Wayne Kerr Electronics

LCR METER

4234 / 4235 / 4236 / 4237

1.0

Specification

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1. SPECIFICATION

Wayne Kerr Electronics Limited reserves the right to change specification without notice

1.1 Measurement Parameters

Any of the following parameters can be measured and displayed:

DC Function

Resistance (Rdc).

AC Functions

Capacitance (C), Inductance (L), Resistance (R), Conductance (G), Susceptance (B), Reactance (X), Dissipation Factor (D), Quality Factor (Q), Impedance (Z), Admittance (Y) and Phase Angle (θ).

The following display formats are available:

Series or Parallel Equivalent Circuit

C+R, C+D, C+Q, L+R, L+Q

Series Equivalent Circuit Only

X+R, X+D, X+Q

Parallel Equivalent Circuit Only

C+G, B+G, B+D, B+Q

Polar Form

Z + Phase Angle, Y + Phase Angle

1.2 Test Conditions

1.2.1 AC Drive

1.2.1.1 Frequency Range

20Hz to 100KHz (4234)

20Hz to 200KHz (4235)

20Hz to 500KHz (4236)

20Hz to 1MHz (4237)

Resolution: 5 digits

Accuracy of set frequency ±0.005%,

1.2.1.2 Drive Level (AC & DC Measurements)

Open circuit voltage:10mV to 2V
Short circuit current:100MA to 20mA
Signal source impedance:100Ω nominal
Resolution:10mV
Accuracy:2%±5mV

1.3 Measurement Speeds

Four selectable speeds for all measurement functions. Selecting slower measurement speed increases reading resolution and reduces measurement noise by averaging.

	Test Frequency				
	DC	□100Hz	□2kHz	>2kHz	□1MHz
MAX	30ms	600ms	120ms	85ms	120 ms
FAST	60ms	650ms	180ms	140 ms	150 ms
MEDIUM	120ms	1.2S	470ms	450 ms	470 ms
SLOW	900ms	1.3S	600ms	600 ms	620 ms

1.4 Display Range

R, Z , X	0.01mΩ to 1GΩ
G, Y, B	0.001nS to 1kS
L	0.1nH to 100kH
C	0.001pF to 1F
D	0.00001 to 1000
Q	0.01 to 1000
Rdc	0.01mΩ to 100MΩ

1.5 Modes Of Operation

1.5.1 MEASUREMENT

Selection of any measurement parameter and test condition.

Single-level function-menu controlled by keypad and soft keys.

Single and repetitive measurements displaying major and minor terms.

Analogue scale with configurable Hi/Lo limits giving PASS/FAIL indication.

1.5.2 MULTI-STEP

Measurement parameters and test conditions set using MULTI-STEP SET MODE.

Up to 30 steps with configurable limits.

PASS/FAIL indication.

Up to 64 multi-step programs can be saved in the non-volatile memory.

1.6 Measurement Connections

4 front panel BNC connectors with the screens at ground potential.

Terminals withstand connection of charged capacitor up to 5V, either polarity.

1.7 Measurement Accuracy

The accuracy statements given apply when the instrument is used under the following measurement conditions.

Slow speed, 4-terminal measurement. The instrument must have warmed up for at least 30 minutes at a steady ambient temperature of between 18°C and 28°C. The instrument must have been trimmed with its measuring leads and fixture at the measurement frequency.

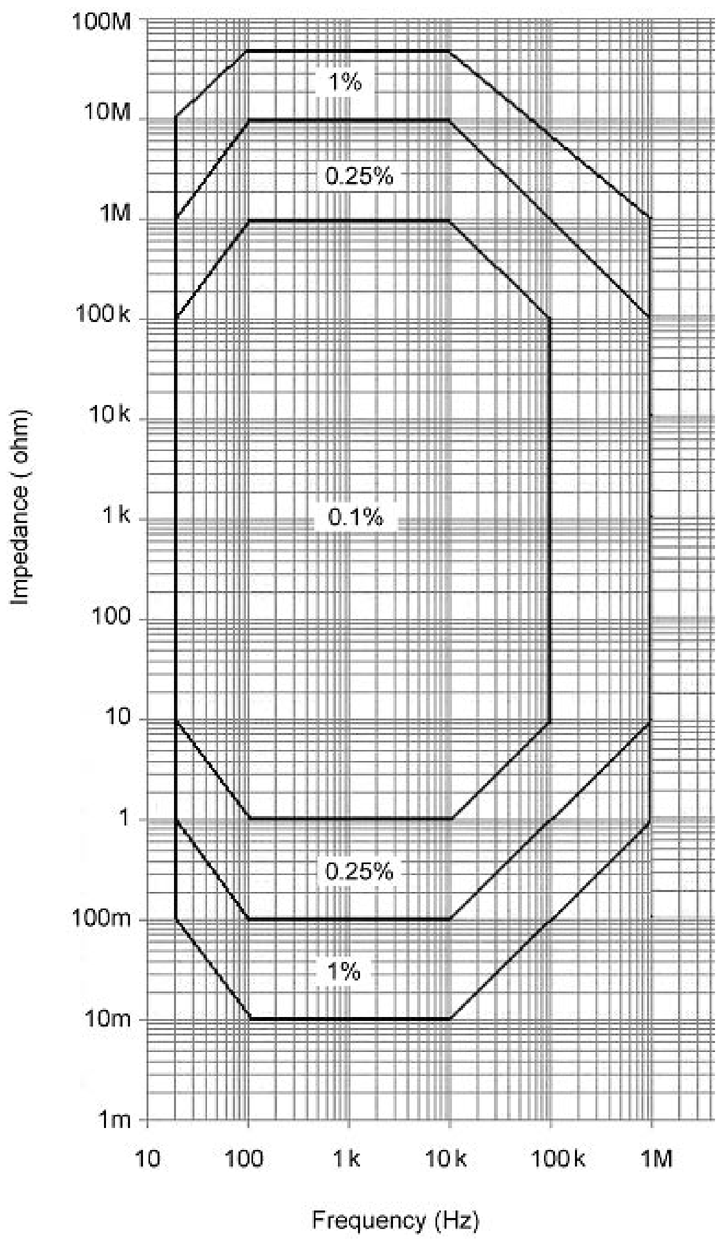
Except on the highest and lowest hardware measurement ranges, the accuracy chart also apply to medium speed. For maximum and fast speed, the figure must be doubled.

Measurement accuracy for the multi-step mode conforms to the maximum speed setting.

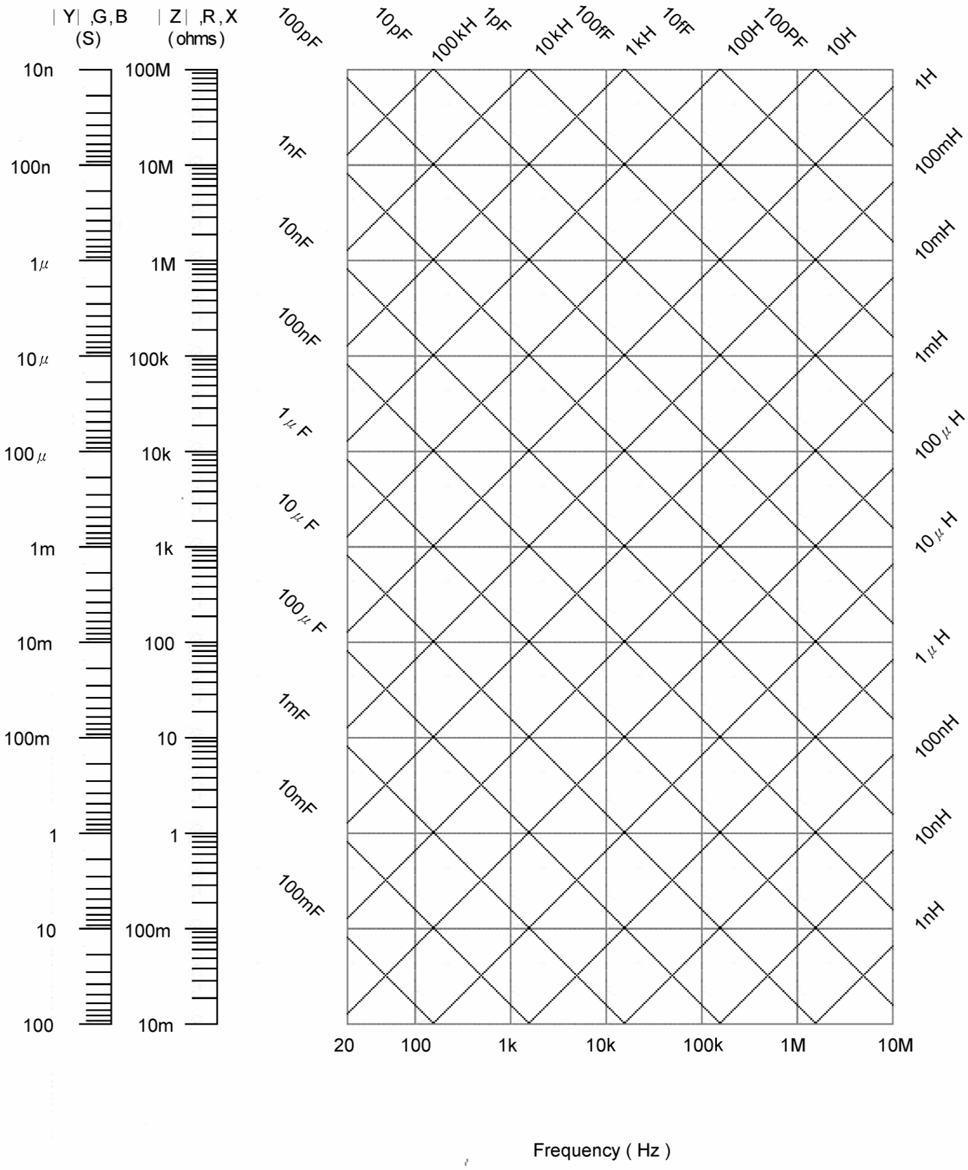
1.8 Accuracy Chart

Accuracy chart define the measurement ranges available, at specified accuracies, over the available frequency band. All curves assume that Slow measurement speed is used, that the meter has been trimmed at the frequency and level used for measurements, factory calibration are valid and that the component under test is pure.

1.8.1 |Z| Accuracy Chart



1.8.2 |Z| vs L, C Chart



1.8.3 |Z|, |Y|, L, C, R, X, G and B Accuracy

For high impedance value:

Ae[%] = ±((A + 0.0000001*Zx) * Kv * Kt)

For low impedance value

Ae[%] = ±((A + 0.1/Zx) * Kv * Kt)

Where,

A= Accuracy from accuracy chart

Zx= Measured value of unknown component

Kv= Test voltage factor (Refer to Table A)

Kt= Temperature factor (Refer to Table B)

L, C, X, and B accuracy apply when D < 0.1

R, G accuracy apply when Qx < 0.1

When D ≧ 0.1, multiply Ae by $\sqrt{1 + D^2}$ for L, C, X and B accuracies.

When Q≧ 0.1, multiply Ae by $\sqrt{1 + Q^2}$ for R, and B accuracies

1.8.4 D Accuracy

De = ±(Ae / 100)

If D > 0.1, multiply D accuracy by $(1+D^2)$

1.8.5 Q Accuracy

$Qe = \pm((Qx^2*De) / (1 \pm Qx*De))$

Where, Qx is the measured Q value,

De is the relative D accuracy.

Accuracy applies when Qx * De < 1

Table A. Test voltage factor

Level	Kv
≧ 1.250	1.2
≧ 0.625	1
≧ 0.313	1.2
≧ 0.156	1.5
≧ 0.078	2
≧ 0.039	2.5
≧ 0.02	5
≧ 0.010	10

Table B Temperature factor

Temperature(°C)	Kt
8-18	2
18-28	1
28-35	2

1.9 General

1.9.1 Power Supply

Input Voltage	115V AC ±10% or 230V AC ±10% (selectable)
Frequency	50/60Hz
VA rating	150VA max
Input fuse rating	115/230V operation: 3AT
	The input fuse is in the fuse holder drawer integral to the IEC input connector.

1.9.2 Display

High contrast black and white LCD module 320 x 240 pixels with CPL back lighting.

Visible area 115 x 86mm.

1.9.3 Remote Control

Designed to GPIB IEEE-488.2 and SCPI 1992.0.

1.9.4 Remote Trigger

Rear panel phone jack with internal pull-up, operates on logic low or contact closure.

1.9.5 Mechanical

Height	150mm
Width	340mm
Depth	460mm
Weight	6.5kg

1.10 Environmental Conditions

This equipment is intended for indoor use only in a non-explosive and non-corrosive atmosphere.

1.10.1 Temperature Range

Storage: -40°C to +70°C.
Operating: 0°C to 40°C.
Normal accuracy: 23±5°C.

1.10.2 Relative Humidity

Up to 80% non-condensing.

1.10.3 Altitude

Up to 2000m.

1.10.4 Installation Category

II in accordance with IEC664.

1.10.5 Pollution Degree

2 (mainly non-conductive).

1.10.6 Safety

Complies with the requirements of EN61010-1.

1.10.7 EMC

Complies with EN61326 for emissions and immunity.

2. THEORY REFERENCE

2.1 Abbreviations

B	Susceptance (= 1/X)	R	Resistance
C	Capacitance	X	Reactance
D	Dissipation factor (tan δ)	Y	Admittance (= 1/Z)
E	Voltage	Z	Impedance
G	Conductance (= 1/R)	ω	2π x frequency
I	Current		
L	Inductance		Subscript s ($_s$) = series
Q	Quality (magnification) factor		Subscript p ($_p$) = parallel

2.2 Formulae

$$Z = \frac{E}{I} \qquad \text{(all terms complex)}$$

$$Y = \frac{I}{E} = \frac{1}{Z}$$

$$Z_s = R + jX = R + j\omega L = R - \frac{j}{\omega C}$$

$$|Z_s| = \sqrt{(R^2 + X^2)}$$

$$|Z_p| = \frac{RX}{\sqrt{(R^2 + X^2)}}$$

$$Y_p = G + jB = G + j\omega C = G - \frac{j}{\omega L}$$

$$|Y_p| = \sqrt{(G^2 + B^2)}$$

$$|Y_s| = \frac{GB}{\sqrt{(G^2 + B^2)}}$$

where $X_L = \omega L \qquad X_C = \frac{1}{\omega C} \qquad B_C = \omega C \qquad B_L = \frac{1}{\omega L}$

$$Q = \frac{\omega L_S}{R_S} = \frac{1}{\omega C_S R_S} \qquad \text{(series R, L, C values)}$$

$$Q = \frac{R_P}{\omega L_P} = \omega C_P R_P \qquad \text{(parallel R, L, C values}$$

$$D = \frac{G_P}{\omega C_P} = \omega L_P G_P \qquad \text{(parallel G, L, C values)}$$

$$D = \frac{R_S}{\omega L_S} = \omega C_S R_S \qquad \text{(series R, L, C values)}$$

$$\text{Note: The value } Q = \frac{1}{D} \text{ is constant regardless of series/parallel convention}$$

2.3 Series/Parallel Conversions

$$R_S = \frac{R_P}{(1+Q^2)} \qquad R_P = R_S(1+Q^2)$$

$$C_S = C_P(1+D^2) \qquad C_P = \frac{C_S}{(1+D^2)}$$

$$L_S = \frac{L_P}{\left(1+\frac{1}{Q^2}\right)} \qquad L_P = L_S\left(1+\frac{1}{Q^2}\right)$$

Conversions using the above formulae will be valid only at the test frequency.

2.4 Polar Derivations

$$R_S = |Z|\cos\theta \qquad G_P = |Y|\cos\theta$$

$$X_S = |Z|\sin\theta \qquad B_P = |Y|\sin\theta$$

Note that, by convention, +ve angle indicates an inductive impedance or capacitive admittance.

If capacitance is measured as inductance, the L value will be –ve.

If inductance is measured as capacitance, the C value will be –ve.

$D = \tan\delta$ where $\delta = (90 - \theta)^\circ$ admittance measurement.

$Q = \dfrac{1}{\tan\delta}$ where $\delta = (90 - \theta)^\circ$ impedance measurement.