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The KT66DL incorporates Anti Trip Technology (ATT) which electronically bypasses RCDs when performing loop impedance tests. This saves time and money by not having to take the RCD out of the circuit during testing and is a safer procedure to follow. With the ATT function enabled, a test of 15mA or less is applied between line & earth. It enables loop impedance measurements without tripping RCDs rated at 30mA and above.
ATT supports measurements using three wires: Line, Earth, and Neutral and also two wires: Line and Earth.
Please read this instruction manual carefully before using this tester.

1. Safe testing

This tester has been designed, manufactured and tested according to IEC 61010: Safety requirements for electrical equipment for measurement, and delivered in the best condition after passing quality control tests. This instruction manual contains warnings and safety rules which must be observed by the user to ensure safe operation of the tester and to maintain it in safe condition. Therefore, read through these operating instructions before starting to use the tester.

⚠DANGER

- Read through and understand instructions contained in this manual before starting to use the tester.
- Keep the manual at hand to enable quick reference whenever necessary.
- The tester is to be used only for its intended applications.
- Understand and follow all the safety instructions contained in the manual.

It is essential that the above instructions are adhered to. Failure to follow the above instructions may cause injury, tester damage and/or damage to equipment under test. Kewtech is by no means liable for any damage resulting from the tester in contradiction to these cautionary notes.

The symbol ⚠ indicated on the tester means that the user must refer to the related parts in the manual for safe operation of the tester. It is essential to read the instructions wherever the symbol ⚠ appears in the manual.

⚠ **DANGER :** is reserved for conditions and actions that are likely to cause serious or fatal injury.

⚠ **WARNING :** is reserved for conditions and actions that can cause serious or fatal injury.

⚠ **CAUTION :** is reserved for conditions and actions that can cause injury or tester damage.

⚠DANGER

- Do not apply voltages above 600V, including voltage to earth across the terminals of this tester.
- The KT66DL is rated to CAT IV 300V/ CAT III 600V. Do not make measurements under the circumstances exceeding the designed measurement categories.
- For safety reasons, only use accessories (test leads, probes, fuses, cases, etc) designed to be used with this instrument and recommended by KEWTECH
- Do not attempt to make measurements in the presence of flammable gasses; otherwise, the use of the tester may cause sparking, which can lead to an explosion.
- Never attempt to use the tester if its surface or your hand is wet.
- Be careful not to short-circuit a power line with the metal part of the test lead during a measurement. It may cause personal injury.
- Never open the battery compartment cover during a measurement.
- The tester should be used only in its intended applications and conditions; otherwise, safety functions equipped with the tester will not work, and tester damage or serious personal injury may be caused.
- Verify proper operation on a known source before use or take actions as a result of the indication of the tester eg: use KEWPROVE3 proving unit.

⚠WARNING

- Do not use the tester or test leads if any abnormal conditions, such as broken cover or exposed metal parts are noted.
- First, firmly connect the test leads to the tester, and then press the test switch.
- Never install substitute parts or make any modifications to the tester. Send the tester to your local Kewtech for repair or recalibration.
- Do not try to replace batteries if the surface of the tester is wet.
- Connect each test lead firmly into the corresponding terminals.
- Stop using the test lead if the outer jacket is damaged and the inner metal or color jacket is exposed.
- Before opening the battery compartment cover for battery or fuse replacement, ensure that no test leads are connected to the tester and the tester is off.
- Never turn the rotary switch while the test leads are connected to the equipment under test.

⚠CAUTION

- Always make sure to set the rotary switch to the appropriate position before making a measurement.
- Power off the tester after use. Remove batteries if the tester is to be stored for a long period.
- Do not expose the tester to direct sunlight, high temperature, humidity or dew.
- Use a slightly damp cloth with neutral detergent for cleaning. Do not use abrasives or solvents.
- This tester is not water-proof. Do not let the tester get wet. Otherwise, it may cause malfunction.
- If the tester is wet, make sure to let it dry before putting it into storage.
- Keep your hand and fingers behind the protective finger guards during a measurement.
- Example of testing parameters are given for demonstrating principles and are from the International Standard IEC60364 at the time of printing. Local standards are derived from these. In the UK they are the IET Wiring regulation (BS7671). Please ensure that you are complying to the correct local standards.

2. Tester layout

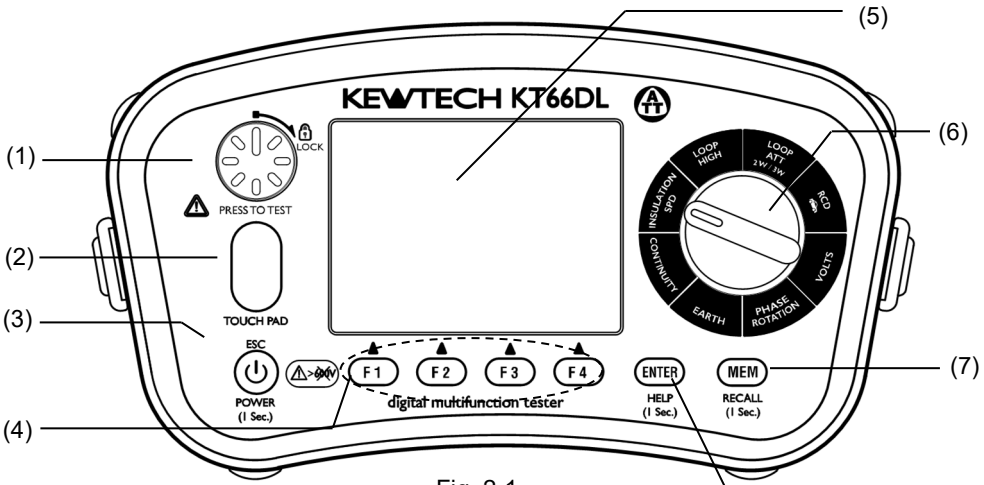


Fig. 2-1

	Item	Description
(1)	Test switch	Starts measurements. (Press and rotate for lock down feature.)
(2)	Touch pad	Checks the electrical potential at the PE terminal
(3)	Power switch	A long press turns on/ off the tester. (A short press works as an ESC switch to return to the previous screen.)
(4)	Function switch	Function setting (F1 ~ F4)
(5)	Display (LCD)	Color LCD
(6)	Rotary switch	Selects measurement functions.
(7)	MEM switch	Saves measured value. (Press 1 sec. to recall the saved data.)
(8)	ENTER switch	Confirms changes or selections. (A long press of 1 sec. shows “HELP” menu.)

Input Terminal

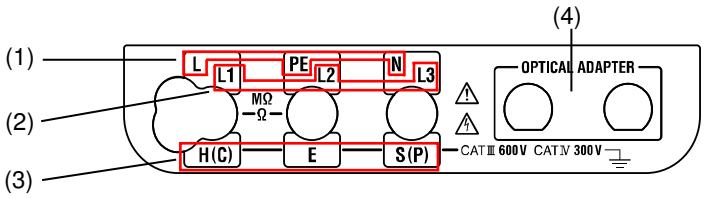


Fig. 2-2

	Function	Terminal
(1)	Terminals for: INSULATION, CONTINUITY LOOP, RCD, VOLTS	L : Line
		PE : Protective Earth
		N : Neutral (for LOOP, RCD)
(2)	Terminal for PHASE ROTATION	L1 : Line1
		L2 : Line2
		L3 : Line3
(3)	Terminal for EARTH	H(C) : Terminal for auxiliary earth spike (current)
		E : Terminal for the earth under test
		S(P) : Terminal for auxiliary earth spike (potential)
(4)	Optical adapter	Communication port for Model 8212USB

3. Accessories

●Test leads

(1) Mains Test Lead (KAMP12)

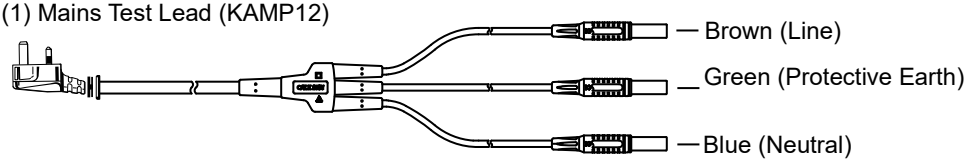


Fig.3-1

(2) Remote Test Lead (ACC064SPN)

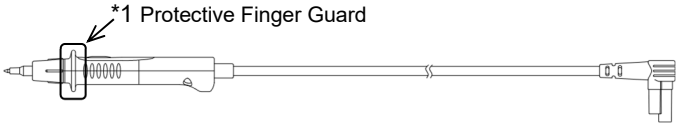


Fig. 3-2

(3) Distribution Board test lead (ACC065)

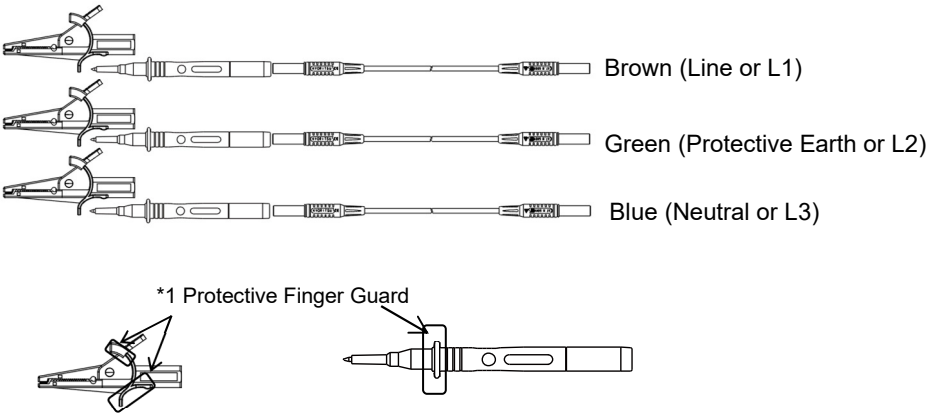


Fig. 3-3

* 1 Protective finger guard is a part providing protection against electrical shock and ensuring the minimum required clearance and creepage distances.

・Other accessories

(1) Test Lead Carry pouch ･･･x1
(2) Carrying Bag ･･･x1
(3) Instruction Manual･･･x1
(4) Shoulder Strap･･･x1
(5) Shoulder Pad ･･･x1
(6) Battery･･･x8
(7) Spare Fuse F 0.5A 600V (Φ6.3 x 32mm)･･･ x1 (SIBA 7009463.0,5)
*Stored in the battery compartment.
(8) Model 8212USB with PC Software “KEW Report”.

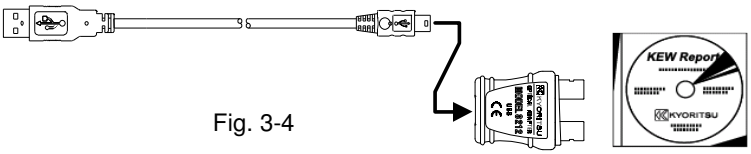


Fig. 3-4

・Optional item

(1) Earth Tests Lead (ACCESKIT) and Auxiliary Earth Spikes

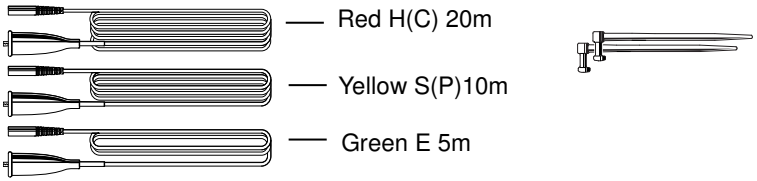


Fig. 3-5

(2) PAT ADAPTER1

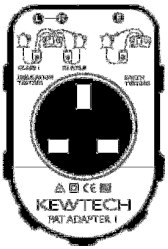


Fig. 3-6

4. Features

The KT66DL Multi-function tester has eight test functions in one tester.

1 Continuity test
2 Insulation resistance test
3 Loop impedance test (High current measurement, No trip (ATT) measurement)
4 Prospective short circuit current test (On Loop impedance function)
5 RCD test
6 Voltage test
7 Phase rotation test
8 Earth test

Continuity function has the following features:

Fuse Protection	Continuity Function has a fuse protection function to prevent a fuse blowing when coming into contact with a live circuit. With this function, a fuse rarely blows while measuring continuity and touching live circuits.
Continuity Null	Allows automatic subtraction of test lead resistance from continuity measurements.
15mA test	Not only 200mA but also 15mA is available.
Continuity 2Ω Buzzer	Buzzer sounds at 2Ω or less at Continuity function. (Switchable on or off)

Insulation function has the following features:

Auto-discharge	Electric charges stored in capacitive circuits are discharged automatically after testing by releasing the test switch.
SPD(VARISTOR) test	Breakdown voltage measurement for surge protective device (varistor)

Loop impedance functions have the following features:

ATT test	Enables loop impedance tests without tripping RCDs rated at 30mA or higher. (applicable to 3 or 2-wire measurements)
LOOP 0.001Ω test	High resolution measurement, 0.001Ω, at a test current of 25A

RCD testing functions have the following features:

RCD Type B test	Capable of testing Type B RCDs of dc residual current.
VAR(variable test current) :	Test current is variable on RCD range.
RCD AUTO TEST	Auto-test in the following sequence: ×1/2(0°)→×1/2(180°)→×1(0°)→×1(180°)→×5(0°) →×5(180°)
EV RCD	EV charger RCD test

The following features are available on all testing functions.

Touch Pad	Gives an alert, when touching the Touch Pad, while the PE terminal is connected to Line by mistake.
Memory Function	Saves the measured data in the internal memory. The data can be edited on a PC by using Communication Adapter Model 8212USB and PC Software “KEW Report”.

5. Specification

5.1 Measurement specification

VOLTS

Range	300.0/600V (Auto-ranging)
Display range	Voltage: 2.0 – 314.9V, 240 – 629V Frequency: 40.0 – 70.0Hz (displayed at 2V or higher)
Measuring range (Guaranteed accuracy range)	Voltage: 2 – 600V Frequency: 45 – 65Hz
Accuracy	Voltage: ±2%rdg±4dgt Frequency: ±0.5%rdg±2dgt

* True-RMS detection. Add ±1%rdg to the declared accuracy for sine wave other than CF<2.5. (850Vpeak or less)

PHASE ROTATION

Measuring range	48 – 600V / 45 - 65Hz
Criteria of judgement	Correct sequence: Clockwise symbol and “1, 2, 3” are displayed. Reversed sequence: Counter-clockwise symbol and “3, 2, 1” are displayed.

EARTH

	Precise measurement	Simplified measurement
Range	20.00/ 200.0/ 2000Ω (auto-ranging)	
Display range	0.00 – 20.99Ω 16.00 – 209.9Ω 160.0 – 2099Ω	
Measuring range (Guaranteed accuracy range)	0 – 2000Ω	
Accuracy	20Ω range; ±2%rdg±0.08Ω The other ranges: ±2%rdg±3dgt (Auxiliary earth resistance: 100Ω)	±2%rdg±0.08Ω The other ranges: ±2%rdg±3dgt
Output current	20Ω range: approx. 3mA 200Ω range: approx. 1.7mA 2000Ω range: approx. 0.7mA Frequency: 825Hz	

CONTINUITY

Range	20.00/200.0/2000Ω (auto-ranging)
Display range	0.00 - 20.99Ω 16.0 - 209.9Ω 160 - 2099Ω
Measuring range (Guaranteed accuracy range)	0 – 2000Ω
Accuracy (NULL enabled)	±2.0%rdg±8dgt
Open-circuit voltage (DC)	7 – 14V
Test current	200mA test: 200mA or more (2Ω or less) 15mA test: 15mA±3mA (short-circuit)

- Enabled if pre-set NULL value is 9Ω or less.
- 2Ω Buzzer: Buzzer sounds when measured resistance is 2Ω or less.

INSULATION

(1) INSULATION RESISTANCE

Rated measurement voltage	100V	250V	500V	1000V
Range	2.000/20.00/200.0MΩ auto-ranging		20.00/200.0/1000MΩ auto-ranging	20.00/200.0/2000MΩ auto-ranging
Display range	0.000 - 2.099MΩ 1.60 - 20.99MΩ 16.0 - 209.9MΩ		0.00 - 20.99MΩ 16.0 - 209.9MΩ 160 - 1049MΩ	0.00 - 20.99MΩ 16.0 - 209.9MΩ 160 - 2099MΩ
Measuring range (Guaranteed accuracy range)	0 - 200MΩ		0 - 1000MΩ	0 - 2000MΩ
Accuracy	2.000MΩ range: ±2%rdg±6dgt 20.00MΩ range: ±2%rdg±6dgt 200MΩ range: ±5%rdg±6dgt		20.00MΩ range: ±(2%rdg+6dgt) 200.0MΩ range: ±(2%rdg+6dgt)	
			1000MΩ range: ±(5%rdg+6dgt)	2000MΩ range: ±(5%rdg+6dgt)
Rated measurement current	1.0 - 1.2mA at 100kΩ	1.0 - 1.2mA at 250kΩ	1.0 - 1.2mA at 500kΩ	1.0 - 1.2mA at 1MΩ

- Open-circuit voltage: 100 – 120% of rated measurement voltage
- Short-circuit current: within 1.5mA
- The tester outputs negative voltage from LINE terminal and positive voltage from EARTH terminal.
- Max. capacitive load: 1μF: capacitive load dischargeable within 10 sec after test (IEC 61010-2-034)
- Discontinuous beeps sound during a measurement on 1000V range.

(2) SPD test

Range	1000V
Display range	1049V
Measuring range	0 - 1049V
Accuracy	±5%rdg±5dgt
Voltage increase rate	100V / sec.
Voltage increase step	Increases by 1V.
Threshold value for current detection	1mA

LOOP ATT

Function		3-Wire L-PE	2-Wire L-PE
Mains input voltage range		100 – 260V 50/60Hz (L-N < 20Ω)	48 – 260V 50/60Hz
Range	LOOP	20.00/200.0/2000Ω (auto-ranging)	
	PFC/PSC	2000A/20kA	2000A/20kA(PFC only)
Display range	LOOP	0.00 – 20.99Ω 21.0 – 209.9Ω 210 – 2099Ω	0.00 –20.99Ω 21.0 –209.9Ω 210 –2099Ω
	PFC/PSC	0 – 2099A 2.10 – 20.99kA	0 – 2099A 2.10 – 20.99kA (PFC only)
Measuring range (Guaranteed accuracy range)	LOOP	0 – 2000Ω	0 – 2000Ω
Accuracy	LOOP	230V+10%-15%:±(3%rdg+6dgt) Other than above voltages: ±(3%rdg+8dgt)	230V+10%-15%:±(3%rdg+10dgt) Other than above voltages: ±(3%rdg+15dgt)
	PFC/PSC	Depending on the accuracies of voltage and LOOP measurements	
Test current @230V		L-N:6A/60ms N-PE:10mA (5.3Hz) EV mode Normal I N-PE:6mA (5.3Hz) Low I N-PE:4mA (5.3Hz)	L-PE: 15mA

* If a reading is unstable, one upper range digit might be used instead of the display range to be used.
* For LOOP 3W EV Normal I, ±2dgt is added to the accuracy listed in above table.
  For Low I, errors may be larger as it will be more susceptible to noise.

LOOP HIGH

Function		L-PE0.01ΩRes	L-PE0.001ΩRes	L-N/L-L
Mains input voltage range		48 - 260V 50/60Hz	100 - 260V 50/60Hz	48 - 500V 50/60Hz
Range	LOOP	20.00/200.0/2000Ω	2.000Ω	20.00Ω
	PFC/PSC	2000A/20kA (PFC only)	2000A/50kA (PFC only)	2000A/20kA (PSC only)
Display range	LOOP	0.00 - 20.99Ω 21.0 - 209.9Ω 210 –2099Ω	0.000 - 2.099Ω	0.00-20.99Ω
	PFC/PSC	0 - 2099A 2.10 - 20.99kA (PFC only)	0 - 2099A 2.10 - 52.49kA (PFC only)	0 - 2099A 2.10 - 20.99kA (PSC only)
Measuring range (Guaranteed accuracy range)	LOOP	0 – 2000Ω	0 – 2Ω	0 – 20Ω
Accuracy	LOOP	230V+10%-15%: ±(3%rdg+4dgt) 100V or less: ±(5%rdg+15dgt) Other than above voltages: ±(3%rdg+8dgt)	230V+10%-15%: ±(3%rdg+25mΩ) Other than above voltages: ±(5%rdg+35mΩ)	230V+10%-15%: ±(3%rdg+4dgt) 100V or less: ±(5%rdg+15dgt) Other than above voltages: ±(3%rdg+8dgt)
	PFC/PSC	Depending on the accuracies of voltage and LOOP measurements		
Test current @230V		20Ω: 6A/20ms 200Ω: 0.5A/20ms 2000Ω: 15mA/500ms	25A/20ms	6A/20ms

* If a reading is unstable, one upper range digit might be used instead of the display range to be used.

RCD

(1) Mains input voltage range: 100V – 260V 50/ 60Hz

For Type AC and A RCDs rated at 100mA or higher: 190 – 260V

(2) Accuracy

Mode	RCD Type		Rated residual operating current (mA) (I⊿n)	Test current		Duration	
				Current value (mA) rms	Accuracy @230V	Measuring time	Accuracy
×1/2	AC	G	10/30/100/300/500/1000	I⊿n×1/2	-8% to-2% VAR:-10% to 0%	2000ms	Trip Time ±(1%+2ms) Measuring time ±3% of FS
		S	100/300/500				
	A/F	G	10/30/100/300/500	I⊿n×0.35	-10% to 0%		
	A	S	100/300/500				
	B	G	10/30/100/300	I⊿n×1/2	-10% to 0%		
		S	100/300				
×1	AC	G	10/30/100/300/500/1000	I⊿n	+2% to +8% VAR:0% to +10%	G:550ms S:1000ms	
		S	100/300/500				
	A/F	G	10/30/100/300/500	10mA: I⊿n×2 Other currents: I⊿n×1.4	0% to +10%		
	A	S	100/300/500				
	B	G	10/30/100/300	I⊿n×2	0% to +10%		
		S	100/300				
	EV		6	I⊿n	0% to +10%	10.5s	
×5	AC	G	10/30/100	I⊿n×5	+2% to +8% VAR:0% to +10%	410ms	
		S	100				
	A/F	G	10/30/100	I⊿n×5×1.4	0% to +10%		
	A	S	100				
	B	G	10/30	I⊿n×2×5	0% to +10%		
Ramp 20% to 110% (EV 30% to 100%)	AC	G	10/30/100/300/500	I⊿n	-4% to +4%	by 10% G: 300ms S: 500ms	Measuring time ±3% of FS
		S	100/300/500				
	A/F	G	10/30/100/300/500	10mA:I⊿n×2 Other currents: I⊿n×1.4	-10% to +10%		
	A	S	100/300/500				
	B	G	10/30/100/300	I⊿n×2	-10% to +10%	by 2% 150ms	
		S	100/300				
	EV		6	I⊿n	-10% to +10%	by 2% 500ms (10s is kept only at 100%)	

・

AUTO-TEST：X1/2(0°)→X1/2(180°)→X1(0°)→X1(180°)→X5(0°)→X5(180°)

The test of “X5” will be skipped when a current is 100mA or higher.

At the auto-test for Type EV, additional 6 mA DC test is performed.

Current waveform

・Type AC: Test current is sine wave.

・Type A and F: Test current is half sine wave.

・Type B and EV: Direct current

(3) Uc (RCD)

Mains input voltage range	100-260V
Range	100V
Display range	0.0 - 104.9V
Measuring range (Guaranteed accuracy range)	0 - 100V
Accuracy	+5% to+15%rdg±8dgt @230V
Test current	50 % or less of IΔn

Possible number of tests with fresh batteries.

CONTINUITY	: Approx. 2000 times min. at load 1Ω
INSULATION RESISTANCE	: Approx. 1500 times min. at load 1MΩ (1000V)
LOOP	: Approx. 3000 times min. (ATT L-PE 3W)
RCD	: Approx. 3500 times min. (G-AC X1 30mA)
EARTH	: Approx. 3000 times min. at load 10Ω
VOLTS/PHASE ROTATION	: Approx. 40h

5.2 General specification

Reference conditions	Specifications are based on the following conditions except where otherwise stated:- 1. Ambient temperature: 23±5℃: 2. Relative humidity: 45% to 75% 3. Nominal voltage of distribution system (Un) : 230V/400V, 50Hz/60Hz 4. Altitude: Less than 2000m
Tester dimensions	235 X 136 X 114mm
Tester weight	1350g (including batteries.)
Battery type	Size AA Alkaline battery (LR6) x 8
Operating temperature and humidity.	-10 to +50℃, relative humidity 80% or less, no condensation
Storage temperature and humidity	-20 to +60ºC, relative humidity 75% or less, no condensation.
Display	Color Dot Matrix LCD 320(W) X 240(H) pixels.
Overload protection	The continuity test circuit is protected by a 0.5A/600V fast acting (HRC) ceramic fuse mounted in the battery compartment, where a spare fuse is also stored. The insulation resistance test circuit is protected by a resistor against 1000V AC for 10 seconds.

5.3 Applied standards

Tester operating Standard	IEC61557-1,2,3,4,5,6,7,10
Safety standard	IEC 61010-1, -2-030, -2-034 CATIII (600V) CATIV (300V) -Tester IEC 61010-031 KAMP12… CATII 250V ACC065 … CATIII 600V/ CATIV 300V ACC064SPN CAT III 600V/ CATIV 300V * When test leads, sometimes with metal tips, are connected and used with the tester, the measurement category and voltage rating of the lowest rated item is applied.
Protection degree	IEC 60529 IP40
EMC	EN 61326-2-2

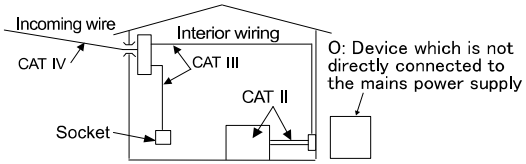
This manual and product may use the following symbols adopted from International Safety Standards;

CAT II	Measurement category “CAT II” applies to; Electrical circuits of equipment connected to an AC electrical outlet by a power cord.
CAT III	Measurement category “CAT III” applies to; Primary electrical circuits of the equipment connected directly to the distribution panel, and feeders from the distribution panel to outlets.
CAT IV	Measurement category “CAT IV” applies to; The circuit from the service drop to the service entrance, and to the power meter and primary overcurrent protection device (distribution panel).
	Equipment protected throughout by DOUBLE INSULATION or REINFORCED INSULATION;
	Caution (refer to accompanying documents)
	Caution, risk of electric shock
	Protection against wrong connection is up to 600V
	Earth Ground
	Complies with WEEE Directive (2002/ 96/ EC) marking requirements. (valid in each EU country)

To ensure safe operation of measuring testers, IEC 61010 establishes safety standards for various electrical environments, categorized as O to CAT IV, and called measurement categories. Higher-numbered categories correspond to electrical environments with greater momentary energy, so a measuring tester designed for CAT III environments can endure greater momentary energy than one designed for CAT II.

O (None, other): Circuits which are not directly connected to the mains power supply.
CAT II : Electrical circuits of equipment connected to an AC electrical outlet by a power cord.
CAT III : Primary electrical circuits of the equipment connected directly to the distribution panel, and feeders from the distribution panel to outlets.

CAT IV : The circuit from the service drop to the service entrance, and to the power meter and primary overcurrent protection device (distribution panel).



5.4 Operating uncertainty

Continuity (EN61557-4)

Operating range compliant with EN61557-4 operating uncertainty	Maximum percentage operating uncertainty
0.20 to 2000Ω	±30%

The influencing variations used for calculating the operating error are denoted as follows;
Temperature: 0ºC and 35ºC
Supply voltage: 8V to 13.8V

Insulation Resistance (EN61557-2)

Volt	Operating range compliant with EN61557-2 operating uncertainty	Maximum percentage operating uncertainty
100V	0.100 to 200.0MΩ	±30%
250V	0.250 to 200.0MΩ	
500V	0.50 to 1000MΩ	
1000V	1.00 to 2000MΩ	

The influencing variations used for calculating the operating error are denoted as follows;
Temperature: 0ºC and 35ºC
Supply voltage: 8V to 13.8V

Loop Impedance (EN61557-3)

Function		Operating range compliant with EN61557-3 operating uncertainty	Maximum percentage operating uncertainty
HIGH	L-PE 0.01Ω Res	0.40 to 2000Ω	±30%
	L-PE 0.001Ω Res	0.400 to 2.000Ω	
	L-N/L-L	0.40 to 20.00Ω	
ATT	2Wire	1.00 to 2000Ω	
	3Wire (Except for EV)	0.40 to 2000Ω	

The influencing variations used for calculating the operating error are denoted as follows;

Temperature: 0 ℃ and 35 ℃
Phase angle: At a phase angle 0° to 30°
System frequency: 49.5Hz to 50.5Hz
System voltage: 230V+10%-15%
Supply voltage: 8V to 13.8V
Harmonics: 5% of 3rd harmonic at 0° phase angle
6% of 5th harmonic at 180° phase angle
5% of 7th harmonic at 0° phase angle
DC quantity: 0.5% of the nominal voltage

RCD (EN61557-6)

Function	Operating uncertainty of trip current
X1/2	-10% to 0%
X1, X5	0% to +10%
Ramp	-10% to +10%

The influencing variations used for calculating the operating error are denoted as follows.

- Temperature : 0ºC and 35ºC
- Earth electrode Resistance (shall not exceed below) :

IΔn	Type AC	Type A/F	Type B	Type EV
6mA	-	-	-	400Ω
10mA	400Ω	200Ω	40Ω	-
30mA	100Ω	40Ω	10Ω	-
100mA	40Ω	20Ω	10Ω	-
300mA	40Ω	20Ω	2Ω	-
500mA	40Ω	20Ω	-	-
1000mA	20Ω	-	-	-

- System voltage: 230V+10%-15%
- Supply voltage : 8V to 13.8V

Earth Resistance (EN61557-5)

Operating range compliant with EN61557-5 operating uncertainty	Maximum percentage operating uncertainty
5.00 to 2000Ω	±30%

The influencing variations used for calculating the operating error are denoted as follows;

- Temperature : 0 ℃ and 35 ℃
- Series interference voltage : 16·2/3Hz, 50Hz, 60Hz, DC:10V
  400Hz: 3V
- Resistance of the probes and auxiliary earth electrode resistance: 100 x RA, 50 kΩ or less
- Supply voltage : 8V to 13.8V

5.5 Symbols and marks displayed on the LCD

	Battery level indicator
	Temperature monitor for internal resistance, applicable to the Loop, RCD function. Further measurements are suspended until the "" symbol disappears.
	Measurements in progress
	Live circuit warning (Continuity / Insulation / Earth Function)
PE Hi V	Caution: Presence of 100V or more at PE terminal, appears when touching the Touch Pad
L-N >20Ω	Alert: Presence of 20Ω or more between Line - Neutral at ATT measurement
	Caution: Presence of noise in the circuit under test during ATT measurement.
N - PE Hi V	Caution: Presence of high voltage between NEUTRAL - EARTH during LOOP ATT measurement.
Uc > UL	Caution: Uc at RCD test is exceeding the preset UL value (25 or 50V).
no	Error message: When on the RCD function, RCD tripped before measuring RCD trip time. Selected IΔn value may not be correct. When on the LOOP, PSC/PFC function, supply may have been interrupted.
	Wiring check for LOOP, RCD function
	Judged result of each test ☑ : Satisfied the reference value, ☒ : Unsatisfied. ! : Unjudgeable: Measured result exceeds the measuring range, and the upper limit of the measuring range is smaller than the reference value. Appears when setting PAT for Continuity/Insulation function and limit value for LOOP measurement.
R_H Hi, Rs Hi	Appears when a Probe resistance of H terminal (R_H) or of S terminal (R_S) at Earth measurement is exceeded the measurable range.
No 3-phase system	Appears to indicate wrong connection at Phase Rotation check.
N-PE Hi Ω	For RCD Type B and EV, appears to indicate too high resistance exists between N-PE to apply test current.

6. Setup mode

Enter in the SETUP mode to change settings of the tester. The following settings are changeable.

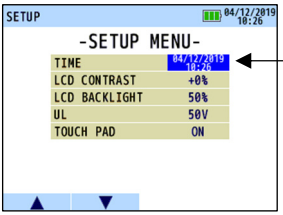
(1) TIME .....Clock adjustment
(2) LCD Contrast .....LCD contrast adjustment LCD
(3) LCD Backlight ....LCD backlight brightness adjustment LCD
(4) UL value.....Selects a UL value for RCD function
(5) Touch Pad.....Enables / disables Touch Pad function

Setting method:

(1) Press F4 “SETUP” while the start-up screen is displayed (approx. 2 sec.) after turning on the tester.
(2) SETUP screen appears. (See Fig. 6-2.)
The screen also can be referenced in the HELP menu: press F4 while the LCD is showing wiring configuration diagram.

Press F4.

Fig. 6-1



Selected item is highlighted in white.

Fig. 6-2

(3) Press ▲(F1) or ▼(F2) switch for item selection and confirm the selection with ENTER switch.
(4) Press ▲(F1) or ▼(F2) switch and change settings. The changeable settings are as follows.

Item	Setting
TIME	Adjusts day, month, year, minute and hour.
LCD Contrast	Up or Down
LCD Backlight	Up or Down
UL value	25V or 50V
Touch Pad	ON or OFF

(5) Press ENTER when settings are done. Then the screen returns to the SETUP MENU screen as Fig. 6-2. Press ESC to cancel the changes.
(6) Pressing ESC on SETUP MENU screen (Fig. 6-2) gets the tester in stand-by mode.

7. Getting started

7.1 Attaching probes / croc clips to test leads

(1) For ACC065 test leads

Either of the following adapters can be attached to.

1. Alligator clip
2. Test probe

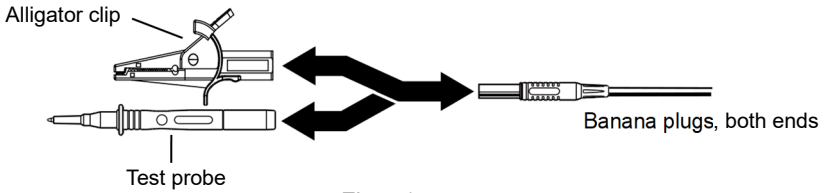


Fig 7-1

⚠ DANGER

To avoid getting electrical shocks, disconnect the test leads from the tester before replacing the metal tip or adapter.

7.2 Battery voltage check

(1) Please refer to Section 20. “Battery and fuse replacement” in this manual and insert batteries in to the tester.
(2) Press the Power switch to turn on the tester.
(3) Check the battery status indicator displayed at the upper right corner of the LCD.
”[▮▮▮]”: Normal. Battery voltage is enough.
”[▮▯▯]”: Low battery voltage: For continuous measurement, please refer to Section 20. “Battery and fuse replacement” and replace the batteries with new ones.
“[▯]”: Battery voltage is below the lower limit of the operating voltage.
In such a condition, accuracy of the measured result isn’t guaranteed. Replace batteries with new ones immediately.

●Battery status indicator might change from ”[▮▮▮]” to ”[▯]” during a measurement depending on measured objects; for example, resistance of the object is low.

7.3 Clock adjustment

The KT66DL has clock function. Time is displayed in the upper right corner of the LCD.
Time display format: Day/ Month/ Year / Hour: Min
Enter the SETUP mode to adjust clock. Press ENTER when clock adjustment is done.
See Section 6. “Setup mode” for further detail of “SETUP” mode.

(1) On the clock adjustment screen (Fig. 7-3), select the parameter (day/ month/ year/ hour/ min) to be adjusted with ◀(F3) or ▶(F4) switch.
(2) Use ▲(F1) or ▼(F2) switch to alter the value of the selected parameter and press ENTER to confirm. (Pressing ESC switch during the adjustment can one step back.)

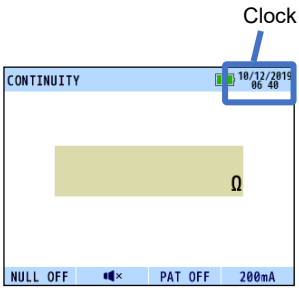


Fig. 7-2

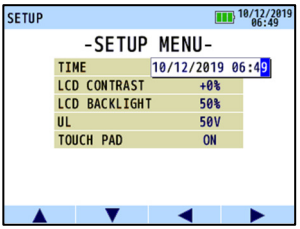


Fig. 7-3 Clock adjustment

Note:
Clock setting will be cleared if the tester does have batteries installed for 10 min. or longer. When battery replacement is required, be careful not to exceed this period. If the clock setting is cleared and restored to the default, please do the setting again.

7.4 Help function

With this function, correct connection for each test can be displayed on the LCD.

To check a connection diagram;
(1) Hold down HELP (ENTER) switch 1 sec.
(2) Then the LCD shows a connection diagram.

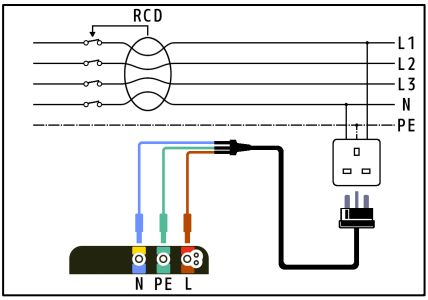


Fig. 7-4 Connection diagram example

(3) When several connections are available, press F1 switch to toggle the diagrams.
(4) Press ESC to close the currently displayed connection diagram screen.

- The SETUP screen for making each setting will appear by pressing F4 (SETUP) switch while the LCD is showing a connection diagram.

8. Continuity (resistance) tests

⚠ DANGER

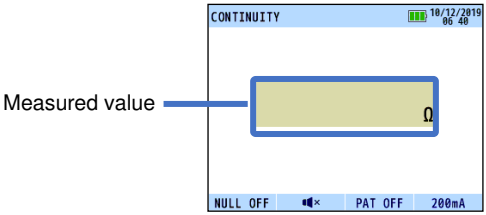
Do not apply voltage to the continuity function. Always check the circuit or equipment under test is surely de-energized before starting a measurement.

8.1 Test procedure

The object of continuity testing is to measure only the resistance of the parts of the wiring system under test. This measurement should not include the resistance of any test leads used. The resistance of the test leads needs to be subtracted from any continuity measurement. The KT66DL is provided with a continuity null feature which allows automatic compensation for any test lead resistance.

You should only use the test leads supplied with the tester.

LCD display and function switches



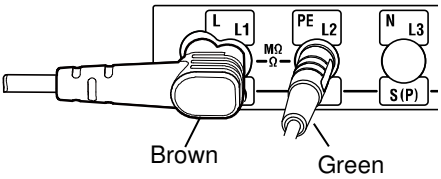
F1	Switches on / off NULL function
F2	Switches on / off 2Ω buzzer
F3	Pat mode setting (OFF, 0.1Ω, 0.3Ω,0.5Ω)
F4	Test current setting 200mA or 15mA

Fig. 8-1

Proceed as follows:

(1) Select the continuity test by turning the rotary switch.

(2) Insert the test leads to the L and PE terminals on the KT66DL respectively as shown in Fig 8-2.



L terminal Brown test lead, or ACC064SPN Remote Test Lead
PE terminal Green test lead

Fig. 8-2

(3) Connect the ends of the test leads firmly together (see Fig. 8-3) and press and lock down the test switch. The value of the lead resistance will be displayed. The "▶" symbol is displayed to the left of the reading during a measurement.

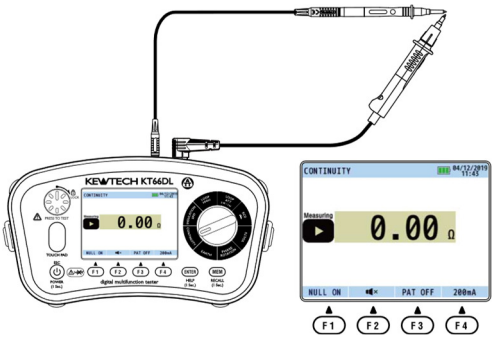


Fig. 8-3

(4) Press the F1(NULL) switch, this will null out the lead resistance and the indicated reading should go to zero.
(5) Release the test switch. Then press the test switch again and ensure the display reads zero before
proceeding. While using the Continuity null function, “NULL ON” is displayed on the LCD as indicated in Fig.8-3.
- The null value will be stored even if the tester is powered off.
- This memorized null value can be cancelled by disconnecting the test leads and pressing F1(NULL) switch with the test switch pressed or locked.
- When this is cancelled you will know because NULL OFF is displayed on the LCD.

> **⚠ CAUTION**
> Before taking any measurements always check the leads have been zeroed. It is good practice to regularly null the test leads, it is advised that each time this is done the previous memorized null should be taken off before running through a new null procedure.

(6) Connect the test leads to the circuit whose resistance is required (see Fig. 8-4 for a typical connection arrangement), having first made sure that **the circuit is not live**. Note that “Live” warning will be displayed on the LCD if the circuit is live - but check first anyway!

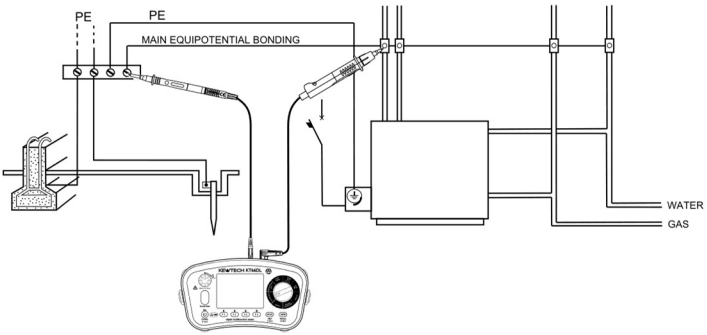


Fig.8-4 Example of continuity test for main equipotential bonding.

(7) Press the test switch and read the circuit resistance from the display. The reading will have the test lead resistance already subtracted if the Continuity null function has been used.

Note: If the reading is greater than 2099Ω the over range symbol '>' will remain displayed.

⚠WARNING

The results of measurements can be adversely affected by impedances of additional operating circuits connected in parallel or by transient currents.

Principle of operation:
Resistance = Voltage/ Current
RX = V/ I

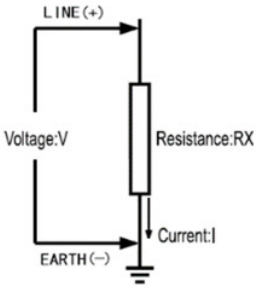


Fig. 8-5

● Circuit protection
The tester has circuit protection function: even if touching with a live circuit during low-resistance measurement unintentionally, the tester will have no damage. There is a backup fuse in the battery compartment. On the very rare occasion that this blows there is a replacement fuse, also in the battery compartment.

8.2 2Ω Buzzer ( ) function
Use F2 switch to enable ( ) / disable ( ) the 2Ω Buzzer. The buzzer sounds when measured resistance is 2Ω or less while this function is enabled.

8.3 Switching test currents
KT66DL can perform continuity test at 200mA and also 15mA. Press F4 switch to switch the current between 200mA and 15mA.

8.4 Pat function
PAT function is available to do continuity test for portable appliances,
(1) Press F3 to select the criteria value for PAT test. (See the table below.)

Item	Criteria of judgement
PAT OFF	-
PAT 0.1Ω	"✓": 0.1Ω or less, "X": over 0.1Ω
PAT 0.3Ω	"✓": 0.3Ω or less, "X": over 0.3Ω
PAT 0.5Ω	"✓": 0.5Ω or less, "X": over 0.5Ω

(2) To conduct PAT testing use the optional accessory PATAdapter1 and refer to section 10 on page 31.
"✓" or "X" will be displayed next to the reading to show PASS/ FAIL.

9. Insulation tests

This tester is used to measure insulation resistance of an electric appliance or circuit to inspect the insulation performance. Check the voltage rating of the object to be tested before making a measurement and select the voltage applied to.

- Depending on the object to be measured, displayed insulation resistance value may not stabilize.
- The tester may give bleep during an insulation resistance measurement; however, this is not a malfunction.
- Measurement time may be longer when measuring a capacitive load.
- In insulation resistance measurement, the earth terminal outputs positive voltage and the line terminal negative voltage.
- Connect the earth lead to the earth terminal. It is recommended to connect the positive side to the earth side when measuring insulation resistance against ground or when a part of the object under test is earthed. Such connection is known to be more suitable for insulation testing since insulation resistance values measured with the positive side connected to earth are typically less than those taken through the reversed connection.

⚠ DANGER

- Be extremely careful not to touch the tip of test probe or the circuit under test to avoid electrical shock during insulation measurement since high voltage is present at the tip of the test probe continuously.
  Wipe the test probe with a soft cloth, if it is wet, and use it after it's dry.
- The battery compartment cover must be closed before you operate the tester.

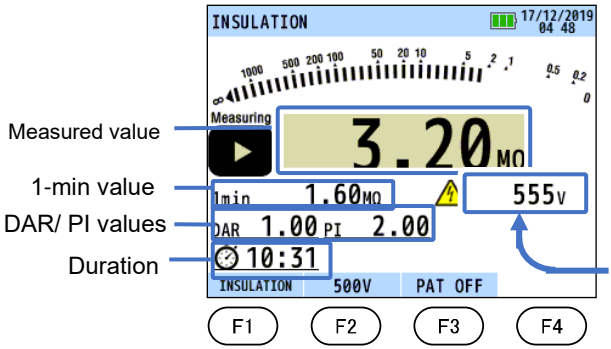
⚠ CAUTION

Always disconnect power to the equipment under test before starting insulation measurement. Do not attempt to make measurements on a live circuit; otherwise, it may damage the tester.

9.1 Measurement method

On the INSULATION function, breakdown voltage of Surge protect device (SPD, VARISTOR) can be tested in addition to normal insulation resistance.

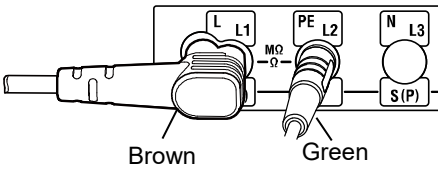
LCD display and function switches



F1	Test mode selection Insulation or SPD
F2	Voltage setting (100V,250V,500V,1000V)
F3	Pat mode setting (OFF, CL1, CL2)

Fig. 9-1

(1) Select INSULATION function with the rotary switch.
(2) Press F1 switch and select the test you wish to do: ”INSULATION” or SPD: ”SPD (VARISTOR)”.
(3) Press F2 switch and select the desired voltage range.
(When selecting SPD test, the range is fixed to 1000V.)
(4) Insert the test leads to the L and PE terminals on KT66DL respectively as shown in Fig. 9-2.



L terminal Brown test lead, or ACC064SPN Remote Test Lead
PE terminal Green test lead

Fig. 9-2

(5) Attach the test leads to the circuit or the appliance under test (See Fig. 9-3, Fig. 9-4, and Fig. 9-5).

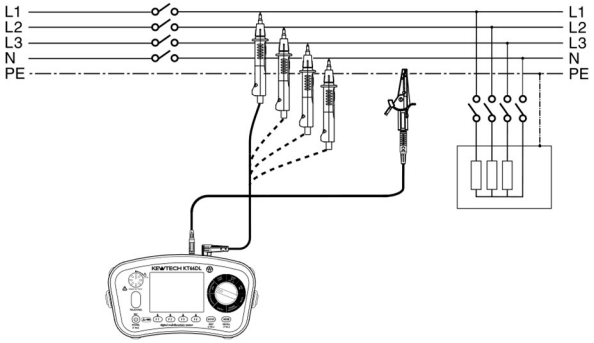


Fig. 9-3 Example of Insulation resistance test on 4 wire-3 phase system

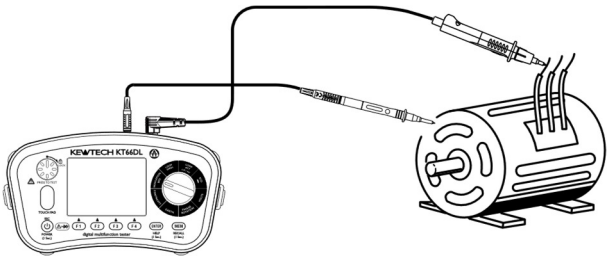


Fig. 9-4

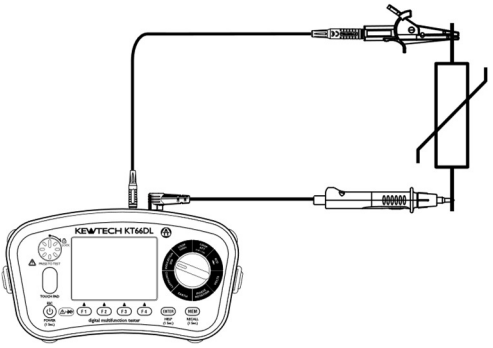


Fig. 9-5 SPD(VARISTOR) test connection

(6) If the “Live” warning is displayed on the LCD and/or the buzzer sounds, **do not press the test switch** but disconnect the tester from the circuit. Make the circuit dead before proceeding.

(7) Press the test switch, the display will show the insulation resistance of the circuit or the appliance to which the tester is connected. At an SPD(VARISTOR) test, the LCD will show a breakdown voltage.

(8) Auto discharge function

This function allows any capacitance charge in the circuit under test to be automatically discharged after measurement. Set the test switch or remote-control switch to off with the test leads connected.

Discharge can be checked with the flashing “⚠” symbol and buzzer.

⚠ DANGER

Never touch the circuit under test immediately after measurement.
Capacitances stored in the circuit may cause electric shock. Leave the test leads connected to the circuit, and do not touch the circuit until flashing ”⚠” goes off.

- Measurement and elapsed time are displayed on the LCD during insulation resistance measurement: up to 99 min. 59 sec. Note: The time counter stops and freezes when it reaches to 99 min. 59 sec.; if the elapsed time exceeds 100 min.
- If the reading measured greater than 2099MΩ (209.9MΩ at 100V/ 250V, 1049MΩ at 500V) the over range reading ‘>’ will be displayed.

Principle of operation:
Resistance = Voltage/ Current
RX = V/ I

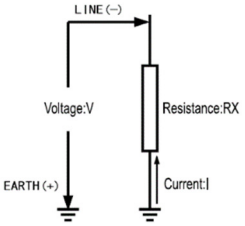


Fig.9-6

9.2 Continuous measurement (Insulation resistance measurement)

For continuous measurement, use the lock-down feature incorporated in the test switch. Press and turn the test switch clockwise to lock the switch in operating position; to unlock the switch, turn it counterclockwise.

⚠ DANGER

Be extremely careful not to touch the tips of test leads to avoid getting electrical shock since high voltage is present continuously.

9.3 Voltage characteristics of measurement terminals

This tester conforms to IEC61557. This standard defines that the rated measurement current shall be at least 1mA, and the lower limit of the insulation resistance maintaining the rated measurement voltage at measurement terminals. (See the table below.) This value is calculated by dividing the rated voltage by rated current. In case that the rated voltage is 500V, the lower limit of the insulation resistance is found as follows.

Divide 500V by 1mA equals 0.5MΩ.

That is, insulation resistance of 0.5MΩ or more is required to provide the rated voltage to the tester.

Rated voltage	100V	250V	500V	1000V
Lower limit of the insulation resistance to provide the rated current of 1mA	0.1MΩ	0.25MΩ	0.5MΩ	1MΩ

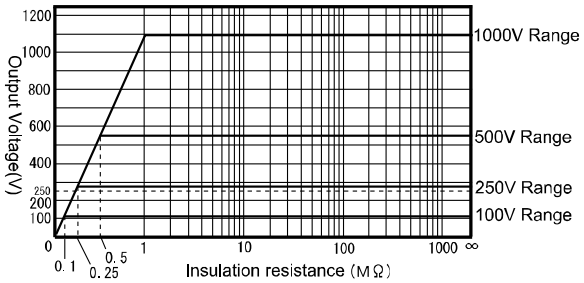


Fig. 9-7

9.4 DAR/ PI measurement, 1-min value display

DAR (Dielectric Absorption Ratio) and PI (Polarization Index) are automatically measured during insulation resistance measurement.
When measurement time elapsed:
- 1 min: LCD shows DAR value.
- 10 min: LCD shows PI value.

The LCD shows the measured value, after 1 min has passed since the start of measurement. Measured value is reviewable when 1 min elapses and also after the end of measurement.

The table below shows the formula and the display range.

Formula	DAR = Resistance (1 min after a start of test) / Resistance (15 sec after a start of test), PI = Resistance (10 min after a start of test) / Resistance (1 min after a start of test)
Display range	0.00 to 9.99

*DAR and PI value to be displayed will be “no” if the resistance value applied in the above formula is 0MΩ or out of display range When DAR and PI values exceed the display range, the LCD shows “>9.99”.

9.5 Pat function

PAT function is available to do insulation test for portable appliances: this function is (1) Press F3 to select the criteria value for PAT test. (See the table below).

Item	Criteria of judgement
PAT OFF	-
PAT CL1	”✓”: 1MΩ or more, ”X”: less than 1MΩ
PAT CL2	”✓”: 2MΩ or more, ”X”: less than 2MΩ

(2) To conduct PAT testing refer to section 10 on page 31.
”✓” or ”X” will be displayed next to the reading to show PASS/ FAIL.

9.6 SPD(Varistor) test

SPD test can measure a voltage which breakdowns surge protective device(varistor). When the test starts, the voltage that the KT66DL outputs automatically increases from 0 V until the SPD breakdowns and the LCD shows the voltage value. (If a 1 mA or higher current flow is detected, the tester judges it is the breakdown point.)

- Press the Test switch to start a test. Pressing F4 or ESC aborts the test.
- The LCD shows SPD breakdown voltage (DCV) and also the assumed AC voltage (ACV). The displayed ACV is determined by the following formula.
  ACV = DCV/ 1.4
- If there’s no SPD breakdown, the LCD shows ”>1049V”.

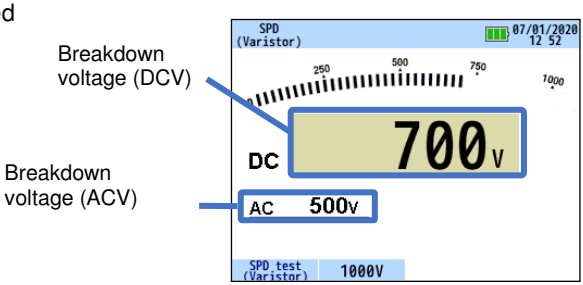


Fig. 9-8 SPD measurement screen

10. PAT FUNCTION

10.1 PAT test with the PAT Adapter1

Using the Kewtech PATAdapter1 with the KT66DL to undertake portable appliance testing. Before each use the adapter should be inspected to ensure that it is not damaged in any way. If any damage is noticed the adapter should be withdrawn from service and replaced.

10.2 Earth Bond.

a. This is a continuity test. Connect the test leads to the tester as shown in figure 8.2 on page 23
b. Connect one test lead from the KT66DL into the PAT Adapter1 at the terminal marked E (Earth Testing)
c. Plug the appliance to be tested into the three pin socket on the front of the PAT Adapter1.
d. Connect the other test lead from the KT66DL to the earthed position on your appliance to be tested.
e. Conduct a continuity test

Note: The test lead resistance can be auto-nulled from the test result, see section 8.1 on page 23 for guidance.

10.3 Insulation Class I

a. Connect the test leads to the tester as shown in fig. 9.2 on page 27.
b. Connect one test probe from the KT66DL to the terminal marked L—N (Insulation Testing) on the PATAdapter1 and the other test lead to the terminal marked E (Earth Testing).
c. Plug the appliance to be tested into the three pin socket on the front of the PAT Adapter.
d. Select either a 250V or 500V whichever is appropriate. Conduct a test.

10.4 Insulation Class II

a. Connect the test leads to the tester as shown in fig. 9.2 on page 27.
b. Connect one test probe from the KT66DL to the terminal marked L—N (Insulation Testing) on the PATAdapter1.
c. Plug the appliance to be tested into the three pin socket on the front of the PAT Adapter.
d. Connect the other lead from the KT66DL to the parts of your appliance to be tested.
e. Conduct a test.

In PAT CL I or PAT CL II mode the insulation 1000V range is disabled. Use 250V for:

1. Appliances and extension leads which include surge protection.
2. Where sensitive electronic equipment could be damaged.

⚠ Refer to the latest publication of the IET Code of Practice for In-Service Inspection and Test of Electrical Equipment for the methodology for testing of electrical equipment.

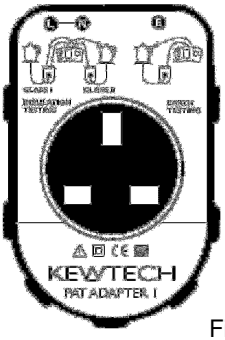


Fig. 10-1

11. LOOP/ PSC/PFC

11.1 Principles of measurement

(1) Principles of measurement of fault loop impedance and PFC
If an electrical installation is protected by over-current protective devices including circuit breakers or fuses, the earth loop impedance should be measured.
In the event of a fault the earth fault loop impedance should be low enough (and the prospective fault current high enough) to allow automatic disconnection of the electrical supply by the circuit protection device within a prescribed time interval. Every circuit must be tested to ensure that the earth fault loop impedance value does not exceed that specified or appropriate for the over-current protective device installed in the circuit. The KT66DL takes a current from the supply and measures the difference between the unloaded and loaded supply voltages. From this difference it is possible to calculate the loop resistance.

TT System
For a TT system the earth fault loop impedance is the sum of the following impedances;
- Impedance of the power transformer secondary winding.
- Impedance of the phase conductor resistance from the power transformer to the location of the fault.
- The impedance of the protective conductor from the fault location to the earth system.
- Resistance of the local earth system (R).
- Resistance of the power transformer earth system (Ro).

The figure below shows (dotted line) the Fault loop impedance for TT systems.

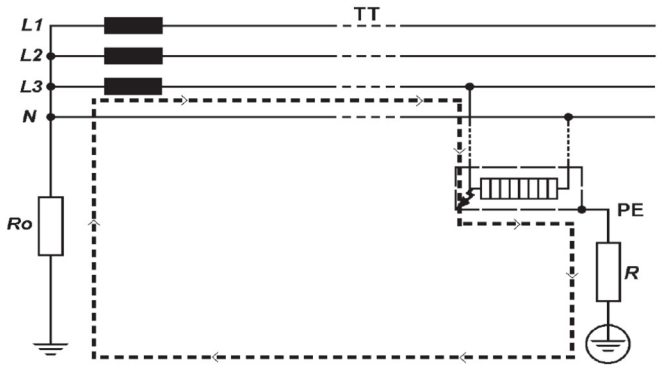


Fig. 11-1

According to the International Standard IEC 60364, for TT systems the characteristics of the protective device and the circuit resistance shall fulfill the following requirements:

Ra x Ia ≤ 50V

Where:
Ra is the sum of the resistances in Ω of the local earth system and the protective conductor for the exposed conductive parts.
50 is the maximum safety touch voltage limit (it can be 25V in particular cases like construction sites, agricultural premises, etc.).
Ia is the current causing the automatic disconnection of the protective device within the maximum disconnecting times required by IEC 60364-41 that, for electrical installations at 230 / 400V AC, are:

- 200 ms for final circuits up to 63A for socket, or up to 32A for fixed connected loads.
- 1 s for distribution circuits and circuits above mentioned over 63A and 32A.

The compliance with the above rules shall be verified by:
1) Measurement of the resistance Ra of the local earth system by Loop tester or Earth tester.
2) Verification of the characteristics and/or the effectiveness of the RCD associated protective device.

Generally, in TT systems, RCDs shall be used as protective device and in this case, Ia is the rated residual operating current IΔn. For instance, in a TT system protected by a RCD the max Ra values are:

Rated residual operating current IΔn	30	100	300	500	1000	(mA)
RA (with touch voltage of 50V)	1667	500	167	100	50	(Ω)
RA (with touch voltage of 25V)	833	250	83	50	25	(Ω)

Shown below is a practical example of verification of the protection by RCD in a TT system according to the international Standard IEC 60364.

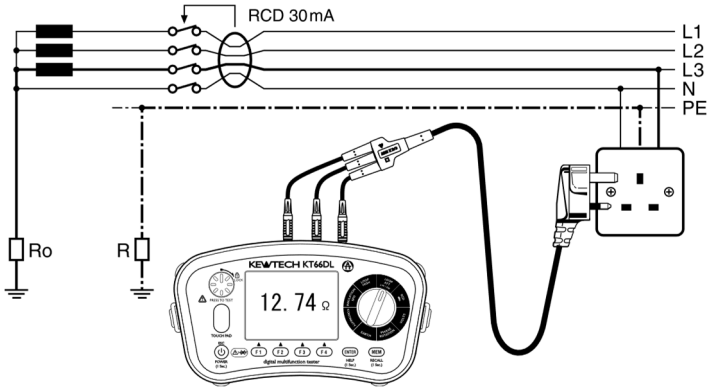


Fig. 11-2

In this example, the max permissible value is 1667Ω (RCD =30mA and contact voltage limit of 50V). The tester reads 12.74Ω, thus the condition RA ≤ 50/Ia is respected. However, considering that the RCD is essential for protection, it must be tested (Please refer to RCD TESTS section).

TN System

For TN systems the earth fault loop impedance is the sum of the following impedances.

- Impedance of the power transformer secondary winding.
- Impedance of the phase conductor from the power transformer to the location of the fault.
- Impedance of the protective conductor from the fault location to the power transformer.

The figure below shows (dotted line) the Fault loop impedance for TN systems.

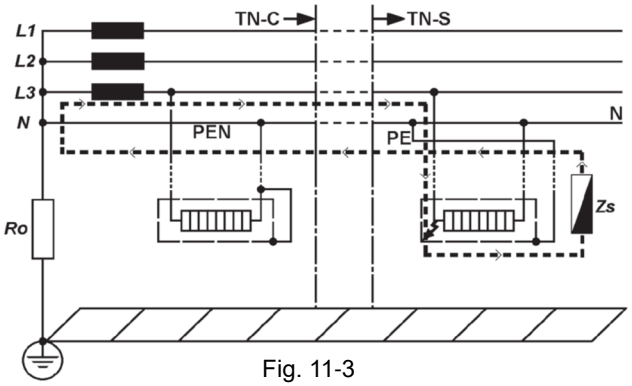


Fig. 11-3

According to the International Standard IEC 60364, for TN system the characteristics of the protective device and the circuit impedance shall fulfill the following requirement:

Zs x Ia ≤ Uo

Where:

Zs is the Fault loop impedance in ohm.

Uo is the nominal voltage between phase to earth (typically 230V AC for both single phase and three phase circuits).

Ia is the current causing the automatic disconnection of the protective device within the maximum disconnecting times required by IEC 60364-41 that, for installation at 230 / 400V AC, are:

- 400 ms for final circuits up to 63A for socket, or up to 32A for fixed connected loads.
- 5 s for distribution circuits and circuits above mentioned over 63A and 32A.

The compliance with the above rules shall be verified by:

1) Measurement of the fault loop impedance Zs by Loop tester.
2) Verification of the characteristics and/or the effectiveness of the associated protective device. This verification shall be made:

- for circuit-breakers and fuses, by visual inspection (i.e. short time or instantaneous tripping setting for circuit-breakers, current rating and type for fuses);
- for RCDs, by visual inspection and test using RCD testers recommending that the

disconnecting times mentioned above are met (Please see RCD TEST section).

For instance in a TN system with nominal mains voltage Uo = 230 V protected by MCBs (Miniature Current Breakers) required by BSEN 60898, the max Zs values could be:

Protected by BSEN 60898 MCB with Uo=230V				
	MCB (Disconn.Time 0.4 and 5s)		MCB (Disconn. Time 0.4s)	MCB (Disconn. Time 5s)
	B	C	C	D
Current rating	Zs(Ω)	Zs(Ω)	Zs(Ω)	Zs(Ω)
6A	7.28	3.64	1.82	3.64
10A	4.37	2.19	1.09	2.19
16A	2.73	1.37	0.68	1.37
20A	2.19	1.09	0.55	1.09
25A	1.75	0.87	0.44	0.87
32A	1.37	0.68	0.34	0.68
40A	1.09	0.55	0.27	0.55
50A	0.87	0.44	0.22	0.44
63A	0.69	0.35	0.17	0.35

Source:BS7671:2008 AMD 3:2015

The most complete Multifunction testers also have such above Zs limit table implemented in their firmware, so that the verification of the overcurrent protection is automatically made by comparing the measured value of Loop impedance and the Zs limit of the table.

Below is a practical example of verification of the protection by MCB in a TN system according to the international Standard IEC 60364.

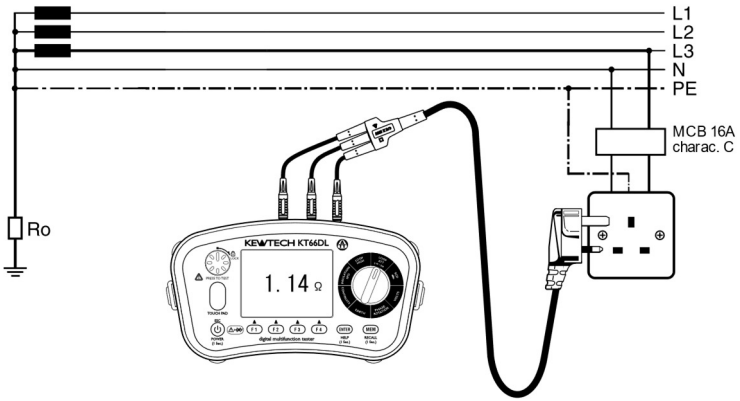


Fig. 11-4

Max value of Zs for this example is 1.37Ω (MCB 16A, characteristic C), the tester reads 1.14Ω (or 202A on Fault current range) it means that the condition
Zs x Ia ≤ Uo is respected.
In fact the Zs of 1.14Ω is less than 1.37Ω (or the Fault current of 202A is more than Ia of 160A).
In other words, in case of fault between phase and earth, the wall socket tested in this example is protected because the MCB will trip within the disconnection time required.

(2) Principles of the measurement of line impedance and PSC
The method for measuring line – neutral impedance and line-line impedance is exactly the same as for earth fault loop impedance measurement with the exception that the measurement is carried out between line and neutral or line and line.

Prospective short circuit or fault current at any point within an electrical installation is the current that would flow in the circuit if no circuit protection operated and a complete (very low impedance) short circuit occurred. The value of this fault current is determined by the supply voltage and the impedance of the path taken by the fault current. Measurement of prospective short circuit current can be used to check that the protective devices within the system will operate within safety limits and in accordance with the safe design of the installation. The breaking current capacity of any installed protective device should be always higher than the prospective short circuit current.

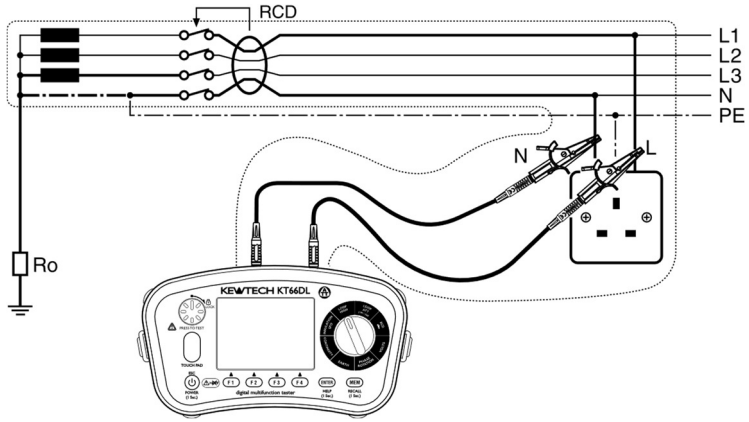


Fig. 11-5

11.2. Measurement method for LOOP high current

LCD display and function switches

F1	Switches measurement mode: L-PE or L-N/L-L
F2	Selects resolution 0.01Ω or 0.001Ω (In case of L-PE)
F3	Selects test lead (0.001ΩRes)
F4	Limit value setting

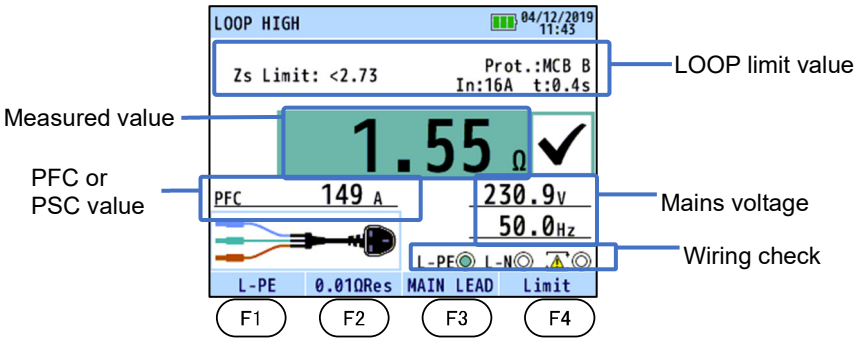


Fig. 11-6

(1) Select LOOP HIGH function with the rotary switch.
(2) Connect the test lead into the tester. (Fig. 11-7 or Fig. 11-8)

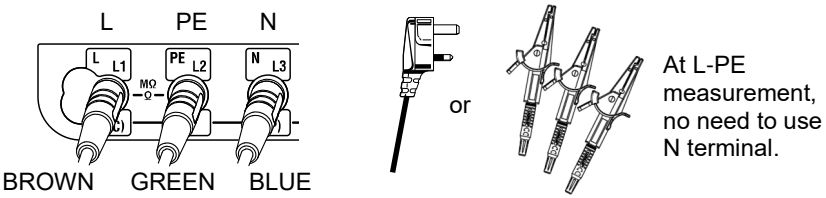


Fig. 11-7 For L-PE and L-N test

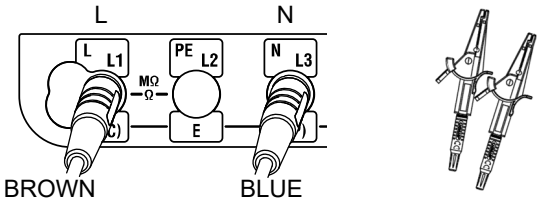


Fig. 11-8 For L-N and L-L test

(3) Press the F1 switch and select L-N to measure L-N/L-L loop impedance or select L-PE to measure earth loop impedance.

- Press F2 switch and select the resolution either 0.01Ω or 0.001Ω at L-PE test.
- Display changes automatically as follows depending on the applied voltages while LOOP(L-N/L-L) is selected.

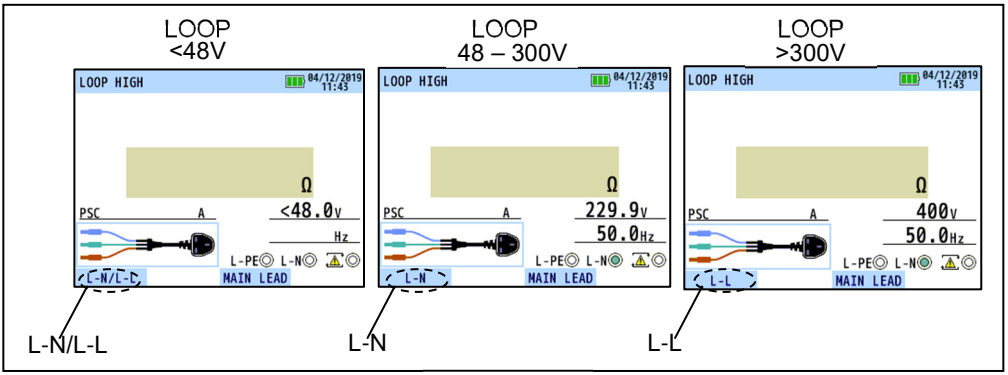


Fig. 11-9

(4) Press F4 switch to enter the setting mode for limit value.
Please refer to “11.4 Loop limit value”.

(5) Connection
Connect the KT66DL to the distribution system to be tested with reference to Fig. 11-12, 11-13, 11-14, and 11-15.

(6) Wiring Check
After the connection, ensure that the symbols for Wiring check on the LCD are in the status indicated in Fig.11-10 before pressing the test switch.

FUNCTION	L-PE ○	L-N ○	⚠ ○
L-PE 0.01ΩRes 0.001ΩRes	●	●	○
		or	
	●	○	○
L-N/L-L	●	●	○
		or	
	○	●	○

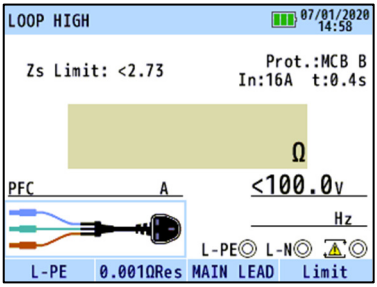
Fig. 11-10

If the status of the symbols for Wiring check differ from Fig.11-10 or ⚠○ symbol is indicated on the LCD, DO NOT PROCEED AS THERE IS INCORRECT WIRING. The cause of the fault must be investigated and rectified.

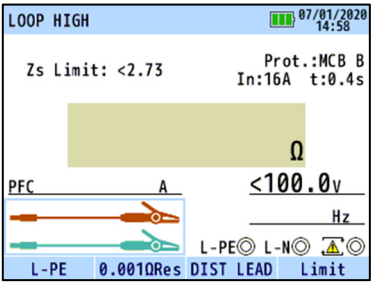
When the tester is first connected to the system, it will display the line-earth voltage (mode L-PE) or line-neutral voltage (mode L-N/ L-L) which is updated every 1s. If this voltage is not normal or as expected, DO NOT PROCEED.

(7) Test lead selection

In case of LOOP HIGH function, use F3 switch to select the test lead to be used. When LOOP HIGH function, the resistance of the test lead to be used affects the measured result; therefore, test lead selection is effective to reduce errors in results. Select either Model Mains test lead (KAMP12) or Distribution board test lead (ACC065).



Mains lead is selected.



Distribution board lead is selected.

Fig. 11-11

(8) Measurement

Press the test switch. A beep will sound as the test is conducted and the value of loop impedance will be displayed. When LOOP limit value has been set, the LCD shows “✓” when the measured value is lower than the limit value and “X” if the value exceeds the limit value. The " ! " symbol appears when the measured result exceeds the measuring range, and the upper limit of the measuring range is smaller than the reference value: it means unjudgeable.

● If the display shows '>' then this usually means the value measured exceeds the range.

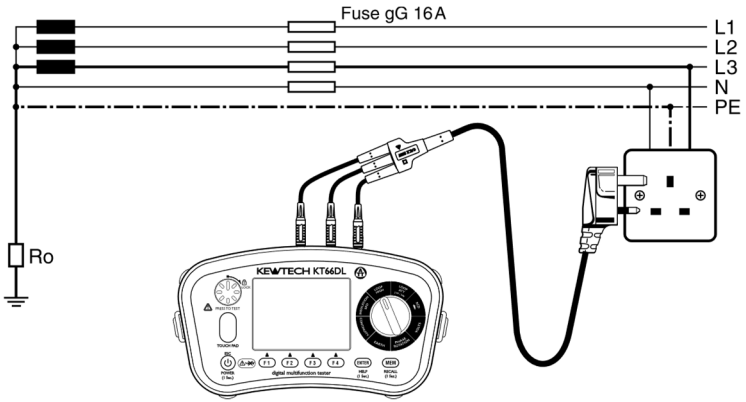


Fig. 11-12 Connection for using socket

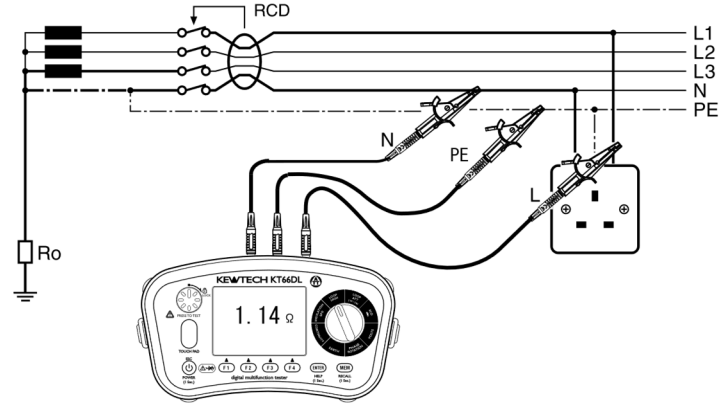


Fig. 11-13 Connection for distribution

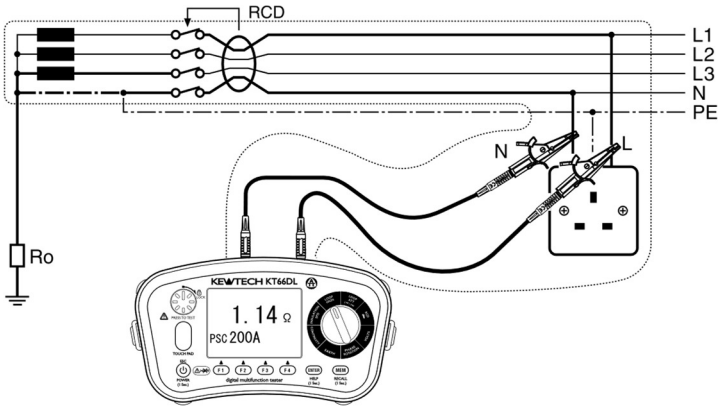


Fig. 11-14 Connection for Line – Neutral measurement

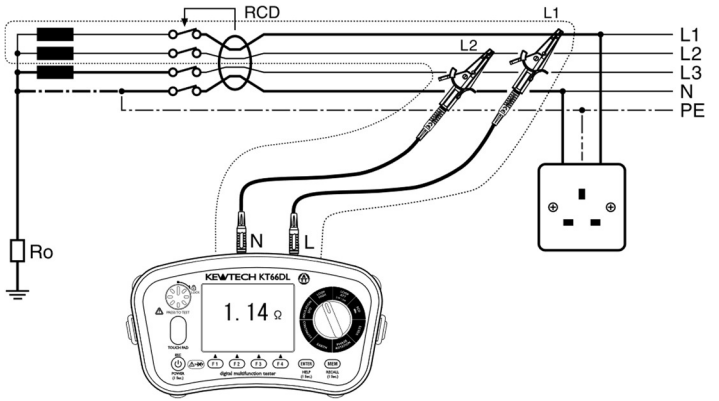


Fig. 11-15 Connection for Line – Line measurement

The test switch may be pressed down and turned clockwise to lock it for auto-mode. In this auto mode, when using distribution board lead set ACC065, tests are conducted by simply disconnecting and reconnecting the brown phase prod avoiding the need to physically press the test switch i.e. 'hands free'.

- Measured result may be influenced depending on the phase angle of the distribution system when making measurement near a transformer and the result may lower than the actual impedance value. Errors in measured result are as follows.

System Phase Difference	Error (approx.)
10°	-1.5%
20°	-6%
30°	-13%

- If the symbol ( )appears, it means that the test resistor is too hot and the automatic cut out circuits have operated. Allow the tester to cool down before proceeding. The overheat circuits protect the test resistor against heat damage.

11.3. Measurement method for LOOP ATT (Anti trip technology)

LCD display and function switches

F1	Switches 3-wire, 3-wire EV & 2 wire Test
F2	Turns on/ off pulse function
F3	Toggles between normal & low current for EVSE loop testing– only shows if L-PE 3W EV is selected at F1
F4	Limit value setting

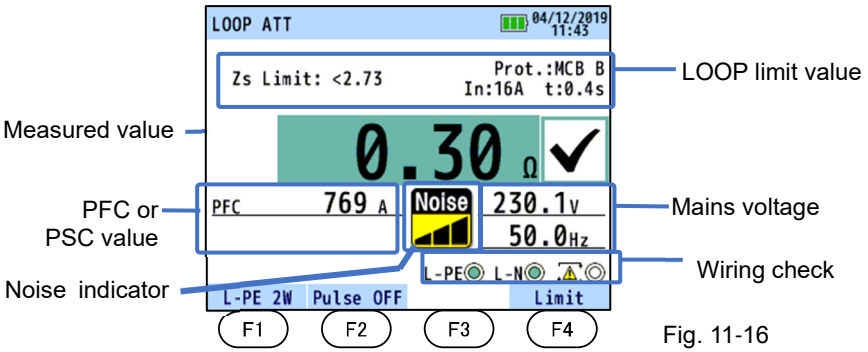


Fig. 11-16

(1) Press the Power switch and turn on the tester. Turn the rotary switch and set it to the LOOP ATT position.

(2) Connect the test lead to the tester. (Fig. 11-17 or Fig. 11-18)

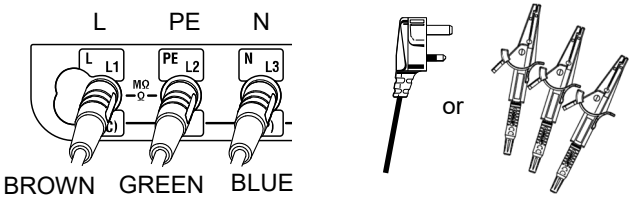


Fig. 11-17 For L-PE 3-wire test

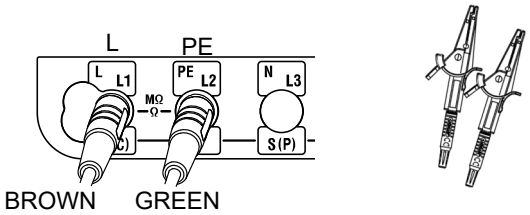


Fig. 11-18 For L-PE 2-wire test

(3) Press F1 switch and select either L-PE 2W (2-wire), L-PE 3W (3-wire) or L-PE 3W EV test.

(4) Pulse function can be turned on or off with F2 switch.
When pulse function is on (enabled), a high current is applied in a short period - RCD won't trip - before starting LOOP measurement. This pulse function can remove the oxidized coating of the circuit under test and contribute to accurate measurements.

⚠CAUTION
When pulse function is enabled, some RCDs may trip depending on their sensitivity. In such a case, turn off the pulse function.

(5) Press F4 switch to enter the setting mode for limit value.
Please refer to "11.4 Loop limit value".

(6) Connection
Connect the KT66DL to the distribution system to be tested with reference to Fig. 11-20, 11-21 and 11-22.

(7) Wiring Check
After the connection, ensure that the symbols for Wiring check on the LCD are in the status indicated in Fig.11-19 before pressing the test switch.

FUNCTION	L-PE ○	L-N ○	⚠ ○
L-PE 3W (EV)	●	●	○
L-PE 2W	●	○	○

Fig. 11-19

If the status of the symbols for Wiring check differ from Fig. 11-19 or the ⚠O symbol is indicated on the LCD, DO NOT PROCEED AS THERE IS INCORRECT WIRING. The cause of the fault must be investigated and rectified.

When the tester is first connected to the system, it will display the line-earth voltage (mode L-PE) which is updated every 1s. If this voltage is not normal or as expected, DO NOT PROCEED.

(8) Measurement

Press the test switch. A beep will sound as the test is conducted and the value of loop impedance will be displayed. When LOOP limit value has been set, the LCD shows "✓" when the measured value is lower than the limit value and "X" if the value is higher than the limit value. The " ! " symbol appears when the measured result exceeds the measuring range, and the upper limit of the measuring range is smaller than the reference value: it means unjudgeable.

●If the display shows '>' then this usually means the value measured exceeds the range.

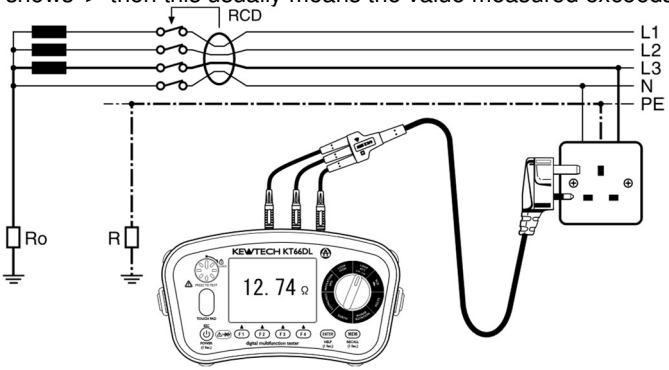


Fig. 11-20 3-wire test (Connection for using outlet)

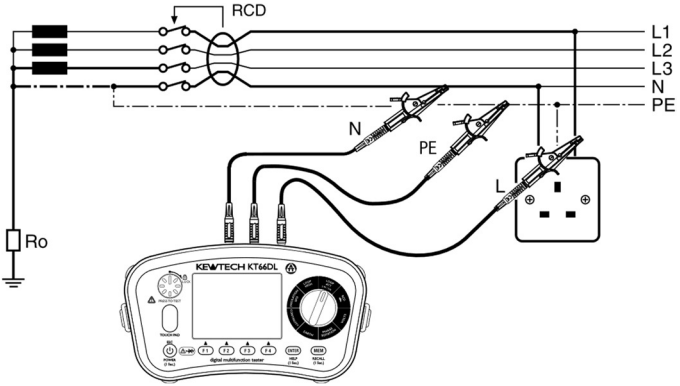


Fig. 11-21 3-wire test (Connection for distribution)

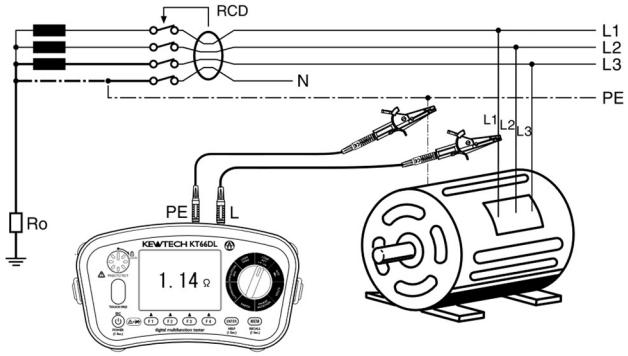


Fig. 11-22 L-PE 2-wire test

● ATT mode enables a measurement without tripping the RCDs with the rated residual current of 30mA or more.

● The L-PE 3W EV setting enables loop testing where sensitive DC monitoring devices are used. Press F 3 to select the test current.

● Measurement in ATT mode requires longer time than that is required for the other measurements (approx. 8 sec). When measuring a circuit with a large electrical noise, the 'Noise' Message is displayed on the LCD and the measurement time will be extended. Noise indicator shows the noise size in three levels. Noise size affects the measurement Time.

Level 1 Level 2 Level 3 Fig. 11-23 Noise indicator

● At L-PE 3W (EV) measurement, when a LOOP impedance between L-N exceeds 20Ω, the LCD shows “L-N>20Ω” and the tester will not make measurements. In this case, set the range to “LOOP HIGH” or test with L-PE 2W ATT.

● If a high voltage exists between N-PE at L-PE 3W (EV) test, the LCD shows “**N-PE HiV**” and the tester will not make measurements. In this case set the range to “LOOP HIGH” or test with L-PE 2W ATT.

The test switch may be turned clockwise to lock it down. In this auto mode, when using the distribution board lead set ACC065, tests are conducted by simply disconnecting and reconnecting the brown phase prod avoiding the need to physically press the test switch i.e. 'hands free'.

- Measured result may be influenced depending on the phase angle of the distribution system when making measurement near a transformer and the result may lower than the actual impedance value. Errors in measured result are as follows.

System Phase Difference	Error (approx.)
10°	-1.5%
20°	-6%
30°	-13%

- If the symbol ( )appears, this means that the test resistor is too hot and the automatic cut out circuits have operated. Allow the tester to cool down before proceeding. The overheat circuits protect the test resistor against heat damage.

11.4 Loop limit value

To set a loop limit value, press F4 switch in the stand-by mode at LOOP test. The following figure shows the setting mode screen.

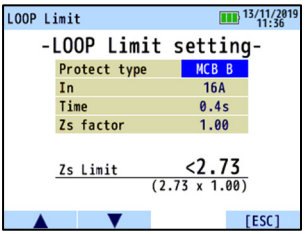


Fig. 11-24 LOOP LIMIT setting screen

・The table below shows the setting parameters.

(a) Protection type	Type of protective device	MCB: B C, D, Type 1, 2, 3, 4 Fuse 88.2, 88.3, 3036, 1362, 1361, RCD
(b) In	Rated current of protective device	In: 6 - 100 A IΔn: 30 mA-1000 mA
(c) Time or Uc	Trip time of protective device	For RCD, Uc limit value setting
(d) Factor	Margin of threshold value	X 1 or 0.8 (80%)

Limit value setting procedures are shown below.
(Press ESC switch to step back one during the process.)

(1) Press F1(▲) or F2(▼) on LOOP LIMIT setting screen to move the cursor on the item to be set, and then press ENTER switch.
(2)The LCD shows the selectable items. Press F1(▲) or F2(▼) and confirm the selection with ENTER switch. For some items, F3(◄) and F4(►) switches are also used.
(3) When changes are done, press ESC to return to LOOP test screen.

Selectable parameters and reference values for limit value are as shown below.

• Loop Limit value for fuse protection

Protection type	BS88-2 Fuse ref BS7671:2008 (2015)				BS88-3 Fuse ref BS7671:2008 (2015)			
Rating (A)	0.4s	5s	0.4s @80%Z	5s @80%Z	0.4s	5s	0.4s @80%Z	5s @80%Z
	Zs(Ω)	Zs(Ω)	Zs(Ω)	Zs(Ω)	Zs(Ω)	Zs(Ω)	Zs(Ω)	Zs(Ω)
5	---	---	---	---	9.93	14.60	7.94	11.68
6	7.80	12.00	6.24	9.60	---	---	---	---
10	4.65	6.80	3.72	5.44	---	---	---	---
16	2.43	4.00	1.95	3.20	2.30	3.90	1.84	3.12
20	1.68	2.80	1.35	2.24	1.93	3.20	1.54	2.56
25	1.29	2.20	1.03	1.76	---	---	---	---
32	0.99	1.70	0.79	1.36	0.91	1.60	0.73	1.28
40	---	1.30	---	1.04	---	---	---	---
45	---	---	---	---	---	1.00	---	0.80
50	---	0.99	---	0.79	---	---	---	---
63	---	0.78	---	0.62	---	0.68	---	0.55
80	---	0.55	---	0.44	---	0.51	---	0.41
100	---	0.42	---	0.34	---	0.38	---	0.30

Protection type	BS3036 ref BS7671:2008 (2015)				BS1362 ref BS7671:2008 (2015)			
Rating (A)	0.4s	5s	0.4s @80%Z	5s @80%Z	0.4s	5s	0.4s @80%Z	5s @80%Z
	Zs(Ω)	Zs(Ω)	Zs(Ω)	Zs(Ω)	Zs(Ω)	Zs(Ω)	Zs(Ω)	Zs(Ω)
3	---	---	---	---	15.60	22.0	12.48	17.60
5	9.10	16.80	7.28	13.44	---	---	---	---
13	---	---	---	---	2.30	3.64	1.84	2.91
15	2.43	5.08	1.94	4.07	---	---	---	---
20	1.68	3.64	1.35	2.91	---	---	---	---
30	1.04	2.51	0.83	2.01	---	---	---	---
45	---	1.51	---	1.21	---	---	---	---
60	---	1.07	---	0.86	---	---	---	---
100	---	0.51	---	0.41	---	---	---	---

Protection type	BS1361 ref BS7671:2008 (2015)			
Rating (A)	0.4s	5s	0.4s @80%Z	5s @80%Z
	Zs(Ω)	Zs(Ω)	Zs(Ω)	Zs(Ω)
5	10.36	16.25	8.28	13.00
15	3.26	4.96	2.61	3.97
20	1.69	2.78	1.35	2.23
30	1.14	1.82	0.91	1.46
45	0.57	0.95	0.46	0.76
60	---	0.69	---	0.55
80	---	0.49	---	0.40
100	---	0.36	---	0.29

●Loop Limit value for RCD protection

	Limit	Uc 50V	Uc 50V @80%Z	Uc 25V	Uc 25V @80%Z	100Ω	100Ω @80%Z	200Ω	200Ω @80%Z
IΔn **(mA)**	30mA	1667Ω	1334Ω	833Ω	666Ω	100.0Ω	80.0Ω	200.0Ω	160.0Ω
	100mA	500Ω	400Ω	250Ω	200.0Ω	100.0Ω	80.0Ω	200.0Ω	160.0Ω
	300mA	167.0Ω	133.6Ω	83.0Ω	66.4Ω	100.0Ω	80.0Ω	---	---
	500mA	100.0Ω	80.0Ω	50.0Ω	40.0Ω	---	---	---	---
	1000mA	50.0Ω	40.0Ω	25.0Ω	20.0Ω	---	---	---	---

Note: Displayed Loop Limit value may not be the same as listed above depending on the countries and regions

	Zs BSEN 60898 MCB & BSEN 61009-1 RCBO table							
	MCB (Disconn. time 0.4 and 5s)		MCB(Disc 0.4s)	MCB(Disc 5s)	MCB (Disconn. time 0.4 and 5s) 80%Z		MCB(Disc 0.4s) 80%Z	MCB(Disc 5s) 80%Z
	B	C	D	D	B	C	D	D
Current rating	Zs(Ω)	Zs(Ω)	Zs(Ω)	Zs(Ω)	Zs(Ω)	Zs(Ω)	Zs(Ω)	Zs(Ω)
6	7.28	3.64	1.82	3.64	5.82	2.91	1.46	2.91
10	4.37	2.19	1.09	2.19	3.50	1.75	0.87	1.75
16	2.73	1.37	0.68	1.37	2.18	1.09	0.55	1.10
20	2.19	1.09	0.55	1.09	1.75	0.87	0.44	0.87
25	1.75	0.87	0.44	0.87	1.40	0.70	0.35	0.70
32	1.37	0.68	0.34	0.68	1.09	0.55	0.27	0.54
40	1.09	0.55	0.27	0.55	0.87	0.44	0.22	0.44
50	0.87	0.44	0.22	0.44	0.70	0.35	0.17	0.35
63	0.69	0.35	0.17	0.35	0.55	0.28	0.14	0.28

	Zs BSEN 3871 MCB table							
	MCB (Disconn. time 0.4 and 5s)				MCB (Disconn. time 0.4 and 5s) 80%Z			
	1	2	3	4	1	2	3	4
Current rating	Zs(Ω)	Zs(Ω)	Zs(Ω)	Zs(Ω)	Zs(Ω)	Zs(Ω)	Zs(Ω)	Zs(Ω)
5	10.93	6.41	4.37	0.87	8.74	5.13	3.50	0.70
6	9.10	5.21	3.64	0.73	7.28	4.16	2.91	0.59
10	5.46	3.10	2.19	0.44	4.37	2.48	1.75	0.35
15	3.64	2.08	1.45	0.29	2.91	1.66	1.16	0.24
16	3.41	1.95	1.37	0.28	2.73	1.56	1.09	0.22
20	2.73	1.56	1.09	0.22	2.18	1.25	0.87	0.17
25	2.19	1.24	0.87	0.17	1.75	1.00	0.70	0.14
30	1.82	1.05	0.73	---	1.46	0.84	0.59	---
32	1.71	0.98	0.68	---	1.37	0.78	0.55	---
40	1.36	0.78	0.55	---	1.09	0.62	0.44	---
50	1.09	0.63	0.44	---	0.87	0.50	0.35	---
63	0.86	0.49	0.35	---	0.69	0.40	0.28	---

12. RCD tests

12.1 Principles of RCD measurement

The RCD tester is connected between phase and protective conductor on the load side of the RCD after disconnecting the load.
A precisely measured current for a carefully timed period is drawn from the phase and returns via the earth, thus tripping the device. The tester measures and displays the exact time taken for the circuit to be opened.
An RCD is a switching device designed for breaking currents when the residual current attains a specific value. It works on the basis of the current difference between phase currents flowing to different loads and returning current flowing through the neutral conductor (for a single-phase installation). In the case where the current difference is higher than the RCD tripping current, the device will trip and disconnect the supply from the load.
There are two parameters for RCDs; the first due to the shape of the residual current wave form (types AC and A) and the second due to the tripping time (types G and S).

- RCD type AC will trip when presented with residual sinusoidal alternating currents whether applied suddenly or slowly rising.
- RCD type A will trip when presented with residual sinusoidal alternating currents (similar to type AC) and residual pulsating direct currents whether suddenly applied or slowly rising.
- RCD Type F will the trip when presented with residual sinusoidal alternating currents at the rated frequency, residual pulsating direct currents and composite residual currents.
  Tests of RCD type F with KT66DL use halfwave rectified current the same as testing Type A RCD.
- RCD type B can detect residual sinusoidal alternating currents up to 1000 Hz, residual pulsating direct currents as well as smooth DC residual currents.
- RCD type G. In this case G stands for general type (without tripping time delay) and is for general use and applications.
- RCD type S where S stands for selective type (with tripping time delay). This type of RCD is specifically designed for installations where the time delay characteristic is required.
- RCD Type EVs are designed specially for EV (electric vehicle) charging systems. They trip by 6mA smooth DC residual currents.

Given that when the protective device is an RCD, Ia is typically 5 times the rated residual operating current IΔn, then the RCD must be tested recommending the tripping time, measured by RCD testers or multifunction testers, shall be lower than the maximum disconnecting times required in IEC 60364-41 at 230V / 400V AC (see also LOOP section) that are:

TT system	200ms	for final circuits up to 63A for socket, or up to 32A for fixed connected loads
TN system	400ms	
TT system	1000ms	for distribution circuits and circuits above mentioned over 63A and 32A.
TN system	5s	

However, it is also good practice to consider even more stringent trip time limits, by following the standard values of trip times at IΔn defined by IEC 61009 (EN 61009) and IEC 61008 (EN 61008). These trip time limits are listed in the table below for IΔn and 5IΔn:

Type of RCD	IΔn	5IΔn
General(G)	300ms max allowed value	40ms max allowed value
Selective(S)	500ms max allowed value	150ms max allowed value
	130ms min allowed value	50ms min allowed value

Examples of tester connections

Practical example of 3-phase + neutral RCD test in a TT system.

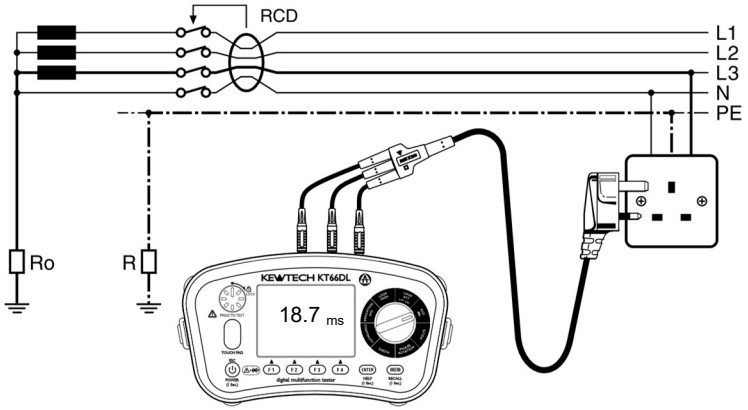


Fig. 12-1

Practical example of single phase RCD test in a TN system.

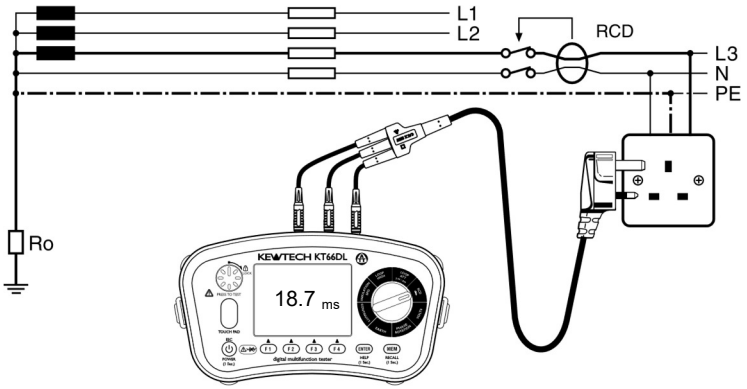


Fig. 12-2

Practical example of RCD test with distribution leads.

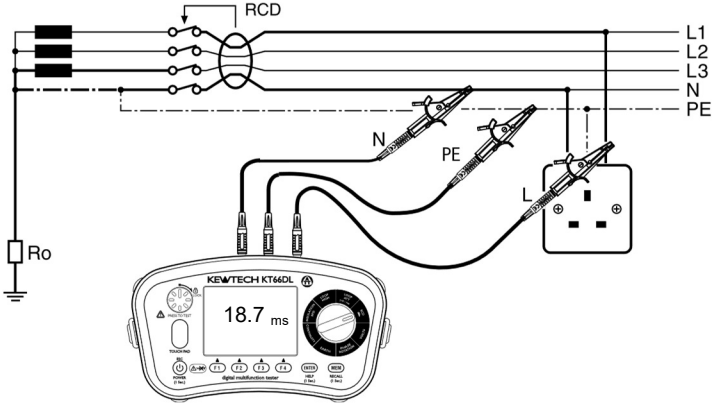


Fig. 12-3

12.2 Principles of Uc measurement

When earth resistance is high as in Fig 12-1, where R exists and if a fault current flows, a potential difference occurs. If a person touches the earthing system then the person will be subjected to this voltage. This is the Uc voltage.

If an RCD is protecting the circuit then the maximum value of Uc can be calculated by multiplying the measured loop by the selected IΔN of the RCD selected.

12.3 Measurement method for RCD

LCD display and function switches

F1	Measurement mode setting (X1/2, X1, X5, Ramp, Auto, Uc)
F2	IΔn setting
F3	RCD Type setting AC-G AC-S A-G A-S F-G B-S B-G TYPE EV
F4	Phase Setting (0º (+) or 180º (-))

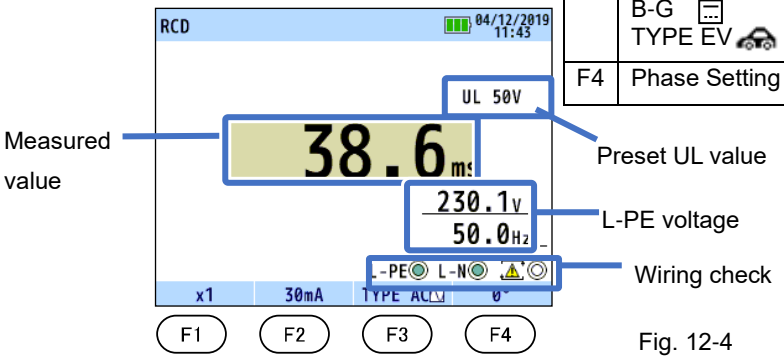


Fig. 12-4

(1) Press the Power switch and turn on the tester. Turn the rotary switch and set it to the RCD position.
(2) Connect the test lead to the tester. (Fig. 12-5)

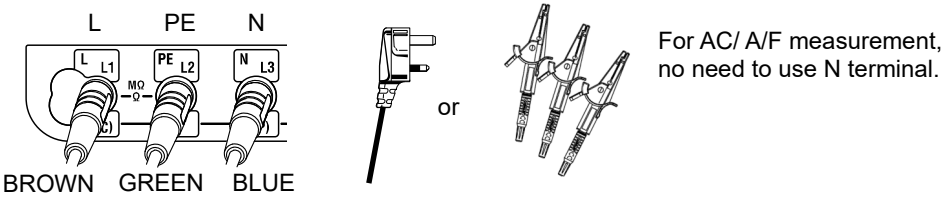


Fig. 12-5 For RCD test

(3) Press the F1 switch and select any desired measurement mode.

X1/2	For testing RCD to verify that they are not too sensitive.
X1	For measuring the trip time.
X5	For testing at IΔn X5
RAMP(◢)	For measuring the tripping level in mA.
AUTO	For automatic measurement in the following sequence: X1/2(0º), X1/2(180º), X1(0º),X1 (180º), X5(0º), X5(180º)
Uc	For measuring Uc

(4) Press the F2 switch to set Rated Tripping Current (IΔn) to the rated trip current of the RCD.
(5) Press F3 switch to select the RCD type.
Refer to "12.1 Principles of RCD measurement" for the details of RCD type.
(Except for Uc measurement)
(6) Press (F4) to select phase at which the test current should start.
(Except for Uc measurement)

***UL value change**
As a UL value, 25V or 50V is selectable. Refer to ”6. Setup mode” in this manual and select either of them.

(7) Connect the test leads to the circuit to be tested. (Fig. 12-1,12-2, and 12-3)
(8) Wiring Check
After the connection, ensure that the symbols for Wiring check on the LCD are in the status indicated in Fig.12-6 before pressing the test switch.

RCD TYPE	L-PE ○	L-N ○	⚠ ○
AC/A/F	●	●	○
		or	
	●	○	○
B/EV	●	●	○

Fig. 12-6

If the status of the symbols for Wiring check differ from Fig. 12-6 or ⚠O symbol is indicated on the LCD, DO NOT PROCEED AS THERE IS INCORRECT WIRING. The cause of the fault must be investigated and rectified.

When the tester is connected to the system for the first time, it will display the line-earth voltage (mode L-PE) which is updated every 1s. If this voltage is not normal or as expected, DO NOT PROCEED.

NOTE: This is a single phase (230V AC) tester and under **no circumstances** should it be connected to 2- phases or a voltage exceeding 230VAC+10%.
If the input voltage is greater than 260V the display will indicate '>260V' and RCD measurements can not be made even if the test switch is pressed.

(9) RCD Measurement

Press the test switch. A beep will sound as the test is conducted and the measured results are displayed.

- X1/2.....The Breaker should not trip.
- X1.....The Breaker should trip.
- X5.....The Breaker should trip.
- Auto Ramp( )..The Breaker should trip. The tripping current should be displayed.
- Uc.....Uc values are displayed.

In case of RCD type S test, you need to wait 30 sec. before starting a test: this waiting time is to reduce the influence of the previous test.

(10) Press the F4(0°(+)/180°(-)) switch to change the phase and repeat step (1).

> The test switch may be turned clockwise to lock it down. In this auto mode, when using distribution board lead set ACC065, tests are conducted by simply disconnecting and reconnecting the brown phase prod of the avoiding the need to physically press the test switch i.e. 'hands free'.

- If the symbol ( )appears, this means that the test resistor is too hot and the automatic cut out circuits have operated. Allow the tester to cool down before proceeding. The overheat circuits protect the test resistor against heat damage.
- Be sure to return the tested RCD to the original condition after the test.
- When the Uc voltage rises to UL value or greater, the measurement is automatically suspended and "Uc > UL" is displayed on the LCD.
- If " IΔn" setting is greater than the rated residual current of the RCD, the RCD will trip and "no" may be displayed on LCD.
- If a voltage exists between the protective conductor and earth, it may influence the measurements.
- If a voltage exists between neutral and earth, it may influence the measurements, therefore, the connection between neutral point of the distribution system and earth should be checked before testing.
- If leakage currents flow in the circuit following the RCD, it may influence the measurements.
- The potential fields of other earthing installations may influence the measurement.
- Special conditions of RCDs of a particular design, for example S- type, should be taken into consideration.
- The earth electrode resistance of a measuring circuit with a probe shall not exceed the earth electrode resistance values, specified in the table below RCD-related description, in 5.4 Operating uncertainty .
- Equipment following the RCD, e.g. capacitors or rotating machinery, may cause a significant lengthening of the measured trip time.

12.4 Auto test

Measurements are automatically performed under the Auto Test function in the following sequence: X1/2(0º), X1/2(180º), X1(0º),X1 (180º), X5(0º), X5(180º).

(1) Press F1 to select Auto.
(2) Press F2 & F3 to select IΔn & RCD type.
(3) The KT66DL performs an RCD test in the sequence described above.
(4) When an RCD trips, turn it back on. Then a next test begins automatically.
(5) The LCD shows results as follows.

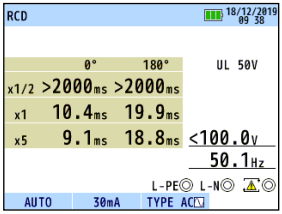


Fig. 12-7

12.5 VAR (variable current value) function

At RCD test, any IΔn value – between 10mA and 1000mA - is selectable. However, X 5 test or depending on the selected RCD test settings, variable range of current value will be limited.

Follow the procedures below to change the current value.
(Pressing ESC switch during the changing process moves one step back.)
(1) Press F1 & F3 to select measurement mode & RCD type.
(2) Press F2 switch to select “VAR”.
(3) The LCD shows current value 2 sec. (Fig. 12-8). Press F1 (SET) switch within this 2 sec. (If 2 sec or longer are elapsed without pressing the switch, press F2 switch again to reshow Fig. 12-8 screen.)
(4) The LCD shows current value changing screen (Fig. 12-9). Press F3(◄) or F4(►) to select the digit to be changed and alter the values with F1(▲) or F2(▼).
(5) Press ENTER to confirm the change. Then the screen returns to stand-by mode for RCD test.

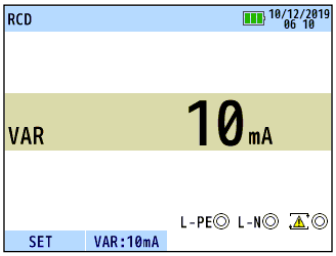


Fig. 12-8

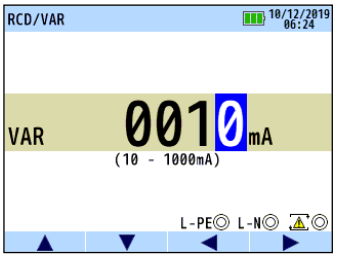


Fig. 12-9

Note: At VAR test, X1/2, X1, and X5 tests are performed; these tests are not available at Uc, AUTO, and RAMP tests.

12.6 EV RCD

When selecting “EV” for RCD TYPE, the tester can test RCDs for EV charger which trip by 6 mA DC: x1, RAMP(◢), and AUTO TEST are selectable.

- At RAMP, current is steadily increased up to 6 mA DC (100%).
  When it reaches to 6 mA DC, the current is kept for 10 sec. (Comply with IEC62752)
- At AUTO TEST, the tester performs tests at 6 mA DC and ×1/2, ×1, and ×5 tests at 30 mA A as shown below.

DC6mA(+) → DC6mA(-) → X1/2(0º) → X1/2(180º)

→ X1(0º) → X1(180º) →X5(0º) → X5(180º).

Type A 30mA

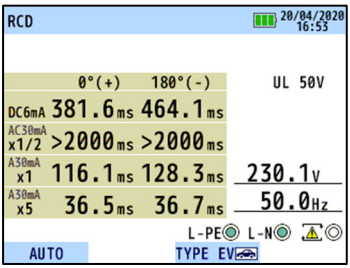


Fig. 12-10

13. Earth tests

13.1 Principles of earth measurement

This tester performs the earth resistance measurement with the fall-of-potential method, which is a method to obtain earth Resistance value Rx by applying AC constant current I between the measurement object E (earth electrode) and H(C) (current electrode), and finding out the potential difference V between E and S(P) (potential electrode).
Rx = V / I

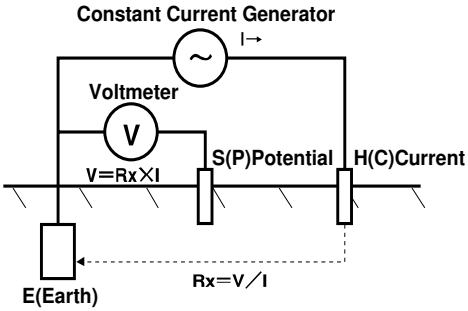


Fig.13-1

13.2 Earth resistance measurement

⚠ WARNING

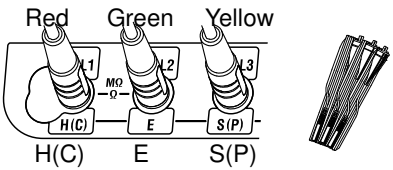
The tester will produce a maximum voltage of about 50V between terminals E-H(C) in earth resistance function. Take enough caution to avoid electric shock hazard.

⚠ CAUTION

When measuring earth resistance, do not apply voltage between measuring terminals.

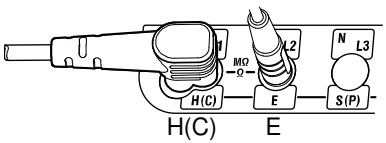
13.3 Measurement method for earth

(1) Press the Power switch and turn on the tester. Turn the rotary switch and set it to the EARTH position.
(2) Press F1 switch to select 3W (3-wire precise measurement) or 2W (2-wire simplified measurement).
(3) Connect the test lead into the tester. (Fig. 13-2, Fig. 13-3)



H(C) terminal Red test lead
E terminal Green test lead
S(P) terminal Yellow test lead

Fig.13-2 For 3W test (Precise measurement)



H(C) terminal Red test lead , or ACC064SPN Remote Test Lead
E terminal Green test lead

Fig.13-3 For 2W test (Simplified measurement)

(4)Connection

3W test (Precise measurement)

Stick the auxiliary earth spikes S(P) and H(C) into the ground deeply. They should be aligned at an interval of 5-10m from the earthed equipment under test. Connect the green test lead to the earthed equipment under test, the yellow test lead to the auxiliary earth spike S(P) and the red test lead to the auxiliary earth spike H(C) from terminals E, S(P) and H(C) of the tester in order.

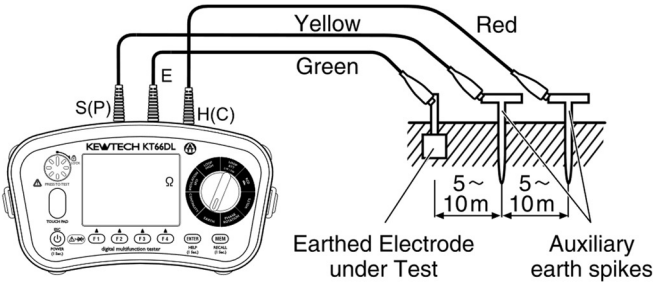


Fig.13-4

Note:

- Make sure to stick the auxiliary earth spikes in the moist part of the soil. Give enough water where the spikes have to be stuck into the dry, stony or sandy part of the earth so that it may become moist.
- In case of concrete, lay the auxiliary earth spike down and water it, or put a wet dust cloth etc. on the spike when making measurement.

2W test (Simplified measurement)

Use this method when the auxiliary earth spike cannot be used. In this method, an existing earth electrode with a low earth resistance, such as a metal water pipe, a common earth of a commercial power supply and an earth terminal of a building, can be used with two-pole method.

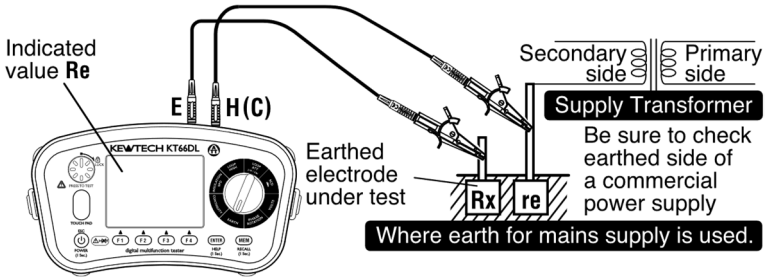


Fig.13-5

Rx = Re – re

Rx: True earth resistance

Re: Indicated value

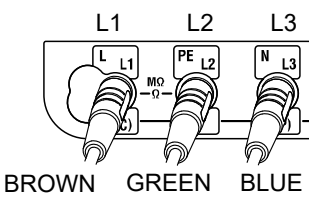
re: Earth resistance of earth electrode

(5) If the “Live” warning is displayed on the LCD and/or the buzzer sounds, **do not press the test switch** but disconnect the tester from the circuit. Make the circuit dead before proceeding.
(6) Press the test switch, the display will show the earth resistance of the circuit.

- If measurement is made with the probes twisted or in touch with each other, the reading of the tester may be affected by induction. When connecting the probes, make sure that they are separated.
- If the earth resistance of auxiliary earth spikes is too large, it may result in inaccurate measurement. Make sure to stick the auxiliary earth spikes in the moist part of the soil, and ensure sufficient connections between the respective connections. High auxiliary earth resistance may exist if “R_S Hi” or “R_H Hi” is displayed during measurements. (”Rs Hi” is displayed only when you press the test button to start a measurement. It won’t appear if any incidents, such as auxiliary earth spikes are disconnected, happen during a measurement,)
- When an earth voltage of 10V or higher (400Hz: 3V) exists, measured earth resistances may include large errors. In this case, power off the devices which is using earth resistance under test to reduce the earth voltages.

14. Phase rotation tests

1. Press the Power switch and turn on the tester. Turn the rotary switch and select the PHASE ROTATION function.
2. Insert the test leads into the tester. (Fig.14-1)



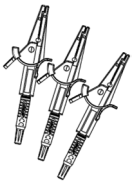


Fig. 14-1

3. Connect each test leads to a circuit. (Fig.14-2)

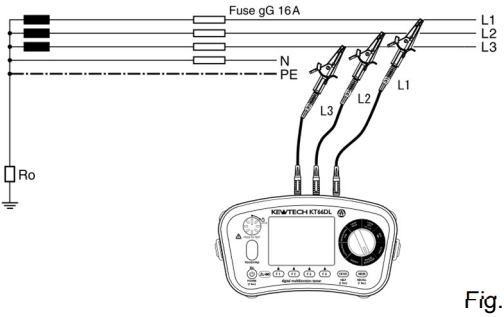


*Fig.*14-2

4. Results are displayed as follows.

Phase sequence (Clockwise)

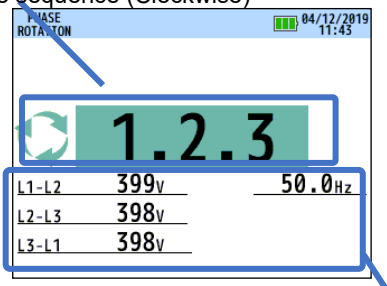


Fig. 14-3 Correct phase sequence

Phase sequence (Counter-clockwise)

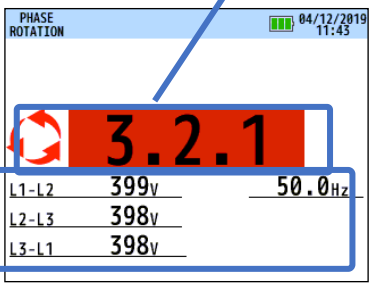


Fig.14-4 Reversed phase sequence

Voltage across the terminals and Frequency of L1-L2 voltage

- When a message “No 3-phase system” or “---” is displayed, the circuit may not be a 3-phase system or a wrong connection may have been made. Check the circuit and the connection.
- Presence of harmonics in measurement voltages, such as an inverter power supply, may influence the measured results.

15. Volts

(1) Press the Power switch and turn on the tester. Turn the rotary switch and select the VOLTS function.
(2) Insert the test leads into the tester. (Fig.15-1)

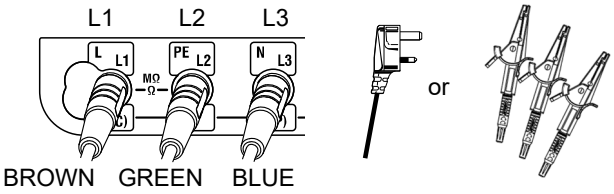


Fig.15-1

(3) Voltage value and frequency will be displayed on the LCD when applying AC voltage.
Note : A message “DC V” may be displayed when measuring AC voltages with frequencies out of the range 45Hz - 65Hz.

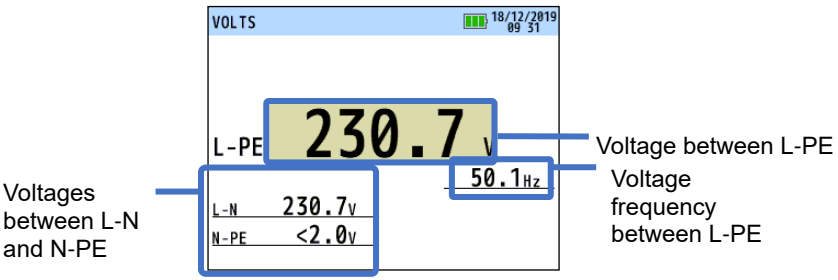


Fig. 15-2

16. Touch pad

(1) The touch pad measures the potential between the operator and the tester’s PE terminal. A message “PE HiV” is displayed on the LCD with the audible buzzer if a potential difference of 100V or more is present between the operator and the PE terminal at touching the Touch pad.
(2) Touch Pad function can be enabled and disabled (ON / OFF).
See ”6. Setup mode” in this manual and select ON or OFF. In case that OFF is selected, a warning for “PE HiV” does not appear and the buzzer does not sound.
* Initial setting: ON

Note : A message “PE HI V” may be displayed when testing inverters or measuring voltages containing high frequencies even if a user isn’t touching with the Touch Pad.

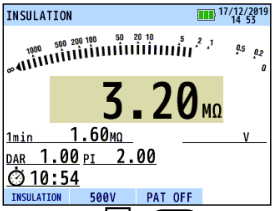
17. Memory function

Measured result at each function can be saved in the memory of the tester.
(MAX: 1000)

17.1 How to save the data

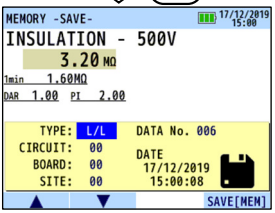
Save the result according to following sequence.
(Press ESC switch during the process to one step back.)

(1) When measurement is done, press MEM switch to enter the save mode. (Fig. 17-2)



MEM

Fig.17-1



MEM

Fig.17-2

Data is saved.

(2) Make setting for following items.

In case of PAT test (Insulation or Continuity function)	Other
1.ID No 2.SITE No. 3.APPLIANCE CODE 4.DATE No	1.TYPE 2.CIRCUIT No 3.BOARD No 4.SITE No 5.DATA No

- Press the F1(▲) or F2(▼) switch to choose the parameter to change.
  In case of PAT test :
  ID No → SITE No → APPLIANCE CODE → DATA No →ID No…..
  Other : TYPE → CIRCUIT No → BOARD No → SITE No → DATA No → TYPE…..

- Press ENTER switch to select the parameter to be changed.
- Use F1(▲) or F2(▼) to alter the value of the parameter and confirm with ENTER switch. The selectable range is shown in the table below.

Type	Depending on test function
ID No	0-99
APPLIANCE CODE	0-99
CIECUIT No.	0-99
BOARD No.	0-99
SITE No.	0-99
DATA No.	0-999

TYPE Selection	
Continuity	r1, r2, rn, R1+R2, R2
Insulation	L/L, L/N, L/E, N/E
Loop (L-PE)	Zs, Ze
RCD	1st RCCB, 2nd RCCB, 3rd RCCB, RCBO

(3) A press of F4 or MEM switch saves the measured data.
Note: Pressing ESC switch moves one step back.

17.2 Recall the saved data

Save data can be displayed on the LCD according to the following sequence.
(Pressing ESC switch during the adjustment moves one step back.)

(1) Hold down MEM switch 1 sec in stand-by mode enters RECALL mode and the LCD shows a list of the save data. (Fig. 17-3)

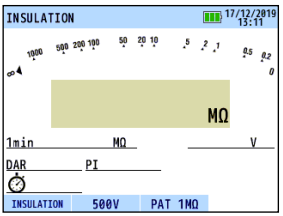


Fig.17-3

MEM

(2) Press ▲(F1) or ▼(F2) switch and select the data you wish to review, and then press ENTER. (Fig. 17-4)

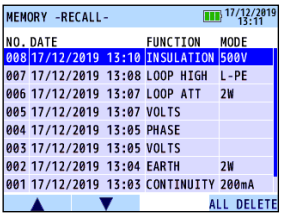


Fig.17-4

ENTER

(3)The selected data will be displayed. (Fig. 17-5)

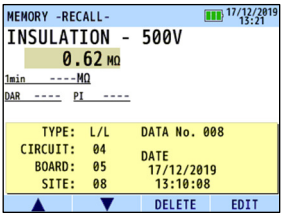


Fig.17-5

(4) Press F4 (EDIT) switch to edit the parameters that have been set at saving. The LCD display will be as follows. Change the parameters - procedures are the same as the saving data – and overwrite and save again; however, DATA No. is unchangeable.

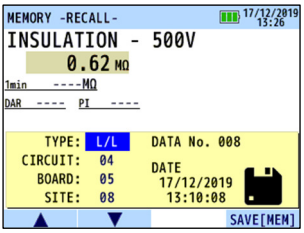


Fig.17-6

17.3 Delete the saved data

(1) To delete the saved data:

Press F3 switch in the state as Fig. 17-5 shows to delete data.
Confirmation message appears as shown below.
Press F3 switch to delete data.

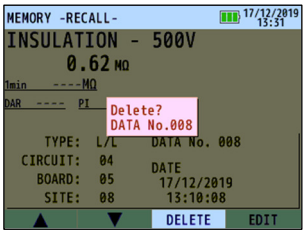


Fig.17-7

(2) To delete whole data:

Press F4 switch in the state as Fig. 17-4 shows to delete all data.
Confirmation message appears as shown below.
Press F4 switch to delete all data.

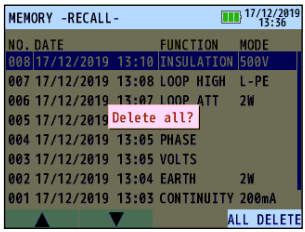


Fig.17-8

18 Transfer the stored data to PC

The stored data can be transferred to PC via Optical Adapter Model 8212USB

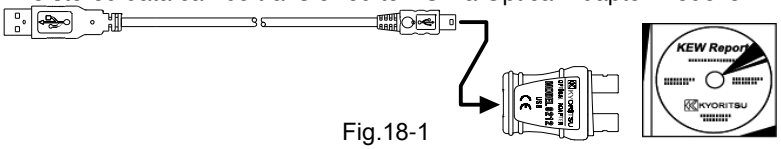


Fig.18-1

● How to transfer the data:

(1) Connect Model 8212USB to the USB Port of a PC. (Special driver for Model 8212USB should be installed. See the instruction manual for Model 8212USB for further details.)

(2) Insert Model 8212USB into the KT66DL as shown in Fig 18-2. Test leads should be removed from the KT66DL at this time.

(3) Power on the KT66DL. (Any function is OK.)

(4) Start special software "KEW Report" on your PC and set the communication port. Then click "Download" command, and the data in the KT66DL will be transferred to your PC. Please refer to the instruction manual of Model 8212USB and HELP of KEW Report for further details.

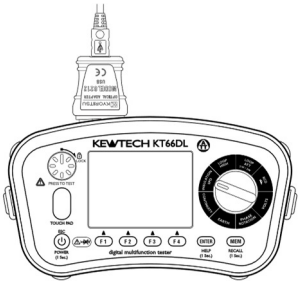


Fig.18-2

Note: Use "KEW Report" version 2.90 or later.
The latest "KEW Report" can be downloaded from our web site.

19. Auto-power-off

This tester has auto-power-off function.
When the tester is inactive for about 10 minutes, it turns off automatically.

Auto-power-off function doesn't work during a measurement, while applying voltage.

If there's no key operation for 2 min, backlight will dim automatically. Pressing any key restores the brightness.

20. Battery and fuse replacement

⚠ DANGER

- Do not open the battery compartment cover if the tester is wet.
- Do not replace batteries nor fuse during a measurement. To avoid getting electrical shock, power off the tester and disconnect all test leads before replacing batteries or fuse.
- The battery compartment cover must be closed and screwed before making measurement.

20.1 Battery replacement

Replace batteries with new ones when the battery indicator shows "▭"; battery level is almost empty.

⚠ CAUTION

- Do not mix new and old batteries nor different types of batteries.
- Install batteries in correct polarity as marked inside.

(1) Power off the tester and disconnect all test leads from the terminals.
(2) Unscrew two screws and remove the battery compartment cover. (Fig. 20-1)
(3) Replace all eight batteries with new ones at once. Observe correct polarity when inserting new batteries, Battery: Size AA Alkaline battery (LR6) x 8 pcs.
(4) Attach the battery compartment cover, and secure it with the two screws,

Note:
Clock setting will be cleared if no batteries were inserted in the tester for 10 min. or longer. When battery replacement is required, be careful not to exceed this period. If the clock setting is cleared and restored to the default, please do the setting again.

20.2 Fuse replacement

The continuity test circuit is protected by a 600V 0.5A HRC ceramic type fuse situated in the battery compartment, together with a spare.

Fuse : F 0.5A 600V (Φ6.3 x 32mm)
SIBA 7009463.0,5

● Procedures

(1) If the tester fails to operate in the continuity test mode, first disconnect the test leads from the tester.
(2) Unscrew two screws and remove the battery compartment cover. (Fig. 20-1)
(3) Take out the fuse and check for continuity with another continuity tester. If the fuse has blown, replace it with the spare fuse.
(4) Attach the battery compartment cover, and secure it with the two screws,

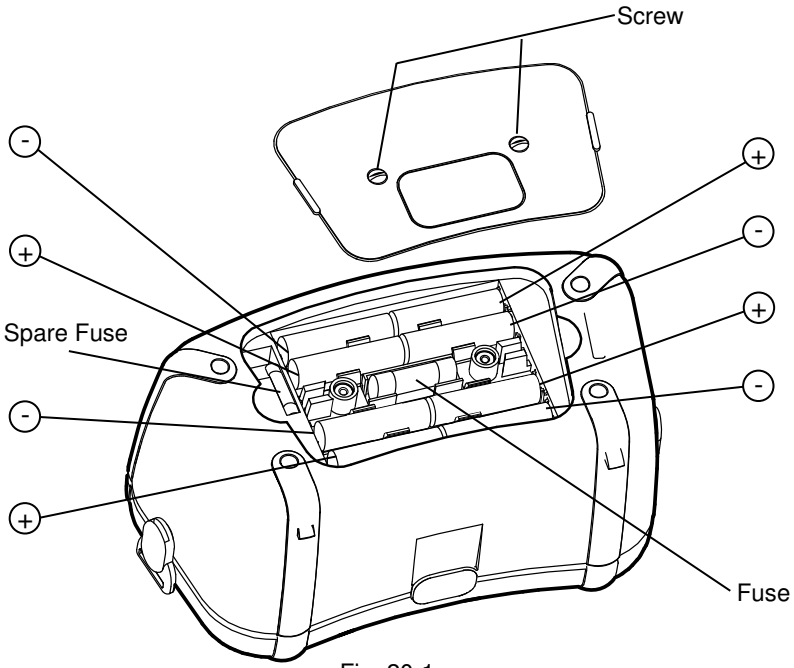


Fig. 20-1

21. Servicing

If this tester should fail to operate correctly, return it to your distributor or directly to Kewtech stating the exact nature of the fault. Before returning the tester ensure that:

(1) The leads have been checked for continuity and signs of damage.
(2) The continuity mode fuse (situated in the battery compartment) has been checked.
(3) The batteries are in good condition.

Please remember to give all the information possible concerning the nature of the fault, as this will mean that the tester will be serviced and returned to you more quickly.

22. Case and strap assembly

Attach the strap belt according to the following procedures. By hanging the tester around the neck, both hands will be left free for testing.

(1) Attach the Buckle to the KT66DL as shown in Fig.22-1.

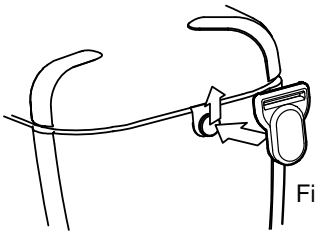


Fig. 22-1

Match the hole of the Buckle and the protrusion at the side face of the KT66DL and slide it upwards.

(2) How to attach the shoulder pad:

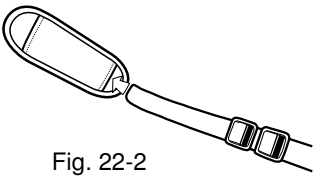


Fig. 22-2

Lead the shoulder pad through the strap belt.

(3) How to install the strap belt:

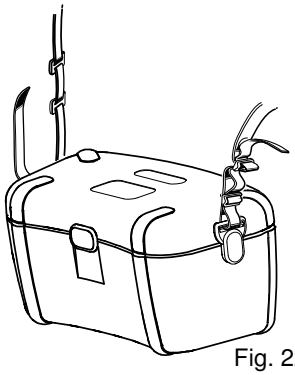


Fig. 22-3

Pass the strap belt down through the buckle from the top, and up.

(4) How to fasten the strap belt:

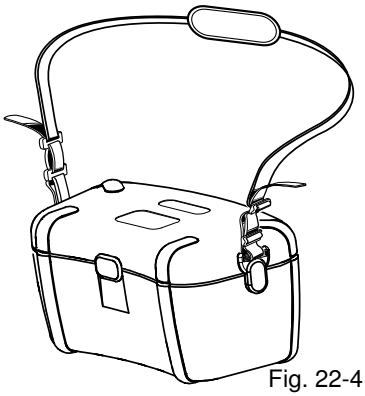


Fig. 22-4

Pass the strap through the buckle, adjust the strap for length and secure.

KEWTECH

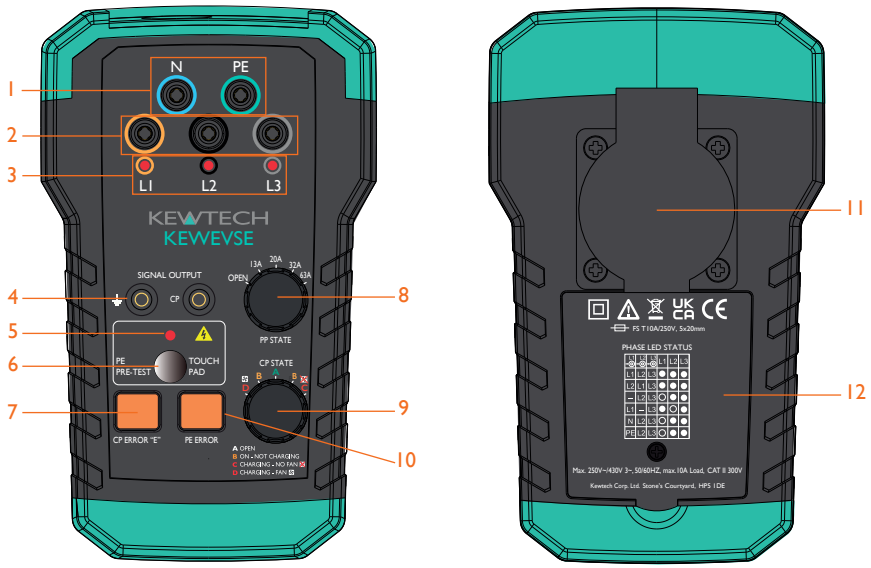
KEWEVSE

EVSE Adapter

Operating Instructions

kewtechcorp.com

Operation elements and connectors



1. Measuring terminals N, PE
2. Measuring terminals L1, L2, L3
3. Phase indicator LEDs for L1, L2, L3 terminals
4. PE and CP Signal output terminals
5. PE Pre-Test warning light indicator
6. PE Pre-Test touch pad
7. "E" - CP Error simulation button
8. PP (Proximity Pilot) State rotary switch selector (open, 13A, 20A, 32A and 63A)
9. CP (Control Pilot) State rotary switch selector (A, B, C, D)
10. PE Error (Earth Fault) simulation button
11. Mains socket. Use for test purpose only. Allowed current max. 10 A
12. Mains socket fuse compartment.

Adapter is equipped with 50cm cable with type 2 EVSE connector.

Safety information and explanation of symbols used

References marked on instrument or in instruction manual.

Warning of a potential danger, read before use and follow the instruction manual when using this instrument.

Reference! Please use utmost care.

Caution! Dangerous voltage. Danger of electrical shock.

Ground / earth terminal.

Continuous double or reinforced insulation category II IEC 536 / DIN EN 61140.

Conformity symbol, the instrument complies with the valid directives. It complies with the EMC Directive (2014/30/EU), Standard EN 61326 is fulfilled. It also complies with the Low Voltage Directive (2014/35/EU) Standards EN 61010-1 and EN 61010-031.

UK conformity mark.

Instrument fulfils the standard (2012/19/EU) WEEE. This marking indicates that this product should not be disposed with other household wastes throughout the EU.

To prevent possible harm to the environment or human health from uncontrolled waste disposal, recycle it responsibly to promote the sustainable reuse of materialresources. To return your used device, please use the return and collection systems orcontact the retailer where the product was purchased. They can take this product forenvironmental safe recycling.

The respective accident prevention regulations established by the professional associations for electrical systems and equipment must be strictly met at all times.

In order to avoid electrical shock, the valid safety and VDE regulations regarding excessive contact voltages must receive utmost attention, when working with voltages exceeding 120V (60V) DC or 50V (25V)rms AC. The values in brackets are valid for limited ranges (as for example medicine and agriculture).

Measurements in dangerous proximity of electrical systems are only to be carried out in compliance with the instructions of responsible electronically skilled technicians, and never alone.

If the operator's safety is no longer ensured, the instrument is to be put out of service and protected against use. Safety is no longer ensured, if the instrument:

- shows obvious damage.
- does not carry out the desired measurements.
- has been stored for too long under unfavourable conditions.
- has been subjected to mechanical stress during transport.

The instrument may only be used within the operating ranges as specified in the technical data section.

Avoid any heating up of the instrument by direct sunlight to ensure perfect functioning and long instrument life.

The opening of the instrument for fuse replacement, for example, may only be carried out by professionals. Prior to opening, the instrument has to be switched off and disconnected from any current circuit.

The instrument may only be used under those conditions and for those purposes for which it was conceived. For this reason, in particular the safety references, the technical data including environmental conditions and the usage in dry environments must be followed.

When modifying or changing the instrument, the operational safety is no longer ensured.

Testing of the charging station

PE Pre-Test
Prior to all other tests the PE pre-test must be successfully carried out. Never touch PE terminals at the mains socket on the back of the adapter before the PE pre-test is successfully finished.

The PE Pre-test allows the operator to test the PE conductor for the possible presence of dangerous voltage against earth.

Normally the PE conductor is connected to earth and has no voltage against earth.

In a situation where the PE conductor is not connected to earth (mistakingly connected to phase or possibly broken) the user is exposed to a 'danger to life' situation.

Test procedure:
- Connect the test adapter to the charging station
- Touch the touch pad (no. 6) with a bare finger
- If the light indicator (no. 5) is illuminated then a dangerous voltage is present at the PE conductor. Stop further testing immediately and remedy the wiring fault.

Do not wear gloves while performing this test and ensure a proper connection to earth. Never touch any metal parts during this test. In the case of improper earthing (e.g., operators body is isolated from the earth) this test may be not reliable.

KEWTECH

Proximity Pilot (PP) State (Cable Simulation)
Using the PP State rotary switch, the current ratings of the charging cable can be simulated. Current ratings are simulated with different resistances connected between PP and PE conductors. Correlation between resistance and current ratings of the charging cable is shown in the table below.

TABLE 1

Cable current rating	Resistance between PP and PE
No cable	Open (∞)
13 A	1.5 k Ω
20 A	680 Ω
32 A	220 Ω
63 A	100 Ω

Control Pilot (CP) State (Vehicle Simulation)
Using the CP State rotary switch selector various vehicle states can be simulated. Vehicle states are simulated with different resistances connected between CP and PE conductors. Correlation between resistance and vehicle states is shown in the table below.

TABLE 2

Vehicle State	State Description	CP-PE Resistance	CP terminal voltage
A	Electric vehicle not connected	Open (∞)	±12V @ 1KHz
B	Vehicle connected, not ready to charge	2.74K	+9V/-12V @ 1KHz
C	Electric vehicle connected, ready to charge, ventilation not required	882Ω	+6V/-12V @ 1KHz
D	Electric vehicle connected, ready to charge, ventilation required	246Ω	+3V/-12V @ 1KHz

CP Signal output terminals

CP signal output terminals are connected to the CP and PE conductors of the tested charging station via the test cable. (No. 4)

Use an oscilloscope to check the waveform and amplitude of the CP signal.

The Control Pilot function uses Pulse Width Modulation (PWM) to code communication between a vehicle and charging station. The duty cycle of the PWM signal defines the possible available charging current, while amplitude defines charger state.

For details of communication protocol please refer to IEC/EN 61851-1 and the documentation of the manufacturer of the charging station.

Important note: In the case of incorrect wiring of the charging station, the signal CP test terminals can become a high live hazardous voltage.

CP Error "E" simulation
"E" - CP Error simulation button (no. 7). With the CP Error "E" button pressed the operator can simulate behaviour of the station when there is a short circuit between CP and PE through an internal diode (acc. to standard IEC/EN 61851-1). When the 'CP Error - E' button is pressed the charging process should be aborted and further charging is prevented.

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PE Error (Earth Fault) simulation
When the PE Error button (no. 10), is pressed the interruption of the PE conductor is simulated. The charging process should be aborted and further charging is prevented.

Phase indicator
The phase indicators are LEDs, one LED for each phase (no. 3). When the test adapter is connected to the charging station and phase voltages are present at the charging connector, the LED indicators will illuminate.

In the case where the neutral (N) conductor is not present or it is interrupted, LED indicators will not indicate possible voltage presence at L1, L2 and L3 conductors. The LED indicators are not intended to be used for phase sequence testing.

- When testing a single phase charging station, only one LED will illuminate.

Mains socket
The mains socket (no. 11) is connected to L1, N and PE conductors of the charging station. External load can be connected to the socket. This output is intended for measuring purposes only and offers the possibility to check the electric power meter functionality. It is not allowed to supply anything else through the socket. The max. current is limited to 10 A with an T10A/250V, 5×20 mm fuse located in the back compartment of the Adapter.

Measuring terminals L1, L2, L3, N and PE
Measuring terminals (no. 1 and 2) are directly connected to L1, L2, L3, N and PE conductors of the tested charging station. It is permitted to use these for measuring purposes only. It is not allowed to draw current over a longer period or supply anything else.

An appropriate measurement instrument is needed.

For electrical safety checks, set the CP state to match the EVSE ratings.

To check the functions of the EVSE charger switch the CP state through from A to C for chargers without ventilation and from A, through to D for chargers with ventilation. With reference to table 2 and the EV charger's manual ensure that the charger performs as it should.

To perform a loop test turn the CP switch to either position C or D (according to the type of charger).

Connect your tester into the KEWEVSE adapter and perform a low current loop test.

To test the RCD and 6mA DC protection, connect your tester to the KEWEVSE adapter. Turn the CP switch to either position C or D (according to the type of charger). Depending on the sequence of tests performed by your tester after each trip, reset the RCD and then turn the PP state switch to the A* position and then back to C or D (whichever is appropriate).

* Some EVS equipment does not require you to do this.

Fuse replacement
The fuse (T10 A / 250 V, 5 x 20 mm). If no voltage is present between the L and N terminals of mains socket when the charging connector is connected to the charging station and the charging station is in charging mode, it is possible that mains socket fuse is broken.

- In that case disconnect adapter from the charging station
- Open cover from the back of the adapter (appropriate screwdriver is necessary)
- Locate and replace fuse with the fuse of the same type.
- Return back cover of the fuse compartment.

Cleaning

If the instrument is dirty after daily usage, it is advised to clean it by using a humid cloth and a mild household detergent. Prior to cleaning, ensure that instrument is switched off and disconnected from external voltage supply and any other instruments connected (such as UUT, control instruments, etc.).

Never use acid detergents or dissolvent for cleaning.

Specifications

Input voltage:	max. 250V (single phase), max. 430V (three phase) 50/60Hz
Measurement Category:	CAT II 300V
Mains socket rating:	250V/10A
Mains socket protection:	Fuse T10A/250V
PP simulation:	Open circuit, 13A, 20A, 32A, 63A
CP simulation:	States A, B, C, D
Error simulation:	CP error "E", PE (earth fault) error
PE Pre-Test:	Yes
Test connector type:	IEC62196-2 Type 2 male
Test cable length:	25cm
Working temperature:	0 … +40°C
Storage temperature:	-10 … +50°C
Humidity:	0-80% RH

For repair and calibration please return to us at :

EXPRESSCAL
Electrical Testing Services

Express Cal
Unit 2, Shaw Wood Business Park, Shaw Wood Way, Doncaster DN2 5TB
01302 761044
expresscal@kewtechcorp.com

KEWTECH

Kewtech Corporation Limited
Midas House, Unit 2b, Stones Courtyard, High Street, Chesham, Bucks HP5 1DE
01494 792212
sales@kewtechcorp.com