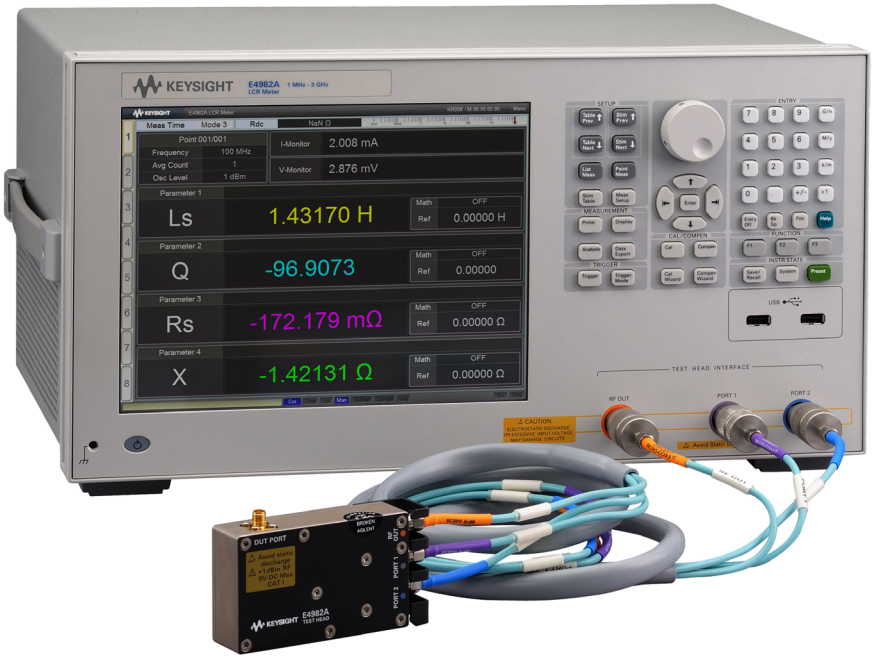
Keysight Technologies
E4982A LCR Meter
1 MHz to 3 GHz
Migration Guide from 4287A

Application Note



KEYSIGHT TECHNOLOGIES

Migrating from the Keysight 4287A RF LCR Meter to the Keysight E4982A LCR Meter

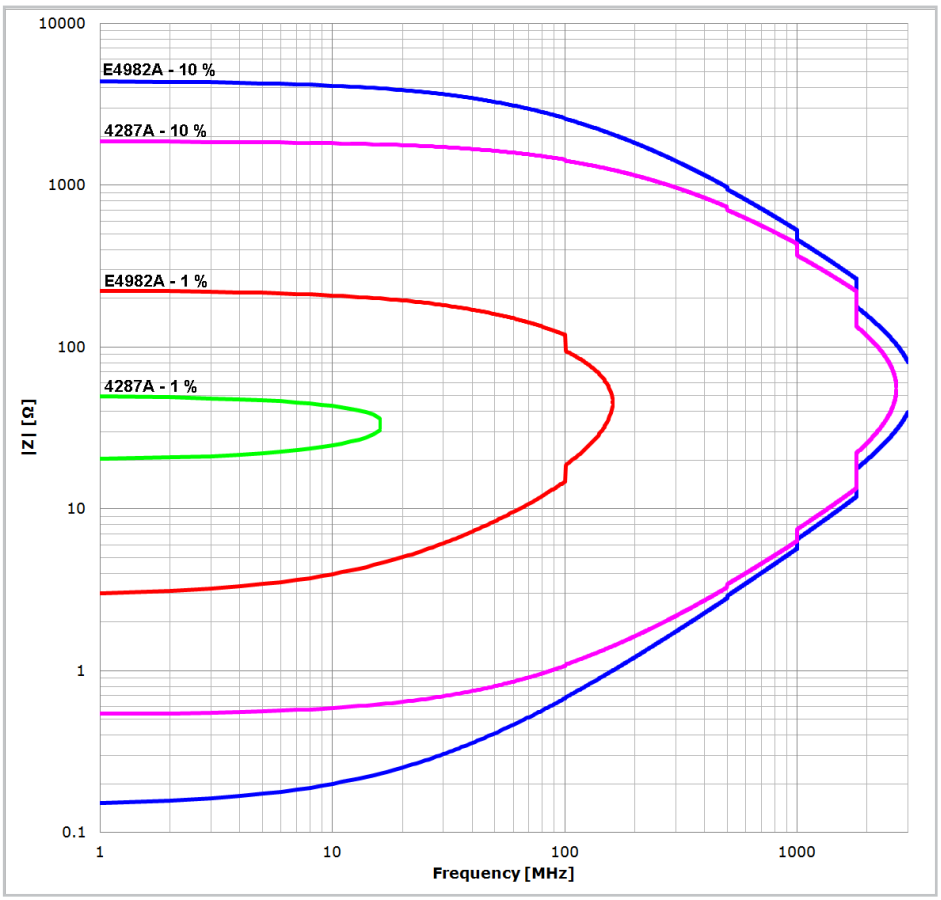
This guide describes the differences between the Keysight Technologies, Inc. E4982A LCR meter and its preceding model, 4287A RF LCR meter to help users in migrating from their 4287A to E4982A with ease.

E4982A LCR Meter

Keysight is proud to introduce the Keysight E4982A LCR meter to replace the 4287A RF LCR meter. Based on the latest technology, this LCR meter provides the best combination of accuracy, speed and versatility for a wide range of component measurements. The light-weight E4982A weighs only 13 kg, has compact body (277 mm depth) and comes with 10.4 inch LCD touch screen. It also offers excellent cost and performance value.

Specification Comparison

Below is the specification comparison chart of E4982A and 4287A.



The setting for the above: Oscillator Level: 1 dBm (for E4982A) & 0 dBm at > 1 GHz (for 4287A), Averaging Factor < 8, Measurement Speed of E4982A: Mode 3, Temperature Deviation ≤ 5 °C

Speed Comparison

The Keysight E4982A LCR Meter provides three measurement speed options – Mode 1, Mode 2 and Mode 3 instead of just one mode on its preceding model, the 4287A RF LCR Meter. The speed of the measurement is inversely proportional to the accuracy of the measurement. As such, a better measurement accuracy can be obtained with the Mode 3 measurement compared to the rest of the modes, as shown in the below table:

Mode	Measurement Speed	Example of Measurement Accuracy (Zx = 50 Ω, at 100 MHz)
1	Fast	± 0.85%
2	Average	± 0.82%
3	Slow	± 0.80%

The table below shows the typical measurement time of Mode 1, 2 and 3 of the E4982A and of 4287A. Mode 1 has the fastest measurement speed with typical measurement time of less than 1 ms.

	E4982A	4287A
Typical measurement time (Index, 1 point)	Mode 1: 0.9 ms	5.9 ms
	Mode 2: 2.1 ms	
	Mode 3: 3.7 ms	

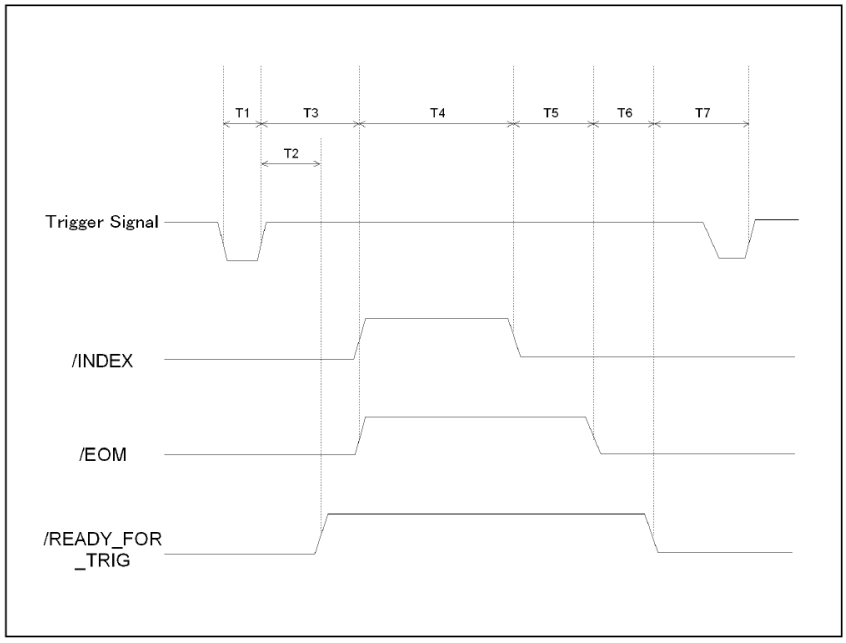
The table below shows the comparison between the typical measurement time of the Mode 3 of E4982A and 4287A for T1 through T7.

		Test Condition						Timing					
		E4982A			4287A			Mode 3 E4982A			4287A		
		Screen Setting	Rdc Meas.	Comparator	Screen Setting	Rdc Meas.	Comparator	Min	Median	Max	Min	Median	Max
T1	Trigger pulse width	-	-	-	-	-	-	2 µs	-	-	2 µs	-	-
T2	Trigger response time of Ready_for_Trig	-	-	-	-	-	-	-	24 µs	29 µs	-	0.3 ms	0.5 ms
T3	Trigger response time of INDEX and EOM	-	-	-	-	-	-	-	24 µs, 31 µs	29 µs, 37 µs	0.6 ms		
T4	Measurement time (INDEX)[1]	-	Off	-	-	Off	-	-	3.7 ms	3.7 ms	-	5.7 ms	5.9 ms
		-	On	-	-	On	-	-	6.6 ms	6.6 ms	-	7.5 ms	7.7 ms
T5	Measurement data calculation time	-	-	On	-	-	On	-	0.5 ms	0.5 ms	-	0.3 ms	0.4 ms
T6	Ready_for_Trig se tting time	1 point meas. Ls-Q meas.	On	On	1 point meas. Ls-Q meas.	On	On	-	0.9 ms	1.0 ms	-	9.8 ms	10.2 ms
T7	Trigger wait time	-	-	-	-	-	-	0	-	-	0	-	-

Condition: DISP:UPD OFF , Trigger delay = 0 , Point delay = 0

1. 1 point measurement

Below is the timing chart of the Handler Interface for the E4982A and 4287A.



Improvement of measurement throughput

The operating system of 4287A and E4982A sometimes get interrupted during the measurement and an extremely large overhead occurs in handler interface timing. With the 4287A, the measurement time can be minimized by adjusting the screen display settings during the measurement. In the E4982A, it is also necessary to consider disabling the Web server function of E4982A in addition to adjust the screen display settings to improve the measurement throughput.

Function Comparison

Added Function

Measurement Time

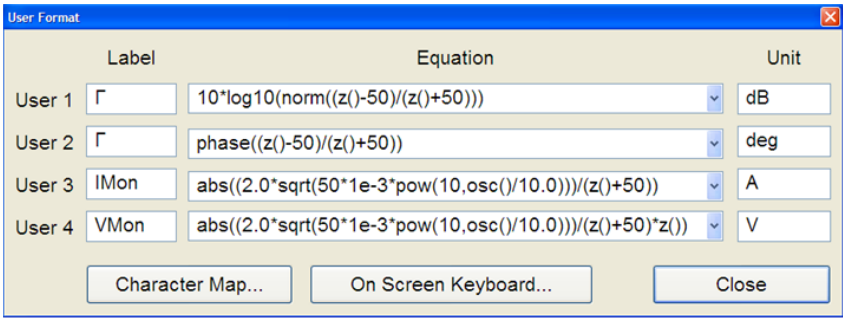
As mentioned earlier in the Speed Comparison, the E4982A LCR Meter comes with three measurement speed options instead of the just one mode on the 4287A RF LCR Meter. The speed of the measurement is inversely proportional to the accuracy of the measurement. The Mode 3 of E4982A provides better measurement accuracy with much faster speed compared to the 4287A.

Maximum number of test points in List

The E4982A maintains the frequency range of 1 MHz to 3 GHz in 100 kHz steps. However, it allows better measurement versatility with maximum of 201 test points for each of the eight tables compared to the maximum of 32 test points only on the 4287A.

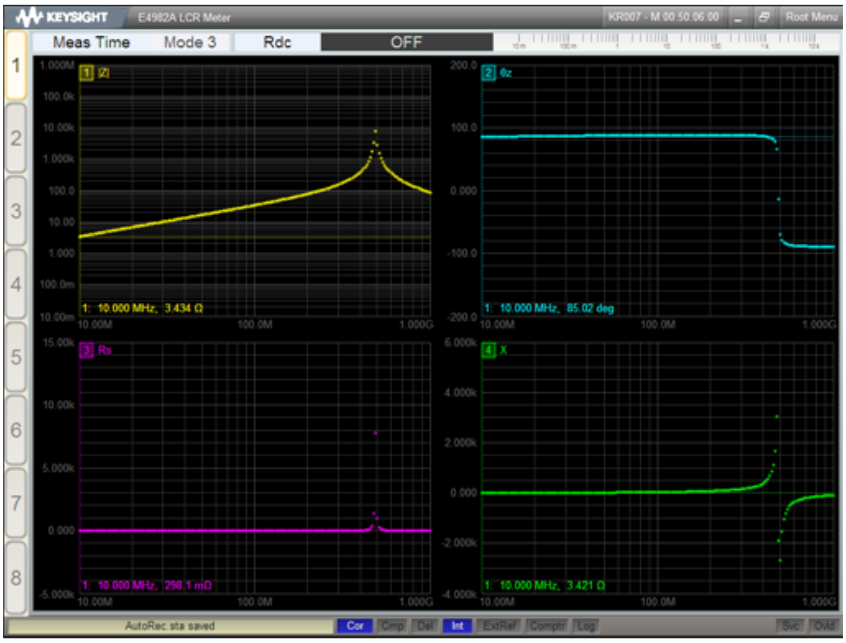
User Define Parameter (User Format)

With the new E4982A, apart from the default parameters, users can also define and custom up to four parameters and specify the preferred equation as well as the unit. Besides the regular on screen keyboard, the character map is also available to enter special characters such as Ω and θ.



Plot

With the 4287A, the measurement result can be viewed in either single point measurement display or list measurement display. However, on the new E4982A, the measurement result can also be viewed as plot of list measurement in the frequency domain, in addition to the single point measurement display and list measurement display. The auto scaling function and log/linear scaling are also available.



Function Key

Three function keys are available on the front panel of the E4982A. Users are allowed to define the functionality of each key. The default settings are shown below.

Key Name	Description
F1	Capture Image. Captures the image of the current screen display.
F2	File Utility. It pops-up the Windows Explorer window.
F3	Toggle Beeper Warning.

Supported Fixture

In the 4287A, the electrical lengths (from 7-mm terminal to DUT connection plane) of the test fixtures 16191A, 16192A, 16193A, 16194A, 16196A, 16196B and 16196C are registered in advance.

In the E4982A, the electrical lengths of 16196D and 16197A are also registered besides the above fixtures.
Note: The fixture selection is required for the compensation of port extension. In the 4287A, the fixture selection is used for both the compensation function and compensation wizard. However, the fixture selection in the E4982A is needed for the compensation function or compensation wizard respectively.

Undo Preset

The E4982A provides Undo Preset option to return to the state prior to the Preset action.

Setup/Bin Table Setting Recall

The 4287A RF LCR meter allows the setup table and BIN sorting setup table to be saved in CSV format only without the option of recalling them. However, the new E4982A allows the saved setup table and BIN sorting setup table to be recalled as well.

USB Ports

The new E4982A comes with two standard types of USB ports:

- USB host port. This port can be used to connect to the USB keyboard, USB mouse and/or USB memory.
- USB (USB TMC – USB Test & Measurement Class) interface port. This port allows remote control equivalent to control via GPIB. As such, the E4982A can be controlled through this port from external controllers.

Changed Function

Calibration kit definition

In the 4287A, changing the calibration kit definition will clear the current calibration status. Cor will be turned OFF (Cor -> UnCal). However, in the E4982A, changing the calibration kit definition will not clear the current calibration status. Cor will not be turned OFF. The updated definition is used at next calibration.

Compensation kit definition

In the 4287A, changing the compensation kit definition will clear the current compensation status. Cmp will be turned OFF. However, in the E4982A, changing the compensation kit definition will not clear the current compensation status. Cmp will not be turned OFF. The updated definition is used at next compensation.

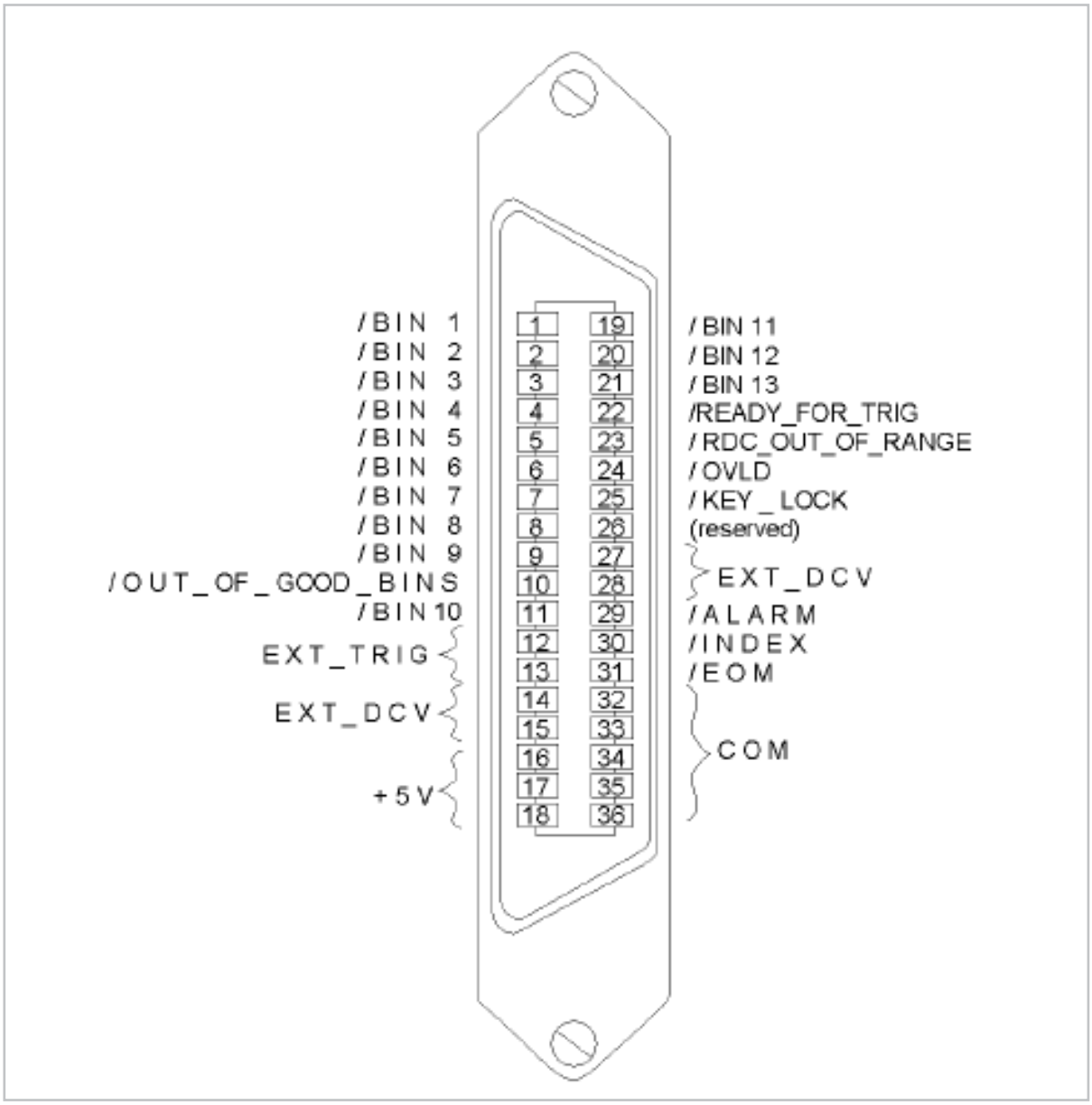
Deleted Function

The floppy disk drive is removed.

Handler Interface Difference

Pin Assignment

The pin assignment of the handler interface is the same on both E4982A and 4287A, as shown in the below figure.



Pull –up Register Location

On the 4287A, the pull-up resistor can be mounted either on the handler interface or outside of the connector.

On the E4982A, the pull-up resistor can no longer be mounted on the handler interface board located inside the instrument. The pull-up resistor can only be placed outside of the connector, which is outside of the instrument.

Input Signal Voltage Level Setting

On the 4287A, it is necessary to set the bit switch on the handler interface to select the voltage range of input signal.

The E4982A allows the input signal voltage level to be set with SCPI command :SYST:HAND:TRIG:VOLT or softkey on front panel (System > Service > Handler Ext Trig.)

Handler Interface Test Commands

Several test commands are available on the E4982A to set and check the handler interface. Once the :TEST:HAND:MODE command value is set to ON, the following commands can be used to control and read the handler interface pin signal value. Upon completion of the handler interface test, the test mode should closed by setting the :TEST:HAND:MODE command value to OFF so that the handler interface pin signal is generated according to the actual measurement results:

:TEST:HAND:BIN
:TEST:HAND:STAT:ALAR
:TEST:HAND:STAT:EOM
:TEST:HAND:STAT:IND
:TEST:HAND:STAT:KEYL
:TEST:HAND:STAT:OVLD
:TEST:HAND:STAT:RDC
:TEST:HAND:STAT:RDYT

Key Features Comparison

The table below shows the comparison of the key features of the E4982A and 4287A.

Characteristics	E4982A	4287A
Frequency	1 MHz to 3 GHz,in 100 kHz steps Max 201 points by 8 boards	1 MHz to 3 GHz, in 100 kHz steps Max 32 points by 8 boards
Interface	GPIB, USB, Handler I/F LAN (10/100/1000Base-T): Telnet	GPIB, Handler I/F LAN (10Base-T): Telnet, FTP
Display	10. 4 inch, color (XGA)	8.4", color
Dimensions of body	426 (W) x 235 (H) x 277 (D) mm	426 (W) x 235 (H) x 445 (D) mm
Weight of body	13 kg	16 kg
Basic accuracy	± 0.8%	± 1%
Range of Z measurement	140 mΩ to 4.8 kΩ (at 1 MHz, accuracy < 10%)	200 mΩ to 3 kΩ (at 1 MHz, accuracy < 10%)

SCPI Command Reference

The table below shows the new SCPI commands added on the E4982A and not available on the 4287A.

Added SCPI Commands	Description
:CALCulate:UFORmat{1-4}[:TEXT]	Specifies the equation formula of the user define parameter
:CALCulate:UFORmat{1-4}:LABel	Specifies the label of the user define parameter
:CALCulate:UFORmat{1-4}:UNIT	Specifies the unit of the user define parameter
:CALCulate:UFORmat:VARiable{1-10}	Specifies the user define variable which can be used in the user define parameter
:DATA[:DATA]:IMPedance?	Returns the real and imaginary parts of the data of each measurement point
:MMEMory:TRANsfer	Sets/Returns data to/from a file on the built-in storage device
:MMEMory:CATalog:DIRectory?	Returns the file and directory names under the selected drive
[:SENSe]:CORRection:COLLect:AVERage[:STATe]	Specifies the ON or OFF state of the custom averaging for calibration and compensation
[:SENSe]:CORRection:COLLect:AVERage:MINimum	Specifies the minimum number of custom averaging for calibration and compensation
[:SENSe][:FIMPedance]:APERture[:MODE]	Specifies the measurement speed mode
:SOURce:LIST:RDC:RF[:STATe]	Specifies the ON or OFF state of the RF signal when the Rdc measurement is made
:SYSTem:SET	Recalls the state of the instrument when the *LRN? query is executed averaging for calibration and compensation
[:SENSe]:CORRection:COLLect:AVERage:MINimum	Specifies the minimum number of custom averaging for calibration and compensation
[:SENSe][:FIMPedance]:APERture[:MODE]	Specifies the measurement speed mode
:SOURce:LIST:RDC:RF[:STATe]	Specifies the ON or OFF state of the RF signal when the Rdc measurement is made
:SYSTem:SET	Recalls the state of the instrument when the *LRN? query is executed
:SYSTem:HANDler:TRIGger:VOLTage	Specifies the handler trigger input voltage
:SERVice:SREVision?	Returns the system version number
:SERVice:LOGGing:CLEar	Clears all the log files about the Event, Power on test, Mech software, Overload, FW close, Recovery
:SERVice:SYSTem:OS:REVision?	Returns the HDD revision number
:SERVice:PROGram:EXECute	Executes the specified program on the windows environment
:TEST:HANDler:MODE	Sets the handler interface test mode
:TEST:HANDler:BIN	Sets the output of the Bin No on the handler interface for test purpose
:TEST:HANDler:STATus:OVLD	Sets the output of the overload pin (pin no.24) on the handler interface for test purpose
:TEST:HANDler:STATus:RDCout	Sets the output of the Rdc out of range pin (pin no.23) on the handler interface for test purpose
:TEST:HANDler:STATus:ALARm	Sets the output of the alarm pin (pin no.29) on the handler interface for test purpose
:TEST:HANDler:STATus:INDex	Sets the output of the Index pin (pin no.30) on the handler interface for test purpose
:TEST:HANDler:STATus:EOM	Sets the output of the EOM (End of Measurement) pin (pin no.31) on the handler interface for test purpose
:TEST:HANDler:STATus:RDYTrig	Sets the output of the ready for trigger pin (pin no.23) on the handler interface for test purpose
:TEST:HANDler:STATus:TRIGger?	Gets the status of the trigger pin (pin no.12 and 13) on the handler interface for test purpose
:TEST:HANDler:STATus:KEYLock?	Gets the status of the key lock pin (pin no.25) on the handler interface for test purpose
:WAIT?	Returns 1 when the instrument is ready for the trigger status
*OPT?	Returns the option numbers equipped with the E4982A
*LRN?	Returns the device setup query

In addition to the new SCPI commands, the E4982A LCR Meter accepts all the SCPI commands of the 4287A. However, the 4287A do not accept all the commands of the E4982A. For example, the SCPI command to configure the LCR Meter to use the specified calibration kit to obtain the data necessary for calculating calibration coefficients is shown below:

On E4982A [:SENSe]:CORRection1:CKIT[:TYPE]?
On 4287A [:SENSe]:CORRection1:CKIT?

In the above example, :CORRection1:CKIT? command can be used on both E4982A and 4287A. However, :CORRection1:CKIT:TYPE? command can only be used on the E4982A and not on the 4287A.

Below is the list of SCPI commands that with minor tweak, are compatible with 4287A.

E4982A	4287A
:CALCulate:PARameter{1-4}:FORMat	Except for :CALCulate:PARameter{1-4}:FORMat USER1 | USER2 | USER3 | USER4
:CALCulate:PARameter{1-4}[:MATH]:EXPRession[:STATe]	:CALCulate:PARameter{1-4}:EXPRession
:CALCulate:COMParator:CONDition{1-4}:PARameter	Except for :CALCulate:COMParator:CONDition{1-4}:PARameter USER1 | USER2 | USER3 | USER4
:DISPlay[:WINDow]:TEXT2:LABel{1-7} OFF parameter (display nothing) is accepted	:DISPlay[:WINDow]:TEXT2:LABel{1-4} OFF parameter (display nothing) is not accepted
:MMEMory:LOAD<file_name>,<*.sta OR *.csv>	:MMEMory:LOAD<file_name>,<*.sta> Does not support *csv format
:MMEMory:CATalog[:USER]?	:MMEMory:CATalog?
[:SENSe]:CORRection1:CKIT[:TYPE]	[:SENSe]:CORRection1:CKIT
[:SENSe]:CORRection2:CKIT[:TYPE]	[:SENSe]:CORRection2:CKIT
[:SENSe]:CORRection2:COLLect[:ACQuire][:ALL]	[:SENSe]:CORRection2:COLLect[:ACQuire]
[:SENSe]:CORRection2:FIXTure[:TYPE]	[:SENSe]:CORRection2:FIXTure
[:SENSe]:CORRection2:FIXTure:LABel{1-8}	[:SENSe]:CORRection2:FIXTure:LABel
[:SENSe]:CORRection2:FIXTure:EDELay{1-8}:DISTance	[:SENSe]:CORRection2:FIXTure:EDELay:DISTance
:SOURce:LIST:RDC[:STATe]	:SOURce:LIST:RDC
:SOURce:LIST[:DATA]	:SOURce:LIST
:SYSTem:ERRor[:DATA]?	:SYSTem:ERRor?

Also, when the commands for calibration/compensation listed below are used with the E4982A, the following command sequence is recommended to ensure the calibration/compensation data acquisition. However, the recommended command sequence is not necessary with the 4287A. Only calibration/compensation commands can be executed with the 4287A.

Commands for calibration

[:SENSe]:CORRection1:COLLect[:ACQuire][:ALL] {STAN1|STAN2|STAN3|STAN4}
[:SENSe]:CORRection1:COLLect[:ACQuire]:DC {STAN1|STAN2|STAN3}
[:SENSe]:CORRection1:COLLect[:ACQuire]:RF {STAN1|STAN2|STAN3|STAN4}

Recommended command sequence for commands above
e.g.
:INIT:CONT OFF
.
.
:CORR1:COLL STAN1
:INIT
*OPC?

Commands for compensation

[:SENSe]:CORRection2:COLLect[:ACQuire][:ALL] {STAN1|STAN2}
[:SENSe]:CORRection2:COLLect[:ACQuire]:DC {STAN1|STAN2}
[:SENSe]:CORRection2:COLLect[:ACQuire]:RF {STAN1|STAN2}

Recommended command sequence for commands above
e.g.
:INIT:CONT OFF
.
.
:CORR2:COLL STAN1
:INIT
*OPC?

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