Warranty

Gainkaita

Gainkaita warrants that Products are free from defects in material and workmanship, and when properly used, will perform in accordance with **Gainkaita's** applicable published specification. If within one (1) year after original shipment it is found not to meet this standard, it will be repaired, or at the option of **Gainkaita**, replaced at no charge when returned to a **Gainkaita** service facility.

Changes in the Product not approved by Gainkaita shall void this warranty.

Gainkaita shall not be liable for any indirect, special or consequential damages, even if notice has been given of the possibility of such damages.

This warranty is in lieu of all other warranties, experssed or implied, including, but not limited to any implied warranty or merchantability or fitness for a perticular purpose.

SERVICE POLICY

Gainkaita policy is to maintain product repair capability for a period of five (5) years after original shipment and to make this capability available at the then prevailing schedule of charges.

1.1 General

The 1061 LCZ meter is microprocessor-controlled automatic LCZ testers that provide high accuracy, convenience, speed, and reliability at low cost. Both test frequency and voltage are selectable. With a GPIB interface option, each meter can respond to remote control.

The versatile, adaptable test fixture, single-function keys, and informative display panel make the 1061 convenient to use. Measurement results are clearly shown with decimal points and units, which are automatically presented to assure correctness. Display resolutions are both up to 4 1/2 full digits for L/C/|Z| on A DISPLAY and Q/D/R/ θ on B DISPLAY(notice that R in SERIES circuit mode is also known as ESR). Preset measurement frequency or voltage (selectable) is displayed simultaneously in 3 digits with unit.

The basic accuracy is 0.1%. Calibration to account for any change of test-fixture parameters is semiautomatic; the operator needs to provide only open-circuit and short-circuit conditions in the procedure.

Range selection is automatic or manual selectable. And equivalent series or parallel circuit mode is selected in toggle mode. All key settings are retained in non-volatile memory.

1.2 BRIEF SPECIFICATIONS

- Measurement Parameter : A DISPLAY -- L, C, |Z|
  B DISPLAY -- Q, D, Rs(ESR)/Rp, θ
- Basic Accuracy : 0.1%(1 KHz)
- Measurement Range : L -- .0000uH ~ 1999.9H
  C -- .0000pF ~ 199.99mF
  |Z| -- .0000Ω ~ 199.99MΩ
  Q -- .0000 ~ 19999
  D -- .0000 ~ 19999
  R -- .0000mΩ ~ 19999kΩ
  θ -- -180.00° ~ 179.99°
- Measurement Frequency : 40Hz to 200KHz, 24 points for selection.
- Measurement Voltage : 20mV, to 1.0Vrms, steps 20mV.
- Equivalent Circuit : Series, Parallel
- Zeroing Calibration : Open, Short
- DC Bias Voltage : External, up to 35 Vdc
- Interface (optional) : GPIB. PRINTER CARD

1.3 ACCESSORY CHECK BEFORE USE

Upon receipt of this instrument, please check the following items:

(1) Any damage or scratch in the outlook the product.

(2) Any missing accessory listed in Table 1-1 and 1-2.

If you find any damage or missing accessory, please notice our company, branches, or agents for prompt service.

Table 1-1 Standard Accessory

Item	Part No.	Quantity	Comment
Power cord	27-82018-181	1	
Test cable	27-A2903-77A	1	77cm long for cilpper use
Power fuse slow 0.6A 32m/m	26-16000-209	1	AC 100V/120V use
Power fuse slow 0.3A 32m/m	26-13000-209	1	AC 220V/240V use
Operation manual	49-10613-001	1	
3P - 2P Adapter	22-88110-122	1	for change power plug

Table 1-2 Optional Accessory

Item	Part No.	Quantity	Comment
Test fixture (1)	61-00BOX-001	1	No extension cable.
Test fixture (2)	61-01000-002	1	1m extension cable.
Test fixture (3)	61-00BOX-002	1	Test fixture
SMT Test Cable	61-01000-012	1	SMT Test Cable
BNC Test Cable	61-01000-013	1	BNC Test Cable
LCR Test Cable	61-01000-015	1	LCR Test Cable
Handler Test Cable	61-01000-016	1	Handler Test Cable
GPIB Interface	55-25007-000	1	For linking with IEEE-488 interface.
Printer Interface	55-25013-000	1	For linking with centronics interface.

PS: To get the missing accessory, just name its Part No. to us.

2.1 Measurement Parameters

There are seven measurement parameter pairs in the 1061 LCZ meter; L/Q, L/D, L/R, C/Q, C/D, C/R and |Z| / θ.

- Primary parameters (on A DISPLAY)

  L : Self-inductance (unit = uH, mH, H)

  C : Static-capacitance (unit = mF, uF, nF, pF)

  |Z| : Value of impedance (unit = Ω, kΩ, MΩ)

- Secondary parameters (on B DISPLAY)

  Q : Quility factor

  D : Dissipation factor

  R : Resistance (unit =mΩ, Ω, kΩ)

  θ : Phase angle (unit = ° ; degree)

  Note : R in SERIES equivalent circuit mode is known as ESR.

- Measurement ranges

  L : .0000uH ~ 1999.9H

  C : .0000pF ~ 199.99mF

  |Z| : .0000Ω ~ 199.99MΩ

  Q : .0000 ~ 19999

  D : .0000 ~ 19999

  R : .0000mΩ ~ 19999kΩ

  θ : -180.00° ~ 179.99°

  Note : If any of these quantities (but not |Z|) is negative, the "-" sign willbe indicated.

- Displays

  4 1/2-digit display for both A and B display.

  3-digit display for measurement frequency and signal level.

And the resolutions are:

Table 2-1 Measurement resolution list

Parameter	Resolution	
	Minimum	Maximum
L	.0001uH	0.1H
C	.0001pF	0.01 mF
|Z|	.0001 Ω	0.01M Ω
D,Q	.0001	1
R	.0001m Ω	1K Ω
θ	.0001°	0.01°

- Equivalent circuit
  Either the equivalent SERIES or equivalent PARALLEL circuit representation of L, C or R may be selected by keyboard control.

2.2 Accuracy

- Within 1 year after factory calibration.
- Temperature : 23℃ ± 5℃
- Relative humidity : 80% maximum
- Warm up : 30 minutes minimum.
- Measurement rate : Slow or Medium.
- Zero calibrated under conditions above.

1). |Z| - θ Accuracy

The basic accuracy is listed in Table 2-2.

- For Fast rate, on all ranges, the accuracy must be doubled.
- At frequency below 400Hz and signal level less than 260mV will cause additional unquantifiable errors dependent on measurement fixture layout.
- For |Z| < 0.2 Ω (f in kHZ , Zx in Ω)
  f<1K : Accuracy = ± [0.1 + 0.005/(f×Zx)] %
  f≧1K : Accuracy = ± [0.1 + (0.005×f)/Zx)] %
  Accuracy of θ = Accuracy of |Z| (%)×0.6 °

Table 2-2 |Z| – θ Accuracy

|Z| Ω		Measurement Frequency (Hz) 40 – 100	120 – 400	1K	2K – 10K	15K – 60K	100 – 200K
200M – 100M	× 0	7.9% 4.0°	7.7% 4.0°	7.4% 4.0°	67% 40°		
100M – 20M	× 0	4.2% 2.2°	4.1% 2.1°	3.7% 1.8°	33.7% 20°		
20M – 10M	× 0	0.84% 0.45°	0.82% 0.45°	0.77% 0.40°	6.7% 3.5°	64% 35°	
10M – 5M	× 0	0.47% 0.3°	0.41% 0.25°	0.41% 0.22°	3.4% 2.0°	32.3% 18°	
5M – 2M	× 0	0.24% 0.15°	0.23% 0.13°	0.23% 0.12°	1.8% 1.0°	16.4% 10.0°	
2M – 1M	× 0	0.13% 0.1°	0.13% 0.09°	0.13% 0.06°	0.72% 0.4°	6.9% 4.0°	92% 55°
1M – 200K	× 0	0.1% 0.1°	0.1% 0.08°	0.1% 0.05°	0.4% 0.3°	3.7% 2.0°	46% 30°
200K – 50K	× 0	0.1% 0.06°	0.1% 0.05°	0.1% 0.03°	0.12% 0.08°	0.84% 0.5°	9.6% 5.5°
50K – 2	× 0	0.1% 0.03°	0.1% 0.03°	0.1% 0.03°	0.1% 0.05°	0.26% 0.15°	2.8% 1.5°
2 – 1	× 0	0.1% 0.05°	0.1% 0.03°	0.1% 0.03°	0.1% 0.03°	0.2% 0.12°	1% 1.0°
1 – 0.5	× 0	0.2% 0.12°	0.11% 0.06°	0.1% 0.05°	0.1% 0.08°	0.56% 0.30°	2.3% 1.5°
0.5 – 0.2	× 0	0.34% 0.20°	0.2% 0.15°	0.11% 0.16°	0.11% 1.0°	1.25% 0.8°	4.9% 3.0°

2). L. C. Accuracy

For Q ≧ 10 (D ≦ 0.1), correspond to accuracy of |Z|, where

$|Z_L| = |2\pi fL|$

$|Z_C| = |1/(2\pi fC)|$

Refer to coversion chart between LC and |Z| in Figure 2-1.

If Q < 10 (D > 0.1), multiply L accuracy by (1 + 1/Q) and muitiply C accuracy by (1 + D).

3). D. Q Accuracy

For D ≦ 0.1

Accuracy of D = ±[(0.0175 × Accuracy of θ (%)]

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

For all Q value

Accuracy of Q = ±[(0.0175 × Accuracy of θ (%) × (1+ Q^2)]

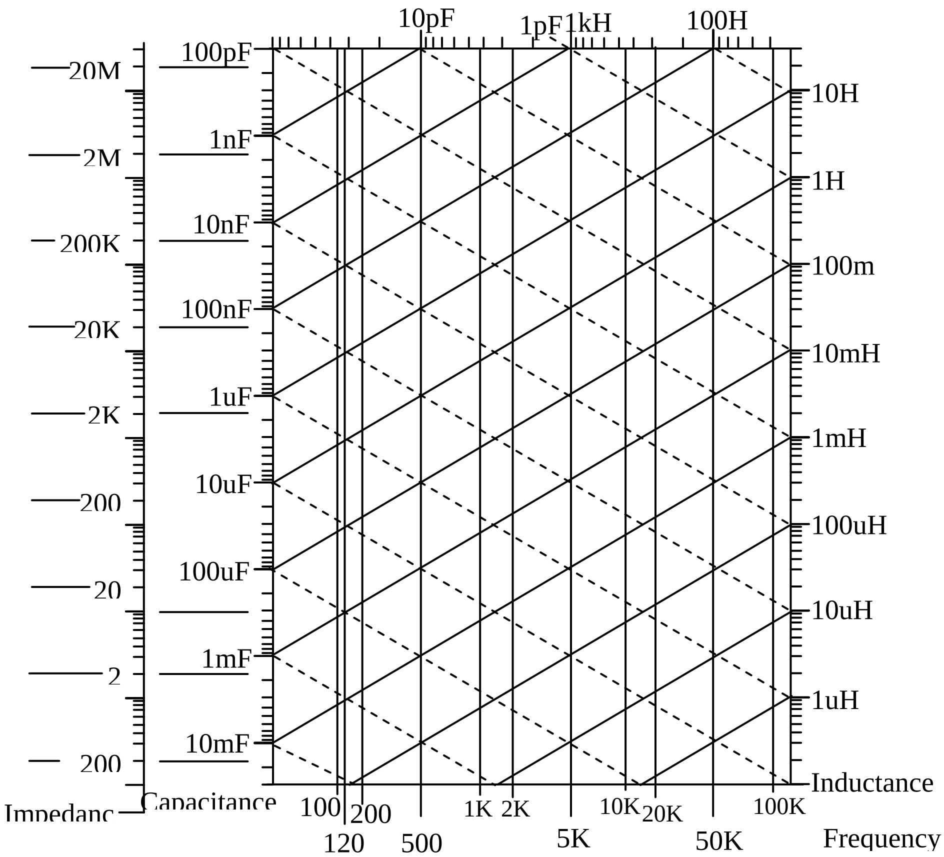
4). R (ESR, EPR) Accuracy

For Q ≦ 0.1

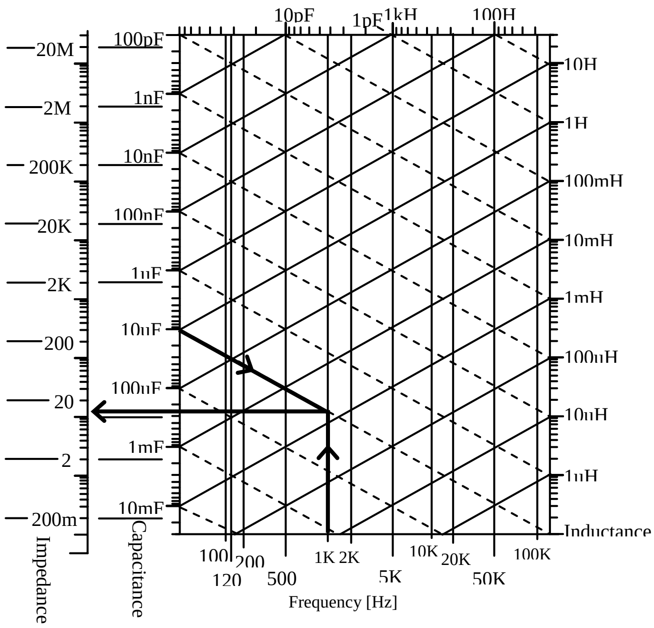
Accuracy of R = Accuracy of |Z|

If Q > 0.1, multiply accuracy by (1 + Q)

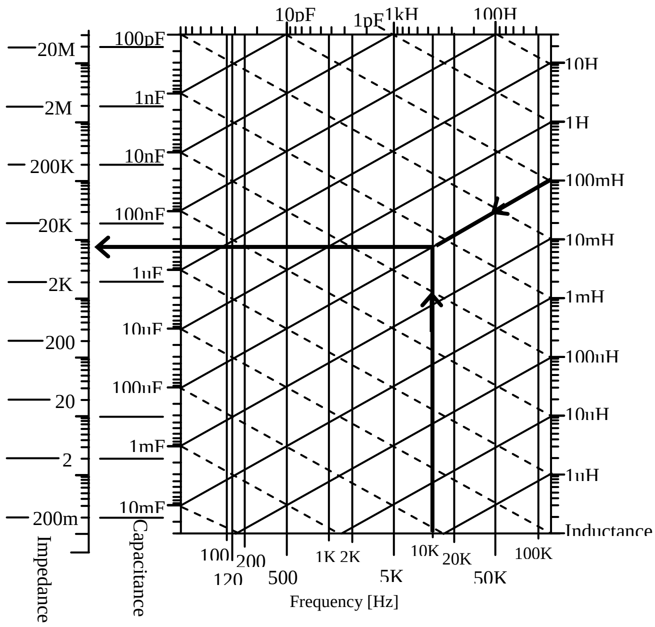
Figure 2-1 LC ←→ |Z| conversion



(a). LC ←→ |Z| conversion chart



(b). C → |Z| conversion chart



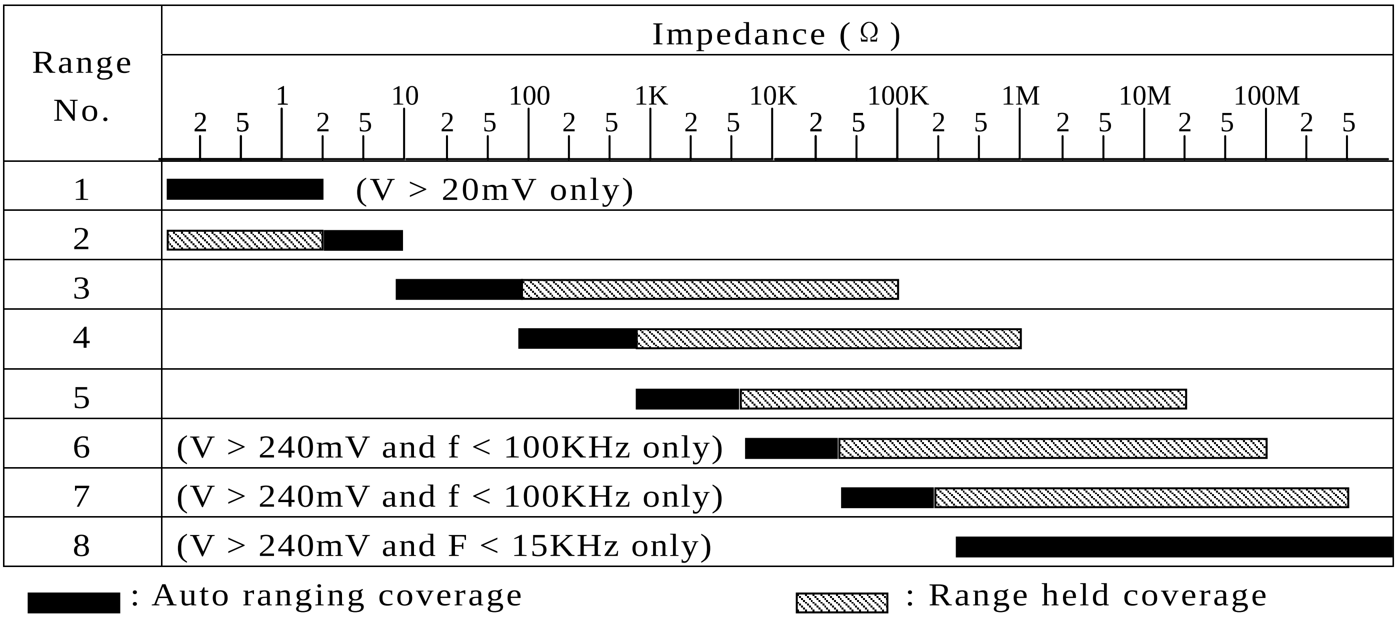
(c). L → |Z| conversion chart

2.3 RANGE SELECTION

Automatic range selection can be inhibited by operating AUTO in OFF state (AUTO indicator flash and "----" messages show for an error range selection). When in Hold (AUTO off), a desired range can be selected by operating RANGE [◀] [▶] keys, and a selected range number shows on A DISPLAY for about 1 second.

The range selection reference is:

Table 2-3 Range Selection



2.4 MEASUEMENT SIGNAL

- Measurement frequency

  There are 30 frequencies between 40 Hz and 200 KHz may be selected using up[▲] and down [▼] keys. They are (Hz): 40, 50, 60, 100, 120, 200, 400, 800, 1K, 2K, 5K, 10K, 15K , 15.7K, 16K, 20K, 22.2K, 25K, 30K, 40K, 50K, 60K, 66.6K, 75K, 80K, 100K, 120K, 150K, 160K, 200K. The frequency accuracy is 0.01%.

- Measurement voltage

  The RMS measurement voltage is selectable from 20mV to 1.0V for 20mV step.

The accuracy is:

±(5% + 2mV), while frequency not exceeds 100kHz.

±(8% + 2mV), while frequency exceeds 100kHz.

- DC Bias

An external bias of up to 35 VDC may be applied to capacitors under test using a panel push-push switch. The applied current should be limited to 1A.

2.5 ZEROING

Open : A simple OPEN operation removes the effects of stray capacitance and conductance of the external test fixture or cable.

Short : A similar SHORT zeroing operation removes the effects of series rsistance and inductance.

2.6 MEASUREMENT TIME

Measurement rate is selected via the [RATE] key. The time required for a complete measurement is typically less than indicated in the following table.

Table 2-4 Measurement Time

Measurement Rate	Measurement Time					
	40Hz	100KHz	120KHz	1KHz	10KHz	100KHz
Slow	400mS	310mS	315mS	282mS	280mS	280S
Fast	250mS	120mS	117mS	70mS	69mS	68mS

Note : 1. If the measurement parameter is |Z| - θ, add 5 ~ 10mS.

2. If IEEE-488 INTERFACE is optioned, add 3mS.

2.7 IEEE-488 INTERFACE (OPTIONAL)

When fitted with this option, the 1061 has a IEEE-488 interface according to the IEEE Std 488-1978 (including 1980 Supplement). All front panel functions are programmable from the bus. All L/C/Z, Q/D/R/ θ data are available as output to the bus. Output format is ASCII. The interface capabilities are:

SH1 -- source handshake (talker)
AH1 -- acceptor handshake (listener)
T5 -- talker (full capability, serial poll)
L4 -- listener (but no listen-only)
SR1 -- request by device for service from controller
RL1 -- complete capability (LLO, LOCAL)
PP0 -- no parallel poll
DC -- device clear
DT1 -- device trigger (typically starts measurement)
C0 -- no controller functions

2.8 PRINTER Interface (Option)

Parallel port interface compare with centronicls printer interface.

When INA, INB, INC, active Lo, Lo, Hi, logic level, 1061 output parallel ASCII code data.

2.9 OTHERS

- Power : 95 to 125 V or 190 to 250 V AC, 48 to 62Hz. Voltage selected by rear panel switch; 50 watts maximum, 40 watts typical.
- Environment: Operating -- 0℃ to 40℃, 10 to 90% relative humidity.
  Storage -- -10℃ to 50℃, 10 to 80% relative humidity.
- Dimensions : 405(W) × 130(H) × 365(D) mm.
- Weight : 4kg.

3.1 Ambient Environment

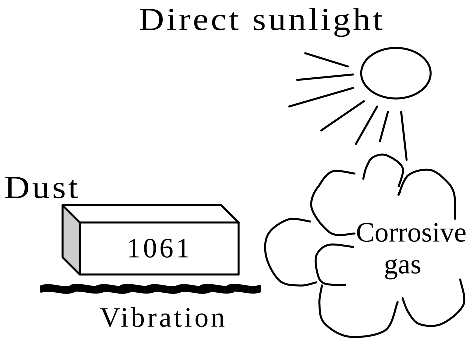
(1). Don't use the meter in a dusty or vibrating location. Don't expose it to direct sunlight, or corrosive gas. Be sure that the ambient temperature is 0~40℃ and that the relative humidity is below 85%.

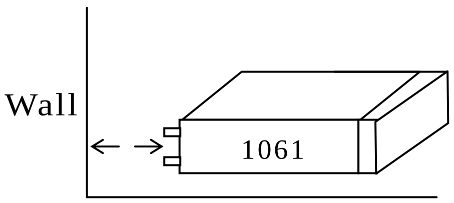
(2). The meter is equipped in the back panel with a fan-out cooling fan to keep from internal temperature increase. Make sure of good ventilation. The meter should be located at over 10cm distance from any object or wall in the behind. Don't block the left and right ventilation holes to keep the meter in good precision.

(3). The meter has been carefully designed to reduce the noise from the AC power source. However, it should be used in a noise environment as low as possible. If the noise is inevitable, please install some power filter.

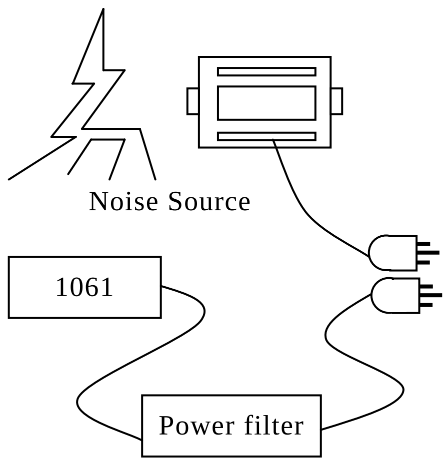
(4). The meter should be stored within the temperature range -25℃ ~ +70℃. In case it is not to be in use for a long time, please store it in the original or similar package, and keep it from direct sunlight and humidity, to ensure a good condition for later use.

Keep from following cases:





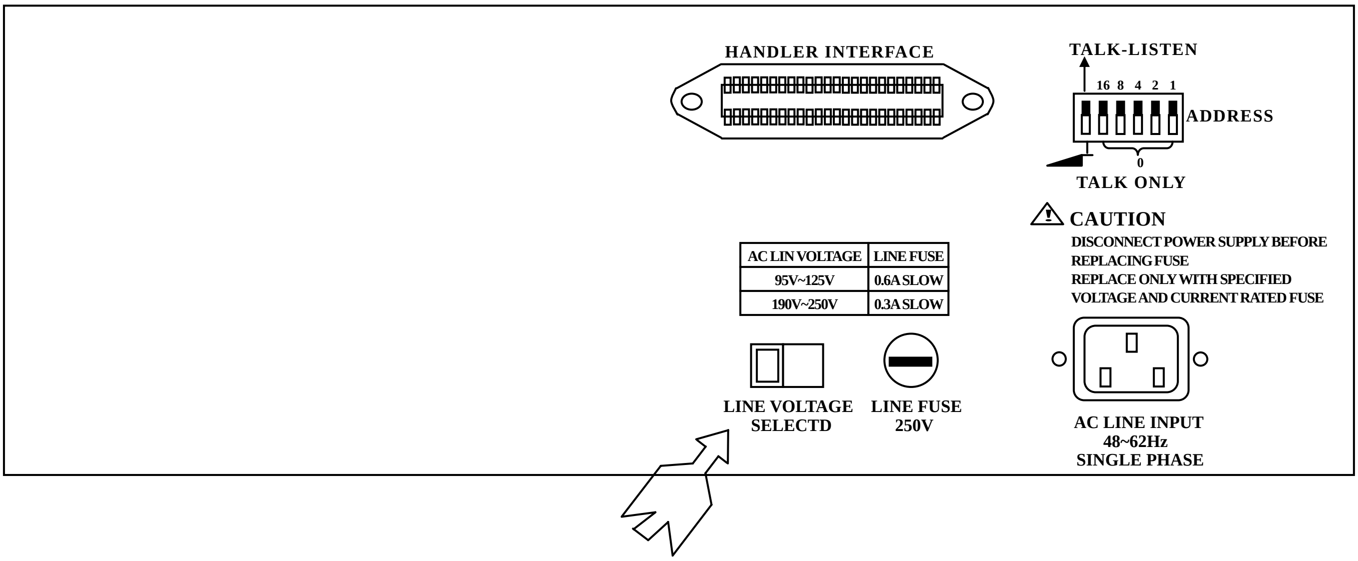
Keep from objects in the Behind at over 10 cm.



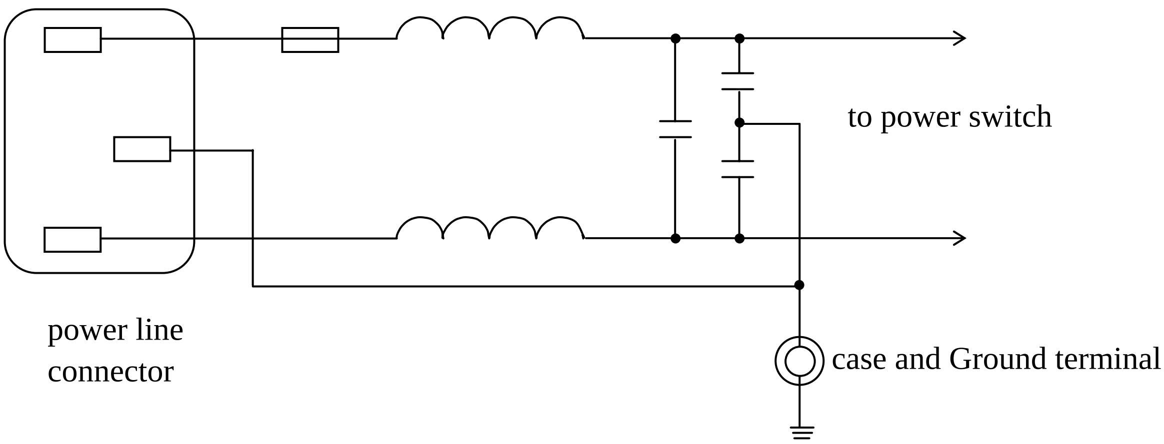
Please install a power filter in case of interference from high power noise.

3.2 POWER-LINE CONNECTION

The power transformer primary windings can be switched, by means of the line voltage switch on the rear panel, to accommodate ac line voltages in either of 2 ranges, as labeled, at a frequency of 50 or 60 Hz, nominal. Making sure that the power cord is disconnected, use a small screwdriver to set this switch to match the measured voltage of your power line.



For safety and noise-prevent reasons, using a 3-wire power cable to connect between the power connector on the rear panel and the power line is required, or connect the GROUND terminal on the front panel to the earth for the same reasons.



3.3 Line-Voltage Regulation

The accuracy of measurements accomplished with precision electronic test equipment operated from ac line sources can often be seriously degraded by fluctuations in primary input power. Line-voltage variations of ±10% are commonly encountered, even in laboratory enviroments. The use of line-voltage regulators between power lines and the test equipment is recommended as the only sure way to rule out the effects on measurement data of variations in line voltage.

3.4 Unknown Connection

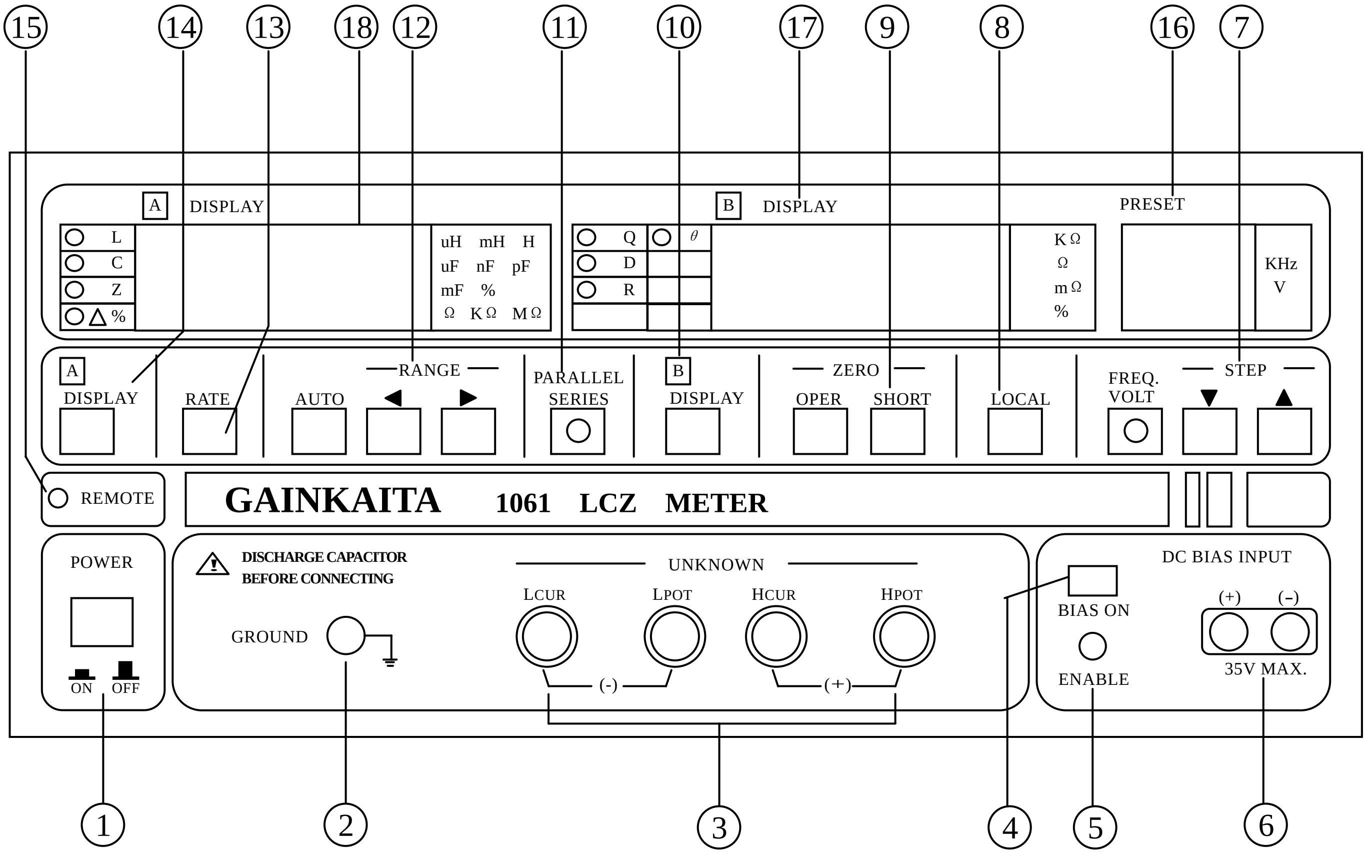
An external test fixture is always required, because connect the 1061 LCZ meter to the DUT (Device Under Test) is provided via BNC connectors, which labeled Hcur, Hpot, Lpot, Lcur. It is important that the Lcur and Lpot leads connect to the same end of the DUT, Hcur and Hpot connect to the other end.

3.5 External Bias Voltage For The DUT

External bias can be provided by connecting a suitable current-limited, floating dc voltage source, as follows.

- Be sure that the voltage is never exceed 35V.
- A current limiting voltage supply is recommended; set the limit at 1A.
- Be sure that the bias supply is floating; do not connect either lead to ground.
- A sell-filtered supply is recommended. Bias-supply hum can affect some measurement, particularly if test frequency is the power frequency.
- Generally the external circuit must include switching for both application of bias after each DUT is in the test fixture and discharge before it is removed.
- Connect the external bias voltage supply and switching circuit, using the A10-001 cable (optional), via the front panel DC BIAS INPUT connectors. Observe polarity marking on the panel; connect the supply accordingly.

4.1 FRONT PANEL DESCRIPTION



(1). POWER switch

Push button, push again to release. Switches the 1061 LCZ meter ON (button in) and OFF (button out). OFF position breaks both side of power circuit.

(2) GROUND terminal

This terminal is directly connected with case. Connecting it to the test fixture for shielding.

(3) UNKNOWN measurement connectors

Four BNC connectors. Connecting an external test fixture or cable for unknown measurement.

HCUR : Current drive terminal, high.

HPOT : Potential detector terminal, high.

LPOT : Potential detector terminal, low.

LCUR : Current drive terminal, high.

Notice that "high" terminals for (+) and "low" terminals for (-) polarity as marked on the front panel while polarized components is under test.

CAUTION
Discharge Capacitors Before Connecting

(4).BIAS ON indicator

LED indicator, indicates that external DC BIAS ENABLE is push-locked enables the bias input.

(5).ENABLE switch

Press switch, is accessed from the front panel with a bladed screwdriver. In the "out" position, bias input is disabled and in the "in" position, bias input is enabled.

(6).DC BIAS INPUT connector

Two dc jacks, labled (+) (-) 35V MAX. Receives cable A10-001 for external bias supply. Observe the voltage and current limits and polarity.

(7). [FREQ/VOLT], [▲], [▼] control keys

Measurement frequency and voltage adjustors, where

[FREQ/VOLT] : Selection of measurement FREQuency or VOLTage setting. An on-key indicator is lit for VOLT.

[▲] : Step up trigger, keep pressed for replicating.

[▼] : Step down trigger, keep pressed for replicating.

(8).[LOCAL] key

When the instrument is in the IEEE-488 remote state (REMOTE indicator on), the [LOCAL] key will return the instrument to front panel operation. However, if local lockout (LLO) was asserted over the IEEE-488 bus, the [LOCAL] key will be inoperative.

(9).ZERO - [OPEN], [SHORT] keys

Open circuit and short circuit zeroing keys.

[OPEN] : An OPEN zeroing will removes the effects of stray capacitance and conductance of the external test fixture or cable.

[SHORT] : An SHORT zeroing operation removes the effects of series resistance and inductance.

(10).[B DISPLAY] key

Selection of secondary parameter Q, D, R or θ. One of Q, D, R and θ indicators on B DISPLAY is lit for the selection. There are both 3 parameters of Q, D and R can be selected in L and C measuring, but only θ is available in Z measuring.

(11).[PARALLEL/SERIES] key

Selection of equivalent circuit. An on-key indicator is lit for SERIES. Measured principal L, C and secondary R values depend on this selection.

(12).RANGE - [AUTO], [◀], [▶] keys

Selection of measurement range.

[AUTO] : Automatic ranging, an on-key indicator is lit when selected. Operating it for the indicator is off, this means the range is held. The on-key indicator will flash for error range selection.

[◀] : Lower impedance measurement range selection and hold the range. A range number will be shown on A DISPLAY about lsec.

[▶] : Higher impedance measurement range selection and hold the range. A range number will be shown on A DISPLAY about lsec.

(13).[RATE] key

Selection of measurement rate. There are fast, medium and slow 3 measurement rates selectable in sequence fast-medium-slow-fast... The measurement time as described in paragraph 2.6 . Use slow rate for batter accuracy; use fast rate for fast. The parameter indicators in A DISPLAY will flash in the rate selected.

(14). [A DISPLAY] key

Selection of principal measurement parameter L, C, or |Z|; in sequence L-C-|Z|-L... as indicated on A DISPLAY.

(15). REMOTE indicator

LED indicator, indicates when remote control is established by external command. (Functions only if an GPIB interface option is installed.)

(16). PRESET display

Display of preset measurement frequency or voltage. Includes a 3 numerals digital display and 2 unit indicators; "kHz" for frequency and "V" for voltage display selection.

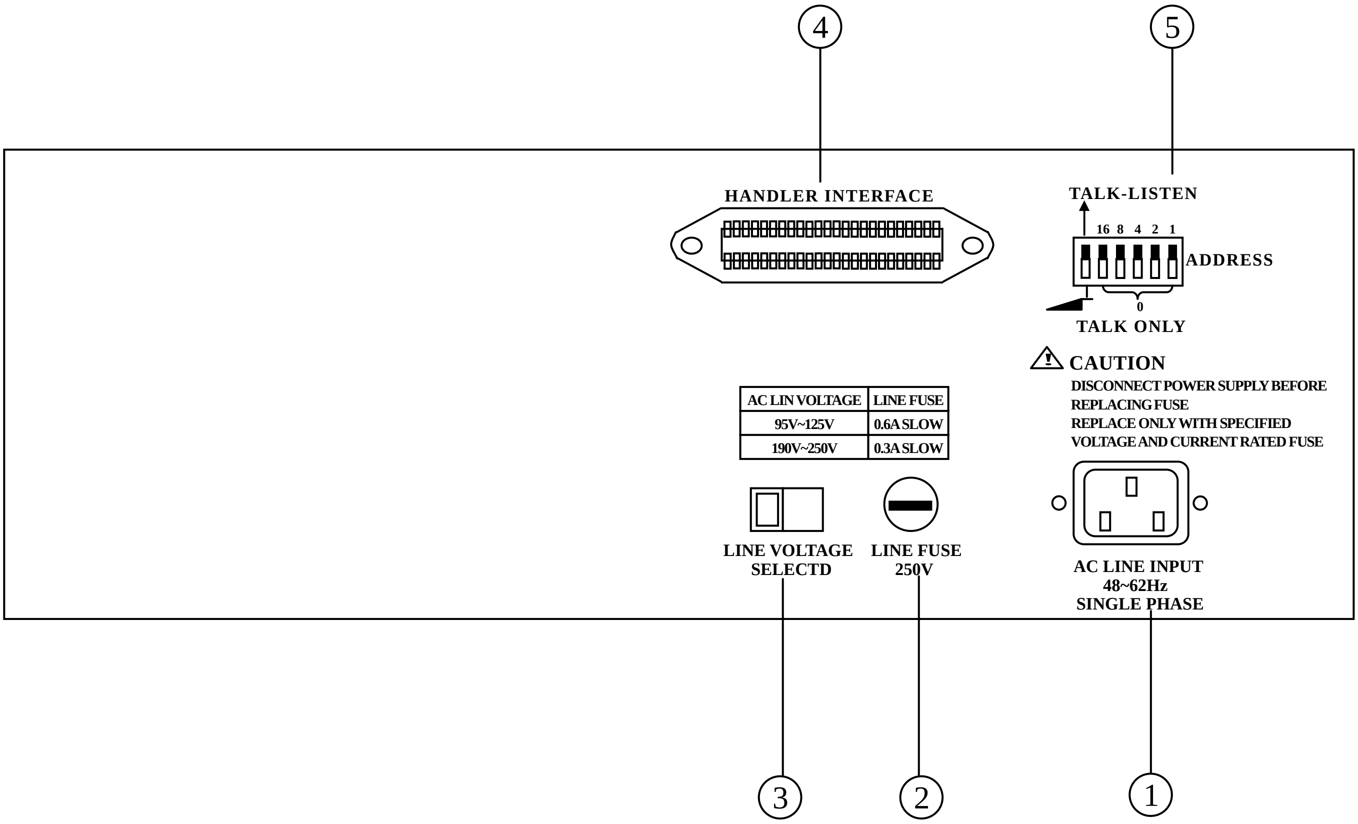
(17). B DISPLAY display

Display of secondary measured value. Includes a 4 1/2 numerals digital display, 4 parameter LED indicators (Q, D, R, θ), and 4 unit indicators(°, kΩ, Ω, mΩ).

(18). A DISPLAY display

Display of principal measured value. Includes a 4 1/2 numerals digital display, 3 parameter LED indicators (L, C, |Z|), and 10 unit indicators (uH, mH, H, mF, uF, nF, pF, Ω, KΩ, MΩ).

4.2 REAR PANEL DESCRIPTION



(1). AC LINE INPUT connector

Shrouded 3-wire plug, conforming to International Electrotechnical Commission 320. Use appropriate power cord, with Belden SPH-386 socket or equivalent. The A00-001 power cord (supplied) is rate for 125V.

(2). LINE FUSE

A 0.6A or 0.3A fuse is equiped to prevent the instrument from overtaking current from a 95~125V or 190~250V power line.

(3). LINE VOLTAGE SELECTED switch

Adapts power supply to line voltage ranges, as indicated. To operate use a small screw driver, not a sharp object.

(4). IEEE-488 INTERFACE connector (interface option only)

Input/output connections according to IEEE Std 488-1978. Functions complete remote control. Output of selected results, with or without controller.

(5). ADDRESS, TALK-ONLY/TALK-LISTEN switches

(IEEE-488 interface option only).

IEEE-488 interface address setting switches and TALK-ONLY/TALK-LISTEN mode selecting switch.

5.1 STARTUP

CAUTION

Set the line voltage switch properly (rear panel)
Before connecting the power cord.

The regular startup procedure is:

(1). After the line voltage switch has been set to the position that coresponds to your power line voltage, then connect the power cord as explained below.

Temperature : If the instrument has been very cold, warm it up in a dry environment, allowing time for the interior to reach 0℃ or above, before applying power. Otherwise, the instrument may be damage by thermal shock.

Power Cord : Connect the power cord to the rear panel connector, and then to your power socket.

(2). If the IEEE-488 interface is installed, set TALK switch (rear panel) to TALK-ONLY (unless instructions are to be received through the IEEE-488 bus).

(3). Push BIAS ENABLE switch to off (out position).

(4) Press the POWER button "in", so that it stays in the depressed position. After 2 seconds, all displays and indicators (not BIAS ON) are lit for 1 second, and then shows "GKT-1060" briefly, indicating that the instrument is automatically executing a power-up routine.

(5) Wait until the measurement is running, and all measurement states are retained as last power-off.

If any abnormal conditions occurs, notify the sales office please.

5.2 PRINCIPAL MEASUREMENT CONDITION

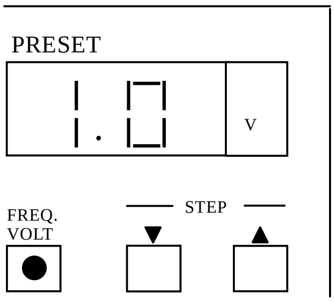
- Measurement Frequency Selection

There are 30 frequencies between 40 Hz and 200 KHz available in the ninstrument.

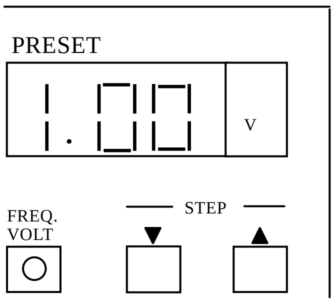
They are (in Hz):

40, 50, 60, 100, 120, 200, 400, 800, 1K, 2K, 5K, 10K, 15K, 15.7K, 16K, 20K, 22.2K, 25K, 30K, 40K, 50K, 60K, 66.6K, 75K, 80K, 100K, 120K, 150K, 160K, 200K.

Select the PRESET display in FREQuency display by pressing [FREQ/VOLT] key. The actual frequency shown will be the last value selected, held in a non-volatile store. Using the [▲] and [▼] keys to increase or decrease the frequency to any of the discrete value listed above. Holding press either these keys will produce a continuous increase or decrease which, after a short while, becomes faster. The change ceases when the limit (upper or lower) is reached.



Measurement voltage selection



Measurement frequency selection

- Measurement Voltage Selection

The RMS measurement voltage is selectable from 20mV to 1.0V, steps 20mV. Select the PRESET display in VOLTage display by pressing [FREQ/VOLT] key. The actual frequency shown will be the last value selected, held in a non-volatile store. And the procedure for changing the measurement voltage is similar to that for measurement frequency (above). The drive currents of the measurement signal in range 1 and 2 are 4mA~100mA correspond to 40mV~1.0V of the preset voltage.

5.3 CONNECTING THE TEST FIXTURE

There are a GROUND terminal and four BNC connectors on the front panel.

GROUND : This terminal is directly connected with case. Connecting it to the test fixture for shielding.

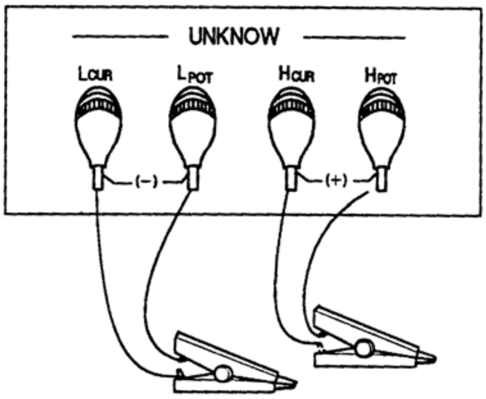
HCUR (+) : Current drive terminal, high.

HPOT (+) : Potential detector terminal, high.

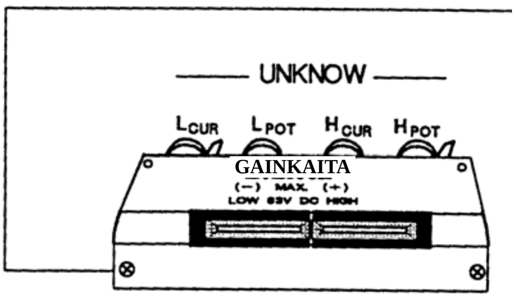
LPOT (−) : Potential detector terminal, low.

LCUR (−) : Current drive terminal, high.

Connecting them to an external test fixture or cables for unknown measurement. If cables is used, it is important that connect the same color (covered on the head of the cable, red preferly for + polarity) cables to HCUR and HPOT terminals, and connect the other cables (black for − polarity) to LCUR and LPOT terminals.



Test Cables Connection



Test Fixture Connection

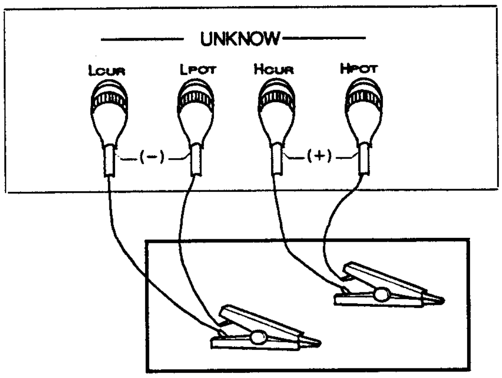
5.4 Zeroing

Before measurement, zero the instrument as follows. In this process, the instrument automatically measures stray parameters and retains the data in non-volatile memory, which it uses to correct measurements so that results represent parameters of the DUT alone, without test fixture capacitance.

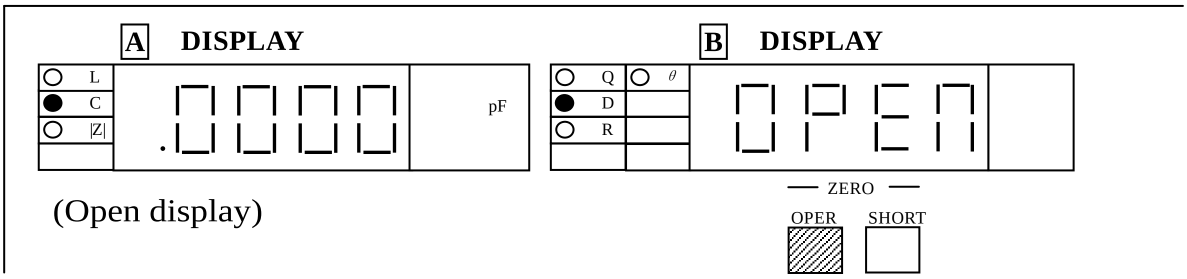
(1). Conditions : Slow measurement rate, 1V measurement voltage, autorange.

(2). Open Circuit :

- Connect the remote test fixture or at least the BNC cables and adaptors that will contact the DUT.



- Be sure that the test fixture is open circuited.
- Press [OPEN] key, the A DISPLAY shows ".0000pF", and the B DISPLAY shows "OPEN".



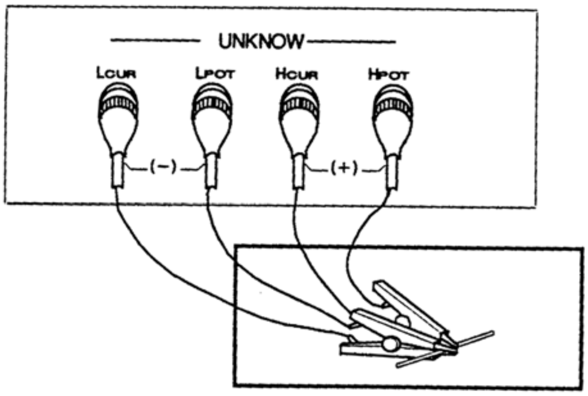
(Open display)

- Keep hands and objects at least 10cm from test fixture.
- Comfirm the operation by pressing [OPEN] key again, or press any other keys to exit this. If [OPEN] key is pressed, the C indicator on A DISLAY will flash during the procedure.

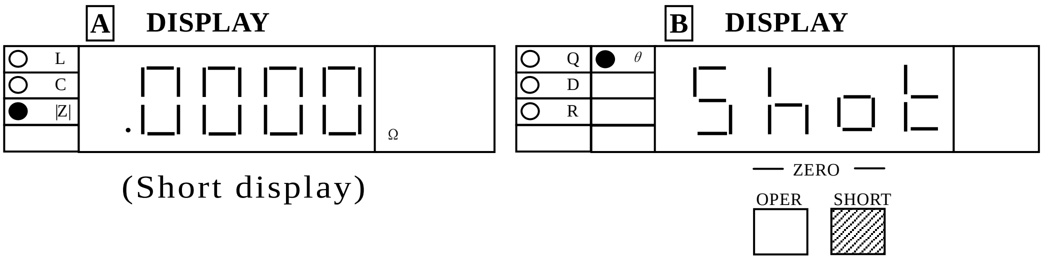
- Wait until the measurement is running again, indicates the open operation is successfully. If a "FAIL" message is shown, indicates a failure operation,and this open-circuit data will be bypassed.

(3). Short Circuit :

- Short the test fixture with a clean copper wire (AWG 18 to 30), lenght 5 to 8cm



- Press [SHORT] key, the A DISPLAY shows ".0000Ω", and the B DISPALY shows "Shot" (Short).



(Short display)

- Press the [SHORT] key again to comfirm, or press any other keys to exit this. If [SHORT] key is pressed again, the |Z| indicator on A DISPLAY will flash during the procedure.
- Wait until the measurement is running again, indicates the short operation is successfully. If a "FALL" message is shown, indicates a failure operation, and this short-circuit data will be bypassed.
- Remove the short circuit.

NOTE

For best accuracy, repeat this zeroing procedure daily and after changing test fixture or frequency.

5.5 Routine Measurement

Select slow measurement rate for best accuracy, and equivalent SERIES circuit (see paragraph 5.6) as a general condition. Then connect the device to be tested with the instrument.

NOTE

Clean the leads of the DUT if they are noticeably dirty, even though the test fixture contacts will usually bite through a film of wax to provide adequate connections.

There are seven measurement parameter pairs available in the instrument, select one of the them for your specify.

(1). L and Q of an Inductor (L : .0000uH ~ 1999.9H, Q : .0000 ~ 19999)

Select A DISPLAY in L parameter by pressing [A DISPALY] key, and select B DISPLAY in Q parameter by pressing [B DISPLAY] key. Place inductor in test fixture. The A DISPLAY shows Ls (series inductance) and units (uH, mH, H); the B DISPLAY shows Q (quality factor). If the value shown on A DISPLAY is negative, means the DUT is capacitive.

(2). L and D of an Inductor (L : .0000uH ~ 1999.9H, D : .0000 ~ 19999)

Select A DISPLAY in L parameter by pressing [A DISPALY] key, and select B DISPLAY in D parameter by pressing [B DISPLAY] key. Place inductor in test fixture. The A DISPLAY shows Ls (series inductance) and units (uH, mH, H); the B DISPLAY shows D (dissipation factor). If the value shown on A DISPLAY is negative, means the DUT is capacitive.

(3). L and R of an Inductor (L : .0000uH ~ 1999.9H, R : .0000mΩ ~ 19999kΩ)

Select A DISPLAY in L parameter by pressing [A DISPALY] key, and select B DISPLAY in R parameter by pressing [B DISPLAY] key. Place inductor in test fixture. The A DISPLAY shows Ls (series inductance) and units (uH, mH, H); the B DISPLAY shows Rs (equivalent series resistance) and units (mΩ, Ω, kΩ). If the value shown on A DISPLAY is negative, means the DUT is capacitive.

WARNING

Charged capacitors may be cause a hazard shock. Never handle their terminals if they have been charged to more than 60V. Routine discharge procedures may not be perfectly dependable.

NOTE

That "high" terminals for (+) and "low" terminals for (-) polarity as marked on the front panel when polarized components is under tested.

(4). C and Q of an Capacitor (C : .0000pF ~ 199.99mF, Q : .0000 ~ 19999)

Select A DISPLAY in C parameter by pressing [A DISPALY] key, and select B DISPLAY in Q parameter by pressing [B DISPLAY] key. Place capacitor in test fixture. The A DISPLAY shows Cs (series capacitance) and units (mF, uF, nF, pF); the B DISPLAY shows Q (quality factor). If the value shown on A DISPLAY is negative, means the DUT is inductive.

(5). C and D of an Capacitor (C : .0000pF ~ 199.99mF, D : .0000 ~ 19999)

Select A DISPLAY in C parameter by pressing [A DISPALY] key, and select B DISPLAY in D parameter by pressing [B DISPLAY] key. Place capacitor in test fixture. The A DISPLAY shows Cs (series capacitance) and units (mF, uF, nF, pF); the B DISPLAY shows D (dissipation factor). If the value shown on A DISPLAY is negative, means the DUT is inductive.

(6). C and R of an Capacitor (C : .0000pF ~ 199.99mF, R : .0000mΩ~ 19999kΩ)Select A DISPLAY in C parameter by pressing [A DISPALY] key, and select B DISPLAY in R parameter by pressing [B DISPLAY] key. Place capacitor in test fixture. The A DISPLAY shows Cs (series capacitance) and units (mF, uF, nF, pF); the B DISPLAY shows Rs (equivalent series resistance) and units (mΩ, Ω, kΩ). If the value shown on A DISPLAY is negative, means the DUT is inductive.

(7). |Z| and θof Component (|Z| : .0000Ω~199.99MΩ, θ: -180.00° ~ 179.99°)Select A DISPLAY in |Z| parameter by pressing [A DISPALY] key, and the B DISPLAY will display θ (phase angle) automatically ([B DISPLAY] key is inoperative now).Connect the component(s) or network to test fixture. The A DISPLAY shows |Z| (value of impedance) and units (Ω, kΩ, MΩ); the B DISPLAY shows θ (phase angle) and degree (°). By convention, a positive phase angle implies an inductive impedance.

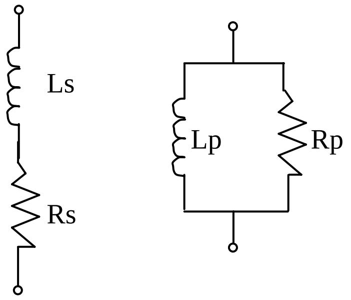
5.6 Equivalent Circuits -- Series, Parallel

The results L, or C (A DISPLAY) or R (B DISPLAY) measurements of many components depend on which of two equivalent circuits is chosen to represent it - series or parallel. As a general guide, series will be preferred for components whose impedance below 1000 ohms, and parallel for components exceed this value.

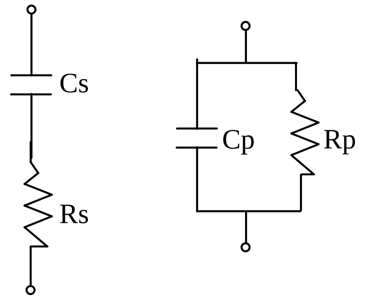
For a relatively pure component, the major term remain substantially the same in series or parallel representation. However, if D is high or Q low, Cs differs substantially from Cp and Ls differs substantially from Lp; and these values are frequency dependent. Usually several measurements at frequencies near the desired evaluation will reveal that either series measurements are less frequency dependent than parallel, or the converse. The equivalent circuit that is less frequency dependent is the better mode of the actual device.

The equivalent circuits are shown in the accompanying figure, together with useful equations relating them. Notice that the instrument measures the equivalent series components Ls, Cs or Rs, if you select SERIES. It measures the parallel equivalent components Lp, Cp, or Rp if you select PARALLEL. D and Q have the same value regardless whether series or parallel equivalent circuits calculated.

- Inductance and Resistance



- Capacitance and Resistance



$$\omega = 2\pi f$$

Inductance and Resistance:

$$Z = Rs + j\omega Ls$$

$$|ZL| = \sqrt{Rs^2 + (\omega L)^2}$$

$$Q = \frac{1}{D} \qquad Q = \frac{\omega Ls}{Rs} \qquad Q = \frac{Rp}{\omega Lp}$$

$$Lp = \frac{1 + Q^2}{Q^2} Ls \qquad Lp = (1 + D^2) Ls$$

$$Rp = (1 + Q^2) Rs$$

$$Rs = \frac{\omega Ls}{Q} \qquad Rp = Q\omega Lp$$

Capacitance and Resistance:

$$Z = Rs + \frac{1}{j\omega Cs}$$

$$|ZC| = \sqrt{Rs^2 + \left(\frac{1}{\omega Cs}\right)^2}$$

$$D = \frac{1}{Q} \qquad D = \omega CsRs \qquad D = \frac{1}{\omega CpRp}$$

$$Cp = \frac{1}{1 + D^2} Cs$$

$$Rp = \frac{1 + D^2}{D^2} Rs$$

$$Rs = \frac{D}{\omega Cs} \qquad Rp = \frac{1}{\omega CpD}$$

$$Rs = |Z| \cos \theta$$

$$Xs = |Z| \sin \theta$$

$$D = \tan (90 - \theta)^\circ$$

$$Q = \cot (90 - \theta)^\circ$$

There are some points worth to be noted:

- ESR for capacitors

  The total loss of a capacitor can be expressed in several ways, including D and "Equivalent Series Resistance" (ESR), which is designated "Rs" in the preceding paragraph. If you want ESR display simultaneously with Cs, be sure that the PARALLEL/SERIES on-key LED is lit; and select A,B DISPLAY in "C" and "R" display. "ESR" is typically much larger than the actual ohmic series resistance of the wire leads and foils that are physically in series with the heart of a capacitor, because ESR includes also the effect of dielectric loss. ESR is related to D by the formula ESR = Rs = D/(2π fCs)

- Equivalent circuit for inductors

  The SERIES circuit is appropriate for small "air-core" inductors, which the significant loss mechanism is usually "ohmic" or "copper loss" in the wire. And the PARALLEL circuit is appropriate for "iron-core" inductors, which the significant loss mechanism may be "core loss" (caused by eddy currents and hysteresis).

5.7 Display Messages

There are some message used in the meter during the measurement procedure.

(1) "----" : Indicates an invalid measurement range selection

(2) "UUUU" : Indicates the impedance of unknown exceeds the measurement range.

(3) AUTO indicator flash : Indicates a non-best range held.

(4) "GP-E" : GPIB command or handshake process error.

6.1 GENERAL

Using the IEEE-488 INTERFACE, your can operate the meter by remote control, transfer data, etc.

6.2 IEEE-488 INTERFACE SPECIFICATION

6.2.1 Applicable Standard

IEEE std 488-1978

6.2.2 IEEE-488 INTERFACE Function

Table 6-1 IEEE-488 INTERFACE Function of The Meter

Code	Meaning
SH1	Source handshake (talker)
AH1	Acceptor handshake (listener)
T5	Basic talker function
	Serial poll function
	Listener-specified talker release function
	Talk-only mode
L4	Basic listener function
	Talker-specified listener release function
	No listen-only mode
SR1	All service request functions
RL1	All remote-local functions
PP0	No parallel poll functions
DC1	Device clear function
DT1	Device trigger function
C0	No controller functions

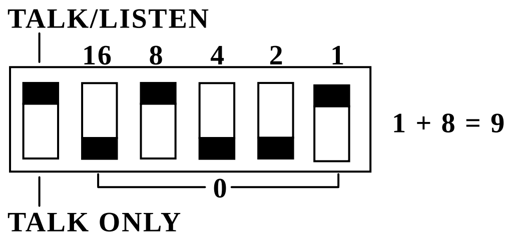
6.2.3 Using code

ISO (ASCII) code

6.2.4 ADDRESS DIP switch (Rear)

The DIP switch is used to set address Talk mode of the meter, setting range of address is 0 ~30. The default is 3. If address change is needed, use minus screwdriver to slide switches as setting.

The set address value is the sum of switched value, as a example 9 :

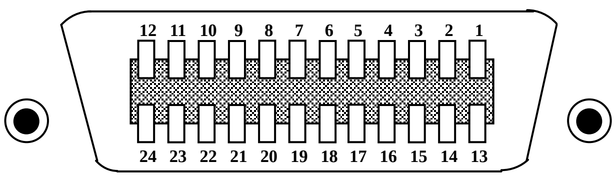


6.2.5 TALK ONLY and TALK/LISTEN functions

This instrument will function as TALK/LISTEN or a TALK ONLY device in the system, depending on the position of TALK switch (included in ADDRESS DIP witch). "TALK/LISTEN" denotes full programmability and is suited for use in a system that has a controller or computer to manage the data flow. TALK ONLY is suited to a simply system - e.g meter and printer - with no controller and no other talker. Either mode provides measurement results to the listeners in the system.

6.2.6 The IEEE-488 INTERFACE connector

- Pin configuration of the meter side connector is as shown below.



1	DIO1	13	DIO5
2	DIO2	14	DIO6
3	DIO3	15	DIO7
4	DIO4	16	DIO8
5	EOI	17	REN
6	DAV	18	GND
7	NRFD	19	GND
8	NDAC	20	GND
9	IFC	21	GND
10	SRQ	22	GND
11	ATN	23	GND
12	SHIELD	24	LOGIC GND

- Meter side connector
  DDK 57LE-20240 or equivalent
- Cable side connector
  DDK 57-10240 or equivalent

6.2.7 Signal Lines of the IEEE 488 Interface Bus

- The interface is composed of the data bus, the handshake bus and the control bus shown in the table below.

Bus Signal Lines		Description
Data Bus	DIO 1 (Data Input Output1) 2 (Data Input Output2) 3 (Data Input Output3) 4 (Data Input Output4) 5 (Data Input Output5) 6 (Data Input Output6) 7 (Data Input Output7) 8 (Data Input Output8)	• Besides data input, it is used for interface and device message input/output.
Handshake Bus	DAV (DAta Vaild)	• Indicates that data on the data bus are valid.
	NRFD (Not Ready For Data)	• Indicates that the listener side is ready to receive.
	NDAC (Not Data ACcepted)	• Indicates that the listener side has finished data reception.
Control Bus	ATN (ATtentioN)	• Indicates whether the signal on the data bus carries data or an interface or device message.
	REN (Remote Enable)	• Switches between the remote and local control modes.
	IFC (InterFace Clear)	• Used to reset the interface.
	SRQ (Service ReQuest)	• Signal sent by the talker side to call the controller.
	EOI (End Of Identify)	• Indicates the end of data.

6.2.8 Response to Interface Messages

- The meter is capable of responding to the following messages.

Interface Message	Response
GET (Group Eecute Trigger)	• Allows triggering only for addressed devices. • Starts measurement, then holds the reading when measurement is completed. The hold mode is released by reading the value.
GTL (Go To Local)	• Only addressed devices that receive this command are set to local mode. • Cancels the remote control mode, making front panel switches operative.
SDC (Selected Device Clear)	• Only addressed devices that receive this command are cleared. • The meter actives as power-up again.
DCL (Device Clear)	• Clear all devices on the bus. • The meter actives as power-up again.
LLO (Local LockOut)	• Disable the local switch function of all devices on the IEEE-488 interface bus. • Make all switches on the instrument front panel lose efficacy.

6.2.9 Bus Driver

- Specifications of the meter bus driver are shown in the table below.

DIO1 - 8 SRQ NRFD NDAC	Open collector
EOI REN DAV IFC ATN	3 states

6.3 LISTENER FUNCTION

6.3.1 General

All the front panel functions of the meter can be operated by remote commands. The input command string are composed by {[Command + parameter]s + End Code } with ASCII code. Between instructions (command + parameter) is no delimiter required or delimit with a space "". The length of the command string is limited in 20 characters. Any error command input occurred, the meter will show a "GP-E" message on A DISPLAY for that.

6.3.2 Command list

COMMANDS USED IN PROGRAMMING VIA IEEE-488 INTERFACE BUS

Program Category	Program Selection	Command Type	Command Entry
A DISPLAY	Value	2 byte	D0
PRESET Display	FREQuency	2 byte	O0
	VOLTage	2 byte	O
Measurement	Fast	2 byte	S0
Rate	Slow	2 byte	S1
Measurement Voltage	Value (in volts) = v	Floating	Vv;
Parameter	Inductance (L/Q)	2 byte	M0
	Capacitance (C/D)	2 byte	M1
	Capacitance (C/R)	2 byte	M2
	Impedance (Z/ θ)	2 byte	M3
	Inductance (L/D)	2 byte	M4
	Inductance (L/R)	2 byte	M5
	Capacitance (C/Q)	2 byte	M6
Equivalent	Parallel	2 byte	C0
Circuit	Series	2 byte	C1

(continued on next page)

(continued)

COMMANDS USED IN PROGRAMMING VIA GP-IB BUS

Program Category	Program Selection	Command Type	Command Entry
Range Control	Hold range	2 byte	R0
	Hold range1	2 byte	R1
	Hold range2	2 byte	R2
	Hold range3	2 byte	R3
	Hold range4	2 byte	R4
	Hold range5	2 byte	R5
	Hold range6	2 byte	R6
	Hold range7	2 byte	R7
	Hold range8	2 byte	R8
	Auto-range	2 byte	R9
Frequency	Value (in kHz) = f	Floating point	Ff;
Zero Calibration	Disable	2 byte	Z0
	Enable open	2 byte	Z1
	Enable short	2 byte	Z2
Initiation	Start a measurement	2 byte	G0

6.4 Talker Function

6.4.1 Basic talker function

The measured result of the meter will be sent to GP-IB bus when the meter is specified as a talker. The output format is : (next page)

DATA OUTPUT FORMAT

Character Sequence	Perpose	Allowed Characters	Meaning
1	Status	(space)	Normal operation, measurement on A basic range
		E	Error-range held (reduce accuracy) ** like AUTO-FLASH message **
		O	Over-range held of range 3,4,5,6,7,8 ** like "UUUU" message **
		U	Invalid range selection ** like "----" message **
2	Format	(space)	
3	A-Parameter	L	Inductance
		C	Capacitance
		Z	Impedance
4	Format	(space)	
5,6	A-Units	(space)H	Henries
		mH	Millihenries
		uH	Microhenrise
		mF	Millifarads
		uF	Microfarads
		nF	Nanofarads
		pF	Picofarads
		(space)O	Ohms
		KO	Kilohms
		MO	Megohms
7	Format	(space)	
8	A-Sign	(space)	Positive L,C,Z
		-	Negative L,C,Z

(continued next page)

(continued)

DATA OUTPUT FORMAT

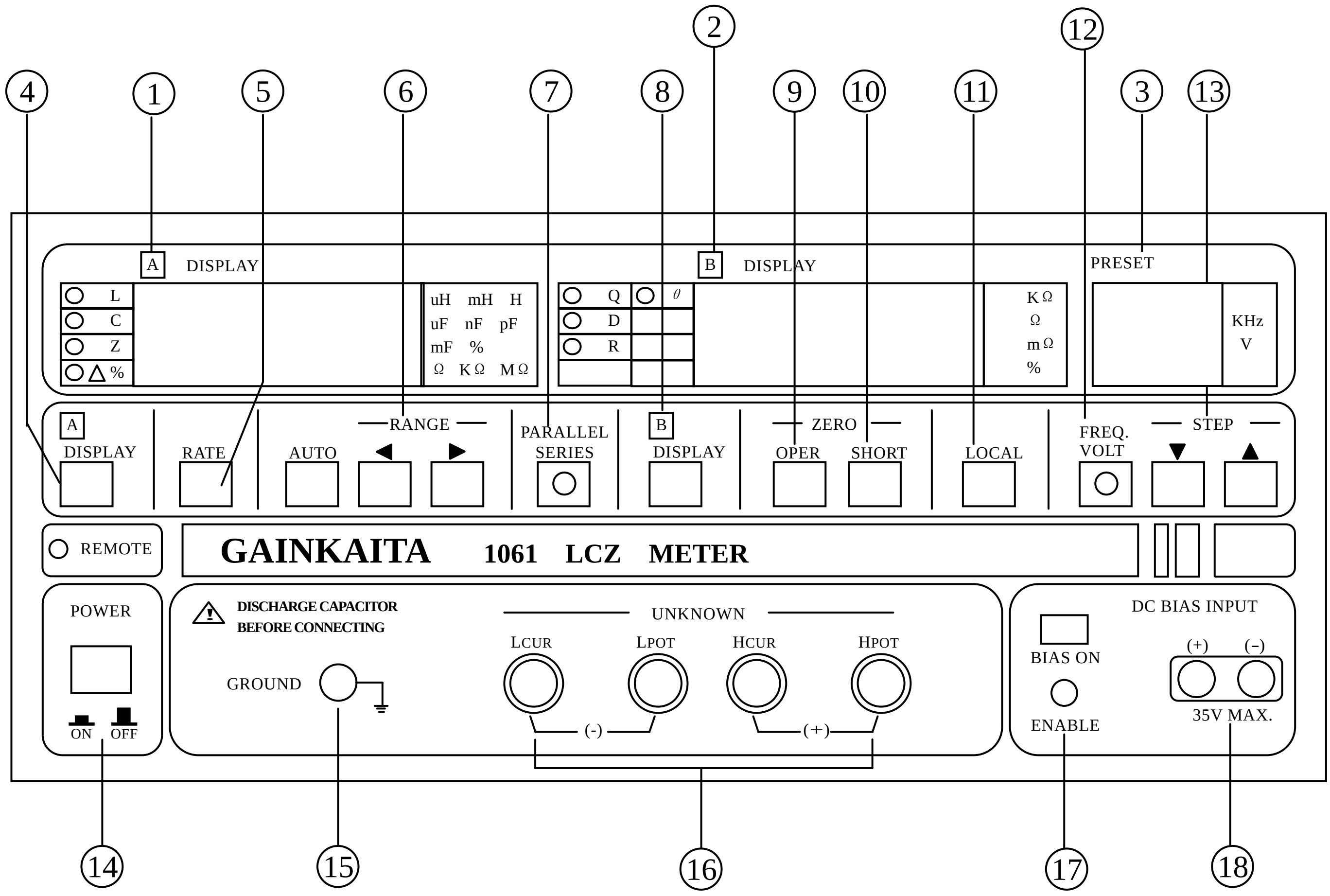
Character Sequence	Perpose	Allowed Characters	Meaning
9...14	A-Number	0123456789. (space)	Measured L/C/Z number, right justified in format field; like the A DISPLAY except the zero before the decimal point is explicitly provided and this number can be as long as six character 999999 for "----" and "UUUU".
15	Format	(space)	
16	B-Parameter	Q	Quility factor
		D	Dissipation factor
		R	Resistance
		S	Phase angle (θ)
17	Format	(space)	
18,19	C-Units	mO	Milliohms
		(space)O	Omhs
		KO	Kilohms
		(2 spaces)	Dimensionless (for Q,D, θ)
20	Format	(space)	
21	B-Sign	(space)	Positive Q,D,R
		-	Negative Q,D,R, θ
22...27	B-Number	0123456789. (space)	Measured Q/D/R/ θ number, right justified in format field; like the A DISPLAY except the zero before the decimal point is explicitly provided and this number can be as long as six characters. 999999 for "----" and "UUUU"
28		(CR)	The standard "carriage return" and
29	Delimiter	(LF)	"line feed" characters; end of string.

6.4.2 Status byte output format

- The status byte indicates the internal condition of the meter. It is output when a serial poll is excuted by the controller.
- The meaning and value of each bit of status byte are shown below. When the controller performs a serial poll and reads the status byte, the meter output the sum of all set bits.

Bit	Value	Condition	Meaning
0	0		
1	2	B valid	QDR θ measured value is available.
2	4	A valid	LCZ measured value is available.
3	0		
4	16	Busy	Measurement in process.
5	32	Zero fail	OPEN/SHORT zeroing fail during process.
6	64	SRQ	Request for service.
7	128	Remote	Remote controlled.

一． 面 板 功 能 说 明



(1). A DISPLAY : L. C. |Z|, △% 数值显示.

(2). B DISPLAY : Q. D. R. θ 数值显示.

(3).PRESET : 测试频率电压显示.

(4). A DISPLAY 键 : 选择 L 或 C 或|Z|, 在 COMP. ENABLE 键 ON 时选择数值或△%.

(5).RATE 键 : 测试速率选择键, 共有三种速率可选: 约每秒测量 8 次, 2.5 次,1 次.

(6).RANGE 选择键 : AUTO 键为自动选档. ◀ 键为向左方单位移动.
▶ 键为向右方单位移动.

(7). PARALLEL 选择键 SERIES : 串并联等效电路选择，灯亮为串联，不亮为并联.(一般阻抗低于 1KΩ使用串联，高于 1KΩ则使用并联-PARALLEL）.

(8). B DISPLAY 键 : 选择 Q. D. R 等功能，在(4). A DISPLAY 键选择 |Z| 时，自动显示θ.

(9).OPEN 键 : 开路归零执行键，测试端开路，按一次出现 "C .0000pF" "OPEN"提示显示幕，再按一次确认执行.

(10).SHORT 键 : 短路归零执行键，测试端短路，按一次出现 "|Z| .0000Ω" "Sho(r)t"提示显示幕，再按一次确认执行.

(11).LOCAL 键 : 以 GPIB 连线控制时，按 LOCAL 键可改由仪器面板操作.

(12).FREQ./VOLT 键 : 频率电压显示选择键，灯亮为电压，不亮为频率.

(13). STEP 键 : 频率电压调整键，视(12) VOLT/FREQ. 键而定，以▲上升键，▼下降键来调整.

(14). POWER 键 : 电源开关，▖开，▀关.

(15). GROUND : 接地端子. 此端子与本机器外壳连接，请连接至大地及测量治具之隔离体.

(16). UNKNOWN : 测试端子. 红色测试线两条一组接右侧，黑色测试线两条一组接左侧.

(17). ENABLE : 外接偏压开关. 使用外加偏压时，请以小型起子伸入调整至 BIAS ON 灯亮.

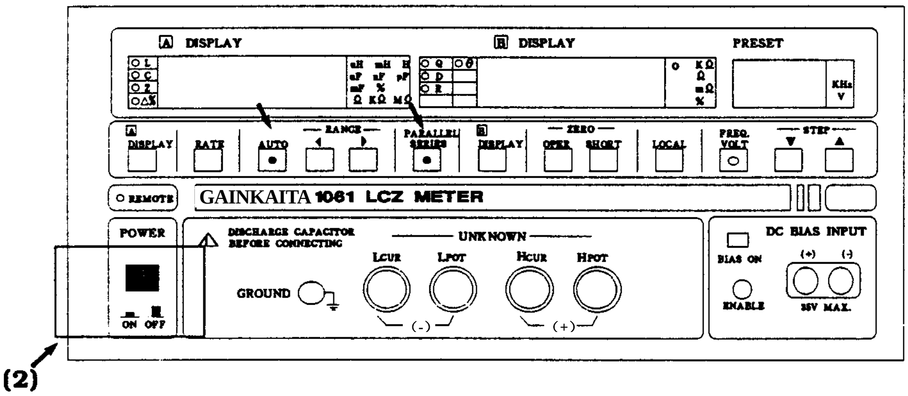
(18). (+) (-) : 外加偏压输入端子. (请注意极性是否正确)

二．操作说明

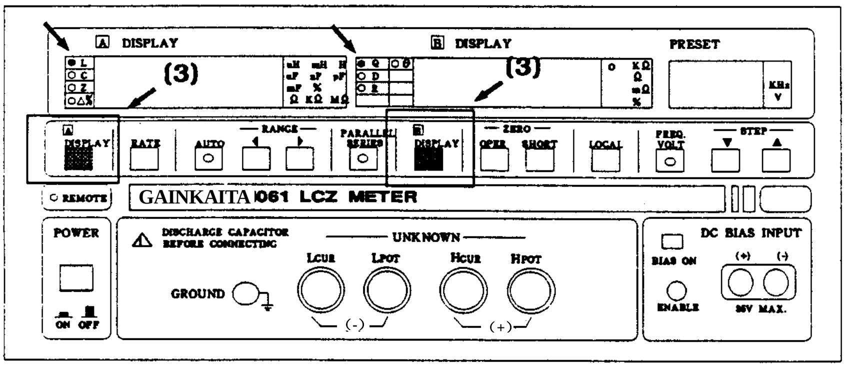
(一). L.C.Z　1061 操作程序

(1). 插上电源 : 并先确认输入电压是否正确. (110V 或 220V)

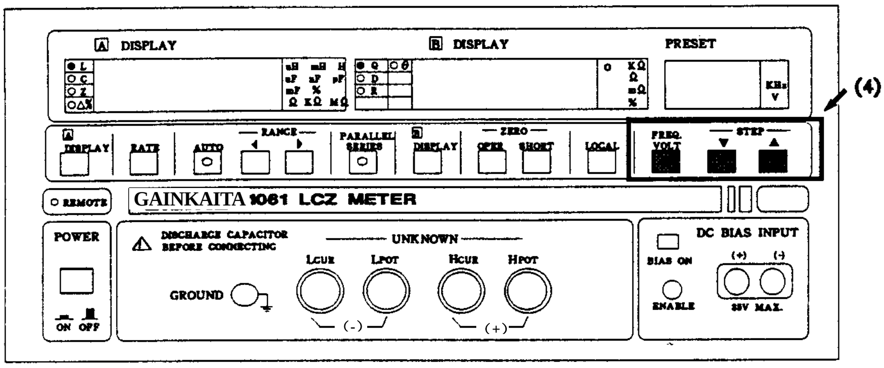
(2). 开机　　: 电源开关 ON → 显示 CH-1061 及上次关机前状态.
新机出厂通常为 RANGE → AUTO 测试迦路 → SERIES(串联)测试.



(3). 选择测试元件参数 : 按 A DISPLAY 键选择 L 或 C 或|Z|, 按 B DISPLAY 键选择 Q 或 D 或 R. 若 A DISPLAY 选至 | Z |, 则 B DISPLAY 自动跳到 θ .



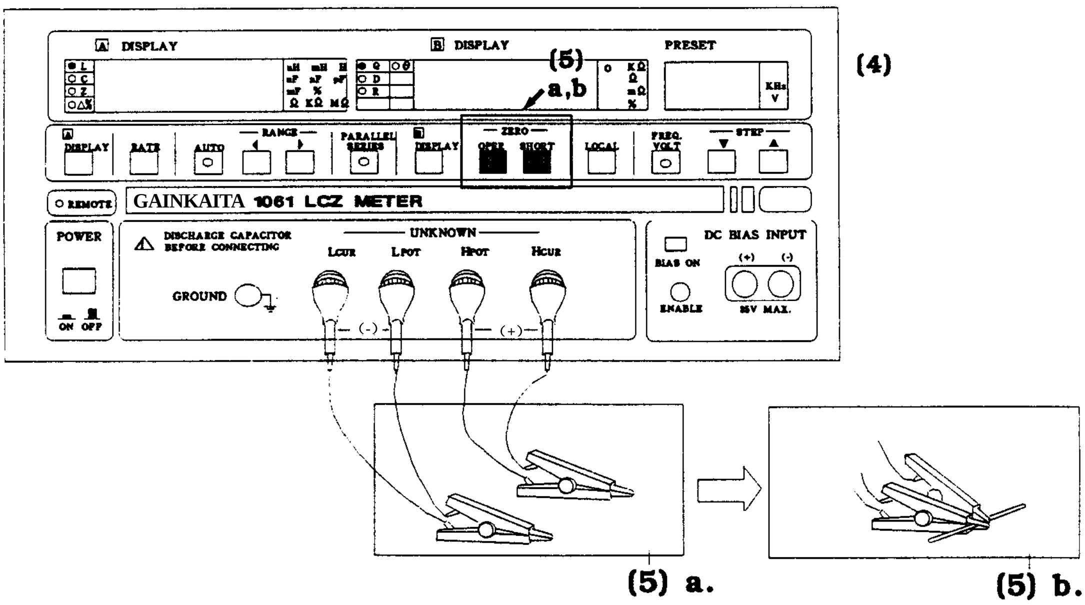
(4). 设定测试频率电压 : 按 FREQ./VOLT 键, 并以 STEP 中的▲上升键, ▼下降键来设定所须之频率或电压值.



(5). 归零 : 在参数频率电压确认设定无误后做, 归零校正.

a. 开路归零 : 将测试端开路, 按 OPEN 键两次, 即执行归零程序, 恢复测试状态即代表归零 OK! 在慢速时, 最后两位有残值或跳动值乃正常现象.

b. 短路归零 : 将测试端短路, 按 SHORT 键两次, 即执行归零程序, 恢复测试状态即代表归零 OK! 在慢速时, 最后两位有残值或跳动值乃正常现象.



(6). 测试 : 将待测物接在测试端即可测得所须参数.