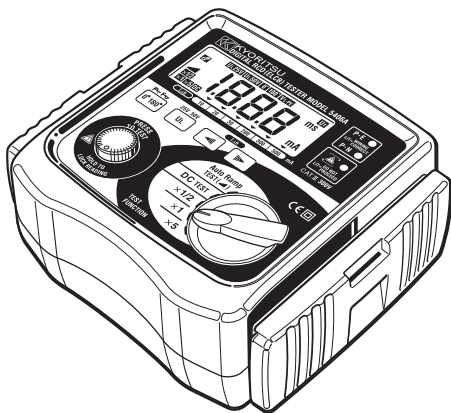


INSTRUCTION MANUAL



DIGITAL RCD(ELCB)TESTER

MODEL 5406A



**KYORITSU ELECTRICAL
INSTRUMENTS WORKS, LTD.**

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1. SAFE TESTING

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.

IMPORTANT:

1. This instrument must only be used by a competent and trained person and operated in strict accordance with the instructions. KYORITSU will not accept liability for any damage or injury caused by misuse or non-compliance with the instructions or with the safety procedures.
2. It is essential to read and to understand the safety rules contained in the instructions or with the safety procedures.

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 phase to neutral operation or for use in OLD-TT system.
- When conducting tests do not touch any exposed metalwork associated with the installation. Such metalwork may become live for the duration of the test.
- When testing, always be sure to keep your fingers behind the safety barriers on the test leads.
- Be sure to remove the test leads from the main power supply promptly after measurement. Do not leave them connected to the main power supply for a long time.

WARNING

- 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.
- **Never open the instrument case** - there are dangerous voltages present. If a fault develops, return the instrument to your distributor for inspection and repair.
- If the overheat symbol appears on the display () disconnect the instrument from the mains supply and allow to cool down.
- If abnormal conditions of any sort are noted (such as a faulty display, unexpected readings, broken case, cracked test leads, etc) do not use the tester and return it to your distributor for repair.
- Never attempt to use the instrument if the instrument or your hand is wet.
- Do not rotate function switch when test button is depressed.
- Stop using the test lead if the outer jacket is damaged and the inner metal or color jacket is exposed.

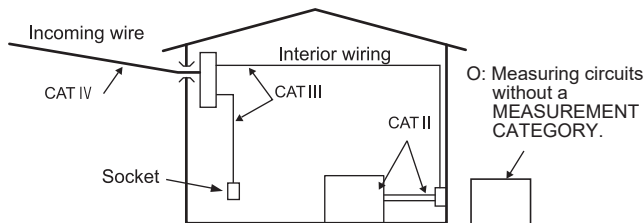
 CAUTION

- For safety reasons only use accessories (test leads, probes, cases, etc) designed to be used with this instrument and recommended by KYORITSU. The use of other accessories is prohibited as they are unlikely to have the correct safety features.
- During testing it is possible that there may be a momentary degradation of the reading due to the presence of excessive transients or discharges on the electrical system under test. Should this be observed, the test must be repeated to obtain a correct reading. If in doubt, contact your distributor.
- Use a damp cloth and detergent for cleaning the instrument. Do not use abrasives or solvents.
- Keep your fingers and hands behind the protective fingerguard during measurement.

○ Measurement categories(Over-voltage categories)

To ensure safe operation of measuring instruments, IEC 61010 establishes safety standards for various electrical environments, categorized as 0 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 : Measuring circuits without a MEASUREMENT CATEGORY.
- 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).



2. PROCEDURE OF REMOVING COVER

Model 5406A has 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

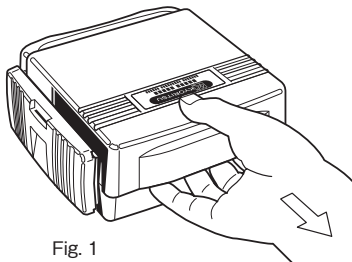


Fig. 1

2.2 Method of storing the cover

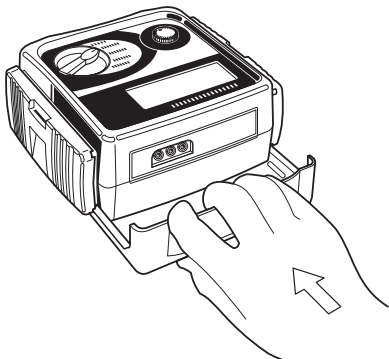
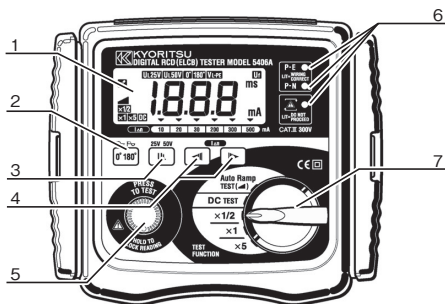


Fig. 2

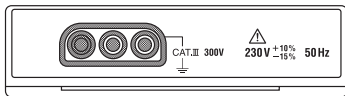
3. FEATURES

3.1 Instrument Layout



- 1 LCD
- 2 0° /180° SWITCH
- 3 UL VALUE SELECT SWITCH (25V/50V)
- 4 I_n SWITCH (up and down)
- 5 TEST BUTTON
- 6 WIRING CHECK LED
- 7 FUNCTION SWITCH

※ LED indication of correct polarity is that The P-E and P-N LEDs illuminate. P and N are reversed when the  reverse LED is lit.



LCD DISPLAY

Test Lead Model 7125 or Model 7121B (Optional Accessory)

Fig. 3

⚠ DANGER

- Use original test lead only.
- Max. allowed voltage between mains test terminals and ground is 300V.
- This unit is only intended for single phase (230V +10%- 15% AC 50Hz) operation or OLD-TT system.

3.2 Test Lead

The instrument is supplied with Model 7125 Lead at socket outlets and Model 7121B distribution board lead (Optional Accessory).

1. Model 7125



2. Model 7121B (Optional Accessory)

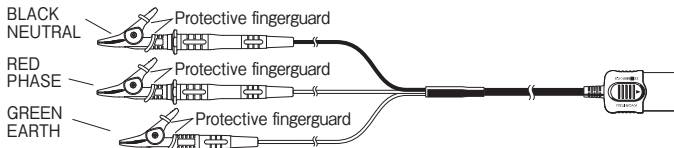


Fig.4

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

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.

⚠ CAUTION

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

3.3 Test Range (Function)

Model 5406A performs five functions.

×1/2...For testing RCD's to verify that they are not too sensitive.

×1...For measuring the trip time.

×5...For testing at $I_{\Delta n} \times 5$

DC TEST...For testing DC sensitive RCD's

AUTO RAMP TEST...For measuring the trip out current.

3.4 Applied Standards

Instrument operation:	IEC 61557-1, IEC 61557-6
Safety:	IEC 61010-1, 2-030 CAT III (300V) - instrument IEC 61010-031 CAT III (600V) - test lead EMC: EN61326-1 RoHS: EN50581
Protection degree:	IEC60529 (IP 54)

3.5 Features

Model 5406A has the following features:

Battery is not used	Model 5406A is not battery-operated, but operates by the voltage supplied from the system.
Wiring check protection	Three LEDs indicate if the wiring of the circuit under test is correct.
Over temperature	Detects overheating of the internal resistor and of the current control MOS FET displaying a warning symbol (🔥) and automatically halting further measurements.
Phase angle selector	The test can be selected from either the positive (0°) or from the negative (180°) half-cycle of voltage. At those two points, tests minimum (best) and maximum (worst) trip times.
Auto data hold and U_f Monitoring	Holds the displayed reading for a time after the test is complete.
UL value selector	Select UL (limit of touch voltage value) 25V or 50V. Where U_f (fault voltage) exceeds UL value, "Uf Hi" will be displayed without starting the measurement.
Optional Accessory	Model 7121B distribution board or lighting circuit test lead.

4. SPECIFICATION

● Measurement Specification

Function	Rated voltage (AC)	Trip Current Settings (I Δ n)	Trip Current Duration	Accuracy	
				Trip current	Trip Time
× 1/2	230V+10% -15% 50Hz	10/20/30 /200/300 /500mA	1000ms	− 8% ~ − 2%	0.6% ± 4dgt
× 1			1000ms	+2% ~ +8%	
× 5			200ms		
DC TEST		(10/20/30 /200/300 /500mA) +6mA dc	1000ms	− 10% ~ +10%	
AUTO RAMP TEST		10/20/30 /200/300 /500mA	Goes up by 10% from 20% to 110% of I Δ n. 300ms × 10	− 8% ~ +8%	

Instrument dimensions

186 × 167 × 89mm

Instrument weight

800g

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 80% or less, no condensation.

Storage temperature and humidity.

-20 to +60°C, relative humidity 75% or less, no condensation.

LED indication of correct polarity

The P-E and P-N LEDs illuminate when the wiring of the circuit under test is correct. The  reverse LED is lit when P and N are reversed.

Auto data hold

The LCD reading is automatically frozen for 3 seconds after measurement.

Display

The liquid crystal display has 3 1/2 digits with a decimal point and units of measurement (ms, mA).

Over voltage

Halts measurement to prevent damages to the body when voltage between phase and earth is approx. 260V or more. "VL-PE Hi" is shown on the display.

Symbols used on the instrument

 Equipment protected throughout by DOUBLE INSULATION or REINFORCED INSULATION.

 Caution (refer to accompanying instruction manual)

● Operating instrumental uncertainty of trip current (IEC 61557-6)

Function	Operating instrumental uncertainty of trip current
× 1/2	-10 ~ 0%
× 1	0 ~ +10%
× 5	
AUTO RAMP	-10% ~ +10%

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

Temperature : 0°C and 40°C

Earth electrode resistance : max 50 Ω (max 20 Ω at × 5 500mA only)

System voltage : 230V+10%-15%

5. Residual Current Device (RCD) Test

5.1 RCD test

RCD is a switching device designed for breaking currents (opening the contacts) when the residual current attains a specific given value. It works on basis of current difference between phase currents flowing to different loads and returning current flowing through neutral conductor (for a single phase installation).

In case the current difference is higher than RCD tripping current, the device will trip disconnecting the main voltage.

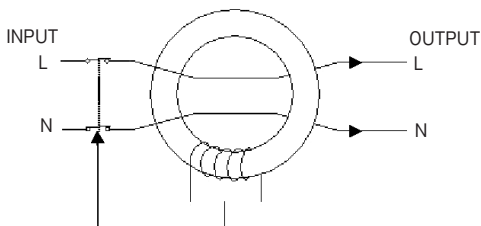


Fig. 5

Basically there are two classifications for RCD's : The first one due to the shape of residual current waveform sensibility (Type AC and A) and the second due to the tripping time (Type G and S).

- RCD type AC, RCD for which tripping is ensured for residual sinusoidal alternating currents, whether suddenly applied or slowly rising. This type is the most frequently used on electrical installations.
- RCD type A, RCD for which tripping is ensured for residual sinusoidal alternating currents (like type AC) and residual pulsating direct currents (DC), whether suddenly applied or slowly rising. It is not very used in practice even if it is becoming more and more popular and in some countries it is requested by the national regulation instead of type AC.
- RCD type G = General type (without trip out time-delay), for general use and application.

- RCD type S = Selective type (with trip out time-delay), this RCD is specially designed for electrical installation where the selectivity characteristic is necessary.

In order to assure successful protection on an electrical installation using RCD's, they should be checked testing:

- Trip out time t_{Δ}
- And in some cases also the Tripping current I_{Δ} .

Trip out time t_{Δ} is time needed by the RCD to trip at rated residual operative current $I_{\Delta N}$. Typically RCD rated residual operative currents $I_{\Delta N}$ are:

10mA, 20mA, 30mA, 200mA, 300mA, 500mA

The standard values of tripping time defined by IEC 61009 (EN61009) and IEC 61008 (EN 61008) are listed in the table below (for $I_{\Delta N}$ and $5I_{\Delta N}$):

Type of RCD	$I_{\Delta N}$	$5I_{\Delta N}$
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

This tripping time values are concerning the RCD's correctly mounted following the manufacturer's specifications.

The RCD tester Model 5406A continues driving test current until RCD trips or up to max test time.

This test is named Trip test ($\times 1 I_{\Delta N}$) or Fast trip test ($\times 5I_{\Delta N}$).

NOTE:

There are special protection devices called "Adjusted RCD" where the tripping time and tripping current are adjustable, in these cases the above table should not be considered.

There is also another kind of RCD called "Type B", for which tripping is ensured for residual sinusoidal alternating currents (like type AC) and residual pulsating DC currents (like type A) and pure or nearly pure DC current, whether suddenly applied or slowly rising. It is also very rarely used in practice because these are only a few models on the market and the price at the moment is very high.

Tripping current I_{Δ} is the lowest residual current which can still cause tripping out RCD.

The RCD tester Model 5406A starts to drive test current from 20% of $I_{\Delta n}$ and then increases it until RCD trips or up to 110% of $I_{\Delta n}$.

This test is normally named Auto ramp test and it can be used to confirm the real sensibility of the RCD.

If RCD trips before the 50% of its $I_{\Delta n}$, there could be a certain leakage or fault current that is already flowing to the ground, or the RCD could be out of characteristics.

In order to check the leakage or fault currents there are specific leakage clamp meters as Model 2432, Model 2433, Model 2413F.

The RCD tester Model 5406A can test the Trip out time t_{Δ} and the Tripping current I_{Δ} .

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

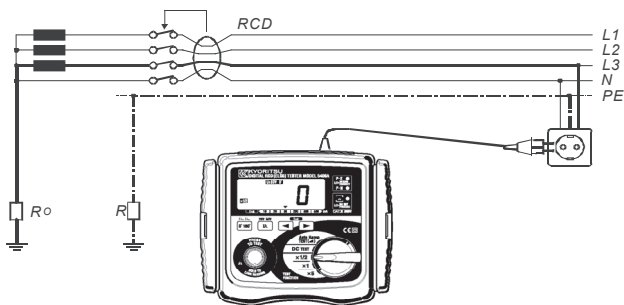


Fig. 6

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

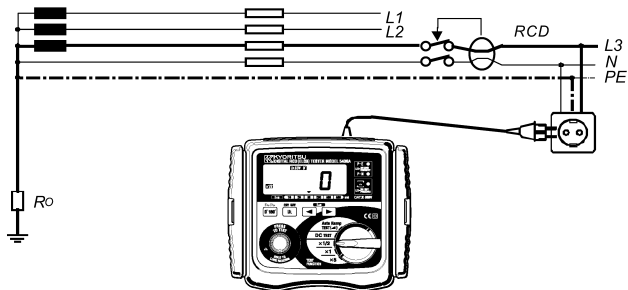


Fig. 7

5.2 RCD test ON "OLD TT SYSTEM"

CAUTION

M5406A can operate in OLD-TT system with the following $I_{\Delta n}$, however, the accuracy is not assured. The instrument does not operate with other $I_{\Delta n}$.

$\times 1/2, \times 1, DC \text{ TEST}, AUTO \text{ RAMP TEST} \cdots I_{\Delta n}: 10\text{mA}, 20\text{mA}, 30\text{mA}, 200\text{mA}, 300\text{mA}$

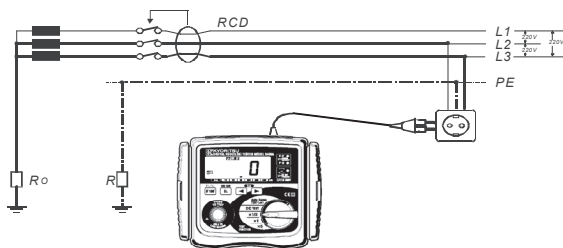
$\times 5 \cdots I_{\Delta n}: 10\text{mA}, 20\text{mA}, 30\text{mA}, 200\text{mA}$

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

Before connecting the model 5406A to this system check by a voltmeter (or a DMM) in order to be sure that the voltage between each phase to earth is 127V (+/-10%).

WARNING

Do not press the "Test button" if the voltmeter reads a value of 220V.



Connecting the model 5406A to this system, all three wiring check LEDs should be lit.

Fig. 8

6. TEST PROCEDURE

6.1. Preparation

- (1) Insert the mains lead into the instrument. (Fig. 9,10)
- (2) Plug the instrument into the socket outlet that is protected by the RCD to be tested.
- (3) Turn the breaker switch ON.
- (4) Press the $I\Delta n$ switch to set the Rated Tripping Current ($I\Delta n$) to the rated trip current of the RCD. "▼" on the LCD moves whenever the $I\Delta n$ switch is pressed, and a present $I\Delta n$ is indicated.
- (5) Press the UL value select switch to select UL value (25 or 50V).

The initial value : $I\Delta n$ 30mA
UL value.....50V
0° / 180°0°

6.2. Wiring Check

Make sure that the P-E and P-N wiring check LEDs are lit and the wiring incorrect LED is not lit. If they are not, disconnect the tester and check the wiring for a possible fault.



WARNING

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.

6.3. TESTING

(1) Set the TEST FUNCTION

- NO TRIP TEST..... $\times 1/2$: Max time 1000ms
- TRIP TEST..... $\times 1$: Max time 1000ms
- FAST TRIP TEST..... $\times 5$: Max time 200ms
- DC TEST.....DC TEST : Max time 1000ms
- AUTO RAMP TEST..... Auto Ramp TEST ()
: 20%~110% of the Rated Tripping
Current ($I_{\Delta n}$).
Max time 300ms $\times 10$.

(2) Press the TEST BUTTON

- NO TRIP TEST.....**The breaker should not trip.**
- TRIP TEST**The breaker should trip.**
- FAST TRIP TEST.....**The breaker should trip.**
- DC TEST.....**The breaker should trip.**
- AUTO RAMP TEST.....The breaker should trip. Check Trip out
Current and Trip out Time at measured trip
out current.

(3) Press the 0° /180° switch to change the phase and repeat step(2) .

(4) Change the phase again and repeat step (2).

● Be sure to return the tested RCD to the original condition after the test.

WARNING

- If the voltage between phase and earth exceeds approx. 260V, "V L-PE" is shown on the LCD when the test button is pressed, and the measurement is halted. Disconnect the instrument from the mains supply and check the voltage between phase and earth if "V L-PE Hi" is indicated.
- If the overheat symbol appears on the display () disconnect the instrument from the mains supply and allow to cool down.
- When making a test with the range larger than the RCD rated tripping current or when wiring is not correct, it can happen that RCD trips and "no" is shown on the display.
- When the Uf voltage rises to UL value or greater, the measurement is automatically suspended and "Uf Hi" is displayed on the LCD.

MAKE SURE TO KEEP CLEAR OF EARTHED METAL DURING THE OPERATION OF THESE TESTS.

Note :

- Measured RCD trip time will be displayed on the LCD.
When the tested RCD didn't trip, OL ms will be displayed instead.
- If the RCD does not trip, the tester will supply the test current for a maximum of 1000ms on the X1/2 and X1 ranges. The fact that the RCD has not tripped will be evident because the P-N and P-E LEDs will still be on.
- 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, shall be taken into consideration.
- Equipment following the RCD, e.g. capacitors or rotating machinery, may cause a significant lengthening of the measured trip time.
- The earth electrode resistance of a measuring circuit with a probe shall not exceed 50 Ω at 500mA (20 Ω at $\times 5$ 500mA only) range.
- If the "Test button" is released, the result will be displayed for 3s before reverting to zero. If the button is held down, the result will be displayed until the button is released. If the breaker trips, the display will read the trip time. The display will be held for approx 10s.

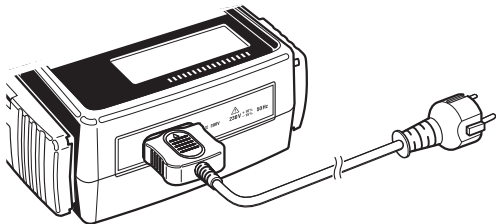
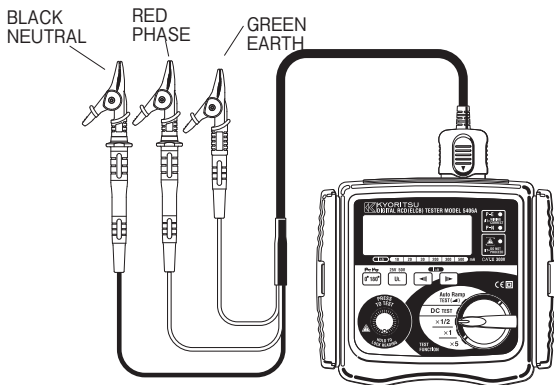


Fig. 9



Test Lead Model 7121B (Optional Accessory)

Fig. 10

⚠ WARNING

Take enough caution not to make faulty wiring when using Model 7121B. Especially, be careful not to connect it to phase-phase.

⚠ CAUTION

Keep your fingers and hands behind the protective fingerguard during a measurement.

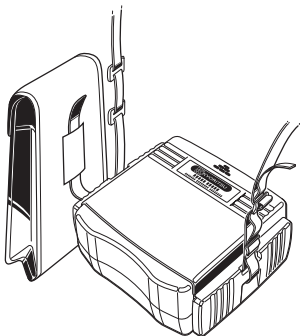
7. SERVICING

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

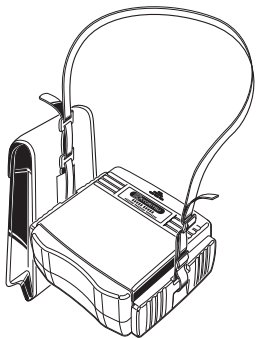
Please remember to give all the information possible concerning the nature of the fault, as this will mean that the instrument will be serviced and returned to you more quickly.

8. CASE AND STRAP BELT ASSEMBLY

Correct assembly is shown in Fig 11. 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.



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

Fig. 11

DISTRIBUTOR

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



KYORITSU ELECTRICAL INSTRUMENTS WORKS, LTD.

2-5-20, Nakane, Meguro-ku,

Tokyo, 152-0031 Japan

Phone: +81-3-3723-0131

Fax: +81-3-3723-0152

Factory: Ehime, Japan

www.kew-ltd.co.jp