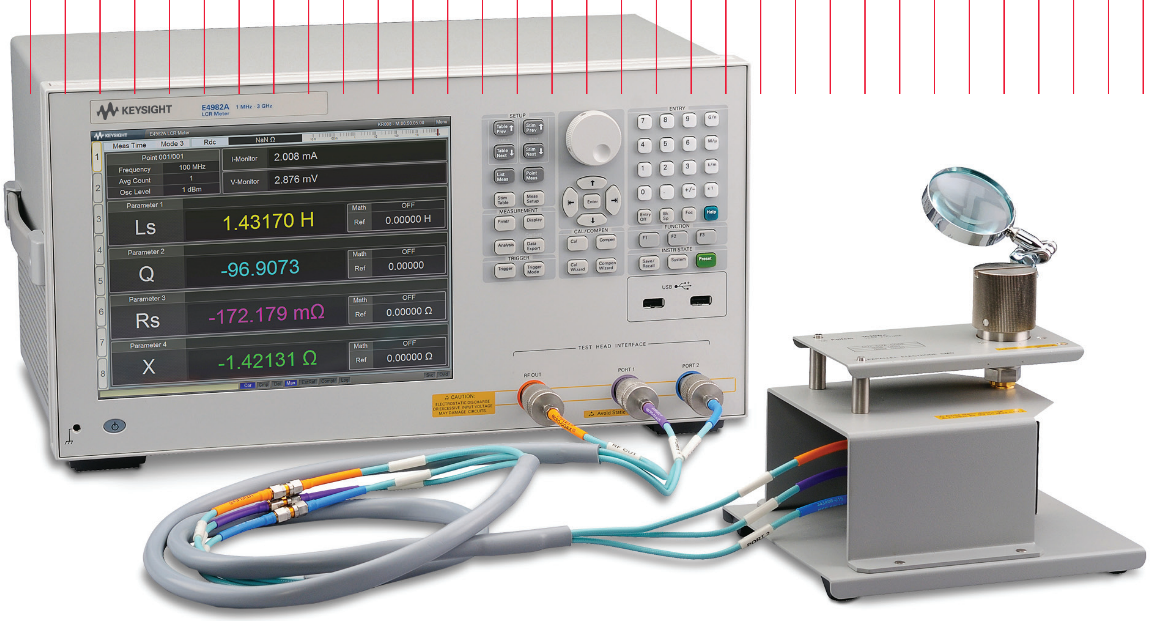
# Keysight Technologies
# E4982A LCR Meter

## 1 MHz to 3 GHz

Data Sheet



KEYSIGHT TECHNOLOGIES

# 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],<br>User defined parameter (A maximum of four parameters can be displayed at one time.) |
| **Measurement range** | |
| Impedance parameters | 140 mΩ to 4.8 kΩ<br>(Frequency = 1 MHz, Averaging factor = 8, Measurement time mode = 3,<br>Oscillator level = 1 dBm, Measurement uncertainty ≤ ± 10%, Calibration is performed within<br>23 °C ± 5 °C, Measurement is performed within ± 5 °C from the calibration temperature) |

## Source Characteristics

| | |
|---|---|
| **Frequency** | |
| Range | 1 MHz to 3 GHz |
| Resolution | 100 kHz |
| Uncertainty | ± 10 ppm (23 °C ± 5 °C)<br>± 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)<br>± 2 dB (frequency ≤ 1 GHz)<br>± 3 dB (frequency > 1 GHz) |
| | (5 °C to 40 °C)<br>± 4 dB (frequency ≤ 1 GHz)<br>± 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:<br>Attenuation [dB] = 0.42 $\sqrt{f}$ (f: Frequency [GHz]) |
| Uncertainty (When 50 Ω LOAD is connected to test port) | (23 °C ± 5 °C)<br>± 3 dB (frequency ≤ 1 GHz)<br>± 4 dB (frequency > 1 GHz) |
| | (5 °C to 40 °C)<br>± 5 dB (frequency ≤ 1 GHz)<br>± 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

### Measurement uncertainty

When OPEN/SHORT/LOAD calibration is performed:

| | |
|---|---|
| $\lvert Z\rvert, \lvert Y\rvert$ | $\pm(E_a + E_b)\ [\%]$ |
| $\Delta\theta$ | $\pm\frac{(E_a + E_b)}{100}\ [\mathrm{rad}]$ |
| L, C, X, B | $\pm(E_a + E_b) \times \sqrt{(1 + D^2_x)}\ [\%]$ |
| R, G | $\pm(E_a + E_b) \times \sqrt{(1 + Q^2_x)}\ [\%]$ |
| $\Delta D$ | |
| at $\left\lvert D_x \tan\left(\frac{E_a + E_b}{100}\right)\right\rvert < 1$ | $\pm\frac{(1 + D_x^2)\tan\left(\frac{E_b + E_b}{100}\right)}{1 \pm D_x \tan\left(\frac{E_b + E_b}{100}\right)}$ |
| Especially, at $D_x \le 0.1$ | $\pm\frac{E_a + E_b}{100}$ |
| $\Delta Q$ | |
| at $\left\lvert Q_x \tan\left(\frac{E_a + E_b}{100}\right)\right\rvert < 1$ | $\pm\frac{(1 + Q_x^2)\tan\left(\frac{E_b + E_b}{100}\right)}{1 \pm Q_x \tan\left(\frac{E_b + E_b}{100}\right)}$ |
| Especially, at $\frac{10}{E_a + E_b} \ge Q_x \ge 10$ | $\pm Q_x^2 \frac{E_a + E_b}{100}$ |

## Measurement uncertainty

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

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

## 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 ≤ 1GHz |
| | | | ± 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 % @ 1GHz < 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 % @ 1MHz ≤ frequency ≤ 100 MHz |
| | | | ± 0.63 % @ 100MHz < frequency ≤ 500 MHz |
| | | | ± 0.94 % @ 500MHz < frequency ≤ 1 GHz |
| | | | ± 2.08 % @ 1GHz < frequency ≤ 1.8 GHz |
| | | | ± 4.46 % @ 1.8GHz < frequency ≤ 3 GHz |
| | | –33 dBm ≤ Oscillator level < –20 dBm | ± 0.65 % @ 1MHz ≤ frequency ≤ 100 MHz |
| | | | ± 0.80 % @ 100MHz < frequency ≤ 500 MHz |
| | | | ± 1.20 % @ 500MHz < frequency ≤ 1 GHz |
| | | | ± 2.50 % @ 1GHz < frequency ≤ 1.8 GHz |
| | | | ± 5.00 % @ 1.8GHz < frequency ≤ 3 GHz |
| | | Oscillator level < –33 dBm | ± 1.00 % @ 1MHz ≤ frequency ≤ 100 MHz |
| | | | ± 1.20 % @ 100MHz < frequency ≤ 500 MHz |
| | | | ± 1.20 % @ 500MHz < frequency ≤ 1 GHz |
| | | | ± 2.50 % @ 1GHz < frequency ≤ 1.8 GHz |
| | | | ± 5.00 % @ 1.8GHz < frequency ≤ 3 GHz |
| Eb = | $\pm\left(\frac{Zs}{\lvert Zx\rvert} + Yo \times \lvert Zx\rvert\right) \times 100\ [\%]$ | | ($\lvert Zx\rvert$ : Measurement value of $\lvert Z\rvert$) |
| Ec | $\pm\left(0.06 + \frac{0.08\times F}{1000}\right)\ [\%]$ | | (F : Frequency [MHz]) |
| 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

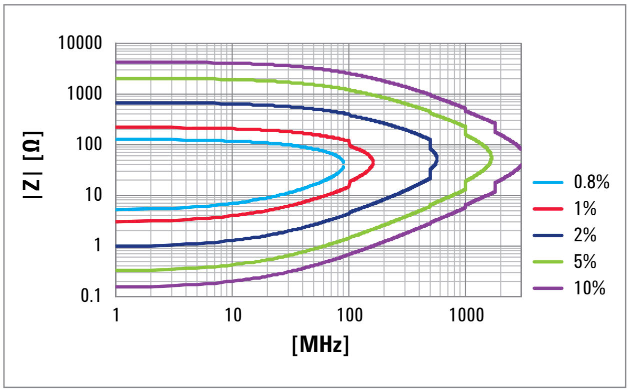



*Figure 1. Measurement Speed: Mode 3, Oscillator Level = 1 dBm, Averaging Factor < 8, Temperature Deviation ≤ 5 °C*

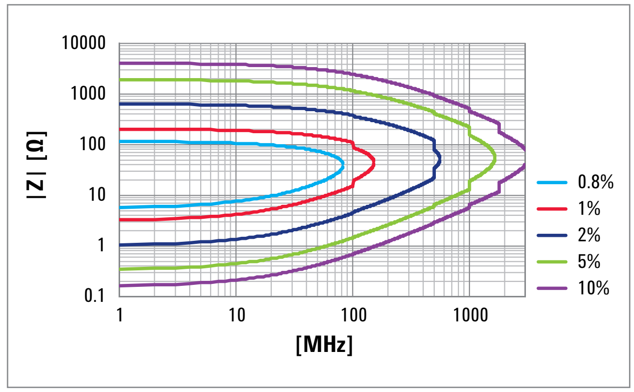



*Figure 2. Measurement Time: Mode 2, Oscillator Level = 1 dBm, Averaging Factor < 8, Temperature Deviation ≤ 5 °C*

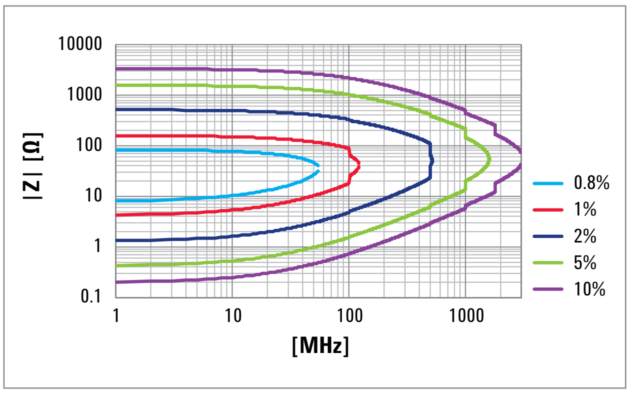



*Figure 3. Measurement Time: Mode 1, Oscillator Level = 1 dBm, Averaging Factor < 8, Temperature Deviation ≤ 5 °C*

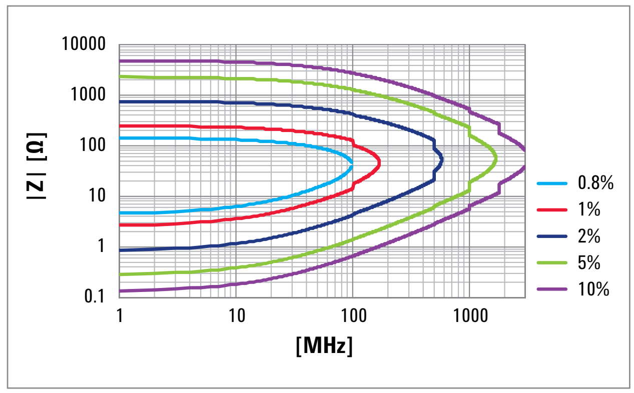



*Figure 4. Measurement Time: Mode 3, Oscillator Level = 1 dBm, Averaging Factor ≥ 8, Temperature Deviation ≤ 5 °C*

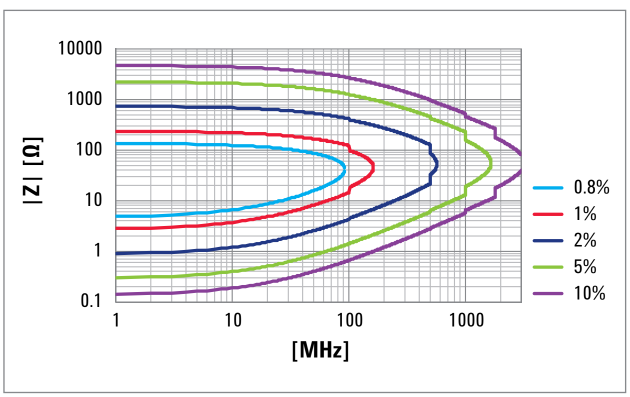



*Figure 5. Measurement Time: Mode 2, Oscillator Level = 1 dBm, Averaging Factor ≥ 8, Temperature Deviation ≤ 5 °C*

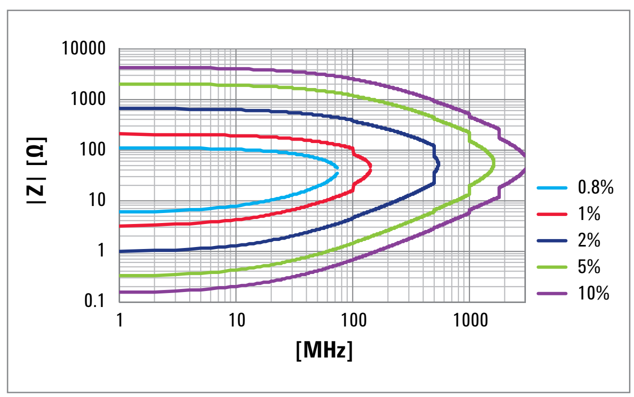



*Figure 6. Measurement Time: Mode 1, Oscillator Level = 1 dBm, Averaging Factor ≥ 8, Temperature Deviation ≤ 5 °C*

# Timing Chart and Measurement Time (SPD)

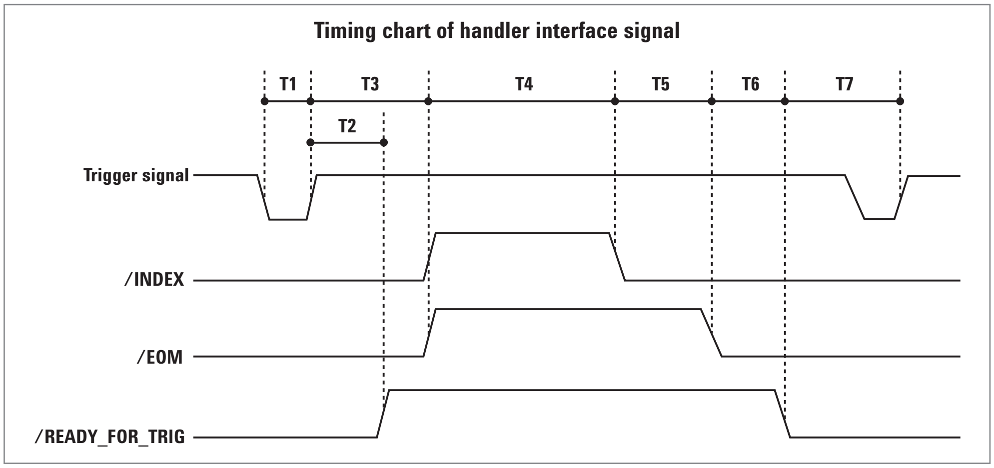



*Figure 7.*

| | | 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 | – | 24 µs | 29 µs | – | 24 µs | 29 µs | – | 24 µs | 29 µs | – | 24 µs | 29 µs |
| T3 | Trigger response time (INDEX, EOM) | – | Off | Off | – | 24 µs, 31 µs | 29 µs, 37 µs | – | 24 µs, 31 µs | 29 µs, 37 µs | – | 24 µs, 31 µs | 29 µs, 37 µs | – | 24 µs, 31 µs | 29 µs, 37 µs |
| T4 | Measurement time (INDEX) | 1 point meas (Preset) | 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 (Preset) | Off | Off | – | 1.7ms | 1.9 ms | – | 1.0 ms | 1.0 ms | – | 2.2 ms | 2.4ms | – | 3.8 ms | 3.8 ms |
| | | | Off | On | – | 2.1 ms | 2.2 ms | – | 1.4 ms | 1.6 ms | – | 2.6 ms | 2.7 ms | – | 4.2 ms | 4.2 ms |
| T4 + T5 + T6 | Ready_for_Trig setting time | 1 point meas. Ls-Q meas. | Off | Off | – | 2.2 ms | 2.3 ms | – | 1.5 ms | 1.7 ms | – | 2.7 ms | 3.0 ms | – | 4.3 ms | 4.5 ms |
| | | | Off | On | – | 2.6 ms | 2.6 ms | – | 1.9 ms | 2.0 ms | – | 3.1 ms | 3.3 ms | – | 3.3 ms | 4.8 ms |
| | | | On | Off | – | 5.5 ms | 5.7ms | – | 4.8 ms | 4.9 ms | – | 6.0 ms | 6.1 ms | – | 6.1 ms | 7.7 ms |
| | | | On | On | – | 5.9 ms | 6.0 ms | – | 5.2 ms | 5.3 ms | – | 6.4 ms | 6.6 ms | – | 8.0 ms | 8.1 ms |
| T7 | Trigger wait time | – | – | – | 0 | – | – | 0 | – | – | 0 | – | – | 0 | – | – |

Condition: Display Off or :DISP:UPD OFF, Trigger delay=0, Point delay=0

## 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.

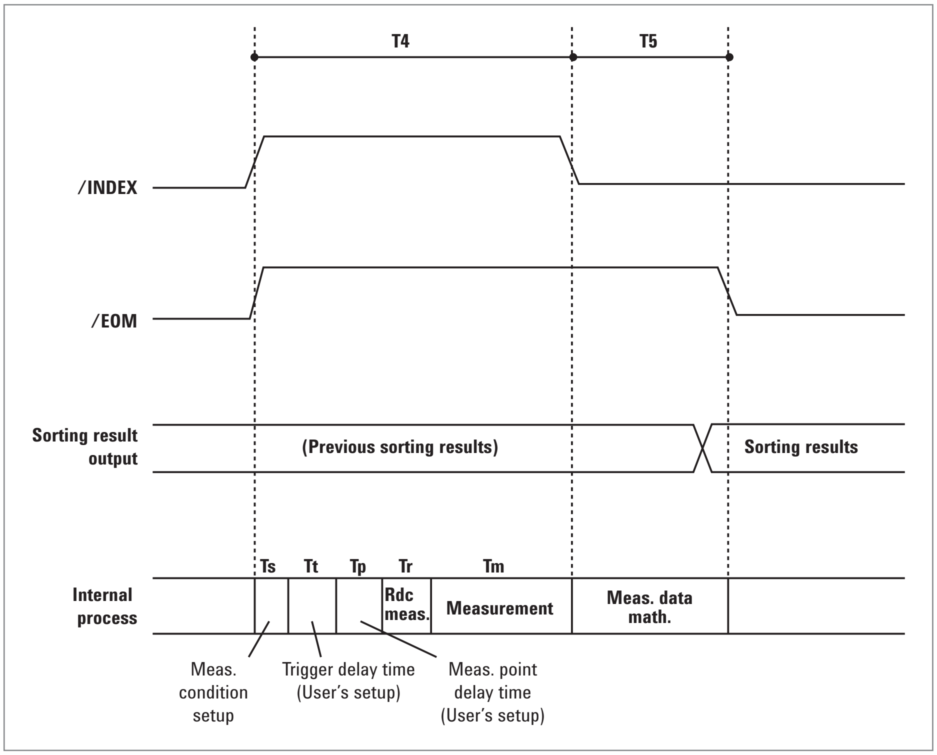



*Figure 8. Measurement time T4 for single point measurement*

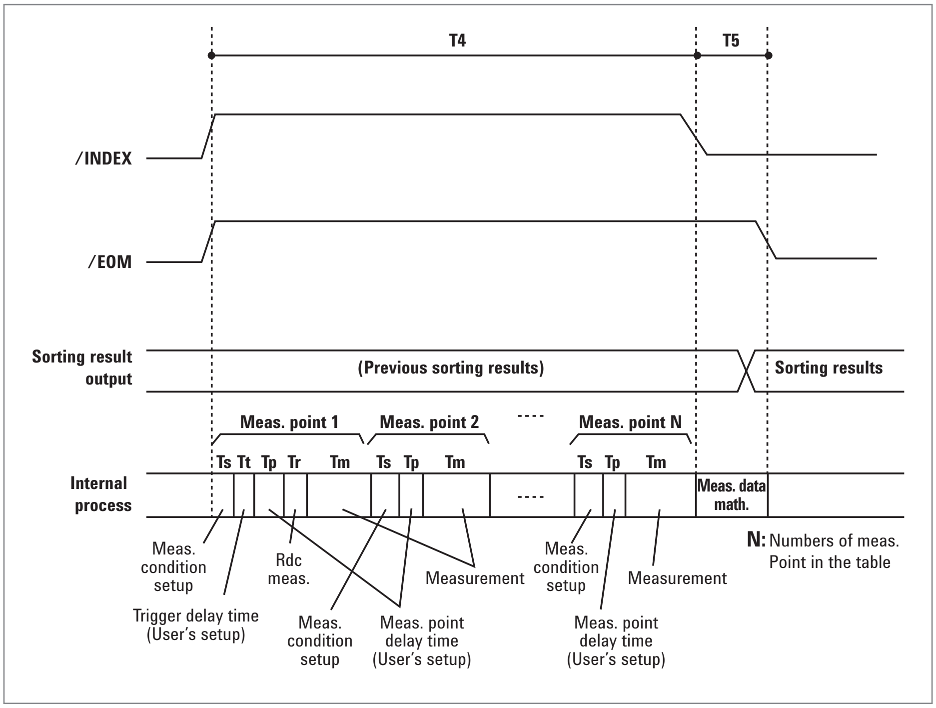



*Figure 9. Measurement time T4 for list measurement*

## Data transfer time (Typical)

| Data transfer format | Number of measurement points | Required time for FETCh? command (ms) | | |
|---|---|---|---|---|
| | | GPIB | USB | LAN (Socket) |
| ASCII | 1 | 0.5 | 0.5 | 0.3 |
| | 2 | 0.8 | 0.5 | 0.3 |
| | 3 | 1.2 | 0.5 | 0.3 |
| Binary | 1 | 0.7 | 1.3 | 0.3 |
| | 2 | 0.8 | 1.3 | 0.3 |
| | 3 | 0.9 | 1.3 | 0.3 |

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.<br>(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 $[\Omega]$<br>(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),<br>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) | $\pm\left[30+\left(10^{\frac{A}{20}}-1\right)\times 100+B\right]$ [%]<br>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<br>(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<br>HIGH threshold voltage: 2.1 V<br>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) |

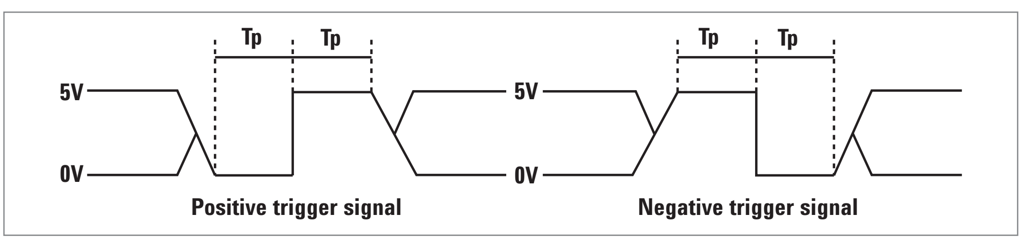



*Figure 10. Definition of pulse width (Tp)*

## Interface

| | |
|---|---|
| GPIB | 24-pin D-Sub (Type D-24), female; compatible with IEEE-488.<br>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<br>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)<br>DC resistance pass/fail (DCR_OUT_OF_RANGE)<br>Overload (OVLD)<br>Alarm (ALARM)<br>End of analog measurement (INDEX)<br>End of measurement (EOM)<br>Ready for trigger (READY_FOR_TRIG) |
| Input signal | Eternal trigger (EXT_TRIG)<br>Key lock (KEY_LOCK) |
| Pin location | See the following figure. Refer to Help for the definition of each pin. |

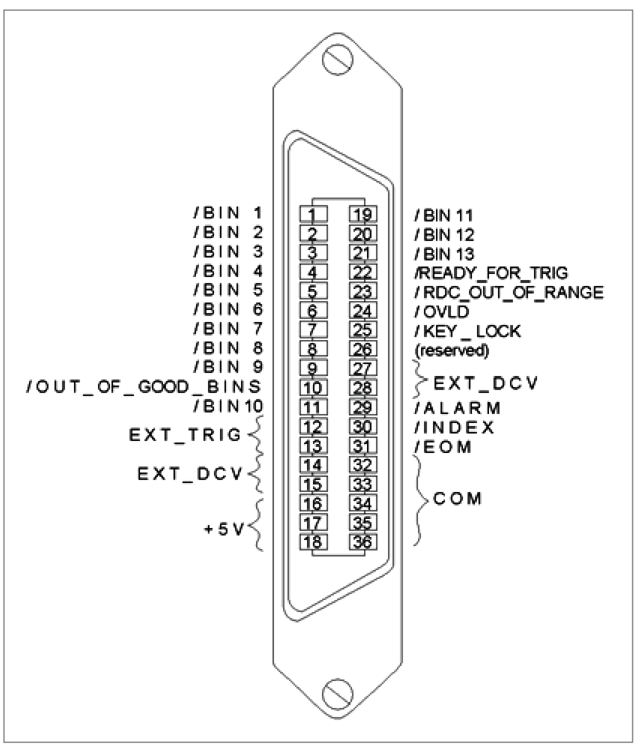



*Figure 11. Pin assignment*

## 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<br>IEC 61326-1:2005<br>EN 61326-1:2006<br>CISPR 11:2003+A1:2004<br>EN 55011:2007<br>Group 1, Class A<br>IEC 61000-4-2:1995 +A2:2000<br>EN 61000-4-2:1995 +A2:2001<br>4 kV CD / 8 kV AD<br>IEC 61000-4-3:2006<br>EN 61000-4-3:2006<br>1-3 V/m, 80-1000 MHz/1.4 GHz - 2.7 GHz, 80% AM<br>IEC 61000-4-4:2004<br>EN 61000-4-4:2004<br>1 kV power/0.5 kV signal lines<br>IEC 61000-4-5:2005<br>EN 61000-4-5:2006<br>0.5 kV line-line/1 kV line-ground<br>IEC 61000-4-6:2003 + A1:2004+ A2:2006<br>EN 61000-4-6:2007<br>3 V, 0.15-80 MHz, 80% AM<br>IEC 61000-4-11:2004<br>EN 61000-4-11:2004<br>0.5-300 cycle, 0%/70%<br><br>**NOTE-1:**<br>When tested at 3 V/m according to EN61000-4-3:2007, 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.<br><br>**NOTE-2:**<br>When tested at 3 V according to EN61000-4-6:2007, 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 |
| N10149 | AS/NZS CISPR11:2004<br>Group 1, Class A |

## Safety

European Council Directive 2006/95/EC
IEC 61010-1:2001 / EN 61010-1:2001
Measurement Category I
Pollution Degree 2
Indoor Use

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

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 |

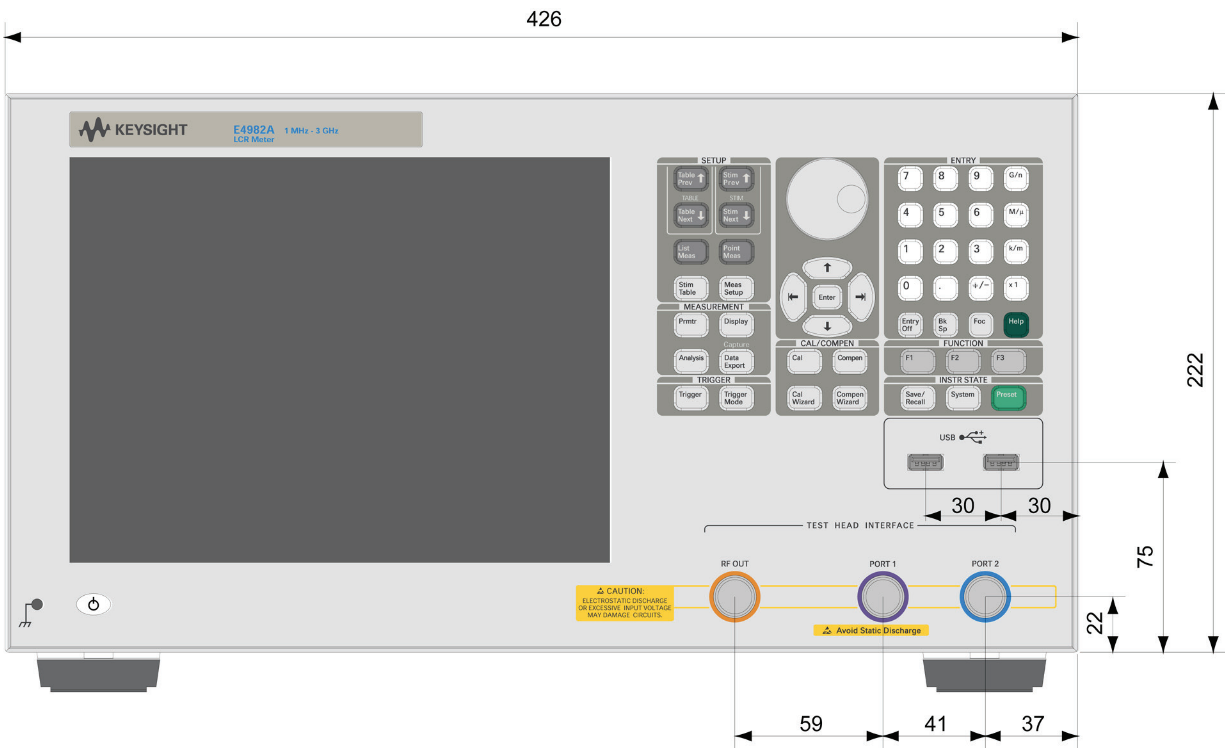



*Figure 12. Front view*

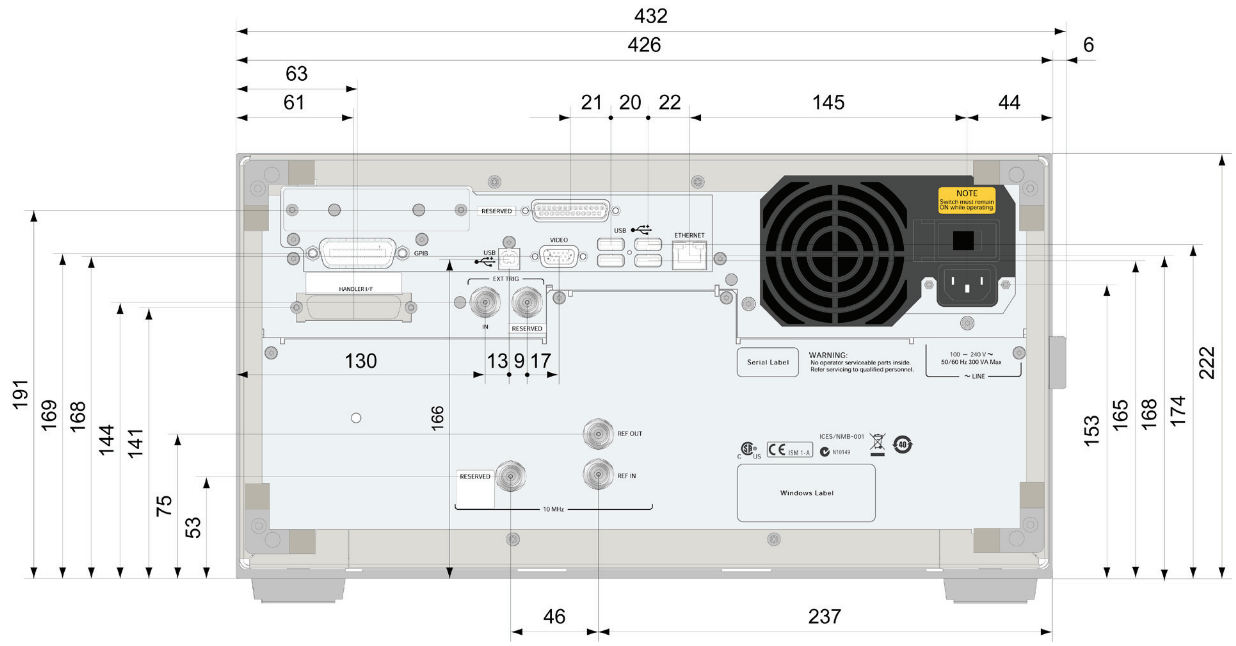



*Figure 13. Rear view*

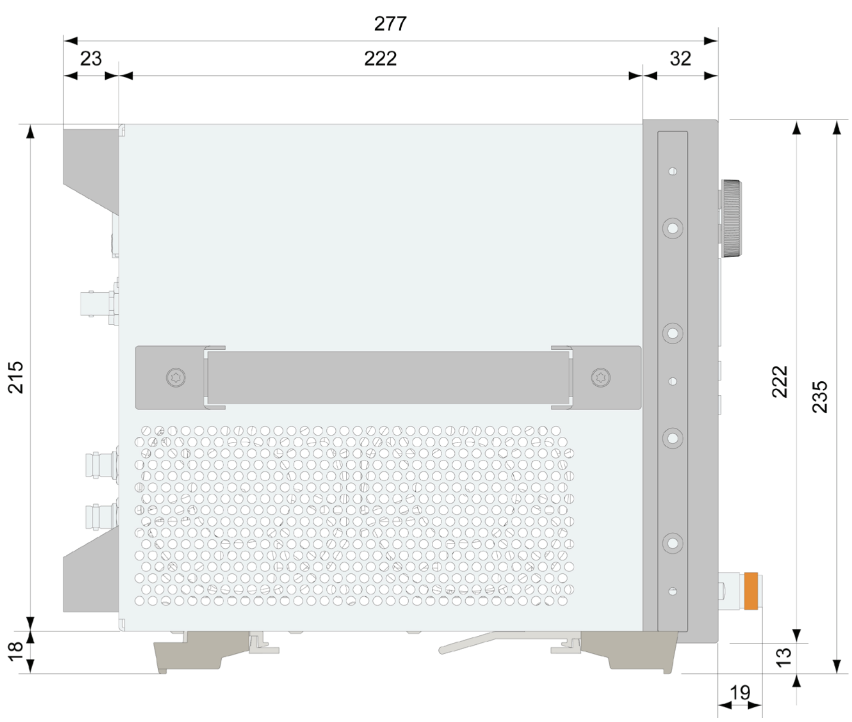



*Figure 14. Side view*

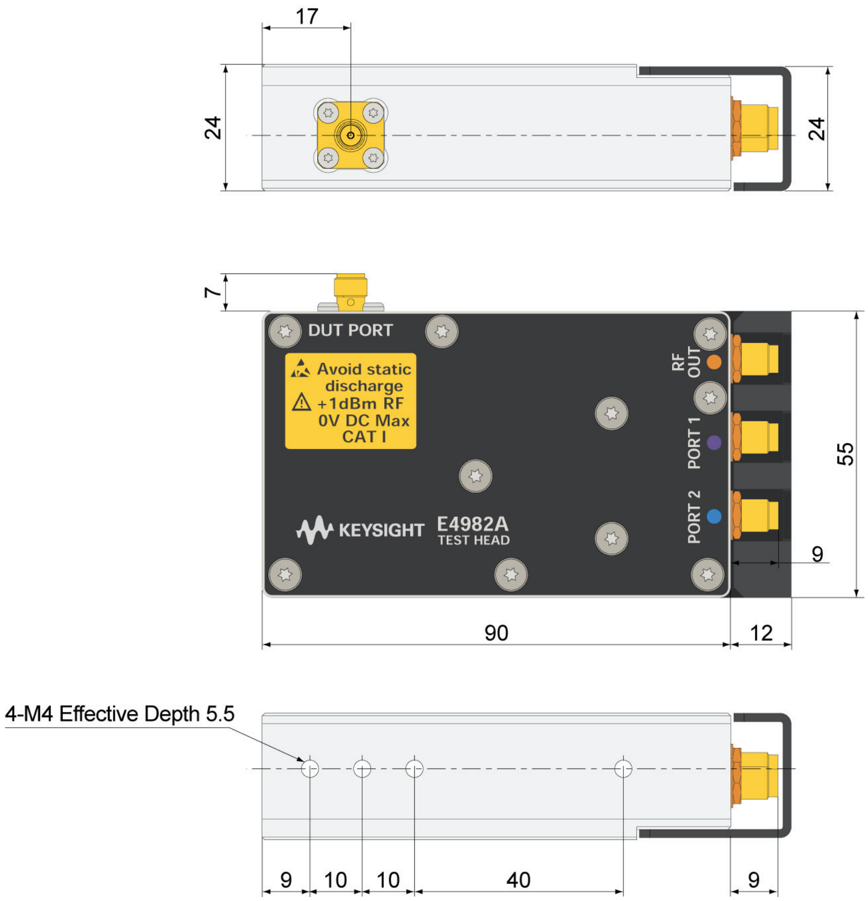



*Figure 15. Test head*

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