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.

HEWLETT® PACKARD

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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.

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.

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

CLASS 1 LED PRODUCT

Ground The Instrument

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

DO NOT Operate In An Explosive Atmosphere

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

Keep Away From Live Circuits

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

DO NOT Service Or Adjust Alone

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

DO NOT Substitute Parts Or Modify Instrument

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

Dangerous Procedure Warnings

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

Warning

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

Exclusive Remedies

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

Assistance

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

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

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.

I On (Supply).

O 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.

Contents

Figures

Tables

1 Introduction

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 π 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 π circuit connected (CI = 25 Ω)	Approx. 5 μW	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	√	√

2

Front Panel, Rear Panel, and Display

Front Panel

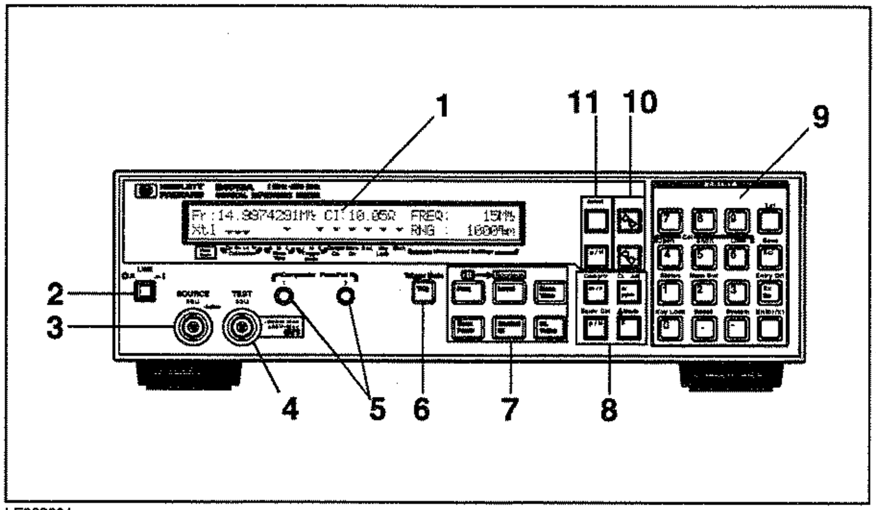

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Figure 2-1. Front Panel of the HP E4915A

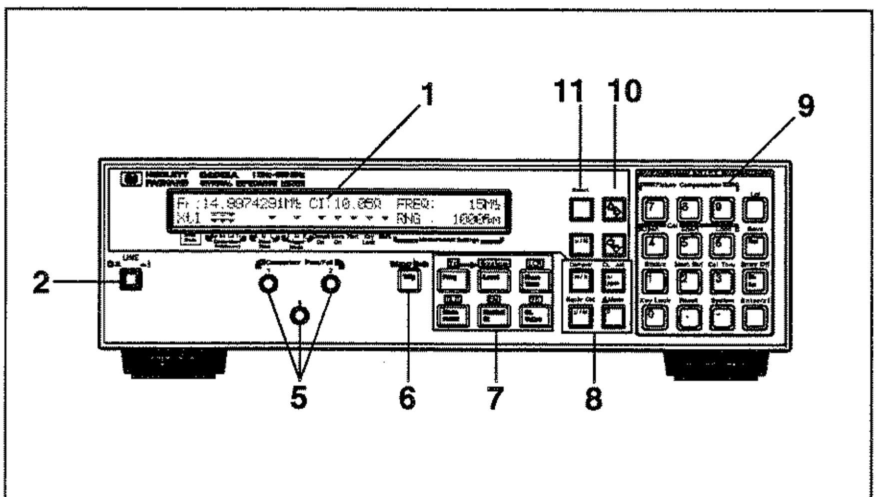

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Figure 2-2. Front Panel of the HP E4916A

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

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

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 (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. (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.

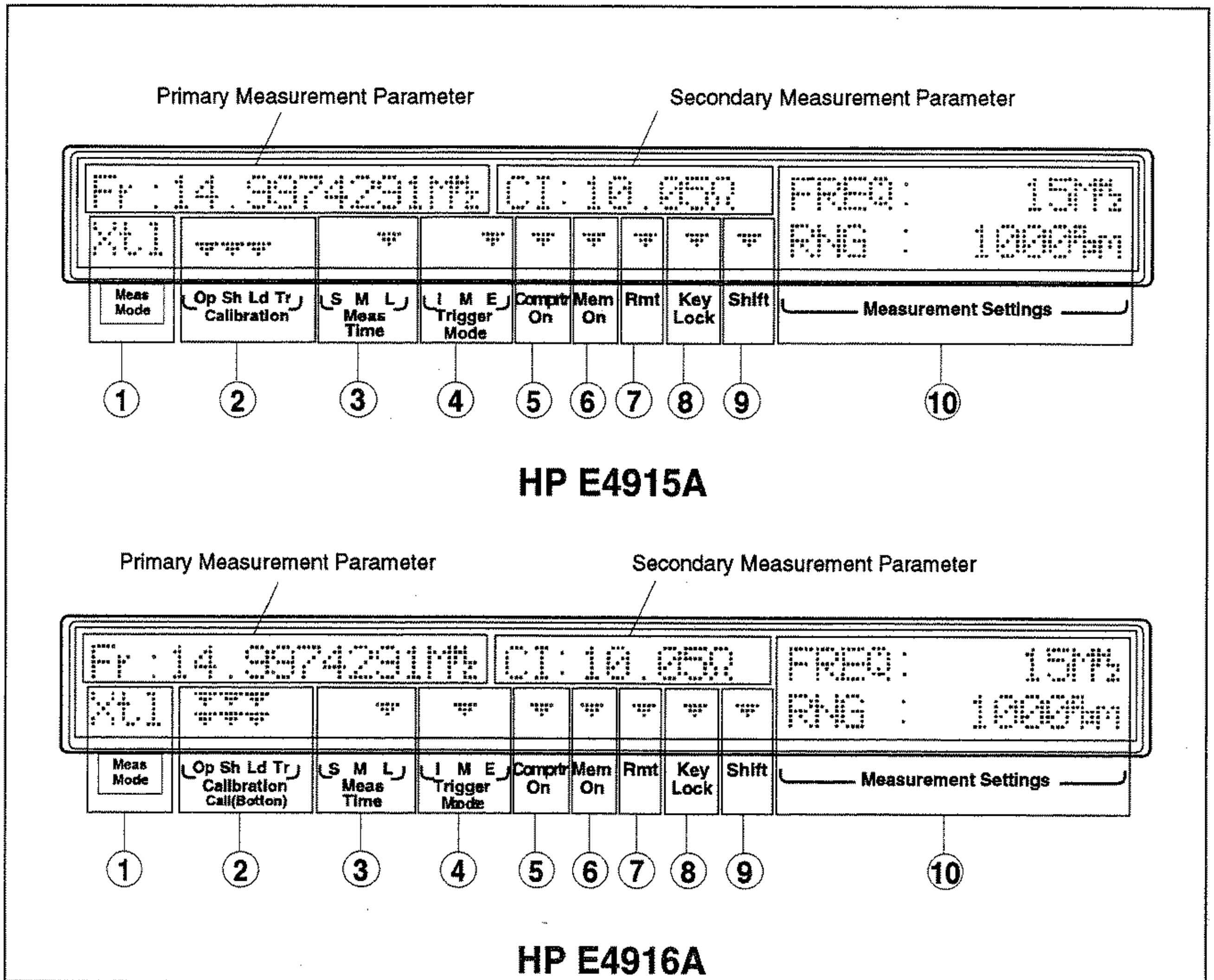

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Figure 2-3. LCD Screen

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 **Compen 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

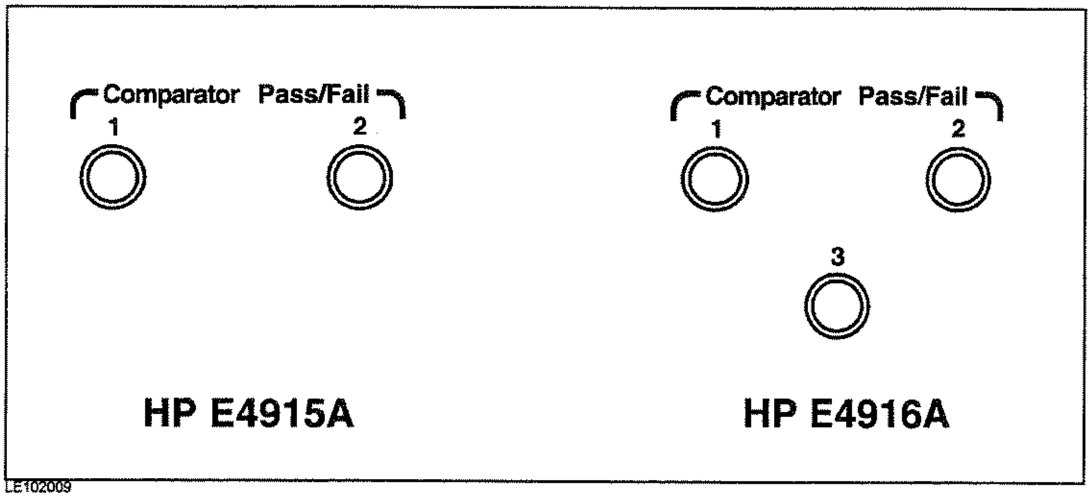

Figure 2-4. LEDs for HP E4915A/E4916A

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

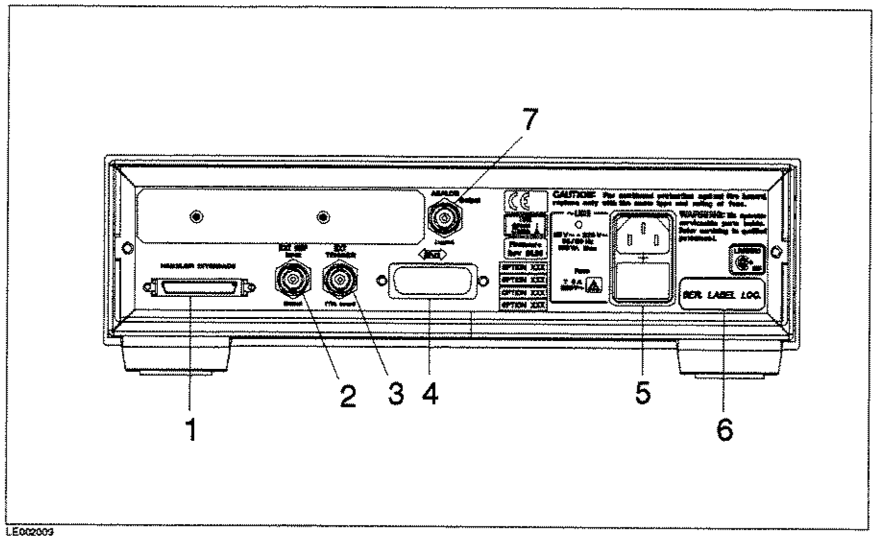

Figure 2-5. Rear Panel (HP E4915A)

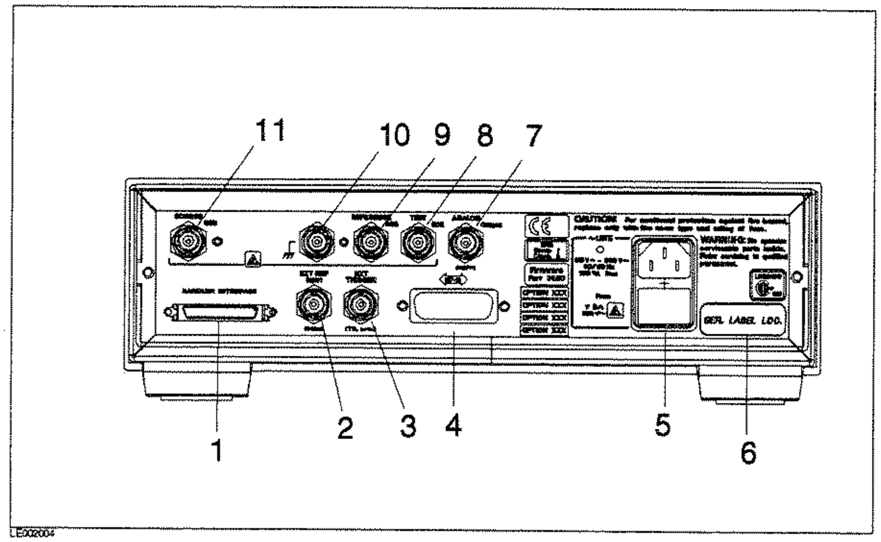

Figure 2-6. Rear Panel (HP E4916A)

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
π circuit	√			√
Z probe	√	(√)	√	√

Function Setting Keys

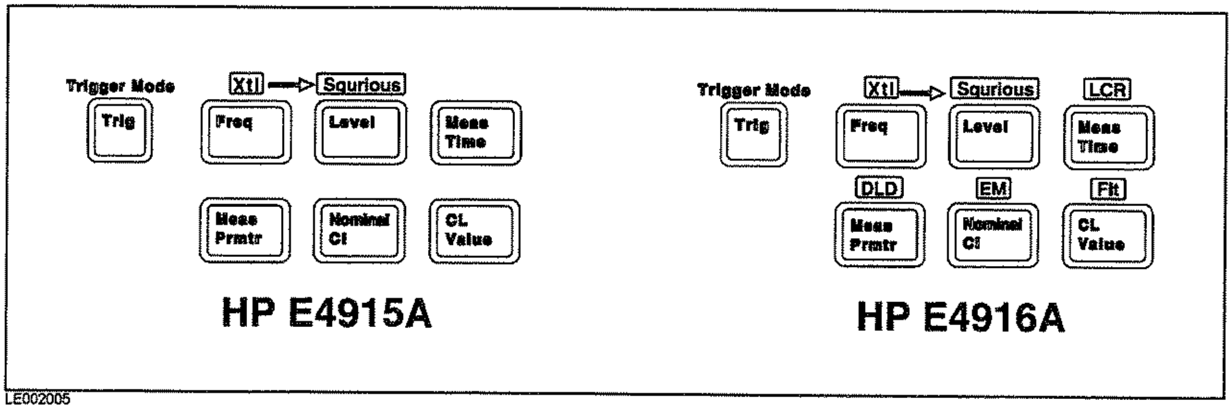

Figure 2-7. Function Setting Key Block

Table 2-2. Sammary: Function Setting Key Block

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

Unit Entry Keys

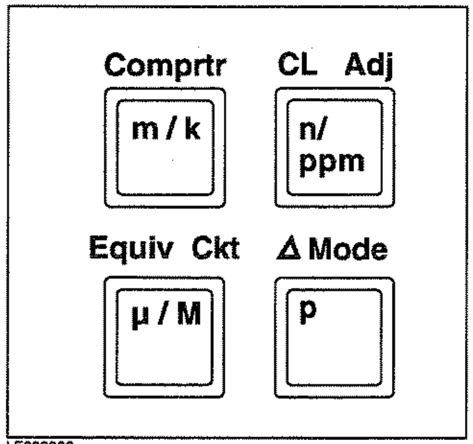

Figure 2-8. Unit Entry Key Blocks

Table 2-3. Summary: Unit Entry Key Blocks

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

Data Entry Keys

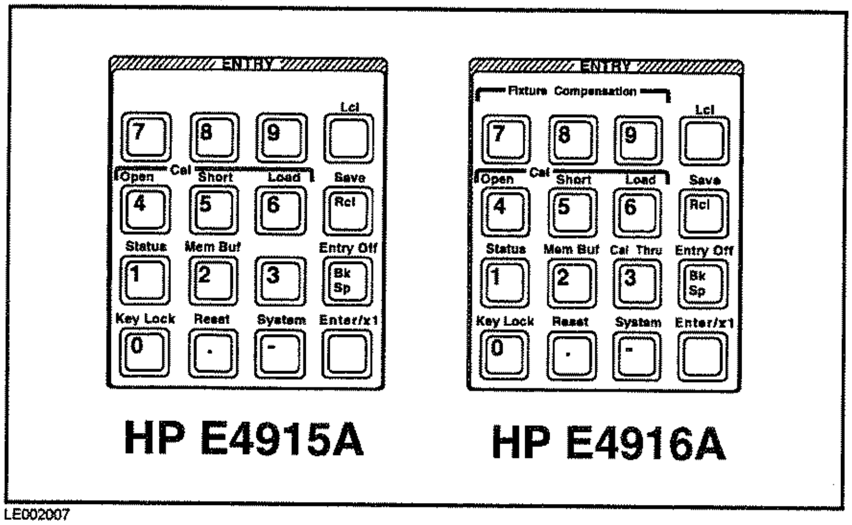

Figure 2-9. Data Entry Key Block

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 calbration 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.	√	√

3

Commands Available via Hard and Soft Keys

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	Applicable Model: HP E4916A
(Trig)	Manual trigger	"Trigger Function" in Chapter 4	TRIGIMMediate	√	√
(blue) + (Trig (Trigger Mode))	Press to set the trigger mode.: {Int|Man|Ext}	"Trigger Function" in Chapter 4	TRIGSOURce␣ {INTernal|MANual| EXTernal|BUS}	√	√
(Freq)	Press to enter the nominal frequency.	"Measurement Modes" in Chapter 4	NOMFreq␣<*value*>	√	√
(blue) + (Freq (Xtl))	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	√	√
(Meas Prmtr)	Press to enter a measurement parameter.	"Measurement Modes" in Chapter 4	MEASPARA␣ {FR|FA|FS|FL}	√	√
(blue) + (Meas Prmtr (DLD))	Press to select Drive Level Dependency measurement mode (DLD mode).	"Drive Level Dependency Measurement Mode (DLD Mode)" in Chapter 4	MEASFunction␣Dld		√
(Level)	Press to enter the power level.	"Measurement Modes" in Chapter 4	POWEr␣<*value*>		√
(blue) + (Level (Spurious))	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	√	√
(Nominal CI)	Press to enter the nominal CI value.	"Measurement Modes" in Chapter 4	NOMCI␣<*value*>	√	√
(blue) + (Nominal CI (EM))	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
(Meas Time)	Press to set the measurement time.	"Measurement Modes" in Chapter 4	MEASTime␣<*value*>	√	√
(blue) + (Meas Time (LCR))	Press to select LCR measurement mode.	"LCR Measurement Mode" in Chapter 4	MEASFunction␣Lcr		√
(CL Value)	Press to enter the target CL value.	"Measurement Modes" in Chapter 4	CLTGT␣<*value*>	√	√
(blue) + (CL Value (Flt))	Press to select Filter measurement mode (Flt mode).	"Filter Measurement Mode (Flt Mode)" in Chapter 4	MEASFunction␣Filter		√
(Select) (upper)	Press to select the upper soft key.			√	√
(Select) (lower)	Press to select the lower soft key.			√	√
(m/k)	Press to enter the unit.			√	√
(blue) + (m/k (Comprtr))	Press to access the Comparator setup menu.	"Comparator Function" in Chapter 4		√	√
(μ/M)	Press to enter the unit.			√	√
(blue) + (μ/M (Equiv Ckt))	Press to turn ON/OFF the Equivalent Circuit function.	"Measurement Modes" in Chapter 4	EQUCkt␣ {DEV4|DEV6|OFF}	√	√
(⇑ ⇒)	Press to move to the upper or right-hand soft key/display position.			√	√
(⇐ ⇓)	Press to move to the left-hand or lower soft key/display position.			√	√
(n/ppm)	Press to enter the unit.			√	√
(blue) + (n/ppm (CL Adj))	Press to activate CL Adj mode.	"Measurement with Capacitance Load (CL_a/CL_t Parameters)" in Chapter 4	CLADJust␣ {OFF|ON|0|1}, CLACTENTer	√	√
(p)	Press to enter the unit.			√	√
(blue) + (p (Δ Mode))	Press to turn ON/OFF delta mode.	"Delta Mode" in Chapter 4	DLTMode␣{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␣{OFF|ON|0|1}	√	√
(blue) + (1 (Status))	Press to turn ON/OFF status display.		DISPSTATus␣{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␣{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	(blue) + Freq (Xtl)	HP E4915A/E4916A
Spurious measurement mode	(blue) + Level (Spurious)	HP E4915A/E4916A
Drive Level Dependency measurement mode	(blue) + Meas Prmtr (DLD)	HP E4916A only
Evaporation Monitor mode	(blue) + Nominal CI (EM)	HP E4916A only
LCR measurement mode	(blue) + Meas Time (LCR)	HP E4916A only(option)
Filter measurement mode	(blue) + CL Value (Flt)	HP E4916A only
Comparator setup mode	(blue) + m/k (Comprtr)	HP E4915A/E4916A
System setup mode	(blue) + − (System)	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
FREQ	*value*	Nominal frequency [Hz]	NOMFreq⊔<*value*>
RNG	*value*	Search range [ppm]	SRCHRange⊔<*value*>
CI	*value*	Nominal impedance [Ω]	NOMCI⊔<*value*>
ALC	{OFF|ON}	ALC MODE ON/OFF	ALC⊔{OFF|ON|0|1}
LVL	*value*	Power level [W,A,V,dBm]	POWEr⊔<*value*> [mW|UW|NW|W|MA|UA|A|MV|UV|V|DBM]
UNIT	{dBm|WATT|AMP|VOLT}	Power unit	POWEr⊔<*value*> [mW|UW|NW|W|MA|UA|A|MV|UV|V|DBM]
TIME	{Short|Med|Long}	Measuring time	MEASTime⊔<*value*>
HI Q	{OFF|ON}	High Q mode ON/OFF	MEASTime⊔<*value*>
EQUC	{OFF|4DEV|6DEV}	Equivalent Circuit Analysis mode ON/OFF	EQUCkt⊔{DEV4|DEV6|OFF}
DspQ	{OFF|ON}	Show/hide the Q parameter	DSPQ⊔{OFF|ON|0|1}
TGT	{Phase|Peak}	Search target specification	SRCHTGT⊔{PHase|PEak}
PHAS	*value*	Target phase [°]	TGTPhase⊔<*value*>
ΔF	{OFF|DEV|PPM}	Delta mode for frequency	DLTMode⊔{SEC}, {OFF|DEV|PCNT}
RefF	{Nominal|User}	Reference frequency for Delta mode [Hz]	DLTREF⊔{PRI}, <*value*>
ΔCI	{OFF|DEV|%}	Delta mode for crystal impedance	DLTMode⊔{SEC}, {OFF|DEV|PCNT}
RefZ	{Nominal|User}	Reference impedance for Delta mode [Ω]	DLTREF⊔{SEC}, <*value*>
AGE	{OFF|ON}	Aging mode ON/OFF	AGING⊔{OFF|ON|0|1}
Time	*value*	Aging interval	AGINGTIME⊔<*value*>
PARA	{Fs|Fr|Fa|FL}	Measurement Parameter	MEASPARA⊔{FR|FA|FS|FL}
CKT	{PI|PROBE|BRIDGE|NONE}	Measurement circuit	CIRcuit⊔{PI|PRObe|BRIdge} PICKTtype⊔{PI41900A|PI41901A| PI41902A}
CL_a	{No-CL|User}	Actual CL value (no CL or user-specified value)	CLACTType⊔{NOCL|USER}, CLACT⊔<*value*>
CL_t	{No-CL|User|=CLact}	Target CL value (no CL, user-specified value, or measured value)	CLTGTType⊔{NOCL|USER|CLACT}, CLTGT⊔<*value*>
CL Compen	{NO|YES}	Execution of CL compensation	CLCOMPen
Ftgt	*value*	Frequency of reference resonator	CLFREQ⊔<*value*>[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
CENT	*value*	Center frequency [Hz]	SPCENTer⊔<*value*>
RNG	*value*	Search range [ppm]	SPRANGe⊔<*value*>[{Hz|Ppm}]
DispSP	{Nth|Worst}	Spurious point to be displayed (Nth or worst spurious)	SPDISP⊔{Worst|Nth}[,<*value*>]
#Spur	*value*	Number of spurious points to search for	SPNUM⊔<*value*>
TGT	{Phase|Peak}	Search target specification	SPTGT⊔{PHase|PEak}
PHAS	*value*	Target phase [°]	SPPHAse⊔<*value*>

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
FREQ	*value*	Nominal frequency [Hz]	NOMFreq⊔<*value*>
RNG	*value*	Search range [Hz/ppm]	SRCHRange⊔<*value*>
CI	*value*	Nominal CI [Ω]	NOMCI⊔<*value*>
SWEP	{Up|UpDown|UpMin|List}	Sweep type	PTSWPType⊔ {UPDOWN|UP|UPMIN|LIST}
TIME	{Short|Med|Long}	Measuring time	MEASTime⊔<*value*>
HI Q	{OFF|ON}	High Q mode ON/OFF	MEASTime⊔<*value*>
MIN	*value*	Minimum drive level [W,A,V,dBm]	PTMINPower⊔<*value*>
MAX	*value*	Maximum drive level [W,A,V,dBm]	PTMAXPower⊔<*value*>
STD	*value*	Reference drive level	PTSTDPower⊔<*value*>
UNIT	{dBm|WATT|AMP|VOLT}	Power unit	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]
WAIT	*value*	Wait time after energization	PTWAIT⊔<*value*>
StartP	*value*	Sweep start point	PTSTARTPoint⊔<*value*>
ABORT	{OFF|ON}	Whether to continue or abort measurement when tracking has failed	PTABORT⊔{OFF|ON|0|1}
ALC	{OFF|ON}	ALC MODE ON/OFF	ALC⊔{OFF|ON|0|1}
ΔF	{OFF|DEV|PPM}	Delta mode for frequency	DLTMode⊔PRI⊔{OFF|DEV|PPM}
RefF	{Nom|User|Start}	Reference frequency for Delta mode [Hz]	DLTREF⊔PRI, <*value*>
ΔCI	{OFF|DEV|%}	Delta mode for CI value	DLTMode⊔SEC⊔{OFF|DEV|PCNT}
RefZ	{Nom|User|Start}	Reference CI value for Delta mode [Ω]	DLTREF⊔SEC, <*value*>
TGT	{Phase|Peak}	Search target specification	SRCHTGT⊔{PHase|PEak}
PHAS	*value*	Target phase [°]	TGTPhase⊔<*value*>
PARA	{Fs|Fr}	Type of search frequency	MEASPARA⊔{FR|FS}
CKT	{PI|PROBE|BRIDGE}	Measurement circuit	CIRcuit⊔{PI|PRObe|BRIdge} PICKTtype⊔{PI41900A|PI41901A|PI41902A}
TRKG	{ON|OFF}	Phase tracking ON/OFF	PTRACK⊔{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
CI	*value*	Nominal CI [Ω]	NOMCI⊔<*value*>
ALC	{OFF | ON}	ALC MODE ON/OFF	ALC⊔{OFF|ON|0|1}
LVL	*value*	Power level [W,A,V,dBm]	POWEr⊔<*value*>
UNIT	{dBm | WATT | AMP | VOLT}	Unit of power	POWEr⊔<*value*>[MW|UW|NW|W|MA|UA|A|MV|UV|V|DBM]
TIME	{Short | Med | Long}	Measuring time	MEASTime⊔<*value*>
HI Q	{OFF | ON}	High Q mode ON/OFF	MEASTime⊔<*value*>
Dir	{UP | DOWN}	Search method of monitor mode	EMDIR⊔{UP|DOWN}
Tout	*value*	Time-out value for trapping	EMTMOUT⊔<*value*>
CKT	PI	Measurement circuit	CIRcuit⊔{NON|PI|PRObe|BRIdge} PICKTtype⊔{PI41900A|PI41901A|PI41902A}
MAN	{OFF | ON}	Entry of trap frequency from front panel	EMMANmode⊔{ON|OFF|0|1}
PARA	Fr	Type of search frequency	MEASPARAmeter⊔{FR}
PHAS	*value*	Target phase [°]	TGTPhase⊔<*value*>
Ftgt	*value*	Target frequency	EMLIST⊔<*value 1*>,<*value 2*>,<*value 3*>,{ON|OFF|0|1},<*value 4*>
Flow	*value*	Lowest trap frequency	EMLIST⊔<*value 1*>,<*value 2*>,<*value 3*>,{ON|OFF|0|1},<*value 4*>
Fmed	*value*	2nd trap frequency	EMLIST⊔<*value 1*>,<*value 2*>,<*value 3*>,{ON|OFF|0|1},<*value 4*>
Fhi	*value*	Highest trap frequency	EMLIST⊔<*value 1*>,<*value 2*>,<*value 3*>,{ON|OFF|0|1},<*value 4*>

LCR Measurement Mode

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

Soft Key	Parameter	Function	HP-IB Command
Pri1	{Z|Y|R|G|Cs|Cp|Ls|Lp}	Primary parameter 1	:SENS:FUNC:ON {FIMP|FADM} :CALC1:FORM {MLIN|REAL|CP|CS|LP|LS}
Sec1	{θz|θy|X|B|D|Q|Rs|Rp|G}	Secondary parameter 1	:SENS:FUNC:ON {FIMP|FADM} :CALC2:FORM {PHAS|IMAG|D|Q|REAL|RP}
Pri2	{Z|Y|R|G|Cs|Cp|Ls|Lp}	Primary parameter 2	:SENS:FUNC:ON {FIMP|FADM} :CALC3:FORM {MLIN|REAL|CP|CS|LP|LS}
Sec2	{θz|θy|X|B|D|Q|Rs|Rp|G}	Secondary parameter 2	:SENS:FUNC:ON {FIMP|FADM} :CALC4:FORM {PHAS|IMAG|D|Q|REAL|RP}
TIME	{Short|Med|Long}	Measurement time	:SENS:FIMP:APER {Short|Med|Long}
AVG	*value*	Averaging factor	:SENS:AVER:COUN <*value*>
LVL	*value*	Power level[W,V,A,dBm]	:SOUR:VOLT <*value*> [A|MA|W|V|MV|DBM]
UNIT	{dBm|WATT|AMP|VOLT}	Power unit	
Vmon	{OFF|ON}	Voltage monitor ON/OFF	CALCulate6:MATH:STATe{ON/OFF}
Imon	{OFF|ON}	Current monitor ON/OFF	CALCulate5:MATH:STATe{ON/OFF}
ΔP1	{OFF|DEV|%}	Delta mode for primary parameter 1	:CALC1:MATH:EXPR:NAME {DEV|PCNT}
Ref	*value*	Reference value of primary parameter 1 for Delta mode	:DATA: REF1,<*value*>
ΔS1	{OFF|DEV|%}	Delta mode for secondary parameter 1	:CALC2:MATH:EXPR:NAME {DEV|PCNT}
Ref	*value*	Reference value of secondary parameter 1 for Delta mode	:CALC2:MATH:EXPR:NAME {DEV|PCNT} :DATA: REF2,<*value*>
ΔP2	{OFF|DEV|%}	Delta mode for primary parameter 2	:CALC3:MATH:EXPR:NAME {DEV|PCNT}
Ref	*value*	Reference value of primary parameter 2 for Delta mode	
ΔS2	{OFF|DEV|%}	Delta mode for secondary parameter 2	:CALC4:MATH:EXPR:NAME {DEV|PCNT}
Ref	*value*	Reference value of secondary parameter 2 for Delta mode	:DATA: REF4,<*value*>
DGT	*value*	Display digits	:DISP:TEXT1:DIG {3|4|5}
CKT	{PI|PROBE|BRIDGE}	Measurement circuit	:CIRcuit␣{PI|PRObe|BRIdge} PICKTtype␣{PI41900A|PI41901A| PI41902A}
FREQ	*value* [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
FREQ	*value*	Nominal frequency [Hz]	NOMFreq⊔<*value*>
RNG	*value*	Search range [Hz/ppm]	SRCHRange⊔<*value*>
xdB	*value*	Down value for filter band width	FLTDB⊔<*value*>
LOSS	{Const|Min}	Select constant/minimum loss	FLTMODE⊔{CONSTant|MINimam}
TIME	{Short|Med|Long}	Measuring time	MEASTime⊔<*value*>
HI Q	{OFF|ON}	High Q mode ON/OFF	MEASTime⊔<*value*>
LVL	*value*	Power level [dBm only]	POWEr⊔<*value*>

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

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

<table>
<tr><th>Soft Key</th><th>Parameter</th><th>Function</th><th>HP-IB Command</th></tr>
<tr><td>COMP</td><td>{OFF|ON}</td><td>Comparator function ON/OFF</td><td>COMPSTATe⊔{OFF|ON|0|1}</td></tr>
<tr><td>SEC</td><td>{OFF|ON}</td><td>Secondary sorting ON/OFF</td><td>COMPSECondary⊔{OFF|ON|0|1}</td></tr>
<tr><td>AUX</td><td>{OFF|ON}</td><td>AUX bin ON/OFF</td><td>COMPSECAUX⊔{OFF|ON|0|1}</td></tr>
<tr><td>PRI</td><td>{ABS_TOL|%TOL|SEQ}</td><td>Sort mode for primary sorting</td><td>COMPPRIMode⊔ {ABSTOL|PCNTTOL|SEQ}</td></tr>
<tr><td>NOM</td><td><i>value</i></td><td>Nominal value applied to Tolerance mode</td><td>COMPTOLSTD⊔<<i>value</i>></td></tr>
<tr><td>BEEP</td><td>{Pass|Fail}</td><td>Whether to indicate Pass or Fail by outputting beep sound.</td><td>COMPBEEPCond⊔{FAIL|PASS}</td></tr>
<tr><td>LED</td><td>{Pass|Fail}</td><td>Whether to indicate Pass or Fail by illuminating LED.</td><td>COMPLEDCond⊔{FAIL|PASS}</td></tr>
<tr><td>PriH</td><td><i>value</i></td><td>Upper limit value for primary sorting</td><td>COMPPLIMit⊔<BIN1>,<<i>value 1</i>>,<<i>value 2</i>></td></tr>
<tr><td>PriL</td><td><i>value</i></td><td>Lower limit value for primary sorting</td><td>COMPPLIMit⊔<BIN1>,<<i>value 1</i>>,<<i>value 2</i>></td></tr>
<tr><td>SecH</td><td><i>value</i></td><td>Upper limit value for secondary sorting</td><td>COMPSLIMit⊔<<i>value 1</i>>,<<i>value 2</i>></td></tr>
<tr><td>SecL</td><td><i>value</i></td><td>Lower limit value for secondary sorting</td><td>COMPSLIMit⊔<<i>value 1</i>>,<<i>value 2</i>></td></tr>
<tr><td>LmΔF</td><td>{OFF|ON}</td><td>ΔF limit test ON/OFF (for DLD mode only)</td><td>COMPDLTF⊔{OFF|ON|0|1}</td></tr>
<tr><td>LmΔZ</td><td>{OFF|ON}</td><td>ΔCI limit test ON/OFF (for DLD mode only)</td><td>COMPDLTCI⊔{OFF|ON|0|1}</td></tr>
<tr><td>ΔF_H</td><td><i>value</i></td><td>ΔF limit value (for DLD mode only)</td><td>COMPDLTFLim⊔<<i>value</i>></td></tr>
<tr><td>ΔZ_H</td><td><i>value</i></td><td>ΔCI limit value (for DLD mode only)</td><td>COMPDLTCILim⊔<<i>value</i>></td></tr>
<tr><td>BW_H</td><td><i>value</i></td><td>Upper limit value for BW (for Flt mode only)</td><td>COMPBWLim⊔<<i>value 1</i>>,<<i>value 2</i>></td></tr>
<tr><td>BW_L</td><td><i>value</i></td><td>Lower limit value for BW (for Flt mode only)</td><td>COMPBWLim⊔<<i>value 1</i>>,<<i>value 2</i>></td></tr>
<tr><td>LmBW</td><td>{OFF|ON}</td><td>BW limit test ON/OFF</td><td>COMPBW⊔{OFF|ON|0|1}</td></tr>
</table>

System Setup Mode

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

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

4

Function Reference

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.

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:

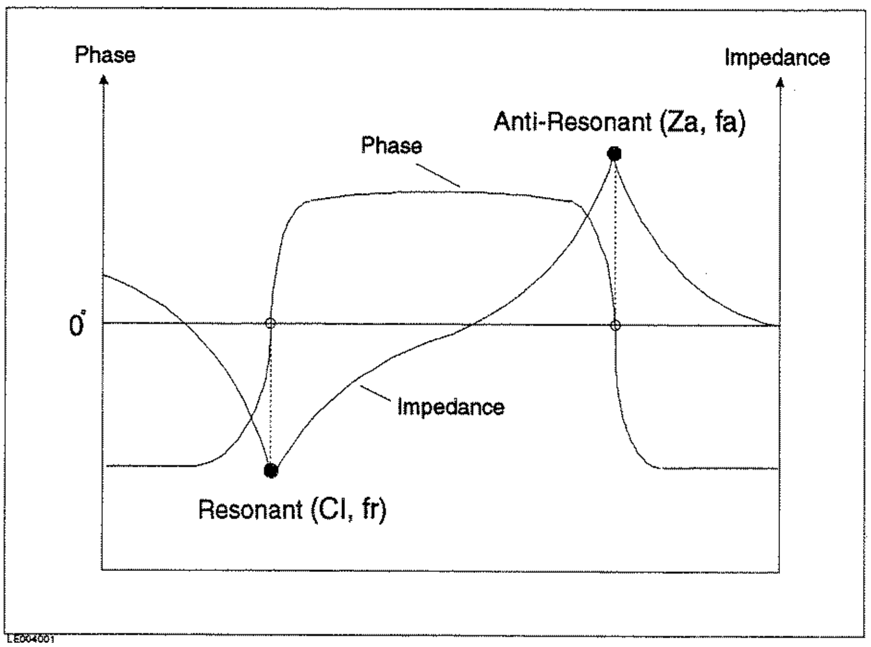

Figure 4-1. Frequency–impedance characteristics of a crystal resonator

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:

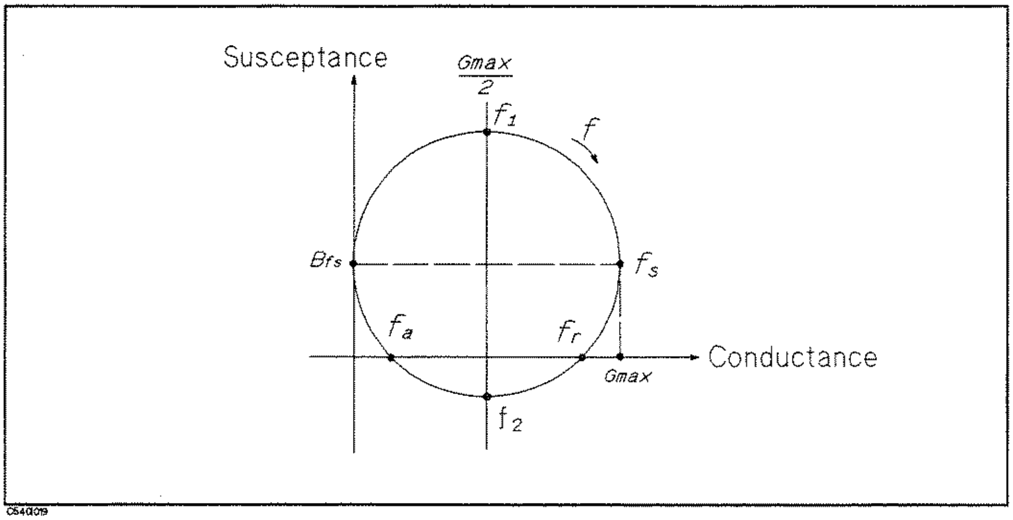

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Figure 4-2. Circle diagram for admittance characteristics

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 (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*>
  - 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)+μ/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: CLACTType␣{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: CLTGTType␣{NOCL|USER|CLACT}, CLTGT␣<*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 π test fixture before using this function.

- Soft key: CL Compen
- Hard key:—
- HP-IB command: CLCOMPen

Note

The HP E4915A/E4916A always returns YES when you select the CL Compen 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␣<*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 π 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 π 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 π 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≠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: Convertion 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: Convertion value from measurement value and CLact FL: Convertion value from measurement value and CLact,CLtgt	Fr: Convertion value from measurement value and CLact FL: Actual measurement value

Note

The CI value dispalyed 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 π 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 staray 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 is 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 Compen 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 π 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.

4.Function Reference

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 obrain 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) + μ/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)

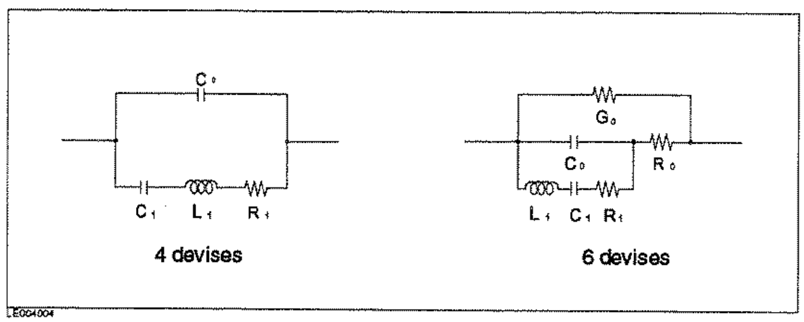


Figure 4-3. Four- and six-element equivalent circuits

The Equivalent Circuit Analysis function calculates the values of the C0, C1, L1, R1, G0, 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 CI) 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*>, ANLGREF␣ <*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.

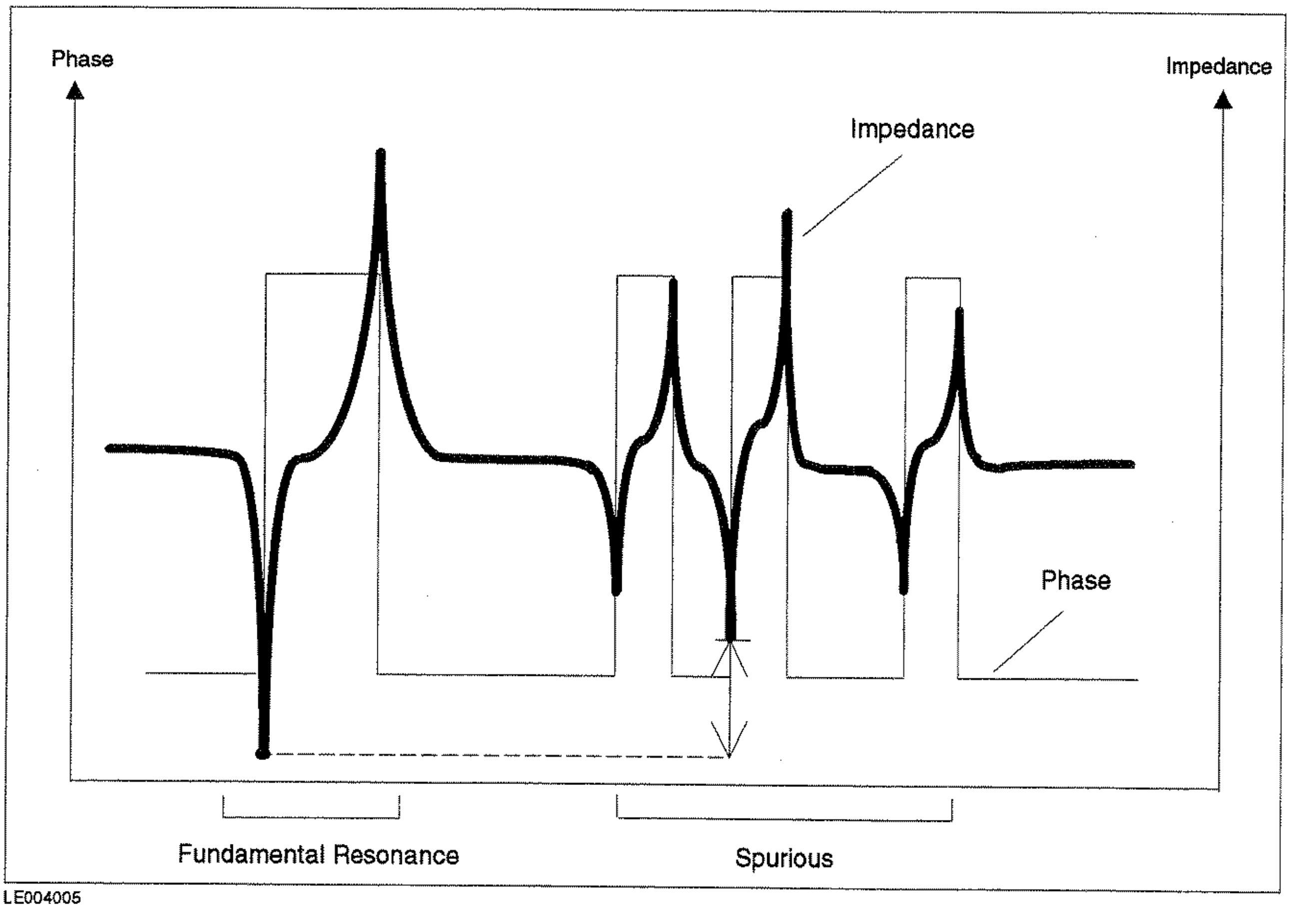


Figure 4-4. Spurious points of a crystal resonator

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.

4.Function Reference

- 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 20log{(Z value at spurious point) / (CI 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.

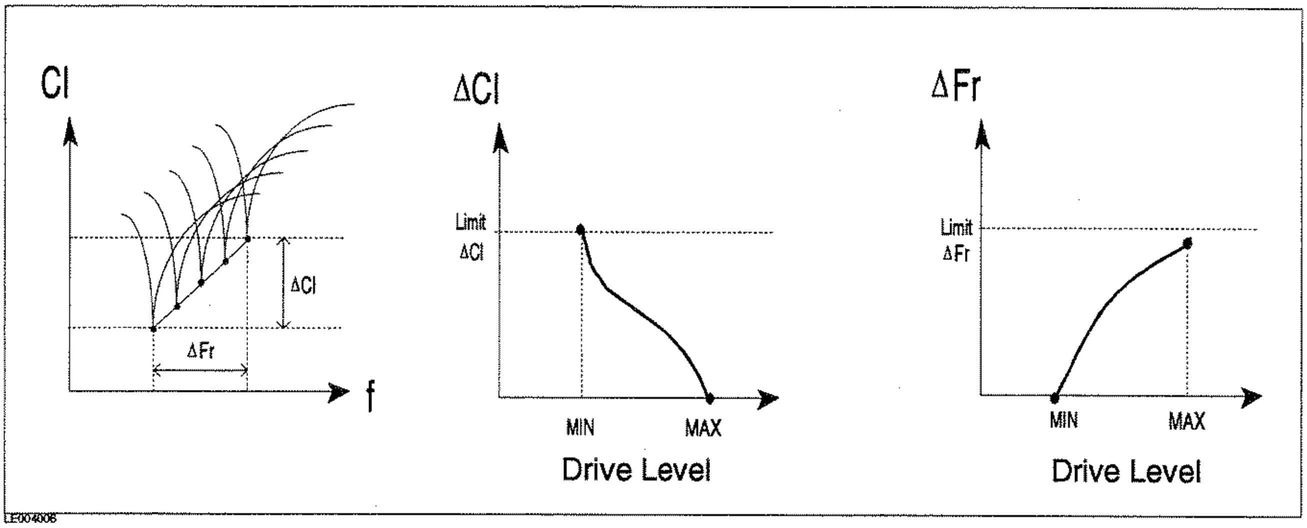


Figure 4-5. Drive level dependency of a crystal resonator

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_MINFor 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: PTSWPType␣{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 paraemter 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 μW	ON
2 μW	ON
3 μW	ON
5 μW	ON
8 μW	ON
10 μW	ON
8 μW	ON
5 μW	ON
3 μW	ON
2 μW	ON
1 μW	ON

Note

When PTSTDP value is inclued 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 inclued 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.

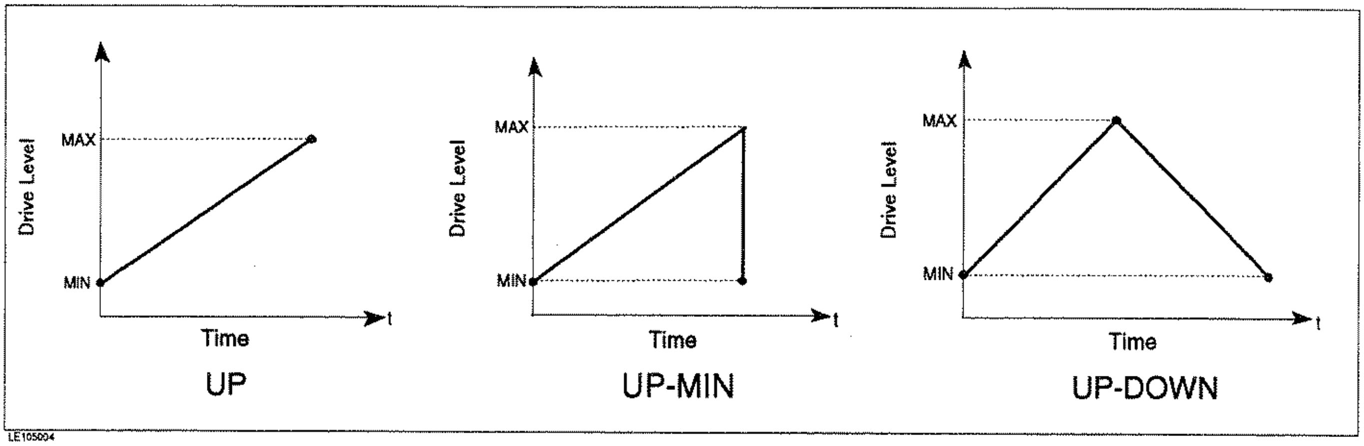


Figure 4-6. Sweep Type

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	MIN	PTMINPower
Maximum value	MAX	PTMAXPower
Sweep type	SWEP	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	ΔF	DEV	(Measured value) – (reference value) [Hz]
		PPM	{(Measured value) – (reference value)} / (reference value) [ppm]
Crystal impedance	ΔCI	DEV	(Measured value) – (reference value) [Ω]
		%	{(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 ΔF limit/ΔCI limit test (ΔFLimit and ΔCILimit

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*>, ANLGREF␣ <*value*>

4.Function Reference

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,

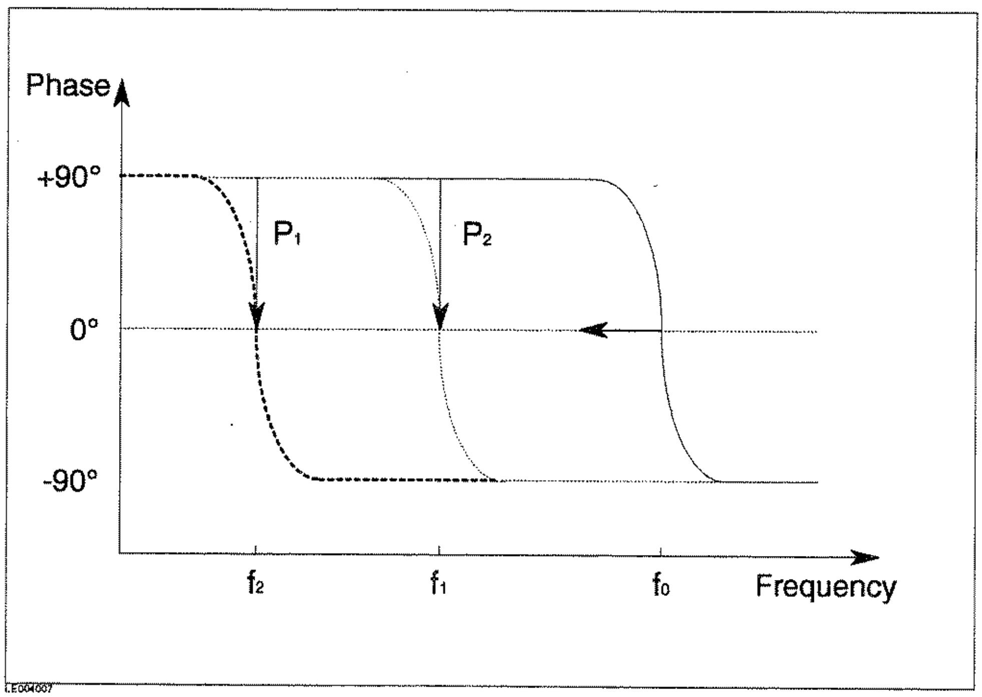


Figure 4-7. Trap function

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`.

4.Function Reference

- 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 # diusplayed 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 [Ω]
- 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 V to +5V, 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: 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*>, ANLGREF⊔ <*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.

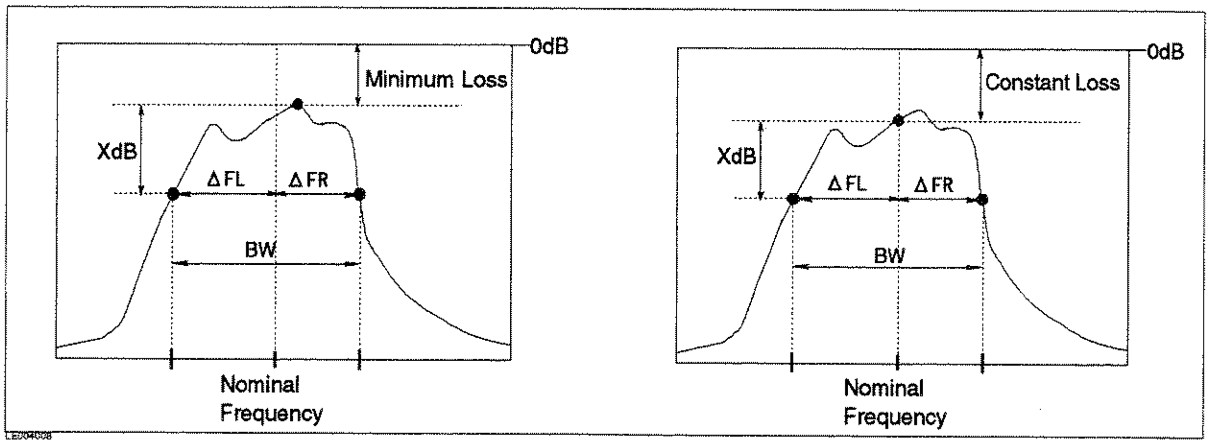


Figure 4-8. Constant loss and minimum loss

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

- Constant or minimum loss
- X-axial dB band width values (ΔFL, ΔFR, and BW; BW=ΔFL+ΔFR)

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␣<*value*>
- `RNG`: Search range. Specify the resonance point search range.
  - Soft key: RNG
  - Hard key: (Freq)
  - HP-IB command: SRCHRange␣<*value*>
- `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: FLTMODE␣{CONSTant|MINimam}

- xdB: Specify the down value for filter band width
  - Soft key: xdB
  - Hard key:—
  - HP-IB command: FLTDB␣<*value*>
- LVL: Lets you specify the signal level.
  - Soft key: LVL
  - Hard key: (Level)
  - HP-IB command: POWEr␣<*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: 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*>

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:

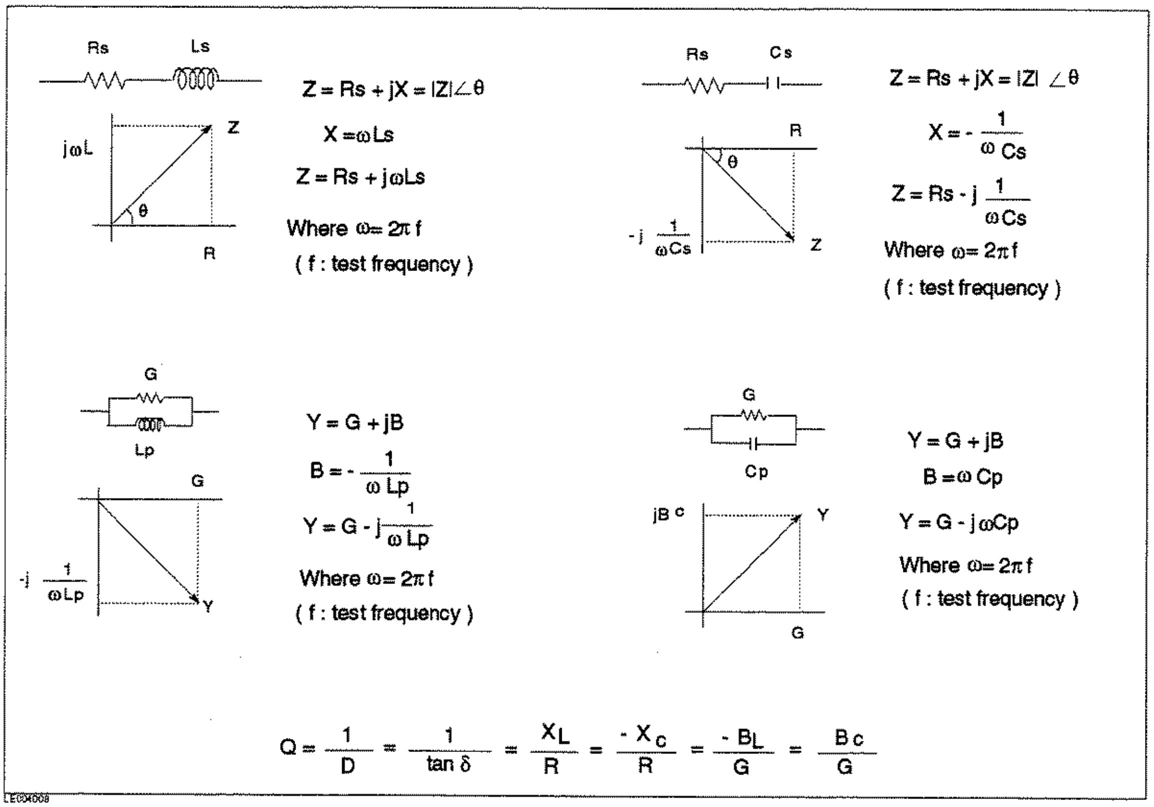


Figure 4-9. Relationship between Measurement Parameters

In Figure 4-9,

Ls :	Equivalent series inductance	Cp :	Equivalent parallel capacitance
Lp :	Equivalent parallel inductance	Q :	Quality factor
Cs :	Equivalent series capacitance	D :	Dissipation Factor

Measurement parameters for LCR measurement mode include the following:

Primary Paremeters	Z,Y,R,G,Cp,Cs,Lp,Ls
Secondary Parameter	θz,θy,X,B,D,Q,G,Rp,Rs

where,

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

Secondary Parameters

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

Parameters and Their Settings

- Deviation (Δ) 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:

  ΔABS mode Displays the difference between the measured value and a reference value. The value is calculated by

  $$MeasuredValue - ReferenceValue$$

  Δ% mode Displays the difference between the measurement value and the reference value as a percentage of the reference value. The value is calculated by

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

  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.

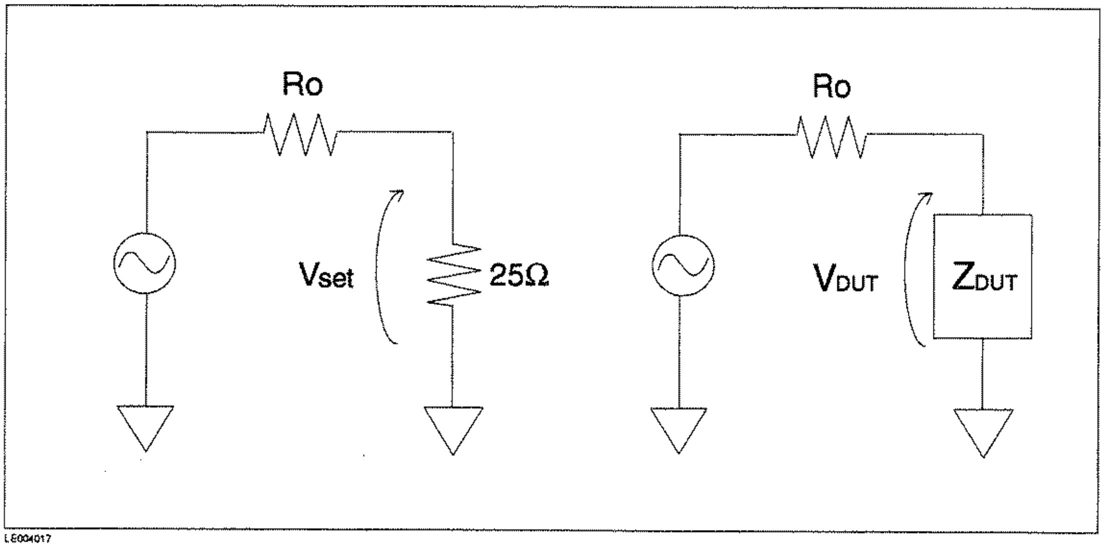


Figure 4-10. Equivalent Circuit of Impedance Probe

Figure 4-10 shows the equivalent circuit model of the HP E4916A and the Impedance probe.When DUT's impedance value is save as the output impedance value of the probe (25 Ω),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 π network fixture or impedance probe connected to the DUT. The Calibration function is particularly useful when you use a π network test fixture to measure the CI characteristics of a DUT.

Calibrating the HP E4915A/E4916A requires the calibration data measured by putting the π 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 π 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.

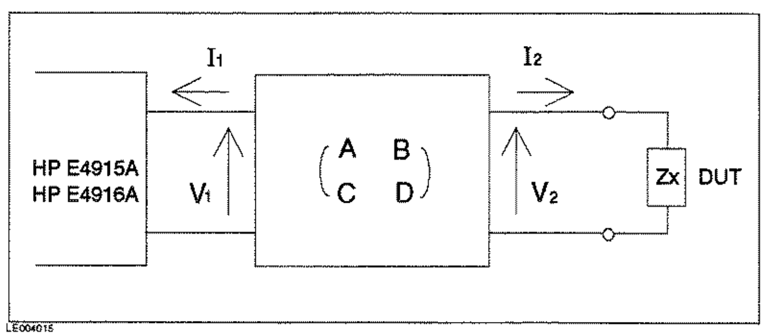


Figure 4-11. Calibration Model

Note

Re calibration and compensation are required when the measurement mode or the measurement circuit is changed. The privious 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)	CALibration␣OPEN
SHORT	(blue) + 5 (Short)	CALibration␣SHORT
LOAD	(blue) + 6 (Load)	CALibration␣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)	COMPENsation␣OPEN
SHORT	(blue) + 8 (Short)	COMPENsation␣OPEN
LOAD	(blue) + 9 (Load)	COMPENsation␣LOAD

Calibration Standard Values

The standard values the HP E4915A/E4916A uses for calibration are factory-preset assuming the use of the HP 41902A π 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.

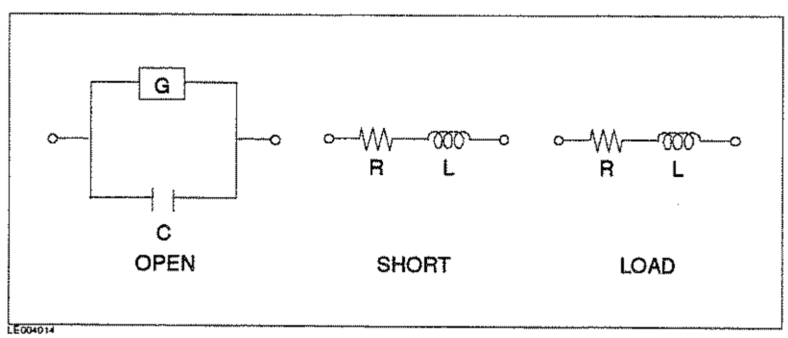


Figure 4-12. Calibration standard model

You can set the calibration standard values for each of the measuring circuit types supported by the HP E4915A/E4916A that is, a π 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 π 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 Ω	0 H	50 Ω	5.75 nH
HP 41900A	0 S	0.1 pF	1μΩ	0.6 nH	50 Ω	14 nH
HP 41901A	0 S	0.1 pF	1μΩ	0.1 nH	50 Ω	3.4 nH
HP 41902A	0 S	0.1 pF	1μΩ	3 nH	50 Ω	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 π 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.

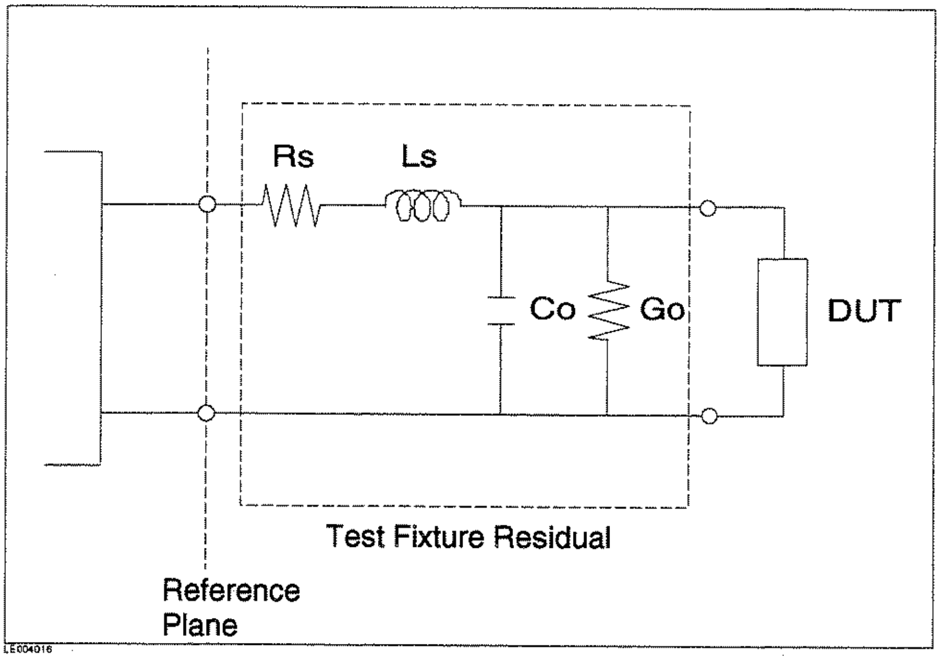


Figure 4-13. OPEN/SHORT compensation model

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 ΔF limit/ΔCI 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 ΔF limit/ΔCI limit test and BW limit test functions are available only with the HP E4916A. Note that description of the ΔF limit/ΔCI 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/Flt 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 (Fmax – Fmin) and CI values (CImax – CImin) of a DUT measured in DLD mode.
  - This extended function also compares the BW value of a DUT measured in Flt 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:

4.Function Reference

- □ 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: COMPPLIMit⊔BIN<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: COMPSECAUX⊔{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 ΔF limit test: Turns ON/OFF the ΔF 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

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.

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	COMPPRIMode␣SEQ
Tolerance	PRI = ABS_TOL	COMPPRIMode␣ABSTOL
	PRI = %TOL	COMPPRIMode␣PCNTTOL

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:

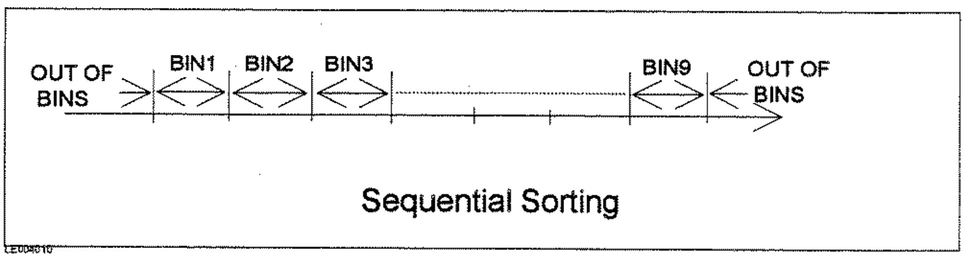


Figure 4-14. Sequential mode

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:

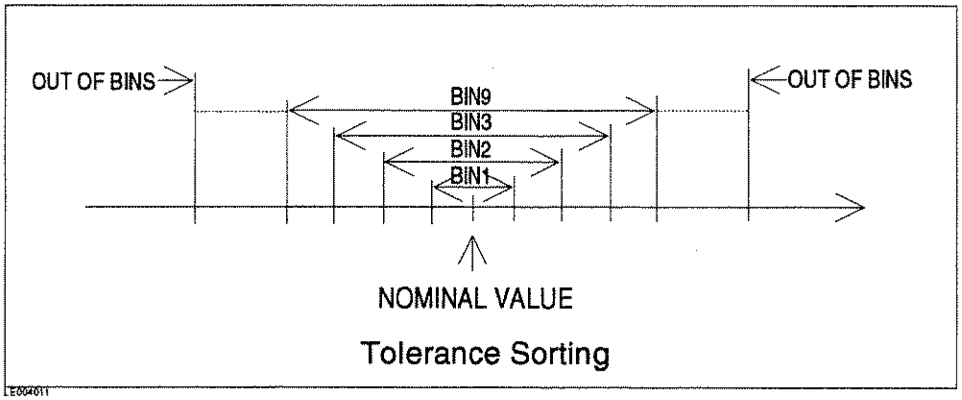


Figure 4-15. Tolerance Mode

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	PRI = ABS_TOL	COMPPRIMode␣ABSTOL
Percentage	Percentage of deviation with respect to reference value	PRI = %TOL	COMPPRIMode␣PCNTTOL

Note

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

4.Function Reference

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

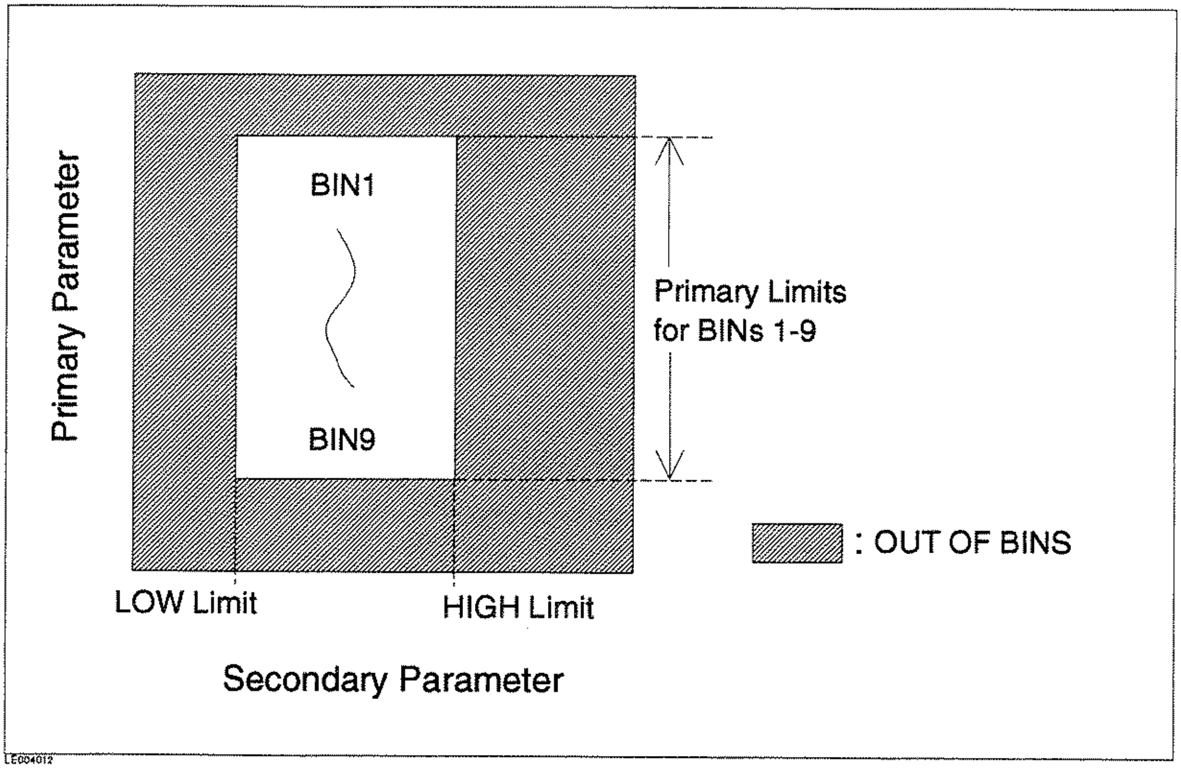


Figure 4-16. Results of secondary sorting with the Aux bin function OFF

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.

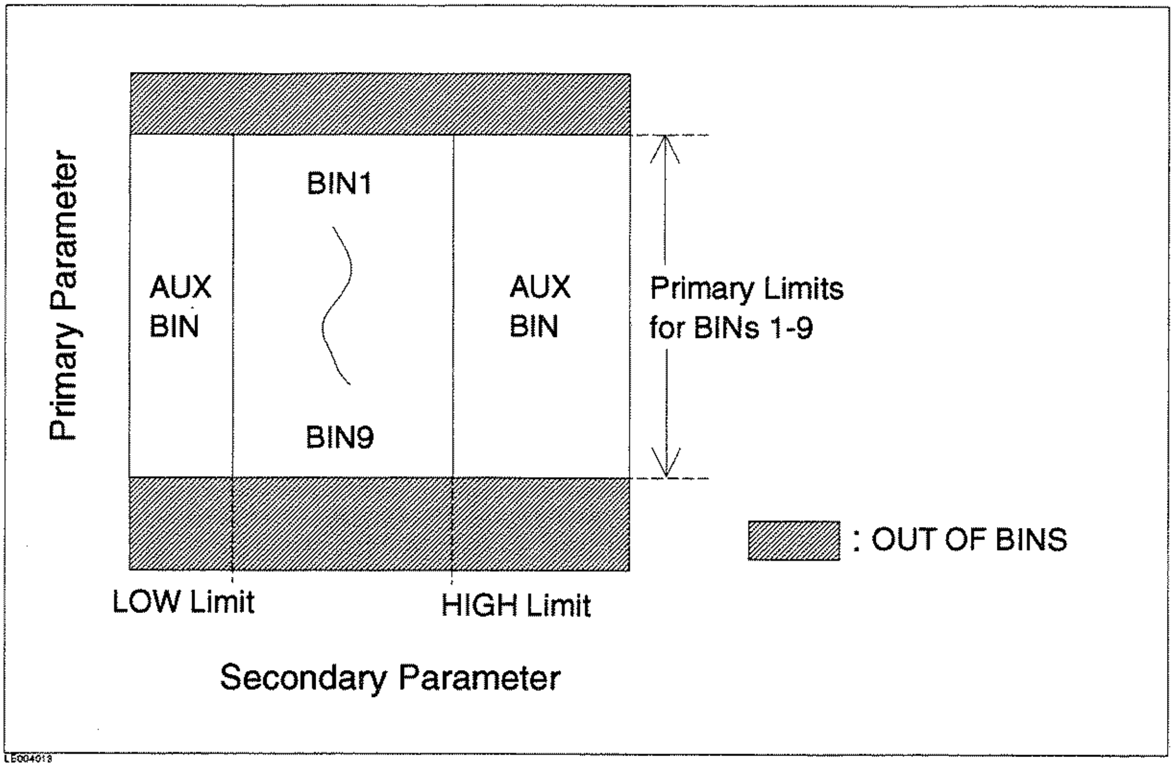


Figure 4-17. Results of secondary sorting with the Aux bin function ON

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 (ΔF limit AND ΔCI limit/BW_L AND BW_H), for either the ΔF limit/ΔCI 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)	*SAV␣ <*value*>
Recall	Rcl	*RCL␣ <*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)	MESTATe␣{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 (π 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 CKT soft key	HP-IB command
π Network test fixture	HP E4915A/E4916A	HP41900A HP41901A HP41902A	PI	CIRcuit␣PI PICKTtype␣ {PI41900A| PI41901A| PI41902A}
Impedance probe	HP E4916A only	Option 001	PROBE	CIRcuit␣PRObe
Reflection bridge	HP E4916A only	—	BRIDGE	CIRcuit␣BRIdge

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 KLOCK␣{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 (Trig) 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	((blue))+(Trig (Trigger Mode))	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).

5

HP-IB Command Reference

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.

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:

ALC␣{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:POIN␣`*<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 in formation 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*>

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: μ (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).

Equivalent Key Sequence	(Meas Time) – 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>*

MEASTime	Measuring time	High Q
1	Short	OFF
2	Med	OFF
3	Long	OFF
4	Short	ON
5	Med	ON
6	Long	ON

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

- ASCII format transfer
  ASCII: <num_elements>,<asc_data><NL^END>
  <asc_data>:=<F>,<FL>,<CI>[,<Q>,<Ts>,<C0>,<C1>,<L1>,
  <R1>[,<G0>,<R0>]] [,<comp>][,<time>]<comp>:=<bin_num>,<pri>,<sec>
- Binary format transfer
  BINARY: #4<num_bytes><bin_data><NL^END>
  <bin_data>:=[<time>]<F><FL><CI>[<Q><Ts><C0><C1><L1><R1>
  [<G0><R0>]][<comp>][<time>]<comp>:=<bin_num><pri><sec>

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 #40256 when 256 bytes are transferred).
  - <F> : F (Measured resonance frequency: Fr, Fa, Fs)
  - <FL> : FL (Measured resonance frequency)
  - <CI> : CI/Z (Measured resonance impedance)
- Data elements transferred with the Equivalent Circuit Analysis function ON (for both 4- and 6-element modes)
  - <Q> : Q
  - <Ts> : Ts
  - <C0> : C0
  - <C1> : C1
  - <L1> : L1
  - <R1> : R1
- Data elements transferred with the Equivalent Circuit Analysis function ON (for 6-element mode only)
  - <G0> : G0
  - <R0> : R0
- 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 Aging mode ON (refer to the OUTPMData command)
  - <time> : Total elapsed time [ms]
- New Line
  - <NL^END>: NewLine^END (1 byte)

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) + μ/M (Equiv Ckt) EQUC
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}

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*>

OUTPMData?

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␣{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␣<*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*>

CLTGTType␣{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 CLTGTType 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 :CLTGTType? (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 Compen
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.

Transferred Data	■ ASCII format transfer ASCII: <num_elements>,<asc_data><NL^END> <asc_data>:=<CL> ■ Binary format transfer BINARY: #4<num_bytes><bin_data><NL^END> <bin_data>:=<CL>
Data Elements	<num_elements> : Number of data elements transferred <num_bytes>: Number of bytes transferred <CL> : Actual CL value <NL^END>: NewLine^END (1 byte)

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

- ASCII format transfer
  ASCII: <num_elements>,<asc_data><NL^END>
  <asc_data>=<F>,<CI>,<spur_num>,<sFworst>,<CIworst>
  [,<sF1>,<sCI1>[,<sF2>,<sCI2>[, ...]]]
- Binary format transfer
  BINARY: #4<num_bytes><bin_data><NL^END>
  <bin_data>=<F><CI><spur_num>,<sFworst>,<CIworst>
  [<sF1><sCI1>[<sF2><sCI2>[...]]]

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 #40048 when 48 bytes are transferred).
  <F> : F (Measured resonance frequency: Fr, Fa, Fs)
  <CI> : CI/Z (Measured resonance impedance)
- When the equivalent circuit analysis is ON.
  <Q> :Q
  <TS> :TS
  <C0> :C0
  <C1> :C1
  <L1> :L1
  <R1> :R1
- When the equivalent circuit analysis is 6 devises mode.
  <C0> :C0
  <R0> :R0
- Number of spurious points
  <spur_num> : Number of detected spurious points
- Worest Suprious
  <sFworst> : Frequency of the point which has the minimum impedance value of all spurious points.
  <sCIworst> : Impedance at the point which has the minimum impedance value of all spurious points.
- Data elements transferred when one or more spurious points are specified by SPNUM.
  <sFn> : Frequency of the spurious point (n:number of spurious specified by SPNUM)
  <sCIn> : Impedance at the spurious point(n:number of spurious specified by SPNUM)
- New Line
  <NL^END>: NewLine^END (1 byte)

FETCh?

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

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}

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*>

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}

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*>

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	`DispSP`
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 `Nth` option (not required for the `Worst` option).
Query Response	<*value*> <*value*> : An integer value that represents the index number of the spurious point currently displayed (returns 0 if the `Worst` option was specified).

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	■ ASCII format transfer ASCII: <num_elements>,<asc_data><NL^END> <asc_data> = <F>,<CI>,<time> ■ Binary format transfer BINARY: #4<num_bytes><bin_data><NL^END> <bin_data> = <F><CI><time>
Data Elements	<num_elements> : Number of data elements transferred <num_bytes>: Number of bytes transferred (#40024) <F> : F (Trap frequency) <CI> : CI/Z (CI value at the trap frequency) <time> : Time required between two trap points (ms) <NL^END>: NewLine^END (1 byte)

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	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}

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}

EMLIST␣<*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?␣<*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	<*value1*> : Number of the trap point <*value2*> Frequency at the trap point <*value3*> 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 <*value4*> : Output data (I/O port output ON only)
Query Response	<*value2*>,<*value3*>,{OFF|ON|0|1},<*value4*> Query response returns <*value4*> regardless of on/off.

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*>: Size of the trap point list. <*value*> : Size of the trap point list
Query Response	<*value*>

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␣<*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	StartP – Presents read-only display of the current value.
Parameter Description	<*value*> : Start point
Query Response	<*value*>

EMTMOUT␣<*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	Tout – Presents read-only display of the current value.
Parameter Description	<*value*> Time-out value [ms] [S|MS|M]: Unit of time (Defaults to the unit used in MS)
Query Response	<*value*>

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*> :
Query Response	{0|1},<*value*> <*value*>:Query response always returns <*value*>.

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*> 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.

Transferred Data	■ ASCII format transfer <num_elements>,<asc_data><NL^END> <asc_data>:=<F>,<CI>,<STAT>,<MinF>,<MaxF>,<MinCI>,<MaxCI> <MaxF-MinF>,<MaxCI-MinCI>[,<comp>] <comp>:=<bin_num>,<pri>,<sec>,<t_1>,<t_2> ■ Binary format transfer #4<num_bytes><bin_data><NL^END> <bin_data>:=<F><CI><STAT><DL><MinF><MaxF><MinCI><MaxCI> <MaxF-MinF><MaxCI-MinCI>[<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 <F> : F (Resonance frequency measured at the reference drive level) <CI> : CI/Z (Resonance impedance measured at the reference drive level). <STAT> : Indicates whether the tracking measurement was successful. 0: PASS 1: FAIL <MinF> : Minimum <F> value <MaxF> : Maximum <F> value <MinCI> : Minimum <CI> value <MaxCI> : Maximum <CI> value <MaxF-MinF> : Difference between maximum and minimum <F> values <MaxCI-MinCI> : Difference between maximum and minimum <CI> values ■ Data elements transferred with the Comparator function ON <bin_num> : Bin identification number -1: OUT OF BIN -2 = AUX BIN 1 to 5 = Bin number <pri> : Result of primary sorting 0: PASS 1: FAIL <sec> : Result of secondary sorting 0: PASS 1: FAIL -1: Secondary sorting OFF <t_1> : Result of ΔF limit test 0: PASS 1: FAIL -1: ΔF limit test OFF <t_2> : Result of ΔCI limit test 0: PASS 1: FAIL -1: ΔCI limit test OFF ■ New Line <NL^END>: NewLine^END (1 byte)

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	WAIT
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	TRKG
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).

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␣*<value>*

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␣*<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 5-1. 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.

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 PTSWPType commands.

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

Equivalent Key Sequence	MIN
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 5-2. 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.

PTMAXPower␣<*value*>

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

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

Equivalent Key Sequence	MAX
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, 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.

PTSWPType␣{UPDOWN|UP|UPMIN|LIST}

Specifies the sweep type.

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

Equivalent Key Sequence	SWEP
Parameter Description	UP: Increases the drive level step by step from the minimum level value to the maximum level value. 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. 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 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.

Transferred Data	■ ASCII format transfer ASCII: <num_elements>,<asc_data><NL^END> <asc_data>:=<Loss>,<Δf_left>,<Δf_right> ■ Binary format transfer BINARY: #4<num_bytes><bin_data><NL^END> <bin_data>:=<Loss><Δf_left><Δf_right>
Data Elements	<num_elements> : Number of data elements transferred <num_bytes>: Number of bytes transferred (#4024) <Loss> : Minimum or constant loss <Δf_left> : -x dB BW (Δf_left) <Δf_right> : -x dB BW (Δf_right)

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).

Equivalent Key Sequence	LOSS
Parameter Description	CONSTant: Constant loss MINimum: Minimum loss
Query Response	{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).

Equivalent Key Sequence	xdB
Parameter Description	*<value>* Band width of the filter band width [dB]
Query Response	*<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).

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*>

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

COMPSEC␣{OFF|ON|0|1}

Turns ON/OFF secondary sorting.

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

Equivalent Key Sequence	SEC
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	SecL – Lower limit value SecH – 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	AUX
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␣<*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*>

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	■ Query response in Crystal Resonator measurement mode <num1> : Count of DUTs in bin 1. ... <num9> : Count of DUTs in bin 9. <num10> : Count of DUTs purged as OUT OF BIN. <num11> : Count of DUTs in the AUX bin. ■ Query response in Drive Level Dependency measurement mode <num1> : Count of DUTs in bin 1. ... <num5> : Count of DUTs in bin 5. <num6> : Count of DUTs purged as OUT OF BIN. <num7> : Count of DUTs in the AUX bin. <num8>~<num11>: Returns 0.

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.

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	BEEP
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).

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␣{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 ΔF limit test function. With this function ON, DUTs are evaluated to the ΔF 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	LmΔF
Parameter Description	OFF: ΔF limit test OFF ON: ΔF limit test ON 0: ΔF limit test OFF 1: ΔF limit test ON
Query Response	{1|0}

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	LmΔZ
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}

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).

Equivalent Key Sequence	LmBW
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

MESTATe␣{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	MemClear
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

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	■ ASCII format transfer ASCII: <asc_data> ... <asc_data><NL^END> <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><NL^END> <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_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

- Data elements transferred whenever TRG is issued
  - <F> : F (Measured resonance frequency: Fr, Fa, Fs)
  - <FL> : FL (Measured resonance frequency)
  - <CI> : CI/Z (Measured resonance impedance)
- Data elements transferred with the Equivalent Circuit Analysis function ON (for both 4- and 6-element modes)
  - <Q> : Q
  - <Ts> : Ts
  - <C0> : C0
  - <C1> : C1
  - <L1> : L1
  - <R1> : R1
- Data elements transferred with the Equivalent Circuit Analysis function ON (for 6-element mode only)
  - <G0> : G0
  - <R0> : R0
- Data elements transferred with Aging mode ON
  - <time> : Total elapsed time [ms]

Spurious measurement mode

- Data elements transferred whenever TRG is issued
  - <F> : F (Measured resonance frequency: Fr, Fa, Fs)
  - <CI> : CI/Z (Measured resonance impedance)
- Data elements transferred with the Equivalent Circuit Analysis function ON (for both 4- and 6-element modes)
  - <Q> : Q
  - <Ts> : Ts
  - <C0> : C0
  - <C1> : C1
  - <L1> : L1
  - <R1> : R1
- Data elements transferred with the Equivalent Circuit Analysis function ON (for 6-element mode only)
  - <G0> : G0
  - <R0> : R0
- Number of spurious points
  - <spur_num> : Number of detected spurious points
- 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.
  - <sF1> : Frequency of the spurious point
  - <sCI1> : Impedance at the spurious point

Drive Level Dependency measurement mode

- Data elements transferred whenever TRG is issued
  - <F> : F (Measured resonance frequency: Fr, Fa, Fs)
  - <CI> : CI/Z (Measured resonance impedance)
  - <STAT> : Indicates whether the tracking measurement was successful.
    - 0: PASS
    - 1: FAIL
  - <DL> : DL value (setting)

Evaporation Monitor mode

- Data elements transferred whenever TRG is issued
  - <F> : F Trap frequency
  - <CI> : CI/Z CI value at the trap frequency
  - <time> : Time required between two trap points
  - <NL^END>: NewLine^END (1 byte)

Filter measurement mode

- Data elements transferred whenever TRG is issued
  - <Loss> : Minimum or constant loss
  - <Δf_left> : -x dB BW (Δf_left)
  - <Δf_right> : -x dB BW (Δf_right)

HP-IB Commands Associated with Delta Mode

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}

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.

Equivalent Key Sequence	ΔF: Frequency value ΔCI: 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}, *<value>*

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}

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},{G01|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 inductandce
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 inductandce
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 πnetwork 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	(Trig)
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	((blue)) + (Trig (Trigger Mode))
Parameter Description	INTernal: Internal (Int) mode – Automatically triggered from within the HP E4915A/E4916A's internal circuitry. MANual: Manual (Man) mode – Triggered when you press the (Trig) key on the front panel. EXTernal: External (Ext) mode – Triggered when a TTL pulse signal is input through the Ext Trigger or Handler Interface port on the rear panel. BUS: Bus mode – Triggered when the GET or *TRG FETCh,TRIGIMM command is issued.
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}

ANLGREF⊔ *<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 ANLGREF? (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

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	CKT
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	HPIB
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 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.

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	`OFF`or`0`:Does not initiate the trigger system continuously. `ON`or`1` :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	BEEP
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␣<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␣{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 extterna 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⊔ *<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

***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 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	(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	—

***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	*<value>*: 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".

***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}

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*>

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}

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}

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}

ANLGREF␣ *<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 ANLGREF? (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).

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	■ Query response in Crystal Resonator measurement mode <num1> : Count of DUTs in bin 1. ... <num9> : Count of DUTs in bin 9. <num10> : Count of DUTs purged as OUT OF BIN. <num11> : Count of DUTs in the AUX bin. ■ Query response in Drive Level Dependency measurement mode <num1> : Count of DUTs in bin 1. ... <num5> : Count of DUTs in bin 5. <num6> : Count of DUTs purged as OUT OF BIN. <num7> : Count of DUTs in the AUX bin. <num8>~<num11>: Returns 0.

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 πnetwork 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},{G01|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 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.

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 Compen
Parameter Description	—
Query Response	Query form not supported.

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}

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}

*CLS

Clears the Status Byte, Operation Status, Questionable Status, and Standard Event Status registers.

Equivalent Key Sequence	—
Parameter Description	—
Query Response	—

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*>

CLTGTType␣{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 CLTGTType 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 :CLTGTType? (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	LmBW
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

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	LmΔZ
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).

Equivalent Key Sequence	ΔZ_H
Parameter Description	<*value1*> Limit value [MA|K|M|U|N|P|F]: Unit
Query Response	<*value1*> Limit value

COMPDLTF␣{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 ΔF limit test function. With this function ON, DUTs are evaluated to the ΔF 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	LmΔF
Parameter Description	OFF: ΔF limit test OFF ON: ΔF limit test ON 0: ΔF limit test OFF 1: ΔF limit test ON
Query Response	{1|0}

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	<*value1*> Limit value [MA|K|M|U|N|P|F]: Unit
Query Response	<*value1*> 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},<*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 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.

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	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}

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	AUX
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).

Equivalent Key Sequence	SEC
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	SecL – Lower limit value SecH – 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 COMP
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).

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.

Equivalent Key Sequence	ΔF : Frequency value ACI : 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}, <*value*>

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}

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	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}

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␣{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␣*<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?␣*<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	*<value1>* : Number of the trap poin *<value2>* Frequency at the trap point *<value3>* 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 *<value4>* : Output data (I/O port output ON only)
Query Response	*<value2>*,*<value3>*,{OFF|ON|0|1},*<value4>*

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␣<*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	StartP – Presents read-only display of the current value.
Parameter Description	<*value*> : Start point
Query Response	<*value*>

EMTMOUT␣<*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	Tout – Presents read-only display of the current value.
Parameter Description	<*value*> Time-out value [ms] [S|MS|M]: Unit of time (Defaults to the unit used in MS)
Query Response	<*value*>

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) + (μ/M (Equiv Ckt)) EQUC
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

5.HP-IB Command Reference

***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 exttema 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	xdB
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}

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	HPIB
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 is 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).

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).

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}

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

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.

Transferred Data	■ ASCII format transfer ASCII: <asc_data> ... <asc_data><NL^END> <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><NL^END> <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	
Spurious measurement mode	■ Data elements transferred whenever TRG is issued <F> : F (Measured resonance frequency: Fr, Fa, Fs) <FL> : FL (Measured resonance frequency) <CI> : CI/Z (Measured resonance impedance) ■ Data elements transferred with the Equivalent Circuit Analysis function ON (for both 4- and 6-element modes) <Q> : Q <Ts> : Ts <C0> : C0 <C1> : C1 <L1> : L1 <R1> : R1 ■ Data elements transferred with the Equivalent Circuit Analysis function ON (for 6-element mode only) <G0> : G0 <R0> : R0 ■ Data elements transferred with Aging mode ON <time> : Total elapsed time [ms]
Drive Level Dependency measurement mode	■ Data elements transferred whenever TRG is issued <F> : F (Measured resonance frequency: Fr, Fa, Fs) <CI> : CI/Z (Measured resonance impedance) ■ Data elements transferred with the Equivalent Circuit Analysis function ON (for both 4- and 6-element modes) <Q> : Q <Ts> : Ts <C0> : C0 <C1> : C1 <L1> : L1 <R1> : R1 ■ Data elements transferred with the Equivalent Circuit Analysis function ON (for 6-element mode only) <G0> : G0 <R0> : R0 ■ Number of spurious points <spur_num> : Number of detected spurious points ■ Data elements transferred when one or more spurious points are detected (these elements are transferred for each of the spurious points detected) <sF1> : Frequency of the spurious point <sCI1> : Impedance at the spurious point
Evaporation Monitor mode	■ Data elements transferred whenever TRG is issued <F> : F (Measured resonance frequency: Fr, Fa, Fs) <CI> : CI/Z (Measured resonance impedance) <STAT> : Indicates whether the tracking measurement was successful. 0: PASS 1: FAIL <DL> : DL value (setting)
Evaporation Monitor mode	■ Data elements transferred whenever TRG is issued <F> : F Trap frequency <CI> : CI/Z CI value at the trap frequency <time> : Time required between two trap points <NLEND>: NewLineEND (1 byte)
Filter measurement mode	■ Data elements transferred whenever TRG is issued <Loss> : Minimum or constant loss <Δf_left> : -x dB BW (Δf_left) <Δf_right> : -x dB BW (Δf_right)

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

MESTATe␣{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␣<*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*>

***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␣<*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

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␣<*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␣{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.

OUTPMData?

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	(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: 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	(blue) + (. (Reset))
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	ABORT
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, 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.

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 PTSWPType commands.

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

Equivalent Key Sequence	MAX
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, 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.

PTMINPower␣<*value*> Specifies the minimum drive level value. This command must be used in conjunction with the PTMAXPower and PTSWPType commands.

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

Equivalent Key Sequence	MIN
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, 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.

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	TRKG
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).

Equivalent Key Sequence	StartP
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	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}

PTSWPType␣{UPDOWN|UP|UPMIN|LIST}

Specifies the sweep type.

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

Equivalent Key Sequence	SWEP
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␣<*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	<*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*>

QSE␣<*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	<*value*>: Register value in decimal notation
Query Response	<*value*>: 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	<*value*> : 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	`CENT`
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	`DispSP`
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 `Nth` option (not required for the `Worst` option).
Query Response	*<value>* *<value>* : An integer value that represents the index number of the spurious point currently displayed (returns 0 if the `Worst` option was specified).

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	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}

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: 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.

Transferred Data

- ASCII format transfer ASCII: <num_elements>,<asc_data><NL^END>
  <asc_data>:=[<time>,]<F>,<FL>,<CI>[,<Q>,<Ts>,<C0>,<C1>,<L1>,<R1>
  [,<G0>,<R0>]] [,<comp>][,<phase>]<comp>:=<bin_num>,<pri>,<sec>
- Binary format transfer BINARY: #4<num_bytes><bin_data><NL^END>
  <bin_data>:=[<time>]<F><FL><CI>[<Q><Ts><C0><C1><L1><R1>
  [<G0><R0>]][<comp>][<phase>]<comp>:=<bin_num><pri><sec>

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 #400256 when 256 bytes are transferred).
  - <F> : F (Measured resonance frequency: Fr, Fa, Fs)
  - <FL> : FL (Measured resonance frequency)
  - <CI> : CI/Z (Measured resonance impedance)
- Data elements transferred with the Equivalent Circuit Analysis function ON (for both 4- and 6-element modes)
  - <Q> : Q
  - <Ts> : Ts
  - <C0> : C0
  - <C1> : C1
  - <L1> : L1
  - <R1> : R1
- Data elements transferred with the Equivalent Circuit Analysis function ON (for 6-element mode only)
  - <G0> : G0
  - <R0> : R0
- 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 Aging mode ON (refer to the OUTPMData command)
  - <time> : Total elapsed time [ms]
- New Line
  - <NL^END>: NewLine^END (1 byte)

*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.

Transferred Data

- ASCII format transfer ASCII: <num_elements>,<asc_data><NL^END>
  <asc_data>:=<CL>
- Binary format transfer BINARY: #4<num_bytes><bin_data><NL^END>
  <bin_data>:=<CL>

Data Elements

<num_elements> : Number of data elements transferred
<num_bytes>: Number of bytes transferred
<CL> : Actual CL value
<NL^END>: NewLine^END (1 byte)

*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.

Transferred Data	■ ASCII format transfer ASCII: <num_elements>,<asc_data><NL^END> <asc_data> = <F>,<CI>,<spur_num>[,<sF1>,<sCI1>[,<sF2>,<sCI2>[, ...]]] ■ Binary format transfer BINARY: #4<num_bytes><bin_data><NL^END> <bin_data> = <F><CI><spur_num>[<sF1><sCI1>[<sF2><sCI2>[...]]]
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 #40048 when 48 bytes are transferred). <F> : F (Measured resonance frequency: Fr, Fa, Fs) <CI> : CI/Z (Measured resonance impedance) ■ Number of spurious points <spur_num> : Number of detected spurious points ■ Data elements transferred when one or more spurious points are detected (these elements are transferred for each of the spurious points detected) <sF1> : Frequency of the spurious point <sCI1> : Impedance at the spurious point ■ New Line <NL^END>: NewLine^END (1 byte)

*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.

Transferred Data	■ ASCII format transfer ASCII: <num_elements>,<asc_data><NL^END> <asc_data> = <F>,<CI>,<time> ■ Binary format transfer BINARY: #4<num_bytes><bin_data><NL^END> <bin_data> = <F><CI><time>
Data Elements	<num_elements> : Number of data elements transferred <num_bytes>: Number of bytes transferred (for example, this element contains #40048 when 48 bytes are transferred). <F> : F (Trap frequency) <CI> : CI/Z (CI value at the trap frequency) <time> : Time required between two trap points <NL^END>: NewLine^END (1 byte)

*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.

Transferred Data

- ASCII format transfer
  <num_elements>,<asc_data><NL^END>
  - <asc_data>:=<F>,<CI>,<STAT>,<DL>,<MinFR>,<MaxF>,<MinCI>,<MaxCI>
  - <MaxF-MinF>,<MaxCI-MinCI>[,<comp>]
  - <comp>:=<bin_num>,<pri>,<sec>,<t_1>,<t_2>
- Binary format transfer
  #4<num_bytes><bin_data><NL^END>
  - <bin_data>:=<F><CI><STAT><DL><MinF><MaxF><MinCI><MaxCI>
  - <MaxF-MinF><MaxCI-MinCI>[<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 #400256 when 256 bytes are transferred).
  - <F> : F (Resonance frequency measured at the reference drive level)
  - <CI> : CI/Z (Resonance impedance measured at the reference drive level).
  - <STAT> : Indicates whether the tracking measurement was successful.
    - 0: PASS
    - 1: FAIL
  - <MinF> : Minimum <F> value
  - <MaxF> : Maximum <F> value
  - <MinCI> : Minimum <CI> value
  - <MaxCI> : Maximum <CI> value
  - <MaxF-MinF> : Difference between maximum and minimum <F> values
  - <MaxCI-MinCI> : Difference between maximum and minimum <CI> values
- 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
  - <t_1> : Result of ΔF limit test
    - 0: PASS
    - 1: FAIL
    - -1: ΔF limit test OFF
  - <t_2> : Result of ΔCI limit test
    - 0: PASS
    - 1: FAIL
    - -1: ΔCI limit test OFF
- New Line
  - <NL^END>: NewLine^END (1 byte)

*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.

Transferred Data	■ ASCII format transfer ASCII: <num_elements>,<asc_data><NL^END> <asc_data>:=<Loss>,<Δf_left>,<Δf_right> ■ Binary format transfer BINARY: #4<num_bytes><bin_data><NL^END> <bin_data>:=<Loss><Δf_left><Δf_right>
Data Elements	<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.

Equivalent Key Sequence	(Trig)
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	(blue) + Trig (Trigger Mode)
Parameter Description	INTernal: Internal (Int) mode – Automatically triggered from within the HP E4915A/E4916A's internal circuitry. MANual: Manual (Man) mode – Triggered when you press the Trig key on the front panel. EXTernal: External (Ext) mode – Triggered when a TTL pulse signal is input through the Ext Trigger or Handler Interface port on the rear panel. BUS: Bus mode – Triggered when the GET or *TRG FETCh,TRIGIMM command is issued.
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	{1|4|8|16} 1: Test1 RAM 4: Test2 Calibration data 8: Test3 Flashmemory(program area) 16: Test4 Backup memory

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

<table>
<tr><th>COMMAND</th><th>PARAMETER</th><th>NOTE</th></tr>
<tr><td>ABORt</td><td></td><td>[No Query]</td></tr>
<tr><td>CALCulate{1|2|3|4}</td><td></td><td></td></tr>
<tr><td>:FORMat</td><td>{REAL|MLINear|CP|CS|LP|LS|
IMAGinary|PHASe|D|Q|REAL|RP}</td><td></td></tr>
<tr><td>:MATH</td><td></td><td></td></tr>
<tr><td>:EXPRession</td><td></td><td></td></tr>
<tr><td>:CATalog?</td><td></td><td>[Query Only]</td></tr>
<tr><td>:NAME</td><td>{DEV|PCNT}</td><td></td></tr>
<tr><td>:STATe</td><td><Boolean></td><td></td></tr>
<tr><td>:PATH?</td><td></td><td>[Query Only]</td></tr>
<tr><td>CALCulate{5|6}</td><td></td><td></td></tr>
<tr><td>:MATH</td><td></td><td></td></tr>
<tr><td>:STATe</td><td><Boolean></td><td></td></tr>
<tr><td>DATA</td><td></td><td></td></tr>
<tr><td>[:DATA]</td><td>{REF1|REF2},<<i>value</i>></td><td></td></tr>
<tr><td>[:DATA]?</td><td>{BUF1|BUF2}
{IMON|VMON}</td><td>[Query Only]
[Query Only]</td></tr>
<tr><td>:FEED</td><td></td><td></td></tr>
<tr><td>:CONTrol</td><td>{ALWays|NEVer}</td><td></td></tr>
<tr><td>:POINts</td><td><<i>value</i>></td><td></td></tr>
<tr><td>DISPlay</td><td></td><td></td></tr>
<tr><td>[:WINDow]</td><td></td><td></td></tr>
<tr><td>[:STATe]</td><td><Boolean></td><td></td></tr>
<tr><td>:TEXT</td><td></td><td></td></tr>
<tr><td>:STATe</td><td><Boolean></td><td></td></tr>
<tr><td>:TEXT1</td><td></td><td></td></tr>
<tr><td>:DIGit</td><td><<i>value</i>></td><td></td></tr>
<tr><td>:TEXT2</td><td></td><td></td></tr>
<tr><td>:PAGE</td><td><<i>value</i>></td><td></td></tr>
<tr><td>FETCh?</td><td></td><td>[Query Only]</td></tr>
<tr><td>FORMat</td><td></td><td></td></tr>
<tr><td>[:DATA]</td><td>{ASCii|REAL[,64]}</td><td></td></tr>
<tr><td>INITiate</td><td></td><td></td></tr>
<tr><td>:CONTinuous</td><td><Boolean></td><td>[No Query]</td></tr>
<tr><td>[:IMMediate]</td><td></td><td>[No Query]</td></tr>
<tr><td>[SENSe]</td><td></td><td></td></tr>
<tr><td>:AVERage</td><td></td><td></td></tr>
<tr><td>:COUNt</td><td><<i>value</i>></td><td></td></tr>
<tr><td>[:STATe]</td><td><Boolean></td><td></td></tr>
<tr><td>:CORRection{1|2}</td><td></td><td></td></tr>
<tr><td>:CKIT</td><td></td><td></td></tr>
<tr><td>:STNdard{1|2|3}</td><td><<i>value</i>>,<<i>value</i>></td><td></td></tr>
<tr><td>:COLLect</td><td></td><td></td></tr>
<tr><td>[:ACQuire]</td><td>STANdard{1|2|3}</td><td>[No Query]</td></tr>
<tr><td>:CORRection</td><td></td><td></td></tr>
<tr><td>:DATA?</td><td></td><td>[Query Only]</td></tr>
<tr><td>:FIMPedance</td><td></td><td></td></tr>
<tr><td>:APERture</td><td>{Short|Med|Long}</td><td></td></tr>
<tr><td>:FUNCtion</td><td></td><td></td></tr>
<tr><td>[:ON]</td><td><sensor_function></td><td></td></tr>
</table>

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]
:SUQuence		
:BIN	<BIN1 low limit>, <BIN1 high limit>,<BIN2 high limit>, <BIN3 high limit>, . . . <BIN*n* 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 on level on the command tree. When the colon is the first character of a command, it specifies that the following command mnemonics a root-level command.

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 then 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.

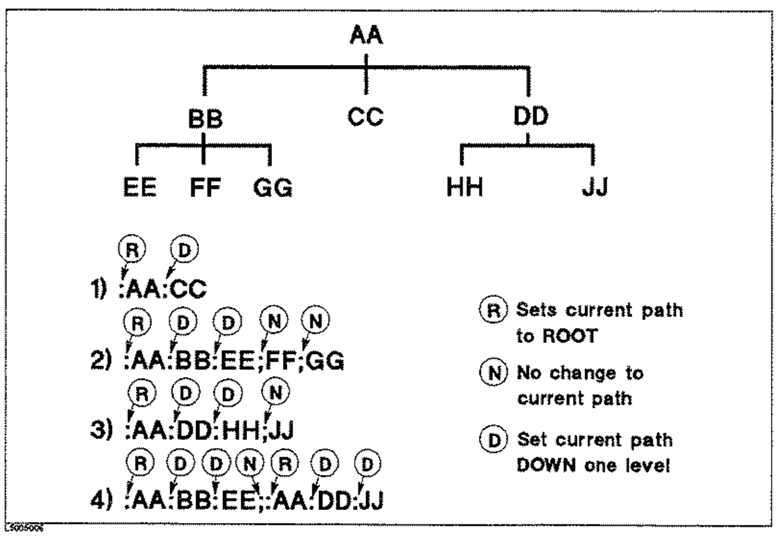


Figure 5-1. Proper Use of the Colon and Semicolon

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 in formation 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 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

<table>
<tr><th>Definition</th><th>Mnemonic</th><th>Usable Unit</th></tr>
<tr><td>10^{6} (Mega)</td><td>MA</td><td rowspan="3">Hz
V
OHM
S</td></tr>
<tr><td>10^{3} (kilo)</td><td>K</td></tr>
<tr><td>10^{-3} (Milli)</td><td>M</td></tr>
</table>

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*>.

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
IMAGinay	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[1]	CALC1|3:FORM	CALC2|4:FORM
Z-θ R-X	"FIMPedance"	MLINear REAL	PHASe IMAGinary
Y-θ G-B	"FADMittance"	MLINear REAL	PHASe IMAGinary
C_P-D C_P-Q C_P-G C_P-R_P	"FADMittance"	CP	D Q REAL RP
C_S-D C_S-Q C_S-R_S	"FIMPedance"	CS	D Q REAL
L_P-D L_P-Q L_P-G L_P-R_P	"FADMittance"	LP	D Q REAL RP
L_S-D L_S-Q L_S-R_S	"FIMPedance"	LS	D Q REAL

1 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 VMON 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>]

<status>	0 (always)
<data1>	Measurement data of 1st primary parameter
<data2>	Measurement data of 1st secondary parameter
<data3>	Measurement data of 2nd primary parameter
<data4>	Measurement data of 2nd secondary parameter
[<comp>]	Comparator result
<num-bytes>	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 ad an error -213 is generated.

:INITiate:CONTinuous {ON|OFF|1|0}

Sets or queries whether the trigger system is continuously initiated or not.

`OFForO`	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,

numeric	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"}.

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:μ	MW:n	W:W	MA:mA	UA:μ
A:A	MV:mV	UV:μ	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 clears 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.
OFFF 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

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>, . . . <BIN*n* 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.

6

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.

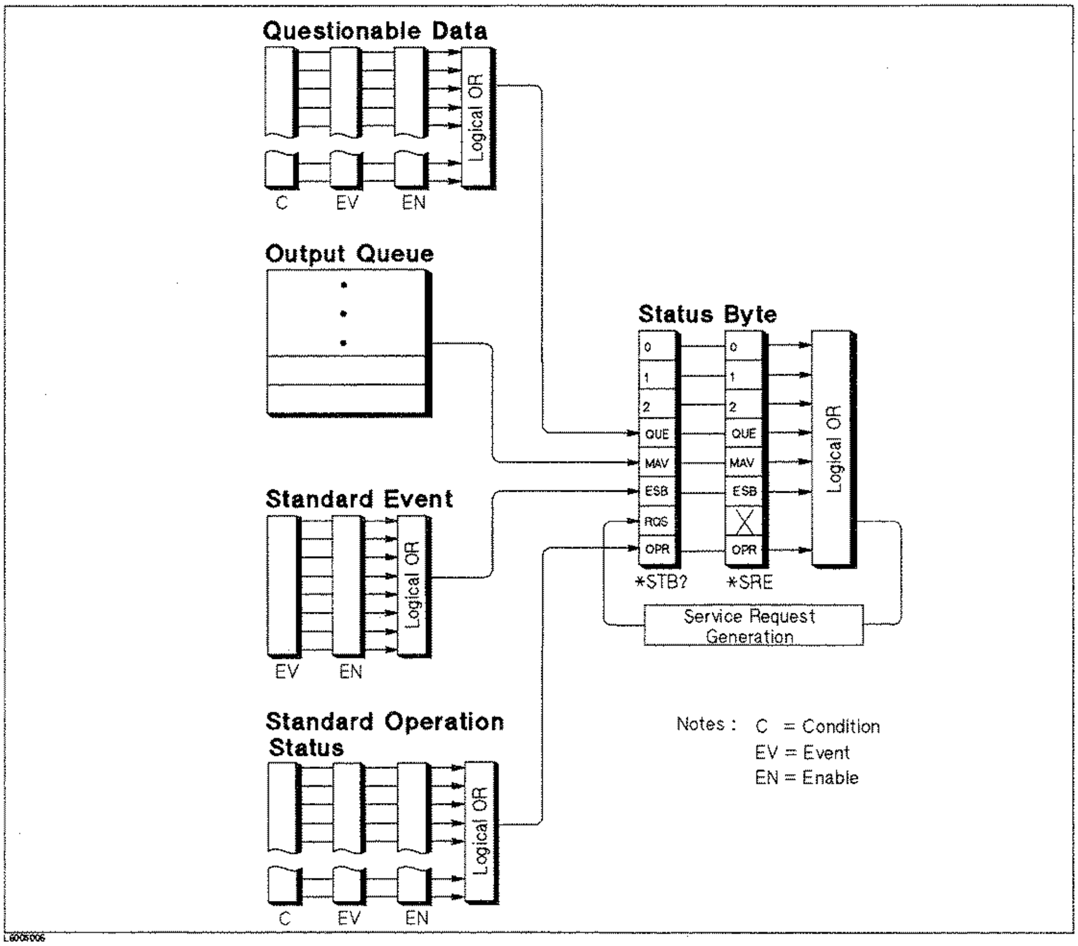


Figure 6-1. General Status Register Model

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 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.

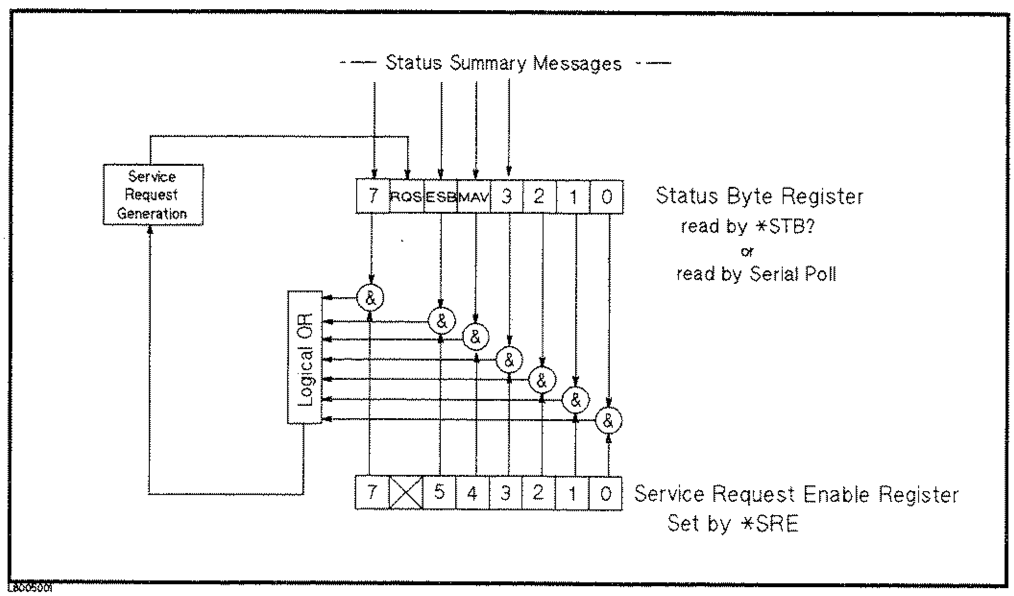


Figure 6-2. Status Byte Register

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)

Statndard 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.

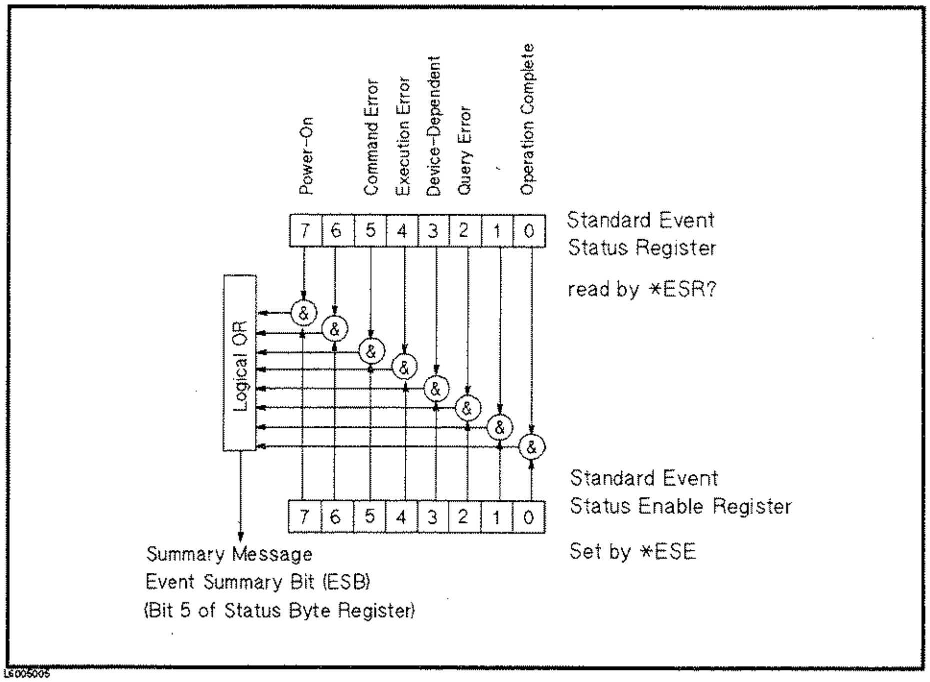


Figure 6-3. Standard Event Status Register

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. • An IEEE 488.2 syntax error occurred. • The HP E4915A/E4916Areceived a Group Execute Trigger (GET)
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.

Standard Operation Status Group

The HP E4915A/E4916A provides two Standard Operation Status group — Operation Status Register group an d 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.

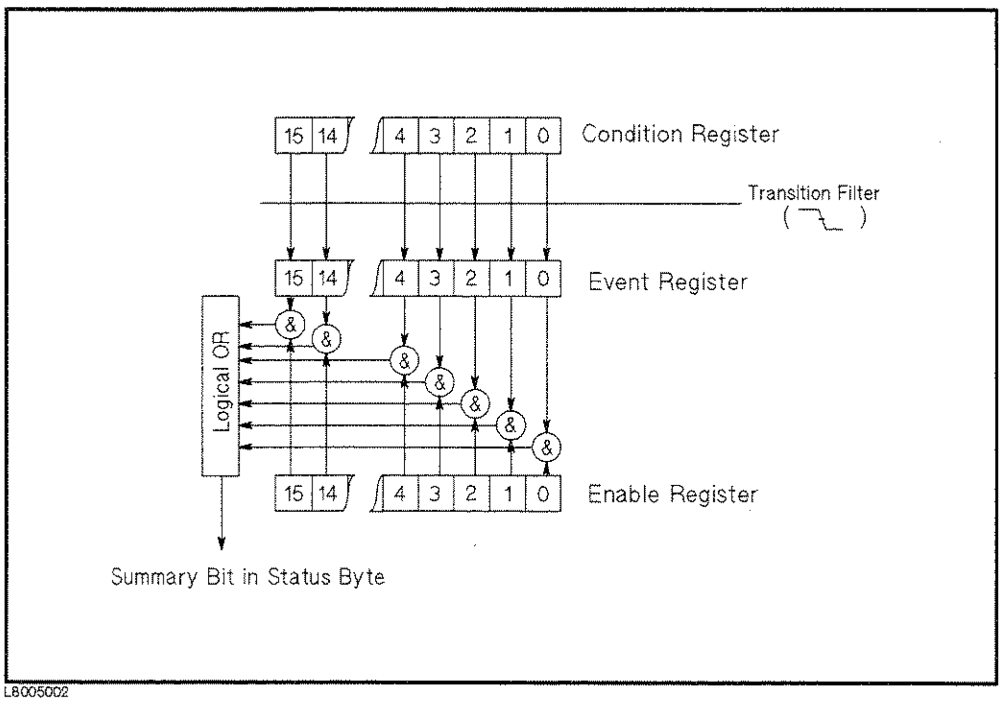


Figure 6-4. Standard Operation Status Group Structure

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)

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"`	*Enable Measuring bit of Operation Status Register*
`REPEAT`	*Wait until the Operation Status Register Summary bit is set*
`  A=SPOLL(717)`	
`UNTIL BIT(A,7)`	

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
```

7

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.

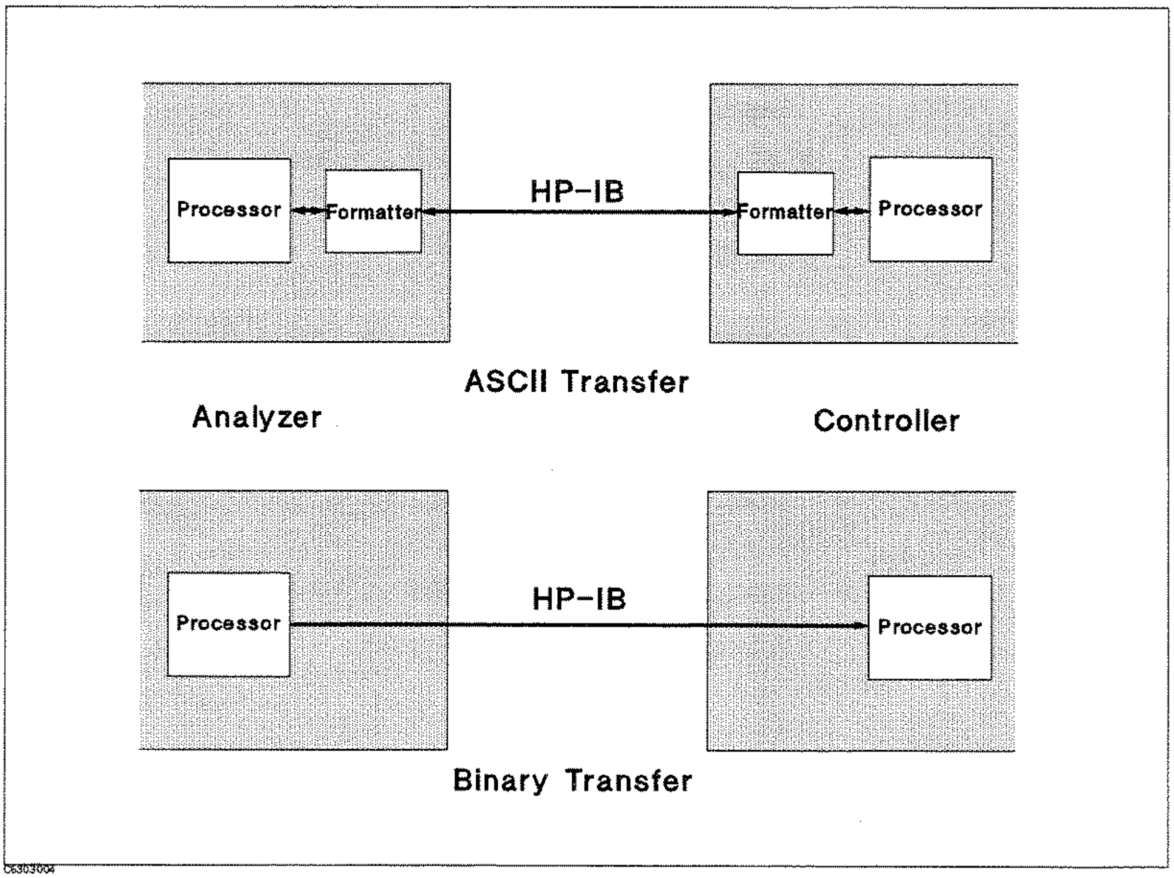


Figure 7-1. Simplified Internal Process of ASCII and Binary Transfer

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)            Define the data array for receiving.
OUTPUT @E4915;"FORM ASC"      Specify the ASCII format.
OUTPUT @E4915;"*TRG"          Trigger and query the data trace.
ENTER @E4915;A,B,C            Retrieve the data.
```

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.

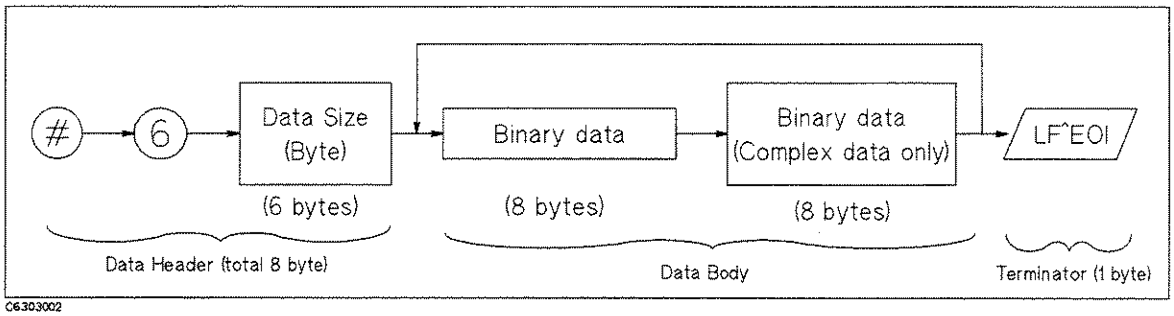


Figure 7-2. IEEE 64-bit floating point format

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.

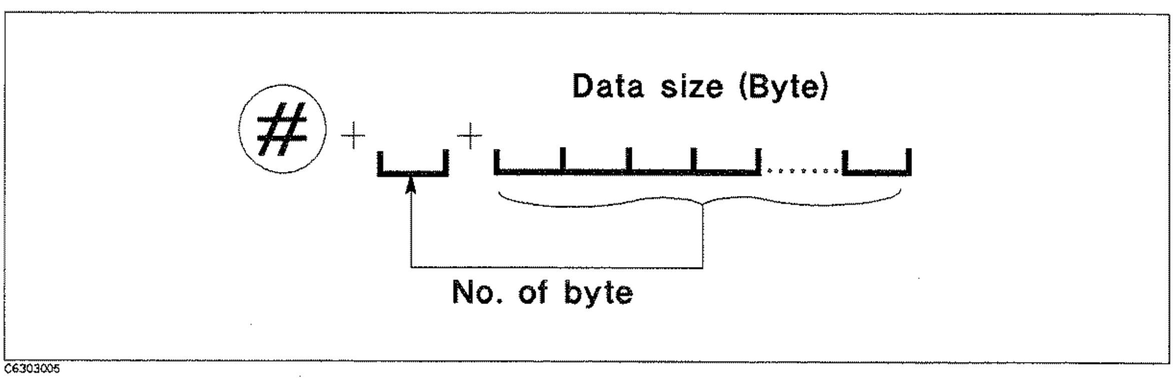


Figure 7-3. Binary Data Header

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`	*Binary path must turn off the formatting. Use* 717 *instead of* 800 *for the external controller.*
`OUTPUT @E4915;"FORM:DATA REAL,64"`	*Specify the format as IEEE 64-bit format.*
`OUTPUT @E4915;"TRG?"`	*Query the data trace array.*
`ENTER @E4915 USING "#,6A";Header$`	*Data header is 6 byte character.*
`ENTER @Dt;A,B,C`	*Receiving data via binary path.*
`ENTER @E4915;End$`	*Reading terminator.*
`OUTPUT @E4915;"FORM:DATA ASC"`	*Set ASCII mode if binary transfer is finished.*

Getting Data from Analyzer Using Binary Transfer

8

Sample Program

This chapter provides sample programs to controll 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 calibartion, 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
```

Comparater 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 ! MESUREMENT 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,-100.0PPM,100.0PPM"
1280 !        0.01% <=  VALUE  <=0.01%
1290   OUTPUT @E4916;":COMPPLIM BIN2,-200.0PPM,200.0PPM"
1300 !        0.02% <=  VALUE  <=0.02%
```

```
1310   OUTPUT @E4916;":COMPPLIM BIN3,-300.0PPM,300.0PPM"
1320 !        0.03% <=  VALUE  <=0.03%
1330   OUTPUT @E4916;":COMPPLIM BIN4,-400.0PPM,400.0PPM"
1340 !        0.04% <=  VALUE  <=0.04%
1350   OUTPUT @E4916;":COMPPLIM BIN5,-500.0PPM,500.0PPM"
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_qu
ery(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;Bufdatab(*)
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     Measdatax(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";"C0 : ";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 0"
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"
```

8.Sample Program

```
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 calibartion, 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 Settting

```
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
```

9

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, Δf_left, Δf_right

Source

Frequency Characteristics

Range .... 1 MHz to 180 MHz

Accuracy (at 23 ± 5°C) .... ±2 ppm

Stability (at 23 ± 5°C) .... 1 ppm/year

Resolution .... 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.

Resolution (HP E4916A only) .... 0.1 dB

Level Accuracy (at 23 ±5°C, −5 dBm output level) .... ± 2 dB

Linearity (at 23 ±5°C, relative to −5 dBm output level at 10 MHz)

HP E4916A .... ±2 dB

Equivalent Output SWR .... ≤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

Reverse Power Protection .... 25 dBm, 25 Vdc

Output Connector .... BNC female

Output Impedance .... 50 Ω (nominal)

Receiver

Input Characteristics

Measurement Range

Frequency .... 1 MHz to 180 MHz

Measurement Resolution

Frequency .... 1 mHz

X'tal Impedance .... 10 mΩ

Return Loss (at 50 Ω input)

1 MHz ≤ 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)

9.Specifications

Ratio Characteristics

Frequency Response

Note Frequency response can be improved by calibration.

Dynamic Accuracy

(at 23 ±5°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	±0.4 dB
−30 dBm to −40 dBm	±0.1 dB
−40 dBm to −50 dBm	±0.05 dB
−50 dBm to −60 dBm	±0.05 dB
−60 dBm to −70 dBm	±0.1 dB
−70 dBm to −80 dBm	±0.5 dB
−80 dBm to −90 dBm	±1.0 dB

HP E4916A

Test channel input level	Dynamic accuracy (SPC)
0 dBm to −20 dBm	±0.5 dB
−20 dBm to −30 dBm	±0.4 dB
−30 dBm to −40 dBm	±0.1 dB
−40 dBm to −50 dBm	±0.05 dB
−50 dBm to −60 dBm	±0.05 dB
−60 dBm to −70 dBm	±0.1 dB
−70 dBm to −80 dBm	±0.5 dB
−80 dBm to −90 dBm	±1.0 dB

Trace Noise

@ 23±5 °C, 10 Hz IFBW .... 20 mdB rms(SPC)

Stability

@ 23±5 °C .... 50 mdB/°C(SPC)

Phase Characteristics

Dynamic Accuracy

(at 23 ±5°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	±3°
−30 dBm to −40 dBm	±0.6°
−40 dBm to −50 dBm	±0.3°
−50 dBm to −60 dBm	±0.6°
−60 dBm to −70 dBm	±0.3°
−70 dBm to −80 dBm	±5°
−80 dBm to −90 dBm	±10°

HP E4916A

Test channel input level	Dynamic accuracy (SPC)
0 dBm to −20 dBm	±5°
−20 dBm to −30 dBm	±3°
−30 dBm to −40 dBm	±0.6°
−40 dBm to −50 dBm	±0.3°
−50 dBm to −60 dBm	±0.6°
−60 dBm to −70 dBm	±0.3°
−70 dBm to −80 dBm	±5°
−80 dBm to −90 dBm	±10°

Trace Noise

@ 23±5 °C, 10 Hz IFBW .... 100 mdeg rms(SPC)

Stability

@ 23±5 °C ....200 mdeg/°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 Ω to 100 kΩ
|Y|,G,B .... 10 μS to 10 S
θ .... −180° to 180°
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 mΩ
|Y|,G,B .... 1 μS

θ .... 0.1°
L .... 10 pH
C .... 1 fF
D 0.0001
Q 0.1

Basic accuracy (for information purpose only) .... 3% (SPC)

$3+(0.001+2.5\times10^{-5}|Z|+0.1|Y|)\times(40+f)$ [%]

(where,Z:Ω,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°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°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_{ih} .... +2 V to +5 V (SPC)
V_{il} .... 0 V to +0.5 V (SPC)
Sink current (Is) .... $Is \leq 0.4$ mA (SPC)
Pulse width (Tp) .... $Tp \geq 25.6$ μsec (SPC)

ANALOG OUTPUT .... ±5 V (SPC)

Furnished Accessories

Accessory	HP part number
Two 30 cm BNC leads[1]	8120-1838
Two 120 cm BNC leads[2]	8120-1840
Operation Manual	E4915-90000
User's Guide	E4915-90001
Sample Program Disk	E4915-61001
Impedance Probe Kit[3]	N/A

Accessory	HP part number
Crystal Measurement Software for HP VEE[4]	N/A
Rack mount kit[5]	5063-9241
Front handle kit[6]	5063-9226

1 HP E4915A only
2 HP E4916A only
3 Option 001 only
4 Option 020 only
5 Option 1CM only
6 Option 1CN only

9.Specifications

Specifications of HP E4916A Option 001 Impedance Probe Specifications

Usable Frequency Range .... 1 MHz to 180 MHz

DC Bias Range .... ±30 V, ±0.5 A

Test Cable Length .... 1.5 m (Nominal)

Dimensions .... 1500 mm

Weight .... approx. 1.7 k

Operation Environment

Temperature .... −20°C to 65°C
Relative humidity .... 95% at 40°C

Storage Environment

Temperature .... −40°C to 65°C

Damage Level .... ±35 Vpp

Supplemental Performance Characteristics

Supplemental characteristics are not guaranteed.

Test Signal Range

HP E4915A

with PI-fixture (CI=25 Ω) .... approximate 5 μW

HP E4916A

with PI-fixture (CI=25 Ω)
Power .... 100 pW to 1 mW
Voltage .... 40 μV to 161 mV
Current .... 2 μA to 6.4 mA
with Z probe (CI=25 Ω)
Power .... 500 pW to 31 mW
Voltage .... 100 μV to 880 mV
Current .... 45 μ to 35 mA

Level Monitor Range

with PI-fixture (CI=25 Ω)
Voltage .... 0 to 320 mV
Current .... 0 to 13 mA
with Z probe (CI=25 Ω)
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 Ω or 37.5 Ω), the test signal level will be two times (+6 dB).

IF Bandwidth

Normal Mode

	Freq/Xtal	Freq/Xtal (LP)[1]	Aging/DLD	EM	LCR	LCR (LP)[1]
Short	300 Hz	50 Hz	1 kHz	800 Hz	300 Hz	50 Hz
Medium	100 Hz	20 Hz	300 Hz	200 Hz	100 Hz	5 Hz
Long	50 Hz	10 Hz	100 Hz	100 Hz	50 Hz	1 Hz

1 When test signal level is less than −29 dBm

High Q mode

	Freq/Xtal	Freq/Xtal (LP)[1]	Aging/DLD	EM
Short	30 Hz	5 Hz	50 Hz	80 Hz
Medium	20 Hz	3 Hz	20 Hz	50 Hz
Long	10 Hz	2 Hz	10 Hz	30 Hz

1 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 $5\ \Omega \leq CI \leq 125\ \Omega$

Fr frequency .... ±2 ppm
X'tal Impedance .... ±5%

Measurement Time

Normal Mode

	Freq/Xtal		Freq/Xtal (LP)[1]		Aging/DLD	EM	LCR	LCR (LP)[1]
	Phase Search	Peak Search	Phase Search	Peak Search				
Short	125 ms	350 ms	250 ms	750 ms	17 ms to 33 ms	4 ms	20ms	33 ms
Medium	280 ms	800 ms	750 ms	2 s	20 ms to 64 ms	5 ms	50 ms	200 ms
Long	800 ms	1.5 s	2 s	4 s	25 ms to 100 ms	10 ms	200 ms	1000 ms

1 When test signal level is less than −29 dBm

High Q Mode

	Freq/Xtal		Freq/Xtal (LP)[1]		Aging/DLD	EM	LCR	LCR (LP)[1]
	Phase Search	Peak Search	Phase Search	Peak Search				
Short	1.5 s	3 s	4.5 s	8 s	35 ms to 190 ms	12 ms	-	-
Medium	3 s	6 s	8 s	16 s	70 ms to 300 ms	20 ms	-	-
Long	8 s	14 s	16 s	33 s	120 ms to 460 ms	30 ms	-	-

1 When test signal level is less than −29 dBm

A

Manual Changes

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.

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.

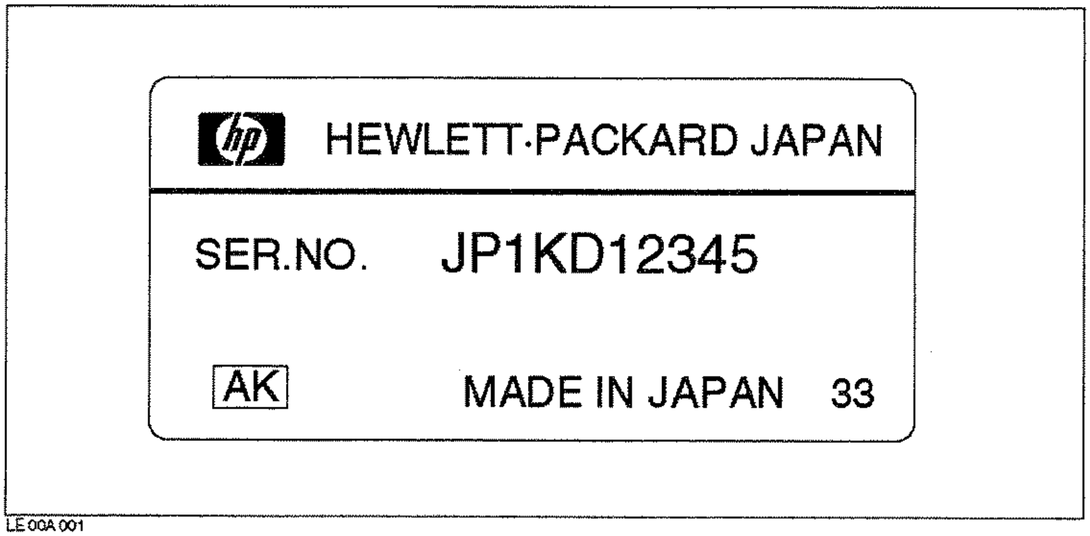


Figure A-1. Serial Number Plate

B

Valid Ranges and Initial Settings

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 exlusive.

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
CI/Z (nominal)	1 Ω to 1 kΩ	25 Ω
ALC	on|off	off
Drive level	−60 dBm to 18 dBm	−5.0 dBm
πNetwork Test Fixture	0.1 nW to 1 mW	5 μW
	2 μA to 6.4 mA	
	50 μV to 160 mV	
Probe, Bridge	500 pW to 31 mW	
	45 μA to 35 mA	
	100 μV 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
Δ mode	DEV|(PPM|%)|off	DEV
Δ mode reference value (F)	Nominal value|User-specified value [Hz]	Nominal value
Δ mode reference value (CI)	Nominal value|User-specified value [Ω]	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|Dld|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 μW
Unit of drive level	W|A|V|dBm	W
ALC	on|off	off
CI (nominal)	1 Ω to 1kΩ	25 Ω
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|Dld|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 Ω to 1 kΩ	25 Ω
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 μW
Maximum drive level.	0.1 nW to 1 mW	10 μW
Standard drive level.	0.1 nW to 1 mW	5 μW
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
Δ mode	DEV|(PPM|%)|off	DEV
Δ mode reference value (F)	Start value|Reference value|Nominal value|User-specified value [Hz]	Nominal value
Δ mode reference value (CI)	Start value|Reference value|Nominal value|User-specified value [Ω]	Nominal value
Search target	Phase	Phase
Target phase value	-180 to 180 °	0 °
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	θz,θy,X,B,D,Q,G,Rp,Rs	θz
Primary measured parameters 2	Z,Y,R,G,Cp,Cs,Lp,Ls	R
Secondary measured parameters 2	θz,θy,X,B,D,Q,G,Rp,Rs	X
Measuring Time	Short|Med|Long	Med
Averaging cycles.	1 to 256 cycles	1 cycle
Signal level. (Vosc)	50 μV 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
Δ mode (ΔPri)	OFF|DEV|%	DEV
ΔPri std.		0
Δ mode (ΔSec)	OFF|DEV|%	DEV
ΔSec 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

ΔF Limit/ΔCI Limit Test Function

The ΔF Limit/ΔCI Limit Test function is available only when the Comparator function is used in Drive Level Dependency measurement mode.

Function	Valid Range	Preset Value
ΔF limit test ON/OFF.	on|off	off
ΔF limit value		0
ΔCI limit test ON/OFF.	on|off	off
ΔCI limit value		0

System Menu Settings

Function	Valid Range	Preset Value
Δ 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 $\geq 1\ \mu s$

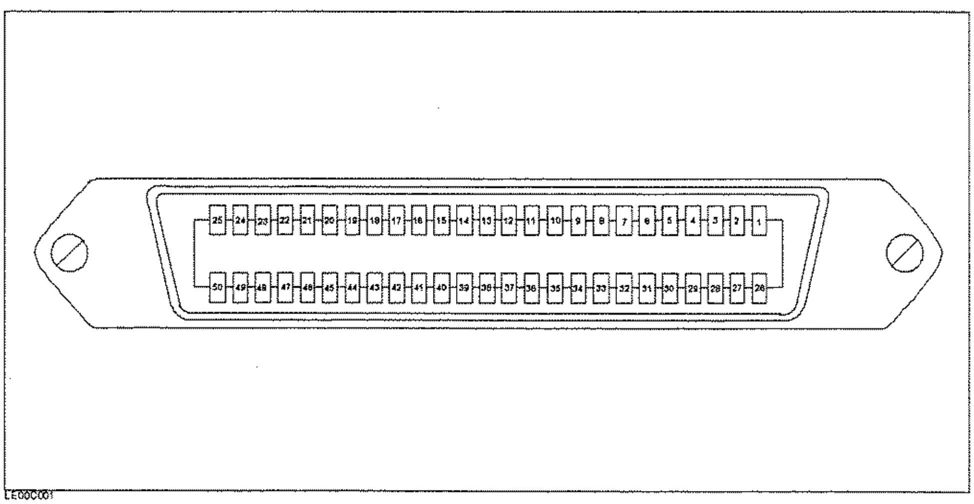


Figure C-1. Pin Assignment of Handler Interface Connector

Table C-1. Pin Assignment of Handler Interface Connector

Pin No.	Signal Name[1]	Description
1		Not used.
2		Not used.
3	/DATA0	Data output[2]
4	/DATA1	Data output[2]
5	/DATA2	Data output[2]
6	/DATA3	Data output[2]
7	/DATA4	Data output[2]
8	/DATA5	Data output[2]
9	/DATA6	Data output[2]
10	/DATA7	Data output[2]
11	/DATA8	Data output[2]
12	/DATA9	Data output[2]
13	/DATA10	Data output[2]
14	/DATA11	Data output[2]
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 ± 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.

1 The / (slash) means that the signal is asserted when LOW.

2 See to Table C-2

Table C-1. Pin Assignment of Handler Interface Connector (continued)

Pin No.	Signal Name[1]	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	

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[1]	BIN8
11	/DATA8	BIN9	IO data	Sec Pass/Fail[1]	BIN9
12	/DATA9	OUT OF BINS	IO data	3rd(1) Pass/Fail[1]	BIN10
13	/DATA10	AUX BIN	IO data	3rd(2) Pass/Fail[1]	OUT OF BINS
14	/DATA11	Search Fail	IO data	Search Fail	AUX BIN

1 Pass:0,Fail:1

C.Handler Interface

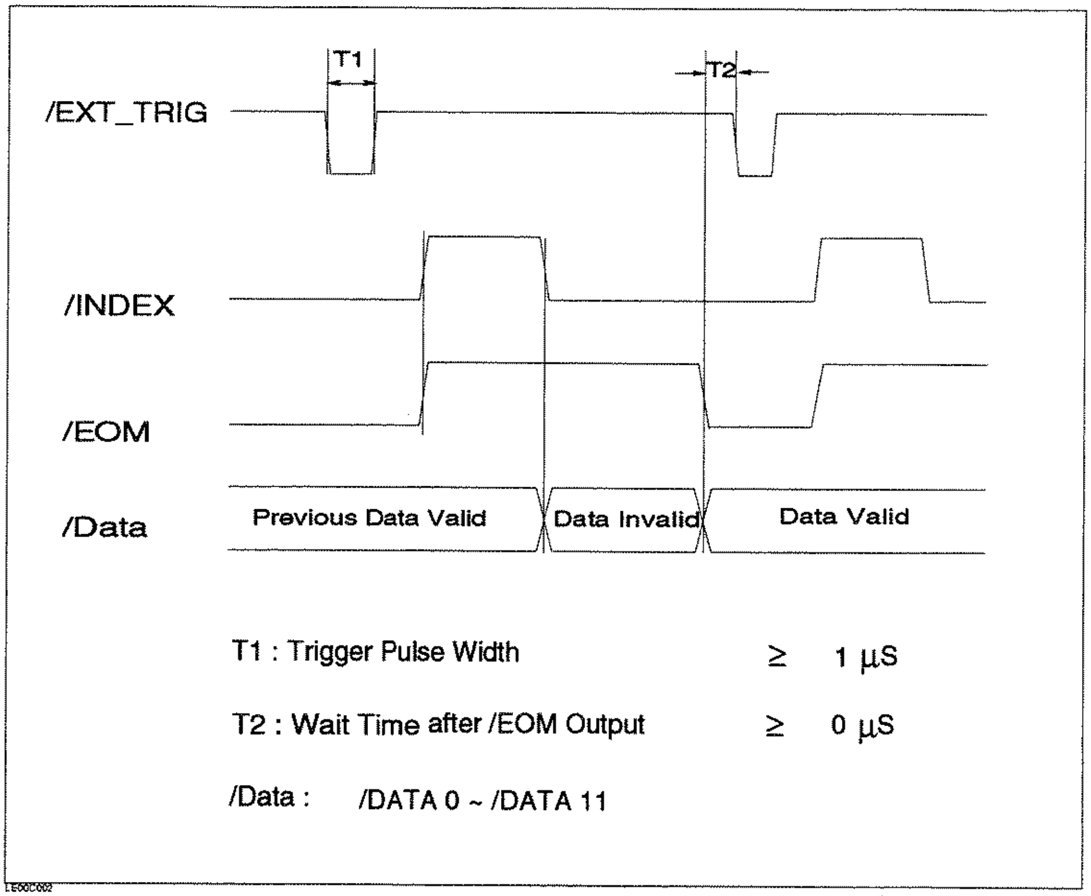


Figure C-2. Timing Diagram

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

C.Handler Interface

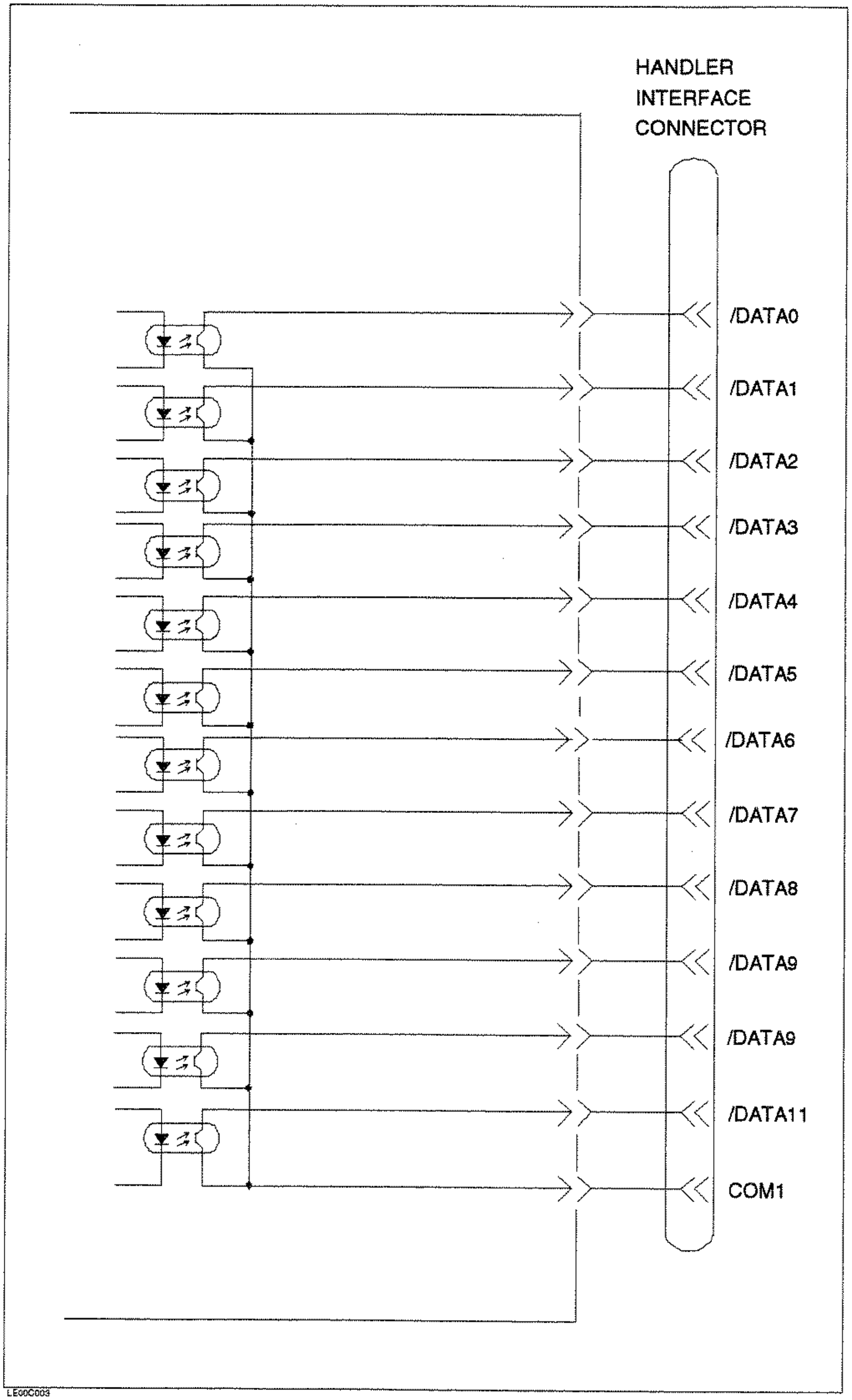


Figure C-3. Handler Interface Comparison Output Signals Diagram

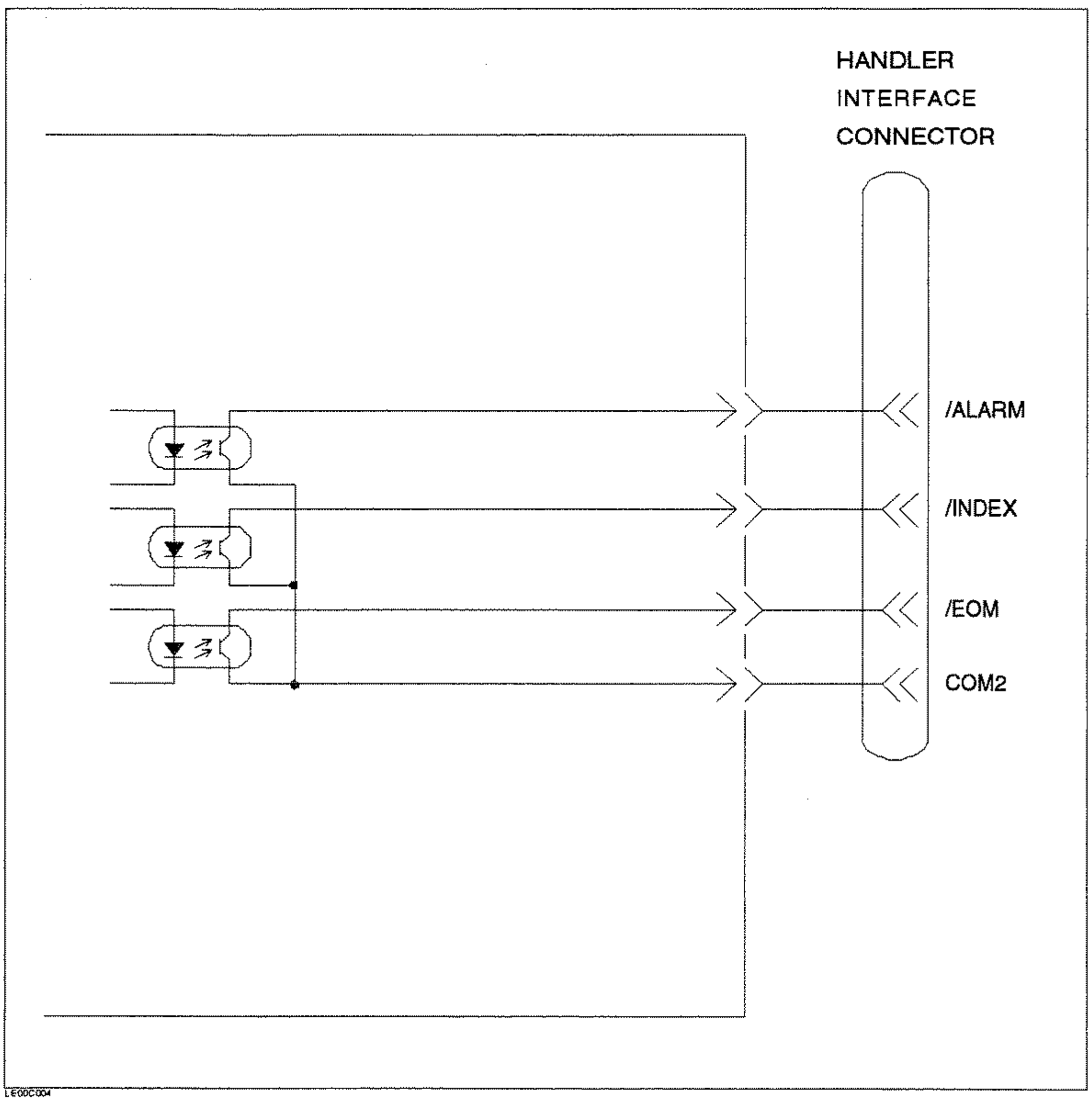


Figure C-4. Handler Interface Control Output Signals Diagram

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

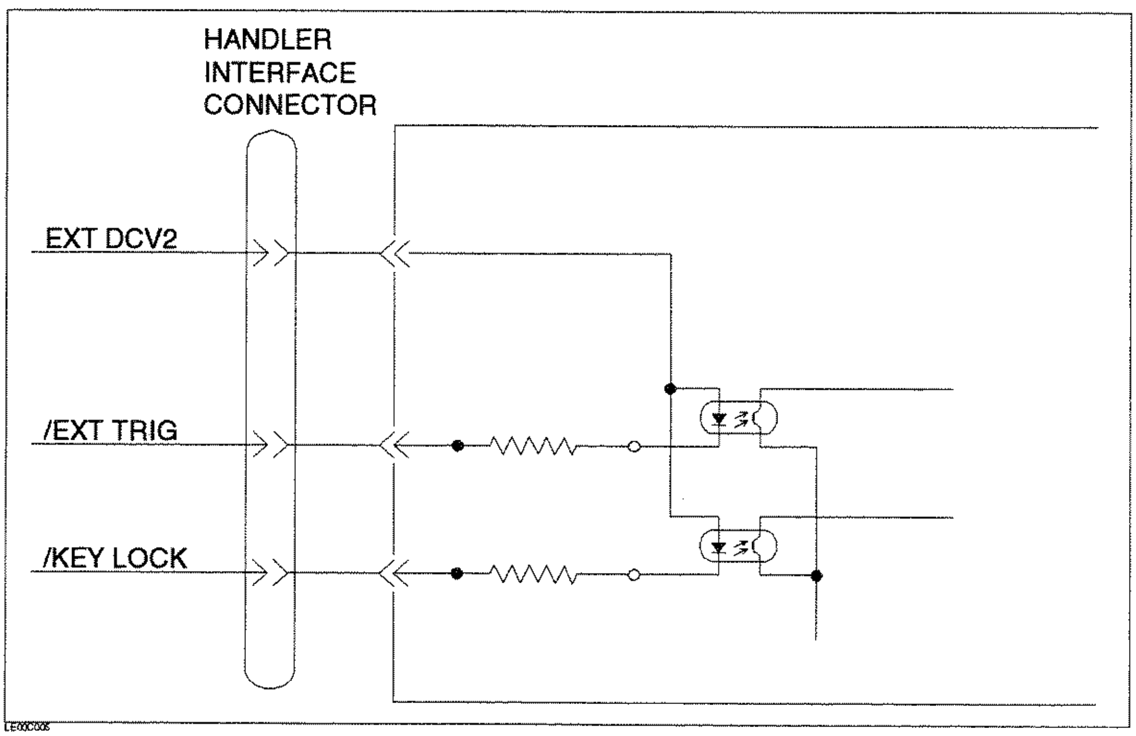


Figure C-5. Handler Interface Input Signal Diagram

D

Installing Option 020 HP VEE Program

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

For more information on HP VEE, please refer the manual furnished with HP VEE.

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 devises 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 Δmode)
- Graphic display, X-axis, point, Y-axis, Measurement value (except for Δmode)

Note

Even all measurement data may not be displayed on the screen, all data will be saved in a text or CSV format file.

D.Installing Option 020 HP VEE Program

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	1μW
Maximum DL Value	See the next table	10μW
Standard DL Value	Less than the Maximum DL and Greater than the Minimum value	5μW
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 μ to 6.4 mA	45 μ to 35 mA
50 u to 161 mV	100 μ 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 Δmode)
- Graphic display, X-axis, Points, Y-axis, Measurement value (Except for Δmode)

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	CI/Za/Zs
Spurious mode	N.A.	N.A.	N.A.
DLD mode	Fr/Fs	1 to 5	CI/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 : π 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

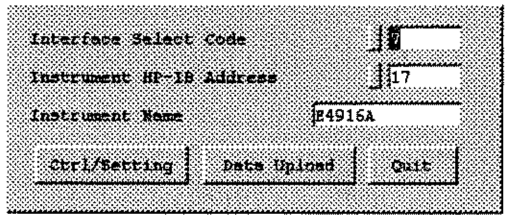


Figure D-1. HP-IB Setup Screen

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.

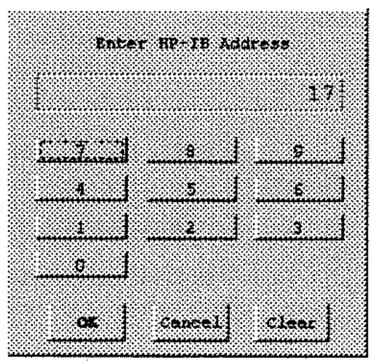


Figure D-2. Numeric Entry Key

Measurement Parameter Setting

Pressing `Ctrl/Setting` of Figure D-1 leads the Setup screen as shown in the following figure.

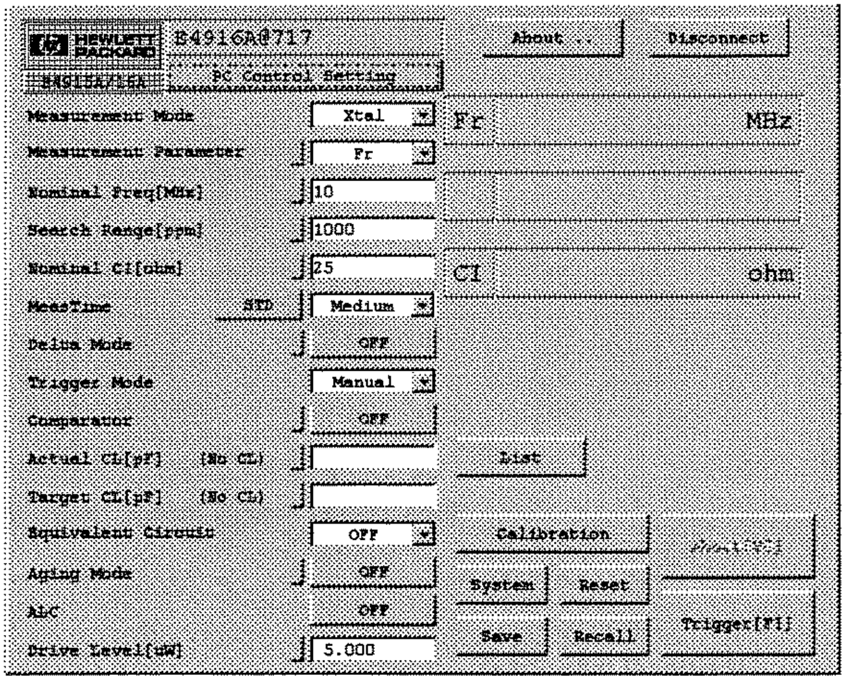


Figure D-3. Setup Screen

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.

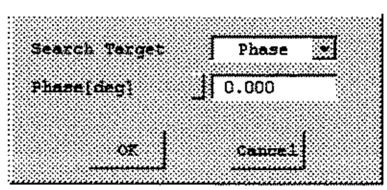


Figure D-4. Measurement Parameter Setup Screen

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.

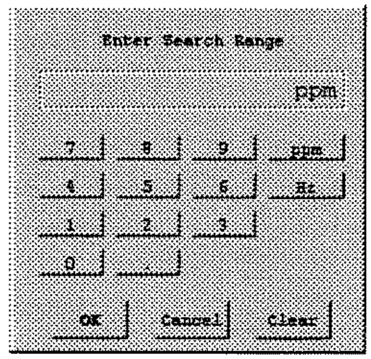


Figure D-5. Search Range Setup Screen

Delta Mode Setting

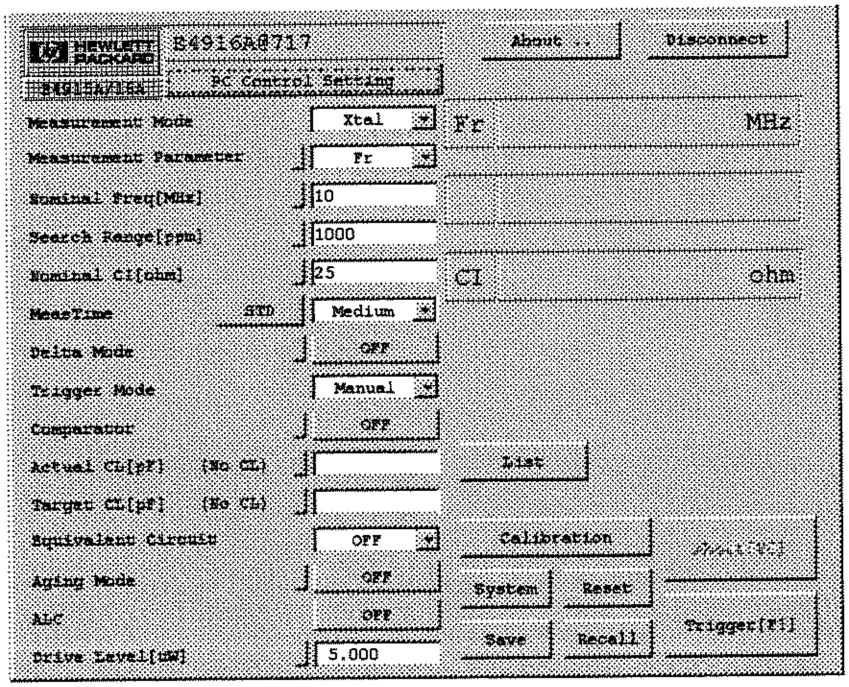


Figure D-6. Setup Screen

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.

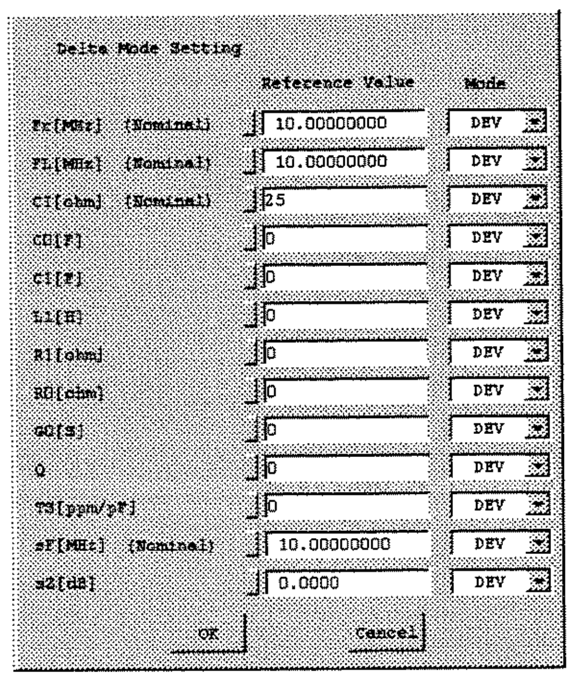


Figure D-7. Delta Mode Setup Screen

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

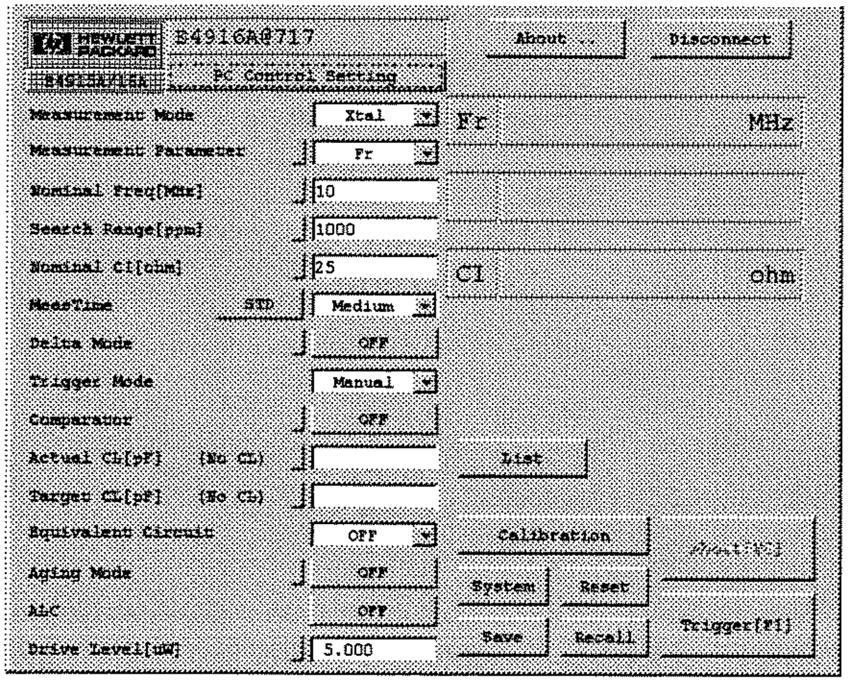


Figure D-8. Setup Screen

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.

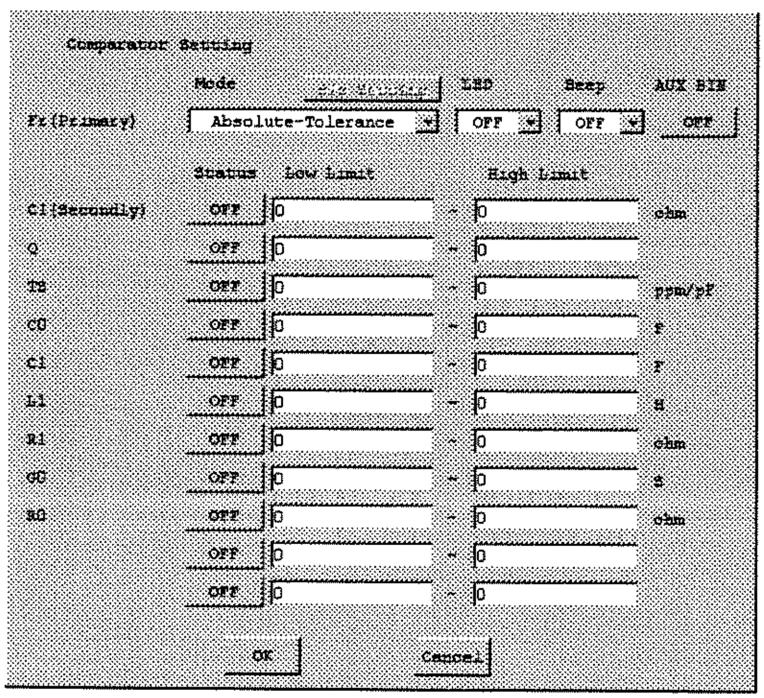


Figure D-9. Comparator Setup Screen

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 comparetor parameter for the crystal measurement mode. In DLD mode, you can also use ΔF, ΔCI.

BIN Setting

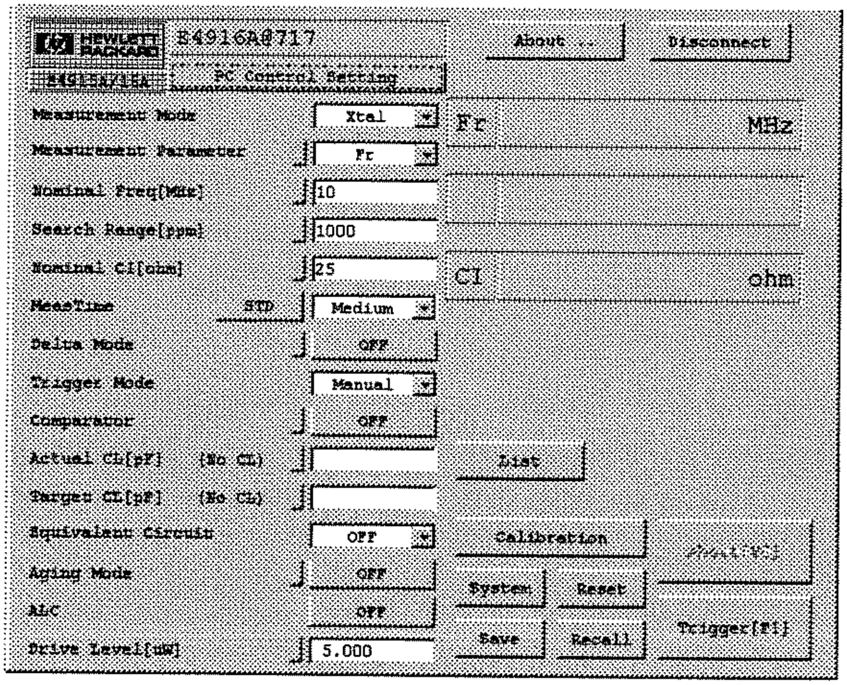


Figure D-10. Setup Screen

Pressing `BIN Setting` shown in Figure D-10 leads the BIN Setup Screen.

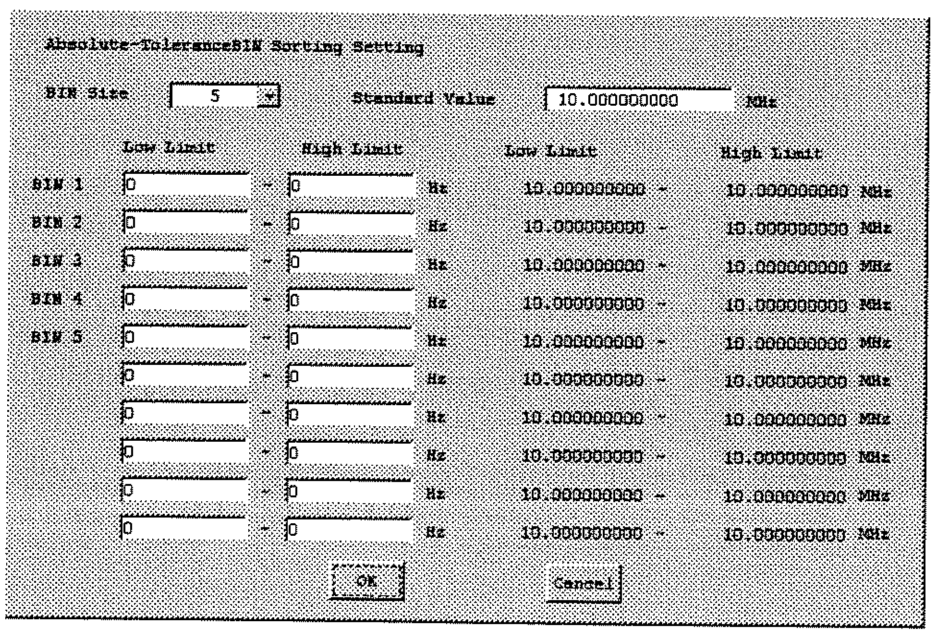


Figure D-11. BIN Setting

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)

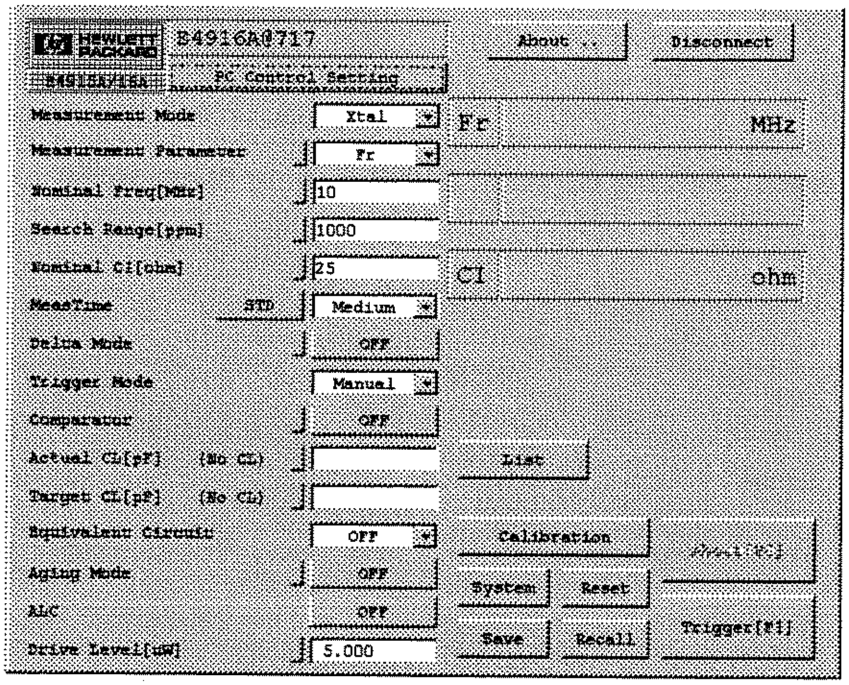


Figure D-12. Setup Screen

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.

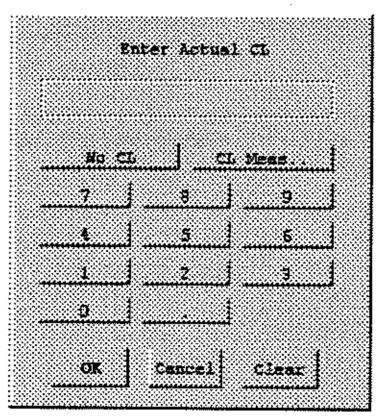


Figure D-13. CL Value Setup Screen

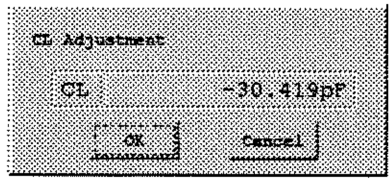


Figure D-14. CL Adjustment Screen

Aging Measurement Setting (Crystal Measurement Mode only)

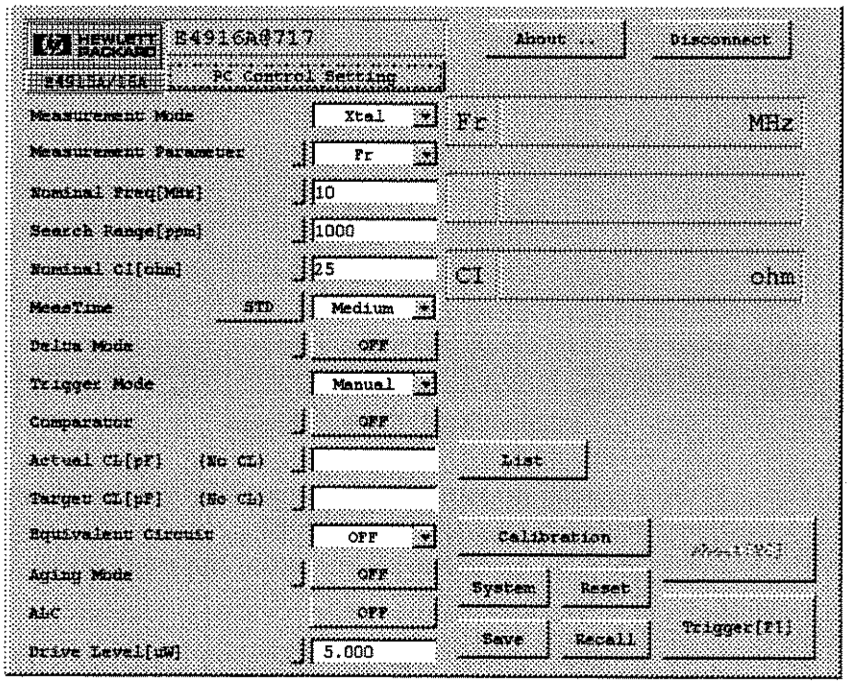


Figure D-15. Setup Screen

Pressing the button at the right side of `Aging Mode` shown in Figure D-15 leads the aging measurement setup screen.

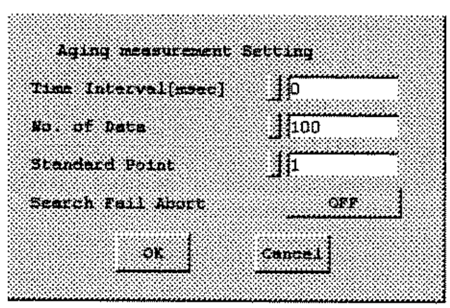


Figure D-16. Aging Measurement Setup Screen

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

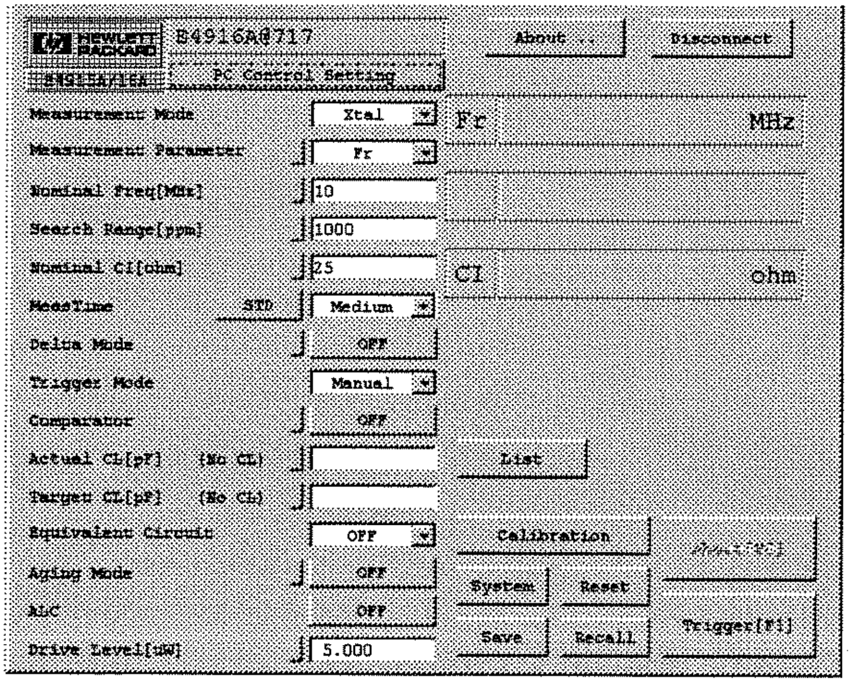


Figure D-17. Setup Screen

Pressing SYSTEM shown in Figure D-17 leads the setup screen as shown in the following figure.

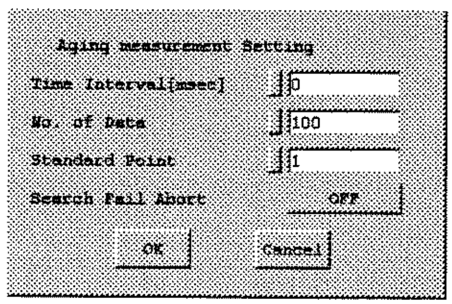


Figure D-18. System Setup Screen

Under PC `Control Setting`, you can not use `Memory Buffer` because the aging measurement and DLD measurement use the buffer area.

Analog Output Setting

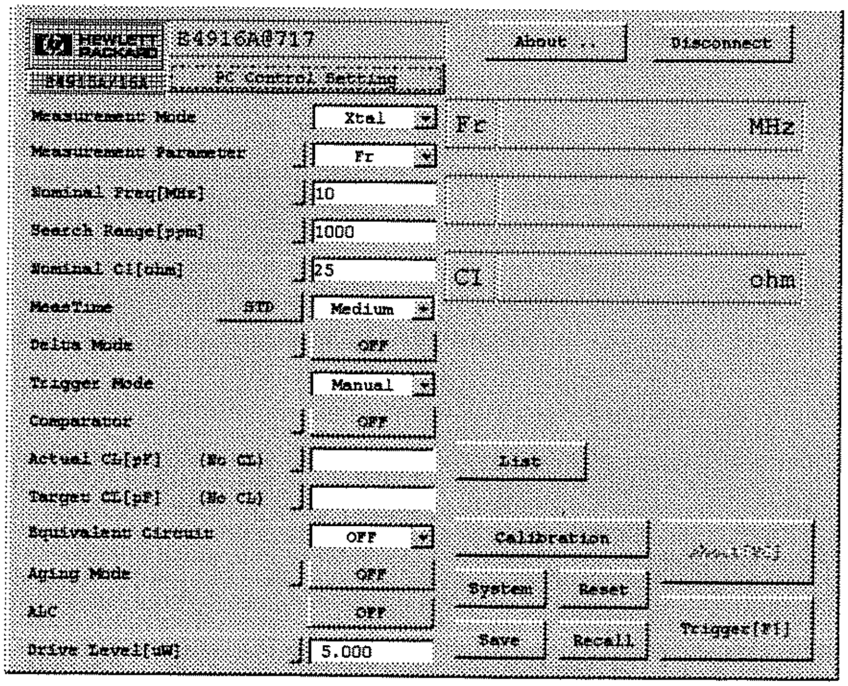


Figure D-19. Setup Screen

Pressing the button at the right side of `Analog Out` shown in Figure D-19 leads the analog output setup screen.

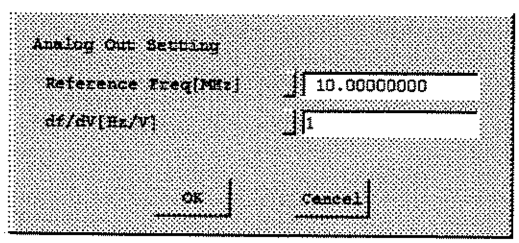


Figure D-20. Analog Output Setting

You can select the unit for analog output parameter (df/dV) from ppm/V and Hz/V using by the entry key.

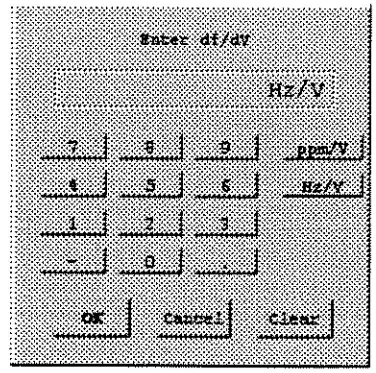


Figure D-21. Analog Output Setting Entry Key

Aging Measurement

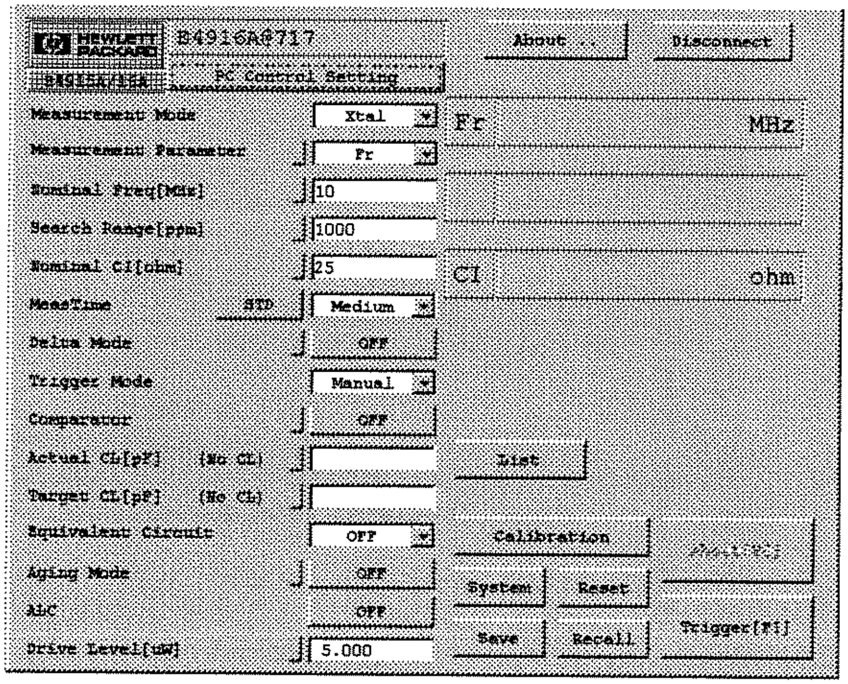


Figure D-22. Setup Screen

In Crystal Measurement Mode, when `Aging Mode` is turn ON, measurement results is displayed as show in the following figure.

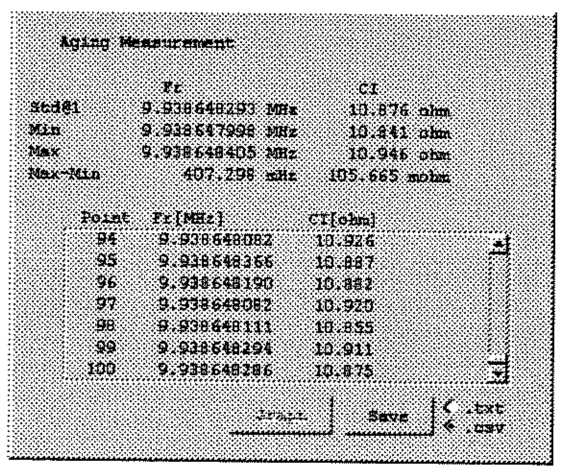


Figure D-23. Aging Measurement Display

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.

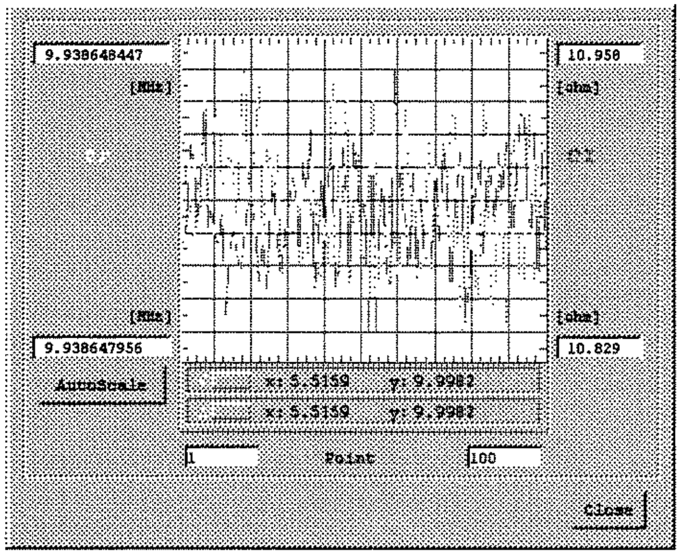


Figure D-24. Graphic Display of Aging Measurement

Equivalent Circuit Analysis for Aging Measurement

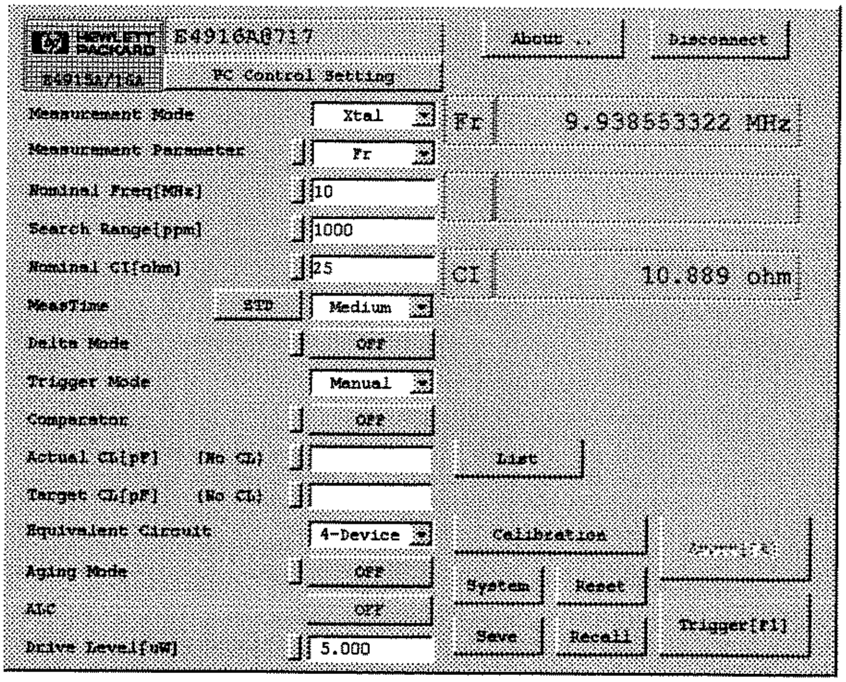


Figure D-25. Setup Screen

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.

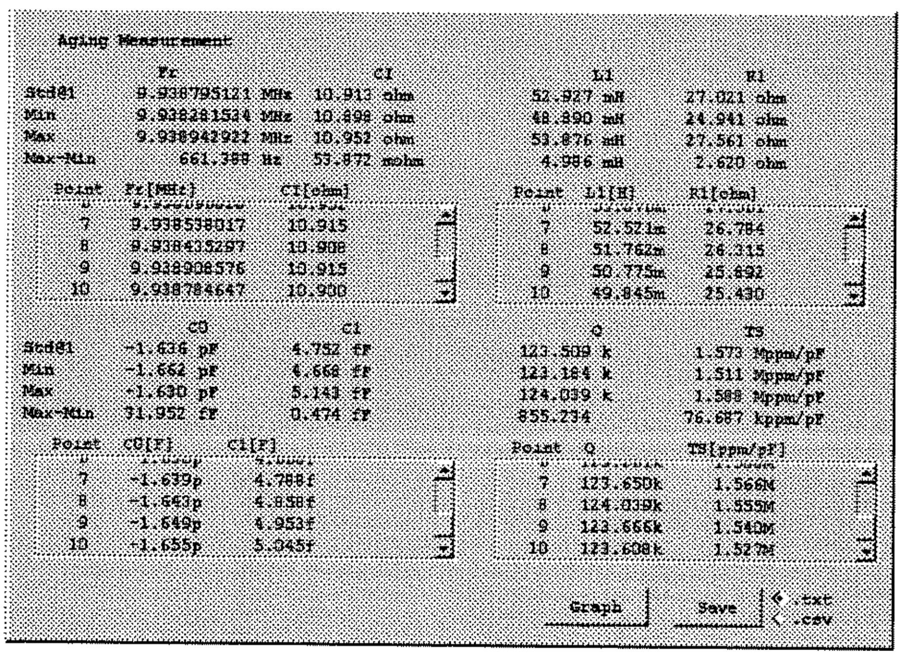


Figure D-26. Equivalent Circuit Analysis Result of Aging Measurement

Pressing Graph leads the graphic display of the results of the equivalent circuit analysis for the aging measurement.

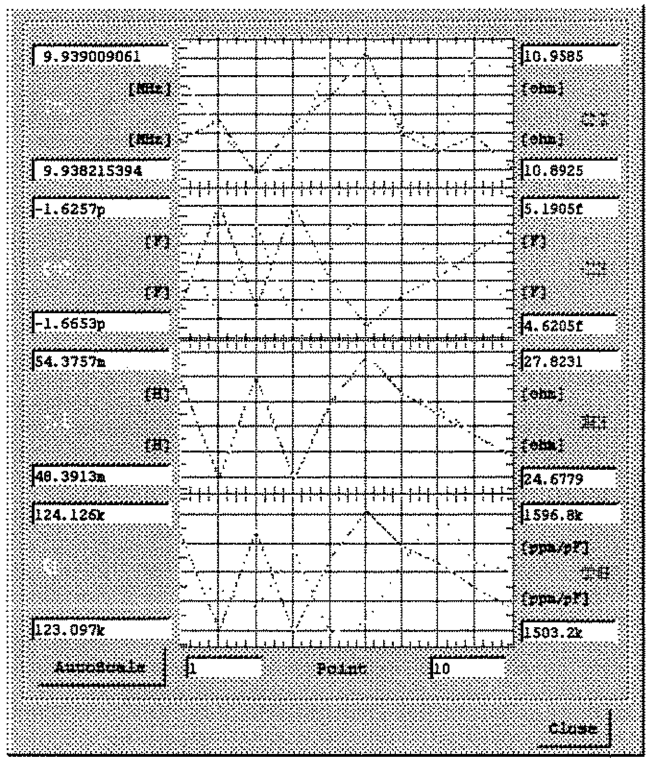


Figure D-27.
Graphic Display of Equivalent Circuit Analysis for Aging Measurement

Devise Level Setting (HP E4916A Only)

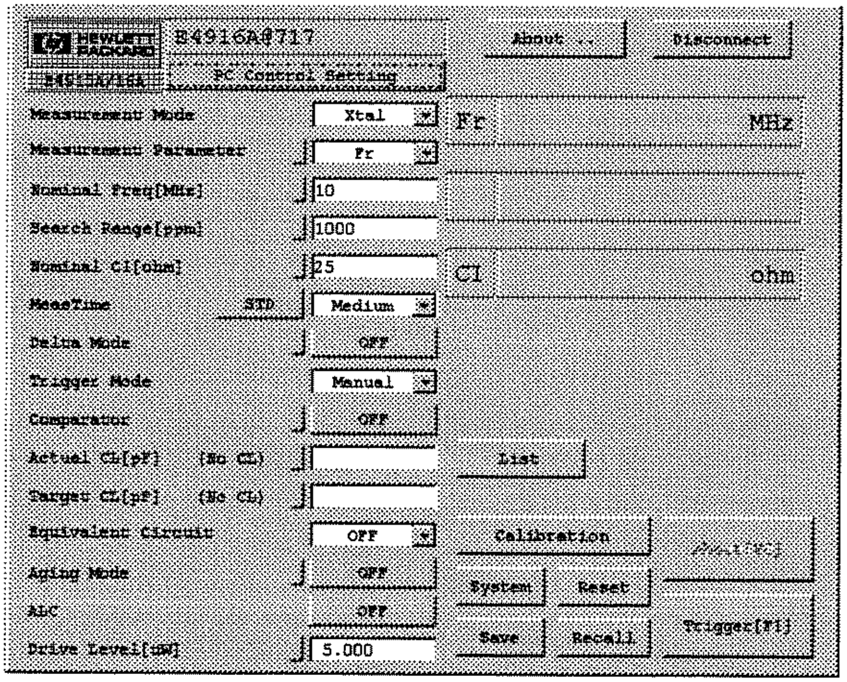


Figure D-28. Setup Screen

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.

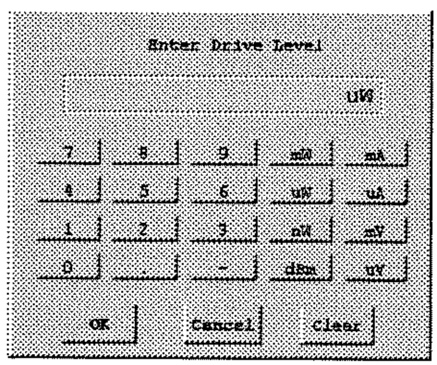


Figure D-29. Drive Level Setup Screen (HP E4916A only)

Calibration and Fixture Compensation, and Standard Setting

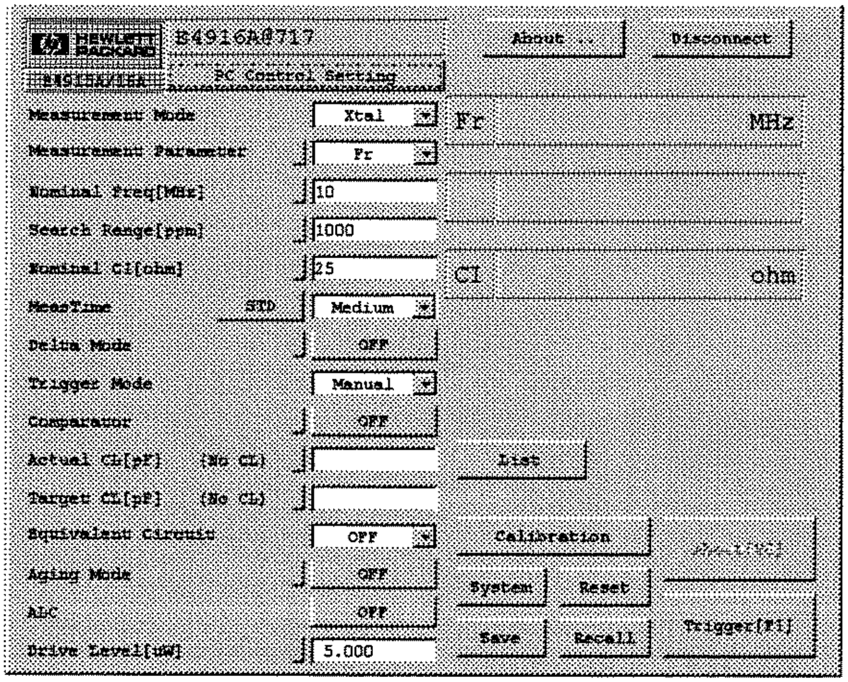


Figure D-30. Setup Screen

Pressing `Calibration` shown in Figure D-30 leads the calibration/fixture compensation setup screen.

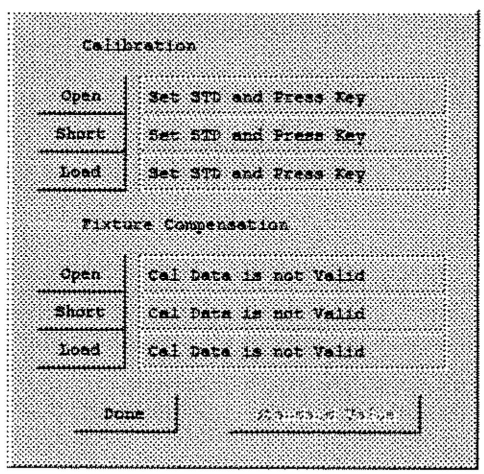


Figure D-31. Calibration / Fixture Compensation Setup Screen

Pressing `Standard Value` in Figure D-31 leads the standard value entry screen.

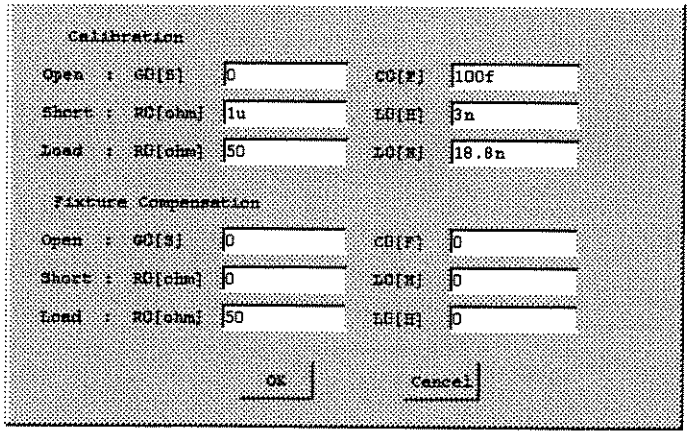


Figure D-32. Standard Value Entry Screen

It may take few quite a few second to complete the setup of standard value, because the data is written into flash memory.

4 Device Equivalent Circuit Analysis for Crystal Measurement Mode

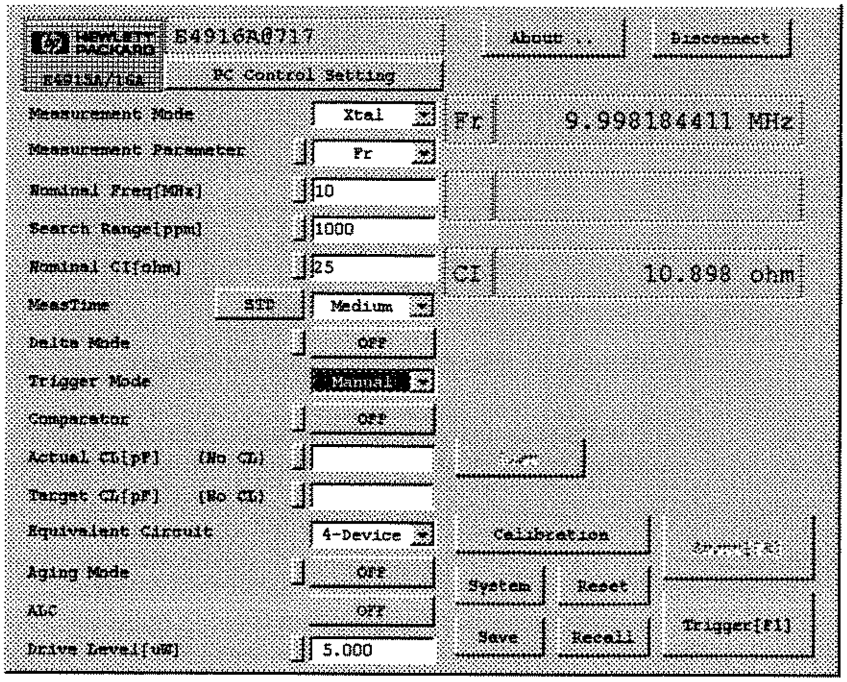


Figure D-33.
Setup Screen for 4 Device Equivalent Circuit Analysis for Crystal Measurement Mode

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.

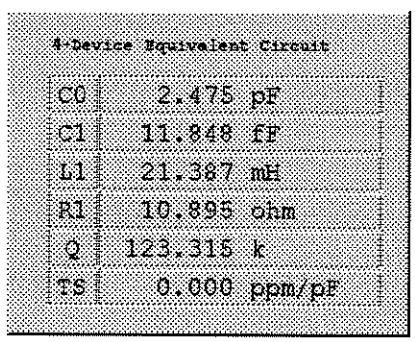
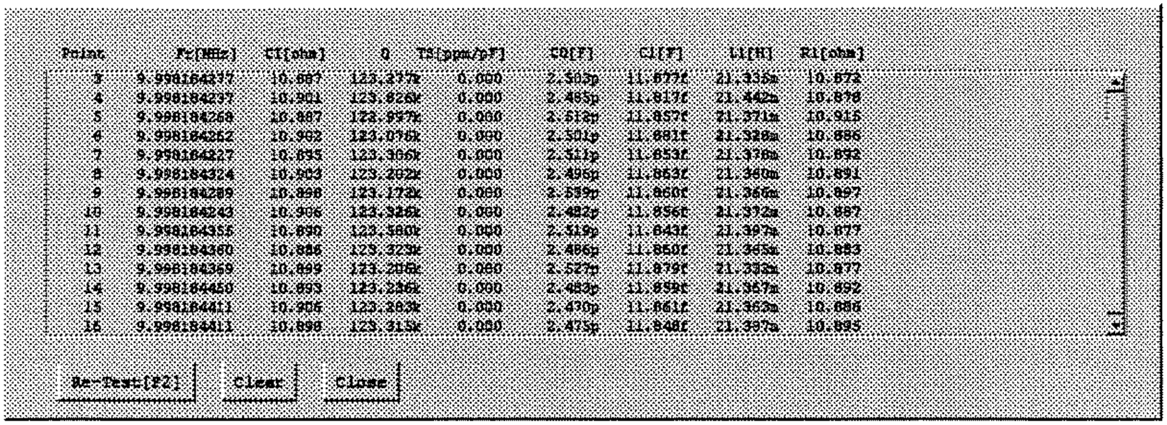


Figure D-34. Equivalent Circuit Parameter

Pressing `List` shown in Figure D-33 leads the list display as shown in the following figure.



Point	Fr[MHz]	CI[ohm]	Q	TS[ppm/pF]	C0[F]	C1[F]	L1[H]	R1[ohm]
3	9.998184277	10.887	123.277k	0.000	2.503p	11.877f	21.336m	10.872
4	9.998184237	10.901	123.826k	0.000	2.485p	11.817f	21.442m	10.878
5	9.998184268	10.887	122.997k	0.000	2.512p	11.857f	21.371m	10.915
6	9.998184262	10.902	123.076k	0.000	2.501p	11.881f	21.328m	10.886
7	9.998184227	10.895	123.306k	0.000	2.511p	11.853f	21.376m	10.892
8	9.998184324	10.903	123.202k	0.000	2.496p	11.863f	21.360m	10.891
9	9.998184289	10.898	123.172k	0.000	2.539p	11.860f	21.366m	10.897
10	9.998184243	10.906	123.326k	0.000	2.482p	11.856f	21.372m	10.887
11	9.998184355	10.890	123.580k	0.000	2.519p	11.843f	21.397m	10.877
12	9.998184360	10.886	123.323k	0.000	2.486p	11.850f	21.365m	10.883
13	9.998184369	10.899	123.206k	0.000	2.527p	11.879f	21.332m	10.877
14	9.998184450	10.893	123.236k	0.000	2.483p	11.859f	21.367m	10.892
15	9.998184411	10.906	123.283k	0.000	2.470p	11.861f	21.363m	10.886
16	9.998184411	10.898	123.315k	0.000	2.475p	11.848f	21.397m	10.895

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

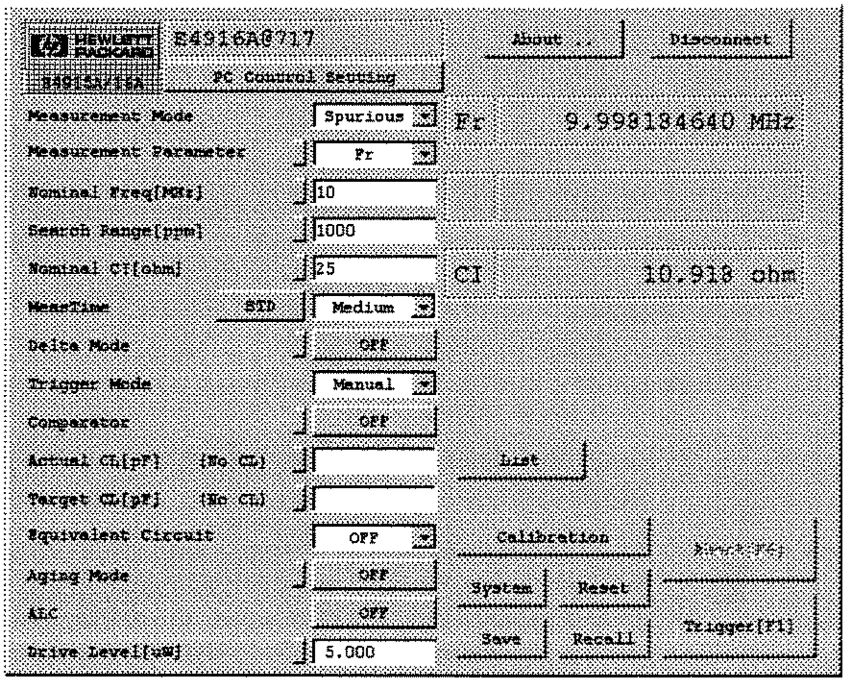


Figure D-36. Setup Screen

When you select `Spurious` as `Measurement Mode`, Spurious mode setting and results are displayed.

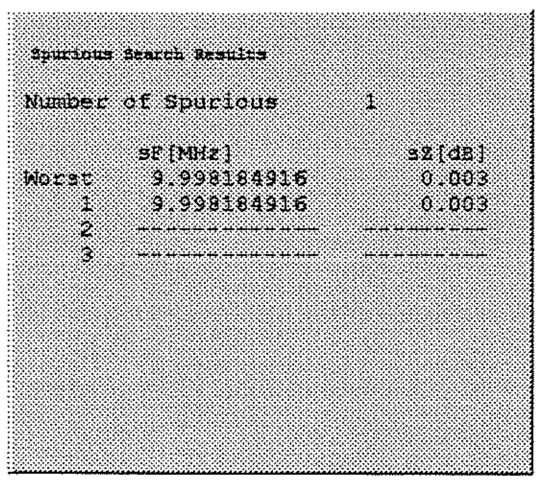


Figure D-37. Spurious Mode Result Display Screen

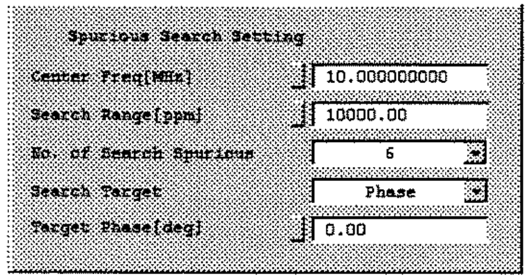


Figure D-38. Spurious mode Setup Screen

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.

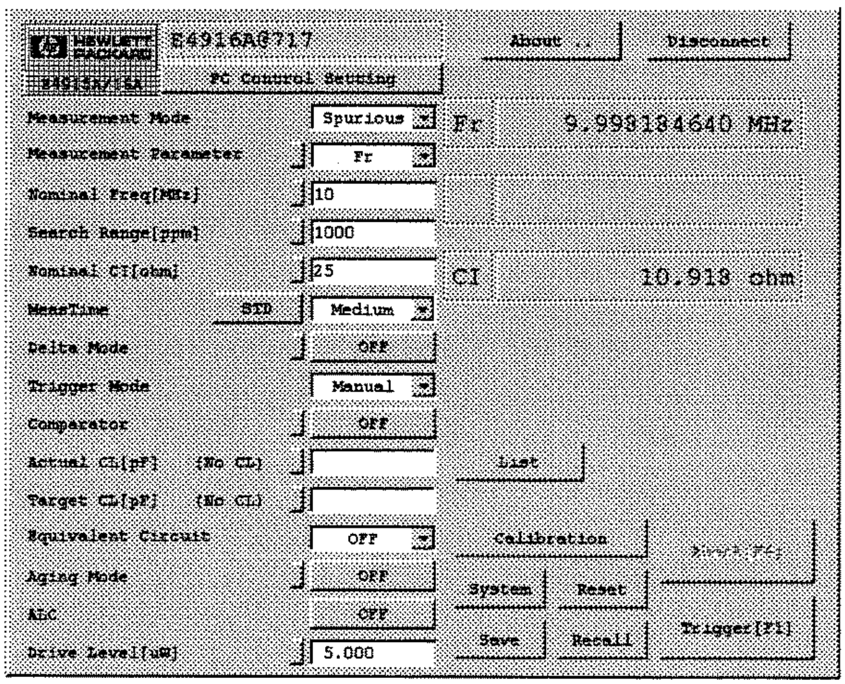


Figure D-39. Setup Screen

Even the measurement mode is the spurious mode, you can turn `Comparator` ON and can display comparator setup screen.

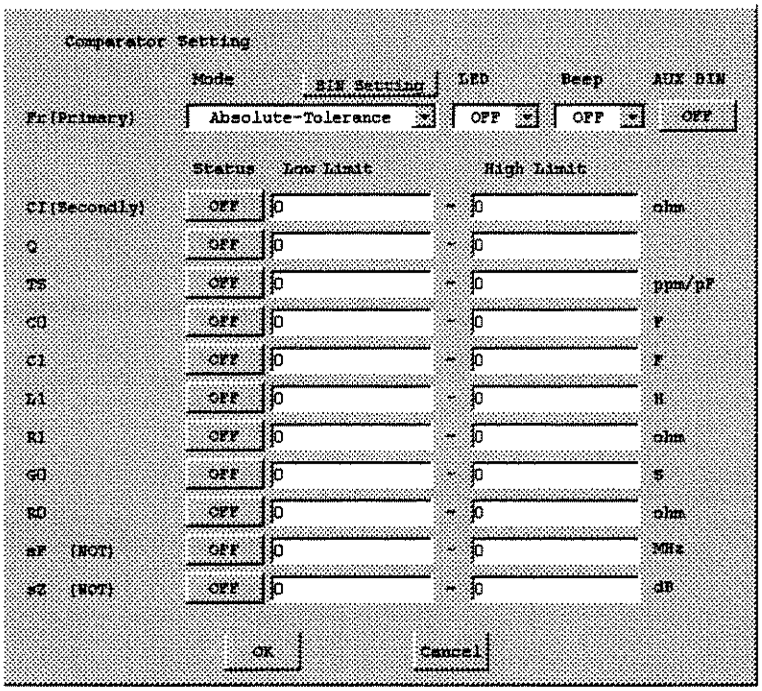


Figure D-40. Comparator Function in Spurious Mode

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:

Low limit $\leq$ Meas. Value $\leq$ High Limit

But sF and SZ limit test return FAIL in this condition.

DLD Measurement Mode

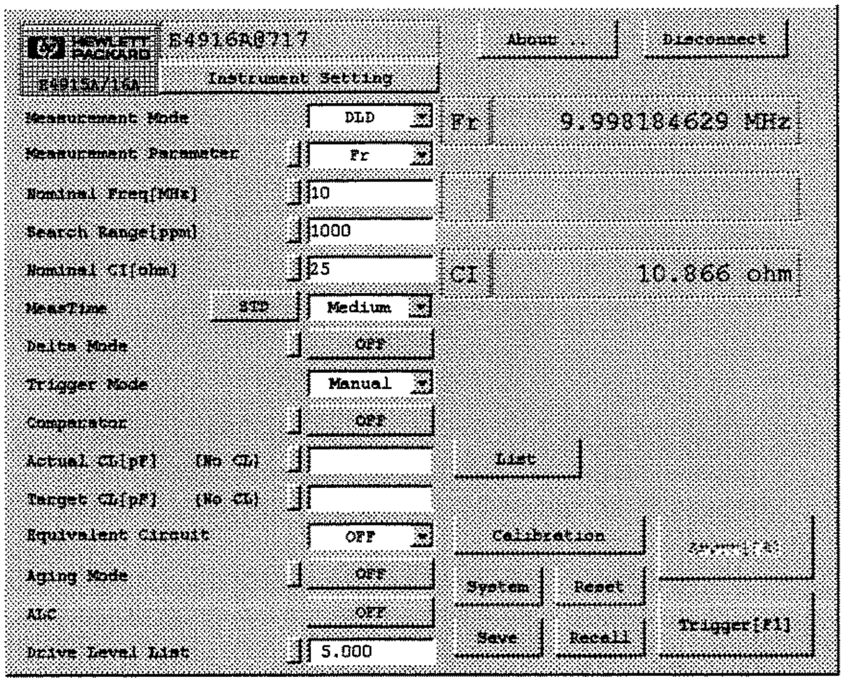


Figure D-41. DLD Measurement Mode Setup Screen

When you select DLD as `Measurement Mode`, DLD measurement results is displayed as shown in Figure D-41.

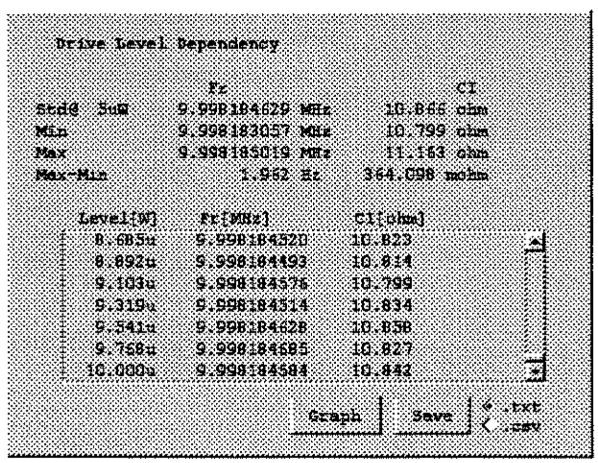


Figure D-42. DLD Measurement Result Screen

Pressing `Graph` displays a graphic display of DLD measurement results as shown in the following figure.

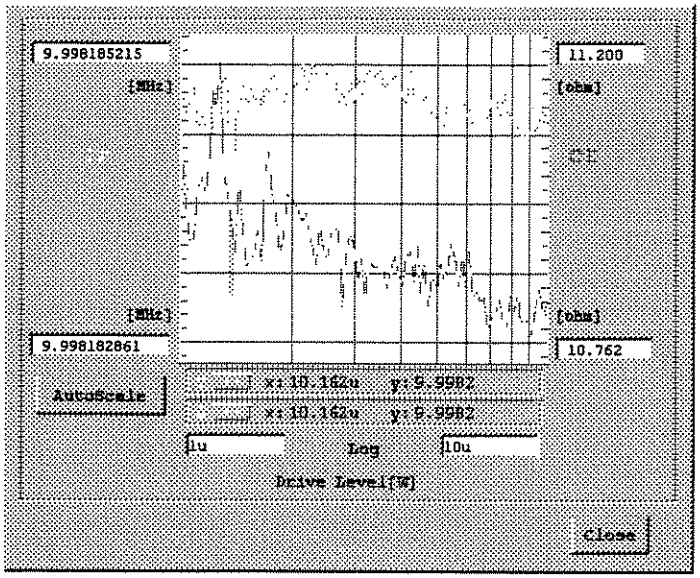


Figure D-43. Graphic Display for DLD Measurement

Pressing the button at the side of `Drive Level List` shown in Figure D-41 leads the drive level Setup Screen.

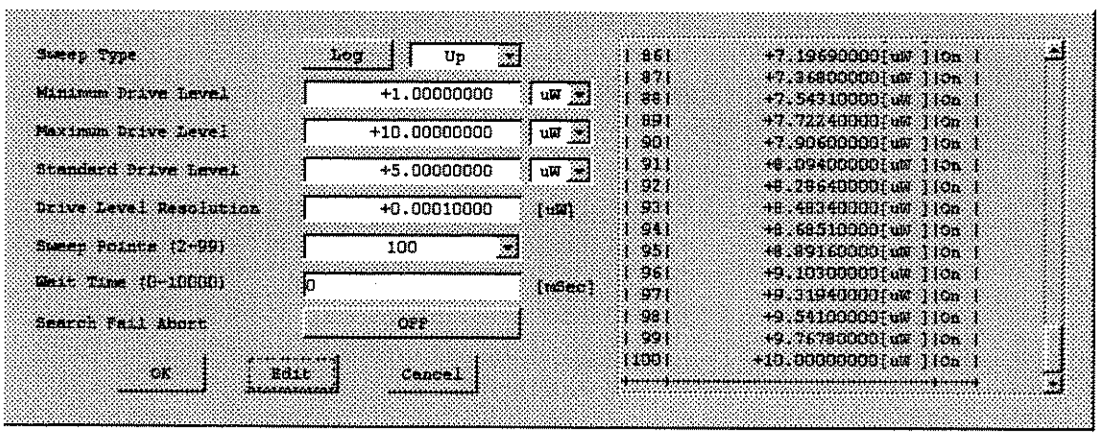


Figure D-44. Drive Level Setup Screen

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

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 text 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 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 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 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°C through 200°C. The usable operating frequency is up to 2 GHz.

Messages

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 occures before OPEN and SHORT calibration. In this case this error may occure 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 mesurement 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 mesurement 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 contersion 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 flush 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 cheksum 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 paremter'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 repaire 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 (se 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 is 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 confict`

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 no 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 a error as defined in IEEE 488.2, 11.5.1.1.7 and 6.3 has occurred.

-410 `Query INTERRPUTED`

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 an 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).

Index

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