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**HP E4915A Crystal Impedance Meter  
HP E4916A Crystal Impedance/LCR Meter**

# **Operation Manual**

## **SERIAL NUMBERS**

This manual applies directly to instruments which have the serial number prefix JP1KD, or firmware revision A.02.0x  
For additional important information about serial numbers, read "Serial Number" in Appendix A.



**HP Part No. E4915-90030  
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## Safety Summary

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

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

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### Note



HP E4915A and HP E4916A comply with INSTALLATION CATEGORY II and POLLUTION DEGREE 2 in IEC1010-1. HP E4915A and HP E4916A are INDOOR USE product.

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### Note



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

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## Ground The Instrument

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

## DO NOT Operate In An Explosive Atmosphere

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

## Keep Away From Live Circuits

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

## DO NOT Service Or Adjust Alone

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

## DO NOT Substitute Parts Or Modify Instrument

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

## Dangerous Procedure Warnings

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

**Warning**



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

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## Exclusive Remedies

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

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## Assistance

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

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

## 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



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



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



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## Introduction

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### About the HP E4915A/E4916A Crystal Impedance Meter

Models HP E4915A and HP E4916A are crystal impedance meters designed to meet various testing needs on crystal resonator production lines. Employing the network analyzer method (transmission  $\pi$  network method), these crystal impedance meters provide highly accurate measurements over a wide range of frequencies: 1 MHz to 180 MHz. The HP E4915A and HP E4916A share the same basic capabilities for crystal impedance testing including the measurement of resonance frequency and impedance characteristics, equivalent circuit analysis, spurious search, High Q mode, and comparator.

The HP E4916A extends the basic capabilities it shares with the HP E4915A. The HP E4916A provides variable signal levels, and incorporates many extended features including Drive Level Dependency measurement mode, Evaporation Monitor mode (trap measurement), Filter measurement mode, and so on. In addition, attaching Options 001/010 to the HP E4916A enables it to function as an LCR meter that supports frequencies from 1 MHz to 180 MHz.

## Specifications and Functions of HP E4915A/E4916A

**Table 1-1. Specifications and Applicable Models**

Spec items		HP E4915A	HP E4916A
Measuring frequency	Range	1 MHz to 180 MHz	1 MHz to 180 MHz
	Accuracy	±2 ppm	±2 ppm
Basic		Fr, Fs, FL, Fa, CI, C1, L1, R1, C0, Q, Spurious	Fr, Fs, FL, Fa, CI, C1, L1, R0, R1, C0, G0, Q, Spurious
Fr/CI accuracy (for reference purpose only)	Fr	±2 ppm	±2 ppm
	CI	±5%	±5%
Fr/CI measuring time (typical)		125 msec to 10 sec	125 msec to 10 sec
Output power	1 to 100 MHz	-5 dBm(constant)	-60 to +22 dBm
	100 to 180 MHz	-5 dBm(constant)	-60 to +16 dBm
	- with $\pi$ circuit connected (CI = 25 $\Omega$ )	Approx. 5 $\mu$ W	0.1 nW to 1 mW

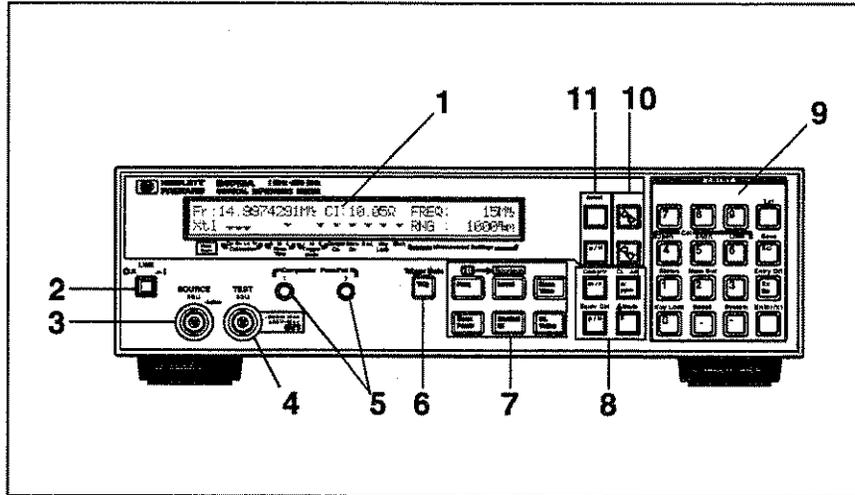
**Table 1-2. Functions and Applicable Models**

Function	HP E4915A	HP E4916A
Crystal Resonator measurement mode	✓	✓
Equivalent circuit analysis	✓	✓
Spurious measurement mode	✓	✓
Drive Level Dependency measurement mode	-	✓
Evaporation Monitor mode	-	✓
Filter measurement mode	-	✓
LCR measurement mode	-	Option 010
Impedance Probe	-	Option 001
Comparator function	✓	✓

# Front Panel, Rear Panel, and Display

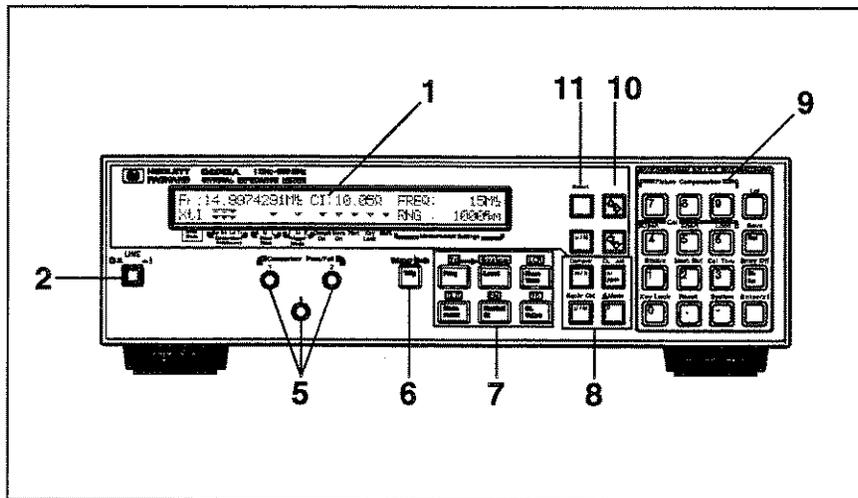
## Front Panel

2. Front Panel, Rear Panel, and Display



LE002001

Figure 2-1. Front Panel of the HP E4915A



LE002002

Figure 2-2. Front Panel of the HP E4916A

- 1. LCD screen - Displays measurement results, instrument settings, and messages.

2. **LINE switch** - Turns ON/OFF the HP E4915A/E4916A.
3. **SOURCE terminal (HP E4915A only)** - Use this terminal, along with the TEST terminal, to connect your HP E4915A with a test fixture. The SOURCE terminal sends source signals to the fixture while the TEST fixture receives measurement signals from the fixture.
4. **TEST terminal (HP E4915A only)** - Use this terminal, along with the SOURCE terminal, to connect your HP E4915A with a test fixture. The TEST fixture receives measurement signals from the fixture while the SOURCE terminal sends source signals to the fixture. **INSTALLATION CATEGORY I**

**Note**

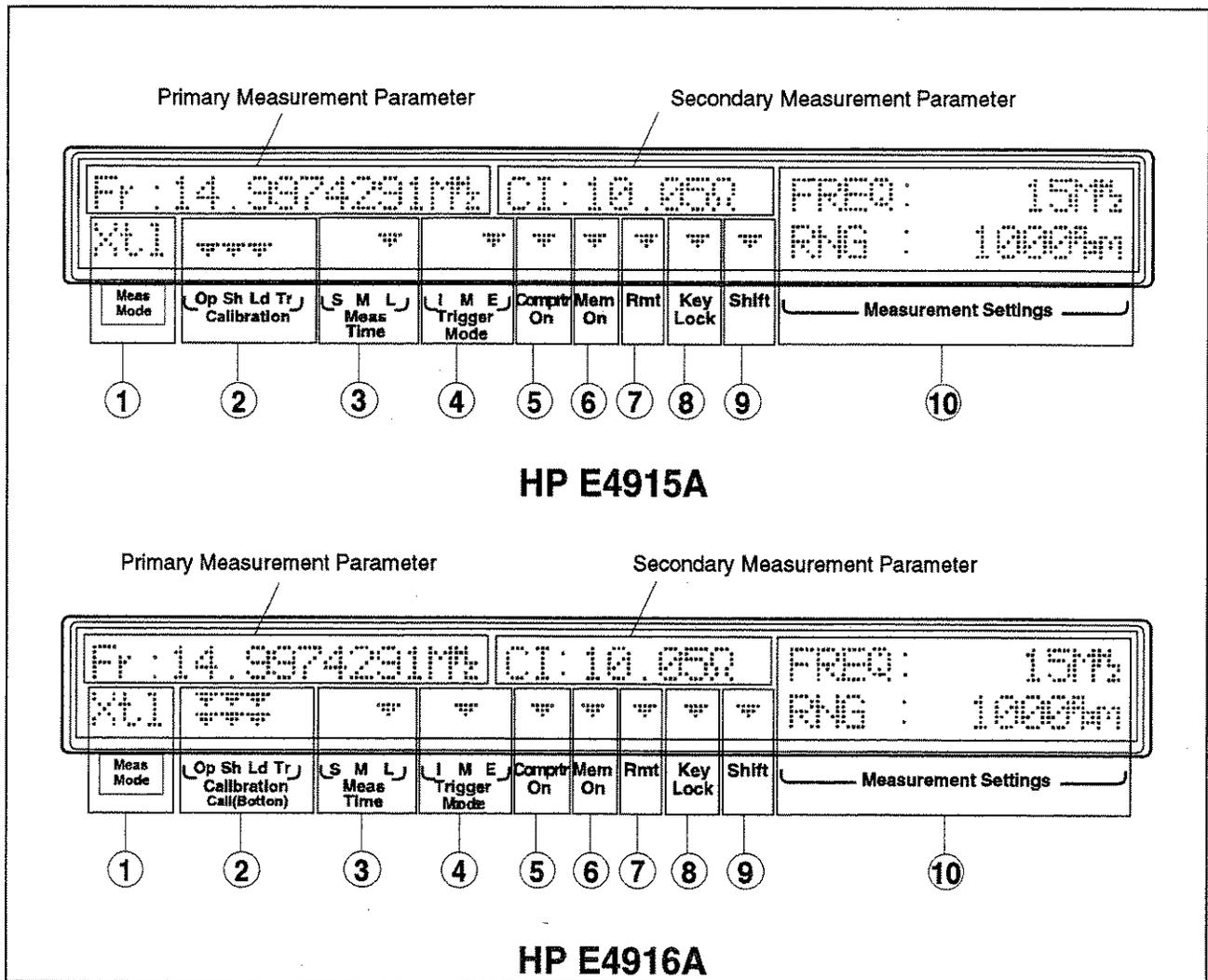

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For the HP E4916A, the SOURCE and TEST terminals are located on the rear panel, instead of the front panel.

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5. **Comparator Pass/Fail LED** - Indicates whether the current DUT has passed or failed the Comparator test.
6. **Trig key** - Press this key to manually trigger the HP E4915A/E4916A.
7. **Function setting key block** - This block contains a number of keys that let you control various functions of the HP E4915A/E4916A. For the individual keys, refer to "Function Setting Keys" in this chapter.
8. **Unit entry key block** - This block contains a number of keys that let you set the units for various parameters.
9. **Data entry key block** - This block contains a number of keys that let you enter the values of various parameters. For the individual keys, refer to "Data Entry Keys" in this chapter.
10. **Arrow keys** - These keys provide navigational means. With no soft key selected, pressing the  key displays the previous pair of soft keys while pressing the  displays the next pair of soft keys. If you have already selected a soft key and the soft key has two or more options, the arrow keys let you move between the options. (For more information on soft keys, refer to Chapter 3).
11. **Select keys** - Two  keys are arranged vertically to the right of the LCD screen. You can press either the upper or lower  key to select the first or second soft key. (For more information on soft keys, refer to Chapter 3).

**LCD Screen** The HP E4915A/E4916A has a 2-line LCD screen on the front panel.



LE002008

**Figure 2-3. LCD Screen**

### Items Displayed on Screen

The LCD screen displays measurement parameter values, measured characteristic values, soft keys, and messages as applicable.

### Labels below the Screen

A series of labels are printed immediately below the LCD screen. Some labels identify what is displayed above it, while other labels indicate the current instrument settings in conjunction with ▼ markers. The following list briefly describes the meaning of each label.

1. **Meas Mode** - Identifies the measurement mode currently in effect. The abbreviated name of the measurement mode currently in effect is displayed above this label.

Xtl	Crystal Resonator Measurement Mode (Xtl Mode)
Spu	Spurious Measurement Mode
DLD	Drive Level Dependency Measurement Mode (DLD Mode)
EM	Evaporation Monitor mode
LCR	LCR Measurement Mode
Flt	Filter Measurement Mode (Flt Mode)

2. **Calibration (HP E4915A) or Compens and Cal (HP E4916A)** - Indicates the current status of each setting of calibration/compensation. A ▼ maker appears above any setting that is already complete.
3. **Meas Time** - Indicates the measuring time setting currently in effect. A ▼ maker always appears above one of the three alternative settings, when High Q mode is ON, two ▼ makes appear.
4. **Trigger** - Indicates the trigger mode currently in effect. A ▼ maker always appears above one of the three alternative modes.
5. **Comparator On** - When the Comparator function is ON, a ▼ maker appears above this label.
6. **Mem ON** - When the Memory Buffer function is ON, a ▼ maker appears above this label.
7. **Rmt ON** - When the instrument is in Remote mode (that is, remote-controlled via HP-IB), a ▼ maker appears above this label.
8. **Key Lock** - When the front panel keys are locked, a ▼ maker appears above this label.
9. **Shift** - When the shift key ((blue)) is ON, a ▼ maker appears above this label. In this case, you can access the second function assigned to each key (printed in blue letters beside the key).
10. **Measurement Settings** - Identifies the soft key display area, which displays a pair of soft keys. With no soft key selected, pressing the (↑⇒) key displays the previous pair of soft keys while pressing the (⇐↓) displays the next pair of soft keys (for more information on soft keys, refer to Chapter 3). You can select one of the soft keys by pressing the corresponding (Select) key. (For more information on soft keys, refer to Chapter 3).

## Comparator Pass/Fail LED

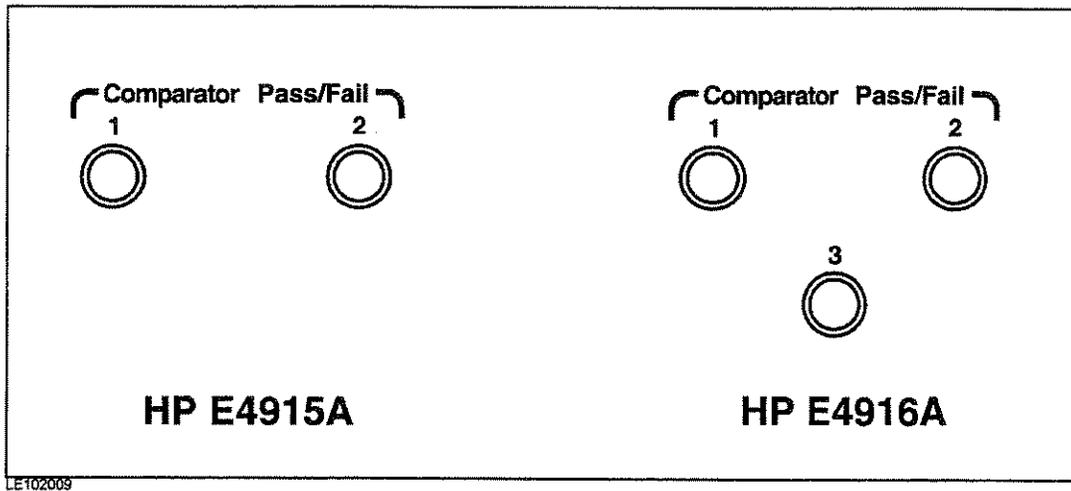


Figure 2-4. LEDs for HP E4915A/E4916A

1. **LED1** - For primary sorting of the primary measurement parameter actual value on the LCD screen using the Comparator function, this LED turns ON depending on the result, "Pass" or "Fail."
2. **LED2** - For secondary sorting of the secondary measurement parameter actual value on the LCD screen using the Comparator function, this LED turns ON depending on the result, "Pass" or "Fail."
3. **LED3 (HP E4916A only)** - For the  $\Delta F/\Delta CI$  limit test or BW test using the tertiary sorting of the Comparator function, this LED turns ON depending on the result, "Pass" or "Fail."

 Rear Panel

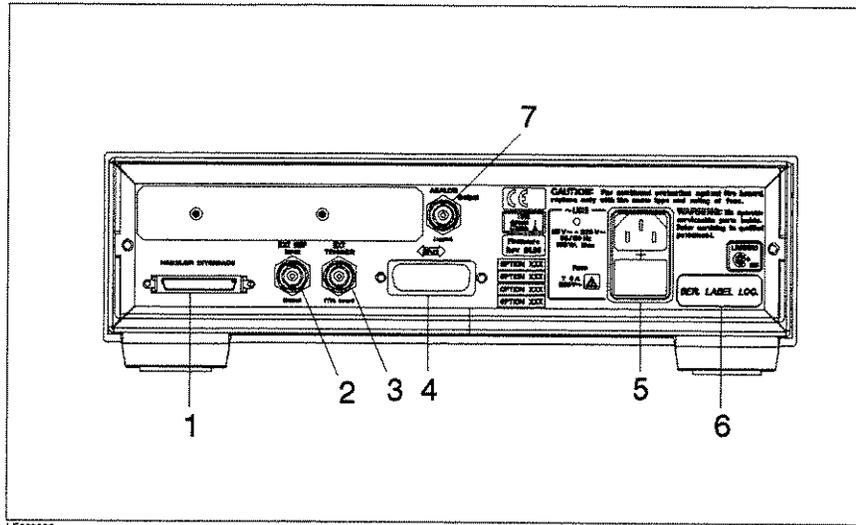


Figure 2-5. Rear Panel (HP E4915A)

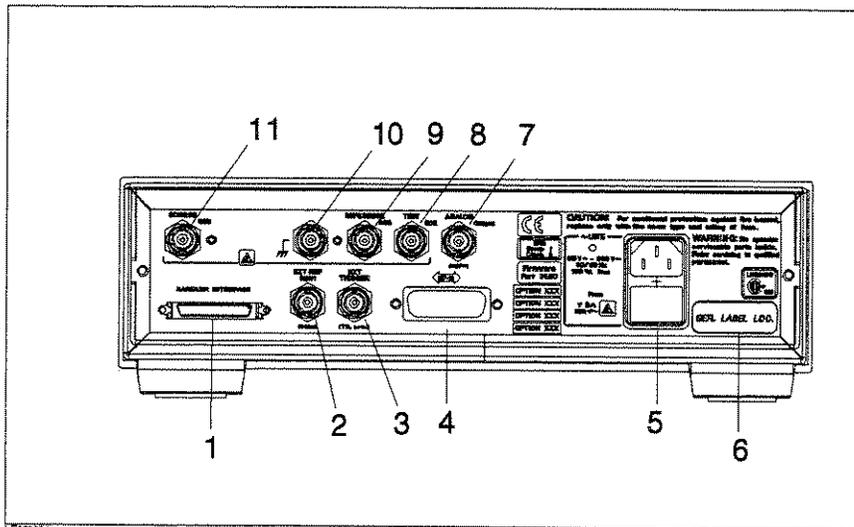


Figure 2-6. Rear Panel (HP E4916A)

1. **Handler Interface connector**- Connects to an external handler.
2. **EXT REF (External Reference) terminal** - Accepts an external reference signal.
3. **EXT Trigger terminal** - Accepts an external trigger signal.
4. **HP-IB Interface connector** - Connects to an external controller that controls the HP E4915A/E4916A via HP-IB.
5. **Power Cable Receptacle with Fuse Holder** - Power cord socket.

6. **Serial Number Plate** - Indicates the serial number of your instrument.
7. **Analog OUT terminal** - Outputs analog signals that represent measurement results. For more information, refer to "Analog OUT Terminal" for each measurement mode in Chapter 4 "Function Reference."
8.  **TEST terminal (HP E4916A only)** - Use this terminal, along with the SOURCE terminal, to connect your HP E4916A with a test fixture. The SOURCE terminal sends source signals to the fixture while the TEST fixture receives measurement signals from the fixture. INSTALLATION CATEGORY I . 0 dBm, ±25 Vdc Input Max.

**Note**

For the HP E4915A, the TEST terminal is located on the front panel, instead of the rear panel.

9.  **REFERENCE terminal (HP E4916A only)** - Use this terminal to connect your HP E4916A with a test probe. INSTALLATION CATEGORY I . 0 dBm, ±25 Vdc Input Max.
10. **Frame or Chassis Terminal terminal (HP E4916A only)** - Terminal for GND signal.
11. **SOURCE terminal (HP E4916A only)** - Use this terminal, along with the TEST terminal, to connect your HP E4916A with a test fixture. The SOURCE terminal sends source signals to the fixture while the TEST fixture receives measurement signals from the fixture.

**Note**

For the HP E4915A, the SOURCE terminal is located on the front panel, instead of the rear panel.

**Table 2-1. Connectors Occupied by the Device**

Devices That Can Be Connected to the HP E4916A	Connectors			
	SOURCE	Chassis Terminal	REFERENCE	TEST
$\pi$ circuit	✓			✓
Z probe	✓	(✓)	✓	✓

## Key Reference

### Function Setting Keys

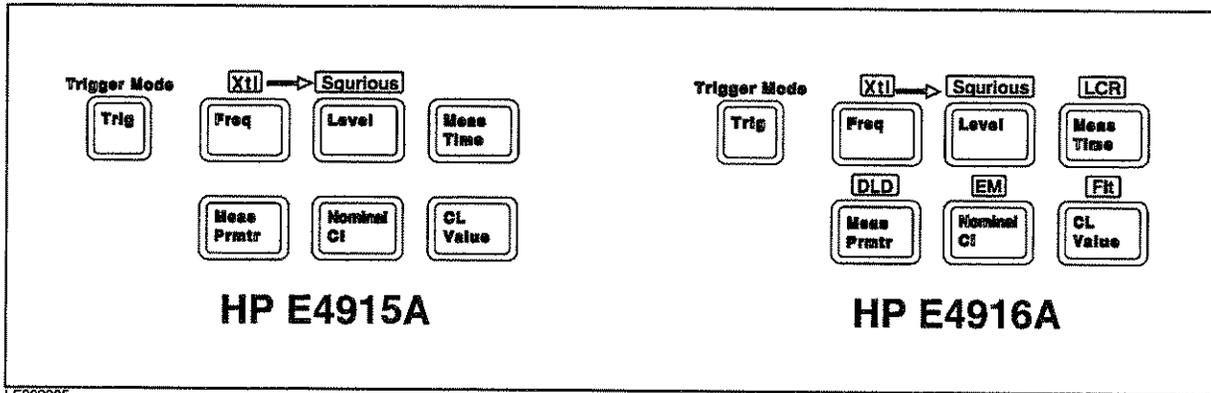
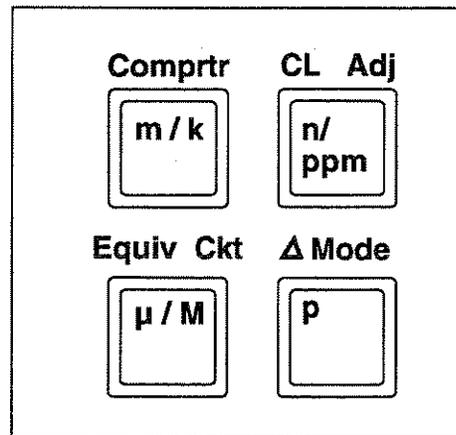


Figure 2-7. Function Setting Key Block

Table 2-2. Summary: Function Setting Key Block

Key	Function	Applicable Model	
		HP E4915A	HP E4916A
<b>Freq</b>	Press to enter the nominal frequency.	✓	✓
<b>(blue) + Freq (Xtl)</b>	Press to select Crystal Resonator measurement mode (Xtl mode).	✓	✓
<b>Level</b>	Press to enter the power level.		✓
<b>(blue) + Level (Spurious)</b>	Press to select Spurious measurement mode.	✓	✓
<b>Meas Time</b>	Press to set the measurement time.	✓	✓
<b>(blue) + Meas Time (LCR)</b>	Press to select LCR measurement mode.		✓
<b>Nominal CI</b>	Press to enter the nominal CI value.	✓	option 010
<b>(blue) + Nominal CI (EM)</b>	Press to select Evaporation Monitor mode (EM mode).		
<b>CL Value</b>	Press to enter the target CL value.	✓	✓
<b>(blue) + CL Value (FIt)</b>	Press to select Filter measurement mode (FIt mode).		✓
<b>Trig</b>	Manual trigger	✓	✓
<b>(blue) + Trig (Trigger Mode)</b>	Press to set the trigger mode	✓	✓
<b>Select (upper)</b>	Press to select the upper soft key.	✓	✓
<b>Select (lower)</b>	Press to select the lower soft key.	✓	✓

## Unit Entry Keys



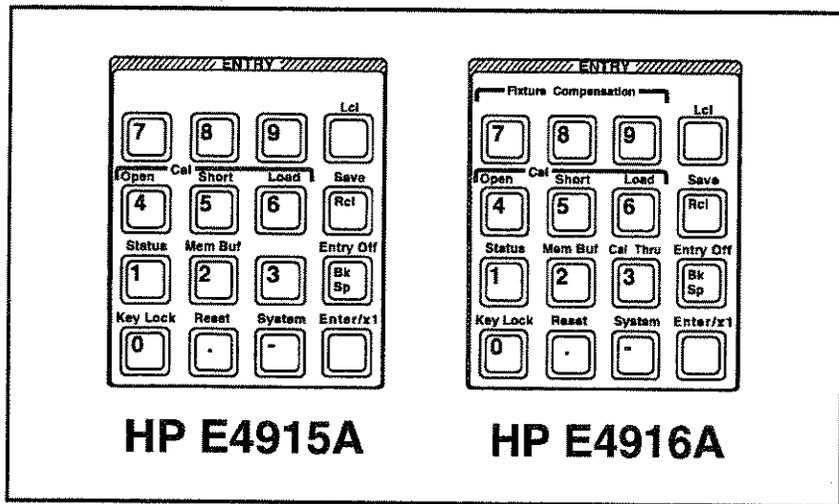
LE002006

Figure 2-8. Unit Entry Key Blocks

Table 2-3. Summary: Unit Entry Key Blocks

Key	Function
<b>m/k</b>	Press to enter the unit.
<b>(blue) + m/k (Comprtr)</b>	Press to access the Comparator setup menu.
<b>n/ppm</b>	Press to enter the unit.
<b>(blue) + n/ppm (CL Adj)</b>	Press to activate CL Adj mode.
<b>μ/M</b>	Press to enter the unit.
<b>(blue) + μ/M (Equiv Ckt)</b>	Press to turn ON/OFF the Equivalent Circuit function.
<b>p</b>	Press to enter the unit.
<b>(blue) + p (Δ Mode)</b>	Press to turn ON/OFF Δ mode.

Data Entry Keys



LE002007

Figure 2-9. Data Entry Key Block

Table 2-4. Summary: Data Entry Key Block

Key	Function	Applicable Model	
		HP E4915A	HP E4916A
(blue) + 7 (Open)	Fixture compensation key for the open compensation measurement.		✓
(blue) + 8 (Short)	Fixture compensation key for the short compensation measurement.		✓
(blue) + 9 (Load)	Fixture compensation key for the load compensation measurement.		✓
(blue) + 4 (Open)	Calibration key for the open calibration measurement.	✓	✓
(blue) + 5 (Short)	Calibration key for the short calibration measurement.	✓	✓
(blue) + 6 (Load)	Calibration key for the load calibration measurement.	✓	✓
(blue) + 1 (Status)	Press to turn ON/OFF status display.	✓	✓
(blue) + 2 (Mem Buf)	Press to access the Memory Buffer function.	✓	✓
(blue) + 3 (Thru)	Calibration key for the thru calibration measurement.		✓
(blue) + 0	Press to turn ON the Key Lock function.	✓	✓
(blue) + . (Reset)	Press to reset the instrument.	✓	✓
(blue) + - (System)	Press to access the System menu.	✓	✓
(blue) + Lcl	Normally serves as the shift key (referred to as the (blue) key throughout this manual). When the instrument is in Remote mode, however, the (blue) key serves as the Lcl key instead of the shift key. The Lcl key allows you to switch the instrument to Local mode.	✓	✓
Rcl	Press to recall previously saved instrument settings.	✓	✓
(blue) + Rcl (Save)	Press to save the current instrument settings.	✓	✓
BkSp	Backspace key.	✓	✓
(blue) + BkSp (Entry Off)	Press to turn OFF entry mode.	✓	✓
(blue) + Enter (x1)	Press to enter a value with no unit.	✓	✓



## Commands Available via Hard and Soft Keys

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### Function Assigned to Keys

The HP E4915A/E4916A has a number of physical keys on its front panel. These physical keys, called **hard keys**, are assigned common functions.

On the other hand, functions specific to each measurement or setup mode are accessible via the LCD on the front panel. The facility that provides access to mode-specific functions or parameters via the LCD is called the **soft key**.

This chapter contains a series of tables that show what functions/parameters are assigned to specific hard or soft keys.

**Hard Keys**

The term **hard key** refers to physical keys provided on the front panel. Each hard key has one or two functions assigned. If a key has two functions, you can access the second function by pressing that key in combination with the **(blue)** key; in other words, the second function is accessible when the key is in the shifted state.

The following table shows the functions assigned to each hard key in its non-shift state and in its shift state.

---

**Note**

- For numeric keys, this table shows only the second function, which is available when the numeric key is pressed in combination with the **(blue)** key.
  - Some functions are available only with the HP E4916A. Refer to the “Applicable Model” column.
  - The **(blue)** key normally serves as the shift key. When the instrument is in Remote mode, however, the **(blue)** key serves as the **(Lcl)** key instead of the shift key. The **(Lcl)** key allows you to switch the instrument to Local mode.
- 

**Note**

For the conventions and the syntax of HP-IB commands, refer to “Conventions and Syntax” in Chapter 5.

---

Table 3-1. Functions Assigned to Hard Keys

Hard Key	Function	Associated Topic in Chapter 4	HP-IB Command	Applicable Model	
				HP E4915A	HP E4916A
<b>Trig</b>	Manual trigger	“Trigger Function” in Chapter 4	TRIGIMMediate	✓	✓
<b>(blue) + Trig (Trigger Mode)</b>	Press to set the trigger mode.: {Int Man Ext}	“Trigger Function” in Chapter 4	TRIGSOURCE␣ {INTernal MANual  EXTernal BUS}	✓	✓
<b>Freq</b>	Press to enter the nominal frequency.	“Measurement Modes” in Chapter 4	NOMFreq␣<value>	✓	✓
<b>(blue) + Freq (Xtl)</b>	Press to select Crystal Resonator Measurement Mode (Xtl mode).	“Crystal Resonator Measurement Mode (Xtl Mode) – common between the HP E4915A and HP E4916A” in Chapter 4	MEASFunction␣Xtal	✓	✓
<b>Meas Prmtr</b>	Press to enter a measurement parameter.	“Measurement Modes” in Chapter 4	MEASPARA␣ {FR FA FS FL}	✓	✓
<b>(blue) + Meas Prmtr (DLD)</b>	Press to select Drive Level Dependency measurement mode (DLD mode).	“Drive Level Dependency Measurement Mode (DLD Mode)” in Chapter 4	MEASFunction␣Dld		✓
<b>Level</b>	Press to enter the power level.	“Measurement Modes” in Chapter 4	POWER␣<value>		✓
<b>(blue) + Level (Spurious)</b>	Press to select Spurious measurement mode.	“Crystal Resonator Measurement Mode (Xtl Mode) – common between the HP E4915A and HP E4916A” in Chapter 4	MEASFunction␣Spur	✓	✓
<b>Nominal CI</b>	Press to enter the nominal CI value.	“Measurement Modes” in Chapter 4	NOMCI␣<value>	✓	✓
<b>(blue) + Nominal CI (EM)</b>	Press to select Evaporation Monitor mode (EM mode).	“Evaporation Monitor Mode (EM Mode)” in Chapter 4	MEASFunction␣Em		✓

Table 3-1. Functions Assigned to Hard Keys (continued)

Hard Key	Function	Associated Topic in Chapter 4	HP-IB Command	Applicable Model	
				HP E4915A	HP E4916A
<b>Meas Time</b>	Press to set the measurement time.	"Measurement Modes" in Chapter 4	MEASTime $\downarrow$ <value>	✓	✓
<b>(blue)</b> + <b>Meas Time (LCR)</b>	Press to select LCR measurement mode.	"LCR Measurement Mode" in Chapter 4	MEASFunction $\downarrow$ LCr		✓
<b>CL Value</b>	Press to enter the target CL value.	"Measurement Modes" in Chapter 4	CLTGT $\downarrow$ <value>	✓	✓
<b>(blue)</b> + <b>CL Value (Flt)</b>	Press to select Filter measurement mode (Flt mode).	"Filter Measurement Mode (Flt Mode)" in Chapter 4	MEASFunction $\downarrow$ Filter		✓
<b>Select</b> (upper)	Press to select the upper soft key.			✓	✓
<b>Select</b> (lower)	Press to select the lower soft key.			✓	✓
<b>m/k</b>	Press to enter the unit.			✓	✓
<b>(blue)</b> + <b>m/k (Comprtr)</b>	Press to access the Comparator setup menu.	"Comparator Function" in Chapter 4		✓	✓
<b><math>\mu</math>/M</b>	Press to enter the unit.			✓	✓
<b>(blue)</b> + <b><math>\mu</math>/M (Equiv Ckt)</b>	Press to turn ON/OFF the Equivalent Circuit function.	"Measurement Modes" in Chapter 4	EQUckt $\downarrow$ {DEV4 DEV6 OFF}	✓	✓
<b><math>\uparrow \Rightarrow</math></b>	Press to move to the upper or right-hand soft key/display position.			✓	✓
<b><math>\Leftarrow \downarrow</math></b>	Press to move to the left-hand or lower soft key/display position.			✓	✓
<b>n/ppm</b>	Press to enter the unit.			✓	✓
<b>(blue)</b> + <b>n/ppm (CL Adj)</b>	Press to activate CL Adj mode.	"Measurement with Capacitance Load (CL_a/CL_t Parameters)" in Chapter 4	CLADJust $\downarrow$ {OFF ON 0 1}, CLACTENter	✓	✓
<b>p</b>	Press to enter the unit.			✓	✓
<b>(blue)</b> + <b>p (<math>\Delta</math> Mode)</b>	Press to turn ON/OFF delta mode.	"Delta Mode" in Chapter 4	DLTMode $\downarrow$ {PRI SEC}, {OFF DEV PCNT PPM}	✓	✓

Table 3-1. Functions Assigned to Hard Keys (continued)

Hard Key	Function	Associated Topic in Chapter 4	HP-IB Command	Applicable Model	
				HP E4915A	HP E4916A
(blue)	Shift key (in Remote mode, press this key to switch to Local mode).			✓	✓
(blue) + 9 (Load)	Fixture compensation key for the LOAD compensation.	"Calibration and Fixture Compensation" in Chapter 4	COMPENSation␣LOAD		✓
(blue) + 8 (Short)	Fixture compensation key for the SHORT compensation.	"Calibration and Fixture Compensation" in Chapter 4	COMPENSation␣SHORT		✓
(blue) + 7 (Open)	Fixture compensation key for the OPEN compensation.	"Calibration and Fixture Compensation" in Chapter 4	COMPENSation␣OPEN		✓
Rcl	Press to recall previously saved instrument settings.	"Memory Facilities" in Chapter 4	*RCL␣ <value>	✓	✓
(blue) + Rcl (Save)	Press to save the current instrument settings.	"Memory Facilities" in Chapter 4	*SAV␣ <value>	✓	✓
(blue) + 6 (Load)	Calibration key for the LOAD calibration.	"Calibration and Fixture Compensation" in Chapter 4	CALibration␣LOAD	✓	✓
(blue) + 5 (Short)	Calibration key for the SHORT calibration.	"Calibration and Fixture Compensation" in Chapter 4	CALibration␣SHORT	✓	✓
(blue) + 4 (Open)	Calibration key for the OPEN calibration.	"Calibration and Fixture Compensation" in Chapter 4	CALibration␣OPEN	✓	✓
BkSp	Backspace key.			✓	✓
(blue) + BkSp (Entry Off)	Press to turn OFF entry mode.			✓	✓

Table 3-1. Functions Assigned to Hard Keys (continued)

Hard Key	Function	Associated Topic in Chapter 4	HP-IB Command	Applicable Model	
				HP E4915A	HP E4916A
(blue) + 3 (Thru)	Calibration key for the thru state.	"Calibration and Fixture Compensation" in Chapter 4	THRUCAL		✓
(blue) + 2 (Mem Buf)	Press to access the Memory Buffer function.	"Memory Facilities" in Chapter 4	MESTATE $\downarrow$ {OFF ON 0 1}	✓	✓
(blue) + 1 (Status)	Press to turn ON/OFF status display.		DISPSTAT $\downarrow$ {OFF ON 0 1}	✓	✓
Enter	Press to put the entered value into effect.			✓	✓
(blue) + Enter (x1)	Press to enter a value with no unit.			✓	✓
(blue) + - (System)	Press to access the System menu.			✓	✓
(blue) + . (Reset)	Press to reset the instrument.	"Reset Function" in Chapter 4	PRESet	✓	✓
(blue) + 0 (Key Lock)	Press to turn ON the Key Lock function.	"Key Lock" in Chapter 4	KLOCK $\downarrow$ {OFF ON 0 1}	✓	✓

### Soft Keys

When you are working in a particular measurement or setup mode, the LCD screen presents you with soft keys that provide access to functions or parameters specific to that mode. The LCD screen consists of two lines, and usually shows a pair of soft keys in the rightmost area. Two physical **Select** keys are arranged vertically to the right of the LCD screen. You can press either the upper or lower **Select** key to select the first or second soft key. You can navigate through alternative pairs of soft keys in a cyclic fashion: Press the **↑⇒** key to access the previous pair of soft keys, or the **⇐↓** key to access the next pair of soft keys.

This section contains a series of subsections each of which briefly describes the soft keys specific to a particular measurement or setup mode. Note that soft keys are displayed in the same order as listed in each subsection.

To begin with, you may want to refer to the following table that shows how to access each of the measurement or settings modes covered in this section.

Measurement/Setup mode	Hard Key for Accessing This Mode	Applicable Model
Crystal Resonator Measurement Mode	<b>(blue)</b> + <b>Freq (Xtl)</b>	HP E4915A/E4916A
Spurious measurement mode	<b>(blue)</b> + <b>Level (Spurious)</b>	HP E4915A/E4916A
Drive Level Dependency measurement mode	<b>(blue)</b> + <b>Meas Prmtr (DLD)</b>	HP E4916A only
Evaporation Monitor mode	<b>(blue)</b> + <b>Nominal Cl (EM)</b>	HP E4916A only
LCR measurement mode	<b>(blue)</b> + <b>Meas Time (LCR)</b>	HP E4916A only(option)
Filter measurement mode	<b>(blue)</b> + <b>CL Value (Flt)</b>	HP E4916A only
Comparator setup mode	<b>(blue)</b> + <b>m/k (Comprtr)</b>	HP E4915A/E4916A
System setup mode	<b>(blue)</b> + <b>- (System)</b>	HP E4915A/E4916A

## Crystal Resonator Measurement Mode (Xtl Mode)

Table 3-2.  
Soft Keys and Functions Specific to Crystal Resonator Measurement Mode

Soft Key	Parameter	Function	HP-IB Command
<b>FREQ</b>	<i>value</i>	Nominal frequency [Hz]	NOMFreq $\sqcup$ < <i>value</i> >
<b>RNG</b>	<i>value</i>	Search range [ppm]	SRCHRange $\sqcup$ < <i>value</i> >
<b>GI</b>	<i>value</i>	Nominal impedance [ $\Omega$ ]	NOMCI $\sqcup$ < <i>value</i> >
<b>ALC</b>	{OFF ON}	ALC MODE ON/OFF	ALC $\sqcup$ {OFF ON 0 1}
<b>LVL</b>	<i>value</i>	Power level [W,A,V,dBm]	POWER $\sqcup$ < <i>value</i> > [mW UW NW W MA UA A MV UV V DBM]
<b>UNIT</b>	{dBm WATT AMP VOLT}	Power unit	POWER $\sqcup$ < <i>value</i> > [mW UW NW W MA UA A MV UV V DBM]
<b>TIME</b>	{Short Med Long}	Measuring time	MEASTime $\sqcup$ < <i>value</i> >
<b>HI Q</b>	{OFF ON}	High Q mode ON/OFF	MEASTime $\sqcup$ < <i>value</i> >
<b>EQUC</b>	{OFF 4DEV 6DEV}	Equivalent Circuit Analysis mode ON/OFF	EQUCkt $\sqcup$ {DEV4 DEV6 OFF}
<b>DspQ</b>	{OFF ON}	Show/hide the Q parameter	DSPQ $\sqcup$ {OFF ON 0 1}
<b>TGT</b>	{Phase Peak}	Search target specification	SRCHTGT $\sqcup$ {PHase PEak}
<b>PHAS</b>	<i>value</i>	Target phase [°]	TGTPhase $\sqcup$ < <i>value</i> >
<b><math>\Delta</math>F</b>	{OFF DEV PPM}	Delta mode for frequency	DLTMode $\sqcup$ {SEC}, {OFF DEV PCNT}
<b>RefF</b>	{Nominal User}	Reference frequency for Delta mode [Hz]	DLTREF $\sqcup$ {PRI}, < <i>value</i> >
<b><math>\Delta</math>CI</b>	{OFF DEV %}	Delta mode for crystal impedance	DLTMode $\sqcup$ {SEC}, {OFF DEV PCNT}
<b>RefZ</b>	{Nominal User}	Reference impedance for Delta mode [ $\Omega$ ]	DLTREF $\sqcup$ {SEC}, < <i>value</i> >
<b>AGE</b>	{OFF ON}	Aging mode ON/OFF	AGING $\sqcup$ {OFF ON 0 1}
<b>Time</b>	<i>value</i>	Aging interval	AGINGTIME $\sqcup$ < <i>value</i> >
<b>PARA</b>	{Fs Fr Fa FL}	Measurement Parameter	MEASPARA $\sqcup$ {FR FA FS FL}
<b>CKT</b>	{PI PROBE BRIDGE NONE}	Measurement circuit	CIRcuit $\sqcup$ {PI PRObe BRIdge} PICKTtype $\sqcup$ {PI41900A PI41901A PI41902A}
<b>CL_a</b>	{No-CL User}	Actual CL value (no CL or user-specified value)	CLACTType $\sqcup$ {NOCL USER}, CLACT $\sqcup$ < <i>value</i> >
<b>CL_t</b>	{No-CL User =CLact}	Target CL value (no CL, user-specified value, or measured value)	CLTGTType $\sqcup$ {NOCL USER CLACT}, CLTGT $\sqcup$ < <i>value</i> >
<b>CL Comp</b>	{NO YES}	Execution of CL compensation	CLCOMPen
<b>Ftgt</b>	<i>value</i>	Frequency of reference resonator	CLFREQ $\sqcup$ < <i>value</i> >[MHZ M KHZ K HZ]

## Spurious Measurement Mode

**Table 3-3.**  
**Soft Keys and Functions Specific to Spurious Measurement Mode**

Soft Key	Parameter	Function	HP-IB Command
<b>CENT</b>	<i>value</i>	Center frequency [Hz]	SPCENTerL< <i>value</i> >
<b>RNG</b>	<i>value</i>	Search range [ppm]	SPRANGeL< <i>value</i> >[{{Hz Ppm}}]
<b>DispSP</b>	{Nth Worst}	Spurious point to be displayed (Nth or worst spurious)	SPDISPL{Worst Nth}[,< <i>value</i> >]
<b>#Spur</b>	<i>value</i>	Number of spurious points to search for	SPNUML< <i>value</i> >
<b>TGT</b>	{Phase Peak}	Search target specification	SPTGTL{PHase PEak}
<b>PHAS</b>	<i>value</i>	Target phase [°]	SPPHaseL< <i>value</i> >

## Drive Level Dependency Measurement Mode (DLD Mode)

Table 3-4.  
Soft Keys and Functions Specific to Drive Level Dependency  
Measurement Mode

Soft Key	Parameter	Function	HP-IB Command
<b>FREQ</b>	<i>value</i>	Nominal frequency [Hz]	NOMFreq $\downarrow$ < <i>value</i> >
<b>RNG</b>	<i>value</i>	Search range [Hz/ppm]	SRCHRange $\downarrow$ < <i>value</i> >
<b>CI</b>	<i>value</i>	Nominal CI [ $\Omega$ ]	NOMCI $\downarrow$ < <i>value</i> >
<b>SWEP</b>	{Up UpDown UpMin List}	Sweep type	PTSWPType $\downarrow$ {UPDOWN UP UPMIN LIST}
<b>TIME</b>	{Short Med Long}	Measuring time	MEASTime $\downarrow$ < <i>value</i> >
<b>HI Q</b>	{OFF ON}	High Q mode ON/OFF	MEASTime $\downarrow$ < <i>value</i> >
<b>MIN</b>	<i>value</i>	Minimum drive level [W,A,V,dBm]	PTMINPower $\downarrow$ < <i>value</i> >
<b>MAX</b>	<i>value</i>	Maximum drive level [W,A,V,dBm]	PTMAXPower $\downarrow$ < <i>value</i> >
<b>STD</b>	<i>value</i>	Reference drive level	PTSTDPower $\downarrow$ < <i>value</i> >
<b>UNIT</b>	{dBm WATT AMP VOLT}	Power unit	PTMINPower $\downarrow$ < <i>value</i> >[mW UW NW  W MA UA A MV UV V DBM] PTMAXPower $\downarrow$ < <i>value</i> >[mW UW NW  W MA UA A MV UV V DBM] PTSTDPower $\downarrow$ < <i>value</i> >[mW UW NW  W MA UA A MV UV V DBM]
<b>WAIT</b>	<i>value</i>	Wait time after energization	PTWAIT $\downarrow$ < <i>value</i> >
<b>StartP</b>	<i>value</i>	Sweep start point	PTSTARTPoint $\downarrow$ < <i>value</i> >
<b>ABORT</b>	{OFF ON}	Whether to continue or abort measurement when tracking has failed	PTABORT $\downarrow$ {OFF ON 0 1}
<b>ALC</b>	{OFF ON}	ALC MODE ON/OFF	ALCL $\downarrow$ {OFF ON 0 1}
<b><math>\Delta</math>F</b>	{OFF DEV PPM}	Delta mode for frequency	DLTMode $\downarrow$ PRI $\downarrow$ {OFF DEV PPM}
<b>RefF</b>	{Nom User Start}	Reference frequency for Delta mode [Hz]	DLTREF $\downarrow$ PRI, < <i>value</i> >
<b><math>\Delta</math>CI</b>	{OFF DEV %}	Delta mode for CI value	DLTMode $\downarrow$ SECL $\downarrow$ {OFF DEV PCNT}
<b>RefZ</b>	{Nom User Start}	Reference CI value for Delta mode [ $\Omega$ ]	DLTREF $\downarrow$ SEC, < <i>value</i> >
<b>TGT</b>	{Phase Peak}	Search target specification	SRCHTGT $\downarrow$ {PHase PEak}
<b>PHAS</b>	<i>value</i>	Target phase [ $^{\circ}$ ]	TGTPHase $\downarrow$ < <i>value</i> >
<b>PARA</b>	{Fs Fr}	Type of search frequency	MEASPARA $\downarrow$ {FR FS}
<b>CKT</b>	{PI PROBE BRIDGE}	Measurement circuit	CIRcuit $\downarrow$ {PI PRObe BRIdge} PICKTtype $\downarrow$ {PI41900A PI41901A  PI41902A}
<b>TRKG</b>	{ON OFF}	Phase tracking ON/OFF	PTRACK $\downarrow$ {ON OFF 0 1}

## Evaporation Monitor mode

Table 3-5.  
Soft Keys and Functions Specific to Evaporation Monitor Mode

Soft Key	Parameter	Function	HP-IB Command
<b>CI</b>	<i>value</i>	Nominal CI [ $\Omega$ ]	NOMCIL< <i>value</i> >
<b>ALC</b>	{OFF ON}	ALC MODE ON/OFF	ALCU{OFF ON 0 1}
<b>LVL</b>	<i>value</i>	Power level [W,A,V,dBm]	POWERL< <i>value</i> >
<b>UNIT</b>	{dBm WATT AMP VOLT}	Unit of power	POWERL< <i>value</i> >[MW UW NW W MA UA A MV UV V DBM]
<b>TIME</b>	{Short Med Long}	Measuring time	MEASTimeL< <i>value</i> >
<b>HI Q</b>	{OFF ON}	High Q mode ON/OFF	MEASTimeL< <i>value</i> >
<b>Dir</b>	{UP DOWN}	Search method of monitor mode	EMDIRL{UP DOWN}
<b>Tout</b>	<i>value</i>	Time-out value for trapping	EMTMOUTL< <i>value</i> >
<b>CKT</b>	PI	Measurement circuit	CIRcuitL{NON PI PRObe BRIDGE} PICKTtypeL{PI41900A PI41901A PI41902A}
<b>MAN</b>	{OFF ON}	Entry of trap frequency from front panel	EMMANmodeL{ON OFF 0 1}
<b>PARA</b>	Fr	Type of search frequency	MEASPARAMeterL{FR}
<b>PHAS</b>	<i>value</i>	Target phase [ $^{\circ}$ ]	TGTPhaseL< <i>value</i> >
<b>Ftgt</b>	<i>value</i>	Target frequency	EMLISTL< <i>value 1</i> >,< <i>value 2</i> >,< <i>value 3</i> >,{ON OFF 0 1},< <i>value 4</i> >
<b>Flow</b>	<i>value</i>	Lowest trap frequency	EMLISTL< <i>value 1</i> >,< <i>value 2</i> >,< <i>value 3</i> >,{ON OFF 0 1},< <i>value 4</i> >
<b>Fmed</b>	<i>value</i>	2nd trap frequency	EMLISTL< <i>value 1</i> >,< <i>value 2</i> >,< <i>value 3</i> >,{ON OFF 0 1},< <i>value 4</i> >
<b>Fhi</b>	<i>value</i>	Highest trap frequency	EMLISTL< <i>value 1</i> >,< <i>value 2</i> >,< <i>value 3</i> >,{ON OFF 0 1},< <i>value 4</i> >

3 Commands Available via  
Hard and Soft Keys

## LCR Measurement Mode

Table 3-6. Soft Keys and Functions Specific to LCR Measurement Mode

Soft Key	Parameter	Function	HP-IB Command
<b>Pri1</b>	{Z Y R G Cs Cp Ls Lp}	Primary parameter 1	:SENS:FUNC:ON {FIMP FADM} :CALC1:FORM {MLIN REAL CP CS LP LS}
<b>Sec1</b>	{ $\theta z$   $\theta y$  X B D Q Rs Rp G}	Secondary parameter 1	:SENS:FUNC:ON {FIMP FADM} :CALC2:FORM {PHAS IMAG D Q REAL RP}
<b>Pri2</b>	{Z Y R G Cs Cp Ls Lp}	Primary parameter 2	:SENS:FUNC:ON {FIMP FADM} :CALC3:FORM {MLIN REAL CP CS LP LS}
<b>Sec2</b>	{ $\theta z$   $\theta y$  X B D Q Rs Rp G}	Secondary parameter 2	:SENS:FUNC:ON {FIMP FADM} :CALC4:FORM {PHAS IMAG D Q REAL RP}
<b>TIME</b>	{Short Med Long}	Measurement time	:SENS:FIMP:APER {Short Med Long}
<b>AVG</b>	<i>value</i>	Averaging factor	:SENS:AVER:COUN < <i>value</i> >
<b>LVL</b>	<i>value</i>	Power level[W,V,A,dBm]	:SOUR:VOLT < <i>value</i> > [A MA W V MV DBM]
<b>UNIT</b>	{dBm WATT AMP VOLT}	Power unit	
<b>Vmon</b>	{OFF ON}	Voltage monitor ON/OFF	CALCulate6:MATH:STATe{ON/OFF}
<b>Imon</b>	{OFF ON}	Current monitor ON/OFF	CALCulate5:MATH:STATe{ON/OFF}
<b>AP1</b>	{OFF DEV %}	Delta mode for primary parameter 1	:CALC1:MATH:EXPR:NAME {DEV PCNT}
<b>Ref</b>	<i>value</i>	Reference value of primary parameter 1 for Delta mode	:DATA: REF1, < <i>value</i> >
<b>AS1</b>	{OFF DEV %}	Delta mode for secondary parameter 1	:CALC2:MATH:EXPR:NAME {DEV PCNT}
<b>Ref</b>	<i>value</i>	Reference value of secondary parameter 1 for Delta mode	:CALC2:MATH:EXPR:NAME {DEV PCNT} :DATA: REF2, < <i>value</i> >
<b>AP2</b>	{OFF DEV %}	Delta mode for primary parameter 2	:CALC3:MATH:EXPR:NAME {DEV PCNT}
<b>Ref</b>	<i>value</i>	Reference value of primary parameter 2 for Delta mode	
<b>AS2</b>	{OFF DEV %}	Delta mode for secondary parameter 2	:CALC4:MATH:EXPR:NAME {DEV PCNT}
<b>Ref</b>	<i>value</i>	Reference value of secondary parameter 2 for Delta mode	:DATA: REF4, < <i>value</i> >
<b>DGT</b>	<i>value</i>	Display digits	:DISP:TEXT1:DIG {3 4 5}
<b>CKT</b>	{PI PROBE BRIDGE}	Measurement circuit	:CIRcuitL{PI PRObe BRIdge} PICKTtypeL{PI41900A PI41901A PI41902A}
<b>FREQ</b>	<i>value</i> [MHz]	Measurement frequency	:SOURce:FREQuency

## Filter Measurement Mode (Flt Mode)

Table 3-7.  
Soft Keys and Functions Specific to Filter Measurement Mode

Soft Key	Parameter	Function	HP-IB Command
<b>FREQ</b>	<i>value</i>	Nominal frequency [Hz]	NOMFreqL< <i>value</i> >
<b>RNG</b>	<i>value</i>	Search range [Hz/ppm]	SRCHRangeL< <i>value</i> >
<b>xdB</b>	<i>value</i>	Down value for filter band width	FLTDBL< <i>value</i> >
<b>LOSS</b>	{Const Min}	Select constant/minimum loss	FLTMODEL{CONSTant MINimam}
<b>TIME</b>	{Short Med Long}	Measuring time	MEASTimeL< <i>value</i> >
<b>HI Q</b>	{OFF ON}	High Q mode ON/OFF	MEASTimeL< <i>value</i> >
<b>LVL</b>	<i>value</i>	Power level [dBm only]	POWERL< <i>value</i> >

## Comparator Setup Mode (Xtal, DLD, Flt, LCR only)

Table 3-8. Soft Keys and Functions Specific to Comparator Setup Mode

Soft Key	Parameter	Function	HP-IB Command
<b>COMP</b>	{OFF ON}	Comparator function ON/OFF	COMPSTATeL{OFF ON 0 1}
<b>SEC</b>	{OFF ON}	Secondary sorting ON/OFF	COMPSECondaryL{OFF ON 0 1}
<b>AUX</b>	{OFF ON}	AUX bin ON/OFF	COMPSECAUXL{OFF ON 0 1}
<b>PRI</b>	{ABS_TOL %TOL SEQ}	Sort mode for primary sorting	COMPPRIModeL {ABSTOL PCNTTOL SEQ}
<b>NOM</b>	<i>value</i>	Nominal value applied to Tolerance mode	COMPTOLSTD L< <i>value</i> >
<b>BEEP</b>	{Pass Fail}	Whether to indicate Pass or Fail by outputting beep sound.	COMPBEEPCondL{FAIL PASS}
<b>LED</b>	{Pass Fail}	Whether to indicate Pass or Fail by illuminating LED.	COMPLEDCondL{FAIL PASS}
<b>PriH</b>	<i>value</i>	Upper limit value for primary sorting	COMPPLIMitL<BIN1>,< <i>value</i> 1>,< <i>value</i> 2>
<b>PriL</b>	<i>value</i>	Lower limit value for primary sorting	COMPPLIMitL<BIN1>,< <i>value</i> 1>,< <i>value</i> 2>
<b>SecH</b>	<i>value</i>	Upper limit value for secondary sorting	COMPSLIMitL< <i>value</i> 1>,< <i>value</i> 2>
<b>SecL</b>	<i>value</i>	Lower limit value for secondary sorting	COMPSLIMitL< <i>value</i> 1>,< <i>value</i> 2>
<b>LmΔF</b>	{OFF ON}	ΔF limit test ON/OFF (for DLD mode only)	COMPDLTF L{OFF ON 0 1}
<b>LmΔZ</b>	{OFF ON}	ΔCI limit test ON/OFF (for DLD mode only)	COMPDLTCIL{OFF ON 0 1}
<b>ΔF_H</b>	<i>value</i>	ΔF limit value (for DLD mode only)	COMPDLTFLimL< <i>value</i> >
<b>ΔZ_H</b>	<i>value</i>	ΔCI limit value (for DLD mode only)	COMPDLTCILimL< <i>value</i> >
<b>BW_H</b>	<i>value</i>	Upper limit value for BW (for Flt mode only)	COMPBWLimL< <i>value</i> 1>,< <i>value</i> 2>
<b>BW_L</b>	<i>value</i>	Lower limit value for BW (for Flt mode only)	COMPBWLimL< <i>value</i> 1>,< <i>value</i> 2>
<b>LmBW</b>	{OFF ON}	BW limit test ON/OFF	COMPBWL{OFF ON 0 1}

## System Setup Mode

Table 3-9. Soft Keys and Functions Specific to System Setup Mode

Soft Key	Parameter	Function	HP-IB Command
<b>DISP</b>	{OFF ON}	Measurement data display ON/OFF	DISPL{OFF ON 0 1}
<b>CAL</b>	{Op Sh Ld}	Calibration standard value	CALSTD{OPEN, {G0 C0}, <value> CALSTD{SHORT LOAD}, {R0 L0}, <value>
<b>COMP</b>	{Op Sh Ld}	Fixture compensation standard value	COMPENSTD{OPEN, {G0 C0}, <value> COMPENSTD{SHORT LOAD}, {R0 L0}, <value>
<b>DelDATA</b>		Clears the last data in the buffer	MEMRETEST
<b>MemClear</b>	{NO YES}	Clears buffer	MEMCLEAr
<b>BEEP</b>	{OFF ON}	Beep ON/OFF When BEEPSTATE is OFF, the beep never sound even an error occurs	BEEPSTATE{OFF ON 0 1}
<b>HPIB</b>	1 to 31	HP-IB address 31:talk only mode(for Print out)	HPIBADDRess{<value>
<b>AnalogOut</b>	{OFF ON}	Analog OUT terminal output ON/OFF	ANLGOUT{OFF ON 0 1}
<b>Settings</b>	{dFdV REF}(Selecting this soft key opens <i>value</i> entry field.	Analog OUT terminal settings	ANLGDVDV{<value>}, ANLGRF{<value>
<b>Service Func</b>	{Key   HNDL   CSUM   RAM   FLASH}	Service test	-
<b>Self Test</b>	{NO YES}	Self test	-



## Function Reference

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This chapter provides descriptive information on various functions incorporated into the HP E4915A/E4916A. It presents the following topics for each function:

- An overview of the function
- Purpose and principle
- Description of parameters
- Applicable models – Indicates whether the function is available with both HP E4915A and HP E4916A or only with the HP E4916A. Note that some functions require a particular option (for example, the LCR Meter function is available only when your instrument is the HP E4916A and it is equipped with Option 010).
- How to access the function – Describes each of the two access means: the front panel and the HP-IB. Note that not all functions are accessible by these two means; some functions are only accessible through the front panel or via the HP-IB.

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## Measurement Modes

The HP E4915A and the HP E4916A provide the following two measurement modes in common:

- Crystal Resonator measurement mode (also referred to as “Xtl mode”).
- Spurious measurement mode

In addition to the above two measurement modes, the HP E4916A provides the following four extended measurement modes:

- Drive Level Dependency measurement mode (also referred to as “DLD mode”)
- Evaporation Monitor mode (also referred to as “EM mode” or “Trap mode”)
- Filter measurement mode (also referred to as “Flt mode”)
- LCR measurement mode (requires Option 001/010)

This section presents the following topics for each measurement mode:

- Purpose and principle
- Parameters and their settings
- Measurement functions available in the measurement mode

■ Output of measurement results

## Crystal Resonator Measurement Mode (Xtl Mode) – common between the HP E4915A and HP E4916A

- Applicable models: HP E4915A and HP E4916A
- Access means: front panel and HP-IB

### Note



When performing measurement using the HP 41902A test fixture, never fail to use the CL adapter boards in a pair regardless of the presence or absence of capacitance load.

Insert the CL adapter board with capacitance load with the CL mark side up and the CL adapter board without capacitance load with the THRU mark side up.

### Purpose and Principle

Crystal Resonator measurement mode is intended for measuring the frequency–impedance characteristics of crystal resonators. A crystal resonator exhibits the following characteristics as the frequency changes:

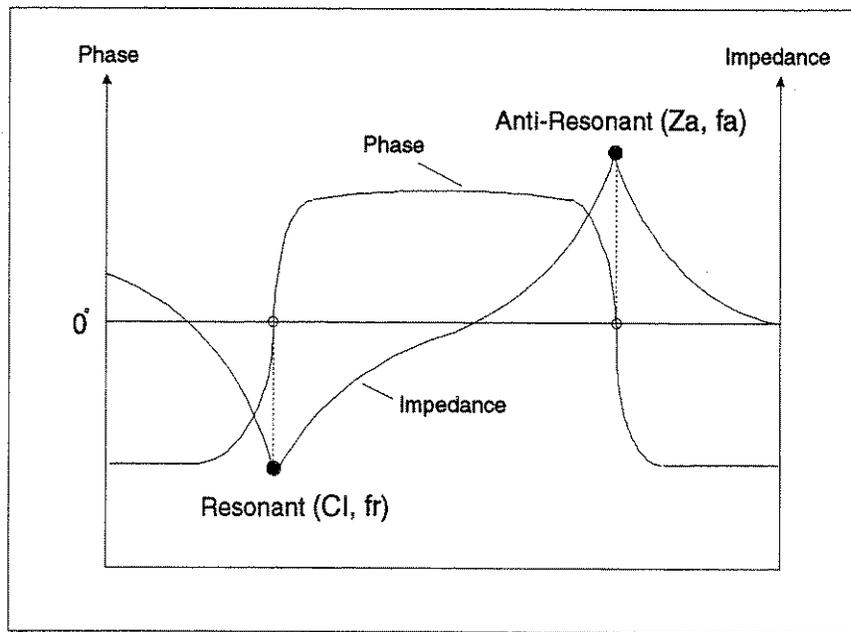


Figure 4-1. Frequency–impedance characteristics of a crystal resonator

In Crystal Resonator measurement mode, the HP E4915A/E4916A searches for a target point that matches one of the following conditions, and determines the crystal impedance at that point:

**Table 4-1.**  
**Search Targets and Search Conditions**  
**For TGT = PHASE (Mainly for Crystal Resonators)**

Measurement parameter	Search target	Search condition
Fr	Resonance point	A lower frequency point with zero phase
Fs	Series resonance point	Point with the maximum conductance
FL	Resonance point with capacitance load	Resonance point with capacitance load
Fa	Anti-resonance point	A higher frequency point with zero phase

**Table 4-2.**  
**Search Targets and Search Conditions**  
**For TGT = PEAK (Mainly for Ceramic Resonators)**

Measurement parameter	Search target	Search condition
Fr	Resonance point	Peak with lowest impedance
Fs	Series resonance point	Point with the maximum conductance
FL	Resonance point with capacitance load	Resonance point with capacitance load
Fa	Anti-resonance point	Peak with highest impedance

Measurement parameters (characteristic parameters) can be displayed on the LCD in one of the following combinations:

Fr – CI

FL – Fr – CI

Fs – Zs

Fa – Za

Fs indicates the frequency at the point with the maximum conductance (Gmax) in the following circle diagram for admittance characteristics:

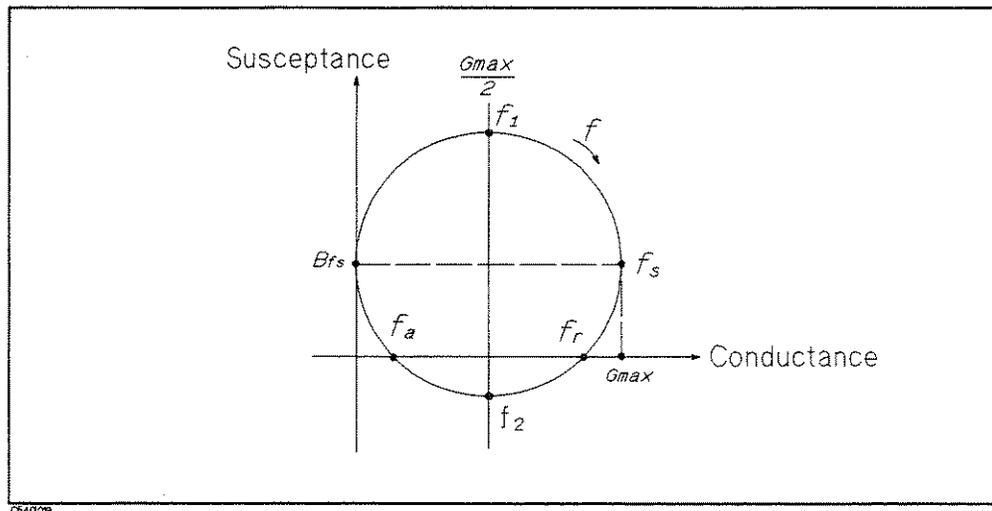


Figure 4-2. Circle diagram for admittance characteristics

### Note



- You can display measurement parameters in one of the valid combinations using the appropriate soft key. (For more information on soft keys, refer to “Search Mode and Pair of Measurement Parameters” later in this section).
- The HP E4915A/E4916A finds a resonance point by searching either for zero phase or for the positive or negative peak impedance, depending on the search mode currently in effect. For more information on search modes, refer to “Search Mode and Pair of Measurement Parameters” later in this section.

## Parameters and Their Settings

This subsection describes the parameters that control the behavior of the HP E4915A/E4916A in Crystal Resonator measurement mode. These parameters are accessible via either a hard key or a soft key, or both. Note that the term **hard key** refers to physical keys provided on the front panel while the term **soft key** refers to a pair of parameters displayed on and accessible through the LCD screen.

- Parameters that determine nominal values
  - **FREQ:** Lets you specify the nominal value for the resonance frequency ( $f_r$ ) or anti-resonance frequency ( $f_a$ ). The value specified here is used as the center frequency for the search range. The unit is MHz.
    - Soft key: **FREQ**
    - Hard key: **Freq**
    - HP-IB command: `NOMFreq<value>`
  - **CI:** Lets you specify the nominal value for crystal impedance. This nominal value is used as the basis for level control (with ALC mode OFF). Also, you can use your specified nominal value as the reference value for Delta mode. (For more information on Delta mode, refer to “Delta Mode” later in this section.)

- Soft key: **CI**
  - Hard key: **Nominal CI**
  - HP-IB command: NOMCI□<value>
- Parameters that determine measuring conditions
    - RNG: Search range. Specify the resonance point search range in ppm or Hz.
      - Soft key: **RNG**
      - Hard key: **Freq**
      - HP-IB command: SRCHRange□<value>
    - LVL: Lets you specify the power level which is applied to the device at the tip of the jig.
      - Soft key: **LVL**
      - Hard key: **Level**
      - HP-IB command: POWER□<value>[mW|UW|NW|W|MA|UA|A|MV|UV|V|DBM]
    - UNIT: Lets you specify the unit of the power level (**LVL** soft key) by selecting dBm, WATT, AMP, or VOLT.
      - Soft key: **UNIT**
      - Hard key:—
      - HP-IB command: POWER□<value>

**Note**

The signal level specified with the HP E4915A indicates the power actually applied to a resonator. However, when you specify dBm as the unit of the signal level, the specified level shows the signal level at the port of the HP E4916A instead of the power applied to a resonator.

With the HP E4915A, the output power level is fixed at -5 dBm.

- TGT: Lets you specify the search target: Phase or Peak. Refer to “Search Mode and Pair of Measurement Parameters” later in this section.
  - Soft key: **TGT**
  - Hard key:—
  - HP-IB command: SRCHTGT□{PHase|PEak}
- PHAS: Lets you specify the target phase value in degrees (°).
  - Soft key: **PHAS**
  - Hard key:—
  - HP-IB command: TGTPhase□<value>
- PARA: Lets you select one of the valid measurement parameters: Fr, FL, Fs, and Fa.
  - Soft key: **PARA**
  - Hard key:—
  - HP-IB command: MEASPARA□{FR|FA|FS|FL}

- Parameters associated with the Equivalent Circuit Analysis function (for more information on equivalent circuit analysis, refer to “Equivalent Circuit Analysis Function” later in this section)
  - EQUC: Lets you turn ON/OFF the Equivalent Circuit Analysis function.
    - Soft key: EQUC
    - Hard key: (blue) +  $\mu/M$  (Equiv Ckt)
    - HP-IB command: EQUCKt{DEV4|DEV6|OFF}
  - DspQ: Lets you show or hide the Q parameter.
    - Soft key: DspQ
    - Hard key:—
    - HP-IB command: DSPQ{OFF|ON|0|1}
- Parameters associated with capacitance load (for more information on capacitance load, refer to “Measurement with Capacitance Load (CL\_a/CL\_t Parameters)” later in this section)
  - CL\_a (Value actually measured by CL Adj function): This parameter indicates the actual capacitance load connected to the DUT. The CL Adj function, when activated via the hard key (blue) + n/ppm (CL Adj), automatically measures the actual capacitance load connected to the DUT.
    - Soft key:—
    - Hard key: (blue) + n/ppm (CL Adj)
    - HP-IB command: CLADJust{OFF|ON|0|1}
  - CL\_a (manual input): When you select the CL\_a soft key, you are presented with two options: NO-CL and User. The User option allows you to manually enter the value of the CL\_a parameter while the NO-CL option causes the HP E4915A/E4916A to assume that no capacitance load is connected to the crystal resonator (i.e., CL\_a=No-CL). (The unit is pF).
    - Soft key: CL\_a
    - Hard key:—
    - HP-IB command: CLACType{NOCL|USER}, CLACT<value>
  - CL\_t: Let you specify the value of the capacitance load connected to the DUT. When you select the CL\_t soft key, you are presented with three options: CL-a, NoCL, and User. The CL\_a option makes the target value equal to the actual value (i.e., CL\_t = CL\_a). The NoCL option causes the HP E4915A/E4916A to assume that the target capacitance load is infinite (i.e., NoCL). The User option allows you to manually enter the value of the CL\_t parameter. (The unit is pF).
    - Soft key: CL\_t
    - Hard key: CL Value
    - HP-IB command: CLTGType{NOCL|USER|CLACT}, CLTGTL<value>
  - CL Compen: Let you execute the CL compensation function. This function calculates the capacitance load value which enables a crystal resonator to oscillate at the frequency of the reference

resonator. It is required to adjust the capacitance load on the  $\pi$  test fixture before using this function.

- Soft key: **CL Compn**
- Hard key:—
- HP-IB command: CLCOMPen

## Note



The HP E4915A/E4916A always returns YES when you select the **CL Compn** soft key.

- Ftgt: Let you specify the frequency of the reference resonator used in CL Compensation function.
  - Soft key: **Ftgt**
  - Hard key:—
  - HP-IB command: CLFREQ□<value>
- Parameters associated with other measurement functions
  - CKT: Lets you specify the type of the circuit to be used for measurement. (For more information, refer to “Selecting the Measuring Circuit Type”).
    - Soft key: **CKT**
    - Hard key:—
    - HP-IB command: CIRcuit□{PI|PRObe|BRIDGE}  
PICKTtype□{PI41900A|PI41901A|PI41902A}
  - ALC: Lets you turn ON/OFF ALC mode. (For more information on ALC mode, refer to “ALC Mode” later in this section).
    - Soft key: **ALC**
    - Hard key:—
    - HP-IB command: ALC□{OFF|ON|0|1}
  - TIME: Lets you specify the measuring time by selecting one of three alternative settings: Short, Med, and Long.
    - Soft key: **TIME**
    - Hard key: **Meas Time**
    - HP-IB command: MEASTime□<value>
  - HI Q: Lets you turn ON/OFF High Q mode. (For more information on High Q mode, refer to “High Q Mode” later in this section).
    - Soft key: **HI Q**
    - Hard key:—
    - HP-IB command: MEASTime□<value>
  - AGE : Lets you turn ON/OFF Aging mode. (For more information on Aging mode, refer to “Aging Mode” later in this section).
    - Soft key: **AGE**
    - Hard key:—
    - HP-IB command: AGING□{OFF|ON|0|1}
  - Time: Lets you enter the length of aging interval (in seconds). (For more information on Aging mode, refer to “Aging Mode” later in this section).

- Soft key: **Time**
- Hard key:—
- HP-IB command: AGINGTIME[ $\leftarrow$ <value>][S|MS|M]

**Note**

- To set the value of a parameter accessible via a soft key, press the **Select** key next to the soft key to put the LCD screen into data entry mode.
- Some parameters accept your manually entered value while the other parameters accept only one of the presented options. To choose an option, use the **↑⇒** or **⇐↓** key. When you have chosen the desired option or entered the appropriate value, press the **Enter** key to put the new setting into effect. To turn the entry of off, press **(blue)**, **BkSp (Entry Off)**.
- When no soft key is selected yet, you can access the previous or next pair of soft keys by pressing the **↑⇒** or **⇐↓** key.

**Search Mode and Pair of Measurement Parameters**

The search mode, which can be either Phase or Peak, determines whether to find a resonance point by searching for a particular phase value or an impedance peak. The following table shows how to select the pair of measurement parameters to be displayed on the LCD screen in each of Phase and Peak modes.

**Table 4-3.**  
**Search Mode and Measurement Parameters**

Measurement Parameters	Search Mode	TGT soft key	PARA soft key
Fr – CI	Phase	Phase	Fr
	CI PEAK	Peak	Fr
FL – CI	Phase	Phase	FL
	CI PEAK	Peak	FL
Fs – Zs	Gmax (maximum conductance)	–	FS
Fa – Za	Phase peak	Phase	Fa
	CI PEAK	Peak	Fa

**Measurement Functions**

This subsection describes the measurement functions available in Crystal Resonator measurement mode.

**Measurement with Capacitance Load (CL\_a/CL\_t Parameters)**

The HP E4915A/E4916A incorporates the following capability to measure the resonance point with capacitance load in addition to Fr measurement.

- By specifying a different capacitance from that of the load connected to the  $\pi$  fixture, HP E4915A/E4916A calculates and displays FL as if the target load was actually connected.

You need to specify 2 load capacitance values to use this function.

- **CL\_a parameter:** Indicates the actually measured capacitance load value. Based on the value of this parameter, the HP E4915A/E4916A calculates the characteristic values compensated for the influence of the capacitance load. Normally, to know actual load value on the  $\pi$  fixture, you can use the CL Adj function. To enter the CL\_a parameter, use the **CL\_a** soft key.
- **CL\_t parameter:** Indicates the target capacitance load value. This parameter allows you to know what characteristics a crystal resonator would exhibit if it were connected with different capacitance load than actually connected.

## Note



Use the capacitance with the similar capacitance value to CL\_t to the  $\pi$  fixture practically. When CL\_a is set to be greatly different from CL\_t, measurement result fluctuates because of the internal calculation result.

The DUT's Q and other factors influence the unstability of the measurement results.

When you need to know what characteristics a crystal resonator would exhibit if it were connected with different capacitance load than actually connected, you set the CL\_t parameter to a different value than the CL\_a parameter.

- **CL\_t  $\neq$  CL\_a:** When you need to know the CL and CI values a crystal resonator would exhibit if it were connected with different capacitance load than actually connected, first assign the actual capacitance load value to the CL\_a parameter (in the same procedure as described for CL\_t = CL\_a), and then set the CL\_t parameter to your desired target value.

Thus, how the FL and CI parameters are measured with capacitance load connected differs depending on the settings of the CL\_a and CL\_t parameters. These relationships are summarized in the following table:

**Table 4-4.**  
**Meas Prmtr (Fr,FL) and Display Value (Fr,FL) (Meas Prmtr = Fr)**

CL_a = NoCL	Fr: Actual measurement value
CL_a = User	Fr: Conversion Value from a measurement value and CLact value

**Table 4-5.**  
**Meas Prmtr (Fr,FL) and Display Value (Fr,FL) (Meas Prmtr = FL)**

	CL_t = NoCL	CL_t = User	CL_t = CLact
CL_a = NoCL	Fr: Actual measurement value FL: same as Fr	Fr: Actual measurement value FL: Conversion value from measurement value and CLtgt	Fr: Actual measurement value FL: same as Fr
CL_a = User	Fr: Conversion value from measurement value and CLact FL: same as Fr	Fr: Conversion value from measurement value and CLact FL: Conversion value from measurement value and CLact,CLtgt	Fr: Conversion value from measurement value and CLact FL: Actual measurement value

**Note**

The CL value displayed in all mode is the value actually measured.

**CL Adj Function**

Measures the capacitance load actually connected to the crystal resonator. The CL value is measured for the  $\pi$  fixture with the capacitance load. To use this function, insert the shorting device instead of a crystal resonator and press the hardkey

**(blue) + (n/ppm (CL Adj))**

**Note**

The stray capacitance when a crystal resonator is connected is different from that when the shorting device is connected. When the HP 41902A is used, the stray capacitance when a crystal resonator is connected is 5pF more than that when the shorting device is connected. As the result, when CL\_a is set, set the CL\_a to 5pF more than the CL Adj measurement result.

To know the stray capacitance of other test fixture, please refer to the manual of it.

**CL Compensation Function**

The HP E4915A/E4916A have a function to calculate the capacitance load value which enables a crystal resonator to oscillate at the frequency of the reference resonator. The calculated capacitance load value is displayed as CL\_t value, while the resonant frequency if the CL\_t is connected as the capacitance load is calculated and displayed as FL value. Then softkey **CL Comp** should be used to use this function, and the softkey **Ftgt** is used to enter the frequency of the reference resonator.

It is required to adjust the capacitance load on the  $\pi$  fixture before using this function and enter the obtained load value into CL\_a. And CL\_t should be set to User when use this function.

**Note**

Note that the CL measurement result when you use the CL Adj function after the capacitance load adjustment. The stray capacitance when a crystal resonator is connected is different from that when the shorting device is connected.

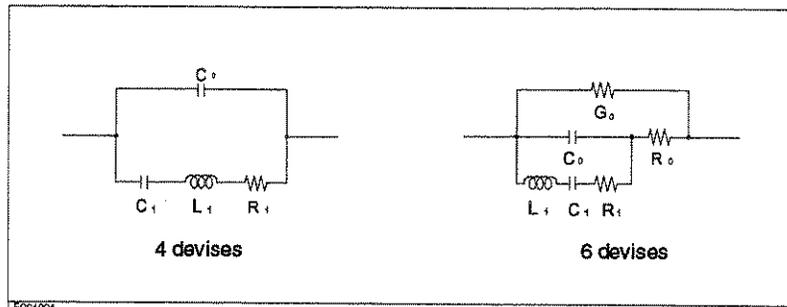
The resonant frequency when the CL\_a is connected is displayed if Fr is selected as the measurement parameter in this setup. Furthermore, the both parameters Fr and FL can be displayed at the same time by pressing (blue) + 1 (Status) hardkeys after selecting FL as a measurement parameter.

To obtain the previous settings, press (blue) + 1 (Status) again.

**Equivalent Circuit Analysis Function**

The Equivalent Circuit Analysis function allows you to determine the 4- or 6-element equivalent circuit that corresponds to the DUT. To access this mode, use the **EQUC** soft key or (blue) +  $\mu$ /M (Equiv Ckt) hard key, and choose one of the three options presented:

- OFF: Equivalent Circuit Analysis function OFF
- 4DEV: Equivalent Circuit Analysis function ON (4-element)
- 6DEV: Equivalent Circuit Analysis function (6-element)



**Figure 4-3. Four- and six-element equivalent circuits**

The Equivalent Circuit Analysis function calculates the values of the  $C_0$ ,  $C_1$ ,  $L_1$ ,  $R_1$ ,  $G_0$ , and  $Q$  parameters.

You can show or hide the  $Q$  parameter using the **DspQ** soft key.

The LCD screen of the HP E4915A/E4916A can only display four of the eight equivalent circuit parameters (plus two parameters: Fr and Cl) at a time. Which four parameters are displayed at a time depends on the settings of the soft keys **EQUC** and **DspQ**, as shown in the following table:

**Table 4-6.**  
**Settings of EQUC and DspQ and Combinations of**  
**Displayed Constants**

EQUC setting	DspQ setting	Constants displayed
4DEV	ON	C1, R1, Q
4DEV	OFF	C0, C1, R1, L1
6DEV	ON	R0, G0, Q
6DEV	OFF	C0, C1, R1, L1

**Note**

It is recommended to use the Equivalent Circuit Analysis function with no capacitance load connected to the DUT. If the DUT is connected with capacitance load, the HP E4915A/E4916A may possibly return incorrect values.

**High Q Mode**

High Q mode is intended for use when the DUT has a high Q value, and it provides longer measuring time. To enable High Q mode, use the **Hi-Q** soft key.

Turning ON High Q mode causes the three measuring time settings (Short, Med, and Long) to provide a longer measurement time than with High Q mode OFF.

**Note**

The HP E4915A/E4916A provides the three alternative measuring time settings (Short, Med, and Long) with High Q Mode OFF, plus the three other alternative settings with High Q mode ON; thus, 6 alternative settings in all. To control the measuring time via the HP-IB, issue the MEASTime command followed by an integer from 1 to 6.

**Table 4-7. High Q Mode**

Parameter	Meas time	High Q
1	Short	OFF
2	Med	OFF
3	Long	OFF
4	Short	ON
5	Med	ON
6	Long	ON

**ALC Mode**

ALC (Auto Level Control) mode, which can be turned ON via the **ALC** soft key, provides level control based on the actual CI value to actually apply the specified power to the DUT. When this mode is OFF, level control is performed based on the user-specified nominal CI value.

**Note**


---

To enter the nominal CI value, use the **Nominal CI** hard key.

---

**Aging Mode**

Aging mode, which can be turned ON via the **AGE** soft key, causes the HP E4915A/E4916A to repeat measurement cycles at user-specified intervals.

**Note**


---

To set the time interval for Aging mode, use the **Time** soft key that appears in pair with, and below, the AGE key. Take care not to confuse this key with the **TIME** soft key that lets you set the measurement time. The time value returned from \*TRG FETCH is the sum of the time interval, not elapsed time from the aging start.

---

**Output of Measurement Results****LCD Screen**

- Characteristic parameters: Fr – CI, FL – CI, Fs – Zs, or Fa – Za
- 4- or 6-element equivalent circuit constants: four of the C0, C1, L1, R1, G0, and Q parameters as specified by the user (output only when the Equivalent Circuit Analysis function is ON)

**Note**


---

HP E4915A/E4916A The LCD screen of the HP E4915A/E4916A can display up to 6 parameters at a time.

---

**HP-IB**

- Characteristic parameters: Fr|Fa|Fs|FL, CI|Za|Zs
- 4- or 6-element equivalent circuit constants: C0, C1, L1, R1, G0, R0, and Q (output only when the Equivalent Circuit Analysis function is ON)
- Elapsed time for Aging mode (if Aging mode is ON)
- Comparator result

**HP-IB talk only mode (for output to printer)**

- Characteristic parameters: Fr|Fa|Fs, FL, CI|Za|Zs
- 4- or 6-element equivalent circuit constants: C0, C1, L1, R1, G0, R0, and Q (if Aging mode is ON)
- Elapsed time for Aging mode (if Aging mode is ON)

**LED Output**

- LED 1: Comparator result for Fr value
- LED 2: Comparator result for CI value

**Note**


---

For the Comparator function, refer to refer to “Comparator Function” in this chapter.

---

**Beep Output**

Beep sound is output when a DUT has passed or failed the comparator test.

**Note**


---

For the Comparator function, refer to refer to “Comparator Function” in this chapter.

---

**Handler Interface**

Refer to Appendix C “Handler Interface.”

**Analog OUT Terminal**

Outputs a DC voltage signal whose level changes within the range of -5V to + 5V in proportion to the Fr, Fs, FL, or Fa value.

**Parameters and Their Settings**

The parameters for controlling the output through the Analog OUT terminal are accessible via the corresponding soft keys contained in the System menu. (To access the System menu, press the (blue) + (System) key).

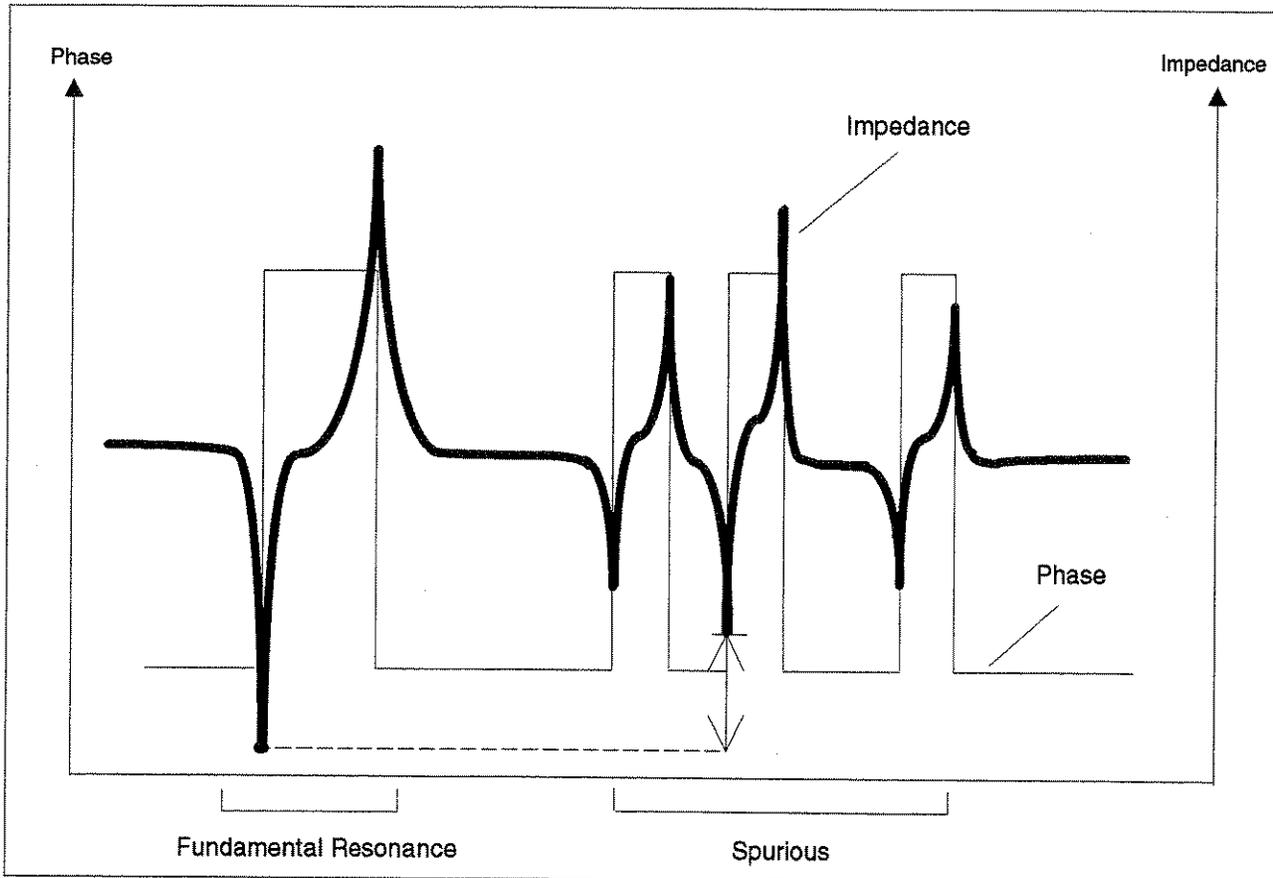
- **AnalogOut:** Lets you turn ON/OFF the DC voltage output through the Analog OUT terminal.
  - Soft key: **AnalogOut**
  - Hard key:—
  - HP-IB command: ANLGOUT {OFF|ON|0|1}
- **Settings:** Lets you specify the coefficient of the DC voltage output from the Analog OUT terminal and the measured frequency. The system increments or decrements the output voltage by 1 V as the frequency changes by the amount represented by this coefficient. When you select the **Settings** soft key, you are presented with two options: a change frequency due to a change in voltag (dFdv) and reference frequency(REF). You can choose one of them and enter your desired value.
  - Soft key: **Settings**
  - Hard key:—
  - HP-IB command: ANLGDFDV <value>, ANLGRFL <value>

## Spurious Measurement Mode – common between the HP E4915A and HP E4916A

- Applicable models: HP E4915A and HP E4916A
- Access means: front panel and HP-IB

### Purpose and Principle

In Spurious measurement mode, the HP E4915A/E4916A searches the specified range for spurious points, and determines the impedance that correspond to each spurious point.



LE004005

**Figure 4-4. Spurious points of a crystal resonator**

To use Spurious measurement mode, you specify the spurious search range as the frequency range centered at a particular center frequency value, and specify the search target as a point where the impedance reaches its peak or the phase reaches 0 degree. Also you can specify any phase value for search point. You can specify the number of spurious points to search for (up to 10). (Refer also to the description of #Spur in "Parameters and Their Settings").

The LCD screen displays only one of the spurious points found. The spurious point displayed on the LCD screen can be either the spurious point that corresponds to a user-specified index or the **worst**

**spurious**, depending on the setting of the **DispSP** soft key (described in “Parameters and Their Settings”). For the index, you can specify 1 for the spurious point with the smallest frequency, 2 for the spurious point with the second smallest frequency, and so on. The **worst spurious** means the spurious point where the magnitude of the negative impedance peak is maximum.

When you are using Spurious measurement mode via the HP-IB, the HP E4915A/E4916A outputs the measurement results for spurious points specified by SPNUM. (For more information, refer to “Output of Measurement Results”).

## Note



- The HP E4915A/E4916A provides Spurious measurement mode as a simple facility to search for spurious response points within a predetermined frequency range, on the assumption that the waveform is free from remarkable irregularities. Thus, if the DUT is expected to exhibit complex characteristics, it is highly recommended to use a network analyzer, instead.

## Parameters and Their Settings

This subsection describes the parameters that control the behavior of the HP E4915A/E4916A in Spurious measurement mode. These parameters are accessible via either a hard key or a soft key, or both.

- Parameters that determine measuring conditions
  - CENT: Lets you specify the center frequency for the spurious search range. The unit is MHz.
    - Soft key: **CENT**
    - Hard key:—
    - HP-IB command: SPCENTER□<value>
  - RNG : Lets you specify the spurious search range. The unit is KHz,Hz or ppm.
    - Soft key: **RNG**
    - Hard key:—
    - HP-IB command: SPRANGE□<value>[{Hz|Ppm}]
  - DispSP: Determines which spurious point to be displayed on the LCD. This soft key provides two alternative options: **Worst** and **Nth**. Use the **Worst** option to display the worst spurious point (i.e., the spurious point where the impedance value reaches the maximum negative peak). On the other hand, the **Nth** option allows you to specify the index number of the spurious point you want displayed; for example, you can specify 1 for the spurious point with the smallest frequency, 2 for the spurious point with the second smallest frequency, and so on.
    - Soft key: **DispSP**
    - Hard key:—
    - HP-IB command: SPDISP□{Worst|Nth[,<value>]}
  - TGT: Lets you specify the spurious search target: Phase or Peak.

- Soft key: **TGT**
  - Hard key:—
  - HP-IB command: SPTGT□{PHase|PEak}
- PHAS: Lets you specify the target phase value in degrees (°).
- Soft key: **PHAS**
  - Hard key:—
  - HP-IB command: SPPHase□<value>
- #Spur: Lets you specify the number of spurious points to search for. The HP E4915A/E4916A searches spurious points from the lowest frequency to high frequency in the search range until #Spur.
- Soft key: **#Spur**
  - Hard key:—
  - HP-IB command: SPNUM□<value>

## Output of Measurement Results

The results of Spurious measurement are output along with those of Crystal resonator measurement. The spurious point displayed on the LCD screen can be either the spurious point that corresponds to a user-specified index or the worst spurious, depending on the setting of the **DispSP** soft key (described in “Parameters and Their Settings”). When you are using Spurious measurement mode via the HP-IB, however, the HP E4915A/E4916A outputs the measurement results for spurious points specified.

The output items are as follows:

- Spurious frequency for each spurious point detected
- Ratio of crystal impedance at each spurious point detected and CI value at FR  
 $20\log\{(Z \text{ value at spurious point}) / (CI \text{ value})\}$
- The number of spurious points detected

## Drive Level Dependency Measurement Mode (DLD Mode)

- Applicable Model: HP E4916A only
- Access means: front panel and HP-IB

### Purpose and Principle

Drive Level Dependency measurement mode is intended for determining the drive level dependency of a crystal resonator, that is, how the frequency–impedance characteristics of a crystal resonator are influenced by changes in drive level. In this mode, the HP E4916A sweeps the drive level in a specified manner, searches for the resonance frequency at each sweep point, and determines the crystal impedance at the resonance point.

Figure 4-5 shows a typical example of the drive level dependency of a crystal resonator.

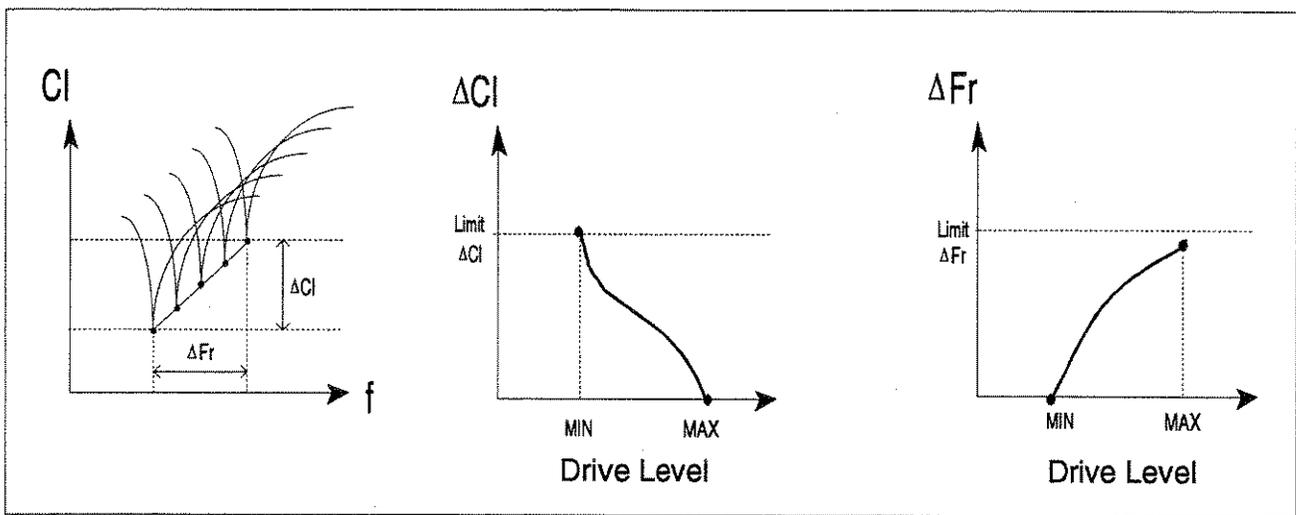


Figure 4-5. Drive level dependency of a crystal resonator

When you are using DLD mode through the front panel, you can choose one of three sweep patterns: UP, UP-DOWN, and UP-MIN. When you are using DLD mode via the HP-IB, you can also define a list of up to 100 sweep points. For more information, refer to “Specifying How To Sweep the Drive Level” later in this section.

Which measurement parameters (characteristic values) can be determined differs depending on whether you are using DLD mode through the front panel or via the HP-IB, as shown in the following table:

**Table 4-8.**  
**Measurement Parameters Determined in DLD Mode**

Parameter	Front panel	HP-IB
Fr value at each level	✓	✓
CI value at each level	✓	✓
Difference between the maximum and minimum values of Fr	✓	✓
Difference between the maximum and minimum values of CI	✓	✓
Maximum and minimum values of Fr		✓
Maximum value of CI	✓	✓
Minimum value of CI		✓
Fr and CI values at reference level	✓	✓

## Parameters and Their Settings

This subsection describes the parameters that control the operation of the HP E4916A in Drive Level Dependency measurement mode (DLD mode). These parameters are accessible via either a hard key or a soft key, or both.

### ■ Parameters that determine nominal values

- **FREQ**: Lets you specify the nominal value for resonance frequency (Fr) or anti-resonance frequency (Fa). The value specified here is used as the center frequency for the search range. The unit is MHz.

- Soft key: **FREQ**

- Hard key: **Freq**

- HP-IB command: NOMFreq□<value>

- **Nominal CI**: Lets you specify the nominal value for crystal impedance. This nominal value is used as the basis for power level setting (with ALC mode OFF).

- Soft key: **CI**

- Hard key: **Nominal CI**

- HP-IB command: NOMCI□<value>

### ■ Parameters that determine measuring conditions

- **RNG** : Lets you specify the search range in Hz or ppm.

- Soft key: **RNG**

- Hard key:

- HP-IB command: SRCHRange□<value>

- **SWEP**: Lets you choose one of three alternative sweep types: UP, UP\_DOWN, UP\_MIN. For more information on level sweep, refer to "Specifying How To Sweep the Drive Level" later in this section.

- Soft key: **SWEP**

- Hard key:—

- HP-IB command: PTSWPTType□{UPDOWN|UP|UPMIN|LIST}

- **MIN** : Lets you specify the minimum drive level value. Use the **UNIT** soft key to specify the unit for this value.

- Soft key: **MIN**
  - Hard key:—
  - HP-IB command: PTMINPower□<value>
- **MAX** : Lets you specify the maximum drive level value. Use the **UNIT** soft key to specify the unit for this value.
- Soft key: **MAX**
  - Hard key:—
  - HP-IB command: PTMAXPower□<value>
- **STD** : Lets you specify the reference drive level value. Use the **UNIT** soft key to specify the unit for this value. The Comparator function will sort the measurement values based on the Fr (Fs) and CI values at the drive level. (For more information, refer to “Comparator Function” later in this chapter).
- Soft key: **STD**
  - Hard key:—
  - HP-IB command: PTSTDPower□<value>
- **UNIT**: Lets you specify the unit for the drive level values by choosing dBm, WATT, AMP, or VOLT.
- Soft key: **UNIT**
  - Hard key:—
  - HP-IB command:
    - PTMINPower□<value>[mW|UW|NW|W|MA|UA|A|MV|UV|V|DBM],
    - PTMAXPower□<value>[mW|UW|NW|W|MA|UA|A|MV|UV|V|DBM],
    - PTSTDPower□<value>[mW|UW|NW|W|MA|UA|A|MV|UV|V|DBM]

**Note**

The signal level specified with the HP E4915A indicates the power actually applied to a resonator. However, when you specify dBm as the unit of the signal level, the specified level shows the signal level at the port of the HP E4916A instead of the power applied to a resonator.

With the HP E4915A, the output power level is fixed at -5 dBm.

- **WAIT**: Lets you specify the time (in seconds) required for the DUT to be stable after it has been energized.
- Soft key: **WAIT**
  - Hard key:—
  - HP-IB command: PTWAIT□<value>
- **TRKG**: Turns ON/OFF the Phase Tracking function. When this function is ON, the resonance frequency at each drive level is searched by sweeping the drive level to detect the CI value at the resonance point. When it is OFF, the resonance frequency is detected by Fr search and then drive level is swept with the frequency maintained.
- Soft key: **TRKG {ON|OFF}**
  - Hard key:—
  - HP-IB command: PTRACK□{ON|OFF|0|1}

- **StartP**: Lets you specify the point at which to start measurement. Use this parameter when you want to start measuring a resonance point not at the MIN value of the drive level, but at the specified level that the drive level has reached. This parameter is set to 1 for normal measurement; start at the MIN value. You can use the Fr (Fs) and CI values at this drive level as the reference values for Delta mode.
  - Soft key: **StartP**
  - Hard key:—
  - HP-IB command: PTSTARTPoint□<value>
- **ABORT**: Turns ON/OFF the Phase Tracking Abort function. When the Abort function is ON and phase tracking fails, the HP E4916A aborts drive level measurement.
  - Soft key: **ABORT**
  - Hard key:—
  - HP-IB command: PTABORT□{OFF|ON|0|1}
- **TGT**: Lets you specify the search target: Phase or Peak.
  - Soft key: **TGT**
  - Hard key:—
  - HP-IB command: SRCHTGT□{PHase|PEak}
- **PHAS**: Lets you specify the target phase value in degrees (°). Use this parameter if you search a resonance point for phase. This parameter is set to 0 for normal measurement.
  - Soft key: **PHAS**
  - Hard key:—
  - HP-IB command: TGTPhase□<value>
- **PARA**: Lets you select one of the valid measurement parameters: Fr and Fs.
  - Soft key: **PARA**
  - Hard key:—
  - HP-IB command: MEASPARA□{FR|FS}
- Parameters that control Delta mode
  - **ΔF**: Provides three options that control Delta mode which provides a frequency value as a deviation with respect to a specified reference value: OFF, DEV, and PPM. The OFF option turns OFF Delta mode; the DEV option causes the HP E4916A to indicate actual deviations while the PPM option causes the HP E4916A to indicate the ppm of a deviation.
    - Soft key: **ΔF**
    - Hard key:—
    - HP-IB command: DLTMode□{PRI|SEC},{OFF|DEV|PCNT|PPM}
  - **RefF**: Lets you specify the reference frequency value for Delta mode. The unit is Hz.
 

You can specify one of these setting.

Nominal:            Nominal value specified by **CI**.

User: Enter a value.  
 Start: Crystal impedance value at the start point of the drive level.

- Soft key: **RefF**
  - Hard key:—
  - HP-IB command: DLTREF□{PRI|SEC}, <value>
- **ΔCI**: Provides three options that control Delta mode for CI values: OFF, DEV, and PPM. The OFF option turns OFF Delta mode; the DEV option causes the HP E4916A to indicate actual deviations while the PPM option causes the HP E4916A to indicate the ppm of a deviation with respect to a specified reference value.

- Soft key: **ΔCI**
  - Hard key:—
  - HP-IB command: DLTMode□{PRI|SEC},{OFF|DEV|PCNT|PPM}
- **RefZ**: Lets you specify the reference CI value for Delta mode. The unit is Hz.

You can specify one of these setting.

Nominal: Nominal value specified by **CI**.

User: Enter a value.

Start: Crystal impedance value at the start point of the drive level.

- Soft key: **RefZ**
  - Hard key:—
  - HP-IB command: DLTREF□{PRI|SEC}, <value>
- Other parameters
- **TIME**: Lets you specify the measuring time by selecting one of three alternative settings: Short, Med, and Long.
- Soft key: **TIME**
  - Hard key: **Meas Time**
  - HP-IB command: MEASTime□<value>
- **HI Q**: Lets you turn ON/OFF High Q mode. (For more information on High Q mode, refer to “High Q Mode” later in this section).
- Soft key: **HI Q**
  - Hard key:—
  - HP-IB command: MEASTime□<value>
- **ALC**: Lets you turn ON/OFF ALC mode. (For more information on ALC mode, refer to “ALC Mode” later in this section).
- Soft key: **ALC**
  - Hard key:—
  - HP-IB command: ALC□{OFF|ON|0|1}
- **CKT**: Lets you specify the type of the circuit to be used for measurement. (For more information, refer to “Selecting the Measuring Circuit Type”).

- Soft key: **CKT**
- Hard key:—
- HP-IB command: CIRcuit␣{PI|PRObe|BRIDGE}  
PICKTtype␣{PI41900A|PI41901A|PI41902A}

**Note**

- To set the value of a parameter accessible via a soft key, press the **Select** key next to the soft key to put the LCD screen into data entry mode.
- Some parameters accept your manually entered value while the other parameters accept only one of the presented options. To choose an option, use the **↑⇒** or **⇐↓** key. When you have chosen the desired option or entered the appropriate value, press the **Enter** key to put the new setting into effect.
- When no soft key is selected yet, you can access the previous or next pair of soft keys by pressing the **↑⇒** or **⇐↓** key.

**Measurement Functions****Specifying How To Sweep the Drive Level**

Drive Level Dependency measurement mode provides two ways to control how the HP E4916A sweeps the drive level:

**Table 4-9. Setting Up Sweep Points**

Method	Front panel	HP-IB
Sweep list	—	✓
Minimum/maximum values and sweep type	✓	✓

The following is the detailed description of the two methods:

- Sweep list (HP-IB only)

To perform drive level dependency measurement at any power point you desire, you must create a list of drive levels (sweep points) using the HP-IB. To create a sweep list, use the PTLIST command. For more information, refer to “HP-IB Commands Specific to Drive Level Dependency Measurement Mode” in Chapter 5 “HP-IB Command Reference.”

In this list, you can arrange sweep points (drive levels) exactly as you desire. Also, you can enable or disable drive level measurement for each of the sweep points; that is, you can define sweep points where no measurement is performed. Auto-sorting for the list is not performed.

**Table 4-10.**  
Setting Up Sweep Points Using the PTLIST  
Command

Parameters	Valid value/range	Unit
Drive level value	0.1 nW ~ 1 mW	[W]/[A]/[V]/[dBm]
Whether or not to perform measurement	ON/OFF	
Number of sweep points	1 ~ 80	

**Table 4-11. Default value of PTLIST**

Drive level setting	DLD measurement ON/OFF
1 $\mu$ W	ON
2 $\mu$ W	ON
3 $\mu$ W	ON
5 $\mu$ W	ON
8 $\mu$ W	ON
10 $\mu$ W	ON
8 $\mu$ W	ON
5 $\mu$ W	ON
3 $\mu$ W	ON
2 $\mu$ W	ON
1 $\mu$ W	ON

**Note**



When PTSTDP value is included into the drive level list specified by PTLIST command, DL reference value is the DL value at PTSTDP. When PTSTDP is not included, the point at PTSTDP is automatically added to the list.

■ **Minimum/maximum values and sweep type**

You can specify the minimum and maximum drive levels, and select one of the three sweep types (UPDOWN, UP, UPMIN) with the PTSWPTYPE command. The selected sweep type determines how the drive level is swept between the specified minimum and maximum level values. (The sweep type can be specified via the **SWEP** soft key or the PTSWPTYPE command).

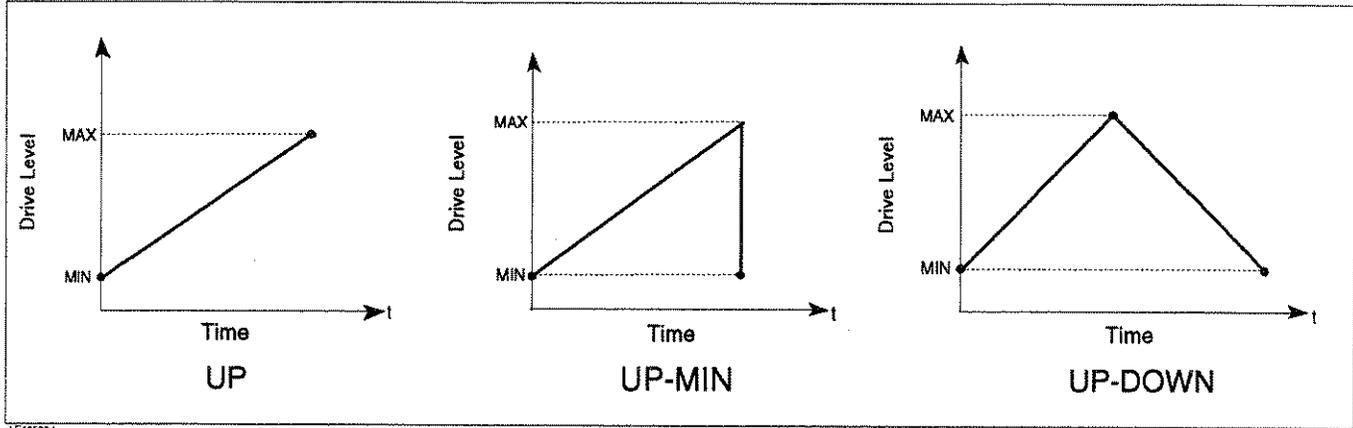
Each sweep type is described below:

- UP: Increases the drive level step by step from the minimum level value to the maximum level value.
- UP-DOWN: Increases the drive level step by step from the minimum level value to the maximum level value, and then decreases the drive level from the maximum value to the minimum value.
- UP-MIN: Increases the drive level step by step from the minimum level value to the maximum level value, and then immediately increases the drive level to the minimum value.

**Note**



When PTSTDP value is included into the drive level list specified by PTLIST command, DL reference value is the DL value at PTSTDP. When PTSTDP is not included, the point at PTSTDP is automatically added to the list.



**Figure 4-6. Sweep Type**

The following table shows how to specify the minimum/maximum values and sweep type for each of the front panel and HP-IB:

**Table 4-12. Soft Keys/Commands Used to Specify the Minimum/Maximum Values and Sweep Type**

Parameter	Front panel (soft key)	HP-IB
Minimum value	<b>MIN</b>	PTMINPower
Maximum value	<b>MAX</b>	PTMAXPower
Sweep type	<b>SWEP</b>	PTSWPType

When you set the sweep points by specifying the minimum/maximum values and sweep type, the HP E4916A uses its internally predefined series of level values (1, 2, 3, 5, 8, 10, 20, 30, 50, 80, 100, 200, 300 ... ). Thus the HP E4915A/E4916A automatically establishes all the individual drive levels between user-specified minimum and maximum drive levels.

The following table shows some examples:

**Table 4-13. Drive Levels Automatically Established**

Maximum level (user-specified)	Maximum level (user-specified)	Individual drive levels (automatically established)
1 nW	10 nW	1,2,3,5,8,10 [nW]
15 nW	250nW	15,20,30,50,80,100,200,250 [nW]

**Note**

- The sweep list method is available only via the HP-IB although the **SWEP** soft key on the front panel provides a List option in addition to the three sweep types (Up, UpDown, and UpMin).
- For more information on how to use DLD mode via the HP-IB, refer to Chapter 5 “HP-IB Command Reference.”

**Delta Mode**

Delta mode for drive level measurement presents deviations in measurement results (frequency and CI values) in one of two forms: actual deviation and percentage. Also, you can turn ON/OFF Delta mode separately between resonance frequency and crystal impedance. The following table shows how to set up Delta mode through the front panel.

**Table 4-14.**  
**Delta Mode and Soft Keys in Drive Level Dependency Measurement Mode**

Measurement parameter	Soft key	Settings	Delta mode display form
Frequency	<b>AF</b>	DEV	(Measured value) – (reference value) [Hz]
		PPM	{(Measured value) – (reference value)} / (reference value) [ppm]
Crystal impedance	<b>ACT</b>	DEV	(Measured value) – (reference value) [ $\Omega$ ]
		%	{(Measured value) – (reference value)} / (reference value) [%]

To set the reference frequency and CI values, use the **RefZ** and **RefF** soft keys, respectively.

**High Q Mode**

High Q mode is intended for use when the DUT has a high Q value, and it provides longer measuring time. To enable High Q mode, use the **Hi-Q** soft key.

Turning ON High Q mode causes the three measuring time settings (Short, Med, and Long) to provide a longer measurement time than with High Q mode OFF.

**Note**

The HP E4916A provides the three alternative measuring time settings (Short, Med, and Long) with High Q Mode OFF, plus the three other alternative settings with High Q mode ON; thus, 6 alternative settings in all. To control the measuring time via the HP-IB, issue the MEASTime command followed by an integer from 1 to 6.

**ALC Mode**

ALC (Auto Level Control) mode, which can be turned ON via the **ALC** soft key, provides level control based on the actual CI value to actually apply the specified power to the DUT. When this mode is OFF, level control is performed based on the user-specified nominal CI value.

**Note**


---

To enter the nominal CI value, use the **Nominal CI** soft key or the **Nominal CI** hard key.

---

**Output of Measurement Results****LCD Screen**

- Fr/Fs and CI/Zs at each DL value
- Each DL value
- Difference between the maximum and the minimum levels of Fr/Fs
- Difference between the maximum and the minimum levels of CI/Zs
- The maximum value of CI

**HP-IB**

- List that shows the drive level (power) values, Fr (FL) value, and CI value at the respective sweep points.

**LED Output**

- LED 1: Comparator result for Fr value at the reference DL value
- LED 2: Comparator result for CI value at the reference DL value
- LED 3: Result of  $\Delta F$  limit/ $\Delta CI$  limit test ( $\Delta F$ Limit and  $\Delta CI$ Limit)

**Note**


---

For the Comparator function, refer to refer to "Comparator Function" in this chapter.

---

**Beep Output**

Beep sound is output when a DUT has passed or failed the comparator test.

**Handler Interface**

Refer to Appendix C "Handler Interface."

**Analog OUT Terminal**

Outputs DC signals whose level changes in proportion to the measured frequency value.

**Parameters and Their Settings**

The parameters for controlling the output through the Analog OUT terminal are accessible via their specific soft keys contained in the System menu. (To access the System menu, press the **(blue)+(- (System))** key).

- AnalogOut: Lets you turn ON/OFF the DC voltage output through the Analog OUT terminal.
  - Soft key: **AnalogOut**
  - Hard key:—
  - HP-IB command: ANLGOUT [ {OFF|ON|0|1} ]

- **Settings:** Lets you specify the coefficient of the DC voltage output from the Analog OUT terminal and the measured frequency. The system increments or decrements the output voltage by 1 V as the frequency changes by the amount represented by this coefficient. When you select the **Settings** soft key, you are presented with two options: dFdv and REF. You can choose one of them and enter your desired value.
  - Soft key: **Settings**
  - Hard key:—
  - HP-IB command: ANLGDFDV□<value>, ANLGRF□ <value>

## Evaporation Monitor Mode (EM Mode)

- Applicable Model: HP E4916A only
- Access means: front panel and HP-IB

### Purpose and Principle

Evaporation Monitor mode allows you to control metal deposition during a deposition process of crystal resonators.

Metal deposition is used during a manufacturing to adjust the frequency of a crystal resonator. The resonant frequency of a crystal resonator becomes lower as deposition proceeds. As described in Figure 4-7, the HP E4916A monitors the phase at a specified frequency  $f_1$  and outputs preset data to the I/O port when the measured phase goes under 0 (or any value you specify as you wish).

HP E4916A, then, moves its focus to the next frequency  $f_2$  and performs another measurement. When the measured phase reaches the specified value again, it outputs different data to the I/O port. This output to the I/O port controls the amount of metal deposition to achieve efficient and accurate metal deposition.

Evaporation Monitor mode is also referred to as “trap function” because it causes the HP E4916A to wait for the phase to match the preset phase at a certain frequency,

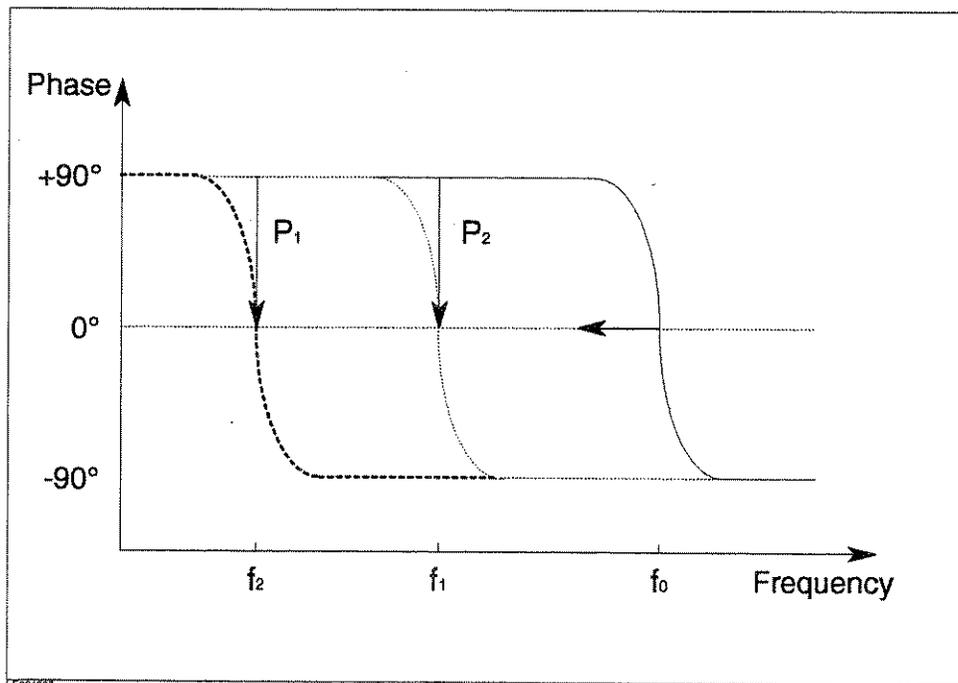


Figure 4-7. Trap function

**Reverse monitor mode**

When the frequency adjustment is performed by grinding a crystal resonator instead of metal deposition, its resonance frequency becomes higher as grinding proceeds. In this case, by reversing the monitor direction of Evaporation Monitor (EM) mode, you can control grinding in the same way as metal deposition. To set the monitor direction, use the **DIR** softkey or the EMDIR HP-IB command.

**Parameters and Their Settings**

This subsection describes the parameters that control the operation in Evaporation Monitor (EM) mode. These parameters are accessible either from the front panel or via the HP-IB, or both. To access from the front panel, turn ON the **MAN** softkey to display softkeys required for the operation in advance.

- **CI**: Determines the nominal crystal impedance, which is used as the basis for level control (with ALC mode OFF).
  - Soft key: **CI**
  - Hard key:—
  - HP-IB command: NOMCI□<value>
- **ALC**: Turns ON/OFF ALC mode. (For more information on ALC mode, refer to “ALC Mode” later in this section).
  - Soft key: **ALC**
  - Hard key:—
  - HP-IB command: ALC□{OFF|ON|0|1}
- **LVL**: Determines the power level which is applied to the device at the tip of the jig.
  - Soft key: **LVL**
  - Hard key:—
  - HP-IB command: POWER□<value>[MW|UW|NW|W|MA|UA|A|MV|UV|V|DBM]
- **UNIT**: Let you select the unit of the power level (**LVL** soft key) from dBm, WATT, AMP, and VOLT.
  - Soft key: **UNIT**
  - Hard key:—
  - HP-IB command: POWER□<value>[MW|UW|NW|W|MA|UA|A|MV|UV|V|DBM]

**Note**

The signal level specified with the HP E4915A indicates the power actually applied to a resonator. However, when you specify dBm as the unit of the signal level, the specified level shows the signal level at the port of the HP E4916A instead of the power applied to a resonator.

With the HP E4915A, the output power level is fixed at -5 dBm.

- **TIME**: Determines the measuring time, which can be one of three alternative settings: Short, Med, and Long.

- Soft key: **TIME**
  - Hard key: **Meas Time**
  - HP-IB command: MEASTime␣<value>
- **HI Q**: Turns ON/OFF High Q mode.
  - Soft key: **HI Q**
  - Hard key:—
  - HP-IB command: MEASTime␣<value>
- **DIR**: Lets you specify the search direction in Evaporation Monitor mode depending on whether the measurement frequency becomes higher or lower as the frequency adjustment proceeds.
  - Soft key: **Dir**
  - Hard key:—
  - HP-IB command: EMDIR␣{UP|DOWN}
- **Tout**: Determines the length of time the Trap function waits for the DUT to reach the specified trap frequency.
  - Soft key: **Tout**
  - Hard key:—
  - HP-IB command: EMTMOUT␣<value>
- **CKT**: Lets you specify the type of the circuit to be used for measurement. (For more information, refer to “Selecting the Measuring Circuit Type”).
  - Soft key: **CKT**
  - Hard key:—
  - HP-IB command: CIRcuit␣{PI|PRObe|BRidge}  
PICKTtype␣{PI41900A|PI41901A|PI41902A}
- **MAN**: Determines whether to enable the setting of the trap frequency from the front panel.
  - Soft key: **MAN {OFF|ON}**
  - Hard key:—
  - HP-IB command: EMMANmode␣{OFF|ON}
- **PARA**: Determines the type of the search resonance frequency, which can be Fr or Fs.
  - Soft key: **PARA {FS|FR}**
  - Hard key:—
  - HP-IB command:—
- **PHAS**: Lets you specify the target phase value.
  - Soft key: **PHAS <value>**
  - Hard key:—
  - HP-IB command:—
- **Ftgt**: Lets you specify the target frequency.
  - Soft key: **Ftgt <value>**
  - Hard key:—
  - HP-IB command: EMLIST␣<value1>,<value2>,<value3>,  
{ON|OFF|0|1},<value4>

- **Flow**: Lets you specify the lowest trap frequency.
  - Soft key: **Flow <value>**
  - Hard key:—
  - HP-IB command: EMLIST␣<value1>,<value2>,<value3>,{ON|OFF|0|1},<value4>
- **Fmed**: Lets you specify the 2nd trap frequency.
  - Soft key: **Fmed <value>**
  - Hard key:—
  - HP-IB command: EMLIST␣<value1>,<value2>,<value3>,{ON|OFF|0|1},<value4>
- **Fhi**: Lets you specify the highest trap frequency.
  - Soft key: **Fhi <value>**
  - Hard key:—
  - HP-IB command: EMLIST␣<value1>,<value2>,<value3>,{ON|OFF|0|1},<value4>

### Setting Using Trap Point List (HP-IB Only)

To specify 4 or more trap points in Evaporation Monitor mode, you are required to create a trap point list using the HP-IB. You can specify up to 30 trap points in the trap point list.

The trap point list contains the following information for each trap point:

- Frequency for the trap point
- Phase value for the trap point
- Whether to turn ON/OFF the output through the I/O port (handler interface)
- Data to be output through the I/O port (12 bit length)

To create a trap point list, use the EMLIST command. For more information, refer to the description of the EMLIST command in Chapter 5 and the sample program attached.

## Measurement Functions

### ALC Mode

ALC (Auto Level Control) mode, which can be turned ON via the **ALC** soft key, provides level control based on the actual CI value to actually apply the specified power to the DUT. When this mode is OFF, level control is performed based on the user-specified nominal CI value.

#### Note



When you are working in Evaporation Monitor mode, displaying **Nominal CI** enables you to verify the nominal CI value but, in this case, the CI value cannot be altered through the front panel.

## Output of Measurement Results

### LCD Screen/HP-IB

- Transition through trap points (indicates the frequency of the trap point that the DUT has passed on a real-time basis)
- “#”, “T”, “F”, “>” are displayed at the bottom of LCD. When EM is started, # is displayed. A number of # displayed shows number of trap points passed.

#	Measurement point does not get to the trap point yet.
T	Time out
F	Measurement point go through the trap point specified
>	Finished correctly

- CI value at the previous trap point [ $\Omega$ ]
- Frequency for the next trap point [Hz]
- Time required between two successive trap points [ms]

### Handler Interface

Outputs the data defined with the appropriate HP-IB command.

### Analog OUT Terminal

**Measurement parameters whose value can be output through the Analog OUT terminal:** Fr, Fs, Fa

**Output voltage:** The Analog OUT terminal outputs a DV signal whose level changes within the range of  $-5\text{ V}$  to  $+5\text{ V}$ , indicating the difference relative to the nominal frequency.

### Parameters and Their Settings

The parameters for controlling the output through the Analog OUT terminal are accessible via their specific soft keys contained in the System menu. (To access the System menu, press the (blue) + (System) key).

- **AnalogOut:** Lets you turn ON/OFF the DC voltage output through the Analog OUT terminal.
  - Soft key: **AnalogOut**
  - Hard key:—
  - HP-IB command: ANLGOUTL {OFF|ON|0|1}
- **Settings:** Lets you specify the coefficient of the DC voltage output from the Analog OUT terminal and the measured frequency. The system increments or decrements the output voltage by 1 V as the frequency changes by the amount represented by this coefficient. When you select the **Settings** soft key, you are presented with two options: dFdv and REF. You can choose one of them and enter your desired value.
  - Soft key: **Settings**

- Hard key:—
- HP-IB command: ANLGDFDV␣<value>, ANLGRF␣ <value>

## Filter Measurement Mode (Flt Mode)

- Applicable Model: HP E4916A only
- Access means: front panel and HP-IB

### Purpose and Principle

Filter measurement mode is intended for determining the insertion loss of a crystal filter (band-pass filter). In this mode, you can measure either constant or minimum loss. The HP E4916A determines the constant loss by measuring the loss at the nominal frequency, and the minimum loss by measuring the loss at the peak frequency.

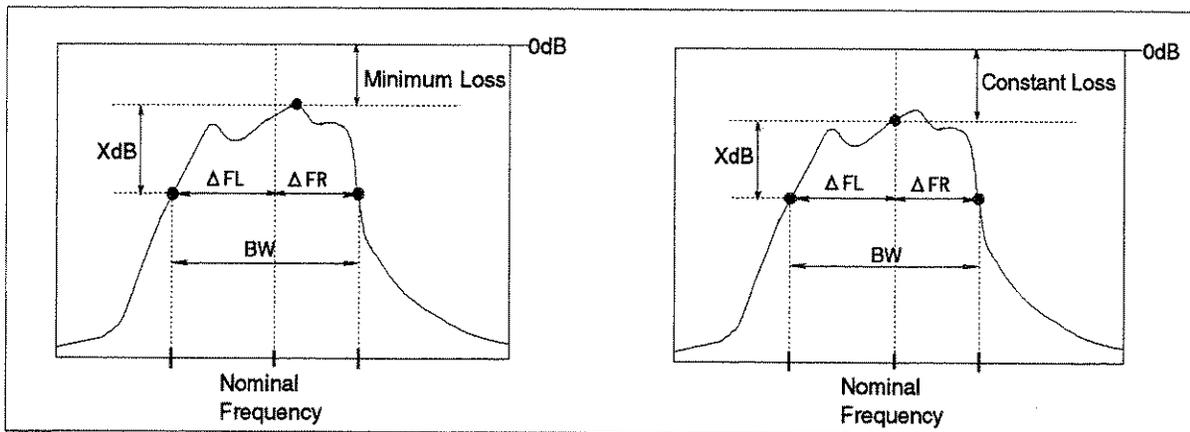


Figure 4-8. Constant loss and minimum loss

Filter measurement mode determines the values of the following characteristic parameters:

- Constant or minimum loss
- X-axial dB band width values ( $\Delta FL$ ,  $\Delta FR$ , and  $BW$ ;  $BW = \Delta FL + \Delta FR$ )

### Parameters and Their Settings

This subsection describes the parameters that control the behavior of the HP E4916A in Filter measurement mode (Flt mode). These parameters are accessible via either a hard key or a soft key, or both.

- **FREQ**: Lets you specify the nominal frequency value.
  - Soft key: **FREQ**
  - Hard key: **Freq**
  - HP-IB command: `NOMFreq`  $\langle value \rangle$
- **RNG**: Search range. Specify the resonance point search range.
  - Soft key: **RNG**
  - Hard key: **Freq**
  - HP-IB command: `SRCHRange`  $\langle value \rangle$
- **LOSS**: Provides two alternative options: **Const** and **Min**. Select **Const** for the constant loss, or **Min** for the minimum loss.

- Soft key: **LOSS**
- Hard key:—
- HP-IB command: FLTMODEL{CONSTant|MINimam}
- **xdB**: Specify the down value for filter band width
  - Soft key: **xdB**
  - Hard key:—
  - HP-IB command: FLTDBL<value>
- **LVL**: Lets you specify the signal level.
  - Soft key: **LVL**
  - Hard key: **(Level)**
  - HP-IB command: POWERL<value>
- **TIME**: Lets you specify the measuring time by selecting one of three alternative settings: Short, Med, and Long.
  - Soft key: **TIME**
  - Hard key: **(Meas Time)**
  - HP-IB command: MEASTimeL<value>
- **HI Q**: Lets you turn ON/OFF High Q mode. (For more information on High Q mode, refer to “High Q Mode” later in this section).
  - Soft key: **HI Q**
  - Hard key:—
  - HP-IB command: MEASTimeL<value>

**Note**

- To set the value of a parameter accessible via a soft key, press the **(Select)** key next to the soft key to put the LCD screen into data entry mode.
- Some parameters accept your manually entered value while the other parameters accept only one of the presented options. To choose an option, use the **(↑⇒)** or **(⇐↓)** key. When you have chosen the desired option or entered the appropriate value, press the **(Enter)** key to put the new setting into effect.
- When no soft key is selected yet, you can access the previous or next pair of soft keys by pressing the **(↑⇒)** or **(⇐↓)** key.

**Measurement Functions****High Q Mode**

High Q mode is intended for use when the DUT has a high Q value, and it provides longer measuring time. To enable High Q mode, use the **Hi-Q** soft key.

Turning ON High Q mode causes the three measuring time settings (Short, Med, and Long) to provide a longer measurement time than with High Q mode OFF.

**Note**

---

The HP E4916A provides the three alternative measuring time settings (Short, Med, and Long) with High Q Mode OFF, plus the three other alternative settings with High Q mode ON; thus, 6 alternative settings in all. To control the measuring time via the HP-IB, issue the MEASTime command followed by an integer from 1 to 6.

---

**Output of Measurement Results****LCD Screen/HP-IB**

- Constant loss or minimum loss
- X-axial dB band width values ( $F_L$  and  $F_R$ )

**Note**

---

In Filter measurement mode, the soft keys remain displayed on screen even when you turn OFF the status display using the **(blue) + 1 (Status)** key.

---

## LCR Measurement Mode

- Applicable Model: HP E4916A only (requires Options 001/010)
- Access means: front panel and HP-IB

### Caution



Make sure that the test signal level is 0 dBm or lower when using the probe. For more information, refer "EMC" in Chapter 9.

### Purpose and Principle

In LCR measurement mode, the HP E4916A measures a DUT's impedance,  $Z$ , which is a vector value, and gives the result using the following equivalent circuits:

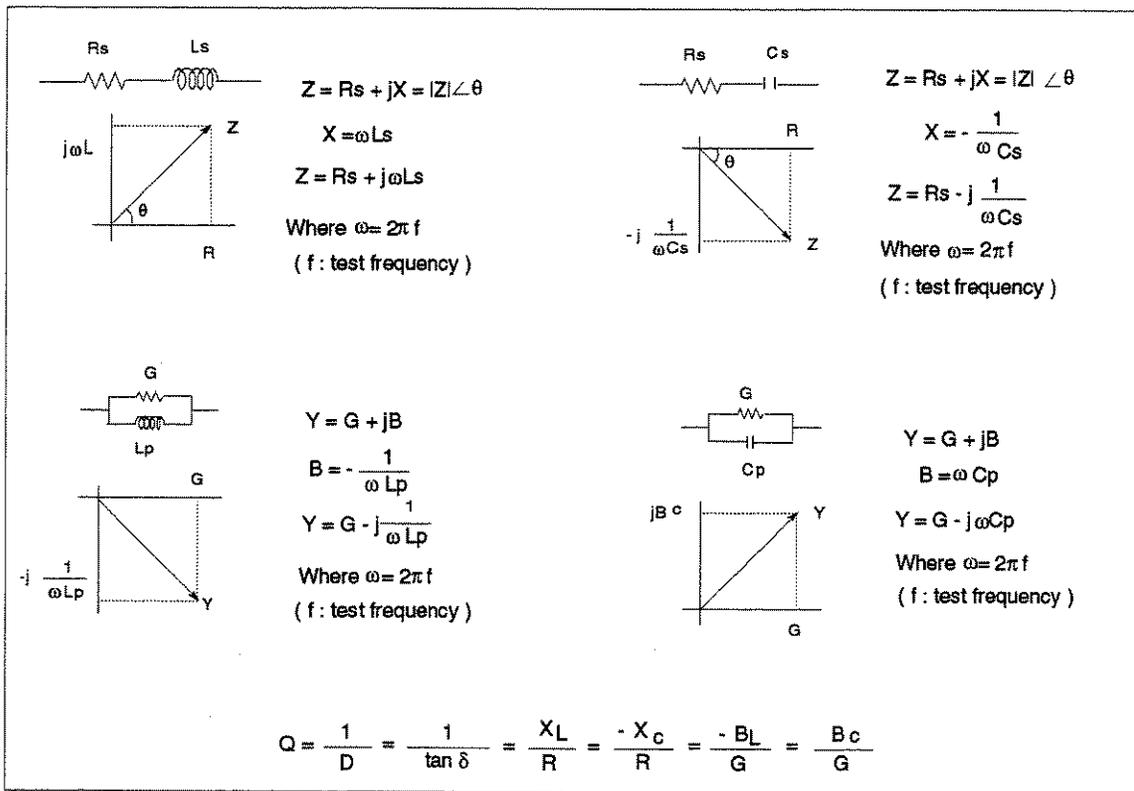


Figure 4-9. Relationship between Measurement Parameters

In Figure 4-9,

- |  |   |
|--|---|
| $L_s$ : Equivalent series inductance   | $C_p$ : Equivalent parallel capacitance |
| $L_p$ : Equivalent parallel inductance | $Q$ : Quality factor                    |
| $C_s$ : Equivalent series capacitance  | $D$ : Dissipation Factor                |

Measurement parameters for LCR measurement mode include the following:

<b>Primary Parameters</b>	Z, Y, R, G, Cp, Cs, Lp, Ls
<b>Secondary Parameter</b>	$\theta_z, \theta_y, X, B, D, Q, G, R_p, R_s$

where,

Z : Absolute value of impedance	Cs : Equivalent series capacitance
Y : Absolute value of admittance	Lp : Equivalent parallel inductance
R : Resistance	Ls : Equivalent series inductance
G : Conductance	
Cp : Equivalent parallel capacitance	

#### Secondary Parameters

$\theta$ : Phase angle	G : Conductance
X : Reactance	Rp : Equivalent parallel resistance
B : Susceptance	
D : Dissipation factor	Rs : Equivalent series resistance
Q : Quality factor	

## Parameters and Their Settings

### ■ Deviation ( $\Delta$ ) measurement

Lets you select the deviation measurement mode which displays the difference between the measured value and a reference value. This key is also used for entering the deviation reference value.

Available deviation modes include the following:

**$\Delta$ ABS mode** Displays the difference between the measured value and a reference value. The value is calculated by

$$\text{MeasuredValue} - \text{ReferenceValue}$$

**$\Delta$ % mode** Displays the difference between the measurement value and the reference value as a percentage of the reference value. The value is calculated by

$$\frac{\text{MeasuredValue} - \text{ReferenceValue}}{\text{ReferenceValue}} \times 100$$

**Off** Turns the deviation measurement mode OFF. (default)

### ■ Measuring time

Let you set measuring time mode: SHORT, MED (Medium), or LONG. A longer measurement time produces a more accurate measurement result. The default setting is MED (Medium).

### ■ Averaging

Lets you set the measurement averaging rate. The averaging rate can be set from 1 to 256. The default setting is 1.

- **Test frequency**

Lets you set the test frequency value within the range between 1 MHz and 180 MHz.

- **The Level Monitor function** monitors the actual signal current flowing through the DUT and the actual signal voltage across the DUT.

## The Actual Signal Level and Setting Level at LCR measurement

The actual signal level applied to DUT depends on the test signal level of HP E4916A, output impedance of the impedance probe, and the impedance value of DUT.

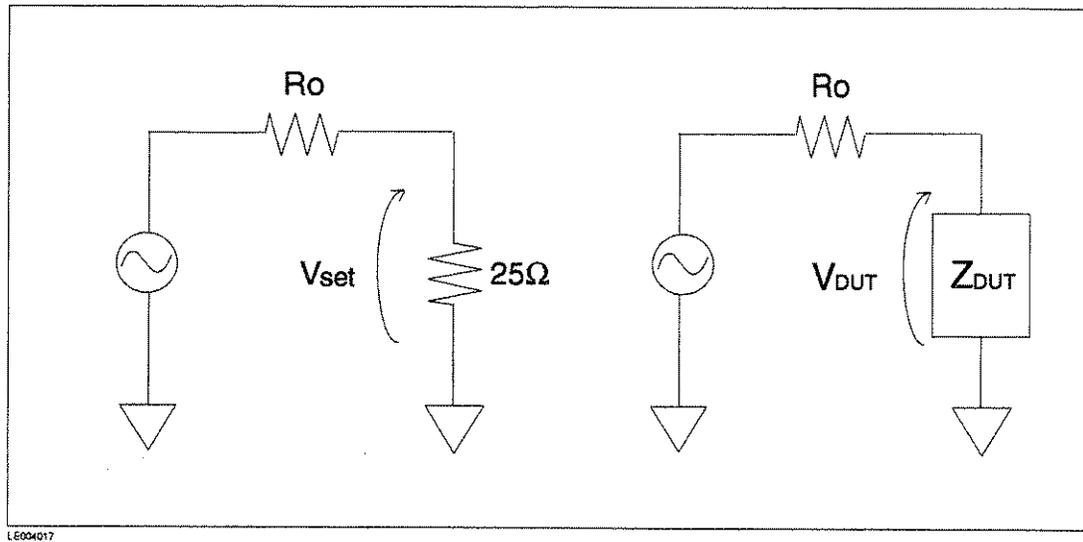


Figure 4-10. Equivalent Circuit of Impedance Probe

Figure 4-10 shows the equivalent circuit model of the HP E4916A and the Impedance probe. When DUT's impedance value is same as the output impedance value of the probe (25  $\Omega$ ), the actual signal level is same as the setting level, the actual signal value is calculated by the following equation.

$$V_{DUT} = 2V_{set} \times \frac{Z_{DUT}}{(Z_{DUT} + R_0)} [V]$$

where,

$V_{DUT}$	Actual signal level applied to DUT
$V_{set}$	Setting signal level
$Z_{dut}$	DUT's Impedance
$R_0$	Output impedance of the impedance probe

## Calibration and Fixture Compensation

This section provides descriptive information on the error correction facilities of the HP E4915A/E4916A: the Calibration function (available with both HP E4915A and HP E4916A) and the Fixture Compensation function (available with the HP E4916A only).

The Calibration function allows you to measure the CI or LCR characteristics while eliminating the influence of an HP  $\pi$  network fixture or impedance probe connected to the DUT. The Calibration function is particularly useful when you use a  $\pi$  network test fixture to measure the CI characteristics of a DUT.

Calibrating the HP E4915A/E4916A requires the calibration data measured by putting the  $\pi$  fixture test terminal or the probe tip into each of the following three states:

- Open – the state in which the fixture or probe is not connected with a DUT.
- Short – the state in which the fixture or probe is short-circuited.
- Loaded – the state in which the fixture or probe is connected with a standard DUT (a device that provides a standard condition).

The Calibration function uses a 2-terminal pair circuit model to analyze a measuring circuit (such as a  $\pi$  network test fixture or impedance probe) between the HP E4915A/E4916A and the DUT. As shown in Figure 4-11, this model is represented by parameters A, B, C, and D that form an F matrix. If the 2-terminal pair circuit network is a linear passive circuit, the four parameters can be determined by measuring a known device in each of the Open, Short, and Loaded states.

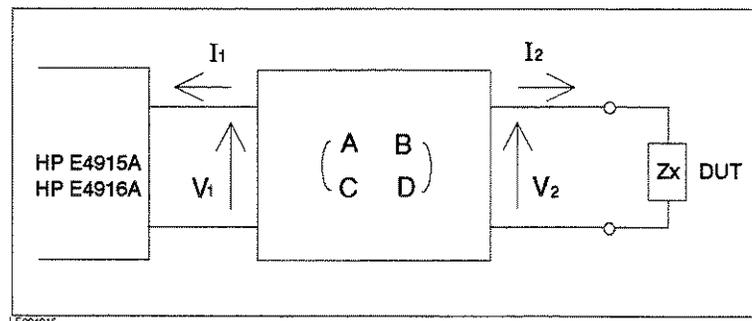


Figure 4-11. Calibration Model

### Note



Re calibration and compensation are required when the measurement mode or the measurement circuit is changed. The previous calibration data will be lost when re-calibration is performed.

## Performing the Calibration and Compensation Measurements

This subsection shows how to perform each of the Calibration and Compensation measurements.

**Table 4-15. Accessing the Calibration Function**

State of connection	Front panel (hard key)	HP-IB command
OPEN	(blue) + 4 (Open)	CALibrationL $\square$ OPEN
SHORT	(blue) + 5 (Short)	CALibrationL $\square$ SHORT
LOAD	(blue) + 6 (Load)	CALibrationL $\square$ LOAD
THRU	(blue) + 3 (Thru)	THRUCAL

**Table 4-16. Accessing the Fixture Compensation Function**

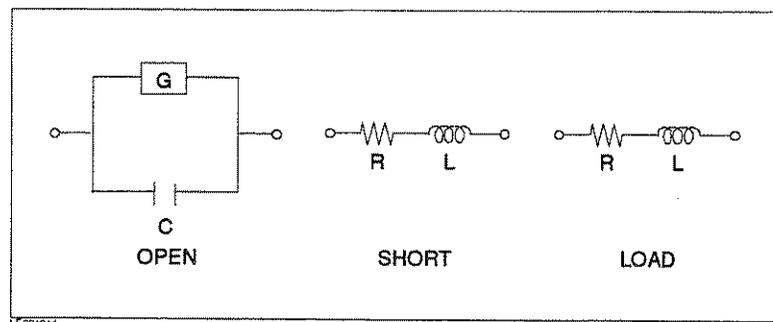
State of connection	Front panel (hard key)	HP-IB command
OPEN	(blue) + 7 (Open)	COMPENsationL $\square$ OPEN
SHORT	(blue) + 8 (Short)	COMPENsationL $\square$ OPEN
LOAD	(blue) + 9 (Load)	COMPENsationL $\square$ LOAD

## Calibration Standard Values

The standard values the HP E4915A/E4916A uses for calibration are factory-preset assuming the use of the HP 41902A  $\pi$  Network Test Fixture and Option 001 Impedance Probe.

There are occasions when you need to use non-default calibration standard values. If this is the case, supply the HP E4915A/E4916A with the standard values for each of the Open, Short, and Loaded states before you calibrate the HP E4915A/E4916A.

The calibration standard values for the HP E4915A/E4916A are defined using such a 2-element model as shown in Figure 4-12.



**Figure 4-12. Calibration standard model**

You can set the calibration standard values for each of the measuring circuit types supported by the HP E4915A/E4916A that is, a  $\pi$  network test fixture, impedance probe, and reflection bridge. For THRU

calibration, you need not set calibration standard values because the Calibration function requires the calibration data for the Thru state only.

The HP E4915A/E4916A retains the calibration standard values even with the power off. The current settings are in effect until you input different values or preset HP E4915A/E4916A.

The following table shows the factory-preset standard values that assume the use of the HP 419002A  $\pi$  Network Test Fixture and Option 001 Impedance Probe:

**Table 4-17. Calibration Standard Values**

	OPEN		SHORT		LOAD	
	G	C	R	L	R	L
Option 001 Impedance Probe	0 S	310 fF	0 $\Omega$	0 H	50 $\Omega$	5.75 nH
HP 41900A	0 S	0.1 pF	1 $\mu\Omega$	0.6 nH	50 $\Omega$	14 nH
HP 41901A	0 S	0.1 pF	1 $\mu\Omega$	0.1 nH	50 $\Omega$	3.4 nH
HP 41902A	0 S	0.1 pF	1 $\mu\Omega$	3 nH	50 $\Omega$	18.8 nH

The standard values can be set from **CAL** and **COMP** softkeys under **(blue) + (System)** key or CALSTD and COMPENSTD commands via HP-IB.

### Fixture Compensation – HP E4916A Only

In addition to the Calibration function, which you can use to correct errors caused by the intervention of a measuring function such as the HP 419002A  $\pi$  Network Test Fixture or Option 001 Impedance Probe, the HP E4916A offers an additional error-correction facility intended to eliminate the influence of a measuring circuit added to the original test configuration. This function, called Fixture Compensation, is useful when you add your custom measuring circuit or an HP test fixture with APC-7 terminals to accommodate the HP 16099A input probe.

The Fixture Compensation function recognizes the Open, Short, and Loaded states as does the Calibration function. However, unlike the Calibration function, the Fixture Compensation function does not always require the compensation value for the loaded state; it uses the compensation values in one of the following two combinations: states:

- Open and Short states
- Open, Short, and Load states

These two different combinations are described in detail in the following subsections.

## Using the Fixture Compensation Function in Open/Short Combination

Typically, you use the Fixture Compensation function in the Open/Short combination when you use the HP E4916A in the LCR measurement mode using with option 001 Impedance probe. In this case, the HP E4916A assumes such a model as shown in Figure 4-13 to represent the residual impedance caused by a test fixture or the like. Then, it can compensate the measured values based on the compensation values for the Open and Short states.

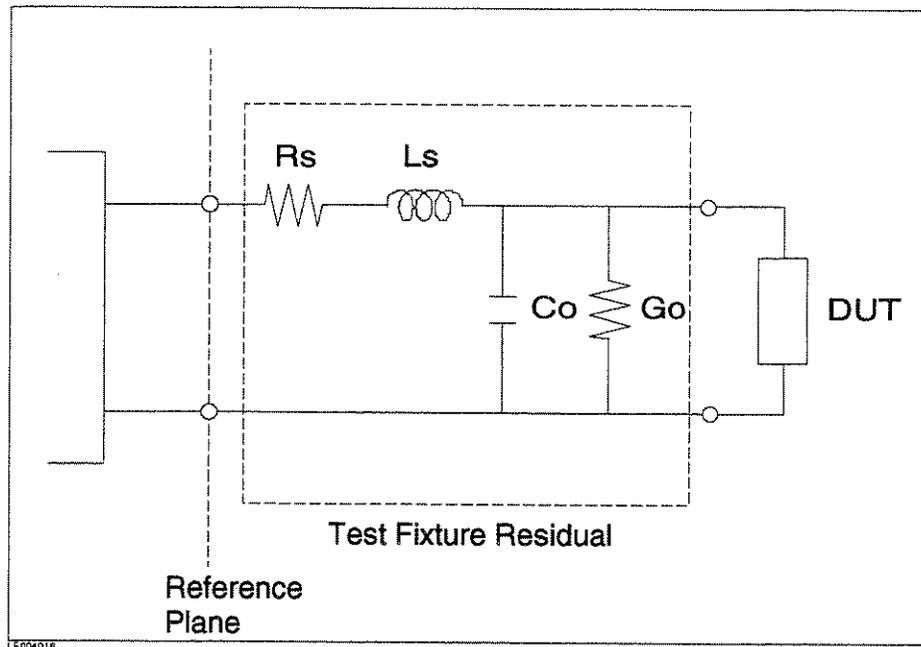


Figure 4-13. OPEN/SHORT compensation model

## Using the Fixture Compensation Function in Open/Short/Loaded Combination

Using the Fixture Compensation function in the Open/Short/Load combination allows you to compensate a fixture or measuring circuit whose residual impedance is too complex to be represented by such a simple model as shown in Figure 4-13, as is often the case when you extended the measuring circuit using a cable or switch box.

Using the Fixture Compensation function in the Open/Short/Loaded combination requires a load device whose impedance value is known and stable. The following are some guidelines for selecting the load device:

- Use a stable resistor. If you plan to use a resistor, select one whose characteristics are stable under possible changes in environmental conditions such as ambient temperature, humidity, and magnetic field.
- The load device used should have physically the same size as the DUT. If the physical position of the measuring electrode differs between the device used for measuring the compensation value for the Loaded state and the device that is actually tested, the Fixture

Compensation function cannot effectively compensate for residual impedance.

- The load device used should have an impedance value as close to the actual DUT as possible, so the compensation can be performed more effectively. If DUTs vary in impedance value, use a load device whose impedance value is as close to the average impedance.
- Use a load device whose impedance value is known. The correct load impedance value is required before you can set the compensation values for the Open, Short, and Loaded states.

## Delta Mode

Delta mode presents measurement results as values relative to a particular reference value. Delta mode causes the HP E4915A/E4916A to output relative values in one of the following two forms:

- Actual deviation between the measured value and the reference value [Hz]/[Ω]
- ppm (frequency) or percentage (other parameters) of the deviation of the measured value with respect to the reference value [ppm]/[%]

## Turning ON/OFF Delta Mode

You can turn ON/OFF Delta mode in one of the following three ways:

Hard key      Pressing the **(blue)** + **p (Δ Mode)** key toggles Delta mode between its ON and OFF states.

HP-IB          DLTMode **⏏**{PRI|SEC}, {OFF|DEV|PCNT|PPM}

### Note



To access the System menu, press the **(blue)** + **(System)** key.

## Setting Up Delta Mode

You can set up the output form and reference value for Delta mode via the System Menu or HP-IB. This subsection describes the System menu soft keys for controlling Delta mode. For how to control Delta mode via the HP-IB, refer to the description of the DLTMode command in Chapter 5.

### Crystal Measurement Mode

- Frequency delta mode ON/OFF
  - Softkey: **ΔF**
  - HP-IB command: DELTMode PRI, {OFF|DEV|PPM}
- Reference frequency for delta mode
  - Softkey: **RefF**
  - HP-IB command: DLTREF PRI, <numeric>
- CI value delta mode ON/OFF
  - Softkey: **ΔCI**
  - HP-IB command: DELTMode SEC, {OFF|DEV|PCNT}
- Reference CI value for delta mode
  - Softkey: **RefZ**
  - HP-IB command: DLTREF SEC, <numeric>

### Drive Level Dependency Measurement Mode (DLD Mode)

The setting menu of DLD mode is same as the menu of Crystal Measurement Mode.

**LCR Measurement Mode**

- 1st Primary Parameter Delta mode ON/OFF
  - Softkey: **ΔP1**
  - HP-IB command: CALC1:MATH:EXPR:NAME {DEV|PCNT}
- Reference of 1st Primary parameter delta mode
  - Softkey: **Ref**
  - HP-IB command: DATA:REF1,<numeric>
- 1st Secondary parameter Delta mode ON/OFF
  - Softkey: **ΔS1**
  - HP-IB command: CALC2:MATH:EXPR:NAME {DEV|PCNT}
- Reference of 1st secondary parameter delta mode
  - Softkey: **Ref**
  - HP-IB command: DATA:REF2,<numeric>
- 2nd Primary parameter Delta mode ON/OFF
  - Softkey: **ΔP2**
  - HP-IB command: CALC3:MATH:EXPR:NAME {DEV|PCNT}
- Reference of 2nd Primary parameter Delta mode
  - Softkey: **Ref**
  - HP-IB command: DATA:REF3,<numeric>
- 2nd Secondary Parameter Delta mode ON/OFF
  - Softkey: **ΔS2**
  - HP-IB command: CALC4:MATH:EXPR:NAME {DEV|PCNT}
- Reference of 2nd Secondary Parameter Delta Mode
  - Softkey: **Ref**
  - HP-IB command: DATA:REF4,<numeric>

**Acquiring Actual Values as Delta Mode Reference Values**

You can acquire actual values as Delta mode reference values in the Crystal Resonator measurement mode and LCR measurement mode.

To acquire actual values, first, choose a desired parameter for the Delta mode reference value with soft keys, and then choose Actual on the LCD selection screen. The actual value is acquired as the Delta mode reference values.

## Comparator Function

The Comparator function is intended to sort crystal resonators and crystal filters according to their characteristic values. This function evaluates the characteristics measured in a particular measurement mode and sorts the crystal resonators and crystal filters into a number of bins. Each bin is defined by the lower and upper limits.

The HP E4915A/E4916A supports two stages of sorting: primary and secondary. In addition to these two stages of sorting, the HP E4916A provides extended test functions; the  $\Delta F$  limit/ $\Delta CI$  limit test based on the measurement result in Drive Level Dependency measurement mode and the BW limit test based on the measurement result in Filter measurement mode.

### Note



The  $\Delta F$  limit/ $\Delta CI$  limit test and BW limit test functions are available only with the HP E4916A. Note that description of the  $\Delta F$  limit/ $\Delta CI$  limit test and BW limit test functions that follows in this section cannot be applicable to HP E4915A.

#### ■ Primary sorting

When you use the Comparator function via the HP-IB, you can define up to 9 bins [Xtal measurement mode], 5 bins [DLD/FIt mode], or 10 bins [LCR mode] for primary sorting. Primary sorting can be performed in one of two modes: Sequential and Tolerance (for more information, refer to “Sequential Mode and Tolerance Mode” later in this section). A DUT passes primary sorting if its characteristic value matches a bin, or fails primary sorting if its characteristic value does not match any bin.

When you use the Comparator function through the front panel, however, you can only define a single bin for primary sorting.

#### ■ Secondary sorting

Secondary sorting uses upper limit and lower limit. A DUT passes secondary sorting if its characteristic value matches the secondary sorting bin, or fails primary sorting if its characteristic value does not match the secondary sorting bin. By default, a DUT that has failed secondary sorting is treated as an Out-Of-Bin article. If necessary, you can separate those DUTs that passed primary sorting but failed secondary sorting into a special bin called the Aux bin (for more information on the Aux bin function, refer to “Aux Bin” later in this section).

#### ■ Tertiary sorting

- This extended function compares the frequency ( $F_{max} - F_{min}$ ) and CI values ( $CI_{max} - CI_{min}$ ) of a DUT measured in DLD mode.
- This extended function also compares the BW value of a DUT measured in FIt mode.

## Parameters That Control the Comparator Function

This subsection describes the parameters that control the Comparator function. Each parameter is shown along with the corresponding hard/soft keys and HP-IB commands. Some parameters are accessible only via the HP-IB.

### Parameter that control the basic behavior of the Comparator function

- Beep state: Turns ON/OFF the beep output of the Comparator function.
  - Soft key: —
  - Hard key: —
  - HP-IB command: `COMPBEEPStat`{OFF|ON|0|1}
- Beep condition: Determines when the Comparator function outputs beep sound; that is, when a DUT has failed or when a DUT has passed the test.
  - Soft key: **BEEP**
  - Hard key: —
  - HP-IB command: `COMPBEEPCond`{FAIL|PASS}
- LED condition: Determines when the Comparator function turns ON the LED; that is, when a DUT has failed or when a DUT has passed the test.
  - Soft key: **LED**
  - Hard key: —
  - HP-IB command: `COMPLEDCond`{FAIL|PASS}

### Parameters that control primary sorting

- Status of primary sorting: Turns ON/OFF primary sorting. (Turning OFF primary sorting disables the Comparator function in its entirety).
  - Soft key: **COMP**
  - Hard key: —
  - HP-IB command: `COMPSTATe`{OFF|ON|0|1}
- Mode of primary sorting: Determines whether to perform primary sorting in Sequential or Tolerance mode. For Tolerance mode, you can specify whether to sort DUTs based on the actual deviation from the reference value, or based on the percentage of the deviation relative to the reference value. For more information on the sorting mode, refer to “Sequential Mode and Tolerance Mode” later in this section.
  - Soft key: **PRI**
  - Hard key: —
  - HP-IB command: `COMPPRIMode`{ABSTOL|PCNTTOL|SEQ}
- Bin definition: You can define a single bin or multiple bins depending on whether you use the front panel or the HP-IB:

- Front panel  
You can only specify a single bin. Use the **PriL** and **PriH** soft keys to define the bin's lower and upper limit values, respectively.
- HP-IB  
Using the `COMPPLimit<n>,<value 1>,<value 2>` command, you can define up to 9 bins [Xtal measurement mode], 5 bins [DLD mode], or 10 bins [LCR mode]. This command sets the upper limit values for one bin each time it is issued (thus, you must issue the command as many times as the number of bins you want to define).
- Soft key: **PriL/PriH**
- Hard key:—
- HP-IB command: `COMPPLimitBIN<n>,<value 1>,<value 2>`
- Nominal value of tolerance mode: Specifies the nominal value as a reference value of tolerance mode.
  - Soft key: **NOM**
  - Hard key:—
  - HP-IB command: `COMPTOLSTD<value>`

### Parameters that control secondary sorting

- Status of secondary sorting: Turns ON/OFF secondary sorting.
  - Soft key: **SEC**
  - Hard key:—
  - HP-IB command: `COMPSECondary{OFF|ON|0|1}`
- Bin definition: Lets you define the upper limit values for the secondary sorting bin.
  - Soft key: **SecL/SecH**
  - Hard key:—
  - HP-IB command: `COMPSLIMit<value 1>,<value 2>` (substitute the lower limit value for *<value 1>*, and the upper limit value for *<value 2>*)
- Status of Aux bin: Turns ON/OFF the Aux bin function. The AUX bin is used to separate those DUTs that passed primary sorting but failed secondary sorting, without purging them as OUT OF BIN together with DUTs that failed both primary and secondary sorting. (For more information, refer to "Aux Bin" later in this section).
  - Soft key: **AUX**
  - Hard key:—
  - HP-IB command: `COMPSECAUXL{OFF|ON|0|1}`

### Parameters that control tertiary sorting

#### Note



The tertiary sorting is available only when you use the Comparator function in conjunction with Drive Level Dependency measurement mode or Filter measurement mode.

- Status of  $\Delta F$  limit test: Turns ON/OFF the  $\Delta F$  limit test.

- Soft key: **LmΔF**
  - Hard key:—
  - HP-IB command: `COMPDLTF{OFF|ON|0|1}`
- ΔF limit value: Specifies the allowable range for frequency with respect to the reference value. A DUT that exceeds this range fails the test.
  - Soft key: **ΔF\_H**
  - Hard key:—
  - HP-IB command: `COMPDLTFLim<value>`
- Status of ΔCI limit test: Turns ON/OFF the ΔCI limit test.
  - Soft key: **LmΔZ**
  - Hard key:—
  - HP-IB command: `COMPDLTCI{OFF|ON|0|1}`
- ΔCI limit value: Specifies the allowable range for crystal impedance with respect to the reference value. A DUT that exceeds this range fails the test.
  - Soft key: **ΔZ\_H**
  - Hard key:—
  - HP-IB command: `COMPDLTCILim<value>`
- Status of BW limit test: Turns ON/OFF the BW limit test.
  - Soft key: **LmBW**
  - Hard key:—
  - HP-IB command: `COMPBW{OFF|ON|0|1}`
- BW limit value: Specifies the upper and lower limit values.
  - Soft key: **BW\_L/BW\_H**
  - Hard key:—
  - HP-IB command: `COMPBWLim<value1>,<value2>` (specify the lower limit value in *<value1>* and the higher in *<value2>*)

**Note**


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LED3 will be turn on when both two limits are pass/fail. BEEP will sound when all limits are passed or one of two limits is failed.

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## Bin Sorting

### Sequential Mode and Tolerance Mode

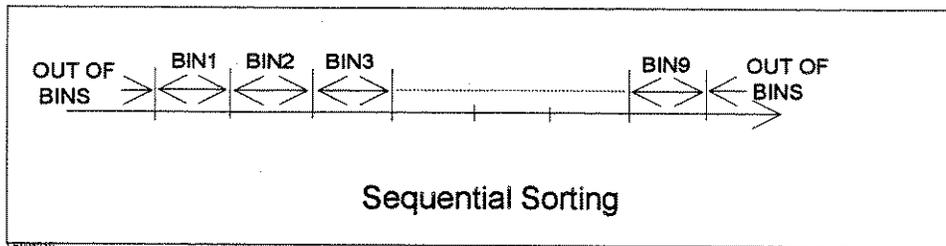
When you use the Comparator function via the HP-IB, you can define up to 9 bins [Xtal measurement mode], 5 bins [DLD mode], or 10 bins [LCR mode] for primary sorting. Primary sorting is performed in either Sequential or Tolerance mode:

**Table 4-18.**  
**Sequential and Tolerance modes for Primary Sorting**

Mode	Settings through the Front Panel	HP-IB Command
Sequential	PRI = SEQ	COMPPRIModeLSEQ
Tolerance	PRI = ABS_TOL	COMPPRIModeLJABSTOL
	PRI = %TOL	COMPPRIModeLPCNTTOL

### Sequential Mode

In Sequential mode, the HP E4916A evaluates the magnitude of a particular characteristic parameter, and sorts each DUT into one of contiguous bins that matches its characteristic value. The bins in Sequential mode are arranged contiguously in the ascending order of their lower limit values, as illustrated below:



**Figure 4-14. Sequential mode**

The upper limit of Bin 1 equals the lower limit of Bin 2, the upper limit of Bin 2 equals the lower limit of Bin 3, and so on. The characteristic value is evaluated in the ascending order of bin numbers.

DUTs are first compared with the range of Bin 1. A DUT whose characteristic value is lower than the lower limit of Bin 1 fails the test and is treated as an Out-Of-Bin article. If a DUT's characteristic value is higher than the upper limit of Bin 1, the DUT is then compared with the range of Bin 2. This way, a DUT that exceeds the upper limit of a particular bin is then evaluated for the next bin. A DUT that exceeds the upper limit of the final bin fails the test and is treated as an Out-Of-Bin article.

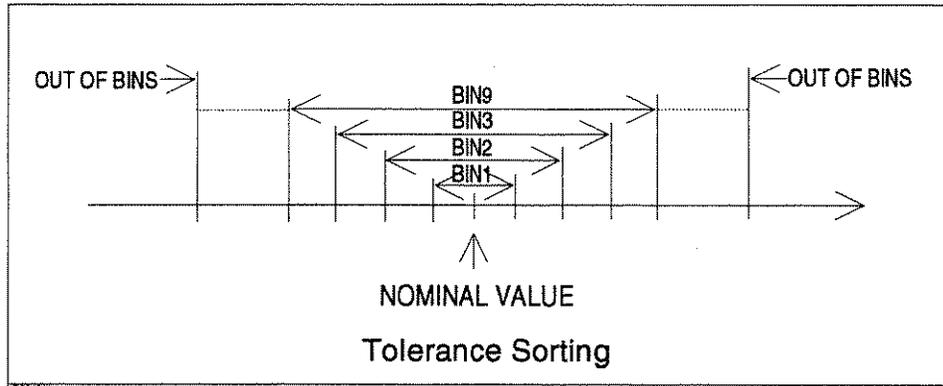
### Note



All bins must be defined within the measurable range for the characteristic parameter.

**Tolerance Mode**

In Tolerance mode, the HP E4916A evaluates how much a particular characteristic parameter deviates from a specified reference value, and sorts each DUT into one of multiple bins that matches the deviation of the DUT's characteristic value. The bins in Tolerance mode are arranged in such an overlapped fashion that all of them extend in both negative and positive directions from the reference value, as illustrated below:



**Figure 4-15. Tolerance Mode**

Bin 1 is defined to have the smallest extend (tolerance). Bin 2 is defined to cover deviations beyond the extent of Bin 1; Bin 3 is defined to cover deviations beyond the extent of Bin 2; and so on.

DUTs are first compared with the range of Bin 1. If a DUT's deviation is beyond the extent of Bin 1, the DUT is then compared with Bin 2. This way, a DUT that exceeds the extent of a particular bin is then evaluated for the next bin. A DUT that exceeds the extent of the final bin fails the test and is treated as an Out-Of-Bin article.

The Comparator function recognizes deviations represented in one of the following two forms:

**Table 4-19. Forms of Deviation**

Form	Meaning	Settings through the Front Panel	HP-IB command
Absolute deviation (actual deviation)	Actual deviation from reference value	<b>PRI</b> = ABS_TOL	COMPPRIModeLJABSTOL
Percentage	Percentage of deviation with respect to reference value	<b>PRI</b> = %TOL	COMPPRIModeLJPCNTTOL

**Note**



All bins must be defined within the measurable range for the characteristic parameter.

**Aux Bin** By default, all DUTs that have failed secondary sorting are treated as Out-Of-Bin articles.

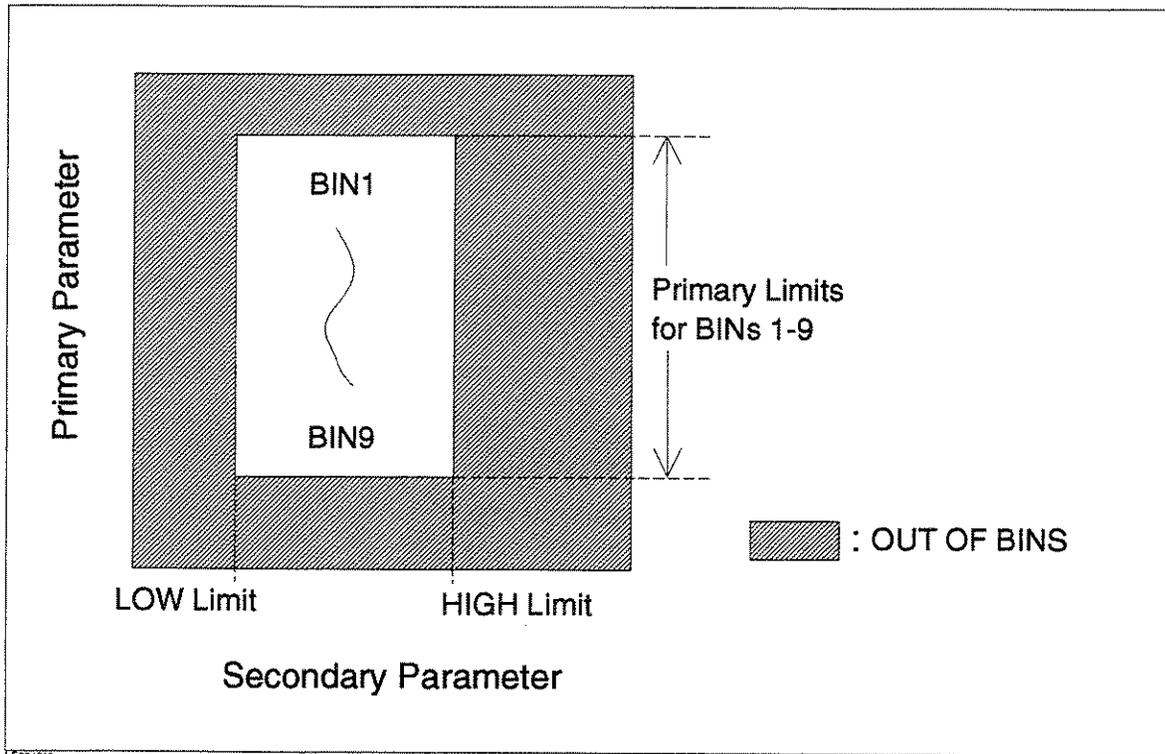


Figure 4-16. Results of secondary sorting with the Aux bin function OFF

There are, however, occasions when you need to separate those DUTs that passed primary sorting but failed secondary sorting, without purging them as OUT OF BIN articles together with DUTs that failed both primary and secondary sorting. If this is the case, you can use the Aux bin, which contains DUTs that failed only secondary sorting separately from those that failed both primary and secondary sorting. With the Aux bin function ON, DUTs are sorted as follows:

**Note**



When the primary sorting is failed, the secondary sorting is not performed even the secondary sorting is ON. However, when the Comparator function is used in Filter measurement mode, the secondary sorting is performed regardless of the result of the primary sorting.

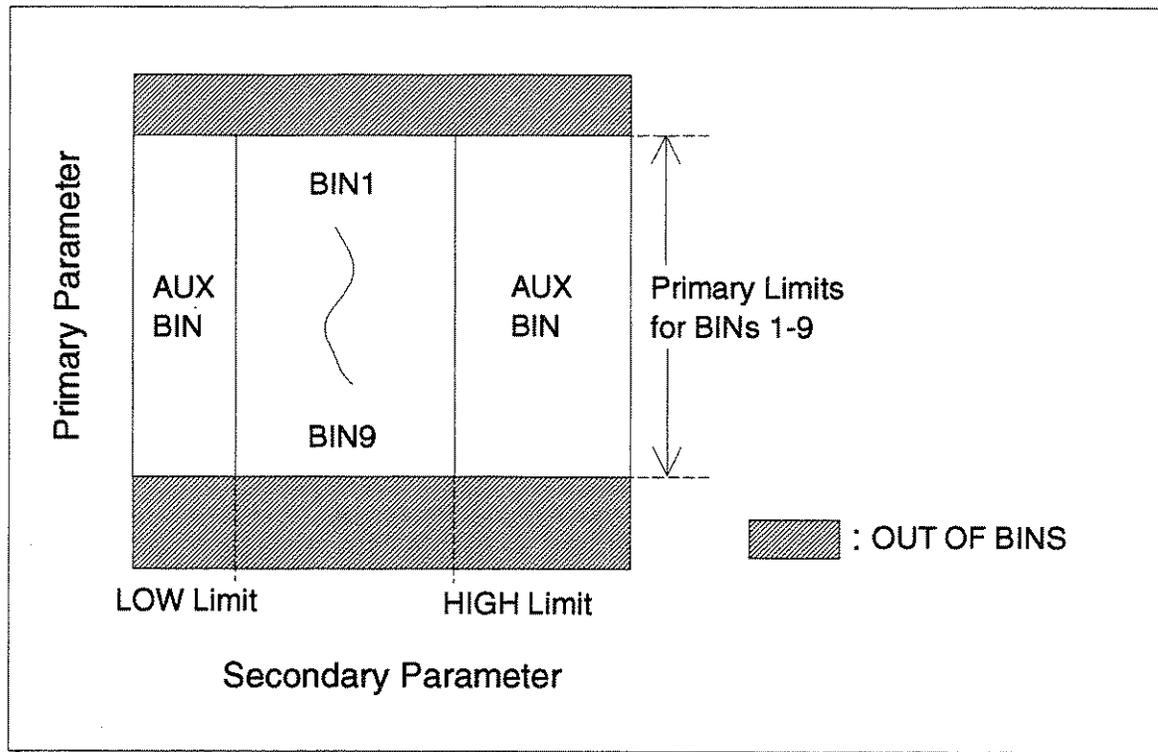


Figure 4-17. Results of secondary sorting with the Aux bin function ON

## Output of Comparison Results

### LCD Screen

Output of comparison results does not display on the LCD Screen.

### LED Output

- LED 1: Result of primary sorting
- LED 2: Result of secondary sorting
- LED 3: AND of both two results ( $\Delta F$  limit AND  $\Delta CI$  limit/BW\_L AND BW\_H), for either the  $\Delta F$  limit/ $\Delta CI$  limit test or the BW limit test.

### Beep Output

Beep sound is output when a DUT has passed or failed the test.

### Note



LED3 will be turn on when both two limits are pass/fail. BEEP will sound when all limits are passed or one of two limits is failed.

### Handler Interface

Outputs the test result (Fail or Pass). The output differs depending on the measurement mode; Xtal, DLD, Flt, or LCR. For more information, refer to Appendix C.

## Memory Facilities

This section describes each of the two memory facilities incorporated into the HP E4915A/E4916A.

### Save/Recall Function

The Save/Recall function allows you to save the current instrument settings and calibration data and recall a previously saved set of instrument settings.

**Table 4-20. Accessing the Save/Recall Function**

	Hard key	HP-IB command
Save	(blue) + Rcl (Save)	*SAVL <value>
Recall	Rcl	*RCLL <value>

The Save/Recall function allows you to save up to 10 sets of instrument settings and calibration data. Each set is identified by an index number from 0 to 9. You can recall your desired set of instrument settings by specifying the index you gave to the set when you save it.

#### Note



Save/recall data created with firmware earlier than version 2.0 is not available on the firmware of version 2.0 or later. After update of the firmware, create new save/recall data.

#### Note



Do not press other keys while calling calibration data. If you press any key by mistake, press the (blue) + (Reset) key to reset the system.

These settings are stored in flash memory contained in the HP E4915A/E4916A. The flash memory retains its contents even with the power OFF.

## Memory Buffer Function

The Memory Buffer function temporarily retains measurement results inside the HP E4915A/E4916A.

When connected to a controller, the HP E4915A/E4916A may be forced to wait for the controller to complete the current task. If this is the case, you can turn ON the Memory Buffer function to temporarily store measurement results inside the HP E4915A/E4916A. The HP E4915A/E4916A's memory buffer can store up to 500 sets of measurement results. (Up to 200 sets for spurious mode)

**Table 4-21. Accessing the Memory Buffer Function**

Hard key	HP-IB command
(blue) + 2 (Mem Buf)	MESTATEL{OFF ON 0 1}

With the Memory Buffer function ON, pressing

(blue) + (System), **DelDATA** makes the LCD screen display

the index for the measurement results currently stored. Using the HP-IB commands associated with the Memory Buffer function, you can perform various manipulations to the memory buffer. For more information, refer to “HP-IB Commands Associated with Memory Buffer Function” in Chapter 5.

## Selecting the Measuring Circuit Type

Crystal Resonator measurement mode and Drive Level Dependency measurement mode allow you to select one of the supported measuring circuit types ( $\pi$  Network test fixture, Impedance probe, a Reflection bridge). In these measurement modes, selecting the **CKT** soft key displays the options that correspond to the supported measuring circuit types.

You can also specify the measuring type circuit via the HP-IB.

The following table lists the supported types of measuring circuit and how to select each type:

**Table 4-22. Selecting the Measuring Circuit Type**

Supported circuit type	Applicable model	Accessories available	Setting of <b>CKT</b> soft key	HP-IB command
$\pi$ Network test fixture	HP E4915A/E4916A	HP41900A	PI	CIRcuitLPI PICKTtypeL {PI41900A  PI41901A  PI41902A}
		HP41901A		
		HP41902A		
Impedance probe	HP E4916A only	Option 001	PROBE	CIRcuitLPRObe
Reflection bridge	HP E4916A only	—	BRIDGE	CIRcuitLBRIdge

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## Key Lock

The Key Lock function locks the front panel keys of the HP E4915A/E4916A to inhibit user operation through the front panel. This feature is primarily intended to prevent the operator working alongside the production line from inadvertently operate the HP E4915A/E4916A while it is being remote-controlled from a controller.

To turn ON the Key Lock function, press the (blue) + 0 and ▼ maker will be displayed. To unlock the keys, press the (blue) + 0 key again. You can also use the KLOCKL{OFF|ON|0|1} command to turn ON/OFF the Key Lock function from a remote controller.

---

## Reset Function

There are occasions when you need to restore the HP E4915A/E4916A to the initial settings (preset values). If this is the case, use the Reset function; you can restore the HP E4915A/E4916A to the preset values by simply pressing the (blue) + (Reset) key. The Reset function does not affect the measurement mode currently in effect; the current measurement mode is retained even after you have reset the HP E4915A/E4916A.

You can also use the PRESet command to reset the HP E4915A/E4916A from a remote controller.

## Trigger Function

This section describes the Trigger function of the HP E4915A/E4916A.

### Trigger Modes

The trigger system of the HP E4915A/E4916A has the following four modes:

**Table 4-23. Trigger Modes of HP E4915A/E4916A**

Mode	Description	Front panel	HP-IB Command
Int	The HP E4915A/E4916A is triggered from within itself.	✓	✓
Man	The HP E4915A/E4916A is triggered only when you have pressed the <b>(Trig)</b> key on the front panel.	✓	✓
Ext	The HP E4915A/E4916A is triggered when a TTL pulse signal is input through the Ext Trigger or Handler Interface port on the rear panel.	✓	✓
Bus	This mode is available when the HP E4915A/E4916A is remote-controlled via the HP-IB, and causes the HP E4915A/E4916A to be triggered when the GET or *TRG command is issued. (For more information, refer to "HP-IB Commands Associated with Trigger Mode" in Chapter 5).		✓

### Selecting a Trigger Mode

The following table shows how to select one of the trigger modes:

**Table 4-24. Selecting a Trigger Mode**

	Key/command	Available trigger mode
Front panel	<b>(blue)</b> + <b>(Trig (Trigger Mode))</b>	Int, Man, Ext
HP-IB	TRIGSOURCE	Int, Man, Ext, Bus

### Note



Bus mode is available only via the HP-IB.

### Display of Trigger Mode Status

The LCD screen shows a ▼ marker that points at the trigger mode currently in effect. When Bus mode is in effect, however, the Trigger display is disabled.

**Manual Trigger (Trig) Key**

When the trigger mode is set to Man, the HP E4915A/E4916A starts one cycle of measurement every time you press the (Trig) key. (For how to set the trigger mode, refer to "Selecting a Trigger Mode" earlier in this section).

## HP-IB Command Reference

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This chapter contains the following three parts:

- **“Command Reference by Function”**: Command reference categorized by function that describes all the HP-IB commands available with the HP E4915A/E4916A, except those that are associated with the optional LCR Meter function (Option 010).
- **“Alphabetical Command Reference”**: Alphabetical command reference that describes all the HP-IB commands available with the HP E4915A/E4916A, except those that are associated with the optional LCR Meter function (Option 010).
- **“LCR Meter Command Reference”**: Command reference dedicated to the HP-IB commands associated with the LCR Meter function (Option 010). Note that the LCR Meter function is an option available for HP E4916A only.

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## Conventions and Syntax

**Conventions** This subsection describes the conventions used to describe the syntax of HP-IB commands.

This reference uses several special characters to represent particular conditions in the syntax. Some examples follow:

**ALCL**{OFF|ON|0|1}

Turns ON/OFF ALC (Auto Level Control) mode.

**SPRANGe**□<value>[{}Hz|Ppm]

Specifies the spurious search range. The unit can be either Hz or ppm. If no unit is specified, the system uses the same unit as used in the last search.

The special characters that appear in the examples above are defined as follows:

- < > Angular brackets enclose words or characters that are used to symbolize a program code parameter or an HP-IB command.
- [] Square brackets indicate that the enclosed items are optional.
- { } When several items are enclosed by braces, one and only one of these elements may be selected. A vertical bar

can be read as “or” and is used to separate alternative parameter options.

| Vertical bars are used to separate the mutually exclusive options contained in { }.

#### Uppercase /lowercase

You can omit any lowercase letters in a command name or parameter value shown in the reference. In your program code, you can describe, for example, SPRANGe as SPRANG and Ppm as P.

Therefore, the two syntax examples show above can be interpreted as follows:

The syntax representation `ALC{OFF|ON|0|1}` indicates that the ALC command can be issued in one of the following four forms: `ALC{OFF}`, `ALC{ON}`, `ALC{0}`, and `ALC{1}`.

The syntax representation `SPRANGe{<value>[Hz|Ppm]}` contains an optional parameter `[Hz|Ppm]`. If you use this parameter, you can specify one of two mutually exclusive values: Hz or Ppm.

## Program Message Syntax

This section provides the construction of SCPI program message. A program message is the message that you send from computer to an instrument. Program message consist of commands combined with appropriate punctuation and program message terminators.

**Case** Letter cases (upper and lower) are ignored.

As a typographic convention, this reference uses uppercase letters to indicate the required part of a command name or parameter value, and lower letters to indicate any optional part. When you actually create your program code, however, you can describe command names in lowercase letters as well as in uppercase letters.

## Program Message Terminator

A program message must end with one of the three **program message terminators**,

`<new line>`, `<^END>`, or `<new line><^END>`. `<^END>` means that End Of Identify (EOI) is asserted on the HP-IB interface at the same time the preceding data byte is sent. For example, the HP BASIC OUTPUT statement is automatically sent after last data byte.

## Common Command Syntax

Common commands do not have a hierarchical structure. They are just sent as follows:

\*CLS

**Parameters** There must be a <space> between the last command mnemonic and the first parameter in a subsystem command.

AGINGTIME␣<parameter>

␣ means a space (ASCII character (decimal 32)).

If you send more than one parameter with a single command, each parameter must be separated by a comma. For example, two parameters are sent following the DATA subsystem's :POINTs command as shown below.

:DATA:POINT␣<parameter> , <parameter>

## Parameter Types

SCPI defines different data formats for use in program message and query responses. The HP E4915A/E4916A accepts commands and parameters in various formats and responds to a particular query in a predefined and fixed format. Each command reference contains information about the parameter types available for the individual commands.

- <value> is used in both common commands and subsystem commands. <value> represents numeric parameters as follows:

100	no decimal point required
100.	fractional digits optional
-1.23, +235	leading signs allowed
4.56e␣3	space allowed after e in exponentials
-7.89E-01	use either E or e in exponentials
.5	digits left of decimal point optional

The HP E4915A/E4916A setting programmed with a numeric parameter can assume a finite number of values, so the HP E4915A/E4916A automatically rounds off the parameter.

Query response of <value> is always a numeric value.

- <Boolean> represents a single binary condition that is either ON or OFF. <Boolean> allows the following parameters:

ON, OFF In a program message  
1, 0 In a program message and query response

## Multiple Messages

To send more than one command in the same message, you must separate them with a semicolon:

\*CLS; :INIT

## Query and Response Message Syntax

All subsystem commands can be queried except for the commands described as "no query" in the command reference. To send a query message, and ? after the last command mnemonic.

:FIMP:APER?

A response message may contain both commas semicolons as separators. When a single query command returns multiple values, a comma is used to separate each item. When multiple queries are sent

in the same message, the group of data items corresponding to each query are separated by a semicolon. For example, the fictitious query :QUERY?;QUERY2? might return a response message of:

<data1>,<data1>;<data2>,<data2>

After the message, <new line><END>is always sent as a response message terminator.

## Command Reference by Function

This section categorizes by function and describes all the HP-IB commands available with the HP E4915A/E4916A, except those associated with the optional LCR Meter function (Option 010). Refer to "LCR Meter Command Reference" for the HP-IB commands associated with the LCR Meter function, which is available as an option for HP E4916A.

## HP-IB Commands Available in All the Measurement Modes

### MEASFunction□{Xtal|Spur|Dld|Em|Lcr|Filter}

This command is used to select one of the available measurement modes/functions.

The query form of this command is MEASFunction? (with no parameter).

Equivalent Key Sequence	Xtal: (blue) + Freq (Xtl) Spur: (blue) + Level (Spurious) Dld: (blue) + Meas Prmtr (DLD) (HP E4916Aonly) Em: (blue) + Nominal CI (EM) (HP E4916Aonly) Lcr: (blue) + Meas Time (LCR) (HP E4916Aonly) Filter: (blue) + CL Value (Flt) (HP E4916Aonly)
Parameter Description	Xtal: Crystal Resonator measurement mode Spur: Spurious measurement mode Dld: Drive Level Dependency measurement mode(HP E4916Aonly) Em: Evaporation Monitor mode (HP E4916Aonly) Lcr: LCR measurement mode (HP E4916Aonly) Filter: Filter measurement mode (HP E4916Aonly)
Query Response	{X S D E L F}

### MEASPARA□{FR|FA|FS|FL}

Selects the frequency type to search for.

The query form of this command is MEASPARA? (with no parameter).

Equivalent Key Sequence	Meas Prmtr PARA
Parameter Description	FR: Resonance frequency FA: Anti-resonance frequency FS: Frequency with the maximum G value (conductance) FL: Resonance frequency with capacitance load
Query Response	{FR FA FS FL}

**SRCHTGT** □ {PHase|PEak}

Determines whether to search for the resonance point based on a target phase or impedance peak.

The query form of this command is SRCHTGT? (with no parameter).

Equivalent Key Sequence	TGT
Parameter Description	PHase: Phase search PEak : Positive/negative peak search
Query Response	{PH PE}

**SRCHRange** □ <value>

Specifies the range to search for the resonance frequency. The unit can be either Hz or ppm. If no unit is specified, the system uses the same unit as used in the last search. Note that the search range is centered at the nominal frequency (refer to NOMFreq).

The query form of this command is SRCHRange? (with no parameter).

Equivalent Key Sequence	RNG
Parameter Description	<value> Frequency search range MHZ M KHZ K HZ PPM: Unit (Defaults to the unit used in the previous search).
Query Response	<value>,{HZ PPM}

**TGTPhase** □ <value>

Specifies the target phase value.

The query form of this command is TGTPhase? (with no parameter).

Equivalent Key Sequence	PHAS
Parameter Description	<value> Target phase value
Query Response	<value>

**NOMFreq** □ <value>

Specifies the nominal resonance frequency. This value is used as the center frequency for the search range (refer to SRCHRange). The unit can be MHZ, KHZ, HZ, M, or K.

The query form of this command is NOMFreq? (with no parameter).

Equivalent Key Sequence	Freq
Parameter Description	<value> Nominal resonance frequency [MHZ M KHZ K HZ]: Unit
Query Response	<value>

Function: Available in All the Modes

MEASTime□&lt;value&gt;

**NOMCI**□<value> Specifies the nominal resonance frequency. When ALC mode is OFF, the system controls the drive level based on this nominal value. The value can also be used as the reference value for Delta mode (refer to DLTMode).

The query form of this command is NOMCI? (with no parameter).

Equivalent Key Sequence	Nominal CI CI
Parameter Description	<value> Nominal resonance impedance
Query Response	<value>

**POWER**□<value> Specifies the power level value. If no unit is specified, the system uses the same unit as used in the last search.

The query form of this command is POWER? (with no parameter).

Equivalent Key Sequence	Level LVL: Lets you enter a value. UNIT: Lets you select a unit.
Parameter Description	<value> Power level value [MW UW NW W MA UA A MV UV V DBM]: Unit (Defaults to the unit used in the previous search). M: m (milli), U: $\mu$ (micro), N: n (nano), MA: mA
Query Response	<value>,{W A V D}

**ALC**□{OFF|ON|0|1} Turns ON/OFF ALC (Auto Level Control) mode. With ALC mode ON, the system controls the drive level based on the actual CI value of the DUT; with ALC mode OFF, the system uses the user-specified nominal CI value.

The query form of this command is ALC? (with no parameter).

Equivalent Key Sequence	ALC
Parameter Description	OFF: Turns OFF ALC mode ON: ALC mode ON 0: ALC mode OFF 1: ALC mode ON
Query Response	{1 0}

**MEASTime**□<value> Sets the measuring time of the HP E4915A/E4916A to one of six levels (levels 1 to 6). The measuring time increases in the ascending order of these six level numbers; that is, level 1 provides the shortest time while level 6 provides the longest time. For DUTs with high Q values, levels 4 to 6 are recommended (High-Q mode is mapped to levels 4 to 6).

The query form of this command is MEASTime? (with no parameter).

MEASTime□&lt;value&gt;

Function: Available in All the Modes

Equivalent Key Sequence	<b>Meas Time</b> – Corresponds to levels 1 to 6.(1 to 3 for LCR Mode)		
	TIME		
	HI Q		
Parameter Description	MEASTime	Measuring time	High Q
	1	Short	OFF
	2	Med	OFF
	3	Long	OFF
	4	Short	ON
	5	Med	ON
	6	Long	ON
Query Response	<value>		

## HP-IB Commands Specific to Crystal Resonator Measurement Mode (Xtl Mode)

- \*TRG** Triggers the measurement process. When trigger mode is BUS trigger, issuing the \*TRG command causes the HP E4915A/E4916A to transfer the measurement results to the controller. The following table describes the format and contents of the data transferred upon the execution of the \*TRG command.

Transferred Data	<ul style="list-style-type: none"> <li>■ ASCII format transfer ASCII: &lt;num_elements&gt;,&lt;asc_data&gt;&lt;NL&gt;&lt;END&gt; &lt;asc_data&gt;:=&lt;F&gt;,&lt;FL&gt;,&lt;CI&gt;[,&lt;Q&gt;,&lt;Ts&gt;,&lt;C0&gt;,&lt;C1&gt;,&lt;L1&gt;,&lt;R1&gt;[,&lt;G0&gt;,&lt;R0&gt;]] [,&lt;comp&gt;][,&lt;time&gt;]&lt;comp&gt;:=&lt;bin_num&gt;,&lt;pri&gt;,&lt;sec&gt;</li> <li>■ Binary format transfer BINARY: #4&lt;num_bytes&gt;&lt;bin_data&gt;&lt;NL&gt;&lt;END&gt; &lt;bin_data&gt;:=[&lt;time&gt;]&lt;F&gt;&lt;FL&gt;&lt;CI&gt;[&lt;Q&gt;&lt;Ts&gt;&lt;C0&gt;&lt;C1&gt;&lt;L1&gt;&lt;R1&gt;[&lt;G0&gt;&lt;R0&gt;]][&lt;comp&gt;][&lt;time&gt;]&lt;comp&gt;:=&lt;bin_num&gt;&lt;pri&gt;&lt;sec&gt;</li> </ul>
Data Elements	<ul style="list-style-type: none"> <li>■ Data elements transferred whenever TRG is issued &lt;num_elements&gt; : Number of data elements transferred &lt;num_bytes&gt;: Number of bytes transferred (for example, this element contains #40256 when 256 bytes are transferred). &lt;F&gt; : F (Measured resonance frequency: Fr, Fa, Fs) &lt;FL&gt; : FL (Measured resonance frequency) &lt;CI&gt; : CI/Z (Measured resonance impedance)</li> <li>■ Data elements transferred with the Equivalent Circuit Analysis function ON (for both 4- and 6-element modes) &lt;Q&gt; : Q &lt;Ts&gt; : Ts &lt;C0&gt; : C0 &lt;C1&gt; : C1 &lt;L1&gt; : L1 &lt;R1&gt; : R1</li> <li>■ Data elements transferred with the Equivalent Circuit Analysis function ON (for 6-element mode only) &lt;G0&gt; : G0 &lt;R0&gt; : R0</li> <li>■ Data elements transferred with the Comparator function ON &lt;bin_num&gt; : Bin identification number -1: OUT OF BIN -2 = AUX BIN 1 to 9 = Bin number &lt;pri&gt; : Result of primary sorting 0: PASS 1: FAIL &lt;sec&gt; : Result of secondary sorting 0: PASS 1: FAIL -1: Secondary sorting OFF</li> <li>■ Data elements transferred with Aging mode ON (refer to the OUTPMDData command) &lt;time&gt; : Total elapsed time [ms]</li> <li>■ New Line &lt;NL&gt;&lt;END&gt;: NewLineEND (1 byte)</li> </ul>

**FETCh?** Outputs the measurement result acquired with the INITiate command. FETCh? outputs the same data as \*TRG.

**EQUCKt**{DEV4|DEV6|OFF}

Controls the Equivalent Circuit Analysis function. With this command, you can cause the Equivalent Circuit Analysis function to simulate either a 4- or 6-element equivalent circuit; or turn off the Equivalent Circuit Analysis function.

The query form of this command is EQUCKt? (with no parameter).

Equivalent Key Sequence	(blue) + $\mu/M$ (Equiv Ckt) EQUCKt
Parameter Description	DEV4: 4-element equivalent circuit DEV6: 6-element equivalent circuit OFF: Equivalent Circuit Analysis function OFF
Query Response	{DEV4 DEV6 OFF}

**DSPQ**{OFF|ON|0|1} Shows or hides the Q parameter on the LCD.

The query form of this command is DSPQ? (with no parameter).

Equivalent Key Sequence	DSPQ
Parameter Description	OFF: Hides the Q parameter. ON: Shows the Q parameter. 0: Hides the Q parameter. 1: Shows the Q parameter.
Query Response	{1 0}

**AGING**{OFF|ON|0|1} Turns ON/OFF Aging mode. With Aging mode ON, the HP E4915A/E4916A measures the DUT repeatedly at specified time intervals (as specified with the AGINGTIME command).

The query form of this command is AGING? (with no parameter).

Equivalent Key Sequence	AGE
Parameter Description	OFF: Aging mode OFF ON: Aging mode ON 0: Aging mode OFF 1: Aging mode ON
Query Response	{1 0}

## Function: Xtl Measurement Mode

CLACT┘&lt;value&gt;

**AGINGTIME┘<value>** Determines the length of the measurement interval in Aging mode.  
The query form of this command is AGINGTIME? (with no parameter).

Equivalent Key Sequence	Time
Parameter Description	<value> Length of time interval [S MS M]: Unit of time
Query Response	<value>

**OUTPMDData?** A query-dedicated command that allows you to obtain measurement data in Aging mode. This command provides a query response equivalent to that of the \*TRG command without affecting the trigger system.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	—

## CLADJust┘{OFF|ON|0|1}

Turns ON/OFF CL Adjust mode.

The query form of this command is CLADJust? (with no parameter).

Equivalent Key Sequence	(blue) + n/ppm (CL Adj)
Parameter Description	OFF: CL Adjust mode OFF ON: CL Adjust mode ON 0: CL Adjust mode OFF 1: CL Adjust mode ON
Query Response	{1 0}

**CLACT┘<value>** Specifies the value of the capacitance load actually connected to the DUT.

The query form of this command is CLACT? (with no parameter).

Equivalent Key Sequence	CL_a
Parameter Description	<value> Capacitance load value (Actual CL) [PF]
Query Response	<value>

**CLACTType**  $\square$  {NOCL|USER}

Determines whether to regard the DUT as being connected with no capacitance load (NOCL) or with a user-specified capacitance load (USER). (Note that, when no capacitance load is connected, the CL value is infinite).

The query form of this command is CLACTType? (with no parameter).

Equivalent Key Sequence	CL_a
Parameter Description	NOCL: Capacitance load not connected (CL value infinite). USER: User-specified CL value
Query Response	{NOCL USER}

**CLTGT**  $\square$  <value>

Specifies the target capacitance load. There are occasions when you want to calculate characteristic values assuming a capacitance load value different than the capacitance load actually connected to the DUT. If this is the case, you can use the CLTGT command to specify your desired non-actual target capacitance load value.

The query form of this command is CLTGT? (with no parameter).

Equivalent Key Sequence	CL Value CL_t
Parameter Description	<value> Target capacitance load value (Target CL) [PF]
Query Response	<value>

**CLTGType**  $\square$  {NOCL|USER|CLACT}

Determines whether to use the actually connected capacitance load (the CLACT option) or a different value (the USER option) as the target capacitance load value. If you want to compensate for the actual capacitance load, use this command with the CLACT command to set the target to the same value as the actual capacitance load by specifying the CLACT option. If you want to assume a different capacitance load than actually connected, use the CLTGType command with the USER option so you can specify your desired non-actual target value with the CLTGT command. In addition, you can use the NOCL option to cause the system to regard the DUT as being connected with no capacitance load.

The query form of this command is :CLTGType? (with no parameter).

Equivalent Key Sequence	CL_t
Parameter Description	NOCL: Capacitance load not connected. CLAct: Causes the system to use the actual CL value as the target CL value. User: Causes the system to accept a CL value specified with the CLTGT .
Query Response	{NOCL USER CLACT}

**CLCOMPen** Calculate the capacitance load which enables a crystal resonator to oscillate at the frequency of the reference resonator using the CL Compensation function.

This command is not available in a query form.

Equivalent Key Sequence	CL Compn
Parameter Description	—
Query Response	Query form not supported.

**CLFREQ□<value>** Specifies the frequency of the reference resonator used in CL Compensation function.

The query form of this command is CLFREQ? (with no parameter).

Equivalent Key Sequence	Ftgt
Parameter Description	<value> Frequency of the reference resonator [MHZ M KHZ K HZ]: Unit of the frequency
Query Response	<value>, {MHZ M KHZ K HZ}

## HP-IB Commands Specific to CL Adjust Mode

**\*TRG** Triggers the measurement process. Issuing the \*TRG command causes the HP E4915A/E4916A to transfer the measurement results to the controller. The following table describes the format and contents of the data transferred upon the execution of the \*TRG command.

<b>Transferred Data</b>	<ul style="list-style-type: none"> <li>■ ASCII format transfer ASCII: &lt;num_elements&gt;,&lt;asc_data&gt;&lt;NLEND&gt; &lt;asc_data&gt;:=&lt;CL&gt;</li> <li>■ Binary format transfer BINARY: #4&lt;num_bytes&gt;&lt;bin_data&gt;&lt;NLEND&gt; &lt;bin_data&gt;:=&lt;CL&gt;</li> </ul>
<b>Data Elements</b>	<p>&lt;num_elements&gt; : Number of data elements transferred                  &lt;num_bytes&gt;: Number of bytes transferred                  &lt;CL&gt; : Actual CL value                  &lt;NLEND&gt;: NewLineEND (1 byte)</p>

**FETCh?** Outputs the measurement result acquired with the INITiate command. FETCh? outputs the same data as \*TRG.

## HP-IB Command Specific to Spurious Measurement Mode

- \*TRG** Triggers the measurement process. Issuing the \*TRG command causes the HP E4915A/E4916A to transfer the measurement results to the controller. Spurious points are reported in the ascending order with respect to the resonance frequency. Use the SPNUM command to specify the number of spurious points to search for.

The following table describes the format and contents of the data transferred upon the execution of the \*TRG command.

Transferred Data	<ul style="list-style-type: none"> <li>■ ASCII format transfer ASCII: &lt;num_elements&gt;, &lt;asc_data&gt; &lt;NL'END&gt; &lt;asc_data&gt; = &lt;F&gt;, &lt;CI&gt;, &lt;spur_num&gt;, &lt;sFworst&gt;, &lt;CIworst&gt; [, &lt;sF1&gt;, &lt;sCI1&gt; [, &lt;sF2&gt;, &lt;sCI2&gt; [, ... ]]]</li> <li>■ Binary format transfer BINARY: #4&lt;num_bytes&gt; &lt;bin_data&gt; &lt;NL'END&gt; &lt;bin_data&gt; = &lt;F&gt; &lt;CI&gt; &lt;spur_num&gt;, &lt;sFworst&gt;, &lt;CIworst&gt; [ &lt;sF1&gt; &lt;sCI1&gt; [ &lt;sF2&gt; &lt;sCI2&gt; [ ... ] ] ]</li> </ul>
Data Elements	<ul style="list-style-type: none"> <li>■ Data elements transferred whenever TRG is issued &lt;num_elements&gt; : Number of data elements transferred &lt;num_bytes&gt; : Number of bytes transferred (for example, this element contains #40048 when 48 bytes are transferred). &lt;F&gt; : F (Measured resonance frequency: Fr, Fa, Fs) &lt;CI&gt; : CI/Z (Measured resonance impedance)</li> <li>■ When the equivalent circuit analysis is ON. &lt;Q&gt; :Q &lt;TS&gt; :TS &lt;C0&gt; :C0 &lt;C1&gt; :C1 &lt;L1&gt; :L1 &lt;R1&gt; :R1</li> <li>■ When the equivalent circuit analysis is 6 devices mode. &lt;C0&gt; :C0 &lt;R0&gt; :R0</li> <li>■ Number of spurious points &lt;spur_num&gt; : Number of detected spurious points</li> <li>■ Worst Spurious &lt;sFworst&gt; : Frequency of the point which has the minimum impedance value of all spurious points. &lt;sCIworst&gt; : Impedance at the point which has the minimum impedance value of all spurious points.</li> <li>■ Data elements transferred when one or more spurious points are specified by SPNUM. &lt;sFn&gt; : Frequency of the spurious point (n:number of spurious specified by SPNUM) &lt;sCIn&gt; : Impedance at the spurious point(n:number of spurious specified by SPNUM)</li> <li>■ New Line &lt;NL'END&gt; : NewLine'END (1 byte)</li> </ul>

**FETCh?** Outputs the measurement result acquired with the INITiate command. FETCh? outputs the same data as \*TRG.

**SPRANGe**  $\square$  *<value>* Specifies the spurious search range. The unit can be either Hz or ppm. If no unit is specified, the system uses the same unit as used in the last search. Note that the search range is centered at the frequency specified with the SPCENter command.

The query form of this command is SPRANGe? (with no parameter).

Equivalent Key Sequence	<b>RNG</b>
Parameter Description	<i>&lt;value&gt;</i> : Frequency range [MHZ M KHZ K HZ PPM]: Unit (Defaults to the unit used in the previous search).
Query Response	<i>&lt;value&gt;</i> , {HZ PPM}

**SPNUM**  $\square$  *<value>* Specifies the number of spurious points to search for.

The query form of this command is SPNUM? (with no parameter).

Equivalent Key Sequence	<b>#Spur</b>
Parameter Description	<i>&lt;value&gt;</i> : Number of spurious points to search for
Query Response	<i>&lt;value&gt;</i>

**SPTGT**  $\square$  {PHase|PEak} Determines whether to search for spurious points based on a particular target phase or impedance peak.

The query form of this command is SPTGT? (with no parameter).

Equivalent Key Sequence	<b>TGT</b>
Parameter Description	Phase: Searches for spurious points that match the target phase. Peak : Searches for spurious points with peak impedance.
Query Response	{PH PE}

**SPPHase**  $\square$  *<value>* Specifies the target phase for spurious search. This command takes effect with the PHase option specified for the SPTGT command.

The query form of this command is SPPHase? (with no parameter).

Equivalent Key Sequence	<b>PHAS</b>
Parameter Description	<i>&lt;value&gt;</i> Target phase value
Query Response	<i>&lt;value&gt;</i>

**Function: Spurious Measurement Mode**

**SPDISP□{Worst|Nth,<value>}**

Determines which spurious point to be displayed on the LCD. This command requires one of the two options: Worst and Nth. Use the Worst option to display the worst spurious point (i.e., the spurious point where the impedance value reaches the maximum negative peak). On the other hand, the Nth option allows you to specify the index number of the spurious point you want displayed; for example, you can specify 1 for the spurious point with the smallest frequency, 2 for the spurious point with the second smallest frequency, and so on.

The query form of this command is SPDISP? (with no parameter).

<b>Equivalent Key Sequence</b>	DispSP
<b>Parameter Description</b>	<p>Worst: Displays the worst spurious point.                      Nth: Displays the Nth spurious point.                      &lt;value&gt; : Specify the index number of the desired spurious point. This parameter must follow the Nth option (not required for the Worst option).</p>
<b>Query Response</b>	<p>&lt;value&gt;                      &lt;value&gt; : An integer value that represents the index number of the spurious point currently displayed (returns 0 if the Worst option was specified).</p>

## HP-IB Commands Specific to the Evaporation Monitor Mode (Trap Function)

**\*TRG** Triggers the measurement process. Issuing the \*TRG command causes HP E4916A to transfer the measurement results to the controller. By default, the measurement results returned include only those at the final trap point. To obtain the measurement results for all the trap points, turn ON the memory buffer function.

The following table describes the format and contents of the data transferred upon the execution of the \*TRG command.

Transferred Data	<ul style="list-style-type: none"> <li>■ ASCII format transfer ASCII: &lt;num_elements&gt;, &lt;asc_data&gt; &lt;NLEND&gt; &lt;asc_data&gt; = &lt;F&gt;, &lt;CI&gt;, &lt;time&gt;</li> <li>■ Binary format transfer BINARY: #4&lt;num_bytes&gt; &lt;bin_data&gt; &lt;NLEND&gt; &lt;bin_data&gt; = &lt;F&gt; &lt;CI&gt; &lt;time&gt;</li> </ul>
Data Elements	<p>&lt;num_elements&gt; : Number of data elements transferred          &lt;num_bytes&gt; : Number of bytes transferred (#40024)          &lt;F&gt; : F (Trap frequency)          &lt;CI&gt; : CI/Z (CI value at the trap frequency)          &lt;time&gt; : Time required between two trap points (ms)          &lt;NLEND&gt; : NewLineEND (1 byte)</p>

**FETCh?** Outputs the measurement result acquired with the INITiate command. FETCh? outputs the same data as \*TRG.

**EMDIR** {DOWN|UP} Determines the change direction of the resonance frequency in frequency adjustment.

The query form of this command is EMDIR? (with no parameter).

Equivalent Key Sequence	<b>Dir</b>
Parameter Description	<p>DOWN: Decreasing direction of the resonance frequency in frequency adjustment          UP: Increasing direction of the resonance frequency in frequency adjustment</p>
Query Response	{DOWN UP}

**EMMANmode** {ON|OFF}

Enables/disables entry of the trap frequency from the front panel.

The query form of this command is EMMANmode? (with no parameter).

## Function: Evaporation Monitor Mode

EMLSIZE  $\square$  *<value>*

Equivalent Key Sequence	MAN
Parameter Description	OFF: Disables entry of the trap frequency from the front panel. ON: Enables entry of the trap frequency from the front panel. 0: Disables entry of the trap frequency from the front panel. 1: Enables entry of the trap frequency from the front panel.
Query Response	{ON OFF}

EMLIST  $\square$  *<value1>*, *<value2>*, *<value3>*, {OFF|ON|0|1}, *<value4>*

Defines a list of trap points. The list contains the following definitions for each trap point:

The query form of this command is EMLIST?  $\square$  *<value1>*. The parameter *<value1>* must be supplied to specify the number of the trap point whose settings you want to obtain.

Equivalent Key Sequence	—
Parameter Description	<i>&lt;value1&gt;</i> : Number of the trap point <i>&lt;value2&gt;</i> : Frequency at the trap point <i>&lt;value3&gt;</i> : Phase value at the trap point (applies only in the case you specified the PHASE option for the SRCHTGT command). OFF: I/O port output OFF ON: I/O port output ON 0: I/O port output OFF 1: I/O port output ON <i>&lt;value4&gt;</i> : Output data (I/O port output ON only)
Query Response	<i>&lt;value2&gt;</i> , <i>&lt;value3&gt;</i> , {OFF ON 0 1}, <i>&lt;value4&gt;</i> Query response returns <i>&lt;value4&gt;</i> regardless of on/off.

EMLSIZE  $\square$  *<value>*

Specifies the size of the trap point list. The list size is represented as the number of lines. You can specify an integer from 1 to 30.

The query form of this command is EMLSIZE? (with no parameter).

Equivalent Key Sequence	—
Parameter Description	<i>&lt;value&gt;</i> : Size of the trap point list.  <i>&lt;value&gt;</i> : Size of the trap point list
Query Response	<i>&lt;value&gt;</i>

**EMLClear** Clears the trap point list.

This command is not available in a query form.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	Query form not supported.

**EMSTARTPoint**  $\square$   $\langle value \rangle$

Specifies the trap point at which to start measuring the DUT in Evaporation Monitor mode.

The query form of this command is EMSTARTPoint? (with no parameter).

Equivalent Key Sequence	<b>StartP</b> — Presents read-only display of the current value.
Parameter Description	$\langle value \rangle$ : Start point
Query Response	$\langle value \rangle$

**EMTMOUT**  $\square$   $\langle value \rangle$

Determines the time-out of the Trap function, that is, the length of time the Trap function waits for the DUT to reach the specified trap frequency.

The query form of this command is EMTMOUT? (with no parameter).

Equivalent Key Sequence	<b>Tout</b> — Presents read-only display of the current value.
Parameter Description	$\langle value \rangle$ Time-out value [ms] [S MS M]: Unit of time (Defaults to the unit used in MS)
Query Response	$\langle value \rangle$

**EMOPEB**  $\square$  {OFF|ON|0|1},  $\langle value \rangle$

Defines the data to be output through the I/O port when the system starts measuring the DUT in Evaporation Monitor mode.

The query form of this command is EMOPEB? (with no parameter).

Equivalent Key Sequence	—
Parameter Description	OFF: Disables output through I/O port. ON: Enables output through I/O port. 0: Disables output through I/O port. 1: Enables output through I/O port. $\langle value \rangle$ :
Query Response	{0 1}, $\langle value \rangle$ $\langle value \rangle$ : Query response always returns $\langle value \rangle$ .

**Function: Evaporation Monitor Mode**

**EMCLOB** {OFF|ON|0|1}, <value>

Defines the data to be output through the I/O port when the system finishes measuring the DUT in Evaporation Monitor mode.

The query form of this command is EMCLOB? (with no parameter).

<b>Equivalent Key Sequence</b>	—
<b>Parameter Description</b>	OFF: Disables output through I/O port. ON: Enables output through I/O port. 0: Disables output through I/O port. 1: Enables output through I/O port. <value> : Output data (I/O port output ON only)
<b>Query Response</b>	{0 1}, <value> Query response always returns <value>.

## HP-IB Commands Specific to Drive Level Dependency Measurement Mode

**\*TRG** Triggers the measurement process. Issuing the \*TRG command causes HP E4916A to transfer the measurement results to the controller. By default, the measurement results returned include only those at the final sweep point. To obtain the measurement results for all the sweep points, turn ON the memory buffer function.

The following table describes the format and contents of the data transferred upon the execution of the \*TRG command.

<b>Transferred Data</b>	<ul style="list-style-type: none"> <li>■ ASCII format transfer  <code>&lt;num_elements&gt;,&lt;asc_data&gt;&lt;NL&gt;END</code>  <code>&lt;asc_data&gt;:=&lt;F&gt;,&lt;CI&gt;,&lt;STAT&gt;,&lt;MinF&gt;,&lt;MaxF&gt;,&lt;MinCI&gt;,&lt;MaxCI&gt;</code>  <code>&lt;MaxF-MinF&gt;,&lt;MaxCI-MinCI&gt;[,&lt;comp&gt;]</code>  <code>&lt;comp&gt;:=&lt;bin_num&gt;,&lt;pri&gt;,&lt;sec&gt;,&lt;t_1&gt;,&lt;t_2&gt;</code> </li> <li>■ Binary format transfer  <code>#4&lt;num_bytes&gt;&lt;bin_data&gt;&lt;NL&gt;END</code>  <code>&lt;bin_data&gt;:=&lt;F&gt;&lt;CI&gt;&lt;STAT&gt;&lt;DL&gt;&lt;MinF&gt;&lt;MaxF&gt;&lt;MinCI&gt;&lt;MaxCI&gt;</code>  <code>&lt;MaxF-MinF&gt;&lt;MaxCI-MinCI&gt;[&lt;comp&gt;]</code>  <code>&lt;comp&gt;:=&lt;bin_num&gt;&lt;pri&gt;&lt;sec&gt;&lt;t_1&gt;&lt;t_2&gt;</code> </li> </ul>
<b>Data Elements</b>	<ul style="list-style-type: none"> <li>■ Data elements transferred whenever TRG is issued  <code>&lt;num_elements&gt;</code> : Number of data elements transferred  <code>&lt;num_bytes&gt;</code> : Number of bytes transferred  <code>&lt;F&gt;</code> : F (Resonance frequency measured at the reference drive level)  <code>&lt;CI&gt;</code> : CI/Z (Resonance impedance measured at the reference drive level).  <code>&lt;STAT&gt;</code> : Indicates whether the tracking measurement was successful.              0: PASS              1: FAIL  <code>&lt;MinF&gt;</code> : Minimum <code>&lt;F&gt;</code> value  <code>&lt;MaxF&gt;</code> : Maximum <code>&lt;F&gt;</code> value  <code>&lt;MinCI&gt;</code> : Minimum <code>&lt;CI&gt;</code> value  <code>&lt;MaxCI&gt;</code> : Maximum <code>&lt;CI&gt;</code> value  <code>&lt;MaxF-MinF&gt;</code> : Difference between maximum and minimum <code>&lt;F&gt;</code> values  <code>&lt;MaxCI-MinCI&gt;</code> : Difference between maximum and minimum <code>&lt;CI&gt;</code> values         </li> <li>■ Data elements transferred with the Comparator function ON  <code>&lt;bin_num&gt;</code> : Bin identification number              -1: OUT OF BIN              -2 = AUX BIN              1 to 5 = Bin number  <code>&lt;pri&gt;</code> : Result of primary sorting              0: PASS              1: FAIL  <code>&lt;sec&gt;</code> : Result of secondary sorting              0: PASS              1: FAIL              -1: Secondary sorting OFF  <code>&lt;t_1&gt;</code> : Result of <math>\Delta F</math> limit test              0: PASS              1: FAIL              -1: <math>\Delta F</math> limit test OFF  <code>&lt;t_2&gt;</code> : Result of <math>\Delta CI</math> limit test              0: PASS              1: FAIL              -1: <math>\Delta CI</math> limit test OFF         </li> <li>■ New Line  <code>&lt;NL&gt;END</code> : NewLine END (1 byte)         </li> </ul>

**FETCh?** Outputs the measurement result acquired with the INITiate command. FETCh? outputs the same data as \*TRG.

**PTWAIT**□<value> Determines the length of time the system waits for the DUT to become stable with the power being applied.  
The query form of this command is PTWAIT? (with no parameter).

Equivalent Key Sequence	<b>WAIT</b>
Parameter Description	<value> Wait time between energization and stabilization of the DUT [S MS M]: Unit of time (Defaults to the unit used in S).
Query Response	<value>

**PTRACK**□{ON|OFF|0|1}

Turns ON/OFF the Phase Tracking function.

The query form of this command is PTRACK? (with no parameter).

Equivalent Key Sequence	<b>TRG</b>
Parameter Description	OFF: Phase tracking OFF. The resonance frequency is detected by Fr search and then drive level is swept with the frequency maintained. ON: Phase tracking ON. The resonance frequency at each drive level is searched by sweeping the drive level to detect the CI value at the resonance point. 0: Phase tracking OFF. The resonance frequency is detected by Fr search and then drive level is swept with the frequency maintained. 1: Phase tracking ON. The resonance frequency at each drive level is searched by sweeping the drive level to detect the CI value at the resonance point.
Query Response	{ON OFF 0 1}

**PTCLEar** Clears the drive level (sweep point) list.  
This command is not available in a query form.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	Query form not supported.

**PTSTARTPoint**□<value>

Specifies the drive level at which to start measuring the drive level characteristics.

The query form of this command is PTSTARTPoint? (with no parameter).

PTSTARTPoint□&lt;value&gt;

Equivalent Key Sequence	StartP
Parameter Description	<value> : Start point
Query Response	<value>

PTABORT□{OFF|ON|0|1}

Turns ON/OFF the phase tracking abort function. When the abort function is ON and phase tracking fails, the system aborts drive level measurement. When the abort function is OFF and phase tracking fails, the system retries to search for the resonance frequency and continue to measure the drive level dependency.

The query form of this command is PTABORT? (with no parameter).

Equivalent Key Sequence	ABR
Parameter Description	OFF: Abort function OFF ON: Abort function ON 0: Abort function OFF 1: Abort function ON
Query Response	{1 0}

PTSTDPower□&lt;value&gt; Specifies the reference drive level.

The query form of this command is PTSTDPower? (with no parameter).

Equivalent Key Sequence	STD
Parameter Description	<value> Reference drive level [MW UW NW W MA UA A MV UV V DBM]: Unit of the power level
Query Response	<value>,{W A V D}

PTLIST□&lt;value1&gt;,&lt;value2&gt;,{OFF|ON|0|1}

Allows you to define a list of drive levels (sweep points). With this command, you can arrange sweep points (drive levels) exactly as you desire. Also, you can enable or disable drive level measurement for each of the sweep points; that is, you can define sweep points where no measurement is performed.

The query form of this command is PTLIST?□<value1>. The parameter <value1> must be supplied to specify the number of the sweep point whose settings you want to obtain.

Function: DLD Measurement Mode

PTMINPower□<value>

Equivalent Key Sequence	—
Parameter Description	<value1> : Number of the sweep point <value2> Drive level at the sweep point [MW UW NW W MA UA A MV UV V DBM]: Unit of the power level OFF: Drive power OFF. ON: Drive power ON.
Query Response	<value2>,{1 0}  <value2> : Drive level at the specified sweep point {OFF ON 0 1}: Whether to enable or disable applying drive power at the specified sweep point

Note



In Drive Level Dependency measurement mode, you can set up the sweep pattern in one of the following two ways:

Table 5-1. Setting Up the Sweep Pattern

Method	HP-IB Commands	Description
Sweep point list	PTLIST, PTSWPTtype	Issue the PTSWPTtype command with the LIST option, and use the PTLIST command to explicitly specify the drive level values for the respective sweep points.
Maximum/minimum values	PTMINPower, PTMAXPower, PTSWPTtype	Specify the minimum and maximum drive levels, and select one of the three sweep types (UPDOWN, UP, UPMIN) with the PTSWPTtype command. The selected sweep type determines how the drive level is swept between the specified minimum and maximum level values.

PTLSIZE□<value>

Sets the size of the drive level (sweep point) list.

The query form of this command is PTLSIZE? (with no parameter).

Equivalent Key Sequence	—
Parameter Description	<value> : The number of lines that represents the size of the sweep point list
Query Response	<value>

PTMINPower□<value>

Specifies the minimum drive level value. This command must be used in conjunction with the PTMAXPower and PTSWPTtype commands.

The query form of this command is PTMINPower? (with no parameter).

Equivalent Key Sequence	<b>MIN</b>
Parameter Description	<value> Minimum drive level value [MW UW NW W MA UA A MV UV V DBM]: Unit of the drive level value
Query Response	<value>,{W A V D}

PTMINPower□&lt;value&gt;

Function: DLD Measurement Mode

**Note**

In Drive Level Dependency measurement mode, you can set up the sweep pattern in one of the following two ways:

**Table 5-2. Setting Up the Sweep Pattern**

Method	HP-IB Commands	Description
Sweep point list	PTLIST, PTSWPTType	Issue the PTSWPTType command with the LIST option, and use the PTLIST command to explicitly specify the drive level values for the respective sweep points.
Maximum/minimum values	PTMINPower, PTMAXPower, PTSWPTType	Specify the minimum and maximum drive levels, and select one of the three sweep types (UPDOWN, UP, UPMIN) with the PTSWPTType command. The selected sweep type determines how the drive level is swept between the specified minimum and maximum level values.

PTMAXPower□&lt;value&gt;

Specifies the maximum drive level value. This command must be used in conjunction with the PTMINPower and PTSWPTType commands.

The query form of this command is PTMAXPower? (with no parameter).

Equivalent Key Sequence	<b>MAX</b>
Parameter Description	<value> Maximum drive level value [MW UW NW W MA UA A MV UV V DBM]: Unit of the drive level value
Query Response	<value>,{W A V D}

**Note**

In Drive Level Dependency measurement mode, you can set up the sweep pattern in one of the following two ways:

**Table 5-3. Setting Up the Sweep Pattern**

Method	HP-IB Commands	Description
Sweep point list	PTLIST, PTSWPTType	Issue the PTSWPTType command with the LIST option, and use the PTLIST command to explicitly specify the drive level values for the respective sweep points.
Maximum/minimum values	PTMINPower, PTMAXPower, PTSWPTType	Specify the minimum and maximum drive levels, and select one of the three sweep types (UPDOWN, UP, UPMIN) with the PTSWPTType command. The selected sweep type determines how the drive level is swept between the specified minimum and maximum level values.

Function: DLD Measurement Mode

PTSWPType□{UPDOWN|UP|UPMIN|LIST}

PTSWPType□{UPDOWN|UP|UPMIN|LIST}

Specifies the sweep type.

The query form of this command is PTSWPType? (with no parameter).

Equivalent Key Sequence	<b>SWEP</b>
Parameter Description	<p>UP: Increases the drive level step by step from the minimum level value to the maximum level value.</p> <p>UPDOWN: Increases the drive level step by step from the minimum level value to the maximum level value, and then decreases the drive level from the maximum value to the minimum value.</p> <p>UPMIN: Increases the drive level step by step from the minimum level value to the maximum level value, and then immediately increases the drive level to the minimum value.</p> <p>LIST: Sweeps the drive level in accordance with the sweep point list defined with the PTLIST command.</p>
Query Response	{UPDOWN UP UPMIN LIST}

**Note**

When you change the sweep type, a previous drive level list will be lost.

## HP-IB Commands Specific to Filter Measurement Mode

**\*TRG** Triggers the measurement process. Issuing the \*TRG command causes HP E4916A to transfer the measurement results to the controller. The following table describes the format and contents of the data transferred upon the execution of the \*TRG command.

<b>Transferred Data</b>	<ul style="list-style-type: none"> <li>■ ASCII format transfer ASCII: &lt;num_elements&gt;,&lt;asc_data&gt;&lt;NLEND&gt; &lt;asc_data&gt;:= &lt;Loss&gt;,&lt;Δf_left&gt;,&lt;Δf_right&gt;</li> <li>■ Binary format transfer BINARY: #4&lt;num_bytes&gt;&lt;bin_data&gt;&lt;NLEND&gt; &lt;bin_data&gt;:= &lt;Loss&gt;&lt;Δf_left&gt;&lt;Δf_right&gt;</li> </ul>
<b>Data Elements</b>	<p>&lt;num_elements&gt; : Number of data elements transferred                  &lt;num_bytes&gt;: Number of bytes transferred (#4024)                  &lt;Loss&gt; : Minimum or constant loss                  &lt;Δf_left&gt; : -x dB BW (Δf_left)                  &lt;Δf_right&gt; : -x dB BW (Δf_right)</p>

**FETCh?** Outputs the measurement result acquired with the INITiate command. FETCh? outputs the same data as \*TRG.

### FLTMODE{CONSTant|MINimum}

Determines whether to measure the minimum or constant loss in Filter measurement mode.

The query form of this command is FLTMODE? (with no parameter).

<b>Equivalent Key Sequence</b>	<b>LOSS</b>
<b>Parameter Description</b>	CONSTant: Constant loss MINimum: Minimum loss
<b>Query Response</b>	{CONST MIN}

**FLTDB<value>** Specifies the down value for the filter's band width.

The query form of this command is FLTDB? (with no parameter).

<b>Equivalent Key Sequence</b>	<b>rdB</b>
<b>Parameter Description</b>	<value> Band width of the filter band width [dB]
<b>Query Response</b>	<value>

## HP-IB Commands Specific to Comparator Function

### COMPSTATE□{OFF|ON|0|1}

Turns ON/OFF the Comparator function.

The query form of this command is COMPSTATE? (with no parameter).

Equivalent Key Sequence	(blue) + (m/k (Comprtr)) or COMP
Parameter Description	OFF: Comparator function OFF ON: Comparator function ON 0: Comparator function OFF 1: Comparator function ON +
Query Response	{1 0}

### COMPPRIMode□{ABSTOL|PCNTTOL|SEQ}

Determines whether to perform primary sorting in Sequential or Tolerance mode. Specify the SEQ option for Sequential mode; for Tolerance mode, specify ABSTOL if you want to sort the DUTs based on the actual deviation from the reference value, or PCNTTOL if you want to sort the DUTs based on the percentage of the deviation relative to the reference value. For more information on the sort mode, refer to "Sequential Mode and Tolerance Mode" in Chapter 4 in Chapter 4.

The query form of this command is COMPPRIMode? (with no parameter).

Equivalent Key Sequence	PRI
Parameter Description	ABSTOL: Tolerance mode (based on the actual deviation from the reference value) PCNTTO: Tolerance mode (based on the percentage relative to the reference value) SEQ: Sequential mode
Query Response	{ABSTOL PCNTTOL SEQ}

### COMPTOLSTD□<value>

Specifies the reference value that is applied when primary sorting is performed in Tolerance mode.

The query form of this command is COMPTOLSTD? (with no parameter).

COMPTOLSTD  $\square$   $\langle$ value $\rangle$ 

Equivalent Key Sequence	<b>NDM</b>
Parameter Description	$\langle$ value $\rangle$ : Reference value for primary sorting [MA K M U N P F]: Unit for the reference value
Query Response	$\langle$ value $\rangle$

COMPPLIMIT  $\square$  BIN  $\langle$ n $\rangle$ ,  $\langle$ value1 $\rangle$ ,  $\langle$ value2 $\rangle$ 

Defines the lower and upper limits for each of the primary sorting bins. For primary sorting, you can define up to 9 bins[Xtal measurement mode], 5 bins[DLD mode] by issuing this command for each bin.

The query form of this command is COMPPLIMIT? BIN  $\langle$ n $\rangle$ . The  $\langle$ n $\rangle$  parameter must be supplied to specify the number of the bin whose lower and upper limits you want to obtain.

Equivalent Key Sequence	<b>PriL</b> – Lower limit value <b>PriH</b> – Upper limit value
Parameter Description	$\langle$ n $\rangle$ : {1 2 3 4 5 6 7 8 9 10} (Bin number) $\langle$ value1 $\rangle$ Lower limit value for the specified bin $\langle$ value2 $\rangle$ Upper limit value for the specified bin
Query Response	$\langle$ value1 $\rangle$ , $\langle$ value2 $\rangle$  $\langle$ value1 $\rangle$ : Lower limit value [MA K M U N P F PPM]: Unit $\langle$ value2 $\rangle$ : Upper limit value [MA K M U N P F PPM]: Unit

COMPSEC  $\square$  {OFF|ON|0|1}

Turns ON/OFF secondary sorting.

The query form of this command is COMPSEC? (with no parameter).

Equivalent Key Sequence	<b>SEC</b>
Parameter Description	OFF: Secondary sorting OFF ON: Secondary sorting ON 0: Secondary sorting OFF 1: Secondary sorting ON
Query Response	{1 0}

## Function: Comparator

## COMPSLIMit□&lt;value1&gt;,&lt;value2&gt;

Specifies the lower and upper limits for secondary sorting bin.

The query form of this command is COMPSLIMit? (with no parameter).

Equivalent Key Sequence	<b>SecL</b> – Lower limit value <b>SecH</b> – Upper limit value
Parameter Description	<value1> Lower limit value [MA K M U N P F]: Unit <value2> Upper limit value [MA K M U N P F]: Unit
Query Response	<value1>,<value2>  <value1> : Lower limit value <value2> : Upper limit value

## COMPSECAUX□{OFF|ON|0|1}

Turns ON/OFF the auxiliary bin (AUX bin) function for secondary sorting. The AUX bin is used to separate those DUTs that passed primary sorting but failed secondary sorting, without purging them as OUT OF BIN together with DUTs that failed both primary and secondary sorting.(For more information, refer to “Aux Bin” in Chapter 4 in Chapter 4).

The query form of this command is COMPSECAUX? (with no parameter).

Equivalent Key Sequence	<b>AUX</b>
Parameter Description	OFF: AUX bin function OFF ON: AUX bin function ON 0: AUX bin function OFF 1: AUX bin function ON
Query Response	{1 0}

## BINSIZE□&lt;value&gt;

Specifies the size of the bin.

The query form of this command is BINSIZE? (with no parameter).

Equivalent Key Sequence	–
Parameter Description	<value> : BIN size (Xtal measurement mode:max9,DLD mode:max5)
Query Response	<value>

**BINCNT?**{**BIN1** | ... | **BIN10**|**OUTOF**|**AUX**}

A query-dedicated command that allows you to obtain the count of DUTs contained in a particular bin or in all bins.

Equivalent Key Sequence	—
Parameter Description	BIN1 ... BIN9: Count of DUTs contained in a particular bin for primary sorting(Xtal measurement mode) BIN1 ... BIN5: Count of DUTs contained in a particular bin for primary sorting(DLD mode) OUTOF: Count of DUTs purged as OUT OF BINS AUX: Count of DUTs contained in the AUX bin
Query Response	<value>: Count of DUTs contained in the specified bin (or, if ALL is specified, count of DUTs contained in all bins).

**BINCNTALL?** A query-dedicated command that allows you to obtain the count of DUTs contained in all bins.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	<ul style="list-style-type: none"> <li>■ Query response in Crystal Resonator measurement mode            &lt;num1&gt; : Count of DUTs in bin 1.            ...            &lt;num9&gt; : Count of DUTs in bin 9.            &lt;num10&gt; : Count of DUTs purged as OUT OF BIN.            &lt;num11&gt; : Count of DUTs in the AUX bin.</li> <li>■ Query response in Drive Level Dependency measurement mode            &lt;num1&gt; : Count of DUTs in bin 1.            ...            &lt;num5&gt; : Count of DUTs in bin 5.            &lt;num6&gt; : Count of DUTs purged as OUT OF BIN.            &lt;num7&gt; : Count of DUTs in the AUX bin.            &lt;num8&gt;~&lt;num11&gt;: Returns 0.</li> </ul>

**BINCNTCLEAR** Resets the DUT count for all bins.

This command is not available in a query form.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	Query form not supported.

**Function: Comparator**

**COMPClear** Clears all the lower and upper limit settings.  
 This command is not available in a query form.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	Query form not supported.

**COMPBEEPStat {OFF|ON|0|1}**

Turns ON/OFF the beep output of the Comparator function.  
 The query form of this command is COMPBEEPStat? (with no parameter).

Equivalent Key Sequence	—
Parameter Description	OFF: Beep output OFF ON: Beep output ON 0: Beep output OFF 1: Beep output ON
Query Response	{1 0}

**COMPBEEPCond {FAIL|PASS}**

Determines when the Comparator function outputs beep sound; that is, when a DUT has failed or when a DUT has passed the test.  
 The query form of this command is COMPBEEPCond? (with no parameter).

Equivalent Key Sequence	<u>BEEP</u>
Parameter Description	FAIL: Beeps when DUT has failed. PASS: Beeps when DUT has passed.
Query Response	{FAIL PASS}

**COMPLEDCond {FAIL|PASS}**

Determines when the Comparator function turns ON the LED; that is, when a DUT has failed or when a DUT has passed the test.  
 The query form of this command is COMPLEDCond? (with no parameter).

COMPLEDCond  $\square$  {FAIL|PASS}

Equivalent Key Sequence	LED
Parameter Description	FAIL: LED turns ON when DUT has failed, and turns OFF when DUT has passed. PASS: LED turns ON when DUT has passed, and turns OFF when DUT has failed.
Query Response	{FAIL PASS}

COMPDLTF  $\square$  {OFF|ON|0|1}

## Note



This command is available only when the Comparator function is used in Drive Level Dependency measurement mode.

Turns ON/OFF the  $\Delta F$  limit test function. With this function ON, DUTs are evaluated to the  $\Delta F$  limit (specified with COMPDLTFLim); if the frequency value measured in DLD mode exceeds the limit, then the DUT fails the test.

The query form of this command is COMPDLTF? (with no parameter).

Equivalent Key Sequence	Lm $\Delta F$
Parameter Description	OFF: $\Delta F$ limit test OFF ON: $\Delta F$ limit test ON 0: $\Delta F$ limit test OFF 1: $\Delta F$ limit test ON
Query Response	{1 0}

COMPDLTCI  $\square$  {OFF|ON|0|1}

## Note



This command is available only when the Comparator function is used in Drive Level Dependency measurement mode.

Turns ON/OFF the  $\Delta CI$  limit test function. With this function ON, DUTs are evaluated to the  $\Delta CI$  limit (specified with COMPDLTCILim); if the CI value measured in DLD mode exceeds the limit, then the DUT fails the test.

The query form of this command is COMPDLTCI? (with no parameter).

Equivalent Key Sequence	Lm $\Delta Z$
Parameter Description	OFF: $\Delta CI$ limit test OFF ON: $\Delta CI$ limit test ON 0: $\Delta CI$ limit test OFF 1: $\Delta CI$ limit test ON
Query Response	{1 0}

Function: Comparator

COMPDLTFLim□<value>

Note



This command is available only when the Comparator function is used in Drive Level Dependency measurement mode.

Sets the ΔF limit. If the frequency value measured in DLD mode exceeds the limit, then the DUT fails the test.

The query form of this command is COMPDLTFLim? (with no parameter).

Equivalent Key Sequence	ΔF_H
Parameter Description	<value> Limit value [MA K M U N P F]: Unit
Query Response	<value> Limit value

COMPDLTCILim□<value>

Note



This command is available only when the Comparator function is used in Drive Level Dependency measurement mode.

Sets the ΔCI limit. If the CI value measured in DLD mode exceeds the limit, then the DUT fails the test.

The query form of this command is COMPDLTCILim? (with no parameter).

Equivalent Key Sequence	ΔZ_H
Parameter Description	<value> Limit value [MA K M U N P F]: Unit
Query Response	<value> Limit value

COMPBW□{OFF|ON|0|1}

Note



This command is available only when the Comparator function is used in Filter measurement mode.

Turns ON/OFF the BW limit test function. With this function ON, DUTs are evaluated to the BW limit (specified with COMPBWLim); if the BW value measured in Flt mode exceeds the limit, then the DUT fails the test.

The query form of this command is COMPBW? (with no parameter).

COMPBW {OFF|ON|0|1}

Equivalent Key Sequence	LnBW
Parameter Description	OFF: BW limit test OFF ON: BW limit test ON 0: BW limit test OFF 1: BW limit test ON
Query Response	{1 0}

COMBWLim <value1>, <value2>

**Note**



This command is available only when the Comparator function is used in Filter measurement mode.

Sets the BW limit. If the frequency value measured in Flt mode exceeds the limit, then the DUT fails the test.

The query form of this command is COMPBWLim? (with no parameter).

Equivalent Key Sequence	BW_L – Lower limit value BW_H – Upper limit value
Parameter Description	<value1> Lower limit value <value2> Upper limit value
Query Response	<value1>, <value2>  <value1> : Lower limit value <value2> : Upper limit value

## HP-IB Commands Associated with Memory Buffer Function

**MEMSTATe**  $\lfloor$  {OFF|ON|0|1}

Turns ON/OFF the Memory Buffer function.

The query form of this command is MEMSTATe? (with no parameter).

Equivalent Key Sequence	(blue) + 2 (Mem Buf)
Parameter Description	OFF: Memory Buffer function OFF ON: Memory Buffer function ON 0: Memory Buffer function OFF 1: Memory Buffer function ON
Query Response	{1 0}

**MEMCLEar** Clears the contents of the memory buffer.

This command is not available in a query form.

Equivalent Key Sequence	<u>MemClear</u>
Parameter Description	—
Query Response	Query form not supported.

**MEMSIZE**  $\lfloor$   $\langle$ value $\rangle$  Sets the memory buffer size.

The query form of this command is MEMSIZE? (with no parameter).

Equivalent Key Sequence	—
Parameter Description	$\langle$ value $\rangle$ : Memory buffer size
Query Response	$\langle$ value $\rangle$ : int16, NR1

**MEMRETEST** Clears the most recent data in the memory buffer.

This command is not available in a query form.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	Query form not supported.

**MEMINDEX?** A query-dedicated command that allows you to obtain the memory buffer index where the most recent data is stored.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	<value>:

**MEMREAD?** A query-dedicated command that allows you to obtain the contents of the memory buffer.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	See the table below.

The following table shows the format and contents of the data transferred when this query is issued.

Transferred Data	<ul style="list-style-type: none"> <li>■ ASCII format transfer ASCII: &lt;asc_data&gt; ... &lt;asc_data&gt;&lt;NL'END&gt; &lt;asc_data&gt;:=&lt;status&gt;,&lt;data&gt;, ... ,&lt;data&gt;[,&lt;comp&gt;] &lt;comp&gt;:=&lt;bin_num&gt;,&lt;pri&gt;,&lt;sec&gt;[,&lt;t_1&gt;,&lt;t_2&gt;]</li> <li>■ Binary format transfer BINARY: #6&lt;num_bytes&gt;&lt;bin_data&gt; ... &lt;bin_data&gt;&lt;NL'END&gt; &lt;bin_data&gt;:=&lt;status&gt;&lt;data&gt; ... &lt;data&gt;[&lt;comp&gt;] &lt;comp&gt;:=&lt;bin_num&gt;&lt;pri&gt;&lt;sec&gt;[&lt;t_1&gt;&lt;t_2&gt;]</li> </ul>
Data Elements	<ul style="list-style-type: none"> <li>■ Data elements transferred whenever TRG is issued &lt;num_bytes&gt;: Number of bytes transferred (for example, this element contains #6000256 when 256 bytes are transferred). &lt;status&gt; : Measurement data status -1: No data 0: Normal measurement data &lt;data&gt; : Mode-dependent measurement data (See the table below).</li> <li>■ Data elements transferred with the Comparator function ON &lt;bin_num&gt; : Bin identification number -1: OUT OF BIN -2 = AUX BIN 1 to 9 = Bin number &lt;pri&gt; : Result of primary sorting 0: PASS 1: FAIL &lt;sec&gt; : Result of secondary sorting 0: PASS 1: FAIL -1: Secondary sorting OFF</li> <li>■ Data elements transferred with the Comparator function ON (DLD mode only) &lt;t_1&gt; : ΔF limit test result 0: PASS 1: FAIL -1: ΔF limit test OFF &lt;t_2&gt; : ΔCI limit test result 0: PASS 1: FAIL -1: ΔF limit test OFF</li> </ul>

## Function: Memory Buffer

## Measurement data that depends on the measurement mode (&lt;data&gt;)

Crystal Resonator measurement mode	<ul style="list-style-type: none"> <li>■ Data elements transferred whenever TRG is issued               <ul style="list-style-type: none"> <li>&lt;F&gt; : F (Measured resonance frequency: Fr, Fa, Fs)</li> <li>&lt;FL&gt; : FL (Measured resonance frequency)</li> <li>&lt;CI&gt; : CI/Z (Measured resonance impedance)</li> </ul> </li> <li>■ Data elements transferred with the Equivalent Circuit Analysis function ON (for both 4- and 6-element modes)               <ul style="list-style-type: none"> <li>&lt;Q&gt; : Q</li> <li>&lt;Ts&gt; : Ts</li> <li>&lt;C0&gt; : C0</li> <li>&lt;C1&gt; : C1</li> <li>&lt;L1&gt; : L1</li> <li>&lt;R1&gt; : R1</li> </ul> </li> <li>■ Data elements transferred with the Equivalent Circuit Analysis function ON (for 6-element mode only)               <ul style="list-style-type: none"> <li>&lt;G0&gt; : G0</li> <li>&lt;R0&gt; : R0</li> </ul> </li> <li>■ Data elements transferred with Aging mode ON               <ul style="list-style-type: none"> <li>&lt;time&gt; : Total elapsed time [ms]</li> </ul> </li> </ul>
Spurious measurement mode	<ul style="list-style-type: none"> <li>■ Data elements transferred whenever TRG is issued               <ul style="list-style-type: none"> <li>&lt;F&gt; : F (Measured resonance frequency: Fr, Fa, Fs)</li> <li>&lt;CI&gt; : CI/Z (Measured resonance impedance)</li> </ul> </li> <li>■ Data elements transferred with the Equivalent Circuit Analysis function ON (for both 4- and 6-element modes)               <ul style="list-style-type: none"> <li>&lt;Q&gt; : Q</li> <li>&lt;Ts&gt; : Ts</li> <li>&lt;C0&gt; : C0</li> <li>&lt;C1&gt; : C1</li> <li>&lt;L1&gt; : L1</li> <li>&lt;R1&gt; : R1</li> </ul> </li> <li>■ Data elements transferred with the Equivalent Circuit Analysis function ON (for 6-element mode only)               <ul style="list-style-type: none"> <li>&lt;G0&gt; : G0</li> <li>&lt;R0&gt; : R0</li> </ul> </li> <li>■ Number of spurious points               <ul style="list-style-type: none"> <li>&lt;spur_num&gt; : Number of detected spurious points</li> </ul> </li> <li>■ Data elements transferred when one or more spurious points are detected (these elements are transferred for each of the spurious points detected) Number of data transferred is specified by SPNUM.               <ul style="list-style-type: none"> <li>&lt;sF1&gt; : Frequency of the spurious point</li> <li>&lt;sCI1&gt; : Impedance at the spurious point</li> </ul> </li> </ul>
Drive Level Dependency measurement mode	<ul style="list-style-type: none"> <li>■ Data elements transferred whenever TRG is issued               <ul style="list-style-type: none"> <li>&lt;F&gt; : F (Measured resonance frequency: Fr, Fa, Fs)</li> <li>&lt;CI&gt; : CI/Z (Measured resonance impedance)</li> <li>&lt;STAT&gt; : Indicates whether the tracking measurement was successful.                   <ul style="list-style-type: none"> <li>0: PASS</li> <li>1: FAIL</li> </ul> </li> <li>&lt;DL&gt; : DL value (setting)</li> </ul> </li> </ul>
Evaporation Monitor mode	<ul style="list-style-type: none"> <li>■ Data elements transferred whenever TRG is issued               <ul style="list-style-type: none"> <li>&lt;F&gt; : F Trap frequency</li> <li>&lt;CI&gt; : CI/Z CI value at the trap frequency</li> <li>&lt;time&gt; : Time required between two trap points</li> <li>&lt;NLEND&gt;: NewLineEND (1 byte)</li> </ul> </li> </ul>
Filter measurement mode	<ul style="list-style-type: none"> <li>■ Data elements transferred whenever TRG is issued               <ul style="list-style-type: none"> <li>&lt;Loss&gt; : Minimum or constant loss</li> <li>&lt;Δf_left&gt; : -x dB BW (Δf_left)</li> <li>&lt;Δf_right&gt; : -x dB BW (Δf_right)</li> </ul> </li> </ul>

## HP-IB Commands Associated with Delta Mode

**DLTSTATE**  $\square$  {OFF|ON|0|1}

Turns ON/OFF Delta mode.

The query form of this command is DLTSTATE? (with no parameter).

Equivalent Key Sequence	(blue) + p (Δ Mode) ΔMOD {OFF ON}
Parameter Description	OFF: Delta mode OFF ON: Delta mode OFF 0: Delta mode OFF 1: Delta mode OFF
Query Response	{1 0}

**DLTMode**  $\square$  PRI, {OFF|DEV|PPM}

**DLTMode**  $\square$  SEC, {OFF|DEV|PCNT}

Turns ON/OFF Delta mode for the measurement parameter for either primary or secondary sorting. To turn ON Delta mode, specify one of the three options, DEV (for deviation), PCNT (for percentage), and PPM to determine how the measured values are displayed in Delta mode.

The query form of this command is DLTMode?  $\square$  {PRI|SEC}. Supply the PRI option to obtain the Delta mode status for primary sorting, or the SEC option to obtain the Delta mode status for secondary sorting.

Equivalent Key Sequence	ΔF: Frequency value ΔZ: Impedance value
Parameter Description	PRI: Measurement parameter for primary sorting (Primary measurement parameter) SEC: Measurement parameter for secondary sorting (Secondary measurement parameter) OFF: Delta mode OFF DEV: Actual deviation (measured value – reference value) PCNT: Percentage {(measured value) – (reference value) / (reference value)} (SEC only) PPM: ppm {(measured value) – (reference value) / (reference value)} (PRI only)
Query Response	{OFF DEV PCNT PPM}

## Function: Delta Mode

DLTREFType□{PRI|SEC},{User|Nom}

DLTREF□{PRI|SEC}, &lt;value&gt;

Specifies the Delta mode reference value for the primary or secondary sorting measurement parameter.

The query form of this command is DLTREF□{PRI|SEC}. Supply the PRI option to obtain the reference value for primary sorting, or the SEC option to obtain the reference value for secondary sorting.

Equivalent Key Sequence	RefF: Reference frequency RefZ: Reference impedance
Parameter Description	PRI: Measurement parameter for primary sorting SEC: Measurement parameter for secondary sorting <value> Reference value
Query Response	<value> : Reference value

DLTREFType□{PRI|SEC},{User|Nom}

Specifies the Delta mode reference value type: user-specified (User) or nominal (Nom).

The query form of this command is DLTREFType?□{PRI|SEC}. Supply the PRI option to obtain the reference value type for primary sorting, or the SEC option to obtain the reference value type for secondary sorting.

Equivalent Key Sequence	—
Parameter Description	User: User-specified value Nom: Nominal value
Query Response	{U N}

## HP-IB Commands Associated with Display

### DISPSTATus□{OFF|ON|0|1}

Shows or hides the instrument settings on the LCD. When the instrument settings are hidden, the LCD displays only the measurement results.

The query form of this command is DISPSTATus? (with no parameter).

Equivalent Key Sequence	(blue) + 1 (Status)
Parameter Description	OFF: Hides instrument settings. ON: Shows instrument settings. 0: Hides instrument settings. 1: Shows instrument settings.
Query Response	{1 0}

### DISP□{OFF|ON|0|1}

Shows or hides measurement data on the LCD.

The query form of this command is DISP? (with no parameter).

Equivalent Key Sequence	DISP
Parameter Description	OFF: Hides measurement data. ON: Shows measurement data. 0: Hides measurement data. 1: Shows measurement data.
Query Response	{1 0}

Function: Calibration and Compensation CALSTD□{Open|Short|Load},{G0|C0|R0|L0},&lt;value&gt;

## HP-IB Commands Associated with Calibration and Compensation

### CALibration□{OPEN|SHORT|LOAD}

Calibrates the HP E4915A/E4916A. This command must be issued with the OPEN, SHORT, or LOAD option to specify the circuit status for which to calibrate the instrument.

This command is not available in a query form.

Equivalent Key Sequence	(blue) + 6 (Load) (blue) + 5 (Short) (blue) + 4 (Open)
Parameter Description	OPEN: OPEN calibration SHORT: SHORT calibration LOAD: LOAD calibration
Query Response	Query form not supported.

### CALSTD□{Open|Short|Load},{G0|C0|R0|L0},<value>

Sets the calibration standard value for the open, short, or load state.

The parameters to this command can be specified in limited combinations. The following table shows valid combinations.

- CALSTD□OPEN,{G0|C0},<value>
- CALSTD□{SHORT|LOAD},{R0|L0},<value>
- CALSTD?□OPEN,{G0|C0}
- CALSTD?□{SHORT|LOAD},{R0|L0}

Equivalent Key Sequence	CAL
Parameter Description	<value> : OPEN:Open calibration standard SHORT:Short calibration standard LOAD:Load calibration standard C0:Open capacitance G0:residual conductance R0:residual resistance L0:residual inductance
Query Response	<value>:

**THRUCAL** Performs calibration for the thru state.

This command is not available in a query form.

Equivalent Key Sequence	(blue) + 3 (Thru)
Parameter Description	—
Query Response	Query form not supported.

### COMPENSation□{OPEN|SHORT|LOAD}

Compensates HP E4916A for the fixture influence. This command must be issued with the OPEN, SHORT, or LOAD option to specify the circuit status for which to perform fixture compensation.

This command is not available in a query form.

Equivalent Key Sequence	(blue) + 9 (Load) (blue) + 8 (Short) (blue) + 7 (Open)
Parameter Description	OPEN: OPEN compensation SHORT: SHORT compensation LOAD: LOAD compensation
Query Response	Query form not supported.

### COMPENSTD□{Open|Short|Load},{C0|R0|L0},<value>

Sets the compensation standard value for the open, short, or load state.

The parameters to this command can be specified in limited combinations. The following table shows valid combinations.

- COMPENSTD□OPEN,{G0|C0},<value>
- COMPENSTD□{SHORT|LOAD},{R0|L0},<value>
- COMPENSTD?□OPEN,{G0|C0},<value>
- COMPENSTD?□{SHORT|LOAD},{R0|L0},<value>

Equivalent Key Sequence	COMP
Parameter Description	<value> : OPEN:Open fixture compensation standard SHORT:Short fixture compensation standard LOAD:Load fixture compensation standard C0:Open capacitance G0:residual conductance R0:residual resistance L0:residual inductance
Query Response	<value>:

**CALSTATE?**{OPEN|SHORT|LOAD|THRU}

A query-dedicated command that allows you to obtain the status of the current calibration (OPEN, SHORT, LOAD, or THRU).

Equivalent Key Sequence	—
Parameter Description	—
Query Response	{SYSCAL INTERPCAL USERCAL}  SYSCAL: Indicates that the HP E4915A/E4916A has not yet been calibrated and is using its internal calibration data. INTERPCAL: Indicates that the HP E4915A/E4916A has already been calibrated at frequency different from the current frequency. In this case, the HP E4915A/E4916A uses the calibration data for that frequency to interpolate measured values. USERCAL: Indicates that the HP E4915A/E4916A has already been calibrated at the current frequency.

**COMPENSTATE?**{OPEN|SHORT|LOAD}

A query-dedicated command that allows you to obtain the status of the current compensation (OPEN, SHORT, or LOAD).

Equivalent Key Sequence	—
Parameter Description	—
Query Response	{SYSCAL INTERPCAL USERCAL}  SYSCAL: Indicates that HP E4916A has not yet been compensated and is using its internal compensation data. INTERPCAL: Indicates that HP E4916A has already been compensated at frequency different from the current frequency. In this case, HP E4916A uses the compensation data for that frequency to interpolate measured values. USERCAL: Indicates that HP E4916A has already been compensated at the current frequency.

**CALERR?** Return the status of calibration measurement. This command can be used when OPEN cal and SHORT cal are set to usercal, and HP network test fixture is used.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	{1 0}  0: Error 1: No error

## HP-IB Commands Associated with Trigger Mode

**TRIGIMMEDIATE** Immediately triggers the currently selected measurement mode.  
This command is not available in a query form.

Equivalent Key Sequence	<b>Trig</b>
Parameter Description	—
Query Response	Query form not supported.

### TRIGSOURCE{INTernal|MANual|EXTernal|BUS}

Selects one of the four trigger modes: Internal, Manual, External, and Bus.

The query form of this command is TRIGSOURCE? (with no parameter).

Equivalent Key Sequence	<b>(blue)</b> + <b>Trig (Trigger Mode)</b>
Parameter Description	<p>INTernal: Internal (Int) mode – Automatically triggered from within the HP E4915A/E4916A's internal circuitry.</p> <p>MANual: Manual (Man) mode – Triggered when you press the <b>Trig</b> key on the front panel.</p> <p>EXTernal: External (Ext) mode – Triggered when a TTL pulse signal is input through the Ext Trigger or Handler Interface port on the rear panel.</p> <p>BUS: Bus mode – Triggered when the GET or *TRG FETCh,TRIGIMM command is issued.</p>
Query Response	{INT MAN EXT BUS}

## HP-IB Commands Associated with the Analog OUT Terminal

### ANLGOUT□ {OFF|ON|0|1}

Turns ON/OFF the Analog OUT terminal. Turning OFF the Analog OUT terminal causes it to output 0V at all times.

The query form of this command is ANLGOUT? (with no parameter).

Equivalent Key Sequence	AnalogOut
Parameter Description	OFF: Analog OUT terminal OFF ON: Analog OUT terminal ON
Query Response	{1 0}

### ANLREF□ <value>

Specifies the reference frequency for the signals output through the Analog OUT terminal. If you do not specify the reference frequency with this command, the reference frequency defaults to the nominal frequency set with the NOMFreq command.

The query form of this command is ANLREF? (with no parameter).

Equivalent Key Sequence	Settings
Parameter Description	<value> Reference frequency [MHZ M KHZ K HZ]: Unit
Query Response	<value>

### ANLGDFDV□<value>

Specifies the coefficient of the DC voltage output from the Analog OUT terminal and the measured frequency. The system increments or decrements the output voltage by 1 V as the frequency changes by the amount represented by this coefficient.

The query form of this command is ANLGDFDV? (with no parameter).

Equivalent Key Sequence	Settings
Parameter Description	<value> Change in frequency represented by a one-volt increment/decrement of the output voltage (df (Hz)/dV or df (ppm)/dV [HZ PPM]: HZ represents Hz/V while PPM represents ppm/V (the unit defaults to the previously specified unit)
Query Response	<value>,{HZ PPM}

## HP-IB Commands Associated with Status Registers

**OSR?** A query-dedicated command that returns the contents of the condition register of the Operation Status Register group.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	<value> : Register value in decimal notation

**OSE**□<value> Sets the enable register of the Operation Status Register group. The query form of this command is OSE? (with no parameter).

Equivalent Key Sequence	—
Parameter Description	<value> : Register value in decimal notation
Query Response	<value> : Register value in decimal notation

**OSER?** A query-dedicated command that returns the contents of the event register of the Operation Status Register group.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	<value> : Register value in decimal notation

**QSR?** A query-dedicated command that returns the contents of the condition register of the Standard Questionable Status Register group.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	<value> : Register value in decimal notation

**QSE**□<value> Sets the enable register of the Standard Questionable Status Register group. The query form of this command is QSE? (with no parameter).

Equivalent Key Sequence	—
Parameter Description	<value>: Register value in decimal notation
Query Response	<value>: Register value in decimal notation

## Function: Status Registers

**QSER?** A query-dedicated command that returns the contents of the event register of the Standard Questionable (QUESTionable) Status Register group.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	<value> : Register value in decimal notation

**SER?** Returns the contents of the condition register of the Search Event Status Register group. HP E4915A/E4916A uses none of the register contents but bit 0. (Query only)

Equivalent Key Sequence	—
Parameter Description	—
Query Response	<value> : Register value in decimal notation

**SEE** <value> Sets the enable register of the Search Event Status Register group. HP E4915A/E4916A uses none of the register contents but bit 0.

Equivalent Key Sequence	—
Parameter Description	<value> : Register value in decimal notation
Query Response	<value> : Register value in decimal notation

**SEER?** Returns the contents of the event register of the Search Event Status Register. HP E4915A/E4916A uses none of the register contents but bit 0. (Query only)

Equivalent Key Sequence	—
Parameter Description	—
Query Response	<value> : Register value in decimal notation

## Other HP-IB Commands

### FORMat□{ASCii|REAL[,64]}

Selects the HP-IB data transfer format to use.

The query form of this command is FORMat? (with no parameter).

Equivalent Key Sequence	—
Parameter Description	ASCii: ASCII format REAL[,64]: REAL format
Query Response	{ASC REAL}

### CIRcuit□{NON|PI|PRObe|BRIdge}

Selects the type of the measurement circuit connected to the HP E4915A/E4916A.

The query form of this command is CIRcuit? (with no parameter).

Equivalent Key Sequence	<b>GKT</b>
Parameter Description	PI: PI-Network Test Fixture PRObe: Impedance probe (HP E4916Aonly) BRIdge: Reflection bridge
Query Response	{PI PRO BRI}

### HPIBADDRess□<value>

Sets the HP-IB address.

The query form of this command is HPIBADDRess? (with no parameter).

Equivalent Key Sequence	<b>HPIB</b>
Parameter Description	<value> : HP-IB address (31:talk only)
Query Response	<value>

### INITIMMediate

Causes all sequences to exit Idle state and enter Initiate state. This command causes the trigger system to initiate and complete one full trigger cycle, returning to Idle state on completion. (No query)

If the HP E4915A/E4916A is not in Idle state or if INITCONTinuous is set to ON, an INITIMMediate command has no effect on the trigger system and an error -213 is generated.

This command is not available in a query form.

## Function: Other Commands

Equivalent Key Sequence	—
Parameter Description	—
Query Response	Query form not supported.

**INITCONTInuous {OFF|ON|0|1}**

Sets or queries whether the trigger system is continuously initiated or not.

The query form of this command is INITCONTInuous? (with no parameter).

Equivalent Key Sequence	—
Parameter Description	OFFor0:Does not initiate the trigger system continuously. ONor1 :Initiates the trigger system continuously.
Query Response	{1 0}

**ABORt**

The ABORt command resets the trigger system and places all trigger sequences in the Idle state. Any actions related to the trigger system that are in progress, such as acquiring a measurement, are aborted immediately. The execution of an :ABORt command will set any pending operation flag to FALSE, for example flags that were set by the initiation of the trigger system.

This command is not available in a query form.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	Query form not supported.

**ERRor?**

A query-dedicated command that returns the number and message of any existing error in the HP E4915A/E4916A's error queue.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	Response error number and error message.

**BEEPSTATe**□{OFF|ON|0|1}

Turns ON/OFF the beep function.

The query form of this command is BEEPSTATe? (with no parameter).

Equivalent Key Sequence	<b>BEEP</b>
Parameter Description	OFF: Beep OFF ON: Beep ON 0: Beep OFF 1: Beep ON
Query Response	0: Beep OFF 1: Beep ON

**VERsion?** A query-dedicated command that returns the number corresponding to the SCPI version to which the HP E4915A/E4916A complies.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	<value>: Number that corresponds to the SCPI version.

**KLOCK**□{OFF|ON|0|1}

Turns ON/OFF the Key Lock function for the front panel.

The query form of this command is KLOCK? (with no parameter).

Equivalent Key Sequence	(blue) + 0
Parameter Description	OFF: Key lock OFF ON: Key lock ON 0: Key lock OFF 1: Key lock ON
Query Response	0: Key lock OFF 1: Key lock ON

**PRESet** Resets the instrument settings to the preset values.

This command is not available in a query form.

Equivalent Key Sequence	(blue) + . (Reset)
Parameter Description	—
Query Response	Query form not supported.

**OUTIO**  $\square$  *<value>* Outputs 11 bits long data through the I/O port.

This command is not available in a query form.

Equivalent Key Sequence	—
Parameter Description	<i>&lt;value&gt;</i> : data (0 to 2048)
Query Response	Query form not supported.

**OUTIOSTATE**  $\square$  {OFF|ON|0|1}

Enables or disables the output of 11 bits long data through the I/O port. When OUTIOSTAT is set to OFF, the output through I/O port is disabled even EM measurement is performed. OUTIO causes the output through I/O port even OUTIOSTAT is set to OFF. The query form of this command is OUTIOSTATE? (with no parameter).

Equivalent Key Sequence	—
Parameter Description	OFF: Disables the output through I/O port. ON: Enables the output through I/O port. 0: Disables the output through I/O port. 1: Enables the output through I/O port.
Query Response	{0 1}  1: Output through I/O port is enabled. 0: Output through I/O port is disabled.

**EXTRLOCK?** Return the status of the external reference input.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	{1 0}  1: Locked to external signal 0: No external signal

## Common Commands

**\*CLS** Clears the Status Byte, Operation Status, Questionable Status, and Standard Event Status registers.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	—

**\*ESE**  $\square$  *<value>* Sets the bits of the Standard Event Status Register.

Equivalent Key Sequence	—
Parameter Description	<i>&lt;value&gt;</i> :
Query Response	—

**\*ESE?** Queries the bits of the Standard Event status register.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	<i>&lt;value&gt;</i> : Register value in decimal notation

**\*ESR?** A query-dedicated command that returns the contents of the Standard Event status register. Note that this query reads and also clears the contents of the Standard Event status register.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	<i>&lt;value&gt;</i> : Register value in decimal notation

**\*IDN?** A query-dedicated command that returns an identification string which consists of four comma-separated fields.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	<i>&lt;field 1&gt;</i> , <i>&lt;field 2&gt;</i> , <i>&lt;field 3&gt;</i> , <i>&lt;field 4&gt;</i> : See the list below.

*<field 1>* Manufacturer (always HEWLETT-PACKARD)  
*<field 2>* Model number

## Function: Common Commands

<field 3> Serial number is HP format (such as 2419J00100)  
 <field 4> Firmware version number (such as 01.00)

**\*OPC** Tells the HP E4915A/E4916A to set bit 0 (OPC bit) in the Standard Event Status Register when it completes all pending operations.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	—

**\*OPC?** Returns 1 when all pending operations have been completed.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	{1 0}:

**\*OPT?** Queries the options installed. (Query only)

Equivalent Key Sequence	—
Parameter Description	—
Query Response	Option number

**\*RCL** <value> Recall the instrument state which was stored in the specified register number. The HP E4915A/E4916A has 10 available storage registers. (No query)

Equivalent Key Sequence	<b>Rcl</b>
Parameter Description	<value>:
Query Response	—

**\*RST** Resets the HP E4915A/E4916A to the initial settings.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	—

**\*SAV**  $\square$  *<value>* Saves the instrument state in the specified register number. The HP E4915A/E4916A has 10 available storage registers. (No query)

Equivalent Key Sequence	(blue) + Rcl (Save)
Parameter Description	<i>&lt;value&gt;</i> :
Query Response	—

**\*SRE** Sets the bits of the Status Byte Enable Register.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	—

**\*SRE?** Queries the contents of the Status Byte Enable Register.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	—

**\*STB?** Queries the contents of the Status Byte Register. (Query only)

Equivalent Key Sequence	—
Parameter Description	—
Query Response	<i>&lt;value&gt;</i> : Status byte register value in decimal notation

**\*TRG** Triggers the HP E4915A/E4916A on condition that the trigger mode is set to Bus trigger mode. (No query)

**Note**



The contents of the data transferred by the \*TRG command differ depending on which measurement mode is currently in effect. For more information, refer to the corresponding sections in "Command Reference by Function".

## Function: Common Commands

**\*TST?** Executes an internal self-test and the test result as the sum of the error cords of all existing errors. If there is no error the HP E4915A/E4916A returns 0.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	{1 4 8 16} 1: Test1 RAM 4: Test2 Calibration data 8: Test3 Flashmemory(program area) 16: Test4 Backup memory

**\*WAI** Causes the HP E4915A/E4916A to wait until all previously sent commands are completed. (No query)

Equivalent Key Sequence	—
Parameter Description	—
Query Response	—

## Alphabetical Command Reference

This section provides alphabetical reference for all the HP-IB commands available with the HP E4915A/E4916A, except those associated with the optional LCR Meter function. Refer to "LCR Meter Command Reference" for the HP-IB commands associated with the LCR Meter function, which is available as an option for HP E4916A.

## Alphabetical Command Reference

**ABORt** The ABORt command resets the trigger system and places all trigger sequences in the Idle state. Any actions related to the trigger system that are in progress, such as acquiring a measurement, are aborted immediately. The execution of an :ABORt command will set any pending operation flag to FALSE, for example flags that were set by the initiation of the trigger system.

This command is not available in a query form.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	Query form not supported.

**AGING**{OFF|ON|0|1} Turns ON/OFF Aging mode. With Aging mode ON, the HP E4915A/E4916A measures the DUT repeatedly at specified time intervals (as specified with the AGINGTIME command).

The query form of this command is AGING? (with no parameter).

Equivalent Key Sequence	AGE
Parameter Description	OFF: Aging mode OFF ON: Aging mode ON 0: Aging mode OFF 1: Aging mode ON
Query Response	{1 0}

## Alphabetical Reference

ANLGOUT  $\{OFF|ON|0|1\}$ 

**AGINGTIME**  $\langle value \rangle$  Determines the length of the measurement interval in Aging mode.  
The query form of this command is AGINGTIME? (with no parameter).

Equivalent Key Sequence	<b>Time</b>
Parameter Description	$\langle value \rangle$ Length of time interval [S MS M]: Unit of time
Query Response	$\langle value \rangle$

**ALC**  $\{OFF|ON|0|1\}$  Turns ON/OFF ALC (Auto Level Control) mode. With ALC mode ON, the system controls the drive level based on the actual CI value of the DUT; with ALC mode OFF, the system uses the user-specified nominal CI value.

The query form of this command is ALC? (with no parameter).

Equivalent Key Sequence	<b>ALC</b>
Parameter Description	OFF: Turns OFF ALC mode ON: ALC mode ON 0: ALC mode OFF 1: ALC mode ON
Query Response	{1 0}

**ANLGDFDV**  $\langle value \rangle$  Specifies the coefficient of the DC voltage output from the Analog OUT terminal and the measured frequency. The system increments or decrements the output voltage by 1 V as the frequency changes by the amount represented by this coefficient.

The query form of this command is ANLGDFDV? (with no parameter).

Equivalent Key Sequence	<b>Settings</b>
Parameter Description	$\langle value \rangle$ Change in frequency represented by a one-volt increment/decrement of the output voltage (df (Hz)/dV or df (ppm)/dV [HZ PPM]: HZ represents Hz/V while PPM represents ppm/V (the unit defaults to the previously specified unit)
Query Response	$\langle value \rangle, \{HZ PPM\}$

**ANLGOUT**  $\{OFF|ON|0|1\}$

Turns ON/OFF the Analog OUT terminal. Turning OFF the Analog OUT terminal causes it to output 0V at all times.

The query form of this command is ANLGOUT? (with no parameter).

**ANLGOUT** {OFF|ON|0|1}

Equivalent Key Sequence	AnalogOut
Parameter Description	OFF: Analog OUT terminal OFF ON: Analog OUT terminal ON
Query Response	{1 0}

**ANLGRF** <value> Specifies the reference frequency for the signals output through the Analog OUT terminal. If you do not specify the reference frequency with this command, the reference frequency defaults to the nominal frequency set with the NOMFreq command.

The query form of this command is ANLGRF? (with no parameter).

Equivalent Key Sequence	Settings
Parameter Description	<value> Reference frequency [MHZ M KHZ K HZ]: Unit
Query Response	<value>

**BEEPSTATE** {OFF|ON|0|1}

Turns ON/OFF the beep function.

The query form of this command is BEEPSTATE? (with no parameter).

Equivalent Key Sequence	BEEP
Parameter Description	OFF: Beep OFF ON: Beep ON 0: Beep OFF 1: Beep ON
Query Response	0: Beep OFF 1: Beep ON

**BINCNT?** {BIN1|...|BIN10|OUTOF|AUX}

A query-dedicated command that allows you to obtain the count of DUTs contained in a particular bin or in all bins.

Equivalent Key Sequence	-
Parameter Description	BIN1 ... BIN9: Count of DUTs contained in a particular bin for primary sorting(Xtal measurement mode) BIN1 ... BIN5: Count of DUTs contained in a particular bin for primary sorting(DLD mode) OUTOF: Count of DUTs purged as OUT OF BINS ALL:Count of DUTs contained in all bins
Query Response	<value>: Count of DUTs contained in the specified bin (or, if ALL is specified, count of DUTs contained in all bins).

Alphabetical Reference

**BINCNTALL?** A query-dedicated command that allows you to obtain the count of DUTs contained in all bins.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	<ul style="list-style-type: none"> <li>■ Query response in Crystal Resonator measurement mode                             <ul style="list-style-type: none"> <li>&lt;num1&gt; : Count of DUTs in bin 1.</li> <li>...</li> <li>&lt;num9&gt; : Count of DUTs in bin 9.</li> <li>&lt;num10&gt; : Count of DUTs purged as OUT OF BIN.</li> <li>&lt;num11&gt; : Count of DUTs in the AUX bin.</li> </ul> </li> <li>■ Query response in Drive Level Dependency measurement mode                             <ul style="list-style-type: none"> <li>&lt;num1&gt; : Count of DUTs in bin 1.</li> <li>...</li> <li>&lt;num5&gt; : Count of DUTs in bin 5.</li> <li>&lt;num6&gt; : Count of DUTs purged as OUT OF BIN.</li> <li>&lt;num7&gt; : Count of DUTs in the AUX bin.</li> <li>&lt;num8&gt;~&lt;num11&gt;: Returns 0.</li> </ul> </li> </ul>

**BINCNTClear** Resets the DUT count for all bins.  
This command is not available in a query form.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	Query form not supported.

**BINSIZE** <value> Specifies the size of the bin.  
The query form of this command is BINSIZE? (with no parameter).

Equivalent Key Sequence	—
Parameter Description	<value> : BIN size (Xtal measurement mode:max9,DLD mode:max5)
Query Response	<value>

**CALERR** Return the status of calibration measurement. This command can be used when OPEN cal and SHORT cal are set to usercal, and HP network test fixture is used.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	{1 0} 0: Error 1: No error

**CALSTATe?**{OPEN|SHORT|LOAD|THRU}

A query-dedicated command that allows you to obtain the status of the current calibration (OPEN, SHORT, LOAD, or THRU).

Equivalent Key Sequence	—
Parameter Description	—
Query Response	{SYSCAL INTERPCAL USERCAL}  SYSCAL: Indicates that the HP E4915A/E4916A has not yet been calibrated and is using its internal calibration data. INTERPCAL: Indicates that the HP E4915A/E4916A has already been calibrated at frequency different from the current frequency. In this case, the HP E4915A/E4916A uses the calibration data for that frequency to interpolate measured values. USERCAL: Indicates that the HP E4915A/E4916A has already been calibrated at the current frequency.

**CALSTD**{Open|Short|Load},{G0|C0|R0|L0},<value>

Sets the calibration standard value for the open, short, or load state.

The parameters to this command can be specified in limited combinations. The following table shows valid combinations.

- CALSTDOPEN,{G0|C0},<value>
- CALSTD{SHORT|LOAD},{R0|L0},<value>
- CALSTD?OPEN,{G0|C0}
- CALSTD?{SHORT|LOAD},{R0|L0}

Equivalent Key Sequence	<b>CAL</b>
Parameter Description	<value> : OPEN:Open calibration standard SHORT:Short calibration standard LOAD:Load calibration standard C0:Open capacitance G0:residual conductance R0:residual resistance L0:residual inductandce
Query Response	<value>:

**CALibration**{OPEN|SHORT|LOAD}

Calibrates the HP E4915A/E4916A. This command must be issued with the OPEN, SHORT, or LOAD option to specify the circuit status for which to calibrate the instrument.

This command is not available in a query form.

Alphabetical Reference

Equivalent Key Sequence	(blue) + 6 (Load) (blue) + 5 (Short) (blue) + 4 (Open)
Parameter Description	OPEN: OPEN calibration SHORT: SHORT calibration LOAD: LOAD calibration
Query Response	Query form not supported.

CIRcuit□{NON|PI|PRObe|BRIDGE}

Selects the type of the measurement circuit connected to the HP E4915A/E4916A.

The query form of this command is CIRcuit? (with no parameter).

Equivalent Key Sequence	CKT
Parameter Description	PI: PI-Network Test Fixture PRObe: Impedance probe (HP E4916Aonly) BRIDGE: Reflection bridge
Query Response	{PI PRO BRI}

CLACT□<value> Specifies the value of the capacitance load actually connected to the DUT.

The query form of this command is CLACT? (with no parameter).

Equivalent Key Sequence	CL_a
Parameter Description	<value> Capacitance load value (Actual CL) [PF]
Query Response	<value>

CLACTType□{NOCL|USER}

Determines whether to regard the DUT as being connected with no capacitance load (NOCL) or with a user-specified capacitance load (USER). (Note that, when no capacitance load is connected, the CL value is infinite).

The query form of this command is CLACTType? (with no parameter).

Equivalent Key Sequence	CL_a
Parameter Description	NOCL: Capacitance load not connected (CL value infinite). USER: User-specified CL value
Query Response	{NOCL USER}

**CLCOMPen** Calculate the capacitance load which enables a crystal resonator to oscillate at the frequency of the reference resonator using the CL Compensation function.

This command is not available in a query form.

Equivalent Key Sequence	CL Comp <del>en</del>
Parameter Description	—
Query Response	Query form not supported.

**CLADJust**  $\square$  {OFF|ON|0|1}

Turns ON/OFF CL Adjust mode.

The query form of this command is CLADJust? (with no parameter).

Equivalent Key Sequence	(blue) + n/ppm (CL Adj)
Parameter Description	OFF: CL Adjust mode OFF ON: CL Adjust mode ON 0: CL Adjust mode OFF 1: CL Adjust mode ON
Query Response	{1 0}

**CLFREQ**  $\square$  <value> Specifies the frequency of the reference resonator used in CL Compensation function.

The query form of this command is CLFREQ? (with no parameter).

Equivalent Key Sequence	F <del>req</del>
Parameter Description	<value> Frequency of the reference resonator [MHZ M KHZ K HZ]: Unit of the frequency
Query Response	<value>, {MHZ M KHZ K HZ}

**\*CLS** Clears the Status Byte, Operation Status, Questionable Status, and Standard Event Status registers.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	—

Alphabetical Reference

**CLTGT** <value> Specifies the target capacitance load. There are occasions when you want to calculate characteristic values assuming a capacitance load value different than the capacitance load actually connected to the DUT. If this is the case, you can use the CLTGT command to specify your desired non-actual target capacitance load value.

The query form of this command is CLTGT? (with no parameter).

Equivalent Key Sequence	CL Value CL_t
Parameter Description	<value> Target capacitance load value (Target CL) [PF]
Query Response	<value>

**CLTGType** {NOCL|USER|CLACT}

Determines whether to use the actually connected capacitance load (the CLACT option) or a different value (the USER option) as the target capacitance load value. If you want to compensate for the actual capacitance load, use this command with the CLACT command to set the target to the same value as the actual capacitance load by specifying the CLACT option. If you want to assume a different capacitance load than actually connected, use the CLTGType command with the USER option so you can specify your desired non-actual target value with the CLTGT command. In addition, you can use the NOCL option to cause the system to regard the DUT as being connected with **no** capacitance load.

The query form of this command is :CLTGType? (with no parameter).

Equivalent Key Sequence	CL_t
Parameter Description	NOCL: Capacitance load not connected. CLAct: Causes the system to use the actual CL value as the target CL value. User: Causes the system to accept a CL value specified with the CLTGT .
Query Response	{NOCL USER CLACT}

**COMPBEEPCond** {FAIL|PASS}

Determines when the Comparator function outputs beep sound; that is, when a DUT has failed or when a DUT has passed the test.

The query form of this command is COMPBEEPCond? (with no parameter).

Equivalent Key Sequence	BEEP
Parameter Description	FAIL: Beeps when DUT has failed. PASS: Beeps when DUT has passed.
Query Response	{FAIL PASS}

**COMPBEEPStat**□{OFF|ON|0|1}

Turns ON/OFF the beep output of the Comparator function.

The query form of this command is COMPBEEPStat? (with no parameter).

Equivalent Key Sequence	—
Parameter Description	OFF: Beep output OFF ON: Beep output ON 0: Beep output OFF 1: Beep output ON
Query Response	{1 0}

**COMPBW**□{OFF|ON|0|1}

**Note**



This command is available only when the Comparator function is used in Filter measurement mode.

Turns ON/OFF the BW limit test function. With this function ON, DUTs are evaluated to the BW limit (specified with COMPBWLim); if the BW value measured in Flt mode exceeds the limit, then the DUT fails the test.

The query form of this command is COMPBW? (with no parameter).

Equivalent Key Sequence	<b>LmBW</b>
Parameter Description	OFF: BW limit test OFF ON: BW limit test ON 0: BW limit test OFF 1: BW limit test ON
Query Response	{1 0}

**COMBWLim**□<value1>,<value2>

**Note**



This command is available only when the Comparator function is used in Filter measurement mode.

Sets the BW limit. If the frequency value measured in Flt mode exceeds the limit, then the DUT fails the test.

The query form of this command is COMBWLim? (with no parameter).

Alphabetical Reference

Equivalent Key Sequence	<b>BW_L</b> – Lower limit value <b>BW_H</b> – Upper limit value
Parameter Description	<value1> Lower limit value <value2> Upper limit value
Query Response	<value1>,<value2>  <value1> : Lower limit value <value2> : Upper limit value

**COMPCLear** Clears all the lower and upper limit settings.  
 This command is not available in a query form.

Equivalent Key Sequence	–
Parameter Description	–
Query Response	Query form not supported.

**COMPDLTCI□{OFF|ON|0|1}**

**Note**  This command is available only when the Comparator function is used in Drive Level Dependency measurement mode.

Turns ON/OFF the ΔCI limit test function. With this function ON, DUTs are evaluated to the ΔCI limit (specified with COMPDLTCILim); if the CI value measured in DLD mode exceeds the limit, then the DUT fails the test.

The query form of this command is COMPDLTCI? (with no parameter).

Equivalent Key Sequence	<b>LnAZ</b>
Parameter Description	OFF: ΔCI limit test OFF ON: ΔCI limit test ON 0: ΔCI limit test OFF 1: ΔCI limit test ON
Query Response	{1 0}

**COMPDLTCILim□<value>**

**Note**  This command is available only when the Comparator function is used in Drive Level Dependency measurement mode.

Sets the ΔCI limit. If the CI value measured in DLD mode exceeds the limit, then the DUT fails the test.

The query form of this command is COMPDLTCILim? (with no parameter).

COMPDLTCILim  $\square$   $\langle$ value $\rangle$

Equivalent Key Sequence	<b><math>\Delta Z</math>_H</b>
Parameter Description	$\langle$ value1 $\rangle$ Limit value [MA K M U N P F]: Unit
Query Response	$\langle$ value1 $\rangle$ Limit value

COMPDLTF  $\square$  {OFF|ON|0|1}

**Note**



This command is available only when the Comparator function is used in Drive Level Dependency measurement mode.

Turns ON/OFF the  $\Delta F$  limit test function. With this function ON, DUTs are evaluated to the  $\Delta F$  limit (specified with COMPDLTFLim); if the frequency value measured in DLD mode exceeds the limit, then the DUT fails the test.

The query form of this command is COMPDLTF? (with no parameter).

Equivalent Key Sequence	<b><math>\Delta</math>AF</b>
Parameter Description	OFF: $\Delta F$ limit test OFF ON: $\Delta F$ limit test ON 0: $\Delta F$ limit test OFF 1: $\Delta F$ limit test ON
Query Response	{1 0}

COMPDLTFLim  $\square$   $\langle$ value $\rangle$

**Note**



This command is available only when the Comparator function is used in Drive Level Dependency measurement mode.

Sets the  $\Delta F$  limit. If the frequency value measured in DLD mode exceeds the limit, then the DUT fails the test.

The query form of this command is COMPDLTFLim? (with no parameter).

Equivalent Key Sequence	<b><math>\Delta F</math>_H</b>
Parameter Description	$\langle$ value1 $\rangle$ Limit value [MA K M U N P F]: Unit
Query Response	$\langle$ value1 $\rangle$ Limit value

## COMPENSTATe?□{OPEN|SHORT|LOAD}

A query-dedicated command that allows you to obtain the status of the current compensation (OPEN, SHORT, or LOAD).

Equivalent Key Sequence	—
Parameter Description	—
Query Response	{SYSCAL INTERPCAL USERCAL}  SYSCAL: Indicates that HP E4916A has not yet been compensated and is using its internal compensation data. INTERPCAL: Indicates that HP E4916A has already been compensated at frequency different from the current frequency. In this case, HP E4916A uses the compensation data for that frequency to interpolate measured values. USERCAL: Indicates that HP E4916A has already been compensated at the current frequency.

## COMPENSTD□{Open|Short|Load},{C0|R0|L0},&lt;value&gt;

Sets the compensation standard value for the open, short, or load state.

The parameters to this command can be specified in limited combinations. The following table shows valid combinations.

- COMPENSTD□OPEN,{G0|C0},<value>
- COMPENSTD□{SHORT|LOAD},{R0|L0},<value>
- COMPENSTD?□OPEN,{G0|C0},<value>
- COMPENSTD?□{SHORT|LOAD},{R0|L0},<value>

Equivalent Key Sequence	COMP
Parameter Description	<value> : OPEN:Open fixture compensation standard SHORT:Short fixture compensation standard LOAD:Load fixture compensation standard C0:Open capacitance G0:residual conductance R0:residual resistance L0:residual inductandce
Query Response	<value>:

## COMPENSation□{OPEN|SHORT|LOAD}

Compensates HP E4916A for the fixture influence. This command must be issued with the OPEN, SHORT, or LOAD option to specify the circuit status for which to perform fixture compensation.

This command is not available in a query form.

**COMPENsation** □ {OPEN|SHORT|LOAD}

Equivalent Key Sequence	(blue) + 9 (Load) (blue) + 8 (Short) (blue) + 7 (Open)
Parameter Description	OPEN: OPEN compensation SHORT: SHORT compensation LOAD: LOAD compensation
Query Response	Query form not supported.

**COMPLEDCond** □ {FAIL|PASS}

Determines when the Comparator function turns ON the LED; that is, when a DUT has failed or when a DUT has passed the test.

The query form of this command is COMPLEDCond? (with no parameter).

Equivalent Key Sequence	LED
Parameter Description	FAIL: LED turns ON when DUT has failed, and turns OFF when DUT has passed. PASS: LED turns ON when DUT has passed, and turns OFF when DUT has failed.
Query Response	{FAIL PASS}

**COMPPLIMit** □ BIN <n>, <value1>, <value2>

Defines the lower and upper limits for each of the primary sorting bins. For primary sorting, you can define up to 9 bins[Xtal measurement mode], 5 bins[DLD mode] by issuing this command for each bin.

The query form of this command is COMPPLIMit? BIN <n>. The <n> parameter must be supplied to specify the number of the bin whose lower and upper limits you want to obtain.

Equivalent Key Sequence	PriL – Lower limit value PriH – Upper limit value
Parameter Description	<n>: {1 2 3 4 5 6 7 8 9 10} (Bin number) <value1> Lower limit value for the specified bin <value2> Upper limit value for the specified bin
Query Response	<value1>, <value2> <value1> : Lower limit value [MA K M U N P F PPM]: Unit <value2> : Upper limit value [MA K M U N P F PPM]: Unit

**COMPPRIMode□{ABSTOL|PCNTTOL|SEQ}**

Determines whether to perform primary sorting in Sequential or Tolerance mode. Specify the SEQ option for Sequential mode; for Tolerance mode, specify ABSTOL if you want to sort the DUTs based on the actual deviation from the reference value, or PCNTTOL if you want to sort the DUTs based on the percentage of the deviation relative to the reference value. For more information on the sort mode, refer to “Sequential Mode and Tolerance Mode” in Chapter 4 in Chapter 4.

The query form of this command is COMPPRIMode? (with no parameter).

Equivalent Key Sequence	<b>PRI</b>
Parameter Description	ABSTOL: Tolerance mode (based on the actual deviation from the reference value) PCNTTOL: Tolerance mode (based on the percentage relative to the reference value) SEQ: Sequential mode
Query Response	{ABSTOL PCNTTOL SEQ}

**COMPSECAUX□{OFF|ON|0|1}**

Turns ON/OFF the auxiliary bin (AUX bin) function for secondary sorting. The AUX bin is used to separate those DUTs that passed primary sorting but failed secondary sorting, without purging them as OUT OF BIN together with DUTs that failed both primary and secondary sorting.(For more information, refer to “Aux Bin” in Chapter 4 in Chapter 4).

The query form of this command is COMPSECAUX? (with no parameter).

Equivalent Key Sequence	<b>AUX</b>
Parameter Description	OFF: AUX bin function OFF ON: AUX bin function ON 0: AUX bin function OFF 1: AUX bin function ON
Query Response	{1 0}

**COMPSEC□{OFF|ON|0|1}**

Turns ON/OFF secondary sorting.

The query form of this command is COMPSEC? (with no parameter).

**COMPSECL**{OFF|ON|0|1}

Equivalent Key Sequence	<b>SEC</b>
Parameter Description	OFF: Secondary sorting OFF ON: Secondary sorting ON 0: Secondary sorting OFF 1: Secondary sorting ON
Query Response	{1 0}

**COMPSLIMit**□<value1>,<value2>

Specifies the lower and upper limits for secondary sorting bin.  
 The query form of this command is COMPSLIMit? (with no parameter).

Equivalent Key Sequence	<b>SecL</b> – Lower limit value <b>SecH</b> – Upper limit value
Parameter Description	<value1> Lower limit value [MA K M U N P F]: Unit <value2> Upper limit value [MA K M U N P F]: Unit
Query Response	<value1>,<value2> <value1> : Lower limit value <value2> : Upper limit value

**COMPSTATe**□{OFF|ON|0|1}

Turns ON/OFF the Comparator function.  
 The query form of this command is COMPSTATe? (with no parameter).

Equivalent Key Sequence	(blue) + m/k (Comprtr) or <b>COMP</b>
Parameter Description	OFF: Comparator function OFF ON: Comparator function ON 0: Comparator function OFF 1: Comparator function ON +
Query Response	{1 0}

**COMPTOLSTD**□<value>

Specifies the reference value that is applied when primary sorting is performed in Tolerance mode.  
 The query form of this command is COMPTOLSTD? (with no parameter).

Alphabetical Reference

Equivalent Key Sequence	NOM
Parameter Description	<value> : Reference value for primary sorting [MA K M U N P F]: Unit for the reference value
Query Response	<value>

**DISP┐{OFF|ON|0|1}** Shows or hides measurement data on the LCD.  
The query form of this command is DISP? (with no parameter).

Equivalent Key Sequence	DISP
Parameter Description	OFF: Hides measurement data. ON: Shows measurement data. 0: Hides measurement data. 1: Shows measurement data.
Query Response	{1 0} {1 0}

**DISPSTATus┐{OFF|ON|0|1}** Shows or hides the instrument settings on the LCD. When the instrument settings are hidden, the LCD displays only the measurement results.  
The query form of this command is DISPSTATus? (with no parameter).

Equivalent Key Sequence	(blue) + 1 (Status)
Parameter Description	OFF: Hides instrument settings. ON: Shows instrument settings. 0: Hides instrument settings. 1: Shows instrument settings.
Query Response	{1 0}

**DLTMode┐PRI,{OFF|DEV|PPM}**

**DLTMode┐SEC,{OFF|DEV|PCNT}**

Turns ON/OFF Delta mode for the measurement parameter for either primary or secondary sorting. To turn ON Delta mode, specify one of the three options, DEV (for deviation), PCNT (for percentage), and PPM to determine how the measured values are displayed in Delta mode.

The query form of this command is DLTMode?┐{PRI|SEC}. Supply the PRI option to obtain the Delta mode status for primary sorting, or the SEC option to obtain the Delta mode status for secondary sorting.

DLTMode□SEC,{OFF|DEV|PCNT}

Equivalent Key Sequence	<b>ΔF</b> : Frequency value <b>ΔZ</b> : Impedance value
Parameter Description	PRI: Measurement parameter for primary sorting (Primary measurement parameter) SEC: Measurement parameter for secondary sorting (Secondary measurement parameter) OFF: Delta mode OFF DEV: Actual deviation (measured value – reference value) PCNT: Percentage {(measured value) – (reference value) / (reference value)} (SEC only) PPM: ppm {(measured value) – (reference value) / (reference value)} (PRI only)
Query Response	{OFF DEV PCNT PPM}

DLTREF□{PRI|SEC}, &lt;value&gt;

Specifies the Delta mode reference value for the primary or secondary sorting measurement parameter.

The query form of this command is DLTREF□{PRI|SEC}. Supply the PRI option to obtain the reference value for primary sorting, or the SEC option to obtain the reference value for secondary sorting.

Equivalent Key Sequence	<b>RefF</b> : Reference frequency <b>RefZ</b> : Reference impedance
Parameter Description	PRI: Measurement parameter for primary sorting SEC: Measurement parameter for secondary sorting <value> Reference value
Query Response	<value> : Reference value

DLTREFType□{PRI|SEC},{User|Nom}

Specifies the Delta mode reference value type: user-specified (User) or nominal (Nom).

The query form of this command is DLTREFType?□{PRI|SEC}. Supply the PRI option to obtain the reference value type for primary sorting, or the SEC option to obtain the reference value type for secondary sorting.

Equivalent Key Sequence	—
Parameter Description	User: User-specified value Nom: Nominal value
Query Response	{U N}

**DLTSTATE□{OFF|ON|0|1}**

Turns ON/OFF Delta mode.

The query form of this command is DLTSTATE? (with no parameter).

Equivalent Key Sequence	(blue) + p (Δ Mode) ΔMOD {OFF ON}
Parameter Description	OFF: Delta mode OFF ON: Delta mode OFF 0: Delta mode OFF 1: Delta mode OFF
Query Response	{1 0}

**DSPQ□{OFF|ON|0|1}**

Shows or hides the Q parameter on the LCD.

The query form of this command is DSPQ? (with no parameter).

Equivalent Key Sequence	DepQ
Parameter Description	OFF: Hides the Q parameter. ON: Shows the Q parameter. 0: Hides the Q parameter. 1: Shows the Q parameter.
Query Response	{1 0}

**EMCLOB□{OFF|ON|0|1},<value>**

Defines the data to be output through the I/O port when the system finishes measuring the DUT in Evaporation Monitor mode.

The query form of this command is EMCLOB? (with no parameter).

Equivalent Key Sequence	—
Parameter Description	OFF: Disables output through I/O port. ON: Enables output through I/O port. 0: Disables output through I/O port. 1: Enables output through I/O port. <value> : Output data (I/O port output ON only)
Query Response	{0 1},<value> <value>: (I/O port output ON only)

**EMDIR**  $\square$  {DOWN|UP} Determines the change direction of the resonance frequency in frequency adjustment.

The query form of this command is EMDIR? (with no parameter).

Equivalent Key Sequence	Dir
Parameter Description	DOWN: Decreasing direction of the resonance frequency in frequency adjustment UP: Increasing direction of the resonance frequency in frequency adjustment
Query Response	{DOWN UP}

**EMLCLeAr** Clears the trap point list.

This command is not available in a query form.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	Query form not supported.

**EMLIST**  $\square$   $\langle$ value1 $\rangle$ ,  $\langle$ value2 $\rangle$ ,  $\langle$ value3 $\rangle$ , {OFF|ON|0|1},  $\langle$ value4 $\rangle$

Defines a list of trap points. The list contains the following definitions for each trap point:

The query form of this command is EMLIST?  $\square$   $\langle$ value1 $\rangle$ . The parameter  $\langle$ value1 $\rangle$  must be supplied to specify the number of the trap point whose settings you want to obtain.

Equivalent Key Sequence	—
Parameter Description	$\langle$ value1 $\rangle$ : Number of the trap point $\langle$ value2 $\rangle$ : Frequency at the trap point $\langle$ value3 $\rangle$ : Phase value at the trap point (applies only in the case you specified the PHase option for the SRCHTGT command). OFF: I/O port output OFF ON: I/O port output ON 0: I/O port output OFF 1: I/O port output ON $\langle$ value4 $\rangle$ : Output data (I/O port output ON only)
Query Response	$\langle$ value2 $\rangle$ , $\langle$ value3 $\rangle$ , {OFF ON 0 1}, $\langle$ value4 $\rangle$

Alphabetical Reference

**EMLSIZE**□<value> Specifies the size of the trap point list. The list size is represented as the number of lines. You can specify an integer from 1 to 30.

The query form of this command is EMLSIZE? (with no parameter).

Equivalent Key Sequence	—
Parameter Description	<value>: int16 Size of the trap point list.  <value> : Size of the trap point list
Query Response	<value>

**EMMANmode**□{ON|OFF}

Enables/disables entry of the trap frequency from the front panel.

The query form of this command is EMMANmode? (with no parameter).

Equivalent Key Sequence	MAN
Parameter Description	OFF: Disables entry of the trap frequency from the front panel. ON: Enables entry of the trap frequency from the front panel. 0: Disables entry of the trap frequency from the front panel. 1: Enables entry of the trap frequency from the front panel.
Query Response	{ON OFF}

**EMOPEB**□{OFF|ON|0|1},<value>

Defines the data to be output through the I/O port when the system starts measuring the DUT in Evaporation Monitor mode.

The query form of this command is EMOPEB? (with no parameter).

Equivalent Key Sequence	—
Parameter Description	OFF: Disables output through I/O port. ON: Enables output through I/O port. 0: Disables output through I/O port. 1: Enables output through I/O port. <value> : Output data (I/O port output ON only)
Query Response	{0 1},<value>  <value>: int16, NR1 (I/O port output ON only)

**EMSTARTPoint**  $\square$  *<value>*

Specifies the trap point at which to start measuring the DUT in Evaporation Monitor mode.

The query form of this command is EMSTARTPoint? (with no parameter).

Equivalent Key Sequence	<b>StartP</b> – Presents read-only display of the current value.
Parameter Description	<i>&lt;value&gt;</i> : Start point
Query Response	<i>&lt;value&gt;</i>

**EMTMOUT**  $\square$  *<value>*

Determines the time-out of the Trap function, that is, the length of time the Trap function waits for the DUT to reach the specified trap frequency.

The query form of this command is EMTMOUT? (with no parameter).

Equivalent Key Sequence	<b>Tout</b> – Presents read-only display of the current value.
Parameter Description	<i>&lt;value&gt;</i> Time-out value [ms] [S M MS M]: Unit of time (Defaults to the unit used in MS)
Query Response	<i>&lt;value&gt;</i>

## Alphabetical Reference

**EQUCKt**{DEV4|DEV6|OFF}

Controls the Equivalent Circuit Analysis function. With this command, you can cause the Equivalent Circuit Analysis function to simulate either a 4- or 6-element equivalent circuit; or turn off the Equivalent Circuit Analysis function.

The query form of this command is EQUCKt? (with no parameter).

Equivalent Key Sequence	(blue) + $\mu$ /M (Equiv Ckt) EQUCK
Parameter Description	DEV4: 4-element equivalent circuit DEV6: 6-element equivalent circuit OFF: Equivalent Circuit Analysis function OFF
Query Response	{DEV4 DEV6 OFF}

**ERROR?** A query-dedicated command that returns the number and message of any existing error in the HP E4915A/E4916A's error queue.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	Response error number and error message.

**\*ESE** <value> Sets the bits of the Standard Event Status Register.

Equivalent Key Sequence	—
Parameter Description	<value>:
Query Response	—

**\*ESE?** Queries the bits of the Standard Event status register.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	<value>: Register value in decimal notation

**\*ESR?** A query-dedicated command that returns the contents of the Standard Event status register. Note that this query reads and also clears the contents of the Standard Event status register.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	<value>: Register value in decimal notation

**EXTRLOCK?** Return the status of the external reference input.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	{1 0} 1: Locked to external signal 0: No external signal

**FLTDB** □ <value> Specifies the down value for the filter's band width.  
 The query form of this command is FLTDB? (with no parameter).

Equivalent Key Sequence	xB
Parameter Description	<value> Band width of the filter band width [dB]
Query Response	<value>

**FLTMODE** □ {CONSTant|MINimum}

Determines whether to measure the minimum or constant loss in Filter measurement mode.

The query form of this command is FLTMODE? (with no parameter).

Equivalent Key Sequence	LOSS
Parameter Description	CONSTant: Constant loss MINimum: Minimum loss
Query Response	{CONST MIN}

Alphabetical Reference

**FORMat**□{ASCIi|REAL[,64]}

Selects the HP-IB data transfer format to use.

The query form of this command is FORMat? (with no parameter).

Equivalent Key Sequence	—
Parameter Description	ASCIi: ASCII format REAL[,64]: REAL format
Query Response	{ASC REAL}

**HPIBADDRESS**□<value>

Sets the HP-IB address.

The query form of this command is HPIBADDRESS? (with no parameter).

Equivalent Key Sequence	<b>HPIB</b>
Parameter Description	<value> : HP-IB address(31:talk only)
Query Response	<value> <value>:

**\*IDN?** A query-dedicated command that returns an identification string which consists of four comma-separated fields.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	<field 1>,<field 2>,<field 3>,<field 4>: See the list below.

- <field 1>      Manufacturer (always HEWLETT-PACKARD)
- <field 2>      Model number
- <field 3>      Serial number in HP format (such as 2419J00100)
- <field 4>      Firmware version number (such as 01.00)

**INITCONTInuous** {OFF|ON|0|1}

Sets or queries whether the trigger system is continuously initiated or not.

The query form of this command is INITCONTInuous? (with no parameter).

**INITCONTinuous {OFF|ON|0|1}**

Equivalent Key Sequence	—
Parameter Description	OFFor0:Does not initiate the trigger system continuously. ONor1 :Initiates the trigger system continuously.
Query Response	{1 0}

**INITIMMediate**

Causes all sequences to exit Idle state and enter Initiate state.This command causes the trigger system to initiate and complete one full trigger cycle, returning to Idle state on completion.(No query)

If the HP E4915A/E4916A is not in Idle state or if INITCONTinuous is set to ON, an INITIMMediate command has no effect on the trigger system ad an error -213 is generated.

This command is not available in a query form.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	Query form not supported.

**KLOCK□{OFF|ON|0|1}**

Turns ON/OFF the Key Lock function for the front panel.

The query form of this command is KLOCK? (with no parameter).

Equivalent Key Sequence	(blue) + 0
Parameter Description	OFF: Key lock OFF ON: Key lock ON 0: Key lock OFF 1: Key lock ON
Query Response	0: Key lock OFF 1: Key lock ON

**MEASFunction□{Xtal|Spur|Dld|Em|Lcr|Filter}**

This command is used to select one of the available measurement modes/functions.

The query form of this command is MEASFunction? (with no parameter).

Alphabetical Reference

Equivalent Key Sequence	Xtal: (blue) + Freq (Xtl) Spur: (blue) + Level (Spurious) Dld: (blue) + Meas Prmtr (DLD) (HP E4916Aonly) Em: (blue) + Nominal Cl (EM) (HP E4916Aonly) Lcr: (blue) + Meas Time (LCR) (HP E4916Aonly) Filter: (blue) + CL Value (Flt) (HP E4916Aonly)
Parameter Description	Xtal: Crystal Resonator measurement mode Spur: Spurious measurement mode Dld: Drive Level Dependency measurement mode(HP E4916Aonly) Em: Evaporation Monitor mode (HP E4916Aonly) Lcr: LCR measurement mode (HP E4916Aonly) Filter: Filter measurement mode (HP E4916Aonly)
Query Response	{X S D E L F}

MEASPARA□{FR|FA|FS|FL}

Selects the frequency type to search for.

The query form of this command is MEASPARA? (with no parameter).

Equivalent Key Sequence	Meas Prmtr PARA
Parameter Description	FR: Resonance frequency FA: Anti-resonance frequency FS: Frequency with the maximum G value (conductance) FL: Resonance frequency with capacitance load
Query Response	{FR FA FS FL}

MEASTime□<value>

Sets the measuring time of the HP E4915A/E4916A to one of six levels (levels 1 to 6). The measuring time increases in the ascending order of these six level numbers; that is, level 1 provides the shortest time while level 6 provides the longest time. For DUTs with high Q values, levels 4 to 6 are recommended (High-Q mode is mapped to levels 4 to 6).

The query form of this command is MEASTime? (with no parameter).

Equivalent Key Sequence	Meas Time – Corresponds to levels 1 to 6.(1 to 3 for LCR Mode) TIME HI Q																					
Parameter Description	<table border="1"> <thead> <tr> <th>MEASTime</th> <th>Measuring time</th> <th>High Q</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Short</td> <td>OFF</td> </tr> <tr> <td>2</td> <td>Med</td> <td>OFF</td> </tr> <tr> <td>3</td> <td>Long</td> <td>OFF</td> </tr> <tr> <td>4</td> <td>Short</td> <td>ON</td> </tr> <tr> <td>5</td> <td>Med</td> <td>ON</td> </tr> <tr> <td>6</td> <td>Long</td> <td>ON</td> </tr> </tbody> </table>	MEASTime	Measuring time	High Q	1	Short	OFF	2	Med	OFF	3	Long	OFF	4	Short	ON	5	Med	ON	6	Long	ON
MEASTime	Measuring time	High Q																				
1	Short	OFF																				
2	Med	OFF																				
3	Long	OFF																				
4	Short	ON																				
5	Med	ON																				
6	Long	ON																				
Query Response	<value> <value>:																					

**MEMCLEAR** Clears the contents of the memory buffer.  
 This command is not available in a query form.

Equivalent Key Sequence	MemClear
Parameter Description	—
Query Response	Query form not supported.

**MEMINDEX?** A query-dedicated command that allows you to obtain the memory buffer index where the most recent data is stored.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	<value>:

**MEMREAD?** A query-dedicated command that allows you to obtain the contents of the memory buffer.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	See the table below.

The following table shows the format and contents of the data transferred when this query is issued.

Alphabetical Reference

Transferred Data

- ASCII format transfer ASCII: <asc\_data> ... <asc\_data><NLEND>  
<asc\_data>:=<status>,<data>, ... ,<data>[,<comp>]  
<comp>:=<bin\_num>,<pri>,<sec>[,<t\_1>,<t\_2>]
- Binary format transfer BINARY: #6<num\_bytes><bin\_data> ...  
<bin\_data><NLEND> <bin\_data>:=<status><data> ... <data>[<comp>]  
<comp>:=<bin\_num><pri><sec>[<t\_1><t\_2>]

Data Elements

- Data elements transferred whenever TRG is issued  
<num\_elements> : Number of data elements transferred  
<num\_bytes> : Number of bytes transferred (for example, this element contains #6000256 when 256 bytes are transferred).  
<status> : Measurement data status  
-1: No data  
0: Normal measurement data  
<data> : Mode-dependent measurement data (See the table below).
- Data elements transferred with the Comparator function ON  
<bin\_num> : Bin identification number  
-1: OUT OF BIN  
-2 = AUX BIN  
1 to 9 = Bin number  
<pri> : Result of primary sorting  
0: PASS  
1: FAIL  
<sec> : Result of secondary sorting  
0: PASS  
1: FAIL  
-1: Secondary sorting OFF
- Data elements transferred with the Comparator function ON (DLD mode only)  
<t\_1> : ΔF limit test result  
0: PASS  
1: FAIL  
-1: ΔF limit test OFF  
<t\_2> : ΔCI limit test result  
0: PASS  
1: FAIL  
-1: ΔF limit test OFF

Measurement data that depends on  
the measurement mode (<data>)

Crystal Resonator measurement mode	<ul style="list-style-type: none"> <li>■ Data elements transferred whenever TRG is issued           <ul style="list-style-type: none"> <li>&lt;F&gt; : F (Measured resonance frequency: Fr, Fa, Fs)</li> <li>&lt;FL&gt; : FL (Measured resonance frequency)</li> <li>&lt;CI&gt; : CI/Z (Measured resonance impedance)</li> </ul> </li> <li>■ Data elements transferred with the Equivalent Circuit Analysis function ON (for both 4- and 6-element modes)           <ul style="list-style-type: none"> <li>&lt;Q&gt; : Q</li> <li>&lt;Ts&gt; : Ts</li> <li>&lt;C0&gt; : C0</li> <li>&lt;C1&gt; : C1</li> <li>&lt;L1&gt; : L1</li> <li>&lt;R1&gt; : R1</li> </ul> </li> <li>■ Data elements transferred with the Equivalent Circuit Analysis function ON (for 6-element mode only)           <ul style="list-style-type: none"> <li>&lt;G0&gt; : G0</li> <li>&lt;R0&gt; : R0</li> </ul> </li> <li>■ Data elements transferred with Aging mode ON           <ul style="list-style-type: none"> <li>&lt;time&gt; : Total elapsed time [ms]</li> </ul> </li> </ul>
Drive Level Dependency measurement mode	<ul style="list-style-type: none"> <li>■ Data elements transferred whenever TRG is issued           <ul style="list-style-type: none"> <li>&lt;F&gt; : F (Measured resonance frequency: Fr, Fa, Fs)</li> <li>&lt;CI&gt; : CI/Z (Measured resonance impedance)</li> </ul> </li> <li>■ Data elements transferred with the Equivalent Circuit Analysis function ON (for both 4- and 6-element modes)           <ul style="list-style-type: none"> <li>&lt;Q&gt; : Q</li> <li>&lt;Ts&gt; : Ts</li> <li>&lt;C0&gt; : C0</li> <li>&lt;C1&gt; : C1</li> <li>&lt;L1&gt; : L1</li> <li>&lt;R1&gt; : R1</li> </ul> </li> <li>■ Data elements transferred with the Equivalent Circuit Analysis function ON (for 6-element mode only)           <ul style="list-style-type: none"> <li>&lt;G0&gt; : G0</li> <li>&lt;R0&gt; : R0</li> </ul> </li> <li>■ Number of spurious points           <ul style="list-style-type: none"> <li>&lt;spur_num&gt; : Number of detected spurious points</li> </ul> </li> <li>■ Data elements transferred when one or more spurious points are detected (these elements are transferred for each of the spurious points detected)           <ul style="list-style-type: none"> <li>&lt;sF1&gt; : Frequency of the spurious point</li> <li>&lt;sCI1&gt; : Impedance at the spurious point</li> </ul> </li> </ul>
Evaporation Monitor mode	<ul style="list-style-type: none"> <li>■ Data elements transferred whenever TRG is issued           <ul style="list-style-type: none"> <li>&lt;F&gt; : F (Measured resonance frequency: Fr, Fa, Fs)</li> <li>&lt;CI&gt; : CI/Z (Measured resonance impedance)</li> <li>&lt;STAT&gt; : Indicates whether the tracking measurement was successful.               <ul style="list-style-type: none"> <li>0: PASS</li> <li>1: FAIL</li> </ul> </li> <li>&lt;DL&gt; : DL value (setting)</li> </ul> </li> </ul>
Evaporation Monitor mode	<ul style="list-style-type: none"> <li>■ Data elements transferred whenever TRG is issued           <ul style="list-style-type: none"> <li>&lt;F&gt; : F Trap frequency</li> <li>&lt;CI&gt; : CI/Z CI value at the trap frequency</li> <li>&lt;time&gt; : Time required between two trap points</li> <li>&lt;NLEND&gt;: NewLineEND (1 byte)</li> </ul> </li> </ul>
Filter measurement mode	<ul style="list-style-type: none"> <li>■ Data elements transferred whenever TRG is issued           <ul style="list-style-type: none"> <li>&lt;Loss&gt; : Minimum or constant loss</li> <li>&lt;<math>\Delta f_{left}</math>&gt; : -x dB BW (<math>\Delta f_{left}</math>)</li> <li>&lt;<math>\Delta f_{right}</math>&gt; : -x dB BW (<math>\Delta f_{right}</math>)</li> </ul> </li> </ul>

Alphabetical Reference

**MEMRETEST** Clears the most recent data in the memory buffer.  
 This command is not available in a query form.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	Query form not supported.

**MEMSIZE**□<value> Sets the memory buffer size.  
 The query form of this command is MEMSIZE? (with no parameter).

Equivalent Key Sequence	—
Parameter Description	<value> : Memory buffer size
Query Response	<value>: int16, NR1

**MEMSTATE**□{OFF|ON|0|1}

Turns ON/OFF the Memory Buffer function.  
 The query form of this command is MEMSTATE? (with no parameter).

Equivalent Key Sequence	(blue) + 2 (Mem Buf)
Parameter Description	OFF: Memory Buffer function OFF ON: Memory Buffer function ON 0: Memory Buffer function OFF 1: Memory Buffer function ON
Query Response	{1 0}

**NOMCI**□<value> Specifies the nominal resonance frequency. When ALC mode is OFF, the system controls the drive level based on this nominal value. The value can also be used as the reference value for Delta mode (refer to DLTMode).

The query form of this command is NOMCI? (with no parameter).

Equivalent Key Sequence	Nominal CI CI
Parameter Description	<value> Nominal resonance impedance
Query Response	<value>

**NOMFreq**  $\square$   $\langle value \rangle$  Specifies the nominal resonance frequency. This value is used as the center frequency for the search range (refer to SRCHRange). The unit can be MHZ, KHZ, HZ, M, or K.

The query form of this command is NOMFreq? (with no parameter).

Equivalent Key Sequence	Freq
Parameter Description	$\langle value \rangle$ Nominal resonance frequency [MHZ M KHZ K HZ]: Unit
Query Response	$\langle value \rangle$

**\*OPC?** Returns 1 when all pending operations have been completed.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	{1 0}:

**\*OPC** Tells the HP E4915A/E4916A to set bit 0 (OPC bit) in the Standard Event Status Register when it completes all pending operations.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	—

**\*OPT?** Queries the options installed. (Query only)

Equivalent Key Sequence	—
Parameter Description	—
Query Response	Option number

**OSE**  $\square$   $\langle value \rangle$  Sets the enable register of the Operation Status Register group.  
 The query form of this command is OSE? (with no parameter).

Equivalent Key Sequence	—
Parameter Description	$\langle value \rangle$ : Register value in decimal notation
Query Response	$\langle value \rangle$ : Register value in decimal notation

Alphabetical Reference

**OSER?** A query-dedicated command that returns the contents of the event register of the Operation Status Register group.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	<value> : Register value in decimal notation

**OSR?** A query-dedicated command that returns the contents of the condition register of the Operation Status Register group.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	<value> : Register value in decimal notation

**OUTIO**<sub>L</sub><value> Outputs 11 bits long data through the I/O port.  
 This command is not available in a query form.

Equivalent Key Sequence	—
Parameter Description	<value> : data (0 to 2048)
Query Response	Query form not supported.

**OUTIOSTATe**<sub>L</sub>{OFF|ON|0|1}

Enables or disables the output of 11 bits long data through the I/O port. When OUTIOSTAT is set to OFF, the output through I/O port is disabled even EM measurement is performed. OUTIO causes the output through I/O port even OUTIOSTAT is set to OFF. The query form of this command is OUTIOSTATe? (with no parameter).

Equivalent Key Sequence	—
Parameter Description	OFF: Disables the output through I/O port. ON: Enables the output through I/O port. 0: Disables the output through I/O port. 1: Enables the output through I/O port.
Query Response	{0 1}  1: Output through I/O port is enabled. 0: Output through I/O port is disabled.

**OUTPMDData?** A query-dedicated command that allows you to obtain measurement data in Aging mode. This command provides a query response equivalent to that of the \*TRG command without affecting the trigger system.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	—

**POWER**□<value> Specifies the power level value. If no unit is specified, the system uses the same unit as used in the last search.

The query form of this command is POWER? (with no parameter).

Equivalent Key Sequence	<div style="border: 1px solid black; border-radius: 5px; padding: 2px; display: inline-block;">Level</div> <b>EVL</b> : Lets you enter a value. <b>UNIT</b> : Lets you select a unit.
Parameter Description	<value> Power level value [MW UW NW W MA UA A MV UV V DBM]: Unit (Defaults to the unit used in the previous search). M: m (milli), U: μ (micro), N: n (nano), MA: mA
Query Response	<value>,{W A V D}

**PRESet** Resets the instrument settings to the preset values.

This command is not available in a query form.

Equivalent Key Sequence	<div style="border: 1px solid black; border-radius: 5px; padding: 2px; display: inline-block;">(blue)</div> + <div style="border: 1px solid black; border-radius: 5px; padding: 2px; display: inline-block;">. (Reset)</div>
Parameter Description	—
Query Response	Query form not supported.

**PTABORT**□{OFF|ON|0|1}

Turns ON/OFF the phase tracking abort function. When the abort function is ON and phase tracking fails, the system aborts drive level measurement. When the abort function is OFF and phase tracking fails, the system retries to search for the resonance frequency and continue to measure the drive level dependency.

The query form of this command is PTABORT? (with no parameter).

Equivalent Key Sequence	<b>ABORT</b>
Parameter Description	OFF: Abort function OFF ON: Abort function ON 0: Abort function OFF 1: Abort function ON
Query Response	{1 0}

**PTCLEar** Clears the drive level (sweep point) list.  
This command is not available in a query form.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	Query form not supported.

**PTLIST␣<value1>,<value2>,{OFF|ON|0|1}**

Allows you to define a list of drive levels (sweep points). With this command, you can arrange sweep points (drive levels) exactly as you desire. Also, you can enable or disable drive level measurement for each of the sweep points; that is, you can define sweep points where no measurement is performed.

The query form of this command is PTLIST?␣<value1>. The parameter <value1> must be supplied to specify the number of the sweep point whose settings you want to obtain.

Equivalent Key Sequence	—
Parameter Description	<value1> : Number of the sweep point <value2> Drive level at the sweep point [MW UW NW W MA UA A MV UV V DBM]: Unit of the power level OFF: Drive power OFF. ON: Drive power ON.
Query Response	<value2>,{1 0}  <value2> : Drive level at the specified sweep point {OFF ON 0 1}: Whether to enable or disable applying drive power at the specified sweep point

**Note**



In Drive Level Dependency measurement mode, you can set up the sweep pattern in one of the following two ways:

**Table 5-4. Setting Up the Sweep Pattern**

Method	HP-IB Commands	Description
Sweep point list	PTLIST, PTSWPTtype	Issue the PTSWPTtype command with the LIST option, and use the PTLIST command to explicitly specify the drive level values for the respective sweep points.
Maximum/minimum values	PTMINPower, PTMAXPower, PTSWPTtype	Specify the minimum and maximum drive levels, and select one of the three sweep types (UPDOWN, UP, UPMIN) with the PTSWPTtype command. The selected sweep type determines how the drive level is swept between the specified minimum and maximum level values.

**PTLSIZE**□<value> Sets the size of the drive level (sweep point) list.

The query form of this command is PTLSIZE? (with no parameter).

Equivalent Key Sequence	—
Parameter Description	<value> : The number of lines that represents the size of the sweep point list
Query Response	<value>

**PTMAXPower**□<value>

Specifies the maximum drive level value. This command must be used in conjunction with the PTMINPower and PTSWPTtype commands.

The query form of this command is PTMAXPower? (with no parameter).

Equivalent Key Sequence	<b>MAX</b>
Parameter Description	<value> Maximum drive level value [MW UW NW W MA UA A MV UV V DBM]: Unit of the drive level value
Query Response	<value>,{W A V D}

**Note**



In Drive Level Dependency measurement mode, you can set up the sweep pattern in one of the following two ways:

**Table 5-5. Setting Up the Sweep Pattern**

Method	HP-IB Commands	Description
Sweep point list	PTLIST, PTSWPTtype	Issue the PTSWPTtype command with the LIST option, and use the PTLIST command to explicitly specify the drive level values for the respective sweep points.
Maximum/minimum values	PTMINPower, PTMAXPower, PTSWPTtype	Specify the minimum and maximum drive levels, and select one of the three sweep types (UPDOWN, UP, UPMIN) with the PTSWPTtype command. The selected sweep type determines how the drive level is swept between the specified minimum and maximum level values.

**PTMINPower**□<value>

Specifies the minimum drive level value. This command must be used in conjunction with the PTMAXPower and PTSWPTtype commands.

The query form of this command is PTMINPower? (with no parameter).

Equivalent Key Sequence	<b>MIN</b>
Parameter Description	<value> Minimum drive level value [MW UW NW W MA UA A MV UV V DBM]: Unit of the drive level value
Query Response	<value>,{W A V D}

**Note**

In Drive Level Dependency measurement mode, you can set up the sweep pattern in one of the following two ways:

**Table 5-6. Setting Up the Sweep Pattern**

Method	HP-IB Commands	Description
Sweep point list	PTLIST, PTSWPTtype	Issue the PTSWPTtype command with the LIST option, and use the PTLIST command to explicitly specify the drive level values for the respective sweep points.
Maximum/minimum values	PTMINPower, PTMAXPower, PTSWPTtype	Specify the minimum and maximum drive levels, and select one of the three sweep types (UPDOWN, UP, UPMIN) with the PTSWPTtype command. The selected sweep type determines how the drive level is swept between the specified minimum and maximum level values.

**PTRACK□{ON|OFF|0|1}**

Turns ON/OFF the Phase Tracking function.

The query form of this command is PTRACK? (with no parameter).

Equivalent Key Sequence	<b>TRKG</b>
Parameter Description	OFF: Phase tracking OFF. The resonance frequency is detected by Fr search and then drive level is swept with the frequency maintained. ON: Phase tracking ON. The resonance frequency at each drive level is searched by sweeping the drive level to detect the CI value at the resonance point. 0: Phase tracking OFF. The resonance frequency is detected by Fr search and then drive level is swept with the frequency maintained. 1: Phase tracking ON. The resonance frequency at each drive level is searched by sweeping the drive level to detect the CI value at the resonance point.
Query Response	{ON OFF 0 1}

**PTSTARTPoint□<value>**

Specifies the drive level at which to start measuring the drive level characteristics.

The query form of this command is PTSTARTPoint? (with no parameter).

**PTSTARTPoint**□<value>

Equivalent Key Sequence	<b>StartP</b>
Parameter Description	<value> : Start point
Query Response	<value>

**PTSTDPower**□<value> Specifies the reference drive level.

The query form of this command is PTSTDPower? (with no parameter).

Equivalent Key Sequence	<b>STD</b>
Parameter Description	<value> Reference drive level [MW UW NW W MA UA A MV UV V DBM]: Unit of the power level
Query Response	<value>,{W A V D}

**PTSWPType**□{UPDOWN|UP|UPMIN|LIST}

Specifies the sweep type.

The query form of this command is PTSWPType? (with no parameter).

Equivalent Key Sequence	<b>SWEP</b>
Parameter Description	UPDOWN: Increases the drive level step by step from the minimum level value to the maximum level value. UP: Increases the drive level step by step from the minimum level value to the maximum level value, and then decreases the drive level from the maximum value to the minimum value. UPMIN: Increases the drive level step by step from the minimum level value to the maximum level value, and then immediately increases the drive level to the minimum value. LIST: Sweeps the drive level in accordance with the sweep point list defined with the PTLIST command.
Query Response	{UPDOWN UP UPMIN LIST}

**Note**



In Drive Level Dependency measurement mode, you can set up the sweep pattern in one of the following two ways:

Table 5-7. Setting Up the Sweep Pattern

Method	HP-IB Commands	Description
Sweep point list	PTLIST, PTSWPType	Issue the PTSWPType command with the LIST option, and use the PTLIST command to explicitly specify the drive level values for the respective sweep points.
Maximum/minimum values	PTMINPower, PTMAXPower, PTSWPType	Specify the minimum and maximum drive levels, and select one of the three sweep types (UPDOWN, UP, UPMIN) with the PTSWPType command. The selected sweep type determines how the drive level is swept between the specified minimum and maximum level values.

**PTWAIT**  $\square$  *<value>* Determines the length of time the system waits for the DUT to become stable with the power being applied.

The query form of this command is PTWAIT? (with no parameter).

Equivalent Key Sequence	WAIT
Parameter Description	<i>&lt;value&gt;</i> Wait time between energization and stabilization of the DUT [S MS M]: Unit of time (Defaults to the unit used in S).
Query Response	<i>&lt;value&gt;</i>

**QSE**  $\square$  *<value>* Sets the enable register of the Standard Questionable (QUESTIONable) Status Register group.

The query form of this command is QSE? (with no parameter).

Equivalent Key Sequence	—
Parameter Description	<i>&lt;value&gt;</i> : Register value in decimal notation
Query Response	<i>&lt;value&gt;</i> : Register value in decimal notation

**QSER?** A query-dedicated command that returns the contents of the event register of the Standard Questionable (QUESTIONable) Status Register group.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	<i>&lt;value&gt;</i> : Register value in decimal notation

**QSR?** A query-dedicated command that returns the contents of the condition register of the Standard Questionable (QUESTionable) Status Register group.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	<value> : Register value in decimal notation

**\*RCL** <value> Recall the instrument state which was stored in the specified register number. The HP E4915A/E4916A has 10 available storage registers. (No query)

Equivalent Key Sequence	Rcl
Parameter Description	<value>:
Query Response	—

**\*RST** Resets the HP E4915A/E4916A to the initial settings.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	—

**\*SAV** <value> Saves the instrument state in the specified register number. The HP E4915A/E4916A has 10 available storage registers. (No query)

Equivalent Key Sequence	(blue) + Rcl (Save)
Parameter Description	<value>:
Query Response	—

**SEE** <value> Sets the enable register of the Search Event Status Register group.

Equivalent Key Sequence	—
Parameter Description	<value> : Register value in decimal notation
Query Response	<value> : Register value in decimal notation

**SEER?** A query-dedicated command that returns the contents of the event register of the Search Event Status Register.(Query only)

Equivalent Key Sequence	—
Parameter Description	—
Query Response	<value> : Register value in decimal notation

**SER?** A query-dedicated command that returns the contents of the condition register of the Search Event Status Register group.(Query only)

Equivalent Key Sequence	—
Parameter Description	—
Query Response	<value> : Register value in decimal notation

**SPCENTER□<value>** Specifies the center frequency for the spurious search range.  
The query form of this command is **SPCENTER?** (with no parameter).

Equivalent Key Sequence	<b>GENT</b>
Parameter Description	<value> Center frequency
Query Response	<value>

**SPDISP□{Worst|Nth,<value>}**

Determines which spurious point to be displayed on the LCD. This command requires one of the two options: **Worst** and **Nth**. Use the **Worst** option to display the worst spurious point (i.e., the spurious point where the impedance value reaches the maximum negative peak). On the other hand, the **Nth** option allows you to specify the index number of the spurious point you want displayed; for example, you can specify 1 for the spurious point with the smallest frequency, 2 for the spurious point with the second smallest frequency, and so on.

The query form of this command is **SPDISP?** (with no parameter).

Equivalent Key Sequence	<b>DispSP</b>
Parameter Description	Worst: Displays the worst spurious point. Nth: Displays the Nth spurious point. <value> : Specify the index number of the desired spurious point. This parameter must follow the <b>Nth</b> option (not required for the <b>Worst</b> option).
Query Response	<value>  <value> : An integer value that represents the index number of the spurious point currently displayed (returns 0 if the <b>Worst</b> option was specified).

**SPDISP** □ {Worst|Nth, <value>}

**SPNUM** □ <value> Specifies the number of spurious points to search for.  
 The query form of this command is SPNUM? (with no parameter).

Equivalent Key Sequence	#Spur
Parameter Description	<value> : Number of spurious points to search for
Query Response	<value>

**SPPHase** □ <value> Specifies the target phase for spurious search. This command takes effect with the PHase option specified for the SPTGT command.  
 The query form of this command is SPPHase? (with no parameter).

Equivalent Key Sequence	PHAS
Parameter Description	<value> Target phase value
Query Response	<value>

**SPRANGe** □ <value> Specifies the spurious search range. The unit can be either Hz or ppm. If no unit is specified, the system uses the same unit as used in the last search. Note that the search range is centered at the frequency specified with the SPCENTer command.  
 The query form of this command is SPRANGe? (with no parameter).

Equivalent Key Sequence	RNG
Parameter Description	<value> : Frequency range [MHZ M KHZ K HZ PPM]: Unit (Defaults to the unit used in the previous search).
Query Response	<value>, {HZ PPM}

**SPTGT** □ {PHase|PEak} Determines whether to search for spurious points based on a particular target phase or impedance peak.  
 The query form of this command is SPTGT? (with no parameter).

Equivalent Key Sequence	TGT
Parameter Description	Phase: Searches for spurious points that match the target phase. Peak : Searches for spurious points with peak impedance.
Query Response	{PH PE}

**SRCHRange**□<value>

Specifies the range to search for the resonance frequency. The unit can be either Hz or ppm. If no unit is specified, the system uses the same unit as used in the last search. Note that the search range is centered at the nominal frequency (refer to NOMFreq).

The query form of this command is SRCHRange? (with no parameter).

Equivalent Key Sequence	<b>RNG</b>
Parameter Description	<value> Frequency search range MHZ M KHZ K HZ PPM: Unit (Defaults to the unit used in the previous search).
Query Response	<value>,{HZ PPM}

**SRCHTGT**□{PHase|PEak}

Determines whether to search for the resonance point based on a target phase or impedance peak.

The query form of this command is SRCHTGT? (with no parameter).

Equivalent Key Sequence	<b>TGT</b>
Parameter Description	PHase: Frequency at target phase PEak : Positive/negative peak value
Query Response	{PH PE}

**\*SRE?** Queries the contents of the Status Byte Enable Register.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	—

**\*SRE** Sets the bits of the Status Byte Enable Register.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	—

**\*STB?** Queries the contents of the Status Byte Register. (Query only)

Equivalent Key Sequence	—
Parameter Description	—
Query Response	<value>: Status byte register value in decimal notation

**TGTPhase**□<value> Specifies the target phase value.

The query form of this command is TGTPhase? (with no parameter).

Equivalent Key Sequence	PHAS
Parameter Description	<value> Target phase value
Query Response	<value>

**THRUCAL** Performs calibration for the thru state.

This command is not available in a query form.

Equivalent Key Sequence	(blue) + 3 (Thru)
Parameter Description	—
Query Response	Query form not supported.

**\*TRG(Crystal Resonator Measurement Mode)**

Triggers the measurement process. Issuing the \*TRG command causes the HP E4915A/E4916A to transfer the measurement results to the controller. The following table describes the format and contents of the data transferred upon the execution of the \*TRG command.

<b>Transferred Data</b>	<ul style="list-style-type: none"> <li>■ ASCII format transfer ASCII: &lt;num_elements&gt;, &lt;asc_data&gt;&lt;NLEND&gt; &lt;asc_data&gt;:= [&lt;time&gt;, &lt;F&gt;, &lt;FL&gt;, &lt;CI&gt;[, &lt;Q&gt;, &lt;Ts&gt;, &lt;C0&gt;, &lt;C1&gt;, &lt;L1&gt;, &lt;R1&gt;[, &lt;G0&gt;, &lt;R0&gt;]] [, &lt;comp&gt;][, &lt;phase&gt;] &lt;comp&gt;:= &lt;bin_num&gt;, &lt;pri&gt;, &lt;sec&gt;</li> <li>■ Binary format transfer BINARY: #4&lt;num_bytes&gt;&lt;bin_data&gt;&lt;NLEND&gt; &lt;bin_data&gt;:= [&lt;time&gt;] &lt;F&gt; &lt;FL&gt; &lt;CI&gt; [ &lt;Q&gt; &lt;Ts&gt; &lt;C0&gt; &lt;C1&gt; &lt;L1&gt; &lt;R1&gt; [ &lt;G0&gt; &lt;R0&gt; ] ] [ &lt;comp&gt; ] [ &lt;phase&gt; ] &lt;comp&gt;:= &lt;bin_num&gt; &lt;pri&gt; &lt;sec&gt;</li> </ul>
<b>Data Elements</b>	<ul style="list-style-type: none"> <li>■ Data elements transferred whenever TRG is issued &lt;num_elements&gt; : Number of data elements transferred &lt;num_bytes&gt; : Number of bytes transferred (for example, this element contains #400256 when 256 bytes are transferred). &lt;F&gt; : F (Measured resonance frequency: Fr, Fa, Fs) &lt;FL&gt; : FL (Measured resonance frequency) &lt;CI&gt; : CI/Z (Measured resonance impedance)</li> <li>■ Data elements transferred with the Equivalent Circuit Analysis function ON (for both 4- and 6-element modes) &lt;Q&gt; : Q &lt;Ts&gt; : Ts &lt;C0&gt; : C0 &lt;C1&gt; : C1 &lt;L1&gt; : L1 &lt;R1&gt; : R1</li> <li>■ Data elements transferred with the Equivalent Circuit Analysis function ON (for 6-element mode only) &lt;G0&gt; : G0 &lt;R0&gt; : R0</li> <li>■ Data elements transferred with the Comparator function ON &lt;bin_num&gt; : Bin identification number -1: OUT OF BIN -2 = AUX BIN 1 to 9 = Bin number &lt;pri&gt; : Result of primary sorting 0: PASS 1: FAIL &lt;sec&gt; : Result of secondary sorting 0: PASS 1: FAIL -1: Secondary sorting OFF</li> <li>■ Data elements transferred with Aging mode ON (refer to the OUTPMDATA command) &lt;time&gt; : Total elapsed time [ms]</li> <li>■ New Line &lt;NLEND&gt;: NewLineEND (1 byte)</li> </ul>

**\*TRG(CL Adjust Mode)**

Triggers the measurement process. Issuing the \*TRG command causes the HP E4915A/E4916A to transfer the measurement results to the controller. The following table describes the format and contents of the data transferred upon the execution of the \*TRG command.

<b>Transferred Data</b>	<ul style="list-style-type: none"> <li>■ ASCII format transfer ASCII: &lt;num_elements&gt;, &lt;asc_data&gt;&lt;NLEND&gt; &lt;asc_data&gt;:= &lt;CL&gt;</li> <li>■ Binary format transfer BINARY: #4&lt;num_bytes&gt;&lt;bin_data&gt;&lt;NLEND&gt; &lt;bin_data&gt;:= &lt;CL&gt;</li> </ul>
<b>Data Elements</b>	<ul style="list-style-type: none"> <li>&lt;num_elements&gt; : Number of data elements transferred</li> <li>&lt;num_bytes&gt; : Number of bytes transferred</li> <li>&lt;CL&gt; : Actual CL value</li> <li>&lt;NLEND&gt;: NewLineEND (1 byte)</li> </ul>

**\*TRG(Spurious Measurement Mode)**

Triggers the measurement process. Issuing the \*TRG command causes the HP E4915A/E4916A to transfer the measurement results to the controller. Spurious points are reported in the ascending order with respect to the resonance frequency. Use the SPNUM command to specify the number of spurious points to search for.

The following table describes the format and contents of the data transferred upon the execution of the \*TRG command.

<b>Transferred Data</b>	<ul style="list-style-type: none"> <li>■ ASCII format transfer ASCII: &lt;num_elements&gt;,&lt;asc_data&gt;&lt;NLEND&gt; &lt;asc_data&gt;=&lt;F&gt;,&lt;CI&gt;,&lt;spur_num&gt;[,&lt;sF1&gt;,&lt;sCI1&gt;[,&lt;sF2&gt;,&lt;sCI2&gt;[ ... ]]]</li> <li>■ Binary format transfer BINARY: #4&lt;num_bytes&gt;&lt;bin_data&gt;&lt;NLEND&gt; &lt;bin_data&gt;=&lt;F&gt;&lt;CI&gt;&lt;spur_num&gt;[&lt;sF1&gt;&lt;sCI1&gt;[&lt;sF2&gt;&lt;sCI2&gt;[ ... ]]]</li> </ul>
<b>Data Elements</b>	<ul style="list-style-type: none"> <li>■ Data elements transferred whenever TRG is issued &lt;num_elements&gt; : Number of data elements transferred &lt;num_bytes&gt;: Number of bytes transferred (for example, this element contains #40048 when 48 bytes are transferred). &lt;F&gt; : F (Measured resonance frequency: Fr, Fa, Fs) &lt;CI&gt; : CI/Z (Measured resonance impedance)</li> <li>■ Number of spurious points &lt;spur_num&gt; : Number of detected spurious points</li> <li>■ Data elements transferred when one or more spurious points are detected (these elements are transferred for each of the spurious points detected) &lt;sF1&gt; : Frequency of the spurious point &lt;sCI1&gt; : Impedance at the spurious point</li> <li>■ New Line &lt;NLEND&gt;: NewLineEND (1 byte)</li> </ul>

**\*TRG(Evaporation Monitor Mode)**

Triggers the measurement process. Issuing the \*TRG command causes HP E4916A to transfer the measurement results to the controller. By default, the measurement results returned include only those at the final trap point. To obtain the measurement results for all the trap points, turn ON the memory buffer function.

The following table describes the format and contents of the data transferred upon the execution of the \*TRG command.

<b>Transferred Data</b>	<ul style="list-style-type: none"> <li>■ ASCII format transfer ASCII: &lt;num_elements&gt;,&lt;asc_data&gt;&lt;NLEND&gt; &lt;asc_data&gt;=&lt;F&gt;,&lt;CI&gt;,&lt;time&gt;</li> <li>■ Binary format transfer BINARY: #4&lt;num_bytes&gt;&lt;bin_data&gt;&lt;NLEND&gt; &lt;bin_data&gt;=&lt;F&gt;&lt;CI&gt;&lt;time&gt;</li> </ul>
<b>Data Elements</b>	<ul style="list-style-type: none"> <li>&lt;num_elements&gt; : Number of data elements transferred</li> <li>&lt;num_bytes&gt;: Number of bytes transferred (for example, this element contains #40048 when 48 bytes are transferred).</li> <li>&lt;F&gt; : F (Trap frequency)</li> <li>&lt;CI&gt; : CI/Z (CI value at the trap frequency)</li> <li>&lt;time&gt; : Time required between two trap points</li> <li>&lt;NLEND&gt;: NewLineEND (1 byte)</li> </ul>

**\*TRG(Drive Level Dependency Measurement Mode)**

Triggers the measurement process. Issuing the \*TRG command causes HP E4916A to transfer the measurement results to the controller. By default, the measurement results returned include only those at the final sweep point. To obtain the measurement results for all the sweep points, turn ON the memory buffer function.

The following table describes the format and contents of the data transferred upon the execution of the \*TRG command.

<b>Transferred Data</b>	<ul style="list-style-type: none"> <li>■ ASCII format transfer               <ul style="list-style-type: none"> <li>&lt;num_elements&gt;,&lt;asc_data&gt;&lt;NLEND&gt;</li> <li>□ &lt;asc_data&gt;:= &lt;F&gt;,&lt;CI&gt;,&lt;STAT&gt;,&lt;DL&gt;,&lt;MinFR&gt;,&lt;MaxF&gt;,&lt;MinCI&gt;,&lt;MaxCI&gt;</li> <li>□ &lt;MaxF-MinF&gt;,&lt;MaxCI-MinCI&gt;[,&lt;comp&gt;]</li> <li>□ &lt;comp&gt;:= &lt;bin_num&gt;,&lt;pri&gt;,&lt;sec&gt;,&lt;t_1&gt;,&lt;t_2&gt;</li> </ul> </li> <li>■ Binary format transfer               <ul style="list-style-type: none"> <li>#4&lt;num_bytes&gt;&lt;bin_data&gt;&lt;NLEND&gt;</li> <li>□ &lt;bin_data&gt;:= &lt;F&gt;&lt;CI&gt;&lt;STAT&gt;&lt;DL&gt;&lt;MinF&gt;&lt;MaxF&gt;&lt;MinCI&gt;&lt;MaxCI&gt;</li> <li>□ &lt;MaxF-MinF&gt;&lt;MaxCI-MinCI&gt;[&lt;comp&gt;]</li> <li>□ &lt;comp&gt;:= &lt;bin_num&gt;&lt;pri&gt;&lt;sec&gt;&lt;t_1&gt;&lt;t_2&gt;</li> </ul> </li> </ul>
<b>Data Elements</b>	<ul style="list-style-type: none"> <li>■ Data elements transferred whenever TRG is issued               <ul style="list-style-type: none"> <li>&lt;num_elements&gt; : Number of data elements transferred</li> <li>&lt;num_bytes&gt;: Number of bytes transferred (for example, this element contains #400256 when 256 bytes are transferred).</li> <li>&lt;F&gt; : F (Resonance frequency measured at the reference drive level)</li> <li>&lt;CI&gt; : CI/Z (Resonance impedance measured at the reference drive level).</li> <li>&lt;STAT&gt; : Indicates whether the tracking measurement was successful.                   <ul style="list-style-type: none"> <li>0: PASS</li> <li>1: FAIL</li> </ul> </li> <li>&lt;MinF&gt; : Minimum &lt;F&gt; value</li> <li>&lt;MaxF&gt; : Maximum &lt;F&gt; value</li> <li>&lt;MinCI&gt; : Minimum &lt;CI&gt; value</li> <li>&lt;MaxCI&gt; : Maximum &lt;CI&gt; value</li> <li>&lt;MaxF-MinF&gt; : Difference between maximum and minimum &lt;F&gt; values</li> <li>&lt;MaxCI-MinCI&gt; : Difference between maximum and minimum &lt;CI&gt; values</li> </ul> </li> <li>■ Data elements transferred with the Comparator function ON               <ul style="list-style-type: none"> <li>&lt;bin_num&gt; : Bin identification number                   <ul style="list-style-type: none"> <li>-1: OUT OF BIN</li> <li>-2 = AUX BIN</li> <li>1 to 9 = Bin number</li> </ul> </li> <li>&lt;pri&gt; : Result of primary sorting                   <ul style="list-style-type: none"> <li>0: PASS</li> <li>1: FAIL</li> </ul> </li> <li>&lt;sec&gt; : Result of secondary sorting                   <ul style="list-style-type: none"> <li>0: PASS</li> <li>1: FAIL</li> <li>-1: Secondary sorting OFF</li> </ul> </li> <li>&lt;t_1&gt; : Result of <math>\Delta F</math> limit test                   <ul style="list-style-type: none"> <li>0: PASS</li> <li>1: FAIL</li> <li>-1: <math>\Delta F</math> limit test OFF</li> </ul> </li> <li>&lt;t_2&gt; : Result of <math>\Delta CI</math> limit test                   <ul style="list-style-type: none"> <li>0: PASS</li> <li>1: FAIL</li> <li>-1: <math>\Delta CI</math> limit test OFF</li> </ul> </li> </ul> </li> <li>■ New Line               <ul style="list-style-type: none"> <li>&lt;NLEND&gt;: NewLineEND (1 byte)</li> </ul> </li> </ul>

**\*TRG(Filter Measurement Mode)**

Triggers the measurement process. Issuing the \*TRG command causes HP E4916A to transfer the measurement results to the controller. The following table describes the format and contents of the data transferred upon the execution of the \*TRG command.

<b>Transferred Data</b>	<ul style="list-style-type: none"> <li>■ ASCII format transfer ASCII: &lt;num_elements&gt;, &lt;asc_data&gt; &lt;NLEND&gt;                      &lt;asc_data&gt;: = &lt;Loss&gt;, &lt;Δf_left&gt;, &lt;Δf_right&gt;</li> <li>■ Binary format transfer BINARY: #4&lt;num_bytes&gt; &lt;bin_data&gt; &lt;NLEND&gt;                      &lt;bin_data&gt;: = &lt;Loss&gt; &lt;Δf_left&gt; &lt;Δf_right&gt;</li> </ul>
<b>Data Elements</b>	<num_elements> : Number of data elements transferred <num_bytes>: Number of bytes transferred (for example, this element contains #400256 when 256 bytes are transferred). <Loss> : Minimum or constant loss <Δf_left> : -x dB BW (Δf_left) <Δf_right> : -x dB BW (Δf_right)

**\*TRG(Common Commands)**

Triggers the HP E4915A/E4916A on condition that the trigger mode is set to Bus trigger mode. (No query)

**Note**



The contents of the data transferred by the \*TRG command differ depending on which measurement mode is currently in effect. For more information, refer to the corresponding sections in "Command Reference by Function".

**TRIGIMMediate**

Immediately triggers the currently selected measurement mode. This command is not available in a query form.

<b>Equivalent Key Sequence</b>	(Trig)
<b>Parameter Description</b>	—
<b>Query Response</b>	Query form not supported.

**TRIGSOURCE**{INTernal|MANual|EXTernal|BUS}

Selects one of the four trigger modes: Internal, Manual, External, and Bus.

The query form of this command is TRIGSOURCE? (with no parameter).

Equivalent Key Sequence	(blue) + Trig (Trigger Mode)
Parameter Description	<p>INTERNAL: Internal (Int) mode – Automatically triggered from within the HP E4915A/E4916A's internal circuitry.</p> <p>MANual: Manual (Man) mode – Triggered when you press the Trig key on the front panel.</p> <p>EXTERNAL: External (Ext) mode – Triggered when a TTL pulse signal is input through the Ext Trigger or Handler Interface port on the rear panel.</p> <p>BUS: Bus mode – Triggered when the GET or *TRG FETCh,TRIGIMM command is issued.</p>
Query Response	{INT MAN EXT BUS}

**\*TST?** Executes an internal self-test and the test result as the sum of the error cords of all existing errors. If there is no error the HP E4915A/E4916A returns 0.

Equivalent Key Sequence	–
Parameter Description	–
Query Response	<p>{1 4 8 16}</p> <p>1: Test1 RAM</p> <p>4: Test2 Calibration data</p> <p>8: Test3 Flashmemory(program area)</p> <p>16: Test4 Backup memory</p>

**VERSION?** A query-dedicated command that returns the number corresponding to the SCPI version to which the HP E4915A/E4916A complies.

Equivalent Key Sequence	–
Parameter Description	–
Query Response	<value>: Number that corresponds to the SCPI version.

**\*WAI** Causes the HP E4915A/E4916A to wait until all previously sent commands are completed. (No query)

Equivalent Key Sequence	–
Parameter Description	–
Query Response	–

## LCR Meter Command Reference

### Subsystem Commands

Subsystem Commands include all measurement functions and some general purpose functions. Each subsystem is a set of commands that roughly corresponds to a functional block inside the instrument. For example, the commands comprising the SOURce (power) subsystem are for signal generation, and the commands comprising the STATus subsystem are for status register access.

Subsystem commands have a hierarchical structure, called a **command tree**, which consists of several key words separated by a colon between each word.

## Subsystem Command List

COMMAND	PARAMETER	NOTE
ABORT		[No Query]
CALCulate{1 2 3 4}		
:FORMat	{REAL MLINear CP CS LP LS  IMAGinary PHASe D Q REAL RP}	
:MATH		
:EXPRession		
:CATalog?		[Query Only]
:NAME	{DEV PCNT}	
:STATe	<Boolean>	
:PATH?		[Query Only]
CALCulate{5 6}		
:MATH		
:STATe	<Boolean>	
DATA		
[:DATA]	{REF1 REF2}, <value>	
[:DATA]?	{BUF1 BUF2}	[Query Only]
:FEED	{IMON VMON}	[Query Only]
:CONTRol	{ALWayS NEVer}	
:POINts	<value>	
DISPlay		
[:WINDow]		
[:STATe]	<Boolean>	
:TEXT		
:STATe	<Boolean>	
:TEXT1		
:DIGit	<value>	
:TEXT2		
:PAGE	<value>	
FETCh?		[Query Only]
FORMat		
[:DATA]	{ASCIi REAL[,64]}	
INITiate		
:CONTInuous	<Boolean>	[No Query]
[:IMMediate]		[No Query]
[SENSe]		
:AVERage		
:COUNt	<value>	
[:STATe]	<Boolean>	
:CORRection{1 2}		
:CKIT		
:STNdard{1 2 3}	<value>, <value>	
:COLLect		
[:ACQuire]	STANdard{1 2 3}	[No Query]
:CORRection		
:DATA?		[Query Only]
:FIMPedance		
:APERture	{Short Med Long}	
:FUNCTion		
[:ON]	<sensor_function>	

Subsystem Command List (continued)

COMMAND	PARAMETER	NOTE
SOURCE		
:FREQUENCY		
:CW	<value> [HZ KHZ]	
:VOLTAGE		
[:LEVEL]		
[:IMMEDIATE]		
[:AMPLITUDE]	<value> [MW UW NW W MA UA A MV UV V DBM]	
STATUS		
:OPERATION		
:CONDITION?		[Query Only]
:ENABLE	<value>	
[:EVENT]?		[Query Only]
:PRESET		
:QUESTIONABLE		
:CONDITION?		[Query Only]
:ENABLE	<value>	
[:EVENT]?		[Query Only]
SYSTEM		
:BEEPER		
[:IMMEDIATE]		[No Query]
:STATE	<Boolean>	
:ERROR?		[Query Only]
:KLOCK	<Boolean>	
:PRESET		[No Query]
:VERSION?		[Query Only]
TRIGGER		
:DELAY	<value> [MS S]	
[:IMMEDIATE]		[No Query]
:SOURCE	{BUS EXTERNAL MANUAL INTERNAL}	
CALCULATE		
:COMPARATOR		
[:STATE]	<Boolean>	[Query Possible]
:MODE	{ABSTOL PCNTTOL SEQ}	[Query Possible]
:TOLERANCE		
:NOMINAL	<value>	[Query Possible]
:BIN<n>	<low limit>, <high limit>	[Query Possible]
:SEQUENCE		
:BIN	<BIN1 low limit>, <BIN1 high limit>, <BIN2 high limit>, <BIN3 high limit>, ... <BINn high limit>	[Query Possible]
:SECONDARY		
:STATE	<Boolean>	
:LIMIT	<low limit>, <high limit>	
:AUXBIN	<Boolean>	[Query Possible]
:BIN		
:CLEAR		[No Query]
:COUNT		
:DATA?		[Query Only]
:CLEAR		[No Query]
:BEEPER		
:CONDITION	{FAIL PASS}	
:STATE	<Boolean>	

Subsystem Command Tree

The top of the subsystem command tree is called the **root command**, or simply the **root**. To reach the low-level commands, you must specify a particular **path** (like DOS file directory path). After Power ON or after \*RST, the current path is set to the root. The path settings are changed as follows:

**Message Terminator** A message terminator, such as < new line> character, sets the current path to the root.

**Colon (:)** When a colon is placed between two command mnemonics, the colon moves the current path down one level on the command tree. When the colon is the first character of a command, it specifies that the following command mnemonics are root-level commands.

**Semicolon (;)** A semicolon separates two commands in the same message without changing the current path.

Common commands, such as \*RST, are not part of any subsystem. The HP E4916A interprets them in the same way, regardless of the current path setting.

Figure 5-1 shows examples of how to use the colon and semicolon to navigate efficiently through the command tree.

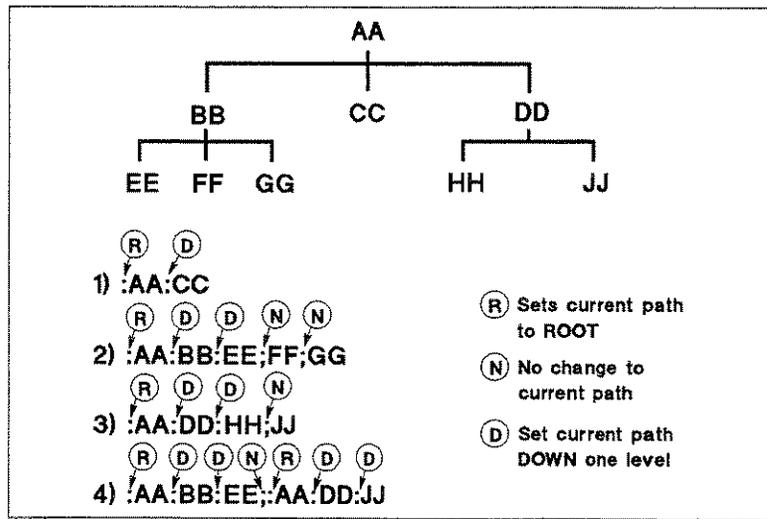


Figure 5-1. Proper Use of the Colon and Semicolon

Figure 5-1 shows how character input time can be saved by properly using semicolons. Sending the message

:AA:BB:EE; FF; GG

is equivalent to sending the following three messages.

:AA:BB:EE

:AA:BB:FF

:AA:BB:GG

### Program Message Syntax

This section provides the construction of SCPI program message. A program message is the message that you send from computer to an instrument. Program message consist of commands combined with appropriate punctuation and program message terminators.

#### Case

Letter cases (upper and lower) are ignored.

### Program Message Terminator

A program message must end with one of the three **program message terminators** ,

<new line>, <^END>, or <new line><^END>. <^END> means that End Of Identify (EOI) is asserted on the HP-IB interface at the same time the preceding data byte is sent. For example, the HP BASIC OUTPUT statement is automatically sent after last data byte.

### Subsystem Command Syntax

Subsystem commands consist of the mnemonic separated by colons. For example,

the command format for APERTure of the [ SENSE]:FIMPedance subsystem is as follows:

```
:FIMPedance:APERTure
```

Mnemonics which are contractions of commands can also be used as commands. In the above example, :FIMP:APER can also be typed.

### Common Command Syntax

Common commands do not have a hierarchical structure. They are just sent as follows:

```
*CLS
```

### Parameters

There must be a <space> between the last command mnemonic and the first parameter in a subsystem command.

```
:FIMUP:APER␣ parameter
```

␣ means a space (ASCII character (decimal 32)).

If you send more than one parameter with a single command, each parameter must be separated by a comma. For example, two parameters are sent following the DATA subsystem's :POINTs command as shown below.

```
:DATA:POIN␣<parameter> , <parameter>
```

### Parameter Types

SCPI defines different data formats for use in program message and query responses. The HP E4916A accepts commands and parameters in various formats and responds to a particular query in a predefined

and fixed format. Each command reference contains information about the parameter types available for the individual commands.

- *<value>* is used in both common commands and subsystem commands. *<value>* represents numeric parameters as follows:

100	no decimal point required
100.	fractional digits optional
-1.23, +235	leading signs allowed
4.56eL3	space allowed after e in exponentials
-7.89E-01	use either E or e in exponentials
.5	digits left of decimal point optional

The HP E4916A setting programmed with a numeric parameter can assume a finite number of values, so the HP E4916A automatically rounds off the parameter. For example, the HP E4916A has a programmable power line frequency of 50 or 60 Hz. If you specified 50.1, it would be rounded off to 50.

The subsystem commands can use extended numeric parameters. Extended numeric parameters accept all numeric parameter values and other special values, for instance, MAXimum, MINimum, or UP, DOWN. The special values available are described in the command's reference description.

Query response of *<value>* is always a numeric value.

- *<Boolean>* represents a single binary condition that is either ON or OFF. *<Boolean>* allows the following parameters:

ON, OFF In a program message  
 1, 0 In a program message and query response

- *<sensor\_function>* is string parameter which contain ASCII characters. A string must begin with a single quote (ASCII 39 decimal) or a double quote (ASCII 34 decimal) and end with the same corresponding character, a single or double quote. The quote to mark the beginning and end of the string is called the delimiter. You can include the delimiter as part of the string by typing it twice without any characters in between.

Example of *<sensor\_function>* 'FIMP',

```
10 OUTPUT @Meter;":FUNC 'FIMP'"          using single quote
20 OUTPUT @Meter;":FUNC ""FIMP""         using double quote
```

The query response is the string between double quote delimiters.

### Units

Units can be used with *value* parameters when so documented in the Command Reference.

Table 5-8. Usable Units

Definition	Mnemonic	Usable Unit
$10^6$ (Mega)	MA	Hz
$10^3$ (kilo)	K	V
$10^{-3}$ (Milli)	M	OHM
		S

The suffix is optional and can be omitted.

### Multiple Messages

To send more than one command in the same message, you must separate them with a semicolon:

```
*CLS;:INIT
```

### Query and Response Message Syntax

All subsystem commands can be queried except for the commands described as "no query" in the command reference. To send a query message, and ? after the last command mnemonic.

```
:FIMP:APER?
```

A response message may contain both commas semicolons as separators. When a single query command returns multiple values, a comma is used to separate each item. When multiple queries are sent in the same message, the group of data items corresponding to each query are separated by a semicolon. For example, the fictitious query :QUERY?:QUERY2? might return a response message of:

```
<data1>,<data1>;<data2>,<data2>
```

After the message, <new line><END>is always sent as a response message terminator.

## Notations

The following conventions and definition are used in this chapter to describe HP-IB operation.

**:CALClate{1|2}:LIMit:LOWer[:DATA] <value>**

Sets or queries the lower limit of the specified parameter.

**:CALClate{1|2}:LIMit:LOWer:STATe{ON|OFF|1|0}**

Sets or queries if the lower limit of the specified parameter is enabled.

**< >** Angular brackets enclose words or characters that are used to symbolize a program code parameter or an HP-IB command.

**[ ]** Square brackets indicate that the enclosed items are optional.

**{ }** When several items are enclosed by braces, one and only one of these elements may be selected. A vertical bar can be read as "or" and is used to separate alternative parameter options.

for example,

**:CALCulate {1|2}** means **:CALC1** or **:CALC2**.

**[DATA]** is optional. This keyword can be omitted as in **:CALC1:LIM:LOW <value>**.

## LCR Meter Command Reference

**Command Reference** This section provides alphabetical command reference for the LCR Meter function.

**:ABORT** The **ABORt** command resets the trigger system and places all trigger sequences in the Idle state. Any actions related to the trigger system that are in progress, such as acquiring a measurement, are aborted immediately. The execution of an **:ABORt** command will set any pending operation flag to **FALSE**, for example flags that were set by the initiation of the trigger system.

Unlike **\*RST**, **:ABORt** does not alter the settings programmed by other commands. (No query)

**Note**

---

After the **:FETCh?query**, the **\*TRG** command, or the **BASIC** command **TRIGGER** command, the **:ABORt** command will cause the HP-IB bus to hang up. To avoid this, clear the HP-IB bus by sending the **BASIC** command **CLEAR (address)** before sending the **:ABORt** command.

---

## CALCulate Subsystem

The CALCulate subsystem controls the measurement-data processing as listed below:

1. To select measurement parameter (:CALCulate{1|2}:FORMat subsystem) with the [:SENSe]:FUNction[:ON] subsystem
2. To control the level monitor function (:CALCulate{1|2}:MATH subsystem)
3. To control deviation measurement mode (:CALCulate{1|2}:MATH subsystem)
4. To control comparator function (:CALCulate:COMParator subsystem)

The HP E4916A performs data processing in the order as listed.

The CALCulate subsystem is logically positioned between the SENSe subsystem and the data output to the bus and display. The CALCulate subsystem, the SENSe subsystem, the DATA subsystem, and FETCh? Query are used together to capture the measurement data.

COMMAND	PARAMETER
CALCulate{1 2 3 4}	
:FORMat	{REAL MLINear CP CS LP LS  IMAGinary PHASe D Q REAL RP}
:MATH	
:EXPRession	
:CATalog?	
:NAME	{DEV PCNT}
:STATe	<Boolean>
:PATH?	
CALCulate{5 6}	
:MATH	
:STATe	<Boolean>

```

:CALCulate{1|3}:FORMat { REAL
| MLINear | CP | CS | LP | LS }
:CALCulate{2|4}:FORMat { IMAGinary | PHASe | D | Q | REAL | RP }

```

Sets or queries the measurement parameter.

This command works with the [:SENSe]:FUNctIon[:ON] subsystem. The HP E4916A makes a vector measurement of the DUT, using the method specified by the SENSe subsystem. After the measurement, the scalar measurement parameter specified by :CALCulate{1|2}:FORMat command is calculated from the measured vector value.

CALCulate1:FORMat	1st primary parameter
CALCulate2:FORMat	1st secondary parameter
CALCulate3:FORMat	2nd primary parameter
CALCulate4:FORMat	2nd secondary parameter

REAL	Real part of impedance (R)	LP	Equivalent parallel inductance
IMAGinary	Imaginary part of impedance (X)	LS	Equivalent series inductance
		D	Dissipation factor
MLINear	Absolute value of impedance	Q	Quality factor ( an inverse value of D )
PHASe	Phase of impedance		
CP	Equivalent parallel capacitance	RP	Equivalent parallel resistance
CS	Equivalent series capacitance		

For information on the selection of measurement parameters, refer to Table 5-9.

## Note



The SENSe:FUNctIon subsystem has priority over the CALCulate{1|2|3|4}:FORMat command. That is,

- When setting the SENS:FUNC:ON command, the setting of the CALC{1|2|3|4}:FORM command is restricted. When the settings of these two commands do not match any measurement parameter shown in Table 5-9, the setting of CALC{1|2|3|4}:FORM is automatically changed to a measurement parameter which matches SENS:FUNC:ON.
- When setting the CALC{1|2|3|4}:FORM command, if the current setting of the SENS:FUNC:ON command does not match any measurement parameter shown in Table 5-9, the CALC{1|2|3|4}:FORM command is rejected, and an error occurs.

Therefore, before setting the CALC{1|2|3|4}:FORM command, the [:SENSe]:FUNctIon:ON command must be set correctly.

Table 5-9. Measurement Parameter Choices

Measurement Parameter	SENS:FUNC:ON <sup>1</sup>	CALC1 3:FORM	CALC2 4:FORM
Z- $\theta$ R-X	"FIMPedance"	MLINear REAL	PHASe IMAGinary
Y- $\theta$ G-B	"FADMittance"	MLINear REAL	PHASe IMAGinary
C <sub>P</sub> -D C <sub>P</sub> -Q C <sub>P</sub> -G C <sub>P</sub> -R <sub>P</sub>	"FADMittance"	CP	D Q REAL RP
C <sub>S</sub> -D C <sub>S</sub> -Q C <sub>S</sub> -R <sub>S</sub>	"FIMPedance"	CS	D Q REAL
L <sub>P</sub> -D L <sub>P</sub> -Q L <sub>P</sub> -G L <sub>P</sub> -R <sub>P</sub>	"FADMittance"	LP	D Q REAL RP
L <sub>S</sub> -D L <sub>S</sub> -Q L <sub>S</sub> -R <sub>S</sub>	"FIMPedance"	LS	D Q REAL

<sup>1</sup> The SENSE:FUNCTION:ON command is documented in the "SENSE Subsystem" section.

**:CALCulate{1|2|3|4}:MATH:EXPRESSION:CATALOG?**

Returns available parameters which can be used with the :CALCulate{1|2}:MATH:EXPRESSION:NAME command. (query only)

See :CALCulate{1|2}:MATH:EXPRESSION:NAME command description for detailed information.

Query response is always DEV,PCNT.

**:CALCulate{1|2|3|4}:MATH:EXPRession:NAME { DEV | PCNT }**

Defines or queries the expression used for the deviation measurement, which is enabled by :CALCulate{1|2|3|4}:MATH:STATe. The reference value is defined using the :DATA[:DATA] command.

CALCulate1	Applies to the primary parameter 1
CALCulate2	Applies to the secondary parameter 1
CALCulate3	Applies to the primary parameter 2
CALCulate4	Applies to the secondary parameter 2

DEV	Absolute value of deviation
PCNT	Percentage of deviation

Query response is DEV or PCNT.

**:CALCulate{1|2|3|4}:MATH:STATe { ON | OFF | 1 | 0 }**

Sets or queries if math processing defined by the :CALCulate{1|2|3|4}:MATH:EXPRession:NAME is enabled or not.

OFF or 0	Disables math processing.
ON or 1	Enables math processing.

Query response is 0 or 1.

**:CALCulate{1|2|3|4}:PATH?**

Returns the CALCulate subsystems in the order in which they are to be performed. (query only)

The HP E4916A always processes measured data in order of :CALCulate{1|2|3|4}:FORMat subsystem, :CALCulate{1|2|3|4|5|6}:MATH subsystem, and :CALCulate{1|2|3|4}:LIMit subsystem.

Query response is always FORM, MATH, LIM.

**:CALCulate{5|6}:MATH:STATe { ON|OFF|1|0 }**

Sets or queries if the level monitor function is ON or OFF.

CALCulate5	Specifies the current monitor.
CALCulate6	Specifies the voltage monitor.
ON or 1	Turns ON the level monitor function.
OFF or 0	Turns OFF the level monitor function.

Query response is 0 or 1.

## DATA Subsystem

The DATA subsystem commands are used for the following data processing:

1. Storing the data to the HP E4916A data buffer.
2. Reading the data from the HP E4916A data buffer.
3. Reading the level monitor value.

HP E4916A has 6 data buffers, BUF1, BUF2, REF1, REF2, IMON and VNON. REF1 and REF2 store a reference value for the deviation measurement, REF1 stores data for the primary parameter and REF2 stores for the secondary parameter. IMON and VNON store a level monitor value.

COMMAND	PARAMETER
DATA	
:DATA	{REF1 REF2},<value>
:DATA?	{BUF1 BUF2} {IMON VMON}
:POINTs	<value>
:FEED	
:CONTrol	{ALWays NEVer}

**:DATA[:DATA] { REF1 | REF2 },<value>**

Enters or queries the reference value for the deviation measurement, which is controlled by the :CALCulate{1|2}:MATH subsystem command.

REF1 and REF2 can store only one value for each buffer, and this command will overwrite the value.

REF1           Reference value for the primary parameter  
REF2           Reference value for the secondary parameter

Query response of :DATA[:DATA]? retrieves REF1 or REF2, according to the format determined by the FORMat subsystem commands. :DATA[:DATA]? query needs parameter, REF1 or REF2, which is the name of the data buffer to be used. So, the query form is :DATA[:DATA]? REF1 or :DATA[:DATA]? REF2.

**:DATA[:DATA]? {BUF1|BUF2}**

Returns the measurement data, according to the format determined by the FORMat subsystem commands. (query only)

This query needs parameter {BUF1|BUF2}, which specifies the measurement data. So, the query form is :DATA[:DATA]? BUF1 or :DATA[:DATA]? BUF2. BUF1 outputs the 1st primary and secondary parameters and BUF2 the 2nd primary and secondary parameters.

Query response is <stat>,<data1>,<data2>,<comp>

Where,

<stat>           Always 0 for the HP E4915A/E4916A  
<data1>          Primary measurement parameter  
<data2>          Secondary measurement parameter  
<comp>           Comparator result

1 to 10  
 :BIN number  
 -1 :Out of BIN  
 -2 :AUX BIN

**:DATA[:DATA]? {IMON|VMON}**

Reads the level monitor value. (query only)

IMON Reads the current monitor.  
 VMON Reads the voltage monitor.

Query response is a numeric value in <NR3> format.

**:DATA:FEED:CONTRol { ALWays | NEVer }**

Sets or queries whether or not data is fed into the data buffer.

ALWays Feeds data into the data buffer whenever new data is available.  
 NEVer Does not feed the data into the data buffer.

Query response is ALW or NEV.

**:DATA:POINTs <value>**

Sets or queries the size of data buffer. You can store as many measurement point data sets.

<value> is,

*numeric* 1 to 500

Query response is a numeric value in <NR1> format.

**DISPlay Subsystem** The DISPlay subsystem controls the selection of displayed mode.

COMMAND	PARAMETER
DISPlay	
[:WINDow]	
[:STATe]	<Boolean>
:TEXT	
:STATe	<Boolean>
:TEXT1	
:DIGit	{ 3   4   5 }
:TEXT2	
:PAGE	{ 1   2   3   4   5   6   7   8   9   10   11 }

**:DISPlay[:WINDow][:STATe] { ON | OFF | 1 | 0 }**

Sets the display ON or OFF, or queries whether the display is set to ON or OFF.

OFF or 0 Sets the display OFF (blank).

ON or 1 Set the display ON.

Query response is 0 or 1.

**:DISPlay[:WINDow]:TEXT:STATe { ON|OFF|1|0 }**

Sets the instrument status display ON/OFF.

ON or 1 Displays the instrument status. (Displayed measurement values are the primary and secondary parameters only.)

OFF or 0 Does no display the instrument status. Other measurement values are displayed as well as the primary and secondary parameters.

**:DISPlay[:WINDow]:TEXT1:DIGit {3|4|5}**

Sets the number of display digits.

3 3 digits display

4 4 digits display

5 5 digits display

Query response is 3, 4 or 5.

**:DISPlay[:WINDow]:TEXT2:PAGE {1|2|3|4|5|6|7|8|9|10|11}**

Selects the mode of Measurement Settings display.

1 Displays the test signal frequency and level.

2 Displays the DC bias setting and averaging rate.

3 Displays the trigger delay and cable length.

4 Displays the comparator limit for the primary parameter.

5 Displays the comparator limit for the secondary parameter.

6 Displays the level monitor value.

Query response is 0, 1, 2, 3, 4, or 11.

**FETCh? Query****:FETCh?**

Trigger the measurement process. Issuing the :FETCh? command causes the HP E4916A to transfer the measurement results to the controller (same as \*TRIG command).

Query response is :

ASCII format transfer: *<status>*,*<data1>*,*<data2>*,*<data3>*,*<data4>*,[*<com*

Binary format transfer: #2*<num-*  
*bytes>*,*<data1>*,*<data2>*,*<data3>*,*<data4>*,[*<comp>*]

<i>&lt;status&gt;</i>	0 (always)
<i>&lt;data1&gt;</i>	Measurement data of 1st primary parameter
<i>&lt;data2&gt;</i>	Measurement data of 1st secondary parameter
<i>&lt;data3&gt;</i>	Measurement data of 2nd primary parameter
<i>&lt;data4&gt;</i>	Measurement data of 2nd secondary parameter
[ <i>&lt;comp&gt;</i> ]	Comparator result
<i>&lt;num-bytes&gt;</i>	Number of bytes transferred

**FORMat Subsystem**

	COMMAND	PARAMETER
FORMat	[ :DATA ]	{ ASCii   REAL [, 64] }

**:FORMat[:DATA] { ASCii | REAL [, 64] }**

Sets the data format for transferring numeric and array information.

- ASCii                Sets the data transfer format to ASCII.
- AL [, 64]           Sets the data transfer format to IEEE 754 floating point numbers of the specified length of 64-bit.

For details on data transfer formats, see "Data Transfer Format".

Query response is ASK or REAL , 64.

**INITiate Subsystem**

The INITiate subsystem controls the initiation of the trigger system. All trigger sequences are indicated as a group. The detailed description of the trigger system is given in "Trigger Function" in Chapter 4.

COMMAND	PARAMETER
INITiate	
:CONTinuous	<Boolean>
[:IMMediate]	

**:INITiate[:IMMediate]**

Causes all sequences to exit Idle state and enter Initiate state. This command causes the trigger system to initiate and complete one full trigger cycle, returning to Idle state on completion. (No query)

If the HP E4916A is not in Idle state or if :INITiate:CONTinuous is set to ON, an :INITiate:IMMediate command has no effect on the trigger system and an error -213 is generated.

**:INITiate:CONTinuous {ON|OFF|1|0}**

Sets or queries whether the trigger system is continuously initiated or not.

OFFor0                      Does not initiate the trigger system continuously.  
ONor1                        Initiates the trigger system continuously.

Query response is 0 or 1.

SENSe Subsystem

COMMAND	PARAMETER
[SENSe]	
:AVERage	
:COUNT	<value>
[:STATe]	<Boolean>
:CORRection{1 2}	
:CKIT	
:STANdard{1 2 3}	<value>,<value>
:COLLect	
[:ACQuire]	STANdard{1 2 3}
:CORRection	
:DATA?	
:FIMPedance	
:APERTure	{Short Med Long}
:FUNCTion	
[:ON]	<sensor_function>

**[[:SENSe]:AVERage:COUNT <value>**

Sets or queries the averaging rate.

<value> is,

<i>numeric</i>	1 to 256
MINimum	1
MAXimum	256

Query response is a numeric value in <NR1> format.

**[[:SENSe]:AVERage[:STATe] {ON|OFF|1|0}**

Sets or queries if averaging is enabled.

OFF or 0	Disables averaging.
ON or 1	Enables averaging.

Query response is 0 or 1.

**[[:SENSe]:CORRection{1|2}:CKIT:STANdard{1|2|3} <value>,<value>**

Sets or queries the standard values for calibration and fixture compensation.

CORRection1	Calibration standard value
CORRection2	Fixture compensation standard value
STANdard1	OPEN
STANdard2	SHORT
STANdard3	LOAD

**Table 5-10.**  
**Standard Values for Calibration and Fixture Compensation**

	<value1>	<value2>
STANdard1 (OPEN)	G0	C0
STANdard2 (SHORT)	R0	L0
STANdard3 (LOAD)	R0	L0

**[[:SENSE]:CORREction{1|2}:COLLECT[:ACQUIRE] STANdard{1|2|3}**

Performs the OPEN, SHORT, or LOAD correction. (no query)

The HP E4916A has three correction functions as follows:

STANdard1 Performs the OPEN correction.  
 STANdard2 Performs the SHORT correction.  
 STANdard3 Performs the LOAD correction. The reference value of the LOAD correction is defined by [[:SENSE]:CORREction:CKIT:STANdard3 command.

The short forms of STANdard1, STANdard2, and STANdard3 are STAN1, STAN2, and STAN3 respectively.

This command sets [[:SENSE]:CORREction[:STATE] ON, which enables the correction function.

**[[:SENSE]:CORREction:DATA?**

Returns the correction data. (Query Only)

```

10 DIM B$[10401]
20 pirnt "--- qry CALDATA? ---"
30 OUTPUT 717;":CALDATA?"
40 ! OUTPUT 717;":SENS:CORR:DATA?" ! for LCR mode
100 ! -----
110 ENTER 717 USING "#,10401A";B$
120 ! -----
130 pause
140 print "--- set CALDATA ---"
150 output 717 USING "#,K;":CALDATA ";B$
160 end
  
```

**Figure 5-2. Correction Data**

**[[:SENSE]:FIMPedance:APERture {Short|Med|Long}**

Sets or queries measurement time mode: Short, Medium, or Long.

**[[:SENSE]:FUNCTion[:ON] <sensor\_function>**

Sets the specified measurement function ON. Or, queries which measurement function is ON.

Please refer to Table 5-9 of the "CALCulate Subsystem" regarding the selection of measurement parameters.

Query response is {"FADM"|"FIMP"}.

## LCR Meter Command Reference

## SOURCE Subsystem

COMMAND	PARAMETER
SOURCE	
:FREQUENCY	
[:CW]	<value> [HZ KHz MHZ]
:VOLTAGE	
[:LEVEL]	
[:IMMEDIATE]	
[:AMPLITUDE]	<value>
	[MW UW NW W MA UA A MV UV V DBM]

**:SOURCE:FREQUENCY[:CW] <value> [HZ|KHz|MHZ]**

Sets or queries the test signal frequency.

<value>:

MAXimum      180 MHz  
MINimum      1 MHz

<value> can be specified in the following units,

HZ:Hz      KHZ:kHz      MHZ:MHz

**:SOURCE:VOLTAGE[:LEVEL][:IMMEDIATE][:AMPLITUDE]**  
**<value> [MW|UW|NW|W|MA|UA|A|MV|UV|V|DBM]**

Sets the test signal level.

<value> can be specified in the following units,

MW:m    MW: $\mu$     MW:n    W:W    MA:mA    UA: $\mu$   
A:A    MV:mV    UV: $\mu$     V:V    DBM:dBm

**STATUS Subsystem**

The STATUS Subsystem commands controls the Operation Status and Questionable Status registers in the status-reporting structures (See "Status Reporting System".)

COMMAND	PARAMETER
STATUS	
:OPERation	
:CONDition?	
:ENABle	<value>
[:EVENT]?	
:PRESet	
:QUEStionable	
:CONDition?	
:ENABle	<value>
[:EVENT]?	

**:STATUS:OPERation[:EVENT]?**

Returns the contents of the event register of the Operation Status Register group. Reading the event register clears it. (Query only)

Query response is a numeric value.

**Note**



The event register is cleared when it is read.

**:STATUS:OPERation:CONDition?**

Returns the contents of the condition register of the Operation Status Register group. Reading the condition register does not clear it. (Query only)

Query response is a numeric value.

**Note**



The condition register does not change even it is read.

**:STATUS:OPERation:ENABle <value>**

Sets the enable register of the Operation Status Register Group.

<value>:

*numeric*          Decimal expression of the contents of the register

Query response is a numeric value.

**:STATUS:PRESet**

Clears the Operation Status and Questionable Status groups. Both the event and enable registers are cleared. (No query)

**:STATUS:QUEStionable[:EVENT]?**

Returns the contents of the event register of the Questionable Status Register group. (Query only)

**:STATus:QUESTIONable:CONDition?**

Returns the contents of the condition register of the Standard Questionable Status Register group. (Query only)

**:STATus:QUESTIONable:ENABle<value>**

Sets or queries the enable register of the Questionable Status Register group.

<value> is,

*value*            Decimal expression of the contents of the register.

The HP E4916A has no operation to report the event to the Questionable Status Event Register.

Query response is a numeric value.

**SYSTEM Subsystem**

The SYSTEM subsystem reports the firmware version and error, sets the beeper, locks the front-panel keys, and defines the power line frequency.

COMMAND	PARAMETER
SYSTEM	
:BEEPer	
[:IMMEDIATE]	
:STATe	<Boolean>
:ERRor?	
:KLOCK	<Boolean>
:PRESet	
:VERSion?	

**:SYSTEM:BEEPer[:IMMEDIATE]**

Produces a beep immediately. (no query)

**:SYSTEM:BEEPer:STATe {ON|OFF|1|0}**

Sets or queries if the beeper is enabled.

- ON or 1            Enables the beeper.
- OFF or 0          Disables all beeper functions, including the error beep.

Query response is 0 or 1.]

**:SYSTEM:ERRor?**

Return the number and message of existing error in the HP E4916A's error queue. (Query only)

**:SYSTEM:KLOCK {ON|OFF|1|0}**

Sets or queries whether the front-panel keys of the HP E4916A are locked,

- ON or 1            Locks the front-panel keys.
- OFF or 0          Does not lock the front-panel keys.

Query response is 0 or 1.

**:SYSTEM:PRESet**

Reset the HP E4916A to the default state. (no query)

The reset state is as follows.

Test signal frequency	:10 MHz
Measurement parameter	:Z-θz,R-X
Deviation measurement	:OFF
Measurement time	:MED
Averaging rate	:1
Trigger mode	:Internal
Trigger delay time	:0 ms
Comparator ON/OFF state	:OFF
Fixture Compensation	:Clear
Display mode	:Measure Display
Beep mode	:PASS

## LCR Meter Command Reference

Data transfer format :ASCII

**:SYSTem:VERSion?**

Returns the value corresponding to the SCPI version to which the instrument complies. (Query only)

The query response is YYYY.V.

Where,

YYYY	Year-version
V	Revision number for the year

**TRIGger subsystem** The TRIGger subsystem controls the measurement trigger functions.

COMMAND	PARAMETER
TRIGger	
:DELay	<value> [MS S]
[ :IMMediated]	
:SOURce	{BUS EXTernal INTernal MANual}

**:TRIGger:DELay<value> [MS|S]**

Sets or queries the trigger delay time.

<value> is,

*numeric* 0 to 9.999 (s)

MINimum 0 (s)[

MAXimum 9.999 (s)

The following units can be used for <value>.

MS:millisecond S:second

Query response is a numeric value in <NR3> format.

**:TRIGger[:IMMediate]**

Causes the trigger to execute a measurement, regardless of the trigger state. (No query

**:TRIGger:SOURce {BUS|EXTernal|INTernal|MANual}**

Sets or queries the trigger mode.

BUS Sets the BUS trigger mode.

EXTernal Sets the External trigger mode.

INTernal Sets the Internal trigger mode.

MANual Sets the Manual trigger mode,

Query response is BUS,EXT',INT,or MAN.

## COMParator Subsystem

The COMParator subsystem command group turns ON/OFF the Comparator function, and sets the limit mode as well as the limit values. The following is the command tree of the COMParator subsystem.

COMMAND	PARAMETER
CALCulate	
:COMParator	
[:STATe]	<Boolean>
:MODE	{ABSTOL PCNTTOL SEQ}
:TOLerance	
:NOMinal	<value>
:BIN<n>	<low limit>, <high limit>
:SUquence	
:BIN	<BIN1 low limit>, <BIN1 high limit>, <BIN2 high limit>, <BIN3 high limit>, ... <BINn high limit>
:SECOndary	
:STATe	<Boolean>
:LIMit	<low limit>, <high limit>
:AUXBIN	<Boolean>
:BIN	
:CLEAr	
:COUNt	
:DATA?	
:CLEAr	
:BEEPer	
:CONdition	{FAIL PASS}
:STATe	<Boolean>

**:CALCulate:COMParator[:STATe] {ON|OFF|1|0}**

Turns ON/OFF the Comparator function. The [:STATe] query returns the current ON/OFF status of the Comparator function.

ON or 1                    Comparator function ON  
OFF or 0                  Comparator function OFF

**:CALCulate:COMParator:MODE {ABSTOL|PCNTTOL|SEQ}**

Determines whether to perform primary sorting in Sequential or Tolerance mode. Specify the SEQ option for Sequential mode; for Tolerance mode, specify ABSTOL if you want to sort the DUTs based on the actual deviation from the reference value, or PCNTTOL if you want to sort the DUTs based on the percentage of the deviation relative to the reference value. For more information on the sort mode, refer to "Sequential Mode and Tolerance Mode" in Chapter 4 in Chapter 4.

The :MODE query returns the current sort mode.

ABSTOL                    Tolerance mode: Actual deviation ([measured value] – [reference value])

PCNTTOL            Tolerance mode: Percentage of the deviation  
                         relative to the reference value  
SEQ                 Sequential mode

**:CALCulate:COMParator:TOLerance:NOMinal <value>**

Specifies the reference value that is applied when primary sorting is performed in Tolerance mode. This command is available only when primary sorting is set to Tolerance mode.

The TOLerance:NOMinal query returns the reference value currently used for Tolerance mode.

This command is equivalent to COMPTOLSTD.

**:CALCulate:COMParator:TOLerance:BIN<n>, <low limit>, <high limit>**

The TOLerance:BIN<n> command defines the lower and upper limits for each of the primary sorting bins. For primary sorting, you can define up to 10 bins by issuing this command for each bin. This command is available only when primary sorting is set to Tolerance mode

The :TOLerance:BIN<n> query returns the lower and upper limits of the bin identified by the <n> parameter.

<n>                    1 to 10 : Bin number  
<low limit>           Lower limit value  
<high limit>           Upper limit value

**:CALCulate:COMParator:SEQuence:BIN <BIN1 low limit>, <BIN1 high limit>, <BIN2 high limit>, ... , <BINn high limit>**

The SEQuence:BIN command defines the lower and upper limits for each of the primary sorting bins. For primary sorting, you can define up to 10 bins by issuing this command for each bin. This command is available only when primary sorting is set to Sequential mode

The SEQuence:BIN query returns the lower and/or upper limits of the bin identified by the parameter.

<BIN1 low limit>        BIN1 lower limit value  
<BIN1 high limit>       BIN1 upper limit value  
<BIN2 high limit>       BIN2 upper limit value  
<BIN10 high limit>      BIN10 upper limit value

The upper limit value must be higher than the lower limit value.

This command is equivalent to COMPPLIMIT.

**:CALCulate:COMParator:SECOndary[:STATe] {ON|OFF|1|0}**

The SECOndary[:STATe] commands turns ON/OFF secondary sorting. The SECOndary[:STATe] query returns the current ON/OFF status of secondary sorting.

ON or 1                Secondary sorting ON  
OFF or 0               Secondary sorting OFF

**:CALCulate:COMParator:SECondary:LIMit <low limit>,<high limit>**

The SECondary:LIMit command specifies the lower and upper limits for secondary sorting bin. The SECondary:LIMit query returns the lower limit and upper limit values currently applied to secondary sorting.

<low limit>            BIN lower limit value  
<high limit>            BIN upper limit value

**:CALCulate:COMParator:AUXBIN{ON|OFF|1|0}**

Turns ON/OFF the auxiliary bin (AUX bin) function for secondary sorting. The AUX bin is used to separate those DUTs that passed primary sorting but failed secondary sorting, without purging them as OUT OF BIN together with DUTs that failed both primary and secondary sorting.(For more information, refer to "Aux Bin" in Chapter 4).

The SECondary:AUXBIN query returns the current ON/OFF status of the AUX bin function.

ON or 1                AUX bin function ON  
OFF or 0                AUX bin function OFF

**:CALCulate:COMParator:BIN:CLEar**

The BIN:CLEar command clears all the lower and upper limit values set for sorting.

**:CALCulate:COMParator:BIN:COUNT:DATA?**

The BIN:COUNT:DATA? Query returns the count of bins in each bin.

Output format

<BIN1count>,<BIN2count>, ... <BIN9count>, <OUT OF BINScount>, <AUX BINcount><NL>END>

<BIN1count> ... <BIN10count>        : Count of bins contained in each of bins 1 to 9.  
<OUT OF BINScount>                : Count of bins purged as OUT OF BINS.  
<AUX BINcount>                    Count of bins contained in the Aux bin.

**:CALCulate:COMParator:BIN:COUNT:CLEar**

The BIN:COUNT:CLEar command resets the DUT count for all bins.

**:CALCulate:COMParator:BEEPer:CONDition {FAIL|PASS}**

Determines when the Comparator function outputs beep sound; that is, when a DUT has failed or when a DUT has passed the test.

FAIL                    Beeps when DUT has failed.  
PASS                    Beeps when DUT has passed.

This command is equivalent to COMPBEEPCond.

**:CALCulate:COMParator:BEEPer[:STATe] {ON|OFF|1|0}**

Turns ON/OFF the beep output of the Comparator function.

ON	Beep will sound under the condition specified by CALCulate:COMParator:BEEPer:CONDition.
OFF	Beep never sound.

## Status Reporting System

---

The HP E4915A/E4916A has status registers that report the system status to the user. The contents of the registers change with a change in the HP E4915A/E4916A status. The user can be informed of the HP E4915A/E4916A status by reading these registers.

This chapter describes the following:

- General status register model
- Organization of the HP E4915A/E4916A's status registers
- Referencing the HP E4915A/E4916A's status registers from HP-IB commands

## General Status Register Model

A general analyzer has the status reporting system to inform the user of its status.

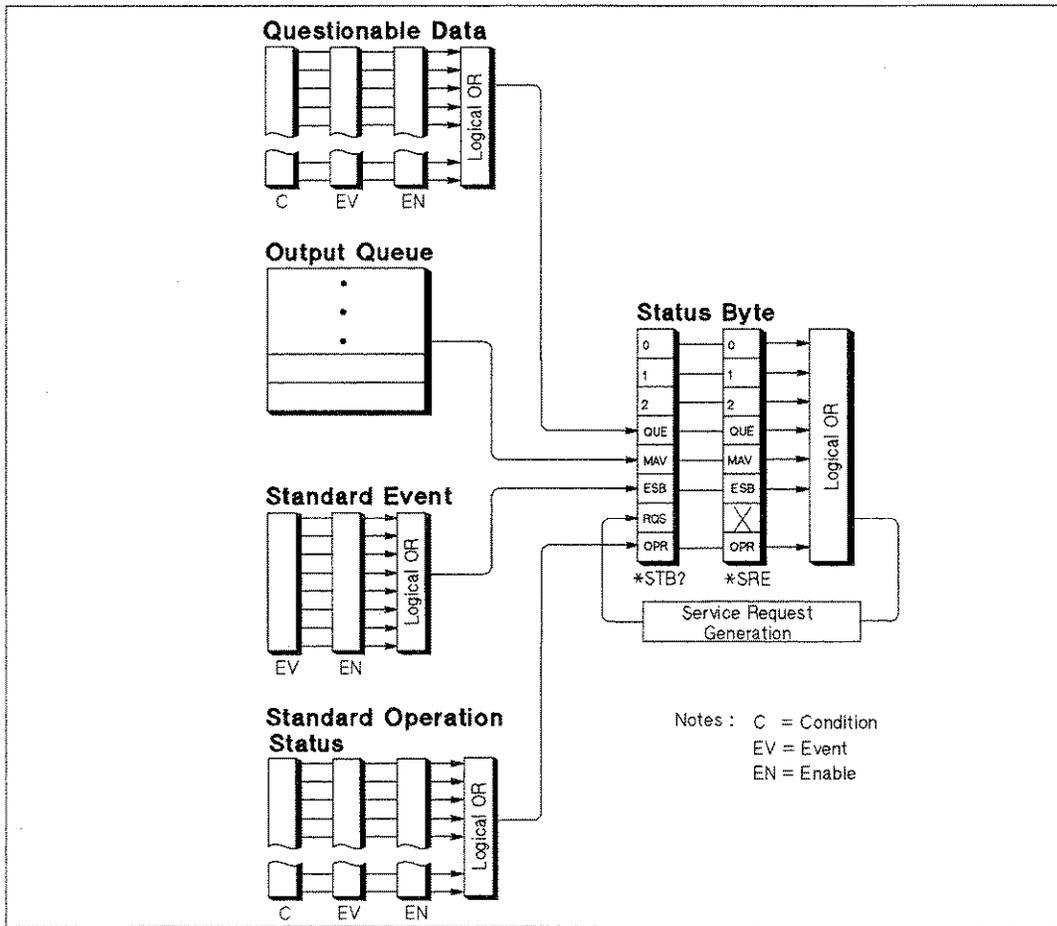


Figure 6-1. General Status Register Model

The status reporting system has a hierarchical structure as shown in Figure 6-1. When the system meets a specific condition, the corresponding bit in the event register is set to 1. Therefore, the user can be informed of the system status by monitoring the status of this register.

Similarly, if the content of a bit (any bit indicated by an arrow in Figure 6-1) in the enable register one level above the event register is already 1 when the corresponding bit in the event register is set to 1, then the corresponding summary bit in the status byte register is also set to 1. The status of this status byte register can be checked by serial polling.

If the content of a bit in the service request enable register is already 1 when the corresponding bit in the status byte register is set to 1, then SRQ is asserted. SRQ can be used to inform the controller that

## LCR Meter Command Reference

the analyzer requests service. SRQ can also be used to generate an interrupt during execution of a program.

### Event Register

Event register represents the status of the corresponding analyzer by the status of its bits. These bits constantly monitor the status of the analyzer. The status of each bit changes when a specific condition is met.

Note that you cannot change the status of these bits using HP-IB commands.

The HP E4915A/E4916A has the following event registers:

- Standard event status register (See Table 6-2.)
- Operation status event register (See Table 6-3.)
- Questionable status event register (See Table 6-5.)
- Search Event status register (See Table 6-6.)

### Enable Register

When you set the status of an enable register, you can select the desired bit in the corresponding event register. This bit can be used to set the summary bit in the status byte register to 1. Register bits serve as mask bits. When the selected bit in the event register is set to 1 and when the corresponding bit in the enable register is already 1, then the summary bit in the status byte register is set to 1. The purpose of using an enable register is to select a bit in an event register for issuing SRQ. When the desired bit in the enable register is 0, the summary bit in the status byte register will not be set to 1 even if the corresponding bit in the event register becomes 1.

Each of the event registers has its own enable register. Bits in these registers have a one-to-one correspondence.

### Status Byte Register

When a bit in the event register is set to 1 and when the corresponding bit in the enable register is already 1, the summary bit in the status byte register is also set to 1. The status byte register contains the output queue and SRQ status as well as the summary bit.

The status byte register can be read from the controller using the SPOLL command or \*STB? command (a Query command). SPOLL reads the status byte register directly by bypassing the CPU of the analyzer. Therefore, SPOLL returns a response faster than \*STB? that can read the status byte register only via the CPU of the analyzer. Neither SPOLL nor \*STB? affects the contents of the status byte register, except that SPOLL clears the RQS bit.

Table 6-1 shows the types of bits contained in the status byte register.

Serial polling (SPOLL) can be used to read bit 6 in the status byte register as RQS bit. \*STB? reads bit 6 as MSS bit. See Table 6-1 for details on the RQS and MSS bits.

Also, SRQ (service request) can be asserted by setting the desired bit in the service request enable register to 1 if the summary bit in the service request enable register is 1. See "Service Request (SRQ)" in this chapter for details on SRQ.

## Status Registers of HP E4915A/E4916A

### Status Reporting Structure

#### Service Request (SRQ)

The HP E4915A/E4916A can send an SRQ (Service Request) control signal when it requires the controller to perform a task. When the HP E4915A/E4916A generates an SRQ, it also sets Bits 6 of the Status Byte Register, RQS (Request Service) bit. Service Request Enable Register allows an application programmer to select which summary messages in the Status Byte Register may cause service requests (See Figure 6-2).

#### Status Byte Register

The Status Byte Register is composed of eight bits that summarize an overlaying status data structure.

The Status Byte Register can be read using either \*STB? or SPOLL, which return a decimal expression of the contents of the register (equal to the sum of the total bit weights of all the bits set to "1"). Refert to "Reporting the Instrument Status" for details.

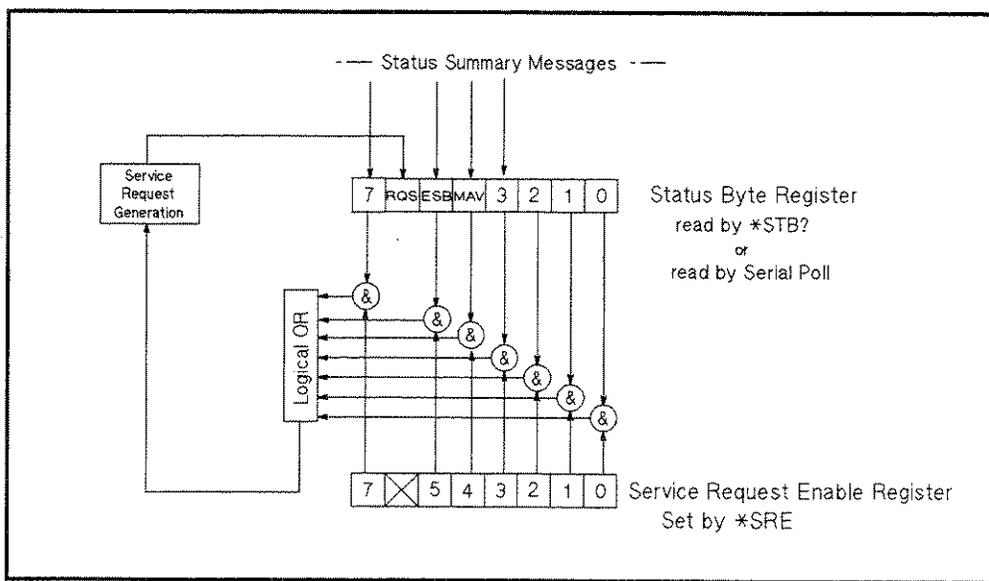


Figure 6-2. Status Byte Register

When a bit is set, it contains a 1; when a bit is reset, it contains a 0.

Table 6-1. Status Byte Assignments

Bit No.	Bit Weight	Description
7	128	Operation Status Register Summary Bit
6	64	Request Service Bit — This bit is set when any enabled bit of the Status Byte Register has been set, which indicates HP E4915A/E4916A has at least one reason for requesting service. SPOLL resets this bit.
5	32	Standard Event Status Register Summary Bit
4	16	Message Available Bit — This bit is set whenever the HP E4915A/E4916A has data available in the Output Queue, and is reset when the available data is read.
3	8	Questionable Status Register Summary Bit.
2~0		Always 0 (zero)

### Standard Event Status Register

The Standard Event Status Register is frequently used and is one of the simplest. You can program it using HP-IB common commands, \*ESE and \*ESR?. Refer to \*ESE command and \*ESR? command in "Command Reference" in Chapter 5.

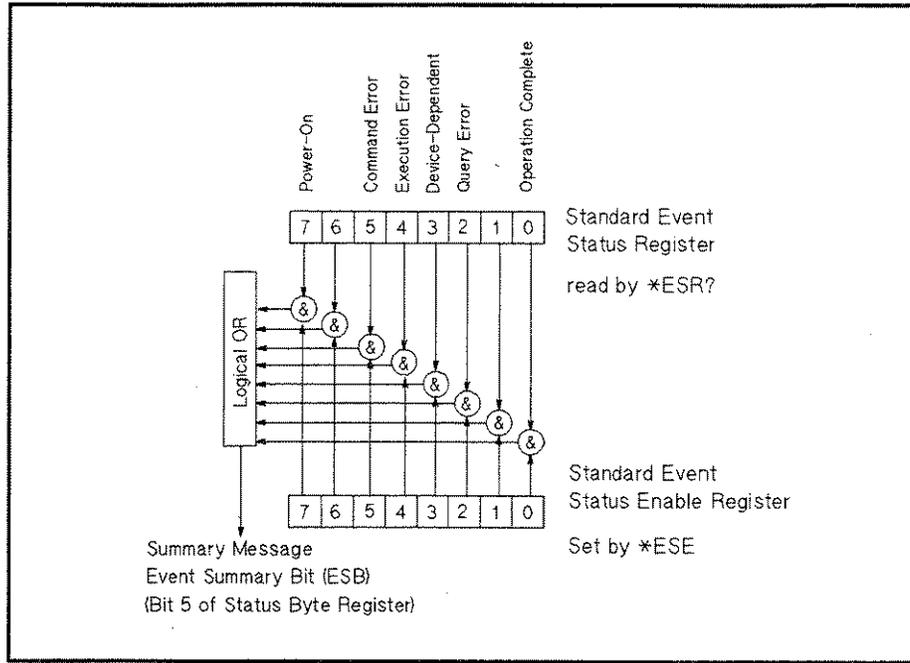


Figure 6-3. Standard Event Status Register

Table 6-2. Standard Event Status Register Assignments

Bit No.	Bit Weight	Description
7	128	Power-On Bit — This bit is set when the HP E4915A/E4916A has been turned OFF and then ON since the last time this register was read.
6		Always 0 (zero)
5	32	Command Error Bit — This bit is set if the following command errors occur. <ul style="list-style-type: none"> <li>• An IEEE 488.2 syntax error occurred.</li> <li>• The HP E4915A/E4916A received a Group Execute Trigger (GET)</li> </ul>
4	16	Execution Error Bit — This is set when a parameter of a HP-IB command was outside of its legal input range or was otherwise inconsistent with the HP E4915A/E4916A's capabilities.
3	8	Device-Dependent Error Bit — This bit is set when so many errors have occurred that the error queue is full.
2	4	Query Error Bit — This bit is set when reading data from the output buffer and no data was present, or when the data was lost.
1		Always 0 (zero)
0	1	Operation Complete Bit — This bit is set when the HP E4915A/E4916A has completed all selected pending operations before sending the *OPC command.

## LCR Meter Command Reference

## Standard Operation Status Group

The HP E4915A/E4916A provides two Standard Operation Status group — Operation Status Register group and Questionable Status Register group — which can be accessed using the STATus subsystem commands. (Refer to STATus subsystem in “HP-IB Commands”.) The individual bit assignment of these registers are given in “Operation Status Register” and “Questionable Status Register” later in this section.

Each group includes a condition register, an event register, and an enable register. (Illustrated in Figure 6-4.)

The condition register reflects the internal states of the HP E4915A/E4916A. So each time the HP E4915A/E4916A's condition is changed, its condition bit is changed from “0” to “1”, or from “1” to “0”.

The event register's bits correspond to the register's bits. A transition filter reports an event to the event register, when a condition register bit changes from “1” to “0” for all bits except for bit no. 8 and 9. For bit no's 8 and 9, when a condition register bit changes from “0” to “1”.

The enable register enable the corresponding bit in the event register to set the status summary bit, bit 7 or bit 3, of the Status Byte Register.

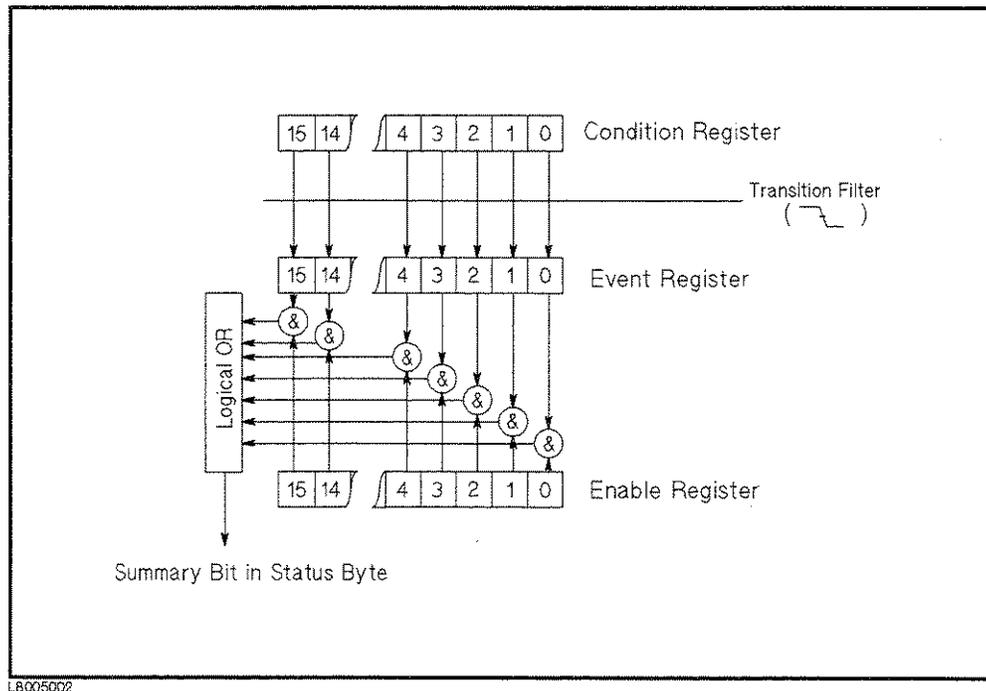


Figure 6-4. Standard Operation Status Group Structure

## Operation Status Register

The Operational Status Register group provides information about the state of the HP E4915A/E4916A measurement system.

**Table 6-3. Operation Status Condition Register Assignments**

Bit No.	Bit Weight	Description
9~15		Always 0 (zero)
8	256	Buffer full.
7	128	Correcting — This bit is set when the correction data measurement is in progress.
6		Always 0 (zero)
5	32	Waiting for Trigger — This bit is set when the HP E4915A/E4916A can accept a trigger.
4	16	Measuring — This bit is set when the HP E4915A/E4916A is actively measuring.
3	8	Sweeping — This bit is set when the HP E4915A/E4916A is sweeping (applicable only to DLD and EM modes).
2	4	Ranging — This bit is set when the HP E4915A/E4916A is currently changing its range.
1	2	Settling — The HP E4915A/E4916A is waiting for signals it controls to stabilize enough to begin a measurement.
0	1	Calibrating

**Table 6-4. Operation Status Event Register Assignments**

Bit No.	Bit Weight	Description
10-15		Always 0 (zero)
9	512	This bit is set when the BUF2 has become full.
8	256	This bit is set when the BUF1 has become full.
7	128	This bit is set when the correction data measurement has completed.
6		Always 0 (zero)
5	32	This bit is set when the HP E4915A/E4916A has become able to accept a trigger.
4	16	This bit is set when the measurement has completed.
3		Always 0 (zero)
2	4	This bit is set when the ranging has completed.
1	2	This bit is set when the settling has completed.
0		Always 0 (zero)

## LCR Meter Command Reference

## Questionable Status Register

The Questionable Status register group provides information on the quality of the output and measurement data of the HP E4915A/E4916A.

**Table 6-5. Questionable Status Register Assignments**

Bit No.	Bit Weight	Description
15~10		Always 0 (zero)
9	512	Search Event Status Bit Summary bit.(a 0 to 1 transition)
8~0		Always 0 (zero)

## Search Event Status Register

The Search Event Status register group provides information on the results of the HP E4915A/E4916A's searching for resonance frequency or spurious points.

**Table 6-6.  
Search Event Status Register Assignments**

Bit No.	Bit Weight	Description
15~1		Always 0 (zero)
0	1	Search target not found.(a 0 to 1 transition)

## Referencing and Setting Status Registers

### Reporting the Instrument Status

You can use the following commands to have the HP E4915A/E4916A report its own status:

- \*CLS
- \*ESE
- \*ESR?
- \*SRE
- \*STB?
- OSER?
- OSR?
- OSE
- QSER?
- QSR?
- QSE
- HP BASIC SPOLL command

The following example generates a service request whenever an error is queued:

```
OUTPUT 717;"*ESE 52; *SRE 32"
```

The following example detects the completion of a measurement cycle:

```
OUTPUT 717;"OSE 16"
```

```
REPEAT
```

```
    A=SPOLL(717)
    UNTIL BIT(A,7)
```

*Enable Measuring bit of  
Operation Status Register  
Wait until the Operation  
Status Register Summary  
bit is set*

## LCR Meter Command Reference

The following example generates an interrupt when an error occurs in the HP E4915A/E4916A:

```

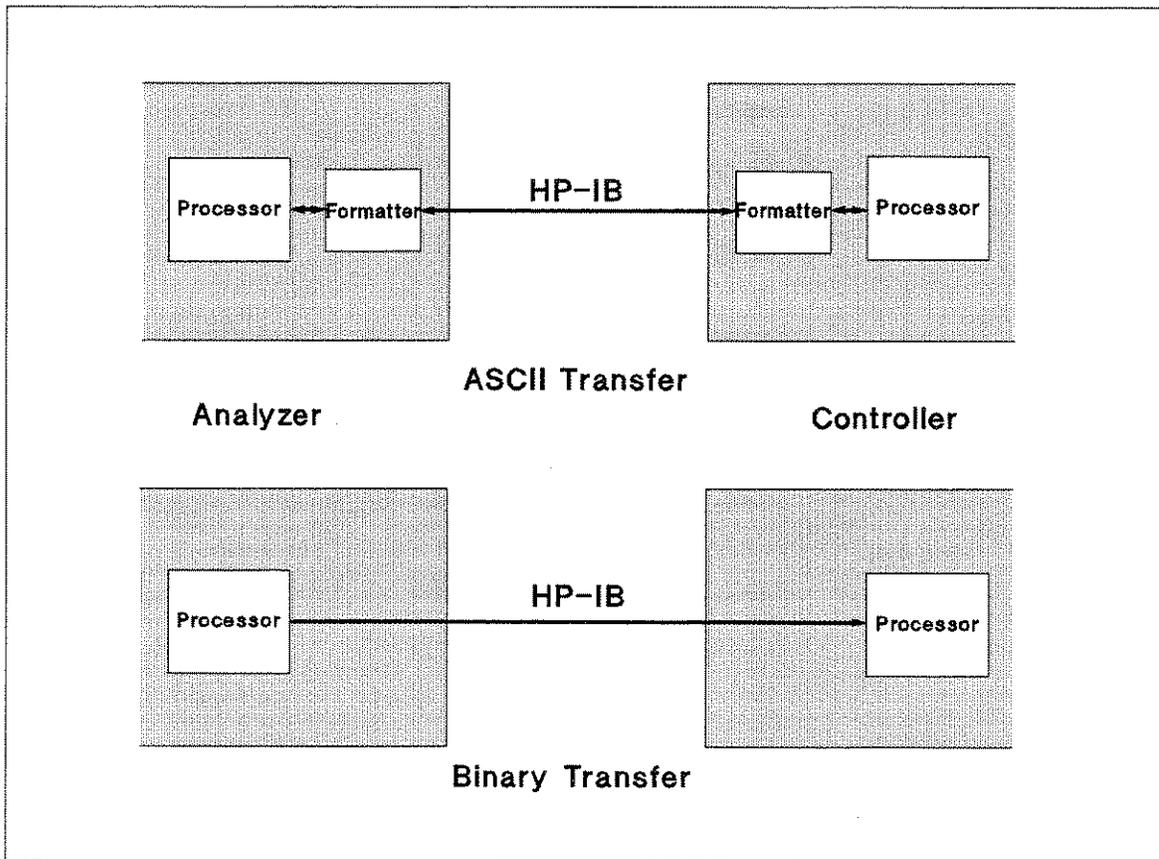
:                                     Clears status byte register
DIM Err$(50)
!
:
OUTPUT 717;"*CLS"
OUTPUT 717;"*ESE 48"                                     Sets Command Error Bit
                                                         and Execution Error Bit
OUTPUT 717;"*SRE 32"                                     Sets Standard Event Sta-
                                                         tus register Summary Bit
!                                                         Tells where to branch when
ON INTR 7 GOSUB Err_report                               interrupted
ENABLE INTR 7;2                                         Enables an interrupt from
                                                         HP-IB interface
!                                                         Clear the SRQ Bit
:
LOOP
:
END LOOP
STOP
!
Err_report;!
Stat=SPOLL(717)
OUTPUT 717;"*ESR?"                                     Queries the contents of the
                                                         Standard Event Status Register
ENTER 717;Estat                                         Requests for output of er-
PRINT "Syntaz Error detected."                          ror number and message
!
OUTPUT 717;"SYST:ERR?"
ENTER 717;Err,Err$
PRINT Err,Err$
!
*CLS
ENABLE INTR 7
RETURN
END

```



## Data Transfer Methods

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



**Figure 7-1. Simplified Internal Process of ASCII and Binary Transfer**

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

## ASCII Transfer

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

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

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

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

DIM Dat(1:201,1:2)	<i>Define the data array for receiving.</i>
OUTPUT @E4915;"FORM ASC"	<i>Specify the ASCII format.</i>
OUTPUT @E4915;"*TRG"	<i>Trigger and query the data trace.</i>
ENTER @E4915;A,B,C	<i>Retrieve the data.</i>

### Retrieving Data from the Analyzer Using ASCII Transfer

## Binary Transfer

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

- IEEE 64-bit Floating Point Format

Figure 7-2 shows the data transfer format of IEEE 64-bit floating point format. Data is stored internally in the 200/300 series computer with the IEEE 64-bit floating point format, eliminating the need for any reformatting by the computer. In this mode, each number takes 8 bytes.

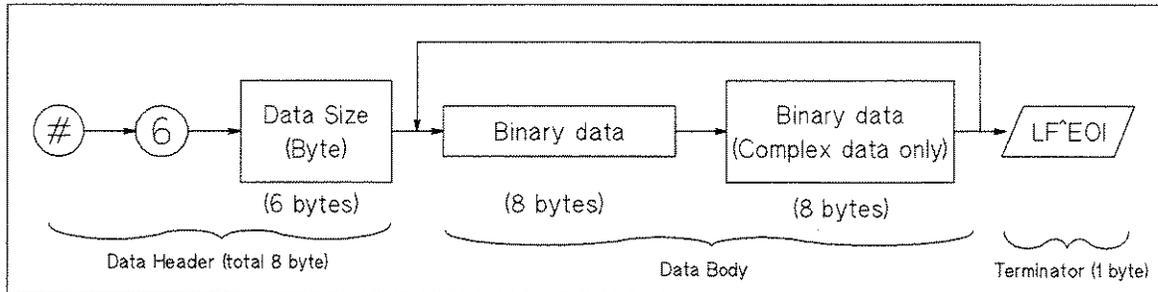


Figure 7-2. IEEE 64-bit floating point format

### Data Header

As shown in Figure 7-2, the data header always precedes the data itself in binary format transfer. When you use a binary transfer, you must handle the data header with the data body.

When you query data in binary format, the analyzer outputs a data header.

When you send the data to data array using binary transfer, you must prepare the data header for the data you send. The data header indicates the size of the transferred data. The data header consists of the following three parts: sharp, Number of byte of "Data Size", and data size.

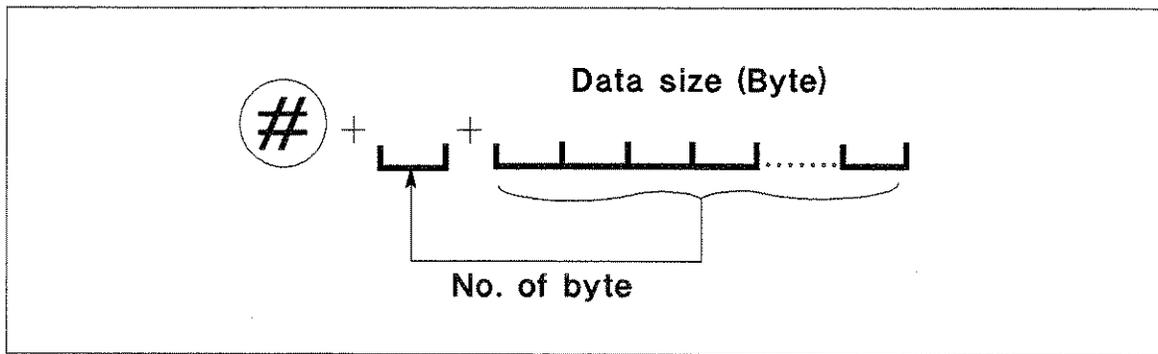


Figure 7-3. Binary Data Header

## Getting Data from Analyzer

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

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

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

ASSIGN @Dt TO 800;FORMAT OFF	<i>Binary path must turn off the formatting. Use 717 instead of 800 for the external controller.</i>
OUTPUT @E4915;"FORM:DATA REAL,64"	<i>Specify the format as IEEE 64-bit format.</i>
OUTPUT @E4915;"TRG?"	<i>Query the data trace array.</i>
ENTER @E4915 USING "#,6A";Header\$	<i>Data header is 6 byte character.</i>
ENTER @Dt;A,B,C	<i>Receiving data via binary path.</i>
ENTER @E4915;End\$	<i>Reading terminator.</i>
OUTPUT @E4915;"FORM:DATA ASC"	<i>Set ASCII mode if binary transfer is finished.</i>

### Getting Data from Analyzer Using Binary Transfer

## Sample Program

---

This chapter provides sample programs to control HP E4915A/E4916A from an external controller via HP-IB. All programs are written by HP BASIC.

---

### Calibration

```
1000 !   ### SAMPLE PROGRAM for Calibration ###
1010 ! Please take care to set Meas.FUNCTION before calibrate!
1020 !
1021   ASSIGN @E4916 TO 717
1030 ! STANDARD CAL VALUE FOR 41902A
1040   OUTPUT @E4916;":CALSTD OPEN,CO,0.1E-12"
1050   OUTPUT @E4916;":CALSTD OPEN,GO,0.0"
1060   OUTPUT @E4916;":CALSTD SHORT,RO,0.1E-6"
1070   OUTPUT @E4916;":CALSTD SHORT,LO,3.0E-9"
1080   OUTPUT @E4916;":CALSTD LOAD,RO,50.0"
1090   OUTPUT @E4916;":CALSTD LOAD,LO,18.8E-9"
1100 !
1110   BEEP
1120   DISP "Remove device for OPEN calibration, then press continue"
1130   PAUSE
1140   DISP "Measuring"
1150   OUTPUT @E4916;":CAL OPEN"
1160   OUTPUT @E4916;":*OPC?"
1170   ENTER @E4916;Dummy
1180   !
1190   BEEP
1200   DISP "Connect short plate for short calibration, then press continue"
1210   PAUSE
1220   DISP "Measuring"
1230   OUTPUT @E4916;":CAL SHORT"
1240   OUTPUT @E4916;":*OPC?"
1250   ENTER @E4916;Dummy
1260   !
1270   BEEP
1280   DISP "Connect 50 ohm for load calibration, then press continue"
1290   PAUSE
1300   DISP "Measuring"
1310   OUTPUT @E4916;":CAL LOAD"
1320   OUTPUT @E4916;":*OPC?"
1330   ENTER @E4916;Dummy
1340   !
1350   END
```

---

## Fixture Compensation

```

1000 ! ### SAMPLE PROGRAM for Compensation ###
1010 !
1020 ASSIGN @E4916 TO 717
1030 BEEP
1040 DISP "Remove device for OPEN compensation, then press continue"
1050 PAUSE
1060 DISP "Measuring OPEN"
1070 OUTPUT @E4916;":COMPEN OPEN"
1080 OUTPUT @E4916;"*OPC?"
1090 ENTER @E4916;Dummy
1100 !
1110 BEEP
1120 DISP "Connect short plate for short compensation, then press continue"
1130 PAUSE
1140 DISP "Measuring SHORT"
1150 OUTPUT @E4916;":COMPEN SHORT"
1160 OUTPUT @E4916;"*OPC?"
1170 ENTER @E4916;Dummy
1180 !
1190 END

```

---

## Comparater Function

### Comparater Function of LCR measurement mode

```

1000 ! ### COMPARATER(%Tolerance for LCR) Sample Program ###
1010 ! This program is only doing setting
1020 !
1030 ASSIGN @E4916 TO 717
1040 GOSUB Comp_set
1050 GOTO 1450
1060 Comp_set: !
1070 ! INITIALIZE
1080 OUTPUT @E4916;":CALC1:FORM CS"
1090 OUTPUT @E4916;":CALC:COMP:BIN:CLE"
1100 OUTPUT @E4916;":CALC:COMP:BIN:COUN:CLE"
1110 !
1120 ! MESUREMENT VALUE
1130 OUTPUT @E4916;":CALC:COMP:STAT ON"
1140 OUTPUT @E4916;":CALC:COMP:MODE PCNTTOL"
1150 OUTPUT @E4916;":CALC:COMP:TOL:NOM 49.5P"
1160 !
1170 ! BEEP & LED CONFIGURATION
1180 OUTPUT @E4916;":COMPBEEPS ON"
1190 OUTPUT @E4916;":COMPBEEPC FAIL"
1200 OUTPUT @E4916;":COMPLEDC PASS"
1210 !

```

```

1220 ! COMPARATOR TABLE
1230 OUTPUT @E4916;":BINSIZE 5"
1240 OUTPUT @E4916;":CALC:COMP:TOL:BIN1 -3.0,3.0"
1250 ! -3.0% <= VALUE <= 3.0%
1260 OUTPUT @E4916;":CALC:COMP:TOL:BIN2 -6.0,6.0"
1270 ! -6.0% <= VALUE <= 6.0%
1280 OUTPUT @E4916;":CALC:COMP:TOL:BIN3 -9.0,9.0"
1290 ! -9.0% <= VALUE <= 9.0%
1300 OUTPUT @E4916;":CALC:COMP:TOL:BIN4 -12.0,12.0"
1310 ! -12.0% <= VALUE <= 12.0%
1320 OUTPUT @E4916;":CALC:COMP:TOL:BIN5 -15.0,15.0"
1330 ! -15.0% <= VALUE <= 15.0%
1340 !
1350 !
1360 ! TABLE CHECK
1370 PRINT "BIN_Number, Upper , Lower"
1380 PRINT "=====
1390 FOR I=1 TO 5
1400 OUTPUT @E4916;":COMPPLIM? BIN"&CHR$(I+48)
1410 ENTER @E4916;Low,High
1420 PRINT CHR$(I+48),Low,High
1430 NEXT I
1440 RETURN
1450 END

```

## Comparator Function of X'tal measurement mode

### Sequential Mode

```

1000 ! ### COMPARATER(Sequential for Xtal) Sample Program ###
1010 ! This program is only doing setting
1020 !
1030 ASSIGN @E4916 TO 717
1040 GOSUB Comp_set
1050 GOTO 1480
1060 Comp_set: !
1070 ! INITIALIZE
1080 OUTPUT @E4916;":PRES"
1090 OUTPUT @E4916;":MEASF Xtal"
1100 OUTPUT @E4916;":COMPCLE"
1110 OUTPUT @E4916;":BINCNTCLE"
1120 !
1130 ! MEASUREMENT VALUE
1140 OUTPUT @E4916;":NOMF 80.0MHZ"
1150 OUTPUT @E4916;":COMPTOLSTD 80.0MA"
1160 ! MA:MEGA ,M:MILI
1170 OUTPUT @E4916;":COMPSTAT ON"
1180 OUTPUT @E4916;":COMPPRIM SEQ"
1190 !
1200 ! BEEP & LED CONFIGURATION
1210 OUTPUT @E4916;":COMPBEEPS ON"
1220 OUTPUT @E4916;":COMPBEEPC FAIL"
1230 OUTPUT @E4916;":COMPLEDC PASS"
1240 !

```

```

1250 ! COMPARATOR TABLE
1260  OUTPUT @E4916;":BINSIZE 5"
1270  OUTPUT @E4916;":COMPPLIM BIN1,78.0MA,79.0MA"
1280 !      78.0 <= VALUE <=79.0
1290  OUTPUT @E4916;":COMPPLIM BIN2,79.0MA,80.0MA"
1300 !      79.0 < VALUE <=80.0
1310  OUTPUT @E4916;":COMPPLIM BIN3,80.0MA,81.0MA"
1320 !      80.0 < VALUE <=81.0
1330  OUTPUT @E4916;":COMPPLIM BIN4,81.0MA,82.0MA"
1340 !      81.0 < VALUE <=82.0
1350  OUTPUT @E4916;":COMPPLIM BIN5,82.0MA,83.0MA"
1360 !      82.0 < VALUE <=83.0
1370 !
1380 !
1390 ! TABLE CHECK
1400  PRINT "BIN_Number, Upper , Lower"
1410  PRINT "=====
1420  FOR I=1 TO 5
1430    OUTPUT @E4916;":COMPPLIM? BIN"&CHR$(I+48)
1440    ENTER @E4916;Low,High
1450    PRINT CHR$(I+48),Low,High
1460  NEXT I
1470  RETURN
1480  END

```

#### Tolerance in Absolute value

```

1000 ! ### COMPARATER(ABS tolerance for Xtal) Sample Program ###
1010 ! This program is only doing setting
1020 !
1030  ASSIGN @E4916 TO 717
1040  GOSUB Comp_set
1050  GOTO 1480
1060  Comp_set: !
1070 ! INITIALIZE
1080  OUTPUT @E4916;":PRES"
1090  OUTPUT @E4916;":MEASF Xtal"
1100  OUTPUT @E4916;":COMPCLE"
1110  OUTPUT @E4916;":BINCNTCLE"
1120 !
1130 ! MESUREMENT VALUE
1140  OUTPUT @E4916;":COMPSTAT ON"
1150  OUTPUT @E4916;":COMPPRIM ABSTOL"
1160  OUTPUT @E4916;":NOMF 80.0MHZ"
1170  OUTPUT @E4916;":COMPTOLSTD 80.0MA"
1180    ! MA:MEGA ,M:MILI
1190 !
1200 ! BEEP & LED CONFIGURATION
1210  OUTPUT @E4916;":COMPBEEPS ON"
1220  OUTPUT @E4916;":COMPBEEPC FAIL"
1230  OUTPUT @E4916;":COMPLEDC PASS"
1240 !
1250 ! COMPARATOR TABLE
1260  OUTPUT @E4916;":BINSIZE 5"
1270  OUTPUT @E4916;":COMPPLIM BIN1,-1.0MA,1.0MA"

```

```

1280 !      -1MHz <= VALUE <= +1MHz
1290 OUTPUT @E4916;":COMPPLIM BIN2,-2.0MA,2.0MA"
1300 !      -2MHz <= VALUE <= +2MHz
1310 OUTPUT @E4916;":COMPPLIM BIN3,-3.0MA,3.0MA"
1320 !      -3MHz <= VALUE <= +3MHz
1330 OUTPUT @E4916;":COMPPLIM BIN4,-4.0MA,4.0MA"
1340 !      -4MHz <= VALUE <= +4MHz
1350 OUTPUT @E4916;":COMPPLIM BIN5,-5.0MA,5.0MA"
1360 !      -5MHz <= VALUE <= +5MHz
1370 !
1380 !
1390 PRINT "BIN_Number, Upper , Lower"
1400 PRINT "=====
1410 ! TABLE CHECK
1420 FOR I=1 TO 5
1430     OUTPUT @E4916;":COMPPLIM? BIN"&CHR$(I+48)
1440     ENTER @E4916;Low,High
1450     PRINT CHR$(I+48),Low,High
1460 NEXT I
1470 RETURN
1480 END

```

### Tolerance in Percentage

```

1000 ! ### COMPARATER(% tollerance for Xtal) Sample Program ###
1010 ! This program is only doing setting
1020 !
1030 ASSIGN @E4916 TO 717
1040 GOSUB Comp_set
1050 GOTO 1480
1060 Comp_set: !
1070 ! INITIALIZE
1080 OUTPUT @E4916;":PRES"
1090 OUTPUT @E4916;":MEASF Xtal"
1100 OUTPUT @E4916;":COMPCLE"
1110 OUTPUT @E4916;":BINCNTCLE"
1120 !
1130 ! MESUREMENT VALUE
1140 OUTPUT @E4916;":COMPSTAT ON"
1150 OUTPUT @E4916;":COMPPRIM PCNTTOL"
1160 OUTPUT @E4916;":NOMF 80.0MHZ"
1170 OUTPUT @E4916;":COMPTOLSTD 80.0MA"
1180     ! MA:MEGA ,M:MILI
1190 !
1200 ! BEEP & LED CONFIGURATION
1210 OUTPUT @E4916;":COMPBEEPS ON"
1220 OUTPUT @E4916;":COMPBEEPC FAIL"
1230 OUTPUT @E4916;":COMPLEDC PASS"
1240 !
1250 ! COMPARATOR TABLE
1260 OUTPUT @E4916;":BINSIZE 5"
1270 OUTPUT @E4916;":COMPPLIM BIN1,-100.OPPM,100.OPPM"
1280 !      0.01% <= VALUE <=0.01%
1290 OUTPUT @E4916;":COMPPLIM BIN2,-200.OPPM,200.OPPM"
1300 !      0.02% <= VALUE <=0.02%

```

```

1310 OUTPUT @E4916;":COMPPLIM BIN3,-300.OPPM,300.OPPM"
1320 !      0.03% <= VALUE <=0.03%
1330 OUTPUT @E4916;":COMPPLIM BIN4,-400.OPPM,400.OPPM"
1340 !      0.04% <= VALUE <=0.04%
1350 OUTPUT @E4916;":COMPPLIM BIN5,-500.OPPM,500.OPPM"
1360 !      0.05% <= VALUE <=0.05%
1370 !
1380 !
1390 ! TABLE CHECK
1400 PRINT "BIN_Number, Upper , Lower"
1410 PRINT "=====
1420 FOR I=1 TO 5
1430     OUTPUT @E4916;":COMPPLIM? BIN"&CHR$(I+48)
1440     ENTER @E4916;Low,High
1450     PRINT CHR$(I+48),Low,High
1460 NEXT I
1470 RETURN
1480 END

```

---

## DLD Measurement and Equivalent Circuit

```

1000 ! ### Sample Program for DLD and Xtal Measment ###
1010 !
1020 ASSIGN @E4916 TO 717
1030 ASSIGN @Binary TO 717;FORMAT OFF
1040 !
1050 DIM Measdata(0:9),Ptlist(1:9,1:3),Bufdata(44),Bufdatab(44),Ptlist_quiry(1:9,1:2)
1060 DIM B_xtal(8),Measdatax(0:9)
1070 REAL B(0:8)
1080 DIM Err$(50)
1090 ! Default value *****
1100 F_nominal=16.643
1110 F_range=1000
1120 Ci_nominal=40
1130 Power=100
1140 !Measurement Settings *****
1150 !
1160 BEEP
1170 INPUT "Enter nominal frequency of Crystal unit [MHz]",F_nominal
1180 BEEP
1190 INPUT "Enter search range for measurement [ppm]",F_range
1200 BEEP
1210 INPUT "Enter nominal CI value of Crystal unit [ohm]",Ci_nominal
1220 BEEP
1230 INPUT "Enter drive level to crystal thru PI-network [uW]",Power
1240 !
1250 !
1260 GOSUB Initset_dld
1270 !
1280 GOSUB Dld_list_setup

```

```

1290 !
1300 GOSUB Initset_xtal
1310 !
1320 GOSUB Calibration
1330 !
1340 !GOSUB Meas_binary
1350 GOSUB Meas_ascii
1360 ! Please chouse BINARY mode or ASCII mode as you need.
1370 !
1380 STOP
1390 !
1400 !
1410 !
1420 Initset_dld:!
1430 !
1440 OUTPUT @E4916;":PRES"
1450 OUTPUT @E4916;":TRIGSOUR BUS"
1460 OUTPUT @E4916;":MEASF DLD"
1470 OUTPUT @E4916;":MEASPARA FR"
1480 OUTPUT @E4916;":NOMF ";F_nominal;"MHZ"
1490 OUTPUT @E4916;":SRCHR ";F_range;"PPM"
1500 OUTPUT @E4916;":SRCHTGT PHASE"
1510 OUTPUT @E4916;":TGTPHASE 0"
1520 OUTPUT @E4916;":NOMCI ";Ci_nominal
1540 OUTPUT @E4916;":ALC OFF"
1550 OUTPUT @E4916;":MEASTIME 2"
1560 OUTPUT @E4916;":PTWAIT OMS"
1570 OUTPUT @E4916;":PTABORT ON"
1580 OUTPUT @E4916;":CIRCUIT PI"
1590 OUTPUT @E4916;":MEMSTATE ON"
1600 OUTPUT @E4916;":MEMCLEAR"
1610 OUTPUT @E4916;":INITCONT ON"
1620 OUTPUT @E4916;":*CLS"
1630 OUTPUT @E4916;":*ESE 48"
1640 OUTPUT @E4916;":*SRE 40"
1650 OUTPUT @E4916;":SEE 1"
1660 OUTPUT @E4916;":QSE 512"
1670 ON INTR 7 GOSUB Err_report
1680 ENABLE INTR 7;2
1690 RETURN
1700 !
1710 !
1720 Initset_xtal:!
1730 !
1740 OUTPUT @E4916;":MEASF XTAL"
1750 OUTPUT @E4916;":MEASPARA FR"
1760 OUTPUT @E4916;":NOMF ";F_nominal;"MHZ"
1770 OUTPUT @E4916;":SRCHR ";F_range;"PPM"
1780 OUTPUT @E4916;":SRCHTGT PHASE"
1790 OUTPUT @E4916;":TGTPHASE 0"
1800 OUTPUT @E4916;":NOMCI ";Ci_nominal
1810 OUTPUT @E4916;":POWER ";Power;"UW"
1820 OUTPUT @E4916;":ALC OFF"
1830 OUTPUT @E4916;":MEASTIME 2"
1840 OUTPUT @E4916;":CIRCUIT PI"

```

```

1850 OUTPUT @E4916;":EQUCKT DEV4"
1860 OUTPUT @E4916;":DSPTSQ OFF"
1870 OUTPUT @E4916;":AGING OFF"
1890 OUTPUT @E4916;":DISP ON"
1900 RETURN
1910 !
1920 !
1930 Dld_list_setup: ! DLD LIST TABLE SETUP *****
1940 !
1950 OUTPUT @E4916;":PTSWPT LIST"
1960 OUTPUT @E4916;":PTCLEAR"
1970 DATA 9 ! Number of power point *****
1980 DATA 1,0.1,1
1990 DATA 2,1,1
2000 DATA 3,10,1
2010 DATA 4,100,1
2020 DATA 5,1000,1
2030 DATA 6,100,1
2040 DATA 7,10,1
2050 DATA 8,1,1
2060 DATA 9,0.1,1
2070 ! *****
2080 !
2090 READ Ptlsize
2100 OUTPUT @E4916;":PTLSIZE ";Ptlsize
2110 !
2120 FOR I=1 TO Ptlsize
2130 READ Ptlist(I,1),Ptlist(I,2),Ptlist(I,3)
2140 OUTPUT @E4916;":PTLIST ";Ptlist(I,1),Ptlist(I,2);"UW,";Ptlist(I,3)
2150 NEXT I
2160 !
2170 OUTPUT @E4916;":MEMSIZE ";Ptlsize
2180 !
2190 FOR I=1 TO Ptlsize
2200 OUTPUT @E4916;":PTLIST?";I
2210 ENTER @E4916;Ptlist_query(I,1),Ptlist_query(I,2)
2220 NEXT I
2230 !
2240 OUTPUT @E4916;"PTSTDP 100UW"
2250 !
2260 RETURN
2270 !
2280 Calibration: ! PI-network calibration *****
2290 ! STANDARD CAL VALUE FOR 41902A
2300 OUTPUT @E4916;":CALSTD OPEN,C0,0.1E-12"
2310 OUTPUT @E4916;":CALSTD OPEN,G0,0.0"
2320 OUTPUT @E4916;":CALSTD SHORT,R0,0.1E-6"
2330 OUTPUT @E4916;":CALSTD SHORT,L0,3.0E-9"
2340 OUTPUT @E4916;":CALSTD LOAD,R0,50.0"
2350 OUTPUT @E4916;":CALSTD LOAD,L0,18.8E-9"
2360 !
2370 BEEP
2380 DISP "Remove device for OPEN calibration, then press continue"
2390 PAUSE
2400 DISP "Measuring"

```

```

2410 OUTPUT @E4916;":CAL OPEN"
2420 OUTPUT @E4916;"*OPC?"
2430 ENTER @E4916;Dummy
2440 !
2450 BEEP
2460 DISP "Connect short plate for short calibration, then press continue"
2470 PAUSE
2480 DISP "Measuring"
2490 OUTPUT @E4916;":CAL SHORT"
2500 OUTPUT @E4916;"*OPC?"
2510 ENTER @E4916;Dummy
2520 !
2530 BEEP
2540 DISP "Connect 50 ohm for load calibartion, then press continue"
2550 PAUSE
2560 DISP "Measuring"
2570 OUTPUT @E4916;":CAL LOAD"
2580 OUTPUT @E4916;"*OPC?"
2590 ENTER @E4916;Dummy
2600 !
2610 RETURN
2620 !
2630 !
2640 Meas_binary: ! *****
*****
2650 !
2660 OUTPUT @E4916;":FORMAT REAL"
2670 LOOP
2680 DISP "CONECT DEVICE, then press continue"
2690 BEEP
2700 PAUSE
2710 DISP
2720 !
2730 OUTPUT @E4916;":MEASF DLD"
2740 OUTPUT @E4916;"*TRG"
2750 ENTER @Binary USING "#,6A";A$
2760 ENTER @Binary;B(*)
2770 ENTER @Binary USING "#,A";D$
2780 OUTPUT @E4916;"MEMREAD?"
2790 ENTER @Binary USING "#,6A";A$
2800 ENTER @Binary;Bufdatatab(*)
2810 ENTER @Binary USING "#,A";D$
2820 OUTPUT @E4916;"MEMCLEAR"
2830 FOR I=1 TO 9
2840 Measdata(I)=B(I-1)
2850 NEXT I
2860 !
2870 OUTPUT @E4916;":MEASF XTAL"
2880 OUTPUT @E4916;"*TRG"
2890 ENTER @Binary USING "#,6A";A$
2900 ENTER @Binary;B_xtal(*)
2910 ENTER @Binary USING "#,A";D$
2920 FOR I=1 TO 9
2930 Measdatamax(I)=B_xtal(I-1)
2940 NEXT I

```

```

2950      !
2960      OUTPUT @E4916;"MEMCLEAR"
2970      GOSUB Printing
2980      END LOOP
2990      RETURN
3000      !
3010 Meas_ascii: ! *****
3020      !
3030      OUTPUT @E4916;":FORMAT ASCII"
3040      OUTPUT @E4916;":TRIGSOUR BUS"
3050      LOOP
3060          DISP "CONNECT DEVICE, then press continue"
3070          BEEP
3080          PAUSE
3090          DISP
3100          !
3110          OUTPUT @E4916;":MEASF DLD"
3120          OUTPUT @E4916;":*TRG"
3130          ENTER @E4916;Measdata(*)
3140          OUTPUT @E4916;":MEMREAD?"
3150          ENTER @E4916;Bufdata(*)
3160          OUTPUT @E4916;"MEMCLEAR"
3170          OUTPUT @E4916;":MEASF XTAL"
3180          OUTPUT @E4916;":TRIGIMMEDIATE"
3190          OUTPUT @E4916;":FETCH?"
3200          ENTER @E4916;Measdatax(*)
3210          OUTPUT @E4916;"MEMCLEAR"
3220          !PRINT Bufdata(*)
3230          GOSUB Printing
3240      END LOOP
3250      RETURN
3260      !
3270 Printing: ! *****
3280      !
3290      PRINT USING "5A,7X,3D.9D,6A";"Fr : ";Measdata(1)/1.E+6;" [MHz]"
3300      PRINT USING "5A,7X,3D.2D,6A";"CI : ";Measdata(2);" [ohm]"
3310      PRINT USING "9A,3X,3D.9D,6A";"Min Fr : ";Measdata(4)/1.E+6;" [MHz]"
3320      PRINT USING "9A,3X,3D.9D,6A";"Max Fr : ";Measdata(5)/1.E+6;" [MHz]"
3330      PRINT USING "9A,3X,3D.2D,6A";"Min CI : ";Measdata(6);" [ohm]"
3340      PRINT USING "9A,3X,3D.2D,6A";"Max CI : ";Measdata(7);" [ohm]"
3350      PRINT USING "13A,1X,3D.3D,6A";"F(max-min) :";Measdata(8);" [Hz]"
3360      PRINT USING "13A,1X,3D.3D,6A";"CI(max-min) :";Measdata(9);" [ohm]"
3370      PRINT USING "5A,3D.9D,6A";"Fr : ";Measdatax(1)/1.E+6;" [MHz]"
3380      PRINT USING "5A,7X,3D.2D,6A";"CI : ";Measdatax(3);" [ohm]"
3390      PRINT USING "5A,7X,3D.2D,6A";"CO : ";Measdatax(6)/1.E-12;" [pF]"
3400      PRINT USING "5A,4X,3D.5D,6A";"C1 : ";Measdatax(7)/1.E-12;" [pF]"
3410      PRINT USING "5A,4X,6D.2D,6A";"L1 : ";Measdatax(8)/1.E-6;" [uH]"
3420      PRINT USING "5A,7X,3D.2D,6A";"R1 : ";Measdatax(9);" [ohm]"
3430      PRINT USING "5A,6X,7D";"Q :";Measdatax(4)
3440      RETURN
3450      !
3460 Err_report: ! *****
3470      !
3480      Stat=SPOLL(@E4916)
3490      OUTPUT @E4916;":*ESR?"

```

```

3500 ENTER @E4916;Estat
3510 PRINT "Syntax Error Detected."
3520 !
3530 OUTPUT @E4916;":ERROR?"
3540 ENTER @E4916;Err,Err$
3550 PRINT Err,Err$
3560 RETURN
3570 !
3580 END

```

---

## Evaporation Monitor Mode (EM Mode)

```

1000 ! ### SAMPLE PROGRAM for Evaporation Measurement ###
1010 !
1020 !
1030 DIM Measdata(3),Bufdata(27)
1040 !Measurement Settings *****
1050 !
1060 BEEP
1070 INPUT "Enter drive level to crystal thru PI-network [uW]",Power
1080 !
1090 ASSIGN @E4916 TO 717
1100 GOSUB Em_initset
1110 GOSUB Xtal_initset
1120 GOSUB Calibration
1130 GOSUB Xtal_measure
1140 GOSUB Em_measure
1150 GOSUB Xtal_measure
1160 STOP
1170 !
1180 !
1190 Em_initset:
1200 OUTPUT @E4916;":PRES"
1210 OUTPUT @E4916;":TRIGSOUR BUS"
1220 OUTPUT @E4916;":MEASF EM"
1230 OUTPUT @E4916;":MEASPARA FR"
1240 OUTPUT @E4916;":SRCHTGT PHASE"
1250 OUTPUT @E4916;":TGTPHASE O"
1260 OUTPUT @E4916;":POWER ";Power;"UW"
1270 OUTPUT @E4916;":ALC OFF"
1280 OUTPUT @E4916;":MEASTIME 1"
1290 OUTPUT @E4916;":CIRCUIT PI"
1300 OUTPUT @E4916;":INITCONT ON"
1310 OUTPUT @E4916;":MEMSTATE ON"
1320 OUTPUT @E4916;":*CLS"
1330 OUTPUT @E4916;":*ESE 48"
1340 OUTPUT @E4916;":*SRE 40"
1350 OUTPUT @E4916;":SEE 1"
1360 OUTPUT @E4916;":QSE 512"
1370 ON INTR 7 GOSUB Err_report
1380 ENABLE INTR 7;2

```

```

1390 !
1400 ! EM Parameter
1420 OUTPUT @E4916;":EMLCLE"
1430 OUTPUT @E4916;":EMSTARTP 1"
1440 OUTPUT @E4916;":EMTMOUT 10S"
1450 OUTPUT @E4916;":EMOPEB ON, ";DVAL("010101010101",2)
1460 OUTPUT @E4916;":EMCLOB ON, ";DVAL("110000000011",2)
1470 OUTPUT @E4916;":DISPSTAT OFF"
1480 ! EM List Table
1490 Size=7
1500 OUTPUT @E4916;":EMLSIZE ";Size
1510 OUTPUT @E4916;":EMLIST 1,10.001000MHz,0.0,ON,";DVAL("011111111110",2)
1520 OUTPUT @E4916;":EMLIST 2,10.000800MHz,0.0,ON,";DVAL("101111111101",2)
1530 OUTPUT @E4916;":EMLIST 3,10.000500MHz,0.0,ON,";DVAL("110111111011",2)
1540 OUTPUT @E4916;":EMLIST 4,10.000350MHz,0.0,ON,";DVAL("111011110111",2)
1550 OUTPUT @E4916;":EMLIST 5,10.000200MHz,0.0,ON,";DVAL("111101101111",2)
1560 OUTPUT @E4916;":EMLIST 6,10.000050MHz,0.0,ON,";DVAL("111110011111",2)
1570 OUTPUT @E4916;":EMLIST 7,09.999950MHz,0.0,ON,";DVAL("111110111111",2)
1580 !
1590 RETURN
1600 !
1610 Xtal_initset: !*****
1620 OUTPUT @E4916;":EMLIST? ";Size
1630 ENTER @E4916;Freq,Phaze,Ioflag,Iodata
1640 OUTPUT @E4916;":MEASF XTAL"
1650 OUTPUT @E4916;":NOMF";Freq/(1.E+6);"MHZ"
1660 OUTPUT @E4916;":MEASTIME 1"
1670 OUTPUT @E4916;":SRCHR 1000PPM"
1680 OUTPUT @E4916;":POWER ";Power;"UW"
1690 OUTPUT @E4916;":MEASPARA FR"
1700 OUTPUT @E4916;":SRCHTGT PHASE"
1710 OUTPUT @E4916;":TGTPHASE 0"
1720 OUTPUT @E4916;":ALC OFF"
1730 OUTPUT @E4916;":CIRCUIT PI"
1740 RETURN
1750 !
1760 Em_measure: !*****
1770 OUTPUT @E4916;":MEASF EM"
1780 OUTPUT @E4916;":MEMSIZE ";Size
1790 OUTPUT @E4916;":MEMCLEAR"
1800 PRINT ""
1810 BEEP
1820 DISP "Ready to E-Measure? then press continue"
1830 PAUSE
1840 OUTPUT @E4916;"FORMAT ASCII"
1850 PRINT ""
1860 PRINT "MESURING!"
1870 OUTPUT @E4916;":TRIGSOUR BUS"
1880 OUTPUT @E4916;"TRIGIMM"
1890 OUTPUT @E4916;"*OPC?"
1900 ENTER @E4916;Dummy
1910 !
1920 OUTPUT @E4916;":MEMREAD?"
1930 ENTER @E4916;Bufdata(*)
1940 GOSUB Em_printing

```

```

1950  OUTPUT @E4916;":MEMCLEAR"
1960  DISP
1970  RETURN
1980  !
1990  Xtal_measure: !*****
2000  OUTPUT @E4916;":MEASF XTAL"
2010  OUTPUT @E4916;":FORMAT ASCII"
2020  OUTPUT @E4916;"*TRG"
2030  ENTER @E4916;Measdata(*)
2040  GOSUB Xtal_printing
2050  RETURN
2060  !
2070  Em_printing: ! *****
2080  FOR I=1 TO Size
2090  PRINT "No. ";I
2100  PRINT "STATUS :";Bufdata((I-1)*4)
2110  PRINT "FREQ.:";Bufdata((I-1)*4+1)/(1.E+6);" [MHz]"
2120  PRINT "CI  :";Bufdata((I-1)*4+2);" [Ohm]"
2130  PRINT "TIME :";Bufdata((I-1)*4+3);" [mSec]"
2140  PRINT ""
2150  NEXT I
2160  RETURN
2170  !
2180  Xtal_printing: ! *****
2190  !
2200  PRINT "XTAL MEASUREMENT"
2210  PRINT "Fr : ";Measdata(1)/1.E+6;" [MHz]"
2220  ! PRINT "FL : ";Measdata(2)/1.E+6;" [MHz]"
2230  PRINT "CI : ";Measdata(3);" [ohm]"
2240  PRINT ""
2250  PRINT ""
2260  RETURN
2270  !
2280  Calibration: ! PI-network calibration *****
2290  ! STANDARD CAL VALUE FOR 41902A
2300  OUTPUT @E4916;":CALSTD OPEN,CO,0.1E-12"
2310  OUTPUT @E4916;":CALSTD OPEN,GO,0.0"
2320  OUTPUT @E4916;":CALSTD SHORT,RO,0.1E-6"
2330  OUTPUT @E4916;":CALSTD SHORT,LO,3.0E-9"
2340  OUTPUT @E4916;":CALSTD LOAD,RO,50.0"
2350  OUTPUT @E4916;":CALSTD LOAD,LO,18.8E-9"
2360  !
2370  BEEP
2380  DISP "Remove device for OPEN calibration, then press continue"
2390  PAUSE
2400  DISP "Measuring"
2410  OUTPUT @E4916;":CAL OPEN"
2420  OUTPUT @E4916;"*OPC?"
2430  ENTER @E4916;Dummy
2440  !
2450  BEEP
2460  DISP "Connect short plate for short calibration, then press continue"
2470  PAUSE
2480  DISP "Measuring"
2490  OUTPUT @E4916;":CAL SHORT"

```

```

2500 OUTPUT @E4916;"*OPC?"
2510 ENTER @E4916;Dummy
2520 !
2530 BEEP
2540 DISP "Connect 50 ohm for load calibartion, then press continue"
2550 PAUSE
2560 DISP "Measuring"
2570 OUTPUT @E4916;":CAL LOAD"
2580 OUTPUT @E4916;"*OPC?"
2590 ENTER @E4916;Dummy
2600 !
2610 DISP "CONNET DEVICE then press continue"
2620 BEEP
2630 PAUSE
2640 CLEAR SCREEN
2650 RETURN
2660 !
2670 Err_report: ! *****
2680 !
2690 Stat=SPOLL(@E4916)
2700 OUTPUT @E4916;"*ESR?"
2710 ENTER @E4916;Estat
2720 PRINT "Syntax Error Detected."
2730 !
2740 OUTPUT @E4916;":ERROR?"
2750 ENTER @E4916;Err,Err$
2760 PRINT Err,Err$
2770 RETURN
2780 END

```

---

## LCR Measurement

```

100 ! ### LCR Measurment Sample Program ###
110 !
120 ASSIGN @E4916 TO 717
130 Osc=500
150 Freq=1
160 INPUT "FREQUENCY [MHz]",Freq
170 INPUT "OSC [mV]",Osc
180 GOSUB Initialize
190 GOSUB Calibration
200 GOSUB Compensation
210 LOOP
220 GOSUB Measure
230 !GOSUB Measure0
240 END LOOP
250 STOP
260 !
270 !
280 Initialize: !
290 OUTPUT @E4916;":SYST:PRES"
300 OUTPUT @E4916;":MEASF LCR"

```

```
310 OUTPUT @E4916;"*OPC?"
320 ENTER @E4916;Dummy
330 OUTPUT @E4916;":CALC1:FORM MLIN"
340 OUTPUT @E4916;":CALC2:FORM PHASE"
350 OUTPUT @E4916;":SOUR:FREQ:CW ";Freq;"MHZ"
360 OUTPUT @E4916;":SOUR:VOLT ";Osc;"MV"
370 OUTPUT @E4916;":TRIG:SOUR BUS"
380 OUTPUT @E4916;":MEAST 1"
390 OUTPUT @E4916;":DATA:FEED:CONT ALW"
400 OUTPUT @E4916;":DATA:POIN 50"
410 !
420 RETURN
430 !
440 Calibration: !
450 !   ### SAMPLE PROGRAM for Calibration ###
460 ! Please take care to set Meas.FUNCTION before calibrate!
470 !
480 PRINT "CALIBRATION"
490 BEEP
500 DISP "Connect open device for OPEN calibration, then press continue"
510 PAUSE
520 DISP "Measuring"
530 OUTPUT @E4916;":CAL OPEN"
540 OUTPUT @E4916;"*OPC?"
550 ENTER @E4916;Dummy
560 !
570 BEEP
580 DISP "Connect short device for short calibration, then press continue"
590 PAUSE
600 DISP "Measuring"
610 OUTPUT @E4916;":CAL SHORT"
620 OUTPUT @E4916;"*OPC?"
630 ENTER @E4916;Dummy
640 !
650 BEEP
660 DISP "Connect 50 ohm for load calibration, then press continue"
670 PAUSE
680 DISP "Measuring"
690 OUTPUT @E4916;":CAL LOAD"
700 OUTPUT @E4916;"*OPC?"
710 ENTER @E4916;Dummy
720 !
730 RETURN
740 !
750 !   ### SAMPLE PROGRAM for Compensation ###
760 !
770 Compensation: !
780 CLEAR SCREEN
790 PRINT "COMPENSATION"
800 BEEP
810 DISP "Remove device for OPEN compensation, then press continue"
820 PAUSE
830 DISP "Measuring OPEN"
840 OUTPUT @E4916;":COMPEN OPEN"
850 OUTPUT @E4916;"*OPC?"
```

```
860 ENTER @E4916;Dummy
870 !
880 BEEP
890 DISP "Connect short plate for short compensation, then press continue"
900 PAUSE
910 DISP "Measuring SHORT"
920 OUTPUT @E4916;":COMPEN SHORT"
930 OUTPUT @E4916;":*OPC?"
940 ENTER @E4916;Dummy
950 DISP ""
960 !
970 RETURN
980 !
990 Measure0: !
1000 !
1010 ! SINGLE TRIGGER
1020 !
1030 DISP "Connect DUT, then press continue"
1040 PAUSE
1050 CLEAR SCREEN
1060 OUTPUT @E4916;":TRIG"
1070 OUTPUT @E4916;":FETC?"
1080 ENTER @E4916;Status,Impedance,Phase,Null
1090 !
1100 PRINT "IMPEDANCE [KOhm]";Impedance/1000.
1110 PRINT "PHASE [Degree]";Phase
1120 !
1130 RETURN
1140 !
1150 Measure: !
1160 !
1170 ! MULTIPLE TRIGER (50 times)
1180 !
1190 DIM D(149)
1200 DISP "Connect DUT, then press continue"
1210 PAUSE
1220 CLEAR SCREEN
1230 !
1240 FOR I=1 TO 50
1250     OUTPUT @E4916;":TRIG"
1260 NEXT I
1270 !
1280 OUTPUT @E4916;":DATA? BUF1"
1290 ENTER 717;D(*)
1300 PRINT "RESULT"
1310 PRINT "Impedance[Kohm]","Phase[deg.]"
1320 PRINT "=====
1330 FOR I=0 TO 147 STEP 3
1340 PRINT D(I+1)/1000,D(I+2)
1350 NEXT I
1360 !
1370 RETURN
1380 !
1390 END
```

**Error Process**

```

1000 ! ### Sample Program for Error Report ###
1010 !
1020 !
1030 DIM Err$[50]
1040 OUTPUT 717;"*CLS"
1050 OUTPUT 717;"*ESE 48"
1060 OUTPUT 717;"*SRE 40"
1070 OUTPUT 717;":SEE 1"
1080 OUTPUT 717;":QSE 512"
1090 ON INTR 7 GOSUB Err_report
1100 ENABLE INTR 7;2
1110 !
1120 STOP
1130 !
1140 Err_report: !
1150 Stat=SPOLL(717)
1160 OUTPUT 717;"*ESR?"
1170 ENTER 717;Estat
1180 PRINT "SYNTAX ERROR DETECTED."
1190 !
1200 OUTPUT 717;"ERR?"
1210 ENTER 717;Err,Err$
1220 PRINT Err,Err$
1230 !
1240 ENABLE INTR 7
1250 RETURN
1260 END

```

**Tips of Programming**

This section provides sample programs to perform specific tasks. For more information on each HP-IB command, refer Chapter 5.

**Basic Setting**

```

ASSIGN @E4916 TO 717      Set address to 717
OUTPUT @E4916;":PRES"
OUTPUT @E4916;":MEASF XTAL"  X'tal mode
OUTPUT @E4916;":NOMF 80MHZ"  meas. freq. 80 MHz
OUTPUT @E4916;":TRIGERSOUR INIT" TRIG mode:INIT

```

**Measurement Setup****Nominal Frequency**

```
OUTPUT 717;":NOMF 20MHZ"
```

**Test Signal Level**

```
OUTPUT 717;":POWE 1UW"
```

**Measurement Time**

```
OUTPUT 717;":MEASTIME 2"
```

**Averaging (LCR only)**

```
:SENSe:AVERAge:COUN 4
```

**Comparater****Beep**

```
OUTPUT 717;":COMPBEEP ON"
OUTPUT 717;":COMPBEEPC FAIL"
```

**LED**

```
OUTPUT 717;":COMPLEDC PASS"
```

**KEYLOCK**

```
OUTPUT 717;":SYST:KLOC ON"
```

**Selftest**

```
OUTPUT 717;"*TST?"
ENTER 717;A
IF A<>0 THEN PRINT "Self Test Error, Code:";A
```

**Delta Mode**

```
OUTPUT 717;"DATA REF1,";d1
OUTPUT 717;"DATA REF2,";d2
OUTPUT 717;"CALC1:MATH:EXPR:NAME DEV"
OUTPUT 717;"CALC2:MATH:EXPR:NAME PCNT"
OUTPUT 717;"CALC1:MATH:STAT ON"
OUTPUT 717;"CALC2:MATH:STAT ON"
```

**Save and Recall**

```
SAVE
OUTPUT 717;"*SAV 1"
RECALL
OUTPUT 717;"*RCL 1"
```

**Binary Data and Data Buffer**

```
ASSIGN @BINARY TO 717;FORMAT OFF
OUTPUT 717;":FORM REAL"
OUTPUT 717;":FETC?"
ENTER @BINARY USING "#,4A";A$
ENTER @BINARY;S,D1,D2
ENTER @BINARY USING "#,A";A$
PRINT S,D1,D2
```

**Data Buffer**

```
OUTPUT 717;":FORMAT REAL"
OUTPUT 717;":MEMSTAT ON"
OUTPUT 717;":MEMCLE"
OUTPUT 717;":MEMSIZE 10"
```

```

!
! READ DATA IN MEM-BUFFER
OUTPUT 717;":MEMREAD?"
ENTER 717;DATA(*)
!
OUTPUT 717;":MEMINDEX?"
ENTER 717;INDEX
PRINT INDEX

```

## Trigger

### Internal Trigger

```

OUTPUT 717;":TRIGSOUR INT"
OUTPUT 717;":INITCONT ON"
LOOP
    OUTPUT 717;":FETC?"
    ENTER 717;S,D1,D2
END LOOP

```

### Manual Trigger

```

OUTPUT 717;":OSE 16"
OUTPUT 717;":*SRE 128"
ON INTR 7 GOSUB Data_available
ENABLE INTR 7;2
!
OUTPUT 717;":TRIGSOUR MAN"
OUTPUT 717;":INITCONT ON"
LOOP
    LOCAL 717 ! Press Trig. Key.
END LOOP
!
Data_available
OUTPUT 717;":FETC?"
ENTER 717;S,D1,D2
PRINT S,D1,D2
A=SPOLL(717)
OUTPUT 717;":OSR?"
ENTER 717;A
ENABLE INTR 7;2
RETURN

```

### External Trigger

```

OUTPUT 717;":OSE 16"
OUTPUT 717;":*SRE 128"
ON INTR 7 GOSUB Data_available
ENABLE INTER 7;2
!
OUTPUT 717;":TRIGSOUR EXT"
OUTPUT 717;":INITCONT ON"
LOOP
END LOOP
!
Data_available: !
OUTPUT 717;":FETC?"
ENTER 717;S,D1,D2

```

```
PRINT S,D1,D2
A=SPOLL(717)
OUTPUT 717;":OSR?"
ENTER 717;A
ENABLE INTR 7;2
RETURN
```

SCPI Command \*TRG

```
OUTPUT 717;":TRIGSOUR BUS"
OUTPUT 717;"*TRG"
ENTER 717;S,D1,D2
```

Any trigger source

```
OUTPUT 717;":TRIG"
OUTPUT 717;":FETC?"
ENTER 717;S,D1,D2
```

## Specifications

---

These specifications are the performance standards or limits against which the instrument is tested. When shipped from the factory, the HP E4915A/E4916A meet the specifications listed in this section.

Specifications describe the instrument's warranted performance over the temperature range of 0°C to 55°C (except as noted). Supplemental characteristics are intended to provide information that is useful in applying the instrument by giving non-warranted performance parameters. These are denoted as *SPC*, *typical*, *typically*, *nominal* or *approximate*.

Warm up time must be greater than or equal to 10 minutes after power on for all specifications.

---

## Measurement Parameters

### HP E4915A/HP E4916A Common

#### X'tal mode

Fr, Fs, Fa, FL, CI, Q, C0, C1, L1, R1, G0, R0

#### Spurious mode

Spurious frequency, Spurious impedance value

#### CL measurement

CL

### HP E4916A only

#### DLD mode

Maximum/Minimum frequency, Maximum/Minimum CI value, difference of maximum and minimum frequency, Difference of maximum and minimum CI values

#### EM mode (HP-IB only)

Trap frequency, CI at trap point, Time for trapping

#### Filter Mode

Insertion loss/constant loss,  $\Delta f_{left}$ ,  $\Delta f_{right}$

## Source

### Frequency Characteristics

<b>Range</b> .....	1 MHz to 180 MHz
<b>Accuracy</b> (at $23 \pm 5^\circ\text{C}$ ) .....	$\pm 2$ ppm
<b>Stability</b> (at $23 \pm 5^\circ\text{C}$ ) .....	1 ppm/year
<b>Resolution</b> .....	1 mHz

### Output Power Characteristics

#### Range

##### HP E4915A

1 MHz to 100 MHz ..... -5 dBm (Nominal)

100 MHz to 180 MHz ..... -5 dBm (Nominal)

##### HP E4916A

#### All mode except for Filter mode

1 MHz to 100 MHz ..... -60 dBm to +18 dBm (Nominal)

100 MHz to 180 MHz ..... -60 dBm to +16 dBm (Nominal)

#### Filter mode

..... -60 dBm to 0 dBm (Nominal)

### Caution



Make sure that the test signal level is 0 dBm or lower when using the probe. For more information, refer "EMC" in this chapter.

<b>Resolution</b> (HP E4916A only) .....	0.1 dB
<b>Level Accuracy</b> (at $23 \pm 5^\circ\text{C}$ , -5 dBm output level) .....	$\pm 2$ dB
<b>Linearity</b> (at $23 \pm 5^\circ\text{C}$ , relative to -5 dBm output level at 10 MHz)	
HP E4916A .....	$\pm 2$ dB
<b>Equivalent Output SWR</b> .....	$\leq 2.5$ (SPC)

### Spectral Purity Characteristics

**Harmonics** (these are supplemental performance characteristics for the HP E4915A/E4916A)

HP E4915A ..... -25 dBc (SPC)

HP E4916A ..... -20 dBc (SPC)

**Non-harmonic Spurious Signals** .....  $< -45$  dBc (SPC)

**Phase Noise** (at 10 kHz offset from 0 dBm fundamental) ..... -90 dBc/Hz (SPC)

**Other Source Information**

<b>Reverse Power Protection</b> .....	25 dBm, 25 Vdc
<b>Output Connector</b> .....	BNC female
<b>Output Impedance</b> .....	50 $\Omega$ (nominal)

**Receiver****Input Characteristics****Measurement Range**

Frequency ..... 1 MHz to 180 MHz

**Measurement Resolution**

Frequency ..... 1 mHz

X'tal Impedance ..... 10 m $\Omega$

**Return Loss (at 50  $\Omega$  input)**

1 MHz  $\leq$  freq. < 180 MHz ..... 20 dB (SPC)

**Maximum Input Level**

HP E4915A ..... -20 dBm (SPC)

HP E4916A

Test Port ..... 0 dBm (SPC)

Reference Port ..... 25 dBm (SPC)

**Damage Level**

DC ..... 25 Vdc

AC ..... 20 dBm

**Averaging Noise Level**

HP E4915A

1 MHz to 10 MHz ..... -105 dBm/Hz (SPC)

10 MHz to 100 MHz ..... -120 dBm/Hz (SPC)

100 MHz to 180 MHz ..... -100 dBm/Hz (SPC)

HP E4916A

1 MHz to 10 MHz ..... -110 dBm/Hz (SPC)

10 MHz to 100 MHz ..... -130 dBm/Hz (SPC)

100 MHz to 180 MHz ..... -105 dBm/Hz (SPC)

■ When the analyzer frequency is identical to the transmitted interference signal frequency, refer to "EMC" in "General Characteristics".

**Crosstalk**

Standard Input

1 MHz to 100 MHz ..... -100 dB (SPC)

100 MHz to 180 MHz ..... -90 dB (SPC)

**Ratio Characteristics****Frequency Response****Note**

Frequency response can be improved by calibration.

**Dynamic Accuracy**

(at  $23 \pm 5^\circ\text{C}$ , 10 Hz IF BW,  $-10$  dBm reference input level relative to maximum input level,  $-20$  dBm test input level relative to maximum input level, except for ramp frequency sweep)

HP E4915A

Test channel input level	Dynamic accuracy (SPC)
$-20$ dBm to $-30$ dBm	$\pm 0.4$ dB
$-30$ dBm to $-40$ dBm	$\pm 0.1$ dB
$-40$ dBm to $-50$ dBm	$\pm 0.05$ dB
$-50$ dBm to $-60$ dBm	$\pm 0.05$ dB
$-60$ dBm to $-70$ dBm	$\pm 0.1$ dB
$-70$ dBm to $-80$ dBm	$\pm 0.5$ dB
$-80$ dBm to $-90$ dBm	$\pm 1.0$ dB

HP E4916A

Test channel input level	Dynamic accuracy (SPC)
$0$ dBm to $-20$ dBm	$\pm 0.5$ dB
$-20$ dBm to $-30$ dBm	$\pm 0.4$ dB
$-30$ dBm to $-40$ dBm	$\pm 0.1$ dB
$-40$ dBm to $-50$ dBm	$\pm 0.05$ dB
$-50$ dBm to $-60$ dBm	$\pm 0.05$ dB
$-60$ dBm to $-70$ dBm	$\pm 0.1$ dB
$-70$ dBm to $-80$ dBm	$\pm 0.5$ dB
$-80$ dBm to $-90$ dBm	$\pm 1.0$ dB

**Trace Noise**@  $23 \pm 5^\circ\text{C}$ , 10 Hz IFBW ..... 20 mdB rms(SPC)**Stability**@  $23 \pm 5^\circ\text{C}$  ..... 50 mdB/ $^\circ\text{C}$ (SPC)**Phase Characteristics****Dynamic Accuracy**

(at  $23 \pm 5^\circ\text{C}$ , 10 Hz IF BW,  $-10$  dBm reference input level relative to maximum input level,  $-20$  dBm test input level relative to maximum input level, except for ramp frequency sweep)

HP E4915A

Test channel input level	Dynamic accuracy (SPC)
-20 dBm to -30 dBm	$\pm 3^\circ$
-30 dBm to -40 dBm	$\pm 0.6^\circ$
-40 dBm to -50 dBm	$\pm 0.3^\circ$
-50 dBm to -60 dBm	$\pm 0.6^\circ$
-60 dBm to -70 dBm	$\pm 0.3^\circ$
-70 dBm to -80 dBm	$\pm 5^\circ$
-80 dBm to -90 dBm	$\pm 10^\circ$

## HP E4916A

Test channel input level	Dynamic accuracy (SPC)
0 dBm to -20 dBm	$\pm 5^\circ$
-20 dBm to -30 dBm	$\pm 3^\circ$
-30 dBm to -40 dBm	$\pm 0.6^\circ$
-40 dBm to -50 dBm	$\pm 0.3^\circ$
-50 dBm to -60 dBm	$\pm 0.6^\circ$
-60 dBm to -70 dBm	$\pm 0.3^\circ$
-70 dBm to -80 dBm	$\pm 5^\circ$
-80 dBm to -90 dBm	$\pm 10^\circ$

**Trace Noise**

@  $23 \pm 5^\circ\text{C}$ , 10 Hz IFBW ..... 100 mdeg rms(SPC)

**Stability**

@  $23 \pm 5^\circ\text{C}$  ..... 200 mdeg/ $^\circ\text{C}$ (SPC)

## LCR Meter Characteristics

(Applies to HP HP E4916A with options 001/010).

**Measuring frequency**

Range ..... 1 MHz to 180 MHz

Resolution ..... 1 mHz

Measurement parameters .....  $|Z|$ ,  $|Y|$ , phase, R, X, G, B, L, C, D, Q

**Measuring range**

$|Z|$ , R, X ..... 0.1  $\Omega$  to 100 k $\Omega$

$|Y|$ , G, B ..... 10  $\mu\text{S}$  to 10 S

$\theta$  .....  $-180^\circ$  to  $180^\circ$

L ..... 1 nH to 1 kH

C ..... 10 fF to 0.1 F

D ..... 0.0001 to 10

Q ..... 0.1 to 10000

**Measurement Resolution**

$|Z|$ , R, X ..... 10 m $\Omega$

$|Y|$ , G, B ..... 1  $\mu\text{S}$

$\theta$ .....	0.1°
L .....	10 pF
C .....	1 fF
D .....	0.0001
Q .....	0.1
Basic accuracy (for information purpose only) .....	3% (SPC)
	$3 + (0.001 + 2.5 \times 10^{-5}  Z  + 0.1  Y ) \times (40 + f)$ [%]
	(where, Z: $\Omega$ , Y: S, f: MHz)
Probe cable length .....	1.5 m (Nominal)

## General Characteristics

### Operating Conditions

Temperature .....	0 to 55 °C
Humidity (at wet bulb $\leq 40^\circ\text{C}$ , without condensation) ..	15% $\leq$ RH $\leq$ 95%
Altitude .....	0 to 2,000 meters
Warm Up Time .....	10 minutes

### Non-operating Conditions

Temperature .....	-40 to 70 °C
Humidity (at wet bulb $\leq 65^\circ\text{C}$ , without condensation) ..	15 % $\leq$ RH $\leq$ 90 %
Altitude .....	0 to 4,572 meters

### Safety

Certified by CSA-C22.2 No. 1010.1-1993, Based on IEC 1010-1(1990) including Amendment 1 (1992)

### EMC

Complies with CISPR 11 (1990)/EN 55011 (1991): Group 1, Class A  
 Complies with IEC 801-2 (1991)/EN 50082-1(1992): 4 kV CD, 8 kV AD  
 Complies with IEC 801-3 (1984)/EN 50082-1(1992): 3 V/m  
 Complies with IEC 801-4 (1988)/EN 50082-1(1992): 1 kV power lines, 0.5 kV signal lines

Note: When tested at 3 V/m according to IEC 801-3/1984, the averaging noise will be within specifications over the full immunity test frequency range of 26 to 1000 MHz except when the analyzer frequency is identical to the transmitted interference signal test frequency, the averaging noise may be out of specifications.

The EMC will Comply CISPR 11 (1990) except when the test signal level is over 0 dBm using with Option 001 Impedance probe.

**Power Requirement** .90 to 132 V or 198 to 264 V, 47 to 63 Hz, 150 VA max

**Weight** (depending on option)

HP E4915A ..... 4.8 kg (SPC)  
 HP E4916A ..... 5.3 kg (SPC)  
**Cabinet Dimensions** ..... 320(W) × 100(H) × 450(D) mm (SPC)

**Others**

**Handler Interface** ..... See Appendix C.

**EXT REF INPUT**

Frequency ..... 1/2/5/10 MHz, ±10 ppm  
 Amplitude ..... 0 ±5 dBm (SPC)  
 Impedance ..... 50 Ω (Nominal)

**EXT TRIGGER**

(Positive edge trigger)

V<sub>ih</sub> ..... +2 V to +5 V (SPC)  
 V<sub>il</sub> ..... 0 V to +0.5 V (SPC)  
 Sink current (I<sub>s</sub>) ..... I<sub>s</sub> ≤ 0.4 mA (SPC)  
 Pulse width (T<sub>p</sub>) ..... T<sub>p</sub> ≥ 25.6 μsec (SPC)

**ANALOG OUTPUT** ..... ±5 V (SPC)

**Furnished Accessories**

Accessory	HP part number	Accessory	HP part number
Two 30 cm BNC leads <sup>1</sup>	8120-1838	Crystal Measurement Software for HP VEE <sup>4</sup>	N/A
Two 120 cm BNC leads <sup>2</sup>	8120-1840	Rack mount kit <sup>5</sup>	5063-9241
Operation Manual	E4915-90000	Front handle kit <sup>6</sup>	5063-9226
User's Guide	E4915-90001		
Sample Program Disk	E4915-61001		
Impedance Probe Kit <sup>3</sup>	N/A		

- 1 HP E4915A only
- 2 HP E4916A only
- 3 Option 001 only
- 4 Option 020 only
- 5 Option 1CM only
- 6 Option 1CN only

## Specifications of HP E4916A Option 001 Impedance Probe Specifications

<b>Usable Frequency Range</b>	..... 1 MHz to 180 MHz
<b>DC Bias Range</b>	..... $\pm 30$ V, $\pm 0.5$ A
<b>Test Cable Length</b>	..... 1.5 m (Nominal)
<b>Dimensions</b>	..... 1500 mm
<b>Weight</b>	..... approx. 1.7 k
<b>Operation Environment</b>	
Temperature	..... $-20^{\circ}\text{C}$ to $65^{\circ}\text{C}$
Relative humidity	..... 95% at $40^{\circ}\text{C}$
<b>Storage Environment</b>	
Temperature	..... $-40^{\circ}\text{C}$ to $65^{\circ}\text{C}$
<b>Damage Level</b>	..... $\pm 35$ Vpp

## Supplemental Performance Characteristics

Supplemental characteristics are not guaranteed.

### Test Signal Range

HP E4915A

with PI-fixture (CI=25  $\Omega$ ) ..... approximate 5  $\mu\text{W}$

HP E4916A

with PI-fixture (CI=25  $\Omega$ )

Power ..... 100 pW to 1 mW

Voltage ..... 40  $\mu\text{V}$  to 161 mV

Current ..... 2  $\mu\text{A}$  to 6.4 mA

with Z probe (CI=25  $\Omega$ )

Power ..... 500 pW to 31 mW

Voltage ..... 100  $\mu\text{V}$  to 880 mV

Current ..... 45  $\mu$  to 35 mA

### Level Monitor Range

with PI-fixture (CI=25  $\Omega$ )

Voltage ..... 0 to 320 mV

Current ..... 0 to 13 mA

with Z probe (CI=25  $\Omega$ )

Voltage ..... 0 to 1.78 V

Current ..... 0 to 71 mA

### Note



The test signal levels are specified for open terminators. If the probe tip is terminated with an output impedance (25  $\Omega$  or 37.5  $\Omega$ ), the test signal level will be two times (+6 dB).

**IF Bandwidth****Normal Mode**

	Freq/Xtal	Freq/Xtal (LP) <sup>1</sup>	Aging/DLD	EM	LCR	LCR (LP) <sup>1</sup>
<b>Short</b>	300 Hz	50 Hz	1 kHz	800 Hz	300 Hz	50 Hz
<b>Medium</b>	100 Hz	20 Hz	300 Hz	200 Hz	100 Hz	5 Hz
<b>Long</b>	50 Hz	10 Hz	100 Hz	100 Hz	50 Hz	1 Hz

<sup>1</sup> When test signal level is less than -29 dBm

**High Q mode**

	Freq/Xtal	Freq/Xtal (LP) <sup>1</sup>	Aging/DLD	EM
<b>Short</b>	30 Hz	5 Hz	50 Hz	80 Hz
<b>Medium</b>	20 Hz	3 Hz	20 Hz	50 Hz
<b>Long</b>	10 Hz	2 Hz	10 Hz	30 Hz

<sup>1</sup> When test signal level is less than -29 dBm

**Measurement Accuracy**

When characteristics of DUT are within the following conditions:  
 $100,000 \leq Q \leq 1000,000$  and  $5 \Omega \leq C1 \leq 125 \Omega$

Fr frequency .....  $\pm 2$  ppm  
 X'tal Impedance .....  $\pm 5\%$

**Measurement Time****Normal Mode**

	Freq/Xtal		Freq/Xtal (LP) <sup>1</sup>		Aging/DLD	EM	LCR	LCR (LP) <sup>1</sup>
	Phase Search	Peak Search	Phase Search	Peak Search				
<b>Short</b>	125 ms	350 ms	250 ms	750 ms	17 ms to 33 ms	4 ms	20ms	33 ms
<b>Medium</b>	280 ms	800 ms	750 ms	2 s	20 ms to 64 ms	5 ms	50 ms	200 ms
<b>Long</b>	800 ms	1.5 s	2 s	4 s	25 ms to 100 ms	10 ms	200 ms	1000 ms

<sup>1</sup> When test signal level is less than -29 dBm

**High Q Mode**

	Freq/Xtal		Freq/Xtal (LP) <sup>1</sup>		Aging/DLD	EM	LCR	LCR (LP) <sup>1</sup>
	Phase Search	Peak Search	Phase Search	Peak Search				
<b>Short</b>	1.5 s	3 s	4.5 s	8 s	35 ms to 190 ms	12 ms	-	-
<b>Medium</b>	3 s	6 s	8 s	16 s	70 ms to 300 ms	20 ms	-	-
<b>Long</b>	8 s	14 s	16 s	33 s	120 ms to 460 ms	30 ms	-	-

<sup>1</sup> When test signal level is less than -29 dBm



## Manual Changes

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### Introduction

This appendix contains the information required to adapt this manual to earlier versions or configurations of the HP E4915A/E4916A than the current printing date of this manual. The information in this manual applies directly to the HP E4915A/E4916A serial number prefix listed on the title page of this manual.

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### Manual Changes

To adapt this manual to your HP E4915A/E4916A, see Table A-1 and Table A-2, and make all the manual changes listed opposite your instrument's serial number and firmware version.

Instruments manufactured after the printing of this manual may be different from those documented in this manual. Later instrument versions will be documented in a manual changes supplement that will accompany the manual shipped with that instrument. If your instrument's serial number or ROM version is not listed on the title page of this manual, in Table A-1, or Table A-2, make changes according to the *yellow MANUAL CHANGES* supplement.

In additions to information on changes, the supplement may contain information for correcting errors (Errata) in the manual. To keep this manual as current and accurate as possible, Hewlett-Packard recommends that you periodically request the latest *MANUAL CHANGES* supplement.

For information concerning serial number prefixes not listed on the title page or in the *MANUAL CHANGE* supplement, contact the nearest Hewlett-Packard office.

To confirm the ROM version, turn ON the power for the HP E4915A/E4916A or execute \*IDN? on the external controller.

**Table A-1. Manual Changes by Serial Number**

Serial Prefix or Number	Make Manual Changes

**Table A-2. Manual Changes by ROM Version**

Version	Make Manual Changes

## Serial Number

Hewlett-Packard uses a two-part, ten-character serial number that is stamped on the serial number plate (see Figure A-1) attached to the rear panel. The first five characters are the serial prefix and the last five digits are the suffix.

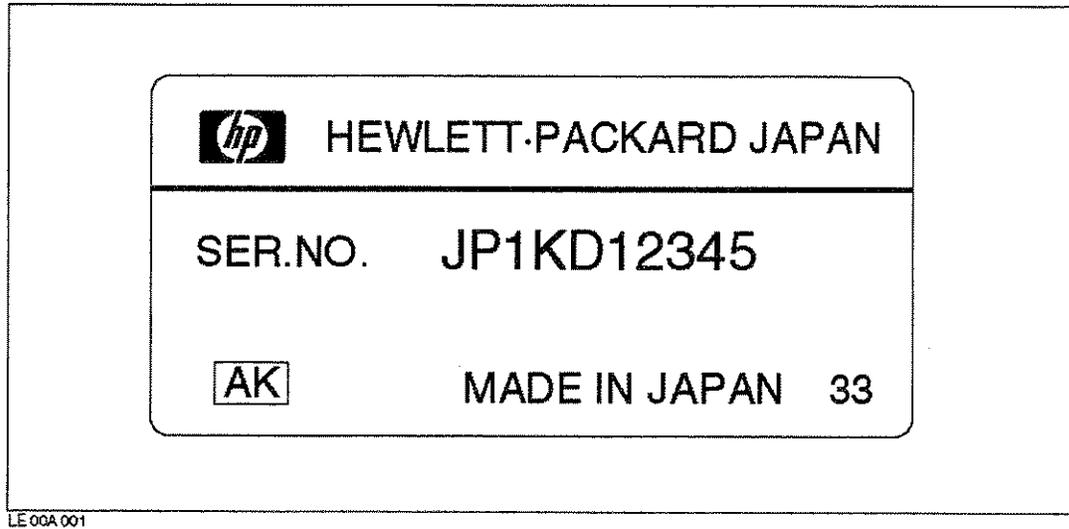


Figure A-1. Serial Number Plate

## Valid Ranges and Initial Settings

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This appendix lists the valid ranges and initial settings of the parameters specific to various measurement modes and functions.

### Note



The tables presented in this appendix use vertical bars (|) and slashes (/) to represent particular conditions:

- Vertical bars (|) are used to separate mutually exclusive options.
  - Slashes (/) are used to simply enumerate elements that may or may not be mutually exclusive.
-

## Crystal Resonator Measurement Mode (Xtl Mode)

Function	Valid Range	Preset Value
Fr/Fa/Fs/FL (nominal)	1 MHz to 180 MHz	10 MHz
Search range	1 ppm to 10000 ppm	1000 ppm
Cl/Z (nominal)	1 $\Omega$ to 1 k $\Omega$	25 $\Omega$
ALC	on off	off
Drive level	-60 dBm to 18 dBm	-5.0 dBm
$\pi$ Network Test Fixture	0.1 nW to 1 mW	5 $\mu$ W
Probe,Bridge	2 $\mu$ A to 6.4 mA 50 $\mu$ V to 160 mV 500 pW to 31 mW 45 $\mu$ A to 35 mA 100 $\mu$ V to 880 mV	
Measuring Time	Short Med Long	Med
High Q mode	on off	off
Equivalent circuit analysis	on off	off
Parameters displayed Ts,Q	on off	off
Search target	Phase Peak	Phase
Target phase value	-180 to 180	0
CL_actual	No_CL 1 to 1000 pF	No_CL
CL_target	No_CL CL_actual 1 to 1000 pF	No_CL
$\Delta$ mode	DEV (PPM %) off	DEV
$\Delta$ mode reference value (F)	Nominal value User-specified value [Hz]	Nominal value
$\Delta$ mode reference value (Cl)	Nominal value User-specified value [ $\Omega$ ]	Nominal value
Aging mode	on off	off
Aging interval	0 sec to 1 hour	0 sec
Measured parameters	Fr Fa Fs FL	Fr
Measurement circuit	PI PROBE BRIDGE	PI
Trigger mode	INT MAN EXT BUS	INT
Measurement mode	Xtal Spur Dld Em Lcr Filter	Xtal

## Spurious Measurement Mode

Function	Valid Range	Preset Value
Spurious measurement mode	on off	off
Center frequency	1 MHz to 180 MHz	10 MHz
Search range	1 ppm to 100000 ppm	10000 ppm 100 kHz
Number of spurious points to search for.	1 to 10	3
Spurious point to be display.	Worst 1 to 10	Worst
Search target	Phase Peak	Phase
Target phase value	-180 to 180 °	0 °
Trigger mode	INT MAN EXT BUS	INT
Measurement mode	Xtal Spur DId Em Lcr Filter	Spur

## Evaporation Monitor Mode (EM Mode)

Function	Valid Range	Preset Value
Search frequency type	Fr	Fr
Drive level	0.1 nW to 1 mW	5 $\mu$ W
Unit of drive level	W A V dBm	W
ALC	on off	off
CI (nominal)	1 $\Omega$ to 1k $\Omega$	25 $\Omega$
Search target	Phase	Phase
Measuring Time	Short Med Long	Med
High Q mode	on off	off
Time-out	0 to 1000 sec	0 sec
Trap point list. (xMAX30)		
Trap frequency.	1 MHz to 180 MHz	10 MHz
Trap phase.	-180 to 180	0
Output through I/O port.	(on off)	off
Trigger mode	INT MAN EXT BUS	MAN
Measurement mode	Xtal Spur DId Em Lcr Filter	Em

## Drive Level Dependency Measurement Mode (DLD Mode)

Function	Valid Range	Preset Value
Search frequency type	Fr	Fr
Fr (nominal)	1 MHz to 180 MHz	10 MHz
Search Range	1 ppm to 10000 ppm	1000 ppm
CI (nominal)	1 $\Omega$ to 1 k $\Omega$	25 $\Omega$
Drive level sweep type.	UP UP_DOWN UP_MIN LIST	UP_DOWN
Measuring Time	Low/Med/High	Med
High Q mode	on off	off
Minimum drive level.	0.1 nW to 1 mW	1 $\mu$ W
Maximum drive level.	0.1 nW to 1 mW	10 $\mu$ W
Standard drive level.	0.1 nW to 1 mW	5 $\mu$ W
Unit of DL.	W A V dBm	W
Measurement wait time.	0 to 10 sec	0 sec
Start point.	1 to 100	1
ABORT	on off	off
ALC	on off	off
$\Delta$ mode	DEV (PPM %) off	DEV
$\Delta$ mode reference value (F)	Start value Reference value Nominal value User-specified value [Hz]	Nominal value
$\Delta$ mode reference value (CI)	Start value Reference value Nominal value User-specified value [ $\Omega$ ]	Nominal value
Search target	Phase	Phase
Target phase value	-180 to 180 $^{\circ}$	0 $^{\circ}$
Trigger mode	INT MAN EXT BUS	MAN
Measurement mode	Xtal Spur Dld Em Lcr Filter	Dld

## LCR Measurement Mode

Function	Valid Range	Preset Value
Primary measured parameters 1	Z, Y, R, G, Cp, Cs, Lp, Ls	Z
Secondary measured parameters 1	$\theta z, \theta y, X, B, D, Q, G, R_p, R_s$	$\theta z$
Primary measured parameters 2	Z, Y, R, G, Cp, Cs, Lp, Ls	R
Secondary measured parameters 2	$\theta z, \theta y, X, B, D, Q, G, R_p, R_s$	X
Measuring Time	Short Med Long	Med
Averaging cycles.	1 to 256 cycles	1 cycle
Signal level. (Vosc)	50 $\mu$ V to 160 mV	12 mV
Unit of Signal level.	W A V dBm	V
Voltage level monitor.	off on	Off
Current level monitor.	off on	Off
$\Delta$ mode ( $\Delta$ Pri)	OFF DEV %	DEV
$\Delta$ Pri std.		0
$\Delta$ mode ( $\Delta$ Sec)	OFF DEV %	DEV
$\Delta$ Sec std.		0
Display digit	3 to 5	5
Test frequency.	1 MHz to 180 MHz	10 MHz
Measuring circuit	PI PROBE BRIDGE	PROBE
Trigger mode	INT MAN EXT BUS	INT
Measurement mode	Xtal Spur Dld Em Lcr Filter	Lcr

## Filter Measurement Mode (Flt Mode)

Function	Valid Range	Preset Value
Test frequency	1 MHz to 180 MHz	10 MHz
Frequency range	10 Hz to 1 MHz	10 kHz
Down value for band width.	0 dB to 100 dB	+3 dB
Filter mode	Constant loss minimum loss	Constant loss
Measuring Time	Short Med Long	Med
High Q mode	on off	off
Signal level	-60 dBm to 0 dBm	-5 dBm
Trigger mode	INT MAN EXT BUS	INT
Measurement mode	Xtal Spur Dld Em Lcr Filter	Filter

## Comparator Function (Bin Sorting)

Function	Valid Range	Preset Value
Comparator ON/OFF.	on off	off
Secondary sorting.	on off	off
Primary sorting.		
Tolerance mode	ABS_TOL %TOL	ABS_TOL
Reference value for Tolerance mode		0
Upper Limit		0
Lower Limit		0
Secondary sorting.		
Upper Limit		0
Lower Limit		0

## $\Delta$ F Limit/ $\Delta$ CI Limit Test Function

The  $\Delta$ F Limit/ $\Delta$ CI Limit Test function is available only when the Comparator function is used in Drive Level Dependency measurement mode.

Function	Valid Range	Preset Value
$\Delta$ F limit test ON/OFF.	on off	off
$\Delta$ F limit value		0
$\Delta$ CI limit test ON/OFF.	on off	off
$\Delta$ CI limit value		0

## System Menu Settings

Function	Valid Range	Preset Value
$\Delta$ Mode	on off	off
Measurement data display ON/OFF.	on off	on
Beep	on off	on
HP-IB address	0 to 31	Not effect
Analog Out	on off	off

## Other Functions

Function	Valid Range	Preset Value
Trigger mode.	Internal/Manual/External	Internal
Key lock.	on off	off
Memory buffer.	on off	off
Save/recall instrument settings.	0 to 9	0
Calibration.	open/short/load, thru	(clear)
Compensation.	open/short/load	(clear)



## Handler Interface

Handler interface outputs the signals for determining measurement completion, comparison result of the comparator function, and PASS/FAIL result of the contact check function. Also, you can input the external trigger signal and the key lock signal to HP E4915A/E4916A via the interface. These signals enable you to easily integrate your HP E4915A/E4916A into the handler.

### Specification

Output signal: Negative TRUE, open collector, opto-isolated

Decision output:

/DATA1 through /DATA11 B/N sort result and comparator result of the primary parameter

/INDEX: Analog measurement complete

/EOM: Full measurement complete

/ALARM: Notification that a momentary power failure or an error was detected.

Input Signal: Opto-isolated

Keylock: Front panel keyboard lockout

External Trigger: Pulse width  $\geq 1 \mu\text{s}$

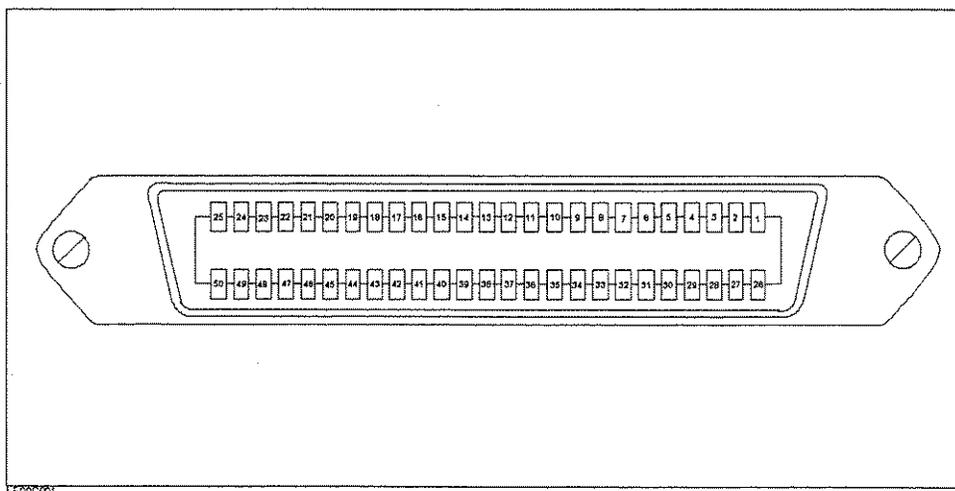


Figure C-1. Pin Assignment of Handler Interface Connector

**Table C-1.  
Pin Assignment of Handler Interface Connector**

Pin No.	Signal Name <sup>1</sup>	Description
1		Not used.
2		Not used.
3	/DATA0	Data output <sup>2</sup>
4	/DATA1	Data output <sup>2</sup>
5	/DATA2	Data output <sup>2</sup>
6	/DATA3	Data output <sup>2</sup>
7	/DATA4	Data output <sup>2</sup>
8	/DATA5	Data output <sup>2</sup>
9	/DATA6	Data output <sup>2</sup>
10	/DATA7	Data output <sup>2</sup>
11	/DATA8	Data output <sup>2</sup>
12	/DATA9	Data output <sup>2</sup>
13	/DATA10	Data output <sup>2</sup>
14	/DATA11	Data output <sup>2</sup>
15		Not used.
16		Not used.
17		Not used.
18	/KEY LOCK	Key Lock : When this line is asserted, all of the HP E4915A/E4916A's front panel key functions are disabled.
19	/EXT TRIG	External Trigger : HP E4915A/E4916A is triggered on the rising edge of a pulse applied to this pin, when the trigger mode is set to External.
20	EXT DCV2	External DC voltage 2 :
21	EXT DCV2	DC voltage supply pins for DC Isolated inputs (/EXT TRIG, /KEY LOCK) and DC Isolated outputs (/ALARM, /INDEX, /EOM). The maximum voltage is +15 V, minimum +5 V.
24	+5 V	Internal voltage supply +5 V $\pm$ 5% (max. output 0.1 A):
25	+5 V	Exceeding 0.1 A will cause the internal voltage output and the output signals to go to zero.
26	COM1	Common line for output signals /DATA0~/DATA11.
27	COM1	
28		Not used.
29		Not used.
30		Not used.
31		Not used.
32		Not used.
33		Not used.

<sup>1</sup> The / (slash) means that the signal is asserted when LOW.

<sup>2</sup> See to Table C-2

**Table C-1.**  
**Pin Assignment of Handler Interface Connector**  
 (continued)

Pin No.	Signal Name <sup>1</sup>	Description
37		Not used.
38		Not used.
39		Not used.
40		Not used.
41		Not used.
42	/ALARM	Alarm : This signal is asserted, when a power failure occurs.
43	/INDEX	Index : This signal is asserted, when an analog measurement is complete and the HP E4915A/E4916A is ready for the next DUT to be connected to the TEST terminals. The measurement data, however, is not valid until the line /EOM is asserted.
44	/EOM	End of Measurement : This signal is asserted, when the measurement data and comparison results are valid.
45	COM2	Common for /EOM, /INDEX, and /ALRM.
46	COM2	
49	GND	Ground tied to chassis.
50	GND	

C.Handler Interface

**Table C-2. Definition of Data Output for Each Measurement Mode.**

Pin No.	Signal Name	Xtal	EM	DLD	LCR
3	/DATA0	BIN1	IO data	BIN1	BIN1
4	/DATA1	BIN2	IO data	BIN2	BIN2
5	/DATA2	BIN3	IO data	BIN3	BIN3
6	/DATA3	BIN4	IO data	BIN4	BIN4
7	/DATA4	BIN5	IO data	BIN5	BIN5
8	/DATA5	BIN6	IO data	OUT OF BINS	BIN6
9	/DATA6	BIN7	IO data	AUX BIN	BIN7
10	/DATA7	BIN8	IO data	Pri Pass/Fail <sup>1</sup>	BIN8
11	/DATA8	BIN9	IO data	Sec Pass/Fail <sup>1</sup>	BIN9
12	/DATA9	OUT OF BINS	IO data	3rd(1) Pass/Fail <sup>1</sup>	BIN10
13	/DATA10	AUX BIN	IO data	3rd(2) Pass/Fail <sup>1</sup>	OUT OF BINS
14	/DATA11	Search Fail	IO data	Search Fail	AUX BIN

<sup>1</sup> Pass:0,Fail:1

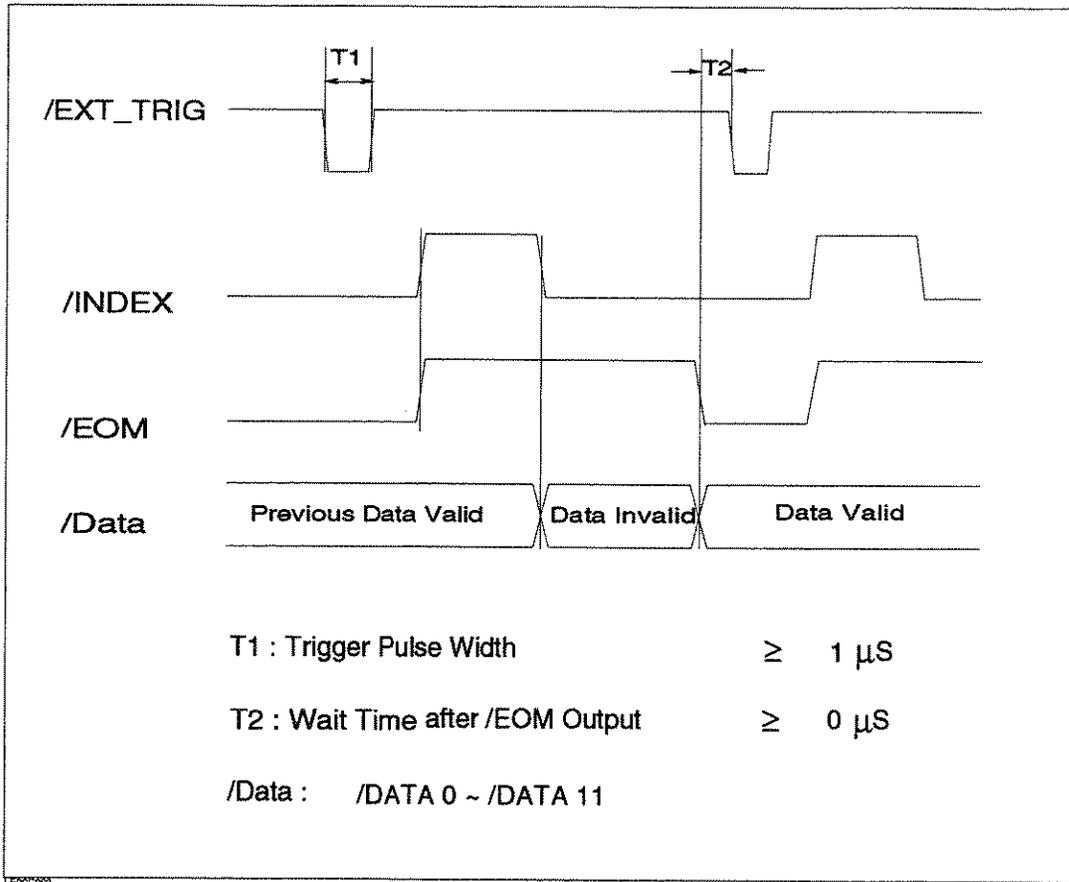


Figure C-2. Timing Diagram

## Electrical Characteristics of the Handler Interface

**Output Signals** Each DC output is isolated using open collector output opto-isolators.

The electrical circuits of the DC isolated outputs are divided into two groups to be able to separate power supplies (refer to Table C-3).

A simplified diagram of the output signals is shown in Figure C-3 for comparison signals and Figure C-4 for control signals.

**Table C-3. Handler Output Electrical Characteristics**

Output Signals	Voltage Output Rating		Maximum Current	Circuit Common
	Low	High		
Comparison Signals /DATA0, /DATA1, /DATA2 /DATA3, /DATA4, /DATA5 /DATA6, /DATA7, /DATA8 /DATA9, /DATA10 /DATA11	$\leq 0.5$ V	5 to 24 V	6 mA	COM1
Control Signals /ALARM /INDEX /EOM	$\leq 0.5$ V	5 to 24 V	5 mA	COM2

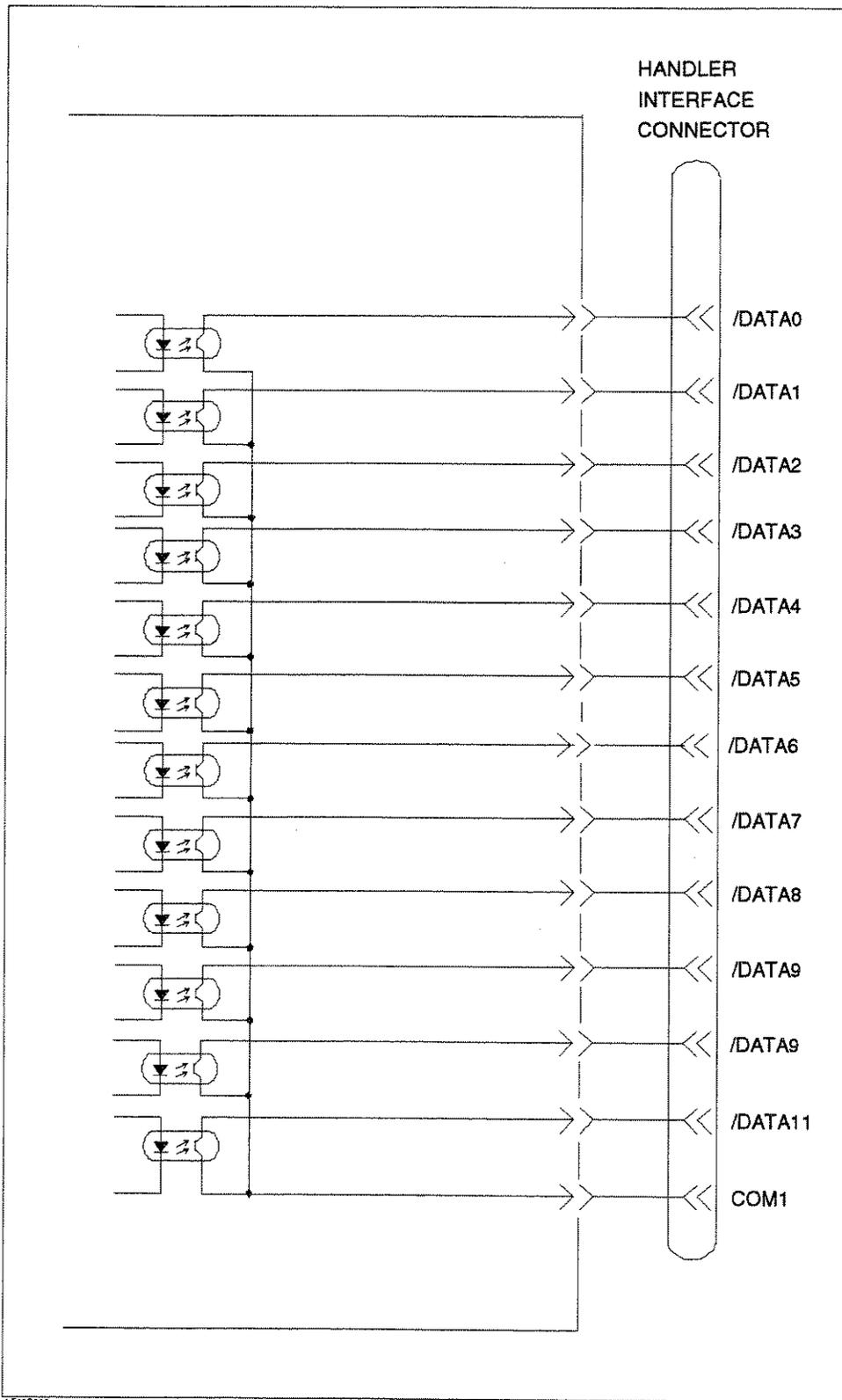
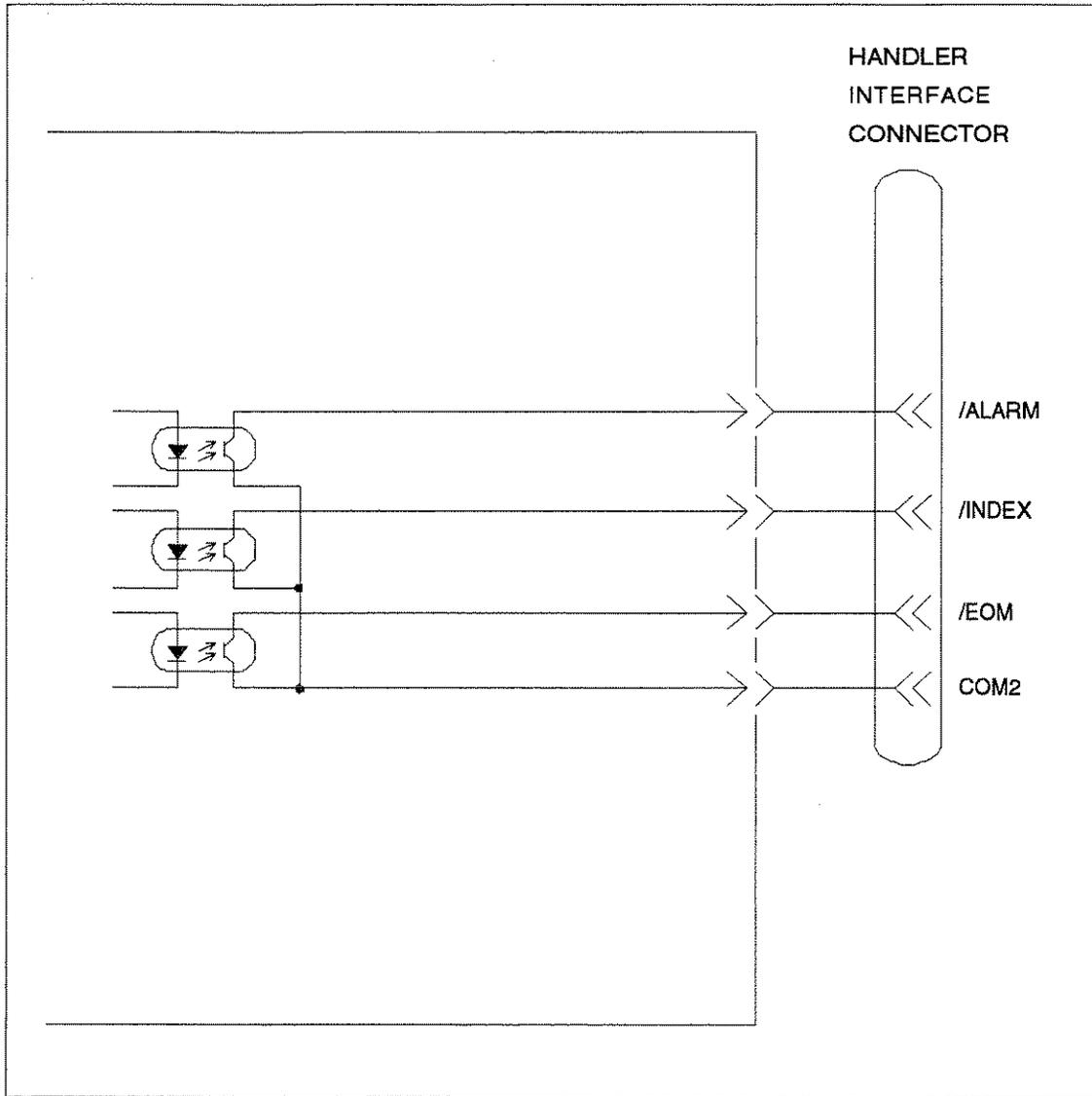


Figure C-3. Handler Interface Comparison Output Signals Diagram



LE00C004

Figure C-4. Handler Interface Control Output Signals Diagram

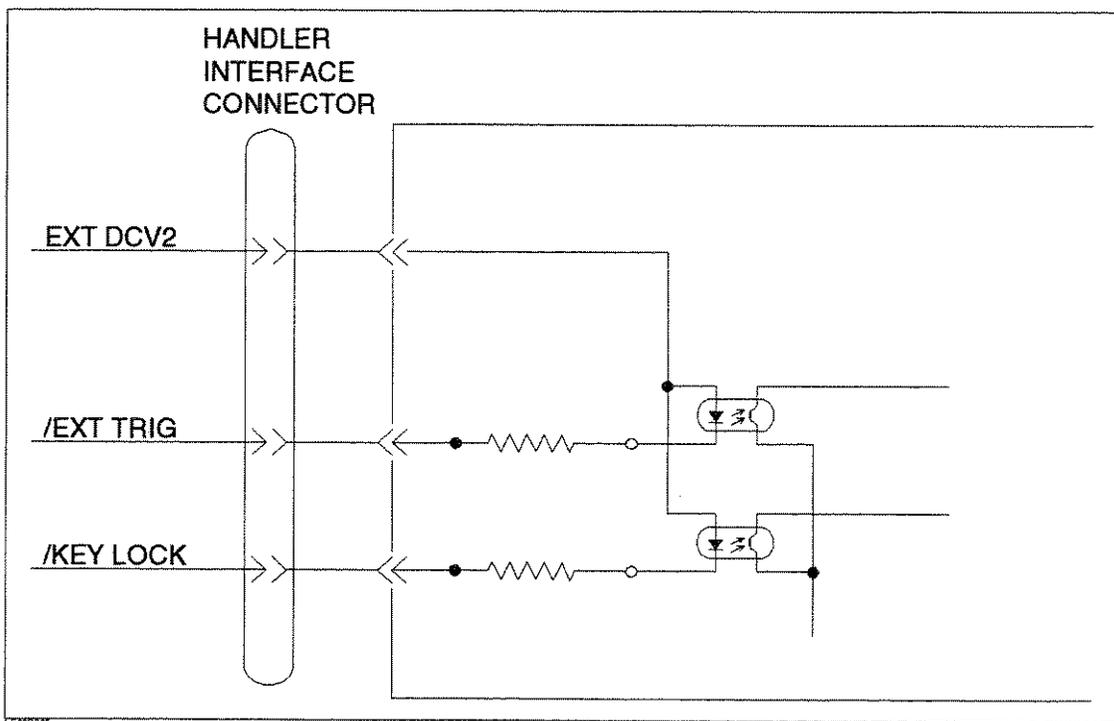
C: Handler Interface

**Input Signals** The DC isolated input signals are connected to the cathodes of the LEDs in the opto-isolators. The anodes of the LEDs are powered by an external voltage source (EXT DCV2).

The electrical characteristics of the input signals are listed in Table C-4. A diagram for the input signals is shown in Figure C-5.

**Table C-4. Handler Interface Input Electrical Characteristics**

Signal	Input Voltage		Input Current (Low)	Circuit Common
	Low	High		
/EXT TRIG	≤1 V	5~6 V	8.7 mA	COM2
/KEY LOCK	≤1 V	5~6 V	7.7 mA	COM2



**Figure C-5. Handler Interface Input Signal Diagram**

## Installing Option 020 HP VEE Program

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This appendix provides an instructions for installing the Option 020 HP VEE Program. You will need an IBM PC or compatible with Windows 3.0 or later and HP VEE.

1. Connect HP E4916A to PC via HP-IB before turning on the PC and HP E4916A.
2. Put the diskette of VEE program disk furnished with the Option 020 in the A: drive (3.5-inch drive) of your PC.
3. From the Windows File Manager, copy **SETUP.EXE** in drive A: to **VEE\_USER** directory in the hard disk drive which HP VEE is installed.
4. Run **SETUP.EXE** of **VEE\_USER**

From Windows Program Manager, pull down the File menu and click on Run. the Run dialog box is displayed. Type the following:

`C:\VEE_USER\SETUP.EXE`

Click on OK.

5. Then, the Setup program will automatically generate a file **E4916A.VEE** in **VEE\_USER** directory.
6. Run HP VEE. pull down the file menu of HP VEE, click on Open, and select **E4916A.VEE**. It will take a few minutes to load **E4916A.VEE** into **HPVEE**.
7. After loading the program, click on Run, VEE program will start.

### Note



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For more information on HP VEE, please refer the manual furnished with HP VEE.

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## Setting Up using the VEE Program

This section shows the functions VEE program can control, Using VEE program, you can setup the meter, measure DUT, and save measurement results.

**Table D-1. Controllable Functions by VEE Program**

Measurement Mode/Function	Setting		Display Measurement Results	
	HP E4916A	HP E4915A	HP E4916A	HP E4915A
Crystal Resonator Measurement	Available	Available	Available	Available
Equivalent Circuit Analysis	Available	Available	Available	Available
Aging Measurement	Available	Available	Available	Available
Spurious Measurement	Available	Available	Available	Available
DLD Measurement	Available	N.A.	Available	N.A.
EM Measurement	N.A.	N.A.	N.A.	N.A.
LCR Measurement	N.A.	N.A.	N.A.	N.A.
Filter Analysis	N.A.	N.A.	N.A.	N.A.
Gain-Phase Measurement	N.A.	N.A.	N.A.	N.A.
Comparator / BIN Sort	Available	Available	Available	Available
Δ Display	Available	Available	Available	Available

N.A.:Not Available

**Note**



HP E4915A/E4916A can not display data uploaded from the memory buffer.

**Note**



There are two setting mode, Instrument Setting and PC Control Setting.

Under "Instrument Setting" mode, you can set measurement conditions using VEE Program as same as setting from the front panel of HP E4915A/E4916A. Under "PC Control Setting", VEE Program controls HP E4915A/E4916A from PC.

There are some difference of measurement parameters for Aging measurement, Comparator / BIN sorting, and UDELTA; measurement between "Instrument Setting" and "PC Control Setting".

**Note**



You can modify measurement condition on VEE program after the trigger mode is changed to Manual, then the measurement is completed and results is displayed. (In Aging mode, ABORT can be acceptable after the first measurement is completed.)

Under measurement using VEE program, you can not abort measurements and change any measurement conditions, because any commands can not be accepted under measurement using VEE program except for RESET.

## Crystal Resonator Measurement Mode

### Setup Item

Basically, the setup times of VEE program for this mode is same as the items accessed from the front panel.

At PC Control Setting, the following items are added for the aging mode.

**Table D-2.  
Additional Setting Items of Aging Mode at PC  
Control Setting**

Setup Item	Setup Range	Default Value
Standard Point	1 to NOP	1
Number of Measurement Point	1 to 500	100

These items are used for the standard point of Comparator / BIN sort and Data upload of each measurement point using the memory buffer.

### Measurement Result

The measurement results of the following parameters are listed at a normal condition.

Fr-CI/Fa-Za/Fs-Zs/FL-CI

At Comparator is turned ON, the following parameters are added to the results.

- BIN Count Graph display
- Pass/Fail or BIN number

At Equivalent Circuit Analysis is turned ON, the following parameters are added to the results.

- 4/6 devices equivalent circuit parameters, Q, TS

At PC Control Setting and Aging mode is turned ON, the following parameters are added to the results. (Even the aging mode is ON, the following parameters is not displayed under Instrument Setting.)

- Measurement value at the standard point, Maximum/Minimum/Difference between MAX & MIN
- Measurement Values at each point (except for  $\Delta$ mode)
- Graphic display, X-axis, point, Y-axis, Measurement value (except for  $\Delta$ mode)

### Note



Even all measurement data may not be displayed on the screen, all data will be saved in a text or CSV format file.

## Spurious Measurement Mode

### Setup Item

All setup items of VEE program for this mode is same as the items accessed from the front panel, except for the following times

- You can select OFF/4-Device/6-Device as the equivalent circuit setup even the measurement mode is the spurious measurement mode, because VEE Program can execute the equivalent circuit analysis in this mode,
- Setting parameter of Number of Spurious displayed is deleted in VEE Program, because VEE program can display all supers found.

### Measurement Result

The following parameters are added to the basic parameter, Fr-CI/Fa-Za/Fs-Zs.

- Spurious Frequency
- Spurious Impedance Value (Unit is dB)

When 4-devises or 6-devises is selected as the equivalent circuit model, the following parameters are added to the results.

- 4/6 devises equivalent circuit parameter, Q, TS

### Note



Even all measurement data may not be displayed on the screen, all data will be saved in a text or CSV format file.

## DLD Measurement Mode (HP E4916A only)

### Setup Item

All setup times of VEE program for this mode is same as the items accessed from the front panel, except for the following times

Using VEE Program, you setup the following items using a list, then choose drive level measurement ON/OFF, change/add/delete drive levels.

**Table D-3. Drive Level Setup using VEE Program**

Setup Item	Setup Range	Default Value
Minimum DL Value	See the next table	1 $\mu$ W
Maximum DL Value	See the next table	10 $\mu$ W
Standard DL Value	Less than the Maximum DL and Greater than the Minimum value	5 $\mu$ W
DL Resolution	Less than Lower Limit	0.1nW
Number of Point	1 to 99	12
DL Sweep Type	UP/UP-DOWN/UP-MINIMUM	UP-DOWN
Waiting Time	0 to 1.6 sec	0

**Table D-4. Drive Level Limit**

PI-Fixture	IV probe / Reflection Bridge
0.1 n to 1 mW	0.5 n to 31 mW
2 $\mu$ to 6.4 mA	45 $\mu$ to 35 mA
50 u to 161 mV	100 $\mu$ to 880 mV
-60 to +18 dBm	-60 to +18 dBm

**Note**

When the standard DL value does not exist in the range defined by the minimum DL value and the maximum DL value, HP E4915A/E4916A will automatically add the standard DL and the NOP will increase one.

When some points have the standard DL value, HP E4915A/E4916A will use the first point which has DL value as the standard value.

**Measurement Result**

The following parameters are added to the results.

- Measurement value at the standard DL value, Maximum/Minimum/Difference between max.& min.
- Measurement value at each points (except for  $\Delta$ mode)
- Graphic display, X-axis, Points, Y-axis, Measurement value (Except for  $\Delta$ mode)

**Comparator / BIN Sort Function**

BIN sort function compares measurement results with some ranges (BINS) that defined by upper and lower limits and output BIN number which includes the measurement results.

The comparator function performs limit tests using an upper limit and a lower limit.

In DLD measurement and Aging measurement mode, the comparator / BIN sort function use the standard point as the test point, because these measurement modes measure some measurement points.

The following table shows the different of functions between Instrument Setting and PC Control Setting.

**Table D-5.**  
**Instrument Setting (Using comparator / BIN sort function of HP E4915A/E4916A)**

Measurement Mode	BIN sort	No. of BIN	Comparator
Crystal Measurement Mode	Fr/Fa/Fs/FL	1 to 9	Cl/Za/Zs
Spurious mode	N.A.	N.A.	N.A.
DLD mode	Fr/Fs	1 to 5	Cl/Zs, Fmax-Fmin, Zmax-Zmin

**Table D-6. PC Control Setting (internal function is not used)**

Measurement Mode	BIN sort	No. of BIN	comparator
Crystal Measurement Mode	Fr/Fa/Fs/FL	1 to 10	CI/Za/Zs, Equivalent Circuit Parameter (4/6) Fmax-Fmin,Zmax-Zmin(Aging)
Spurious mode	Fr/Fa/Fs	1 to 10	CI/Za/Zs,Equivalent Circuit Parameter(4/6) sF,sZ
DLD mode	Fr/Fs	1 to 10	CI/Zs,Fmax-Fmin,Zmax-Zmin Fmin,Fmax,Zmin,Zmax

**Note**  At PC Control Setting, HP E4915A/E4916A does not output any results of comparator and BIN sort through the handler interface, the beep, the LED, because the internal comparator/BIN Sorting function is not used.

**Note**  The limit parameters sF,sZ of Spurious mode are quit different from other limit values. These limit output FAIL when the spurious is included upper and lower limit.

### Measurement Results

The following parameters of each DUT are displayed.

- Each sort parameter value (ex. Fr-CI)
- Count number of each bin
- Pass / Fail
- Limit values of comparator / BIN sort
- Graphic display of DUT count number

Under Instrument Setting, HP E4915A/E4916A outputs test results to the handler interface, the beep, and the LED of HP E4915A/E4916A.

### Δdisplay function

This function displays a relative value of difference between a measurement value and a standard value defined. You can use the nominal value as the standard value or define any value you specify.

The following table shows the different of functions between Instrument Setting and PC Control Setting.

**Table D-7. Instrumnet Setting**

Measurement Mode	Parameter
Crystal Measurement Mode	Fr-CI/Fa-Za/Fs-Zs/FL-CI
Spurious mode	N.A.
DLD mode	Fr-CI/Fs-Zs

Table D-8. PC Control Setting

Measurement Mode	Parameter
Crystal Measurement Mode	Fr-CI/Fa-Za/Fs-Zs/FL-CI,Equivalent Circuit Parameter Fmax-Fmin,Zmax-Zmin,Fmax,Fmin,Zmax,Zmin(Aging)
Spurious mode	Fr-CI/Fa-Za/Fs-Zs,Equivalent Circuit Parameter ,sF,sZ
DLD mode	Fr-CI/Fs-Zs,Fmax-Fmin,Zmax-Zmin,Fmin,Fmax,Zmin,Zmax

**Note**

You can not use the nominal value as Equivalent Circuit Parameter and the standard value of sZ.

A value of sZ is always display as A absolute value is always displayed as sZ, because unit of sZ is dB and a relative value of sZ has no meaning.

Values of Fmax-Fmin,Zmax-Zmin is not different values from a standard value, because these values are already difference values.

**Other function**

The following section shows specific functions of the VEE program.

- trigger mode :trigger mode setting of VEE program is not same as the setting of HP E4915A/E4916A
  - When trigger mode of the VEE program is Internal or Manual, the trigger mode of HP E4915A/E4916A is BUS trigger.
  - When trigger mode of the VEE program is External, the trigger mode of HP E4915A/E4916A is External trigger.
  - Disconnect changes HP E4915A/E4916A HP-IB mode into Local and the trigger mode of HP E4915A/E4916A becomes the same mode of VEE program.
- CL adjust mode : Available for the crystal Measurement Mode only
- Save / Recall : You can save / recall the setting of HP E4915A/E4916A into a file as a text file.
- Calibration standard : You can specify the calibration standard value of calibration, compensation, and each measurement circuit
- Memory Buffer : Available under Instrument Setting only
  - Buffer Size : Available under Instrument Setting only
  - Buffer Clear: Available under Instrument Setting only
- Measurement Circuit selection :  $\pi$  only (HP E4915A only)
- Compensation function : Not available for HP E4915A
- List data display/save : Save data into a file of a text or CSV format.

## Using VEE Program

### HP-IB Setup Screen

Figure D-1. HP-IB Setup Screen

You can use a keyboard to input data at the input entry box.

Instrument Name : You can input appropriate name in this box.

**Ctrl/Setting** is used to select setting and control of HP E4915A/E4916A

**Data Upload** is used to read internal data of HP E4915A/E4916A and display it.

### Entry Screen

Pressing button at the left side of the entry box shown in Figure D-1 leads the numeric entry key as shown in the following figure.

Figure D-2. Numeric Entry Key

### Measurement Parameter Setting

Pressing **Ctrl/Setting** of Figure D-1 leads the Setup screen as shown in the following figure.

Figure D-3. Setup Screen

Pressing **PC Control Setting** make the softkey label change to **Instrument Setting** and the internal setting of HP E4915A/E4916A is changed.

Under PC Control Setting, the internal setting of HP E4915A/E4916A does not change.

Pressing **About ...** displays the serial number, firmware version, and VEE program version.

## Measurement Parameter Setting

Pressing the button at the right side of the Measurement Parameter leads the measurement parameter setup screen shown in the following figure.

Figure D-4. Measurement Parameter Setup Screen

**Search Range Setting**

Pressing the button at the right side of Search Range [ppm] shown in Figure D-3 leads the entry screen. This screen is used to select the unit of search range from ppm and Hz.

The screenshot shows a screen titled "Enter Search Range". At the top right, the unit "ppm" is displayed. Below this is a numeric keypad with digits 0-9. At the bottom, there are three buttons: "OK", "Cancel", and "Clear".

Enter Search Range			
			ppm
7	8	9	ppm
4	5	6	Hz
1	2	3	
0			
OK	Cancel	Clear	

**Figure D-5. Search Range Setup Screen**

Delta Mode Setting

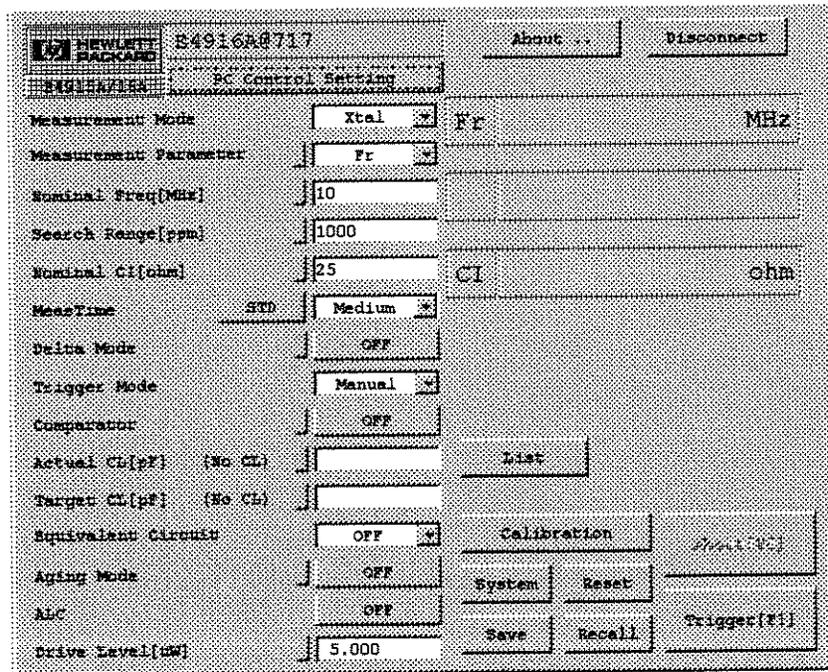


Figure D-6. Setup Screen

Pressing the button at the right side of Delta Mode shown in Figure D-6 leads the delta mode setup screen as shown in the following figure.

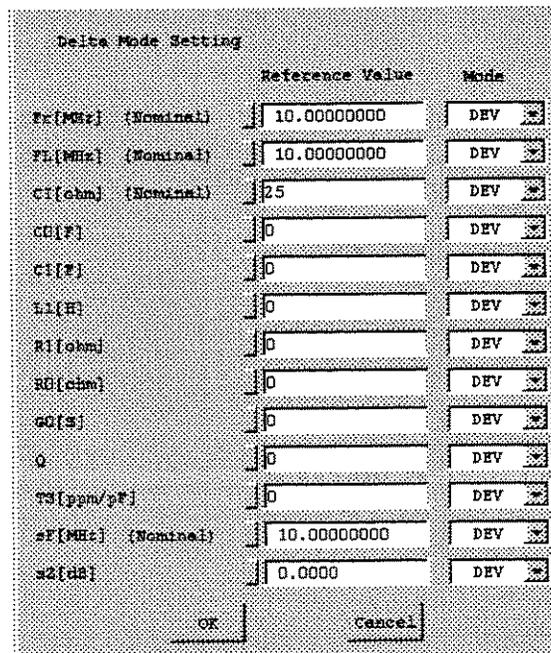


Figure D-7. Delta Mode Setup Screen

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Delta mode Setup Screen is used to set the standard value and mode.  
Press **Nominal** to use the nominal value as the standard value.

## Comparator Setting

**HEWLETT PACKARD** 84916A8717 About ... Disconnect  
**HP VEE/VEE** PC Control Setting

Measurement Mode	<input type="text" value="Xtal"/>	<input type="text" value="Fr"/>	<input type="text" value="MHz"/>
Measurement Parameter	<input type="text" value="Fr"/>		
Nominal Freq[MHz]	<input type="text" value="10"/>		
Search Range[ppm]	<input type="text" value="1000"/>		
Nominal Cl[ohm]	<input type="text" value="25"/>	<input type="text" value="Cl"/>	<input type="text" value="ohm"/>
MeasTime	STD	<input type="text" value="Medium"/>	
Delta Mode	<input type="text" value="OFF"/>		
Trigger Mode	<input type="text" value="Manual"/>		
Comparator	<input type="text" value="OFF"/>	<input type="text" value="List"/>	
Actual Cl[pF] (No Cl)	<input type="text" value=""/>		
Target Cl[pF] (No Cl)	<input type="text" value=""/>		
Equivalent Circuit	<input type="text" value="OFF"/>	Calibration	<input type="text" value="Print[AC]"/>
Aging Mode	<input type="text" value="OFF"/>	System	Reset
ALC	<input type="text" value="OFF"/>	Save	Recall
Drive Level[uW]	<input type="text" value="5.000"/>		Trigger[PI]

Figure D-8. Setup Screen

Pressing the button at the right side of Comparator shown in Figure D-8 leads the comparator setup screen as shown in Figure D-9.

Comparator Setting

	Mode	LED	Beep	AUX BIT
Fr (Primary)	Absolute-Tolerance	OFF	OFF	OFF
	Status	Low Limit	High Limit	
Cl (Secondly)	OFF	<input type="text" value="0"/>	<input type="text" value="0"/>	ohm
Q	OFF	<input type="text" value="0"/>	<input type="text" value="0"/>	
TR	OFF	<input type="text" value="0"/>	<input type="text" value="0"/>	ppm/pF
CO	OFF	<input type="text" value="0"/>	<input type="text" value="0"/>	f
Cl	OFF	<input type="text" value="0"/>	<input type="text" value="0"/>	f
L1	OFF	<input type="text" value="0"/>	<input type="text" value="0"/>	u
R1	OFF	<input type="text" value="0"/>	<input type="text" value="0"/>	ohm
GO	OFF	<input type="text" value="0"/>	<input type="text" value="0"/>	u
RG	OFF	<input type="text" value="0"/>	<input type="text" value="0"/>	ohm
	OFF	<input type="text" value="0"/>	<input type="text" value="0"/>	
	OFF	<input type="text" value="0"/>	<input type="text" value="0"/>	

OK CANCEL

Figure D-9. Comparator Setup Screen

Comparator Setup Screen is used to set the limit value, ON/OFF, LED, BEEP and AUX BIN conditions. Also this screen is used to select the mode for the primary parameter from Absolute Tolerance, Relative Tolerance, and Sequence.

Under Instrument Setting, you can use the primary parameter and secondary parameter as the comparator parameter for the crystal measurement mode. In DLD mode, you can also use  $\Delta F$ ,  $\Delta CI$ .

## BIN Setting

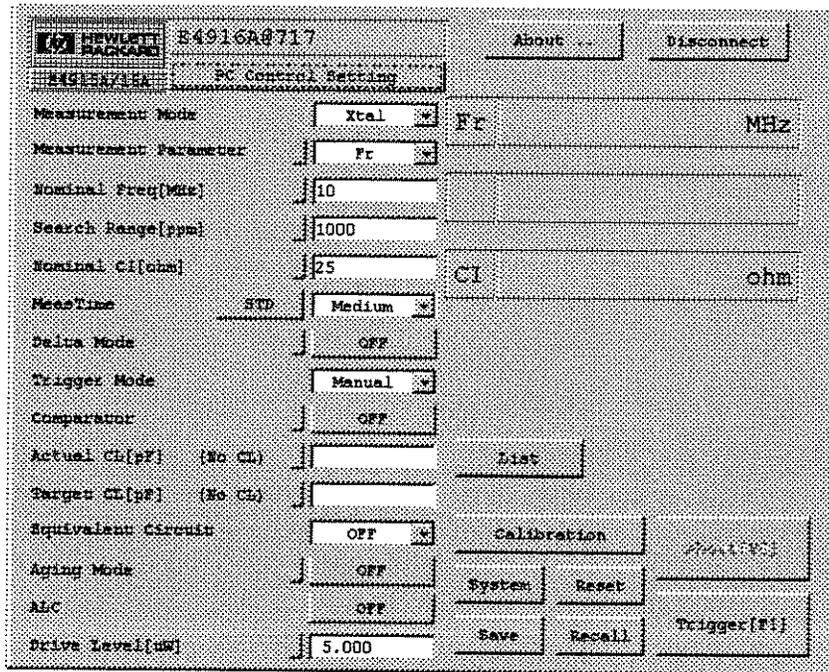


Figure D-10. Setup Screen

Pressing **BIN Setting** shown in Figure D-10 leads the BIN Setup Screen.

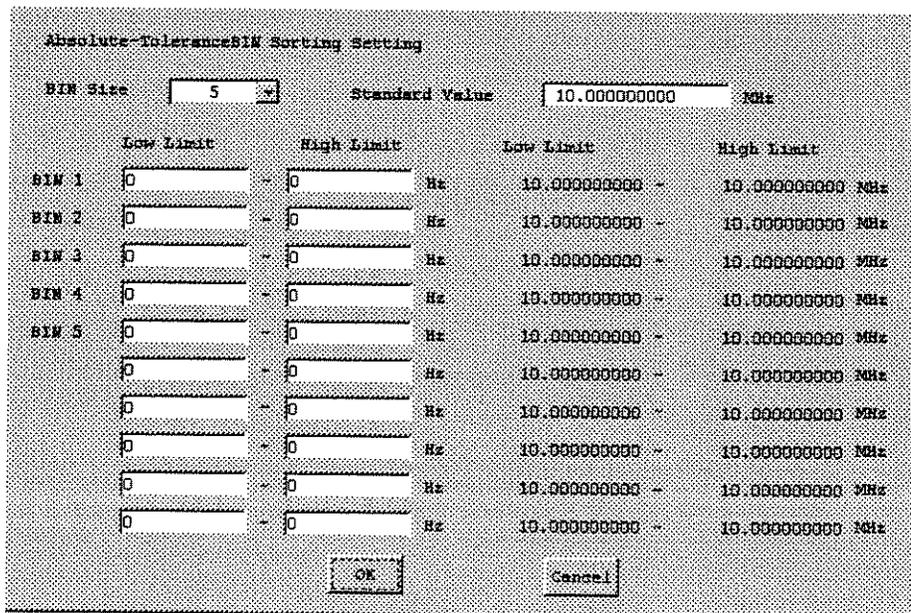


Figure D-11. BIN Setting

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Under Instrument Setting, you can set BIN number until 9 for the crystal measurement mode and until 5 for DLD mode. Under PC Control Setting, you can set BIN number until 10.

CL Value Setup Screen (Crystal Measurement Mode only)

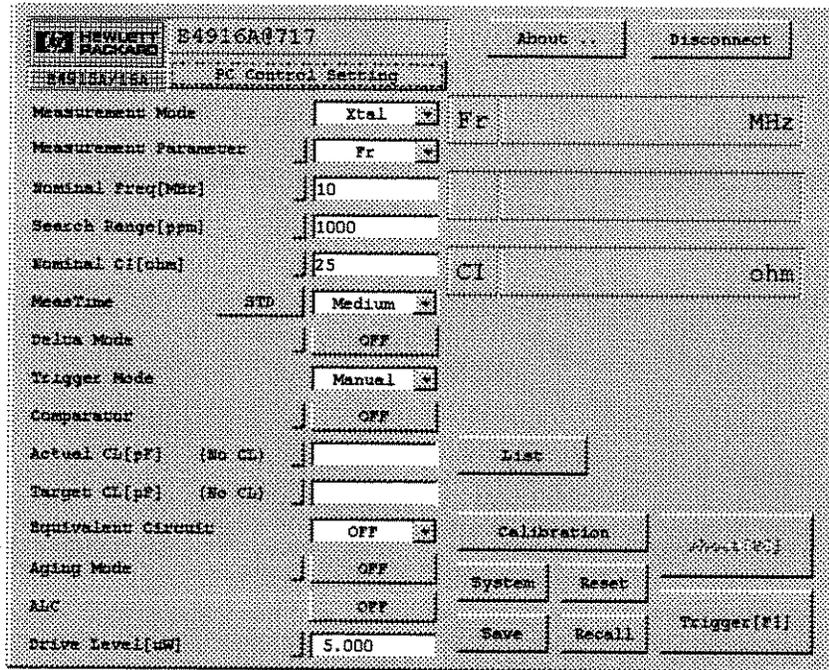


Figure D-12. Setup Screen

Pressing the button at the right side of Actual CL [pF] shown in Figure D-12 leads CL Value Setup Screen. Pressing CL Meas... leads the CL adjustment screen which display CL measurement value.

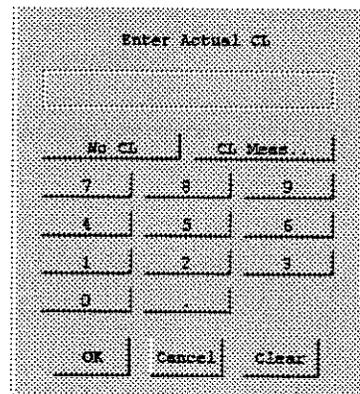


Figure D-13. CL Value Setup Screen

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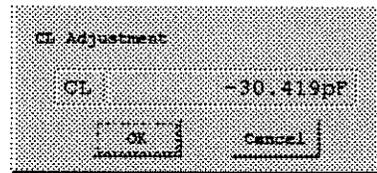


Figure D-14. CL Adjustment Screen

### Aging Measurement Setting (Crystal Measurement Mode only)

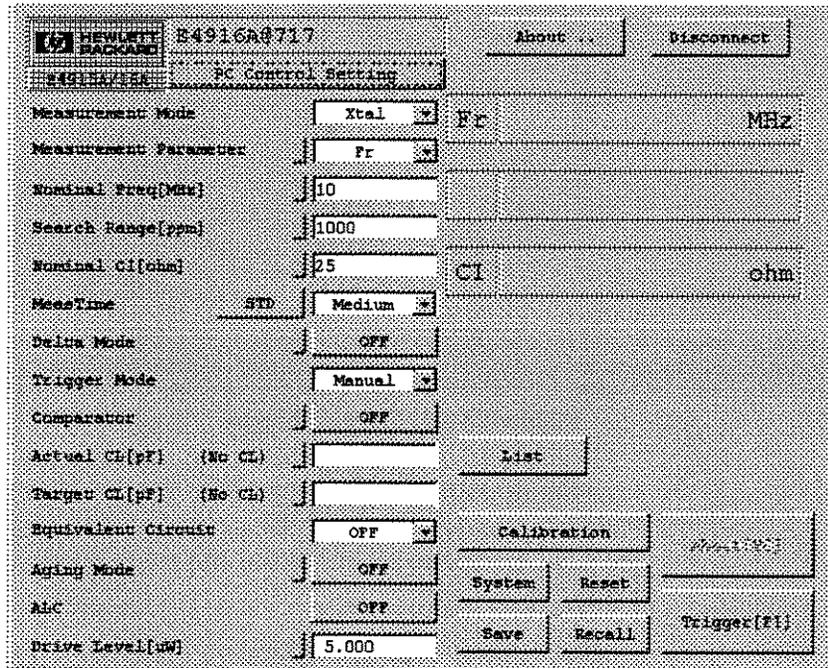


Figure D-15. Setup Screen

Pressing the button at the right side of Aging Mode shown in Figure D-15 leads the aging measurement setup screen.

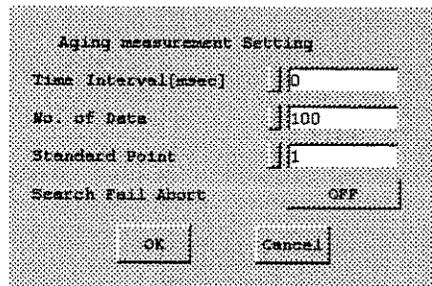


Figure D-16. Aging Measurement Setup Screen

The following items shows the difference of functions between Instrument Setting and PC Control Setting.

- Under PC Control Setting, you can use the data upload and comparator functions using by NO of Data, Standard Point.
- Under Instrument Setting, you can not use the data upload function.

## System Setting

B4916A8717		About ..	Disconnect
PC Control Setting			
Measurement Mode	Xcal	Fr	MHz
Measurement Parameter	Fr		
Nominal Freq[MHz]	10		
Search Range[ppm]	1000		
Nominal Cl[ohm]	25	Cl	ohm
Resol	Medium		
Delta Mode	OFF		
Trigger Mode	Manual		
Comparator	OFF		
Actual Cl[pF] (No Cl)		List	
Target Cl[pF] (No Cl)			
Equivalence Circuit	OFF	Calibration	Reset
Aging Mode	OFF	System	Reset
ALC	OFF	Save	Recall
Drive Level[mW]	5.000		Trigger[F1]

Figure D-17. Setup Screen

Pressing **SYSTEM** shown in Figure D-17 leads the setup screen as shown in the following figure.

Aging measurement Setting	
Time Interval[ms]	0
No. of Data	100
Standard Point	1
Search Fail Abort	OFF
OK	Cancel

Figure D-18. System Setup Screen

Under PC Control Setting, you can not use Memory Buffer because the aging measurement and DLD measurement use the buffer area.

## Analog Output Setting

HEWLETT PACKARD	E4916A0717	About ..	Disconnect
PC Control Setting			
Measurement Mode	Xtal	Fr	MHz
Measurement Parameter	Fr		
Nominal Freq[MHz]	10		
Search Range[ppm]	1000		
Nominal Ci[ohm]	25	CI	ohm
ResTime	STD	Medium	
Delta Mode	OFF		
Trigger Mode	Manual		
Comparator	OFF		
Actual Ci[pF] (No CL)		List	
Target Ci[pF] (No CL)			
Equivalent Circuit	OFF	Calibration	
Aging Mode	OFF	System	Reset
AIC	OFF	Save	Recall
Drive Level[dB]	5.000		Trigger[SI]

Figure D-19. Setup Screen

Pressing the button at the right side of Analog Out shown in Figure D-19 leads the analog output setup screen.

Analog Out Setting	
Reference Freq[MHz]	10.0000000
df/dV[Hz/V]	1
OK	Cancel

Figure D-20. Analog Output Setting

You can select the unit for analog output parameter (df/dV) from ppm/V and Hz/V using by the entry key.

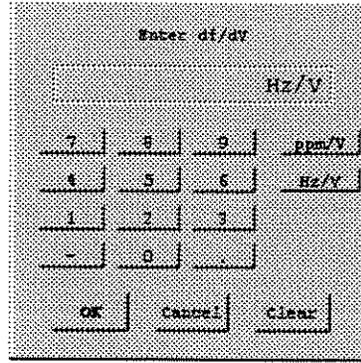


Figure D-21. Analog Output Setting Entry Key

## Aging Measurement

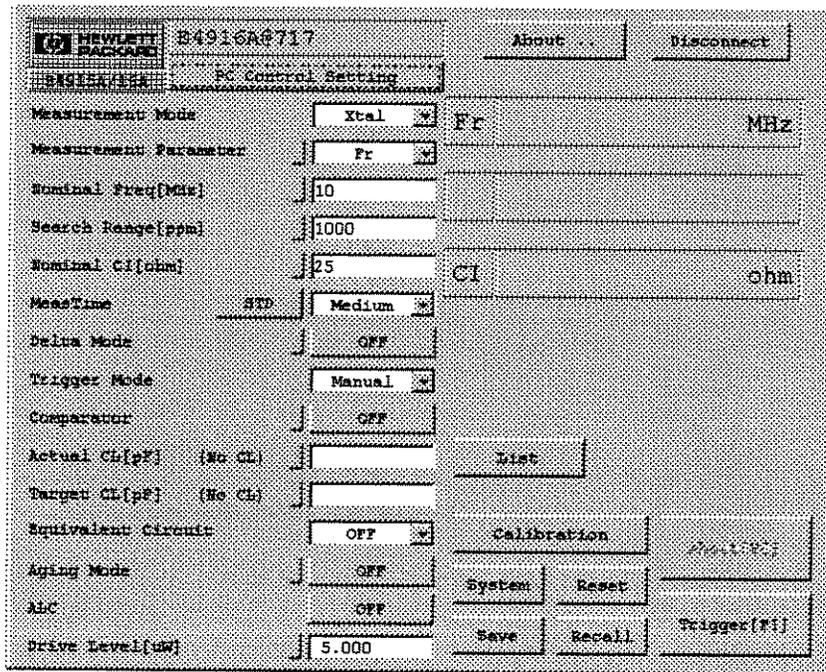


Figure D-22. Setup Screen

In Crystal Measurement Mode, when Aging Mode is turn ON, measurement results is displayed as show in the following figure.

The screenshot shows the 'Aging Measurement' display. It provides summary statistics and a detailed table of measurement points.

	Fr	CI
StdDev	9.938648293 MHz	10.876 ohm
Min	9.938647998 MHz	10.841 ohm
Max	9.938648405 MHz	10.946 ohm
Max-Min	407.298 mHz	105.665 mOhm

Point	Fr [MHz]	CI [ohm]
84	9.938648082	10.926
95	9.938648156	10.887
96	9.938648190	10.882
97	9.938648082	10.920
98	9.938648111	10.895
99	9.938648294	10.911
100	9.938648286	10.875

Buttons at the bottom include 'Print', 'Save', and file format options: '.txt' and '.csv'.

Figure D-23. Aging Measurement Display

Pressing **Save** allows you to save data into a file. You can select the file format from TEXT and CSV formats.

Pressing **Graph** leads graphic display as shown in the following figure.

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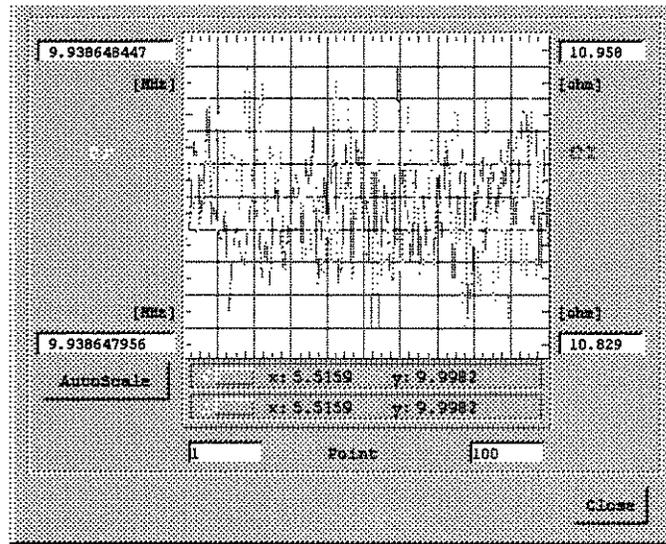


Figure D-24. Graphic Display of Aging Measurement

Equivalent Circuit Analysis for Aging Measurement

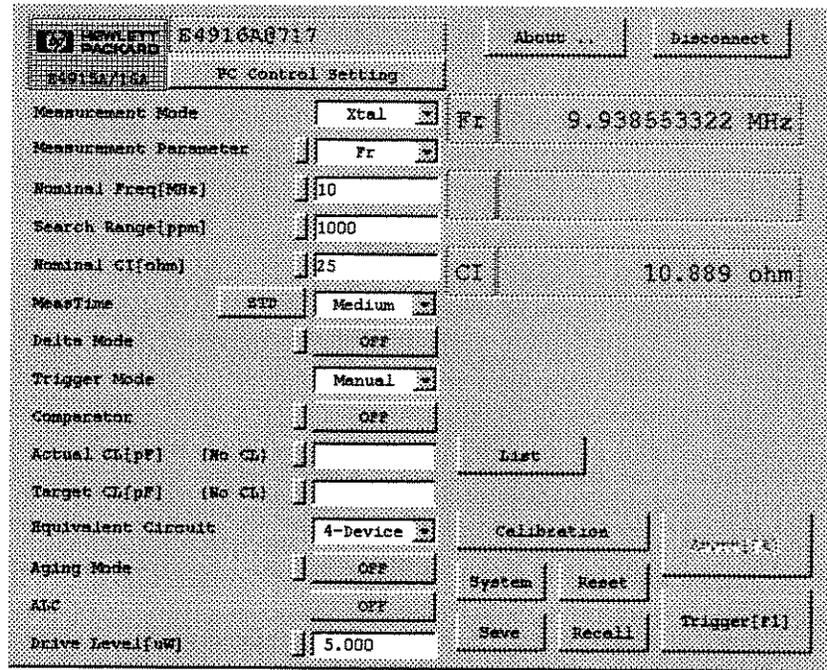


Figure D-25. Setup Screen

In the Crystal Measurement Mode, when you select 4-Device as the equivalent circuit and turns Aging Mode ON, results of equivalent circuit analysis is displayed as shown in the following figure.

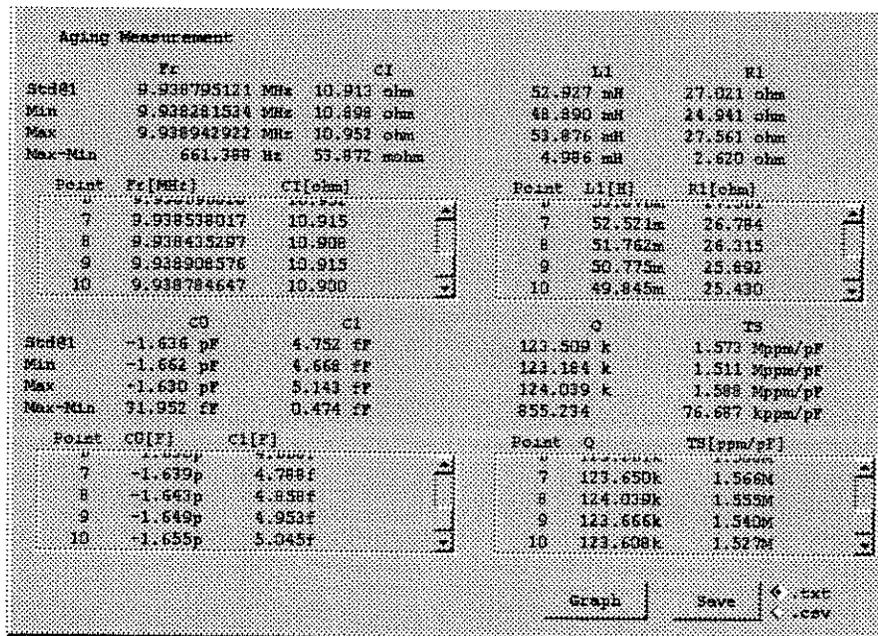
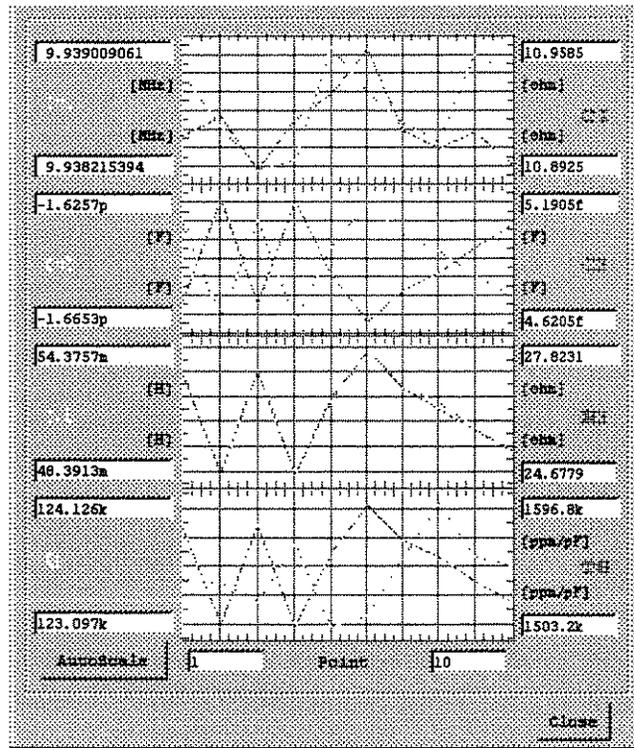


Figure D-26. Equivalent Circuit Analysis Result of Aging Measurement

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Pressing **Graph** leads the graphic display of the results of the equivalent circuit analysis for the aging measurement.



**Figure D-27.**  
**Graphic Display of Equivalent Circuit Analysis for Aging Measurement**

Devise Level Setting (HP E4916A Only)

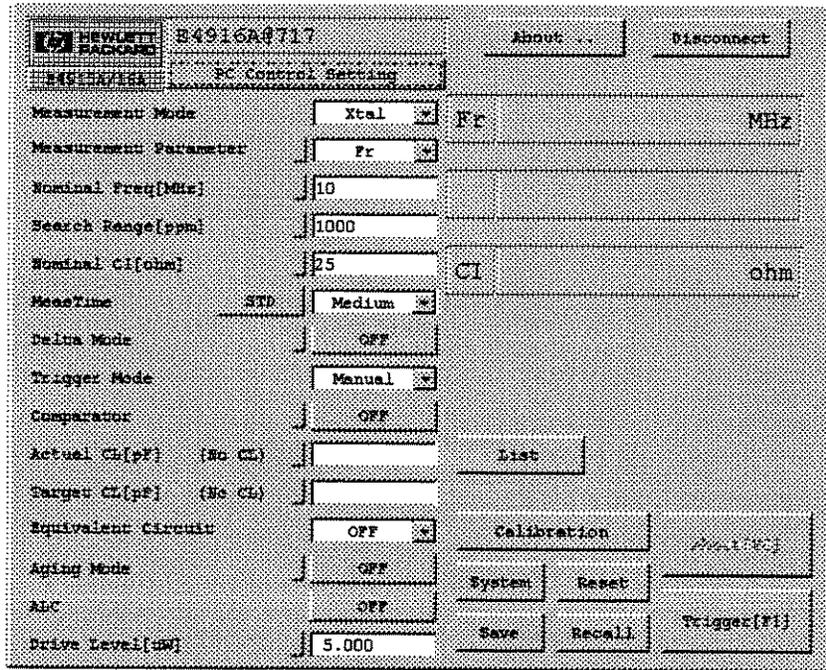


Figure D-28. Setup Screen

Pressing the button at the right side of Drive Level shown in Figure D-28 leads the entry key as shown in the following figure. You can also select the unit of the drive level.

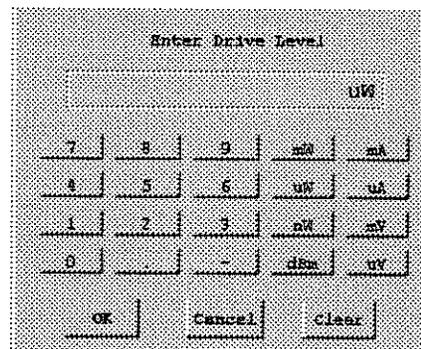


Figure D-29. Drive Level Setup Screen (HP E4916A only)

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## Calibration and Fixture Compensation, and Standard Setting

Figure D-30. Setup Screen

Pressing **Calibration** shown in Figure D-30 leads the calibration/fixture compensation setup screen.

Figure D-31. Calibration / Fixture Compensation Setup Screen

Pressing **Standard Value** in Figure D-31 leads the standard value entry screen.

Calibration				
Open :	CG[R]	0	CG[F]	100f
Short :	RC[ohm]	1u	LC[R]	3n
Load :	RL[ohm]	50	LD[R]	18.8n
Fixture Compensation				
Open :	CG[S]	0	CG[F]	0
Short :	RC[ohm]	0	LD[R]	0
Load :	RL[ohm]	50	LC[R]	0
OK		Cancel		

**Figure D-32. Standard Value Entry Screen**

It may take quite a few seconds to complete the setup of standard value, because the data is written into flash memory.

## 4 Device Equivalent Circuit Analysis for Crystal Measurement Mode

HP Hewlett Packard E4916A/16A PC Control Setting

Measurement Mode: Xtal Fr: 9.998184411 MHz

Measurement Parameter: Pr

Nominal Freq(MHz): 10

Search Range(ppm): 1000

Nominal CI(ohm): 25 CI: 10.898 ohm

MeasTime: STD Medium

Delta Mode: OFF

Trigger Mode: Manual

Comparator: OFF

Actual C0(pF) (No CI):

Target C0(pF) (No CI):

Equivalent Circuit: 4-Device

Aging Mode: OFF

ALC: OFF

Drive Level(uW): 5.000

Calibration: [ ]

System [ ] Reset [ ]

Save [ ] Recall [ ] Trigger[F1]

**Figure D-33.**  
Setup Screen for 4 Device Equivalent Circuit Analysis for Crystal Measurement Mode

When you select 4-Device as Equivalent Circuit as shown in the Figure D-33, Equivalent Circuit Parameter is displayed as shown in the following figure.

4-Device Equivalent Circuit	
C0	2.475 pF
C1	11.848 pF
L1	21.387 mH
R1	10.895 ohm
Q	123.315 k
TS	0.000 ppm/pF

**Figure D-34.** Equivalent Circuit Parameter

Pressing **List** shown in Figure D-33 leads the list display as shown in the following figure.

Point	Fc[MHz]	CI[ohm]	G	TS[ppm/pF]	CR[F]	CI[F]	LI[H]	RI[ohm]
3	9.998184277	10.887	123.177%	0.000	2.503p	11.877f	21.335a	10.872
4	9.998184237	10.901	123.828%	0.000	2.485p	11.817f	21.442a	10.878
5	9.998184268	10.887	123.937%	0.000	2.512p	11.857f	21.371a	10.816
6	9.998184252	10.902	123.076%	0.000	2.501p	11.881f	21.328a	10.886
7	9.998184227	10.895	123.366%	0.000	2.511p	11.853f	21.378a	10.892
8	9.998184324	10.903	123.292%	0.000	2.496p	11.863f	21.360a	10.891
9	9.998184289	10.898	123.172%	0.000	2.539p	11.860f	21.366a	10.897
10	9.998184243	10.906	123.286%	0.000	2.482p	11.856f	21.372a	10.887
11	9.998184355	10.890	123.380%	0.000	2.519p	11.843f	21.397a	10.877
12	9.998184360	10.886	123.323%	0.000	2.486p	11.850f	21.345a	10.883
13	9.998184369	10.899	123.206%	0.000	2.527p	11.879f	21.332a	10.877
14	9.998184450	10.893	123.236%	0.000	2.482p	11.858f	21.357a	10.892
15	9.998184411	10.905	123.283%	0.000	2.470p	11.861f	21.362a	10.886
16	9.998184411	10.898	123.313%	0.000	2.475p	11.848f	21.397a	10.895

Re-Test[F2]    Clear    Close

Figure D-35. List Display of 4 Device Equivalent Circuit Analysis Measurement

Under Instrument Setting, **Re-Test [F2]** and **Clear** shown in Figure D-35 can be used to control HP E4915A/E4916A.

### Note



Under Instrument Setting, setting parameters of comparator function and Delta mode function are same as the setting from front panel of HP E4915A/E4916A. In other word, the setting parameters under Instrument Setting has some limit from the parameters under PC Control Setting. Also under Instrument Setting, you can not use the comparator function in the Spurious mode.

Spurious mode

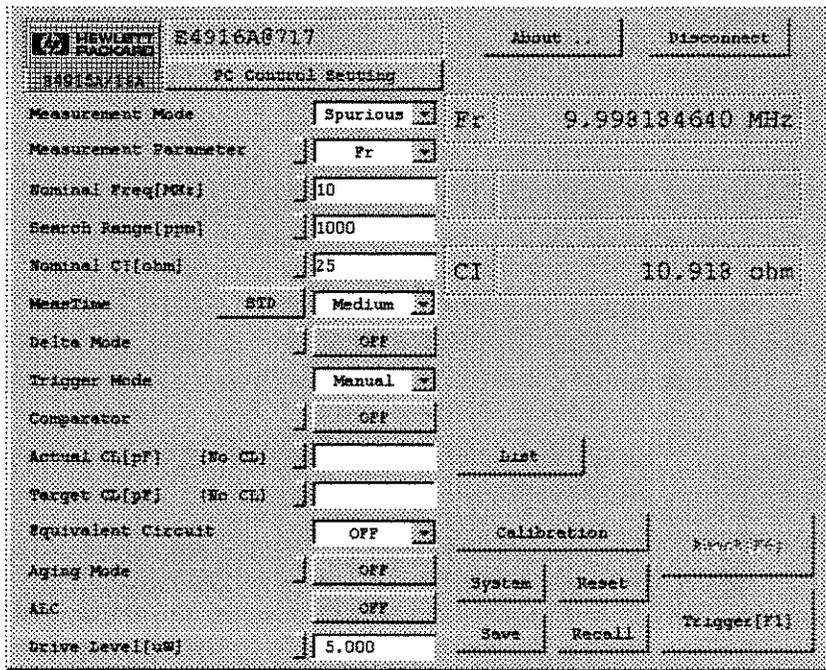


Figure D-36. Setup Screen

When you select Spurious as Measurement Mode, Spurious mode setting and results are displayed.

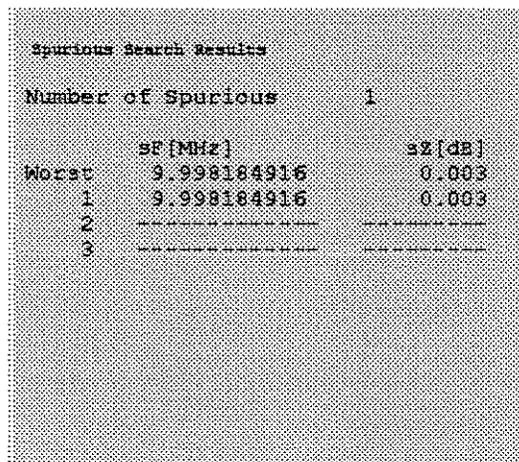


Figure D-37. Spurious Mode Result Display Screen

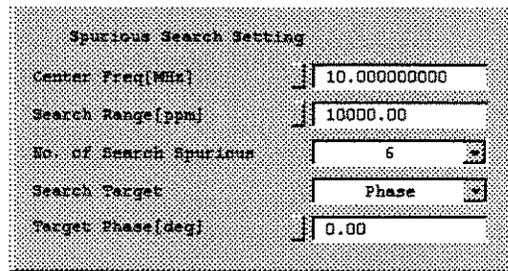


Figure D-38. Spurious mode Setup Screen

Pressing the button at the side of Search Range allows you input the search range(ppm/Hz)

### Comparator Function at Spurious Mode

Under PC Control Setting, you can use comparator function in the spurious mode.

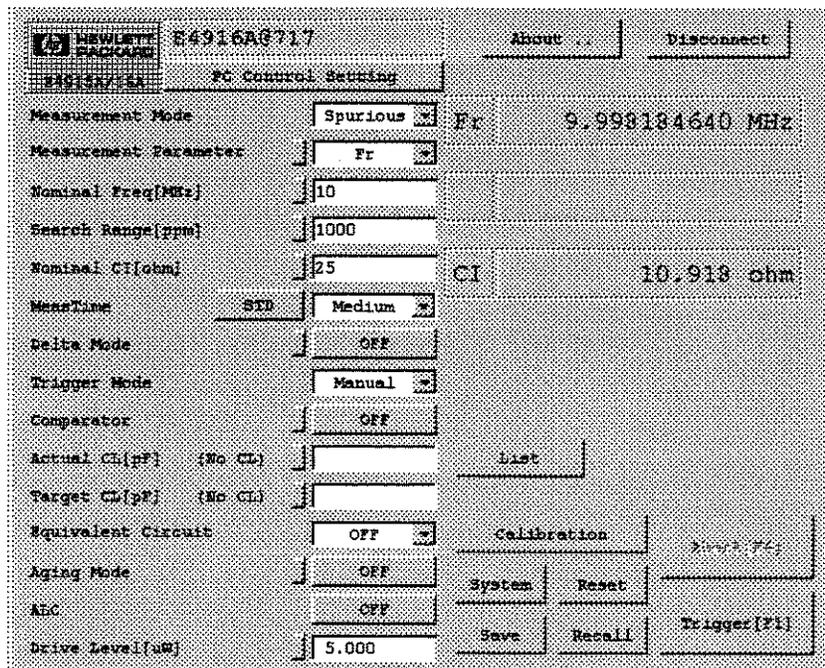


Figure D-39. Setup Screen

Even the measurement mode is the spurious mode, you can turn Comparator ON and can display comparator setup screen.

D. Installing Option 020 HP VEE Program

Comparator Setting

	Mode	BIN Setting	LED	Beep	AUX BIN
Fc(Primary):	Absolute-Tolerance		OFF	OFF	OFF
CI(Secondly):	OFF	0	-	0	ohm
Q	OFF	0	-	0	
TS	OFF	0	-	0	ppm/pF
CO	OFF	0	-	0	F
CI	OFF	0	-	0	F
LI	OFF	0	-	0	u
RI	OFF	0	-	0	ohm
GO	OFF	0	-	0	s
EO	OFF	0	-	0	ohm
sF (NOT)	OFF	0	-	0	MHz
sZ (NOT)	OFF	0	-	0	dB

OK Cancel

Figure D-40. Comparator Function in Spurious Mode

When the measurement value is in the range specified by the limit value sF (NOT), sZ (NOT), the comparator result is FAIL.

So, normal limit test return PASS when the following condition is covered:

$$\text{Low limit} \leq \text{Meas. Value} \leq \text{High Limit}$$

But sF and SZ limit test return FAIL in this condition.

## DLD Measurement Mode

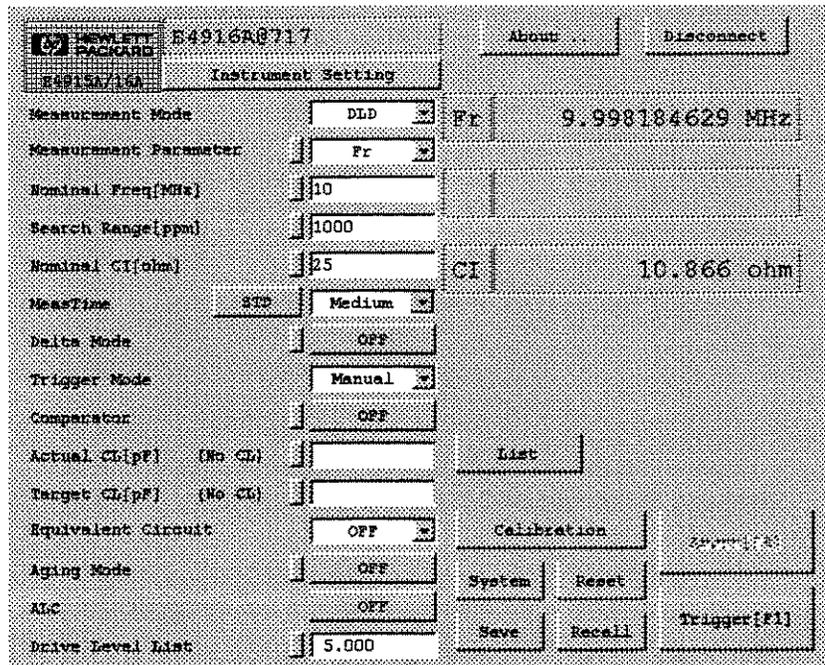


Figure D-41. DLD Measurement Mode Setup Screen

When you select DLD as Measurement Mode, DLD measurement results is displayed as shown in Figure D-41.

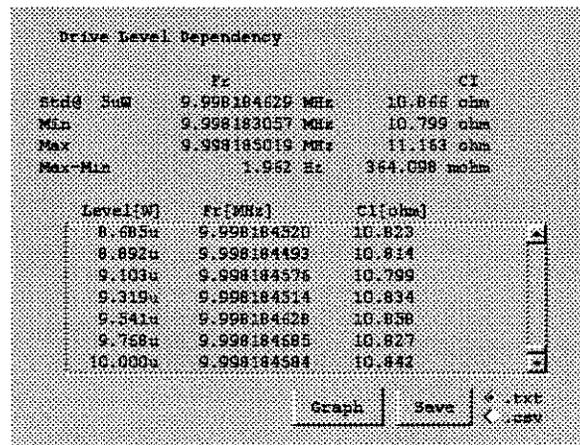


Figure D-42. DLD Measurement Result Screen

Pressing **Graph** displays a graphic display of DLD measurement results as shown in the following figure.

D Installing Option 020 HP VEE Program

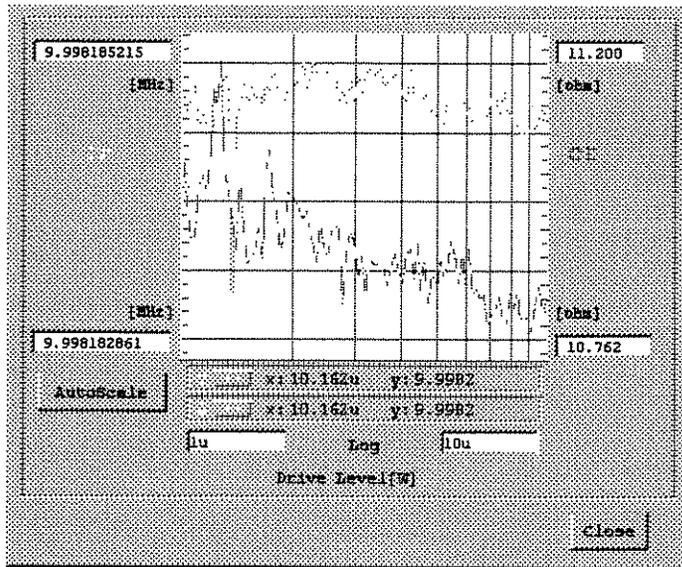


Figure D-43. Graphic Display for DLD Measurement

Pressing the button at the side of Drive Level List shown in Figure D-41 leads the drive level Setup Screen.

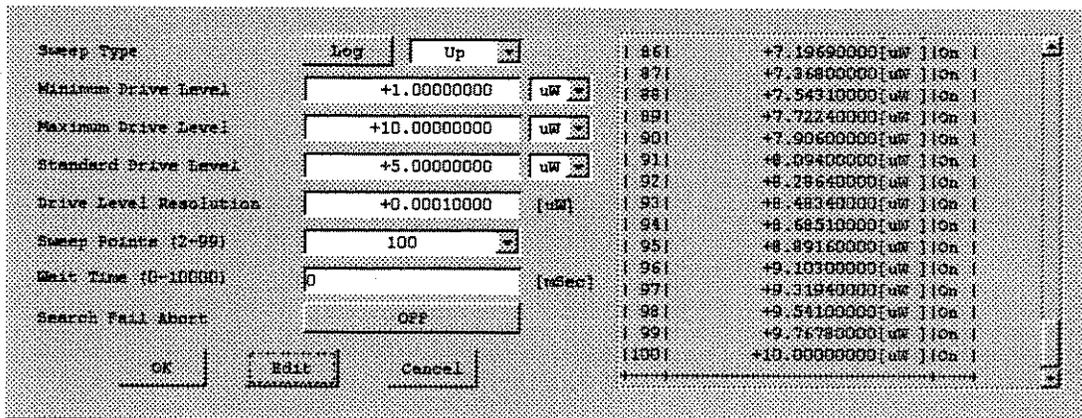


Figure D-44. Drive Level Setup Screen

Pressing **Edit** allow you to modify each drive level which is set automatically.

**Note**



For more information of VEE, please refer VEE manuals furnished with the HP VEE.

## Options and Accessories

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### Introduction

This chapter lists available options and accessories for the HP E4915A/E4916A. Although most options are available on condition that you order them when you purchase the instrument, certain options are available also after you have purchased the instrument.

---

### Options Available

#### Options Available for Both HP E4915A and HP E4916A

##### **Option 020 Crystal Resonator Measurement Software for HP VEE**

This software runs on the HP VEE and provides computer-aided solutions for measuring the characteristics of crystal resonators. It allows you to set measuring conditions, view measurement results, and output reports under the Windows environment.

##### **Option 1CN Front Handle Kit**

This option is a rack mount kit containing a pair of handles and the necessary hardware to mount the instrument.

##### **Option 1CM Rack mount Kit**

This option is a rack mount kit containing a pair of flanges and the necessary hardware to mount the instrument, with handles detached, in an equipment rack with 482.6 mm (19 inches) horizontal spacing.

#### Options Dedicated to HP E4916A

##### **Option 001 Add Impedance Probe Kit**

This option adds an impedance probe complete with a 1.5 m long cable. Adding this option along with Option 010 to your HP E4916A enables it to function as an LCR meter that works within the range between 1 MHz and 180 MHz. Option 001 is available at and after your purchase of the HP E4916A.

##### **Option 010 Add LCR Meter Function**

This option adds LCR meter capabilities. Adding this option along with Option 001 to your HP E4916A enables it to function as an LCR meter that works within the range between 1 MHz and 180 MHz. Option 010 is available at and after your purchase of the HP E4916A.

## Accessories Available

### HP 41902A Economy PI-Network Test Fixture

The HP 41902A is a PI-network test fixture that measures the characteristics of crystal resonators at high repeatability. The HP 41902A provides an economical choice, designed to accommodate an optional SMD contact block. This test fixture supports frequencies up to 180 MHz.

### HP 41900A PI-Network Test Fixture

The HP 41900A is a PI-network test fixture that measures the characteristics of crystal resonators at high repeatability while supporting frequencies up to 200 MHz.

### HP 41901A SMD PI-network Test Fixture

The HP 41901A is a PI-network test fixture that measures the characteristics of surface-mounted crystal resonators at high repeatability while supporting frequencies up to 300 MHz.

### HP 16092A Spring Clip Test Fixture

The HP 16092A provides a convenient capability for easily connecting and disconnecting samples. It has a usable operating frequency up to 500 MHz.

### HP 16093A/B Binding Post Test Fixtures

The HP 16093A is suited for the measurement of relatively large size, axial and radial lead components or devices that do not fit other fixtures. The HP 16093A is provided with two small binding post measurement terminals set at 7 mm intervals. The usable frequency operating of the HP 16093A is up to 250 MHz.

### HP 16099A Test Fixture Adapter

The HP 16099A is used to connect the test fixture with APC-7 connector to &#16a; with the impedance probe (Option 001). The usable frequency operating of the HP 16099A is up to 100 MHz.

### HP 16191A Side Electrode SMD Test Fixture

The HP 16191A is used to measure a side electrodes surface mount device (SMD) with high repeatability. The usable operating frequency is up to 2 GHz.

### **HP 16192A Parallel Electrode SMD Test Fixture**

The HP 16192A is used to measure a parallel electrodes surface mount device (SMD) with high repeatability. The usable operating frequency is up to 2 GHz.

### **HP 16193A Small Side Electrode SMD Test Fixture**

The HP 16193A is used to measure a small, side electrodes surface mount device (SMD) with high repeatability. The usable operating frequency is up to 2 GHz.

### **HP 16194A High Temperature Component Fixture**

The HP 16194A is used to measure a component over a wide range of temperatures. The operating temperature range is from  $-55^{\circ}\text{C}$  through  $200^{\circ}\text{C}$ . The usable operating frequency is up to 2 GHz.



## Messages

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### Messages

This appendix lists the messages that are displayed on the HP E4915A/E4916A's LCD screen or transmitted by the instrument over HP-IB in numerical order.

---

## Warning Messages

### W60 Talk Only

HP-IB address is invalid. Change the HP-IB address to the proper value.

### W62 Out of Limit

LOAD calibration data is over the limit. When this error occurs after OPEN and SHORT calibration, LOAD calibration is not completed correctly. In this case, perform LOAD calibration again. You can ignore this error message when it occurs before OPEN and SHORT calibration. In this case this error may occur even no problem.

### W63 Out of Srch Rng/High Q

The HP E4915A/E4916A failed to find resonance frequency. Change the nominal frequency and search range to the proper value, or make measurement speed slow.

### W64 Out of Srch Rng, Phase

The HP E4915A/E4916A failed to find resonance frequency, since the start phase is bigger than the target phase. Change the nominal frequency and search range to the proper value.

### W65 Freq Search Time Over

The HP E4915A/E4916A can't find resonance frequency in the measurement time. This problem is caused when resonance frequency is drafted.

### W67 Invalid Phase Value

Measured phase value is different from target phase value. This problem is caused when the DUT is miscontacted with the test fixture.

**W68 Invalid CI Value**

Abnormal CI value is detected. Change the nominal CI to the proper value, or confirm the DUT.

**W69 Out of Srch Rng**

The HP E4915A/E4916A failed to find resonance frequency. Change the nominal frequency and search range to the proper value.

**W70 Gmax Not Found**

The HP E4915A/E4916A failed to find series resonance frequency (Fs). Change the nominal frequency and search range to the proper value.

**W71 F1 or F2 Not Found**

The HP E4915A/E4916A failed to find f1 and/or f2. Change the nominal frequency and search range to the proper value.

---

**Instrument Errors****E11 ADC failure**

An A/D conversion error occurred. Contact your nearest Hewlett-Packard office.

**E12 RAM TEST FAILED**

A checksum error occurred in the RAM. The RAM must be replaced with new one. Contact your nearest Hewlett-Packard office.

**E13 RAM TEST FAILED**

A checksum error occurred in the RAM. The RAM must be replaced with new one. Contact your nearest Hewlett-Packard office.

**E14 FLASH MEM R/W FAILED**

A read/write error occurred in the flash memory. The flash memory must be replaced with new one. Contact your nearest Hewlett-Packard office.

**E15 User cal data lost**

Calibration/Compensation data or instrument setting data was lost from the Flash memory. The Flash memory must be replaced with new one. Contact your nearest Hewlett-Packard office.

**E16 Prev. setting lost**

Instrument settings were lost from the backup memory. Note that the HP E4915A/E4916A retains the instrument settings in the backup memory for a certain period after the power was turned OFF.

**E17 Save failed**

The HP E4915A/E4916A failed to write data into the flush memory. The flash memory must be replaced with new one. Contact your nearest Hewlett-Packard office.

**E18 Recall failed**

The flash memory contains no instrument settings stored, or does contain illegal data or value the HP E4915A/E4916A cannot recognize (possibly due to a checksum error in the stored data). The flash memory must be replaced with new one. Contact your nearest Hewlett-Packard office.

**E19 Printer no response**

This error occurs when:

- The printer has no power cord connected
- The printer is not correctly connected through a valid HP-IB cable to your HP E4915A/E4916A
- The printer is not set to "Listen Always" mode.

Correctly connect or set the printer.

**E21 Lockout by handler**

The front panel keys are currently locked via the Handler interface. The key lock function applied via the Handler interface can only be released via the Handler interface, not via the front panel keys or HP-IB commands.

**E22 Invalid range**

You attempted to enter a value beyond the parameter's valid range. To avoid this error, be sure to enter a value within the valid range.

**E26 Start point > nop**

The start point is over NOP for EM/DLD measurement mode.

**E28 Code Test Fail**

Program data in the flash memory is corrupt. Contact your nearest Hewlett-Packard office to repair the flash memory.

**E30 Invalid CI/Level value**

Nominal CI or level value is not in correct range. Change the nominal CI and level value to the proper value.

## HP-IB Errors

### -100 Command error

This is a generic syntax error that the HP E4915A/E4916A cannot detect more specific errors. This code indicates only that a command error, as defined in IEEE 488.2, 115.1.1.4, has occurred.

### -101 Invalid character

A syntax element contains a character which is invalid for that type; for example, a header containing an ampersand, SENSE&

### -102 Syntax error

An unrecognized command or data type was encountered; for example, a string was received when the HP E4915A/E4916A was not expecting to receive a string.

### -103 Invalid separator

The syntax analyzer was expecting a separator and encountered an illegal character; for example, the semicolon was omitted after a program message unit, \*RST:TRIG.

### -104 Data type error

The syntax analyzer recognized an unallowed data element; for example, numeric or string data was expected but block data was encountered.

### -105 GET not allowed

A group Execute Trigger (GET) was received within a program message (see IEEE488.2,7.7).

### -108 Parameter not allowed

More parameter were received than expected for the header; for example, the AVER command only accepts one parameter, so receiving AVER 2,4 is not allowed.

### -109 Missing parameter

Fewer parameters were received than required for the header; for example, the AVER commands requires one parameter, so receiving AVER is not allowed.

### -112 Program mnemonic too long

The header contains more than twelve characters (see IEEE 488.2,7.6.1.4.1).

### -113 Undefined header

The header is syntactically correct, but it is undefined for the HP E4915A/E4916A for example, \*XYZ is not defined for the HP E4915A/E4916A.

**-121 Invalid character in number**

An invalid character for the data type being parsed was encountered; for example, an alpha character in a decimal number or a "9" in octal data.

**-123 numeric overflow**

The magnitude of exponent was larger than 32000 (see IEEE488.2,7.7.2.4.1).

**-124 Too many digits**

The mantissa of a decimal numeric data element contains more than 255 digits excluding leading zeros (see IEEE 488.2,7.7.2.4.1)

**-128 Numeric data not allowed**

Legal numeric data element was received, but the HP E4915A/E4916A does not accept it in this position for a header.

**-131 Invalid suffix**

The suffix does not follow the syntax described in IEEE 788.2,7.7.3.2, or the suffix is inappropriate for the HP E4915A/E4916A.

**-138 Suffix not allowed**

A suffix was encountered after a numeric element which does not allow suffixes.

**-140 Character data error**

This error, as well as errors -141 through -148, are generated analyzing the syntax of a character data element. This particular error message is used if the HP E4915A/E4916A cannot detect a more specific error.

**-141 Invalid character data**

Either the character data element contains an invalid character or the particular element received is not valid for the header.

**-144 Character data too long**

The character data element contains more than twelve characters (see IEEE 488.2, 7.7.1.4).

**-148 Character data not allowed**

A legal character data element was encountered that's prohibited by the HP E4915A/E4916A.

**-150 String data error**

This error as well as errors -151 through -158, are generated when analyzing the syntax of a string data element. This particular error message is used if the HP E4915A/E4916A cannot detect a more specific error.

**-151 Invalid string data**

A string data element was expected, but was invalid for some reason (see IEEE 488.2, 7.7.5.2); for example, an END message was received before the terminal quote character.

**-158 String data not allowed**

A string data element was encountered but was not allowed by the HP E4915A/E4916A at this point in the syntax analysis process.

**-160 Block data error**

This error as well as errors -161 through -168, are generated when analyzing the syntax of a block data element. This particular error message is used if the HP E4915A/E4916A cannot detect a more specific error.

**-161 Invalid block data**

A block data element was expected, but was invalid for some reason (see IEEE 488.2, 7.7.6.2); for example, an END message was received before the length was satisfied.

**-168 Block data not allowed**

A legal block data element was encountered but was not allowed by the HP E4915A/E4916A at this point in the syntax analysis process.

**-170 Expression error**

This error as well as errors -171 through -178, are generated when analyzing the syntax of an expression data element. This particular error message is used if the HP E4915A/E4916A cannot detect a more specific error.

**-171 Invalid expression**

The expression data element was invalid (see IEEE 488.2, 7.7.7.2); for example, unmatched parentheses or an illegal character.

**-178 Expression data not allowed**

A legal expression data was encountered but was not allowed by the HP E4915A/E4916A at this point in the syntax analysis process.

**-200 Execution error**

This is the generic syntax error that the HP E4915A/E4916A cannot detect more specific errors. This code indicates only that an execution error as defined in IEEE 488.2, 11.5.1.1.5 has occurred.

**-211 Trigger ignored**

A GET, \*TRG, or triggering signal was received and recognized by the HP E4915A/E4916A but was ignored because of HP E4915A/E4916A timing considerations,\; for example, the HP E4915A/E4916A was not ready to respond.

**-213 Init ignored**

A request for a measurement initiation was ignored as another measurement was already in progress.

**221 Setting conflict**

A legal program data element was parsed but could not be executed due to the current device state (see IEEE 488.2, 6.4.5.3 and 11.5.1.1.5).

**-222 Data out of range**

A legal program data element was parsed but could not be executed because the interpreted value was outside the legal range as defined by the HP E4915A/E4916A (see IEEE 488.2, 11.5.1.1.5).

**-223 Too much data**

A legal program data element of block, expression, or string type was received that contained more data than the HP E4915A/E4916A could handle due to memory or related device-specific.

**-230 Data corrupt or stale**

Possibly invalid data; new reading started but not completed since access.

**-241 Hardware missing**

A legal program command or query could not be executed because of missing HP E4915A/E4916A hardware; for example, an option was not installed.

**310 System error**

Some error, termed "system error" by the HP E4915A/E4916A, has occurred.

**-311 Memory error**

An error was detected in the HP E4915A/E4916A's memory.

**-313 Calibration memory lost**

The nonvolatile calibration data has lost.

**-350 Queue overflow**

A specific code entered into the queue in lieu of the code that caused the error. This code indicates that there is no room in the queue and an error occurred but was not recorded.

**-400 Query error**

This is the generic query error that the HP E4915A/E4916A cannot detect more specific errors. This code indicates only that an error as defined in IEEE 488.2, 11.5.1.1.7 and 6.3 has occurred.

**-410 Query INTERRUPTED**

A condition causing an interrupted error occurred (see IEEE 488.1, 6.3.2.3); for example, a query followed by DAB or GET before a response was completely sent.

**-420 Query UNTERMINATED**

A condition causing an unterminated query error occurred (see IEEE 488.2, 6.3.2); for example, the HP E4915A/E4916A was addressed to talk and an incomplete program message was received.

**-430 Query DEADLOCKED**

A condition causing a deadlocked query error occurred (see IEEE 488.2, 6.3.1.7); for example, both input buffer and output buffer are full and the HP E4915A/E4916A cannot continue.

**-440 Query UNTERMINATED after indefinite response**

A query was received in the same program message after an query requesting an indefinite response was executed (see IEEE 488.2, 6.5.7.5.7).

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