ADEX

ADEX CORPORATION

INSTRUCTION MANUAL

OPERATION MANUAL
OF
ADEX LCR METER
MODEL **AX-221N**

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CONTENT

1. OUTLINE

ADEX LCR Meter, Model AX-221N is capable of measuring easily and handily the contact resistance of electronic components such as a coil, condenser, resistor as well as switch, relay, etc. and also measuring the internal resistance of a battery, the junction capacitance of a semiconductor as well as any kind of elements.

With the auto range and auto mode functions, it is capable of selecting automatically an optimum range for the measuring object with unknown value. Also, as the manual selection of range is possible, time required for the measurement with the change of range can be shortened.

The display unit displays LCR value in 3-1/2 digit and in case of the measuring L or C, the value of D (dissipation factor) is also displayed in 3-1/2 digit at the same time.

As a direct current voltage proportional to the measured value is output, it is capable of connecting an analog recorder and analog comparator, etc. to this model AX-221N.

2. MAINTENANCE AND SERVICE

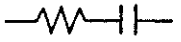
Maintenance and service work shall in principle be made on the product sent back from the enduser at the manufacturer's premises.

3. SPECIFICATIONS

Measuring items	:	C (capacitance) and D (dissipation factor) L (inductance) and D (dissipation factor) R (resistance)
Display	:	in 3-1/2 digit, max. indication 1999
Measuring circuit mode	:	Automatic selection of parallel equivalent circuit and series equivalent circuit.
Measuring terminal	:	Consists of 5 terminals of voltage, current and guard terminal.
Range changeover	:	Automatic and manual
Measuring frequency	:	1 KHz ± 5%

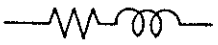
External bias	:	0 to 50V DC When measuring capacitance, the external bias can be impressed from the binding post on the back panel.
Analog output	:	1.999V/1999 count, internal resistance 1Kohm LCR and D output are output from the BNC receptacle on the back panel.
Measuring time	:	less than 1 second until the measured value becomes stable.
Sampling time	:	10 times per second approx.
Time required for automatic ranging	:	100 × n (ms) ("n" stands for the number of range which the automatic ranging circuit steps)
Ambient condition	:	Temperature 0 deg C to 40 deg C Humidity below 85%RH
Storage condition	:	–20 deg. C to +70 deg. C
Power supply	:	AC 100V/117V/220V/240V ± 10% 48-66Hz, below 15VA
Outer dimension	:	260 (W) × 90 (H) × 250 (D) mm approx.
Weight	:	2.2 kg approx.

C-D measurement (at 23 deg. C ± 5 deg. C)

Measuring range	C	1999pF	1.999nF	19.99nF	199.9nF	1.999μF	19.99μF	199.9μF	1999μF
	D	0.001 ~ 1.999							
Measuring signal level		1V		100mV		150uA	1.5mA	15mA	15mA
Measuring circuit mode		Parallel equivalent circuit 				Series equivalent circuit 			
Accuracy	C	0.3 + 2 count + 0.2pF				0.5% + 2 count			1% + 2 count
	D	0.5% + (2 + 1000/CX) count				1% + (5 + C X/ 500) count			

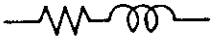
Accuracy: ± (% reading + counts)

L-D measurement (at 23 deg. C ± 5 deg. C)

Measuring range	L	199.9μH	1.999mH	19.99mH	199.9mH	1.999H	19.99H	199.9H
	D	0.001 ~ 1.999						
Measuring signal level		10mA	10mA	1mA	100μA	10μA		1μA
Measuring circuit mode		Series equivalent circuit 						
Accuracy	L	0.5% + 2 count + 0.2μH						1% + 2 count
	D	1% + (3 + 200/LX) count						

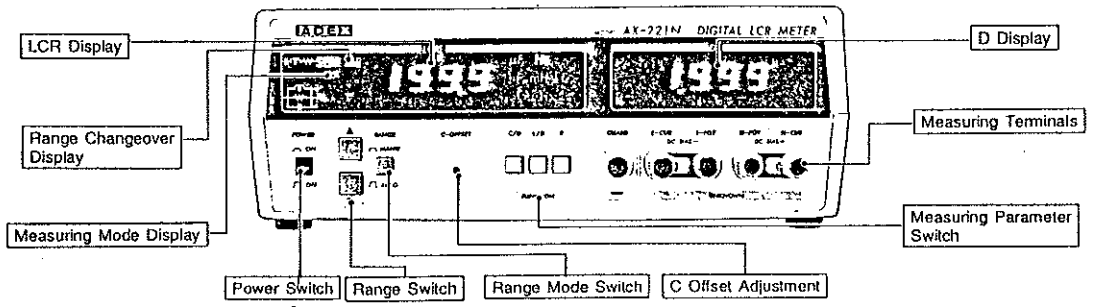
Accuracy: ± (% reading + counts)

R measurement (at 23 deg. C ± 5 deg. C)

Measuring range	1.999Ω	19.99Ω	199.9Ω	1.999kΩ	19.99kΩ	199.9kΩ	1999kΩ
Measuring signal level	100mA	10mA	1mA	100μA	10μA		1μA
Measuring circuit mode	Series equivalent circuit 						
Accuracy	0.3% + 2 count + 2mΩ						

Accuracy: ± (% reading + counts)

4. NAMING AND FUNCTION OF EACH SECTION



(1) Power ON/OFF Switch

When the power switch is put on, this unit is in operating condition.

(2) Range Switch

While keeping the range switch put on, the range rises up by one digit with each one push on △ button and falls down by one digit with each one push on ▽ button.

(3) Range Mode (Manual/Auto) Switch

When this switch is put off, the range is automatically selected and when the switch is put on, the range is fixed one that range which is selected at the moment.

(4) C-Offset Adjustment

When capacitance is measured, the stray capacitance of measuring jig, etc. can be erased.

(5) Measuring Parameter Switch (Function Switch)

Measuring circuit parameter is selected.

FUNCTION	PARAMETER TO BE MEASURED
C/D	Capacitance and dissipation factor
L/D	Inductance and dissipation factor
R	Resistance

(6) UNKNOWN Terminal (Measuring Terminals)

This is the terminal to which the measuring object is connected. It consists of 4 terminals, H current terminal (H-CUR), H voltage terminal (H-POT), L current terminal (L-CUR) and L voltage terminal (L-POT). When Guard terminal is added, it consists of 5 terminals. Please take note that H-CUR is short-circuited to H-POT with short-circuit board and L-CUR to L-POT, thus it consists of 3 terminals when the Meter is delivered from the manufacturer's factory. Therefore, please dis-connect them when you use it for the 4-terminal measurement. Besides, when the external bias is impressed with designated polarity from BIAS terminal on the back panel + DC bias voltage is impressed on the side of H terminal.

(7) D Display

This displays dissipation factor. This display is blank when resistance is measured and when the count number of inductance or capacitance is below 180. When "D" value overflows, "1999" is displayed.

(8) LCR Display

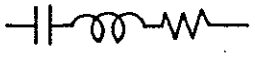
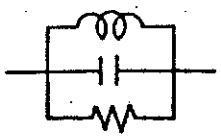
This displays inductance value, capacitance value and resistance value. These value are displayed with the decimal point and measuring unit in 3-1/2 digit. This display is blank when the count number is above 1999 or below 180 in case of the series mode (1.999μF range – 1999μF range) for C/D measurement.

(9) Range Changeover Display

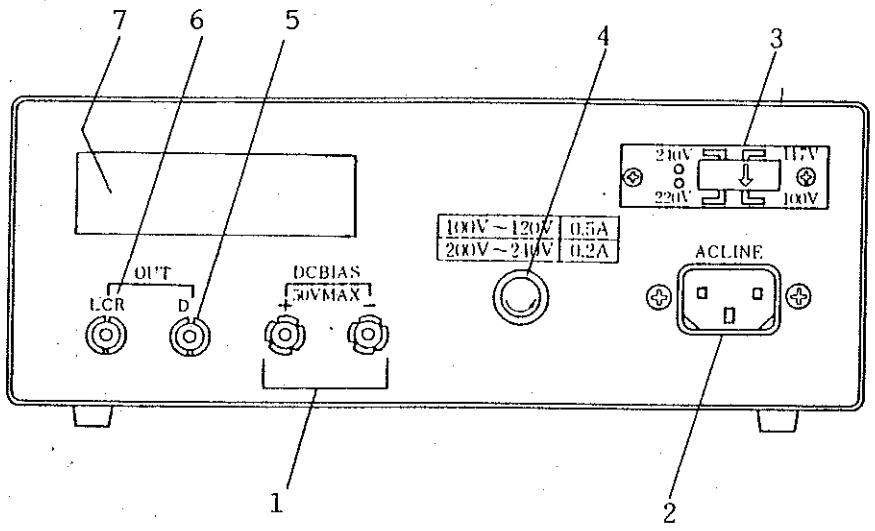
This displays the direction of range selection with manual range. When the optimum range is selected, neither △ nor ▽ lights up. When △ lights up, please raise the range up and when ▽ lights up, lower the range down. When △ lights up with automatic range, it indicates the over-range.

(10) Measuring Mode Display

This displays measuring equivalent circuit.

SER		Series capacitance Series inductance Series resistance
PARA		Parallel capacitance

4-2. BACK PANEL



(1) DC BIAS Terminal

The external DC voltage bias upto 50V is impressed on the measuring object through this terminal.

(2) AC Line Connector

AC 100V or 117V or AC 220 or 240V is supplied through this connector.

(3) Changeover Switch for AC Line Power Supply

It is possible to select AC supply voltage, 100V, 117V, or 220V, 240V.

(4) Fuse Holder

Please use 0.5A fuse for AC100V-120V and 0.2A fuse for AC200V-240V.

(5) D Analog DC Voltage Output

DC voltage proportional to D display is output.
(1.999/1999 count approx.)

(6) L C R Analog DC Voltage Output

DC voltage proportional to L C or R display is output.
(1.999/1999 count approx.)

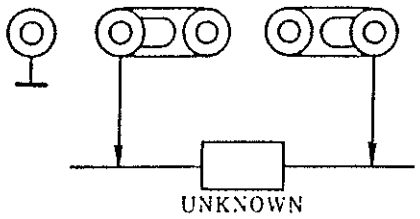
(7) BCD Output Connector

Datas of LCR and D are output.
(Option)

5. HOW TO CONNECT MEASURING TERMINAL

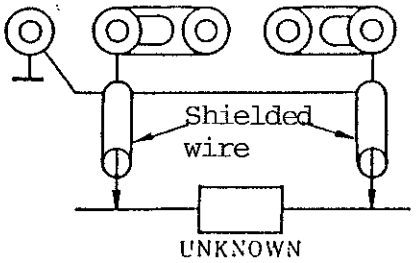
5-1. 2-terminal measuring method

This method is used for the measurement of impedance of the object within the range of 100 ohm and 10k ohm or when the measuring accuracy is not so important.



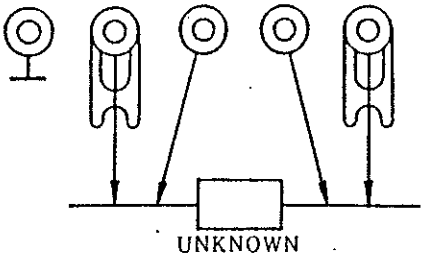
5-2. 3-terminal measuring method

With this method, we can get rid of the influence of wafting capacitance between measuring leads and a nearby conductor, and this method is used for the measurement of small capacitance, high inductance and high resistance.



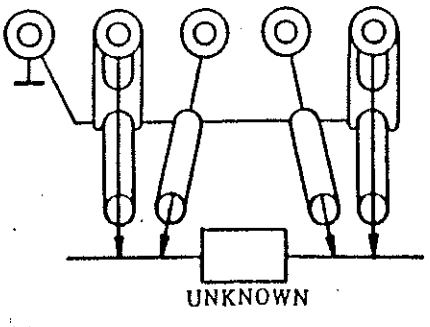
5-3. 4-terminal measuring method

With this method, we can get rid of the influence of resistance and inductance of measuring lead and contact resistance with the measuring object, and this method is used for the measurement of a big capacitance, low inductance and low resistance.



5-4. 5-terminal measuring method

With this method, we can get rid of the influence of wafting capacitance between measuring leads and a nearby conductor, the influence of resistance and inductance of measuring lead and contact resistance with the measuring object, and this method is used for the measurement with regard to all measuring ranges.



6. HOW TO USE

6-1. Preparation

1) AC single phase power of 100V-240V (±10%) should be supplied to the meter. Power consumption is about 15VA. When delivering from the manufacturer's factory, the voltage is set on the one designted in your order sheet. So, when the supply voltage other than the designted one is applied, change "Changeover Switch for AC Line Power Supply" on the rear panel.
   In case of using of 220/240V, exchange fuse with

2) Before connecting the power line to the plug socket, make sure that the supply voltage is correct.

3) Putting Power Switch off, connect the power plug to the plug socket with designated voltage.

4) Make Range Mode Switch to Auto.

5) Connect the measuring terminal according to "5. How to Connect Measuring Terminal" and make sure that H-CUR is short-circuited to H-POT withs the short-circuit board and L-CUR L-POT, or connected externally.

6) When Power Switch is put on, the power is supplied.

6-2. C/D Measurement

1) Function Switch (Measuring Parameter Switch) should be set on C/D

2) Under the condition that the measuring object is not connected to the measuring terminal, adjust C-OFFSET with-driver so that LCR Display shows 00.0pF.

3) When the measurement is made with the external DC BIAS voltage is being impressed, supply DC voltage to the designated polarity. Make sure that the external DC BIAS voltage more than 50V or with reverse polarity should never be imprssed. Be careful not to damage the instrument.

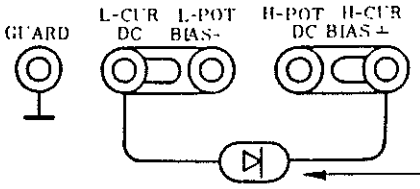
4) When the measuring object is connected to the measuring terminal, LCR Display displays capacitance value and unit and D Display displays dissipation factor value.

5) In case of C/D measurement, the range of 199.9pF-199.9nF is measured in parallel equivalent circuit mode and the range of 1.999μF-1999μF in series equivalent circuit mode.
When the number of count is over 1999 with parallel equivalent circuit mode and below 180 or over 1999 with series equivalent circuit mode, both LCR Display and D Display are blank.

6) When D Display is '1999' even if LCR Display is shown, LCR Display (capacitance value) is void.
In this case, Auto range is unstable and the phenomenon like the breakdown may be observed but the instrument is not out of order.

7) When a big capacitance is measured with the external DC BIAS voltage being impressed, it takes time for the voltage on the measuring object to reach the impressed voltage. Until the voltage on the measuring object becomes stable, the displayed value is unstable and the display flickers. So, please read the value after the display has become stable.

8) For the measurement of junction capacitance of semi conductor the measurement should be made under the condition that bias voltage above DC 1V is impressed through the external bias terminal.



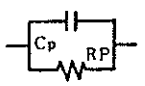
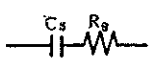
Please see that connection is made to the direction of reverse bias.

9) When almost equal capacitance is measured continuously, you can save time for the change of range if you fix the range by putting on Range Mode Switch while the first measuring object is being measured.

10) When the equivalent circuit of measuring mode is different, the measured value displays different value. For example, parallel capacitance (C_p) 1000pF with dissipation factor (D) 0.5 is equivalent to series capacitance (C_s) 1250pF at 1KHz.

When dissipation factor (D) is smaller than 0.01, the value of parallel equivalent is almost equal to the value of series equivalent. Dissipation factor of a certain measuring object is same regardless of parallel equivalent and series equivalent provided that the frequency is fixed.

Conversion Equation for other mode:

Circuit Mode		Dissipation Factor	Conversion equation for Other Mode
C_p mode		$D = \frac{1}{2\pi f C_p R_p}\left(-\frac{1}{Q}\right)$	$C_s = (1+D^2)\ C_p,\ R_s = \frac{D^2}{1+D^2}\ R_p$
C mode		$D = 2\pi f C R_s\left(-\frac{1}{Q}\right)$	$C_p = \frac{1}{1+D^2}\ C_s,\ R_p = \frac{1+D^2}{D^2}\ R_s$

f: Frequency of testing signal

The reciprocal of dissipation factor (D) is Q. Also D is sometimes expressed in tan δ of dissipation angle.

11) If a condenser to be measured charged with voltage and the measurement is made on such a condenser, the LCR Meter may be damaged. So, please discharge the voltage from a condenser prior to the measurement.

6-3. L/D Measurement

1) Function Switch (Measuring Parameter Switch) should be set on L/D.

2) When the measuring object with unknown value is measured, Range Mode Switch should be set on AUTO and the object be connected to the measuring terminal. Then the optimum range is automatically selected and inductance value and D value are displayed.

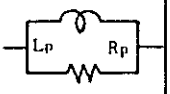
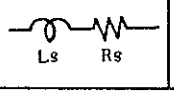
3) When almost equal inductance is measured continuously, you can save time for the change range if you fix the range by putting on Range Mode Switch while the first measuring object is being measured.

4) When Function Switch is set improperly (for instance, in case of measuring capacitance of the object at L/D position), LCR Display shows "–". In this case, LCR Display and D Display are void. However, when LCR Display shows "–" in the vicinity of "000", it is normal.

5) When D Display is 1999 even if LCR Display is shown, LCR Display (inductance value) is void. In this case, Auto range is unstable and the phenomenon like the breakdown may be observed but the instrument is not out of order.

6) The measuring mode for L/D measurement is series equivalent circuit and if the equivalent circuit is different, the measured value displays different value.
Please calculate the value of parallel equivalent circuit according to the equation below.

Conversion Equation for other mode:

Circuit Mode		Dissipation Factor	Conversion equation for Other Mode
L_p mode		$D = \frac{2\pi f L_p}{R_p} \left(= \frac{1}{Q}\right)$	$L_s = \frac{1}{1+D^2} L_p,\ R_s = \frac{D^2}{1+D^2} R_p$
L_s mode		$D = \frac{R_s}{2\pi f L_s} \left(= \frac{1}{Q}\right)$	$L_p = (1+D^2) L_s,\ R_p = \frac{1+D^2}{D^2} R_s$

f: Frequency of testing signal

7) With regard to an object like inductor with iron core which the measured values varies according to the measuring current, the measured value may be different from the value measured with other measuring instrument. So, please be careful about measuring condition. Besides, when such an object is measured with "Auto" of Range Mode Switch and the selection of range is made repeatedly and unsteadily, please set the optimum measuring range for the object with "MANU" of Range Mode Switch.

8) In case of L/D measurement, please make sure that the external BIAS voltage never be impressed.

6-4. R Measurement

1) Function Switch should be set on R.

2) When an object with unknown value is measured, Range Mode Switch should be set on AUTO and the object be connected to the measuring terminal. Then, the optimum range is automatically selected and resistance value is displayed on LCR Display. In this case, D Display is blank.

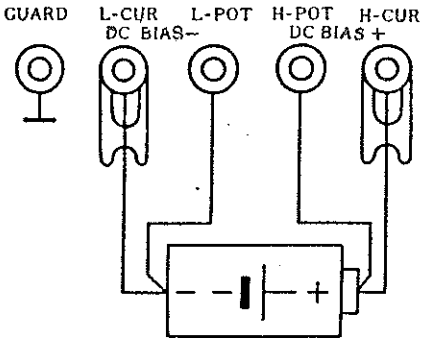
3) When almost equal resistance is measured continuously, you can save time for the change of range if you fix the range by putting on Range Mode Switch to MANU while the first measuring object is being measured.

4) Series resistance of electrolytic condenser, inductor and transformer can be measured with R measuring mode.
In this case, it may happen that displayed number of digit is lessened.
This resistance can also be measured with C/D or L/D mode and be calculated with the following equation.

$R_s = D/\omega C_s$ (C_s-D measurement)
$R_s = \omega L_s \cdot D$ (L_s-D measurement)

5) When series resistance of inductor with iron core is measured, the range is unstable with AUTO of Range Mode Switch and the phenomenon like the breakdown may be observed. In this case, please select the optimum range with MANU of Range Mode Switch or calculate R_S according to the afore-mentioned equation in 6-4, 4) Measuring the resistance with L/D mode.

6) When the internal resistance of an object having electromotive force like battery and cell is measured under the condition of non load, please be careful about the polarity and the connection should be made as per the following drawing. The measurement of an object having electromotive force of more than 50V may damage the instrument and cannot be made. (In this case, please make open BIAS connector on the back panel.)



Remarks: Be careful about the polarity (50V=)