Instruction Manual

KYORITSU ELECTRICAL INSTRUMENTS WORKS, LTD.

K4118

Loop Impedance and PSC Tester

MAJOR TECH

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1. SAFE TESTING ⚠

Electricity is dangerous and can cause injury and death. Always treat it with the greatest of respect and care. If you are not quite sure how to proceed, stop and take advice from a qualified person. 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 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. MAJORTECH 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.
3. 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

- 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.
- 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 lead from the mains power supply promptly after measurement. Do not leave the instrument connected to the mains power supply for a long time.

⚠ WARNING

- **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 in 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.

⚠ CAUTION

- For those testers without the D-LOK circuitry (K4118A) all RCD's (RCCB, ELCB) in the circuit must be by-passed for the duration of the test (except on loop-2000Ω range).
  Do not operate the RCD Test Button with the RCD by-passed.
- 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.

2. PROCEDURE OF REMOVING COVER

K4118A , 4120A 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

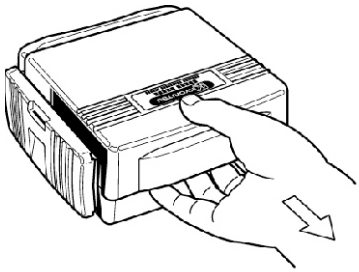


Fig. 1

2.2 Method of housing the cover

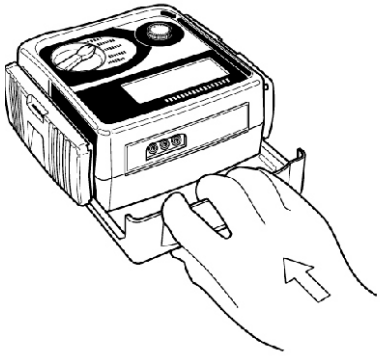
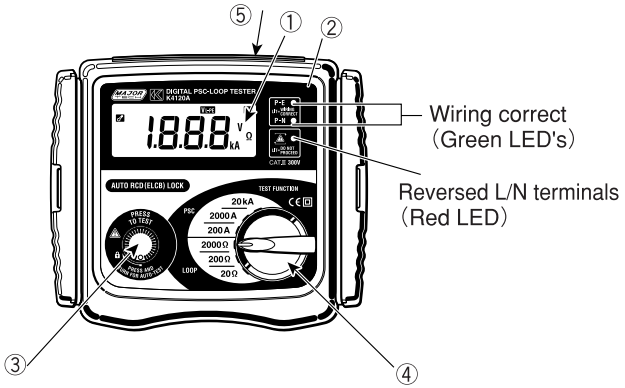


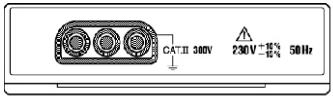
Fig. 2

3. FEATURES

3.1 Instrument Layout



LCD



Connector

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 7126 lead at socket outlets and Model 7121 distribution board lead.

(1) Model 7126

(2) Model 7121 (Included as standard equipment for K4118A and 4120A.)

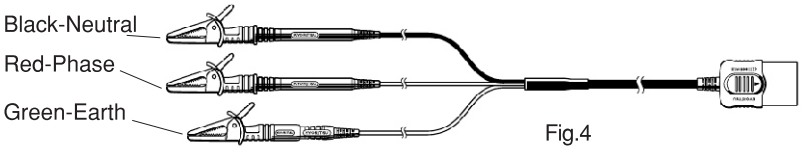


Fig.4

3.3 Features

3.3-1 Test Range (Function):

Model	K4120A	K4118A
D-LOK Circuit *	○	×
Loop 0-19.99Ω/ 0-199.9Ω/0-1999Ω	○	○
PSC 0-199.9A/ 0-1999A/0-4.00kA	○	○

Note:

- *D-LOK=Automatic device (RCD) lock
- D-LOK dose not operate on the Loop-2000Ω.
- Mains voltage with which D-LOK operates is as shown in the table below.

Range	D-LOK Operating Voltage
Loop200Ω/PSC200A	190～253V
Loop20Ω/PSC2000A, 20kA	205～253V

3.3-2 Applied Standards:

Instrument operation:	IEC /EN 61557-1, IEC61557-3
Safety:	IEC/EN 61010-1 CAT III (300V) - instrument
	IEC/EN 61010-2-31 CAT III (300V) - test lead
Protection degree:	IEC60529 (IP 54)

3.3-3 K4118A , 4120A have the following 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 260V or more. "VL-PE Hi" is shown on the display.
● D-LOK circuit	K4120A with unique D-LOK circuit avoids the need to by-pass most RCD's.
● 15mA Loop measurement	Loop impedance 2000Ω 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 (Ω, 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-7121, tests are conducted by simply disconnecting and reconnecting the red phase prod of the M-7121 avoiding the need to physically press the test button i.e. "hands free".

⚠ CAUTION

● The D-LOK circuits may not by-pass some RCD's and this will result in the RCD tripping out as they would do with a conventional loop tester. Also, in the case of high sensitivity RCD's rated at 10mA or less the D-LOK circuits may not function.

4. SPECIFICATIONS

● Measurement Specification

Loop Impedance (IEC61557-3)

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

Prospective Short-circuit Current (K4118A, K4120A)

Range	Measuring range	Nominal test current at 0Ω external loop	Accuracy
200A	0.0 ～199.9A	2.3A / 40ms	Consider accuracy of Loop Impedance
2000A	0 ～1999A	25A / 20ms	
20kA	0.00 ～ 4.00kA	25A / 20ms	

Voltage

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

Instrument dimensions	186×167×89mm
Instrument weight	K4120A / 960g, K4118A / 750g
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. Position: horizontal 4. AC power source: 230V, 50Hz 5. Altitude: Up to 2000m
Operating temperature and humidity	0 to +40℃, relative humidity 80% or less, no condensation.
Storage temperature and humidity	−20 to +60℃, relative humidity 75% 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 Error of Loop Impedance (61557-3)**

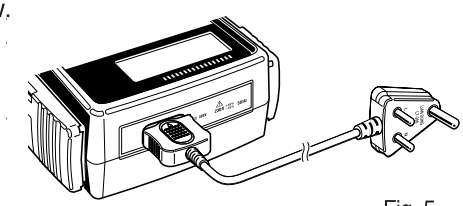
Range	Measuring range to keep operating error	Maximum percentage operating error
20Ω	0.20 ～ 19.99Ω	±30%
200Ω	20.0 ～ 199.9Ω	
2000Ω	200 ～ 1999Ω	

The influencing variations used for calculating the operating error are denoted as follows:
Temperature：0℃ and 40℃
Phase angle ：At a phase angle 0° to 18°
System frequency：49.5Hz to 50.5Hz
System voltage：230V+10%-15%

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.



Lead Plug

Fig. 5

⚠ **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.

(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**

- 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.

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 0.28 Ω. 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.

5.3 Measurement of Prospective Short Circuit Current — (K4118A and K4120A)

(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.

Note:

- For loop impedance greater than 210Ω on PSC 200A range and 25 Ω on 2000A, 20kA ranges, the fault voltage may become high and dangerous due to the D-LOK current, therefore, the unit is designed to lock out PSC ranges showing "Uf-Hi" symbol.

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.

6. DETAILED EXPLANATION

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 Ro.

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

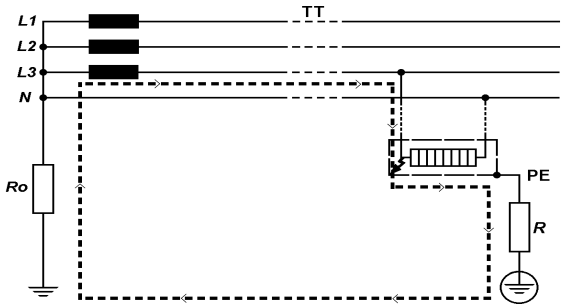


Fig.6

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.

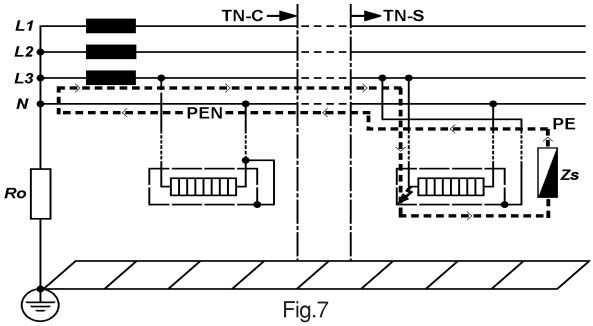


Fig.7

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

RA≤50/Ia

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)
- **Ia** is the current causing the automatic disconnection of the protective device within 5 s.

When the protection device is a residual current device (RCD), **Ia** is the rated residual operating current I ⊿n.
For instance in a TT system protected by a RCD the max RA values are:

Rated residual operating current I⊿n.	10	30	100	300	500	1000	mA
RA (at 50V)	5000	1667	500	167	100	50	Ω
RA (at 25V)	2500	833	250	83	50	25	Ω

Note:

- The loop tester K4120A / K4118A 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.

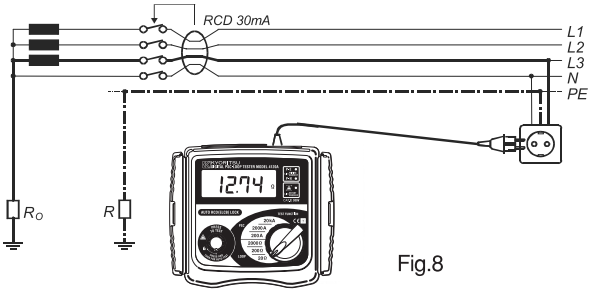


Fig.8

For this example max value is 1667Ω, the loop tester reads 12.74Ω, it means that the condition **RA≤50/Ia** 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:

Zs≤Uo/Ia

Where:

- **Zs** is the Fault loop impedance.
- **Uo** is the nominal voltage between phase to earth.
- **Ia** is the current causing the automatic disconnection of the protective device within the time stated in table as follows:

Uo (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), **Ia** is the rated residual operating current I⊿n.

For instance in a TN system with nominal mains voltage Uo = 230 V protected by gG fuses the **Ia** and max **Zs** values could be:

Rating (A)	Disconnecting time 5s		Disconnecting time 0.4s	
	Ia (A)	Zs (Ω)	Ia (A)	Zs (Ω)
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 K4120A and K4118A can be also tested the Prospective Fault current.
Prospective Fault current measured by instruments must be higher than **Ia** of the protective device concerned

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

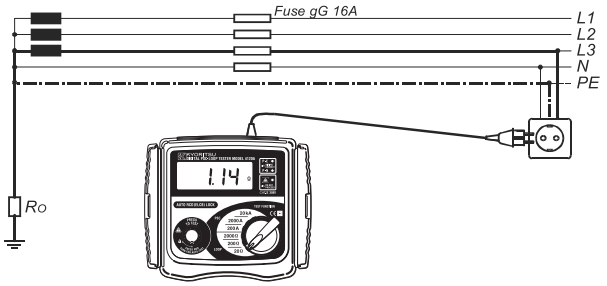


Fig.9

Max value of Zs for this example is 2.1 Ω (16A gG fuse, 0.4s) the loop tester reads 1.14 Ω (or 202 A on Fault current range) it means that the condition **Zs ≤Uo/Ia** is respected.
In fact the Zs of 1.14 Ω is less than 2.1 Ω (or the Fault current of 202 A is more than Ia 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.

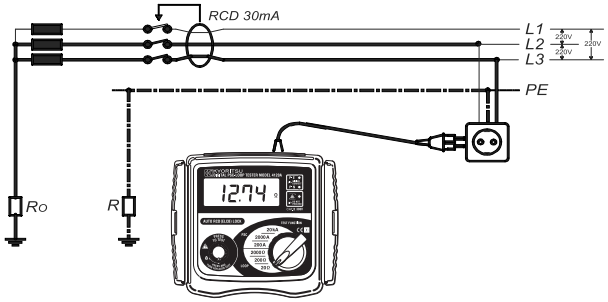


Fig.10

⚠ **WARNING** (OLD-TT system only)

- **DO NOT PRESS** the "Test button" if the display reads a value of 220V!
  The RCD could trip during the tests also with K4120A.

⚠ **CAUTION**

- The D-LOK circuit of K4120A can not works with 127V between phase to earth.

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 (only for K4120A and K4118A):

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

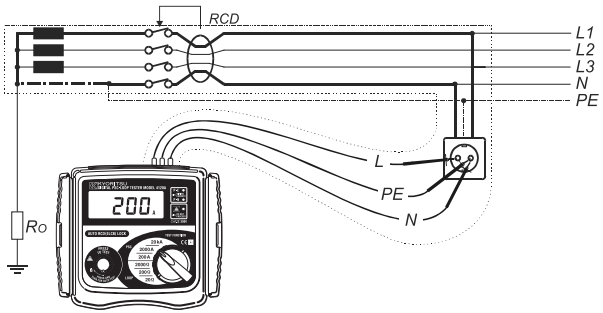


Fig.11

⚠ WARNING

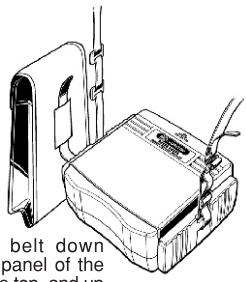
- This instrument is intended only for use in single phase operation at 230V +10% -15% AC phase to earth or for use in OLD-TT system phase to neutral.
- If the overheat symbol appears in the display ( ) disconnect the instrument from the mains supply and allow to cool down.
- When testing installation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

7. SERVICING

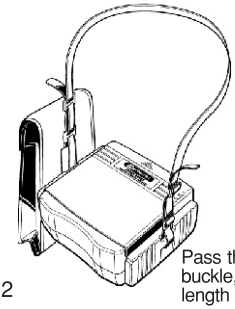
If this tester should fail to operate correctly, return it to your distributor stating the exact nature of the fault.
Please remember to give all the information possible concerning the nature of the fault, as this will mean that the instrument will be serviced and returned to you more quickly.

8. CASE AND STRAP BELT ASSEMBLY

Correct assembly is shown in Fig 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.



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

Fig.12

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