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.
Manual Printing History

August 1996 ........................................ First Edition
January 1997 ......................................... Second Edition
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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.

⚠️ \( \text{Instruction manual symbol: the product is marked with this symbol when it is necessary for the user to refer to the instruction manual.} \)

تردد \( \text{Alternating current.} \)

تردد \( \text{Direct current.} \)

 питание \( \text{On (Supply).} \)

 питание \( \text{Off (Supply).} \)

 питание \( \text{In position of push-button switch.} \)

 питание \( \text{Out position of push-button switch.} \)

_frame/엔지니어링/\( \text{Frame (or chassis) terminal. A connection to the frame (chassis) of the equipment which normally include all exposed metal structures.} \)

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

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

About the HP E4915A/E4916A Crystal Impedance Meter

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

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

Table 1-1. Specifications and Applicable Models

<table>
<thead>
<tr>
<th>Spec items</th>
<th>HP E4915A</th>
<th>HP E4916A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring frequency Range</td>
<td>1 MHz to 180 MHz</td>
<td>1 MHz to 180 MHz</td>
</tr>
<tr>
<td>Accuracy ±2 ppm</td>
<td>±2 ppm</td>
<td></td>
</tr>
<tr>
<td>Basic Fr, Fx, FL, Fa, CI, C1, L1, R1, C0, Q, Spurious Q, Spurious</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fr/C1 accuracy Pr ±2 ppm</td>
<td>±2 ppm</td>
<td></td>
</tr>
<tr>
<td>(for reference purpose only)</td>
<td></td>
<td>±5%</td>
</tr>
<tr>
<td>Fr/C1 measuring time Cl</td>
<td>125 msec to 10 sec</td>
<td>125 msec to 10 sec</td>
</tr>
<tr>
<td>Output power</td>
<td>1 to 100 MHz</td>
<td>-5 dBm(constant)</td>
</tr>
<tr>
<td>100 to 180 MHz</td>
<td>-5 dBm(constant)</td>
<td>-60 to +22 dBm</td>
</tr>
<tr>
<td>- with π circuit connected</td>
<td>Approx. 5 µW</td>
<td>0.1 nW to 1 mW</td>
</tr>
<tr>
<td>(CI = 25 Ω)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1-2. Functions and Applicable Models

<table>
<thead>
<tr>
<th>Function</th>
<th>HP E4915A</th>
<th>HP E4916A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crystal Resonator measurement mode</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Equivalent circuit analysis</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Spurious measurement mode</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Drive Level Dependency</td>
<td></td>
<td>√</td>
</tr>
<tr>
<td>measurement mode</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaporation Monitor mode</td>
<td></td>
<td>√</td>
</tr>
<tr>
<td>Filter measurement mode</td>
<td></td>
<td>√</td>
</tr>
<tr>
<td>LCR measurement mode</td>
<td></td>
<td>Option 010</td>
</tr>
<tr>
<td>Impedance Probe</td>
<td></td>
<td>Option 001</td>
</tr>
<tr>
<td>Comparator function</td>
<td>√</td>
<td>√</td>
</tr>
</tbody>
</table>
Front Panel, Rear Panel, and Display

Front Panel

Figure 2-1. Front Panel of the HP E4915A

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. **Trigger** 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 \( \uparrow \rightarrow \) key displays the previous pair of soft keys while pressing the \( \downarrow \leftarrow \) 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.

Figure 2-3. LCD Screen

Items Displayed on Screen

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

Labels below the Screen

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

1. **Meas Mode** - Identifies the measurement mode currently in effect. The abbreviated name of the measurement mode currently in effect is displayed above this label.
Xtl      Crystal Resonator Measurement Mode (Xtl Mode)
Spu      Spurious Measurement Mode
DLD      Drive Level Dependency Measurement Mode
         (DLD Mode)
EM       Evaporation Monitor mode
LCR      LCR Measurement Mode
Flt      Filter Measurement Mode (Flt Mode)

2. **Calibration (HP E4915A) or Compens and Cal (HP E4916A)** - Indicates the current status of each setting of calibration/compensation. A △ maker appears above any setting that is already complete.

3. **Meas Time** - Indicates the measuring time setting currently in effect. A △ maker always appears above one of the three alternative settings, when High Q mode is ON, two △ makers 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 ← key 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).
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 ΔF/ΔCI limit test or BW test using the tertiary sorting of the Comparator function, this LED turns ON depending on the result, "Pass" or "Fail."
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. **Analogue OUT terminal** - Outputs analogue signals that represent measurement results. For more information, refer to "Analogue OUT Terminal" for each measurement mode in Chapter 4 "Function Reference."

8. **TEST terminal (HP 4916A only)** - Use this terminal, along with the SOURCE terminal, to connect your HP 4916A 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 4915A, the TEST terminal is located on the front panel, instead of the rear panel.

9. **REFERENCE terminal (HP 4916A only)** - Use this terminal to connect your HP 4916A with a test probe. INSTALLATION CATEGORY I, 0 dBm, ±25 Vdc Input Max.

10. **Frame or Chassis Terminal** - Terminal for GND signal.

11. **SOURCE terminal (HP 4916A only)** - Use this terminal, along with the TEST terminal, to connect your HP 4916A 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 4915A, the SOURCE terminal is located on the front panel, instead of the rear panel.

<table>
<thead>
<tr>
<th>Devices That Can Be Connected to the HP 4916A</th>
<th>Connectors</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Source</td>
<td>Chassis Terminal</td>
</tr>
<tr>
<td>π circuit</td>
<td>✓</td>
</tr>
<tr>
<td>Z probe</td>
<td>✓</td>
</tr>
</tbody>
</table>

*Table 2-1. Connectors Occupied by the Device*
Figure 2-7. Function Setting Key Block

Table 2-2. Summary: Function Setting Key Block

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

![Diagram of Unit Entry Key Blocks]

Figure 2-8. Unit Entry Key Blocks

<table>
<thead>
<tr>
<th>Key</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>m/k</td>
<td>Press to enter the unit.</td>
</tr>
<tr>
<td>(blue) + m/k (Comprrt)</td>
<td>Press to access the Comparator setup menu.</td>
</tr>
<tr>
<td>n/ppm</td>
<td>Press to enter the unit.</td>
</tr>
<tr>
<td>(blue) + n/ppm (CL Adj)</td>
<td>Press to activate CL Adj mode.</td>
</tr>
<tr>
<td>μ/M</td>
<td>Press to enter the unit.</td>
</tr>
<tr>
<td>(blue) + μ/M (Equiv Ckt)</td>
<td>Press to turn ON/OFF the Equivalent Circuit function.</td>
</tr>
<tr>
<td>P</td>
<td>Press to enter the unit.</td>
</tr>
<tr>
<td>(blue) + P (Δ Mode)</td>
<td>Press to turn ON/OFF Δ mode.</td>
</tr>
</tbody>
</table>
Data Entry Keys

HP E4915A  HP E4916A

Figure 2-9. Data Entry Key Block
<table>
<thead>
<tr>
<th>Key</th>
<th>Function</th>
<th>Applicable Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>(blue)+7 (Open)</td>
<td>Fixture compensation key for the open compensation measurement.</td>
<td>✓</td>
</tr>
<tr>
<td>(blue)+8 (Short)</td>
<td>Fixture compensation key for the short compensation measurement.</td>
<td>✓</td>
</tr>
<tr>
<td>(blue)+9 (Load)</td>
<td>Fixture compensation key for the load compensation measurement.</td>
<td>✓</td>
</tr>
<tr>
<td>(blue)+4 (Open)</td>
<td>Calibration key for the open calibration measurement.</td>
<td>✓</td>
</tr>
<tr>
<td>(blue)+5 (Short)</td>
<td>Calibration key for the short calibration measurement.</td>
<td>✓</td>
</tr>
<tr>
<td>(blue)+6 (Load)</td>
<td>Calibration key for the load calibration measurement.</td>
<td>✓</td>
</tr>
<tr>
<td>(blue)+1 (Status)</td>
<td>Press to turn ON/OFF status display.</td>
<td>✓</td>
</tr>
<tr>
<td>(blue)+2 (Mem Buf)</td>
<td>Press to access the Memory Buffer function.</td>
<td>✓</td>
</tr>
<tr>
<td>(blue)+3 (Thru)</td>
<td>Calibration key for the thru calibration measurement.</td>
<td>✓</td>
</tr>
<tr>
<td>(blue)+0</td>
<td>Press to turn ON the Key Lock function.</td>
<td>✓</td>
</tr>
<tr>
<td>(blue)+- (Reset)</td>
<td>Press to reset the instrument.</td>
<td>✓</td>
</tr>
<tr>
<td>(blue)+- (System)</td>
<td>Press to access the System menu.</td>
<td>✓</td>
</tr>
<tr>
<td>(blue)+Lcl</td>
<td>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.</td>
<td>✓</td>
</tr>
<tr>
<td>Rcl</td>
<td>Press to recall previously saved instrument settings.</td>
<td>✓</td>
</tr>
<tr>
<td>(blue)+Rcl (Save)</td>
<td>Press to save the current instrument settings.</td>
<td>✓</td>
</tr>
<tr>
<td>BkSp</td>
<td>Backspace key.</td>
<td>✓</td>
</tr>
<tr>
<td>(blue)+BkSp (Entry Off)</td>
<td>Press to turn OFF entry mode.</td>
<td>✓</td>
</tr>
<tr>
<td>(blue)+Enter (x1)</td>
<td>Press to enter a value with no unit.</td>
<td>✓</td>
</tr>
</tbody>
</table>
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 **(Ld)** key instead of the shift key. The **(Ld)** 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>
<thead>
<tr>
<th>Hard Key</th>
<th>Function</th>
<th>Associated Topic in Chapter 4</th>
<th>HP-IB Command</th>
<th>Applicable Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trig</td>
<td>Manual trigger</td>
<td>“Trigger Function” in Chapter 4</td>
<td>TRIGIMMediate</td>
<td>✓   ✓</td>
</tr>
<tr>
<td>(blue) + Trig (Trigger Mode)</td>
<td>Press to set the trigger mode: {Int</td>
<td>Man</td>
<td>Ext}</td>
<td>“Trigger Function” in Chapter 4</td>
</tr>
<tr>
<td>Freq</td>
<td>Press to enter the nominal frequency.</td>
<td>“Measurement Modes” in Chapter 4</td>
<td>NOMFreq&lt;value&gt;</td>
<td>✓   ✓</td>
</tr>
<tr>
<td>(blue) + Freq (Xti)</td>
<td>Press to select Crystal Resonator Measurement Mode (Xti mode).</td>
<td>“Crystal Resonator Measurement Mode (Xti Mode) – common between the HP E4915A and HP E4916A” in Chapter 4</td>
<td>MEASFunction</td>
<td>XTal</td>
</tr>
<tr>
<td>Meas Prmtr</td>
<td>Press to enter a measurement parameter.</td>
<td>“Measurement Modes” in Chapter 4</td>
<td>MEASPARAM{FR</td>
<td>FA</td>
</tr>
<tr>
<td>(blue) + Meas Prmtr (DLD)</td>
<td>Press to select Drive Level Dependency measurement mode (DLD mode).</td>
<td>“Drive Level Dependency Measurement Mode (DLD Mode)” in Chapter 4</td>
<td>MEASFunction</td>
<td>Dld</td>
</tr>
<tr>
<td>Level</td>
<td>Press to enter the power level.</td>
<td>“Measurement Modes” in Chapter 4</td>
<td>POWEr&lt;value&gt;</td>
<td>✓   ✓</td>
</tr>
<tr>
<td>(blue) + Level (Spurious)</td>
<td>Press to select Spurious measurement mode.</td>
<td>“Crystal Resonator Measurement Mode (Xti Mode) – common between the HP E4915A and HP E4916A” in Chapter 4</td>
<td>MEASFunction</td>
<td>Spur</td>
</tr>
<tr>
<td>Nominal CI</td>
<td>Press to enter the nominal CI value.</td>
<td>“Measurement Modes” in Chapter 4</td>
<td>NOMCl&lt;value&gt;</td>
<td>✓   ✓</td>
</tr>
<tr>
<td>(blue) + Nominal CI (EM)</td>
<td>Press to select Evaporation Monitor mode (EM mode).</td>
<td>“Evaporation Monitor Mode (EM Mode)” in Chapter 4</td>
<td>MEASFunction</td>
<td>Em</td>
</tr>
<tr>
<td>Hard Key</td>
<td>Function</td>
<td>Associated Topic in Chapter 4</td>
<td>HP-IB Command</td>
<td>Applicable Model</td>
</tr>
<tr>
<td>------------------------------</td>
<td>---------------------------------------</td>
<td>----------------------------------------</td>
<td>-------------------------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Meas Time</td>
<td>Press to set the measurement time.</td>
<td>&quot;Measurement Modes&quot; in Chapter 4</td>
<td>MEASTime&lt;value&gt;</td>
<td>✓</td>
</tr>
<tr>
<td>(blue) + Meas Time (LCR)</td>
<td>Press to select LCR measurement mode.</td>
<td>&quot;LCR Measurement Mode&quot; in Chapter 4</td>
<td>MEASFunction:LCR</td>
<td>✓</td>
</tr>
<tr>
<td>CL Value</td>
<td>Press to enter the target CL value.</td>
<td>&quot;Measurement Modes&quot; in Chapter 4</td>
<td>CLTGT&lt;value&gt;</td>
<td>✓</td>
</tr>
<tr>
<td>(blue) + CL Value (Flt)</td>
<td>Press to select Filter measurement mode (Flt mode).</td>
<td>&quot;Filter Measurement Mode (Flt Mode)&quot; in Chapter 4</td>
<td>MEASFunction:Filter</td>
<td>✓</td>
</tr>
<tr>
<td>Select (upper)</td>
<td>Press to select the upper soft key.</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Select (lower)</td>
<td>Press to select the lower soft key.</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>(m/k)</td>
<td>Press to enter the unit.</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>(blue) + m/k (Comprt)</td>
<td>Press to access the Comparator setup menu.</td>
<td>&quot;Comparator Function&quot; in Chapter 4</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>μ/M</td>
<td>Press to enter the unit.</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>(blue) + μ/M (Equiv Ckt)</td>
<td>Press to turn ON/OFF the Equivalent Circuit function.</td>
<td>&quot;Measurement Modes&quot; in Chapter 4</td>
<td>EQUCkt&lt;value&gt; {DEV4</td>
<td>DEV5</td>
</tr>
<tr>
<td>↑</td>
<td>Press to move to the upper or right-hand soft key/display position.</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>&lt;=</td>
<td>Press to move to the left-hand or lower soft key/display position.</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>(n/ppm)</td>
<td>Press to enter the unit.</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>(blue) + n/ppm (CL Adj)</td>
<td>Press to activate CL Adj mode.</td>
<td>&quot;Measurement with Capacitance Load (CL_a/CL_t Parameters)&quot; in Chapter 4</td>
<td>CLADJust&lt;value&gt; {OFF</td>
<td>ON}[0</td>
</tr>
<tr>
<td>(blue) + p (Δ Mode)</td>
<td>Press to turn ON/OFF delta mode.</td>
<td>&quot;Delta Mode&quot; in Chapter 4</td>
<td>DLTMode&lt;value&gt;[PRI</td>
<td>SEC], {OFF</td>
</tr>
</tbody>
</table>

3-4 Commands Available via Hard and Soft Keys
<table>
<thead>
<tr>
<th>Hard Key</th>
<th>Function</th>
<th>Associated Topic in Chapter 4</th>
<th>HP-IB Command</th>
<th>Applicable Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>(blue)</td>
<td>Shift key (in Remote mode, press this key to switch to Local mode).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(blue) + (9) (Load)</td>
<td>Fixture compensation key for the LOAD compensation.</td>
<td>“Calibration and Fixture Compensation” in Chapter 4</td>
<td>COMPENSation:LOAD</td>
<td>✓</td>
</tr>
<tr>
<td>(blue) + (8) (Short)</td>
<td>Fixture compensation key for the SHORT compensation.</td>
<td>“Calibration and Fixture Compensation” in Chapter 4</td>
<td>COMPENSation:ISHORT</td>
<td>✓</td>
</tr>
<tr>
<td>(blue) + (7) (Open)</td>
<td>Fixture compensation key for the OPEN compensation.</td>
<td>“Calibration and Fixture Compensation” in Chapter 4</td>
<td>COMPENSation:IOpen</td>
<td>✓</td>
</tr>
<tr>
<td>Rcl</td>
<td>Press to recall previously saved instrument settings.</td>
<td>“Memory Facilities” in Chapter 4</td>
<td>*RCL &lt;value&gt;</td>
<td>✓</td>
</tr>
<tr>
<td>(blue) + (Rcl, Save)</td>
<td>Press to save the current instrument settings.</td>
<td>“Memory Facilities” in Chapter 4</td>
<td>*SAV &lt;value&gt;</td>
<td>✓</td>
</tr>
<tr>
<td>(blue) + (6) (Load)</td>
<td>Calibration key for the LOAD calibration.</td>
<td>“Calibration and Fixture Compensation” in Chapter 4</td>
<td>CALibration:LOAD</td>
<td>✓</td>
</tr>
<tr>
<td>(blue) + (5) (Short)</td>
<td>Calibration key for the SHORT calibration.</td>
<td>“Calibration and Fixture Compensation” in Chapter 4</td>
<td>CALibration:ISHORT</td>
<td>✓</td>
</tr>
<tr>
<td>(blue) + (4) (Open)</td>
<td>Calibration key for the OPEN calibration.</td>
<td>“Calibration and Fixture Compensation” in Chapter 4</td>
<td>CALibration:OPEN</td>
<td>✓</td>
</tr>
<tr>
<td>BkSp</td>
<td>Backspace key.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(blue) + (BkSp, Entry Off)</td>
<td>Press to turn OFF entry mode.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 3-1. Functions Assigned to Hard Keys (continued)

<table>
<thead>
<tr>
<th>Hard Key</th>
<th>Function</th>
<th>Associated Topic in Chapter 4</th>
<th>HP-IB Command</th>
<th>Applicable Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>(blue) - 5 (Thru)</td>
<td>Calibration key for the thru state.</td>
<td>“Calibration and Fixture Compensation” in Chapter 4</td>
<td>THRCAL</td>
<td>✓</td>
</tr>
<tr>
<td>(blue) - 2 (Mem Buf)</td>
<td>Press to access the Memory Buffer function.</td>
<td>“Memory Facilities” in Chapter 4</td>
<td>MESTAT{0/1} {OFF/ON}[0/1]</td>
<td>✓ ✓</td>
</tr>
<tr>
<td>(blue) - 1 (Status)</td>
<td>Press to turn ON/OFF status display.</td>
<td>DISPSTAT{0/1} {OFF/ON}[0/1]</td>
<td>✓ ✓</td>
<td></td>
</tr>
<tr>
<td>Enter</td>
<td>Press to put the entered value into effect.</td>
<td></td>
<td>✓ ✓</td>
<td></td>
</tr>
<tr>
<td>(blue) - Enter (x1)</td>
<td>Press to enter a value with no unit.</td>
<td></td>
<td>✓ ✓</td>
<td></td>
</tr>
<tr>
<td>(blue) - - (System)</td>
<td>Press to access the System menu.</td>
<td></td>
<td>✓ ✓</td>
<td></td>
</tr>
<tr>
<td>(blue) - - (Reset)</td>
<td>Press to reset the instrument.</td>
<td>“Reset Function” in Chapter 4</td>
<td>PRESet</td>
<td>✓ ✓</td>
</tr>
<tr>
<td>(blue) - 0 (Key Lock)</td>
<td>Press to turn ON the Key Lock function.</td>
<td>“Key Lock” in Chapter 4</td>
<td>KLOCK{OFF/ON}[0/1]</td>
<td>✓ ✓</td>
</tr>
</tbody>
</table>

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.
<table>
<thead>
<tr>
<th>Measurement/Setup mode</th>
<th>Hard Key for Accessing This Mode</th>
<th>Applicable Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crystal Resonator Measurement Mode</td>
<td>(blue) + Freq (Xti)</td>
<td>HP E4915A/E4916A</td>
</tr>
<tr>
<td>Spurious measurement mode</td>
<td>(blue) + Level (Spurious)</td>
<td>HP E4915A/E4916A</td>
</tr>
<tr>
<td>Drive Level Dependency measurement mode</td>
<td>(blue) + Meas Prmtr (DLD)</td>
<td>HP E4916A only</td>
</tr>
<tr>
<td>Evaporation Monitor mode</td>
<td>(blue) + Nominal CI (EM)</td>
<td>HP E4916A only</td>
</tr>
<tr>
<td>LCR measurement mode</td>
<td>(blue) + Meas Time (LCR)</td>
<td>HP E4916A only (option)</td>
</tr>
<tr>
<td>Filter measurement mode</td>
<td>(blue) + CL Value (Pt)</td>
<td>HP E4916A only</td>
</tr>
<tr>
<td>Comparator setup mode</td>
<td>(blue) + m/k (Comprtr)</td>
<td>HP E4915A/E4916A</td>
</tr>
<tr>
<td>System setup mode</td>
<td>(blue) + [ ] (System)</td>
<td>HP E4915A/E4916A</td>
</tr>
</tbody>
</table>
## Crystal Resonator Measurement Mode (Xtal Mode)

**Table 3-2:**

<table>
<thead>
<tr>
<th>Soft Key</th>
<th>Parameter</th>
<th>Function</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>FREQ</td>
<td>value</td>
<td>Nominal frequency [Hz]</td>
<td>NOMFreq&lt;value&gt;</td>
</tr>
<tr>
<td>RNG</td>
<td>value</td>
<td>Search range [ppm]</td>
<td>SRCRRange&lt;value&gt;</td>
</tr>
<tr>
<td>CI</td>
<td>value</td>
<td>Nominal impedance [Ω]</td>
<td>NOMCl&lt;value&gt;</td>
</tr>
<tr>
<td>ALC</td>
<td>{OFF</td>
<td>ON}</td>
<td>ALC MODE ON/OFF</td>
</tr>
<tr>
<td>LVL</td>
<td>value</td>
<td>Power level [W,A,V,dBm]</td>
<td>POWEr{value}</td>
</tr>
<tr>
<td>UNIT</td>
<td>{dBm</td>
<td>WATT</td>
<td>AMP</td>
</tr>
<tr>
<td>TIME</td>
<td>{Short</td>
<td>Med</td>
<td>Long}</td>
</tr>
<tr>
<td>HT_Q</td>
<td>{OFF</td>
<td>ON}</td>
<td>High Q mode ON/OFF</td>
</tr>
<tr>
<td>EQUC</td>
<td>{OFF</td>
<td>4DEV</td>
<td>6DEV}</td>
</tr>
<tr>
<td>DSPQ</td>
<td>{OFF</td>
<td>ON}</td>
<td>Show/hide the Q parameter</td>
</tr>
<tr>
<td>TG1</td>
<td>{Phase/Peak}</td>
<td>Search target specification</td>
<td>SRTC{T</td>
</tr>
<tr>
<td>PHAS</td>
<td>value</td>
<td>Target phase [°]</td>
<td>TGTPhase{value}</td>
</tr>
<tr>
<td>AP</td>
<td>{OFF</td>
<td>DEV</td>
<td>PPM}</td>
</tr>
<tr>
<td>RefF</td>
<td>{Nominal</td>
<td>User}</td>
<td>Reference frequency for Delta mode [Hz]</td>
</tr>
<tr>
<td>ACI</td>
<td>{OFF</td>
<td>DEV</td>
<td>%}</td>
</tr>
<tr>
<td>RefZ</td>
<td>{Nominal</td>
<td>User}</td>
<td>Reference impedance for Delta mode [Ω]</td>
</tr>
<tr>
<td>AGE</td>
<td>{OFF</td>
<td>ON}</td>
<td>Aging mode ON/OFF</td>
</tr>
<tr>
<td>TIME</td>
<td>value</td>
<td>Aging interval</td>
<td>AGINGTIME{value}</td>
</tr>
<tr>
<td>PARA</td>
<td>{Ps</td>
<td>Pr</td>
<td>Fa</td>
</tr>
<tr>
<td>CKT</td>
<td>{PI</td>
<td>PROBE</td>
<td>BRIDGE</td>
</tr>
<tr>
<td>Cl_a</td>
<td>{No-CL</td>
<td>User}</td>
<td>Actual CL value (no CL or user-specified value)</td>
</tr>
<tr>
<td>Cl_t</td>
<td>{No-CL</td>
<td>User=CLact}</td>
<td>Target CL value (no CL, user-specified value, or measured value)</td>
</tr>
<tr>
<td>CL Comp</td>
<td>{NO</td>
<td>YES}</td>
<td>Execution of CL compensation</td>
</tr>
<tr>
<td>Freq</td>
<td>value</td>
<td>Frequency of reference resonator</td>
<td>CLFREQ&lt;value&gt;[MHz</td>
</tr>
</tbody>
</table>
# Spurious Measurement Mode

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

<table>
<thead>
<tr>
<th>Soft Key</th>
<th>Parameter</th>
<th>Function</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>CENT</td>
<td>value</td>
<td>Center frequency [Hz]</td>
<td>$\text{SFCENTER}&lt;\text{value}&gt;$</td>
</tr>
<tr>
<td>RLG</td>
<td>value</td>
<td>Search range [ppm]</td>
<td>$\text{SPRANGe}&lt;\text{value}&gt;[(\text{Hz}[\text{Ppm}])]$</td>
</tr>
<tr>
<td>DispSp</td>
<td>{Nth</td>
<td>Worst}</td>
<td>Spurious point to be displayed (Nth or worst spurious)</td>
</tr>
<tr>
<td>#Spur</td>
<td>value</td>
<td>Number of spurious points to search for</td>
<td>$\text{SPNUM}&lt;\text{value}&gt;$</td>
</tr>
<tr>
<td>TGT</td>
<td>{Phase</td>
<td>Peak}</td>
<td>Search target specification</td>
</tr>
<tr>
<td>PHAS</td>
<td>value</td>
<td>Target phase [°]</td>
<td>$\text{SPPHAS}&lt;\text{value}&gt;$</td>
</tr>
</tbody>
</table>
# Drive Level Dependency Measurement Mode (DLD Mode)

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

<table>
<thead>
<tr>
<th>Soft Key</th>
<th>Parameter</th>
<th>Function</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>FREQ</td>
<td>value</td>
<td>Nominal frequency [Hz]</td>
<td>NOMFreq&lt;value&gt;</td>
</tr>
<tr>
<td>RNG</td>
<td>value</td>
<td>Search range [Hz/ppm]</td>
<td>SRCHRange&lt;value&gt;</td>
</tr>
<tr>
<td>CI</td>
<td>value</td>
<td>Nominal CI [0]</td>
<td>NOMC&lt;value&gt;</td>
</tr>
<tr>
<td>SWEP</td>
<td>{Up</td>
<td>UpDown</td>
<td>UpMin</td>
</tr>
<tr>
<td>TIME</td>
<td>{Short</td>
<td>Med</td>
<td>Long}</td>
</tr>
<tr>
<td>HI-Q</td>
<td>{OFF</td>
<td>ON}</td>
<td>High Q mode ON/OFF</td>
</tr>
<tr>
<td>MIN</td>
<td>value</td>
<td>Minimum drive level [W,A,V,dBm]</td>
<td>PTMINPower&lt;value&gt;</td>
</tr>
<tr>
<td>MAX</td>
<td>value</td>
<td>Maximum drive level [W,A,V,dBm]</td>
<td>PTMAXPower&lt;value&gt;</td>
</tr>
<tr>
<td>STD</td>
<td>value</td>
<td>Reference drive level</td>
<td>PTSTDPower&lt;value&gt;</td>
</tr>
<tr>
<td>UNIT</td>
<td>{dBm</td>
<td>WATT</td>
<td>AMP</td>
</tr>
<tr>
<td>WATT</td>
<td>value</td>
<td>Wait time after energization</td>
<td>PWAITU&lt;value&gt;</td>
</tr>
<tr>
<td>StartP</td>
<td>value</td>
<td>Sweep start point</td>
<td>PSTARTPointU&lt;value&gt;</td>
</tr>
<tr>
<td>ABORT</td>
<td>{OFF</td>
<td>ON}</td>
<td>Whether to continue or abort measurement when tracking has failed</td>
</tr>
<tr>
<td>ALC</td>
<td>{OFF</td>
<td>ON}</td>
<td>ALC mode ON/OFF</td>
</tr>
<tr>
<td>AF</td>
<td>{OFF</td>
<td>DEV</td>
<td>PPM}</td>
</tr>
<tr>
<td>RefF</td>
<td>{Nom</td>
<td>User</td>
<td>Start}</td>
</tr>
<tr>
<td>ALC</td>
<td>{OFF</td>
<td>DEV</td>
<td>%}</td>
</tr>
<tr>
<td>Ref2</td>
<td>{Nom</td>
<td>User</td>
<td>Start}</td>
</tr>
<tr>
<td>TGT</td>
<td>{Phase/Peak}</td>
<td>Search target specification</td>
<td>SRCHTGTU{Phase</td>
</tr>
<tr>
<td>PHAS</td>
<td>value</td>
<td>Target phase [*]</td>
<td>TGTPhaseU&lt;value&gt;</td>
</tr>
<tr>
<td>PARA</td>
<td>{Fs</td>
<td>Fr}</td>
<td>Type of search frequency</td>
</tr>
<tr>
<td>GET</td>
<td>{PI</td>
<td>PROBE</td>
<td>BRIDGE}</td>
</tr>
<tr>
<td>TRACK</td>
<td>{ON</td>
<td>OFF}</td>
<td>Phase tracking ON/OFF</td>
</tr>
</tbody>
</table>

3-10 Commands Available via Hard and Soft Keys
## Evaporation Monitor mode

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

<table>
<thead>
<tr>
<th>Soft Key</th>
<th>Parameter</th>
<th>Function</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE</td>
<td>value</td>
<td>Nominal C1 [0]</td>
<td>NOMClI&lt;value&gt;</td>
</tr>
<tr>
<td>ALC</td>
<td>{OFF</td>
<td>ON}</td>
<td>ALC MODE ON/OFF</td>
</tr>
<tr>
<td>LVL</td>
<td>value</td>
<td>Power level [W,A,V,dBm]</td>
<td>POWErI&lt;value&gt;</td>
</tr>
<tr>
<td>UNIT</td>
<td>{dBm</td>
<td>WATT</td>
<td>AMP</td>
</tr>
<tr>
<td>TIME</td>
<td>{Short</td>
<td>Med</td>
<td>Long}</td>
</tr>
<tr>
<td>HI Q</td>
<td>{OFF</td>
<td>ON}</td>
<td>High Q mode ON/OFF</td>
</tr>
<tr>
<td>Dir</td>
<td>{UP</td>
<td>DOWN}</td>
<td>Search method of monitor mode</td>
</tr>
<tr>
<td>Tot</td>
<td>value</td>
<td>Time-out value for trapping</td>
<td>EMTMOUTI&lt;value&gt;</td>
</tr>
<tr>
<td>CIR</td>
<td>PI</td>
<td>Measurement circuit</td>
<td>CIRcuitI{NON</td>
</tr>
<tr>
<td>MAN</td>
<td>{OFF</td>
<td>ON}</td>
<td>Entry of trap frequency from front panel</td>
</tr>
<tr>
<td>PARA</td>
<td>Fr</td>
<td>Type of search frequency</td>
<td>MEASPARAmeterI{FR}</td>
</tr>
<tr>
<td>PHAS</td>
<td>value</td>
<td>Target phase [*]</td>
<td>TGTPhaseI&lt;value&gt;</td>
</tr>
<tr>
<td>Figt</td>
<td>value</td>
<td>Target frequency</td>
<td>EMListI&lt;value 1&gt;,&lt;value 2&gt;,&lt;value 3&gt;,&lt;value 4&gt;,&lt;ON&lt;0</td>
</tr>
<tr>
<td>Flow</td>
<td>value</td>
<td>Lowest trap frequency</td>
<td>EMListI&lt;value 1&gt;,&lt;value 2&gt;,&lt;value 3&gt;,&lt;ON&lt;0</td>
</tr>
<tr>
<td>Fadd</td>
<td>value</td>
<td>2nd trap frequency</td>
<td>EMListI&lt;value 1&gt;,&lt;value 2&gt;,&lt;value 3&gt;,&lt;ON&lt;0</td>
</tr>
<tr>
<td>Fhi</td>
<td>value</td>
<td>Highest trap frequency</td>
<td>EMListI&lt;value 1&gt;,&lt;value 2&gt;,&lt;value 3&gt;,&lt;ON&lt;0</td>
</tr>
<tr>
<td>Soft Key</td>
<td>Parameter</td>
<td>Function</td>
<td>HP-IB Command</td>
</tr>
<tr>
<td>----------</td>
<td>-----------</td>
<td>----------</td>
<td>---------------</td>
</tr>
<tr>
<td>Pri1</td>
<td>{Z</td>
<td>Y</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>CALC1:FORM</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>{MLN</td>
</tr>
<tr>
<td>Sec1</td>
<td>{θ</td>
<td>Z</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>CALC2:FORM</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>{PHAS</td>
</tr>
<tr>
<td>Pri2</td>
<td>{Z</td>
<td>Y</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>CALC3:FORM</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>{MLN</td>
</tr>
<tr>
<td>Sec2</td>
<td>{θ</td>
<td>Z</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>CALC4:FORM</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>{PHAS</td>
</tr>
<tr>
<td>TIME</td>
<td>{Short</td>
<td>Med</td>
<td>Long}</td>
</tr>
<tr>
<td>AVG</td>
<td>value</td>
<td>Averaging factor</td>
<td>SENS:AVER:COUNT &lt;value&gt;</td>
</tr>
<tr>
<td>LVL</td>
<td>value</td>
<td>Power level [W,VA,dBm]</td>
<td>SOUR:VOLT &lt;value&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[A</td>
</tr>
<tr>
<td>UNIT</td>
<td>{dBm</td>
<td>WATT</td>
<td>AMP</td>
</tr>
<tr>
<td>Vmon</td>
<td>{OFF</td>
<td>ON}</td>
<td>Voltage monitor ON/OFF</td>
</tr>
<tr>
<td>Imon</td>
<td>{OFF</td>
<td>ON}</td>
<td>Current monitor ON/OFF</td>
</tr>
<tr>
<td>AP1</td>
<td>{OFF</td>
<td>DEV</td>
<td>%}</td>
</tr>
<tr>
<td>Ref</td>
<td>value</td>
<td>Reference value of primary parameter 1 for Delta mode</td>
<td>DATA: REF1,&lt;value&gt;</td>
</tr>
<tr>
<td>AS1</td>
<td>{OFF</td>
<td>DEV</td>
<td>%}</td>
</tr>
<tr>
<td>Ref</td>
<td>value</td>
<td>Reference value of secondary parameter 1 for Delta mode</td>
<td>DATA: REF2,&lt;value&gt;</td>
</tr>
<tr>
<td>AP2</td>
<td>{OFF</td>
<td>DEV</td>
<td>%}</td>
</tr>
<tr>
<td>Ref</td>
<td>value</td>
<td>Reference value of primary parameter 2 for Delta mode</td>
<td>DATA: REF4,&lt;value&gt;</td>
</tr>
<tr>
<td>AS2</td>
<td>{OFF</td>
<td>DEV</td>
<td>%}</td>
</tr>
<tr>
<td>Ref</td>
<td>value</td>
<td>Reference value of secondary parameter 2 for Delta mode</td>
<td>DATA: REF4,&lt;value&gt;</td>
</tr>
<tr>
<td>DGT</td>
<td>value</td>
<td>Display digits</td>
<td>DISP:TEXT1:DI{G} {8</td>
</tr>
<tr>
<td>CUM</td>
<td>{PI</td>
<td>PROBE</td>
<td>BRIDGE}</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>PI</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>PI41900A</td>
</tr>
<tr>
<td>FREQ</td>
<td>value [MHz]</td>
<td>Measurement frequency</td>
<td>SOURce:FREQuency</td>
</tr>
</tbody>
</table>
## Filter Measurement Mode (Flt Mode)

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

<table>
<thead>
<tr>
<th>Soft Key</th>
<th>Parameter</th>
<th>Function</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>FREQ</td>
<td>value</td>
<td>Nominal frequency [Hz]</td>
<td>NOMFrequ&lt;value&gt;</td>
</tr>
<tr>
<td>RBG</td>
<td>value</td>
<td>Search range [Hz/ppm]</td>
<td>SRCHRange&lt;value&gt;</td>
</tr>
<tr>
<td>xdB</td>
<td>value</td>
<td>Down value for filter band width</td>
<td>FLTDBL&lt;value&gt;</td>
</tr>
<tr>
<td>LOSS</td>
<td>&lt;Const</td>
<td>Min&gt;</td>
<td>Select constant/minimum loss</td>
</tr>
<tr>
<td>TIME</td>
<td>&lt;Short</td>
<td>Med</td>
<td>Long&gt;</td>
</tr>
<tr>
<td>HI-Q</td>
<td>&lt;OFF</td>
<td>ON&gt;</td>
<td>High Q mode ON/OFF</td>
</tr>
<tr>
<td>LVL</td>
<td>value</td>
<td>Power level [dBm only]</td>
<td>POWERL&lt;value&gt;</td>
</tr>
</tbody>
</table>
# Comparator Setup Mode (Xtal, DLD, Flt, LCR only)

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

<table>
<thead>
<tr>
<th>Soft Key</th>
<th>Parameter</th>
<th>Function</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMP</td>
<td>{OFF</td>
<td>ON}</td>
<td>Comparator function ON/OFF</td>
</tr>
<tr>
<td>SEC</td>
<td>{OFF</td>
<td>ON}</td>
<td>Secondary sorting ON/OFF</td>
</tr>
<tr>
<td>AUX</td>
<td>{OFF</td>
<td>ON}</td>
<td>AUX bin ON/OFF</td>
</tr>
<tr>
<td>PRI</td>
<td>ABS_TOL</td>
<td>XTOL</td>
<td>SEQ</td>
</tr>
<tr>
<td>NOM</td>
<td>value</td>
<td>Nominal value applied to Tolerance mode</td>
<td>COMPTOLSTDU&lt;value&gt;</td>
</tr>
<tr>
<td>BEEP</td>
<td>Pass</td>
<td>Fail</td>
<td>Whether to indicate Pass or Fail by outputting beep sound.</td>
</tr>
<tr>
<td>LED</td>
<td>Pass</td>
<td>Fail</td>
<td>Whether to indicate Pass or Fail by illuminating LED.</td>
</tr>
<tr>
<td>PriU</td>
<td>value</td>
<td>Upper limit value for primary sorting</td>
<td>COMPPLimitU{BIN1},&lt;value 1&gt;,&lt;value 2&gt;</td>
</tr>
<tr>
<td>PriL</td>
<td>value</td>
<td>Lower limit value for primary sorting</td>
<td>COMPPLimitU{BIN1},&lt;value 1&gt;,&lt;value 2&gt;</td>
</tr>
<tr>
<td>SecU</td>
<td>value</td>
<td>Upper limit value for secondary sorting</td>
<td>COMPSLimitU&lt;value 1&gt;,&lt;value 2&gt;</td>
</tr>
<tr>
<td>SecL</td>
<td>value</td>
<td>Lower limit value for secondary sorting</td>
<td>COMPSLimitU&lt;value 1&gt;,&lt;value 2&gt;</td>
</tr>
<tr>
<td>LtAF</td>
<td>{OFF</td>
<td>ON}</td>
<td>ΔF limit test ON/OFF (for DLD mode only)</td>
</tr>
<tr>
<td>LtAZ</td>
<td>{OFF</td>
<td>ON}</td>
<td>ΔCI limit test ON/OFF (for DLD mode only)</td>
</tr>
<tr>
<td>AFU</td>
<td>value</td>
<td>ΔF limit value (for DLD mode only)</td>
<td>COMPDLTFLU&lt;value&gt;</td>
</tr>
<tr>
<td>AFU</td>
<td>value</td>
<td>ΔCI limit value (for DLD mode only)</td>
<td>COMPDLTCLU&lt;value&gt;</td>
</tr>
<tr>
<td>BWU</td>
<td>value</td>
<td>Upper limit value for BW (for Flt mode only)</td>
<td>COMPBWLU&lt;value 1&gt;,&lt;value 2&gt;</td>
</tr>
<tr>
<td>BWL</td>
<td>value</td>
<td>Lower limit value for BW (for Flt mode only)</td>
<td>COMPBWL&lt;value 1&gt;,&lt;value 2&gt;</td>
</tr>
<tr>
<td>LbBW</td>
<td>{OFF</td>
<td>ON}</td>
<td>BW limit test ON/OFF</td>
</tr>
</tbody>
</table>
## System Setup Mode

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

<table>
<thead>
<tr>
<th>Soft Key</th>
<th>Parameter</th>
<th>Function</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DISP</strong></td>
<td>(0FF</td>
<td>ON)</td>
<td>Measurement data display ON/OFF</td>
</tr>
<tr>
<td><strong>CAL</strong></td>
<td>{0p</td>
<td>Sh</td>
<td>Ld}</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>COMP</strong></td>
<td>{0p</td>
<td>Sh</td>
<td>Ld}</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>DelDATA</strong></td>
<td>{NO</td>
<td>YES}</td>
<td>Clears the last data in the buffer</td>
</tr>
<tr>
<td><strong>MemClear</strong></td>
<td>{NO</td>
<td>YES}</td>
<td>Clears buffer</td>
</tr>
<tr>
<td><strong>BEEP</strong></td>
<td>{OFF</td>
<td>ON}</td>
<td>Beep ON/OFF</td>
</tr>
<tr>
<td></td>
<td></td>
<td>When BEEPSTATE is OFF the beep never sound even an error occurs</td>
<td></td>
</tr>
<tr>
<td><strong>HPIB</strong></td>
<td>1 to 31</td>
<td>HP-IB address 31: talk only mode (for Print out)</td>
<td>`HP</td>
</tr>
<tr>
<td><strong>AnalogOut</strong></td>
<td>{OFF</td>
<td>ON}</td>
<td>Analog OUT terminal output ON/OFF</td>
</tr>
<tr>
<td><strong>Settings</strong></td>
<td>{dF</td>
<td>v</td>
<td>REF}</td>
</tr>
<tr>
<td><strong>Service Func</strong></td>
<td>{Key</td>
<td>HNDL</td>
<td>CSUM</td>
</tr>
<tr>
<td><strong>Self Test</strong></td>
<td>{NO</td>
<td>YES}</td>
<td>Self test</td>
</tr>
</tbody>
</table>
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 “Xil 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:

![Graph showing frequency-impedance characteristics of a crystal resonator](image)

**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)

<table>
<thead>
<tr>
<th>Measurement parameter</th>
<th>Search target</th>
<th>Search condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fr</td>
<td>Resonance point</td>
<td>A lower frequency point with zero phase</td>
</tr>
<tr>
<td>Fs</td>
<td>Series resonance point</td>
<td>Point with the maximum conductance</td>
</tr>
<tr>
<td>FL</td>
<td>Resonance point with capacitance load</td>
<td>Resonance point with capacitance load</td>
</tr>
<tr>
<td>Fa</td>
<td>Anti-resonance point</td>
<td>A higher frequency point with zero phase</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Measurement parameter</th>
<th>Search target</th>
<th>Search condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fr</td>
<td>Resonance point</td>
<td>Peak with lowest impedance</td>
</tr>
<tr>
<td>Fs</td>
<td>Series resonance point</td>
<td>Point with the maximum conductance</td>
</tr>
<tr>
<td>FL</td>
<td>Resonance point with capacitance load</td>
<td>Resonance point with capacitance load</td>
</tr>
<tr>
<td>Fa</td>
<td>Anti-resonance point</td>
<td>Peak with highest impedance</td>
</tr>
</tbody>
</table>

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

- Fr – CI
- FL – Fr – CI
- Fs – Zs
- Fa – Za

Fs indicates the frequency at the point with the maximum conductance (Gmax) in the following circle diagram for admittance characteristics:
Figure 4-2. Circle diagram for admittance characteristics

Note

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

Parameters and Their Settings

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

- Parameters that determine nominal values

  □ FREQ: Lets you specify the nominal value for the resonance frequency (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>

  □ CT: 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: CT
- Hard key: (Nominal CT)
- HP-IB command: NOMCl<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|MV|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: TGPPhase<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: EQUCkU{DEV4|DEV6|OFF}

- **DispQ**: Lets you show or hide the Q parameter.
  - Soft key: DispQ
  - 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: CLADJustU{OFF|ON|0|1}

- **CL_a (manual input)**: When you select the **CL_a** soft key, you are presented with two options: ND-CL and User. The User option allows you to manually enter the value of the CL_a parameter while the ND-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: CLACTTypeU{NOCL|USER}, CLACT\u2190<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: CLTGTTypeU{NOCL|USER|CLACT}, CLTGT\u2190<value>

- **CL Compex**: Let you execute the CL compensation function. This function calculates the capacitance load value which enables a crystal resonator to oscillate at the frequency of the reference
resonator. It is required to adjust the capacitance load on the \( \pi \) test fixture before using this function.

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

**Note**

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

- **Fgt**: Let you specify the frequency of the reference resonator used in CL Compensation function.
  - Soft key: Fgt
  - Hard key: —
  - HP-IB command: CLFREQU\{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: AGINGTIMEU/value[SMSM]

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 \( \uparrow \rightarrow \) or \( \downarrow \rightarrow \) 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), (Exit) (Entry Off).

- When no soft key is selected yet, you can access the previous or next pair of soft keys by pressing the \( \uparrow \rightarrow \) or \( \downarrow \rightarrow \) 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>
<thead>
<tr>
<th>Measurement Parameters</th>
<th>Search Mode</th>
<th>TGT soft key</th>
<th>PAR soft key</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fr – CI</td>
<td>Phase</td>
<td>Phase</td>
<td>Fr</td>
</tr>
<tr>
<td></td>
<td>CI PEAK</td>
<td>Peak</td>
<td>Fr</td>
</tr>
<tr>
<td>FL – CI</td>
<td>Phase</td>
<td>Phase</td>
<td>FL</td>
</tr>
<tr>
<td></td>
<td>CI PEAK</td>
<td>Peak</td>
<td>FL</td>
</tr>
<tr>
<td>Fa – Za</td>
<td>Gmax (maximum conductance)</td>
<td>–</td>
<td>FS</td>
</tr>
<tr>
<td>Fa – Za</td>
<td>Phase peak</td>
<td>Phase</td>
<td>Fa</td>
</tr>
<tr>
<td></td>
<td>CI PEAK</td>
<td>Peak</td>
<td>Fa</td>
</tr>
</tbody>
</table>

Measurement Functions

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

Measurement with Capacitance Load (CL_a/CL_t Parameters)

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

- By specifying a different capacitance from that of the load connected to the \( \pi \) fixture, HP E4915A/E4916A calculates and displays FL as if the target load was actually connected.
You need to specify 2 load capacitance values to use this function.

- **CL_a parameter**: Indicates the actually measured capacitance load value. Based on the value of this parameter, the HP E4915A/E4916A calculates the characteristic values compensated for the influence of the capacitance load. Normally, to know actual load value on the 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 instability 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.**

<table>
<thead>
<tr>
<th>Meas Prmtr (Fr,FL) and Display Value (Fr,FL) (Meas Prmtr = Fr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CL_a = NoCL Fr: Actual measurement value</td>
</tr>
<tr>
<td>CL_a = User Fr: Conversion Value from a measurement value and CLact value</td>
</tr>
</tbody>
</table>

---

4-10 Function Reference
Table 4-5. Meas Prmtr (Fr,FL) and Display Value (Fr,FL) (Meas Prmtr = FL)

<table>
<thead>
<tr>
<th>CL_t = NoCL</th>
<th>CL_t = User</th>
<th>CL_t = CLact</th>
</tr>
</thead>
<tbody>
<tr>
<td>CL_a = NoCL</td>
<td>Fr: Actual measurement value</td>
<td>Fr: Actual measure value</td>
</tr>
<tr>
<td></td>
<td>FL: same as Fr</td>
<td>FL: same as Fr</td>
</tr>
<tr>
<td>CL_a = User</td>
<td>Fr: Conversion value from</td>
<td>Fr: Conversion value from</td>
</tr>
<tr>
<td></td>
<td>measurement value and</td>
<td>measurement value and</td>
</tr>
<tr>
<td></td>
<td>CLact</td>
<td>CLact</td>
</tr>
<tr>
<td></td>
<td>FL: same as Fr</td>
<td>FL: conversion value from</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CLact, CLzgt</td>
</tr>
</tbody>
</table>

Note: The CI value displayed in all mode is the value actually measured.

CL Adj Function

Measures the capacitance load actually connected to the crystal resonator. The CL value is measured for the 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 stray capacitance of other test fixture, please refer to the manual of it.

CL Compensation Function

The HP E4915A/E4916A have a function to calculate the capacitance load value which 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_Comp should be used to use this function, and the softkey Freq 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.
Note that the CL measurement result when you use the CL Adj function after the capacitance load adjustment. The stray capacitance when a crystal resonator is connected is different from that when the shorting device is connected.

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

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

**Equivalent Circuit Analysis Function**

The Equivalent Circuit Analysis function allows you to determine the 4- or 6-element equivalent circuit that corresponds to the DUT. To access this mode, use the **EQUC** soft key or (blue)+F/1M (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](image)

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 **DispQ** soft key.

The LCD screen of the HP E4915A/E4916A can only display four of the eight equivalent circuit parameters (plus two parameters: Fr and Cl) at a time. Which four parameters are displayed at a time depends on the settings of the soft keys EQUC and DispQ, as shown in the following table:
Table 4-6.
Settings of EQUC and DSPQ and Combinations of Displayed Constants

<table>
<thead>
<tr>
<th>EQUC setting</th>
<th>DSPQ setting</th>
<th>Constants displayed</th>
</tr>
</thead>
<tbody>
<tr>
<td>4DEV ON</td>
<td>ON</td>
<td>C1, R1, Q</td>
</tr>
<tr>
<td>4DEV OFF</td>
<td>ON</td>
<td>C0, C1, R1, L1</td>
</tr>
<tr>
<td>6DEV ON</td>
<td>ON</td>
<td>R0, C0, Q</td>
</tr>
<tr>
<td>6DEV OFF</td>
<td>ON</td>
<td>C0, C1, R1, L1</td>
</tr>
</tbody>
</table>

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 R1-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

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Meas time</th>
<th>High Q</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Short</td>
<td>OFF</td>
</tr>
<tr>
<td>2</td>
<td>Med</td>
<td>OFF</td>
</tr>
<tr>
<td>3</td>
<td>Long</td>
<td>OFF</td>
</tr>
<tr>
<td>4</td>
<td>Short</td>
<td>ON</td>
</tr>
<tr>
<td>5</td>
<td>Med</td>
<td>ON</td>
</tr>
<tr>
<td>6</td>
<td>Long</td>
<td>ON</td>
</tr>
</tbody>
</table>

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.
To enter the nominal Cl value, use the (Nominal Cl) 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.

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 - Cl, FL - Cl, 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)

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

Note

HP-IB

- Characteristic parameters: Fr|Fa|Fs|FL, Cl|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, Cl|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 Cl 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: ANLGOUTU {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: ANLGDFDVU<value>, ANLGREFU<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.

![Graph showing phase and impedance](image)

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

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

The LCD screen displays only one of the spurious points found. The spurious point displayed on the LCD screen can be either the spurious point that corresponds to a user-specified index or the **worst**
spurious, depending on the setting of the DispSP soft key (described in "Parameters and Their Settings"). For the index, you can specify 1 for the spurious point with the smallest frequency, 2 for the spurious point with the second smallest frequency, and so on. The worst spurious means the spurious point where the magnitude of the negative impedance peak is maximum.

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

**Note**

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

### Parameters and Their Settings

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

- **Parameters that determine measuring conditions**

  □ CENT: Lets you specify the center frequency for the spurious search range. The unit is MHz.
    - Soft key: CENT
    - Hard key:—
    - HP-IB command: SPCENTer≤<value>

  □ RNG: Lets you specify the spurious search range. The unit is KHz, Hz or ppm.
    - Soft key: RNG
    - Hard key:—
    - HP-IB command: SPRANGE≤<value>[(Hz|Ppm)]

  □ DispSP: Determines which spurious point to be displayed on the LCD. This soft key provides two alternative options: Worst and Nth. Use the Worst option to display the worst spurious point (i.e., the spurious point where the impedance value reaches the maximum negative peak). On the other hand, the Nth option allows you to specify the index number of the spurious point you want displayed; for example, you can specify 1 for the spurious point with the smallest frequency, 2 for the spurious point with the second smallest frequency, and so on.
    - Soft key: DispSP
    - Hard key:—
    - HP-IB command: SPDISP≤{Worst|Nth{,<value>}}

  □ TGT: Lets you specify the spurious search target: Phase or Peak.
- Soft key: TGT
- Hard key:—
- HP-IB command: SPTGT{PHase|PEak}

- PHAS: Lets you specify the target phase value in degrees (°).
  - Soft key: PHAS
  - Hard key:—
  - HP-IB command: SPPHAS{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 Cl value at FR 20log{(Z value at spurious point) / (Cl 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

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Front panel</th>
<th>HP-IB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fr value at each level</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Cl value at each level</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Difference between the maximum and minimum values of Fr</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Difference between the maximum and minimum values of Cl</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Maximum and minimum values of Fr</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Maximum value of Cl</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Minimum value of Cl</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Fr and Cl values at reference level</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

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\textless value\textgreater
  - 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: [Cl]
    - Hard key: [Nominal Cl]
    - HP-IB command: NOMCl\textless value\textgreater

- **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\textless value\textgreater
  - SWEF: Lets you choose one of three alternative sweep types: UP, UP_DOWN, UP_MIN. For more information on level sweep, refer to “Specifying How To Sweep the Drive Level” later in this section.
    - Soft key: [SWEF]
    - Hard key: —
    - HP-IB command: PTSWPTyPe\{UP\textsl{DOWN}\{UP\textsl{MIN}\}\textsl{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\{\textless 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\{\textless 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\{\textless 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\{\textless value\}\{mW\}[UW][NW][W][MA][UA][A][MV][UV][V][DBM],
    PTMAXPower\{\textless value\}\{mW\}[UW][NW][W][MA][UA][A][MV][UV][V][DBM],
    PTSTDPower\{\textless 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: PTTWAIT\{\textless value\}

- **TRK**: 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: **TRK** [ON|OFF]
  - Hard key:—
  - HP-IB command: PTRACK\{ON|OFF\}[0|1]
- **StartP**: Lets you specify the point at which to start measurement. Use this parameter when you want to start measuring a resonance point not at the MIN value of the drive level, but at the specified level that the drive level has reached. This parameter is set to 1 for normal measurement; start at the MIN value. You can use the Fr (Fs) and CI values at this drive level as the reference values for Delta mode.
  
  - Soft key: **StartP**
  - Hard key:—
  - HP-IB command: PTSTARTPoint\{value\}

- **ABORT**: Turns ON/OFF the Phase Tracking Abort function. When the Abort function is ON and phase tracking fails, the HP E4916A aborts drive level measurement.
  
  - Soft key: **ABORT**
  - Hard key:—
  - HP-IB command: PTABORT\{OFF\{ON\}\{0\}\\{1\}\}

- **TGT**: Lets you specify the search target: Phase or Peak.
  
  - Soft key: **TGT**
  - Hard key:—
  - HP-IB command: SRCHTGT\{PHase\{PEak\}\}

- **PHAS**: Lets you specify the target phase value in degrees (°). Use this parameter if you search a resonance point for phase. This parameter is set to 0 for normal measurement.
  
  - Soft key: **PHAS**
  - Hard key:—
  - HP-IB command: TGTPhase\{value\}

- **PARA**: Lets you select one of the valid measurement parameters: Fr and Fs.
  
  - Soft key: **PARA**
  - Hard key:—
  - HP-IB command: MEASPARA\{FR\\{FS\}\}

Parameters that control Delta mode

- **ΔF**: Provides three options that control Delta mode which provides a frequency value as a deviation with respect to a specified reference value: OFF, DEV, and PPM. The OFF option turns OFF Delta mode; the DEV option causes the HP E4916A to indicate actual deviations while the PPM option causes the HP E4916A to indicate the ppm of a deviation.
  
  - Soft key: **ΔF**
  - Hard key:—
  - HP-IB command: DLTMode\{PRI\{SEC\}\\{OFF\\{DEV\\{PCNT\\{PPM\}\}\}\}\}

- **RefF**: Lets you specify the reference frequency value for Delta mode. The unit is Hz.

  You can specify one of these settings.

  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: DLTREFU{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: DLTModeU{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 settings.

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: DLTREFU{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: MEAStimeU<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: MEAStimeU<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: ALCU{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: [CET]
- Hard key: —
- HP-IB command: CIRCuit[(P|PRObe|BRIdge)
PICKTtypeU{(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 [r->] or [l<-] 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 [r->] or [l<-] 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**

<table>
<thead>
<tr>
<th>Method</th>
<th>Front panel</th>
<th>HP-IB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweep list</td>
<td>—</td>
<td>✓</td>
</tr>
<tr>
<td>Minimum/maximum values and sweep type</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Valid value/range</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drive level value</td>
<td>0.1 nW ~ 1 mW [W]/[A]/[V]/[dBm]</td>
<td></td>
</tr>
<tr>
<td>Whether or not to perform measure</td>
<td>ON/OFF</td>
<td></td>
</tr>
<tr>
<td>Number of sweep points</td>
<td>1 ~ 80</td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Drive level setting</th>
<th>DLD measurement</th>
<th>ON/OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 μW</td>
<td></td>
<td>ON</td>
</tr>
<tr>
<td>2 μW</td>
<td></td>
<td>ON</td>
</tr>
<tr>
<td>3 μW</td>
<td></td>
<td>ON</td>
</tr>
<tr>
<td>5 μW</td>
<td></td>
<td>ON</td>
</tr>
<tr>
<td>8 μW</td>
<td></td>
<td>ON</td>
</tr>
<tr>
<td>10 μW</td>
<td></td>
<td>ON</td>
</tr>
<tr>
<td>8 μW</td>
<td></td>
<td>ON</td>
</tr>
<tr>
<td>5 μW</td>
<td></td>
<td>ON</td>
</tr>
<tr>
<td>3 μW</td>
<td></td>
<td>ON</td>
</tr>
<tr>
<td>2 μW</td>
<td></td>
<td>ON</td>
</tr>
<tr>
<td>1 μW</td>
<td></td>
<td>ON</td>
</tr>
</tbody>
</table>

#### Note

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

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

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

  Each sweep type is described below:

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

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

---

**Figure 4-6. Sweep Type**

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

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Front panel (soft key)</th>
<th>HP-IB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum value</td>
<td>MIN</td>
<td>PTMINPower</td>
</tr>
<tr>
<td>Maximum value</td>
<td>MAX</td>
<td>PTMAXPower</td>
</tr>
<tr>
<td>Sweep type</td>
<td>SWEP</td>
<td>PTSWPType</td>
</tr>
</tbody>
</table>

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>
<thead>
<tr>
<th>Maximum level (user-specified)</th>
<th>Maximum level (user-specified)</th>
<th>Individual drive levels (automatically established)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 nW</td>
<td>10 nW</td>
<td>1, 2, 3, 5, 8, 10 [nW]</td>
</tr>
<tr>
<td>15 nW</td>
<td>250 nW</td>
<td>15, 20, 30, 50, 80, 100, 200, 250 [nW]</td>
</tr>
</tbody>
</table>

4-26 Function Reference
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

<table>
<thead>
<tr>
<th>Measurement parameter</th>
<th>Soft key</th>
<th>Settings</th>
<th>Delta mode display form</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>AF</td>
<td>DEV (Measured value) -- (reference value) [Hz]</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>PPM {(Measured value) -- (reference value) / (reference value) [ppm]}</td>
<td></td>
</tr>
<tr>
<td>Crystal impedance</td>
<td>ACI</td>
<td>DEV (Measured value) -- (reference value) [%]</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>% {(Measured value) -- (reference value) / (reference value) [%]}</td>
<td></td>
</tr>
</tbody>
</table>

To set the reference frequency and CI values, use the \text{Ref} \text{F} and \text{Ref} \text{Z} 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 \text{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 \text{MEASTTime} 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.
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

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: \( dF/dV \) and REF. You can choose one of them and enter your desired value.

- **Soft key**: Settings
- **Hard key**: —
- **HP-IB command**: ANLGDFDV\( <value> \), ANLGRF\( <value> \)
Evaporation Monitor Mode (EM Mode)

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

Purpose and Principle

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

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

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

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

![Phase vs Frequency Diagram](image)

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[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|A|MV|UV|V|DBM]

- **UNIT**: Let you select the unit of the power level (**LVL** soft key) from dBm, WAIT, AMP, and VOLT.
  - Soft key: **UNIT**
  - Hard key:—
  - HP-IB command: POWER<value>[MW|UW|NW|W|MA|A|MV|UV|V|DBM]

Note

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

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

- **TIME**: Determines the measuring time, which can be one of three alternative settings: Short, Med, and Long.
- Soft key: **TIME**
- Hard key: **Meas Time**
- HP-IB command: MEASTime\(\langle value\rangle\)

- **HI Q**: Turns ON/OFF High Q mode.
  - Soft key: **HI Q**
  - Hard key:—
  - HP-IB command: MEASTime\(\langle value\rangle\)

- **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\(\langle value\rangle\)

- **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 \(\langle value\rangle\)**
  - Hard key:—
  - HP-IB command:—

- **F tgt**: Lets you specify the target frequency.
  - Soft key: **F tgt \(\langle value\rangle\)**
  - Hard key:—
  - HP-IB command: EMLIST\(\langle value1\rangle,\langle value2\rangle,\langle value3\rangle,\langle value4\rangle\), \{ON\|OFF\|0\|1\}\, \langle value4\rangle
■ Flow: Lets you specify the lowest trap frequency.
  □ Soft key:  
  □ Hard key:—
  □ HP-IB command: EMLIST:J<value1>,<value2>,<value3>,
                    {ON|OFF|0|1},<value4>

■ Fmed: Lets you specify the 2nd trap frequency.
  □ Soft key:  
  □ Hard key:—
  □ HP-IB command: EMLIST:J<value1>,<value2>,<value3>,
                    {ON|OFF|0|1},<value4>

■ Fhi: Lets you specify the highest trap frequency.
  □ Soft key:  
  □ Hard key:—
  □ HP-IB command: EMLIST:J<value1>,<value2>,<value3>,
                    {ON|OFF|0|1},<value4>

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

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

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

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

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

### Measurement Functions

**ALC Mode**

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

**Note**

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

LCD Screen/HP-IB

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

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

- CI value at the previous trap point [0]
- 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: ANLGOUTU{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.

![Diagram](image)

**Figure 4-8. Constant loss and minimum loss**

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

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

Parameters and Their Settings

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

- **FREQ**: Lets you specify the nominal frequency value.
  - Soft key: `FREQ`
  - Hard key: `<FREQ`
  - HP-IB command: `NOMFreq<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\}

**dB**: Specify the down value for filter band width
Soft key: dB
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 \(\uparrow\Rightarrow\) or \(\downarrow\) 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 \(\uparrow\Rightarrow\) or \(\downarrow\) 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.
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 \( \text{[blue]} + \text{[1} \text{(Status)]} \) 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:

\[
Z = R_s + jX = |Z|e^{j\theta}
\]

\[
X = \omega L_s
\]

\[
Z = R_s + j\omega L_s
\]

Where \( \omega = 2\pi f \)

\( f \): test frequency

\[
Y = G + jB
\]

\[
B = \frac{1}{\omega L_p}
\]

\[
Y = G + j\frac{1}{\omega L_p}
\]

Where \( \omega = 2\pi f \)

\( f \): test frequency

\[
Q = \frac{1}{D} = \frac{1}{\tan \delta} = \frac{X_L}{R} = \frac{X_C}{R} = \frac{B_L}{G} = \frac{B_C}{G}
\]

Figure 4-9. Relationship between Measurement Parameters

In Figure 4-9,

- \( L_s \): Equivalent series inductance
- \( L_p \): Equivalent parallel inductance
- \( C_s \): Equivalent series capacitance
- \( C_p \): Equivalent parallel capacitance
- \( Q \): Quality factor
- \( D \): Dissipation Factor
<table>
<thead>
<tr>
<th>Primary Parameters</th>
<th>Z, Y, R, G, C_p, C_s, L_p, L_s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secondary Parameter</td>
<td>θ_z, θ_y, X, B, D, Q, G, R_p, R_s</td>
</tr>
</tbody>
</table>

where,

- **Z**: Absolute value of impedance
- **Y**: Absolute value of admittance
- **R**: Resistance
- **G**: Conductance
- **C_p**: Equivalent parallel capacitance
- **C_s**: Equivalent series capacitance
- **L_p**: Equivalent parallel inductance
- **L_s**: Equivalent series inductance

**Secondary Parameters**

- **θ**: Phase angle
- **X**: Reactance
- **B**: Susceptance
- **D**: Dissipation factor
- **Q**: Quality factor
- **G**: Conductance
- **R_p**: Equivalent parallel resistance
- **R_s**: 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.

![Equivalent Circuit of Impedance Probe](image)

**Figure 4-10. Equivalent Circuit of Impedance Probe**

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

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

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](image)

Note

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

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

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

<table>
<thead>
<tr>
<th>State of connection</th>
<th>Front panel (hard key)</th>
<th>HP-IB command</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPEN</td>
<td>(blue) + 4 (Open)</td>
<td>CALibration:OPEN</td>
</tr>
<tr>
<td>SHORT</td>
<td>(blue) + 5 (Short)</td>
<td>CALibration:SHORT</td>
</tr>
<tr>
<td>LOAD</td>
<td>(blue) + 6 (Load)</td>
<td>CALibration:LOAD</td>
</tr>
<tr>
<td>THRU</td>
<td>(blue) + 3 (Thru)</td>
<td>THRUCAL</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>State of connection</th>
<th>Front panel (hard key)</th>
<th>HP-IB command</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPEN</td>
<td>(blue) + 7 (Open)</td>
<td>COMPENSation:OPEN</td>
</tr>
<tr>
<td>SHORT</td>
<td>(blue) + 8 (Short)</td>
<td>COMPENSation:OPEN</td>
</tr>
<tr>
<td>LOAD</td>
<td>(blue) + 9 (Load)</td>
<td>COMPENSation:LOAD</td>
</tr>
</tbody>
</table>

**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](image)

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>
<thead>
<tr>
<th>Table 4-17. Calibration Standard Values</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OPEN</strong></td>
</tr>
<tr>
<td><strong>G</strong></td>
</tr>
<tr>
<td>Option 001 Impedance Probe</td>
</tr>
<tr>
<td>HP 41900A</td>
</tr>
<tr>
<td>HP 41901A</td>
</tr>
<tr>
<td>HP 41902A</td>
</tr>
</tbody>
</table>

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.

![Diagram of fixture compensation model](image)

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]+[Δ (Mode)] key toggles Delta mode between its ON and OFF states.
- HP-IB: DLTModePRI{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: AF
  - HP-IB command: DLTMode PRI,[OFF][DEV][PPM]
- Reference frequency for delta mode
  - Softkey: RefF
  - HP-IB command: DLTREF PRI,<numeric>
- CI value delta mode ON/OFF
  - Softkey: ACI
  - HP-IB command: DLTMode 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.

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/Fit mode], or 10 bins [LCR mode] for primary sorting. Primary sorting can be performed in one of two modes: Sequential and Tolerance (for more information, refer to “Sequential Mode and Tolerance Mode” later in this section). A DUT passes primary sorting if its characteristic value matches a bin, or fails primary sorting if its characteristic value does not match any bin.

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

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

- Tertiary sorting
  - This extended function compares the frequency (Fmax – Fmin) and CI values (Clmax – Clmin) of a DUT measured in DLD mode.
  - This extended function also compares the BW value of a DUT measured in Fit mode.
Parameters That Control the Comparator Function

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

Parameter that control the basic behavior of the Comparator function

- Beep state: Turns ON/OFF the beep output of the Comparator function.
  - Soft key: —
  - Hard key: —
  - HP-IB command: COMPBEEPS\{OFF|ON\}

- Beep condition: Determines when the Comparator function outputs a beep sound; that is, when a DUT has failed or when a DUT has passed the test.
  - Soft key: \textbf{BEEP}
  - Hard key: —
  - HP-IB command: COMPBEEPCond\{FAIL|PASS\}

- LED condition: Determines when the Comparator function turns the LED on; that is, when a DUT has failed or when a DUT has passed the test.
  - Soft key: \textbf{LED}
  - Hard key: —
  - HP-IB command: COMPLEDC\{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: \textbf{COMP}
  - Hard key: —
  - HP-IB command: COMPSTATE\{OFF|ON\}

- 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: \textbf{PRI}
  - Hard key: —
  - HP-IB command: COMPPRIMode\{ABSTOL|PCNTTOL|SEQ\}

- Bin definition: You can define a single bin or multiple bins depending on whether you use the front panel or the HP-IB:
☐ Front panel
You can only specify a single bin. Use the PrIL and PrIH soft keys to define the bin’s lower and upper limit values, respectively.

☐ HP-IB
Using the COMPPLIMIT<n>,<value 1>,<value 2> command, you can define up to 9 bins [Xtal measurement mode], 5 bins [DLD mode], or 10 bins [LCR mode]. This command sets the upper limit values for one bin each time it is issued (thus, you must issue the command as many times as the number of bins you want to define).

☐ Soft key: PrIL/PrIH
☐ Hard key:—
☐ HP-IB command: COMPPLIMITBIN<n>,<value 1>,<value 2>

- Nominal value of tolerance mode: Specifies the nominal value as a reference value of tolerance mode.
  ☐ Soft key: NOM
  ☐ Hard key:—
  ☐ HP-IB command: COMPTOLSTD<n><value>

Parameters that control secondary sorting

- Status of secondary sorting: Turns ON/OFF secondary sorting.
  ☐ Soft key: SEC
  ☐ Hard key:—
  ☐ HP-IB command: COMPSECOND<n>{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<n>,<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: COMPSCAUX<n>{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: \texttt{LmAF}
- Hard key: --
- HP-IB command: COMPDLTFU\{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: \texttt{AF_H}
  - Hard key: --
  - HP-IB command: COMPDLTFLim\\{\texttt{<value>}}

- Status of ΔCI limit test: Turns ON/OFF the ΔCI limit test.
  - Soft key: \texttt{LmdZ}
  - Hard key: --
  - HP-IB command: COMPDLTCLim\\{\texttt{<value>}}

- **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: \texttt{AZ_H}
  - Hard key: --
  - HP-IB command: COMPDLTCLim\\{\texttt{<value>}}

- Status of BW limit test: Turns ON/OFF the BW limit test.
  - Soft key: \texttt{LmBW}
  - Hard key: --
  - HP-IB command: COMPBW\\{\texttt{<value>}}

- **BW limit value**: Specifies the upper and lower limit values.
  - Soft key: \texttt{BW_L/BW_H}
  - Hard key: --
  - HP-IB command: COMPBW\\{\texttt{<value1>,<value2>}} (specify the lower limit value in \texttt{<value1>} and the higher in \texttt{<value2>})

\textbf{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>
<thead>
<tr>
<th>Mode</th>
<th>Settings through the Front Panel</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sequential</td>
<td>PRT = SEQ</td>
<td>COMPPRIModel:SEQ</td>
</tr>
<tr>
<td>Tolerance</td>
<td>PRT = ABS_TOL</td>
<td>COMPPRIModel:JABSTOL</td>
</tr>
<tr>
<td>Tolerance</td>
<td>PRT = %TOL</td>
<td>COMPPRIModel:PCNHTDL</td>
</tr>
</tbody>
</table>

**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:

![Sequential Sorting](image)

**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:

![Tolerance Sorting Diagram]

**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**

<table>
<thead>
<tr>
<th>Form</th>
<th>Meaning</th>
<th>Settings through the Front Panel</th>
<th>HP-IB command</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absolute deviation</td>
<td>Actual deviation from reference value</td>
<td>PRL = ABS_TOL</td>
<td>COMPPRIMode:ABS_TOL</td>
</tr>
<tr>
<td>Percentage</td>
<td>Percentage of deviation with respect to reference value</td>
<td>PRL = %TOL</td>
<td>COMPPRIMode:PCWTOL</td>
</tr>
</tbody>
</table>

**Note**

All bins must be defined within the measurable range for the characteristic parameter.
Aux Bin
By default, all DUTs that have failed secondary sorting are treated as Out-Of-Bin articles.

![Diagram of primary and secondary parameters with bins and limits]

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.
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 ΔCl limit/BW.L AND BW.H), for either the ΔF limit/ΔCl 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

<table>
<thead>
<tr>
<th>Hard key</th>
<th>HP-IB command</th>
</tr>
</thead>
<tbody>
<tr>
<td>Save</td>
<td>*(SAV) &lt;value&gt;</td>
</tr>
<tr>
<td>Recall</td>
<td>*(RCL) &lt;value&gt;</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Hard key</th>
<th>HP-IB command</th>
</tr>
</thead>
<tbody>
<tr>
<td>(blue)</td>
<td>-2 (Mem Buf)</td>
</tr>
<tr>
<td></td>
<td>MESTATRel{OFF</td>
</tr>
</tbody>
</table>

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>
<thead>
<tr>
<th>Supported circuit type</th>
<th>Applicable model</th>
<th>Accessories available</th>
<th>Setting of CKT soft key</th>
<th>HP-IB command</th>
</tr>
</thead>
<tbody>
<tr>
<td>π Network test fixture</td>
<td>HP E4915A/E4916A</td>
<td>HP41901A</td>
<td>PI</td>
<td>Circuit:πPT</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>PICKType:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>{π</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>41901A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>41902A}</td>
</tr>
<tr>
<td>Impedance probe</td>
<td>HP E4916A only</td>
<td>Option 001</td>
<td>PROBE</td>
<td>Circuit:PRObe</td>
</tr>
<tr>
<td>Reflection bridge</td>
<td>HP E4916A only</td>
<td>—</td>
<td>BRIDGE</td>
<td>Circuit:BRidge</td>
</tr>
</tbody>
</table>
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 \text{[blue]} + \text{0} and \text{▼} maker will be displayed. To unlock the keys, press the \text{[blue]} + \text{2} 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>
<thead>
<tr>
<th>Mode</th>
<th>Description</th>
<th>Front panel</th>
<th>HP-IB Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>Int</td>
<td>The HP E4915A/E4916A is triggered from within itself.</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Man</td>
<td>The HP E4915A/E4916A is triggered only when you have pressed the Trig key on the front panel.</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Ext</td>
<td>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.</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Bus</td>
<td>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 &quot;HP-IB Commands Associated with Trigger Mode&quot; in Chapter 5).</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

Selecting a Trigger Mode

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

<table>
<thead>
<tr>
<th>Key/command</th>
<th>Available trigger mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Front panel (blue) + (Trig) (Trigger Mode)</td>
<td>Int, Man, Ext</td>
</tr>
<tr>
<td>HP-IB TRIGSOURCE</td>
<td>Int, Man, Ext, Bus</td>
</tr>
</tbody>
</table>

Note

Bus mode is available only via the HP-IB.

Display of Trigger Mode Status

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

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

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 SPRANGue{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>`

`Ù` means a space (ASCII character (decimal 32)).

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

`:DATA:POINT, <parameter>, <parameter>`

Parameter Types

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

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

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

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

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

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

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

Multiple Messages

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

`*CLS;:INIT`

Query and Response Message Syntax

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

`:FIMP:APER?

A response message may contain both commas semicolons as separators. When a single query command returns multiple values, a comma is used to separate each item. When multiple queries are sent
in the same message, the group of data items corresponding to each query are separated by a semicolon. For example, the fictitious query :QUERY?;QUERY2? might return a response message of:

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

After the message, `<new line>` 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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Xtal: (blue) + (Freq (Xtal))</th>
<th>Spur: (blue) + (Level (Spurious))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dld: (blue) + (Meas Prmtr (DLD)) (HP E4916Aonly)</td>
<td>Em: (blue) + (Nominal CI (EM)) (HP E4916Aonly)</td>
</tr>
<tr>
<td></td>
<td>Lcr: (blue) + (Meas Time (LCR)) (HP E4916Aonly)</td>
<td>Filter: (blue) + (CL Value (PI)) (HP E4916Aonly)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter Description</th>
<th>Xtal: Crystal Resonator measurement mode</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Spur: Spurious measurement mode</td>
</tr>
<tr>
<td></td>
<td>Dld: Drive Level Dependency measurement mode (HP E4916Aonly)</td>
</tr>
<tr>
<td></td>
<td>Em: Evaporation Monitor mode (HP E4916Aonly)</td>
</tr>
<tr>
<td></td>
<td>Lcr: LCR measurement mode (HP E4916Aonly)</td>
</tr>
<tr>
<td></td>
<td>Filter: Filter measurement mode (HP E4916Aonly)</td>
</tr>
</tbody>
</table>

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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Meas Prmtr</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PARA</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter Description</th>
<th>FR: Resonance frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FA: Anti-resonance frequency</td>
</tr>
<tr>
<td></td>
<td>FS: Frequency with the maximum G value (conductance)</td>
</tr>
<tr>
<td></td>
<td>FL: Resonance frequency with capacitance load</td>
</tr>
</tbody>
</table>

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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>TGT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>Phase: Phase search</td>
</tr>
<tr>
<td></td>
<td>Peak: Positive/negative peak search</td>
</tr>
<tr>
<td>Query Response</td>
<td>{PH</td>
</tr>
</tbody>
</table>

### SRCHR\{range\} <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 `SRCHR\{range\}? (with no parameter).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>RIG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>&lt;value&gt; Frequency search range</td>
</tr>
<tr>
<td></td>
<td>MHZ</td>
</tr>
<tr>
<td>Query Response</td>
<td>&lt;value&gt;,{HZ</td>
</tr>
</tbody>
</table>

### TGT\{phase\} <value>

Specifies the target phase value.

The query form of this command is `TGT\{phase\}? (with no parameter).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>PHAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>&lt;value&gt; Target phase value</td>
</tr>
<tr>
<td>Query Response</td>
<td>&lt;value&gt;</td>
</tr>
</tbody>
</table>

### NOMFreq\{range\} <value>

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

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

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Freq</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>&lt;value&gt; Nominal resonance frequency</td>
</tr>
<tr>
<td></td>
<td>[MHZ</td>
</tr>
<tr>
<td>Query Response</td>
<td>&lt;value&gt;</td>
</tr>
</tbody>
</table>
**Function: Available in All the Modes**

**NOMCl\{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 DLMode).

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

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Nominal Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cl</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter Description</th>
<th>&lt;value&gt; Nominal resonance impedance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query Response</td>
<td>&lt;value&gt;</td>
</tr>
</tbody>
</table>

**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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>LVL: Lets you enter a value.</td>
<td></td>
</tr>
<tr>
<td>UNIT: Lets you select a unit.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter Description</th>
<th>&lt;value&gt; Power level value</th>
</tr>
</thead>
<tbody>
<tr>
<td>[MW</td>
<td>UW</td>
</tr>
<tr>
<td>Query Response</td>
<td>&lt;value&gt;, {W</td>
</tr>
</tbody>
</table>

**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 Cl value of the DUT; with ALC mode OFF, the system uses the user-specified nominal Cl value.

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

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>ALC</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Parameter Description</th>
<th>OFF: Turns OFF ALC mode</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ON: ALC mode ON</td>
</tr>
<tr>
<td></td>
<td>0: ALC mode OFF</td>
</tr>
<tr>
<td></td>
<td>1: ALC mode ON</td>
</tr>
<tr>
<td>Query Response</td>
<td>{1</td>
</tr>
</tbody>
</table>

**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).
<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Meas Time</th>
<th>TIME</th>
<th>Hi-Q</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>MEASTime</td>
<td>Measuring time</td>
<td>High Q</td>
</tr>
<tr>
<td>1</td>
<td>Short</td>
<td>OFF</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Med</td>
<td>OFF</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Long</td>
<td>OFF</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Short</td>
<td>ON</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Med</td>
<td>ON</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Long</td>
<td>ON</td>
<td></td>
</tr>
</tbody>
</table>

Query Response: `<value>`

Function: Available in All the Modes
**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.

<table>
<thead>
<tr>
<th>Transferred Data</th>
<th>Data Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ASCII format transfer</strong>&lt;br&gt;ASCII: <code>&lt;num_elements&gt;</code>, <code>&lt;asc_data&gt;</code> <code>&lt;NLEND&gt;</code>&lt;br&gt;<code>&lt;asc_data&gt;</code> = <code>&lt;F&gt;</code>, <code>&lt;FL&gt;</code>, <code>&lt;C1&gt;</code> <code>&lt;Q&gt;</code>, <code>&lt;Tb&gt;</code>, <code>&lt;C0&gt;</code>, <code>&lt;C1&gt;</code>, <code>&lt;L1&gt;</code>&lt;br&gt;<code>&lt;R1&gt;</code> <code>[.&lt;G0&gt;,&lt;R0&gt;]</code> <code>[.&lt;comp&gt;],[&lt;time&gt;],[&lt;comp&gt;]=</code> <code>&lt;bin_num&gt;</code>, <code>&lt;pri&gt;</code>, <code>&lt;sec&gt;</code></td>
<td><strong>Data elements transferred whenever TRG is issued</strong>&lt;br&gt;<code>&lt;num_elements&gt;</code> : Number of data elements transferred&lt;br&gt;<code>&lt;num_bytes&gt;</code> : Number of bytes transferred (for example, this element contains #40256 when 256 bytes are transferred).&lt;br&gt;<code>&lt;F&gt;</code> : F (Measured resonance frequency: F0, F1, F2)&lt;br&gt;<code>&lt;FL&gt;</code> : FL (Measured resonance frequency)&lt;br&gt;<code>&lt;C1&gt;</code> : C1/Z (Measured resonance impedance)&lt;br&gt;<strong>Data elements transferred with the Equivalent Circuit Analysis function ON (for both 4- and 6-element modes)</strong>&lt;br&gt;<code>&lt;Q&gt;</code> : Q&lt;br&gt;<code>&lt;Tb&gt;</code> : Tb&lt;br&gt;<code>&lt;C0&gt;</code> : C0&lt;br&gt;<code>&lt;C1&gt;</code> : C1&lt;br&gt;<code>&lt;L1&gt;</code> : L1&lt;br&gt;<code>&lt;R1&gt;</code> : R1</td>
</tr>
<tr>
<td><strong>Data elements transferred with the Comparator function ON</strong>&lt;br&gt;<code>&lt;bin_num&gt;</code> : Bin identification number&lt;br&gt;1: OUT OF BIN&lt;br&gt;2 = AUX BIN&lt;br&gt;1 to 9 = Bin number&lt;br&gt;<code>&lt;pri&gt;</code> : Result of primary sorting&lt;br&gt;0: PASS&lt;br&gt;1: FAIL&lt;br&gt;<code>&lt;sec&gt;</code> : Result of secondary sorting&lt;br&gt;0: PASS&lt;br&gt;1: FAIL&lt;br&gt;-1: Secondary sorting OFF</td>
<td><strong>Data elements transferred with Aging mode ON (refer to the OUTPMData command)</strong>&lt;br&gt;<code>&lt;time&gt;</code> : Total elapsed time [ms]&lt;br&gt;<strong>New Line</strong>&lt;br&gt;<code>&lt;NLEND&gt;</code> : NewLine END (1 byte)</td>
</tr>
</tbody>
</table>
**Function: Xtl Measurement Mode**

**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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Parameter Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(blue) + μ/M (Equiv Ckt)</td>
<td>DEV4: 4-element equivalent circuit</td>
</tr>
<tr>
<td></td>
<td>DEV6: 6-element equivalent circuit</td>
</tr>
<tr>
<td></td>
<td>OFF: Equivalent Circuit Analysis function OFF</td>
</tr>
</tbody>
</table>

| 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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Parameter Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(depq)</td>
<td>OFF: Hides the Q parameter.</td>
</tr>
<tr>
<td></td>
<td>ON: Shows the Q parameter.</td>
</tr>
<tr>
<td></td>
<td>0: Hides the Q parameter.</td>
</tr>
<tr>
<td></td>
<td>1: Shows the Q parameter.</td>
</tr>
</tbody>
</table>

| 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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Parameter Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(age)</td>
<td>OFF: Aging mode OFF</td>
</tr>
<tr>
<td></td>
<td>ON: Aging mode ON</td>
</tr>
<tr>
<td></td>
<td>0: Aging mode OFF</td>
</tr>
<tr>
<td></td>
<td>1: Aging mode ON</td>
</tr>
</tbody>
</table>

| Query Response | {1|0} |
**Function: Xtl Measurement Mode**

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

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>(&lt;value&gt;) Length of time interval (\text{[S</td>
</tr>
<tr>
<td>Query Response</td>
<td>(&lt;value&gt;)</td>
</tr>
</tbody>
</table>

**OUTPMD ata?**
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.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>-</td>
</tr>
<tr>
<td>Query Response</td>
<td>-</td>
</tr>
</tbody>
</table>

**CLADJust\(\{\text{OFF|ON|0|1}\}\)**
Turns ON/OFF CL Adjust mode.
The query form of this command is CLADJust? (with no parameter).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>((\text{blue}) + \text{n/ppm (CL Adj)})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>OFF: CL Adjust mode OFF ON: CL Adjust mode ON 0: CL Adjust mode OFF 1: CL Adjust mode ON</td>
</tr>
<tr>
<td>Query Response</td>
<td>{0</td>
</tr>
</tbody>
</table>

**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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>CL(<em>\alpha</em>)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>(&lt;value&gt;) Capacitance load value (Actual CL) [PF]</td>
</tr>
<tr>
<td>Query Response</td>
<td>(&lt;value&gt;)</td>
</tr>
</tbody>
</table>
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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>CL_a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>NOCL: Capacitance load not connected (CL value infinite). USER: User-specified CL value</td>
</tr>
<tr>
<td>Query Response</td>
<td>{NOCL{USER}</td>
</tr>
</tbody>
</table>

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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>CL Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>{&lt;value&gt;} Target capacitance load value (Target CL) [FF]</td>
</tr>
<tr>
<td>Query Response</td>
<td>{&lt;value&gt;}</td>
</tr>
</tbody>
</table>

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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>CL_t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>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.</td>
</tr>
<tr>
<td>Query Response</td>
<td>{NOCL{USER}CLACT}</td>
</tr>
</tbody>
</table>
Function: Xtl Measurement Mode

**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.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>CL Compen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
<tr>
<td>Query Response</td>
<td>Query form not supported.</td>
</tr>
</tbody>
</table>

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

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

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Freq</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>&lt;value&gt; Frequency of the reference resonator [MHz</td>
</tr>
<tr>
<td>Query Response</td>
<td>&lt;value&gt;, [MHz</td>
</tr>
</tbody>
</table>
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.

<table>
<thead>
<tr>
<th>Transferred Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>- ASCII format transfer ASCII:</td>
</tr>
<tr>
<td>&lt;num_elements&gt;,&lt;asc_data&gt;&lt;NLEND&gt;</td>
</tr>
<tr>
<td>&lt;asc_data&gt;:=&lt;CL&gt;</td>
</tr>
<tr>
<td>- Binary format transfer</td>
</tr>
<tr>
<td>BINARY: #4&lt;num_bytes&gt;&lt;bin_data&gt;&lt;NLEND&gt;</td>
</tr>
<tr>
<td>&lt;bin_data&gt;:=&lt;CL&gt;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Data Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>- &lt;num_elements&gt; : Number of data elements transferred</td>
</tr>
<tr>
<td>- &lt;num_bytes&gt; : Number of bytes transferred</td>
</tr>
<tr>
<td>- &lt;CL&gt; : Actual CL value</td>
</tr>
<tr>
<td>- &lt;NLEND&gt; : NewLineEND (1 byte)</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Transferred Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>■ ASCII format transfer</td>
</tr>
<tr>
<td><strong>ASCII</strong>: <code>&lt;num_elements&gt;,&lt;asc_data&gt;,&lt;NLEND&gt;</code></td>
</tr>
<tr>
<td><code>&lt;asc_data&gt; = </code>&lt;F&gt;,&lt;CI&gt;,&lt;spur_num&gt;,&lt;sFworst&gt;,&lt;CIworst&gt;`</td>
</tr>
<tr>
<td>[<code>,&lt;sF1&gt;,&lt;sCI1&gt;</code>,<code>sF2&gt;,&lt;sCI2&gt;</code>, <code>.</code> , <code>]</code></td>
</tr>
<tr>
<td>■ Binary format transfer</td>
</tr>
<tr>
<td><strong>BIN</strong>: <code>&lt;num_bytes&gt;,&lt;bin_data&gt;,&lt;NLEND&gt;</code></td>
</tr>
<tr>
<td><code>&lt;bin_data&gt; = </code>&lt;F&gt;,&lt;CI&gt;,&lt;spur_num&gt;,&lt;sFworst&gt;,&lt;CIworst&gt;`</td>
</tr>
<tr>
<td>[<code>,&lt;sF1&gt;,&lt;sCI1&gt;</code>,<code>sF2&gt;,&lt;sCI2&gt;</code>, <code>.</code> , <code>]</code></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Data Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>■ Data elements transferred whenever TRG is issued</td>
</tr>
<tr>
<td><code>&lt;num_elements&gt;</code> : Number of data elements transferred</td>
</tr>
<tr>
<td><code>&lt;num_bytes&gt;</code> : Number of bytes transferred (for example, this element contains #40046 when 48 bytes are transferred).</td>
</tr>
<tr>
<td><code>&lt;F&gt;</code> : F (Measured resonance frequency: Fr, Fa, Fs)</td>
</tr>
<tr>
<td><code>&lt;CI&gt;</code> : CI/Z (Measured resonance impedance)</td>
</tr>
<tr>
<td>■ When the equivalent circuit analysis is ON.</td>
</tr>
<tr>
<td><code>&lt;Q&gt;</code> : Q</td>
</tr>
<tr>
<td><code>&lt;TS&gt;</code> : TS</td>
</tr>
<tr>
<td><code>&lt;C0&gt;</code> : C0</td>
</tr>
<tr>
<td><code>&lt;C1&gt;</code> : C1</td>
</tr>
<tr>
<td><code>&lt;L1&gt;</code> : L1</td>
</tr>
<tr>
<td><code>&lt;R1&gt;</code> : R1</td>
</tr>
<tr>
<td>■ When the equivalent circuit analysis is 6 devises mode.</td>
</tr>
<tr>
<td><code>&lt;C0&gt;</code> : C0</td>
</tr>
<tr>
<td><code>&lt;R0&gt;</code> : R0</td>
</tr>
<tr>
<td>■ Number of spurious points</td>
</tr>
<tr>
<td><code>&lt;spur_num&gt;</code> : Number of detected spurious points</td>
</tr>
<tr>
<td>■ Worst Suprious</td>
</tr>
<tr>
<td><code>&lt;sFworst&gt;</code> : Frequency of the point which has the minimum impedance value of all spurious points.</td>
</tr>
<tr>
<td><code>&lt;sCIworst&gt;</code> : Impedance at the point which has the minimum impedance value of all spurious points.</td>
</tr>
<tr>
<td>■ Data elements transferred when one or more spurious points are specified by SPNUM.</td>
</tr>
<tr>
<td><code>&lt;sFa&gt;</code> : Frequency of the spurious point (n: number of spurious specified by SPNUM)</td>
</tr>
<tr>
<td><code>&lt;sCI&gt;</code> : Impedance at the spurious point (n: number of spurious specified by SPNUM)</td>
</tr>
<tr>
<td>■ New Line</td>
</tr>
<tr>
<td><code>&lt;NLEND&gt;</code> : NewLineEND (1 byte)</td>
</tr>
</tbody>
</table>
Function: Spurious Measurement Mode

**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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Parameter Description</th>
<th>Query Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>#SPR</td>
<td>&lt;value&gt;: Frequency range: [MHZ</td>
<td>KHZ</td>
</tr>
</tbody>
</table>

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

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

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Parameter Description</th>
<th>Query Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>#Spur</td>
<td>&lt;value&gt;: Number of spurious points to search for</td>
<td>&lt;value&gt;</td>
</tr>
</tbody>
</table>

**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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Parameter Description</th>
<th>Query Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>TGT</td>
<td>Phase: Searches for spurious points that match the target phase. Peak : Searches for spurious points with peak impedance.</td>
<td>{PH</td>
</tr>
</tbody>
</table>

**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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Parameter Description</th>
<th>Query Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>#PHAS</td>
<td>&lt;value&gt;: Target phase value</td>
<td>&lt;value&gt;</td>
</tr>
</tbody>
</table>
Function: Spurious Measurement Mode

\[ \text{SPDISP}\{\text{Worst}|\text{Nth},<value>\} \]

Determines which spurious point to be displayed on the LCD. This command requires one of the two options: \text{Worst} and \text{Nth}. Use the \text{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 \text{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 \text{SPDISP}? (with no parameter).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>\text{DispSP}</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Parameter Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Worst: Displays the worst spurious point.</td>
</tr>
<tr>
<td>Nth: Displays the \text{Nth} spurious point.</td>
</tr>
<tr>
<td>(&lt;value&gt;): Specify the index number of the desired spurious point. This parameter</td>
</tr>
<tr>
<td>must follow the \text{Nth} option (not required for the \text{Worst} option).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Query Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>(&lt;value&gt;): An integer value that represents the index number of the spurious</td>
</tr>
<tr>
<td>point currently displayed (returns 0 if the \text{Worst} option was specified).</td>
</tr>
</tbody>
</table>
Function: Evaporation Monitor Mode

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.

<table>
<thead>
<tr>
<th>Transferred Data</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ASCII format transfer</strong></td>
<td></td>
</tr>
<tr>
<td>ASCII: <code>&lt;num_elements&gt;,&lt;asc_data&gt;&lt;NL.END&gt;</code></td>
<td></td>
</tr>
<tr>
<td><code>&lt;asc_data&gt; = &lt;F&gt;,&lt;CI&gt;,&lt;time&gt;</code></td>
<td></td>
</tr>
<tr>
<td><strong>Binary format transfer</strong></td>
<td></td>
</tr>
<tr>
<td>BINAR Y: #4&lt;num_bytes&gt;&lt;bin_data&gt;&lt;NL.END&gt;</td>
<td></td>
</tr>
<tr>
<td><code>&lt;bin_data&gt; = &lt;F&gt;&lt;CI&gt;&lt;time&gt;</code></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Data Elements</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;num_elements&gt;</code>: Number of data elements transferred</td>
<td></td>
</tr>
<tr>
<td><code>&lt;num_bytes&gt;</code>: Number of bytes transferred (#40024)</td>
<td></td>
</tr>
<tr>
<td><code>&lt;F&gt;</code>: F (Trap frequency)</td>
<td></td>
</tr>
<tr>
<td><code>&lt;CI&gt;</code>: CI/Z (CI value at the trap frequency)</td>
<td></td>
</tr>
<tr>
<td><code>&lt;time&gt;</code>: Time required between two trap points (ms)</td>
<td></td>
</tr>
<tr>
<td><code>&lt;NL.END&gt;</code>: NewLineEND (1 byte)</td>
<td></td>
</tr>
</tbody>
</table>

**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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th><code>Dir</code></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Parameter Description</strong></td>
<td></td>
</tr>
<tr>
<td>DOWN: Decreasing direction of the resonance frequency in frequency adjustment</td>
<td></td>
</tr>
<tr>
<td>UP: Increasing direction of the resonance frequency in frequency adjustment</td>
<td></td>
</tr>
<tr>
<td><strong>Query Response</strong></td>
<td>`{DOWN</td>
</tr>
</tbody>
</table>

**EMMANmode{ON|OFF}**  Enables/disables entry of the trap frequency from the front panel.

The query form of this command is EMMANmode? (with no parameter).
**Function: Evaporation Monitor Mode**

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>EMLSIZEm&lt;value&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td></td>
</tr>
<tr>
<td>OFF: Disables entry of the trap frequency from the front panel.</td>
<td></td>
</tr>
<tr>
<td>ON: Enables entry of the trap frequency from the front panel.</td>
<td></td>
</tr>
<tr>
<td>0: Disables entry of the trap frequency from the front panel.</td>
<td></td>
</tr>
<tr>
<td>1: Enables entry of the trap frequency from the front panel.</td>
<td></td>
</tr>
<tr>
<td>Query Response</td>
<td>{ON</td>
</tr>
</tbody>
</table>

**EMLISTm<value1>,<value2>,<value3>,m<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?m<value1>. The parameter <value1> must be supplied to specify the number of the trap point whose settings you want to obtain.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
</tr>
<tr>
<td>&lt;value1&gt;: Number of the trap point</td>
</tr>
<tr>
<td>&lt;value2&gt;: Frequency at the trap point</td>
</tr>
<tr>
<td>&lt;value3&gt;: Phase value at the trap point (applies only in the case you specified the PHase option for the SRCHTG command).</td>
</tr>
<tr>
<td>OFF: I/O port output OFF</td>
</tr>
<tr>
<td>ON: I/O port output ON</td>
</tr>
<tr>
<td>0: I/O port output OFF</td>
</tr>
<tr>
<td>1: I/O port output ON</td>
</tr>
<tr>
<td>&lt;value4&gt;: Output data (I/O port output ON only)</td>
</tr>
<tr>
<td>Query Response</td>
</tr>
<tr>
<td>&lt;value2&gt;,&lt;value3&gt;,m&lt;OFF</td>
</tr>
</tbody>
</table>

**EMLSIZEm<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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
</tr>
<tr>
<td>&lt;value&gt;: Size of the trap point list.</td>
</tr>
<tr>
<td>Query Response</td>
</tr>
<tr>
<td>&lt;value&gt;</td>
</tr>
</tbody>
</table>
Function: Evaporation Monitor Mode

**EMLCLEar**
Clears the trap point list.
This command is not available in a query form.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
<tr>
<td>Query Response</td>
<td>Query form not supported.</td>
</tr>
</tbody>
</table>

**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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th><strong>Start</strong> — Presents read-only display of the current value.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>$&lt;value&gt;$ : Start point</td>
</tr>
<tr>
<td>Query Response</td>
<td>$&lt;value&gt;$</td>
</tr>
</tbody>
</table>

**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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th><strong>Tout</strong> — Presents read-only display of the current value.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>$&lt;value&gt;$ Time-out value [ms]</td>
</tr>
<tr>
<td></td>
<td>[S][MS][M]: Unit of time (Defaults to the unit used in MS)</td>
</tr>
<tr>
<td>Query Response</td>
<td>$&lt;value&gt;$</td>
</tr>
</tbody>
</table>

**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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>OFF: Disables output through I/O port.</td>
</tr>
<tr>
<td></td>
<td>ON: Enables output through I/O port.</td>
</tr>
<tr>
<td></td>
<td>0: Disables output through I/O port.</td>
</tr>
<tr>
<td></td>
<td>1: Enables output through I/O port.</td>
</tr>
<tr>
<td></td>
<td>$&lt;value&gt;$ :</td>
</tr>
<tr>
<td>Query Response</td>
<td>${0</td>
</tr>
<tr>
<td></td>
<td>$&lt;value&gt;$: Query response always returns $&lt;value&gt;$.</td>
</tr>
</tbody>
</table>
Function: Evaporation Monitor Mode

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

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

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

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
</table>
| **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.

<table>
<thead>
<tr>
<th>Transferred Data</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>\text{ASCII format transfer}</strong></td>
</tr>
<tr>
<td>&lt;num_elements&gt;,&lt;asc_data&gt;,&lt;NL_END&gt;</td>
</tr>
<tr>
<td>&lt;asc_data&gt;: -&lt;F&gt;,&lt;CI&gt;,&lt;STAT&gt;,&lt;MinF&gt;,&lt;MaxF&gt;,&lt;MinCI&gt;,&lt;MaxCI&gt;</td>
</tr>
<tr>
<td>&lt;MaxF-MinF&gt;,&lt;MaxCI-MinCI&gt;[,&lt;comp&gt;]</td>
</tr>
<tr>
<td>&lt;comp&gt;: -&lt;bin_num&gt;,&lt;pri&gt;,&lt;sec&gt;,&lt;t_1&gt;,&lt;t_2&gt;</td>
</tr>
<tr>
<td><strong>\text{Binary format transfer}</strong></td>
</tr>
<tr>
<td>#4&lt;num_bytes&gt;&lt;bin_data&gt;&lt;NL_END&gt;</td>
</tr>
<tr>
<td>&lt;bin_data&gt;: -&lt;F&gt;&lt;CI&gt;&lt;STAT&gt;&lt;DL&gt;&lt;MinF&gt;&lt;MaxF&gt;&lt;MinCI&gt;&lt;MaxCI&gt;</td>
</tr>
<tr>
<td>&lt;MaxF-MinF&gt;&lt;MaxCI-MinCI&gt;[,&lt;comp&gt;]</td>
</tr>
<tr>
<td>&lt;comp&gt;: -&lt;bin_num&gt;&lt;pri&gt;&lt;sec&gt;&lt;t_1&gt;&lt;t_2&gt;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Data Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Data elements transferred whenever TRG is issued</strong></td>
</tr>
<tr>
<td>&lt;num_elements&gt;: Number of data elements transferred</td>
</tr>
<tr>
<td>&lt;num_bytes&gt;: Number of bytes transferred</td>
</tr>
<tr>
<td>&lt;F&gt;: F (Resonance frequency measured at the reference drive level)</td>
</tr>
<tr>
<td>&lt;CI&gt;: CI/Z (Resonance impedance measured at the reference drive level)</td>
</tr>
<tr>
<td>&lt;STAT&gt;: indicates whether the tracking measurement was successful</td>
</tr>
<tr>
<td>0: PASS</td>
</tr>
<tr>
<td>1: FAIL</td>
</tr>
<tr>
<td>&lt;MinF&gt;: Minimum &lt;F&gt; value</td>
</tr>
<tr>
<td>&lt;MaxF&gt;: Maximum &lt;F&gt; value</td>
</tr>
<tr>
<td>&lt;MinCI&gt;: Minimum &lt;CI&gt; value</td>
</tr>
<tr>
<td>&lt;MaxCI&gt;: Maximum &lt;CI&gt; value</td>
</tr>
<tr>
<td>&lt;MaxF-MinF&gt;: Difference between maximum and minimum &lt;F&gt; values</td>
</tr>
<tr>
<td>&lt;MaxCI-MinCI&gt;: Difference between maximum and minimum &lt;CI&gt; values</td>
</tr>
<tr>
<td><strong>Data elements transferred with the Comparator function ON</strong></td>
</tr>
<tr>
<td>&lt;bin_num&gt;: Bin identification number</td>
</tr>
<tr>
<td>-1: OUT OF BIN</td>
</tr>
<tr>
<td>-2: AUX BIN</td>
</tr>
<tr>
<td>1 to 5: Bin number</td>
</tr>
<tr>
<td>&lt;pri&gt;: Result of primary sorting</td>
</tr>
<tr>
<td>0: PASS</td>
</tr>
<tr>
<td>1: FAIL</td>
</tr>
<tr>
<td>&lt;sec&gt;: Result of secondary sorting</td>
</tr>
<tr>
<td>0: PASS</td>
</tr>
<tr>
<td>1: FAIL</td>
</tr>
<tr>
<td>-1: Secondary sorting OFF</td>
</tr>
<tr>
<td>&lt;t_1&gt;: Result of AF limit test</td>
</tr>
<tr>
<td>0: PASS</td>
</tr>
<tr>
<td>1: FAIL</td>
</tr>
<tr>
<td>-1: AF limit test OFF</td>
</tr>
<tr>
<td>&lt;t_2&gt;: Result of ACI limit test</td>
</tr>
<tr>
<td>0: PASS</td>
</tr>
<tr>
<td>1: FAIL</td>
</tr>
<tr>
<td>-1: ACI limit test OFF</td>
</tr>
<tr>
<td><strong>New Line</strong></td>
</tr>
<tr>
<td>&lt;NL_END&gt;: NewLine_END (1 byte)</td>
</tr>
</tbody>
</table>
Function: DLD Measurement Mode

**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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>WAIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>&lt;value&gt; Wait time between energization and stabilization of the DUT [S</td>
</tr>
<tr>
<td>Query Response</td>
<td>&lt;value&gt;</td>
</tr>
</tbody>
</table>

**PTRACK<ON|OFF|0|1>**

Turns ON/OFF the Phase Tracking function.

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

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>TRIG</th>
</tr>
</thead>
</table>
| 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.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
<tr>
<td>Query Response</td>
<td>Query form not supported.</td>
</tr>
</tbody>
</table>

**PTSTARTPoint<value>**

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

The query form of this command is PTSTARTPoint? (with no parameter).
PTSTARTPoint\{value\}<br />
Equivalent Key Sequence StartP<br />
Parameter Description \(\langle value\rangle\) : Start point<br />
Query Response \(\langle value\rangle\)

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\}<br />
Specifies the reference drive level.

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

Equivalent Key Sequence STD
Parameter Description \langle value\rangle Reference drive level
[\{MW\|UW\|NW\|W\|MA\|UA\|A\|MV\|UV\|V\|DBM\}: Unit of the power level
Query Response \langle value\rangle,\{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 \langle value1\rangle must be supplied to specify the number of the sweep point whose settings you want to obtain.
Function: DLD Measurement Mode

PTMINPower\[<value>\]

Equivalent Key Sequence

Parameter Description
<value> : Number of the sweep point
<value> : Drive level at the sweep point
[MW|UW|NW|W|MA|UA|AM|MV|UV|V]DBM: Unit of the drive level
OFF: Drive power OFF
ON: Drive power ON

Query Response
<value>,{1[0]}

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

<table>
<thead>
<tr>
<th>Method</th>
<th>HP-IB Commands</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweep point list</td>
<td>PTLIST, PTSWPTYpe</td>
<td>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.</td>
</tr>
<tr>
<td>Maximum/minimum values</td>
<td>PTMINPower, PTMAXPower, PTSWPTYpe</td>
<td>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.</td>
</tr>
</tbody>
</table>

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

Parameter Description
<value> : Minimum drive level value
[MW|UW|NW|W|MA|UA|AM|MV|UV|V]DBM: Unit of the drive level value

Query Response
<value>,{W|A|V|D}
PTMINPower<value>

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

<table>
<thead>
<tr>
<th>Method</th>
<th>HP-IB Commands</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweep point list</td>
<td>PTLIST, PTSWPType</td>
<td>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.</td>
</tr>
<tr>
<td>Maximum/minimum values</td>
<td>PTMINPower, PTPMAXPower, PTSWPType</td>
<td>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.</td>
</tr>
</tbody>
</table>

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).

Table 5-3. Setting Up the Sweep Pattern

<table>
<thead>
<tr>
<th>Method</th>
<th>HP-IB Commands</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweep point list</td>
<td>PTLIST, PTSWPType</td>
<td>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.</td>
</tr>
<tr>
<td>Maximum/minimum values</td>
<td>PTMINPower, PTPMAXPower, PTSWPType</td>
<td>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.</td>
</tr>
</tbody>
</table>
**Function:** DLD Measurement Mode

**PTSWPType** {UPDOWN|UP|UPMIN|LIST}

Specifies the sweep type.

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

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>UP</strong></td>
<td>Increases the drive level step by step from the minimum level value to the maximum level value.</td>
</tr>
<tr>
<td><strong>UPDOWN</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>UPMIN</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>LIST</strong></td>
<td>Sweeps the drive level in accordance with the sweep point list defined with the <strong>PTLIST</strong> command.</td>
</tr>
</tbody>
</table>

**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.

<table>
<thead>
<tr>
<th>Transferred Data</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ASCII format transfer ASCII: <code>&lt;num_elements&gt;,&lt;asc_data&gt;,NLEND&gt;</code></td>
<td></td>
</tr>
<tr>
<td></td>
<td><code>&lt;asc_data&gt;</code>: <code>&lt;Loss&gt;,&lt;Delta_left&gt;,&lt;Delta_right&gt;</code></td>
</tr>
<tr>
<td>Binary format transfer BINARY: <code>#4&lt;num_bytes&gt;,&lt;bin_data&gt;,NLEND&gt;</code></td>
<td></td>
</tr>
<tr>
<td></td>
<td><code>&lt;bin_data&gt;</code>: <code>&lt;Loss&gt;,&lt;Delta_left&gt;,&lt;Delta_right&gt;</code></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Data Elements</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;num_elements&gt;</code>: Number of data elements transferred</td>
<td></td>
</tr>
<tr>
<td><code>&lt;num_bytes&gt;</code>: Number of bytes transferred (#4024)</td>
<td></td>
</tr>
<tr>
<td><code>&lt;Loss&gt;</code>: Minimum or constant loss</td>
<td></td>
</tr>
<tr>
<td><code>&lt;Delta_left&gt;</code>: x dB BW (Δf_left)</td>
<td></td>
</tr>
<tr>
<td><code>&lt;Delta_right&gt;</code>: x dB BW (Δf_right)</td>
<td></td>
</tr>
</tbody>
</table>

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

**FLTMODE**<CONST|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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>LOSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>CONSTANT: Constant loss</td>
</tr>
<tr>
<td></td>
<td>MINimum: Minimum loss</td>
</tr>
<tr>
<td>Query Response</td>
<td>{CONST</td>
</tr>
</tbody>
</table>

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

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

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>x[dB]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td><code>&lt;value&gt;</code> Band width of the filter band width [dB]</td>
</tr>
<tr>
<td>Query Response</td>
<td><code>&lt;value&gt;</code></td>
</tr>
</tbody>
</table>
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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>(blue) + m/k (Comprtr) or COMP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>OFF: Comparator function OFF</td>
</tr>
<tr>
<td></td>
<td>ON: Comparator function ON</td>
</tr>
<tr>
<td></td>
<td>0: Comparator function OFF</td>
</tr>
<tr>
<td></td>
<td>1: Comparator function ON</td>
</tr>
<tr>
<td>Query Response</td>
<td>{1</td>
</tr>
</tbody>
</table>

**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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>PRI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>ABSTOL: Tolerance mode (based on the actual deviation from the reference value)</td>
</tr>
<tr>
<td></td>
<td>PCNTTOL: Tolerance mode (based on the percentage relative to the reference value)</td>
</tr>
<tr>
<td></td>
<td>SEQ: Sequential mode</td>
</tr>
<tr>
<td>Query Response</td>
<td>{ABSTOL</td>
</tr>
</tbody>
</table>

**COMPTOLSTD\<value\>**

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

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

Function: Comparator

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>NOM</th>
</tr>
</thead>
</table>

Parameter Description: 

- `<value>`: Reference value for primary sorting.
- `[MA][K][M][U][N][P][P]`: Unit for the reference value.

Query Response: `<value>`

COMPPLIMIT_BIN

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.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>PRI&lt;1&gt; – Lower limit value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PRI&lt;2&gt; – Upper limit value</td>
</tr>
</tbody>
</table>

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][P]`: Unit
  - `<value2>`: Upper limit value
  - `[MA][K][M][U][N][P][P]`: Unit

COMPSEC_O{OFF|ON|0|1}

Turns ON/OFF secondary sorting.

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

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>SEC</th>
</tr>
</thead>
</table>

Parameter Description:

- OFF: Secondary sorting OFF
- ON: Secondary sorting ON
- 0: Secondary sorting OFF
- 1: Secondary sorting ON

Query Response: `{1|0}`
COMPSLIMi\{<value1>,<value2>\}

Specifies the lower and upper limits for secondary sorting bin.

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

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Secl</th>
<th>Sech</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lower limit value</td>
<td>Upper limit value</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;value1&gt; Lower limit value</td>
</tr>
<tr>
<td>[MA</td>
</tr>
<tr>
<td>&lt;value2&gt; Upper limit value</td>
</tr>
<tr>
<td>[MA</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Query Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;value1&gt;,&lt;value2&gt;</td>
</tr>
<tr>
<td>&lt;value1&gt; : Lower limit value</td>
</tr>
<tr>
<td>&lt;value2&gt; : Upper limit value</td>
</tr>
</tbody>
</table>

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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>AUX</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OFF: AUX bin function OFF</td>
</tr>
<tr>
<td></td>
<td>ON: AUX bin function ON</td>
</tr>
<tr>
<td></td>
<td>0: AUX bin function OFF</td>
</tr>
<tr>
<td></td>
<td>1: AUX bin function ON</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Query Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>{1</td>
</tr>
</tbody>
</table>

BINSIZE\{<value>\}

Specifies the size of the bin.

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

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;value&gt; : BIN size (Xtal measurement mode:max9,DLD mode:max5)</td>
</tr>
</tbody>
</table>

Query Response <value>
Function: Comparator

**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.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
</table>
| 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.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
</tbody>
</table>
| 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.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
<tr>
<td>Query Response</td>
<td>Query form not supported.</td>
</tr>
</tbody>
</table>
Function: Comparator

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

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
<tr>
<td>Query Response</td>
<td>Query form not supported.</td>
</tr>
</tbody>
</table>

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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
</table>
| 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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>BEEP</th>
</tr>
</thead>
</table>
| Parameter Description    | FAIL: Beeps when DUT has failed.  
PASS: Beeps when DUT has passed. |
| Query Response           | {FAIL|PASS} |

COMPLEDCond\{FAIL\|PASS\}

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

**Function:** Comparator

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>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.</td>
</tr>
<tr>
<td>Query Response</td>
<td>{FAIL</td>
</tr>
</tbody>
</table>

**COMPDLTFL**

**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 COMPDLTFL? (with no parameter).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>LmΔF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>OFF: ΔF limit test OFF ON: ΔF limit test ON 0: ΔF limit test OFF 1: ΔF limit test ON</td>
</tr>
<tr>
<td>Query Response</td>
<td>{1</td>
</tr>
</tbody>
</table>

**COMPDLTCIL**

**Note**

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

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

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

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>LmΔCl</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>OFF: ΔCl limit test OFF ON: ΔCl limit test ON 0: ΔCl limit test OFF 1: ΔCl limit test ON</td>
</tr>
<tr>
<td>Query Response</td>
<td>{1</td>
</tr>
</tbody>
</table>
Function: Comparator

**COMPDLTFLim**\(<\textit{value}>\)

---

**Note**

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

Sets the $\Delta F$ limit. If the frequency value measured in DLD mode exceeds the limit, then the DUT fails the test.

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

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>$\Delta F_{-H}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>$&lt;\textit{value}&gt;$ Limit value</td>
</tr>
<tr>
<td></td>
<td>[MA][K][U][N][P][F]: Unit</td>
</tr>
<tr>
<td>Query Response</td>
<td>$&lt;\textit{value}&gt;$ Limit value</td>
</tr>
</tbody>
</table>

**COMPDLTCILim**\(<\textit{value}>\)

---

**Note**

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

Sets the $\Delta CI$ 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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>$\Delta CI_{-H}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>$&lt;\textit{value}&gt;$ Limit value</td>
</tr>
<tr>
<td></td>
<td>[MA][K][U][N][P][F]: Unit</td>
</tr>
<tr>
<td>Query Response</td>
<td>$&lt;\textit{value}&gt;$ Limit value</td>
</tr>
</tbody>
</table>

**COMPBW**\{OFF|ON|0|1\}

---

**Note**

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

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

The query form of this command is COMPBW? (with no parameter).
### COMPBW\{OFF\|ON\|0\|1\}

**Function:** Comparator

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>_LmBW_</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Parameter Description</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFF: BW limit test OFF</td>
<td></td>
</tr>
<tr>
<td>ON: BW limit test ON</td>
<td></td>
</tr>
<tr>
<td>0: BW limit test OFF</td>
<td></td>
</tr>
<tr>
<td>1: BW limit test ON</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Query Response</th>
<th>{1|0}</th>
</tr>
</thead>
</table>

### COMBWL\text{Lim}<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 COMBWL\text{Lim}? (with no parameter).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>_BW.L_ – Lower limit value</th>
</tr>
</thead>
<tbody>
<tr>
<td>_BW.H_ – Upper limit value</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter Description</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(&lt;value1&gt;) Lower limit value</td>
<td></td>
</tr>
<tr>
<td>(&lt;value2&gt;) Upper limit value</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Query Response</th>
<th>(&lt;value1&gt;),(&lt;value2&gt;)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(&lt;value1&gt;) : Lower limit value</td>
<td></td>
</tr>
<tr>
<td>(&lt;value2&gt;) : Upper limit value</td>
<td></td>
</tr>
</tbody>
</table>
## HP-IB Commands Associated with Memory Buffer Function

**ME$\text{STATE} <\{\text{OFF|ON|0|1}\}>**

Turns ON/OFF the Memory Buffer function.

The query form of this command is **ME$\text{STATE}$?** (with no parameter).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>(blue) + 2 (Mem Buff)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td></td>
</tr>
<tr>
<td></td>
<td>OFF: Memory Buffer function OFF</td>
</tr>
<tr>
<td></td>
<td>ON: Memory Buffer function ON</td>
</tr>
<tr>
<td></td>
<td>0: Memory Buffer function OFF</td>
</tr>
<tr>
<td></td>
<td>1: Memory Buffer function ON</td>
</tr>
<tr>
<td>Query Response</td>
<td>{1</td>
</tr>
</tbody>
</table>

**MEM$\text{CLEA}$r**

Clears the contents of the memory buffer.

This command is not available in a query form.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>MEM$\text{CLEA}$r</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td></td>
</tr>
<tr>
<td>Query Response</td>
<td>Query form not supported.</td>
</tr>
</tbody>
</table>

**MEM$\text{SIZE}$<value>*

Sets the memory buffer size.

The query form of this command is **MEM$\text{SIZE}$?** (with no parameter).

| Equivalent Key Sequence | | |
|-------------------------|-----------------|
| Parameter Description   | <value>: Memory buffer size |
| Query Response          | <value>: int16, NR1 |

**MEM$\text{RETE}$ST**

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>]`<br>`<comp>:=<bin_num>,<pri>,<sec>[,<t_1>,<t_2>]`<br>- Binary format transfer BINARY: `<num_bytes><bin_data> ... <bin_data><NL-END> <bin_data>:=<status><data> ... <data>[<comp>]`<br>`<comp>:=<bin_num><pri><sec>[<t_1><t_2>]`<br>

**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).<br>`<status>`: Measurement data status
  - 1: No data<br>  0: Normal measurement data<br>`<data>`: Mode-dependent measurement data (See the table below).<br>- Data elements transferred with the Comparator function ON
  `<bin_num>`: Bin identification number
    - 1: OUT OF BIN<br>    2: AUX BIN<br>    1 to 9: Bin number<br>`<pri>`: Result of primary sorting
    0: PASS<br>    1: FAIL<br>`<sec>`: Result of secondary sorting
    0: PASS<br>    1: FAIL<br>- Secondary sorting OFF<br>- Data elements transferred with the Comparator function ON (DLD mode only)
  `<t_1>`: ΔF limit test result
    0: PASS<br>    1: FAIL<br>-1: ΔF limit test OFF
`<t_2>`: ΔCI limit test result
    0: PASS<br>    1: FAIL<br>-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)
  - `<Cl>`: 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
  - `<G0>`: G0
- 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)
  - `<CL>`: 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.
  - `<F1>`: Frequency of the spurious point
  - `<Cl>`: 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)
  - `<CL>`: CI/Z (Measured resonance impedance)
  - `<لات>`: Indicates whether the tracking measurement was successful.
    - 0: PASS
    - 1: FAIL
  - `<di>`: 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>`: NewLineEND (1 byte)

#### Filter measurement mode
- Data elements transferred whenever TRG is issued
  - `<Loss>`: Minimum or constant loss
  - `<Af_left>`: -x dB BW (Af_left)
  - `<Af_right>`: -x dB BW (Af_right)
# HP-IB Commands Associated with Delta Mode

**DLTSTATE\(\uparrow\)\{OFF\|ON\|0\|1\}**

Turns ON/OFF Delta mode.

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

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>(blue) + (p) (A Mode)</th>
<th>(\text{AMCD}) {OFF|ON}</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Parameter Description</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OFF: Delta mode OFF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ON: Delta mode OFF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0: Delta mode OFF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1: Delta mode OFF</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Query Response</strong></td>
<td></td>
<td>{1|0}</td>
</tr>
</tbody>
</table>

**DLTMode\(\uparrow\)\{PRI\|DEV\|PPM\}**

**DLTMode\(\uparrow\)\{SEC\|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?\(\uparrow\)\{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.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>AF: Frequency value</th>
<th>AC: Impedance value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Parameter Description</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PRI: Measurement parameter for primary sorting (Primary measurement parameter)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SEC: Measurement parameter for secondary sorting (Secondary measurement parameter)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OFF: Delta mode OFF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEV: Actual deviation (\text{(measured value} - \text{reference value}))</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PCNT: Percentage (\text{(measured value) \text{/ (reference value)}}) (SEC only)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PPM: ppm (\text{(measured value) \text{/ (reference value)}}) (PRI only)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Query Response</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Function: Delta Mode

`DLTREFu{PRI|SEC}, <value>`

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

The query form of this command is `DLTREFu{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.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>RefF: Reference frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ref2: Reference impedance</td>
</tr>
</tbody>
</table>

| Parameter Description  | PRI: Measurement parameter for primary sorting |
|                        | SEC: Measurement parameter for secondary sorting |
|                        | `<value>` Reference value |

| Query Response | `<value>` : Reference value |

`DLTREFTypeu{PRI|SEC}, {User|Nom}`

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

The query form of this command is `DLTREFTypeu{PRI|SEC}, {User|Nom}`. 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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>(blue) + 1 (Status)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>OFF: Hides instrument settings. ON: Shows instrument settings. 0: Hides instrument settings. 1: Shows instrument settings.</td>
</tr>
<tr>
<td>Query Response</td>
<td>{1</td>
</tr>
</tbody>
</table>

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

Shows or hides measurement data on the LCD.

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

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>DISP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>OFF: Hides measurement data. ON: Shows measurement data. 0: Hides measurement data. 1: Shows measurement data.</td>
</tr>
<tr>
<td>Query Response</td>
<td>{1</td>
</tr>
</tbody>
</table>
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.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>(blue) + 6 (Load)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(blue) + 5 (Short)</td>
</tr>
<tr>
<td></td>
<td>(blue) + 4 (Open)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPEN: OPEN calibration</td>
</tr>
<tr>
<td>SHORT: SHORT calibration</td>
</tr>
<tr>
<td>LOAD: LOAD calibration</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Query Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query form not supported.</td>
</tr>
</tbody>
</table>

**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\}

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>CAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;value&gt; :</td>
<td></td>
</tr>
<tr>
<td>OPEN:Open calibration standard</td>
<td></td>
</tr>
<tr>
<td>SHORT:Short calibration standard</td>
<td></td>
</tr>
<tr>
<td>LOAD:Load calibration standard</td>
<td></td>
</tr>
<tr>
<td>C0:Open capacitance</td>
<td></td>
</tr>
<tr>
<td>G0:residual conductance</td>
<td></td>
</tr>
<tr>
<td>R0:residual resistance</td>
<td></td>
</tr>
<tr>
<td>L0:residual inductance</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Query Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;value&gt; :</td>
</tr>
</tbody>
</table>
**Function: Calibration and Compensation**

**THRU CAL**
Performs calibration for the thru state.
This command is not available in a query form.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>(blue) + 8 (Thru)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>--</td>
</tr>
<tr>
<td>Query Response</td>
<td>Query form not supported.</td>
</tr>
</tbody>
</table>

**COMPENSA TION [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) + 8 (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], [C0|C0],<value>
- COMPENSTD [SHORT|LOAD], [R0|L0],<value>
- COMPENSTD [OPEN], [G0|C0],<value>
- COMPENSTD [SHORT|LOAD], [R0|L0],<value>

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

**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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
<tr>
<td>Query Response</td>
<td>{SYSCAL, INTERPCAL, USERCAL}</td>
</tr>
</tbody>
</table>

**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 a 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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
<tr>
<td>Query Response</td>
<td>{SYSCAL, INTERPCAL, USERCAL}</td>
</tr>
</tbody>
</table>

**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 a 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 π network test fixture is used.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
<tr>
<td>Query Response</td>
<td>{1</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>(\text{Trig})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
<tr>
<td>Query Response</td>
<td>Query form not supported.</td>
</tr>
</tbody>
</table>

**TRIGSOURCe \{\text{IN}Ternal|\text{MA}Nual|\text{EX}Ternal|\text{BU}S\}**

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

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

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>((\text{blue}) + \text{Trig (Trigger Mode)})</th>
</tr>
</thead>
</table>
| Parameter Description   | \(\text{IN}Ternal: \text{Internal (Int) mode — Automatically triggered from within the HP E4915A/E4916A’s internal circuitry.}\)  
                         | \(\text{MA}Nual: \text{Manual (Man) mode — Triggered when you press the } \text{Trig} \text{ key on the front panel.}\)  
                         | \(\text{EX}Ternal: \text{External (Ext) mode — Triggered when a TTL pulse signal is input through the Ext Trigger or Handler Interface port on the rear panel.}\)  
                         | \(\text{BU}S: \text{Bus mode — Triggered when the GET or } \ast\text{TRG FETCH,TRIGIMM command is issued.}\) |
| Query Response          | \{\text{IN|MA|EX|BU}\} |
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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th><strong>AnalogOut</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>OFF: Analog OUT terminal OFF&lt;br&gt;ON: Analog OUT terminal ON</td>
</tr>
<tr>
<td>Query Response</td>
<td>{1</td>
</tr>
</tbody>
</table>

**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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th><strong>Settings</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>&lt;value&gt; Reference frequency&lt;br&gt;[MHz</td>
</tr>
<tr>
<td>Query Response</td>
<td>&lt;value&gt;</td>
</tr>
</tbody>
</table>

**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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th><strong>Settings</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>&lt;value&gt; Change in frequency represented by a one-volt increment/decrement of the output voltage (df (Hz)/dV or df (ppm)/dV&lt;br&gt;[Hz/PPM]: Hz represents Hz/V while FPM represents ppm/V (the unit defaults to the previously specified unit))</td>
</tr>
<tr>
<td>Query Response</td>
<td>&lt;value&gt;,{Hz</td>
</tr>
</tbody>
</table>
# 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.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
<tr>
<td>Query Response</td>
<td>$&lt;value&gt;$ : Register value in decimal notation</td>
</tr>
</tbody>
</table>

### OSE $<value>$
Sets the enable register of the Operation Status Register group.
The query form of this command is OSE? (with no parameter).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>$&lt;value&gt;$ : Register value in decimal notation</td>
</tr>
<tr>
<td>Query Response</td>
<td>$&lt;value&gt;$ : Register value in decimal notation</td>
</tr>
</tbody>
</table>

## OSER?
A query-dedicated command that returns the contents of the event register of the Operation Status Register group.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
<tr>
<td>Query Response</td>
<td>$&lt;value&gt;$ : Register value in decimal notation</td>
</tr>
</tbody>
</table>

## QSR?
A query-dedicated command that returns the contents of the condition register of the Standard Questionable Status Register group.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
<tr>
<td>Query Response</td>
<td>$&lt;value&gt;$ : Register value in decimal notation</td>
</tr>
</tbody>
</table>

## QSE $<value>$
Sets the enable register of the Standard Questionable Status Register group.
The query form of this command is QSE? (with no parameter).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>$&lt;value&gt;$ : Register value in decimal notation</td>
</tr>
<tr>
<td>Query Response</td>
<td>$&lt;value&gt;$ : Register value in decimal notation</td>
</tr>
</tbody>
</table>
**Function: Status Registers**

**QSER?**
A query-dedicated command that returns the contents of the event register of the Standard Questionable (QUEStionable) Status Register group.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
<tr>
<td>Query Response</td>
<td><code>&lt;value&gt;</code> : Register value in decimal notation</td>
</tr>
</tbody>
</table>

**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)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
<tr>
<td>Query Response</td>
<td><code>&lt;value&gt;</code> : Register value in decimal notation</td>
</tr>
</tbody>
</table>

**SEEEn<value>**
Sets the enable register of the Search Event Status Register group. HP E4915A/E4916A uses none of the register contents but bit 0.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td><code>&lt;value&gt;</code> : Register value in decimal notation</td>
</tr>
<tr>
<td>Query Response</td>
<td><code>&lt;value&gt;</code> : Register value in decimal notation</td>
</tr>
</tbody>
</table>

**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)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
<tr>
<td>Query Response</td>
<td><code>&lt;value&gt;</code> : Register value in decimal notation</td>
</tr>
</tbody>
</table>
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).

<table>
<thead>
<tr>
<th>Equivalent Key</th>
<th>Sequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter</td>
<td>Description</td>
</tr>
<tr>
<td></td>
<td>ASCII: ASCII format</td>
</tr>
<tr>
<td></td>
<td>REAL[,64]: REAL format</td>
</tr>
<tr>
<td>Query</td>
<td>Response</td>
</tr>
<tr>
<td></td>
<td>{ASCII</td>
</tr>
</tbody>
</table>

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).

<table>
<thead>
<tr>
<th>Equivalent Key</th>
<th>Sequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter</td>
<td>Description</td>
</tr>
<tr>
<td></td>
<td>PI: PI-Network Test Fixture</td>
</tr>
<tr>
<td></td>
<td>PRObe: Impedance probe (HP E4916A only)</td>
</tr>
<tr>
<td></td>
<td>BRIdge: Reflection bridge</td>
</tr>
<tr>
<td>Query</td>
<td>Response</td>
</tr>
<tr>
<td></td>
<td>{PI</td>
</tr>
</tbody>
</table>

HPIBADDRes\{<value>\}

Sets the HP-IB address.

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

<table>
<thead>
<tr>
<th>Equivalent Key</th>
<th>Sequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter</td>
<td>Description</td>
</tr>
<tr>
<td></td>
<td>&lt;value&gt;: HP-IB address (31:talk only)</td>
</tr>
<tr>
<td>Query</td>
<td>Response</td>
</tr>
<tr>
<td></td>
<td>&lt;value&gt;</td>
</tr>
</tbody>
</table>

INITIIMMediate

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 INITCONTinous is set to ON, an INITIIMMediate command has no effect on the trigger system ad an error -213 is generated.

This command is not available in a query form.
Function: Other Commands

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
<tr>
<td>Query Response</td>
<td>Query form not supported.</td>
</tr>
</tbody>
</table>

**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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>OFF: Does not initiate the trigger system continuously. 0: Initiates the trigger system continuously.</td>
</tr>
<tr>
<td>Query Response</td>
<td>{1</td>
</tr>
</tbody>
</table>

**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.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
<tr>
<td>Query Response</td>
<td>Query form not supported.</td>
</tr>
</tbody>
</table>

**ERRor?**
A query-dedicated command that returns the number and message of any existing error in the HP E4915A/E4916A’s error queue.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
<tr>
<td>Query Response</td>
<td>Response error number and error message.</td>
</tr>
</tbody>
</table>
BEEPSTATE ‹ {OFF|ON|0|1} †

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

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>BEEP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>OFF: Beep OFF</td>
</tr>
<tr>
<td></td>
<td>ON: Beep ON</td>
</tr>
<tr>
<td></td>
<td>0: Beep OFF</td>
</tr>
<tr>
<td></td>
<td>1: Beep ON</td>
</tr>
<tr>
<td>Query Response</td>
<td>0: Beep OFF</td>
</tr>
<tr>
<td></td>
<td>1: Beep ON</td>
</tr>
</tbody>
</table>

VERSion?  A query-dedicated command that returns the number corresponding to the SCPI version to which the HP E4915A/E4916A complies.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
<tr>
<td>Query Response</td>
<td>&lt;value&gt;: Number that corresponds to the SCPI version.</td>
</tr>
</tbody>
</table>

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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>(blue) + 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>OFF: Key lock OFF</td>
</tr>
<tr>
<td></td>
<td>ON: Key lock ON</td>
</tr>
<tr>
<td></td>
<td>0: Key lock OFF</td>
</tr>
<tr>
<td></td>
<td>1: Key lock ON</td>
</tr>
<tr>
<td>Query Response</td>
<td>0: Key lock OFF</td>
</tr>
<tr>
<td></td>
<td>1: Key lock ON</td>
</tr>
</tbody>
</table>

PRESet             Resets the instrument settings to the preset values.
The command is not available in a query form.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>(blue) + . (Reset)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
<tr>
<td>Query Response</td>
<td>Query form not supported.</td>
</tr>
</tbody>
</table>
### Function: Other Commands

**OUTIO\[<value>\]**  
Outputs 11 bits long data through the I/O port.  
This command is not available in a query form.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td><code>&lt;value&gt;</code> : data (0 to 2048)</td>
</tr>
<tr>
<td>Query Response</td>
<td>Query form not supported.</td>
</tr>
</tbody>
</table>

**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 OUTIOSTAT? (with no parameter).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th></th>
</tr>
</thead>
</table>
| 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.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td></td>
</tr>
<tr>
<td>Query Response</td>
<td>{1}{0}</td>
</tr>
</tbody>
</table>
|                         | 1: Locked to external signal  
|                         | 0: No externa signal |
Common Commands

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

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
<tr>
<td>Query Response</td>
<td>—</td>
</tr>
</tbody>
</table>

**ESE**  
Sets the bits of the Standard Event Status Register.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>&lt;value&gt;</td>
</tr>
<tr>
<td>Query Response</td>
<td>—</td>
</tr>
</tbody>
</table>

**ESE?**  
Queries the bits of the Standard Event status register.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
<tr>
<td>Query Response</td>
<td>&lt;value&gt;: Register value in decimal notation</td>
</tr>
</tbody>
</table>

**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.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
<tr>
<td>Query Response</td>
<td>&lt;value&gt;: Register value in decimal notation</td>
</tr>
</tbody>
</table>

**IDN?**  
A query-dedicated command that returns an identification string which consists of four comma-separated fields.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
<tr>
<td>Query Response</td>
<td>&lt;field 1&gt;,&lt;field 2&gt;,&lt;field 3&gt;,&lt;field 4&gt;: See the list below.</td>
</tr>
</tbody>
</table>

  
  <field 1> Manufacture (always HEWLETT-PACKARD)
  <field 2> Model number
Function: Common Commands

*RST

Serial number is HP format (such as 2419J00100)
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.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
<tr>
<td>Query Response</td>
<td>—</td>
</tr>
</tbody>
</table>

*OPC?
Returns 1 when all pending operations have been completed.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
<tr>
<td>Query Response</td>
<td>{1</td>
</tr>
</tbody>
</table>

*OPT?
Queries the options installed. (Query only)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
<tr>
<td>Query Response</td>
<td>Option number</td>
</tr>
</tbody>
</table>

*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)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Rel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>&lt;value&gt;:</td>
</tr>
<tr>
<td>Query Response</td>
<td>—</td>
</tr>
</tbody>
</table>

*RST
Resets the HP E4915A/E4916A to the initial settings.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
<tr>
<td>Query Response</td>
<td>—</td>
</tr>
</tbody>
</table>
**Function: Common Commands**

*SAV\(\) <\textit{value}>  Saves the instrument state in the specified register number. The HP E4915A/E4916A has 10 available storage registers. (No query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>(blue) () + \textit{Rcl (Save)}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>$&lt;\textit{value}&gt;:$</td>
</tr>
<tr>
<td>Query Response</td>
<td>$-$</td>
</tr>
</tbody>
</table>

**SRE**  Sets the bits of the Status Byte Enable Register.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>$-$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>$-$</td>
</tr>
<tr>
<td>Query Response</td>
<td>$-$</td>
</tr>
</tbody>
</table>

**SRE?**  Queries the contents of the Status Byte Enable Register.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>$-$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>$-$</td>
</tr>
<tr>
<td>Query Response</td>
<td>$-$</td>
</tr>
</tbody>
</table>

**STB?**  Queries the contents of the Status Byte Register. (Query only)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>$-$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>$-$</td>
</tr>
<tr>
<td>Query Response</td>
<td>$&lt;\textit{value}&gt;$: Status byte register value in decimal notation</td>
</tr>
</tbody>
</table>

**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”.

---

5-56  HP-IB Command Reference
## Function: Common Commands

### *TST?*
Executes an internal self-test and the test result as the sum of the error codes of all existing errors. If there is no error the HP E4915A/E4916A returns 0.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Parameter Description</th>
<th>Query Response</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>{1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1: Test1 RAM</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4: Test2 Calibration data</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8: Test3 Flashmemory(program area)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>16: Test4 Backup memory</td>
</tr>
</tbody>
</table>

### *WAI*
Causes the HP E4915A/E4916A to wait until all previously sent commands are completed. (No query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Parameter Description</th>
<th>Query Response</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Alphabetical 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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Time</th>
</tr>
</thead>
</table>
| Parameter Description   | <value> Length of time interval  
[S][M][S]: 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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>ALC</th>
</tr>
</thead>
</table>
| 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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Settings</th>
</tr>
</thead>
</table>
| 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/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).
ANLGOUT \(\text{[OFF|ON|0|1]}\)

**Equivalent Key Sequence**

| AnalogOut |

**Parameter Description**

- OFF: Analog OUT terminal OFF
- ON: Analog OUT terminal ON

| Query Response |

\(\{0|1\}\)

**ANLGREF\(\text{[value]}\)**

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**

- \(<\text{value}>\) Reference frequency
- [MHZ|M|KHZ|K|HZ]: Unit

| Query Response |

\(<\text{value}>\)

**BEEPSTATE\(\text{[OFF|ON|0|1]}\)**

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?\(\text{[BIN1|...|BIN10|OUTOF|AUX]}\)**

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 ... BIN9: 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 |

\(<\text{value}>\): 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.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
</tbody>
</table>
| 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.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
<tr>
<td>Query Response</td>
<td>Query form not supported.</td>
</tr>
</tbody>
</table>

**BINSIZE<value>**  Specifies the size of the bin.  
The query form of this command is BINSIZE? (with no parameter).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>&lt;value&gt; : BIN size (Xtal measurement mode:max0, DLD mode:max5)</td>
</tr>
<tr>
<td>Query Response</td>
<td>&lt;value&gt;</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
</tbody>
</table>
| 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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
<tr>
<td>Query Response</td>
<td>{SYSCALL</td>
</tr>
</tbody>
</table>

SYSCALL: 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}

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>CAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>&lt;value&gt;</td>
</tr>
</tbody>
</table>

- OPEN: Open calibration standard
- SHORT: Short calibration standard
- LOAD: Load calibration standard
- C0: Open capacitance
- G0: Residual conductance
- R0: Residual resistance
- L0: Residual inductance

**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.
**CLACTType** \{NOCL\|USER\}

Equivalent Key Sequence: \[(\text{blue}) + 6 \text{ (Load)} \]
\[(\text{blue}) + 5 \text{ (Short)} \]
\[(\text{blue}) + 4 \text{ (Open)} \]

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: \[\text{CXT}\]

Parameter Description:
- PI: PI-Network Test Fixture
- PRObe: Impedance probe (HP E4916A only)
- 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: \[\text{CL}_x\]

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: \[\text{CL}_x\]

Parameter Description:
- NOCL: Capacitance load not connected (CL value infinite).
- USER: User-specified CL value

Query Response: \{NOCL\|USER\}
### CLCOMPen

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

This command is not available in a query form.

| Equivalent Key Sequence | CL: Comp
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
<tr>
<td>Query Response</td>
<td>Query form not supported.</td>
</tr>
</tbody>
</table>

### 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) + \(n/pm\) (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 | Figt
|-------------------------|------|
| 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.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
<tr>
<td>Query Response</td>
<td>—</td>
</tr>
</tbody>
</table>
**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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>CL.T</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>&lt;value&gt; Target capacitance load value (Target CL) [PF]</td>
</tr>
<tr>
<td>Query Response</td>
<td>&lt;value&gt;</td>
</tr>
</tbody>
</table>

**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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>CL.T</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>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.</td>
</tr>
<tr>
<td>Query Response</td>
<td>{NOCL</td>
</tr>
</tbody>
</table>

**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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>BEEP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>FAIL: Beeps when DUT has failed. PASS: Beeps when DUT has passed.</td>
</tr>
<tr>
<td>Query Response</td>
<td>{FAIL</td>
</tr>
</tbody>
</table>
**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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>OFF: Beep output OFF</td>
</tr>
<tr>
<td></td>
<td>ON: Beep output ON</td>
</tr>
<tr>
<td></td>
<td>0: Beep output OFF</td>
</tr>
<tr>
<td></td>
<td>1: Beep output ON</td>
</tr>
<tr>
<td>Query Response</td>
<td>{1</td>
</tr>
</tbody>
</table>

**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 COMPBWLimit); 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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>LaBW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>OFF: BW limit test OFF</td>
</tr>
<tr>
<td></td>
<td>ON: BW limit test ON</td>
</tr>
<tr>
<td></td>
<td>0: BW limit test OFF</td>
</tr>
<tr>
<td></td>
<td>1: BW limit test ON</td>
</tr>
<tr>
<td>Query Response</td>
<td>{1</td>
</tr>
</tbody>
</table>

**COMBWLimit** \langle value1\rangle, \langle value2\rangle

**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 COMBWLimit? (with no parameter).
### COMPDLTCLim\(\text{\textless}value\)\(\text{\textgreater}\)

| Equivalent Key Sequence | \(\text{BW}_\text{L}\) – Lower limit value  
| \(\text{BW}_\text{H}\) – Upper limit value |
| Parameter Description  | \(<\text{value}_1>\) Lower limit value  
| \(<\text{value}_2>\) Upper limit value |
| Query Response         | \(<\text{value}_1>,<\text{value}_2>\)  
|                         | \(<\text{value}_1>\) : Lower limit value  
|                         | \(<\text{value}_2>\) : 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.|

### COMPDLTCLim\(\text{\{OFF|ON\}|0|1}\)

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

Turns ON/OFF the \(\Delta CI\) limit test function. With this function ON, DUTs are evaluated to the \(\Delta CI\) limit (specified with COMPDLTCLim); if the CI value measured in DLD mode exceeds the limit, then the DUT fails the test.  
The query form of this command is COMPDLTCLim? (with no parameter).

| Equivalent Key Sequence | \(\text{L} \text{\{OFF|ON\}0|1}\) |
| Parameter Description   | OFF: \(\Delta CI\) limit test OFF  
|                         | ON: \(\Delta CI\) limit test ON  
|                         | 0: \(\Delta CI\) limit test OFF  
|                         | 1: \(\Delta CI\) limit test ON |
| Query Response          | \{1|0\} |

### COMPDLTCLim\(\text{\textless}value\)\(\text{\textgreater}\)

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

Sets the \(\Delta CI\) 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 COMPDLTCLim? (with no parameter).
### COMPDLTFLim\(\leq <\text{value}>\)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>(\leq \text{APL})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>(&lt;\text{value}&gt;) Limit value [M</td>
</tr>
<tr>
<td>Query Response</td>
<td>(&lt;\text{value}&gt;) Limit value</td>
</tr>
</tbody>
</table>

**Note**

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

Sets the \(\Delta F\) limit. If the frequency value measured in DLD mode exceeds the limit, then the DUT fails the test.

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

### COMPDLTFL\(\leq \{\text{OFF}|\text{ON}|0|1\}\)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>(\leq \text{LMAF})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>OFF: (\Delta F) limit test OFF ON: (\Delta F) limit test ON 0: (\Delta F) limit test OFF 1: (\Delta F) limit test ON</td>
</tr>
<tr>
<td>Query Response</td>
<td>{1[0]}</td>
</tr>
</tbody>
</table>

**Note**

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

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

The query form of this command is COMPDLTFL? (with no parameter).
COMPENSTATE? □ {OPEN|SHORT|LOAD}

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

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
<tr>
<td>Query Response</td>
<td>{SYSCAL</td>
</tr>
<tr>
<td></td>
<td>SYSCAL: Indicates that HP E4916A has not yet been compensated and is using its internal compensation data.</td>
</tr>
<tr>
<td></td>
<td>INTERCAL: 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.</td>
</tr>
<tr>
<td></td>
<td>USERCAL: Indicates that HP E4916A has already been compensated at the current frequency.</td>
</tr>
</tbody>
</table>

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>

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>COMP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>&lt;value&gt;:</td>
</tr>
<tr>
<td></td>
<td>OPEN: Open fixture compensation standard</td>
</tr>
<tr>
<td></td>
<td>SHORT: Short fixture compensation standard</td>
</tr>
<tr>
<td></td>
<td>LOAD: Load fixture compensation standard</td>
</tr>
<tr>
<td></td>
<td>C0: Open capacitance</td>
</tr>
<tr>
<td></td>
<td>G0: residual conductance</td>
</tr>
<tr>
<td></td>
<td>R0: residual resistance</td>
</tr>
<tr>
<td></td>
<td>L0: residual inductance</td>
</tr>
</tbody>
</table>

Query Response <value>: 

COMPENsation □ {OPEN|SHORT|LOAD}

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

This command is not available in a query form.
COMPENsation\{OPEN|SHORT|LOAD\}

Equivalent Key Sequence

\[\text{(blue)} = 9 \text{ (Load)}\]
\[\text{(blue)} = 6 \text{ (Short)}\]
\[\text{(blue)} = 7 \text{ (Open)}\]

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\{FAIL\|PASS\} (with no parameter).

Equivalent Key Sequence
\[\text{LED}\]

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
\[\text{PrL1} \quad \text{Lower limit value}\]
\[\text{PrH1} \quad \text{Upper limit value}\]

Parameter Description
\(<n> : \{1|2|3|4|5|6|7|8|9|10\} \text{ (Bin number)}\)
\(<value1> \quad \text{Lower limit value for the specified bin}\)
\(<value2> \quad \text{Upper limit value for the specified bin}\)

Query Response
\(<value1>,<value2>\)
\(<value1> : \text{Lower limit value}\)
\[\text{[MA|K|M|U|N|P|F|PPM]} : \text{Unit}\]
\(<value2> : \text{Upper limit value}\)
\[\text{[MA|K|M|U|N|P|F|PPM]} : \text{Unit}\]
**COMPRI 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 query form of this command is COMPRI Mode? (with no parameter).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>PRI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td></td>
</tr>
<tr>
<td>ABSTOL: Tolerance mode (based on the actual deviation from the reference value)</td>
<td></td>
</tr>
<tr>
<td>PCNTTOL: Tolerance mode (based on the percentage relative to the reference value)</td>
<td></td>
</tr>
<tr>
<td>SEQ: Sequential mode</td>
<td></td>
</tr>
<tr>
<td>Query Response</td>
<td>{ABSTOL</td>
</tr>
</tbody>
</table>

**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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>AUX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td></td>
</tr>
<tr>
<td>OFF: AUX bin function OFF</td>
<td></td>
</tr>
<tr>
<td>ON: AUX bin function ON</td>
<td></td>
</tr>
<tr>
<td>0: AUX bin function OFF</td>
<td></td>
</tr>
<tr>
<td>1: AUX bin function ON</td>
<td></td>
</tr>
<tr>
<td>Query Response</td>
<td>{0</td>
</tr>
</tbody>
</table>

**COMPSEC** \{OFF|ON|0|1\}

Turns ON/OFF secondary sorting.

The query form of this command is COMPSEC? (with no parameter).
COMPSEC = {OFF|ON[0|1]  
Equivalent Key Sequence  
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  
SecU - Upper limit value  
Parameter Description  
<value1> Lower limit value  
[MA|K|M[U][N][P][P]: Unit  
<value2> Upper limit value  
[MA|K|M[U][N][P][P]: 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 (Comprf) 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).
### Alphabetical Reference

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \text{DLTMode}\uparrow\text{SEC},{\text{OFF}\mid \text{DEV}\mid \text{PCNT}} )</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter Description</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \langle\text{value}\rangle )</td>
<td>Reference value for primary sorting</td>
</tr>
<tr>
<td>[ \text{MA}</td>
<td>\text{K}</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Query Response</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \langle\text{value}\rangle )</td>
<td></td>
</tr>
</tbody>
</table>

### DISP\(\downarrow\{\text{OFF}\mid \text{ON}\mid 0\mid 1\}\)

Shows or hides measurement data on the LCD.

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

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \text{DISP} )</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter Description</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \text{OFF} ): Hides measurement data.</td>
<td></td>
</tr>
<tr>
<td>( \text{ON} ): Shows measurement data.</td>
<td></td>
</tr>
<tr>
<td>( 0 ): Hides measurement data.</td>
<td></td>
</tr>
<tr>
<td>( 1 ): Shows measurement data.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Query Response</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>{1</td>
<td>0} {1</td>
</tr>
</tbody>
</table>

### DISPSTATus\(\downarrow\{\text{OFF}\mid \text{ON}\mid 0\mid 1\}\)

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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \text{DISPSTAT} + 1 \text{ (Status)} )</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter Description</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \text{OFF} ): Hides instrument settings.</td>
<td></td>
</tr>
<tr>
<td>( \text{ON} ): Shows instrument settings.</td>
<td></td>
</tr>
<tr>
<td>( 0 ): Hides instrument settings.</td>
<td></td>
</tr>
<tr>
<td>( 1 ): Shows instrument settings.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Query Response</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>{1</td>
<td>0}</td>
</tr>
</tbody>
</table>

### DLTMode\(\uparrow\text{PRI},\{\text{OFF}\mid \text{DEV}\mid \text{PPM}\}\)

### DLTMode\(\uparrow\text{SEC},\{\text{OFF}\mid \text{DEV}\mid \text{PCNT}\}\)

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?\(\uparrow\{\text{PRI}\mid \text{SEC}\}\). Supply the PRI option to obtain the Delta mode status for primary sorting, or the SEC option to obtain the Delta mode status for secondary sorting.
**DLTMode**\{SEC\}, {OFF|DEV|PCNT}  

**Alphabetical Reference**

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>AF: Frequency value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AG: Impedance value</td>
</tr>
</tbody>
</table>

**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 \((\text{measured value} - \text{reference value})\)
- PCNT: Percentage \(\{(\text{measured value}) - (\text{reference value}) / (\text{reference value})\}\) (SEC only)
- PPM: ppm \(\{(\text{measured value}) - (\text{reference value}) / (\text{reference value})\}\) (PRI only)

| Query Response | \{OFF|DEV|PCNT|PPM\} |

**DLTREF**\{PRI|SEC\}, \(<\text{value}>\)**

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.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>RefF: Reference frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RefZ: Reference impedance</td>
</tr>
</tbody>
</table>

**Parameter Description**
- PRI: Measurement parameter for primary sorting
- SEC: Measurement parameter for secondary sorting
- \(<\text{value}>\) Reference value

| Query Response | \(<\text{value}>\) : 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.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
</table>

**Parameter Description**
- User: User-specified value
- Nom: Nominal value

| Query Response | \{U|N\} |
**DLTSTATe** \(\{\text{OFF|ON|0|1}\} \)  

Turns ON/OFF Delta mode.  

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

| Equivalent Key Sequence | (blue) + \(2(\text{A Mode})\) \(\text{AMOD}\) \(\{\text{OFF|ON}\}\) |
|-------------------------|------------------------------------------------------------------|
| Parameter Description   | OFF: Delta mode OFF  
ON: Delta mode OFF  
0: Delta mode OFF  
1: Delta mode OFF |
| Query Response          | \(\{1|0\}\) |

**DSPQ** \(\{\text{OFF|ON|0|1}\} \)  

Shows or hides the Q parameter on the LCD.  

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

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>(red) (\text{DSPQ})</th>
</tr>
</thead>
</table>
| 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** \(\{\text{OFF|ON|0|1}\},<value>\)  

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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>----</th>
</tr>
</thead>
</table>
| 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.  
\(<\text{value}>\): Output data (I/O port output ON only) |
| Query Response          | \(\{0|1\},<value>\)  
\(<\text{value}>\): (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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Dir</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>DOWN: Decreasing direction of the resonance frequency in frequency adjustment. UP: Increasing direction of the resonance frequency in frequency adjustment.</td>
</tr>
<tr>
<td>Query Response</td>
<td>{DOWN</td>
</tr>
</tbody>
</table>

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 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 SRCITGT 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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
</table>
| 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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>MANN</th>
</tr>
</thead>
</table>
| 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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
</table>
| 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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>(\text{StartP} - ) Presents read-only display of the current value.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>(&lt;value&gt;) : Start point</td>
</tr>
<tr>
<td>Query Response</td>
<td>(&lt;value&gt;)</td>
</tr>
</tbody>
</table>

**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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>(\text{Tout} - ) Presents read-only display of the current value.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>(&lt;value&gt;) Time-out value [ms]</td>
</tr>
<tr>
<td></td>
<td>[S</td>
</tr>
<tr>
<td>Query Response</td>
<td>(&lt;value&gt;)</td>
</tr>
</tbody>
</table>
**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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>(\text{blue} + \mu M (\text{Equiv Ckt}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>DEV4: 4-element equivalent circuit</td>
</tr>
<tr>
<td></td>
<td>DEV6: 6-element equivalent circuit</td>
</tr>
<tr>
<td></td>
<td>OFF: Equivalent Circuit Analysis function OFF</td>
</tr>
<tr>
<td>Query Response</td>
<td>{DEV4</td>
</tr>
</tbody>
</table>

**ERROR?**

A query-dedicated command that returns the number and message of any existing error in the HP E4915A/E4916A’s error queue.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>--</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>--</td>
</tr>
<tr>
<td>Query Response</td>
<td>Response error number and error message</td>
</tr>
</tbody>
</table>

**ESE\{<value>\]**

Sets the bits of the Standard Event Status Register.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>--</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>(&lt;value&gt;:)</td>
</tr>
<tr>
<td>Query Response</td>
<td>--</td>
</tr>
</tbody>
</table>

**ESE?**

Queries the bits of the Standard Event status register.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>--</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>--</td>
</tr>
<tr>
<td>Query Response</td>
<td>(&lt;value&gt;:) Register value in decimal notation</td>
</tr>
</tbody>
</table>
**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.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>–</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>–</td>
</tr>
<tr>
<td>Query Response</td>
<td><code>&lt;value&gt;</code>: Register value in decimal notation</td>
</tr>
</tbody>
</table>

**EXTRLOCK?**  Return the status of the external reference input.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>–</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>–</td>
</tr>
<tr>
<td>Query Response</td>
<td><code>{1}[0]</code></td>
</tr>
<tr>
<td></td>
<td>1: Locked to external signal</td>
</tr>
<tr>
<td></td>
<td>0: No external signal</td>
</tr>
</tbody>
</table>

**FLTDB[<value>]**  Specifies the down value for the filter’s band width.

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

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>XDB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td><code>&lt;value&gt;</code> Band width of the filter band width [dB]</td>
</tr>
<tr>
<td>Query Response</td>
<td><code>&lt;value&gt;</code></td>
</tr>
</tbody>
</table>

**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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>LOSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>CONSTant: Constant loss</td>
</tr>
<tr>
<td></td>
<td>MINimum: Minimum loss</td>
</tr>
<tr>
<td>Query Response</td>
<td>`{CONST</td>
</tr>
</tbody>
</table>
**FORMat**\[\{ASCII\|REAL[,64]\}]

Selects the HP-IB data transfer format to use.

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

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>ASCII: ASCII format. REAL[, 64]: REAL format</td>
</tr>
<tr>
<td>Query Response</td>
<td>{ASCII|REAL}</td>
</tr>
</tbody>
</table>

**HPIBADDRess**\[\langle value\rangle\]

Sets the HP-IB address.

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

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>HPIB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>\langle value\rangle: HP-IB address(31:talk only)</td>
</tr>
<tr>
<td>Query Response</td>
<td>\langle value\rangle:</td>
</tr>
</tbody>
</table>

**\*IDN?**

A query-dedicated command that returns an identification string which consists of four comma-separated fields.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>-</td>
</tr>
<tr>
<td>Query Response</td>
<td>\langle field 1\rangle,\langle field 2\rangle,\langle field 3\rangle,\langle field 4\rangle: See the list below.</td>
</tr>
</tbody>
</table>

*\langle field 1\rangle* Manufacture (always HEWLETT-PACKARD)

*\langle field 2\rangle* Model number

*\langle field 3\rangle* Serial number in HP format (such as 2419J00100)

*\langle field 4\rangle* Firmware version number (such as 01.00)

**INITCONTinuous** \{OFF\|ON\|0\|1\}

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

The query form of this command is INITCONTinuous? (with no parameter).
**INITCONTinuous** \{OFF|ON|0|1\}

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>--</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>OFF: Does not initiate the trigger system continuously. ON: Initiates the trigger system continuously.</td>
</tr>
<tr>
<td>Query Response</td>
<td>{1</td>
</tr>
</tbody>
</table>

**INITIMMediate**
Causes all sequences to exit Idle state and enter Initiate state. This command causes the trigger system to initiate and complete one full trigger cycle, returning to Idle state on completion. (No query)

If the HP E4915A/E4916A is not in Idle state or if INITCONTinuous is set to ON, an INITIMMediate command has no effect on the trigger system and an error -213 is generated.

This command is not available in a query form.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>--</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>--</td>
</tr>
<tr>
<td>Query Response</td>
<td>Query form not supported.</td>
</tr>
</tbody>
</table>

**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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>(blue) + 0</th>
</tr>
</thead>
</table>
| Parameter Description   | OFF: Key lock OFF  
                          | ON: Key lock ON  
                          | 0: Key lock OFF  
                          | 1: Key lock ON |
| Query Response          | 0: Key lock OFF  
                          | 1: Key lock ON |

**MEASFunction\{Xtal|Spur|Dld|Em|Lcr|Filter\}**
This command is used to select one of the available measurement modes/functions.
The query form of this command is MEASFunction? (with no parameter).
**Alphabetical Reference**

**MEASTime<value>**

Equivalent Key Sequence:
- **Xtal:** (blue) + [Freq (Xtl)]
- **Spur:** (blue) + (Level [Spurious])
- **Dld:** (blue) + [Meas Prmtr (DLD)] (HP E4915Aonly)
- **Em:** (blue) + [Nominal Cl (EM)] (HP E4916Aonly)
- **Lcr:** (blue) + [Meas Time (LCR)] (HP E4916Aonly)
- **Filter:** (blue) + [CL Value (Fltr)] (HP E4916Aonly)

Parameter Description:
- **Xtal:** Crystal Resonator measurement mode
- **Spur:** Spurious measurement mode
- **Dld:** Drive Level Dependency measurement mode (HP E4916Aonly)
- **Em:** Evaporation Monitor mode (HP E4916Aonly)
- **Lcr:** LCR measurement mode (HP E4916Aonly)
- **Filter:** Filter measurement mode (HP E4916Aonly)

Query Response:
{X|S|D|E|L|F}

**MEASPARA{FR|FA|FS|FL}**

Selects the frequency type to search for.

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

Equivalent Key Sequence:
- **Meas Prmtr**
- **PARA**

Parameter Description:
- **FR:** Resonance frequency
- **FA:** Anti-resonance frequency
- **FS:** Frequency with the maximum G value (conductance)
- **FL:** Resonance frequency with capacitance load

Query Response:
{FR|FA|FS|FL}

**MEASTime<value>**

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

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

Equivalent Key Sequence:
- **Meas Time** – Corresponds to levels 1 to 6, (1 to 3 for LCR Mode)
- **TIME**
- **HI-Q**

Parameter Description:

<table>
<thead>
<tr>
<th>MEASTime</th>
<th>Measuring time</th>
<th>High Q</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Short</td>
<td>OFF</td>
</tr>
<tr>
<td>2</td>
<td>Med</td>
<td>OFF</td>
</tr>
<tr>
<td>3</td>
<td>Long</td>
<td>OFF</td>
</tr>
<tr>
<td>4</td>
<td>Short</td>
<td>ON</td>
</tr>
<tr>
<td>5</td>
<td>Med</td>
<td>ON</td>
</tr>
<tr>
<td>6</td>
<td>Long</td>
<td>ON</td>
</tr>
</tbody>
</table>

Query Response:
<value>
<value>:
**MEMCLEar**  Clears the contents of the memory buffer.
This command is not available in a query form.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>MemClear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
<tr>
<td>Query Response</td>
<td>Query form not supported.</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
<tr>
<td>Query Response</td>
<td>&lt;value&gt;</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
<tr>
<td>Query Response</td>
<td>See the table below.</td>
</tr>
</tbody>
</table>

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

Transferred Data

- ASCII format transfer ASCII: `<asc_data> ... <asc_data><NL-END>`
  `<asc_data>:={<status>,<data>, ... ,<data>[<comp>]}`
  `<comp>=<bin_num>,<pri>,<sec>[,<t1>,<t2>]`
- Binary format transfer BINARY: `#6<num_bytes><bin_data> ...`
  `<bin_data><NL-END>` `<bin_data>:={<status><data> ... ,<data>[<comp>]}
  `<comp>=<bin_num><pri><sec>[,<t1>,<t2>]`

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)
  `<t1>`: ΔF limit test result
    0: PASS
    1: FAIL
  -1: ΔF limit test OFF
  `<t2>`: ΔCI limit test result
    0: PASS
    1: FAIL
  -1: ΔF limit test OFF
### Crystal Resonator measurement mode

**Spurious measurement mode**
- Data elements transferred whenever TRG is issued
  - \(<F>\) : F (Measured resonance frequency: \(F_r, F_a, F_s\))
  - \(<FL>\) : FL (Measured resonance frequency)
  - \(<CIZ>\) : CI/Z (Measured resonance impedance)
- Data elements transferred with the Equivalent Circuit Analysis function ON (for both 4- and 6-element modes)
  - \(<Q>\) : Q
  - \(<Bs>\) : Bs
  - \(<C0>\) : 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
  - \(<\text{time}>\) : Total elapsed time [ms]

**Drive Level Dependency measurement mode**
- Data elements transferred whenever TRG is issued
  - \(<F>\) : F (Measured resonance frequency: \(F_r, F_a, F_s\))
  - \(<CIZ>\) : CI/Z (Measured resonance impedance)
- Data elements transferred with the Equivalent Circuit Analysis function ON (for both 4- and 6-element modes)
  - \(<Q>\) : Q
  - \(<Bs>\) : Bs
  - \(<C0>\) : 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
  - \(<\text{spur\_num}>\) : 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)
  - \(<F1>\) : Frequency of the spurious point
  - \(<\text{sp}1>\) : Impedance at the spurious point

**Evaporation Monitor mode**
- Data elements transferred whenever TRG is issued
  - \(<F>\) : F (Measured resonance frequency: \(F_r, F_a, F_s\))
  - \(<CIZ>\) : CI/Z (Measured resonance impedance)
  - \(<\text{STAT}>\) : Indicates whether the tracking measurement was successful.
    - 0: PASS
    - 1: FAIL
  - \(<\text{DL}>\) : DL value (setting)

**Evaporation Monitor mode**
- Data elements transferred whenever TRG is issued
  - \(<F>\) : F Trap frequency
  - \(<\text{CI}>\) : CI/Z CI value at the trap frequency
  - \(<\text{time}>\) : Time required between two trap points
  - \(<\text{NL}\_\text{END}>\) : NewLine\_END (1 byte)

**Filter measurement mode**
- Data elements transferred whenever TRG is issued
  - \(<\text{Loss}>\) : Minimum or constant loss
  - \(<\delta_f\_\text{left}>\) : \(-x\) dB BW (\(\delta_f\_\text{left}\))
  - \(<\delta_f\_\text{right}>\) : \(-x\) dB BW (\(\delta_f\_\text{right}\))
Alphabetical Reference

**MEMRETEST**
Clears the most recent data in the memory buffer.
This command is not available in a query form.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
<tr>
<td>Query Response</td>
<td>Query form not supported.</td>
</tr>
</tbody>
</table>

**MEMSIZE <value>**
Sets the memory buffer size.
The query form of this command is MEMSIZE? (with no parameter).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>&lt;value&gt; : Memory buffer size</td>
</tr>
<tr>
<td>Query Response</td>
<td>&lt;value&gt;: int16, NR1</td>
</tr>
</tbody>
</table>

**MESTATE {OFF|ON|0|1}**
Turns ON/OFF the Memory Buffer function.
The query form of this command is MESTATE? (with no parameter).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>(blue) + 2 (Mem Buf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>OFF: Memory Buffer function OFF</td>
</tr>
<tr>
<td></td>
<td>ON: Memory Buffer function ON</td>
</tr>
<tr>
<td></td>
<td>0: Memory Buffer function OFF</td>
</tr>
<tr>
<td></td>
<td>1: Memory Buffer function ON</td>
</tr>
<tr>
<td>Query Response</td>
<td>{1</td>
</tr>
</tbody>
</table>

**NOMC1 <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 DLTMMode).
The query form of this command is NOMC1? (with no parameter).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Nominal C1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C1</td>
</tr>
<tr>
<td>Parameter Description</td>
<td>&lt;value&gt; Nominal resonance impedance</td>
</tr>
<tr>
<td>Query Response</td>
<td>&lt;value&gt;</td>
</tr>
</tbody>
</table>

HP-IB Command Reference 5-87
**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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>(Freq)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>&lt;value&gt; Nominal resonance frequency [MHz</td>
</tr>
<tr>
<td>Query Response</td>
<td>&lt;value&gt;</td>
</tr>
</tbody>
</table>

**OPC?** Returns 1 when all pending operations have been completed.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>-</td>
</tr>
<tr>
<td>Query Response</td>
<td>{1</td>
</tr>
</tbody>
</table>

**OPC** Tells the HP E4915A/E4916A to set bit 0 (OPC bit) in the Standard Event Status Register when it completes all pending operations.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>-</td>
</tr>
<tr>
<td>Query Response</td>
<td>-</td>
</tr>
</tbody>
</table>

**OPT?** Queries the options installed. (Query only)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>-</td>
</tr>
<tr>
<td>Query Response</td>
<td>Option number</td>
</tr>
</tbody>
</table>

**OSE**<value> Sets the enable register of the Operation Status Register group.

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

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>&lt;value&gt;: Register value in decimal notation</td>
</tr>
<tr>
<td>Query Response</td>
<td>&lt;value&gt;: Register value in decimal notation</td>
</tr>
</tbody>
</table>
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. OUTIÖ 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.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
<tr>
<td>Query Response</td>
<td>—</td>
</tr>
</tbody>
</table>

POWER\downarrow<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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>(Level)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LVL: Lets you enter a value.</td>
</tr>
<tr>
<td></td>
<td>UNIT: Lets you select a unit.</td>
</tr>
<tr>
<td>Parameter Description</td>
<td>&lt;value&gt; Power level value</td>
</tr>
<tr>
<td></td>
<td>[MW</td>
</tr>
<tr>
<td>Query Response</td>
<td>&lt;value&gt;,{W</td>
</tr>
</tbody>
</table>

PRESet Resets the instrument settings to the preset values.

This command is not available in a query form.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>(blue) + (Reset)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
<tr>
<td>Query Response</td>
<td>Query form not supported.</td>
</tr>
</tbody>
</table>

PTABORT\uparrow(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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>ABORT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>OFF: Abort function OFF</td>
</tr>
<tr>
<td></td>
<td>ON: Abort function ON</td>
</tr>
<tr>
<td></td>
<td>0: Abort function OFF</td>
</tr>
<tr>
<td></td>
<td>1: Abort function ON</td>
</tr>
<tr>
<td>Query Response</td>
<td>{1</td>
</tr>
</tbody>
</table>
Alphabetical Reference

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

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
<tr>
<td>Query Response</td>
<td>Query form not supported.</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>&lt;value1&gt;: Number of the sweep point&lt;br&gt;&lt;value2&gt;: Drive level at the sweep point&lt;br&gt;[MW</td>
</tr>
<tr>
<td>Query Response</td>
<td>&lt;value2&gt;,{1</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Method</th>
<th>HP-IB Commands</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweep point list</td>
<td>PTLIST, PTSWPType</td>
<td>Issue the PTCWPType command with the LIST option, and use the PTLIST command to explicitly specify the drive level values for the respective sweep points.</td>
</tr>
<tr>
<td>Maximum/minimum values</td>
<td>PTMINPower, PTMAXPower, PTSWPType</td>
<td>Specify the minimum and maximum drive levels, and select one of the three sweep types (UP</td>
</tr>
</tbody>
</table>

Table 5-4. Setting Up the Sweep Pattern
**PTLSIZE** <value>  
Sets the size of the drive level (sweep point) list.  
The query form of this command is PTLSIZE? (with no parameter).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>&lt;value&gt; : The number of lines that represents the size of the sweep point list</td>
</tr>
<tr>
<td>Query Response</td>
<td>&lt;value&gt;</td>
</tr>
</tbody>
</table>

**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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>MAX</th>
</tr>
</thead>
</table>
| Parameter Description   | <value> Maximum drive level value  
[MW|UV|NW|W|MA|UA|AY|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**

<table>
<thead>
<tr>
<th>Method</th>
<th>HP-IB Commands</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweep point list</td>
<td>PTLIST, PTSWPType</td>
<td>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.</td>
</tr>
<tr>
<td>Maximum/minimum values</td>
<td>PTMINPower, PTMAXPower, PTSWPType</td>
<td>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.</td>
</tr>
</tbody>
</table>

**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).
Alphabetical Reference

**PTSTARTPoint**<value>

Equivalent Key Sequence | MIN
---|---

Parameter Description | <value> Minimum drive level value
[MW|UW|NW|W|M|MA|LM|MV|LV|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**

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

**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 | TREG
---|---

Parameter Description | OFF: Phase tracking OFF. The resonance frequency is detected by Fr search and then drive level is swept with the frequency maintained.
ON: Phase tracking ON. The resonance frequency at each drive level is searched by sweeping the drive level to detect the CI value at the resonance point.
0: Phase tracking OFF. The resonance frequency is detected by Fr search and then drive level is swept with the frequency maintained.
1: Phase tracking ON. The resonance frequency at each drive level is searched by sweeping the drive level to detect the CI value at the resonance point.

Query Response | {ON|OFF|0|1}

**PTSTARTPoint**<value>

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

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

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>StartP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Parameter Description</strong></td>
<td>(&lt;value&gt;) : Start point</td>
</tr>
<tr>
<td><strong>Query Response</strong></td>
<td>(&lt;value&gt;)</td>
</tr>
</tbody>
</table>

**PTSTD**

<value> Specifies the reference drive level.

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

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>STDP</th>
</tr>
</thead>
</table>
| **Parameter Description** | \(<value>\) Reference drive level  
[MW][UW][NW][MA][UA][MV][UV][MV][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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>SWPT</th>
</tr>
</thead>
</table>
| **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>
<thead>
<tr>
<th>Method</th>
<th>HP-IB Commands</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweep point list</td>
<td>PTLIST, PTSWPType</td>
<td>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.</td>
</tr>
<tr>
<td>Maximum/minimum values</td>
<td>PTMINPower, PTMAXPower, PTSWPType</td>
<td>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.</td>
</tr>
</tbody>
</table>

**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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>&lt;value&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>Wait time between energization and stabilization of the DUT [S</td>
</tr>
<tr>
<td>Query Response</td>
<td>&lt;value&gt;</td>
</tr>
</tbody>
</table>

**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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>&lt;value&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>Register value in decimal notation</td>
</tr>
<tr>
<td>Query Response</td>
<td>&lt;value&gt;</td>
</tr>
</tbody>
</table>

**QSER?** A query-dedicated command that returns the contents of the event register of the Standard Questionable (QUESTionable) Status Register group.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>&lt;value&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td></td>
</tr>
<tr>
<td>Query Response</td>
<td>&lt;value&gt; : Register value in decimal notation</td>
</tr>
</tbody>
</table>
Alphabetical Reference

**QSR?**  A query-dedicated command that returns the contents of the condition register of the Standard Questionable (QUESTionable) Status Register group.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>–</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>–</td>
</tr>
<tr>
<td>Query Response</td>
<td>(&lt;value&gt;: ) Register value in decimal notation</td>
</tr>
</tbody>
</table>

**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)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th><strong>Rcl</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>(&lt;value&gt;:)</td>
</tr>
<tr>
<td>Query Response</td>
<td>–</td>
</tr>
</tbody>
</table>

**RST**  Resets the HP E4915A/E4916A to the initial settings.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>–</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>–</td>
</tr>
<tr>
<td>Query Response</td>
<td>–</td>
</tr>
</tbody>
</table>

**SAV \(<value>\)**  Saves the instrument state in the specified register number. The HP E4915A/E4916A has 10 available storage registers. (No query)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th><strong>(blue) + Rcl (Save)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>(&lt;value&gt;:)</td>
</tr>
<tr>
<td>Query Response</td>
<td>–</td>
</tr>
</tbody>
</table>

**SEE \(<value>\)**  Sets the enable register of the Search Event Status Register group.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>–</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>(&lt;value&gt;: ) Register value in decimal notation</td>
</tr>
<tr>
<td>Query Response</td>
<td>(&lt;value&gt;: ) Register value in decimal notation</td>
</tr>
</tbody>
</table>

5-96  HP-IB Command Reference
**SEER?**  A query-dedicated command that returns the contents of the event register of the Search Event Status Register. (Query only)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
<tr>
<td>Query Response</td>
<td><code>&lt;value&gt;</code>: Register value in decimal notation</td>
</tr>
</tbody>
</table>

**SER?**  A query-dedicated command that returns the contents of the condition register of the Search Event Status Register group. (Query only)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
<tr>
<td>Query Response</td>
<td><code>&lt;value&gt;</code>: Register value in decimal notation</td>
</tr>
</tbody>
</table>

**SPCENTer<value>**  Specifies the center frequency for the spurious search range.  
The query form of this command is SPCENTer? (with no parameter).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>&lt;CENT&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td><code>&lt;value&gt;</code>: Center frequency</td>
</tr>
<tr>
<td>Query Response</td>
<td><code>&lt;value&gt;</code></td>
</tr>
</tbody>
</table>

**SPDISP<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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>&lt;DispSP&gt;</th>
</tr>
</thead>
</table>
| 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>`: 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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>$Spur$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>$&lt;value&gt;$ : Number of spurious points to search for</td>
</tr>
<tr>
<td>Query Response</td>
<td>$&lt;value&gt;$</td>
</tr>
</tbody>
</table>

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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>PHAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>$&lt;value&gt;$ Target phase value</td>
</tr>
<tr>
<td>Query Response</td>
<td>$&lt;value&gt;$</td>
</tr>
</tbody>
</table>

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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>RRG</th>
</tr>
</thead>
</table>
| Parameter Description   | $<value>$ : Frequency range  
[MHz|M|kHz|kHz|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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>TGT</th>
</tr>
</thead>
</table>
| 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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Parameter Description</th>
<th>Query Response</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RNG</strong></td>
<td>(&lt;value&gt;) Frequency search range &lt;br&gt;MHZ[M</td>
<td>KHZ[K</td>
</tr>
</tbody>
</table>

**SRCHTGT**\({\text{P}h\text{a}se|P\text{e}ak}\)

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).

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>Parameter Description</th>
<th>Query Response</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TGT</strong></td>
<td>(P\text{h}\text{a}se: Frequency at target phase &lt;br&gt;P\text{e}ak : Positive/negative peak value</td>
<td>{&quot;PH</td>
</tr>
</tbody>
</table>

**SRE?** Queries the contents of the Status Byte Enable Register.

**SRE** Sets the bits of the Status Byte Enable Register.
**STB?** Queries the contents of the Status Byte Register. (Query only)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
<tr>
<td>Query Response</td>
<td>&lt;value&gt;: Status byte register value in decimal notation</td>
</tr>
</tbody>
</table>

**TGTPHase** <value> Specifies the target phase value.

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

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>PHAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>&lt;value&gt; Target phase value</td>
</tr>
<tr>
<td>Query Response</td>
<td>&lt;value&gt;</td>
</tr>
</tbody>
</table>

**THRU CAL** Performs calibration for the thru state.

This command is not available in a query form.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>(blue) + S (Thru)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>—</td>
</tr>
<tr>
<td>Query Response</td>
<td>Query form not supported.</td>
</tr>
</tbody>
</table>

**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.
Alphabetical Reference

**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><NLEND>`, `<asc_data>:=<CL>`
- **Binary format transfer BINARY:** `#4<num_bytes><bin_data><NLEND>`

### Data Elements

- `<num_elements>`: Number of data elements transferred
- `<num_bytes>`: Number of bytes transferred
- `<CL>`: Actual CL value
- `<NLEND>`: NewLineEND (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.

<table>
<thead>
<tr>
<th>Transferred Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>■ ASCII format transfer ASCII: &lt;num_elements&gt;, &lt;asc.data&gt;, &lt;NL-END&gt;</td>
</tr>
<tr>
<td>&lt;asc.data&gt;&lt;(&lt;F&gt;,&lt;CI&gt;,&lt;spur_num&gt;[,&lt;sF1&gt;,&lt;sCI1&gt;[,&lt;sF2&gt;,&lt;sCI2&gt;[,...]])&lt;bin.data&gt;&lt;NL-END&gt;</td>
</tr>
<tr>
<td>■ Binary format transfer BINARY: #4&lt;num_bytes&gt;&lt;bin.data&gt;&lt;NL-END&gt;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Data Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>■ Data elements transferred whenever TRG is issued</td>
</tr>
<tr>
<td>&lt;num_elements&gt; : Number of data elements transferred</td>
</tr>
<tr>
<td>&lt;num_bytes&gt; : Number of bytes transferred (for example, this element contains #40048 when 48 bytes are transferred).</td>
</tr>
<tr>
<td>&lt;F&gt; : F (Measured resonance frequency: Fr, Fa, Fs)</td>
</tr>
<tr>
<td>&lt;CI&gt; : CI/Z (Measured resonance impedance)</td>
</tr>
<tr>
<td>■ Number of spurious points</td>
</tr>
<tr>
<td>&lt;spur_num&gt; : Number of detected spurious points</td>
</tr>
<tr>
<td>■ Data elements transferred when one or more spurious points are detected (these elements are transferred for each of the spurious points detected)</td>
</tr>
<tr>
<td>&lt;sF1&gt; : Frequency of the spurious point</td>
</tr>
<tr>
<td>&lt;sCI1&gt; : Impedance at the spurious point</td>
</tr>
<tr>
<td>■ New Line</td>
</tr>
<tr>
<td>&lt;NL-END&gt; : NewLineEND (1 byte)</td>
</tr>
</tbody>
</table>

*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.

<table>
<thead>
<tr>
<th>Transferred Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>■ ASCII format transfer ASCII: &lt;num_elements&gt;, &lt;asc.data&gt;, &lt;NL-END&gt;</td>
</tr>
<tr>
<td>&lt;asc.data&gt;&lt;(&lt;F&gt;,&lt;CI&gt;,&lt;time&gt;)</td>
</tr>
<tr>
<td>■ Binary format transfer BINARY: #4&lt;num_bytes&gt;&lt;bin.data&gt;&lt;NL-END&gt;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Data Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;num_elements&gt; : Number of data elements transferred</td>
</tr>
<tr>
<td>&lt;num_bytes&gt; : Number of bytes transferred (for example, this element contains #40048 when 48 bytes are transferred).</td>
</tr>
<tr>
<td>&lt;F&gt; : F (Trap frequency)</td>
</tr>
<tr>
<td>&lt;CI&gt; : CI/Z (CI value at the trap frequency)</td>
</tr>
<tr>
<td>&lt;time&gt; : Time required between two trap points</td>
</tr>
<tr>
<td>&lt;NL-END&gt; : NewLineEND (1 byte)</td>
</tr>
</tbody>
</table>
Alphabetical Reference

*TRG(Drive Level Dependency Measurement Mode)

*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.

<table>
<thead>
<tr>
<th>Transferred Data</th>
<th>Data Elements transferred whenever TRG is issued</th>
</tr>
</thead>
<tbody>
<tr>
<td>- ASCII format transfer</td>
<td>- Data elements transferred whenever TRG is issued</td>
</tr>
<tr>
<td>◯ &lt;asc_data&gt;:=[&lt;F&gt;,&lt;CI&gt;,&lt;STAT&gt;,&lt;DL&gt;,&lt;MinF&gt;,&lt;MaxF&gt;,&lt;MinCI&gt;,&lt;MaxCI&gt;]</td>
<td>◯ Data elements transferred whenever TRG is issued</td>
</tr>
<tr>
<td>◯ &lt;MaxF-MinF&gt;,&lt;MaxCI-MinCI&gt;[&lt;comp&gt;]</td>
<td></td>
</tr>
<tr>
<td>◯ &lt;comp&gt;:=&lt;bin_num&gt;,&lt;pri&gt;,&lt;sec&gt;,&lt;t_1&gt;,&lt;t_2&gt;</td>
<td>◯ Data elements transferred whenever TRG is issued</td>
</tr>
<tr>
<td>- Binary format transfer</td>
<td>- Data elements transferred whenever TRG is issued</td>
</tr>
<tr>
<td>◯ &lt;bin_data&gt;:=&lt;F&gt;,&lt;CI&gt;,&lt;STAT&gt;,&lt;DL&gt;,&lt;MinF&gt;,&lt;MaxF&gt;,&lt;MinCI&gt;,&lt;MaxCI&gt;</td>
<td>◯ Data elements transferred whenever TRG is issued</td>
</tr>
<tr>
<td>◯ &lt;MaxF-MinF&gt;,&lt;MaxCI-MinCI&gt;[&lt;comp&gt;]</td>
<td></td>
</tr>
<tr>
<td>◯ &lt;comp&gt;:=&lt;bin_num&gt;,&lt;pri&gt;,&lt;sec&gt;,&lt;t_1&gt;,&lt;t_2&gt;</td>
<td>◯ Data elements transferred whenever TRG is issued</td>
</tr>
</tbody>
</table>

- 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
  - <NLEND>: NewLineEND (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.

<table>
<thead>
<tr>
<th>Transferred Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>• ASCII format transfer ASCII: &lt;num_elements&gt;,&lt;asc_data&gt;&lt;NLEND&gt;</td>
</tr>
<tr>
<td>&lt;asc_data&gt;: &lt;Loss&gt;,&lt;Δf_left&gt;,&lt;Δf_right&gt;</td>
</tr>
<tr>
<td>• Binary format transfer BINARY: #&lt;num_bytes&gt;&lt;bin_data&gt;&lt;NLEND&gt;</td>
</tr>
<tr>
<td>&lt;bin_data&gt;: &lt;Loss&gt;,&lt;Δf_left&gt;,&lt;Δf_right&gt;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Data Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;num_elements&gt;: Number of data elements transferred</td>
</tr>
<tr>
<td>&lt;num_bytes&gt;: Number of bytes transferred (for example, this element contains</td>
</tr>
<tr>
<td>#400256 when 256 bytes are transferred).</td>
</tr>
<tr>
<td>&lt;Loss&gt;: Minimum or constant loss</td>
</tr>
<tr>
<td>&lt;Δf_left&gt;: X dB BW (Δf_left)</td>
</tr>
<tr>
<td>&lt;Δf_right&gt;: X dB BW (Δf_right)</td>
</tr>
</tbody>
</table>

**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.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
<th>(Trig)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Description</td>
<td>--</td>
</tr>
<tr>
<td>Query Response</td>
<td>Query form not supported.</td>
</tr>
</tbody>
</table>

**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).
**LCR Meter Command Reference**

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>(blue) + Trig [Trigger Mode]</td>
</tr>
</tbody>
</table>

**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,TRIGMM 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.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
</tr>
</tbody>
</table>

**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.

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
</tr>
</tbody>
</table>

**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)

<table>
<thead>
<tr>
<th>Equivalent Key Sequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
</tr>
</tbody>
</table>

**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>
<thead>
<tr>
<th>COMMAND</th>
<th>PARAMETER</th>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABORT</td>
<td></td>
<td>[No Query]</td>
</tr>
<tr>
<td>CALCulate{1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>:STATE</td>
<td>{DEV</td>
</tr>
<tr>
<td></td>
<td>:PATH? :STATE</td>
<td>&lt;Boolean&gt;</td>
</tr>
<tr>
<td></td>
<td>:MATH</td>
<td>&lt;Boolean&gt;</td>
</tr>
<tr>
<td>CALCulate{5</td>
<td>6}</td>
<td>DATA [:DATA]</td>
</tr>
<tr>
<td></td>
<td>[:DATA]?</td>
<td>{BUF1</td>
</tr>
<tr>
<td></td>
<td>:FEED :CONTrol</td>
<td>{ALWAYS</td>
</tr>
<tr>
<td></td>
<td>:POInts</td>
<td>&lt;value&gt;</td>
</tr>
<tr>
<td>DISPLAY</td>
<td>[:WINDOW] [:STATE]</td>
<td>&lt;Boolean&gt;</td>
</tr>
<tr>
<td></td>
<td>:TEXT :STATe</td>
<td>&lt;Boolean&gt;</td>
</tr>
<tr>
<td></td>
<td>:TEXT1 :DIGit</td>
<td>&lt;value&gt;</td>
</tr>
<tr>
<td></td>
<td>:TEXT2 :PAGE</td>
<td>&lt;value&gt;</td>
</tr>
<tr>
<td>FETCH?</td>
<td>FORMAT [:DATA]</td>
<td>{ASCII</td>
</tr>
<tr>
<td>INITiate</td>
<td>:COntinuous [:IMmediate]</td>
<td>&lt;Boolean&gt;</td>
</tr>
<tr>
<td>[SENSe]</td>
<td>:AVERAge [:STATe]</td>
<td>&lt;value&gt;</td>
</tr>
<tr>
<td></td>
<td>:COUNTER{1</td>
<td>2} :CRIT</td>
</tr>
<tr>
<td></td>
<td>:STDard{1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>:COLECT [:ACQuire]</td>
<td>STANDARD{1</td>
</tr>
<tr>
<td></td>
<td>:CORREction [:DATA?]</td>
<td>&lt;value&gt;</td>
</tr>
<tr>
<td></td>
<td>:FIMPedance [:APERTure]</td>
<td>(Short</td>
</tr>
</tbody>
</table>
|         | :FUNCTION [:ON] | <sensor_function> | [Query Only]
### LCR Meter Command Reference

#### Subsystem Command List (continued)

<table>
<thead>
<tr>
<th>COMMAND</th>
<th>PARAMETER</th>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOURCE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>:FREQuency</td>
<td>&lt;value&gt; [HZ</td>
<td>KHz]</td>
</tr>
<tr>
<td>:CW</td>
<td>&lt;value&gt;</td>
<td></td>
</tr>
<tr>
<td>:VOLtage</td>
<td>[:LEVEL]</td>
<td>[:IMMediate] [AMP]</td>
</tr>
<tr>
<td>:CONDition?</td>
<td>&lt;value&gt;</td>
<td>[Query Only]</td>
</tr>
<tr>
<td>:ENABLE</td>
<td>&lt;value&gt;</td>
<td>[Query Only]</td>
</tr>
<tr>
<td>:PRESet</td>
<td>&lt;value&gt;</td>
<td>[Query Only]</td>
</tr>
<tr>
<td>:QUESTIONable</td>
<td>&lt;value&gt;</td>
<td>[Query Only]</td>
</tr>
<tr>
<td>:STATE</td>
<td>BUS</td>
<td>External</td>
</tr>
<tr>
<td>TRIGGER</td>
<td>[:IMMediate]</td>
<td></td>
</tr>
<tr>
<td>:ERROR?</td>
<td>&lt;value&gt; [MS</td>
<td>S]</td>
</tr>
<tr>
<td>:KLOCK</td>
<td>&lt;value&gt;</td>
<td>[Query Only]</td>
</tr>
<tr>
<td>:PRESet</td>
<td></td>
<td>[No Query]</td>
</tr>
<tr>
<td>:VERSION?</td>
<td></td>
<td>[Query Only]</td>
</tr>
<tr>
<td>CALCulate</td>
<td>:COMPArator</td>
<td>:STATE</td>
</tr>
<tr>
<td>:MODE</td>
<td>&lt;value&gt;</td>
<td>[Query Possible]</td>
</tr>
<tr>
<td>:TOLERance</td>
<td>ABSTOL</td>
<td>PCNTTOL</td>
</tr>
<tr>
<td>:NOMinal</td>
<td>&lt;value&gt;</td>
<td>[Query Possible]</td>
</tr>
<tr>
<td>:BIN&lt;n&gt;</td>
<td>&lt;value&gt;</td>
<td>[Query Possible]</td>
</tr>
<tr>
<td>:SUQUENCE</td>
<td>&lt;value&gt;</td>
<td>[Query Possible]</td>
</tr>
<tr>
<td>:BIN</td>
<td>&lt;value&gt;</td>
<td>[Query Possible]</td>
</tr>
<tr>
<td>:SECONDary</td>
<td>:STATE</td>
<td>:LIMIT</td>
</tr>
<tr>
<td>:STATE</td>
<td>&lt;value&gt;</td>
<td>[Query Possible]</td>
</tr>
<tr>
<td>:LIMIT</td>
<td>&lt;value&gt;</td>
<td>[Query Possible]</td>
</tr>
<tr>
<td>:AUXIBIN</td>
<td>&lt;value&gt;</td>
<td>[Query Possible]</td>
</tr>
<tr>
<td>:BIN</td>
<td>&lt;value&gt;</td>
<td>[Query Possible]</td>
</tr>
<tr>
<td>CLEAR</td>
<td>&lt;value&gt;</td>
<td>[No Query]</td>
</tr>
<tr>
<td>COUNT</td>
<td>&lt;value&gt;</td>
<td>[Query Only]</td>
</tr>
<tr>
<td>DATA? Clear</td>
<td>&lt;value&gt;</td>
<td>[No Query]</td>
</tr>
<tr>
<td>BEEPPer</td>
<td>:CUMDition</td>
<td>:STATE</td>
</tr>
<tr>
<td></td>
<td>FAIL</td>
<td>PASS</td>
</tr>
<tr>
<td></td>
<td>Boolean</td>
<td>[Query Only]</td>
</tr>
</tbody>
</table>
Subsystem Command Tree

The top of the subsystem command tree is called the **root command**, or simply the **root**. To reach the low-level commands, you must specify a particular **path** (like DOS file directory path). After Power ON or after *RST, the current path is set to the root. The path settings are changed as follows:

**Message Terminator**
A message terminator, such as `<new line>` character, sets the current path to the root.

**Colon (:)**
When a colon is placed between two command mnemonics, the colon moves the current path down one level on the command tree. When the colon is the first character of a command, it specifies that the following command mnemonics 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 them in the same way, regardless of the current path setting.

Figure 5-1 shows examples of how to use the colon and semicolon to navigate efficiently through the command tree.

![Diagram of command tree](image)

**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`
**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:

:RESPedance: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.

:RESPedance:APER\-url parameter

\url 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 :POI\nts command as shown below.

:DATA:POIN\=\url<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
LCR Meter Command Reference

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'"
20 OUTPUT @Meter;"::FUNC ""FIMP""
```

using single quote
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>
<thead>
<tr>
<th>Definition</th>
<th>Mnemonic</th>
<th>Usable Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$10^5$ (Mega)</td>
<td>MA</td>
<td>Hz</td>
</tr>
<tr>
<td>$10^3$ (kilo)</td>
<td>K</td>
<td>V</td>
</tr>
<tr>
<td>$10^{-3}$ (Milli)</td>
<td>M</td>
<td>OHM</td>
</tr>
</tbody>
</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 :QUERY1;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.

:CALCulate{1|2}:LIMIT:LOWER[:DATA] <value>

Sets or queries the lower limit of the specified parameter.

:CALCulate{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:LIMIT:LOW <value>.
LCR Meter Command Reference

Command Reference

This section provides alphabetical command reference for the LCR Meter function.

:ABORt

The :ABORt command resets the trigger system and places all trigger sequences in the Idle state. Any actions related to the trigger system that are in progress, such as acquiring a measurement, are aborted immediately. The execution of an :ABORt command will set any pending operation flag to FALSE, for example flags that were set by the initiation of the trigger system.

Unlike *RST, :ABORt does not alter the settings programmed by other commands. (No query)

Note

After the :FETCH? query, the *TRG command, or the BASIC command TRIGGER command, the :ABORt command will cause the HP-IB bus to hang up. To avoid this, clear the HP-IB bus by sending the BASIC command CLEAR (address) before sending the :ABORt command.
CALCulate Subsystem

The CALCulate subsystem controls the measurement-data processing as listed below:

1. To select measurement parameter (:CALCulate{1|2}:FORMat subsystem) with the [:SENSe]:FUNCTION[:ON] subsystem

2. To control the level monitor function (:CALCulate{1|2}:MATH subsystem)

3. To control deviation measurement mode (:CALCulate{1|2}:MATH subsystem)

4. To control comparator function (:CALCulate:COMParator subsystem)

The HP E4916A performs data processing in the order as listed.

The CALCulate subsystem is logically positioned between the SENSe subsystem and the data output to the bus and display. The CALCulate subsystem, the SENSe subsystem, the DATA subsystem, and FETCH Query are used together to capture the measurement data.

<table>
<thead>
<tr>
<th>COMMAND</th>
<th>PARAMETER</th>
</tr>
</thead>
<tbody>
<tr>
<td>CALCulate{1</td>
<td>2</td>
</tr>
<tr>
<td>:FORMat</td>
<td>IMAGinary</td>
</tr>
<tr>
<td>:MATH</td>
<td>{DEV</td>
</tr>
<tr>
<td>:EXPRession</td>
<td>&lt;Boolean&gt;</td>
</tr>
<tr>
<td>:CATalog?</td>
<td></td>
</tr>
<tr>
<td>:NAME</td>
<td></td>
</tr>
<tr>
<td>:STATE</td>
<td></td>
</tr>
<tr>
<td>:PATH</td>
<td></td>
</tr>
<tr>
<td>CALCulate{5</td>
<td>6}</td>
</tr>
<tr>
<td>:MATH</td>
<td></td>
</tr>
<tr>
<td>:STATE</td>
<td>&lt;Boolean&gt;</td>
</tr>
</tbody>
</table>
LCR Meter Command Reference

: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 | IMAGinary | MLINear | PHASE | CP | CS |
| Real part of impedance (R) | Imaginary part of impedance (X) | Absolute value of impedance | Phase of Impedance | Equivalent parallel capacitance | Equivalent series capacitance |
| LP | LS | D | Q | RP |
| Equivalent parallel inductance | Equivalent series inductance | Dissipation factor | Quality factor (an inverse value of D) | Equivalent parallel resistance |

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 SENSE:FUNCTION 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 SENSE:FUNCTION.

- When setting the CALC{1|2|3|4}:FORM command, if the current setting of the SENSE:FUNCTION 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:ON² | CALC1|3:FORM | CALC2|4:FORM |
|------------------------|----------------|-------|--------|--------|
| Z-θ                    | "FIMPedance"   |       |        |        |
| R-X                    | MLINEar       | REAL  | PHASE | IMAGinary |
| Y-θ                    | "FADMittance" |       |        |        |
| G-B                    | MLINEar       | REAL  | PHASE | IMAGinary |
| CP-D                   | "FADMittance" |       |        |        |
| CP-Q                   | CP             | D     | Q     | REAL RP|
| CP-G                   |                |       |        |        |
| CP-RP                  | "FIMPedance"  |       |        |        |
| CS-D                   | CS             | D     | Q     | REAL  |
| CS-Q                   |                |       |        |        |
| CS-Rs                  | "FADMittance" |       |        |        |
| LP-D                   | LP             | D     | Q     | REAL RP|
| LP-Q                   |                |       |        |        |
| LP-G                   |                |       |        |        |
| LP-Rp                  | "FIMPedance"  |       |        |        |
| LS-D                   | LS             | D     | Q     | REAL  |
| LS-Q                   |                |       |        |        |
| LS-Rs                  |                |       |        |        |

1 The SENS:FUNC: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.
LCR Meter Command Reference

: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 VMON. 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.

<table>
<thead>
<tr>
<th>COMMAND</th>
<th>PARAMETER</th>
</tr>
</thead>
<tbody>
<tr>
<td>[:DATA]</td>
<td>{REF1</td>
</tr>
<tr>
<td>[:DATA]?</td>
<td>{BUF1</td>
</tr>
<tr>
<td>POINTs</td>
<td>&lt;value&gt;</td>
</tr>
<tr>
<td>FEED</td>
<td></td>
</tr>
<tr>
<td>:CONTROL</td>
<td>{ALWAYS</td>
</tr>
</tbody>
</table>

:**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]? {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.

<table>
<thead>
<tr>
<th>COMMAND</th>
<th>PARAMETER</th>
</tr>
</thead>
<tbody>
<tr>
<td>DISPlay [:WINDow] [:STATe]</td>
<td>&lt;Boolean&gt;</td>
</tr>
<tr>
<td>:TEXT [:STATe]</td>
<td>&lt;Boolean&gt;</td>
</tr>
<tr>
<td>:TEXT1 :DIGit</td>
<td>{3 4 5}</td>
</tr>
<tr>
<td>:TEXT2 :PAGE</td>
<td>{1 2 3 4 5 6 7 8 9 10 11}</td>
</tr>
</tbody>
</table>

**: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>,[<comp>]

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

<table>
<thead>
<tr>
<th>COMMAND</th>
<th>PARAMETER</th>
</tr>
</thead>
<tbody>
<tr>
<td>:FORMat[:DATA]</td>
<td>{ASCII</td>
</tr>
</tbody>
</table>

: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.

<table>
<thead>
<tr>
<th>COMMAND</th>
<th>PARAMETER</th>
</tr>
</thead>
<tbody>
<tr>
<td>INITiate</td>
<td></td>
</tr>
<tr>
<td>:CONTinous</td>
<td>&lt;Boolean&gt;</td>
</tr>
<tr>
<td>[:IMMediate]</td>
<td></td>
</tr>
</tbody>
</table>

**: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:CONTinous is set to ON, an :INITiate:IMMediate command has no effect on the trigger system ad an error -213 is generated.

**:INITiate:CONTinous {ON|OFF|1|0}**

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

- OFFor0: Does not initiate the trigger system continuously.
- ONor1: Initiates the trigger system continuously.

Query response is 0 or 1.
SENSe Subsystem

<table>
<thead>
<tr>
<th>COMMAND</th>
<th>PARAMETER</th>
</tr>
</thead>
<tbody>
<tr>
<td>[:SENSe]</td>
<td></td>
</tr>
<tr>
<td>:AVERAGE</td>
<td>&lt;value&gt;</td>
</tr>
<tr>
<td>:COUNT&lt;value&gt;</td>
<td></td>
</tr>
<tr>
<td>[:STATe]</td>
<td>&lt;Boolean&gt;</td>
</tr>
<tr>
<td>[:CORRection{1</td>
<td>2}]</td>
</tr>
<tr>
<td>:CIK</td>
<td></td>
</tr>
<tr>
<td>[:STANDard{1</td>
<td>2</td>
</tr>
<tr>
<td>:COLLeCT&lt;value&gt;</td>
<td></td>
</tr>
<tr>
<td>[:ACQuire]</td>
<td>STANDard{1</td>
</tr>
<tr>
<td>:CORRection</td>
<td></td>
</tr>
<tr>
<td>:DATA&lt;value&gt;</td>
<td></td>
</tr>
<tr>
<td>:FIMPedance</td>
<td>{Short</td>
</tr>
<tr>
<td>:APerture&lt;sensor_function&gt;</td>
<td></td>
</tr>
<tr>
<td>:FUNCtion&lt;sensor_function&gt;</td>
<td></td>
</tr>
<tr>
<td>[:SENSe]:AVERAGE:COUNt&lt;value&gt;</td>
<td>Sets or queries the averaging rate.</td>
</tr>
<tr>
<td></td>
<td>&lt;value&gt; is,</td>
</tr>
<tr>
<td>numeric</td>
<td>1 to 256</td>
</tr>
<tr>
<td>MINimum</td>
<td>1</td>
</tr>
<tr>
<td>MAXimum</td>
<td>256</td>
</tr>
<tr>
<td>Query response is a numeric value in &lt;NR1&gt; format.</td>
<td></td>
</tr>
<tr>
<td>[:SENSe]:AVERAGE:STATe&lt;ON</td>
<td>OFF</td>
</tr>
<tr>
<td>OFF or 0</td>
<td>Disables averaging.</td>
</tr>
<tr>
<td>ON or 1</td>
<td>Enables averaging.</td>
</tr>
<tr>
<td>Query response is 0 or 1.</td>
<td></td>
</tr>
<tr>
<td>[:SENSe]:CORRection{1</td>
<td>2}:CIK:STANDard{1</td>
</tr>
<tr>
<td></td>
<td>Sets or queries the standard values for calibration and fixture compensation.</td>
</tr>
<tr>
<td>CORRection1</td>
<td>Calibration standard value</td>
</tr>
<tr>
<td>CORRection2</td>
<td>Fixture compensation standard value</td>
</tr>
<tr>
<td>STANDard1</td>
<td>OPEN</td>
</tr>
<tr>
<td>STANDard2</td>
<td>SHORT</td>
</tr>
<tr>
<td>STANDard3</td>
<td>LOAD</td>
</tr>
</tbody>
</table>

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Table 5-10.
Standard Values for Calibration and Fixture Compensation

<table>
<thead>
<tr>
<th>&lt;value1&gt;</th>
<th>&lt;value2&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>STANdard1 (OPEN)</td>
<td>G0 C0</td>
</tr>
<tr>
<td>STANdard2 (SHORT)</td>
<td>R0 L0</td>
</tr>
<tr>
<td>STANdard3 (LOAD)</td>
<td>R0 L0</td>
</tr>
</tbody>
</table>

[: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[:STANte] ON, which enables the correction function.

[:SENSe]:CORRection:DATA?

Returns the correction data. (Query Only)

```
10 DIM B$(10401)
20 print "--- qry CALDATA? ---"
30 OUTPUT 717;"CALDATA?"
40 ! OUTPUT 717;":SENSe:CORR:DATA?" ! for LCR mode
100 ! ------------------------------
110 ENTER 717 USING ",10401A";B$
120 ! ------------------------------
130 pause
140 print "--- set CALDATA ---"
150 output 717 USING ",K:";CALDATA ";B$
160 end
```

Figure 5-2. Correction Data

[:SENSe]:FIMPedance:APERture {Short|Med|Long}

Sets or queries measurement time mode: Short, Medium, or Long.

[:SENSe]:FUNCTION[:ON] <sensor_function>

Sets the specified measurement function ON. Or, queries which measurement function is ON.

Please refer to Table 5-9 of the “CALCulate Subsystem” regarding the selection of measurement parameters.
Query response is {"FADM"|"FIMP"}. 
## LCR Meter Command Reference

### SOURce Subsystem

<table>
<thead>
<tr>
<th>COMMAND</th>
<th>PARAMETER</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOURce</td>
<td></td>
</tr>
<tr>
<td>:FREQuency</td>
<td>&lt;value&gt;[HZ</td>
</tr>
<tr>
<td>[:CW]</td>
<td></td>
</tr>
<tr>
<td>:VOLTage</td>
<td></td>
</tr>
<tr>
<td>[:LEVEL]</td>
<td></td>
</tr>
<tr>
<td>[:MIMMEDIATE]</td>
<td>&lt;value&gt;</td>
</tr>
<tr>
<td>[:AMPLitude]</td>
<td>[MW</td>
</tr>
</tbody>
</table>

**: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][:MIMMEDIATE][: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").

<table>
<thead>
<tr>
<th>COMMAND</th>
<th>PARAMETER</th>
</tr>
</thead>
<tbody>
<tr>
<td>STATus :OPERation</td>
<td></td>
</tr>
<tr>
<td>:CONDition?</td>
<td></td>
</tr>
<tr>
<td>:ENABLE</td>
<td>&lt;value&gt;</td>
</tr>
<tr>
<td>[:EVENT]?</td>
<td></td>
</tr>
<tr>
<td>:PRESet</td>
<td></td>
</tr>
<tr>
<td>:QUESTionable</td>
<td></td>
</tr>
<tr>
<td>:CONDition?</td>
<td></td>
</tr>
<tr>
<td>:ENABLE</td>
<td>&lt;value&gt;</td>
</tr>
<tr>
<td>[:EVENT]?</td>
<td></td>
</tr>
</tbody>
</table>

**: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)
LCR Meter Command Reference

: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.

<table>
<thead>
<tr>
<th>COMMAND</th>
<th>PARAMETER</th>
</tr>
</thead>
<tbody>
<tr>
<td>SYSTem</td>
<td></td>
</tr>
<tr>
<td>:BEEPer</td>
<td></td>
</tr>
<tr>
<td>[:IMMediate]</td>
<td></td>
</tr>
<tr>
<td>:STATe</td>
<td>&lt;Boolean&gt;</td>
</tr>
<tr>
<td>:ERRor?</td>
<td></td>
</tr>
<tr>
<td>:KLOCK</td>
<td>&lt;Boolean&gt;</td>
</tr>
<tr>
<td>:PRESet</td>
<td></td>
</tr>
<tr>
<td>:VERSion?</td>
<td></td>
</tr>
</tbody>
</table>

**:SYSTem:BEEPer[:IMMediate]**

Produces a beep immediately. (no query)

**:SYSTem:BEEPer:STATe {ON|OFF|1|0}**

Sets or queries if the beeper is enabled.

- ON or 1 Enables the beeper.
- OFF or 0 Disables all beeper functions, including the error beep.

Query response is 0 or 1.

**:SYSTem:ERRor?**

Return the number and message of existing error in the HP E4916A's error queue. (Query only)

**:SYSTem:KLOCK {ON|OFF|1|0}**

Sets or queries whether the front-panel keys of the HP E4916A are locked,

- ON or 1 Locks the front-panel keys.
- OFF or 0 Does not lock the front-panel keys.

Query response is 0 or 1.

**:SYSTem:PRESet**

Reset the HP E4916A to the default state. (no query)

The reset state is as follows.

- Test signal frequency : 10 MHz
- Measurement parameter : Z-θz,R-X
- Deviation measurement : OFF
- Measurement time : MED
- Averaging rate : 1
- Trigger mode : Internal
- Trigger delay time : 0 ms
- Comparator ON/OFF state : OFF
- Fixture Compensation : Clear
- Display mode : Measure Display
- Beep mode : PASS
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,

<table>
<thead>
<tr>
<th>YYYY</th>
<th>Year-version</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>Revision number for the year</td>
</tr>
</tbody>
</table>
**TRIGger subsystem**  
The TRIGger subsystem controls the measurement trigger functions.

<table>
<thead>
<tr>
<th>COMMAND</th>
<th>PARAMETER</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRIGger</td>
<td></td>
</tr>
<tr>
<td>:DELay</td>
<td>&lt;value&gt;[MS</td>
</tr>
<tr>
<td>[:IMMediated]</td>
<td></td>
</tr>
<tr>
<td>:SOURce</td>
<td>{BUS</td>
</tr>
</tbody>
</table>

**: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.

<table>
<thead>
<tr>
<th>COMMAND</th>
<th>PARAMETER</th>
</tr>
</thead>
<tbody>
<tr>
<td>CALCulate</td>
<td></td>
</tr>
<tr>
<td>:COMParator</td>
<td></td>
</tr>
<tr>
<td>[:STATE]</td>
<td>&lt;Boolean&gt;</td>
</tr>
<tr>
<td>:MODE</td>
<td>{ABSTOL</td>
</tr>
<tr>
<td>:TOLERance</td>
<td></td>
</tr>
<tr>
<td>:NOMinal</td>
<td>&lt;value&gt;</td>
</tr>
<tr>
<td>:BIN&lt;n&gt;</td>
<td>&lt;low limit&gt;, &lt;high limit&gt;</td>
</tr>
<tr>
<td>:SUquence</td>
<td></td>
</tr>
<tr>
<td>:BIN</td>
<td>&lt;BIN1 low limit&gt;, &lt;BIN1 high limit&gt;, &lt;BIN2 high limit&gt;, &lt;BIN3 high limit&gt;, ... &lt;BINn high limit&gt;</td>
</tr>
<tr>
<td>:SECONDary</td>
<td></td>
</tr>
<tr>
<td>:STATE</td>
<td>&lt;Boolean&gt;</td>
</tr>
<tr>
<td>:LIMIT</td>
<td>&lt;low limit&gt;, &lt;high limit&gt;</td>
</tr>
<tr>
<td>:AUXBIN</td>
<td>&lt;Boolean&gt;</td>
</tr>
<tr>
<td>:BIN</td>
<td></td>
</tr>
<tr>
<td>:CLEAR</td>
<td></td>
</tr>
<tr>
<td>:COUNT</td>
<td></td>
</tr>
<tr>
<td>:DATA?</td>
<td></td>
</tr>
<tr>
<td>:CLEAR</td>
<td></td>
</tr>
<tr>
<td>:BEEPer</td>
<td></td>
</tr>
<tr>
<td>:CONDition</td>
<td>{FAIL</td>
</tr>
<tr>
<td>:STATE</td>
<td>&lt;Boolean&gt;</td>
</tr>
</tbody>
</table>

: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])
LCR Meter Command Reference

**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
LCR Meter Command Reference

: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:BEEmer: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.
LCR Meter Command Reference

:CALCulate:COMParator:BEEPer[:STATe] {ON|OFF|1|0}

Turns ON/OFF the beep output of the Comparator function.

ON
Beep will sound under the condition specified by CALCulate:COMParator:BEEPer:CONDition.

OFF
Beep never sound.
Status Reporting System

The HP E4915A/E4916A has status registers that report the system status to the user. The contents of the registers change with a change in the HP E4915A/E4916A status. The user can be informed of the HP E4915A/E4916A status by reading these registers.

This chapter describes the following:

- General status register model
- Organization of the HP E4915A/E4916A's status registers
- Referencing the HP E4915A/E4916A's status registers from HP-IB commands
General Status Register Model

A general analyzer has the status reporting system to inform the user of its status.

Figure 6-1. General Status Register Model

The status reporting system has a hierarchical structure as shown in Figure 6-1. When the system meets a specific condition, the corresponding bit in the event register is set to 1. Therefore, the user can be informed of the system status by monitoring the status of this register.

Similarly, if the content of a bit (any bit indicated by an arrow in Figure 6-1) in the enable register one level above the event register is already 1 when the corresponding bit in the event register is set to 1, then the corresponding summary bit in the status byte register is also set to 1. The status of this status byte register can be checked by serial polling.

If the content of a bit in the service request enable register is already 1 when the corresponding bit in the status byte register is set to 1, then SRQ is asserted. SRQ can be used to inform the controller that
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"). Refer to “Reporting the Instrument Status” for details.

--- Status Summary Messages ---

![Diagram](image_url)

**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

<table>
<thead>
<tr>
<th>Bit No.</th>
<th>Bit Weight</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>128</td>
<td>Operation Status Register Summary Bit</td>
</tr>
<tr>
<td>6</td>
<td>64</td>
<td>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. SP0LL resets this bit.</td>
</tr>
<tr>
<td>5</td>
<td>32</td>
<td>Standard Event Status Register Summary Bit</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
<td>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.</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>Questionable Status Register Summary Bit.</td>
</tr>
<tr>
<td>2~0</td>
<td></td>
<td>Always 0 (zero)</td>
</tr>
</tbody>
</table>

Standard Event Status Register

The Standard Event Status Register is frequently used and is one of the simplest. You can program it using HP-IB common commands, *ESE and *ESR?. Refer to *ESE command and *ESR? command in “Command Reference” in Chapter 5.
Figure 6-3. Standard Event Status Register

Table 6-2. Standard Event Status Register Assignments

<table>
<thead>
<tr>
<th>Bit No.</th>
<th>Bit Weight</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>128</td>
<td>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. Always 0 (zero)</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>Command Error Bit — This bit is set if the following command errors occur. • An IEEE 488.2 syntax error occurred. • The HP E4915A/E4916A received a Group Execute Trigger (GET)</td>
</tr>
<tr>
<td>5</td>
<td>32</td>
<td>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.</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
<td>Device-Dependent Error Bit — This bit is set when so many errors have occurred that the error queue is full.</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>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.</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>Operation Complete Bit — This bit is set when the HP E4915A/E4916A has completed all selected pending operations before sending the *OPE command. Always 0 (zero)</td>
</tr>
</tbody>
</table>
Standard Operation Status Group

The HP E4915A/E4916A provides two Standard Operation Status group — Operation Status Register group and Questionable Status Register group — which can be accessed using the STATus subsystem commands. (Refer to STATus subsystem in “HP-IB Commands”. ) The individual bit assignment of these registers are given in “Operation Status Register” and “Questionable Status Register” later in this section.

Each group includes a condition register an event register, and an enable register. (Illustrated in Figure 6-4.)

The condition register reflects the internal states of the HP E4915A/E4916A. So each time the HP E4915A/E4916A’s condition is changed, its condition bit is changed from “0” to “1”, or from “1” to “0”.

The event register’s bits correspond to the register’s bits. A transition filter reports an event to the event register, when a condition register bit changes from “1” to “0” for all bits except for bit no. 8 and 9. For bit no’s 8 and 9, when a condition register bit changes from “0” to “1”.

The enable register enable the corresponding bit in the event register to set the status summary bit, bit 7 or bit 3, of the Status Byte Register.

Figure 6-4. Standard Operation Status Group Structure
# Operation Status Register

The Operational Status Register group provides information about the state of the HP E4915A/E4916A measurement system.

## Table 6-3. Operation Status Condition Register Assignments

<table>
<thead>
<tr>
<th>Bit No.</th>
<th>Bit Weight</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>9~15</td>
<td></td>
<td>Always 0 (zero)</td>
</tr>
<tr>
<td>8</td>
<td>256</td>
<td>Buffer full.</td>
</tr>
<tr>
<td>7</td>
<td>128</td>
<td>Correcting — This bit is set when the correction data measurement is in progress.</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>Always 0 (zero)</td>
</tr>
<tr>
<td>5</td>
<td>32</td>
<td>Waiting for Trigger — This bit is set when the HP E4915A/E4916A can accept a trigger.</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
<td>Measuring — This bit is set when the HP E4915A/E4916A is actively measuring.</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>Sweeping — This bit is set when the HP E4915A/E4916A is sweeping (applicable only to DLD and EM modes).</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>Ranging — This bit is set when the HP E4915A/E4916A is currently changing its range.</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>Settling — The HP E4915A/E4916A is waiting for signals it controls to stabilize enough to begin a measurement.</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>Calibrating</td>
</tr>
</tbody>
</table>

## Table 6-4. Operation Status Event Register Assignments

<table>
<thead>
<tr>
<th>Bit No.</th>
<th>Bit Weight</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-15</td>
<td></td>
<td>Always 0 (zero)</td>
</tr>
<tr>
<td>9</td>
<td>512</td>
<td>This bit is set when the BUF2 has become full.</td>
</tr>
<tr>
<td>8</td>
<td>256</td>
<td>This bit is set when the BUF1 has become full.</td>
</tr>
<tr>
<td>7</td>
<td>128</td>
<td>This bit is set when the correction data measurement has completed.</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>Always 0 (zero)</td>
</tr>
<tr>
<td>5</td>
<td>32</td>
<td>This bit is set when the HP E4915A/E4916A has become able to accept a trigger.</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
<td>This bit is set when the measurement has completed.</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>Always 0 (zero)</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>This bit is set when the ranging has completed.</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>This bit is set when the settling has completed.</td>
</tr>
<tr>
<td>0</td>
<td></td>
<td>Always 0 (zero)</td>
</tr>
</tbody>
</table>

6-8 Status Reporting System
LCR Meter Command Reference

Questionable Status Register

The Questionable Status register group provides information on the quality of the output and measurement data of the HP E4915A/E4916A.

Table 6-5. Questionable Status Register Assignments

<table>
<thead>
<tr>
<th>Bit No.</th>
<th>Bit Weight</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>15~10</td>
<td></td>
<td>Always 0 (zero)</td>
</tr>
<tr>
<td>9</td>
<td>512</td>
<td>Search Event Status Bit Summary bit.(a 0 to 1 transition)</td>
</tr>
<tr>
<td>8~0</td>
<td></td>
<td>Always 0 (zero)</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Bit No.</th>
<th>Bit Weight</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>15~1</td>
<td></td>
<td>Always 0 (zero)</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>Search target not found.(a 0 to 1 transition)</td>
</tr>
</tbody>
</table>
Referencing and Setting Status Registers

Reporting the Instrument Status

You can use the following commands to have the HP E4915A/E4916A report its own status:

- *CLS
- *ESE
- *ESR?
- *SRE
- *STB?
- OSER?
- OSR?
- OSE
- QSER?
- QSR?
- QSE
- HP BASIC SPOLL command

The following example generates a service request whenever an error is queued:

```
OUTPUT 717;"*ESE 52; *SRE 32"
```

The following example detects the completion of a measurement cycle:

```
OUTPUT 717;"OSE 16"
REPEAT
A=SPOLL(717)
UNTIL BIT(A,7)
```

Enable Measuring bit of Operation Status Register
Wait until the Operation Status Register Summary
bit is set
The following example generates an interrupt when an error occurs in the HP E4915A/E4916A:

```
: DIM Err$[50]
! :
OUTPUT 717;"*CLS"
OUTPUT 717;"*ESE 48"
OUTPUT 717;"*SRE 32"
!
ON INTR 7 GOSUB Err_report
ENABLE INTR 7;2
!
:
LOOP
:
END LOOP
STOP
!
Err_report;;
Stat=SPOLL(717)
OUTPUT 717;"*ESR?"

ENTER 717;Estat
PRINT "Syntax Error detected."
!
OUTPUT 717;"SYST:ERR?"
ENTER 717;Err,Err$
PRINT Err,Err$
!
*CLS
ENABLE INTR 7
RETURN
END
```

**Clears status byte register**

**Sets Command Error Bit and Execution Error Bit**

**Sets Standard Event Status register Summary Bit**

**Tells where to branch when interrupted**

**Enables an interrupt from HP-IB interface**

**Clear the SRQ Bit**

**Queries the contents of the Standard Event Status Register**

**Requests for output of error number and message**
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.

![Diagram of data transfer methods](image)

**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 CE4915;"FORM ASC"    Specify the ASCII format.
OUTPUT CE4915;"*TRG"        Trigger and query the data traces.
ENTER CE4915;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.

![Diagram of 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.

![Diagram of Binary Data Header]
Getting Data from Analyzer

To get 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 @D1 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 @D1: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

---

74  Data Transfer Methods
Sample Program

This chapter provides sample programs to control HP E4915A/E4916A from an external controller via HP-IB. All programs are written by HP BASIC.

Calibration

1000 ! ### SAMPLE PROGRAM for Calibration ###
1010 ! Please take care to set Meas.FUNCTION before calibrate!
1020 !
1021 ASSIGN @E4916 TO 717
1030 ! STANDARD CAL VALUE FOR 41902A
1040 OUTPUT @E4916;:"CALSTD OPEN,C0,0.1E-12"
1050 OUTPUT @E4916;:"CALSTD OPEN,GO,0.0"
1060 OUTPUT @E4916;:"CALSTD SHORT,R0,0.1E-6"
1070 OUTPUT @E4916;:"CALSTD SHORT,LO,3.0E-9"
1080 OUTPUT @E4916;:"CALSTD LOAD,RO,50.0"
1090 OUTPUT @E4916;:"CALSTD LOAD,LO,18.8E-9"
1100 !
1110 BEEP
1120 DISP "Remove device for OPEN calibration, then press continue"
1130 PAUSE
1140 DISP "Measuring"
1150 OUTPUT @E4916;:"CAL OPEN"
1160 OUTPUT @E4916;:"#OPC?"
1170 ENTER @E4916;Dummy
1180 !
1190 BEEP
1200 DISP "Connect short plate for short calibration, then press continue"
1210 PAUSE
1220 DISP "Measuring"
1230 OUTPUT @E4916;:"CAL SHORT"
1240 OUTPUT @E4916;:"#OPC?"
1250 ENTER @E4916;Dummy
1260 !
1270 BEEP
1280 DISP "Connect 50 ohm for load calibration, then press continue"
1290 PAUSE
1300 DISP "Measuring"
1310 OUTPUT @E4916;:"CAL LOAD"
1320 OUTPUT @E4916;:"#OPC?"
1330 ENTER @E4916;Dummy
1340 !
1350 END
Fixture Compensation

1000 ! ### SAMPLE PROGRAM for Compensation ###
1010 !
1020 ASSIGN &E4916 TO 717
1030 BEEP
1040 DISP "Remove device for OPEN compensation, then press continue"
1050 PAUSE
1060 DISP "Measuring OPEN"
1070 OUTPUT &E4916;";COMPEN OPEN"
1080 OUTPUT &E4916;&*OPC?"
1090 ENTER &E4916;Dummy
1100 !
1110 BEEP
1120 DISP "Connect short plate for short compensation, then press continue"
1130 PAUSE
1140 DISP "Measuring SHORT"
1150 OUTPUT &E4916;";COMPEN SHORT"
1160 OUTPUT &E4916;&*OPC?"
1170 ENTER &E4916;Dummy
1180 !
1190 END

Comparater Function

Comparater Function of LCR measurement mode

1000 ! ### COMPARATOR/YTolerance 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 ! MEASUREMENT 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 !

8-2 Sample Program
Comparator Function of X'tal measurement mode

Sequential Mode

1000 ! ### COMPARATOR(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.OMHZ"
1150 OUTPUT @E4916;".COMPTOLSTD 80.OMA"
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;":COMPLIM BIN1,78.0MA,79.0MA"
1280 !  78.0 <= VALUE <=79.0
1290  OUTPUT @E4916;":COMPLIM BIN2,79.0MA,80.0MA"
1300 !  79.0 < VALUE <=80.0
1310  OUTPUT @E4916;":COMPLIM BIN3,80.0MA,81.0MA"
1320 !  80.0 < VALUE <=81.0
1330  OUTPUT @E4916;":COMPLIM BIN4,81.0MA,82.0MA"
1340 !  81.0 < VALUE <=82.0
1350  OUTPUT @E4916;":COMPLIM 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;":COMPLIM? 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 ! ### COMPARATOR(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;":COMPICLE"
1110  OUTPUT @E4916;":BINCTCLE"
1120 !
1130 ! MEASUREMENT 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;":COMPLIM BIN1,-1.0MA,1.0MA"
1280 ! -1MHz <= VALUE <= +1MHz
1290 OUTPUT @E4916;"::COMPPLIM BINO,-2.0MA,2.0MA"
1300 ! -2MHz <= VALUE <= +2MHz
1310 OUTPUT @E4916;"::COMPPLIM BIN2,-3.0MA,3.0MA"
1320 ! -3MHz <= VALUE <= +3MHz
1330 OUTPUT @E4916;"::COMPPLIM BIN3,-4.0MA,4.0MA"
1340 ! -4MHz <= VALUE <= +4MHz
1350 OUTPUT @E4916;"::COMPPLIM BIN4,-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 ! ### COMPARATOR(% tolerence for Xtal) Sample Program ###
1010 ! This program is only doing setting
1020 !
1030 ASSIGN @E4916 TO 717
1040 GOSUB Comp_set
1050 GOTO 1480
1060 Comp_set: !
1070 ! INITIALIZE
1080 OUTPUT @E4916;"::PRES"
1090 OUTPUT @E4916;"::MEASF Xtal"
1100 OUTPUT @E4916;"::COMPCLE"
1110 OUTPUT @E4916;"::BINCNTCLE"
1120 !
1130 ! MEASUREMENT VALUE
1140 OUTPUT @E4916;"::COPMSTAT ON"
1150 OUTPUT @E4916;"::COMPPRM PCNTTOL"
1160 OUTPUT @E4916;"::NONE 80.0MHz"
1170 OUTPUT @E4916;"::COMPORTSTD 80.0MA"
1180 ! MA:MEGA ,M:MILI
1190 !
1200 ! BEEP & LED CONFIGURATION
1210 OUTPUT @E4916;"::COMPBEEP ON"
1220 OUTPUT @E4916;"::COMPBEEP FAIl"
1230 OUTPUT @E4916;"::COMPLED ON"
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%
DLD Measurement and Equivalent Circuit

1000 ! ### Sample Program for DLD and Xtal Measurement ###
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_query(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;:"SRTCIR PHASE"
1510 OUTPUT @E4916;:"TGTDPHASE 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 XTL"
1750 OUTPUT @E4916;:"MEASPARA FR"
1760 OUTPUT @E4916;:"NOMF ";F_nominal:"MHZ"
1770 OUTPUT @E4916;:"SRCHR ";F_range:"PPM"
1780 OUTPUT @E4916;:"SRTCIR PHASE"
1790 OUTPUT @E4916;:"TGTDPHASE 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 Ptlsze
2100 OUTPUT @E4916;"PTLSIZE ";Ptlsze
2110 !
2120 FOR I=1 TO Ptlsze
2130 READ Ptlst(I,1),Ptlst(I,2),Ptlst(I,3)
2140 OUTPUT @E4916;"PTLIST ";Ptlst(I,1),Ptlst(I,2);"UW",;Ptlst(I,3)
2150 NEXT I
2160 !
2170 OUTPUT @E4916;"MEMSIZE ";Ptlsze
2180 !
2190 FOR I=1 TO Ptlsze
2200 OUTPUT @E4916;"PTLST?";I
2210 ENTER @E4916;Ptlst_query(I,1),Ptlst_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,C0,0.0"
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 calibration, 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 "CONNECT 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;Bufdata(B*)
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
! 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;Measdata(*)
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 : ";Measdata(1)/1.E+6;" [MHz]"
3380 PRINT USING "5A,7X,3D.2D,6A";"CI : ";Measdata(3);" [ohm]"
3390 PRINT USING "5A,7X,3D.2D,6A";"CO : ";Measdata(6)/1.E-12;" [pF]"
3400 PRINT USING "5A,4X,3D.5D,6A";"CI : ";Measdata(7)/1.E-12;" [pF]"
3410 PRINT USING "5A,4X,6D.2D,6A";"L1 : ";Measdata(8)/1.E-6;" [uh]"
3420 PRINT USING "5A,7X,3D.2D,6A";"R1 : ";Measdata(9);" [ohm]"
3430 PRINT USING "5A,6X,7D";"Q : ";Measdata(4)
3440 RETURN
3450 !
3460 Err_report: ! *****************************************************************************
3470 !
3480 Stat=SPOLL(@E4916)
3490 OUTPUT @E4916;"*ESR?"
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;":INICONT 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;:"EMOUT 10S"
1450 OUTPUT @E4916;:"EMOE 0N,";DVAL("010101010101",2)
1460 OUTPUT @E4916;:"EMCM 0N,";DVAL("110000000011",2)
1470 OUTPUT @E4916;:"DISPSTAT OFF"
1480 ! EM List Table
1490 Size=7
1500 OUTPUT @E4916;:"EMLSIZE ",Size
1510 OUTPUT @E4916;:"EMLIST 1,10.00100000MHz,0.0,0N,";DVAL("011111111110",2)
1520 OUTPUT @E4916;:"EMLIST 2,10.00080000MHz,0.0,0N,";DVAL("101111111101",2)
1530 OUTPUT @E4916;:"EMLIST 3,10.00050000MHz,0.0,0N,";DVAL("110111111011",2)
1540 OUTPUT @E4916;:"EMLIST 4,10.00035000MHz,0.0,0N,";DVAL("111011111011",2)
1550 OUTPUT @E4916;:"EMLIST 5,10.00020000MHz,0.0,0N,";DVAL("111101110111",2)
1560 OUTPUT @E4916;:"EMLIST 6,10.00005000MHz,0.0,0N,";DVAL("111100111111",2)
1570 OUTPUT @E4916;:"EMLIST 7,09.99995000MHz,0.0,0N,";DVAL("111101011111",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;:"SRC 1000PPM"
1680 OUTPUT @E4916;:"POWER ";Power;"W"
1690 OUTPUT @E4916;:"MEASPARA FR"
1700 OUTPUT @E4916;:"SRC HTG PHASE"
1710 OUTPUT @E4916;:"TGT PHASE 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;:"TRIG SOUR BUS"
1880 OUTPUT @E4916;:"TRIG IMM"
1890 OUTPUT @E4916;:"*OPC?"
1900 ENTER @E4916; Dummy
1910 !
1920 OUTPUT @E4916;:"MEM READ?"
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,CO,0.0"
2320 OUTPUT @E4916:"CALSTD SHORT,R0,0.1E-6"
2330 OUTPUT @E4916:"CALSTD SHORT,LO,3.0E-9"
2340 OUTPUT @E4916:"CALSTD LOAD,R0,50.0"
2350 OUTPUT @E4916:"CALSTD LOAD,LO,18.8E-9"
2360 !
2370 BEEP
2380 DISP "Remove device for OPEN calibration, then press continue"
2390 PAUSE
2400 DISP "Measuring"
2410 OUTPUT @E4916:"CAL OPEN"
2420 OUTPUT @E4916:"*OPC?"
2430 ENTER @E4916;Dummy
2440 !
2450 BEEP
2460 DISP "Connect short plate for short calibration, then press continue"
2470 PAUSE
2480 DISP "Measuring"
2490 OUTPUT @E4916:"CAL SHORT"
2500  OUTPUT @E4916;"*0PC?"
2510  ENTER @E4916;Dummy
2520  !
2530  BEEP
2540  DISP "Connect 50 ohm for load calibration, then press continue"
2550  PAUSE
2560  DISP "Measuring"
2570  OUTPUT @E4916;":CAL LOAD"
2580  OUTPUT @E4916;"*0PC?"
2590  ENTER @E4916;Dummy
2600  !
2610  DISP "CONNECT 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 Measurement 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;":COMPPEN 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 "IMPEANCE [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? BUFI"
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$(50)
1040 OUTPUT 717;'*CLS''
1050 OUTPUT 717;'*ESE 48''
1060 OUTPUT 717;'*SRE 40''
1070 OUTPUT 717;'*SIE 1''
1080 OUTPUT 717;'*QSE 512''
1090 ON INTR 7 GOSUB Err_report
1100 ENABLE INTR 7;2
1110 !
1120 STOP
1130 !
1140 Err_report: !
1150 Stat=SPOLL(717)
1160 OUTPUT 717;'*ESR?'
1170 ENTER 717;Estat
1180 PRINT "SYNTAX ERROR DETECTED."
1190 !
1200 OUTPUT 717;'*ERR?'
1210 ENTER 717;Err,Err$
1220 PRINT Err,Err$
1230 !
1240 ENABLE INTR 7
1250 RETURN
1260 END

Tips of Programming

This section provides sample programs to perform specific tasks. For more information on each HP-IB command, refer Chapter 5.

Basic Setting

ASSIGN @E4916 TO 717 Set address to 717
OUTPUT @E4916;".PRES"
OUTPUT @E4916;".MEASF XTAL" X'tal mode
OUTPUT @E4916;".NMIF 80MHZ" meas. freq. 80 MHz
OUTPUT @E4916;".TRIGERSOUR INIT" TRIG mode:INIT

Measurement Setup

Nominal Frequency

OUTPUT 717;".NMIF 20MHZ"

Test Signal Level

OUTPUT 717;".POW 1UW"
Measurement Time
  OUTPUT 717;".MEASTIME 2"

Averaging (LCR only)
  :SENSe:AVERage:COUN 4

Comparator
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;"FETCH?"
  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;"FETCH?"
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;"FETCH?"
ENTER 717;S,D1,D2
PRINT S,D1,D2
A=SPOLL(717)
OUTPUT 717;".0SR?"
ENTER 717;A
ENABLE INTR 7;2
RETURN

SCPI Command "TRG"

OUTPUT 717;".TRIGSOURCE BUS"
OUTPUT 717;"*TRG"
ENTER 717;S,D1,D2

Any trigger source

OUTPUT 717;".TRIG"
OUTPUT 717;".FETC?"
ENTER 717;S,D1,D2
Specifications

These specifications are the performance standards or limits against which the instrument is tested. When shipped from the factory, the HP E4915A/E4916A meet the specifications listed in this section.

Specifications describe the instrument’s warranted performance over the temperature range of 0°C to 55°C (except as noted). Supplemental characteristics are intended to provide information that is useful in applying the instrument by giving non-warranted performance parameters. These are denoted as $SPC, typical, typically, nominal$ or $approximate$.

Warm up time must be greater than or equal to 10 minutes after power on for all specifications.

Measurement Parameters

HP E4915A/HP E4916A Common

X'tal mode

Fr, Fs, Fa, FL, CI, Q, C0, C1, L1, R1, G0, R0

Spurious mode

Spurious frequency, Spurious impedance value

CL measurement

CL

HP E4916A only

DLD mode

Maximum/Minimum frequency, Maximum/Minimum CI value, difference of maximum and minimum frequency, Difference of maximum and minimum CI values

EM mode (HP-IB only)

Trap frequency, CI at trap point, Time for trapping

Filter Mode

Insertion loss/constant loss, $\Delta f_{left}$, $\Delta f_{right}$
Source

Frequency Characteristics

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)
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

<table>
<thead>
<tr>
<th>Test channel input level</th>
<th>Dynamic accuracy (SPC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-20 dBm to -30 dBm</td>
<td>±0.4 dB</td>
</tr>
<tr>
<td>-30 dBm to -40 dBm</td>
<td>±0.1 dB</td>
</tr>
<tr>
<td>-40 dBm to -50 dBm</td>
<td>±0.05 dB</td>
</tr>
<tr>
<td>-50 dBm to -60 dBm</td>
<td>±0.05 dB</td>
</tr>
<tr>
<td>-60 dBm to -70 dBm</td>
<td>±0.1 dB</td>
</tr>
<tr>
<td>-70 dBm to -80 dBm</td>
<td>±0.5 dB</td>
</tr>
<tr>
<td>-80 dBm to -90 dBm</td>
<td>±1.0 dB</td>
</tr>
</tbody>
</table>

HP E4916A

<table>
<thead>
<tr>
<th>Test channel input level</th>
<th>Dynamic accuracy (SPC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 dBm to -20 dBm</td>
<td>±0.5 dB</td>
</tr>
<tr>
<td>-20 dBm to -30 dBm</td>
<td>±0.4 dB</td>
</tr>
<tr>
<td>-30 dBm to -40 dBm</td>
<td>±0.1 dB</td>
</tr>
<tr>
<td>-40 dBm to -50 dBm</td>
<td>±0.05 dB</td>
</tr>
<tr>
<td>-50 dBm to -60 dBm</td>
<td>±0.05 dB</td>
</tr>
<tr>
<td>-60 dBm to -70 dBm</td>
<td>±0.1 dB</td>
</tr>
<tr>
<td>-70 dBm to -80 dBm</td>
<td>±0.5 dB</td>
</tr>
<tr>
<td>-80 dBm to -90 dBm</td>
<td>±1.0 dB</td>
</tr>
</tbody>
</table>

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

Stability
@ 23±5 °C .................................. 50 mdB/°C(SCR)

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
<table>
<thead>
<tr>
<th>Test channel input level</th>
<th>Dynamic accuracy (SPC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>−20 dBm to −30 dBm</td>
<td>±3°</td>
</tr>
<tr>
<td>−30 dBm to −40 dBm</td>
<td>±0.6°</td>
</tr>
<tr>
<td>−40 dBm to −50 dBm</td>
<td>±0.3°</td>
</tr>
<tr>
<td>−50 dBm to −60 dBm</td>
<td>±0.6°</td>
</tr>
<tr>
<td>−60 dBm to −70 dBm</td>
<td>±0.3°</td>
</tr>
<tr>
<td>−70 dBm to −80 dBm</td>
<td>±5°</td>
</tr>
<tr>
<td>−80 dBm to −90 dBm</td>
<td>±10°</td>
</tr>
</tbody>
</table>

**HP E4916A**

<table>
<thead>
<tr>
<th>Test channel input level</th>
<th>Dynamic accuracy (SPC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 dBm to −20 dBm</td>
<td>±5°</td>
</tr>
<tr>
<td>−20 dBm to −30 dBm</td>
<td>±3°</td>
</tr>
<tr>
<td>−30 dBm to −40 dBm</td>
<td>±0.6°</td>
</tr>
<tr>
<td>−40 dBm to −50 dBm</td>
<td>±0.3°</td>
</tr>
<tr>
<td>−50 dBm to −60 dBm</td>
<td>±0.6°</td>
</tr>
<tr>
<td>−60 dBm to −70 dBm</td>
<td>±0.3°</td>
</tr>
<tr>
<td>−70 dBm to −80 dBm</td>
<td>±5°</td>
</tr>
<tr>
<td>−80 dBm to −90 dBm</td>
<td>±10°</td>
</tr>
</tbody>
</table>

**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**

<table>
<thead>
<tr>
<th>Range</th>
<th>1 MHz to 180 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resolution</td>
<td>1 mHz</td>
</tr>
</tbody>
</table>

**Measurement parameters**...

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>$</td>
<td>Z</td>
</tr>
</tbody>
</table>

**Measuring range**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>$</td>
<td>Z</td>
</tr>
<tr>
<td>$</td>
<td>Y</td>
</tr>
<tr>
<td>$\theta$</td>
<td>−180° to 180°</td>
</tr>
<tr>
<td>L</td>
<td>1 nH to 1 kH</td>
</tr>
<tr>
<td>C</td>
<td>10 fF to 0.1 F</td>
</tr>
<tr>
<td>D</td>
<td>0.0001 to 10</td>
</tr>
<tr>
<td>Q</td>
<td>0.1 to 10000</td>
</tr>
</tbody>
</table>

**Measurement Resolution**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>$</td>
<td>Z</td>
</tr>
<tr>
<td>$</td>
<td>Y</td>
</tr>
</tbody>
</table>
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+2.5×10−5|Z|+0.1|Y|)×(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 ≤ 40°C, without condensation) . 15% ≤ RH ≤ 95%
Altitude ..................................................... 0 to 2,000 meters
Warm Up Time ............................................. 10 minutes

Non–operating Conditions
Temperature .................................................. −40 to 70 °C
Humidity (at wet bulb ≤ 65°C, without condensation) 15 % ≤ RH ≤ 80 %
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 (1999) 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)
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)

\[ V_{th} \] ................................................... +2 V to +5 V (SPC)
\[ V_{il} \] ...................................................... 0 V to +0.5 V (SPC)
Sink current (Is) .......................................... Is ≤ 0.4 mA (SPC)
Pulse width (Tp) ........................................... Tp ≥ 25.6 μsec (SPC)

ANALOG OUTPUT ........................................... ±5 V (SPC)

Furnished Accessories

<table>
<thead>
<tr>
<th>Accessory</th>
<th>HP part number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two 30 cm BNC leads(^1)</td>
<td>8120-1838</td>
</tr>
<tr>
<td>Two 120 cm BNC leads(^2)</td>
<td>8120-1840</td>
</tr>
<tr>
<td>Operation Manual</td>
<td>E4915-90000</td>
</tr>
<tr>
<td>User’s Guide</td>
<td>E4915-90001</td>
</tr>
<tr>
<td>Sample Program Disk</td>
<td>E4915-61001</td>
</tr>
<tr>
<td>Impedance Probe Kit(^3)</td>
<td>N/A</td>
</tr>
<tr>
<td>Crystal Measurement Software for</td>
<td>N/A</td>
</tr>
<tr>
<td>HP VEZ(^4)</td>
<td></td>
</tr>
<tr>
<td>Rack mount kit(^5)</td>
<td>5063-9241</td>
</tr>
<tr>
<td>Front handle kit(^6)</td>
<td>5063-9226</td>
</tr>
</tbody>
</table>

1 HP E4915A only
2 HP E4916A only
3 Option 001 only
4 Option 020 only
5 Option 1CM only
6 Option 1CN only
Specifications of HP E4916A Option 001 Impedance Probe Specifications

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 (Cl=25 Ω) ................ approximate 5 μW

HP E4916A
with Pi-fixture (Cl=25 Ω)
Power ...................................... 100 pW to 1 mW
Voltage ..................................... 40 μV to 161 mV
Current .................................... 2 μA to 6.4 mA
with Z probe (Cl=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 (Cl=25 Ω)
Voltage ..................................... 0 to 320 mV
Current .................................... 0 to 13 mA
with Z probe (Cl=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**

<table>
<thead>
<tr>
<th></th>
<th>Freq/Xtal</th>
<th>Freq/Xtal (LP)</th>
<th>Aging/DLD</th>
<th>EM</th>
<th>LCR</th>
<th>LCR (LP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short</td>
<td>300 Hz</td>
<td>50 Hz</td>
<td>1 kHz</td>
<td>800 Hz</td>
<td>300 Hz</td>
<td>50 Hz</td>
</tr>
<tr>
<td>Medium</td>
<td>100 Hz</td>
<td>20 Hz</td>
<td>300 Hz</td>
<td>200 Hz</td>
<td>100 Hz</td>
<td>5 Hz</td>
</tr>
<tr>
<td>Long</td>
<td>50 Hz</td>
<td>10 Hz</td>
<td>100 Hz</td>
<td>100 Hz</td>
<td>50 Hz</td>
<td>1 Hz</td>
</tr>
</tbody>
</table>

1 When test signal level is less than –29 dBm

**High Q mode**

<table>
<thead>
<tr>
<th></th>
<th>Freq/Xtal</th>
<th>Freq/Xtal (LP)</th>
<th>Aging/DLD</th>
<th>EM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short</td>
<td>30 Hz</td>
<td>5 Hz</td>
<td>50 Hz</td>
<td>80 Hz</td>
</tr>
<tr>
<td>Medium</td>
<td>20 Hz</td>
<td>3 Hz</td>
<td>20 Hz</td>
<td>50 Hz</td>
</tr>
<tr>
<td>Long</td>
<td>10 Hz</td>
<td>2 Hz</td>
<td>10 Hz</td>
<td>30 Hz</td>
</tr>
</tbody>
</table>

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 $5 \Omega \leq C_1 \leq 125 \Omega$
- Freq frequency ....... $\pm 2$ ppm
- X'tal Impedance .......... $\pm 5\%$

### Measurement Time

**Normal Mode**

<table>
<thead>
<tr>
<th></th>
<th>Freq/Xtal (LP)</th>
<th>Aging/DLD</th>
<th>EM</th>
<th>LCR</th>
<th>LCR (LP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short</td>
<td>125 ms</td>
<td>250 ms</td>
<td>17 ms to 33 ms</td>
<td>4 ms</td>
<td>20 ms</td>
</tr>
<tr>
<td>Medium</td>
<td>280 ms</td>
<td>750 ms</td>
<td>20 ms to 64 ms</td>
<td>5 ms</td>
<td>50 ms</td>
</tr>
<tr>
<td>Long</td>
<td>800 ms</td>
<td>2 s</td>
<td>25 ms to 100 ms</td>
<td>10 ms</td>
<td>200 ms</td>
</tr>
</tbody>
</table>

1 When test signal level is less than –29 dBm

**High Q Mode**

<table>
<thead>
<tr>
<th></th>
<th>Freq/Xtal (LP)</th>
<th>Aging/DLD</th>
<th>EM</th>
<th>LCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short</td>
<td>1.5 s</td>
<td>4.5 s</td>
<td>35 ms to 190 ms</td>
<td>12 ms</td>
</tr>
<tr>
<td>Medium</td>
<td>3 s</td>
<td>8 s</td>
<td>70 ms to 300 ms</td>
<td>20 ms</td>
</tr>
<tr>
<td>Long</td>
<td>8 s</td>
<td>16 s</td>
<td>120 ms to 460 ms</td>
<td>30 ms</td>
</tr>
</tbody>
</table>

1 When test signal level is less than –29 dBm
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>
<thead>
<tr>
<th>Table A-1. Manual Changes by Serial Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serial Prefix or Number</td>
</tr>
<tr>
<td>---------------------------------</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table A-2. Manual Changes by ROM Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>Version</td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
Serial Number

Hewlett-Packard uses a two-part, ten-character serial number that is stamped on the serial number plate (see Figure A-1) attached to the rear panel. The first five characters are the serial prefix and the last five digits are the suffix.

Figure A-1. Serial Number Plate
Valid Ranges and Initial Settings

This appendix lists the valid ranges and initial settings of the parameters specific to various measurement modes and functions.

Note

The tables presented in this appendix use vertical bars (|) and slashes (/) to represent particular conditions:

- Vertical bars (|) are used to separate mutually exclusive options.
- Slashes (/) are used to simply enumerate elements that may or may not be mutually exclusive.
## Crystal Resonator Measurement Mode (Xtl Mode)

<table>
<thead>
<tr>
<th>Function</th>
<th>Valid Range</th>
<th>Preset Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$F_{r}$/$F_{a}$/$F_{s}$/$F_{l}$ (nominal)</td>
<td>1 MHz to 180 MHz</td>
<td>10 MHz</td>
</tr>
<tr>
<td>Search range</td>
<td>1 ppm to 10000 ppm</td>
<td>1000 ppm</td>
</tr>
<tr>
<td>$C$/$Z$ (nominal)</td>
<td>1 Ω to 1 kΩ</td>
<td>25 Ω</td>
</tr>
<tr>
<td>ALC</td>
<td>on/off</td>
<td>off</td>
</tr>
<tr>
<td>Drive level</td>
<td>$-60$ dBm to $18$ dBm</td>
<td>$-5.0$ dBm</td>
</tr>
<tr>
<td>Network Test Fixture</td>
<td>$0.1$ nW to $1$ mW</td>
<td>$5 \mu$W</td>
</tr>
<tr>
<td>Probe,Bridge</td>
<td>$2$ µA to $6.4$ mA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$50$ µV to $160$ mV</td>
<td></td>
</tr>
<tr>
<td>Measuring Time</td>
<td>Short</td>
<td>Med</td>
</tr>
<tr>
<td>High Q mode</td>
<td>on/off</td>
<td>off</td>
</tr>
<tr>
<td>Equivalent circuit analysis</td>
<td>on/off</td>
<td>off</td>
</tr>
<tr>
<td>Parameters displayed $T_{k}$,$Q$</td>
<td>on/off</td>
<td>off</td>
</tr>
<tr>
<td>Search target</td>
<td>Phase</td>
<td>Peak</td>
</tr>
<tr>
<td>Target phase value</td>
<td>$-180$ to $180$</td>
<td>0</td>
</tr>
<tr>
<td>$C_{L}$,actual</td>
<td>No...$C_{L}$</td>
<td>1 to 1000 pF</td>
</tr>
<tr>
<td>$C_{L}$,target</td>
<td>No...$C_{L}$</td>
<td>[$C_{L}$,actual]</td>
</tr>
<tr>
<td>$\Delta$ mode</td>
<td>DEV</td>
<td>[$($PPM$)$%]</td>
</tr>
<tr>
<td>$\Delta$ mode reference value (F)</td>
<td>Nominal value</td>
<td>User-specified value</td>
</tr>
<tr>
<td>$\Delta$ mode reference value (Cl)</td>
<td>Nominal value</td>
<td>User-specified value</td>
</tr>
<tr>
<td>Aging mode</td>
<td>on/off</td>
<td>off</td>
</tr>
<tr>
<td>Aging interval</td>
<td>0 sec to 1 hour</td>
<td>0 sec</td>
</tr>
<tr>
<td>Measured parameters</td>
<td>$F_{r}$</td>
<td>$F_{a}$</td>
</tr>
<tr>
<td>Measurement circuit</td>
<td>$P$</td>
<td>$P$</td>
</tr>
<tr>
<td>Trigger mode</td>
<td>INT</td>
<td>MAN</td>
</tr>
<tr>
<td>Measurement mode</td>
<td>Xtal</td>
<td>Spur</td>
</tr>
</tbody>
</table>
## Spurious Measurement Mode

<table>
<thead>
<tr>
<th>Function</th>
<th>Valid Range</th>
<th>Preset Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spurious measurement mode</td>
<td>on</td>
<td>off</td>
</tr>
<tr>
<td>Center frequency</td>
<td>1 MHz to 180 MHz</td>
<td>10 MHz</td>
</tr>
<tr>
<td>Search range</td>
<td>1 ppm to 100000 ppm</td>
<td>10000 ppm</td>
</tr>
<tr>
<td>Number of spurious points to search for</td>
<td>1 to 10</td>
<td>100 kHz</td>
</tr>
<tr>
<td>Spurious point to be display</td>
<td>Worst</td>
<td>1 to 10</td>
</tr>
<tr>
<td>Search target</td>
<td>Phase</td>
<td>Peak</td>
</tr>
<tr>
<td>Target phase value</td>
<td>−180 to 180 °</td>
<td>0 °</td>
</tr>
<tr>
<td>Trigger mode</td>
<td>INT</td>
<td>MAN</td>
</tr>
<tr>
<td>Measurement mode</td>
<td>Xtal</td>
<td>Spur</td>
</tr>
</tbody>
</table>

## Evaporation Monitor Mode (EM Mode)

<table>
<thead>
<tr>
<th>Function</th>
<th>Valid Range</th>
<th>Preset Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Search frequency type</td>
<td>Fr</td>
<td>Fr</td>
</tr>
<tr>
<td>Drive level</td>
<td>0.1 nW to 1 mW</td>
<td>5 μW</td>
</tr>
<tr>
<td>Unit of drive level</td>
<td>W</td>
<td>A</td>
</tr>
<tr>
<td>ALC</td>
<td>on</td>
<td>off</td>
</tr>
<tr>
<td>CI (nominal)</td>
<td>1 Ω to 1kΩ</td>
<td>25 Ω</td>
</tr>
<tr>
<td>Search target</td>
<td>Phase</td>
<td>Phase</td>
</tr>
<tr>
<td>Measuring Time</td>
<td>Short</td>
<td>Med</td>
</tr>
<tr>
<td>High Q mode</td>
<td>on</td>
<td>off</td>
</tr>
<tr>
<td>Time-out</td>
<td>0 to 1000 sec</td>
<td>0 sec</td>
</tr>
<tr>
<td>Trap point list. (xMAX30)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trap frequency</td>
<td>1 MHz to 180 MHz</td>
<td>10 MHz</td>
</tr>
<tr>
<td>Trap phase.</td>
<td>−180 to 180</td>
<td>0</td>
</tr>
<tr>
<td>Output through I/O port</td>
<td>(on</td>
<td>off)</td>
</tr>
<tr>
<td>Trigger mode</td>
<td>INT</td>
<td>MAN</td>
</tr>
<tr>
<td>Measurement mode</td>
<td>Xtal</td>
<td>Spur</td>
</tr>
</tbody>
</table>
## Drive Level Dependency Measurement Mode (DLD Mode)

<table>
<thead>
<tr>
<th>Function</th>
<th>Valid Range</th>
<th>Preset Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Search frequency type</td>
<td>Fr</td>
<td>Fr</td>
</tr>
<tr>
<td>Fr (nominal)</td>
<td>1 MHz to 180 MHz</td>
<td>10 MHz</td>
</tr>
<tr>
<td>Search Range</td>
<td>1 ppm to 10000 ppm</td>
<td>1000 ppm</td>
</tr>
<tr>
<td>CI (nominal)</td>
<td>1 Ω to 1 kΩ</td>
<td>25 Ω</td>
</tr>
<tr>
<td>Drive level sweep type.</td>
<td>UP</td>
<td>UP_DOWN</td>
</tr>
<tr>
<td>Measuring Time</td>
<td>Low/Med/High</td>
<td>Med</td>
</tr>
<tr>
<td>High Q mode</td>
<td>on/off</td>
<td>off</td>
</tr>
<tr>
<td>Minimum drive level.</td>
<td>0.1 nW to 1 mW</td>
<td>1 µW</td>
</tr>
<tr>
<td>Maximum drive level.</td>
<td>0.1 nW to 1 mW</td>
<td>10 µW</td>
</tr>
<tr>
<td>Standard drive level.</td>
<td>0.1 nW to 1 mW</td>
<td>5 µW</td>
</tr>
<tr>
<td>Unit of DL.</td>
<td>W</td>
<td>A</td>
</tr>
<tr>
<td>Measurement wait time.</td>
<td>0 to 10 sec</td>
<td>0 sec</td>
</tr>
<tr>
<td>Start point.</td>
<td>1 to 100</td>
<td>1</td>
</tr>
<tr>
<td>ABORT</td>
<td>on/off</td>
<td>off</td>
</tr>
<tr>
<td>ALC</td>
<td>on/off</td>
<td>off</td>
</tr>
<tr>
<td>Δ mode</td>
<td>DEV</td>
<td>(PPM)%</td>
</tr>
<tr>
<td>Δ mode reference value (F)</td>
<td>Start value</td>
<td>Reference value</td>
</tr>
<tr>
<td>Δ mode reference value (CI)</td>
<td>Start value</td>
<td>Reference value</td>
</tr>
<tr>
<td>Search target</td>
<td>Phase</td>
<td>Phase</td>
</tr>
<tr>
<td>Target phase value</td>
<td>-180 to 180 °</td>
<td>0 °</td>
</tr>
<tr>
<td>Trigger mode</td>
<td>INT</td>
<td>MAN</td>
</tr>
<tr>
<td>Measurement mode</td>
<td>Xtal</td>
<td>Spur</td>
</tr>
</tbody>
</table>
## LCR Measurement Mode

<table>
<thead>
<tr>
<th>Function</th>
<th>Valid Range</th>
<th>Preset Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary measured parameters 1</td>
<td>Z,Y,R,G,Cp,Cs,Lp,LS</td>
<td>Z</td>
</tr>
<tr>
<td>Secondary measured parameters 1</td>
<td>( \delta ),( \delta y ),X,B,D,Q,G,Rp,Rs</td>
<td>( \delta z )</td>
</tr>
<tr>
<td>Primary measured parameters 2</td>
<td>Z,Y,R,G,Cp,Cs,Lp,LS</td>
<td>R</td>
</tr>
<tr>
<td>Secondary measured parameters 2</td>
<td>( \delta ),( \delta y ),X,B,D,Q,G,Rp,Rs</td>
<td>X</td>
</tr>
<tr>
<td>Measuring Time</td>
<td>Short</td>
<td>Med</td>
</tr>
<tr>
<td>Averaging cycles.</td>
<td>1 to 256 cycles</td>
<td>1 cycle</td>
</tr>
<tr>
<td>Signal level. (Vosc)</td>
<td>50 ( \mu )V to 160 mV</td>
<td>12 mV</td>
</tr>
<tr>
<td>Unit of Signal level.</td>
<td>W</td>
<td>A</td>
</tr>
<tr>
<td>Voltage level monitor.</td>
<td>off</td>
<td>on</td>
</tr>
<tr>
<td>Current level monitor.</td>
<td>off</td>
<td>on</td>
</tr>
<tr>
<td>( \Delta ) mode (( \Delta )Pri)</td>
<td>OFF</td>
<td>DEV</td>
</tr>
<tr>
<td>( \Delta )Pri std.</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>( \Delta ) mode (( \Delta )Sec)</td>
<td>OFF</td>
<td>DEV</td>
</tr>
<tr>
<td>( \Delta )Sec std.</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Display digit</td>
<td>3 to 5</td>
<td>5</td>
</tr>
<tr>
<td>Test frequency.</td>
<td>1 MHz to 180 MHz</td>
<td>10 MHz</td>
</tr>
<tr>
<td>Measuring circuit</td>
<td>PI</td>
<td>PROBE</td>
</tr>
<tr>
<td>Trigger mode</td>
<td>INT</td>
<td>MAN</td>
</tr>
<tr>
<td>Measurement mode</td>
<td>Xtal</td>
<td>Spur</td>
</tr>
</tbody>
</table>

## Filter Measurement Mode (Flt Mode)

<table>
<thead>
<tr>
<th>Function</th>
<th>Valid Range</th>
<th>Preset Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test frequency</td>
<td>1 MHz to 180 MHz</td>
<td>10 MHz</td>
</tr>
<tr>
<td>Frequency range</td>
<td>10 Hz to 1 MHz</td>
<td>10 kHz</td>
</tr>
<tr>
<td>Down value for band width.</td>
<td>0 dB to 100 dB</td>
<td>+3 dB</td>
</tr>
<tr>
<td>Filter mode</td>
<td>Constant loss</td>
<td>minimum loss</td>
</tr>
<tr>
<td>Measuring Time</td>
<td>Short</td>
<td>Med</td>
</tr>
<tr>
<td>High Q mode</td>
<td>on</td>
<td>off</td>
</tr>
<tr>
<td>Signal level</td>
<td>(-50 ) dBm to 0 dBm</td>
<td>(-5 ) dBm</td>
</tr>
<tr>
<td>Trigger mode</td>
<td>INT</td>
<td>MAN</td>
</tr>
<tr>
<td>Measurement mode</td>
<td>Xtal</td>
<td>Spur</td>
</tr>
</tbody>
</table>
Comparator Function (Bin Sorting)

<table>
<thead>
<tr>
<th>Function</th>
<th>Valid Range</th>
<th>Preset Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comparator ON/OFF.</td>
<td>on</td>
<td>off</td>
</tr>
<tr>
<td>Secondary sorting.</td>
<td>on</td>
<td>off</td>
</tr>
<tr>
<td>Primary sorting.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tolerance mode</td>
<td>ABS.TOL</td>
<td>%TOL</td>
</tr>
<tr>
<td>Reference value for Tolerance mode</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Upper Limit</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Lower Limit</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Secondary sorting.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper Limit</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Lower Limit</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

$\Delta F$ Limit/$\Delta CI$ Limit Test Function

The $\Delta F$ Limit/$\Delta CI$ Limit Test function is available only when the Comparator function is used in Drive Level Dependency measurement mode.

<table>
<thead>
<tr>
<th>Function</th>
<th>Valid Range</th>
<th>Preset Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Delta F$ limit test ON/OFF.</td>
<td>on</td>
<td>off</td>
</tr>
<tr>
<td>$\Delta F$ limit value</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>$\Delta CI$ limit test ON/OFF.</td>
<td>on</td>
<td>off</td>
</tr>
<tr>
<td>$\Delta CI$ limit value</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

System Menu Settings

<table>
<thead>
<tr>
<th>Function</th>
<th>Valid Range</th>
<th>Preset Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Delta$ Mode</td>
<td>on</td>
<td>off</td>
</tr>
<tr>
<td>Measurement data display ON/OFF.</td>
<td>on</td>
<td>off</td>
</tr>
<tr>
<td>Beep</td>
<td>on</td>
<td>off</td>
</tr>
<tr>
<td>IP-IB address</td>
<td>0 to 31</td>
<td>Not effect</td>
</tr>
<tr>
<td>Analog Out</td>
<td>on</td>
<td>off</td>
</tr>
</tbody>
</table>
## Other Functions

<table>
<thead>
<tr>
<th>Function</th>
<th>Valid Range</th>
<th>Preset Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trigger mode.</td>
<td>Internal/Manual/External</td>
<td>Internal</td>
</tr>
<tr>
<td>Key lock.</td>
<td>on/off</td>
<td>off</td>
</tr>
<tr>
<td>Memory buffer.</td>
<td>on/off</td>
<td>off</td>
</tr>
<tr>
<td>Save/recall instrument settings.</td>
<td>0 to 9</td>
<td>0</td>
</tr>
<tr>
<td>Calibration.</td>
<td>open/short/load, thru</td>
<td>(clear)</td>
</tr>
<tr>
<td>Compensation.</td>
<td>open/short/load</td>
<td>(clear)</td>
</tr>
</tbody>
</table>
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 ≥ 1 µs

Figure C-1. Pin Assignment of Handler Interface Connector
<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Signal Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>Not used.</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Not used.</td>
</tr>
<tr>
<td>3</td>
<td>/DATA0</td>
<td>Data output</td>
</tr>
<tr>
<td>4</td>
<td>/DATA1</td>
<td>Data output</td>
</tr>
<tr>
<td>5</td>
<td>/DATA2</td>
<td>Data output</td>
</tr>
<tr>
<td>6</td>
<td>/DATA3</td>
<td>Data output</td>
</tr>
<tr>
<td>7</td>
<td>/DATA4</td>
<td>Data output</td>
</tr>
<tr>
<td>8</td>
<td>/DATA5</td>
<td>Data output</td>
</tr>
<tr>
<td>9</td>
<td>/DATA6</td>
<td>Data output</td>
</tr>
<tr>
<td>10</td>
<td>/DATA7</td>
<td>Data output</td>
</tr>
<tr>
<td>11</td>
<td>/DATA8</td>
<td>Data output</td>
</tr>
<tr>
<td>12</td>
<td>/DATA9</td>
<td>Data output</td>
</tr>
<tr>
<td>13</td>
<td>/DATA10</td>
<td>Data output</td>
</tr>
<tr>
<td>14</td>
<td>/DATA11</td>
<td>Data output</td>
</tr>
<tr>
<td>15</td>
<td></td>
<td>Not used.</td>
</tr>
<tr>
<td>16</td>
<td></td>
<td>Not used.</td>
</tr>
<tr>
<td>17</td>
<td></td>
<td>Not used.</td>
</tr>
<tr>
<td>18</td>
<td>/KEY LOCK</td>
<td>Key Lock:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>When this line is asserted, all of the HP E4915A/E4916A's front panel key functions are disabled.</td>
</tr>
<tr>
<td>19</td>
<td>/EXT TRIG</td>
<td>External Trigger:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>HP E4915A/E4916A is triggered on the rising edge of a pulse applied to this pin, when the trigger mode is set to External.</td>
</tr>
<tr>
<td>20</td>
<td>EXT DCV2</td>
<td>External DC voltage 2:</td>
</tr>
<tr>
<td>21</td>
<td>EXT DCV2</td>
<td>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.</td>
</tr>
<tr>
<td>24</td>
<td>+5 V</td>
<td>Internal voltage supply +5 V ± 5% (max. output 0.1 A);</td>
</tr>
<tr>
<td>25</td>
<td>+5 V</td>
<td>Exceeding 0.1 A will cause the internal voltage output and the output signals to go to zero.</td>
</tr>
<tr>
<td>26</td>
<td>COM1</td>
<td>Common line for output signals /DATA0~/DATA11.</td>
</tr>
<tr>
<td>27</td>
<td>COM1</td>
<td>Not used.</td>
</tr>
<tr>
<td>28</td>
<td></td>
<td>Not used.</td>
</tr>
<tr>
<td>29</td>
<td></td>
<td>Not used.</td>
</tr>
<tr>
<td>30</td>
<td></td>
<td>Not used.</td>
</tr>
<tr>
<td>31</td>
<td></td>
<td>Not used.</td>
</tr>
<tr>
<td>32</td>
<td></td>
<td>Not used.</td>
</tr>
<tr>
<td>33</td>
<td></td>
<td>Not used.</td>
</tr>
</tbody>
</table>

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)

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Signal Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>37</td>
<td></td>
<td>Not used.</td>
</tr>
<tr>
<td>38</td>
<td></td>
<td>Not used.</td>
</tr>
<tr>
<td>39</td>
<td></td>
<td>Not used.</td>
</tr>
<tr>
<td>40</td>
<td></td>
<td>Not used.</td>
</tr>
<tr>
<td>41</td>
<td></td>
<td>Not used.</td>
</tr>
<tr>
<td>42</td>
<td>/ALARM</td>
<td>Alarm: This signal is asserted, when a power failure occurs.</td>
</tr>
<tr>
<td>43</td>
<td>/INDEX</td>
<td>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.</td>
</tr>
<tr>
<td>44</td>
<td>/EOM</td>
<td>End of Measurement: This signal is asserted, when the measurement data and comparison results are valid.</td>
</tr>
<tr>
<td>45</td>
<td>COM2</td>
<td>Common for /EOM, /INDEX, and /ALRM.</td>
</tr>
<tr>
<td>46</td>
<td>COM2</td>
<td></td>
</tr>
<tr>
<td>49</td>
<td>GND</td>
<td>Ground tied to chassis.</td>
</tr>
<tr>
<td>50</td>
<td>GND</td>
<td></td>
</tr>
</tbody>
</table>

### Table C-2. Definition of Data Output for Each Measurement Mode.

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Signal Name</th>
<th>Xtal</th>
<th>EM</th>
<th>DLD</th>
<th>LCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>/DATA0</td>
<td>BIN1</td>
<td>IO data</td>
<td>BIN1</td>
<td>BIN1</td>
</tr>
<tr>
<td>4</td>
<td>/DATA1</td>
<td>BIN2</td>
<td>IO data</td>
<td>BIN2</td>
<td>BIN2</td>
</tr>
<tr>
<td>5</td>
<td>/DATA2</td>
<td>BIN3</td>
<td>IO data</td>
<td>BIN3</td>
<td>BIN3</td>
</tr>
<tr>
<td>6</td>
<td>/DATA3</td>
<td>BIN4</td>
<td>IO data</td>
<td>BIN4</td>
<td>BIN4</td>
</tr>
<tr>
<td>7</td>
<td>/DATA4</td>
<td>BIN5</td>
<td>IO data</td>
<td>BIN5</td>
<td>BIN5</td>
</tr>
<tr>
<td>8</td>
<td>/DATA5</td>
<td>BIN6</td>
<td>IO data</td>
<td>OUT OF BINS</td>
<td>BIN6</td>
</tr>
<tr>
<td>9</td>
<td>/DATA6</td>
<td>BIN7</td>
<td>IO data</td>
<td>AUX BIN</td>
<td>BIN7</td>
</tr>
<tr>
<td>10</td>
<td>/DATA7</td>
<td>BIN8</td>
<td>IO data</td>
<td>Pri Pass/Fail&lt;sup&gt;1&lt;/sup&gt;</td>
<td>BIN8</td>
</tr>
<tr>
<td>11</td>
<td>/DATA8</td>
<td>BIN9</td>
<td>IO data</td>
<td>Sec Pass/Fail&lt;sup&gt;1&lt;/sup&gt;</td>
<td>BIN9</td>
</tr>
<tr>
<td>12</td>
<td>/DATA9</td>
<td>OUT OF BINS</td>
<td>IO data</td>
<td>3rd(1) Pass/Fail&lt;sup&gt;1&lt;/sup&gt;</td>
<td>BIN10</td>
</tr>
<tr>
<td>13</td>
<td>/DATA10</td>
<td>AUX BIN</td>
<td>IO data</td>
<td>3rd(2) Pass/Fail&lt;sup&gt;1&lt;/sup&gt;</td>
<td>OUT OF BINS</td>
</tr>
<tr>
<td>14</td>
<td>/DATA11</td>
<td>Search Fail</td>
<td>IO data</td>
<td>Search Fail</td>
<td>AUX BIN</td>
</tr>
</tbody>
</table>

<sup>1</sup> Pass:0, Fail:1
T1 : Trigger Pulse Width \( \geq 1 \mu S \)

T2 : Wait Time after /EOM Output \( \geq 0 \mu S \)

/Data : /DATA 0 ~ /DATA 11

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>
<thead>
<tr>
<th>Table C-3. Handler Output Electrical Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Output Signals</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Comparison Signals</td>
</tr>
<tr>
<td>/DATA0, /DATA1, /DATA2</td>
</tr>
<tr>
<td>/DATA3, /DATA4, /DATA5</td>
</tr>
<tr>
<td>/DATA6, /DATA7, /DATA8</td>
</tr>
<tr>
<td>/DATA9, /DATA10, /DATA11</td>
</tr>
<tr>
<td>Control Signals</td>
</tr>
<tr>
<td>/ALARM</td>
</tr>
<tr>
<td>/INDEX</td>
</tr>
<tr>
<td>/EOM</td>
</tr>
</tbody>
</table>
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>
<thead>
<tr>
<th>Signal</th>
<th>Input Voltage</th>
<th>Input Current (Low)</th>
<th>Circuit Common</th>
</tr>
</thead>
<tbody>
<tr>
<td>/EXT TRIG</td>
<td>≤1 V</td>
<td>5~6 V</td>
<td>8.7 mA</td>
</tr>
<tr>
<td>/KEY LOCK</td>
<td>≤1 V</td>
<td>5~6 V</td>
<td>7.7 mA</td>
</tr>
</tbody>
</table>

**Figure C-5. Handler Interface Input Signal Diagram**
Installing Option 020 HP VEE Program

This appendix provides 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

<table>
<thead>
<tr>
<th>Measurement Mode/Function</th>
<th>Setting</th>
<th>Display Measurement Results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HP E4916A</td>
<td>HP E4915A</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-----------</td>
<td>----------------------------</td>
</tr>
<tr>
<td>Crystal Resonator Measurement</td>
<td>Available</td>
<td>Available</td>
</tr>
<tr>
<td>Equivalent Circuit Analysis</td>
<td>Available</td>
<td>Available</td>
</tr>
<tr>
<td>Aging Measurement</td>
<td>Available</td>
<td>Available</td>
</tr>
<tr>
<td>Spurious Measurement</td>
<td>Available</td>
<td>Available</td>
</tr>
<tr>
<td>DLD Measurement</td>
<td>Available</td>
<td>N.A.</td>
</tr>
<tr>
<td>EM Measurement</td>
<td>N.A.</td>
<td>N.A.</td>
</tr>
<tr>
<td>LCR Measurement</td>
<td>N.A.</td>
<td>N.A.</td>
</tr>
<tr>
<td>Filter Analysis</td>
<td>N.A.</td>
<td>N.A.</td>
</tr>
<tr>
<td>Gain-Phase Measurement</td>
<td>N.A.</td>
<td>N.A.</td>
</tr>
<tr>
<td>Comparator / BIN Sort</td>
<td>Available</td>
<td>Available</td>
</tr>
<tr>
<td>∆ Display</td>
<td>Available</td>
<td>Available</td>
</tr>
</tbody>
</table>

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>
<thead>
<tr>
<th>Setup Item</th>
<th>Setup Range</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Point</td>
<td>1 to NOP</td>
<td>1</td>
</tr>
<tr>
<td>Number of Measurement Point</td>
<td>1 to 500</td>
<td>100</td>
</tr>
</tbody>
</table>

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.
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-Cl/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**

<table>
<thead>
<tr>
<th>Setup Item</th>
<th>Setup Range</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum DL Value</td>
<td>See the next table</td>
<td>1μW</td>
</tr>
<tr>
<td>Maximum DL Value</td>
<td>See the next table</td>
<td>10μW</td>
</tr>
<tr>
<td>Standard DL Value</td>
<td>Less than the Maximum DL and Greater than the Minimum value</td>
<td>5μW</td>
</tr>
<tr>
<td>DL Resolution</td>
<td>Less than Lower Limit</td>
<td>0.1nW</td>
</tr>
<tr>
<td>Number of Point</td>
<td>1 to 99</td>
<td>12</td>
</tr>
<tr>
<td>DL Sweep Type</td>
<td>UP/UP-DOWN/UP-MINIMUM</td>
<td>UP-DOWN</td>
</tr>
<tr>
<td>Waiting Time</td>
<td>0 to 1.6 sec</td>
<td>0</td>
</tr>
</tbody>
</table>
Table D-4. Drive Level Limit

<table>
<thead>
<tr>
<th>PI-Fixture</th>
<th>IV probe / Reflection Bridge</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1 n to 1 mW</td>
<td>0.5 n to 31 mW</td>
</tr>
<tr>
<td>2 μ to 6.4 mA</td>
<td>45 μ to 35 mA</td>
</tr>
<tr>
<td>50 u to 161 mV</td>
<td>100 μ to 880 mV</td>
</tr>
<tr>
<td>−60 to +18 dBm</td>
<td>−60 to +18 dBm</td>
</tr>
</tbody>
</table>

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.

---

**Note**

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)**

<table>
<thead>
<tr>
<th>Measurement Mode</th>
<th>BIN sort</th>
<th>No. of BIN</th>
<th>Comparator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crystal Measurement</td>
<td>Fr/FA/Fs/FL</td>
<td>1 to 9</td>
<td>Cl/ZA/ZA</td>
</tr>
<tr>
<td>Spurious mode</td>
<td>N.A.</td>
<td>N.A.</td>
<td>N.A.</td>
</tr>
<tr>
<td>DLD mode</td>
<td>Fr/Fs</td>
<td>1 to 5</td>
<td>Cl/ZA, Fmax-Fmin, Zmax-Zmin</td>
</tr>
</tbody>
</table>

---

**D Installing Option 020 HP VEE Program**
Table D-6. PC Control Setting (internal function is not used)

<table>
<thead>
<tr>
<th>Measurement Mode</th>
<th>BIN sort</th>
<th>No. of BIN</th>
<th>comparator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crystal Measurement Mode</td>
<td>Fr/Fl/Fs/FL</td>
<td>1 to 10</td>
<td>Cl-Za/Ze, Equivalent Circuit Parameter (4/6)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Fmax-Fmin,Zmax-Zmin(Aging)</td>
</tr>
<tr>
<td>Spurious mode</td>
<td>Fr/Fl/Fs</td>
<td>1 to 10</td>
<td>Cl-Za/Ze, Equivalent Circuit Parameter (4/6)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>sF/sZ</td>
</tr>
<tr>
<td>DLD mode</td>
<td>Fr/Fl</td>
<td>1 to 10</td>
<td>Cl-Za,Fmax-Fmin,Zmax-Zmin</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Fmin,Fmax, Zmin, Zmax</td>
</tr>
</tbody>
</table>

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.

The limit parameters sF, sZ of Spurious mode are quite 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.

Display 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. Instrument Setting

<table>
<thead>
<tr>
<th>Measurement Mode</th>
<th>Parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crystal Measurement Mode</td>
<td>Fr-Cl/Fl-Za/Fl-Zs/FL-Cl</td>
</tr>
<tr>
<td>Spurious mode</td>
<td>N.A.</td>
</tr>
<tr>
<td>DLD mode</td>
<td>Fr-Cl/Fl-Za</td>
</tr>
</tbody>
</table>
### Table D-8. PC Control Setting

<table>
<thead>
<tr>
<th>Measurement Mode</th>
<th>Parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crystal Measurement Mode</td>
<td>Fr-Cl/Fs-Za/Fs-Za/FL-Cl,Equivalent Circuit Parameter, Fmax,Fmin,Zmax-Zmin(Zmin(Aging))</td>
</tr>
<tr>
<td>Spurious mode</td>
<td>Fr-Cl/Fs-Za/Fs-Za,Equivalent Circuit Parameter, sFsaZ</td>
</tr>
<tr>
<td>DLD mode</td>
<td>Fr-Cl/Fs-Za,Fmax,Fmin,Zmax-Zmin,Fmin,Fmax,Zmax,Zmin,Zmax</td>
</tr>
</tbody>
</table>

**Note**

You cannot use the nominal value as Equivalent Circuit Parameter and the standard value of sZ.

A value of sZ is always display as A absolute value is always displayed as sZ, because unit of sZ is dB and a relative value of sZ has no meaning.

Values of Fmax-Fmin,Zmax-Zmin is not different values from a standard value, because these values are already difference values.

### Other function

The following section shows specific functions of the VEE program.

- **trigger mode**: trigger mode setting of VEE program is not same as the setting of HP E4915A/E4916A
  - When trigger mode of the VEE program is Internal or Manual, the trigger mode of HP E4915A/E4916A is BUS trigger.
  - When trigger mode of the VEE program is External, the trigger mode of HP E4915A/E4916A is External trigger.
  - Disconnect changes HP E4915A/E4916A HP-IB mode into Local and the trigger mode of HP E4915A/E4916A becomes the same mode of VEE program.

- **CL adjust mode**: Available for the crystal Measurement Mode only

- **Save / Recall**: You can save / recall the setting of HP E4915A/E4916A into a file as a text file.

- **Calibration standard**: You can specify the calibration standard value of calibration, compensation, and each measurement circuit

- **Memory Buffer**: Available under Instrument Setting only
  - **Buffer Size**: Available under Instrument Setting only
  - **Buffer Clear**: Available under Instrument Setting only

- **Measurement Circuit selection**: \( \pi \) only (HP E4915A only)

- ** Compensation function**: Not available for HP E4915A

- **List data display/save**: Save data into a file of a text or CSV format.
Using VEE Program

HP-IB Setup Screen

![Interface Select Code](image)

Instrument Name: E4915A

![Control/Selection](image)

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.

![Numeric Entry Key](image)

Measurement Parameter Setting

Pressing Control/Selection of Figure D-1 leads the Setup screen as shown in the following figure.
Figure D-3. Setup Screen

Pressing **PC Control Setting** makes 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.

![Search Range Setup Screen](image)

Figure D-5. Search Range Setup Screen
Delta Mode Setting

![Figure D-6. Setup Screen](image)

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](image)
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 comparator parameter for the crystal measurement mode. In DLD mode, you can also use $\Delta F$, $\Delta CI$. 
BIN Setting

Figure D-10. Setup Screen

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

Figure D-11. BIN Setting
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
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.
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](image)

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](image)
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](image)

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)](image)
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.
## Figure D-35. List Display of 4 Device Equivalent Circuit Analysis Measurement

<table>
<thead>
<tr>
<th>Device</th>
<th>Freq (MHz)</th>
<th>SW (ohm)</th>
<th>U</th>
<th>P (ppm/kF)</th>
<th>C1 (F)</th>
<th>C2 (F)</th>
<th>L1 (H)</th>
<th>R1 (ohm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9.999164377</td>
<td>10.687</td>
<td>19.327</td>
<td>0.000</td>
<td>2.434p</td>
<td>11.6732</td>
<td>21.3716</td>
<td>10.872</td>
</tr>
<tr>
<td>2</td>
<td>9.999164377</td>
<td>10.687</td>
<td>19.327</td>
<td>0.000</td>
<td>2.434p</td>
<td>11.6732</td>
<td>21.3716</td>
<td>10.872</td>
</tr>
<tr>
<td>3</td>
<td>9.999164377</td>
<td>10.687</td>
<td>19.327</td>
<td>0.000</td>
<td>2.434p</td>
<td>11.6732</td>
<td>21.3716</td>
<td>10.872</td>
</tr>
<tr>
<td>4</td>
<td>9.999164377</td>
<td>10.687</td>
<td>19.327</td>
<td>0.000</td>
<td>2.434p</td>
<td>11.6732</td>
<td>21.3716</td>
<td>10.872</td>
</tr>
</tbody>
</table>

### Note

Under Instrument Setting, Re-Test[F2] and Clear shown in Figure D-35 can be used to control HP E4915A/E4916A.

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

![Setup Screen Image](image)

Figure D-36. Setup Screen

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

![Spurious Search Results](image)

Figure D-37. Spurious Mode Result Display 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.

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:

\[
\text{Low limit} \leq \text{Meas. Value} \leq \text{High Limit}
\]

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

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

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 test fixture supports frequencies up to 180 MHz.

**HP 41900A PI-Network Test Fixture**

The HP 41900A is a PI-network test fixture that measures the characteristics of crystal resonators at high repeatability while supporting frequencies up to 200 MHz.

**HP 41901A SMD PI-Network Test Fixture**

The HP 41901A is a PI-network test fixture that measures the characteristics of surface-mounted crystal resonators at high repeatability while supporting frequencies up to 300 MHz.

**HP 16092A Spring Clip Test Fixture**

The HP 16092A provides a convenient capability for easily connecting and disconnecting samples. It has a usable operating frequency up to 500 MHz.

**HP 16093A/B Binding Post Test Fixtures**

The HP 16093A is suited for the measurement of relatively large size, axial and radial lead components or devices that do not fit other fixtures. The HP 16093A is provided with two small binding post measurement terminals set at 7 mm intervals. The usable frequency operating of the HP 16093A is up to 250 MHz.

**HP 16099A Test Fixture Adapter**

The HP 16099A is used to connect the test fixture with APC-7 connector to &16a; with the impedance probe (Option 001). The usable frequency operating of the HP 16099A is up to 100 MHz.

**HP 16191A Side Electrode SMD Test Fixture**

The HP 16191A is used to measure a side electrodes surface mount device (SMD) with high repeatability. The usable operating frequency is up 2 GHz.
HP 16192A Parallel Electrode SMD Test Fixture

The HP 16192A is used to measure a parallel electrodes surface mount device (SMD) with high repeatability. The usable operating frequency is up to 2 GHz.

HP 16193A Small Side Electrode SMD Test Fixture

The HP 16193A is used to measure a small, side electrodes surface mount device (SMD) with high repeatability. The usable operating frequency is up to 2 GHz.

HP 16194A High Temperature Component Fixture

The HP 16194A is used to measure a component over a wide range of temperatures. The operating temperature range is from $-55^\circ C$ through $200^\circ C$. The usable operating frequency is up to 2 GHz.
Messages

This appendix lists the messages that are displayed on the HP E4915A/E4916A's LCD screen or transmitted by the instrument over HP-IB in numerical order.

Warning Messages

**W60 Talk Only**

HP-IB address is invalid. Change the HP-IB address to the proper value.

**W62 Out of Limit**

LOAD calibration data is over the limit. When this error occurs after OPEN and SHORT calibration, LOAD calibration is not completed correctly. In this case, perform LOAD calibration again. You can ignore this error message when it occurs before OPEN and SHORT calibration. In this case this error may occur even no problem.

**W63 Out of Srch Rng/High Q**

The HP E4915A/E4916A failed to find resonance frequency. Change the nominal frequency and search range to the proper value, or make measurement speed slow.

**W64 Out of Srch Rng, Phase**

The HP E4915A/E4916A failed to find resonance frequency, since the start phase is bigger than the target phase. Change the nominal frequency and search range to the proper value.

**W65 Freq Search Time Over**

The HP E4915A/E4916A can't find resonance frequency in the measurement time. This problem is caused when resonance frequency is drafted.

**W67 Invalid Phase Value**

Measured phase value is different from target phase value. This problem is caused when the DUT is miscontacted with the test fixture.
**W68 Invalid CI Value**

Abnormal CI value is detected. Change the nominal CI to the proper value, or confirm the DUT.

**W69 Out of Srch Rng**

The HP E4915A/E4916A failed to find resonance frequency. Change the nominal frequency and search range to the proper value.

**W70 Gmax Not Found**

The HP E4915A/E4916A failed to find series resonance frequency (Fs). Change the nominal frequency and search range to the proper value.

**W71 F1 or F2 Not Found**

The HP E4915A/E4916A failed to find f1 and/or f2. Change the nominal frequency and search range to the proper value.

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**Instrument Errors**

**E11 ADC failure**

An A/D conversion error occurred. Contact your nearest Hewlett-Packard office.

**E12 RAM TEST FAILED**

A checksum error occurred in the RAM. The RAM must be replaced with new one. Contact your nearest Hewlett-Packard office.

**E13 RAM TEST FAILED**

A checksum error occurred in the RAM. The RAM must be replaced with new one. Contact your nearest Hewlett-Packard office.

**E14 FLASH MEM R/W FAILED**

A read/write error occurred in the flush memory. The flush 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 flash memory. The flash memory must be replaced with new one. Contact your nearest Hewlett-Packard office.

E18 Recall failed

The flash memory contains no instrument settings stored, or does contain illegal data or value the HP E4915A/E4916A cannot recognize (possibly due to a checksum error in the stored data). The flash memory must be replaced with new one. Contact your nearest Hewlett-Packard office.

E19 Printer no response

This error occurs when:
- The printer has no power cord connected
- The printer is not correctly connected through a valid HP-IB cable to your HP E4915A/E4916A
- The printer is not set to "Listen Always" mode.

Correctly connect or set the printer.

E21 Lockout by handler

The front panel keys are currently locked via the Handler interface. The key lock function applied via the Handler interface can only be released via the Handler interface, not via the front panel keys or HP-IB commands.

E22 Invalid range

You attempted to enter a value beyond the parameter's valid range. To avoid this error, be sure to enter a value within the valid range.

E26 Start point > nop

The start point is over NOP for EM/DLD measurement mode.

E28 Code Test Fail

Program data in the flash memory is corrupt. Contact your nearest Hewlett-Packard office to repair the flash memory.

E30 Invalid CI/Level value

Nominal CI or level value is not in correct range. Change the nominal CI and level value to the proper value.
HP-IB Errors

-100 Command error
This is a generic syntax error that the HP E4915A/E4916A cannot
detect more specific errors. This code indicates only that a command
error, as defined in IEEE 488.2, 115.1.1.4, has occurred.

-101 Invalid character
A syntax element contains a character which is invalid for that type;
for example, a header containing an ampersand, SENSE&

-102 Syntax error
An unrecognized command or data type was encountered; for
example, a string was received when the HP E4915A/E4916A was not
expecting to receive a string.

-103 Invalid separator
The syntax analyzer was expecting a separator and encountered an
illegal character; for example, the semicolon was omitted after a
program message unit, *RST:TRIG.

-104 Data type error
The syntax analyzer recognized an unallowed data element; for
example, numeric or string data was expected but block data was
encountered.

-105 GET not allowed
A group Execute Trigger (GET) was received within a program
message (see IEEE488.2,7.7).

-108 Parameter not allowed
More parameter were received than expected for the header; for
example, the AVER command only accepts one parameter, so receiving
AVER 2,4 is not allowed.

-109 Missing parameter
Fewer parameters were received than required for the header; for
example, the AVER commands requires one parameter, so receiving
AVER is not allowed.

-112 Program mnemonic too long
The header contains more than twelve characters (see IEEE
488.2,7.6.1.4.1).

-113 Undefined header
The header is syntactically correct, but it is undefined for the
HP E4915A/E4916A for example, *XYZ is not defined for the HP
E4915A/E4916A.
-121 Invalid character in number
An invalid character for the data type being parsed was encountered; for example, an alpha character in a decimal number or a "9" in octal data.

-123 numeric overflow
The magnitude of exponent was larger than 32000 (see IEEE488.2, 7.7.2.4.1).

-124 Too many digits
The mantissa of a decimal numeric data element contains more than 255 digits excluding leading zeros (see IEEE 488.2, 7.7.2.4.1)

-128 Numeric data not allowed
Legal numeric data element was received, but the HP E4915A/E4916A does not accept it 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 conflict
A legal program data element was parsed but could not be executed due to the current device state (see IEEE 488.2, 6.4.5.3 and 11.5.1.1.5).

-222 Data out of range
A legal program data element was parsed but could not be executed because the interpreted value was outside the legal range as defined by the HP E4915A/E4916A (see IEEE 488.2, 11.5.1.1.5).

-223 Too much data
A legal program data element of block, expression, or string type was received that contained more data than the HP E4915A/E4916A could handle due to memory or related device-specific.

-230 Data corrupt or stale
Possibly invalid data; new reading started but not completed since access.

-241 Hardware missing
A legal program command or query could not be executed because of missing HP E4915A/E4916A hardware; for example, an option was not installed.

310 System error
Some error, termed "system error" by the HP E4915A/E4916A, has occurred.

-311 Memory error
An error was detected in the HP E4915A/E4916A's memory.

-313 Calibration memory lost
The nonvolatile calibration data has lost.

-350 Queue overflow
A specific code entered into the queue in lieu of the code that caused the error. This code indicates that there is no room in the queue and an error occurred but was not recorded.

-400 Query error
This is the generic query error that the HP E4915A/E4916A cannot detect more specific errors. This code indicates only that an error as defined in IEEE 488.2, 11.5.1.1.7 and 6.3 has occurred.
-**410 Query INTERRUPTED**

A condition causing an interrupted error occurred (see IEEE 488.1, 6.3.2.3); for example, a query followed by DAB or GET before a response was completely sent.

-**420 Query UTERMINATED**

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 UTERMINATED after indefinite response**

A query was received in the same program message after an query requesting an indefinite response was executed (see IEEE 488.2, 6.5.7.5.7).
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