

# R&S® LCX LCR METER

The top-class in component testing



Data Sheet  
Version 02.01

**ROHDE & SCHWARZ**

Make ideas real



# AT A GLANCE

The R&S®LCX LCR meters are versatile, extremely accurate and perform measurements quickly. They are ideal for challenging applications in research, development and production. Two instrument models and various options cover applications with a test signal frequency of up to 10 MHz. Internal and external bias functions, comprehensive analysis options and versatile test fixtures expand the wide range of possible applications.

The R&S®LCX100 LCR meter covers the frequency range from 4 Hz to 300 kHz. The R&S®LCX200 has an upper frequency limit of 500 kHz and can be extended to 1 MHz or 10 MHz using software options when needed. All instruments offer DC measurements as well. Internally generated voltages of up to 10 V cover most applications. Optionally, bias voltages of up to 40 V can be applied externally.

A fast logging function records all measured values up to 10 times per second.

Dynamic impedance measurements can be performed using the advanced analysis function. In these sweep measurements, the impedance values are determined for a series of frequency values or other parameters.

Measurements can be triggered and controlled externally via digital I/O ports. The binning function enables the measured components to be sorted by their values into up to eight categories.

The large capacitive touchscreen is the central element for modern and intuitive operation of the instruments and enables the graphical display of the measurement results.

Remote controllability and rack installation predestine the R&S®LCX for system applications.

## Key facts

| Features                                  | R&S®LCX100          | R&S®LCX200  |
|---|---------------------|---|
| Test signal frequency                     | DC, 4 Hz to 300 kHz | DC, 4 Hz to 10 MHz (option)   |
| Test signal voltage                       | 10 mV to 10 V       | ≤ 1 MHz: 10 mV to 10 V,<br>≤ 5 MHz: 50 mV to 2 V,<br>> 5 MHz: 100 mV to 1 V |
| DC bias voltage (internal)                | 0 V to +10 V        |   |
| DC bias current (internal)                | 0 mA to 200 mA      |   |
| External DC bias voltage, input           | 0 V to +40 V        |   |
| Source impedance                          | 100 Ω, 10 Ω         |   |
| Measurement range                         | 10 mΩ to 100 MΩ     |   |
| Basic accuracy for impedance measurements | 0.05%               |   |



# BENEFITS AND KEY FEATURES

## Universal LCR meter

- ▶ Fast, accurate and versatile
- ▶ Selectable frequency range
- ▶ Test signals for all requirements
- ▶ DC bias
- ▶ Measurement functions
- ▶ Data logging function

## Options for advanced applications

- ▶ R&S®LCX-K106 advanced analysis functions
- ▶ R&S®LCX-K107 digital I/O ports and binning function
- ▶ R&S®LCX-K108 extended bias functions
- ▶ R&S®LCX-K201/-K210 frequency upgrade to 1 MHz/10 MHz

## Easy operation

- ▶ High-resolution touchscreen
- ▶ Graphical representation of measurements
- ▶ Save and recall instrument settings

## Test fixtures

- ▶ R&S®LCX-Z1 test fixture for axial/radial lead type devices
- ▶ R&S®LCX-Z2 Kelvin clip lead
- ▶ R&S®LCX-Z3 test fixture for SMD components
- ▶ R&S®LCX-Z4 test tweezers for SMD components
- ▶ R&S®LCX-Z5 transformer test cables
- ▶ R&S®LCX-Z11 BNC extension

## Ideal for use in labs and test systems

- ▶ Tailored for use in labs and system racks
- ▶ Full remote capabilities
- ▶ Advanced instrument design: compact form factor, quiet operation



# UNIVERSAL LCR METER

## Fast, accurate and versatile

Both R&S®LCX models combine high measurement speed, accuracy and versatile measurement capabilities. This makes them the ideal instruments for standard measurements in development, for material analysis in research as well as for fast production testing. With their broad measurement ranges, they also cover applications with extremely low and extremely high impedances.

Three measurement times are available:

- ▶ Fast:  $\leq 15$  ms
- ▶ Medium:  $\leq 100$  ms
- ▶ Slow:  $\leq 500$  ms

The basic accuracy for impedance measurements is  $\pm 0.05\%$ , and for phase measurements  $\pm 0.03^\circ$ .

## Selectable frequency range

All R&S®LCX models measure under DC conditions. The AC range already begins at 4 Hz. The upper frequency limit on the R&S®LCX100 is 300 kHz. In its base configuration, the R&S®LCX200 is designed for a maximum frequency of 500 kHz; this frequency limit can, however, be extended to 1 MHz or 10 MHz. This means that the ideal instrument is available for any given application and budget.

## Test signals for all requirements

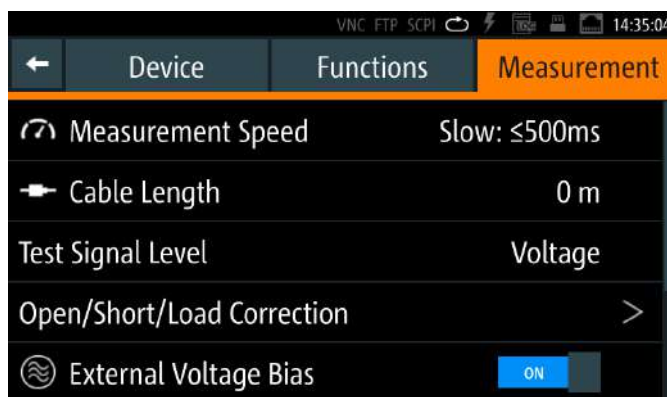
Test signals can be generated from 10 mV to 10 V and deliver a current of up to 200 mA. The instruments have a selectable output impedance of  $100 \Omega$  or  $10 \Omega$ . The actual current flow and the voltage applied are measured using the monitor function.

## DC bias

In many applications, an adjustable DC bias is necessary in order to measure C and L components at different operating points. The R&S®LCX100 and R&S®LCX200 generate a DC bias voltage of up to 10 V. As an option, it is also possible to set a DC bias current (up to 200 mA). DC bias voltages of up to 40 V can be applied at an external connection on the rear panel (R&S®LCX-K108 option) using a standard DC power supply, for example an R&S®NGA.



Up to four measurement parameters can be shown on the display at the same time



Test signals and measurement functions can be configured as required

## Measurement functions

In addition to the many different impedance measurements, the two R&S®LCX LCR meters are also able to measure resistances with DC voltage as well as transformers. The display can show up to four measurement parameters at the same time, and the measurement functions can be selected in pairs from the following table:

## Data logging function

The R&S®LCX LCR meters provide a fast logging function for recording all measured values. The data can be saved on an external USB flash drive or transferred to an external PC via USB or LAN. With a data rate of up to 10 sample/s, the measured values are available every 100 ms.

| List of measurement functions |   |
|-------------------------------|---|
| Cp                            | Capacitance value measured with parallel-equivalent circuit model               |
| Cs                            | Capacitance value measured with series-equivalent circuit model                 |
| Lp                            | Inductance value measured with parallel-equivalent circuit model                |
| Ls                            | Inductance value measured with series-equivalent circuit model                  |
| D                             | Dissipation factor  |
| Q                             | Quality factor (inverse of D)   |
| G                             | Equivalent parallel conductance measured with parallel-equivalent circuit model |
| Rp                            | Equivalent parallel resistance measured with parallel-equivalent circuit model  |
| Rs                            | Equivalent series resistance measured with series-equivalent circuit model      |
| Rdc                           | Direct current resistance   |
| R                             | Resistance  |
| X                             | Reactance   |
| Z                             | Impedance   |
| Y                             | Admittance  |
| $\theta_d$                    | Phase angle of impedance/admittance (degree)                                    |
| $\theta_r$                    | Phase angle of impedance/admittance (radian)                                    |
| B                             | Susceptance   |
| M                             | Mutual inductance   |
| N                             | Turns ratio   |



Measurement functions can be selected in pairs



# OPTIONS FOR ADVANCED APPLICATIONS

## R&S®LCX-K106 advanced analysis functions

In most cases, an LCR meter is used for measuring impedance values. However, depending on the type of component, these values vary to a greater or lesser degree at different frequencies and levels.

The R&S®LCX-K106 option, which is activated using a keycode (to be ordered separately), can be used for dynamic impedance measurements. In these sweep measurements, the impedance values are determined for a series of frequency values. The voltage or current values of the test signals or of the bias signal can also be used as sweep parameters. The results are shown in tables and graphically.

## R&S®LCX-K107 digital I/O ports and binning function

A further option for the R&S®LCX100/LCX200 instruments is a set of digital I/O ports. This includes a trigger input (implemented as a BNC connector) and eight data lines for binning. With this function, the measurement results can be divided into up to eight tolerance ranges and the measured components sorted by their values (controlled via these digital lines) into sorting containers installed by the customer.

The hardware of the R&S®LCX-K107 option is already installed; the function is activated using a keycode.



Digital I/O ports on rear panel

## R&S®LCX-K108 extended bias functions

As standard, the R&S®LCX100 and R&S®LCX200 generate internal DC bias voltages of up to 10 V. This already allows a wide variety of measurements to be performed. The R&S®LCX-K108 option extends the range of applications. On the one hand, this provides a larger voltage range when using the external bias ports on the rear of the LCR meters. Voltages of up to 40 V, e.g. from an external power supply unit, can be applied at the two 4 mm safety sockets. In this case, the current is protected by means of an externally accessible 0.5 A fine-wire fuse.

On the other hand, this option allows the internal bias source to be operated in current regulation mode with an adjustable current of up to 200 mA.

As with the previously mentioned option, the hardware of the R&S®LCX-K108 option is also already installed. It can be activated using a keycode (to be ordered separately).



Ports for external bias voltages on rear panel

## R&S®LCX-K201/-K210 frequency upgrade to 1 MHz/10 MHz

The R&S®LCX200 LCR meter has more powerful analysis hardware than the R&S®LCX100. In addition to DC, the R&S®LCX200 base unit offers a frequency bandwidth of 4 Hz to 500 kHz. Depending on the measurement requirements, the R&S®LCX-K201 option can be added on the instrument at any time to extend the bandwidth to 1 MHz. Alternatively, the R&S®LCX-K210 option is available to extend the bandwidth to 10 MHz.

Both options are keycodes, which can be installed on the R&S®LCX200 at any time; no hardware modification or additional calibration is required.

# EASY OPERATION

## High-resolution touchscreen

The large capacitive touchscreen is the central operating element of the R&S®LCX LCR meters. A virtual keyboard for entering the desired value is displayed by lightly tapping on a numerical value. Alternatively, the voltage, current and frequency can be set using the rotary knob. Functions that are less frequently used can be accessed and operated via menus.

With a very high resolution, the display sets new standards for LCR meters. The large, high-contrast display makes it easy to read all measured values, even from a distance. A wide variety of additional information, such as settings or statistics, can also be displayed. Icons clearly show the status of the set special functions.



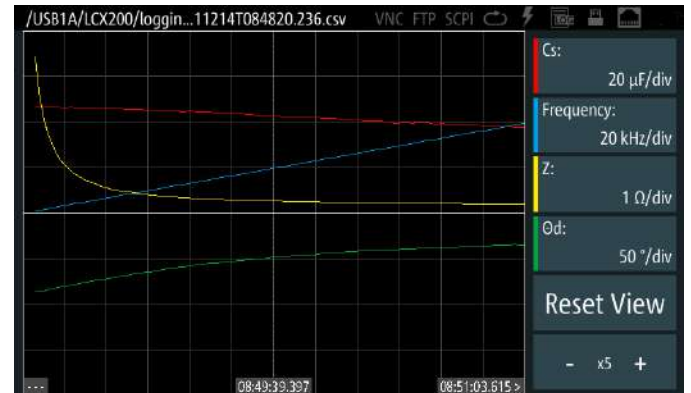
The measured values are displayed with up to 5-digit resolution. Up to four measured values can be displayed at a time.



Virtual keypad for entering numerical values

## Graphical representation of measurements

The large display can also be used for graphics. Up to four measurement functions can be selected and plotted versus time, and minimum and maximum values can be marked additionally.



The high-resolution display can also be used for graphical presentations. This example shows traces for impedance measurements of a capacitor.

## Save and recall instrument settings

The save and recall functions make it easy to save and recall frequently used settings. Three instrument settings can be accessed directly on the touchscreen. Other settings can be stored freely.



Three instrument settings can be called directly on the touchscreen

# TEST FIXTURES

LCR meters from Rohde & Schwarz can perform measurements on a wide range of components. Test fixtures are available that match the shape of the component.

The auto-balancing bridge (Kelvin bridge) measurement method requires the respective test lead pair to be routed up to the component to be measured (four-terminal measurement). This is ensured by all test fixtures, which makes them essential for accurate measurements and for minimizing parasitic impedances.

The fixtures are easily connected to the base unit by means of locking levers.

## R&S®LCX-Z1 test fixture for axial/radial lead type devices

This test fixture has two spring-loaded insertion slots into which axial/radial lead type devices can be inserted. A shorting plate is included for short-circuit correction.



## R&S®LCX-Z2 Kelvin clip lead

The Kelvin clips of the R&S®LCX-Z2 are used for connecting components which, e.g. due to their size, cannot be tested using conventional test fixtures. The two clip parts of each Kelvin clip are isolated from each other and therefore connected separately to the CUR and POT lines. This ensures that the two test leads are only connected directly at the DUT.



## R&S®LCX-Z3 test fixture for SMD components

The R&S®LCX-Z3 SMD test fixture is ideal for the qualification of SMD components. The terminal contact ends of the SMD component to be measured are clamped between the two contact pins (measuring contacts) provided.





### R&S®LCX-Z4 test tweezers for SMD components

Similar to the Kelvin clips mentioned above, the test tweezers can be used for contacting SMD components that cannot be placed in the SMD test fixture.



### R&S®LCX-Z5 transformer test cables

This test fixture is designed for measuring transformers and transducers in combination with the transformer measurement functions of the R&S®LCX LCR meters. It is a convenient tool for measuring the mutual inductance ( $M$ ), turns ratio ( $N$ ) and phase angle ( $\Theta$ ) of a transformer in the frequency range up to 100 kHz. To perform the measurement, the primary and secondary windings of the transformer to be measured are connected to the test leads according to the circuit diagram printed on the test fixture.



### R&S®LCX-Z11 BNC extension

This 1 m long extension allows the test fixture to be used at a distance from the measuring instrument. The effect of the cables is compensated by the base unit.



# IDEAL FOR USE IN LABS AND TEST SYSTEMS

## Tailored for use in labs and system racks

The R&S®LCX LCR meters are the right choice for challenging applications. They are used in R&D labs and integrated into production test systems.

The instruments can be installed in 19" racks using the R&S®ZZA-GE23 rack adapter. The compact design is critical for use in test systems.

## Full remote capabilities

For use in test systems, the R&S®LCX LCR meters can be remotely controlled. The following interfaces are available:

- ▶ USB and LAN (Ethernet) interfaces are installed as standard. All instrument parameters can be remotely controlled via these interfaces.
- ▶ IEEE-488 (GPIB) interface (R&S®NG-B105 option):  
The R&S®NG-B105 interface with IEEE-488 (GPIB) port can also be retrofitted by the user.

## Advanced instrument design: compact form factor, quiet operation

There is never enough space on the bench or in the rack. The R&S®LCX LCR meters take up very little space thanks to their compact design.

Since the built-in fan is temperature-controlled, it often runs at a low speed, resulting in extremely low operating noise.



All remote control interfaces are available on the rear panel of the instrument (example: R&S®LCX200 with installed IEEE-488 option)

# SPECIFICATIONS

## Definitions

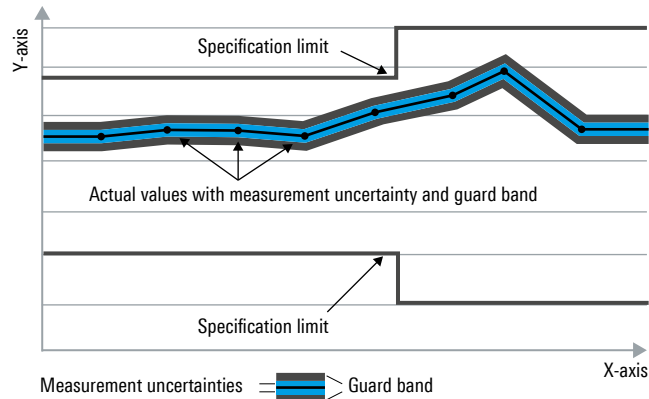
### General

Product data applies under the following conditions:

- ▶ Three hours storage at ambient temperature followed by 30 minutes warm-up operation
- ▶ All data is valid at +23°C (–3°C/+7°C) after 30 minutes warm-up time
- ▶ Specified environmental conditions met
- ▶ Recommended calibration interval adhered to
- ▶ All internal automatic adjustments performed, if applicable

### Specifications with limits

Represent warranted product performance by means of a range of values for the specified parameter. These specifications are marked with limiting symbols such as  $<$ ,  $\leq$ ,  $>$ ,  $\geq$ ,  $\pm$ , or descriptions such as maximum, limit of, minimum. Compliance is ensured by testing or is derived from the design. Test limits are narrowed by guard bands to take into account measurement uncertainties, drift and aging, if applicable.



### Specifications without limits

Represent warranted product performance for the specified parameter. These specifications are not specially marked and represent values with no or negligible deviations from the given value (for example, dimensions or resolution of a setting parameter). Compliance is ensured by design.

### Typical data (typ.)

Characterizes product performance by means of representative information for the given parameter. When marked with  $<$ ,  $>$  or as a range, it represents the performance met by approximately 80% of the instruments at production time. Otherwise, it represents the mean value.

### Nominal values (nom.)

Characterize product performance by means of a representative value for the given parameter (for example, nominal impedance). In contrast to typical data, a statistical evaluation does not take place and the parameter is not tested during production.

### Measured values (meas.)

Characterize expected product performance by means of measurement results gained from individual samples.

### Uncertainties

Represent limits of measurement uncertainty for a given measurand. Uncertainty is defined with a coverage factor of 2 and has been calculated in line with the rules of the Guide to the Expression of Uncertainty in Measurement (GUM), taking into account environmental conditions, aging, wear and tear.

Device settings and GUI parameters are indicated as follows: "parameter: value".

Typical data as well as nominal and measured values are not warranted by Rohde&Schwarz.

In line with the 3GPP standard, chip rates are specified in million chips per second (Mcps), whereas bit rates and symbol rates are specified in billion bit per second (Gbps), million bit per second (Mbps), thousand bit per second (kbps), million symbols per second (Msps) or thousand symbols per second (ksps), and sample rates are specified in million samples per second (Msample/s). Gbps, Mcps, Mbps, Msps, kbps, ksps and Msample/s are not SI units.

All data is valid at +23°C (– 3°C/+ 7°C) after 60 minutes warm-up time. All voltage/current data are RMS values unless otherwise specified.

| <b>Test signals</b>                   |  |  |
|---------------------------------------|--|--|
| <b>Test signal frequency</b>          |  |  |
| Frequency range                       | R&S®LCX100   | DC, 4 Hz to 300 kHz  |
|                                       | R&S®LCX200   | DC, 4 Hz to 500 kHz  |
|                                       | R&S®LCX200 with R&S®LCX-K201 option  | DC, 4 Hz to 1 MHz  |
|                                       | R&S®LCX200 with R&S®LCX-K210 option  | DC, 4 Hz to 1 MHz (at 10 Ω),<br>DC, 4 Hz to 10 MHz (at 100 Ω)  |
| Frequency resolution                  |  | 4 Hz to < 1 kHz: 0.1 Hz,<br>1 kHz to < 10 kHz: 1 Hz,<br>10 kHz to < 100 kHz: 10 Hz,<br>100 kHz to < 1 MHz: 100 Hz,<br>1 MHz to 10 MHz: 1 kHz |
| Frequency accuracy                    |  | ±100 ppm   |
| <b>Test signal modes</b>              |  |  |
| Modes                                 |  | open voltage (V), short current (C),<br>DC resistance (Rdc)  |
| <b>Test signal impedance</b>          |  |  |
| Source impedance                      |  | 100 Ω, 10 Ω  |
| Source impedance accuracy             | ±(% of setting + offset)   | < 2% + 200 mΩ (nom.)   |
| <b>Test signal level</b>              | Specifications are valid for impedance measurements (AC measurements) as well as for Rdc measurements. <sup>1)</sup> |  |
| <b>Test signal voltage (at 100 Ω)</b> |  |  |
| Voltage range                         | without load   | ≤ 1 MHz: 10 mV to 10 V <sup>2)</sup> ,<br>≤ 5 MHz: 50 mV to 2 V,<br>> 5 MHz: 100 mV to 1 V   |
| Voltage resolution                    |  | ≤ 2 V: 1 mV,<br>> 2 V: 10 mV   |
| Voltage setting accuracy in mode V    | ±(% of setting + offset)   | ≤ 1 MHz: < 5% + 2.5 mV,<br>> 1 MHz: < 10% + 5 mV,<br>> 5 MHz: < 15% + 10 mV  |
| <b>Test signal voltage (at 10 Ω)</b>  |  |  |
| Voltage range                         | without load   | ≤ 100 kHz: 10 mV to 2 V,<br>> 100 kHz to ≤ 1 MHz: 10 mV to 1 V   |
| Voltage resolution                    |  | 1 mV   |
| Voltage setting accuracy in mode V    | ±(% of setting + offset)   | < 5% + 2.5 mV (meas.)  |
| <b>Test signal current (at 100 Ω)</b> |  |  |
| Current range                         |  | ≤ 1 MHz: 0.1 mA to 100 mA,<br>≤ 5 MHz: 0.5 mA to 20 mA,<br>> 5 MHz: 1 mA to 10 mA  |
| Current resolution                    |  | ≤ 20 mA: 10 μA,<br>> 20 mA: 100 μA   |
| Current setting accuracy in mode C    | ±(% of setting + offset)   | ≤ 1 MHz: < 5% + 25 μA (meas.),<br>> 1 MHz: < 10% + 50 μA (meas.)   |
| <b>Test signal current (at 10 Ω)</b>  |  |  |
| Current range                         |  | ≤ 100 kHz: 1 mA to 200 mA,<br>> 100 kHz to ≤ 1 MHz: 1 mA to 100 mA   |
| Current resolution                    |  | 100 μA   |
| Current setting accuracy in mode C    | ±(% of setting + offset)   | < 5% + 25 μA (meas.)   |
| <b>Test signal monitor</b>            |  |  |
| Voltage monitor accuracy              | AC component   | voltage, current   |
| Voltage monitor accuracy              | ±(% of measured value + offset)  | ≤ 1 MHz: ≤ 2.5% + 5 mV   |
| Current monitor accuracy              | ±(% of measured value + offset)  | ≤ 1 MHz: ≤ 2.5% + 50 μA  |

<sup>1)</sup> All test signal specifications for voltages < 100 mV and for currents < 1 mA are only valid for R&S®LCX100 LCR meters with the firmware release 02.036 and for R&S®LCX200 LCR meters with serial numbers ≥ 102000.

<sup>2)</sup> If a 1 m long test cable is used, the maximum test voltage is reduced to 9.5 V.

| <b>DC bias signals</b>                    |  |   |
|---|--|---|
| <b>Internal bias voltage</b>              |  |   |
| Voltage range <sup>3)</sup>               | at 100 Ω source impedance                      | 0 V to 10 V (DC)  |
|   | at 10 Ω source impedance                       | 0 V to 2 V (DC)   |
| Voltage resolution                        |  | 10 mV   |
| Voltage setting accuracy                  | ±(% of setting + offset)                       | test signal < 5 V: < (1% + 4 mV) × K <sub>t</sub><br>test signal ≥ 5 V: < (1% + 12 mV) × K <sub>t</sub> |
|   | <b>K<sub>t</sub> (temperature coefficient)</b> |   |
|   | +23°C (–3°C/+7°C)                              | 1   |
|   | other temperatures                             | 1 + 0.1 × abs(T <sub>a</sub> – 23)  |
| <b>Internal bias current</b>              |  |   |
|   | R&S®LCX-K108 required                          |   |
| Current range                             |  | 0 mA to 200 mA (DC)   |
| Current resolution                        |  | 1 mA  |
| Current setting accuracy                  | ±(% of setting + offset)                       | < 1% + 1 mA   |
| Maximum DC resistance of DUT              | at 100 Ω source impedance                      | 50 Ω  |
|   | at 10 Ω source impedance                       | 5 Ω   |
| <b>External bias voltage<sup>4)</sup></b> |  |   |
|   | R&S®LCX-K108 required                          |   |
| Voltage range                             |  | 0 V to +40 V (DC)   |
| Voltage monitor resolution                |  | 11 mV   |
| Measurement accuracy                      | ±(% of measured value + offset)                | < 2.5% + 44 mV  |

| <b>Measurements</b>          |                           |  |
|------------------------------|---------------------------|--|
| <b>Measurement functions</b> |                           | L, C, R, Z, X, Y, G, B, D, Q, Θ, M, N, Rdc   |
| Impedance measurement range  | at 100 Ω source impedance | 100 mΩ to 100 MΩ                             |
|                              | at 10 Ω source impedance  | 10 mΩ to 100 Ω                               |
| Phase measurement range      |                           | –180° to +180°                               |
| Range selection              |                           | auto, manually                               |
| Cable length                 |                           | 0 m, 1 m                                     |
| Maximum test cable length    |                           | 1 m  |
| Measurement time             | test frequency ≥ 1 kHz    | fast: ≤ 15 ms,                               |
|                              |                           | medium: ≤ 100 ms,<br>slow: ≤ 500 ms          |
| <b>Compensation function</b> |                           |  |
|                              |                           | open, short, load                            |
| Open limits                  |                           | ≤ 5 MHz: min. 100 kΩ,<br>> 5 MHz: min. 10 kΩ |
| Short limits                 |                           | ≤ 5 MHz: max. 3 Ω,<br>> 5 MHz: max. 10 Ω     |

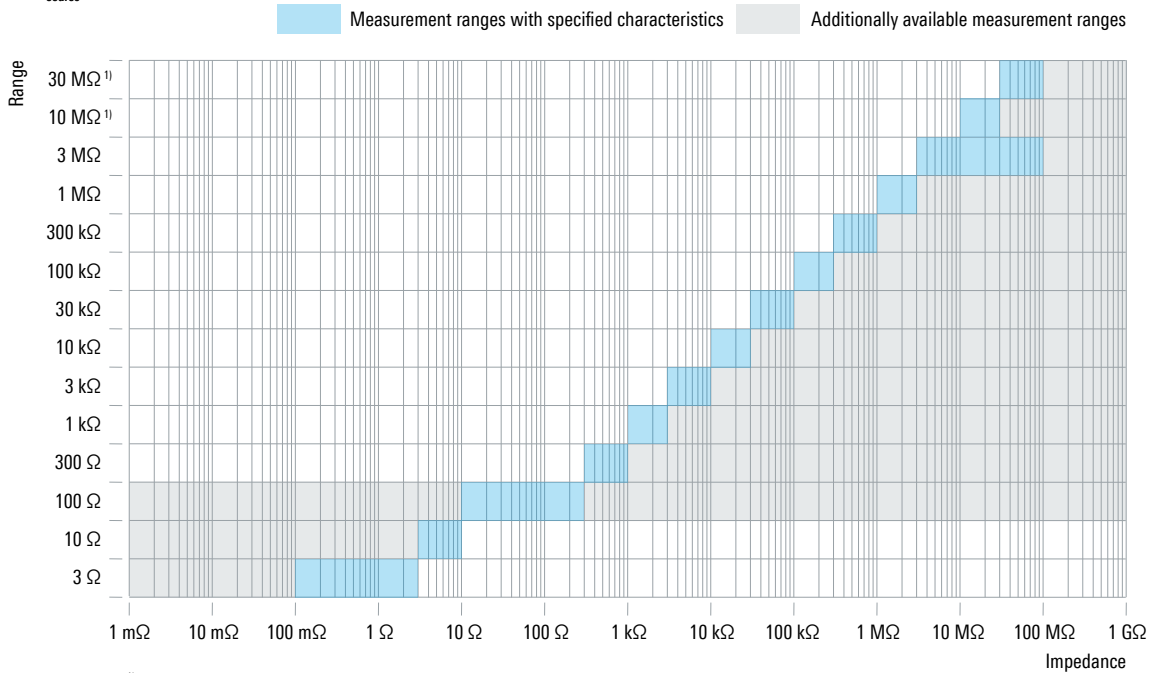
<sup>3)</sup> The combined output voltage (internal voltage bias plus the test signal voltage) is limited to 15 V (peak).

<sup>4)</sup> When using external voltage bias, the test signal level is limited to 2 V.



## Effective measurement ranges

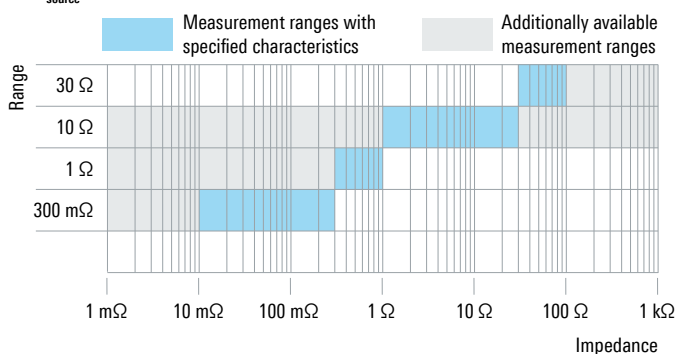
For  $R_{\text{source}} = 100 \Omega$



Specified measurement ranges for  $R_{\text{source}} = 100 \Omega$

- ▶ 3  $\Omega$  range: 0.1  $\Omega$  to 3  $\Omega$
- ▶ 10  $\Omega$  range: 3  $\Omega$  to 10  $\Omega$
- ▶ 100  $\Omega$  range: 10  $\Omega$  to 300  $\Omega$
- ▶ 300  $\Omega$  range: 300  $\Omega$  to 1 k $\Omega$
- ▶ 1 k $\Omega$  range: 1 k $\Omega$  to 3 k $\Omega$
- ▶ 3 k $\Omega$  range: 3 k $\Omega$  to 10 k $\Omega$
- ▶ 10 k $\Omega$  range: 10 k $\Omega$  to 30 k $\Omega$
- ▶ 30 k $\Omega$  range: 30 k $\Omega$  to 100 k $\Omega$
- ▶ 100 k $\Omega$  range: 100 k $\Omega$  to 300 k $\Omega$
- ▶ 300 k $\Omega$  range: 300 k $\Omega$  to 1 M $\Omega$
- ▶ 1 M $\Omega$  range: 1 M $\Omega$  to 3 M $\Omega$
- ▶ 3 M $\Omega$  range: 3 M $\Omega$  to 100 M $\Omega$
- ▶ 10 M $\Omega$  (> 2 V only): 10 M $\Omega$  to 30 M $\Omega$
- ▶ 30 M $\Omega$  range (> 2 V only): 30 M $\Omega$  to 100 M $\Omega$

For  $R_{\text{source}} = 10 \Omega$  (low Z mode)

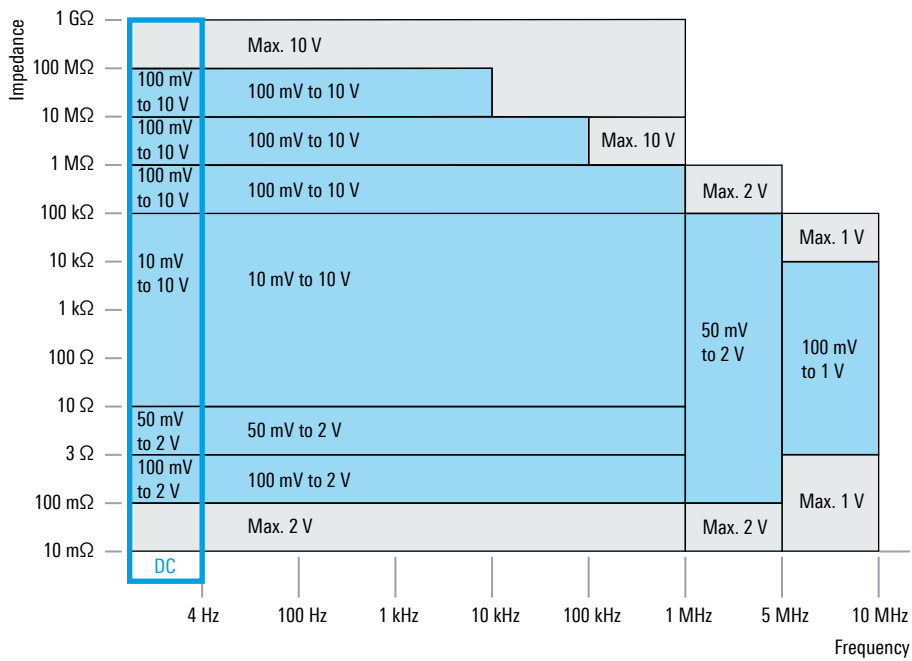


Specified measurement ranges for  $R_{\text{source}} = 10 \Omega$

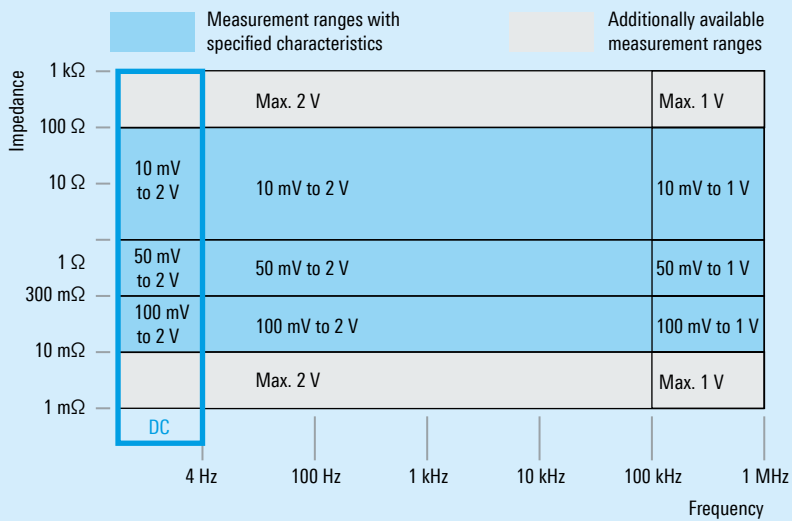
- ▶ 0.3  $\Omega$  range: 0.01  $\Omega$  to 0.3  $\Omega$
- ▶ 1  $\Omega$  range: 0.3  $\Omega$  to 1  $\Omega$
- ▶ 10  $\Omega$  range: 1  $\Omega$  to 30  $\Omega$
- ▶ 30  $\Omega$  range: 30  $\Omega$  to 100  $\Omega$

## Effective measurement ranges

For  $R_{\text{source}} = 100 \Omega$



For  $R_{\text{source}} = 10 \Omega$  (low Z mode)



<sup>1)</sup> All test signal specifications for voltages < 100 mV and for currents < 1 mA are only valid for R&S®LCX100 LCR meters with the firmware release 02.036 and for R&S®LCX200 LCR meters with serial numbers ≥ 102000.

## Measurement accuracy

The measurement accuracy is determined according to the following rule:

### Impedance (Z) measurement accuracy:

Impedance measurement accuracy in % = basic accuracy  $\times K_{sl} \times K_{ms} \times K_{cl} \times K_b \times K_t \times K_i$

Absolute impedance accuracy in % = impedance measurement accuracy in % + impedance calibration accuracy in %

### Phase (Phi) measurement accuracy:

Phase measurement accuracy in deg ( $^\circ$ ) =  $(180/\pi) \times$  impedance (measurement accuracy in %/100)

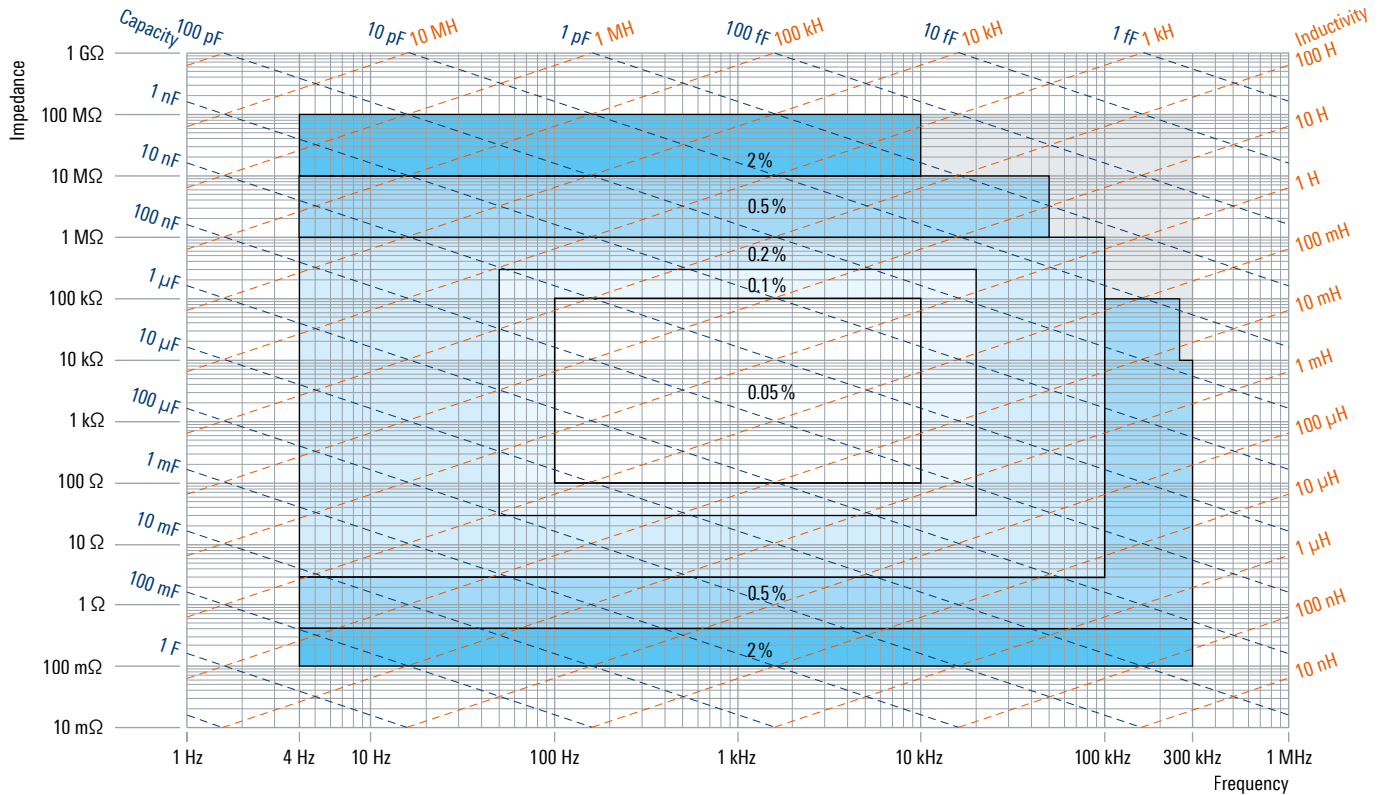
The minimum measurement accuracy is  $0.03^\circ$ .

Absolute phase accuracy in deg ( $^\circ$ ) = phase measurement accuracy in  $^\circ$  + phase calibration accuracy in  $^\circ$

### Basic accuracy (BA) of R&S<sup>®</sup> LCX100 for $R_{source} = 100 \Omega$

BA in % = accuracy in % +  $(Z_m/Z_o \times 100) + (Z_s/Z_m \times 100)$

$Z_m$  is the measured impedance;  $Z_o$  and  $Z_s$  are given in the table below



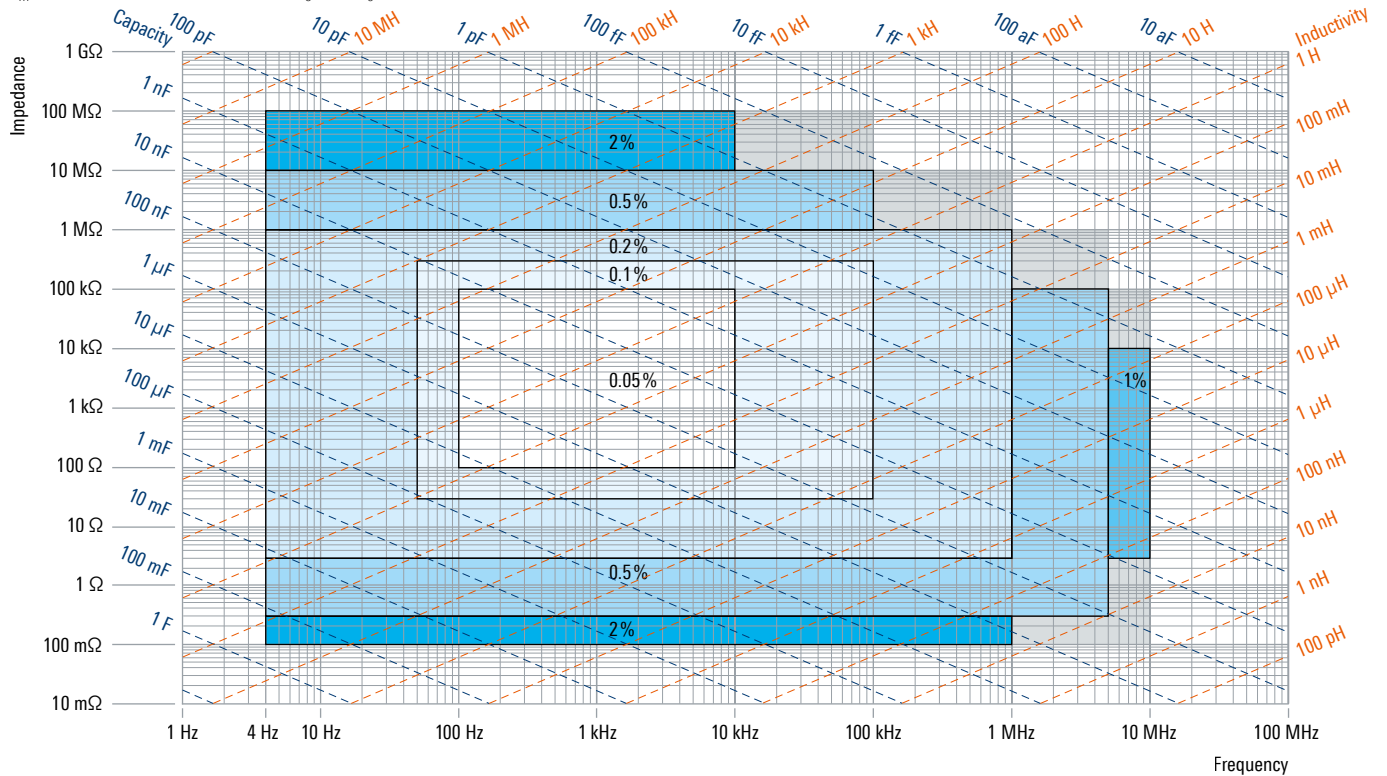
| Impedance open/short | Test signal frequency     | $Z_o$  | $Z_s$  |
|----------------------|---------------------------|--------|--------|
|                      | $\leq 1$ kHz              | 2 GΩ   | 1 mΩ   |
|                      | 1 kHz to $\leq 10$ kHz    | 1 GΩ   | 1 mΩ   |
|                      | 10 kHz to $\leq 100$ kHz  | 250 MΩ | 1.5 mΩ |
|                      | 100 kHz to $\leq 300$ kHz | 100 MΩ | 2.5 mΩ |

## Measurement accuracy

### Basic accuracy (BA) of R&S®LCX200 for $R_{source} = 100 \Omega$

BA in % = accuracy in % +  $(Z_m/Z_o \times 100)$  +  $(Z_o/Z_m \times 100)$

$Z_m$  is the measured impedance;  $Z_o$  and  $Z_s$  are given in the table below



| Impedance open/short | Test signal frequency    | $Z_o$          | $Z_s$          |
|----------------------|--------------------------|----------------|----------------|
|                      | $\leq 1$ kHz             | 2 G $\Omega$   | 1 m $\Omega$   |
|                      | 1 kHz to $\leq 10$ kHz   | 1 G $\Omega$   | 1 m $\Omega$   |
|                      | 10 kHz to $\leq 100$ kHz | 250 M $\Omega$ | 1.5 m $\Omega$ |
|                      | 100 kHz to $\leq 1$ MHz  | 150 M $\Omega$ | 1.5 m $\Omega$ |
|                      | 1 MHz to $\leq 5$ MHz    | 10 M $\Omega$  | 10 m $\Omega$  |
|                      | 5 MHz to $\leq 10$ MHz   | 1 M $\Omega$   | 30 m $\Omega$  |

In the case of operating points that occur at frequency-dependent limits, the basic accuracy which is valid for frequencies lower than the observed frequency applies.

▷ Example: 1 k $\Omega$  at 1 MHz ▷ 0.2% basic accuracy or 1 k $\Omega$  at 100 Hz ▷ 0.1% basic accuracy

In the case of operating points that occur at impedance-dependent limits, the basic accuracy which is valid for impedances higher than the observed impedance applies.

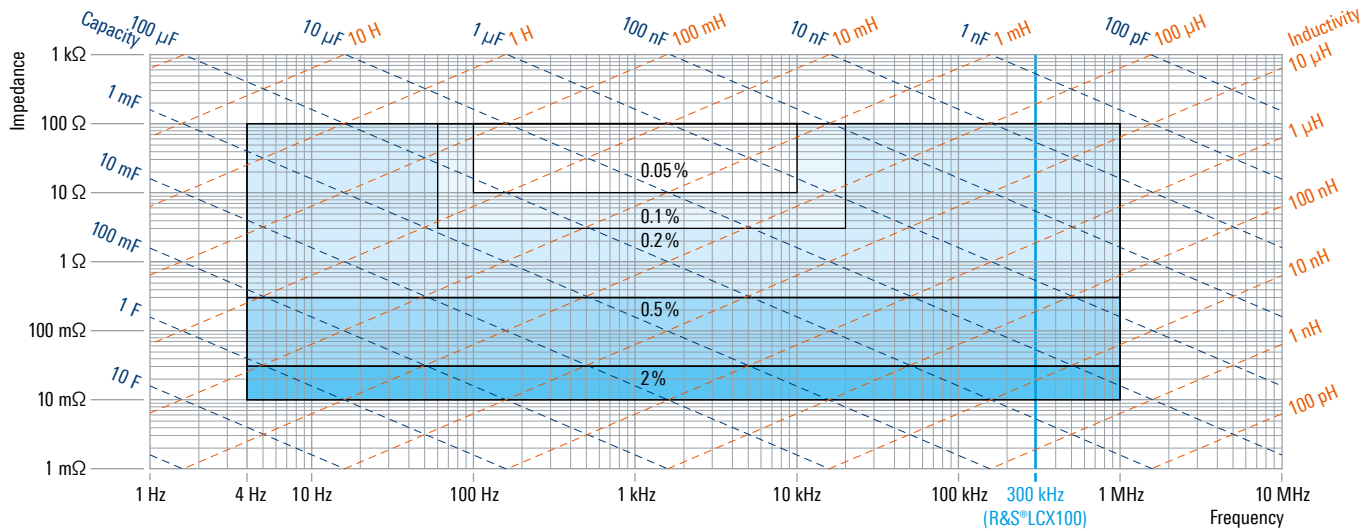
▷ Example: 100 k $\Omega$  at 1 kHz ▷ 0.1% basic accuracy or 3  $\Omega$  at 1 kHz ▷ 0.2% basic accuracy

## Measurement accuracy

### Basic accuracy (BA) of R&S®LCX100/LCX200 for $R_{source} = 10 \Omega$ (low Z mode)

BA in % = accuracy in % +  $(Z_s/Z_m \times 100)$

$Z_m$  is the measured impedance;  $Z_s$  is given in the table below (low Z mode)



#### Impedance short

Test signal frequency

$Z_s$

≤ 10 kHz

0.5 mΩ

10 kHz to ≤ 100 kHz

1 mΩ

100 kHz to ≤ 1 MHz

1.5 mΩ

## Measurement accuracy

### Basic accuracy (BA) of Rdc measurements for $R_{source} = 100 \Omega$

BA in % = accuracy in % +  $(Z_m/20 \text{ G}\Omega \times 100)$  +  $(1 \text{ m}\Omega/Z_m \times 100)$

$Z_m$  is the measured impedance

#### Impedance range

#### Accuracy

< 300 mΩ

2.0%

300 mΩ to < 30 Ω

0.5%

30 Ω to < 100 Ω

0.2%

100 Ω to < 100 kΩ

0.1%

100 kΩ to < 300 kΩ

0.2%

300 kΩ to < 10 MΩ

0.5%

10 MΩ to 100 MΩ

2.0%

## Measurement accuracy

#### $K_{sl}$ (level coefficient)

#### Sv

#### $K_{sl}$

0 mV to 200 mV

$1 + 0.2/Sv^{5)}$

> 200 mV to 500 mV

$0.5 + 0.5/Sv$

> 500 mV to 1 V

$1/Sv$

> 1 V to 2 V

$0.5 + 2/Sv$

> 2 V to 5 V

$1 + 5/Sv$

> 5 V to 10 V

$1 + 10/Sv$

#### $K_{ms}$ (measurement speed coefficient)

fast

8

medium

3

slow

1

#### $K_{cl}$ (cable length coefficient)

0 m

1

1 m

1.5

<sup>5)</sup> Sv: setting value in V.



| Measurement accuracy   |  |  |                            |
|--|--|--|----------------------------|
| $K_b$ (bias coefficient)   | <b>bias setting</b>                                    | $K_b$  |                            |
|  | bias voltage on<br>(internal or external bias voltage) | 2  |                            |
|  | bias current on  | 5 (for test frequency < 1 kHz),<br>2 (for test frequency $\geq$ 1 kHz) |                            |
|  | bias off   | 1  |                            |
| $K_t$ (temperature coefficient)  | +23 °C (-3 °C/+7 °C)                                   | 1  |                            |
|  | other temperatures                                     | $1 + 0.1 \times \text{abs}(T_a - 23)$                                  |                            |
| $K_f$ (frequency coefficient)  | test signal frequency $\leq$ 300 kHz                   | 1  |                            |
|  | test signal frequency > 300 kHz                        | $(f + 4550)/4850$ with f in kHz  |                            |
| <b>Calibration accuracy of R&amp;S®LCX100/LCX200 for <math>R_{\text{source}} = 100 \Omega</math> and <math>\leq 2 \text{ V}</math></b> |  |  |                            |
|  | Test frequency   | Impedance calibration accuracy   | Phase calibration accuracy |
| 3 $\Omega$ and 10 $\Omega$ range   | $\leq$ 1 MHz   | $\pm 0.03\%$   | $\pm 0.025^\circ$          |
|  | > 1 MHz to $\leq$ 5 MHz                                | $\pm 0.05\%$   | $\pm 0.025^\circ$          |
|  | > 5 MHz to 10 MHz                                      | $\pm 0.2\%$  | $\pm 0.05^\circ$           |
| 100 $\Omega$ and 300 $\Omega$ range  | $\leq$ 1 MHz   | $\pm 0.03\%$   | $\pm 0.025^\circ$          |
|  | > 1 MHz to $\leq$ 5 MHz                                | $\pm 0.05\%$   | $\pm 0.025^\circ$          |
|  | > 5 MHz to 10 MHz                                      | $\pm 0.2\%$  | $\pm 0.05^\circ$           |
| 1 k $\Omega$ and 3 k $\Omega$ range  | $\leq$ 1 MHz   | $\pm 0.03\%$   | $\pm 0.025^\circ$          |
|  | > 1 MHz to $\leq$ 5 MHz                                | $\pm 0.05\%$   | $\pm 0.025^\circ$          |
|  | > 5 MHz to 10 MHz                                      | $\pm 0.2\%$  | $\pm 0.05^\circ$           |
| 10 k $\Omega$ and 30 k $\Omega$ range  | $\leq$ 1 MHz   | $\pm 0.03\%$   | $\pm 0.025^\circ$          |
| 100 k $\Omega$ and 300 k $\Omega$ range  | $\leq$ 1 MHz   | $\pm 0.03\%$   | $\pm 0.025^\circ$          |
| 1 M $\Omega$ and 30 M $\Omega$ range   | $\leq$ 100 kHz   | $\pm 0.05\%$   | $\pm 0.05^\circ$           |
| <b>Calibration accuracy of R&amp;S®LCX100/LCX200 for <math>R_{\text{source}} = 100 \Omega</math> and <math>&gt; 2 \text{ V}</math></b> |  |  |                            |
|  | Test frequency   | Impedance calibration accuracy   | Phase calibration accuracy |
| 3 $\Omega$ and 10 $\Omega$ range   | $\leq$ 1 MHz   | $\pm 0.03\%$   | $\pm 0.025^\circ$          |
| 100 $\Omega$ and 300 $\Omega$ range  | $\leq$ 1 MHz   | $\pm 0.03\%$   | $\pm 0.025^\circ$          |
| 1 k $\Omega$ and 3 k $\Omega$ range  | $\leq$ 1 MHz   | $\pm 0.03\%$   | $\pm 0.025^\circ$          |
| 10 k $\Omega$ and 30 k $\Omega$ range  | $\leq$ 1 MHz   | $\pm 0.03\%$   | $\pm 0.025^\circ$          |
| 100 k $\Omega$ and 300 k $\Omega$ range  | $\leq$ 1 MHz   | $\pm 0.03\%$   | $\pm 0.025^\circ$          |
| 1 M $\Omega$ and 3 M $\Omega$ range  | $\leq$ 1 MHz   | $\pm 0.03\%$   | $\pm 0.025^\circ$          |
| 10 M $\Omega$ and 30 M $\Omega$ range  | $\leq$ 100 kHz   | $\pm 0.05\%$   | $\pm 0.05^\circ$           |
| <b>Calibration accuracy of R&amp;S®LCX100/LCX200 for <math>R_{\text{source}} = 10 \Omega</math> and <math>\leq 2 \text{ V}</math></b>  |  |  |                            |
|  | Test frequency   | Impedance calibration accuracy   | Phase calibration accuracy |
| 300 m $\Omega$ , 1 $\Omega$ , 10 $\Omega$ and 30 $\Omega$ ranges   | $\leq$ 1 MHz   | $\pm 0.03\%$   | $\pm 0.025^\circ$          |
|  | > 1 MHz to $\leq$ 5 MHz                                | $\pm 0.1\%$  | $\pm 0.05^\circ$           |
| <b>Basic accuracy</b>  |  |  |                            |
| Impedance  |  | $\pm 0.05\%$   |                            |
| Rdc  |  | $\pm 0.1\%$  |                            |
| Phase  |  | $\pm 0.03^\circ$   |                            |

## Special functions

|   |                       |   |
|---|-----------------------|---|
| <b>Transformer measurements</b>               |                       | R&S®LCX-Z5 required   |
| Test signal frequency                         |                       | 4 Hz to 100 kHz   |
| Test signal voltage                           |                       | 10 mV to 2 V  |
| Measurement ranges                            | turns ratio (N)       | 0.95 N to 500 N   |
|   | phase angle (Θ)       | -180° to +180°  |
|   | mutual inductance (M) | 1 μH to 100 H   |
| Accuracy                                      |                       | N ≤ 10 and 100 Hz ≤ f ≤ 10 kHz: N: ±1% (meas.)<br>Θ: ±0.2° (meas.) (with minimal primary impedance: 100 Ω)      |
|   | mutual inductance (M) | N ≤ 20, f ≤ 10 kHz and 300 μH ≤ M ≤ 50 mH:<br>±0.5% ±1 μH (meas.)   |
| <b>Digital trigger and control interfaces</b> |                       | R&S®LCX-K107 required   |
| Trigger mode                                  |                       | continuous,<br>manual (hardkey on front),<br>external via remote control,<br>external via digital I/O interface |
| Trigger delay time                            |                       | 0 s to 60 s (100 ms increments)   |
| <b>Digital trigger</b>                        |                       |   |
| Maximum digital voltage                       | BNC connector         | 24 V DC   |
| Pull-down resistor                            | BNC connector         | 6.1 kΩ  |
| Input level                                   | BNC connector         | < 0.8 V (nom.),<br>> 5.0 V (nom.)   |
| <b>Digital control</b>                        |                       |   |
| Maximum digital voltage                       | D-Sub port            | 24 V DC   |
| Pull-down resistor                            | D-Sub port            | 20 kΩ   |
| Input level                                   | D-Sub port            | < 0.8 V (nom.),<br>> 2.4 V (nom.)   |
| Maximum drain current (OUT)                   |                       | 500 mA  |
| <b>Binning</b>                                |                       | R&S®LCX-K107 required   |
| Number of bins                                |                       | up to 8   |
| Binning modes                                 |                       | nominal, absolute   |
| <b>Sweep</b>                                  |                       | R&S®LCX-K106 required   |
| Sweep parameters                              |                       | test frequency, test signal voltage, bias voltage,<br>bias current  |
| Sweep modes                                   |                       | points (1 to 65536 points), interval  |
| <b>Data logging</b>                           |                       | R&S®LCX-K106 required   |
| Maximum acquisition rate                      |                       | 10 sample/s   |
| Memory depth                                  |                       | internal (up to 950 Mbyte) or external memory   |
| Voltage resolution                            |                       | see monitor resolution  |
| Voltage accuracy                              |                       | see monitor accuracy  |
| Current resolution                            |                       | see monitor resolution  |
| Current accuracy                              |                       | see monitor accuracy  |
| <b>Special measurement functions</b>          | R&S®LCX-K106 required | dynamic impedance measurements, graphical<br>chart view   |

## Protection functions

|                      |                         |                             |
|----------------------|-------------------------|-----------------------------|
| Discharge protection | $V_{\max} < \sqrt{2}/C$ | 1 Joule, max. 200 V (meas.) |
|----------------------|-------------------------|-----------------------------|

## Display and interfaces

|                                |          |   |
|--------------------------------|----------|---|
| Display                        |          | TFT 5" 800 × 480 pixel WVGA touch display |
| Measurement terminal           |          | 4 BNC connectors                          |
| Remote control interfaces      | standard | USB-TMC,<br>USB-CDC (virtual COM),<br>LAN |
|                                | optional | IEEE-488 (GPIB)                           |
| Remote command processing time |          | < 5 ms (nom.)                             |
| Control interface              |          | 15-pin D-Sub trigger I/O                  |
| Trigger interface              |          | BNC connector                             |
| Save/recall                    |          | unlimited (internal or external memory)   |
| Presets                        |          | 3   |

## Options

### R&S®LCX-Z1 test fixture for axial/radial lead type devices

|                       |  |  |
|-----------------------|--|--|
| Measurable components |  | resistors, coils or capacitors with axial or radial connecting wires |
| Frequency range       |  | DC to 10 MHz   |
| DC bias               |  | 0 V to 40 V  |
| Weight                |  | approx. 200 g  |

### R&S®LCX-Z2 Kelvin clip lead

|                       |  |                                |
|-----------------------|--|--------------------------------|
| Measurable components |  | resistors, coils or capacitors |
| Frequency range       |  | DC to 100 kHz                  |
| DC bias               |  | 0 V to 40 V                    |
| Weight                |  | approx. 250 g                  |

### R&S®LCX-Z3 test fixture for SMD components

|                       |  |                                    |
|-----------------------|--|------------------------------------|
| Measurable components |  | SMD resistors, coils or capacitors |
| Frequency range       |  | DC to 10 MHz                       |
| DC bias               |  | 0 V to 40 V                        |
| Weight                |  | approx. 325 g                      |

### R&S®LCX-Z4 test tweezers for SMD components

|                       |  |                                    |
|-----------------------|--|------------------------------------|
| Measurable components |  | SMD resistors, coils or capacitors |
| Frequency range       |  | DC to 10 MHz                       |
| DC bias               |  | 0 V to 40 V                        |
| Weight                |  | approx. 280 g                      |

### R&S®LCX-Z5 transformer test cables

|                       |  |                            |
|-----------------------|--|----------------------------|
| Measurable components |  | transformers, transmitters |
| Frequency range       |  | DC to 100 kHz              |
| DC bias               |  | 0 V to 40 V                |
| Weight                |  | approx. 260 g              |

### R&S®LCX-Z11 BNC extension

|                 |  |               |
|-----------------|--|---------------|
| Frequency range |  | DC to 1 MHz   |
| Length          |  | 1 m           |
| Weight          |  | approx. 300 g |

| General data                               |   |  |
|--|---|--|
| <b>Environmental conditions</b>            |   |  |
| Temperature (base units and test fixtures) | operating temperature range   | +5°C to +40°C  |
|  | storage temperature range   | -20°C to +70°C   |
| Humidity                                   | without condensation  | 5% to 95%  |
| Altitude                                   | operating altitude  | max. 2000 m above sea level  |
| <b>Power rating</b>                        |   |  |
| Mains nominal voltage                      |   | 100 V to 240 V AC (±10%)   |
| Mains frequency                            |   | 50 Hz to 60 Hz   |
| Maximum power consumption                  |   | 60 W (meas.)   |
| Rated current                              |   | max. 1 A (meas.)   |
| Mains fuses                                |   | IEC 60127-2/5 T2.0H/250 V  |
| <b>Product conformity</b>                  |   |  |
| Electromagnetic compatibility              | EU: in line with EU EMC Directive 2014/30/EU                                | applied standards:<br><ul style="list-style-type: none"> <li>▶ EN 61326-1</li> <li>▶ EN 61326-2-1</li> <li>▶ EN 55011 (Class A)</li> <li>▶ EN 61000-3-2</li> <li>▶ EN 61000-3-3</li> <li>▶ KN61000-4-11</li> </ul> |
|  | Korea   | KC mark  |
| Electrical safety                          | EU:<br>in line with Low Voltage Directive 2014/35/EU                        | applied harmonized standard:<br>EN 61010-1   |
|  | USA, Canada   | CNA/CSA C22.2 No. 61010-1-12   |
| RoHS                                       | in line with EU Directive 2011/65/EU  | EN IEC 63000   |
| <b>Mechanical resistance</b>               |   |  |
| Vibration                                  | sinusoidal  | 5 Hz to 55 Hz, 0.3 mm (peak-to-peak),<br>55 Hz to 150 Hz, 0.5 g constant,<br>in line with EN 60068-2-6   |
|  | wideband noise  | 8 Hz to 500 Hz, acceleration: 1.2 g (RMS),<br>in line with EN 60068-2-64   |
| Shock                                      |   | 40 g shock spectrum,<br>in line with MIL-STD-810E, method 516.4,<br>procedure I  |
| <b>Mechanical data</b>                     |   |  |
| Dimensions                                 | W × H × D   | 362 mm × 99 mm × 357 mm<br>(14.25 in × 3.9 in × 14.06 in)  |
| Weight                                     |   | 2.7 kg (5.95 lb)   |
| Rack installation                          | R&S®ZZA-GE23  | 19", 2 HU  |
| Recommended calibration interval           | operation 40 h/week over entire range of specified environmental conditions | 1 year   |



R&S®LCX200, rear view

# ORDERING INFORMATION

| Designation   | Type         | Order No.    |
|---|--------------|--------------|
| <b>Base units</b>   |              |              |
| LCR meter, 300 kHz  | R&S®LCX100   | 3629.8856.02 |
| LCR meter, 500 kHz  | R&S®LCX200   | 3629.8856.03 |
| <b>Accessories supplied:</b> set of power cables, quick start guide |              |              |
| <b>Options</b>  |              |              |
| Advanced analysis functions   | R&S®LCX-K106 | 3630.1922.03 |
| Digital I/O ports and binning function                              | R&S®LCX-K107 | 3660.7741.03 |
| Extended bias functions   | R&S®LCX-K108 | 3692.9791.03 |
| Frequency upgrade to 1 MHz, for R&S®LCX200                          | R&S®LCX-K201 | 3630.1880.03 |
| Frequency upgrade to 10 MHz, for R&S®LCX200                         | R&S®LCX-K210 | 3630.1900.03 |
| IEEE-488 (GPIB) interface, for R&S®NGP/LCX                          | R&S®NG-B105  | 5601.6000.02 |
| <b>Test fixtures</b>  |              |              |
| Test fixture for axial/radial lead type devices                     | R&S®LCX-Z1   | 3639.2296.02 |
| Kelvin clip lead  | R&S®LCX-Z2   | 3638.6446.02 |
| Test fixture for SMD components                                     | R&S®LCX-Z3   | 3639.2509.02 |
| Test tweezers for SMD components                                    | R&S®LCX-Z4   | 3639.2515.02 |
| Transformer test cables   | R&S®LCX-Z5   | 3639.2521.02 |
| BNC extension, length: 1 m  | R&S®LCX-Z11  | 3639.2538.02 |
| <b>System components</b>  |              |              |
| 19" rack adapter, 2 HU  | R&S®ZZA-GE23 | 5601.4059.02 |

| Warranty   |         |   |
|--|---------|---|
| Base unit  |         | 3 years   |
| All other items <sup>1)</sup>                          |         | 1 year  |
| <b>Service options</b>                                 |         |   |
| Extended warranty, one year                            | R&S®WE1 | Contact your local Rohde & Schwarz sales office for more information. |
| Extended warranty, two years                           | R&S®WE2 |   |
| Extended warranty with calibration coverage, one year  | R&S®CW1 |   |
| Extended warranty with calibration coverage, two years | R&S®CW2 |   |

## Extended warranty with a term of one and two years (WE1 and WE2)

Repairs carried out during the contract term are free of charge<sup>2)</sup>. Necessary calibration and adjustments carried out during repairs are also covered.

## Extended warranty with calibration coverage (CW1 and CW2)

Enhance your extended warranty by adding accredited calibration coverage at a package price. This package ensures that your Rohde & Schwarz product is regularly calibrated, inspected and maintained during the term of the contract. It includes all repairs<sup>2)</sup> and calibration at the recommended intervals as well as any calibration carried out during repairs or option upgrades.

<sup>1)</sup> For options installed, the remaining base unit warranty applies if longer than 1 year. Exception: all batteries have a 1 year warranty.

<sup>2)</sup> Excluding defects caused by incorrect operation or handling and force majeure. Wear-and-tear parts are not included.



## Service at Rohde & Schwarz You're in great hands

- ▶ Worldwide
- ▶ Local and personalized
- ▶ Customized and flexible
- ▶ Uncompromising quality
- ▶ Long-term dependability

## Rohde & Schwarz

The Rohde&Schwarz technology group is among the trail-blazers when it comes to paving the way for a safer and connected world with its leading solutions in test & measurement, technology systems and networks&cybersecurity. Founded more than 85 years ago, the group is a reliable partner for industry and government customers around the globe. The independent company is headquartered in Munich, Germany and has an extensive sales and service network with locations in more than 70 countries.

[www.rohde-schwarz.com](http://www.rohde-schwarz.com)

## Sustainable product design

- ▶ Environmental compatibility and eco-footprint
- ▶ Energy efficiency and low emissions
- ▶ Longevity and optimized total cost of ownership

Certified Quality Management

**ISO 9001**

## Rohde & Schwarz training

[www.training.rohde-schwarz.com](http://www.training.rohde-schwarz.com)

## Rohde & Schwarz customer support

[www.rohde-schwarz.com/support](http://www.rohde-schwarz.com/support)



取扱代理店

 **国華電機株式会社**  
KOKKA ELECTRIC CO.,LTD.

|         |                    |
|---------|--------------------|
| 本 社     | TEL : 06-6353-5551 |
| 京都営業所   | TEL : 075-671-0141 |
| 滋賀営業所   | TEL : 077-566-6040 |
| 奈良営業所   | TEL : 0742-33-6040 |
| 兵庫営業所   | TEL : 078-452-3332 |
| 姫路営業所   | TEL : 079-271-4488 |
| 姫路中央営業所 | TEL : 079-284-1005 |
| 川崎営業所   | TEL : 044-222-1212 |

メールでのお問い合わせ : [webinfo@kokka-e.co.jp](mailto:webinfo@kokka-e.co.jp)