12. SPECIFICATIONS

This chapter details the nominal specification for the 6500B series.

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

Measurement Parameters

Any of the following parameters can be measured and displayed.

AC Functions

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

Equivalent Circuit

Series or Parallel.

Test Conditions

Frequency Range

6505B

20Hz to 5MHz

6510B

20Hz to 10MHz

6515B

20Hz to 15MHz

6520B

20Hz to 20MHz

6530B

20Hz to 30MHz

6550B

20Hz to 50MHz

65120B

20Hz to 120MHz

For all models: Accuracy of set frequency: ±0.005%

Frequency step size: <1mHz

AC Drive

Drive Level (AC Measurements)

Open Circuit Voltage	Short Circuit Current
10mV to 1V rms (< 50MHz)	200µA to 20mA rms (< 50MHz)
10mV to 0.5V rms (> 50MHz)	200µA to 10mA rms (> 50MHz)

Signal source impedance: 50Ω nominal

Internal DC Bias /D1 (Optional)

Current

DC bias 0 to +100mA.

DC Bias Current	Resolution	Accuracy
1 – 10mA	0.1mA	±1% ±1uA
10 – 100mA	1mA	±1% ±10uA

Voltage

DC bias 0 to +40V

DC Bias Voltage	Resolution	Accuracy
0 – 4V	5mV	±1% ±5mV
4 – 12V	10mV	±1% ±10mV
12 – 40V	35mV	±1% ± 35mV

Measurement Speeds

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

Maximum speed.

Fast speed.

Medium speed.

Slow speed.

A custom speed may be set which allows for user defined measurement speeds to be set to enhance noise performance.

Custom speed 1-256

When set to the maximum speed the typical 6500 measurement times are as follows:-

	Meter Mode	Analysis Mode
1kHz	250ms	190ms
10kHz	70ms	70ms
100kHz	70ms	70ms
>1MHz	60ms	60ms

Measurement Accuracy

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

AC Drive Level: 1V/20mA

Speed: SLOW

Fixture: 1J1011

Instrument fully trimmed

Temperature range: 23±5°C

30 minute warm up period

Resistance / Reactance (R / X)

±0.05% *

Conductance / Susceptance (G / B)

±0.05% *

Capacitance (C)

±0.05% *

Inductance (L)

±0.05% *

Dissipation Factor (D)

±0.05% $(1+D^2)$*

Quality Factor (Q)

±0.05% (Q+1/Q)*

*Varies with frequency, drive level and measured impedance.

Measurement Ranges

R, Z, X	0.01mΩ to >2GΩ
G, Y, B	0.01nS to >2kS
L	0.1nH to >2kH
C	1fF to >1F
D	0.00001 to >1000
Q	0.00001 to >1000

Internal Hardware Ranges

The impedance of the Device under Test (DUT) and the measurement frequency determine the hardware range used internally. Auto ranging is available which sets the most appropriate range for a measurement.

Range	Impedance Ω	Frequency Range
1	< 5	Full range
2	<50	Full range
3	>50	Full range
4	>500	Full range
5	>5000	Up to 1MHz
6	>50000	Up to 100kHz
7	>500000	Up to 10kHz

Measurement Connections

4 front panel BNC connectors permit 3- and 4-terminal connections with the screens at ground potential.

Terminals withstand connection of charged capacitor up to 500V.

Analysis Mode (Graphical Sweep)

Any two measurement parameters may be selected and measurements made while varying frequency, AC drive level or dc bias (option).

Meter Mode

Provides a standard LCR meter interface presenting numerical results of single or repetitive measurements. All instrument measurement parameters may be set prior to making measurements.

Set-up Data

Up to 20 instrument set-ups may be locally stored for each mode. Additional set-ups in either mode may be stored on the external USB memory.

General

Power Supply

Input Voltage	90V – 264V AC, auto-ranging
Frequency	47 – 63Hz
VA rating	150VA max
Input fuse rating	2.5AT

Display

8.4” high contrast colour VGA (640 x 480 pixels) TFT module with CPL back lighting.

Touch screen interface.

Visible area 170 x 130mm.

Printer Output

HP-PCL compatible graphics printing

Ethernet direct print

Centronics/parallel printer port, Epson compatible text/ticket printing

GPIB Remote Control

Designed to GPIB IEEE-488.2 and SCPI 1992.0.

External Trigger In

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

Universal Serial Bus (USB)

Two Universal Serial Bus Interfaces

USB 1.0 compliant

VGA External Monitor

15-way D-type connector to drive an external monitor in addition to the instrument display.

Local Area Network (LAN)

10/100-BASETX Ethernet controller.

RJ45 connector

Mouse interface

Standard USB or PS/2 mouse port. Touch screen remains enabled with the mouse.

Keyboard interface

Standard USB or PS/2 keyboard port. Instrument front panel remains active with the keyboard.

Mechanical

Height	190mm (7.5")
Width	440mm (17.37")
Depth	525mm (20.7")
Weight	13.8kg (30.4 lbs)

Environmental Conditions

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

Temperature Range

Storage:	-20°C to +60°C.
Operating:	0°C to 40°C.
Normal accuracy:	18°C to 28°C.

Relative Humidity

Up to 80% non-condensing.

Altitude

Up to 2000m.

Installation Category

II in accordance with IEC664.

Pollution Degree

2 (mainly non-conductive)

Safety

Complies with the requirements of EN61010-1.

EMC

Complies with EN61326 for emissions and immunity.

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13. THEORY REFERENCE

Outlined in this chapter are the abbreviations used in this manual and the 6500 series instruments.

The formulae section documents the derivation of the measurement parameters.

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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	

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

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

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

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

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

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

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.

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.

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