Agilent 4279A
1MHz C-V Meter
(Including Options 003)

Operation Manual

MANUAL IDENTIFICATION

Model Number: 4279A
Date Printed: March 2000
Part Number: 04279-90010

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

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

SERIAL PREFIX OR NUMBER	MAKE MANUAL CHANGES
All	1

SERIAL PREFIX OR NUMBER	MAKE MANUAL CHANGES

◆ New Item

ERRATA

CHANGES 1

CHANGE 1 contains the information needed to adapt the 4279A's manual.

Change the company name from YOKOGAWA-HEWLETT-PACKARD, LTD., or its abbreviation YHP to Agilent Technologies Japan, Ltd.

NOTE

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

PRINTED IN JAPAN

Agilent Technologies

The pink sheet titled "CAUTIONS ON OPERATION"

Change the page title as follows.

⚠ CAUTIONS ON OPERATION

Third page of the front matter "SAFETY SUMMARY"

Add the following note.

Note 4279A complies with INSTALLATION CATEGORY II and POLLUTION DEGREE 2 in IEC1010-1. 4279A is INDOOR USE product.

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

CLASS 1 LED PRODUCT

Forth page of the front matter "SAFTY SYMBOLS"

Add the following symbols.

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

On (Supply).

Off (Supply).

In position of push-button switch.

Out position of push-button switch.

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

"TABLE OF CONTENTS"

Change the SECTION1 as follows.

SECTION1

Installation and Set Up Guide

1-1. Incoming Inspection 1-1

1-2. Power requirements 1-2

1-3. ⚠ Line Voltage and Fuse Selection 1-4

1-4. Operation Environment 1-5

1-5. Electromagnetic Compatibility 1-5

1-6. Ventilation Requirements 1-6

1-7. Instruction for Cleaning 1-6

1-8. Rack/Handle Installation 1-6

Change the 2-2 as follows.

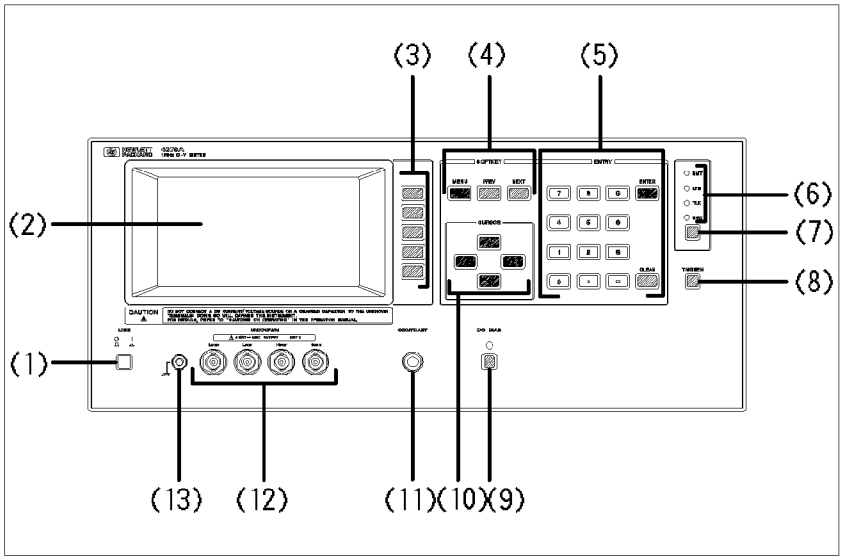
2-2. ⚠ PANEL FEATURES 2-1

Change the 5-4-1. as follows.

5-4-1. ⚠ DC BIAS MODE 5-5

Page2-2 "Figure2-1 Front Panel Features"

Change the figure as follows.



Page2-3 “PANEL FEATURES”

Change the (12)UNKNOWN Terminals as follows.

(12) ⚠ UNKNOWN Terminals

These terminals are used to connect four terminal-pair test fixtures or test leads to the 4279A. Available four terminal-pair test fixtures or test leads are refer to the Accessories Selection Guide For Impedance Measurements (Catalog number 5963-6834E).

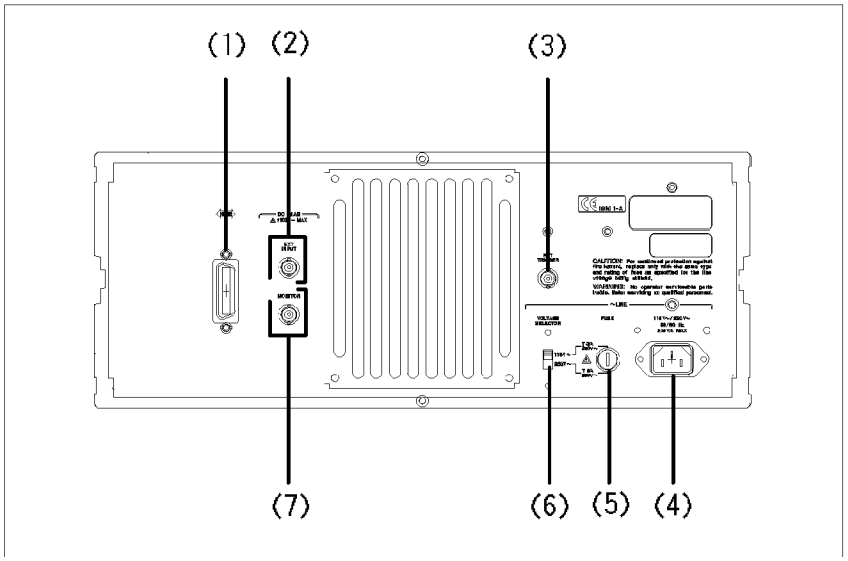
INSTALLATION CATEGORY I

Change the (13)Guard Terminal as follows.

(13)FRAME Terminal

Page 2-4 “Figure2-2 Rear Panel Features”

Change the figure as follow.



Page5-6 “EXT DC BIAS MODE:”

Change the EXT DC BIAS MODE: as follows.

EXT DC BIAS MODE:

Add the following warning.

WARNING

Do not touch the UNKNOWN terminal, the MONITOR terminal, and the portion connecting with them, to avoid hazardous electrical when the DC bias exceeding ± 40V, ±2mV is applied to the EXT INPUT port.

Page8-1 “Figure 8-1. Serial Number Plate”

Change the figure as follows.

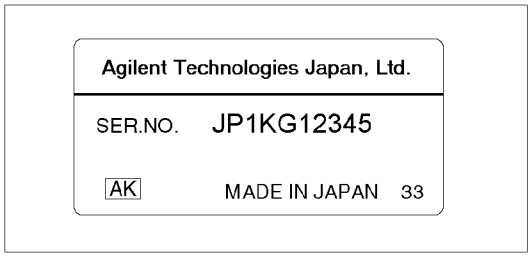


Figure 8-1. Serial Number Plate

Page8-6 “OPERATING ENVIRONMENT”

Add the following information.

Altitude 0m to 2000m

“SECTION 1 RECEIVING AND GETTING READY TO USE YOUR 4279A”

Change the SECTION as the following pages.

Installation and Set Up Guide

This chapter provides the information necessary for performing an incoming inspection and setting up the 4279A. The main topics in this chapter are:

1-1. Incoming Inspection

1-2. Power requirements

1-3. Line Voltage and Fuse Selection

1-4. Operation Environment

1-5. Electromagnetic Compatibility

1-6. Ventilation Requirements

1-7. Instruction for Cleaning

1-8. Rack/Handle Installation

1-1. Incoming Inspection

WARNING To avoid hazardous electrical shock, do not turn on the 4279A 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 4279A 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 Agilent Technologies office. If the shipping container is damaged, or the cushioning material shows signs of unusual stress, notify the carrier as well as the Agilent Technologies office. Keep the shipping materials for the carrier's inspection.

Table 1-1. 4279A Contents

Description	Qty.	Agilent Part Number
4279A		
Power cable[1]	1	—
Operation Manual	1	04279-90010
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

1 Power Cable depends on where the instrument is used, see "Power Cable".

1-2. Power Requirements

The 4279A requires the following power source:

Voltage : 90 to 132 Vac, 198 to 252 Vac

Frequency : 48 to 66 Hz

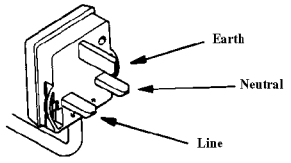
Power : 200 VA maximum

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.

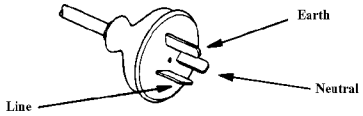
WARNING For protection from electrical shock, the power cable ground must not be defeated.The power plug must be plugged into an outlet that provides a protective earth ground connection.

OPTION 900 United Kingdom



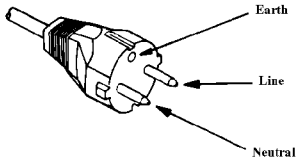
Plug : BS 1363A, 250V
Cable : HP 8120-1351

OPTION 901 Australia / New Zealand



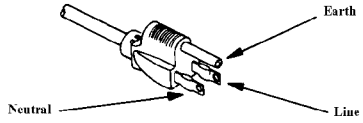
Plug : NZSS 198/AS C112, 250V
Cable : HP 8120-1369

OPTION 902 European Continent



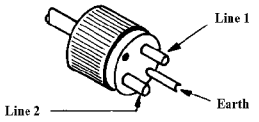
Plug : CEE-VII, 250V
Cable : HP 8120-1689

OPTION 903 U.S. / Canada



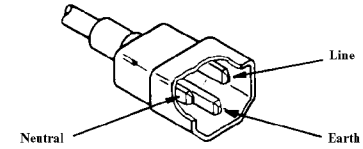
Plug : NEMA 5-15P, 125V, 15A
Cable : HP 8120-1378

OPTION 904 U.S. / Canada



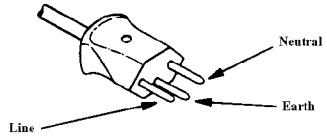
Plug : NEMA 6-15P, 250V, 15A
Cable : HP 8120-0698

OPTION 905* Any country



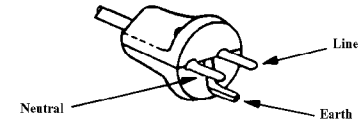
Plug : CEE 22-VI, 250V
Cable : HP 8123-1396

OPTION 906 Switzerland



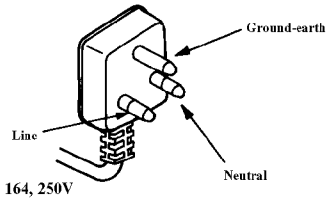
Plug : SEV 1011.1959-24507 Type 12, 250V
Cable : HP 8120-2104

OPTION 912 Denmark



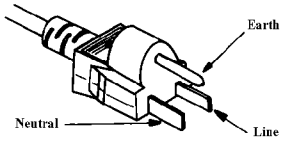
Plug : DHCR 107, 220V
Cable : HP 8120-2956

OPTION 917 India / Republic of S.Africa



Plug : SABS 164, 250V
Cable : HP 8120-4211

OPTION 918 Japan



Plug : JIS C 8303, 125V, 15A
Cable : HP 8120-4753

NOTE: Each option number includes a 'family' of cords and connectors of varoius materials and plug body configurations (straight, 90° etc.).

* Plug option 905 is frequently used for interconnecting system components and peripherals.

Figure 1-1. Power Cable Supplied

1-3. Line Voltage and Fuse Selection

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

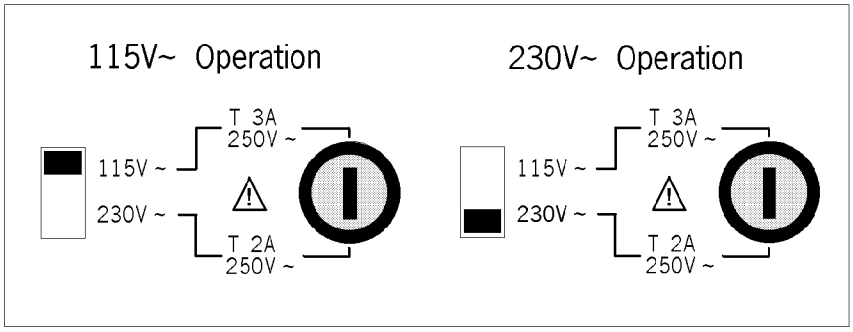


Figure 1-2. Line Voltage Selector

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, 48–66 Hz
230 V~	198–252 V, 48–66 Hz

⚠ Fuse Selection

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 Agilent 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 Agilent Technologies 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!

1-4. Operation Environment

The 4279A must be operated under within the following environment conditions, and sufficient space must be kept behind the 4279A to avoid obstructing the air flow of the cooling fans.

Temperature: 5°C to 45°C

Humidity: less than 95% RH at 40°C

Note The 4279A must be protected from temperature extremes which could cause condensation within the instrument.

1-5.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.

1-6. Ventilation Requirements

To ensure adequate ventilation, make sure that there is adequate clearance around the 4279A.

1-7. Instruction for Cleaning

To prevent electrical shock, disconnect the 4279A 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 4279A internally.

1-8. 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 4279A.

Table 1-4. Rack Mount Kits

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

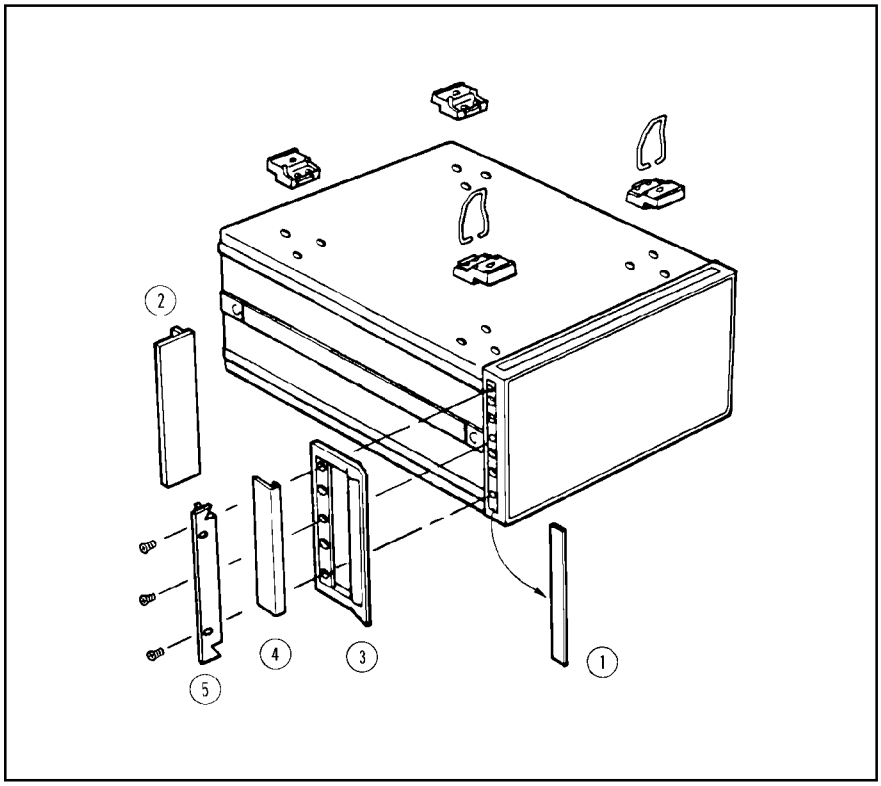


Figure 1-3. Rack Mount Kits Installation

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 4279A. (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 4279A. (Refer to Figure 1-3.)
2. Attach the rack mount flange ④ to the left and right front sides of the 4279A 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 4279A.
2. Attach the front handle 3 and the rack mount flange 5 together on the left and right front sides of the 4279A 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).

Agilent 4279A
1MHz C-V Meter

MANUAL IDENTIFICATION

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Date Printed: March 2000
Part Number: 04279-90010

Operation Manual

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1. Make all ERRATA corrections
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SERIAL PREFIX OR NUMBER	MAKE MANUAL CHANGES
2737J00120 and above	1

SERIAL PREFIX OR NUMBER	MAKE MANUAL CHANGES

◆ New Item

ERRATA

CHANGES 1

CHANGE 1 contains the information needed to adapt the 4279A's manual to instruments with ROM-based firmware 2.0.

NOTE

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PRINTED IN JAPAN

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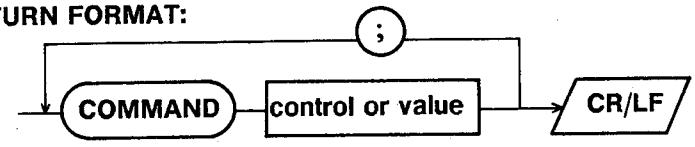
Page 4-3, 4-5. *LRN? COMMAND:

Change the return format and the order of the returned commands as follows:

RETURN FORMAT:



The order of the returned commands are:

Order	Command	Order	Command	Order	Command
1	MPAR	15	SHOR	25	DPAG
2	OSC	16	STD	26	DDIG
3	BIAS	17	SPAR	27	VMON
4	BMOD	18	CSTD=	28	TRIG
5	SBI=	19	DSTD=	29	DFMT
6	BTAB=		or	30	DSEC
7	APOL		GSTD=	31	DPOL
8	RANG	20	MCOM0		
9	ITIM		or		
10	AVE=		MCOM1;CNO=		
11	TDEL=	21	AOFF		
12	SDEL=	22	OFFA=		
13	CABL	23	BOFF		
14	OPEN	24	OFFB=		

Page 5-33, 5-9-4. MULTI-COMPENSATION:

Add the following information to paragraph 5-9-4.

When multi compensation is used, either the **'MULTI COMPEN'** softkey must be pressed or the **MCOM1** HP-IB command must be sent. When multi compensation is not used (single compensation mode), either the **'SINGLE COMPEN'** softkey must be pressed or the **MCOM0** HP-IB command must be sent. The default setting for the compensation mode is the **multi copensation mode.**

NOTE

When the compensation mode is changed from multi to single the compensation data remains the same. The compensation data cannot be changed while in the single compensation mode.

NOTE

The settling time for the test signal selection in the single compensation mode is much shorter than the settling time for the test signal selection in the multi compensation mode.

Add the following step before step 1 in the [MULTI COMPENSATION PROCEDURE].

Press the **'MULTI COMPEN'** softkey.

Add the following HP-IB device dependent command.

HP-IB DEVICE DEPENDENT COMMANDS

MCOM command

This command sets the compensation mode to either the multi compensation mode or the single compensation mode. The default setting is MCOM1.

SYNTAX:

CONTROL PARAMETER: The control parameter choices are:

Control Parameter	Description
0	Set the compen.mode to **SINGLE COMPEN** mode
1	Set the compen.mode to **MULTI COMPEN** mode

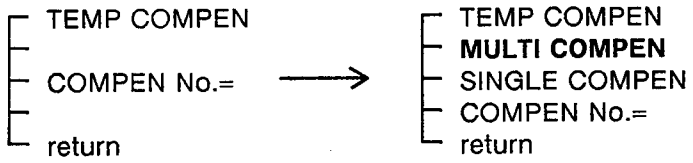
EXAMPLE: OUTPUT 717;"MCOM0"!Set the compen.mode to SINGLE COMPEN mode

Page 8-19, Table 8-4. Supplimental Performance Characteristics:

Delete the settling time for the test signal level selection.

Page B-2, APPENDIX B.SOFTKEY TREE:

Change part of the softkey tree on page 2 of 4 as follows.



Page C-1, APPENDIX C. DEFAULT SETTINGS AND INTERNAL MEMORY, C-1. DEFAULT SETTINGS AT POWER-ON:

Add the following item to the table.

Compensation Mode	MULTI COMPEN
Compensation Data Number(CNO=)	0

Page G-1, APPENDIX G.QUICK REFERENCE LIST OF HP-IB COMMAND:

Add the following commands to the list.

MCOM0	Single Compensation Mode
MCOM1	Multi Compensation Mode (Default Setting)

CAUTIONS ON OPERATION

CAUTION

DO NOT APPLY A DC VOLTAGE OR CURRENT TO THE UNKNOWN (MEASUREMENT) TERMINALS. DOING SO WILL DAMAGE THE 4279A. BEFORE YOU MEASURE A CAPACITOR, BE SURE THE CAPACITOR IS FULLY DISCHARGED.

WARNING

DO NOT CONNECT A CAPACITANCE OF MORE THAN 0.05μF. THE ELECTRICAL ENERGY STORED IN THE CAPACITOR MAY CAUSE PERSONAL INJURY.

Agilent Technologies
Innovating the HP Way

DECLARATION OF CONFORMITY

According to ISO/IEC Guide 22 and CEN/CENELEC EN 45014

Manufacturer's Name: Agilent Technologies Japan, Ltd.
Manufacturer's Address: Component Test PGU-Kobe
1-3-2, Murotani, Nishi-ku, Kobe-shi,
Hyogo, 651-2241 Japan

Declares, that the product

Product Name: 1 MHz C-V Meter
Model Number: 4279A
Product Options: All options and customized products based on the above

Is in conformity with:

EMC European Council Directive 89/336/EEC and carries the CE-marking accordingly
EMC Standards required by the Australia Radio Communications Act
CISPR 11:1990 / EN 55011:1991 / AS/NZS 2064.1– Group 1 Class A [1]
EN61000-3-3:1995 / IEC61000-3-3:1994
EN50082-1:1992
IEC 801-2:1991 (4 kV CD, 8 kV AD)
IEC 801-3:1984 (3 V/m 80% AM)
IEC 801-4:1988 (1 kV power line, 0.5 kV Signal line)

Safety European Council Directive 73/23/EEC and carries the CE-marking accordingly
IEC 61010-1:1990+A1+A2 / EN 61010-1:1993+A2

Additional Information:

LEDs in this product are Class 1 in accordance with EN 60825-1:1994.

[1] The product was tested in a typical configuration.

Dec. 15, 1999
Date

Name Yukihiko Ota / Quality Engineering Manager

For further information, please contact your local Agilent Technologies sales office, agent or distributor.

Safety Summary

When you notice any of the unusual conditions listed below, immediately terminate operation and disconnect the power cable.
Contact your local Agilent Technologies sales representative or authorized service company for repair of the instrument. If you continue to operate without repairing the instrument, there is a potential fire or shock hazard for the operator.

- Instrument operates abnormally.
- Instrument emits abnormal noise, smell, smoke or a spark-like light during the operation.
- Instrument generates high temperature or electrical shock during operation.
- Power cable, plug, or receptacle on instrument is damaged.
- Foreign substance or liquid has fallen into the instrument.

Herstellerbescheinigung

GERÄUSCHEMISSION

LpA < 70 dB
am Arbeitsplatz
normaler Betrieb
nach DIN 45635 T. 19

Manufacturer's Declaration

ACOUSTIC NOISE EMISSION

LpA < 70 dB
operator position
normal operation
per ISO 7779

Agilent 4279A 1MHz C-V Meter
(Including Options 003)

Operation Manual

Agilent Technologies

Agilent Part No. 04279-90010
Printed in JAPAN March 2000

Third Edition

Notice

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

Agilent Technologies Japan, Ltd.
Component Test PGU-Kobe
1-3-2, Murotani, Nishi-ku, Kobe-shi,
Hyogo, 651-2241 Japan

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 that are incorporated at reprint do not cause the date to change.) The manual part number changes when extensive technical changes are incorporated.

September 1987 .....First Edition (part number: 04279-90000)

December 1996 .....Second Edition (part number: 04279-90010)

March 2000 .....Third Edition (part number: 04279-90010)

Certification

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

Warranty

This Agilent Technologies 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 *General Information* of this manual, the warranty shall be for the specified period. During the warranty period, Agilent Technologies will, at its option, either repair or replace products that prove to be defective.

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

Agilent Technologies warrants that its software and firmware designated by Agilent Technologies for use with an instrument will execute its programming instruction when property installed on that instrument. Agilent Technologies 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 the environmental specifications for the product, or improper site preparation or maintenance.

No other warranty is expressed or implied. Agilent Technologies 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. Agilent Technologies 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 Agilent Technologies products.

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

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 Agilent Technologies assumes no liability for the customer's failure to comply with these requirements.

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 Agilent Technologies 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.

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

This **Note** sign 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.

Typeface Conventions

Bold	Boldface type is used when a term is defined. For example: **icons** are symbols.
Italics	Italic type is used for emphasis and for titles of manuals and other publications. Italic type is also used for keyboard entries when a name or a variable must be typed in place of the words in italics. For example: `copy` *filename* means to type the word `copy`, to type a space, and then to type the name of a file such as `file1`.
`Computer`	Computer font is used for on-screen prompts and messages.
HARDKEYS	Labeled keys on the instrument front panel are enclosed in .
SOFTKEYS	Softkeys located to the right of the LCD are enclosed in .

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SECTION 1

RECEIVING AND GETTING READY TO USE YOUR HP 4279A

1-1. INTRODUCTION

This section covers the receiving and setting up of your HP 4279A. Figure 1-1 shows the HP 4279A with its furnished accessories.

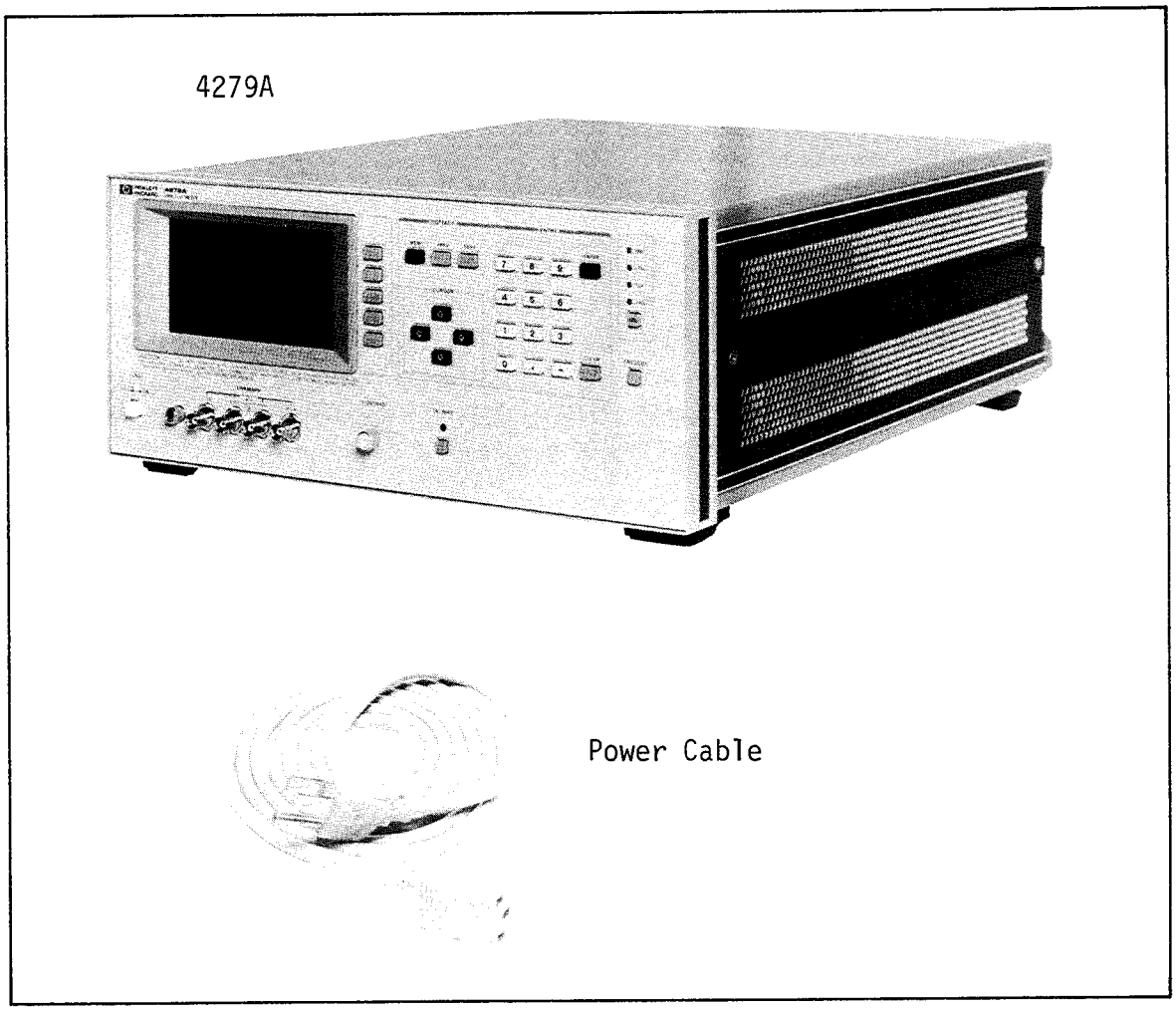


Figure 1-1. HP 4279A and Furnished Accessories

1-2. INITIAL INSPECTION

When shipped from the factory, the 4279A meets all of the specifications listed in Section 8. When you receive the 4279A, inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the shipment has been checked for completeness, and the instrument has been verified mechanically and electrically. The shipping container should contain everything shown in Figure 1-1. Procedures for verifying the electrical performance of the 4279A are given in Section 9. If the shipment is incomplete, or if the instrument is damaged in any way, or if the instrument does not pass the Performance Tests outlined in Section 9, notify the carrier and Hewlett-Packard. Keep the shipping materials for the carrier to inspect. Your HP sales office will arrange for repair or replacement of a damaged 4278A, you won't have to wait for the claim to be settled.

1-3. PREPARATION FOR USE

1-3-1. POWER REQUIREMENTS

The 4279A requires a power source of 100, 120, 220V AC ±10%, or 240VAC +5% -10%, 48 to 66Hz, single phase; power consumption is 200VA, maximum.

WARNING

THIS IS A SAFETY CLASS 1 PRODUCT (PROVIDED WITH A PROTECTIVE EARTH TERMINAL). A NONINTERRUPTABLE SAFETY EARTH GROUND MUST BE PROVIDED FROM THE MAIN POWER SOURCE TO THE 4278A'S POWER INPUT TERMINALS, POWER CORD, OR FURNISHED POWER CORD SET. IF THE SAFETY EARTH GROUND BECOMES IMPAIRED, DISCONNECT THE 4279A AND SECURE IT AGAINST ANY OPERATION. IF YOUR 4279A IS TO BE ENERGIZED VIA AN AUTOTRANSFORMER FOR VOLTAGE REDUCTION, MAKE SURE THE COMMON TERMINAL IS CONNECTED TO THE EARTH TERMINAL OF THE POWER SOURCE.

1-3-2. LINE VOLTAGE AND FUSE SELECTION

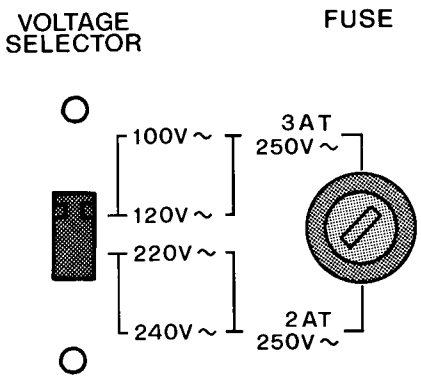
CAUTION

BEFORE CONNECTING THE INSTRUMENT TO THE POWER SOURCE, MAKE SURE THE CORRECT FUSE IS INSTALLED AND THE LINE VOLTAGE SELECTION SWITCH IS SET TO THE CORRECT VOLTAGE.

Figure 1-2 shows the line voltage selector switch and the fuse holder, and provides instructions for line voltage and fuse selection. Fuse current ratings are printed on the rear panel and are listed, along with the fuse's HP part number, in Figure 1-2.

CAUTION

USE ONLY THE CORRECT FUSE FOR THE LINE VOLTAGE SELECTED. MAKE SURE THAT ONLY FUSES WITH THE REQUIRED CURRENT RATING AND OF THE SPECIFIED TYPE ARE USED AS REPLACEMENTS. NEVER USE A MENDED FUSE AND NEVER SHORT-CIRCUIT THE FUSE HOLDER.



Line Voltage Selection

Set the VOLTAGE SELECTOR switch to the required line voltage.

Fuse Removal

Turn the fuse holder counterclockwise until it pops out of the holder.

Line Voltage	Fuse Rating	Part No.
100V/120V	3A Slow:	2110-0381
220V/240V	2A Slow:	2110-0303

Figure 1-2. Line Voltage and Fuse Selection

1-3-3. POWER CABLE

To protect operating personnel, the National Electrical Manufacturer's Association (NEMA) recommends both the instrument panel and cabinet be grounded. The 4279A is equipped with a three-conductor power cable that, when plugged into an appropriate AC power receptacle, grounds the instrument. The offset pin on the power cable is ground.

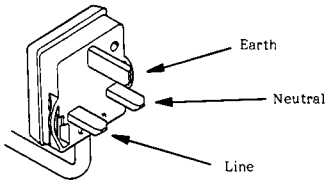
To preserve the protection feature when operating the instrument from a two contact outlet, use a three-prong to two-prong adapter (PN 1251-8196) and connect the green pigtail on the adapter to the power-line ground.

CAUTION

THE POWER PLUG MUST BE PLUGGED INTO AN OUTLET THAT PROVIDES A PROTECTIVE EARTH CONNECTION. DO NOT USE AN EXTENSION CORD OR POWER CABLE THAT DOES NOT HAVE A PROTECTIVE GROUND.

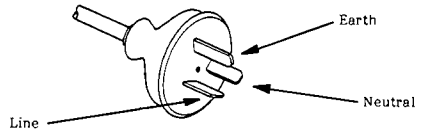
Figure 1-3 shows the available power cords used in various countries. Also shown is the standard power cord furnished with the instrument. HP part numbers, applicable standards for power plugs, electrical characteristics, and the countries using each power cord are listed in Figure 1-3. For assistance in selecting the correct power cable, contact the nearest Hewlett-Packard sales office.

OPTION 900 United Kingdom



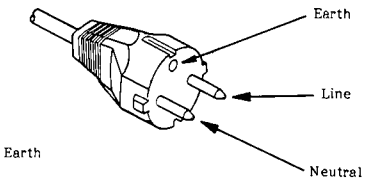
Plug: BS 1363A, 250V
Cable: HP 8120-1351

OPTION 901 Australia/New Zealand



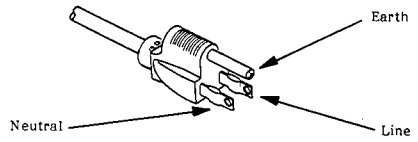
Plug: NZSS 198/AS C112, 250V
Cable: HP 8120-1369

OPTION 902 European Continent



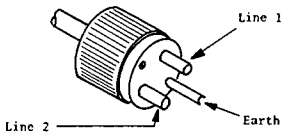
Plug: CEE-VII, 250V
Cable: HP 8120-1689

OPTION 903 U.S./Canada



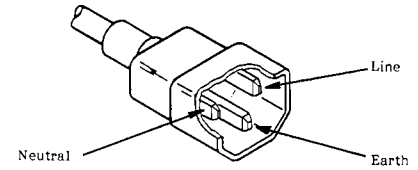
Plug: NEMA 5-15P, 125V, 15A
Cable: HP 8120-1378

OPTION 904 U.S./Canada



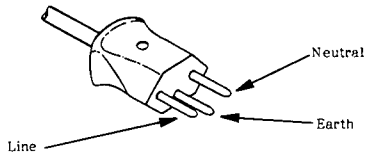
Plug: NEMA 6-15P, 250V, 15A
Cable: HP 8120-0698

OPTION 905* Any country



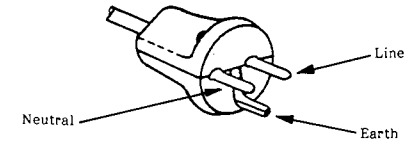
Plug: CEE 22-VI, 250V
Cable: HP 8120-1396

OPTION 906 Switzerland



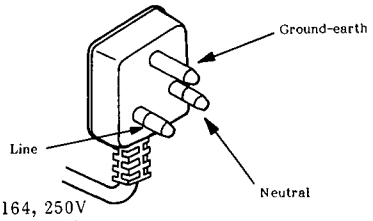
Plug: SEV 1011.1959-24507 Type 12, 250V
Cable: HP 8120-2104

OPTION 912 Denmark



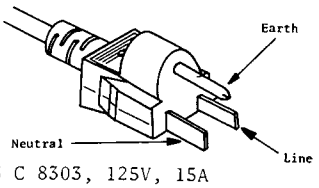
Plug: DHCR 107, 220V
Cable: HP 8120-2956

OPTION 917 India/Republic of S.Africa



Plug: SABS 164, 250V
Cable: HP 8120-4211

OPTION 918 Japan



Plug: JIS C 8303, 125V, 15A
Cable: HP 8120-4753

NOTE: Each option number includes a 'family' of cords and connectors of various materials and plug body configurations (straight, 90° etc.).

* Plug option 905 is frequently used for interconnecting system components and peripherals.

Figure 1-3. Available (furnished) Power Cables

1-4. HP-IB CONNECTION

The 4279A is designed for operation on the Hewlett-Packard Interface Bus (HP-IB).

The 4279A is connected to the HP-IB by connecting an HP-IB interface cable to the HP-IB connector on the rear panel. A typical HP-IB system interconnection is shown in Figure 1-4.

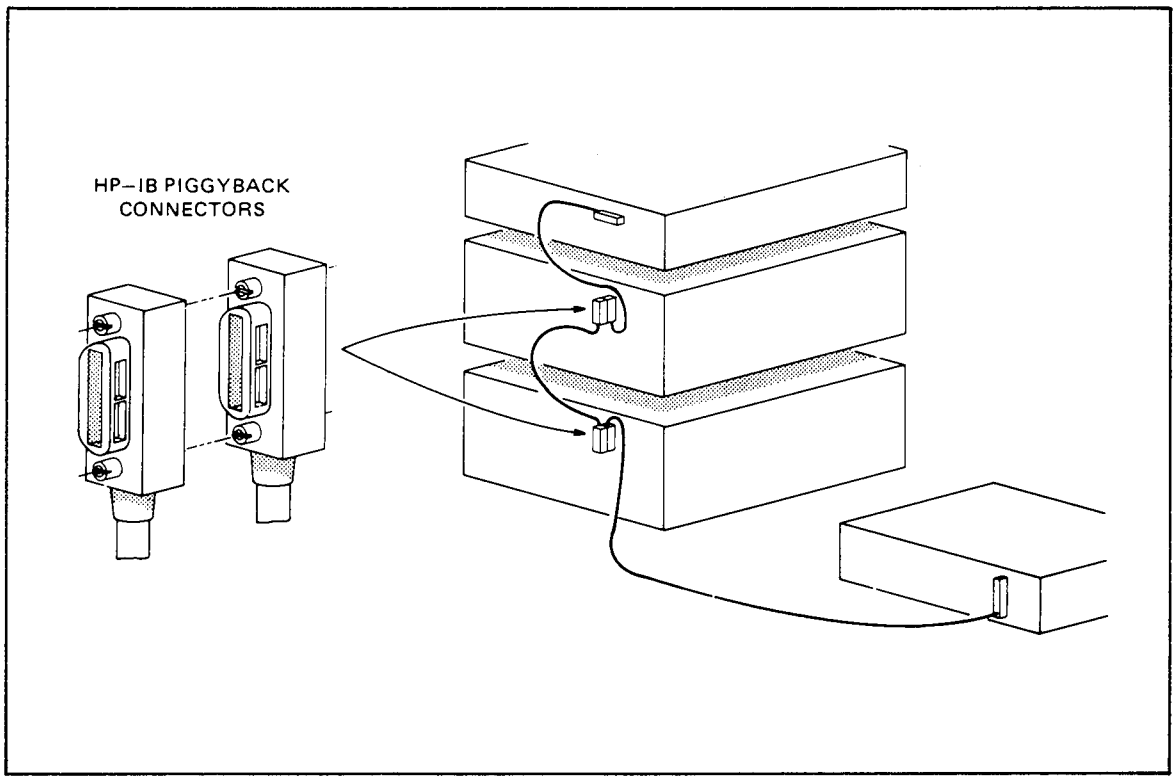
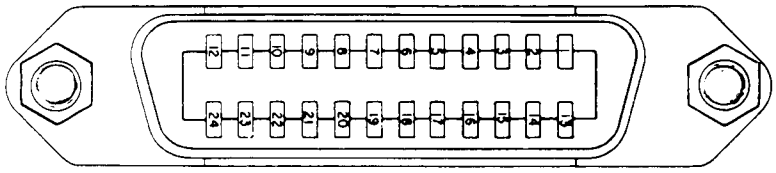


Figure 1-4. Typical HP-IB System Interconnection

Up to 15 HP-IB compatible instruments can be interconnected using the HP-IB interface bus. The HP 10833 HP-IB cables use back to back male-female connectors so several cables can be connected at a single point without having to use special adapters or switch boxes. System components and devices can be connected in virtually any configuration as long as a path exists between each device and the controller. If too many connectors are stocked together, their weight can produce sufficient leverage to damage the connector mounting. Be sure that each connector is screwed firmly in place to keep it from working loose during use. The HP 4278A uses all of the available HP-IB lines, so damage to any connector pin will adversely affect HP-IB operation. See Figure 1-5.

CAUTION

THE 4279A CONTAINS METRIC THREADED HP-IB CABLE MOUNTING STUDS. THE METRIC VERSION OF THE HP 10833A, B, C, OR D HP-IB CABLE FASTENERS ARE DISTINGUISHED FROM THE ENGLISH VERSION BY COLOR. ENGLISH THREADED FASTENERS ARE SILVER; METRIC THREADED FASTENERS BLACK. DO NOT ATTEMPT TO MATE SILVER AND BLACK FASTENERS TO EACH OTHER. IF YOU DO, THE THREADS OF EITHER OR BOTH WILL BE DAMAGED.



PIN	LINE
1	DI01
2	DI02
3	DI03
4	DI04
13	DI05
14	DI06
15	DI07
16	DI08
5	EOI
17	REN
6	DAV
7	NRFD
8	NDAC
9	IFC
10	SRQ
11	ATN
12	SHIELD–CHASSIS GROUND
18	P/O TWISTED PAIR WITH PIN 6
19	P/O TWISTED PAIR WITH PIN 7
20	P/O TWISTED PAIR WITH PIN 8
21	P/O TWISTED PAIR WITH PIN 9
22	P/O TWISTED PAIR WITH PIN 10
23	P/O TWISTED PAIR WITH PIN 11
24	ISOLATED DIGITAL GROUND

THESE PINS ARE INTERNALLY GROUNDED

HP-IB Interconnect Cables

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)

Figure 1-5. HP-IB Interfacing

SECTION 2

PANEL FEATURES AND DISPLAY FORMAT

2-1. INTRODUCTION 2-1

2-2. PANEL FEATURES 2-1

2-3. DISPLAY FORMAT 2-6

2-3-1. MEASUREMENT PAGE FORMAT 2-6

2-3-2. STATUS PAGE FORMAT 2-7

2-3-3. BLANK PAGE FORMAT 2-8

SECTION 2

PANEL FEATURES AND DISPLAY FORMAT

2-1. INTRODUCTION

This section provides information on the panel features and the display format of the HP 4279A 1MHz C-V Meter.

The **WARNINGS**, **CAUTIONS**, and **Notes** given throughout this document must be carefully followed to ensure the operator's safety and the serviceability of the 4279A.

WARNING

BEFORE TURNING THE 4279A ON, BE SURE ALL PROTECTIVE EARTH TERMINALS, EXTENSION CORDS, AUTO-TRANSFORMERS, AND DEVICES CONNECTED TO THE 4279A ARE CONNECTED TO EARTH GROUND. ANY INTERRUPTION OF EARTH GROUND CONSTITUTES A SHOCK HAZARD WHICH MAY RESULT IN PERSONAL INJURY.

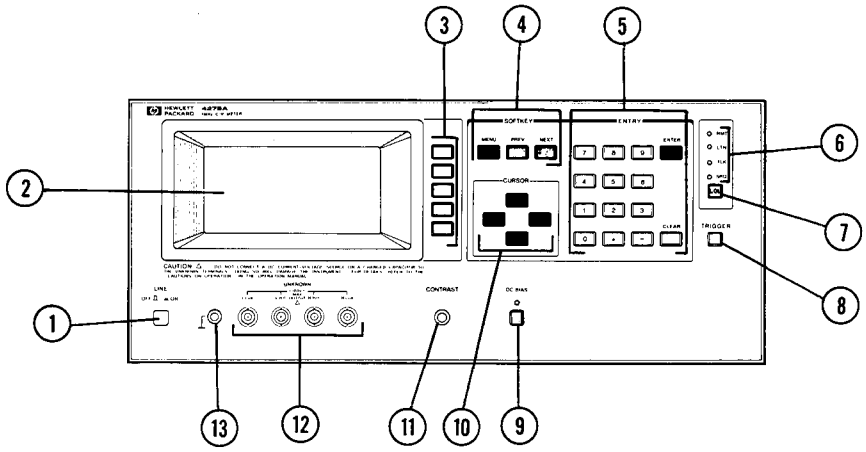
ONLY FUSES WITH THE REQUIRED CURRENT RATING AND OF THE SPECIFIED TYPE CAN BE USED. DO NOT USE A SUBSTITUTE FOR THE PROPER FUSE AND NEVER SHORT CIRCUIT THE FUSE-HOLDER. DOING SO CONSTITUTES A SHOCK AND FIRE HAZARD.

CAUTION

BEFORE YOU TURN THE 4279A ON, SET THE VOLTAGE SELECTOR TO THE LINE VOLTAGE TO BE USED, OR THE INSTRUMENT WILL BE DAMAGED.

2-2. PANEL FEATURES

Figures 2-1 and 2-2 identify and briefly describe the purpose of each key, indicator, and connector on the front and rear panels of the 4279A.



(1) **LINE ON/OFF** Switch

ON= key in, **OFF**= key out.

(2) **LCD** (liquid crystal display)

Displays measurement results, test conditions, etc.

(3) **Softkeys**

Controls the 4279A's settings. The softkey function labels are displayed in the softkey area of the LCD.

(4) **SOFTKEY** Page Control Keys

These keys are used to change the displayed softkey labels. The **MENU** key returns the displayed softkey labels to the first page of the highest level. The **PREV** and **NEXT** keys display the previous or next set of softkey labels.

(5) **ENTRY** Keys

These keys are used to enter numeric data into the 4279A. The **ENTER** key terminates numeric input and enters the displayed value on the Input Line (third line from the bottom of the LCD). The **ENTER** key is also used to execute commands displayed on the LCD. The **CLEAR** key clears the Input Line and the Message Line (bottom line on LCD).

Figure 2-1. Front Panel Features (Sheet 1 of 2)

(6) **HP-IB** Status Indicators

The **RMT** (remote), **TLK** (talk), **LTN** (listen), and **SRQ** (service request) indicators are used to show the status of the 4279A's status when interfaced to a controller via HP-IB.

(7) **LCL** (local) Key

This key sets the 4279A to local control.

(8) **TRIGGER** Key

This key is used to trigger the 4279A when the 4279A is set to the **MAN**ual **TRIG**ger mode.

(9) **DC BIAS** Key

The **DC BIAS** key sets the DC BIAS mode to ON or OFF.

(10) **CURSOR** keys

These four arrow keys move the cursor on the LCD in the direction of the arrow.

(11) **CONTRAST** Adjust Control

Controls the LCD contrast.

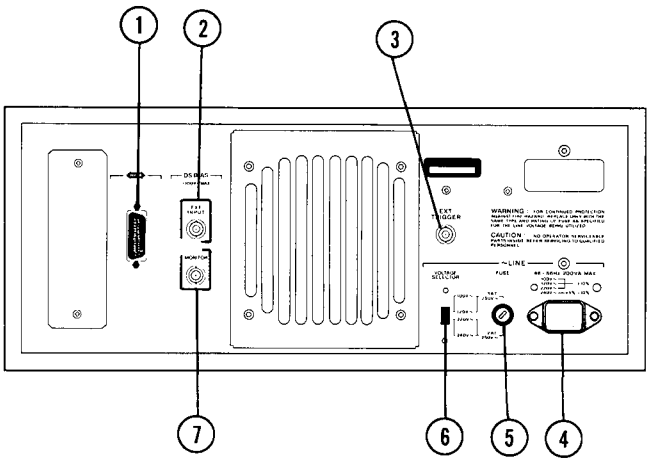
(12) **UNKNOWN** Terminals

These terminals are used to connect four terminal-pair test fixtures or test leads to the 4278A.

(13) **Guard** Terminal

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

Figure 2-1. Front Panel Features (Sheet 2 of 2)



This illustration shows the 4279A's rear panel.

(1) **HP-IB** Connector

The HP-IB interface connectors will be installed as shown.

(2) **EXT INPUT** Connector

A DC bias voltage of up to ±100V applied at this connector is applied to the DUT when the dc bias mode is set to **EXT**ernal.

(3) **EXT TRIGGER** Connector

A positive-going TTL pulse applied at this connector triggers the 4279A when the trigger mode is set to **EXT**ernal.

(4) ~ **LINE** Input Receptacle

AC power cord receptacle.

(5) ~ **LINE** Fuse Holder

The 4279A's line fuse is installed in this fuse holder. Refer to Section 1 to determine the correct line fuse rating.

Figure 2-2. Rear Panel Features (Sheet 1 of 2)

(6) ~ **LINE VOLTAGE SELECTOR**

AC operating voltage selector switch.

(7) **MONITOR** Connector

Output terminal for the internal or external dc bias source.

Figure 2-2. Rear Panel Features (Sheet 2 of 2)

2-3. DISPLAY FORMATS

The following paragraphs describe the display formats on the LCD display.

2-3-1. MEASUREMENT PAGE FORMAT

On this page, measurement results are displayed in the measurement data field in large characters, as shown in Figure 2-3. The time requires to display each measurement result is approximately 5ms.

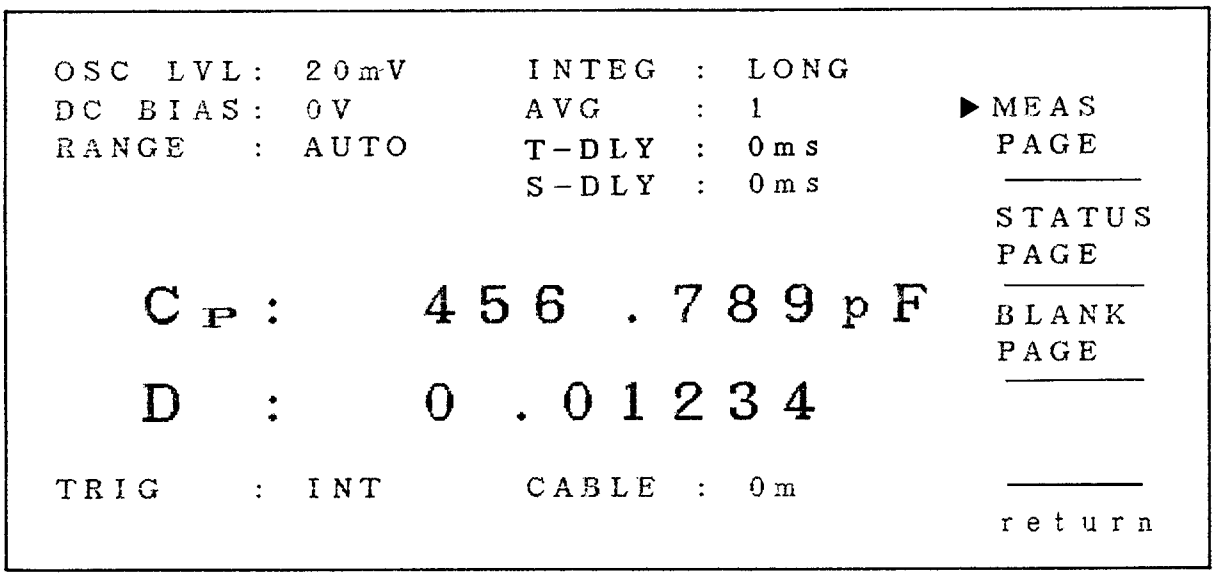


Figure 2-3. Measurement Page Format

2-3-2. STATUS PAGE FORMAT

Open compensation admittance data, short compensation impedance data, standard reference data, standard actual measurement data for standards compensation, and display offset data are displayed in the measurement data field of this page as shown in Figure 2-4. This format does not display the results of each measurement, so the time required to display measurement is saved, but when the compensation data number is changed, the time required to display the compensation data is approximately 110ms. For more information about compensation, refer to Section 5-9, Compensation.

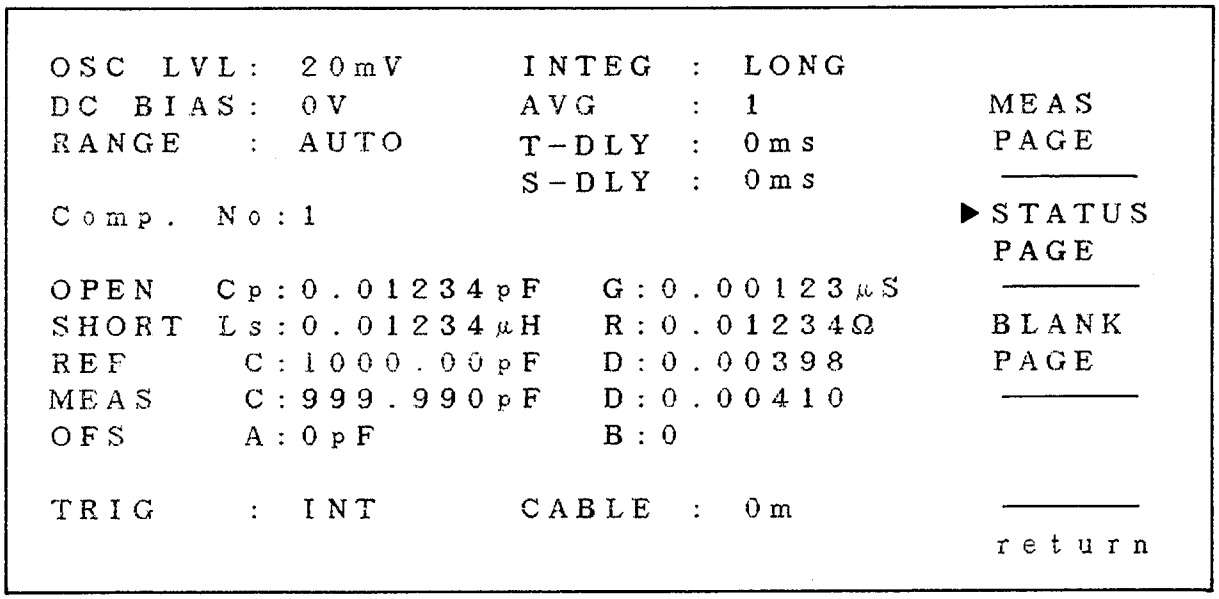


Figure 2-4. Status Page Format

2-3-3. BLANK PAGE FORMAT

On this page, only the softkey labels are displayed on the LCD display, and the measurement values and status data are not displayed. Therefore the time required to display the measurement results and the compensation data is saved. This format is useful when the 4279A is used as part of an automatic capacitor test system.

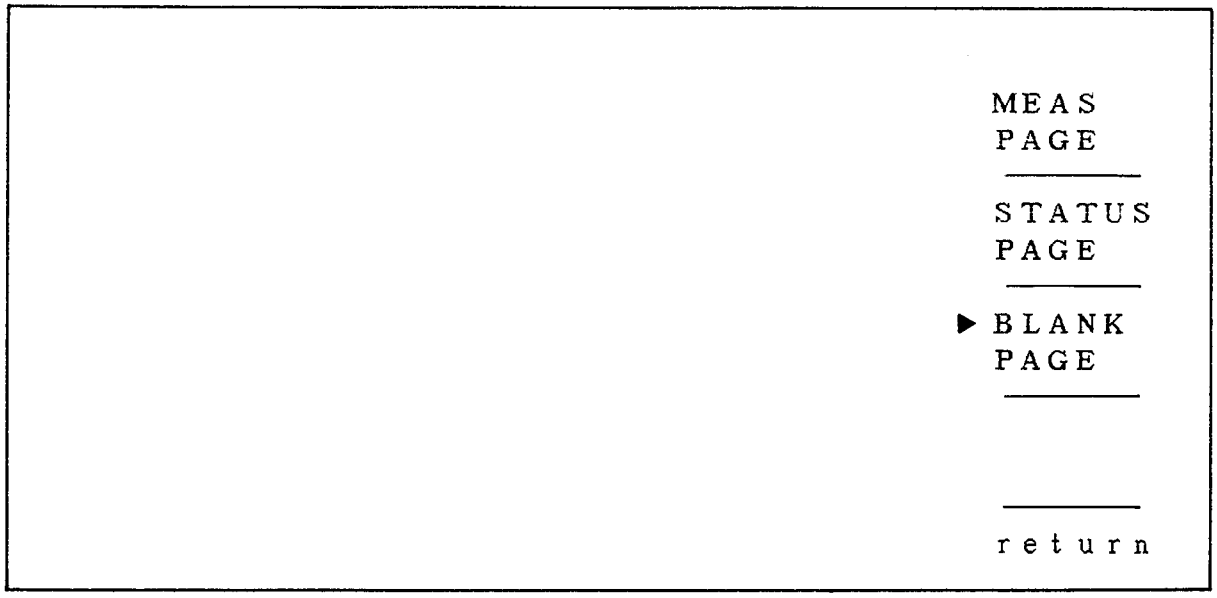


Figure 2-5. Blank Page Format

SECTION 3

HP IB INTERFACE

3-1. INTRODUCTION 3-1

3-2. HP-4279A HP-IB CAPABILITY 3-1

3-3. HP-IB ADDRESSING 3-1

3-4. HP-IB BUS COMMANDS 3-2

3-5. HP-4279A DEVICE DEPENDENT HP-IB COMMANDS 3-5

3-6. STATUS BYTE 3-7

SECTION 3

HP-IB INTERFACE

3-1. INTRODUCTION

The HP 4279A can be controlled on the HP-IB bus by desktop computers and minicomputers with other instruments to create automated measurement systems. HP-IB is Hewlett-Packard's implementation of IEEE Standard 488-1978, IEEE Standard 728-1982, Digital Interface for Programmable Instrumentation.

3-2. HP 4279A HP-IB CAPABILITY

Table 3-1 lists the 4279A's IEEE Standard 488-1978, 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 3-1. HP-IB Interface Capability

CODE	FUNCTION
SH1	Complete Source Handshake capability
AH1	Complete Acceptor Handshake capability
T5	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

3-3. HP-IB ADDRESSING

The 4279A's HP-IB address is stored in non-volatile memory and can be set to any address from 0 to 30 with front panel key entry. When the 4279A is shipped from the factory its default HP-IB address is 17. For more information, refer to SECTION 5, 5-14. HP-IB DEFINITION.

3-4. HP-IB BUS COMMAND

The 4279A will respond to the following bus commands which are given as HP 200 series BASIC statements.

1. **ABORT I/O (IFC):**

   ABORT I/O halts all bus activity and deselects the 4279A.

   ABORT 7

2. **CLEAR LOCKOUT/SET LOCAL:**

   CLEAR LOCKOUT/SET LOCAL 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.

   LOCAL 7

3. **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 4279A will initialize itself when it receives this command. It is good programming practice to perform initialization at the very start of a program.

   CLEAR 7: clears all devices on port 7.

   CLEAR 717: clears the instrument with address 17.

4. **LOCAL (GTL):**

   LOCAL returns control of a listening device to front panel control.

   LOCAL 717

5. **LOCAL LOCKOUT (LLO):**

   LOCAL LOCKOUT disables the **LOCAL** key of all devices on the bus. After this command is sent you will be unable to operate the 4279A from the front panel. Execute the **LOCAL** command to undo **LOCAL LOCKOUT**.

   LOCAL LOCKOUT 7

6. **REMOTE:**

REMOTE sets the 4279A to the remote mode. When this command is sent, the front panel with the exception of the **LCL** key will be disabled. If **LOCAL LOCK-OUT** is asserted then the front panel **LCL** key will also be disabled.

REMOTE 7: sets all devices on port 7 to remote

REMOTE 717: sets the instrument with address 17 to remote.

7. **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 4279A's operating state. See paragraph 3-6 for more information on the status byte.

Var=SPOLL(717): the instrument with address 17 is serial polled.

8. **SERVICE REQUEST:**

The 4279A 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 4279A 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 4279A 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 4279A to set the **SRQ** line. See paragraph 3-6. for more information on the status byte.

9. **TRIGGER (GET):**

Enables the 4279A 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 4279A must first be addressed as listener before the trigger message is sent.

SEND 7;UNL MTA LISTEN 17

TRIGGER 7

UNL=UNLISTEN: unaddresses all listeners

MTA=MY TALK ADDRESS: sets the controller to talk

LISTEN: sets the instrument addressed as 17 to listen

3-5. 4279A DEVICE DEPENDENT COMMANDS

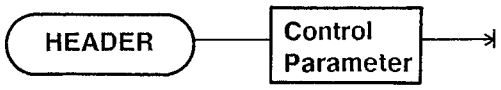
The 4279A device dependent commands are 4279A specific commands which are classified into three types as follows. For information on 4279A specific commands, TYPE 1 commands are described in SECTION 4 as HP-IB common commands, and TYPE 2 and 3 commands are described mostly in SECTIONS 5 and 6.

[TYPE 1]

For example: *RST, *TRG, ERR?

TYPE 1 commands consist only of a command header. All commands of this type, except for the compensation commands (XOP, XSH, XSTD, and XTMP commands), are described in SECTION 4, HP-IB COMMON COMMANDS.

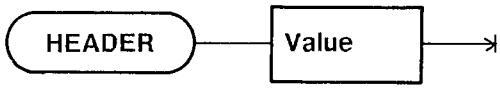
[TYPE 2]



For example: OSC1, RANG3, ITIM2

TYPE 2 commands consist of a command header and a control parameter. The numeric part of the control parameter is an integer. Do not put a space or a sign (+/ -) between the command header and the control parameter.

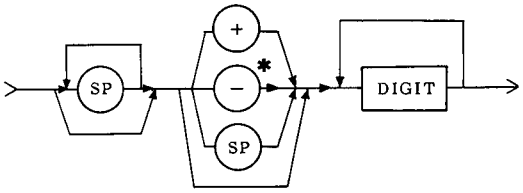
[TYPE 3]



For example: DTIM=.1E-3, OFFA=6E-12

Type 3 commands consist of a command header and a value. The numeric part of this value is can be in IEEE 728-1982 number format NR1, NR2, or NR3, which are defined as follows.

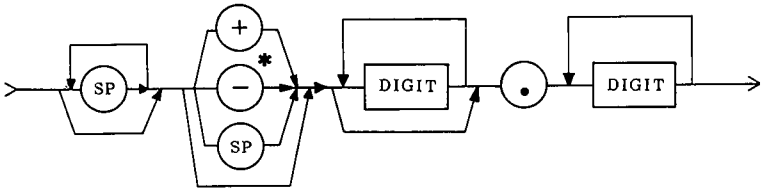
[NR1]



*: Not preferred for ZERO valued numeric data

NR1 example : -444, +16, 7

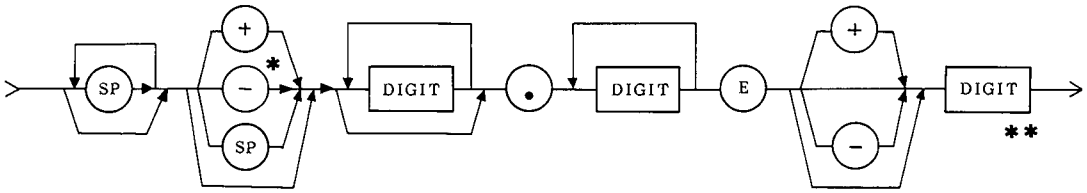
[NR2]



*: Not preferred for ZERO valued numeric data

NR2 example : 1.23, -1.23, .23

[NR3]



*: Not preferred for ZERO valued numeric data
**: This should be 3 digits

NR3 example : 3.0E-4, -.6E2, 4.5E+20

3-6. STATUS BYTE

The status-byte resister contains an 8-bit status word that is placed on the HP-IB bus when the 4279A is serially polled.

The value of each bit indicates the status of one of the 4279A's internal functions. Bits are set to "1" and reset to "0". The bit assignments of the status byte are listed below.

Table 3-2. Status Byte Assignments

BIT	Value	Description
0(LSB)	0/1	**Measurement Complete**
1	0/1	**End of Conversion**
2	0/1	**Ignore Trigger**
3	0/1	**End Status**
4	0	**always 0 (zero)**
5	0/1	**Error**
6	0/1	**RQS (Request Service)**
7(MSB)	0	**always 0 (zero)**

The definition of each bit is as follows:

BIT 0 (Measurement Complete):

BIT 0 is set when a measurement is completed, or when a measurement using dc bias sweep is executed and all measurements are completed.

BIT 1 (End of Conversion):

This bit is set when an analog measurement is completed. Then the measurement data is not valid yet.

BIT 2 (Ignore Trigger):

This bit is set when the instrument is busy taking measurement or compensation data in the EXT_TRIG mode, EXT_TRIG signal is entered. This bit is also set when the instrument is busy taking measurement or compensation data in the MAN_TRIG mode, MAN_TRIG signal is entered.

BIT 3 (End Status):

This bit is set when the following operations are completed.

1. End of open/short/standard compensation measurement
2. End of the self test
3. End of the EEPROM operation

BIT 4 (always 0):

This bit is always 0 (zero).

BIT 5 (Error):

This bit is the logical OR of all error conditions in 4279A. The error conditions include all HP-IB, hardware, and operation errors.

BIT 6 (RQS (Request Service)):

This bit is set when the instrument pulls the **SRQ** line low, and is cleared when a serial-poll is performed. This bit is non-maskable.

BIT 7 (always 0):

This bit is always 0 (zero).

Note

1. The status byte is cleared, reset to 0, when it is serially polled and **SRQ** is high, or when the ***CLS** command is used.
2. The status byte can be read by sending an ***STB?** query common command. The ***STB?** query common command will not clear the status byte.

Note

Masking the Status Byte

A service request will be generated when any unmasked bit in the status byte is set. The **SRQ** mask may be loaded by sending an ***SRE** command followed by an ASCII mask byte. In the default instrument state the setting is ***SRE0** (all zero: all bits masked). ***SRE** ranges from ***SRE0** to ***SRE255**.

For example:

***SRE1**	Enable B0 for SRQ
***SRE2**	Enable B1 for SRQ
***SRE3**	Enable B0 and B1 for SRQ
***SRE4**	Enable B2 for SRQ
***SRE8**	Enable B3 for SRQ
***SRE32**	Enable B5 for SRQ
***SRE45**	Enable B0, B2, B3, B5 for SRQ

SECTION 4

HP 4279A HP IB COMMON COMMANDS

4-1. INTRODUCTION 4-1

4-2. ERR? COMMAND 4-1

4-3. *CLS COMMAND 4-2

4-4. IDN? COMMAND 4-2

4-5. *LRN? COMMAND 4-3

4-6. *OPT? COMMAND 4-4

4-7. *RST COMMAND 4-4

4-8. *SRE COMMAND 4-5

4-9. *SRE? COMMAND 4-6

4-10. *STB? COMMAND 4-6

4-11. *TRG COMMAND 4-7

SECTION 4

HP 4279A HP IB COMMON COMMANDS

4-1. INTRODUCTION

This section provides information about the common HP-IB commands (noninstument specific HP-IB commands) used in writing HP-IB test programs. The common HP-IB commands consist of only a header. Each command is described using a SYNTAX diagram and an EXAMPLE is given using the HP 9000 Series 200 computer BASIC language.

4-2. ERR? COMMAND

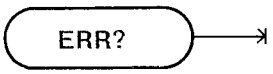
The **ERR?** command is used to read the current error message number, refer to APPENDIX D to match the error message corresponding to the returned error number. If no error has occurred a " **0** " is returned.

Note

When the **ERR?** command is executed the error number is stored in the 4279A's error register. The error register is cleared by the following.

1. ***RST** command is sent via HP-IB
2. The 4279A is powered-up
3. ***CLS** command is sent via HP-IB
4. The error number is read using the **ERR?** command

SYNTAX:



EXAMPLE:

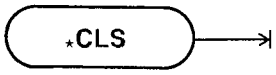
```
10    OUTPUT 717;"ERR?" ! Return the error number
20    ENTER 717;A ! Read the error number
30    DISP A ! Display the error number
40    END
```

Running the above program displays the current error message number.

4-3. *CLS COMMAND

The ***CLS** command is used to clear the status byte and the SRQ control signal. The status byte and SRQ control signal will be cleared even though the status byte is masked.

SYNTAX:



EXAMPLE:

```
OUTPUT 717;"*CLS" ! Clear the status byte
```

4-4. IDN? COMMAND

Executing the **IDN?** command returns the model name and ROM version number of the addressed instrument as follows:

HEWLETTPACKARD,4279A,0000A00000,REVn.n

Where
REVn.n is ROM version number.

SYNTAX:

EXAMPLE:

```
10   DIM A$[38]
20   OUTPUT 717;"*IDN?" ! Returns the identification
30   ENTER 717;A$ ! Read the identification
40   PRINT A$ ! Display the identification
50   END
```

Running the preceding program returns and displays the identification of the instrument with HP-IB address 717.

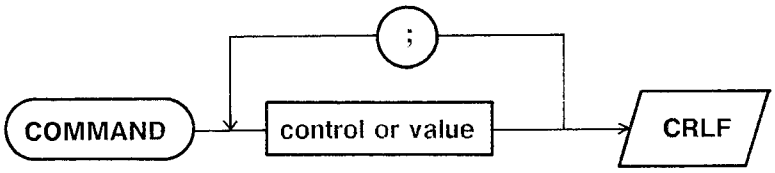
4-5. *LRN? COMMAND

The ***LRN?** command returns the current status of the 4279A.

SYNTAX:

RETURN FORMAT:

The current instrument's status are returned as follows:



The order of the returned commands are as follows:

Order	Command	Order	Command	Order	Command
1	**MPAR**	15	**SHOR**	27	**VMON**
2	**OSC**	16	**STD**	28	**TRIG**
3	**BIAS**	17	**SPAR**	29	**DFMT**
4	**BMOD**	18	**CSTD=**	30	**DSEC**
5	**SBI=**	19 [1]	**DSTD=**	31	**DPOL**
6	**BTAB=**		or		
7	**APOL**		**GSTD=**		
8	**RANG**	20	**CNO=**		
9	**ITIM**	21	**AOFF**		
10	**AVE=**	22	**OFFA=**		
11	**TDEL=**	23	**BOFF**		
12	**SDEL=**	24	**OFFB=**		
13	**CABL**	25	**DPAG**		
14	**OPEN**	26	**DDIG**		

[1] The returned command depends on the setting parameter of STD compensation when the ***LRN?** command is sent.

EXAMPLE:

```
10   DIM Lrn$[750]
20   OUTPUT 717;"*LRN?" ! Returns the current conditions
30   ENTER 717;Lrn$ ! Read the current conditions
40   PRINT Lrn$ ! Display the current conditions
50   END
```

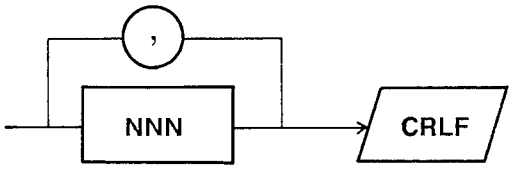
Running the preceding program returns and displays the current status of the addressed instrument.

4-6. *OPT? COMMAND

The ***OPT?** command is used to display the installed option number(s).

SYNTAX:

RETURNED FORMAT:



Option No.

(N: 0 to 9)

EXAMPLE:

```
10    DIM Opt$[50]
20    OUTPUT 717;"*OPT?" ! Returns all option numbers
30    ENTER 717;Opt$ ! Display all option numbers
40    PRINT Opt$ ! Display all option numbers
50    END
```

Running the preceding program displays all option numbers.

4-7. *RST COMMAND

The ***RST** command resets the 4279A to the power-on default conditions except for the following.

1. The 4279A is set to the remote mode.
2. The 4279A is set to the listener mode.
3. The SRQ line is not reset.
4. The mask for the status byte is not reset.
5. The status byte is not cleared.

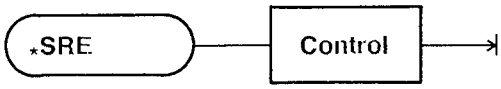
SYNTAX:

EXAMPLE: OUTPUT 717;"*RST" ! Reset the instrument

4-8. *SRE COMMAND

The service request command is a special HP-IB function that allows the instrument to flag the controller when a requested operation has taken place. The service request will be generated when any unmasked bit in the status byte is set. Then this command is used to mask or unmask bits in the status byte.

SYNTAX:



VALUE:

In the default instrument state the setting is ***SRE0** (all zeros: all bits masked). ***SRE** ranges from ***SRE0** to ***SRE255**. Use the following bit definitions to determine the bit mask pattern for your application.

Status Bit	"0"	"1"
B7 (always 0)	-	-
B6 (RQS)	Non-maskable	
B5 (Error)	Mask B5	enable B5 SRQ
B4 (Always 0)	-	-
B3 (End status)	Mask B3	enable B3 SRQ
B2 (Ignore trigger)	Mask B2	enable B2 SRQ
B1 (EOC)	Mask B1	enable B1 SRQ
B0 (Meas. complete)	Mask B0	enable B0 SRQ

For example:

***SRE1**	Enable B0 for SRQ
***SRE2**	Enable B1 for SRQ
***SRE3**	Enable B0 and B1 for SRQ
***SRE4**	Enable B2 for SRQ
***SRE8**	Enable B3 for SRQ
***SRE32**	Enable B5 for SRQ
***SRE45**	Enable B0, B2, B3, B5 for SRQ

EXAMPLE:

```
OUTPUT 717;"*SRE1" ! Enable B0 for SRQ.
```

4-9. *SRE? COMMAND

The ***SRE?** command is used to read the status byte mask pattern input by the ***SRE** command.

SYNTAX:

EXAMPLE:

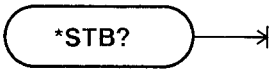
```
10    OUTPUT 717;"*SRE?" ! Returns the *SRE's input value
30    ENTER 717;A ! Read *SRE's input value
40    DISP A ! Display *SRE's input value
50    END
```

Running the above program returns and displays the value input with the ***SRE** command.

4-10. *STB? COMMAND

The ***STB?** command is used to read the current status byte. ***STB?** returns the status byte without clearing it.

SYNTAX:



EXAMPLE:

```
10    OUTPUT 717;"*STB?" ! Returns the status byte
30    ENTER 717;A ! Read the status byte
40    DISP A ! Display the status byte
50    END
```

Running the preceding program returns and displays the status byte.

4-11. *TRG COMMAND

The ***TRG** command triggers the addressed instrument if the addressed instrument is set to the external trigger mode.

SYNTAX:

EXAMPLE:

```
10    OUTPUT 717;"TRIG2" ! Set TRIG MODE to EXT_TRIG
20    OUTPUT 717;"*TRG" ! Trigger the instrument
30    END
```

Running this program triggers the instrument which has HP-IB address 717.

SECTION 5

HP 4279A CONTROL SETTINGS

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SECTION 5

HP 4279A CONTROL SETTINGS

5-1. INTRODUCTION

This section provides information on the 4279A's control settings which are displayed as softkey labels.

The 4279A's softkey are nested to a maximum of four levels. When you press a softkey which has lower levels of softkeys, the softkey labels automatically change to the next lower level. When you press the **'return'** softkey, the softkey labels change to the next higher level. When you press a softkey which doesn't have lower levels of softkeys, the function of the softkey will be selected or a function will be executed.

When two or more softkey pages are available, the softkey page number and the number of softkey pages for that function, divided by a slash (/), are displayed, read for example as page 2 of 4. Pressing the **PREV** or **NEXT** key will change the softkey page number and order number. When you press the **MENU** key, the first softkey page is redisplayed. The 4279A's softkey tree is shown in Appendix B.

In this section, the explanations of the control settings are described in descending order from the highest level softkey for a function, refer to Figure 5-1.

MEAS PARMTR	CABLE LENGTH	DISPLY PAGE	HP-IB DEFINE
OSC LEVEL	TRIG MODE	DISPLY DIGIT	
DC BIAS			SVC FNCTN
MEAS RANGE	COMPEN	VALUE MONITR	
MEAS TIME 1/4	OFFSET 2/4	3/4	4/4

Figure 5-1. Highest Level Softkey Labels (Main Menu).

The softkeys related to HP-IB device dependent commands are described with each control setting for your programming convenience. The commands are described with a SYNTAX diagram and an EXAMPLE written in BASIC for the HP 9000 Series 200 computers.

5-2. MEASUREMENT PARAMETERS

The 4279A's measurement parameters and their relationships are described in the following paragraph.

5-2-1. PARAMETERS

The 4279A measures parallel capacitance C_P and series capacitance C_S, and one of the following parameters: Dissipation Factor **D**, Quality Factor **Q**, Conductance **G** in parallel with C_P, and Equivalent Series Resistance R_S in series with C_S. The measurement parameter combinations which can be selected are C_P-**D**, C_P-**Q**, C_P-**G**, C_S-**D**, C_S-**Q**, and C_S-R_S.

Note

The 4279A displays equivalent series resistance as R_S.

5-2-2. PARAMETER RELATIONSHIPS

D and **Q** are not dependent on the equivalent circuit model, so **D** in C_P-**D** and C_S-**D** are equal, and **Q** in C_P-**Q** and C_S-**Q** are equal. The following equations show the relationship between C_P and C_S, and between **G** and R_S. C_P and C_S are equal for the ideal capacitor, where **D=0**. C_S will be greater than C_P if **D** is greater than 1. Figure 5-2 shows the relationships among the measurement parameters.

$$C_S = (D^2 + 1)C_P$$

$$1/ESR = ((1/D^2) + 1)G$$

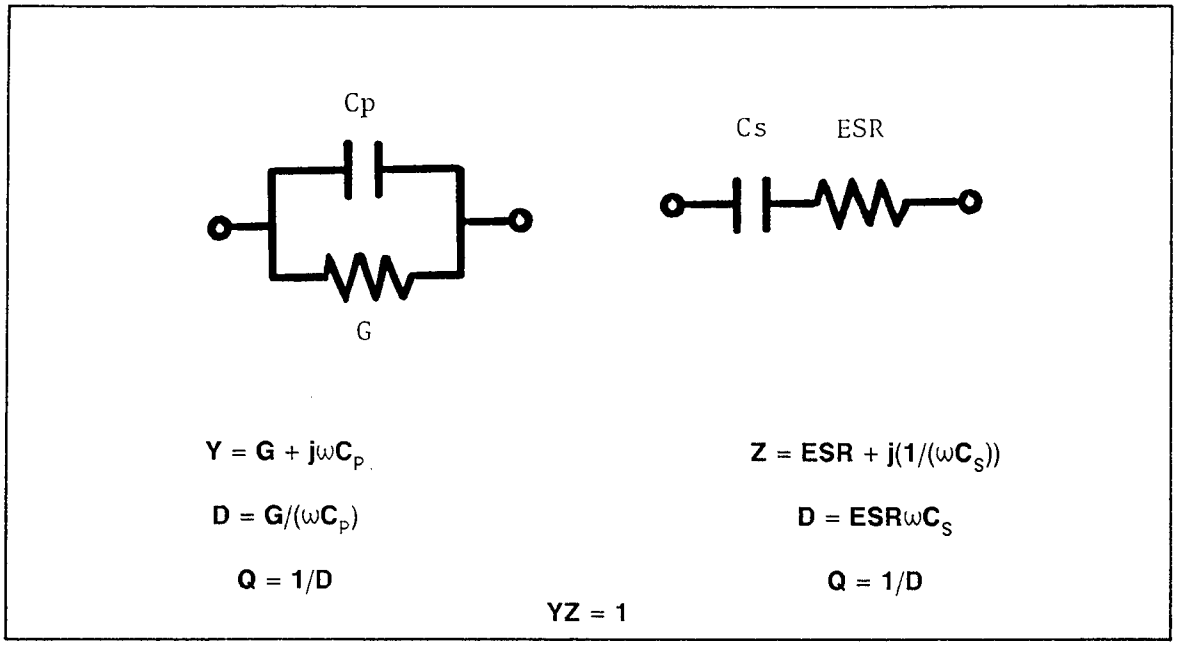
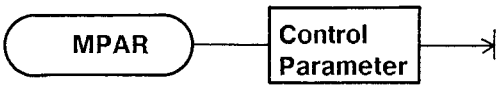


Figure 5-2. Measurement Parameter Relationships

MPAR command

This command sets the measurement parameter. The default setting is **MPAR1**.

SYNTAX:



CONTROL PARAMETER:

The control parameter choices are:

Control Parameter	Description
1	Sets the measurement parameter to $\mathbf{C_P}$-**D**.
2	Sets the measurement parameter to $\mathbf{C_P}$-**Q**.
3	Sets the measurement parameter to $\mathbf{C_P}$-**G**.
4	Sets the measurement parameter to $\mathbf{C_S}$-**D**.
5	Sets the measurement parameter to $\mathbf{C_S}$-**Q**.
6	Sets the measurement parameter to $\mathbf{C_S}$-$\mathbf{R_S}$.

EXAMPLE: OUTPUT 717;"MPAR4" ! Set the measurement parameter to $\mathbf{C_S}$-**D**

5-3. OSCILLATOR LEVEL

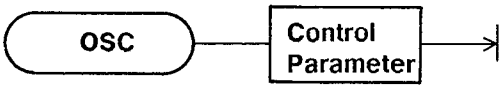
A 1MHz sine wave signal is used as the 4279A's test signal. The test signal voltage (oscillator level) can be set to 20mVrms, 50mVrms, 100mVrms, 200mVrms, 500mVrms, and 1000mVrms. The test signal output impedance is very low, so the test signal voltage output by the 4279A to the capacitor under test is held constant.

HP-IB DEVICE DEPENDENT COMMANDS

OSC command

This command sets the oscillator level. The default setting is OSC1.

SYNTAX:



CONTROL PARAMETER:

The control parameter choices are:

Control Parameter	Description	
1	Sets the oscillator level to	20mV
2	Sets the oscillator level to	50mV
3	Sets the oscillator level to	100mV
4	Sets the oscillator level to	200mV
5	Sets the oscillator level to	500mV
6	Sets the oscillator level to	1000mV

EXAMPLE: OUTPUT 717;"OSC4" ! Set the oscillator level to 200mV

5-4. DC BIAS

The 4279A has three dc bias modes, the dc bias monitor function, and the auto bias polarity control function.

5-4-1. DC BIAS MODE

The 4279A has three dc bias modes--**SPOT**, **PROG**rammed **SWEEP**, and **EXT**ernal.

Note

For each dc bias mode, the dc bias voltage will be output after setting the **DC BIAS** switch on the front panel to **ON** or sending the **BIAS1** command to the 4279A via HP-IB. If you don't, the dc bias voltage will be not be output in spite of setting the dc bias voltage.

Note

When measuring a bias voltage dependent device without a bias voltage, turn the 4279A's **DC BIAS** to **0N** and set the bias voltage to zero. There is a small dc offset voltage at the UNKNOWN terminals when the DC BIAS switch is turned off, but when this procedure is followed the 0V dc bias output is calibrated so the offset voltage is cancelled.

SPOT DC BIAS MODE:

The spot internal dc bias can be set from 0V to ±38V with a resolution as shown in Table 5-1. The spot dc bias voltage can be controlled by using **'SPOT BIAS='** softkey or the **SBI=** HP-IB command.

Table 5-1. Internal DC Bias

Bias Voltage	Resolution
±(0.000 to 4.000)V	1mV
±(4.002 to 8.000)V	2mV
±(8.005 to 20.000)V	5mV
±(20.01 to 38.00)V	10mV

PROGRAMMED SWEEP DC BIAS MODE:

The internal point dc bias source can be programmed remotely via HP-IB to sweep up to 51 bias points. To set the dc bias sweep points, you must use the **BTAB=** command to create the dc bias programmed sweep point table. When triggered the 4279A's internal dc bias voltage is automatically stepped according to the values in the dc bias programmed sweep point table. The measurement results (up to 51) are stored in the measurement data buffer and upon the completion of the sweep the stored data is transmitted simultaneously via HP-IB to the controller by using the **DATA?** command. Data transmission at each measurement point is not necessary, so the overall data transmission time is substantialy reduced

EXT DC BIAS MODE:

An external dc bias voltage source of up to ±100V can be used to make capacitance measurements by connecting the dc bias source to the **EXT INPUT** connector on the rear panel as shown in Figure 5-3.

CAUTION

NEVER APPLY AN EXTERNAL VOLTAGE GREATER THAN ±100V TO THE 4279A'S EXT INPUT CONNECTOR, OR ELSE THE 4279A WILL BE DAMAGED.

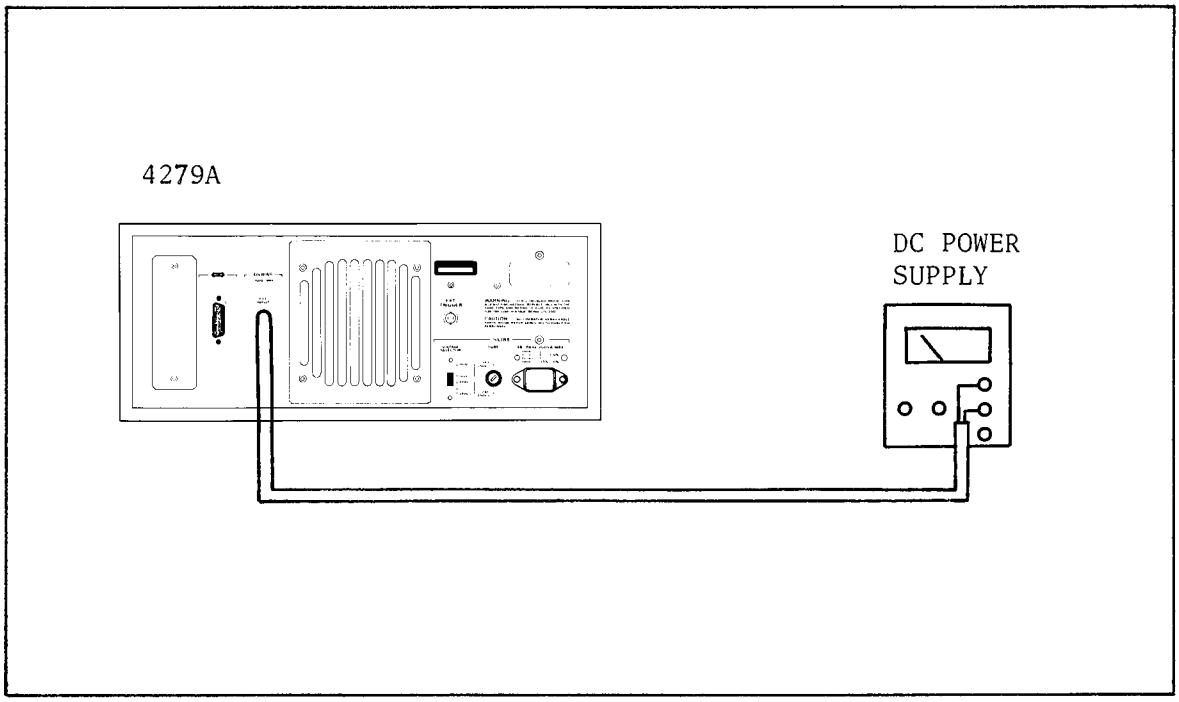
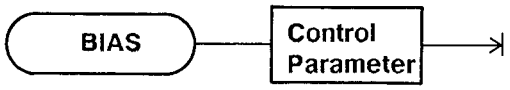


Figure 5-3. External DC Bias Operation

BIAS command

This command turns the dc bias ON or OFF. The default setting is **BIAS0** (dc bias OFF).

SYNTAX:



CONTROL PARAMETER: The control parameter choices are:

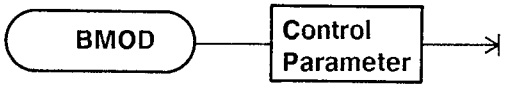
Control Parameter	Description
0	dc bias OFF.
1	dc bias ON.

EXAMPLE: OUTPUT 717;"BIAS1" ! Turn the dc bias ON

BMOD command

This command sets the dc bias mode. The default setting is **BMOD1** (SPOT BIAS).

SYNTAX:



CONTROL PARAMETER: The control parameter choices are:

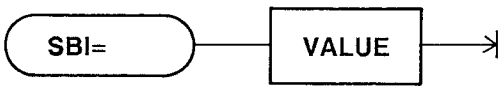
Control Parameter	Description
1	Set the dc bias mode to **SPOT BIAS**.
2	Set the dc bias mode to **PROG SWEEP BIAS**.
3	Set the dc bias mode to **EXT BIAS**.

EXAMPLE: OUTPUT 717;"BMOD3" ! Set the dc bias mode to EXT BIAS

SBI= command

This command sets the dc bias voltage in the spot bias mode. The default setting is **SBI=0** (set dc bias to 0V).

SYNTAX:



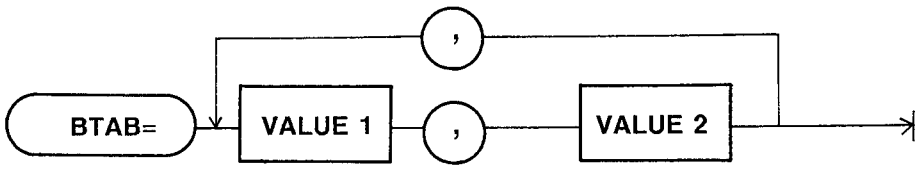
VALUE: 0V to ±38V. The unit is V.

EXAMPLE: OUTPUT 717;"SBI=30" ! Set the spot bias to 30V

BTAB= command

Use this command to create the sweep point table. The maximum number of sweep points is 51. The default setting is **BTAB=0,0**.

SYNTAX:



VALUE 1: The dc bias voltage, which can be set from 0V to ±38V. The unit is V.

VALUE 2: The measurement range. You can select the measurement range when the bias voltage specified by VALUE 1 is applied to the DUT. You must select a measurement range even if you don't need it for the parameter you are measuring. VALUE 2 uses the following numbers for the measurement ranges. If you are using the AUTO range, you must set the range for each dc bias sweep point to AUTO.

VALUE 2	Measurement Range
0	Auto range
1	2pF range
2	8pF range
3	32pF range
4	128pF range
5	512pF range
6	1024pF range

EXAMPLE: OUTPUT 717;"BTAB=0.5,3,1.5,2,4,2,7,2"

When the above line is executed, the 4279A's dc bias sweep points are set as follows.

Bias Point	DC Bias	Meas. Range
1	0.5V	32pF range
2	1.5V	8pF range
3	4V	8pF range
4	7V	8pF range

5-4-2. DC BIAS MONITOR

A DVM can be used to monitor the internal and external dc bias voltage by connecting it the **MONITOR** connector on the rear panel. Refer to Figure 5-4.

Note

When the dc bias voltage is monitored at the **MONITOR** connector, a resistor (approximately 1kΩ) is used to isolate the bias voltage from the monitor connector. If the DVM used to monitor the voltage at the **MONITOR** connector has an input resistance greater than 10MΩ, the voltage drop caused by the resistor 1kΩ can be ignored, the actual bias voltage across the DUT will be monitored. Otherwise DVMs with less than 10MΩ input impedance draw enough current through the 1KΩ resistor to cause a measurement error.

When the DUT is connected to the 4279A through test leads, the residual resistance of the test leads and the residual resistance (10Ω max) of the LOW Terminal will generate a voltage drop. But when a varactor diode is biased in the reverse state by the 4279A, the current through the varactor diode is almost zero, so an insignificant amount of current flows through the test leads and the resultant voltage drop due to the residual resistance of the test leads and the LOW Terminal can be ignored. Thus the voltage at the **MONITOR** BNC connector is virtually the same as the voltage applied to the varactor diode.

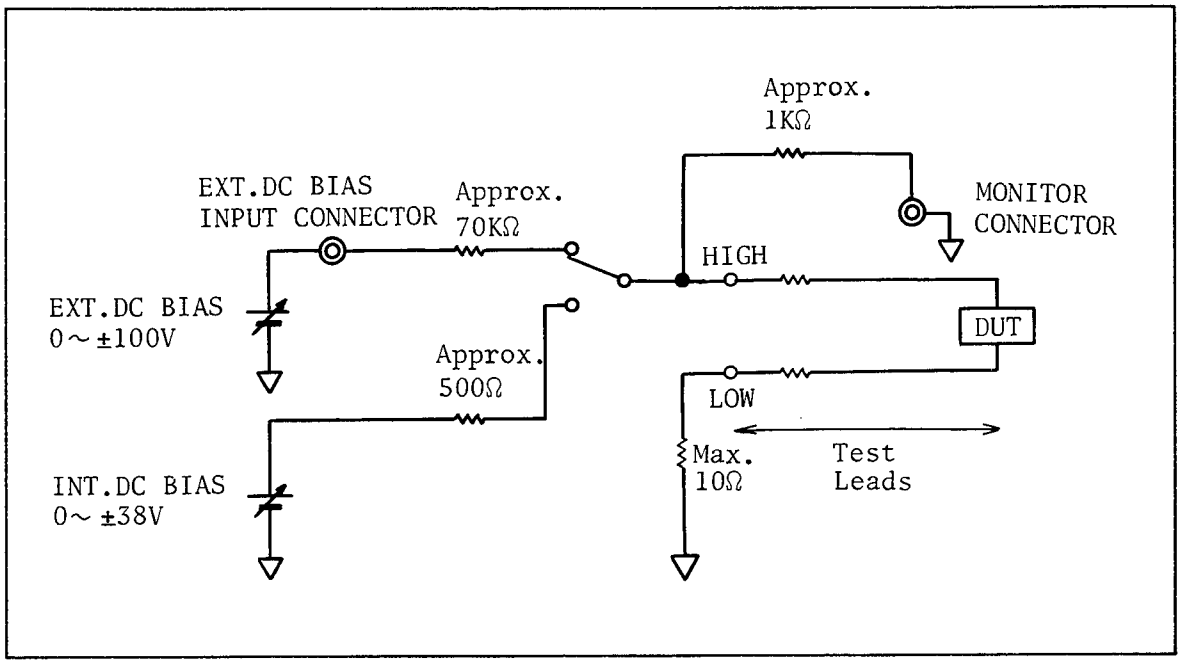


Figure 5-4. Monitor Simplified Schematic Diagram.

5-4-3. AUTO BIAS POLARITY CONTROL FUNCTION

The Auto Bias Polarity Control function is used to measure varactor diodes. The 4279A senses the polarity of the varactor diode by applying an internal dc bias voltage of approximately 1V across it sets the polarity of the applied dc bias so as to reverse bias the varactor diode (refer to Figure 5-5). You don't have to check the polarity of a varactor diode before placing it in the test fixture. When the auto polarity control function is used, either the **'AUTO INVERT'** softkey must be pressed or the **APOL1** HP-IB command must be sent. When the auto polarity control is not used, either the **'FIX POLARITY'** softkey must be pressed or the **APOL0** HP-IB command must be sent.

Note

Use only positive bias voltage settings when you are using the AUTO BIAS POLARITY CONTROL function during varactor diode testing. The AUTO BIAS POLARITY CONTROL function determines the polarity of a varactor diode by applying a positive voltage (approximately 1V) across it.

Note

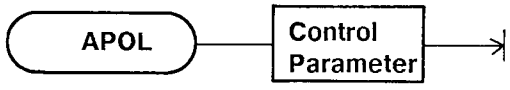
When the external dc bias mode is selected, the auto bias polarity control function is automatically set to OFF (fixed polarity mode), and you cannot enable the auto bias polarity control function when you are using an external bias source.

HP-IB DEVICE DEPENDENT COMMANDS

APOL command

This command turns the auto bias polarity control function ON or OFF. The default setting is **APOL0**, OFF.

SYNTAX:

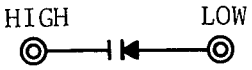


CONTROL PARAMETER: The control parameter choices are:

Control Parameter	Description
0	Set the polarity control to OFF.
1	Set the polarity control to ON.

EXAMPLE: OUTPUT 717;"APOL1" ! Set the polarity control to ON

(1) When the varactor diode is connected as shown below.

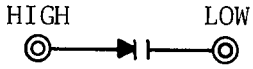


The bias voltage applied to the varactor diode will have the the same polarity as the bias voltage setting (High terminal is + and Low terminal is -).

For example,

Bias Voltage Setting	**Applied Bias Voltage**
1V	1V
3V	3V
10V	10V

(2) When the varactor diode is connected as shown below.



The bias voltage applied to the varactor diode will be the inverse of the bias voltage setting (High terminal is - and Low terminal is +).

For example,

Bias Voltage Setting	**Applied Bias Voltage**
1V	-1V
3V	-3V
10V	-10V

Figure 5-5. Auto Bias Polarity Control Function

5-5. MEASUREMENT RANGE

The 4279A has six capacitance measurement ranges -- 2pF, 8pF, 32pF, 128pF, 512pF, and 1024pF. Table 5-2 lists the maximum measurement values for each of the measurement parameters. The maximum values for **D** and **Q** are 9.99999 and 99999.9, respectively, and the display format of **D** and **Q** is fixed for all ranges.

Table 5-2. Measurement Range

Range	C_P/C_S	G	R_S (ESR)
2pF	2.50000pF	12.5664μS	999.999kΩ
8pF	10.0000pF	50.2655μS	99.9999kΩ
32pF	40.0000pF	201.062μS	9.99999kΩ
128pF	160.000pF	0.80425mS	9.99999kΩ
512pF	640.000pF	3.21699mS	999.999Ω
1024pF	1280.00pF	6.43398mS	999.999Ω

Note

Leading zeros preceding the one's digit are place holders and will not be displayed. Measurement results which are greater than the values listed in the preceding table may be displayed.

When the number of display digits is set to less than six digits (4 or 5) the remaining digits will not be displayed.

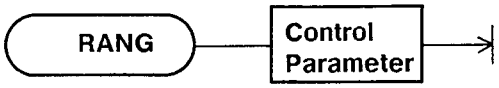
Note

The measurement range set by the **RANG** command or the lower level softkey of **'MEAS RANGE'** softkey is invalid in the programmed sweep bias mode. The measurement range follows the measurement range set by the **BTAB=** command in the programmed sweep bias mode.

RANG command

This command sets the measurement range. The default setting is RANG0.

SYNTAX:



CONTROL PARAMETER: The control parameter choices are:

Control Parameter	Description
0	Set the measurement range to AUTO.
1	Set the measurement range to 2pF.
2	Set the measurement range to 8pF.
3	Set the measurement range to 32pF.
4	Set the measurement range to 128pF.
5	Set the measurement range to 512pF.
6	Set the measurement range to 1024pF.

EXAMPLE: OUTPUT 717;"RANG1" ! Set the measurement range to 2pF

5-6. MEASUREMENT TIME

The measurement time starts from the moment the measurement is triggered until the 4279A is ready to start the next measurement. The 4279A's measurement time is determined by the INTEG TIME (A-D conversion time) setting, the AVG RATE (number of measurements averaged) setting, the TRIGGER DELAY TIME (time delay between the trigger and the start of the measurement) setting, the STEP DELAY TIME (time the 4279A waits before making a measurement after the sweep bias voltage changes or the spot bias voltage is set), and the DISPLAY PAGE (display format) selection. Figure 5-6 shows measurement times (DC BIAS switch: OFF). Figure 5-7 shows the timing diagram for the SPOT bias mode (DC BIAS switch: ON). Figure 5-8 shows the timing diagram for the PROGRAMMED SWEEP bias mode (DC BIAS switch: ON).

5-6-1. INTEGRATION TIME

When a capacitor is connected and the 4279A is triggered, the 4279A's analog measurement circuit generates a voltage proportional to the measurement results. Integration time (INTEG TIME) is the time required to perform an A-D conversion of the analog output voltage from the measurement circuit. Generally, a longer conversion times result in more stable and accurate measurement results. SHORT, MEDIUM, or LONG integration times can be selected.

5-6-2. AVERAGING

The 4279A's averaging function arithmetically averages the results of two or more A-D conversions. The number of conversions averaged can be set to 1, 2, 4, 8, 16, 32, 64, 128, or 256.

5-6-3. TRIGGER DELAY TIME

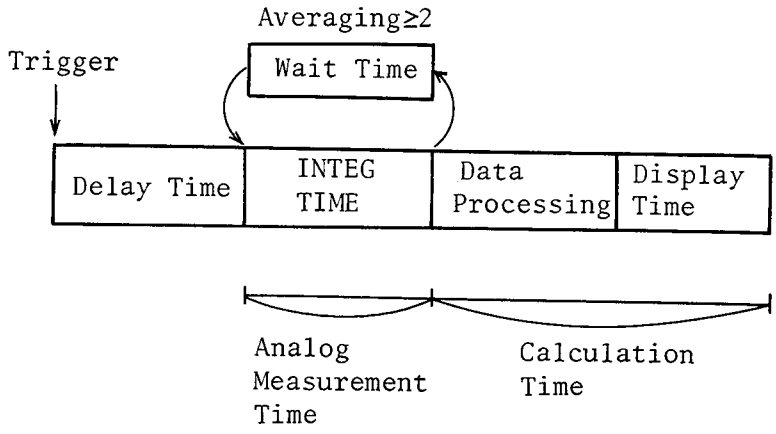
The 4279A's trigger delay time function allows you to set a trigger delay to delay the start of a measurement on receiving a trigger signal. The trigger delay time can be set from 0ms to 1000ms in 1ms steps. This function is useful if a component handler triggers the 4279A before stable contact is made with the DUT.

5-6-4. STEP DELAY TIME

The 4279A's step delay time function allows you to set a measurement delay so the 4279A will wait for the applied bias voltage to stablize before making a measurement. The step delay time can be set from 3ms to 1000ms in 1ms steps.

Note

Although the step delay time can be set from 0ms to 3ms the 4279A will wait approximately 3ms for the bias voltage to stablize.



Trigger Delay Time: Selectable from 0ms to 1000ms in 1ms steps

INTEG.TIME and Data Processing Time:

INTEG.TIME		Data Processing Time
SHORT	2.4ms	approx. 4ms
MEDIUM	10.8ms	approx. 4.2ms
LONG	21.6ms	approx. 6ms

Display Time:

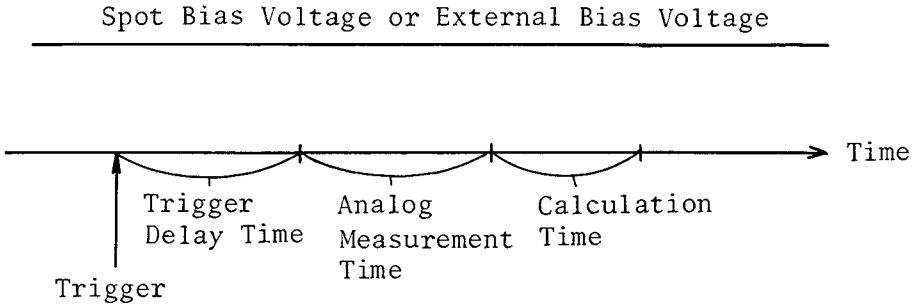
Display Page Format	Display Time
MEAS. PAGE	aprrox. 5ms
STATUS PAGE	0
BLANK PAGE	0

Wait Time: approx. 4ms

Figure 5-6. Measurement Time (DC BIAS switch: OFF)

Auto Bias Polarity Control: OFF

When the 4278A is triggered it will wait for the set trigger delay time then make a measurement.



Auto Bias Polarity Control: ON

When the 4279A is triggered it waits for the set trigger delay time, and then determines what polarity bias voltage to use (by applying aproximately 1V across the device). The auto bias polarity switching time is less than 4ms. The 4279A applies the specified dc bias of the correct polarity to the device under test and waits for the set step delay time for the dc bias voltage to stablize before making the first measurement. The step delay time can be set from 3ms to 1000ms in 1ms steps. If the step delay time is not set or is set to less than 3ms, the 4279A will still wait approximately 3ms for the bias voltage stablize.

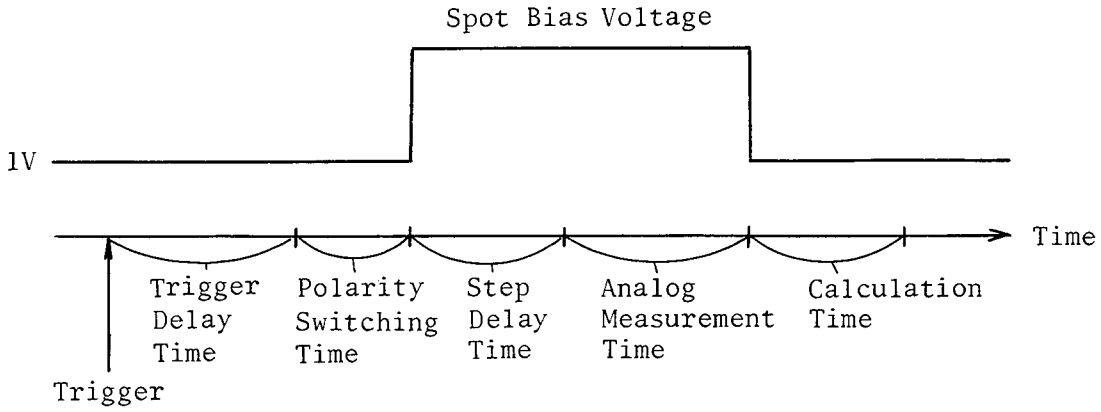


Figure 5-7. Timing Diagram for the SPOT BIAS Mode

1. First Measurement of a Programmed Bias Sweep (Part 1):

Auto Bias Polarity Control: OFF

When triggered, the 4279A waits for the trigger delay time, applies the first specified dc bias to the device under test, and then wait for the specified step delay time for the dc bias voltage to settle before making the first measurement. The step delay time can be set from 3ms to 1000ms in 1ms steps. If the step delay time is not set or the step delay time is set to the time less than 3ms, the 4279A will wait approximately 3ms for the bias voltage to stabalize.

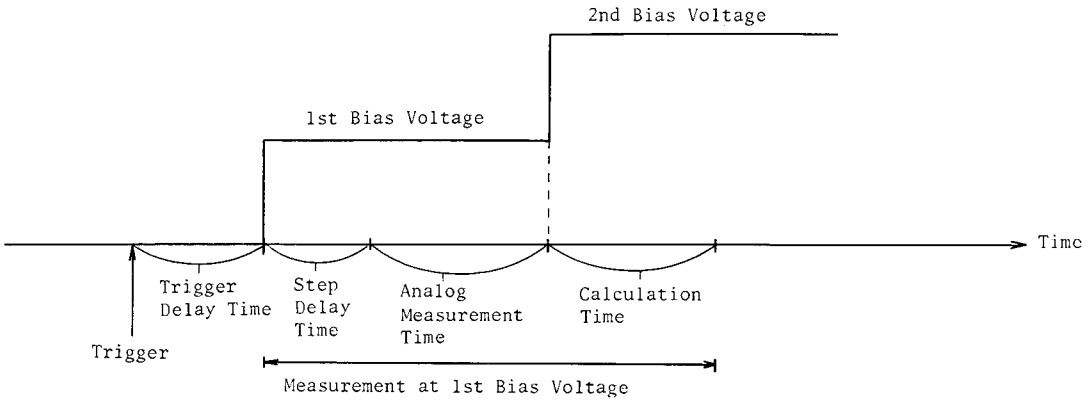


Figure 5-8. Timing Diagram at PROGRAMMED SWEEP BIAS mode (1 of 4)

1. First Measurement of a Programmed Bias Sweep (Part 2):

Auto Bias Polarity Control: ON

When triggered the 4279A waits for the specified trigger delay time, applies 1V across the device, and then sets the bias voltage polarity based on the current measurement. Then the auto bias polarity switching time is less than 4ms. The 4279A then applies the first specified dc bias to the device under test, and waits for the step delay time for the dc bias voltage to settle before making the first measurement. The step delay time can be set from 3ms to 1000ms in 1ms steps. If the step delay time is not set or is set to a value of less than 3ms, the 4279A will still wait approximately 3ms for the bias voltage to stablize.

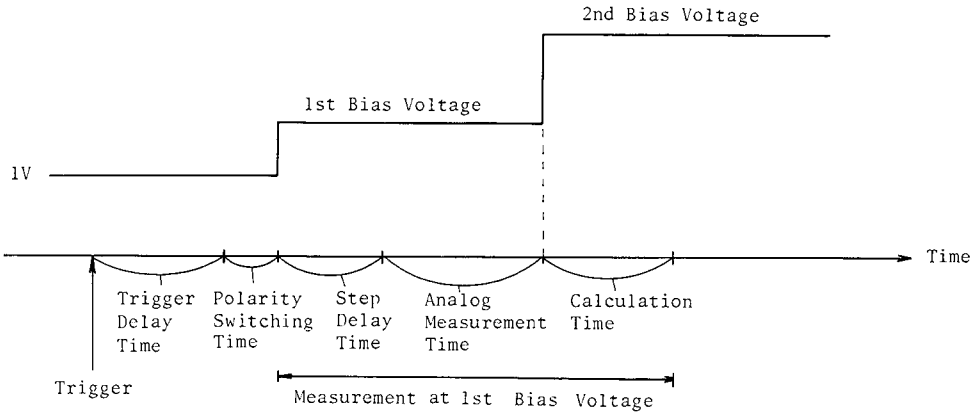


Figure 5-8. Timing Diagram for the PROGRAMMED SWEEP BIAS Mode (2 of 4)

2. Programmed Bias Sweep:

The (N+1)TH sweep voltage is applied to the device under test at the end of the NTH measurement's analog measurement period, just before the start of the NTH measurement's calculation period. The (N+1)TH measurement starts after a delay time equal to the specified step delay time or the NTH calculation time whichever is longer. Thus if the specified step delay time is less than the NTH calculation time, the (N+1)TH measurement will begin immediately at the end of the NTH measurement's calculation period.

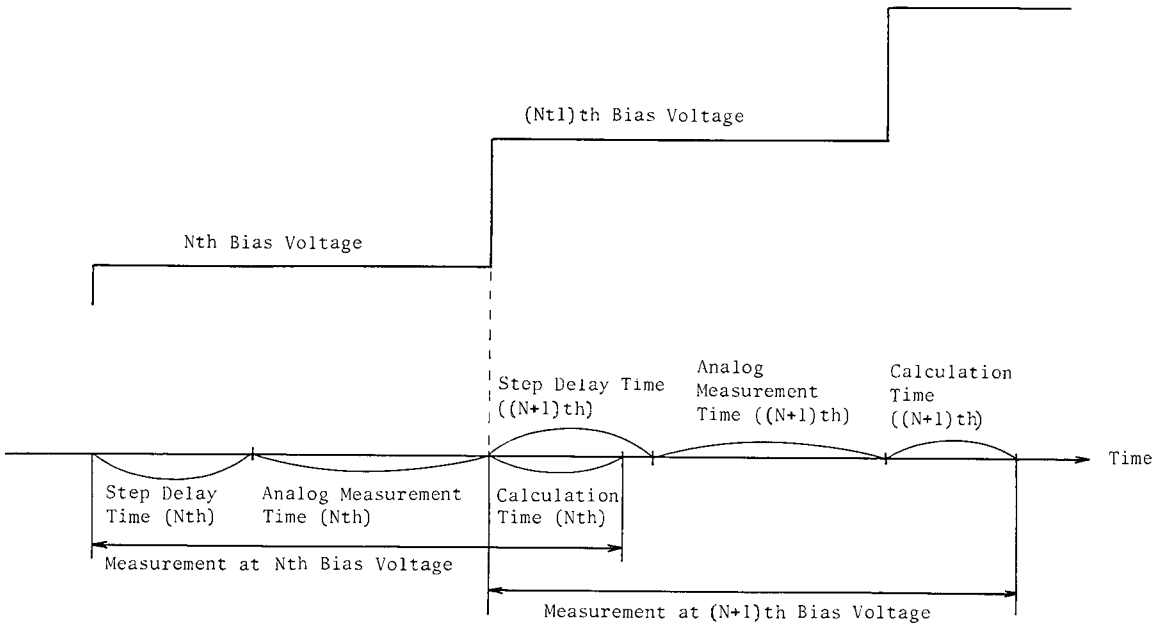


Figure 5-8. Timing Diagram for the PROGRAMMED SWEEP BIAS Mode (3 of 4)

3. The Last Measurement of a Programmed Bias Sweep:

At the end of the bias sweep analog measurement, the dc bias source output voltage will be set to same voltage that was being output before the sweep began (In case of setting the auto bias polarity control to ON, the output voltage will be set to a approximately 1V.), and the measurement range will be set to the range specified for the first measurement. At the end of the calculation time of the last measurement, bit **B0** (measurement complete) of the status byte will be set.

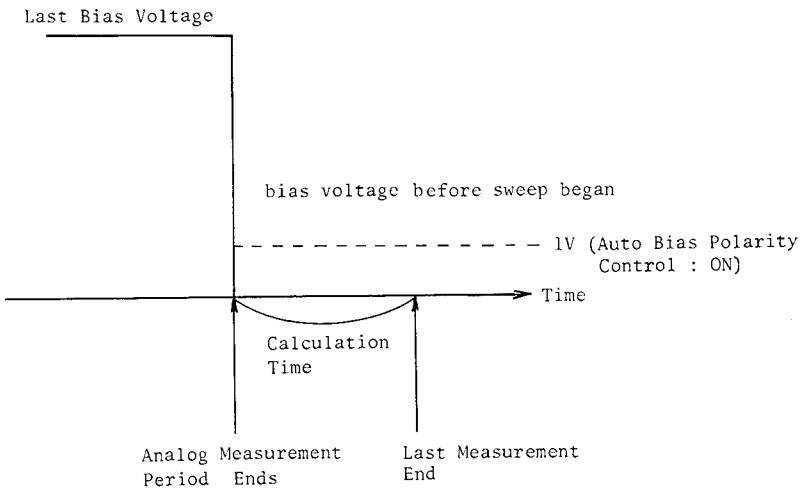
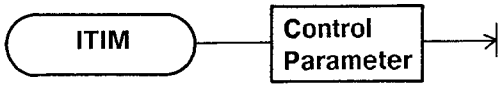


Figure 5-8. Timing Diagram for the PROGRAMMED SWEEP BIAS Mode (4 of 4)

ITIM command

This command sets the integration time. The default setting is **ITIM2**.

SYNTAX:



CONTROL PARAMETER:

The control parameter choices are:

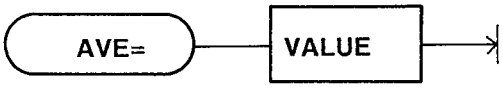
Control Parameter	Description
1	Set the integration time to **SHORT**.
2	Set the integration time to **MEDIUM**.
3	Set the integration time to **LONG**.

EXAMPLE: OUTPUT 717;"ITIM1" ! Set the integration time to SHORT

AVE= command

This command sets the averaging rate. The default setting is **AVE=1**.

SYNTAX:



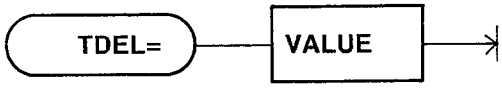
VALUE: 1, 2, 4, 8, 16, 32, 64, 128, or 256

EXAMPLE: OUTPUT 717;"AVE=64" ! Set the averaging rate to 64.

TDEL= command

This command sets the trigger delay time. The default setting is **TDEL=0**.

SYNTAX:



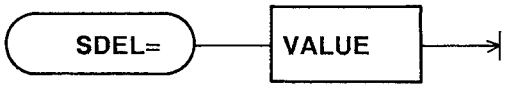
VALUE: 0 to 1000ms.

EXAMPLE: OUTPUT 717;"TDEL=360" ! Set the trigger delay time to 360ms

SDEL= command

This command sets the step delay time. The default setting is **SDEL=0**.

SYNTAX:



VALUE: 3 to 1000ms.

EXAMPLE: OUTPUT 717;"SDEL=10" ! Set the step delay time to 10ms

5-7. CABLE LENGTH SELECTION

The 4279A has three planes of calibration -- at the **UNKNOWN** terminal (0m) to the end of the HP 16048A/B test leads (1m), and to the end of the HP 16048D test leads (2m). Measurement accuracy is specified at these three points. Select the cable length which corresponds to the length of cables you are using.

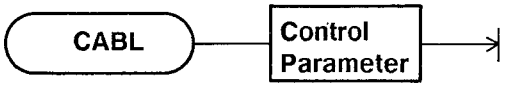
When you select **0m**, the four outer conductors of the HCUR, HPOT, LPOT, and LCUR leads must be tied together at the UNKNOWN terminals. When you select **1m**, the four outer conductors of the HCUR, HPOT, LPOT, and LCUR leads must be tied together at the end of the 1m leads. When you select **2m**, the four outer conductors of the HCUR, HPOT, LPOT, and LCUR leads must be tied together at the end of the 2m leads. In other words, the four-terminal pair configuration must be terminated at the calibration plane for the cable length selected. When the HP 16048A/B/D test leads are used, use the furnished terminal plate at the end of the cables for easy configuration.

HP-IB DEVICE DEPENDENT COMMANDS

CABL command

This command sets the cable length. The default setting is **CABL1**.

SYNTAX:



CONTROL PARAMETER:

The control parameter choices are:

Control Parameter	Description
0	Set the cable length to 0m.
1	Set the cable length to 1m.
2	Set the cable length to 2m.

EXAMPLE: OUTPUT 717;"CABL1" ! Set the cable length to 1m

5-8. TRIGGER MODES

The 4279A has three trigger modes -- **INT**ernal, **EXT**ernal, and **MAN**ual.

INT TRIG:

When set to **INT**ernal trigger the 4279A continuously repeats measurements except during special operations, e.g., executing open compensation.

MAN TRIG:

The 4279A performs a single measurement every time the **TRIGGER** key on the front panel is pressed.

EXT TRIG:

The 4279A performs a single measurement every time a positive going TTL pulse is applied to the rear panel **EXT TRIGGER** connector. External triggering can also be achieved by momentarily switching the center conductor of the **EXT TRIGGER** connector to chassis ground (the center conductor circuit contains a pull-up resistor so switching the center conductor to ground generates a high to low going edge to trigger the 4279A). Figure 5-9 shows the required TTL pulse.

Note

The 4279A triggers does not retrigger while a measurement is in progress. Wait until the current measurement is complete before triggering the 4279A again.

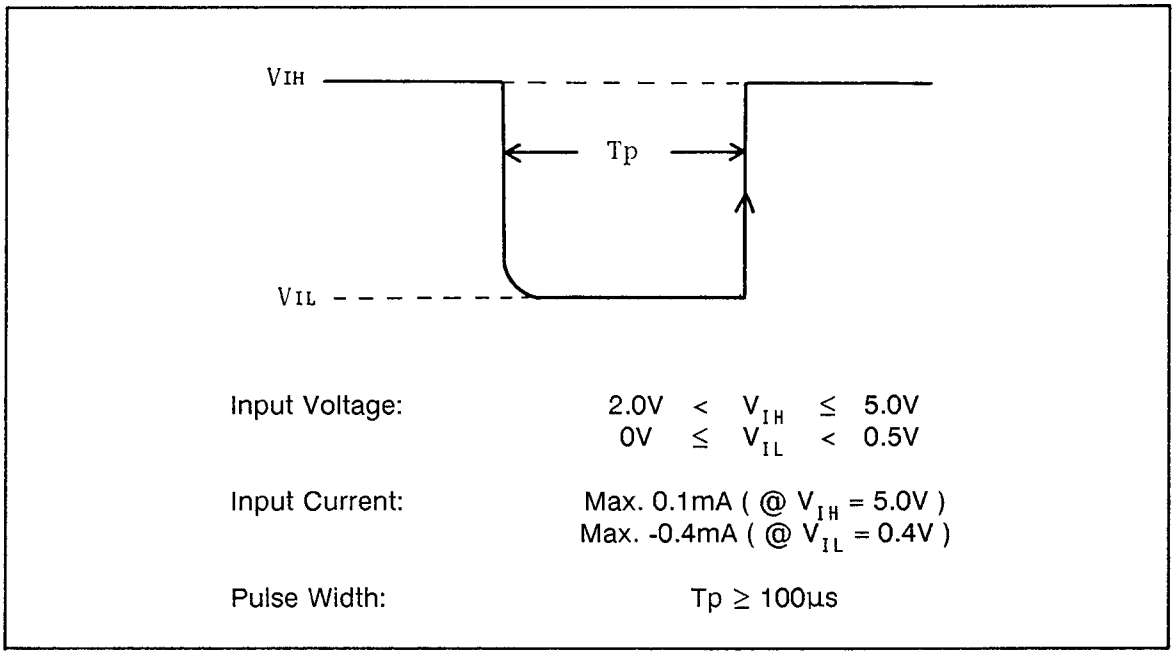
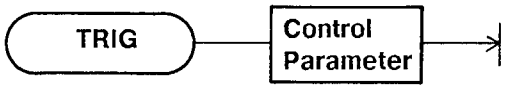


Figure 5-9. External Trigger Pulse

TRIG command

This command sets the trigger mode. The default setting is **TRIG1**.

SYNTAX:



CONTROL PARAMETER:

The control parameter choices are:

Control Parameter	Description
1	Set the trigger mode to INT_TRIG.
2	Set the trigger mode to EXT_TRIG.
3	Set the trigger mode to MAN_TRIG.

EXAMPLE: OUTPUT 717;"TRIG2" ! Set the trigger mode to EXT_TRIG

5-9. COMPENSATION

The 4279A has four compensation functions -- Open, Short, Standard, and Temperature compensation.

5-9-1. OPEN COMPENSATION

Use the OPEN compensation function to compensate for the stray admittance existing from the calibration plane (depends on the CABLE LENGTH selection) to the connection contacts for the capacitor under test. Perform the following steps to use the OPEN compensation function.

1. First, without the capacitor connected, press the **'OPEN COMPEN'** softkey to measure the OPEN admittance (capacitance and conductance).

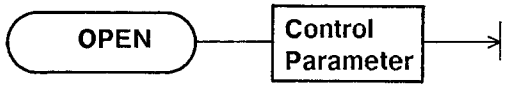
2. Press the **'OPEN ON'** softkey to enable compensation calculations for subsequent measurements. OPEN compensation data is stored in nonvolatile memory.

HP-IB DEVICE DEPENDENT COMMANDS

OPEN command

This command makes the OPEN compensation data valid or invalid. The default setting is **OPEN0**.

SYNTAX:



CONTROL PARAMETER:

The control parameter choices are:

Control Parameter	Description
0	Make the open compen. data invalid.
1	Make the open compen. data valid.

EXAMPLE: OUTPUT 717;"OPEN1" ! Make the open compen. data valid

XOP command

This command is used to make an OPEN compensation measurement.

SYNTAX:

EXAMPLE:

```
OUTPUT 717;"XOP" ! Measure the open data
```

OPM? command

This command returns the OPEN measurement data (ASCII format only).

SYNTAX:

EXAMPLE:

```
10    OUTPUT 717;"OPM?" ! Return the open meas. data
20    ENTER 717;C,G ! Read the open meas. data
30    PRINT     C,G ! Display the open meas. data
40    END
```

When the preceding program is run the OPEN compensation measurement data is returned and displayed.

5-9-2. SHORT COMPENSATION

The short compensation function is used to compensate for the residual impedance existing from the calibration plane (depends on the CABLE LENGTH selection) to the connection contacts of the capacitor under test. Perform the following steps to use the SHORT compensation function.

1. Short the capacitor contacts together and press the **'SHORT COMPEN'** softkey to make a SHORT impedance (inductance and resistance) measurement.

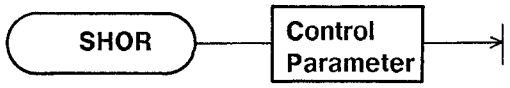
2. Press the **'SHORT ON'** softkey to enable the compensation calculation. The SHORT compensation data is stored in nonvolatile memory.

HP-IB DEVICE DEPENDENT COMMANDS

SHOR command

This command makes the short compensation data valid or invalid. The default setting is **SHOR0**.

SYNTAX:



CONTROL PARAMETER:

The control parameter choices are:

Control Parameter	Description
0	Make the short compen. data invalid.
1	Make the short compen. data valid.

EXAMPLE: OUTPUT 717;"SHOR1" ! Make the short compen. data valid

XSH command

Use the XSH command to make a SHORT compensation measurement.

SYNTAX:

EXAMPLE:

OUTPUT 717;"XSH" ! Measure the short data

SHM? command

Use SHM? command to return the short measurement data (ASCII format only).

SYNTAX:

EXAMPLE:

```
10    OUTPUT 717;"SHM?" ! Return the short meas. data
20    ENTER 717;L,R ! Read the short open meas. data
30    PRINT     L,R ! Display the short meas. data
40    END
```

When the preceding program is run the SHORT compensation measurement data is returned and displayed.

5-9-3. STANDARD COMPENSATION

The STANDARD compensation function is used to compensate for other errors by using the transmission coefficient derived from the relationship between the standard's (premeasured) reference value and the actual (uncompensated) measurement value. Perform the following steps to use the STANDARD compensation function.

1. First enter the standard's (premeasured) reference value using **'C='** , **'D='** or **'G='** softkeys. The reference value should be premeasured value of the C_P**-D** or C_P**-G** parameter. To make this selection press the **'STD PARMTR'** softkey and press either the **'C-D'** or **'C-G'** softkey.

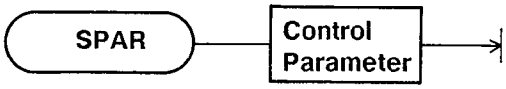
2. Connect the standard as the DUT and press the **'STD COMPEN'** softkey. Press the **'STD ON'** softkey to make a compensation calculation. The STANDARD compensation data is stored in nonvolatile memory.

HP-IB DEVICE DEPENDENT COMMANDS

SPAR Command

This command sets the STANDARD compensation parameter. The default parameter is **SPAR1**.

SYNTAX:



CONTROL PARAMETER: The control parameter choices are:

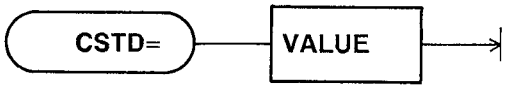
Control Parameter	Description
1	Set the parameter to **C-D**.
2	Set the parameter to **C-G**.

EXAMPLE: OUTPUT 717;"SPAR2" ! Set the parameter to C-G

CSTD= Command

This command sets the standard compensation reference value (**C**) which is stored in nonvolatile memory.

SYNTAX:



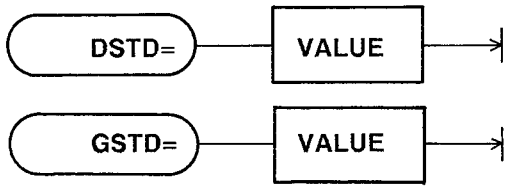
VALUE: You cannot use units (F) or suffixes (for example: p(pico)), with the reference value.

EXAMPLE: OUTPUT 717;"CSTD=10.2E-12" ! SetS CSTD to 10.2pF

DSTD=, GSTD= Command

This command sets the standard compensation reference value (**D** or **G**) which is stored in nonvolatile memory.

SYNTAX:



VALUE: You cannot use a unit (S) or suffixes (for example: m(milli)), with the reference value.

EXAMPLES: OUTPUT 717;"DSTD=0.0002" ! Set the DSTD to 0.0002

OUTPUT 717;"GSTD=10E-3" ! Set the GSTD to 10mS

XSTD command

This command is used to make a **STANDARD** compensation measurement.

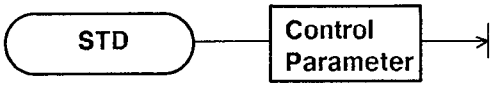
SYNTAX:

EXAMPLE: OUTPUT 717;"XSTD" ! Measure the STANDARD data

STD command

This command makes the STANDARD compensation data valid or invalid. The default setting is **STD0**.

SYNTAX:



CONTROL PARAMETER: The control parameter choices are:

Control Parameter	Description
0	Make the std compen. data invalid.
1	Make the std compen. data valid.

EXAMPLE: OUTPUT 717;"STD1" ! Make the std compen. data valid

STM? command

This command returns the STANDARD compensation measurement data (ASCII format only).

SYNTAX:

EXAMPLE:

```
10    OUTPUT 717;"STM?" ! Return the standard meas. data
20    ENTER 717;C,D ! Read the standard meas. data
30    PRINT     C,D ! Display the standard meas. data
40    END
```

When the preceding program is run the STANDARD compensation measurement data is returned and displayed.

STR? command

This command returns the STANDARD compensation reference data (ASCII format only).

SYNTAX:

EXAMPLE:

```
10    OUTPUT 717;"STR?" ! Return the standard ref. data
20    ENTER 717;C,D ! Read the standard ref. data
30    PRINT     C,D ! Display the standard ref. data
40    END
```

When the preceding program is run the STANDARD compensation reference data is returned and displayed.

5-9-4. MULTI-COMPENSATION

The 4279A can store up to sixteen sets of compensation (OPEN, SHORT, STANDARD) measurement data allowing it to be connected to the scanner of up to 16 channels. This function can be used to compensate for the stray admittance, residual impedance, and the other errors of each channel which exist from the calibration plane (depends on the CABLE LENGTH selection) to the connection contacts of the capacitor under test. Therefore the 4279A can accurately measure the capacitor connected to each channel using this function. Refer to Figure 5-10.

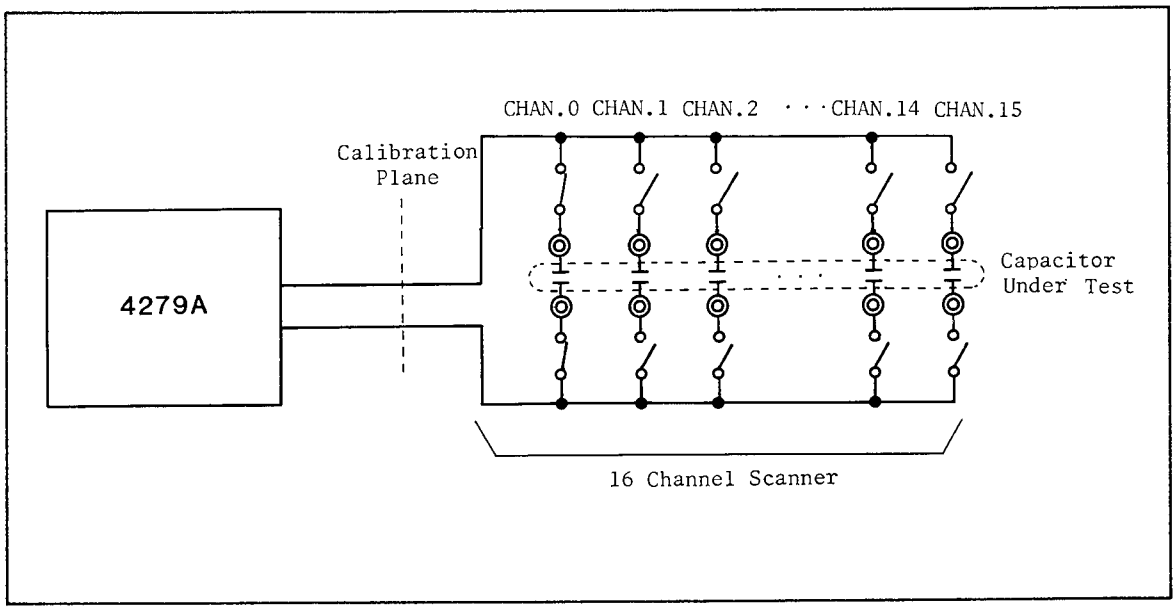


Figure 5-10. Multi-Compensation

The compensation data is labled from 0 to 15, and is set using the **'Compen no.='** softkey or the **CNO**= command. All compensation data is stored in nonvolatile memory, but the compensation data label is set to CNO=0 when the instrument is reset.

When the 4279A is connected to a scanner as shown in Figure 5-10, the procedure for the multi-compensation is as follows.

[MULTI-COMPENSATION PROCEDURE]

1. Set the comepensation data number to 0 to correspond scanner scanner CHAN 0.
2. Set CHAN 0 of the scanner to OPEN.
3. Press the **'OPEN COMPEN'** softkey.
4. Increment the scanner channel and the compensation data number by 1 and repeat steps 2 and 3 for channels 1 through 15.
5. Set the compensation data number and the scanner channel to CHAN 0.
6. Set CHAN 0 of the scanner to SHORT.
7. Press the **'SHORT COMPEN'** softkey.

8. Increment the scanner channel and the compensation data number by 1 and repeat steps 6 and 7 for channels 1 through 15.

9. Enter the standard reference value using the **'C='** and the **'D='** or **'G='** softkey.

10. Connect the standard for which the reference value was entered to CHAN 0 of the scanner.

11. Press the **'STD COMPEN'** softkey.

12. Increment the scanner channel number and the compensation data number by 1 and repeat steps 10 and 11 for channels 1 through 15.

Note

Reference data for only one standard reference can be stored at a time. Therefore you must connect the same STANDARD to each channel.

13. Press the **'OPEN ON'** softkey to enable OPEN compensation calculations on subsequent measurements.

14. Press the **'SHORT ON'** softkey to enable SHORT compensation calculations on subsequent measurements.

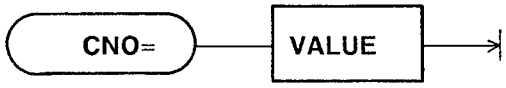
15. Press the **'STD ON'** softkey to enable STANDARD compensation calculations on subsequent measurements.

HP-IB DEVICE DEPENDENT COMMANDS

CNO= Command

This command sets the compensation data number. The default setting is **CNO=0**.

SYNTAX:



VALUE: 0 to 15 in 1 step

EXAMPLE: OUTPUT 717;"CNO=3" ! Set the compensation data number to 3

5-9-5. TEMPERATURE COMPENSATION

Temperature compensation is used to minimize the temperature induced measurement error of the analog measurement circuit. When you press the **'TEMP COMPEN'** softkey, the 4279A measures the key offset voltages in the measurement circuit and compensates the measurement value on subsequent measurements. The compensation data is stored in volatile memory, so once you turn the 4279A off, the temperature compensation data will be lost. Press the **'TEMP COMPEN'** softkey when you are making accurate measurements.

HP-IB DEVICE DEPENDENT COMMANDS

XTMP command

This command minimizes measurement error entroduced by temperature change.

SYNTAX:

EXAMPLE:

```
OUTPUT 717;"XTMP" ! Execute the temp. compen.
```

5-10. DISPLAY OFFSET

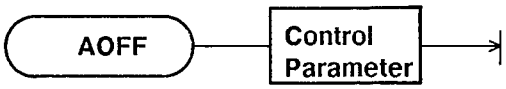
The 4279A has a display value offset function that adds or subtracts a constant value to/ from the measurement result. Offset A subtracts a previously entered value from the capacitance measurement result. Offset B subtracts a previously entered value from one of the following parameters **D**, **Q**, **G**, and **ESR** (R_S). The pre-entered Offset B value is dependent on the parameter selected. For example, assume that you have entered the offset B value when the C_P-**D** parameter is selected and offset B is on. If the measurement parameter is changed to a parameter other than C_P-**D** or C_S-**D**, the offset B function is automatically turned off, because the secondary parameter (**D**) does not match.

HP-IB DEVICE DEPENDENT COMMANDS

AOFF command

This command makes the offset A data valid or invalid. The default setting is **AOFF0**.

SYNTAX:



CONTROL PARAMETER: The control parameter choices are:

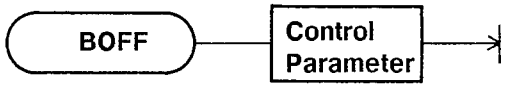
Control Parameter	Description
0	Make offset A data invalid.
1	Make offset A data valid.

EXAMPLE: OUTPUT 717;"AOFF1" ! Make offset A data valid

BOFF command

This command makes the offset B data valid or invalid. The default setting is **BOFF0**.

SYNTAX:



CONTROL PARAMETER: The control parameter choices are:

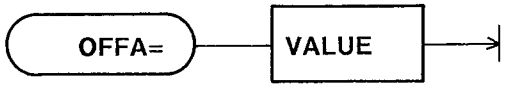
Control Parameter	Description
0	Make offset B data invalid.
1	Make offset B data valid.

EXAMPLE: OUTPUT 717;"BOFF1" ! Make offset B data valid

OFFA= command

This command sets the offset A data which is stored in nonvolatile memory.

SYNTAX:



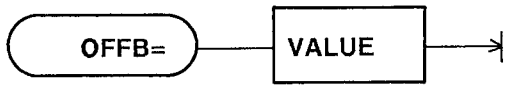
VALUE: Unit is F, but you cannot use a unit, or a suffix (for example: p(pico)), with offset A data.

EXAMPLE: OUTPUT 717;"OFFA=10E-12" ! Set the offset A data to 10pF

OFFB= command

This command sets the offset B data which is stored in nonvolatile memory.

SYNTAX:



VALUE: The offset B data unit depends on the measurement parameter selected when this command is sent. You cannot use a unit (for example: S), or a suffix (for example: p(pico)), with offset B data.

EXAMPLE: OUTPUT 717;"OFFB=0.0001" ! Set the offset B data to 0.0001

5-11. DISPLAY PAGE

The 4279A has three LCD display formats (MEAS PAGE, STATUS PAGE, and BLANK PAGE) to choose from. The MEAS PAGE format is useful when manually performing capacitor measurements. The STATUS PAGE format is useful when the current compensation condition is checked. The BLANK PAGE format is useful when the 4279A is used as part of an automatic capacitor test system. Refer to SECTION 2.

Note

NON-NUMERIC DISPLAY

The 4279A may display **"UNBAL"** or **"------"** in the place of the numeric measurement data. When the impedance (or the admittance) of the capacitor exceeds the range of the analog measurement circuit's capability, **"UNBAL"** will be displayed. When the analog measurement circuit can measure the capacitor, but the data format (the number of display digits) selected will not hold the calculated result, **"------"** will be displayed and is called overflow.

HP-IB DEVICE DEPENDENT COMMANDS

DPAG command

This command sets the display page. The default setting is **DPAG1**.

SYNTAX:

CONTROL PARAMETER:

The control parameter choices are:

Control Parameter	Description
1	Set the display page to **MEAS PAGE.**
2	Set the display page to **STATUS PAGE.**
3	Set the display page to **BLANK PAGE.**

EXAMPLE: OUTPUT 717;"DPAG3" ! Set the display page to the BLANK PAGE

5-12. DISPLAY DIGITS

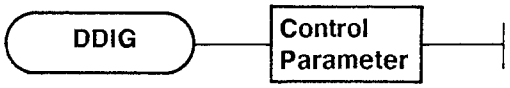
Measurement results can be displayed with a maximum of six digits of display resolution, and values to ±999999. Decimal point position (data format) is fixed, depending on the measurement range selected. If you do not require the last one or two display digits, you can set display digit resolution to four or five digits.

HP-IB DEVICE DEPENDENT COMMANDS

DDIG command

This command sets the number of the display digits. The default setting is **DDIG6** (6 digits).

SYNTAX:



CONTROL PARAMETER:

The control parameter choices are:

Control Parameter	Description
4	Set 4 display digits.
5	Set 5 display digits.
6	Set 6 display digits.

EXAMPLE: OUTPUT 717;"DDIG4" ! Set the 4 display digits

5-13. VALUE MONITOR

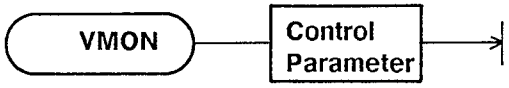
The 4279A's value monitor function is used to monitor the open capacitance and conductance for open compensation, short inductance, and resistance for short compensation, reference value (pre-measured) of a standard capacitor, actual measurement value of a standard capacitor, and display offset values. When a compensation measurement is made, the monitor will be automatically turned on.

HP-IB DEVICE DEPENDENT COMMANDS

VMON command

This command selects the monitor display on the monitor line. The default setting is **VMON0** (monitor display OFF).

SYNTAX:



CONTROL PARAMETER:

The control parameter choices are:

Control Parameter	Description
0	Set the monitor display to OFF.
1	Set the monitor display to OPEN data.
2	Set the monitor display to SHORT data.
3	Set the monitor display to STD meas data
4	Set the monitor display to STD ref. data
5	Set the monitor display to OFFSET data.

EXAMPLE: OUTPUT 717;"VMON1" ! Set the monitor display to OPEN data

5-14. HP-IB DEFINITION

The HP-IB definition settings (addressable/talk only and HP-IB address number) are stored in nonvolatile memory.

Addressable Mode:

The 4279A's HP-IB address can be set from 0 to 30. The factory set HP-IB address is 17. The procedure for setting the HP-IB address is as follows.

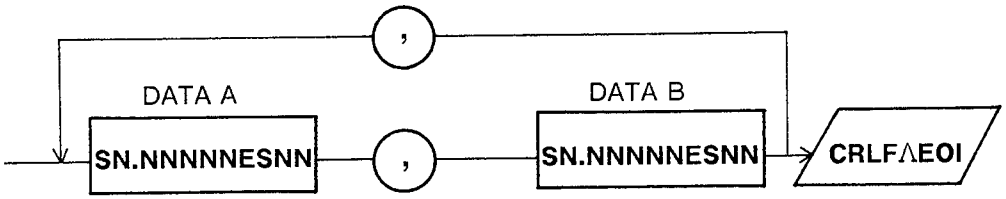
1. Press the **MENU** and the **PREV** keys.
2. Press the **'HP-IB DEFINE'** and the **'ADRSABLE'** softkeys.
3. Press the **'HP-IB ADRS='** softkey. "ADDRESS= (current address)" will be displayed.
4. Enter the desired address using the front panel numeric keys, and press the **ENTER** key.

Note

Press the **'HP-IB ADRS='** softkey to display the current address setting the input line. When the 4279A is reset the 4279A, "ADRS=(current address)" will be displayed on the system message line.

Talk Only Mode:

The 4279A is set to the HP-IB talk-only mode, and outputs the measurement data to the bus. When connected with a Listen-Only printer, an automatic measurement data recording system is realized without using an HP-IB controller. The output data is restricted to ASCII characters. The output data format is shown below. When the block data output mode is used (the sweep point table) DATA A/B is repeated as many times as there are points in the programmed sweep bias table.



(N: 0 to 9, S: + or -)

Note

In the talk-only mode, the 4279A doesn't wait for the completion of the handshake before starting next measurement. If the printer is too slow and doesn't print properly, use the trigger delay function to adjust the 4279A's measurement speed to the printer speed.

5-15. SERVICE FUNCTIONS

The 4279A has special service functions for checking operation, troubleshooting, and performing calibration. For detailed information on the service functions, refer to the 4279A's Service Manual.

SECTION 6

DATA TRANSFER

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SECTION 6

DATA TRANSFER

6-1. INTRODUCTION

Data transfer (data format, HP-IB commands etc.) is discussed in this section. The 4279A transfers measurement data when it receives the **DATA?** command from the controller. When in the programmed sweep bias mode the measurement data for each dc bias point in the sweep is stored in a measurement buffer until the end of the sweep, then the **DATA?** command is executed to transmit all buffered measurement data to the controller. Refer to Figure 6-1. If the dc bias is swept in the SPOT BIAS mode by programming, transferring measurement data requires time to transmit the measurement data for each measurement point, but if the programmed sweep bias table is used the overall data transmission time will be greatly reduced.

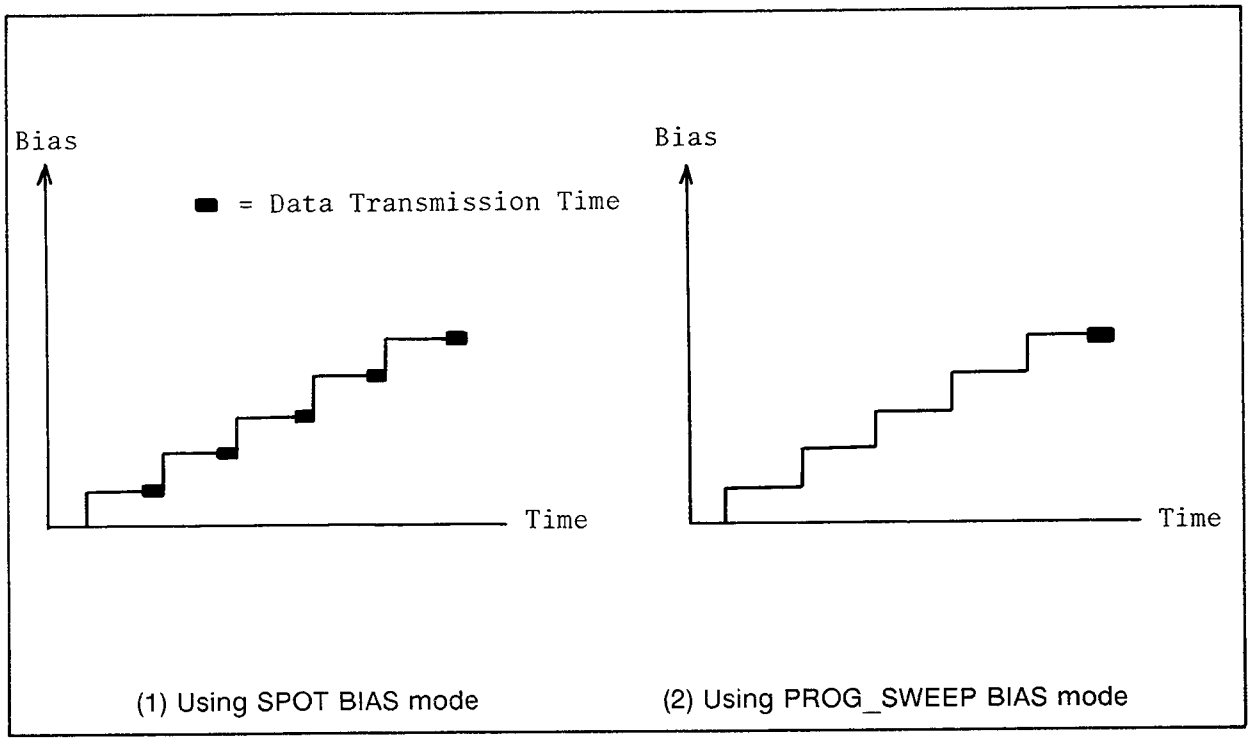


Figure 6-1. Data Transmission Time

6-2. DATA FORMAT

The 4279A offers two data formats for HP-IB transfers of data to the controller, ASCII and BINARY. The data transfer rates for these data formats are different.

6-2-1. ASCII FORMAT

The ASCII data format is the default data output format. When the **DFMT1** command is executed the 4279A transfers data in the ASCII format. The ASCII output format is described in Figure 6-2. When the block data output mode is set (sweep point table) DATA A/B is repeated as many times as there are points in the programmed sweep bias table.

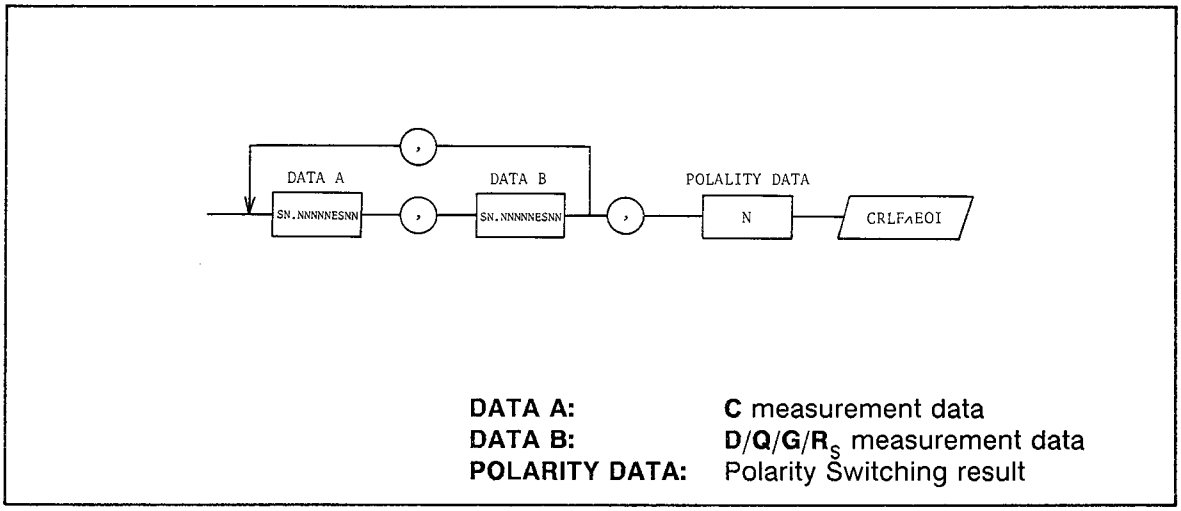


Figure 6-2. ASCII Format 1

The DATA A/B and the POLARITY DATA formats are as follows.

(1) **DATA A/B** format:

The data output formats for data A (**C** measurement data), and data B (**D/Q/G/R_S** measurement data) uses the 12 ASCII character fixed length format shown below.

SN.NNNNNESNN (S: +/-, N: 0 ~ 9, E: Exponent)

(2) **POLARITY DATA** format:

The auto polarity data output format is a single ASCII character. When the bias voltage polarity is inverted by the auto bias polarity control function, the polarity data is set to 1, and when it is not inverted the polarity data is set to 0.

The ASCII output format can be changed using the **DSEC** command and the **DPOL** command. **DSEC** command is used to select the measurement data with or without the secondary parameter data (DATA B) when the **DATA?** command is used to return the data. The **DPOL** command can also be used to select the measurement data with or without the polarity switching result data when the **DATA?** command is used to return the data. Refer to Figure 6-3.

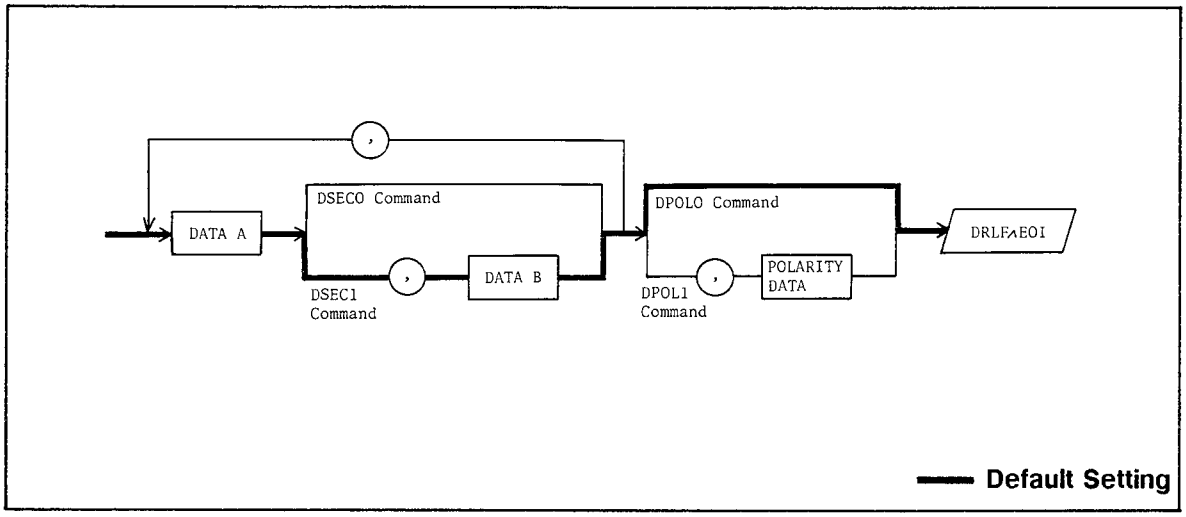


Figure 6-3. ASCII Format 2

Note

When "**UNBAL**" or "**---**" is displayed on the LCD display, the output data is returned in the following ASCII format.

Display	C data	D/Q/G/Rs data
UNBAL	2.00000E+20	2.00000E+20
---	Calculated Result	Calculated Result

Note: When "**---**" is displayed on the LCD display, the analog measurement circuit can measure the capacitor, but the data format selected can not display all of the calculated result on the LCD display. However, the output data returned is the full calculated result.

6-2-2. BINARY FORMAT (IEEE 64 BIT FORMAT):

The BINARY format is the 64-bit floating point binary number format specified in IEEE Standard 728-1982. This is the data format used by HP Series 200 computers. When the **DFMT2** command is executed the 4279A transfers data in the BINARY format. The BINARY format syntax diagrams are shown in Figure 6-4. When the block data output is set (the sweep point table) DATA A/B is repeated the same number of times as there are bias sweep points.

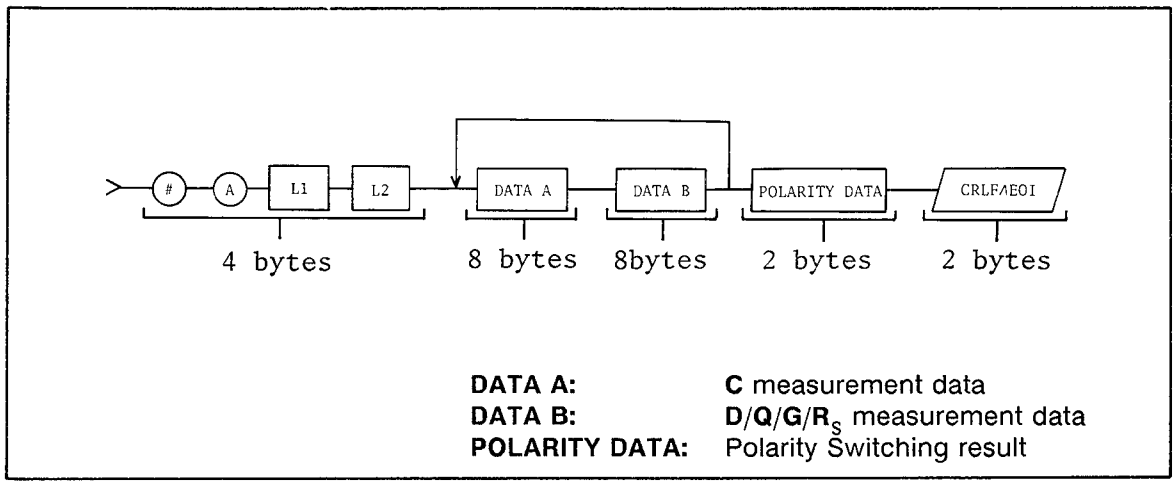


Figure 6-4. BINARY Format 1

This data field is initiated by using a unique code, the number sign (#). A second byte, (A), designates the data byte. L1 and L2 are the block (L1: high byte, L2: low byte). The count includes all data bytes and the terminator, CR/LF (2 bytes), if they are used.

(1) DATA A/B format:

Each output format for data A (**C** measurement data) and data B (**D/Q/G/R_S** measurement data) uses the data bytes (8 bytes) as follows.

S E E E E E E E E E E E M F F F F F F F F F F F F F F F F F F F F

F F F F F F F F F F F F F F F F F F F F F F F F F F F F F F F F L

Where:

S is the sign bit of the fractional part
E is the exponent part
M is the most significant bit of the fractional part
F is an intermediate fractional bit
L is the least significant fractional bit

Real Numbers (RN) can be defined in the following ways.

1) If Exponent part >=1 then

$$RN=(-1)^{S} * 2^{(\text{Exponent part}-1023)} * (1.\text{Fractional part})$$

2) If Exponent part=0 then

$$RN=(-1)^{S} * 2^{(-1022)} * (0.\text{Fractional Part})$$

3) If Exponent part=0 and Fractional part=0 then

RN=0

For example:

a) If the sign bit=0, the exponent part = all ones (1023) and the fractional part=all ones this format represents ~ +2.0.

b) BINARY 64-bit data

0 1 1 1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

represents +1.5.

(2) **POLARITY DATA** format:

The result of the auto bias polarity control is output in the 2-byte binary integer format shown at the end of this paragraph. When the bias voltage polarity is inverted, using the auto bias polarity control, the polarity data bit is set to 1 otherwise the polarity data bit is 0.

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 L

L: the least significant bit
1: Polarity Inverted
0: Polarity Non-inverted

The BINARY output format can be changed by using the **DSEC** and **DPOL** commands. The **DSEC** command can be used to select the measurement data with or without the secondary parameter data (DATA B) when the **DATA?** command is used to return the data. The **DPOL** command can also be used to select the measurement data with or without the polarity switching result data when the **DATA?** command is used to return the data. Refer to Figure 6-5.

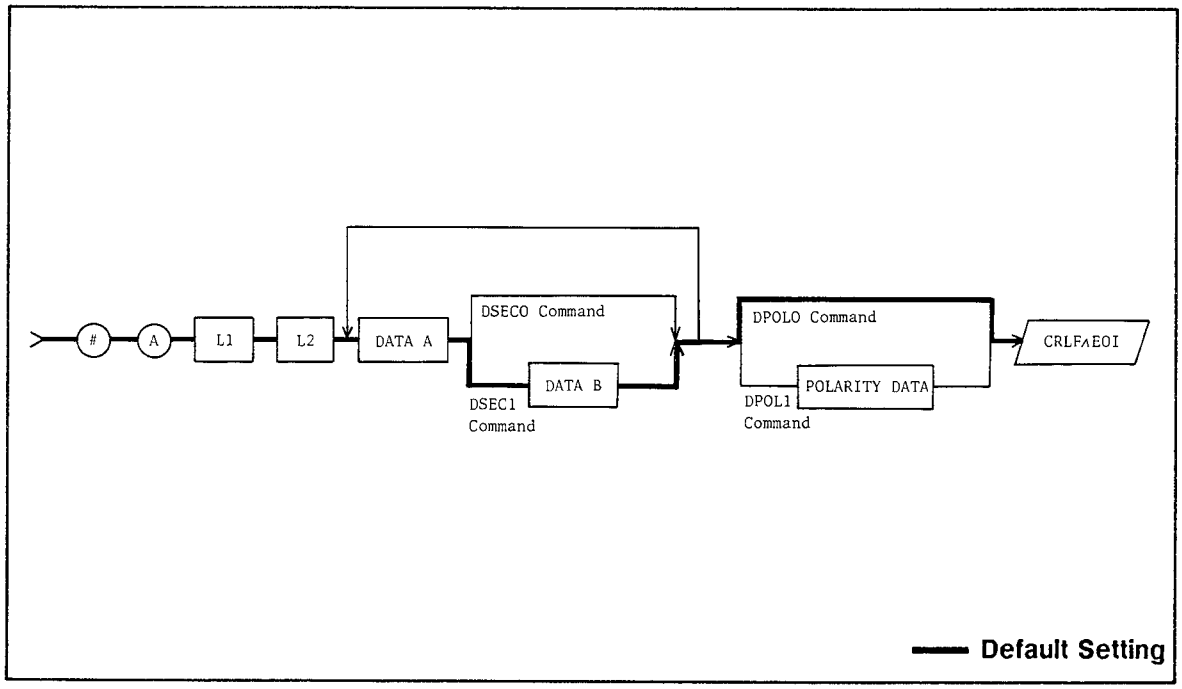


Figure 6-5. BINARY Format 2

Note

When "**UNBAL**" is displayed on the LCD display, the output data returned is greater than 2.0E+20 in the BINARY format. (The 4279A outputs 612D78ECH, the hexadecimal number which represents "UNBAL".)

When "**---**" is displayed on the LCD display, the analog measurement circuit can measure the capacitor, but the data format selected can not display all of the calculated result on the LCD display. However, the output data returned is the full calculated result.

6-3. DATA TRANSFER RATE

The data transfer rate for each data format is different. Table 6-1 lists the typical data transfer rates.

Table 6-1. Data Transfer Rates

1. Data transfer rate when using the **ENTER** command with an HP Series 200 (9816) computer and the spot dc bias is being used.

Format	Data Type	Transfer Rate
ASCII	Data A/B and Polarity Data	approx. 10.4ms
	Data A/B	approx. 9.3ms
	Data A and Polarity Data	approx. 7.6ms
	Data A only	approx. 6.5ms
BINARY	Data A/B and Polarity Data	approx. 6.0ms
	Data A/B	approx. 5.8ms
	Data A and Polarity Data	approx. 5.3ms
	Data A only	approx. 5.1ms

2. Data transfer rate when using the **ENTER** command with an HP Series 200 (9816) computer and dc bias sweep (bias point=51, and meas. range: AUTO) is being used.

Format	Data Type	Transfer Rate
ASCII	Data A/B and Polarity Data	approx. 278ms
	Data A/B	approx. 277ms
	Data A and Polarity Data	approx. 142ms
	Data A only	approx. 141ms
BINARY	Data A/B and Polarity Data	approx. 45.3ms
	Data A/B	approx. 44.8ms
	Data A and Polarity Data	approx. 25.5ms
	Data A only	approx. 25.3ms

6-4. HP-IB DEVICE DEPENDENT DATA TRANSFER COMMANDS

HP-IB device dependent data transfer commands are described using a SYNTAX diagram, and an EXAMPLE is given using the BASIC language for the HP 9000 Series 200 computers.

6-4-1. DATA? COMMAND

The **DATA?** command is used to return measurement values. The data output format is selected using the **DFMT**, **DSEC** and **DPOL** commands.

SYNTAX:

EXAMPLE:

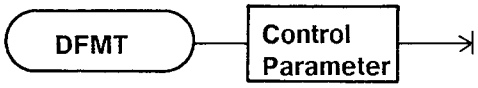
```
10   OUTPUT 717;"TRIG2" ! Return the error number
20   OUTPUT 717;"*TRG" ! Trigger the 4279A
30   WAIT .1 ! Wait for the end of the measurement
40   OUTPUT 717;"DATA?" ! Return the data
50   ENTER 717;C,D ! Read the error number
60   PRINT C,D ! Display the readings
70   END
```

When you run the above program, the 4279A is triggered to make a measurement, and the measurement data is displayed.

6-4-2. DFMT COMMAND

The **DFMT** command is used to select the data output format (ASCII format or BINARY format). The default setting is **DFMT1** (ASCII format).

SYNTAX:



CONTROL PARAMETER:

The control parameter choices are:

Control Parameter	Description
1	ASCII format
2	BINARY format

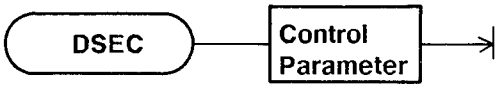
EXAMPLE:

OUTPUT 717;"DFMT2" ! Set the data output format to BINARY format

6-4-3. DSEC COMMAND

The **DSEC** command is used to return the data with or without the secondary parameter data (DATA B) when the **DATA?** command is used to return the data. The default setting is DSEC1 (the data with DATA B).

SYNTAX:



CONTROL PARAMETER:

The control parameter choices are:

Control Parameter	Description
0	Returns the data without DATA B
1	Returns the data with DATA B

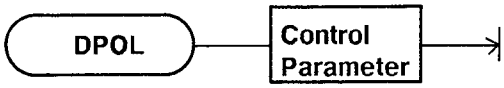
EXAMPLE:

OUTPUT 717;"DSEC0" ! Set to return the data without DATA B

6-4-4. DPOL COMMAND

The **DPOL** command is used to select the data with the polarity switching result (POLARITY DATA) or the data without the polarity switching result (POLARITY DATA) when the **DATA?** command is used to return the data. The default setting is DPOL0 (the data without the POLARITY DATA).

SYNTAX:



CONTROL PARAMETER:

The control parameter choices are:

Control Parameter	Description
0	Set to return the data without the POLARITY DATA
1	Set to return the data with the POLARITY DATA

EXAMPLE:

OUTPUT 717;"DPOL1" ! Set to return the data without POLARITY DATA

SECTION 7

PROGRAMMING

7-1. INTRODUCTION 7-1

7-2. HP 4279A CONTROL SETTINGS 7-1

7-2-1. CONTROL SETTINGS (Excluding the DC Bias Settings) 7-1

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7-3. MEASUREMENT AND DATA TRANSFER 7-8

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SECTION 7

PROGRAMMING

7-1. INTRODUCTION

This section provides the programming information needed to configure the HP 4279A to make measurements and to transfer data in ASCII or BINARY formats.

7-2. 4279A CONTROL SETTINGS

This paragraph is split into two parts: 4279A control settings excluding the dc bias settings, and including the dc bias settings.

7-2-1. CONTROL SETTINGS (Excluding the DC Bias Settings)

The 4279A uses the following control settings.

Measurement Parameter
OSC LEVEL
Measurement Range
INTEG.TIME
Averaging Rate
Trigger Delay Time
Cable Length
Compen. Data. Number
OPEN Compensation ON/OFF
SHORT Compensation ON/OFF
STANDARD Compensation ON/OFF
Display OFFSET A ON/OFF
Display OFFSET B ON/OFF
Display Format
Display Digit
Value Monitor
Trigger Mode

The first step in your program should initialize the 4279A to the desired control configuration (Refer to Table 7-1). This table supplies a model of the program code needed to initialize the 4279A's measurement configuration, each line of code sets a control parameter or value. Follow the procedure given next to use the program model in Table 7-1.

[PROCEDURE]

1. Note the 4279A's current HP-IB address.
2. Enter the HP-IB address in the □ at line 10.
3. Most program lines below line 10 have a blank □. Enter the value for the control parameter required in each blank □.
4. Load BASIC and enter the program lines listed in Table 7-1.

Note

This BASIC program can be run on the HP 9000 series 200 or 300 computer.

5. Run the program to initialize the 4279A's control settings.

Table 7-1. HP 4279A Initialization Program Model

PROGRAM	Meaning	Control Parameter or value
10 ASSIGN @Hp_adrs TO 7☐	HP-IB address	0 to 30
20 REMOTE @Hp_adrs	Remote 4279A	
30 OUTPUT @Hp_adrs;"*RST"	Reset 4279A	
40 OUTPUT @Hp_adrs;"MPAR☐"	Meas.Parameter	**1:Cp-D** 2:Cp-Q 3:Cp-G 4:Cs-D 5:Cs-Q 6:Cs-Rs
50 OUTPUT @Hp_adrs;"OSC☐"	OSC level	**1:20mV** 2:50mV 3:100mV 4:200mV 5:500mV 6:1000mV
60 OUTPUT @Hp_adrs;"RANG☐"	Meas. Range	**0:AUTO** 1:2pF 2:8pF 3:32pF 4:512pF 5:1024pF
70 OUTPUT @Hp_adrs;"ITIM☐"	Integ. Time	1:SHORT **2:MED** 3:LONG
80 OUTPUT @Hp_adrs;"AVE=☐"	Averaging Rate	**1**, 2, 4, 8, 16, 32, 64, 128, or 256
90 OUTPUT @Hp_adrs;"TDEL=☐"	Trig Delay	**0** to 1000
100 OUTPUT @Hp_adrs;"CABL☐"	Cable Length	**0:0m** 1:1m 2:2m
110 OUTPUT @Hp_adrs;"CNO=☐"	Compen.no.	**0** to 15
120 OUTPUT @Hp_adrs;"OPEN☐"	OPEN compen.	**0:OFF** 1:ON
130 OUTPUT @Hp_adrs;"SHOR☐"	SHORT compen.	**0:OFF** 1:ON
140 OUTPUT @Hp_adrs;"STD☐"	STD compen.	**0:OFF** 1:ON
150 OUTPUT @Hp_adrs;"AOFF☐"	OFFSET A	**0:OFF** 1:ON
160 OUTPUT @Hp_adrs;"BOFF☐"	OFFSET B	**0:OFF** 1:ON
170 OUTPUT @Hp_adrs;"DPAG☐"	Display Page	**1:MEAS_PAGE** 2:STATUS_PAGE 3:BLANK_PAGE
180 OUTPUT @Hp_adrs;"DDIG☐"	Display Digit	4:4digits 5:5digits **6:6digits**
190 OUTPUT @Hp_adrs;"VMON☐"	Value Monitor	**0:OFF** 1:OPEN 2:SHORT 3:STD MEAS 4:STD REF 5:OFFSET
200 OUTPUT @Hp_adrs;"TRIG☐"	Trigger Mode	**1:INT_TRIG** 2:MAN_TRIG 3:EXT_TRIG
210 END		

Sample program 1 (Figure 7-1) initializes the 4279A as listed below. Then HP-IB address is 17.

Measurement Parameter:	C_P-D
OSC LEVEL:	100mV
Measurement Range:	AUTO
INTEG.TIME:	MED
Averaging Rate:	1
Trigger Delay Time:	10ms
Cable Length:	1m
Compen. Data. Number:	0
OPEN Compensation:	ON
SHORT Compensation:	ON
STANDARD Compensation:	ON
Display OFFSET A:	ON
Display OFFSET B:	OFF
Display Format:	BLANK
Display Digit:	6
Value Monitor:	OFF
Trigger Mode:	EXT_TRIG

```
10    ASSIGN @Hp_adrs TO 717
20    REMOTE @Hp_adrs
30    OUTPUT @Hp_adrs;"*RST"
40    OUTPUT @Hp_adrs;"MPAR1"
50    OUTPUT @Hp_adrs;"OSC3"
60    OUTPUT @Hp_adrs;"RANG0"
70    OUTPUT @Hp_adrs;"ITIM2"
80    OUTPUT @Hp_adrs;"AVE=1"
90    OUTPUT @Hp_adrs;"TDEL=10"
100   OUTPUT @Hp_adrs;"CABL1"
110   OUTPUT @Hp_adrs;"CNO=0"
120   OUTPUT @Hp_adrs;"OPEN1"
130   OUTPUT @Hp_adrs;"SHOR1"
140   OUTPUT @Hp_adrs;"STD1"
150   OUTPUT @Hp_adrs;"AOFF1"
160   OUTPUT @Hp_adrs;"BOFF0"
170   OUTPUT @Hp_adrs;"DPA63"
180   OUTPUT @Hp_adrs;"DDI66"
190   OUTPUT @Hp_adrs;"VMON0"
200   OUTPUT @Hp_adrs;"TRI62"
210   END
```

Figure 7-1. Sample Program 1

Bolded control parameters or values in the program model listed in Table 7-1 indicate a default parameter or value. If you want to use a default setting skip the program line for that parameter. For example, the sample program in Figure 7-1 has been simplified by skipping some the program lines to use default values as shown in Figure 7-2.

```
10    ASSIGN @Hp_adrs TO 717
20    REMOTE @Hp_adrs
30    OUTPUT @Hp_adrs;"*RST"
40    OUTPUT @Hp_adrs;"OSC3"
50    OUTPUT @Hp_adrs;"TDEL=10"
60    OUTPUT @Hp_adrs;"CABL1"
70    OUTPUT @Hp_adrs;"OPEN1"
80    OUTPUT @Hp_adrs;"SHOR1"
90    OUTPUT @Hp_adrs;"STD1"
100   OUTPUT @Hp_adrs;"AOFF1"
110   OUTPUT @Hp_adrs;"DPAG3"
120   OUTPUT @Hp_adrs;"TRIG2"
130   END
```

Figure 7-2. Sample Program 2

7-2-2. DC BIAS SETTINGS

The dc bias settings are as follows:

DC BIAS mode
SPOT BIAS setting
PROG SWEEP BIAS setting
Auto Bias Polarity Control ON/OFF
Step Delay Time
DC BIAS Switch ON/OFF

There are two dc bias modes, the **SPOT BIAS** mode and the **PROG SWEEP BIAS** mode.

(1) SETTING SPOT BIAS

Table 7-2 lists a program model for writing spot bias measurement programs. A program written based on the program model in Table 7-2 to initialize the following dc bias settings is listed in Figure 7-3. The HP-IB address is 17.

DC BIAS mode:	SPOT
SPOT BIAS value:	10V
Auto Bias Polarity Control:	ON
Step Delay Time:	4ms
DC BIAS Switch:	ON

Table 7-2. Program Model For SPOT BIAS

PROGRAM		Meaning	Control Parameter or value
10	ASSIGN @Hp_adrs TO 7☐	HP-IB address	0 to 30
20	REMOTE @Hp_adrs	Remote 4279A	
30	OUTPUT @Hp_adrs;"BMOD1"	SPOT_BIAS mode	
40	OUTPUT @Hp_adrs;"SBI=☐"	Spot dc bias	**0** to ±38
50	OUTPUT @Hp_adrs;"APOL☐"	Polarity Control	**0:OFF** 1:ON
60	OUTPUT @Hp_adrs;"SDEL=☐"	Step Delay	**0** to 1000
70	OUTPUT @Hp_adrs;"BIAS☐"	Bias on/off	**0:OFF** 1:ON
80	END		

```
10    ASSIGN @Hp_adrs TO 717
20    REMOTE @Hp_adrs
30    OUTPUT @Hp_adrs;"BMOD1"
40    OUTPUT @Hp_adrs;"SBI=10"
50    OUTPUT @Hp_adrs;"APOL1"
60    OUTPUT @Hp_adrs;"SDEL=4"
70    OUTPUT @Hp_adrs;"BIAS1"
80    END
```

Figure 7-3. Sample Program 3

(2) SETTING PROGRAMMED SWEEP BIAS

Table 7-3 lists a program model to initialize the programmed sweep bias table. A sample program created using this model to initialize the following dc bias settings and the programmed points table is listed in Figure 7-4. The HP-IB address is 17.

DC BIAS mode:	PROG SWEEP
Step Delay Time:	4ms
Auto Bias Polarity Control:	ON
DC BIAS Switch:	ON

PROG SWEEP BIAS setting:

DC BIAS	Meas. Range
1V	1024pF
2V	512pF
5V	128pF
10V	32pF
15V	32pF
20V	32pF

Table 7-3. Program Model for PROG SWEEP BIAS

PROGRAM	Meaning	Control Parameter or value
10 ASSIGN @Hp_adrs TO 7□	HP-IB address	0 to 30
20 REMOTE @Hp_adrs	Remote 4279A	
30 OUTPUT @Hp_adrs;"BMOD2"	Sweep bias mode	
40 DIM Sweep_table(1:□,1)	Dimension	1 to 51 (Sweep point number)
50 DATA □,□	Sweep point(1)	dc bias_1 and meas.range_1
60 DATA □,□	Sweep point(2)	dc bias_2 and meas.range_2
---	---	---
---	---	---
550 DATA □,□	Sweep point(51)	dc bias_51 and meas.range_51
560 READ Sweep_table(*)	Read all data	
570 OUTPUT @Hp_adrs;"BTAB=";Sweep_table(*)	Sweep Table	
580 OUTPUT @Hp_adrs;"APOL□"	Polarity Control	**0:OFF** 1:ON
590 OUTPUT @Hp_adrs;"SDEL=□"	Step Delay	**0** to 1000
600 OUTPUT @Hp_adrs;"BIAS□"	DC Bias	**0:OFF** 1:ON
610 END		

Note: 1. Lines 50 to 550 depend on the number of bias sweep points used.

2. The following values are used for the measurement ranges. Then when you use AUTO range, you must set each range corresponding to each sweep points to AUTO.

Meas. Range	Setting Value
AUTO	0
2pF	1
8pF	2
32pF	3
128pF	4
512pF	5
1024pF	6

```
10    ASSIGN @Hp_adrs TO 717
20    REMOTE @Hp_adrs
30    OUTPUT @Hp_adrs;"BMOD2"
40    DIM Sweep_table(1:6,1)
50    DATA 1,6
60    DATA 2,5
70    DATA 5,4
80    DATA 10,3
90    DATA 15,3
100   DATA 20,3
110   READ Sweep_table(*)
120   OUTPUT @Hp_adrs;"BTAB=";Sweep_table(*)
130   OUTPUT @Hp_adrs;"APOL1"
140   OUTPUT @Hp_adrs;"SDEL=4"
150   OUTPUT @Hp_adrs;"BIAS1"
160   END
```

Figure 7-4. Sample Program 4

7-3. MEASUREMENT AND DATA TRANSFER

The 4279A can be programmed to transfer the following types of data.

DATA Format (ASCII or BINARY)
Secondary Parameter Data Output ON/OFF
Auto Bias Polarity Switching Result Output ON/OFF

The 4279A can be programmed to use ASCII or BINARY data transfer formats. This paragraph includes sample programs for each.

7-3-1. ASCII FORMAT

Table 7-4 lists a program model for writing programs which use the ASCII data transfer format. Two examples are included in this paragraph, (1. Using the spot bias mode (Figure 7-5), and 2. Using the programmed sweep bias mode (Figure 7-6)). Enter and run either of these programs to trigger the 4279A, collect and display measurement data, and to transfer the data in the ASCII data transfer format.

Table 7-4. Program Model for the ASCII Data Transfer Format

PROGRAM		Meaning	Control Parameter or value
10	ASSGIN @Hp_adrs TO 7□	HP-IB address	0 to 30
20	REMOTE @Hp_adrs	Remote the 4279A	
30	DIM Result(1:□,1)	Dimension	1 to 51 (bias point number)
40	OUTPUT @Hp_adrs;"TRIG2"	Set the trigger mode to external trigger.	
50	OUTPUT @Hp_adrs;"*SRE1"	Enable B0 for SRQ	
60	OUTPUT @Hp_adrs;"DFMT1"	ASCII format	
70	OUTPUT @Hp_adrs;"DSEC□"	Second parameter data output	0:OFF **1:ON**
80	OUTPUT @Hp_adrs;"DPOL□"	Polarity Control Result Output	**0:OFF** 1:ON
90	ON INTR 7 GOTO Meas_end	Goto the Meas_end label line, on receiving an SRQ interrupt.	
100	ENABLE INTR 7;2	Enable the interrupt	
110	OUTPUT @Hp_adrs;"*TRG"	Trigger the 4279A	
120	Waiting:GOTO Waiting	Wait for the end of the measurement	
130	Meas_end:S=SPOLL(@Hp_adrs)	Clear the status byte	
140	OUTPUT @Hp_adrs;"DATA?"	Read the data	
150	ENTER @Hp_adrs;Result(*) (ENTER @Hp_adrs;Result(*),P)	Enter the data without the polarity result (Enter the data with the polarity result)	
160	PRINT Result(*) (PRINT Result(*),P)	Display the result without the polarity result (Display the result with the polarity result)	
170	END	End the program	

(1) Using the Spot Bias Mode

Sample program 5 (Figure 7-5) initializes the 4279A to the settings listed below, trigger the 4279A to make a measurement, and display the measurement data. The program code listed in the box in Figure 7-5 (taken from the program listed in Figure 7-3) sets up the **spot bias** mode.

DATA Format:	ASCII
Secondary Parameter Data Output:	ON
Auto Bias Polarity Switching Result:	ON

```
10    ASSIGN @Hp_adrs TO 717
20    REMOTE @Hp_adrs
30    OUTPUT @Hp_adrs;"BMOD1"
40    OUTPUT @Hp_adrs;"SBI=10"
50    OUTPUT @Hp_adrs;"APOL1"
60    OUTPUT @Hp_adrs;"SDEL=4"
70    OUTPUT @Hp_adrs;"BIAS1"
80    DIM Result(1:1,1)
90    OUTPUT @Hp_adrs;"TRIG2"
100   OUTPUT @Hp_adrs;"*SRE1"
110   OUTPUT @Hp_adrs;"DFMT1"
120   OUTPUT @Hp_adrs;"DSEC1"
130   OUTPUT @Hp_adrs;"DPOL1"
140   ON INTR 7 GOTO Meas_end
150   ENABLE INTR 7;2
160   OUTPUT @Hp_adrs;"*TRG"
170 Waiting:GOTO Waiting
180 Meas_end:S=SPOLL(@Hp_adrs)
190   OUTPUT @Hp_adrs;"DATA?"
200   ENTER @Hp_adrs;Result(*),P
210   PRINT Result(*),P
220   END
```

Refer to Figure 7-3

Figure 7-5. Sample Program 5

(2) Using the Programmed Sweep Bias Mode

Sample program 6 (Figure 7-6) initializes the 4279A to the settings listed below, trigger the 4279A to make a measurement, and display the measurement data. The program code listed in the box in Figure 7-6 (taken from the program listed in Figure 7-4) sets up the **programmed sweep bias table** mode.

DATA Format:	ASCII
Secondary Parameter Data Output:	ON
Auto Bias Polarity Switching Result:	ON

```
10    ASSIGN @Hp_adrs TO 717
20    REMOTE @Hp_adrs
30    OUTPUT @Hp_adrs;"BMOD2"
40    DIM Sweep_table(1:6,1)
50    DATA 1,6
60    DATA 2,5
70    DATA 5,4
80    DATA 10,3
90    DATA 15,3
100   DATA 20,3
110   READ Sweep_table(*)
120   OUTPUT @Hp_adrs;"BTAB=";Sweep_table(*)
130   OUTPUT @Hp_adrs;"APOL1"
140   OUTPUT @Hp_adrs;"SDEL=4"
150   OUTPUT @Hp_adrs;"BIAS1"
160   DIM Result(1:6,1)
170   OUTPUT @Hp_adrs;"TRIG2"
180   OUTPUT @Hp_adrs;"*SRE1"
190   OUTPUT @Hp_adrs;"DFMT1"
200   OUTPUT @Hp_adrs;"DSEC1"
210   OUTPUT @Hp_adrs;"DPOL1"
220   ON INTR 7 GOTO Meas_end
230   ENABLE INTR 7;2
240   OUTPUT @Hp_adrs;"*TRG"
250 Waiting:GOTO Waiting
260 Meas_end:S=SPOLL(@Hp_adrs)
270   OUTPUT @Hp_adrs;"DATA?"
280   ENTER @Hp_adrs;Result(*),P
290   PRINT Result(*),P
300   END
```

Refer to Figure 7-4

Figure 7-6. Sample Program 6

7-3-2. BINARY FORMAT

Table 7-5 lists a program model for you to use as a guide when writing BINARY format data transfer programs. Two examples are given in this paragraph, (1. Using the spot bias mode, and 2. Using the programmed sweep bias mode). Enter and run either of these programs trigger the 4279A, collect and display measurement data, and to transfer the data in the BINARY data transfer format.

Table 7-5. Program Model for the BINARY Data Transfer Format

PROGRAM	Meaning	Control Parameter or value
10 INTEGER Header_1,Header_2,P	Integer Valiables	
20 ASSGIN @Hp_adrs TO 7□;FORMAT ON	HP-IB address	0 to 30
30 ASSIGN @Binary TO7□;FORMAT OFF	HP-IB address	0 to 30
40 REMOTE @Hp_adrs	Remote the 4279A	
50 DIM Result(1:□,1)	Dimension	1 to 51 (bias point number)
60 OUTPUT @Hp_adrs;"TRIG2"	Set the trigger mode to the EXT_TRIG.	
70 OUTPUT @Hp_adrs;"*SRE1"	Enable B0 for SRQ	
80 OUTPUT @Hp_adrs;"DFMT2"	BINARY format	
70 OUTPUT @Hp_adrs;"DSEC□"	Second parameter data output	0:OFF **1:ON**
80 OUTPUT @Hp_adrs;"DPOL□"	Polarity Control Result Output	**0:OFF** 1:ON
90 ON INTR 7 GOTO Meas_end	Goto the Meas_end label line, on receiving an SRQ interrupt.	
100 ENABLE INTR 7;2	Enable interrupt	
110 OUTPUT @Hp_adrs;"*TRG"	Trigger the 4279A	
120 Waiting:GOTO Waiting	Wait for the end of the measurement	
130 Meas_end:S=SPOLL(@Hp_adrs)	Clear status byte	
140 OUTPUT @Hp_adrs;"DATA?"	Read the data	
150 ENTER @Binary;Header_1,Header_2, Result(*) (ENTER @Binary;Header_1,Header_2, Result(*),P)	Enter the data without the polarity Result (Enter the data with the polarity result)	
160 PRINT Result(*) (PRINT Result(*),P)	Display the result without the polarity result (Display the result with the polarity result)	
170 END	End the program	

(1) Using the Spot Bias Mode

Sample program 7 (Figure 7-7) initializes the 4279A to the settings listed below, trigger the 4279A to make a measurement, and display the measurement data. The program code listed in the box in Figure 7-7 (taken from the program listed in Figure 7-3) sets up the **spot bias** mode.

DATA Format:	BINARY
Secondary Parameter Data Output:	ON
Auto Bias Polarity Switching Result:	ON

```
10    INTEGER Header_1,Header_2,P
20    ASSIGN @Hp_adrs TO 717;FORMAT ON
30    ASSIGN @Binary TO 717;FORMAT OFF
40    REMOTE @Hp_adrs
50    OUTPUT @Hp_adrs;"BMOD1"
60    OUTPUT @Hp_adrs;"SBI=10"
70    OUTPUT @Hp_adrs;"APOL1"
80    OUTPUT @Hp_adrs;"SDEL=4"
90    OUTPUT @Hp_adrs;"BIAS1"
100   DIM Result(1:1,1)
110   OUTPUT @Hp_adrs;"TRIG2"
120   OUTPUT @Hp_adrs;"*SRE1"
130   OUTPUT @Hp_adrs;"DFMT2"
140   OUTPUT @Hp_adrs;"DSEC1"
150   OUTPUT @Hp_adrs;"DPOL1"
160   ON INTR 7 GOTO Meas_end
170   ENABLE INTR 7;2
180   OUTPUT @Hp_adrs;"*TRG"
190 Waiting:GOTO Waiting
200 Meas_end:S=SPOLL(@Hp_adrs)
210   OUTPUT @Hp_adrs;"DATA?"
220   ENTER @Binary;Header_1,Header_2,Result(*),P
230   PRINT Result(*),P
240   END
```

Refer to Figure 7-3

Figure 7-7. Sample Program 7

(2) Using the Programmed Sweep Bias Mode

Sample program 8 (Figure 7-8) using Table 7-4, initializes the 4279A to the settings listed below, trigger the 4279A to make a measurement, and display the measurement data. The program code listed in the box in Figure 7-8 (taken from the program listed in Figure 7-4) sets up the **programmed bias** mode.

DATA Format:	BINARY
Secondary Parameter Data Output:	ON
Polarity Check Result:	ON

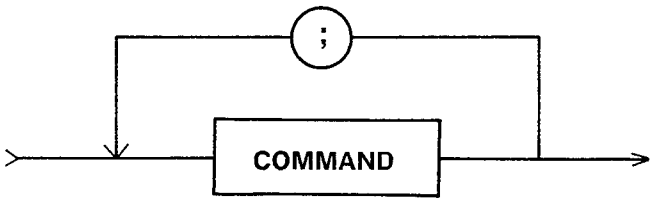
```
10    INTEGER Header_1,Header_2,P
20    ASSIGN @Hp_adrs TO 717;FORMAT ON
30    ASSIGN @Binary TO 717;FORMAT OFF
40    REMOTE @Hp_adrs
50    OUTPUT @Hp_adrs;"BMOD2"
60    DIM Sweep_table(1:6,1)
70    DATA 1,6
80    DATA 2,5
90    DATA 5,4
100   DATA 10,3
110   DATA 15,3
120   DATA 20,3
130   READ Sweep_table(*)
140   OUTPUT @Hp_adrs;"BTAB=";Sweep_table(*)
150   OUTPUT @Hp_adrs;"APOL1"
160   OUTPUT @Hp_adrs;"SDEL=4"
170   OUTPUT @Hp_adrs;"BIAS1"
180   DIM Result(1:6,1)
190   OUTPUT @Hp_adrs;"TRIG2"
200   OUTPUT @Hp_adrs;"*SRE1"
210   OUTPUT @Hp_adrs;"DFMT2"
220   OUTPUT @Hp_adrs;"DSEC1"
230   OUTPUT @Hp_adrs;"DPOL1"
240   ON INTR 7 GOTO Meas_end
250   ENABLE INTR 7;2
260   OUTPUT @Hp_adrs;"*TRG"
270 Waiting:GOTO Waiting
280 Meas_end:S=SPOLL(@Hp_adrs)
290   OUTPUT @Hp_adrs;"DATA?"
300   ENTER @Binary;Header_1,Header_2,Result(*),P
310   PRINT Result(*),P
320   END
```

Refer to Figure 7-4

Figure 7-8. Sample Program 8

7-4. MULTIPLE COMMANDS

Multiple 4279A device dependent commands can be placed on a line by using a semicolon (;) as a separator as shown in below.



For example:

OUTPUT 717;"TRIG2;OSC2;AVE=4"

Note

You cannot use the following commands on a multiple command line.

ERR?	**XSH**	***OPT?**
OPM?	**XSTD**	***RST**
SHM?	**XTMP**	***SRE**
STM?	***CLS**	***SRE?**
STR?	***IDN?**	***STB?**
XOP	***LRN?**	***TRG**

For example, The sample program (Figure 7-2) can be rewritten as shown in Figure 7-9 by using semicolon (;) separators.

```
10    ASSIGN @Hp_adrs TO 717
20    REMOTE @Hp_adrs
30    OUTPUT @Hp_adrs;"*RST"
40    OUTPUT @Hp_adrs;"OSC3;TDEL=10;CABL1;OPEN1;SHOR1;STD1;AOFF1;DPAG3;TRIG2"
50    END
```

Figure 7-9. Sample Program 9

SECTION 8

GENERAL INFORMATION

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SECTION 8

GENERAL INFORMATION

8-1. INTRODUCTION

This section covers the specifications, supplemental performance characteristics, installation, and other information about the HP 4279A.

8-2. SPECIFICATIONS

Table 8-3 lists the complete 4279A specifications. These specifications are the performance standards or limits against which the instrument is tested. When shipped from the factory, the 4279A meets the specifications listed in Table 8-3. Section 9 contains the procedures for verifying the 4279A's specifications. Table 8-4 lists supplemental performance characteristics. Supplemental performance characteristics are not specifications but they are typical characteristics included as additional information for the operator.

8-3. SAFETY CONSIDERATIONS

The 4279A conforms to the safety requirements of the International Electromechanical Committee, (IEC), Safety Class I instruments and is shipped from the factory in a safe state.

8-4. INSTRUMENTS COVERED BY THIS MANUAL

Hewlett-Packard uses a two-part nine character serial number which is stamped on the serial number plate (see Figure 8-1) attached to the instrument's rear panel. The first four digits and the letter are the serial 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 prefixes listed under Serial Numbers on the title page.

Figure 8-1. 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 a new instrument may be accompanied by a yellow Manual Changes supplement or have a different manual part number. The Manual Changes supplement contains "change information" that explains how to adapt the manual to newer instruments.

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.

Listed on the title page of this manual is microfiche part number. This number can used to order 4 by 6 inch microfilm transparencies of the manual pages. Each microfiche contains up to 60 photoduplicates of the manual pages. The microfiche package also includes the latest manual changes supplement as well as all pertinent service notes. To order an additional manual, use the part number listed on the title page of this manual.

8-5. OPERATING ENVIRONMENT

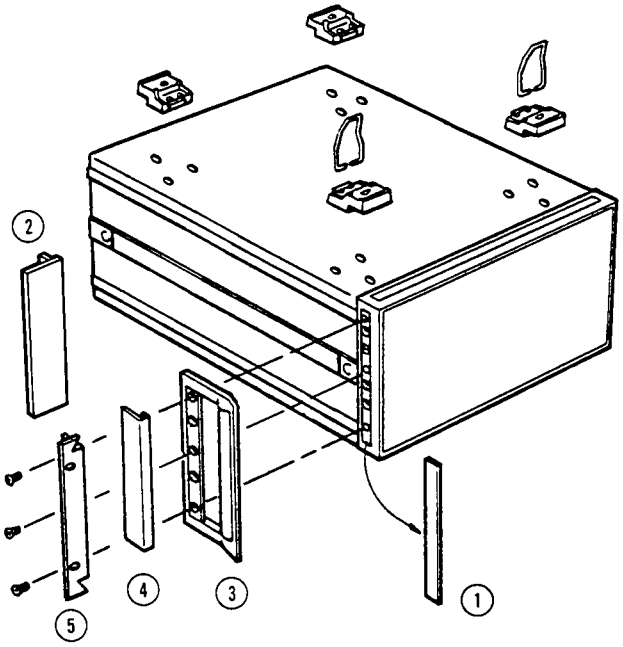
Temperature The 4279A must be operated in ambient temperatures ranging from 5 to 45 °C.

Humidity The instrument may be operated in environments with relative humidities up to 95% at 40 °C. The 4279A should be protected from temperature extremes which could cause condensation within the instrument.

8-6. INSTALLATION OF OPTIONS 907, 908, AND 909

The 4279A can be rack mounted and used as a component of a measurement system. Information on rack mounting the 4279A is provided in Figure 8-2.

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



1. Remove the adhesive-backed trim strips 1 from the left and right front sides of the 4279A.

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 4279A 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 4279A using the screws provided.

5. When rack mounting the 4279A (3 and 4 above), remove all four feet (lift bar on the inner side of the foot, and slide the foot toward the bar).

Figure 8-2. Rack Mount Kits

8-7. STORAGE AND SHIPMENT

8-7-1. ENVIRONMENT

The 4279A should be stored in a clean, dry environment. The following environmental limitations apply for both storage and shipping:

Temperature:	-20 to 60 °C
Humidity:	up to 95% (at 40 °C)

To prevent condensation from forming on the inside of the 4279A, protect it from temperature extremes.

8-7-2. ORIGINAL PACKAGING

A container 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.

8-7-3. USING OTHER PACKING MATERIALS

The following general instructions should be used when repacking with commercially available materials:

1. Wrap the 4279A 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 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 control panel.

4. Seal the shipping container securely.

5. Mark the shipping container **FRAGILE** to help ensure careful handling.

6. In any correspondence, refer to the 4279A by model number and its full serial number.

8-8. ELECTRICAL OPTION MODIFICATIONS

Electrical options can be added or deleted after you receive the 4279A. Tables 8-1 and 8-2 list the necessary parts, and the modification procedures are given in the Service Manual.

Note

The part numbers listed below may need to be changed when circuit enhancements are made. Contact your nearest Hewlett-Packard service center to confirm the part numbers before ordering parts.

Table 8-1. Parts Necessary to Shift the Test Frequency by 1%

HP Part Number	Description	QTY.
1813-0551	Crystal Oscillator Module 8.08MHz	1
5080-3152	"04279-66572" Label	1

Table 8-2. Parts Necessary for not shifting the Test Frequency

HP Part Number	Description	QTY.
1813-0550	Crystal Oscillator Module 8.00MHz	1

Table 8-3. Specifications (Sheet 1 of 13)

GENERAL

OPERATING ENVIRONMENT:

Temperature: 5°C to 45°C

Relative Humidity: ≤95% RH @ 40°C.
Condensation must be avoided.

STORAGE ENVIRONMENT:

Temperature: -20°C to +60°C

Relative Humidity: ≤95% RH @ 40°C.

SAFETY:

Based on IEC-348, CSA-BULLETIN-556B and UL-1244

POWER REQUIREMENTS:

Line Voltage: 100, 120, and 220VAC ±10%, 240VAC +5% -10%

Line Frequency: 48 to 66Hz

Power Consumption: 200VA max.

DIMENSIONS:

Approximately 426W by 177H by 498D (mm)

WEIGHT:

Approximately 15kg (33lb., standard)

DISPLAY:

Dot-matrix liquid crystal display (LCD). Displays measurement values with a resolution of 4, 5, or 6 digits (max. 999999 counts), front panel control settings, comparator limits, and the comparator's decision output.

This ISM device complies with Canadian ICES-001.
Cet appareil ISM est conforme à la norme NMB-001 du Canada.

Table 8-3. Specifications (Sheet 2 of 13)

BASIC SPECIFICATIONS

PARAMETER MEASURED:

C_P-D, C_P-Q, C_P-G, C_S-D, C_S-Q, and **C_S-ESR**

Where:

C_P is the capacitance in parallel circuit mode
C_S is the capacitance in series circuit mode
D is the dissipation factor
Q is the quality factor (=1/**D**)
G is the conductance in the parallel circuit mode
ESR is equivalent series resistance

MEASUREMENT CIRCUIT MODE:

Parallel equivalent circuit (**C_P-D**, **C_P-Q**, and **C_P-G**)

Series equivalent circuit (**C_S-D**, **C_S-Q**, and **C_S-ESR**)

RANGING:

Auto, Manual, and Program

TEST FREQUENCY:

1MHz ±0.02%

TEST SIGNAL LEVEL:

20mV, 50mV, 100mV, 200mV, 500mV, 1000mVrms, ±10% (The test signal is specified when the **UNKNOWN** Terminals are opened.)

MEASUREMENT TERMINAL:

Four-terminal pair, guarded

TEST CABLE LENGTH:

Selection of 0m, 1m, and 2m

COMPENSATION:

Compensation Data Storage:

A maximum of sixteen sets of compensation data can be stored in the 4279A's internal memory. Only one compensation data set can be used per measurement (sweep).

OPEN Compensation:

The open compensation function compensates for the stray admittance of the test fixture.

SHORT Compensation:

The short compensation function compensates for the residual impedance of the test fixture.

Standard Compensation:

The standard compensation function is used to compensate for other errors by using the standard's reference value and the actual measurement value.

Temperature Compensation:

The temperature compensation function is used to minimize the temperature induced measurement error portion of the analog measurement error.

OFFSET FUNCTION:

Arithmetic compensation for measurement offset errors is performed by entering the proper compensation value.

MEASUREMENT TIME MODE:

Integration Time: SHORT, MEDIUM, and LONG

Trigger Delay Time:

The time delay between the trigger and the start of a measurement can be set between 0 to 1000ms, in 1ms steps.

Averaging:

Displays or outputs the averaged value as the measurement data. The choice of averaging rates is -- 1, 2, 4, 8, 16, 32, 64, 128, and 256.

Table 8-3. Specifications (Sheet 4 of 13)

TRIGGER MODE:

Internal, External, and Manual

SELF TEST:

Checks basic instrument operation.

MEASUREMENT RANGE & RESOLUTION:

PARAMETER	Meas. Range		
C_P, C_S	0.00001pF	to	1280.00pF
D	0.00001	to	9.99999
Q	0.1	to	99999.9
G	0.0001μS	to	9.99999mS
ESR	0.001Ω	to	999.999kΩ

Q is displayed as the result of 1/**D**. The **C** ranges apply when **D**≤0.2. The **ESR** and **G** ranges depend on the measured value of **C** . Up to 125% of full scale can be measured at **D**≤0.2.

MEASUREMENT ACCURACY:

Specified at the front panel **UNKNOWN** connectors or at the ends of the standard 1m or 2m test leads when all of the following conditions are satisfied.

(1) Warm up time ≥ 10 minutes

(2) Ambient temperature 23°C ±5°C: rate of temperature change <0.2°C/ minute

(3) Test cable length set to 0, 1 or 2m (HP 16048A/B/D)

(4) **OPEN** / **SHORT** compensation and temperature compensation have been performed.

(5) Copen << Cdut

Where Copen: Capacitance of measurement terminal with no connections, before performing the open compensation.

Cdut: Capacitance of the DUT after performing the open/ short compensation.

(6) D≤0.1

Accuracies are relative to the calibration standards.

For the temperature range between 5°C and 18°C, or between 28°C and 45°C, the measurement accuracy is given by multiplying the values shown in Table A to D by two.

Table A. **C** Measurement Accuracy

C range (Cf)	OSC level			
	20mV	50mV	100mV	200mV-1V
1024pF 512pF 128pF	0.15%+0.05% 0.07%+0.03% 0.07%+0.03%	0.15%+0.05% 0.07%+0.03% 0.07%+0.03%	0.15%+0.05% 0.07%+0.03% 0.07%+0.03%	0.1%+0.05% 0.07%+0.03% 0.07%+0.03%
32pF	0.15%+0.08% 0.06%+0.04% 0.07%+0.03%			
8pF	0.15%+0.15% 0.06%+0.08% 0.06%+0.05%	0.15%+0.08% 0.06%+0.04% 0.07%+0.03%		
2pF	0%+0.5% 0%+0.3% 0%+0.2%	0%+0.3% 0%+0.15% 0%+0.1%	0%+0.2% 0%+0.1% 0.06%+0.04%	0.1%+0.05%* 0.06%+0.04% 0.06%+0.04%

[1] Accuracy is read as:

C: ±(% of reading + % of full scale)

[2] Accuracies in the table represent: SHORT MODE
MEDIUM MODE
LONG MODE

* Accuracy as follows when set to 2pF range, 200mV, and SHORT mode.

0.1% + 0.07%

Table B. **D** Measurement Accuracy

C range (Cf)	OSC level			
	20mV	50mV	100mV	200mV-IV
1024pF	0.0015+0.0005/α 0.0005+0.0005/α 0.0007+0.0003/α	0.0015+0.0005/α 0.0005+0.0005/α 0.0007+0.0003/α	0.0015+0.0005/α 0.0005+0.0005/α 0.0007+0.0003/α	0.001+0.0005/α 0.0005+0.0005/α 0.0007+0.0003/α
512pF 128pF	0.0015+0.0005/α 0.0005+0.0005/α 0.0004+0.0003/α	0.0015+0.0005/α 0.0005+0.0005/α 0.0004+0.0003/α	0.0015+0.0005/α 0.0005+0.0005/α 0.0004+0.0003/α	0.001+0.0005/α 0.0005+0.0005/α 0.0004+0.0003/α
32pF	0.0015+0.0008/α 0.0005+0.0005/α 0.0004+0.0003/α			
8pF	0.0015+0.0015/α 0.0004+0.0008/α 0.0004+0.0007/α	0.0015+0.0008/α 0.0005+0.0005/α 0.0004+0.0004/α		
2pF	0.007/α 0.005/α 0.003/α	0.005/α 0.002/α 0.0015/α	0.003/α 0.0005+0.001/α 0.0005+0.0005/α	0.001+0.0005/α* 0.0005+0.0005/α 0.0005+0.0005/α

[1] Accuracy is read as:

D: ±(absolute value of **D**)

[2] Accuracies in the table represent: SHORT MODE
MEDIUM MODE
LONG MODE

[3] $\alpha = C_X/C_F$

Where $\mathbf{C}_X$: Reading of **C** (pF)
$\mathbf{C}_F$: Full scale of **C** range (pF)

[4] Accuracy of **Q** is as shown below (when $(\mathbf{Q}_X)(\mathbf{D}_E) < 1$):

$$\pm \left(\frac{(\mathbf{Q}_X{}^2)(\mathbf{D}_E)}{1 \mp (\mathbf{Q}_X)(\mathbf{D}_E)} \right)$$

Where $\mathbf{Q}_X$: Reading of **Q**
$\mathbf{D}_E$: Accuracy of **D**

For example, for the conditions ($\mathbf{Q}_X$: 200, Reading of **C**: 100pF, measurement range: 128pF, and INTEG.TIME: LONG), the accuracy of **Q** is as follows.

$D_E = 0.0004 + 0.0003 \times 128/100 = 0.000784$

Accuracy of **Q** = $\pm \left(\frac{(200)^2 \times 0.000784}{1 \mp 200 \times 0.000784} \right)$

Therefore accuracy of **Q**: +37.2, -27.1

* Accuracy as follows at 2pF range, 200mV, and SHORT mode

$$0.001 + 0.001/\alpha$$

Table C. **ESR** Measurement Accuracy

C range (Cf)	OSC level			
	20mV	50mV	100mV	200mV-1V
1024pF	(239+80/α)/Cx Ω (80+80/α)/Cx Ω (112+48/α)/Cx Ω	(239+80/α)/Cx Ω (80+80/α)/Cx Ω (112+48/α)/Cx Ω	(239+80/α)/Cx Ω (80+80/α)/Cx Ω (112+48/α)/Cx Ω	(160+80/α)/Cx Ω (80+80/α)Cx Ω (112+48/α)/Cx Ω
512pF 128pF	(239+80/α)/Cx Ω (80+80/α)/Cx Ω (64+48/α)/Cx Ω	(239+80/α)/Cx Ω (80+80/α)/Cx Ω (64+48/α)/Cx Ω	(239+80/α)/Cx Ω (80+80/α)/Cx Ω (64+48/α)/Cx Ω	(160+80/α)/Cx Ω (80+80/α)/Cx Ω (64+48/α)/Cx Ω
32pF	(239+128/α)/Cx Ω (80+80/α)/Cx Ω (64+48/α)/Cx Ω			
8pF	(239+239/α)/Cx Ω (64+128/α)/Cx Ω (64+112/α)/Cx Ω	(239+128/α)/Cx Ω (80+80/α)Cx Ω (64+64/α)/Cx Ω		
2pF	$2229/Cx^2$ Ω $1592/Cx^2$ Ω $955/Cx^2$ Ω	$1592/Cx^2$ Ω $637/Cx^2$ Ω $478/Cx^2$ Ω	$955/Cx^2$ Ω (80+160/α)/Cx Ω (80+80/α)/Cx Ω	(160+80/α)/Cx Ω* (80+80/α)/Cx Ω (80+80/α)/Cx Ω

[1] Accuracy is read as:

ESR: ±(absolute value of **ESR**)

[2] Accuracies in the table represent:

SHORT MODE
MEDIUM MODE
LONG MODE

[3] $\mathbf{C}_X$: Reading of **C** (pF)
$\mathbf{C}_F$: Full scale of C range (pF)
$\alpha = \mathbf{C}_X/\mathbf{C}_F$

* Accuracy as follows at 2pF range, 200mV, and SHORT mode

$$(160 + 160/\alpha)/\mathbf{C}_X\ \Omega$$

Table D. **G** Measurement Accuracy

C range (Cf)	OSC level			
	20mV	50mV	100mV	200mV-IV
1024pF	(0.0095Cx+3.22)μS (0.0032Cx+3.22)μS (0.0044Cx+1.93)μS	(0.0095Cx+3.22)μS (0.0032Cx+3.22)μS (0.0044Cx+1.93)μS	(0.0095Cx+3.22)μS (0.0032Cx+3.22)μS (0.0044Cx+3.22)μS	(0.0063Cx+3.22)μS (0.0032Cx+3.22)μS (0.0044Cx+1.93)μS
512pF	(0.0095Cx+1.61)μS (0.0032Cx+1.61)μS (0.0026Cx+0.97)μS	(0.0095Cx+1.61)μS (0.0032Cx+1.61)μS (0.0026Cx+0.97)μS	(0.0095Cx+1.61)μS (0.0032Cx+1.61)μS (0.0026Cx+0.97)μS	(0.0063Cx+1.61)μS (0.0032Cx+1.61)μS (0.0026Cx+0.97)μS
128pF	(0.0095Cx+0.4)μS (0.0032Cx+0.4)μS (0.0026Cx+0.24)μS	(0.0095Cx+0.4)μS (0.0032Cx+0.4)μS (0.0026Cx+0.24)μS	(0.0095Cx+0.4)μS (0.0032Cx+0.4)μS (0.0026Cx+0.24)μS	(0.0063Cx+0.4)μS (0.0032Cx+0.4)μS (0.0026Cx+0.24)μS
32pF	(0.0095Cx+0.16)μS (0.0032Cx+0.1)μS (0.0026Cx+0.06)μS	(0.0095Cx+0.1)μS (0.0032Cx+0.1)μS (0.0026Cx+0.06)μS	(0.0095Cx+0.1)μS (0.0032Cx+0.1)μS (0.0026Cx+0.06)μS	(0.0063Cx+0.1)μS (0.0032Cx+0.1)μS (0.0026Cx+0.06)μS
8pF	(0.0095Cx+0.076)μS (0.0026Cx+0.04)μS (0.0026Cx+0.035)μS	(0.0095Cx+0.04)μS (0.0032Cx+0.025)μS (0.0026Cx+0.02)μS	(0.0095Cx+0.025)μS (0.0032Cx+0.025)μS (0.0026Cx+0.015)μS	(0.0063Cx+0.025)μS (0.0032Cx+0.025)μS (0.0026Cx+0.015)μS
2pF	0.088μS 0.063μS 0.038μS	0.063μS 0.025μS 0.019μS	0.038μS (0.0032Cx+0.0126)μS (0.0032Cx+0.0063)μS	(0.0063Cx+0.0063)μS* (0.0032Cx+0.0063)μS (0.0032Cx+0.0063)μS

[1] Accuracy is read as:

G: ±(absolute value of **G**)

[2] Accuracies in the table represent: SHORT MODE
MEDIUM MODE
LONG MODE

[3] $\mathbf{C}_X$: Reading of **C** (pF)

* Accuracy as follows at 2pF range, 200mV, and SHORT mode

$$(0.0063\mathbf{C}_X + 0.0126)\mu\mathbf{S}$$

Table 8-3. Specifications (Sheet 10 of 13)

DC BIAS:

Internal dc bias: 0V to ±38V

BIAS (V)	Resolution	Accuracy (23±5°C)
±(0.000 to 4.000)V	1mV	±(0.1% of setting + 1mV)
±(4.002 to 8.000)V	2mV	±(0.1% of setting + 2mV)
±(8.005 to 20.000)V	5mV	±(0.1% of setting + 3mV)
±(20.01 to 38.00)V	10mV	±(0.1% of setting + 10mV)

Auto Bias Polarity Control:

This function is used to automatically control the polarity of the bias voltage according to the polarity of the DUT.

Programming Sweep: Max.51 points (via HP-IB)

Step Delay Time:

The delay time between applying the bias voltage and the start of a measurement can be set between 3ms to 1000ms, in 1ms steps.

External DC bias: 0V to ±100V

HP-IB INTERFACE:

Remote control and data output (ASCII and binary) via HP-IB. Based on IEEE-STD488 and ANSI-MC1.1.

Remote control all the front panel controls and program of the dc bias voltage except for the power line switch

OPTIONS

Option 003 -- 1% Frequency Shift:

Test frequency is 1% higher than the standard unit to prevent possible test signal interference when the component test contacts are located close to those of other test units.

Option 009 -- Delete Manual

Option 907 -- Front Handle Kit

Option 908 -- Rack Flange Kit

Option 909 -- Rack Flange/Handle Kit

Option 910 -- Extra Manual

ACCESSORIES

FURNISHED ACCESSORIES:

Power Line Fuse	Depends on the line voltage selection. Refer to Section 1.
Power Cable	Depends on what country the 4279A is being used in. Refer to Section 1.

AVAILABLE ACCESSORIES:

Test Fixtures, Test Leads:

HP 16334A (1m, Tweezer-type for Chip Components)

HP 16034E (0m, Test fixture for Chip Components)

HP 16047A (0m, Test fixture for General Purpose)

HP 16047C (0m, Test fixture for General Purpose)

HP 16048A (1m, BNC)

HP 16048B (1m, SMC)

HP 16048D (2m, BNC)

HP-IB Interconnection Cables:

HP 10833A	HP-IB Cable, 1m
HP 10833B	HP-IB Cable, 2m
HP 10833C	HP-IB Cable, 4m
HP 10833D	HP-IB Cable, 0.5m

Table 8-3. Specifications (Sheet 13 of 13)

Impedance Standards:

HP 16380A	Standard Air Capacitor Set (1, 10, 100, and 1000pF)
HP 16074A	Calibration R-L Standard (0.1, 1, 10, and 100Ω and 1, 10, and 100kΩ, OPEN and SHORT, 100mH and 100μH)

Maintenance Accessories:

PN 04278-66596	Extender Board (Half size board)
PN 04278-66597	Extender Board (Digital board)
PN 04278-66598	Extender Board (Analog Board)

Table 8-4. Supplemental Performance Characteristics

SUPPLEMENTAL CHARACTERISTICS

MEASUREMENT TIME:

With the 4279A set up as follows: (trigger delay time: 0ms, step delay time: 0ms, display format: BLANK page), the measurement times for a programmed sweep are as follows.

SHORT mode: approximately (3 + 7.5 × bias point number) ms
MEDIUM mode: approximately (3 + 16 × bias point number) ms
LONG mode: approximately (3 + 28 × bias point number) ms

Measurement time includes the internal bias settling time and ranging time. The time required to display each measurement result is approximately 5ms.

Ranging time:

≤3ms (program mode), ≤20ms/range (auto range)

Internal bias settling time:

≤3ms (time required to reach the 99% bias voltage of the setting bias voltage)

Auto bias polarity switching time:

≤4ms (after the 4279A is triggered)

Settling time after test signal level:

1.5s (typical value)

HP-IB:

Data output: Max. 100 bytes/ms, depending on the controller being used.

Handshake: Typical 2 to 3ms (when used with an HP 9826/9836)

SECTION 9

PERFORMANCE TESTS

9-1. INTRODUCTION 9-1

9-2. TEST EQUIPMENT 9-1

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9-4. CALIBRATION CYCLE 9-2

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SECTION 9

PERFORMANCE TESTS

9-1. INTRODUCTION

Use the test procedures in this section to verify the HP 4279A is within the specifications listed in Table 8-3. All tests are performed without having to access the interior of the 4279A. Performance tests are used to perform incoming inspection of the 4279A, and to verify that the 4279A is within specifications after it has been serviced. If the performance tests indicate that the 4279A is not within specifications, double check your test setup, then proceed to sections which cover Adjustments or Troubleshooting.

Note

Allow the 4279A at least a 10 minute warmup time before performing any of the performance tests.

Note

Performance tests are valid only when performed in an ambient temperature of 23 °C ±5 °C.

9-2. TEST EQUIPMENT

Table 9-1 lists the test equipment required for performance testing. Use only **calibrated** test equipment for these performance tests. If the recommended test equipment is not available, 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 Standards (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.

9-3. PERFORMANCE TEST RECORD

Record the performance test results into the Performance Test Record located at the end of this section. The performance record lists each test, the parameters tested, and the tolerance limits. Keep a log of past performance test results for comparison purposes to help you spot any possible areas of developing trouble.

Note

The test limits listed for each performance test do not take into account the measurement errors induced by the test equipment used. Be sure to take this factor into consideration when determining whether or not the 4279A is within specifications.

9-4. CALIBRATION CYCLE

The 4279A requires periodic performance verification. How often you perform this verification depends on the operating and environmental conditions under which the 4279A is being used. Run the performance verification tests described in this section 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 9-1. Recommended Test Equipment (1 of 2)

Equipment	Requirements	Recommended Model
Electronic Counter	Frequency: 1MHz Accuracy: << 0.02%	HP 5314A
RMS Voltage Meter	Frequency: 1MHz Accuracy: << 10% Voltage range: 0.03V to 1.0Vrms	HP 3400A
Digital Voltage Meter	Frequency: 1MHz Accuracy: << 0.1% Voltage range: 10mV to 38V Resolution: 0.1mV	HP 3478A
Standard Capacitor	Capacitance Range: 1pF to 1000pF Frequency : 1MHz Calibration Accuracy:<0.01%	HP 16380A
Resistance Standard	OPEN reference SHORT reference	HP 16074A Standard Resistor Set
Adaptor	BNC(f)-to-BNC(f), 4ea.	PN 1250-0080
Cable	BNC(m)-to-BNC(m), 30cm	PN 8120-1838

Table 9-1. Recommended Test Equipment (2 of 2)

Equipment	Requirements	Recommended Model
Test Leads	Cable Length, (1m) Cable Length, (2m)	HP 16048A HP 16048D
HP-IB Cable	HP-IB cable, 1m	HP 10833A
Computer	HP Technical Computer	HP 9826

9-5. TEST SIGNAL FREQUENCY ACCURACY TEST

This test verifies that the accuracy of the 4279A's test signal frequency is within ±0.02%.

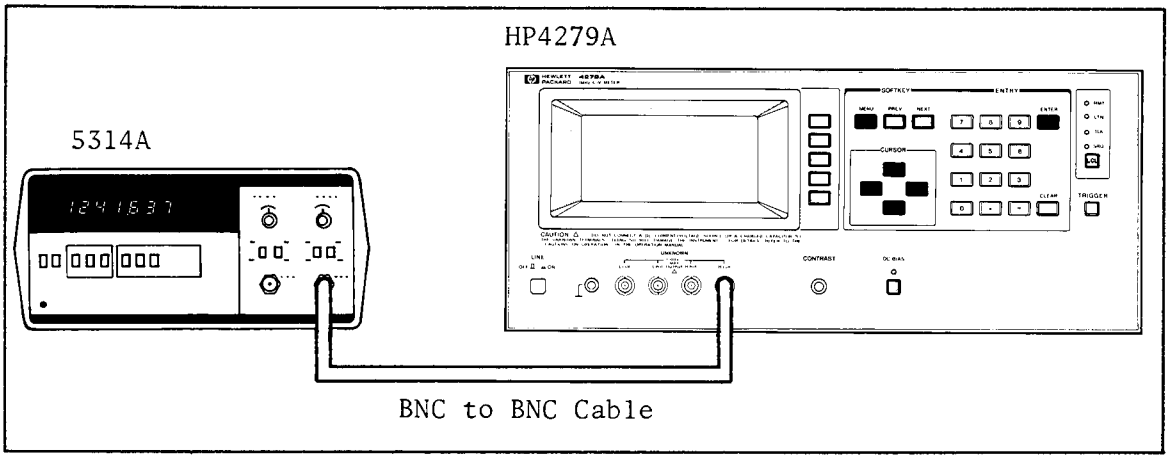


Figure 9-1. Test Frequency Accuracy Test Setup

EQUIPMENT:

Electronic Counter	HP 5314A
BNC(m)-to-BNC(m) Cable, 30cm	PN 8120-1838

PROCEDURE:

1. Connect **INPUT B** of the 5314A to the 4279A's HCUR terminal as shown in Figure 9-1.

2. Set the controls of the 4279A as follows:

DC BIAS switch	OFF
OSC level	1000mVrms
Other Controls	Initialized Settings

3. Confirm that the frequency is 1MHz ±200Hz.

Note

If the 4279A is equipped with Option 003, the test limit is 1.01MHz ±202Hz.

9-6. TEST SIGNAL LEVEL ACCURACY TEST

This test verifies that the 4279A's test signal level is within the specified level accuracy of ±10%.

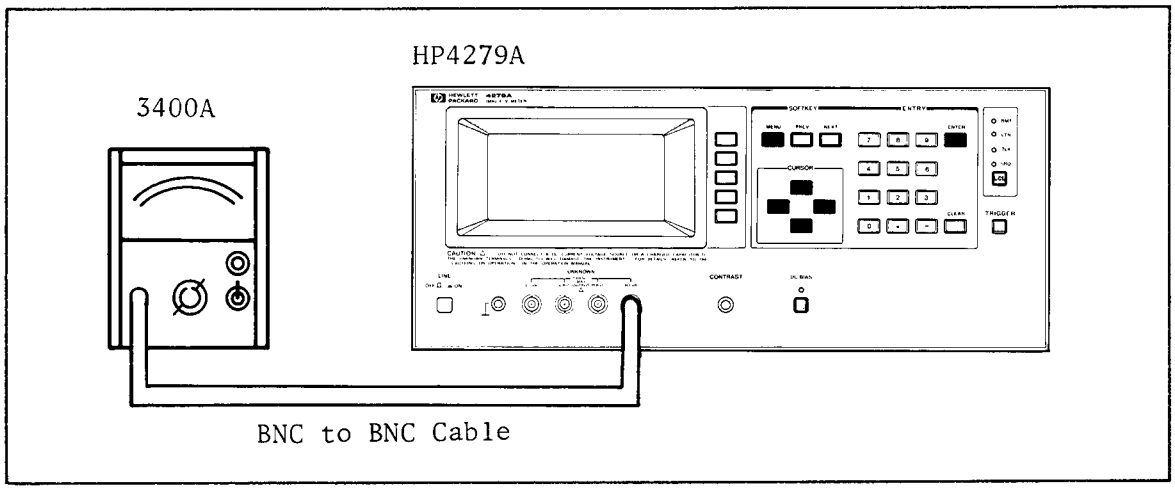


Figure 9-2. Test Signal Level Accuracy Test Setup

EQUIPMENT:

RMS Voltage Meter	HP 3400A
BNC(m)-to-BNC(m) Cable, 30cm	PN 8120-1838

PROCEDURE:

1. Connect the 3400A to the 4279A as shown in Figure 9-2.

2. Set the 4279A's controls as follows:

DC BIAS switch	OFF
OSC level	20mVrms
Other Controls	Initial Settings

3. Confirm that the output level of the 4279A is within the test limits listed in Table 9-2.

4. Set the **OSC level** to the levels listed in Table 9-2, and repeat step 3.

Table 9-2. Test Signal Level Test Limits

OSC Level	**Test Limits**
20mV	18mV to 22mV
50mV	45mV to 55mV
100mV	90mV to 110mV
200mV	180mV to 220mV
500mV	450mV to 550mV
1000mV	900mV to 1100mV

9-7. DC BIAS VOLTAGE ACCURACY TEST

This test verifies the accuracy of the 4279A's internal dc bias voltage.

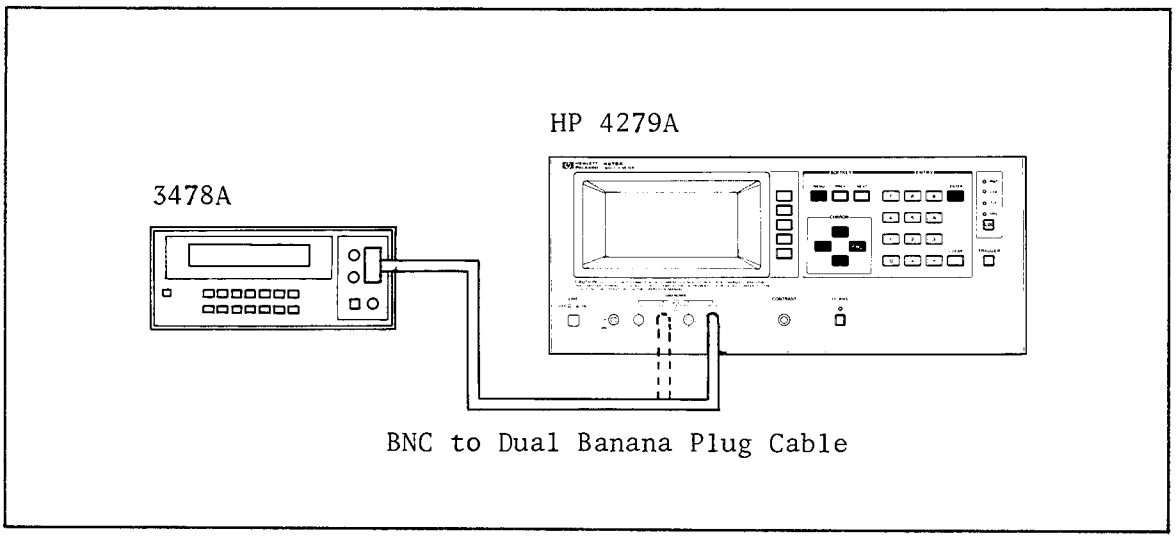


Figure 9-3. DC Bias Voltage Accuracy Test Setup

EQUIPMENT:

Digital Voltage Meter	HP 3478A
BNC(m)-to-BNC(m) Cable, 30cm	PN 8120-1838
BNC(f)-to-Dual Banana Plug	PN 1251-2277

PROCEDURE:

1. Connect the 3478A to the LPOT terminals of the 4279A.
2. Set the 4279A's controls as follows:

DC BIAS switch	ON
OSC Level	20mVrms
DC BIAS mode	SPOT
SPOT BIAS	0V
Trigger Mode	INT_TRIG
Other Controls	Initialized Settings

3. Record the readout value of the 3478A as V(L).
4. Disconnect the cable from the 4279A LPOT terminal, and connect it to the 4279A HCUR terminal.
5. Record the readout value of the 3478A as V(H).
6. Calculate V using the following equation.

$$V = V(H) - V(L)$$

7. Confirm that the calculated value (V) is within the test limits listed in Table 9-3.

8. Set the spot dc bias to the values listed in Table 9-3, and repeat steps 5 to 7. V(L) is the value when the spot bias is set to 0V.

Table 9-3. DC Bias Test Limits

dc Bias Voltage	Test Limits		
0V	-0.001V	to	0.001V
1V	0.998V	to	1.002V
2V	1.997V	to	2.003V
4V	3.995V	to	4.005V
6V	5.992V	to	6.008V
10V	9.987V	to	10.013V
20V	19.977V	to	20.023V
30V	29.96V	to	30.04V
38V	37.952V	to	38.048V
-1V	-0.998V	to	-1.002V
-2V	-1.997V	to	-2.003V
-4V	-3.995V	to	-4.005V
-6V	-5.992V	to	-6.008V
-10V	-9.987V	to	-10.013V
-20V	-19.977V	to	-20.023V
-30V	-29.96V	to	-30.04V
-38V	-37.952V	to	-38.048V

WARNING

BE SURE TO TURN OFF THE INTERNAL DC BIAS SWITCH AND TO SET THE DC BIAS VOLTAGE TO ZERO VOLT AFTER PERFORMING THE PRECEDING TEST.

9-8. CAPACITANCE ACCURACY TEST

This test verifies the capacitance measurement accuracy. Capacitance measurement accuracy is verified by connecting a standard capacitor to the 4279A and comparing the measurement result to the calibrated value listed for the the standard. Measurement accuracy of dissipation factors near zero are also verified during this test.

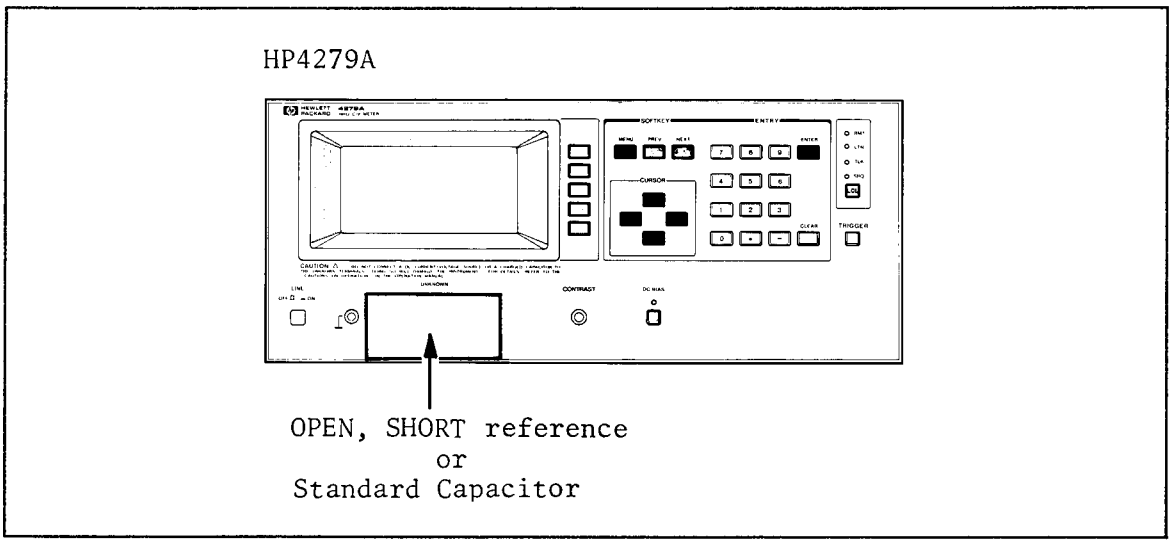


Figure 9-4. Capacitance Accuracy Test Set up 1

EQUIPMENT:

1pF Standard Capacitor	HP 16381A	HP 16380A
10pF Standard Capacitor	HP 16382A	
100pF Standard Capacitor	HP 16383A	
1000pF Standard Capacitor	HP 16384A	
OPEN reference	HP 16074A	
SHORT reference	Standard Resistor Set	
Test Leads	HP 16048A (1m) HP 16048D (2m)	
BNC(f)-to-BNC(f) Adapter	PN 1250-0080 (4ea.)	

PROCEDURE:

1. Connect the **OPEN** reference to the **UNKNOWN** terminals.

2. Set the 4279A's controls as follows:

DC BIAS switch	OFF
Measurement Parameter	**C_p-G**
INTEG TIME	MED
Measurement Range	2pF
OSC Level	20mVrms
Cable Length	0m
Trigger Mode	MAN TRIG
Other Controls	Initialized Settings

[Temperature Compensation]

3. Press the **MENU** key, and the **NEXT** key.

4. Press the **'COMPEN'** softkey, and press the **PREV** key.

5. Press the **'TEMP COMPEN'** softkey. Wait for the completion of the measurement.

[0m Open Compensation]

6. Press the **NEXT** key.

7. Press the **'OPEN COMPEN'** softkey. Wait for the completion of the measurement.

8. Press the **'OPEN ON'** softkey.

[0m Short Compensation]

9. Disconnect the **OPEN** reference, and connect the **SHORT** reference to the **UNKNOWN** terminals.

10. Press the **NEXT** key.

11. Press the **'SHORT COMPEN'** softkey. Wait for the completion of the measurement.

12. Press the **'SHORT ON'** softkey.

[Open Offset Error Check]

13. Disconnect the **SHORT** reference, and connect the **OPEN** reference to the **UNKNOWN** terminals.

14. Press the **TRIGGER** key.

15. Confirm $\mathbf{C_P}$ is within ±0.006pF and **G** is within ±0.0628μS.

[Range Change Accuracy Check]

16. Disconnect the **OPEN** reference, and connect the 1pF standard capacitor to the **UNKNOWN** terminals.

17. Change the measurement parameter to $\mathbf{C_P}$**-D**.

18. Press the **TRIGGER** key.

19. Confirm that $\mathbf{C_P}$ and **D** are within the test limits in Table 9-4.

20. Set the standard capacitor and the measurement range in accordance with Table 9-4. Repeat steps 18 and 19.

Table 9-4. Capacitance Accuracy Test limits 1

Setting		Test Limits	
Standard Capacitor	**Measurement Range**	$\mathbf{C_P}$	**D**
1pF	2pF	C.V. ±0.006pF	±0.01000
10pF	8pF	C.V. ±0.0124pF	±0.00104
100pF	128pF	C.V. ±0.108pF	±0.00114
1000pF	1024pF	1.0003*C.V. ±1.0pF	±0.00102

C.V. : Calibration Value of standard capacitors at 1kHz

Note

The 16380A standard capacitor set is calibrated at 1kHz. Use the 1kHz calibration values for the 1pF, 10pF, and 100pF standard capacitors for 1MHz, but the 1000pF standard capacitor's Calibration value at 1MHz must use the 1kHz calibration value plus 0.03%. (Refer to the 16380A's Data Sheet).

[Integration Time Change Accuracy Check]

21. Disconnect the 1000pF standard capacitor and connect the 100pF standard capacitor to the **UNKNOWN** terminals.

22. Change the 4279A's controls as follows:

OSC level	100mVrms
Measurement Range	128pF
INTEG.TIME	SHORT

23. Press the **TRIGGER** key.

24. Confirm that $\mathbf{C_p}$ and **D** are within the test limits listed in Table 9-5.

25. Set the INTEG.TIME in accordance with Table 9-5. Repeat steps 23 and 24.

Table 9-5. Capacitance Accuracy Test Limits 2

Setting	**Test Limits**	
INTEG TIME	**C**	**D**
SHORT	C.V. ±0.214pF	±0.00214
MED	C.V. ±0.108pF	±0.00114
LONG	C.V. ±0.108pF	±0.00078

C.V. : Calibration value of the 100pF Standard Capacitor at 1kHz

[1m Open Compensation]

26. Disconnect the 100pF standard capacitor, and connect the **OPEN** reference using the 16048A test leads (1m) as shown in Figure 9-5.

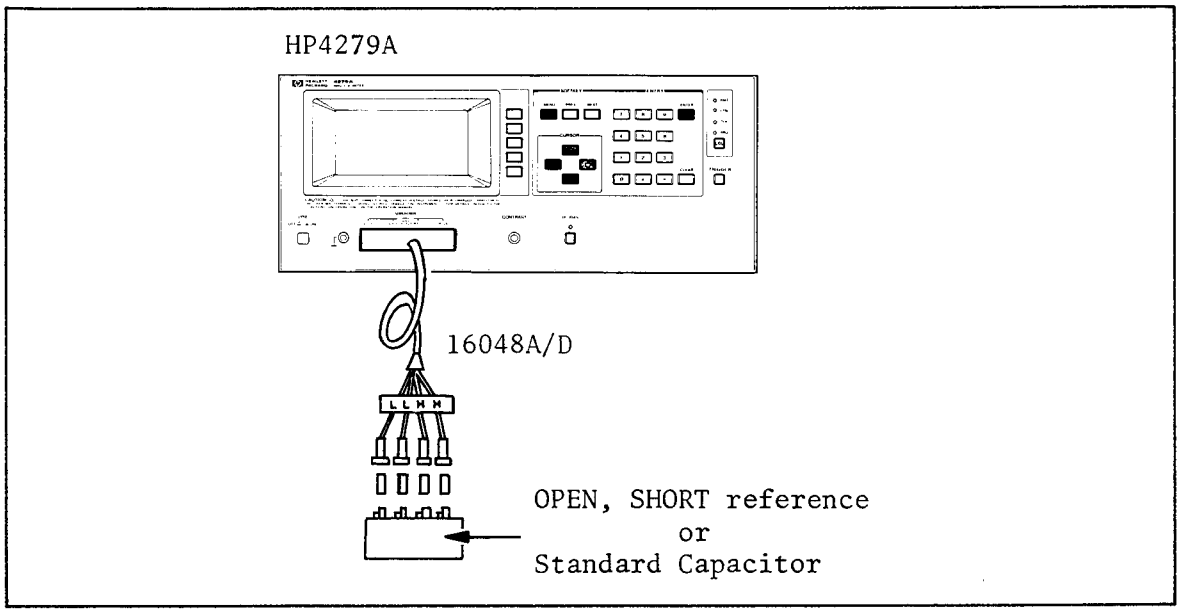


Figure 9-5. Capacitance Accuracy Test Setup 2

27. Set the cable length to 1m.

28. Press the **MENU** and **NEXT** keys, then the **'COMPEN'** softkey.

29. Press **'OPEN COMPEN'** softkey. Wait for the completion of the measurement. Confirm that **'OPEN ON'** is set to ON.

[1m Short Compensation]

30. Disconnect the **OPEN** reference and connect the **SHORT** reference to the test leads.

31. Press the **NEXT** key.

32. Press the **'SHORT COMPEN'** softkey and wait for completion of the measurement. Confirm that **'SHORT ON'** is set to **ON**.

[Cable Length Compensation Accuracy Check]

33. Disconnect the **SHORT** reference and connect the 100pF standard capacitor to the test leads.

34. Press the **TRIGGER** key.

35. Confirm that $\mathbf{C_p}$ and **D** are within the test limits listed in Table 9-6.

Table 9-6. Capacitance Accuracy Test Limits 3

Setting	Test Limits	
Cable Length	**C**	**D**
1m	C.V.±0.108pF	±0.00078
2m	C.V.±0.108pF	±0.00078

C.V. : Calibration value of the 100pF Standard Capacitor at 1kHz

[2m Open/Short Compensation and Cable Length Compensation Accuracy Check]

36. Disconnect the 16048A test leads and the 100pF standard capacitor. Connect the 16048D test leads (2m) to the **UNKNOWN** terminals and connect the OPEN reference to the test leads.

Note

Make sure there is a good connection between the 4279A's front panel ground terminal (next to the **UNKNOWN** terminals) and the 16048D's ground lead.

37. Set the cable length to 2m.

38. Repeat steps 28 through 35.

9-9. HP-IB INTERFACE TEST

This test verifies the 4279A HP-IB function.

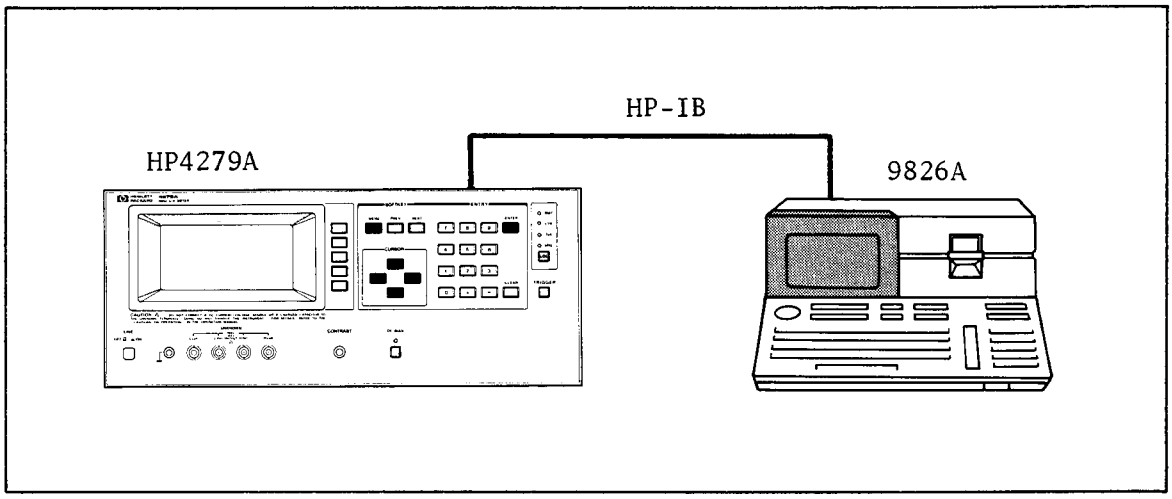


Figure 9-6. HP-IB Interface Test Setup

EQUIPMENT:

Personal Technical Computer	HP 9826
HP-IB Cable	HP 10833A

PROCEDURE:

1. Set the 4279A HP-IB address to 17.

2. Set up the equipment as shown in Figure 6-8. Use the HP 9826's interface Select Code (**7**).

3. Load BASIC and enter the following program, but do not **RUN** the program yet.

```
10  DIM A$[38]
20  OUTPUT 717;"*IDN?"
30  ENTER 717;A$
40  PRINT A$
50  OUTPUT 717;"*SRE32"
60  OUTPUT 717;"ABC"
70  PRINT SPOLL(717)
80  END
```

4. Press the HP 9826A's **STEP** key three times to single step to line number 20.

5. Confirm that the **LTN** and **RMT** lamps are lit and that the softkey label page does not change when the **NEXT** key is pressed.

6. Press the **LCL** key on the 4279A.

7. Confirm that the **LTN** lamp stays lit, the **RMT** lamp goes out, and that the softkey label page changes when the **NEXT** key is pressed.

8. Press the HP 9826 **STEP** key to execute line 30 and confirm that the **TLK** lamp is lit.

9. Single step to line 40 and confirm that the HP 9826 displays the following message.

   "**HEWLLETPACKARD,4279A,0000A00000,REV1.0**"

10. Single step to line 60, and confirm that the **SRQ**, **LTN**, and **RMT** lamps are lit.

11. Single step to line 80 and confirm that the HP 9826 displays a status byte value greater than 96.

PERFORMANCE TEST RECORD

Hewlett-Packard 4279A
1MHz C-V Meter

Tested by _____
Date _____
Serial No. _____

Test		Results		
		Minimum	Actual	Maximum
9-5. TEST FREQUENCY ACCURACY TEST				
Test Frequency:	1MHz	999.8kHz	_____	1000.2kHz
Option 003 Test Frequency:	1MHz	1009.798kHz	_____	1010.202kHz
9-6. TEST SIGNAL LEVEL ACCURACY TEST				
OSC level:	20mV	18mV	_____	22mV
	50mV	45mV	_____	55mV
	100mV	90mV	_____	110mV
	200mV	180mV	_____	220mV
	500mV	450mV	_____	550mV
	1000mV	900mV	_____	1100mV
9-7. DC BIAS VOLTAGE ACCURACY TEST				
DC BIAS:	0V	-0.0001V	_____	0.0001V
	1V	0.998V	_____	1.002V
	2V	1.997V	_____	2.003V
	4V	3.995V	_____	4.005V
	6V	5.992V	_____	6.008V
	10V	9.987V	_____	10.013V
	20V	19.977V	_____	20.023V
	30V	29.96V	_____	30.04V
	38V	37.952V	_____	38.048V
	-1V	-0.998V	_____	-1.002V
	-2V	-1.997V	_____	-2.003V
	-4V	-3.995V	_____	-4.005V
	-6V	-5.992V	_____	-6.008V
	-10V	-9.987V	_____	-10.013V
	-20V	-19.977V	_____	-20.023V
	-30V	-29.96V	_____	-30.04V
	-38V	-37.952V	_____	-38.048V

Test		Results		
		Minimum	Actual	Maximum
9-8. CAPACITANCE MEASUREMENT ACCURACY TEST				
[Open Offset Error Check]				
	C_P	-0.006pF	____	0.006pF
	G	-0.0628µS	____	0.0628µS
[Range Change Accuracy Check]				
Meas. Range: 2pF	C_P	C.V.-		C.V.+
DUT: 1pF		0.006pF	____	0.006pF
	D	-0.01000	____	0.01000
Meas. Range: 8pF	C_P	C.V.-		C.V.+
DUT: 10pF		0.0124pF	____	0.0124pF
	D	-0.00104	____	0.00104
Meas. Range: 128pF	C_P	C.V.-		C.V.+
DUT: 100pF		0.108pF	____	0.108pF
	D	-0.00114	____	0.00114
Meas. Range: 1024pF	C_P	1.0003*C.V.		1.0003*C.V.
DUT: 1000pF		-1.0pF	____	+1.0pF
	D	-0.00102	____	0.00102
[Integ Time Change Accuracy Check]				
Integ.Time: SHORT	C	C.V.-		C.V.+
		0.214pF	____	0.214pF
	D	-0.00214	____	0.00214
Integ.Time: MED	C	C.V.-		C.V.+
		0.108pF	____	0.108pF
	D	-0.00114	____	0.00114
Integ.Time: LONG	C	C.V.-		C.V.+
		0.108pF	____	0.108pF
	D	-0.00078	____	0.00078
[Cable Length Compensation Accuracy Check]				
Cable Length: 1m	C	C.V.-		C.V.+
		0.108pF	____	0.108pF
	D	-0.00078	____	0.00078
Cable Length: 2m	C	C.V.-		C.V.+
		0.108pF	____	0.108pF
	D	-0.00078	____	0.00078

Test	Results		
	Minimum	Actual	Maximum
9-9. HP-IB INTERFACE TEST	FAIL	_____	PASS

APPENDICES

Appendix A MANUAL CHANGES A-1

Appendix B SOFTKEY TREE B-1

Appendix C DEFAULT SETTINGS AND INTERNAL MEMORY C-1

Appendix D DISPLAY MESSAGES D-1

Appendix E DISPLAY FIELD DEFINITION E-1

Appendix F TEST LEAD CONNECTION TECHNIQUES F-1

Appendix G QUICK REFERENCE LIST OF HP-IB COMMANDS G-1

APPENDIX A

MANUAL CHANGES

This appendix contains information for adapting this manual to HP 4279A's to which the content of this manual does not directly apply.

To adapt this manual to your 4279A, refer to Table A and make all of the manual changes listed opposite your 4279A's serial number.

If your 4279A's serial number is not listed on the title page of this manual or in Table A, it may be documented in a yellow MANUAL CHANGES supplement. For additional information on serial number coverage, refer to INSTRUMENTS COVERED BY THIS MANUAL in SECTION 8.

Table A. Manual Changes by Serial Number

Serial Prefix or Number	Make Manual Changes

NOTES

APPENDIX B

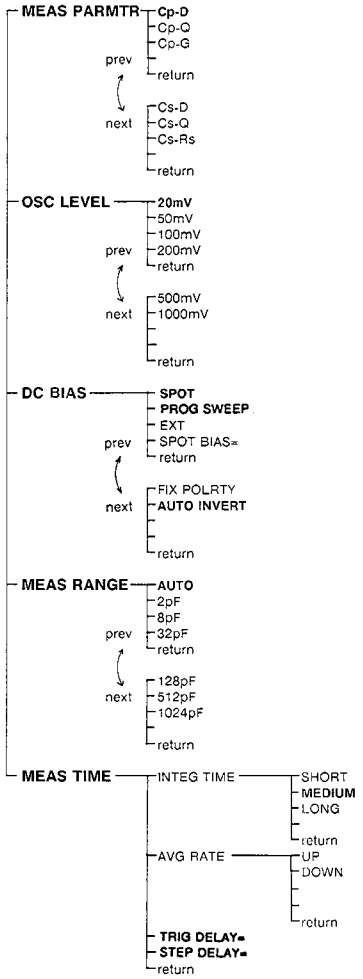
SOFTKEY TREE

This appendix describes the HP 4279A's softkey tree. A bolded softkey label indicates the softkey is a default setting.

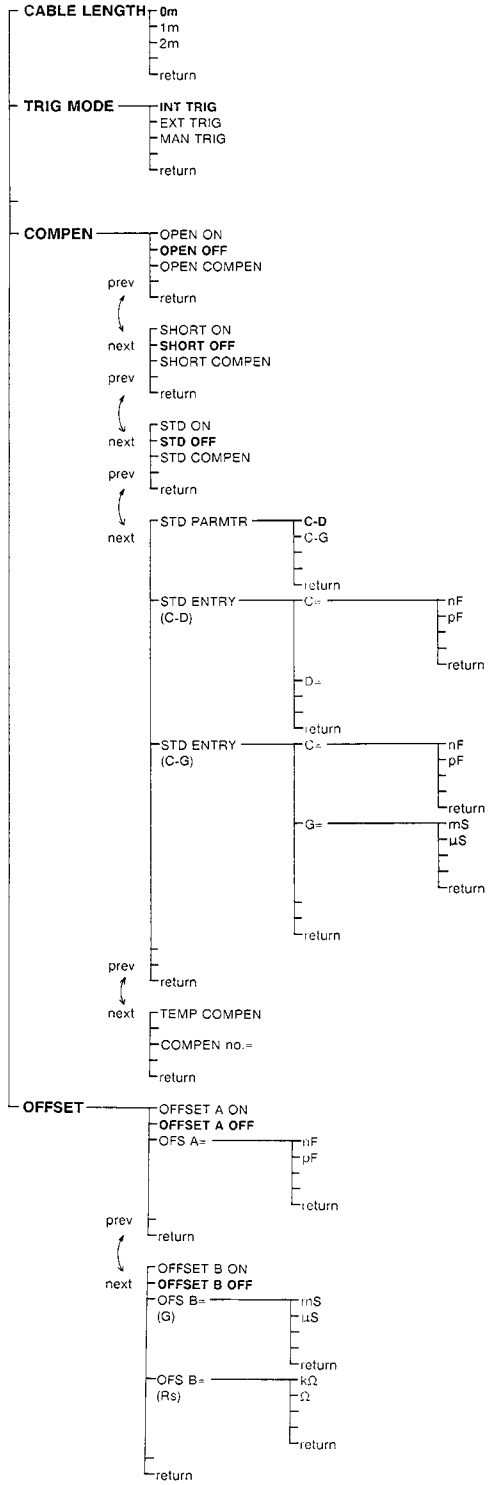
The 4279A's softkey are nested to a maximum of four levels. When you press a softkey for which lower levels of softkeys are nested, the softkey labels automatically change to the next lower level. When you press **'return'** softkey, the softkey labels change to the next higher level. When you press a softkey which doesn't have lower levels of softkeys, the function of the softkey will be selected or a function will be executed.

When two or more softkey pages are available, the order of the softkey page and the number of softkey pages available , divided by a slash (/), are displayed. By pressing the **PREV** or **NEXT** key, the softkey page and the softkey order number will change. When you press the **MENU** key, the softkey page is returned to the first softkey page.

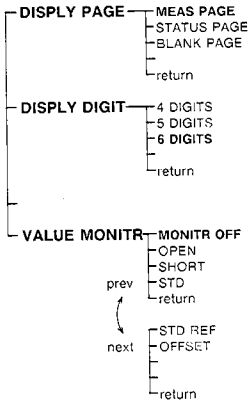
SOFTKEY PAGE 1 of 4



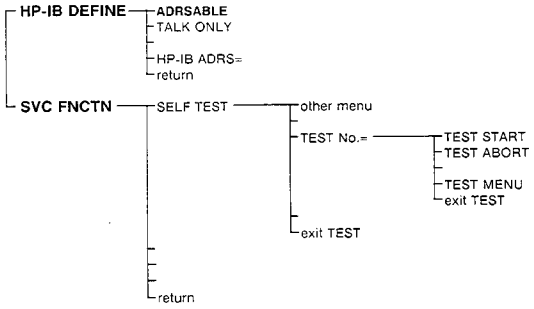
SOFTKEY PAGE 2 of 4



SOFTKEY PAGE 3 of 4



SOFTKEY PAGE 4 of 4



NOTES

APPENDIX C

DEFAULT SETTINGS AND INTERNAL MEMORY

C-1. DEFAULT SETTINGS AT POWER-ON

When the 4279A is turned on its control settings are automatically initialized as listed in the following table.

Measurement Parameter	**C_P-D**
DC Bias Mode	SPOT
Auto Bias Polarity Control	OFF
Measurement Range	AUTO
Integration Time	MEDIUM
Average Rate	1
Cable Length	0m
Trigger Mode	INT TRIG
Open Compensation	OFF
Short Compensation	OFF
Standard Compensation	OFF
Standard Parameter	**C-D**
Offset A	OFF
Offset B	OFF
Display Page	Measurement Page
Number of Display Digit	6 Digits
Value Monitor	OFF
DC BIAS Switch	OFF

Settings with numeric data are as follows:

Oscillator Level	20mV
DC bias(SPOT)	0V
DC bias(Programmed sweep)	0V, and AUTO measurement range
Trigger Delay Time	0ms
Step Delay Time	0ms
HP-IB Address	17 [1]

[1] The 4279A's HP-IB address is stored in internal nonvolatile memory. If you change the address, the address you set will replace address 17. The 4278A's HP-IB address is set to 17 when shipped from the factory, and it may be reset to 17 if the 4279A is repaired.

C-2. INTERNAL MEMORY (NONVOLATILE)

The 4279A stores the following data in the 4279A's internal EEPROM.

(1) Compensation Measurement data (up to 16 sets of the compensation measurement data)

Stray admittance data for OPEN compensation
Residual impedance data for SHORT compensation
Standard actual data for STD compensation

(2) Standard Compensation Reference Data (a set of data)

Standard reference data for STD compensation

(3) Offset Value (a set of data)

Offset capacitance value for OFFSET A
OFFSET B parameter and value

(4) HP-IB Settings

Addressable/Talk only and Address

APPENDIX D

DISPLAY AND ERROR MESSAGES

D-1. DISPLAY MESSAGES

This appendix explains the HP 4279A's display messages.

The condition of the 4279A is displayed on the LCD Message Line. Display messages consist of Comment and Error Messages. Comments instruct the operator what to do, and informs the operator when the 4279A has completed a special operation (compensation, etc.). Error Messages indicates an operator error.

Comments are listed in alphabetical order. Error messages are listed in the numerical order of the error numbers.

COMMENTS

Comment	Meaning
Open offset compen. completed	This message will be displayed after the successful completion of a open compensation data acquisition measurement.
Short offset compen. completed	This message will be displayed after the successful completion of a short compensation data acquisition measurement.
Std. compensation completed	This message will be displayed after the successful completion of a standard compensation data acquisition measurement.
Temp compensation completed	This message will be displayed after the **'TEMP COMPEN'** softkey is pressed. Temperature compensation data acquisition measurement was successfully completed.
Test in progress...	This message is related to the self test. The self test must be performed by an HP Service Engineer.
Test completed	This message is related to the self test. The self test must be performed by an HP Service Engineer.
Test aborted	This message is related to the self test. The self test must be performed by an HP Service Engineer.

Comment	Meaning
verA.AA BBCC opt-DDD ADRS=EE	This message is displayed when the 4279A is turned on. "A.AA" indicates the last two digits of the firmware version. "BB" indicates the last two digits of the firmware release year. "CC" indicates the week that the firmware was released. When "DDD" is "***" the 4279A is not supplied with option 003. When "DDD" is "003" the 4279A is supplied with option 003. "EE" indicates the current HP-IB address.
Warning, Compen data out of range	The compensation data measurement result is excessive, but will still be effective.

D-2. ERROR MESSAGES

Note

Use the **ERR?** command to read error numbers via the HP-IB bus. The operation that caused the error message will be ignored and the 4279A will not be affected by the operation.

No.	Error Message	Meaning
1	**Command error**	This message will be displayed when an unspecified remote control command is sent. The command is ignored.
2	**Syntax error**	This message will be displayed when a syntax error exists in the entered value or the remote control command. The command is ignored.
3	**Out of parameter range**	This message will be displayed when the entered value is out of the setable range. The command is ignored.
4	**A2 B'd is not installed**	This message will be displayed when a hardware problem exists.
5	**A4 B'd is not installed**	This message will be displayed when a hardware program exists.
6	**A5 B'd is not installed**	This message will be displayed when a hardware problem exists.
7	**A6 B'd is not installed**	This message will be displayed when a hardware problem exists.
8	**Numeric overflow**	This message will be displayed when you try to send numeric data that is not of the IEEE-32 bit format via HP-IB.
9	**Compensation data is unmeasurable**	This message will be displayed when the measurement circuit was unable to measure the OPEN, SHORT, or STANDARD data.

No.	Error Message	Meaning
10	**A6 B's is not working**	This message will be displayed when the A-D converter on the A6 board is not working properly. Hardware problem.
11	**MENU not allowed in Self Test**	The **MENU** key is inhibited during the self test operation. Press the **'exit TEST'** softkey first.
12	**MENU not allowed in Calibration**	This message is calibration relayed. Calibration must be performed by HP Service Engineer.
13	**Operation not allowed**	This message will be displayed when you try to perform an operation that is inhibited for the instrument's current state.
14	**Different parameters of OFS B**	The **'OFFSET B ON'** softkey was pressed when the B parameter was not the same as the entered offset B protect position.
15	**EEPROM write failed**	This message is calibration related. Calibration must be performed by an HP Service Engineer.

APPENDIX E

DISPLAY FIELD DEFINITION

The 4279A is equipped with a 40 character by 16 line LCD display.

The last six character spaces of each line are reserved for softkey labels. This entire area is referred to as the SOFTKEY field.

The lowest line of the softkey field displays the MORE field. This field indicates the number of softkey pages available, and which softkey label page is presently being displayed. For example, if four levels of softkey label pages are available, and the first softkey label page is displayed, **1/4** will be displayed, indicating that page one of four pages is being displayed. Pressing the **PREV** or **NEXT** keys will display the previous or next set of softkey labels.

The row to the left of the softkey area is the MARKER field. A marker (►) will be displayed beside the selected softkey label.

The 4279A's settings and measurement results are displayed on the rest of the display-- a column 33 characters wide starting from the left-hand side of the display. The first five lines from the top is the STATUS field. The fields for, test signal voltage (**OSC LVL :**), dc bias voltage (**DC BIAS :**), measurement range (**RANGE :**), A-D conversion time settings (**INTEG TIME :** SHORT, MEDIUM or LONG), number of measurements to be averaged (**AVG :**), and delay time (**T-DLY :**), (**S-DLY :**) are displayed in the status field.

The next seven lines comprise the MEASUREMENT DATA field. Measurement results are displayed in this field. The top and bottom lines of the measurement data field are not used.

The line immediately below the measurement data field is also part of the STATUS field. The trigger mode (**TRIG :** INT, MAN, or EXT) and cable length settings (**CABLE :** 0m, 1m, or 2m) are displayed on this line.

The next line is the INPUT LINE (third line from the bottom of the LCD) and numeric data input using the front panel keys is displayed on this line.

The second line from the bottom of the LCD is the MONITOR LINE where compensation data is displayed.

The bottom LCD line is the MESSAGE LINE where comments and error messages are displayed.

Figure E-1 on the next page shows the display fields.

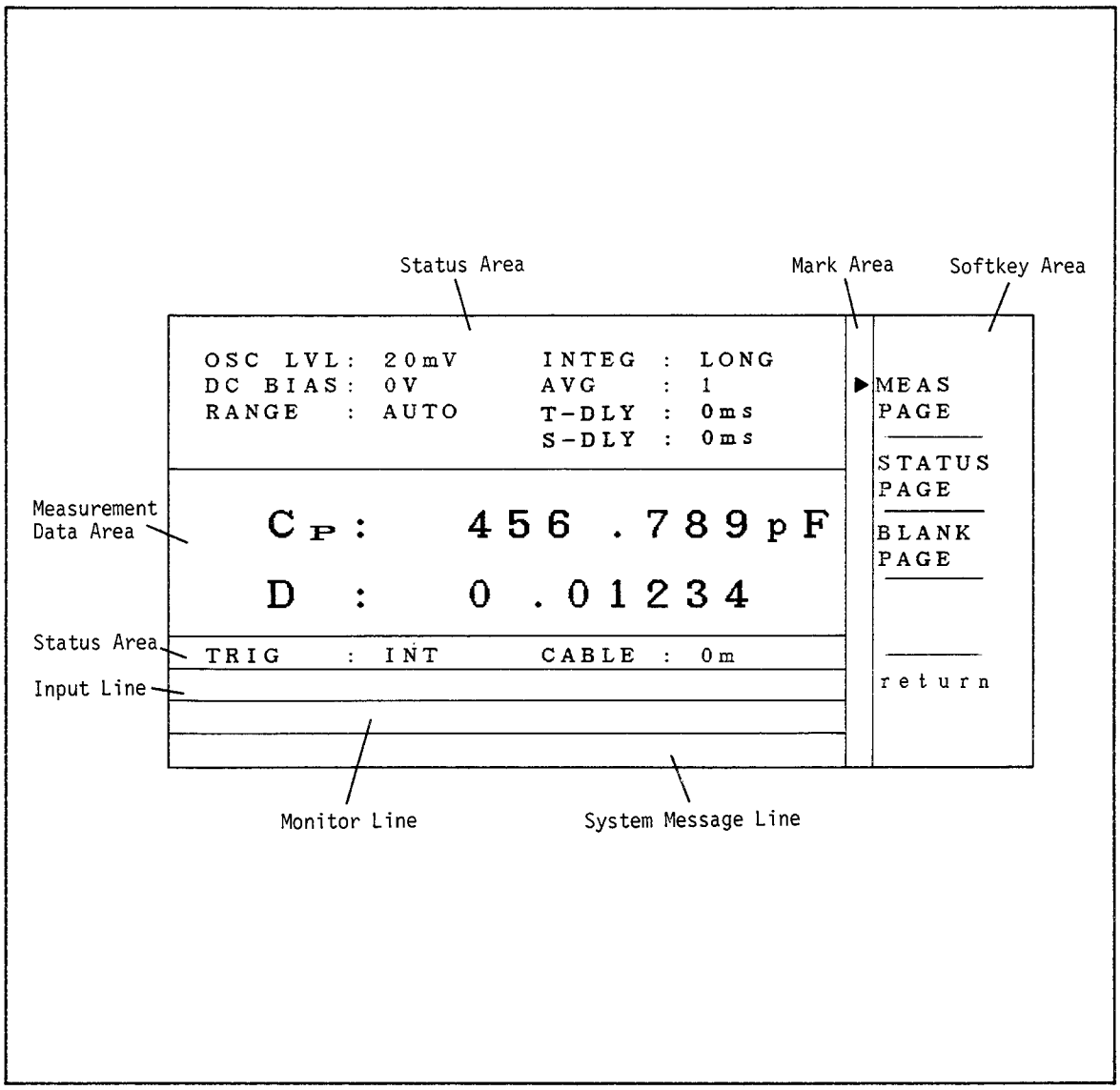


Figure E-1. Display Fields

APPENDIX F

TEST LEAD CONNECTION TECHNIQUES

F-1. INTRODUCTION

This appendix provides information about test lead connection techniques, from the 4279A to the connection contacts for the capacitor to be tested.

F-2. CONNECTING TEST LEADS

Figure F-1 shows how to connect the test leads. The 4279A uses the four-terminal pair measurement technique, so a special test lead configuration is used. When interconnecting four-terminal pair test leads, the shields of the HCUR, HPOT, LPOT, and LCUR test leads must interconnect at the point to be measured. The cable shields are floating, they are **NOT** grounded.

The four-terminal pair configuration ends at the point where the shields are connected. Therefore, the four-terminal pair configuration extends from the 4279A to the point where the shields are connected. The connection configuration from the shield interconnection point to the device to be tested (capacitor), can be a two pair, shielded two pair, four-terminal, or shielded four-terminal configuration. Figure F-2 shows the center conductors of the test leads connected to a capacitor. When the pairs HCUR, HPOT, and LPOT, LCUR make contact just at the capacitor, the four terminal pair configuration is realized. When the HCUR, HPOT and LCUR, LPOT pairs are connected together before making contact with the capacitor, a two terminal pair configuration is realized.

To make accurate measurements, it is important to keep connections between the point at which the shielding ends and the capacitor leads as short as possible, because, the wiring between where the shielding ends and the connection to the capacitor contributes the most measurement error due to stray capacitance, residual impedance, and mutual inductance. Error compensation will reduce these errors, but if the error factor fluctuates (due to cables shifting and inconsistent contact resistance) it will be difficult to compensate for the errors. Therefore, when making high accuracy measurements, you must reduce the error factor as much as possible, and reduce the error fluctuation as much as possible.

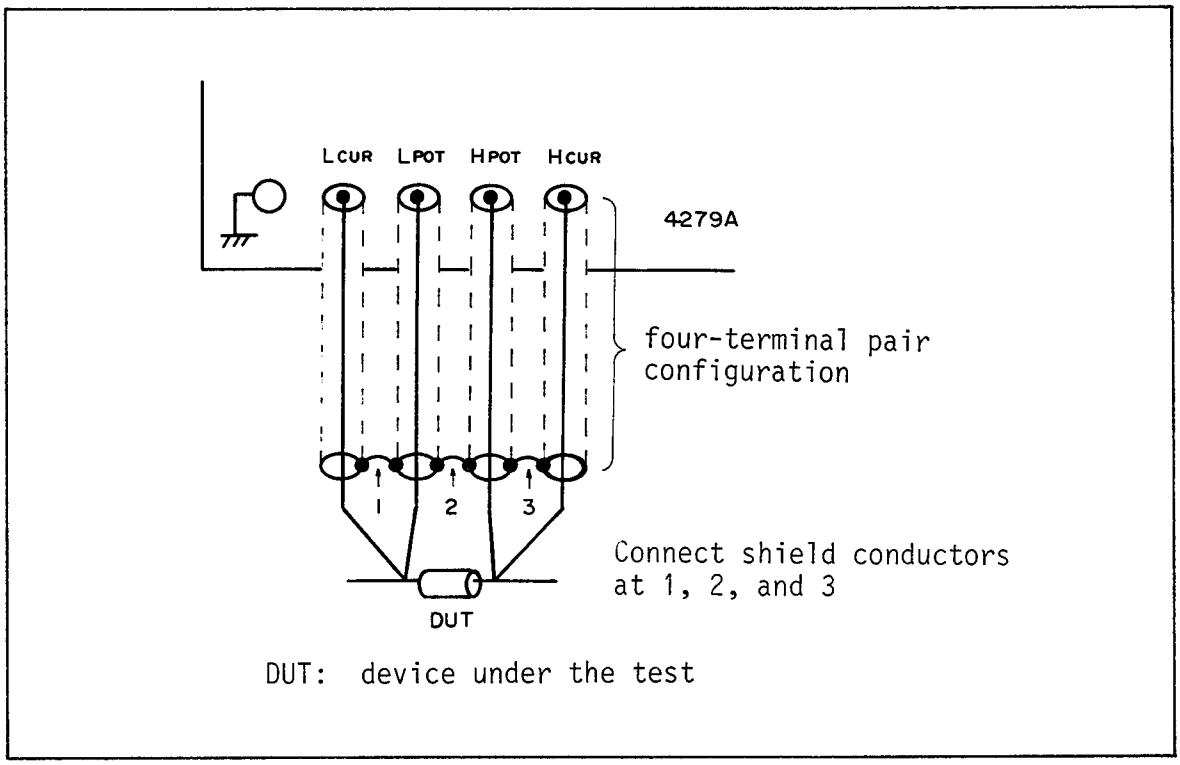


Figure F-1. Test Lead Connections

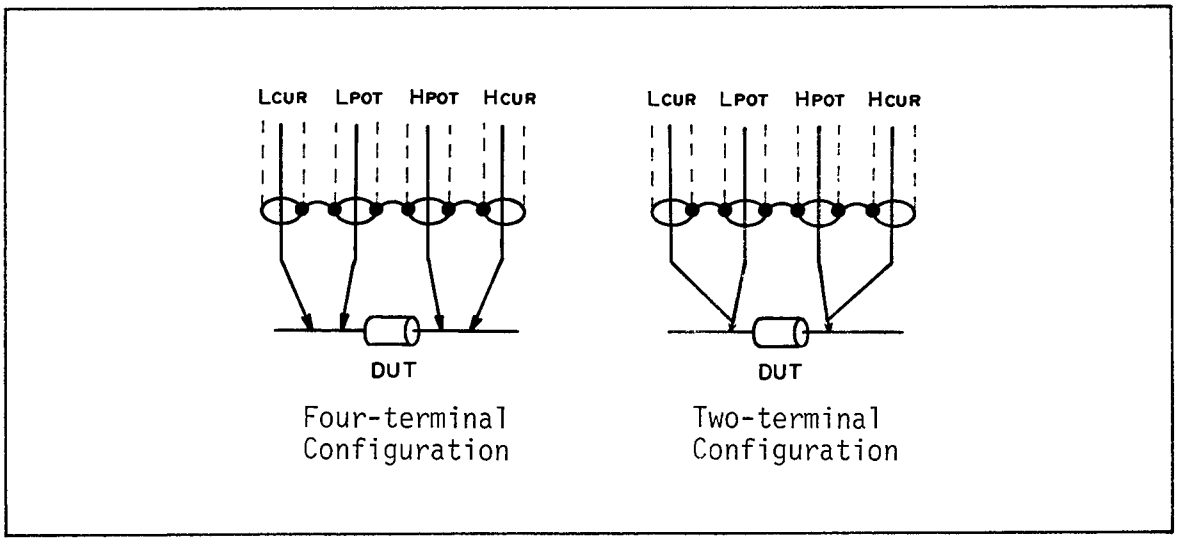


Figure F-2. DUT Connection

F-3. EXTENDING THE FOUR-TERMINAL PAIR TEST LEADS

When extending the four-terminal pair leads to the contacts of the capacitor, use BNC or SMC connectors. Select extension leads which have the same electrical characteristics as the test leads and make the connections as shown in Figure F-3. Each connector junction should be electrically isolated from the other connectors. Small variations in characteristics can be tolerated by using the 4279A's compensation function. If the junction connector touches the conductor, the connection from this point to the device under test will not be a four-terminal pair configuration. At the point of extension leads, the shield conductors interconnect each other. Keep the length of the center conductor to the point of contact with the capacitor as short as possible, see Figure F-3.

When the wiring is extended for the four-terminal pair, the 4279A's compensation function cannot compensate correctly. This error cannot be reduced by OPEN/SHORT compensation but the 4279A's STANDARD compensation can be used to reduce this error. Also, the total cable length should not exceed 2.5m.

If the shielded two-terminal or shielded four-terminal connection is used for extending the test leads, use the connector bracket supplied with the four-terminal pair test lead. The shielded two-terminal is suitable for measuring low values of capacitance and the shielded four-terminal configuration is suitable for measuring high values of capacitance. The following explains the important points of each connection method.

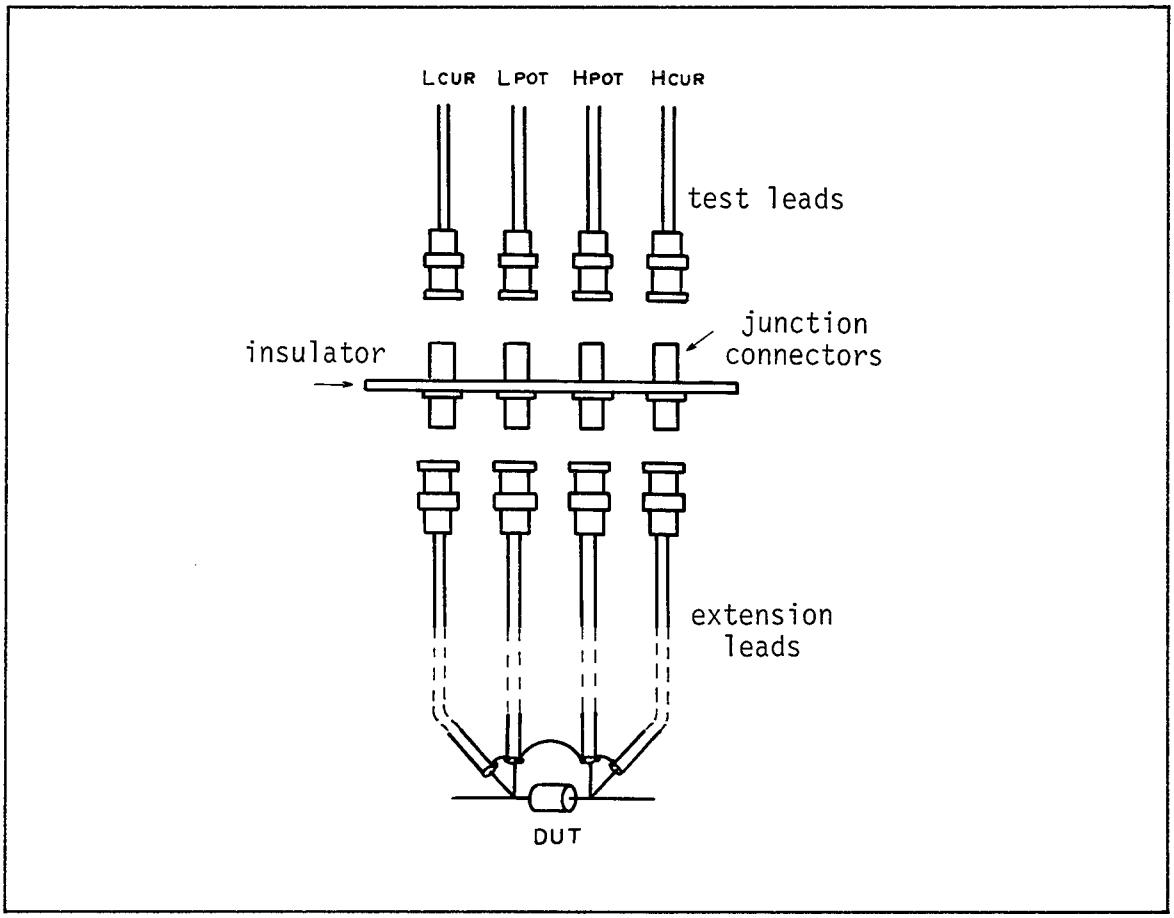


Figure F-3. Extension of Four-terminal Pair Method

F-3-1. SHIELDED TWO-TERMINAL CONNECTION METHOD

Figure F-4 shows how to interconnect the 4279A's four-terminal pair UNKNOWN terminals to two-terminal test leads. As Figure F-4 shows, interconnect the two-terminal test lead's shield conductors at both ends of the test leads, and connect the shield conductors to the 4279A's connector bracket at the HCUR terminal. This method significantly reduces measurement errors.

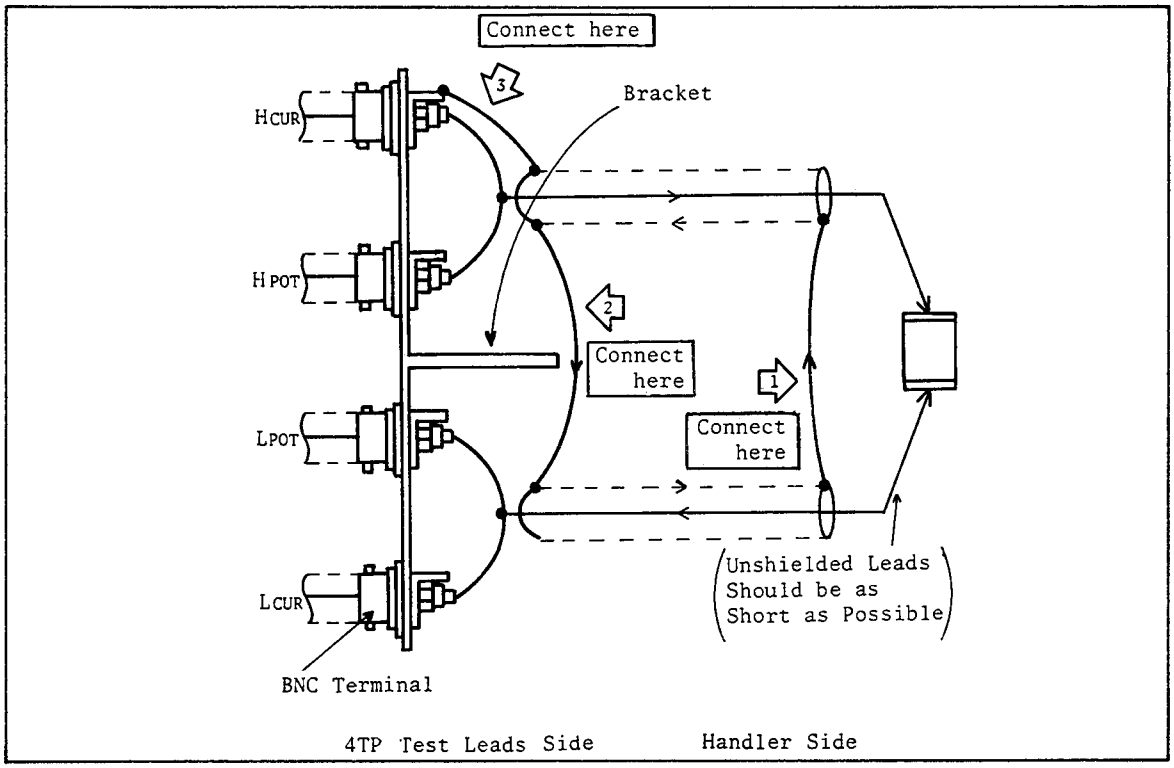


Figure F-4. Shielded Two-Terminal Connection Method

F-3-2. SHIELDED FOUR-TERMINAL CONNECTION METHOD

Figure F-5 shows the shielded four-terminal connection configuration, all shields of the shielded four-terminal cables are connected at the junction connector as shown in 1 of Figure F-5. Connect these shields to the bracket as shown in 2 of Figure F-5. Connect the shields at a junction point on the handler end of the cables as shown in 3 of Figure F-5. This will reduce the cable inductance and the coupling coefficient between the cables. For the shielded four-terminal configuration when the inductive coupling is strong, it is difficult to reduce the coupling to the point to where it can be ignored, so it is recommended that you use to the four-terminal pair configuration.

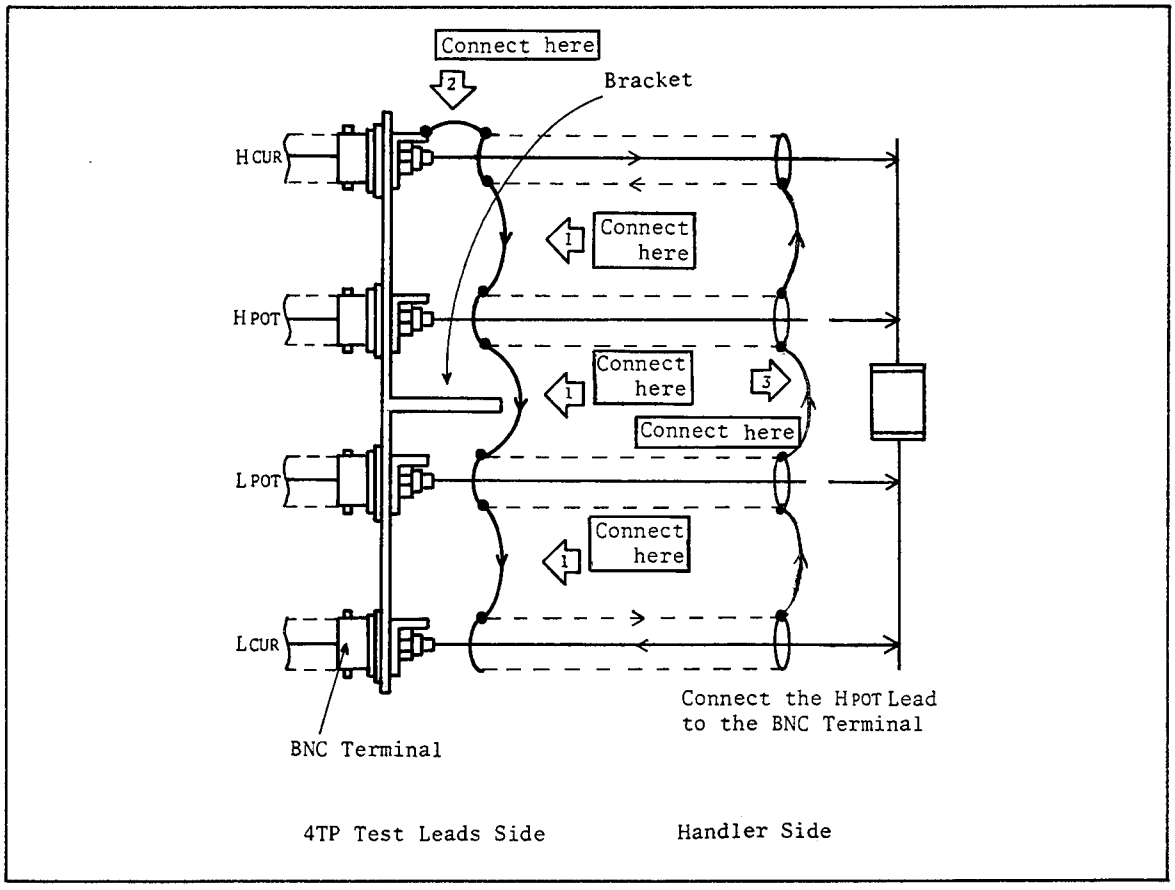


Figure F-5. Four-Terminal Connection Method

F-4. USING A GUARD PLATE

Use a guard plate to minimize measurement errors caused by stray capacitance when measuring low values of capacitance, such as low capacitance chip capacitors. Figure F-6 shows an example of a DUT connection using a guard plate in the four-terminal pair measurement configuration.

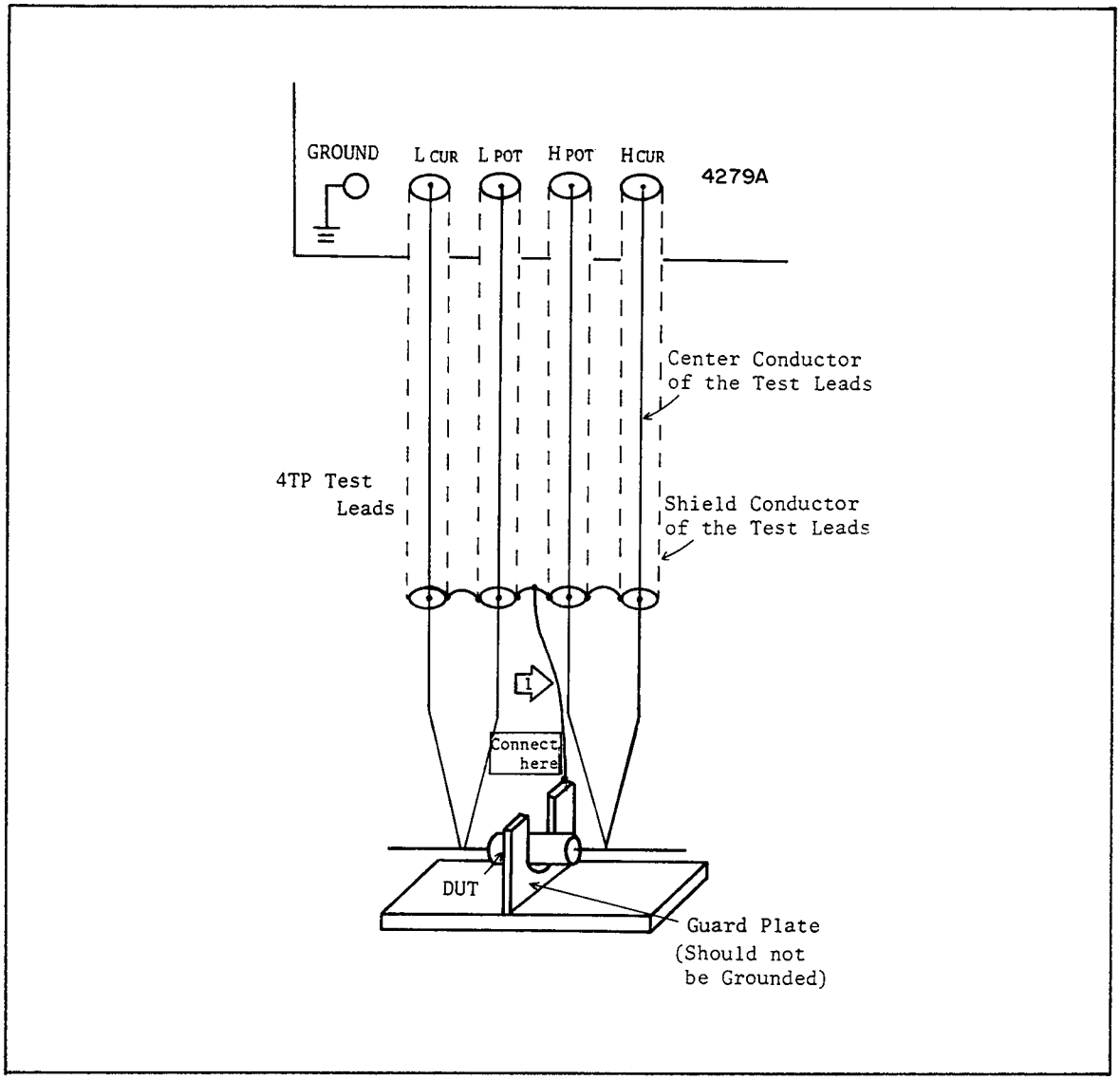


Figure F-6. Example DUT Guard Plate Connection

Connect the test lead shields to the guard plate as shown, and do not ground the guard plate. Be sure to connect the test lead shields as close as possible to the end of the test leads, then make a short connection from the point at which the shields are connected together to the guard plate.

If the guard plate is grounded at the 4279A's front panel ground terminal, measurement errors will be introduced because the stray capacitance due to the proximity of the LPOT lead and the guard plate, will generate measurement errors.

F-5. SHIELDING

Shielding minimizes the effects of electrical noise picked up by the test leads, so provide an additional shield cover for the four-terminal pair test leads as shown in Figure F-7. If you suspect other instruments located near the 4279A may be generating noise on the ac line, connect the 4279A to a separate line source and install line filters at the output terminal of the power source. Also, provide a common ground for all peripherals connected to the 4279A. A high quality isolation transformer between the 4279A and the power source will be an assist if you are having noise problems. Another technique is to have a an effective ground plane on the bench or table that the 4279A is on.

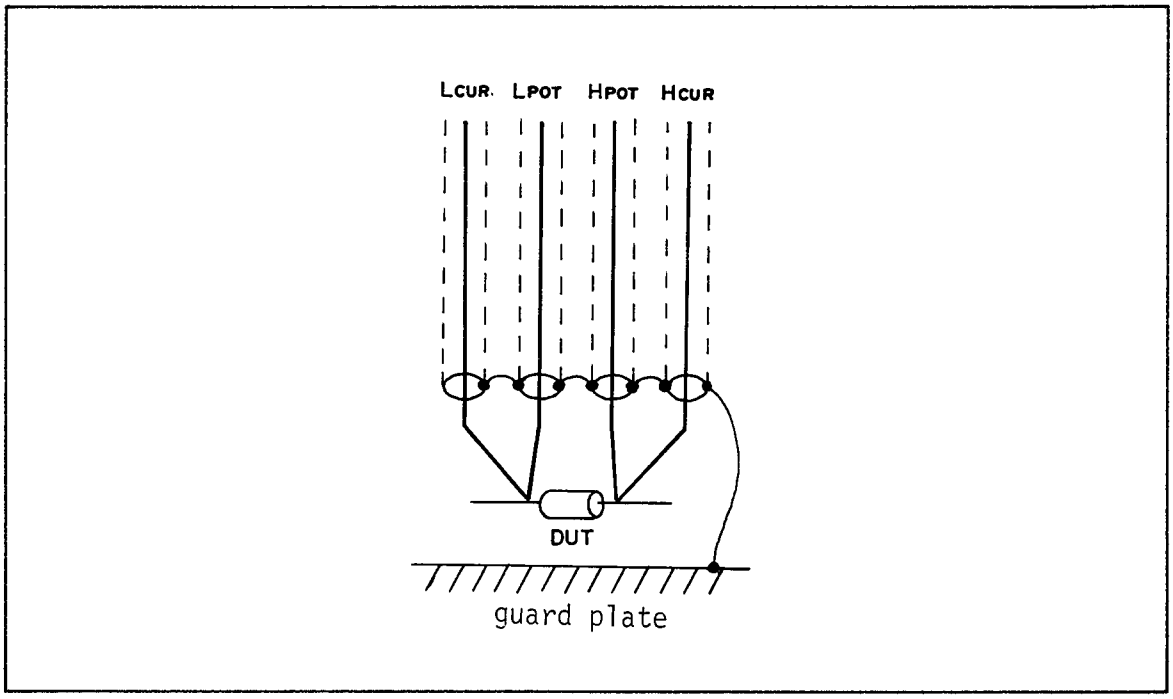


Figure F-7. Additional Shield Covering

F-6. CONSIDERATIONS FOR ACCURATE C-D MEASUREMENTS

To measure capacitors of 10 pF or less, the stray capacitance (when the conductors are grounded, this is capacitance to ground), between contact terminals and the conductors near the capacitor will influence the measurement. this stray capacitance becomes an important error factor as follows.

As shown in the equivalent circuit in Figure F-8a, stray capacitance exists between the **HIGH** and **LOW** contacts to ground if a grounded conductor is close to the capacitor. In reality, impedance $\mathbf{Z_G}$ exists in addition to the stray capacitances, $\mathbf{C_H}$ and $\mathbf{C_L}$. A portion of the current passing through $\mathbf{C_H}$ and $\mathbf{C_L}$ is in parallel with the signal current flowing into $\mathbf{C_X}$, this parallel current is additional error factor. The measurement error not only depends on $\mathbf{C_H}$ and $\mathbf{C_L}$, but is also dependent on the impedance $\mathbf{Z_G}$ which exists between the ground conductor and the common terminal of four-terminal pair circuits. Therefore, if $\mathbf{Z_G}$ is large, the error will be large, and the resistance and reactance factors of $\mathbf{Z_G}$ will adversely influence the capacitance measurement and **D/Q/ESR/G** measurement (If the shields are not grounded, the adverse influence will be at a maximum).

If $\mathbf{C_X}$ is small, the influence of $\mathbf{C_H}$ and $\mathbf{C_L}$ will be greater, configure the contacts of the handler carefully. Techniques for making accurate measurement of low value capacitors will be discussed in the following paragraph.

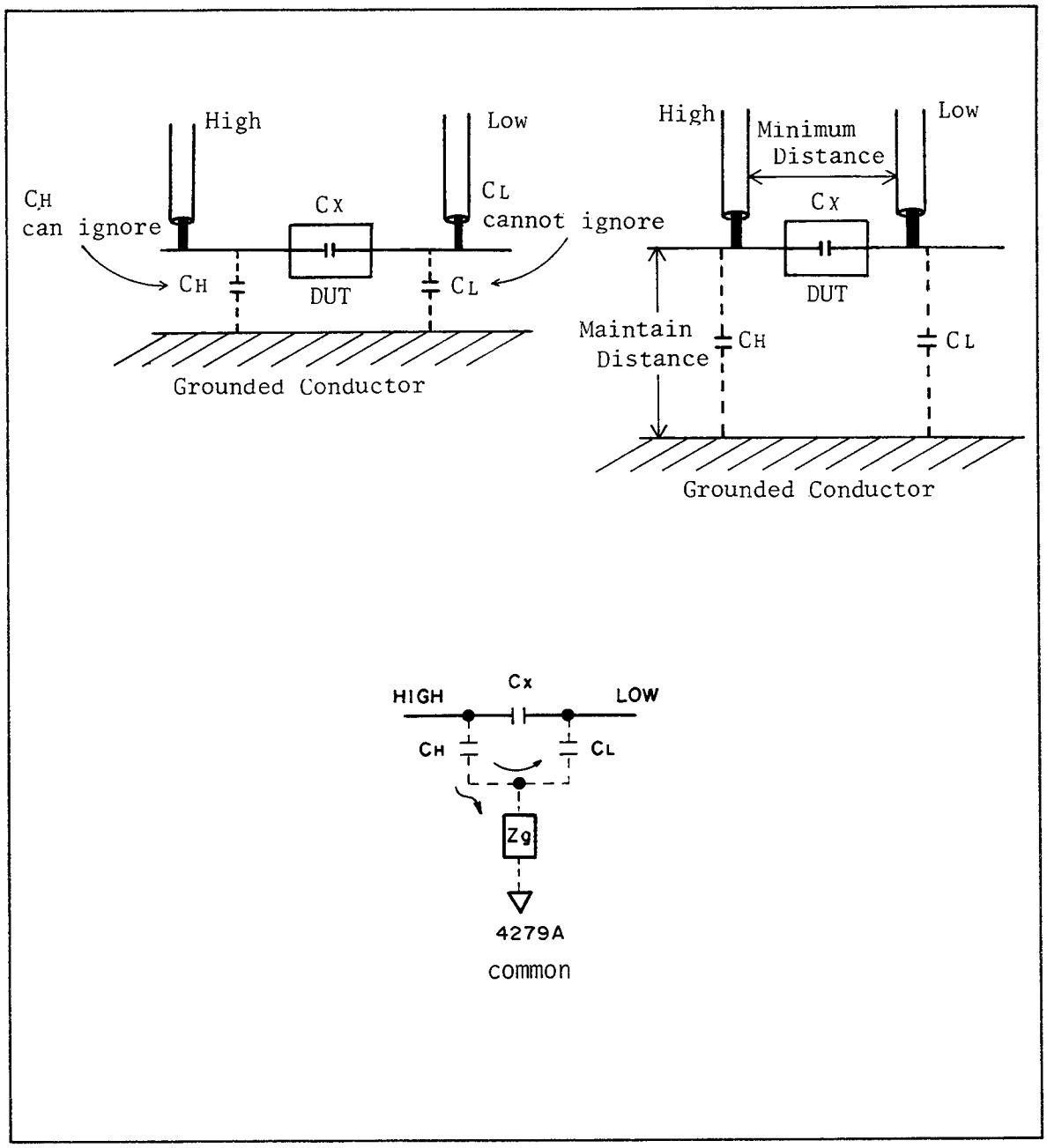


Figure F-8. Equivalent Circuit

F-6-1. REDUCING CAPACITANCE TO GROUND

The closer the DUT is positioned to a grounded conductor, the greater the stray capacitance value $\mathbf{C_L}$ (refer to Figure F-8a). As Figure F-8b shows, the DUT should be kept as far as possible from a grounded conductor, or an insulator with a dielectric constant of approximately 1 should be inserted between the DUT and the grounded conductor. The tips of the test leads should also be located as close as possible to the body of the DUT.

Also, to minimize the stray capacitance of the test leads, the center conductor of the test leads should not extend past the shielded portion more than 1.5cm, and should be kept as short as possible. Refer to Figure F-9.

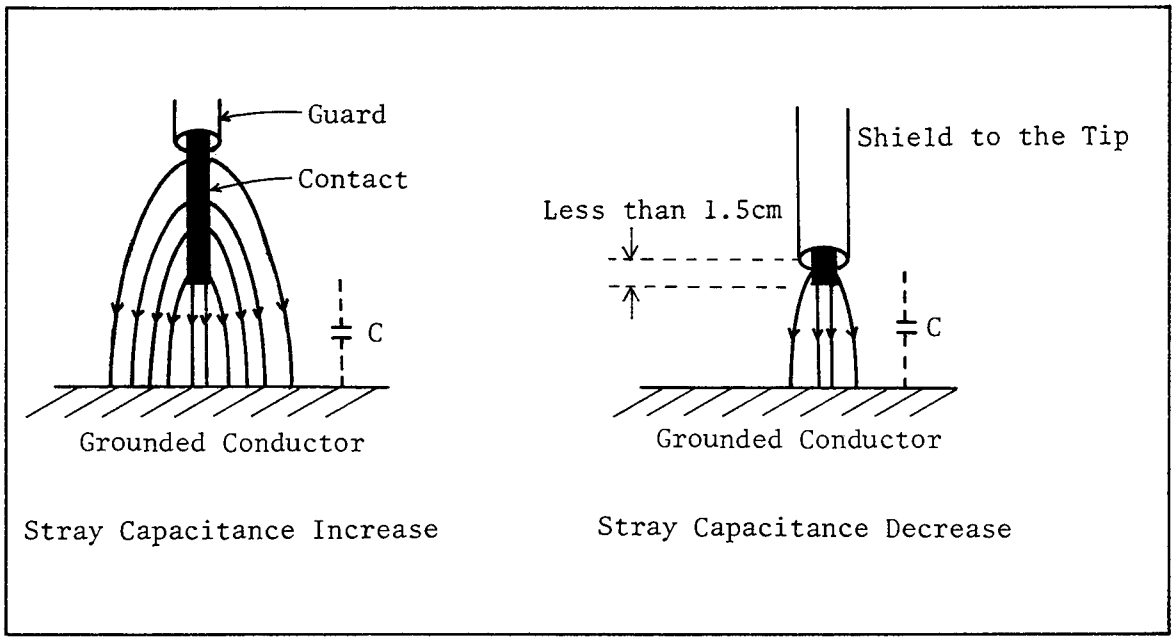


Figure F-9. Stray Capacitance of Test Leads

Other Considerations

To maximize measurement accuracy when measuring low-value capacitors, your measurement setup should conform to the following specifications.

- Two-terminal test lead length should not exceed 30cm
- Residual inductance must be less than 30nH
- Stray capacitance between the Low and High terminals must be less than 0.1pF

F-6-2. DECREASING THE EFFECTS OF STRAY CAPACITANCE TO GROUND

If four-terminal pair connections are close to the point where contact is made with the capacitor, interconnect the shields of the measurement cables to the conductor to reduce the influence of the stray capacitance to ground, see Figure F-10. Since all of the current flowing into C_H flows through the shields of the test leads from the the 4279A making the potential on both sides of C_L becomes zero, current does not flow through C_L. (C_H and C_L are changed the earth capacity to the guard capacity and it's influence is reduced.)

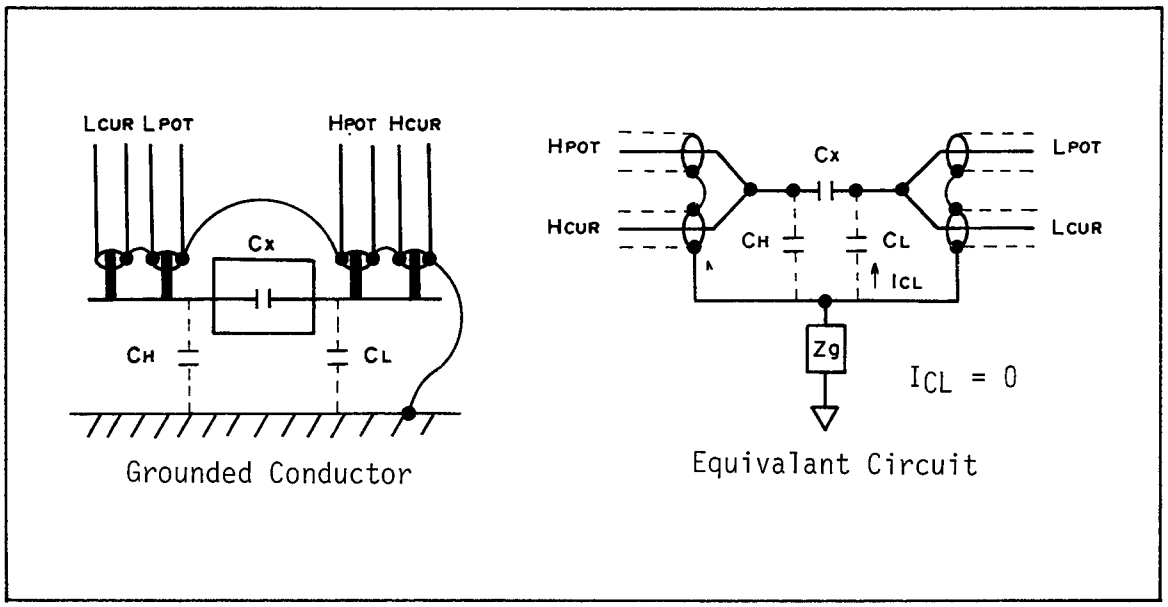


Figure F-10. Reducing the Effects of Stray Capacitance to Ground

F-7. EFFECTS OF CONTACT RESISTANCE AND COUNTERMEASURES

Contact resistance between the contacting terminals and capacitor is the most important cause of measurement inaccuracy. Contact resistance especially causes measurement errors when making dissipation factor measurements. The error caused by contact resistance is dependent on the type of test lead setup used for the measurement.

When the two terminal measurement method is used, the contact resistances R_A and R_B are effectively in series, as shown in Figure F-11. Therefore, the dissipation factor **D** includes the error given by the following equation.

$$D_{ERROR} = \omega C_X(R_A + R_B)$$

When measuring large values of capacitance, reduce all contact resistance as much as possible, and stabilize the connection so that the contact resistance is constant, because the measurement error of **D** is proportional to both ω and C_X. For example, when the **D** of a 1000pF capacitance is measured, the summation of R_A and R_B must be less than 16mΩ, for the error contributed by contact resistance to be less than 0.0001.

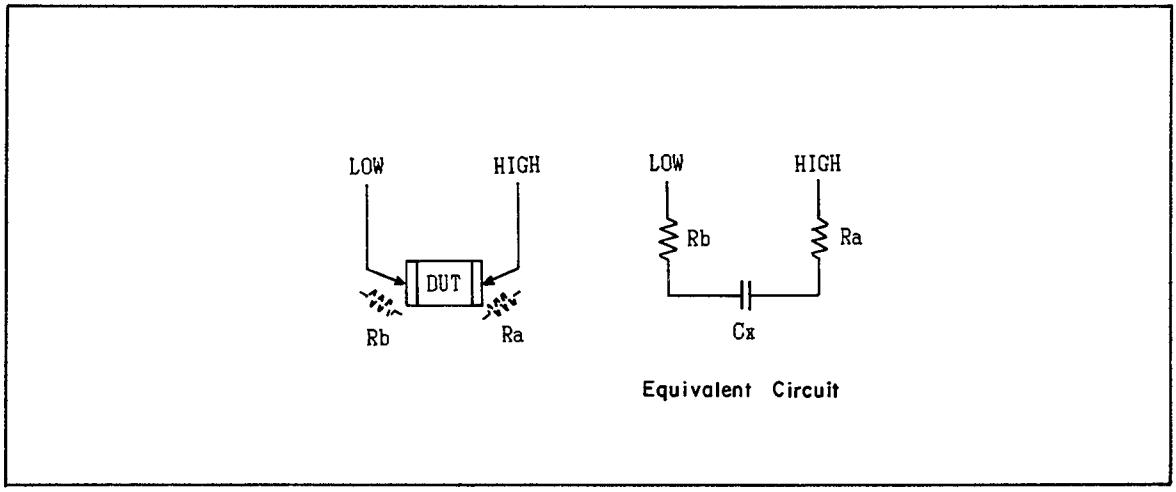


Figure F-11. Two Terminal Method Contact Resistance

When using the four terminal method shown in Figure F-12, the contact resistances of the HCUR, HPOT, LCUR, and LPOT connectors is represented by R_A, R_B, R_C, and R_D respectively. Especially contact resistances R_B and R_D affect dissipation factor measurements. The negative measurement error is given by:

$$D_{ERROR} \simeq - \omega(C_B R_B + C_D R_D)$$

Where C_B and C_D are the distributed capacitance of the test leads connected to HPOT and LCUR.

You can reduce the measurement error by reducing the contact resistance as much as possible, and by using short leads to reduce the distributed capacitance, because the measurement error is dependent on the distributed capacitance and is proportional to ω, C_B, and C_D.

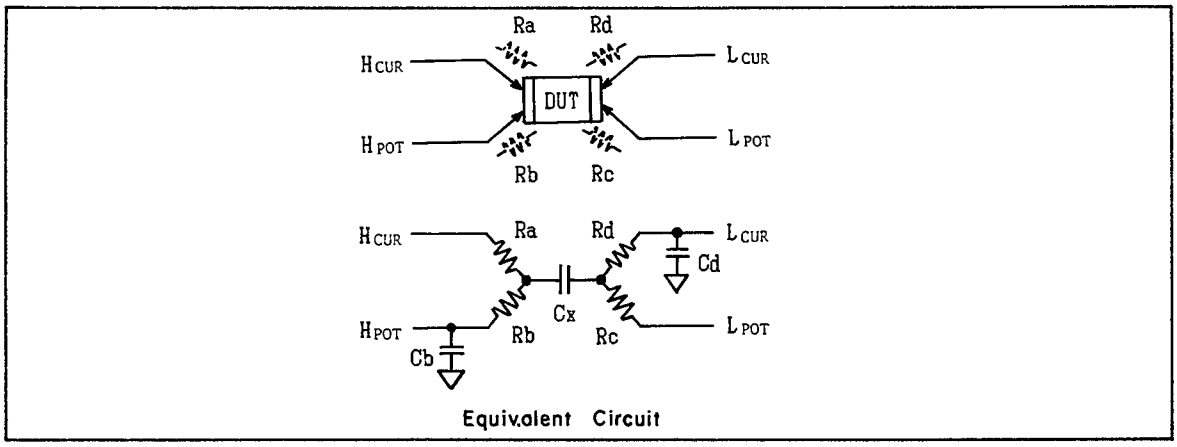


Figure F-12. Four Terminal Method Contact Resistance

When measuring large values of capacitance, the four terminal method has the advantage of less measurement error as compared to the two terminal method. But, when measuring small values of capacitance, there are some cases when the error using the two terminal method is less than when using the four terminal method as shown in Figure F-13.

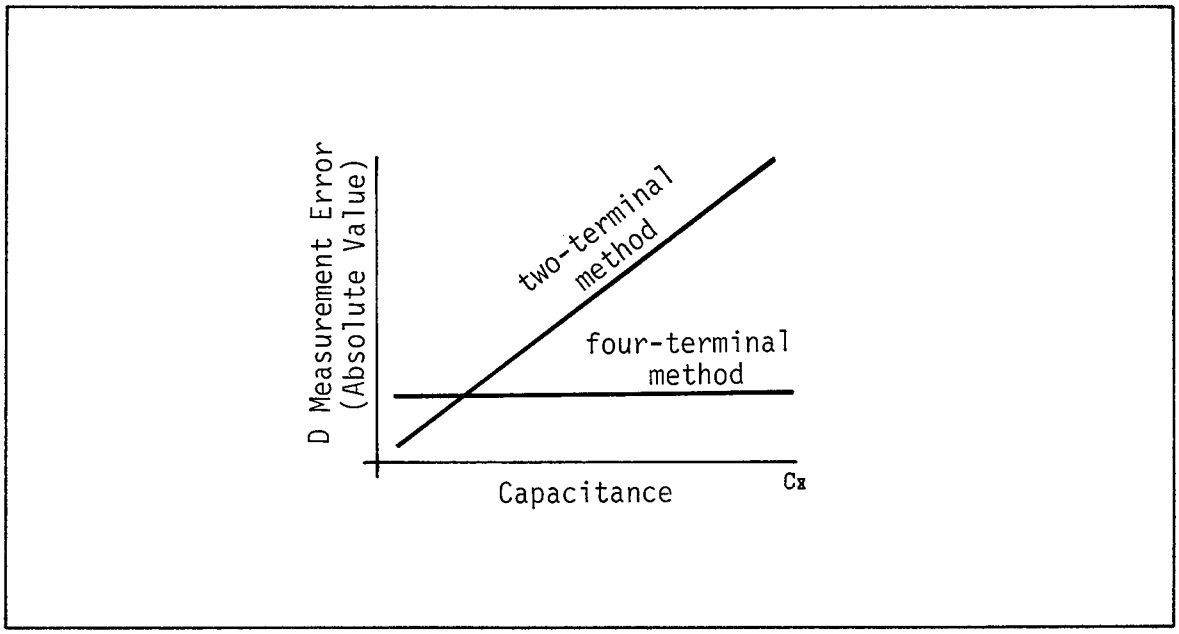


Figure F-13. Two-Terminal and Four-Terminal Measurement Error
(constant contact resistance)

NOTES

APPENDIX G
QUICK REFERENCE LIST OF HP IB COMMANDS

This appendix provides two command lists, an Alphabetical ordered list and a Functional ordered list.

G-1. COMMANDS IN FUNCTIONAL ORDER

This list covers all commands in their functional order as follows:

1. **MEASUREMENT**
2. **COMPENSATION**
3. **OFFSET**
4. **DISPLAY**
5. **DATA OUTPUT**
6. **OTHERS**

Note

@ indicates a selected command as power-on default setting.

G-1-1. MEASUREMENT

Function		Code	
Measurement Parameter:	C_P-D	MPAR1	@
	C_P-Q	MPAR2	
	C_P-G	MPAR3	
	C_S-D	MPAR4	
	C_S-Q	MPAR5	
	C_S-R_S	MPAR6	
Trigger:	Internal	TRIG1	@
	External	TRIG2	
	Manual	TRIG3	
OSC LEVEL:	20mV	OSC1	@
	50mV	OSC2	
	100mV	OSC3	
	200mV	OSC4	
	500mV	OSC5	
	1000mV	OSC6	
DC BIAS:	OFF	BIAS0	
	ON	BIAS1	
	Spot Bias Mode	BMOD0	@
	Sweep Bias Mode	BMOD1	
	External Bias Mode	BMOD2	
	Spot Bias Setting	SBI=	
	Sweep Bias Setting	BTAB=	
	Fixed Polarity	APOL0	@
	Polarity Invert	APOL1	
Range:	AUTO Range	RANG0	@
	2pF Range	RANG1	
	8pF Range	RANG2	
	32pF Range	RANG3	
	128pF Range	RANG4	
	512pF Range	RANG5	
	1024pF Range	RANG6	
Integration Time:	SHORT	ITIM1	
	MEDIUM	ITIM2	@
	LONG	ITIM3	
Average Rate:		AVE=	
Trigger Delay Time:		TDEL=	
Step Delay Time:		SDEL=	
Cable Length:	0m	CABL0	@
	1m	CABL1	
	2m	CABL2	

G-1-2. COMPENSATION

Function		Code	
OPEN:	OPEN OFF	OPEN0	@
	OPEN ON	OPEN1	
	OPEN MEAS	XOP	
	OPEN data query	OPM?	
SHORT:	SHORT OFF	SHOR0	@
	SHORT ON	SHOR1	
	SHORT MEAS	XSH	
	SHORT data query	SHM?	
STANDARD:	STD OFF	STD0	@
	STD ON	STD1	
	STD MEAS	XSTD	
	STD Parameter (C-D)	SPAR1	@
	STD Parameter (C-G)	SPAR2	
	Reference Value (C)	CSTD=	
	Reference Value (D)	DSTD=	
	Reference Value (G)	GSTD=	
	STD meas. data query	STM?	
	STD ref. data query	STR?	
COMPENSATION NUMBER SELECT:		CNO=	
TEMPERATURE COMPENSATION:		XTMP	

G-1-3. OFFSET

Function		Code	
OFFSET A:	OFF	AOFF0	@
	ON	AOFF1	
	Input data	OFFA=	
OFFSET B:	OFF	BOFF0	@
	ON	BOFF1	
	Input data	OFFB=	

G-1-4. DISPLAY

Function		Code
Display Page:	MEASurement Page	DPAG1 @
	STATUS Page	DPAG2
	BLANK Page	DPAG3
Display Digit:	4 digits	DDIG4
	5 digits	DDIG5
	6 digits	DDIG6 @
Value Monitor:	Monitor OFF	VMON0 @
	OPEN MEAS Value	VMON1
	SHORT MEAS Value	VMON2
	STD MEAS Value	VMON3
	STD Reference Data	VMON4
	OFFSET Data	VMON5

G-1-5. DATA OUTPUT

Function		Code
DATA Query:		DATA?
DATA Format:	ASCII format	DFMT1 @
	BINARY format	DFMT2
SECONDARY DATA Output:	OFF	DSEC0
	ON	DSEC1 @
DATA Output With Pole:	OFF	DPOL0 @
	ON	DPOL1

G-1-6. OTHERS

Function	Code
Clear Status Byte:	*CLS
Identification Query:	*IDN?
Learn Device Setup Query:	*LRN?
Option Identification Query:	*OPT?
Reset the instrument:	*RST
Masking Status Byte:	*SRE
Masking Resister Query:	*SRE?
Read Status Byte:	*STB?
Trigger:	*TRG
Error Number Query:	ERR?

NOTES

G-2. ALPHABETICALLY ORDERED LIST

This list covers all commands are listed in alphabetical order.

-A-

AOFF0	OFFSET A OFF
AOFF1	OFFSET A ON
APOL0	Fix Polarity
APOL1	Polarity Invert
AVE=	Averaging Rate

-B-

BTAB=	Sweep Bias Entry
BIAS0	DC BIAS OFF
BIAS1	DC BIAS ON
BOFF0	OFFSET B OFF
BOFF1	OFFSET B ON
BMOD1	DC BIAS Mode (Spot Bias)
BMOD2	DC BIAS Mode (Sweep Bias)
BMOD3	DC BIAS Mode (External Bias)

-C-

CABL0	Cable Length (0m)
CABL1	Cable Length (1m)
CABL2	Cable Length (2m)
CNO=	Compensation Number Select
CSTD=	Reference data (**C**) of the standard capacitor

-D-

DATA?	DATA OUTPUT query
DDIG4	Display Digit (4 digits)
DDIG5	Display Digit (5 digits)
DDIG6	Display Digit (6 digits)
DFMT1	Data Transfer Format (ASCII Mode)
DFMT2	Data Transfer Format (BINARY 64bit Mode)
DPAG1	Display Page (MEASUREMENT PAGE)
DPAG2	Display Page (STATUS PAGE)
DPAG3	Display Page (BLANK PAGE)
DPOL0	Auto Bias Polarity Switching Result Output OFF
DPOL1	Auto Bias Polarity Switching Result Output ON
DSEC0	Secondary Data Output OFF
DSEC1	Secondary Data Output ON
DSTD=	Reference data (**D**) of the standard capacitor

-E-

ERR?	Error Message Query

-F-

-G-

GSTD= Reference data (**G**) of the standard capacitor

-H-

-I-

ITIM1	Integration Time (SHORT)
ITIM2	Integration Time (MEDIUM)
ITIM3	Integration Time (LONG)

-J-

-K-

-L-

-M-

MPAR1	Measurement Parameter (**C_P-D**)
MPAR2	Measurement Parameter (**C_P-Q**)
MPAR3	Measurement Parameter (**C_P-G**)
MPAR4	Measurement Parameter (**C_S-D**)
MPAR5	Measurement Parameter (**C_S-Q**)
MPAR6	Measurement Parameter (**C_S-R_S**)

-N-

-O-

OFFA=	OFFSET A Data
OFFB=	OFFSET B Data
OPEN0	OPEN Compensation OFF
OPEN1	OPEN Compensation ON
OPM?	OPEN Compensation data query
OSC1	OSC LEVEL (20mV)
OSC2	OSC LEVEL (50mV)
OSC3	OSC LEVEL (100mV)
OSC4	OSC LEVEL (200mV)
OSC5	OSC LEVEL (500mV)
OSC6	OSC LEVEL (1000mV)

-P-

-Q-

-R-

RANG0	AUTO Range
RANG1	2pF Range
RANG2	8pF Range
RANG3	32pF Range
RANG4	128pF Range
RANG5	512pF Range
RANG6	1024pF Range

-S-

SBI= Spot Bias Entry
SDEL= Step delay Time Entry
SHM? SHORT Compensation data query
SHOR0 SHORT Compensation OFF
SHOR1 SHORT Compensation ON
SPAR1 Standard Parameter (**C-D**)
SPAR2 Standard Parameter (**C-G**)
STD0 STANDARD Compensation OFF
STD1 STANDARD Compensation ON
STM? STANDARD Compensation meas. data query
STR? STANDARD Compensation ref. data query

-T-

TDEL= Trigger Delay Time Entry
TRIG1 Trigger Mode (Internal)
TRIG2 Trigger Mode (External)
TRIG3 Trigger Mode (Manual)

-U-

-V-

VMON0 Value Monitor OFF
VMON1 Value Monitor (OPEN Measurement Value)
VMON2 Value Monitor (SHORT Measurement Value)
VMON3 Value Monitor (STANDARD Measurement Value)
VMON4 Value Monitor (STANDARD Reference Value)
VMON5 Value Monitor (OFFSET Reference Value)

-W-

-X-

XOP Measure OPEN Compensation data
XSH Measure SHORT Compensation data
XSTD Measure STANDARD Compensation data
XTMP Execute Temperature Compensation

-Y-

-Z-

-OTHERS-

***CLS**	Clear Status Byte
***IDN?**	Identification Query
***LRN?**	Learn Device Setup Query
***OPT?**	Option Identification Query
***RST**	Reset the instrument
***SRE**	Mask the status byte
***SRE?**	*SRE resister (masking number) Query
***STB?**	Read the status resister
***TRG**	Trigger command

NOTES

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