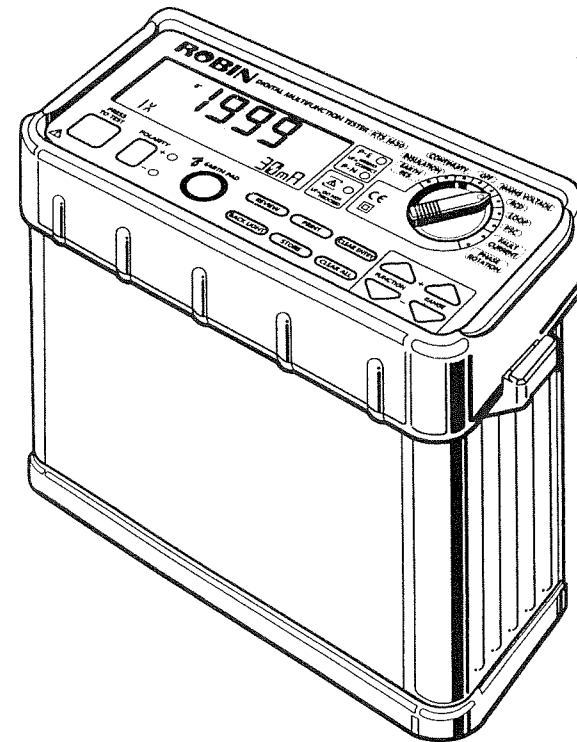


DISTRIBUTOR

INSTRUCTION MANUAL



ADVANCED MULTI-FUNCTION TESTER

MODEL KTS 1630

ROBIN

ROBIN ELECTRONICS LIMITED.

Precision Centre
Dwight Road, Watford, Herts
WD1 8HG, England
Sales Order Line 01923 218744
Administration Line 01923 232000
Fax.01923 218898

Contents


1. Safe Testing	3
2. Introduction	5
3. Instrument Layout	6
3.1 Front Panel	6
3.2 Test Terminals	7
3.3 Back Panel	8
3.4 Test Leads	9
3.5 LCD Display	10
4. Specifications	11
4.1 General Features	11
4.1.1 Earth Resistance	13
4.1.2 Insulation Resistance	13
4.1.3 Continuity	14
4.1.4 Mains Voltage	14
4.1.5 RCD	14
4.1.6 Loop Impedance	15
4.1.7 PSC Tests	16
4.1.8 Earth Fault	16
4.1.9 Phase Rotation	16
4.1.10 General	16
5. Testing	17
5.1 General Description	17
5.1.1 Rotary Function Switch	17
5.1.2 Test Button	17
5.1.3 Membrane Push Buttons	17
5.1.4 Earth Voltage Touchpad	18
5.2 General Safety Checks and Procedures before Testing	18
6. Continuity Testing	19
6.1 Instrument Layout	19
6.2 Test Procedure	19
7. Insulation Tests	21
7.1 The Nature of Insulation Resistance	21
7.1.1 Capacitive Current	21
7.1.2 Conduction Current	22
7.1.3 Surface Leakage Current	22
7.1.4 Total Leakage Current	23
7.1.5 Damage to Voltage-Sensitive Equipment	24
7.2 Preparation for Measurement	24
7.3 Insulation Testing	25

8. Mains Voltage Tests	26
9. Loop Impedance Tests	27
9.1 Voltage Measurement	27
9.1.1 What is Earth Fault Loop Impedance?	27
9.1.2 Automatic Over-Temperature Cut-Out	27
9.1.3 The Loop Impedance Test	27
9.2 Loop Impedance Testing	28
9.3 Loop Impedance at 3 Phase Equipment	29
10. Prospective Short Circuit Current (PSC) Tests	30
10.1 What is Prospective Short Circuit Current?	30
10.2 Testing Prospective Short Circuit Current	30
11. Earth Fault Current Tests	32
12. RCD Tests	33
12.1 Purpose of the RCD Test	33
12.2 What does the RCD Test do?	33
12.3 RCD Testing	34
12.4 Testing RCD's used to Provide Supplementary Protection	35
12.5 Testing Time Delayed RCD's	35
12.6 Testing DC Sensitive RCD's	35
12.7 AUTOTEST Procedure	36
13. Earth Resistance Tests	37
13.1 Normal Earth Resistance Measurement	37
13.2 Check for Overlapping Resistance Areas	38
13.3 Earth Resistance Measurement	39
14. Phase Rotation Tests	40
15. Memory Functions-Store , Clear and Printing	41
15.1 Storing Results	41
15.2 Storing	41
15.3 Clearing an Entry	42
15.4 Clearing the Store	42
15.5 Printing Information	43
16. Battery Replacement	44
17. Fuse Replacement	45
18. Servicing	45

There are corrections in the pages 18, 19, 25 and 41, and details of these corrections are explained in the addendum at the rear page of this manual.
Therefore, please refer this addendum.

1. Safe Testing

Electricity is dangerous and can cause injury and death when a lack of caution or poor safety practice is used. 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.

1. This instrument must only be used by a competent and trained person and operated in strict accordance with the instructions. Robin Electronics 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. They must always be observed when using the instrument.
3. This instrument is intended only for single phase operation at 230V AC 50Hz phase to earth or phase to neutral operation, and then only for loop, prospective short circuit current (PSC), mains voltage measurement, fault current measurement and RCD testing. The instrument can only be used on 3 phase 400V circuits for phase rotation indication only. No other 3 phase system testing must be undertaken with this instrument. For use in the continuity testing and insulation testing modes it must be used **ONLY** on circuits which are de-energised - ensure these are dead before proceeding.
4. When conducting tests, do not touch any exposed metalwork associated with the installation. Such metalwork may become live for the duration of the test.
5. Never open the instrument case except for fuse and battery replacement (and in this case disconnect all leads first) because dangerous voltages are present. Only fully trained and competent electrical engineers should open the case. If a fault develops, return the instrument to Robin Electronics for inspection and repair.
6. If the overheat symbol appears in the display () disconnect the instrument from the mains supply and allow to cool down.
7. For loop impedance tests on circuits containing residual current devices (RCD's) when not using the D-Lok function all RCD's must be taken out of the circuit and temporarily replaced with a suitably rated MCB unit. The RCD must be replaced after the loop test has been completed.
8. 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 Robin Electronics for repair.
9. For safety reasons only use accessories (test leads, probes, fuses, cases etc) designed to be used with this instrument and recommended by Robin Electronics. The use of other accessories is prohibited, as they are unlikely to have the correct safety features.

10. When testing, always be sure to keep your fingers behind the safety barriers on the test leads.
11. 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 Robin Electronics.
12. The sliding shutter on the top of the instrument is a safety device. The instrument should not be used if it is damaged or impaired in any way, but returned to Robin Electronics for attention.
13. Robin recommends the use of fused test leads particularly when measuring voltages in high energy circuits. Where assessments show that the risk is significant, then the use of fuse test leads constructed in accordance with the HSE Guidance Note GS38 should be used. The test accessories supplied with this product for working on live circuits are fused.
14. Do not operate the function selector switch whilst the instrument is connected to a circuit. If, for example, the instrument has just completed a continuity test and an insulation test is to follow, disconnect the test leads from the circuit before moving the selector switch.

2. Introduction

The KTS 1630 is an Advanced Multi-function Tester that provides all the test functions generally required to verify the safety of electrical installations. The unit has been designed to the requirements of BS7671 (IEE Wiring Regulations) and relevant safety standards.

The KTS1630 provides 10 separate test functions:

1. Earth resistance tests (3 or 4 wire)
2. Insulation tests
3. Continuity tests
4. Mains voltage measurement
5. RCD tests
6. Loop impedance tests
7. Prospective Short Circuit current (PSC) tests
8. Fault current tests
9. Phase rotation indication
10. Mains frequency measurement

The tester is designed to safety standards IEC 1010-1/BS EN 61010-1 CAT III (300V). In the insulation resistance testing mode the instrument provides a rated test current of 1mA as required by BS7671 and BS EN 61557-2 1997. In the continuity testing mode the instrument provides a short circuit test current of 200mA as required by BS7671 and BS EN 61557-4 1997.

The instrument has an on-board memory with the ability to store up to 999 individual test results. These can be down-loaded to a serial printer or computer by transmitting the data contained in the memory through the integral Infra Red Communication port (IR PORT) located on one side of the instrument. No physical connection to the printer or PC is required during the downloading operation. If your PC or Printer does not have an integral IR port then an IR adaptor is required from Robin Electronics.

The instrument is supplied as a complete kit and contains the following:

1. Digital Multi-function Tester
2. Distribution board test leads (1 set) for Loop and RCD testing
3. Model SL20 SNAP-LOK test leads (1 set)
4. Moulded plug test leads for Loop and RCD testing at sockets
5. Model SLP5 external earth probe
6. Earth resistance spikes (2 off)
7. Earth resistance test leads (1 set)
8. Accessory pouch
9. Durable Holdall
10. Batteries
11. Certificate of Conformity

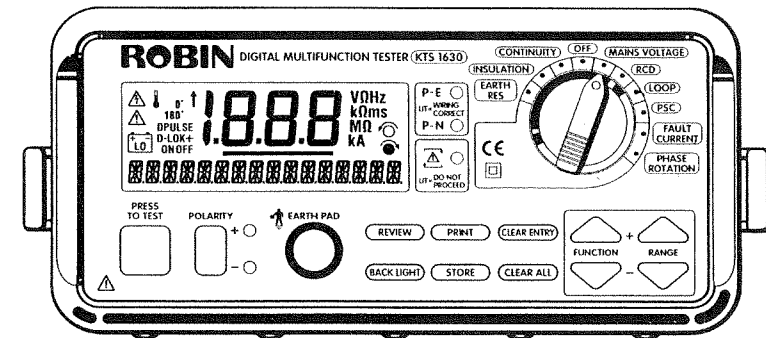
3. Instrument Layout

3.1 Front Panel (refer to fig 1)

All control switches and the instrument display are accessible on the front panel whilst test lead connections are made on the topside of the front panel.

The front panel contains the following:

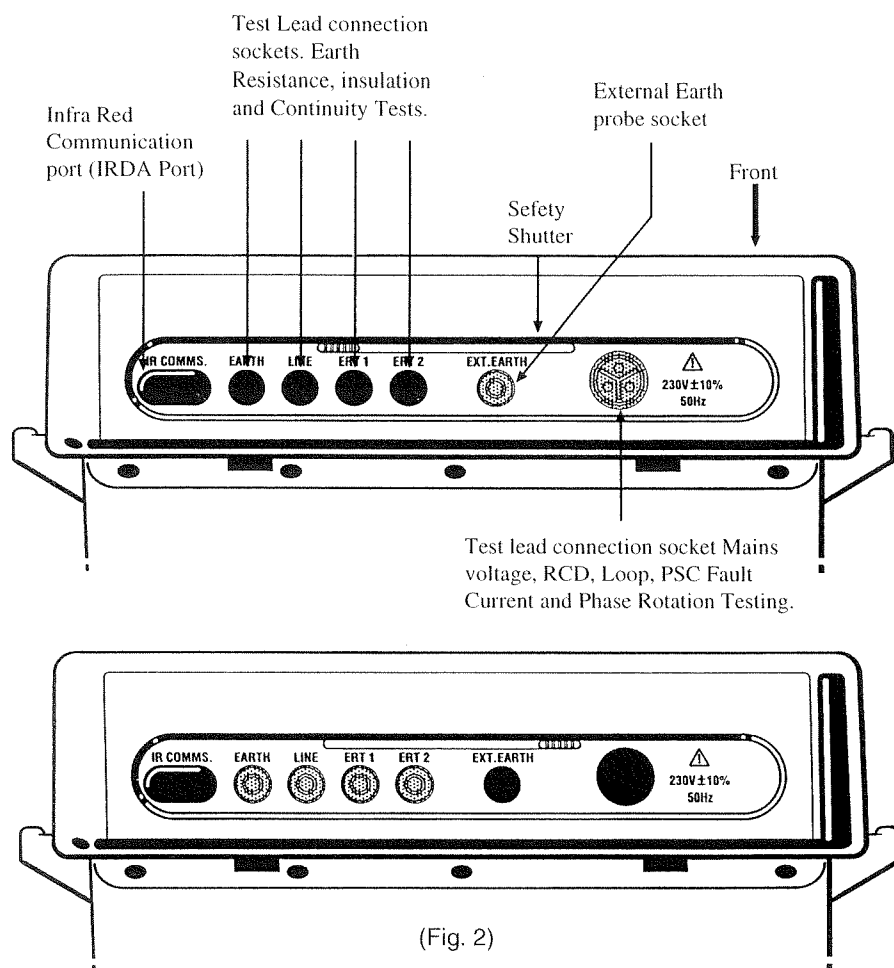
- LCD Display with backlight
- Main status and polarity LED indicators
- Rotary function switch
- Membrane type control buttons
- Earth Touch Pad



(Fig. 1)

3.2 Test Terminals (refer fig 2)

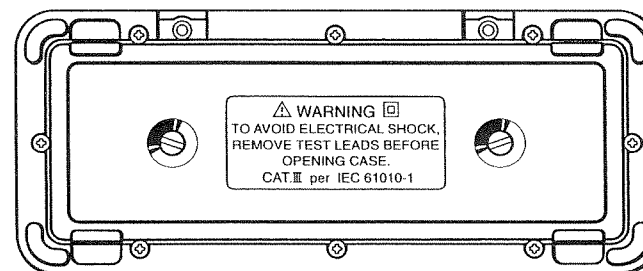
All of the instrument input terminals and the Irda port for communication are conveniently located above the front panel. When the instrument is being used with the shoulder strap the terminals are easily accessible for the connection of test leads. A sliding safety shutter mechanism prevents incorrect connection of test leads when the instrument is being used for different functions. To prevent incorrect connection of test leads and to maintain safety, the dedicated terminals used for continuity, insulation, and earth resistance tests are automatically covered when using the terminals for loop impedance, PSC, phase rotation, fault current and RCD tests. Note that the tester should not be used if this shutter is damaged in any way.



(Fig. 2)

3.3 Back Panel (refer fig 3)

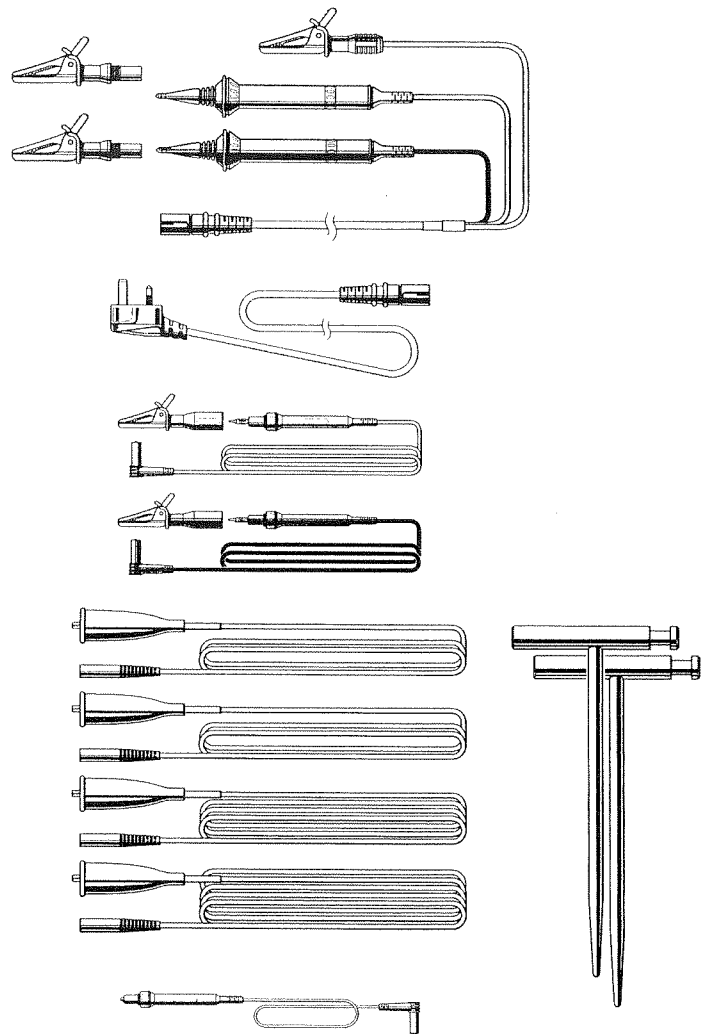
The removable back panel provides access to the instrument's battery compartment. The instrument is powered by 8 x 1.5V LR6 batteries. The back panel can be removed by unscrewing the two retaining screws and lifting off the panel.



(Fig. 3)

3.4 Test Leads (refer fig 4)

The instrument is supplied with all test leads required to perform each of the available functions. Be sure to use the correct leads for each particular type of test and only use the leads supplied with the instrument or suitable replacement parts from Robin Electronics. The use of non-standard test leads may result in instrument damage or personal injury.

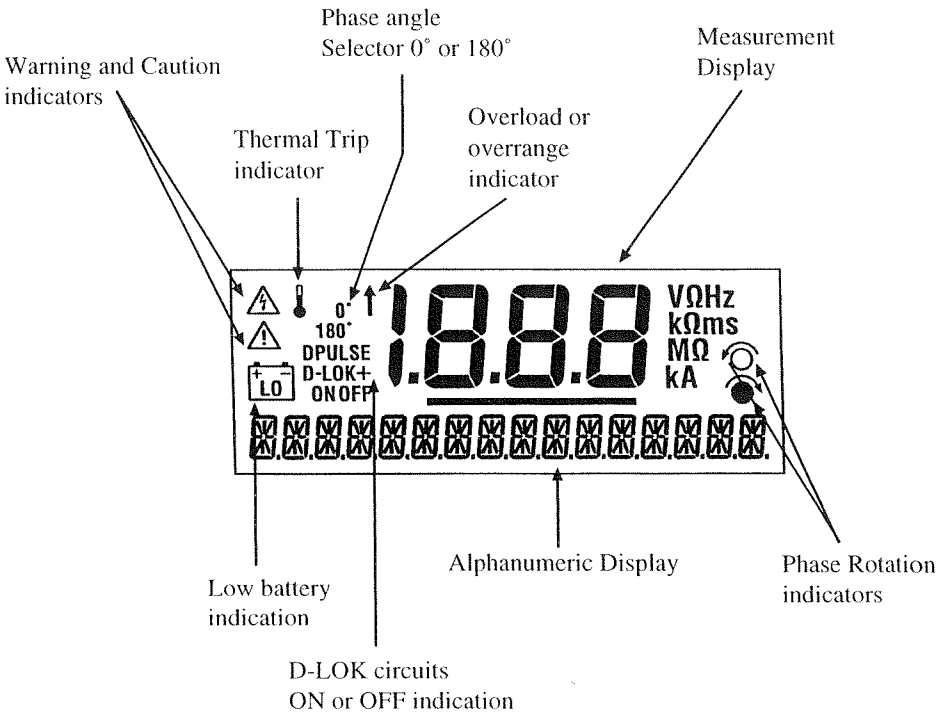


(Fig. 4)

3.5 LCD Display (refer to fig 5)

The multiplexed LCD has been designed to provide clear readings when used in general site conditions. The display provides all information regarding the type of tests being undertaken and prompts the user through the test sequence when required.

Refer to figure 5 below for a detailed overview of the indications that can be found in the LCD display.



(Fig. 5)

4. Specifications

4.1 General Features

The earth resistance function has the following features:

Voltage warning User warning display if voltage at input terminals is greater than 25V

Continuity and insulation resistance functions have the following features:

Live circuit warning Warning tone beeps and a warning message is shown on the LED display if the circuit under is live.
Continuity Null Allows automatic subtraction of test lead resistance from continuity measurements.
Polarity switch Allows switching of polarity during continuity and insulation tests.
Auto discharge Electric charges stored in capacitive circuits are discharged automatically after testing.

Loop impedance, PSC and RCD testing functions have the following features:

Voltage Measurement Supply voltage is displayed when the instrument is connected to the supply until the test button is pressed.
Wiring check Three LED' indicate if the wiring of the circuit under test is correctly connected.
Over temperature protection Detects overheating of the internal resistor (used for loop and PSC tests) and of the current MOS FET (used for RCD tests) 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. This will prevent tripping of some polarised RCDs when loop testing and may give a more accurate reading when testing RCDs.
DC test Allows testing of RCD's which are sensitive to DC fault currents.
Auto data hold Holds the displayed reading for a time after the test is complete.
Auto power off automatically switches the instrument off after a period of approximately 10 minutes of non-use. The power-off state returns to normal when the rotary switch is re-set to any power-on position or a voltage is input.
V-NE Monitoring Circuit Automatically aborts measurement when the N-E voltage rises to 50V greater on RCD ranges.

Fault current function has the following features;

High Resolution Resolution of 1A available for fault currents up to 2KA
Overload Protection Overload protection up to 450V@50Hz.

Phase rotation function has the following features;

Clear Indication indication of clockwise or anticlock wise rotation.
Over load Protection overload protection up to 450V@50Hz

Additional Features;

LED indication of live circuit warning Illuminates if there is an alternating voltage of 50V AC or more in the circuit under test before continuity or insulation resistance tests. When DC voltage is detected across the measuring terminal the LED lights up.
LED indication of correct Polarity The P-E and P-N illuminate when the wiring of the circuit under test is correct. The red LED lamp is lit when P and N are reversed.
Display The liquid crystal display has 3 1/2 digits with a decimal point and units of measurement (Ω, MΩ, A, kA, V and ms) relative to selected function. The display is updated approximately five times per second.
Overload protection The continuity test circuit is protected by a 0.5 A 600 V fact acting (HRC) ceramic fuse mounted in the battery compartment, where a spare fuse is also stored.

Measurement Specification

4.1.1. Earth Resistance

Function	Rang	Resolution	Accuracy
20 Ω	0-19.99 Ω	0.01 Ω	$\pm(2\%rdg+5dgt)$
200 Ω	0-199.9 Ω	0.1 Ω	$\pm(2\%rdg+3dgt)$
2000 Ω	0-1999 Ω	1 Ω	$\pm(2\%rdg+3dgt)$

Output Voltage 70V peak to peak square wave
 Frequency 720Hz \pm 5%
 Max Current 2mA (current limited)
 Overload protection: 450V @ 50Hz

4.1.2. Insulation resistance

Test voltage	Range	Resolution	Rated Current	Accuracy
250V	20M Ω	0.01M Ω	1mA@250k Ω	$\pm(2\%rdg+3dgt)$ 0-20M Ω
250V	200M Ω	0.1M Ω	1mA@250k Ω	$\pm(2\%rdg+3dgt)$ 0-200M Ω
250V	2000M Ω	1M Ω	1mA@250k Ω	$\pm(2\%rdg+3dgt)$ 0-100M Ω $\pm(2\%rdg+4dgt)$ >100M Ω -2000M Ω
500V	20M Ω	0.01M Ω	1mA@500k Ω	$\pm(2\%rdg+3dgt)$ 0-20M Ω
500V	200M Ω	0.1M Ω	1mA@500k Ω	$\pm(2\%rdg+3dgt)$ 0-200M Ω
500V	2000M Ω	1M Ω	1mA@500k Ω	$\pm(2\%rdg+3dgt)$ 0-100M Ω $\pm(2\%rdg+4dgt)$ >100M Ω -2000M Ω
1000V	20M Ω	0.01M Ω	1mA@1M Ω	$\pm(2\%rdg+3dgt)$ 0-20M Ω
1000V	200M Ω	0.1M Ω	1mA@1M Ω	$\pm(2\%rdg+3dgt)$ 0-200M Ω
1000V	2000M Ω	1M Ω	1mA@1M Ω	$\pm(2\%rdg+3dgt)$ 0-100M Ω $\pm(2\%rdg+4dgt)$ >100M Ω -2000M Ω

Accuracy's quoted for circuit capacitance less than 100nF
 Overload protection: 450V @ 50Hz

4.1.3. Continuity

Function	Range	Resolution	Short Circuit Current	Accuracy
20 Ω	0-19.99 Ω	0.01 Ω	>200mA	$\pm(1.5\%rdg+5dgt)$
200 Ω	0-199.9 Ω	0.1 Ω	>200mA	$\pm(1.5\%rdg+3dgt)$
2000 Ω	0-1999 Ω	1 Ω	>200mA	$\pm(2.5\%rdg+3dgt)$

Auto Null functional for up to 10 Ω of lead resistance
 Overload protection: 600V @ 50Hz

4.1.4. Mains Voltage

Function	Range	Resolution	Accuracy
Mains	0-450V	1V	$\pm(2\%rdg\pm 1dgt)$
Frequency	45.0-64.9Hz	0.1Hz	$\pm(0.5\%rdg\pm 1dgt)$

Overload protection: 450V @ 50Hz

4.1.5. RCD

Rated Voltage: 230V (200V - 260V) @ 50Hz
 Overload protection: 450V @ 50Hz

Range	Factor	I Δ n mA	Test Current (mA)		Max Time (ms)
				Accuracy's	
RCD	X0.5	10/30/100/300/500	5/15/150/250	+0% -6% of range	2000
RCD	X1	10/30/100/300/500	10/30/100/300/500	\pm 5% of range	2000
RCD*	X5	10/30/100/300/500	50/150/500/1500/-	\pm 5% of range	200
DC(6mA dc)	-	10/30/100/300/500	(10/30/100/300/500) + 6mA dc	\pm 10% of range	2000
AUTOTEST*	-	10/30/100/300	-	\pm 5% of range	Variable
FAST TRIP	-	30	150	\pm 5% of range	50
AUTORAMP	-	10/30/100/300/500	10/30/100/300/500 (max)	\pm 5% of range	2000

Rated Voltage: 120V (100V - 130V) @ 50Hz

Range	Factor	I Δ n mA	Test Current (mA)		Max Time (ms)
				Accuracy's	
RCD	X0.5	10/30/100/300/500	5/15/150/250	+0% -6% of range	2000
RCD	X1	10/30/100/300	10/30/100/300/500	$\pm 5\%$ of range	2000
RCD*	X5	10/30/100/300/500	50/150/500/1500/-	$\pm 5\%$ of range	200
DC(6mA dc)	-	10/30/100/300/500	(10/30/100/300/500) + 6mA dc	$\pm 10\%$ of range	2000
AUTOTEST*	-	10/30/100/300	-	$\pm 5\%$ of range	Variable
FAST TRIP	-	30	150	$\pm 5\%$ of range	50
AUTORAMP	-	10/30/100/300/500	10/30/100/300/500 (max)	$\pm 5\%$ of range	2000

*The test signal is current limited to a maximum of 1500mA so 5 x 500mA is not allowed. Accuracy's quoted assume an external loop impedance upto 20 ohm max.

The test currents are controlled up to 1000mA at a 200-260V and 100-130V. AT 5 x 300mA and autotest 5 x 300mA the accuracies are only valid for a P-E loop of 1 Ω maximum.

Test current	Duration	Function	Resolution	Accuracy
0-199.9ms		1/2X 10mA.30mA	0.1ms	$\pm (5\% \text{rdg} + 5 \text{dgt})$
		1X 10mA		
		All other ranges	0.1ms	$\pm (2\% \text{rdg} + 5 \text{dgt})$
200-2000 ms		All ranges	1ms	$\pm (2\% \text{rdg} + 5 \text{dgt})$

4.1.6. Loop Impedance

Rated Voltage: 230V @ 50Hz
Overload protection: 450V @ 50Hz

Function	Range	Resolution	Current	Accuracy
20 Ω	0-19.99 Ω	0.01 Ω	25A@230V	$\pm (5\% \text{rdg} + 5 \text{dgt}) @ 230V$
200 Ω	0-199.9 Ω	0.1 Ω	1.2A@230V	$\pm (3\% \text{rdg} + 5 \text{dgt}) @ 230V$
2000 Ω	0-1999 Ω	1 Ω	1.2A@230V	$\pm (3\% \text{rdg} + 5 \text{dgt}) @ 230V$

4.1.7. PSC Tests

Rated Voltage: 230V @ 50Hz
Overload protection: 450V @ 50Hz

Function	Range	Resolution	Current	Accuracy
2KA	0-1999A	1A	1.2A@230V	$\pm (10\% \text{rdg} + 5 \text{dgt}) @ 230V$
20KA	0-19.99kA	0.01kA	25A@230V	Derived from Loop impedance value

4.1.8. Earth Fault


Rated Voltage: 230V @ 50Hz
Overload protection: 450V @ 50Hz


Function	Range	Resolution	Current	Accuracy
2KA	0-1999A	1A	1.2A@230V	$\pm (10\% \text{rdg} + 5 \text{dgt}) @ 230V$
20KA	0-19.99kA	0.01kA	25A@230V	Derived from Loop impedance value

4.1.9. Phase Rotation

Rated Voltage: 230V @ 50Hz
Overload protection: 450V @ 50Hz

4.1.10. General

Over range indication	“  ” Symbol appears in the display
Operating temperature range	0° to + 40°C
Storage temperature range	-10 to + 60°C
Altitude	Up to 2000m
Operating Relative Humidity	75% or less, no condensation
Storage Relative Humidity	75% or less, no condensation
Weight	1.924kg
Power Supply	8 x 1.5v LR6

Low battery warning “” symbol appears in the display and the buzzer beeps if the battery voltage drops below 9.0V

Dimensions	210 x 105 x 240mm
Pollution Degree	2
Enclosure	Designed to comply with IP54
Safety	BS EN 61010-1 CAT III 300V
Performance	BS EN 61557 parts 1,2,3,4,5,6,7,8. BS 7671

5. Testing *REFER TO ADDENDUM*

5.1 General Description

Refer to section 3 Instrument layout details.

The front panel has the following controls:

5.1.1. Rotary Function Switch

Position	Name	Test function
1	Earth Res	Earth resistance test
2	Insulation1MΩ	Insulation test
3	Continuity	Continuity test
4	Off	Power off position
5	Mains Voltage	Unit displays mains (P-N) or N-E Voltage
6	RCD	RCD tests
7	Loop	Phase to earth loop impedance tests
8	PSC	Phase to Neutral (P-N) prospective short circuit current test
9	Earth Fault	Phase to Earth (P-E) prospective short circuit current test
10	Phase Rotation	3 phase rotation indication

5.1.2. Test Button

The “Press to test” button initiates all tests

5.1.3. Membrane Push buttons

There are 10 membrane push buttons.

Store	Enters the result shown on the display into the internal memory
Clear Entry	Clears an entry from the memory
Clear All	Clears the entire memory
Print	Outputs the stored data in the memory to a printer or computer

- Range	Selects the previous test range
+ Range	Selects the next test range
- Function	Selects the previous test function
+ Function	Selects the next test function
Polarity	This selects the insulation/continuity output polarity and RCD start phase and Loop/PSC/Earth Fault pulse polarity (with D-Lok off only)
Back-light	Turns on the display back light for approximately 30 seconds when pressed. The back-light automatically extinguishes after this time.
Review	Initiates the display of the second screen of results where applicable

5.1.4. Earth Voltage Touchpad

This is a conductive pad located on the front panel to check the integrity of the testers earth connection and operates in all modes. This feature provides a display indication if a voltage greater than 50V exists between the earth connection of the tester and you.

1. In any mode touch a finger to the metal disc on the instrument front panel. This is a safe operation and there is no danger.
2. If a voltage greater than 50V exists between your finger and the earth connection the instrument will display “>50V”.

5.2 General Safety Checks and Procedures Before Testing

Always check your instrument and all test leads for abnormality or damage before testing. If there is any doubt do not proceed and return the instrument to Robin Electronics to be repaired and/or inspected.

For Insulation, Continuity and Earth Resistance testing the circuits must not be live-**check first**. If at any time the mains LED’s illuminate or the voltage warning buzzer sounds stop immediately. The circuit is live and needs to be de-energised. Please note that the energy stored in charged capacitors or capacitive circuits can also be dangerous.

When conducting Loop, RCD, PSC and earth fault tests ensure the mains status LED’s are lit in the following sequence:

- P-E Green LED must be ON
- P-N Green LED must be ON
- Red LED must be OFF

If the above sequence is not displayed or the Red LED is ON for any reason do not proceed as there may be incorrect wiring. NOTE: When carrying out Phase rotation tests all three LED’s will be lit which is normal . Always check that the low battery flag is not showing. If it is, replace the batteries before proceeding.

6. Continuity Testing *REFER TO ADDENDUM*

Warning

Ensure that the Circuits are de-energised before proceeding

6.1 Instrument layout (see section 3)

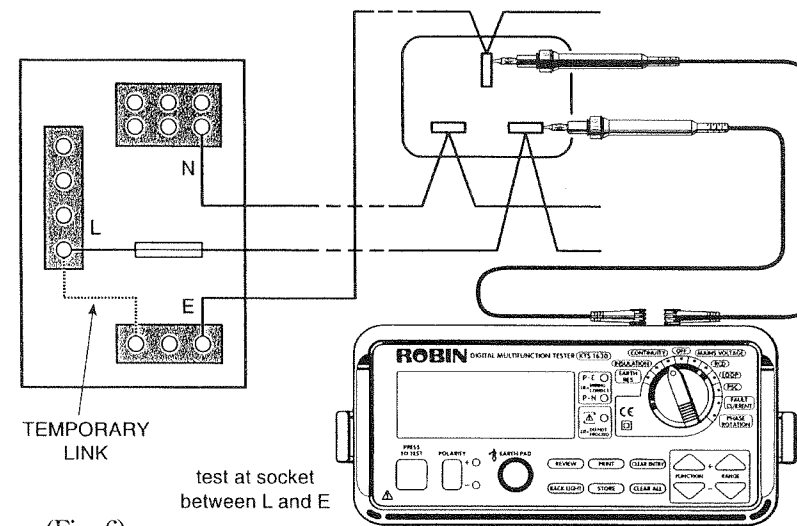
6.2 Test Procedure

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 KTS 1630 is provided with a continuity null feature which allows automatic compensation for any test lead resistance.

Proceed as follows:

1. Select the Continuity function on the rotary function switch
2. Connect the SL20 leads to the continuity input terminals marked Earth and Line
3. Press the Range + or - keys to select the range required 20Ω , 200Ω , 2000Ω . Press the Function + or - keys to enter the test leads null mode. The display will ask you to short the test leads and press the test button.
4. Short the leads firmly together and press the test button. The KTS 1630 will display and memorise the test lead resistance. Press the Function + and - keys to enter the continuity mode after the display has stabilized. Check that shorting the test leads and pressing the test button reads zero on the display.
5. Connect to the circuit under test (see **fig6** for a typical connection arrangement) Check that the circuit is **not live**. Note that the circuit warning lamp will illuminate if the circuit is live. Press the test button to take a measurement. If required press the STORE button to store the result in the KTS1630 memory.
6. Note that if the circuit resistance is greater than the range selected the symbol "↑" will appear in the display and you will need to select the next range by pressing the Range keys.

NOTE: The value of the leads resistance will be held in the memory and automatically subtracted from all measurements. If the KTS1630 is switched off and then on again this stored value is lost and you must repeat the leads null procedure. Before testing you should always check the continuity of the test leads to ensure they are not open circuit or have a high resistance. If you quickly switch pass the OFF position the stored value of the leads resistance may be lost as well- it always best to check that the display shows zero before proceeding with a testing session.



(Fig. 6)

The KTS 1630 is provided with a facility to change the polarity of the test current used by the instrument during continuity tests.

This can overcome effects caused by the polarisation of the installation during which may cause inaccurate readings. To use this function proceed as follows;

1. Perform a continuity test as outlined in the procedures above
2. Operate the polarity key to change the polarity +VE or -VE.
3. Repeat the continuity test and the polarity of the test current will be reversed
4. A comparison can then be made between the two test results which should give the same reading under normal circumstances.

7. Insulation Tests

Warning

Ensure that the Circuits are de-energised before proceeding

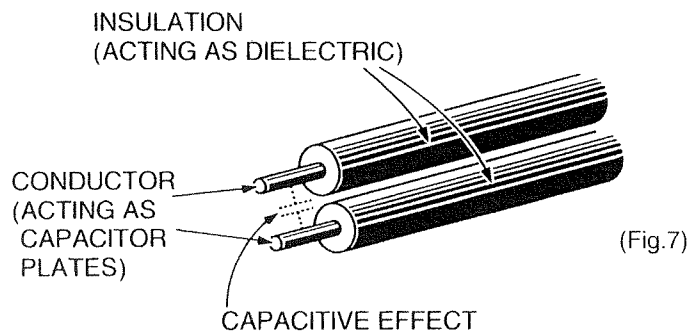
7.1 The nature of insulation resistance

Live conductors are separated from each other and from earth by insulation, which has a resistance which is high enough to ensure that the current between conductors and to earth is kept at an acceptably low level. Ideally insulation resistance is infinite and no current should be able to flow through it. In practice, there will normally be a current between live conductors and to earth, and this is known as leakage current. This current is made up of three components, which are:

1. capacitive current
2. conduction current
3. surface leakage current.

7.1.1. Capacitive Current

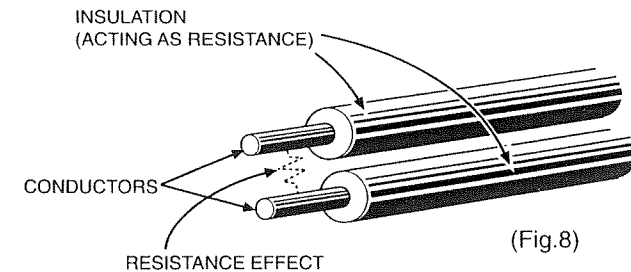
The insulation between conductors which have a potential difference between them behaves as the dielectric of a capacitor, the conductors acting as the capacitor plates. When a direct voltage is applied to the conductors, a charging current will flow to the system which will die away to zero (usually less than a second) when the effective capacitor becomes charged. This charge must be removed from the system at the end of a test, a function which is automatically performed by the KTS 1630. If an alternating voltage is applied between the conductors, the system continuously charges and discharges as the applied voltage alternates, so that there is a continuous alternating leakage current flowing to the system.



7.1.2. Conduction Current

Since the installation resistance is not infinite, a small leakage current flows through the insulation between conductors. Since Ohm's Law applies, the leakage current can be calculated from

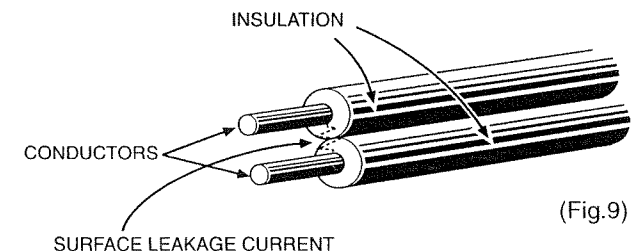
$$\text{Leakage current } (\mu\text{A}) = \frac{\text{Applied voltage (V)}}{\text{Insulation resistance (M}\Omega\text{)}}$$



7.1.3. Surface Leakage Current

Where insulation is removed, for the connection of conductors and so on, current will flow across the surfaces of the insulation between the bare conductors. The amount of leakage current depends on the condition of the surfaces of the insulation between the conductors. If the surfaces are clean and dry, the value of the leakage current will be very small. Where the surfaces are wet and/or dirty, the surface leakage current may be significant. If it becomes large enough, it may constitute a flashover between the conductors.

Whether this happens depends on the condition of the insulation surfaces and on the applied voltage; this is why insulation tests are carried out at higher voltages than those normally applying to the circuit concerned.



7.1.4. Total Leakage Current

The total leakage current is the sum of the capacitive, conduction and surface leakage current described above. Each of the currents, and hence the total leakage current, is affected by factors such as ambient temperature, conductor temperature, humidity and the applied voltage.

If the circuit has alternating voltage applied, the capacitive current (7.1.2) will always be present and can never be eliminated. This is why a direct voltage is used for insulation resistance measurement, the leakage current in this case quickly falling to zero so that it has no effect on the measurement. A high voltage is used because this will often break down poor insulation and cause flashover due to surface leakage (see 7.1.4), thus showing up potential faults which would not be present at lower levels. The insulation tester measures the applied voltage level and the leakage current through the insulation. These values are internally calculated to give the insulation resistance using the expression:-

$$\text{Insulation resistance (M } \Omega) = \frac{\text{Test voltage (V)}}{\text{Leakage Current (} \mu \text{ A)}}$$

As the capacitance of the system charges up, so the charging current falls to zero and a steady insulation resistance reading indicates that the capacitance of the system is fully charged. The system is charged to the full test voltage, and will be dangerous if left with this charge. The KTS 1630 provides an automatic path for discharging current as soon as the test is complete to ensure that the circuit under test is safely discharged.

If the wiring system is wet and/or dirty, the surface leakage component of the leakage current will be high, resulting in low insulation resistance reading. In the case of a very large electrical installation, all the individual circuit insulation resistance's are effectively in parallel and the overall resistance reading will be low. The greater the number of circuits connected in parallel the lower will be the overall insulation resistance.


7.1.5. Damage to Voltage-Sensitive Equipment

An increasing number of electronic-based items of equipment are being connected to electrical installations. The solid state circuits in such equipment are likely to be damaged by the application of the levels of voltage used to test insulation resistance. To prevent such damage, it is important that voltage-sensitive equipment is disconnected from the installation before the test is carried out and reconnected again immediately afterwards. The devices which may need to be disconnected before the test include:-

- Electronic fluorescent starter switches
- Security system detection devices (eg. PIR's)
- Dimmer switches
- Touch switches
- Delay timers
- Power controllers
- Emergency lighting units
- Electronic RCDs
- Computers and printers
- Electronic point-of-sale terminals (cash registers)
- Any other device which includes electronic components

7.2 Preparation for measurement

Before testing, always check the following:-

1. The low battery indication “” is not displayed
2. There is no visually obvious damage to the tester or to the test leads
3. Test the continuity of the test leads by switching to continuity test and shorting out the ends. A high reading is will indicate that there is a faulty lead.
4. MAKE SURE THAT THE CIRCUIT TO BE TESTED IS NOT LIVE. A warning lamp is lit if the instrument is connected to a live circuit but test the circuit as well !

7.3 Insulation Testing *REFER TO ADDENDUM*

Warning

Ensure that the Circuits are de-energised before proceeding

Proceed as follows:

1. Select the Insulation function on the Rotary function switch
2. Connect the SL20 test leads to the Insulation input terminals marked Earth and Line
3. Press the Function + or - keys to select the required insulation test voltage 250V, 500V or 1000V
4. Press the Range + or - keys to select the required range 20M Ω , 200M Ω or 2000M Ω
5. Connect the leads to the circuit under test. Press the test button to take a measurement. Press Store to store the result if required. NOTE: it is important that you release the test button before disconnecting the test leads to allow for any stored capacitive or inductive charges to decay. If a charge is present the tester will indicate this by displaying a voltage which will decay to zero after which you may disconnect the leads.

NOTE: If the measured value is greater than 2000M the overrange symbol “↑” will be displayed.

CAUTION

Never turn the function selector switch whilst the test button is depressed as this may damage the instrument.

Never touch the circuit, test lead tips or the appliance under test during insulation testing.

8. Mains Voltage Tests

Proceed as follows:

1. Select the mains function by turning the rotary selector switch to the mains voltage position.
2. Connect the moulded plug lead or the distribution board test leads to the circuit to be tested.
3. The display will show the mains voltage (P-N). Pressing the REVIEW key will toggle the display between P-N voltage, N-E voltage and frequency.
4. The colour coded LED's will indicate correct polarity as follows:

P-E Green LED must be ON
P-N Green LED must be ON
Red LED must be OFF

If the above sequence is not displayed or the Red LED is ON for any reason do not proceed as there may be incorrect wiring.

9. Loop Impedance Tests


9.1 Voltage Measurement

If you wish to measure the mains voltage before performing a loop impedance test use the separate mains voltage measurement function first. This voltage display is automatically updated five times every second.

9.1.1. What is earth fault loop impedance?

The path followed by fault current as a result of a low impedance fault occurring between the phase conductor and earth is called earth fault loop. Fault current is driven round the loop by the supply voltage, the amount of current flowing depends on the voltage of the supply and on the impedance of the loop. The higher the impedance, the lower will be the fault current and the longer it will take for the circuit protection (fuse or circuit breaker) to operate and interrupt the fault. To make sure that fuses will blow or that circuit breakers will operate quickly enough in the event of a fault, the loop impedance must be low, the actual maximum value depending on the characteristics of the fuse or the circuit breaker concerned. The IEE Wiring Regulations (BS 7671) provides tables showing the maximum permissible values of loop impedance in circuits protected by various fuses and circuit breakers. Every circuit must be tested to make sure that the actual loop impedance does not exceed that specified for the protective device concerned.

9.1.2. Automatic over-temperature cut-out

During the short test period the instrument dissipates power of about 6 kW. If frequent tests are conducted over a prolonged period of time, the internal test resistor will overheat. When this happens, further tests are automatically inhibited and the over-temperature symbol () appears in the display. The instrument must then be left to cool down, when testing may be resumed.

9.1.3. The loop impedance test

Since the earth fault loop is made up of a conducting path which includes the supply system back to the supply transformer, it follows that loop testing can only be carried out after the mains supply has been connected. In many cases, any RCD in the circuit will be tripped by this test, which draws current from the phase and returns it through the earth system. The RCD will see this as the type of fault it is designed to protect against, and will trip. To prevent this unwanted RCD tripping during loop testing, the KTS1630 is provided with D-Lok circuits which will prevent the tripping of most passive type RCD's when performing a loop impedance test. Any RCD that is not protected from tripping by the D-Lok system must be taken out of the circuit and temporarily replaced with a suitably rated MCB unit for the duration of the test. The RCD will need to be replaced after the loop test is completed.

9.2 Loop Impedance Testing

WARNING


DO NOT PROCEED WITH TESTING UNLESS THE P-E AND P-N LED'S ARE LIT TO CONFIRM THAT WIRING IS CORRECTLY CONNECTED. Should these two lamps not be lit, investigate the wiring connection of the installation and rectify any faults before proceeding with the test. If the red Led is lit DO NOT Proceed.

Proceed as follows for testing at socket outlets:

1. Select the Loop Function on the Rotary switch
2. Connect the socket mains lead to the tester and the circuit under test
3. Check the LED's are lit as follows:

P-E Green LED must be ON
P-N Green LED must be ON
Red LED must be OFF

If the above sequence is not displayed or the Red LED is ON for any reason do not proceed as there may be incorrect wiring.

4. Press the Range + or - keys to select the required range 20 Ω , 200 Ω or 2000 Ω
5. Press the Function + or - keys to switch the D-Lok circuits ON or OFF. A flag will appear in the display informing you whether the circuits are on or off. Always switch the circuits on if you wish to bypass an RCD in the circuit (Note that D-Lok bypasses most passive type RCD's). If there is no RCD in the circuit then keep D-Lok off as this reduces the amount of heat generated by the test and hence increases the number of tests possible in a given period of time.
6. Press the test button to take a reading. Note for very low values of loop impedance it is a good idea to take more than one reading and then average the results.
7. If the measured value is greater than the range selected the overrange symbol "  " will appear in the display and you will need to switch up a range using the Range keys and repeat the test.

NOTE: if D-Lok is off you can also use the POLARITY switch to reverse the direction of the Loop pulse which may result in bypassing some types of RCD. On certain circuits and when using the D-Lok function the test may take up to 10 seconds for a reading to be displayed, this is normal and there is no fault with the instrument.

Distribution Board

The procedure for testing at a distribution board is the same except you must use the distribution board test lead. In this case connect the red prod to Phase, the black prod to Neutral and the green earth clip to Earth. If you require a phase neutral loop reading simply connect the green earth clip to the same point as the black prod i.e the neutral of the test circuit (in this case the LED status indicators will not show any polarity fault). Alternatively you can use the two wire lead available.

External earth probe: the phase-earth loop impedance of exposed metalwork (e.g. pipes/conduit etc) can be tested using the external earth probe. Connect the unit to the socket as normal. Plug the external earth probe into the instrument external earth probe socket, ensuring the probe is held with fingers behind the finger guard. This will break the earth continuity at the socket and the red LED will switch on. The point at which the probe is now connected becomes the new earth point instead of at the socket. The Led mains status should revert to the correct sequence as previously described. When this happens, press the test button to measure the loop impedance.

9.3 Loop impedance at 3 phase equipment

Use the same procedure as in 9.2 (distribution Board) above ensuring that only one phase is connected at a time i.e: First Test: red prod to phase 1, black prod to neutral, green crocodile clip to earth.

Second Test: red prod to phase 2, black prod to neutral, green crocodile clip to earth etc.

WARNING : NEVER CONNECT THE INSTRUMENT TO TWO PHASES AT THE SAME TIME

Note: Testing as described in 9.2 and 9.3 above will measure the Phase-earth loop impedance. If you wish to measure the Phase-Neutral loop impedance then the same procedure should be followed except the earth clip should be connected to the neutral of the system i.e: the same point as the black neutral probe. If the system has no neutral then you must connect the black probe to the earth i.e: the same point as the green earth clip. This will only work if there is no RCD in this type of system as the operating current of the tester may cause the RCD to trip.

10. Prospective Short Circuit Current (PSC) Tests

WARNING

NEVER CONNECT THE INSTRUMENT ACROSS 2 PHASES. NEVER ATTEMPT TO MEASURE THE PHASE TO PHASE PROSPECTIVE SHORT CIRCUIT CURRENT.

10.1 What is Prospective Short Circuit Current?

The 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 (PSC) can be used to check that protective devices within the system will operate within safety limits and in accordance with the safe design of the installation.

10.2 Testing Prospective Short Circuit Current

PSC is normally measured at the distribution board between the phase and neutral, or at a socket outlet between phase and earth.

If testing at a distribution board proceed as follows:

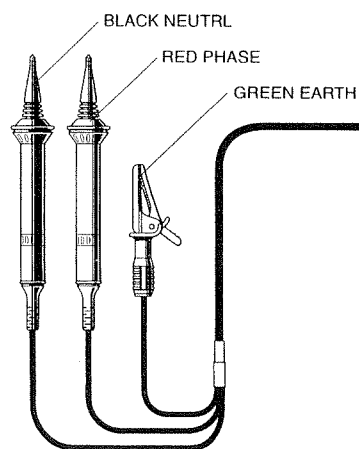
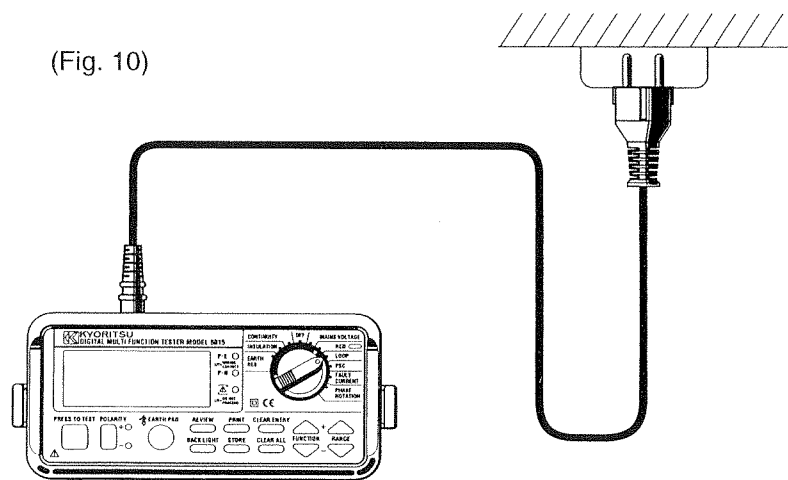
1. Select the ^{PSC}~~loop~~ function on the rotary switch
2. Select the 2000A or 20kA range using the Range + or - keys
3. Connect the distribution board test lead to the socket on the instrument
4. Connect the red phase probe of the test lead to the phase of the system, the black probe to the neutral of the system and the green crocodile clip to the neutral of the system, check that the wiring connection LED'S are lit correctly.
5. Press the test button. A bleep will sound as the test is conducted and the value of PSC will be displayed
6. Wait for the display to clear to zero before conducting another test or disconnecting the instrument. It is good practice to disconnect the phase lead first.

NOTE: For Loop impedance's greater than 50Ω (PSC less than 5A approx.) it is not possible to obtain an accurate PSC reading and the unit will lock out the PSC range by displaying the "↑" over-range symbol.

If the PSC ranges are selected whilst connected to a socket outlet via the mains plug test lead, a test will take place between Phase and Earth due to fixed wiring of the moulded mains plug i.e a **Phase-earth fault current** test.

NOTE: PSC testing generates more power than loop testing so do not carry out more tests than the minimum required as the overheat circuits will operate quicker.

(Fig. 10)



(Fig. 11)

11. Earth Fault Current Tests

WARNING

NEVER CONNECT THE INSTRUMENT ACROSS 2 PHASES. NEVER ATTEMPT TO MEASURE THE PHASE TO PHASE PROSPECTIVE FAULT CURRENT.

Follow the same procedure as for PSC but select the earth fault range on the rotary switch. Note that if you are testing a distribution board with the distribution board test lead you must connect the red prod to the phase, and the black prod to the neutral and the green earth clip to the earth of the system to obtain the correct result.

NOTE: Earth fault current testing generates more power than loop testing so do not carry out more tests than the minimum required as the overheat circuits will operate quicker.

12. RCD Tests

12.1 Purpose of the RCD Test

The RCD must be tested to ensure that operation takes place quickly enough to ensure that there is unlikely to be serious danger to a person experiencing an electric shock from the system. This test must NOT be confused with that taking place when the “Test” button on the RCD is pressed; operation of the test button simply trips the breaker to ensure that it is working, but does not measure the time taken to break the circuit.

12.2 What does the RCD Test do?

The RCD is designed to trip out when the difference between the phase current and the neutral current (this is called the residual current) reaches the tripping value (or rating) of the device. The tester provides a carefully pre-set value of residual current depending on its setting and then measures the time lapse between the application of the current and the operation of the RCD.

The general procedure is as follows:

1. Select the RCD function on the Rotary Switch
2. Press the Function + or - keys to select the required test type. The following options are available.

1/2X	For testing RCD's to verify that they are not too sensitive
1X	For measuring the trip time
1X S type	For testing s type RCD's (delayed type)
5X	For testing at 5x I Δ N
AUTO-RAMP	For finding out the exact value of current that the RCD trips at
FASTRIP	For testing 30mA RCD's installed for supplementary protection
DC	For testing DC sensitive RCD's
AUTO-TEST	For carrying out a sequence of tests automatically
3. Whichever test is selected use the POLARITY button to set 0° phase or 180° phase (this does not apply to the AUTOTEST).
4. Press the Range + or - keys to select the RCD rated current. The following options are available
10/30/100/300/500 mA.

CAUTION: Settings up to 300mA are effective in the RCD x5 function. In 500/1000mA range current value is limited to 1.5A. Also, settings up to 500mA are effective in the RCD DC function.

12.3 RCD Testing

Proceed as follows:

1. Set the RCD rated tripping switch to the trip rating of the RCD under test
2. Use the Function + or - keys to select X1/2 from the “no trip” test, which ensures that the RCD is operating within its specification and is not too sensitive.
3. Press the polarity switch to indicate 0° in the display
4. Connect the instrument to the RCD to be tested either via a suitable socket outlet (see fig 10) or using the Distribution Board test lead set (SEE FIG 10)
5. Make sure that the P-E and P-N wiring check lamps are lit and the wiring incorrect Red LED is not lit. If they are not, disconnect the tester and check the wiring for a possible fault
6. If the lamps are correctly lit, press the test button to apply half rated tripping current for 2000 ms, when the RCD should not trip. The PN and PE LEDs should remain on indicating the RCD has not tripped.
7. Press the polarity switch to indicate 180° in the display and repeat the test.
8. In the event of the RCD tripping, the trip time will be displayed, but the RCD may be faulty
9. Use the Function + or - keys to select X1 for the “trip” test, which measures the time taken for the RCD to trip with the set residual current.
10. Press the polarity switch to indicate 0° on the display
11. Make sure that the P-E and P-N wiring check lamps are lit. If they are not, disconnect the tester and check the wiring for a possible fault.
12. If the lamps are lit, press the test button to apply full rated tripping current and the RCD should trip, the tripping time being shown on the display. If the RCD has tripped the PN and PE LEDs should be off. Check this is so.
13. Press the polarity switch to indicate 180° in the display and repeat the test.
14. MAKE SURE TO KEEP CLEAR OF EARTHED METAL DURING THE OPERATION OF THESE TESTS.

12.4 Testing RCDs used to provide supplementary protection (X5 TRIP TEST)

RCDs rated at 30mA or less are sometimes used to provide extra protection against electric shock. Such RCDs require a special test procedure as follows:

- 1. Use the Function + or - keys to select X5 for the “fast” trip test
- 2. Press the polarity switch to indicate 0° in the display
- 3. Connect the test instrument to the RCD to be tested.
- 4. Make sure that the P-E and P-N wiring check lamps are lit. If they are not, disconnect the tester and check the wiring for a possible fault
- 5. If the lamps are correctly lit, press the test button to apply a test current of 150 mA, where the RCD should trip within 40ms, the tripping time being shown on the display.
- 6. Press the polarity switch to indicate 180° in the display and repeat the test.
- 7. MAKE SURE TO KEEP CLEAR OF EARTHED METAL DURING THE OPERATION OF THESE TESTS.

12.5 Testing time delayed RCDs (S-Type)

RCDs with a built-in time delay are used to ensure discrimination, that is, that the correct RCD operates first. Testing is carried out in accordance with item 12.3 above, except that the displayed tripping times are likely to be longer than those for a normal RCD. Since the maximum test is longer, there may be danger if earth metal is touched during the test.

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

NOTE: If the RCD does not trip the tester will supply the test current for a maximum of 2000ms on the X1/2 and X1 ranges.

12.6 Testing DC sensitive RCDS

The KTS 1630 has a facility to test RCDs that are sensitive to DC fault currents. It is primarily designed to test breakers of 30mA trip rating. Proceed as follows:

- 1. Set the RCD rated tripping current to 30mA
- 2. Use the Function + or - keys to select the DC test indicated in the Display
- 3. Press the polarity switch to indicate 0° in the display

- 4. Make sure that the P-E and P-N wiring check lamps are lit. If they are not, disconnect the tester and check the wiring for a possible fault
- 5. If the lamps are correctly lit, press the test button to apply rated current and the RCD should trip, the tripping time being shown on the display.
- 6. Press the polarity switch to indicate 180° in the display and repeat the test.
- 7. MAKE SURE TO KEEP CLEAR OF EARTHED METAL DURING THE OPERATION OF THESE TESTS.

12.7 AUTOTEST Procedure

The Autotest Function can be used to perform a predetermined sequence of tests. This can be used to reduce the time taken to perform individual tests. Proceed as follows;

- 1. Select the RCD function on the rotary selector switch
- 2. Use the Function keys to select AUTOTEST
- 3. Use the Range keys to select rated tripping current of the RCD e.g. 30 mA
- 4. Press the Test button. The KTS 1630 will cycle through 6 tests. Some tests will trip the RCD and you will be prompted to reset the device at the appropriate times during the sequence. At the end of the test sequence you can press the REVIEW button to view the results and a typical scenario may be as follows:

AUTO 1/2X	30mA		Screen 1
37ms		0° flag	Screen 2
AUTO 1X	30mA		
46ms		180° flag	Screen 3
AUTO 1X	30mA		
4ms		0° flag	Screen 4
AUTO 5X	30mA		
3ms		180° flag	Screen 5
AUTO 5X	30mA		
PASS			

If the RCD tripped at 1/2X:

32ms			
AUTO 1/2X	30mA		These messages cycle
RCD tripped	FAIL		

If the RCD fails to trip at 1X the display shows:

↑ 1			
AUTO 1X	30mA		These messages cycle
No trip	FAIL		

If the RCD fails to trip at 5X the display shows:

↑ 1			
AUTO 5X	30mA		These messages cycle
No trip	FAIL		

13. Earth Resistance Tests

The KTS1630 can perform 3 and 4 wire earth resistance tests. The tests are performed in fundamentally the same way however, when undertaking 3 wire earth tests the connecting lead length is limited and when performing 4 wire tests the connecting lead length between the instrument and the installation under test is not critical. A high frequency, high voltage output signal is used to provide sufficient accuracy and to overcome contact resistance.

WARNING

The instrument produces a voltage of approximately 100V between the earth, live, ERT1 and ERT2 terminals depending on the test selected. **DO NOT TOUCH THE TEST LEADS OR INSTALLATION DURING TESTING.**

13.1 Normal Earth Resistance Measurement (3 wire)

1. Select Earth Resistance on the function selector switch
2. Use the Function + or - keys to select 3 wire tests
3. Use the Range + or - keys to select the 20Ω , 200Ω or 2000Ω range
4. Drive the auxiliary test spikes in a straight line into the ground as shown in fig 2. The spacing of the test spikes will depend on the ground resistance, but usually the distance of 5-10m is sufficient.
5. Connect the green lead to the terminal marked Earth on the instrument and to the earth electrode under test and connect the black lead to the electrode under test and terminal marked "ERT2"
6. Connect the yellow lead to the terminal marked ERT1 on the instrument and to the central (closer) earth spike
7. Connect the red lead to the terminal marked Line on the instrument and to the other (furthest) earth spike.
8. Take a resistance reading.

IMPORTANT

If the earth into which the auxiliary spikes have been driven is not already moist, make it so by watering. If it is impossible to drive the auxiliary spikes into the ground (e.g. if the area concerned is concreted) a good reading can often be taken when the spikes are laid in the correct positions on the surface and well watered. The method described does not work on an asphalt surface.

NOTE:

If the display reads "Poor Probe Earth" this indicates that the earth resistance measurement exceeds 2000Ω . This may be due to;

1. Excessive resistance to earth from the auxiliary electrodes. This can be reduced by watering them, or driving them more firmly into the ground.
2. Very high resistance to earth from the electrode under test. This can be reduced by using a longer electrode driven deeper into the ground. By driving extra electrodes close to the first and interconnecting them, or by burying a conducting plate. **DO NOT** try to obtain a lower reading by watering the earth electrode, as its resistance will increase again as it dries out, possibly affecting the operation of protective devices.

CAUTION

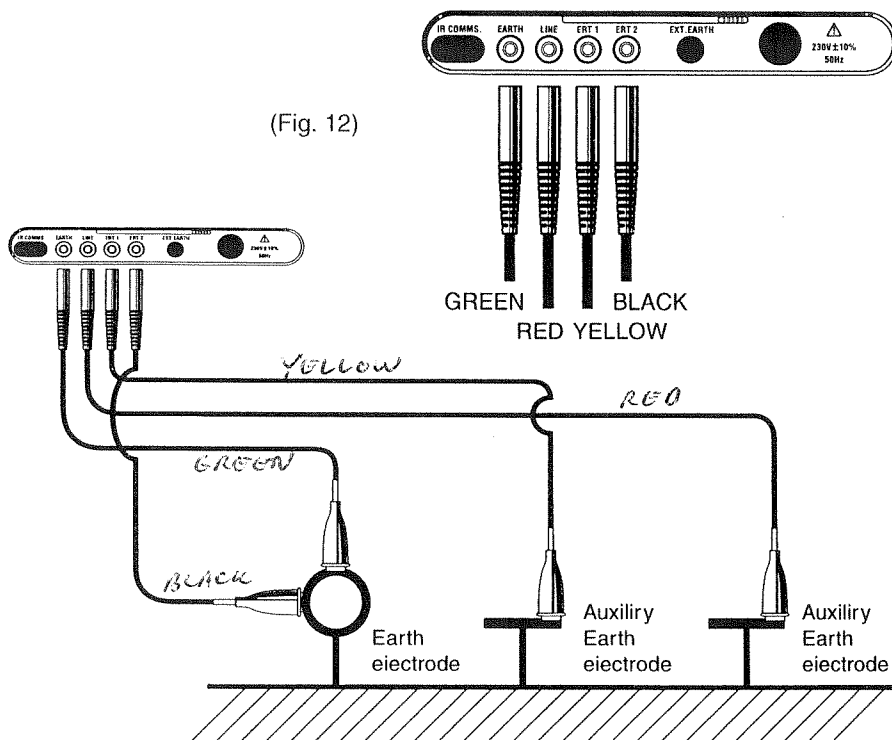
Make sure that the connections to the earth electrode and to the two auxiliary electrodes are separated during measurement. If the leads are twisted or touching, the reading may be affected by induced voltages. Also ensure that connections to the electrode under test, the auxiliary electrodes and the instrument are firmly made. Poor connections can also affect the accuracy of readings

13.2 Check for overlapping Resistance Areas

If the resistance of the auxiliary and main electrodes overlap, a false reading will result. The presence of overlapping resistance areas can be checked by the following procedure.

1. Move the central auxiliary electrode (connected by the yellow lead to the terminal marked ERT1 on the instrument) 3m nearer to the electrode under test than its original position. Take a further resistance reading.
2. Move the central auxiliary electrode (connected by the yellow lead to the terminal marked ERT1 on the instrument) 3m further from the electrode under test than its original position. Take a further resistance reading.
3. If the original resistance reading and the subsequent readings differ by more than 5% (one part in 20) there is an overlap of resistance areas. In this case, the main auxiliary spike (connected by the red lead to the ERT2 terminal of the

instrument) must be moved further away from the electrode under test.



The secondary auxiliary electrode (connected by the yellow lead to the terminal marked ERT1 on the instrument) is driven midway between the electrode under test and the main auxiliary electrode. The tests (including those to ensure that resistance areas do not overlap) are then repeated to obtain satisfactory readings. If the readings are still not satisfactory, the test must be repeated again with the auxiliary electrodes still further from the electrode under test.

A warning message is shown when conducting three wire tests if the voltage at the earth reference is above a safe limit. The symbol “ Δ ” will appear in the display to indicate the voltage has exceeded 50V

13.3 Earth Resistance Measurement (4 wire)

This test method is performed in exactly the same way as the 3 wire method, all connections and the test sequence are the same (see section 13.1).

Make sure to select the 4 wire test using the function + or - keys.

The difference when using this method is that you are not restricted by the connecting lead length. The 4 wire method can be applied if you are using your own test leads that may be longer than those supplied with the instrument or on an installation that requires longer connecting leads.

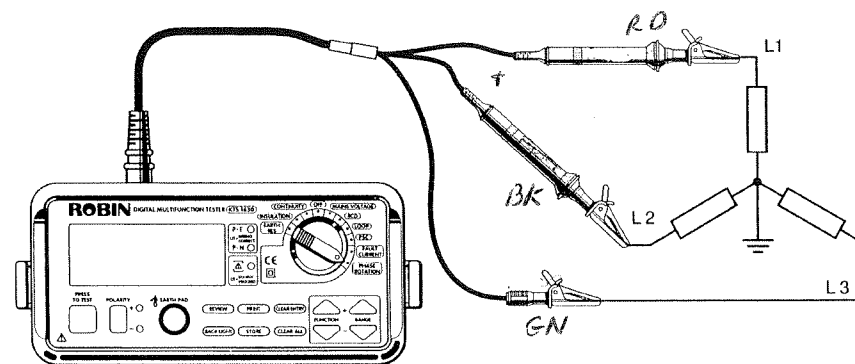
14. Phase Rotation Tests

The KTS 1630 is provided with a Phase Rotation function that allows the checking of phase sequence on a 3 phase (upto 415V) AC 50Hz supply. The check is performed using the three wire mains lead labelled 1, 2 and 3. The KTS 1630 determines the order of rotation of the phases and will display whether rotation is clockwise or anti-clockwise. A missing phase is detected by measuring a significantly lower voltage between two phases to two other phases, in the event of this occurring a warning message will be displayed.

Proceed as follows:

1. Select the Phase Rotation function on the function selector switch.
 2. Connect the three wire test lead to the terminals of a three phase power source
 3. Press the test button. The phase order (which relates to the sequence of this test lead connections 1, 2 and 3) will be displayed and the display will indicate whether the sequence is clockwise or anti-clockwise.
1. If a missing phase is detected a warning message will appear in the display e.g. 'Missing phase 2'.

Note that the three wiring connection check Leds will all be lit if all three phases are present-this is normal. If any LED is off there is a fault which must be investigated.



(Fig. 13)

15. Memory Functions - Store, Clear and Printing

15.1 Storing Results *REFER TO APPENDUM*

The latest result on the display (or set of results, for MAINS VOLTAGE and other tests which give multiple results) can be stored in the on-board non-volatile memory for later printing or downloading.

Result sets are stored sequentially and each is assigned a unique entry number. It is the responsibility of the user to keep track of what was tested against each entry number.

An entry can be deleted from store, which by default is the last entry but can be any of them, selected with the RANGE keys. The entries are not physically deleted from store but are marked as deleted, therefore they still occupy storage space. To free up memory you must CLEAR the entire store.

A warning is given when the memory is nearly or completely full. The CLEAR ALL button wipes the store. A timeout is built in to this potentially dangerous function.

The store is maintained even when the instrument batteries are exhausted.

There are 1000 storage locations available. The number of locations used by each result set is as follows:

MAINS VOLTAGE	2
RCD (except auto-test and auto-ramp)	1
RCD AUTO-RAMP	2
RCD AUTO-TEST	6
LOOP	1
PSC	1
EARTH FAULT	1
PHASE ROTATION	1
CONTINUITY	2
INSULATION	2
EARTH RESISTANCE	1

So, for example, 166 RCD AUTO-TEST result sets or 1000 LOOP results can be stored.

15.2 Storing

When the STORE button is pressed, providing there is sufficient storage space available, the numeric display shows the next free storage location and the starburst display shows messages:

998	
Entry Number	
Press START	These messages cycle
To save result	

If the store is nearly full, an additional warning message is shown:

Entry Number	
Store > 3/4 full	
Press START	These messages cycle
To save result	

If the store is full, only one warning message is shown and the numeric display is clear:

“Store is full”

After 10 seconds, or if the START button is used to save the result or if any other switch is used the display reverts to showing the current test function.

15.3 Clearing an Entry

When the CLEAR ENTRY button is pressed the numeric display shows the last storage location used and the starburst shows messages:

123	
Entry number	
Use START	These messages cycle
To clear entry	

The FUNCTION keys can be used to select another entry

After 10 seconds or if the START button is used to clear the result or if any other switch is used the display reverts to showing the current test function.

15.4 Clearing the Store

When the CLEAR ALL button is pressed the numeric display clears and the starburst shows messages:

Hold START	
To delete all	These messages cycle

While the START button is pressed the numeric display counts down from 5. After 5 seconds the store starts to clear. While clearing is in progress a message is shown:

Erasing. Do not Switch off | These messages cycle

If START is not pressed and held, after 10 seconds or if any other switch is used the display reverts to showing the current test function.

15.5 Printing Information

To print from the KTS 1630 you must have a Robin SP1000 printer and a Robin IR Adapter. Plug the Robin Model IRDA100 into the SP1000. Make sure the printer is set for 2400bps operation and then switch on. Read the SP1000 and Robin Model IRDA100 instruction manuals for further details.

All the results printed out in the order of that they were stored. Each result is distinguished by a record number for ease of reference. If you need to stop the printout at any point simply turn the KTS 1630 rotary switch to the OFF position.

When the PRINT button is pressed, a header is printed followed by all stored results sets are printed out as with their entry numbers, for example:


ENTRY	TEST		RESULT	
1	P-N voltage		250.0V	
	N-E voltage		10.0V	
	Frequency		49.9Hz	
3	1/2X	30mA	19Ω	
4	1X	30mA	32ms	
5	5X	30mA	32ms	
6	AUTO-RAMP	30mA	4ms	
7	FASTRIP	150mA	74ms	
8	DC	30mA	187ms	
9	AUTO 1/2X	30mA	9Ω	
	AUTO 1X	30mA	37ms	0deg
	AUTO 1X	30mA	46ms	180deg
	AUTO 5X	30mA	3ms	0deg
	AUTO 5X	30mA	46ms	180deg
10	P-E LOOP	20Ω	11.30Ω	
11	P-N PSC	2kA	1978A	
12	P-E FAULT	20kA	11.34kA	

13	PHASE ORDER	132	ANTICLOCKWISE
14	CONTINUITY 20Ω	12.46Ω	
15	INSU 500V 20MΩ	0.98MΩ	
16	ERT 3W 200Ω	78.6Ω	
17	ERT 4W 200Ω	78.6Ω	

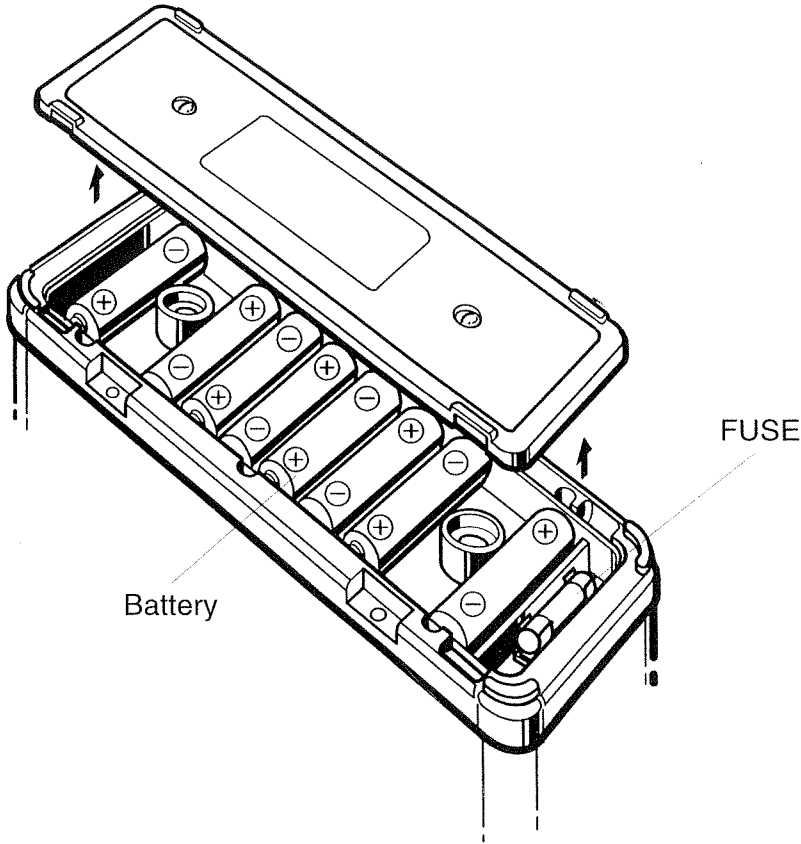
Deleted entries (in the example above, entry 2 was cleared) are not printed.

While printing a message flashes on the display. Printing can be stopped at any time by turning the rotary switch to the OFF position.

16. Battery Replacement

When the display shows the low battery indication “ ” switch off the instrument and disconnect the test leads from the instrument. Remove the battery cover and the batteries. Replace with eight (8) new 1.5 V LR6 batteries, taking care to observe correct polarity. Replace the battery cover.

(Fig. 14)



17. Fuse Replacement

The continuity test circuit is protected by a 0.5 A HRC ceramic type fuse situated in the battery compartment, together with a spare. If the instrument fails to operate in the continuity test mode, first disconnect the test leads from the instrument. Next remove the battery cover, take out the fuse and test its continuity with another continuity tester. If it has failed, replace it with a spare, before refitting the battery cover. Do not forget to obtain a new fuse and place it in the spare position.

If the instrument will not operate in the loop impedance, PSC, Fault Current, Phase Rotation and RCD modes, it may be that the protective fuses on the printed circuit board have blown. If you suspect that the fuses have failed, return the instrument to Robin Electronics for service - Do Not Attempt to replace the fuses yourself.

18. Servicing

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

Return the instrument to :

Service Department

Fluke Precision Measurement Ltd.
52, Hurricane Way
Norwich, Norfolk
NR6 6J3
United Kingdom

Internet
www.fluke.co.uk/tpm

Phone
+44 (0) 1603 256600

Fax
+44 (0) 1603 483670

Regular re-calibration is recommended for this instrument. Robin Electronics recommends that with normal use, the instrument be calibrated at least once in every 12 month interval. When the instrument is due for re-calibration return it to the address above marked for the attention of the Calibration Department and be sure to include all accessory leads, as these are part of the calibration procedure.

(Please add to the end of page 18 the following sections:)

5.3 Setting up prior to Testing

The KTS 1630 allows you to assign all tests performed to a site reference, a distribution board reference and a distribution board way number. This tags each test with a unique set of details which can subsequently be used to identify all results when reviewing stored test results or when downloading results after all testing complete.

Before performing any tests the site reference must be established. Following testing and before results are stored the DB and WAY number details must be set up as follows:

5.3.1 Site Selection

Prior to carrying out any electrical tests it is important to identify a site reference. This allows the instrument to assign all tests performed at a given site to that unique reference. The KTS 1630 allows recording of a site identity in numerical order from 001 to a maximum of 999 sites. Upon switching the unit on in any desired measurement quantity, the site reference prompt allows setting up of a new site reference by selecting the "Range" keys. The site reference number can be incremented or decremented by pressing the "Range" keys.

5.3.2 Distribution Board/Circuit Data

When a test has been completed and the store key is pressed a message appears on the display screen as follows:

"DB XXX WAY XXX"

DB = Distribution Board Number

E.g. **DB 001**

To enter the figure 001 use the "Function" up/down keys

WAY = The Way number on the distribution board

E.g. **WAY 003**

To enter the figure 003 use the "Range" up/down keys

To accept the data for the above press the "Press to Test" key.

When the "Test" key is pressed, the display message changes to "Current Store" message. Pressing "Test" again stores the data to the memory and simultaneously updates the DB and WAY fields if a mistake has been made. The current DB/WAY appear again at the next test being stored.

All other measured quantities will require data on DB/WAY. Please note that any test carried out at the origin of the installation should be reference as DB 000 and WAY 000.

(Please enter this section to page 19 under proceed as follows at the end of paragraph 6.)

6.2.1 Continuity Test Fields

The KTS 1630 allows you to identify what type of a continuity test you have performed and assign the result to the particular type of test. Continuity tests can be assigned as the following:

P = Phase Continuity

N = Neutral Continuity

CPC = Circuit Protective Conductor Continuity

R1+R2 = Continuity

R2 = Continuity

When the store button is pressed following completion of a continuity test the display will request the Distribution Board and Way numbers. The continuity tests can then be assigned a type as those labelled above by using the Review key. Up to a maximum of 5 tests may be carried out.

(Please insert this section on Page 25 under proceed as follows at the end of paragraph 5. Before "NOTE: it is important that you release the test button...")

7.3.1 Insulation Test Fields

The KTS 1630 allows you to identify what type of insulation test you have performed and assign the result to the particular type of test. Insulation tests can be assigned as the following:

PN = Phase to Neutral

PE = Phase to Earth

NE = Neutral to Earth

PP = Phase to Phase

When the store button is pressed following completion of a insulation test the display will request the Distribution Board and Way numbers. The insulation tests can be assigned a type as those labelled above by using the Review key. Up to a maximum of 5 tests may be carried out.

NOTE: When the store key is first pressed the display will show:

INSU PP

This is the default situation and if no selection is made for the type of insulation test, result will be stored as Phase to Phase.

(Please insert the following into section 15.1 on page 41 after "There are 1000 storage locations available. The number of locations used by each result set is as follows:")

SITE REFERENCE	1
DISTRIBUTION BOARD REFERENCE	1
CIRCUIT NUMBER	1