3200SERIES

ELECTRICAL TEST EQUIPMENT CALIBRATOR

TRANSMILLE
SOLUTIONS IN CALIBRATION

THE METROLOGISTS CHOICE

FIVE CALIBRATORS IN ONE INSTRUMENT

3200

Electrical Test Equipment Calibrator

Operation Manual

Version 1.00
May 2006

www.transmille.com

IMPORTANT NOTICE

THIS CALIBRATOR
WILL
REQUIRE AN
UNLOCK CODE
AFTER THE EVALUATION
PERIOD HAS EXPIRED.

(60 Days after invoice date)

AFTER THE EVALUATION PERIOD HAS EXPIRED THE OPERATION OF THE CALIBRATOR IS LOCKED AND THE DISPLAY SHOWS A NUMBER WHICH MUST BE QUOTED TO TRANSMILLE TO RECEIVE THE UNLOCK CODE

THE UNLOCK CODE IS
AVAILALBLE
FROM TRANSMILLE
ONLYAFTER PAYMENT
HAS BEEN RECEIVED.

(This code is only entered once in the life of the instrument.)

Please contact Transmille or use the form in the back of the manual to obtain the code.

Transmille Ltd.
Staplehurst , Kent.
Tel: 44 (0)1580 890700 : Fax 44(0)1580 890711
email:- sales@transmille.com

DECLARATION OF CONFORMITY CE

Manufacturer's Name: **Transmille Ltd.**
Manufacturer's Address: **Unit 4, Select Business Centre**
Lodge Road
Staplehurst
TN12 0QW

Declares, that the product

Product Name: **Electrical Test Calibrator**
Model Number: **3200**
Product Options: This declaration covers all options of the above product(s)

Conforms with the following European Directives:

The product herewith complies with the requirements of the Low Voltage Directive 73/73EEC and the EMC Directive 89/336/EEC (including 93/68/EEC) and carries the CE Marking accordingly

Conforms with the following product standards:

EMC

Standard	**Limit**
IEC616326-1:1997+A1:1998 / EN 61326-1	*:1997+A1:1998*
EN55011:1991	
IEC 61000-4-2:1995+A1:1998 / EN 61000-4-2:1995	*Group 1Class A*
IEC 61000-4-3:1995 / EN 61000-4-3:1995	*4kV CD, 8kV AD*
IEC 61000-4-4:1995 / EN 61000-4-4:1995	*3 V/m, 80-1000 MHz*
IEC 61000-4-5:1995 / EN 61000-4-5:1995	*0.5kV signal lines, 1kV power lines*
IEC 61000-4-6:1996 / EN 61000-4-6:1996	*0.5kV line-line, 1kV line-ground*
IEC 61000-4-11:1994 / EN 61000-4-11:1994	*3V, 0.15-80 MHz I cycle, 100%*
	Dips: 30% 10ms; 60% 100ms
	Interrupt > 95%@5000ms

SAFETY

IEC 61010-1:1990+A1:1992+A2:1995 / EN 61010-1:1993+A2:1995

06/03/2006

Revision No: 1.1
Date 06/03/2006

Managing Director

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3200 Electrical Test Equipment Calibrator Introduction

The 3200 Electrical Test Equipment Calibrator is a breakthrough in electrical test equipment calibration providing a complete solution for testing :

- Insulation Testers
- RCD Testers
- LOOP Testers
- Portable Appliance Testers (PATs)

Extended Functionality
The 3200 Calibrator can be enhanced with options to provide high accuracy resistance, auto loop measurement and two external resistance inputs to extend the range of available resistors.

A complete electrical test equipment calibration solution from one instrument. Designed to provide an accurate cost effective portable instrument for the calibration of Insulation testers, RCD testers, LOOP testers and PATs the 3200 calibrator can be combined with the ProCal Calibration System to allow automated calibration.

IMPORTANT OPERATIONAL NOTE 1

DUE TO THE OPERATIONAL CHARACTERISTICS OF THE 3200 ELECTRICAL TEST EQUIPMENT CALIBRATOR, AN UNPROTECTED SUPPLY (WITHOUT RCD TRIP) MUST BE USED *.

* Use of an isolation transformer can be employed in conjunction with a protected supply (with RCD Trip), however this will degrade performance of the calibrator.
Please contact Transmille for further details.

IMPORTANT OPERATIONAL NOTE 2

It is also necessary that for correct operation the Phase (Live) and Phase (Neutral) MUST be connected round the correct way (some plugs used in non-UK countries can be connected either way round, therefore this check is necessary). There should only be a small voltage between Phase (Neutral) and Phase (Earth).

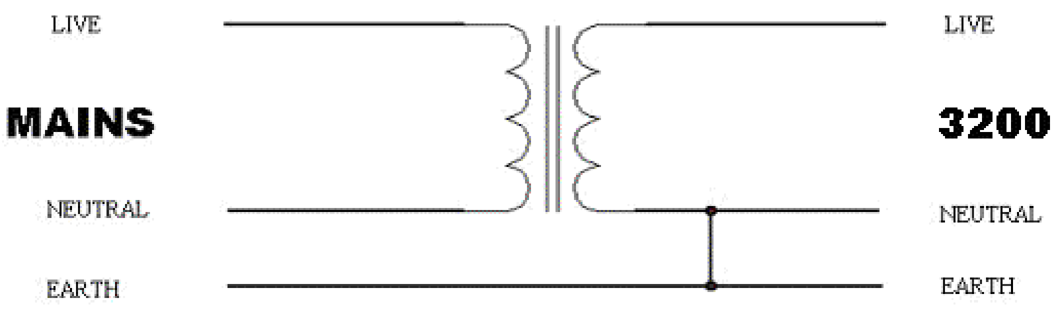
Installation & Power Requirements for the 3200

For correct operation of the 3200 it must be powered from an unprotected (ie. no RCD trip) supply. This is because the 3200 will pass current down the Earth conductor when performing tests and therefore trip any protection device present - FOR THIS REASON IT IS ESSENTIAL THAT THE 3200 IS PROPERLY EARTHED.

It is also necessary that for correct operation the Phase (Live) and Phase (Neutral) MUST be connected round the correct way (some plugs used in non-UK countries can be connected either way round, therefore this check is necessary). There should only be a small voltage between Phase (Neutral) and Phase (Earth).

To keep the LOOP impedance value to a minimum, the mains input to the 3200 is of a direct cable type. This avoids any introduction of unnecessary impedance.
It is desirable that the 3200 is connected to a supply point with low LOOP impedance as this will limit the lowest value available LOOP impedance from the 3200 using as good a quality outlet (contact wise) as possible.

If an unprotected supply is not available, use of an **Isolation Transformer** can be employed, however this will increase the lowest LOOP impedance available. Connection of the isolation transformer should be as detailed below :



Designed for on use in the laboratory or portable on site calibration.
The 3200 calibrator is equally suitable for use in the standards laboratory or for on site calibration work. The Small footprint and low weight makes the 3200 calibrator ideal for on site calibration. The serial interface allows direct connection to a portable PC.

Retro fit options allows extra functions to be added as required.
Several internal retro fit options including auto loop, high accuracy resistance and external resistance input allow the user to select the most cost effective solution for the calibration work required at the time with the ability to add extra functions as required.

Serial Line RS232 Interface as standard.
All functions and outputs of the 3200 calibrator are fully programmable over the RS232 interface fitted as standard. The use of the RS232 interface saves the cost of fitting IEEE cards to the PC, and also allows easy connection to portable PC's, reducing the set up time for on site calibration.

Input / Output Connection
The input and output terminal configuration is designed to enable simple connection to a full range of instrumentation using the supplied adapter lead. Use of a dedicated input adapter lead allows resistance measurement functions such as LOOP testing to be calibrated to include residual values right up to the socket into which test equipment is plugged.

All outputs are isolated when not in use, with an LED indicator showing the active input / output terminal(s).

Preparing the calibrator for use.

Initial Inspection.

After shipment the calibrator should be inspected for any signs of external damage. Should external damage be found contact the carrier immediately. Do not connect a damaged instrument to the line power as this may result in internal damage. Please keep the original box which can be used when returning the calibrator for service and re-calibration.

Shipping Checklist

1 x Serial Communication lead (9 Way ‘D’ female to 9 Way ‘D’ male connectors)
1 x Operation manual (this document)
1 x PAT Test Lead

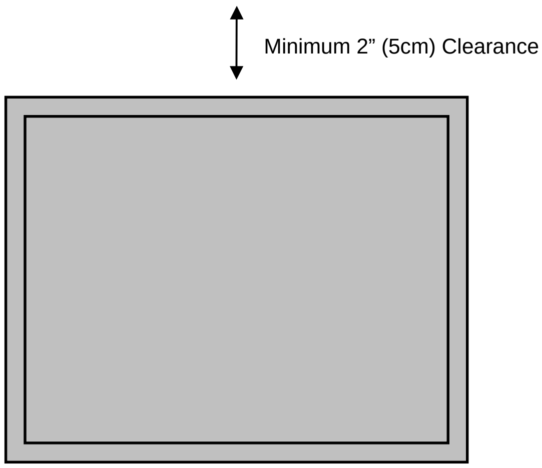
Lifting and carrying the calibrator

The calibrator can be carried easily by one person in any position by either holding the front handles or by supporting from underneath (note : observe all normal practices for health and safety when carrying). A custom carry case with shoulder strap is available if the calibrator is to be regularly transported - see options list. The calibrator should always be placed down on a firm flat surface on its base feet. Standing the calibrator down on its back may cause damage. Avoid knocking or banging the calibrator and always place down smoothly.

Warning
DO NOT DROP THE CALIBRATOR as this may cause internal damage.

Positioning the Calibrator.

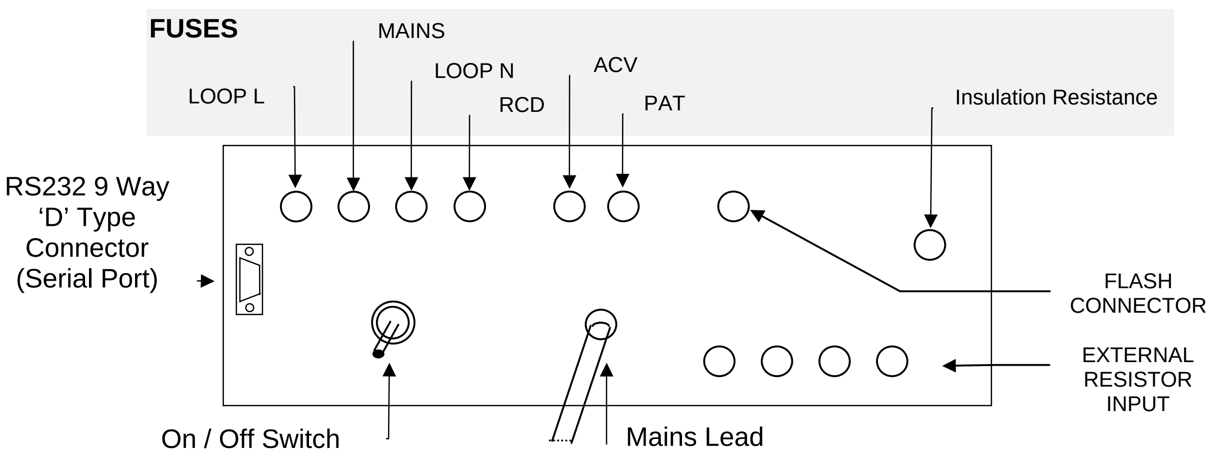
The calibrator can be used free standing on a bench or mounted in a standard 19” rack enclosure. The calibrator can be operated at any angle, the two front feet have tilt legs for bench operation. For all installations care must be taken not to cover the ventilation slots underneath. A 2” (5cm) space behind the instrument is also required for line and interface connections (See diagram) :



Rear Panel Connections and controls

Connections on the rear panel consist of a 9Pin Serial interface connector for the computer interface, this is optically isolated from the calibrator outputs.

Fuse holders for individual instrument types are accessible from the back of the calibrator. These are bayonet type fuse holders which allow a screwdriver to be used to turn the fuse carrier until it ‘pops’ out of the fuse holder body .The fuse carrier can then be withdrawn from the fuse holder body for inspection / replacement.



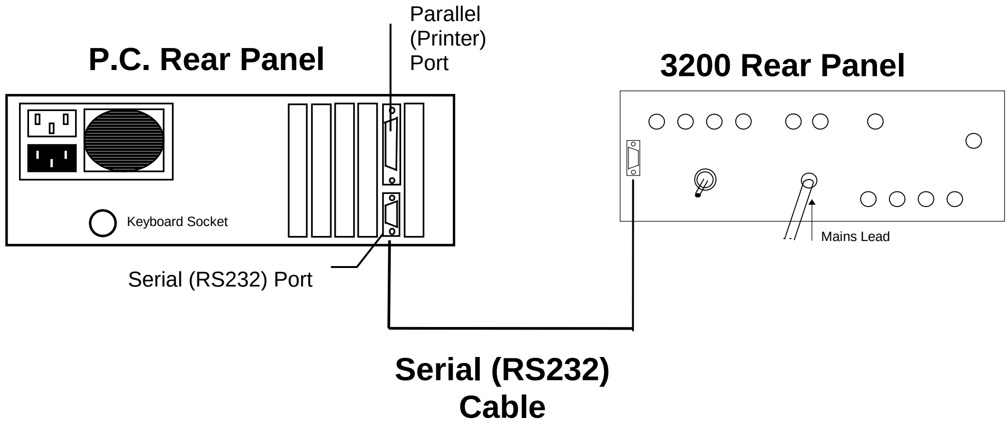
Setting and checking the Line Voltage.

> ***Warning***
> **The line power cord must have an earth conductor to avoid risk of shock. This instrument must be correctly earthed.**

The calibrator has been designed to work from either 100-120 Volt line supply or 200 - 240 Volt line supply. Check Supply voltage as marked on the rear panel before connecting to power line. Connecting the calibrator to the wrong supply will cause internal damage to the instrument. To Change the line voltage it is necessary to remove the rear panel and rewire the transformer. The calibrator will have been shipped wired for 110V operation for USA, 240V for Europe.

Connecting to a computer

If required a standard serial 9 pin cable may be used to connect the calibrator to a Comm port on a PC. A Null modem cable is **not** needed.



Powering up the calibrator

After connecting line power the calibrator can be switched on with the line power switch above the mains inlet socket on the rear panel.

The front panel display will illuminate indicating power. The display will show program version number and after a short delay, during which time the processor performs a self test of the instrument, the display will show the default start-up display :

```
3200 CALIBRATOR Ver x.x
    TRANSMILLE LTD.
```

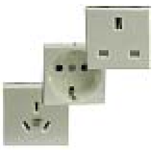
The calibrator has been designed to be powered up continuously, automatically switching the display to power save mode after a pre-set period of time from the last command. In power save mode the display back light will turn off.

Output Connections

Warning - Risk of shock.
High voltages may be present on the output sockets.

Output sockets comprise of the following types :

IEC 3-Pin Socket :
For use with the supplied PAT test lead.



13A Socket (UK)* : For use directly with LOOP / RCD tester
or EURO Socket*
or Australian Socket*

4mm Safety Sockets: For connection to Insulation Testers

* Fitted depending on country

Operation

SAFETY WARNINGS

This instrument is capable of generating high voltages

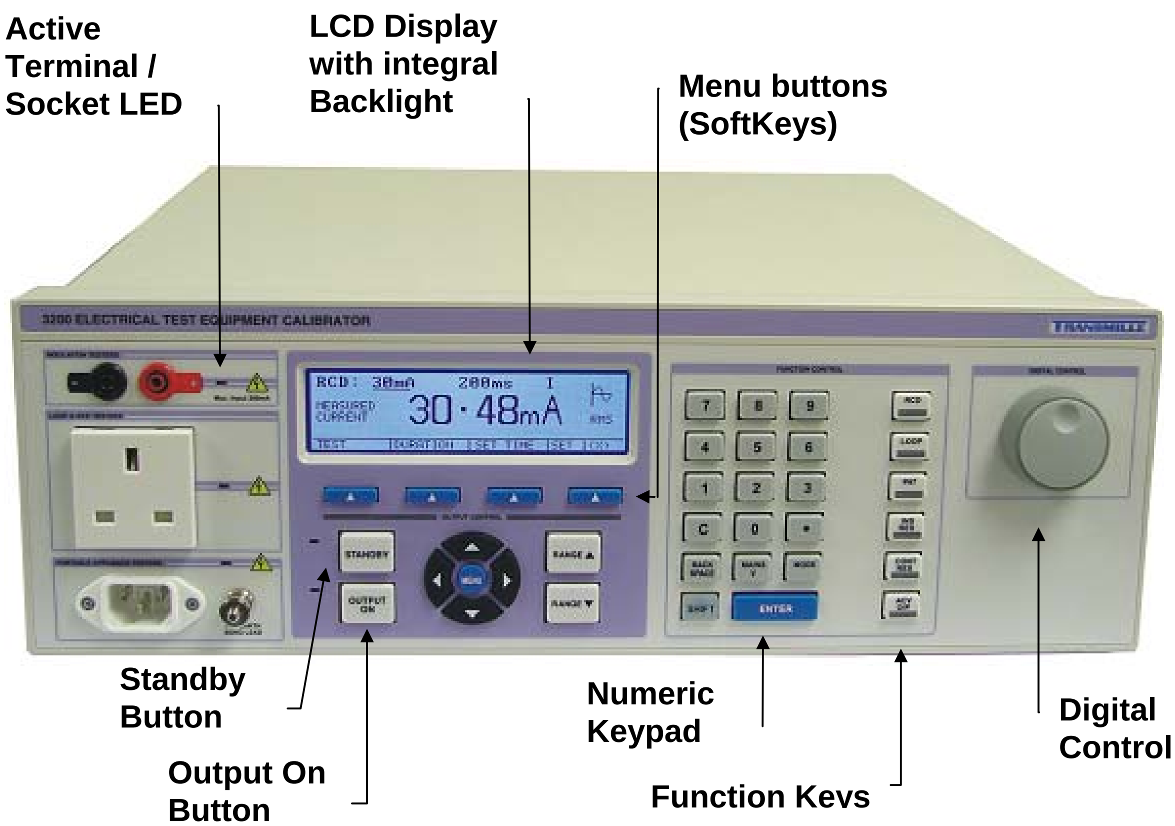
WARNING

The information in this section is intended only for qualified personnel.
The user must at all times be adequately protected from electric shock
Qualified personnel must ensure that operators of the equipment are adequately insulated from connection points.

A carry-case is available for regular transportation of the calibrator.

Introduction to Operation

All functions of the 3200 Calibrator can be controlled from the front panel or controlled remotely by a computer over the RS232 interface.



Front panel Keyboard

The front panel of the 3200 Calibrator utilises a high quality rubber switch panel with tactile feel buttons and integral display window. The front panel is therefore sealed against the ingress of moisture and dirt enabling the calibrator to be used in working environments without risk of dirt causing early failure of the operating buttons. The front panel can easily be wiped clean with a soft cloth. Care should be taken not scratch the display window. All graphics are ‘under printed’ so that they will not wear off with use.

IMPORTANT NOTE
The front panel key buttons are for use with fingers only - do not press the key with hard or sharp objects e.g. Ball-point pens, pencils, screwdrivers etc. Repeated actions like this will almost certainly cause the keyboard to fail. (This will not be covered under warranty). Care should also be taken when transporting the instrument - do not leave test leads plugged in which may get squashed into the display area or keys which can also cause damage.

The Keyboard is divided into sections to allow rapid operation.
The Numeric section *allowing values to be entered,*

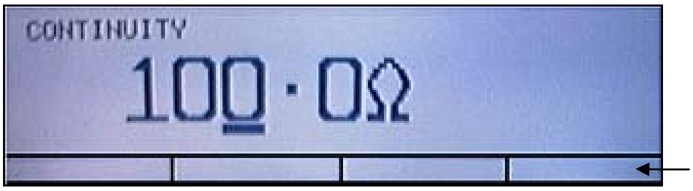
Functions keys *for RCD, LOOP, PAT, Insulation Resistance, Continuity Resistance and ACV Output*

Range up and range down keys allows range changing for the currently selected function

Left/right arrow keys select the digit to be controlled by the digital control knob.

Output on / Standby keys allow the calibrator output to be disconnected from the terminals. Led indicators are incorporated in these switches to clearly show the output status.

Graphic LCD Display

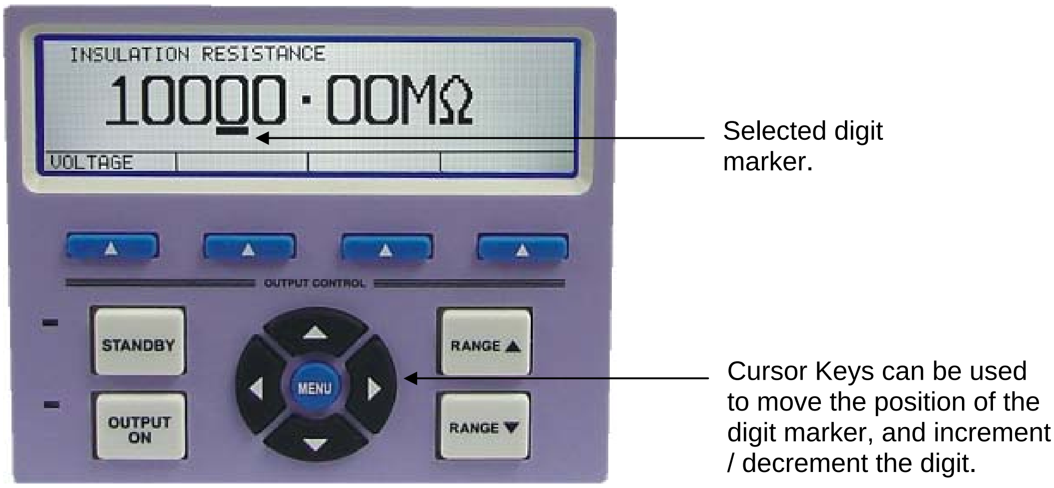


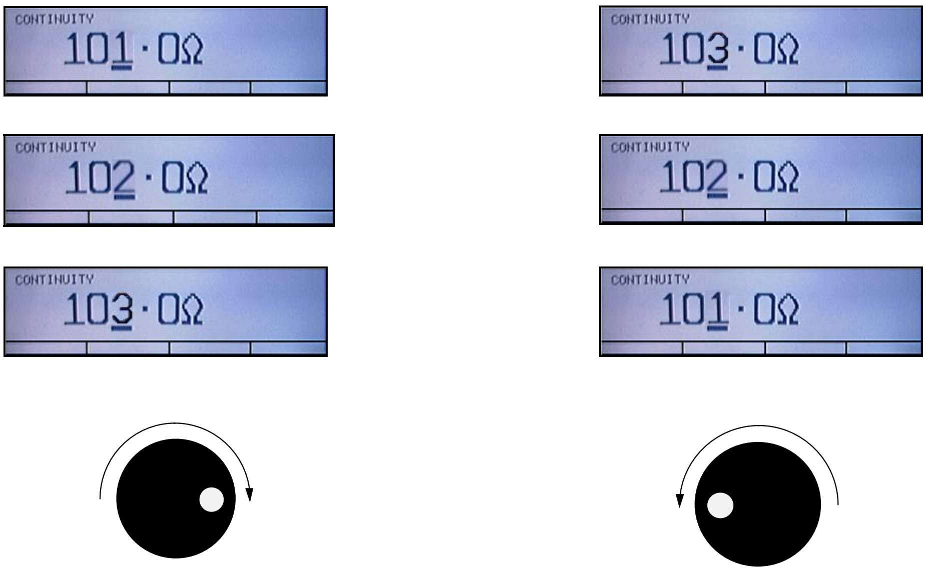
SoftKey Menu items

A back lit graphic LCD display shows the present setting and instrument status. The bottom line of the display is used to assign the function of the four ‘ soft (menu) keys’ immediately under the display. The display utilises a back light which automatically turns off if no activity takes place. The back light turns on as soon as a key is pressed or a command is received.

Using the Digital Control

A digital Control allows selected digits on the display to be incremented (turning clockwise) or decrement (turning anti-clockwise).



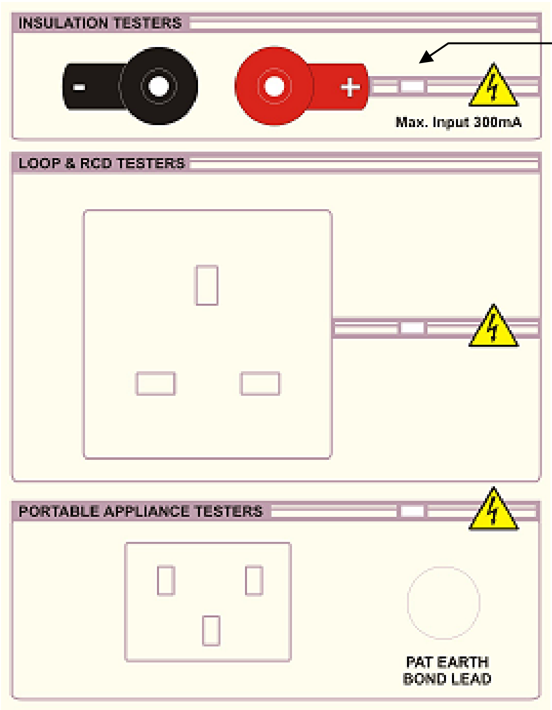


Clockwise Rotation
(Increment Digit)

Anti-Clockwise Rotation
(Decrement Digit)

Terminal status LEDs

LED's above the terminals indicate the active terminal.



Active terminals indicated by illuminated LED

PAT Test IEC Socket

WARNING
Dangerous voltage may be present on these terminals.

LOOP & RCD TEST Socket

WARNING
Dangerous voltage may be present on these terminals.

INSULATION TEST 4mm terminals

WARNING
Dangerous voltage may be present on these terminals.

PAT GND Terminal Post

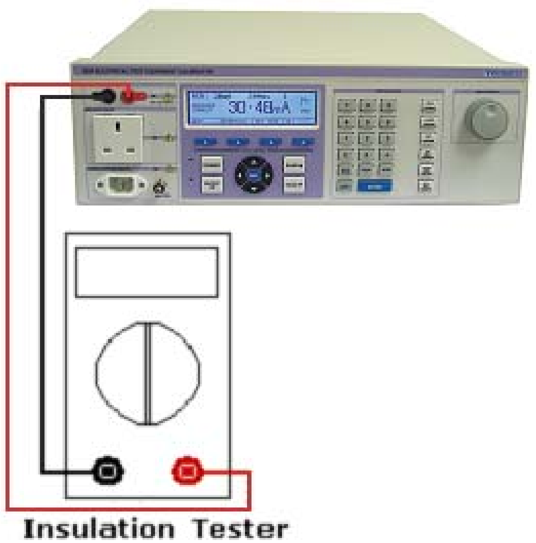
Calibrating Instruments Using the 3200

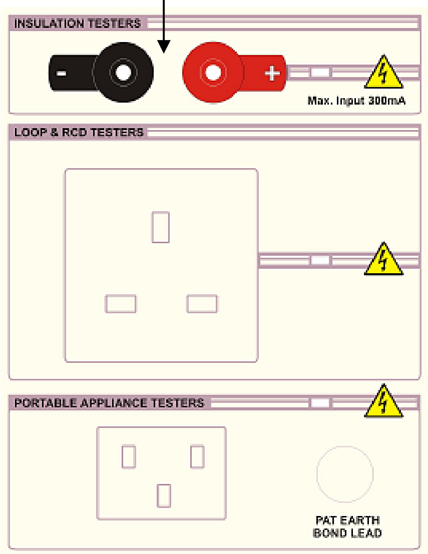
Calibrating Insulation Testers

The 3200 has five functions for calibrating insulation testers :

1. High value resistance output for insulation testing (0MΩ to 2,000MΩ)
2. Measurement of the insulation test voltage
3. Low value resistance for continuity testing
(0.1Ω to 20.0Ω Variable, 100R & 1kΩ Fixed Ranges)
4. Insulation test current measurement
5. A.C. voltage output at 100V, 200V, 240V, 300V and 400V

Use the 4mm sockets labelled INSULATION TESTERS for all insulation meter tests.





1. High Value Resistance for Insulation Testing

Step 1 Select 'INS RES' from the function key section of the 3200 front panel

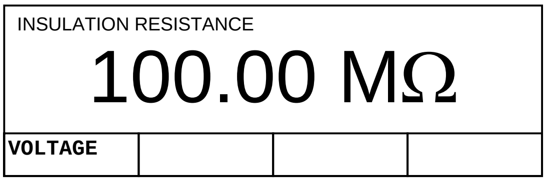
Step 2 Connect the insulation tester to the Black & Red 4mm terminals.

Step 3 Enter the required resistance in MΩ from 10kΩ to 10,000MΩ on the keyboard followed by Enter. An alternative way to select the required resistance is to use the digital Control to increment / decrement the digit indicated by the cursor. The Left and Right arrow keys allow the selected digit to be changed

2. Measuring Insulation Test Voltages & Current

Step 1

From the Insulation Resistance menu displayed on the 3200, select the **`Voltage`** function using the ‘SoftKey’.



Step 2

Select the required voltage range using either the digital Control or the up / down arrow keys. Ranges include 50V, 100V, 250V, 500V and 1000V. The impedance of each range is automatically set to give the correct load 1mA / 0.5mA (see test current below) at the applied nominal voltage range.

RANGE	**INPUT IMPEDANCE**	
	1mA	0.5mA
50V	50kOhm	100kOhm
100V	100kOhm	200kOhm
250V	250kOhm	500kOhm
500V	500kOhm	1Mohm
1000V	1Mohm	2MOhm

Step 3

Select the required measurement current using the SoftKeys.

The default setting for current load is 1mA nominal which is the correctly load/test current for the 16th Edition equipment - e.g. must be able to supply 1mA at the test voltage. Older insulation testers (15th Edition Reg.) only had to produce 0.5mA current at the test voltage. The 3200 should be set to 0.5mA current for these instruments. Very old tester’s may only produce a very small current and the voltage will collapse under any load - these cannot be tested with the 3200.

TEST VOLTAGE - 1000V / 1mA UNDER-RANGE/POLARITY TEST CURRENT : 1.00mA			
		CURRENT	BACK

Step 4

Press the test button on the insulation tester to apply the insulation test voltage and read the voltage and current on the 3200 display.
To return from the Voltage measurement screen to the insulation resistance select the **Back** menu item using the Softkey.
If the voltage applied by the tester is less than 30% of the range or the polarity is incorrect, the display will show UNDER-RANGE / POLARITY (note some tester's 'positive' red terminals are supplying negative voltage and need to have test leads reversed.

NOTE:- NEGATIVE INPUT OF 3200 (BLACK) IS CONNECTED TO SUPPLY EARTH.

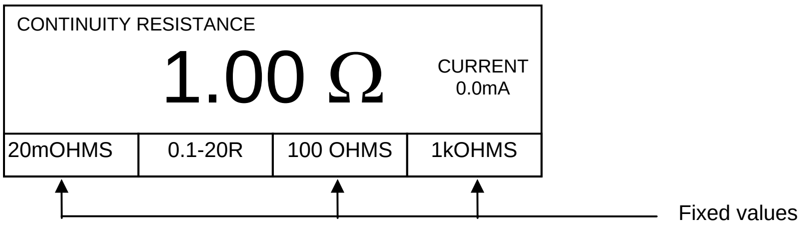
Warning : The maximum input voltage is 1100 volts

The correct polarity must be applied to obtain a reading

3. Low Value Resistance for Continuity Testing

Step 1 Connect the insulation tester to the Black & Red 4mm sockets.

Step 2 Select 'CONT RES' from the function key section of the 3200 front panel



Step 3 Select the required resistance in Ω from 20mΩ to 1kΩ

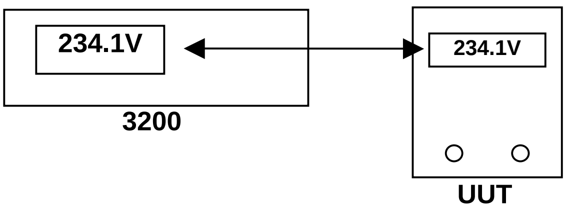
on the 3200 keyboard followed by Enter, or by using the softkeys.
An alternative way to select the required resistance is to use the digital Control to increment / decrement the digit indicated by the cursor.
The Left and Right arrow keys allow the selected digit to be changed.

NOTE : 20mΩ, 100Ω and 1kΩ are fixed values. 0.1Ω to 20Ω is a variable range

The measured current is also displayed when a resistance of 1Ω is set..

4. A.C. Voltage Output

Notes on ACV Output
To provide the power necessary for some insulation testers, the AC output from the 3200 is derived from transformer tappings. The output is *unregulated* and will vary with line voltage and loading. The actual output voltage at any time is measured and displayed by the 3200 which can be compared to the displayed value on the UUT.



<u>Example</u>
3200 set to 230V range, measures mains and displays a measured value of 234.1V.
The UUT is compared to check its accuracy at this value.

Step 1 Connect the insulation tester to the Black & Red 4mm sockets.

Step 2 Select 'ACV O/P' from the function key section of the 3200 front panel

Step 3 Select the required voltage using either the range up / range down buttons or by incrementing / decrementing the range using the digital Control.

Step 4 Read the voltage displayed on the insulation tester meter. and compare it with the value displayed on the 3200

*Use the **Output Standby** and **Output On** buttons to control the output.*

5. 5kV Insulation Tester Extension Adapter [OPTION]

This option allows the testing of Insulation Testers with test voltages up to 5kV and Insulation range up to 200GΩ.

The insulation tester must have a guard terminal for this adapter to function correctly

Step 1 Select 'INS RES' from the function key section of the 3200 front panel

Step 2 Connect the 5kV Adapter flying leads to the 3200 Insulation tester terminals (observing correct polarity)

Step 3 Connect the Insulation tester to the adapter box

Step 4 Calculate the value needed to be entered in order to give the required resistance (this will be 100^{th} of the actual required resistance less the input impedance of the tester - typically 10MΩ, example to simulate 100GΩ select 990MΩ on the 3200)

In most cases it is not necessary to allow for the input impedance of the tester.

This value can be entered on the keyboard followed by Enter. An alternative way to select the required resistance is to use the digital Control to increment / decrement the digit indicated by the cursor. The Left and Right arrow keys allow the selected digit to be changed

Introduction to RCD Testers

Increasingly in modern installations, earth leakage circuit breakers are used to provide protection in addition to conventional fuses and circuit breakers. These devices are referred to by a variety of names including RCD (Residual Current Devices), RCCB (Residual Current Circuit Breaker), ELCB (Earth Leakage Circuit Breaker) and GFI (Ground Fault Interrupt).

The devices operate by sensing when the current in the phase and neutral conductors within an installation are not equal and opposite. Any imbalance would imply that an additional path existed for the current to flow, invariably through the earth due to excessive leakage and/or fault situation.

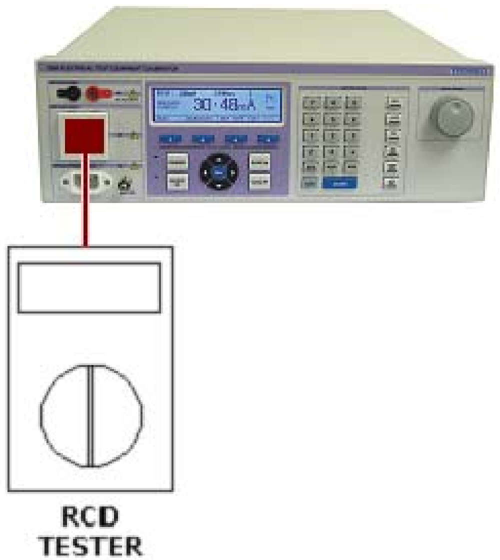
RCD testers are designed to simulate a range of fault currents, with restrictions on the duration of the fault current, and to time the operation of the device. This will indicate the ability of the RCD to interrupt a particular fault current within certain time limits to ensure protection against fire, damage and electrocution.

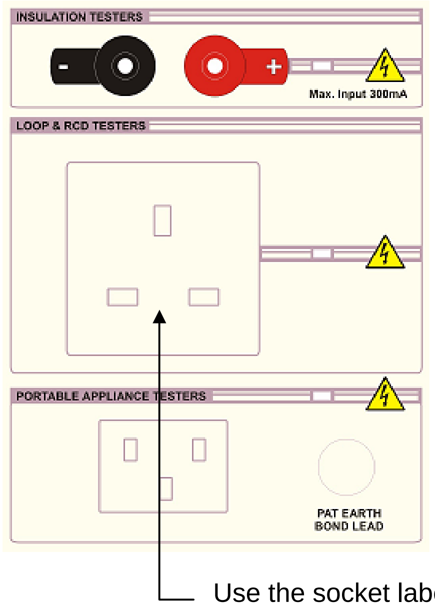
It is important to understand that an RCD tester does not generate the current, but acts as a resistor allowing current to flow from the live to earth, simulating a fault. The 3200 measures the current flowing back to earth.

Calibrating RCD Testers using the 3200

The 3200 has three functions which can be used for complete testing of an RCD tester:

1. RCD Current measurement
2. RCD Trip Time measurement
3. RCD Duration Measurement





Use the socket labelled LOOP & RCD TESTERS for RCD testing

The RCD testing function can use two different modes :

- Zero Crossing Mode
  This allows timing to be started from the zero crossing preceding 75% of the trip value.

- Immediate Mode
  This allows timing to be started immediately on detection of current greater than 5% of the trip value set.

1. RCD Current Measurements

Warning : Mains output is present during RCD testing

Some RCD testers may require a settling delay between the application of mains from the 3200 calibrator and pressing of the TEST button on the RCD tester. This may be indicated by a symbol on the display of the RCD tester.

Certain manufacturers RCD testers may also require the user to ***keep the TEST button depressed*** *for the duration of the test.*

The current measured by the 3200 is the true current drawn by the RCD tester with no allowance for the mains voltage at the time of test. Most RCD testers current specifications apply at a specific mains voltage and their current will be dependant upon mains voltage.

In this case a linear correction can be made to obtain the current at a specific mains voltage or the 3200 may be run from a variac (variable voltage transformer).

In practice, most manufacturers now specify the current at 230V. If these RCD testers are then tested at 240V the may well be out of specification.

Step 1 Connect the RCD tester to the LOOP & RCD TESTER socket

Step 2 Select 'RCD' from the function key section of the 3200 front panel

Step 3 Using the 'SoftKey' beneath the **SET I(X)** menu item, select the required current mode (e.g. ½ I, I, 2I, 5I).

RCD :	**100mA**	**200ms**	**I**
Measured Current	0.0mA		
TEST	DURATION	SET TIME	**SET I(X)**

Step 4

Use the 'SoftKey' beneath the **SET TIME** menu item to select the time setting menu. Time values can be typed in using the keyboardor chosen from pre-set values using the range up / range down. buttons Use the **TIME MODE** menu item to select the timing mode (Immediate or Zero Crossing).
Select the **BACK** menu item to return to the main RCD test screen.

RCD :	100mA	200ms	I
TIMING MODE : ZERO CROSSING			
	TIME MODE		BACK

Step 5

Press the 'SoftKey' beneath the test menu item to begin the test.

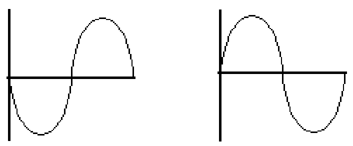
RCD :	100mA	200ms	I
Measured Current	0.0mA		
TEST	DURATION	SET TIME	SET I(X)

Step 6

Press the test button on the RCD tester to allow the 3200 to measure the current.

Step 7

Read the measured current from the display of the 3200.
The polarity and measurement technique will also be indicated on the 3200 screen.



Polarity

PEAK

RMS

Measurement Technique

2. RCD Trip Time Measurements

Warning : Mains output is present during RCD testing

Some RCD testers may require a settling delay between the application of mains from the 3200 calibrator and pressing of the TEST button on the RCD tester. This may be indicated by a symbol on the display of the RCD tester.

*Certain manufacturers RCD testers may also require the user to **keep the TEST button depressed** for the duration of the test.*

Step 1 Connect the RCD tester to the LOOP & RCD TESTER socket

Step 2 Select 'RCD' from the function key section of the 3200 front panel

Step 3 Using the 'SoftKey' beneath the **SET I(X)** menu item, select the required current mode (e.g. ½ I, I, 2I, 5I).

RCD :	100mA	200ms	I
Measured Current	0.0mA		
TEST	DURATION	SET TIME	**SET I(X)**

Step 4 Use the 'SoftKey' beneath the **SET TIME** menu item to select the time setting menu. Time values can be typed in using the keyboardor chosen from pre-set values using the range up / range down. Buttons
Use the **TIME MODE** menu item to select the timing mode (Immediate or Zero Crossing).
Select the **BACK** menu item to return to the main RCD test screen.

RCD :	100mA	200ms	I
TIMING MODE : ZERO CROSSING			
	TIME MODE		BACK

Step 5 Press the 'SoftKey' beneath the test menu item to begin the test.

RCD :	100mA	200ms	I
Measured Current	0.0mA		
TEST	DURATION	SET TIME	SET I(X)

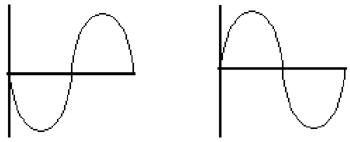
Step 6

Press the ‘TEST’ button on the RCD tester to allow the 3200 to output the current.

Step 7

Read the measured time from the display of the RCD tester.

The polarity and measurement technique will also be indicated on the 3200 screen.



Polarity

PEAK

RMS

Measurement Technique

3. RCD Current Duration Measurements

To alter the current range for RCD duration tests, go back to the main RCD menu and select the current range using the RANGE UP / RANGE DOWN buttons or the digital Control.

Step 1 Connect the RCD tester to the LOOP & RCD TESTER socket

Step 2 Select 'RCD' from the function key section of the 3200 front panel

Step 3 Select 'DURATION' using the softkey button under the 3200 display.

RCD :	100mA	200ms	I
Measured Current	0.0mA		
TEST	DURATION	SET TIME	**SET I(X)**

Step 4 Press the TEST button on the RCD tester to begin the test.

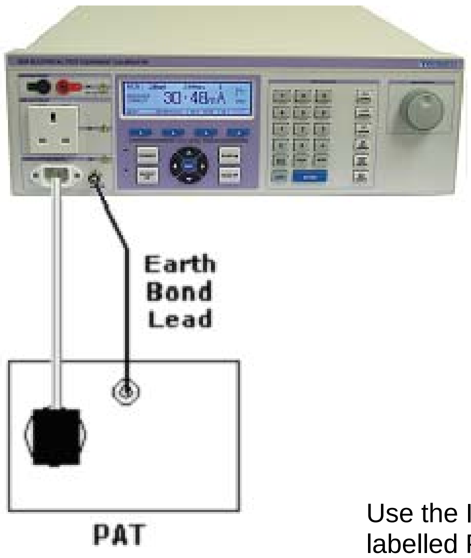
RCD :	100mA	200ms	I
	0.0mA		
ABORT			

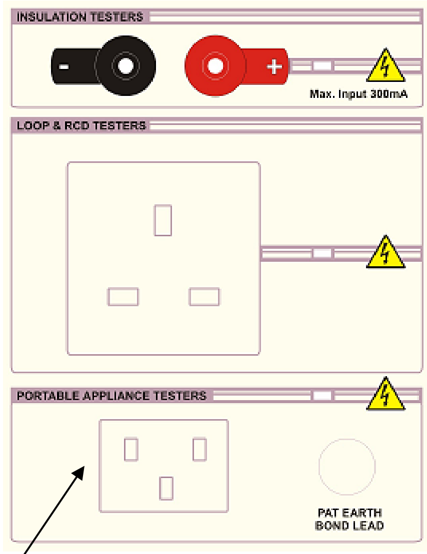
Step 5 On completion of the measurement, read the value displayed on the 3200 display

Calibrating Portable Appliance Testers (PATs)

The 3200 has six functions which can be used for testing of Portable Appliance Testers (PATs) :

1. Earth Bond Resistance measurement
2. Earth Bond Current measurements
3. Insulation testing
4. Load testing
5. Flash Testing
6. Leakage Testing





Use the IEC socket labelled PAT TESTERS for PAT testing

Use the PAT EARTH BOND LEAD terminal for earth bond current testing.

1. PAT : Earth Bond Resistance

Step 1

Connect the PAT tester to the PAT TEST IEC socket using using the test lead supplied.

Connect the PAT tester earth lead to the PAT EARTH BOND LEAD terminal on the 3200 using the lead supplied with the PAT.

Clip onto the PAT EARTH BOND LEAD terminal with the large crocodile type clips commonly used by PAT manufacturers.

Step 2 — Select ‘PAT’ from the function key section of the 3200 front panel

Step 3 — Using the ‘SoftKeys’ beneath the on-screen PAT menu, select **BOND RES**

PAT TESTING

CONNECT PAT TO IEC INLET SOCKET

BOND RES	BOND I	INS RES	LOAD

Step 4 — Select the required resistance value using either the range up / range down buttons or by incrementing / decrementing the range using the digital control.
See ‘Using the Digital Control’ for more details.

Step 5 — Press the test button on the PAT to begin testing.

Step 6 — Read the measured resistance value from the display of the PAT.

Notes on the PAT Earth Bond Function
The 3200 uses a fixed set of resistors to produce the earth bond resistances. The value displayed by the 3200 is the measured value as determined during the calibration of the 3200. This calibrated value also includes the resistance of the PAT lead supplied with the 3200.
It is important that this supplied lead is used for all PAT earth bond testing.

2. PAT : Earth Bond Current

Step 1 — Connect the PAT tester to the PAT TEST IEC socket using the test lead supplied.

Connect the PAT tester earth lead to the PAT EARTH BOND LEAD terminal on the 3200 using the lead supplied with the PAT.

To clip onto the PAT EARTH BOND LEAD terminal with the large crocodile type clips commonly used by PAT manufacturers, simply unscrew the terminal and clip onto the post.

Step 2 — Select ‘PAT’ from the function key section of the 3200 front panel

Step 3 — Using the ‘SoftKeys’ beneath the on-screen PAT menu, select **BOND I**

PAT TESTING

CONNECT PAT TO IEC INLET SOCKET

BOND RES	**BOND I**	INS RES	LOAD

Step 4 Using the RANGE UP and RANGE DOWN buttons, select the required current range (100mA, 10A or 30A).

EARTH BOND CURRENT			
MEASURED CURRENT	0.00A		**RANGE - 30A**
TEST			BACK

Step 5 Press the 'SoftKey' beneath the **TEST** menu item to allow the 3200 to begin detecting the PAT output current.

EARTH BOND CURRENT			
MEASURED CURRENT	0.00A		RANGE - 30A
TEST			BACK

Step 6 Press the PAT 'TEST' button to output current from the PAT.

Step 7 After a short sampling period, read the measured current value from the display of the 3200.

3. PAT : Insulation Testing

Step 1 Connect the PAT tester to the PAT TEST IEC socket using the test lead supplied.

Step 2 Select 'PAT' from the function key section of the 3200 front panel

Step 3 Using the 'SoftKeys' beneath the on-screen PAT menu, select **INS RES**

PAT TESTING			
CONNECT PAT TO IEC INLET SOCKET			
BOND RES	BOND I	**INS RES**	LOAD

Step 4 Enter the required resistance in MΩ from 0Ω to 10,000MΩ on the 3200 keyboard followed by Enter. An alternative way to select the required resistance is to use the digital Control to increment / decrement the digit indicated by the cursor. The Left and Right arrow keys allow the selected digit to be changed.

Step 5 Read the measured resistance value from the display of the PAT.

4. PAT : Load Testing

Step 1 Connect the PAT tester to the PAT TEST IEC socket using using the test lead supplied.

Step 2 Select ‘PAT’ from the function key section of the 3200 front panel

Step 3 Using the ‘SoftKeys’ beneath the on-screen PAT menu, select ‘NEXT’

PAT TESTING

CONNECT PAT TO IEC INLET SOCKET

BOND RES	BOND I	INS RES	**NEXT**

Step 4 Using the ‘SoftKeys’ beneath the on-screen PAT menu, select ‘LOAD’

PAT TESTING

CONNECT PAT TO IEC INLET SOCKET

LOAD	FLASH	LEAKAGE	BACK

Step 5 Using the ‘SoftKeys’ beneath the on-screen load menu, select the required mode :

PAT LOAD TESTS

MODE : 0.13kVA LOAD

0.13KVA	S/C	O/C	BACK

0.13kVA	: 0.13kVA Load
S/C	: Short Circuit
O/C	: Open Circuit

Step 6 Read the value from the display of the PAT.

5. PAT : Flash Testing [OPTION]

The PAT Flash testing mode is an option which requires use of the PAT Flash adapter pod.

Step 1 Connect the Flash adapter pod to the 3200 back panel socket.

Step 2 Select 'PAT' from the function key section of the 3200 front panel

Step 3 Using the 'SoftKeys' beneath the on-screen PAT menu, select 'NEXT'

PAT TESTING			
CONNECT PAT TO IEC INLET SOCKET			
BOND RES	BOND I	INS RES	**NEXT**

Step 4 Using the 'SoftKeys' beneath the on-screen PAT menu, select 'FLASH'

PAT TESTING			
CONNECT PAT TO IEC INLET SOCKET			
LOAD	**FLASH**	LEAKAGE	BACK

Step 5 Using the 'SoftKeys' beneath the on-screen PAT menu, select Class 1 (1.5kV) or Class 2 (3kV) as required.
The 'FLASH' Voltage generated by the PAT Tester can either be measured under a nominal 1mA load or measured as the 'open circuit' voltage. Use the soft (1mA Load) key to select required.

PAT : FLASH TESTING		CLASS 2	
	0.00mA	0000V	
	CLASS 1	**CLASS 2**	BACK

- The Flash voltage for **CLASS 1** is measured between **LIVE** and **EARTH** on the IEC socket of the flash adapter.
- The Flash voltage for **CLASS 2** is measured between the **LIVE** of the IEC socket and the **3kV TEST POINT** of the flash adapter.

THE EARTH OF THE IEC SOCKET MUST BE LEFT OPEN CIRCUIT TO OBTAIN CORRECT READINGS FOR THIS TEST.

Step 6 Apply the Flash test voltage from the PAT under test.
Read the voltage and current displayed on the 3200

Warning : High voltages are present during PAT Flash testing

6. PAT : Leakage [OPTION]

Step 1 Connect the PAT tester to the PAT TEST IEC socket using using the test lead supplied.

Step 2 Select 'PAT' from the function key section of the 3200 front panel

Step 3 Using the 'SoftKeys' beneath the on-screen PAT menu, select 'NEXT'

PAT TESTING

CONNECT PAT TO IEC INLET SOCKET

BOND RES	BOND I	INS RES	**NEXT**

Step 4 Using the 'SoftKeys' beneath the on-screen PAT menu, select 'LEAKAGE'

PAT TESTING

CONNECT PAT TO IEC INLET SOCKET

LOAD	FLASH	**LEAKAGE**	BACK

Step 5 Using the 'SoftKeys' beneath the on-screen PAT menu, select the required. range

PAT : LEAKAGE

LEAKAGE CURRENT 0.000mA

Range : 240uA PAT Voltage 0.7V

LOAD	FLASH	**LEAKAGE**	BACK

Step 6 Set the PAT to leakage mode.
Read the leakage measurement from the 3200 display.

Introduction to LOOP Testers

What is the loop ?
When an appliance is connected to the mains supply a circuit is made. It completes the loop current flow round the circuit loop from the power station in the live wire through the appliance and then back to the power station in the neutral wire. Voltage is dropped around the loop due to the resistance of the cables etc. in which the current is flowing.

What is the loop resistance ?
The resistance of the cables etc. connecting your appliance to the power station.

There are two loop’s connecting to the power station
1: The Phase-live to Phase-neutral loop.
2: The Phase-live to earth loop

Normally current will flow round the live to neutral loop but in a fault condition current from the live could return to the power station through the EARTH conductor,

What is PSCC and why is loop resistance important?
Using ohms law the loop resistance will determine the maximum current that can possibly flow round a circuit, as an example if the loop resistance is 1 ohm and the supply voltage 230 Volts using ohms law where

VOLTAGE / RESISTANCE = CURRENT

(230 V / 1Ohm) = 230 Amps

It can be seen that the maximum current that could flow would be 230 Amps even if the appliance was a dead short circuit. It can be clearly seen that a fuse or protection device lower than 230 amps would be needed to protect this circuit. It should be noted that some testers take the lowest loop, either live/neutral or live/phase to calculate the PSCC while other will use only the live/earth loop resistance.

Why is it normal to get large variations in PSCC measurements ?
PSCC is calculated by dividing the mains voltage by loop by the loop resistance. Loop resistance’s are often very low, 0.1 to 0.4 ohms and the accuracy , resolution & repeatability possible when measuring loop resistance will give rise to large variation in PSCC as the supply voltage is being divided by a number approaching zero.

Example
A 230 volt supply with loop resistance of **0.2ohms**
(230V / 0.2ohm) = **gives a PSCC of 1150Amps**

where if the loop resistance was only 0.05Ohms less at **0.15 ohms**
(230V / 0.15ohms) = **gives a PSCC of 1533 Amps**

What is a Loop tester measuring

Loop testers measure the resistance in ohms of the mains supply at a power socket, most loop testers only measure the resistance of the live(Phase) to earth resistance, some testers can measure also the resistance o the live to neutral circuit. Some loop testers can also display the PSCC (Prospective Short circuit current) or sometimes called the PFC (Prospective fault current)

How do they work **?**

Loop testers work by applying a heavy load, usually 23 amps for a short duration and measuring the drop in voltage when the load is applied, then using ohms law display the loop resistance.

What happens on an RCD protected circuit when using a loop tester ?

As the test current (23Amps) flows down the earth conductor any current RCD (Residual current breaker) in the circuit will trip out. To test loop impedance on protected circuits the breaker must either be temporally wired out or a loop tester with a ***no trip*** range must be used. On the 'No Trip' range the testers load current is much lower & only loads the supply or a very short periods of time so to prevent the RCD from operating. In this mode the tester will internally repeat the measurement several times and take an average. As a result the measurement takes longer and the measurement less accurate, especially if the supply in noisy. As any PSCC calculation is a reciprocal of the loop resistance (Volts/Resistance) error in the reading of resistance can make big differences in the PSCC value.

How do I Calibrate a Loop Testers

To calibrate a Loop tester first the loop impedance of the supply must be known, then several known values of resistance must be inserted in the loop to increase the loop resistance so the tester can be calibrated at several points. The resistance can either be in the live or earth return. (it is common practice to place the resistors in the earth return for safety reasons). The value displayed on the tester can then be compared to that of the known value of the resistor. plus the loop resistance of the supply.
The 3200 has 8 calibrated resistance values which are non inductive and are able to withstand the 23 Amps needed.

How can I accurately measure the loop impedance of my Test Socket ?

Firstly it is important to define what is the test socket. This is the socket into which the **Instrument being calibrated will be directly plugged into**. This is not the same as the socket on the wall which then has an extension lead to run it down to the test bench first, remember every bit of cable, plug, fuse etc is adding resistance.

IMPORTANT SAFETY WARNING

THE FOLLOWING PROCEDURE MAKES CONNECTION DIRECTLY TO MAINS LINE VOLTAGES WHICH ARE UNPROTECTED BY AN RCD BREAKER - THERE IS EXTREME RISK OF ELECTRIC SHOCK UNLESS PROPER SAFETY PRECAUTIONS ARE TAKEN.

THIS PROCEDURE MUST ONLY BE PERFORMED BY QUALIFIED ENGINEERS.

Equipment Required.
Loop resistance can be measured using a DMM calibrated on AC volts, a DMM calibrated on AC amps and a load resistor, which can easily be switched on/off, capable of taking around 10amps for a minute without a large change in value, an electric kettle can be used if nothing else is available which will take the power.

Connections
First connect the amp meter in series with the load to enable measurement of the current taken by the load. Then connect both the switched load in series with the amp meter & the AC volts measuring DMM between the **live and earth** pins in a mains plug. *(**NOTE** Do not connect the load at the DMM terminals otherwise the resistance of the test leads will also be measured, both leads must go to the plug.)*

Measurement Method.
Insure all connections are insulated and the load is off.
Connect the measurement Plug in to the test socket.
1: Record the off load voltage measured by the DMM.
2: Switch on the load and record
3: The current taken by the load
4: The AC volts under load.
Repeat several times and calculate the average. Use the formula below to calulate loop resistance:-

Loop resistance = (Off load Voltage - On load voltage) / Load Current in Amps

When using the 3200 it is important to remember the test socket is the socket at the end of the adapter cable, *NOT THE RESISTANCE OF THE SOCKET INTO WHICH THE 3200 IS PLUGGED.* The loop value measured at this test socket can then be manually entered into the 3200 which will add this value to the calibrated values.

The AUTOLOOP option measures the loop resistance of the supply internally by performing automatically the procedure above, the internal load of the 3200 is approx 4 Amps and the on/off load voltage measurements are taken 32 times, with noisy readings caused by mains spikes etc being discarded. The 3200 then adds the supply loop value it has measured plus a small correction for the resistance of the test adptor. (Note this is not the value of the socket the 3200 is plugged in to but the value at the test socket, which is always greater due to the resistance added by the 3200 wiring.)

How can I calibrate a Loop Tester at Zero
It is desirable when calibrating loop testers to calibrate at as near zero as possible. However practical limitations govern how low a value can be achieved.

NOTE It is not possible to get a calibration point lower than the resistance of the supply test socket itself. Typically the 3200 will add 0.15Ohms to the resistance of the socket which the 3200 is plugged into.

The lowest value will be obtained near where the supply enters the building. Remember every switch, fuse socket, even the 3200 will add resistance. If it is required to calibrate at values below that available from of the 3200 then a short length of extension cable of which the resistance of the live + earth conductors have been measured by a 4 wite DMM can be used.

Generally however it is not necessary to calibrate at values below a normal supply. If 3 points spread across the instruments range can be achieved and the linearity can be verified it can be assumed that the zero will be correct. (The manufactures would after all have verified that the design is linear on the lowest part of the scale.)

Other Problems with calibrating Loop testers.

Loop tester measure resistance down to milli ohm levels using two wire connection, it is well understood that connection/lead resistance etc at this level make a significant difference’s.

The instrument specifications assume all nice new clean contacts in to tightly fitting sockets, and we all know plugs, sockets etc get dirty and worn. This obviously increases the resistance which can easily put the instrument out of spec.

It is very difficult to achieve reliable 2 wire connection when measuring milli ohms, simply plugging in and out can change a connection resistance by 100milli ohms so this is the first place to look. Also check the lead is the same as the lead supplied with the instrument, even the fuse will make a difference.

The 3200 is supplied with good quality sockets to help maintain a low contact resistance, also the mains lead is directly connected to avoid another possible problem. It is however to be expected that variation in the order of ten’s of milli ohms will be present in two wire systems.

The other main problem with loop testers is they often fail short circuit resulting in a big bang when plugged in. The 3200 first checks the tester for this by checking the current flowing with 1kohm in the earth line before a full power test. If the 3200 detects a faulty instrument the test is automatically aborted.

Calibrating LOOP Testers using the 3200

Loop testing using the 3200 is performed using a fixed set of resistance ranges, with auto (optional extra) and manual loop measurement.

■ Auto Loop Measurement

NOTE : Auto loop measurement is an optional extra specified when a 3200 is ordered.

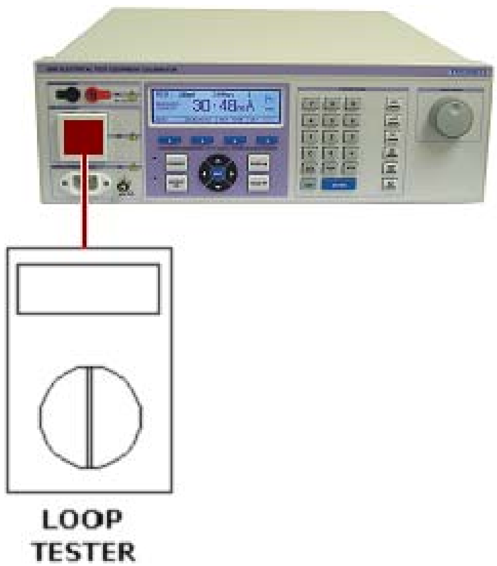
The auto loop measurement allows the 3200 to automatically measure the loop resistance of the mains supply to the 3200. THE RESISTANCE MEASURED IS NOT THE RESISTANCE AT THE SOCKET INTO WHICH THE 3200 IS PLUGGED, BUT THE RESISTANCE AT THE TEST ADAPTER SOCKET INTO WHICH THE LOOP TESTER BEING CALIBRATED IS PLUGGED. This measurement incorporates the resistance of the supplied adapter lead and the mains circuit to provide the value at the test socket.

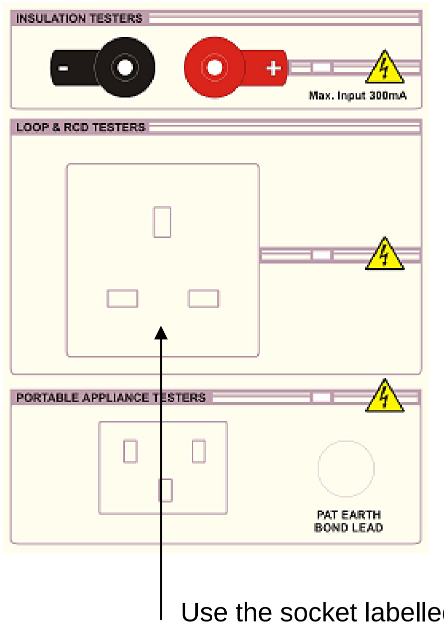
The adapter lead is typically 23mOhms ± 3mOhms

The 3200 will then incorporate this value into its displayed loop resistance values.

■ Manual Loop Entry

This standard function allows the user to enter a loop resistance measurement manually by typing the figure in using the keyboard **NOTE THIS MUST BE THE VALUE OF THE LOOP RESISTANCE MEASURED AT THE TEST SOCKET**. The 3200 will then incorporate this value into its displayed loop resistance values.





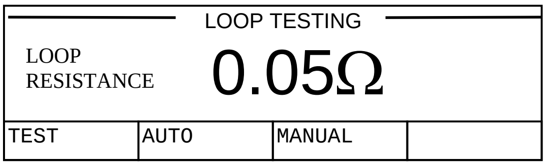
Use the socket labelled LOOP & RCD TESTERS for LOOP testing

When the TEST softkey is pressed on the 3200 front panel, the 3200 ***pre-tests*** *the LOOP tester to detect faulty devices. Should a faulty device be detected the output will be automatically switched off and a fault message will be displayed on the 3200 display.*

Step 1 Connect the LOOP tester to the LOOP & RCD TESTER socket

Step 2 Select ‘LOOP’ from the function key section of the 3200 front panel

Step 3 Use the ‘SoftKeys’ beneath the loop measurement modes to select the loop resistance measurement mode.



Step 4 Select the required resistance value using either the range up / range down buttons or by incrementing / decrementing the range using the digital Control.
See ‘Using the Digital Control’ for more details.

Step 5 Press the ‘TEST’ softkey on the 3200 to apply mains to the LOOP tester

Step 6 Press the ‘TEST’ button on the LOOP tester to begin testing.

Step 7 Read the loop resistance from the display of the LOOP tester.

Notes on the LOOP Function

By incorporating the supply loop impedance into the displayed value, this allows direct comparison to the value displayed on the loop tester being calibrated. The resistance value displayed by the 3200 is comprised of the following :

1. The **measured value of the resistor** (as measured during 3200 calibration)
2. The **supply loop impedance**
   (as measured and stored by the 3200 via the manual or auto loop function)

The loop impedance of a supply will change over time, therefore it is important that the loop impedance value is checked regularly by running the auto loop function or updating the manual loop resistance.

If the 3200 is moved to another location or plugged into a different socket, this will have an impact on the loop impedance – the auto loop function will need to be used or the specific socket’s impedance measured and entered manually.

PSC (Prospective Short Circuit) Testing

Some LOOP / Installation testers have the capability to measure PSCC (Prospective Short Circuit Current) which is the largest Prospective Fault Current (PFC) which could flow.

This current is limited by the LOOP resistance of the circuit and can be calculated for either :

- Phase (Live) to Earth
- Phase (Live) to Phase (Neutral)

The more usual is Phase (Live) to Phase (Neutral)
The LOOP / Installation testers calculate this measurement from the measured LOOP resistance using the sum :

$$\textbf{PSCC} = \frac{\textbf{Nominal supply voltage}}{\textbf{LOOP Resistance}}$$

This function can be calibrated with the 3200 by using the LOOP function

The standard lead supplied with the 3200 will enable you to simulate Phase (Live) to Earth PSCC. If Phase (Live) to Phase (Neutral) PSCC testing is required, the lead detailed below will need to be made :

To calibrate, compare the reading obtained on the Installation tester with the value calculated from the formula above using the LOOP impedance displayed on the 3200.

Remote Programming

The RS232 interface

The calibrator can be fully controlled and calibrated via the bi-directional RS232 interface. The interface uses the standard 9 pin PC connector and a standard serial lead. The interface is fully optically isolated from the rest of the calibrator circuitry. Baud rate is fixed at 9600 baud, no parity and one stop bit which allows a complete output command to be sent in less than 20ms. The calibrator can send to the computer information about the output status, calibration factors, value of internal standards together with other information. The internal processor decodes the commands and returns control codes to verify the correct operation of that command. The calibrator can be sent individual commands directly from the Windows HYPER Terminal program, any basic or high level program or from the ProCal98 Calibration System.

Programming Commands

The 3200 is controlled by a set of simple high level commands.

Function	Command	Description
CONTINUITY TESTING	**F1**	**Select the continuity function**
	Sxx.xx	**Set resistance value** e.g. S12.3 for 12.3Ω
INSULATION TESTING	**F2**	**Select the insulation function**
	Sxxxx	**Set resistance value** e.g. S1000 for 1GΩ
INSULATION TEST VOLTAGE	**F3**	**Select the insulation test voltage function**
	R1	**Set 50V range**
	R2	**Set 100V range**
	R3	**Set 250V range**
	R4	**Set 500V range**
	R5	**Set 1000V range**
	L0	**Set 1mA range**
	L1	**Set 500uA range**
	T	**Transmit measured values : Voltage in 100mV units : Current in 1uA units**
INSULATION TESTER VOLTAGE MEASURE	**F4**	**Select the insulation tester voltage measurement function**
	R1	**Set 100V range**
	R2	**Set 200V range**
	R3	**Set 240V range**
	R4	**Set 300V range**
	R5	**Set 400V range**
	T	**Transmit output value in 100mV units.**

PAT : EARTH BOND RESISTANCE	**F11**	**Select the insulation tester voltage measurement function**
	R1	**Set 0Ω range**
	R2	**Set 0.05Ω range**
	R3	**Set 0.1Ω range**
	R4	**Set 0.22Ω range**
	R5	**Set 0.33Ω range**
	R6	**Set 0.5Ω range**
	R7	**Set 1Ω range**
	R8	**Set 5Ωrange**
	R9	**Set 10Ω range**
	R10	**Set 100Ω range**
	R11	**Set 1000Ω range**
	R12	**Set EXT 1 range**
	R13	**Set EXT 2 range**
	T	**Transmit output value in 1uΩ units.**
	Zxxxxxx	**Set calibration factor (1uΩ Units)**

PAT : EARTH BOND CURRENT	**F87**	**Select the PAT earth bond current menu**
	R1	**Set 100mA range**
	R2	**Set 10A range**
	R3	**Set 30A range**
	F12	**Start the PAT earth bond current test**
	T	**Transmit measured value in 1mA units.**
	Zxxxxxx	**Set calibration factor**

PAT : INSULATION TESTING	**F13**	**Select the PAT insulation testing function**
	Sxxxx	**Set resistance value** e.g. S1000 for 1GΩ

PAT : LOAD TESTING	**F14**	**Select the PAT load test function**
	R1	**Select 440Ω load between live and neutral**
	R2	**Select short circuit**
	R3	**Select open circuit**

PAT : FLASH TESTING	**F15**	**Select the PAT Flash testing function**
	F58	**Select the CLASS 1 [1.5kV] Flash test mode**
	F59	**Select the CLASS 2 [3kV] Flash test mode**
	T	**Transmit measured values** **Flash Current in 1uΩ units.** **Flash Voltage in 1V units**

PAT : LEAKAGE TESTING	**F16**	**Select the PAT leakage testing function**
	R1	**Set 240uA range**
	R2	**Set 1mA range**
	R3	**Set 3mA range**
	T	**Transmit measured value in 1uA units.**

RCD	F85	Select the RCD trip current menu
	F86	Select the RCD trip time menu
	Sxxxx	Set trip current in mA or trip time in ms depending on menu displayed.
	F21	Start RCD test
	T	Transmit measured current in 10uA units
	F52	RCD timing mode menu
	N0	Zero crossing Mode
	N1	Immediate Mode
	A	Abort RCD test

RCD Internal Calibration Mode	F22	Set to RCD internal calibration mode
	Zxxxxxx	Set calibration factor (10uA Units)

RCD CURRENT DURATION	F85	Set to RCD internal calibration mode
	Sxxxx	Set trip current in mA
	F24	Start RCD current duration test
	T	Transmit current duration in 100us units
	A	Abort RCD current duration test

LOOP RESISTANCE	F31	Select the loop resistance function
	R1	Set 0Ω range
	R2	Set 0.05Ω range
	R3	Set 0.1Ω range
	R4	Set 0.22Ω range
	R5	Set 0.33Ω range
	R6	Set 0.5Ω range
	R7	Set 1Ω range
	R8	Set 5Ωrange
	R9	Set 10Ω range
	R10	Set 100Ω range
	R11	Set 1000Ω range
	R12	Set EXT 1 range
	R13	Set EXT 2 range
	P	Switch on mains and start test (Incorporates pre-test for fault detection)
	T	Transmit output value (internal resistor value + loop resistance) in 1uΩ units (12 Chars) Transmit Mains Voltage in mV (12 Chars)
	F53	Command 3200 to measure its mains resistance
	F84	Select manual mains resistance menu
	Sx.xxx	Send manual mains resistance in ohms For use in conjunction with F84 command
	Zxxxxxx	Set calibration factor (uΩ)

MISCELLANEOUS COMMANDS	**U**	**Transmit all calibration factors** **A1 to A20 : Insulation Test Voltage** **B21 to B40 : ACV Output** **C41 to C60 : Earth Bond Resistance** **D61 to D80 : Earth Bond Current** **E81 to E100 : RCD** **F101 to F120 : LOOP Resistance** **G121 to G140 : General** **G121 : LOOP Resistance Load** **G122 : LOOP Resistance Voltage** **G123 : LOOP Resistance Offset** **G124 : RCD Relay Time** **G125 : Manual LOOP Offset** **G126 : Auto LOOP Offset** **G127 : Earth Bond Offset**
	!	**Reverse display mode**
	&21xxxxxxxxxxxxxxxx	**Store text string (16 chars max.)**
	#	**Display stored text string**
	F80	**Set 3200 back to main menu**

Example command sequences

Note : A forward slash can be used to separate commands on a single line.

To set up the 3200 to Insulation mode, 1GΩ the following commands would be used :

F2/S1000	**Set to 1GΩ Insulation**

To set up and execute a 10ms @ 100mA RCD test, the following commands would be used :

F85/S100	**Set to 100mA trip current range**
F86/S10	**Set to 10ms trip time range**
F21	**Start test**
T	**Transmit measured current in 10uA units**

To set up and execute a 10A PAT Earth Bond Current test, the following commands would be used :

F87/R2	**Set to 10A earth bond current range**
F12	**Start test**
T	**Transmit measured current in 1mA units**

Technical Description

General

The 3200 calibrator uses the latest in reference, resistor and processor technology designed to minimise cost and size yet maximise performance. The micro processor controls and monitors all functions of the calibrator. Calibration constants are held in non volatile memory allowing the calibration to be performed without removing the covers. There are no internal adjustments required in normal service.

⚠ *Warning* risk of shock ⚠

The line power cord must be disconnected before opening the instrument

The circuitry comprises of three printed circuit boards :

- Main PCB.
- Processor board
- Front Panel Display and keyboard control

Construction

The calibrator is constructed in a 3U 19” case. The calibrator is constructed is modular to allow easy of servicing.

Internal Fuses.

In normal operation these fuses should never need to be replaced.
Only under fault conditions will they require changing.

NOTE : To access these fuses it is necessary to dismantle the case which should only be carried out by an engineer. See removing top cover.

***Warning* risk of shock**
The line power cord must be disconnected before opening the instrument.

Internal fuses include :
± 12V Supply A/S 2Amp 20mm

Opening The Case

***Warning* risk of shock**
The line power cord must be disconnected before opening the instrument.

To gain access to the inside remove the six screws which hold the top cover in place. These are located on the underside edges of the 3200 calibrator. The two side screws on the plastic front panel must also be removed to allow the top cover to be slid back. Once these screws are removed, simply slide the top cover toward the read of the instrument to remove.
Once the rear panel is removed the top or bottom cover can, if required, slide out allowing full access.

Access to Internal Fuses

After removing the top cover (see above) the fuses will be clearly visible.

PCB Removal (Not required to gain access to internal fuses).

The main PCB can only be removed from the front of the case by removing the front panel.

Processor Board

Plugs into the main PCB and controls all functions within the calibrator. The processor board is a complete working board containing RAM, PROM, Clock, Cal Ram, I/O and RS232. The processor also applies all calibration factors held in RAM. Cal Factors are stored twice to prevent errors. The processor runs a self test to detect malfunction and overloads.

Warning
Removal of the processor board may corrupt the calibration factors.

Calibration and Maintenance

WARNING
The information in this section is intended only for qualified personnel. The user must at all times be adequately protected from electric shock.

General

The 3200 calibrator maintenance requirements are listed below. Please note that the calibrator **does not** require any regular internal servicing or adjustment.

1: Electrical Safety Checks on Line power lead and case
2: Cleaning the external case
3: Calibration and operation verifications

Electrical Safety Tests

These can be carried out as frequently as required. Earth bond and insulation can be tested as a class 1 standard. Flash testing is not recommended due to the possibility of damage to internal components. .

Cleaning the external case

Use a damp cloth with a mild water based cleaner for the outside case and front panel. Do not use alcohol based cleaners or solvents and do not spill or allow liquid to enter the case.

Calibration Overview

The calibration of the 3200 calibrator can be performed covers on. Calibration factors for positive, negative and zero are store in non volatile memory for each range. Values for resistance will only need adjusting after repair.

Calibration can be carried out automatically via the RS232 interface if required. Adjustments to the calibration can only be made using the interface see remote commands section of this manual for details. A Calibration Control Panel (CCP) program is available from Transmille which allows full control and adjustment of the calibrator.

The recalibration of 3200 calibrator should be performed annually in a standards laboratory with the correct equipment. Adjustment should not be attempted without the required standards.

Before calibration it is important to have meet the conditions listed below

1: The correct environmental condition .
2: The calibrator must have fully warmed up and been allowed to stabilise for the correct period of time.
3: Operated from the correct line voltage.
4: To use the correct calibration equipment.
5: To have available the Correct Test leads required
6: To understand the required test specifications.
7: To operate the calibrator at all times within its load and voltage capabilities

COMPREHENSIVE CALIBRATION INSTRUCTIONS ARE AVAILABLE IN THE 3200 SERVICE MANUAL.

Guarantee and service

Transmille Ltd. guarantees this instrument to be free from defects under normal use and service for a period of 1 year from purchase. This guarantee applies only to the original purchaser and does not cover fuses, or any instrument which, in Transmille's opinion, has been modified, misused or subjected to abnormal handling or operating conditions.

Transmille's obligation under this guarantee is limited to replacement or repair of an instrument which is returned to Transmille within the warranty period. If Transmille determines that the fault has been caused by the purchaser, Transmille will contact the purchaser before proceeding with any repair.

To obtain repair under this guarantee the purchaser must send the instrument (carriage prepaid) and a description of the fault to Transmille at the address shown below. The instrument will be repaired at the factory and returned to the purchaser, carriage prepaid.

Note :
TRANSMILLE ASSUMES NO RESPONSIBILITY FOR DAMAGE IN TRANSIT

THIS GUARANTEE IS THE PURCHASER'S SOLE AND EXCLUSIVE GUARANTEE AND IS IN LEIU OF ANY OTHER GUARANTEE, EXPRESS OR IMPLIED. TRANSMILLE SHALL NOT BE LIABLE FOR ANY INCIDENTAL, INDIRECT, SPECIAL OR CONSEQUENTIAL DAMAGES OR LOSS.

TRANSMILLE
SOLUTIONS IN CALIBRATION

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Tel : **+44 0 1580 890700**
Fax : **+44 0 1580 890711**
Email : **sales@transmille.com**
Web : **www.transmille.com**

3200 Fax Back Form

Your 3200 Electrical Test Equipment Calibrator is fitted with a *security system* which requires a *security code* to be entered to allow continued operation of the unit beyond the 65 Day evaluation period.

Please complete the following details :

Company Name : ______________________________

Contact Name : ______________________________

Address : ______________________________

____

____

____

Country : ______________________________

Tel. : ____________________

Fax : ____________________

Instrument Model : 3200 Electrical Test Equipment Calibrator

Serial Number : ____________________

Please Fax This Form To : +44 (0) 1580 890711.

On receipt of this fax Transmille will, on receipt of payment for the calibrator, send details of the security code with details on how to enter this code.

3200

Electrical Test Equipment Calibrator

Operation Manual
Appendix A

MODEL 3200

EXTENDED SPECIFICATIONS

TRANSMILLE
SOLUTIONS IN CALIBRATION

ELECTRICAL TEST EQUIPMENT CALIBRATOR

DECLARATION OF CONFORMITY

CE

Manufacturer's Name: Transmille Ltd.
Manufacturer's Address: Unit 4, Select Business Centre
Lodge Road
Staplehurst
TN12 0QW.
United Kingdom.

Declares, that the product

Product Name: Electrical Test Calibrator
Model Number: 3200
Product Options:
This declaration covers all options of the above product(s)

Conforms with the following European Directives:

The product herewith complies with the requirements of the Low Voltage Directive 73/73EEC and the EMC Directive 89/336/EEC (including 93/68/EEC) and carries the CE Marking accordingly

Conforms with the following product standards:

EMC

IEC616326-1:1997+A1:1998 / EN 61326-1:1997+A1:1998 EN55011:1991

Standard	Limit
IEC 61000-4-2:1995+A1:1998 / EN 61000-4-2:1995	*Group 1Class A*
IEC 61000-4-3:1995 / EN 61000-4-3:1995	*4kV CD, 8kV AD*
IEC 61000-4-4:1995 / EN 61000-4-4:1995	*3 V/m, 80-1000 MHz*
IEC 61000-4-5:1995 / EN 61000-4-5:1995	*0.5kV signal lines, 1kV power lines*
IEC 61000-4-6:1996 / EN 61000-4-6:1996	*0.5kV line-line, 1kV line-ground*
IEC 61000-4-11:1994 / EN 61000-4-11:1994	*3V, 0.15-80 MHz I cycle, 100%*
	Dips: 30% 10ms; 60% 100ms
	Interrupt > 95%@5000ms

SAFETY

IEC 61010-1:1990+A1:1992+A2:1995 / EN 61010-1:1993+A2:1995

06/03/2006

Date Of Issue **Managing Director**

Revision No: 1.10 : 06/03/2006

Warm Up Time	Double the time since last used up to 20 minutes maximum	
Standard Interfaces	RS232	
Optional Interfaces	USB (Universal Serial Bus)	
Temperature Performance	Storage : -5°C to +60°C Operation : 0°C to +50°C	
Relative Humidity	Operation : <80% to 30°C, <70% to 40°C, <40% to 50°C Storage : <95%, non-condensing	
Altitude	Operation : 3000m (10,000ft) Maximum Transit : 12000m (40,000ft) Maximum	
EMC & Safety	The calibrator line input plug must be earthed See D.O.C for full details	
Line Power	Line Voltage Selectable : 110V / 230V Line Frequency : 50Hz to 60Hz Line Voltage Variation : -6% +10%	
Power Consumption	28 Watts	
Connections	PAT Testing Connection	1x IEC Plug
	LOOP & RCD Testing Connection	1x UK / European / Australian type socket
	Insulation Tester Connection	1xBlack : 1xRed 4mm Low Thermal Sockets
	PAT Ground Connection	1x 4mm terminal post
	RS232 Interface	1x Female 'D' type socket
RS232 Settings	Baud Rate	9600
	Parity	None
	Data Bits	8
	Stop Bits	1
Display Information	Type	Backlit Black on white film STN type
	Viewing Area	124.3mm * 34mm
	Resolution	256 * 94 dots
	Backlight Type	Cold fluorescent lamp
	Brightness	70 to 90 cd/m^2
Indicators	PAT Testing Connection	Red LED above plug
	LOOP & RCD Testing Connection	Red LED above socket
	Insulation Tester Connection	Red LED above terminals
Keyboard	Membrane type with tactile feedback	
Fuses	Loop (Live)	5A Anti-Surge
	Mains	2A
	Loop (Neutral)	5A Anti-Surge
	RCD	2A
	ACV	100mA
	PAT	1A
	Insulation Resistance	100mA
Isolation	Outputs are opto-isolated from mains earth and the RS-232 interface Maximum common mode voltage between earth and the low terminals 30 Volts ac/dc.	
Dimensions & Weights	Calibrator Only	45cm x 44cm x 14cm : 10kgs
Warranty Period	1 Year	
Recommended Service Interval	1 Year	
Supplied Connections	1x Serial Interface Connection 1x 1m PAT Test Lead	
Mounting Kit (optional)	3U rack mount kit	
Case Colour	Cream (RAL9002)	

Due to continuous development specifications may be subject to change.

Continuity Resistance*

Standard Accuracy - Relative to Calibration Standards Specifications

Range	Type	Resolution	Accuracy		
			%	±	mΩ
0.1Ω to 20Ω	Continuously Variable	10mΩ	1	±	25
100Ω	Fixed	10mΩ	1	±	25
1kΩ	Fixed	10mΩ	1	±	25

High Accuracy (option) - Relative to Calibration Standards Specifications

Range	Type	Resolution	Accuracy		
			%	±	mΩ
0.1Ω to 20Ω	Continuously Variable	10mΩ	0.25	±	25
100Ω	Fixed	10mΩ	0.25	±	25
1kΩ	Fixed	10mΩ	0.25	±	25

*** Maximum Test Current 300mA**
Test current maximum can be exceeded for a maximum of 5 seconds

Continuity Current Measurement

Accuracy - Relative to Calibration Standards Specifications

Range	Load	Accuracy		
		%	±	Counts
0 to 320mA	1Ω	1.3	±	6

Insulation Resistance

Standard Accuracy - Relative to Calibration Standards Specifications

Range	Type	Resolution	Maximum Voltage/Power[1]	Accuracy %
0Ω to 5MΩ	Continuously Variable	10kΩ	1.1kV or 1 Watt	0.3
5MΩ to 2GΩ	Continuously Variable	10kΩ	1.1kV or 1 Watt	3

High Accuracy (option) - Relative to Calibration Standards Specifications

Range	Type	Resolution	Maximum Voltage/Power[1]	Accuracy %
0Ω to 5MΩ	Continuously Variable	10kΩ	1.1kV or 1 Watt	0.1
5MΩ to 2GΩ	Continuously Variable	10kΩ	1.1kV or 1 Watt	1

Note 1 : A 5kV option is available for Insulation Testers incorporating *Active Guard* .

10GΩ Range (Option) - Relative to Calibration Standards Specifications

Range	Type	Resolution	Maximum Voltage/Power[1]	Accuracy %
2GΩ to 10GΩ (Option)	Continuously Variable	10kΩ	1.1kV or 1 Watt	5

Note : Can be fitted to Standard or High accuracy models

Insulation Test Voltage Measurement

Accuracy - Relative to Calibration Standards Specifications

Ranges	Current Measurement	Resolution	Accuracy %	±	Counts
50V • 100V • 250V • 500V • 1kV	0.5mA • 1mA	0.1V	1	±	8

AC Voltage Output

Accuracy - Relative to Calibration Standards Specifications

Ranges	Accuracy %	±	Counts
100V • 200V • 230V • 300V • 400V	0.2	±	1

Resistance Multiplier Option 5KV

Multiplies resistance output of 3200 by 100

Accuracy - Relative to Calibration Standards Specifications

Range	Resolution	Maximum Voltage Peak AC+DC	Accuracy		
1GOhm to 1TOhm[1]	1MOhm	10kV	1.50%	±	R^{CAL}

[1]Requires 10GOhm Option fitted to 3200, otherwise maximum resistance = 200GOhms

R^{CAL} = Resistance set on 3200

Due to continuous development specifications may be subject to change.

RCD Time

Accuracy - Relative to Calibration Standards Specifications

Range	Resolution
20ms to 5s	10ms

RCD (Residual Current Device) Current

Trip Current Range 0.5 to 3000mA
Current Multiplier 0.5, 1, 2, 5
3200 Keypad Input : 1mA to 1000mA in 1mA steps

Accuracy - Relative to Calibration Standards Specifications

Range	Resolution	Time Interval*	Series Resistance	Accuracy		
	to 200mA			%	±	Counts
3mA to 10mA	0.01mA	up to 5s <190ms	100Ohms	1.2 5	± ±	6 20
10.1mA to 100mA	0.01mA	up to 5s <190ms	10Ohms	1.2 5	± ±	6 20
101mA to 1A	0.1mA	up to 5s <190ms	1Ohm	1.2 5	± ±	6 20
1.01A to 3A	1mA	up to 5s <190ms	0.1Ohm	1.2 5	± ±	6 20

Range selection automatic, depending on trip value : All ranges 15% Overrange

Additional Features	
Timing Modes	Immediate • Zero Crossing
Current Modes	½I • I •2I •5I
Display Modes	0°, 180° of Phase & Half Wave / DC

Intelligent Protection :

The 3200 incorporates a pre-test scan where power is ramped up to the UUT - the test is automatically aborted if a faulty UUT is detected. This avoids further damage to the UUT and safeguards the 3200.

**Current measurement modes :*

Above 200ms : DC coupled True RMS allowing accurate measurement of both sinusoidal current and half wave (positive or negative)

Intelligent firmware captures and analyses the current waveform automatically discarding pre-test (no-trip) currents and switch on spikes automatically capturing and measuring only the true test current.

Fast Mode (Below 200ms) : Peak capture divided by 1.41 to give mathematically calculated RMS for sinusoidal only

RCD Current Duration

RCD current duration is the measurement of the period the fault current flows

RCD Current Duration	
Measurement Range	10ms to 5s
Resolution	0.1ms
Timing Accuracy	0.4ms

Due to continuous development specifications may be subject to change.

Loop Resistance

Accuracy - Relative to Calibration Standards Specifications

Nominal Resistance Values	Resolution	Accuracy %	±	mΩ
0.05Ω	0.1mΩ	0.5	±	4
0.1Ω	0.1mΩ	0.5	±	4
0.22Ω	0.1mΩ	0.5	±	4
0.33Ω	0.1mΩ	0.5	±	4
0.5Ω	0.1mΩ	0.5	±	4
1Ω	0.1mΩ	0.5	±	4
5Ω	0.1mΩ	0.5	±	4
10Ω	0.1mΩ	0.5	±	4
100Ω	1mΩ	0.5	±	4
1kΩ	1mΩ	0.5	±	4

Power Dissipation :

All resistors are 50W : Maximum test current for 200ms = 40A
Thermal protection is provided in the event of overheating.

Intelligent Protection :

The 3200 incorporates a pre-test scan where power is ramped up to the UUT - the test is automatically aborted if a faulty UUT is detected.
This avoids further damage to the UUT and safeguards the 3200.

Manual Loop Correction

Correction range 0.001 to 2 Ohms - manually entered using 3200 keypad

Auto Loop (Option)

The auto loop function automatically corrects for supplied loop impedance.

Maximum Correction	2Ω
Resolution	100uΩ
Accuracy	±18mΩ
Measurement Current	4A

Due to continuous development specifications may be subject to change.

All PAT functions are isolated from mains earth to enable calibration of PAT testers which cannot function with connections to ground.

PAT Earth Bond Resistance

Accuracy - Relative to Calibration Standards Specifications

Nominal Resistance Values	Resolution	Accuracy %	±	mΩ
0.05Ω	0.1mΩ	0.5	±	4
0.1Ω	0.1mΩ	0.5	±	4
0.22Ω	0.1mΩ	0.5	±	4
0.33Ω	0.1mΩ	0.5	±	4
0.5Ω	0.1mΩ	0.5	±	4
1Ω	0.1mΩ	0.5	±	4
5Ω	0.1mΩ	0.5	±	4
10Ω	0.1mΩ	0.5	±	4
100Ω	1mΩ	0.5	±	4
1kΩ	1mΩ	0.5	±	4

PAT Earth Bond Current Measurement

Range	Resolution	Accuracy %	±	Counts
100mA	1mA	1.5	±	6
10A	10mA	1.5	±	6
30A	10mA	1.5	±	6

PAT Insulation Resistance

Standard Accuracy - Relative to Calibration Standards Specifications

Range	Type	Resolution	Maximum Voltage/Power[1]	Accuracy %
0Ω to 5MΩ	Continuously Variable	10kΩ	1.1kV or 1 Watt	0.3
5MΩ to 2GΩ	Continuously Variable	10kΩ	1.1kV or 1 Watt	3

High Accuracy (Option) - Relative to Calibration Standards Specifications

Range	Type	Resolution	Maximum Voltage/Power[1]	Accuracy %
0Ω to 5MΩ	Continuously Variable	10kΩ	1.1kV or 1 Watt	0.1
5MΩ to 2GΩ	Continuously Variable	10kΩ	1.1kV or 1 Watt	1

PAT Leakage Current

Range	Resolution	Accuracy %	±	Counts
240uA	1uA	1.5	±	2
1mA		1.5	±	2
3mA	1uA	1.5	±	2

Due to continuous development specifications may be subject to change.

PAT Leakage Test Voltage

Range (RMS)	Resolution	Accuracy %	±	Counts
100V to 300V	0.1V	1.5	±	9

PAT Load Testing

Range	Accuracy Ohms	±	%
Short Circuit	-	-	-
Open Circuit	-	-	-
0.13kW	440Ω	±	5

PAT Flash Voltage Measurement

Class	Range	Resolution	Load Resistance	Accuracy %	±	Counts
Class 1 (1.5kV)	1kV to 1.8kV	1V	600kΩ (2.5mA@1.5kV)	4	±	10
Class 2 (3kV)	2kV to 3.6kV	1V	1.2MΩ (2.5mA@3kV)	4	±	10

PAT Flash Current Measurement

Range	Resolution	Accuracy %
1mA to 3mA	10uA	5

Due to continuous development specifications may be subject to change.

Line Voltage Measurement

Range	Resolution	Accuracy
200V to 260V	0.1V	0.8% ± 6 Counts

Due to continuous development specifications may be subject to change.

AC / DC VOLTAGE MEASUREMENT

Range	Resolution	Accuracy (1 Year Rel.)		
		%	±	Counts
3kV	10V	0.5	±	3
12kV	10V	0.5	±	3

AC / DC CURRENT MEASUREMENT

Range	Resolution	Accuracy (1 Year Rel.)		
		%	±	Counts
200uA	100nA	0.5	±	4
2mA	1uA	0.5	±	3
20mA	10uA	0.5	±	3

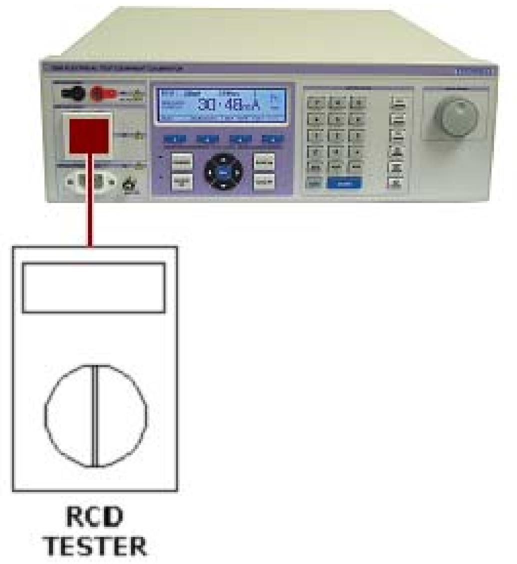
Due to continuous development specifications may be subject to change.

3200

Electrical Test Equipment Calibrator

Operation Manual
Appendix B

Introduction to RCD Testers



Residual circuit breaker testers manufactured by many companies are designed to test and measure the break time of AC mains (RCB) trips at set test currents. To do this they allow a fault current to pass between live phase and earth. The 'fault' current is started by pressing a button on the tester, usually an LCD counter on the tester measures the time in milliseconds until the mains supply is disconnected.

Calibrating RCD Testers

To calibrate an RCD tester, it is necessary to measure the fault current taken by the tester which will normally have several set currents selected by a switch (note : this is a load current taken by the tester - it can be considered as a resistor placed between live and earth and is not a current generated by the tester!). The time reading on the display can be calibrated by disconnecting the supply after a set time interval. Some RCB testers have additional functions such as which half cycle of the mains the fault current started etc. which should be tested as pass/fail tests.

Many of the newer testers, e.g. CM400/500 from Avo-Megger also automatically do a 'no trip' test, first at 1/4, then 1/2 of the fault current to test that a trip is not too sensitive.

Considerations for RCD Testers

There are many different designs of RCB testers which regulate the fault current and perform the measurement of disconnect time in different ways and to calibrate different testers the 3200 calibrator has different modes of operation.

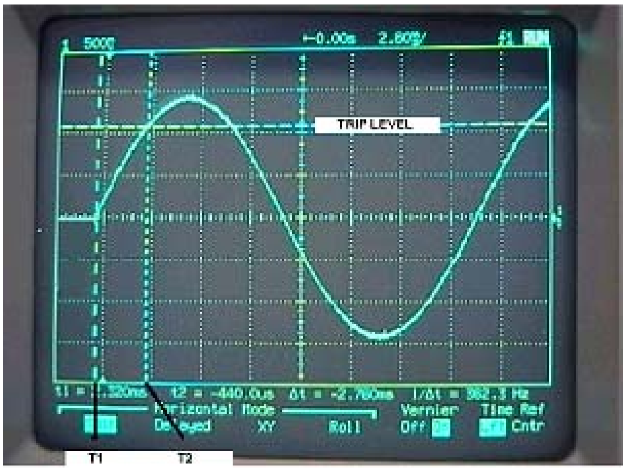
Timing tests are the most complex to understand as the problems and errors are quite different from measuring a DC pulse. The timing period measured by the tester is the time from the start of the fault current to the disconnection of supply. The errors in this measurement are not caused by the accuracy of the counters involved, which are usually crystal controlled and very accurate. Errors are due to the detection of start and stop times on an AC waveform about the zero crossing point.

Simply put, it is impossible for the tester to detect at the zero crossing point of the mains if the mains has been disconnected or not. The same problem exists for the 3200, which has to detect the start of the fault current. Most testers will start their timing at the next zero crossing point after the test button is pressed, but obviously the 3200 can not detect the fault current until a short time later.

3200 Timing Modes

To reduce this error the 3200 has two methods to detect the start of timing.

ZERO CROSSING MODE
Firstly and most used is the zero crossing mode where the 3200 waits until it detects the RCB current selected (this allows pre-test currents to be ignored by the 3200) and then takes its timing from the preceding zero crossing point of the mains.



The diagram above shows the start of the fault current from an RCB tester. The test button would have been pressed at a point in the previous cycle PRECEDING the point T1 - up until then there would either have been no current or with some testers a PRE-TEST current below the trip current level.

The RCB tester will begin its timing at T1 (the zero crossing point preceding the test current). The 3200 has to wait until the current rises to the trip level T2 before it knows this is the FULL trip test (not a pre-test). For accurate timing the 3200 must synchronise itself to the counter running within the RCB tester which started at T1. To do this the 3200 automatically corrects its internal counter using the time interval from the FULL trip point to the zero crossing point, i.e. T2-T1.

IMMEDIATE MODE
Alternatively, mainly for 15th edition IEE testers, the immediate mode starts timing when 5% of the set RCB current is detected - this method will not work with testers which perform pre tests. (See above).

The 3200 uses a fast analogue to digital converter to measure RCB current and the results are stored in memory and processed at the end of a test. Two methods are used to calculate the RCB current. For periods longer than 200ms the RCB current is calculated as true RMS, for periods shorter than 200ms the peak current is taken and divided by 1.414 to give an RMS equivalent value.

3200 Timing Accuracy

In practical terms, the accuracy of the 3200 is far greater than any RCB testers available. The published specification of the 3200 is limited by the method with which it can be realistically verified in a UKAS laboratory, however the theoretical accuracy of the 3200, at 30ppm ± 100us, is far higher.

Calibration Errors Due to Mains Voltage

The mains voltage at which an RCD tester is calibrated affects the current drawn by the tester. Most testers have little or no regulation at all against variation in mains voltage and generally speaking a 10% increase in mains voltage will result in an identical increase in current.

Some manufacturers include the voltage at calibration on the rating plate attached to the instrument, whereas others will include this in the specifications section of the handbook / manual.

Older testers designed for the UK market will have certainly been calibrated for 240VAC whilst units for Europe will be 220VAC. More recently, manufacturers use 230VAC for all testers.

This variation will result very often in an instrument being apparently out of specification if tested at the incorrect mains voltage.
As the relationship for most testers between mains voltage and current is linear, it is possible to use the formula below to correct for the error assuming that the manufacturers specifications for the voltage rating of the tester is known and the mains voltage at the time of calibration is known.

$$\text{CURRENT @ SPEC} = \text{DISPLAYED CURRENT} \times \frac{\text{RCD TESTER MAINS SPEC}}{\text{MEASURED MAINS VOLTAGE}}$$

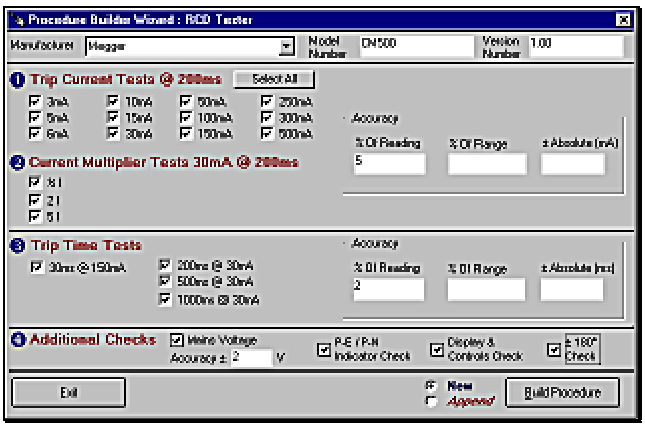
This formula can be used in ProCal to automatically correct for the difference in mains voltage.

However, some testers do regulate their current to some extent and therefore applying the formula will cause errors.

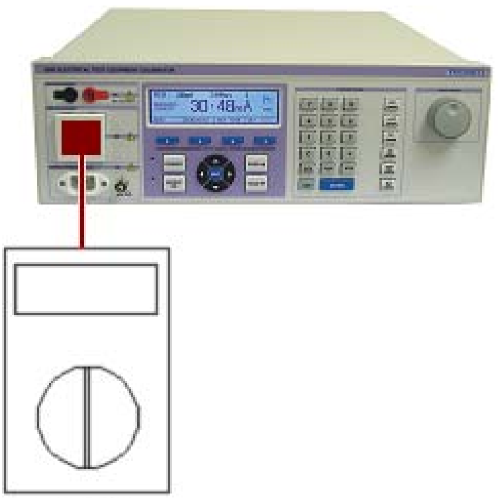
An alternative approach to solve this problem is to power the 3200 from a variable voltage transformer and set the supply voltage to the correct mains voltage (as specified by the RCD tester manufacturer).

Automating Calibration With ProCal

ProCal can fully control all operations of the 3200 via an optically isolated RS232 connection. Using the built in procedure wizards, procedures can be rapidly created. For installation testers, a combination of tests can be added together to create a comprehensive procedure.



Introduction to Calibrating Loop Testers



Loop Testers measure the resistance of the mains supply at a power outlet socket. They do this by measuring the voltage drop when an internal load is applied. The resistance is then calculated and displayed in Ohms. All loop testers work this way, some loop testers will measure only the resistance of the live to earth loop and have only one load current, usually 26 Amps, others can also measure the Live to Neutral Phase and also display PSCC.
Some have ranges which use much smaller load currents or only apply the load for a short period to avoid tripping circuit protection devices.

What is the loop ?

When an appliance is connected to the mains supply a circuit is made. It completes a **loop** for current to flow round, from the power station to the appliance and then back to the power station. Voltage is dropped around the **loop** due to the resistance of the cables etc. in which the current is flowing.

What is PSCC and why is loop resistance important?

Using ohms law the loop resistance will determine the maximum current that can possibly flow round a circuit, as an example if the loop resistance is 1 ohm and the supply voltage 230 Volts using ohms law where

VOLTAGE / RESISTANCE =CURRENT
(230 V / 1Ohm) = 230 Amps

It can be seen that the maximum current that could flow would be 230 Amps even if the appliance was a dead short circuit. It can be clearly seen that a fuse or protection device lower than 230 amps would be needed to protect this circuit. It should be noted that some testers take the lowest loop, either live/neutral or live/phase to calculate the PSCC while other will use only the live/earth loop resistance.

Why is it normal to get large variations in PSCC measurements ?

PSCC is calculated by dividing the mains voltage by loop by the loop resistance. Loop resistance's are often very low, 0.1 to 0.4 ohms and the accuracy , resolution & repeatability possible when measuring loop resistance will give rise to large variation in PSCC as the supply voltage is being divided by a number approaching zero.

Supply Requirements For Calibrating Loop testers

As loop testers pass current from live phase to earth they will 'blow' any earth fault protection device's in the line, it is therefore necessary to have a supply **without an earth leakage trip / protection device**. An isolation transformer can be used but this will add resistance to the loop. Alternatively if no other option exists it is possible to rewire the 3200 to take the earth return to the neutral. This obviously presents a electrical shook hazard and should only be used by qualified engineer's

Interface Isolation of the 3200

Special consideration has been given to the design of the 3200 when connecting to a computer. The RS232 Interface on the 3200 in opto-isolated and the socket is plastic avoiding the outer shell of the RS232 connector grounding the case of the 3200 which would cause multiple earth paths resulting in current passing back to the computer and causing potential damage and / or inconsistent calibration results.

Calibrating Loop Testers

Loop testers normally have 2 or 3 ranges, example 1.999 ohm, 19.99 ohms & 199.9 ohms. It is necessary to calibrate the lowest range at a series of points across its span to confirm linearity. The higher ranges can then be calibrated at just one or two points at least at or higher than 50% of the scale to confirm range accuracy.

The method used is to switch in additional known (calibrated) resistance values in the supply loop, which increases the loop resistance by a known amount. The additional resistance is normally added in the earth line.

It is important to understand that this only adds resistance to the existing supply loop, values below the supply loop resistance cannot be obtained This is the reason for requiring a supply socket with as low as loop resistance as possible.

A loop tester could be calibrated by simply recording the differences from one value to the next. It is much better however if the resistance of the supply loop is known which can then be added to the additional resistance values used for calibration.

Correcting For Supply Loop

One of the advantages of the 3200 is the **AUTO-LOOP** option which measures the supply loop resistance very accurately and automatically adds this to the displayed reading so that the reading on the tester can be compared directly with that displayed.
It is important to measure the supply loop as accurately as possible as all other values are based on this reading.

Measuring the Supply Loop Accurately

The 3200 has been very carefully designed to measure supply loop resistance very accurately. By using its internal high speed/high accuracy A/D converter it digitises each ½ cycle of the mains wave form in real time taking peak / RMS values of each. An internal 4Amp load is repeatedly switched on & off. The high performance A/D in the 3200 allows a smaller load to be used than in a loop tester, this therefore reduces load variation due to self heating and allows a larger number of measurement to be made. Advanced firmware discards cycles containing spike or noise.

From the drop in mains voltage under load the 3200 can calculate the loop resistance and then adds in the calibrated resistance of the adapter test socket to give the true value at the socket which is displayed. The value displayed by the 3200 is not the loop resistance of the socket into which the 3200 is powered from, but the loop resistance at the test socket.

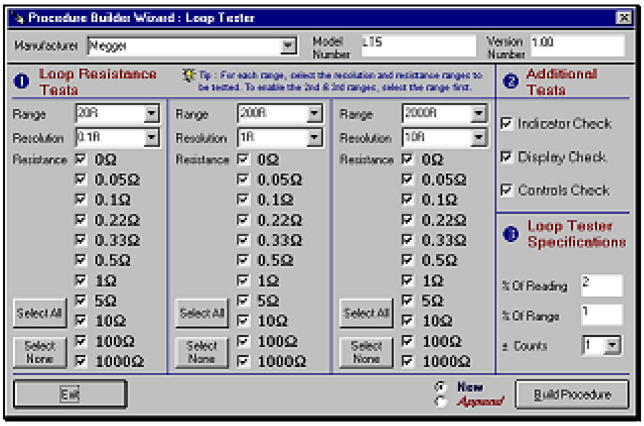
If the auto loop option is not fitted then the resistance at the test socket can be manual entered.
When running with the ProCal calibration software the loop value from the display is read back to the PC and used as the calibration value. Procedures should be written to perform the 'AUTO-LOOP' correction at the start of calibration.

To Calibrate a PSCC range it is necessary to put the resistance in the neutral return. This is easily accomplished by making a special adapter socket rewired to take both earth and neutral to the earth pin on the 3200. Then using the formula shown previously in this application note PSCC can be calculated.

Some Loop testers also can display mains voltage which can be easily calibrated by comparing with the supply voltage displayed on the 3200.

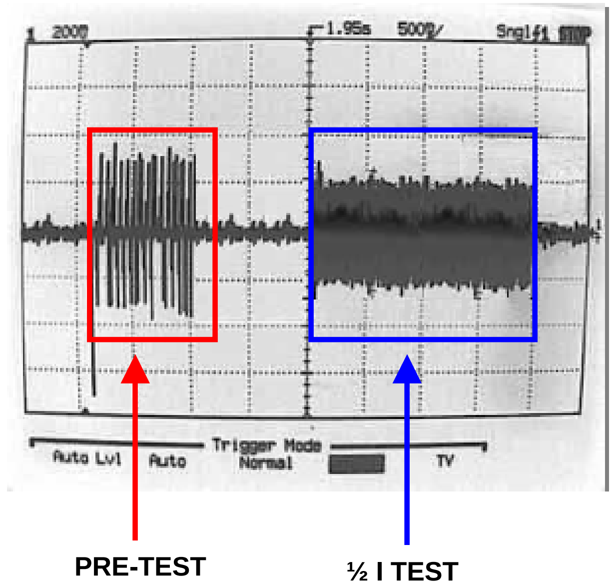
Automating Calibration With ProCal

ProCal can fully control all operations of the 3200 via an optically isolated RS232 connection. Using the built in procedure wizards, procedures can be rapidly created. For installation testers, a combination of tests can be added together to create a comprehensive procedure.



Introduction

Some testers produce a pre-test signal which can be the same size as the current being tested on the ½ I setting of a tester.



This pre-test will cause the 3200 to trigger and begin its reading cycle which will now be analysing the 'pre-test' section of the waveform. This will give incorrect measurements because of this.

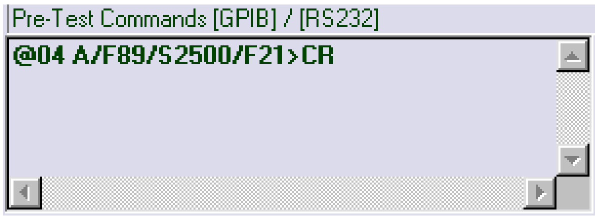
Setting the Pre-Test Delay

NOTE: This requires a 3200 with firmware **version 7.21 or above**

The 3200 starts making measurements from a pre-set percentage of the selected RCD current.

Using an additional pre-test delay command, the 3200 measurement cycle can be delayed until the pre-test period has finished and the actual ½ I test has begun – for example the MEGGER CM500 needs a 2500ms delay when testing the ½ I function.

To overcome this problem, extra commands can be set in the Procal procedure. Open the test procedure with ProEdit, select the instruments tab and add the pre-test command shown below. This will set the pre-test delay to 2500ms

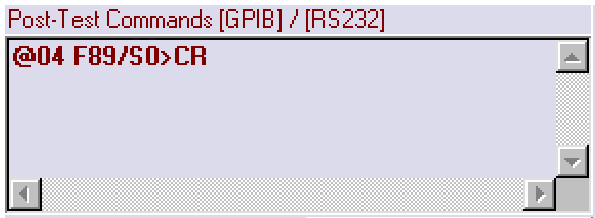


Pre-Test delay changed to 2500ms (S2500)

Where :

@**04** : The 3200 calibrator (traceable instrument 4)
A : Aborts current test
F89 : Set 3200 to RCD pre-test delay set mode
S2500 : Sets delay time to 2500ms (must be in milli seconds)
F21 : Restarts current test

The pre-test delay should be set back to ZERO at the end of the test as shown below.



Pre-Test changed back to 0ms (S0)

Please note the pre-test delay *cannot* be set from the 3200 front panel.

Notes on RCD Current testing

Almost all tester specifications for RCD current ½ I tests are in the format, for example, –6% +0%. This means that the current drawn will not be less than the RCD trip current, therefore the nominal value will be higher than the trip current. For example a tester set on the 100mA range and ½ I setting with the spec. –6% +0% will have a nominal trip current of 48.5mA.

Introduction to connections for LOOP/RCD Calibration.

The intrinsic function of both loop & RCD testers is to test the live/earth connection and the protection devices in that circuit. To perform the tests they will pass current from the live into the earth conductor.

To calibrate these instruments in the same way they are used they will need to be connected to a supply without a earth fault leakage protection device, otherwise the trip will blow when the instrument is operated.

In situation where an unprotected supply is not available there are two alternatives by either rewiring or using an isolation transformer as shown later in this application The isolation transformer offers a much safer solution but is general unsuitable for loop tester calibration due to the increase in loop resistance, while rewiring earth to neutral can be dangerous if not used correctly.

It should be understood that to avoid blowing the trip, current which passes through the loop/RCD tester must not flow round the live/earth but flow round the live/neutral loop.

Correct Connection for the 3200

For correct operation of the 3200 it must be powered from an unprotected (i.e. no RCD trip) supply. This is because the 3200 will pass current down the Earth conductor when performing tests and therefore trip any protection device present.

It is also necessary that for correct operation the Phase (Live) and Phase (Neutral) MUST be connected round the correct way (some plugs used in non-UK countries can be connected either way round, therefore this check is necessary). There should only be a small voltage between Phase (Neutral) and Phase (Earth).

3200 Automatic Supply Test

The 3200 automatically tests the supply when it is turned on and will display an error message and prevent operation if the voltage between live and earth is not greater than 200 Volts.

Calibrating Loop Testers

To enable the low range's of loop testers to be calibrated it is essential that the 3200 is connected to a supply point with as low loop resistance as possible. The 3200 can only add to the available loop supply resistance.

The 3200 has been designed to add the minimum amount of resistance to which is why the mains / power lead is a direct cable type connected internally to the 3200. This avoids any introduction of unnecessary impedance caused by additional connectors etc.

Extending the lead will of course add resistance so if this is required the thickest cable available should be used.

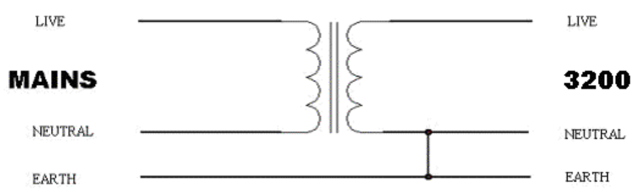
The 3200 must also be connected through a good quality outlet (contact wise) as possible.

Connecting using an Isolation Transformer

If an unprotected supply is not available, use of an Isolation Transformer can be employed, however this will increase the lowest LOOP impedance available. Testing of RCD testers will not be affected.

Some isolation transformer will leave the earth return from the 3200 floating others will connect it through to the supply earth. Either way there is now no path for current to flow from the live (coming from the floating winding of the transformer) down to earth, therefore a loop / RCD tester cannot work as it cannot pass current. Hence it is necessary to connect the low (neutral) end of the transformer also to earth.

Connection of the isolation transformer should be as detailed below :



Rewiring Earth to neutral

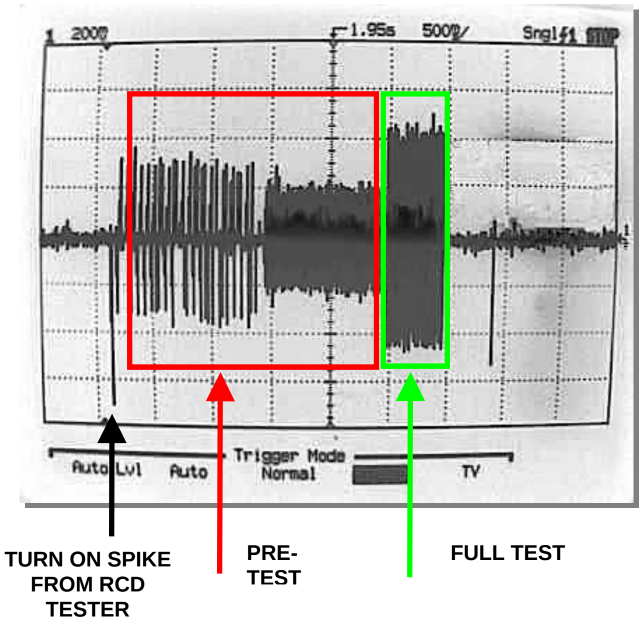
If no other option is available the 3200 can be re-wired (internally) to take the earth return current from the tester back to the neutral. The case of the 3200 can be kept wired to mains earth, but the return-earth from the front panel sockets can be taken to neutral.

If required, Transmille can fit a rear panel switch to perform the above operation without requiring internal re-wiring.

Introduction

Some testers produce a random switch on 'spike' which can be larger than the trip current being tested. This spike can be short in duration, and does not trip a mechanical RCD.

Most modern testers also perform a 'no-trip' pretest before the actual trip test begins (which the 3200 recognises and ignores) – this is shown below.



This 'spike' will, however, cause the 3200 to trigger and begin its reading cycle which will now be analysing the 'pre-test' section of the waveform. This will give incorrect measurements because of this.

Testers from the following manufacturers have been found to exhibit this 'spike' :

- **Chauvin Arnoux**
- **Kewtech**

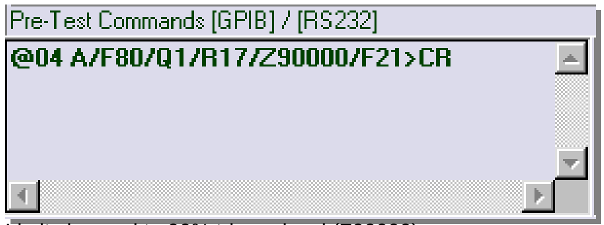
Setting the Trigger level

The 3200 starts making measurements from a pre-set percentage of the selected RCD current.

As default, this is set to 62%, so if the RCD tester is set to 100mA then current measurements will start when the 3200 sees a current of 62mA.
This is to stop the 3200 triggering its timing cycle during an RCD pre-test when a tester draws ½ of the selected current.

The 62% level is suitable for most testers, but some use higher levels during their pre-test and some generate a switch on spike which although is too fast to trip an RCD it will trigger the timing on a 3200.

To overcome this problem, extra commands can be set in the Procal procedure. Open the test procedure with ProEdit, select the instruments tab and add the pre-test command shown below.
This will set the trig level to 90%.

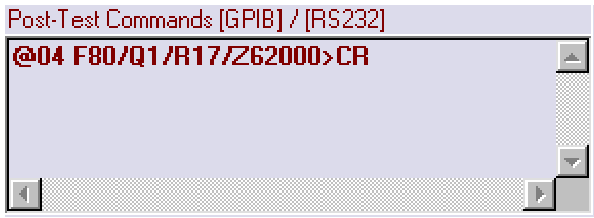


Limit changed to 90% trigger level (Z90000)

Where :

@04 : The 3200 calibrator (traceable instrument 4)
A : Aborts the test which has already begun
F80 : Set 3200 back to its main menu
Q1 : Sets enables access to internal settings
R17 : Selects RCD trigger level constant
Z90000 : Set trigger level to 90%
F21 : Re-starts RCD trip test

The trigger level should be set back to the 62% default at the end of the test as shown below.



Limit changed back to default 62% trigger level (Z62000)

Please note the trigger level cannot be set from the 3200 front panel.

Notes on RCD Current testing

Almost all tester specifications for RCD current are in the format, for example, –0% +6%.
This means that the current drawn will not be less than the RCD trip current, therefore the nominal value will be higher than the trip current. For example a 100mA trip with the spec. –0% +6% will have a nominal trip current of 103mA.

General Operation

The adaptor works by resistively dividing down the applied test voltage between the ‘High Voltage’ output and the ‘guard’ terminal. The test voltage is divided down by a factor of 100, reducing the 5kV to just 50 Volts.

The insulation resistance decade in the 3200 is then connected in series from this divided down voltage to the current input of the tester. As the voltage applied to the 3200 is 100 times smaller, the current to the tester is therefore a 100 times smaller which makes the displayed value of resistance on the tester 100 times the value of resistance set on the 3200.

This circuit provides a low cost solution to the calibration of high voltage, high ohm insulation tester at a number of points without the need for high voltage, high value resistances which are both expensive and difficult to obtain.

The disadvantages of this method are :

1: The tester must have an ***active guard*** terminal, which can be used for the low end of the voltage divider.

2: The tester must be able to supply the current required by the divider without collapsing. This can be checked by measuring the voltage between guard and output with an HV probe and check to insure it does not reduce when the divider is connected.

3: For linear multiplication of the resistance set on the 3200, the current flowing in the divider chain must be much greater than the current flowing into the tester input. This limits the lowest value that can be set.

4: The ‘low’ side of the 3200 decade is earthed which can give rise to earth loop problems if the tester is mains powered. It must be remembered that the testers input is working at nano-amp level and stray paths can easily be introduced.

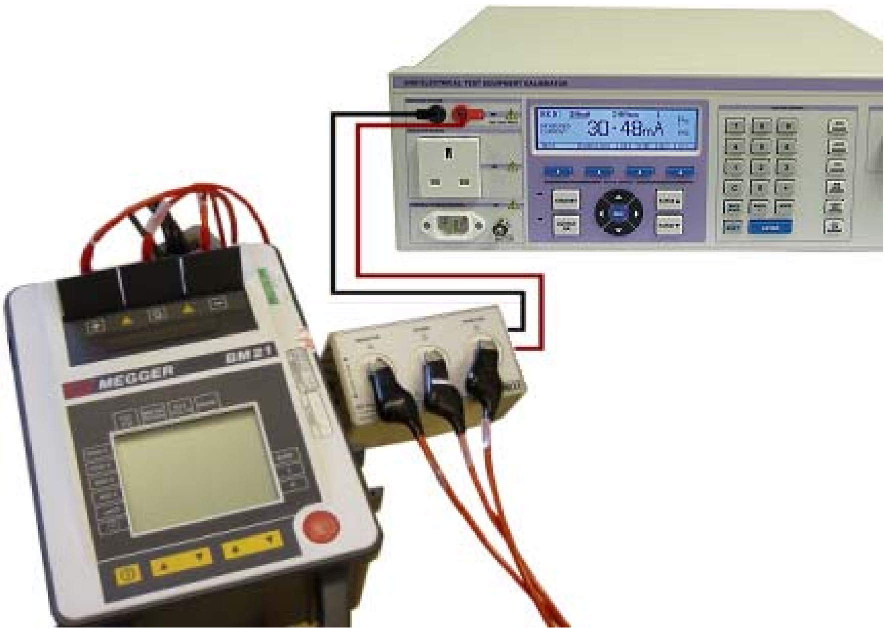


Fig 1 : Typical setup