### **HP 4284A PRECISION LCR METER**

### **OPERATION MANUAL**

(Including Option 001, 002, 006, 201, 202, 301)

#### **SERIAL NUMBERS**

This manual applies directly to instruments with the serial number prefix of 2940J02283,02285 and above, and whose ROM-based firmware is version 01.20. For additional important information about serial numbers, read "Serial Number" in Chapter 9 of this Operation Manual.



HP Part No. 04284-90040 Printed in JAPAN August 1998

Sixth Edition

### **Notice**

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### Manual Printing History

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

December 1988 First	Edition
April 1991Second	Edition
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March 1994Fourth	Edition
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August 1998 Sixth	Edition

### **Safety Summary**

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific WARNINGS elsewhere in this manual may impair the protection provided by the equipment. In addition it violates safety standards of design, manufacture, and intended use of the instrument.

The Hewlett-Packard Company assumes no liability for the customer's failure to comply with these requirements.

Note



HP 4284A complies with INSTALLATION CATEGORY II and POLLUTION DEGREE 2 in IEC1010-1.HP 4284A is INDOOR USE product.

Note



LEDs in this product are Class 1 in accordance with IEC825-1.

#### CLASS 1 LED PRODUCT

#### **Ground The Instrument**

To avoid electric shock hazard, the instrument chassis and cabinet must be connected to a safety earth ground by the supplied power cable with earth blade.

#### DO NOT Operate In An Explosive Atmosphere

Do not operate the instrument in the presence of flammable gasses or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

#### Keep Away From Live Circuits

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified maintenance personnel. Do not replace components with the power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power and discharge circuits before touching them.

#### DO NOT Service Or Adjust Alone

Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

### DO NOT Substitute Parts Or Modify Instrument

Because of the danger of introducing additional hazards, do not install substitute parts or perform unauthorized modifications to the instrument. Return the instrument to a Hewlett-Packard Sales and Service Office for service and repair to ensure that safety features are maintained.

### Dangerous Procedure Warnings

Warnings, such as the example below, precede potentially dangerous procedures throughout this manual. Instructions contained in the warnings must be followed.

#### Warning



Dangerous voltages, capable of causing death, are present in this instrument. Use extreme caution when handling, testing, and adjusting this instrument.

#### **Safety Symbols**

General definitions of safety symbols used on equipment or in manuals are listed below.



Instruction manual symbol: the product is marked with this symbol when it is necessary for the user to refer to the instruction manual.



Alternating current.



incinating current

Direct current. On (Supply).



Off (Supply).



In position of push-button switch.



Out position of push-button switch.



Frame (or chassis) terminal. A connection to the frame (chassis) of the equipment which normally include all exposed metal structures.

#### Warning



This **Warning** sign denotes a hazard. It calls attention to a procedure, practice, condition or the like, which, if not correctly performed or adhered to, could result in injury or death to personnel.

#### Caution



This **Caution** sign denotes a hazard. It calls attention to a procedure, practice, condition or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product.

#### Note



**Note** denotes important information. It calls attention to a procedure, practice, condition or the like, which is essential to highlight.



Affixed to product containing static sensitive devices use anti-static handling procedures to prevent electrostatic discharge damage to component.

# How To Use This Manual

This manual, the Operation Manual for the HP 4284A Precision LCR Meter, contains ten chapters plus appendixes, organized for the convenience of the first time user. After you receive your HP 4284A, begin with Chapter 1.

# Chapter 1 Getting Started

Chapter 1 provides unpacking, initial inspection, and preparation information necessary for you to know before you apply AC power.

# Chapter 2 Overview

Chapter 2 provides information including a product overview and a tour of the front panel, which will help you to quickly learn how to operate the HP 4284A.

# Chapter 3 DISPLAY FORMAT

Chapter 3 provides detailed information for the display format and measurement function, corresponding to <code>DISPLAY FORMAT</code> menu key.

### Chapter 4 MEAS SETUP

Chapter 4 provides detailed information for the measurement condition setup, corresponding to MEAS SETUP menu key.

# Chapter 5 CATALOG/SYSTEM CONFIGURATION

Chapter 5 provides detailed information for the internal/external memory and system configuration catalog of the HP 4284A, corresponding to CATALOG/SYSTEM menu key.

# Chapter 6 Measurement Basics

Chapter 6 provides the basic measurement procedure with the general impedance theory and measurement techniques, and practical measurement examples.

### Chapter 7 Remote Control

Chapter 7 provides information to control the HP 4284A using the HP-IB interface.

# Chapter 8 Command Reference

Chapter 8 provides detailed information for each of the HP 4284A HP-IB commands.

# Chapter 9 General Information

Chapter 9 provides the specifications, rack mount/handle kit installation, and other general information on the HP 4284A.

# **Chapter 10 Performance Test**

Chapter 10 provides the performance tests for the HP 4284A used for incoming inspection and verification that your instrument is completely calibrated.

# Appendix A Manual Changes

Appendix A contains Manual Changes and provides information for using this manual with an HP 4284A manufactured before the printing date of the manual.

### Appendix B Error and Warning Messages

Appendix B lists the HP 4284A's error and warning messages with brief descriptions and solutions and the system messages.

### Appendix C Initial Settings and System Memory

Appendix C lists the HP 4284A's initial settings and functions whose status is stored in internal system memory.

# Appendix D Correction Data

Appendix D provides information about the relationship between the test frequency and the correction data.

## Appendix E Write Protection

Appendix E provides the procedure for write protecting all of the stored data in the HP 4284A's memory card and internal EEPROM memory.

# Appendix F Test Frequency Points

Appendix F lists all available test frequency points from 1 kHz to 1  $\rm MHz$ .

# Appendix G Transient States Caused by Measurement Condition Changes

Appendix G describes the measurement condition changes which cause the transient states, and lists the delay times required for various transient states.

### Typeface Conventions

**Bold** Boldface type is used when a term is defined.

For example: icons are symbols.

Italics Italic type is used for emphasis and for titles

of manuals and other publications.

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

a file such as file1.

Computer Computer font is used for on-screen prompts

and messages.

(HARDKEYS) Labeled keys on the instrument front panel

are enclosed in  $\bigcap$ .

#### SOFTKEYS

#### Certification

Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Institute of Standards and Technology (NIST), to the extent allowed by the Institute's calibration facility, or to the calibration facilities of other International Standards Organization members.

### Warranty

This Hewlett-Packard instrument product is warranted against defects in material and workmanship for a period of one year from the date of shipment, except that in the case of certain components listed in "Components not Covered by Warranty" in Chapter 9 of this manual, the warranty shall be for the specified period. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products which prove to be defective.

For warranty service or repair, this product must be returned to a service facility designated by HP. Buyer shall prepay shipping charges to HP and HP shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to HP from another country.

HP warrants that its software and firmware designated by HP for use with an instrument will execute its programming instruction when property installed on that instrument. HP does not warrant that the operation of the instrument, or software, or firmware will be uninterrupted or error free.

# Limitation of Warranty

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

No other warranty is expressed or implied. HP specifically disclaims the implied warranties of merchantability and fitness for a particular purpose.

### **Exclusive Remedies**

The remedies provided herein are buyer's sole and exclusive remedies. HP shall not be liable for any direct, indirect, special, incidental, or consequential damages, whether based on contract, tort, or any other legal theory.

#### **Assistance**

Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

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Description
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### Installation and Set Up Guide

This chapter provides the information necessary for performing an incoming inspection and setting up the HP 4284A. The main topics in this chapter are:

- Incoming Inspection
- Power requirements
- Line Voltage and Fuse Selection
- Operation Environment
- Electromagnetic Compatibility
- Ventilation Requirements
- Instruction for Cleaning
- Rack/Handle Installation

### **Incoming Inspection**

Warning



To avoid hazardous electrical shock, do not turn on the HP 4284A when there are signs of shipping damage to any portion of the outer enclosure (for example, covers, panel, or display)

Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the HP 4284A has been checked mechanically and electrically. The contents of the shipment should be as listed in Table 1-1. If the contents are incomplete, if there is mechanical damage or defect, or if the analyzer does not pass the power-on selftests, notify the nearest Hewlett-Packard office. If the shipping container is damaged, or the cushioning material shows signs of unusual stress, notify the carrier as well as the Hewlett-Packard office. Keep the shipping materials for the carrier's inspection.

Table 1-1. HP 4284A Contents

Description	Qty.	HP Part Number
HP 4284A		
Power cable <sup>1</sup>	1	_
Operation Manual	1	04284-90020
Option 004 Memory Card		
Memory Card	1	04278-89001
Option 201 Fuse		
Fuse	2	2110-0046
Option 907 Handle Kit		
Handle kit	1	5061-9690
Option 908 Rack Flange Kit		
Rack Flange Kit	1	5061-9678
Option 909 Rack Flange & Handle Kit		
Rack Flange & Handle Kit	1	5061-9684

<sup>1</sup> Power Cable depends on where the instrument is used, see "Power Cable".

### **Power Requirements**

The HP 4284A requires the following power source:

Voltage: 90 to 132 Vac, 198 to 252 Vac

Frequency: 47 to 66 Hz Power: 200 VA maximum

#### **Power Cable**

In accordance with international safety standards, this instrument is equipped with a three-wire power cable. When connected to an appropriate ac power outlet, this cable grounds the instrument frame.

The type of power cable shipped with each instrument depends on the country of destination. Refer to Figure 1-1 for the part numbers of the power cables available.

#### Warning



For protection from electrical shock, the power cable ground must not be defeated.

The power plug must be plugged into an outlet that provides a protective earth ground connection.

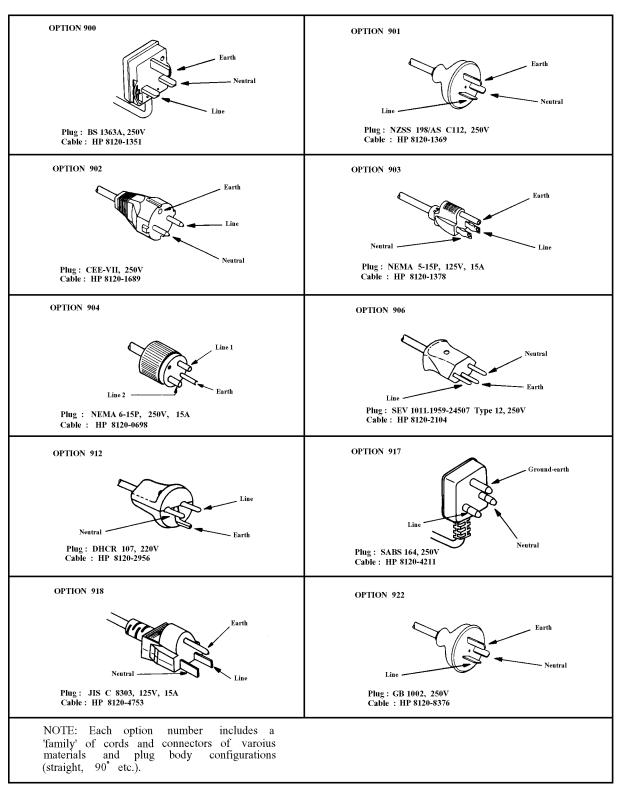


Figure 1-1. Power Cable Supplied

### Line Voltage and **Fuse Selection**

Figure 1-2 illustrates the line voltage selection switch and fuseholder on the instrument's rear panel.

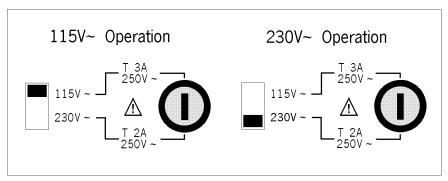


Figure 1-2. Line Voltage Selector

#### Caution



Before connecting the instrument to the power source, make sure that the correct fuse has been installed and the Line Voltage Selection Switch is correctly set.

#### **Line Voltage Selection**

Select the proper voltage selector according to the Table 1-2.

Table 1-2. Line Voltage Selection

Voltage Selector	Line Voltage	
115 V∼	90–132 V, 47–66 Hz	
230 V∼	198–252 V, 47–66 Hz	



Select proper fuse according to the Table 1-3. Current ratings for the fuse are printed under the fuseholder on the rear panel, and are listed, along with the fuse's HP part number, in Table 1-3.

Table 1-3. Fuse Selection

Operating Voltage	Fuse Rating/Type	Fuse Part Number
115 V∼	3A 250Vac UL/CSA type Time Delay	2110-0381
230 V∼	2A 250Vac UL/CSA type Time Delay	2110-0303

If you need this fuse, contact your nearest Hewlett-Packard Sales and Service Office.

To remove the fuse, turn the fuse holder counterclockwise until the fuse pops out.

### Caution



Use the proper fuse for the line voltage selected. Use only fuses with the required current rating and of the specified type as replacements. DO NOT use a mended fuse or short-circuit the fuse-holder in order to by-pass a blown fuse. Find out what caused the fuse to blow!

## **Operation Environment**

The HP 4284A must be operated under within the following environment conditions, and sufficient space must be kept behind the HP 4284A to avoid obstructing the air flow of the cooling fans.

Temperature: 0°C to 55°C

less than 95% RH at 40°C Humidity:

Note



The HP 4284A must be protected from temperature extremes which could cause condensation within the instrument.

# **Electromagnetic** Compatibility

This product has been designed and tested to the requirements of the Electromagnetic Compatibility (EMC) Directive 89/336/EEC. To use a properly shielded cable or shielded coaxial cable (such as those recommended in the General Information and the Performance Test) to connect each of the ports to their respective controllers, peripherals, equipments or devices may ensure to meet the requirements.

# **Ventilation** Requirements

To ensure adequate ventilation, make sure that there is adequate clearance around the HP 4284A.

# Instruction for Cleaning

To prevent electrical shock, disconnect the HP 4284A power cable from the receptacle before cleaning. Use a dry cloth or a cloth slightly dipped in water to clean the casing. Do not attempt to clean the HP 4284A internally.

# Rack/Handle Installation

The analyzer can be rack mounted and used as a component in a measurement system. Figure 1-3 shows how to rack mount the HP 4284A.

Table 1-4. Rack Mount Kits

Option	Description	HP Part Number
907	Handle Kit	5061-9690
908	Rack Flange Kit	5061-9678
909	Rack Flange & Handle Kit	5061-9684

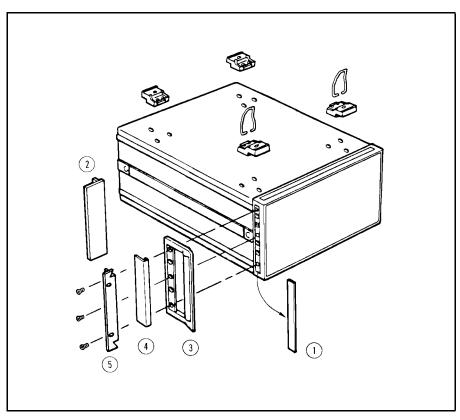


Figure 1-3. Rack Mount Kits Installation

## **Option 907 Handle Kit**

Option 907 is a handle kit containing a pair of handles and the necessary hardware to attach them to the instrument.

## Installing the Handle

- 1. Remove the adhesive-backed trim strips (1) from the left and right front sides of the HP 4284A. (Refer to Figure 1-3.)
- 2. Attach the front handles ② to the sides using the screws provided.
- 3. Attach the trim strips (3) to the handles.

## **Option 908 Rack Flange** Kit

Option 908 is a rack flange kit containing a pair of flanges and the necessary hardware to mount them to the instrument in an equipment rack with 482.6 mm (19 inches) horizontal spacing.

## Mounting the Rack

- 1. Remove the adhesive-backed trim strips (1) from the left and right front sides of the HP 4284A. (Refer to Figure 1-3.)
- 2. Attach the rack mount flange (4) to the left and right front sides of the HP 4284A using the screws provided.
- 3. Remove all four feet (5) (lift bar on the inner side of the foot, and slide the foot toward the bar.)

## **Option 909 Rack Flange** & Handle Kit

Option 909 is a rack mount kit containing a pair of flanges and the necessary hardware to mount them to an instrument which has handles attached, in an equipment rack with 482.6 mm (19 inches) spacing.

## Mounting the Handle and Rack

- 1. Remove the adhesive-backed trim strips 1 from the left and right front sides of the HP 4284A.
- 2. Attach the front handle 3 and the rack mount flange 5 together on the left and right front sides of the HP 4284A using the screws provided.
- 3. Remove all four feet (lift bar on the inner side of the foot, and slide the foot toward the bar).

## **Overview**

## Introduction

This Chapter provides the information you will need to know before operating the Hewlett-Packard Model 4284A Precision LCR Meter. Before using the HP 4284A, read through this Chapter so you can quickly and efficiently learn the HP 4284A's operation.

## **Product Introduction**

The HP 4284A is a general purpose LCR meter for incoming inspection of components, quality control, and laboratory use. The HP 4284A is used for evaluating LCR components, materials, and semiconductor devices over a wide range of frequencies (20 Hz to 1 MHz) and test signal levels (5 mV to 2  $V_{\rm rms}, 50~\mu A$  to 20 mA $_{\rm rms}$ ). With Option 001 the HP 4284A's test signal level range spans 5 mV to 20  $V_{\rm rms},$  and 50  $\mu A$  to 100 mA $_{\rm rms}$ .

The HP 4284A offers C-D measurements with a basic accuracy of  $\pm$  0.05% (C),  $\pm$  0.0005 (D) at all test frequencies with six digit resolution (the dissipation factor resolution is 0.000001) on every range.

With its built-in comparator, the HP 4284A can output comparison/decision results for sorting components into a maximum of ten bins. By using the handler interface and scanner interface options, the HP 4284A can easily be combined with a component handler, a scanner, and a system controller to fully automate component testing, sorting, and quality control data processing.

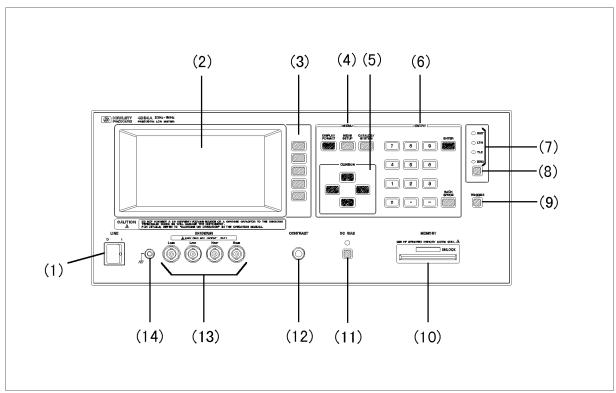
The HP 4284A's new list sweep function permits entry of up to ten frequencies, test signal levels, or bias level points to be automatically measured.

The HP-IB interface is a standard interface on the HP 4284A and can be used to build an automatic test system to completely characterize new components and materials, and to fully automatic production line testing.

The HP 4284A with Option 002 can apply a 0 to 20A (Maximum 40A: When two HP 42841As are paralleled.) DC current bias to the DUT (Device Under Test). So, high current biased impedance measurement of coils or transformers can be performed easy, fast and safe.

# A Tour of the Front Panel

Figure 2-1 shows the brief description of each key on the HP 4284A's front panel.



L1002001

Figure 2-1. Front Panel Overview

#### (1) LINE On/Off

Power on/off switch. In the "ON" position all operating voltages are applied to the instrument. In the "OFF" position NO operating voltages are applied to the instrument.

## (2) LCD

The Liquid Crystal Display (LCD) displays measurement results, test conditions, etc.

#### (3) SOFTKEYs

Five softkeys are used to select control and parameter functions. Each softkey has a softkey label along its left side.

## (4) MENU Keys

Menu selection keys. There are three menu keys, (DISPLAY FORMAT), (MEAS SETUP), and (CATALOG/SYSTEM). The menu keys are used to access the corresponding selection of instrument controls.

#### (5) CURSOR Keys

The CURSOR keys are used to move the field select cursor from field to field on the LCD display page. When the cursor is moved to a field, the field changes to an inverse video image of the original field. The cursor can only be moved from field to field.

#### (6) ENTRY Keys

The ENTRY keys are used to enter numeric data into the HP 4284A. The ENTRY keys are composed of the digits ① to ②, a period ①, a minus sign ①, ENTER, and BACK SPACE keys. ENTER terminates numeric input data and enters the displayed value on the Input Line (second line from the bottom of the LCD screen). BACK SPACE deletes one last character of the input value.

## (7) HP-IB Status Indicators

The HP-IB status indicators consist of the RMT (remote), TLK (talk), LTN (listen), and SRQ (service request) indicators. These indicators are used to show the HP 4284A's HP-IB status when it is interfaced to a controller via HP-IB.

## (8) LCL Key

This is the Local (LCL) key which sets the HP 4284A to local (front-panel) control, if it was in REMOTE and if the HP-IB controller had not invoked a local lockout. LCL is the only front-panel key that is active when the HP 4284A is in REMOTE state.

## (9) (TRIGGER) Key

This is the TRIGGER key used to manually trigger the HP 4284A when it is set to the Manual Trigger mode.

#### (10) MEMORY Card Slot and UNLOCK Button

The MEMORY card slot is where you insert the memory cards. The UNLOCK button is used to eject a memory card.

## (11) (DC BIAS) Key

This is DC BIAS used to enable the DC bias output. DC BIAS is a toggle type switch, and the DC BIAS ON/OFF LED indicator is located above DC BIAS. When DC BIAS is set to ON, the DC BIAS ON/OFF LED indicator is ON. When DC BIAS is set to OFF, the DC BIAS ON/OFF LED indicator is OFF. If DC BIAS is set to OFF, even though the DC bias is set to ON according to the LCD display, the DC bias isn't output.

#### (12) CONTRAST Control Knob

This knob is used to adjust the LCD's CONTRAST.

# (13) UNKNOWN Terminals

These are the UNKNOWN Terminals used to connect a four-terminal pair test fixture or test leads for measuring the device under test. Available four terminal-pair test fixtures or test leads are refer to the Accessories Selection Guide For Impedance Measurements (Catalog number 5963-6834E).

#### INSTALLATION CATEGORY I

## Caution



Do not apply DC voltage or current to the UNKNOWN terminals. Doing so will damage the HP 4284A. Before you measure a capacitor, be sure the capacitor is fully discharged.

## (14) FRAME Terminal

This is the FRAME Terminal which is tied to the instrument's chassis and which can be used for measurements that require guarding.

## A Tour of the Rear Panel

Figure 2-2 shows a brief description of the HP 4284A's rear panel.

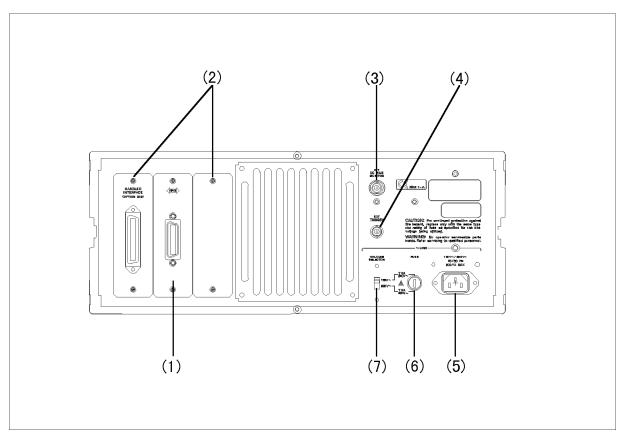


Figure 2-2. Rear Panel Overview

## (1) HP-IB Interface Connector

This is the HP-IB interface connector used when operating on the Hewlett-Packard Interface Bus.

### (2) Interface Connectors

When interface options are installed, the interface connectors will be installed as shown. When the HP 4284A is not equipped with an interface option, blank covers are installed.

#### (3) INT DC BIAS MONITOR Connector

This BNC connector is the internal DC BIAS monitor connector used for monitoring the DC bias voltage applied to the device under test. This connector is installed only when Option 001 is installed.

## (4) EXT TRIGGER Connector

This BNC connector is the external trigger connector used to input the positive-going TTL pulse signal to trigger the HP 4284A. (The trigger mode must be set to EXTernal.)

## (5) ∼LINE Input Receptacle

AC power cord receptacle.

# (6) $\wedge$ ~LINE Fuse Holder

Fuse holder for the HP 4284A's line fuse. Refer to CHAPTER 1 to determine the correct line fuse rating.

## (7) $\sim$ LINE VOLTAGE SELECTOR

The switch used to match the HP 4284A to the AC operating voltage being used. Refer to CHAPTER 1 to determine the correct operating voltage.

# **Display**

The following paragraphs define the display areas and fields, and describes the LCD's display pages.

## **Display Area Definition**

The HP 4284A uses a 40 character by 16 line Liquid Crystal Display (LCD), and the display area on the LCD is divided into the areas shown in Figure 2-3.

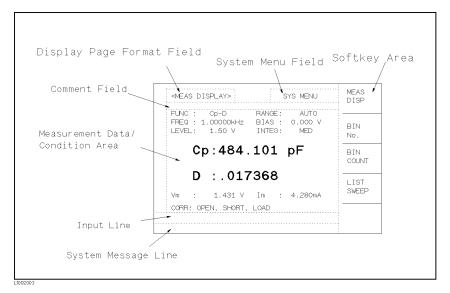


Figure 2-3. Display Area Definition

#### **Display Page Area**

This is the display page area. This area identifies the current display page.

## System Menu Field

The system menu area is always displayed on all pages (except for the *SELF TEST* page) as the *SYS MENU* field. When the cursor is set on the *SYS MENU* field, common system functions which are not displayed on the display pages (for example, LOAD/STORE function), or controls which cannot be set on a display page's fields, are made available.

#### **Comment Line Area**

The comment line area is used to display comment messages sent via the HP-IB bus using the DISPlay:LINE command or entered on the *MEAS SETUP* page using the ① to ②, ① (period), ② (minus) keys. Up to 30 characters can be displayed. The comment line area is displayed on the following pages.

- MEAS DISPLAY
- BIN No. DISPLAY
- LIST SWEEP DISPLAY
- MEAS SETUP

- LIST SWEEP SETUP
- SYSTEM CONFIG

#### Softkey Area

The last six character positions of each line are reserved for softkey labels. The softkeys displayed correspond to the field at the cursor's position on the LCD.

## Measurement Data/Conditions Area

This area is where measurement results and measurement conditions are displayed.

#### Note



Under certain conditions one of the following messages may be displayed instead of the measurement results.

"UNBAL": This message is displayed when the impedance of the

device exceeds the range of the analog measurement

circuit's capability.

"ADC ERR": This message is displayed when the A/D converter in

the measurement circuit is not functioning.

"----": This message is displayed and is called "overflow"

when the analog measurement circuit can measure the device, but the data format used will not hold

the calculated results.

"INFINITY": This message is displayed when an attempt is made

to divide by zero during parameter calculation. For example, if you set the  $\Delta$  % measurement function without setting the reference value, this message will

be displayed.

#### **Input Line Area**

This area is the input line where numeric input data entered with the front panel keys is displayed.

#### System Message Area

This area is where system messages, comments, and error messages are displayed.

# MENU keys and Display Page

The HP 4284A has three MENU keys which are used to define the LCD display pages.

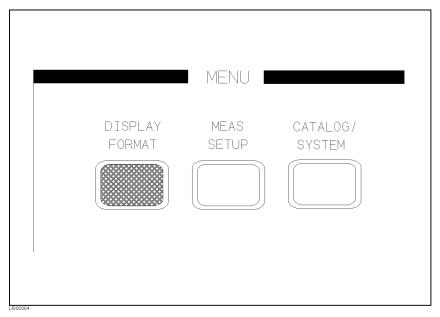


Figure 2-4. MENU keys

Each MENU key has three or four display pages as follows.

#### **DISPLAY FORMAT MENU key**

This MENU key has the following four pages.

- MEAS DISPLAY
- BIN No. DISPLAY
- BIN COUNT DISPLAY
- LIST SWEEP DISPLAY

These display pages are used for displaying the measurement results, and displaying the sorting results. Some controls for each display page can be set from the display page. Only from the above display pages can the HP 4284A measure a device under test. When DISPLAY FORMAT is pressed, the MEAS DISPLAY page will be displayed on the LCD screen, and the softkeys used to select the other three pages are displayed. The cursor will be positioned at the MEAS DISPLAY field. The power-on default display page is the MEAS DISPLAY page. For more information under DISPLAY FORMAT, refer to Chapter 3.

## **MEAS SETUP MENU key**

This MENU key has the following four pages.

- MEAS SETUP
- CORRECTION
- LIMIT TABLE SETUP

#### ■ LIST SWEEP SETUP

These display pages are used for setting the measurement conditions (including the correction function), or setting the bin sorting limits. When one of these display pages are being displayed, the HP 4284A cannot perform measurement, and also cannot perform bin sorting judgments. (The HP 4284A can only measure a device under test and can perform the bin judgments from the display pages under DISPLAY FORMAT).) When MEAS SETUP is pressed, the MEAS SETUP page must be displayed, and the softkeys used to select the other three pages are displayed. The cursor will be positioned at the MEAS SETUP field. For more information about MEAS SETUP, refer to Chapter 3.

## **CATALOG/SYSTEM** menu key

This MENU key has the following three pages.

- $\blacksquare$  CATALOG
- $\blacksquare$  SYSTEM CONFIGURATION
- SELF TEST

These display pages are used for operating conditions other than main measurement control. When CATALOG/SYSTEM is pressed, the CATALOG page will be displayed, and the softkeys used to select the other two pages are displayed. The cursor will be positioned at the CATALOG field. For more information about CATALOG/SYSTEM, refer to Chapter 5.

Starting from the next paragraph, a summary for each display page will be given.

## **Summary of Pages**

Figure 2-5 shows all display pages. Each summary of each page is shown below.

## MEAS DISPLAY (under (DISPLAY FORMAT))

This display page provides the measurement result information, and control settings are entered from this page. The HP 4284A measures the device under test from this page, and displays the measurement results in large characters.

## BIN No. DISPLAY (under (DISPLAY FORMAT))

This display page provides the bin sorting result information, the measurement results, and comparator function on/off settings. The HP 4284A measures the device under test from this page. The bin number is displayed in large characters, and the measurement results are displayed in normal characters.

## BIN COUNT DISPLAY (under (DISPLAY FORMAT))

This display page provides the limit table's conditions, and the comparator's bin counter results. The HP 4284A can measure the device under test from this page, but the measurement results will not be displayed.

## LIST SWEEP DISPLAY (under (DISPLAY FORMAT))

This display page provides the list sweep measurement results, and the sweep mode step/seq selection. The HP 4284A measures the device under test according to the list sweep conditions in the LIST SWEEP SETUP page. An asterisk (\*) shows the current measuring point in the list sweep points. The list sweep point cannot be set from this page. You must use the LIST SWEEP SETUP (in MEAS SETUP) page to set the list sweep points.

#### MEAS SETUP (under (MEAS SETUP))

This display page provides all of the measurement control settings. The HP 4284A cannot perform a measurement from this page, and the measurement result can not be displayed on this page. When you measure the device under test using the control settings on this page, use one of the display pages from DISPLAY FORMAT.

## CORRECTION (under MEAS SETUP)

This display page provides the correction function. The correction function must be used to measure the device under test accurately. The HP 4284A cannot measure the device under test from this page, and the measurement results will not be displayed. When you measure a device under test, use one of the display pages from DISPLAY FORMAT.

## LIMIT TABLE SETUP (under (MEAS SETUP))

This display page provides the limit table settings for bin sorting. The HP 4284A cannot perform a measurement from this page, and the comparison results can not be displayed. When you want to see the comparison results, either the BIN No. DISPLAY page (under DISPLAY FORMAT) or the BIN COUNT DISPLAY page (under DISPLAY FORMAT) must be used.

## LIST SWEEP SETUP (under (MEAS SETUP))

This display page provides the control settings for the List Sweep measurement function. The HP 4284A cannot measure the device under test from this page, and the list sweep measurement results can not be displayed from this page. When you measure the device under test using the control settings on the LIST SWEEP SETUP page, the LIST SWEEP DISPLAY page (in DISPLAY FORMAT) must be used.

## CATALOG (under (CATALOG/SYSTEM))

This display page provides the catalog of the stored contents in internal memory or a from the memory card.

## SYSTEM CONFIG (under (CATALOG/SYSTEM))

This display page provides the operation of either the HP-IB interface or the HP 4284A's options, and will also tell you the option installation information.

#### **SELF TEST (under** (CATALOG/SYSTEM))

This display page provides the HP 4284A's self test utilities and the the Performance Test given in Chapter 10.

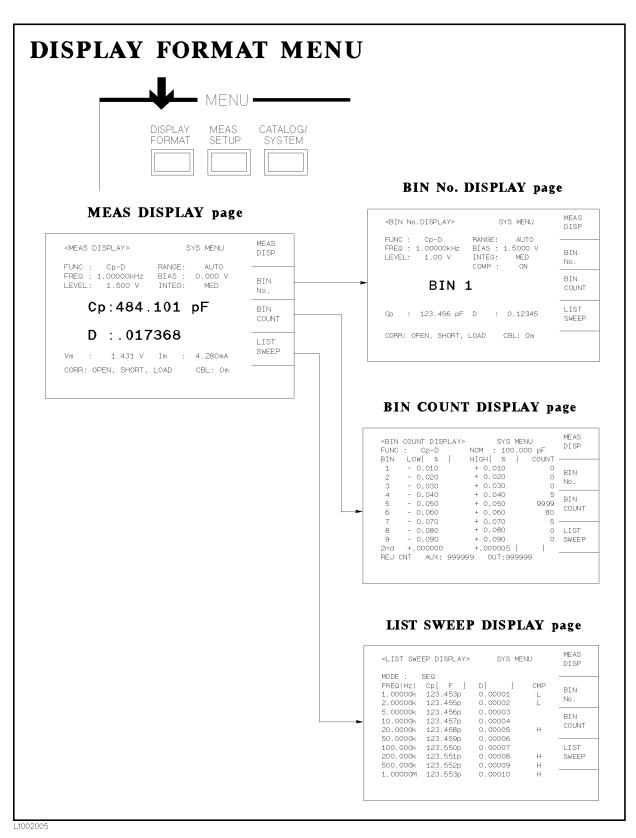


Figure 2-5. Display Pages (1/3)

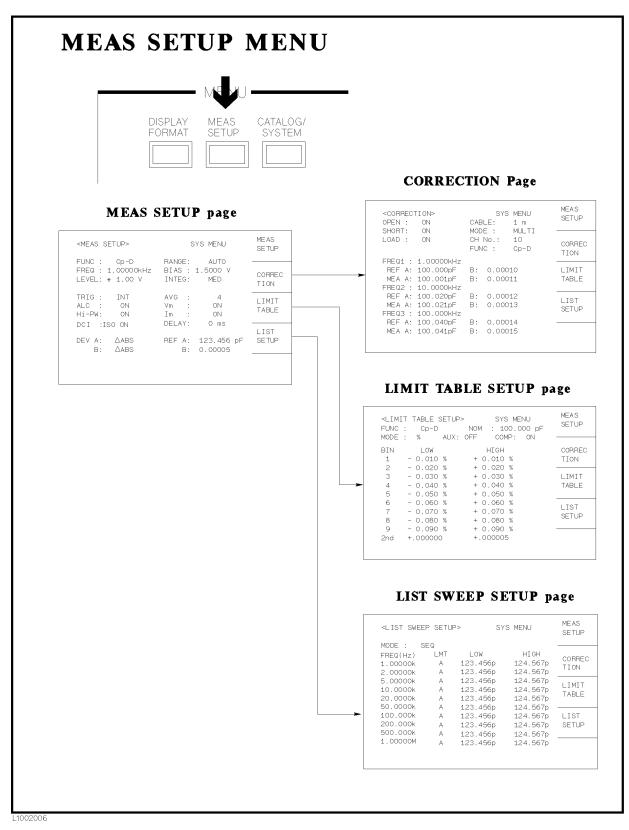


Figure 2-5. Display Pages (2/3)

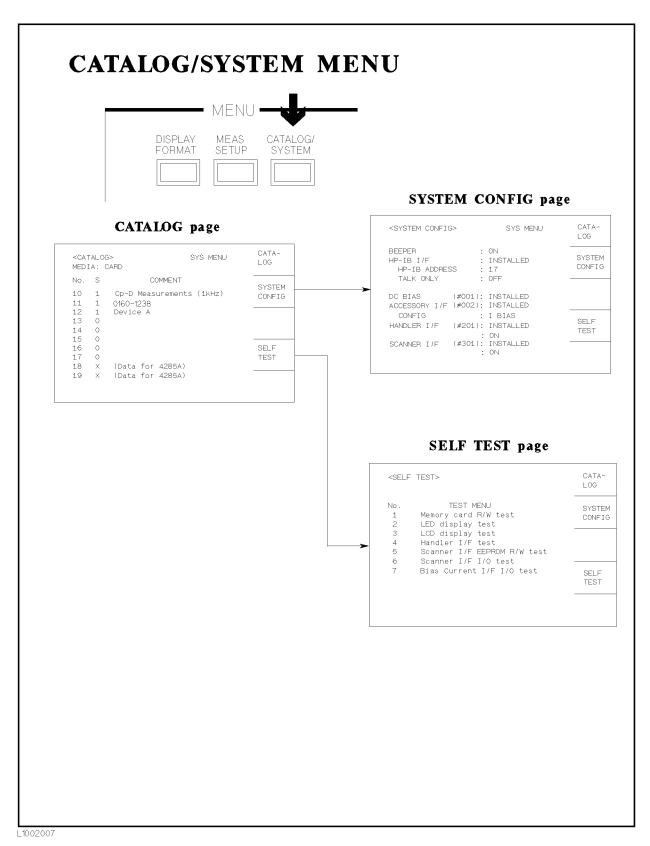


Figure 2-5. Display Pages (3/3)

# **Basic Operation**

The HP 4284A's basic operation is described in the following paragraphs.

- Display the desired display page using both the MENU keys and the softkeys. (Refer to Figure 2-5.)
- Move the cursor to the field to be used using the CURSOR arrow keys. The cursor will be an inverse video marker, and the field is the area to which you can set the cursor.

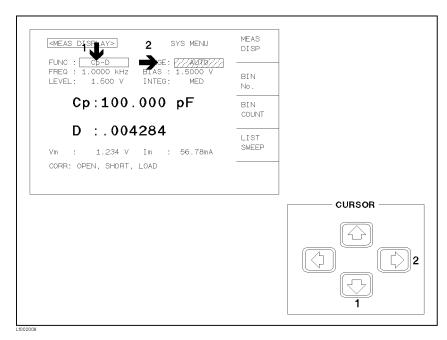


Figure 2-6. CURSOR Keys and Field Operation Example

■ The softkeys corresponding to the field pointed to by the cursor will be displayed. Select and press a softkey. The numeric entry keys and (ENTER) are used to enter numeric data.

When one of the numeric entry keys is pressed, the softkeys will change to the available unit softkeys. You can use these unit softkeys instead of ENTER. When ENTER is used, the numeric data is entered with Hz, V, or A as the default unit depending on the cursor field selected, e.g., test frequency's unit will be Hz, etc.

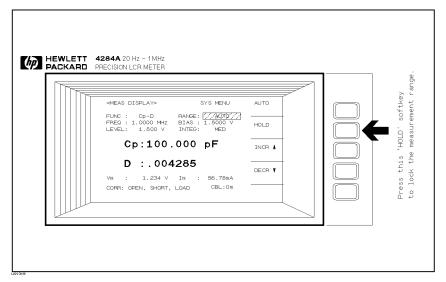


Figure 2-7. Softkey Selection Example

## **DISPLAY FORMAT Menu**

## Introduction

This Chapter provides information about the function of each page of (DISPLAY FORMAT). The following four display pages can be called from (DISPLAY FORMAT).

- MEAS DISPLAY
- BIN No. DISPLAY
- BIN COUNT DISPLAY
- LIST SWEEP DISPLAY

This Chapter describes the functions on each page in the order of the preceding list.

## MEAS DISPLAY Page

When you press (DISPLAY FORMAT), the MEAS DISPLAY page will be displayed. On this MEAS DISPLAY page, the measurement results are displayed in large characters, and the following measurement controls can be set from this page. (The field in parenthesis is used to set the control function.)

- $\blacksquare$  Measurement Function (FUNC)
- $\blacksquare$  Measurement Range (RANGE)
- Test Frequency (FREQ)
- Oscillator Level (*LEVEL*)
- DC Bias (BIAS)
- Integration Time (INTEG)
- System Menu (SYS MENU)

There are eight fields on this page: MEAS DISPLAY, FUNC, RANGE, FREQ, LEVEL, BIAS, INTEG, and SYS MENU. Each control function is described in the following paragraphs.

This page also provides the following information in monitor areas on the displayed page. These conditions can be set from the MEAS SETUP page or CORRECTION page. (For more detail of the following information, refer to Chapter 4.)

- $\blacksquare$  Oscillator Level Voltage/Current Monitor value  $(V_m, I_m)$
- OPEN, SHORT, LOAD on/off setting conditions (CORR)
- $\blacksquare$  Channel Number (CH) when the scanner interface is used.

The available fields and the softkeys which correspond to the fields on this page are shown in Figure 3-1 and Figure 3-2 respectively.

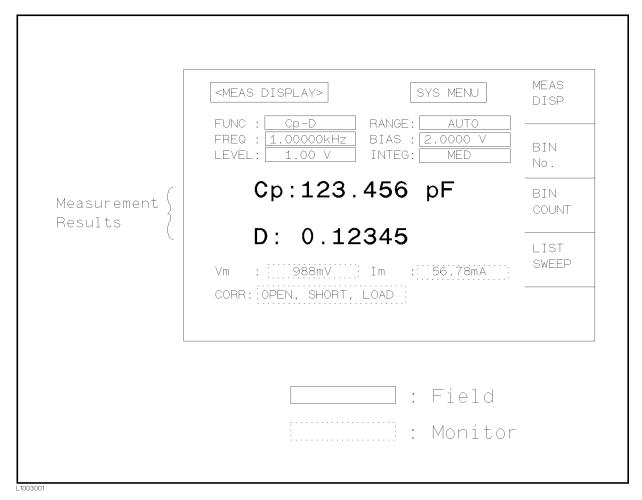


Figure 3-1. Available Fields on the MEAS DISPLAY Page

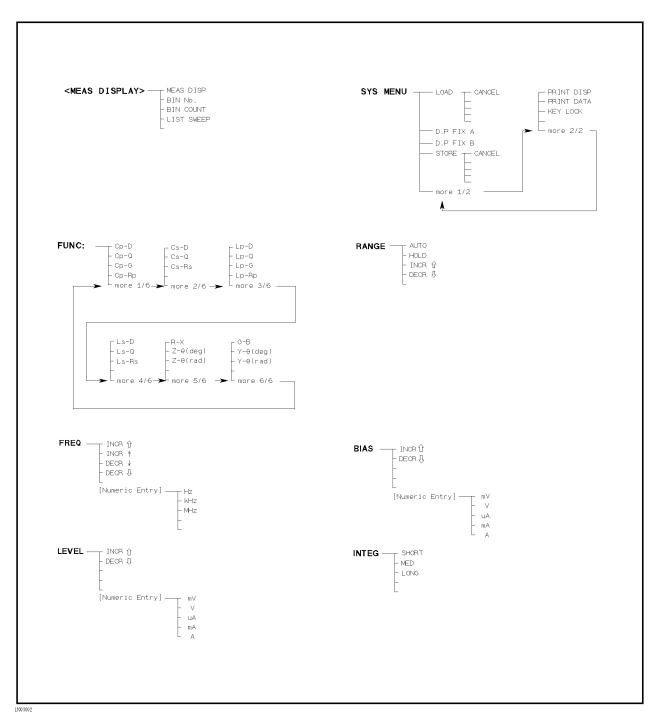


Figure 3-2. Available Softkeys on the MEAS DISPLAY Page

#### **Measurement Function**

### **Description**

The HP 4284A measures two components of the complex impedance (parameters) at the same time in a measurement cycle. The measurement parameters are listed as follows.

## ■ Primary Parameters

```
|\mathbf{Z}|
         (absolute value of impedance)
|\mathbf{Y}|
         (absolute value of admittance)
L
         (inductance)
\mathbf{C}
         (capacitance)
R
         (resistance)
         (conductance)
\mathbf{G}
```

#### ■ Secondary Parameters

```
D
        (dissipation factor)
Q
        (quality factor)
R_{s}
        (ESR (equivalent series resistance))
R_{\rm p}
        (equivalent parallel resistance)
Χ
        (reactance)
В
        (susceptance)
\theta
        (phase angle)
```

The primary parameter measurement result is located on the upper line as two large character lines on this page, and the secondary parameter measurement result is located on the lower line as two large character lines on this page.

The combinations of primary and secondary parameters, including the equivalent parallel and serial combinations, are listed in Table 3-1.

**Table 3-1. Measurement Function** 

Primary Parameter	Serial Mode	Parallel Mode
Z	$egin{array}{l} Z  ext{-} heta & (\mathrm{rad}) \ Z  ext{-} heta & (\mathrm{deg}) \end{array}$	
Y		$egin{array}{l} \mathbf{Y} ext{-} heta & (\mathrm{rad}) \ \mathbf{Y} ext{-} heta & (\mathrm{deg}) \end{array}$
C	$egin{array}{l} C_s-D \\ C_s-Q \\ C_s-R_s \end{array}$	$egin{array}{c} C_p ext{-}D \ C_p ext{-}Q \ C_p ext{-}G \ C_p ext{-}R_p \end{array}$
L	$\begin{array}{c} \rm L_s\text{-}D \\ \rm L_s\text{-}Q \\ \rm L_s\text{-}R_s \end{array}$	$egin{array}{c} \mathbf{L_p} ext{-}\mathbf{D} \\ \mathbf{L_p} ext{-}\mathbf{Q} \\ \mathbf{L_p} ext{-}\mathbf{G} \\ \mathbf{L_p} ext{-}\mathbf{R_p} \end{array}$
R	R-X	
G		G-B

## Front Panel Operation for Setting the Measurement Function

Perform the following steps to set the measurement function.

- 1. Use the CURSOR arrow keys to move the cursor to the FUNCfield. The following softkeys will be displayed.
  - Cp-D
  - Cp-Q
  - Cp-G
  - Cp-Rp
  - more 1/6
- 2. Select and press a softkey to set the measurement function. If the softkey you want is not displayed, press more 1/6 to display the following set of softkeys.
  - Cs-D
  - Cs-Q
  - Cs-Rs
  - more 2/6
- 3. Select and press a softkey to set the measurement function. If the softkey you want is not displayed, press more 2/6 to display the following set of softkeys.
  - Lp-D
  - Lp-Q

- Lp-G
- Lp-Rp
- more 3/6
- 4. Select and press a softkey to set the measurement function. If the softkey you want is not displayed, press more 3/6 to display the following set of softkeys.
  - Ls-D
  - Ls-Q
  - Ls-Rs>
  - more 4/6
- 5. Select and press a softkey to set the measurement function. If the softkey you want is not displayed, press more 4/6 to display the following set of softkeys.
  - R-X
  - $Z-\theta$  (deg)
  - $Z-\theta$  (rad)
  - more 5/6
- 6. Select and press a softkey to set the measurement function. If the softkey you want is not displayed, press more 5/6 to display the following set of softkeys.
  - G-B
  - $Y-\theta$  (deg)
  - $Y-\theta$  (rad)
  - more 6/6
- 7. Select and press a softkey to set the measurement function. When more 6/6 is pressed, the softkeys shown in step 1 will be displayed. Retry steps 1 through 7 if you missed the function you were looking for.

## **Measurement Range**

## **Description**

The HP 4284A has eight measurement ranges:  $10\Omega$ ,  $100\Omega$ ,  $300\Omega$ , 1  $k\Omega$ , 3  $k\Omega$ , 10  $k\Omega$ , 30  $k\Omega$ , and 100  $k\Omega$ . When Option 001 is installed, the HP 4284A has nine measurement ranges:  $1\Omega$ ,  $10\Omega$ ,  $100\Omega$ ,  $300\Omega$ , 1  $k\Omega$ , 3  $k\Omega$ , 10  $k\Omega$ , 30  $k\Omega$ , and 100  $k\Omega$ . The measurement range is selected according to the DUT's impedance even if measurement parameter is capacitance or inductance.

Figure 3-3 shows the display range and effective measuring range for each measurement range while in the impedance mode (|Z|, R, X). For example, 50 k $\Omega$  DUT impedance can be measured using from

the 100  $\Omega$  to the 30 k $\Omega$  range, but the HP 4284A's measurement accuracy specification is only met by using the 30 k $\Omega$  range. If this DUT is measured by the 100 k $\Omega$  range, UNBAL will be displayed.

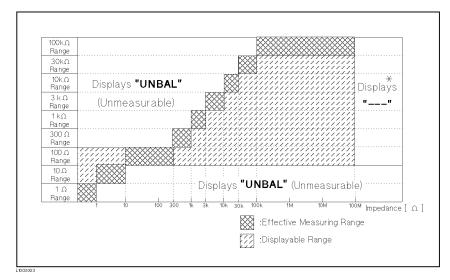


Figure 3-3. Effective Measuring Range for Each Measurement Range

Figure 3-4 and Figure 3-5 show the effective measuring range of each measurement range, in which the HP 4284A's measurement accuracy meets its specification. When the measurement range is set manually, the optimum measurement range should be selected by matching the DUT's impedance to the effective measuring range shown in Figure 3-4 and Figure 3-5. When the measurement range is set to AUTO, the optimum measurement range is automatically selected according to the impedance of each DUT.

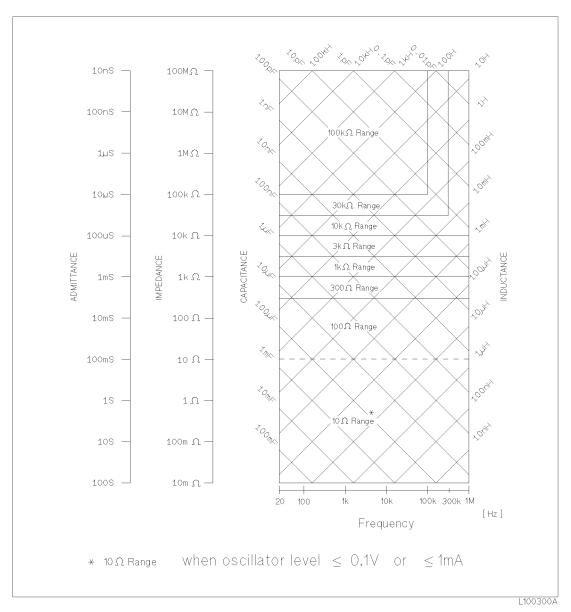


Figure 3-4. **Effective Measuring Range** (Oscillator Level  $\leq$  2V or  $\leq$  20 mA)

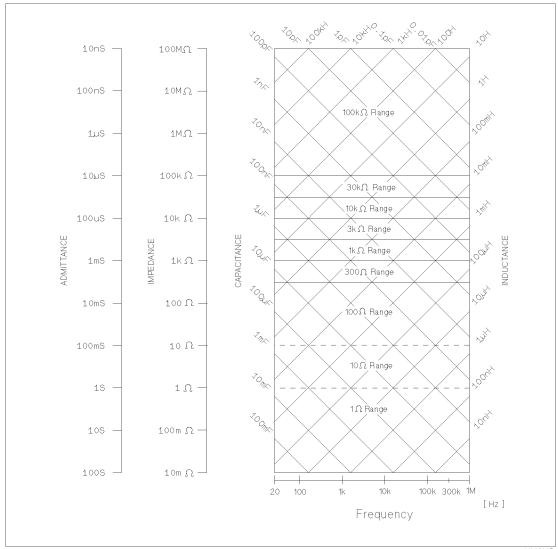


Figure 3-5. **Effective Measuring Range** (Oscillator Level > 2V or > 20 mA)

Note



The measurement range is limited by the test frequency setting when the oscillator level is equal to 2 V or less than 2 V. When the measurement range and the test frequency are set under the above conditions, the test frequency must be set first, and then the measurement range. If you set the measurement range first and then frequency, the resulting measurement range may not be the one you wanted to set.

#### Front Panel Operation for Setting the Measurement Range

Perform the following procedure to set the measurement range.

1. Move the cursor to the RANGE field using the CURSOR keys. The following softkeys will be displayed.

This softkey is used to set the measurement range to AUTO AUTO.

HOLD This softkey is used to change the measurement range from the AUTO mode to the HOLD mode. When the measurement range is set to the HOLD mode, the impedance range is fixed at the current range setting, and the impedance range is displayed in the RANGEfield.

INCR 介 This softkey is used to increment the measurement range in the HOLD (fixed range) mode.

This softkey is used to decrement the measurement DECR ↓↓ range in the HOLD (fixed range) mode.

2. Use the softkeys to set the measurement range.

## **Test Frequency**

#### **Description**

The HP 4284A operates from 20 Hz to 1 MHz with 8610 frequency steps in between. All of test frequency points (F) are calculated values using the following formula. (All available frequency points above 1 kHz are shown in Appendix F.)

$$F = \frac{m}{n} \qquad [kHz]$$

Where,

Frequency [F]	m	n
$20 \text{ Hz} \le F \le 5 \text{ kHz} (8467 \text{ points})$	$60, 62.5, \\ and 75$	13 to 3750 (integer)
$5 \text{ kHz} < F \le 10 \text{ kHz} (34 \text{ points})$	120, 125, and 150	13 to 29 (integer)
$10 \text{ kHz} < F \le 20 \text{ kHz} (34 \text{ points})$	240,250, and $300$	13 to 29 (integer)
$20 \text{ kHz} < F \le 250 \text{ kHz} (63 \text{ points})$	480, 500 and 600	2 to 29 (integer)
$250 \text{ kHz} < F \le 500 \text{ kHz} \text{ (6 points)}$	960, 1000 and 1200	2, 3, and $4$
$500 \text{ kHz} < \text{F} \le 1 \text{ MHz} (6 \text{ points})$	1920, 2000 and 2400	2, 3, and $4$

When numeric data is entered, the nearest available frequency point is automatically set.

#### Front Panel Operation for Setting the Test Frequency

There are two ways to set the test frequency. One is to use the softkeys, and the other is to use the numeric entry keys. Perform the following steps to set the test frequency.

1. Move the CURSOR to the FREQ field. The following softkeys will be displayed.

## ■ INCR ↑

This softkey is the coarse frequency increment softkey used to increment the test frequency to the next sequentially higher tenfold value after 20 Hz. The frequency points set using this softkey are as follows.

20 Hz 100 Hz 1 kHz 10 kHz 100 kHz 1 MHz

#### ■ INCR ↑

This softkey is the fine frequency increment softkey used to increment the current test frequency to the next sequentially higher frequency point. There are 10 frequency points between successive decade values. The sequential frequency points which can be set using this softkey are as follows.

```
20 Hz
            100 Hz
                            1 \text{ kHz}
                                        10 kHz 100 kHz
                                                                     1~\mathrm{MHz}
            120 Hz 1.2 kHz
25~\mathrm{Hz}
                                        12 kHz 120 kHz
30~\mathrm{Hz}
            150 Hz 1.5 kHz
                                        15 kHz 150 kHz
40~\mathrm{Hz}
            200~\mathrm{Hz}
                            2 \text{ kHz}
                                        20 kHz 200 kHz
50~\mathrm{Hz}
            250~\mathrm{Hz} 2.5~\mathrm{kHz}
                                        25 kHz 250 kHz
60~\mathrm{Hz}
            300~\mathrm{Hz}
                            3 \text{ kHz}
                                        30 \text{ kHz} 300 \text{ kHz}
80 Hz
            400~\mathrm{Hz}
                            4 \text{ kHz}
                                       40 \text{ kHz} 400 \text{ kHz}
            500~\mathrm{Hz}
                            5 \text{ kHz}
                                        50 \text{ kHz} 500 \text{ kHz}
            600~\mathrm{Hz}
                            6 kHz
                                        60 kHz 600 kHz
            800~\mathrm{Hz}
                            8 \text{ kHz} 80 \text{ kHz} 800 \text{ kHz}
```

## ■ DECR |

This softkey is the fine frequency decrement softkey used to decrease the test frequency to the next sequentially lower frequency point. There are ten frequency points between successive decade values. The frequency points set using this softkey are the same values as set using INCR ↑.

## ■ DECR ↓

This softkey is the coarse frequency decrement softkey which is used to decrement the test frequency to the next sequentially lower tenth value. The frequency points set using this softkey are the same as the frequency points set using INCR  $\Uparrow$ .

2. Select and set the test frequency using either the softkeys or the numeric entry keys. When the test frequency is entered using the numeric entry keys, the softkey labels are changed to the available

units (Hz, kHz, and MHz), and so you can use these softkeys instead of (ENTER) to enter the units and enter the data. When (ENTER) is used, the numeric data is entered with Hz as the default unit.

#### Oscillator Level

#### Description

The HP 4284A's oscillator level can be set as the effective value (RMS value) of a sine wave of the test frequency from the HP 4284A's internal oscillator. You can set either the oscillator voltage level or the oscillator current level. The output impedance is  $100\Omega$ .

#### Note



The set value of the oscillator current level is the value set when the measurement contacts (UNKNOWN Terminals) are shorted together.

The set value of the oscillator voltage level is the value set when the measurement contacts (UNKNOWN Terminals) are opened.

When the Option 001 (power amplifier/DC-bias) isn't installed, the oscillator voltage level can be set from 0  $V_{rms}$  to 2  $V_{rms}$  with a resolution as listed in Table 3-2, or the oscillator current level can be set from 0  $A_{rms}$  to 20  $mA_{rms}$  with a resolution as listed in Table 3-2.

Table 3-2. Oscillator Level and Resolution (Std.)

Mode	Oscillator Level	Resolution
Voltage	$\begin{array}{c} 0~\rm{V_{rms}} \\ 5~\rm{mV_{rms}}~\rm{to}~200~\rm{mV_{rms}} \end{array}$	$1~\mathrm{mV_{rms}}$
	$210~\mathrm{mV_{rms}}$ to $2~\mathrm{V_{rms}}$	$10~\mathrm{mV_{rms}}$
Level	$\begin{array}{c} 0~\rm A_{rms} \\ 50~\mu A_{rms}~\rm to~2~m A_{rms} \\ 2.1~\rm m A_{rms}~\rm to~20~m A_{rms} \end{array}$	$\begin{array}{c} 10~\mu\mathrm{A_{rms}} \\ 100~\mu\mathrm{A_{rms}} \end{array}$

When the option 001 (power amplifier/DC-bias) is installed, the oscillator voltage level can be set form 0  $V_{rms}$  to 20  $V_{rms}$  with a resolution as listed in Table 3-3, or the oscillator current level can be set from  $0 \text{ A}_{rms}$  to  $200 \text{ mA}_{rms}$  with a resolution as listed in Table 3-3.

#### Note



It is possible to make the option 001 valid or invalid from the MEASSETUP page. When the option 001 function is used, the high power mode must be set to ON in the MEAS SETUP page. (For more information, refer to Chapter 4.)

Table 3-3. Oscillator Level and Resolution (Opt.001)

Mode	Oscillator Level	Resolution
Voltage	$\begin{array}{c} 0~\rm{V_{rms}} \\ 5~\rm{mV_{rms}}~\rm{to}~200~\rm{mV_{rms}} \\ 210~\rm{mV_{rms}}~\rm{to}~2~\rm{V_{rms}} \\ 2.1~\rm{V_{rms}}~\rm{to}~20~\rm{V_{rms}} \end{array}$	$\begin{array}{c} 1~\mathrm{mV_{rms}} \\ 10~\mathrm{mV_{rms}} \\ 100~\mathrm{mV_{rms}} \end{array}$
Level	$\begin{array}{c} 0~\mathrm{A_{rms}} \\ 50~\mu\mathrm{A_{rms}}~\mathrm{to}~2~\mathrm{mA_{rms}} \\ 2.1~\mathrm{mA_{rms}}~\mathrm{to}~20~\mathrm{mA_{rms}} \\ 21~\mathrm{mA_{rms}}~\mathrm{to}~200~\mathrm{mA_{rms}} \end{array}$	$\begin{array}{c} 10~\mu\mathrm{A_{rms}} \\ 100~\mu\mathrm{A_{rms}} \\ 1~\mathrm{mA_{rms}} \end{array}$

The HP 4284A can measure a device using a constant voltage or current level by using the automatic level control function. (The automatic level control function (ALC field) can be set to ON from the MEAS SETUP page.) When a constant voltage or current level measurement is performed, the asterisk mark (\*) is located at the head of the oscillator level value. For more information about the automatic level control function, refer to Chapter 4.

#### Front Panel Operation for Setting the Oscillator Level

There are two ways to set the oscillator level. One is to use the softkeys, and the other is to use the use the numeric entry keys. Perform the following steps to set the oscillator level.

- 1. Move the cursor to the LEVEL field. The following softkeys will be displayed.
  - INCR ↑

Press this softkey to increases the oscillator's output level.

■ DECR ↓

Press this softkey to decreases the oscillator's output level.

2. Select and set the oscillator level using either the softkeys or the numeric entry keys. When the oscillator level is entered using the numeric entry keys, the softkey labels are changed to the available units labels (mV, V,  $\mu$ A, mA, and A), and you can use these softkeys to enter the units and enter the data instead of ENTER. When (ENTER) is used, the numeric data is entered with V or A as the default unit.

Note



When you want to change the oscillator level from voltage to current, or from current to voltage, the numeric entry keys and units' softkeys must be used.

### **DC Bias**

### **Description**

The HP 4284A has internal dc bias voltage selections of 0 V, 1.5 V, and 2.0 V.

When option 001 is installed, the dc bias voltage can be set from 0 V to  $\pm$  40 V with a resolution as listed in Table 3-4, or the DC bias current can be set from 0 A to  $\pm$  100 mA with a resolution as listed in Table 3-4.

#### Note



Option 001 can be made valid or invalid from the MEAS SETUP page. When the option 001 function is used, the high power mode must be set to ON from the MEAS SETUP page. (For more information, refer to Chapter 4.)

Table 3-4. DC bias and Resolution (Opt.001)

Mode	DC Bias Level	Resolution
Voltage	± (0 V to 4 V) ± (4.002 V to 8 V) ± (8.005 V to 20 V) ± (20.01 V to 40 V)	1 mV 2 mV 5 mV 10 mV
Current	± (0 A to 40 mA) ± (40.02 mA to 80 mA) ± (80.05 mA to 100 mA)	$10  \mu { m A} \ 20  \mu { m A} \ 50  \mu { m A}$

#### Note



The setting value of the dc bias current is the value set when the measurement contacts (UNKNOWN Terminals) are shorted. (Refer to Figure 3-6.) When a DUT is connected to the measurement contacts, the setting current value is different from the actual current through the DUT. To determine the bias current through a device, refer to BIAS CURRENT ISOLATION FUNCTION, Chapter 4.

The setting value of the DC bias voltage is the value set when the measurement contacts (UNKNOWN Terminals) are opened.

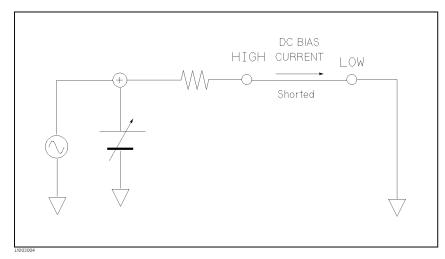


Figure 3-6. DC BIAS Current

Note



The DC bias will be output after setting <code>DC BIAS</code> on the front panel to ON. <code>DC BIAS</code> is used to enable the dc bias output. <code>DC BIAS</code> is a toggle type switch, and the DC BIAS on/off LED indicator is located above <code>DC BIAS</code>. When <code>DC BIAS</code> is set to ON, the DC BIAS on/off LED indicator is ON. When <code>DC BIAS</code> is set to OFF, the DC BIAS on/off LED indicator is OFF. If <code>DC BIAS</code> is set to OFF, even though the dc bias is set to ON according to the LCD display, the set dc bias isn't output.

Note



When both the dc bias and the oscillator level are set under the following conditions, the amount of the dc bias plus the oscillator level is limited as listed in Table 3-5.

- Option 001 is installed.
- The high power mode (Hi-PW) is set to ON.
- DC BIAS on the front panel is set to ON.

Table 3-5. DC Bias and Oscillator level Setting limits

	Osc Level Setting	Limit			
$V_{dc}(V)$	$ m V_{osc}(V_{rms})$	$V_{\rm osc} \times \sqrt{2} \times 1.1 + V_{\rm dc} \times 1.002 < 42 \text{ V}$			
$V_{dc}(V)$	$I_{ m osc}(A_{ m rms})$	$I_{\rm osc} \times \sqrt{2} \times 110 + V_{\rm dc} \times 1.002 < 42 \text{ V}$			
$I_{dc}(A)$	$ m V_{osc}(V_{rms})$	$V_{\rm osc} \times \sqrt{2} \times 1.1 + I_{\rm dc} \times 100.2 < 42 \text{ V}$			
$I_{dc}(A)$	$I_{ m osc}(A_{ m rms})$	$I_{\rm osc} \times (\sqrt{2} / \pi) \times 1.1 + I_{\rm dc} \times 1.01 < 0.11 \text{ A}$			

When Option 001 is installed, the DC bias voltage across the DUT can be monitored at the INT DC BIAS MONITOR connector on the rear panel. See Figure 3-7. There are resistors (approximately 9.9)

 $k\Omega$ ) in series between the INT DC BIAS MONITOR connector and the  $H_{\rm CUR}$  Terminal. So if you use a dc voltmeter to find the actual DC bias voltage, use the following formula to calculate it.

$$V_{dc} = \left(1 + \frac{9.9k}{R_{in}}\right) \times V_m - V_{low}$$

Where,

 $V_{dc}$ : Actual DC bias voltage

 $R_{in}$ : Input Resistor of the DC voltage meter

 $V_m$ : Actual monitor value at the INT DC BIAS

MONITOR connector

 $V_{low}$ : Residual voltage at the LOW Terminal (Typical: 2

mV, Max.: 6 mV (DCI:ISO ON), 20 mV (DCI:ISO

OFF))

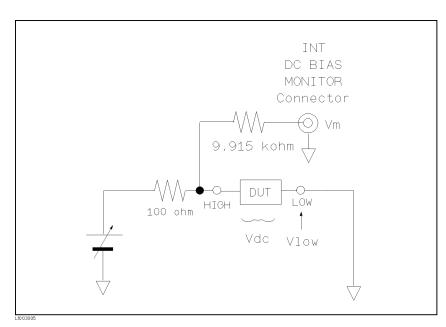


Figure 3-7. DC BIAS Monitor Circuits

#### Front Panel Operation for Setting the DC Bias

There are two ways to set the DC bias, one is to use the softkeys, and the other is to use the numeric entry keys. Perform the following steps to set the DC bias.

- 1. Move the cursor to the BIAS field. The following softkeys will be displayed.
  - a. INCR ↑

Press this softkey to increase the DC bias level.

b. DECR ↓

Press this softkey to decrease the DC bias level.

2. Set the dc bias to your desired bias using either the softkeys or the numeric entry keys. When the dc bias is entered using the numeric entry keys, the softkey labels are changed to the available units (mV, V,  $\mu A$ , mA, and A), and so you can use these softkeys instead of (ENTER). When (ENTER) is used, the numeric data is entered with V or A as the default unit.

### Note



When you want to change the DC bias from voltage to current or from current to voltage, you must use the numeric entry keys and the units' softkeys.

3. Set (DC BIAS) on the front panel to ON to output the dc bias.

## Integration Time

#### Description

The HP 4284A's measurement time is determined by the following.

- Integration Time (A/D conversion)
- Averaging Rate (number of measurement averaged)
- Delay Time (time delay between the trigger and the start of the measurement)
- Measurement result's display time

On this page, only the Integration Time in the above items can be set, the other settings except for the measurement result's display time can be set from the MEAS SETUP page.

The HP 4284A uses an integrating A/D converter in the internal circuits to convert the analog signal to a digital signal. The Integration Time is the time required to perform an A/D conversion. Generally, a longer conversion time will result in more stable and accurate measurement results. SHORT, MEDIUM, or LONG integration times can be selected. The measurement time of each integration time is shown in "Measurement Time" in Chapter 9.

#### Front Panel Operation for Setting the Integration Time

Perform the following steps to set the integration time.

- 1. Move the cursor to the *INTEG* field. The following softkeys will be displayed.
  - SHORT
  - MED
  - LONG
- 2. Use the preceding softkeys to select and set the integration time.

## System Menu

The system menu allows you to perform the following functions.

- Load/Store
- Decimal fixed point
- Printer
- Keylock

This paragraph describes each function in the order listed above.

#### **Load/Store Function**

■ Display page format

The HP 4284A uses two types of non-volatile memory: the internal EEPROM and an external memory card for storing and retrieving a maximum of 20 sets of instrument control settings. The following data will be stored in non-volatile memory as one record.

#### Note



DC BIAS ON/OFF condition on the front panel cannot be stored in non-volatile memory.

When the memory card is inserted into the MEMORY card slot and the HP 4284A is turned on, the HP 4284A's Auto Load function will load the control settings stored in record number 10. If there are no control settings stored in record number 10, the power-on default settings will be used, the same ones loaded without the memory card.

#### Note



The following items are stored in internal nonvolatile memory without using the load/store function.

- Control settings on the CORRECTION page.
  - □ OPEN, SHORT, LOAD correction on/off
  - □ OPEN, SHORT correction data for all test frequencies.
  - OPEN, SHORT, LOAD correction data at FREQ 1, FREQ 2, FREQ 3. (OPEN correction data at each frequency, SHORT correction data at each frequency, and LOAD correction reference data and actual data at each frequency.)
- Control settings on the SYSTEM CONFIG page.
  - □ Beeper on/off
  - □ HP-IB address
  - □ Talk Only on/off
  - □ Handler I/F on/off
  - □ Scanner I/F on/off

Perform the following steps to store the control settings to the internal non-volatile memory or to the external memory card.

- 1. Select and set all control settings on the MEAS DISPLAY page.
- 2. Move the cursor to the SYS MENU field.
- 3. Insert a memory card in the MEMORY card slot, if you are going to store the data to the memory card.
- 4. Press STORE. The message Enter record number to STORE will be displayed on the system message line.
- 5. Enter a record number using the numeric entry keys and ENTER to store the current control settings. Then when the record is stored in the internal EEPROM, the record number can be set from 0 to 9. When the record is stored in the memory card, record numbers from 10 to 19 can be set used.

Perform the following steps to load the control settings from the internal non-volatile memory or from an external memory card.

- 1. Move the cursor to the SYS MENU field.
- 2. Insert the memory card into the MEMORY card slot, if you are going to use a memory card.

- 3. Press LOAD. The message Enter record number to LOAD will be displayed on the system message line.
- 4. Enter record number you want to load using the numeric entry keys and ENTER

#### **Fixed Decimal Point Function**

The HP 4284A displays the measurement data using a six digit floating point display format. The fixed decimal point function is used to display the measurement data using a fixed point display format. This function can also be used to change the number of digits displayed.

Perform the following steps to use the fixed decimal point function.

- 1. Move the cursor to the SYS MENU field.
- 2. Press D.P. FIX A to fix the decimal point for the main parameter's data. The ▲ mark will be displayed at the decimal fixed point. Each time D.P. FIX A is pressed, the last digit is dropped, the value is rounded off.
- 3. Press D.P. FIX B to fix the decimal point for the sub parameter's data. The ▲ mark will be displayed at the decimal fixed point. Each time D.P.FIX B is pressed, the value is rounded off giving one less digit.

Note



In the following cases the fixed decimal point function is automatically disabled.

- The measurement function is changed.
- $\blacksquare$  When the deviation measurement (which is set on the MEAS SETUP page) is performed, the deviation measurement function  $(\Delta ABS, \Delta\%, OFF)$  is changed.

#### **Printer Function**

The HP 4284A's printer function is used to make a hardcopy of the displayed information (except for the softkey labels) or the measurement results without the need of an external controller. The HP 4284A must be set to the HP-IB talker mode, and the printer must be set to the HP-IB listener mode. There are two print modes: the PRINT DISPLAY mode and the PRINT DATA mode.

#### ■ PRINT DISPLAY mode

The print display mode is used to print out all of information on the displayed page by sending ASCII character strings to a printer. An example is shown Figure 3-8.

<meas display> sys menu

FUNC : Cp-D RANGE: AUTO
FREQ :1.00000MHz BIAS : 1.000 V
LEVEL: 1.00 V INTEG: MED

Cp: 99.9929pF

D: .000071

Vm : 1.009 V Im : 633.9uA CORR: OPEN,SHORT,LOAD CH: 0

Figure 3-8. MEAS DISPLAY Page Example

#### Note



The following characters are not recognized by the printer, so the character in [] on the same line will be printed instead.

 $\begin{array}{ccc} \Omega & \longrightarrow & \sqcup \text{ (space)} \\ \theta & \longrightarrow & [0] \\ \Delta & \longrightarrow & [d] \\ \mu & \longrightarrow & [u] \\ \blacktriangleright & \longrightarrow & [>] \end{array}$ 

#### ■ PRINT DATA mode

The print data mode is used to print out the measurement results using the following format. This format is the same as the ASCII format used for data transfer via HP-IB. For details, refer to Chapter 7.

<DATA A>,<DATA B>,<STATUS>,<BIN No.><CR><LF>

<DATA A> ::= The measurement results of the main parameter

(|Z|, |Y|, C, L, R, G). 12 ASCII characters (SN.NNNNNESNN)

<DATA B> ::= The measurement results of the sub parameter

 $(\theta, D, Q, G, R_s, X, B)$ . 12 ASCII characters

(SN.NNNNNESNN)

<STATUS> ::= 0: Normal Measurement.

1: Analog Bridge is unbalanced.

2: A/D converter not working.

3: Signal source is overloaded.

4: ALC unable to regulate.

 $\langle BIN No. \rangle ::= 0: OUT OF BINS$ 

1: BIN 1

2: BIN 2

3: BIN 3

8: BIN 8

9: BIN 9

10: AUX BIN

#### Note



BIN number data is valid only when the comparator function is set to ON. When the comparator function is set to OFF, the BIN number data isn't output as shown below.

In the talk only mode, the HP 4284A waits for the completion of the handshake before starting the next measurement. The measurement cycle of the HP 4284A depends on the printer's speed.

When the  $\langle STATUS \rangle$  is 1 or 2 the measurement data is 9.9E37. When the  $\langle STATUS \rangle$  is 0, 3, or 4 the actual measurement data are output.

Use the PRINT DISP mode and perform the following steps to print out all of information on the display page except for the softkey labels.

- 1. Connect the HP 4284A to the printer using an HP-IB cable.
- 2. Set the printer to the listen only mode.
- 3. Set the talk only mode to ON from the SYSTEM CONFIG page.
- 4. Press DISPLAY FORMAT to display the MEAS DISPLAY page.
- 5. Move the cursor to the SYS MENU field.
- 6. Press more 1/2.
- 7. Press PRINT DISP.

Use the PRINT DATA mode and perform the following steps to print out the measurement results to the printer.

- Connect the HP 4284A to the printer using an HP-IB cable.
- Set the printer to the listen only mode.
- Set the talk only mode to ON from the SYSTEM CONFIG page.
- Press (DISPLAY FORMAT) to display the MEAS DISPLAY page.
- Move the cursor to the SYS MENU.
- Press more 1/2.
- Press PRINT DATA. The marker will appear at the side of PRINT DATA. The measurement results are sent out to the printer on subsequent measurements.

#### **Keylock Function**

The HP 4284A has keyboard lock-out capability that disables all front panel operation except for the power LINE switch, CONTRAST knob, (TRIGGER) key, and KEYLOCK. This is useful when you don't want the control settings changed, for example, if the HP 4284A is performing bin sorting for a large number of capacitors.

Perform the following steps to disable all front panel operation on the MEAS DISPLAY page.

- 1. Move the cursor to the SYS MENU field.
- 2. Press more 1/2.
- 3. Press KEY LOCK (which is a toggle type softkey). The key mark will be shown on the left side of KEY LOCK, and the Keys locked message will be displayed on the system message line.
- 4. Press KEY LOCK again, when you want to enable all front panel keys again.

## BIN No. DISPLAY Page

When you press (DISPLAY FORMAT), and BIN No., the BIN No. DISPLAY page will be displayed. The bin sorting results are displayed in large characters and the measurement results are displayed in normal characters on the BIN No. DISPLAY page, and the following measurement controls can be set from the BIN No. DISPLAY page. (The field in parenthesis is used when this control is set.)

- Comparator Function ON/OFF (COMP)
- System Menu (SYS MENU)

There are three fields on this page: *All No. DISPLAY*, COMP, and SYS MENU fields.

Each control is described in the following paragraphs.

This page also provides the following information in the monitor areas (each monitor area looks like a field, but is not). These conditions can be set from the MEAS SETUP page, and most conditions can be set from the MEAS DISPLAY page.

- $\blacksquare$  Measurement Function (FUNC)
- $\blacksquare$  Measurement Range (RANGE)
- $\blacksquare$  Test Frequency (FREQ)
- Oscillator Level (*LEVEL*)
- $\blacksquare$  DC Bias (BIAS)
- Integration Time (INTEG)
- OPEN, SHORT, LOAD on/off setting conditions (CORR)

The available fields and the softkeys which correspond to each field on this page are shown in Figure 3-9 and Figure 3-10.

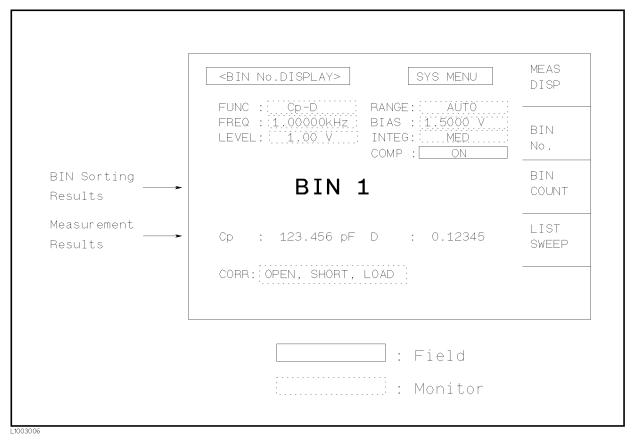


Figure 3-9. Available Fields on the BIN No. DISPLAY Page

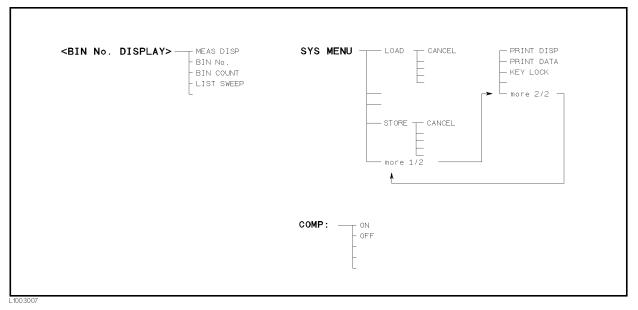


Figure 3-10. Available Softkeys on the BIN No. DISPLAY Page

## Comparator Function ON/OFF

#### Description

The HP 4284A's built-in comparator can sort devices into a maximum of ten bins (BIN 1 to BIN 9 and the OUT OF BINS bin) using a maximum of nine pairs of primary limits and one pair of secondary parameter limits. Also, a device whose primary parameter is within limits, but whose secondary parameter measurement result is not within limits can be sorted into an AUXiliary BIN. The comparator function is especially useful when using the HP 4284A with a component handler (handler interface option is installed). These limit settings for bin sorting are only set on the LIMIT TABLE page under (MEAS SETUP) (refer to the Chapter 4). So this COMP field allows you to only set the comparator function to ON or OFF.

# Front Panel Operation for Setting the Comparator Function to ON or

Perform the following steps to set the comparator function to ON or OFF.

- 1. Move the cursor to the COMP field. The following softkeys will be displayed.
  - ON
  - OFF
- 2. Use the softkeys to set the comparator function to ON or OFF.

### System Menu

The system menu on this page allows you to use the following functions.

- Load/Store
- Printer
- Keylock

These functions are the same as the functions on the system menu on the MEAS DISPLAY page (Refer to page 3-19, "System Menu"). So only the procedure for each function is given in the following paragraphs.

#### Load/Store Function

Perform the following steps to store the control settings to the internal non-volatile memory or the external memory card or load the control settings from the internal non-volatile memory or the external memory card.

- 1. Set all controls.
- 2. ON the BIN No. DISPLAY page move the cursor to the SYS MENU field using the CURSOR keys.

- 3. If you are going to store the settings on a memory card, insert a memory card to the MEMORY card slot.
- 4. Press STORE when you want to use the STORE function. The message Enter record number to STORE will be displayed on the system message line.

Press LOAD when you want to use the LOAD function. Then the Enter record number to LOAD will be displayed on the system message line.

5. Use the numeric entry keys and (ENTER) to enter the record number at which the current control settings will be STORED to or LOADED from.

#### **Printer Function**

Perform the following steps to print out the displayed page or the measurement data using the PRINT DISP mode or PRINT DATA mode.

- 1. Connect the HP 4284A to the printer using an HP-IB cable
- 2. Set the printer to the listen only mode.
- 3. Set the talk only mode to ON on the SYSTEM CONFIG page.
- 4. Press (DISPLAY FORMAT), and press BIN No. to display the BIN No. DISPLAY page.
- 5. Move the cursor to the SYS MENU field.
- 6. Press more 1/2.
- 7. Press PRINT DISP when you want to print out the displayed page. The displayed page is printed out as shown in Figure 3-8.

Press PRINT DATA when you want to print out the measurement data. The marker will appear beside PRINT DATA. The measurement results are printed out on subsequent measurements. <BIN No. DISPLAY> SYS MENU

FUNC : Cp-D RANGE: AUTO FREQ :1.00000MHz BIAS : 1.000 V LEVEL: 1.00 V INTEG: MED

> COMP : ON

B I N6

Cp: 99.9609pF D: .000387

CORR: OPEN, SHORT, LOAD CH: O

Figure 3-11. BIN No. DISPLAY Page Example

## **Keylock Function**

Perform the following steps from the BIN No. DISPLAY page to disable all front panel operation.

- 1. Move the cursor to the  $SYS\ MENU$  field.
- 2. Press more 1/2.
- 3. Press KEY LOCK (which is a toggle type softkey). The key mark will be shown on the left side of KEY LOCK, and the Keys locked message will be displayed on the system message line.
- 4. Press KEY LOCK again to enable all front panel keys.

# **BIN COUNT DISPLAY Page**

When you press (DISPLAY FORMAT) and BIN COUNT, the BIN COUNT DISPLAY page will be displayed. On the BIN COUNT DISPLAY page, the comparator's count results are displayed, and the following measurement controls can be set.

■ System Menu (SYS MENU)

So there are two fields on this page: *<BIN COUNT DISPLAY>* and SYS MENU fields.

The system menu is described in the following paragraphs.

This page also provides the following information in monitor areas (the monitor areas look like fields, but they are not). These conditions can be set from the LIMIT TABLE page. (For more details on the following controls, refer to Chapter 4.)

- Nominal Value
- Measurement Function
- Bin Sorting Low/High Limits

The available fields and the softkeys which corresponded to each field on this page are shown in Figure 3-12 and Figure 3-13.

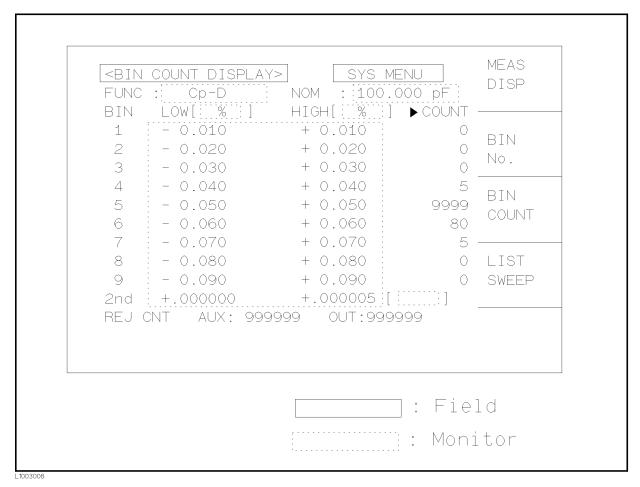


Figure 3-12. Available Fields on the BIN COUNT DISPLAY Page

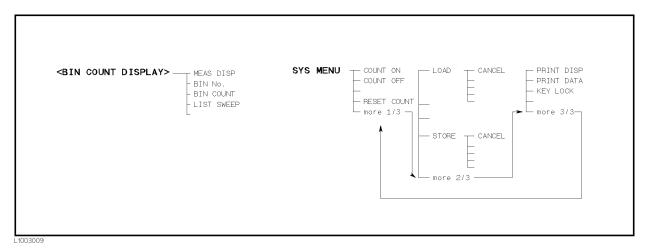


Figure 3-13. Available Softkeys on the BIN COUNT DISPLAY Page

## System Menu

The system menu on this page allows you to perform the following functions.

- Counter ON/OFF
- Load/Store
- Printer
- Keylock

These functions, except for the counter function, are the same as the functions displayed on the system menu of the MEAS DISPLAY page. (Refer to page 3-19, "System Menu") So in the case of the counter function, the description and setting procedures are described in the following paragraphs, for the other functions, only the procedure is described.

#### **Counter Function**

The HP 4284A has bin counting capability. When many devices are being sorted into bins using the comparator function, the number of devices sorted into each bin is counted. The maximum count is 999999, the overflow message "----" will be displayed when this value is exceeded. The bin counter will still be operating, so you can only get the count data via HP-IB.

Perform the following steps to set the counter function to ON or OFF from the BIN COUNT DISPLAY page.

- $\blacksquare$  Move the cursor to SYS MENU field on the BIN COUNTDISPLAY page.
- Press COUNT ON to set the counter function to ON. An arrow will be displayed at the left of COUNT.
- Press COUNT OFF when you want to set the counter function to OFF. The arrow will disappear.
- Press RESET COUNT when all counts are reset to zero. The message RESET COUNT, do you proceed? will be displayed on the system message line, and YES and NO will be displayed. Press YES.

#### **Load/Store Function**

Perform the following steps to store the current control settings to the internal non-volatile memory or the external memory card, and to load the control settings from the internal non-volatile memory or the external memory card.

- 1. Set all controls.
- 2. Move the cursor to the SYS MENU field on the BIN COUNT DISPLAY page.
- 3. Insert a memory card into the MEMORY card slot, if you are going to store or load the settings to or from a memory card.
- 4. Press more 1/3.

- 5. Press STORE when you want to use the STORE function. The message Enter record number to STORE will be displayed on the system message line.
  - Press LOAD when you want to use the LOAD function. Then the Enter record number to LOAD will be displayed on the system message line.
- 6. Use the numeric entry keys and **ENTER** to enter the record number at which the current control settings will be STORED to or LOADED from.

#### **Printer Function**

Use the PRINT DISP or PRINT DATA mode and perform the following steps to print out the display page or the measurement data.

- 1. Connect the HP 4284A to the printer using an HP-IB cable.
- 2. Set the printer to the listen only mode.
- 3. Set the talk only mode to ON on the SYSTEM CONFIG page.
- 4. Press DISPLAY FORMAT, and press BIN COUNT to display the BIN COUNT DISPLAY page.
- 5. Move the cursor to the SYS MENU field.
- 6. Press more 1/3 and then press more 2/3.
- 7. Press PRINT DISP when you want to print out the displayed page. Figure 3-10 shows a sample print out of the display page.

Press PRINT DATA when you want to print out the measurement results. The marker will appear beside PRINT DATA. The measurement results are printed out on subsequent measurements.

```
<BIN COUNT DISPLAY>
                        SYS MENU
                NOM : 100.000pF
FUNC:
        Cp-D
BIN LOW [ % ] HIGH[ % ] >COUNT
                 0.001
                               0
       0.001
               + 0.003
                               0
       0.003
       0.005
               + 0.005
                               0
       0.010
                 0.010
                               0
       0.030
               + 0.030
                               0
               + 0.050
                              76
       0.050
       0.100
               + 0.100
                               0
       0.500
                 0.500
       1.000
               + 1.000
               +.000300
2nd +.000000
REJ CNT AUX: 12
                     OUT: 38
```

Figure 3-14. BIN COUNT DISPLAY Page Example

#### **Keylock Function**

Perform the following steps to disable all front panel operations on the BIN COUNT DISPLAY page.

- $\blacksquare$  Move the cursor to the SYS MENU field.
- Press more 1/3. and press more 2/3.
- Press KEY LOCK (a toggle type softkey). The key mark will be displayed on the left side of KEY LOCK, and the message Keys locked will be displayed on the system message line.
- Press KEY LOCK again, if you want to enable the front panel keys.

## LIST SWEEP **DISPLAY Page**

The HP 4284A's LIST SWEEP function permits entry of up to ten frequencies, signal levels, or DC bias levels, and the measurement limits on the LIST SWEEP SETUP page under the MEAS SETUP page. These points are automatically swept and the measurement results are compared to the limits set. When you press (DISPLAY FORMAT) and LIST SWEEP, the LIST SWEEP DISPLAY page will be displayed. On the LIST SWEEP DISPLAY page, the sweep points are swept and the measurement results are compared to the limits. During a sweep, an asterisk mark (\*) will appears on the left side of the current measuring list sweep point. The following measurement controls can be set from this page. (Each field in parenthesis is used when that control is set.)

- $\blacksquare$  Sweep Mode of the List sweep Measurement (MODE)
- System Menu (SYS MENU)

So there are three fields on this page: *<LIST SWEEP DISPLAY>*, MODE, and SYS MENU fields.

The system menu is described in the following paragraphs.

The list sweep point can not be set from this page, but can only be set from the LIST SWEEP SETUP page.

The available fields and the softkeys which corresponded to each field on this page are shown in Figure 3-15 and Figure 3-16.

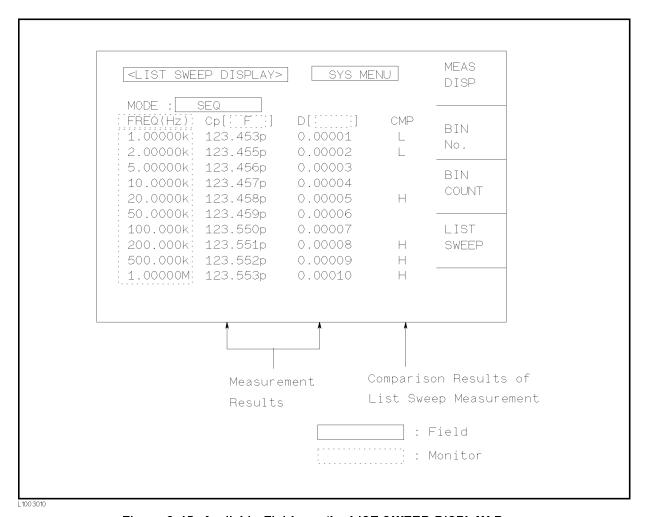


Figure 3-15. Available Fields on the LIST SWEEP DISPLAY Page

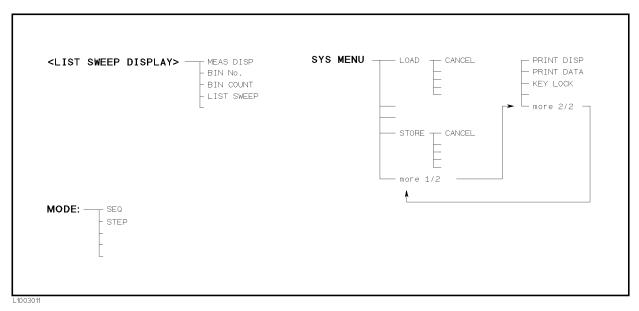


Figure 3-16. Available Softkeys on the LIST SWEEP DISPLAY Page

## **Sweep Mode**

The HP 4284A's List Sweep Measurement function permits up to 10 test frequencies, oscillator levels, or DC bias points to be automatically measured. There are two measurement modes for list sweep measurements: sequential (SEQ) mode and step (STEP) mode. In the case of SEQ mode, when the HP 4284A is triggered once, all sweep points are automatically swept. In the case of the STEP mode, each time the HP 4284A is triggered the sweep point is swept by one step.

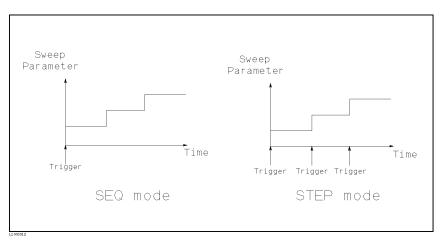


Figure 3-17. SEQ Mode and STEP Mode

Note



When two or more sweep points are the same, and are adjacent the HP 4284A measures the device once, and then the measurement result is compared to limits set for each sweep point.

### Front Panel Operation for Setting the Sweep Mode of the List Sweep Measurement

Perform the following steps to set the list sweep measurement mode to the SEQ or STEP modes.

- 1. Move the cursor to the MODE field. The following softkeys will be displayed.
  - SEQ
  - STEP
- 2. Use the softkeys to select and set the list sweep measurement mode (SEQ or STEP mode).

## System Menu

The system menu on this page allows you to perform the following functions.

- Load/Store
- Printer
- Keylock

These functions are the same as the functions of the system menu on the MEAS DISPLAY page. (Refer to "System Menu" on page 3-19) So only the procedure is given for each function.

#### Load/Store Function

Perform the following steps to store the control settings in the internal non-volatile memory or in an external memory card.

- 1. Set all controls.
- 2. Move the cursor to the SYS MENU field.
- 3. Insert a memory card to the MEMORY card slot, if you are going to store the settings in a memory card.
- 4. Press STORE. The message Enter record number to STORE will be displayed on the system message line.
- 5. Use the entry keys and (ENTER) to enter the record number where the current control setting are to be stored. When the data is to be stored in the internal EEPROM, record numbers 0 to 9 are used, and when the record is stored in a memory card, record numbers 10 to 19 are used.

Perform the following steps to load the control settings from the internal non-volatile memory or from an external memory card.

- 1. Move the cursor to the SYS MENU field.
- 2. Insert the appropriate memory card into the MEMORY card slot, if you are going to load the settings from a memory card.
- 3. Press LOAD. The message Enter record number to LOAD will be displayed on the system message line.

4. Enter the record number using the numeric entry keys and ENTER.

#### **Printer Function**

Perform the following steps to print out the display page or to list sweep measurement results using the PRINT DISP mode or PRINT DATA mode.

- 1. Connect the HP 4284A to the printer using an HP-IB cable.
- 2. Set the printer to the listen only mode.
- 3. Set the talk only mode to ON from the SYSTEM CONFIG page.
- 4. Press DISPLAY FORMAT, and press LIST SWEEP to display the LIST SWEEP DISPLAY page.
- 5. Move the cursor to the SYS MENU field.
- 6. Press more 1/2.
- 7. Press PRINT DISP to print out the display page. The displayed page will be printed out as shown in Figure 3-18.

<list s<="" th=""><th>WEEP DISPLAY:</th><th>&gt; SYS</th><th>MENU</th></list>	WEEP DISPLAY:	> SYS	MENU
MODE : :	SEQ		
FREQ[H:	z] Cp[F]	D[ ]	CMP
1.0000	0k 99.6257p	.008338	L
2.0000	0k 99.8398p	.003280	L
3.0000	0k 99.8841p	.002077	L
4.0000	0k 99.9033p	.001570	
5.0000	0k 99.9187p	.001228	
6.0000	0k 100.021p	.000936	
6.9444	4k 100.016p	.000787	
8.0000	0k 100.002p	.000691	
8.9285	7k 100.015p	.000646	
10.000	0k 100.014p	.000810	

Figure 3-18. LIST SWEEP DISPLAY Page Example

Press PRINT DATA to print out the measurement results. A marker will appear beside PRINT DATA. The measurement results will be printed out on subsequent measurements according to the following data format. (This format is as same as the ASCII format of the data transfer via HP-IB. For more details, refer to Chapter 7.)

```
<DATA A>,<DATA B>,<STATUS>,<IN/OUT><CR><LF>
<DATA A>::= The measurement results of the main parameter (|Z|, |Y|, C, L, R, G).
12 ASCII characters (SN.NNNNNESNN)
```

<DATA B>::= Measurement results of the sub parameter  $(\theta, D,$ 

Q, G, Rs, X, B).

12 ASCII characters (SN.NNNNNESNN)

<STATUS>::= 0: Normal Measurement.

1: Analog Bridge is unbalance.

2: A/D converter doesn't work.

3: Signal source overload.

4: ALC unable to regulate.

<IN/OUT>::= -1: LOW

0: IN

1: HIGH

#### Note



When the sequential sweep mode is used, the above formats are repeated at each sweep point.

When the  $\langle STATUS \rangle$  is 1 or 2, 9.9E37 is output as the measurement data. When the <STATUS> is 0, 3, or 4, the actual measurement results are output.

#### **Keylock Function**

Perform the following steps from the LIST SWEEP DISPLAY page to disable all front panel operation.

- 1. Move the cursor to the SYS MENU field.
- 2. Press more 1/2.
- 3. Press KEY LOCK (a toggle type softkey). A key symbol will be displayed on the left side of KEY LOCK, and the Keys locked message will be displayed on the system message line.
- 4. Press KEY LOCK again, if you want to enable all front panel keys.

## **MEAS SETUP Menu**

## Introduction

This Chapter provides information for each page's function under (MEAS SETUP). (MEAS SETUP) have four display pages as listed below.

- $\blacksquare$  MEAS SETUP
- $\blacksquare$  CORRECTION
- LIMIT TABLE SETUP
- LIST SWEEP SETUP

This Chapter describes each function of each page in the order of the preceding list.

# **MEAS SETUP** page

When you press (MEAS SETUP), the MEAS SETUP page will be displayed. On this MEAS SETUP page, all of the following measurement control functions can be set. (Each field in parenthesis is used when each control is set.)

- Comment Line (comment line)
- Measurement Function (FUNC)
- Measurement Range (RANGE)
- Test Frequency (FREQ)
- Oscillator Level (LEVEL)
- DC Bias (BIAS)
- Integration Time (INTEG)
- Trigger Mode (TRIG)
- Automatic Level Control (ALC)
- High Power Mode ON/OFF (*Hi-PW*)
- Bias Current Isolation Mode ON/OFF (DCI:ISO)
- $\blacksquare$  Averaging Rate (AVG)
- Voltage Level Monitor ON/OFF (Vm)
- Current Level Monitor ON/OFF (Im)
- Delay Time (DELAY)
- System Menu (SYS MENU)
- Deviation Measurement A Mode (DEV A)
- Deviation Measurement B Mode (DEV) B)
- Reference Value for the Deviation Measurement A (REF A)
- $\blacksquare$  Reference Value for the Deviation Measurement B (REF) B)

Some fields on the MEAS SETUP page are the same as the fields on the MEAS DISPLAY page as follows. So, these fields are not described in this Chapter, and the other functions on the MEAS SETUP page are described in the following paragraphs.

- $\blacksquare$  Measurement Function (FUNC)
- Measurement Range (RANGE)
- Test Frequency (FREQ)
- $\blacksquare$  Oscillator Level (LEVEL)
- $\blacksquare$  DC Bias (BIAS)
- Integration Time (INTEG)

The available fields and the softkeys which corresponded to each field on this page are shown in Figure 4-1 and Figure 4-2.

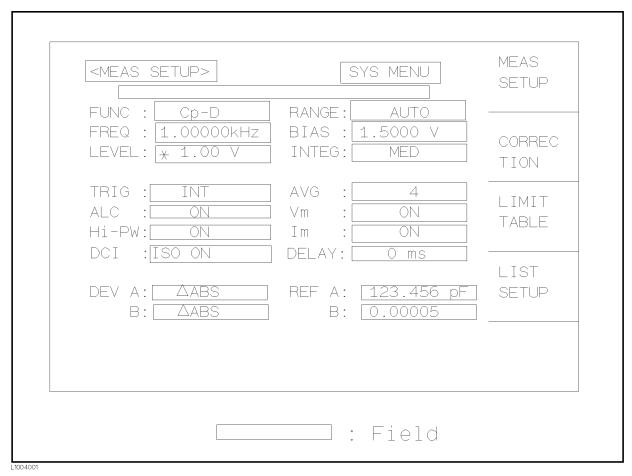


Figure 4-1. Available Fields on the MEAS SETUP Page

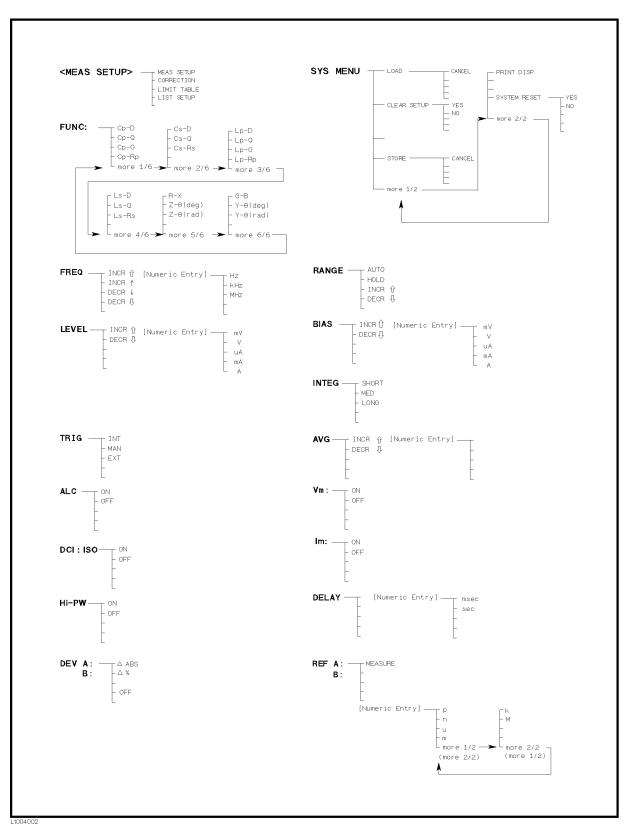


Figure 4-2. Available Softkeys on the MEAS SETUP Page

#### Comment

#### Description

You can enter a comment using the numeric entry keys (0) to (9), (-) (minus), () (period)) on the comment line field. This comment line is stored to the internal non-volatile memory or to the external memory card with the HP 4284A control settings. Also this comment line is loaded from the internal non-volatile memory or from the external memory card with the control settings. A comment can be up to 30 characters long.

#### Note



When you want to enter the ASCII characters on the comment line, only the DISPlay:LINE HP-IB command must be sent via HP-IB.

#### Front Panel Operation for Entering a Comment Number

Perform the following steps to enter a comment.

- 1. Move the cursor to the comment line field.
- 2. Enter the comment using the numeric entry keys, then press (ENTER).

## **Trigger Mode**

#### Description

The HP 4284A has four trigger modes: INTernal, EXTernal, MANual, and BUS.

When the trigger mode is set to INT trigger mode, the HP 4284A continuously repeats measurements on any display page under (DISPLAY FORMAT).

When the trigger mode is set to MAN trigger mode, the HP 4284A performs a single measurement on any display page under (DISPLAY FORMAT) every time (TRIGGER) on the front panel is pressed.

When the trigger mode is set to EXT trigger mode, the HP 4284A performs a single measurement on any display page under (DISPLAY FORMAT) every time a positive going TTL pulse is applied to the EXT TRIGGER connector on the rear panel. External triggering can be also be achieved by momentarily switching the center conductor of the EXT TRIGGER connector to chassis ground (center conductor circuit contains a pull-up resistor). Figure 4-3 shows the required TTL pulse.

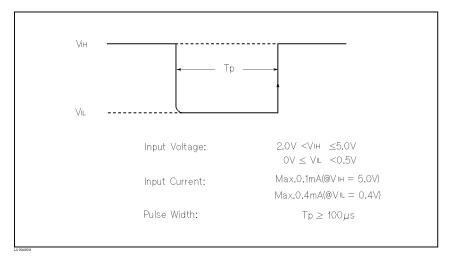


Figure 4-3. External Trigger Pulse

Note



The HP 4284A ignores triggers that are applied while a measurement is in progress. Trigger the HP 4284A after the measurement is completed.

Select the EXT trigger mode when the HP 4284A is triggered via an optional interface.

When the trigger mode is set to BUS trigger mode, the HP 4284A performs a single measurement every time the TRIGGER command is sent to the HP 4284A via HP-IB. Then the BUS trigger mode cannot be set on the front panel.

#### Front Panel Operation for Setting the Trigger Mode

Perform the following steps to set the trigger mode except for in the BUS TRIG mode. To set the trigger mode in the BUS TRIG mode, the TRIGger: SOURce BUS command should be sent via HP-IB.

- 1. Move the cursor to the TRIG field. The following softkeys will be displayed.
  - INT
  - MAN
  - EXT
- 2. Set the trigger mode using the softkeys.

# Automatic Level Control Function

### Description

The automatic level control (ALC) function regulates the actual test level (voltage across the DUT, or current through the DUT) to your desired level. So by using this function, the test signal voltage or current level at the DUT can be held constant.

When the automatic level control function is used, the oscillator level settings are limited as follows.

■ When Option 001 is not installed, or the high power mode is set to OFF

Voltage Level:  $10~{\rm mV_{rms}}$  to  $1~{\rm V_{rms}}$  Current Level:  $100~\mu{\rm A_{rms}}$  to  $10~{\rm mA_{rms}}$ 

■ When the high power mode is set to ON

Voltage Level:  $10~\mathrm{mV_{rms}}$  to  $10~\mathrm{V_{rms}}$  Current Level:  $100~\mu\mathrm{A_{rms}}$  to  $100~\mathrm{mA_{rms}}$ 

Note



When the ALC function is active, if the oscillator level setting exceeds the above limits, the ALC function is automatically set to OFF and the setting value is entered as a normal oscillator level.

Note



The automatic level control is achieved using feedback with the level monitor function as shown in Figure 4-4. The feedback operation performs a level measurement/OSC level adjustment 2 to 6 times per measurement. (The time required (n in the following formula) depends on the device being tested. The more non-linear the device is, the greater the time required.) When the ALC function can't regulate the level using 6 output level measurement/adjustment cycles (when a device has non-linear characteristics, the ALC function may stop before the 6 output level measurement/adjustment cycles), the ALC function stops, and a warning message ALC unable to regulate is displayed, and sets the oscillator level to equal your setting value, open-loop, the output level will be the same as when ALC is set to OFF. The time required for the ALC function to operate is calculated using the following formula.

(meas.time (SHORT) + approx. 115 msec.)  $\times$  n Where, n = 2 (min.) n = 6 (max.)

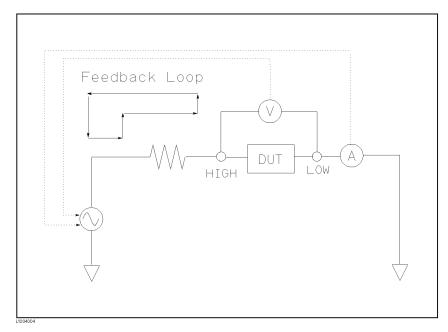


Figure 4-4. Feedback Circuit

The available operation range for the ALC function is shown in Figure 4-5. The solid line shows the operation range for a resistor as the DUT, and the dotted line shows the operation range for a capacitor or inductor as the DUT.

The uncertainty of the limitation of the operating range is:

Hi-PW mode: off  $\pm$  13% Hi-PW mode: on  $\pm$  16%

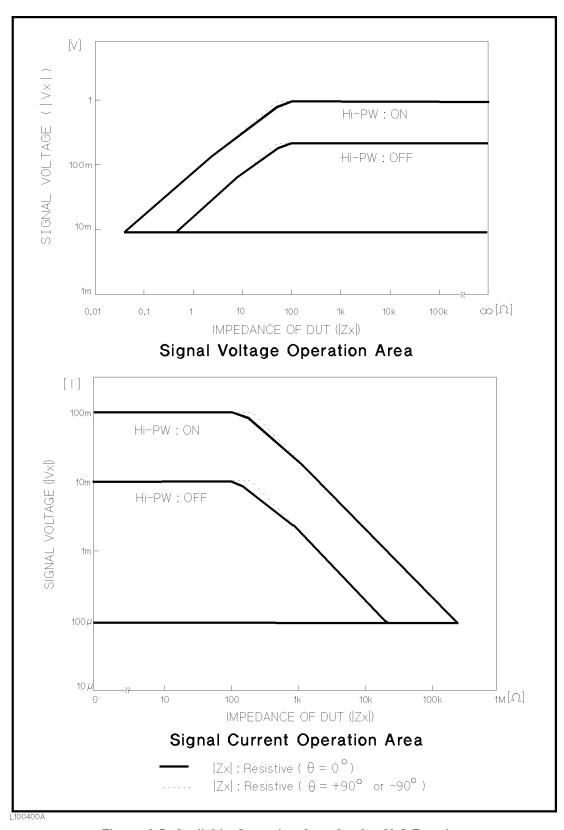


Figure 4-5. Available Operating Area for the ALC Function

#### Front Panel Operation for Setting the Automatic Level Control Function

Perform the following steps to set the automatic level control function to ON or OFF.

- 1. Move the cursor to the ALC field. The following softkeys will be displayed.
  - 0N
  - OFF
- 2. Press ON to set the automatic level control function to ON. Press OFF to set the automatic level control function OFF.

## **High Power Mode**

#### Description (Refer to Appendix G.)

When Option 001 (Power Amplifier/DC Bias) is installed, the oscillator level can be set from the 5 mV<sub>rms</sub> to 20 V<sub>rms</sub>, and from 50  $\mu$ A<sub>rms</sub> to 200 mA<sub>rms</sub>, and also the dc bias can be set up to  $\pm 40$  V. The Hi-PW field allows you to make Option 001 valid or invalid. So if the high power mode is set to OFF, the oscillator level or the dc bias controls are the same as the oscillator level or the dc bias controls of an HP 4284A without Option 001.

Note



When Option 001 is installed, the power-on default setting of the high power mode is ON.

When the low test signal level measurement is performed without using dc bias, the measurement value at the high power mode: OFF may be more stable than the measurement value at the high power mode: ON.

Note



When the HP 42841A is connected to the HP 4284A, the high power mode is set to OFF, and Option 001 is disabled.

#### Front Panel Operation for Setting the High Power Mode

Perform the following steps to set the high power mode to ON or OFF when Option 001 is installed.

- 1. Move the cursor to the Hi-PW field. The following softkeys will be displayed.
  - ON
  - OFF
- 2. Press ON to set the high power mode to ON. Press OFF to set the high power mode to OFF.

# Bias Current Isolation Function

## Description (Refer to Appendix G.)

When Option 001 (Power Amplifier/DC Bias is installed, the dc bias can be set up to  $\pm 40$  V. The dc bias current through the device under test can be calculated using the following formula.

$$\begin{split} I_{\mathrm{dc}} &= \frac{V \mathrm{s}}{100 + R_{\mathrm{dc}}} \\ &= \frac{I \mathrm{s} \times 100}{100 + R_{\mathrm{dc}}} \end{split}$$

Where, Idc: Actual Bias Current [A]

Rdc: DUT's DC resistance  $[\Omega]$ 

Vs: Setting Value of the dc bias [V]

Is: Setting Value of the dc bias [A]

This bias current isolation function prevents the DC current from affecting the measurement input circuit. The *DCI:ISO* field allows you to set the bias current isolation function to ON or OFF. When the bias current isolation function is set to ON, the bias current through the device can be up to 100 mA. When the bias current isolation function is set to OFF, the current through the device can be set to the values listed in Table 4-1. When the current through a device exceeds the values listed in Table 4-1, normal measurement can't be performed.

Table 4-1. Maximum DC Bias Current

Measurement Range	$100\Omega$	$300\Omega$	1 kΩ	3 kΩ	10 kΩ	30 kΩ	100 kΩ
Max. current	2 mA	2 mA	1 mA	$300~\mu\mathrm{A}$	$100~\mu\mathrm{A}$	$30~\mu\mathrm{A}$	10 μA

Note



The bias current isolation function influences the measurement accuracy. (Refer to "Relative Measurement Accuracy with Bias Current Isolation" in Chapter 9.) So when measuring a high impedance device at low frequency with low bias current, the bias current isolation function should be set to OFF.

#### Front Panel Operation for Setting the Bias Current Isolation Function

Perform the following steps to set the bias current isolation function to ON or OFF when high power mode is set to ON.

- 1. Move the cursor to the DCI:ISO field. The following softkeys will be displayed.
  - 0N
  - OFF

2. Press ON to set the bias current isolation function to ON. Press OFF to set the bias current isolation function to OFF.

## **Averaging Rate**

#### Description

The HP 4284A's averaging rate function arithmetically averages the results of two or more A/D conversions. (The A/D conversion time can be set in the INTEG field.) The number of conversions averaged can be set from 1 to 256, in steps of 1.

#### Front Panel Operation for Setting the Averaging Rate

Perform the following steps to set the averaging rate.

- 1. Move the cursor to the AVG field. The following softkeys will be displayed.
  - INCR ↑

This softkey is used to increment the averaging rate. (1, 2, 4, 8, 16, 32, 64, 128, and 256)

■ DECR ↓

This softkey is used to decrement the averaging rate. (1, 2, 4, 8, 16, 32, 64, 128, and 256)

2. Use the softkeys to set the averaging rate, or enter the averaging rate using the numeric entry keys, and (ENTER).

## **Delay Time**

#### Description (Refer to Appendix G.)

The HP 4284A's delay time function allows you to set a trigger delay so the HP 4284A will delay the start of the measurement after it is triggered. (When the list sweep measurement is performed, the HP 4284A will delay the start of the measurement at each sweep point using the trigger delay time.) The trigger delay time can be set from 0 s to 60 s in 1 ms steps. This function is useful if a component handler triggers the HP 4284A before stable contact is made with the device under test (DUT).

#### Front Panel Operation for Setting the Delay Time

Perform the following steps to set the delay time.

- 1. Move the cursor to the *DELAY* field.
- 2. Enter the delay time using the numeric entry keys. When one of the numeric entry keys is pressed, the following unit softkeys will be displayed, these can be used instead of (ENTER).
  - msec
  - sec

#### **Level Monitor Function**

#### Description

The level monitor function allows you to monitor the actual voltage level across the device under test or the actual current level though the device under test. The voltage monitor value is only displayed on the MEAS DISPLAY page at Vm monitor area. The current monitor value is only displayed on the MEAS DISPLAY page at Im monitor area.

#### Note



The correction function interacts with the level monitor function. So the monitor value may be changed by the correction data change or the OPEN/SHORT/LOAD correction ON/OFF condition change.

#### Front Panel Operation for Setting the Level Monitor Function

Perform the following steps to set the level monitor function to ON or OFF.

- 1. Move the cursor to the  $V_m$  field. The following softkeys will be displayed.
  - 0N
  - 0FF
- 2. Press ON to set the voltage level monitor function to ON. Press OFF to set the voltage level monitor function to off.
- 3. Move the cursor to the Im field. The following softkeys will be displayed.
  - ON
  - 0FF
- 4. Press ON to set the current level monitor function to ON. Press OFF to set the current level monitor function to OFF.

## **Deviation Measurement Function**

#### **Description**

The deviation measurement function allows you to display the deviation value instead of the actual measurement value. The deviation value is the value calculated by taking the difference between the actual measurement value and a previously stored reference value. This function is useful when the change of a component's value versus changes in temperature, frequency, bias, etc. are being observed. Deviation measurements can be made for either or both primary parameter and/or secondary parameter measurements. There are two types of deviation measurements.

■ △ABS (Delta ABSolute) deviation measurement

The difference between the measured value of the DUT and a previously stored reference value are displayed. The formula used to calculate the deviation is as follows.

 $\Delta ABS = X - Y$ 

Where, X: The measured value of the DUT

Y: The stored reference value

 $\blacksquare$   $\Delta\%$  (Delta percent) deviation measurement

The difference between the measured value of the DUT and a previously stored reference value are displayed as a percentage of the reference value. The formula used to calculate the percent deviation is as follows.

 $\Delta\% = (X - Y) / Y \times 100 [\%]$ 

Where, X: The measured value of the DUT

Y: The stored reference value

# Front Panel Operation for the Deviation Measurement Function

Perform the following steps to execute the deviation measurement function.

1. Move the cursor to the *REF A* field to enter the reference value for the primary parameter. The following softkey will be displayed.

#### ■ MEA-SURE

When the device which has a reference value is connected, pressing this MEA-SURE, the HP 4284A measures the device, and the measurement results are entered as a reference value for REF A and REF B values.

- 2. Enter the reference value for the primary parameter using MEA-SURE or the numeric entry keys.
- 3. Move the cursor to the (REF) B field to enter the reference value for the secondary parameter. The following softkey will be displayed.

### ■ MEA-SURE

When the device is to be used as the reference value is connected, MEA-SURE is pressed, the HP 4284A measures the device, and the measurement results are entered as a reference value for REF A and REF B values.

- 4. Enter the reference value for the secondary parameter using MEA-SURE or the numeric entry keys. If the reference values for A and B are entered using MEA-SURE in step 2, skip this step.
- 5. Move the cursor to the DEVA field. The following softkeys will be displayed.

- A ABS
- A %
- OFF
- 6. Select and press a softkey to select the deviation mode for the primary parameter.
- 7. Move the cursor to the (DEV) B field. The following softkeys will be displayed.
  - A ABS
  - ∆ %
  - 0FF
- 8. Select and press a softkey to select the deviation mode for the secondary parameter.

# System Menu

The system menu on this page allows you to perform the following control functions.

- Load/Store
- Clear Setup
- Printer
- System Reset

These functions, except for the clear setup function and system reset function, are the same as the functions on the system menu on the *MEAS DISPLAY* page. (The description of each function is given on page 3-19, system menu.) So in the case of the clear setup function and the system reset function, the description and setting procedure are given, while in the case of the other functions, only the procedure is given.

# Load/Store Function

Perform the following steps on the *MEAS SETUP* page to store the control settings to the internal non-volatile memory or the external memory card, or to load the control settings from the internal non-volatile memory or the external memory card.

- 1. Set all controls.
- 2. Move the cursor to the  $SYS\ MENU$  field on the  $MEAS\ SETUP$  page.
- 3. If you are using a memory card insert the memory card into the MEMORY card slot.
- 4. Press STORE when you want to use the store function. The message Enter record number to STORE will be displayed on the system message line.

Press LOAD when you want to use the load function. The message Enter record number to LOAD will be displayed on the system message line.

5. Enter the record number using the numeric entry keys and ENTER to store the current control settings, or load the control settings.

# **Clear Setup Function**

This function allows you to set all of the operation on the MEAS SETUP page to the power on default settings. The control settings on the other pages are not initialized. Figure 4-6 shows the MEAS SETUP page after performing the clear setup function.

LOAD <MEAS SETUP> SYS MENU FUNC : Cp-D RANGE: **AUTO** FREQ: 1.00000kHz BIAS : 0.000 V CLEAR LEVEL: 1.00 V INTEG: MED SETUP TRIG : INT AVG 1 ALC : OFF Vm ON OFF Hi-PW: ON DCI : ISO OFF DELAY: 0 ms STORE DEV A: OFF REF A: 0.00000 F B: OFF B: 0.00000 more 1/2

Hi-PW: ON (When Option 001 is installed)

Figure 4-6. MEAS SETUP page After Clearing the Setup

Perform the following steps to set only all of the operations on the  $MEAS\ SETUP$  page to the power on default settings.

- 1. Move the cursor to the  $SYS\ MENU$  field.
- 2. Press CLEAR SETUP. The message Clearing setup. Are you sure? will be displayed, and the following softkeys will be displayed.
  - YES
  - NO
- 3. Press YES to set all of the control settings on the MEAS SETUP page to the power-on default settings.

#### **Printer Function**

Perform the following steps to print out the display page using the PRINT DISP mode.

- 1. Connect a printer to the HP 4284A using an HP-IB cable.
- 2. Set the printer to the Listen Only mode.
- 3. Set the Talk Only mode to ON from the SYSTEM CONFIG page.
- 4. Press (MEAS SETUP) to display the MEAS SETUP page.
- 5. Move the cursor to the SYS MENU field.
- 6. Press more 1/2.
- 7. Press PRINT DISP. The display page will be printed out to the printer as shown below.

<meas display=""></meas>	SYS MENU
FREQ :1.00000kHz BI	ANGE: AUTO IAS: 0.000 V NTEG: MED
ALC : OFF Vm Hi-Pw: ON Im	VG : 1 m : ON m : ON ELAY: Oms
	A: 10.0000pF B: 500.000u

Figure 4-7. MEAS SETUP page Example

# **SYSTEM RESET Function**

This function allows you to set all of the control settings to the power-on default values. (For more detail information about the default settings, refer to Appendix C.)

Perform the following steps to execute the SYSTEM RESET function.

- 1. Move the cursor to the SYS MENU field on the MEAS SETUP page.
- 2. Press more 1/2.
- 3. Press SYSTEM RESET. The message Resetting system, Are you sure? will be displayed, and the following softkeys will be displayed.
  - YES
  - NO

 $4 \cdot \text{ Press}$  YES to reset the HP 4284A.

# **CORRECTION Page**

When you press MEAS SETUP, and CORRECTION, the CORRECTION page will be displayed. On the CORRECTION page, the OPEN, SHORT, LOAD correction for correcting the stray admittance, the residual impedance, and the other errors can be performed, and also the cable length can be selected. The correction function has two kinds of correction methods. In one method the open and short correction can be performed at all of the frequency points using the interpolation method, and in the other method the open, short, and load correction can be performed at the frequency points you specify.

The following operations can be performed from this page. The field is in parenthesis.

- OPEN Correction (OPEN)
- SHORT Correction (SHORT)
- LOAD Correction (LOAD)
- Cable Length Selection (CABLE)
- Multi/Single Correction Mode Selection (MODE)
- $\blacksquare$  Measurement Function for LOAD Correction (FUNC)
- Frequency 1, 2, 3 for OPEN, SHORT, LOAD Correction (FREQ1, FREQ2, and FREQ3)
- Reference Values (A, B) at each three frequencies for LOAD Correction (REF A, B)
- Cable Length Selection (CABLE)
- System Menu (SYS MENU)

There are seventeen available fields on this page: < CORRECTION>,  $SYS\ MENU$ , OPEN, SHORT, LOAD, CABLE, MODE, FUNC, FREQ1,  $REF\ A$ , B, FREQ2,  $REF\ A$ , B, FREQ3,  $REF\ A$ , and B.

These controls are described in the following paragraphs.

This page also provides the following monitor information (the monitor area looks like a field, but it is not).

- Actual Measurement Values for LOAD Correction
- Channel Number on the MULTI Correction Mode

The actual measurement values for LOAD Correction can be measured from the FREQ1, FREQ2, or FREQ3 fields on this page, and the channel number can be set using the scanner interface connector or HP-IB.

The available fields and the softkeys which are corresponded with each field on this page are shown in Figure 4-8 and Figure 4-9.

<pre><correction> OPEN : ON SHORT: ON</correction></pre>	SYS MENU  CABLE: 0 m  MODE: MULTI	MEAS SETUP
LOAD : ON	CH No.: 100 FUNC: Cp-D	CORREC TION
FREQ1: 1.00000kHz REF A: 100.000pF MEA A: 100.001pF FREQ2: 10.0000kHz	B: 0.00010 B: 0.00011	LIMIT TABLE
REF A: 100.020pF MEA A: 100.021pF FREQ3: 100.000kHz	B: 0.00013	LIST SETUP
REF A: 100.040pF MEA A: 100.041pF	B: 0.00014 B: 0.00015	
	: Field	

Figure 4-8. Available Fields on the CORRECTION Page

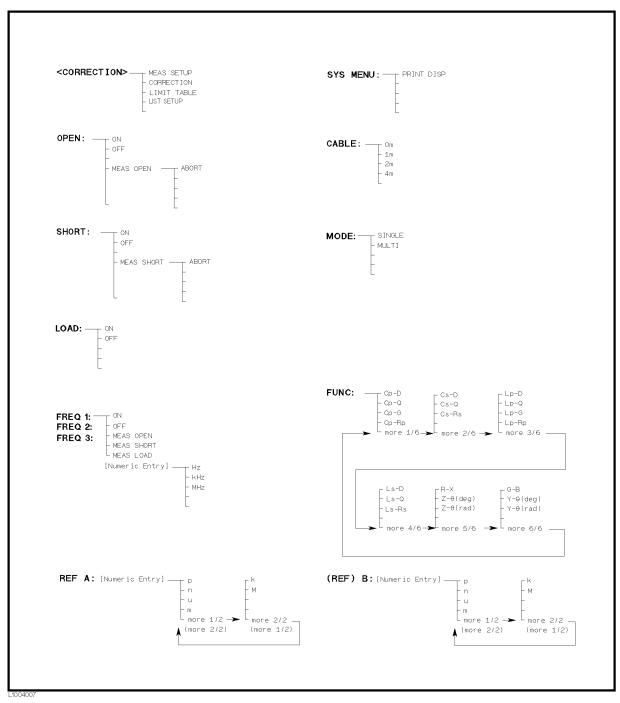


Figure 4-9. Available Softkeys on the CORRECTION Page

# **OPEN Correction**

### Description

The HP 4284A's OPEN correction capability cancels errors due to the stray admittance (G, B) in parallel with the device under test (Refer to Figure 4-10).

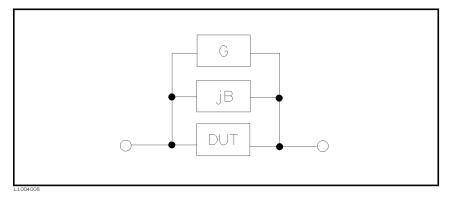
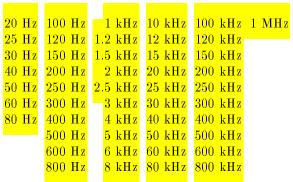


Figure 4-10. Stray Admittance

The HP 4284A uses two kinds of OPEN correction data as follows.

■ The OPEN correction data is taken at all 48 preset frequency points, independent of the test frequency you set. Except for those 48 frequency points, the OPEN correction data for each measurement point over the specified range is calculated using the interpolation method (Refer to Figure 4-11 in the next page). The following is a list of the 48 preset frequency points.



To take the OPEN correction data at the preset frequencies, MEAS OPEN displayed when the cursor is moved to the *OPEN* field, is used.

■ The OPEN correction data which is taken at the frequency points you specify allows you to set up to three frequency points in the FREQ1, FREQ2, and FREQ3 fields. To take the OPEN correction data at the frequency points you specify, MEAS OPEN displayed when the cursor is moved to the FREQ1, FREQ2, or FREQ3 field, is used.

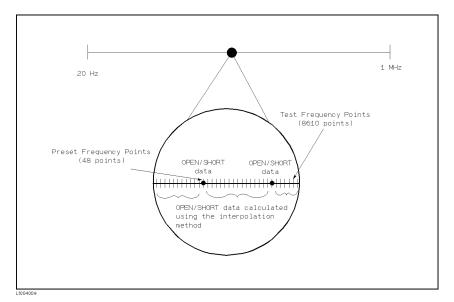


Figure 4-11. OPEN/SHORT Correction Using The Interpolation Method

# Front Panel Operation for the Open Correction

There are two procedures: OPEN correction using the interpolation method, and OPEN correction at the frequency points you specify.

Perform the following steps to execute the OPEN correction at all frequency points using the interpolation method. When you want to execute the OPEN correction at a single frequency point, refer to "LOAD Correction".

- 1. Move the cursor to the OPEN field. The following softkeys will be displayed.
  - ON
  - 0FF
  - MEAS OPEN
- 2. Connect your test fixture to the UNKNOWN Terminals without connecting the device under test.
- 3. Press MEAS OPEN. The HP 4284A will measure the OPEN admittance (capacitance, and inductance) at the preset frequency points. The time required to measure the open correction data is approximately 90 s. During the OPEN correction measurement, the following softkey is available.

### ■ ABORT

This softkey is used to stop an OPEN correction data measurement. The previous OPEN correction data will still be stored.

4. Press ON to perform the OPEN correction calculations on subsequent measurements using the OPEN interpolation

correction data when the FREQ1, FREQ2, and FREQ3 fields are set to OFF.

When the FREQ1, FREQ2, and FREQ3 fields are set to ON, and the test frequency is equal to FREQ1/2/3, the OPEN correction data at FREQ1/2/3 is used. (Refer to APPENDIX D.)

5. Press OFF not to perform the OPEN correction calculations on subsequent measurements.

# **SHORT Correction**

# Description

The HP 4284A's SHORT correction capability corrects for the residual impedance (R, X) in serial with the device under test (Refer to Figure 4-12).

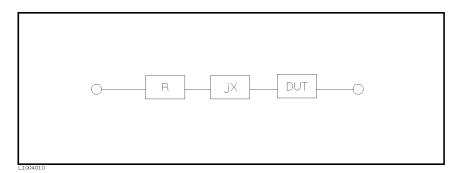


Figure 4-12. Residual Impedance

The HP 4284A uses the following two kinds of SHORT correction data.

■ The SHORT correction data is taken at all 48 preset frequency points independent of the test frequency(ies) you set, and the SHORT correction data for each measurement point other than those present frequency points are calculated using the interpolation method(Refer to Figure 4-11). All preset frequency points (48 frequency points) are as same as the preset frequencies for the OPEN correction using the interpolation method.

To take the SHORT correction data at the preset frequency points, MEAS SHORT, which is displayed when the cursor is moved to the SHORT field, is used.

■ The SHORT correction data which is taken at the frequency points you specify. You can set up to three frequency points in the FREQ1, FREQ2, and FREQ3 fields.

To take the SHORT correction data at the frequency points you specify, MEAS SHORT, which is displayed when the cursor is moved to the FREQ1, FREQ2, or FREQ3 field, is used.

# Front Panel Operation for the Short Correction

There are two procedures: SHORT correction at all frequency points, and SHORT correction at user specified frequency points.

Perform the following steps to execute the SHORT correction for all frequency points. When you want to execute the short correction at the user specified frequency points, refer to "LOAD Correction".

- 1. Move the cursor to the *SHORT* field. The following softkeys will be displayed.
  - 0N
  - 0FF
  - MEAS SHORT
- 2. Connect the test fixture to the UNKNOWN Terminals, and short the measurement contacts together.

Press MEAS SHORT. The HP 4284A will measure the short impedance (inductance and resistance) at the preset frequency points. The time required to measure the short correction data is approximately 90 s. During the SHORT correction measure cycle, the following softkey is available.

# ■ ABORT

This softkey is used to stop the short correction data measurement. The previous SHORT correction data is still stored.

3. Press ON to perform SHORT correction calculations on subsequent measurements when the FREQ1, FREQ2, and FREQ3 fields are set to OFF.

When the FREQ1, FREQ2, and FREQ3 fields are set to ON, and the test frequency is equal to FREQ1/2/3, the SHORT correction data at FREQ1/2/3 is used. (Refer to Appendix D.)

4. Press OFF to halt SHORT correction calculations on subsequent measurements.

# **LOAD** Correction

### Description

The HP 4284A's LOAD correction capability corrects for the other errors by using the transmission coefficient derived from the relationship between a standard's (premeasured) reference value to the actual measurement value at the frequency points you specify (up to three frequency points). So, OPEN/SHORT/LOAD corrections can be performed at the frequency points you specify (Refer to Figure 4-13). The three frequency points can be set in the FREQ1, FREQ2, and FREQ3 fields. The standard's reference values are set in the REFA, and B fields. Before entering the standard's reference values, the measurement function for the standard must

be set in the FUNC field. The standard's value can be measured using MEAS LOAD, which is displayed when the cursor is moved to the FREQ1, FREQ2, or FREQ3 fields.

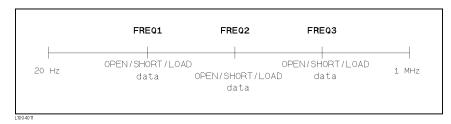


Figure 4-13. OPEN/SHORT/LOAD Correction

# Front Panel Operation for the OPEN/SHORT/LOAD Correction

Perform the following steps to perform the OPEN/SHORT/LOAD correction at the frequency points you want to specify.

1. Move the cursor to the FREQ1, FREQ2, or FREQ3 field to specify the frequency for the OPEN/SHORT/LOAD correction. The following softkeys will be displayed.

# ■ 0N

This softkey is used to make the OPEN/SHORT/LOAD correction data at the FREQ1, FREQ2, or FREQ3 frequency point valid.

# ■ OFF

This softkey is used to make the OPEN/SHORT/LOAD correction data at the FREQ1, FREQ2, or FREQ3 frequency point invalid.

# ■ MEAS OPEN

This softkey is used to perform an OPEN correction measurement at the FREQ1, FREQ2, or FREQ3 frequency points.

# ■ MEAS SHORT

This softkey is used to perfom a SHORT correction measurement at the FREQ1, FREQ2, or FREQ3 frequency points.

#### ■ MEAS LOAD

This softkey is used to perform a LOAD correction measurement at the FREQ1, FREQ2, or FREQ3 frequency points.

- 2. Press ON to show the previous frequency for the OPEN/SHORT/LOAD correction.
- 3. Enter the frequency using the numeric entry keys. When pressing one of the numeric entry keys, the softkey labels are changed to

the available units (Hz, kHz, and MHz), so you can use these softkeys to enter the unit and terminate the entry without hitting ENTER. (When ENTER is used, the numeric data is entered with Hz.)

4. Connect the test fixture to the UNKNOWN Terminals.

—OPEN correction—

- 5. Leave the connection contacts open.
- 6. Press MEAS OPEN. The HP 4284A performs an OPEN correction measurement at the frequency points you specified. After which, the OPEN correction measurement data are displayed on the system message line.
- 7. Move the cursor to the *OPEN* field.
- 8. Press ON to perform the OPEN correction calculations for subsequent measurements at the specified frequency points.

—SHORT correction—

- 9. Move the cursor to the FREQ1, FREQ2, or FREQ3 field at which you specified the frequency.
- 10. Short the connection contacts ogether.t
- 11. Press MEAS SHORT. The HP 4284A will perform a SHORT correction measurement, and display the SHORT correction data on the system message line.
- 12. Move the cursor to the SHORT field.
- 13. Press ON to perform the SHORT correction calculations for subsequent measurements at the specified frequency points.

—LOAD correction—

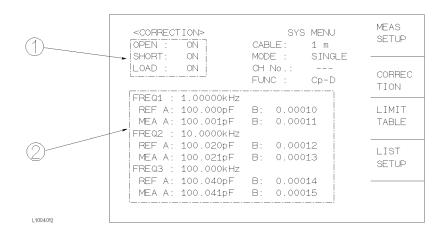
- 14. Prepare the standard for measurement.
- 15. Move the cursor to the FUNC field.
- 16. Set the measurement function for your standard. (Refer to the next paragraph (Measurement function for the standard.))
- 17. Move the cursor to the REF A field of your specified frequency.
- 18. Enter the premeasured value of your standard's primary parameter using the numeric entry keys and the unit softkeys.
- 19. Move the cursor to the B field on the right side of your set REF A field.
- 20. Enter your standard's premeasured secondary parameter value using the numeric entry keys and the unit softkeys.
- 21. Move the cursor to the FREQ1, FREQ2 or FREQ3 field at which you specified the frequency.
- 22. Connect the standard to the measurement contacts.

- 23. Press MEAS LOAD. The HP 4284A will perform a LOAD correction measurement, and display the LOAD correction data on the system message line.
- 24. Move the cursor to the *LOAD* field.
- 25. Press ON to enable the LOAD correction calculations for subsequent measurements at the specified frequency points.

### Note



The relationship between the *CORRECTION* page and OPEN/SHORT/LOAD correction function are as follows.



- ① This area is used as follows.
- To perform the OPEN/SHORT/LOAD correction calculations using either the OPEN/SHORT interpolation correction data or the OPEN/SHORT/LOAD correction data at the spot frequency you specify. This correction data selection depends on the test frequency.
- To obtain the OPEN/SHORT interpolation correction data.
- (2) This area is used as follows.
- To obtain the OPEN/SHORT/LOAD correction data at the spot frequencies you specify (FREQ1, FREQ2, or FREQ3).
- To make the OPEN/SHORT/LOAD correction data at the spot frequencies you specify (FREQ1, FREQ2, or FREQ3) valid or invalid.

The correction data used depends on the test frequency as follows. (For more detail, refer to APPENDIX D.)

Correction	Test Frequency ≠ FREQ1-3		Test Frequency = FREQ1-3	
M ode	FREQ1-3 <b>OFF</b>	FREQ1-3 <b>ON</b>	FREQ1-3 <b>OFF</b>	FREQ1-3 ON
OPEN: ON	INTPOL	INTPOL	INTPOL	SPOT
SHORT: ON	INTPOL	INTPOL	INTPOL	SPOT
LOAD: ON	×	×	×	SPOT

SPOT: The correction data for the frequency points you

specified is used.

INTPOL: Interpolation correction data is used.

x: Correction isn't performed even if the correction

function is set to ON in the OPEN, SHORT, or

LOAD fields.

When the frequency you specify is equal to a frequency already specified, the following correction data is used.

■ Test Frequency = FREQ1 = FREQ2

Correction data: Data at FREQ1

 $\blacksquare$  Test Frequency = FREQ2 = FREQ3

Correction data: Data at FREQ2

■ Test Frequency = FREQ1 = FREQ2 = FREQ3

Correction data: Data at FREQ1

# Measurement Function for the Standard

# **Description**

When the LOAD correction is performed, the reference (pre-measured) value of the standard must be entered. The reference value should be the premeasured value of the following measurement functions.

$C_p$ - $D$	$L_p$ -D	R-X
$C_p$ -Q	$ m L_p$ - $ m Q$	$Z-\theta \ (deg)$
$C_p$ - $G$	$L_{p}$ -G	$Z-\theta \text{ (rad)}$
$C_p$ - $R_p$	$ m L_p$ - $ m R_p$	G-B
$C_{s}$ - $D$	$L_{s}$ - $D$	$Y-\theta \ (deg)$
$C_{s}$ - $Q$	$L_{s}$ - $Q$	$Y-\theta$ (rad)
$C_{a}$ - $R_{a}$	$L_a$ - $R_a$	

The LOAD correction corrects the errors using the transmission coefficient derived from the relationship between the standard's reference value and the actual raw measurement value. The above function is used only for calculating the transmission coefficient.

# Front Panel Operation for Setting the Standard's Measurement Function

Perform the following steps to set the measurement function for the standard.

- 1. Move the cursor to the FUNC field. The following softkeys will displayed.
  - Cp-D
  - Cp-Q
  - Cp-G
  - Cp-Rp
  - more 1/6
- 2. Select and press a softkey to set the measurement function. If the measurement function softkey you want isn't displayed, press more 1/6. The following softkeys will be displayed.
  - Cs-D
  - Cs-Q
  - Cs-Rs
  - more 2/6
- 3. Select and press a softkey to set the measurement function. If the measurement function softkey you want isn't displayed, press more 2/6. The following softkeys will be displayed.
  - Lp-D
  - Lp-Q
  - Lp-G
  - Lp-Rp
  - more 3/6
- 4. Select and press a softkey to set the measurement function. If the measurement function softkey you want isn't displayed, press more 3/6. The following softkeys will be displayed.
  - Ls-D
  - Ls-Q
  - Ls-Rs
  - more 4/6
- 5. Select and press a softkey to set the measurement function. If the measurement function softkey you want isn't displayed, press more 4/6. The following softkeys will be displayed.
  - R-X

- $Z-\theta$  (deg)
- $Z-\theta$  (rad)
- more 5/6
- 6. Select and press a softkey to set the measurement function. If the measurement function softkey isn't displayed, press more 5/6. The following softkeys will be displayed.
  - G-B
  - $Y-\theta$  (deg)
  - $Y-\theta$  (rad)
  - more 6/6
- 7. Select and press a softkey to set the measurement function.

# Single/Multi Correction **Mode Selection**

# Description

When the Option 301 (Scanner Interface) is installed, the HP 4284A can store up to 128 sets of OPEN, SHORT, LOAD correction measurement data, and one LOAD correction reference data for each of the three test frequencies (FREQ1, FREQ2, and FREQ3), and this correction mode is the MULTI correction mode. (The normal correction mode is the SINGLE correction mode.)

#### Note



When the MULTI correction mode is used, the OPEN/SHORT correction using the interpolation method cannot be performed. (Only the OPEN/SHORT/LOAD correction at the frequencies you specify can performed.)

The FREQ1, FREQ2, and FREQ3 frequency points are dependent on the correction mode (SINGLE, MULTI).

This MODE field allows you to select the single correction mode or the multi correction mode. For more information about the multi correction mode, refer to Chapter 3, option 301. scanner interface operation note.

In the case of the multi correction mode, the channel number for selecting the correction data is displayed at the CH No. monitor area.

# Front Panel Operation for Setting the Correction Mode to the Multi **Correction Mode**

- 1. Press (CATALOG/SYSTEM), and SYSTEM CONFIG to display the SYSTEM CONFIG page.
- 2. Move the cursor to the SCANNER INTERFACE SETTING field.
- 3. Press ON to make the scanner interface function valid.
- 4. Press (MEAS SETUP), and CORRECTION to return to the CORRECTION page.
- 5. Move the cursor to the MODE field. The following softkeys will be displayed.
  - SINGLE
  - MULTI
- 6. Press MULTI to select the multi correction mode. If you want to set the single correction mode, press SINGLE.

# **Cable Length Selection**

# Description

The HP 4284A has two reference planes—to the UNKNOWN Terminals (0m), and to the end of the HP 16048A/B test leads (1m). When Option 006 (2m/4m Cable Length Operation) is installed, the HP 4284A has four reference planes—to the UNKNOWN Terminals (0m), to the end of the HP 16048A/B Test Leads (1m), to the end of the HP 16048D test leads (2m), and to the end of the HP 16048E test leads (4m). Measurement accuracy is specified at these points.

When you select 0m, the four outer conductors of the  $H_{\rm POT},\,H_{\rm CUR},\,L_{\rm POT}$ , and  $L_{\rm CUR}$  test leads must be tied together at the UNKNOWN terminals.

When you select 1m, the four outer conductors of the  $H_{\rm POT}$ ,  $H_{\rm CUR}$ ,  $L_{\rm POT}$ , and  $L_{\rm CUR}$  test leads must be tied together at the end of the HP 16048A/B 1m leads.

When you select 2m, the four outer conductors of the test leads must be tied together at the end of the HP 16048D 2m test leads.

When you select 4m, the four outer conductors of the  $H_{\rm POT}$ ,  $H_{\rm CUR}$ ,  $L_{\rm POT}$ , and  $L_{\rm CUR}$  test leads must be tied together at the end of the HP 16048E 4m test leads.

In other words, the four-terminal pair configuration must be terminated for the cable length selected. When an HP 16048A/B/D/E test leads are used, use the furnished terminal plate at the end of the cable for easy configuration.

### Front Panel For Selecting the Cable Length

Perform the following steps to select the cable length.

- 1. Move the cursor to the *CABLE* field. The following softkeys will be displayed.
  - 0 m
  - 1 m
  - 2 m
  - 4 m
- 2. Select and press a softkey to select the cable length.

# System Menu

The system menu on this page allows you to perform the following control functions.

### ■ Printer

This function is the same as the functions on the system menu on the *MEAS DISPLAY* page. (A description of this function is given in "System Menu" in Chapter 3.) So only the procedure is given in the following paragraphs.

#### **Printer Function**

Perform the following steps to print out the information of the *CORRECTION* page using the PRINT DISP mode.

- 1. Connect the HP 4284A to the printer using an HP-IB cable.
- 2. Set the printer to the Listen Only mode.
- 3. Set the Talk Only mode to ON from the SYSTEM CONFIG page.
- 4. Press (MEAS SETUP), and CORRECTION to display the CORRECTION page.
- 5. Move the cursor to the SYS MENU field.
- 6. Press PRINT DISP to print out the display page. The display page is printed out to the printer as shown in Figure 4-14.

```
<CORRECTION>
                       SYS MENU
OPEN:
                CABLE : O m
         0 N
SHORT:
         ON
                MODE : MULTI
LOAD :
         ON
                CH No.: O
                FUNC : Cp-D
FREQ1 :1.00000kHz
REF A: 100.000pF
                  B: .000000
MEA A: 99.6222pF
                   B: .008178
FREQ2 :2.00000kHz
REF A: 100.000pF B: .000000
MEA A: 99.8350pF
                   B: .003234
FREQ2 :1.00000MHz
REF A: 100.000pF
                   B: .000003
MEA A: 99.9439pF B: .000266
```

Figure 4-14. CORRECTION Page Example

# LIMIT TABLE SETUP Page

When you press MEAS SETUP, and LIMIT TABLE, the LIMIT TABLE SETUP page will be displayed. The LIMIT TABLE SETUP page allows you to set the HP 4284A's comparator. The HP 4284A's built-in comparator can sort devices into a maximum of ten bins (BIN 1 to BIN 9 and one OUT OF BINS) using a maximum of nine pairs of primary limits and one pair of secondary parameter limits. Also, devices whose primary parameter is within limits, but whose secondary parameter measurement result not within limits, can be sorted into an AUXiliary BIN. The comparator function is especially useful when using the HP 4284A with a component handler (handler interface option is installed). These limit settings for bin sorting are only set on this LIMIT TABLE SETUP page.

- $\blacksquare$  Measurement Function (FUNC)
- Comparator Function's Limit Mode (MODE)

- Nominal Value for tolerance mode (NOMINAL)
- Auxiliary bin ON/OFF(AUX)
- Comparator Function ON/OFF (*COMP*)
- Low Limit Value of each bin (LOW)
- High Limit Value of each bin (HIGH)

Each function is described in the following paragraphs.

The available fields and the softkeys which correspond to the fields on this page are shown in Figure 4-15 and Figure 4-16.

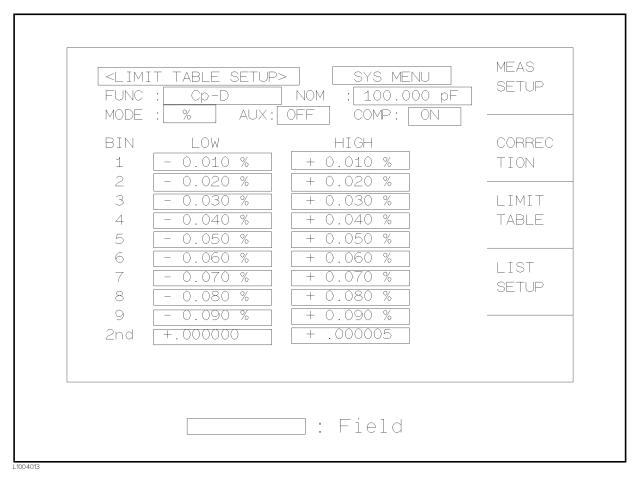


Figure 4-15. Available Fields on the LIMIT TABLE SETUP Page

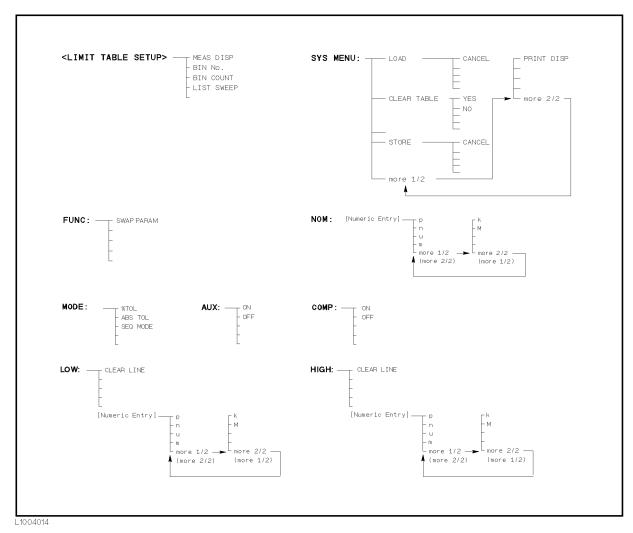


Figure 4-16. Available Softkeys on the LIMIT TABLE SETUP Page

# Swap Parameter Function

# Description

The swap parameter function is used to swap the primary parameter for the secondary parameter in the FUNC field. For example, when the measurement function is  $C_p$ -D, the swap parameter function sets the measurement function to D-C<sub>p</sub>. (Refer to Figure 4-17) Then the comparison limits for D are a maximum of nine pairs of comparison limits, and the comparison limits for  $C_p$  are now one pair.

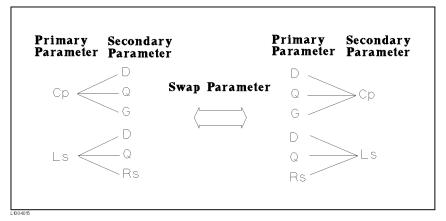


Figure 4-17. Swap Parameter Function

# Front Panel Operation for Swapping the Primary Parameter for the Secondary Parameter

Perform the following steps to swap the primary parameter for the secondary parameter.

- 1. Move the cursor to the FUNC field. The following softkey will be displayed.
  - SWAP PARAM
- 2. Press SWAP PARAM to swap the primary parameter for the secondary parameter.
- 3. Press SWAP PARAM again to return the measurement function to the previous combination.

# Limit Mode for Comparator

# Description

There are two methods for specifying primary parameter limits, as follows. (Refer to Figure 4-18)

- Tolerance Mode The tolerance mode specifies comparison limits by the deviation from the specified nominal value. (The nominal value is specified at *NOM* field.) There are two methods used to specify the tolerance mode limits, the ratio in percent and by parameter value
- Sequential Mode The sequential mode specifies comparison limits as the absolute measurement value. The limits must be set in order from the smallest value to the largest value.

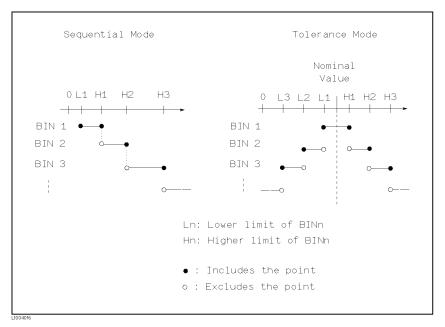


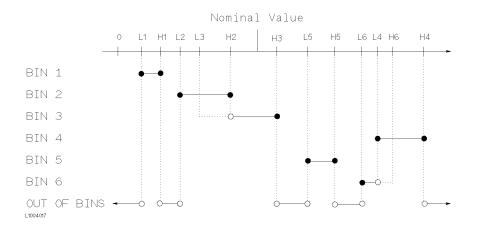
Figure 4-18. Tolerance Mode and Sequential Mode

Note



The limit values for tolerance mode sorting must be placed in the order of the narrower limits to the wider limits. If BIN 1 has the widest limits, all of the DUTs will be sorted into BIN 1.

In tolerance mode sorting, the lower limit doesn't have to be less than the nominal value, and the upper limit doesn't have to be greater than the nominal value. As you can see in the following illustration, there can be openings and there can be duplications.



### Front Panel Operation for Setting the Limit Mode for the Comparator

Perform the following steps to set the limit mode for the comparator.

1. Move the cursor to the MODE field. Then the following softkeys will be displayed.

# ■ % TOL

This softkey is used to set the limit mode to the tolerance mode (the ratio in percent).

# ■ ABS TOL

This softkey is used to set the limit mode to the tolerance mode (parameter value).

# ■ SEQ

This softkey is used to set the limit mode to the sequential mode.

2. Select and set the limit mode using the softkeys.

# **Nominal Value for Tolerance Mode**

# Description

When the tolerance mode is used as a limit mode for the primary parameter, the nominal value must be set. The nominal value can be set within the range of the following measurement range of the primary parameter.

Primary	Parameter	and	Display	Range
---------	-----------	-----	---------	-------

Parameter	Range
Z , R, X	$0.01~\mathrm{m}\Omega$ to $99.9999~\mathrm{M}\Omega$
Y , G, B	0.01 nS to 99.9999 S
С	$0.01~\mathrm{fF}$ to $9.99999~\mathrm{F}$
L	0.01 nH to 99.9999 kH
D	0.000001 to 9.99999
Q	0.01 to 99999.9
heta	−180.000 ° to 180.000 °

When the limit mode for the primary parameter is the sequential mode, the nominal value can be set, but this has no meaning in the sequential mode.

# Front Panel Operation for Setting the Nominal Value

Perform the following steps to set the nominal value.

- 1. Move the cursor to the *NOM* field.
- 2. Enter the nominal value using the numeric entry keys. When the numeric data is entered, the suffix softkeys  $(p, n, \mu, m, k, M)$ can be used instead of (ENTER).

# Comparator Function ON/OFF

# **Description**

The HP 4284A's built-in comparator can sort devices into a maximum of ten bins (BIN 1 to BIN 9 and the OUT OF BINS bin) using a maximum of nine pairs of primary limits and one pair of secondary parameter limits. Also, a device whose primary parameter is within limits, but whose secondary parameter measurement result is not within limits can be sorted into the AUXiliary BIN. The comparator function is especially useful when using the HP 4284A with a component handler (handler interface option is installed).

# Front Panel Operation for Setting the Comparator Function to ON or OFF

Perform the following steps to set the comparator function to ON or OFF.

- 1. Move the cursor to the *COMP* field. The following softkeys will be displayed.
  - 0N
  - OFF
- 2. Use the softkeys to set the comparator function to ON or OFF.

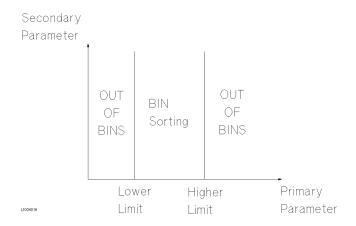
# **Auxliary Bin ON/OFF**

# Description

When the secondary parameters affect the sorting results, the limits for the secondary parameter can be set in 2nd LOW/HIGH fields. So there are three patterns for the sorting area of the secondary parameter.

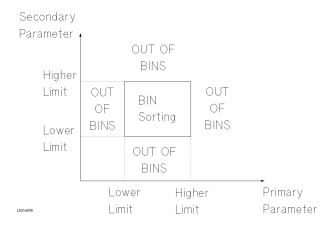
■ When the secondary parameter limits are not specified on the *LIMIT TABLE SETUP* page.

Devices will be sorted according to primary parameter comparison results.



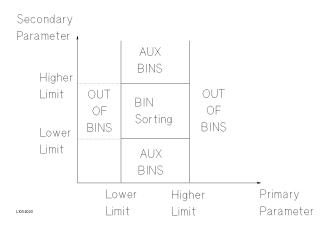
■ When the secondary parameter limits are set and AUX BIN are set to OFF.

Only devices with secondary limits are sorted by the primary parameter result. Devices not within the secondary parameter limits are sorted OUT OF BINS even if the device's primary parameter is within limits.



■ When the secondary parameter limits are set and AUX BIN are set to ON.

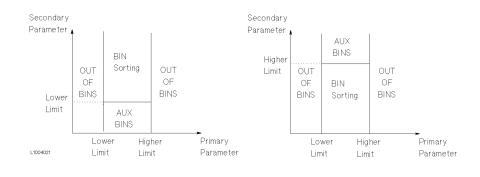
Devices whose primary parameter is not within limits are sorted OUT OF BINS. Devices whose primary parameter is within limits, but whose secondary parameter is out of limits are sorted into the AUX BIN.



Note



When only the lower limit of the secondary parameter is set and the AUX BIN are set to ON, the devices whose primary parameter is within limits, but whose secondary parameter is equal to or below the lower limit are sorted into the AUX BIN. Also when only the higher limit of the secondary parameter is set and the AUX BIN are set to ON, the devices whose primary parameter is within limits, but whose secondary parameter is equal or above the higher limit are sorted into the AUX BIN. (See below.)



The AUX field allows you to set the AUX BIN to ON or OFF.

# Front Panel Operation for Setting the AUX BIN to ON or OFF

Perform the following steps to set the AUX BIN to ON or OFF.

1. Move the cursor to the AUX field. The following softkeys will be displayed.

- ON
- OFF
- 2. Select and press a softkey to set AUX BIN to ON or OFF.

# Low/High Limits

# Description

The HP 4284A's built-in comparator can sort devices into a maximum of ten bins (BIN 1 to BIN 9, and OUT OF BINS) using a maximum of nine pairs of primary parameter limits and one pair of secondary parameter limits. These primary parameter low/high limits can be set in the BIN 1 to BIN 9 LOW/HIGH fields, and the secondary parameter low/high limits can be set in the 2nd LOW/HIGH fields.

# Note



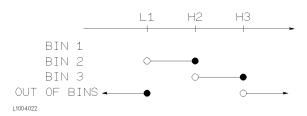
Do NOT enter a value which is lower than the LOW limit into the HIGH limit in the tolerance sorting mode. If you do, the warning message Warning, Improper high/low limits will be displayed (this isn't an error), and the HP 4284A will not sort a DUT into the BINs you specify.

The limit values for sequential mode sorting can be set without setting the lower/higher limits of BIN1. For example,

■ BIN 1: Low Limit (L1) only

BIN 2: High Limit (H2)

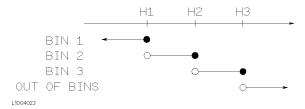
BIN 3: High Limit (H3)



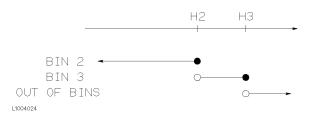
■ BIN 1: High Limit (H1) only

BIN 2: High Limit (H2)

BIN 3: High Limit (H3)



■ BIN 2: High Limit (H2) BIN 3: High Limit (H3)



# Front Panel Operation for Setting the Low/High Limits

Perform the following steps to set the bin sorting limits.

- 1. Set the measurement function for the comparator function, the nominal value, and the limit mode for the primary parameter.
- 2. Move the cursor to the SYS MENU field, and perform the clear table function.
- 3. Move the cursor to the *BIN 1 LOW* field. When you use the tolerance mode, perform steps 4 through 7. When you use the sequential mode, perform steps 8 through 12.
  - —Tolerance Mode is used—
- 4. Enter the limit value of the BIN 1 at BIN 1 LOW field using the numeric entry keys. When one of the numeric entry keys is pressed, the suffix softkeys (p, n, μ, m, k, and M) are available, and so you can use these softkeys to enter the unit and terminate the entry without hitting ENTER. When the limit value of BIN 1 is entered in the BIN 1 LOW field, the BIN 1 low limit becomes (absolute input value), and the BIN 1 high limit becomes + (absolute input value).
- 5. The cursor will be automatically moved to the  $BIN\ 2\ LOW$  field. Repeat step 4 until the limits of the BIN 9 is entered. After that, the cursor will be moved to the  $2nd\ LOW$  field.
- 6. Enter the low limit value of the secondary parameter. After that, the cursor will be automatically moved to the 2nd HIGH field.
- 7. Enter the high limit value of the secondary parameter. Then the entry example using the tolerance mode is shown in Figure 4-16.
  - —Sequential Mode is used—
- 8. Enter the low limit of the BIN 1 using the numeric entry keys. When the one of the numeric entry keys is pressed, the suffix soft-keys  $(p, n, \mu, m, k, and M)$  are available, so you can use

- these softkeys to enter the unit and terminate the entry without hitting (ENTER).
- 9. The cursor will be automatically moved to the BIN 1 HIGH field after entering the low limit of the BIN 1. Enter the high limit of the BIN 1.
- 10. The cursor will be automatically moved to the BIN 2 HIGH field. Because the BIN 2 low limit value is as same as the BIN 1 high limit value. Enter the high limit of the BIN 2.
- 11. Repeat step 5 until the BIN 9 limits are entered. After entering the BIN 9 high limit, the cursor will be automatically moved to the 2nd LOW field. Enter the low limit value of the secondary parameter.
- 12. The cursor will be automatically moved to the 2nd HIGH field. Enter the high limit value of the secondary parameter. The entry example using the sequential mode is shown below.

FUNC		> SYS MENU NOM : 100.000 pF ON COMP: ON	MEAS SETUP
BIN 1 2	LOW +100.000pF	HIGH +110.000pF +120.000pF	CORREC TION
3 4 5		+130.000pF +140.000pF +150.000pF	LIMIT TABLE
6 7 8 9		+160.000pF +170.000pF +180.000pF +190.000pF	LIST SETUP
2nd	+ 0.000	+ 0.005	

Figure 4-19. Limit Table Using the Sequential Mode

# System Menu

The system menu on this page allows you to perform the following control functions.

- Load/Store
- Clear Table
- Printer

These functions, except for the clear table function, are the same as the functions in the system menu on the *MEAS DISPLAY* page. (A description of each function is given in "System Menu" in Chapter 3.) So, in the case of the clear table function, the description and procedure are given, and in the case of the other functions, only the procedure is given.

# **Load/Store Function**

Perform the following steps on the *LIMIT TABLE SETUP* page to Load/Store the control settings to the internal non-volatile memory or to the external memory card.

- 1. Set all controls.
- 2. Move the cursor to the SYS MENU field on the LIMIT TABLE SETUP page.
- 3. Insert the memory card to the MEMORY card slot, if you are using a memory card.
- 4. Press STORE when you want to use the store function. The message Enter record number to STORE will be displayed on the system message line.

Press LOAD when you want to use the load function. The message Enter record number to LOAD will be displayed on the system message line.

5. Enter the record number using the numeric entry keys and ENTER to store the current control settings, or load the control settings.

#### Clear Table Function

This function allows you to clear all of the limit values. So, when you change the limit mode, this function must be used.

Perform the following steps to clear all of bin sorting limits on the  $LIMIT\ TABLE\ SETUP$  page.

- 1. Move the cursor to the SYS MENU field.
- 2. Press CLEAR TABLE. The message Clearing table, Are you sure? will be displayed, and the following softkeys will be displayed.
  - YES
  - NO
- 3. Press YES to clear all of the bin sorting limits.

### **Printer Function**

Perform the following steps to print out the display page using the PRINT DISP mode.

- 1. Connect the HP 4284A to the printer using the HP-IB cable.
- 2. Set the printer to the Listen Only mode.
- 3. Set the talk only mode to ON on the SYSTEM CONFIG page.
- 4. Press (MEAS SETUP) and LIMIT TABLE to display the LIMIT TABLE SETUP page.
- 5. Move the cursor to the SYS MENU field.
- 6. Press more 1/2.
- 7. Press PRINT DISP. The display page is printed out to the printer as shown in Figure 4-20.

```
<LIMIT TABLE SETUP>
                        SYS MENU
FUNC: Cp-D
                NOM: 100.000pF
MODE:
      %
             AUX: ON
                       COMP: ON
BIN
      LOW
                     HIGH
      0.001 %
                  + 0.001 %
2
      0.002 %
                  + 0.002 %
                  + 0.005 %
      0.005 %
      0.010 %
                  + 0.010 %
      0.020 %
                  + 0.020 %
      0.050 %
                  + 0.050 %
      0.100 %
                  + 0.100 %
      0.200 %
                  + 0.200 %
      0.500 %
                  + 0.500 %
2nd +.000000
                  +.000010
```

Figure 4-20. LIMIT TABLE SETUP Page Example

# LIST SWEEP SETUP Page

When you press MEAS SETUP and LIST SETUP, the LIST SWEEP SETUP page will be displayed. The HP 4284A has a list sweep measurement function which permits up to ten test frequencies, oscillator levels, or DC bias points to be automatically measured. On the LIST SWEEP SETUP page, the following control settings of the list sweep measurement can be set. (Each field in parenthesis is used when that control is set.)

- Sweep Mode (MODE)
- Sweep Parameter Selection (FREQ[Hz], LEVEL[V], LEVEL[A], BIAS[V], or BIAS[A])
- Sweep Point Settings (sweep point)
- $\blacksquare$  Limit Parameter Selection (LMT)
- Low/High Limit Values (LOW, HIGH)

There are following fields on this page: <LIST SWEEP SETUP>, MODE, FREQ [Hz] (LEVEL [V], LEVEL [A], BIAS [V], or BIAS [A]), LMT, LOW/HIGH, SYS MENU, and sweep points.

These functions are described in the following paragraphs.

The available fields and softkeys which corresponded to the fields on this page are shown in Figure 4-21 and Figure 4-22.

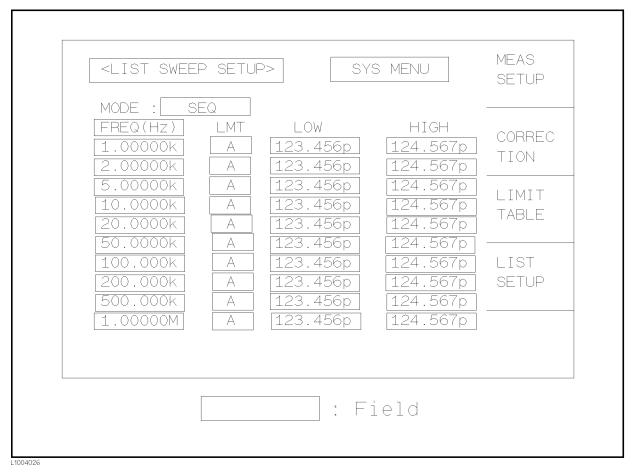


Figure 4-21. Available Fields on the LIST SWEEP SETUP Page

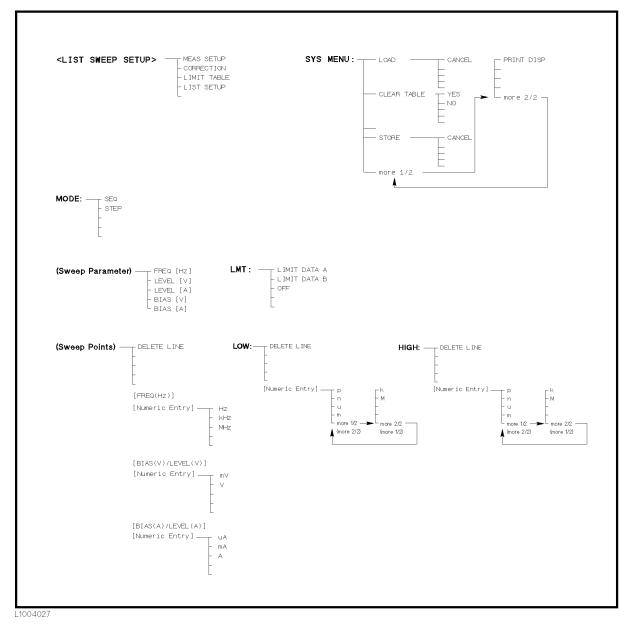


Figure 4-22. Available Softkeys on the LIST SWEEP SETUP Page

# **Sweep Mode**

#### Description

The HP 4284A has a List Sweep measurement function which permits up to 10 test frequencies, oscillator levels, or DC bias points to be automatically measured. There are two sweep modes for the list sweep measurements: sequential (SEQ) mode and step (STEP) mode. In the case of the sequential mode, when the HP 4284A is triggered once, the device is automatically measured at all sweep points. In the case of the step mode, the sweep point is incremented each time the HP 4284A is triggered.

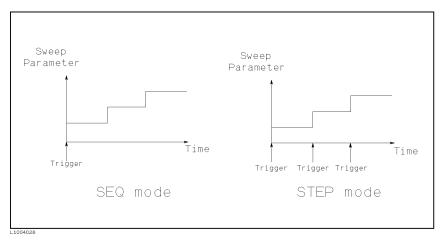


Figure 4-23. SEQ mode and STEP mode

Note



When two or more sweep points are the same, and are adjacent the HP 4284A measures the device once, and then the measurement result is compared to limits set for each sweep point.

#### Front Panel Operation for Setting the List Sweep Measurement Mode

Perform the following steps to set the list sweep measurement mode to the sequential mode, or to the step mode.

- 1. Move the cursor to the *MODE* field. The following softkeys will be displayed.
  - SEQ
  - STEP
- 2. Select and press a softkey to set the list sweep measurement mode.

#### **List Sweep Parameter**

#### Description

The sweep point parameter for the list sweep measurement can be set to the test frequency, oscillator level, and DC bias. This field allows you to set the parameter of the list sweep measurement.

#### Front Panel Operation for Setting the List Sweep Parameter

Perform the following steps to set the list sweep parameter.

- 1. Move the cursor to the FREQ [Hz] (LEVEL [V], LEVEL [A], BIAS [V], or BIAS [A]) field. The following softkeys will be displayed.
  - FREQ [Hz]
  - LEVEL [V]
  - LEVEL [A]
  - BIAS [V]

- BIAS [A]
- 2. Select and press a softkey to set the list sweep measurement sweep parameter.

# Sweep Points and Limit Mode

#### Description

The list sweep function permits entry of up to 10 points and measurement limits. Figure 4-24 shows the available fields for setting the sweep points, the limit parameter, and the high/low limit values.

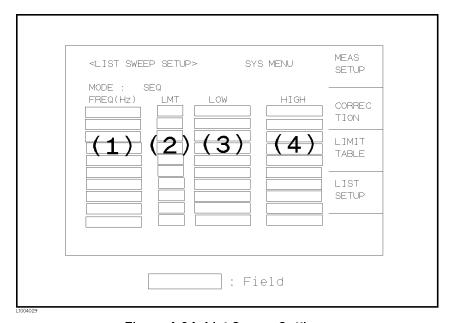


Figure 4-24. List Sweep Settings

Note



When only the low limits of the sweep points are set, the devices whose selected parameter's data are equal, or are above the low limits are sorted as IN. When only the high limits of the sweep points are set, the devices whose selected parameter's data are equal, or are below the high limits are sorted as IN.

Note



The comparison results are always IN when the paramter selection for the limit function is performed, but the low/high limit values aren't entered.

Note



The comparison results is always LOW under the following conditions (which are equal to the condition at  $\langle STATUS \rangle \neq 0$  in the data format.)

- Analog Bridge is unbalanced.
- A/D converter isn't working.
- Signal source is overloaded.
- ALC is unable to regulate.

#### Note



Do NOT enter a value which is lower than the LOW limit into the HIGH limit. If you do, the warning message Warning, Improper high/low limits will be displayed (this isn't an error). The comparison results are as follows.

■ Measurement results < LOW limit

Result: LOW

 $\blacksquare$  Measurement results  $\geq$  LOW limit

Result: HIGH

#### Front Panel Operation for Setting the Sweep Points

Perform the following steps to set the sweep points and measurement limits.

- 1. Move the cursor to the *sweep parameter* field and set the sweep parameter.
- 2. Move the cursor to the sweep point field.
- Enter the sweep point using the numeric entry keys. When the one of the numeric entry keys is pressed, the unit softkeys (μ, m, k, and M) are available, so you can use these softkeys to enter the unit and terminate the entry without hitting (ENTER).
- 4. The cursor will move automatically to the *LMT* field after you enter a sweep point. The following softkeys will be displayed.

#### ■ LIMIT DATA A

This softkey is used to set the limit parameter to the primary parameter of the measurement function. When this softkey is pressed, the cursor will automatically move to the LOW field.

#### ■ LIMIT DATA B

This softkey is used to set the limit parameter to the secondary parameter of the measurement function. When this softkey is pressed, the cursor will move automatically to the LOW field.

#### ■ OFF

This softkey is used to set the list sweep measurement's limit function to OFF for the sweep point. When this softkey is pressed, the cursor will move automatically to the next sweep point field.

- 5. Press the softkey to set the limit parameter.
- 6. The cursor will move automatically to the *LOW* field. (If you pressed OFF in the previous step, the cursor will move automatically to the next sweep point field.) Enter the low limit value.
- 7. The cursor will move automatically to the HIGH field. Enter the high limit value using the numeric entry keys. After entering the

high limit value, the cursor will move automatically to the next sweep point field. Repeat steps 3 through 7.

# System Menu

The system menu on this page allows you to perform the following control functions.

- Load/Store
- Clear Table
- Printer

These functions, except for the clear table function, are the same as the functions in the system menu on the *MEAS DISPLAY* page. (A description of each function is given in "System Menu" in Chapter 3 on page 3-19.) So in the case of the clear table function, the description and procedure are given, and in the case of the other functions, only the procedure is given.

#### **Load/Store Function**

Perform the following steps on the LIST SWEEP SETUP page to Load/Store the control settings from/to internal non-volatile memory or an external memory card.

- 1. Set all controls.
- 2. Move the cursor to the SYS MENU field on the LIST SWEEP SETUP page.
- 3. If you are using a memory card insert the memory card to the MEMORY card slot.
- 4. Press STORE when you want to use the store function. The message Enter record number to STORE will be displayed on the system message line.

Press LOAD when you want to use the load function. The message Enter record number to LOAD will be displayed on the system message line.

5. Enter the record number using the numeric entry keys and ENTER to Load/Store the current control settings.

#### **Clear Table Function**

This function allows you to clear all of the list sweep points and limits. When you change from the current sweep parameter to the other sweep parameter, this function must be used.

Perform the following steps to set only all of the operations on the LIST SWEEP SETUP page to the power on default settings.

- 1. Move the CURSOR to the SYS MENU field.
- 2. Press CLEAR TABLE. Then the message Clearing table, Are you sure? will be displayed, and the following softkeys will be displayed.

- YES
- NO
- 3. Press YES to clear all of the list sweep points and limits.

#### **Printer Function**

Perform the following steps to print out the display page using the PRINT DISP mode.

- 1. Connect the HP 4284A to the printer using an HP-IB cable.
- 2. Set the printer to the Listen Only mode.
- 3. Set the talk only mode to ON on the SYSTEM CONFIG page.
- 4. Press (MEAS SETUP) and LIST SETUP to display the LIST SWEEP SETUP page.
- 5. Move the cursor to the  $SYS\ MENU$  field.
- 6. Press more 1/2.
- 7. Press PRINT DISP. The display page is printed out to the printer as shown in Figure 4-25.

<list swe<="" th=""><th>EEP S</th><th>ETUP&gt;</th><th>SYS MENU</th><th></th></list>	EEP S	ETUP>	SYS MENU	
MODE : SE	ΞQ			
FREQ[Hz]	LMT	LOW	HIGH	
1.00000k	Α	100.000p	100.030p	
2.00000k	Α	100.000p	100.030p	
5.00000k	Α	100.000p	100.030p	
10.0000k	Α	100.000p	100.030p	
20.0000k	Α	100.000p	100.030p	
50.0000k	Α	100.000p	100.030p	
100.000k	Α	100.000p	100.030p	
200.000k	Α	100.000p	100.030p	
500.000k	Α	100.000p	100.030p	
1.00000M	A	100.000p	100.030p	

Figure 4-25. LIST SWEEP SETUP Page Example

# Catalog/System Configuration

### Introduction

This chapter provides information on the function of each page of (CATALOG/SYSTEM). The following three pages can be called from (CATALOG/SYSTEM).

- CATALOG
- SYSTEM CONFIG
- SELF TEST

This chapter describes the functions on each page in the order of the preceding list of display pages.

# **CATALOG Page**

When you press CATALOG/SYSTEM, the CATALOG page will be displayed. On this CATALOG page, the catalog of the HP 4284A's internal memory (EEPROM) or the external memory card which is inserted into the front panel MEMORY card slot, and the following control functions can be set from this page. (The field in parenthesis is used to set the control function.)

■ System Menu (SYS MENU)

There are two fields on this page:  $\langle CATALOG \rangle$  and  $SYS\ MENU$ fields.

The available fields and the softkeys which corresponded to each field on this page are shown in Figure 5-1 and Figure 5-2.

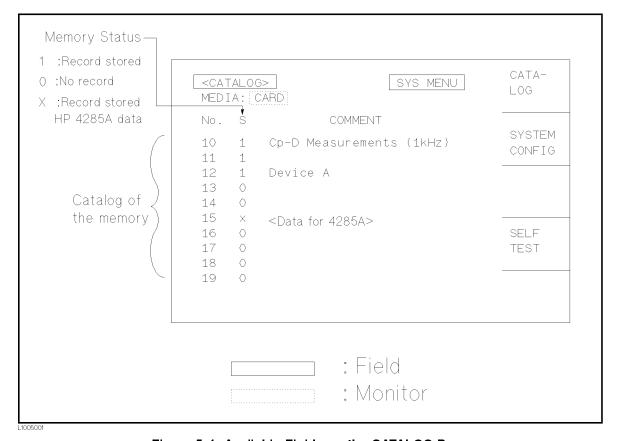


Figure 5-1. Available Fields on the CATALOG Page

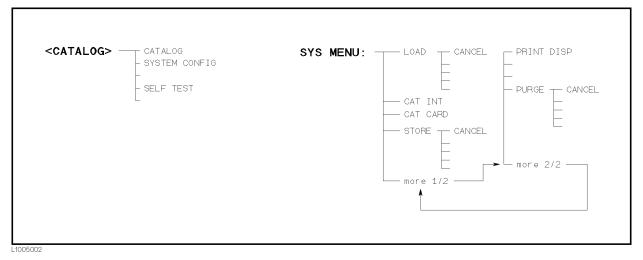


Figure 5-2. Available Softkeys on the CATALOG Page

# System Menu

The system menu on this page allows you to perform the following functions.

- Load/Store
- Media Specifying
- Printer
- Purge

The load/store function is the same as the functions displayed on the system menu of the MEAS DISPLAY page. And the printer function is the same as the function of PRINT DISP of the system menu on the MEAS DISPLAY page. (The description of each function is given in "System Menu" in Chapter 3.) So in the case of the MEDIA SPECIFYING and the PURGE functions, the description and setting procedures are described in the following paragraphs, only the procedure is described for the other functions.

#### **Media Specifying**

On the CATALOG page, the catalog of the HP 4284A's internal memory (EEPROM) or the external memory card which are inserted into the MEMORY card slot on the front panel are displayed, with memory status (records stored or no record in the memory) and the comments (displayed on the comment line) for each settings.

To specify the media of memory to be displayed the catalog, CAT INT or CAT CARD can be used.

Perform the following steps to specify the media of memory.

- 1. Move the cursor to the SYS MENU field using the CURSOR arrow keys. The following softkeys will be displayed in the softkey label area.
  - CAT INT
  - CAT CARD
- 2. Select the memory media, using CAT INT for the internal memory, or CAT CARD for the memory card.

#### Load/Store Function

Perform the following steps to store the current control settings to the internal non-volatile memory or to the external memory card, or to load the control settings from the internal non-volatile memory or from the external memory card.

- 1. Set all controls.
- 2. Move the cursor to the SYS MENU field on the CATALOG page.
- 3. Insert the memory card into the MEMORY card slot, if you are going to store or load the settings to or from a memory card.

4. Press STORE when you want to use the STORE function. The message Enter record number to STORE will be displayed on the system message line.

Press LOAD when you want to use the LOAD function. The message Enter record number to LOAD will be displayed on the system message line.

5. Use the numeric entry keys and (ENTER) to enter the record number at which the current control settings will be STORED to or LOADED from.

#### **Printer Function**

Perform the following steps to print out the displayed page using the PRINT DISP mode.

- 1. Connect the HP 4284A to the printer using an HP-IB cable.
- 2. Set the printer to the Listen Only mode.
- 3. Set the Talk Only mode to ON from the SYSTEM CONFIG page.
- 4. Press (CATALOG/SYSTEM) to display the CATALOG page.
- 5. Move the cursor to the SYS MENU field.
- 6. Press more 1/2.
- 7. Press PRINT DISP to print out the displayed page. The displayed page is printed out as shown in Figure 5-3.

```
<CATALOG>
                         SYS MENU
MEDIA : CARD
No. S
              COMMENT
10 1 470pF Ceramic Capacitor
11
12 1
      Magnetic Head test
13 1
      9140-401
14 0
15 0
16 0
17 0
18 0
19 0
```

Figure 5-3. CATALOG Page Example

#### **Purge Function**

Perform the following steps to purge the control settings from the internal non-volatile memory or from the external memory card.

1. Move the cursor to the SYS MENU field on the CATALOG page.

- 2. Insert the memory card into the MEMORY card slot, if you are going to purge the settings from a memory card.
- 3. Press more 1/2, and PURGE. The message Enter record number to PURGE will be displayed on the system message line.
- 4. Use the numeric entry keys and (ENTER) to enter the record number at which the control settings will be PURGED.

# SYSTEM CONFIG Page

When you press (CATALOG/SYSTEM) and SYSTEM CONFIG, the SYSTEM CONFIG page will be displayed. On this SYSTEM CONFIG page, the status of HP-IB interface and the options are displayed, and the following control functions can be set from this page. (The field in parenthesis is used to set the control function.)

- Beeper function ON/OFF (BEEPER)
- HP-IB address (*HP-IB ADDRESS*)
- HP-IB talk only mode ON/OFF (TALK ONLY)
- Handler Interface (Option 201 or 202) ON/OFF (HANDLER I/F)
- Scanner Interface (Option 301) ON/OFF (SCANNER I/F)
- System Menu (SYS MENU)

So there are seven fields on this page:  $\langle SYSTEM\ CONFIG \rangle$ , BEEPER, HP-IB ADDRESS, TALK ONLY, HANDLER I/F, SCANNER I/F, and SYS MENU fields.

Each control function is described in the following paragraphs.

This page also the following information as a monitor. These conditions is set depending on the status of the options installed in the instrument.

- HP-IB interface installed/not installed (HP-IB I/F)
- Power Amplifier (Option 001) installed /not installed (POWER AMP (#001)
- Bias current interface (Option 002) installed /not installed (I BIAS) I/F (#002)
- 2m/4m cable operation (Option 006) installed /not installed  $(2m/4m\ CABLE\ (\#006))$
- Handler Interface (Option 201 or 202) installed /not installed (HANDLER I/F (#201 or #202))
- Scanner Interface (Option 301) installed /not installed (SCANNER I/F (#301)

The available fields and the softkeys which correspond to each field on this page are shown in Figure 5-4 and Figure 5-5.

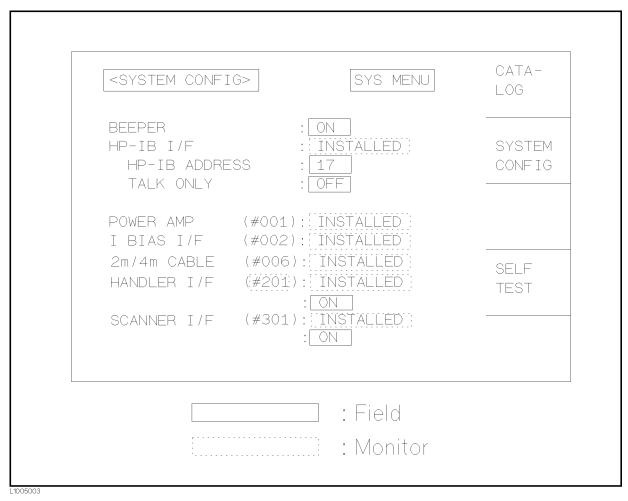


Figure 5-4. Available Fields on the SYSTEM CONFIG Page

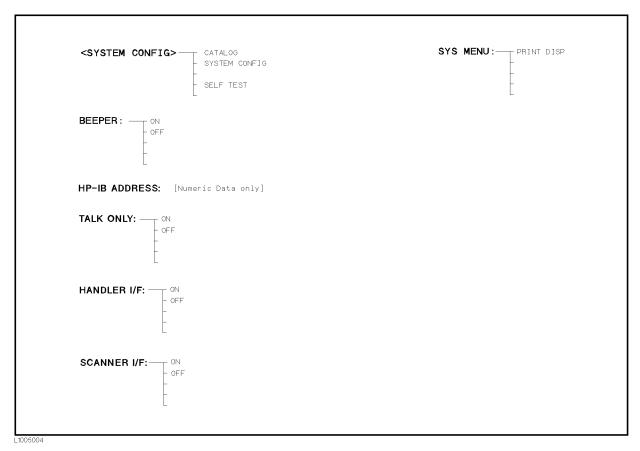


Figure 5-5. Available Softkeys on the SYSTEM CONFIG Page

# **Beeper Function** ON/OFF

#### **Description**

The HP 4284A has a beeper which it beeps if any of the following conditions occur.

- ADCERR is displayed.
- An error has occurred.
- Warning message is displayed.
- Correction data measurement at 48 preset frequencies is completed.
- Comparison judgment Result is out of bin.
- Failed sweep comparison judgment.
- Key lock ON/OFF is switched.

### How to Set the Beeper to ON or OFF

Perform the following steps to set the beeper function to ON or OFF.

1. Move the cursor to the BEEPER field on the SYSTEM CONFIG page. The following softkeys will be displayed in the softkey label area.

- 0N
- 0FF
- 2. Use the softkeys to set the beeper function to the ON or OFF.

### **HP-IB Setting**

#### Description

All HP 4284As except those with Option 109 Delete HP-IB Interface are equipped with an HP-IB interface so they can be controlled via the HP-IB bus. The HP 4284A can be linked to other instruments and computers to form an automated measurement system. The status of the HP-IB interface installed/not installed is monitored on this SYSTEM CONFIG page  $(HP-IB\ I/F)$ .

The HP-IB address and the Talk Only mode can be set on this page.

#### How to Set the HP-IB Address

Perform the following steps to set HP-IB address.

- 1. Move the cursor to the HP-IB ADDRESS field on the SYSTEM CONFIG page.
- 2. Enter the HP-IB address using the numeric entry keys, and press ENTER).

### How to Set the Talk Only Mode

Perform the following steps to set the HP 4284A to the Talk Only mode (ON). To set the HP 4284A to the addressable mode, perform the following steps to set the Talk Only mode to OFF.

- 1. Move the cursor to the TALK ONLY field on the SYSTEM CONFIG page. The following softkeys will be displayed in the softkey label area.
  - ON
  - OFF
- 2. Use the softkeys to set the Talk Only mode to ON (Talk only), or to OFF (addressable).

# **Handler Interface** Setting

#### Description

When the HP 4284A is equipped with an Option 201 or 202 Handler Interface, the 36-pin Amphenol connector on the rear panel is used to interface between the HP 4284A and the handler to pass control input/output signals and the comparator function bin judgment results. Refer to the HP 4284A Option 201 or 202 Operation Note.

The status of the handler interface installed/not installed is monitored on this SYSTEM CONFIG page (HANDLER I/F (#201 or #202)).

#### How to Set the Handler Interface to ON or OFF

When the handler interface is set to ON, the handler interface signals through the interface connector are enabled. Perform the following steps to set the handler interface signal input/output to ON or OFF.

- 1. Move the cursor to the  $HANDLER\ I/F\ (\#201)$  field (or the  $HANDLER\ I/F\ (\#202)\ field)$  on the  $SYSTEM\ CONFIG\ page.$ The following softkeys will be displayed in the softkey label area.
  - ON
  - OFF
- 2. Use the softkeys to set the handler interface function to ON or OFF.

# Scanner Interface Setting

#### Description

When the HP 4284A is equipped with the Option 301 Scanner Interface, the multi channel correction function can be used. The 14-pin Amphenol connector on the rear panel is used to interface between the HP 4284A and the scanner to pass control output signals and channel selection signals for multi channel correction. Refer to the HP 4284A Option 301 Operation Note.

The status of the scanner interface installed/not installed is monitored on this SYSTEM CONFIG page (SCANNER I/F (#301)).

#### How to Set the Scanner Interface to ON or OFF

When the scanner interface is set to ON, the scanner interface signals through the interface connector are enabled. Perform the following steps to set the handler interface to ON or OFF.

#### Note



To set the correction mode to MULTI, this procedure must be performed, even if the multi channel correction function is used without the interface connector on the rear panel, for example in the case of controlling a scanner and the HP 4284A via HP-IB.

- 1. Move the cursor to the SCANNER I/F (#301) field on the SYSTEM CONFIG page. The following softkeys will be displayed in the softkey label area.
  - ON
  - OFF

2. Use the softkeys to set the scanner interface function to ON or OFF.

## System Menu

The system menu on this page allows you to perform the following functions.

#### ■ Printer

The printer function is the same as the function of PRINT DISP of the system menu on the MEAS DISPLAY page. (The description of the function is given in "System Menu" in Chapter 4.) So only the setting procedures for this function are described in the following paragraphs.

#### **Printer Function**

Perform the following steps to print out the displayed page or the measurement data using the PRINT DISP mode.

- 1. Connect the HP 4284A to the printer using an HP-IB cable.
- 2. Set the printer to the Listen Only mode.
- 3. Set the Talk Only mode to ON from the SYSTEM CONFIG page.
- 4. Move the cursor to the SYS MENU field.
- 5. Press PRINT DISP to print out the displayed page. The displayed page is printed out as shown in Figure 5-6.

```
<SYSTEM CONFIG>
                          SYS MENU
BEEPER
                 : OFF
HP-IB I/F
                  : INSTALLED
  HP-IB ADDRESS
                : 17
  TALK ONLY
                  : ON
POWER AMP
            (#001): INSTALLED
I BIAS I/F (#002): NOT INSTALLED
2m/4m CABLE (#006): NOT INSTALLED
HANDLER I/F (#201): INSTALLED
                  : ON
SCANNER I/F (#301): INSTALLED
                  : ON
```

Figure 5-6. SYSTEM CONFIG page Example

# **SELF TEST Page**

When you press (CATALOG/SYSTEM) and SELF TEST, the SELF TEST page will be displayed. This SELF TEST page is for service use. You can check the HP 4284A's digital functions using the self test functions listed on this page. The following self tests are included in this page. (Each number in parenthesis is used when each test is selected.)

- Memory Card Read/Write Test (No.1)
- LED Display Test (No.2)
- LCD Display Test (No.3)
- Handler Interface Test (No.4)
- Scanner Interface EEPROM Read/Write Test (No.5)
- Scanner Interface Input/Output Test (No.6)
- Bias Current Interface Input/Output Test (No.7)

There are two fields on this page,  $\langle SELF|TEST \rangle$ , and TESTMENU.

Each test is described in the following paragraphs.

The available fields and the softkeys which corresponded to the field on this page are shown in Figure 5-7 and Figure 5-8.

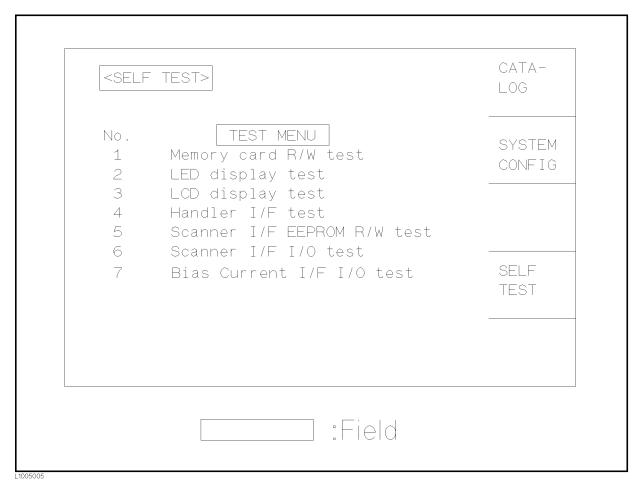


Figure 5-7. Available Fields on the SELF TEST Page

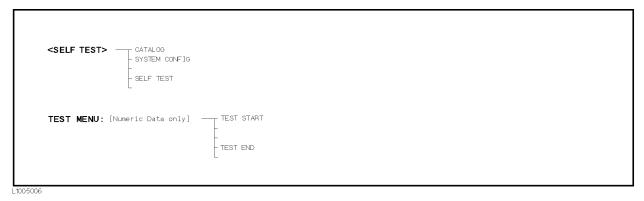


Figure 5-8. Available Softkeys on the SELF TEST Page

### **Memory Card R/W Test**

#### Description

This test is used to check the read and write functions of the memory card. When this test is started, a bit pattern is written to the lower address of the memory card, then pattern is read back and checked. This write pattern check is repeated from the low to high memory addresses.

#### How to Perform the Memory Card R/W Test

Perform the following steps to perform the memory card R/W test.

- 1. Move the cursor to the  $TEST\ MENU$  field on the  $SELF\ TEST$  page.
- 2. Press 1 and ENTER, to select test number 1. The ▶ MEMORY CARD R/W TEST screen will be displayed, and the following information indicating the address of the memory card is displayed.

START ADRS (HEX) = : Start address as a hexadecimal

expression

 $END \ ADRS \ (HEX) = :$  End address as a hexadecimal

expression

 $TEST \ ADRS \ (HEX) = :$  Current testing address as a

hexadecimal expression

3. Insert a memory card into the MEMORY card slot on the front panel.

Note



When this test is performed, data stored on the memory card is retained.

#### Caution



While this test is in progress, DO NOT remove the memory card, and DO NOT turn the HP 4284A OFF. If you do the data stored on the memory card may be lost.

4. Press TEST START to start the test.

#### Note



To abort the test, press TEST END.

If the test failed, the test is aborted and TEST ADRS (HEX)=on the display shows the address at which the test failed. Retry the test from step 1.

If the test passed, Test completed. will be displayed on the system message line.

5. Press TEST END to exit from the ►MEMORY CARD R/W TEST display.

### **LED Display Test**

#### Description

This test checks the five LEDs on the front panel. When this test is started, five LED indicators, RMT, LTN, TLK, SRQ and DC BIAS, will be toggled ON and OFF once per second.

#### How to Perform the LED Display Test

Use the following steps to perform the LED display test.

- 1. Move the cursor to the TEST MENU field on the SELF TEST page.
- 2. Press (2) and (ENTER) to select test number 2. The  $\triangleright LED$ DISPLAY TEST screen will be displayed.
- 3. Press TEST START to start the test. The five LED indicators, RMT, LTN, TLK, SRQ and DC BIAS, will be toggled ON and OFF once per second.
- 4. Press TEST END to stop the test and to exit from the  $\triangleright LED$ DISPLAY TEST screen.

# LCD Display Test

#### Description

This test checks the front panel LCD. When this test is started, all LCD characters used are displayed and toggled between the normal and inverse modes once per second.

#### How to Perform the LCD Display Test

Perform the following steps to perform the LCD display test.

- 1. Move the cursor to the TEST MENU field on the SELF TESTpage.
- 2. Press (3) and (ENTER), to set the test number to 3. The  $\blacktriangleright LCD$ DISPLAY TEST screen and all LCD characters will be displayed.
- 3. Press TEST START to start the test. The display will toggle between the normal and inverse modes once per second.
- 4. Press TEST END to stop the test and to exit from the  $\triangleright LCD$ DISPLAY TEST screen.

# Handler I/F Test

#### Description

This test checks the output signals of the Option 201 or 202 Handler Interface. When this test is started, each of the handler output signals is sequentially asserted for one second, until all output signals have been asserted, then the sequence is repeated until TEST END is pressed. This test using the Handler Simulator (HP PN 04278-65001) is described on CHAPTER 10, PERFORMANCE TEST.

# Scanner I/F EEPROM **R/W Test**

#### Description

This test checks the read and write functions of EEPROM for the Option 301 Scanner Interface. When this test is started, a bit pattern is written to the lower address of the EEPROM, then the write pattern is checked by reading back the bit pattern. This write pattern check is repeated from low to high EEPROM addresses.

#### How to Perform the Scanner I/F EEPROM R/W Test

Perform the following steps to perform the scanner interface EEPROM R/W test.

- 1. Move the cursor to the TEST MENU field on the SELF TEST page.
- 2. Press (5) and (ENTER), to set the test number to 5. The ►SCANNER I/F EEPROM R/W TEST screen will be displayed, and the following messages indicating the address of the scanner interface EEPROM are displayed.

START ADRS (HEX) = : Start address as a hexadecimal

expression

 $END \ ADRS \ (HEX) = :$ End address as a hexadecimal

expression

 $TEST\ ADRS\ (HEX) = :$ Current testing address as a

hexadecimal expression

Note



The Data stored in the EEPROM is retained when this test is performed.

3. Press TEST START to start the test.

Note



To abort the test, press TEST END.

If the test failed, the test is aborted and  $TEST\ ADRS\ (HEX) =$ on the display will show the address at which the test failed. Restart from step 1.

If the test passed, the message Test completed. will be displayed on the system message line.

4. Press TEST END to exit from the ▶SCANNER I/F EEPROM  $R/W\ TEST$  screen.

### Scanner I/F I/O Test

#### Description

This test checks the input/output signals of the Option 301 Scanner Interface. When the test is started, two scanner output signals (/INDEX and /EOM) are asserted alternately, and the input signals (CH No. and /CH\_VALID) are read when only the status of these signals is switched. These sequence is repeated until TEST END is pressed. This test uses the Scanner Simulator (HP PN 04278-65301) described on CHAPTER 10, PERFORMANCE TEST.

# Bias Current I/F I/O Test

### Description

This test checks the input/output signals of the Option 002 Bias Current Interface. When the test is started, the /CS\_0 and /CS\_1 output signals are alternately asserted, and ADDRESS and DO0 to DO7 output signals are changed in ascending order. Input signals DI0 to DI15 are read when only the status of these signals is switched. This sequence is repeated until TEST END is pressed. This test uses the Bias Current Interface Simulator (HP PN 42841-65001) described on Chapter 10.

# **Measurement Procedure and Examples**

# Introduction

This Chapter provides basic measurement procedures, basic L, C, and R measurement theory, and measurement hints. After the descriptions of basic measurement procedures, practical measurement examples are given using the HP 4284A.

# **Basic Measurement Procedure**

The following description shows the basic procedures used to measure the impedance of capacitors, inductors, resistors and other components. Follow the procedure to perform impedance measurements, referring to the paragraphs noted on right side of each step.

Procedure	Reference Paragraph
Start	
Setup the HP 4284A	■ IMPEDANCE PARAMETERS
measurement conditions.	■ PARALLEL/SERIES CIRCUIT MODE
	■ SIGNAL LEVEL
Connect the test fixture to the HP 4284A.	■ FOUR-TERMINAL PAIR CONFIGURATION
	■ MEASUREMENT CONTACTS
Setup the correction function.	■ CORRECTION FUNCTION
Connect DUT to the test fixture.	■ PARASITICS INCIDENT TO DUT CONNECTION
Perform measurement.	■ CHARACTERISTICS EXAMPLES

# **Impedance Parameters**

All circuit components, resistors, capacitors or inductors, have parasitic components lurking in the shadows waiting for the unwary, for example unwanted resistance in capacitors, unwanted capacitance in inductors, and unwanted inductance in resistors. Thus simple components should be modeled as complex impedances, for in fact that is what they are!

Figure 6-1 (A) shows the impedance definitions and (B) shows vector representation of impedance. Impedance, Z is the total opposition that a circuit or device offers to the flow of alternating current at a given frequency. Z contains a real and an imaginary part, and it is expressed in rectangular form as Resistance and Reactance, or in polar form as magnitude of Impedance and Phase as follows.

$$Z = R + jX = |Z| \angle \theta$$

$$|\mathbf{Z}| = \sqrt{\mathbf{R}^2 + \mathbf{X}^2}$$

$$\theta = \arctan\left(\frac{|X|}{R}\right)$$

$$R = R_s$$

Where,

Z:Impedance  $[\Omega]$ R:Resistance [ $\Omega$ ] X : Reactance  $[\Omega]$ 

 $|\mathbf{Z}|$ : Magnitude of Impedance [ $\Omega$ ]  $\theta$  : Phase of Impedance [deg or rad]

Series Resistance [ $\Omega$ ]  $R_s$ :

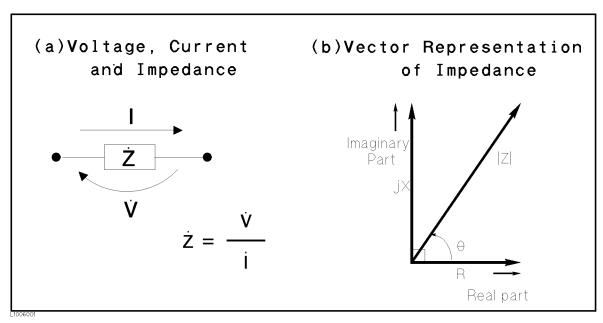


Figure 6-1. Definition of Impedance

The following parameters can be used to represent the reactance.

$$X = 2\pi f L$$

Where,

f: Frequency [Hz] L:Inductance [H]

In addition to these parameters, the Quality Factor (Q) and Dissipation Factor (D) are used to describe the quality of components.

$$Q = \frac{1}{D} = \frac{|X|}{R}$$

Where,

Q:Quality Factor D : Dissipation Factor

In some case, the reciprocal of impedance (Admittance), Y is used. Figure 6-2 shows the vector representation of admittance. As Z (Impedance), Y contains a real and an imaginary part, and is expressed in rectangular form as Conductance and Susceptance, or in polar form as magnitude of Admittance and Phase. The following are expressions for Admittance.

$$Y = \frac{1}{Z}$$

$$Y = G + jB = |Y| \angle \phi$$

$$|Y| = \sqrt{G^2 + B^2} = \frac{1}{|Z|}$$

$$\phi = \arctan\left(\frac{|B|}{G}\right) = -\theta$$

$$B = 2\pi fC$$

$$Q = \frac{1}{D} = \frac{|B|}{G}$$

$$G = \frac{1}{R_p}$$

Where,

Y: Admittance [S]
G: Conductance [S]
B: Susceptance [S]

|Y|: Magnitude of Admittance [S]  $\phi$ : Phase of Admittance [deg or rad]

C: Capacitance [F]

 $R_p$ : Parallel Resistance [  $\Omega$  ]

Note



The |Y|- $\theta$  measurement function of the HP 4284A can obtain the |Y| and  $\phi$  parameters given in the above equations.

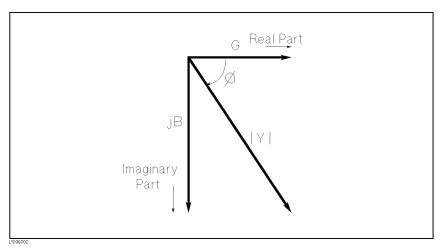


Figure 6-2. Vector Representation of Admittance

# Parallel/Series Circuit Mode

To measure L, C, or R, there are two equivalent circuit models, the parallel and series modes as shown in Table 6-1, and the HP 4284A can select the mode by setting the FUNC (C<sub>p</sub>, C<sub>s</sub>, L<sub>p</sub> or L<sub>s</sub>) on the MEAS SETUP page. To determine which mode is best, consider the relative impedance magnitude of the reactance and  $R_s$  and  $R_p$ .

Table 6-1. Parallel/Series Circuit Mode				
Circuit Mode	M easurement Function	Definition of D, Q and G		
$\mathrm{C}_{\mathrm{p}}$ mode	$egin{array}{c} C_p ext{-}D \\ C_p ext{-}Q \\ C_p ext{-}G \\ C_p ext{-}R_p \end{array}$	$D = \frac{1}{2\pi f C_p R_p} = \frac{1}{Q}$ $G = \frac{1}{R_p}$		
$\mathrm{C_s}$ mode	$egin{array}{c} C_s ext{-}D \ C_s ext{-}Q \ C_s ext{-}R_s \end{array}$	$D = 2\pi f C_s R_s = \frac{1}{Q}$		
$ m L_p\ mode$	$\begin{array}{c} L_p\text{-}D \\ L_p\text{-}Q \\ L_p\text{-}G \\ L_p\text{-}R_p \end{array}$	$Q = \frac{R_p}{2\pi f L_p} = \frac{1}{D}$ $G = \frac{1}{R_p}$		
$\rm L_s$ mode	$\begin{array}{c} L_s\text{-}D \\ L_s\text{-}Q \\ L_s\text{-}R_s \end{array}$	$Q = \frac{2\pi f L_s}{R_s} = \frac{1}{D}$		

Table 6-1 Parallel/Series Circuit Mode

# **Selecting Circuit Mode** of Capacitance

The following description gives some practical guide lines for selecting the capacitance measurement circuit mode.

#### Small Capacitance (modeled by (a) in Figure 6-3)

Small capacitance yields large reactance, which implies that the effect of the parallel resistance (R<sub>D</sub>) has relatively more significance than that of series resistance (R<sub>s</sub>). The low value of resistance represented by R<sub>s</sub> has negligible significance compared with the capacitive reactance, so the parallel circuit mode (C<sub>p</sub>-D or C<sub>p</sub>-G) should be

### Large Capacitance (modeled by (b) in Figure 6-3)

When the converse is true and the measurement involves a large value of capacitance (low impedance), R<sub>s</sub> has relatively more significance than R<sub>p</sub>, so the series circuit mode (C<sub>s</sub>-D or C<sub>s</sub>-Q) should be used.

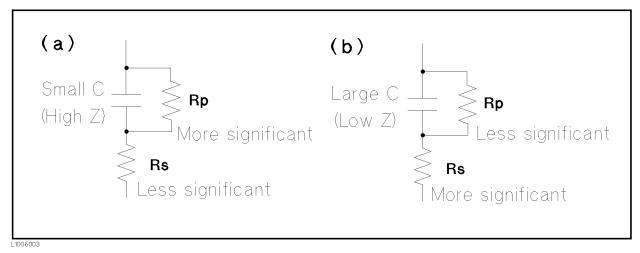


Figure 6-3. Capacitance Circuit Mode Selection

The following is a rule of thumb for selecting the circuit mode according to the impedance of the capacitor.

•Above approx. 10 k $\Omega$ : use parallel circuit mode •Below approx. 10  $\Omega$ : use series circuit mode •Between above values : follow the manufacturer's recommendation

For example, to measure a 20  $\mu$ F capacitor at 1 kHz (impedance will be approximately  $8 \Omega$ ), the  $C_s$ -D or  $C_s$ -Q function is suitable.

### Selecting Circuit Mode of Inductance

The following description gives some practical guide lines for selecting the inductance measurement circuit mode.

#### Large Inductance (modeled by (a) in Figure 6-4)

The reactance at a given frequency is relatively large (compared with that of a small inductance), so the parallel resistance becomes more significant than the series component. So, a measurement in the parallel equivalent circuit mode (L<sub>p</sub>-D, L<sub>p</sub>-Q or L<sub>p</sub>-G) is more suitable.

### Small Inductance (modeled by (b) in Figure 6-4)

Conversely, for low values of inductance the reactance becomes relatively small (compared with that of a large inductance) so the series resistance component is more significant. So, the series equivalent circuit mode (L<sub>s</sub>-D or L<sub>s</sub>-Q) is the appropriate choice.

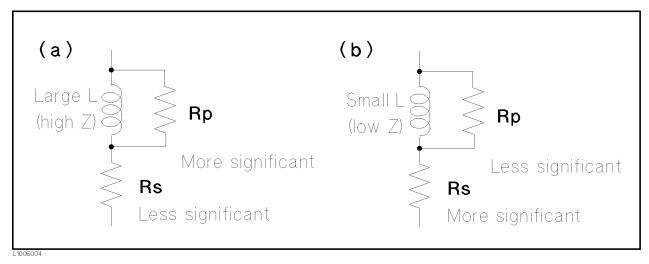


Figure 6-4. Inductance Circuit Mode Selection

The following is a rule of thumb for selecting the circuit mode according to the impedance of the inductor.

•Below approx. 10  $\Omega$ : use series circuit mode • Above approx. 10 k $\Omega$ : use parallel circuit mode •Between above values: follow the manufacturer's

recommendation

For example, to measure a 1 mH inductor at the 1 kHz (impedance may be approximately 6.3  $\Omega$ ), L<sub>s</sub>-D or L<sub>s</sub>-Q function is suitable.

# Signal Level

Most components have impedance characteristics that are dependent on the applied signal level. So, the oscillator level setting should be set appropriate for the DUT.

## Signal Level **Across The DUT**

Figure 6-5 shows a simplified model of the HP 4284A and a DUT. The signal level across the DUT depends on the oscillator level, the source resistance of the HP 4284A, and the impedance of the DUT, as follows.

$$\begin{aligned} |V_{\rm m}| &= \frac{|Z_{\rm x}|}{|R_{\rm so} + Z_{\rm x}|} \times |V_{\rm osc}| \\ |I_{\rm m}| &= \frac{|V_{\rm osc}|}{|R_{\rm so} + Z_{\rm x}|} \end{aligned}$$

Where,  $|V_{\rm osc}|$ : oscillator voltage level of the HP 4284A,

 $R_{so}$ : Source resister of the HP 4284A (= 100  $\Omega$ ),

|V<sub>m</sub>|: Signal voltage level applied on DUT, |I<sub>m</sub>|: Signal current level flowed in DUT,

 $|Z_x|$ : Impedance of DUT.

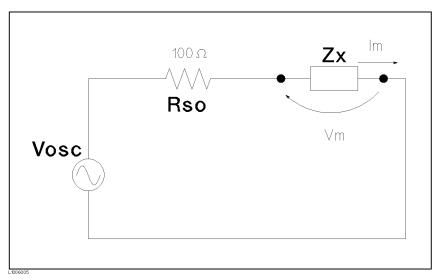


Figure 6-5. Simplified Model of Signal Level and DUT

### Oscillator Level Setting

The HP 4284A's oscillator level (Vosc in Figure 6-5) can be set to the appropriate value in the voltage or current mode. Using the ALC (automatic level control) function, the signal level set is the same as the applied level across the DUT (Vm or Im in Figure 6-5). So the signal level setting mode can be selected in the following four ways.

- Oscillator level set as voltage and ALC set to OFF: The open terminal voltage is set to the entered voltage value in the LEVEL field.
- Oscillator level set as current and ALC set to OFF: The short terminal current is set to the entered current value in the LEVEL field.
- Oscillator level set as voltage and ALC set to ON: The signal level across the DUT is set to the entered voltage value in the LEVEL field.
- Oscillator level set as current and ALC set to ON: The signal level across the DUT is set to the entered current value in the LEVEL field.

For more information for the ALC function, refer to Chapter 4, Automatic Level Control Function.

Note



By using the level monitor function (Vm and Im on the MEAS DISPLAY page), the actual signal level across the DUT (Vm and Im in Figure 6-5) can be monitored.

#### Signal Level Setting Selection Example for Inductance Measurements

An inductor's inductance value may differ widely depending on the current through the inductor due to the permeability of its core material. Inductance measurements under constant current signal levels allows you to extract the frequency characteristics of the inductor isolated from its signal level characteristics.

To make constant current level measurements, set appropriate oscillator level in current value, and set ALC to ON. The signal current level through the inductor will be constant.

# Four-Terminal Pair Configuration

Generally, any mutual inductance, interference of the measurement signals, and unwanted residual factors in the connection method incidental to ordinary termination methods will have significant effects on the measurements, especially at a high frequency. The HP 4284A employs the four-terminal pair measurement configuration which permits easy, stable, and accurate measurements and avoids the measurement limitations inherent to such factors.

Figure 6-6 shows the four-terminal pair measurement principle. The UNKNOWN terminals consists of four coaxial connectors.

■ H<sub>CUB</sub> : High current ■ H<sub>POT</sub>: High potential  $\blacksquare$  L<sub>POT</sub> : Low potential  $\blacksquare$  L<sub>CUR</sub> : Low current

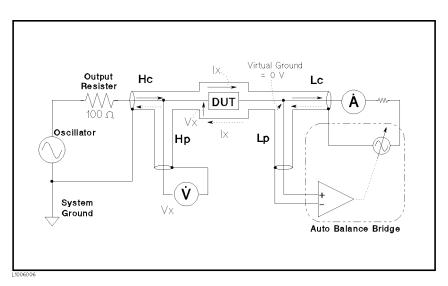


Figure 6-6. Four-Terminal Pair Measurement Principle

The four-terminal pair measurement method has the advantage in both low and high impedance measurements. The outer shield conductors work as the return path for the measurement signal current (they are not grounded). The same current flows through both the center conductors and outer shield conductors (in opposite directions), but no external magnetic fields are generated around the conductors (the magnetic fields produced by the inner and outer currents completely cancel each other). Because the measurement signal current does not develop an inductive magnetic field, test leads do not contribute additional errors due to self or mutual inductance between the individual leads.

# **Measurement Contacts**

This paragraph gives general notes and techniques for using the four-terminal pair configuration efficiently. To realize accurate measurements using the four-terminal pair measurement technique, the following are required to make measurement contacts (the number labels in the following description corresponds to the numbers in Figure 6-7).

- 1. The signal path between the HP 4284A and DUT should be as short as possible.
- 2. To construct the four-terminal pair measurement circuit configuration, the outer shields of H<sub>CUR</sub> and H<sub>POT</sub>, L<sub>CUR</sub> and L<sub>POT</sub> terminals must be respectively connected together at the point as near as possible to the point at which the DUT will connected.
- 3. Keep connections between the point at which the shielding ends and DUT as short as possible.

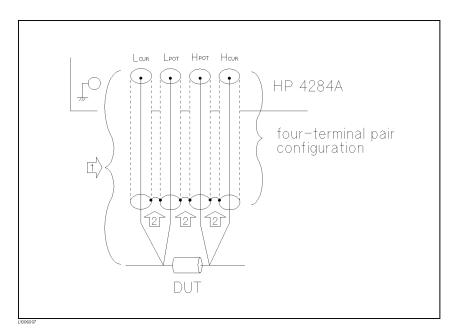


Figure 6-7. Measurement Contacts

The following paragraphs will give you some techniques for using the four-terminal pair configuration effectively and efficiently.

# **Capacitance To Ground**

To measure capacitors of 10 pF or less, the stray capacitance (when the conductors are grounded, this is capacitance to ground), between the measurement contacts and the conductors near the capacitor will influence the measurement, as shown in Figure 6-8.

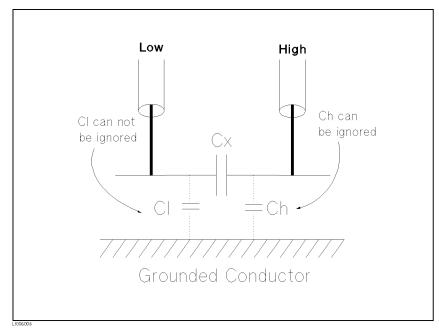


Figure 6-8. Model of Capacitance to Ground

To minimize the stray capacitance of the test leads, the center conductor of the test leads should be kept as short as possible, as shown in Figure 6-9 (A). If four-terminal pair connections are close to the point where contact is made with the DUT, interconnect the shields of the measurement terminals to the conductor to reduce the influence of the stray capacitance to ground, as shown in Figure 6-9 (B).

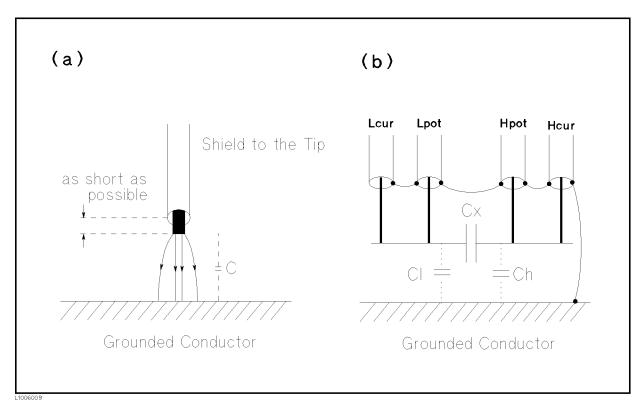


Figure 6-9. Reducing Capacitance to Ground

#### **Contact Resistance**

Contact resistance between the contacting terminals and the DUT causes measurement error when measuring large values of capacitance, especially in D (dissipation factor) measurements.

When measuring large capacitance values, the four-terminal measurement contacts have the advantage of less measurement error as compared to the two terminal method. Select a test fixture which can hold the DUT tight to stabilize the connection.

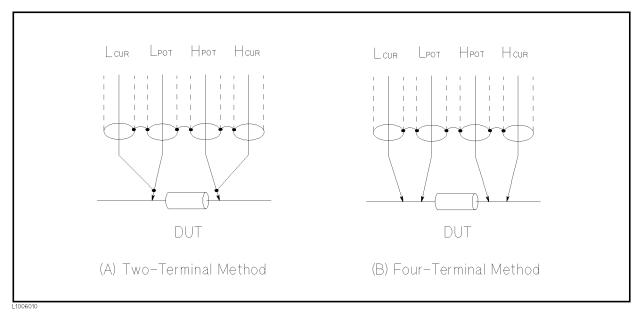


Figure 6-10. Contact Resistance

# **Extending Test Leads**

When extending the four-terminal pair test leads to the contacts of DUT, make the contacts as shown in Figure 6-11. If the measurement contact cannot be made using the four-terminal pair configuration, use one of the connection methods shown in Figure 6-12, to make the measurement contact.

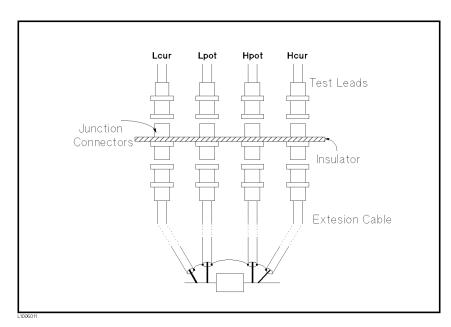


Figure 6-11. Extending The Four-Terminal Pair Test Leads

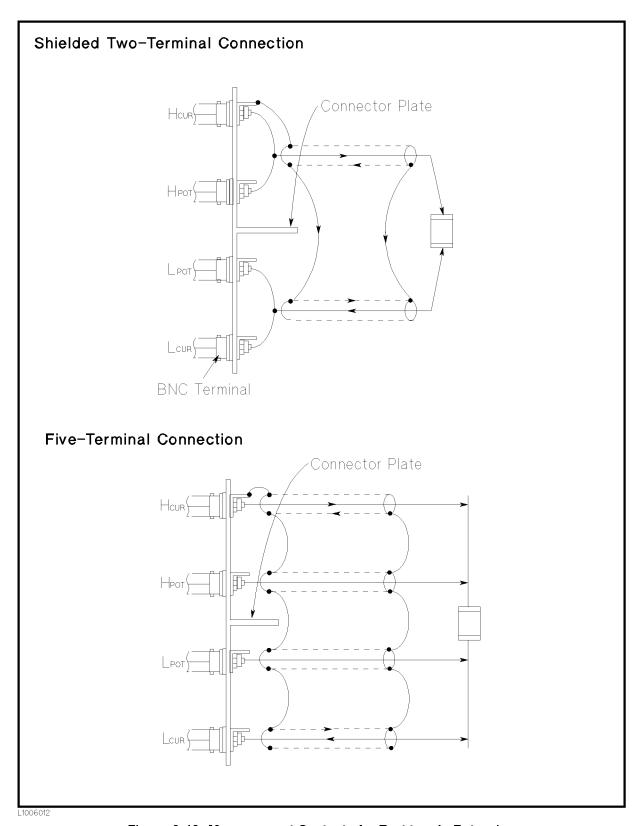


Figure 6-12. Measurement Contacts for Test Leads Extension

# **Guarding For Low** Capacitance Measurements

Use a guard plate to minimize measurement errors caused by stray capacitance when measuring low capacitance values, such as low capacitance chip capacitors. Figure 6-13 shows an example of measurement contacts using a guard plate in the four-terminal pair measurement configuration.

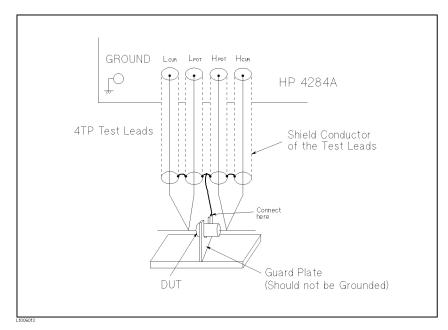


Figure 6-13. Example DUT Guard Plate Connection

# **Shielding**

Shielding minimizes the effects of electrical noise picked up by the test leads. So provide a shield plate and connect it to the outer shield conductors of the four-terminal pair test leads as shown in Figure 6-14.

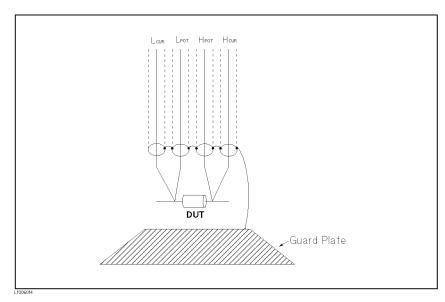


Figure 6-14. Guard Shield

# **Correction Functions**

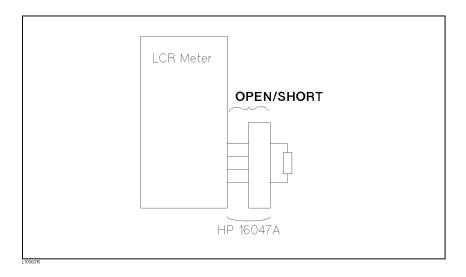
The HP 4284A has powerful correction functions, Cable Length correction, and OPEN, SHORT, and LOAD corrections. These correction functions are used to correct additional error due to the test fixture and the test leads. Table 6-2 lists the Correction functions with a brief description.

**Table 6-2. Correction Functions** 

Correction	Description	Typical Usage			
Selection	2 55 52 19 52 521	1, prodr o 2480			
Cable Length Correction	Correct phase shift error due to the 1 or 2 m test Leads.	• Measurements using the HP 16048A/D			
OPEN Correction	Correct for stray admittance due to the test fixture.	• High impedance measurements			
SHORT Correction	Correct for residual impedance due to test fixture.	• Low impedance measurements			
OPEN/ SHORT Correction	Correct the stray admittance and residual impedance due to the test fixture.	• Precise measurements			
OPEN/ SHORT/ LOAD due to the test fixture and test leads by using the standard.		<ul> <li>Measurements to be referenced to a standard</li> <li>Measurements using a test fixture that has complicated impedance</li> </ul>			
		characteristics  For example, the HP 4284A  combined with the scanner.			

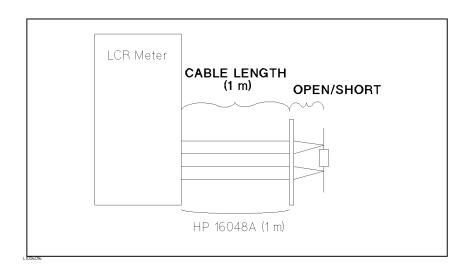
■ Simple measurements using an HP supplied direct connecting test fixture

In this case, LOAD correction is not required, OPEN/SHORT correction is enough to correct the residual errors.



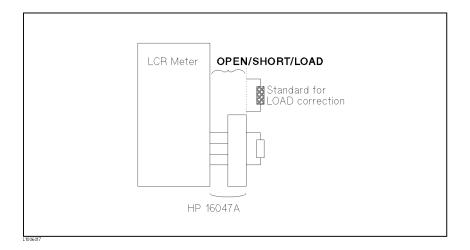
■ Measurements using HP test leads and a test fixture.

In this case, CABLE LENGTH and OPEN/SHORT correction is used. Of course CABLE CORRECTION must be performed completely described in "Cable Length Selection" in Chapter 4.



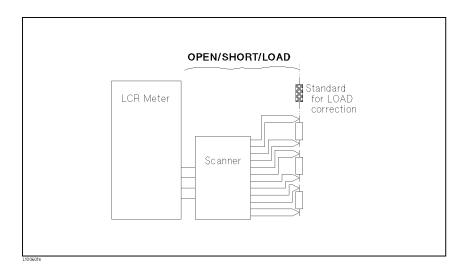
■ Precise measurements to be referenced to a working standard. Use the working standard as the LOAD reference DUT and

perform the OPEN/SHORT/LOAD correction.



■ Measurements using a test fixture that has complicated impedance characteristics.

In this case, use the OPEN/SHORT/LOAD correction. When you combine a scanner, the HP 4284A with Option 301 scanner interface provides powerful error correction functions for up to three sets of OPEN/SHORT/LOAD correction data for 128 channels.



## **Performing OPEN** Correction

To perform an OPEN correction data measurement, set up an OPEN condition, nothing is connected to the test fixture. When the OPEN measurement is being performed, don't touch or move your hands near the test fixture.

## **Performing SHORT** Correction

To perform a SHORT correction data measurement, set up a SHORT condition, using a shorting bar to short between high terminal and low terminal of the UNKNOWN terminals.

Figure 6-15 shows a sample shorting bar (HP Part Number 5000-4226) for the HP 16047A/C/D test fixtures.

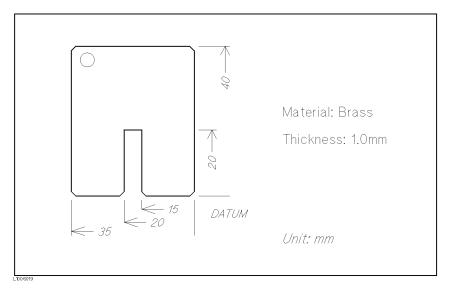


Figure 6-15. Sample Shorting Plate

The shorting bar should have very low residual impedance, so a high conductivity metal plate that is not easily corroded, is recommended for the shorting plate. (It must be clean.)

Photo

### Figure 6-16. Shorting Plate Connection

## **Performing LOAD** Correction

To perform LOAD correction data measurement, connect the LOAD standard to the measurement contacts.

### Preparing the Standard

It is necessary to prepare the working standard, such as a standard resistor and standard capacitor. It is recommended that you select a standard whose impedance is as close as possible to DUT's impedance. The following are recommendations for selecting standards.

■ For capacitance measurements:

A standard capacitor whose capacitance is nearly equal to the DUT capacitance is recommended.

■ For resistance measurements:

A standard resistor whose resistance is nearly equal to DUT's resistance is recommended.

■ For inductance measurements:

A standard inductor whose inductance is nearly equal to DUT's inductance is recommended.

#### Reference Values of the LOAD Standard

Enter specified reference values of the standard as the REF A and  $REF\ B$  values using the appropriate function on the CORRECTIONpage. For example, When using a standard capacitor which has a specified parallel capacitance and D values, enter the specified

parallel capacitance value as the REFA value and the specified D value as the  $REF\ B$  value with  $C_p$ -D function.

Note



If the REF A and REF B values are entered with the  $C_p$ -D function, measurements with other functions (such as the  $|Z|-\theta$  function) can be performed.

### Using the Pre-Measured Device for the LOAD

Even if you have no standard which has specified reference values, you can perform a LOAD correction using a device such as a general purpose capacitor or resistor. The pre-measured values of a device are used for the  $REF\ A$  and  $REF\ B$  values. Follow the procedure shown in below to use a device for the LOAD standard.

- 1. Prepare a device, whose impedance is as close as possible to the DUT's impedance, for the LOAD standard.
- 2. If the device has BNC connectors constructed in the four-terminal pair configuration, measure the device directly, do not use a test fixture (connect it directly to the HP 4284A).

If the device does not have four-terminal pair measurement terminals, measure the device using a direct coupling test fixture (such as the HP 16047A/C/D).

3. On the CORRECTION page, enter the measured values obtained in step 2 as the REFA and REFB values with the function used in step 2.

# **Parasitics Incident** to DUT Connection

You should consider that some parasitics remain in measurement path even after performing corrections, as follows.

Figure 6-16 shows parasitic impedance model after corrections performed using the HP 16047A/C/D test fixture. In this case, to minimize the influence of parasitics on measurement the values, insert DUT completely into the test fixture (keep the leads of the DUT as short as possible).

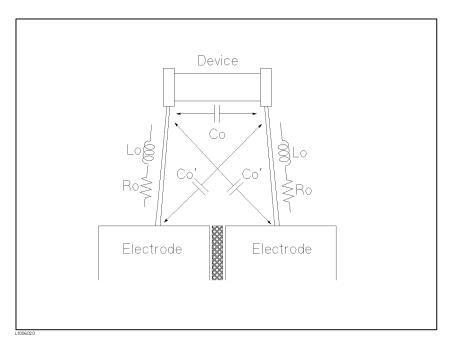


Figure 6-17. Parasitic Impedance Model (Using the HP 16047A/C/D)

L<sub>o</sub>: Residual inductance in DUT lead Lead resistance in DUT lead  $R_o$ :

 $C_o$ : Stray capacitance

# **Characteristics Example**

Figure 6-18 shows typical characteristics of various components. As can be seen in the figure, a component may have different effective parameter values dependent upon its operating conditions. The measured values most useful in actual applications are obtained from precise measurement under the actual operating conditions.

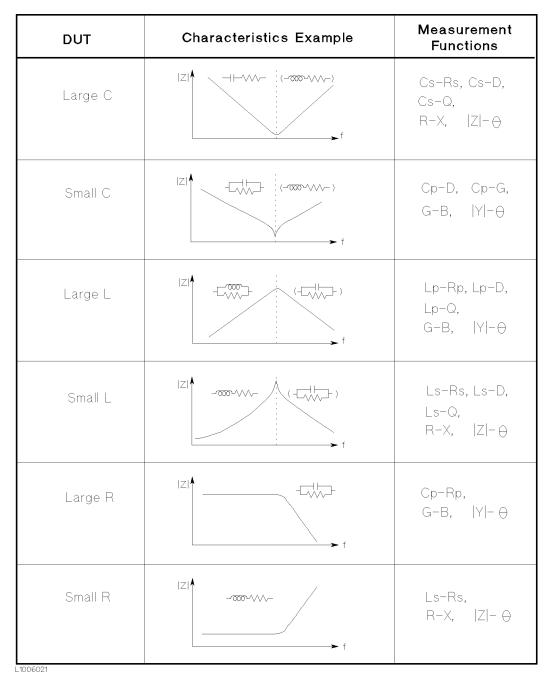


Figure 6-18. Typical Characteristics of Components

# Capacitor Measurements

This paragraph describes practical example of measuring a 470 pF ceramic capacitor.

The basic procedure flow to perform this measurement is the same as the BASIC MEASUREMENT PROCEDURE described previously. In this example a 470 pF ceramic capacitor will be measured under the following conditions.

Sample (DUT): 470 pF ceramic capacitor (HP Part Number

0160 - 3335)

Measurement Conditions

Function:  $C_{p}$ -D $1 \mathrm{~MHz}$ Frequency: 1.5 V Test Signal Level:

### Caution



Do not apply DC voltage or current to the UNKNOWN terminals. Doing so will damage the HP 4284A. Before you measure a capacitor, be sure the capacitor is fully discharged.

1. Turn the HP 4284A ON.

2. Setup the HP 4284A's measurement conditions by filling in the fields on the MEAS DISPLAY page.

Set FREQ field to 1 MHz, and LEVEL field to 1.5 V. (The other functions, including the measurement function are left as the default settings.)

- a. Move the cursor to the FREQ field. The current measurement frequency, 1.00000kHz, is displayed in this field.
- b. Press (1). 1 will be displayed on the system message line, and the softkey labels will change to the available units (Hz, kHz, and MHz). Press MHz. 1.00000MHz is now displayed in the FREQ field.

#### Note



The FREQUENCY can be changed using INCR and DECR displayed when the CURSOR moved to the FREQ field.

- c. Move the cursor to the LEVEL field. The current test signal level, 1.00V, is displayed in this field.
- d. Press (1), (5). 1.5 will be displayed on the system message line, and the softkey labels are changed to the available units (mV, V,  $\mu$ A, mA and A). Press V. 1.50V is now displayed in the LEVEL field.

### Note



The OSC LEVEL can be changed using with INCR and DECR displayed when the cursor is moved to the LEVEL field.

#### Note



These measurement conditions can also be set from the MEAS SETUP page which is displayed when (MEAS SETUP) is pressed. The set up operation from the MEAS SETUP page is the same as in the preceding steps 1 to 4.

3. Connect the test fixture to the HP 4284A.

The HP 16047A Direct Couple Test Fixture (general purpose) is used for this measurement.

Connect the HP 16047A to the HP 4284A's UNKNOWN terminals, as shown in Figure 6-19.

Figure CONNECT-FIXTURE here.

Figure 6-19. Connecting the HP 16047A

4. Perform the correction.

To compensate for the HP 16047A's residuals and strays, an OPEN/SHORT correction is required.

- a. Leave the HP  $16047\mathrm{A}$  in an OPEN condition as shown in Figure 6-17.
- b. Press (MEAS SETUP), and CORRECTION. The CORRECTION page will now be displayed.
- c. Move the cursor to the OPEN field. ON, OFF and MEAS OPEN will be displayed.
- d. Press MEAS OPEN to perform the OPEN correction data measurement. Wait until the message OPEN measurement completed. is displayed on the system message line.
- e. Press ON to set the OPEN correction function to ON.
- f. Connect a shorting bar to the HP 16047A to set up the SHORT condition as shown in Figure 6-20.

Figure SHORT-BAR here.

### Figure 6-20. Connecting A Shorting Bar

- g. Move the cursor to the SHORT field. ON , OFF and MEAS SHORT will be displayed.
- h. Press MEAS SHORT to perform the SHORT correction data measurement. Wait until the message SHORT measurement completed. is displayed on the system message line.
- i. Press ON to set the SHORT correction function to ON.
- 5. Connect DUT to the test fixture.

Insert the DUT into the HP 16047A's measurement contacts deeply as shown in Figure 6-21.

Figure DUT here.

Figure 6-21. Connecting DUT

6. Perform the measurement.

# Press (DISPLAY FORMAT)

Measurements are performed continuously by the internal trigger, and the capacitors measured C<sub>p</sub> and D values are displayed as large characters as shown in Figure 6-22.

MEAS <MEAS DISPLAY> SYS MENU DISP FUNC : Cp-D RANGE: AUT0 BIAS : FREQ: 1.00000MHz 0.000 V BIN LEVEL: 1.50 V INTEG: MED No. Cp: 484.101 рF BIN COUNT .017368 LIST SWEEP 1.431 V : 4.280mA  $\vee m$ Ιm CORR: OPEN. SHORT

Figure 6-22. Measurement Results of A 470 pF Capacitor

# Inductance **Measurements**

This paragraph describes a practical example of measuring a 64  $\mu$ H magnetic-core inductor.

The basic procedure flow to perform this measurement is the same as for the BASIC MEASUREMENT PROCEDURE described previously. A 64  $\mu$ H magnetic-core inductor will be measured under the following conditions.

Sample (DUT):  $64 \mu H$  magnetic-core inductor (HP Part Number 9140-1401)

Measurement Conditions

Function:  $L_s$ - $R_s$ Frequency: 100 kHz

Test Signal Level: 10 mA (constant)

- 1. Turn the HP 4284A ON.
- 2. Setup the HP 4284A measurement conditions by filling the fields on the MEAS DISPLAY page.

Set FUNC to L<sub>s</sub>-R<sub>s</sub>, FREQ to 100 kHz, and LEVEL to 10 mA constant. (The other functions will be left as the default settings.)

- a. Move the cursor to the FUNC field. The Current measurement function,  $C_{p}$ -D, is displayed in this field, and Cp-D, Cp-Q, Cp-G, Cp-Rp and more 1/6 are displayed.
- b. Press more 1/6. Cs-D, Cs-Q, Cs-Rs and more 2/6 will be displayed.
- c. Press more 2/6. Lp-D, Lp-Q, Lp-G, Lp-Rp and more 3/6 will be displayed.
- d. Press more 3/6. Ls-D, Ls-Q, Ls-Rs and more 4/6 will be displayed.
- e. Press Ls-Rs to select the  $L_s$ - $R_s$  measurement function.
- f. Move the cursor to the FREQ field. The current measurement frequency, 1.00000kHz, will be displayed in this field.
- g. Press (1), (0), (0). 100 will be displayed on the system message line, and the softkey labels will change to the available units (Hz, kHz, and MHz). Press kHz. 100.000 kHz is displayed on the FREQ field.

#### Note



FREQ can be changed using INCR and DECR displayed when the CURSOR is moved to the FREQ field.

- h. Move the cursor to the LEVEL field. The current test signal level, 1.00V, will be displayed in this field.
- i. Press (1), and (0). 10 will be displayed on the system message line, and the softkey labels are changed to the available units  $(mV, V, \mu A, mA \text{ and } A)$ . Press mA. 10.0mA is displayed on the LEVEL field.

#### Note



These measurement conditions can also be set from the MEASSETUP page displayed when (MEAS SETUP) is pressed. The setting operation on the MEAS SETUP page is same as in the preceding steps (a) to (i).

- j. Press (MEAS SETUP). The MEAS SETUP page is displayed.
- k. Move the CURSOR to the ALC field. The current status of the ALC function, OFF, is displayed on this field, and ON and OFF are displayed.
- 1. Press ON to set the test signal current level to be constant.
- 3. Connect the test fixture to the HP 4284A.

The HP 16047A Direct Couple Test Fixture (general purpose) is used for this measurement.

Connect the HP 16047A to the HP 4284A's UNKNOWN terminals, as shown in Figure 6-23.

### Figure CONNECT-FIXTURE-L here.

### Figure 6-23. Connecting the HP 16047A

4. Perform the correction.

To compensate the HP 16047A's residuals and strays, an OPEN/SHORT correction is required.

- a. Leave the HP 16047A in an OPEN condition as shown in Figure 6-21.
- b. Press (MEAS SETUP), and CORRECTION. The CORRECTIONpage will be displayed.
- c. Move the cursor to the OPEN field. ON, OFF and MEAS OPEN will be displayed.
- d. Press MEAS OPEN to perform the OPEN correction data measurement. Wait until the message OPEN measurement completed. is displayed on the system message line.
- e. Press ON to set the OPEN correction function to ON.
- f. Connect a shorting bar to the HP 16047A to set up the SHORT condition as shown in Figure 6-24.

Figure SHORT-BAR-L here.

### Figure 6-24. Connecting A Shorting Bar

- g. Move the cursor to the SHORT field. ON, OFF and MEAS SHORT will be displayed.
- h. Press MEAS SHORT to perform the SHORT correction data measurement. Wait until the message SHORT measurement completed. is displayed on the system message line.
- i. Press ON to set the SHORT correction function to ON.
- 5. Connect the DUT to the test fixture.

Insert the DUT into the HP 16047A's measurement contacts deeply, as shown in Figure 6-25.

Figure DUT-L here.

#### Figure 6-25. Connecting DUT

6. Perform the measurement.

## Press (DISPLAY FORMAT).

Measurements are performed continuously by the internal trigger, and the measured L<sub>s</sub> and R<sub>s</sub> values of the magnetic-cored inductor are displayed in large characters as shown in Figure 6-26.

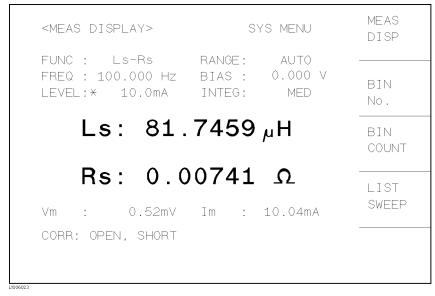


Figure 6-26. Measurement Results of The Magnetic-Cored Inductor

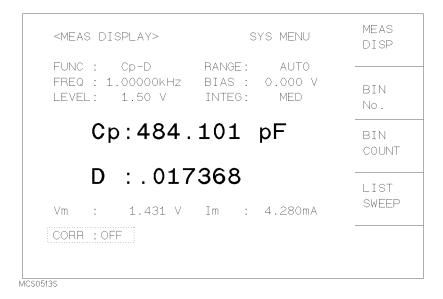
# If the HP 4284A does NOT Measure Correctly

The HP 4284A is working correctly but its measurement results seem strange. For example:

- The HP 4284A does not measure at all.
- Measurement value is strange.
- Measurement value is strange at a specific frequency point or points.

These situations may be caused by the incorrect correction data. If you come upon these situations, use the following procedure to check the instrument.

- 1. Turn correction OFF.
  - a. Press (MEAS SETUP), CORRECTION.
  - b. Move the cursor to the *OPEN* field and press **OFF**.
  - $^{\mathrm{c.}}$  Move the cursor to the SHORT field and press OFF.
  - d. Move the cursor to the LOAD field and press OFF.
  - e. Press (DISPLAY FORMAT) and confirm CORR: turns OFF.



2. Measure the DUT again. If the HP 4284A now measures properly then the correction data may have been improperly obtained or saved. Carefully perform the correction procedure again and measure the DUT.

For more information on the correction procedure, refer to chapter 4, "CORRECTION Page".

# **Remote Control**

## Introduction

This chapter provides the following information to remotely control the HP 4284A via the Hewlett-Packard Interface Bus (HP-IB).

- Reference information for programming the HP 4284A
- Introduction to the Standard Commands for Programmable Instruments (SCPI)
- Tutorial information for the SCPI programmer

# **Hewlett-Packard** Interface Bus (HP-IB)

HP-IB is Hewlett-Packard's implementation of IEEE standard 488.1-1987. And IEEE standard 488.1-1987 is identical to the original IEEE standard 488-1978.

#### **HP-IB Connection**

When configuring an HP-IB system, the following restrictions must be adhered to.

- The total length of cable in one bus system must be less than or equal to two meters times the number of devices connected on the bus (the HP-IB controller counts as one device) and the total length of cable must not exceed 20 meters.
- A maximum of 15 devices can be connected on one bus system.
- There are no restrictions on how the cables are connected together. However, it is recommended that no more than four piggyback connectors be stacked together on any one device. The resulting structure could exert enough force on the connector mounting to damage it.

For example, a system containing six devices can be connected together with cables that have a total length of less than or equal to 12 meters (six devices  $\times$  2m/device = 12 meters). The individual length of cable may be distributed in any manner desired as long as the total length does not exceed the allowed maximum. If more than ten devices are to be connected together, cables shorter than two meters must be used between some of the devices to keep the total cable length less than 20 meters.

Figure 7-1 shows an HP-IB interface connector. The HP 4284A uses all of the available HP-IB lines; therefore, damage to any connector pin will adversely affect its HP-IB operation.

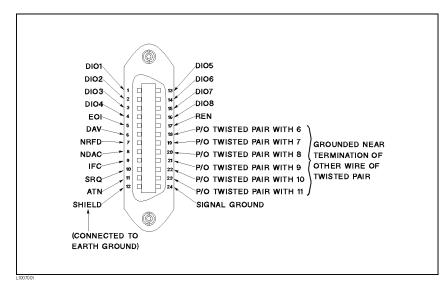


Figure 7-1. HP-IB Connector Signal/Pin Configuration

Table 7-1. HP-IB Interconnect Cables

HP Part Number	Length
10833A	1 m (3.3 ft)
10833B	2 m (6.6 ft)
10833C	4 m (13.2 ft)
10833D	0.5 m (1.6 ft)

Typical HP-IB system interconnection is shown in Figure 7-2. The HP-IB connector is firmly fastened using two bolts to keep it from working loose during use.

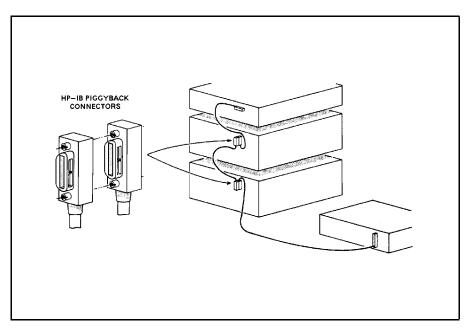


Figure 7-2. Typical HP-IB System Interconnection

# **HP-IB** Capability

Table 7-2 lists the HP 4284A's HP-IB capabilities and functions. These functions provide the means for an instrument to receive, process, and transmit, commands, data, and status over the HP-IB bus.

Table 7-2. HP-IB Interface Capability

Code	Function
SH1	Complete Source Handshake capability
AH1	Complete Acceptor Handshake capability
Т5	Basic Talker; serial poll; unaddressed if MLA; Talk-Only
L4	Basic Listener; unaddressed if MTA; no Listen Only
SR1	Service Request capability
RL1	Remote/Local capability
DC1	Device Clear capability
DT1	Device Trigger capability
C0	No Controller capability
E1	Drivers are open-collector

## **HP-IB Addressing**

The HP 4284A's HP-IB address is stored in non-volatile memory and can be set to any address from 0 to 30 by front panel key entry in the SYSTEM CONFIG page. When the HP 4284A is shipped from the factory the default HP-IB address is 17. For more information, refer to "How to Set the HP-IB Address" in Chapter 5.

## **HP-IB Bus Capability**

The HP 4284A will respond to the following bus commands which are given as HP 9000 series 200/300 BASIC statements.

#### ABORT I/O (IFC)

ABORT I/O (IFC control line TRUE) halts all bus activity and deselects the HP 4284A.

For example:

ABORT 7

### CLEAR LOCKOUT/SET LOCAL

CLEAR LOCKOUT/SET LOCAL (REN control line false) releases devices on the bus from the lockout mode and returns them to local (front panel) control. The difference between CLEAR LOCKOUT/SET LOCAL, and LOCAL is in the addressing method used.

For example:

LOCAL 7

#### **DEVICE CLEAR (SDC or DCL)**

This command can be used with an address to clear a particular device (SDC: selected device clear) or used without an address (DCL: clears all devices). The HP 4284A will initialize the following items only when it receives this command. Then the:

- Input buffer is cleared
- Output data buffer is cleared
- Bit 4 (MAV bit) of the status byte is set to "0"

For example:

CLEAR 7

### LOCAL (GTL)

LOCAL returns control of a listening device to front panel control.

For example:

LOCAL 717

#### LOCAL LOCKOUT (LLO)

LOCAL LOCKOUT disables the LOCAL operation (HP 4284A: Pressing (LCL)) of all devices on the bus. After this command is sent you will be unable to operate the HP 4284A from the front panel. Execute the LOCAL command to undo LOCAL LOCKOUT.

For example:

LOCAL LOCKOUT 7

#### REMOTE

REMOTE sets the HP 4284A to the remote mode. When this command is sent, front panel with the exception of LCL will be disabled.

For example:

REMOTE 717

#### **SPOLL**

SPOLL is the serial polling command. SPOLL is used to place the status byte of the addressed instrument on the bus. The eight bits of the status byte can be masked off and read to determine the HP 4284A's operating state.

For example:

Var=SPOLL(717)

#### **SERVICE REQUEST**

The HP 4284A can send an SRQ (Service Request) control signal when it requires the controller to perform a task. An SRQ can be thought of as an interrupt which informs the controller that information is ready to be transmitted, or that an error condition exists in the instrument. When the HP 4284A sends an SRQ it also sets Bit 6 of the status byte. Bit 6 is the RQS (Request Service) bit, sometimes referred to as the status bit in connection with polling. When the HP 4284A is serially polled, it clears the RQS bit and the SRQ line, one of the five management control lines of the system interface. Any bit in the status byte can initiate an SRQ. The status byte may be masked by the user to determine which bits caused the HP 4284A to set the SRQ line. For more information on the status byte, refer to "Status Byte".

#### TRIGGER (GET)

Enables the HP 4284A to the TRIGGER bus command. This command may be sent to a selected device or to all devices addressed as listeners on the HP-IB bus. The HP 4284A must first be addressed as a listener, second the trigger mode is set to the BUS trigger mode before the trigger message is sent.

For example:

Standard Commands for Programmable Instruments(SCPI) Standard Commands for Programmable Instrument(SCPI) is the new universal command set adopted by Hewlett-Packard for test and measurement instrumentation by extending IEEE 488.2-1987. (SCPI is equal to TMSL, Test and Measurement Systems Language, which developed by Hewlett-Packard.) This language uses standard HP-IB hardware and will be used in many future Hewlett-Packard Products. SCPI uses easy to learn, self explanatory commands, and is flexible for both beginners and expert programmers. Detailed SCPI command descriptions are given in Chapter 8.

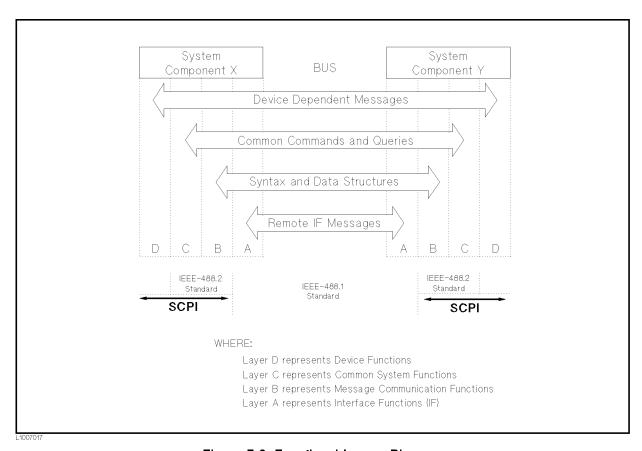


Figure 7-3. Functional Layers Diagram

## **Data Transfer**

The HP 4284A offers two data formats for HP-IB data transfer to the controller, ASCII and BINARY. The data transfer rates for these data formats are different.

### **ASCII Format**

The ASCII data format is the default output format. When the FORMat: DATA ASCII command is executed, the HP 4284A transfers data in the ASCII format. The ASCII data output format on the MEAS DISPLAY, BIN No. DISPLAY, or BIN COUNT DISPLAY page is described in Figure 7-4.

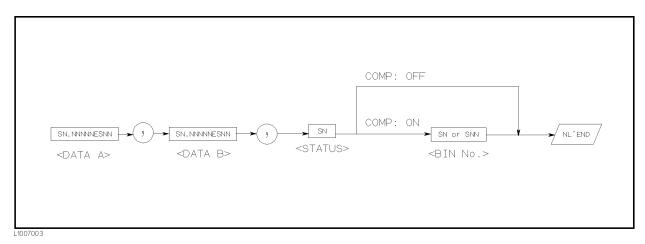


Figure 7-4. ASCII Format 1

The <DATA A>, <DATA B>, <STATUS>, and <BIN No.> formats are as follows.

 $\blacksquare$  <DATA A> and <DATA B> format:

The data output formats for <DATA A> (primary parameter's measurement data), and <DATA B> (secondary parameter's measurement data) uses the 12 ASCII character fixed length format as follows.

SN.NNNNNESNN (S: +/-, N: 0 to 9, E: Exponent Sign)

■ <STATUS> Format:

The *STATUS* data shows the measurement status when getting the measurement data as follows.

Status	Description			
-1	No data (in the data buffer memory)			
0	Normal measurement data.			
+1	Analog bridge is unbalanced.			
+2	A/D converter is not working.			
+3	Signal source overloaded.			
+4	ALC unable to regulate.			

The data output formats for <STATUS> uses the 2 ASCII character fixed length format as follows.

SN 
$$(S: +/-, N: 0 \text{ to } 4)$$

Note



When the  $\langle STATUS \rangle$  is -1, 1, or 2, the measurement data is 9.9E37. When the  $\langle STATUS \rangle$  is 0, 3, or 4, the actual measurement data is output.

#### ■ <BIN No.> Format:

The <BIN No.> data shows the bin sorting results as follows.

Data	Sorting Results				
0	OUT_OF_BINS				
+1	BIN 1				
+2	BIN 2				
+3	BIN 3				
+4	BIN 4				
+5	BIN 5				
+6	BIN 6				
+7	BIN 7				
+8	BIN 8				
+9	BIN 9				
+10	$AUX_BIN$				

The <BIN No.> data is output with the measurement data only when the comparator function is set to ON.

The data output formats for <BIN No.> uses a 2 or 3 ASCII character data length format as follows.

SN or SNN 
$$(S: +/-, N: 0 \text{ to } 9)$$

The ASCII data output format on the LIST SWEEP DISPLAY page is described in Figure 7-5. The data loop is repeated for the number of the sweep points.

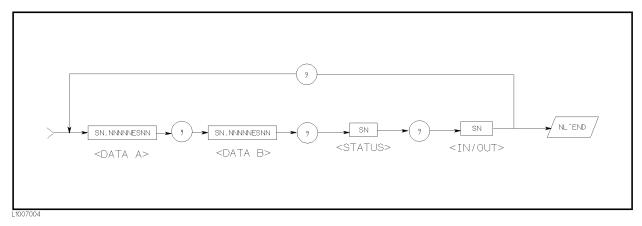


Figure 7-5. ASCII Format 2 (List Sweep)

The <DATA A>, <DATA B>, <STATUS> formats are the same as the formats on the MEAS DISPLAY, BIN No. DISPLAY, or BIN COUNT DISPLAY page. So the only the <IN/OUT> format will be described.

 $\blacksquare$  <IN/OUT> format:

The <IN/OUT> data shows the result of the list sweep's comparator function.

Data	Result			
-1	LOW			
0	IN			
+1	HIGH			

When the comparator function of the list sweep measurement isn't used, the  $\langle IN/OUT \rangle$  data output result is 0 (zero).

The data output formats for <IN/OUT> use the 2 ASCII character fixed length format as follows.

$$SN (S: +/-, N: 0 \text{ to } 1)$$

#### **Binary Format**

When the FORMat: DATA REAL, 64 command is executed the HP 4284A transfers data in the BINARY format. The BINARY format is the 64-bit floating point binary format specified in IEEE Standard 754-1985. This is the same data format used by the HP Technical computers, such as the HP 9000 series 200/300 computers. The BINARY data output format on the MEAS DISPLAY, BIN No. DISPLAY, or BIN COUNT DISPLAY page is shown in Figure 7-6.

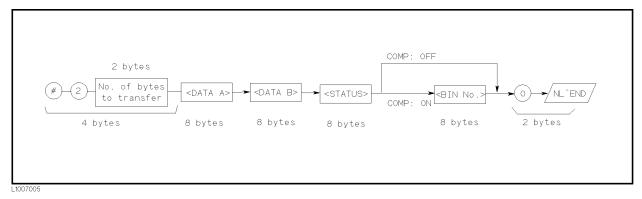


Figure 7-6. BINARY Format 1

This data field is initiated by a unique code, the number sign (#). A second byte, (2), designates the number of the bytes for the "No. of the bytes transfer". "No. of the bytes transfer" designates the data byte length. The last byte is zero (0), and has no meaning. The response message terminator is, the EOI line is asserted while the New Line (Line Feed) character (10 decimal) is being sent on the bus.

# **Floating Point Format**

Each data format of the <DATA A>, <DATA B>, <STATUS>, and <BIN No.> are common formats (8 bytes, IEEE 754 floating point format) as follows. The meaning of each data is the same as the meaning of each data in the ASCII format.

**IEEE 754 Floating Point Format** 

Bit No.	7	6	5	4	3	2	1	0
First byte sent	$\mathbf{S}$	$\rm E_{msb}$	E	E	$\mathbf{E}$	E	E	E
Second byte sent	$\mathbf{E}$	$\mathbf{E}$	$\mathbf{E}$	$\mathrm{E}_{\mathrm{lsb}}$	$\mathrm{F}_{\mathrm{msb}}$	F	$\mathbf{F}$	$\mathbf{F}$
Third – seventh	$\mathbf{F}$	$\mathbf{F}$	F	$\mathbf{F}$	$\mathbf{F}$	$\mathbf{F}$	F	F
byte sent	•	:	:	:	:	:	:	:
Last byte sent	F	$\mathbf{F}$	F	$\mathbf{F}$	$\mathbf{F}$	F	F	$\mathrm{F}_{\mathrm{lsb}}$

Where,

E<sub>msb</sub>: is the most significant bit of the exponent.

 $E_{lsb}$ : is the least significant bit of the exponent.

 $F_{msb}$ : is the most significant bit of the fractional part.  $F_{lsb}$ : is the least significant bit of the fractional part.

S: is the sign bit.

E: is an exponent bit.

F: is a fraction bit.

The real number RN represented in floating point format are provided using the following formula. (EXP: Exponent part of number, f: Fractional part of number)

$$RN = (-1)^S \times 2^{(EXP-1023)} \times (1 + f/2^{52})$$

■ When e = 0

$$RN = (-1)^S \times 2^{-1022} \times (f/2^{52})$$

■ When e = 0, f = 0,

$$RN = 0$$

For example,

S = 1

$$RN = (-1)^{1} \times 2^{(1023-1023)} \times \left(1 + \frac{2^{51}}{2^{52}}\right)$$
$$= -1 \times 1 \times 1.5$$
$$= -1.5$$

When the list sweep measurement is performed, the binary data format is as follows. <DATA A>, <DATA B>, <STATUS>, and <IN/OUT> are repeated as many times as there are sweep points. Each data format is the same as the 8-byte data format described in the "Floating Point Format". The meaning of each data is the same as each data in the ASCII format.

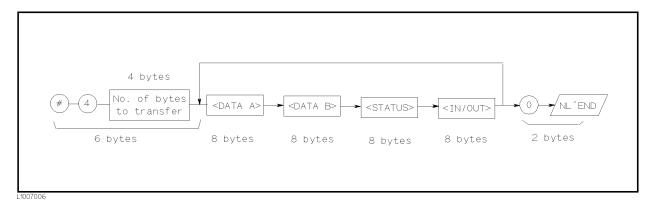


Figure 7-7. Binary Data Format For List Sweep Measurement

## **Trigger System**

Figure 7-8 shows the HP 4284A trigger state diagram when in REMOTE.

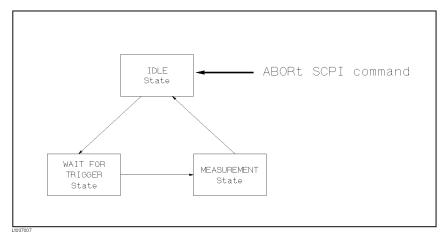


Figure 7-8. Trigger State Diagram

Each HP-IB trigger state is described in the following paragraphs.

#### ■ IDLE state

During the IDLE state, the measurement data can be read by a controller via HP-IB using the FETCh? query. To change the IDLE state to the WAIT FOR TRIGGER state, the INITiate subsystem command must be used as shown in Figure 7-9.

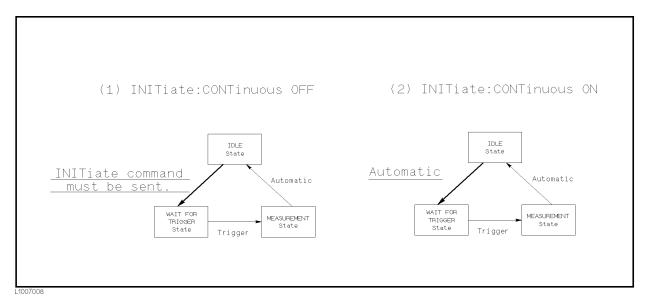


Figure 7-9. INITiate Subsystem Commands and Trigger System

There are the following two conditions for the INITiate subsystem commands.

1. INITiate: CONTinuous OFF condition

In this condition, the INITiate: IMMediate command must be sent via HP-IB to change the IDLE state to the WAIT FOR TRIGGER state after reading the measurement data by a controller.

#### 2. INITiate: CONTinuous ON condition

In this condition, the IDLE state is automatically changed to the WAIT FOR TRIGGER state without using the INITiate: IMMediate command after reading the measurement data by a controller.

### Note



When the ABORt command is sent under any state, the HP 4284A state is forced to the IDLE state. In this condition there are no data stored in the HP 4284A. If the FETCh? query is sent in this case, an error (error message -230: "Data corrupt or stale") will occur.

#### ■ WAITING FOR TRIGGER state

In this state, the HP 4284A can accept a trigger command while in the remote condition. When the trigger command is sent to the HP 4284A, the state is automatically changed to the MEASUREMENT state.

There are three kinds of the trigger commands: \*TRG common command, Group Execution Trigger (GET) bus command, and TRIGger: IMMediate SCPI command. These commands are divided into two types in this trigger system. (Refer to Figure 7-10.)

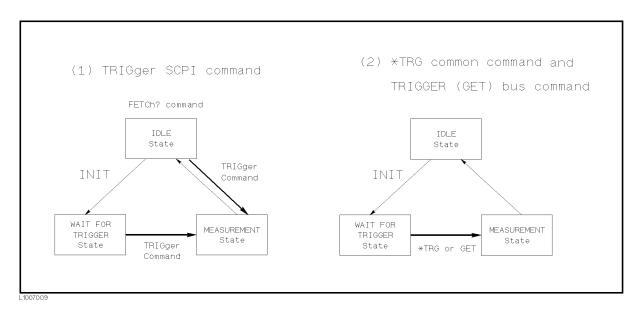


Figure 7-10. Trigger System and Trigger Commands

1. TRIGger: IMMediate SCPI command

Either the WAIT FOR TRIGGER state or the IDLE state, the HP 4284A is triggered by sending the TRIGGER: IMMediate command. When the measurement results can be read by a controller under the IDLE state, the FETCh? command must be used.

2. \*TRG common command or Group Execution Trigger (GET) bus command

In the WAIT FOR TRIGGER state, the HP 4284A is triggered by sending the \*TRG common command or GET bus command, and the measurement results in one trigger sequence can be read without sending the FETCh? command under the IDLE state. Thus,

```
"*TRG" = "TRIGger: IMMediate; :FETCh?"
```

Figure 7-11 and Figure 7-12 shows the difference between the TRIGger: IMMediate command and \*TRG or GET command by using the sample programs.

```
10
       ASSIGN @Meter TO 717
20
       REMOTE @Meter
30
       OUTPUT @Meter; "*RST; *CLS"
40
       OUTPUT @Meter; "TRIG:SOUR BUS"
       OUTPUT @Meter; "ABORT; : INIT"
50
60
       OUTPUT @Meter; "TRIGGER: IMMEDIATE"
70
       OUTPUT @Meter; "FETCH?"
80
       ENTER @Meter; A, B, C
90
       PRINT A,B,C
100
       END
```

Figure 7-11. TRIGger:IMMediate Command Sample Program

```
10
       ASSIGN @Meter TO 717
20
       REMOTE @Meter
       OUTPUT @Meter; "*RST; *CLS"
30
       OUTPUT @Meter; "TRIG: SOUR BUS"
40
50
       OUTPUT @Meter; "ABORT; : INIT"
       OUTPUT @Meter; "*TRG"
60
70
       ENTER @Meter; A, B, C
80
       PRINT A,B,C
90
       END
```

Figure 7-12. \*TRG or GET Command Sample Program

#### Note



When the HP 4284A is set to the EXT TRIG mode, and is triggered via the EXT TRIGGER connector or an optional interface under the remote condition, this trigger signal has the same effect as the TRIGger: IMMediate SCPI command.

#### ■ MEASUREMENT state

In this state, DUT measurement is being performed. After the DUT measurement is completed, trigger state automatically changes to the IDLE state.

#### Note



The HP 4284A can only measure a DUT on one page of the MEAS DISPLAY, BIN No. DISPLAY, BIN COUNT DISPLAY, and LIST SWEEP DISPLAY pages under (DISPLAY FORMAT) even if the HP 4284A is in remote.

A typical flowchart of data transfer using the trigger system is shown below.

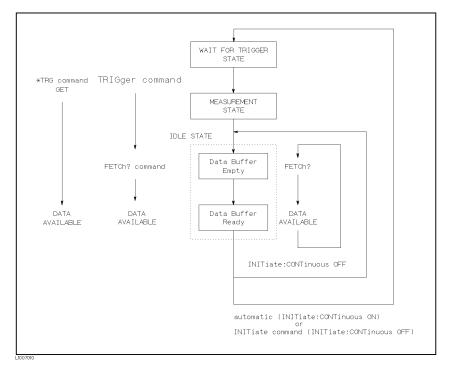


Figure 7-13. Triggering System and Data Transfer

## **Data Buffer Memory**

The HP 4284A has data buffer memory capability. The data buffer memory can hold up to 128 sets of measurement results, and all buffered measurement results are transferred at once to the controller using the MEMory: READ? DBUF command as shown in Figure 7-14. So the overall data transmission time will be greatly reduced.

```
OPTION BASE 1
20
       DIM D(5,4)
30
       ASSIGN @Meter TO 717
40
       REMOTE @Meter
50
       OUTPUT @Meter; "*RST; *CLS"
60
       OUTPUT @Meter; "FORM ASCII"
70
       OUTPUT @Meter; "TRIG:SOUR BUS"
       OUTPUT @Meter; "DISP: PAGE MEAS"
80
90
       OUTPUT @Meter; "MEM:DIM DBUF,5"
100
       OUTPUT @Meter; "MEM: FILL DBUF"
110
       FOR I=1 TO 5
120
         OUTPUT @Meter; "TRIGGER: IMMEDIATE"
130
       NEXT I
       OUTPUT @Meter; "MEM: READ? DBUF"
140
       ENTER @Meter;D(*)
150
160
       PRINT D(*)
       OUTPUT @Meter; "MEM: CLE DBUF"
170
180
       END
```

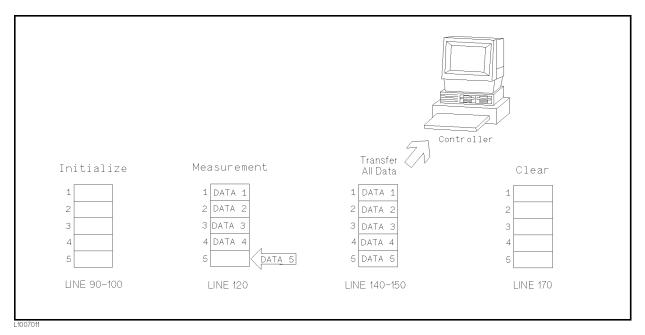


Figure 7-14. Buffered Data Transfer Sample Program and Description

#### Note



When the data buffer memory is used, use the following rules.

- The measurement data after sending the MEMory:FILL DBUF command to use the data buffer memory capabilities are stored into the data buffer memory in the order measured.
- When triggering the HP 4284A using the TRIGger:IMMediate command, the measurement results are entered only into the data buffer memory. So you don't have to clear the output buffer. When triggering using the \*TRG or Group Execution Trigger (GET) command, the measurement results are entered into both the data buffer memory and the output buffer. So the output buffer must be cleared every time the HP 4284A's controller reads the measurement results. If you don't, error (-410, "Query INTERRUPTED") will occur.
- When the number of sets of measurement data exceeds the capacity of the buffer memory, all of the overflowed measurement data are lost, error 90: "Data Memory Overflow" occurs, and bit 3 of the standard event status register is set to 1. If you enter new data into the data buffer memory, the data buffer memory should first be cleared using the MEMory:CLEar DBUF command.
- When the number of sets of measurement data is less than the capacity of the buffer memory, the following data, instead of the actual measurement data, are input to the unused portion of the data buffer memory.

```
<DATA A>: 9.9E37

<DATA B>: 9.9E37

<STATUS>: -1

<BIN No.> or <IN/OUT>: 0
```

- When the data buffer memory capabilities are used during a list sweep measurement, the measurement result of one sweep point is stored as one set of measurement data. So when two or more sweep points are the same, and are adjacent, the HP 4284A measures the device once, but the number of data sets stored is equal to the number of sweep points.
- When the limit function of the list sweep measurement is set to OFF at a sweep point, <IN/OUT> is 0. Also when the comparator function is set to OFF, the <BIN No.> is 0.

There are two formats returned by MEMory: READ? DBUF query, ASCII and BINARY. Each format is described below. (The sample programs using the data buffer memory (returned format: ASCII and BINARY) are shown later in this chapter.)

■ ASCII Format

When the ASCII format is selected as a data format, the returned format is as follows. The <DATA A>, <DATA B>, <STATUS>,

<BIN No.>, or <IN/OUT> data format and meaning are the same as the ASCII data format described in "ASCII Format".

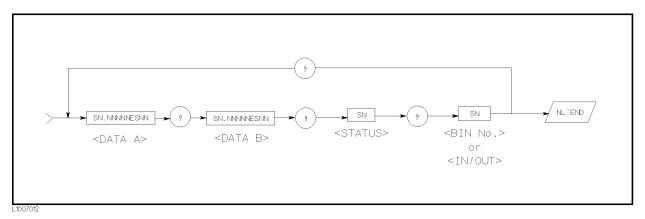


Figure 7-15. ASCII Format (Buffer Memory)

### ■ BINARY Format

When the BINARY format is selected as the data format, the returned format is as follows. The <DATA A>, <DATA B>, <STATUS>, <BIN No.>, or <IN/OUT> data format and meaning are the same as the BINARY data format described in "Binary Format".

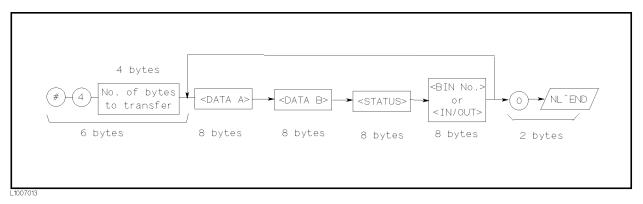


Figure 7-16. BINARY Format (Buffer Memory)

Each data format has a different data transfer rate. Table 7-3 shows the typical time required from sending the FETCh? command or the MEM: READ? DBUF command to enter the data using the ENTER command with an HP 9000 series 300 computer.

Table 7-3. Data Format and Data Transfer Time

Format	Data Type	Time
ASCII	Data without BIN No.	10 ms
	Data with BIN No.	11 ms
	List Sweep Data (10 points)	$75~\mathrm{ms}$
	Data Buffer Memory (128 sets of data)	960  ms
BINARY	Data without BIN No.	8 ms
	Data with BIN No.	8.8 ms
	List Sweep Data (10 points)	34 ms
	Data Buffer Memory (128 sets of data)	406  ms

# **Status Byte**

The status byte register contains an 8-bit word that the HP 4284A places on the HP-IB bus when it is serially polled.

The value of each bit indicates the status of an internal HP 4284A function, and two bits of the status byte are used as the summary bits of the registers (Refer to Figure 7-17). Bits are set to "1" and reset to "0".

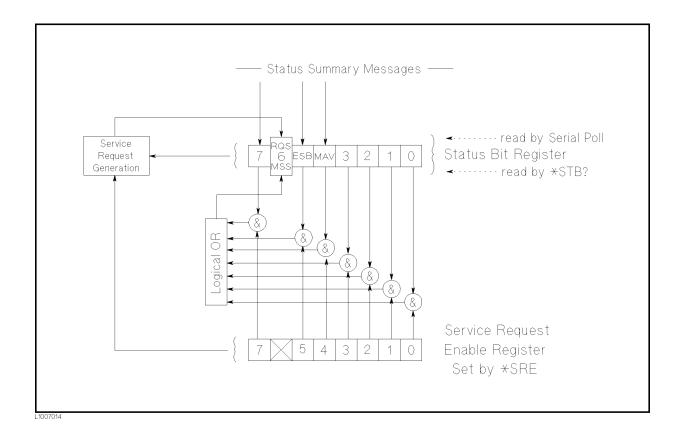


Figure 7-17. Status Byte Register

The individual bit assignments of the status byte and its bit weights are given in Table 7-4. When you read the status byte using HP-IB serial polling, the value is the sum of the total bit weights of all the high bits at the time you read the byte. After serial polling the status byte, only bit 6 (RQS) is cleared.

Table 7-4. Status Byte Assignments

Bit No.	Bit Weight	Description
7	128	Operation Status Event Register Summary Bit
		This bit is set to "1" when one or more enabled bits of the operation status event register (discussed later in this chapter) has been set to "1". This bit is cleared when all bits of the operation status register are set to 0. (This bit isn't cleared by serial-polling.)
6	64	Bit 6 serves two functions RQS/MSS depending on how it is read.
		• RQS (Request Service) Bit
		If bit 6 is read in the serial polling process, it is treated as the RQS bit and is reset during the serial polling process.
		• MSS (Master Summary) Bit
		If bit 6 is read using the *STB? (status byte) query, it is treated as the MSS bit, and its value is not changed by the executing the *STB? query.
		To understand this operation think of the RQS and MSS bits as two inputs to a multiplexer (MUX) and the output of the MUX being bit 6 of the status byte register.
		During the serial polling operation the MUX path selected is from the service request generation circuit to bit 6, so bit 6 represents the RQS bit.
		During execution of the *STB? query the MUX path selected is from the master summary bit generation circuit to bit 6, so bit 6 represents the MSS bit.
		To clear the MSS bit, all bits of the original registers corresponding to the enabled summary bit in the status byte and the output buffer of the HP 4284A must be cleared. When you read the status byte including the MSS bit instead of the RQS bit, the *STB? query must be used. *STB? query clears neither the MSS bit nor the RQS bit.
5	32	Standard Event Status Register Summary Bit
		This bit is set to "1" when any enabled bits of the standard event status register (discussed later in this section) has been set to "1". This bit is cleared when all bits of the standard event status register are set to 0. (This bit isn't cleared by serial-polling.)
4	16	MAV (Message Available) Bit
		This bit is set to "1" whenever the HP 4284A has data available to output. This bit is cleared when the available data is read.  (This bit isn't cleared by serial-polling.)
3	8	always 0 (zero)
2	4	always 0 (zero)
1	2	always 0 (zero)
0	1	always 0 (zero)

# Enabling the Status Byte

A service request (SRQ) will be generated when any enable bit in the status byte register is set to "1". So to enable/disable any bits of the status byte register, you can set bits in the service request enable register. These bits correspond to bits in the status byte. When a bit is set in the service request enable register it enables that bit in the status byte to request service. To set bits in the service request enable register, the \*SRE command is used. The syntax of the \*SRE command is:

\*SRE < n >

Where,  $\langle n \rangle$ : decimal number (0 to 255)

For example,

If  $\langle n \rangle$  is equal to 34 (00100010 in binary), bit 1 and bit 5 are enabled, as follows.

Bit No. of		IS	В		LSB				
Status Byte	7	6	5	4	3	2	1	0	
Bit Pattern									
for *SRE command	0	0	1	0	0	0	1	0	

In this case, when either bit 1 or bit 5 of the status byte is set to "1", a service request is generated.

The default setting is \*SRE 0 (all bits of the status byte are disabled).

Bit 6 (RQS) is non-maskable, and bits 0 to 3 are always 0 (zero). Thus, it is meaningless to mask these bits. (The \*SRE command's bit pattern for masking bit 6 is ignored, and the \*SRE command's bit pattern for masking bits 0 to 3 are accepted, but is meaningless.)

# **Operation Status Register Group**

The operation status register group provides operation status reporting by summarizing multiple events into a summary message (bit 7) of the status byte. The structure of the operation status register group is shown in Figure 7-18. The operation status register group consists of the standard operation status condition register, the standard operation status event register, and the standard operation status event enable register.

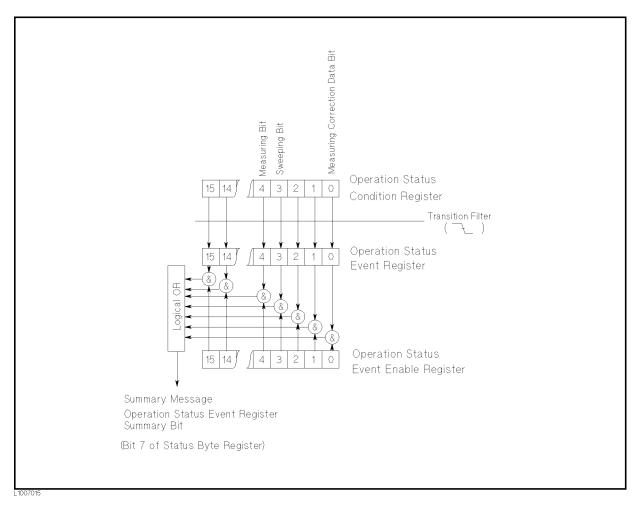


Figure 7-18. Operation Status Register Structure

#### **Standard Operation Status Condition Register**

The standard operation status condition register consists of 16-bits, and reflects these states in its condition bits. So each time the HP 4284A's condition is changed, its condition bit is changed from "0" to "1", or from "1" to "0". Each bit of the standard operation status condition register is shown below.

Table 7-5.
Standard Operation Status Condition Register
Assignments

Bit No.	Bit Weight	Description
15 - 5		always 0 (zero)
4	16	Measuring Bit
3	8	0 : Measurement not in progress 1 : Measurement in progress Sweeping Bit 0 : List sweep measurement not in progress 1 : List sweep measurement in progress
2	4	always 0 (zero)
1	2	always 0 (zero)
0	1	Measuring Correction Data Bit
		0 : Correction data measurement not in progress 1 : Correction data measurement in progress

When you read the contents of the standard operation status condition register using the STATus:OPERation:CONDition? query, the standard operation status condition register isn't cleared. To clear the standard operation status condition register, the device's condition state should only be changed by setting all bits to 0.

### **Standard Operation Status Event Register**

The standard operation status event register consists of 16-bit registers, and each event bit in the event register corresponds to a condition bit in the standard operation status condition register. Each event bit is set to "1" when its corresponding bit in the condition register makes a "1" to "0" transition only, a negative transition filter is used.

Table 7-6. **Standard Operation Status Event Register Assignments** 

Bit No.	Bit Weight	Description
15 - 5		always 0 (zero)
4	16	Measurement Complete Bit
		This bit is set to "1" when a single point measurement is completed.
3	8	List Sweep Measurement Complete Bit
		This bit is set to "1" when a last sweep point measurement of the list sweep measurement is completed.
2	4	always 0 (zero)
1	2	always 0 (zero)
0	1	Correction Data Measurement Complete Bit
		This bit is set to "1" when the OPEN, SHORT, or LOAD correction data measurement is completed.

When you read the contents of the operation status event register using the STATus: OPERation: EVENt? query, the operation status event register is cleared, and bit 7 of the status byte is set to "0".

#### Standard Operation Status Event Enable Register

A operation status summary bit (bit 7 of the status byte) will be set when any enable bit in the operation status event register is set to "1". To enable/disable any bits of the operation status event register, the standard operation event enable register is used. The standard operation event enable register is the same length as the standard operation event register. When a bit is set in the operation status event register it enables the corresponding bit in the operation event register to request service. To set any bit in the operation status event enable register, The STATus:OPERation:ENABle command is used. The syntax of the STATus:OPERation:ENABle command is:

 $\mathtt{STATus}:\mathtt{OPERation}:\mathtt{ENABle} < n >$ 

Where,  $\langle n \rangle$ : decimal number (0 to 65535)

For example,

Bit No. of	MS	SB													LS	В
Event Register	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Event Enable																
Register	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0

In this case, when either bit 3 of the operation status event register is set to "1", the operation status summary bit (bit 7 of the status byte) is set to "1".

The default setting is STATus: OPERation: ENABle O (all bits of the operation status event register are disabled).

Bit 1, bit 2, and bits 5 to 15 are always 0 (zero). Thus, it is meaningless to mask these bits.

# **Standard Event Status Register**

The standard event status register contains the 16-bits of the operation status report which is defined in IEEE 488.2-1987 as shown in Figure 7-19. If one or more enable bits of the standard event status register is set to "1", bit 5 (standard event status register summary bit) of the status byte is set to "1". Each bit of the standard event status register is shown on the next page.

When each error bit (bit 2, bit 3, bit 4, and bit 5) of the standard event status register is set to "1", an error message with the following error numbers is input to the error queue. For details, refer to Appendix B.

Bit No.	Error No.
5 (Command Error)	-100 to -178
4 (Execution Error)	-211  to  -230
3 (Device Specific Error)	10 to 101, -310, -311
2 (Query Error)	-400 to -440

When you read the contents of the standard event status register using the \*ESR? command, the standard event status register is cleared, and bit 5 of the status byte is set to "0".

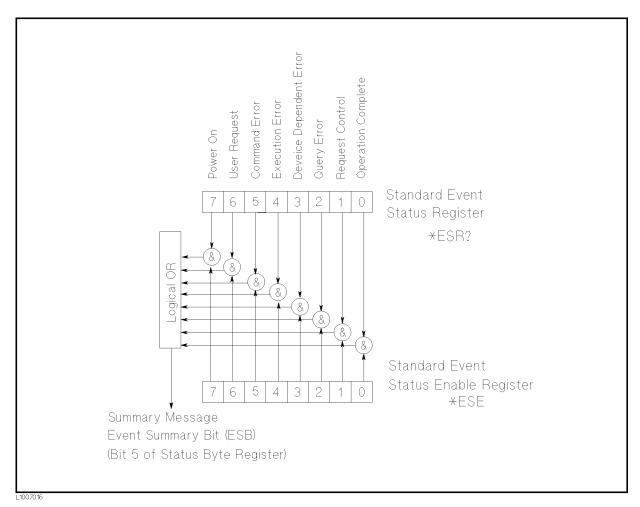


Figure 7-19. Standard Event Status Register

Table 7-7. Standard Event Status Register Assignments

Bit No.	Bit Weight	Description
7	128	Power On (PON) Bit
		This bit is set to "1" when the HP 4284A's power supply has been turned OFF and then ON since the last time this register was read.
6	64	User Request (URQ) Bit
		always 0 (zero)
5	32	Command Error (CME) Bit
		This bit is set to "1" if the following the command errors occur. An IEEE 488.2 syntax error occurred.  The device received a Group Execute Trigger (GET) inside a program message.
4	16	Execution Error (EXE) Bit
		This bit is set to "1" when a parameter following a header of a HP-IB command was evaluated by the HP 4284A as being outside of its legal input range or is otherwise inconsistent with the HP 4284A's capabilities.
3	8	Device Specific Error (DDE) Bit
		This bit is set to "1" when a device dependent error (except for the command error, query error, and execution error) has occurred.
2	4	Query Error (QYE) Bit
		This bit is set to "1" when reading data from the output buffer and no data was present, or when the data was lost.
1	2	Request Control (RQC) Bit
		always 0 (zero)
0	1	Operation Complete (OPC) Bit
		This bit is set to "1" when the HP 4284A has completed all selected pending operations before sending the *OPC command.

# Enabling the Event Status Register

An event status register summary bit (bit 6 of the status byte) will be set to "1" when any enable bit in the standard event status register is set to "1". To enable/disable any bits of the standard event status register, you can set the bits in the standard event status enable register. These bits correspond to bits in the standard event status enable register. When a bit is set in the standard event status enable register it enables the corresponding bit in the standard event status register and sets bit 6 of the status byte (event status register summary bit) to "1". To set any bit in the standard event status enable register, the \*ESE command is used. The syntax of the \*ESE command is:

\*ESE < n >

Where,  $\langle n \rangle$ : decimal number (0 to 255)

For example,

If  $\langle n \rangle$  is equal to 34 (00100010), bit 1 and bit 5 are enabled, as follows.

Bit No. of Event		MSB					LSB			
Status Register	7 6	5	4	3	2	1	0			
Bit Pattern										
for *ESE command	0 0	1	0	0	0	1	0			

When either bit 1 or 5 of the standard event status register is set to "1", the event status register summary bit (bit 6 of the status byte) is set to "1".

The default setting is \*ESE 0 (all bits of the standard event status byte are disabled).

Bits 1 and 6 of the event status register are always 0 (zero). Thus masking these bits has no meaning.

# **Sample Programs**

This paragraph provides some HP BASIC sample programs for control set and data transfer.

# **Control Settings**

The HP 4284A has four control setting pages under (MEAS SETUP) as follows.

- MEAS SETUP
- CORRECTION
- LIMIT TABLE SETUP
- LIST SWEEP SETUP

So, the control settings on each page should be set. The sample programs are shown in the order of the preceding list starting on the next page.

Note



In case of the front panel operation, the available control settings depends on the display page. But in the case of HP-IB operation, all of control settings can be set without concern to the page being displayed.

Note



When the HP 4284A measures a DUT, one of the following pages under (DISPLAY FORMAT) must be used even if the HP 4284A is in the remote condition.

- MEAS DISPLAY
- BIN No. DISPLAY
- BIN COUNT DISPLAY
- LIST SWEEP DISPLAY

#### **MEAS SETUP page**

This sample program sets all of the setting controls on the MEAS SETUP page.

```
ASSIGN @Meter TO 717
10
20
      REMOTE @Meter
30
      OUTPUT @Meter; "DISP: PAGE MSET"
40
      OUTPUT @Meter; "DISP:LINE ""Control Example"""
50
      OUTPUT @Meter; "FUNC: IMP ZTD"
60
      OUTPUT @Meter; "FREQ 1MHZ"
70
      OUTPUT @Meter; "VOLT 1V"
      OUTPUT @Meter; "TRIG:SOUR BUS"
      OUTPUT @Meter; "AMPL: ALC ON"
100
      OUTPUT @Meter; "OUTP: HPOW ON"
110
      OUTPUT @Meter; "OUTP:DC:ISOL ON"
120
      OUTPUT @Meter; "FUNC: IMP: RANG 10KOHM"
130
      OUTPUT @Meter; "BIAS: VOLT 5"
140
      OUTPUT @Meter; "APER LONG, 4"
150
      OUTPUT @Meter; "FUNC: SMON: VAC ON"
      OUTPUT @Meter; "FUNC: SMON: IAC ON"
160
170
      OUTPUT @Meter; "TRIG: DEL 5"
180
      OUTPUT @Meter; "FUNC: DEV1: MODE ABS"
190
      OUTPUT @Meter; "FUNC: DEV2: MODE ABS"
200
      OUTPUT @Meter; "FUNC: DEV1: REF 10000"
210
      OUTPUT @Meter; "FUNC: DEV2: REF 1"
220
      END
```

Figure 7-20. MEAS SETUP Page

### **CORRECTION** page

This sample program sets the setting controls on the CORRECTION page after the correction data have already been stored.

```
ASSIGN @Meter TO 717
10
20
      REMOTE @Meter
      OUTPUT @Meter; "DISP:PAGE CSET"
30
40
      OUTPUT @Meter; "CORR: OPEN STAT ON"
50
      OUTPUT @Meter; "CORR: SHOR: STAT ON"
60
      OUTPUT @Meter; "CORR:LOAD:STAT ON"
      OUTPUT @Meter; "CORR:LENG 1"
70
80
      OUTPUT @Meter; "CORR: METH MULT"
      OUTPUT @Meter; "CORR: USE 10"
90
100
      OUTPUT @Meter; "CORR:LOAD: TYPE CPD"
      OUTPUT @Meter; "SPOT1:STAT ON"
110
120
      OUTPUT @Meter; "SPOT2:STAT ON"
130
      OUTPUT @Meter; "SPOT3:STAT ON"
140
      {\tt END}
```

Figure 7-21. CORRECTION page

#### LIMIT TABLE SETUP page

This sample program sets all of the setting controls on the LIMIT  $TABLE\ SETUP$  page.

```
10
      ASSIGN @Meter TO 717
20
      REMOTE @Meter
      OUTPUT @Meter; "DISP: PAGE LTAB"
30
40
      OUTPUT @Meter; "FUNC: IMP CPD"
      OUTPUT @Meter; "COMP: TOL: NOM 10E-12"
50
60
      OUTPUT @Meter; "COMP ON"
70
      OUTPUT @Meter; "COMP: ABIN ON"
      OUTPUT @Meter; "COMP: MODE PTOL"
      OUTPUT @Meter; "COMP: TOL: BIN1 -1,1"
100
      OUTPUT @Meter; "COMP: TOL: BIN2 -2,2"
110
      OUTPUT @Meter; "COMP: TOL: BIN3 -3,3"
120
      OUTPUT @Meter; "COMP: TOL: BIN4 -4,4"
      OUTPUT @Meter; "COMP: TOL: BIN5 -5,5"
130
140
      OUTPUT @Meter; "COMP: TOL: BIN6 -6,6"
150
      OUTPUT @Meter; "COMP: TOL: BIN7 -7,7"
160
      OUTPUT @Meter; "COMP: TOL: BIN8 -8,8"
170
      OUTPUT @Meter; "COMP: TOL: BIN9 -9,9"
180
      OUTPUT @Meter; "COMP:SLIM 0,0.00005"
190
      END
```

Figure 7-22. LIMIT TABLE SETUP page

#### LIST SWEEP SETUP page

This sample program sets all of the setting controls on the LIST SWEEP SETUP page.

```
10
      ASSIGN @Meter TO 717
20
      REMOTE @Meter
      OUTPUT @Meter; "DISP: PAGE LSET"
30
      OUTPUT @Meter; "LIST: MODE SEQ"
40
      OUTPUT @Meter; "LIST: FREQ 1KHZ, 2KHZ, 5KHZ, 10KHZ, 20KHZ, 50KHZ, 100KHZ, 200KHZ, 500KHZ, 1MHZ"
50
      OUTPUT @Meter; "LIST: BAND1 A,100,200"
60
70
      OUTPUT @Meter; "LIST: BAND2 A, 100, 200"
80
      OUTPUT @Meter; "LIST: BAND3 A,100,200"
90
      OUTPUT @Meter; "LIST: BAND4 A, 100, 200"
      OUTPUT @Meter; "LIST: BAND5 A, 100, 200"
100
110
      OUTPUT @Meter; "LIST: BAND6 A, 100, 200"
120
      OUTPUT @Meter; "LIST: BAND7 A, 100, 200"
130
      OUTPUT @Meter; "LIST: BAND8 A,100,200"
      OUTPUT @Meter; "LIST: BAND9 A, 100, 200"
140
      OUTPUT @Meter; "LIST: BAND10 A,100,200"
150
160
      END
```

Figure 7-23. LIST SWEEP SETUP

## **Data Transfer Examples**

The HP 4284A has two data transfer formats, ASCII and BINARY. This paragraph includes sample programs for each.

#### **ASCII Format**

The sample programs using the ASCII data format are in the following three patterns.

- Measurement data transfer when the comparator function of the limit table is set to ON. (Figure 7-24)
- Measurement data transfer using the buffer memory function when the comparator function of the limit table is set to ON. (Figure 7-25)
- Measurement data transfer when the list sweep measurement is performed. (Figure 7-26)

```
10
      ASSIGN @Meter TO 717
20
      REMOTE @Meter
30
      OUTPUT @Meter;"*RST;*CLS"
                                            !\
40
      OUTPUT @Meter; "FORM ASCII"
                                            ! Setup
50
      OUTPUT @Meter; "TRIG:SOUR BUS"
                                            ! Measurement
60
      OUTPUT @Meter; "COMP ON"
                                            ! Condition
70
      OUTPUT @Meter; "INIT: CONT ON"
                                           !/
80
      FOR I=0 TO 9
90
        TRIGGER @Meter
                                            ! Perform measurement
100
        ENTER @Meter; A, B, C, D
                                            ! Transfer data to controller
110
        PRINT A,B,C,D
                                           ! Print measurement result
120
      NEXT I
      END
130
```

Figure 7-24. Sample Program (Comparator) Using ASCII Format

```
10
      DIM D(127,3)
20
      ASSIGN @Meter TO 717
30
      REMOTE @Meter
40
      OUTPUT @Meter;"*RST;*CLS"
                                          !\
      OUTPUT @Meter;"FORM ASCII"
50
                                          ! Setup
60
      OUTPUT @Meter; "MEM: DIM DBUF, 128"
                                          ! Measurement
70
      OUTPUT @Meter; "TRIG: SOUR BUS"
                                          ! Condition
80
      OUTPUT @Meter; "COMP ON"
                                          !/
      OUTPUT @Meter; "MEM: FILL DBUF"
90
                                          ! Enable the buffer memory
100
    FOR I=O TO 127
      OUTPUT @Meter;"TRIGGER"
                                          ! Perform measurement 128 times
110
120
      NEXT I
                                          !/
      OUTPUT @Meter; "MEM: READ? DBUF"
130
                                          !\
140 ENTER @Meter; D(*)
                                          !/Transfer the measurement result
150 PRINT D(*)
                                          ! Display the measurement result
      OUTPUT @Meter; "MEM: CLE DBUF"
                                          ! Disable the buffer memory
160
170
      END
```

Figure 7-25. Sample Program (Buffer Memory) Using ASCII Format

```
10
      DIM D(6.3)
20
      ASSIGN @Meter TO 717
30
      REMOTE @Meter
      OUTPUT @Meter;"*RST;*CLS"
                                            !\
40
      OUTPUT @Meter;"FORM ASCII"
                                            ! |
50
60
      OUTPUT @Meter; "TRIG:SOUR BUS"
                                            ! |
70
      OUTPUT @Meter; "LIST: MODE SEQ"
                                            ! |
80
      OUTPUT @Meter; "LIST: FREQ 1KHZ, 2KHZ, 5KHZ, 10KHZ, 20KHZ, 50KHZ, 100KHZ"
90
      OUTPUT @Meter; "LIST: BAND1 A, 100, 200"! Setup
100
      OUTPUT @Meter; "LIST: BAND2 A, 100, 200"! Measurement
110
      OUTPUT @Meter; "LIST: BAND3 A, 100, 200"! Condition
      OUTPUT @Meter; "LIST: BAND4 A, 100, 200"! |
120
130
      OUTPUT @Meter; "LIST: BAND5 A, 100, 200"! |
      OUTPUT @Meter; "LIST: BAND6 A, 100, 200"! |
140
      OUTPUT @Meter; "LIST: BAND7 A, 100, 200"! |
150
      OUTPUT @Meter; "DISP: PAGE LIST"
160
                                          ! |
      OUTPUT @Meter;"INIT:CONT ON"
                                           !/
170
180
     TRIGGER @Meter
                                            ! Perform measurement
190
      ENTER @Meter;D(*)
                                            ! Transfer measurement data
200
     PRINT D(*)
                                            ! Display measurement data
210
      END
```

Figure 7-26. Sample Program (List Sweep) Using ASCII Format

#### **BINARY Format**

The sample programs using the BINARY data format are in the following three patterns. (The contents of the sample programs are same as the contents of the ASCII format's sample programs.)

- Measurement data transfer when the comparator function of the limit table is set to ON. (Figure 7-27)
- Measurement data transfer using the buffer memory function when the comparator function of the limit table is set to ON. (Figure 7-28)
- Measurement data transfer when the list sweep measurement is performed. (Figure 7-29)

```
10
      INTEGER Header_1,Header_2,Term
20
      ASSIGN @Meter TO 717; FORMAT ON
30
      ASSIGN @Binary TO 717; FORMAT OFF
      REMOTE @Meter
40
      OUTPUT @Meter; "*RST; *CLS"
50
                                            !\
      OUTPUT @Meter; "FORM REAL, 64"
                                            ! Setup
60
      OUTPUT @Meter; "TRIG:SOUR BUS"
                                            ! Measurement
70
      OUTPUT @Meter; "COMP ON"
80
                                            ! Condition
      OUTPUT @Meter; "INIT: CONT ON"
90
                                           !/
100
      FOR I=0 TO 9
        TRIGGER @Meter
                                            ! Perform measurement
110
        ENTER @Binary; Header_1, Header_2, A, B, C, D, Term! Transfer data
120
130
        PRINT A,B,C,D
                                            ! Display measurement result
140
      NEXT I
150
      END
```

Figure 7-27. Sample Program (Comparator) Using BINARY Format

```
10
      INTEGER Header_1, Header_2, Header_3, Term
20
      DIM D(127,3)
30
      ASSIGN @Meter TO 717; FORMAT ON
40
      ASSIGN @Binary TO 717; FORMAT OFF
50
      REMOTE @Meter
60
      OUTPUT @Meter;"*RST;*CLS"
                                            !\
70
      OUTPUT @Meter; "FORM REAL, 64"
                                            ! Setup
80
      OUTPUT @Meter; "MEM: DIM DBUF, 128"
                                            ! Measurement
      OUTPUT @Meter; "TRIG:SOUR BUS"
                                           ! Condition
90
100
     OUTPUT @Meter; "COMP ON"
                                           !/
     OUTPUT @Meter; "MEM: FILL DBUF"
110
                                           ! Enable the buffer memory
120
     FOR I=0 TO 127
130
        OUTPUT @Meter; "TRIGGER"
                                           ! Perform the measurement 128 times
     NEXT I
140
     OUTPUT @Meter;"MEM:READ? DBUF"
                                           ! Transfer data
150
     ENTER @Binary; Header_1, Header_2, Header_3, D(*), Term
160
170
     PRINT D(*)
                                           ! Display the measurement result
     OUTPUT @Meter; "MEM: CLE DBUF"
180
                                           ! Disable the buffer memory
190
```

Figure 7-28. Sample Program (Buffer Memory) Using BINARY Format

```
10
      INTEGER Header_1, Header_2, Header_3, Term
20
      DIM D(6,3)
      ASSIGN @Meter TO 717; FORMAT ON
30
40
      ASSIGN @Binary TO 717; FORMAT OFF
50
      REMOTE @Meter
60
      OUTPUT @Meter;"*RST;*CLS"
                                            !\
      OUTPUT @Meter; "FORM REAL, 64"
70
      OUTPUT @Meter; "TRIG:SOUR BUS"
80
90
      OUTPUT @Meter; "LIST: MODE SEQ"
                                            ! |
      OUTPUT @Meter; "LIST: FREQ 1KHZ, 2KHZ, 5KHZ, 10KHZ, 2OKHZ, 5OKHZ, 10OKHZ"
100
110
      OUTPUT @Meter; "LIST: BAND1 A, 100, 200"! Setup
      OUTPUT @Meter; "LIST: BAND2 A, 100, 200"! List
120
      OUTPUT @Meter; "LIST: BAND3 A, 100, 200"! Sweep
130
      OUTPUT @Meter; "LIST: BAND4 A, 100, 200"! Table
140
150
      OUTPUT @Meter; "LIST: BAND5 A, 100, 200"!
160
      OUTPUT @Meter; "LIST: BAND6 A, 100, 200"!
      OUTPUT @Meter; "LIST: BAND7 A, 100, 200"!
170
180
      OUTPUT @Meter; "DISP: PAGE LIST"
                                          ! |
      OUTPUT @Meter; "INIT: CONT ON"
190
                                            !/
200
      TRIGGER @Meter
                                            ! Perform measurement
      ENTER @Binary; Header_1, Header_2, Header_3, D(*), Term! Transfer measurement data
210
220
      PRINT D(*)
                                            ! Display measurement data
230
      END
```

Figure 7-29. Sample Program (List Sweep) Using BINARY Format

# **Command Reference**

## Introduction

This chapter provides descriptions of all the HP 4284A's available HP-IB commands which correspond to Standard Commands for Programmable Instruments(SCPI) command sets, listed in functional subsystem order. Use this chapter as a reference. Each command description contains the following paragraphs:

Field A field name corresponding to a SCPI

command.

**Command Syntax** The way you must type in the command,

including all of the required and optional

parameters.

Query Syntax The way you must type in the query, including

all of the required and optional parameters.

Query Response HP 4284A's response data format.

A case serving as a typical model for the more Example

common uses of the command.

# **Notation** Conventions and **Definitions**

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

- Angular brackets enclose words or characters that are used to symbolize a program code parameter or an HP-IB command.
- Square brackets indicates that the enclosed items are optional. The square brackets with the asterisk (for example,  $[\langle value \rangle^*]$  means the enclosed item  $(\langle value \rangle)$  repeats until the maximum counted number.
- { } When several items are enclosed by braces, one and only one of these elements may be selected.

The following definitions are used:

<NL $^E$ ND>Terminators (the EOI line is asserted by New Line or

ASCII Line Feed character (decimal 10))

White space Single ASCII character (0–9, 11–32 decimal)

For example, Carriage Return (13 decimal) or Space

(32 decimal)

# **Command Structure**

The HP 4284A commands are divided into two types: HP-IB common commands and SCPI commands. The HP-IB common commands are defined in IEEE std. 488.2-1987, and these commands are common for all devices. The SCPI commands are used to control all of the HP 4284A's functions. The SCPI commands are tree structured three levels deep. (The highest level commands are called the subsystem commands in this manual.) So the lower level commands are legal only when the subsystem commands have been selected. A colon (:) is used to separate the higher level commands and the lower level commands. See Figure 8-1 for a sample.

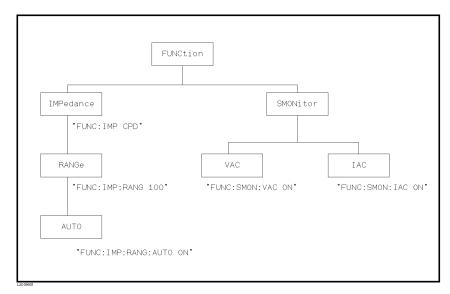


Figure 8-1. Command Tree Example

The basic rules of the command tree are as follows.

■ Letter case (upper and lower) is ignored.

```
For example,
FUNC:IMP CPD = func:imp CpD = FuNc:IMp cPd
```

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

```
For example,
(\operatorname{wrong}) \; \mathtt{FUNC} \sqcup : \sqcup \mathtt{IMP} \; \mathtt{CPD} \; \to (\operatorname{right}) \; \mathtt{FUNC} \colon \mathtt{IMP} \; \mathtt{CPD}
```

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

```
For example,
FUNCTION: IMPEDANCE CPD = FUNC: IMP CPD
```

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

```
For example,
FUNC: IMP?
```

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

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

```
For example,
FUNC: SMON: VAC ON; IAC ON
```

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

```
For example,
FUNC: IMP CPD; : FUNC: SMON: VAC ON
```

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

```
For example,
FUNC: IMP CPD; *SRE 32
```

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

```
For example,
FUNC: IMP CPD; *SRE 32; SMON: VAC ON; IAC ON
```

# Command **Abbreviations**

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

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

#### For example:

BIAS abbreviates to BIAS. TRIGger abbreviates to TRIG. LEVel abbreviates to LEV. FREQuency abbreviates to FREQ.

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

#### For example:

Percent TOLerance abbreviates to PTOL. (The long form is PTOLERANCE.)

#### Note



The HP 4284A accepts the three forms of the same SCPI commands: all upper case, all lower case, and mixed upper and lower case.

# Header and **Parameters**

The HP-IB control commands consists of a command header and parameters. (See the following.)

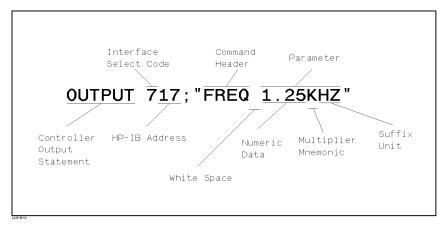


Figure 8-2. Command Header and Parameters

Headers can be of the long form or the short form. The long form allows easier understanding of the program code and the short form allows more efficient use of the computer. Parameters may be of two types as follows.

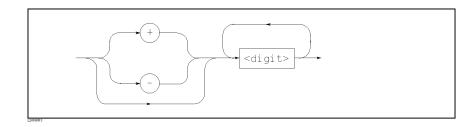
## ■ Character Data and String Data

Character data consists of ASCII characters. The abbreviation rules are the same as the rules for command headers. String data consists of ASCII characters enclosed by double quotes (" ").

#### ■ Numeric Data

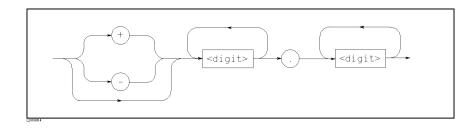
Integer (NR1), fixed point (NR2), or floating point (NR3). These three numeric data types are defined in IEEE 488.2-1988. (Refer to the syntax diagrams on the next page.) The available range for numeric data is  $\pm$  9.9E37.

## NR1



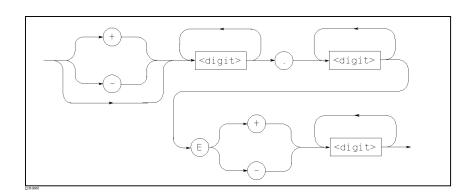
For example, 123 + 123 - 12345

# NR2



For example, 12.3 + 1.234 - 123.4

## NR3



For example, 1.23E+5123.4E-56

When numeric data is used as a parameter, the suffix multiplier mnemonics and suffix units (The suffix multiplier must be used with the suffix unit.) can be used for some commands as follows.

**Table 8-1. Multiplier Mnemonics** 

D	efinition	Mnemonic
1E18	(EXA)	EX
1E15	(PETA)	PE
1E12	(TERA)	Т
1E9	(GIGA)	G
1E6	(MEGA)	${ m MA^1}$
1E3	(KILO)	K
1E-3	(MILLI)	M
1E-6	(MICRO)	U
1E-9	(NANO)	N
$1E{-}12$	(PICO)	Р
1E-15	(FEMTO)	F
1E-18	(ATTO)	A

<sup>1:</sup> M or MA is available only when the suffix unit is HZ.

Table 8-2. Suffix Units and Available Commands

Suffix Unit	Available Command
HZ	FREQuency
	LIST:FREQuency
	CORRection:SPOT <n>:FREQuency</n>
V	VOLTage
	BIAS: VOLTage
	LIST: VOLTage
	LIST:BIAS:VOLTage
A	CURRent
	BIAS:CURRent
	LIST: CURRent
	LIST:BIAS:CURRent
ОНМ	FUNCtion:IMPedance:RANGe
M	CORRection: LENGth
S	TRIGger: DELay

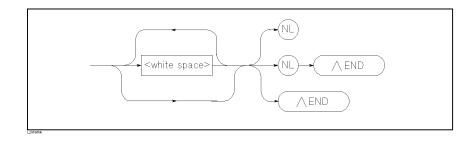
The header separator is placed between the header and its parameter. This is one white space which is defined as a single ASCII character in the range 0 through 9 or 11 through 32 decimal. This includes the ASCII space (32 decimal) code.

## **Terminators**

There are two kinds of the terminators: program message terminators and response message terminators.

## **Program Message Terminators**

The HP 4284A responds to the input data message when it is in the remote mode (REN control line true) and is addressed to listen. The input data message contain a string of HP-IB commands and terminators. The HP-IB commands are executed after the terminators are received. The terminators defined as follows.



White Space Single ASCII character (0 to 9, 11 to 32 decimal)

For example, Carriage Return (13 decimal) or Space

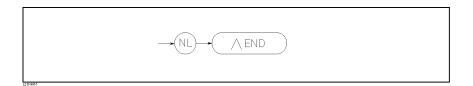
(32 decimal)

NLNew Line (Line Feed (10 decimal))

^END EOI is asserted with the last byte is sent.

# **Response Message Terminators**

The HP 4284A can send an output data message when it is in the local or remote modes, when it is addressed to talk, or in the talk-only mode. The data message contains the message returned by the query command and the terminators. Terminators defined as follows.



The EOI line is asserted while the New Line or Line Freed character (10 decimal) is being sent on the bus.

# Command Reference

All commands in this reference are fully explained and listed in the following functional command order.

#### **HP 4284A Subsystem Commands**

• DISPlay • OUTPut • TRIGger MEMory FREQuency INITiate • CORRection • BIAS • FETCh? • VOLTage FUNCtion • COMParator CURRent • LIST ABORt • Mass MEMory AMPLitude FORMat • SYSTem APERture • STATus

#### **HP-IB Common Commands**

• *CLS	• *SRE	• *OPC?	• *TST?
• *ESE	• *STB?	• *WAI	• *TRG
• *ESR?	• *IDN?	• *RST	• *LRN?
			• *OPT?

The explanation of each subsystem command is patterned as follows.

- 1. Subsystem command name
- 2. Command Tree (Subsystem command only)
- 3. Compound Command Name
- 4. Command Description
- 5. Command Syntax
- 6. Example Using The Above Command Syntax
- 7. Query Syntax
- 8. Query Response
- 9. Example Using The Above Query Syntax

# **DISPlay Subsystem**

The DISPlay subsystem command group sets the display page, and enters ASCII characters on the comment line. Figure 8-3 shows the command tree of the DISPlay subsystem command group.

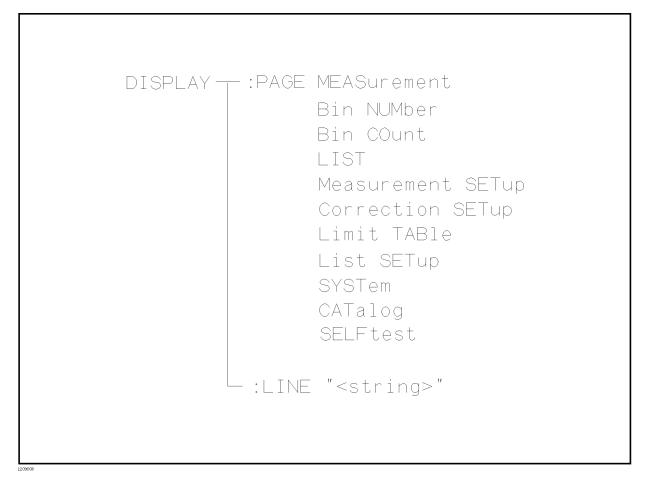


Figure 8-3. DISPlay Subsystem Command Tree

## :PAGE

The :PAGE command sets the display page. The :PAGE? query returns the abbreviated page name currently displayed on the LCD screen.

# **Command Syntax**

DISPlay:PAGE < page name>

Where,  $\langle page \ name \rangle$  is:

MEASurement Sets display page to MEAS DISPLAY Sets display page to BIN No.DISPLAY BNUMber BCOunt Sets display page to BIN COUNT DISPLAY LIST Sets display page to LIST SWEEP DISPLAY Sets display page to MEAS SETUP MSETup Sets display page to CORRECTION CSETup Sets display page to LIMIT TABLE SETUP LTABle Sets display page to LIST SWEEP SETUP LSETup

Sets display page to CATALOG CATalog

Sets display page to SYSTEM CONFIG SYSTem

SELF Sets display page to SELF TEST

## **Example**

OUTPUT 717; "DISP: PAGE BCO" ! Set to the BIN COUNT DISPLAY

#### **Query Syntax**

DISPlay: PAGE?

#### **Query Response**

Returned data format is:

<page name><NL^END>

Where,

page as shown in the preceding list.

### **Example**

10 OUTPUT 717; "DISP:PAGE?"

20 ENTER 717; A\$

30 PRINT A\$

40 END

:LINE

The :LINE command enters an arbitrary comment line of up to 30 ASCII characters in the comment field. The :LINE? query returns the comment line characters.

**Command Syntax** 

DISPlay:LINE "<string>"

Where, *<string>* is ASCII character string (maximum of 30 characters)

**Example** 

OUTPUT 717; "DISP:LINE ""This is a comment."""

**Query Syntax** 

DISPlay:LINE?

**Query Response** 

Returned data format is:

<string><NL^END>

**Example** 

10 OUTPUT 717; "DISP:LINE?"

20 ENTER 717; A\$ 30 PRINT A\$

## **FREQuency Subsystem**

The FREQuency command sets the oscillator frequency. The FREQuency? query returns the current test frequency setting.

## **Command Syntax**

$$ext{FREQuency} ig[: ext{CW}ig] \left\{ egin{array}{l} < value > \ ext{MIN} \ ext{MAX} \end{array} 
ight\}$$

Where,

 $\langle value \rangle$ is the NR1, NR2, or NR3 format Sets to the minimum value (20 Hz) MIN Sets to the maximum value (1 MHz) MAX

#### Note



A suffix multiplier and a suffix unit, HZ (hertz), can be used with this command. Either MAHZ and MHZ can be used as the suffix multiplier for MHz (1E6 Hz).

### **Example**

OUTPUT 717; "FREQ 1KHZ" ! Set to 1 kHz

OUTPUT 717; "FREQ MIN" ! Set to 20 Hz

OUTPUT 717; "FREQ MAX" ! Set to 1 MHz

### **Query Syntax**

#### **Query Response**

Returned Format is:

<NR3><NL^END>

#### **Example**

10 OUTPUT 717; "FREQ? MIN"

20 ENTER 717; A

30 PRINT A

# **VOLTage Subsystem**

The VOLTage command sets the oscillator's output voltage level. The VOLTage? query returns the current oscillator voltage level.

## **Command Syntax**

$$\texttt{VOLTage}\big[: \texttt{LEVel}\,\big] \left\{ \begin{array}{l} < value > \\ \texttt{MIN} \\ \texttt{MAX} \end{array} \right\}$$

Where,

 $\langle value \rangle$ is the NR1, NR2, or NR3 format

MIN Sets or returns to the minimum oscillator voltage level

 $(5 \mathrm{mV})$ 

MAX Sets or returns to the maximum oscillator voltage level

> (When Hi-PW mode is OFF: 2V When Hi-PW mode is ON: 20V)

Note



A suffix multiplier and a suffix unit, V (volt), can be used with this command. If this query is received when the oscillator level set to a current level, error -230 Data corrupt or stale will occur.

**Example** 

OUTPUT 717; "VOLT 100 MV" ! Set to 100 mV

OUTPUT 717; "VOLT MIN" ! Set to 5 mV

OUTPUT 717; "VOLT MAX" ! Set to 2 V (the HP 4284A standard configuration)

**Query Syntax** 

**Query Response** 

Returned format is:

<NR3><NL^END>

Example

10 OUTPUT 717; "VOLT? MIN"

20 ENTER 717; A

30 PRINT A

## **CURRent Subsystem**

The CURRent command sets the oscillator's output current level. The CURRent? query returns the current oscillator current level.

## **Command Syntax**

$$\texttt{CURRent}\big[: \texttt{LEVel}\,\big] \left\{ \begin{matrix} < value > \\ \texttt{MIN} \\ \texttt{MAX} \end{matrix} \right\}$$

Where,

is the NR1, NR2 or NR3 format  $\langle value \rangle$ 

MIN Sets or returns the minimum oscillator current level

 $(50\mu A)$ 

MAX Sets or returns the maximum oscillator current level

> (When Hi-PW mode is OFF: 20mA When Hi-PW mode is ON:200mA)

In case of ALC ON, this command sets to ALC OFF

and sets the maximum oscillator current level.

#### Note



A suffix multiplier and a suffix unit, A (ampere), can be used with this command. If this query is received when the oscillator level set to a current level, error -230 Data corrupt or stale will occur.

Example

OUTPUT 717; "CURR 10MA" ! Set to 10 mA

OUTPUT 717; "CURR MAX" ! Set to 20 mA (the HP 4284A standard configuration)

Query Syntax

CURRent[:LEVel]? 
$$\begin{bmatrix} MIN \\ MAX \end{bmatrix}$$

**Query Response** 

Returned format is:

<NR3><NL^END>

**Example** 

10 OUTPUT 717; "CURR? MIN"

20 ENTER 717; A

30 PRINT A

## **AMPLitude** Subsystem

The AMPLitude command sets the Automatic Level Control (ALC) to ON or OFF. The AMPLitude? query returns the current ALC ON/OFF state.

**Command Syntax** 

Where,

1 (decimal 49) When the function is ON O (decimal 48) When the function is OFF

**Example** OUTPUT 717; "AMPL: ALC ON"

AMPLitude: ALC? **Query Syntax** 

Returned format is: **Query Response** 

<NR1><NL^END>

10 OUTPUT 717; "AMPL: ALC?" **Example** 

> 20 ENTER 717; A 30 PRINT A

## **OUTPut Subsystem**

The OUTPut subsystem command sets the DC bias monitor function. Figure 8-4 shows the command tree of the OUTPut subsystem group.

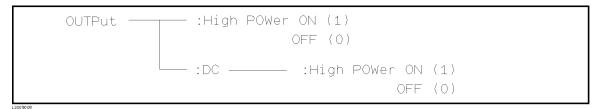


Figure 8-4. OUTPut Subsystem Command Tree

## :High POWer

The : High POWer command sets the high power mode to ON or OFF, which means that Option 001(Power Amplifier/DC Bias) is valid or invalid when Option 001 is installed. The :High POWer? query returns the current high power mode setting. Refer to Appendix G.

## **Command Syntax**

$$0 \text{UTPut:HPOWer} \left\{ \begin{array}{c} 0 \text{N} \\ 0 \text{FF} \\ 1 \\ 0 \end{array} \right\}$$

Where,

1 (decimal 49) When the function is ON O (decimal 48) When the function is OFF

**Example** 

OUTPUT 717; "OUTP: HPOW ON"

OUTPUT 717; "OUTP: HPOW O"

**Query Syntax** 

OUTPut: HPOWer?

**Query Response** 

Returned format is:

<NR1><NL^END>

**Example** 

10 OUTPUT 717; "OUTP: HPOW?"

20 ENTER 717:A

30 PRINT A

### :DC:ISOLation

The :DC:ISOLation command sets the bias current isolation to ON or OFF. The :DC:ISOLation? query returns the current setting of the bias current isolation function. Refer to Appendix G.

## **Command Syntax**

$$\begin{array}{c}
0N \\
0FF \\
1 \\
0
\end{array}$$

Where,

1 (decimal 49) When the function is ON O (decimal 48) When the function is OFF

**Example** 

OUTPUT 717; "OUTP: DC: ISOL ON"

OUTPUT 717; "OUTP: DC: ISOL O"

**Query Syntax** 

OUTPut: DC: ISOLation?

**Query Response** 

Returned format is:

<NR1><NL^END>

**Example** 

10 OUTPUT 717; "OUTP: DC: ISOL?"

20 ENTER 717:A

30 PRINT A

# **BIAS Subsystem**

The BIAS subsystem command group sets the DC BIAS switch to ON or OFF, and sets the DC bias voltage value or the DC bias current value. Figure 8-5 shows the command tree of the BIAS subsystem command group. Refer to Appendix G.

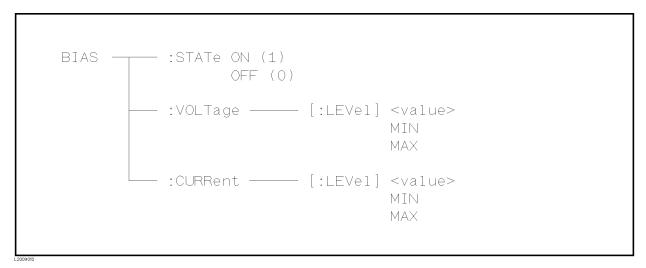


Figure 8-5. BIAS Subsystem Command Tree

## :STATe

The :STATe command turns the DC BIAS switch to ON or OFF. Setting BIAS: VOLTage or BIAS: CURRent do not implicitly turn this ON. The :STATe? query returns the current DC BIAS switch ON/OFF state. \*RST default value is OFF. And when Instrument control settings are loaded from the internal memory or memory card, this switch is set to OFF.

## **Command Syntax**

$$BIAS:STATe \left\{ \begin{array}{l} ON \\ OFF \\ 1 \\ O \end{array} \right\}$$

Where,

1 (decimal 49) When the switch is ON O (decimal 48) When the switch is OFF

**Example** 

OUTPUT 717; "BIAS: STAT 1"

**Query Syntax** 

BIAS:STATe?

**Query Response** 

Returned format is:

<NR1><NL^END>

**Example** 

10 OUTPUT 717; "BIAS: STAT?"

20 ENTER 717; A 30 PRINT A

# :VOLTage

The : VOLTage command sets the DC bias voltage. Setting BIAS: VOLTage does not implicitly turn the DC bias ON. The : VOLTage? query returns the current DC bias voltage setting value. Refer to Appendix G.

## **Command Syntax**

$$\texttt{BIAS:VOLTage} \big[ : \texttt{LEVel} \big] \left\{ \begin{matrix} < value > \\ \texttt{MIN} \\ \texttt{MAX} \end{matrix} \right\}$$

Where,

is the NR1, NR2, or NR3 format < value >

MIN Sets to the minimum DC bias voltage level (0V) MAX Sets to the maximum DC bias voltage level

> (When Hi-PW mode is OFF: 2V When Hi-PW mode is ON: 40V)

**Example** 

OUTPUT 717; "BIAS: VOLT 1.5V"

Query Syntax

### **Query Response**

Returned format is:

<NR3><NL^END>

**Example** 

10 OUTPUT 717; "BIAS: VOLT? MAX"

20 ENTER 717; A

30 PRINT A

40 END

#### Note



A suffix multiplier and a suffix unit, V (volt), can be used with this command. If this query is received when the DC bias level is set to a current level, error -230 Data corrupt or stale will occur.

### :CURRent

The : CURRent command sets the DC bias current. Setting BIAS: CURRent does not implicitly turn the DC bias ON. The :CURRent? query returns the current DC bias current setting value. This command is effective when the Option 001 DC Bias is installed or the HP 42841A and the HP 42842A/B are combined.

## **Command Syntax**

$$\texttt{BIAS:CURRent}\big[:\texttt{LEVel}\,\big] \left\{ \begin{array}{l} < value > \\ \texttt{MIN} \\ \texttt{MAX} \end{array} \right\}$$

Where,

< value >NR1, NR2, or NR3 format

MIN Sets or returns the minimum DC bias current level (OV) MAX Sets or returns the maximum DC bias current level

(When Hi-PW mode is ON: 100mA)

Note



A suffix multiplier and a suffix unit, A (ampere), can be used with this command. If this query is received when the DC bias level is set to a current level, error -230 Data corrupt or stale will occur.

**Example** 

OUTPUT 717; "BIAS: CURR 10MA"

**Query Syntax** 

BIAS:CURRent[:LEVel]? MIN MAX

**Query Response** 

Returned format is:

<NR3><NL^END>

**Example** 

10 OUTPUT 717; "BIAS: CURR?"

20 ENTER 717; A

30 PRINT A

## **FUNCtion Subsystem**

The FUNCtion subsystem command group sets the measurement function, the measurement range, monitor ON/OFF control, and the deviation measurement control. Figure 8-6 shows the command tree of the FUNCtion subsystem command group.

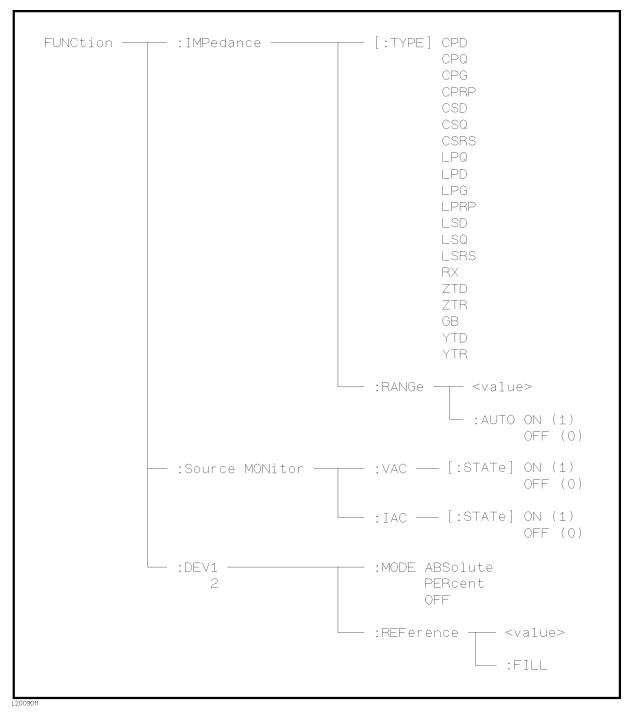


Figure 8-6. FUNCtion Subsystem Command Tree

# :IMPedance[:TYPE]

The :IMPedance command sets the measurement function. The :IMPedance? query returns the current measurement function.

## **Command Syntax**

```
\verb|FUNCtion:IMPedance||: \verb|TYPE|| < function>
```

Where,  $\langle function \rangle$  is:

CPD	Sets function to C <sub>p</sub> -D	LPRP	Sets function to L <sub>p</sub> -R <sub>p</sub>
CPQ	Sets function to C <sub>p</sub> -Q	LSD	Sets function to L <sub>s</sub> -D
CPG	Sets function to C <sub>p</sub> -G	LSQ	Sets function to L <sub>s</sub> -Q
CPRP	Sets function to C <sub>p</sub> -R <sub>p</sub>	LSRS	Sets function to L <sub>s</sub> -R <sub>s</sub>
CSD	Sets function to C <sub>s</sub> -D	RX	Sets function to R-X
csQ	Sets function to C <sub>s</sub> -Q	ZTD	Sets function to $Z-\theta$ (deg)
CSRS	Sets function to C <sub>s</sub> -R <sub>s</sub>	ZTR	Sets function to $Z-\theta$ (rad)
LPQ	Sets function to L <sub>p</sub> -Q	GB	Sets function to G-B
LPD	Sets function to L <sub>p</sub> -D	YTD	Sets function to Y- $\theta$ (deg)
	Sets function to L <sub>p</sub> -G	YTR	Sets function to Y-θ (rad)

**Example** 

OUTPUT 717; "FUNC: IMP GB" ! Set to the G-B function

**Query Syntax** 

FUNCtion:IMPedance[:TYPE]?

**Query Response** 

Returned format is:

 $<\!function\!>\!<\!\texttt{NL^END}\!>$ 

Example

10 OUTPUT 717; "FUNC: IMP?"

20 ENTER 717; A\$

30 PRINT A\$

### :IMPedance:RANGe

The :IMPedance: RANGe command sets the measurement range. Any value can be used as the setting value. The HP 4284A selects an appropriate measurement range for the setting value. The :IMPedance:RANGe? query returns the current measurement range even if the measurement range is set to AUTO. Refer to Appendix G.

## **Command Syntax**

 ${\tt FUNCtion:IMPedance:RANGe}\ < value>$ 

Where,  $\langle value \rangle$  is the impedance value of DUT in the NR1, NR2, or NR3 format

Note



A suffix multiplier and a suffix unit, OHM, can be used with this command. If this command is received while auto range is ON, the auto range function is automatically set to OFF and the range will be held at the range dictated by the received command.

**Example** 

OUTPUT 717; "FUNC: IMP: RANG 5KOHM"

**Query Syntax** 

FUNCtion: IMPedance: RANGe?

### **Query Response**

Returned format is:

< value><  $NL^END>$ 

Where,  $\langle value \rangle$  is

$1^{1}$	10	100
300	1000	3000
10000	30000	100000

<sup>1</sup> When Option 001 is installed

#### **Example**

```
10 OUTPUT 717; "FUNC: IMP: RANG?"
```

20 ENTER 717; A

30 PRINT A

## :IMPedance:RANGe :AUTO

The :IMPedance:RANGe:AUTO command sets the auto range to ON or OFF. The :IMPedance:RANGe:AUTO? query returns the current auto range ON/OFF condition.

## **Command Syntax**

$$FUNCtion:IMPedance:RANGe:AUTO \left\{ \begin{array}{l} UN \\ OFF \\ 1 \\ O \end{array} \right\}$$

Where,

1 (decimal 49) When the function is ON O (decimal 48) When the function is OFF

**Example** OUTPUT 717; "FUNC: IMP: RANG: AUTO ON"

OUTPUT 717; "FUNC: IMP: RANG: AUTO 1"

FUNCtion: IMPedance: RANGe: AUTO? **Query Syntax** 

Returned format is: **Query Response** 

<NR1><NL^END>

10 OUTPUT 717; "FUNC: IMP: RANG: AUTO?" **Example** 

20 ENTER 717; A

30 PRINT A

## :Source **MONitor:VAC**

The :Source MONitor: VAC command sets the voltage level monitor to ON or OFF. The :Source MONitor: VAC? query returns the voltage level monitor ON/OFF condition.

## **Command Syntax**

$$FUNCtion:SMONitor:VAC[:STATe] \begin{cases} 0N \\ 0FF \\ 1 \\ 0 \end{cases}$$

Where,

1 (decimal 49) When the switch is ON O (decimal 48) When the switch is OFF

**Example** OUTPUT 717; "FUNC: SMON: VAC ON"

OUTPUT 717; "FUNC: SMON: VAC 1"

FUNCtion:SMONitor:VAC[:STATe]? **Query Syntax** 

**Query Response** Returned format is:

<NR1><NL^END>

10 OUTPUT 717; "FUNC:SMON: VAC?" **Example** 

> 20 ENTER 717; A 30 PRINT A 40 END

:Source MONitor:IAC

The :Source MONitor: IAC command sets the current level monitor to ON or OFF. The :Source MONitor: IAC? query returns the current ON/OFF condition of the current level monitor.

**Command Syntax** 

$$FUNCtion:SMONitor:IAC[:STATe] \left\{ \begin{array}{l} 0N\\0FF\\1\\0 \end{array} \right\}$$

Where,

1 (decimal 49) When the switch is ON O (decimal 48) When the switch is OFF

**Example** 

OUTPUT 717; "FUNC: SMON: IAC 1"

**Query Syntax** 

FUNCtion:SMONitor:IAC[:STATe]?

**Query Response** 

Returned format is:

<NR1><NL^END>

Example

10 OUTPUT 717; "FUNC: SMON: IAC?"

20 ENTER 717; A

30 PRINT A

## :DEV<n>:MODE

The :DEV< n >: MODE command sets the deviation measurement mode. The :DEV< n >:MODE? query returns the current setting of the deviation measurement mode.

## **Command Syntax**

$$\texttt{FUNCtion:DEV} < n > : \texttt{MODE} \left\{ \begin{array}{l} \texttt{ABSolute} \\ \texttt{PERCent} \\ \texttt{OFF} \end{array} \right\}$$

Where,

 $\Delta$  ABSolute deviation mode ABSolute

PERCent  $\Delta$  % deviation mode

OFF Turn the deviation measurement mode OFF

 $\langle n \rangle$  is:

1 (decimal 49) Deviation mode setting for primary parameter 2 (decimal 50) Deviation mode setting for secondary parameter

**Example** 

OUTPUT 717; "FUNC: DEV1: MODE ABS"

OUTPUT 717; "FUNC: DEV2: MODE OFF"

**Query Syntax** 

FUNCtion: DEV < n > : MODE?

**Query Response** 

Returned format is:

**Example** 

10 OUTPUT 717; "FUNC: DEV1: MODE?"

20 ENTER 717;A\$

30 PRINT A\$

## :DEV<n>:REFerence

The :DEV< n >:REFerence command sets the reference value for deviation measurement. The :DEV< n>:REFerence? query returns the current reference values.

### **Command Syntax**

 $\mathtt{FUNCtion}: \mathtt{DEV} < n > : \mathtt{REFerence} < value >$ 

Where.

< value >is the NR1, NR2, or NR3 format

 $\langle n \rangle$  is:

1 (decimal 49) Reference value setting for primary parameter 2 (decimal 50) Reference value setting for secondary parameter

**Example** 

OUTPUT 717; "FUNC: DEV1: REF 10"

OUTPUT 717; "FUNC: DEV2: REF 2E-3"

**Query Syntax** 

FUNCtion: DEV < n > : REFerence?

**Query Response** 

Returned format is:

<NR3><NL^END>

Example

10 OUTPUT 717; "FUNC: DEV1: REF?"

20 ENTER 717; A

30 PRINT A

40 END

## :DEV<n> :REFerence:FILL

The :DEV< n>:REFerence:FILL command executes a single measurement and enters two measured values (the primary and secondary parameters) into each of the reference values for the deviation measurement.

### **Command Syntax**

FUNCtion: DEV < n > : REFerence: FILL

Where,  $\langle n \rangle$  is

1 or 2 (Both reference values are measured simultaneously.)

**Example** 

OUTPUT 717; "FUNC: DEV1: REF: FILL"

## **LIST Subsystem**

The LIST subsystem command group sets the List Sweep measurement function, including the sweep point settings, the sweep mode and limit values for the limit function. Figure 8-7 shows the command tree of the LIST subsystem command group.

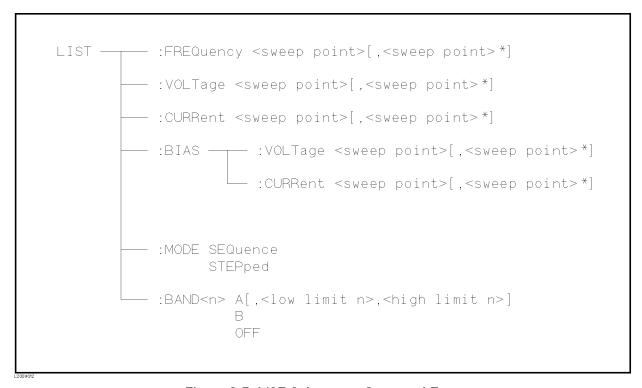


Figure 8-7. LIST Subsystem Command Tree

## :FREQuency

The :FREQuency command clears the previous List Sweep point table, and sets the frequency sweep points. The :FREQuency? query returns the current settings of the frequency sweep points.

## **Command Syntax**

```
LIST:FREQuency \langle value \rangle [, \langle value \rangle^*]
```

\*Repeat Max. 10 sweep points

Where,

 $\langle value \rangle$  is the NR1, NR2, or NR3 format

### Example

#### Note



A suffix multiplier and a suffix unit, HZ (hertz), can be used with this command. Either MAHZ and MHZ can be used as the suffix multiplier for MHz (1E6 Hz).

### **Query Syntax**

LIST: FREQuency?

## **Query Response**

Returned format is:

### **Example**

10 DIM A\$[100]

20 OUTPUT 717; "LIST: FREQ?"

30 ENTER 717; A\$

40 PRINT A\$

50 END

#### Note



If this query is received when the List Sweep parameter is set to anything other than frequency, error -230 Data corrupt or stale will occur.

## :VOLTage

The : VOLTage command clears the previous list sweep point table, and sets the oscillator voltage level sweep points. The :VOLTage? query returns the current settings of the voltage sweep points.

## **Command Syntax**

```
LIST: VOLTage \langle value \rangle [, \langle value \rangle^*]
```

\*Max. 10 sweep points

Where.

< value> is the NR1, NR2, or NR3 format

### **Example**

```
OUTPUT 717; "LIST: VOLT 1.5" !Set 1.5V to point 1
OUTPUT 717; "LIST: VOLT 1E-2,2E-2,3E-2,4E-2"
! Set 10 mV to point 1, .... 40 mV to point 4
```

#### Note



A suffix multiplier and a suffix unit, V (voltage), can be used with this command.

## Query Syntax

LIST: VOLTage?

### **Query Response**

Returned format is:

## **Example**

- 10 DIM A\$[100]
- 20 OUTPUT 717; "LIST: VOLT?"
- 30 ENTER 717; A\$
- 40 PRINT A\$
- 50 END

#### Note



If this query is received when the List Sweep parameter is set to anything other than voltage, error -230 Data corrupt or stale will occur.

### :CURRent

The :CURRent command clears the previous list sweep point table, and sets the oscillator current level sweep points. The : CURRent? query returns the current settings of current sweep points.

## **Command Syntax**

```
LIST: CURRent \langle value \rangle [, \langle value \rangle^*]
```

\*Max. 10 sweep points

Where.

 $\langle value \rangle$  is the NR1, NR2, or NR3 format

### **Example**

```
OUTPUT 717; "LIST: CURR 100MA" !Set 100mA to point 1
OUTPUT 717; "LIST: CURR 1E-2, 2E-2, 3E-2, 4E-2"
! Set 10 mA to point 1, ... 40 mA to point 4
```

#### Note



A suffix multiplier and a suffix unit, A (ampere), can be used with this command.

## **Query Syntax**

LIST: CURRent?

### **Query Response**

Returned format is:

### **Example**

10 DIM A\$[100]

20 OUTPUT 717; "LIST: CURR?"

30 ENTER 717; A\$

40 PRINT A\$

50 END

#### Note



If this query is received when the List Sweep parameter is set to anything other than current, error -230 Data corrupt or stale will occur.

## :BIAS:VOLTage

The :BIAS: VOLTage command clears the previous List Sweep point table, and sets the DC bias voltage level sweep points. The :BIAS: VOLTage? query returns the current settings of the DC voltage sweep points. Refer to Appendix G

## **Command Syntax**

LIST:BIAS:VOLTage  $\langle value \rangle$  [,  $\langle value \rangle^*$ ]

\*Max. 10 sweep points

Where.

< value> is the NR1, NR2, or NR3 format

### Example

OUTPUT 717; "LIST:BIAS: VOLT 1.5V" !Set 1.5V to point 1 OUTPUT 717; "LIST:BIAS: VOLT 2E-1,4E-1,6E-1,8E-1" ! Set 200 mV to point 1, ... 800 mV to point 4

#### Note



A suffix multiplier and a suffix unit, V (voltage), can be used with this command.

#### **Query Syntax**

LIST:BIAS:VOLTage?

### **Query Response**

Returned format is:

<NR3>[,<NR3>\*]<NL^END>

#### **Example**

10 DIM A\$[100]

20 OUTPUT 717; "LIST:BIAS: VOLT?"

30 ENTER 717; A\$

40 PRINT A\$

50 END

#### Note



If this query is received when the List Sweep parameter is set to anything other than bias voltage, error -230 Data corrupt or stale will occur.

### :BIAS:CURRent

The :BIAS:CURRent command clears the previous List Sweep point table, and sets the DC bias current level sweep points. The :BIAS:CURRent? query returns the current settings of the DC current sweep points.

## **Command Syntax**

 $\texttt{LIST:BIAS:CURRent} \ <\! value \! > \! \big\lceil \ \mathsf{,} <\! value \! > \! ^* \big\rceil$ 

\*Max. 10 sweep points

Where.

 $\langle value \rangle$  is the NR1, NR2, or NR3 format

## Example

OUTPUT 717; "LIST: BIAS: CURR 100MA" !Set 100mA to point 1 OUTPUT 717; "LIST: BIAS: CURR 1E-2, 2E-2, 3E-2, 4E-2" ! Set 10 mA to point 1, ... 40 mA to point 4

#### Note



A suffix multiplier and a suffix unit, A (ampere), can be used with this command.

### **Query Syntax**

LIST:BIAS:CURRent?

### **Query Response**

Returned format is:

<NR3>[,<NR3>\*]<NL^END>

#### **Example**

10 DIM A\$[100]

20 OUTPUT 717; "LIST: BIAS: CURR?"

30 ENTER 717; A\$

40 PRINT A\$

50 END

#### Note



If this query is received when the List Sweep parameter is set to anything other than bias current, error -230 Data corrupt or stale will occur.

## :MODE

The :MODE command sets the sweep mode of the List Sweep measurement function. The :MODE? query returns the current mode setting of the List Sweep measurement function.

**Command Syntax** 

$$LIST: \texttt{MODE} \left\{ \begin{array}{l} \texttt{SEQuence} \\ \texttt{STEPped} \end{array} \right\}$$

Where,

SEQuence Sets to sequence mode Sets to stepped mode STEPped

**Example** 

OUTPUT 717; "LIST: MODE SEQ"

**Query Syntax** 

LIST: MODE?

**Query Response** 

Returned format is:

$${SEQ \atop STEP}$$
 < NL^END>

**Example** 

10 OUTPUT 717; "LIST: MODE?"

20 ENTER 717; A\$

30 PRINT A\$

## :BAND<n>

The :BAND< n > command sets the limit values of the limit function for the list sweep measurement. The :BAND< n>? query returns the current limit value settings.

## **Command Syntax**

LIST: BAND < n > < parameter > [, < low limit n >, < high limit n > ]

Where,

1 to 10 (NR1): Sweep point number  $\langle n \rangle$ 

cparameter> is : A Limit setting enable for primary parameter

Limit setting enable for secondary

parameter

OFF Limit setting disable

 $< low \ limit \ n >$ NR1, NR2, or NR3 format: low limit for sweep

point < n >

NR1, NR2, or NR3 format: high limit for sweep  $< high \ limit \ n >$ 

point < n >

Example

OUTPUT 717; "LIST: BAND1 A,10,20"

OUTPUT 717; "LIST: BAND3 OFF"

**Query Syntax** 

LIST:BAND < n > ?

**Query Response** 

Returned format is:

< parameter >, < low limit n >, < high limit n >

**Example** 

10 DIM A\$[30]

20 OUTPUT 717; "LIST: BAND3?"

30 ENTER 717; A\$

40 PRINT A\$

## **APERture Subsystem**

The APERture command sets the integration time of the A/D converter and the averaging rate. The APERture? query returns the current integration time and the averaging rate settings.

**Command Syntax** 

$$\texttt{APERture} \left\{ \begin{array}{l} \texttt{SHORt} \\ \texttt{MEDium} \\ \texttt{LONG} \end{array} \right\} \left[ \ \texttt{,} < value > \ \right]$$

Where,

SHORt Short integration time Medium integration time MEDium Long integration time LONG

1 to 128 (NR1): Averaging rate < value >

OUTPUT 717; "APER SHOR" **Example** 

OUTPUT 717; "APER MED, 64"

**Query Syntax** APERture?

**Query Response** Returned format is:

SHOR
MED
LONG
,<NR1><NL^END>

10 OUTPUT 717; "APER?" **Example** 

20 ENTER 717; A\$

30 PRINT A\$

## **TRIGger Subsystem**

The TRIGger subsystem command group is used to enable a measurement or a sweep measurement, and to set the trigger mode and the trigger delay time. Figure 8-8 shows the command tree of the TRIGger subsystem command group.

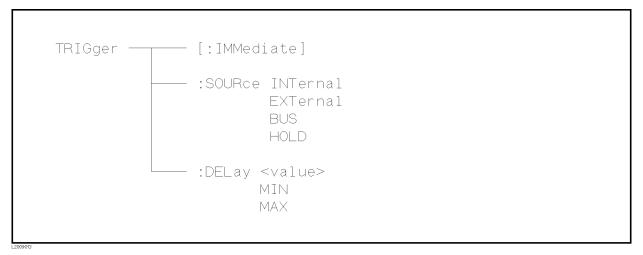


Figure 8-8. TRIGger Subsystem Command Tree

## :IMMediate

The :IMMediate command causes the trigger to execute a measurement or a sweep measurement, regardless of the trigger state. Refer to "Trigger System" in Chapter 7, for details.

**Command Syntax** 

TRIGger[:IMMediate]

**Example** 

OUTPUT 717; "TRIG"

OUTPUT 717; "TRIG: IMM"

## :SOURce

The :SOURce command sets the trigger mode. The :SOURce? query returns the current trigger mode.

### **Command Syntax**

Where,

INTernal Internal trigger mode EXTernal External trigger mode BUS Bus trigger mode

HOLD Trigger hold (Manual trigger mode)

**Example** OUTPUT 717; "TRIG: SOUR BUS"

**Query Syntax** TRIGger:SOURce?

**Query Response** Returned format is:

**Example** 

10 OUTPUT 717; "TRIG:SOUR?"

20 ENTER 717; A\$

30 PRINT A\$

## :DELay

The :DELay command sets the trigger delay time. The :DELay? query returns the current delay time.

## **Command Syntax**

$$exttt{TRIGger:DELay} \left\{ egin{array}{l} < value > \ exttt{MIN} \ exttt{MAX} \end{array} 
ight\}$$

Where,

is the NR1, NR2, or NR3 format; 0 to 60 [s] in 1 ms  $\langle value \rangle$ 

resolution

MIN Sets the minimum delay value (0 s) MAX Sets the maximum delay value (60 s)

### **Example**

OUTPUT 717; "TRIG: DEL 5S" ! Set delay time to 5 s

OUTPUT 717; "TRIG: DEL MIN" ! Set delay time to O s

#### Note



A suffix multiplier and a suffix unit, S (second), can be used with this command.

### **Query Syntax**

## **Query Response**

Returned Format is:

<NR3><NL^END>

#### **Example**

10 OUTPUT 717; "TRIG: DEL?"

20 ENTER 717; A

30 PRINT A

## **INITiate Subsystem**

The INITiate subsystem command group controls initiation of the triggering system. Figure 8-9 shows the command tree of the INITiate subsystem command group.

```
- [:IMMediate]
INITiate -
               - :CONTinuous ON (1)
                             OFF (0)
```

Figure 8-9. INITiate Subsystem Command Tree

# [:IMMediate]

The [:IMMediate] command changes the trigger state to the IDLE STATE to the WAIT FOR TRIGGER STATE for one trigger sequence. For details, refer to "Trigger System" in Chapter 7.

**Command Syntax** 

INITiate[IMMediate]

**Example** 

OUTPUT 717; "INIT"

OUTPUT 717; "INIT: IMM"

### :CONTinuous

The :CONTinuous command sets the trigger system to the CONTinuous ON or OFF condition. In the CONTinuous ON condition, after reading the measurement data by a controller, the IDLE STATE is automatically set to the WAIT FOR TRIGGER STATE. For details refer to "Trigger System" in Chapter 7. The :CONTinuous? query responds the current condition of the CONTinuous ON or OFF.

## **Command Syntax**

INITiate: CONTinuous 
$$\left\{ \begin{array}{l} 0N \\ 0FF \\ 1 \\ 0 \end{array} \right\}$$

Where,

1 (decimal 49) When the function is ON O (decimal 48) When the function is OFF

OUTPUT 717; "INIT: CONT ON" **Example** 

INITiate: CONTinuous? **Query Syntax** 

**Query Response** Returned format is:

<NR1><NL^END>

10 OUTPUT 717; "INIT: CONT?" Example

> 20 ENTER 717; A 30 PRINT A 40 END

## FETCh? Subsystem

The FETCh? subsystem command group is a sensor-only command which retrieves the measurement data taken by measurement(s) initiated by a trigger, and places the data into the HP 4284A's output buffer.

Figure 8-10 shows the command tree of the FETCh? subsystem command group.

```
- :Source MONitor — :VAC?
— :IAC?
```

Figure 8-10. FETCh? Subsystem Command Tree

# [:IMP]?

The [:IMP]? query sets the latest measurement data of the primary and secondary parameters into the HP 4284A's output buffer. For the returned format, refer to "Data Transfer" in Chapter 7.

```
FETCh[:IMP]?
Query Syntax
                    10 OUTPUT 717; "TRIG:SOUR BUS"
    Example
                    20 OUTPUT 717; "TRIG"
                    30 OUTPUT 717; "FETC?"
                    40 ENTER 717; A, B, C
                    50 PRINT A,B,C
                    60 END
```

### :Source MONitor:VAC?

The :Source MONitor: VAC? query sets the latest measured voltage monitor data into the HP 4284A's output buffer.

**Query Syntax** 

FETCh: SMONitor: VAC?

**Query Response** 

Returned format is:

<NR3><NL^END>.

Example

- 10 OUTPUT 717; "TRIG: SOUR BUS"
- 20 OUTPUT 717;"TRIG"
- 30 OUTPUT 717; "FETC: SMON: VAC?"
- 40 ENTER 717; A
- 50 PRINT A
- 60 END

#### Note



If this query is received when the voltage level monitor is set to OFF, returned data is 9.9E37.

## :Source MONitor:IAC?

The :Source MONitor: IAC? query sets the latest measured current monitor data into the HP 4284A's output buffer.

**Query Syntax** 

FETCh: SMONitor: IAC?

**Query Response** 

Returned format is:

<NR3><NL^END>.

Example

- 10 OUTPUT 717; "TRIG: SOUR BUS"
- 20 TRIGGER 717
- 30 OUTPUT 717; "FETC: SMON: IAC?"
- 40 ENTER 717; A
- 50 PRINT A
- 60 END

Note



If this query is received when the current level monitor is set to OFF, returned data is 9.9E37.

# **ABORt Subsystem**

The ABORt command sets the trigger system to reset, and the trigger state is in the IDLE STATE on the state diagram. For detail, refer to "Trigger System" in Chapter 7.

**Command Syntax** ABORt

> **Example** OUTPUT 717; "ABOR"

# **FORMat Subsystem**

The FORMat command sets the data output format. For details, refer to "Data Transfer" in Chapter 7. The FORmat? query returns the current data format setting.

**Command Syntax** 

$$FORMat[:DATA] \left\{ egin{array}{l} ASCii \\ REAL[,64] \end{array} 
ight\}$$

Where,

is set by the ASCII data format ASCii

REAL[,64] is set by the IEEE-64 bit floating point data format

**Example** 

OUTPUT 717; "FORM REAL"

**Query Syntax** 

FORMat[:DATA]?

**Query Response** 

Returned data format is:

**Example** 

10 OUTPUT 717; "FORM?"

20 ENTER 717; A\$

30 PRINT A\$

# **MEMory Subsystem**

The MEMory subsystem command group controls the HP 4284A's data buffer. Figure 8-11 shows the command tree of the MEMory subsystem command group.

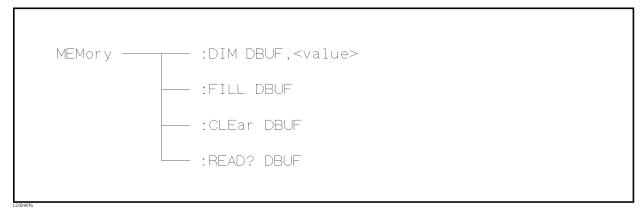


Figure 8-11. MEMory Subsystem Command Tree

#### :DIM

The :DIM command clears the data buffer memory, and sets the size of the data buffer memory. For details, refer to "Data Transfer" in Chapter 7.

#### **Command Syntax**

MEMory: DIM DBUF, < value>

Where,

 $\langle value \rangle$ 1 to 128 (NR1): Number of data sets

#### **Example**

OUTPUT 717; "MEM: DIM DBUF, 3"

! Specify the DBUF size for 3 sets of measurement data

### :FILL

The :FILL command enables the data buffer memory to store the measurement data. After execution of the :FILL command, all measurement data will be stored in the data buffer memory. For details, refer to "Data Transfer" in Chapter 7.

**Command Syntax** 

MEMory: FILL DBUF

Example

OUTPUT 717; "MEM: FILL DBUF"

### :CLEar

The :CLEar command clears the data buffer memory. After execution of this command, measurement data will not be stored in the data buffer memory until execution of the :FILL command. For details, refer to "Data Transfer" in Chapter 7.

MEMory: CLEar DBUF **Command Syntax** 

> OUTPUT 717; "MEM: CLE DBUF" **Example**

# :READ?

The :READ? query places the data in the data buffer memory into the output buffer. If the data buffer memory is not filled to the specified size (specified by the :DIM command), the data locations in which data is not stored will be set to -1 (no data). For details of the returned data format, refer to "Data Transfer" in Chapter 7.

MEMory: READ? DBUF **Query Syntax** 

> OUTPUT 717; "MEM: READ? DBUF" **Example**

# **CORRection Subsystem**

The CORRection subsystem command group sets the correction function, including the cable length correction settings, and the OPEN/SHORT/LOAD correction settings. Figure 8-12 shows the command tree of the CORRection subsystem command group.

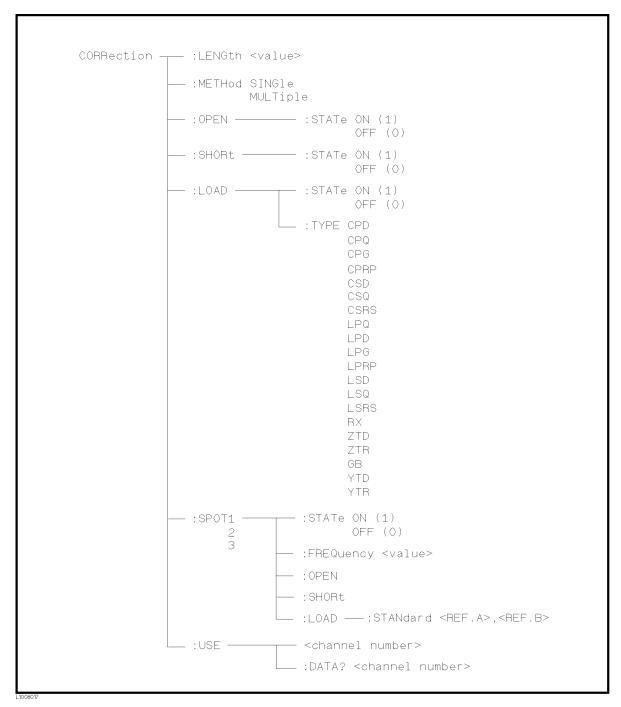


Figure 8-12. CORRection Subsystem Command Tree

:LENGth

The :LENGth command sets the cable length correction setting. The :LENGth? query returns the current settings of the cable length

correction.

**Command Syntax** 

 ${\tt CORRection: LENGth} < value>$ 

Where,

< value >0, 1, or 2 is Cable length in [m]

Note



A suffix with a suffix unit, M (meter), can be used with this command.

**Example** 

OUTPUT 717; "CORR: LENG 1M"

**Query Syntax** 

CORRection: LENGth?

**Query Response** 

Returned format is:

<NR1><NL^END>

**Example** 

10 OUTPUT 717; "CORR: LENG?"

20 ENTER 717; A

30 PRINT A

:METHod

The :METHod command sets the correction mode. The :METHod? query returns the current settings of the correction mode.

**Command Syntax** 

$$\texttt{CORRection:METHod} \left\{ \begin{array}{l} \texttt{SINGle} \\ \texttt{MULTi} \end{array} \right\}$$

Where,

SINGle Sets or returns the single channel correction mode Sets or returns the multi channel correction mode MULTi

**Example** 

OUTPUT 717; "CORR: METH MULT"

**Query Syntax** 

CORRection: METHod?

**Query Response** 

Returned format is:

$${SING \choose MULT}$$
 < NL^END>

**Example** 

10 OUTPUT 717; "CORR: METH?"

20 ENTER 717; A\$

30 PRINT A\$

40 END

:OPEN

The :OPEN command executes 51 presetted OPEN correction data

measurement points.

**Command Syntax** 

CORRection: OPEN

**Example** 

OUTPUT 717; "CORR: OPEN"

#### :OPEN:STATe

The :OPEN:STATe command sets the OPEN correction function to ON or OFF. The :OPEN:STATe? query returns the current ON/OFF condition of the OPEN correction.

**Command Syntax** 

$$\texttt{CORRection:OPEN:STATe} \left\{ \begin{array}{l} \texttt{ON} \\ \texttt{OFF} \\ \texttt{1} \\ \texttt{O} \end{array} \right\}$$

Where,

1 (decimal 49) When the function is ON O (decimal 48) When the function is OFF

**Example** 

OUTPUT 717; "CORR: OPEN: STAT ON"

**Query Syntax** 

CORRection: OPEN: STATe?

**Query Response** 

Returned format is:

<NR1><NL^END>

**Example** 

10 OUTPUT 717; "CORR: OPEN: STAT?"

20 ENTER 717; A 30 PRINT A 40 END

:SHORt

The :SHORt command executes 51 presetted SHORT correction data measurement points.

**Command Syntax** 

CORRection: SHORt

**Example** 

OUTPUT 717; "CORR: SHOR"

# :SHORt:STATe

The :SHORt:STATe command sets the SHORT correction function to ON or OFF. The :SHORt:STATe? query responds the current ON/OFF condition of the SHORT correction.

**Command Syntax** 

$$\begin{array}{c}
CORRection:SHORt:STATe \\
0 \\
1 \\
0
\end{array}$$

Where,

1 (decimal 49) When the function is ON O (decimal 48) When the function is OFF

**Example** OUTPUT 717; "CORR: SHOR: STAT ON"

CORRection: SHORt: STATe? **Query Syntax** 

Returned format is: **Query Response** 

<NR1><NL^END>

10 OUTPUT 717; "CORR:SHOR:STAT?" **Example** 

> 20 ENTER 717; A 30 PRINT A 40 END

### :LOAD:STATe

The :LOAD:STATe command sets the LOAD correction function to ON or OFF. The :LOAD:STATe? query responds the current ON/OFF condition of the LOAD correction.

**Command Syntax** 

$$\texttt{CORRection:LOAD:STATe} \left\{ \begin{array}{l} \texttt{ON} \\ \texttt{OFF} \\ \texttt{1} \\ \texttt{0} \end{array} \right\}$$

Where,

1 (decimal 49) When the function is ON O (decimal 48) When the function is OFF

**Example** OUTPUT 717; "CORR: LOAD: STAT ON"

**Query Syntax** CORRection:LOAD:STATe?

Returned format is: **Query Response** 

<NR1><NL^END>

10 OUTPUT 717; "CORR: LOAD: STAT?" **Example** 

> 20 ENTER 717; A 30 PRINT A

# :LOAD:TYPE

The :LOAD:TYPE command sets the function of the reference values for the load correction. The :LOAD:TYPE? query responds the current function of the reference values.

## **Command Syntax**

CORRection:LOAD:TYPE < function>

Where,  $\langle function \rangle$  is:

CPD	Sets function to C <sub>p</sub> -D	LPRP	Sets function to L <sub>p</sub> -R <sub>p</sub>
CPQ	Sets function to C <sub>p</sub> -Q	LSD	Sets function to L <sub>s</sub> -D
CPG	Sets function to C <sub>p</sub> -G	LSQ	Sets function to $L_s$ -Q
CPRP	Sets function to C <sub>p</sub> -R <sub>p</sub>	LSRS	Sets function to $L_s$ - $R_s$
CSD	Sets function to C <sub>s</sub> -D	RX	Sets function to R-X
CSQ	Sets function to $C_{s}$ -Q	ZTD	Sets function to $Z-\theta$ (deg)
CSRS	Sets function to C <sub>s</sub> -R <sub>s</sub>	ZTR	Sets function to Z- $\theta$ (rad)
LPQ	Sets function to L <sub>p</sub> -Q	GB	Sets function to G-B
LPD	Sets function to L <sub>p</sub> -D	YTD	Sets function to Y- $\theta$ (deg)
LPG	Sets function to L <sub>p</sub> -G	YTR	Sets function to Y- $\theta$ (rad)

**Example** OUTPUT 717; "CORR:LOAD: TYPE CPD"

CORRection:LOAD:TYPE? **Query Syntax** 

### **Query Response**

Returned format is:

```
<function><NL^END>
```

<function> returns the current function of the reference value, using the abbreviations listed above.

### **Example**

```
10 OUTPUT 717; "CORR:LOAD: TYPE?"
```

20 ENTER 717;A\$

30 PRINT A\$

## :SPOT<n>:STATe

The :SPOT< n >:STATe command sets the specified frequency point correction (FREQ1, FREQ2 or FREQ3) to ON or OFF. The :SPOT< n >:STATe? query responds the current ON/OFF setting of the specified frequency point correction.

## **Command Syntax**

$$\texttt{CORRection:SPOT} \! < \! n \! > \! : \! \texttt{STATe} \left\{ \begin{array}{l} \texttt{ON} \\ \texttt{OFF} \\ \texttt{1} \\ \texttt{0} \end{array} \right\}$$

Where,

1 (decimal 49) When the function is ON O (decimal 48) When the function is OFF

 $\langle n \rangle$  is:

1 State setting for FREQ1 point 2 State setting for FREQ2 point State setting for FREQ3 point

Example

OUTPUT 717; "CORR: SPOT1: STAT ON"

**Query Syntax** 

CORRection: SPOT < n > : STATe?

**Query Response** 

Returned format is:

<NR1><NL^END>

**Example** 

10 OUTPUT 717; "CORR: SPOT1: STAT?"

20 ENTER 717; A

30 PRINT A

# :SPOT<n>:FREQuency

The :SPOT< n>:FREQuency command sets the frequency points (FREQ1, FREQ2 or FREQ3) for the specified frequency point correction. The :SPOT< n>:FREQuency? query returns the current settings of the frequency points (FREQ1, FREQ2 or FREQ3).

#### **Command Syntax**

 $\mathtt{CORRection}: \mathtt{SPOT} < n > : \mathtt{FREQuency} < value>$ 

Where.

< value >is the NR1, NR2, or NR3 format

 $\langle n \rangle$  is:

- Frequency setting for FREQ1 point
- 2 Frequency setting for FREQ2 point
- 3 Frequency setting for FREQ3 point

#### Example

OUTPUT 717; "CORR:SPOT1:FREQ 2KHZ"! Set 2 kHz to FREQ1

#### Note



A suffix multiplier and a suffix unit, HZ (hertz), can be used with this command. Either MAHZ and MHZ can be used as the suffix multiplier for MHz (1E6 Hz).

#### **Query Syntax**

CORRection: SPOT < n > : FREQuency?

#### **Query Response**

Returned format is:

<NR3><NL^END>

#### **Example**

- 10 OUTPUT 717; "CORR: SPOT1: FREQ?"
- 20 ENTER 717; A
- 30 PRINT A
- 40 END

#### Note



If this query is received when the List Sweep parameter is set to anything other than frequency, error -230 Data corrupt or stale will occur.

# :SPOT<n>:OPEN

The :SPOT< n >:OPEN command executes the OPEN correction data measurement for the specified frequency point (FREQ1, FREQ2 or FREQ3) correction.

#### **Command Syntax**

CORRection:SPOT < n > :OPEN

Where,  $\langle n \rangle$  is:

- 1 State setting for FREQ1 point
- 2 State setting for FREQ2 point
- 3 State setting for FREQ3 point

#### **Example**

OUTPUT 717; "CORR: SPOT1: OPEN"

# :SPOT<n>:SHORt

The :SPOT< n >:SHORt command executes the SHORT correction data measurement for the specified frequency point (FREQ1, FREQ2 or FREQ3) correction.

#### **Command Syntax**

CORRection:SPOT<n>:SHORt

Where,  $\langle n \rangle$  is:

- 1 State setting for FREQ1 point
- 2 State setting for FREQ2 point
- 3 State setting for FREQ3 point

#### **Example**

OUTPUT 717; "CORR: SPOT1: SHOR"

# :SPOT<n>:LOAD

The :SPOT< n>:LOAD command executes the LOAD correction data measurement for the specified frequency point (FREQ1, FREQ2 or FREQ3) correction.

# **Command Syntax**

 ${\tt CORRection:SPOT} < n > : {\tt LOAD}$ 

Where, < n > is:

1 State setting for FREQ1 point 2 State setting for FREQ2 point 3 State setting for FREQ3 point

**Example** OUTPUT 717; "CORR: SPOT1: LOAD"

# :SPOT<n>:LOAD :STANdard

The :SPOT< n >:LOAD:STANdard command sets the reference values of the standard at the specified frequency point (FREQ1, FREQ2 or FREQ3). The :SPOT< n >:LOAD:STANdard? query returns the current settings of the reference values for FREQ1, FREQ2 or FREQ3.

#### **Command Syntax**

 ${\tt CORRection:SPOT} < n > : {\tt LOAD:STANdard} < REF.A >$  , < REF.B >

Where,

1 Setting for FREQ1 point < n >

2 Setting for FREQ2 point

3 Setting for FREQ3 point

 $\langle REF.A \rangle$ is the NR1, NR2, or NR3 format:

Primary parameter's reference value of the standard

 $\langle REF.B \rangle$ is the NR1, NR2, or NR3 format:

Secondary parameter's reference value of the

standard

**Example** OUTPUT 717; "CORR: SPOT1: LOAD: STAN 100.7,0.0002"

**Query Syntax** CORRection: SPOT < n > : LOAD: STANdard?

Returned format is: **Query Response** 

<NR3>, <NR3><NL^END>

10 OUTPUT 717; "CORR: SPOT1:LOAD: STAN?" Example

20 ENTER 717; A, B

30 PRINT A,B

:USE

The :USE command sets the channel number to be used for multi channel correction. The :USE? query returns the current settings of the channel selected.

**Command Syntax** 

 ${\tt CORRection:USE} < channel\ number>$ 

Where,  $\langle channel\ number \rangle$  is: 1 to 127 (NR1, NR2, or NR3):

channel number

**Example** 

OUTPUT 717; "CORR: USE 10" ! Set to channel number 10

**Query Syntax** 

CORRection: USE?

**Query Response** 

Returned format is:

<channel number><NL^END>

**Example** 

10 OUTPUT 717; "CORR: USE?"

20 ENTER 717; A

30 PRINT A

#### :USE:DATA?

The :USE:DATA? query returns the OPEN/SHORT/LOAD correction measurement data at FREQ1, FREQ2 or FREQ3.

#### **Query Syntax**

CORRection: USE: DATA? < channel number>

Where,  $\langle channel\ number \rangle$  is: 1 to 127 (NR1)

### **Query Response**

#### Returned format is:

<open1 A>, <open1 B>, <short1 A>, <short1 B>, <load1 A>, < load 1 B>,

<open2 A>, <open2 B>, <short2 A>, <short2 B>, <load2 A>,

< load 2 B>,

<open3 A>, <open3 B>, <short3 A>, <short3 B>, <load3 A>,

< load 3 B >.

#### Where,

< open 1/2/3 A >NR3 format: primary OPEN correction data at

FREQ1/2/3.

< open 1/2/3 B >NR3 format: secondary OPEN correction data at

FREQ1/2/3.

<short1/2/3 A> NR3 format: primary SHORT correction data at

FREQ1/2/3.

<short1/2/3 B> NR3 format: secondary SHORT correction data

at FREQ1/2/3.

< load 1/2/3 A >NR3 format: primary LOAD correction data at

FREQ1/2/3.

< load 1/2/3 B >NR3 format: secondary LOAD correction data at

FREQ1/2/3.

#### Example

- 10 OPTION BASE 1
- 20 DIM A(18)
- 30 OUTPUT 717; "CORR: USE: DATA? 89"
- 40 ENTER 717; A(\*)
- 50 PRINT A(\*)
- 60 END

# **COMParator Subsystem**

The COMParator subsystem command group sets the comparator function, including its ON/OFF setting, limit mode, and limit values. Figure 8-13 shows the command tree of the COMParator subsystem command group.

```
COMParator — [:STATe] ON (1)
           - :MODE Absolute TOLerance
                  Percent TOLerance
                  SEQuence
           ├ :TOLerance ┬─ :NOMinal <value>
                          - :BIN<n> <low limit>,<high limit>
           — :SEQuence — :BIN <BIN1 low limit>,<BIN1 high limit>,
                              <BIN2 high limit>,<BIN3 high limit>,
                              ..... ,<BINn high limit>
           ├ :Secondary LIMimit <low limit>,<high limit>
           - :Auxiliary BIN ON(1)
                           OFF(0)
           -: SWAP ON (1)
               OFF (0)
           L:BIN ----: CLEar
                          — :COUNt —— [:STATe]
                                      - :CLEar
```

Figure 8-13. COMParator Subsystem Command Tree

# [:STATe]

The [:STATe] command sets the comparator function to ON or OFF. The [:STATe]? query responds the current ON/OFF condition of comparator function.

# **Command Syntax**

$$\texttt{COMParator}\big[:\texttt{STATe}\,\big] \left\{ \begin{array}{l} \texttt{ON} \\ \texttt{OFF} \\ \texttt{1} \\ \texttt{0} \end{array} \right\}$$

Where,

1 (decimal 49) When the function is ON O (decimal 48) When the function is OFF

OUTPUT 717; "COMP ON" **Example** 

COMParator[:STATe]? **Query Syntax** 

**Query Response** Returned format is:

<NR1><NL^END>

10 OUTPUT 717; "COMP?" **Example** 

20 ENTER 717; A

30 PRINT A

:MODE

The :MODE command sets the limit mode of the comparator function. The :MODE? query returns the current settings of the limit mode.

**Command Syntax** 

Where,

ATOLerance Set the absolute tolerance mode (parameter value) PT0Lerance Set the percent tolerance mode (the ratio in percent)

SEQuence Set the sequential mode

**Example** 

OUTPUT 717; "COMP: MODE ATOL"

**Query Syntax** 

COMParator: MODE?

**Query Response** 

Returned format is:

**Example** 

10 OUTPUT 717; "COMP: MODE?"

20 ENTER 717; A\$

30 PRINT A\$

#### :TOLerance:NOMinal

The :TOLerance:NOMinal command sets the nominal value for the tolerance mode of the comparator function. This can be set only when the limit mode is set to the tolerance mode. The :TOLerance:NOMinal? query returns the current settings of the nominal value for the tolerance mode.

#### **Command Syntax**

 ${\tt COMParator:TOLerance:NOMinal} < value>$ 

Where,

< value >is the NR1, NR2, or NR3 format: nominal value

OUTPUT 717; "COMP: TOL: NOM 100E-12" **Example** 

COMParator: TOLerance: NOMinal? **Query Syntax** 

Returned Format is: **Query Response** 

<NR3><NL^END>

**Example** 10 OUTPUT 717; "CORR: TOL: NOM?"

20 ENTER 717; A

30 PRINT A 40 END

# :TOLerance:BIN<n>

The :TOLerance:BIN< n > command sets the low/high limit values of each BIN for the comparator function tolerance mode. These limits can be set only when the limit mode is set to the tolerance mode. The :TOLerance:BIN< n> query returns the current settings of the low/high limit values of each of the BINs.

### **Command Syntax**

 $\texttt{COMParator:TOLerance:BIN} < n > < low \ limit > , < high \ limit >$ 

Where,

< n> 1 to 9 (NR1): BIN number

< low limit> NR1, NR2, or NR3 format: low limit value < high limit>NR1, NR2, or NR3 format: high limit value

#### Note



The low limit value should be lower than the high limit value. If the low limit value is set higher than the high limit, a warning message is displayed when this command is received (an error does not occur).

**Example** OUTPUT 717; "COMP:TOL:BIN1 -5,5"

OUTPUT 717; "COMP: TOL: BIN2 -10,10"

COMParator: TOLerance: BIN < n > ?Query Syntax

Returned Format is: **Query Resopnse** 

<low limit>,<high limit><NL^END>

10 OUTPUT 717; "COMP:TOL:BIN1?" Example

20 ENTER 717; A, B

30 PRINT A,B

#### :SEQuence:BIN

The :SEQuence:BIN command sets the low/high limit values of the BINs for the sequence mode of the comparator function. These limits can be set only when the limit mode is set to the sequence mode. The :SEQuence:BIN query returns the current settings of the low/high limit values of the BINs.

### **Command Syntax**

 $\texttt{COMParator:SEQuence:BIN} < BIN1 \ low \ limit>$ ,  $< BIN1 \ high$ limit>,  $\langle BIN2 \ high \ limit>$ , ...,  $\langle BINn \ high \ limit>$ 

Where,

< BIN1 low limit >NR1, NR2, or NR3 format: low limit value for

BIN1

<BIN1 high limit> NR1, NR2, or NR3 format: high limit value

for BIN1

<BINn high limit> NR1, NR2, or NR3 format: high limit value

for BINn (n : max. 9)

#### Note



The low limit value should be lower than the high limit value.

#### **Example**

OUTPUT 717; "COMP: SEQ: BIN 10,20,30,40,50"

#### **Query Syntax**

COMParator: SEQuence: BIN?

#### **Query Response**

Returned Format is:

<BIN1 low limit>, <BIN1 high limit>, <BIN2 high limit>, ..., <BINn high limit><NL^END>

#### **Example**

10 DIM A\$[200]

20 OUTPUT 717; "COMP: SEQ: BIN?"

30 ENTER 717; A\$

40 PRINT A\$

# :Secondary LIMit

The :Secondary LIMit command sets the low/high limit values for the comparator function secondary parameter. The :Secondary LIMit? query returns the current settings of the secondary parameter low/high limit values.

#### **Command Syntax**

COMParator:SLIMit < low limit>, < high limit>

Where.

< low limit> is the NR1, NR2, or NR3 format: low limit value < high limit>is the NR1, NR2, or NR3 format: high limit value

#### Note



The low limit value should be lower than the high limit value. If the low limit value is set higher than the high limit, a warning message is displayed when this command is received (an error does not occur).

**Example** 

OUTPUT 717; "COMP:SLIM 0.001,0.002"

Query Syntax

COMParator:SLIMit?

**Query Response** 

Returned Format is:

<NR3>,<NR3><NL^END>

**Example** 

10 OUTPUT 717; "COMP:SLIM?"

20 ENTER 717; A, B

30 PRINT A,B

# :Auxiliary BIN

The : Auxiliary BIN command sets the auxiliary BIN counting function of the comparator to ON or OFF. The :Auxiliary BIN query responds the current ON/OFF condition of the auxiliary BIN counting function.

## **Command Syntax**

$$\begin{array}{c} \texttt{COMParator:Auxiliary BIN} \left\{ \begin{array}{c} \texttt{ON} \\ \texttt{OFF} \\ \texttt{1} \\ \texttt{O} \end{array} \right\}$$

Where,

O (decimal 48) When the function is OFF 1 (decimal 49) When he function is ON

**Example** 

OUTPUT 717; "COMP: ABIN ON"

**Query Syntax** 

COMParator: Auxiliary BIN?

**Query Response** 

Returned Format is:

<NR1><NL^END>

**Example** 

10 OUTPUT 717; "COMP: ABIN?"

20 ENTER 717; A

30 PRINT A

#### :SWAP

The :SWAP command sets the swap parameter function to ON (9) BIN settings for secondary parameter) or OFF (9 BIN settings for primary parameter). The :SWAP? query responds the current ON/OFF condition of the auxiliary BIN counting function.

## **Command Syntax**

$$\begin{array}{c}
COMParator:SWAP \\
1 \\
0
\end{array}$$

Where,

O (decimal 48) When the function is OFF 1 (decimal 49) When the function is ON

**Example** 

OUTPUT 717; "COMP: SWAP ON"

**Query Syntax** 

COMParator: SWAP?

**Query Response** 

Returned Format is:

<NR1><NL^END>

**Example** 

10 OUTPUT 717; "COMP: SWAP?"

20 ENTER 717; A 30 PRINT A

40 END

:BIN:CLEar

The :BIN:CLEar command clears all of the limit value settings.

**Command Syntax** 

COMParator:BIN:CLEar

**Example** 

OUTPUT 717; "COMP:BIN:CLE"

# :BIN:COUNt[:STATe]

The :BIN:COUNt[:STATe] command sets the BIN count function to ON or OFF. The :BIN:COUNt[:STATe]? query responds with the current ON/OFF condition of the BIN count function.

**Command Syntax** 

$$\begin{array}{c}
COMParator:BIN:COUNt[:STATe] & ON \\
0FF \\
1 \\
0
\end{array}$$

Where,

O (decimal 48) When the function is OFF 1 (decimal 49) When the function is ON

**Example** OUTPUT 717; "COMP:BIN:COUN ON"

COMParator:BIN:COUNt[:STATe]? **Query Syntax** 

Returned Format is: **Query Response** 

<NR1><NL^END>

**Example** 10 OUTPUT 717; "COMP:BIN:COUN?"

20 ENTER 717; A

30 PRINT A

### :BIN:COUNt:DATA?

The :BIN:COUNt:DATA? query returns the comparator BIN count results.

**Query Syntax** 

COMParator: BIN: COUNt: DATA?

#### **Query Response**

Returned Format is:

 $< BIN1 \ count >$ ,  $< BIN2 \ count >$ , ...,  $< BIN9 \ count >$ ,  $< OUT \ OF$ BIN count>, <AUX BIN count><NL^END>

Where,

 $< BIN1-9 \ count >$ NR1 format : count result of BIN1-9 NR1 format : count result of OUT OF <OUT OF BINS count>

BINS

<AUX BIN count> NR1 format: count result of AUX

BIN

### **Example**

10 OPTION BASE 1

20 DIM A(11)

30 OUTPUT 717; "COMP:BIN:COUN:DATA?"

40 ENTER 717; A(\*) 50 PRINT A(\*)

60 END

### :BIN:COUNt:CLEar

The :BIN:COUNt:CLEar command clears all BIN counts.

**Command Syntax** 

COMParator:BIN:COUNt:CLEar

**Example** 

OUTPUT 717; "COMP:BIN:COUN:CLE"

# **Mass MEMory Subsystem**

The Mass MEMory subsystem command group loads or stores setting data from/to the internal EEPROM and the external memory card. Figure 8-14 shows the command tree of the Mass MEMory subsystem command group.

```
- :LOAD ---- :STATe <record number>
 :STORe --- :STATe < record number >
```

Figure 8-14. Mass MEMory Subsystem Command Tree

### :LOAD:STATe

The :LOAD:STATe command loads the setting data from the internal EEPROM or a memory card.

### **Command Syntax**

 ${\tt MMEMory:LOAD:STATe} < value>$ 

Where,

< value >O to 9 (NR1): record number for internal EEPROM

10 to 19 (NR1): record number for memory card

#### **Example**

OUTPUT 717; "MMEM: LOAD: STAT 10"

#### :STORe:STATe

The :STORe:STATe command stores the setting data to the internal EEPROM or to the memory card.

#### **Command Syntax**

 ${\tt MMEMory:STORe:STATe} < value>$ 

Where,

< value >0 to 9 (NR1): record number for EEPROM

10 to 19 (NR1): record number for memory card

#### **Example**

OUTPUT 717; "MMEM: STOR: STAT 5"

#### SYSTem:ERRor?

The SYSTem: ERRor? query returns the existing error numbers with the error messages for the errors in the HP 4284A's error queue.

The HP 4284A's error queue stores errors generated by the HP 4284A. As errors are generated, they are placed in the error queue which stores up to five errors. This is a first in, first out queue (FIFO).

If the error queue overflows, the last error in the queue is replaced with error -350, "Too many errors". Anytime the queue overflows, the least recent errors remain in the queue, and the most recent errors are discarded.

When all errors have been read from the queue, further SYSTem: ERRor? queries will return error 0, "no errors". Reading an error from the queue removes that error from the queue, opening a position in the queue for a new error, if one is subsequently generated.

### **Query Syntax**

SYSTem: ERRor?

#### **Query Response**

Returned Format is:

< number >, "< message >"

Where,

< number>NR1 format: error number

For details, refer to Appendix B.

< message >ASCII string: error message

For details, refer to Appendix B.

#### **Example**

10 DIM A\$[50]

20 FOR I=1 to 5

30 OUTPUT 717; "SYST: ERR?"

40 ENTER 717; A\$

50 PRINT A\$

60 NEXT I

# **STATus Subsystem**

The STATus subsystem command group sets the Operation Status Registers which report events which are part of the HP 4284A's normal operation, including measuring and sweeping. Figure 8-15 shows the command tree of the STATus subsystem command group.

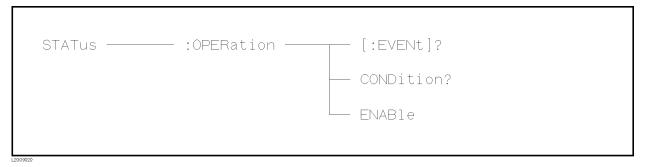


Figure 8-15. STATus Subsystem Command Tree

# :OPERation[:EVENt]?

The :OPERation[:EVENt]? query returns the contents of the standard operation status event register. Reading the event register using this query has the effect of clearing its contents, but has no effect on the operation status condition register.

**Query Syntax** 

STATus: OPERation [: EVENt]?

**Query Response** 

Returned Format is:

<value><NL^END>

Where,

< value >

NR1 format: decimal expression of the contents of the operation status event register

The definition of each bit of the operation status event register is as follows.

Bit No.	Description
15 - 5	Always 0 (zero)
4	Measurement Complete Bit
3	List Sweep Measurement Complete Bit
2, 1	Always 0 (zero)
0	Correction Data Measurement Complete Bit

### **Example**

10 OUTPUT 717; "STAT: OPER?"

20 ENTER 717; A

30 PRINT A

# :OPERation:CONDition?

The :OPERation:CONDition? query returns the contents of the standard operation status condition register. Reading a condition register using this query does not clear its contents.

STATus: OPERation: CONDition? **Query Syntax** 

Returned Format is: **Query Response** 

 $<\!value><\!\text{NL^END>}$ 

Where,

 $\langle value \rangle$ NR1 format: decimal expression of the contents of the

operation status condition register

The definition of each bit in the operation status condition register is as follows.

Bit No.	Description	
15 - 5	Always 0 (zero)	
4	Measuring Bit	
3	Sweeping Bit	
2, 1	Always 0 (zero)	
0	Measuring Correction Data Bit	

**Example** 

10 OUTPUT 717; "STAT: OPER: COND?"

20 ENTER 717; A

30 PRINT A

### :OPERation:ENABle

The :OPERation:ENABle command sets the enable bits of the standard operation status event register that allows true conditions in the event register to be reported in the summary bit of the status byte register. The :OPERation:ENABle? query returns the current setting of the enable bits of the operation status event register.

### **Command Syntax**

 ${ t STATus: OPERation: ENABle} < value>$ 

Where,

< value >NR1 format: decimal expression of enable bits of the operation status event register

The definition of each bit in the operation status event register is as follows.

Bit No.	Description
15 - 5	Always 0 (zero)
4	Measurement Complete Bit
3	List Sweep Measurement Complete Bit
2, 1	Always 0 (zero)
0	Correction Data Measurement Complete Bit

OUTPUT 717; "STAT: OPER: ENAB 16"! Bit 4 enable **Example** 

**Query Syntax** STATus: OPERation: ENABle?

**Query Response** Returned Format is:

< value><  $NL^END>$ 

10 OUTPUT 717; "STAT: OPER: ENAB?" Example

20 ENTER 717; A

30 PRINT A

# **Common Commands**

The HP-IB Common commands are defined as IEEE 488.2-1987, and are noninstrument specific HP-IB commands. A common command consists of an asterisk (\*) and a header. The HP 4284A acceptable HP-IB common commands are as follows.

#### **HP-IB Common Commands**

• *CLS	• *SRE	• *UPC?	• *TST?
• *ESE	• *STB?	• *WAI	• *TRG
• *ESR?	• *IDN?	• *RST	• *LRN?
			• *OPT?

# \*CLS

The \*CLS command (clear status command) clears the status byte register, the event register of the standard operation status register structure, and the standard event status register. It also clears the error queue (refer to the description of the SYSTem: ERRor? query).

**Command Syntax** \*CLS

> OUTPUT 717;"\*CLS" **Example**

### \*ESE

The \*ESE command (standard Event Status Enable command) sets the enable bits of the standard event status register. The \*ESE? query returns the current setting of the enable bits of the event status register.

### **Command Syntax**

\*ESE < value >

Where,

< value >

NR1 format: decimal expression of enable bits of the operation status register

The definition of each bit in the event status register is as follows.

Bit No.	Description
7	Power On (PON) Bit
6	User Request (URQ) Bit
5	Command Error (CME) Bit
4	Execution Error (EXE) Bit
3	Device Dependent Error (DDE) Bit
2	Query Error (QYE) Bit
1	Request Control (RQC) Bit
0	Operation Complete (OPC) Bit

**Example** OUTPUT 717; "\*ESE 36"! Bit 2 and 5 enabled

\*ESE? **Query Syntax** 

Returned format is: **Query Response** 

 $<\!value\!><\! exttt{NL^END>}$ 

**Example** 10 OUTPUT 717; "\*ESE?"

20 ENTER 717; A

30 PRINT A

# \*ESR?

The \*ESR? query returns the contents of the standard event status register. Using the \*ESR query command to read the standard event status register clears its contents.

**Query Syntax** 

\*ESR?

**Query Response** 

Returned format is:

 $<\!value><\!\text{NL^END>}$ 

Where,

< value >

NR1 format: decimal expression of the contents of the event status register

The definition of each bit of the event status register is as follows.

Bit No.	Description
7	Power On (PON) Bit
6	User Request (URQ) Bit
5	Command Error (CME) Bit
4	Execution Error (EXE) Bit
3	Device Dependent Error (DDE) Bit
2	Query Error (QYE) Bit
1	Request Control (RQC) Bit
0	Operation Complete (OPC) Bit

### **Example**

10 OUTPUT 717;"\*ESR?"

20 ENTER 717; A

30 PRINT A

# \*SRE

The \*SRE command (Service Request Enable command) sets the enable bits of the status byte register. The \*SRE? query returns the current setting of the status byte register.

### **Command Syntax**

\*SRE < value>

Where,

< value >NR1 format: decimal expression of enable bits of the

status byte register

The definition of each bit of the status byte register is as follows.

Bit No.	Description
7	Operation Status Register Summary Bit
6	RQS (Request Service) Bit
5	Standard Event Status Register Summary Bit
4	MAV (Message Available) Bit
3 - 0	Always 0 (zero)

**Example** 

OUTPUT 717; "\*SRE 32"! Bit 5 enabled

**Query Syntax** 

\*SRE?

**Query Response** 

Returned format is:

 $<\!value\!><\! exttt{NL^END>}$ 

**Example** 

10 OUTPUT 717; "\*SRE?"

20 ENTER 717; A

30 PRINT A

40 END

# \*STB?

The \*STB? query reads the status byte by reading the master summary status (MSS) bit. These bits represent the contents of the status byte register. Execution of the \*STB query command has no effect on the contents of the status byte register.

**Query Syntax** 

\*STB?

**Query Response** 

Returned format is:

 $<\!value><\!\text{NL^END>}$ 

Where,

< value >

NR1 format: decimal expression of the contents of the status byte register

The definition of each bit of the status byte is as follows.

Bit No.	Description
7	Operation Status Register Summary Bit
6	RQS (Request Service) Bit
5	Standard Event Status Register Summary Bit
4	MAV (Message Available) Bit
3 - 0	Always 0 (zero)

**Example** 

10 OUTPUT 717;"\*STB?"

20 ENTER 717; A

30 PRINT A

40 END

### \*IDN?

The \*IDN? query returns the HP 4284A ID.

### **Query Syntax**

\*IDN?

### **Query Response**

Returned format is:

<manufacturer>,<model>,<serial no.>,<firmware><NL^END>

Where,

<manufacturer> HEWLETT-PACKARD

< model >4284A

< serial number > 0 (not available) <firmware> REVdd.dd

(dd.dd: ROM firmware revision number)

# **Example**

10 DIM A\$[30]

20 OUTPUT 717;"\*IDN?"

20 ENTER 717; A\$

30 PRINT A\$

40 END

### Note



This string data is an arbitrary ASCII response. So, this command should not be sent before a normal query in a program message. (For example, \*IDN?; FREQ? can not accepted, FREQ?; \*IDN? should be sent.)

# \*OPC

The \*OPC command (operation complete command) tells the HP 4284A to set bit 0 (OPC bit) in the standard event status register when it completes all pending operations. The \*OPC? command tells the HP 4284A to place an ASCII "1" (decimal 49) in the HP 4284A's output buffer when it completes all pending operations.

### **Command Syntax**

\*0PC

### **Example**

OUTPUT 717; "\*OPC" ! Set the HP 4284A to set OPC bit ! when the operation executed by previous command is completed.

### **Query Syntax**

\*0PC?

### **Query Response**

Returned format is:

1<NL^END>

Where.

1 (ASCII, decimal 49)

### **Example**

```
10 OUTPUT 717; "CORR: OPEN" ! Perform OPEN correction measurement
20 OUTPUT 717;"*OPC?"
                           ! Wait for OPEN correction
30 ENTER 717; A
                               measurement completed
40 END
```

# \*WAI

The \*WAI command (the wait to continue command) makes the HP 4284A wait until all previously sent commands are completed. The HP 4284A then continues executing the commands that follow the \*WAI command.

### **Command Syntax**

\*WAI

### **Example**

OUTPUT 717;"\*WAI"

# \*RST

The \*RST command (reset command) sets the HP 4284A to its initial settings. The initial settings set by the \*RST command are given in Appendix C. When the HP 4284A receives a \*RST command, it aborts all pending operations, and forgets about any previously received \*OPC commands and \*OPC? queries.

**Command Syntax** 

\*RST

**Example** 

OUTPUT 717; "\*RST"

### \*TST?

The \*TST? query (self-test query) causes the device to execute an internal self-test and reports whether or not it detected any errors. In the case of the HP 4284A, the response to this query is always "0" (no error).

Query Syntax

\*TST?

**Query Response** 

Returned format is:

O<NL^END>

Where,

0 (NR1 format)

**Example** 

10 OUTPUT 717;"\*TST?"

20 ENTER 717; A

30 END

# \*TRG

The \*TRG command (trigger command) performs the same function as the Group Execute Trigger command (refer to "Trigger System" in Chapter 7). This command also moves the primary and secondary parameter measurement data into the HP 4284A's output buffer.

**Command Syntax** \*TRG

> 10 OUTPUT 717;"\*TRG" **Example**

20 ENTER 717; A, B, C

30 PRINT A,B,C

40 END

### \*LRN?

The \*LRN? query (learn device setup query) tells the HP 4284A to send a response that contains all the necessary commands to set the HP 4284A to its present state. The response can later be sent back to the HP 4284A to place it in this state. This provides the user with a means of setting up a device manually and then reading the device setting and storing the information for later use.

### Query Syntax

\*LRN?

### **Query Response**

Returned format is:

```
:FREQ <NR3>;:VOLT (or CURR) <NR3>;
:AMPL:ALC {0|1};:OUTP:HPOW {0|1};DC:ISOL {0|1};
:BIAS: VOLT (or CURR) <NR3>:STAT {0|1};
:CORR:LENG <NR1>; METH {SING | MULT};
:CORR:OPEN:STAT {0|1};:CORR:SHOR:STAT {0|1};
:CORR:LOAD:STAT \{0 \mid 1\}; TYPE < function >;
:CORR:SPOT1:STAT \{0 \mid 1\}; FREQ \langle NR3 \rangle; LOAD:STAN \langle REF.A \rangle, \langle REF.B \rangle;
:CORR:SPOT2:STAT \{0 \mid 1\}; FREQ <NR3>; LOAD:STAN <REF.A>, <REF.B>;
:CORR:SPOT3:STAT \{0 \mid 1\}; FREQ <NR3>; LOAD:STAN \langle REF.A \rangle, \langle REF.B \rangle;
:CORR:USE <NR1>;
:FUNC:IMP:TYPE < function >; RANG < NR3 >; RANG:AUTO \{0 \mid 1\};
:FUNC:SMON:VAC:STAT {0|1};FUNC:SMON:IAC:STAT {0|1};
:FUNC:DEV1:MODE {ABS|PERC|OFF}; REF <NR3>;
:FUNC:DEV2:MODE {ABS|PERC|OFF}; REF <NR3>;
:APER {SHOR | MED | LONG}, <NR1>;
:TRIG:SOUR {INT|EXT|BUS|HOLD};DEL <NR3>;
:DISP:PAGE < page name>;LINE "<string>";
:FORM {ASC|REAL,64};
:COMP:STAT {0|1}; MODE {ATOL|PTOL|SEQ}; TOL:NOM <NR3>;
(BIN1 \langle low \rangle, \langle high \rangle; BIN2 \langle low \rangle, \langle high \rangle, ...;) or
(:COMP:SEQ:BIN < BIN1 low>, < BIN2 high>, < BIN3 high>, ...;)
[:COMP:SLIM \langle low \rangle, \langle high \rangle;]
:COMP:ABIN {0|1}; SWAP {0|1}; BIN:COUN {0|1};
:LIST:FREQ (VOLT, CURR, BIAS: VOLT, or BIAS: CURR) < NR3>[, < NR3>*];
:LIST:MODE {SEQ | STEP};
BAND1 < parameter>, < low>, < high>;
BAND2 \langle parameter \rangle, \langle low \rangle, \langle high \rangle;
     ::
BAND < n > < parameter > , < low > , < high >
```

For details, refer to each command reference page.

```
Example
```

```
10 DIM A$[1000]
20 OUTPUT 717; "*LRN?"
30 ENTER 717; A$
40 !
50 OUTPUT 717; A$
60 END
```

# \*OPT?

The \*OPT? query (OPTion identification query) tells the HP 4284A to identify the options installed in the system interface.

### **Query Syntax**

\*0PT?

### **Query Response**

Returned format is:

```
< power \ amp >, < I \ bias \ IF >, < 2m/4m \ cable >, < handler
I/F>, < scanner\ I/F>< NL^END>
```

Where,

 $< power\ amp > is$ : 001 (ASCII): Option 001 is installed

(ASCII): Option 001 is not installed

 $\langle I \text{ bias } I/F \rangle$  is: 002 (ASCII): Option 002 is installed

(ASCII): Option 002 is not installed

 $<2m/4m\ cable>$  is: 006 (ASCII): Option 006 is installed

(ASCII): Option 006 is not installed

<handler I/F> is : 201 (ASCII) : Option 201 is installed 202 (ASCII): Option 202 is installed

(ASCII): Option 201 and 202 are not installed

<scanner I/F> is : 301 (ASCII) : Option 301 is installed

(ASCII): Option 301 is not installed

#### Note



This string data is the arbitrary ASCII response. So this command should not be sent before a normal query in a program message. (For example, \*OPT?; FREQ? can not accepted, FREQ?; \*OPT? should be sent.)

### Example

10 OUTPUT 717;"\*OPT?"

20 ENTER 717; A\$

30 END

# **General Information**

### Introduction

This chapter describes specifications, supplemental performance characteristics, storage/repackaging, and other general information about the HP 4284A.

# Components not Covered by Warranty

The memory card is not covered under the HP 4284A's warranty. If the memory card becomes defective even within the warranty period of the HP 4284A, the memory card must be paid for by the user.

### Serial Number

Hewlett-Packard uses a two-section, nine character serial number which is stamped on the serial number plate (Figure 9-1) attached to the instrument's rear panel. The first four digits and a letter are the serial number prefix, and the last five digits are the suffix. The letter placed between the two sections identifies the country where the instrument was manufactured. The prefix is the same for all identical instruments; it changes only when a change is made to the instrument. The suffix, however, is assigned sequentially and is different for each instrument. The contents of this manual apply to instruments with the serial number prefix(es) listed under the serial numbers on the title page.



Figure 9-1. Serial Number Plate

An instrument manufactured after the printing of this manual may have a serial number prefix that is not listed on the title page. This unlisted serial number prefix indicates the instrument is different from those described in this manual. The manual for this new instrument may be accompanied by a yellow Manual

Change supplement or have a different manual part number. This sheet contains "change information" that explains how to adapt the manual to the newer instrument.

In addition to change information, the supplement may contain information for correcting errors (Errata) in the manual. To keep this manual as current and accurate as possible, Hewlett-Packard recommends that you periodically request the latest Manual Changes supplement. The supplement for this manual is identified by this manual's printing date and its part number, both of which appear on the manual's title page. Complimentary copies of the supplement are available from Hewlett-Packard. If the serial prefix or number of an instrument is lower than that on the title page of this manual, see Appendix A, MANUAL CHANGES.

For information concerning, a serial number prefix that is not listed on the title page or in the Manual Change supplement, contact the nearest Hewlett-Packard office.

# **Specifications**

The complete HP 4284A specifications are listed below. These specifications are the performance standards or limits against which the instrument is tested. When shipped from the factory, the HP 4284A meets the specifications listed in this section. The specification test procedures are covered in Chapter 10.

#### **Measurement Functions**

#### **Measurement Parameters**

|Z| : Absolute value of impedance

|Y| : Absolute value of admittance

L : Inductance C : Capacitance R : Resistance G: Conductance D: Dissipation factor Q : Quality factor

R<sub>s</sub>: Equivalent series resistance

R<sub>p</sub>: Parallel resistance

X : Reactance : Susceptance : Phase angle

#### Combinations

$ \mathbf{Z} ,\  \mathbf{Y} $	${f L},{f C}$	R	$\mathbf{G}$
$\theta(\deg), \theta(\operatorname{rad})$	$D,Q,R_{\rm s},R_{\rm p},G$	X	В

#### **Mathematical Functions**

The deviation and the percent of deviation of measurement values from a programmable reference value.

### **Equivalent Measurement Circuit**

Parallel and Series

#### Ranging

Auto and Manual (Hold/Up/Down)

### **Trigger**

Internal, External, BUS (HP-IB), and Manual.

### **Delay Time**

Programmable delay from the trigger command to the start of the measurement, 0 to 60.000 sec. in 1 msec. steps.

#### Measurement terminals

Four-terminal pair

### **Test Cable Length**

**Standard.** 0 m and 1 m selectable

With Option 006. 0 m, 1 m, 2 m and 4 m selectable

#### Integration Time

Short, Medium and Long (See Supplemental Performance Characteristics for the measurement time.)

#### **Averaging**

1 to 256, programmable

# **Test Signal**

#### Frequency

20 Hz to 1 MHz, 8610 selectable frequencies (refer to Appendix F for selectable frequencies.)

Accuracy.  $\pm 0.01\%$ 

### Signal Modes

**Normal.** Programs selected voltage or current at the measurement terminals when they are opened or shorted, respectively.

**Constant.** Maintains selected voltage or current at the device under test independent of changes in the device's impedance.

### Signal Level

	Mode	Range	Setting Accuracy
Voltage	Non-constant	$5~\mathrm{mV_{rms}}$ to $2~\mathrm{V_{rms}}$	$\pm (10\% + 1 \text{ mV}_{\text{rms}})$
	Constant <sup>1</sup>	$10~\mathrm{mV_{rms}}$ to $1~\mathrm{V_{rms}}$	$\pm (6\% + 1 \text{ mV}_{\rm rms})$
Current	Non-constant	$50~\mu\mathrm{A_{rms}}$ to $20~\mathrm{mA_{rms}}$	$\pm (10\% + 10 \ \mu A_{rms})$
	$Constant^1$	$100~\mu\mathrm{A_{rms}}$ to $10~\mathrm{mA_{rms}}$	$\pm (6\% + 10 \ \mu A_{rms})$

<sup>1</sup> Automatic Level Control Function is set to ON.

### **Output Impedance**

 $100 \Omega, \pm 3\%$ 

### **Test Signal Level Monitor**

Mode	Range	Accuracy
Voltage <sup>1</sup>	$5~\mathrm{mV_{rms}}$ to $2~\mathrm{V_{rms}}$	$\pm (3\% \text{ of reading} + 0.5 \text{ mV}_{rms})$
	$0.01~\mathrm{mV_{rms}}$ to $5~\mathrm{mV_{rms}}$	$\pm (11\% \text{ of reading} + 0.1 \text{ mV}_{\text{rms}})$
Current <sup>2</sup>	$50~\mu\mathrm{A_{rms}}$ to $20~\mathrm{mA_{rms}}$	$\pm (3\% \text{ of reading} + 5 \mu A_{rms})$
	$0.001~\mu\mathrm{A_{rms}}$ to $50~\mu\mathrm{A_{rms}}$	$\pm (11\% \text{ of reading} + 1 \mu A_{rms})$

<sup>1</sup> Add the impedance measurement accuracy [%] to the voltage level monitor accuracy when the DUT's impedance is  $< 100~\Omega$ .

Accuracies apply when test cable length is 0 m or 1 m. additional error when test cable length is 2 m or 4 m is given as:

$$f_m \times \frac{L}{2}$$
 [%]

Where,  $f_m$  is test frequency [MHz],

L is test cable length [m].

Example DUT's impedance : 50  $\Omega$ 

Test signal level : 0.1  $V_{\rm rms}$  Measurement accuracy : 0.1 %

Then, Voltage level monitor accuracy is

 $\pm (3.1 \% \text{ of reading} + 0.5 \text{ mV}_{rms})$ 

<sup>2</sup> Add the impedance measurement accuracy [%] to the current level monitor accuracy when the DUT's impedance is  $\geq$  100  $\Omega$ .

# **Display Range**

Parameter	Range
Z , R, X	$0.01~\mathrm{m}\Omega$ to $99.9999~\mathrm{M}\Omega$
Y , G, B	0.01 nS to 99.9999 S
С	0.01 fF to 9.99999 F
L	0.01 nH to 99.9999 kH
D	0.000001 to 9.99999
Q	0.01 to 99999.9
$\theta$	-180.000 ° to 180.000 °
$\Delta$	-999.999% to 999.999%

# **Absolute Measurement** Accuracy

Absolute measurement accuracy is given as the sum of the relative measurement accuracy plus the calibration accuracy.

### |Z|, |Y|, L, C, R, X, G and B Accuracy

|Z|, |Y|, L, C, R, X, G and B accuracy is given as,

$$A_e + A_{cal}$$
 [%]

Where,  $A_e$  is the relative accuracy,  $A_{cal}$  is the calibration accuracy.

L, C, X and B accuracies apply when  $D_x$  (measured D value)  $\leq 0.1$ . R and G accuracies apply when  $Q_x$  (measured Q value)  $\leq 0.1$ . G accuracy described in this paragraph applies to the G-B combination only.

### D accuracy

D accuracy is given as,

$$D_e + \theta_{cal}$$

Where,  $D_e$  is the relative D accuracy,  $\theta_{cal}$  is the calibration accuracy [radian].

Accuracy applies when  $D_x$  (measured D value)  $\leq 0.1$ .

#### **Q** Accuracy

Q accuracy is given as,

$$\pm \frac{Q_x^2 \times D_a}{1 \mp Q_x \times D_a}$$

Where,  $Q_x$  is the measured Q value,  $D_a$  is the absolute D accuracy.

Accuracy applies when  $Q_x \times D_a < 1$ .

### $\theta$ Accuracy

 $\theta$  accuracy is given as,

$$\theta_e + \theta_{cal}$$
 [deg]

Where,  $\theta_e$  is the relative  $\theta$  accuracy [deg],  $\theta_{cal}$  is the calibration accuracy [deg].

### **G** Accuracy

When  $D_x$  (measured D value)  $\leq 0.1$ .

G accuracy is given as,

$$B_x \times D_a$$
 [S]

$$B_x = 2\pi f C_x = \frac{1}{2\pi f L_x}$$

Where,  $B_x$  is the measured B value [S],  $C_x$  is the measured C value [F],  $L_x$  is the measured L value [H],  $D_a$  is the absolute D accuracy, f is the test frequency [Hz].

G accuracy described in this paragraph applies to the  $C_p$ -G and  $L_p$ -G combinations only.

### Rp Accuracy

When  $D_x$  (measured D value)  $\leq 0.1$ 

 $R_{
m p}$  accuracy is given as,

$$\pm \frac{R_{px} \times D_a}{D_x \mp D_a} \qquad [\Omega]$$

Where,  $R_{px}$  is the measured  $R_p$  value  $[\Omega]$ ,  $D_x$  is the measured D value,  $D_a$  is the absolute D accuracy.

### R<sub>S</sub> Accuracy

When  $D_x$  (measured D value)  $\leq 0.1$ 

 $R_s$  accuracy is given as,

$$X_x \times D_a$$
  $[\Omega]$ 

$$X_x = 2\pi f L_x = \frac{1}{2\pi f C_x}$$

Where,  $X_x$  is the measured X value  $[\Omega]$ ,  $C_x$  is the measured C value [F],  $L_x$  is the measured L value [H],  $D_a$  is the absolute D accuracy, f is the test frequency [Hz].

### **Relative Measurement Accuracy**

Relative measurement accuracy includes stability, temperature coefficient, linearity, repeatability and calibration interpolation error. Relative measurement accuracy is specified when all of the following conditions are satisfied:

- 1. Warm-up time :  $\geq 30$  minutes
- 2. Test cable length: 0 m, 1 m, 2 m or 4 m (HP 16048 A/B/D/E) For 2 m or 4 m cable length operation, test signal voltage and test frequency are set according to Figure A. (2 m and 4 m cable can be used only when Option 006 is installed.)
- 3. OPEN and SHORT corrections have been performed.
- 4. Bias current isolation: OFF (For accuracy with bias current isolation, refer to supplemental performance characteristics.)
- 5. Test signal voltage and DC bias voltage are set according to Figure B.
- 6. The optimum measurement range is selected by matching the DUT's impedance to the effective measuring range shown in Table 3-1-1, page 3-7. (For example, if the DUT's impedance is 50 k $\Omega$ , the optimum range is the 30 k $\Omega$  range.)

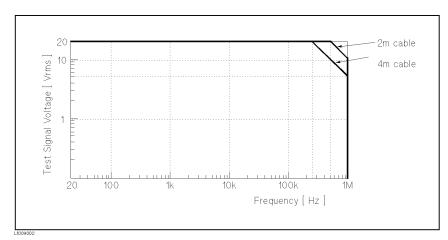


Figure 9-2. Test Signal Voltage and Test Frequency upper Limits to apply measurement accuracy to 2 m and 4 m Cable Length Operation.

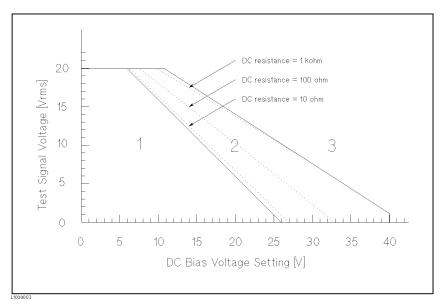


Figure 9-3.
Test Signal Voltage and DC Bias Voltage Upper Limits Apply for Measurement Accuracy.

Range 1: Measurement accuracy can apply.

Range 2: The limits applied for measurement accuracy differ according to DUT's DC resistance. Three dotted lines show the upper limits when the DC resistance is 10  $\Omega$ , 100  $\Omega$  and 1 k $\Omega$ .

### |Z|, |Y|, L, C, R, X, G and B Accuracy

|Z|, |Y|, L, C, R, X, G and B accuracy  $A_e$  is given as

$$A_e = \pm [A + (K_a + K_{aa} + K_b \times K_{bb} + K_c) \times 100 + K_d] \times K_e$$
 [%]

A: Basic Accuracy (Refer to Figure C and D.)

 $K_a$ : Impedance Proportional Factor (Refer to Table A.)

 $K_{aa}$ : Cable Length Factor (Refer to Table B.)

 $K_b$ : Impedance Proportional Factor (Refer to Table A.)

 $K_{bb}$ : Cable Length Factor (Refer to Table C.)

 $K_c$ : Calibration Interpolation Factor (Refer to Table D.)

 $K_d$ : Cable Length Factor (Refer to Table E.)

 $K_e$ : Temperature Factor (Refer to Table F.)

L, C, X and B accuracies apply when  $D_x$  (measured D value)  $\leq 0.1$ . R and G accuracies apply when  $Q_x$  (measured Q value)  $\leq 0.1$ . When  $D_x \geq 0.1$ , multiply  $A_e$  by  $\sqrt{1+D_x^2}$  for L, C, X and B accuracies.

When  $Q_x \geq 0.1$ , multiply  $A_e$  by  $\sqrt{1+Q_x^2}$  for R and G accuracies.

G accuracy described in this paragraph applies to the G-B combination only.

### D accuracy

D accuracy  $D_e$  is given as,

$$D_e = \pm \frac{A_e}{100}$$

Accuracy applies when  $D_x$  (measured D value)  $\leq 0.1$ .

When  $D_x > 0.1$ , multiply  $D_e$  by  $(1 + D_x)$ .

### **Q** Accuracy

Q accuracy is given as,

$$\pm \frac{Q_x^2 \times D_e}{1 \mp Q_x \times D_e}$$

 $Q_x$  is the measured Q value, Where,  $D_e$  is the relative D accuracy.

Accuracy applies when  $Q_x \times D_e < 1$ .

### $\theta$ Accuracy

 $\theta$  accuracy is given as,

$$\frac{180}{\pi} \times \frac{A_e}{100} \qquad [deg]$$

### **G** Accuracy

When  $D_x$  (measured D value)  $\leq 0.1$ .

G accuracy is given as,

$$B_x \times D_e$$
 [S] 
$$B_x = 2\pi f C_x = \frac{1}{2\pi f L_x}$$

Where,  $B_x$  is the measured B value [S],  $C_x$  is the measured C value [F],  $L_x$  is the measured L value [H],  $D_e$  is the relative D accuracy, f is the test frequency [Hz].

G accuracy described in this paragraph applies to the  $C_p$ -G and  $L_p$ -G combinations only.

# Rp Accuracy

When  $D_x$  (measured D value)  $\leq 0.1$ 

R<sub>p</sub> accuracy is given as,

$$\pm \frac{R_{px} \times D_e}{D_x \mp D_e} \qquad [\Omega]$$

Where,  $R_{px}$  is the measured  $R_p$  value  $[\Omega]$ ,  $D_x$  is the measured D value,  $D_e$  is the relative D accuracy.

### **R<sub>S</sub> Accuracy**

When  $D_x$  (measured D value)  $\leq 0.1$ 

 $R_s$  accuracy is given as,

$$X_x \times D_e$$
  $[\Omega]$ 

$$X_x = 2\pi f L_x = \frac{1}{2\pi f C_x}$$

Where,  $X_x$  is the measured X value  $[\Omega]$ ,  $C_x$  is the measured C value [F],  $L_x$  is the measured L value [H],  $D_e$  is the relative D accuracy, f is the test frequency [Hz].

# **Example of C-D Accuracy Calculation**

#### **Measurement Conditions**

1 kHzFrequency: C measured: 100 nF Test Signal Voltage:  $1 V_{\rm rms}$ Integration Time: **MEDIUM** Cable Length: 0 m

Then,

$$A = 0.05$$

$$\begin{split} |Z_{\rm m}| &= \frac{1}{2\pi \times 1 \times 10^3 \times 100 \times 10^{-9}} \\ &= 1590 \quad [\Omega] \end{split}$$

$$K_{a} = \frac{1 \times 10^{-3}}{1590} \left( 1 + \frac{200}{1000} \right)$$
$$= 7.5 \times 10^{-7}$$

$$K_b = 1590 \times 1 \times 10^{-9} \left( 1 + \frac{70}{1000} \right)$$
  
= 1.70 × 10<sup>-6</sup>

$$K_{\rm c}=0$$

Therefore,

$$C_{accuracy} = \pm [0.05 + (7.5 \times 10^{-7} + 1.70 \times 10^{-6}) \times 100]$$
  
  $\approx \pm 0.05$  [%]

$$D_{accuracy} = \pm \frac{0.05}{100}$$
  
=  $\pm 0.0005$ 

# Specification Charts and Tables

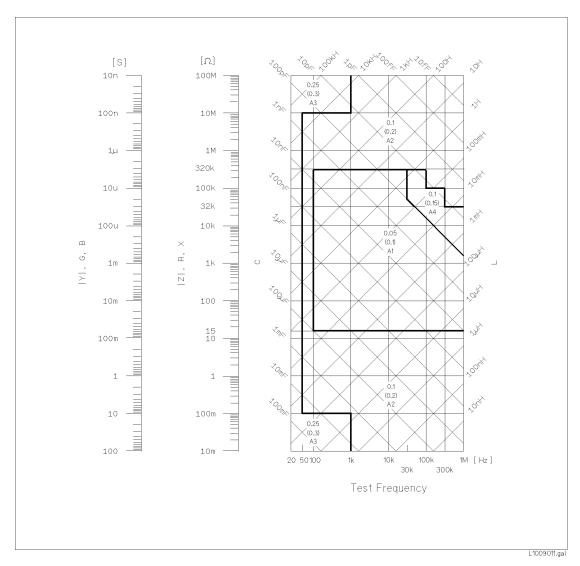


Figure 9-4. Basic Accuracy A (1 of 2)

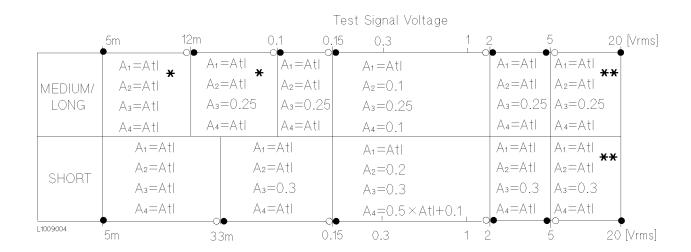
On boundary line apply the better value.

Example of how to find the A value.

- 0.05— A value when 0.3  $V_{\rm rms} \le V_{\rm s} \le$  1  $V_{\rm rms}$  and integration time is MEDIUM and LONG.
- (0.1)— A value when 0.3  $V_{\rm rms} \leq V_{\rm s} \leq$  1  $V_{\rm rms}$  and integration time is SHORT.
- $A_1$  A value when  $V_s < 0.3 \ V_{rms}$  or  $V_s > 1 \ V_{rms}$ . To find the value of  $A_1$ ,  $A_2$ ,  $A_3$  and  $A_4$  refer to Figure 9-5.

Where,  $V_s$ : Test Signal Voltage

The following table lists the value of  $A_1$ ,  $A_2$ ,  $A_3$ , and  $A_4$ . When Atl is indicated find the Atl value using the following graph.



\*. Multiply the A values as follows, when the test frequency is less than 300 Hz.

> $100~{\rm Hz} \le f_m < 300~{\rm Hz};~{\rm Multiply~the~A}$  values by 2.  $f_m < 100$ Hz: Multiply the A values by 2.5.

\*\*: Add 0.15 to the A values when all of the following measurement conditions are satisfied.

> Test Frequency: 300 kHz  $< f_m \le 1 \text{ MHz}$ Test Signal Voltage :  $5 \text{ V}_{\text{rms}} < \text{V}_{\text{s}} \leq 20 \text{ V}_{\text{rms}}$ DUT : Inductor,  $|Z_m| < 200 \Omega \ (|Z_m| : \text{impedance of DUT})$

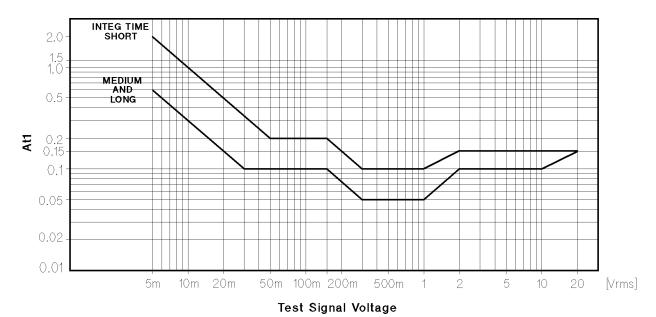


Figure 9-5. Basic Accuracy A (2 of 2)

 $K_a$  and  $K_b$  values are the incremental factors in low impedance and high impedance measurements, respectively.  $K_a$  is practically negligible for impedances above 500  $\Omega$ , and  $K_b$  is also negligible for impedances below 500  $\Omega$ .

Table 9-1. Impedance Proportional Factors  $K_a$  and  $K_b$ 

Integ- time	Frequency	Ка	Кь
MEDIUM LONG	$f_m < 100 \; \mathrm{Hz}$	$\left(\frac{1\times10^{-3}}{ \mathrm{Z_m} }\right)\left(1+\frac{200}{\mathrm{V_s}}\right)\left(1+\sqrt{\frac{100}{\mathrm{f_m}}}\right)$	$ Z_{\rm m}  \left(1 \times 10^{-9}\right) \left(1 + \frac{70}{V_{\rm s}}\right) \left(1 + \sqrt{\frac{100}{f_{\rm m}}}\right)$
LONG	$100 \; \mathrm{Hz} \le f_m \le 100 \; \mathrm{kHz}$	$\left(\frac{1\times10^{-3}}{ \mathbf{Z}_{\mathbf{m}} }\right)\left(1+\frac{200}{\mathbf{V}_{\mathbf{s}}}\right)$	$ Z_{\rm m} \left(1\times10^{-9}\right)\left(1+\tfrac{70}{V_{\rm s}}\right)$
	$100 \text{ kHz} < f_m \le 300 \text{ kHz}$	$\left(\frac{1\times10^{-3}}{ \mathbf{Z}_{\mathbf{m}} }\right)\left(2+\frac{200}{\mathbf{V}_{\mathbf{s}}}\right)$	$ Z_{\rm m}  \left(3 \times 10^{-9}\right) \left(1 + \frac{70}{V_{\rm s}}\right)$
	$300 \text{ kHz} < f_m \le 1 \text{ MHz}$	$\left(\frac{1 \times 10^{-3}}{ \mathbf{Z_m} }\right) \left(3 + \frac{200}{\mathbf{V_s}} + \frac{\mathbf{V_s^2}}{10^8}\right)$	$ \mathbf{Z}_{\mathrm{m}} \left(10\times10^{-9}\right)\left(1+\frac{70}{\mathrm{V_{s}}}\right)$
SHORT	$f_m < 100~\mathrm{Hz}$	$\left(\frac{2.5\times10^{-3}}{ \mathrm{Z_m} }\right)\left(1+\frac{400}{\mathrm{V_s}}\right)\left(1+\sqrt{\frac{100}{\mathrm{f_m}}}\right)$	$ Z_{\rm m}  \left(2 \times 10^{-9}\right) \left(1 + \frac{100}{V_{\rm s}}\right) \left(1 + \sqrt{\frac{100}{f_{\rm m}}}\right)$
	$100 \; \mathrm{Hz} \le f_m \le 100 \; \mathrm{kHz}$	$\left(\frac{2.5\times10^{-3}}{ \mathrm{Z}_{\mathrm{m}} }\right)\left(1+\frac{400}{\mathrm{V}_{\mathrm{s}}}\right)$	$ Z_{\rm m}  \left(2 \times 10^{-9}\right) \left(1 + \frac{100}{V_{\rm s}}\right)$
	$100 \text{ kHz} < f_m \le 300 \text{ kHz}$	$\left(\frac{2.5 \times 10^{-3}}{ Z_{\rm m} }\right) \left(2 + \frac{400}{V_{\rm s}}\right)$	$ Z_{\rm m}  \left(6 \times 10^{-9}\right) \left(1 + \frac{100}{V_{\rm s}}\right)$
	$300 \text{ kHz} < f_m \le 1 \text{ MHz}$	$\left(\frac{2.5 \times 10^{-3}}{ \mathrm{Z_m} }\right) \left(3 + \frac{400}{\mathrm{V_s}} + \frac{\mathrm{V_s^2}}{10^8}\right)$	$ Z_{\rm m}  \left(20 \times 10^{-9}\right) \left(1 + \frac{100}{V_{\rm s}}\right)$

$$\begin{split} f_{\rm m}: & {\rm Test~Frequency~[Hz]} \\ |Z_{\rm m}|: & {\rm Impedance~of~DUT~[\Omega]} \\ V_{\rm s}: & {\rm Test~Signal~Voltage~[mV_{\rm rms}]} \end{split}$$

 $K_{aa}$  is practically negligible for impedances above 500  $\Omega$ .

Table 9-2. Cable Length Factor Kaa

Test Signal	Cable Length					
voltage	0 m	1 m	2 m	4 m		
$\leq 2~\mathrm{V_{rms}}$	0	0	$\frac{\mathbf{K_{a}}}{2}$	$ m K_a$		
$> 2 \mathrm{\ V_{rms}}$	0	$\frac{2\times10^{-3}\times f_{\mathrm{m}}^{2}}{ Z_{\mathrm{m}} }$	$\frac{(1+5\times f_{\rm m}^2)\times 10^{-3}}{ Z_{\rm m} }$	$\frac{(2+10\times f_{\rm m}^2)\times 10^{-3}}{ Z_{\rm m} }$		

 $f_m$ : Test Frequency [MHz]  $|Z_m|$ : Impedance of DUT [ $\Omega$ ]

 $K_a$ : Impedance Proportional Factor

Table 9-3. Cable Length Factor K<sub>bb</sub>

Frequency	Cable Length						
	0 m	1 m	2 m	4 m			
$f_m \leq 100 \text{ kHz}$	1	$1+5\times f_m$	$1+10\times f_m$	$1 + 20 \times f_m$			
$100 \text{ kHz} < f_m \le 300 \text{ kHz}$	1	$1+2\times f_m$	$1+4\times f_m$	$1+8\times f_m$			
$300 \text{ kHz} < f_m \le 1 \text{ MHz}$	1	$1+0.5 \times f_m$	$1+1\times f_m$	$1+2\times f_m$			
$f_m$ : Test Frequency [MHz]							

Table 9-4. Calibration Interpolation Factor  $\mathbf{K}_{\mathbf{C}}$ 

Test Frequency	K <sub>c</sub>
Direct Calibration Frequencies	0
Other Frequencies	0.0003

Direct Calibration Frequencies are the following 48 frequencies.

**Table 9-5. Preset Calibration Frequencies** 

			20	25	30	40	50	60	80	[Hz]
100	120	150	200	250	300	400	500	600	800	[Hz]
1	1.2	1.5	2	2.5	3	4	5	6	8	[kHz]
10	12	15	20	25	30	40	50	60	80	[kHz]
100	120	150	200	250	300	400	500	600	800	[kHz]
1	[MHz]									

Table 9-6. Cable Length Factor  $K_d$ 

Test Signal	Cable Length						
level	vel 1 m 2 m 4						
$\leq 2 \ V_{\rm rms}$	$2.5 \times 10^{-4} (1 + 50 \times f_m)$	$5 \times 10^{-4} (1 + 50 \times f_m)$	$1 \times 10^{-3} (1 + 50 \times f_m)$				
$> 2~{ m V_{rms}}$	$2.5 \times 10^{-3} (1 + 16 \times f_m)$	$5 \times 10^{-3} (1 + 16 \times f_m)$	$1 \times 10^{-2} (1 + 16 \times f_m)$				
$f_m$ : Test Frequency [MHz]							

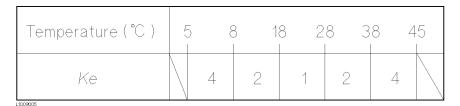
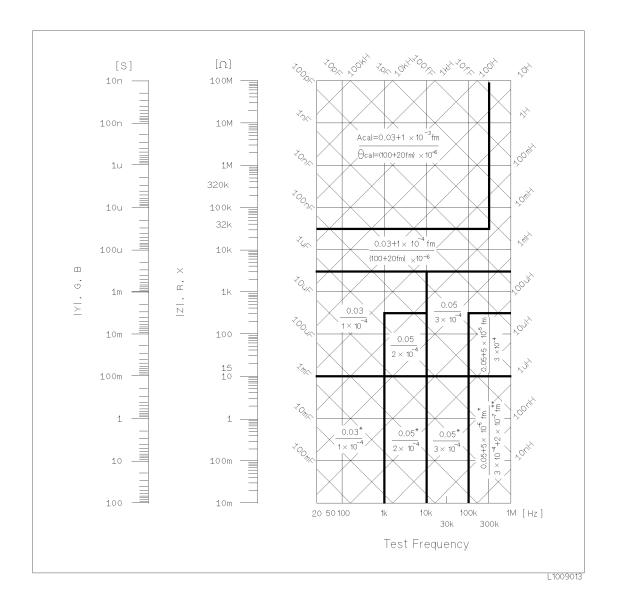


Figure 9-6. Temperature Factor  $K_{\mbox{\scriptsize e}}$ 

# **HP 4284A Calibration Accuracy**

Calibration accuracy is shown in the following figure.



 $f_m$ : test frequency [kHz]

On boundary line apply the better value.

Upper value (A<sub>cal</sub>) is |Z|, |Y|, L, C, R, X, G and B calibration accuracy [%].

Lower value ( $\theta_{cal}$ ) is phase calibration accuracy in radians.

- $\begin{array}{l} {\rm A_{cal}\,=\,0.1\%~when~Hi\text{-}PW~mode~is~ON.} \\ {\rm A_{cal}\,=\,(300+}f_m)\times10^{-6}~{\rm [rad]~when~Hi\text{-}PW~mode~is~ON.} \end{array}$

Phase calibration accuracy in degree,  $\theta_{\rm cal}$  [deg], is given as,

$$\theta_{cal} \quad [deg] = rac{180}{\pi imes \theta_{cal}} \qquad [rad]$$

#### **Correction Functions**

### Zero Open

Eliminates measurement errors due to parasitic stray impedances of the test fixture.

#### Zero Short

Eliminates measurement errors due to parasitic residual impedances of the test fixture.

#### Load

Improves the measurement accuracy by using a working standard (calibrated device) as a reference.

### **List Sweep**

A maximum of 10 frequencies or test signal levels can be programmed. Single or sequential test can be performed. When Option 001 is installed, DC bias voltages can also be programmed.

# **Comparator Function**

Ten bin sorting for the primary measurement parameter, and IN/ OUT decision output for the secondary measurement parameter.

### **Sorting Modes**

Sequential mode

Sorting into unnested bins with absolute upper and lower limits.

Tolerance Mode

Sorting into nested bins with absolute or percent limits.

#### **Bin Count**

0 to 999999

### **List Sweep Comparator**

HIGH/IN/LOW decision output for each point in the list sweep table.

#### DC Bias

0 V, 1.5 V, and 2 V selectable

#### **Setting Accuracy**

 $\pm 5\%$  (1.5 V, 2 V)

### Other Functions

### Store/Load

Ten instrument control settings, including comparator limits and list sweep programs, can be stored and loaded from and into the internal non-volatile memory. Ten additional settings can also be stored and loaded from each removable Memory Card.

#### HP-IB

All control settings, measured values, comparator limits, list sweep program. ASCII and 64-bit binary data format. HP-IB buffer memory can store measured values for a maximum of 128 measurements and output packed data over the HP-IB bus. Complies with IEEE-488.1 and 488.2. The programming language is SCPI.

Interface Functions. SH1, AH1, T5, L4, SR1, RL1, DC1, DT1, C0, E1

#### **Self Test**

Softkey controllable. Provides a means to confirm proper operation.

# **Options**

#### Option 001 (Power Amp/DC Bias)

Increases test signal level and adds the variable dc bias voltage function.

#### **Test Signal Level**

	Mode	Range	Setting Accuracy
Voltage	Non-constant Constant <sup>1</sup>	$5~\mathrm{mV}$ to $20~\mathrm{Vrms}$ $10~\mathrm{mV}$ to $10~\mathrm{Vrms}$	$\pm (10\% + 1 \text{ mV})  \pm (10\% + 1 \text{ mV})$
Current	Non-constant Constant <sup>1</sup>	$50~\mu\mathrm{A}$ to 200 mArms $100~\mu\mathrm{A}$ to $100~\mathrm{mArms}$	$\pm (10\% + 10 \ \mu\text{A})  \pm (10\% + 10 \ \mu\text{A})$

<sup>1</sup> Automatic Level Control Function is set to ON.

#### **Output Impedance**

100  $\Omega, \pm 6\%$ 

**Test Signal Level Monitor** 

Mode	Range	Accuracy
Voltage <sup>1</sup>	$> 2~{ m V_{rms}}$ $5~{ m mV}$ to $2~{ m V_{rms}}$ $0.01~{ m mV}$ to $5~{ m mV_{rms}}$	$\begin{array}{c} \pm (3\% \text{ of reading} + 5 \text{ mV}) \\ \pm (3\% \text{ of reading} + 0.5 \text{ mV}) \\ \pm (11\% \text{ of reading} + 0.1 \text{ mV}) \end{array}$
Current <sup>2</sup>	$> 20~\mathrm{mA_{rms}}$ $50~\mu\mathrm{A}$ to $20~\mathrm{mA_{rms}}$ $0.001~\mu\mathrm{A}$ to $50~\mu\mathrm{A_{rms}}$	$\pm (3\% \text{ of reading} + 50 \ \mu\text{A})$ $\pm (3\% \text{ of reading} + 5 \ \mu\text{A})$ $\pm (11\% \text{ of reading} + 1 \ \mu\text{A})$

<sup>1</sup> Add the impedance measurement accuracy [%] to the voltage level monitor accuracy when the DUT's impedance is  $< 100 \Omega$ .

Accuracies apply when test cable length is 0 m or 1 m. Additional error for 2 m or 4 m test cable length is given as:

$$f_m \times \frac{L}{2}$$
 [%]

Where,

 $f_m$  is test frequency [MHz], L is test cable length [m].

### **DC Bias Level**

The following DC bias level accuracy is specified for an ambient temperature range of 23°C±5°C. Multiply the temperature induced setting error listed in Table F for the temperature range of 0°C to 55°C.

Test Signal Level  $\leq$  2  $V_{rms}$ 

Voltage Ra	ange	Resolution	Setting Accuracy
$\pm (0.000 \text{ to } 4.$	000) V	1 mV	$\pm (0.1\% \text{ of setting} + 1 \text{ mV})$
$\pm (4.002 \text{ to } 8.$	000) V	2  mV	$\pm (0.1\% \text{ of setting} + 2 \text{ mV})$
$\pm (8.005 \text{ to } 20$	.000) V	$5~\mathrm{mV}$	$\pm (0.1\% \text{ of setting} + 5 \text{ mV})$
$\pm (20.01 \text{ to } 40)$	0.00) V	10 mV	$\pm (0.1\% \text{ of setting} + 10 \text{ mV})$

Test Signal Level > 2  $V_{rms}$ 

Voltage Range	Resolution	Setting Accuracy
$\pm (0.000 \text{ to } 4.000) \text{ V}$	1  mV	$\pm (0.1\% \text{ of setting} + 3 \text{ mV})$
$\pm (4.002 \text{ to } 8.000) \text{ V}$	2  mV	$\pm (0.1\% \text{ of setting} + 4 \text{ mV})$
$\pm (8.005 \text{ to } 20.000) \text{ V}$	$5~\mathrm{mV}$	$\pm (0.1\% \text{ of setting} + 7 \text{ mV})$
$\pm (20.01 \text{ to } 40.00) \text{ V}$	$10~\mathrm{mV}$	$\pm (0.1\% \text{ of setting} + 12 \text{ mV})$

<sup>2</sup> Add the impedance measurement accuracy [%] to the current level monitor accuracy when the DUT's impedance is  $\geq 100~\Omega$ .

Setting accuracies apply when the bias current isolation function is set to OFF. When the bias current isolation function is set to ON, add  $\pm 20$  mV to each accuracy value (DC bias current  $\leq 1 \mu A$ ).

#### **Bias Current Isolation Function**

A maximum DC bias current of 100 mA (typical value) can be applied to the DUT.

#### **DC Bias Monitor Terminal**

Rear panel BNC connector

Other Options	Option 002	Bias Current Interface Allows the HP 4284A to control the HP 42841A Bias Current Source.
	Option 006	2 m/4 m Cable Length Operation
	Option 008	Add Operation Manual (Japanese)
	Option 009	Delete operation manual
	Option 109	Delete HP-IB Interface
	Option 201	Handler Interface
	Option 202	Handler Interface
	Option 301	Scanner Interface
	Option 907	Front Handle Kit
	Option 908	Rack Mount Kit
	Option 909	Rack Flange and Handle Kit
	Option 910	Extra Operation Manual
	Option W30	3 Year Extended Warranty

### **Furnished Accessories**

Operation Manual HP Part Number 04284-90000

Memory Card HP Part Number 04278-89001

Power Cable Depends on the country where the HP 4284A is

being used. Refer to Page 1-6, Figure 1-3

Fuse Only for Option 201, HP Part Number

2110-0046, 2ea.

# **Power Requirements**

#### Line Voltage

90 to 132 Vac, 198 to 252 Vac

### **Line Frequency**

47 to 66 Hz

### **Power Consumption**

200 VA max.

# **Operating Environment**

### **Temperature**

0°C to 55°C

### **Humidity**

 $\leq 95\%$  R.H. at 40°C

#### Altitude

0m to 2000m

**Dimensions** 

426(W) by 177(H) by 498(D) (mm)

Weight

Approximately 15 kg (33 lb., standard)

Display

LCD dot-matrix display.

### Capable of Displaying

Measured values Control settings

Comparator limits and decisions

List sweep tables

Self test message and annunciations

### **Number of Display Digits**

6-digits, maximum display count 999999

# **Supplemental Performance Characteristics**

The HP 4284A supplemental performance characteristics are listed starting from page 9-26. Supplemental performance characteristics are not specifications but are typical characteristics included as supplemental information for the operator.

Stability

MEDIUM integration time and operating temperature at 23°C  $\pm$ 5°C

$$|\mathbf{Z}|,\,|\mathbf{Y}|,\,\mathbf{L},\,\mathbf{C},\,\mathbf{R}\,<\,0.01\%$$
 / day

D < 0.0001 / day

## **Temperature Coefficient**

MEDIUM integration time and operating temperature at 23°C  $\pm 5$ °C

Test Signal Level	$ \mathbf{Z} , \mathbf{Y} ,\mathbf{L},\mathbf{C},\mathbf{R}$	D
$\geq$ 20 mV $_{\rm rms}$	< 0.0025%/°C	< 0.000025/°C
$<$ 20 mV $_{\rm rms}$	< 0.0075%/°C	< 0.000075/°C

# **Settling Time**

### Frequency (fm)

$$< 70 \text{ ms } (f_m \ge 1 \text{ kHz}) \\ < 120 \text{ ms } (100 \text{ Hz} \le f_m < 1 \text{ kHz}) \\ < 160 \text{ ms } (f_m < 100 \text{ Hz})$$

### **Test Signal Level**

 $< 120 \mathrm{\ ms}$ 

### **Measurement Range**

 $< 50 \text{ ms/range shift } (f_m \ge 1 \text{ kHz})$ 

# **Input Protection**

Internal circuit protection, when a charged capacitor is connected to the UNKNOWN terminals.

The maximum capacitor voltage is:

$$V_{max} = \sqrt{\frac{1}{C}} \qquad [V]$$

Where,  $V_{max} \le 200 \text{ V},$ C is in Farads.

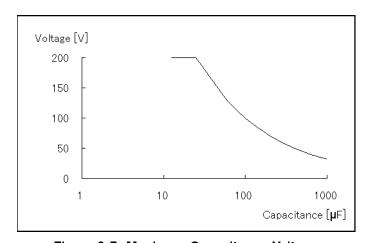
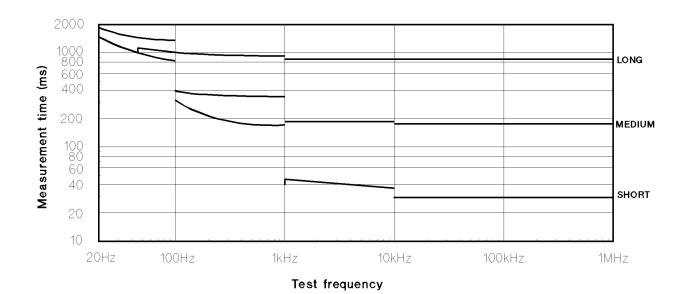


Figure 9-7. Maximum Capacitance Voltage

### **Measurement Time**

Typical measurement times from the trigger to the output of EOM at the Handler Interface. (EOM: End of Measurement)

Integ.	Test Frequency					
Time	100 Hz	1 kHz	10 kHz	1 MHz		
SHORT	$270~\mathrm{ms}$	40  ms	$30  \mathrm{ms}$	$30~\mathrm{ms}$		
MEDIUM	$400~\mathrm{ms}$	190 ms	$180 \; \mathrm{ms}$	$180~\mathrm{ms}$		
LONG	$1040~\mathrm{ms}$	$830~\mathrm{ms}$	$820~\mathrm{ms}$	$820~\mathrm{ms}$		



### **Display Time**

Display time for each display format is given as

MEAS DISPLAY page approx. 8 ms BIN No. DISPLAY page approx. 5 ms BIN COUNT DISPLAY page approx. 0.5 ms

### **HP-IB Data Output Time**

Internal HP-IB data processing time from EOM output to measurement data output on HP-IB lines (excluding display time).

Approx. 10 ms

DC Bias (1.5 V/2 V) Output Current: 20 mA max.

Option 001 (Power Amp/DC Bias)

DC Bias Voltage

DC Bias voltage applied to DUT  $(V_{dut})$  is given as,

$$V_{dut} = V_b - 100 \times I_b \qquad [V]$$

Where,  $V_b$  is DC bias setting voltage [V],  $I_b$  is DC bias current [A].

**DC Bias Current** 

DC bias current applied to DUT  $(I_{dut})$  is given as,

$$I_{dut} = \frac{V_b}{100 + R_{dc}} \qquad [A]$$

Where,  $V_b$  is DC bias setting voltage [V],  $R_{dc}$  is the DUT's DC resistance [ $\Omega$ ].

Maximum DC bias current when the normal measurement can be performed is as follows.

M easurement Range		10 Ω	100 Ω	300 Ω	1 kΩ	3 kΩ	10 kΩ	30 kΩ	100 kΩ
Bias Current	On				1	00 mA			
Isolation	Off	2 mA	2 mA	2 mA	1  mA	$300 \ \mu A$	100 μA	$30 \mu A$	10 μA

### Relative Measurement Accuracy with Bias Current Isolation

When the bias current isolation function is set to ON, add the display fluctuation (N) given in the following equation to the Ae of relative measurement accuracy (Refer to "relative measurement accuracy" of specification).

The following equation is specified when all of the following conditions are satisfied.

DUT impedance  $\geq 100 \Omega$ 

Test signal level setting  $\leq 1 V_{\rm rms}$ 

DC bias current > 1 mA

Integration time: MEDIUM

$$N = P \times \frac{DUT_{impedance} [\Omega]}{Measurement \ Range \ [\Omega]} \times \frac{DC_{bias \ current} \ [mA]}{Test \ signal \ level \ [V_{rms}]} \times \frac{1}{\sqrt{n}} \times 10^{-4} \quad [\%]$$

Where, P is the coefficient listed on Table A, n is the number of averaging.

When the DC bias current is less than 1 mA, apply N value at 1 mA. When integration time is set to SHORT, multiply N value by 5. When integration time is set to LONG, multiply N value by 0.5.

Table 9-7. Coefficient Related to Test Frequency and Measurement Range

Meas.	Test Frequency f <sub>m</sub> [Hz]					
Range	$20 \le f_{\rm m} < 100$	$100{\le}f_{\mathbf{m}}{<}1~k$	$1~k{\le}f_m{<}10~k$	$10~k{\le}f_m{\le}1~M$		
100 Ω	0.75	0.225	0.045	0.015		
300 Ω	2.5	0.75	0.15	0.05		
$1~\mathrm{k}\Omega$	7.5	2.25	0.45	0.15		
$3~\mathrm{k}\Omega$	25	7.5	1.5	0.5		
10 kΩ	75	22.5	4.5	1.5		
30 kΩ	250	75	15	5		
100 kΩ	750	225	45	15		

# **Calculation Example**

#### **Measurement Conditions**

DUT : 100 pF

Test signal level:  $20 \text{ mV}_{rms}$ Test frequency: 10 kHz Integration time: MEDIUM

DUT's impedance =  $1/(2\pi \times 10^4 \times 100 \times 10^{-12}) = 159 \text{ k}\Omega$ Then,

> Measurement range is 100 k $\Omega$ DC bias current << 1 mAP = 15 (according to Table A)

 $A_e$  of relative measurement accuracy without bias current isolation is  $\pm 0.22$  [%]. (Refer to "relative measurement accuracy" of specification.)

Then, N = 
$$15 \times (159 \times 10^3)/(100 \times 10^3) \times 1/(20 \times 10^{-3}) \times 10^{-4}$$
  
=  $0.12$  [%]

Therefore, Relative Capacitance measurement accuracy is:

$$\pm (0.22+0.12) = \pm 0.34$$
 [%]

# **DC Bias Settling Time**

When DC bias is set to ON, add the settling time listed in the following table to the measurement time. This settling time does not include the DUT charge time.

Test	Bias Current Isolation		
Frequency $(f_m)$	ON	OFF	
$20 \text{ Hz} \le f_m < 1 \text{ kHz}$	210 ms		
$1 \text{ kHz} \le f_m < 10 \text{ kHz}$	$70   \mathrm{ms}$	$20  \mathrm{ms}$	
$10 \text{ kHz} \le f_m \le 1 \text{ MHz}$	$30   \mathrm{ms}$		

Sum of DC bias settling time plus DUT (capacitor) charge time is shown in the following figure.

	Bias Source	Bias Current Isolation	Test Frequency (f <sub>m</sub> )
1	Standard	On/Off	$20 \text{ Hz} \le f_m \le 1 \text{ MHz}$
2	Option 001	Off	$20 \text{ Hz} \le f_m \le 1 \text{ MHz}$
3		On	$10 \text{ kHz} \le f_m \le 1 \text{ MHz}$
4			$1 \text{ kHz} \le f_m < 10 \text{ kHz}$
(5)			$20~\mathrm{Hz} \le f_m < 1~\mathrm{kHz}$

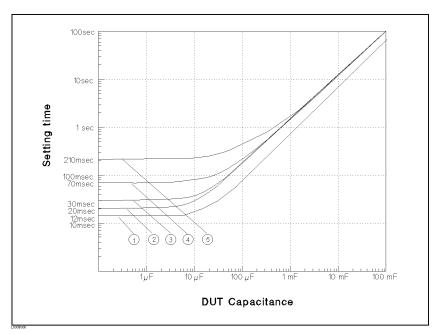


Figure 9-8. Measurement Time

# Rack/Handle Installation

The HP 4284A can be rack mounted and used as a component of a measurement system. Following figure shows how to rack mount the HP 4284A.

Table 9-8. Rack Mount	t Ki	its	3
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Option	Description	Kit Part Number
907	Handle Kit	HP Part Number 5061-9690
908	Rack Flange Kit	HP Part Number 5061-9678
909	Rack Flange & Handle Kit	HP Part Number 5061-9684

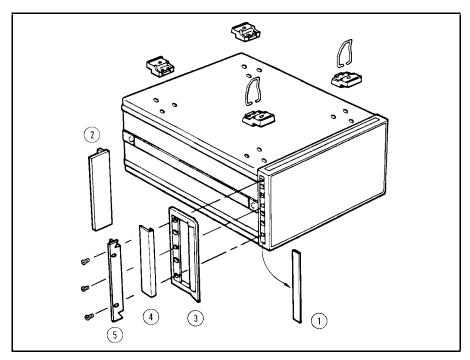


Figure 9-9. Rack Mount Kits Installation

- 1. Remove the adhesive-backed trim strips ① from the left and right front sides of the HP 4284A.
- 2. HANDLE INSTALLATION: Attach the front handles ③ to the sides using the screws provided and attach the trim strip (4) to the handle.
- 3. RACK MOUNTING: Attach the rack mount flange ② to the left and right front sides of the HP 4284A using the screws provided.
- 4. HANDLE AND RACK MOUNTING: Attach the front handle ③ and the rack mount flange (5) together on the left and right front sides of the HP 4284A using the screws provided.

5. When rack mounting the HP 4284A (3 and 4 above), remove all four feet (lift bar on the inner side of the foot, and slide the foot toward the bar).

# Storage and Repacking

This paragraph describes the environment for storing or shipping the HP 4284A, and how to repackage the HP 4284A for shipment when necessary.

#### **Environment**

The HP 4284A should be stored in a clean, dry environment. The following environmental limitations apply for both storage and shipment.

-20°C to 60°C Temperature: < 95% RH (at 40°C) Humidity:

To prevent condensation from taking place on the inside of the HP 4284A, protect the instrument against temperature extremes.

# **Original Packaging**

Containers and packing materials identical to those used in factory packaging are available through your closest Hewlett-Packard sales office. If the instrument is being returned to Hewlett-Packard for servicing, attach a tag indicating the service required, the return address, the model number, and the full serial number. Mark the container FRAGILE to help ensure careful handling. In any correspondence, refer to the instrument by model number and its full serial number.

### Other Packaging

The following general instructions should be used when repacking with commercially available materials:

- 1. Wrap the HP 4284A in heavy paper or plastic. When shipping to a Hewlett-Packard sales office or service center, attach a tag indicating the service required, return address, model number, and the full serial number.
- 2. Use a strong shipping container. A double-walled carton made of at least 350 pound test material is adequate.
- 3. Use enough shock absorbing material (3 to 4 inch layer) around all sides of the instrument to provide a firm cushion and to prevent movement inside the container. Use cardboard to protect the front panel.
- 4. Securely seal the shipping container.
- 5. Mark the shipping container FRAGILE to help ensure careful handling.
- 6. In any correspondence, refer to the HP 4284A by model number and by its full serial number.

# Caution



The memory card should be removed, before packing the HP 4284A.

## **Performance Tests**

## Introduction

This chapter provides the test procedures to verify that the HP 4284A meets the specifications listed in Chapter 9. All tests can be performed without accessing the indicator of the instruments. Performance tests are used to perform incoming inspection and to verify that the HP 4284A is within its performance specification after troubleshooting or adjustment have been performed. If the performance tests indicate that the HP 4284A is not within specifications, check your test setup, then proceed to Adjustment or Troubleshooting as required.

Note



Allow the HP 4284A to warm up a minimum of 30 minutes before starting any of the performance tests.

Note



The performance tests are valid only when performed in an ambient temperature of 23 °C  $\pm 5$  °C.

## **Test Equipment**

Table 10-1 lists the test equipment required to perform the tests described in this chapter. Use only calibrated test instruments when performance testing the HP 4284A. If the recommended equipment with specifications equal to or surpassing those of the recommended equipment may be used.

Note



Components used as standards must be (1) calibrated using an instrument whose specifications are traceable to the National Bureau of Standard (NBS) or an equivalent standards group, or (2) calibrated directly by an authorized calibration organization, such as NBS. The calibration cycle depends on the stability specification of each component.

## **Performance Test** Record

Record the results of each performance test in the Performance T est Record located at the end of this chapter. The performance record lists each test, parameters tested, and acceptable tolerance limits. Keep a record of past performance test results for comparison purposes to help indicate any possible areas of developing trouble.

Note



The test limits indicated in each performance test do not take into account the measurement errors induced by the st equipment used. Be sure to consider this when determining whether or not the HP 4284A meets is indicated specifications.

## **Calibration Cycle**

The HP 4284A required periodic performance verification. How often you verify performance depends on the operating and envioremental conditions. Check the HP 4284A using the performance tests described in this chapter at least once a year. To minimize instrument down-time and to ensure optimum operation, perform preventive maintenance and calibration at least twice a year.

Table 10-1. Recommended Test Equipment

Equipment	Requirements	Recommended Model
Electronic Counter	Frequency: 20 Hz to 1 MHz	HP 5334B
	Accuracy: <<0.01%	
RMS Voltmeter	Frequency: 20 Hz to 1 MHz	HP 3458A
	Voltage Range: 5 mV $_{\rm rms}$ to 20 V $_{\rm rms}$	
	Accuracy: <<3.0%	
DC Voltmeter	Voltage range: -40 V to 40 V	HP 3458A
	Accuracy: <<0.1%	
Standard Capacitor	No substitute	HP16380A
		HP 16380C
Standard Resister	No Substitute	HP 16074A
DC Power Source	+5 V, 0.1 A	HP 6214C
Adapter	BNC(f) to BNC(f)	HP PN 1250-0080
	Tee, $BNC(m)(f)(f)$	HP PN 1250-0781
	BNC(f) to Dual Banana	HP PN 1251-2277
Cable	BNC(m)-to-BNC(m), 30 cm	HP PN 8120-1838
Test Leads	2 BNC(m) to 3 alligator clips	HP PN 8120-1661
	4 BNC(m), Cable Length 1 m	HP 16048A
	4 BNC(m), Cable Length 2 m	HP 16048D
	4 BNC(m), Cable Length 4 m	HP 16048E
HP-IB Cable	HP-IB cable, 1 m	HP 10388A
Computer	HP Technical Computer	HP 9000 Series 200 Model 226
Memory Card	(furnished accessory)	HP PN 04278-89001
Bias IF Simulator	No substitute	HP PN 42841-65001
Handler Simulator	No substitute	HP PN 04278-65001
Scanner Simulator	No substitute	HP PN 04278-65301
Simulator Cable	No substitute	HP PN 04278-61635
Bias IF Cable	GP-IO Cable	HP PN 42841-61640

# **System Reset**

By using SYSTEM RESET function the HP 4284A can be set easily for the performance test. SYSTEM RESET can be performed using the following procedure.

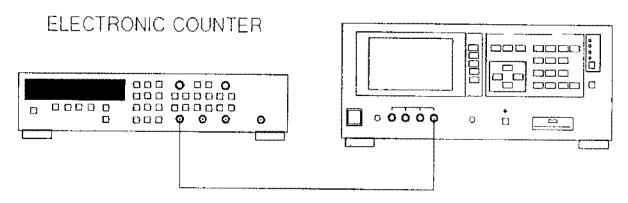
## **Procedure**

- 1. Press (MEAS SETUP) to display MEAS SETUP page.
- 2. Use CURSOR keys to move the cursor to the SYS MENU field.
- 3. Press more 1/2 softkey to display SYSTEM RESET.
- 4. Press SYSTEM RESET.
- 5. Press YES to perform a SYSTEM RESET.

## **Test Frequency Accuracy Test**

This test verifies that the accuracy of the HP 4284A's test frequency is within  $\pm 0.01\%$ .

HP 4284A



BNC(m)-BNC(m) Cable 30 cm

Figure 10-1. Test Frequency Accuracy Test Setup

Electronic Counter HP 5334B **Equipment** 

> BNC(m)-to-BNC(m) Cable, 30 cm HP PN 8120-1838

**Procedure:** 

- 1. Set up the equipment as shown in Figure 10-1.
- 2. Perform a SYSTEM RESET as described in "System Reset".
- 3. Set the Test Frequency in accordance with Table 10-2, and confirm that the counter readings are within the test limits given in the table.

Table 10-2. Test Frequency Test limits

Test Frequency	Test Limits
1 kHz	0.9999 kHz to 1.0001 kHz
8 kHz	7.9992 kHz to 8.0008 kHz
20 kHz	19.998 kHz to 20.002 kHz
80 kHz	79.992 kHz to 80.008 kHz
400 kHz	399.96 kHz to 400.04 kHz
1 MHz	0.9999 MHz to 1.0001 MHz

## **Test Signal** Level/Level-Monitor **Accuracy Test**

This test verifies the HP 4284A's test signal level, and test signal level monitor accuracy.

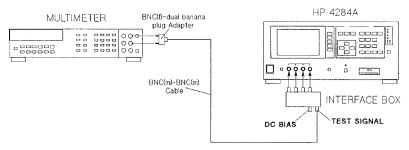


Figure 10-2. Test Signal Level Accuracy Test Setup Using an Interface Box

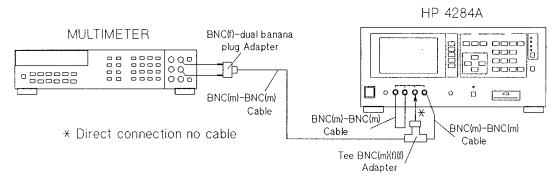


Figure 10-3. Test Signal Level Accuracy Test Setup Without an Interface Box

Note



The BNC to BNC cables used in this test should be shorter than 30 cm.

**Equipment:** Interface Box HP PN 04284-65007

> Multimeter HP 3458A

Cable BNC(m)-to-BNC(m) 30 cm HP PN 8120-1838 BNC(f) to dual banana plug Adapter HP PN 1251-2277

## **Procedure:**

1. Set up the equipment as shown in Figure 10-2.

### Note



If the Interface Box is not available, use the following cables and adapters as a substitute. Figure 10-3 shows the test setup without the interface box.

BNC(m) to BNC(m) Cable, 30 cm Tee, BNC(m)(f)(f) Adapter

HP PN 8120-1838 2ea. HP PN 1250-0781

- 2. Set the multimeter to ACV.
- 3. Perform a SYSTEM RESET as described in "System Reset".
- 4. Set HP 4284A's controls as follows:

Test Frequency: 1.25 kHz High Power Option: OFF

- 5. Display the MEAS DISPLAY page.
- 6. Set the Oscillator Level in accordance with Table 10-3, and confirm that the Multimeter reading and the Level Monitor reading are within the test limits given in the table.
- 7. Set the Test Frequency to 960 kHz and perform step 6.

#### Note



Steps 8 through 11 should be performed only when the HP 4284A is equipped with Option 001.

8. Set the controls of the HP 4284A as follows:

Test Frequency: 1.25 kHz High Power Option: ON

- 9. Display the **MEAS DISPLAY** page.
- 10. Set the Oscillator Level in accordance with Table 10-4, and confirm that the Multimeter reading and the Level Monitor reading are with in the test limits given in Table 10-3.
- 11. Set the Test Frequency to 960 kHz and perform step 10.

Table 10-3. Test Signal Level/Level-Monitor Test Limits (Hi-PW OFF)

Test Signal	Test Limits			
Level	Multimeter Reading	Level Monitor Reading		
5  mV	$5~\mathrm{mV}~\pm1.5~\mathrm{mV}$	M.R. $\pm (3\% + 0.5 \text{ mV})$		
10  mV	$10~\mathrm{mV}~\pm 2~\mathrm{mV}$	M.R. $\pm (3\% + 0.5 \text{ mV})$		
$20~\mathrm{mV}$	$20~\mathrm{mV}~\pm 3~\mathrm{mV}$	M.R. $\pm (3\% + 0.5 \text{ mV})$		
$50~\mathrm{mV}$	$50~\mathrm{mV}~\pm6~\mathrm{mV}$	M.R. $\pm (3\% + 0.5 \text{ mV})$		
100 mV	$100~\mathrm{mV}~\pm11~\mathrm{mV}$	M.R. $\pm (3\% + 0.5 \text{ mV})$		
200 mV	$200~\mathrm{mV}~\pm21~\mathrm{mV}$	M.R. $\pm (3\% + 0.5 \text{ mV})$		
$250~\mathrm{mV}$	$250~\mathrm{mV}~\pm26~\mathrm{mV}$	M.R. $\pm (3\% + 0.5 \text{ mV})$		
$500~\mathrm{mV}$	$500~\mathrm{mV}~\pm51~\mathrm{mV}$	M.R. $\pm (3\% + 0.5 \text{ mV})$		
1 V	$1~\mathrm{V}~\pm101~\mathrm{mV}$	M.R. $\pm (3\% + 0.5 \text{ mV})$		
2 V	$2~\mathrm{V}~\pm201~\mathrm{mV}$	M.R. $\pm (3\% + 0.5 \text{ mV})$		

M.R. is the Multimeter Reading for the HP 4284A's output signal level.

Table 10-4. Test Signal Level/Level-Monitor Test Limits (Hi-PW ON)

Test Signal	Test Limits		
Level	Multimeter Reading	Level Monitor Reading	
10 mV	$10~\mathrm{mV}~\pm 2~\mathrm{mV}$	M.R. $\pm (3\% + 0.5 \text{ mV})$	
1 V	$1~\mathrm{V}~\pm0.11~\mathrm{V}$	M.R. $\pm (3\% + 0.5 \text{ mV})$	
2.5 V	$2.5~\mathrm{V}~\pm0.26~\mathrm{V}$	M.R. ±(3%+5 mV)	
20 V	$20~\mathrm{V}~\pm2.01~\mathrm{V}$	M.R. $\pm (3\% + 5 \text{ mV})$	

M.R. is the Multimeter Reading for the HP 4284A's output signal level.

# **DC Bias Level Accuracy Test**

This test verifies the accuracy of the HP 4284A's internal dc bias

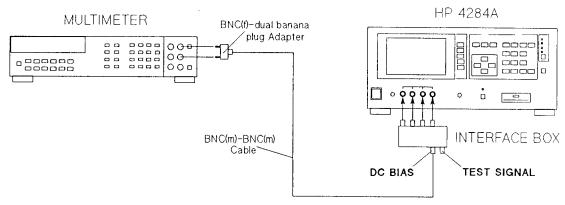


Figure 10-4. DC Bias Level Accuracy Test Setup Using an Interface Box

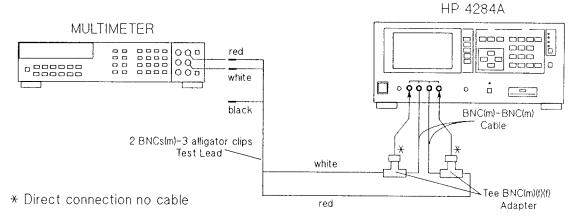


Figure 10-5. DC Bias Level Accuracy Test Setup Without an Interface Box

Interface Box HP PN 04284-65007 **Equipment:** 

> Multimeter HP 3458A

HP PN 8120-1838 Cable BNC(m)-to-BNC(m) 30 cm BNC(f) to dual banana plug Adapter HP PN 1251-2277

### Procedure:

1. Connect the equipment as shown in Figure 10-4.

#### Note



if the Interface Box is not available, use the following cables and adapters as a substitute. Figure 10-5 shows the test setup without the interface box. The center conductors of H<sub>CUR</sub> and H<sub>POT</sub> are connected to the Hi-input of the multimeter. The center conductors of the L<sub>CUB</sub> and L<sub>POT</sub> are connected to Lo-input of the multimeter.

Cable BNC(m)-to-BNC(m) 30 cm HP PN 8120-1838 2 ea. HP PN 8120-1661 Test Lead 2 BNCs(m) to

3 alligator clips

Tee, BNC(m)(f)(f) Adapter HP PN 1250-0781 2 ea.

2. Set the multimeter to DCV.

3. Perform a SYSTEM RESET as described in "System Reset".

4. Set HP 4284A's controls as follows:

Test Signal level: 0 mV High Power Option: OFF

DC Bias: ON

#### Note



The High Power Mode cannot be changed when the DC Bias is set to ON.

Set the DC Bias voltage in accordance with Table 10-5, and confirm that the Multimeter readings are within the test limits given in Table 10-5.

Table 10-5. DC Bias Level Test Limits (Hi-PW OFF)

Bias Level	Test Limits	
1.5 V	1.425 V to 1.575 V	
2 V	1.9 V to 2.1 V	

#### Note



Steps 6 through 7 should be performed only when the HP 4284A is equipped with Option 001.

5. set the HP 4284A's controls as follows:

Test Signal Level: 0 mV High Power Option: ON

DC Bias: ON

6. Set the DC Bias Level in accordance with Table 10-6, and confirm that the Multimeter readings are within the test limits given in Table 10-6.

Table 10-6. DC Bias Level Test Limits (Hi-PW ON)

Bias Level	Test Limits
0 V	0.0010 V to -0.0010 V
0.1 V	0.0989 V to 0.1011 V
2 V	1.9970 V to 2.0030 V
6 V	5.9920 V to 6.0080 V
14 V	13.981 V to 14.019 V
30 V	29.960 V to 30.040 V
40 V	39.950 V to 40.050 V
-0.1 V	$-0.1011~{ m V}$ to $-0.0989~{ m V}$
−2 V	$-2.0030~\mathrm{V}$ to $-1.9970~\mathrm{V}$
−6 V	$-6.0080~\mathrm{V}$ to $-5.9920~\mathrm{V}$
-14 V	$-14.019~{ m V}$ to $-13.981~{ m V}$
-30 V	$-30.040~\mathrm{V}$ to $-29.960~\mathrm{V}$
-40 V	$-40.050~\mathrm{V}$ to $-39.950~\mathrm{V}$

## **Impedance Measurement Accuracy Test**

This test verifies the HP 4284A's impedance measurement accuracy.

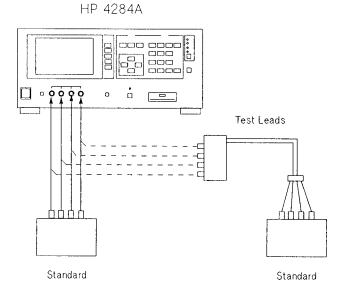


Figure 10-6. Impedance Measurement Accuracy Test Setup

	-	~~	nt:
 •	$\sim$ 1	-	

10 pF Standard Capacitor	HP 16382A
100 pF Standard Capacitor	HP 16383A HP 16380A
1000 pF Standard Capacitor	HP 16384A
$0.01~\mu\mathrm{F}$ Standard Capacitor	HP 16385A
$0.1~\mu\mathrm{F}$ Standard Capacitor	HP 16386A HP 16380C
$1~\mu \mathrm{F}$ Standard Capacity	HP 16387A
Calibration R-L Standard	HP 16074A
Adapter $BNC(f)$ to $BNC(f)$	HP PN 1250-0080 4 ea.
Test Leads (1 m)	HP 16048A
Test Leads (2 m)	HP 16048D (Option 006 only)
Test Leads (4 m)	HP 16048E (Option 006 only)

## Procedure:

- 1. Perform a SYSTEM RESET as described on in "System Reset".
- 2. Press the (MEAS SETUP) MENU key and the CORRECTION softkey to display the CORRECTION page.
- 3. Set the **CORRECTION** page as shown in Figure 10-7.

### CORRECTION page

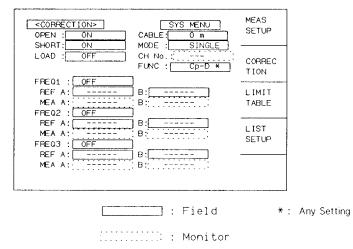


Figure 10-7. Correction Page Setup

#### Note



It takes approx. 90 s each to store the **OPEN CORRECTION** data and the SHORT CORRECTION data.

- 4. Connect the OPEN termination to the HP 4284A's UNKNOWN terminals.
- 5. Move the cursor to the **OPEN** field.
- 6. Press the MEAS OPEN softkey to store the open correction data.
- 7. Connect the SHORT termination to the HP 4284A's UNKNOWN terminals.
- 8. Move the cursor to the **SHORT field**.
- 9. Press the MEAS SHORT softkey to store the short correction data.
- 10. Set the HP 4284A to the Manual Trigger mode.
- 11. Perform Steps 12 through 14 for the all standards and settings listed in Table 10-7.

#### Note



Test signal level is set to 5.1 V only when the HP 4284A is equipped with Option 001

- 12. Connect the Standard to the HP 4284A's UNKNOWN terminals.
- 13. Press the (TRIGER) key.
- 14. Confirm that the HP 4284A's reading is within the test limits in Table 10-7.

Table 10-7. Impedance Measurement Accuracy Test Limits (1 of 2)

Se	etting		Test Limits (Cp, D)		
Signal Level	Test Frequency		10 pF Standard	100 pF Standard	1000 pF Standard
510 mV	20 Hz	Ср			C.V. ±32.09 pF
		D			$\pm 0.00319$
	125 Hz	Ср		C.V. $\pm 1.759$ pF	$C.V. \pm 3.05 pF$
		D		$\pm 0.01739$	$\pm 0.00286$
	$1~\mathrm{kHz}$	Ср		C.V. $\pm 0.312~\mathrm{pF}$	C.V. ±1.00 pF
		D		$\pm 0.00293$	$\pm 0.00081$
	$12.5~\mathrm{kHz}$	Ср	$\mathrm{C.V.} \pm 0.0318~\mathrm{pF}$	C.V. $\pm 0.137~\mathrm{pF}$	C.V. ±1.13 pF
		D	$\pm 0.0031$	$\pm 0.00130$	$\pm 0.00095$
	48 kHz	Ср	C.V. $\pm 0.0246$ pF	C.V. $\pm 0.162$ pF	C.V. ±1.16 pF
		D	$\pm 0.0028$	$\pm 0.0190$	$\pm 0.00103$
	96 kHz	Ср	C.V. $\pm 0.0275~\mathrm{pF}$	C.V. $\pm 0.122$ pF	C.V. ±1.31pF
		D	$\pm 0.0035$	$\pm 0.00116$	$\pm 0.00111$
	$1~\mathrm{MHz}$	Ср	C.V. $\pm 0.0249~\mathrm{pF}$	C.V. $\pm 0.102$ pF	$C.V.^{1} \pm 1.53 pF$
		D	$\pm 0.0038$	$\pm 0.00082$	$\pm 0.00083$
20 mV	1 kHz	Ср		C.V. $\pm 0.898$ pF	$\mathrm{C.V.}\ \pm 2.53\ \mathrm{pF}$
	1 MHz	Ср	$\mathrm{C.V.} \pm 0.0402~\mathrm{pF}$	C.V. $\pm 0.208$ pF	$C.V.^{1} \pm 2.59 pF$
5.1 V*	1 kHz	Ср		C.V. $\pm 0.293$ pF	C.V. ±1.48 pF
	1 MHz	Ср	C.V. $\pm 0.0297$ pF	C.V. $\pm 0.152$ pF	$C.V.^{1} \pm 2.03 pF$

C.V.: Standard's calibration value at 1 kHz.

C.V.<sup>1</sup>: C.V. multiplied by 1.0003

<sup>\*</sup>Option 001 only

Table 10-7. Impedance Measurement Accuracy Test Limits (2 of 2)

Setting		Test Limits (Cp)		
Signal Level	Test Frequency	0.01 $\mu$ F Standard	0.1 $\mu$ F Standard	1 $\mu$ F Standard
510 mV				
	1 kHz	$\mathrm{C.V.}\ \pm0.0082\ \mathrm{nF}$	C.V. $\pm 0.081 \text{ nF}$	C.V. $\pm 0.81~\mathrm{nF}$
$20~\mathrm{mV}$				
	1 kHz	C.V. $\pm 0.0188$ nF	C.V. $\pm 0.182 \text{ nF}$	C.V. $\pm 1.87~\mathrm{nF}$
$5.1 \text{ V}^*$				
	1 kHz	$C.V. \pm 0.0132 \text{ nF}$	C.V. ±0.131 nF	$C.V. \pm 1.31 \text{ nF}$

C.V.: Standard's calibration value at 1 kHz.

 $C.V.^1$ : C.V. multiplied by 1.0005C.V.<sup>2</sup>: C.V. multiplied by 1.0002

- 15. Set the measurement function to R-X.
- 16. Perform Steps 17 through 19 for all the standards and settings listed in Table 10-8.
- 17. Connect the Standard to the HP 4284A's UNKNOWN terminals.
- 18. Press the (TRIGGER) key.
- 19. Confirm that the HP 4284A's readings are within the test limits listed in Table 10-8.

<sup>\*</sup>Option 001 only

Table 10-8. Impedance Measurement Accuracy Test Limits

S	Setting	Test Limits (R)		
Signal Level	Test Frequency	100 $\Omega$ Standard	$1~\mathrm{k}\Omega~\mathrm{Standard}^*$	
510 mV	20 Hz	C.V. $\pm 0.285~\Omega$	C.V. $\pm 2.81~\Omega$	
	125 Hz	C.V. $\pm 0.112~\Omega$	C.V. $\pm 1.11 \Omega$	
	1 kHz	C.V. $\pm 0.082~\Omega$	C.V. $\pm 0.81~\Omega$	
	12.5 kHz	C.V. $\pm 0.132~\Omega$	C.V. $\pm 1.31~\Omega$	
	48 kHz	C.V. ±O.132 Ω	C.V. $\pm 1.31~\Omega$	
	96 kHz	C.V. $\pm 0.132~\Omega$	C.V. $\pm 1.31~\Omega$	
	1 MHz	C.V. $\pm 0.154~\Omega$	C.V. $\pm 1.02~\Omega$	
20 mV	20 Hz	C.V. ±0.691 Ω	C.V. $\pm 6.60~\Omega$	
	1 kHz	C.V. ±O.191 Ω	C.V. $\pm 1.82~\Omega$	
	1 MHz	C.V. $\pm 0.264~\Omega$	C.V. $\pm 2.06~\Omega$	
5.1 V**	20 Hz	C.V. *0.284 Ω	$C.V. \pm 2.81\Omega$	
	1 kHz	C.V. ±O.131 Ω	C.V. $\pm 1.31 \Omega$	
	1 MHz	C.V. $\pm 0.204~\Omega$	C.V. $\pm 1.52~\Omega$	

C.V.: Standard's calibration value at DC.

- 20. Connect the 1 m Test Leads (HP 16048A) to the UNKNOWN terminals.
- 21. Press the MEAS SETUP MENU key and the CORRECTION softkey to display the CORRECTION page.
- 22. Set the CABLE length selection switch to 1 m.
- 23. Store the **OPEN CORRECTION** data and the **SHORT CORRECTION** data referring to Steps 4 through 9. In this procedure the OPEN termination and the SHORT termination should be connected to the 1 m Test Leads (HP 16048A).
- 24. Set the HP 4284A to the manual trigger mode.
- 25. Set the measurement function to Cp-D.
- 26. Connect the 1000 pF standard to the 1 m Test Leads (HP 16048A)
- 27. Perform Step 28 through 29 for all the test frequencies listed in Table 10-9.

 $<sup>^*1~</sup>k\Omega$  standard should be measured on the  $300~\Omega$  range.

<sup>\*\*</sup>Option 001 only

- 28. Press the (TRIGGER) key.
- 29. Confirm that HP 4284A's reading is within the test limits in Table 10-9.

Table 10-9. Impedance Measurement Accuracy Test Limits for 1 m Cable Length Operation

Setting		Test Limits (Cp)	
Signal Level	Test Frequency		
510 mV	20 Hz	$\mathrm{C.V.}\ \pm 32.10\ \mathrm{pF}$	
	125 Hz	$C.V. \pm 3.06 pF$	
	1 kHz	C.V. ±1 00 pF	
	12.5 kHz	C.V. ±1.14 pF	
	48 kHz	C.V. ±1.17 pF	
	96 kHz	$C.V. \pm 1.32 pF$	
	1 MHz	$C.V.^{1} \pm 1.66 \text{ pF}$	
20 mV	1 kHz	$\text{C.V.} \pm 2.54 \text{ pF}$	
	1 MHz	$C.V.^{1} \pm 2.72 \text{ pF}$	
5.1 V*	20 Hz	C.V. ±28.94 pF	
	1 kHz	C.V. ±1.50 pF	
	1 MHz	$\mathrm{C.V.^1}~\pm 2.47~\mathrm{pF}$	

C.V.: Standard's calibration value at DC.

 $C.V.^1$ : C.V. multiplied by 1.0003

Note



Steps 30 through 49 should be performed only when the HP 4284A is equipped with Option 006.

<sup>\*</sup>Option 001 only

- 30. Connect the 2 m Test Leads (HP 16048D) to the UNKNOWN terminals.
- 31. Press the MEAS SETUP MENU key and the CORRECTION softkey to display the CORRECTION page.
- 32. Set the CABLE to 2 m.
- 33. Store the **OPEN CORRECTION** data and the **SHORT CORRECTION** data referring to Step 4 through 9. In this procedure the OPEN termination and the SHORT termination should be connected to the 2 m Test Leads (HP 16048D).
- 34. Set the HP 4284A to the Manual Trigger mode.
- 35. Set the measurement function to **Cp-D**.
- 36. Connect the 1000 pF standard to the 2 m Test Leads (HP 16048D).
- 37. Perform Steps 38 through 39 for all the test frequencies listed in Table 10-10.
- 38. Press the (TRIGGER) key.
- 39. Confirm that the HP 4284A's reading is within the test limits in Table 10-10.
- 40. Connect the 4 m Test Leads (HP 16048E) to the UNKNOWN terminals.
- 41. Press the MEAS SETUP MENU key and the CORRECTION softkey to display the CORRECTION page.
- 42. Set the **CABLE** to 4 m.
- 43. Store the **OPEN CORRECTION** data and the **SHORT CORRECTION** data referring to steps 4 through 9. In this procedure the OPEN termination and the SHORT termination should be connected to the 4 m Test Leads (HP 16048E).
- 44. Set the HP 4284A to the Manual Trigger mode.
- 45. Set the measurement function to Cp-D.
- 46. Connect the 1000 pF standard to the 4 m Test Leads (HP 16048E).
- 47. Perform Steps 48 through 49 for all the test frequencies listed in Table 10-10.
- 48. Press the (TRIGGER) key.
- 49. Confirm that the HP 4284A's reading is within the test limits listed in Table 10-10.

Table 10-10. Impedance Measurement Accuracy Test Limits for 2 m and 4 m Cable Length Operation

Setting		Test Limits (Cp)		
Signal Level	Test Frequency	2 m Cable	4 m Cable	
510 mV	20 Hz	C.V. ±32.10 pF	C.V. $\pm 32.11$ pF	
	$125~\mathrm{Hz}$	C.V. ±3.06 pF	$\text{C.V.} \pm 3.07 \text{ pF}$	
	1 kHz	C.V. ±1.00 pF	C.V. $\pm 1.01$ pF	
	$12.5~\mathrm{kHz}$	C.V. ±1.14 pF	C.V. $\pm 1.15$ pF	
	48 kHz	C.V. ±1.18 pF	$C.V. \pm 1 19 pF$	
	96 kHz	C.V. ±1.34 pF	C.V. $\pm 1.37~\mathrm{pF}$	
	$1~\mathrm{MHz}$	$C.V.^{1} \pm 1.80 pF$	$\mathrm{C.V.^1}\ \pm 2.06\ \mathrm{pF}$	
20 mV	1 kHz	C.V. ±2.54 pF	$\text{C.V.} \pm 2.56 \text{ pF}$	
	$1~\mathrm{MHz}$	$C.V.^{1} \pm 2.90 pF$	$\mathrm{C.V.^1}\ \pm 3.20\ \mathrm{pF}$	
5.1 V*	20 Hz	C.V. ±28.97 pF	C.V. ±29.02 pF	
	1 kHz	C.V. ±1.53 pF	C.V. $\pm 1.58$ pF	
	$1~\mathrm{MHz}$	$C.V.^{1} \pm 2.92 pF$	$\mathrm{C.V.^1}\ \pm 3.81\ \mathrm{pF}$	

C.V.: Standard's calibration value at DC.

 $C.V.^{1}$ : C.V. multiplied by 1.0003

<sup>\*</sup> Option 001 only

## Store and Load **Function Test**

This test verifies the HP 4284A's ability to store information to, and load information from a memory card.

Memory Card HP PN 04278-89001 **Equipment:** 

Procedure:

- 1. Perform a SYSTEM RESET as described in "System Reset".
- 2. Insert a memory card into the MEMORY card slot.
- 3. Display the MEAS SETUP page.

Note



This test should be performed from the MEAS SETUP page.

- 4. Change the measurement function from Cp-D to Cp-G in the FUNC field.
- 5. Use the CURSOR arrow keys to move the cursor to the SYS MENU field.
- 6. Press the STORE softkey to store the HP 4284A's control settings to the memory card as data record-number 10.
- 7. Press the CLEAR SETUP softkey to clear the set up, and then confirm that FUNC is set to Cp-D.
- 8. Press the LOAD softkey to load data record-number 10 from the memory card.
- 9. Confirm that the measurement function is set to **Cp-G**.

## **HP-IB Interface Test**

This test verifies the HP 4284A'S HP-IB function.

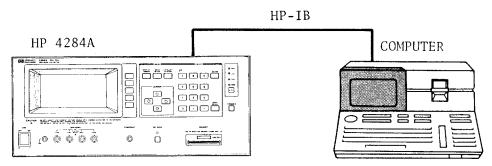


Figure 10-8. HP-IB Interface Test Setup

Personal Technical Computer HP 9000 Series 200 Model 226 **Equipment:** 

HP-IB Cable

HP 10833A

#### Procedure:

- 1. Set the HP 4284A's HP-IB address to 17.
- 2. Set up the equipment as shown in Figure 10-8. Use the computer's interface Select Code (7).
- 3. Load BASIC and input the following program, but do not RUN the program yet.
  - DIM A\$[38] 10
  - OUTPUT 717; "\*IDN?" 20
  - 30 ENTER 717; A\$
  - 40 PRINT AS
  - 50 OUTPUT 717; "\*SRE328"
  - OUTPUT 717; "ABC" 60
  - 70 PRINT SPOLL (717)
  - 80
- 4. Press the computer's STEP key three times to single step to line 20.
- 5. Confirm that the LTN and RMT lamps are ON and that the softkey label page cannot be changed by pressing the MENU keys.
- 6. Press the LCL key on the HP 4284A.
- 7. Confirm that the LTN lamp stays ON, the RMT lamp is OFF, and the softkey label page can be changed by pressing the MENU keys.
- 8. Press the computer's STEP key to execute line 30 and confirm that the **TLK** lamp is ON.
- 9. Step to line 40 and confirm that the following message is displayed on the computer.

"HEWLETT-PACKARD, 4284A, 0, REV01.01"

- 10. Step to line 60, and confirm that the  $\mathbf{SRQ}$ ,  $\mathbf{LTN}$ , and  $\mathbf{RMT}$ lamps are ON.
- 11. Step to line 80 and confirm that the status byte value displayed on the computer is greater than 95.

# **Bias Current Interface Function** Test (Option 002 only)

This test verifies the bias current interface functions.

**Equipment:** 

Bias Interface Simulator

HP PN 42841-65001

Bias Interface Cable

HP PN 42841-61640

DC Power Supply

HP 6214C

Procedure:

1. Set all switches of S1 and S2 on the bias interface simulator to '1' as shown in Figure 10-9.

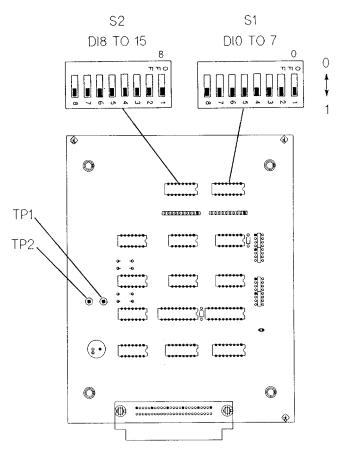


Figure 10-9. Bias Interface Simulator

2. Set DC power supply output voltage +5 V. Connect TP2(GND) on the bias interface simulator to '-' terminal of the power supply. Then connect TP1(Vcc) on the simulator to '+' terminal of the power supply. (refer to Figure 10-9 and Figure 10-10)

#### Note



DC power for the bias interface simulator can be supplied from the HP 4284A instead of from an external DC power supply. For further details, see "Supplying DC Power to the Simulator".

3. Interconnect the bias interface simulator and bias interface connector on the rear panel of the HP 4284A with the bias interface cable as shown in Figure 10-10.

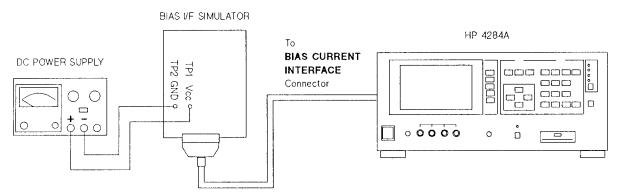


Figure 10-10. Bias Current Interface Function Test Setup

- 4. Turn the HP 4284A ON.
- 5. Press the (CATALOG/SYSTEM) MENU key.
- 6. Press the SELF TEST softkey to display the SELF TEST page.
- 7. Use the CURSOR arrow keys to move the cursor to the TEST MENU field.
- 8. Press the 7 and the ENTER keys to select the Bias Current I/F I/O test.

#### Note



Check the settings of S1 and S2 described in the step 1, if the HP 4284A's LCD displays "E74:Illegal test setup".

- 9. Confirm the /RESET LED on the bias interface simulator turns ON.
- 10. Confirm CS0 and CS1 LEDs on the simulator turn ON as the HP 4284A's output signal is displayed on the LCD. (Refer to Figure 10-11).
- 11. Confirm that ADRS1-ADRS6 LEDs on the simulator turn ON in laccordance with the hexadecimal number displayed on the LCD. One of the 6 LEDs turns ON in sequence as shown in Figure 10-11.
- 12. Confirm that DO0-DO7 LEDs on the simulator turn ON in accordance with the hexadecimal number displayed on the LCD. One of the 8 LEDs turns ON in sequence as shown in Figure 10-11.

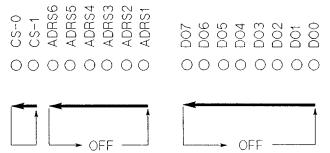


Figure 10-11. Bias Current Interface Function Test

- 13. Confirm that "DI0 TO 7" and "DI8 TO 15" on the LCD of the HP 4284A display hexadecimal number "FF".
- 14. Set switches S1 and S2 on the bias interface simulator to '0'. Then confirm that hexadecimal number "00" is displayed by "DI0 TO 7" and "DI8 TO 15".

Note



The states of S1(DI0 TO 7) and S2(DI1 TO 8) are displayed as a hexadecimal number on the HP 4284A's LCD.

15. Press the TEST END softkey.

## Caution



Do not execute any SELF TEST except for the Bias Current I/F I/O Test or the HP 4284A will become inoperative.

## Handler Interface **Function Test** (Option 201 only)

Perform this test only when troubleshooting the Option 201 Handler Interface Board.

This test verifies the handler interface functions.

Handler Simulator HP PN 04278-65001 **Equipment:** 

1. Disconnect the power cable from the HP 4284A and allow 1 Procedure: minute for the internal capacitors to discharge.

## Warning



Dangerous energy/voltage exists when the HP 4284A is in operation, and for a time after it is powered down. Allow 1 minutes for the internal capacitors to discharge.

- 2. Disconnect the two rear feet which lock the top cover and rear panel together.
- 3. Fully loosen the top cover retaining screws located on the rear of the top cover.
- 4. Slide the top cover toward rear and lift it off. The top shield plate will be visible.
- 5. Remove the top shield plate to expose the PC boards.
- 6. Disconnect a flat cable from the handler interface board which has an ORANGE and a BLACK, or an ORANGE and a RED extractors. See Figure 10-12.

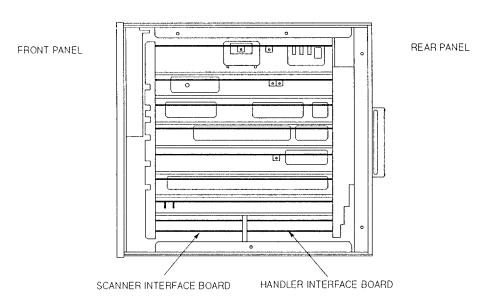


Figure 10-12. Interface Board Locations

7. Remove the handler interface board.

## Caution



The interface board contains electronic components that can be damaged by static electricity through electrostatic discharge (ESD). To prevent ESD damage, maintain frequent contact with any bare sheet metal surface on the chassis. A grounding wrist strap (or similar device) is useful for this purpose. Handle the board carefully at all times. Avoid touching electronic components or circuit paths.

#### Note



Before performing step 8, note the jumper settings in order to return them to the same settings at the end of this function test.

- 8. Set the jumpers on the handler interface board to the same settings as when the board is shipped from the factory. Configure the interface board according the color of the extractors, see step (1) for ORANGE and BLACK extractors and step (2) for ORANGE and RED extractors.
  - (1) ORANGE and BLACK (See Figure 10-13.)

OPEN (remove): W1, W2, W3, W5, W6, W8, W9, W10,

and R101 thru R121

SHORT: W4, W7, and W11

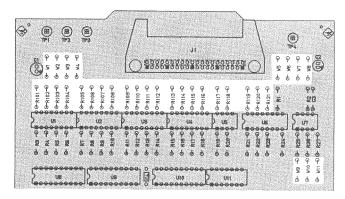


Figure 10-13. Jumper Settings

(2) ORANGE and RED (See Figure 10-14.)

SET: All Jumper Switches to position "N" OPEN (remove): R101 thru R121

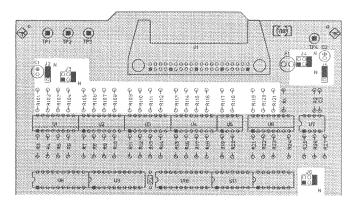


Figure 10-14. Jumper Settings

- 9. Replace the handler interface board, top shield plate, rear feet, and the top cover.
- 10. Turn the HP 4284A ON.
- 11. Connect the handler interface connector on the HP 4284A's rear panel to the handler simulator as shown in Figure 10-14.
- 12. Press the (CATALOG/SYSTEM) MENU key.
- 13. Press the SELF TEST softkey to display the SELF TEST page.

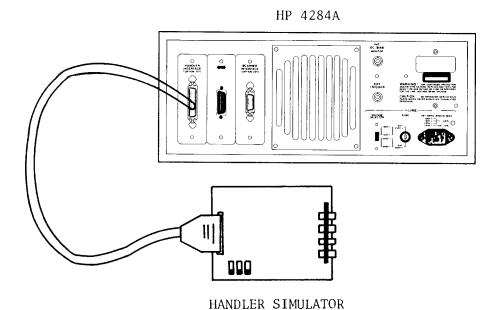


Figure 10-15. Handler Interface Function Test Set UP

- 14. Use the CURSOR arrow keys to move the cursor to the TEST MENU field.
- 15. Press the (4) and the (ENTER) keys to select the Handler I/F test.
- 16. Press the TEST START softkey.
- 17. Confirm that the LEDs on the handler simulator turn ON in accordance with the HP 4284A's output signals displayed on the LCD. The LEDs turns ON light in the sequence shown in Figure 10-15.

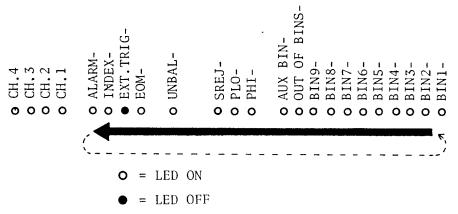


Figure 10-16. Handler Interface Function Check

18. Press the TEST END softkey.

## Caution



Do not execute any SELF TEST except for the Bias Current I/F I/O Test or the HP 4284A will become inoperative. The remaining SELF TEST are for serviceuse only.

19. Return the jumper settings on the handler interface board to their original settings.

## Handler Interface **Function Test** (Option 202 only)

Perform this test only when troubleshooting the Option 202 handler interface board.

This test verifies the Option 202 handler interface functions. When this test is performed the following LEDs WILL NOT turn ON because the signals they represent are not used by the Option 202 handler interface board.

### PHI-, PLO-, SREJ-, UNBAL- and ALARM-

## **Equipment:**

Handler Simulator HP PN 04278-65001 Cable HP PN 04278-61635

#### Procedure:

- 1. Perform steps 1 through 5 described "Procedure:".
- 2. Disconnect the flat cable from the handler interface board. The handler interface board has brown and an orange extractors and its location is shown in Figure 10-12.
- 3. Remove the handler interface board.

#### Caution



The interface board contains electronic components that can be damaged by static electricity through electrostatic discharge (ESD). To prevent ESD damage, maintain frequent contact with any bare sheet metal surface on the chassis. A grounding wrist strap (or similar device) is useful for this purpose. Handle the board carefully at all times. Avoid touching electronic components or circuit paths.

### Note



Before performing step 4, note the jumper settings in order to return them to the same setting at the end of this function test.

4. Set the jumpers on the handler interface board the same settings as when the board is shipped from the factory referring to Figure 10-16.

 $\begin{array}{lll} \text{OPEN} & \text{W1, W4, W5, W7, W8, W11, W12} \\ \text{SHORT} & \text{W2, W3, W6, W9, W10, W13} \\ \text{OPEN (remove)} & \text{R101 thru R113} \end{array}$ 

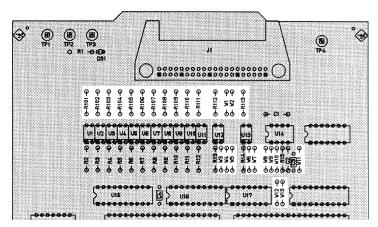
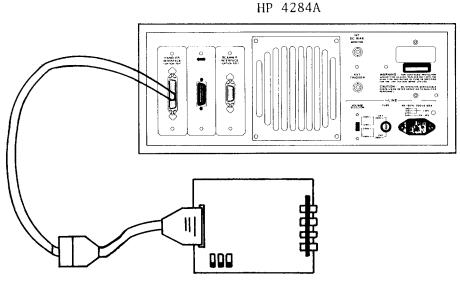


Figure 10-17. Jumper Settings

- 5. Replace the handler interface board, top shield board, rear feet, and the top cover.
- 6. Turn the HP 4284A ON.
- 7. Connect the handler interface connector on the HP 4284A's rear panel with the handler simulator as shown in Figure 10-17.



HANDLER SIMULATOR

Figure 10-18. Handler Interface Function Test Set up

- 8. Press the CATALOG/SYSTEM MENU key.
- 9. Press the SELF TEST softkey to display the SELF TEST page.

- 10. Move the cursor to the **TEST MENU** field.
- 11. Press the 4 and ENTER keys to select the Handler I/F test.
- 12. Press the TEST START softkey.
- 13. Confirm that the LEDs on the handler simulator board turn ON in accordance with the HP 4284A's output signals displayed on the LCD. The LEDs should turn ON in the sequence shown in Figure 10-18.

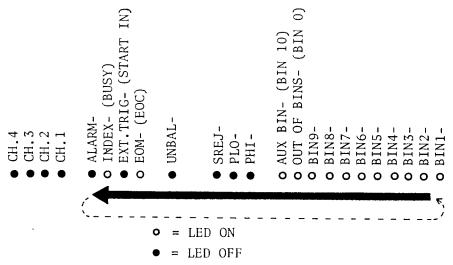


Figure 10-19. Handler Interface Function Check

14. Press the TEST END softkey.

## Caution



Do not execute any SELF TEST except for the Bias Current I/F I/O Test or the HP 4284A will become inoperative. The remaining SELF TEST are for serviceuse only.

15. Return the jumper settings on the handler interface board to the original settings.

# Scanner Interface **Function Test** (Option 301 only)

Perform this test only when troubleshooting the Option 301 scanner interface board.

This test verifies the scanner interface function.

**Equipment:** 

Scanner Simulator DC Power Supply

HP PN 04278-65301

Test Leads

Procedure:

1. Perform steps 1 through 5 described "Procedure:".

HP 6414C

2. Disconnect the flat cable from the scanner interface board. The scanner interface board has black and yellow extractors and its location is shown in Figure 10-12.

3. Remove the scanner interface board.

### Caution



The interface board contains electronic components that can be damaged by static electricity through electrostatic discharge (ESD). To prevent ESD damage, maintain frequent contact with any bare sheet metal surface on the chassis. A grounding wrist strap (or similar device) is useful for this purpose. Handle the board carefully at all times. Avoid touching electronic components or circuit paths.

4. Set SW1 and SW2 on the scanner interface board to the same settings as when the board is shipped from the factory referring to Figure 10-19.

#### Note



Before performing step 4, note the switch settings in order to return to the same settings at the end of this function test.

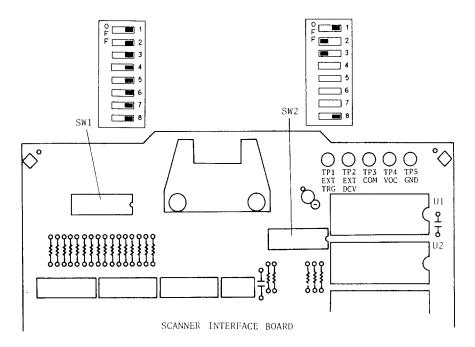


Figure 10-20. SW1 and SW2 settings

- 5. Replace the scanner interface board and reconnect the flat cable.
- 6. Set DC power supply output voltage +5 V. Connect TP2(GND) on the bias interface simulator to '-' terminal of the power supply. Then connect TP1 (Vcc) on the simulator to '+' terminal of the power supply. (refer to Figure 10-20)

Note



DC power for the bias interface simulator can be supplied from the HP 4284A instead of an external DC power supply. For further details, see "Supplying DC Power to the Simulator".

7. Connect the scanner simulator to the scanner interface connector on the HP 4284A's rear panel as shown in Figure 10-20.

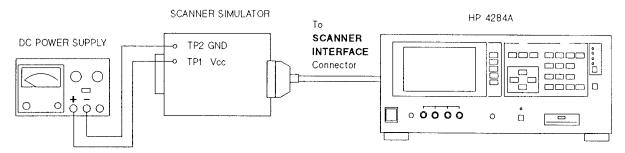


Figure 10-21. Scanner Simulator Connections

8. Replace the top shield plate, rear feet, and top cover. Turn the HP 4284A ON.

- 9. Press the (CATALOG/SYSTEM) MENU key.
- 10. Press the SELF TEST softkey to display the SELF TEST page.
- 11. Use the CURSOR arrow keys to move the cursor to the TEST MENU field.
- 12. Press the 6 and ENTER keys to select the Scanner I/F I/O test.
- 13. Press the TEST START softkey.
- 14. Confirm that LEDs on the scanner simulator board turn ON in accordance with the HP 4284A settings displayed in the LCD.
- 15. Press the TEST END softkey.

#### Caution



Do not execute any SELF TEST except for the Bias Current I/F I/O Test or the HP 4284A will become inoperative. The remaining SELF TEST are for serviceuse only.

- 16. Remove the top cover, top shield plate and expose the scanner interface board. Set SW1 and SW2 on the scanner interface board to their settings before this test.
- 17. Replace the top shield plate, rear feet, and top cover.

# **Supplying DC Power** to the Simulator

This paragraph shows the procedure supplying +5 V DC to the Bias Interface Simulator or the Scanner Simulator from the HP 4284A interior.

#### Procedure:

1. Disconnect the power cable from the HP 4284A and allow 1 minutes for the internal capacitors to discharge.

#### Warning



Dangerous energy/voltage exists when the HP 4284A is in operation, and for a time after it is powered down. Allow 1 minutes for the internal capacitors to discharge.

- 2. Disconnect the two rear feet which lock the top cover and rear panel together.
- 3. Fully loosen the top cover retaining screws located on the rear of the top cover.
- 4. Slide the top cover towards the rear and lift it off. The top shield plate will be visible.

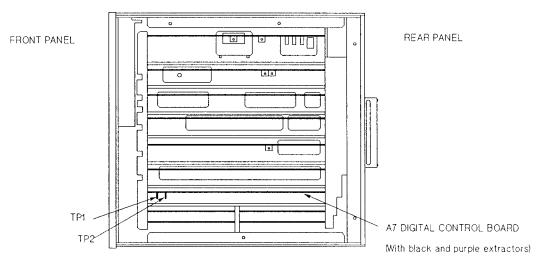


Figure 10-22. A7 Board Location

5. Connect TP2 (GND) on the A7 digital control board to the TP2 (GND) on the simulator board. Then connect TP1 on the A7 board to TP1 (5 V or Vcc) on the simulator board. Figure 10-21 shows the location of TP1 and TP2 on the A7 board.

Perforn Record	mance Te	st							
	Hewlett-Packa	ırd HP 428	34A		Т	ested by			
]	Presision LCR	R Meter			D	ate			
					Se	erial No			
Test S	Signal Freq Accurac FRE			1 kHz	8 kHz	20 kHz	80 kHz	400 kHz	1 MHz
	RESULT	PASS FAIL		[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Lev	Test : vel/Level-M Accurac		(Signal PASS [	] //onitor Rea	r: 1.25 k FAl	:Hz, Hi-PW: • :L [ ] :Hz, Hi-PW: •	·		
OSC LEVEL	MULTIM I READI			INIMUM M.R.–0.5 n	$\mathbf{nV})$	ACTUA	L	MAXIM (1.03×M.R	
5 mV 10 mV									
$20~\mathrm{mV}$									
50 mV									
100  mV $200  mV$									
250 mV									
$500~\mathrm{mV}$					_				
1 V									

M.R. is the Multimeter Reading for the HP 4284A's test signal level.

## Multimeter Reading (Signal Frequency: 960 kHz, Hi PW: OFF)

		PASS [ ]	FAIL [ ]	
OSC LEVEL	MULTIMETER READING	$\begin{array}{c} \textbf{MINIMUM} \\ (0.97\!\times\!\textbf{M.R.}\!-\!0.5~\textbf{mV}) \end{array}$	ACTUAL	$\begin{array}{c} \textbf{MAXIMUM} \\ (1.03 \times \textbf{M.R.} + 0.5 \ \textbf{mV}) \end{array}$
$5~\mathrm{mV}$				
$10~\mathrm{mV}$				·
$20~\mathrm{mV}$				
50  mV				
100  mV				
200  mV				·
250 mV				
500 mV				
1 V 2 V				
2 V				
		Multimeter Reading (Signal Frequency: 1. Option 001 ONLY PASS [ ]	.25 kHz, Hi PW: ON) FAIL [ ]	
		Level Monitor Readin (Signal Frequency: 1. Option 001 ONLY	g	
OSC LEVEL	MULTIMETER READING	$\begin{array}{c} {\rm MINIMUM} \\ (0.97\!\times\!{\rm M.R.}\!-\!0.5{\rm mV}) \end{array}$	ACTUAL	$\begin{array}{c} \textbf{MAXIMUM} \\ \textbf{(1.03} \times \textbf{M.R.} + \textbf{0.5 mV)} \end{array}$
10 mV		$(0.97 \times M.R0.5 \text{ mV})$	)	$(1.03 \times M.R. + 0.5 \text{ mV})$
		$(0.97 \times M.R0.5 \text{ mV})$		$(1.03 \times M .R. + 0.5 mV)$
1 V		$(0.97 \times M.R5 \text{ mV})$		$(1.03 \times M.R. + 5 mV)$
2.5 V		$(0.97 \times M.R5 \text{ mV})$		$(1.03 \times M. R. + 5 mV)$
20 V				

**Multimeter Reading** (Signal Frequency: 960 kHz, Hi PW: ON) Option 001 ONLY

PASS [ ] FAIL [ ]

#### **Level Monitor Reading** (Signal Frequency: 960 kHz, Hi-PW: ON) Option 001 ONLY

OSC LEVEL	MULTIMETER READING	$_{(0.97\times\mathrm{M.R.}-0.5~\mathrm{mV})}^{\mathrm{MINIMUM}}$	ACTUAL	$\begin{array}{c} \text{MAXIMUM} \\ (1.03{\times}\text{M.R.}{+}0.5 \text{ mV}) \end{array}$
10 17		$(0.97 \times M.R0.5 \text{ mV})$		$(1.03 \times M.R. + 0.5 \text{ mV})$
10 mV		$(0.97 \times M.R0.5 \text{ mV})$		$(1.03 \times M.R. + 0.5 \text{ mV})$
1 V		$(0.97 \times M.R5 \text{ mV})$		${(1.03\times M.R.+5 \text{ mV})}$
2.5 V 20 V		$(0.97 \times M.R5 \text{ mV})$		${(1.03\times\mathrm{M.R.}+5\ \mathrm{mV})}$
∠∪ V		<del></del>		

# DC Bias Voltage Accuracy Test

# Hi-PW OFF

PASS [ ] FAIL [ ]

## Hi-PW ON (Option 001 only)

BIAS VOLTAGE	MINIMUM	ACTUAL	MAXIMUM
0 V	-0.0010  V		0.0010 V
0.1 V	0.0989  V		0.1011 V
2 V	1.9970  V		2.0030 V
6 V	5.9920  V		6.0080 V
14 V	13.981  V		14.019 V
30 V	29.960  V		30.040 V
40 V	39.950  V		40.050 V
-0.1  V	-0.1011  V		0.0989 V
-2  V	-2.0030  V		1.9970 V
-6 V	-6.0080  V		5.9920 V
-14  V	-14.012  V		13.988 V
-30  V	-30.040  V		29.960 V
-40  V	-30.040  V		29.960 V
-40  V	-40.050  V		39.950 V

# Impedance **Measurement Accuracy**

10 pF Standard

Test C.V.: \_\_\_\_\_(Cal. Value at 1 kHz)

OSC Level: 510 mV

SIGNAL FREQUENCY	-	MINIMUM	ACTUAL	MAXIMUM
$12.5~\mathrm{kHz}$	Ср	C.V0.0318 pF		C.V. +0.0318 pF
	D	-0.0031		0.0031
$48~\mathrm{kHz}$	Cp	C.V0.0246 pF		$\mathrm{C.V.} + 0.0246~\mathrm{pF}$
	D	-0.0028		0.0028
$96~\mathrm{kHz}$	Ср	C.V0.0275 pF		$\mathrm{C.V.} + 0.0275~\mathrm{pF}$
	D	-0.0035		0.0035
$1~\mathrm{MHz}$	Ср	C.V0.0249 pF		$\mathrm{C.V.} + 0.0249~\mathrm{pF}$
	D	-0.0038		0.0038

OSC Level: 20 mV

PASS [ ] FAIL [ ]

## OSC Level: 5.1 V (Option 001 only)

PASS [ ] FAIL [ ]

100 pF Standard

C.V.: \_\_\_\_\_(Cal. Value at 1 kHz)

OSC Level: 510 mV

SIGNAL FREQUENCY	T	MINIMUM	ACTUAL	MAXIMUM
$125~\mathrm{Hz}$	Ср	C.V1.7595 pF		C.V. +1.759 pF
	D	-0.01739		0.01739
$1~\mathrm{kHz}$	Ср	C.V0.312 pF		C.V. +0.312 pF
	D	-0.00293		0.00293
$12.5~\mathrm{kHz}$	Ср	C.V0.137 pF		C.V. +0.137 pF
	D	-0.00130		0.00130
$48~\mathrm{kHz}$	Ср	C.V0.162 pF		C.V. +0.162 pF
	D	-0.0190		0.0190
96 kHz	Ср	C.V0.122 pF		C.V. +0.122 pF
	D	-0.00116	-	0.00116
$1~\mathrm{MHz}$	Ср	C.V0.102 pF		C.V. +0.102 pF
	D	-0.00082		0.00082

OSC Level: 20 mV

PASS [ ] FAIL [ ]

OSC Level: 5.1 V (Option 001 only)

PASS [ ] FAIL [ ]

#### OSC Level: 510 mV

SIGNAL FREQUENCY	7.	MINIMUM	ACTUAL	MAXIMUM
20 Hz	Ср	C.V32.09 pF		C.V. +32.09 pF
	D	-0.00319		0.00319
$125~\mathrm{Hz}$	Ср	C.V3.05 pF		C.V. +3.05 pF
	D	-0.00286		0.00286
$1~\mathrm{kHz}$	Ср	C.V1.00 pF		C.V. +1.00 pF
	D	-0.00081		0.00081
$12.5~\mathrm{kHz}$	Ср	C.V1.13 pF		C.V. +1.13 pF
	D	-0.00095		0.00095
$48~\mathrm{kHz}$	Ср	C.V1.16 pF		C.V. +1.16 pF
	D	-0.00103		0.00103
96 kHz	Ср	C.V1.31 pF		C.V. +1.31 pF
	D	-0.00111		0.00111
$1~\mathrm{MHz}$	Ср	$C.V.^{1} - 1.53 pF$		$C.V.^{1} + 1.53 pF$
	D	-0.00083		0.00083

 $C.V.^{1}: 1.0003 \times C.V.$ 

OSC Level: 20 mV

PASS [ ] FAIL [ ]

OSC Level: 5.1 V (Option 001 only)

PASS [ ] FAIL [ ]

```
0.01 \muF Standard C.V.: _____ (Cal. Value at 1 kHz)
                   OSC Level: 510 mV
               SIGNAL
                                                 ACTUAL
                              MINIMUM
                                                                  MAXIMUM
             FREQUENCY
                  20 Hz Cp C.V.^1 \times 0.0573 \text{ nF} _____ C.V.^1 + 0.0573 \text{ nF}
                        Cp C.V.^2 \times 0.0125 \text{ nF} _____ C.V. +0.0125 \text{ nF}
                 125~\mathrm{Hz}
                  1 kHz Cp C.V.×0.0082 nF _____ C.V. +0.0082 nF
                     C.V.^{1}: 1.0005 \times C.V
                     C.V.^2: 1.0002×C.V.
                    OSC Level: 20 mV
                   PASS [ ]
                                      FAIL [ ]
                   OSC Level: 5.1 V (Option 001 only)
                   PASS [ ]
                                     FAIL [ ]
                   C.V.: _____(Cal.Value at1 kHz)
 0.1 \muF Standard
                   OSC Level:510 mV
                 SIGNAL
                                MINIMUM ACTUAL MAXIMUM
              FREQUENCY
                   20 Hz Cp \text{C.V.}^1 - 0.310 \text{ nF} _____ \text{C.V.}^1 + 0.310 \text{ nF}
                  125 Hz Cp C.V.<sup>2</sup> -0.112 nF _____ C.V. +0.112 nF
                   1 kHz Cp C.V. -0.081 \text{ nF} _____ C.V. +0.081 \text{ nF}
                     C.V.^{1}: 1.0005 \times C.V
                     C.V.^2: 1.0002×C.V.
                   OSC Level: 20 mV
                   PASS [ ]
                                      FAIL [
                    OSC Level: 5.1 V (Option 001 only)
                   PASS [ ]
                                      FAIL [ ]
```

1 $\mu$ F Standa	rd C.V.:	(Cal	.Value at 1 kHz)	
	OSC Level	:510 mV		
	SIGNAL FREQUENCY	MINIMUM	ACTUAL	MAXIMUM
	20 Hz Cp	$C.V.^{1}$ $-2.83 \text{ nF}$		$C.V.^{1} + 2.83 \text{ nF}$
	$125~\mathrm{Hz}$ Cp	$\mathrm{C.V.^2}$ $-1.11~\mathrm{nF}$		_ C.V. +1.11 nF
	1 kHz Cp	C.V. $-0.081 \text{ nF}$		_ C.V. +0.081 nF
		1.0005×C.V 1.0002×C.V.		
	OSC Level	: 20 mV		
	PASS [ ]	FAIL [	]	
	OSC Level	: 5.1 V (Option 001	only)	
	PASS [ ]	FAIL [	]	
100 $\Omega$ Standa	rd C.V.:	(Cal	.Value at 1 DC)	
	OSC Level	:510 mV		
	SIGNAL FREQUENCY	MINIMUM	ACTUAL	MAXIMUM
	20 Hz R	C.V. $-0.285 \Omega$		_ C.V. $+0.285 \Omega$
	$125~\mathrm{Hz}~\mathrm{R}$	C.V. $-0.112 \Omega$		_ C.V. $+0.112 \Omega$
	$1~\mathrm{kHz}$ R	C.V. $-0.082 \Omega$		_ C.V. $+0.082 \Omega$
	$12.5~\mathrm{kHz}$ R	C.V. $-0.132 \Omega$		_ C.V. $+0.132 \Omega$
	48 kHz R	C.V. $-0.132 \Omega$		_ C.V. $+0.132 \Omega$
	96 kHz R	C.V. $-0.132~\Omega$		_ C.V. $+0.132 \Omega$
	$1~\mathrm{MHz}$ R	C.V. $-0.154 \Omega$		_ C.V. $+0.154$ Ω
	OSC Level	: 20 mV		
	PASS [ ]	FAIL [	]	
	OSC Level	: 5.1 V (Option 001	only)	
	PASS [ ]	FAIL [	]	

1k  $\Omega$  Standard C.V.: \_\_\_\_\_(Cal.Value at 1 kHz)

#### OSC Level:510 mV

SIGNAL FREQUENC	$\mathbf{Y}$	MINIMUM	ACTUAL	MAXIMUM
$20~\mathrm{Hz}$	R	C.V. $-2.81~\Omega$		C.V. $+2.81 \Omega$
$125~\mathrm{Hz}$	$\mathbf{R}$	C.V. $-1.11~\Omega$		C.V. $+1.11~\Omega$
$1~\mathrm{kHz}$	R	C.V. $-0.81~\Omega$		C.V. $+0.81~\Omega$
$12.5~\mathrm{kHz}$	R	C.V. $-1.31~\Omega$		C.V. $+1.31~\Omega$
$48~\mathrm{kHz}$	R	C.V. $-1.31~\Omega$		C.V. $+1.31~\Omega$
96 kHz	R	C.V. $-1.31~\Omega$		C.V. $+1.31~\Omega$
$1~\mathrm{MHz}$	$\mathbf{R}$	C.V. $-1.02~\Omega$		C.V. $+1.02~\Omega$

#### OSC Level: 20 mV

	PASS [ ]	FAIL [ ]
1 m Cable Length Operation	PASS [ ]	FAIL [ ]
2 m Cable Length Operation (Option 006 only)	PASS [ ]	FAIL [ ]
4 m Cable Length Operation (Option 006 only)	PASS [ ]	FAIL [ ]
Store and Load Function Test	PASS [ ]	FAIL [ ]
HP-IB Interface Test	PASS [ ]	FAIL [ ]
Bias Current Interface Function Test (Option 002 only)	PASS [ ]	FAIL [ ]

# **Manual Changes**

#### Introduction

This appendix contains the information required to adapt this manual to earlier versions or configurations of the HP 4284A than the current printing date of this manual. The information in this manual applies directly to HP 4284A Precision LCR Meter whose serial number prefix is listed on the title page of this manual.

# **Manual Changes**

To adapt this manual to your HP 4284A, refer to Table A-1 and Table A-2, and make all of the manual changes listed opposite your instrument's serial number and ROM-based firmware's version.

Instruments manufactured after the printing of this manual may be different than those documented in this manual. Later instrument versions will be documented in a manual changes supplement that will accompany the manual shipped with that instrument. If your instrument serial number is not listed on the title page of this manual or in Table A-1, it may be documented in a yellow MANUAL CHANGES supplement.

Refer to the description of the \*IDN? query in "\*IDN?" in Chapter 8 for confirmation of the ROM-based firmware's version. For additional information on serial number coverage, refer to "Serial Number" in Chapter 9.

Table A-1. Manual Changes by Serial Number

Serial Prefix or Number	Make Manual Changes
$2940\mathrm{J}02282$ and below	1
2940J02284	1
2940J08389 and below	2

Table A-2. Manual Changes by Firmware's Version

Version	Make Manual Changes
1.11 and below	1

# **CHANGE1**

HP 4284A Operation Manual :Page 5-2, Figure 5-1. CATALOG Page Add the following description.

#### Caution



Memory card for HP 4285A is compatible to HP 4284A. However, HP 4284A ignores the HP 4285A's data record status and displays Memory Status 0 (Which means "NO record"). To prevent overriding the HP 4285A's data, check the card's Memory Status using HP 4285A before storing the HP 4284A's data.

## **CHANGE2**

HP 4284A Operation Manual :Page 1-2, Table 1-1. HP 4284A Contents

Change the following table.

Table 1-1. HP 4284A Contents

Description	Qty.	HP Part Number
HP 4284A		
Power cable <sup>1</sup>	1	_
Memory Card	1	04278-89001
Operation Manual	1	04284-90020
Option 201 Fuse		
Fuse	2	2110-0046
Option 907 Handle Kit		
Handle kit	1	5061-9690
Option 908 Rack Flange Kit		
Rack Flange Kit	1	5061-9678
Option 909 Rack Flange & Handle Kit		
Rack Flange & Handle Kit	1	5061-9684

<sup>1</sup> Power Cable depends on where the instrument is used, see "Power Cable" in Chapter 1.

# **Error and Warning Messages**

#### Introduction

This appendix lists the HP 4284A's error and warning messages with brief descriptions and solutions, and lists the sysstem messages in alphabetical order.

### **Error Messages**

The HP 4284A displays error messages on the System Message Line when a measurement error occurs or when an illegal operation is attempted. There are two categories of errors as follows.

#### **Operation Errors**

These errors occur while attempting an improper operation. If one of these errors occur, the HP 4284A displays the error number and a message on its system message line. There are two kinds of errors in this category.

- Device-Specific Error (error numbers 1 to 32767, -300 to -399) These errors will set the Device-Specific Error bit (bit 3) in the Event Status Register.
- Execution Error (error numbers -200 to -299) These errors will set the Execution Error bit (bit 4) in the Event Status Register.

#### **HP-IB Errors**

These errors occur when the HP 4284A received an improper command via HP-IB. If one of these errors occur, the HP 4284A displays the warning message, HP-IB error occurred on the system message line, check the command syntax. There are two kinds of errors in this category.

- Command Error (error numbers -100 to -199) These errors will set the Command Error bit (bit 5) in the Event Status Register.
- Query Error (error numbers -400 to -499) These errors will set the Query Error bit (bit 2) in the Event Status Register.

#### Sample Program to **Detect the Error**

When you write an HP-IB control program for the HP 4284A, the following sample program is a useful debugging tool (using the HP 4284A status bytes and the SYST: ERRor? query) for detecting the errors.

```
100
       OUTPUT 717;"*ESE 60"
                                    ! Event Status Resister enable
110
                                    ! (error bits enable)
120
       OUTPUT 717;"*SRE 32"
                                    ! Status Byte Resister enable
130
                                    ! (Event Status Summary bit enable)
140
       ON INTR 7,2 CALL Errors
150
       ENABLE INTR 7;2
500
       SUB Errors
510
         DIM Err$[50]
520
         Sp=SPOLL(717)
530
         IF BIT(Sp,5) THEN
540
           OUTPUT 717;"*ESR?"
                                    ! Clear the Event Status Resister
550
           ENTER 717; Esr
560
           PRINT "Event Status Resister ="; Esr
570
580
             OUTPUT 717; "SYST: ERR?"! Error No. & message query
590
             ENTER 717; Err$
             EXIT IF VAL(Err$)=0  ! Exit if no error
600
             PRINT Err$
610
620
           END LOOP
630
         END IF
         ENABLE INTR 7;2
640
650
       SUBEND
```

The following is a list of the HP 4284A's error numbers and messages.

# **Operation Errors**

Error	Displayed Message	• Description		
No.		ightarrow Solution		
Devic	e-Specific Error			
10	Exceeded AC+DC limit	• AC+DC level exceeds 42V or 110mA peak.		
		ightarrow Reduce the LEVEL or BIAS setting.		
11	ALC disabled	• LEVEL setting is out of the ALC's available level range.		
		$\rightarrow$ Change LEVEL to be within the ALC's available level range.		
12	power AMP opt not installed	• Illegal operation, Hi-PW mode set to ON when Option 001 is not installed.		
		→ Install Option 001.		
13	Can't change Hi-PW mode	• Illegal operation, Hi-PW mode set to ON when the DC BIAS is set to ON.		
		→ Set BIAS to OFF(DC BIAS indicator is not ON)first, then set the Hi-PW mode to ON.		
		• Illegal operation, Hi-PW mode set to OFF when the LEVEL is more than 2V/20mA, or the BIAS is more than 2V.		
		$\rightarrow$ Reduce the LEVEL or BIAS, or set the Hi-PW mode to ON.		
		• Illegal operation, Hi-PW mode set to ON when the HP 42841A is connected.		
		→ Disconnect the HP 42841A.		
14	V bias disabled	• Illegal operation, set to DC voltage bias when the HP 4284A, HP 42841A, and HP 42842A/B are interconnected.		
		→ Disconnect the HP 42842A/B from the HP 42841A, or change BIAS to a current value.		
15	I bias not available	• Illegal operation, set to DC current bias when the HP 4284A is in the standard configuration.		
		→ Set BIAS to a voltage value.		
16	Measurement aborted	REF data Measurement aborted.		
		→ Re-measure.		

Error	Displayed Message	Description		
No.		→ Solution		
17	Can't change DCI Isolasion	• Illegal operation, DCI set to ISO ON when the Hi-PW is OFF.		
		$\rightarrow$ Set DCI to ISO OFF.		
		• Illegal operation, DCI setting changed when the DC BIAS is set to ON.		
		$\rightarrow$ Set DC BIAS OFF.		
20	DC bias unit powered down	• Illegal operation, set to DC current bias when an inoperative HP 42841A is connected to the HP 4284A.		
		$\rightarrow$ Turn the HP 42841A on.		
21	Fixture circuit defective	• Back-emf protection circuit of the HP 42842A/B is defective.		
		ightarrow Contact your nearest Hewlett-Packard office.		
22	Fixture over temperature	• Temperature of the HP 42842A/B bias current test fixture exceeded its limit.		
		$\rightarrow$ Turn the DC BIAS off to let the HP 42842A/B cool down.		
23	Fixture OPEN det. defective	• Fixture cover open detection wire is open.		
		ightarrow Contact your nearest Hewlett-Packard office.		
24	Fixture cover open	• The cover of the HP 42842A/B is open.		
		$\rightarrow$ Close the cover of the HP 42842A/B.		
25	DC bias I source overload	• The DC bias source current is overloaded.		
		→ If this message is displayed all the time when measuring a DUT which conforms to specifications, contact your nearest Hewlett-Packard office.		
26	DC bias I sink overload	• The DC bias sink current is overloaded.		
		→ If this message is displayed all the time when measuring a DUT which conforms to specifications, contact your nearest Hewlett-Packard office.		
40	Scanner I/F disabled	• Illegal operation, MULTI channel correction mode set or CORRection: USE command is sent via HP-IB when the SCANNER I/F is not installed or to OFF.		
		$\rightarrow$ Install the SCANNER I/F and set it to ON.		

Error	Displayed Message	• Description		
No.		→ Solution		
41 Measurement aborted		• Correction data measurement aborted.		
		ightarrow Re-measure.		
42	$2\mathrm{m}/4\mathrm{m}$ opt. not installed	• Illigal operation, 2m/4m CABLE length set when Option 006 is not installed.		
		→ Install Option 006, or set 0m CABLE length and use the OPEN/SHORT/LOAD correction function.		
43	Measurement failed	• Measurement error(for example, bridge unbalance) occurred during the correction data measurement.		
		→ Confirm measurement condition and measurement contacts, then re-measure.		
44	Correction data protected	• Correction data write protected by DIP switch A7SW3. (Refer to Appendix E)		
		$\rightarrow$ Set bit 6 of DIP switch A7SW3 to the OFF position, and retry.		
45	Valid in single mode only	• Illegal operation, OPEN/SHORT correction data (for 48 frequency points) measured when the MULTI channel correction mode is set.		
		→ Set to SINGLE mode first, or perform OPEN/SHORT data measurements at FREQ1–3.		
46	Correction memory error	Correction data write error.		
		ightarrow Contact your nearest Hewlett-Packard office.		
50	Clear the table first	• Illegal operation, MODE of the LIMIT TABLE changed when the table exists.		
		$\rightarrow$ Clear the table first.		
51	Inconsistent limit setting	• Illegal operation, COMParator: SEQuence command sent when the TOLerance mode is set, or the COMParator: TOLerance command was sent when the SEQuence mode is set.		
		ightarrow Set TOLerance or SEQuence mode appropriately.		
60	No values in sweep list	• Illegal operation, LIST SWEEP measurement performed when no sweep point settings exist in the LIST SWEEP SETUP.		
		→ Set sweep points in the LIST SWEEP SETUP first.		

Error	Displayed Message	• Description		
No.		→ Solution		
61	Clear the table first	• Illegal operation, the sweep parameter of the LIST SWEEP SETUP is changed when the sweep list for other parameter exists.		
		→ Clear the existing list first.		
62	Bias off, Turn bias on	• Illegal operation, DC bias sweep was attempted while the DC BIAS is OFF.		
		$\rightarrow$ Press $\bigcirc$ DC BIAS to set DC bias to on.		
70	Handler I/F not installed	• Illegal operation, HANDLER I/F set to ON when Option 201 or 202 was not installed.		
		$\rightarrow$ Install Option 201 or 202.		
		• Illegal operation, HANDLER I/F test was performed when Option 201 or 202 were not installed.		
		$\rightarrow$ Install Option 201 or 202.		
71	Scanner I/F not installed	• Illegal operation, SCANNER I/F set to ON when Option 301 was not installed.		
		<ul> <li>→ Install Option 301.</li> <li>Illegal operation, Scanner I/F EEPROM R/W test or Scanner I/F I/O test were performed when Option 301 was not installed.</li> </ul>		
		→ Install Option 301.		
72	HP-IB I/F not installed	• Illegal operation, HP-IB interface used when Option 109 was installed.		
		$\rightarrow$ Install the HP-IB interface.		
73	I BIAS I/F not installed	• Illegal operation, BIAS Current I/F I/O test performed when Option 002 is not installed.		
		ightarrow Install the Option 002 Bias Current interface.		
74	Illegal test setup	• Illegal operation, ACCESSORY CONTROL I/F test performed when the HP 4284A and the HP 42841A are connected with the accessory control interface cable.		
		ightarrow Disconnect the interface cable from the HP 42841A.		
80	Setup data protected	• Setup data write protected by DIP switch A7SW3. (Refer to Appendix E.)		
		$\rightarrow$ Set bit 5 of DIP switch A7SW3 to the OFF position.		

Error	Displayed Message	• Description		
No.		→ Solution		
81	No memory card	• Illegal operation, attempted to store data in record No. 10 to 19 when a memory card was not inserted.		
		→ Insert a memory card, or store to record No.0 to 9 (internal memory)		
82	Store failed	• Memory card hardware failure (storing function) occurred.		
		ightarrow Use another memory card.		
		• Internal EEPROM hardware failure (storing function) occurred.		
		ightarrow Contact your nearest Hewlett-Packard office.		
83	No data to load	Memory card is not inserted.		
		ightarrow Insert the memory card completely.		
		• No setup data to load in the record number entered.		
		$\rightarrow$ Confirm the CATALOG, and retry.		
84	Load failed	• Memory card hardware failure (loading function) occurred.		
		ightarrow Use another memory card.		
		• Internal EEPROM hardware failure (loading function) occurred.		
		ightarrow Contact your nearest Hewlett-Packard office.		
90	Data buffer overflow	• The amount of data to be stored into the data buffer memory (DBUF) exceeded the defined data buffer size.		
		ightarrow Re-define the data buffer memory size, or clear DBUF.		
100	Printer down	• Data sent to the output buffer when a printer was not connected to the HP 4284A with an HP-IB cable or the printer was turned OFF.		
		→ Connect a printer to the HP 4284A with an HP-IB cable, or turn the printer ON.		
		• Printing speed of printer cannot keep up with the HP 4284A's data output transfer rate.		
		→ Set the HP 4284A's DELAY time appropriately or replace the printer with a higher speed printer that can match the HP 4284A's data transfer rate.		
101	TALK ONLY disabled	• Data sent to the output buffer when the HP 4284A is addressable.		
		→ Set the HP 4284A to the talk only mode, and set the printer to the listen only mode.		

Error	Displayed Message	• Description		
No.		→ Solution		
-310	System error	• Severe error.		
		→ Contact your nearest Hewlett-Packard office.		
-311	Memory error	• Severe error.		
		ightarrow Contact your nearest Hewlett-Packard office.		
Execu	ntion Error			
-211	Trigger ignored	• The HP 4284A Triggered before the previous trigger was executed.		
		→ Widen the time interval between triggers.		
-222	Data out of range	Data is out of the setting range.		
		→ Enter a value within the available setting range.		
-230	Data corrupt or stale	• FETCh? query received after the ABORt or the *RST command was received, or after the power on reset was performed.		
		→ Send the FETCh? query during idle state and when the data is valid (after a measurement is performed).		
		• FETCh? query received after INITiate command was received, and a trigger was not received.		
		→ Send the FETCh? command after the trigger is received.		
		• FETCh? query received after the trigger was received in the list sweep mode and the table was not setup.		
		→ Setup the list sweep table.		
		• Setting value query (for example, VOLTage?, BIAS:CURRent?, LIST:VOLTage?) received when the setting mode is mismatched.		
		→ Send a setting value query command which matches the current setting mode.		

#### **HP-IB Errors**

Error No.	Error Message String	• Description			
Comn	Command Error				
-100	Command error	• Improper command.			
-101	Invalid character	• Invalid character was received.			
-102	Syntax error	• Unrecognized command or data type was received.			
-103	Invalid message unit separator	• The message unit separator (for example, ";", ",") is improper.			
-104	Data type error	• Improper data type used (for example, string data was expected, but numeric data was received).			
-105	GET not allowed	• GET is not allowed inside a program message.			
-108	Parameter not allowed	• Too many parameters for the command received.			
-109	Missing parameter	• A command with improper number of parameters received.			
-112	Program mnemonic too long	• Program mnemonic is too long (maximum length is 12 characters).			
-113	Undefined header	• Undefined header or an unrecognized command was received (operation not allowed).			
-121	Invalid character in number	• Invalid character in numeric data.			
-123	Numeric overflow	• Numeric data value was too large (exponent magnitude $>32\mathrm{k}$ ).			
-124	Too many digits	• Numeric data length was too long (more than 255 digits received).			
-128	Numeric data not allowed	• Numeric data not allowed for this operation.			
-131	Invalid suffix	• Units are unrecognized, or the units are not appropriate.			
-138	Suffix not allowed	• A suffix is not allowed for this operation.			
-141	Invalid character data	• Bad character data or unrecognized character data was received.			
-144	Character data too long	• Character data is too long (maximum length is 12 characters).			
-148	Character data not allowed	Character data not allowed for this operation.			
-150	String data error	• String data is improper.			

Error No.	Error Message String	• Description	
-151	Invalid string data	• Invalid string data was received (for example, END received before close quote).	
-158	String data not allowed	String data is not allowed.	
-160	Block data error	Block data is improper.	
-161	Invalid block data	• Invalid block data was received (for example, END received before length satisfied).	
-168	Block data not allowed	Block data is not allowed.	
-170	Expression error	Expression is improper.	
-171	Invalid expression	• Invalid expression was received (for example, illegal character in expression).	
-178	Expression data not allowed	• Expression data is not allowed.	
Query	v Error		
-400	Query error	• Query is improper.	
-410	Query INTERRUPTED	• Query is followed by DAB or GET before the response was completed.	
-420	Query UNTERMINATED	Addressed to talk, incomplete program message received.	
-430	Query DEADLOCKED	• Input buffer and output buffer are full; cannot continue.	
-440	Query UNTERMINATED error after indefinite response	• The query which requests arbitrary data response (*IDN? and *OPT? queries) is sent before usual queries in a program message. (for example, FREQ?;*IDN? was expected, but *IDN?;FREQ? is recieved.)	

# System Message

System messages are displayed on the System Message Line to provide operation instructions for the user, and to report on the HP 4284A's status. There are two categories of system messages, warning messages and instruction messages.

#### Warning Messages

The HP 4284A displays warning messages on the System Message Line when an inappropriate operation is attempted, or when the setting is changed automatically due to an inappropriate operation. The warning operation should not set an error bit. The following list describes the HP 4284A's warning messages.

Warning Message	Description		
Warning, 1 I bias unit	When the HP 4284A finds one current bias unit connected, this message is displayed.		
Warning, 2 I bias unit	When the HP 4284A finds two current bias units connected, this message is displayed.		
Warning, ALC turned off	When the LEVEL setting is out of the ALC's available range, the ALC function is automatically turned OFF. Set the LEVEL to be within the ALC's available range, and then set ALC to ON.		
Warning, ALC unable to regulate	When the LEVEL setting is inappropriate for use with the ALC function, the ALC function will not work, the operation will be the same as if the ALC function is turned OFF. (The data status is set to 4.) Set the LEVEL appropriate for the device.		
Warning, Correction not effective	When the MULTI correction mode is used and the measurement frequency is not equal to FREQ1-3 (correction frequency), correction will not be performed.		
Warning, Deviation measurement ON	The deviation measurement is set to ON when the display page is changed to the BIN No. DISPLAY, BIN COUNT DISPLAY, or LIMIT TABLE SETUP page.		
Warning, I bias unit disconnected	This message is displayed when the status is changed after the current bias unit is disconnected.		
Warning, Improper high/low limits	The high limit value is less than the low limit value of the limit table.		
Warning, Level changed for ALC	When the ALC is turned on and the LEVEL setting is out of the ALC's available range, the LEVEL setting is changed to be within the ALC's available range.		
Warning, Signal source overload	When the signal source is overloaded, the measurement data is not guaranteed to be valid. (The data status is set to 3.) Reduce the LEVEL.		
Warning, DCI Isolation turned off	When Hi-PW mode is set to OFF and DCI ISO ON is set, DCI is automatically set to ISO OFF.		

#### **Instruction Messages**

The following is a list of the instruction messages in alphabetical order.

A Auto load completed

C Clearing setup. Are you sure?

Clearing table. Are you sure?

Enter comment

Enter record number to LOAD

Enter record number to PURGE

Enter record number to STORE

Enter REF value or select MEASURE

Enter test number Enter V or I value

Enter value

Enter value or INCR/DECR

Enter value or select

Fixed decimal point mode

Frequency changed, re-measure

HP-IB error occurred

K Keys locked

L LOAD measurement completed

LOAD measurement in progress

OPEN measurement completed

OPEN measurement in progress

Press ENTER

Press ENTER or select a unit

Press ENTER or select CANCEL

**R** Resetting count. Are you sure?

Resetting system. Are you sure?

Saving correction data

SHORT measurement completed SHORT measurement in progress

Storing ...

U Use softkeys to select

# **Initial Settings and System Memory**

#### Introduction

This appendix lists the HP 4284A's initial settings and functions whose status is stored in system memory.

There are three ways to initialize the HP 4284A:

- POWER ON Turn the LINE ON/OFF switch ON.
- \*RST Press SYSTEM RESET in the SYS MENU field of MEAS SETUP page, or send the \*RST common command via HP-IB.
- DEVICE CLEAR Send the device clear bus command (SDC:selected device clear or DCL:clears all devices) via HP-IB.

The following list indicates the differences between the three initialization methods on the functions to be initialized. Functions whose status are stored in internal system memory are indicated by "Sys. Memory" on the "POWER ON" column in the following list.

Functions		Initialize Method		
		Power ON	*RST	Device Clear
Settings	·			•
MEAS SETUP	FUNC	Cp-D	Cp-D	Not Affected
	FREQ	$1  \mathrm{kHz}$	$1~\mathrm{kHz}$	Not Affected
	LEVEL	1 V	1 V	Not Affected
	RANGE	AUTO	AUTO	Not Affected
	BIAS	0 V	0 V	Not Affected
	DC BIAS (On/Off)	OFF	OFF	Not Affected
	$\overline{INTEG}$	MED	MED	Not Affected
	TRIG	$\operatorname{INT}$	INT	Not Affected
	ALC	OFF	OFF	Not Affected
	Hi-POW(Opt.001 installed)	ON	ON	Not affected
	Hi-POW(Opt.001 not installed)	OFF	OFF	Not affected
	DCI	ISO OFF	ISO OFF	Not affected
	AVG	1	1	Not Affected
	Vm	ON	ON	Not Affected
	Im	ON	ON	Not Affected
	DELAY	0 s	0 s	Not Affected
	DEV A	OFF	OFF	Not Affected
	REF A	0	0	Not Affected
	DEV B	OFF	OFF	Not Affected
	REF B	0	0	Not Affected

Func	tions	Initialize Method		
		Power ON	*RST	Device Clear
CORRECTION	OPEN	Sys. Memory	Not Affected	Not Affected
	SHORT	Sys. Memory	Not Affected	Not Affected
	LOAD	Sys. Memory	Not Affected	Not Affected
	CABLE	Sys. Memory	Not Affected	Not Affected
	MODE	Sys. Memory	Not Affected	Not Affected
	CH No.	Sys. Memory	Not Affected	Not Affected
	FUNC	Sys. Memory	Not Affected	Not Affected
	FREQ1 - 3	Sys. Memory	Not Affected	Not Affected
	REFA	Sys. Memory	Not Affected	Not Affected
	REFB	Sys. Memory	Not Affected	Not Affected
LIMIT TABLE	NOM	0	0	Not Affected
SETUP	MODE	%	%	Not Affected
	A UX	OFF	OFF	Not Affected
	COMP	OFF	OFF	Not Affected
	BIN 1 - 9 LOW	$\operatorname{Cleared}$	Cleared	Not Affected
	BIN 1 - 9 HIGH	$\operatorname{Cleared}$	Cleared	Not Affected
	2nd LOW	$\operatorname{Cleared}$	Cleared	Not Affected
	2nd HIGH	Cleared	Cleared	Not Affected
BIN COUNT	COUNT ON/OFF	OFF	OFF	Not Affected
LIST SWEEP	MODE	$\operatorname{SEQ}$	SEQ	Not Affected
SETUP	sweep parameter	FREQ [Hz]	FREQ [Hz]	Not Affected
	sweep points	Cleared	Cleared	Not Affected
SYSTEM	BEEPER	Sys. Memory	Not Affected	Not Affected
CONFIG	HP-IB ADDRESS	Sys. Memory	Not Affected	Not Affected
	TALK ONLY	Sys. Memory	Not Affected	Not Affected
	HANDLER I/F	Sys. Memory	Not Affected	Not Affected
	SCANNER I/F	Sys. Memory	Not Affected	Not Affected
Display Control	•			
	<pre><display page=""></display></pre>	MEAS DISPLAY	MEAS DISPLAY	Not Affected
	D.P. FIX A	OFF	OFF	Not Affected
	D.P. FIX B	OFF	OFF	Not Affected
Measurement Data				
	Measurement Data	Cleared	Cleared	Not Affected
	List Sweep Data	Cleared	Cleared	Not Affected
	V / I Monitor Data	Cleared	Cleared	Not Affected
	BIN Count Data	Cleared	Cleared	Not Affected

Functions		Initialize Method			
		Power ON	*RST	Device Clear	
HP-IB					
	Data Buffer Memory	Cleared	Cleared	Not Affected	
	Data Format	ASCII	ASCII	Not Affected	
	Input Buffer	Cleared	Not Affected	Cleared	
	Output Buffer	Cleared	Not Affected	Cleared	
	Error Queue	Cleared	Not Affected	Not Affected	
Status Byte <sup>1</sup>	Bit 7	0	Not Affected	Not Affected	
	Bit 6	0	Not Affected	Not Affected	
	Bit 5	0	Not Affected	Not Affected	
	Bit 4	0	Not Affected	0	
	Enable Resister	0	Not Affected	Not Affected	
Operation Status	Bit 4	0	0	Not Affected	
$ m Register^1$	Bit 3	0	0	Not Affected	
	Bit 0	0	0	Not Affected	
	Enable Resister	0	Not Affected	Not Affected	
Standard Event	Bit 7	1	Not Affected	Not Affected	
Status Register <sup>1</sup>	Bit 6	0	Not Affected	Not Affected	
	Bit 5	0	Not Affected	Not Affected	
	Bit 4	0	Not Affected	Not Affected	
	Bit 3	0	Not Affected	Not Affected	
	Bit 2	0	Not Affected	Not Affected	
	Bit 0	0	Not Affected	Not Affected	
	Enable Resister	0	Not Affected	Not Affected	
Others					
	comment	Cleared	Cleared	Not Affected	
	$KEY\ LOCK$	OFF	OFF	Not Affected	

<sup>1</sup> Any other bits described in this table are not used. (always 0)

# **Correction Data**

#### Introduction

This appendix provides information about the relationship between the test frequency and the correction data.

# **Test Frequency and** Correction Frequency

There are two types of correction data for the OPEN/SHORT/LOAD correction, interpolation correction data, and spot frequency (FREQ1, FREQ2, and FREQ3) correction data. These correction data are selected automatically depending on the correction mode and the test frequency. The details for interpolation correction data are described in SECTION 4, OPEN correction, SHORT correction, and for spot frequency correction data in SECTION 4, LOAD correction.

The relationship between the test frequency and the correction data for the single/multi correction modes are described on the following page.

# Single Channel Correction Mode

When the correction mode is set to SINGLE, the OPEN/SHORT interpolation correction data or the FREQ1/FREQ2/FREQ3 correction data are selected automatically, depending on the test frequency and the settings of the OPEN, SHORT, LOAD, FREQ1, FREQ2 and FREQ3 fields. Table D-1 shows the correction data selection rules for the SINGLE mode and corresponding test frequencies.

Table D-1. Correction Data Selecting Rule for SINGLE Mode

Test	FRQ1/2/3 setting	OPEN		SHORT		LOAD	
Frequency		ON	OFF	ON	OFF	ON	OFF
Test Freq= FRQ1	FRQ1:ON	FRQ1 OPEN data	Not performed	FRQ1 SHORT data	Not performed	FREQ1 LOAD data	$egin{array}{c} \operatorname{Not} \\ \operatorname{performed} \end{array}$
	FRQ1:OFF	OPEN data	$\operatorname{Not}$ performed	$_{\rm data}^{\rm SHORT}$	Not performed	Not performed	$rac{ ext{Not}}{ ext{performed}}$
Test Freq= FRQ2	FRQ2:ON	FRQ2 OPEN data	$egin{array}{l} \operatorname{Not} \\ \operatorname{performed} \end{array}$	FRQ2 SHORT data	Not performed	FRQ2 LOAD data	$egin{array}{c} \operatorname{Not} \\ \operatorname{performed} \end{array}$
	FRQ2:OFF	OPEN data	Not performed	$_{\rm data}^{\rm SHORT}$	Not performed	Not performed	$\operatorname{Not}$ performed
Test Freq= FRQ3	FRQ3:ON	FRQ3 OPEN data	$egin{array}{l} \operatorname{Not} \\ \operatorname{performed} \end{array}$	FRQ3 SHORT data	Not performed	FRQ3 LOAD data	$egin{array}{c} \operatorname{Not} \\ \operatorname{performed} \end{array}$
	FRQ3:OFF	OPEN data	Not performed	$_{\rm data}^{\rm SHORT}$	Not performed	Not performed	$\operatorname{Not}$ performed
Test Freq≠ FRQ1/2/3	FRQ1:ON FREQ2:ON FRQ3:ON	OPEN data	Not performed	SHORT data	Not performed	Not performed	$egin{array}{c} \operatorname{Not} \\ \operatorname{performed} \end{array}$
	FRQ1:OFF FRQ2:OFF FRQ3:OFF	OPEN data	Not performed	SHORT data	Not performed	Not performed	Not performed

Test Freq : Test frequency

OPEN data : OPEN interpolation correction data SHORT data : SHORT interpolation correction data FREQ1/2/3 OPEN data : OPEN correction data at FREQ1/2/3

frequency

FREQ1/2/3 SHORT data : SHORT correction data at FREQ1/2/3

frequency

FREQ1/2/3 LOAD data : LOAD correction data at FREQ1/2/3

frequency

#### Multi Channel **Correction Mode**

To use the multi channel correction mode, Option 301 Scanner Interface must be installed, and the scanner interface function should be set to ON from the SYSTEM CONFIG page. When the correction mode is set to MULTI, only FREQ1/FREQ2/FREQ3 correction data is used for correction. If the settings of the FREQ1, FREQ2 and FREQ3 fields are OFF (even the OPEN, SHORT and LOAD fields are ON), correction will not be performed. Table D-2 shows the correction data selection rules for MULTI mode and corresponding test frequencies.

Table D-2. Correction Data Selecting Rule for MULTI Mode

Test	FRQ1/2/3 setting	OPEN		SHORT		LOAD	
Frequency		ON	OFF	ON	OFF	ON	OFF
Test Freq= FRQ1	FRQ1:ON	FRQ1 OPEN data	$egin{array}{c} \operatorname{Not} \\ \operatorname{performed} \end{array}$	FRQ1 SHORT data	Not performed	FRQ1 LOAD data	$egin{array}{c} \operatorname{Not} \\ \operatorname{performed} \end{array}$
	FRQ1:OFF	Not performed	$\operatorname{Not}$ performed	Not performed	Not performed	Not performed	$egin{array}{c} \operatorname{Not} \\ \operatorname{performed} \end{array}$
Test Freq= FRQ2	FRQ2:ON	FRQ2 OPEN data	Not performed	FRQ2 SHORT data	$egin{array}{c} \operatorname{Not} \\ \operatorname{performed} \end{array}$	FRQ2 LOAD data	$egin{array}{c} \operatorname{Not} \\ \operatorname{performed} \end{array}$
	FRQ2:OFF	Not performed	$\operatorname{Not}$ performed	Not performed	Not performed	$\operatorname{Not}$ performed	$\operatorname{Not}$ performed
Test Freq= FRQ3	FRQ3:ON	FRQ3 OPEN data	$egin{array}{l} \operatorname{Not} \\ \operatorname{performed} \end{array}$	FRQ3 SHORT data	Not performed	FRQ3 LOAD data	$egin{array}{c} \operatorname{Not} \\ \operatorname{performed} \end{array}$
	FRQ3:OFF	Not performed	Not performed	Not performed	Not performed	Not performed	$\operatorname{Not}$ performed
Test Freq≠ FRQ1/2/3	FRQ1:ON FREQ2:ON FRQ3:ON	Not performed	Not performed	Not performed	Not performed	Not performed	$egin{array}{c} \operatorname{Not} \\ \operatorname{performed} \end{array}$
	FRQ1:OFF FRQ2:OFF FRQ3:OFF	Not performed	$\operatorname{Not}$ performed	Not performed	Not performed	Not performed	$egin{array}{c} \operatorname{Not} \\ \operatorname{performed} \end{array}$

Test Freq : Test frequency

: OPEN interpolation correction data OPEN data SHORT data : SHORT interpolation correction data FREQ1/2/3 OPEN data : OPEN correction data at FREQ1/2/3

frequency

FREQ1/2/3 SHORT data : SHORT correction data at FREQ1/2/3

frequency

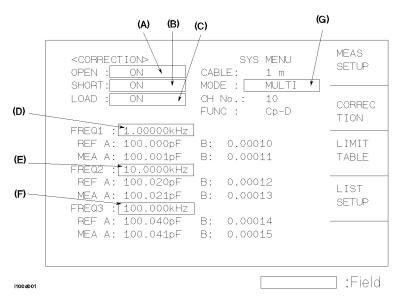
FREQ1/2/3 LOAD data : LOAD correction data at FREQ1/2/3

frequency

# CORRECTION FUNCTION SETTING

To set the correction function or to obtain the correction data, use the following summary of the correction function setting fields with their HP-IB commands (given in the short form). (A) through (F) shown in the figure correspond to the description of each field.

# **CORRECTION Page**



	${f Field}$	Softkey	Command	Description
(A)	OPEN	ON	CORR:OPEN:STAT ON	: Performs OPEN correction using OPEN data or FREQ1/2/3 OPEN data.
		OFF	CORR:OPEN:STAT OFF	: Not perform OPEN correction.
		$\begin{array}{c} \text{MEAS} \\ \text{OPEN} \end{array}$	CORR:OPEN	: Obtains OPEN interpolation data
(B)	SHORT	ON	CORR:SHOR:STAT ON	: Performs SHORT correction using SHORT data or FREQ1/2/3 SHORT data.
		OFF	CORR:SHOR:STAT OFF	: Not perform SHORT correction.
		MEAS	CORR:SHOR	: Obtains SHORT interpolation SHORT data.
(C)	LOAD	ON	CORR:LOAD:STAT ON	: Performs LOAD correction using FREQ1/2/3 LOAD data.
		OFF	CORR:LOAD:STAT OFF	: Not perform LOAD correction.

	${f Field}$	Softkey	Command	Description
(D)	FREQ1	ON	CORR:SPOT1:STAT ON	: Use FREQ1 OPEN/SHORT/LOAD data.
		OFF	CORR:SPOT1:STAT OFF	: Not use FREQ1 OPEN/SHORT/LOAD data.
		MEAS OPEN	CORR:SPOT1:OPEN	: Obtains FREQ1 OPEN data.
		MEAS SHORT	CORR:SPOT1:SHOR	: Obtains FREQ1 SHORT data.
		MEAS	CORR:SPOT1:LOAD	: Obtains FREQ1 LOAD data.
(E)	FREQ2	ON	CORR:SPOT2:STAT ON	: Use FREQ2 OPEN/SHORT/LOAD data.
		OFF	CORR:SPOT2:STAT OFF	: Not use FREQ2 OPEN/SHORT/LOAD data.
		MEAS OPEN	CORR:SPOT2:OPEN	: Obtains FREQ2 OPEN data.
		MEAS SHORT	CORR:SPOT2:SHOR	: Obtains FREQ2 SHORT data.
		MEAS LOAD	CORR:SPOT2:LOAD	: Obtains FREQ2 SHORT data.
(F)	FREQ3	ON	CORR:SPOT3:STAT ON	: Use FREQ3 OPEN/SHORT/LOAD data.
		OFF	CORR:SPOT3:STAT OFF	: Not use FREQ3 OPEN/SHORT/LOAD data.
		MEAS OPEN	CORR:SPOT3:OPEN	: Obtains FREQ3 OPEN data.
		MEAS	CORR:SPOT3:SHOR	: Obtains FREQ3 SHORT data.
		$\begin{array}{c} \text{MEAS} \\ \text{LOAD} \end{array}$	CORR:SPOT3:LOAD	: Obtains FREQ3 LOAD data.
(G)	MODE	SINGLE	CORR:METH:SING	: Sets the single channel correction mode.
		MULTI	CORR:METH:MULT	: Sets the multi channel correction mode

## **Write Protection**

#### Introduction

The HP 4284A is equipped with an internally mounted write-protect switch. This switch has two write protection features. One feature disables the STORE function for write protecting all of the stored data in the memory card and EEPROM internal memory, and the other feature prevents changing any of the previous correction settings on the CORRECTION page. This feature is useful when you want to retain specific HP 4284A control settings for everyday use, for example, on a production line where it is not necessary to store any information on a memory card, thereby making it impossible to accidentally erase or overwrite the stored data in the memory card or the EEPROM internal memory, and also making it impossible to accidentally erase or overwrite the correction settings.

## Write Protection **Procedure**

The procedure for setting the write protection switch to ON is as follows.

1. Turn the HP 4284A off and remove the power cord. Allow 1 minutes for the internal capacitors to discharge.

#### Warning



Dangerous voltage may be present in the HP 4284A even through the power switch is off. Be sure to wait 1 minutes for the internal capacitors to discharge.

- 2. Remove the two feet at the back of the top cover.
- 3. Fully loosen the screw that secures the top cover.
- 4. Pull the top cover towards the rear of the HP 4284A and lift up to remove.
- 5. Loosen the five screws that secure the top shield plate (Larger one).
- 6. Slide the top shield forward then lift it off.
- 7. Remove the A7 board. Figure E-1 shows the A7 board's location.

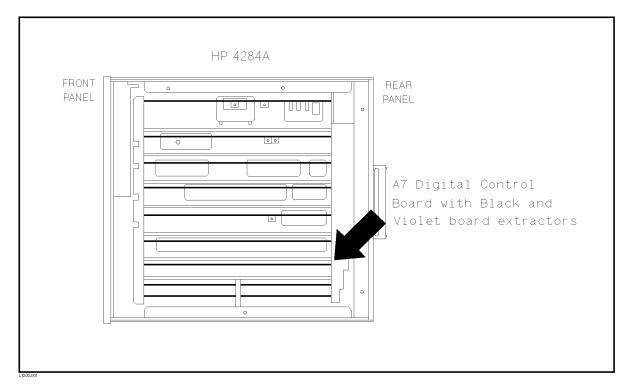


Figure E-1. A7 Digital Board Location

#### Caution



Semiconductor components are installed on the A7 board. When handling the A7 board, be aware that electrostatic discharge can damage these components.

- 8. Set A7S3-6 to the right-most position (ON) to disable HP 4284A's STORE function. Set A7S3-6 to the left-most position (OFF) to enable storing. Refer to Figure E-2.
- 9. Set A7S3-7 to the right-most position (ON) to disable to change all of the correction settings on the *CORRECTION* page. Set A7S3-7 to the left-most position (OFF) to enable to change all of the correction settings on the *CORRECTION* page. Refer to Figure E-2.



Figure E-2. Write Protection Switch

Note



Do not change any of the other switch settings on the A7 board.

- 10. Install the configured A7 board into the HP 4284A.
- 11. Replace the top shield plate, top cover, and rear feet.

# **Test Frequency Point**

## Introduction

This appendix lists all available test frequency points from 1 kHz to 1  $\,\mathrm{MHz}.$ 

# **Frequency Points**

The available test frequency points from 1 kHz to 1 MHz are as listed from the next page.

The available test frequency points below 1 kHz (20 Hz to 1 kHz) can be calculated using the following formula.

$$F(Hz) = \frac{m}{n}$$

Where,

m = 6000, 6250, or 7500

n = 13 to 3750 (Integer)

1.00000 MHz	90 4110 LHz	10 4949 LH -	9 40000 latte
1.00000 MHz	29.4118 kHz	10.4348 kHz	3.40909 kHz
960.000 kHz	28.5714 kHz	10.4167 kHz	3.33333 kHz
800.000 kHz	28.2353 kHz	10.3448 kHz	3.28947 kHz
666.667 kHz	27.7778 kHz	10.0000 kHz	3.26087 kHz
640.000 kHz	27.2727 kHz	9.61538 kHz	3.15789 kHz
600.000 kHz	26.6667 kHz	9.37500 kHz	3.12500 kHz
500.000 kHz	26.3158 kHz	9.23077 kHz	3.00000 kHz
480.000 kHz	26.0870 kHz	8.92857 kHz	2.97619 kHz
400.000 kHz	25.2632 kHz	8.82352 kHz	2.88462 kHz
333.333  kHz	25.0000  kHz	$8.57243~\mathrm{kHz}$	2.85714  kHz
320.000  kHz	24.0000  kHz	8.33333  kHz	2.84091  kHz
300.000  kHz	23.8095  kHz	8.00000  kHz	2.77778  kHz
250.000  kHz	23.0769  kHz	7.89474  kHz	2.72727  kHz
240.000  kHz	$22.8571~\mathrm{kHz}$	$7.81250~\mathrm{kHz}$	2.71739  kHz
200.000  kHz	$22.7272~\mathrm{kHz}$	$7.50000~\mathrm{kHz}$	$2.67857~\mathrm{kHz}$
166.667  kHz	22.2222  kHz	$7.35294~\mathrm{kHz}$	$2.60870~\mathrm{kHz}$
160.000  kHz	21.8182  kHz	$7.14286~\mathrm{kHz}$	$2.60417~\mathrm{kHz}$
$150.000~\mathrm{kHz}$	$21.7391~\mathrm{kHz}$	$7.05882~\mathrm{kHz}$	$2.58621~\mathrm{kHz}$
$125.000~\mathrm{kHz}$	$21.4286~\mathrm{kHz}$	6.94444 kHz	$2.50000~\mathrm{kHz}$
$120.000~\mathrm{kHz}$	$20.8696~\mathrm{kHz}$	$6.81818~\mathrm{kHz}$	$2.41935~\mathrm{kHz}$
100.000 kHz	$20.8333~\mathrm{kHz}$	6.66666  kHz	$2.40385~\mathrm{kHz}$
96.0000 kHz	$20.6897~\mathrm{kHz}$	$6.57895~\mathrm{kHz}$	$2.40000~\mathrm{kHz}$
$85.7143~\mathrm{kHz}$	$20.0000~\mathrm{kHz}$	$6.52174~\mathrm{kHz}$	$2.34375~\mathrm{kHz}$
83.3333 kHz	$19.2308~\mathrm{kHz}$	$6.31579~\mathrm{kHz}$	$2.31481~\mathrm{kHz}$
80.0000 kHz	18.7500 kHz	$6.25000~\mathrm{kHz}$	$2.30769~\mathrm{kHz}$
75.0000 kHz	18.4615 kHz	6.00000 kHz	2.27273 kHz
72.4286 kHz	17.8571 kHz	5.95238 kHz	2.23214 kHz
68.5714 kHz	17.6471 kHz	5.76923 kHz	2.22222 kHz
66.6666 kHz	17.1429 kHz	5.71429 kHz	2.20588 kHz
62.5000 kHz	16.6667 kHz	5.68182 kHz	2.15517 kHz
60.0000 kHz	16.0000 kHz	5.55556 kHz	2.14286 kHz
55.5556 kHz	15.7895 kHz	5.45455 kHz	2.14200 kHz 2.08333 kHz
54.5455 kHz	15.6250 kHz	5.43478 kHz	2.06897 kHz
53.3333 kHz	15.0000 kHz	5.35714 kHz	2.00397 kHz
50.0000 kHz	14.7059 kHz	5.21739 kHz	2.02103 kHz
48.0000 kHz	14.7655 kHz	5.20833 kHz	2.00000 kHz
46.1538 kHz	14.1176 kHz	5.17241 kHz	1.97368 kHz
45.4545 kHz	13.8889 kHz	5.00000 kHz	1.97308 kHz
43.6364 kHz	13.6364 kHz	4.80769 kHz 4.68750 kHz	1.93548 kHz 1.92308 kHz
42.8571 kHz	13.3333 kHz		
41.6667 kHz	13.1579 kHz	4.61538 kHz	1.89394 kHz
40.0000 kHz	13.0435 kHz	4.46429 kHz	1.87500 kHz
38.4615 kHz	12.6316 kHz	4.41176 kHz	1.83824 kHz
37.5000 kHz	12.5000 kHz	4.28571 kHz	1.82927 kHz
36.9231 kHz	12.0000 kHz	4.16667 kHz	1.81818 kHz
35.7143 kHz	11.9048 kHz	4.00000 kHz	1.78571 kHz
35.2941 kHz	11.5385 kHz	3.94737 kHz	1.76471 kHz
34.2857 kHz	11.4286 kHz	3.90625 kHz	1.74419 kHz
33.3333 kHz	11.3636 kHz	3.75000 kHz	1.73611 kHz
32.0000 kHz	11.1111 kHz	3.67647 kHz	1.71429 kHz
31.5789  kHz	10.9091 kHz	$3.57143~\mathrm{kHz}$	1.70455  kHz
31.2500  kHz	10.8696  kHz	$3.52942~\mathrm{kHz}$	1.68919  kHz
30.0000  kHz	10.7143 kHz	$3.47222~\mathrm{kHz}$	1.66667 kHz

1.64474 kHz	$1.09090 \; \mathrm{kHz}$
1.63043 kHz	1.08696 kHz
1.62612 kHz	1.07759 kHz
1.60256 kHz	1.07143 kHz
1.59574 kHz	1.05932 kHz
1.57895 kHz	1.05634 kHz
1.56250 kHz	1.05263 kHz 1.04167 kHz
1.53846 kHz	
1.53061 kHz	1.03448 kHz
1.52439 kHz	1.02740 kHz
1.50000 kHz	1.02459 kHz
1.48810 kHz	1.01695 kHz
1.47059 kHz	1.01351 kHz
1.46341 kHz	1.00806 kHz
$1.45349~\mathrm{kHz}$	1.00000  kHz
$1.44231~\mathrm{kHz}$	
$1.42857~\mathrm{kHz}$	
$1.42045~\mathrm{kHz}$	
1.41509 kHz	
$1.39535~\mathrm{kHz}$	
$1.38889~\mathrm{kHz}$	
$1.36364~\mathrm{kHz}$	
$1.35870~\mathrm{kHz}$	
$1.33929~\mathrm{kHz}$	
$1.32979~\mathrm{kHz}$	
$1.31579~\mathrm{kHz}$	
$1.30435~\mathrm{kHz}$	
$1.30208~\mathrm{kHz}$	
$1.29310~\mathrm{kHz}$	
$1.27660~\mathrm{kHz}$	
$1.27551~\mathrm{kHz}$	
1.27119 kHz	
1.25000 kHz	
1.22951 kHz	
1.22549 kHz	
1.22449 kHz	
1.20968 kHz	
1.20192 kHz	
1.20000 kHz	
1.19048 kHz	
1.17925 kHz	
1.17647 kHz	
1.17188 kHz	
1.15741 kHz	
1.15385 kHz	
1.13637 kHz	
1.13208 kHz	
1.11940 kHz	
1.11607 kHz	
1.11111 kHz	
1.10294 kHz	
1.09649 kHz	

# **Transient States Caused by Measurement Condition** Changes

#### Introduction

The HP 4284A's internal circuit may enter a transient state due to changes in measurement conditions. In a transient state, the HP 4284A will not meet its specifications. So in this case, a delay time (DELAY field) must be inserted into the measurement cycle until the HP 4284A is no longer in a transient state. This appendix describes the measurement condition changes which cause the transient states, and lists the delay times required for various transient states. (Refer to Table G-1.)

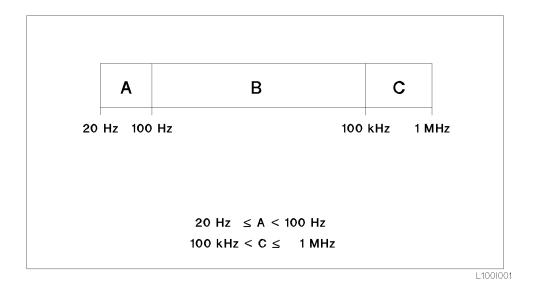
**Table G-1. Measurement Condition Changes** 

Change in	DC BIAS: OFF	DC BIAS: ON		
measurement condition		DCI ISO: OFF	DCI ISO: ON	
Frequency	1			
Meas. Range	2-(1) <sup>1</sup>	2-(2)1	$2-(3)^1$	
DC Bias Voltage		3-(1) <sup>1</sup>	$3-(2)^1$	
Short-circuit Recovery		4-(1)	4-(2)	

<sup>1</sup> Test Frequency f<1kHz only

# **Changing the Test** Frequency

When the test frequency is changed from range A to range C, the minimum required delay time is 50 ms. Delay times of greater than 150 ms aren't required.



Note



A delay time isn't necessary for range changes other than a range A to C change.

## Changing the **Measurement Range**

When the measurement range frequency is set below 1 kHz, use the appropriate delay time as shown below.

1. After changing the measurement range under the following conditions use the delay times shown in Figure G-1.

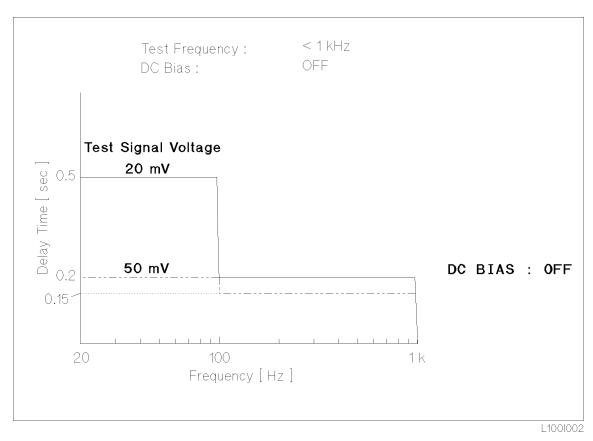


Figure G-1. Required Delay Time After Changing the Measurement Range (1)

Note



A delay time is not required when the test signal voltage is U100 mVrms.

2. After changing the measurement range under the following conditions, use the appropriate delay times as shown in Figure G-2.

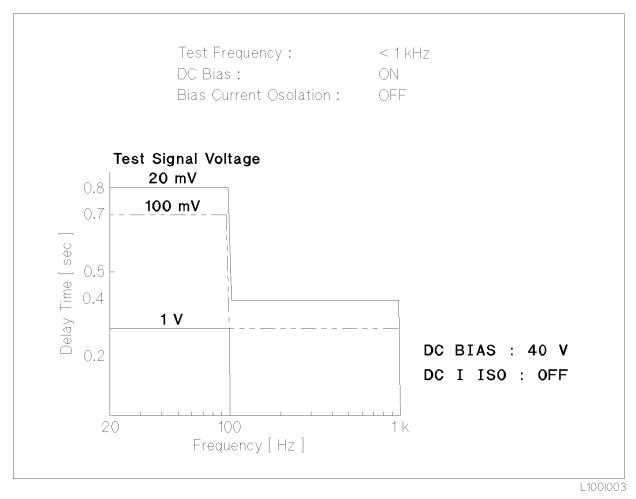


Figure G-2. Required Delay Time After Changing the Measurement Range (2)

3. After changing the measurement range under the following conditions, use the appropriate delay times as shown in Figure G-3.

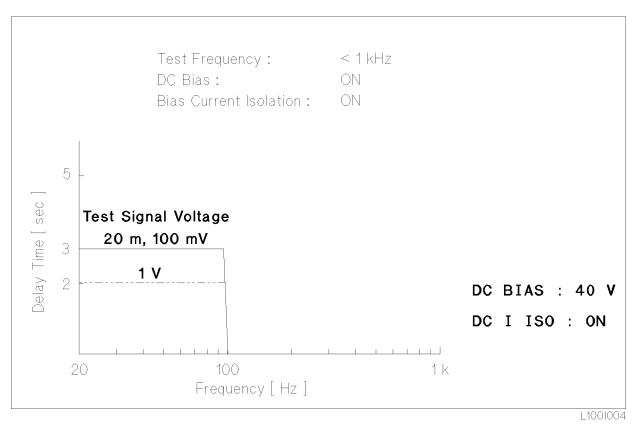


Figure G-3. Required Delay Times After Changing the Measurement Range (3)

Note



When the test signal voltage is > 1 Vrms, the wait time is the same as used for 1 Vrms.

### CHANGING THE DC **BIAS VOLTAGE**

When the dc bias voltage is changed at frequencies below 1 kHz, the delay wait time must be set as shown below.

1. After changing the measurement range under the following conditions, use the appropriate delay times as shown in Figure G-4.

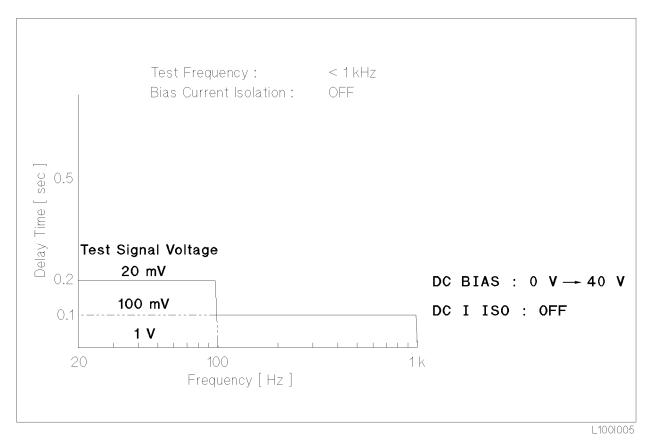


Figure G-4. Required Delay Times After Changing the DC Bias (1)

Note



A delay is unnecessary When the test signal voltage is U500 mVrms.

2. After changing the dc bias voltage under the following conditions, use the appropriate delay times as shown in Figure G-5.

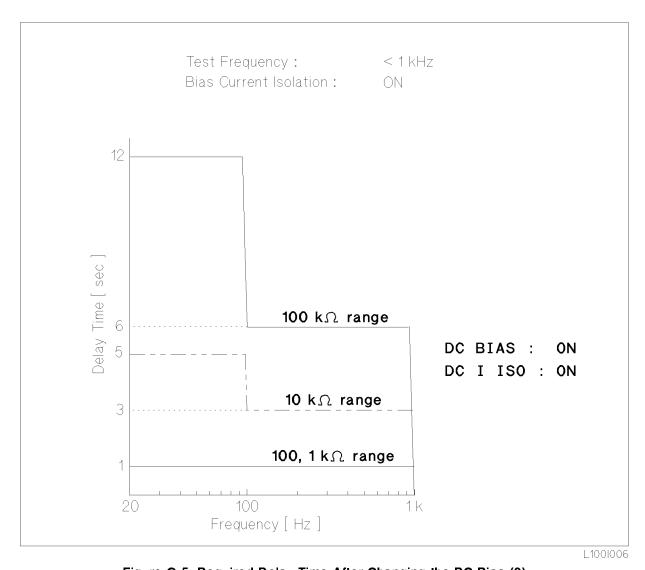


Figure G-5. Required Delay Time After Changing the DC Bias (2)

# **Short Circuit** Recovery

When the DUT is changed after the HP 4284A has been unbalanced by a shorted (or low impedance) DUT, use a delay time as shown below to recover from the short circuit.

1. To recover from a short circuit condition under the following conditions, use the appropriate delay times as shown in Figure G-6 and Figure G-7.

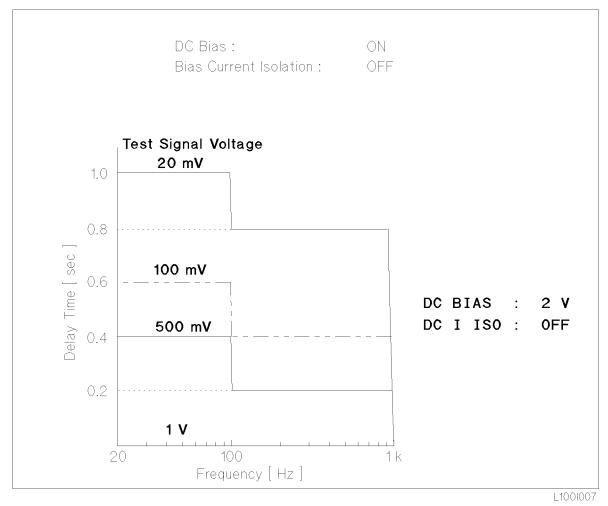


Figure G-6. Required Delay Times For Short Circuit Recovery (1)

Note



A delay time is unnecessary when the test signal voltage is  $\geq 1 \text{Vrms}$ , a delay time is unnecessary.

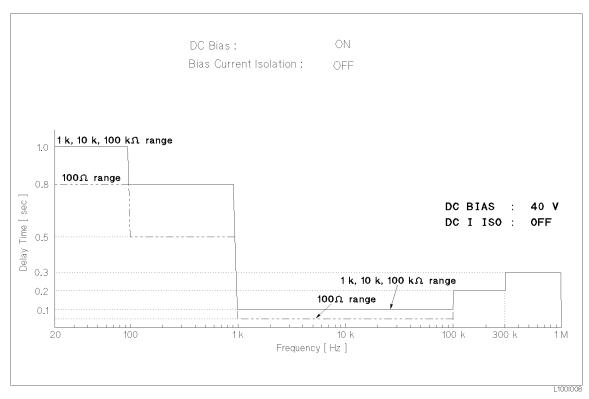


Figure G-7. Required Delay Times For Short Circuit Recovery (2)

2. Use the delay times shown in Figure G-8 to recover from a short circuit under the following conditions.

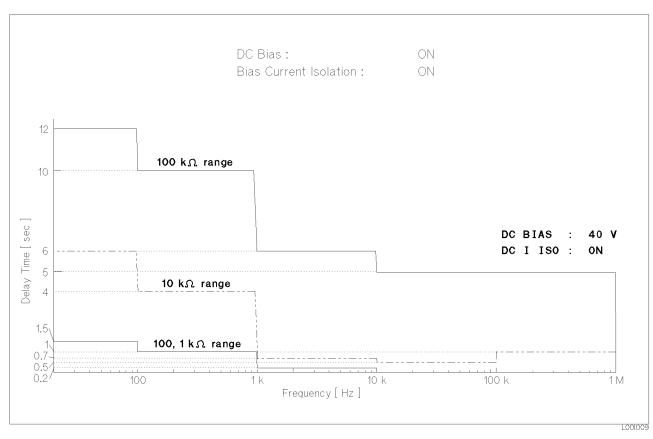


Figure G-8. Short Circuit Recovery Delay Times (3)

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