

# INSTRUCTION MANUAL



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**DIGITAL PSC-LOOP TESTER**

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**MODEL 4118A**



**KYORITSU ELECTRICAL  
INSTRUMENTS WORKS, LTD.**

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# 1. SAFE TESTING

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This instrument has been designed and tested according to IEC Publication 61010: Safety Requirements for Electronic Measuring Apparatus. This instruction manual contains warnings and safety rules which must be observed by the user to ensure safe operation of the instrument and retain it in safe condition. Therefore, read through these operating instructions before starting using the instrument.

## **WARNING**

- Read through and understand instructions contained in this manual before starting using the instrument.
- Save and keep the manual handy to enable quick reference whenever necessary.
- The instrument is to be used only in its intended applications.
- Understand and follow all the safety instructions contained in the manual.

Failure to follow the instructions may cause injury, instrument damage and/or damage to equipment under test. Kyoritsu is by no means liable for any damage resulting from the instrument in contradiction to this cautionary note.

The symbol  indicated on the instrument means that the user must refer to the related sections in the manual for safe operation of the instrument. Be sure to carefully read instructions following each symbol  in this 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 a minor injury or instrument damage.

**⚠ DANGER**

- The instrument is to be used only in its intended applications or conditions. Otherwise, safety functions equipped with the instrument will not work, and instrument damage or serious personal injury may occur. Verify proper operation on a known source before use or taking action as a result of the indication of the instrument.
- This instrument is intended only for use in single phase operation at 230V +10% -15% AC phase to earth or for use in OLD-TT system phase to neutral.
- Do not exceed the maximum allowable input of any measurement range.
- Never attempt to use the instrument if its surface or your hand is wet.
- When conducting tests do not touch any exposed metalwork associated with the installation. Such metalwork may become live for the duration of the test.
- Keep your fingers and hands behind the protective fingerguard during measurement.
- Be sure to remove the test lead from the mains power supply promptly after measurement. Do not leave the instrument connected to the mains power supply for a long time.
- Do not attempt to make measurement in the presence of flammable gasses, fumes, vapor or dust. Otherwise, the use of the instrument may cause sparking, which can lead to an explosion.
- The instrument should be used only in its intended applications or conditions. Otherwise, safety functions equipped with the instrument do not work, and instrument damage or serious personal injury may be caused.

**⚠ WARNING**

- Do not turn the function selector switch with plugged in test leads connected to the circuit under test
- Do not install substitute parts or make any modification to the instrument. Return the instrument to Kyoritsu or your distributor for repair or re-calibration.
- If the overheat symbol appears in the display () disconnect the instrument from the mains supply and allow to cool down.
- Never attempt to make any measurement, if the instrument has any structural abnormality such as cracked case and exposed metal part.
- Stop using the test lead if the outer jacket is damaged and the inner metal or color jacket is exposed.

**⚠ CAUTION**

- Do not expose the instrument to the direct sun, extreme temperatures or dew fall.
- Always make sure to insert each plug of the test leads fully into the appropriate terminal on the instrument.
- This instrument isn't dust & water proofed. Keep away from dust and water.
- Use a damp cloth and detergent for cleaning the instrument. Do not use abrasives or solvents.

**● Measurement categories(Over-voltage categories)**

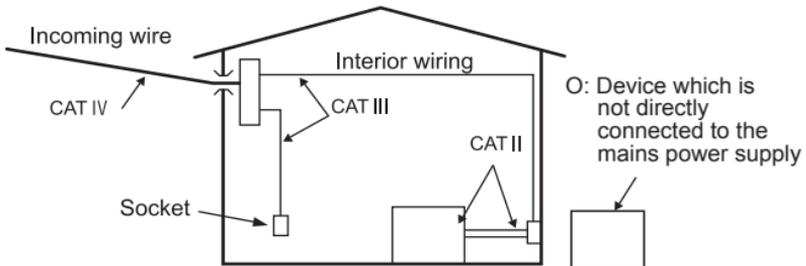
To ensure safe operation of measuring instruments, IEC 61010 establishes safety standards for various electrical environments, categorized as O to CAT IV, and called measurement categories. Higher-numbered categories correspond to electrical environments with greater momentary energy, so a measuring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

O : 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).



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## 2. PROCEDURE OF REMOVING COVER

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Model 4118A have a dedicated cover to protect against an impact from the outside and prevent the operation part, the LCD and the connector socket from becoming dirty. The cover can be detached and put on the back side of the main body during measurement.

### 2.1 Method of removing the cover

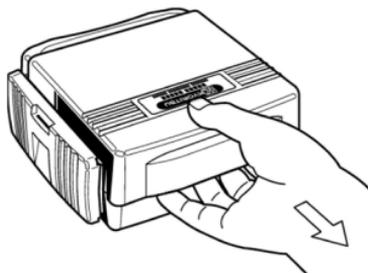


Fig. 1

### 2.2 Method of housing the cover

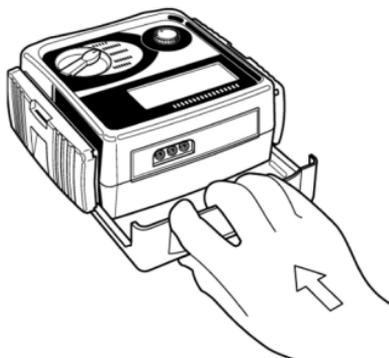


Fig. 2

## 3. FEATURES

### 3.1 Instrument Layout

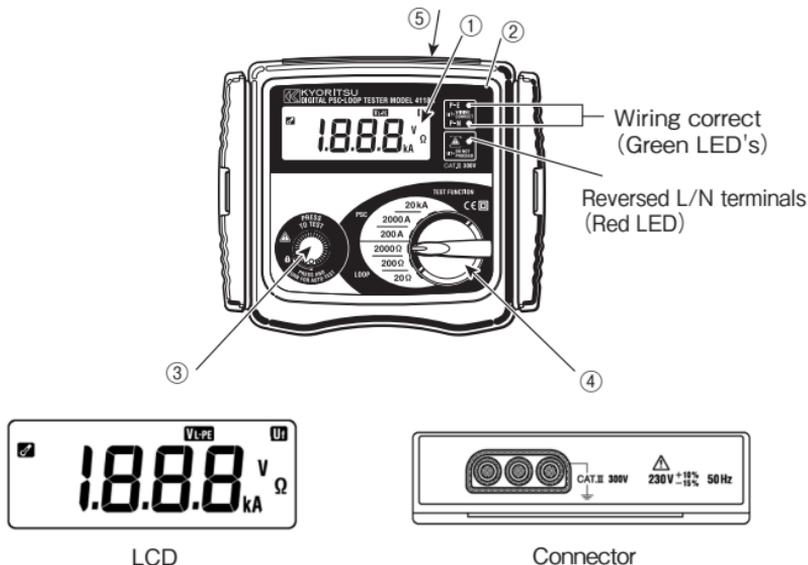


Fig. 3

- 1..... LCD display
- 2..... Wiring check LEDs
- 3..... Test button
- 4..... Range switch
- 5..... Connector

#### **⚠ DANGER**

- Use original test lead only.
- Max. allowed voltage between mains test terminals and ground is 300V.
- This instrument is intended only for use in single phase operation at 230V +10% -15% AC phase to earth or for use in OLD-TT system phase to neutral.

### 3.2 Test Lead

The instrument is supplied with Model 7125 lead at socket outlets and Model 7121B distribution board lead.

#### (1) Model 7125



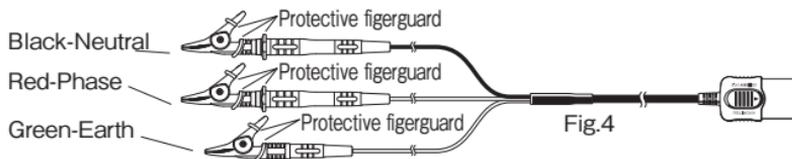
Mains lead mentioned in this instruction manual is Model 7125(EU) European SCHUKO plug, however, there are some other types for the areas, and the shipping is made along with the suitable plug-shaped cable according to the areas of the globe as follows;

Model 7123 (AU) for Australian plug

Model 7124 (UK) for British plug (13A)

Model 7126 (SA) for South African plug

#### (2) Model 7121B



Protective figerguard:

It is a part providing protection against electrical shock and ensuring the minimum required air and creepage distances.

The loop impedance of this instrument is adjusted to show the true value by using the attached mains lead (either of Models 7123 through 7126) prior to the shipment.

However, when the attached test lead for distribution board Model 7121B is used, the total internal resistance shows approx.  $0.1 \Omega$  bigger than those of other mains lead due to the internal fuse resistance. Therefore, when measurement is taken by using the Model 7121B, the measured value between PHASE-EARTH shows approx.  $0.1 \Omega$  bigger than the true value. PHASE make sure that  $0.1 \Omega$  subtracted from the measured value leaves the true value in case of using the test lead of this distribution board.

As for the PSC range, use the following equation and divide supply voltage by loop impedance, therefore, the measured value shows smaller than the true value contrary to the case of the case of loop impedance range.

●  $PSC(A) = \text{Supply Voltage}(V) / \text{Loop Impedance}(\Omega)$

Choose and use the test leads and caps that are suitable for the measurement category.

When the instrument and the test lead are combined and used together, whichever lower category either of them belongs to will be applied.

Mechanical safety part:

Barrier: provides protection against electrical shock and ensuring the minimum required air and creepage distances.

### 3.3 Features

#### 3.3-1 Test Range (Function):

LOOP: 0-19.99 $\Omega$ /0-199.9 $\Omega$ /0-1999 $\Omega$

PSC: 0-199.9A/0-1999A/0-19.99kA

#### 3.3-2 Applied Standards:

Instrument operation: IEC 61557-1, IEC61557-3

Safety: IEC 61010-1,2-030 CAT III (300V) - instrument  
IEC 61010-031 CAT III (300V) - test lead

Protection degree: IEC60529 (IP 54)

EMC: IEC61326-1,-2-2

RoHS: EN50581

### 3.3-3 Other Features:

- Battery is not used All models are not battery-operated, but operate by the voltage supplied from the system.
- Wiring check Three LEDs indicate if the wiring of the circuit under test is correct. The P-E and P-N LEDs illuminate when the wiring polarity of the circuit under test is correct.  
The  Reverse LED is lit when P and N are reversed.
- Over temperature protection Detects overheating of the internal resistor displaying a warning symbol () and automatically halting further measurements.
- Overload protection Halts measurement to prevent damages to the body when voltage between VL-PE is more than 260V.  
"VL-PE Hi" is shown on the display.
- 15mA Loop measurement Loop impedance 2000  $\Omega$  range measurement is carried out with low test current (15mA). The current will not cause tripping out involved RCD even the one with the lowest nominal differential current (30mA).
- Display The liquid crystal display has 3 1/2 digits with a decimal point and units of measurement ( $\Omega$ , A, kA,V).
- Manual and Autotest mode
  - Manual — Press and release the "Press to Test" button. The result will be displayed for 3s and then the display will revert to AC voltage.
  - Autotest — The "Press to Test" button can be turned clockwise to lock it down. In this auto mode, when using distribution board lead M-7121B, tests are conducted by simply disconnecting and reconnecting the red phase prod of the M-7121B avoiding the need to physically press the test button i.e. "hands free".

## 4. SPECIFICATIONS

### ● Measurement Specification

#### Loop Impedance

Range	Measuring range	Nominal test current at 0 Ω external loop	Accuracy
20 Ω	0.00 ~ 19.99 Ω	25A / 20ms	± (2%rdg + 4dgt)
200 Ω	0.0 ~ 199.9 Ω	2.3A / 40ms	
2000 Ω	0 ~ 1999 Ω	15mA / 280ms	

#### Prospective Short-circuit Current

Range	Measuring range	Nominal test current at 0 Ω external loop	Accuracy
200A	0.0 ~ 199.9A	2.3A / 40ms	Consider accuracy of Loop Impedance
2000A	0 ~ 1999A	25A / 20ms	
20kA	0.00 ~ 19.99kA	25A / 20ms	

Test current: a half-sine wave

#### Voltage

Measuring range	Accuracy
110 ~ 260V	± (2%rdg + 4dgt)

Instrument dimensions 186×167×89mm

Instrument weight 750g

Reference conditions Specifications are based on the following conditions except where otherwise stated:

1. Ambient temperature: 23 ± 5 °C
2. Relative humidity: 45% to 75%
3. Position: horizontal
4. AC power source: 230V, 50Hz
5. Altitude: Up to 2000m

Operating temperature and humidity 0 to +40°C, relative humidity 85% or less, no condensation.

Storage temperature and humidity -20 to +60°C, relative humidity 85% or less, no condensation.

Symbols used on the instrument

- Equipment protected throughout by DOUBLE INSULATION or REINFORCED INSULATION.
- Caution (refer to accompanying instruction manual)

### ● Operating Instrumental Uncertainty of Loop Impedance (61557-3)

Range	Measuring range to keep operating error	Maximum percentage operating instrumental uncertainty
20 $\Omega$	0.35 ~ 19.99 $\Omega$	± 30%
200 $\Omega$	20.0 ~ 199.9 $\Omega$	
2000 $\Omega$	200 ~ 1999 $\Omega$	

The influencing variations used for calculating the operating instrumental uncertainty are denoted as follows:

Temperature : 0°C and 40°C

Phase angle : At a phase angle 0° to 18°

System frequency : 49.5Hz to 50.5Hz

System voltage : 230V+10%-15%

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

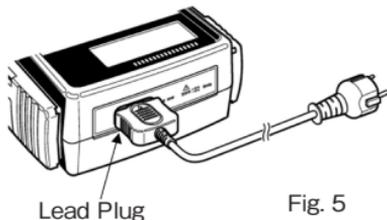
D.C quantity : 0.5% of the nominal voltage

## 5. OPERATING INSTRUCTIONS

**5.1 Initial Checks** - To be carried out before any testing.

(1) Test Lead Connection

Insert the lead plug into the connector on the instrument correctly as shown below.



**⚠ CAUTION**

- Always inspect your test instrument and lead accessories for abnormality or damage. If abnormal conditions exist DO NOT PROCEED WITH TESTING.

(2) Wiring Check

Before pressing the "Test Button" always check the LED's for the following sequence:

P-E Green LED must be ON

P-N Green LED must be ON

☐ Red LED must be OFF

**⚠ WARNING**

- If the above sequence is NOT displayed or the RED LED is on for any reason , DO NOT PROCEED AS THERE IS INCORRECT WIRING. The cause of the fault must be investigated and rectified.
- THE WIRING CHECK LED (P-E, P-N) of this instrument is to protect the user from electrical shock resulting from incorrect connection of Line and Neutral or Line and Earth.  
When the Neutral and Earth conductors are incorrectly wired, the WIRING CHECK LED function cannot identify the incorrect connection. Other procedures and test must be conducted to check and confirm that the wiring is correct prior to making measurement.  
Do not use this instrument to check the correct wiring of the power supply. Kyoritsu will not be held liable for any accident that may result from incorrect wiring of the power supply line.

(3) Voltage Measurement

When the instrument is first connected to the system, it will display the phase-neutral voltage which is updated every 1s. This mode is cancelled whenever the test button is pressed. If this voltage is not normal or as expected, DO NOT PROCEED.

**⚠ WARNING**

- If the above sequence is NOT displayed or the RED LED is on for any reason , DO NOT PROCEED AS THERE IS INCORRECT WIRING. The cause of the fault must be investigated and rectified.

**5.2 Measurement of the Loop Impedance**

- (1) Set the instrument to the 200Ω or 2000Ω range.  
If the instrument is set to the 20Ω range slight sparking may occur when testing with the distribution board lead although the unit has been designed to minimize this.
- (2) Connect the lead to the instrument.
- (3) Plug the moulded mains plug to the socket being tested.
- (4) Check the LED's are lit as indicated in section 5.1. If not DO NOT PROCEED - check wiring.
- (5) Note the mains voltage if required.

- (6) Press the "Press to Test" button. The value of loop impedance will be displayed with the appropriate units. A bleep will sound on completion of the test.  
For best results always test on the lowest possible range.

For example, a loop impedance measured on the 200Ω range may give an indication of 0.3Ω whereas on the 20Ω range it may read 0.28Ω. In the event of the reading being in excess of the range (e.g. more than 20Ω on the 20Ω range) the appropriate over-range symbol "OL" will appear on the display.

No harm will be done to the instrument by selecting too low a range.

**⚠ CAUTION**

- Even though the test current in the 2000 ohm range (15mA test current) is low some RCD's, may trip due to sensitivity or where there may already be additional leakage in the circuit being tested.

The Loop impedance in a TN system is small and therefore it is not recommended to test in the 2000 ohm range. RCD's will have to be bridged to avoid tripping when using other test ranges.

- 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%

### 5.3 Measurement of Prospective Short Circuit Current

- (1) Set the instrument to the 20kA range.
- (2) Connect the test lead to the instrument.
- (3) Attach the plug to the socket to be tested.

- (4) Check that the LED's are lit in the sequence indicated in section 5.1. If not, disconnect from the mains and check the wiring at the socket.
- (5) Press the "Press to Test" button. The prospective short circuit current (PSC) will be directly displayed on the LCD with the appropriate units. This will remain for 3s and then revert to AC voltage display. An audible beep will sound on completion of the test. For best results always test on the lowest possible range. For example a PSC measured on the 2000A range may read 60A whilst on the 200A range it may read 56.0A. To hold the reading keep the button held down or turn clockwise to lock for Auto Test.

Normally PSC tests are conducted at point of origin, e.g. distribution boards, between phase and neutral.

When conducting PSC tests at socket outlets, a test will be conducted between phase and earth due to the fixed wiring of the moulded mains plug.

 **WARNING**

- This instrument is intended only for use in single phase operation at 230V +10% -15% AC phase to earth or for use in OLD-TT system phase to neutral.

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## 6. DETAILED EXPLANATION

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### 6.1 Measurement of Fault Loop Impedance and Prospective Fault Current

If the electrical installations are protected by over-current protection devices or by fuses, the Fault loop impedance should be measured.

In the event of a fault, the Fault loop impedance should be low enough (and the Prospective Fault current higher enough) in order to have the automatic disconnection of supply by the installed protection device within prescribed time interval.

Every circuit must be tested to make sure that the fault loop impedance does not exceed that specified for the over current protection device concerned.

For TT system the Fault loop impedance is the sum of the following partial impedances:

- Impedance of power transformer's secondary.
- Phase conductor resistance from power transformer to fault location.
- Protection conductor resistance from fault location to local earth system.
- Resistance of local earth system  $R$ .
- Resistance of power transformer's earth system  $R_o$ .

*The figure below shows in marked line the Fault loop impedance for TT system.*

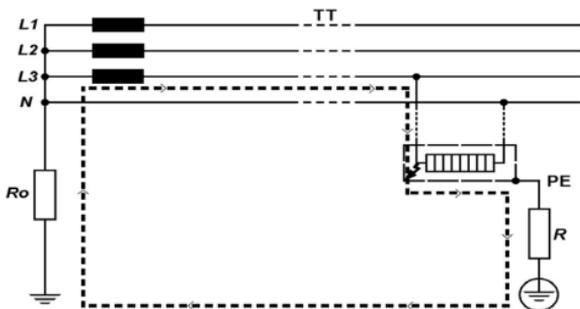
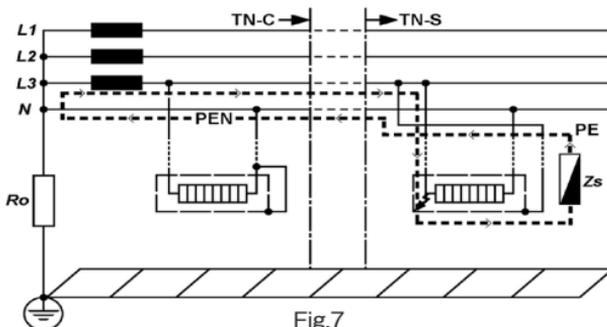


Fig.6

For TN system the Fault loop impedance is the sum of the following partial impedances:

- Impedance of power transformer's secondary
- Phase conductor resistance from power transformer to fault location
- Protection conductor resistance from fault location to power transformer

The figure below shows in marked line the Fault loop impedance for TN system.



According to the international Standard IEC 60364 for TT system the following condition shall be fulfilled for each circuit:

$$RA \leq 50/la$$

Where:

- **RA** is the sum of the resistances of the local earth system R and protection conductor connecting it to the exposed conductive part.
- **50** is the max contact voltage limit (it could be 25V in particular cases)
- **la** is the current causing the automatic disconnection of the protective device within 5 s.

When the protection device is a residual current device (RCD), **la** is the rated residual operating current  $I_{\Delta n}$ .

For instance in a TT system protected by a RCD the max RA values are:

Rated residual operating current $I_{\Delta n}$	10	30	100	300	500	1000	mA
RA (at 50V)	5000	1667	500	167	100	50	$\Omega$
RA (at 25V)	2500	833	250	83	50	25	$\Omega$

**Note:**

- The loop tester models 4118A measure the fault loop impedance that is a value normally a little bit higher of RA.  
But, if the electrical installation is protected considering the loop impedance value, also the RA formula will be fulfilled.

*Practical example of verification of the protection in a TT system according to the international Standard IEC 60364.*

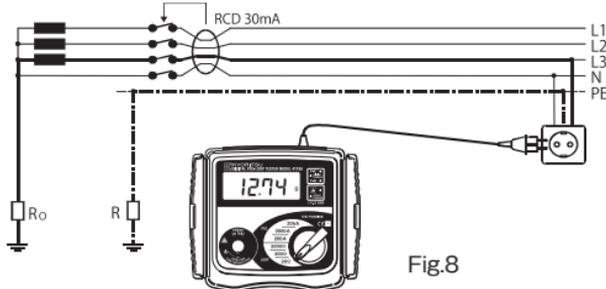


Fig.8

For this example max value is  $1667\ \Omega$ , the loop tester reads  $12.74\ \Omega$ , it means that the condition  $RA \leq 50/la$  is respected.

It is fundamental for this example to test also the RCD to ensure that operation takes place quickly enough to respect the safety requirements. In order to do it, can be used the RCD tester model 5406A.

According to the international Standard IEC 60364 for TN system the following condition shall be fulfilled for each circuit:

$$Z_s \leq U_o/la$$

Where:

- $Z_s$  is the Fault loop impedance.
- $U_o$  is the nominal voltage between phase to earth.
- $la$  is the current causing the automatic disconnection of the protective device within the time stated in table as follows:

$U_o$ (Volts)	T (seconds)
120	0.8
230	0.4
400	0.2
>400	0.1

**Note:**

- For a distribution circuit a disconnection time not exceeding 5s is permitted.
- When the protection device is a residual current device (RCD),  $la$  is the rated residual operating current  $I_{\Delta n}$ .

For instance in a TN system with nominal mains voltage  $U_0 = 230\text{ V}$  protected by gG fuses the  $I_a$  and max  $Z_s$  values could be:

Rating (A)	Disconnecting time 5s		Disconnecting time 0.4s	
	$I_a$ (A)	$Z_s$ ( $\Omega$ )	$I_a$ (A)	$Z_s$ ( $\Omega$ )
6	28	8.2	47	4.9
10	46	5	82	2.8
16	65	3.6	110	2.1
20	85	2.7	147	1.56
25	110	2.1	183	1.25
32	150	1.53	275	0.83
40	190	1.21	320	0.72
50	250	0.92	470	0.49
63	320	0.71	550	0.42
80	425	0.54	840	0.27
100	580	0.39	1020	0.22

Using the current ranges on models 4118A can be also tested the Prospective Fault current.

Prospective Fault current measured by instruments must be higher than  $I_a$  of the protective device concerned

*Practical example of verification of the protection in a TN system according to the international Standard IEC 60364.*

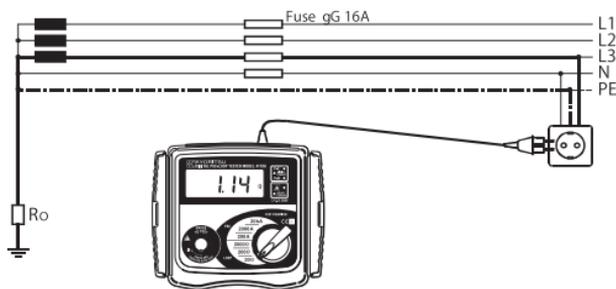


Fig.9

Max value of  $Z_s$  for this example is  $2.1 \Omega$  (16A gG fuse, 0.4s) the loop tester reads  $1.14 \Omega$  (or 202 A on Fault current range) it means that the condition  $Z_s \leq U_0/I_a$  is respected.

In fact the  $Z_s$  of  $1.14 \Omega$  is less than  $2.1 \Omega$  (or the Fault current of 202 A is more than  $I_a$  of 110A).

### **⚠ WARNING**

- This instrument is intended only for use in single phase operation at 230V +10% -15% AC phase to earth or for use in OLD-TT system phase to neutral.
- If the overheat symbol appears in the display (🔥) disconnect the instrument from the mains supply and allow to cool down.

## 6.2 Measurement of "OLD-TT System"

OLD-TT system is a TT system with phase to phase voltage of 220 V (instead of 400 V) and phase to earth of 127 V (instead of 230V) and normally the neutral conductor is not used.

Connecting the loop testers to this system, all three wiring check LEDs should be lit and the display reads a value of 127 V.

Only if **all** these conditions are respected the test can be carry out.

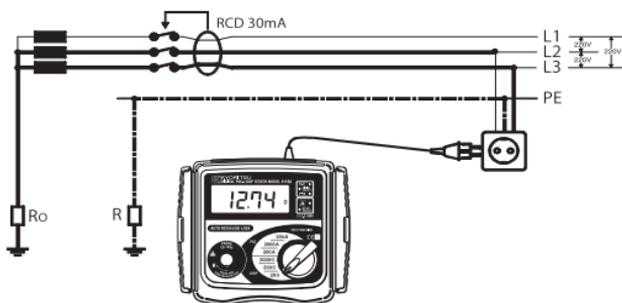


Fig.10

**⚠ WARNING (OLD-TT system only)**

- **DO NOT PRESS** the "Test button" if the display reads a value of 220V!

### 6.3 Measurement of Line Impedance and Prospective Short Circuit Current

Line Impedance on single-phase system is the impedance measured between phase and neutral terminals.

Measurement principle used inside the instrument is exactly the same as at Fault Loop Impedance measurement, but the measurement is carried out between L and N terminals.

Breaking current capacity of installed over-current protection devices should be higher than Prospective Short-Circuit current, otherwise it is necessary to change the rated current of involved over-current protection device.

Practical example of line impedance test and prospective short-circuit current test:

*The figure below shows in marked line the Line impedance phase to neutral for TN system.*

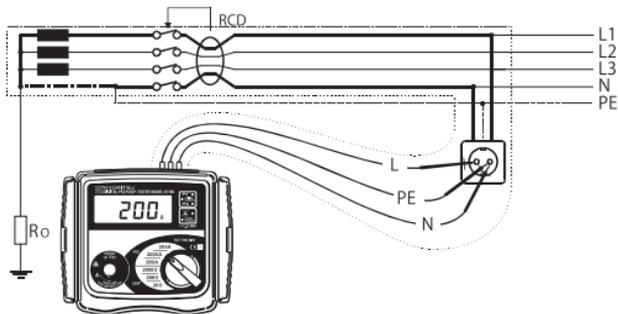


Fig.11

### **⚠ WARNING**

- This instrument is intended only for use in single phase operation at 230V +10% -15% AC phase to earth or for use in OLD-TT system phase to neutral.
- If the overheat symbol appears in the display (  ) disconnect the instrument from the mains supply and allow to cool down.
- When testing installation that has a large current capacity, such as a power line, be sure not to short live conductors with the tip of a probe. Failure to follow these instruction can cause hazards to the user.

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## 7. SERVICING

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If this tester should fail to operate correctly, return it to your distributor stating the exact nature of the fault.

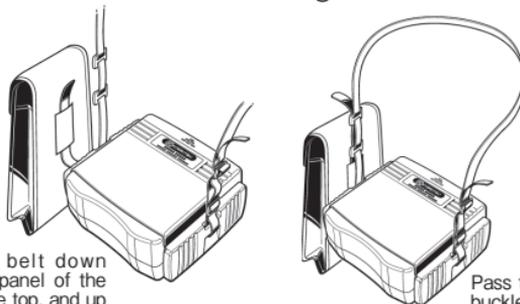
Please remember to give all the information possible concerning the nature of the fault, as this will mean that the instrument will be serviced and returned to you more quickly.

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## 8. CASE AND STRAP BELT ASSEMBLY

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Correct assembly is shown in Fig 12. By hanging the instrument round the neck, both hands will be left free for testing.



Pass the strap belt down through the side panel of the main body from the top, and up through the slots of the probe case from the bottom.

Fig.12

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



## DISTRIBUTOR

92-2233A

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Kyoritsu reserves the rights to change specifications or designs described in this manual without notice and without obligations.



## **KYORITSU ELECTRICAL INSTRUMENTS WORKS, LTD.**

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