parameter value

{numeric 2}: Limit test result

0: FAIL

1: PASS

-1: Test was off.

{numeric 3}: Upper border value of the limit

{numeric 4}: Lower border value of the limit

Corresponding key

No front panel key is available to execute this function.

OUTPMAX?

Syntax

OUTPMAX?

Description

Reads out the maximum measurement parameter value and the sweep parameter value at the position, within the waveform analysis range set with the “ANARANG” command on page 267. If there are several measurement points of the maximum measurement parameter value, reads out the value of the leftmost measurement point within the analysis range. (Query only)

Query response

{numeric 1},{numeric 2}<newline><^END>

Readouts are as follows:

{numeric 1}: Maximum measurement parameter value.

{numeric 2}: Sweep parameter value at the position of the maximum measurement parameter value.

Corresponding key

No front panel key is available to execute this function.

OUTPMEMO?

Syntax

OUTPMEMO?

Description

Reads out the values (complex number) of all measurement points in the memory array (refer to “Internal data arrays” on page 81). (Query only)

Query response

{numeric 1},{numeric 2},..,{numeric NOP×2-1},{numeric NOP×2}<newline><^END>

Reads out the real part and imaginary part of each measurement point value (complex number) separately. Where, NOP is the number of points, and n is an integer between 1 and NOP.

{numeric n×2-1}: Measurement parameter value of the n-th measurement point (real part).

{numeric n×2}: Measurement parameter value of the n-th measurement point (imaginary part).

Corresponding key

No front panel key is available to execute this function.

OUTPMEMOP?

Syntax

OUTPMEMOP? <numeric 1>

Description

Reads out the value (complex number) of the specified measurement point in the memory array (refer to “Internal data arrays” on page 81). (Query only)

Parameters

	<numeric 1>
Description	Number of the measurement point you want to read out (the number assigned in order from the left edge assuming that the number of the leftmost measurement point is 1)
Range	1 to the number of points
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric 2},{numeric 3}<newline><^END>

The real part and imaginary part are read out separately as shown below.

{numeric 2}: Measurement parameter value of the specified measurement point (real part).

{numeric 3}: Measurement parameter value of the specified measurement point (imaginary part).

Corresponding key

No front panel key is available to execute this function.

OUTPMIN?

Syntax OUTPMIN?

Description Reads out the value of the minimum measurement parameter value within the waveform analysis range set with the "ANARANG" command on page 267 and the sweep parameter value at the position. If there are several measurement points of the minimum measurement parameter value, reads out the value of the leftmost measurement point within the analysis range.(Query only)

Query response {numeric 1},{numeric 2}<newline><^END>

Readouts are as follows:

{numeric 1}: Minimum measurement parameter value.

{numeric 2}: Sweep parameter value at the position of the minimum measurement parameter value

Corresponding key No front panel key is available to execute this function.

OUTPMINMAX?

Syntax OUTPMINMAX?

Description Within the waveform analysis range set with the "ANARANG" command on page 267, reads out the maximum measurement parameter value and the sweep parameter value at the position and the minimum measurement parameter value and the sweep parameter value at the position. If there are several measurement points of the minimum or maximum measurement parameter value, reads out the value of the leftmost measurement point within the analysis range. (Query only)

Query response {numeric 1},{numeric 2},{numeric 3},{numeric 4}<newline><^END>

Readouts are as follows:

{numeric 1}: Minimum measurement parameter value.

{numeric 2}: Sweep parameter value at the position of the minimum measurement parameter value.

{numeric 3}: Maximum measurement parameter value.

{numeric 4}: Sweep parameter value at the position of the maximum measurement parameter value.

Corresponding key No front panel key is available to execute this function.

OUTPMKR?

Syntax OUTPMKR?

Description For the active trace (set with the “TRAC” command on page 457), reads out the measurement parameter value and sweep parameter value at the marker position. If the marker function is off, executing this command causes an error and the read out values are invalid.(Query only)

Query response {numeric 1},{numeric 2},{numeric 3}<newline><^END>

Readouts are as follows:

{numeric 1}: Readout of the measurement parameter value at the marker position. If the measurement parameter is a scalar value (for other than COMPLEX Z-Y), the measurement parameter value is read out. If the measurement parameter is a vector value (for COMPLEX Z-Y), the readout is as follows:

- If the polar chart format is selected, the amplitude is read out.
- If the complex plane format is selected, resistance (for trace A) or conductance (for trace B) is read out.

{numeric 2}: Subsidiary readout of the measurement parameter value at the marker position. If the measurement parameter is a scalar value (for other than COMPLEX Z-Y), 0 is always read out. If the measurement parameter is a vector value (for COMPLEX Z-Y), the readout is as follows:

- If the polar chart format is selected, the phase is read out.
- If the complex plane format is selected, reactance (for trace A) or susceptance (for trace B) is read out.

{numeric 3}: Sweep parameter value at the marker position.

Corresponding key No front panel key is available to execute this function.

OUTPMSTA?

Syntax

OUTPMSTA?

Description

For the active trace (set with the “TRAC” command on page 457), calculates the statistics (mean value, standard deviation, and difference value between the maximum value and the minimum value) within the search range on the trace selected as the marker use target trace (set with the “MKRO” command on page 356), and reads out the result. (Query only)

Query response

{numeric 1},{numeric 2},{numeric 3}<newline><^END>

	{numeric 1}	{numeric 2}	{numeric 3}
Description	Mean value	Standard deviation	Difference value between the maximum value and the minimum value

Corresponding key

No front panel key is available to execute this function.

OUTPMTRC?

Syntax

OUTPMTRC?

Description

Reads out the values of all measurement points in the memory trace array (refer to “Internal data arrays” on page 81). (Query only)

Query response

{numeric 1},{numeric 2},..,{numeric NOP×2-1},{numeric NOP×2}<newline><^END>

Reads out the readout and subsidiary readout of the measurement parameter value of each measurement point as shown below. Where, NOP is the number of points, and n is an integer between 1 and NOP.

{numeric n×2-1}: Readout of the n-th measurement point. If the measurement parameter is a scalar value (for other than COMPLEX Z-Y), the measurement parameter value is read out. If the measurement parameter is a vector value (for COMPLEX Z-Y), resistance (for trace A) or conductance (for trace B) is read out.

{numeric n×2}: Subsidiary readout of the n-th measurement point. If the measurement parameter is a scalar value (for other than COMPLEX Z-Y), 0 is always read out. If the measurement parameter is a vector value (for COMPLEX Z-Y), reactance (for trace A) or susceptance (for trace B) is read out.

Corresponding key

No front panel key is available to execute this function.

OUTPMTRCP?

Syntax

OUTPMTRCP? <numeric 1>

Description

Reads out the value of the specified measurement point in the memory trace array (“Internal data arrays” on page 81). (Query only)

Parameters

	<numeric 1>
Description	Number of the measurement point you want to read out (the number assigned in order from the left edge assuming that the number of the leftmost measurement point is 1)
Range	1 to the number of points
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric 2},{numeric 3}<newline><^END>

Reads out the readout and subsidiary readout of the measurement parameter value as shown below..

{numeric 2}: Readout of the specified measurement point. If the measurement parameter is a scalar value (for other than COMPLEX Z-Y), the measurement parameter value is read out. If the measurement parameter is a vector value (for COMPLEX Z-Y), resistance (for trace A) or conductance (for trace B) is read out.

{numeric 3}: Subsidiary readout of the specified measurement point. If the measurement parameter is a scalar value (for other than COMPLEX Z-Y), 0 is always read out. If the measurement parameter is a vector value (for COMPLEX Z-Y), reactance (for trace A) or susceptance (for trace B) is read out.

Corresponding key

No front panel key is available to execute this function.

OUTPMWID?

Syntax

OUTPMWID?

Description

For the active trace (set with the “TRAC” command on page 457), if the trace bandwidth analysis function is on (specified to ON with the “WIDT” command on page 461), reads out the result of the bandwidth search. (Query only)

Query response

{numeric 1},{numeric 2},{numeric 3},{numeric 4},{numeric 5},{numeric 6}<newline><^END>

The readouts are as follows:

{numeric 1}:	Bandwidth.
{numeric 2}:	Center frequency.
{numeric 3}:	Quality factor.
{numeric 4}:	Measurement parameter value of the maker position.
{numeric 5}:	Value of the left cutoff point sweep parameter value minus the center value of the sweep range.
{numeric 6}:	Value of the right cutoff point sweep parameter value minus the center value of the sweep range.

If the trace bandwidth analysis function is off, the readouts are invalid.

Corresponding key

No front panel key is available to execute this function.

OUTPRESO?

Syntax

OUTPRESO?

Description

If the sweep parameter is frequency and the measurement parameter is |Z|-θ, within the waveform analysis range specified with the "ANARANG" command on page 267, analyzes the resonant point and reads out the result. If the sweep parameter is not frequency or if the measurement parameter is not |Z|-θ, executing this command causes an error and all readouts are 0. (Query only)

Query response

{numeric 1},{numeric 2},{numeric 3},{numeric 4}<newline><^END>

The readouts are as follows:

{numeric 1}: Value of Z_r (resonant impedance).

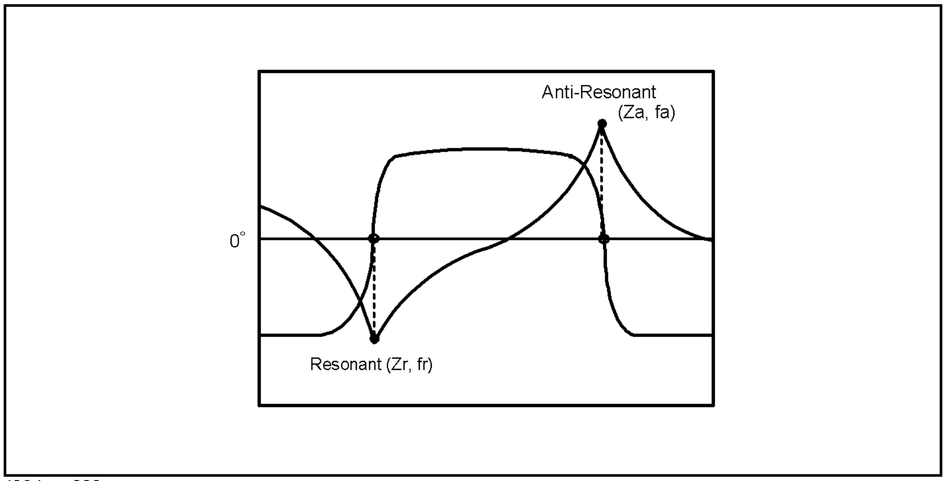
{numeric 2}: Value of f_r (resonant frequency).

{numeric 3}: Value of Z_a (anti-resonant impedance).

{numeric 4}: Value of f_a (anti-resonant frequency).

This command searches for points of phase 0° within the analysis range from the left edge, and defines the 1st detected point as the resonant point and the 2nd detected point as the anti-resonant point. Even if 3 or more phase 0° points are detected, only the first 2 points are used. If only 1 phase 0° point is detected, 0 is read out for both Z_a and f_a. If no phase 0° point is detected, 0 is read out for all the parameters.

Figure 16-5 **Analyzed parameters**



4294ape002

Corresponding key

No front panel key is available to execute this function.

16. GPIB Command Reference (O - R)

OUTPRESR?

Syntax

OUTPRESR?

Description

If the sweep parameter is frequency and the measurement parameter is |Z|-θ, within the waveform analysis range specified with the "ANARANG" command on page 267, analyzes the resonant point and ripple, and reads out the result. If the sweep parameter is not frequency or if the measurement parameter is not |Z|-θ, executing this command causes an error and all readouts are 0. (Query only)

Query response

{numeric 1},{numeric 2},{numeric 3},{numeric 4},{numeric 5},{numeric 6},{numeric 7}<newline><^END>

The readouts are as follows:

{numeric 1}: Value of Z_r (resonant impedance).

{numeric 2}: Value of f_r (resonant frequency).

{numeric 3}: Value of Z_a (anti-resonant impedance).

{numeric 4}: Value of f_a (anti-resonant frequency).

{numeric 5}: Rpl_1 (the maximum value of the left-side ripple (the sweep parameter difference between the peak and the left adjacent negative peak) within the range to the left of the resonant point within the waveform analysis range).

{numeric 6}: Value of Rpl_2 (the maximum value of the right ripple (the sweep parameter difference between the peak and the right adjacent negative peak) within the range between the resonant point and the anti-resonant point within the waveform analysis range).

{numeric 7}: Rpl_3 (the maximum value of the left-side ripple within the range to the right of the resonant point within the waveform analysis range).

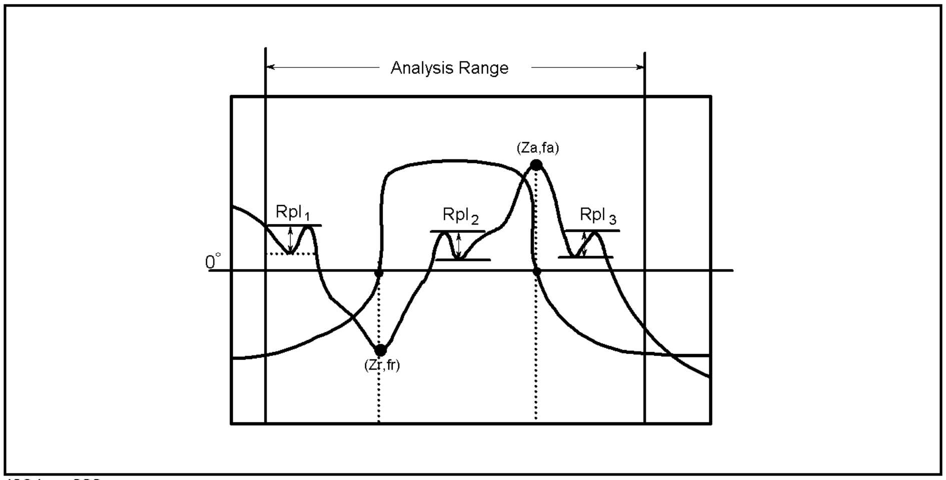
This command searches for phase 0° points within the analysis range from the left edge, and defines the 1st detected point as the resonant point and the 2nd detected point as the anti-resonant point. Even if 3 or more phase 0° points are detected, only the first 2 points are used. If only 1 phase 0° point is detected, 0 is read out for parameters other than Z_r, f_r, and Rpl_1. If no phase 0° point is detected, 0 is read out for all the parameters.

The peak and negative peak used at the execution of this command satisfies the condition set with the "THRR" command on page 452. They are not related to the peak definition in the marker search function.

Corresponding key

No front panel key is available to execute this function.

Figure 16-6 **Analyzed parameters**



OUTPSMKR{1-7}?

Syntax

OUTPSMKR{1|2|3|4|5|6|7}?

Description

For the active trace (set with the “TRAC” command on page 457), reads out the measurement parameter value and sweep parameter value at the sub marker (marker number 1 to 7) position. If the sub marker is off, executing this command causes an error and the readouts are invalid. (Query only)

Query response

{numeric 1},{numeric 2},{numeric 3}<newline><^END>

Readouts are as follows:

{numeric 1}: Readout of the measurement parameter value at the sub marker position. If the measurement parameter is a scalar value (for other than COMPLEX Z-Y), the measurement parameter value is read out. If the measurement parameter is a vector value (for COMPLEX Z-Y), the readout is as follows.

- If the polar chart format is selected, the amplitude is read out.
- If the complex plane format is selected, resistance (for trace A) or conductance (for trace B) is read out.

{numeric 2}: Subsidiary readout of the measurement parameter value at the sub marker position. If the measurement parameter is a scalar value (for other than COMPLEX Z-Y), 0 is always read out. If the measurement parameter is a vector value (for COMPLEX Z-Y), the readout is as follows:

- If the polar chart format is selected, the phase is read out.
- If the complex plane format is selected, reactance (for trace A) or susceptance (for trace B) is read out.

{numeric 3}: Sweep parameter value at the sub marker position.

Corresponding key

No front panel key is available to execute this function.

OUTPSWPRM?

Syntax

OUTPSWPRM?

Description

Reads out the sweep parameter values of all measurement points. (Query only)

Query response

{numeric 1},{numeric 2},..,{numeric NOP}<newline><^END>

Where, NOP is the number of points.

Corresponding key

No front panel key is available to execute this function.

OUTPSWPRMP?

Syntax

OUTPSWPRMP? <numeric 1>

Description

Reads out the sweep parameter value of the specified measurement point. (Query only)

Parameters

	<numeric 1>
Description	Number of the measurement point you want to read out (the number assigned in order from the left edge assuming that the number of the leftmost measurement point is 1)
Range	1 to the number of points
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric 2}<newline><^END>

	{numeric 2}
Description	Read-out sweep parameter value

Corresponding key

No front panel key is available to execute this function.

OUTPVAC?

Syntax

OUTPVAC?

Description

When the oscillator level monitor function is set to on (set to ON with “OMON” command on page 365), reads out the oscillator voltage level monitor values of all measurement points. (Query only)

Query response

{numeric 1},{numeric 2},..,{numeric NOP}<newline><^END>

Where, NOP is the number of points.

If the oscillator level monitor function is set to off, the readouts are invalid.

Corresponding key

No front panel key is available to execute this function.

OUTPVACP?

Syntax

OUTPVACP? <numeric 1>

Description

When the oscillator level monitor function is set to on (set to ON with “OMON” command on page 365), reads out the oscillator voltage level monitor value of the specified measurement point. (Query only)

Parameters

	<numeric 1>
Description	Number of the measurement point you want to read out (the number assigned in order from the left edge assuming that the number of the leftmost measurement point is 1)
Range	1 to the number of points
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric 2}<newline><^END>

	{numeric 2}
Description	Voltage monitor value of the oscillator level

If the oscillator level monitor function is set to off, the readout is invalid.

Corresponding key

No front panel key is available to execute this function.

PARS

Syntax

PARS {ON|OFF|1|0}

PARS?

Description

For the marker search function for the active trace (set with the “TRAC” command on page 457), determines whether to perform partial search.

Parameters

	Description
ON or 1	Enables the partial search.
OFF or 0 (initial value)	Disables the partial search.

Query response

{1|0}<newline><^END>

Corresponding key

[Search] - SEARCH RANGE MENU - PART SRCH on OFF

PAVER

Syntax

PAVER {ON|OFF|1|0}

PAVER?

Description

Enables/disables the point averaging function.

Parameters

	Description
ON or 1	Enables the point averaging function.
OFF or 0 (initial value)	Disables the point averaging function.

Query response

{1|0}<newline><^END>

Corresponding key

[Bw/Avg] - **POINT AVG on OFF**

PAVERFACT

Syntax

PAVERFACT <numeric>

PAVERFACT?

Description

Sets the point averaging count when using the point averaging function. To set the point averaging count of each segment when creating the list sweep table, also use this command.

Parameters

	<numeric>
Description	Point averaging count
Range	1 to 256
Initial value	4 (Note that, if you use this command to create a segment, the initial value for segment 1 is 1, and the initial value of an additional segment is the set value of the previous segment.)
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Bw/Avg] - **POINT AVG FACTOR**

PDELT

Syntax

PDELT <numeric>[S]

PDELT?

Description

Sets the delay time for each measurement point.

Parameters

	<numeric>
Description	Delay time for each measurement point
Range	0 to 30
Initial value	0
Unit	s (second)
Resolution	0.001

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Sweep] - TIME - POINT DELAY

PEAK?

Syntax

PEAK?

Description

Within the waveform analysis range set with the "ANARANG" command on page 267, searches for the maximum peak and reads out the measurement parameter value and the sweep parameter value of the peak. If there are several maximum peaks, reads out the value of the leftmost peak within the analysis range. If no peak exists, 0 is read out.

The peak searched for at the execution of this command satisfies the condition set with the "THRR" command on page 452. It is not related to the peak definition in the marker search function. (Query only)

Query response

{numeric 1},{numeric 2}<newline><^END>

Readouts are as follows:

{numeric 1}: Measurement parameter value of the maximum peak.

{numeric 2}: Sweep parameter value of the maximum peak.

Corresponding key

No front panel key is available to execute this function.

PEAKCENT

Syntax

PEAKCENT

Description

For the active trace (set with the “TRAC” command on page 457), searches for a peak using the marker and changes the sweep center value setting to the marker sweep parameter value (in other words, the sweep parameter value of the detected peak). If the marker function is off, executing this command causes an error and the command is ignored. (No query)

Corresponding key

[Marker→] - **more 1/2** - **PEAK → CENTER**

PHAU

Syntax

PHAU {DEG|RAD}

PHAU?

Description

For the active trace (set with the “TRAC” command on page 457), sets the display unit in the phase display format. The scale parameters in the selected unit are automatically set so that traces do not exceed the display range on the screen.

Parameters

	Description
DEG (initial value)	Specifies degree (°) as the display unit.
RAD	Specifies radian as the display unit.

Query response

{DEG|RAD}<newline><^END>

Corresponding key

[Format] - **PHASE UNIT [ ]**

PKDLTX

Syntax

PKDLTX <numeric>[HZ|MHZ|V|A]

PKDLTX?

Description

For the active trace (set with the “TRAC” command on page 457), sets the ΔX value (refer to Figure 7-1 on page 97) parameter to define the peak searched for in the marker search function.

Parameters

		<numeric>
Description		ΔX value
When the sweep parameter is frequency	Range	0 to 110E6
	Initial value	500E3
	Unit	Hz
When the sweep parameter is OSC level (voltage)	Range	0 to 1
	Initial value	5E-3
	Unit	V (volt)
When the sweep parameter OSC level (current)	Range	0 to 20E-3
	Initial value	100E-6
	Unit	A (ampere)
When the sweep parameter is dc bias level (voltage)	Range	0 to 80
	Initial value	0.4
	Unit	V (volt)
When the sweep parameter is dc bias level (current)	Range	0 to 200E-3
	Initial value	1E-3
	Unit	A (ampere)

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Search] - **PEAK** - **PEAK DEF MENU** - **PEAK DEF: ΔX**

PKDLTY

Syntax

PKDLTY <numeric>[OHM|DEG|RAD|SIE|H|F|PCT]

PKDLTY?

Description

For the active trace (set with the "TRAC" command on page 457), sets the ΔY value (refer to Figure 7-1 on page 97) parameter to define the peak searched for in the marker search function.

Parameters

	<numeric>
Description	ΔY value
Range	0 to 100E6
Initial value	1
Unit	Varies depending on the measurement parameter (refer to the explanation of unit in "SCAL" on page 423).

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Search] - PEAK - PEAK DEF MENU - PEAK DEF: ΔY

PKPOL

Syntax

PKPOL {POS|NEG}

PKPOL?

Description

For the active trace (set with the "TRAC" command on page 457), sets the polarity of the peak searched for in the marker search function.

Parameters

	Description
POS (initial value)	Specifies positive peaks.
NEG	Specifies negative peaks.

Query response

{POS|NEG}<newline><^END>

Corresponding key

[Search] - PEAK - PEAK DEF MENU - PEAK PLRTY [ ]

POIN

Syntax

POIN <numeric>

POIN?

Description

Sets the number of points measured at each sweep. To set the number-of-points setting of each segment when creating the list sweep table, also use this command.

Parameters

	<numeric>
Description	Number of points
Range	2 to 801 (Note on the number-of-points setting of a segment. The upper limit is the smaller value: value obtained by subtracting the sum of the numbers of points of already set segments from 801 or 201.)
Initial value	201 (Note on the number-of-points setting of a segment. If the maximum number of settable points is less than 201, the maximum number of settable points.)
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Sweep] - NUMBER OF POINTS

PORE

Syntax

PORE {ON|OFF|1|0}

PORE?

Description

Toggles on and off the port extension compensation function.

Parameters

	Description
ON or 1	Turns on the port extension compensation function.
OFF or 0 (initial value)	Turns off the port extension compensation function.

Query response

{1|0}<newline><^END>

Corresponding key

[CAL] - PORT EXTENSION - EXTENSION on OFF

PORTL

Syntax

PORTL <numeric>[M]

PORTL?

Description

Sets the port extension compensation amount in electrical length.

Parameters

	<numeric>
Description	Port extension compensation amount
Range	-10×2.998E8 to 10×2.998E8
Initial value	0
Unit	m (meter)
Resolution	1E-6

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[CAL] - **PORT EXTENSION** - **VALUE (RENGTH)**

PORTZ

Syntax

PORTZ <numeric>[S]

PORTZ?

Description

Sets the port extension compensation amount in time.

Parameters

	<numeric>
Description	Port extension compensation amount
Range	-10 to 10
Initial value	0
Unit	s (second)
Resolution	1E-12

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[CAL] - **PORT EXTENSION** - **VALUE (TIME)**

POSL

Syntax

POSL

POSL?

Description

Sets the input/output signals of the 24-bit I/O port (data and test PASS/FAIL output) to positive logic. To set to negative logic, use the “NEGL” command on page 362.

Query response

{1|0}<newline><^END>

	Description
1	Positive logic is specified.
0	Positive logic is not specified. In other words, negative logic (preset state) is specified.

Corresponding key

No front panel key is available to execute this function.

POWE

Syntax

POWE <numeric>[V|A]

POWE?

Description

Sets the oscillator (OSC) power level. To set the oscillator power level of each segment when creating the list sweep table, also use this command. To select voltage or current to set the level, use the “POWMOD” command on page 404.

Parameters

	<numeric>
Description	Oscillator power level
Range	For voltage setting: 5E-3 to 1 For current setting: 200E-6 to 20E-3
Initial value	For voltage setting: 0.5 For current setting: 200E-6
Unit	For voltage setting: V (volt) For current setting: A (ampere)
Resolution	For voltage setting: 1E-3 For current setting: 10E-6

Note that, if you use this command to create a segment, the initial value when creating segment 1 is the current oscillator power level value and the initial value when creating an additional segment is the oscillator power level value of the previous segment.

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Source] - **LEVEL**

POWMOD

Syntax

POWMOD {VOLT|CURR}

POWMOD?

Description

Selects voltage or current to set the oscillator (OSC) power level. To set the oscillator power level setting method of each segment when creating the list sweep table, use this command.

Parameters

	Description
VOLT (initial value)	Specifies the voltage setting.
CURR	Specifies the current setting.

Note that, if you use this command to create a segment, the initial value when creating segment 1 is the current setting method selection value and the initial value when creating an additional segment is the setting method selection value of the previous segment.

Query response

{VOLT|CURR}<newline><^END>

Corresponding key

[Source] - OSC UNIT [ ]

PREP

Syntax

PREP

Description

When the measurement results are listed as a result of the execution of the “LISV” command on page 341, displays the previous page of the list. To display the next page, execute the “NEXP” command on page 363.(No query)

Corresponding key

[Copy] - SELECT CONTENTS - LIST VALUE - PREV PAGE

PRES

Syntax

PRES

Description

Resets to the preset state. The preset state is almost the same as that of the reset using the “*RST” command on page 260, though there are some differences shown bellow. (No query)

- The sweep mode is set to CONT.
- The HP Instrument BASIC is not reset.

Corresponding key

[Preset]

PRIC

Syntax

PRIC {STAN|FIXE|VARI}

PRIC?

Description

Sets the print color for printout.

Parameters

	Description
STAN (initial value)	Black and white output
FIXE	Color output (clean colors when printed on white paper)
VARI	Color output (colors close to those on the display screen)

Query response

{STAN|FIXE|VARI}<newline><^END>

Corresponding key

[Copy] - **SETUP** - {**B&W** | **FIXED COLOR** | **IMAGE COLOR**}

PRINALL

Syntax

PRINALL

Description

Outputs as-is image displayed on the LCD screen to a printer. Note that, softkey label output is disabled (specified to OFF with the "PRSOFT" command on page 405), the softkey labels at the left of the screen are not outputted. (No query)

Corresponding key

[Copy] - **START**

PRSOFT

Syntax

PRSOFT {ON|OFF|1|0}

PRSOFT?

Description

When outputting the LCD screen to a printer using the "PRINALL" command on page 405, enables/disables the output of the description part (softkey label) of each softkey displayed at the right of the screen.

Parameters

	Description
ON or 1	Enables the softkey label output.
OFF or 0 (initial value)	Disables the softkey label output.

Query response

{1|0}<newline><^END>

Corresponding key

[Copy] - **SETUP** - **more 1/2** - **SOFTKEY on OFF**

PURG

Syntax

PURG <string>

Description

Deletes the specified file on a built-in mass storage of the 4294A specified with the "STOD" command on page 445. When specifying a file, use a file name including its extension (refer to Table 8-1 on page 113). If the specified file does not exist, an error occurs. (No query)

Parameters

	<string>
Description	File name (including the extension) you want to delete
Range	12 characters or less (including the extension)

If the specified file name has characters that exceed the maximum length, only the string of up to the maximum length is valid and the remaining characters are ignored.

Corresponding key

[Save] - **FILE UTILITIES** - **PURGE FILE ➤**

READ?

Syntax READ?

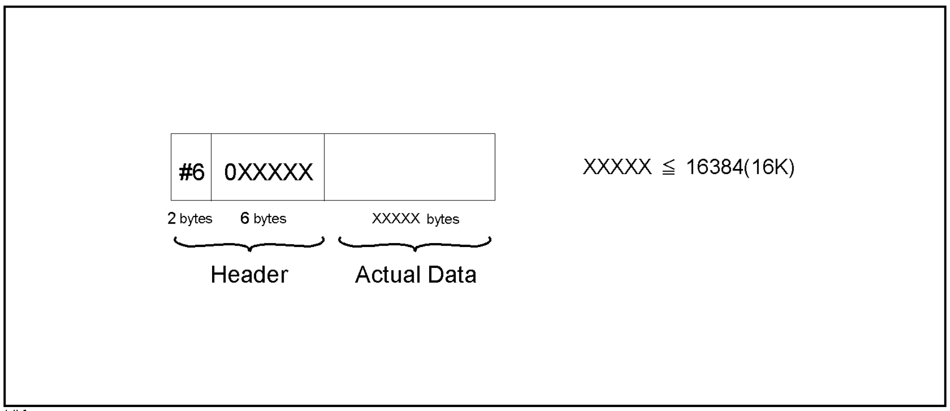
Description Reads data from a file that has been read-enabled using the ``ROPEN" command. The returned data is in the fixed length block format defined in IEEE488.2. The fixed length block format, as shown in Figure 16-7, consists of a header part indicating the data size and an actual data part. In the case of the 4294A, the number of digits to indicate the data size is 6 and the maximum length of the actual data part is 16 Kbytes. If a file contains data greater than 16 Kbytes, execute this command repeatedly to read it.

Generally, this command is used in combination with the “ROPEN”(412page) command and the “CLOSE”(280page) command, as shown in Figure 16-8 on page 412. (No query)

Query response {block}<newline><^END>

Corresponding key No front panel key is available to execute this function.

Figure 16-7 **Fixed length block format**



blkform

RECD

Syntax

RECD <string>

Description

Recalls an instrument state or measured data from the specified file on a built-in mass storage of the 4294A specified with the “STOD” command on page 445. When specifying a file, use a file name including its extension (refer to Table 8-1 on page 113). If the specified file does not exist, an error occurs and the command is ignored. (No query)

Parameters

	<string>
Description	File name (including the extension) you want to recall
Range	12 characters or less (including the extension)

If the specified file name has characters that exceed the maximum length, only the string of up to the maximum length is valid and the remaining characters are ignored.

Corresponding key

[Recall]

REFP

Syntax

REFP <numeric>

REFP?

Description

Specifies the position of the reference line in the linear Y axis format. To specify the position, use the grid line number, which is given in the increasing order from the bottom assuming that the bottom grid line is 0.

Parameters

	<numeric>
Description	Position of the reference line (grid line number)
Range	0 to 10
Initial value	5 (0, if the measurement parameter is |Z| and |Y|.)
Resolution	0.01

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Scale Ref] - **REFERENCE POSITION**

REFV

Syntax

REFV <numeric>[OHM|DEG|RAD|SIE|H|F|PCT]

REFV?

Description

Sets the value indicating the reference line in the linear Y axis format, or the full scale value in the polar chart format. To set the value indicating the reference line in the complex plane format, use the "REFX" command on page 410 and "REFY" command on page 410.

Parameters

	<numeric>
Description	Value indicated by the reference line or full scale
Range	For the linear Y axis format: Varies depending on the measurement parameter as follows: For |Z|, R, X: -1E12 to 1E12 For other than |Z|, R, X: -1E9 to 1E9 For polar chart format: 10E-15 to 1E9
Initial value	For the linear Y axis format: Varies depending on the measurement parameter as follows: For |Z|, R, X, Rs, Rp: 500E3 For θ: 0 For |Y|, G, B, D: 500E-3 For Cs, Cp: 500E-6 For Ls, Lp: 5 For Q: 500 For polar chart format: 1
Unit	Varies depending on the measurement parameter (refer to the explanation of unit in "SCAL" on page 423).
Resolution	1E-15 *1

*1.This is the minimum value (when the set value is small). The resolution becomes larger as the set value becomes larger.

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Scale Ref] - **REFERENCE VALUE**

REFX

Syntax

REFX <numeric>[OHM|SIE]

REFX?

Description

Sets the X-axis reference value (center value) in the complex plane format.

Parameters

	<numeric>
Description	X-axis reference value
Range	-1E9 to 1E9
Initial value	0
Unit	For trace A: Ω (ohm) For trace B: S (siemens)
Resolution	1E-15 *1

*1.This is the minimum value (when the set value is small). The resolution becomes larger as the set value becomes larger.

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Scale Ref] - **REFERENCE X VALUE**

REFY

Syntax

REFY <numeric>[OHM|SIE]

REFY?

Description

Sets the Y-axis reference value (center value) in the complex plane format.

Parameters

	<numeric>
Description	Y-axis reference value
Range	-1E9 to 1E9
Initial value	0
Unit	For trace A: Ω(ohm) For trace B: S (siemens)
Resolution	1E-15 *1

*1.This is the minimum value (when the set value is small). The resolution becomes larger as the set value becomes larger.

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Scale Ref] - **REFERENCE Y VALUE**

RESAVD

Syntax RESAVD <string>

Description Updates the specified file on the built-in mass storage of the 4294A specified with the "STOD" command on page 445. When specifying a file, use a file name including its extension (refer to Table 8-1 on page 113). If the specified file does not exist, an error occurs and the command is ignored. (No query)

Parameters

	<string>
Description	File name (including the extension) you want to update
Range	12 characters or less (including the extension)

If the specified file name has characters that exceed the maximum length, only the string of up to the maximum length is valid and the remaining characters are ignored.

Corresponding key **[Save]** - **RE-SAVE FILE** ➢

RESD

Syntax RESD

Description Changes the measured value list display screen to the normal measurement screen. To return to the list display screen, execute the "LISV" command on page 341. (No query)

Corresponding key **[Copy]** - **SELECT CONTENTS** - **LIST VALUE** - **RESTORE DISPLAY** ➢

ROPEN

Syntax

ROPEN <string>

Description

Makes a specified file read-enabled. If the file does not exist, an error occurs.

Generally, this command is used in combination with the “READ?”(407page) command and the “CLOSE”(280page) command, as shown in Figure 16-8. (No query)

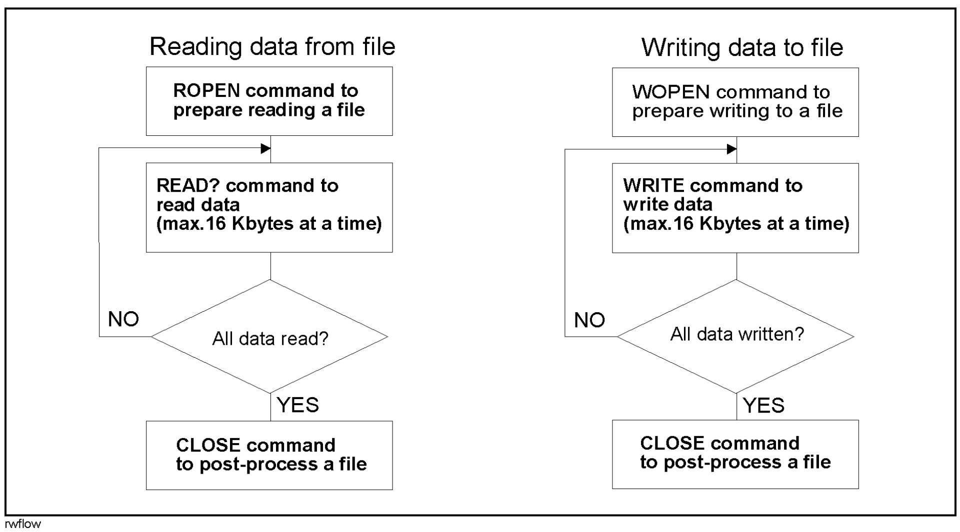
Parameters

	Description
<string>	File name of up to 12 characters including its extension

Corresponding key

No front panel key is available to execute this function.

Figure 16-8 **Procedure of executing commands to read/write data**



RPLHEI?

Syntax RPLHEI?

Description Within the waveform analysis range specified with the “ANARANG” command on page 267, calculates ripples (measurement parameter value difference between the peak and its right and left adjacent negative peaks), and reads out the maximum value. If the value cannot be obtained because no peak or negative peak is detected, 0 is read out.

The peak and negative peak used at the execution of this command satisfies the condition set with the “THRR” command on page 452. It is not related to the peak definition in the marker search function. (Query only)

Query response {numeric}<newline><^END>

Corresponding key No front panel key is available to execute this function.

RPLLHEI?

Syntax RPLLHEI?

Description Within the waveform analysis range specified with the “ANARANG” command on page 267, calculates the left-side ripple (measurement parameter value difference between the peak and its left adjacent negative peak), and reads out the maximum value. If the value cannot be obtained because no peak or negative peak is detected, 0 is read out.

The peak and negative peak used at the execution of this command satisfies the condition set with the “THRR” command on page 452. It is not related to the peak definition in the marker search function. (Query only)

Query response {numeric}<newline><^END>

Corresponding key No front panel key is available to execute this function.

RPLPP?

Syntax RPLPP?

Description Within the waveform analysis range specified with the “ANARANG” command on page 267, reads out the difference between the maximum peak measurement parameter value and the minimum negative peak measurement parameter value. If the value cannot be obtained because no peak or negative peak is detected, 0 is read out.

The peak searched for at the execution of this command satisfies the condition set with the “THRR” command on page 452. It is not related to the peak definition in the marker search function. (Query only)

Query response {numeric}<newline><^END>

Corresponding key No front panel key is available to execute this function.

RPLPPS?

Syntax

RPLPPS?

Description

Within the waveform analysis range specified with the “ANARANG” command on page 267, reads out the difference between the maximum peak measurement parameter value and the minimum negative peak measurement parameter value and the sweep parameter value of the peaks (if there are several maximum peaks or minimum negative peaks, the value of the leftmost peak within the analysis range). If the value cannot be obtained because no peak or negative peak is detected, 0 is read out.

The peak and negative peak used at the execution of this command satisfies the condition set with the “THRR” command on page 452. It is not related to the peak definition in the marker search function. (Query only)

Query response

{numeric 1},{numeric 2},{numeric 3}<newline><^END>

Readouts are as follows:

{numeric 1}:	Difference between the maximum peak measurement parameter value and the minimum negative peak measurement parameter value.
{numeric 2}:	Sweep parameter value of the maximum peak.
{numeric 3}:	Sweep parameter value of the minimum negative peak.

Corresponding key

No front panel key is available to execute this function.

RPLRHEI?

Syntax

RPLRHEI?

Description

Within the waveform analysis range specified with the “ANARANG” command on page 267, calculates the right ripple (measurement parameter value difference between the peak and its right adjacent negative peak), and reads out the maximum value. If the value cannot be obtained because no peak or negative peak is detected, 0 is read out.

The peak and negative peak used at the execution of this command satisfies the condition set with the “THRR” command on page 452. It is not related to the peak definition in the marker search function. (Query only)

Query response

{numeric}<newline><^END>

Corresponding key

No front panel key is available to execute this function.

RSCO

Syntax

RSCO

Description

Returns the tint (set with the “TINT” command on page 454), brightness (set with the “CBRI” command on page 276), and chroma (set with the “COLOR” command on page 281) of the display color of the item selected with the “COLO” command on page 280 to the factory states. (No query)

Corresponding key

[Display] - **more 1/2** - **MODIFY COLOR** - **MODIFY ITEM COLOR** - **MODIFY COLOR** - **RESET COLOR**

SADD

Syntax SADD [<numeric>]

Description In creation/edit of the list sweep table, adds a new segment, change the edit target segment to the added segment, and starts edit. The position where a segment is added is as follows:

- If a segment is specified:

  Added in the line below the specified segment.

- If no segment is specified:

  Added in the line below the segment specified as the edit target segment (set with the “SEGM” command on page 435).

The number of the added segment is a value of the specified segment number (if no segment is specified, the edit target segment number before the execution of the command) plus 1, and the number of each following segment also increases by 1.

After the completion of the parameter setting of the segment, execute the “SDON” command on page 426 to finish the edit work. After executing this command and the “SEDI” command on page 434 (to start segment edit), executing this command, without executing the “SDON” command, causes an error and the command is ignored.

If the total number of points in segments is 800 or 801, executing this command causes an error, and, without adding a segment, the edit of the specified segment (if no segment is specified, the segment set as the edit target) is started.

If the creation/edit of the previous segment has not been started, executing this command automatically starts table creation/edit and then adds a segment. (No query)

Parameters

	<numeric>
Description	Segment number immediately before the addition and insertion location
Range	1 to the number of segments in the list sweep table
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Corresponding key **[Sweep] - EDIT LIST - ADD ➢**

SAVCAL

Syntax

SAVCAL {ON|OFF|1|0}

SAVCAL?

Description

When saving the internal data array (refer to “Internal data arrays” on page 81) in a file with the “SAVDASC” command on page 416 and “SAVDDAT” command on page 417, enables/disables the save of the calibration data array and compensation data array. If user calibration data has not been measured or inputted using the command, the save file does not contain values in the calibration data array. This is also applicable to the compensation data array.

Parameters

	Description
ON or 1	Enables the save of the calibration data array and compensation data array.
OFF or 0 (initial value)	Disables the save of the calibration data array and compensation data array.

Query response

{1|0}<newline><^END>

Corresponding key

[Save] - DATA - SELECT CONTENTS - CAL on OFF

SAVDASC

Syntax

SAVDASC <string>

Description

Saves the internal data arrays (refer to “Internal data arrays” on page 81) specified to be saved with the “SAVCAL”(416page), “SAVDAT”(417page), “SAVDTRC”(420page), “SAVMEM”(420page) and “SAVMTRC”(421page) commands in the ASCII format into the specified file. The number of saved points is the current number of sweep points. When specifying a file, you can use a file name including its extension (refer to Table 8-1 on page 113) or a file name whose extension is omitted. If the extension is not specified, the file name is the specified file name with the “.TXT” extension added. (No query)

Parameters

	<string>
Description	Save file name
Range	When the extension is not specified: 8 characters or less When the extension is specified: 12 characters or less

If the specified file name has characters that exceed the maximum length, only the string of up to the maximum length is valid and the remaining characters are ignored.

Corresponding key

[Save] - DATA - ASCII ➤

SAVDAT

Syntax

SAVDAT {ON|OFF|1|0}

SAVDAT?

Description

When saving the internal data array (refer to “Internal data arrays” on page 81) into a file with the “SAVDASC” command on page 416 and “SAVDDAT” command on page 417 commands, enables/disables the save of the data array.

Parameters

	Description
ON or 1	Enables the save of the data array.
OFF or 0 (initial value)	Disables the save of the data array.

Query response

{1|0}<newline><^END>

Corresponding key

[Save] - DATA - SELECT CONTENTS - DATA on OFF

SAVDDAT

Syntax

SAVDDAT <string>

Description

Saves the internal data arrays (refer to “Internal data arrays” on page 81) specified to be saved with the “SAVCAL”(416page), “SAVDAT”(417page), “SAVDTRC”(420page), “SAVMEM”(420page) and “SAVMTRC”(421page) commands in the binary format into the specified file. The number of saved points is the current number of sweep points. When specifying a file, you can use a file name including its extension (refer to Table 8-1 on page 113) or a file name whose extension is omitted. If the extension is not specified, the file name is the specified file name with the “.DAT” extension added. (No query)

Parameters

	<string>
Description	Save file name
Range	When the extension is not specified: 8 characters or less When the extension is specified: 12 characters or less

If the specified file name has characters that exceed the maximum length, only the string of up to the maximum length is valid and the remaining characters are ignored.

Corresponding key

[Save] - DATA - BINARY ➢

SAVDS1P

Syntax

SAVDS1P <string>

Description

Converts the data array into the touchstone format and saves it into a specified file. You can use a file name with or without the extension (refer to Table 8-1, “Filename extension,”) to specify a file. When you omit the extension, the extension ".S1P" is added to the specified file name. (No query)

Parameters

	<string>
Description	A file name you want to save.
Range	When you omit the extension: 8 characters or less When you specify the extension: 12 characters or less

If the specified file name exceeds the maximum number of characters, characters until the maximum is reached are valid and remaining characters are ignored.

Equivalent key

[Save] - **TOUCHSTONE ➤**

SAVDSTA

Syntax SAVDSTA <string>

Description Saves the instrument setting state, calibration data array, compensation data array, and memory array (refer to “Internal data arrays” on page 81) into the specified file. Regardless of the settings with the “SAVCAL”(416page), “SAVDAT”(417page), “SAVDTRC”(420page), “SAVMEM”(420page) and “SAVMTRC”(421page) commands, the arrays are saved. When specifying a file, you can use a file name including its extension (refer to Table 8-1 on page 113) or a file name whose extension is omitted. If the extension is not specified, the file name is the specified file name with the “.STA” extension added. (No query)

Parameters

	<string>
Description	Save file name
Range	When the extension is not specified: 8 characters or less When the extension is specified: 12 characters or less

If the specified file name has characters that exceed the maximum length, only the string of up to the maximum length is valid and the remaining characters are ignored.

Corresponding key **[Save]** - **STATE ➢**

SAVDTIF

Syntax SAVDTIF <string>

Description Saves image on the LCD screen into the specified file in the TIF format. When specifying a file, you can use a file name including its extension (refer to Table 8-1 on page 113) or a file name whose extension is omitted. If the extension is not specified, the file name is the specified file name with the “.TIF” extension added.(No query)

Parameters

	<string>
Description	Save file name
Range	When the extension is not specified: 8 characters or less When the extension is specified: 12 characters or less

If the specified file name has characters that exceed the maximum length, only the string of up to the maximum length is valid and the remaining characters are ignored.

Corresponding key **[Save]** - **GRAPHICS ➢**

SAVDTRC

Syntax

SAVDTRC {ON|OFF|1|0}

SAVDTRC?

Description

When saving the internal data array (refer to "Internal data arrays" on page 81) into a file using the "SAVDASC" command on page 416 and "SAVDDAT" command on page 417, enables/disables the save of the data trace array.

Parameters

	Description
ON or 1 (initial value)	Enables the save of the data trace array.
OFF or 0	Disables the save of the data trace array.

Query response

{1|0}<newline><^END>

Corresponding key

[Save] - DATA - SELECT CONTENTS - TRACE DATA ON off

SAVMEM

Syntax

SAVMEM {ON|OFF|1|0}

SAVMEM?

Description

When saving the internal data array (refer to "Internal data arrays" on page 81) into a file using the "SAVDASC" command on page 416 and "SAVDDAT" command on page 417, enables/disables the save of the memory array.

Parameters

	Description
ON or 1	Enables the save of the memory array.
OFF or 0 (initial value)	Disables the save of the memory array.

Query response

{1|0}<newline><^END>

Corresponding key

[Save] - DATA - SELECT CONTENTS - MEMORY on OFF

SAVMTRC

Syntax

SAVMTRC {ON|OFF|1|0}

SAVMTRC?

Description

When saving the internal data array (refer to "Internal data arrays" on page 81) into a file using the "SAVDASC" command on page 416 and "SAVDDAT" command on page 417, enables/disables the save of the memory trace array.

Parameters

	Description
ON or 1 (initial value)	Enables the save of the memory trace array.
OFF or 0	Disables the save of the memory trace array.

Query response

{1|0}<newline><^END>

Corresponding key

[Save] - DATA - SELECT CONTENTS - TRACE MEN ON off

SAVPSTA

Syntax

SAVPSTA

Description

Saves the current instrument state and internal data arrays (refer to "Internal data arrays" on page 81) into the built-in mass storage, flash memory, as a file having the AUTOREC.STA file name. The AUTOREC.STA file is automatically recalled at power-on. Therefore, if you execute this command before power-off, the instrument state and internal data arrays before the power-off can be restored at the next power-on. (No query)

Corresponding key

[Save] - POWER ON CONFIG ➢

SCAC

Syntax

SCAC {ON|OFF|1|0}

SCAC?

Description

For the active trace (set with the “TRAC” command on page 457), enables/disables the use of the same scale for the data trace and memory trace. If the scale setting differs between the data trace and the memory trace, executing this command to specify the use of the same scale unifies the scale setting to that of the scale setting target trace (set with the “SCAF” command on page 422).

If either the data trace or the memory trace is not displayed, executing this command causes an error and the command is ignored.

Parameters

	Description
ON or 1 (initial value)	Enables the use of the same scale.
OFF or 0	Disables the use of the same scale.

Query response

{1|0}<newline><^END>

Corresponding key

[Scale Ref] - **more1/2** - **D&M COUPLE ON off**

SCAF

Syntax

SCAF {DATA|MEMO}

SCAF?

Description

For the active trace (set with the “TRAC” command on page 457), if the setting is made so that data trace and memory trace do not use the same scale (set to OFF with the “SCAC” command on page 422), selects the trace to which the scale setting is applied.

If either the data trace or the memory trace is not displayed, executing this command causes an error and the command is ignored.

Parameters

	Description
DATA (initial value)	Specifies the data trace to which the scale setting is applied.
MEMO	Specifies the memory trace to which the scale setting is applied.

Query response

{DATA|MEMO}<newline><^END>

Corresponding key

[Scale Ref] - **more1/2** - **SCALE FOR [ ]**

SCAL

Syntax

SCAL <numeric>[OHM|DEG|RAD|SIE|H|F|PCT]

SCAL?

Description

Sets the value of 1 grid tick in the Y axis (vertical axis) direction in the linear Y axis format or the value of 1 grid tick in the X axis (horizontal axis) and Y axis directions in the complex plane format.

Parameters

	<numeric>
Description	Value of 1 grid tick
Range	1E-15 to 100E6
Initial value	For the linear Y axis format: Varies depending on the measurement parameter as follows: For |Z|, R, X, Rs, Rp: 100E3 For θ: 36 For |Y|, G, B, D: 100E-3 For Cs, Cp: 100E-6 For Ls, Lp: 1 For Q: 100 For the complex plane format: 50
Unit	Varies depending on the measurement parameter as follows: For |Z|, Z, R, X, Rs, Rp: Ω(ohm) For θ: °(degree) [*1] For |Y|, Y, G, B: S (siemens) For Cs, Cp: F (farad) For Ls, Lp: H (henry) For Q, D: No unit
Resolution	1E-15 [*2]

*1.Can be changed to radian using the “PHAU” command on page 398.

*2.This is the minimum value (when the set value is small). The resolution becomes larger as the set value becomes larger.

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Scale Ref] - **SCALE/DIV**

SCOL

Syntax

SCOL <numeric>

SCOL?

Description

In the creation/edit of the list sweep table, specifies the trace color of each segment using pen number in the HP Instrument BASIC screen.

Parameters

	<numeric>
Description	Pen number
Range	1 to 6
Initial value	For the trace A: 3 For the trace B: 5
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Sweep] - EDIT LIST - PEN

SCRN

Syntax

SCRN {ON|OFF|1|0}

Description

Toggles on and off the LCD screen display. (No query)

Parameters

	Description
ON or 1 (initial value)	Turns on the LCD screen display.
OFF or 0	Turns off the LCD screen display.

Corresponding key

No front panel key is available to execute this function.

SDEL

Syntax

SDEL [<numeric>]

Description

In the creation/edit of the list sweep table, deletes the specified segment (if no segment is specified, the segment specified as the edit target) from the table.

The segment number of each segment after the deleted segment decreases by 1. As a result, the segment, whose number was changed to the same number as the deleted segment, is set to the edit target. Note that, if the last segment is deleted, the segment immediately before the deleted segment is set to the edit target. You can set any segment to the edit target using the "SEGM" command on page 435.

During segment edit (after the execution of the "SADD" command on page 415 or "SEDI" command on page 434 and before the execution of the "SDON" command on page 426), executing this command causes an error and the command is ignored.

If the creation/edit of the list sweep table has not been started, executing this command automatically starts table creation/edit and then deletes the segment. (No query)

NOTE

Executing the "EDITDONE" command on page 310 brings the created/edited list sweep table to take effect.

Parameters

	<numeric>
Description	Segment number you want to delete
Range	1 to the number of segments in the list sweep table
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Corresponding key

[Sweep] - EDIT LIST - DELETE

SDELT

Syntax

SDELT <numeric>[S]

SDELT?

Description

Sets the delay time for each sweep.

Parameters

	<numeric>
Description	Delay time for each sweep
Range	0 to 30
Initial value	0
Unit	s (second)
Resolution	0.001

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Sweep] -TIME - SWEEP DELAY

SDON

Syntax

SDON

Description

In creation/edit of the list sweep table, finishes segment creation/edit. Executing this command brings the created/edited segment to take effect. (No query)

NOTE

Executing the "EDITDONE" command on page 310 brings the created/edited list sweep table to take effect.

Corresponding key

[Sweep] - EDIT LIST - EDIT - done

SEAL

Syntax

SEAL

Description

For the active trace (set with the "TRAC" command on page 457), moves the marker to the target (set with the "SEATARG" command on page 433) to the left of the current marker position. If no target is detected, the marker is not moved and the message saying "Not detected" is displayed (no error occurs). If the marker function is off, executing this command causes an error and the command is ignored. (No query)

Corresponding key

[Search] - TARGET - SEARCH LEFT

SEAM

Syntax

SEAM {MAX|MIN|TARG|PEAK|OFF}

SEAM?

Description

For the active trace (set with the "TRAC" command on page 457), executes the specified search function. If no search target is detected, the message saying "Not detected" is displayed (no error occurs).

Parameters

	Description
MAX	Specifies the maximum value search.
MIN	Specifies the minimum value search.
TARG	Specifies the target search. The target closest to the current marker position is searched for.
PEAK	Specifies the peak search. The maximum peak (minimum peak if the peak has been defined as negative peak) is searched for.
OFF (initial value)	Turns off the search function.

Query response

{MAX|MIN|TARG|PEAK|OFF}<newline><^END>

Corresponding key

[Search] - {**MAX** | **MIN** | **TRAGET ➢** | **PEAK ➢**}

SEANPK

Syntax

SEANPK

Description

For the active trace (set with the "TRAC" command on page 457), moves the marker to the next smaller peak of the last detected peak. If no peak is detected, the message saying "Not detected" is displayed (no error occurs). If the marker function is off, executing this command causes an error and the command is ignored. (No query)

Corresponding key

[Search] - **PEAK** - **NEXT PEAK**

SEANPKL

Syntax

SEANPKL

Description

For the active trace (set with the "TRAC" command on page 457), moves the marker to a peak to the left of the current marker position. If no peak is detected, the message saying "Not detected" is displayed (no error occurs). If the marker function is off, executing this command causes an error and the command is ignored. (No query)

Corresponding key

[Search] - **PEAK** - **NEXT PEAK LEFT**

SEANPKR

Syntax

SEANPKR

Description

For the active trace (set with the “TRAC” command on page 457), moves the marker to a peak to the right of the current marker position. If no peak is detected, the message saying “Not detected” is displayed (no error occurs). If the marker function is off, executing this command causes an error and the command is ignored. (No query)

Corresponding key

[Search] - **PEAK** - **NEXT PEAK RIGHT**

SEAR

Syntax

SEAR

Description

For the active trace (set with the “TRAC” command on page 457), moves the marker to the target (set with the “SEATARG” command on page 433) to the right of the current marker position. If no target is detected, the message saying “Not detected” is displayed (no error occurs). If the marker function is off, executing this command causes an error and the command is ignored. (No query)

Corresponding key

[Search] - **TARGET** - **SEARCH LIGHT**

SEARLINE

Syntax

SEARLINE {ON|OFF|1|0}

SEARLINE?

Description

For the active trace (set with the “TRAC” command on page 457), enables/disables the display of the lines indicating the search range at list sweep.

Parameters

	Description
ON or 1	Enables the display of the lines indicating the search range.
OFF or 0 (initial value)	Disables the display of the lines indicating the search range.

Query response

{1|0}<newline><^END>

Corresponding key

[Search] - **SEARCH RANGE MENU** - **RNG LINE on OFF**

SEARMAX

Syntax

SEARMAX <numeric>[HZ|MHZ|V|A]

SEARMAX?

Description

For the marker search function for the active trace (set with the “TRAC” command on page 457), if the partial search is enabled (specified to ON with the “PARS” command on page 395), sets the partial search range upper border value.

Parameters

		<numeric>
Description		Upper border value of the partial search range
When the sweep parameter is frequency	Range	40 to 110E6
	Initial value	110E6
	Unit	Hz
	Resolution	1E-3
When the sweep parameter is OSC level (voltage)	Range	5E-3 to 1
	Initial value	1
	Unit	V (volt)
	Resolution	1E-3
When the sweep parameter is OSC level (current)	Range	200E-6 to 20E-3
	Initial value	20E-3
	Unit	A (ampere)
	Resolution	1E-6
When the sweep parameter is dc bias level (voltage)	Range	-40 to 40
	Initial value	40
	Unit	V (volt)
	Resolution	1E-3
When the sweep parameter is dc bias level (current)	Range	-100E-3 to 100E-3
	Initial value	100E-3
	Unit	A (ampere)
	Resolution	20E-6

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Search] - SEARCH RANGE MENU - MAXIMUM

SEARMAXP

Syntax

SEARMAXP <numeric>

SEARMAXP?

Description

For the marker search function for the active trace (set with the “TRAC” command on page 457), if the partial search is enabled (specified to ON with the “PARS” command on page 395), sets the partial search range upper border value to the specified measurement point.

Parameters

	<numeric>
Description	Number of the measurement point you want to set to the upper border value (the number assigned in order from the left edge assuming that the number of the leftmost measurement point is 1)
Range	1 to the number of points
Initial value	number of points
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

No front panel key is available to execute this function.

SEARMIN

Syntax

SEARMIN <numeric>[HZ|MHZ|V|A]

SEARMIN?

Description

For the marker search function for the active trace (set with the “TRAC” command on page 457), if the partial search is enabled (specified to ON with the “PARS” command on page 395), sets the partial search range lower border value.

Parameters

		<numeric>
Description		Lower border value of the partial search range
When the sweep parameter is frequency	Range	40 to 110E6
	Initial value	40
	Unit	Hz
	Resolution	1E-3
When the sweep parameter is OSC level (voltage)	Range	5E-3 to 1
	Initial value	5E-3
	Unit	V (volt)
	Resolution	1E-3
When the sweep parameter is OSC level (current)	Range	200E-6 to 20E-3
	Initial value	200E-6
	Unit	A (ampere)
	Resolution	1E-6
When the sweep parameter is dc bias level (voltage)	Range	-40 to 40
	Initial value	-40
	Unit	V (volt)
	Resolution	1E-3
When the sweep parameter is dc bias level (current)	Range	-100E-3 to 100E-3
	Initial value	-100E-3
	Unit	A (ampere)
	Resolution	20E-6

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Search] - SEARCH RANGE MENU - MINIMUM

SEARMINP

Syntax

SEARMINP <numeric>

SEARMINP?

Description

For the marker search function for the active trace (set with the “TRAC” command on page 457), if the partial search is enabled (specified to ON with the “PARS” command on page 395), sets the partial search range lower border value to the specified measurement point.

Parameters

	<numeric>
Description	Number of the measurement point you want to set to the lower border value (the number assigned in order from the left edge assuming that the number of the leftmost measurement point is 1)
Range	1 to the number of points
Initial value	1
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

No front panel key is available to execute this function.

SEARNG

Syntax

SEARNG {FULL|SEGMENT}

SEARNG?

Description

For the active trace (set with the “TRAC” command on page 457), sets the search range for the list sweep: all segments (entire sweep range) or a single segment. To specify a segment when the search range is set to a single segment, use the “SEGMNUM” command on page 436.

Parameters

	Description
FULL (initial value)	Specifies all segments as the search range.
SEGMENT	Specifies a single segment as the search range.

Query response

{FULL|SEGMENT}<newline><^END>

Corresponding key

[Search] - **SEARCH RANGE MENU** - {**FULL** | **SEGMENT**}

SEATARG

Syntax

SEATARG <numeric>[DEG|RAD|OHM|SIE|H|F|PCT]

SEATARG?

Description

For the active trace (set with the “TRAC” command on page 457), sets the target value (value in the Y axis direction) when performing the target search in the marker search function. In the Δ marker mode, the value set with this command is dealt as a relative value form the Δ marker. Therefore, to set the target value, use a relative value from the Δ marker.

Parameters

	<numeric>
Description	Target value at the execution of the target search
Range	-100M to 100M
Initial value	0
Unit	Varies depending on the measurement parameter (refer to the explanation of unit in “SCAL” on page 423).

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Search] - TARGET - TARGET VALUE

SEATARGL

Syntax

SEATARGL {ON|OFF|1|0}

SEATARGL?

Description

For the active trace (set with the “TRAC” command on page 457), enables/disables the display of the line indicating the target value (target line) when performing the target search in the marker search function.

Parameters

	Description
ON or 1	Enables the display of the target line.
OFF or 0 (initial value)	Disables the display of the target line.

Query response

{1|0}<newline><^END>

Corresponding key

[Search] - TARGET - LINE on OFF

SEDI

Syntax

SEDI [<numeric>]

Description

In the creation/edit of the list sweep table, starts the edit of the segment specified as the edit target (set with the “SEGM” command on page 435). Note that, if a segment is specified, the edit target segment is changed to the specified segment and then the edit is started.

After the completion of the parameter setting of the segment, execute the “SDON” command on page 426 to finish the edit work. After executing this command and the “SADD” command on page 415 (to start segment edit), executing this command, without executing the “SDON” command, causes an error and the command is ignored.

If the creation/edit of the list sweep table has not been started, executing this command automatically starts table creation/edit and then starts the edit of the segment. (No query)

Parameters

	<numeric>
Description	Segment number you want to edit
Range	1 to the number of segments in the list sweep table
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Corresponding key

[Sweep] - **EDIT LIST** - **EDIT ➢**

SEGM

Syntax

SEGM <numeric>

SEGM?

Description

Sets the execution target segment used when no segment is specified at the execution of the "SADD" command on page 415, "SDEL" command on page 425 and "SEDI" command on page 434. The setting of the execution target segment, when the creation/edit of the list sweep table is finished, is initialized.

If the creation/edit of the list sweep table is not started, executing this command automatically starts table creation/edit and then sets the execution target segment.

Parameters

	<numeric>
Description	Segment number you want to specify as the edit target
Range	1 to the number of segments in the list sweep table
Initial value	Segment number of the last line in the list sweep table
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

If the creation/edit of the list sweep table is not started, 0 is always read out.

Corresponding key

[Sweep] - **EDIT LIST** - **SEGMENT**

SEGMNUM

Syntax

SEGMNUM <numeric>

SEGMNUM?

Description

For the active trace (set with the “TRAC” command on page 457), if the search range is set to a segment for the list sweep (specified to SEGMENT with the “SEARNG” command on page 432), sets a segment as the search range.

Parameters

	<numeric>
Description	Segment number of the search range
Range	1 to the number of segments in the list sweep table
Initial value	1
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Search] - SEARCH RANGE MENU - SEGMENT NUMBER

SETCDATE

Syntax

SETCDATE <year>,<month>,<day>

SETCDATE?

Description

Sets the date of the built-in clock of the 4294A.

Parameters

	<year>	**<month>**	**<day>**
Description	Year	Month	Day
Range	1900 to 2099	1 to 12	1 to 31
Resolution	1	1	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{year},{month},{day}<newline><^END>

Corresponding key

[System] - CLOCK - DATE ➤

SETCTIME

Syntax

SETCTIME <hour>,<min>,<sec>

SETCTIME?

Description

Sets the time of the built-in clock of the 4294A.

Parameters

	<hour>	<min>	<sec>
Description	Time (24 hours)	Minute	Second
Range	0 to 23	0 to 59	0 to 59
Resolution	1	1	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{hour},{min},{sec}<newline><^END>

Corresponding key

[System] - CLOCK - TIME ➢

SIMFCHAR

Syntax

SIMFCHAR

Description

Executes the simulation of the frequency characteristic of the equivalent circuit. (No query)

Corresponding key

[Display] - more 1/2 - EQUIV CKT - SIMULATE F-CHRST

SING

Syntax

SING

Description

Performs a single sweep. After the sweep, the sweep mode goes to HOLD. (No query)

Corresponding key

[Trigger] - SINGLE

SMKR{1-7}

Syntax

SMKR{1|2|3|4|5|6|7} {ON|OFF|1|0}

SMKR{1|2|3|4|5|6|7}?

Description

For the active trace (set with the “TRAC” command on page 457), turns on/off a sub marker (marker number 1 to 7). In the coupled marker mode (set with the “MKRCOUP” command on page 352), the setting is applied to both the A and B traces regardless of the active trace setting. The sub marker set to on with this command is displayed at the same position as the marker. If the marker function is off, executing this command causes an error and the command is ignored.

Parameters

	Description
ON or 1	Turns on a sub marker.
OFF or 0 (initial value)	Turns off a sub marker.

Query response

{ON|OFF|1|0}<newline><^END>

Corresponding key

[Marker] - **SUB MKR** - {**1: OFF** | **2: OFF** | **3: OFF** | **4: OFF** | **5: OFF** | **6: OFF** | **7: OFF**}

[Marker] - **CREAR SUB MKR** - {**1: OFF** | **2: OFF** | **3: OFF** | **4: OFF** | **5: OFF** | **6: OFF** | **7: OFF**}

SMKRAUV{1-7}?

Syntax

SMKRAUV{1|2|3|4|5|6|7}?

Description

For the active trace (set with the “TRAC” command on page 457), if the measurement parameter is a vector value (for COMPLEX Z-Y), reads out the subsidiary readout of the measurement parameter value at the sub marker position (marker number 1 to 7). (Query only)

Query response

{numeric}<newline><^END>

If the measurement parameter is a scalar value (for other than COMPLEX Z-Y), 0 is always read out. If the measurement parameter is a vector value (for COMPLEX Z-Y), the readout is as follows:

- If the polar chart format is selected, the phase is read out.
- If the complex plane format is selected, reactance (for trace A) or susceptance (for trace B) is read out.

Corresponding key

No front panel key is available to execute this function.

SMKRP{1-7}

Syntax

SMKRP{1|2|3|4|5|6|7} <numeric>

SMKRP{1|2|3|4|5|6|7}?

Description

For the active trace (set with the "TRAC" command on page 457), moves a sub marker (marker number 1-7) to the specified measurement point. In the coupled marker mode (set with the "MKRCOUP" command on page 352), regardless of the active trace setting, moves the sub marker on both the A and B traces. If this command is executed as Query, it reads out the measurement point number at the sub marker position. If the sub marker is off, executing this command causes an error and the command is ignored.

Parameters

	<numeric>
Description	Number of the measurement point where you want to move the sub marker (the number assigned in order from the left edge assuming that the number of the leftmost measurement point is 1)
Range	1 to the number of points
Initial value	1
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

No front panel key is available to execute this function.

SMKRPRM{1-7}

Syntax

SMKRPRM{1|2|3|4|5|6|7} <numeric>[HZ|MHZ|V|A]

SMKRPRM{1|2|3|4|5|6|7}?

Description

For the active trace (set with the “TRAC” command on page 457), moves a sub marker (marker number 1-7) to the position of the specified sweep parameter value. In the coupled marker mode (set with the “MKRCOUP” command on page 352), regardless of the active trace setting, moves the sub marker on both the A and B traces. If this command is executed as Query, it reads out the sweep parameter value of the sub marker position.

If the Δ marker mode is on, the sub marker moves the distance of the specified sweep parameter value relative to the Δ marker. Therefore, specify the position where you want to move the sub marker by the difference from the Δ marker. Also, the readout, when executed as query, is the difference value from the Δ marker.

If the sub marker is off, executing this command causes an error and the command is ignored.

Parameters

	<numeric>
Description	Position where you want to move the sub marker
Range	“Sweep start value” to “sweep stop value”
Initial value	0
Unit	Varies depending on the sweep parameter (refer to the explanation of unit in “CENT” on page 277).
Resolution	Varies depending on the sweep parameter (refer to the explanation of resolution in “CENT” on page 277).

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

No front panel key is available to execute this function.

SMKRVAL{1-7}?

Syntax

SMKRVAL{1|2|3|4|5|6|7}?

Description

For the active trace (set with the “TRAC” command on page 457), reads out the measurement parameter value at a sub marker (marker number 1-7) position. (Query only)

Query response

{numeric}<newline><^END>

If the measurement parameter is a scalar value (for other than COMPLEX Z-Y), the measurement parameter value is read out. If the measurement parameter is a vector value (for COMPLEX Z-Y), the readout is as follows:

- If the polar chart format is selected, the amplitude is read out.
- If the complex plane format is selected, resistance (for trace A) or conductance (for trace B) is read out.

Corresponding key

No front panel key is available to execute this function.

SPAN

Syntax

SPAN <numeric>[HZ|MHZ|V|A]

SPAN?

Description

Sets the span value of the sweep range. To set the span value of each segment when creating the list sweep table, also use this command.

Parameters

		<numeric>
Description		Span value
When the sweep parameter is frequency	Range	0 to 109.99996E6 (for linear sweep) 20 to 109.99996E6 (for log sweep)
	Initial value	109.99996E6
	Unit	Hz
	Resolution	1E-3
When the sweep parameter is OSC level (voltage)	Range	0 to 0.995
	Initial value	0.995
	Unit	V (volt)
	Resolution	1E-3
When the sweep parameter is OSC level (current)	Range	0 to 19.8E-3
	Initial value	19.8E-3
	Unit	A (ampere)
	Resolution	10E-6
When the sweep parameter is dc bias level (voltage)	Range	0 to 80
	Initial value	0
	Unit	V (volt)
	Resolution	1E-3
When the sweep parameter is dc bias level (current)	Range	0 to 200E-3
	Initial value	0
	Unit	A (ampere)
	Resolution	10E-6

Note that, if you use this command to create a segment, the initial value is 0 regardless of the sweep parameter.

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Span]

SPLD

Syntax

SPLD {ON|OFF|1|0}

SPLD?

Description

Enables/disables the vertically separate display for traces A and B.

If the separate display of traces A and B is enabled, the upper half of the LCD screen is used as trace A measurement result display screen, and the lower half, as trace B measurement result display screen. If the separate display of traces A and B is disabled, the measurement results of traces A and B are superimposed on the same screen.

If the screen is set so that the upper half of the LCD screen is used as the measurement result display screen and the lower half as the HP Instrument BASIC screen (specified to HIHB with the “DISA” command on page 298), regardless of the setting to enable/disable the separate display, both traces are superimposed on the same screen.

Parameters

	Description
ON or 1	Enables the separate display of traces A and B.
OFF or 0 (initial value)	Disables the separate display of traces A and B.

Query response

{1|0}<newline><^END>

Corresponding key

[Display] - **SPLIT on OFF**

STAR

Syntax

STAR <numeric>[HZ|MHZ|V|A]

STAR?

Description

Sets the sweep range start value.

Parameters

		<numeric>
Description		start value
When the sweep parameter is frequency	Range	40 to 110E6 (for linear sweep) 40 to 109.9998E6 (for log sweep)
	Initial value	40
	Unit	Hz
	Resolution	1E-3
When the sweep parameter is OSC level (voltage)	Range	5E-3 to 1
	Initial value	5E-3
	Unit	V (volt)
	Resolution	1E-3
When the sweep parameter is OSC level (current)	Range	200E-6 to 20E-3
	Initial value	200E-6
	Unit	A (ampere)
	Resolution	10E-6
When the sweep parameter is dc bias level (voltage)	Range	-40 to 40
	Initial value	0
	Unit	V (volt)
	Resolution	1E-3
When the sweep parameter is dc bias level (current)	Range	-100E-3 to 100E-3
	Initial value	0
	Unit	A (ampere)
	Resolution	10E-6

Note that, if you use this command to create a segment, the initial value when creating segment 1 is the current sweep range start value and the initial value when creating an additional segment is the sweep range stop value of the previous segment.

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Start]

STOD

Syntax STOD {DISK|MEMO|FLASH}

Description Selects a mass storage to which file operation is applied. (No query)

Parameters

	Description
DISK (initial value)	Specifies the flexible disk drive.
MEMO	Specifies the built-in RAM disk (volatile).
FLASH	Specifies the built-in flash disk (non-volatile).

Corresponding key **[Save]** - **STORE DEV [ ]** - {**FLOPPY** | **MEMORY** | **FLASH MEMORY**}

STOP

Syntax

STOP <numeric>[HZ|MHZ|V|A]

STOP?

Description

Sets the sweep range stop value.

Parameters

		<numeric>
Description		Stop value
When the sweep parameter is frequency	Range	40 to 110E6 (for linear sweep) 60 to 110E6 (for log sweep)
	Initial value	110E6
	Unit	Hz
	Resolution	1E-3
When the sweep parameter is OSC level (voltage)	Range	5E-3 to 1
	Initial value	1
	Unit	V (volt)
	Resolution	1E-3
When the sweep parameter is OSC level (current)	Range	200E-6 to 20E-3
	Initial value	20E-3
	Unit	A (ampere)
	Resolution	10E-6
When the sweep parameter is dc bias level (voltage)	Range	-40 to 40
	Initial value	0
	Unit	V (volt)
	Resolution	1E-3
When the sweep parameter is dc bias level (current)	Range	-100E-3 to 100E-3
	Initial value	0
	Unit	A (ampere)
	Resolution	10E-6

Note that, if you use this command to create a segment, the initial value when creating segment 1 is the current sweep range start value and the initial value when creating an additional segment is the sweep range stop value of the previous segment.

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Stop]

SUBNET

Syntax

SUBNET <1st>,<2nd>,<3rd>,<4th>

SUBNET?

Description

When using the 4294A connected to LAN, sets the subnet mask for IP address. The value actually used as the subnet mask is the logical OR of the value set with this command and the value determined depending on the IP address of the 4294A as shown below.

IP address	Value used for OR
0.0.0.0-127.255.255.255 (class A)	255.0.0.0
128.0.0.0-191.255.255.255 (class B)	255.255.0.0
192.0.0.0-223.255.255.255 (class C)	255.255.255.0

For example, if the IP address of the 4294A is 150.100.10.1 and the value set with this command is 0.0.192.0, the value actually used as the subnet mask is 255.255.192.0.

NOTE

To bring the setting of the changed subnet mask to take effect, reboot (turn off and then on again) the 4294A after the setting.

Parameters

	<1st>*1	<2nd>*1	<3rd>*1	<4th>*1
Description	1st number of the subnet mask	2nd number of the subnet mask	3rd number of the subnet mask	4th number of the subnet mask
Range	0 to 255	0 to 255	0 to 255	0 to 255
Initial value	0	0	0	0
Resolution	1	1	1	1

***1.** For example, to set the subnet mask to 255.255.192.0, <1st> is 255, <2nd> is 255, <3rd> is 192, and <4th> is 0.

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{1st},{2nd},{3rd},{4th}<newline><^END>

Corresponding key

[Local] - **SUBNET MASK** - **1st**, **2nd**, **3rd**, **4th**

SWED

Syntax

SWED {UP|DOWN}

SWED?

Description

Selects the sweep direction.

Parameters

	Description
UP (initial value)	Specifies the sweep parameter increasing direction (from left to right on the screen).
DOWN	Specifies the sweep parameter decreasing direction (from right to left on the screen).

Query response

{UP|DOWN}<newline><^END>

Corresponding key

[Sweep] - DIRECTION [ ]

SWET

Syntax

SWET <numeric>[S]

SWET?

Description

Sets the sweep time.

Parameters

	<numeric>
Description	Sweep time
Range	0 to 10000 (Note that, the lower limit varies depending on the measurement condition.)
Initial value	Varies depending on the measurement condition.
Unit	s (second)
Resolution	0.001

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Sweep] - TIME - SWEEP TIME

SWPP

Syntax

SWPP {FREQ|OLEV|DCB}

SWPP?

Description

Sets the sweep parameter.

Parameters

	Description
FREQ (initial value)	Specifies the frequency sweep.
OLEV	Specifies the oscillator (OSC) level sweep.
DCB	Specifies the dc bias level sweep.

Query response

{FREQ|OLEV|DCB}<newline><^END>

Corresponding key

[Sweep] - **PARAMETER [ ]** - {**FREQ** | **OSC LEVEL** | **DC BIAS**}

SWPT

Syntax

SWPT {LIN|LOG|LIST}

SWPT?

Description

Sets the sweep type.

Parameters

	Description
LIN (initial value)	Specifies the linear sweep.
LOG	Specifies the log sweep (settable only for frequency sweep).
LIST	Specifies the list sweep.

Query response

{LIN|LOG|LIST}<newline><^END>

Corresponding key

[Sweep] - **TYPE [ ]** - {**LINEAR** | **LOG** | **LIST**}

TARL?

Syntax

TARL? <numeric 1>

Description

Within the waveform analysis range specified with the “ANARANG” command on page 267, searches the analysis range from right to left for a point of the specified measurement value, and reads out the sweep parameter value at the first detected point. If the specified measurement parameter value is not detected, 0 is read out.(Query only)

Parameters

	<numeric 1>
Description	Measurement parameter value you want to search for
Range	-9.9E37 to 9.9E37
Unit	Varies depending on the measurement parameter (refer to the explanation of unit in “SCAL” on page 423).

If the specified parameter is out of the setting range, an error occurs and the command is ignored.

Query response

{numeric 2}<newline><^END>

	{numeric 2}
Description	Sweep parameter value of the detected point
Unit	Varies depending on the sweep parameter (refer to the explanation of unit in “CENT” on page 277).

Corresponding key

No front panel key is available to execute this function.

TARR?

Syntax TARR? <numeric 1>

Description Within the waveform analysis range specified with the “ANARANG” command on page 267, searches the analysis range from left to right for a point of the specified measurement value, and reads out the sweep parameter value at the first detected point. If the specified measurement parameter value is not detected, 0 is read out.(Query only)

Parameters

	<numeric 1>
Description	Measurement parameter value you want to search for
Range	-9.9E37 to 9.9E37
Unit	Varies depending on the measurement parameter (refer to the explanation of unit in “SCAL” on page 423).

If the specified parameter is out of the setting range, an error occurs and the command is ignored.

Query response {numeric 2}<newline><^END>

	{numeric 2}
Description	Sweep parameter value of the detected point
Unit	Varies depending on the sweep parameter (refer to the explanation of unit in “CENT” on page 277).

Corresponding key No front panel key is available to execute this function.

THRR

Syntax

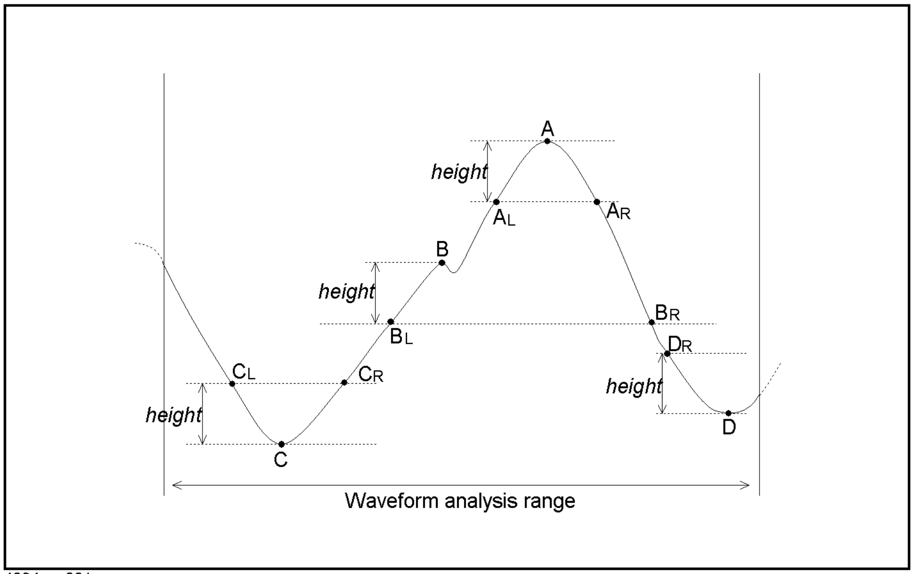
THRR <numeric>

THRR?

Description

Within the waveform analysis range specified with the “ANARANG” command on page 267, sets the condition on which peaks are defined among all maximal values and negative peaks are defined among all minimal values: *height* (refer to Figure 16-9).

Figure 16-9 **Condition of the peak/negative peak**



4294ape001

If 2 measurement points having a value less than the maximal value minus *height* exist on both left and right sides of a maximal value, and the maximal value is the maximum within the range between those measurement points, it is considered as a peak. For example, for maximal value A in Figure 16-9, there are 2 points on both left and right sides having a value less than the maximal value minus *height*: measurement point A_L and A_R, and A is the maximum within the range between A_L and A_R. Therefore, it is considered as a peak. On the other hand, for maximal value B, there are 2 points on both left and right sides having a value less than the maximal value minus *height*: measurement point B_L and B_R, but B is not the maximum within the range between B_L and B_R. Therefore, it is not considered as a peak.

In the same way, if 2 measurement points having a value of the minimal value plus *height* exist on both left and right sides of a minimal value, and the minimal value is the minimum within the range between those measurement points, it is considered as a negative peak. For example, for minimal value C in Figure 16-9, there are 2 points on both left and right sides having a value larger than the minimal value plus *height*: measurement point C_L and C_R, and C is the minimum within the range between C_L and C_R, it is considered as a negative peak. For minimal value D, there is no measurement point on the right side having a value larger than the minimal value plus *height*, it is not considered as a negative peak.

Depending on the display format, the definition of height differs as shown below (in the previous description, a measurement point having a value less than the maximal value minus *height* (or a value larger than the minimal value plus *height*) means a threshold value for the linear Y axis format.)

For the linear Y axis format

height is a threshold value of the distance between the maximal value (or minimal value) and the measurement point value (in Figure 16-9, value of $|A-A_L|$, $|C-C_R|$, and so on).

For the log Y axis format

height is a threshold value of the ratio of the larger value to the smaller value: maximal value (or minimal value) and measurement point value (in Figure 16-9, values of A/A_L and C_R/C, and so on). More specifically, the threshold value shown below.

When $H > 0$, $L > 0$: H / L

When $H < 0$, $L < 0$: L / H (for negative values, a larger value has a smaller absolute value, and therefore the denominator and numerator are reversed.)

When $H \geq 0$, $L \leq 0$: No peak and negative peak are detected. Note that, only when the value of *height* is 1 (initial value), all maximal values (or minimal values) are considered as peaks (or negative peaks).

Where, H is the larger value and L is the smaller value. More specifically, when judging whether a maximal value is a peak, H is the maximal value and L is the measurement point value. When judging whether a minimal value is a negative peak, H is the measurement point value and L is the minimal value.

For the linear Y axis format, if *height* is set to 0 (initial value), all maximal values (or minimal values) are considered as peaks (or negative peaks). On the other hand, for the log Y axis format, if *height* is set to 1 (initial value), all maximal values (or minimal values) are considered as peaks (or negative peaks).

Parameters

	<numeric>
Description	Condition of the peak/negative peak: *height*
Range	For the linear Y axis format: 0 to 9.9E37 For the log Y axis format: 1 to 9.9E37
Initial value	For the linear Y axis format: 0 For the log Y axis format: 1
Unit	Varies depending on the measurement parameter (refer to the explanation of unit in “SCAL” on page 423).

If the specified parameter does not reach the lower limit of the setting range, it is set to the lower limit. If the specified parameter exceeds the upper limit of the setting range, an error occurs and the command is ignored.

Query response {numeric}<newline><^END>

Corresponding key No front panel key is available to execute this function.

TINT

Syntax

TINT <numeric>

TINT?

Description

Sets the hue of the display color of the item selected with the “COLO” command on page 280 command.

Parameters

	<numeric>
Description	Value indicating the hue (0 or 100: red, 33: green, 66: blue)
Range	0 to 100
Initial value	Varies depending on the display item selected with the “COLO” command on page 280.
Resolution	1

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Display] - **more 1/2** - **MODIFY COLOR** - **MODIFY ITEM COLOR** - **MODIFY COLOR** - **TINT**

TITL

Syntax

TITL <string>

TITL?

Description

For the active trace (set with the “TRAC” command on page 457), sets a string displayed in the title area on the display screen.

Parameters

	<string>
Description	String displayed in the title area
Range	65 characters or less
Initial value	Blank ("")

If the specified file name has characters that exceed the maximum length, only the string of up to the maximum length is valid and the remaining characters are ignored.

Query response

{string}<newline><^END>

Corresponding key

[Display] - **more 1/2** - **TITLE ➢**

TMARG

Syntax

TMARG <numeric>

TMARG?

Description

Sets the top margin (white space) of printed forms for printout.

Parameters

	<numeric>
Description	Top margin
Range	0 to 5
Initial value	1
Unit	inch
Resolution	0.01

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Copy] - **SETUP** - **TOP MARGIN**

TOPV

Syntax

TOPV <numeric>[OHM|DEG|RAD|SIE|H|F|PCT]

TOPV?

Description

Sets the maximum value of the display screen in the Y axis (vertical axis) direction (value of the top of the grid).

If the difference, between this maximum value and the minimum value in the Y-axis direction on the display screen (set with the "BOTV" command on page 273), is less than 10E-15 (for the log Y axis format, the ratio between the maximum value and the minimum value is less than 5), the minimum value is automatically changed so that it is less than the maximum value minus 10E-15 (for the log Y axis format, the value at which the ratio between the maximum value and the minimum value is 5). Also, the single grid tick width (SCALE/DIV) and the reference line value (REFERENCE VALUE) are automatically changed so that they match the setting of the minimum value/maximum value in the Y-axis direction.

In the log Y axis format, if the sign differs from that of the display screen minimum value, the sign of the minimum value is automatically changed to the same sign as the maximum value.

Parameters

	<numeric>
Description	Maximum value of the display screen in the Y axis (vertical axis) direction
Range	Varies depending on the measurement parameter as follows: For |Z|, R, X: -1E12 to 1E12 For other than |Z|, R, X: -1E9 to 1E9
Initial value	Varies depending on the measurement parameter as follows: For |Z|, R, X, Rs, Rp: 1E6 For θ: 180 For |Y|, G, B, D: 1 For Cs, Cp: 1E-3 For Ls, Lp: 10 For Q: 1E3
Unit	Varies depending on the measurement parameter (refer to the explanation of unit in "SCAL" on page 423).
Resolution	1E-15 [*1]

*1.This is the minimum value (when the set value is small). The resolution becomes larger as the set value becomes larger.

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Scale Ref] - TOP VALUE

TRAC

Syntax

TRAC {A|B}

TRAC?

Description

Sets the active trace.

Parameters

	Description
A (initial value)	Specifies trace A as the active trace.
B	Specifies trace B as the active trace.

Query response

{A|B}<newline><^END>

Corresponding key

{**[A]** | **[B]**}

TRACK

Syntax

TRACK {ON|OFF|1|0}

TRACK?

Description

For the active trace (set with the "TRAC" command on page 457), toggles on and off the search tracking function.

Parameters

	Description
ON or 1	Turns on the search tracking function.
OFF or 0 (initial value)	Turns off the search tracking function.

Query response

{1|0}<newline><^END>

Corresponding key

[Search] - **SEARCH TRK on OFF**

TRGEVE

Syntax

TRGEVE {SWE|POIN}

TRGEVE?

Description

Sets the mode of trigger events.

Parameters

	Description
SWE (initial value)	Specifies the mode in which each trigger performs a single sweep (if the averaging function is on, a set number of times as the averaging count).
POIN	Specifies the mode in which each trigger performs the measurement of a single measurement point.

Query response

{SWE|POIN}<newline><^END>

Corresponding key

[Trigger] - **SOURCE [ ]** - **EVENT [ ]**

TRGP

Syntax

TRGP {POS|NEG}

TRGP?

Description

Sets the polarity of the external trigger signal inputted from the EXT TRIGGER terminal on the rear panel.

Parameters

	Description
POS (initial value)	Specifies positive (generating a trigger at a rise from the LOW level to the HIGH level).
NEG	Specifies negative (generating a trigger at a fall from the HIGH level to the LOW level).

Query response

{POS|NEG}<newline><^END>

Corresponding key

[Trigger] - **SOURCE [ ]** - **EXT POLRTY [ ]**

TRGS

Syntax

TRGS {INT|EXT|BUS|MAN}

TRGS?

Description

Selects a trigger source.

Parameters

	Description
INT (initial value)	Specifies the internal trigger.
EXT	Specifies the external trigger inputted from the EXT TRIGGER terminal on the rear panel.
BUS	Specifies the GPIB/LAN trigger (trigger by executing the "*TRG" command on page 261).
MAN	Specifies the manual trigger (trigger by the following key sequence on the front panel: **[Trigger]** - **SOURCE [ ]** - **MANUAL**).

Query response

{INT|EXT|BUS|MAN}<newline><^END>

Corresponding key

[Trigger] - **SOURCE [ ]** - {**FREE RUN** | **EXTERNAL** | **HP-IB/LAN** | **MANUAL**}

USKEY

Syntax

USKEY

Description

Displays user keys (ON KEY LABELS) of Instrument BAISC. (No query)

Corresponding key

[System] - **IBASIC** - **ON KEY LABELS**

WIDFVAL

Syntax

WIDFVAL <numeric>[OHM|DEG|RAD|SIE|H|F|PCT]

WIDFVAL?

Description

For the active trace (set with the “TRAC” command on page 457), if the free cutoff value setting is enabled (specified to FIXed with the “WIDVTYPE” command on page 462), sets a cutoff point. If Δmaker is on, the cutoff value is set the result of subtracting the specified value from the measurement parameter value of Δmaker position.

Parameters

	<numeric>
Description	Cutoff value*1
Range	-100E6 to 100E6
Initial value	0
Unit	Varies depending on the measurement parameter (refer to the explanation of unit in “SCAL” on page 423).

*1.If the measurement parameter is a vector value (for COMPLEX Z-Y) and if the polar chart format is selected, set the value in amplitude. If the complex plane format is selected, set the value in resistance (for trace A) or conductance(for trace B).

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response

{numeric}<newline><^END>

Corresponding key

[Search] - **WIDTHS DEF MENU** - **FIXED VALUE**

WIDSIN

Syntax

WIDSIN

Description

For the trace bandwidth analysis function for the active trace (set with the “TRAC” command on page 457), further searches for another cutoff point inside the already detected cutoff point. If no cutoff point is detected, the message indicating the result is displayed (no error occurs). If the trace bandwidth analysis function is off, executing this command causes an error and the command is ignored. (No query)

Corresponding key

[Search] - **WIDTHS DEF MENU** - **SEARCH IN**

WIDSOUT

Syntax

WIDSOUT

Description

For the trace bandwidth analysis function for the active trace (set with the “TRAC” command on page 457), further searches for another cutoff point outside the already detected cutoff point. If no cutoff point is detected, the message indicating the result is displayed (no error occurs). If the trace bandwidth analysis function is off, executing this command causes an error and the command is ignored. (No query)

Corresponding key

[Search] - **WIDTHS DEF MENU** - **SEARCH OUT**

WIDT

Syntax

WIDT {ON|OFF|1|0}

WIDT?

Description

For the active trace (set with the “TRAC” command on page 457), toggles on and off the trace bandwidth analysis function. If the trace bandwidth analysis function is set to on and If no bandwidth can be detected, the message indicating the result is displayed (no error occurs). If the marker function is off, executing this command causes an error and the command is ignored.

Parameters

	Description
ON or 1	Turns on the trace bandwidth analysis function.
OFF or 0 (initial value)	Turns off the trace bandwidth analysis function.

Query response

{1|0}<newline><^END>

Corresponding key

[Search] - **WIDTHS on OFF**

WIDVTYPE

Syntax

WIDVTYPE {DIVS2|MULS2|DIV2|FIXed}

WIDVTYPE?

Description

For the active trace (set with the “TRAC” command on page 457), selects the method to set a cutoff point in the trace bandwidth analysis function.

Parameters

	Description
DIVS2	The value obtained by dividing the measurement parameter value at the marker position by $\sqrt{2}$ is set as the cutoff point.
MULS2	The value obtained by multiplying the measurement parameter value at the marker position and $\sqrt{2}$ is set as the cutoff point.
DIV2	The value obtained by dividing the measurement parameter value at the marker position by 2 is set as the cutoff point.
FIXed (initial value)	Lets you set the cutoff point freely using the “WIDFVAL” command on page 460.

If the measurement parameter is a vector value (for COMPLEX Z-Y), you can select FIXed only.

Query response

{DIVS2|MULS2|DIV2|FIXed}<newline><^END>

Corresponding key

[Search] - **WIDTHS DEF MENU** - {**MKRVAL/(√2)** | **MKRVAL*(√2)** | **MKRVAL/2** | **FIXED VALUE**}

WOPEN

Syntax

ROPEN <string>

Description

If the specified file exists, this command makes it write-enabled; otherwise, creates a new file and makes it write-enabled. This command takes its arguments in a different way, depending on the file format.

The size of an existing file cannot be changed. Therefore, if you want to change them, delete the file itself using the “PURG”(406page) command and then create a new file using this command.

This command is used in combination with the “WRITE”(463page) command and the “CLOSE”(280page) commands, as shown in Figure 16-8 on page 412. (No query)

Parameters

	Description
<string>	File name of up to 12 characters including its extention

Corresponding key

No front panel key is available to execute this function.

WRITE

Syntax WRITE <block>

Description Writes data in a file that has been write-enabled using the ``WOPEN" command. Written data must take the fixed length block format (see Figure 16-7 on page 407) defined in IEEE488.2. The maximum length of data is 16 Kbytes. If data is greater than 16 Kbytes, execute this command repeatedly to write it.

Parameters

	Description
<block>	Data in the fixed length block format

Corresponding key No front panel key is available to execute this function.

ZMAPER

Syntax ZMAPER <numeric>[PCT]

ZMAPER?

Description Sets the zooming aperture value in a percentage of the span value. If the marker function is off, executing this command causes an error and the command is ignored.

Parameters

	<numeric>
Description	Zooming aperture value
Range	0.01 to 100
Initial value	10
Unit	% (percentage)
Resolution	0.01

If the specified parameter is out of the allowable setting range, the minimum value (if the lower limit of the range is not reached) or the maximum value (if the upper limit of the range is exceeded) is set.

Query response {numeric}<newline><^END>

Corresponding key **[Marker→]** - **more 1/2** - **ZOOMING APERTURE**

Instrument BASIC control commands

This section describes the commands used to control Instrument BASIC from the external controller. The commands described here cannot be executed using Instrument BASIC.

:PROGram:CATalog?

Syntax

:PROGram:CATalog?

Description

Reads out the program name defined with the ":PROGram[:SELected]:NAME" command on page 466. The 4294A provides no practical function. (Query only)

Corresponding key

No front panel key is available to execute this function.

:PROGram[:SELected]:DEFine

Syntax

:PROGram[:SELected]:DEFine <block>

:PROGram[:SELected]:DEFine?

Description

Downloads an HP Instrument BASIC program from the external controller to the 4294A. If the size of the downloaded program exceeds available space in the Instrument BASIC program workspace, lines of the program sent before the overflow are stored, and program lines sent after the overflow are ignored.

Executing this command as a query uploads the Instrument BASIC program on the 4294A to the external controller. Uploading is available when the status of the program is PAUSE or STOP.

Parameters

	<block>
Description	Program data of arbitrary length block

Arbitrary length block data consists of a header part and a following data part (program to be sent). The header part has 2 formats as follows.

#0 Indicates that the size of the data part is not defined. In this case, after sending the header part, data of an arbitrary size is sent. After all the data is sent, send an end signal (<LF>+EOI) (for example, in the case of HP BASIC, send END in an OUTPUT statement) to finish sending the data. Transmission in this format can be executed only from GPIB, but cannot from LAN.

#NMM...M Defines the size of the data part (N specifies the number of digits of the number to indicate the size (the MM...M part); MM...M specifies the size). In this case, data of the defined size is sent, following the header part.

Query response

{block}<newline><^END>

Reads out a program in an arbitrary length block in which the header part defines the data size and the data part follows it.

Corresponding key

No front panel key is available to execute this function.

:PROGram[:SELected]:DELete:ALL

Syntax

:PROGram[:SELected]:DELete:ALL

Description

Deletes all programs on the 4294A Instrument BASIC editor. (No query)

Corresponding key

No front panel key is available to execute this function.

:PROGram[:SELected]:DELete:[SELected]

Syntax

:PROGram[:SELected]:DELete:[SELected]

Description

Deletes a program on the 4294A. (No query)

Corresponding key

No front panel key is available to execute this function.

:PROGram[:SELected]:EXECute

Syntax

:PROGram[:SELected]:EXECute <string>

Description

Execute the specified program command. This command can be executed only when the status of the program is PAUSE or STOP. (No query)

Parameters

	<string>
Description	Command you want to execute

Corresponding key

No front panel key is available to execute this function.

:PROGram[:SELected]:MALLocate

Syntax

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

:PROGram[:SELected]:MALLocate?

Description

The 4294A provides no practical function.

Corresponding key

No front panel key is available to execute this function.

:PROGram[:SELected]:NAME

Syntax

:PROGram[:SELected]:NAME <string>

:PROGram[:SELected]:NAME?

Description

Defines a program name. Note that, in the case of the 4294A, you need not to define any program name.

Parameters

	<string>
Description	Program name
Initial value	"PROG"

Corresponding key

No front panel key is available to execute this function.

:PROGram[:SELected]:NUMBer

Syntax

:PROGram[:SELected]:NUMBer <variable name>,<numeric 1>[,<numeric 2>,..,<numeric n>]

:PROGram[:SELected]:NUMBer? <variable name>

Description

Sets values into the specified numeric variable or numeric array of the program on the 4294AInstrument BASIC editor.

Parameters

	Description
<variable name>	Numeric variable name you want to specify. It does not need to be enclosed in double quotation marks (").
<numeric 1>	Value you want to set into the numeric variable. (If the numeric variable is an array, the 1st value of the array.)
<numeric n>	If the numeric variable is an array, the n-th value of the array.

Query response

{numeric 1}[,{numeric 2},..,{numeric n}]<newline><^END>

Corresponding key

No front panel key is available to execute this function.

:PROGram[:SELected]:STATe

Syntax

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

:PROGram[:SELected]:STATe?

Description

Sets the status of the program on the 4294A Instrument BASIC editor.

Parameters

	Description
RUN	Causes the program to run.
PAUSe	Causes the program to pause.
STOP	Causes the program to stop.
CONTinue	Causes the program in pause to run.

If the program is running and this command is executed with RUN specified, an error occurs and the command is ignored.

If the program is stopped and this command is executed with PAUSe specified, the program remains stopped.

If the program is in a status other than PAUSE and this command is executed with CONTinue specified, an error occurs and the command is ignored.

Query response

{RUN|PAUS|STOP}<newline><^END>

Corresponding key

No front panel key is available to execute this function.

:PROGram[:SELected]:STRing

Syntax

:PROGram[:SELected]:STRing <variable name>,<string 1>[,<string 2>,..,<string n>]

:PROGram[:SELected]:STRing? <variable name>

Description

Sets a value into the specified string variable or numeric array in the program on the 4294A Instrument BASIC editor.

Parameters

	Description
<variable name>	Numeric variable name you want to specify. $ at the end of a variable name is not needed. It does not need to be enclosed in double quotation marks (").
<string 1>	String you want to set into the string variable. (If the numeric variable is an array, the 1st value of the array.) It must be enclosed in double quotation marks (").
<string n>	When the string variable is an array, the n-th string of the array. It must be enclosed in double quotation marks (").

Query response

{string 1}[,{string 2},..,{string n}]<newline><^END>

Corresponding key

No front panel key is available to execute this function.

:PROGram[:SELected]:WAIT

Syntax

:PROGram[:SELected]:WAIT

:PROGram[:SELected]:WAIT?

Description

Makes the setting so that the 4294A accepts no commands until the status of the program on the 4294A Instrument BASIC editor becomes STOP or PAUSE from RUN.

If this command is executed as Query, 1 is read out when the program status changes from RUN to STOP or PAUSE.

Query response

{1}<newline><^END>

Corresponding key

No front panel key is available to execute this function.

Commands starting with :PROGram:EXPLicit

The commands starting with :PROGram:EXPLicit have the same function as those starting with :PROGram[:SELected]. The below table shows their relationship.

Commands starting with :PROGram:EXPLicit:	Commands starting with :PROGram[:SELected]:
:PROGram:EXPLicit:DEFine "PROG"	:PROGram[:SELected]:DEFine
:PROGram:EXPLicit:DELete "PROG"	:PROGram[:SELected]:DELete:[SELected]
:PROGram:EXPLicit:EXECute "PROG"	:PROGram[:SELected]:EXECute
:PROGram:EXPLicit:MALLocate "PROG"	:PROGram[:SELected]:MALLocate
:PROGram:EXPLicit:NAME "PROG"	:PROGram[:SELected]:NAME
:PROGram:EXPLicit:NUMBer "PROG"	:PROGram[:SELected]:NUMBer
:PROGram:EXPLicit:STATe "PROG"	:PROGram[:SELected]:STATe
:PROGram:EXPLicit:STRing "PROG"	:PROGram[:SELected]:STRing
:PROGram:EXPLicit:WAIT "PROG"	:PROGram[:SELected]:WAIT

If you change the definition of the program name with the ":PROGram[:SELected]:NAME" command on page 466, the "PROG" part in the table must be replaced with the program name.

A Manual Changes

This appendix contains the information required to adapt this manual to earlier versions or configurations of the Agilent 4294A than the current printing date of this manual. The information in this manual applies directly to a 4294A model that has a serial number prefix listed on the title page of this manual.

Manual Changes

To adapt this manual to your Agilent 4294A, refer to Table A-1 and Table A-2.

Table A-1 **Manual Changes by Serial Number**

Serial Prefix or Number	Make Manual Changes

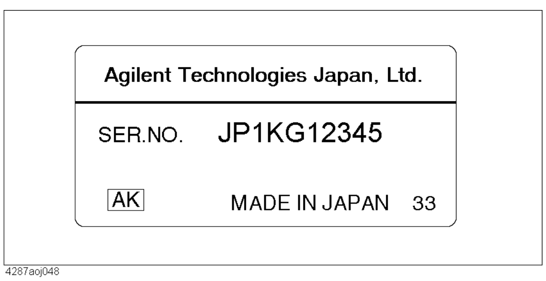
Table A-2 **Manual Changes by Firmware Version**

Version	Make Manual Changes
Rev 1.10	"Change 1" on page 471
Rev 1.11	"Change 2" on page 472

Agilent Technologies uses a two-part, ten-character serial number that is stamped on the serial number plate (see Figure A-1). The first five characters are the serial prefix and the last five digits are the suffix.

Execute the "*IDN?" command on page 259 to check the firmware version.

Figure A-1 **Example of Serial Number Plate**



Change 1

The firmware revision 1.0x does not support the following function.

- Saving an internal data array in the touchstone format.
- SCPI Command “MANR” on page 346

Change to the revision 1.0x

Chapter 6 , “Reading/Writing Measurement Data,” on page 77

Delete the following sentence in “Saving array as file” on page 83

NOTE You can save an internal data array in the touchstone format by “SAVDS1P” on page 418. But you cannot recall the file.

Chapter 8 , “Saving/Recalling a Measurement Result/Measurement Setup,” on page 111

Delete the following sentence in “Saving data into a file” on page 112

The following command available for save a data array to a file in the touchstone format.

- “SAVDS1P” on page 418

Chapter 13 , “Application Sample Programs,” on page 185

Delete the following section

- “Measurement using scanner” on page 229

Chapter 16 , “GPIB Command Reference,” on page 255

Delete the following commands.

- “MANR”(346page)
- “SAVDS1P”(418page)

Change 2

The firmware revision 1.10 and below does not support the following function.

- File Transfer function

Change to the revision 1.10

Chapter 13 , “Application Sample Programs,” on page 185

Delete the following section

- “File Transfer Function” on page 239

Chapter 16 , “GPIB Command Reference,” on page 255

Delete the following commands.

- “CLOSE”(280page)
- “CWD?”(284page)
- “FNAME?”(316page)
- “FNUM?”(316page)
- “FSIZE?”(318page)
- “READ?”(407page)
- “ROPEN”(412page)
- “WOPEN”(462page)
- “WRITE”(463page)

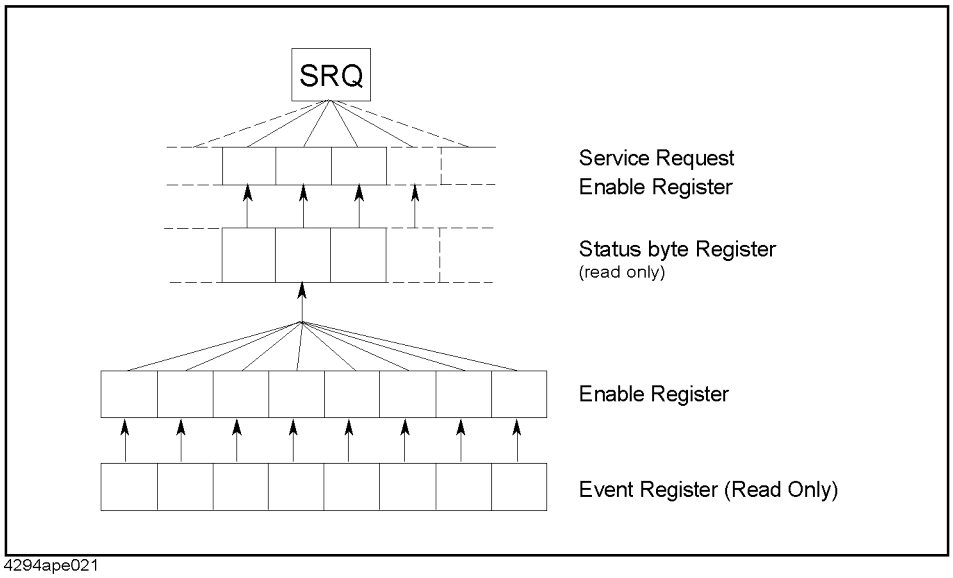
B Status Reporting System

This appendix describes the status reporting system of the Agilent 4294A.

General Status Register Model

The Agilent 4294A has a status reporting system to report the condition of the instrument.

Figure B-1 **General Status Register Model**



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

When the event register bit is set to “1” and a corresponding enable register bit (a bit marked with an arrow in Figure B-1) 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 bit of the service request enable register is “1”, service request (SRQ) is generated with the positive transition of the corresponding status byte register bit. By generating SRQ, you can notify the controller that the 4294A is requesting service. This implies that interruption by SRQ can be programmed. For more information on using SRQ, see “Using the status register” on page 74 in Chapter 5 , “Starting a Measurement (Trigger) and Detecting the Completion of a Measurement (End of Sweeps),” or “Using the Status Register” on page 132 in Chapter 10 , “Handling Errors.”

Event register

Reflects the correspondent condition of the 4294A (e.g. occurrence of an event) as a bit status. These bits monitor the changing 4294A's state continuously and change bit status when the condition (e.g. change bit status to "1" if a specific event occurs) for each bit is met. You cannot change bit status by GPIB command.

4294A has the following event registers:

- Instrument Event Status Register (See Table B-3 for details)
- Standard Event Status Register (See Table B-2 for details)
- Operation Status Event Register (See Table B-4 for details)

Enable register

Setting the enable register allows you to specify event register bits which can set "1" to the summary bit of the status byte register when an event occurs. The register bits work like mask bits; setting "1" to an enable register will enable a corresponding bit in the event register.

For example, when you want to set "1" the summary bit in the status byte register by a specific register condition, set the corresponding enable register to "1".

Status byte register

If the enabled event register is set to "1", a corresponding bit of the status byte register is also 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 "*STB?" command on page 261 or serial poll (SPOLL statement in HP BASIC) from the controller. The "*STB?" sets the analyzer to remote mode. On the other hand, the SPOLL statement in HP BASIC reads the status byte register value directly without the instrument being set to remote. Therefore, you can continue to operate front panel keys while a controller is reading the status byte register.

Reading the status byte register by the "*STB?" command does not affect the contents of the status byte register. However, reading with the SPOLL statement of HP BASIC will clear the RQS bit in the status byte register.

Table B-1 shows the contents of the status byte register for the 4294A. A serial poll initiated by using the SPOLL command reads bit 6 of the status byte register as the RQS bit. The "*STB?" command reads bit 6 as the MSS bit. See Table B-1 for details on RQS and MSS bits.

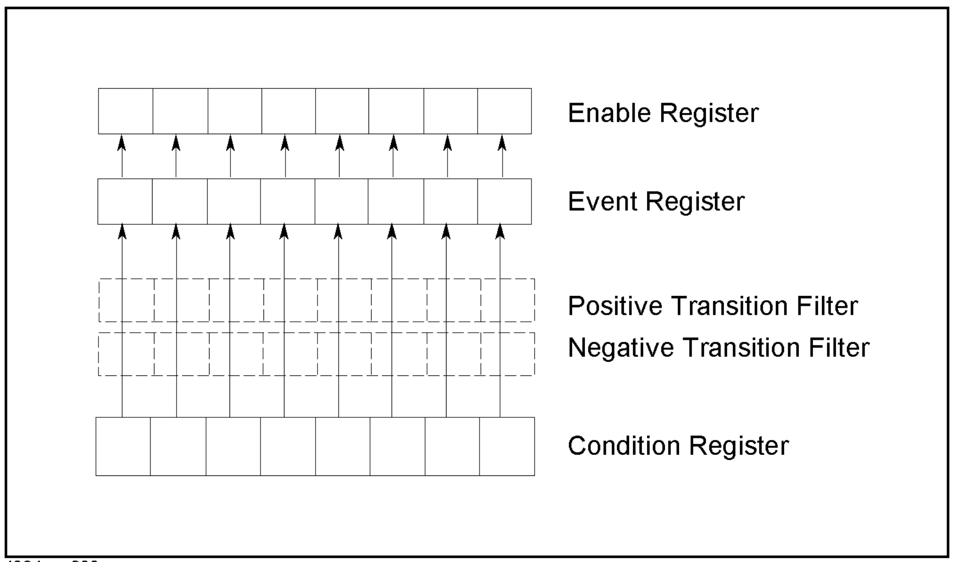
SRQ (Service Request) can be generated linking with the status byte register by setting the service request enable register.

Transition filter and condition register

The transition filter allows you to select which transitions of the condition of the 4294A 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 condition register.

Figure B-2 **Transition Filter and Condition Register**



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For the 4294A, only the “Program Running” and “Printing” bits of the operation status register has a transition filter (See Figure B-3). By using the transition filter, you can generate an SRQ at the start and/or the end of the program execution.

Status Register Structure

The status reporting system has a hierarchical structure as shown in Figure B-3. The status byte register is a summary of registers in its lower level. This section describes status registers in each hierarchy. Each bit of the status register is described in Table B-1 through Table B-4.

Figure B-3 Status Register Structure

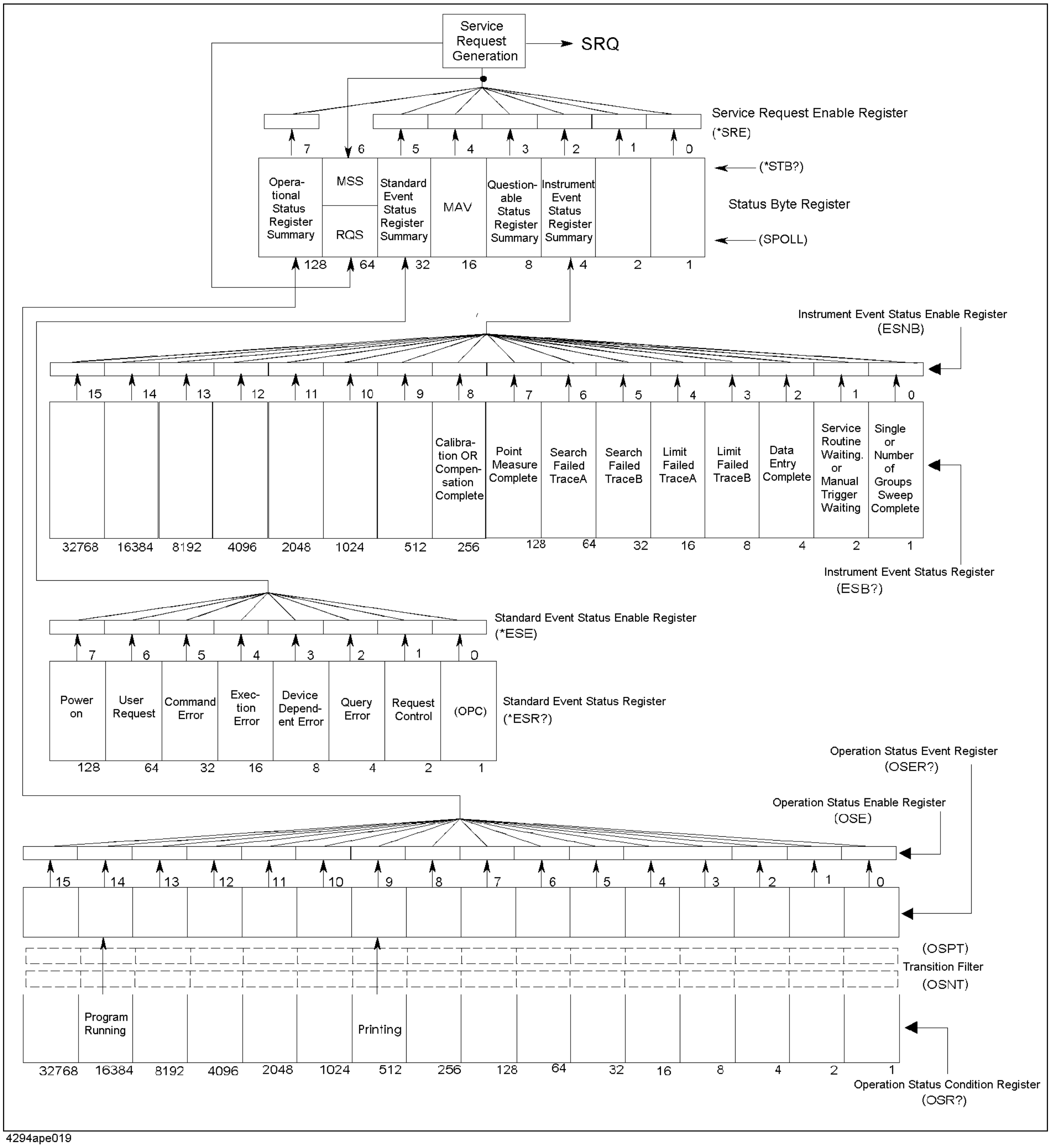

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Table B-1 Status Bit Definitions of the Status Byte (STB)

Bit	Name	Description
2	Instrument Event Status Register Summary Bit	“1” is set when any of the enabled bits in the instrument event status register is set to “1.”
3	Questionable Status Register Summary Bit	The event reporting system of the 4294A reports no event to the questionable status register. This register is provided to assure compatibility with other SCPI instruments.
4	MAV (Message Available)	“1” is set when Output Queue has data and “0” is set when Output Queue has no data.
5	Standard Event Status Register Summary Bit	Set to “1” when any of the enabled bits in the status event status register is set to “1.”
6	RQS (when reading the status byte register through the serial poll.)	“1” is set when an SRQ is generated by the 4294A. “0” is set when the status byte register is read through the serial poll.
	MSS (when reading the status byte register using “*STB?” on page 261.)	“1” is set when any of bits enabled by the service request enable register in the status byte register of the 4294A is set to “1.”
7	Operation Status Register Summary Bit	“1” is set when any of the enabled bits in the operational status register is set to “1.”

Executing “*CLS” command on page 258 will clear all bits of the status byte register.

Table B-2 Status Bit Definitions of the Event Status Register (ESR)

Bit	Name	Description
0	Operation Complete	"1" is set when all the operations of the overlap command sent before sending "*OPC" command on page 259.
1	Request Control	"1" is set when the 4294A requests GPIB control to continuously operate for controlling its peripheral devices.
2	Query Error	1. "1" is set when the 4294A receives a query request, but there is nothing in the output queue to transmit. 2. "1" is set when data in the output queue is lost.
3	Device Dependent Error	"1" is set when an error, other than a command error, a query error, and an execution error occurs.
4	Execution Error	1. "1" is set when any parameter in an GPIB command exceeds its input range, or is inconsistent with the 4294Acapabilities. 2. "1" is set when an GPIB command could not be properly executed due to some condition of the 4294A.
5	Command Error	1. "1" is set when an IEEE 488.2 syntax error has been occurred (a command sent to the 4294A does not follow the IEEE 488.2 syntax). Possible violations include, the command parameter violates the 4294A listening formats or is unacceptable to the 4294A. 2. "1" is set when a semantic error occurs. Possible causes include, a command which contains misspelling was sent to the 4294A, or an IEEE 488.2 command that was not supported by the 4294A was sent. 3. "1" is set when GET (Group Execution Trigger) is inputted to the program input buffer.
6	User Request	"1" is set when an operator presses a front panel key, a key on the keyboard connected to the 4294A, or turns the rotary knob.
7	Power ON	"1" is set when the 4294A is powered ON.

Executing "*CLS" command on page 258 will clear all bits of the standard event status register.

Table B-3 **Status Bit Definitions of the Instrument Status Register**

Bit	Name	Description
0	Single or Number of Groups Sweep Complete	“1” is set when a single or group sweep was completed after the last read of the register.
1	Service Routine Waiting or Manual Trigger Waiting	1. “1” is set when execution of an internal service routine is completed or when the routine is put into waiting state for operator’s response. 2. “1” is set when the 4294A is put into the manual trigger mode or GPIB/LAN trigger mode and is waiting for a manual trigger.
2	Data Entry Complete	“1” is set when the terminator key is pressed.
3	Limit Failed, Trace B	“1” is set when a limit test failed on trace B.
4	Limit Failed, Trace A	“1” is set when a limit test failed on trace A.
5	Search Failed, Trace B	“1” is set when no value was obtained for a target of marker search on trace B.
6	Search Failed, Trace A	“1” is set when no value was obtained for a target of marker search on trace A.
7	Point Measurement Complete[*1]	“1” is set when a measurement of a single point is completed in sweep measurement. (when using the point trigger)
8	Calibration or Compensation Complete	“1” is set when each measurement data is completely obtained for the adapter setting, user calibration, and fixture compensation.

*1.This bit is set only when both of bits associated with the service request enable register and the instrument event status enable register are enabled.

Executing “*CLS” command on page 258 will clear all bits of the instrument status register.

Table B-4 **Status Bit Definitions of the Operation Status Condition Register**

Bit	Name	Description
9	Printing	“1” is set while data is being transferred to the printer.
14	Program Running	“1” is set while an HP Instrument BASIC program is running.

Executing “*CLS” command will clear all bits of the operation status condition register.

C GPIB command table

This appendix provides the Agilent 4294A GPIB command list sorted according to function.

GPIB command list sorted according to function

Function	Setting/Operation			GPIB command
Measurement condition	Preset			"*RST" on page 260 "PRES" on page 404
	Active trace			"TRAC" on page 457
	Measurement parameter			"MEAS" on page 348
	Number of points			"POIN" on page 401
	Sweep	Parameter		"SWPP" on page 449
		Type		"SWPT" on page 449
		Direction		"SWED" on page 448
		Time		"SWET" on page 448
		Delay time	Sweep	"SDELT" on page 426
			Measurement point	"PDELT" on page 397
		Range	Start value	"STAR" on page 444
			Stop value	"STOP" on page 446
			Center value	"CENT" on page 277
			Span	"SPAN" on page 442
		Manual sweep	On/Off	"MANS" on page 347
			Point setting	"MANP" on page 345
			Range setting	"MANR" on page 346
	OSC	Level	setting mode	"POWMOD" on page 404
			setting	"POWE" on page 403
		Frequency		"CWFREQ" on page 285
	DC bias	On/Off		"DCO" on page 291
		Range		"DCRNG" on page 294
		Mode		"DCMOD" on page 291
		Level	Current	"DCI" on page 290
			Voltage	"DCV" on page 295
			Maximum voltage	"MAXDCV" on page 347
			Minimum voltage	"MINDCV" on page 350
	Bandwidth			"BWFACT" on page 274
	Averaging	Sweep	On/Off	"AVER" on page 269
			Factor	"AVERFACT" on page 269
			Restart	"AVERREST" on page 269
		Measurement point	On/Off	"PAVER" on page 396
			Factor	"PAVERFACT" on page 396
List sweep	Span display type (Single/Segment)			"LISPAN" on page 341
	List	Edit		"EDITLIST" on page 310
		Clear		"CLEL" on page 279
		Done		"EDITDONE" on page 310

Function	Setting/Operation				GPIB command
List sweep	Segment	Edit			"SEDI" on page 434
		Add			"SADD" on page 415
		Determine target segment			"SEGM" on page 435
		Delete			"SDEL" on page 425
		Done			"SDON" on page 426
		Parameter setting	Sweep range	Start value	"STAR" on page 444
				Stop value	"STOP" on page 446
				Center value	"CENT" on page 277
				Span	"SPAN" on page 442
			Number of points		"POIN" on page 401
			OSC Level	Setting mode	"POWMOD" on page 404
				Setting	"POWE" on page 403
			DC bias	Mode	"DCMOD" on page 291
				Level: Current	"DCI" on page 290
				Level: Voltage	"DCV" on page 295
			Bandwidth		"BWFACT" on page 274
			Point averaging factor		"PAVERFACT" on page 396
		Trace color			"SCOL" on page 424
Display	On/Off				"SCRN" on page 424
	Backlight On/Off				"BLIGHT" on page 272
	Trace A/B split display ON/Off				"SPLD" on page 443
	Displayed trace setting				"DISP" on page 301
	Copy measurement data to memory				"DATMEM" on page 285
	Accumulate display On/Off				"ACCUD" on page 263
	Non-active trace display On/Off				"HIDI" on page 318
	Allocation (Measurement/IBASIC) setting				"DISA" on page 298
	Level monitor display setting	OSC			"OMON" on page 365
		DC bias			"BMON" on page 272
	Title setting				"TITL" on page 454
	Offset value setting				"DATOVAL" on page 286
	Format setting				"FMT" on page 315
	Phase unit setting				"PHAU" on page 398
	Expanded phase display On/Off				"EXPP" on page 314
	Scale	Auto-scaling			"AUTO" on page 268
		Grid (Linear/Log Y-axis format)	Minimum value		"BOTV" on page 273
			Maximum value		"TOPV" on page 456
			reference value	location	"REFP" on page 408
				value	"REFV" on page 409
			Scale/div.		"SCAL" on page 423
		Grid (Complex plane format)	X-axis reference value		"REFX" on page 410
			Y-axis reference value		"REFY" on page 410
			Scale/div		"SCAL" on page 423
		Full scale value (Polar chart format)			"REFV" on page 409
		Scaled trace (Data/Memory)	Coupled scale On/Off		"SCAC" on page 422
			Trace selection		"SCAF" on page 422

Function	Setting/Operation					GPIB command
Limit test	On/Off					"LIMITEST" on page 328
	Beep On/Off					"BEEPFAIL" on page 271
	Limit line table	Edit				"EDITLIML" on page 310
		Clear				"LIMCLEL" on page 324
		Done				"LIMEDONE" on page 326
	Segment	Edit				"LIMSEDI" on page 332
		Add				"LIMSADD" on page 330
		Determine target segment				"LIMSEGM" on page 333
		Delete				"LIMSDEL" on page 331
		Quit				"LIMSQUI" on page 333
		Done				"LIMSDON" on page 331
		Parameter Setting	Start value			"LIMSTAR" on page 334
			Stop value			"LIMSTOP" on page 336
			Limit	Start	Upper value	"LIMUSTAR" on page 337
					Lower value	"LIMLSTAR" on page 328
					Middle value	"LIMVSTAR" on page 339
					Delta	"LIMDSTAR" on page 325
				Stop	Upper value	"LIMUSTOP" on page 338
					Lower value	"LIMLSTOP" on page 329
					Middle value	"LIMVSTOP" on page 340
					Delta	"LIMDSTOP" on page 326
			On/Off			"LIMSTEST" on page 335
	Limit range offset	Limit value (X-axis) offset				"LIMIAMPO" on page 327
		Sweep parameter value (Y-axis) offset				"LIMIPRMO" on page 327
	Test result output	All measurement points				"OUTPLIML?" on page 383
		Marker position				"OUTPLIMM?" on page 384
		Failed measurement point				"OUTPLIMF?" on page 383
		Number of failed measurement point				"OUTPFAIP?" on page 380
Adapter setting	Adapter selection					"E4TP" on page 309
	Data for setup data calculation	Measurement				"ECAL{P|A|B|C}" on page 309
		Calculate and store to EEPROM				"ECALDON" on page 309
		Measurement cancel				"ECALQUI" on page 310
User calibration	Standard for data measurement	Definition	Open			"DCALOPEN{G|C}" on page 288
			Short			"DCALSHOR{R|L}" on page 289
			Load			"DCALLOAD{R|L}" on page 287
		Display Defined value				"CALS" on page 275
	On/Off					"CALST" on page 276
	Data measurement point setting (User/Fixed)					"CALP" on page 275
	Data for calibration coefficient calculation	Measurement				"CAL{A|B|C}" on page 274
		Calculate and store to RAM				"CALDON" on page 274
		Measurement cancel				"CALQUI" on page 275
		Input data				"INPUCALC{1-3}" on page 320
		Output data				"OUTPCALC{1-3}?" on page 373
Port extension compensation	On/Off					"PORE" on page 401
	Port extension value	Delay time				"PORTZ" on page 402
		Electrical length				"PORTL" on page 402

Function	Setting/Operation					GPIB command
Fixture compensation	Standard for data measurement	Definition	Open			"DCOMOPEN{G|C}" on page 293
			Short			"DCOMSHOR{R|L}" on page 294
			Load			"DCOMLOAD{R|L}" on page 292
		Display Defined value				"COMS" on page 281
	On/Off					"COMST{A|B|C}" on page 282
	Data measurement point setting (User/Fixed)					"CALP" on page 275
	Data for compensation coefficient calculation	Measurement				"COM{A|B|C}" on page 281
		Input data				"INPUCOMC{1-3}" on page 321
		Output data				"OUTPCOMC{1-3}?" on page 374
Measurement	Sweep	Mode setting	Continuous			"CONT" on page 282
			Hold			"HOLD" on page 318
		Operation	Single			"SING" on page 437
			Specified number			"NUMG" on page 364
	Trigger	Source selection				"TRGS" on page 459
		Polarity of external trigger signal				"TRGP" on page 458
		Trigger event mode				"TRGEVE" on page 458
		GPIB/LAN triggering				"*TRG" on page 261
Data read/write	Data transfer format selection	ASCII format				"FORM4" on page 317
		IEEE 32-bit floating point format				"FORM2" on page 316
		IEEE 64-bit floating point format				"FORM3" on page 316
		MS-DOS personal computer format				"FORM5" on page 317
	Read	Data array	All measurement points			"OUTPDATA?" on page 375
			Specified measurement point			"OUTPDATAP?" on page 375
		Memory array	All measurement points			"OUTPMEMO?" on page 385
			Specified measurement point			"OUTPMEMOP?" on page 385
		Data trace array	All measurement points			"OUTPDTRC?" on page 378
			Specified measurement point			"OUTPDTRCP?" on page 379
		Memory trace array	All measurement points			"OUTPMTRC?" on page 388
			Specified measurement point			"OUTPMTRCP?" on page 389
		User calibration data array				"OUTPCALC{1-3}?" on page 373
		Fixture compensation data array				"OUTPCOMC{1-3}?" on page 374
		Sweep parameter array	All measurement points			"OUTPSWPRM?" on page 394
			Specified measurement point			"OUTPSWPRMP?" on page 394
		level monitor result	OSC	Voltage	All measurement points	"OUTPVAC?" on page 394
					Specified measurement point	"OUTPVACP?" on page 395
				Current	All measurement points	"OUTPIAC?" on page 380
					Specified measurement point	"OUTPIACP?" on page 381
			DC bias	All measurement points		"OUTPDC?" on page 376
				Specified measurement point		"OUTPDCP?" on page 376
		Limit test result	All measurement points			"OUTPLIML?" on page 383
			Marker position			"OUTPLIMM?" on page 384
			Failed measurement points			"OUTPLIMF?" on page 383
			Number of failed measurement points			"OUTPFAIP?" on page 380
		Occurred error information (Error queue)				"OUTPERRO?" on page 380

Function	Setting/Operation				GPIB command
Data read/write	Write	Data array			"INPUDATA" on page 321
		Data trace array			"INPUDTRC" on page 322
		User calibration data array			"INPUCALC{1-3}" on page 320
		Fixture compensation data array			"INPUCOMC{1-3}" on page 321
Marker	Marker movement setting	Movement mode (Continuous/Discrete)			"MKRMOV" on page 355
		Trace A/B coupled mode On/Off			"MKRCOUP" on page 352
	Objective trace selection (Data/Memory)				"MKRO" on page 356
	Marker (Main marker)	On/Off			"MKR" on page 350
		Read marker value	Measurement parameter value		"MKRVAL?" on page 360
			Secondary measurement parameter value		"MKRAUV?" on page 351
			Sweep parameter value		"MKRPRM" on page 358
			Measurement/Sweep parameter value		"OUTPMKR?" on page 387
		Move	Specified measurement point		"MKRP" on page 357
			Specified sweep parameter value		"MKRPRM" on page 358
	Sub marker	On/Off			"SMKR{1-7}" on page 438
		Read marker value	Measurement parameter value		"SMKRVAL{1-7}?" on page 441
			Secondary measurement parameter value		"SMKRAUV{1-7}?" on page 438
			Sweep parameter value		"SMKRPRM{1-7}" on page 440
			Measurement/Sweep parameter value		"OUTPSMKR{1-7}?" on page 393
		Move	Specified measurement point		"SMKRP{1-7}" on page 439
			Specified sweep parameter value		"SMKRPRM{1-7}" on page 440
	Δ marker	Mode setting			"DMKR" on page 302
		Read marker value	Measurement parameter value		"DMKRVAL" on page 306
			Secondary measurement parameter value		"DMKRAUV" on page 303
			Sweep parameter value		"DMKRPRM" on page 305
			Measurement/Sweep parameter value		"OUTPDMKR?" on page 377
		Move	Specified measurement point		"DMKRP" on page 304
			Fixed Δ marker only	Specified measurement parameter value	"DMKRVAL" on page 306
				Specified secondary measurement parameter value	"DMKRAUV" on page 303
			Specified sweep parameter value		"DMKRPRM" on page 305
	Unit of sweep parameter value				"MKRXUNIT" on page 361
	Level monitor value display mode setting				"MKRMON" on page 355
	Marker list function On/Off				"MKRL" on page 352
	Marker sweep parameter value	→ Sweep start value			"MKRSTAR" on page 359
		→ Sweep stop value			"MKRSTOP" on page 359
		→ Sweep center value	Set		"MKRCENT" on page 351
			Set and zoom span		"MKRZM" on page 361
			Zooming aperture setting		"ZMAPER" on page 463
		→ Measurement point of manual sweep			"MKRMANP" on page 354
		→ Start point of limit range			"MKRLIMSTAR" on page 353
		→ Stop point of limit range			"MKRLIMSTOP" on page 353
	Difference of sweep parameter between marker and Δ marker → Span				"MKRDSPAN" on page 352
	Marker measurement parameter value	→ Grid reference value			"MKRREF" on page 358
		→ X-axis offset value of limit range			"MKRAMPO" on page 351
		→ Start point middle value of limit range			"MKRLIMVSTAR" on page 354
		→ Stop point middle value of limit range			"MKRLIMVSTOP" on page 354

Function	Setting/Operation			GPIB command
Marker search	Search range setting	Partial search On/Off		"PARS" on page 395
		Upper limit	Specified measurement point	"SEARMAXP" on page 430
			Specified sweep parameter value	"SEARMAX" on page 429
			Marker position	"MKRTRMAX" on page 359
		Lower limit	Specified measurement point	"SEARMINP" on page 432
			Specified sweep parameter value	"SEARMIN" on page 431
			Marker position	"MKRTRMIN" on page 360
		Range between marker and Δ marker		"MKRTR" on page 359
	Search range setting for List sweep	Search range (All segments/Specified segment)		"SEARNG" on page 432
		Search segment		"SEGMNUM" on page 436
		Search range line display On/Off		"SEARLINE" on page 428
	Search tracking function On/Off			"TRACK" on page 457
	Peak definition	ΔX value setting		"PKDLTX" on page 399
		ΔY value setting		"PKDLTY" on page 400
		Polarity setting		"PKPOL" on page 400
		Automatic definition using marker		"MKRPKD" on page 357
	Search (Maximum value/Minimum value/Peak/Target value)			"SEAM" on page 427
	Peak search	Next peak search		"SEANPK" on page 427
		Left Peak search		"SEANPKL" on page 427
		Right Peak search		"SEANPKR" on page 428
		Peak value → sweep center value		"PEAKCENT" on page 398
	Target search	Target value setting		"SEATARG" on page 433
		Target line display On/Off		"SEATARGL" on page 433
		Left target search		"SEAL" on page 426
		Right target search		"SEAR" on page 428
Analysis	Equivalent circuit analysis	Equivalent circuit model	Selection	"EQUC" on page 311
			Display On/Off	"DISECIRC" on page 298
		Equivalent circuit parameter calculation		"CALECPARA" on page 275
		Equivalent circuit parameter	Display On/Off	"DISECPARA" on page 299
			Read/Definition	"DEFEC{R1|C1|L1|C0}" on page 296
		Frequency response simulation		"SIMFCHAR" on page 437
	Statistical analysis	On/Off		"MEASTAT" on page 349
		Read analysis result		"OUTPMSTA?" on page 388
	Trace bandwidth analysis	On/Off		"WIDT" on page 461
		Cutoff point definition	definition type	"WIDVTYPE" on page 462
			Fixed value setting	"WIDFVAL" on page 460
		Read analysis result		"OUTPMWID?" on page 390
		Inside cutoff point search		"WIDSIN" on page 460
		Outside cutoff point search		"WIDSOUT" on page 461

Function	Setting/Operation				GPIB command
Analysis	Waveform analysis	Condition	Range setting	Specified range	“ANARANG” on page 267
				Sweep range	“ANARFULL” on page 268
			Segment selection		“ANASEGM” on page 268
			Trace selection	Data trace	“ANAODATA” on page 266
				Memory trace	“ANAOMEMO” on page 266
			Peak definition		“THRR” on page 452
		Analysis commands	Maximum value search		“OUTPMAX?” on page 384
			Minimum value search		“OUTPMIN?” on page 386
			Maximum and minimum values search		“OUTPMINMAX?” on page 386
			Maximum positive peak search		“PEAK?” on page 397
			Next maximum positive peak search		“NEXPK?” on page 363
			Minimum negative peak search		“NPEAK?” on page 364
			Next minimum negative peak search		“NEXNPK?” on page 362
			*n*th positive peak search		“LMAXS?” on page 343
			*n*th negative peak search		“LMINS?” on page 344
			Specified measurement parameter value search	To right	“TARR?” on page 451
				To left	“TARL?” on page 450
			Analysis of maximum difference between positive and negative peaks	value	“RPLPP?” on page 413
				value and peak position	“RPLPPS?” on page 414
			Analysis of maximum difference between positive peak and its adjacent negative peak	Both sides	“RPLHEI?” on page 413
				Left side	“RPLLHEI?” on page 413
				Right side	“RPLRHEI?” on page 414
			Resonator analysis	0-phase point	“OUTPRESO?” on page 391
				0-phase point and ripple	“OUTPRESR?” on page 392
				Ceramic resonator parameter	“OUTPCERR?” on page 373
				Equivalent circuit parameter of crystal resonator	“EQUCPARS4?” on page 312
				parallel capacitance	“EQUC0?” on page 311
Save, recall and so on	Save	State (meas. condition, memory/user cal. data/fixture compen. data array)			“SAVDSTA” on page 419
		Screen graphics			“SAVDTIF” on page 419
		Internal data arrays	Save	ASCII file	“SAVDASC” on page 416
				Binary file	“SAVDDAT” on page 417
				Touchstone file (Data array only)	“SAVDS1P” on page 418
			Select	Data array	“SAVDAT” on page 417
				Memory array	“SAVMEM” on page 420
				Data trace array	“SAVDTRC” on page 420
				Memory trace array	“SAVMTRC” on page 421
				User cal. data / fixture compen. data array	“SAVCAL” on page 416
	Update				“RESAVD” on page 411
	Save state as AUTOREC.STA				“SAVPSTA” on page 421
	Recall				“RECD” on page 408
	Storage device selection				“STOD” on page 445
	Directory		Create		“CRED” on page 284
			Move		“CHAD” on page 278
	File		Copy		“FILC” on page 315
			Delete		“PURG” on page 406
	Disk formatting				“INID” on page 319

Function	Setting/Operation			GPIB command
Status report structure	Clear registers			"*CLS" on page 258 "CLES" on page 279
	Set service request enable register			"*SRE" on page 260
	Read status byte register			"*STB?" on page 261
	Set standard event status enable register			"*ESE" on page 258
	Read standard event status register			"*ESR?" on page 259
	Set instrument event status enable register			"ESNB" on page 314
	Read instrument event status register			"ESB?" on page 313
	Set operation status enable register			"OSE" on page 365
	Set positive transition filter of operation status register			"OSPT" on page 367
	Set negative transition filter of operation status register			"OSNT" on page 366
	Read operation status event register			"OSER?" on page 366
	Read operation status condition register			"OSR?" on page 367
LAN	4294A IP address setting			"ADDRIP" on page 265
	Gateway IP address setting			"ADDRGW" on page 264
	Subnet mask			"SUBNET" on page 447
Printer	Displayed item selection	Trace (Normal display)		"RESD" on page 411
		list of sweep parameter and measurement parameter values	Display	"LISV" on page 341
			Display next page	"NEXP" on page 363
			Display previous page	"PREP" on page 404
		list of measurement condition parameters		"OPEP" on page 365
		list of standard definitions for user calibration		"CALS" on page 275
		list of standard definitions for fixture compensation		"COMS" on page 281
		List sweep table	Display	"DISL" on page 299
			table format selection	"DISMPRM" on page 300
		Limit line table	Display	"DISLLIST" on page 299
			table format selection	"DISMAMP" on page 300
	Printing	Print		"PRINALL" on page 405
		Cancel		"COPA" on page 282
		Setting	Reset	"DFLT" on page 297
			Resolution	"DPI" on page 308
			Formfeed On/Off	"FORMFEED" on page 317
			Direction	"LANDSCAPE" on page 324
			Left margin	"LMARG" on page 342
			Top margin	"TMARG" on page 455
			Softkey label printing On/Off	"PRSOFT" on page 405
			Time stamp function On/Off	"COPT" on page 283
			Color	"PRIC" on page 405
LCD	Screen	Intensity		"INTE" on page 322
		Background intensity		"BACI" on page 270
	Display element	Element selection		"COLO" on page 280
		Brightness		"CBRI" on page 276
		Chroma		"COLOR" on page 281
		Hue		"TINT" on page 454
	Reset	All settings		"DEFC" on page 295
		Specified		"RSCO" on page 414

Function	Setting/Operation			GPIB command
I/O port	8 bit I/O port	Data output		"OUT8IO" on page 368
		Data input		"INP8IO?" on page 319
	24 bit I/O port	Data output	Port A	"OUTAIO" on page 369
			Port B	"OUTBIO" on page 369
			Port C	"OUTCIO" on page 370
			Port D	"OUTDIO" on page 370
			Port E	"OUTEIO" on page 371
			Port F	"OUTFIO" on page 371
			Port G	"OUTGIO" on page 372
			Port H	"OUTHIO" on page 372
		Data input	Port C	"OUTPINPCIO?" on page 381
			Port D	"OUTPINPDIO?" on page 382
			Port E	"OUTPINPEIO?" on page 382
		Port C setting	Set output port	"COUT" on page 283
			Set input port	"CIN" on page 278
		Port D setting	Set output port	"DOUT" on page 307
			Set input port	"DIN" on page 297
		Check INPUT1 pulse input		"INPT?" on page 319
		OUTPUT1 setting	High level / Low level	"OUT1{H|L}" on page 367
			Operation when INPUT1 detects pulse input	"OUT1ENV{H|L}" on page 367
		OUTPUT2 setting	High level / Low level	"OUT2{H|L}" on page 368
			Operation when INPUT1 detects pulse input	"OUT2ENV{H|L}" on page 368
		Positive / Negative logic selection	Positive logic	"POSL" on page 403
			Negative logic	"NEGL" on page 362
Beep	On/Off setting of the beep to notify the completion of operation			"BEEPDONE" on page 270
	On/Off setting of the beep when the limit test result is FAIL			"BEEPFAIL" on page 271
	On/Off setting of the beep when an error occurred or when an invalid key is pressed			"BEEPWARN" on page 271
Clock	Date display format setting			"DMODE" on page 307
	Date setting			"SETCDATE" on page 436
	Time setting			"SETCTIME" on page 437
Key	Disable front panel key and rotary knob			"DSKEY" on page 308
	Enable front panel key and rotary knob			"ENKEY" on page 310
	Send key code			"KEY" on page 323
	Show ON KEY LABELS			"USKEY" on page 459
Others	Wait for command operation completion			"*WAI" on page 262
	Read 1 when operation completes			"*OPC?" on page 259
	Set 1 to OPC bit when operation completes			"*OPC" on page 259
	Controller GPIB address setting			"ADDRCONT" on page 263
	Read product information			"*IDN?" on page 259
	Read option information			"*OPT?" on page 260
	Self test operation			"*TST?" on page 261

D Error messages

The Agilent 4294A provides error messages to indicate its operating status. This appendix describes the error messages of the the 4294A.

Error messages are outputted on the 4294A’s LCD or through GPIB. This section gives you the description of each error message and its remedy.

NOTE If an error with a positive error number occurs, only its error message is displayed on the LCD following the string of "CAUTION:"(in this case, its error number is not displayed). On the other hand, if an error with a negative error number occurs, CAUTION: GPIB error occurred" is always displayed on the LCD. When error messages are outputted through GPIB, their error number and error message are outputted for all errors ("CAUTION:" is not added). Some messages displayed on the LCD do not have "CAUTION:"; these are not error messages. Messages without "CAUTION:" are not described here.

Errors with a negative error number are basically general errors for GPIB instruments defined by IEEE488.2. On the other hand, errors with a positive error number are ones defined specifically for the 4294A.

Order of error number

0 **(No error)**

No error has occurred.

This message is not displayed on the LCD. 0 is returned as the error number if no error has occurred in the instrument when the OUTPERRO? command is sent through GPIB.

10 **ADDITIONAL STANDARDS NEEDED**

Before the measurement of all the calibration standards (OPEN, SHORT, LOAD) required to complete user calibration or four-terminal pair extension setting were completed, an GPIB command (CALDON or ECALDON) to calculate error coefficients was sent. The command was invalid. Measure all the required calibration standards.

11 **CALIBRATION REQUIRED**

In user calibration or fixture compensation, though error coefficients based on the measurement of the required calibration standards (OPEN, SHORT, or LOAD) had not been acquired, an GPIB command (CALST ON, COMCA ON, COMCB ON, or COMCC ON) that turned on the user calibration function or fixture compensation function was sent. Valid error coefficients were not detected. The command was invalid. For user calibration, it is required to measure all the calibration standards (OPEN, SHORT, LOAD) and acquire error coefficients based on the measurement. On the other hand, for fixture compensation, it is required to measure a calibration standard (OPEN, SHORT, or LOAD) corresponding to the fixture compensation function (OPEN compensation function, SHORT compensation function, or LOAD compensation function) you want to turn on and obtain error coefficients based on the measurement.

12 **CALIBRATION NOT USABLE**

A command to execute data measurement for unnecessary (not allowed) calibration (user calibration or fixture compensation) for the current adapter selection is sent. The command is invalid. For example, when NONE (no adapter) is selected as the adapter selection, sending the CALA command, which executes OPEN data measurement for the user calibration, causes this error (when the adapter selection is NONE, you cannot execute the user calibration).

Execute the measurement of necessary (allowed) calibration data for the current adapter selection. For more information on the appropriate adapter selection and calibration, refer to “Adapter Setting” on page 54

13 **CALIBRATION ABORTED**

One of the following occurred.

- In the middle of or after the completion of the setup for user calibration or fixture compensation (measurement of required calibration data and calculation and storage of error coefficients), the setting of calibration points (FIXED or USER) was changed. The current setup and error coefficients previously stored are now invalid.
- When the setting of calibration points was USER, in the middle of or after the completion of the setup for user calibration or fixture compensation (measurement of required calibration data and calculation and storage of error coefficients), the sweep condition (sweep range, sweep parameter, number of sweep points, sweep type) was changed. The current setup and error coefficients previously stored are now invalid.
- In the middle of the setup for user calibration or four-terminal pair extension (measurement of required calibration data and calculation and storage of error coefficients), the setup was canceled (the cancel key, CALQUI command, or ECALQUI command was executed). The setup is invalid. However, error coefficients previously stored are available.

If necessary, perform the setup for user calibration, fixture compensation, or four-terminal pair extension.

17 **BACKUP DATA LOST**

The contents of the battery-backed memory (SRAM), storing user calibration data, fixture compensation data, GPIB address, IP address, and so on, were lost, causing an error (check sum error). Its cause is running out of the battery for backup. To enable the battery backup for the memory again, turn on the power and keep it approximately 10 minutes to charge the battery completely.

19 **UNEXPECTED DATA DETECTED**

During the measurement of calibration data (OPEN, SHORT, LOAD) for user calibration, fixture compensation, and four-terminal pair extension setting, abnormal data was detected and the acquisition of the calibration data was aborted. Check to see if there is no problem in standards or setup you use.

26 **PRINTER: not on, not connected, out of paper**

The printer does not respond to the control from the 4294A. Check the power to the printer, online status, paper, and so on. Or, the connected printer may not be supported. For information on supported printers, refer to the "Options and accessories" chapter.

34 **MEMORY TRACE NOT ACTIVE**

Though no data was stored in the memory trace, you attempted to execute a command (DISP MEMO, DMNM, and so on) that used the memory trace. The command was invalid. First, use the DATMEM command and store data in the memory trace.

35 **CAN'T CALCULATE EQUIVALENT PARAMETERS**

Because measurement data does not match with the selected equivalent circuit, equivalent circuit parameters cannot be calculated. Acquire data again or select another equivalent circuit.

36 **MUST BE MORE THAN 2 POINTS FOR ANALYSIS**

Though the calculation of equivalent circuit parameters (CALCULATE PARAMETERS key, CALC PARMS key, or CALECPARA command) was executed, because the number of points (NOP) within the sweep range (if the partial search function is on, within the specified search range) is 2, they cannot be calculated. Set the number of points within the sweep range (if the partial search function is on, within the specified search range) to 3 or more.

37 **DISPLAY BUFFER IS FULL**

The use of the DRAW or MOVE command of HP Instrument BASIC made 4294A’s display buffer full. Further write to the display buffer is impossible.

48 **PHASE LOCK LOOP UNLOCKED**

Anomalies in the 4294A’s internal circuit were detected (phase lock loop was not locked). The instrument needs adjustment or repair. Contact your local Agilent Technologies sales office or the company you purchased this instrument from.

54 **TOO MUCH DATA**

When data was sent from the controller to the 4294A in the FORM2, FORM3, or FORM5 data transfer format, the amount of the sent binary data was too large, or data items exceeded the number of points (NOP) set in the 4294A. Set data to be sent or the number of points of the 4294A correctly.

55 **NOT ENOUGH DATA**

When data was sent from the controller to the 4294A in the FORM2, FORM3, or FORM5 data transfer format, the amount of the sent binary data was too small, or data items did not reach the number of points (NOP) set in the 4294A. Set data to be sent or the number of points of the 4294A correctly.

64 **TOO MANY SEGMENTS**

You attempted to add segments whose quantity exceeded the maximum number (18) to the limit line table. The number of segments you can set in the limit line table is up to 18.

74 **CURRENT EDITING SEGMENT SCRATCHED**

During the edit of a segment in the list sweep table or limit line table, a key or command not related to edit of the table was executed, and the segment that was being edited became invalid. To avoid this, press "done key" in the segments menu, SDON (command to finish the edit of a list sweep segment), or LIMSDON (command to finish the edit of a limit segment), and then perform other settings.

75 **COMMAND IGNORED -SEGMENT NOT DONE YET**

During the edit of a segment in the list sweep table or limit line table, an inappropriate edit command (EDIT LIML, EDITLIST, LIMCLEL, LIMSEDI, LIMSADD, LIMSDEL, SLEL, SEDI, SADD, SEGM) was sent and, as a result, the command was ignored. If necessary, execute SDON (command to finish the edit of a list sweep segment), or LIMSDON (command to finish the edit of a limit segment) to finish the edit of the segment, and then perform the setting.

77 **TOO MANY SEGMENTS OR POINTS**

During the edit of the list sweep table, you attempted to set a value that exceeded the maximum of segments (18), the maximum number of points per segment (201), or the maximum number of total points in all segments (801). Set a value of the number of segments or the number of points that does not exceed the maximum value.

82 **CAN'T CHANGE -ANOTHER CONTROLLER ON BUS**

When an active controller was on the same GPIB bus, you attempted to set the 4294A as a system controller. Unless another active controller is removed from the same GPIB bus, you cannot set the 4294A as a system controller.

83 **NOT VALID FOR COMPLEX MEASUREMENT**

When the COMPLEX Z-Y measurement parameter (that is, complex parameter measurement) is selected, a command to execute one of the following is sent. As a result, the command is ignored.

- Setting or reading an offset value in the trace calculation function (DATOVAL command)
- Assigning the main marker to the offset value in the trace calculation function (MKROFS command)
- Selecting DELTA % in the trace calculation function (DISP DELP command)

When making the above settings, first select a measurement parameter other than COMPLEX Z-Y.

84 **NOT VALID FOR SCALAR MEASUREMENT**

When a measurement parameter other than COMPLEX Z-Y (that is, scalar parameter measurement) is selected, a command to execute one of the following is sent. As a result, the command is ignored.

- Setting the secondary measurement parameter value of the fixed Δ marker (DMKRAUV command)
- Selecting DATA/MEM in the trace calculation function (DISP DDVM command)

When making the above settings, first select the COMPLEX Z-Y measurement parameter.

85 **FORMAT NOT VALID FOR COMPLEX MEASUREMENT**

When COMPLEX Z-Y (i.e., complex parameter measurement) was selected as a measurement parameter, you attempted to select a display format not available for the measurement parameter, for example, the linear scale format (FMT LINY command) and, as a result, the command was ignored. When COMPLEX Z-Y is selected as a measurement parameter, set the display format to the complex plane display format (command: FMT COMP) or the polar coordinates display format (command: FMT POLA).

86 **FORMAT NOT VALID FOR SCALOR MEASUREMENT**

When a measurement parameter other than COMPLEX Z-Y (i.e., scalar parameter measurement) was selected, you attempted to select a display format not available for the measurement parameter, for example, the complex plane display format (command: FMT COMP) and, as a result, the command was ignored. When a measurement parameter other than COMPLEX Z-Y is selected, select a display format from the linear scale format (command: FMT LINY), the log scale format (command: FMT LOGY), or the percent format (command: FMT PERC).

87 **THETA MEASUREMENT NOT SELECTED**

When the setting of the phase (q) was not active as a measurement parameter, you attempted to execute a command to set the phase unit (PHAU DEG or PHAU RAD) or a command to set the phase expansion display (EXPP ON or EXPP OFF) and, as a result, the command was ignored. The active status of the phase (θ) setting means:

- |Z|-θ or |Y|-θ is selected as a measurement parameter and trace B is active.

- COMPLEX Z-Y is selected as a measurement parameter, and the display format is PLOAR (polar coordinates display format) for the selected active trace.

Before executing a command to set the phase unit or a command to set the phase expansion display, perform one of the above settings.

88 **MATH FUNCTION NOT VALID FOR PERCENT FORMAT**

When the percent format was selected as the display format, you attempted to change the setting of data operations. In the percent format, data operations are fixed to delta % (command: MATH DELP), and therefore, you cannot change the data operation setting to DATA (command: MATH DATA), DATA-MEM (command: MATH DMNM), or DATA/MEM (command: MATH DDVM).

89 **PERCENT FORMAT NOT SELECTED**

When the percent format was not selected as the display format, you attempted to select delta % as the data operation setting (you sent the MATH DELP command). If you want to select delta % as the data operation setting, the percent format (command: FMT PERC) must have been selected as the display format.

90 **SCALE PARAMETER NOT VALID**

You attempted to set a display scale not settable for the selected display format and, as a result, the command was ignored. For example, when the log scale (command: FMT LOGY) was selected as the display format, you attempted to perform the SCALE/DIV setting (command: SCAL <value>).

91 **DATA AND MEMORY TRACE NOT DISPLAYED**

When both of the data trace and the memory trace were not displayed, you attempted to change the setting of the data & memory couple (command: SCAC ON or SCAC OFF). To change the setting of the data & memory couple, first, display both of the data trace and the memory trace (command: DISP DATM).

93 **DATA TRACE NOT DISPLAYED**

When the data trace was not displayed, you attempted to set the function that needed the display of the data trace and, as a result, the command was ignored. For example, a command (MKRO DATA or SCAF DATA) corresponding to the MARKER ON [DATA] key or the SCALE FOR [DATA] key was sent. Before setting the function that needs the display of the data trace, display the data trace (command: DISP DATA or DISP DATM).

94 **MEMORY TRACE NOT DISPLAYED**

When the memory trace was not displayed, you attempted to set the function that needed the display of the memory trace and, as a result, the command was ignored. For example, a command (MKRO MEMO or SCAF MEMO) corresponding to the MARKER ON [MEMORY] key display or the SCALE FOR [MEMO] key display was sent. Before setting the function that needs the display of the memory trace, display the memory trace (command: DISP MEMO or DISP DATM).

98 **NO ACTIVE MARKER**

When the marker was not displayed, you attempted to execute the marker moving (Marker?) function and, as a result, the command was ignored. For example, when the marker was not displayed, a command corresponding to the MKR?START key (MKRSTAR) was sent. Before executing the marker moving function, display the marker (command: MKR ON).

99 **DELTA MARKER OFF**

When the delta marker was not displayed, you attempted to execute a function that needed the display of the delta marker and, as a result, the command was ignored. For example, when the delta marker was not displayed, a command corresponding to the MKRD?SPAN key (MKRDSPAN) was sent. Before executing a function using the delta marker, first display the delta marker (command: DMKR ON).

100 **NO FIXED DELTA MARKER**

When the fixed Δ marker (FIXED DMKR) was not displayed, you attempted to execute a command of a function that needed the display of the fixed Δ marker and, as a result, the command was ignored. For example, when the fixed Δ marker was not displayed, a command corresponding to the FIXED DMKR VALUE, FIXED DMKR AUX VALUEN key (DMKRVAL <value>, DMRRAUV <value>) was sent. Before executing a function using the fixed Δ marker, first display the fixed Δ marker (command: DMKR FIX).

101 **SEARCH WIDTH OFF**

When the band width function was off, you attempted to execute a command to search the cutoff point on the trace (WIDSIN or WIDSOUT) and, as a result, the command was ignored. Before executing the cutoff point search of the band width function, turn on the band width function (command: WIDT ON).

102 **SEARCH RANGE TYPE IS NOT SEGMENT**

Though, in the list sweep, all segments (entire sweep range) were specified as the search range (command: SEARNG FULL), you attempted to execute a command to specify a certain segment as a search target (SEGMNUM <value>) and, as a result, the command was ignored. Before executing the search function by specifying a certain list sweep segment, set the search range to a single segment (command: SEARNG SEGMENT).

105 **MEASUREMENT PARAMETER NOT FOR ANALYSIS**

When a measurement parameter other than |Z|-q was set, you attempted to execute a waveform analysis command (for example, OUTPCERR?) and, as a result, the command was ignored. Before executing a waveform analysis command, set the measurement parameter to |Z|-θ (command: MEAS IMPH).

110 **SAVE ERROR**

When saving a file, anomalies in the storage media were detected. For example, if you attempt to save a file on a floppy disk, it may be damaged. Check to see if there is no problem in the storage media.

111 **RECALL ERROR: INSTR STATE PRESET**

Because an error occurred during reading out a file, the 4294A is being preset. This error occurs, for example, when data in a file to be read out is destroyed or when an extension for a file name does not match with the contents of the file.

112 **INVALID FILE NAME**

When the recall command (RECD <string>) or the resave command (RESAVD <string>) was executed, a string that indicated a file name was not followed by a necessary extension and, as a result, the command was ignored. Add a required extension, and then perform recall or resave. This message occurs, for example, when you attempt to execute the recall or resave command without adding an extension (".STA", ".DAT", ".TXT") to a file name. Also, it does when you attempt to execute resave of a graphics file without adding an extension (".TIF").

113 **NO STATE/DATA FILES ON DISK**

Though you attempted to display the list of files and directories on a floppy disk on the softkey label by executing the recall ([Recall]) key, file resave (RE-SAVE FILE) key, file deletion (PURGE FILE) key, directory change (CHANGE DIRECTORY) key, or file copy (COPY FILE) key, no file or directory corresponding to the execution of the key was on the floppy disk.

114 **CAN'T SAVE GRAPHICS WHEN COPY IN PROGRESS**

You commanded to save the graphics screen during the execution of copying (outputting to a printer), but the graphics screen cannot be saved during output to a printer.

116 **NO STATE/DATA FILES ON MEMORY**

Though you attempted to display the list of files and directories on a volatile memory disk or nonvolatile memory disk (flash memory) on the softkey label by executing the recall ([Recall]) key, file resave (RE-SAVE FILE) key, file deletion (PURGE FILE) key, directory change (CHANGE DIRECTORY) key, file copy (COPY FILE) key, and so on, no file or directory corresponding to the execution of the key was on the volatile memory disk or nonvolatile memory disk (flash memory).

118 **DEVICE TYPE IS NOT DOS**

The execution of write access to the mass storage could not be executed because the format type of the mass storage was not DOS.

124 **LIST TABLE EMPTY OR INSUFFICIENT TABLE**

When the list sweep table was empty or insufficient, you attempted to select LIST as the sweep type (command: SWPT LIST) and, as a result, the command was ignored. Before selecting the list sweep as the sweep type, set the list sweep table correctly.

130 **CAN'T CHANGE ON ZERO SPAN**

During the execution of the list sweep when the sweep span of each segment was zero, you attempted to change the list sweep span (integrated total span of individual segments specified as the horizontal axis of the graph for the list sweep) to the single span (the way to specify a linear frequency axis for the horizontal axis of the graph whose left edge and right edge are the minimum frequency and the maximum frequency within all segments) using the LIST SPAN [ ] key or the LISPAN SINGLE command and, as a result, the command was ignored. When executing the list sweep while the sweep span of each segment being zero, the list sweep span is automatically set to the segment span and cannot be changed.

131 **FREQUENCY SWEEP ONLY**

When a sweep parameter other than the frequency was specified, you attempted to execute an equivalent circuit analysis command (CALECPARA and so on). You can execute the equivalent circuit analysis only when the sweep parameter is the frequency.

132 **LIST SWEEP ONLY**

When a sweep type other than the list sweep was specified, you attempted to execute a command to specify all segments (entire sweep range) as the search range setting (SEARNG FULL) or a command to specify a certain segment as the search target (SEGMNUM <value>) and, as a result, the command was ignored. Before setting the search range for the list sweep, specify the list sweep as the sweep type (command: SWPT LIST).

133 **CAN'T CHANGE ON LIST SWEEP**

When the sweep type was set to the list sweep, you attempted to execute a command to specify the lower limit of a partial search range (SEARMIN) or a command to specify the upper limit of a partial search range (SEARMAX) and, as a result, the command was ignored. When the sweep type is the list sweep, you cannot specify a partial search range using the lower limit and the upper limit. Before specifying a partial search range using the lower limit and the upper limit, specify a sweep type other than the list sweep (command: SWPT LIN or SWPT LOG).

134 **REDUCE OSC LEVEL**

The oscillator level is considerably higher than the measured |Z| (absolute value of impedance) of the DUT, causing increased nonlinear measurement error that cannot be ignored. This message is displayed when the oscillator level is set to greater than 0.5 V while |Z| of the DUT is smaller than 48 Ω. To avoid this error, set the oscillator level below 0.5 V.

135 **ADC OVERLOAD**

Due to, for example, a sudden change of the connection of a DUT, the internal circuit (ADC) was temporarily overloaded. Measurement data at the occurrence of this error is invalid. If this error often occurs in usual measurements, the instrument may fail. In this case, Contact your local Agilent Technologies sales office or the company you purchased this instrument from.

136 **BRIDGE UNBALANCED**

Because the connection of a DUT or the setting for it was incorrect, the internal circuit (BRIDGE) temporarily could not perform measurements (UNBALANCED).

- The setting of the four-terminal pair extension (NONE, 4TP 1M, 4TP 2M, 7mm 42942A, PROBE 42941A) may not match with the fixture, cable, adapter, or probe actually connected. Check and correct the setting.
- The setup (acquisition of calibration data) for the setting of the four-terminal pair extension may have failed. If necessary, perform the setup again.
- Some measured DUTs may cause this error due to their characteristics. In this case, the error may be avoided by changing the measurement condition (for example, lowering the measurement signal level).

If this error often occurs in usual measurements, the instrument may fail. In this case, Contact your local Agilent Technologies sales office or the company you purchased this instrument from.

137 **DCBIAS OVERLOAD**

When the DC bias was applied, DC current that exceeded the setting of the DC bias range (<1mA, <10mA, or <100mA) was supplied from the bias source, or the overcurrent limit circuit of the DC bias source operated. Increase the setting of the DC bias range, or decrease the level of the applied DC bias.

138 **DCBIAS CONSTANT OPERATION FAILED**

When the DC bias mode was constant voltage (VOLT CONSTANT) or constant current (CURRRENT CONSTANT), the actual DC bias output did not converge to the set DC voltage value or DC current value, or it exceeded the set voltage limit or current limit. If a DUT needs time to be stabilized after DC bias is applied, specify the point delay. If necessary, change the voltage limit value or the current limit value.

139 **DCBIAS LEVEL MONITOR NOT VALID**

When the DC bias level monitor was not on, you attempted to execute the command to turn on the marker DC voltage level monitor or the marker DC current level monitor (MKRMON DCV or MKRMON DCI) and, as a result, the command was ignored. Before turning on the marker DC voltage level monitor or the marker DC current level monitor, turn on the corresponding DC bias level monitor (command: BMON VOLT or BMON CURR).

140 **OSC LEVEL MONITOR NOT VALID**

When the oscillator level monitor was not on, you attempted to execute a command to turn on the marker AC voltage level monitor or the marker AC current level monitor (MKRMON ACV or MKRMON ACI) and, as a result, the command was ignored. Before turning on the marker AC voltage level monitor or the marker AC current level monitor, turn on the AC bias level monitor (command: OMON ON).

141 **INSUFFICIENT MEMORY**

Multiple processes were executed at the same time and the memory was exhausted, which caused the last process to be aborted. For example, if the execution of an HP Instrument BASIC program, the printout of the screen, and the transfer of the data array are executed at the same time, the memory of the system is exhausted, and this message may be displayed. In this case, terminate some of the processes and then perform the next operation.

142 **WRONG I/O PORT DIRECTION**

For a 24-bit input/output (I/O) shared port (port C and port D), you attempted to execute input/output (I/O) of data in the direction opposite from the preset input/output direction. The command was invalid. For example, if you use the CIN command to specify port C as an input port and then use the OUTCIO <value> command to output data from port C, this error is displayed.

143 **FLOATING POINT ERROR OCCURED**

Due to the execution of an application inside the instrument for inappropriate data sent from outside the instrument, an error for floating point operations occurred inside the instrument. The result of the operation may be incorrect. Contact your local Agilent Technologies sales office or the company you purchased this instrument from.

154 **INVALID DATE**

You attempted to specify the date of the built-in clock using the DATE key or the SETCDATE command, but the date was out of range and, as a result, the setting you attempted to execute became invalid. The settable range is: 1900 to 2099 for year, 1 to 12 for month, and 1 to 31 for day. Also, you cannot specify a date that does not exist actually. Specify correct date data.

193 **POWER ON TEST FAILED**

In the power-on self-test, a fault of the instrument was detected. Contact your local Agilent Technologies sales office or the company you purchased this instrument from.

194 **EEPROM WRITE FAIL**

A write error was detected in the memory (EEPROM) to store the OPEN, SHORT, and LOAD data for the four-terminal pair extension setting. Contact your local Agilent Technologies sales office or the company you purchased this instrument from.

-100 **Command error**

A comprehensive syntax error occurred for which the 4294A could not detect further details of the error. This error code simply indicates the occurrence of a command error that is defined in IEEE488.2,11.5.1.1.4.

-101 **Invalid character**

Invalid characters exist in the program message string. For example, for a correct program message, "MEAS IRIM," an ampersand (&) is inserted by mistake, like "MEAS&IRIM".

-102 **Syntax error**

There is a command or data type that cannot be recognized. For example, though the 4294A did not accept any strings, a string was received.

-103 **Invalid separator**

The parser (syntax analysis program) expected a separator, but a character other than a separator was sent. For example, though the correct way is using ";" to separate 2 sent program messages like "MEAS IRIM;FMT LOGY", a semicolon (;) to separate the program messages is missing, like "MEAS IRIM FMT LOGY".

-104 **Data type error**

The parser recognized impossible data elements. For example, numeric value or string data was expected, but block data was sent.

-105 **GET not allowed**

A group execution trigger (GET) was received in a program message. (Refer to IEEE488.2,7.7.)

-108 **Parameter not allowed**

The number of parameters is larger than that the command requires. For example, though the "POIN" command requires 1 parameter like "POIN 101," 2 parameters are added like "POIN 101,1."

-109 **Missing parameter**

The number of parameters is less than that the command requires. For example, though the "POIN" command requires 1 parameter like "POIN 101," no parameter is added like "POIN."

-111 **Header separator error**

The header separator is wrong.

This error is displayed when a character other than a defined header follows the header. For example, when, though "*SRE 4" is correct, a character follows the header without a space like "*SRE4", this error is displayed.

-112 **Program mnemonic too long**

The length of the header exceeds 12 characters. (Refer to IEEE488.2,7.6.1.4.1.))

-113 **Undefined header**

A header not defied for the 4294A was received. For example, "*XYZ" not defined for the 4294A was received.

-114 **Headers Suffix out of range**

The suffix of the header is out of range. The suffix of a numeral parameter that follows the SCPI command makes the header invalid.

-120 **Numeric data error**

Numeric data (including numeric data without a decimal point) causes an error. A numeric value error other than -121 to -129 occurred.

-121 **Invalid character in number**

An invalid character for the data type of the syntax analysis target was received. For example, alphabetical characters exist in a decimal value, or "9" exits in octal data.

-123 **Exponent too large**

The absolute value of the exponent exceeds 32,000. (Refer to IEEE488.2,7.7.2.4.1.)

-124 **Too many digits**

The number of digits of the mantissa of the decimal value data element exceeds 255 except preceding 0s. (Refer to IEEE488.27.7.2.4.1.)

-128 **Numeric data not allowed**

A numeric value data element (that did not violate the standard) was received at where the 4294A did not accept any numeric value data elements.

-130 **Suffix error**

A suffix error.

An error other than -131 to -139 occurred in the notation of a suffix.

-131 **Invalid suffix**

The suffix does not meet the syntax defined in IEEE488.2,7.7.3.2 or it is inappropriate for the 4294A.

-134 **Suffix too long**

The suffix is too long.

The suffix contains the notation of 12 characters or more. (Refer to IEEE488.2,7.7.3.4.)

-138 **Suffix not allowed**

A suffix is added to a numeric value element to which no suffix can be added.

-140 **Character data error**

An error not included in error numbers between -141 and -149 occurred during the syntax analysis of a character data element.

-141 **Invalid character data**

There are invalid characters in a character data element or the received parameter is not valid. For example, though a correct program message was "MEAS LSR," a wrong program message, "MEAS LSD," was received.

-144 **Character data too long**

The length of the character data element exceeds 12 characters. (Refer to IEEE488.2,7.7.1.4.)

-148 **Character data not allowed**

A character data element (that did not violate the standard) was received at where the 4294A did not accept any character data elements. For example, a parameter must be enclosed with double quotation marks (") but they are missing.

-150 **String data error**

An error not included in error numbers between -151 and -159 occurred during the syntax analysis of a string data element.

-151 **Invalid string data**

Character string data was expected but given string data was invalid for some reasons. (Refer to IEEE488.2,7.7.5.2.) For example, the END message was received before the end quotation mark character appeared.

-158 **String data not allowed**

A string data element was received at where the 4294A did not accept any string data elements.

-160 **Block data error**

An error not included in error numbers between -161 and -169 occurred during the syntax analysis of block data.

-161 **Invalid block data**

Block data was expected but given block data was invalid for some reasons. (Refer to IEEE488.2,7.7.6.2.) For example, the END message was received before the length of the block data was reached.

-168 **Block data not allowed**

A block data element was received at where the 4294A did not accept any block data elements.

-170 **Expression error**

An error not included in error numbers between -171 and -179 occurred during the syntax analysis of equation data.

-171 **Invalid expression**

The equation data element is invalid. (Refer to IEEE488.2,7.7.7.2.) For example, parentheses are not paired or a character violates the standard.

-178 **Expression data not allowed**

An equation data element was received at where the 4294A did not accept any equation data elements.

-200 **Execution error**

A comprehensive execution error occurred for which the 4294A could not detect further details of the error. This error code simply indicates the occurrence of an execution error that is defined in IEEE488.2,11.5.1.1.5.

-210 **Trigger error**

A trigger error. An error other than -211 to -219 occurred.

-211 **Trigger ignored**

A trigger command or trigger signal was received and recognized by the 4294A, but it was ignored due to the timing relationship with the 4294A (for example, when the 4294A was not ready to respond).

-213 **Init ignored**

Another measurement was being executed and the measurement start request was ignored.

-220 **Parameter error**

An error not included in error numbers between -221 and -229 occurred during the analysis of a program data element. This error occurs, for example, when you attempt to specify an invalid value for the LOAD correction reference value or the LOAD correction data (values that are not finite when converted to R-X form impedance values). If this error occurs, the command is ignored. This error also occurs when you attempt to specify an invalid LOAD correction reference value from front panel keys.

-221 **Setting confict**

A program data element complying with the syntax standard was analyzed but the 4294A could not execute it at present.

-222 **Data out of range**

A data element (that did not violate the standard) out of the range the 4294A defined was received.

-223 **Too much data**

The received block, equation, or string type program data complied with the standard but its amount exceeded the limit that the 4294A could deal with, due to memory or device-specific conditions related to memory.

-224 **Illegal parameter value**

The value of the parameter is illegal.

-225 **Data out of memory**

To perform the requested operation, the 4294A does not have enough memory.

-230 **Data corrupt or stale**

The data may be invalid. Or, a newly initiated read operation has not been completed since the latest access.

-231 **Data questionable**

Data may be questionable. The accuracy of measurement data may be deteriorated.

-240 **Hardware error**

A hardware error.

The program command could not be executed due to an hardware-related error. An error other than -241 to -249 occurred.

-241 **Hardware missing**

The received command or Query complied with the standard but could not be executed due to hardware-related reasons (for example, the option was not installed).

-250 **MASS STORAGE ERROR**

A mass storage error occurred.

A mass storage error other than -257 occurred.

-252 **Missing media**

You attempted to access the storage device, but media did not exit or was not installed correctly. This message is displayed, for example, when you specifies the floppy disk drive as the storage device but no floppy disk is set into the drive (correctly).

-256 **File name not found**

The specified filename was not found and, as a result, the command was not executed correctly. This message is displayed, for example, when you attempt to read/write a file that does not exist on the disk.

-257 **FILE NAME ERROR**

There was an error in the filename and, as a result, the command was not executed correctly.

This message is displayed, for example, when you attempt to copy a file using the same filename.

-258 **Media protected**

You attempted to save/delete data to/from the storage device or initialize the media, but the media was write-protected, and, as a result, the operation could not be executed. This message is displayed, for example, when you have specified the floppy disk drive as the storage device and a floppy disk is write-protected. If necessary, disable the write-protection for the floppy disk.

-280 **Program error**

A program error.

An error occurred in a downloaded program. An error other than -281 to -289 occurred.

-281 **Cannot create program**

Programs cannot be created. Insufficient memory is suspected.

-282 **Illegal program name**

The program name is illegal. This message is displayed, for example, when you attempt to delete a program name that does not exist, define an existing program name again, or refer to a program that does not exist.

-283 **Illegal variable name**

The variable name is illegal. This message is displayed when you attempt to refer to a variable that does not exist.

-284 **Program currently running**

The program is running.

This message is displayed when you attempt to perform an operation that cannot be executed during the execution of a program. For example, when you attempt to delete a running program.

-285 **Program syntax error**

A program syntax error.

A program syntax error occurred in the downloaded program.

-286 **Program runtime error**

An error occurred while an HP Instrument BASIC program is being executed. To obtain detailed information on the occurred error, use theERRM$ or ERRM command of HP Instrument BASIC.

-310 **System error**

One of "system errors" defined for the 4294A occurred.

-311 **Memory error**

An error was detected in the memory of the 4294A.

-330 **Self-test failed**

The result of the self-test was a failure. Contact your local Agilent Technologies sales office or service center, or refer to the service manual.

-350 **Queue overflow**

The queue contains a certain code, instead of the code that caused this error. This code indicates that an error has occurred due to insufficient space in the queue but it has not been recorded.

-400 **Query error**

A comprehensive Query error occurred for which 4294A could not detect further details of the error. This code simply indicates the occurrence of a Query error that is defined in IEEE488.2,11.5.1.1.7 and 6.3.

-410 **Query INTERRPUTED**

Status that causes an "INTERRUPTED" Query error. (Refer to IEEE488.1,6.3.2.3.) This error occurs, for example, when, after Query, data byte (DAB) or GET is received before the response has been sent completely.

-420 **Query UNTERMINATED**

Status that causes an "UNTERMINATED" Query error. (Refer to IEEE488.2,6.3.2.) This error occurs, for example, when the 4294A is specified as a talker and an incomplete program message is received.

-430 **Query DEADLOCKED**

Status that causes a "DEADLOCKED" Query error. (Refer to IEEE488.2,6.3.1.7.) This error occurs, for example, when both input and output buffers become full and the 4294A cannot continue processing.

-440 **Query UNTERMINATED after indefinite response**

In a certain program message, after a Query that requested an ambiguous response was executed, another Query was received. (Refer to IEEE488.2,6.5.7.5.7.)

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Call Center
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Tokyo 192-8510, Japan
(tel) (81) 426 56 7832
(fax) (81) 426 56 7840

Latin America:
Agilent Technologies
Latin American Region Headquarters
5200 Blue Lagoon Drive, Suite #950
Miami, Florida 33126
U.S.A.
(tel) (305) 267 4245
(fax) (305) 267 4286

Australia/New Zealand:
Agilent Technologies Australia Pty Ltd
347 Burwood Highway
Forest Hill, Victoria 3131
(tel) 1-800 629 485 (Australia)
(fax) (61 3) 9272 0749
(tel) 0 800 738 378 (New Zealand)
(fax) (64 4) 802 6881

Asia Pacific:
Agilent Technologies
24/F, Cityplaza One, 1111 King's Road,
Taikoo Shing, Hong Kong
(tel) (852)-3197-7777
(fax) (852)-2506-9284