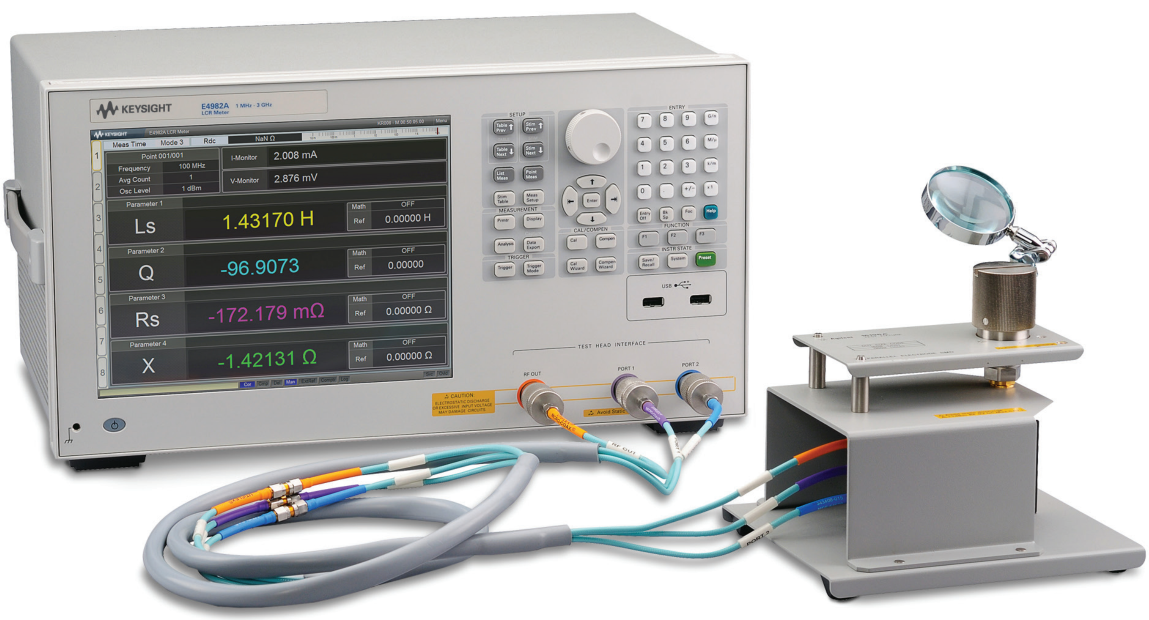
Keysight Technologies

E4982A LCR Meter

1 MHz to 300 MHz/500 MHz/1 GHz/3 GHz

Data Sheet



KEYSIGHT TECHNOLOGIES

Unlocking Measurement Insights

Definitions

Specification (spec.):

Warranted performance. Specifications include guardbands to account for the expected statistical performance distribution, measurement uncertainties, and changes in performance due to environmental conditions. Supplemental information is intended to provide information that is helpful for using the instrument but that is not guaranteed by the product warranty.

Typical (typ.):

Describes performance that will be met by a minimum of 80% of all products. It is not guaranteed by the product warranty.

Supplemental performance data (SPD):

Represents the value of a parameter that is most likely to occur; the expected mean or average. It is not guaranteed by the product warranty.

General characteristics:

A general, descriptive term that does not imply a level of performance.

Basic Measurement Characteristic

Measurement parameters	
Impedance parameters	|Z|, |Y|, Ls, Lp, Cs, Cp, Rs, Rp, X, G, B, D, Q, Øz [°], Øz [rad], Øy [°], Øy [rad], User defined parameter (A maximum of four parameters can be displayed at one time.)
Measurement range	
Impedance parameters	140 mΩ to 4.8 kΩ (Frequency = 1 MHz, Averaging factor = 8, Measurement time mode = 3, Oscillator level = 1 dBm, Measurement uncertainty ≤ ± 10%, Calibration is performed within 23 °C ± 5 °C, Measurement is performed within ± 5 °C from the calibration temperature)

Source Characteristics

Frequency	
Range	1 MHz to 300 MHz (Option 030) 1 MHz to 500 MHz (Option 050) 1 MHz to 1 GHz (Option 100) 1 MHz to 3 GHz (Option 300)
Resolution	100 kHz
Uncertainty	± 10 ppm (23 °C ± 5 °C) ± 20 ppm (5 °C to 40 °C)
Oscillator level	
Cable Length = 1m:	
Power range (When 50 Ω LOAD is connected to test port)	–40 dBm to 1dBm
Current range (When SHORT is connected to test port)	0.0894 mArms to 10 mArms
Voltage range (When OPEN is connected to test port)	4.47 mVrms to 502 mVrms
Uncertainty (When 50 Ω LOAD is connected to test port)	(23 °C ± 5 °C) ± 2 dB (frequency ≤ 1 GHz) ± 3 dB (frequency > 1 GHz)
	(5 °C to 40 °C) ± 4 dB (frequency ≤ 1 GHz) ± 5 dB (frequency > 1 GHz)
Resolution	0.1 dB (When the unit is set at mV or mA, the entered value is rounded to 0.1 dB resolution.)
Cable Length = 2m (When option 002 is used):	
Power range	Subtract the following attenuation from the power (setting value) at 1 m cable length: Attenuation [dB] = 0.42 $\sqrt{f}$ (f: Frequency [GHz])
Uncertainty (When 50 Ω LOAD is connected to test port)	(23 °C ± 5 °C) ± 3 dB (frequency ≤ 1 GHz) ± 4 dB (frequency > 1 GHz)
	(5 °C to 40 °C) ± 5 dB (frequency ≤ 1 GHz) ± 6 dB (frequency > 1 GHz)
Resolution	0.1 dB (When the unit is set at mV or mA, the entered value is rounded to 0.1 dB resolution.)

Output impedance

Output impedance	50 Ω (nominal)

Measurement Accuracy

Condition for definition of accuracy:
- 23 °C ± 5 °C
- 7-mm connector of 3.5-mm-7-mm adapter connected to 3.5-mm terminal of test heads

Basic measurement uncertainty (Typical)

0.45 %

Measurement uncertainty

When OPEN/SHORT/LOAD calibration is performed:

$\|Z\|, \|Y\|$	$\pm (E_a + E_b)\ [\%]$
$\Delta\theta$	$\pm \frac{(E_a + E_b)}{100}\ [rad]$
L, C, X, B	$\pm (E_a + E_b) \times \sqrt{(1 + D_x^2)}\ [\%]$
R, G	$\pm (E_a + E_b) \times \sqrt{(1 + Q_x^2)}\ [\%]$
ΔD	
at $\left\| D_x \tan\left(\frac{E_a + E_b}{100}\right) \right\| < 1$	$\pm \frac{(1 + D_x^2)\tan\left(\frac{E_b + E_b}{100}\right)}{1 \pm D_x \tan\left(\frac{E_b + E_b}{100}\right)}$
Especially, at $D_x \leq 0.1$	$\pm \frac{E_a + E_b}{100}$
ΔQ	
at $\left\| Q_x \tan\left(\frac{E_a + E_b}{100}\right) \right\| < 1$	$\pm \frac{(1 + Q_x^2)\tan\left(\frac{E_b + E_b}{100}\right)}{1 \pm Q_x \tan\left(\frac{E_b + E_b}{100}\right)}$
Especially, at $\frac{10}{E_a + E_b} \geq Q_x \geq 10$	$\pm Q_x^2 \frac{E_a + E_b}{100}$

Measurement uncertainty

When OPEN/SHORT/LOAD/Low Loss capacitance calibration is performed (SPD):

$\lvert Z \rvert, \lvert Y \rvert$	$\pm\left(E_a + E_b\right)\ [\%]$
$\Delta\theta$	$\pm \dfrac{E_c}{100}\ [\text{rad}]$
L, C, X, B	$\pm \sqrt{\left(E_a + E_b\right)^2 + \left(E_c D_x\right)^2}\ [\%]$
R, G	$\pm \sqrt{\left(E_a + E_b\right)^2 + \left(E_c Q_x\right)^2}\ [\%]$
ΔD	
at $\left\lvert D_x \tan\left(\dfrac{E_c}{100}\right)\right\rvert < 1$	$\pm \dfrac{\left(1 + D_x^2\right) \tan\left(\dfrac{E_c}{100}\right)}{1\ \text{m}\ D_x \tan\left(\dfrac{E_c}{100}\right)}$
Especially, at $D_x \leq 0.1$	$\pm \dfrac{E_c}{100}$
ΔQ	
at $\left\lvert Q_x \tan\left(\dfrac{E_c}{100}\right)\right\rvert < 1$	$\pm \dfrac{\left(1 + Q_x^2\right) \tan\left(\dfrac{E_c}{100}\right)}{1 \pm Q_x \tan\left(\dfrac{E_c}{100}\right)}$
Especially, at $\dfrac{10}{E_c} \geq Q_x \geq 10$	$\pm Q_x^2 \dfrac{E_c}{100}$

Definition of each parameter

Dx =	Measurement value of D		
Qx =	Measurement value of Q		
Ea =	Within 23 ± 5 °C from the calibration temperature. Measurement accuracy applies when the calibration is performed at 23 ± 5 °C. When the calibration is performed beyond 23 ± 5 °C, the measurement accuracy decreases to half that described.		
	Measurement Time: Mode 1	Oscillator level = 1 dBm	± 0.54 % @ 1 MHz ≤ frequency ≤ 100 MHz
			± 0.62 % @ 100 MHz < frequency ≤ 500 MHz
			± 0.92 % @ 500 MHz < frequency ≤ 1 GHz
			± 2.05 % @ 1 GHz < frequency ≤ 1.8 GHz
			± 4.42 % @ 1.8 GHz < frequency ≤ 3 GHz
		–20 dBm ≤ Oscillator level < 1 dBm	± 0.66 % @ 1 MHz ≤ frequency ≤ 100 MHz
			± 0.74 % @ 100 MHz < frequency ≤ 500 MHz
			± 1.11 % @ 500 MHz < frequency ≤ 1 GHz
			± 2.36 % @1 GHz < frequency ≤ 1.8 GHz
			± 4.81 % @ 1.8 GHz < frequency ≤ 3 GHz
		-33 dBm ≤ Oscillator level < –20 dBm	± 1.13 % @ 1 MHz ≤ frequency ≤ 100 MHz
			± 1.22 % @ 100 MHz < frequency ≤ 500 MHz
			± 1.84 % @ 500 MHz < frequency ≤ 1 GHz
			± 3.54 % @1 GHz < frequency ≤ 1.8 GHz
			± 6.35 % @ 1.8 GHz < frequency ≤ 3 GHz
		Oscillator level < –33 dBm	± 2.08 % @ 1 MHz ≤ frequency ≤ 100 MHz
			± 2.26 % @ 100 MHz < frequency ≤ 500 MHz
			± 2.27 % @ 500 MHz < frequency ≤ 1 GHz
			± 4.34 % @ 1 GHz < frequency ≤ 1.8 GHz
			± 7.60 % @ 1.8 GHz < frequency ≤ 3 GHz
	Mode 2	Oscillator level = 1 dBm	± 0.52 % @ 1 MHz ≤ frequency ≤ 100 MHz
			± 0.59 % @ 100 MHz < frequency ≤ 500 MHz
			± 0.89 % @ 500 MHz < frequency ≤ 1 GHz
			± 1.99 % @ 1 GHz < frequency ≤ 1.8 GHz
			± 4.34 % @ 1.8 GHz < frequency ≤ 3 GHz
		–20 dBm ≤ Oscillator level < 1 dBm	± 0.58 % @ 1 MHz ≤ frequency ≤ 100 MHz
			± 0.66 % @ 100 MHz < frequency ≤ 500 MHz
			± 0.98 % @ 500 MHz < frequency ≤ 1 GHz
			± 2.14 % @ 1 GHz < frequency ≤ 1.8 GHz
			± 4.54 % @ 1.8 GHz < frequency ≤ 3 GHz
		–33 dBm ≤ Oscillator level < –20 dBm	± 0.81 % @ 1 MHz ≤ frequency ≤ 100 MHz
			± 0.90 % @ 100 MHz < frequency ≤ 500 MHz
			± 1.35 % @ 500 MHz < frequency ≤ 1 GHz
			± 2.74 % @ 1 GHz < frequency ≤ 1.8 GHz
			± 5.31 % @ 1.8 GHz < frequency ≤ 3 GHz
		Oscillator level < –33 dBm	± 1.30 % @ 1 MHz ≤ frequency ≤ 100 MHz
			± 1.44 % @ 100 MHz < frequency ≤ 500 MHz
			± 1.44 % @ 500 MHz < frequency ≤ 1 GHz
			± 2.92 % @ 1 GHz < frequency ≤ 1.8 GHz
			± 5.59 % @ 1.8 GHz < frequency ≤ 3 GHz

Definition of each parameter (continued)

Ea =	Mode 3	Oscillator level = 1 dBm	± 0.51 % @ 1 MHz ≤ frequency ≤ 100 MHz
			± 0.59 % @ 100 MHz < frequency ≤ 500 MHz
			± 0.87 % @ 500 MHz < frequency ≤ 1 GHz
			± 1.97 % @ 1 GHz < frequency ≤ 1.8 GHz
			± 4.32 % @ 1.8 GHz < frequency ≤ 3 GHz
		–20 dBm ≤ Oscillator level < 1 dBm	± 0.55 % @ 1 MHz ≤ frequency ≤ 100 MHz
			± 0.63 % @ 100 MHz < frequency ≤ 500 MHz
			± 0.94 % @ 500 MHz < frequency ≤ 1 GHz
			± 2.08 % @ 1 GHz < frequency ≤ 1.8 GHz
			± 4.46 % @ 1.8 GHz < frequency ≤ 3 GHz
		–33 dBm ≤ Oscillator level < –20 dBm	± 0.65 % @ 1 MHz ≤ frequency ≤ 100 MHz
			± 0.80 % @ 100 MHz < frequency ≤ 500 MHz
			± 1.20 % @ 500 MHz < frequency ≤ 1 GHz
			± 2.50 % @ 1 GHz < frequency ≤ 1.8 GHz
			± 5.00 % @ 1.8GHz < frequency ≤ 3 GHz
		Oscillator level < –33 dBm	± 1.00 % @ 1 MHz ≤ frequency ≤ 100 MHz
			± 1.20 % @ 100 MHz < frequency ≤ 500 MHz
			± 1.20 % @ 500 MHz < frequency ≤ 1 GHz
			± 2.50 % @ 1 GHz < frequency ≤ 1.8 GHz
			± 5.00 % @ 1.8 GHz < frequency ≤ 3 GHz
Eb =	$\pm\left(\frac{Zs}{\lvert Zx\rvert} + Yo \times \lvert Zx\rvert\right) \times 100\ [\%]$ $\left(\lvert Zx\rvert : \text{Measurement value of } \lvert Z\rvert\right)$		
Ec	$\pm\left(0.06 + \frac{0.08\times F}{1000}\right)\ [\%]$ $\left(F : \text{Frequency}\ [\text{MHz}]\right)$		
Zs =	Within 23 ± 5 °C from the calibration temperature. Measurement accuracy applies when the calibration is performed at 23 ± 5 °C. When the calibration is performed beyond 23 ± 5 °C, the measurement accuracy decreases to half that described. (F: Frequency [MHz])		
	Measurement Time Mode 1	Oscillator level = 1 dBm, Average factor ≥ 8	± (14 + 0.5 × F) [mΩ]
		Oscillator level = 1 dBm, Average factor < 8	± (19 + 0.5 × F) [mΩ]
		–20 dBm ≤ Oscillator level < 1 dBm, Average factor ≥ 8	± (20 + 0.5 × F) [mΩ]
		–20 dBm ≤ Oscillator level < 1 dBm, Average factor < 8	± (37 + 0.5 × F) [mΩ]
		–33 dBm ≤ Oscillator level < –20 dBm, Average factor ≥ 8	± (36 + 0.5 × F) [mΩ]
		–33 dBm ≤ Oscillator level < –20 dBm, Average factor < 8	± (110 + 0.5 × F) [mΩ]
		Oscillator level < –33 dBm	± (248 + 0.5 × F) [mΩ]

Definition of each parameter (continued)

Zs =	Mode 2	Oscillator level= 1 dBm, Average factor ≥ 8	± (13 + 0.5 × F) [mΩ]
		Oscillator level= 1 dBm, Average factor < 8	± (15 + 0.5 × F) [mΩ]
		–20 dBm ≤ Oscillator level < 1 dBm, Average factor ≥ 8	± (16 + 0.5 × F) [mΩ]
		–20 dBm ≤ Oscillator level < 1 dBm, Average factor < 8	± (24 + 0.5 × F) [mΩ]
		–33 dBm ≤ Oscillator level< -20 dBm, Average factor ≥ 8	±(24+0.5×F) [mΩ]
		–33 dBm ≤ Oscillator level < –20 dBm, Average factor < 8	± (64 + 0.5 × F) [mΩ]
		Oscillator level < –33 dBm	± (133 + 0.5 × F) [mΩ]
	Mode 3	Oscillator level = 1 dBm, Average factor ≥ 8	± (12 + 0.5 × F) [mΩ]
		Oscillator level = 1 dBm, Average factor < 8	± (14 + 0.5 × F) [mΩ]
		–20 dBm ≤ Oscillator level < 1 dBm, Average factor ≥ 8	± (15 + 0.5 × F) [mΩ]
		–20 dBm ≤ Oscillator level < 1 dBm, Average factor < 8	± (20 + 0.5 × F) [mΩ]
		–33 dBm ≤ Oscillator level < –20 dBm, Average factor ≥ 8	± (20 + 0.5 × F) [mΩ]
		–33 dBm ≤ Oscillator level < –20 dBm, Average factor < 8	± (50 + 0.5 × F) [mΩ]
		Oscillator level < –33 dBm	± (100 + 0.5 × F) [mΩ]
Yo =	Within 23 ± 5 °C from the calibration temperature. Measurement accuracy applies when the calibration is performed at 23 ± 5 °C. When the calibration is performed beyond 23 ± 5 °C, the measurement accuracy decreases to half that described. (F: Frequency [MHz])		
	Measurement Time: Mode 1	Oscillator level = 1 dBm, Average factor ≥ 8	± (22 + 0.15 × F) [µS]
		Oscillator level = 1 dBm, Average factor < 8	± (28 + 0.15 × F) [µS]
		–20 dBm ≤ Oscillator level < 1 dBm, Average factor ≥ 8	± (30 + 0.15 × F) [µS]
		–20 dBm ≤ Oscillator level < 1 dBm, Average factor < 8	± (53 + 0.15 × F) [µS]
		–33 dBm ≤ Oscillator level < –20 dBm, Average factor ≥ 8	± (52 + 0.15 × F) [µS]
		–33 dBm ≤ Oscillator level < –20 dBm, Average factor < 8	± (110 + 0.15 × F) [µS]
		Oscillator level < –33 dBm	± (247 + 0.15 × F) [µS]
	Mode 2	Oscillator level = 1 dBm, Average factor ≥ 8	± (20 + 0.15 × F) [µS]
		Oscillator level = 1 dBm, Average factor < 8	± (23 + 0.15 × F) [µS]
		–20 dBm ≤ Oscillator level < 1 dBm, Average factor ≥ 8	± (24 + 0.15 × F) [µS]
		–20 dBm ≤ Oscillator level < 1 dBm, Average factor < 8	± (35 + 0.15 × F) [µS]
		–33 dBm ≤ Oscillator level< –20 dBm, Average factor ≥ 8	± (35 + 0.15 × F) [µS]
		–33 dBm ≤ Oscillator level< –20 dBm, Average factor < 8	± (63 + 0.15 × F) [µS]
		Oscillator level < –33 dBm	± (133 + 0.15 × F) [µS]

Definition of each parameter (continued)

Yo =	Mode 3	Oscillator level = 1 dBm, Average factor ≥ 8	± (19 + 0.15 × F) [µS]
		Oscillator level = 1 dBm, Average factor < 8	± (22 + 0.15 × F) [µS]
		–20 dBm ≤ Oscillator level < 1 dBm, Average factor ≥ 8	± (22 + 0.15 × F) [µS]
		–20 dBm ≤ Oscillator level < 1 dBm, Average factor < 8	± (30 + 0.15 × F) [µS]
		–33 dBm ≤ Oscillator level < –20 dBm, Average factor ≥ 8	± (30 + 0.15 × F) [µS]
		–33 dBm ≤ Oscillator level < –20 dBm, Average factor < 8	± (50 + 0.15 × F) [µS]
		Oscillator level < –33 dBm	± (100 + 0.15 × F) [µS]

Measurement error may exceed the specifications described above at 90 MHz due to the E4982A's spurious characteristics.

Examples of Calculated Impedance Measurement Accuracy

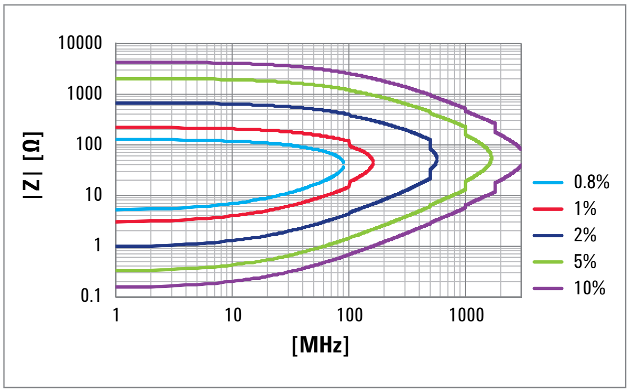


Figure 1. Measurement Speed: Mode 3, Oscillator Level = 1 dBm, Averaging Factor < 8, Temperature Deviation ≤ 5 °C

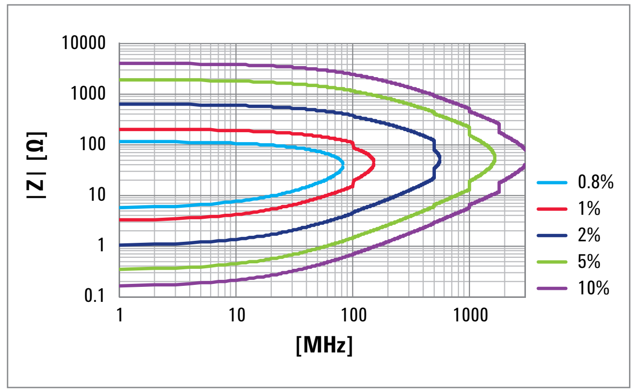


Figure 2. Measurement Time: Mode 2, Oscillator Level = 1 dBm, Averaging Factor < 8, Temperature Deviation ≤ 5 °C

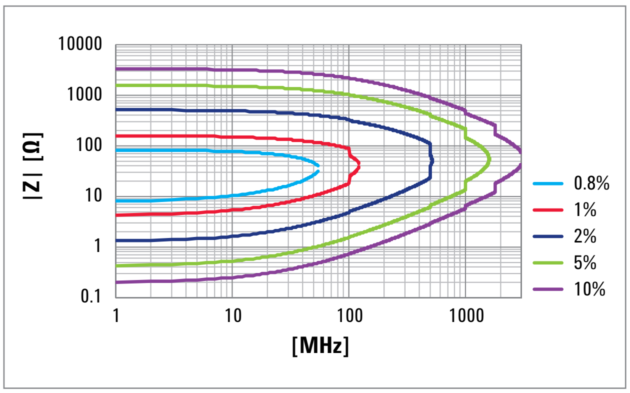


Figure 3. Measurement Time: Mode 1, Oscillator Level = 1 dBm, Averaging Factor < 8, Temperature Deviation ≤ 5 °C

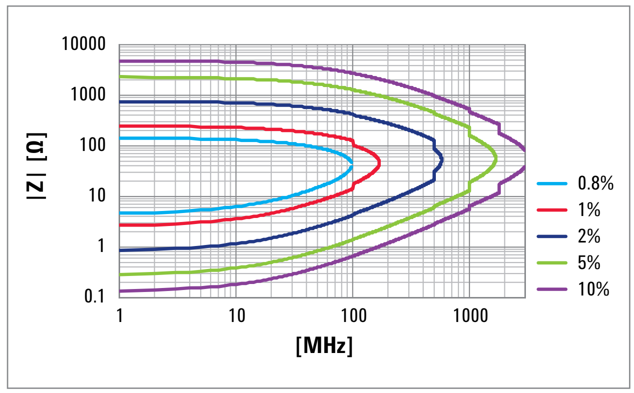


Figure 4. Measurement Time: Mode 3, Oscillator Level = 1 dBm, Averaging Factor ≥ 8, Temperature Deviation ≤ 5 °C

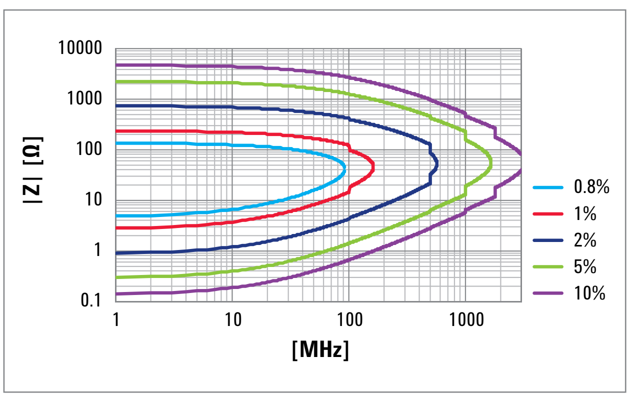


Figure 5. Measurement Time: Mode 2, Oscillator Level = 1 dBm, Averaging Factor ≥ 8, Temperature Deviation ≤ 5 °C

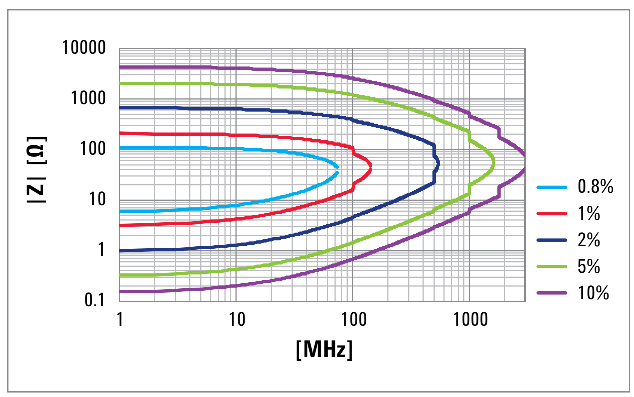


Figure 6. Measurement Time: Mode 1, Oscillator Level = 1 dBm, Averaging Factor ≥ 8, Temperature Deviation ≤ 5 °C

Timing Chart and Measurement Time (SPD)

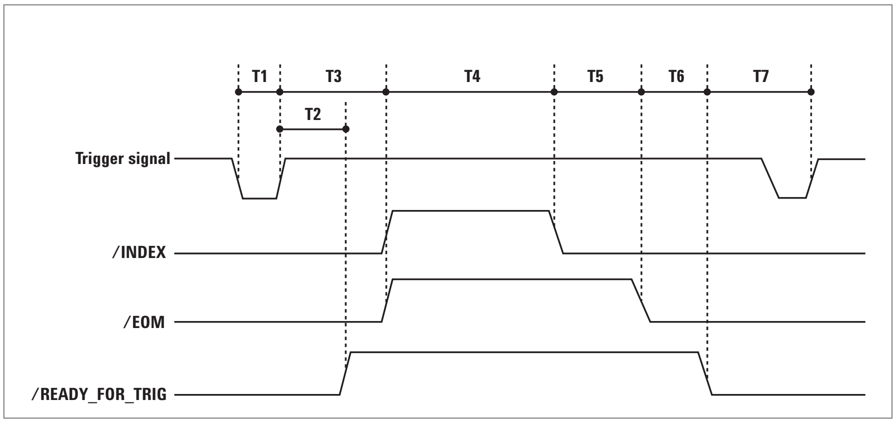


Figure 7. Timing chart of handler interface signal

Cycle Time

		Test condition			Timing											
					Mode 1 (1 MHz)			Mode 1 (100 MHz)			Mode 2			Mode 3		
		Screen Setting	Rdc meas.	Comparator	Min.	Median	Max.	Min.	Median	Max.	Min.	Median	Max.	Min.	Median	Max.
T1	Trigger pulse width	–	Off	Off	2 µs	–	–	2 µs	–	–	2 µs	–	–	2 µs	–	–
T2	Trigger response time of Ready_ for_Trig	–	Off	Off		–	<50 µs		–	<50 µs		–	<50 µs		–	<50 µs
T3	Trigger response time (INDEX, EOM)	–	Off	Off		–	<50 µs		–	<50 µs		–	<50 µs		–	<50 µs
T4	Measurement time (INDEX)	1 point meas (Pre-set)	Off	Off	–	1.6 ms	1.6 ms		0.9 ms	0.9 ms		2.1 ms	2.1 ms		3.7 ms	3.7 ms
			On	Off	–	4.5 ms	4.5 ms		3.8 ms	3.8 ms		5.0 ms	5.0 ms		6.6 ms	6.6 ms
T4 + T5	Measurement data calculation time (EOM)	1 point meas (Pre-set)	Off	Off	–	1.6 ms	1.8 ms		0.9 ms	1.1 ms		2.1 ms	2.3 ms		3.7 ms	4.0 ms
			Off	On	–	1.7 ms	1.9 ms	–	1.0 ms	1.2 ms	–	2.2 ms	2.7 ms	–	3.8 ms	4.1 ms
T4 + T5 + T6	Ready_for_Trig setting time	1 point meas. Ls-Q meas.	Off	Off	–	1.8 ms	2.2 ms	–	1.1 ms	1.4 ms	–	2.3 ms	2.8 ms	–	3.9 ms	4.4 ms
			Off	On	–	1.9 ms	2.3 ms	–	1.2 ms	1.9 ms	–	2.4 ms	3.3 ms	–	4.0 ms	4.5 ms
			On	Off	–	5.1 ms	5.6 ms	–	4.4 ms	4.9 ms	–	5.6 ms	6.1 ms	–	7.2 ms	7.7 ms
			On	On	–	5.2 ms	5.7 ms	–	4.5 ms	4.9 ms	–	5.7 ms	6.3 ms	–	7.2 ms	7.8 ms
T7	Trigger wait time	–	–	–	0	–	–	0	–	–	0	–	–	0	–	–

Condition: Display Off or :DISP:UPD OFF, Trigger delay=0, Point delay=0
E4982A OS: Windows 7 (Serial Prefix: MY523)

Test condition for Measurement Time

The measurement time of E4982A is scattered to some extent by an overhead of the internal operation system and other conditions, so it is difficult to define the specification of handler interface timing. Thus, for your reference, we provide “SPD” data on it in table by defining the following test condition.

Median: Median value of running one minute of measurement data
Max.: Maximum value of running one minute of measurement data

NOTE

1. The instrument’s operating system sometimes suffers interruptions during measurement, and we sometimes observe an extremely large overhead in handler interface timings. The table excludes such special cases, thus you can sometimes see timing over the maximum value data shown in the table. If you make a handshake using the READY_FOR_TRIGGER signal of the handler interface, your test system can continue to work correctly regardless of such an irregular measurement time drift.
2. If your system communicates with external devices, you will see longer timing results than those on the table.
3. In the case of using a bus trigger in the GPIB/LAN/USB system instead of the handler interface, you should measure the test cycle time for yourself, because the system performance depends heavily on the system parameters. Of course, you will see much longer test cycle times from your system software overhead.

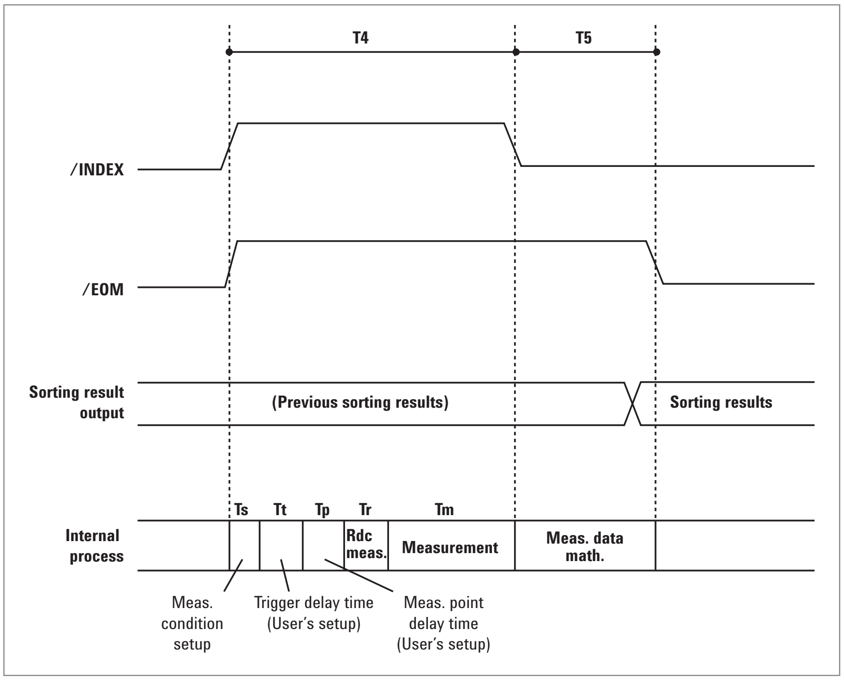


Figure 8. Measurement time T4 for single point measurement

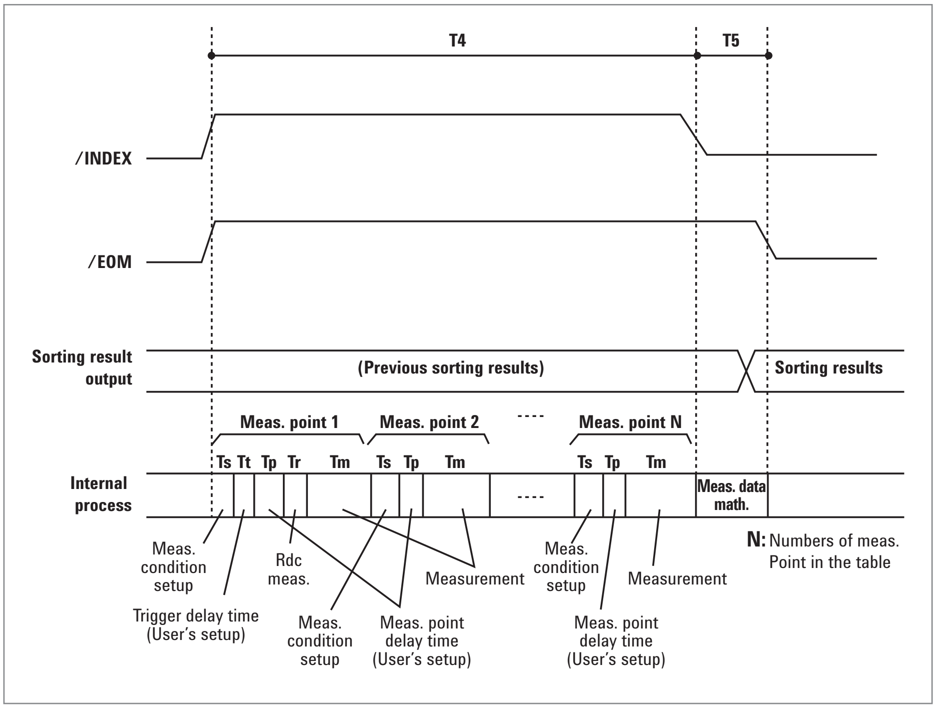


Figure 9. Measurement time T4 for list measurement

Data transfer time (Typical)

Mode 3

Data transfer format	Number of measurement points	Required time for FETCh? command (ms)		
		GPIB	USB	LAN (Socket)
ASCII	1	0.4	0.4	0.6
	2	0.7	0.4	0.6
	3	1.0	0.4	0.7
Binary	1	0.5	1.1	0.6
	2	0.5	1.1	0.5
	3	0.6	1.1	0.6

Host computer: DELL PRECISION 390 Intel Core2Duo 6300 1.86 GHz/RAM: 2GB
GPIB I/F: Keysight Technologies, Inc. PCI GPIB E2078A/82350A
IO Lib: Keysight IO Libraries Suite 16.1.14931.0

E4982A Setting:

Frequency:	100 MHz
OSC Level:	0 dBm
Average:	1
Display:	Off

List Measurement

Measurement Parameter:	Ls-Q (Parameters No.3 and 4: Off)
Measurement Signal Level Monitor:	Off
Comparator:	Off
Rdc Measurement:	Off

Measurement Support Functions

Error correction function

Available calibration and compensation

OPEN/SHORT/LOAD calibration	Connect OPEN, SHORT, and LOAD standards to the desired reference plane and measure each kind of calibration data. The reference plane is called calibration reference plane.
Low-Loss capacitor calibration	Connect the dedicated standard (Low-Loss capacitor) to the calibration reference plane and measure the calibration data.
Port extension compensation (Fixture selection)	When a device is connected to the terminal that is extended from the calibration reference plane, set the electrical length between the calibration plane and the device contact. Select a model number of the registered test fixtures in the E4982A's softkey menu or enter the electrical length for user's test fixture.
OPEN/SHORT compensation	When a device is connected to the terminal that is extended from the calibration reference plane, make OPEN and/or SHORT states at the device contact and measure each kind of compensation date.

Calibration/compensation data measurement point

Data measurement points	Same as measurement points which are set in the measurement point setup display. (Changing the frequency, oscillator level, or measurement speed settings after the calibration or compensation makes the calibration and compensation data invalid.)

DC resistance (Rdc) measurement

Measurement range	0.1 Ω to 100 Ω
Measurement resolution	1 mΩ
Test Signal Level	1 mA (maximum)
Error correction	OPEN/SHORT/LOAD Calibration, OPEN/SHORT Compensation. (Changing the frequency or oscillator level settings after the calibration or compensation makes the calibration and compensation data invalid.)
Measurement uncertainty (SPD)	$\pm\left[1+\left(\frac{0.05}{Rdut}+\frac{Rdut}{10000}\right)\times 100\right]$ [%] Rdut : DC resistance measurement value [Ω] (At averaging factor=128, within ± 5 °C from the calibration temperature. Measurement accuracy applies when the calibration is performed at 23 °C ± 5 °C. When the calibration is performed beyond 23 °C ± 5 °C, the measurement accuracy decreases to half that described.)

Trigger function

Trigger mode	Internal, External (external trigger input connector or handler interface), Bus (GPIB, USB or LAN), Manual (front key)

Measurement time

Time	Mode 1 (Short), Mode 2 (Mid), Mode 3 (Long)

Averaging function

Setting range	1 to 100 (integer)

List measurement function

Number of measurement points	201 points for each table (maximum)
Number of tables	8 tables

Test signal level monitor function

Uncertainty of monitor value (SPD)	$\pm\left[30+\left(10^{\frac{A}{20}}-1\right)\times 100+B\right]$ [%] A: Uncertainty of oscillator level [dB], B: Uncertainty of impedance measurement [%]

Front panel

Ports	Type N (3 ea.) connected to test head	
Display	Type/size	10.4 inch TFT color LCD
	Resolution	XGA (1024 × 768) [1]
USB	Universal serial bus jack, Type A configuration; female; provides connection to mouse, key board, printer or USB stick memory.	

[1] Valid pixels are 99.99% and more. Below 0.01% of fixed points of black, blue, green or red are not regarded as failure.

Measurement terminal (at test head)

Connector type	3.5-mm (female) connector (can be converted to 7-mm connector using the 3.5 mm-7 mm adapter)

Rear panel

External reference signal input connector

Frequency	10 MHz ± 10 ppm (Typ.)
Level	0 dBm ± 3 dB (Typ.)
Input impedance	50 Ω (nominal)
Connector type	BNC (female)

Internal reference signal output connector

Frequency	10 MHz ± 10 ppm (Typ.)
Uncertainty of frequency	Same as frequency uncertainty described in “Source Characteristics”.
Level	0 dBm ± 3 dB into 50 Ω (Typ.)
Input impedance	50 Ω (nominal)
Connector type	BNC (female)

External trigger signal input connector

Level	LOW threshold voltage: 0.5 V HIGH threshold voltage: 2.1 V Input level range: 0 to +5 V
Pulse Width (Tp)	≥ 2usec (SPD). See the following figure for definition of Tp
Polarity	Positive or negative (Selective)
Connector type	BNC (female)

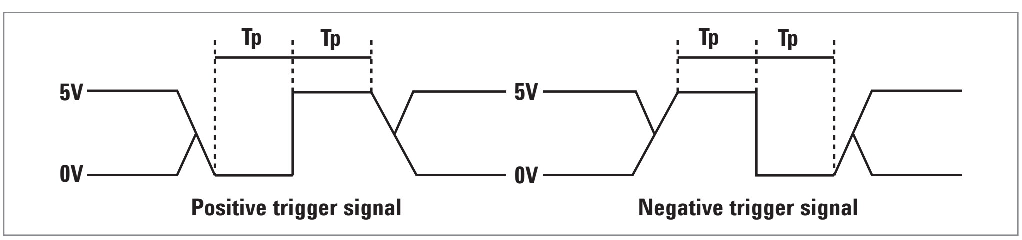


Figure 10. Definition of pulse width (Tp)

Interface

GPIB	24-pin D-Sub (Type D-24), female; compatible with IEEE-488. IEEE-488 interface specification is designed to be used in environment where electrical noise is relatively low. LAN or USBTMC interface is recommended to use at the higher electrical noise environment.
USB host port	Universal serial bus jack, Type A configuration; female; provides connection to mouse, key board, printer or USB stick memory.
USB (USBTMC) interface port	Universal serial bus jack, Type B configuration (4 contacts inline); female; provides connection to an external PC; compatible with USBTMC-USB488 and USB 2.0.LA USB Test and Measurement Class (TMC) interface that communicates over USB, complying with the IEEE 488.1 and IEEE 488.2 standards.
LAN	10/100/1000 Base T Ethernet, 8-pin configuration; auto selects between the two data rates
Video output	15-pin mini D-Sub; female; drives VGA compatible monitors

Handler interface

Connector type	36-pin centronics, female
Signal type	Negative logic, opto-isolated, open collector output
Output signal	BIN sort result (BIN 1 to BIN 13, OUT_OF_GOOD_BINS) DC resistance pass/fail (DCR_OUT_OF_RANGE) Overload (OVLD) Alarm (ALARM) End of analog measurement (INDEX) End of measurement (EOM) Ready for trigger (READY_FOR_TRIG)
Input signal	Eternal trigger (EXT_TRIG) Key lock (KEY_LOCK)
Pin location	See the following figure. Refer to Help for the definition of each pin.

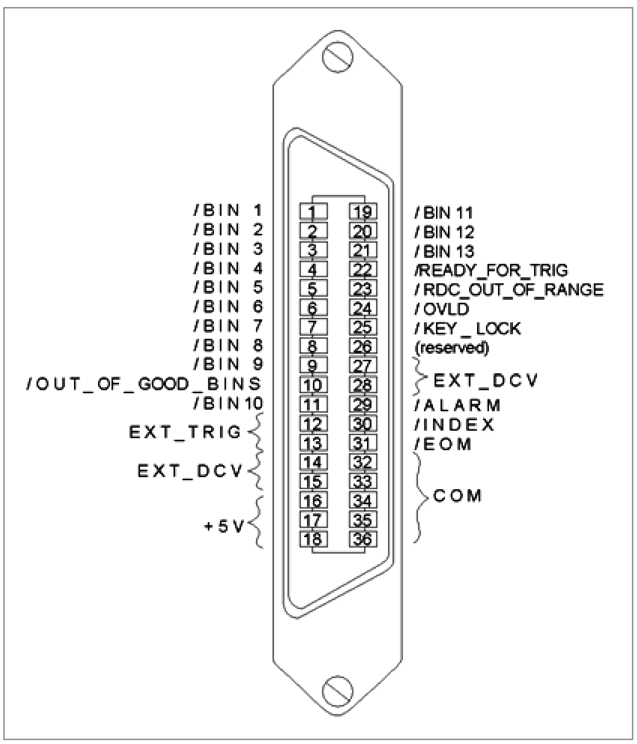


Figure 11. Pin assignment

Line power

Frequency	47 to 63 Hz
Voltage	90-264 VAC (Vpeak > 120 V)
VA max	300 VA max.

EMC, safety, environment and compliance

EMC

ISM 1-A	European Council Directive 2004/108/EC IEC 61326-1:2012 EN 61326-1:2013 CISPR 11:2009 +A1:2010 EN 55011: 2009 +A1:2010 Group 1, Class A IEC 61000-4-2:2008 EN 61000-4-2:2009 4 kV CD / 8 kV AD IEC 61000-4-3:2006 +A1:2007 +A2:2010 EN 61000-4-3:2006 +A1:2008 +A2:2010 3 V/m, 80-1000 MHz, 1.4 - 2.0 GHz / 1V/m, 2.0 - 2.7 GHz, 80% AM IEC 61000-4-4:2004 +A1:2010 EN 61000-4-4:2004 +A1:2010 1 kV power lines / 0.5 kV signal lines IEC 61000-4-5:2005 EN 61000-4-5:2006 0.5 kV line-line / 1 kV line-ground IEC 61000-4-6:2008 EN 61000-4-6:2009 3 V, 0.15-80 MHz, 80% AM IEC 61000-4-8:2009 EN 61000-4-8:2010 30A/m, 50/60Hz IEC 61000-4-11:2004 EN 61000-4-11:2004 0.5-300 cycle, 0% / 70% **NOTE-1:** When tested at 3 V/m according to EN61000-4-3, the measurement accuracy will be within specifications over the full immunity test frequency range except when the analyzer frequency is identical to the transmitted interference signal test frequency. **NOTE-2:** When tested at 3 V according to EN61000-4-6, the measurement accuracy will be within specifications over the full immunity test frequency range except when the analyzer frequency is identical to the transmitted interference signal test frequency.
ICES/NMB-001	ICES-001:2006 Group 1, Class A
	AS/NZS CISPR11:2004 Group 1, Class A
MSIP-REM-Kst-WNMODSF36	KN11, KN61000-6-1 and KN61000-6-2 Group 1, Class A

Safety

ISM 1-A	European Council Directive 2006/95/EC IEC 61010-1:2001 / EN 61010-1:2001 Measurement Category I Pollution Degree 2 Indoor Use **NOTE-1:** When tested at 3 V/m according to EN61000-4-3, the measurement accuracy will be within specifications over the full immunity test frequency range except when the analyzer frequency is identical to the transmitted interference signal test frequency. **NOTE-2:** When tested at 3 V according to EN61000-4-6, the measurement accuracy will be within specifications over the full immunity test frequency range except when the analyzer frequency is identical to the transmitted interference signal test frequency.
LR95111C	CAN/CSA C22.2 No. 61010-1-04 Measurement Category I Pollution Degree 2 Indoor Use

Environment

This product complies with the WEEE Directive (2002/96/EC) marking requirements. The affixed label indicates that you must not discard this electrical/electronic product in domestic household waste.

Product Category: With reference to the equipment types in the WEEE Directive Annex I, this product is classed as a "Monitoring and Control instrumentation" product.
Do not dispose in domestic household waste.

To return unwanted products, contact your local Keysight office, or see http://www.keysight.com/environment/product/ for more information.

Compliance

LXI	Class C

Analyzer Environmental Specifications and Dimensions

Operating environment

Temperature	+5 °C to +40 °C
Error-corrected temperature range	23 °C (± 5 °C) with < 5 °C deviation from calibration temperature
Humidity	20% to 80% at wet bulb temperature < +29 °C (non-condensation)
Altitude	0 to 2,000 m (0 to 6,561 feet)
Vibration	0.21 G maximum, 5 Hz to 500 Hz

Non-operating environment

Temperature	–10 °C to +60 °C
Humidity	20% to 90% at wet bulb temperature < 40 °C (non-condensation)
Altitude	0 to 4,572 m (0 to 15,000 feet)
Vibration	2.1 G maximum, 5 Hz to 500 Hz

Dimensions, weight

Weight	Main unit: 13 kg, test head: 250 g with plate

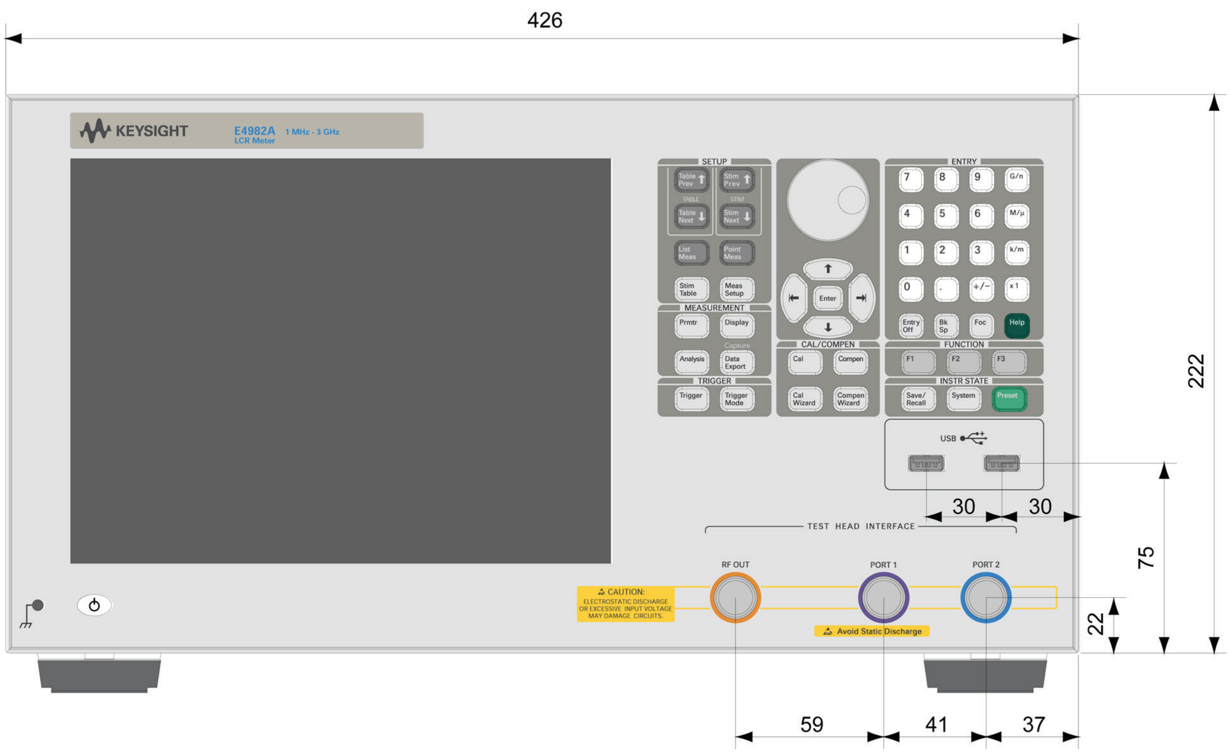


Figure 12. Front view

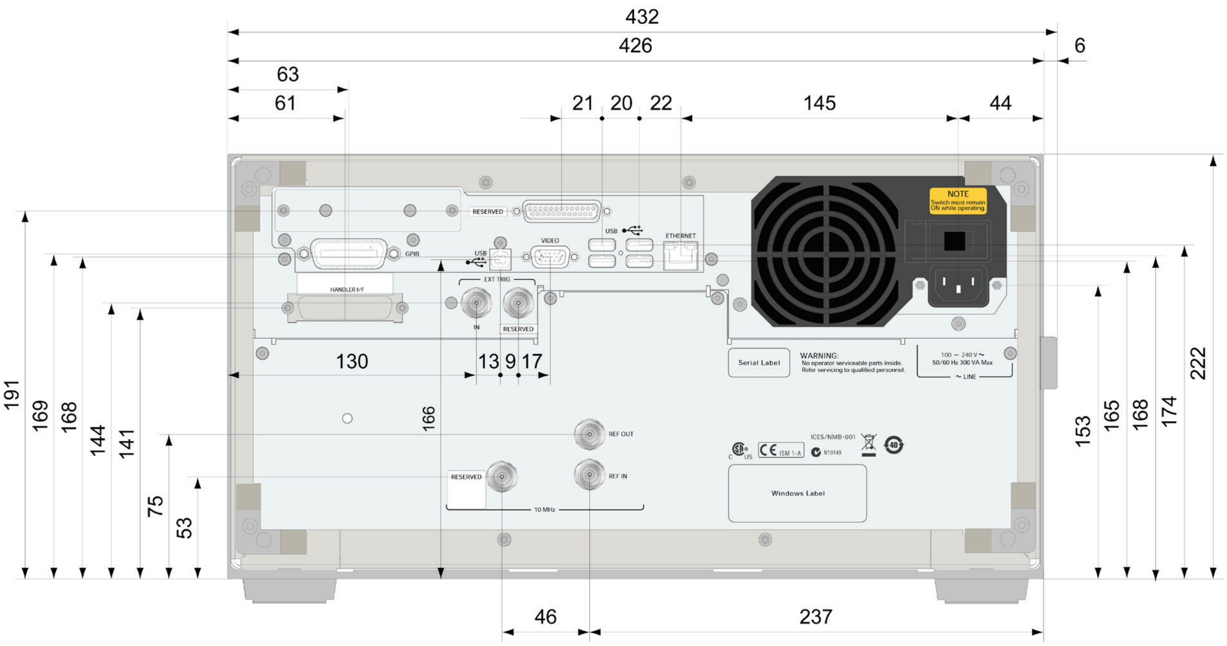


Figure 13. Rear view

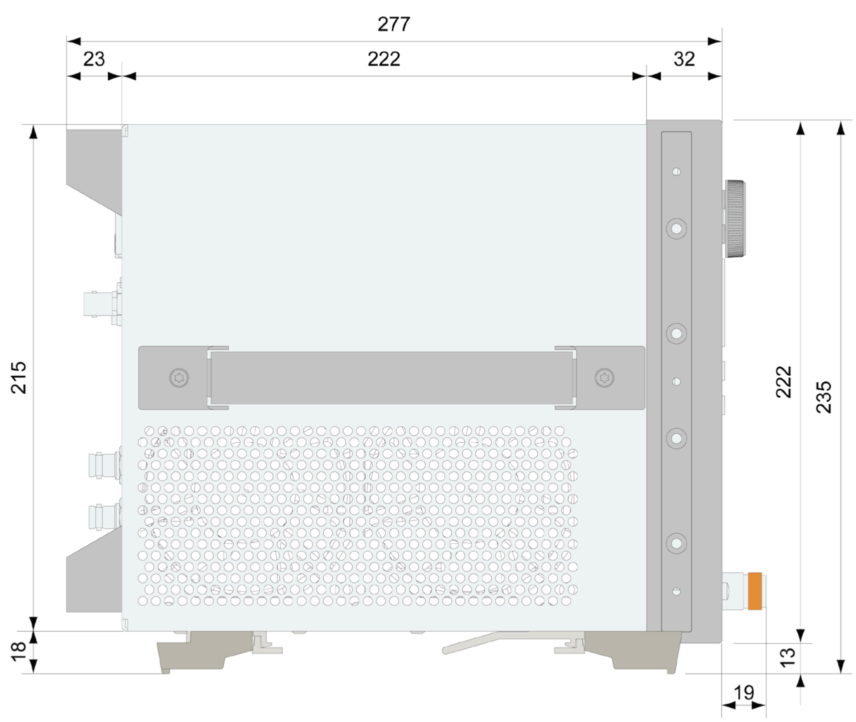


Figure 14. Side view

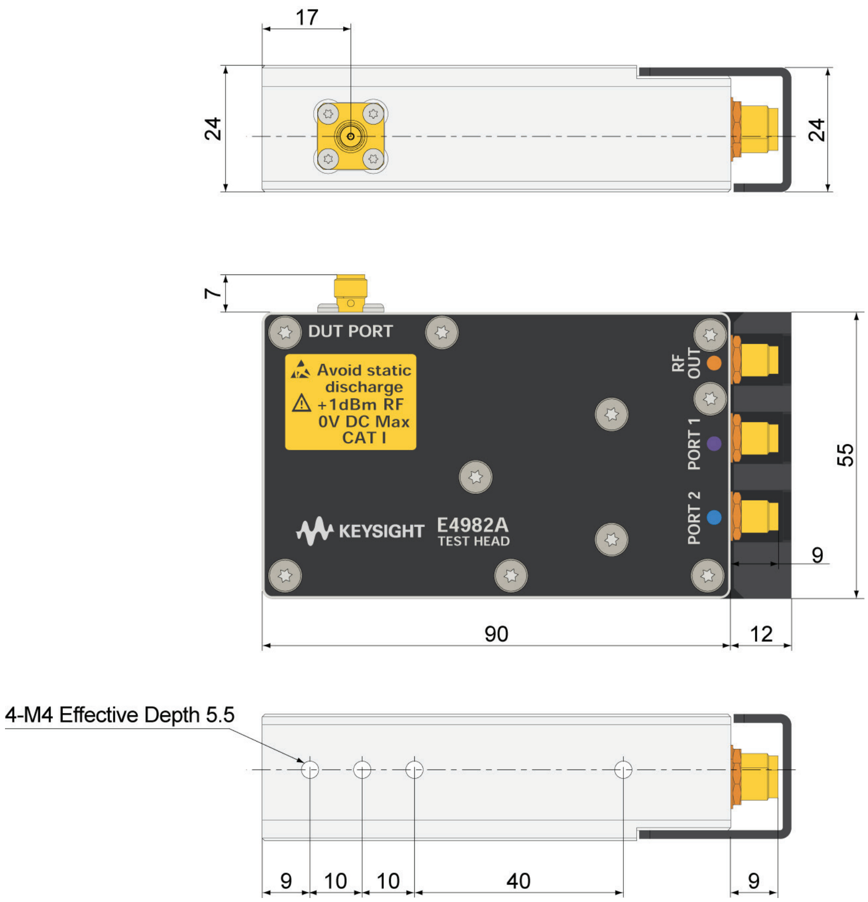


Figure 15. Test head

From Hewlett-Packard through Agilent to Keysight

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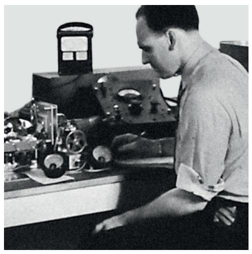
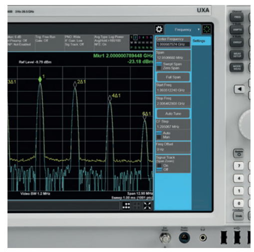

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