

Models
885 & 886
LCR METER
OPERATING
MANUAL

MANUAL DE INSTRUCCIONES

MEDIDOR LCR

Modelos 885 & 886

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1. Introduction

1.1 General

The B&K Precision Models 885 & 886 Synthesized In-Circuit LCR/ESR Meter is a high accuracy hand held portable test instrument used for measuring inductors, capacitors and resistors with a basic accuracy of 0.2%. It is the most advanced handheld AC/DC impedance measurement instrument to date. The 885 or 886 can help engineers and students to understand the characteristic of electronics components as well as being an essential tool on any service bench.

The instrument is auto or manual ranging. Test frequencies of 100Hz, 120Hz, 1KHz 10KHz or 100KHz (886) may be selected on all applicable ranges. The test voltages of 50mVrms, 0.25Vrms, 1Vrms or 1VDC (DCR only) may also be selected on all applicable ranges. The dual display feature permits simultaneous measurements.

Components can be measured in the series or parallel mode as desired; the more standard method is automatically selected first but can be overridden.

The Model 885 and 886 offers three useful modes for sorting components.

The highly versatile Models can perform virtually all the functions of most bench type LCR bridges. With a basic accuracy of 0.2%, this economical LCR meter may be adequately substituted for a

more expensive LCR bridge in many situations. The meter is powered from two AA Batteries and is supplied with an AC to DC charging adapter and two AA Ni-Mh Rechargeable Batteries.

The instrument has applications in electronic engineering labs, production facilities, service shops, and schools. It can be used to check ESR values of capacitors, sort values, select precision values, measure unmarked and unknown inductors, capacitors or resistors, and to measure capacitance, inductance, or resistance of cables, switches, circuit board foils, etc.

The key features are as following:

- Test condition:
 - 1 Frequency : 100Hz / 120Hz / 1KHz / 10KHz / 100KHz (886)
 2. Level : 1Vrms / 0.25Vrms / 50mVrms / 1VDC (DCR only)
- Measurement Parameters : Z, Ls, Lp, Cs, Cp, DCR, ESR, D, Q and θ
- Basic Accuracy: 0.2%
- Dual Liquid Crystal Display
- Fast/Slow Measurement
- Auto Range or Range Hold
- Open/Short Calibration
- Primary Parameters Display:
 - Z : AC Impedance
 - DCR : DC Resistance
 - Ls : Serial Inductance
 - Lp : Parallel Inductance

- Cs : Serial Capacitance
 - Cp : Parallel Capacitance
- Second Parameter Display:
 - θ : Phase Angle
 - ESR : Equivalence Serial Resistance
 - D : Dissipation Factor
 - Q : Quality Factor
- Combinations of Display:
 - Serial Mode : $Z - \theta$, Cs – D, Cs – Q, Cs – ESR, Ls – D, Ls – Q, Ls – ESR
 - Parallel Mode : Cp – D, Cp – Q, Lp – D, Lp – Q

1.2 Impedance Parameters

Due to the different testing signals on the impedance measurement instrument, there are DC impedance and AC impedance. The common digital multi-meter can only measure the DC impedance, but the Model 885 can do both. It is a very important issue to understand the impedance parameters of the electronic component.

When we analysis the impedance by the impedance measurement plane (Figure 1.1). It can be visualized by the real element on the X-axis and the imaginary element on the y-axis. This impedance measurement plane can also be seen as the polar coordinates. The Z is the magnitude and the θ is the phase of the impedance.

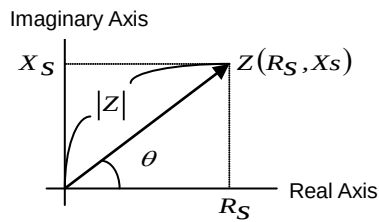


Figure 1.1

$$Z = R_s + jX_s = |Z| \angle \theta \text{ } (\Omega)$$

$$R_s = |Z| \cos \theta \qquad |Z| = \sqrt{R_s^2 + X_s^2}$$

$$X_s = |Z| \sin \theta \qquad \theta = \tan^{-1} \left(\frac{X_s}{R_s} \right)$$

Z = (Impedance)

R_s = (Resistance)

X_s = (Reactance)

Ω = (Ohm)

There are two different types of reactance: Inductive (X_L) and Capacitive (X_C). It can be defined as follows:

$$\begin{array}{ll} X_L = \omega L = 2\pi f L & L = \text{Inductance (H)} \\ X_C = \frac{1}{\omega C} = \frac{1}{2\pi f C} & C = \text{Capacitance (F)} \\ & f = \text{Frequency (Hz)} \end{array}$$

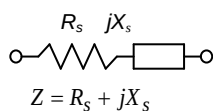
Also, there are quality factor (Q) and the dissipation factor (D) that need to be discussed. For component, the quality factor serves as a measure of the reactance purity. In the real world, there is always

some associated resistance that dissipates power, decreasing the amount of energy that can be recovered. The quality factor can be defined as the ratio of the stored energy (reactance) and the dissipated energy (resistance). Q is generally used for inductors and D for capacitors.

$$\begin{aligned}
 Q &= \frac{1}{D} = \frac{1}{\tan \delta} \\
 &= \frac{|X_s|}{R_s} = \frac{\omega L_s}{R_s} = \frac{1}{\omega C_s R_s} \\
 &= \frac{|B|}{G} \\
 &= \frac{R_p}{|X_p|} = \frac{R_p}{\omega L_p} = \omega C_p R_p
 \end{aligned}$$

There are two types of the circuit mode. One is series mode, the other is parallel mode. See Figure 1.2 to find out the relation of the series and parallel mode.

Real and imaginary components are serial



Real and imaginary components are Parallel

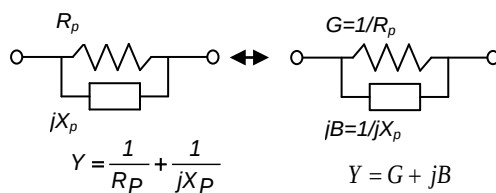


Figure 1.2

1.3 Specification

- LCD Display Range:

Parameter	Range	
Z	0.000 Ω	to 9999 M Ω
L	0.000 μ H	to 9999 H
C	0.000 pF	to 9999 F
DCR	0.000 Ω	to 9999 M Ω
ESR	0.000 Ω	to 9999 Ω
D	0.000	to 9999
Q	0.000	to 9999
θ	-180.0 $^\circ$	to 180.0 $^\circ$

- Accuracy (Ae):

Z Accuracy:

$ Z_x $ Freq.	20M ~ 10M (Ω)	10M ~ 1M (Ω)	1M ~ 100K (Ω)	100K ~ 10 (Ω)	10 ~ 1 (Ω)	1 ~ 0.1 (Ω)
DCR	2% $\pm$ 1	1% $\pm$ 1	0.5% $\pm$ 1	0.2% $\pm$ 1	0.5% $\pm$ 1	1% $\pm$ 1
100Hz	❶					❶
120Hz						
1KHz						
10KHz	5% $\pm$ 1 ❶	2% $\pm$ 1				
100KHz (886)	NA	5% $\pm$ 1 ❶				

Note : 1.The accuracy applies when the test level is set to 1Vrms.
 2.Ae multiplies 1.25 when the test level is set to 250mVrms.
 3.Ae multiplies 1.50 when the test level is set to 50mVrms.
 4.When measuring L and C, multiply Ae by $\sqrt{1+D_x^2}$ if the $D_x > 0.1$.

❶ : Ae is not specified if the test level is set to 50mV.

C Accuracy :

100Hz	79.57 pF 159.1 pF	159.1 pF 1.591 nF	1.591 nF 15.91 nF	15.91 nF 159.1 uF	159.1 uF 1591 uF	1591 uF 15.91 mF
	2% ± 1 ①	1% ± 1	0.5% ± 1	0.2% ± 1	0.5% ± 1	1% ± 1 ①
120Hz	66.31 pF 132.6 pF	132.6 pF 1.326 nF	1.326 nF 13.26 nF	13.26 nF 132.6 uF	132.6 uF 1326 uF	1326 uF 13.26 mF
	2% ± 1 ①	1% ± 1	0.5% ± 1	0.2% ± 1	0.5% ± 1	1% ± 1 ①
1KHz	7.957 pF 15.91 pF	15.91 pF 159.1 pF	159.1 pF 1.591 nF	1.591 nF 15.91 uF	15.91 uF 159.1 uF	159.1 uF 1.591 mF
	2% ± 1 ①	1% ± 1	0.5% ± 1	0.2% ± 1	0.5% ± 1	1% ± 1 ①
10KHz	0.795 pF 1.591 pF	1.591 pF 15.91 pF	15.91 pF 159.1 pF	159.1 pF 1.591 uF	1.591 uF 15.91 uF	15.91 uF 159.1 uF
	5% ± 1 ①	2% ± 1	0.5% ± 1	0.2% ± 1	0.5% ± 1	1% ± 1 ①
100KHz (886)	NA	0.159 pF 1.591 pF	1.591 pF 15.91 pF	15.91 pF 159.1 nF	159.1 nF 1.591 uF	1.591 uF 15.91 uF
	NA	5% ± 1 ①	2% ± 1	0.4% ± 1	2% ± 1	5% ± 1 ①

L Accuracy :

100Hz	31.83 KH 15.91 KH	15.91 KH 1591 H	1591 H 159.1 H	159.1 H 15.91 mH	15.91 mH 1.591 mH	1.591 mH 159.1 uH
	2% ± 1 ①	1% ± 1	0.5% ± 1	0.2% ± 1	0.5% ± 1	1% ± 1 ①
120Hz	26.52 KH 13.26 KH	13.26 KH 1326 H	1326 H 132.6 H	132.6 H 13.26 mH	13.26 mH 1.326 mH	1.326 mH 132.6 uH
	2% ± 1 ①	1% ± 1	0.5% ± 1	0.2% ± 1	0.5% ± 1	1% ± 1 ①
1KHz	31.83 KH 1.591 KH	1.591 KH 159.1 H	159.1 H 15.91 H	15.91 H 1.591 mH	1.591 mH 159.1 uH	159.1 uH 15.91 uH
	2% ± 1 ①	1% ± 1	0.5% ± 1	0.2% ± 1	0.5% ± 1	1% ± 1 ①
10KHz	318.3 H 159.1 H	159.1 H 15.91 H	15.91 H 1.591 uH	1.591 H 159.1 uH	159.1 uH 15.91 uH	15.91 uH 1.591 uH
	5% ± 1 ①	2% ± 1	0.5% ± 1	0.2% ± 1	0.5% ± 1	1% ± 1 ①
100KHz (886)	31.83 H 15.91 H	15.91 H 1.591 H	1.591 H 159.1 mH	159.1 mH 15.91 uH	15.91 uH 1.591 uH	1.591 uH 0.159 uH
	NA	5% ± 1 ①	2% ± 1	0.4% ± 1	2% ± 1	5% ± 1 ①

D Accuracy :

$\frac{ Z_x }{\text{Freq.}}$	20M ~ 10M (Ω)	10M ~ 1M (Ω)	1M ~ 100K (Ω)	100K ~ 10 (Ω)	10 ~ 1 (Ω)	1 ~ 0.1 (Ω)
100Hz	± 0.020 ①	± 0.010	± 0.005	± 0.002	± 0.005	± 0.010 ①
120Hz						
1KHz						
10KHz	± 0.050 ①	± 0.020				
100KHz (886)	NA	± 0.050 ①	± 0.020	± 0.004	± 0.020	± 0.050 ①

θ Accuracy :

$\frac{ Z_x }{\text{Freq.}}$	20M ~ 10M (Ω)	10M ~ 1M (Ω)	1M ~ 100K (Ω)	100K ~ 10 (Ω)	10 ~ 1 (Ω)	1 ~ 0.1 (Ω)
100Hz	± 1.046 ①	± 0.523	± 0.261	± 0.105	± 0.261	± 0.523 ①
120Hz						
1KHz						
10KHz	± 2.615 ①	± 1.046				
100KHz (886)	NA	± 2.615 ①	± 1.046	± 0.209	± 1.046	± 2.615 ①

Z Accuracy:

As shown in table 1.

C Accuracy:

$$|Z_X| = \frac{1}{2 \cdot \pi \cdot f \cdot C_X}$$

C_{Ae} = Ae of $|Z_X|$

f : Test Frequency (Hz)

C_X : Measured Capacitance Value (F)

$|Z_X|$: Measured Impedance Value (Ω)

Accuracy applies when D_X (measured D value) ≤ 0.1

When $D_X > 0.1$, multiply C_{Ae} by $\sqrt{1 + D_X^2}$

Example:

Test Condition:

Frequency : 1KHz

Level : 1Vrms

Speed : Slow

DUT : 100nF

Then

$$|Z_X| = \frac{1}{2 \cdot \pi \cdot f \cdot C_X}$$

$$= \frac{1}{2 \cdot \pi \cdot 10^3 \cdot 100 \cdot 10^{-9}} = 1590\Omega$$

Refer to the accuracy table, get $C_{Ae} = \pm 0.2\%$

L Accuracy:

$$|Z_X| = 2 \cdot \pi \cdot f \cdot L_X$$

$$L_{Ae} = Ae \text{ of } |Z_X|$$

f : Test Frequency (Hz)

L_X : Measured Inductance Value (H)

$|Z_X|$: Measured Impedance Value (Ω)

Accuracy applies when D_X (measured D value) ≤ 0.1

When $D_X > 0.1$, multiply L_{Ae} by $\sqrt{1 + D_X^2}$

Example:

Test Condition:

Frequency : 1KHz

Level : 1Vrms

Speed : Slow

DUT : 1mH

Then

$$|Z_X| = 2 \cdot \pi \cdot f \cdot L_X$$

$$= 2 \cdot \pi \cdot 10^3 \cdot 10^{-3} = 6.283\Omega$$

Refer to the accuracy table, get $L_{Ae} = \pm 0.5\%$

ESR Accuracy:

$$ESR_{Ae} = \pm X_X \cdot \frac{Ae}{100}$$

$$X_X = 2 \cdot \pi \cdot f \cdot L_X = \frac{1}{2 \cdot \pi \cdot f \cdot C_X}$$

$$ESR_{Ae} = Ae \text{ of } |Z_x|$$

f : Test Frequency (Hz)

Xx : Measured Reactance Value (Ω)

Lx : Measured Inductance Value (H)

Cx : Measured Capacitance Value (F)

Accuracy applies when Dx (measured D value) ≤ 0.1

Example:

Test Condition:

Frequency : 1KHz

Level : 1Vrms

Speed : Slow

DUT : 100nF

Then

$$|Z_x| = \frac{1}{2 \cdot \pi \cdot f \cdot C_x}$$

$$= \frac{1}{2 \cdot \pi \cdot 10^3 \cdot 100 \cdot 10^{-9}} = 1590\Omega$$

Refer to the accuracy table, get

$C_{Ae} = \pm 0.2\%$,

$$ESR_{Ae} = \pm X_x \cdot \frac{Ae}{100} = \pm 3.18\Omega$$

D Accuracy:

$$D_{Ae} = \pm \frac{Ae}{100}$$

$$D_{Ae} = Ae \text{ of } |Zx|$$

Accuracy applies when Dx (measured D value) ≤ 0.1

When $Dx > 0.1$, multiply Dx by $(1+Dx)$

Example:

Test Condition:

Frequency : 1KHz

Level : 1Vrms

Speed : Slow

DUT : 100nF

Then

$$|Zx| = \frac{1}{2 \cdot \pi \cdot f \cdot Cx}$$

$$= \frac{1}{2 \cdot \pi \cdot 10^3 \cdot 100 \cdot 10^{-9}} = 1590\Omega$$

Refer to the accuracy table, get

$C_{Ae} = \pm 0.2\%$,

$$D_{Ae} = \pm \cdot \frac{Ae}{100} = \pm 0.002$$

Q Accuracy:

$$Q_{Ae} = \pm \frac{Qx^2 \cdot De}{1 \mp Qx \cdot De}$$

$$Q_{Ae} = Ae \text{ of } |Zx|$$

Qx : Measured Quality Factor Value

De : Relative D Accuracy

Accuracy applies when $Qx \cdot De < 1$

Example:

Test Condition:

Frequency : 1KHz
Level : 1Vrms
Speed : Slow
DUT : 1mH

Then

$$\begin{aligned}|Zx| &= 2 \cdot \pi \cdot f \cdot Lx \\ &= 2 \cdot \pi \cdot 10^3 \cdot 10^{-3} = 6.283\Omega\end{aligned}$$

Refer to the accuracy table, get

$L_{Ae} = \pm 0.5\%$,

$$De = \pm \cdot \frac{Ae}{100} = \pm 0.005$$

If measured $Qx = 20$

Then

$$\begin{aligned}Q_{Ae} &= \pm \frac{Qx^2 \cdot De}{1 \mp Qx \cdot De} \\ &= \pm \frac{2}{1 \mp 0.1}\end{aligned}$$

θ Accuracy:

$$\theta_e = \frac{180}{\pi} \cdot \frac{Ae}{100}$$

Example:

Test Condition:

Frequency : 1KHz
Level : 1Vrms
Speed : Slow
DUT : 100nF

Then

$$|Z_x| = \frac{1}{2 \cdot \pi \cdot f \cdot C_x}$$
$$= \frac{1}{2 \cdot \pi \cdot 10^3 \cdot 100 \cdot 10^{-9}} = 1590\Omega$$

Refer to the accuracy table, get

$Z_{Ae} = \pm 0.2\%$,

$$\theta_{Ae} = \pm \frac{180}{\pi} \cdot \frac{Ae}{100}$$
$$= \pm \frac{180}{\pi} \cdot \frac{0.2}{100} = \pm 0.115 \text{ deg}$$

- Testing Signal:
Level Accuracy : $\pm 5\%$
Frequency Accuracy : 0.1%
- Output Impedance : $100\Omega \pm 5\%$
- Measuring Speed:
Fast : 4.5 meas. / sec.
Slow : 2.5 meas. / sec.

- General:
 - Temperature : 0°C to 70°C (Operating)
-20°C to 70°C (Storage)
 - Relative Humidity : Up to 85%
 - Battery Type : 2 AA size Ni-Mh or Alkaline
 - Battery Charge : Constant current 150mA
approximately
 - Battery Operating Time : 2.5 Hours typical
 - AC Operation : 110/220V AC, 60/50Hz with proper
adapter
 - Low Power Warning : under 2.2V
 - Dimensions : 174mm x 86mm x 48mm (L x W x H)
6.9" x 3.4" x 1.9"
 - Weight : 470g

Considerations

Test Frequency. The test frequency is user selectable and can be changed. Generally, a 1 KHz test signal or higher is used to measure capacitors that are 0.01uF or smaller and a 120Hz test signal is used for capacitors that are 10uF or larger. Typically a 1 kHz test signal or higher is used to measure inductors that are used in audio and RF (radio frequency) circuits. This is because these components operate at higher frequencies and require that they be measured at a higher frequency of 1 KHz. Generally, inductors below 2mH should be measured at 1 kHz and inductors above 200H should be measured at 120Hz.

It is best to check with the component manufacturers' data sheet to determine the best test frequency for the device.

Charged Capacitors

Always discharge any capacitor prior to making a measurement since a charged capacitor may seriously damage the meter.

Effect Of High D on Accuracy

A low D (Dissipation Factor) reading is desirable. Electrolytic capacitors inherently have a higher dissipation factor due to their normally high internal leakage characteristics. If the D (Dissipation Factor) is excessive, the capacitance measurement accuracy may be degraded.

It is best to check with the component manufacturers' data sheet to determine the desirable D value of a good component.

Measuring Capacitance of Cables, Switches or Other Parts

Measuring the capacitance of coaxial cables is very useful in determining the actual length of the cable. Most manufacturer specifications list the amount of capacitance per foot of cable and therefore the length of the cable can be determined by measuring the capacitance of that cable.

For example: A manufacturers, specification calls out a certain cable, to have a capacitance of 10 pF per foot, After measuring the cable a capacitance reading of 1.000 nF is displayed. Dividing 1000pF (1.000 nF) by 10 pF per foot yields the length of the cable to be approximately 100 feet.

Even if the manufacturers' specification is not known, the capacitance of a measured length of cable (such as 10 feet) can be used to determine the capacitance per foot; do not use too short a length such as one foot, because any error becomes magnified in the total length calculations.

Sometimes, the capacitance of switches, interconnect cables, circuit board foils, or other parts, affecting stray capacitance can be critical to circuit design, or must be repeatable from one unit to another.

Series Vs Parallel Measurement (for Inductors)

The series mode displays the more accurate measurement in most cases. The series equivalent mode is essential for obtaining an accurate Q reading of low Q inductors. Where ohmic losses are most significant, the series equivalent mode is preferred. However, there are cases where the parallel equivalent mode may be more appropriate. For iron core inductors operating at higher frequencies where hysteresis and eddy currents become significant, measurement in the parallel equivalent mode is preferred.

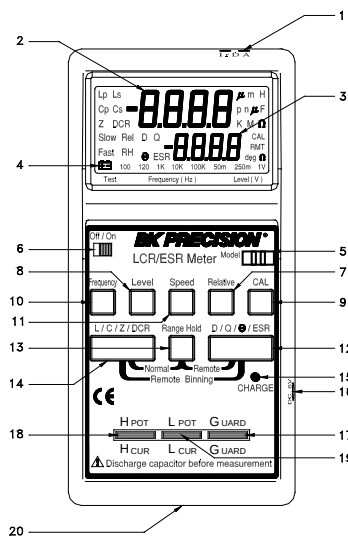
1.4 Accessories

- Operating Manual 1 pc
- 2 AA Size Ni-Mh Rechargeable Batteries 2 pc
- Shorting Bar 1 pc
- AC to DC Adapter 1 pc
- TL885A SMD Test Probe 1 pc
- TL885B 4-Wire Test Clip (Optional)
- TL08C Kelvin Clip (Optional)

- Carrying Case (Optional)

2. Operation

2.1 Physical Description



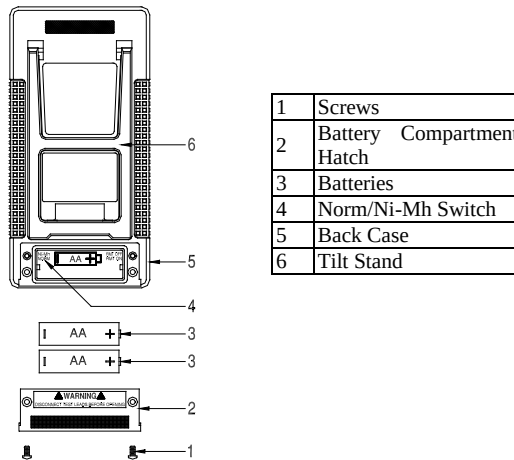
- | | |
|--------------------------------|-------------------------------|
| 1. NA | 2. Primary Parameter Display |
| 3. Secondary Parameter Display | 4. Low Battery Indicator |
| 5. Model Number | 6. Power Switch |
| 7. Relative Key | 8. Measurement Level Key |
| 9. Open/Short Calibration Key | 10. Measurement Frequency Key |
| 11. Display Update Speed Key | 12. D/Q/θ/ESR Function Key |
| 13. Range Hold Key | 14. L/C/Z/DCR Function Key |
| 15. Battery Charge Indicator | 16. DC Adapter Input Jack |
| 17. Guard Terminal | 18. HPOT/HCUR Terminal |
| 19. LPOT/LCUR Terminal | 20. Battery Compartment |

2.2 Making Measurement

2.2.1 Battery Replacement

When the LOW BATTERY INDICATOR lights up during normal operation, the batteries in the Models 885 & 886 should be replaced or recharged to maintain proper operation. Please perform the following steps to change the batteries:

1. Remove the battery hatch by unscrewing the screw of the battery compartment.
2. Take out the old batteries and insert the new batteries into the battery compartment. Please watch out for battery polarity when installing new batteries.
3. Replace the battery hatch by reversing the procedure used to remove it.



Battery Replacement

2.2.2 Battery Recharging/AC operation

Caution

Only the Models 885 or 886 standard accessory AC to DC adapter can be used with Model 885. Other battery eliminator or charger may result in damage to Models 885 or 886.

The Models 885 & 886 works on external AC power or internal batteries. To power the Model 885 with AC source, make sure that the Models 885 or 886 is off, then plug one end of the AC to DC adapter into the DC jack on the right side of the instrument and the other end into an AC outlet.

There is a small slide switch inside the battery compartment called Battery Select Switch. If the Ni-Mh or Ni-Cd rechargeable batteries are installed in Models 885 or 886, set the Battery Select Switch to "Ni-Mh" position. The Ni-Mh or Ni-Cd batteries can be recharged when the instrument is operated by AC source. The LED for indicating battery charging will light on. If the non-rechargeable batteries (such as alkaline batteries) are installed in Models 885 or 886, set the Battery Select Switch to "NORM" position for disconnecting the charging circuit to the batteries.

Warning

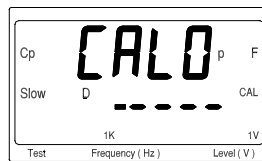
The Battery Select Switch must be set in the "NORM" position when using non-rechargeable batteries. Non-rechargeable batteries may explode if the AC adapter is used with non-rechargeable batteries. Warranty is voided if this happened.

2.2.3 Open and Short Calibration

The Models 885 & 886 provides open/short calibration capability so the user can get better accuracy in measuring high and low impedance. We recommend that the user performs open/short calibration if the test level or frequency has been changed.

- Open Calibration

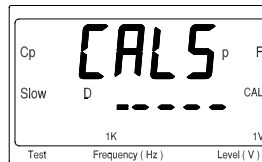
First, remaining the measurement terminals with the open status, then press the **CAL** key shortly (no more than two second), the LCD will display:



This calibration takes about 10 seconds. After it is finished, the Model 885 will beep to show that the calibration is done.

- Short Calibration

To perform the short calibration, insert the Shorting Bar into the measurement terminals. Press the **CAL** key for more than two second, the LCD will display:



This calibration takes about 10 seconds. After it is finished, the Model 885 will beep to show that the calibration is done.

2.2.4 Display Speed

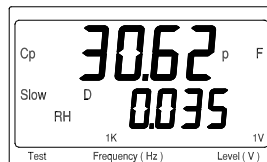
The Models 885 & 886 provides two different display speeds (Fast/Slow). It is controlled by the **Speed** key. When the speed is set to fast, the display will update 4.5 readings every second. When the speed is set to slow, it's only 2.5 readings per second.

2.2.5 Relative Mode

The relative mode lets the user to make quick sort of a bunch of components. First, insert the standard value component to get the standard value reading. (Approximately 5 seconds in Fast Mode to get a stable reading.) Then, press the **Relative** key, the primary display will reset to zero. Remove the standard value component and insert the unknown component, the LCD will show the value that is the difference between the standard value and unknown value.

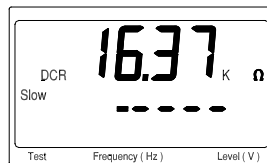
2.2.6 Range Hold

To set the range hold, insert a standard component in that measurement range. (Approximately 5 seconds in Fast Mode to get a stable reading.) Then, by pressing the **Range Hold** key it will hold the range within 0.5 to 2 times of the current measurement range. When the **Range Hold** is press the LCD display:



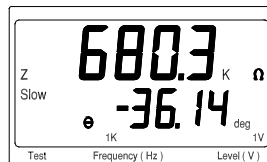
2.2.7 DC Resistance Measurement

The DC resistance measurement measures the resistance of an unknown component by 1VDC. Select the **L/C/Z/DCR** key to make the DCR measurement. The LCD display:



2.2.8 AC Impedance Measurement

The AC impedance measurement measures the Z of an unknown device. Select the **L/C/Z/DCR** key to make the Z measurement. The LCD display:

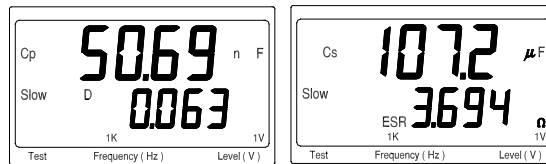


The testing level and frequency can be selected by pressing the **Level** key and **Frequency** key, respectively.

2.2.9 Capacitance Measurement

To measure the capacitance of a component, select the **L/C/Z/DCR** key to Cs or Cp mode. Due to the circuit structure, there are two modes can be selected (Serial Mode – Cs and Parallel Mode – Cp). If the serial mode (Cs) is selected, the D, Q and ESR can be shown on the secondary display. If the parallel mode (Cp) is selected, only the D and Q can be shown on the secondary display. The following

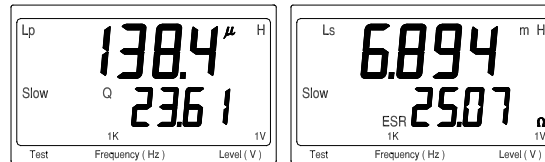
shows some examples of capacitance measurement:



The testing level and frequency can be selected by pressing the **Level** key and **Frequency** key, respectively.

2.2.10 Inductance Measurement

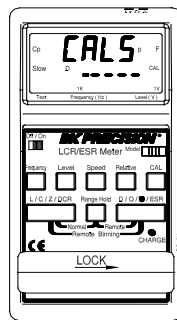
Select the **L/C/Z/DCR** key to Ls or Lp mode for measuring the inductance in serial mode or parallel mode. If the serial mode (Ls) is selected, the D, Q and ESR can be shown on the secondary display. If the parallel mode (Lp) is selected, only the D and Q can be shown on the secondary display. The following shows some examples of capacitance measurement:



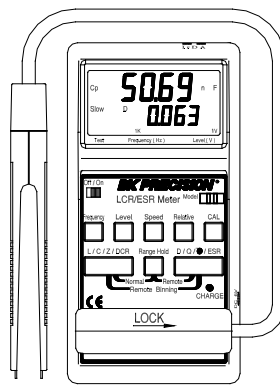
The testing level and frequency can be selected by pressing the **Level** key and **Frequency** key, respectively.

2.3 Accessory Operation

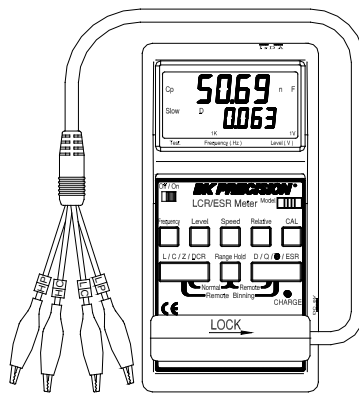
Follow the figures below to attach the test probes for making measurement.



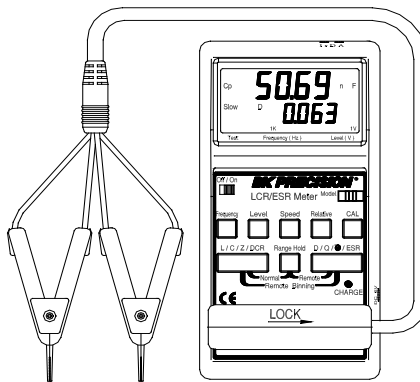
Shorting Bar



TL885A SMD Test Probe



TL885B 4-Wire Test Clip



TL08C Kelvin Clip

4. Application

4.1 Test Leads Connection

Auto balancing bridge has four terminals (H_{CUR} , H_{POT} , L_{CUR} and L_{POT}) to connect to the device under test (DUT). It is important to understand what connection method will affect the measurement accuracy.

- 2-Terminal (2T)

2-Terminal is the easiest way to connect the DUT, but it contains many errors which are the inductor and resistor as well as the parasitic capacitor of the test leads (Figure 3.1). Due to these errors in measurement, the effective impedance measurement range will be limited at 100Ω to $10K\Omega$.

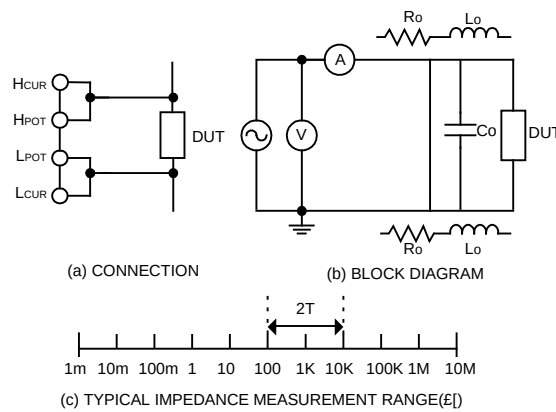


Figure 3.1

- 3-Terminal (3T)

3-Terminal uses coaxial cable to reduce the effect of the parasitic capacitor (Figure 3.2). The shield of the coaxial cable should connect to guard of the instrument to increase the measurement range up to $10\text{M}\Omega$.

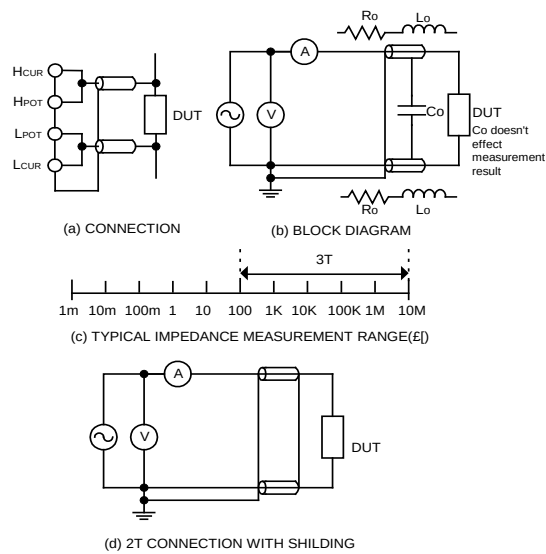


Figure 3.2

- 4-Terminal (4T)
4-Terminal connection reduces the effect of the test lead

resistance (Figure 3.3). This connection can improve the measurement range down to $10\text{m}\Omega$. However, the effect of the test lead inductance can't be eliminated.

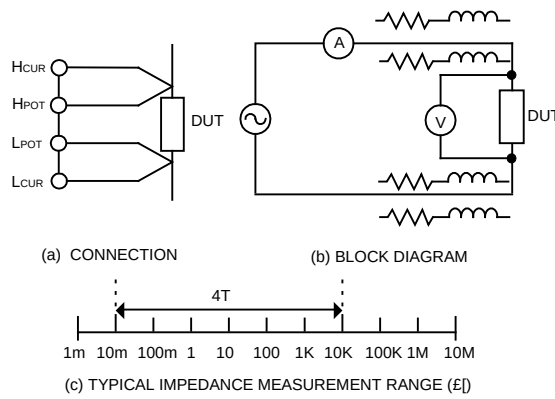


Figure 3.3

- **5-Terminal (5T)**

5-Terminal connection is the combination of 3T and 4T (Figure 3.4). It has four coaxial cables. Due to the advantage of the 3T and 4T, this connection can widely increase the measurement range for $10\text{m}\Omega$ to $10\text{M}\Omega$.

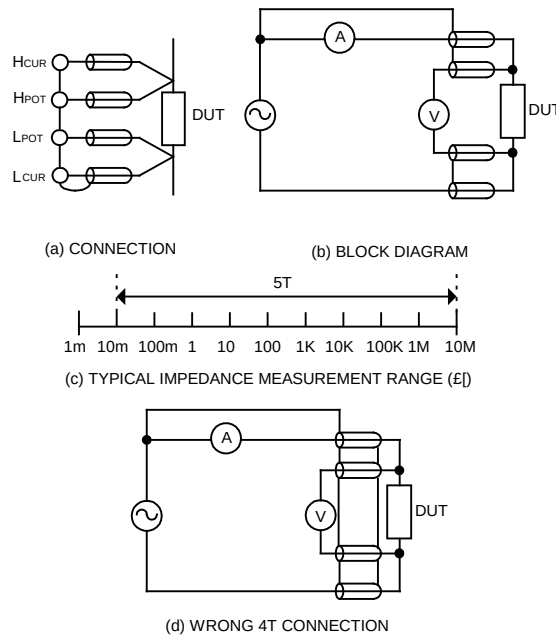


Figure 3.4

- **4-Terminal Path (4TP)**

4-Terminal Path connection solves the problem that caused by the test lead inductance. 4TP uses four coaxial cables to isolate the current path and the voltage sense cable (Figure 3.5). The return current will flow through the coaxial cable as well as the shield. Therefore, the magnetic flux that generated by internal conductor will cancel out the magnetic flux generated by external conductor (shield). The 4TP connection increases the

measurement range from $1\text{m}\Omega$ to $10\text{M}\Omega$.

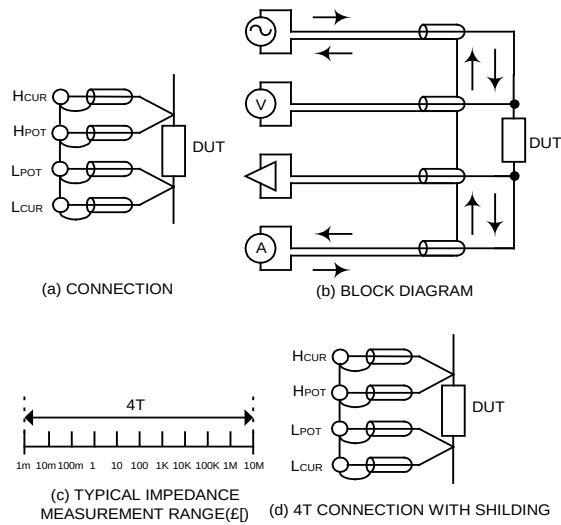


Figure 3.5

- **Eliminating the Effect of the Parasitic Capacitor**
When measuring the high impedance component (i.e. low capacitor), the parasitic capacitor becomes an important issue (Figure 3.6). In figure 3.6(a), the parasitic capacitor C_d is paralleled to DUT as well as the C_i and C_h . To correct this problem, add a guard plane (Figure 3.6(b)) in between H and L terminals to break the C_d . If the guard plane is connected to instrument guard, the effect of C_i and C_h will be removed.

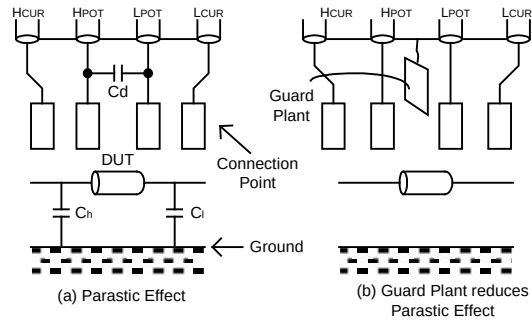


Figure 3.6

4.2 Open/Short Compensation

For those precision impedance measuring instrument, the open and short compensation need to be used to reduce the parasitic effect of the test fixture. The parasitic effect of the test fixture can be treated like the simple passive components in figure 3.7(a). When the DUT is open, the instrument gets the conductance $Y_p = G_p + j\omega C_p$ (Figure 3.7(b)). When the DUT is short, the instrument gets the impedance $Z_s = R_s + j\omega L_s$ (Figure 3.7(c)). After the open and short compensation, Y_p and Z_s are for calculating the real Z_{dut} (Figure 3.7(d)).

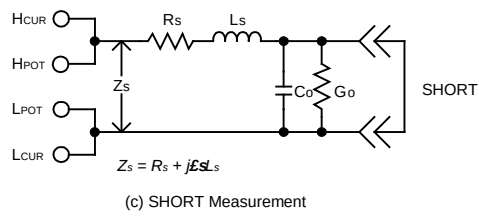
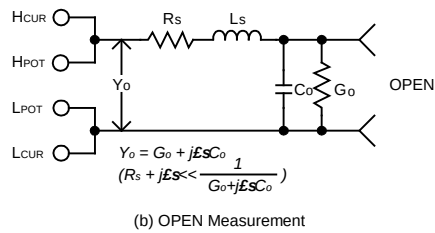
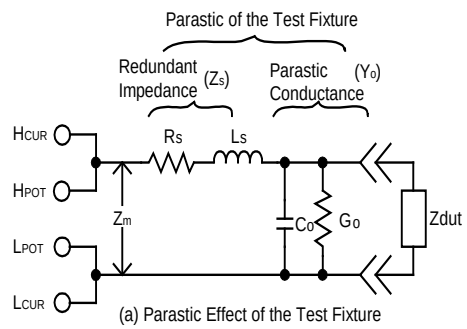


Figure 3.7

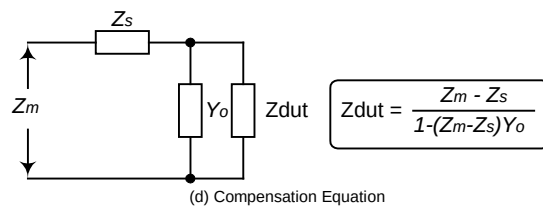


Figure 3.7 (Continued)

4.3 Selecting the Series or Parallel Mode

According to different measuring requirement, there are series and parallel modes to describe the measurement result. It is depending on the high or low impedance value to decide what mode to be used.

- Capacitor
The impedance and capacitance in the capacitor are negatively proportional. Therefore, the large capacitor means the low impedance; the small capacitor means the high impedance. Figure 3.8 shows the equivalent circuit of capacitor. If the capacitor is small, the R_p is more important than the R_s . If the capacitor is large, the R_s shouldn't be avoided. Hence, uses parallel mode to measure low capacitor and series mode to measure high capacitor.

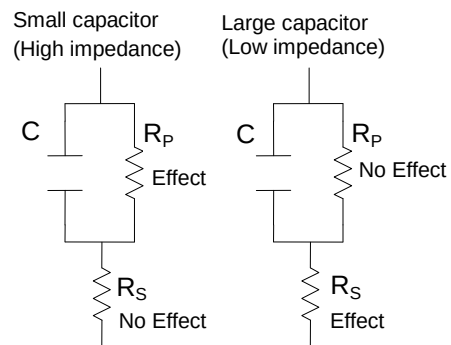


Figure 3.8

- Inductor

The impedance and inductive in the inductor are positively proportional. Therefore, the large inductor equals to the high impedance and vice versa. Figure 3.9 shows the equivalent circuit of inductor. If the inductor is small, the R_S is more important than the R_P . If the inductor is large, the R_P should be taking care of. So, uses series mode to measure low inductor and parallel mode to measure high inductor.

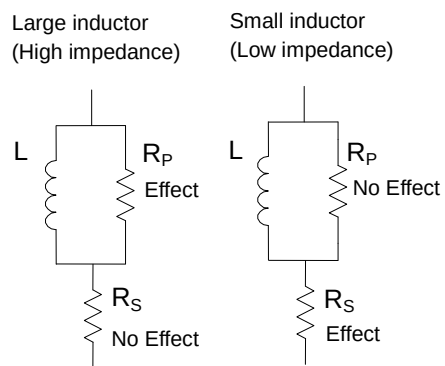


Figure 3.9

5. Limited Three-Year Warranty

B&K Precision Corp. warrants to the original purchaser that its products and the component parts thereof, will be free from defects in workmanship and materials for a period of **three years** from date of purchase.

B&K Precision Corp. will, without charge, repair or replace, at its option, defective product or component parts. Returned product must be accompanied by proof of the purchase date in the form of a sales receipt.

Exclusions: This warranty does not apply in the event of misuse or abuse of the product or as a result of unauthorized alternations or repairs. It is void if the serial number is alternated, defaced or removed.

B&K Precision Corp. shall not be liable for any consequential damages, including without limitation damages resulting from loss of use. Some states do not allow limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

This warranty gives you specific rights and you may have other rights, which vary from state-to-state.

Service Information

Warranty Service: Please return the product in the original packaging with proof of purchase to the below address. Clearly state in writing the performance problem and return any leads, connectors and accessories that you are using with the device.

Non-Warranty Service: Return the product in the original packaging to the below address. Clearly state in writing the performance problem and return any leads, connectors and accessories that you are using with the device. Customers not on open account must include payment in the form of a money order or credit card. For the most current repair charges contact the factory before shipping the product.

Return all merchandise to B&K Precision Corp. with pre-paid shipping. The flat-rate repair charge includes return shipping to locations in North America. For overnight shipments and non-North America shipping fees contact B&K Precision Corp..

Include with the instrument your complete return shipping address, contact name, phone number and description of problem.

6. Safety Precaution

SAFETY CONSIDERATIONS

The Models 885 & 886 LCR Meter has been designed and tested according to Class 1A 1B or 2 according to IEC479-1 and IEC 721-3-3, Safety requirement for Electronic Measuring Apparatus.

SAFETY PRECAUTIONS

SAFETY NOTES

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument.

The manufacturer assumes no liability for the customer's failure to comply with these requirements.

BEFORE APPLYING POWER

Verify that the product is set to match the available line voltage is installed.

SAFETY SYMBOLS



Caution, risk of electric shock



Earth ground symbol



Equipment protected throughout by double insulation or reinforced insulation



Caution (refer to accompanying documents)

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the instrument. Return the instrument to a qualified dealer for service and repair to ensure that safety features are maintained.

INSTRUMENTS WHICH APPEAR DAMAGED OR DEFECTIVE SHOULD NOT BE USED! PLEASE CONTACT B&K PRECISION FOR INFORMATION ON REPAIRS.