

PeakTech[®]

Prüf- und Messtechnik

 Spitzentechnologie, die überzeugt



PeakTech[®] 2170

**Bedienungsanleitung
Operation manual**

Digital LCR/ESR-Meter

1. Safety Precautions

This product complies with the requirements of the following European Community Directives 2004/108/EC (Electromagnetic Compatibility) and 2006/95/EC (Low Voltage) as amended by 2004/22/EC (CE-Marking).

To ensure safe operation of the equipment and eliminate the danger of serious injury due to short-circuits (arcing) the following safety precautions must be observed.

Damages resulting from failure to observe these safety precautions are exempt from any legal claims whatever.

- * Do not use this instrument for high-energy industrial installation measurement.
- * Do not place the equipment on damp or wet surfaces.
- * Do not operate the equipment near strong magnetic fields (motors, transformers etc.).
- * Disconnect test leads or probe from the measuring circuit before switching modes or functions.
- * To avoid electric shock, disconnect power to the unit under test and discharge all capacitors before taking any resistance measurements.
- * Do not conduct voltage measurements in resistance measurement function!
- * Check test leads and probes for faulty insulation or bare wires before connection to the equipment.
- * Please use only 4mm-safety test leads to ensure immaculate function.
- * To avoid electric shock, do not operate this product in wet or damp conditions. Conduct measuring works only in dry clothing and rubber shoes, i. e. on isolating mats.
- * Never touch the tips of the test leads or probe.
- * Comply with the warning labels and other info on the equipment.

- * The measurement instrument is not to be operated unattended.
- * Always start with the highest measuring range when measuring unknown values.
- * Do not subject the equipment to direct sunlight or extreme temperatures, humidity or dampness.
- * Do not subject the equipment to shocks or strong vibrations.
- * Keep hot soldering irons or guns away from the equipment.
- * Allow the equipment to stabilize at room temperature before taking up measurement (important for exact measurements).
- * Do not input values over the maximum range of each measurement to avoid damages of the meter.
- * Replace the battery as soon as the battery indicator “BAT” appears. With a low battery, the meter might produce false reading that can lead to electric shock and personal injury.
- * Fetch out the battery when the meter will not be used for long period.
- * Periodically wipe the cabinet with a damp cloth and mild detergent. Do not use abrasives or solvents.
- * The meter is suitable for indoor use only
- * Do not operate the meter before the cabinet has been closed and screwed safely as terminal can carry voltage.
- * Do not store the meter in a place of explosive, inflammable substances.
- * Do not modify the equipment in any way
- * Do not place the equipment face-down on any table or work bench to prevent damaging the controls at the front.
- * Opening the equipment and service – and repair work must only be performed by qualified service personnel
- * **-Measuring instruments don't belong to children hands.-**

Cleaning the cabinet

Clean only with a damp, soft cloth and a commercially available mild household cleanser. Ensure that no water gets inside the equipment to prevent possible shorts and damage to the equipment.

1.1. Safety Symbols




Caution! Refer to accompanying documents!



Caution! Risk of electric shock.

2. General Specifications

Display	4 ½ digit LCD Multi-Function Display, max. 19999/1999 Counts
Overload indication	"OL" display
Low battery indication	The  is displayed when the battery voltage drops below the operating level.
Auto power	As the "APO" is displayed on the LCD, the meter will shut down by itself if unused for about 5 minutes, press the power key to resume power-on mode. The meter will cancel auto power off function when PCLINK or external power is in use.
Dimensions (WxHxD)	98 x 205 x 48 mm
Weight	approx. 495g (including battery)
Accessories	Kelvin-Clips, 1 pcs. short-socket for SHORT-calibration, USB-interface cable, software-CD for windows XP/VISTA/7, 6 x 1,5 V AAA-batteries, carrying case, operation manual
Optional Accessories	AC-DC Adapter 12V/500mA DC

3. Specification

Parameter	Primary	DCR: DC resistance Ls/Cs: Series - inductance / capacitance Lp/Cp: Parallel – inductance / capacitance	
	Secondary	θ : phase angle D: dissipation factor ESR: equivalent series resistance Q: quality factor Rp: equivalent parallel resistance Rs: Winding resistance	
Frequency	100/120 Hz/1/10/100 kHz		
Display	Dual display + analog bargraph		
Measurement range	L	100/120 Hz	20 mH ~ 20 kH
		1 kHz	2000 μ H ~ 2000 H
		10 kHz	200 μ H ~ 20 H
		100 kHz	20 μ H ~ 200 mH
	C	100/120 Hz	20 nF ~ 20 mF
		1 kHz	2000 pF ~ 2 mF
		10 kHz	200 pF ~ 200 μ F
		100 kHz	200 pF ~ 20 μ F
	R	100/120 MHz	200 Ω ~ 200 M Ω
		1 kHz	20 Ω ~ 200 M Ω
		10 kHz	20 Ω ~ 20 M Ω
		100 kHz	20 Ω ~ 2 M Ω
	DCR	200 Ω ~ 200 M Ω	
	D/Q	0.001 ~ 1999	
	ESR	0.00 Ω ~ 20.0 M Ω	
θ	0.00° ~ \pm 180.0°		

Test level	0.6Vrms	
Range mode	Auto and Hold	
Equivalent Circuit	Parallel and Series	
Calibration function	Open/Short	
Interface	Mini-USB	
Measurement speed	Approx. 1.2 times/second	
Measurement terminal	4-terminal	
Basic accuracy	0.3%	
Power	6 x 1,5 V AAA (UM4) batteries	
Auto power off	5 min (with batteries)	
Operating environment	temperature	0°C ~ 40°C
	humidity	≤80% RH
Storage temperature	-25°C ~ 50°C	

3.1. Inductance display range

Function: L_s/L_p

Fre- quency	Scale Range	Reso- lution	Accuracy	De	θ_e	ESR/Rp
100Hz/ 120Hz	20.000 mH*	1 μ H	$\pm(0,3\%+2)$	$\pm 0,003$	$\pm 0,17^\circ$	$\pm 1,88L$ $\times 100+2$
	200.00 mH	0.01 mH	$\pm(0,3\%+2)$	$\pm 0,003$	$\pm 0,17^\circ$	$\pm 1,88L$ $\times 100+2$
	2000.0 mH	0.1 mH	$\pm(0,3\%+2)$	$\pm 0,003$	$\pm 0,17^\circ$	$\pm 1,88L$ $\times 100+2$
	20.000 H	1 mH	$\pm(0,3\%+2)$	$\pm 0,003$	$\pm 0,17^\circ$	$\pm 1,88L$ $\times 100+2$
	200.00 H	0.01 H	$\pm(0,5\%+3)$	$\pm 0,005$	$\pm 0,29^\circ$	$\pm 3,14L$ $\times 100+3$
	2000.0 H	0.1 H	$\pm(1,0\%+5)$	$\pm 0,010$	$\pm 0,57^\circ$	$\pm 6,28L$ $\times 100+5$
	20.000 kH	0.001 kH	$\pm(1,0\%+5)$	$\pm 0,010$	$\pm 0,57^\circ$	$\pm 6,28L$ $\times 100+5$
1 kHz	2000.0 μ H	0.1 μ H	$\pm(0,3\%+2)$	$\pm 0,003$	$\pm 0,17^\circ$	$\pm 1,88L$ $\times 101+2$
	20.000 mH	1 μ H	$\pm(0,3\%+2)$	$\pm 0,003$	$\pm 0,17^\circ$	$\pm 1,88L$ $\times 101+2$
	200.00 mH	0.01 mH	$\pm(0,3\%+2)$	$\pm 0,003$	$\pm 0,17^\circ$	$\pm 1,88L$ $\times 101+2$
	2000.0 mH	0.1 mH	$\pm(0,3\%+2)$	$\pm 0,003$	$\pm 0,17^\circ$	$\pm 1,88L$ $\times 101+2$
	20.000 H	1 mH	$\pm(0,5\%+3)$	$\pm 0,005$	$\pm 0,29^\circ$	$\pm 3,14L$ $\times 101+3$
	200.00 H	0.01 H	$\pm(1,0\%+5)$	$\pm 0,010$	$\pm 0,57^\circ$	$\pm 6,28L$ $\times 101+5$
	2000.0 H	0.1 H	$\pm(1,0\%+5)$	$\pm 0,010$	$\pm 0,57^\circ$	$\pm 6,28L$ $\times 101+5$

Fre- quency	Scale Range	Reso- lution	Accuracy	De	θ_e	ESR/Rp
10 kHz	200.00 μH	0.01 μH	$\pm(0,3\%+2)$	$\pm 0,003$	$\pm 0,17^\circ$	$\pm 1,88\text{L}$ $\times 100+2$
	2000.0 μH	0.1 μH	$\pm(0,3\%+2)$	$\pm 0,003$	$\pm 0,17^\circ$	$\pm 1,88\text{L}$ $\times 100+2$
	20.000 mH	1 μH	$\pm(0,3\%+2)$	$\pm 0,003$	$\pm 0,17^\circ$	$\pm 1,88\text{L}$ $\times 100+2$
	200.00 mH	0.01 mH	$\pm(0,3\%+2)$	$\pm 0,003$	$\pm 0,17^\circ$	$\pm 1,88\text{L}$ $\times 100+2$
	2000.0 mH	0.1 mH	$\pm(0,5\%+3)$	$\pm 0,005$	$\pm 0,29^\circ$	$\pm 3,14\text{L}$ $\times 100+3$
	20.000 H	1 mH	$\pm(2,0\%+4)$	$\pm 0,000$	$\pm 1,15^\circ$	$\pm 1,26\text{L}$ $\times 103+5$
100kHz	20.000 μH	0.001 μH	$\pm(1,0\%+5)$	$\pm 0,010$	$\pm 0,57^\circ$	$\pm 3,14\text{L}$ $\times 103+3$
	200.00 μH	0.01 μH	$\pm(0,5\%+3)$	$\pm 0,005$	$\pm 0,17^\circ$	$\pm 3,14\text{L}$ $\times 103+3$
	2000.0 μH	0.1 μH	$\pm(0,5\%+3)$	$\pm 0,005$	$\pm 0,17^\circ$	$\pm 3,14\text{L}$ $\times 103+3$
	20.000 mH	1 μH	$\pm(0,5\%+3)$	$\pm 0,005$	$\pm 0,17^\circ$	$\pm 3,14\text{L}$ $\times 103+3$
	200.00 mH	0.01 mH	$\pm(1,0\%+5)$	$\pm 0,010$	$\pm 0,17^\circ$	$\pm 6,28\text{L}$ $\times 103+5$

* If the counts of LCD display are less than 2000, the unit will be " μH ".

3.2. Capacitance display range

Function: C_s/C_p

Fre- quency	Scale Range	Reso- lution	Accuracy	De	θ_e	ESR/Rp
100 Hz/ 120 Hz	20.000 nF*	1 pF	$\pm(0,3\%+2)$	$\pm 0,003$	$\pm 0,17^\circ$	$\pm 4,78 \times 10^{-6}/C+2$
	200.00 nF	0.01 nF	$\pm(0,3\%+2)$	$\pm 0,003$	$\pm 0,17^\circ$	$\pm 4,78 \times 10^{-6}/C+2$
	2000.0 nF	0.1 nF	$\pm(0,3\%+2)$	$\pm 0,003$	$\pm 0,17^\circ$	$\pm 4,78 \times 10^{-6}/C+2$
	20.000 μ F	1 nF	$\pm(0,3\%+2)$	$\pm 0,003$	$\pm 0,17^\circ$	$\pm 4,78 \times 10^{-6}/C+2$
	200.00 μ F	0.01 μ F	$\pm(0,5\%+3)$	$\pm 0,005$	$\pm 0,29^\circ$	$\pm 7,96 \times 10^{-6}/C+3$
	2000.0 μ F	0.1 μ F	$\pm(1,0\%+5)$	$\pm 0,010$	$\pm 0,57^\circ$	$\pm 1,59 \times 10^{-5}/C+5$
	20.00 mF	0.01 mF	$\pm(1,0\%+5)$	$\pm 0,010$	$\pm 0,57^\circ$	$\pm 1,59 \times 10^{-5}/C+5$
1 kHz	2000.0 pF	0.1 pF	$\pm(0,3\%+2)$	$\pm 0,003$	$\pm 0,17^\circ$	$\pm 4,78 \times 10^{-6}/C+2$
	20.000 nF	1 pF	$\pm(0,3\%+2)$	$\pm 0,003$	$\pm 0,17^\circ$	$\pm 4,78 \times 10^{-6}/C+2$
	200.00 nF	0.01 nF	$\pm(0,3\%+2)$	$\pm 0,003$	$\pm 0,17^\circ$	$\pm 4,78 \times 10^{-6}/C+2$
	2000.0 nF	0.1 nF	$\pm(0,3\%+2)$	$\pm 0,003$	$\pm 0,17^\circ$	$\pm 4,78 \times 10^{-6}/C+2$
	20.000 μ F	1 nF	$\pm(0,5\%+3)$	$\pm 0,005$	$\pm 0,29^\circ$	$\pm 7,96 \times 10^{-6}/C+3$
	200.00 μ F	0.01 μ F	$\pm(1,0\%+5)$	$\pm 0,010$	$\pm 0,57^\circ$	$\pm 1,59 \times 10^{-5}/C+5$
	2000 μ F	1 μ F	$\pm(1,0\%+5)$	$\pm 0,010$	$\pm 0,57^\circ$	$\pm 1,59 \times 10^{-5}/C+5$

Fre- quency	Scale Range	Reso- lution	Accuracy	De	θ_e	ESR/Rp
10 kHz	200.00 pF	0.01 pF	$\pm(0,3\%+2)$	$\pm 0,003$	$\pm 0,17^\circ$	$\pm 4,78 \times 10^{-6}/C+2$
	2000.0 pF	0.1 pF	$\pm(0,3\%+2)$	$\pm 0,003$	$\pm 0,17^\circ$	$\pm 4,78 \times 10^{-6}/C+2$
	20.000 nF	1 pF	$\pm(0,3\%+2)$	$\pm 0,003$	$\pm 0,17^\circ$	$\pm 4,78 \times 10^{-6}/C+2$
	200.00 nF	0.01 nF	$\pm(0,3\%+2)$	$\pm 0,003$	$\pm 0,17^\circ$	$\pm 4,78 \times 10^{-6}/C+2$
	2000.0 nF	0.1 nF	$\pm(0,5\%+3)$	$\pm 0,005$	$\pm 0,29^\circ$	$\pm 7,96 \times 10^{-6}/C+3$
	20.000 μ F	1 nF	$\pm(1,0\%+5)$	$\pm 0,010$	$\pm 0,57^\circ$	$\pm 1,59 \times 10^{-5}/C+5$
	200.0 μ F	0.1 μ F	$\pm(1,0\%+5)$	$\pm 0,010$	$\pm 0,57^\circ$	$\pm 1,59 \times 10^{-5}/C+5$
100kHz	200.00 pF	0.01 pF	$\pm(0,5\%+3)$	$\pm 0,005$	$\pm 0,29^\circ$	$\pm 7,96 \times 10^{-6}/C+3$
	2000.0 pF	0.1 pF	$\pm(0,5\%+3)$	$\pm 0,005$	$\pm 0,29^\circ$	$\pm 7,96 \times 10^{-6}/C+3$
	20.000 nF	1 pF	$\pm(0,5\%+3)$	$\pm 0,005$	$\pm 0,29^\circ$	$\pm 7,96 \times 10^{-6}/C+3$
	200.00 nF	0.01 nF	$\pm(1,0\%+5)$	$\pm 0,010$	$\pm 0,57^\circ$	$\pm 1,59 \times 10^{-5}/C+5$
	2000.0 nF	0.1 nF	$\pm(2,0\%+5)$	$\pm 0,020$	$\pm 1,15^\circ$	$\pm 3,18 \times 10^{-8}/C+5$
	20.00 μ F	0.01 μ F	$\pm(2,0\%+5)$	$\pm 0,020$	$\pm 1,15^\circ$	$\pm 3,18 \times 10^{-8}/C+5$

* If the counts of LCD display are less than 2000, the unit will be „ μ F“

3.3. Resistance display range

Function: R_S/R_p

Frequency	Scale Range	Resoluton	Accuracy
100 Hz/ 120 Hz	200.00 Ω	0.01 Ω	$\pm(0,3\%+2)$
	2.000 k Ω	0.1 Ω	$\pm(0,3\%+2)$
	20.000 k Ω	1 Ω	$\pm(0,3\%+2)$
	200.00 k Ω	0.01 k Ω	$\pm(0,5\%+3)$
	2.0000 M Ω	0.1 k Ω	$\pm(1,0\%+5)$
	20.000 M Ω	1 k Ω	$\pm(1,0\%+5)$
1 kHz	20.000 Ω	1 m Ω	$\pm(0,3\%+2)$
	200.00 Ω	0.01 Ω	$\pm(0,3\%+2)$
	2.0000 k Ω	0.1 Ω	$\pm(0,3\%+2)$
	20.000 k Ω	1 Ω	$\pm(0,3\%+2)$
	200.00 k Ω	0.01 k Ω	$\pm(0,5\%+3)$
	2.0000 M Ω	0.1 k Ω	$\pm(1,0\%+5)$
10 kHz	20.000 Ω	1 m Ω	$\pm(0,3\%+2)$
	200.00 Ω	0.01 Ω	$\pm(0,3\%+2)$
	2.0000 k Ω	0.1 Ω	$\pm(0,3\%+2)$
	20.000 k Ω	1 Ω	$\pm(0,3\%+2)$
	200.00 k Ω	0.01 k Ω	$\pm(0,5\%+3)$
	2.000 M Ω	0.1 k Ω	$\pm(2,0\%+5)$
100 kHz	20.00 M Ω	0.01 M Ω	$\pm(2,0\%+5)$
	20.000 Ω	1 m Ω	$\pm(0,5\%+3)$
	200.00 Ω	0.01 Ω	$\pm(0,5\%+3)$
	2.000 k Ω	0.1 Ω	$\pm(0,5\%+3)$
	20.000 k Ω	1 Ω	$\pm(0,5\%+3)$
	200.00 k Ω	0.01 k Ω	$\pm(1,0\%+5)$
2.000 M Ω	1 k Ω	$\pm(2,0\%+5)$	

3.4. DC resistance display range

Function	Scale Range	Resolution	Accuracy
DCR	200.00 Ω	0.01 Ω	±(0,3%+2)
	2.000 kΩ	0.1 Ω	±(0,3%+2)
	20.000 kΩ	1 Ω	±(0,3%+2)
	200.00 kΩ	0.01 kΩ	±(0,5%+3)
	2.0000 MΩ	0.1 kΩ	±(1,0%+5)
	20.000 MΩ	1 kΩ	±(1,0%+5)

3.5. Impedance accuracy Ae

The below-listed specifications are guaranteed by the meter with normal use under the operating temperature of 18°-28° and relative humidity less than 80%.

Z Freq.	0.1- 1 Ω	1 – 10 Ω	10 – 100 kΩ	100 kΩ – 1 MΩ	1 – 20 MΩ	20 – 200 MΩ	Remark
DCR	1.0 % o.r. + 5 dgt.	0.5 % o.r. + 3 dgt.	0.3 % o.r. + 2 dgt.	0.5 % o.r. + 3 dgt.	1.0 % o.r. + 5 Dgt.	2.0 % o.r. + 5 dgt.	D < 0,1
100/ 120 Hz	1.0 % o.r. + 5 dgt.	0.5 % o.r. + 3 dgt.	0.3 % o.r. + 2 dgt.	0.5 % o.r. + 3 dgt.	1.0 % o.r. + 5 Dgt.	2.0 % o.r. + 5 dgt.	
1 kHz	1.0 % o.r. + 5 dgt.	0.5 % o.r. + 3 dgt.	0.3 % o.r. + 2 dgt.	0.5 % o.r. + 3 dgt.	1.0 % o.r. + 5 Dgt.	5.0 % o.r. + 5 dgt.	
10 kHz	1.0 % o.r. + 5 dgt.	0.5 % o.r. + 3 dgt.	0.3 % o.r. + 2 dgt.	0.5 % o.r. + 3 dgt.	2.0 % o.r. + 5 Dgt.	N/A	
100 kHz	2.0 % o.r. + 5 dgt.	1.0 % o.r. + 5 dgt.	0.5 % o.r. + 3 dgt.	1.0 % v. M. + 5 dgt.	2.0 % v. M. + 5 dgt. (1M – 2MΩ)		

Note: All accuracy is guaranteed by proper ratio resistor calibration and open/short calibration.

If $D > 0.1$, the accuracy should be multiplied by $\sqrt{1 + D^2}$

$$Z_C = \frac{1}{2\pi f c} \quad \text{if } D \ll 0.1 \text{ in capacitance mode}$$

$$Z_L = 2\pi f L \quad \text{if } D \ll 0.1 \text{ in inductance mode}$$

Sub-display parameters accuracy:

Ae = impedance (Z) accuracy

$$\text{Definition: } Q = \frac{1}{D}$$

$$R_p = \text{ESR (or } R_s) * (1 + 1/D^2)$$

1. D value accuracy: $D_e = \pm A_e \times (1 + D)$

2. ESR accuracy: $R_e = \pm Z_M \times A_e (\Omega)$

ie., $Z_M = \text{impedance calculated by } \frac{1}{2\pi f c} \text{ or } 2\pi f L$

3. Phase angle θ accuracy: $\theta_e = \pm(180/\pi) \times A_e (\text{deg})$

Note:

<i>D</i>	<i>dissipation factor</i>
<i>Q</i> :	<i>quality factor</i>
<i>ESR</i> :	<i>equivalent series resistance</i>
<i>R_p</i> :	<i>equivalent series parallel resistance</i>
<i>θ</i> :	<i>phase angle</i>

4. Operation Instruction

Caution!

It is recommended, that you read the safety and operating instructions before using the meter.

Warning!

Be sure that the circuit under test has all power removed and that any associated capacitors are fully discharged before you make a measurement.

Do not use the meter if test leads, alligator clips and appearance look cracked and damaged. Please check periodically.

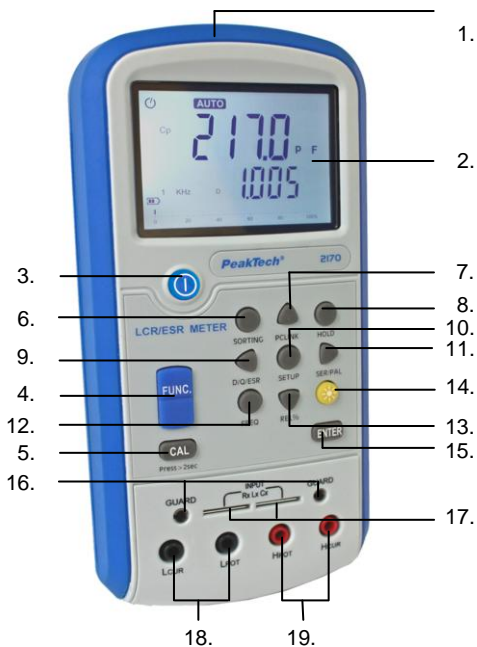
To avoid electric shock, discharge the circuits completely, before taking any measurements.

Caution!

When it appears to have abnormal situations, such as you can not turn on the meter to operate.

1. It is a normal situation, when you cannot turn on the meter after power off the meter just for few seconds before. Please wait a moment to turn it on again.
2. When you cannot operate the meter normally, please turn it off and restart the meter.

5. Frontview



1. Mini USB interface

Connect with PC, easily for data transmission and management.

2. LCD

Used for displaying the measuring results and various symbols.

3. ON/OFF- key

Used for turn on or off the meter.

4. FUNC. key

When FUNC. key is pressed, the main test mode could be selected sequentially: Auto-LCR mode → Auto-L mode → Auto-C mode → Auto-R mode → DCR mode → Auto-LCR mode.

5. CAL key

Used to do OPEN/SHORT calibration.

6. SORTING key

Press this key to enter into sorting mode, which could help the user to make a quick sort for a bunch of components.

7. PCLINK key

Press this key to communicate with PC.

8. HOLD key

Used to maintain the measurement data unchanging, by pressing the key again it will resume the measurement.

9. D/Q/ESR key

In L/C measurement mode, press the key to select parameters of D/Q/θ/ESR.

10. SETUP key

When sorting mode is active, press SETUP key to modify the reference value, range and the tolerance settings sequentially.

11. SER/PAL key

Used to select series and parallel mode.

12. FREQ key

Press FREQ key to select five different test frequencies in turn:
100/120Hz/1/10/100kHz

13. REL% key

Press REL% key to enter into relative measurement mode. In auto LCR mode, this key is not available.

14. Backlight key

By pressing this key for once, the backlight of the LCD screen will be opened and after 60 seconds the meter will automatically turn off the backlight. It is also possible to turn off the backlight by pressing this key before the 60 seconds.

15. ENTER key

In sorting mode, press ENTER- key to confirm the data modification.

16. Guard terminal

Grounding/shielding terminal

17. Input terminal

For direct connection of components to be tested

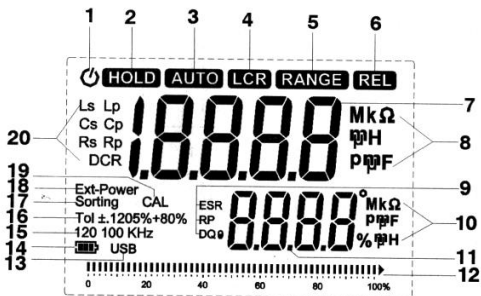
18. LCur & LPot- terminal

Connect black Kelvin-Test leads

19. HCur & HPot-Socket

Connect red Kelvin-Test leads

6. Description of Display-symbols



NO.	Meaning	NO.	Meaning
1.	Auto power off indication	11.	Sub-display
2.	Data hold	12.	Analog bar indication
3.	Auto mode indication	13.	The Meter is in the data transmission mode (USB).
4.	Auto LCR mode indication	14.	battery indication (with battery supply)
5.	Range indication	15.	Frequency indication
6.	Relative Measurement mode.	16.	Tolerance range
7.	Main-display	17.	Sorting mode indication
8.	Unit for main parameters	18.	External power supply is connected
9.	Secondary parameters	19.	Open/Short calibration mode indication
10.	Unit for secondary parameters	20.	Primary parameters

7. Operating instruction

7.1. Power on the meter

- * Press On/Off key to turn on the power
- * The default mode is AUTOLCR smart mode and the default test frequency is 1 kHz
- * When ON/OFF- key is pressed during power-on mode, the instrument will enter power-off mode
- * The LCD will show the "OFF" state before powering off

7.2. Parameters setting

Press **FUNC.** key to select the following parameters sequentially: AUTO LCR, L-Q, C-D, R, DCR.

Parameter	Meaning
AUTO LCR	Auto LCR smart mode
L-Q	Inductance measurement the parameter on sub-display is quality factor Q.
C-D	Capacitance measurement, the parameter on sub-display is dissipation factor D.
R	Resistance measurement
DCR	DC resistance measurement mode

L/C/R measurement readings can be positive or negative. In C-D measurement, if the main parameter is "-", the actual component being tested is inductive; In L - Q measurement, if the main parameter is "-", the actual component being tested is capacitive; Theoretically, R is positive, in some cases, R is "-", which may be calibration error, please re-calibrate the instrument.

7.3. Auto LCR smart mode

Note:

In order to avoid damaging the instrument, the capacitance requires discharge before measuring.

- * The default test mode is Auto LCR mode which could check the type of impedance smartly.
- * If $|\theta| < 11^\circ$, the Auto-R mode is selected. The parameter on sub-display is θ .
- * If $\theta > 11^\circ$, the Auto-L mode is selected. The parameter on sub-display is Q.
- * If $\theta < -11^\circ$, the Auto-C mode is selected. The parameter on sub-display is D.
- * If the $C < 5\text{pF}$, the parameter on sub-display is parallel resistance R_p .

7.4. Frequency setting

Press **FREQ** key to select frequency value:

100/120Hz/1/10/100kHz. The LCR impedance scale ranges are depended on the test frequency.

7.5. Data hold

Press this key to hold the measurement data and press it again to resume the measurement.

7.6. Relative mode

During relative measurement the meter remembers the current readings on primary display (called initial value) when pressing the **REL%** key, and "REL" symbol appears on LCD. The secondary display will show the percentage of relative value REL%.

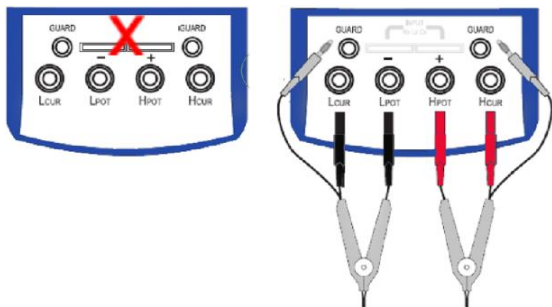
The $\text{REL}\% = (\text{present value} - \text{initial value}) / \text{initial value} \times 100\%$.

Press **REL%** key again to show the current readings on primary display and the "REL" symbol will be blinking. The percentage range is from -99.9% ~ 99.9%. When the present value is larger than double of initial value, the "OL" indication will be shown on the secondary display.

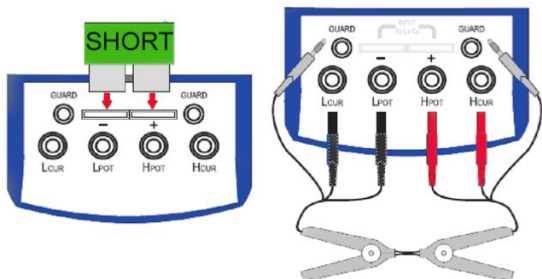
During relative measurement, analog bar is always indicating the present measurement value, but not the relative value.

7.7. Open/Short calibration

1. Press **CAL** key larger than 2 seconds to start the open/short calibration procedure.
2. In open calibration mode, the secondary display will show "Open". There are two ways for open state input:
3. When using square terminals, the square terminals and $L_{CUR}/L_{POT}/H_{POT}/H_{CUR}$ terminals hang in the air
4. When using $L_{CUR}/L_{POT}/H_{POT}/H_{CUR}$ terminals, insert the black and red testing lines with alligator clip into the "L_{CUR}", "L_{POT}" terminal and "H_{CUR}", "H_{POT}" terminal respectively
5. Press **CAL** key and the 30-second countdown will be shown on LCD. If the open calibration is finished, the PASS or FAIL symbol will appear on the primary display. Press **CAL** key again to save the calibration data and enter into the short calibration mode.



- In short calibration mode, the secondary display will show "Short". There are two ways for short state input:
- When using square terminals, insert the short socket to the square terminals and make $L_{CUR}/L_{POT}/H_{POT}/H_{CUR}$ terminals hang in the air
- When using $L_{CUR}/L_{POT}/H_{POT}/H_{CUR}$ terminals, insert the black and red testing lines with alligator clip into the " L_{CUR} ", " L_{POT} " terminal and " H_{CUR} ", " H_{POT} " terminal respectively. Connect the mouth of clips.
- Press **CAL** key and the 30-second countdown will be shown on LCD panels. If the short calibration is finished, the PASS or FAIL symbol will appear on the primary display. Press **CAL** key again to save the calibration data.



Note:

- To get the better accuracy, the open/short calibration should be done before measurement.
- The purpose of open/short calibration is to reduce the parasitic effect of the test fixture.
- Open or short circuit is selected automatically according to the measurement terminal.
- In short calibration, there may be FAIL situations, which may be caused by not using the low resistance short line or unreliable contact, please try again after reliable short-circuit

7.8. Equivalent Circuit

1. When any L/C/R functional mode is selected, the default measurement in series or parallel mode is auto selected and the AUTO segment will be shown on LCD display. It depends on the total equivalent impedance measured.
2. If the impedance is larger than $10k\Omega$, parallel mode is set and Lp/Cp/Rp is shown on the display.
3. If it is less than $10k\Omega$, series mode is set and Ls/Cs/Rs is shown on the display.
4. When SEL/PAL key is pressed, the impedance measurement will be set in series mode or in parallel mode sequentially.

Note:

The actual capacitance, inductance and resistance is not ideal component of pure reactance and pure resistance. Usually, the resistance and reactance exist simultaneously. A practical impedance can be simulated by an ideal resistance and ideal reactance (inductor or capacitor) in series or parallel form.

7.9. Sorting mode

The sorting mode could help the user to make a quick sort for a bunch of components. Use the setting steps as following:

1. According to the component type, press **FUNC.** key to select L, C or R measurement mode.
2. Insert the standard component into the input terminal. Press **SORTING** key to enter into the sorting mode and the "Sorting" symbol appears on LCD. If the LCD reading is OL or less than 200 counts, the **SORTING** key is not available.
3. When sorting mode is active, press **SETUP** key to modify the range, reference value and the tolerance settings sequentially.

4. "Range" symbol is flashing when setting the range. Press **D/Q/ESR** (←) key to shift the decimal point unit to left and press **SER/PAL** (→) key to right. Press **ENTER** key to confirm and enter into the reference value setting mode automatically. At this time, "Range" symbol disappears.
5. When setting the reference value, press **D/Q/ESR** (←) key and **SER/PAL** (→) key to shift the bit to left and right respectively. Press **PCLINK** (↑) key and **REL%** (↓) key to make the digit +1 or -1. The flashing bit is the current setting bit. The reference value setting is available from 20 to 1999 counts. Press **ENTER** key to confirm and enter into the tolerance setting mode automatically.
6. When setting the tolerance, press **D/Q/ESR** (←)key and **SER/PAL** (→)key to select tolerance range: $\pm 1\%$ → $\pm 2\%$ → $\pm 5\%$ → $\pm 10\%$ → $\pm 20\%$ → $\pm 80\%$ - 20% . The default tolerance is $\pm 1\%$. Press **ENTER** key to confirm.
7. After setting the parameters, remove the standard component and insert the component to be measured. If the impedance measured does not exceed tolerance range, the primary display will show "PASS", otherwise show "FAIL". The current measurement result will be shown on the secondary display.
8. Press **SORTING** key again to exit the sorting mode.

Note:

In AUTO LCR mode, the SORTING key is not available.

7.10. PC-LINK mode

Press **PCLINK** key and USB symbol appears on LCD. Connect the instrument to PC through USB interface, and the measured data can be recorded, analyzed, processed and printed by PC. Press **PCLINK** key again to cancel the data transmission. Then USB symbol disappears.

Due to the power consumption in data transmission, please extinguish USB display when there is no need to transmit data.

7.11. Auto Power Off Function

To prevent battery life the instrument automatically turns off after 5 minutes.

If any external power supply will be connected to the provided terminal at the instrument, the auto-power off function will be disabled and long-time-measurements are possible without any interruptions.

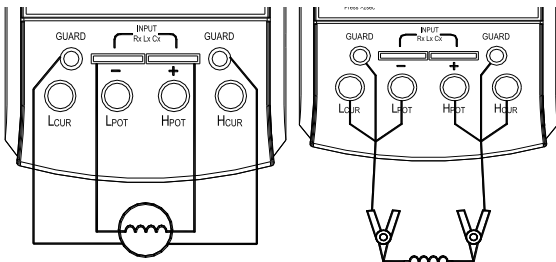
External power supplies are:

- * 12V/500mA DC-Adaptor
- * Power supply via USB interface when USB-cable is connected to PC.

8. Measurement

8.1. Inductance measurement

1. Turn on the power.
2. Insert the measured inductance into the input terminal directly
3. Connect the alligator clips to the ends of the measured inductance
4. The default test mode is Auto LCR mode, the inductance value will be show on primary display and the quality factor Q will show on secondary display. In Auto LCR mode, the **D/Q/ESR** key, **SEL/PAL** key, **SORTING** key and **REL%** key are not available.
5. Press **FUNC.** key to select Auto-L mode. The primary LCD display will show the inductance value. The secondary LCD display will show the quality factor Q. The equivalent resistance ESR/Rp, phase angle θ or dissipation factor D can also be shown by pressing the **D/Q/ESR** key.
6. Press **FREQ** key to select frequency value: 100/120 Hz/1/10/100 kHz.
7. Press **SER/PAL** key to select series or parallel mode.

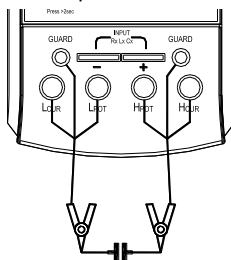
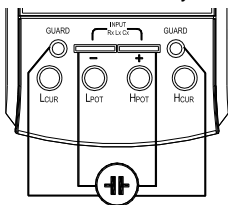


8.2. Capacitance measurement

WARNING:

If there exist voltage in the capacitor (charged), connect the two ends of the capacitor for a short time to discharge. Otherwise, the device can be damaged through overvoltage.

1. Turn on the power.
2. Insert the positive polarity of capacitance into the positive terminal and its negative polarity into the negative terminal.
3. Insert the black and red testing lines with alligator clip into the "L_{CUR}", "L_{POT}" terminal and "H_{CUR}", "H_{POT}" terminal respectively. Connect the alligator clips to the two ends of capacitance corresponding to its polarity.
4. The default test mode is Auto LCR mode, the capacitance value will be shown on primary display and the dissipation factor D will be shown on secondary display. In Auto LCR mode, the **D/Q/ESR** key, **SEL/PAL** key, **SORTING** key and **REL%** key are not available.
5. Press **FUNC.**- key twice to select Auto-C mode. The primary LCD display will show the capacitance value. The secondary LCD display will show the dissipation factor D. The quality factor Q, equivalent resistance ESR/R_p or phase angle θ can also be shown by pressing the **D/Q/ESR** key.
6. Press **FREQ** key to select frequency value: 100/120 Hz/1/10/100 kHz.
7. Press **SER/PAL** key to select series or parallel mode.

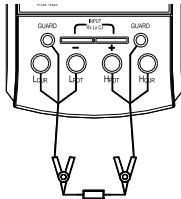
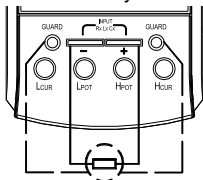


Note:

1. When Auto-LCR mode is active, the secondary parameter will show the equivalent resistance in parallel mode (R_p) to replace the D factor if the C measured value is less than 5pF.
2. In order to avoid damaging the instrument, the capacitance requires discharge before measuring.

8.3. Resistance measurement

1. Turn on the power.
2. Insert the measured resistance into the input terminal directly.
3. Connect the alligator clips to the ends of the measured resistance.
4. The default test mode is Auto LCR mode, the resistance value will show on primary display and the phase angle θ will be shown on secondary display. In Auto LCR mode, the **D/Q/ESR** key, **SEL/PAL** key, **SORTING** key and **REL%** key are not available.
5. Press **FUNC.**-key three times to select Auto-R (ACR) mode. The primary LCD display will show the resistance value. The secondary parameter is omitted and the **D/Q/ESR** key is not available.
6. Press **FREQ** key to select frequency value: 100/120Hz/1/10/100 kHz.
7. Press **SER/PAL** key to select series or parallel mode.
8. Press **FUNC.** key four times to select DCR mode. The primary LCD display will show the resistance value. The secondary parameter is omitted and the **D/Q/ESR** key, **SEL/PAL** key and **FREQ** key are not available.



Note:

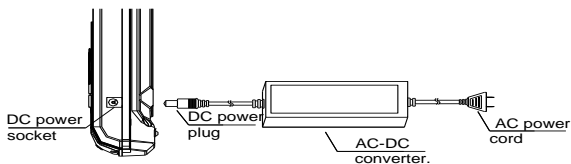
The phase angle θ will be shown on secondary display only in Auto-LCR mode. During Auto-R mode or DCR mode, the secondary parameter is not available.

9. To use Adapter**WARNING:**

1. Please use an AC power adapter with the specifications below, using other AC power adapter may damage your instrument.
2. The AC power adapter can only be used indoors.
3. Please plug the AC power cord into an electrical outlet first and then firmly insert DC plug into DC input end in the right of the meter. When unplugged, firstly pull out the DC plug perpendicular to DC input end and then unplug the AC plug from the electrical outlet.
4. In use, it is a normal phenomenon that the AC power adapter will be hot.
5. Do not demolish the AC power adapter. Otherwise, it may be dangerous.
6. Do not use the AC power adapter in a high temperature or wet place.
7. Please make the AC power adapter avoid a strong bump.
8. It is normal when the AC power adapter make some noise in use.

Connecting the power adapter:

1. Connect the AC power cord to the AC/DC converter.
2. Plug the AC power cord into an electrical outlet (100V-240V).
3. Plug the DC power plug of the converter into DC power socket of the meter.



AC/DC adapter information:

Input : 100V-240VAC,50-60Hz 1.8A

Output : DC 12V  500 mA

Polarity : 

Note:

Under external power adapter, the automatic power off function is not available

10. Maintenance


10.1. Cleaning

Periodically wipe the case with a damp cloth and detergent; do not use abrasives or solvents.

10.2. Calibration

Calibrate your instrument once a year to ensure that it performs according to its specifications.

10.3. Replacing the Battery

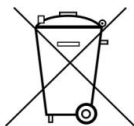
Please change the battery when the battery symbol  shows less than one segment

Turn off the power of the instrument. When you change the battery, and screw off the breechblock on the battery cabinet cover, then take off it and instead the fresh battery.

Statutory Notification about the Battery Regulations

The delivery of many devices includes batteries, which for example serve to operate the remote control. There also could be batteries or accumulators built into the device itself. In connection with the sale of these batteries or accumulators, we are obliged under the Battery Regulations to notify our customers of the following:

Please dispose of old batteries at a council collection point or return them to a local shop at no cost. The disposal in domestic refuse is strictly forbidden according to the Battery Regulations. You can return used batteries obtained from us at no charge at the address on the last side in this manual or by posting with sufficient stamps.



Batteries, which contain harmful substances, are marked with the symbol of a crossed-out waste bin, similar to the illustration shown left. Under the waste bin symbol is the chemical symbol for the harmful substance, e.g. „Cd“ for cadmium, „Pb“ stands for lead and „Hg“ for mercury.

You can obtain further information about the Battery Regulations from the Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (*Federal Ministry of Environment, Nature Conservation and Reactor Safety*).

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This manual is according the latest technical knowing. Technical changings which are in the interest of progress, reserved.

We herewith confirm that the units are calibrated by the factory according to the specifications as per the technical specifications.

We recommend to calibrate the unit again, after 1 year.

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